PSM 1-6-6A



DHC-6 TWIN OTTER

(SERIES 100/200/300)

COMPONENT MAINTENANCE MANUAL

VOLUME 1

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VIKING

Revision 12 – Dec. 18, 2001

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VOLUME 5A

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COMPONENT MAINTENANCE MANUAL

VOLUME 6

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Revision 12 – Dec. 18, 2001

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January 31, 2006

Viking Air Limited
Customer Service and Product Support (CSPS)
7757 8th St. NE
Calgary, Alberta
Canada
T2E 8A2

September 06, 2018

Subject: DHC-6 Twin Otter - Component Maintenance Manual (CMM) PSM1-6-6A

From: Viking Technical Services

To our valued customers,

All CMMs in PSM1-6-6A are to be used for reference only and information contained therein is to be validated directly with the appropriate Original Equipment Manufacturers. All Temporary Revisions that were issued against the CMM will not be incorporated into a new full revision of PSM1-6-6A.

If it is determined that a revision of an individual CMM that is proprietary to Viking Air Limited is warranted, i.e., CMM for P/N C6U1103 Main Landing Gear Leg in Chapter 32, then at that time any outstanding Temporary Revisions against that specific CMM will be incorporated.

Sincerely,

Mr. Kevin Rude
Manager, Technical Services
Customer Service and Product Support (CSPS)
Viking Air Limited www.vikingair.com
Tel: +1 (487) 430-0572 Ext. 4114
Fax: +1 (403) 295-8888
Email: technical.support@vikingair.com

RECORD OF REVISIONS

Retain this record in the front of the manual. On receipt of revisions, insert revised pages in the manual and enter date inserted and initials against the appropriate Rev date.

	REV. NO.	REVISION DATE	INSERTION DATE	BY WHOM
	1 to 11 Incorporated by DHC			
	12	12/18/01	8/21/02	ATP/ MG
CHAPTER 32-10-11	7	12/7/2011	12/30/2011	ATP/RLL
Section 32-20-11 and 32-50-11		9/20/2012	10/16/2012	ATP/RLL
Section 32-10-11	8	MAY 18, 2018	MAY 25, 2018	ATP/RLL
Section 32-20-11	9	JUL 27, 2018	JUL 30, 2018	ATP/RLL

REV. NO.	REVISION DATE	INSERTION DATE	BY WHOM

BOMBARDIER
AEROSPACE

de Havilland Inc.
DHC–6 TWIN OTTER
COMPONENT MAINTENANCE MANUAL
TEMPORARY REVISIONS INDEX

Retain this index in the front of the manual. When Temporary Revisions are issued or cancelled, enter the relevant information in the columns below.

T.R. No.	Date Inserted	Date Removed	Chapter Manual	T.R. No.	Date Inserted	Date Removed	Chapter Manual
23048–001–01	24 Apr 1987		24 Page 130–41	32–10	12 Jan 1996	12/30/2011	32–10–11 Page 704
23048–001–02	15 Jun 1987		24 Pages 5–1, –5 & –6	32–11	05 Feb 1997	Superseded by TR 32–12	32–10–11 Page 605
29–1	17 Sep 1987		29–10–16 Page 7	32–12	12 Mar 1997	10/16/2012	32–10–11 Page 605
29–2	17 Sep 1987		29–10–15 Page 6	32–13	03 Sep 1997	12/30/2011	32–10–11 Page 1010
32–1	21 May1980		32–43–23 Page 303/304 & 411/412	32–14	03 Sep 1997	12/30/2011	32–10–11 Page 1006
32–2	Not issued			32–15	05 Jun 1998	10/16/2012	32–20–11 Multi Pages
32–3	13 Sep 1983		32–43–23 Page 502 & 601/602	32-18	12/7/2011	Superseded by TR 32-19	Chapter 32 Contents
32–4	17 Sep 1987	10/16/2012	32–20–11 Page 1122	32-19	9/20/2012	Supersede by TR 32-20	Chapter 32 Contents
32–5	17 Sep 1987	10/16/2012	32–20–11 Page 112	23-1	2/28/2014		Chapter 23 Contents
32–6	25 Jul 1994	10/16/2012	32–20–11 Page 408	23-2	2/28/2014		Chapter 23 23-09-01
32–7	14 Oct 1994	10/16/2012	32–50–11 Page 1103	23-3	2/28/2014		Chapter 23 23-09-01
32–8	24 Apr 1995	Superseded by TR 32–13	32–10–11 Page 1010	27-1	2/28/2014		Chapter 27 Contents
32–9	12 Jan 1996	12/30/2011	32–10–11 Page 701	27-2	2/28/2014		Chapter 27 27-26-11

TEMPORARY REVISIONS INDEX (CONT'D)

T.R. No.	Date Inserted	Date Removed	Chapter Manual	T.R. No.	Date Inserted	Date Removed	Chapter Manual
27-3	2/28/2014		Chapter 27 27-36-11				
32-20	MAY 25, 2018	JUL 30, 2018	Chapter 32 Contents - page 1				
32-21	JUL 30, 2018		Chapter 32 Contents - page 1				
28-1	JAN 24, 2020		Chapter 28 28-10-1				

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January 23rd, 2020

To: Distribution

Subject: PSM 1-6-6A, DHC-6 – Component Maintenance Manual

Incorporate Temporary Revision 28-1, dated January 23, 2020

Incorporate Tank Filler Cap Assembly Component Maintenance Manual

1 Incorporate Temporary Revision 28-1 into Chapter 28 – CONTENTS, of PSM 1-6-6A, as directed in the placement instructions on the cover page of the Temporary Revision.

2 Incorporate 28-10-1, Tank Filler Cap Assembly Part Number 38040-1 Component Maintenance Manual after 28 – CONTENTS, page 2.

3 Update the Log of Temporary Revisions in the front of the manual.

Note: We recommend that this transmittal letter be kept for record purposes and inserted at the front of the manual.

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@vikingair.com

July 27th, 2018

To: Distribution

Subject: PSM 1-6-6A – Component Maintenance Manual
Viking Overhaul Manual – Chapter 32 – Landing Gear

This Revision is to the Overhaul Manual for the Nose Gear Leg Assembly, Part No. 71-100 (Heroux), contained in PSM 1-6-6A, Component Maintenance Manual.

1. In Chapter 32, Section 32-20-11– remove the entire section for the overhaul of the Heroux Nose Gear Leg Assy, P/N 71-100, and replace with Revision 7, dated July 27, 2018.
2. Remove and replace the List of Effective Pages.
3. Update the Record of Revisions Index in the front of the overhaul manual.

Note: We recommend that this transmittal letter be kept for record purposes and inserted at the front of the manual.

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July 27th, 2018

To: Distribution

Subject: PSM 1-6-6A, DHC-6 – Component Maintenance Manual

Incorporate Temporary Revision 32-21, dated July 27, 2018

1 Incorporate Temporary Revision 32-21 into Chapter 32 – Contents, of PSM 1-6-6A as directed in the placement instructions on the cover page of this Temporary Revision.

Please note that TR 32-21 supersedes TR 32-20.

2 Update the Log of Temporary Revisions in the front of the manual.

Note: We recommend that this transmittal letter be kept for record purposes and inserted at the front of the manual.

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May 23rd, 2018

To: Distribution

Subject: PSM 1-6-6A, DHC-6 – Component Maintenance Manual

Incorporate Temporary Revision 32-20, dated May 18, 2018

1 Incorporate Temporary Revision 32-20 into Chapter 32 – Contents, of PSM 1-6-6A as directed in the placement instructions on the cover page of this Temporary Revision.

Please note: TR 32-20 replaces TR 32-19.

2 Update the Log of Temporary Revisions in the front of the manual.

Note: We recommend that this transmittal letter be kept for record purposes and inserted at the front of the manual.

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May 23rd, 2018

To: Distribution

Subject: Viking Overhaul Manual for Main Landing Gear Assembly – ATA 32-10-11, Revision No. 8, dated May 18, 2018.

This revision is to the Overhaul Manual for the Main Landing Gear Leg Assembly Part No. C6U1103, Chapter 32-10-11, contained in PSM 1-6-6A – Component Maintenance Manual.

1. In Chapter 32 – Landing Gear, remove the complete Overhaul Manual, Part No. C6U1103 Revision 7, dated Dec 7/11 and replace with Revision 8.

Please note: Revision 8 removes Chapter 32-10-11, Overhaul Manual for Main Landing Gear Leg Assembly, Part No. C6U1103.

2. Remove and replace the List of Effective Pages.

3. Update the Record of Revision Index in the front of the manual.

Note: We recommend that this transmittal letter be kept for record purposes and inserted at the front of the manual.

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September 21, 2012

To: Distribution

Subject: PSM 1-6-6A – Component Maintenance Manual
Viking Overhaul Manual – Chapter 32 – Landing Gear

This Revision is to the Overhaul Manual for Nose Gear Leg Assembly, Part No. 71-100 (Heroux), and Nose Wheel Steering Actuator and Links Sub-Assembly, Part No. 71-190 (Heroux), contained in PSM 1-6-6A, Component Maintenance Manual.

1. Using the List of Effective Pages incorporate revised pages, dated September 20, 2012, into Section 32-20-11– Nose Gear Leg Assembly.

   Please note that these revised pages incorporate TRs 32-4, 32-5, 32-6, 32-12 and 32-15.

2. Using the List of Effective Pages incorporate revised pages, dated September 20, 2012, into Section 32-50-11 – Nose Wheel Steering Actuator and Links Sub-Assembly.

   Please note that these revised pages incorporate TR 32-7.

2. Remove and replace the List of Effective Pages.

3. Update the Record of Revision Index in the front of the manual.

Note: We recommend that this transmittal letter be kept for record purposes and inserted at the front of the manual.

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September 21, 2012

To: Distribution

Subject: PSM 1-6-6A, DHC-6 – Component Maintenance Manual

Incorporate Temporary Revision 32-19, dated September 20, 2012

1 Incorporate Temporary Revision 32-19 into Chapter 32 – Contents, of PSM 1-6-2 as directed in the placement instructions on the cover page of this Temporary Revision.

Please note that TR 32-19 supersedes TR 32-18.

2 Update the Log of Temporary Revisions in the front of the manual.

Note: We recommend that this transmittal letter be kept for record purposes and inserted at the front of the manual.

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@vikingair.com

December 7, 2011

To: Distribution

Subject: PSM 1-6-6A, DHC-6 – Component Maintenance Manual

Incorporate Temporary Revision 32-18, dated December 7, 2011

1 Incorporate Temporary Revision 32-18 into Chapter 32 – Contents, of PSM 1-6-2 as directed in the placement instructions on the cover page of this Temporary Revision.

Please note that TR 32-18 replaces TR 32-16.

2 Update the Log of Temporary Revisions in the front of the manual.

Note: We recommend that this transmittal letter be kept for record purposes and inserted at the front of the manual.

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@vikingair.com

December 07, 2011

To: Distribution

Subject: Viking Overhaul Manual for Main Landing Gear Assembly – ATA 32-10-11, Revision No. 7, dated December 07, 2011.

This revision is to Overhaul Manual for Main Landing Gear Leg Assembly Part No. C6U1103, Chapter 32-10-11, contained in PSM 1-6-6A – Component Maintenance Manual.

1. In Chapter 32 – Landing Gear, remove the entire Overhaul Manual Part Number C6U Revision 6, dated Nov 8/91 and replace with Revision 7, dated Dec 7/11.

   Please note that Revision 7 incorporates TRs 32-9, 32-10, 32-13, 32-14 and 32-17.

2. Remove and replace the List of Effective Pages.

3. Update the Record of Revision Index in the front of the manual.

Note: We recommend that this transmittal letter be kept for record purposes and inserted at the front of the manual.

BOMBARDIER
AEROSPACE
de Havilland Inc.
123 Garratt Boulevard
Downsview, Ontario
Canada
M3K 1Y5

To: Distribution

Date: December 18, 2001

Subject: Twin Otter Component Maintenance Manual PSM 1-6-6A, Revision No. 12 dated December 18, 2001

This Revision is to PSM 1-6-6A dated May 15, 1987 and introduces new material received since the last Revision.

A vertical line in the left hand margin of the revised Contents pages indicates the new material added by the Revision.

Incorporate this Revision as follows:

1. Insert Technical Publications Manual Change Request (MCR) form following Volume one, frontispiece page.
2. Remove and destroy the existing Temporary Revision Index page and replace with the revised Temporary Revision Index page.
3. Remove and destroy the existing List of Chapters page and replace with the revised List of Chapters page.
4. Remove and destroy the existing Introduction pages and replace with the revised Introduction pages.
5. Remove and destroy the existing Table of Content pages for Chapters 21, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 52, 61, 61-References, 71, 71-References, 72, 73, 77, 79 and 80 and replace with the revised Table of Content pages for Chapters 21, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 52, 61, 61-References, 71, 71-References, 72, 73, 77, 79 and 80.
6. Insert the new and revised documents as follows. Refer to the Revision Highlights section of this transmittal letter to identify the chapter into which each document is to be inserted, and then use the revised Table of Contents page(s) for that chapter as a guide to the placement of each document within the chapter.
7. Record the incorporation of the Revision in the Record of Revision pages at the front of Volume 1.

Revision Highlights:

You will note that all Table of Contents pages either have a full page revision bar in the left-hand margin or a footer length revision bar in the left-hand margin. This revision bar is to indicate; a new header and footer, This page left intentional blank statement, title change, table structure change, fount change, introduction of ATA Number column, Revision Status Column, Service Bulletins/Temporary Revision column and general TOC format changes. Details as to specific changes to Vendor's manuals will be stipulated below.

Chapter 21: Listing of Barber-Colman CMM for Micropositioners, P/N F-5114-4 dated May 1, 1961.

Amendment to Table of Contents to reflect that FL Aerospace is now owners of the Vendor Janitrol Aero Division CMM, Mixing Valve Assembly CMM, P/N A58D72.

Chapter 21 Cont'd

Amendment to Table of Contents to reflect addition of reference, address, phone, facsimile number, E-mail address and contact name to indicate that Keith Products will supply their CMM for Vapor Cycle Air-conditioning Systems, P/N TR-128.

Amendment to Table of Contents to reflect that Whittaker Controls is now owners of the following CMM's from Sundstrand Aviation, Bleed Air Shutoff Valve, P/N 26440051, ATA 30-40-1 and Solenoid Actuated (Pilot) Poppet Shutoff Valve Assembly, P/N 320195, ATA 75-10-02.

Incorporation of revision1 to the CMM for Whittaker Controls, Solenoid Actuated (Pilot) Poppet Shutoff Valve Assembly, P/N 320295, ATA 75-10-02 dated February 1, 1998. This manual is issued in its entirety. Remove and destroy your copy of Whittaker Controls, Solenoid Actuated (Pilot) Poppet Shutoff Valve Assembly, P/N 320295, ATA 75-10-02 and replace with supplied CMM for Whittaker Controls, Solenoid Actuated (Pilot) Poppet Shutoff Valve Assembly, P/N 320295, ATA 75-10-02 dated February 1, 1998.

Chapter 23:

Amendment to Table of Contents to reflect that the manufacturer AirMed title has changed to AirMed A Clement Clark Communication Company.

Chapter 24:

Incorporation of CMM for Eldec, a Crane Company, Proximity Sensor, P/N 1-899, ATA 24-09-08, Revision 8 dated August 1, 2001. This manual is issued in its entirety by the vendor. Insert this manual at the beginning of Chapter 24.

NOTE: Revision 6 & 7 "Revision Transmittal" pages to Eldec, a Crane Company, Proximity Sensor, P/N 1-899, ATA 24-09-08 are supplied as reference material only.

Incorporation of CMM for Electro Development Corporation which is supported by Eldec, a Crane Company, Proximity Switch, P/N 2-899 and Sensor Assembly, P/N 1-899, ATA 24-09-01 revised date of April 1, 1969. This manual is issued in its entirety by the vendor. Insert this manual following the Eldec, a Crane Company, Proximity Sensor, P/N 1-899, ATA 24-09-08.

Amendment to Table of Contents to reflect that the manufacturer Flite-Tronics title has changed to Flite-Tronics Products a Marathon Power Technologies Company.

It has been brought to our attention that some holder of the CMM for Marathon Power Technologies, Aircraft Static Inverter, Models PC14 through PC-14D many be missing the new frontus page, Page i and Page ii. If you are in possession on these page then discard these pages in a secure facility. If you are not in possession of these pages then insert at the beginning of the Marathon Power Technologies CMM.

Incorporation of CMM for Flite-Tronics, Static Inverter, P/N PC15 and PC15B and PC-15BC, 10th printing dated June 1975. Remove and destroy your copy of the Flite-Tronics, Static Inverter, P/N PC15 and PC15B and PC-15BC CMM and replace with supplied Flite-Tronics, Static Inverter, P/N PC15 and PC15B and PC-15BC, 10th printing dated June 1975 CMM. This manual is issued in its entirety.

Chapter 24: Cont'd

Amendment to Table of Contents to reflect that the manufacture Garrett has changed to Honeywell Canada.

Incorporation of CMM for Marathon Flite-Tronics, 250 VA Static Inverter, P/N PC-250, ATA 24-20-03, revision 3 dated June 1, 1982. This manual is issued in its entirety. Insert this manual following the Flite-Tronics, Static Inverter, P/N PC15BC manual, ATA 24-20-XX.

Incorporation of CMM for Phoenix Aerospace Inc., Solid State Static Inverter (Transverter), P/N 095165 (DH-1030-24-600-CS, Type IIB), ATA 24-20-X dated January 3, 1992. This manual is issued in its entirety. Insert this manual following the Phoenix Aerospace Inc. CMM for Solid State Static Inverter (Transverter), P/N 095032 (DH-1030-24-600-CS), ATA 24-20-X.

Incorporation of CMM for SAFT, Electrical Storage Battery, P/N 4076, ATA 24-30-22 dated January 30, 1986. This manual is issued in its entirety. Remove and destroy pervious copy of SAFT, Electrical Storage Battery, P/N 4076 and replace with supplied Electrical Storage Battery, P/N 4076, ATA 24-30-22 dated January 30, 1986.

Incorporation of TRW Aeronautical Systems, Lucas Aerospace, Service Information Letter Number 23704 dated August 24, 2001. Insert this SIL at the beginning of CMM for TRW Aeronautical Systems, Lucas Aerospace, DC Starter Generator, P/N 23048, ATA 24-30-74.

Incorporation of CMM for TRW Aeronautical/Lucas Aerospace was Lear Siegler, A Division of Lucas, DC Starter Generator, P/N 23048-001 through -028, ATA 24-30-74 dated December 15, 2000. This manual is issued in its entirety. Insert this manual following the Spar Aerospace CMM for Static Power Inverter, P/N 5590F1-1 (Model SPS48).

Amendment to Table of Contents manufacture column to reflect that the manufacture Weston Component Maintenance Manuals are now supported by Ametek Aerospace.

Chapter 25:

Amendment to Table of Contents to reflect addition of reference, address, phone, facsimile number and contact name to indicate that B/E Aerospace will supply their CMM for Liquid Container, Model No. 306, ATA 25-32-03.

Incorporation of CMM for TUL Safety Equipment Ltd., Life Preserver, Adult, Type 35 MK IV (-2) and (-3), P/N TUL-6174, ATA 25-60-05 at revision 5 dated December 2, 1991. This manual is issued in its entirety. Remove and destroy your copy of the TUL Safety Equipment Ltd., Life Preserver, Adult, Type 35 MK IV ( ) and (-1), P/N TUL-6174, ATA 25-60-05 and insert this TUL Safety Equipment Ltd., Life Preserver, Aircrew, Type 35 MK IV ( ) and (-1), P/N TUL-6174, ATA 25-60-05 at revision 5 dated December 2, 1991 in its place.

Chapter 26:

Incorporation of CMM for Flag Fire Equipment Ltd., Portable Fire Extinguisher & Bracket, Model No. HAL-035-AVH, ATA 26-25-02 , revision 2 dated January 4, 1994. This manual is issued in its entirety by the vendor. Insert this manual following the America Standard, Extinguisher, Bulletin Number 601-004-001.

Chapter 26: Cont'd

Incorporation of CMM for Pacific Scientific Walter Kidde HTL/Kin-Tech Division, Fire Extinguisher, P/N 17300/17400, ATA 26-20-200, revision 3 dated March 15, 1999. This manual is issued in its entirety by the vendor. Remove and destroy your copy of the Kidde/HTL Advanced Technology, Fire Extinguisher, P/N 17300/17400, ATA 26-20-200 and insert this Pacific Scientific Walter Kidde HTL/Kin-Tech Division, Fire Extinguisher, P/N 17300/17400, ATA 26-20-200, revision 3 dated March 15, 1999 in its place.

NOTE: This issue of Pacific Scientific Walter Kidde HTL/Kin-Tech Division, Fire Extinguisher, P/N 17300/17400, ATA 26-20-200, revision 3 dated March 15, 1999 is accompanied with Service Bulletin Part No. 17310, Revision A dated of May 22, 1980; SB P/N 17400; SB P/N 30100010 Rev. A dated February 2, 1997; SB 31000010-26-2 Rev dated December 9, 1983 & SB P/N 30700002.

Incorporation of CMM for Pacific Scientific Walter Kidde HTL/Kin-Tech Division, Fire Extinguisher, 37 Cubic Inch through to 988 Cubic Inch, ATA 26-20-202, Initial issue dated July 15, 1999. This manual is issued in its entirety by the vendor. Insert this manual following the CMM for Pacific Scientific Walter Kidde HTL/Kin-Tech Division, Fire Extinguisher, P/N 17300/17400, ATA 26-20-200.

NOTE: This issue of Pacific Scientific Walter Kidde HTL/Kin-Tech Division, Fire Extinguisher, 37 Cubic Inch through to 988 Cubic Inch, ATA 26-20-202, Initial issue dated July 15, 1999 is accompanied with Supplement Number 30100043 dated July 15, 1999.

Incorporation of CMM for Walter Kidde Aerospace Division of KIDDE Technologies Inc., Discharge Indicators, P/N 800495, 843787, 843969 & 922315, ATA 26-20-50 was 26-20-00, revision 8 dated November 30, 1995. This manual is issued in its entirety by the vendor. Remove and destroy your copy of the Kidde, Discharge Indicators and Connectors, P/N 800495, 843787, 843969 & 922315, ATA 26-20-00 and insert this Walter Kidde, Discharge Indicators, P/N 800495, 843787, 843969 & 922315, ATA 26-20-50 was 26-20-00, revision 8 dated November 30, 1995 in it place.

Incorporation of CMM for Walter Kidde Aerospace; Division of KIDDE Technologies Inc., Control Unit Fire Detecting System Continuous Type DC with Short Discriminator Circuit, P/N 893229-0350 through to -0500-1, ATA 26-10-30, revision No. 3 dated September 15, 1998. This manual is issued in its entirety by the vendor. Insert this manual following the CMM for Walter Kidde Aerospace, Discharge Indicators, P/N 800495, 843787, 843969 & 922315, ATA 26-20-50 was 26-20-00.

Incorporation of CMM for Walter Kidde Aerospace; Division of KIDDE Technologies Inc., Power Device Cartridges, ATA 26-21-34 dated May 15, 1996. This manual is issued in its entirety by the vendor. Insert this manual following the CMM for Walter Kidde Aerospace, Division of KIDDE Technologies Inc., Control Unit Fire Detecting System Continuous Type DC with Short Discriminator Circuit, P/N 893229-0350 through to -0500-1, ATA 26-10-30.

NOTE: Walter Kidde Aerospace manuals in the Table of Contents have been reorganized to maintain the Alpha/numeric manual consistency.

Chapter 27: Incorporation of revision 2 to the CMM for the Bombardier Aerospace/de Havilland, Geared Tab Gearing Mechanism Assembly, P/N C6CF1174, ATA 27–26–11 dated December 17, 2001. Incorporate revision as instructed by the Letter of Transmittal for the BA/dHI, Geared Tab Gearing Mechanism Assy., P/N C6CF1174, ATA 27–26–11.

Incorporation of CMM for Eldec Corporation, Solid State Proximity Switch PC Assembly, P/N 8–060–02, –07 & –10, ATA 27–09–01, revision 9 dated June 30, 1991. This manual is issued in its entirety by the vendor. Insert this manual at the beginning of the Chapter 27 CMM's.

NOTE: This issue of Eldec Corporation, Solid State Proximity Switch PC Assembly, P/N 8–060–02, –07 & –10, ATA 27–09–01, revision 9 dated June 30, 1991 is accompanied with Service Information Letter Number 27–02 dated February 28, 1975.

Chapter 28: Incorporation of CMM for De Laval Turbine, a Adel Division, Fuel Booster Pump, P/N 71383–3 & –3A, ATA 28–20–6 dated March 1, 1969. This manual is issued in its entirety by the vendor. Insert this manual at the beginning of the Chapter 28 CMM's.

Deletion of the manufacturer Auto Valve from manufactures column. Remove and destroy Overhaul manual for Drain Valves, P/N 996B and 996C.
Quote – "AVI Technical Information and Repair Policy
Technical information, drawings, part numbers and spare parts are supplied only to direct AVI customers and cannot be supplied to end–users or repair facilities. All questions related to these issues should be directed to the appropriate aircraft manufacturer or original equipment manufacturer (OEM).
The quality and reliability of field repaired units can not be ensured, therefor, there are NO authorized facilities permitted to repair or rebuild any AVI assemblies. As of 1 December 1995, all AVI repair kits and maintenance manuals are considered invalid and will no longer be issued or updated. The repair or rebuild of these assemblies may be performed by AVI when requested through the appropriate OEM.
Requests for repair or technical information from the OEM to AVI should be made in writing by letter or FAX. To ensure the validity of these requests, a signed and dated "Affidavit of Material Usage" (supplied by AVI) will be required for new customers and/or customers that do not have a current affidavit on file. – rev B 5/27/98"
End of Quote.

Incorporation of CMM for Crane (Hydro–Aire), Fuel Booster Canister Pump, P/N 72266–3 & 72390–2, ATA 28–20–24, revision 1 dated February 21, 1986. This manual is issued in its entirety by the vendor. Remove and destroy your copy of Crane (Hydro–Aire), Fuel Booster Canister Pump, P/N 72266–3 & 72390–2, ATA 28–20–24, Initial issue revision dated July 1, 1977 and insert this Crane (Hydro–Aire), Fuel Booster Canister Pump, P/N 72266–3 & 72390–2, ATA 28–20–24 at revision 1 dated February 21, 1986 in its place.

Incorporation of CMM for Simmonds Precision Products, Inc., Liquid Quantity Transmitter, P/N 391088–002 through –006, ATA 28–41–04, revision A dated July 29, 1988. This manual is issued in its entirety by the vendor. Remove and destroy your copy of the Simmonds Precision Products, Inc., Liquid Quantity Transmitter, P/N 391088–002 through –006, ATA 28–41–04 and insert this Simmonds Precision Products, Inc., Liquid Quantity Transmitter, P/N 391088–002 through –006, ATA 28–41–04, revision A dated July 29, 1988 in its place.

Chapter 29: Incorporation of revision number 3 to the CMM for PTI Technologies Inc., Filter, P/N 50220 dated June 30, 1993. This manual is issued in its entirety by the vendor. Remove and destroy the vendor Purolator Products Incorporated CMM, P/N 50220 and substitute with PTI Technologies Inc., Filter, P/N 50220, revision 3 dated June 30, 1993.

Incorporation of revision to the CMM for Teledyne Republic, Hydraulic Hand Pumps, P/N 3–1158–18 (914 – AN6201–1). This manual is issued in its entirety by the vendor. Remove and destroy the vendor Republic Manufacturing Co., Hydraulic Hand Pumps dated March 1, 1968 and substitute with Teledyne Republic, Hydraulic Hand Pumps, P/N 3–1158–18 (914 – AN6201–1).

Chapter 30: Incorporation of CMM for B.F. Goodrich Aerospace / Rosemount Aerospace Inc., Windshield Wiper Motor Assembly, P/N 2311M95, 96 & 97, ATA 30–42–10 dated October 1, 1993. This manual is issued in its entirety by the vendor. Refer to Rosemount Aerospace Inc. Highlights page for reason for reason for issuing. Insert this manual following the CMM for B. F. Goodrich Aerospace was Bendix, Water Separator, P/N 44E06–2A.

Incorporation of the CMM for Lucas Western, Deicer Distributing valve, P/N 1532–2A,–3A,–3B,–3C,–6A, & –6C, Publication No. 1532U–23–865B, revision 1 dated October 1993. This manual is issued in its entirety by the vendor. Insert this manual following the CMM for B.F. Goodrich Aerospace / Rosemount Aerospace Inc., Windshield Wiper Motor Assembly, P/N 2311M95, 96 & 97, ATA 30–42–10.

Incorporation of CMM for Lucas Western, Deicer Distributing valve, P/N 1532–8A,–8C,–10A & –10C, Publication No. 1532U–23–865G revised dated of October 1990. This manual is issued in its entirety. Insert manual following Lucas Western, Deicer Distributing valve, P/N 1532–2A,–3A,–3B,–3C,–6A, & –6C, Publication No. 1532U–23–865B, revision 1 dated October 1993.

Incorporation of CMM for Lucas Western, Regulating & Relief Valve, P/N 38E96–2C through –6A, Publication No. 38U–23–8511B revised dated of January 1995. This manual is issued in its entirety. Insert manual following Lucas Western, Deicer Distributing valve, P/N 1532–8A,–8C,–10A & –10C, Publication No. 1532U–23–865G revised dated of October 1990.

Incorporation of CMM for Lucas Western, Water Separator & Filter, P/N 44E15–1A through –2B, Publication No. 44U–23–8511A revised dated of March 1992. This manual is issued in its entirety. Insert manual following Lucas Western, Regulating & Relief Valve, P/N 38E96–2C through –6A, Publication No. 38U–23–8511B.

Chapter 31: No CMM changes, only page structure changes to TOC.

Chapter 32: Incorporation of Service Letters (SL) for Aircraft Braking Systems Corporation (ABSC) numbers; GS–SL–46 dated October 10, 1997, GS–SL–47 dated February 28, 1998, GS–SL–48 dated June 15, 1998 and GS–SL–49 dated October 15, 1998. Insert these SL's at the beginning of the Chapter 32 CMM's or as instructed by the specific SL.

Incorporation of CMM for Aircraft Braking Systems Corporation (ABSC) was Goodyear, Wheel Assembly, P/N 5000444, –1 & –3, ATA 32–40–12 dated September 28, 1990. This manual is issued in its entirety by the vendor. Remove and destroy the CMM for Goodyear, Main Wheel Assembly, P/N 5000444, –1, –2 & 5006586, ATA 32–40–12 Insert this manual following ABSC Service Letter Number GS–SL–49 dated October 15, 1998.

Chapter 32: Cont'd

NOTE: This issue of the CMM for Aircraft Braking Systems Corporation (ABSC) was Goodyear, Wheel Assembly, P/N 5000444, −1 & −3, ATA 32−40−12 dated September 28, 1990 is accompanied with Temporary Revision number 32−2 dated October 20, 1992.

Incorporation of CMM for Aircraft Braking Systems Corporation (ABSC), Brake Assembly P/N 5001571. −1 through −6, ATA 32−43−12 dated January 15, 1990. This manual is issued in its entirety by the vendor. Insert this manual at the following Aircraft Braking Systems Corporation (ABSC), Wheel Assembly, P/N 5000444, −1 & −3, ATA 32−40−12.

NOTE: This issue of the CMM for Aircraft Braking Systems Corporation (ABSC), P/N 5001571. −1 through −6, ATA 32−43−12 dated January 15, 1990 is accompanied with Service Bulletin No. ARAVA−102−32−2, ARAVA−201−32−2 & ARAVA−202−32−2 dated June 7, 1990 and Temporary Revision number 32−2 dated December 3, 1992.

Incorporation of CMM for Aircraft Braking Systems Corporation (ABSC), Main Wheel Assembly, P/N 95443832, −1 & −2, ATA 32−40−24 dated October 30, 1988. This manual is issued in its entirety by the vendor. Insert this manual following Aircraft Braking Systems Corporation (ABSC), P/N 5001571. −1 through −6, ATA 32−43−12.

NOTE: This issue of the CMM for Aircraft Braking Systems Corporation (ABSC), P/N 5001571. −1 through −6, ATA 32−43−12 dated January 15, 1990 is accompanied with Temporary Revision number 32−4 dated December 11, 1992.

Incorporation of CMM for Aircraft Braking Systems Corporation (ABSC), Brake Assembly, P/N 9550377, −1, −2 & −4, ATA 32−43−23 dated July 1, 1990. This manual is issued in its entirety by the vendor. Insert this manual following Aircraft Braking Systems Corporation (ABSC), P/N 95443832, −1 & −2, ATA 32−40−24.

NOTE: This issue of the CMM for Aircraft Braking Systems Corporation (ABSC), Brake Assembly, P/N 9550377, −1, −2 & −4, ATA 32−43−23 dated July 1, 1990 is accompanied with Temporary Revision number 32−5 dated July 1, 1993 and Temporary Revision number 32−6 dated March 12, 1999.

Incorporation of CMM for Parker Fluid Connectors/Stratoflex/Waterman Products, Hydraulic Fuse, P/N G831−8−10A (de Havilland P/N 7SC0110), ATA No. 32−42−00 issue dated January 22, 1998. This manual is issued in its entirety. Insert this manual following Aircraft Braking Systems Corporation (ABSC), Brake Assembly, P/N 9550377, −1, −2 & −4, ATA 32−43−23.

NOTE: This issue of the CMM for Parker Fluid Connectors/Stratoflex/Waterman Products, Hydraulic Fuse, P/N G831−8−10A (de Havilland P/N 7SC0110), ATA No. 32−42−00 issue dated January 22, 1998 is accompanied with Service Bulletin number G831−32−1 dated October 17, 1991 and Temporary Revision number 32−1 dated June 5, 1992.

Chapter 33: Incorporation of Parts Breakdown Sheet for Grimes, Tandem Oscillating Light, Model Number 41905. Insert this Sheet following Aircraft Navigational Rotating Warning Light, P/N G8400A36−24, ATA 33−40−21.

Chapter 34: Incorporation of CMM for Litton Aeronetics, Radio Magnetic Indicator, P/N 2105–210L through 2109–2109L dated November 21, 1969. This manual is issued in its entirety by the vendor. Insert this manual following Kollsman, Altimeter, P/N 671CPX–6–051.

Incorporation of CMM for SIRS Navigation Ltd., Standby Compass, P/N KCA0104W, ATA 34–25–21 dated January 20, 2001. This manual is issued in its entirety by the vendor. Remove and destroy the CMM for Smith Industries Limited, Standby Compass, P/N KCA 0104W, ATA 34–20–38/53, Dated November 1978 and replace with supplied CMM for SIRS Navigation Ltd., Standby Compass, P/N KCA0104W, ATA 34–25–21 dated January 20, 2001.

NOTE: This issue of the CMM for SIRS Navigation Ltd., Standby Compass, P/N KCA0104W, ATA 34–25–21 dated January 20, 2001 is accompanied with Service Information Letter number 34–47 dated June 2000.

Chapter 35: Incorporation of CMM to Adams Rite Sabre International, Portable Oxygen Cylinder assembly, P/N 900–700–039–04,–06,–12 & –29, Model 4113, ATA No. 35–31–08, revision 1 dated November 20, 1986. This manual is issued in its entirety. Insert this manual at the beginning of Chapter 35.

NOTE: This issue of Adams Rite Sabre International, Portable Oxygen Cylinder assembly, P/N 900–700–039–04, –06, –12 & –29, Model 4113, ATA No. 35–31–08, revision 1 dated November 20, 1986 is accompanied with Service Procedure No. SP 0002 dated May 18, 1995. Insert this SP 0002 as directed by item three, Instructions.

Introduction of CMM for Scott Aviation, Portable Oxygen Breathing Equipment, P/N 5500 Series and 5600 Series, ATA 35–30–78, revision 10 dated May 31, 1989. This manual is issued in its entirety. Insert this manual following the CMM for Alar Products, Continuous Flow Oxygen Regulator, P/N A–2000W.

Introduction of CMM for Scott Aviation, Cylinder and Valve Assembly, P/N 6350 Series, ATA 35–21–19, revision 6 dated June 1/1981. This manual is issued in its entirety. Insert this manual following the CMM for Scott Aviation, Portable Oxygen Breathing Equipment, P/N 5500 Series and 5600 Series, ATA 35–30–78.

Introduction of CMM for Scott Aviation, Cylinder and Valve Assembly, P/N 6350 Series, ATA 35–21–20 was 35–30–120, revision 8 dated October 15/1986. This manual is issued in its entirety. Remove and destroy the CMM for Scott Aviation, Cylinder and Valve Assembly, 6350 Series revision dated Dec 15/1966 and insert this CMM for Scott Aviation, Cylinder and Valve Assembly, P/N 6350 Series, ATA 35–21–20, revision 8 dated October 15/1986 following the CMM for Scott Aviation, Cylinder and Valve Assembly, P/N 6350 Series, ATA 35–21–19.

Chapter 36: No CMM changes, only page structure changes to TOC.

Chapter 52: Incorporation of CMM for Eldec Corporation, Proximity Switch assembly, P/N 8–240–04, ATA No. 52–70–02 initial issue dated May 1, 1979. This manual is issued in its entirety. Insert this manual following the Adams Rite, Locks Door and Related Handles and Latches, P/N AR24B9 or AR24B12.

Chapter 61: No CMM changes, only page structure changes to TOC.

Chapter 61–: References No CMM changes, only page structure changes to TOC.

Chapter 71: No CMM changes, only page structure changes to TOC.

Chapter 72–: References No CMM changes, only page structure changes to TOC.

Chapter 73: Incorporation of revision to the CMM for Sundstrand Corporation, Power Driven Rotary Pump, P/N 025323–402 through –402D, ATA No. 73–10–04, revision 8 dated March 1, 1995. Insert this manual by using the instruction from Sundstrand Corporation Highlights page.

Chapter 77: Incorporation of revision to the CMM for Aircraft Appliances and Equipment Limited (AMI), Tachometer Generator, P/N 32005–007 through –037, Manual No. M–7084, dated August 1997. This manual is issued in its entirety and supercedes File No. 3206. Remove and destroy AMI CMM for Tachometer Generator Model 32005–7 & Difference Data Sheets –008, –023 and replace with supplied CMM for AMI, Tachometer Generator, P/N 32005–007 through –037, Manual No. M–7084, dated August 1997.

Incorporation of CMM for Allied – Bendix Aerospace, Indicators, New P/N 3571810–0003 (Old P/N 25510B25B8A3 through 25516C96A14A3), ATA No. 77–10–40, revision 2 dated October 2, 1987. This manual is issued in its entirety by the vendor. Insert this manual following the CMM for Bendix Flight & Engine Instruments Division, Tachometer Indicator, New P/N 3571260–7001 (Old P/N 34107C1AG13–1A3), ATA 70–6–4.

Incorporation of revision 24 to the CMM for Smith Industries, Millivoltmeter Temperature Indicators, ATA 77–20–205 / 5, revision dated January 15, 1991. Insert this manual by page comparison to Smith Industries Millivoltmeter Temperature Indicator List of Effective Pages.

NOTE: This issue of CMM for Smith Industries, Millivoltmeter Temperature Indicators, ATA 77–20–205 / 5 is accompanied with Service Bulletin 77–119 dated July 1970 & SB 77–102, Revision No 1 dated November 1970. Insert these SB's in–front of the CMM for Smith Industries, Millivoltmeter Temperature Indicators, ATA 77–20–205 / 5

Chapter 79: No CMM changes, only page structure changes.

Chapter 80: No CMM changes, only page structure changes.

NOTE: We recommend that this letter of transmittal be retained for record purposes and inserted in the front of the manual.

R. Lesica

Robert Lesica

for/ Ms. Martine Hallé
Manager
Technical Publications
Customer Support Department

MH/BS/rl

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INTRODUCTION

1. GENERAL

This manual contains component maintenance manuals for components manufactured by Bombardier / de Havilland and selected vendors. Additional manuals and revisions will be forwarded periodically as they are originated by Bombardier / de Havilland or received from vendors. This manual is organized according to ATA chapterization. Each ATA chapter contains a table of contents which lists the vendor component maintenance manuals in alphabetical order of vendor.

2. AVIONICS COMPONENTS

Manuals are not included for most avionics components as the avionics configuration varies considerably from customer to customer. Operators will receive avionics manuals directly from the vendors. Most vendors of avionics components prefer to deal directly with de Havilland's customers. It is recommended that you contact the appropriate vendors for the avionics components installed in your aircraft to ensure you are on their mailing list for follow–up revisions, bulletins or newsletters. Following para. 6 is a list of all vendors who supply Bombardier / de Havilland with avionics components at this time. This list will be amended as new vendors are added.

3. PROPELLER AND AIR CONDITIONING SYSTEM (HARTZELL)

Component Maintenance Manuals for these systems are not included in this manual but are available from the vendor. The manuals that are available are listed on the appropriate contents page along with the address of the vendor. Operators will receive propeller component maintenance manuals directly from the vendor.

4. ENGINE

Engine and accessory overhaul manuals for PT6A–20 P/N No. 3011403 (Series 100/200) or PT6A–27 Engine Overhaul Manual No. 3013242 (Series 300) are not included in this publication but are available on request at the following address. Operators will receive engine manuals directly from the vendor:

Pratt & Whitney Canada Corp.,
Attention: Publications Customer Services (01CA4)
1000 Marie–Victorin Blvd.,
Longueuil, Quebec,
Canada
J4G 1A1
General Telephone Number: 514–442–8000
General Facsimile Number: 514–442–8300
Email: publications@pwc.ca
WWW: www.pwc.ca

4. ENGINE (CONT'D)

United States Publications Customer Representive	Tel:	450-647-2707
Europe & Africa Publications Customer Representive:	Tel:	450-647-2706
Australia & Pacific Rim Publications Customer Representive:	Tel:	450-647-2764
South, Central Americas & Caribbean Publications Customer Representive:	Tel:	450-647-2720

* Refer to following Customer Support Information Bulletin No. 23 for revision service.

5. REVISIONS

(a) Normal Revisions

Revisions to this manual will be made as required and holders will receive copies without request.

(b) Temporary Revisions

Temporary revisions will be issued at the earliest opportunity to notify the operator of important changes effecting the maintenance of these components. These temporary revisions will be printed on yellow paper for instant identification when inserted in the manual, and will be followed up by normal revision procedures.

6. MICROFICHE

This Component Maintenance manual is also available in microfiche.

Queries regarding manual content should be directed to:

Bombardier Inc.
Bombardier Aerospace
Garratt Boulevard
Downsview, Ontario,
Canada
M3K 1Y5

Attn.: Mrs. Matine Hallé	Telephone No. (416)	375-3437
Technical Publications Manager	Facsimile No. (416)	375-4538
Mail Stop No. N42-25	Email:	mhalle@dehavilland.ca
or		
Mr. William (Bill) Sura	Telephone No. (416)	373-5076
Technical Publications Supervisor	Facsimile No. (416)	375-4538
Mail Stop No. N42-25	Email:	wsura@dehavilland.ca

Queries regarding microfiche or manual Distribution should be directed to:

Attn.: Mr. Ronald Smith
Production, Printing & Manual Distribution Manager
Mail Stop No. N42-25

Telephone No. (416) 373-5561
Facsimile No. (416) 375-3830
Email: ronaldsmith@dehavilland.ca

VENDORS WHO SUPPLY AVIONICS COMPONENTS

VENDOR	VENDOR CODE	ADDRESS
Aerosonic Corporation/ Teledyne Controls	98571	12333 West Olympic Blvd. West, Los Angeles, California U.S.A. 90064 Tel: 310-820-4616 Fax: 310-442-4324 Fax: 310-442-4325 Tel. A.O.G: 310-207-6086
BF Goodrich Aerospace Avionics System Division formerly Jet Electronics and Technology, Inc.	25583	5353-52nd Street South East, P.O. Box 873, Grand Rapids, Michigan U.S.A. 49588-0873 Tel: 616-949-6600 Fax: 616-285-4224 A.O.G. Tel: 1-800-253-9525 for: Publications Information Tel: 616-285-4203 Fax: 616-977-6898
Gables Engineering Inc.	99837	247 Greco Avenue, Coral Gables, Florida U.S.A. 33146 Tel: 305-442-2578 Fax: 305-774-4465 Tel. A.O.G: 305-541-4271

VENDORS WHO SUPPLY AVIONICS COMPONENTS (CONT'D)

VENDOR	VENDOR CODE	ADDRESS
Honeywell		All Customer Operations; Tel: 1-800-421-2133 Fax: 602-365-3343 E-mail: msscuspctr@honeywell.com WWW: www.honeywell.com
Honeywell/AlliedSignal/(Bendix/King) Aerospace General Aviation Avionics Division	22373	400 North Rogers Road, Olathe, Kansas U.S.A. 66062-1212, Tel: 913-768-2085 Fax: 913-791-1302 Customer Access System; Tel: 1-800-707-4555 or Tel: 1-800-257-0726 WWW: www.bendixking.com
Honeywell/AlliedSignal Aerospace	97896	15001 N.E. 36th Street, P.O. Box 97001, Redmond, Washington U.S.A. 98073-9701 Tel: 206-885-8367 Fax: 206-885-8722 Customer Access System Tel: 1-800-707-4555 or Tel: 1-800-257-0726
Honeywell/Garrett		Customer Access System; Tel: 1-800-707-4555 or Tel: 1-800-257-0726
Honeywell Incorporated (Sperry Commercial Flight Systems)	55939	Customer Access System Tel: 1-800-707-4555 or Tel: 1-800-257-0726 Technical Support: Tel: 1-800-543-3711 ext. 4400 Tel: 602-436-8954 (General) Fax: 602-436-7100 (General)

VENDORS WHO SUPPLY AVIONICS COMPONENTS (CONT'D)

VENDOR	VENDOR CODE	ADDRESS
Rockwell International Corp. Collins General Aviation Division	94154	400 Collins Road, N.E., Cedar Rapids, Iowa U.S.A. 52498-0001 North America Tel: 1-888-2655467 Fax: 319-295-4941 Email: collins@collins.rockwell.com
Pointer Avionics Ltd.	77365	1235 Shawson Drive, Unit 11B, Mississauga, Ontario Canada L4W 1C4 Tel.: 905-564-1600 Fax.: 905-564-1601
Sundstrand Data Control, Inc. is now AlliedSignal		Customer Access System Tel: 1-800-707-4555 Fax: 1-800-303-7828

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LIST OF CHAPTERS

The following is a List of Chapters contained in this manual arrangement:

Chapter Number	Chapter Title	Latest Effective Revision Date
21	Air Conditioning	Dec 18, 2001
23	Communications	Dec 18, 2001
24	Electrical Power	Dec 18, 2001
25	Equipment/Furnishings	Dec 18, 2001
26	Fire Protection	Dec 18, 2001
27	Flight Controls	Dec 18, 2001
28	Fuel	Dec 18, 2001
29	Hydraulic Power	Dec 18, 2001
30	Ice and Rain Protection	Dec 18, 2001
31	Instruments	Dec 18, 2001
32	Landing Gear	Dec 18, 2001
33	Lights	Dec 18, 2001
34	Navigation	Dec 18, 2001
35	Oxygen	Dec 18, 2001
36	Pneumatic	Dec 18, 2001
52	Doors	Dec 18, 2001
61	Propellers	Dec 18, 2001
71	Power Plant	Dec 18, 2001
72	Engines	Dec 18, 2001
73	Engine Fuel and Controls	Dec 18, 2001
77	Engine Indicating	Dec 18, 2001
79	Oil	Dec 18, 2001
80	Starting	Dec 18, 2001

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CHAPTER

21

AIR CONDITIONING

de Havilland Inc.
DHC–6 TWIN OTTER
COMPONENT MAINTENANCE MANUAL
CHAPTER 21 – AIR CONDITIONING
TABLE OF CONTENTS

MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B./T.R.
Barber–Colman	Temperature Sensor	AYLF 3001–1	F–5130	Jan 15/1952	
	Electro–Mechanical Rotary Actuator Valve	BYLB 9304–10, –11	F–14065	Oct 1/1968	T.R. No. 1
	Split Series Drive Motor	DYLM 43400–13	F–14091	Dec 23/1968	
	Thermistor and Blower Assembly	BYLF 7469	F–10446	Mar 31/1961	
	Permanent Magnet Drive Motor	FYLM 23800–2	F–10447	Mar 31/1961	
	Automatic Temperature Controller & Micropositioner	CYLZ 3230	F6882	May 1/1955	
	Micropositioners	F–5114–4	–	May 1/1961	
Dynamic Air	Vaneaxial Blower	M5861AD–6B	21–50–11	Sep 18/1970	
FL Aerospace was Janitrol	Mixing Valve Assembly	A58D72 (C6SC1099–1)	–	Aug 10/1970	
* Keith Products	Vapor Cycle Air–Conditioning Systems	TR–128	–	–	
Whittaker Controls was Sundstrand	Bleed Air Shutoff Valve	26440051	30–40–1	Jul 1/1977	
	Solenoid Actuated (Pilot) Poppet Shutoff Valve Assembly	320295, –1	(21) 75–10–02	Feb 1/1998	

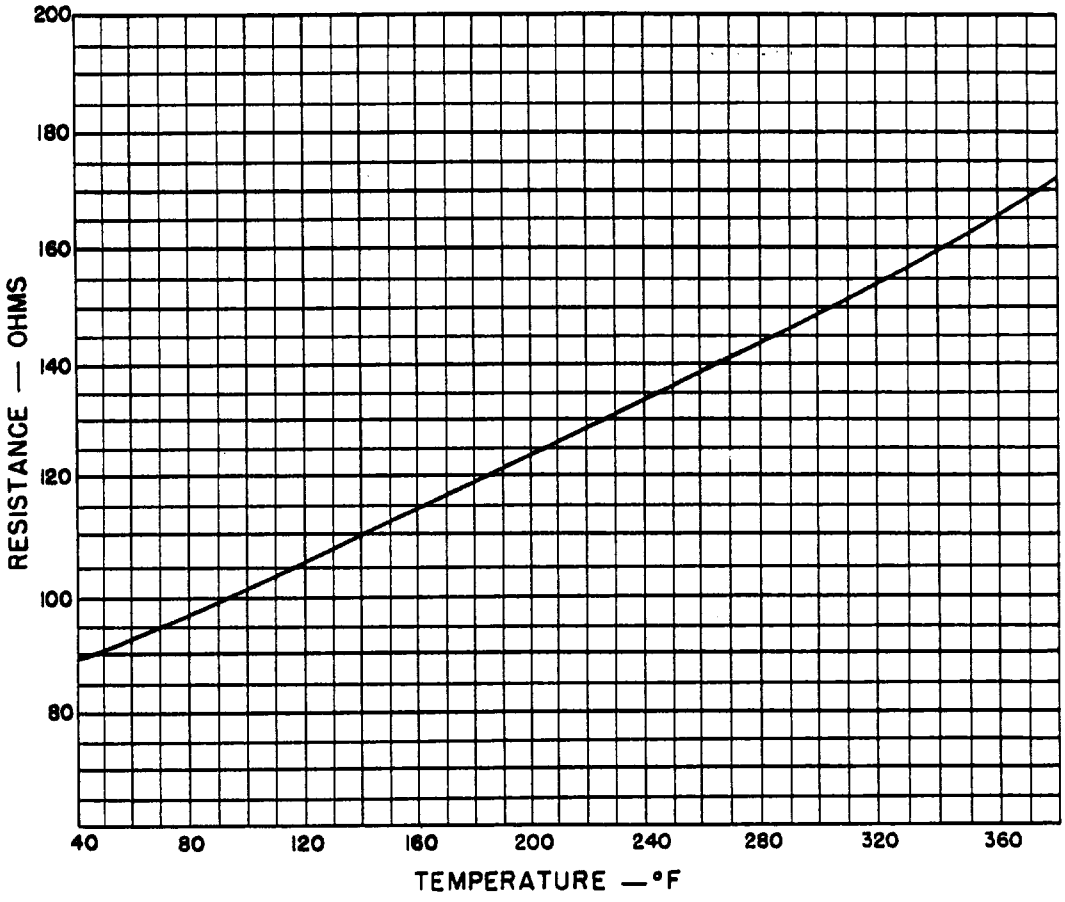
* This listing provided for reference only. Technical data will be sent directly from Vendor. Any requests for data should be directed to:

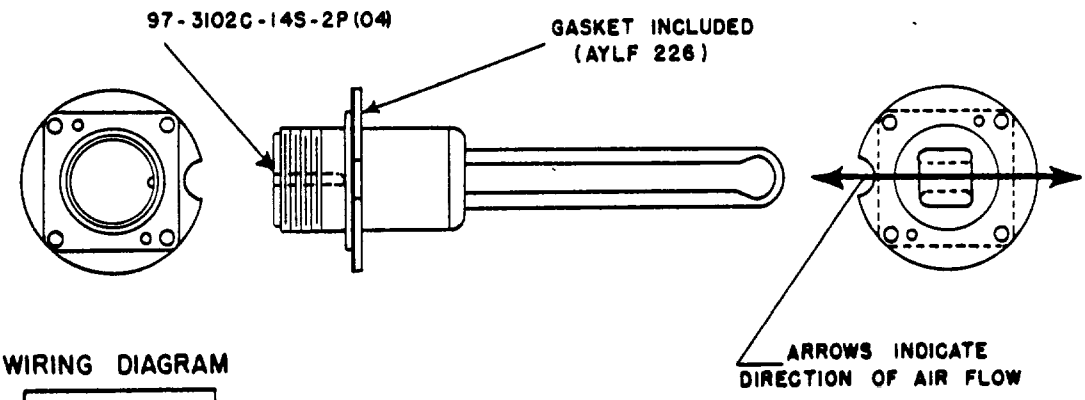
* Keith Products Inc.
Environmental Systems
4554 Claire Chennault
Dallas, Texas
U.S.A.
75248

Telephone: 214–407–1234
Facsimile: 214–407–1571

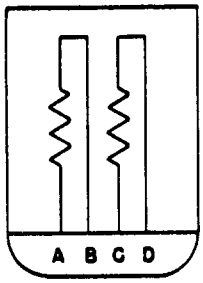
Contact: Mr. Richard Vooshees (Product Support Manager)
E–mail: richard@keithproducts.com

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WIRING DIAGRAM



AYLF 3001-1

TEMPERATURE SENSING ELEMENT

BARBER-COLMAN COMPANY
Rockford, Illinois

OVERHAUL MANUAL

BYLB 9304-10 AND -11 ELECTRO-MECHANICAL ROTARY ACTUATED VALVE

1. DESCRIPTION AND OPERATION

A. The function of the mixing valve is to control the cabin temperature at a pre-selected level.

B. LEADING PARTICULARS

(1) Valve Data

(a)	Diameter	- 0.937 inches
(b)	Maximum Pressure	- 80 PSIG at 470°F or 68 PSIG at 580°F
(c)	Proof Pressure	- 102 PSIG at 580°F
(d)	Burst Pressure	- 136 PSIG at 580°F
(e)	Leakage (Max.)	
	(1) Int Leakage	- 0.20 LB/MIN @ 80 PSIG and 470°F
	(2) Ext Leakage	- 0.02 LB/MIN @ 80 PSIG and 470°F

(2) Actuator Data

(a)	Motor Number	- DYLM 43400-13
(b)	Motor Type	- Split Series
(c)	Operating Voltage	- 28 Volts DC
(d)	Rated Current	- 0.4 Amps
(e)	Rated Load	- 5 lb in.
(f)	Time Stroke	- 22 - 38 sec/90° at 5 lb in.
(g)	Duty Cycle	- Continuous
(h)	Gear Reduction	- 50131/1
(i)	Enclosure	- Explosion Proof
(j)	Rheostat	- 90 Ohms/90°
(k)	Weight (approx)	- 1 lb
(l)	Temperature Range	- -65°F to +160°F

NOTE: Improved rheostat assembly makes BYLB 9304-10 into BYLB 9304-11.

2. DISASSEMBLY (See Figure 4)

A. Index numbers in Figure 4 are in disassembly order except for the attaching parts which follow immediately after the part that they attach; disassemble in this manner except where noted below:

CAUTION: EXERCISE CARE WHEN BREAKING THE SEAL BETWEEN GEAR PLATE ASSEMBLY (39) AND GEAR TRAIN HOUSING (61) TO AVOID SCARRING THE MATING EDGES.

2. DISASSEMBLY (Continued)

(1) Do not attempt to remove bearings from gear plate assembly (39).

CAUTION: TAG ALL GEAR ASSEMBLIES TO INSURE SETS BEING KEPT TOGETHER AND NOT INTERMIXED WITH THOSE OF OTHER UNITS.

(2) Do not remove ring (11) from butterfly assembly unless replacement is necessary.

NOTE: Refer to Barber-Colman Company publication for overhaul of drive motor (61).

3. CLEANING

A. Clean non-electrical parts with an approved cleaning solvent, Trichlorethylene, Specification MIL-T-7003, or equivalent, and dry with compressed air.

CAUTION: DO NOT CLEAN OILITE BEARINGS OR ASSEMBLIES CONTAINING OILITE BEARINGS IN CLEANING SOLVENT. USE A CLEAN, DRY, LINT-FREE CLOTH.

B. Clean electrical parts with a clean, dry, lint-free cloth.

4. INSPECTION

A. Inspect all parts visually for cracks, excessive wear, deformities, or damaged threads to determine their suitability for reuse.

B. Thoroughly inspect all parts listed in Table 1.

(1) Replace all parts not meeting requirements listed.

(2) If steel bearings contained in gear plate assembly (39) and gear housing assembly (61) are damaged or do not meet the requirements listed, replace the assembly containing the defective bearing.

C. Inspect ball bearings (59 and 60) for excessive wear or looseness. Replace if necessary.

D. Switches (34) can be inspected for continuity or breakdown; however, it is recommended that they be replaced at overhaul.

E. Inspect all gears for excessive play between teeth and inspect pinion shafts for wear.

4. INSPECTION (Continued)

F. Inspect rheostat assembly (25) for dirt or other foreign material. Check that the windings are smooth, tight, and intact.

G. Inspect wiper arm assembly (22) for roughness that may damage the rheostat assembly.

5. REPAIR OR REPLACEMENT. The design of the valve and actuator limits repair to the removal of slight dents and deformities in covers, supports, plates, etc. All other parts found to be defective during visual inspection and testing shall be replaced.

6. ASSEMBLY

A. Assembly is essentially the reverse order of disassembly paying particular attention to the following:

Material Used During Assembly

Grease	A mixture consisting of ten percent by weight of Molybdenum disulfide, Specification MIL-M-7866, to grease, Specification MIL-G-7118.
Grease	Aeroshell No. 7A per MIL-G-23827.
Glyptal	General Electric Company No. 1201.
Gasoila	Federal Process Company
Tape	Minnesota Mining and Manufacturing Company No. 56.

(1) See Figure 1 for proper gear train installation.

(a) Lubricate bearings, studs, and gear assemblies forming the gear train with a mixture consisting of ten percent by weight of Molybdenum disulfide, Specification MIL-M-7866, to grease, Specification MIL-G-7118. The total amount of lubricant shall not exceed one level teaspoon.

CAUTION: DO NOT PACK GEAR PLATE HOUSING WITH GREASE AS OVER LUBRICATING WILL AFFECT OPERATION IN EXTREME TEMPERATURE.

6. ASSEMBLY (Continued)

(2) When assembling motor and housing assembly (61) to gear train plate assembly (39), dip threads of screws (40) in Glyptal, General Electric Company, No. 1201, or equivalent, prior to assembly.

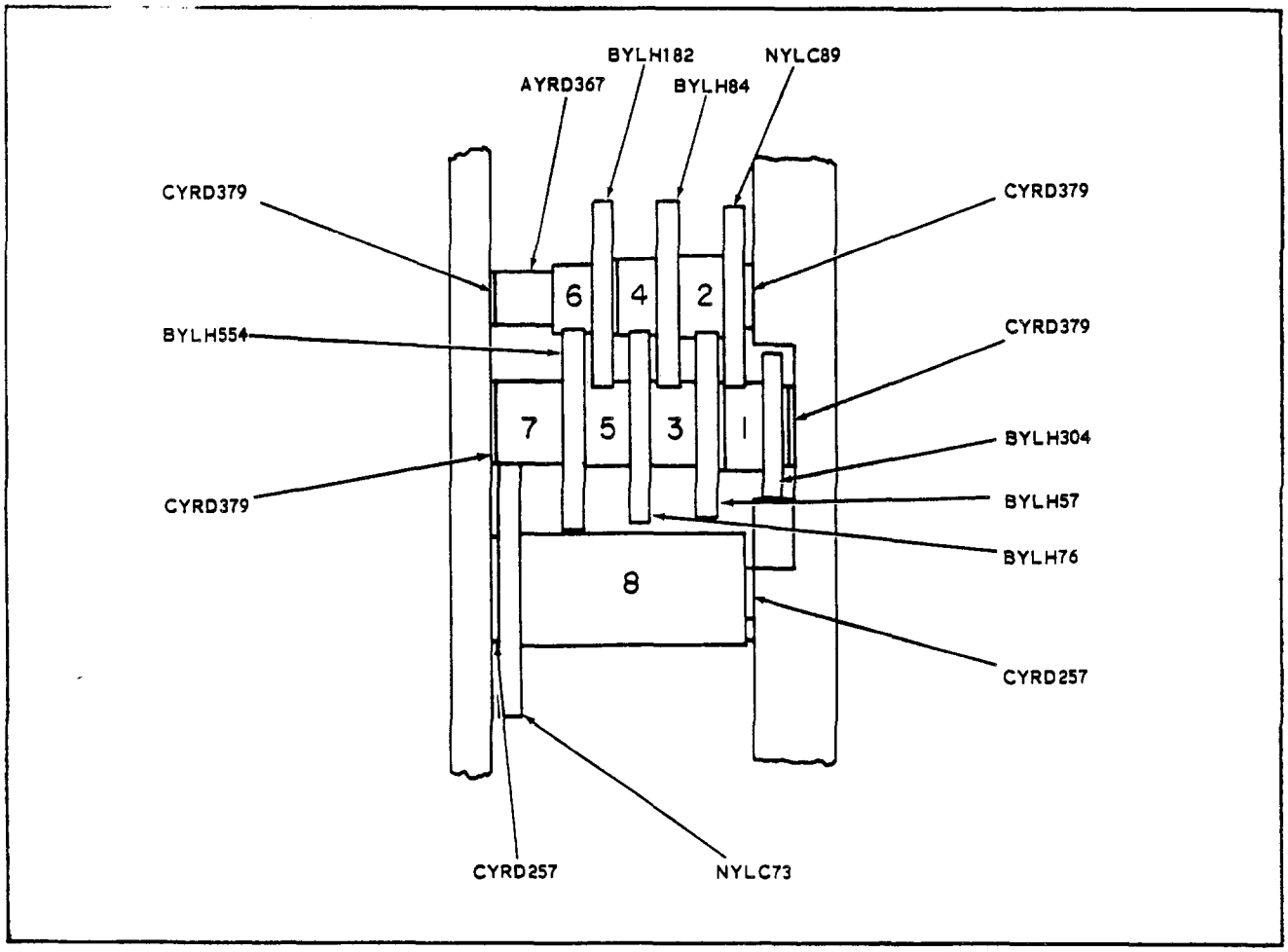


Figure 1. Gear Train Installation

(3) Fill ball bearing (60) 1/3 full of grease per MIL-G-23827.

(4) Install washers (57) as required to obtain minimum end play of output shaft (56). End play must be 0.001 to 0.005 inch.

6. ASSEMBLY (Continued)

(5) Seal mating edges of gear train plate assembly (39) and gear train housing assembly with Gasoila, manufactured by the Federal Process Company, Cleveland, Ohio, or equivalent.

(6) Adjust cam assemblies (29) so that travel is $90^{\circ} \pm 3^{\circ}$ before mounting the rheostat assembly (25). (See Actuator Adjustment.)

(7) Run the actuator to the counterclockwise end of travel and set wiper arm assembly (22) at corresponding end of travel on rheostat assembly (25).

(8) Locate key of connector (16) toward top end of actuator.

(9) Dip nameplate screws (3) in Glyptal.

(10) Safety wire switch housing screws (19 and 20), gear train plate assembly screws (40), and connector screws (17).

(11) Tape or securely fasten all leads so they cannot come in contact with moving or sharp parts.

(12) Rewire, if necessary, in accordance with Figure 2.

(13) Gap ring (11) to 0.006 - 0.003 inch, if necessary.

B. Actuator Adjustment

(1) Mount actuator in a suitable test fixture, and connect to test circuit, as shown in wiring diagram, Figure 2.

(2) Install a pulley wheel at least eight inches in diameter on the main shaft and weight to load the actuator to 5 lb in. Be sure the weight is always hanging on the side of the pulley so the weight is lifted when the actuator is operating.

(3) Mount a protractor on the main shaft. Apply power to pin "C" and rotate the shaft to its clockwise limit. Set the pointer on the protractor to the 0° mark.

(4) Apply power to pin "B" to rotate the shaft to its counterclockwise limit. The protractor shall show a rotation of $90^{\circ} \pm 3^{\circ}$.

(5) Adjust travel, if required, by removing the switch housing cover (18), the rheostat housing (21), the rheostat assembly (25), and the wiper arm

6. ASSEMBLY (Continued)

assembly (22). Loosen the hex nut (26) and rotate the cam assemblies (29) until a travel of $90^{\circ} \pm 3^{\circ}$ has been obtained. Tighten the nut (26) securely after adjustment of the cam assemblies. Run the actuator to the counter-clockwise position and remove from the test fixture.

C. Assemble the valve making sure that the butterfly coupling (62) shows correct butterfly position. Place the butterfly valve in the closed position and mount the actuator to the valve with screws (4).

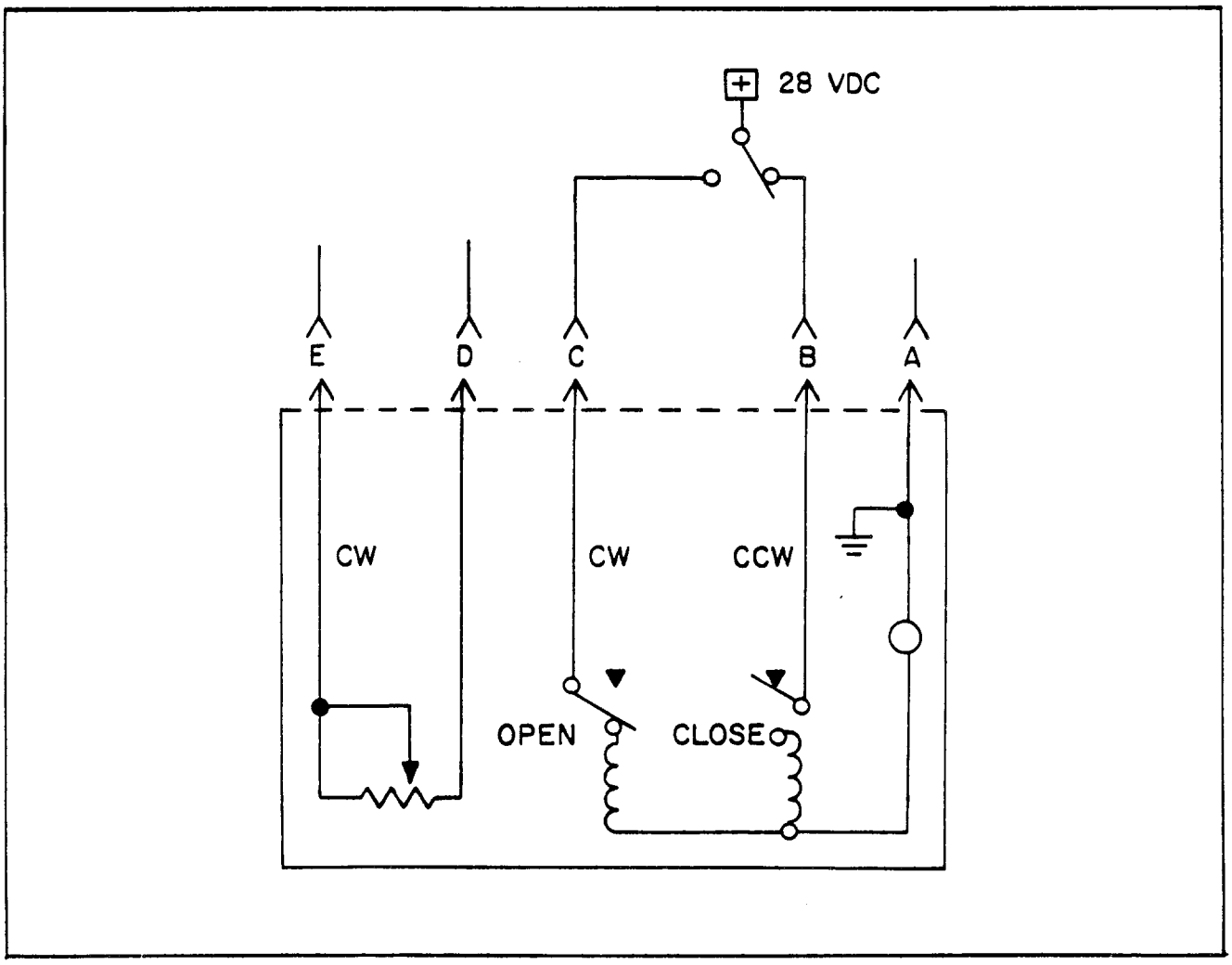


Figure 2. Internal Wiring and Test Circuit Diagram

BARBER-COLMAN COMPANY
Rockford, Illinois

OVERHAUL MANUAL

BYLB 9304-10 AND -11 ELECTRO-MECHANICAL ROTARY VALVE

TEMPORARY REVISION NO. 1
Insert Adjacent to Page 7

7. FITS AND CLEARANCES

Table 1. Wear Limits

Index No.	Nomenclature	Maximum Clearance (Inches)
53	Worm Gear Assembly (OD of Shaft)	0.003
39	Gear Train Plate Assembly (ID of Bearing)	
39	Gear Train Plate Assembly Shafts OD	0.003
42, 43, 44, 45, 46, 47, 50	Spur Gear Assembly ID	

8. TESTING

A. Mount the assembled valve and actuator in a suitable test fixture similar to Figure 3.

B. Apply power to pin "B". The valve must move to the full closed position.

C. The resistance between pins "D" and "E" shall be 1 ± 1 ohm.

D. Internal leakage must be checked with butterfly valve closed and shut-off valve open. Internal leakage shall not exceed 0.20 LB/MIN at 80 PSIG and room temperature.

E. Apply power to pin "C". The valve shall move to the full open position ($90^{\circ} \pm 3^{\circ}$).

F. The resistance between pins "D" and "E" shall be 90 ± 5 ohms.

G. External leakage must be checked with butterfly valve open and shut-off valve closed. External leakage shall not exceed 0.02 LB/MIN at 80 PSIG and room temperature.

H. Check timing. The valve shall travel $90^{\circ} \pm 3^{\circ}$ to the full open or full closed position within 22 to 38 seconds at 80 PSIG and room temperature.

7. FITS AND CLEARANCES

Table 1. Wear Limits

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53	Worm Gear Assembly (OD of Shaft)	0.003
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39	Gear Train Plate Assembly Shafts OD	0.003
42, 43, 44 45, 46, 47 50	Spur Gear Assembly ID	

8. TESTING

A. Mount the assembled valve and actuator in a suitable test fixture

Note: See Temporary Revision For This Page

osi-

hut-
80

D. Apply power to pin "C". The valve shall move to the full open position ($90^{\circ} \pm 3^{\circ}$).

E. External leakage must be checked with butterfly valve open and shut-off valve closed. External leakage shall not exceed 0.02 LB/MIN at 80 PSIG and room temperature.

F. Check timing. The valve shall travel $90^{\circ} \pm 3^{\circ}$ to the full open or full closed position within 22 to 38 seconds at 80 PSIG and room temperature.

NOTE: Please see the TEMPORARY REVISION that revises this page.

8. TESTING (Continued)

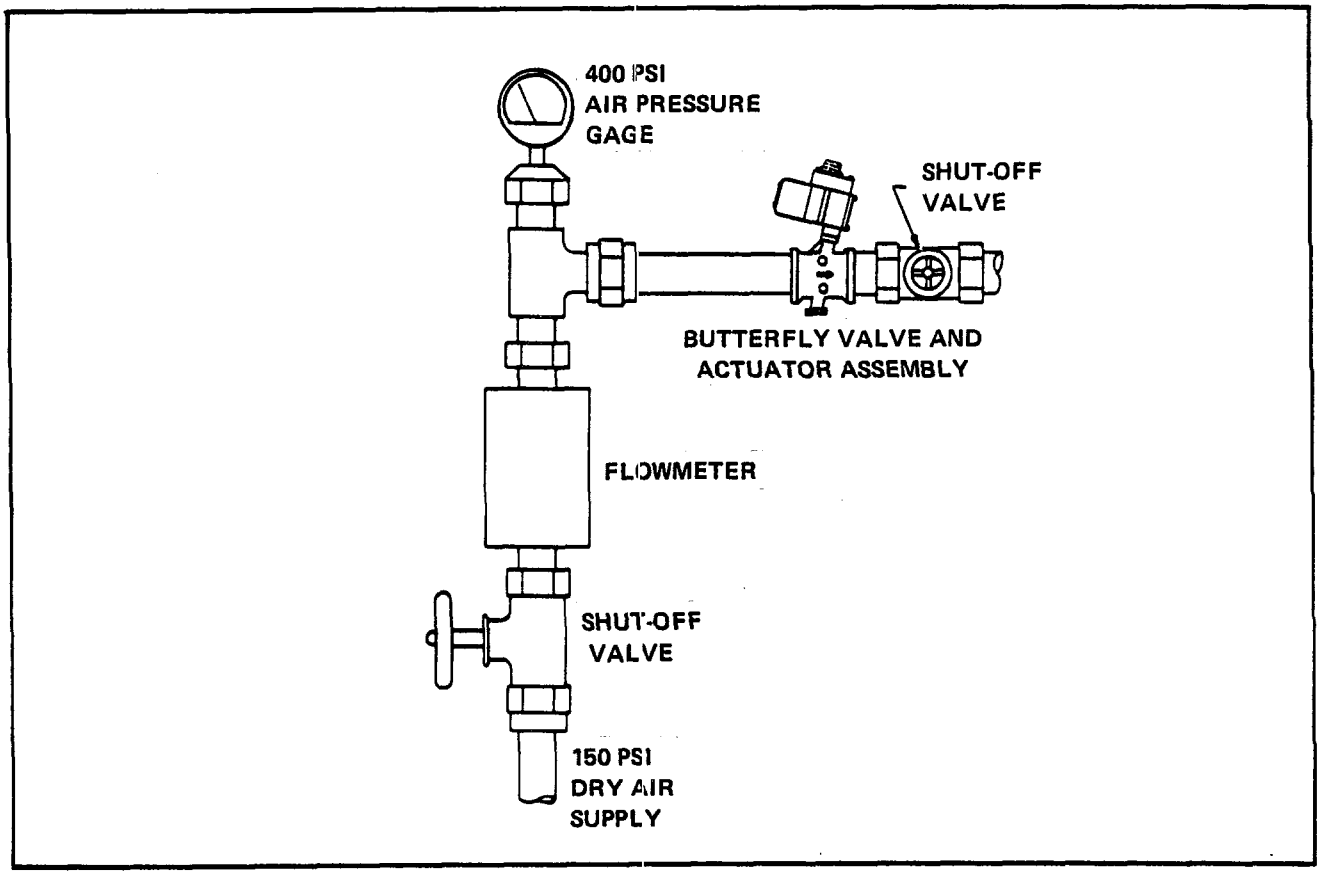


Figure 3. Valve and Actuator Test Fixture

9. ILLUSTRATED PARTS LIST

Fig. & Index No.	Part No.	1 2 3 4 5 6 7 Nomenclature	Usage Code	Units Per Assy
4-1	BYLB 9304-10	VALVE, ELECTRO-MECHANICAL . . . ROTARY, ACTUATED		1
	BYLB 9304-11	VALVE, ELECTRO-MECHANICAL . . . ROTARY, ACTUATED		1
-2	NYRZ 1-11-1	. PLATE, IDENTIFICATION . . . . (ATTACHING PARTS)		1
-3	AN 515-2-2	. SCREW, MACHINE V(05624 . . . . NO. BYRF 517)		2
		---*---		
	BYLB 82-40	. VALVE . . . . . (ATTACHING PARTS)		1
-4	JYRF 50	. SCREW, MACHINE		4
		---*---		
-5	AYRF 53	. . RING, RETAINING		1
-6	BYLB 298	. . SHAFT, SHOULDERED.		1
-7	BYLB 73	. . WASHER, FLAT		1
-8	BYLB 76	. . PACKING		1
-9	DYLZ 508	. . SPACER		2
-10	BYLB 79	. . BUTTERFLY.		1
-11	BYLB 74	. . RING		1
-12	DYLZ 509	. . SLEEVE, BEARING		1
-13	CYRB 105	. . BEARING, ROLLER, NEEDLE . .		1
-14	CYRB 106	. . BEARING, ROLLER, NEEDLE . .		1
-15	BYLB 296	. . BODY, VALVE		1
	NYLC 9336	. ACTUATOR, ELECTRO-MECHANICAL . ROTARY		1
-16	MS-3102A-16S-1P	. . CONNECTOR V(05624 . . . . . NO. BYLC-133-1) (ATTACHING PARTS)		1
-17	AN 500A-4-4	. . SCREW, MACHINE V(05624 . . . NO. BYRF 1008)		4
		---*---		
-17A	AYLZ 43	. . LUG, TERMINAL		1
-18	NYLC 3	. . COVER, SWITCH HOUSING . . . (ATTACHING PARTS)		1
-19	AN 500A4-14	. . SCREW, MACHINE V(05624 . . . NO. BYRF 578)		2
-20	AN 500A-4-24	. . SCREW, MACHINE V(05624 . . . NO. BYRF 1017)		2
		---*---		

9. ILLUSTRATED PARTS LIST (Continued)

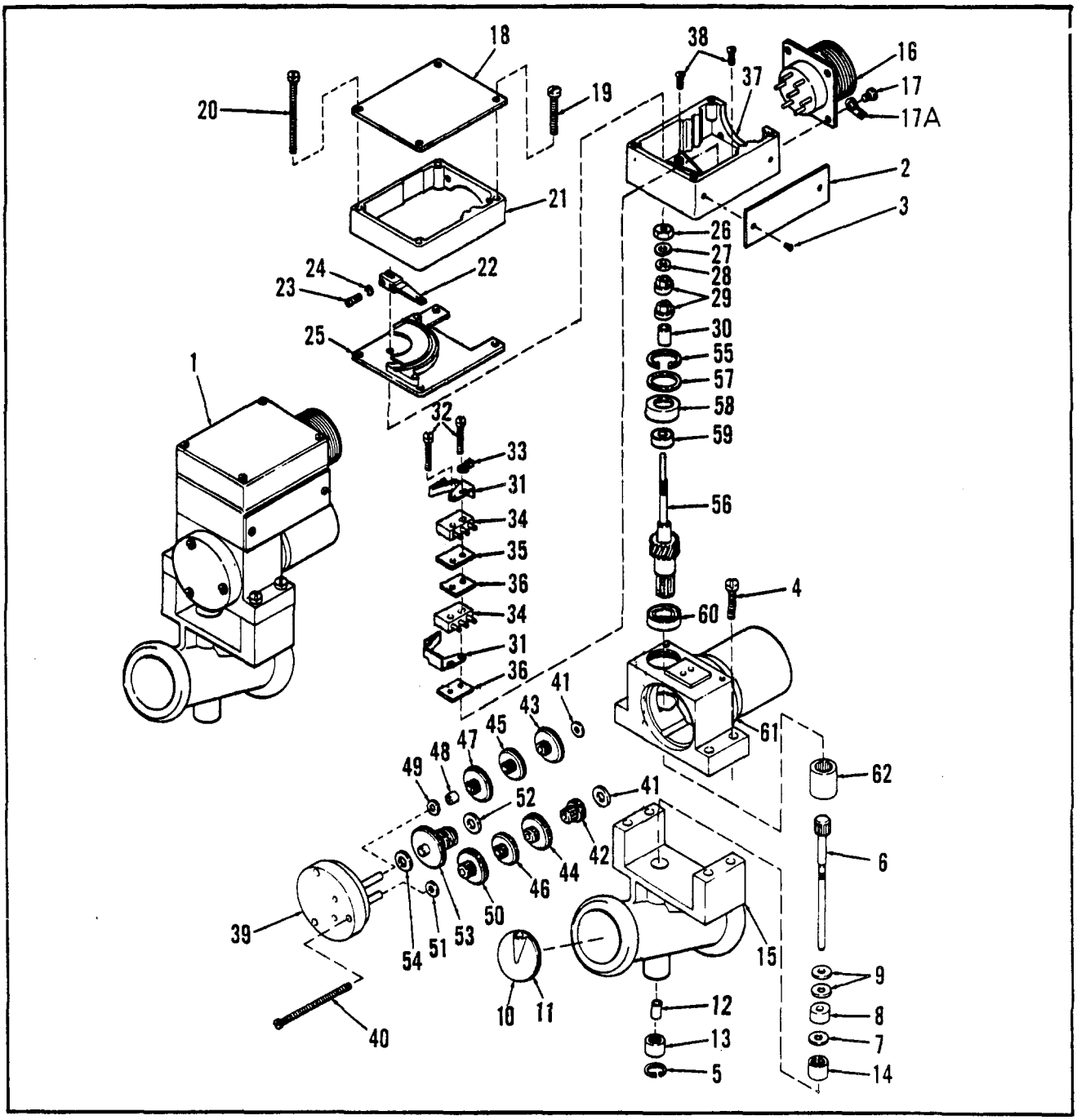


Figure 4. Exploded View

9. ILLUSTRATED PARTS LIST (Continued)

Fig. & Index No.	Part No.	1 2 3 4 5 6 7 Nomenclature	Usage Code	Units Per Assy
4-21	NYLC 428	. . HOUSING, RHEOSTAT		1
-22	NYLC 993	. . WIPER ARM ASSEMBLY . . . . . (ATTACHING PARTS)		1
-23	BYRF 732	. . SCREW, MACHINE		1
-24	CYRD 188	. . WASHER, LOCK . . . . . ---*---		1
-25	NYLC 932-1	. . RHEOSTAT ASSEMBLY		1
-26	DYRF 96	. . NUT, HEXAGON		1
-27	CYRD 237	. . WASHER, LOCK		1
-28	CYRD 235	. . WASHER, FLAT		1
-29	NYLC 10-1	. . CAM ASSEMBLY		2
-30	AYRD 544-1	. . SPACER, CAM		1
-31	CYZP 403-1	. . ACTUATOR, SWITCH . . . . . (ATTACHING PARTS)		2
-32	AN 500AC-2-10	. . SCREW, MACHINE V(05624 . . . NO. JYRF 45) ---*---		2
-33	FYRE 54	. . TERMINAL		1
-34	1SX1-T	. . SWITCH V(MFD by 91929) . . . V(05624 NO. CYZP 387)		2
-35	NYLC 144	. . SPACER, SWITCH		1
-36	JX 10001	. . INSULATOR, SWITCH . . . . . V(MFD by 91929) V(05624 NO. NYLC 6)		2
-37	NYLC 427	. . HOUSING, SWITCH . . . . . (ATTACHING PARTS)		1
-38	AN 505-4-4	. . SCREW, MACHINE V(05624 . . . NO. BYRF 217) ---*---		2
-39	NYLC 65	. . PLATE, GEAR TRAIN ASSY . . . (ATTACHING PARTS)		1
-40	JYRF 36	. . SCREW, MACHINE		3
-41	CYRD 379	. . WASHER, FLAT . . . . . ---*---		2
-42	BYLH 304	. . GEAR ASSEMBLY, SPUR		1
-43	NYLC 89	. . GEAR ASSEMBLY, SPUR		1
-44	BYLH 57	. . GEAR ASSEMBLY, SPUR		1
-45	BYLH 84	. . GEAR ASSEMBLY, FLAT		1
-46	BYLH 76	. . GEAR ASSEMBLY, SPUR		1
-47	BYLH 182	. . GEAR ASSEMBLY, SPUR		1

9. ILLUSTRATED PARTS LIST (Continued)

Fig. & Index No.	Part No.	1 2 3 4 5 6 7 Nomenclature	Usage Code	Units Per Assy
4-48	AYRD 367	. . SPACER		1
-49	CYRD 379	. . WASHER, FLAT		1
-50	BYLH 554	. . GEAR ASSEMBLY, SPUR		1
-51	CYRD 379	. . WASHER, FLAT		1
-52	CYRD 257	. . WASHER, FLAT		AR
-53	NYLC 73	. . GEAR ASSEMBLY, WORM		1
-54	CYRD 257	. . WASHER, FLAT		2
-55	5000-56-MF	. . RING, RETAINING . . . . . V(MFD by 79136) V(05624 NO. AYRF 57)		1
-56	NYLC 431	. . SHAFT, OUTPUT		1
-57	NYLC 96	. . WASHER, FLAT		AR
-58	NYLC 7	. . CARTRIDGE, BEARING		1
-59	33KDD3FS30160	. . BEARING, BALL . . . . . V(MFD by 17402) V(05624 NO. CYRB80)		1
-60	SR18103MMABEC-3	. . BEARING, BALL . . . . . V(MFD by 83086) V(05624 NO. CYRB160)		1
-61	DYLM43400-13	. . MOTOR AND HOUSING ASSEMBLY .		1
-62	BYLB 22	. COUPLING		1

VENDOR'S CODE

05624	Barber-Colman Company, Rockford, Illinois
17402	Fafnir Bearing Company, Inc., Woodside, New York
79136	Waldes Kohinoor, Inc., Long Island City, N.Y.
83086	New Hampshire Ball Bearing, Inc., Peterborough, N.H.
91929	Minneapolis Honeywell Regulator Company Micro Switch Division Freeport, Illinois

BARBER-COLMAN COMPANY
ROCKFORD, ILLINOIS

OVERHAUL MANUAL

SPLIT SERIES DRIVE MOTOR

DYLM 43400-13

1. DESCRIPTION AND OPERATION.

A. The subject motor is used in a Barber-Colman Company actuator. For overhaul of actuator see actuator overhaul instructions.

B. Refer to table 1 for characteristics of motor.

2. DISASSEMBLY. (See figure 1.)

A. Index numbers in figure 1 are in disassembly order except for the attaching parts which follow immediately after the parts which they attach; disassemble in this manner except as noted below:

(1) Using a bearing puller, remove and discard gear (1) and bearings (16) from armature assembly shaft.

(2) Unsolder brush cables from terminals in rear end cap assembly (11) and discard brushes (8).

CAUTION: DISASSEMBLY OF COMPONENT PARTS OF REAR END CAP ASSEMBLY (11), COIL ASSEMBLY (14), OR ARMATURE ASSEMBLY (17) IS NOT RECOMMENDED.

3. CLEANING.

A. Clean all non-electrical parts with an approved cleaning solvent and dry with compressed air.

B. Clean electrical parts with a clean, dry, lint-free cloth.

4. INSPECTION.

A. Visually inspect all parts for cracks, dents, excessive wear, stripped threads or other damage to determine their suitability for reuse.

B. Check bearing bores in end caps (11 and 15). Replace end caps if the bearings do not fit with a snug slip fit in bearing bores.

5. REPAIR.

A. The design of the motor limits repair to the removal of the slight dents and deformities in metal parts.

(1) If the armature assembly commutator is pitted, grooved, or burned replace the armature assembly (17).

B. No other repair of component items shall be attempted. All other parts found defective during inspection and testing shall be replaced with new or servicable parts.

C. Replace gear (1), brushes (8), bearings (16) and all other items of a similar nature which are not recommended for reuse, at overhaul.

6. ASSEMBLY. (See figure 1)

A. Press bearings (16) on armature assembly shaft using a bearing installer.

CAUTION: WHEN INSTALLING BEARINGS, APPLY PRESSURE ON INNER RACE ONLY.

B. Press a new gear (1) on armature assembly shaft. Support the armature assembly by the shaft in a suitable fixture to press gear in position. Gear (1) must not slip with ten lb. in. torque applied.

CAUTION: BE CERTAIN ARMATURE ASSEMBLY IS SUPPORTED BY SHAFT TO PREVENT DAMAGE TO BEARINGS.

C. Pull leads through front end cap (15). Assembly front end cap (15), coil assembly (14) and rear end cap assembly (11) over armature assembly (17) and secure with screws (12) and washers (13). Seal between coil assembly (14) and front end cap assembly (15), between coil assembly (14) and rear end cap assembly (11) with 3M Co. EC 801 potting compound or equivalent. Dip threads of screws (12) in General Electric Co. Glyptal No. 1201 or equivalent before assembly.

D. Install washers (10) and retainer ring (9). Check end play of armature assembly shaft, installing washers (10) as required to obtain proper shaft end play of 0.002 to 0.012 inch with ten pound axial load causing movement.

E. Solder brush cables to terminals on rear end cap assembly with 580° F solder. Insert brushes in brush guides and place end of spring in slot in end of brush thus holding the brush in position.

(1) Brush cables shall have a minimum of 5/8 inch free length between the brush and the terminal solder point and must be bent toward the brush spring.

(2) Cables must not be stiff from excess solder nor shall they contain any frayed leads.

F. Insulate inside of rear cover (2) with Minnesota Mining and Manufacturing Co. No. 27 tape or equivalent.

G. Position cover on rear of assembly. Seal between cover (2) and rear end cap assembly (11) with 3M Co. EC 801 potting compound or equivalent.

H. Secure cover (2) using washer (4) and screws (3) and (5). Dip threads of screws in General Electric Co. Glyptal No. 1201 or equivalent.

I. Cycle motor at 27 vdc for a period of four hours using a duty cycle of one minute on, 30 seconds off, reversing direction after every off interval.

7. TESTING.

A. Connect drive motor to a 27 volt d-c supply containing a SPDT center off switch and check for proper rotation and operation as follows:

(1) Viewing motor from shaft end, the shaft shall rotate CW with the "plus" side of DC power supply connected to red lead and "minus" connected to the white lead.

(2) Motor shall reach no load speed as specified in table 1 within 20 seconds after start in either direction of rotation.

(3) Running current at no load must not exceed that specified in table 1 in either direction of rotation.

TABLE 1-TEST DATA

MOTOR NO.	OPERATING VOLTAGE DC	SPEED RPM NO LOAD	DUTY CYCLE	MAX. NO LOAD AMPS
DYLM 43400-13	27	27,250 ± 6750	Continuous	.5

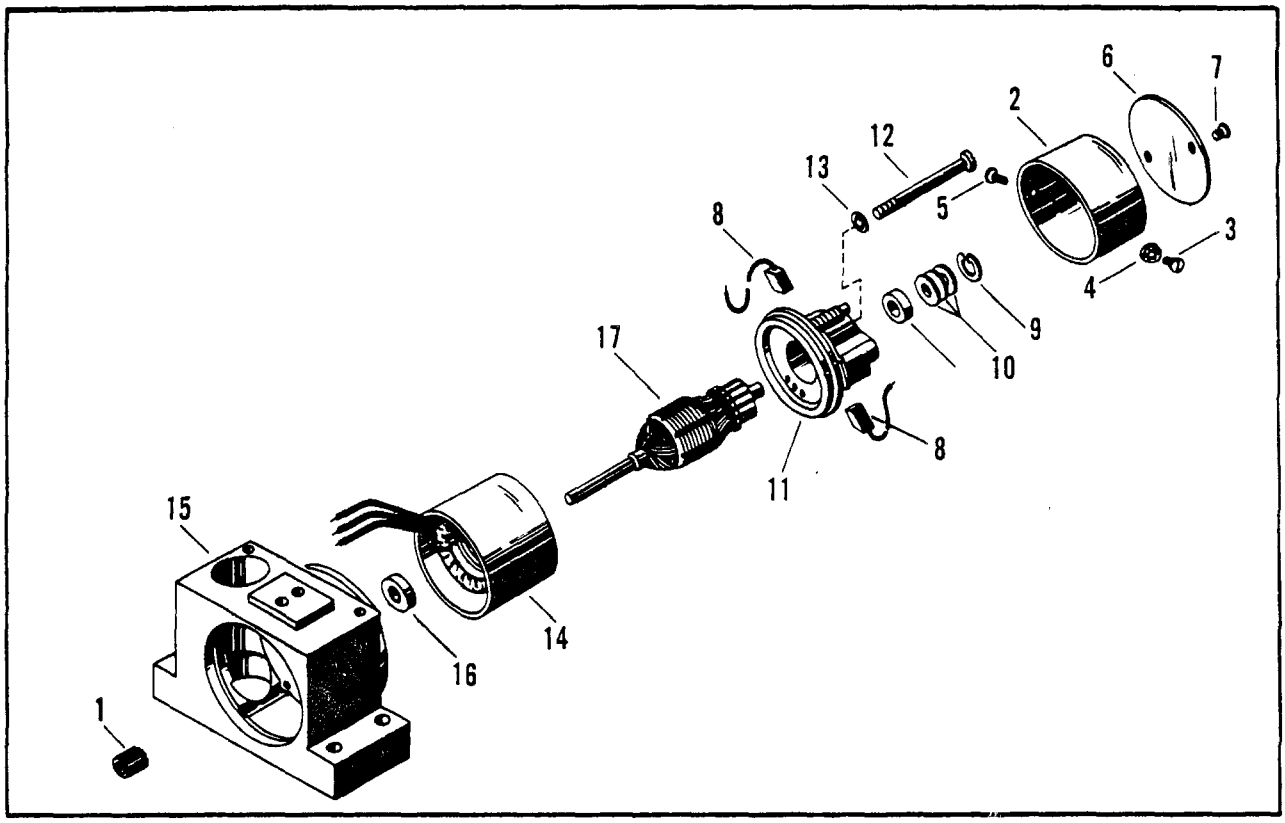


Figure 1, Exploded View

Fig. & Index No.	Part No.	1 2 3 4 5 6 7 NOMENCLATURE	Units Per Assembly
1-	DYLM 43400-13	MOTOR ASSY.	
-1	BYRG 293	. GEAR, SPUR.	1
-2	DYLM 525-21	. COVER, Rear	1
		ATTACHING PARTS	
-3	COMM	. SCREW Binding hd stl cd pl No. 2-56 x 3/16 m. lg V(05624 No. BYRF 592).	1
-4	AN935-2L	. WASHING, Lock V(05624 No. CYRD 292)	1
-5	AN505-2-4	. SCREW, Flt hd stl cd plt No. 2-56 x 1/4 lg V(05624 No. BYRF 688).	1
		---*---	
-6	NYRZ 1-061-4	. PLATE, *Identification*.	1
		ATTACHING PARTS	
-7	AN430A2-3	. RIVET V(05624 No. EYRF 78-1).	2
		---*---	
-8	DYLM 26-1	. BRUSH, Motor.	2
-9	5000-37-W	. RING, Retainer V(Mfd by 89462) V(05624 No. AYRF 31). .	1
-10	CYRD 310	. WASHER, Shim .015 in. thick . .	AR
	CYRD 310-1	. WASHER, Shim .010 in. thick . .	AR
	CYRD 310-2	. WASHER, Shim .008 in. thick . .	AR
	CYRD 310-3	. WASHER, Shim .006 in. thick . .	AR
	CYRD 310-4	. WASHER, Shim .005 in. thick . .	AR
-11	DYLM 504-5	. CAP ASSY. Rear End	1
		ATTACHING PARTS	
-12	COMM	. SCREW, Fil hd sst No. 2-56 x 1 3/8 in. lg V(05624 No. BYRF 662)	2
-13	AN935-2L	. WASHER, Lock V(05624 No. CYRD 292).	2
		---*---	
-14	DYLM 579-12-1	. COIL ASSY. Field	1
-15	NYLC 110	. CAP, Front End	1
-16	CYRB 234	. BEARING, Shielded	2
-17	DYLM 506-54	. ARMATURE Assy	1

VENDOR'S CODE

CODE	NAME AND ADDRESS
05624	Barber-Colman Company, Rockford, Illinois
89462	Waldes Koh-I-Noor, Inc., Cambridge, Mass.

BARBER-COLMAN COMPANY
Rockfor, Illinois

OVERHAUL MANUAL

BYLF 7469 THERMISTOR AND BLOWER ASSEMBLY

1. DESCRIPTION AND OPERATION

A. The blower assembly is to provide sufficient airflow to obtain a representative air sampling across the sensing element.

2. DISASSEMBLY (See figure 3)

A. Index numbers in figure 3 are in disassembly order except for the attaching parts which follow immediately after the parts which they attach.

NOTE: Refer to overhaul instructions F-10447 for overhaul of drive motor (6).

3. CLEANING

A. Clean non-electrical parts with an approved cleaning solvent and dry with compressed air.

B. Clean electrical parts with a clean, dry, lint-free cloth.

4. INSPECTION

A. Inspect all parts for cracks, excessive wear, deformities, or damaged threads to determine their suitability for reuse.

5. REPAIR

A. Remove scratches, dents, or other minor damages to metal parts.

B. Replace all parts found to be defective during inspection or testing with new or serviceable parts.

6. ASSEMBLY

A. Reassemble all parts which were removed during disassembly paying particular attention to the following:

(1) Dip threads of screws (7) in Glyptal, General Electric No. 1201, or equivalent before installing.

6. ASSEMBLY (Continued)

(2) Assemble connector (10) with key located toward top of unit.

(3) Rewire as shown in figure 1.

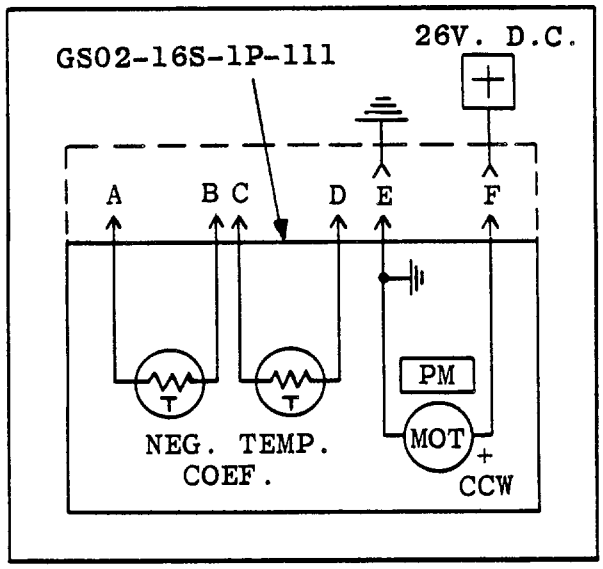


FIGURE 1. WIRING DIAGRAM

(4) Make certain there is free running clearance between blower wheel and cover and also between the blower wheel and the mounting plate.

7. TESTING (figure 1)

A. Connect the unit to an external 26-volt d-c source through a suitable switch to pin E (-) and F (+).

(1) The motor shall operate the blower to draw air into the louvers on the front face of the unit.

B. The unit shall be placed in air chamber having a controlled temperature of 75° ± 5°F. The velocity of the air in the chamber shall be sufficient to prevent stratification.

7. TESTING (figure 1) (Continued)

(1) Use a resistance measuring device * of a very low current type to keep self-heating to a minimum.

(2) The resistance between pins C and D shall be 220 ohms ± 6 ohms. RESISTANCE A-B = C-D.

NOTE: The resistance of the element may slowly decrease. This is due to the potential applied with the resistance measuring device. *

C. Check resistance between each pin and the connector shell at 500 volts d-c. Minimum resistance shall be 5 megohms.

* Wheatstone bridge, or equivalent.

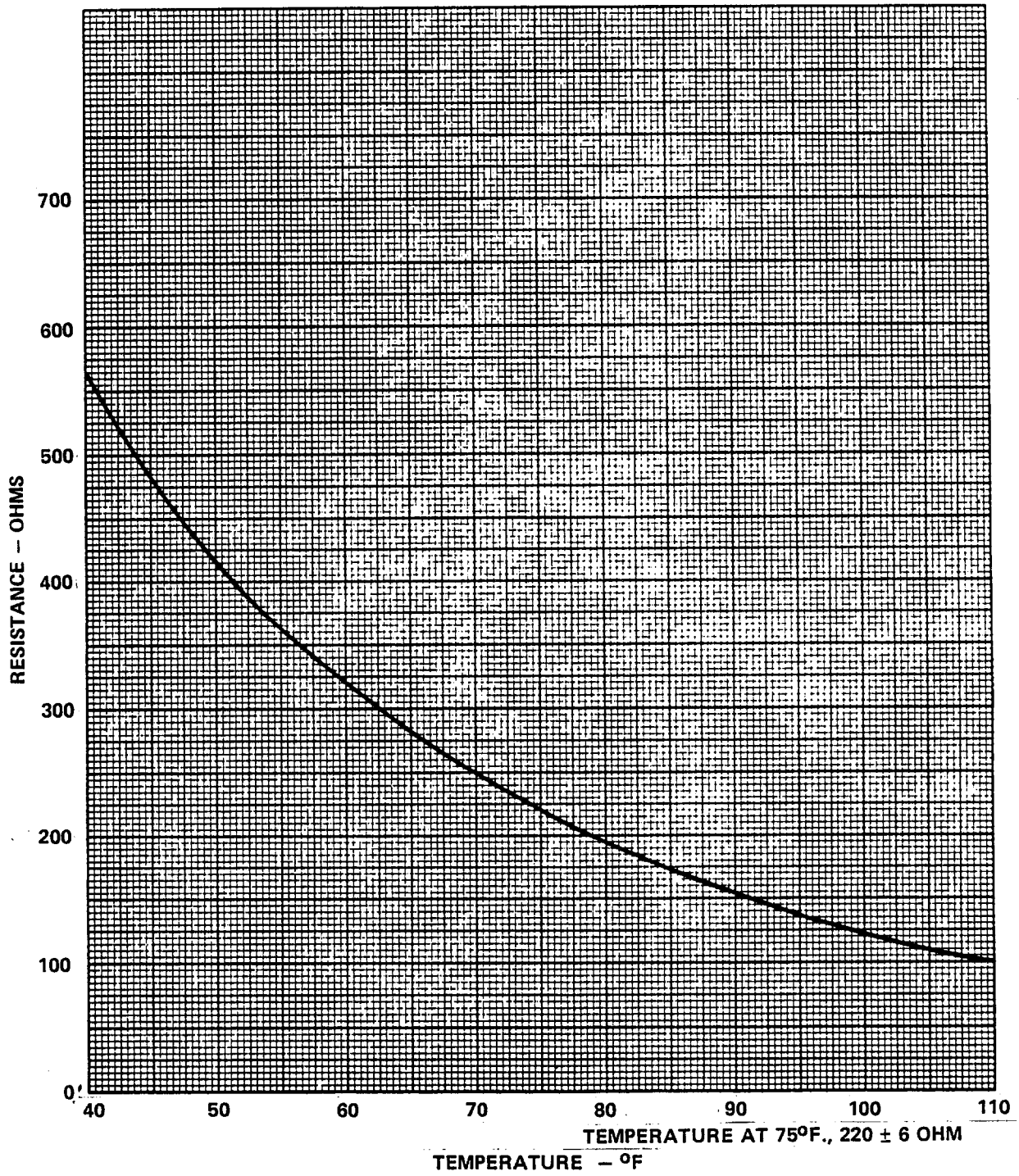


FIGURE 2. RESISTANCE - TEMPERATURE GRAPH

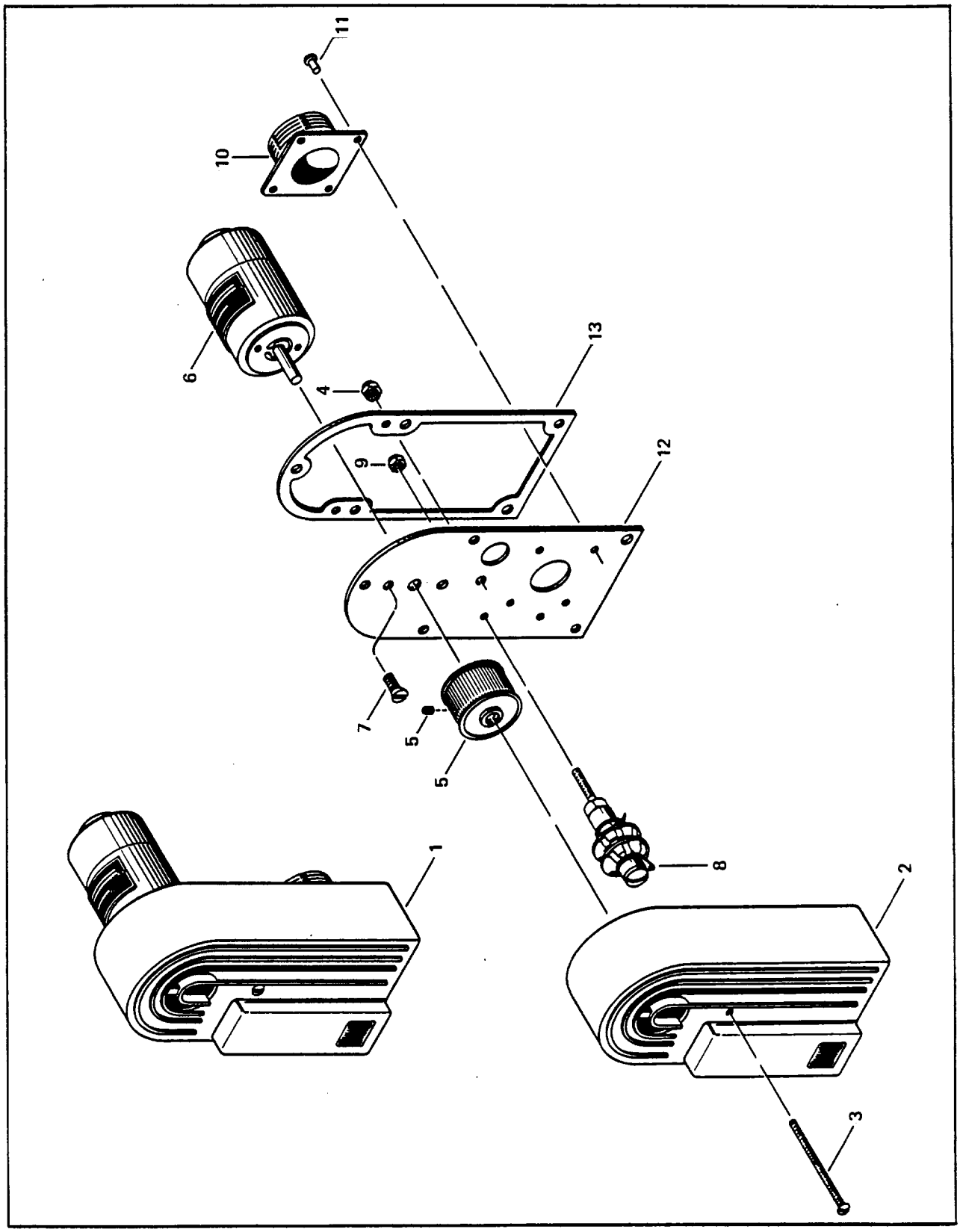


FIGURE 3. EXPLODED VIEW

BYLF 7469 THERMISTOR AND BLOWER ASSEMBLY

8. ILLUSTRATED PARTS LIST

Fig. & Index No.	Part No.	1 2 3 4 5 6 7 Nomenclature	Units Per Assy.
3-1	BYLF 7469	ELEMENT, ELECTRICAL.	
2	BYLF 6	. COVER.	1
		ATTACHING PARTS	
3	BYRF 686	. SCREW, MACHINE	1
4	22NC1-40	. NUT, SELF-LOCKING V(Mfd by 72962) V(05624 No. DYRF 176). . .	1
		-----*-----	
	BYLF 4	. PLATE, MOUNTING ASSEMBLY	1
5	BYLF 1	. . WHEEL, BLOWER.	1
		ATTACHING PARTS	
5	No Number	. . SCREW, SET (PART OF BLOWER WHEEL). .	REF
		-----*-----	
6	FYLM 23800-2	. . MOTOR, DIRECT CURRENT.	1
		ATTACHING PARTS	
7	BYRF 365	. . SCREW, MACHINE	2
		-----*-----	
8	AYLF 394	. . RESISTOR, THERMAL.	2
		ATTACHING PARTS	
9	AN 365-440A	. . NUT, HEXAGON V(05624 No. AYLZ 158) .	2
		-----*-----	
10	BYLF 2	. . CONNECTOR, ELECTRICAL.	1
		ATTACHING PARTS	
11	EYRF 174	. . RIVET, SOLID	4
		-----*-----	
12	BYLF 3	. . PLATE, MOUNTING, BLOWER.	1
13	BYLF 7	. . WASHER, NEOPRENE	1

NOTE: WHEN ORDERING SPARES FROM BARBER-COLMAN COMPANY USE ONLY BARBER-COLMAN COMPANY PART NUMBERS.

VENDOR'S CODE

05624 Barber-Colman Company, Rockford, Ill.

72962 Elastic Stop Nut Corp. of America, Union, New Jersey

BARBER-COLMAN COMPANY
Rockford, Illinois

OVERHAUL MANUAL

FYLM 23800-2 PERMANENT MAGNET DRIVE MOTOR

1. DESCRIPTION AND OPERATION

A. The FYLM 23800-2 drive motor is used in Barber-Colman Company Sensing Elements. For overhaul of individual sensing elements see applicable overhaul instructions.

B. This is a permanent magnet motor with an operating voltage of 27 V DC.

2. DISASSEMBLY (SEE FIGURE 3)

A. Index numbers in figure 3 are in disassembly order except for the attaching parts which follow immediately after the parts that they attach; disassemble in this manner except as noted below:

(1) Using a bearing puller, remove bearings (12) from armature assembly shaft.

(2) Unsolder brush cables from terminal in rear end cap assembly (2) and discard brushes (5).

CAUTION: DISASSEMBLY OF COMPONENT PARTS OF REAR END CAP ASSEMBLY (2), MOTOR HOUSING (16), OR ARMATURE ASSEMBLY (11) IS NOT RECOMMENDED.

3. CLEANING

A. Clean all non-electrical parts with an approved cleaning solvent and dry with compressed air.

B. Clean electrical parts with a clean, dry, lint-free cloth.

4. INSPECTION

A. Visually inspect all parts for cracks, dents, excessive wear, stripped threads, or other damage to determine their suitability for reuse.

B. Check bearing bores in end cap (2). Bearing should fit with a snug fit in bearing bores.

5. REPAIR

A. The design of the motor limits repair to removal of slight dents and deformities in metal parts and refinishing of the armature assembly commutator.

(1) If the armature assembly commutator is slightly pitted, grooved, or burned, polish with silica sand polishing sandpaper, or equivalent.

(a) If the pitting has progressed deeper, turn the commutator on a lathe to approximately 100 micro-inch finish, 250 threads per inch when measured visually with a set of standard comparator gauge blocks.

CAUTION: DO NOT DRESS THE COMMUTATOR DIAMETER SMALLER THAN 0.437 INCHES.

B. No other repair of component items shall be attempted. All other parts found defective during inspection and testing shall be replaced.

C. Replace brushes (5), bearings (12), and all other items of a similar nature which are not recommended for reuse, at overhaul.

D. Replace end cap (2) if fit between bearings and bearing bores of either end cap is loose (See Step 4.B).

6. ASSEMBLY (SEE FIGURE 3)

A. Press bearing (12) on armature assembly shaft using a bearing installer.

CAUTION: WHEN INSTALLING BEARINGS, APPLY PRESSURE ON INNER RACE ONLY.

B. Install washer (14) and retainer ring (13). Check end play of armature assembly shaft installing washers (14) as required to obtain proper shaft end play of 0.004 to 0.012 inch with approximately 2 pounds axial load causing movement.

CAUTION: BE CERTAIN ARMATURE ASSEMBLY IS SUPPORTED BY SHAFT TO PREVENT DAMAGE TO BEARINGS.

C. Solder brush cables to terminals on rear end cap assembly with a high temperature (over 550°F) solder. Insert brushes in brush guides and place end of spring in slot in end of brush thus holding the brush in position.

(1) Brush cables shall have a minimum of 5/8 inch free length between the brush and the terminals solder point and must be bent toward the brush spring.

(2) Cables must not be stiff from excess solder nor shall they contain any frayed leads.

(3) Do not allow flux or solder to run down onto the brush spring.

NOTE: After complete assembly run in brushes by operating motor continuously at no-load and rated voltage until 75% of each brush face is in contact with the commutator.

D. Remagnetize the magnets as follows:

(1) Place the motor in a magnetizer which has pole faces curved to fit the curvature of the motor. Magnetize so that, as viewed from the shaft end, plus voltage at red lead will produce CCW rotation.

NOTE: Magnetizing force shall be 30,000 ampere turns minimum.

E. Insulate inside of rear end cap (2) with pressure sensitive teflon tape.

7. FITS AND CLEARANCES

A. Bearings (12) should fit with a snug fit in bearing bores of end cap (2).

8. TESTING

A. Connect the motor to test circuit as shown in Figure 1. Viewing motor from shaft end, plus voltage at red lead will produce CCW rotation.

B. Within 20 seconds the running current and speed at no load must be within the limits specified in Table I in either direction of rotation.

TABLE I

Motor Number	Operating Voltage DC	Speed RPM No Load	Max No. Load Amps
FYLM 23800-2	27	11,500 ± 1150	0.22

OVERHAUL MANUAL

FYLM 23800-2 PERMANENT MAGNET DRIVE MOTOR

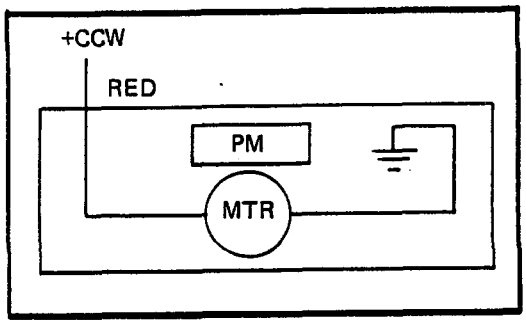


Figure 1. Wiring Diagram

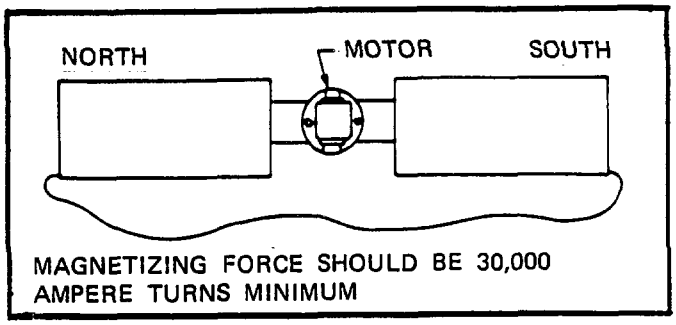


Figure 2. Magnetizing Fixture

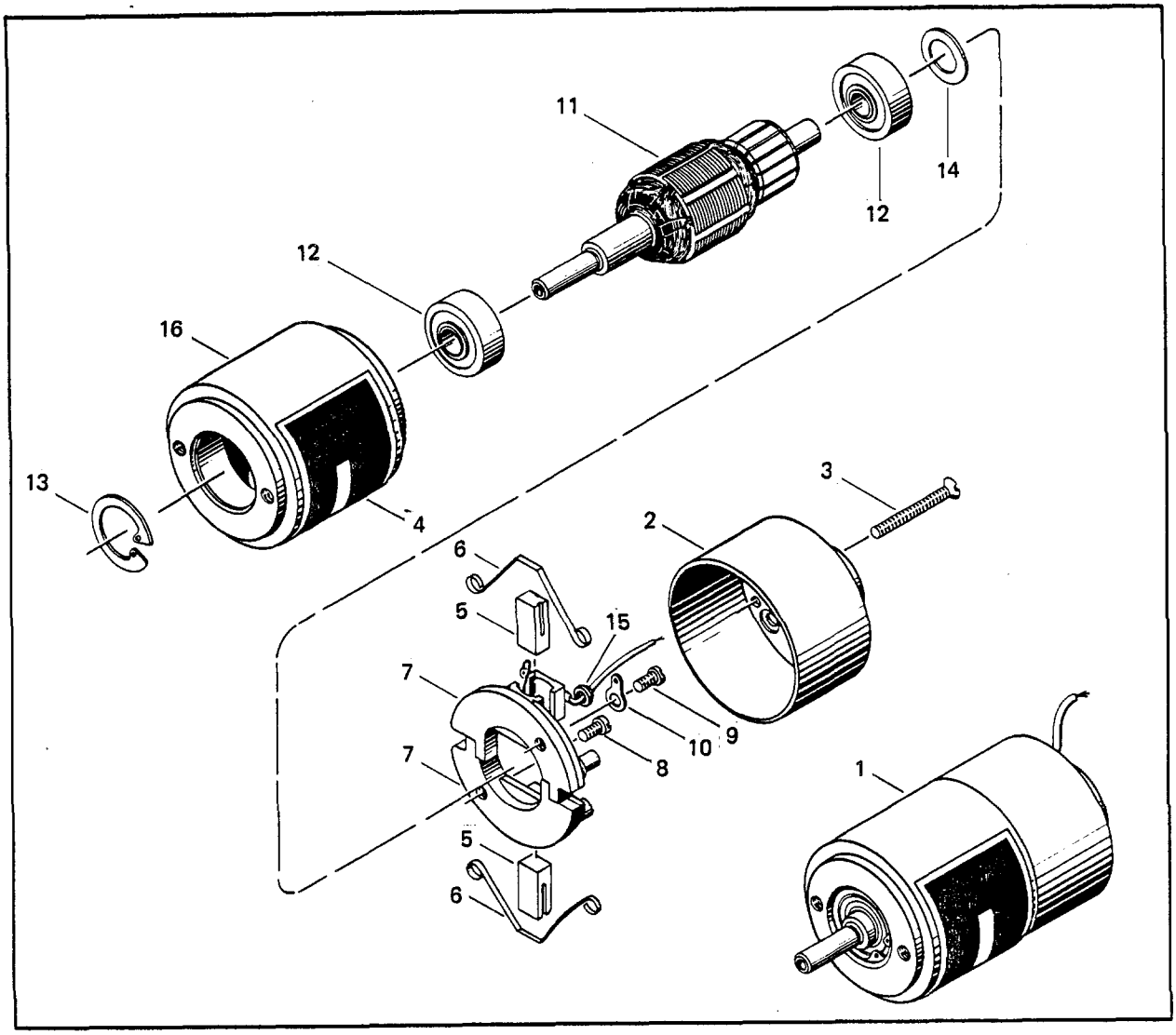


Figure 3. Exploded View

F-10447
March 31, 1961

9. ILLUSTRATED PARTS LIST

Fig. & Index No.	Part No.	1 2 3 4 5 6 7 Nomenclature	Units Per Assy.
3-1	FYLM 23800-2	MOTOR, DIRECT CURRENT	
2	FYLM 4	. CAP, END, REAR.	1
		ATTACHING PARTS	
3	AN505C4-10	. SCREW, MACHINE V(05624 NO. JYRF 12) . .	2
		-----*-----	
4	FYLM 24	. PLATE, IDENTIFICATION	1
5	FYLM 10	. BRUSH, ELECTRICAL	2
6	FYLM 9	. SPRING, BRUSH	2
7	FYLM 11-1	. BRUSH, HOLDER	2
		ATTACHING PARTS	
8	AN505JB2-3	. SCREW, MACHINE V(05624 NO. BYRF 636). .	1
9	BYRF 1047	. SCREW, MACHINE.	1
10	12550	. LUG, TERMINAL V(MFD by 71785) V(05624 NO. FYRE 39)	1
		-----*-----	
11	FYLM 505-010	. ARMATURE ASSEMBLY	1
12	R-3-FFM	. BEARING, BALL V(MFD by 38443) V(05624 NO. CYRB 66-1)	2
13	AYLF 47	. RING, RETAINER.	1
14	CYRD 310	. WASHER, SHIM.	1
15	AYRZ 40	. GROMMET, RUBBER	1
16	FYLM 25	. HOUSING, MOTOR.	1

NOTE: WHEN ORDERING SPARES FROM BARBER-COLMAN COMPANY USE ONLY BARBER-COLMAN COMPANY PART NUMBERS.

VENDOR'S CODE

05624	Barber-Colman Co., Rockford, Ill.
38443	Marlin-Rockwell Corp., Jamestown, N.Y.
71785	Cinch Mfg Corp., Chicago, Ill.

INSPECTION AND OVERHAUL INSTRUCTIONS

FOR BARBER-COLMAN

CONTROL UNIT

TYPE CYLZ 3230 (24V)

INSPECTION AND OVERHAUL INSTRUCTIONS FOR CYLZ 3230 (24V)

TEST EQUIPMENT REQUIRED

Ohmmeter and Wheatstone Bridge

500 volt d-c megger

Equipment necessary to make up test circuit as shown in F6852. Equipment necessary to make Micropositioner calibration fixture and other overhaul tools as described in Micropositioner Overhaul sections, F5114-2.

FUNCTIONAL INSPECTION

Remove the control box cover. With no external connections to the box, check resistance values as follows:

PINS	ITEM	RESISTANCE
N-I	R1	164 ± 6 ohms
L-I	R2 CW	0 + 2 - 0 ohms
	R2 CCW	75 ± 8 ohms

NOTE

Operational tests on the control box must be performed in an area which is reasonably free from electric fields. The presence of a strong electric field will affect the calibration of the control box.

Connect test circuit as shown in F6852.

Rotate R2 rheostat in CW direction. Mark where red indicator lamp lights. Turn R2 rheostat in CCW direction. Mark where green indicator lamp lights. Set R2 rheostat midway between points where lamps light.

Seal shaft of R2 rheostat. Disconnect test circuit and check resistance to ground of all pins. It should be 5 megohms or more.

Check all electrical wiring and soldered joints. All wiring to connector pins and rheostat lugs should be covered with sleeving.

All wires should be securely cabled with cabling twine. Solid wire resistor leads should be as short as possible.

OVERHAUL INSTRUCTIONS

(Refer to Assembly drawing of CYLZ 3230. F6883.)

All parts found to be defective or damaged should br replaced. Disassemble the receptacle insert from the shell by removing the snap ring.

Micropositioner may be unplugged after removal of screw No. 24. Refer to Micropositioner Overhaul Instructions F5114-2 for inspection, overhaul and calibration.

Inspect relay coil shunting resistors No. 21 to see that they are intact and of proper resistance. (1000 ohms).

Inspect dividohm No. 13 to see that it is intact. Check for a mounting washer No. 12 between the mounting plate No. 25 and the dividohm, and between the dividohm and the stop nut No. 14. Resistance of dividohm No. 13 should be set at 164 ohms.

Check the arc suppressor No. 27. It is a hermetically sealed unit containing two .25 MFD., 100 W.V. d-c condensors and one 560 ohm, 1/2 watt resistance connected in a "Y" circuit.

The rheostat No. 17 (R2) has a resisttance of 75 ohms. It is a wire-wound screwdriver adjusted unit, and must be sealed after final calibration is made.

Check all electrical wiring and soldered joints. All wires to receptacle pins must be protected with glyptal and sleeving. Wiring should be securely laced.

Clean up burned or pitted contacts with a burnishing tool and/or hard finish paper.

Repeat functional test procedure.

PARTS LIST, CYLZ 3230 CONTROL BOX

KEY NO.	KEY NO.*	BARBER-COLMAN PART NO.	DESCRIPTION	NO.	OPTIONAL SOURCE **
1		CYLZ 146	CONTROL BOX	1	
	1-1	CYLZ 92	CONTROL BOX END FRAME	1	
	1-2	CYLZ 150	CONTROL BOX END FRAME	1	
	1-3	CYLZ 918	CONTROL BOX BASE	1	
	1-4	CYLZ 94	CONTROL BOX MOUNTING FOOT	2	
	1-5	CYLZ 96	FELT CUSHION	2	
	1-6	CYLZ 97 B	FELT STRIP	2	
	1-7	CYLZ 98 B	CONTROL BOX COVER	1	
	1-8	CYLZ 99	#8-32 X 1/2" WASHER HD. SCREW	1	AN 525-832-8
	1-9	CYLZ 93	#8-32 ANCHOR NUT	4	AN 3660F832A
	1-10	BYRF 50	#8-32 X 3/8" RD. HD. SCREW	8	AN 515-8-6
	7	CYLZ 95	#8-32 STOP NUT	8	AN 364-832A
	10	EYRF 116	#3/32" X 3/16" RD. HD. RIVET ALM.	8	AN 430A3-3
2		BYRF 422	#4-40 X 1/2" RD. HD. SCREW	4	ANY SCREW MANUFACTURER
3		CYLZ 118	CONNECTOR (RECEPTACLE)	1	AN 3102-20-27P
4		BYLC 357-1	RECEPTACLE SPACER	1	
5		AYLZ 158	#4-40 STOP NUT	4	AN 365-440A
6		BYRF 377	#8-32 X 1 1/4" RD. HD. SCREW	4	AN 515-8-20
7		CYLZ 95	#8-32 X 3/8" STOP NUT	8	AN 364-832A
8		AYRD 178	SPACER	4	
9		DYRF 153	#6-32 STOP NUT	2	
10		EYRF 78-1	1/16" X 3/16" RD. HD. RIVET ALUM.	2	AN 430A2-3
11		BYRF 355-2	#6-32 X 2 1/8" RD. HD. SCREW	1	ANY SCREW MANUFACTURER
12		CYRD 245	INSULATING WASHER	2	
13		CYZR 103	300 OHM. 10 WATT DIVIDOHM	1	OHMITE #1016
14		DYRF 109	#6-32 STOP NUT	3	AN 364-632A
15		AYRZ 6	GROMMET	1	LAVELLE #911
16		AYRZ 14	GROMMET	2	LAVELLE #905
17		BYZR 15	RHEOSTAT	1	CENTRA LAB V-118
18		BYRF 321	#6-32 X 1/4" RD. HD. SCREW	8	AN 515-6-4
19		CYRD 154	#6 SHAKEPROOF WASHER	8	AN 936A6
20		CYZP 104	RELAY	2	
21		CYZR 171-7	1000-OHM, 1 WATT FIXED RESISTOR	2	RC-30-AE-102-K
22		AYLZ 2757 P	MICRO-POSITIONER	1	
23		AYLZ 207	OCTAL SOCKET	1	AMPHENOL #78-S8
24		BYRF 500-1	#6-32 X 9/16" RD. HD. SCREW	2	ANY SCREW MANUFACTURER
25		CYLZ 338-2	MOUNTING PLATE	1	
26		AYRD 229	SPACER	2	
27		CYZR 202	ARC SUPPRESSOR	1	
28		CYLZ 376-1	MOUNTING PLATE	1	
29		BYRF 372	#6-32 X 1/2" FL. HD. SCREW	2	AN 505-6-8

* INDICATES REPLACABLE PARTS OF SUB-ASSEMBLIES
** DO NOT USE OPTIONAL SOURCE PART NUMBERS WHEN ORDERING FROM BARBER-COLMAN CO.

F 6884 BARBER-COLMAN CO. ROCKFORD, U.S.A. LITHO IN U.S.A. 1 MARCH 1955

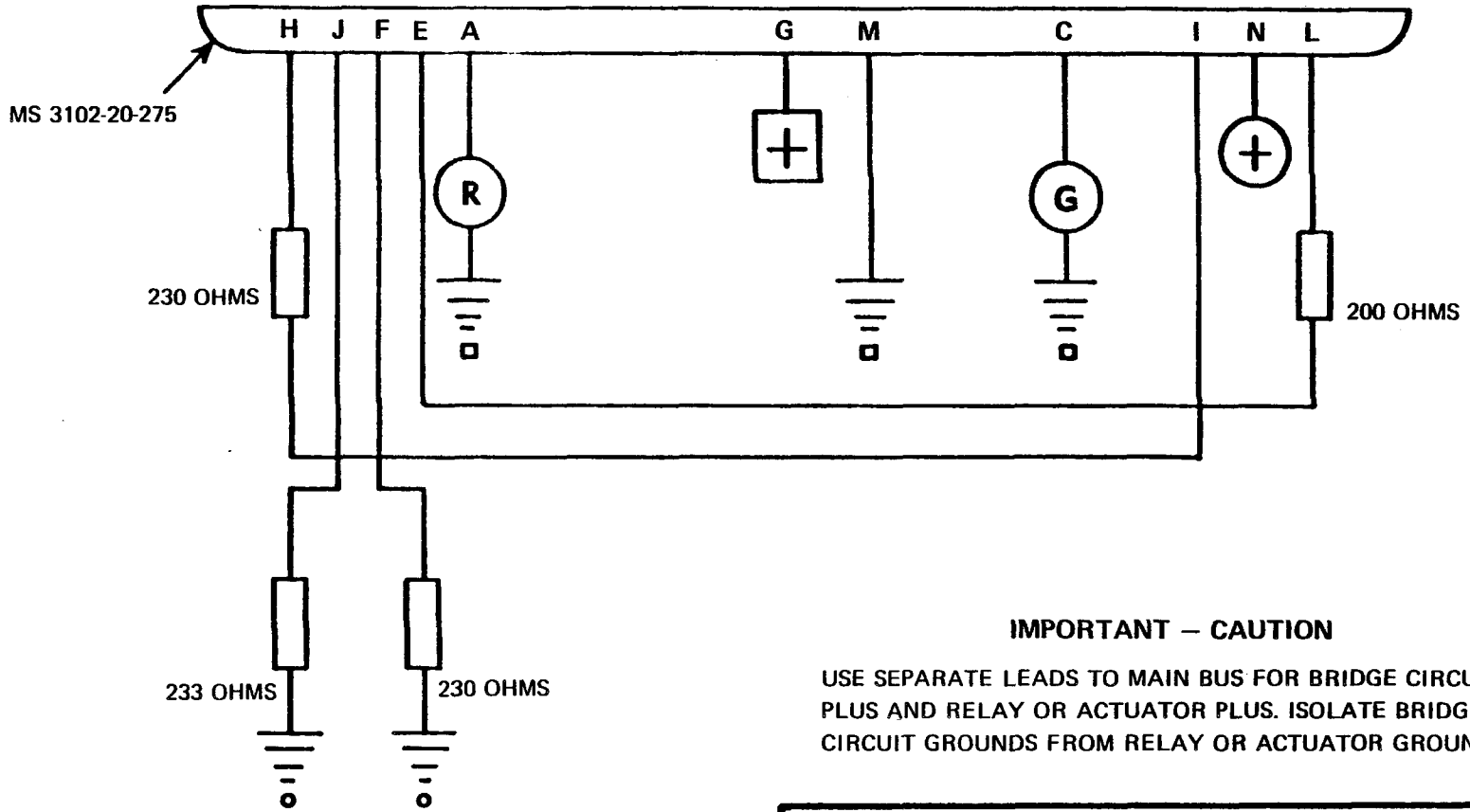
PARTS LIST, CYLZ 3230 CONTROL BOX

KEY NO.	KEY NO.*	BARBER-COLMAN PART NO.	DESCRIPTION	NO. REQ'D	OPTIONAL SOURCE **
30		CYLZ 623	NAMEPLATE	1	
31		CYRD 170	WASHER	2	

* INDICATES REPLACABLE PARTS OF SUB-ASSEMBLIES
** DO NOT USE OPTIONAL SOURCE PART NUMBERS WHEN ORDERING FROM BARBER-COLMAN CO.

F 6884BK BARBER-COLMAN CO. ROCKFORD, ILLINOIS, U.S.A. LITHO IN U.S.A. 1 MARCH 1955

4



IMPORTANT – CAUTION

USE SEPARATE LEADS TO MAIN BUS FOR BRIDGE CIRCUIT PLUS AND RELAY OR ACTUATOR PLUS. ISOLATE BRIDGE CIRCUIT GROUNDS FROM RELAY OR ACTUATOR GROUNDS.

⊕ BRIDGE POWER 26 + 1 V DC

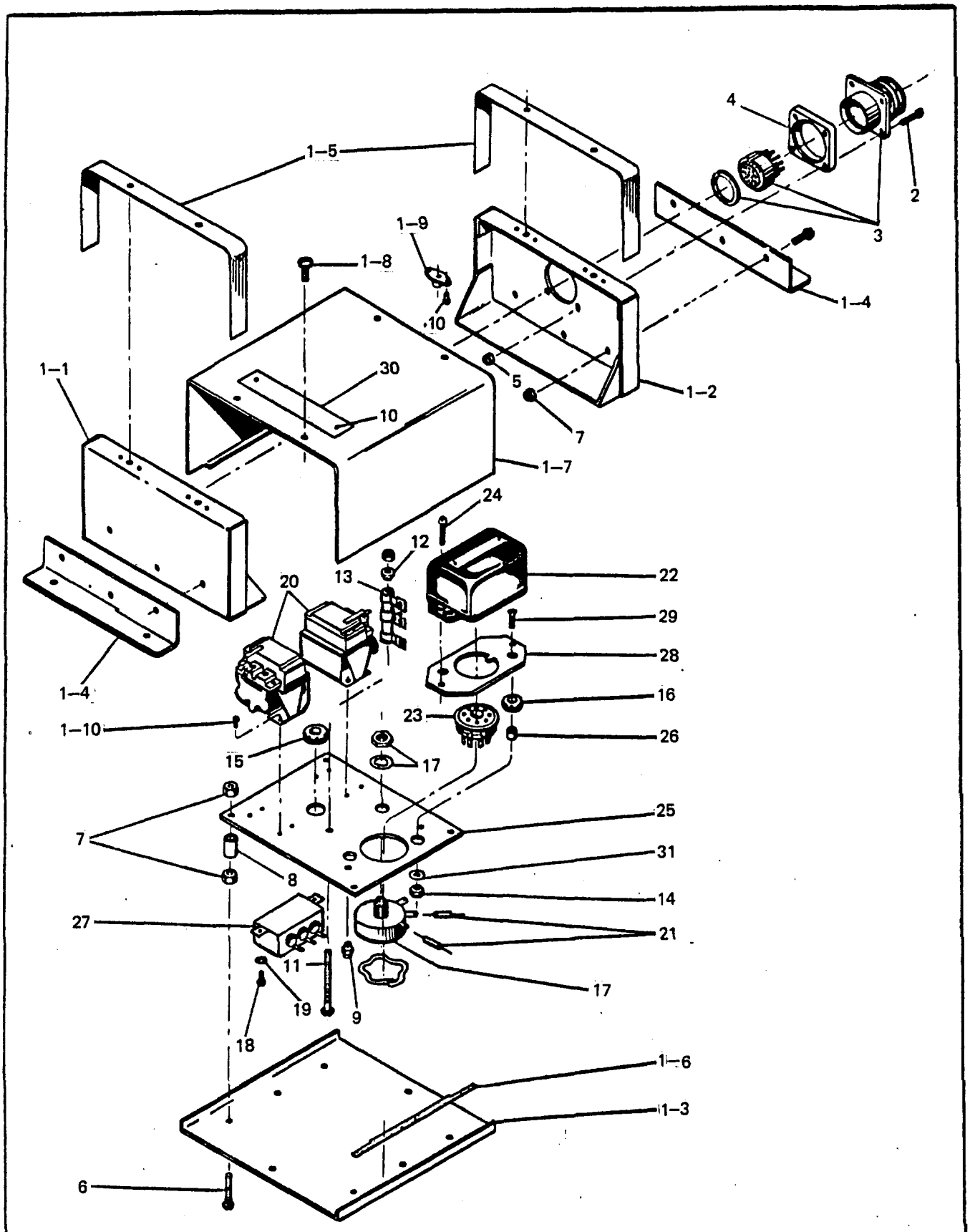
BRIDGE GROUND

⊞ ACTUATOR POWER 26 + 1 V DC

ACTUATOR GROUND

TEST CIRCUIT

CYLZ 3230 AND CYLZ 4090


4
2
3
1–5
1–9
1–8
10
1–4
1–1
30
5
1–2
10
7
1–7
24
12
22
13
20
29
28
1–4
16
23
1–10
26
15
17
25
7
31
8
14
27
21
11
17
19
9
18
1–6
1–3
6

CYLZ 3230

5

Subject: Micropositioner, Method of Overhaul,

Barber-Colman Company has recommended in the past that Micropositioners be returned to the factory for overhaul. However, because of the expense and time required with customs regulations and foreign exchange for foreign operators, we are issuing these instructions for your optional use. We continue to recommend that Micropositioners be returned to us for overhaul whenever possible, since our production fixtures, techniques, and test equipment are essential for best results.

Special equipment required:

To adequately overhaul the Micropositioner, it is recommended that the following tools and fixtures be obtained.

Magnetizer - the magnetizer should consist of coils of approximately 30,000 total ampere-turns. The poles of the magnetizer must be large enough to contact the entire surface of the upper and lower pole pieces of the Micropositioner. It is essential that the polarity of the unit be clearly shown to insure that the Micropositioner be polarized in the correct direction.

Armature Shims - brass shims to protect the armature from the sudden impulse of the magnetic field during magnetizing should be made as shown in Figure 1.

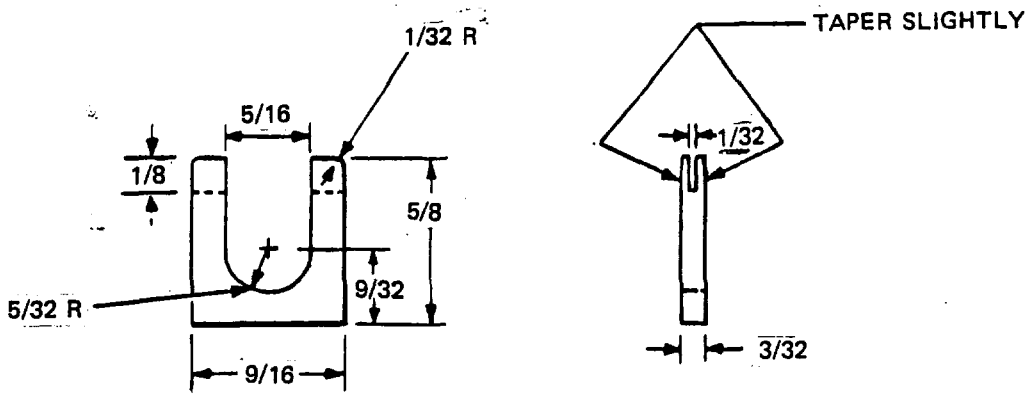


Figure 1

Demagnetizer - the demagnetizer should be an air core type coil operating on alternating current regulated by a 'variac' transformer. This is necessary to allow control of the degree of demagnetizing. An approximate recommended value for the coil is 1000 ampere-turns. If a variable power source is not available, the degree of demagentizing may be controlled by the proximity to the coil.

Calibration Fixture - Refer to Figure 2. This fixture is used for adjusting the sensitivity of the Micropositioner and checking the contact gap. It should incorporate an accurate direct current millivoltmeter with a one milliampere movement, zero center. Suitable multipliers should be provided to give a range of 500 millivolts. The load specified in Table 1, page 10, should be used. Refer to your system wiring diagrams for correct polarity.

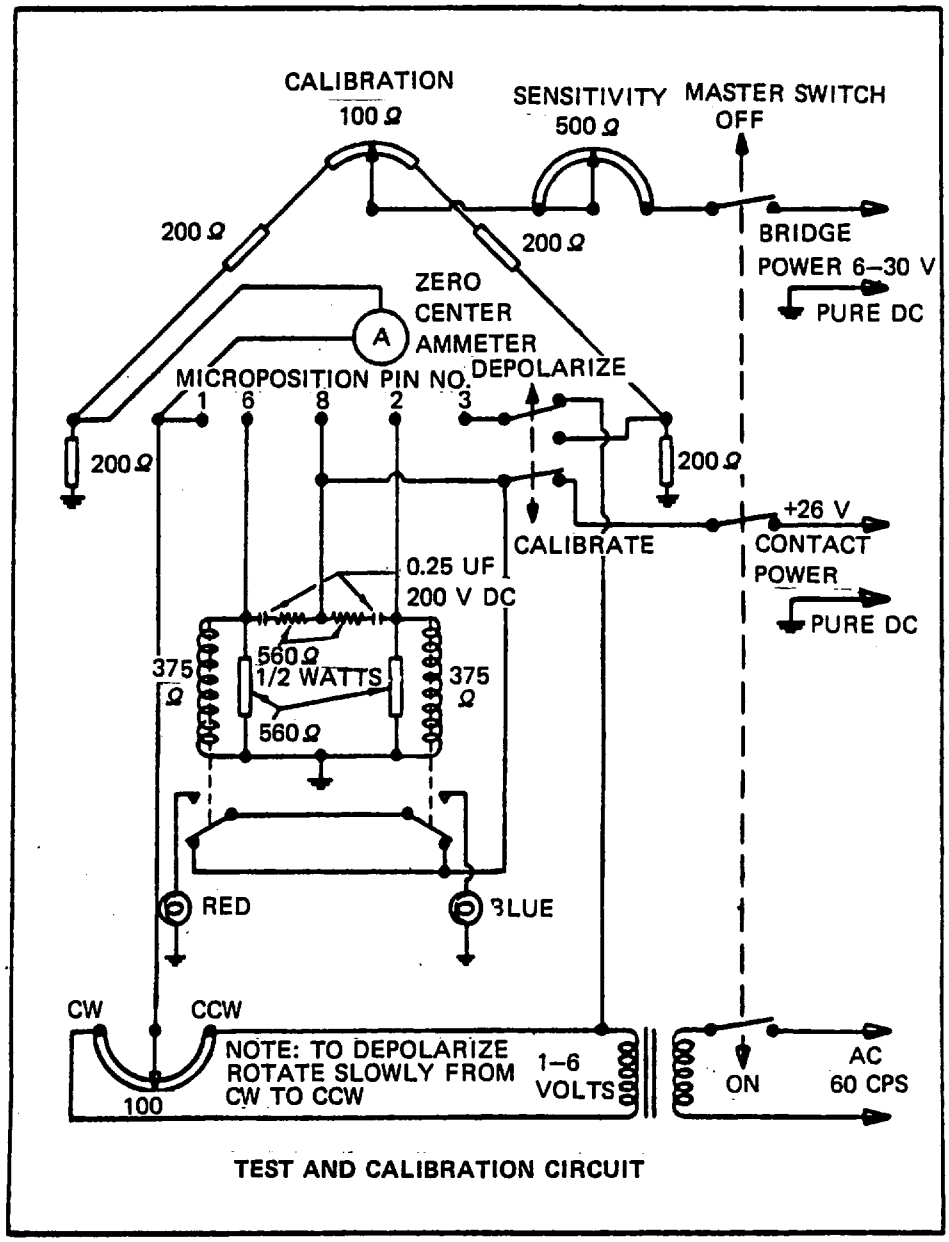


Figure 2

Solder Pot - the pot should have a center tube which will protect the bakelite locating pin on the octal plug.

Shunt Bar Adjustment Wrench - this wrench may be made from a piece of non-magnetic 1/4" round stock as shown in Figure 3.

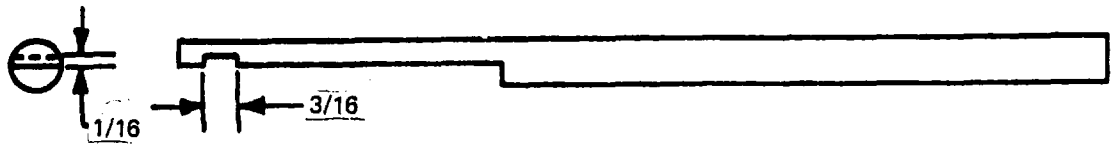


Figure 3

Contact Screw Adjustment Wrench - this wrench should be a small 3/16" open end type of nonmagnetic material to make contact gap adjustments.

Contact Screw Installation Wrench - this wrench may be a standard 3/16" hex head screwdriver type socket wrench modified as shown in Figure 4 to protect the contacts. It is used for the installation and removal of the contact screws.

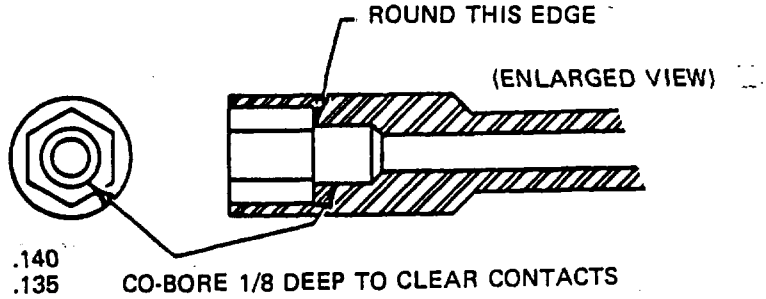


Figure 4

Double Toothed Screwdriver - this tool may be made by milling or grinding a slot in a standard blade screwdriver (maximum torque of 10 lb. in.). It is used in the assembling of the base mounting nut, AYLZ 112. Refer to Figure 5.

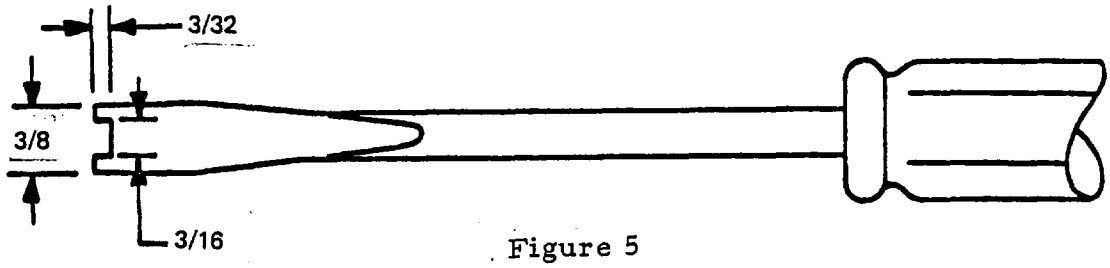


Figure 5

Feeler Gauge - clean, smooth feeler gauges of the following sizes are required: .006", .008", .011", and 013". They are used for adjusting contact gaps.

Magnifier - an eye glass type magnifier (jeweler's loupe) is recommended so that the contact gap may be set accurately.

Overhaul Instructions:

1. Demagnetize the complete Micropositioner by inserting inside the demagnetizing coil as shown in Figure 6. If a variable power source is used, be sure that the voltage is gradually reduced to zero before removing the Micropositioner from the coil. If a fixed power source is used, the Micropositioner should be slowly withdrawn from the coil field until outside of its effective magnetic field.

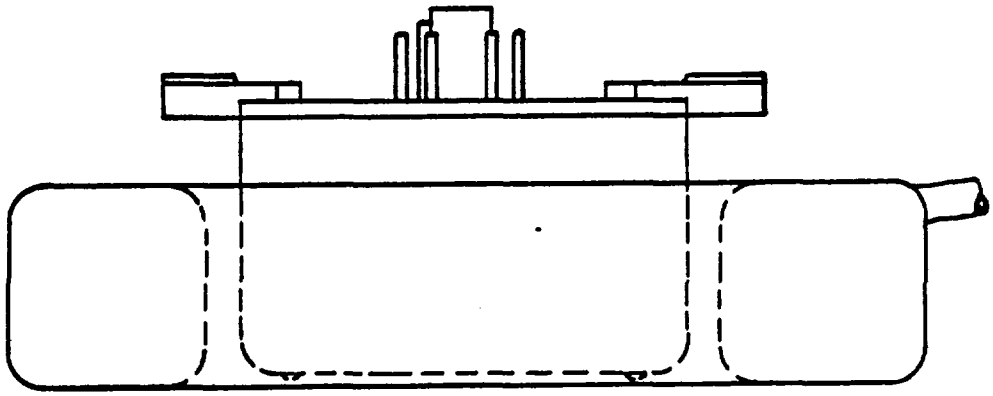


Figure 6

2. Remove cover from Micropositioner. (AYLZ 211-1)

NOTE

AYLZ 237-1 base permits armature to be replaced without complete disassembly. Loosen screws AYLZ 110 and AYLZ 30. Remove armature. Replace stationary contacts if necessary. Install new armature. Set contact gaps and calibrate per Table I.

3. Remove two screws AYLZ 32, nut AYLZ 112, and spring washer AYLZ 111, attaching bakelite base to Micropositioner subassembly. Refer to Figure 7, page 5.

4. For octal plug type - remove the wires from the pins on base plug by dipping the plug in a solder pot equipped with a center metal tube to protect the bakelite locating post.

   For other types - the wires are removed individually by means of a soldering iron.

   IT IS EXTREMELY IMPORTANT that all coil wires be securely tagged or otherwise identified since the proper recalibration of the Micropositioner will depend upon correct coil polarities.

5. Remove the four shunt bars AYLZ 77-2 from the pole piece AYLZ 90. Refer to Figure 8, page 6.

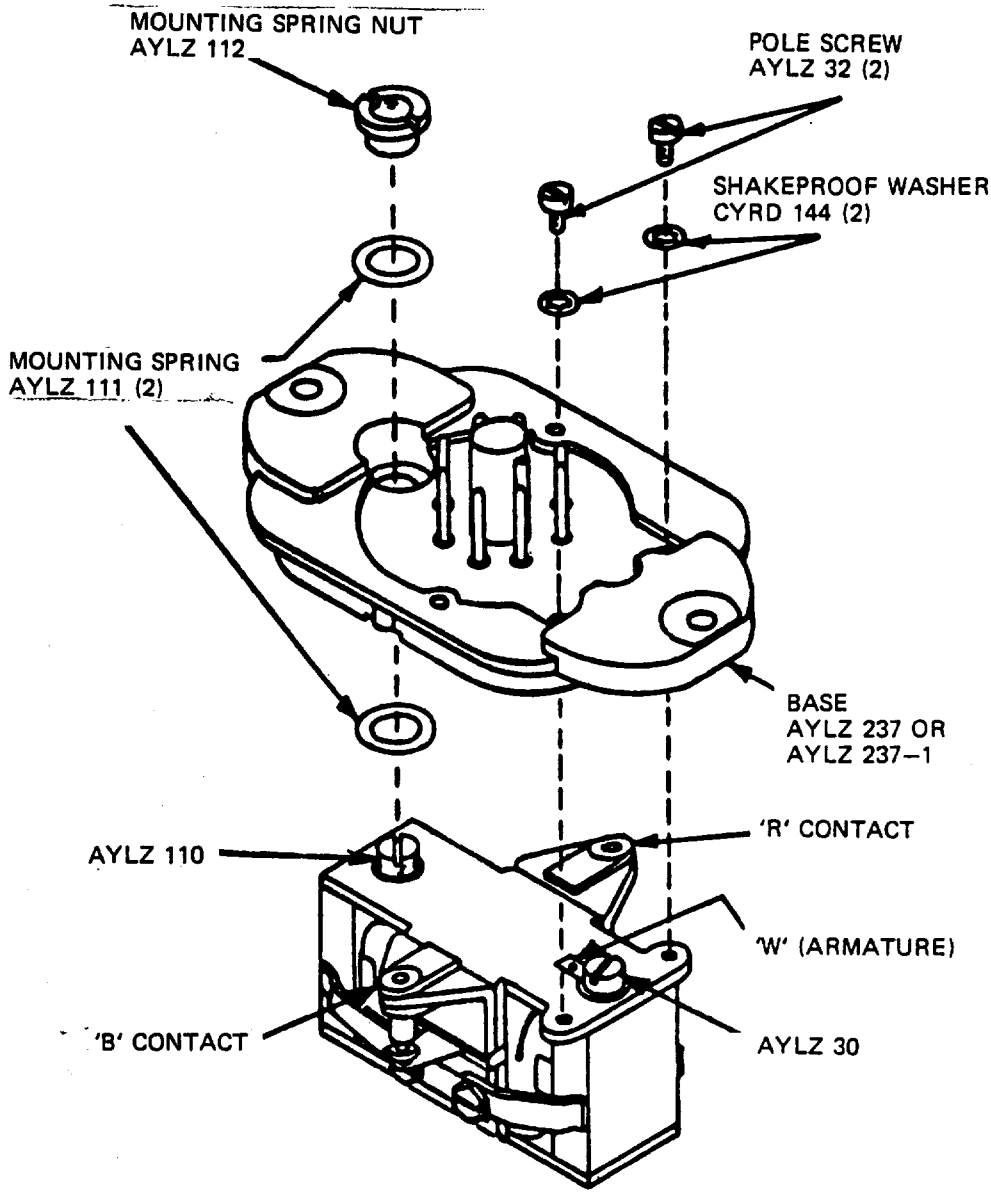


Figure 7 - Octal Base Micropositioner

6. Remove the magnet screws AYLZ 110 and AYLZ 30.

NOTE

Use a sharp knife or other suitable instrument to remove cement bonding upper and lower pole pieces to coil.

7. Remove and discard coil (if necessary), armature, and contact screws. Replacement parts are furnished as noted in Table 1.

8. Inspect lower pole piece assembly for loose contact supports and cracked insulating washers. Replace if damaged.

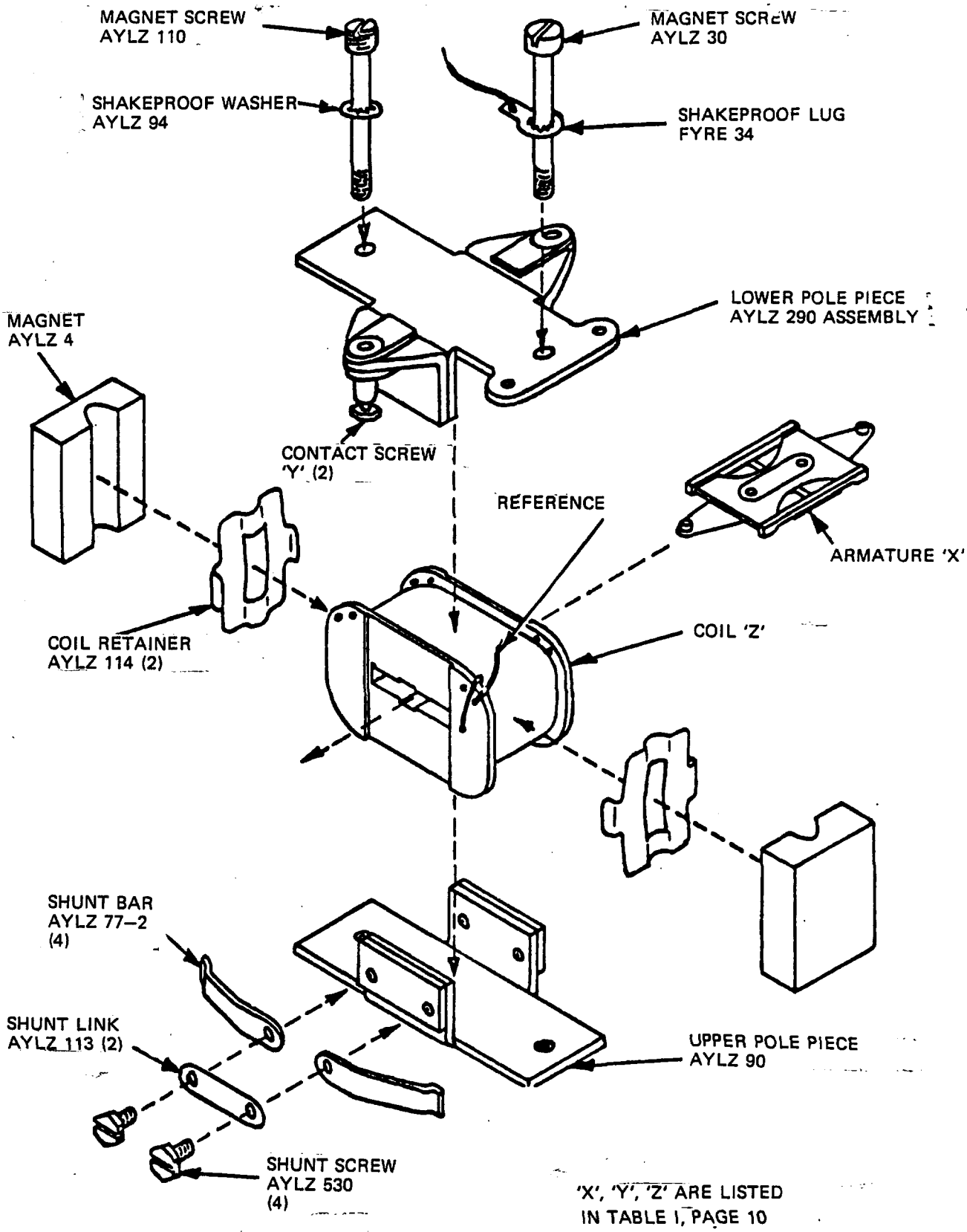

MAGNET SCREW
AYLZ 110
SHAKEPROOF WASHER
AYLZ 94
MAGNET SCREW
AYLZ 30
SHAKEPROOF LUG
FYRE 34
LOWER POLE PIECE
AYLZ 290 ASSEMBLY
MAGNET
AYLZ 4
CONTACT SCREW
'Y' (2)
REFERENCE
ARMATURE 'X'
COIL RETAINER
AYLZ 114 (2)
COIL 'Z'
SHUNT BAR
AYLZ 77-2
(4)
SHUNT LINK
AYLZ 113 (2)
UPPER POLE PIECE
AYLZ 90
SHUNT SCREW
AYLZ 530
(4)
'X', 'Y', 'Z' ARE LISTED
IN TABLE I, PAGE 10

Figure 8

9. Install coil, armature, and contact screws. Brass shim stock, .005 inch thick, is used to center the armature in the coil slot. Refer to Figure 9. Before assembling the magnets and pole pieces it is recommended that the mating surfaces be thoroughly inspected for corrosion or foreign particles so that a good magnetic circuit is obtained.

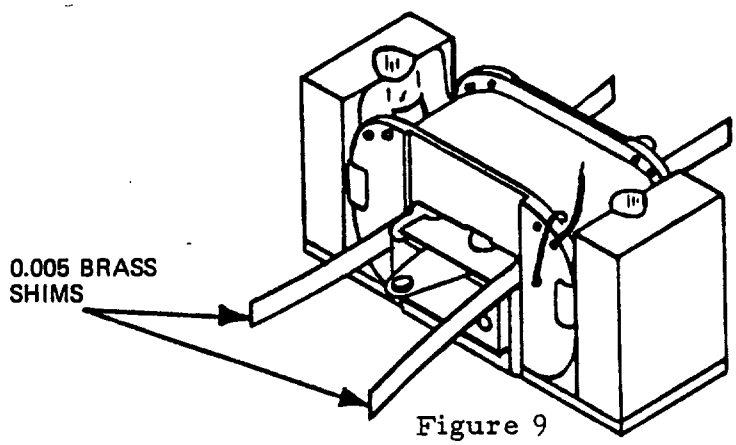


Figure 9

10. Alternately tighten magnet screws until snug. When clamping magnets between upper and lower pole pieces, place enough finger pressure on the magnets toward the coil to allow magnets to be clamped flush with the ends and sides of the pole pieces. Inspect for centering and alignment of armature. Especially note that 'side rails' are at right angles to face of pole pieces. Then securely tighten magnet screws. Caution: Do not exceed 10 lb. in. torque on screwdriver.

11. Reinstall shunt bars AYLZ 77-2, link AYLZ 113, and screws AYLZ 530 on the assembly, moving the shunt bars to the top of the magnet (toward the AYLZ 90 pole piece). Refer to Figure 8.

12. Adjust the contact gaps, first by rotating the stationary contacts with a 3/16" open end wrench until a gap approximately equal to half that specified in Table I is obtained on both contacts. After the approximate gap is obtained, the total gap should be measured and adjusted as shown in Figure 10. The total gap values in inches are given in Table I; tolerances of plus or minus .001 inch are allowable. Recheck the gap on each contact.

    It should be explained that the factory method of overhaul differs at this stage from the above procedure in that the contact gap is not measured in terms of distance, but rather as a particular torque value which is obtained by applying a specific weight to a shop fixture. The weight closes the contact when the correct value of torque is reached. This method is generally too elaborate for field use.

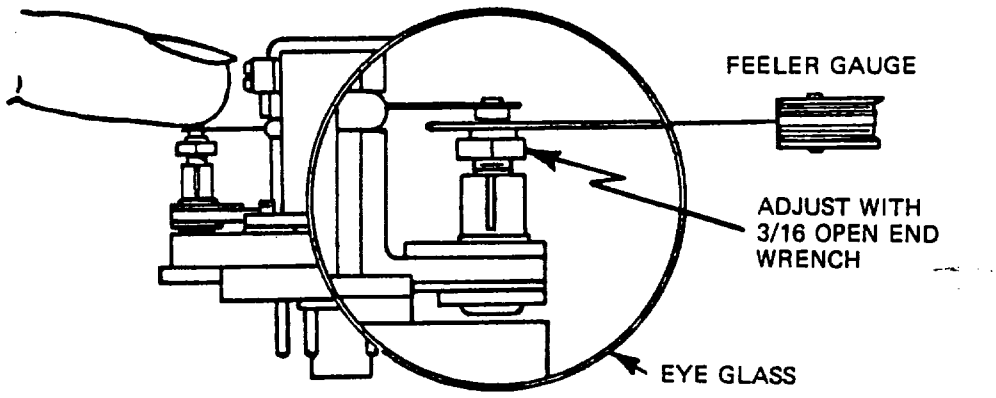


Figure 10

13. Place the assembly in the magnetizer. Insert the nonmagnetic shims in the armature to protect it from the sudden impulse of the magnetic field during magnetizing. Upper pole piece AYLZ 90 forms the south pole; lower pole piece forms the north pole. Therefore, the Micropositioner should be placed in the magnetizer with AYLZ 90 adjacent to the magnetizer's north pole. Magnetize the assembly.

14. Solder leads from the detent coils to the correct contacts. Caution: Correct polarity is essential for proper operation.

15. Prepare remaining leads for soldering to plug.

16. Install the Micropositioner subassembly on the bakelite base with two AYLZ 32 screws and AYLZ 112 nut. Two spring washers AYLZ 111 are placed one on each side of the base as shown in Figure 7. They should be placed so that the convex surface is adjacent to the base. It is very important that the washers be properly centered so as to provide a resilient mounting.

17. Wire all connections to their respective pins or lugs. In the case of the octal plug-in type, the pin should be dipped into a solder pot with the bakelite centering post inserted into the protecting metal tube. Refer to Table II, page 11, for wiring diagram.

    Note that the recommended solder is standard 50/50 type with no resin core. A noncorrosive flux is very important. A recommended flux is Kester #415T. The whole soldered area must be cleaned with a solution of alcohol after completion. All fumes from flux and soldering iron must be kept away from contacts. Gyptal solvent fumes also foul contacts. It is recommended that the cover be on the Micropositioner whenever possible during soldering operations.

18. Insert the Micropositioner into the calibration test fixture and apply a variable AC voltage to the coil to insure depolarization. Reduce AC voltage slowly to zero. Using the calibration bridge, calibrate the unit to the values shown in Table I with an allowable tolerance of plus or minus 20%.

When checking the sensitivity, check the sensitivity of one contact, adjust shunt bars, if necessary, and then reverse the coil voltage toward making the opposite contact before rechecking the first contact.

The shunt bars are to be adjusted up or down with the nonmagnetic shunt bar adjustment wrench. Raising shunt bars causes contact to close at lower voltage; lowering shunt bars causes contact to close at high voltage. Adjustment of shunt bars on one side of the Micropositioner will be found to have the greatest effect on the contact on the opposite side. When adjusting shunt bars, move each shunt bar an equal amount to obtain proper sensitivity. Keep shunt bars symmetrically adjusted.

The shunt bars should be approximately centered on the sides of the magnets when calibrated. If the shunt bars are near the bottom of the magnets, the units should be demagnetized slightly with the demagnetizing coil. Maximum stability is obtained when the magnets are demagnetized slightly after the initial magnetization.

19. Remove Micropositioner from the test fixture and replace cover. Recheck calibration with cover installed.

Charges: Barber-Colman Company will supply the required parts as listed in Table I.

Optional: Barber-Colman Company continues to recommend that whenever possible, the Micropositioner should be returned to the factory for overhaul. Factory overhaul is accomplished at a nominal charge of approx. $5.00 each net plus price of any parts which need replacement.

Further information:

1. The Micropositioner should be treated as a delicate instrument and it is strongly recommended that the above method of overhaul be carried out in the instrument shop.

2. Caution: To insure accurate and reproducible calibration of the Micropositioner, the units should not be calibrated or checked in the immediate vicinity of any other magnetic fields, either direct or alternating current. Other troubles sometimes encountered in checking and calibrating fixtures are: Ferrous panels, tables, or table supports; unshielded permanent magnet instruments; heavy current bus bars; and d-c or a-c generators.

3. If a Micropositioner is exposed to sudden shock, such as that resulting from rough handling or dropping, the unit should be completely recalibrated.

4. It is recommended that periodic service checks be made of the contacts and calibration. The contacts can be cleaned with a fine burnishing tool or #4/0 polishing paper if thoroughly cleaned afterwards with C.P. carbon tetrachloride or any equivalent solvent which will not leave a residue.

Table I (Footnotes, Page 11)

NEW PART NUMBER	OLD PART NUMBER	Sens 1		Approx. Diff. 2		Cal'bn lead 3	Arc Supp.	Detent Turns 4	Total Gap	Call Res.	Wiring Diag. * 7	Armature - X 1 Req'd.	Contact Screws - Y 2 Req'd	Call - 2 1 Req'd
AYLZ 910-200	AYLZ 910-1S	.15	V	.088	V	TWO CYZP 175 RELAYS SHUNTED WITH 560 OHMS OPERATING TWO INDICATOR LIGHTS	USE 1/4 MICROFARAD PLUS 560 OHMS IN ALL CASES		.008	215	4	AYLZ 305-1	AYLZ 18-1	AYLZ 20-4
AYLZ 2274-200	AYLZ 2274S	.11	V	.006	V				.006	215	4	AYLZ 305-1	AYLZ 18-1	AYLZ 20-4
AYLZ 2276-201	AYLZ 2276P	.11	V	.006	V				.008	140	4	AYLZ 305-2	AYLZ 179	AYLZ 20-7
AYLZ 2284-200	AYLZ 2284S	.35	V	.02	V				.011	215	4	AYLZ 305-1	AYLZ 18-1	AYLZ 20-4
AYLZ 2324-300-1	AYLZ 2324-1S	.35	V	.09	V				.011	215	4	AYLZ 305-1	AYLZ 18-1	AYLZ 20-4
AYLZ 2324-301-1	AYLZ 2324-3P	.60	V	.38	V			26 TURNS, R AND B	.011	215	5+	AYLZ 305-2	AYLZ 179	AYLZ 209-3
AYLZ 2472-301	AYLZ 2472P	.07	V	.004	V				.006	88	4	AYLZ 305-2	AYLZ 179	AYLZ 20-11
AYLZ 2513-100	AYLZ 2513S	.105	V	.045	V			5 TURNS, R AND B	.006	140	2–	AYLZ 305-1	AYLZ 18-1	AYLZ 209-4
AYLZ 2514-100	AYLZ 2514S	.11	V	.006	V				.006	215	1	AYLZ 305-1	AYLZ 18-1	AYLZ 20-4
AYLZ 2515-100	AYLZ 2515S	.11	V	.006	V				.008	140	1	AYLZ 305-1	AYLZ 18-1	AYLZ 20-7
AYLZ 2515-101	AYLZ 2515P	.11	V	.006	V				.008	140	1	AYLZ 305-2	AYLZ 179	AYLZ 20-7
AYLZ 2537-100	AYLZ 2537S	.075	V	.035	V			4 ¾ TURNS	.006	140	3	AYLZ 305-1	AYLZ 18-1	AYLZ 208-3
AYLZ 2543-100	AYLZ 2543S	.35	V	.02	V				.011	215	1	AYLZ 305-1	AYLZ 18-1	AYLZ 20-4
AYLZ 2546-100	AYLZ 2546S	.075	V	.004	V				.006	140	1	AYLZ 305-1	AYLZ 18-1	AYLZ 20-7
AYLZ 2580-201	AYLZ 2580P	.10	V	.07	V			6¾ TURNS, R AND B	.006	215	5–	AYLZ 305-2	AYLZ 179	AYLZ 208-4
AYLZ 2599 201	AYLZ 2599P	.45	V	.023	V				.011	215	4	AYLZ 305-2	AYLZ 179	AYLZ 20-4
AYLZ 2659-200	AYLZ 2659S	.15	V	.014	V			¾ TURNS, R AND B	.008	215	5+	AYLZ 305-1	AYLZ 18-1	AYLZ 208-5
AYLZ 2660-100	AYLZ 2660S	.15	V	.014	V			¾ TURNS, R AND B	.008	215	2+	AYLZ 305-1	AYLZ 18-1	AYLZ 208-5
AYLZ 2750-101	AYLZ 2750P	.12	V	.02	V			2 TURNS, R AND B	.008	140	2	AYLZ 305-2	AYLZ 179	AYLZ 209-10
AYLZ 2757-101	AAYLZ 2757P	.11	V	.05	V			5 TURNS, R AND B	.006	215	2+	AYLZ 305-2	AYLZ 179	AYLZ 209-9
AYLZ 2809-101	AYLZ 2809P	.145	V	.05	V			5 TURNS, R	.008	215	8+	AYLZ 305-2	AYLZ 179	AYLZ 209-7
AYLZ 2866-101	AYLZ 2866P	.140	V	.13	V			12 TURNS, R AND B	.006	250	2+	AYLZ 305-2	AYLZ 179	AYLZ 209-11
AYLZ 2867-101	AYLZ 2867P	.35	V	.14	V			12 TURNS, R AND B	.011	250	2+	AYLZ 305-2	AYLZ 179	AYLZ 209-11
AYLZ 3002-101	AYLZ 3002P	.35	V	.02	V			2 TURNS, R AND B	.011	215	2+	AYLZ 305-2	AYLZ 179	AYLZ 209-12
AYLZ 3125-101	AYLZ 3125P	.12	V	.02	V			2 TURNS, R AND B	.008	140	7	AYLZ 305-2	AYLZ 179	AYLZ 209-10
AYLZ 3195-101	AYLZ 3195P	.15	V	.03	V			2 TURNS, R AND B	.008	215	7	AYLZ 305-2	AYLZ 179	AYLZ 209-12
AYLZ 3290-100	AYLZ 3290S	.11	V	.03	V			2¾ TURNS, R AND B	.006	215	2+	AYLZ 305-1	AYLZ 18-1	AYLZ 208-5
AYLZ 3367-301	AYLZ 3367P	.07	V	.004	V				.006	88	4	AYLZ 305-2	AYLZ 179	AYLZ 20-11
AYLZ 3383-101	AYLZ 3383P	.095	V	.022	V			2 TURNS, R AND B	.006	215	7	AYLZ 305-2	AYLZ 179	AYLZ 209-12
AYLZ 3565-101	AYLZ 3565-P	.105	V	.03	V			3 TURNS, R AND B	.006	140	2–	AYLZ 305-2	AYLZ 179	AYLZ 209-8
AYLZ 3602-100	AYLZ 3602S	.33	V	.018	V			2 TURNS, R AND B	.011	215	7	AYLZ 305-1	AYLZ 18-1	AYLZ 209-12
AYLZ 3683-100	AYLZ 3683S	.11	V	.006	V				.008	113	6	AYLZ 305-1	AYLZ 18-1	AYLZ 209-15
AYLZ 3744-101	AYLZ 3744P	.118	V	.014	V			2 TURNS, R AND B	.011	54	2+	AYLZ 305-2	AYLZ 179	AYLZ 20-6
AYLZ 3849-101	AYLZ 3849P	.24	V	.045	V			3 TURNS, R AND B	.008	350	7	AYLZ 305-2	AYLZ 179	AYLZ 20-12
AYLZ 4798-300	AYLZ 4798S	.57	Ma	.01	Ma			2 TURNS, R AND B	.008	350	5	AYLZ 305-1	AYLZ 18-1	AYLZ 20-12
AYLZ 5322-101	AYLZ 5322P	.80	Ma	.28	Ma				.008	180	3	AYLZ 305-2	AYLZ 179	AYLZ 539

ADDITIONAL CHARGE FOR EXPORT PACKING AND/OR PRESERVATION PACKAGING.
PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

* REFER TO TABLE II

Footnotes,
Table I:

1 The sensitivity is the voltage or current necessary to close either contact.

When current flow from C1 to C2 (C1 is plus with respect to C2), W closes to contact R. Opposite flow of current causes W to close to contact B.

2 Maximum differential between make and break of the Micropositioner contacts indicates the amount under the make voltage or current that the contacts should reopen. This is dependent upon the load if detent coils are used.

3 Note power source for contacts; be sure polarity agrees with actual application. Refer to your system wiring diagrams for the correct wiring circuit of the simulated load.

4 Detenting is that action caused by auxiliary coils wound around the main coil to aid in eliminating armature bounce. The load current forms a magnetic field which aids in holding the contact closed. Detents are also used to provide a maximum frequency limit on heater cycling controls.

5 Current 5 to 7 detents contact R. Current 7 to 5 detents contact B.

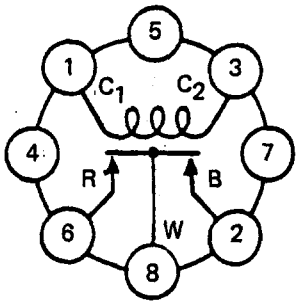
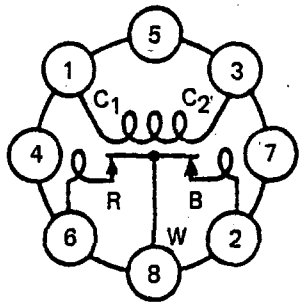
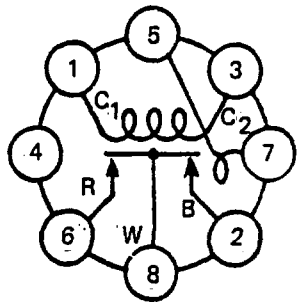
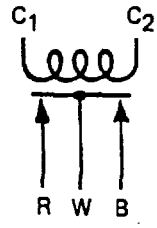
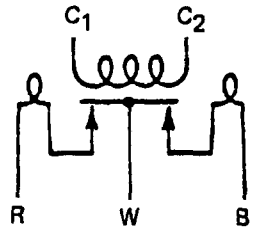
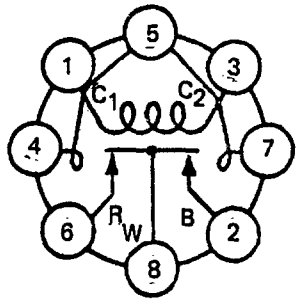
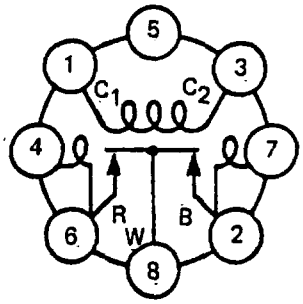
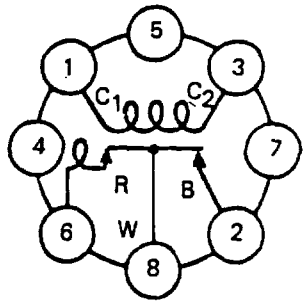
6 CYZP 175 relays are available at a unit net price of $10.60 It is a 26 V. d-c, 375 ohm coil relay.

7 Plus symbol indicates detent current flow from "W" to "R" or "B". Negative symbol indicates current flow in reverse direction.

8 Inherent make to break differential on the micropositioners is approximately 5% of sensitivity.

15 April 1954
F-5114-4
REVISED
1 May 1961

Table II

 1	 2	 3	 4
 5	 6	 7	 8

DHC-6 TWIN OTTER

OVERHAUL MANUAL

VANEAXIAL BLOWER

(DYNAMIC AIR PART NO. M5861AD-6B)

Sep 18/70

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RECORD OF REVISIONS

Retain this record in the front of the manual. On receipt of revisions, insert revised pages in the manual and enter the revision number, revision date, insertion date, and initials of person incorporating the revision, in the appropriate block on the revision record.

Rev. No.	Rev. Date	Insertion Date	By

Rev. No.	Rev. Date	Insertion Date	By

LIST OF EFFECTIVE PAGES

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DYNAMIC AIR M5861AD-6B

INTRODUCTION

This manual contains instructions for the overhaul of the Dynamic Air Engineering Vaneaxial Blower M5861AD-6B complete with motor M3424CB.

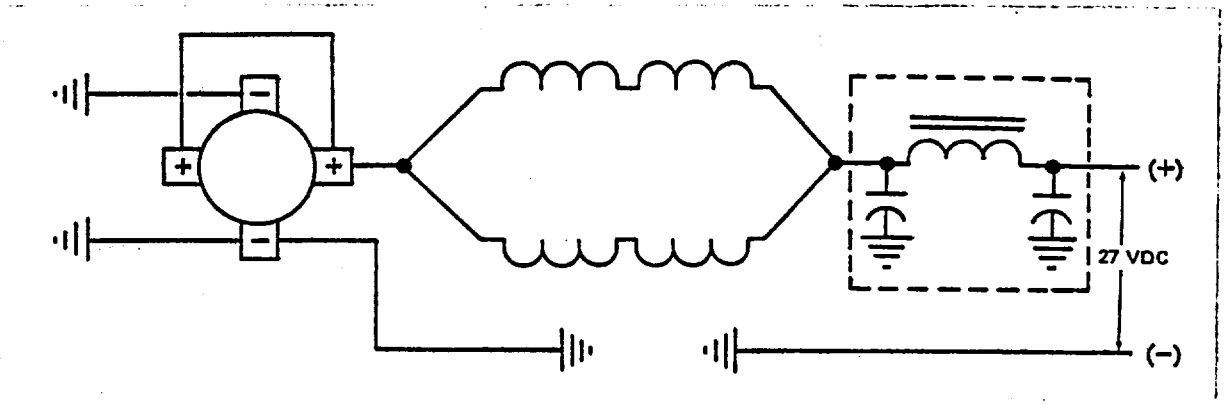
1. Description and Operation

A. Physical Characteristics

The vaneaxial blower consists of a propeller driven by a series type, dc electric motor and enclosed in a housing having beaded ends for connection to inlet and outlet ducts by means of clamps. The motor is energized through a low-pass, pi-section filter (see Figure 1) to prevent transmission through the aircraft wiring of any electromagnetic interference which may be generated by the motor.

B. Operation

The blower is used to circulate air through an airconditioning duct and is driven by 27 volts dc (nominal).



Internal Wiring Diagram

Figure 1

C. Leading Particulars

The leading particulars of the blower are shown in Table 1.

Table 1

Leading Particulars

Energizing Voltage	27 volts dc (nominal)
Operating Current	21 amperes (maximum)
Operating Speed	10,450 rpm (minimum)
Service Duty	Continuous, sea level to 8000 ft
Performance (nominal)	See Figure 2
Operating Temperature	-54°C (-65°F) to +121°C (+250°F)
Electromagnetic Interference	Filtered
Motor Brushes	Body Length, New, 9/16 inch Useful Length 7/16 inch
Rotation	Counterclockwise viewed from propeller end
Minimum Useful Diameter of Commutator	1.0625 inches
Bearing Insert Seats, Inside Diameter	1.1810/1.1814 inches
Weight	7 1/4 pounds

2. Disassembly

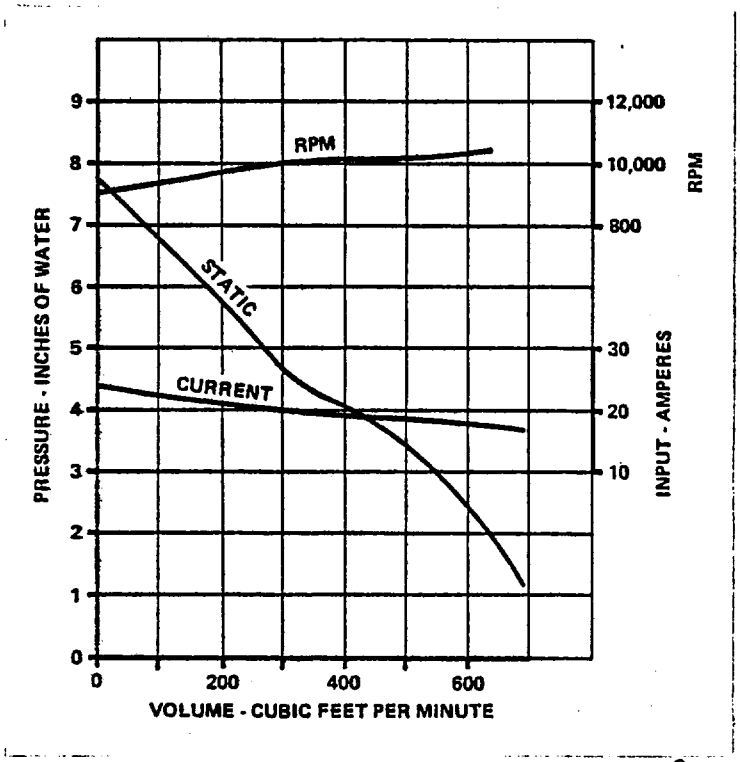
NOTE: If unit is operative, perform test procedure as outlined in paragraph 8 before disassembly.

A. Disassemble Vaneaxial Blower (Figure 3)

(1) Remove pin (2) and detach propeller (3) from motor shaft.

(2) Disconnect electrical leads at housing by removing nuts (4, 6), washers (5, 7, 8, 9, 11, 12), insulator (10) and bolts (13).

(3) Cut and remove lockwire from bolts (14). Remove bolts (14), washers (15) and spacers (16). Slide housing and nameplate assembly (17) off motor and filter assembly. Do not remove nameplate (18) from housing (19).



Performance at Standard Air Density 0.0765 at 15°C(59°F)

Figure 2

(4) Disconnect electrical leads at filter (22) by removing nuts (23) and washers (24, 25). Remove lead (27).

(5) Detach filter (22) from motor assembly (31) by removing nuts (20) and washers (21). Remove spacers (26).

(6) Detach lead (30) from cap assembly (34) by removing nut (28) and washer (29). Detach negative motor lead from cap assembly.

NOTE: Identify negative and positive motor leads for guidance on reassembly.

(7) Detach cap assemblies (34) by removing nuts (32) and washers (33).

(8) Remove brush and spring assemblies (35) from motor, and inspect as detailed in paragraph 4.

NOTE: Mark each brush and spring assembly and corresponding holder so that brush and spring assemblies can be reassembled in the original positions if replacement is not required.

(9) Remove screws (36) and washers (37). Remove end head (38) from motor.

(10) Remove armature assembly (43) complete with ring (39), washer (40), bearings (41) and shields (42). Separate ring, washer, bearings and shields from armature assembly.

(11) Remove bridges (45) and grommet (46) from stator and end head assembly.

(12) Remove screws (47, 48, 49), holder and lead assemblies (50, 52), and holders (51, 55) from end head (53). Note wiring connections for guidance on reassembly.

(13) Separate end head (53) from stator assembly (54).

(14) Remove holder (55) from stator assembly (54).

3. Cleaning

A. General

(1) Clean electrical leads and motor parts using clean, dry compressed air and a clean, lint-free cloth.

CAUTION: DO NOT SPIN BEARINGS WITH COMPRESSED AIR.

(2) Other parts may be washed in kerosene or solvent (refer to Table 2). After cleaning, dry parts thoroughly using clean, dry, compressed air and a clean, lint-free cloth.

WARNING: USE SOLVENT AND KEROSENE IN A WELL-VENTILATED AREA. AVOID BREATHING FUMES. AVOID SKIN CONTACT. KEEP AWAY FROM FLAME.

Table 2

Cleaning Materials and Compounds

MATERIAL	SPECIFICATION OR MANUFACTURER
Kerosene Solvent	VV-K-211 P-D-680

4. Inspection/Check (Figure 3)

A. General

(1) Inspect all parts for obvious wear, damage or corrosion.

(2) Inspect electrical leads for damage such as broken wires, broken or deteriorated insulation.

(3) Inspect threaded parts for damaged, stripped or crossed threads.

(4) Check brush and spring assemblies (35) for amount of wear. Wear must not exceed 20 percent of useful length (refer to Table 1).

(5) Inspect bearing seat inserts in end heads (38, 53) for physical damage, fret-corrosion, or evidence of rotating bearings. Check inside diameter of each bearing seat insert. If inside diameter exceeds 1.1814 inches, reject end head.

(6) Check that bearings (41) rotate freely with no binding or roughness.

(7) Inspect armature assembly (43) for commutator wear and eccentricity. Minimum diameter of commutator should be greater than 1.0625 inches.

(8) Check stator assembly (54) for physical damage.

B. Perform Dielectric, Insulation and Continuity Tests

CAUTION: MAKE SURE THAT ALL CARBON DUST HAS BEEN REMOVED WITH COMPRESSED AIR BEFORE

MAKING DIELECTRIC, INSULATION AND CONTINUITY TESTS.

(1) Make dielectric and insulation tests of armature assembly between commutator and shaft. Armature assembly shall withstand ac hi-potential test of 500 volts rms at 60 Hz for one minute without signs of insulation breakdown. Dc insulation resistance shall be 200 megohms or greater. Check armature windings for continuity.

(2) Make dielectric and insulation tests of stator assembly between leads and frame. Stator assembly shall withstand ac hi-potential test of 500 volts rms at 60 Hz for one minute without signs of insulation breakdown. Dc insulation resistance shall be 200 megohms or greater. Check stator windings for continuity.

5. Repair (Figure 3)

A. General

(1) Replace all parts that do not pass inspection and are damaged beyond simple repair.

(2) Remove minor scratches, burns and corrosion from steel parts using crocus abrasive cloth (refer to Table 3).

(3) To refinish defective cadmium-plated surfaces, smooth out using abrasive paper, clean thoroughly and restore plating in accordance with Specification QQ-P-416.

(4) To refinish defective painted areas, smooth out using abrasive paper, clean thoroughly and apply one coat of primer. Allow to air-dry for 18 hours. Then apply two coats of black lacquer in accordance with manufacturer's directions.

(5) Replace bearings (41) if unit has been in service for 500 hours or longer since last overhaul or if brush and spring assemblies are being replaced.

(6) To true up commutator, mount armature assembly (43) on lathe and turn commutator concentric with armature shaft,

Table 3

Repair Materials and Compounds

MATERIAL	SPECIFICATION OR MANUFACTURER
Crocus Abrasive Cloth	P-C-458
Abrasive Paper (Grit No. 600)	P-P-101
Primer	MIL-P-8585
Black Lacquer	Commercial (to match existing finish)
Kraft Paper	UU-P-268

removing minimum metal necessary and checking that commutator diameter remains greater than 1.0625 inches. After turning, undercut mica between commutator bars to approximately 0.031 inch deep being careful to remove all mica particles. Polish commutator with abrasive paper. Thoroughly clean using dry, compressed air. Repeat dielectric and insulation tests. Wrap armature assembly in lint-free cloth or kraft paper until reassembly.

6. Assembly (Figure 3)

A. Assemble Motor Assembly

(1) Install holder and lead assemblies (50, 52) and holders (51, 55) into end head (53), making sure that they will clear commutator by 1/32-inch and that the rectangular portion of each will be exactly parallel to the centerline of the commutator. Retain by installing set screws (47, 48, 49). See Figure 1 for electrical connections.

(2) Install grommet (46) into end head (53), pass electrical leads through grommet and position stator assembly (54) in correct alignment to end head.

(3) Install bridges (45) in stator assembly.

(4) Install one shield (42), one bearing (41) and washer (40) on commutator end of shaft of armature assembly (43).

CAUTION: SPRING FINGERS OF WASHER (40) MUST BEAR AGAINST OUTER RACE OF BEARING (41). UP-

SET CENTER OF SHIELD (42) MUST BEAR AGAINST INNER RACE OF BEARING.

(5) Apply a very thin film of LUB 300 to the outer race of bearing (refer to Table 4).

NOTE: Bearings (41) are prepacked with grease. Specification MIL-G-3278.

(6) Install armature, shield, bearing and washer subassembly into stator and end head assembly, making sure that bearing seats properly in end head.

(7) Install shield (42), bearing (41) and ring (39) on propeller end of armature shaft.

CAUTION: UPSET CENTER OF SHIELD MUST BEAR AGAINST INNER RACE OF BEARING.

(8) Apply a very thin film of LUB 300 to the outer race of bearing and install end head (38), making sure that bearing seats properly in end head.

(9) Check clearances and alignment of holder and lead assemblies (50, 52) and holders (51, 55) to commutator and adjust if necessary.

(10) Secure end head (38) to stator and end head assembly (44) using screws (36) and washers (37). Take care not to trap electrical leads.

(11) Install brush and spring assemblies (35) and cap assemblies (34). Secure with nuts (32) and washers (33).

NOTE: Two nuts (32) are used at set screw (48).

(12) Attach propeller (3) to motor shaft and secure with cotter pin (2).

(13) Connect negative motor lead to set screw (48) and secure temporarily with nut (28).

B. Seating of Motor Brushes

WARNING: SECURE MOTOR TO TEST BENCH AND ENCLOSE PROPELLER WITH A SUITABLE CAGE TO PROTECT PERSONNEL BEFORE APPLYING POWER TO MOTOR.

(1) When new brushes have been installed, or commutator has been trued, operate motor on 8 to 14 volts dc until brushes are 75 to 90 percent seated. Check that air flow direction is from propeller towards armature end of motor. If air flow direction is incorrect, check internal wiring connections.

(2) After brushes are seated satisfactorily, operate motor on 27 volts dc for 20 minutes. Then check that operating current is not greater than 20.8 amperes and operating speed is not less than 9650 rpm. Disconnect motor from dc power supply.

C. Assemble Vaneaxial Blower

(1) Install spacers (26) on set screws (49), and then install filter (22) and secure with nuts (20) and washers (21).

(2) Connect positive motor lead to filter using one nut (23), one washer (24) and one washer (25).

(3) Remove nut (28) from set screw (48) leaving negative motor lead connected to set screw. Connect lead (30) to set screw (48) and secure with nut (28) and washer (29).

(4) Connect lead (27) to filter (22) using one nut (23), one washer (24) and one washer (25).

(5) Install motor assembly into housing and nameplate assembly (17) and secure loosely with bolts (14), washers (15) and spacers (16). Torque bolts (14) to 10 pound-inches initially, then to 20 pound-inches and finally to 30 pound-inches. Lock adjacent pairs of bolts together using lockwire MS20995C32.

(6) Connect lead (30) to housing and nameplate assembly (17) at NEG position, using one bolt (13), two washers (12), one washer (8), one washer (7) and one nut (6).

(7) Connect lead (27) to housing and nameplate assembly (17) at POS position, using one bolt (13), one washer (12), washer (11), insulator (10), washer (9), one washer (8), one washer (7) and one nut (6).

(8) Install washers (5) and nuts (4) on NEG and POS terminals.

Table 4

Assembly Materials and Compounds

MATERIAL	SPECIFICATION OR MANUFACTURER
LUB300 Wire, Corrosion-resistant	Dynamic Air MS20995C32

7. Fits and Clearances

Not applicable.

8. Testing

A. Test Equipment

Refer to paragraph 11.

B. Test Procedure

(1) Apply 27 volts dc to blower NEG and POS terminals and operate for 20 minutes.

(2) Then check that operating current is not greater than 21 amperes and operating speed is not less than 10,450 rpm.

(3) Check blower for bucking and excessive vibration. Vibration must not exceed 2 mils.

C. Test Results

(1) Blowers which meet the requirements of the test procedure, may be put into service.

(2) If any blower fails to meet the requirements of the test procedure, refer to the trouble shooting procedure.

9. Trouble Shooting

A. If the blower fails to meet the requirements of the test procedure, refer to Table 5 to determine the possible cause and correction for the malfunction.

Table 5

Trouble Shooting Information

TROUBLE	POSSIBLE CAUSE	CORRECTION
1. Blower fails to operate.	Open wiring.	Replace defective wiring.
	Defective filter.	Replace filter.
	Brushes not in contact with commutator.	Replace brush and spring assemblies.
	Open field windings.	Replace stator assembly.
2. Excessive current and low speed.	Bearings misaligned or preloaded.	Move armature back and forth to relieve any preload.
	Bearings defective.	Replace bearings.
3. Low speed.	Brushes not properly seated.	Reseat brushes.
4. Excessive current and high speed.	Shorted field windings.	Replace stator assembly
5. Excessive current and bucking.	Shorted armature windings.	Replace armature assembly.
6. Bucking.	Open armature windings.	Replace armature assembly.
7. Excessive vibration.	Armature out of balance.	Rebalance or replace armature assembly.
	Propeller out of balance.	Rebalance or replace propeller.
	Propeller damaged.	Replace propeller.

10. Storage Instructions

A. Preparation

(1) Wrap vaneaxial blower in water vapor resistant barrier material, including a desiccant (refer to Table 6).

(2) Affix label giving following information:

(a) Identification

(b) Date of overhaul

(c) Inspection

Table 6

Storage Materials and Compounds

MATERIAL	SPECIFICATION OR MANUFACTURER
Barrier Material	MIL-B-121
Desiccant	MIL-D-3464

11. Special Tools

No special tools are required. Overhaul of the blower can be accomplished with the use of tools, fixtures and other equipment normally available at overhaul facilities. The equipment described in Table 7 is required for use in overhaul of this unit.

Table 7

Overhaul Equipment

EQUIPMENT	CAPABILITIES	APPLICATION
Dielectric Tester	500 volts ac rms, 60 Hz	Dielectric tests
Megger	0 - 200 megohms minimum	Insulation tests
Ohmmeter	Low resistance range	Continuity tests

Table 7 (Cont'd)

Overhaul Equipment

EQUIPMENT	CAPABILITIES	APPLICATION
Torque Wrench	30 pound-inches torque	Assembly of blower
Dc Power Supply	27 volts, 21 amperes (minimum)	Assembly and testing
Dc Ammeter	0 - 21 amperes (minimum)	Assembly and testing
Stroboscopic Tachometer	0 - 12, 000 rpm (minimum)	Assembly and testing
Vibration Meter	0 - 2 mils (minimum)	Testing

12. Illustrated Parts List

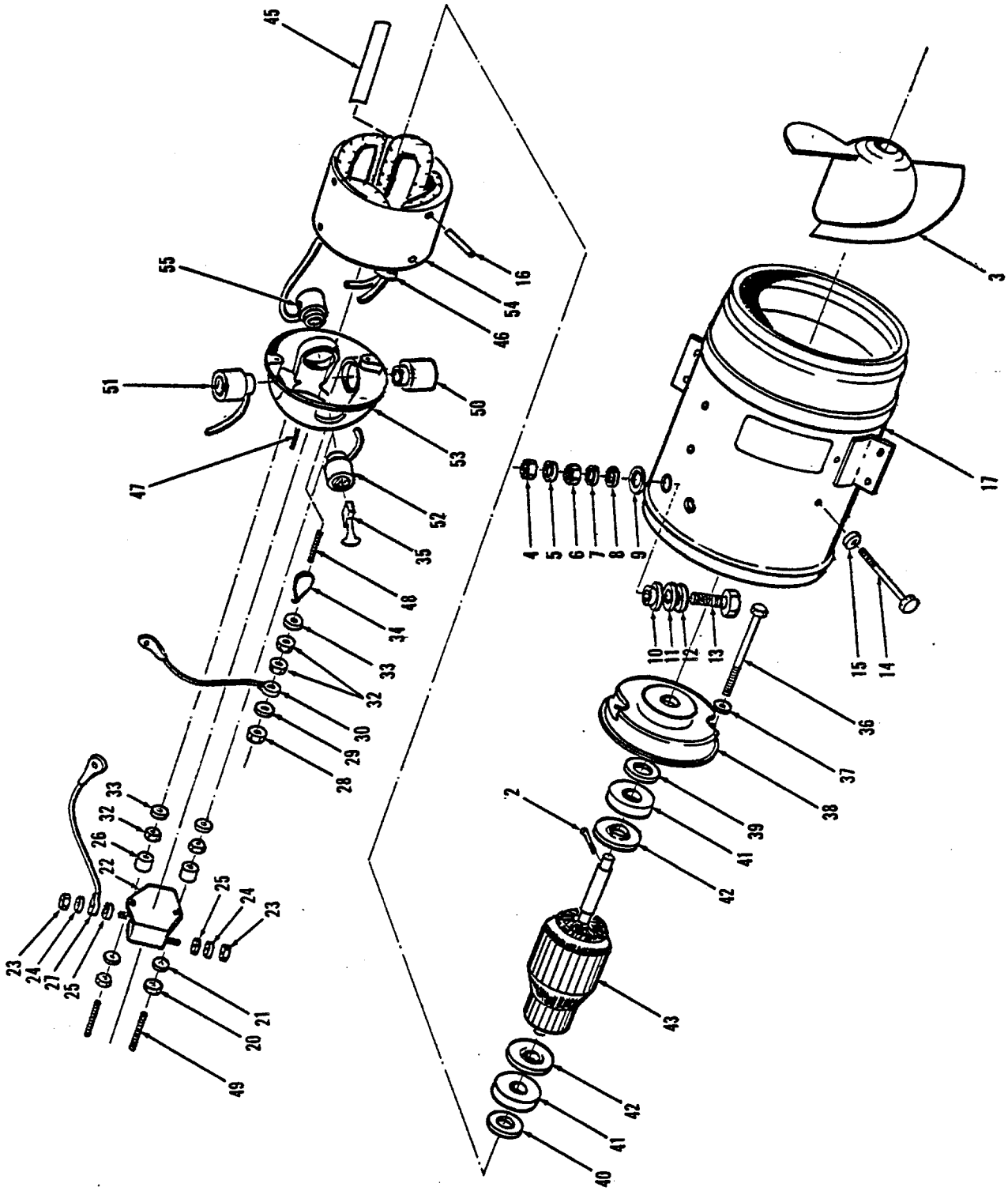
A. For explanation of vendor codes used in the illustrated parts list, refer to Table 8.

B. Item numbers preceded with a dash (-) are not illustrated.

Table 8

Vendor Codes

CODE	VENDOR NAME AND ADDRESS
V18965	Dynamic Air Engineering Inc., 620 East Dyer Road, Santa Ana, California 92705, U.S.A.



Exploded View - Vaneaxial Blower M5861AD-6B

Figure 3

FIGURE AND INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
3- 1	M5861AD-6B	Blower Assembly	V18965		1
2	MS24665-134	. Pin, Cotter			1
3	593D-9	. Propeller	V18965		1
4	AN345-10	. Nut, Plain			2
5	AN960-10	. Washer, Plain			2
6	AN345-10	. Nut, Plain			2
7	AN935-10	. Washer, Lock			2
8	K127G-5	. Washer, Flat	V18965		2
9	2003-2	. Washer, Fiberglass	V18965		1
10	2721-15	. Insulator, Bushing	V18965		1
11	K127G-5	. Washer, Flat	V18965		1
12	AN960-10	. Washer, Plain			3
13	3140-3	. Bolt, Machine	V18965		2
14	AN3H14A	. Bolt, Machine			6
15	AN960-10	. Washer, Plain			6
16	1081-15	. Spacer, Motor Mounting	V18965		6
17	A2781-432	. Housing and Nameplate Assembly	V18965		1
-18	2068-563	. . Nameplate	V18965		NP
-19	3249-21	. . Housing, Fan	V18965		NP
20	AN340-8	. Nut, Plain			2
21	AN935-8	. Washer, Lock			2
22	2793-72	. Filter, Electromagnetic Interference	V18965		1
23	AN340-8	. . Nut, Plain			2
24	AN935-8	. . Washer, Lock			2
25	AN960-8	. . Washer, Plain			2
26	1081-89	. Spacer, Filter Mounting	V18965		2
27	1376-134	. Lead, Electrical	V18965		1
28	AN340-8	. Nut, Plain			1
29	AN935-8	. Washer, Lock			1
30	1376-135	. Lead, Electrical	V18965		1
-31	M3424CB	. Motor Assembly	V18965		1
32	AN340-8	. . Nut, Plain			5
33	AN936B8	. . Washer, Lock			4

FIGURE AND INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
3-					
34	417H-3	. . Cap Assembly, Brush	V18965		4
35	420A-10	. . Brush and Spring Assembly	V18965		4
36	AN500A10-48	. . Screw, Machine			2
37	AN960-10L	. . Washer, Plain			2
38	5801N-9	. . End Head, Shaft End	V18965		1
39	461	. . Ring, Slinger	V18965		1
40	K129-1	. . Washer, End Play	V18965		1
41	K271-200SSL	. . Bearing, Ball	V18965		2
42	536-2	. . Shield, Bearing	V18965		2
43	3410L-46	. . Armature Assembly	V18965		1
-44	2239-8D	. . Stator and End Head Assembly	V 18965		1
45	2372-8	. . . Bridge, Pole	V18965		2
46	K323-3-5A	. . . Grommet, Elastic	V18965		1
47	AN565D8H8	. . . Screw, Set			1
48	AN565D8H14	. . . Screw, Set			1
49	AN565D8H16	. . . Screw, Set			2
50	447A-37	. . . Holder and Lead Assembly, Negative Brush	V18965		1
51	419-16	. . . Holder, Negative Brush	V18965		1
52	447A-5	. . . Holder and Lead Assembly, Positive Brush	V18965		1
53	657B-17	. . . End Head, Commutator End	V18965		1
54	2237-53	. . . Stator Assembly	V18965		1
55	419-4	. . . . Holder, Positive Brush	V18965		1

OVERHAUL MANUAL
WITH
ILLUSTRATED PARTS LIST

MIXING VALVE ASSEMBLY

PART NO. A58D72

JANITROL AERO DIVISION
Midland-Ross Corporation
42 Surface Road
Columbus, Ohio 43228

JANITROL AERO DIVISION
Midland-Ross Corporation

JANITROL AERO DIVISION
OVERHAUL MANUAL WITH
ILLUSTRATED PARTS LIST
A58D72

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OVERHAUL MANUAL WITH
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RECORD OF REVISIONS

	LOCATION

ASSIGNED TO (JOB TITLE)

REV. NO.	INSERTION DATE	BY	REV. NO.	INSERTION DATE	BY	REV. NO.	INSERTION DATE	BY	REV. NO.	INSERTION DATE	BY

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JANITROL AERO DIVISION
OVERHAUL MANUAL WITH
ILLUSTRATED PARTS LIST
A58D72

SERVICE BULLETIN LIST

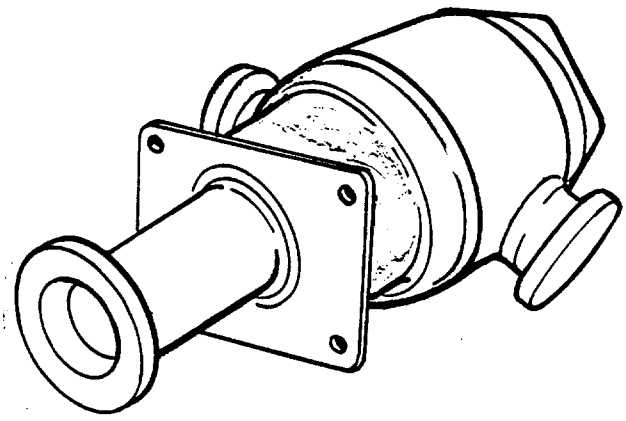
SERVICE BULLETIN	INCORP.	SERVICE BULLETIN	INCORP.

JANITROL AERO DIVISION
OVERHAUL MANUAL WITH
ILLUSTRATED PARTS LIST
A58D72

DESCRIPTION AND OPERATION

1. Description

The A58D72 Mixing Valve Assembly (see figure 1) is designed for use in an aircraft bleed air cabin heating system. Its function is to mix a hot air stream with a cold air stream in such proportions that the outlet temperature of the valve will be maintained within the range of 270° F to 350° F. The valve will shut off downstream flow entirely at outlet temperatures exceeding 350° F, a primary safety feature.



Mixing Valve Assembly
Figure 1

2. Operation

The A58D72 Valve consists of a cast cylindrical body, which provides a hot air inlet port, a cold air inlet port, and a common outlet for the mixed bleed air stream. A thermal element with a moving piston controls the position of a closely fitted spool inside the valve body. This spool opens and closes the hot and/or cold air ports to regulate downstream temperatures within the desired range.

3. Leading Particulars

Refer to figure 2 for leading particulars.

Envelope size (inches)	3.0 dia x 7.0 long
Weight	2.0 lbs approx
Inlet air pressure range	0-100 psia
Inlet air temperature range	+150° F to +562° F
Outlet air temperature range	+150° F to 350° F

Leading Particulars
Figure 2

DISASSEMBLY

NOTE: The valve should be disassembled for inspection or repair as outlined below.

1. Remove cap (2, IPL figure 5).

2. Remove gasket (4) and spring (3) from body (12).

3. Remove slide and stator assembly (5), with stem (6) attached. Slide and stator are matched parts and must be replaced as an assembly.

4. Remove cotter pin (7) and stem (6). Remove packings (8) from slide and stator assembly.

5. Remove element (9) and ring (11) as an assembly by inserting a hooked tool through the body (12) from the large end and pulling the ring through the body. Under no circumstances is pressure to be used against the end of element (9) to push the parts out.

6. Cut lockwire (10). Unscrew and remove element (9) from ring (11). No more than 5 in/lb of torque should be applied to element (9) during removal.

CLEANING

Clean all metal parts in cleaning solvent, Federal Specification P-D-680. If foreign material is difficult to remove, use a soft bristle brush to aid in the cleaning process. Dry the parts thoroughly with dry, filtered, compressed air.

WARNING: USE SOLVENT IN A WELL-VENTILATED AREA. AVOID PROLONGED INHALATION OF VAPOR AND PROLONGED OR REPEATED CONTACT WITH SKIN. KEEP AWAY FROM HEAT OR OPEN FLAME. DO NOT APPLY SOLVENT TO NEW GASKETS AND PACKINGS.

INSPECTION/CHECK

1. Inspect cap (2, IPL figure 5) for cracks or damaged threads.

2. Check spring (3) for distortion or loss of tension. Normal spring tension is 10 lbs when compressed to 1.40 inches; 15 lbs when compressed to 0.90 inch length.

3. Check mating surfaces of slide and stator (5) for scoring or wear patterns, and nicks or burrs which might cause binding of the slide.

4. Check stem (6) for damaged threads.

5. Check housing for cracks or damaged port flanges.

REPAIR

The only repair to the A58D72 Valve Assembly consists of replacement of those parts found to be defective during the inspection procedure.

ASSEMBLY

1. Secure element (9, IPL figure 5) to ring (11) and install lockwire (10).

2. Install packings (8) onto stator (5).

3. Place body (12) in a holding fixture. Install element ring (11) with element assembled. Install stator (5). Place slide inside stator (5) and align the hot air ports of both parts. Check alignment by viewing the ports through the hot air inlet on the side of the body.

4. When the hot air ports are properly aligned, install a wood or rubber plug through the hot air port in the slide and stator, to hold the parts in alignment.

5. Install stem (6) in slide, screwing in until the stem just touches the piston of element (9). Carefully remove slide and stem from stator, and secure stem (6) in place by installing pin (7).

   NOTE: If slots in slide and hole in stem (6) do not align, turn stem counter-clockwise until the thru hole lines up with the nearest slot, and install pin (7).

6. Reassemble stem and slide into stator. Install spring (3), gasket (4) and cap (2). Tighten cap to 40-50 in/lbs torque.

7. Lockwire cap (2) to body after completion of testing.

TESTING

1. Test Equipment Required

   A. Pressure Regulator, 0-150 psig

   B. Pressure Gage, 0-150 psig (P_1)

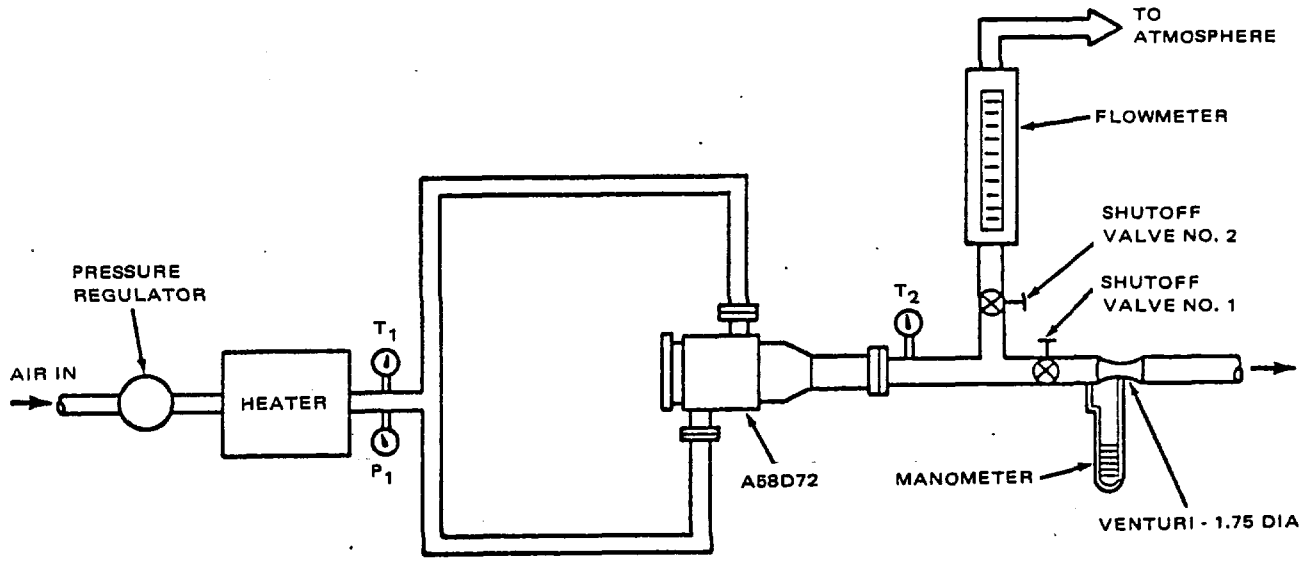
   C. Temperature Gage, 0-500° F (2 required - T_1 and T_2)

   D. Heating device to produce 120 cfm of heated air at variable temperatures between 250° F and 400° F, and 30 $\pm$ 5 psig pressure

   E. Flowmeter, 0-30 cfm

   F. Water Manometer, 0-50 in H_2O

   G. Ductwork and fittings as shown in figure 3.



Test Set-up
Figure 3

2. Test Procedures

A. Install valve in the test set-up as shown in figure 3.

B. Open shutoff valve No. 1, and close shutoff valve No. 2.

C. Apply inlet air pressure at 30 ±5 psig and adjust temperature T_1 to 250° F.

D. Slowly increase inlet air temperature (T_1). Continue to increase T_1 temperature while observing T_2 temperature. When T_2 reaches 335° F, increase P_1 to 100 ±5 psig.

E. Continue to increase T_1 until T_2 reaches 350° F or valve shutoff occurs. Valve shutoff occurs when the flowmeter reading is less than 29.7 cfm. If manometer shows a pressure drop at the venturi of greater than .15 in. H_2O, shutoff has not occured. Check flowmeter reading by closing valve No. 1 and opening valve No. 2, only when venturi pressure drop is less than .15 in. H_2O.

NOTE: When the valve shutoff occurs, the thermal element begins to cool. After approximately one minute, the valve will reopen. As soon as shutoff occurs, check flowmeter reading; then close shutoff valve No. 2 and open shutoff valve No. 1, to prevent flowmeter damage when valve reopens.

F. If valve shutoff does not occur, shut off the air heater. Allow T_2 to decrease to below 250° F. Reduce inlet pressure to zero, then remove the valve cap and the adjusting screw cotter pin. Rotate the adjusting screw one full turn in the clockwise direction. Replace the cotter pin and cap. Repeat steps A through E.

G. If valve shutoff occurs at a temperature less than 340° F shut off the air heater and allow T_2 to decrease to less than 250° F. Reduce inlet pressure to zero, then remove the valve cap and cotter pin. Rotate the adjusting screw one full turn in the counterclockwise direction. Replace cotter pin and cap. Repeat steps A through E.

H. If valve shutoff occurs between 340° F and 350° F at T_2, the valve operation is acceptable. Shut off the air heater, and reduce P_1 pressure to 30 psig, allowing T_2 to cool to less than 250° F, before removing valve from fixture.

I. If valve fails to perform as specified, and adjustments cannot be made to bring performance to within specifications, return the valve to Janitrol Aero Division, Midland-Ross Corporation, for replacement and calibration of a new thermal element.

TROUBLE SHOOTING

Refer to figure 4 for trouble shooting procedures.

TROUBLE	CAUSE	ISOLATION PROCEDURES	REMEDY
Downstream air temperature too high or too low	Slide stuck in stator	Disassemble valve and check slide for freedom of movement inside stator.	Replace slide and stator as a matched set.
	Thermal element not properly adjusted	Test valve as outlined under Testing section.	Adjust stem adjusting screw as outlined in Testing section.
	Thermal element defective	Test valve as outlined under Testing section.	Return unit to Janitrol Aero for installation and calibration of new element.
	Leakage in one or both inlet air lines	Check inlet air lines for leaks.	Repair or replace as necessary.
		Check for loose or defective band clamps.	Tighten or replace clamps as necessary

Trouble Shooting
Figure 4

STORAGE INSTRUCTIONS

1. Wrap the Mixing Valve Assembly with cushioning material, Military Specification MIL-C-81013.

2. Enclose the assembly, with desiccant, Military Specification MIL-D-3464, in heat sealable film, Military Specification MIL-F-22191, and seal the film using a sealing iron, Military Specification MIL-S-43336.

3. Store the assembly in an area with a temperature range of 65° F to 120° F.

ILLUSTRATED PARTS LIST

1. This illustrated parts list describes and illustrates the detail parts of the Mixing Valve Assembly, Part No. A58D72.

2. All parts of the equipment are listed except parts which lose their identity by being welded or otherwise permanently fastened to other parts of assemblies and not subject to disassembly.

3. Explanation of Columns Used in the Parts List.

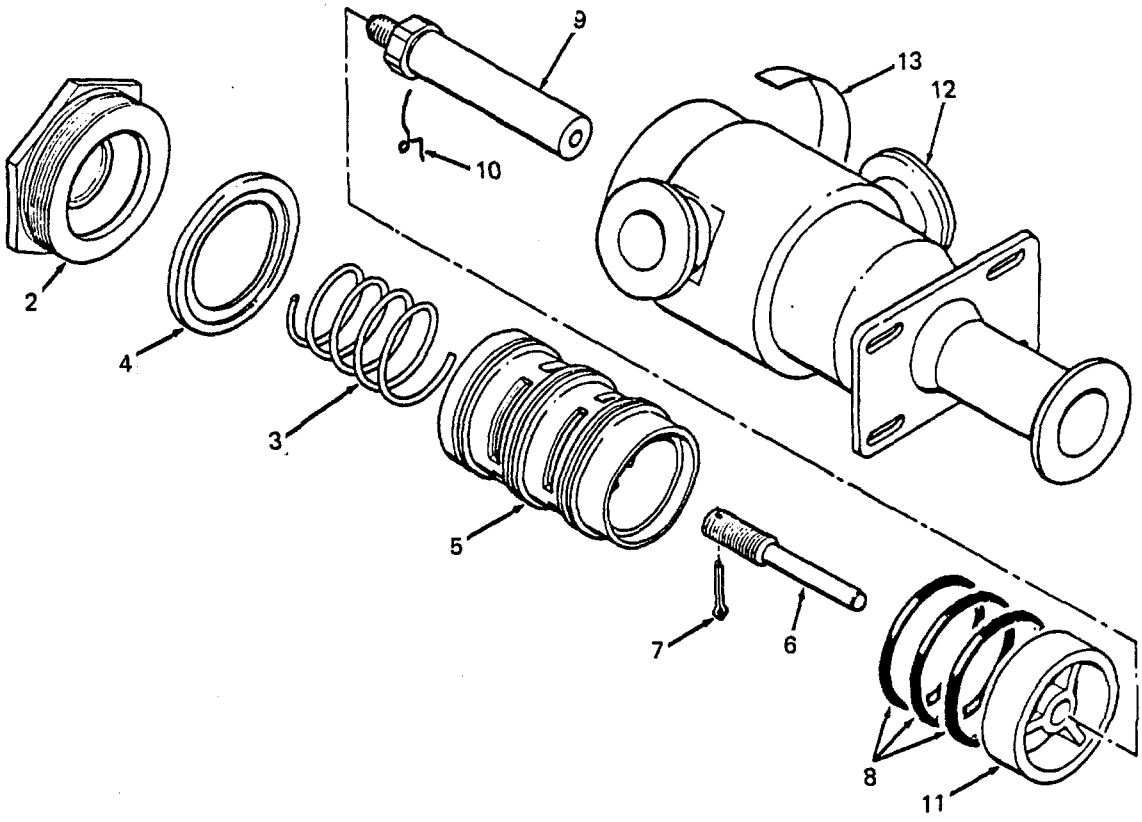
   A. Figure and item number column: The figure and item numbers key the parts breakdown list to the applicable illustration. The number preceding the dash is the figure number of the illustration. The item numbers are arranged in sequence and generally reflect the order of disassembly.

   B. Part number column: This column contains the manufacturer's part number.

   C. Nomenclature column: This column identifies the parts being listed by noun name followed by modifiers when applicable.

   D. Effect Code column: This column is used to designate part number variations within assemblies by use of a letter code. When blank, parts are applicable to all models. An explanation of Effect Codes is presented at the end of the parts list.

   E. Units per assembly column: This column indicates the quantity of parts required for the assembly or subassembly in which that part appears. The quantities listed indicate the number of parts used in one assembly.



Exploded View
Mixing Valve Assembly
Figure 5

FIG.	ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY
5	-1	A58D72	VALVE ASSEMBLY, MIXING		1
	2	63D10	. CAP, MIXING VALVE		1
	3	68D18	. SPRING, COMPRESSION		1
	4	63D57	. GASKET, CAP		1
	5	63D18	. SLIDE AND STATOR ASSEMBLY (Serviced only as a matched set)		1
	6	63D08	. STEM		1
	7	MS9245-26	. PIN, COTTER (96906)		1
	8	25C85-78	. PACKING, PREFORMED		3
	9	63D07	. ELEMENT, THERMAL		1
	10	MS20995C32-12	. LOCKWIRE (96906)		2
	11	63D09	. RING, ELEMENT		1
	12	63D32	. BODY, VALVE		1
	13	68D14	. PLATE, IDENTIFICATION		NP

- Item Not Illustrated

NP - Denotes not procurable as a separate part.

SUNDSTRAND AVIATION MECHANICAL
UNIT OF SUNDSTRAND CORPORATION
ROCKFORD, ILLINOIS 61101

COMPONENT MAINTENANCE MANUAL
WITH ILLUSTRATED PARTS LIST
SHUTOFF VALVE (1-INCH)
PART NUMBER 26440051

30-40-1
Original Issue Dec 15/68
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SUNDSTRAND AVIATION MECHANICAL

COMPONENT MAINTENANCE MANUAL WITH IPL
PART NUMBER 26440051

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SUNDSTRAND AVIATION MECHANICAL

COMPONENT MAINTENANCE MANUAL WITH IPL
PART NUMBER 26440051

RECORD OF REVISIONS

REV NO.	ISSUE DATE	DATE INSERTED	BY	REV NO.	ISSUE DATE	DATE INSERTED	BY	REV NO.	ISSUE DATE	DATE INSERTED	BY
1	Jul 1/77										

LIST OF ABBREVIATIONS

ABBREVIATION	DEFINITION	ABBREVIATION	DEFINITION
Adc	amperes direct current		
Assy	Assembly		
°C	degrees Celsius		
°F	degrees Fahrenheit		
ft	feet		
ft-lb	foot pounds		
ID	inside diameter		
in.	inch(es)		
in. Hg A	inches of mercury absolute		
in. lbs	inch pounds		
kg	kilogram		
kPaA	kilopascals absolute		
kPag	kilopascals gage		
lbs	pounds		
M	metre(s)		
mm	millimetres		
Mod	Modification		
No.	Number		
psig	pounds per square inch gage		
S.B.	Service Bulletin		
Scfm	Standard cubic feet per minute		
Scmm	Standard cubic metre per minute		
VDC	volts direct current		
%	percent		
±	plus or minus		

COMPONENT MAINTENANCE MANUAL WITH IPL
PART NUMBER 26440051

SERVICE BULLETIN LIST

S.B. NO.	DESCRIPTION	PARTS ADDED OR CHANGED	MOD. SYMBOL	SERIAL NO. EFFECTIVITY
	(SERVICE BULLETINS WILL BE ADDED WHEN ISSUED)			

COMPONENT MAINTENANCE MANUAL WITH IPL
PART NUMBER 26440051

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	1004	Jul 1/77
	1005	Jul 1/77

DESCRIPTION AND OPERATION

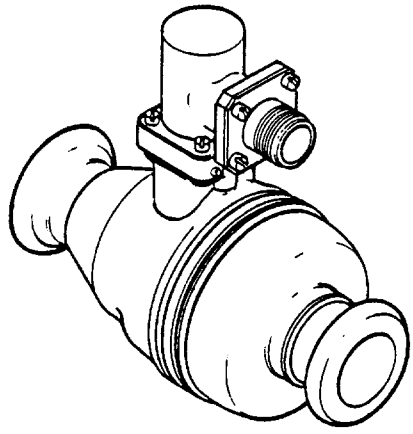
1. Description

The inline shutoff valve, part number 26440051 (Figure 1), controls the flow of hot bleed air from the engine by means of a pneumatically operated piston. The valve is a poppet type shutoff valve with 1.00 inch (25.4 millimetres) inlet and outlet ports. The valve contains a coaxially mounted piston that travels to the open position pneumatically, and returns to the closed position mechanically by means of a compression spring. The valve is manufactured by Sundstrand Aviation Mechanical, Unit of Sundstrand Corporation, Rockford, Illinois 61101.

2. Operation

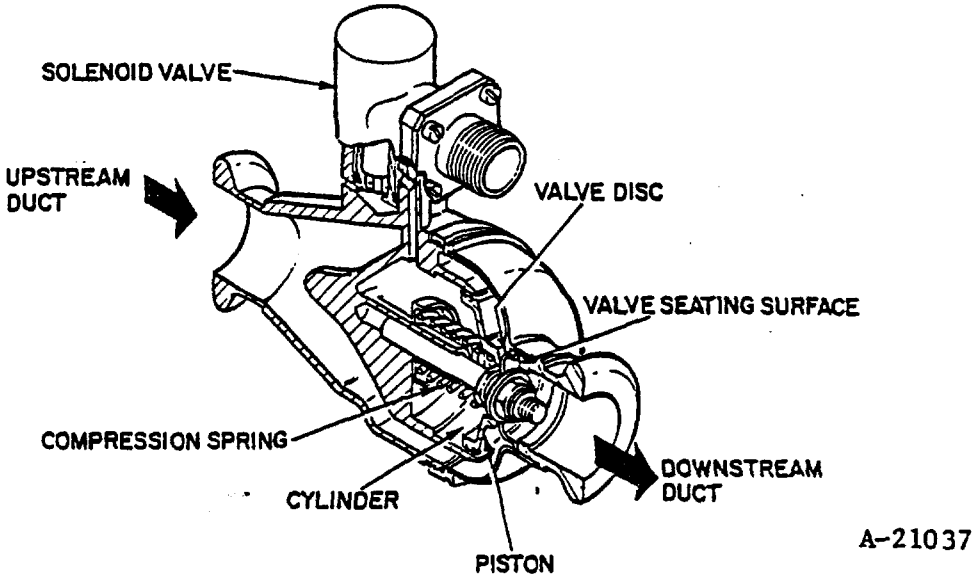
The shutoff valve is pilot solenoid operated. It is spring loaded closed and will open when the pilot solenoid is in the open position (energized) and the upstream bleed air ducting is pressurized. When the pilot solenoid is energized, an air passage between the actuation chamber and the pilot solenoid is opened to atmosphere reducing the actuation chamber pressure to atmospheric pressure (refer to Figure 2). The resultant pressure force acts upon the piston to move it in the open direction. This force is equal to the difference between the inlet duct and actuation chamber pressures times the difference between the actuation chamber area and the valve disc area.

As the piston moves toward the open position, the entire disc area is exposed to the pressure and the resultant force is great enough to overcome the spring force and all frictional forces.



A-21036

Shutoff Valve
Figure 1



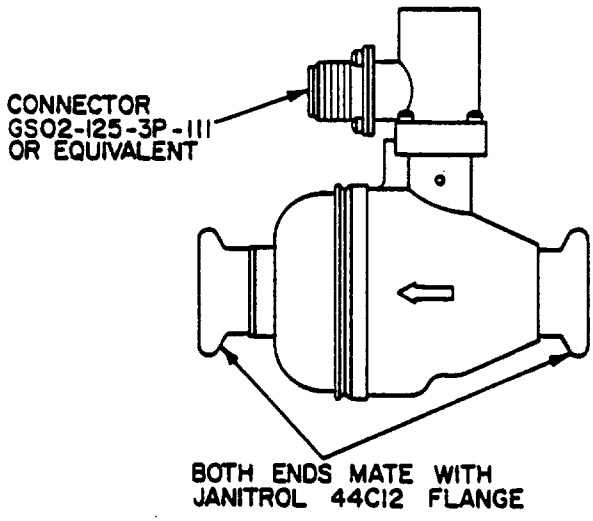
Cutaway View
Figure 2

In response to closing the solenoid pilot valve (solenoid de-energized) the control line from the actuation chamber is closed and the actuation chamber pressure increases to the inlet duct pressure level. When the pressures on both sides of the piston have equalized, the spring force moves the piston toward the closed position. As the piston and disc move toward the closed position a pressure drop occurs across the disc face. This pressure differential provides an additional closing force.

Shutoff valve leading particulars are listed in Figure 3. Mating flange and connector information is shown in Figure 4.

Flow Media	Air
Ambient Altitude Range	
Minimum	0 ft (0 M)
Maximum	50,000 ft (15,240 M)
Ambient Air Temperature Range	
Minimum	-65°F (-54°C)
Maximum	+300°F (+149°C)
Inlet Air Temperature (Maximum)	+610°F (+321°C)
Inlet Air Pressure (Maximum)	250 in. Hg A (844 kPaA)
Pressure Required to Open (Maximum)	3 psig (20.7 kPag)
Duty	Continuous
Useful Life	25,000 cycles
Overall Dimensions:	
Height	4.76 in. (120.90 mm)
Width	2.63 in. (66.80 mm)
Length	4.80 in. (121.92 mm)
Weight	1.8 lbs (0.816 kg)
Solenoid Voltage	18 to 30 Vdc
Solenoid Current (at 24 Vdc and 70°F/21°C)	1 Adc maximum

Leading Particulars
Figure 3



A-22679

Shutoff Valve Mounting Features
Figure 4

TESTING AND TROUBLESHOOTING

1. Testing

A. General

(1) For shutoff valves removed from service proceed as follows:

(a) Visually check shutoff valve for external damage or defects that could affect serviceability.

(b) Check shutoff valve for contamination, corrosion, or other obstructions that could affect its performance. Manually depress piston and observe that it returns to the normally closed position.

CAUTION: APPROPRIATE FLANGE ADAPTERS SHOULD BE USED FOR TESTING AS THE USE OF ANY TYPE OF COMPRESSION (CLAMPING) FIXTURE COULD RESULT IN VALVE DAMAGE.

(c) If shutoff valve has no obvious defects, it should be tested according to the following conditions and tests.

(d) If shutoff valve passes all the tests it may be returned to service.

(e) If shutoff valve fails any test condition, proceed with troubleshooting and maintenance.

(2) On completion of any maintenance, it will be necessary to verify proper operation of shutoff valve. Verification is obtained by testing shutoff valve according to the following tests, conditions, and setups.

B. Test Conditions

(1) The test setups used to test shutoff valve are shown in Figure 101, 102, 103, and 104 and includes the following test equipment:

(a) Pressure gage, Ashcroft Model 1220 (or equivalent) . . . . . 0 to 15 pounds per square inch gage (0 to 103.5 kilopascals gage)

(b) Pressure gage, Marsh Model 103 (or equivalent) . . . . . 0 to 150 pounds per square inch gage (0 to 1035 kilopascals gage)

(c) Pressure gage, Marsh Model 103 (or equivalent) . . . . . 0 to 300 pounds per square inch gage (0 to 2070 kilopascals gage)

(d) Flowmeter, Brooks Model 1412, Size 8 (or equivalent) . . . . . 0 to 3.05 standard cubic feet per minute (0 to 0.086376 standard cubic metres per minute)

(e) Ammeter, Simpson Model 1349 (or equivalent) . . . . . 0 to 2 amperes direct current

(f) Voltmeter, Assembly Products Model 561 (or equivalent) . . . . . 0 to 35 volts direct current

(2) The test setups used to test the shutoff valve require the following compressed air conditions:

(a) Pressure . . . . . 0 to 150 pounds per square inch gage (0 to 1035 kilopascals gage)

(b) Temperature . . . . . 65° to 75° Fahrenheit (18.33° to 23.88° Celsius)

(c) Conditioning . . . . . Dry, filtered

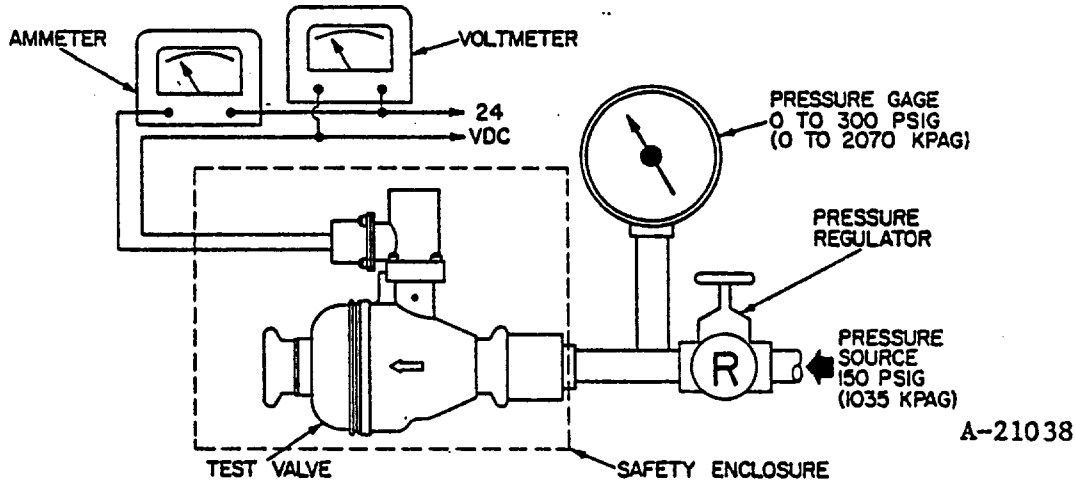
(3) The test setups used to test the shutoff valve require 24 volts direct current.

C. Proof Pressure Test

(1) Install shutoff valve in setup shown in Figure 101.

CAUTION: CONDUCT ALL TESTS WITH THE UNIT IN A SAFETY ENCLOSURE CAPABLE OF CONTAINING PARTS SHOULD THE UNIT FAIL UNDER PRESSURE.

(2) De-energize the shutoff valve, and gradually apply a pressure of 150 pounds per square inch gage (1035 kilopascals gage) to the valve inlet port.



Proof Pressure Test Setup
Figure 101

(3) Maintain the 150 pounds per square inch gage (1035 kilopascals gage) pressure for 1 minute, then reduce to atmospheric pressure.

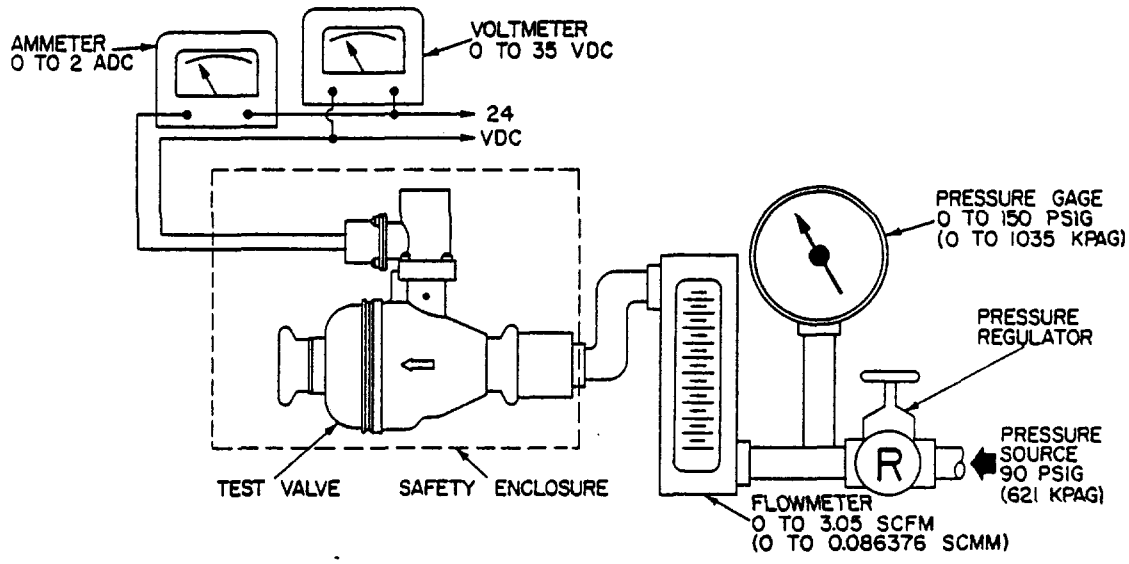
(4) Remove shutoff valve from test setup. Visually inspect shutoff valve for damage. There must be no damage or deformation of components.

D. Total Leakage Test

(1) Install shutoff valve in setup shown in Figure 102.

(2) De-energize the shutoff valve, and apply a pressure of 75 pounds per square inch gage (517.5 kilopascals gage) to valve inlet port.

(3) Maintain pressure of 75 pounds per square inch gage (517.5 kilopascals gage) and observe total leakage as indicated by flowmeter. Total leakage must not exceed 0.20 pound per minute (0.075 standard cubic metre per minute).



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Total Leakage Test Setup
Figure 102

E. Operational Test

(1) Install shutoff valve in setup shown in Figure 103.

(2) With solenoid energized, gradually increase air pressure to shutoff valve inlet port and observe inlet air pressure required to open shutoff valve. Shutoff valve must open before inlet air pressure exceeds 3.0 pounds per square inch gage (20.7 kilopascals gage).

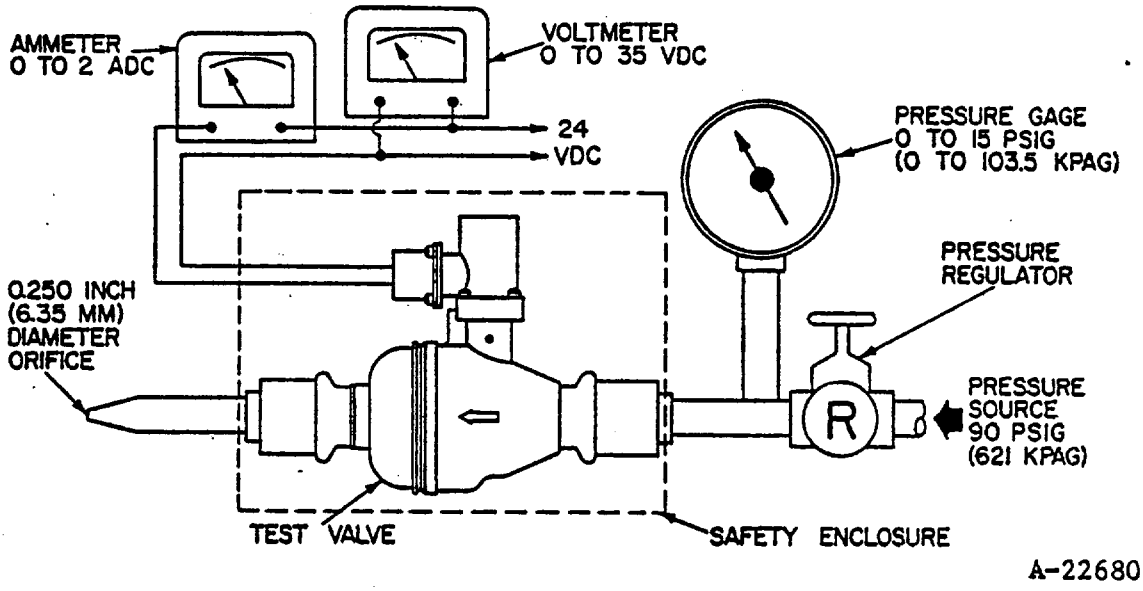
F. Performance Test

(1) Install shutoff valve in setup shown in Figure 103.

(2) Energize solenoid air valve with 24 volts direct current.

(3) Check that current through solenoid coil does not exceed 1.0 ampere.

(4) Apply a pressure of 75 pounds per square inch gage (517.5 kilopascals gage) to shutoff valve inlet port and alternately de-energize and energize solenoid three times. Check that shutoff valve alternately opens and closes.



Operational and Performance Test Setup
Figure 103

2. Troubleshooting

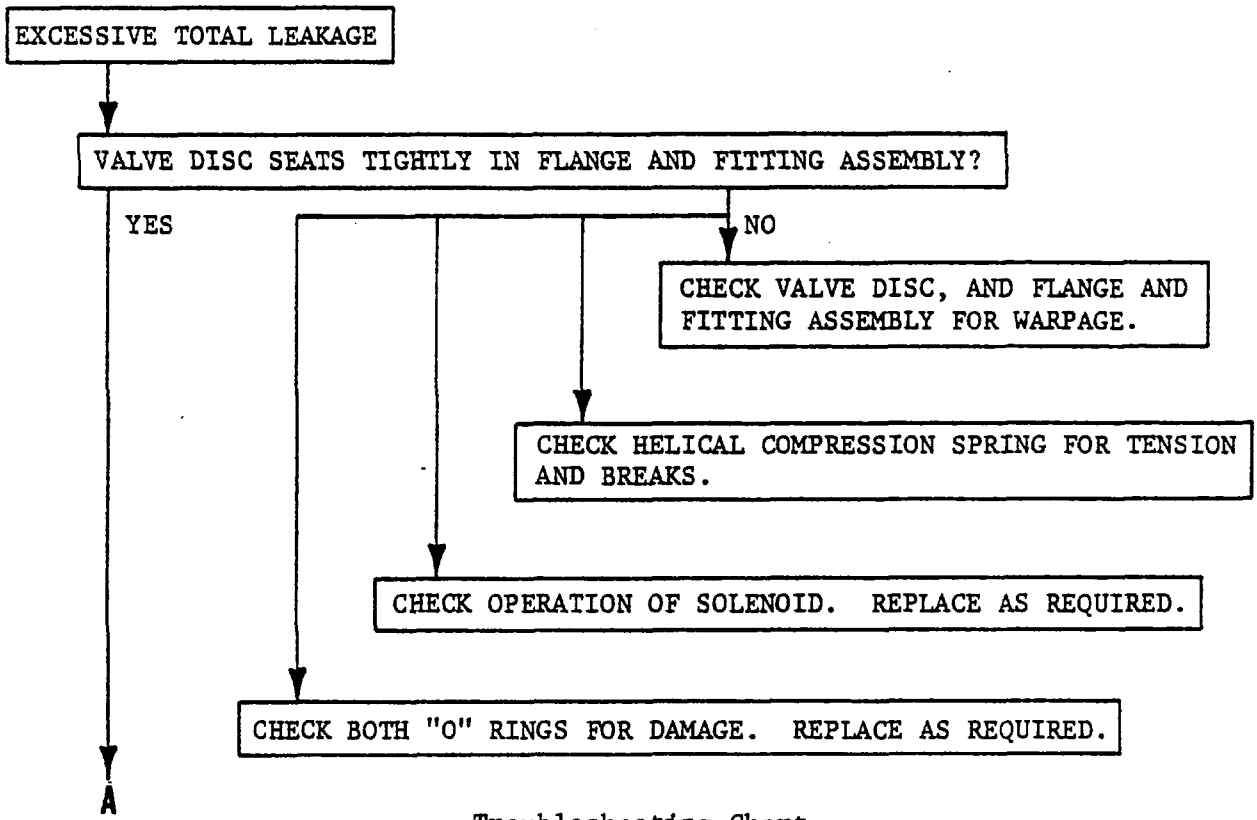
A. General

The troubles covered in this section are those that can be located using maintenance test equipment. They do not include those troubles that might develop in related equipment and may appear to be the fault of the shutoff valve. They include troubles apt to be found in after-maintenance test and in equipment prematurely removed from service.

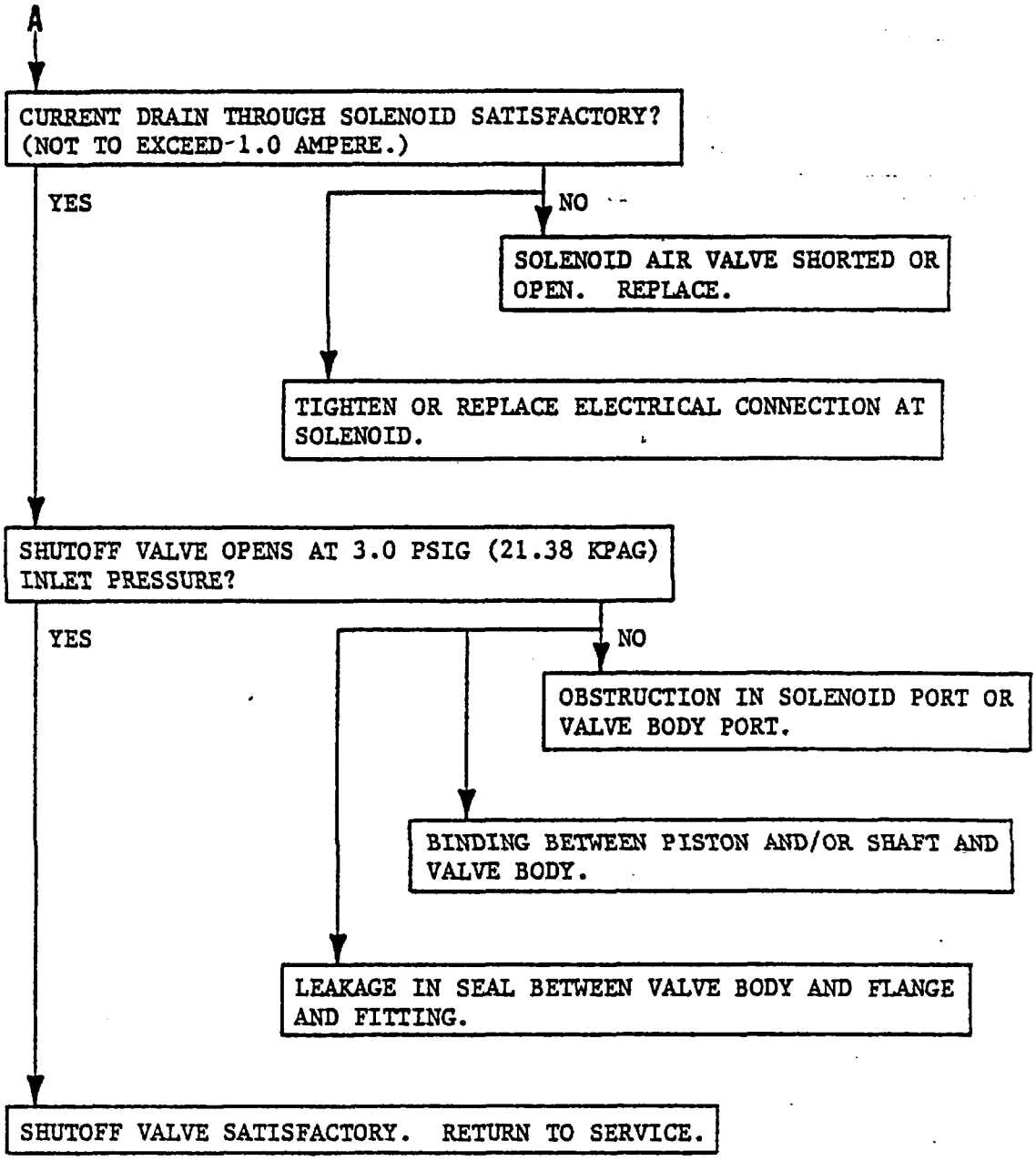
B. Troubleshooting Chart

Troubles most likely to occur in the shutoff valve are listed in Figure 104 along with their possible cause, isolation procedure, and correction.

Whenever a problem is encountered during test, shut off all pressure sources. Relieve pressure in shutoff valve by de-energizing solenoid. Remove shutoff valve. Disassemble and inspect parts, with particular emphasis on components listed in the troubleshooting chart. Repair or replace defective parts and assemble the shutoff valve according to ASSEMBLY. Repeat all tests to determine if corrective action has solved the problem.



Troubleshooting Chart
Figure 104 (Sheet 1 of 2)



Troubleshooting Chart
Figure 104 (Sheet 2 of 2)

DISASSEMBLY

1. General

A. If shutoff valve removed from service shows no visual indication of damage, corrosion, or contamination (reference CHECK) the shutoff valve shall be tested in accordance with TEST AND TROUBLESHOOTING to determine if maintenance is required.

B. Shutoff valves that require maintenance shall be disassembled to the extent required to correct fault (reference TEST AND TROUBLESHOOTING) according to the instructions in this section.

C. Parts recommended for discard are listed in Figure 301.

D. Refer to FITS AND CLEARANCES for summarized disassembly procedures.

IPL Figure 1001, Item Number and Description
15 and 20 ("O" RINGS)
35 (SELF-LOCKING NUT)
50 (PISTON RINGS)

Parts Recommended for Discard
Figure 301

2. Disassembly

A. Perform disassembly as follows:

WARNING: WEAR EYE PROTECTION WHEN REMOVING LOCKWIRE.

(1) Remove all accessible lockwire.

(2) Remove screws (10, Figure 1001) and lift off solenoid (5).

(3) Remove "O" ring (15) from recess in valve body (85) and "O" ring (20) from groove in solenoid air valve (5).

WARNING: REMOVE FLANGE AND FITTING ASSEMBLY (25) SLOWLY AND CAREFULLY. HELICAL COMPRESSION SPRING (60) IS UNDER COMPRESSION.

CAUTION: BEFORE PLACING SHUTOFF VALVE IN BOTTOM CLAMP AND THE TOP CLAMP AND FIXTURE ONTO THE SHUTOFF VALVE, MAKE CERTAIN THAT ALL MATING SURFACES ARE CLEAN AND FREE OF FOREIGN MATERIAL.

(4) Using top clamp and fixture assembly CES-20611 and bottom clamp CES-20612 (refer to Figures 901 and 902) unscrew flange and fitting assembly (25) from valve body (85).

(5) Remove nut (35), spacer (40), valve disc (30), piston (45), piston rings (50), and shaft (55) from valve body (85) as an assembly.

(6) Remove nut (35), spacer (40), and valve disc (30) from shaft (55).

(7) Slide piston (45) off shaft (55); then, remove piston rings (50) from grooves in piston (45).

(8) Remove helical compression spring (60) and spring seat (65) from valve body (85).

(9) Do not remove identification plate (70) or screws (75) unless identification plate has been damaged or is illegible.

(10) Do not remove bearing ball (80).

CLEANING

1. General

Solvents and materials required for cleaning are listed in Figure 401. Clean according to procedures in paragraph 2.

Brush, Soft Bristle	Commercially Available
Wipers, Cotton	Commercially Available
Solvent, 1,1,1 Trichloroethane Technical Inhibited (Federal Specification O-T-620C)	Commercially Available
NOTE: Equivalent substitutes may be used for above items.	

Cleaning Materials
Figure 401

2. Cleaning

WARNING: USE SOLVENT IN WELL VENTILATED AREA AND AVOID BREATHING FUMES. KEEP SOLVENT AWAY FROM OPEN FLAME.

A. Clean all metallic parts except solenoid (5, Figure 1001) by immersion in grease dissolving solvent using a small brush with the solvent to loosen accumulation of foreign matter.

WARNING: DO NOT DIRECT COMPRESSED AIR AGAINST SKIN.

CAUTION: AFTER CLEANING AND AIRBLOWING PARTS DRY, ALLOW PARTS TO COME UP TO ROOM TEMPERATURE. THIS IS NECESSARY TO REMOVE THE FILM OF MOISTURE THAT MAY CONDENSE ON SURFACES DUE TO THE COOLING EFFECT OF AIRBLOWING DRY.

B. Dry parts with compressed air at 30 pounds per square inch gage (207 kilopascals gage) maximum.

CHECK

1. General

Visually check all parts for obvious wear, corrosion, or damage. Repair or replace defective parts. Perform detailed checks of parts according to paragraph 2, Check Notes. Refer to FITS AND CLEARANCES for summarized check procedures.

2. Check Notes

Note 1: Check threaded parts for stripped threads, cross-threading, and wear.

Note 2: Check all parts for damage or deformation.

Note 3: Check seating surface of valve disc (30, Figure 1001) to assure that surface is not damaged in any way that would prevent tight sealing.

Note 4: Check that assembled shaft (55), piston (45), and piston rings (50) slide freely in valve body (85).

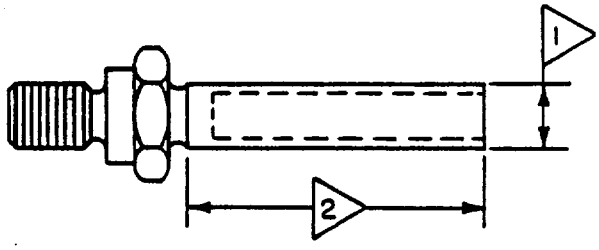
Note 5: Check piston rings (50) according to FITS AND CLEARANCES.

Note 6: Check diameter and hard chrome plating of shaft (55) according to Figure 501. Replace shaft if it is worn below minimum diameter.

Note 7: Check for deformed spring (60). Spring may be dimensionally checked according to FITS AND CLEARANCES. Replace spring if defective.

Note 8: Check identification plate (70) for illegibility and damage. If it is illegible or damaged refer to REPAIR.

Note 9: Check valve body (85) according to Figure 502.



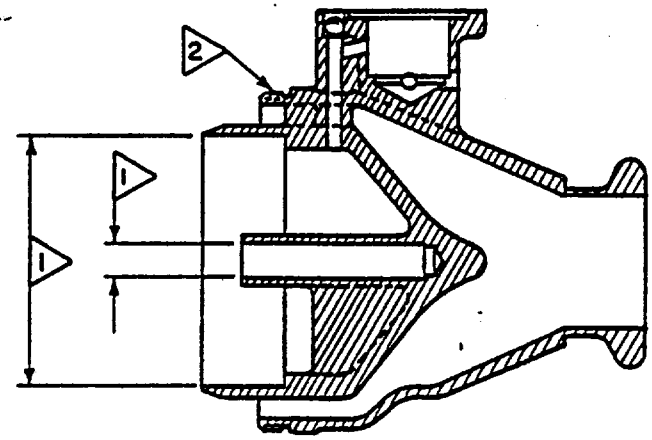
A-20144

NOTES AND DIMENSIONS

1 Noted diameter shall be 0.245 inch (6.223 millimetres) minimum.

2 Check hard chrome plating over this area for wear.

Check of Shaft 25816570
Figure 501



A-21043-1

NOTES

1 Inspect noted bores. If metallic surface of bores is scored, replace the valve body. If dry-film lubricant is worn evenly through to the metal, reapply dry-film lubricant according to instructions in REPAIR or replace the valve body.

2 Inspect noted threads. If dry-film lubricant is worn through to the metal, reapply dry-film lubricant according to instructions in REPAIR or replace the valve body.

Check of Valve Body 26446031
Figure 502

REPAIR

1. General

Repair procedures are provided in this section in the form of text. Materials required for repair are listed in Figure 601. Refer to FITS AND CLEARANCES for summarized repair procedures.

Adhesive Tape No. 202 (or equivalent)	3M Company 3M Center St. Paul, MN 55101
Aluminum Oxide Grit, 120 mesh MMS411	Commercially Available
Cloth, Crocus Abrasive	Commercially Available
Dry-film Lubricant 4396	Electrofilm Corp. 7116 Laurel Canyon Blvd. North Hollywood, CA 91605
Masking Tape No. 250 (or equivalent)	3M Company 3M Center St. Paul, MN 55101

Repair Materials
Figure 601

2. Repair Notes

Note 51: Remove minor nicks, surface scratches, or surface corrosion in ferrous parts, on other than microfinished surfaces, by polishing with crocus abrasive cloth. (Refer to Figure 601.)

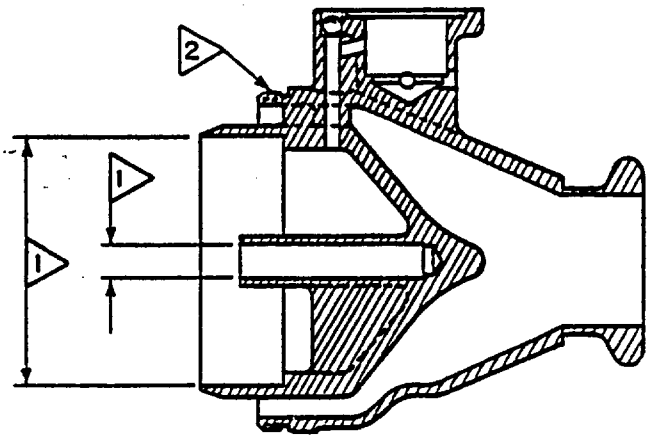
Note 52: If check reveals illegible or otherwise damaged identification plate (70, Figure 1001), prepare a new plate by vibro-etching the serial number and manufactured date (as it appears on old plate) on new plate.

Note 53: If check reveals worn dry-film lubricant, strip completely and reapply dry-film lubricant as follows:

CAUTION: TAKE SPECIAL PRECAUTIONS TO ASSURE THAT ALL HOLES AND DRILLED PASSAGES ARE PLUGGED OR OTHERWISE COVERED TO PREVENT CONTAMINATION WITH GRIT.

1. Refer to Figure 602. Using masking tape (refer to Figure 601) mask surfaces not to be gritblasted.

2. Gritblast surfaces to be coated using 120 mesh aluminum oxide, with low pressure compressed air, 10 to 15 pounds per square inch gage (69.0 to 103.5 kilopascals gage).



A-21043-1

NOTES

1. If dry-film lubricant is worn evenly through to the metal, reapply dry-film lubricant according to instructions in steps 1 through 8, or replace the valve body.

2. If dry-film lubricant is worn through to the metal, reapply dry-film lubricant according to instructions in steps 1 through 8, or replace the valve body.

Valve Body 26446031
Figure 602

CAUTION: WEAR CLEAN COTTON GLOVES TO HANDLE CLEANED PARTS. DO NOT HANDLE CLEANED PARTS WITH BARE HANDS AS SKIN OILS CAN CAUSE POOR ADHESION OF THE DRY-FILM LUBRICANT.

3. Remove masking tape.

4. Thoroughly clean parts. Refer to CLEANING.

5. Use masking tape to mask surfaces not to be coated with dry-film lubricant.

WARNING: PROLONGED BREATHING OF DRY-FILM LUBRICANT SOLVENT VAPORS OR CONTACT WITH SKIN IS HARMFUL. USE IN WELL VENTILATED AREA. PROTECT HANDS WITH RUBBER GLOVES.

CAUTION: IMPROPER APPLICATION OF DRY-FILM LUBRICANT ON PARTS MAY LEAD TO PREMATURE FAILURE OF THE VALVE.

6. Apply dry-film lubricant to parts with air brush as noted in Figure 602. Thin concentrate as prescribed by manufacturer for proper viscosity. Thickness of dry-film lubricant to be 0.00015 to 0.00040 inch (0.00381 to 0.01016 millimetres) with no runs or drips and a uniform appearance (color) when dry.

7. Remove masking material and cure dry-film lubricant in an air circulating oven at 375° Fahrenheit (191° Celsius) for 1-1/2 hours.

8. Visually inspect for smooth appearance, free of blisters, runs, or irregularities. There shall be no trace of grit, rough particles, or separation of ingredients. Scratches that have penetrated through to the pretreated surface of the base material shall be cause for rejection.

9. With parts at room temperature inspect for adhesion using the following method: firmly press a piece of adhesive tape onto the coated area covering a minimum of 1/2 square inch (12.7 square millimetres). Remove tape in an abrupt stripping motion and visually examine tape. The presence of traces of fine powdery material is acceptable: however, the presence of particles or flakes shall be cause for rejection.

10. Parts failing inspection shall be completely stripped and reworked according to steps 1 through 8. Touchup is not permissible.

11. Protect coated dry-film lubricated surfaces against rubbing or scratching.

ASSEMBLY

1. General

Assembly procedures are provided in this section in the form of text. When it is necessary, assembly illustrations are also provided. The item numbers in the assembly illustrations are identical to those in the ILLUSTRATED PARTS LIST. Materials required during assembly are listed in Figure 701. Refer to FITS AND CLEARANCES for summarized assembly procedures and torque values.

Lockwire, MS20995-C20 (0.020 inch, corrosion resistant steel)	Commercially Available
Silastic Compound P/N S-2007	Dow Corning Corp. S. Saginaw Rd. Midland, MI 68640

Assembly Materials
Figure 701

2. Assembly

A. Assemble shutoff valve as follows:

(1) Polish piston bore of valve body (85, Figure 1001) with a soft lint-free cloth.

(2) Apply silastic compound (refer to Figure 701) to threaded surface of valve body (85).

(3) Place spring seat (65) and helical compression spring (60) in valve body (85, Figure 1001).

(4) Assemble piston (45), valve disc (30), and spacer (40) on shaft (55) and secure with self-locking nut (35). Tighten self-locking nut (35) for 12 to 15 inch pounds torque.

(5) Install piston rings (50) on piston (45) and set piston ring gaps 180 degrees apart from each other.

(6) Insert piston (45), valve disc (30), spacer (40), shaft (55), piston rings (50), and self-locking nut (35) in valve body (85) as an assembly.

CAUTION: DO NOT ALLOW PISTON RINGS TO DISENGAGE FROM BORE DURING INSTALLATION OF FLANGE AND FITTING ASSEMBLY OR PARTS WILL BE DAMAGED.

(7) Assemble flange and fitting assembly (25) on valve body (85) and tighten for 70 to 80 foot pounds torque. Refer to Figures 901 and 902.

(8) Manually operate piston (45, Figure 1001) and check for smooth travel and unrestricted return to normal position.

WARNING: USE CARE HANDLING HEATED PARTS TO AVOID BURNS.

(9) Cure silastic compound by placing shutoff valve in an air circulating oven at 250° Fahrenheit (121° Celsius) for 3 hours.

(10) After shutoff valve has returned to room temperature, place large "O" ring (15) into recess in valve body (85) and small "O" ring (20) in groove around solenoid (5).

(11) Insert end of solenoid (5) into valve body (85) orienting solenoid connector toward outlet end of valve, and secure with screws (10). Tighten screws (10) evenly for 10 to 12 inch pounds torque.

(12) If removed, install identification plate (70) and secure with screws (75).

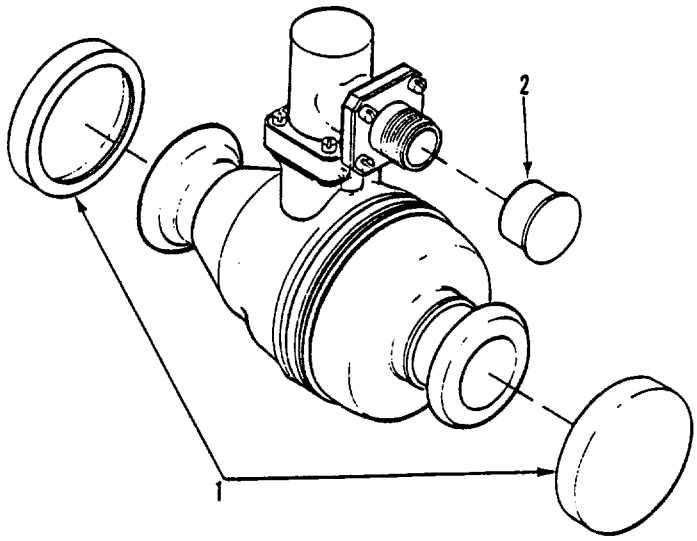
(13) Test the assembled solenoid according to TESTING AND TROUBLESHOOTING.

(14) Lockwire all external screws and other parts drilled for lockwire in accordance with MS33540 (refer to Figure 701). Location of lockwire is optional.

3. Storage After Assembly

A. Apply protective plastic covers on valve ports and electrical connector. (Refer to Figure 702.)

B. Seal valve in a dust and moisture proof bag and place in a paper or wooden box. Store in a dry location.



A-21045

FIGURE ITEM	PART NUMBER	NOMENCLATURE	UNITS PER ASSY
702 1	26226203-01	CAP - FLANGE PROTECTIVE	2
2	MS25178-12	CAP - DUST	1

Storage Parts
Figure 702

FITS AND CLEARANCES

1. General

This section contains fits and clearances data required for assembly and inspection. Where applicable, permissible wear tolerances are also included.

2. Fits and Clearances

A. Torque values are shown on summarized assembly view, Figure 804.

B. Spring specifications are listed in Figure 801.

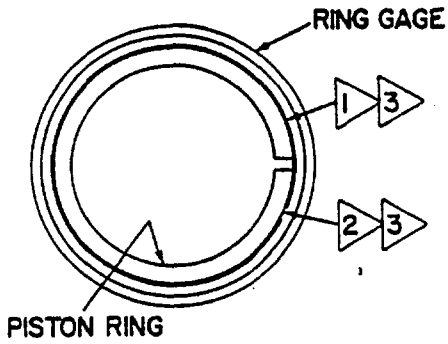
C. Determine light-tightness of piston rings (50, Figure 1001) when placed squarely in a 1.8765 inch (47.663 millimetres) diameter ring gage according to Figure 802.

D. A summary of disassembly and check information is shown in Figure 803. Notes 1 through 50 are keyed to check notes in CHECK. Notes 51 through 100 are keyed to repair notes in REPAIR.

E. A summary of assembly information including special assembly and reference to figures with FITS AND CLEARANCES is shown in Figure 804.

Item Number (IPL Fig. 1001)	Identifying Dimensions		Inspection Dimension
	Spring Diameter	Wire Diameter	Load/Height
60	0.750 ± 0.005 inch (19.05 ± 0.127 millimetres)	0.062 ± 0.005 inch (1.575 ± 0.127 millimetres)	5.960 ± 0.596 pounds (2.703 ± 0.270 kilograms) at 0.656 inch (16.662 millimetres) 2.490 ± 0.249 pounds (1.129 ± 0.113 kilograms) at 1.031 inches (26.187 millimetres) Solid compressed height shall be 0.562 inch (14.275 millimetres) maximum. Free length shall be 1.30 ± 0.13 inches (33.02 ± 3.302 millimetres)

Spring Specifications
Figure 801



A-21046

NOTES AND DIMENSIONS

1 Ring gage inside diameter.

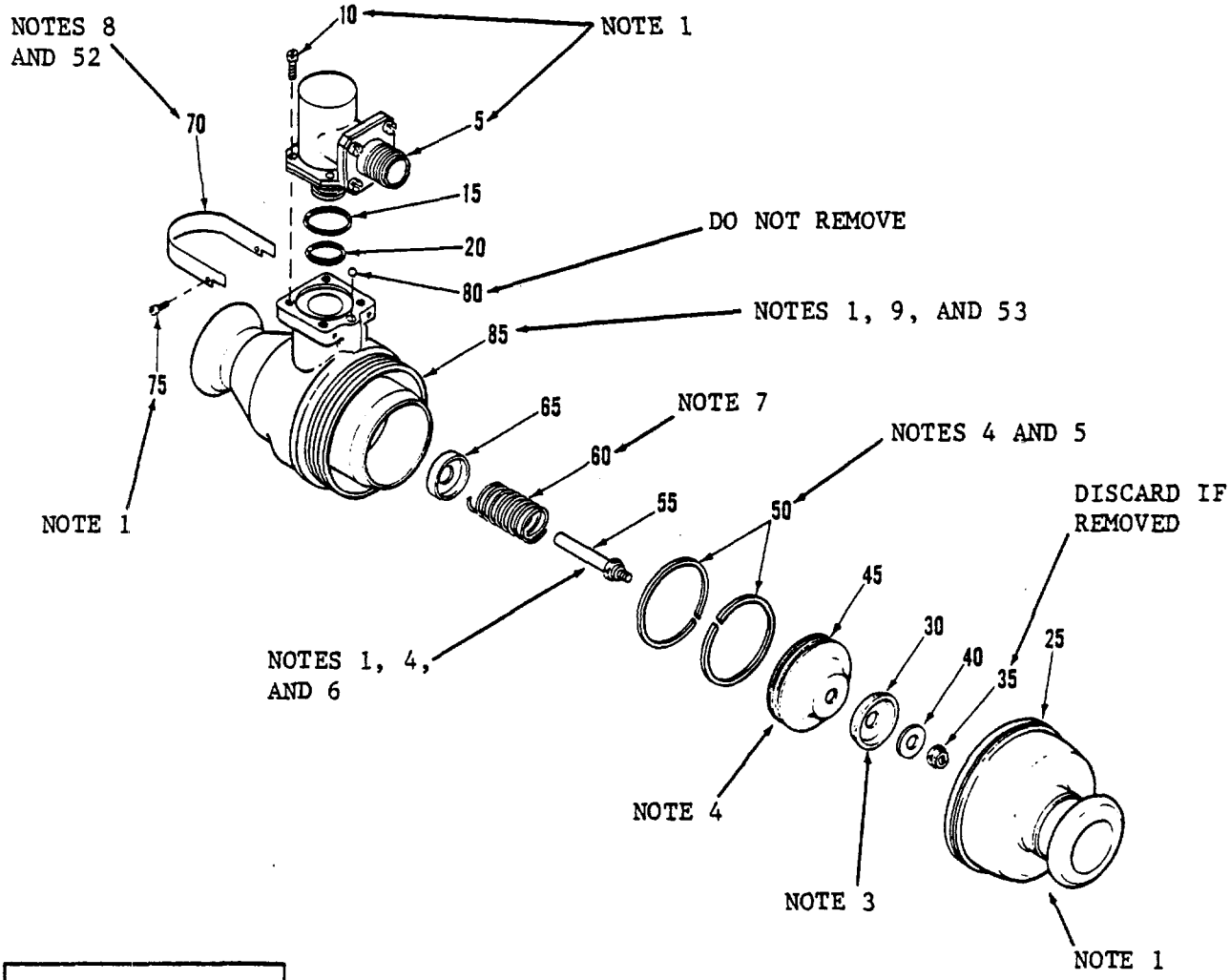
2 Piston ring outside diameter.

3 The fits between the dimensions noted by 1 and 2 shall be 75% light-tight. (75% of the ring circumference shall exclude the passage of light.)

Determination of Light-tightness
Figure 802

NOTE: REFER TO IPL FIGURE 1001 FOR ASSOCIATED PART NUMBERS.

CAUTION: WEAR EYE PROTECTION WHEN REMOVING LOCKWIRE.



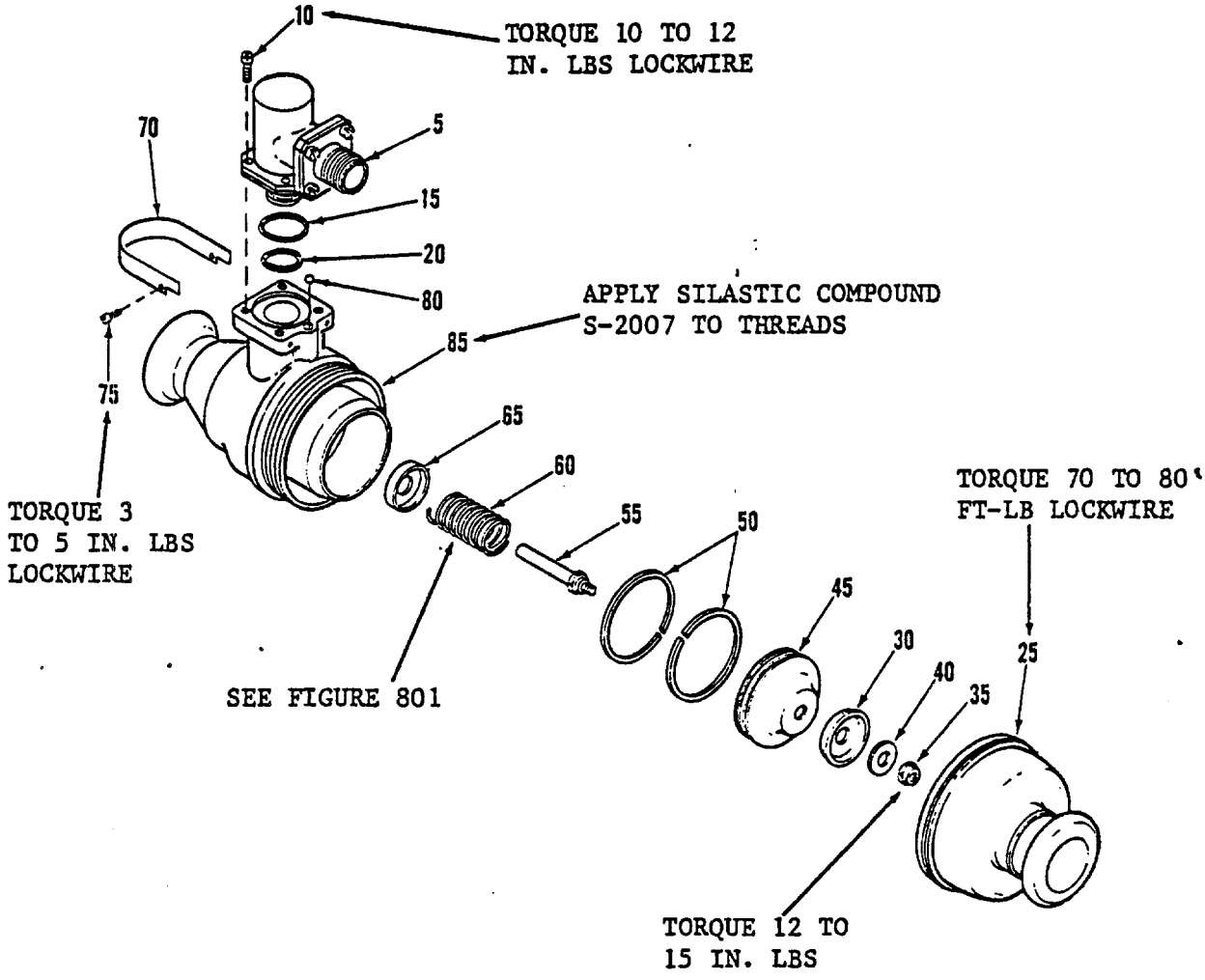
REPLACE "O" RINGS IF DISTURBED

REFER TO PAGE 501 FOR NOTES 1 THROUGH 9. REFER TO PAGE 601 FOR NOTES 52 AND 53.

A-21047

Summarized Information - Disassembly, Inspection and Repair of Shutoff Valve
Figure 803

NOTE: REFER TO IPL FIGURE 1001 FOR ASSOCIATED PART NUMBERS



Summarized Information - Assembly of Shutoff Valve
Figure 804

SPECIAL TOOLS, FIXTURES, AND EQUIPMENT

1. General

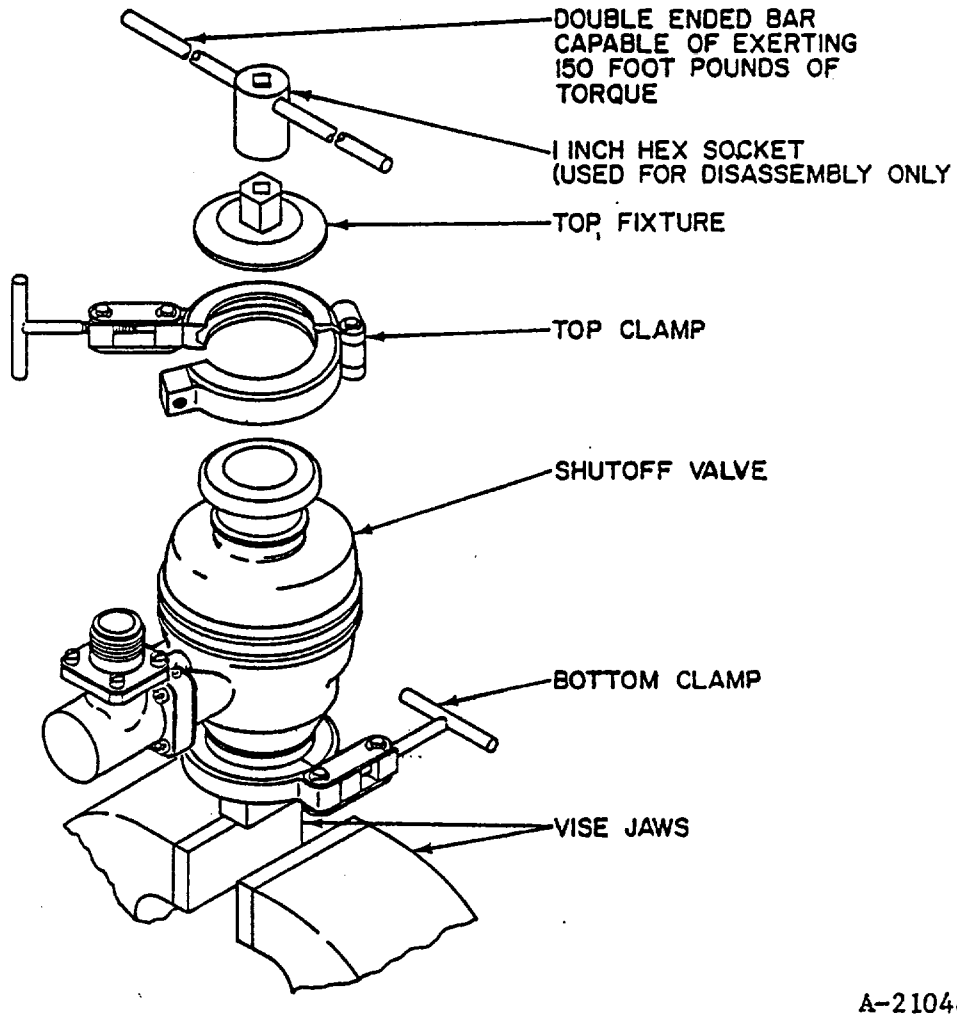
Special tools, fixtures and equipment required are listed in Figure 901.

2. Test Equipment

All general equipment required for testing is listed in TESTING AND TROUBLE-SHOOTING. The list includes information about equipment requirements, accuracy, and sources.

TOOL NUMBER	TOOL NAME	TOOL USE
CES-20611	Top Clamp and Fixture Assembly	Used to separate during disassembly, and torque during assembly the flange and fitting assembly and valve body.
CES-20612	Bottom Clamp	

Special Tools, Fixtures, and Equipment
Figure 901



Disassembly and Assembly Tools in Use
Figure 902

ILLUSTRATED PARTS LIST

1. Introduction

This Illustrated Parts List contains a Detailed Parts List and a breakdown of the equipment that illustrates, lists, and describes all assemblies and subassemblies that can be disassembled, reassembled, or replaced.

A. Detailed Parts List

(1) Order of Listing. The Detailed Parts List consists of illustrations and associated columnar listings of parts arranged in the sequence of disassembly. Attaching parts are listed following the items attached and are preceded by the words (Attaching Parts). A separation symbol (***) is used to indicate the end of each attaching part group.

(2) Figure and Item Number Column. Figure and item numbers are separated by a blank space. The figure (or illustration) number is shown only at the beginning of each page. Since index numbers are assigned to all parts, some parts that are not illustrated will be listed with a dash before the index number to indicate they are not illustrated.

(3) In general, identical parts occurring in the same general location in the equipment are illustrated and indexed only once. Then identical parts in the same assembly, removed at the same time, are illustrated for clarity only. One index number will be assigned. Where necessary to indicate disassembly sequence, identical parts will be assigned different index numbers.

(4) Part Number Column. Part numbers are used to identify all items listed. Government standard part numbers are listed when applicable. All other part numbers are those of the design manufacturer, either the prime contractor or a vendor, as applicable. If the item is a vendor part, code is inserted in parentheses following the description of the part (refer to paragraph 6).

(5) Nomenclature Column. The Description Column contains the design manufacturer's drawing nomenclature, plus modifiers and additional description as required to identify the item.

(6) All manufacturer's code numbers are cross referenced to manufacturer's (vendor's) in Figure 1101. The absence of a code following a part, other than a government standard part in the nomenclature column, indicates that the part is manufactured by Sundstrand Aviation Mechanical, Unit of Sundstrand Corporation, 4747 Harrison Avenue, Rockford, Illinois 61101 USA.

(7) The description is indented to show relationship of parts, the indent code being shown at the top of the column. The first position (no indentation) is reserved for the first item in a list; this may be the end article assembly or subassembly. Second position (indent 1) items will either be detail parts of the first position item or lower order assemblies (or subassemblies). Each group of items with greater indentation will always be a part of a preceding item with one less indent. This system follows drawing relationship and provides rapid determination of the parts comprising an assembly, or the next higher assembly for any particular part. In scanning for item relationship, remember that attaching parts follow the part attached and threrfore an attaching part group may precede the breakdown of an assembly.

(8) When a separate illustration and list are used for the breakdown of an assembly, the initial listing of the item will refer to the applicable illustration and list by figure number. Regardless of the indent number of the initial listing, the item will be listed in the first position in the separate breakdown as a convenience in preparing the list.

(9) The Effect Code Column. This column shows differences between two or more similar units or assemblies listed together in the same parts list. Parts not used in all of the units of assemblies bear the code letter or letters for the particular unit or assembly in which the parts are located. When the column is blank, the part is used in all of the units of assemblies listed together.

(10) Units Per Assembly Column. With the exception of attaching parts, this column contains the number of units required per assembly, or per subassembly, as applicable. If more than one assembly is required, the total used is shown. When the same item in the same location is listed a second time, one listing will show the quantity in the Units Per Assembly column, and the other listing will show the abbreviation "RF" in the Units Per Assembly column, indicating that reference must be made to the other listing for units per assembly. The quantities shown for attaching parts are per part attached.

B. Numerical Index

The Numerical Index has been omitted because of the small number of parts in the Detailed Parts List.

2. How to Use the Illustrated Parts Breakdown

A. If the part number is not known, but its location, index number or shape are known, proceed as follows:

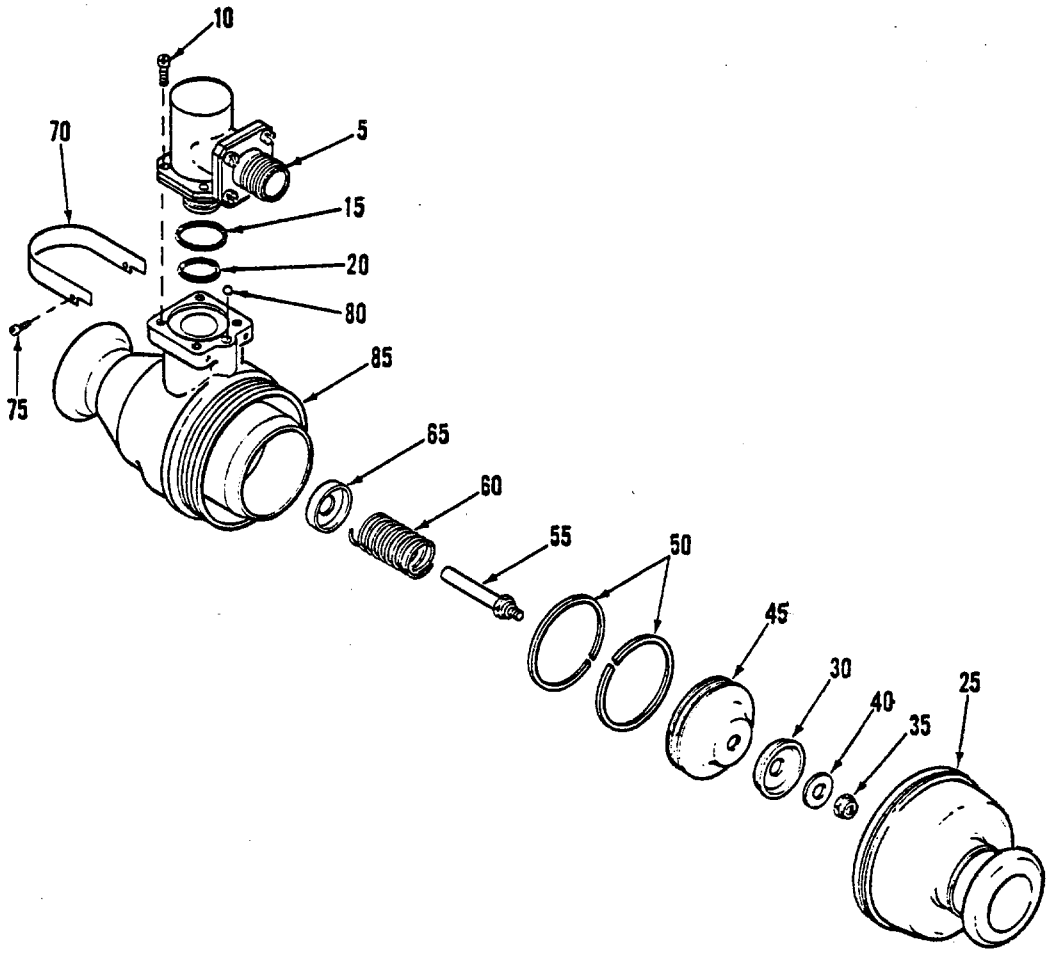
(1) Turn to figure and locate the desired part on the illustration.

(2) From the illustration, obtain the index number assigned to the part desired. Refer to the accompanying description in the Detailed Parts List for specific information regarding the part.

B. If the part number is known, but its location, index number or shape are not known, proceed as follows:

(1) Turn to the Detailed Parts List and locate the desired part number.

(2) From the FIG. ITEM column, note the Illustrated Parts List figure and index number. The location of the part may be determined by locating the index number in the illustration.



Shutoff Valve
Figure 1001

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY.
1001 -1	26440051	VALVE - SHUTOFF		RF
5	26430063	. SOLENOID		1
		ATTACHING PARTS		
10	AN500AC4-6	. SCREW - MACHINE		4
		***		
15	25716068	. "O" RING		1
20	25626545-01	. "O" RING		1
25	27529146	. FLANGE AND FITTING ASSEMBLY		1
30	25816571	. DISC - VALVE		1
		ATTACHING PARTS		
35	AN363C428	. NUT - SELF-LOCKING		1
		***		
40	25716061	. SPACER		1
45	25926062	. PISTON		1
50	25916207	. RING - PISTON		2
55	25816570	. SHAFT		1
60	25816572	. SPRING - HELICAL COMPRESSION		1
65	25816578	. SEAT - SPRING		1
70	26426203	. PLATE - IDENTIFICATION		1
		ATTACHING PARTS		
75	26226236	. SCREW - SELF-TAPPING		2
		***		
80	25816010-08	. BALL - BEARING		1
85	26446031	. BODY - VALVE		1

- ITEM NOT ILLUSTRATED

WHITTAKER CONTROLS
A Unit of Whittaker Corporation
12838 SATICOY STREET • NORTH HOLLYWOOD, CALIFORNIA • TELEPHONE: 818/765-8160 • CAGE CODE: 79318

Component Maintenance Manual With Illustrated Parts List

SOLENOID VALVE

PART NUMBERS:
320295
320295-1

75-10-02

PAGE T-1/2
ORIGINAL – AUG 31/79
REVISION 1 – FEB 1/98

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3	Disassembly	301
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8	Fits and Clearances	801
9	Special Tools, Fixtures, and Equipment	901
10	Illustrated Parts List	1001

WHITTAKER CONTROLS

A UNIT OF WHITTAKER CORPORATION
COMPONENT MAINTENANCE MANUAL
320295

REVISION RECORD

Keep this record in the front of the manual. When you get the revisions, put the revised pages in the manual. Write the revision number, the date issued, the date inserted, and your initials below.

REVISION NUMBER	ISSUE DATE	DATE REVISION INSERTED	BY (INITIALS)
1	Feb 1/98		

WHITTAKER CONTROLS

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REVISION NUMBER	DATE ISSUED	DATE INSERTED	DATE REMOVED	INCORPORATOR'S INITIALS	REMOVER'S INITIALS

WHITTAKER CONTROLS

A UNIT OF WHITTAKER CORPORATION
COMPONENT MAINTENANCE MANUAL
320295

TO: HOLDERS OF WHITTAKER CONTROLS MANUAL 75-10-02, SOLENOID VALVE, PART NUMBER 320295, COMPONENT MAINTENANCE MANUAL WITH ILLUSTRATED PARTS LIST DATED AUG 31/79

REVISION NUMBER 1 DATED FEB 1/98

HIGHLIGHTS

Pages which have been added or revised are outlined below together with the highlights of the revision. Remove and insert the affected pages as listed and enter date inserted and your name on the Revision Record page.

CHAPTER/SECTION AND PAGE NO.	DESCRIPTION OF CHANGES
75-10-02	Added coverage for Part Number 320295-1.
Page 1005	Added coverage of the parts necessary for support of Part Number 320295-1 and effectivity codes indicating the applicability of the parts to the next higher assembly versions. Added Item 55A.

WHITTAKER CONTROLS

A UNIT OF WHITTAKER CORPORATION
COMPONENT MAINTENANCE MANUAL
320295

SERVICE BULLETIN LIST

Following is a list of Service Bulletins, applicable to this manual, issued by Whittaker Controls. The Service Bulletins are shown by the date of incorporation in the manual..

SERVICE BULLETIN	TITLE	ISSUE DATE	DATE INCORP-ORATED	BY (INI-TIALS)

WHITTAKER CONTROLS

A UNIT OF WHITTAKER CORPORATION
COMPONENT MAINTENANCE MANUAL
320295

LIST OF EFFECTIVE PAGES

SUBJECT	PAGE	DATE
Title Page	T-1/2	Feb 1/98*
Revision Record	RR-1/2	Feb 1/98*
Temporary Revision Record	TRR-1/2	Feb 1/98*
Service Bulletin List	SBL-1/2	Feb 1/98*
List of Effective Pages	LEP-1/2	Feb 1/98*
Table of Contents	TC-1/2	Aug 31/79
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	604	Aug 31/79
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	702	Aug 31/79
	703/704	Aug 31/79
Fits and Clearances	801	Aug 31/79
	802	Aug 31/79
Special Tools, Fixtures and Equipment	901/902	Aug 31/79
Illustrated Parts List	1001	Aug 31/79
	1002	Aug 31/79
	1003	Aug 31/79
	1004	Aug 31/79
	1005/1006	Feb 1/98*

Revision 1 ..... Feb 1/98
Original ..... Aug 31/79

* Indicates pages which were revised or added by Revision 1.

INTRODUCTION

This manual provides procedures that will enable the technician to restore the equipment to a usable condition. The procedures in this manual are presented for use by the technician performing shop work, and not for the aircraft mechanic.

Corrective maintenance in this manual is based primarily in connection with correcting malfunctions that occur during test and assembly checkout operations.

1. Description and Operation

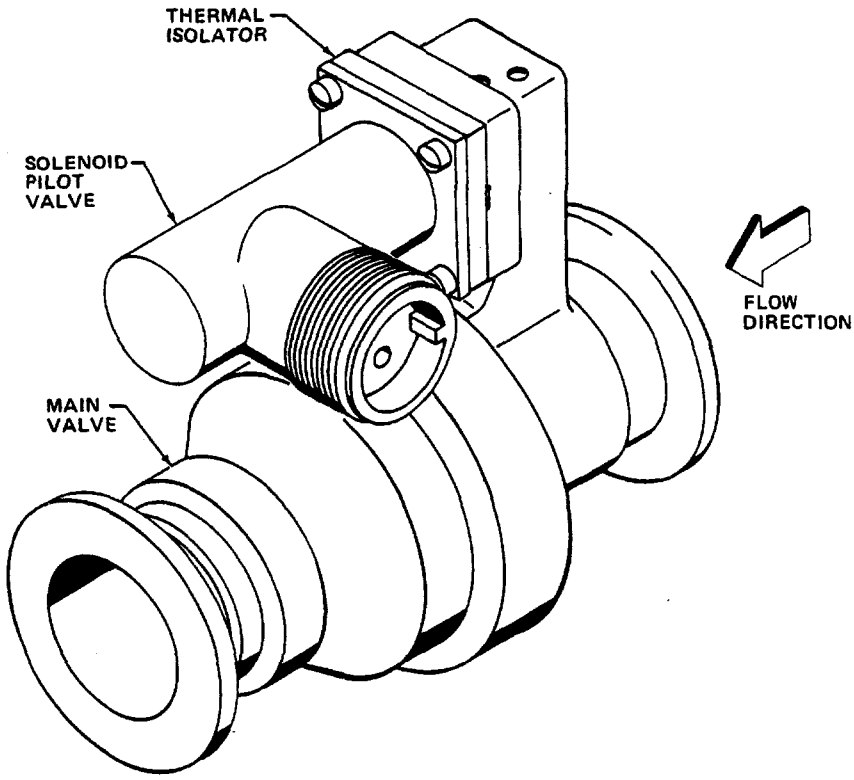
A. Description (Ref Fig. 1)

(1) The Solenoid Actuated (Pilot) Poppet Shutoff Valve (hereinafter called the "valve") is a two position valve, used in a turbine engine bleed air system. The valve is essentially a poppet-type, two position main valve controlled by a solenoid operated two position, three-way pilot valve.

(2) The valve inlet and outlet ports are designed for "V"-band couplings, with flanges in accordance with Marman Division, Aeroquip Corporation, Specification MFM 68660-100.

(3) The electrical connector on the solenoid valve is designed to mate with an MS3106-12S-3S electrical plug.

(4) The main valve housing, poppet, and flange are manufactured from 17-4 PH CRES, passivated per Whittaker requirements. The solenoid stem is made from CRES, Rc35 minimum harness, with no plating. The piston OD of the poppet is chrome plated.



Valve - General Arrangement
Figure 1

(5) A thermal isolator (Mykroy-1100 or Supramica-1100) between the solenoid and main valve housing gives the solenoid thermal protection from the heat (engine bleed air) to which the main valve is exposed.

(6) The seat in the pilot valve (ball seat) is made from CRES 316, 321, or 347; per QQ-S-763, and is ball-lapped for minimum leakage.

(7) The main valve poppet spring is made from Inconel X-750 per AMS 5699, and passivated per Whittaker requirements.

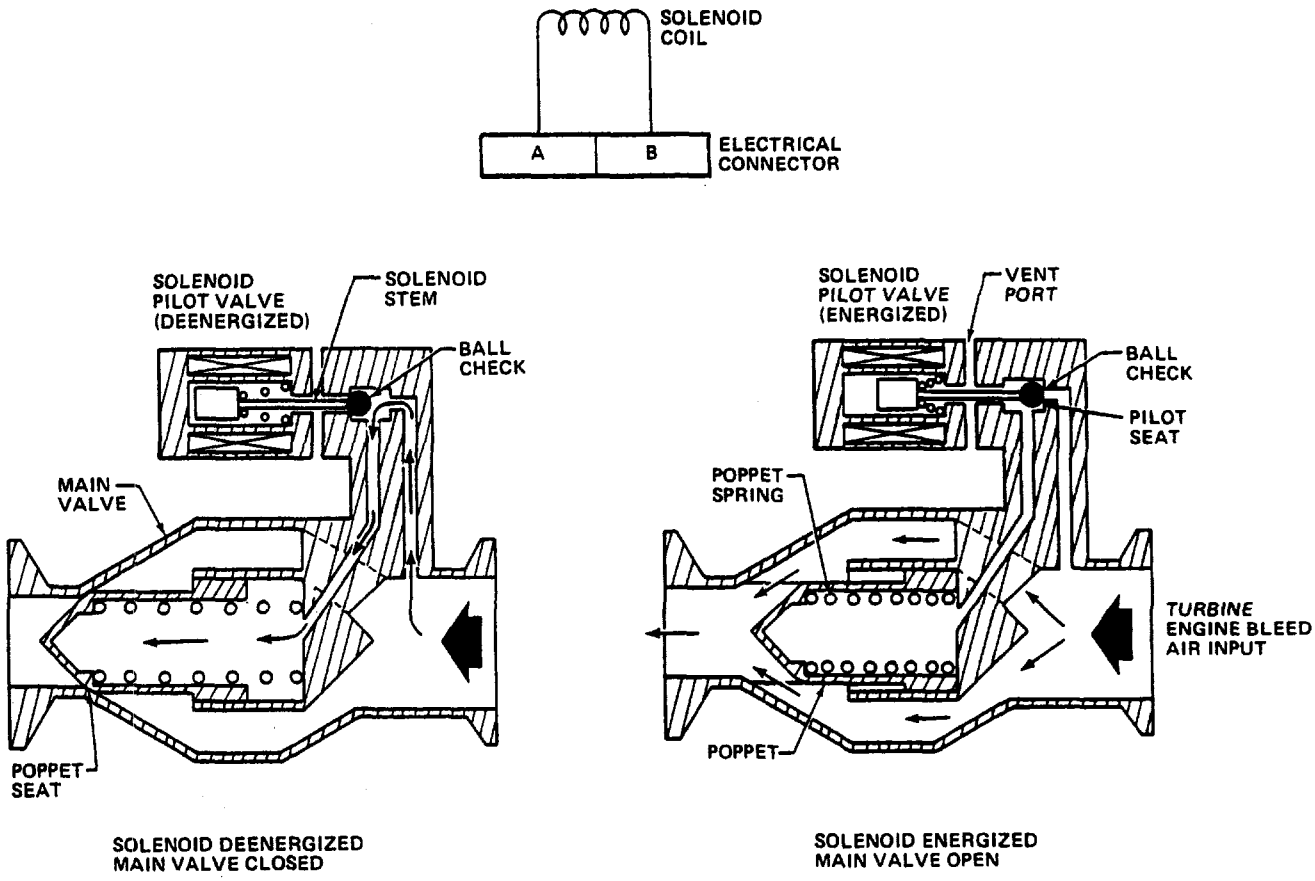
(8) The two piston rings for the main valve poppet are carbon ACF-10QE, and maintained in contact against the main valve housing by means of a CRES 301 or 302 expander, hardened per QQ-S-766, and passivated per Whittaker requirements.

B. Operation (Ref Fig. 2)

(1) The valve has two positions: open and closed. Valve position is controlled by the solenoid pilot valve and applied turbine engine bleed air pressure. When the solenoid is deenergized, the main valve is closed; when the solenoid is energized, the main valve will start to open when turbine engine bleed air pressure reaches 3 psig, and will reach full open when turbine engine bleed air pressure reaches 5 psig. At pressures above 5 psig, the main valve will be maintained in the open position. If turbine engine bleed air pressure subsequently drops below 5 psig, the main valve will begin to close, reaching full closed when turbine engine bleed air pressure drops below 3 psig.

(2) In the solenoid deenergized condition, the main valve poppet is held closed by the internal spring, plus any inlet pressure that reaches the interior of the poppet from the pilot valve. If there is no inlet pressure to the main valve, the ball check in the pilot valve will effectively be free, and the poppet interior will be vented to atmosphere. If there is inlet pressure present, that pressure will push the ball check onto the pilot valve vent seat, and the inlet pressure will be applied to the interior of the poppet, increasing the effective seating force of the poppet on the poppet seat of the main valve.

(3) When the solenoid is energized (18 to 30 volts dc applied to the electrical connector of the solenoid), the solenoid coil assembly causes the stem of the solenoid to push the ball check off the vent port of the pilot valve, and to seat the ball check on the pilot seat. This action shuts off the input pressure (turbine engine bleed air pressure) to the interior of the main valve poppet, and vents the interior of the poppet to atmosphere, leaving only the poppet spring to hold the poppet closed on the main valve poppet seat. As turbine engine bleed air pressure



Flow and Electrical Schematics - Simplified
Figure 2

increases, that air pressure is applied to the effective flat plate area of the seating end of the main valve poppet; when the inlet pressure reaches 3 psig, the effective force on the seat end of the poppet is sufficient to begin overcoming the spring force applied to the closing side of the poppet, and the poppet begins to move away from the main valve poppet seat. When turbine engine bleed air pressure reaches 5 psig, the pressure applied to the poppet is sufficient to completely overcome the spring-load force, and the poppet will be moved to the main valve full open position. The poppet will stay in the valve open position as long as turbine engine bleed air pressure remains above 5 psig.

(4) With the pilot valve solenoid held energized, and on reducing turbine engine bleed air pressure to below 5 psig, the main valve poppet will begin to close, and the poppet spring force will be sufficient to completely close the main valve if the turbine engine bleed air pressure drops below 3 psig.

(5) With turbine engine bleed air pressure above 5 psig and the pilot valve solenoid energized, the main valve will remain open until the turbine engine bleed air pressure drops as just described. If the pilot valve solenoid is deenergized while the main valve is open, then the ball check will be pushed off the pilot seat and seated on the pilot vent seat, and the turbine engine bleed air pressure will be applied to the interior of the main valve poppet, adding to the poppet spring force and closing the main valve poppet.

C. Leading Particulars

Service . . . . . Turbine Engine Bleed Air
Performance Data:
Flow . . . . . In direction shown on Fig. 1
Operating Pressure . . . . . 3 to 175 psig
Leakage:
Internal. . . . . 0.2 pound per minute maximum
External. . . . . 0.05 pound per minute maximum
Operating Time:
Open . . . . . 1 second maximum
Close . . . . . 1 second maximum
Temperature:
Ambient. . . . . -65°F to +300°F (-53.9°C to +148.9°C)
Bleed Air. . . . . +650°F (+343.3°C) maximum
Electrical Data:
Voltage. . . . . 18 to 30 volts dc, continuous duty solenoid
Current. . . . . 1.5 amperes maximum operating current
Installation Data:
Valve Ports. . . . . "V"-Band coupling. Flanges per Marman Division, Aeroquip Corporation, Specification MFM 68660-100
Electrical Connector . . . . . Mates with MS3106-12S-3S plug
Operation:
Open . . . . . Energize solenoid; valve starts to open at 3 psig; full open at 5 psig
Close . . . . . Deenergize solenoid
Weight (calculated) . . . . . 1.40 pounds

2. Testing and Troubleshooting

NOTE: If the valve passes the tests in the following paragraphs prior to disassembly, return to service.

A. Test Equipment and Materials

NOTE: Equivalent substitutes may be used for the items listed below.

Equipment/Materials	Description
Pressure Source	Capable of supplying air pressure at 0 to 300 psig, at a temperature of +70 ±20°F (+21.1 ±11.1°C) and filtered to 10 microns.
Inlet Pressure Gage (proof test)	0 to 1000 psig; accuracy ±2% of full scale.
Inlet Pressure Gage (other tests)	0 to 300 psig; accuracy ±0.5% of full scale.
Downstream Pressure Gage	0 to 300 psig; accuracy ±0.5% of full scale.
Flowmeter (leakage tests)	0 to 0.25 pound per minute; accuracy ±0.5% of full scale.
Voltmeter (electrical tests)	0 to 50 volts dc; accuracy ±0.2% of full scale.
Ammeter (current tests)	0 to 5 amperes dc; accuracy 0.5% of full scale.
Electrical Power Supply	12 to 30 volts dc, adjustable; current capability is 1.5 amperes.

B. Test Conditions

(1) The following tests may be accomplished under normal shop ambient conditions.

C. Operational Tests and Troubleshooting

(1) Proof Test

(a) Connect air pressure source to both inlet and outlet ports of main valve.

(b) With solenoid deenergized, simultaneously apply 290 to 300 psig to the main valve inlet and outlet ports, and maintain pressure for one minute; then, reduce pressure to zero.

(c) There shall be no evidence of failure, distortion, or permanent set. If any malfunctions are observed, replace defective component(s).

(2) Actuation Test

(a) Connect valve into test setup (Ref Fig. 101).

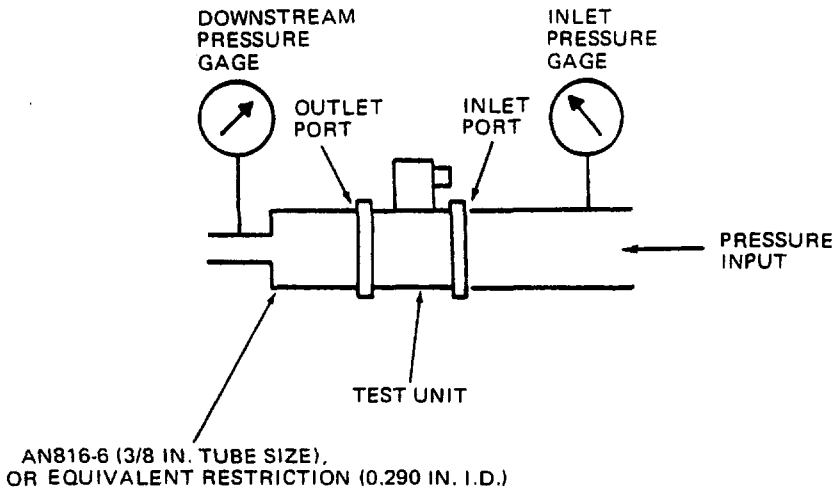
(b) Connect 12 to 30 volt dc electrical power supply to solenoid connector. Set power supply at 12 to 13 volts dc.

(c) With solenoid energized, slowly increase inlet port pressure, starting from zero psig, until the valve opens (as evidenced by flow from outlet port); opening pressure shall be a maximum of 5 psig. Reduce pressure to zero psig and deenergize solenoid.

(d) Repeat step (c) three times.

(e) If valve fails to open on increasing pressure with solenoid energized, check the following:

Possible Cause	Remedy
Solenoid not energized	Check external power supply.
Solenoid defective	Replace solenoid assembly.
Ball check stuck	Replace ball in pilot valve.
Poppet stuck in main valve (poppet must move freely in main valve flange without sticking or binding)	Check poppet; replace if defective. Make sure piston rings are not damaged. Make sure bore of valve flange not damaged, preventing poppet motion; replace if defective. Check poppet is lubed sparingly (Ref Assembly, paragraph 7, for lubrication details).
Defective piston rings on poppet (excessive leakage into poppet)	Replace piston rings and expander.



Test Setup - Typical
Figure 101

(f) If opening pressure is too low or too high, but valve does open, check that poppet spring is not broken (too low opening pressure) or cocked, stuck, or otherwise applying too much force (opening pressure too high). Replace if defective.

(g) Raise inlet pressure to 5 psig, and energize solenoid with 12 to 13 volts dc; valve shall open within one second. Deenergize solenoid; valve shall close within one second. Reduce inlet pressure to zero psig.

(h) Repeat step (g) at 25 psig, 90 psig, 130 psig, and 175 psig; same requirements must be met.

(2) Current Drain Test

(a) Energize solenoid by applying 29 to 30 volts dc to solenoid connector pins.

(b) Check that solenoid current drain does not exceed 1.5 amperes.

(c) If current drain is excessive, check for shorts in wiring leading from electrical power supply to solenoid electrical connector; correct test wiring as necessary. If wiring is satisfactory, excessive current drain may be caused by a faulty solenoid assembly; replace defective solenoid assembly.

(4) Internal Leakage Test

(a) Connect valve in test setup (Fig. 101), with a flowmeter connected downstream of the outlet port of the valve under test.

(b) With solenoid deenergized, slowly increase inlet pressure from zero psig to 175 psig, and measure internal leakage indicated on flowmeter.

(c) Internal leakage through valve shall not exceed 0.2 pounds per minute at inlet pressure from 5 to 175 psig.

(d) If internal leakage is excessive, check the following:

Possible Cause	Remedy
Poppet not seating on poppet seat of main valve flange	Poppet stuck; free up as may be necessary.
	Flange not smooth for poppet travel; repair or replace as necessary. Make sure poppet is properly lubed.
	Check seat end of poppet; repair or replace if nicked, scored, or damaged.
	Check poppet seat on flange; repair or replace as necessary.
	Check poppet spring not cocked, broken, or weakened; replace if defective.
Solenoid in energized position	If solenoid stuck open; free or replace. Make sure solenoid stem is not stuck, holding ball check partially off vent seat or against pilot seat in main valve housing (signaling poppet to open).

(5) External Leakage Test

(a) Block outlet port of valve under test.

(b) Connect inlet port of valve under test to air pressure source, with flowmeter installed upstream from valve.

(c) With solenoid deenergized, raise pressure at inlet port to 5 psig, and measure external leakage (total leakage indicated on upstream flowmeter. Reduce inlet pressure to zero.

(d) Repeat step (c), except raise pressure to 175 psig.

(e) Repeat steps (c) and (d), except with solenoid energized with 12 to 13 volts dc.

(f) The external leakage measured during each of the preceding tests shall not exceed 0.05 pound per minute.

(g) If external leakage is observed in both the solenoid energized and deenergized conditions:

Possible Cause	Remedy
Poor seal between flange and main valve housing	Check with soap solution under pressure. If leakage is observed, disassemble and repair or replace the defective component. Particularly check condition of mating surfaces. Make sure threads are properly lubricated before reassembling.
Ball in pilot valve not seated (leakage out pilot vent port)	Check pilot vent port for leakage (use soap solution or listen for audible noise).

(h) If external leakage is observed only with solenoid deenergized (leakage within limits when solenoid is energized):

Possible Cause	Remedy
Solenoid stem may be stuck partially extended, holding ball check off seat.	Check solenoid; replace if defective.
Defective pilot vent port seat.	Check for damage to ball-lapped seat; repair or replace if defective. Make sure seat is not leaking past threads.

(i) If external leakage is observed only with solenoid energized (leakage within limits when solenoid is deenergized):

Possible Cause	Remedy
Solenoid stem may not be seating ball check on pilot seat.	Check solenoid stroke; make sure ball is not stuck, and that seat on housing is not damaged; repair or replace defective components.
Leakage past piston rings may be excessive.	Check for air leakage out of pilot vent port with solenoid energized; this can be piston ring leakage and/or ball check leakage (see above); replace defective components.

3. Disassembly

NOTE: See Testing and Troubleshooting, paragraph 2, to establish the condition of the unit or the most probable cause of malfunction. This is to determine the extent of disassembly required without completely tearing down the unit.

A. Disassemble the valve as follows (Ref IPL Fig. 1):

(1) If installed, remove closures (75) from ports of valve.

(2) If installed, remove closure (70) from electrical connector of solenoid assembly (5).

(3) Remove four screws (10), and separate solenoid assembly (5) from housing assembly (65).

(4) Remove any installed washers (15, 16, 17) from solenoid assembly (5) or housing assembly (65). Tie washers together to retain previously established shim thickness to facilitate later reassembly.

(5) Remove thermal isolator (20) from housing assembly (65).

(6) Unscrew seat (25) from housing assembly (65).

NOTE: The seat (25) is bonded to the housing assembly with sealing compound during assembly; some slight resistance may be encountered when breaking this seal in order to unscrew the seat from housing assembly (65).

(7) Remove any installed washers (30, 31, 32) from seat (25) or housing assembly (65). Tie washers together to retain previously established shim thickness to facilitate later reassembly.

(8) Hold housing assembly (65) with port for solenoid assembly (5) down, and allow ball (35) to fall out of housing assembly.

(9) Unscrew flange (40) from housing assembly.

CAUTION: THE POPPET (45) IS SPRING-LOADED INSIDE THE HOUSING ASSEMBLY (65) TO CAUSE IT TO SEAT ON THE FLANGE (40). USE CARE WHEN THE FLANGE FINALLY SEPARATES FROM THE HOUSING ASSEMBLY TO PREVENT THE POPPET FROM BEING FORCIBLY EJECTED FROM THE VALVE, AND POSSIBLY FALLING AND BEING DAMAGED. IF CARE IS TAKEN TO RESTRAIN ANY SUDDEN SEPARATION OF THE FLANGE AND HOUSING ASSEMBLY, THE POPPET WILL BE HELD INSIDE THE FLANGE AT SEPARATION, AND THE SPRING WILL BE RETAINED INSIDE THE FLANGE OR HOUSING ASSEMBLY.

(10) Remove poppet (45) from flange (40), and remove spring (50) from poppet or housing assembly (65).

(11) Remove two rings (55) and expander (60) from ring groove of poppet (45).

4. Cleaning

A. Cleaning Materials

NOTE: Equivalent substitutes may be used for the items listed below.

Solvent, Cleaning (P-D-680)	Commercially Available
Cloth, Lint-free	Commercially Available
Brush, Stiff Bristle	Commercially Available

B. Cleaning Procedure

WARNING: SOLVENT MAY BE TOXIC. USE ONLY IN A WELL-VENTILATED AREA. AVOID PROLONGED INHALATION OF FUMES AND DIRECT CONTACT WITH SKIN. USE NECESSARY FIRE PRECAUTIONS. DO NOT DIRECT COMPRESSED AIR AGAINST SKIN.

(1) Immerse and wash all metallic parts in solvent.

(2) Dry all parts thoroughly with a clean, lint-free cloth, or use low-pressure air blast (20 psig maximum nozzle pressure).

(3) Use a stiff bristle brush to dislodge stubborn dirt and other material accumulations in threads and cavities.

(4) Place cleaned parts in a dust-proof container until ready for check and reassembly.

5. Check

A. Equipment Required

NOTE: Equivalent substitutes may be used for the equipment listed below.

Insulation Resistance Tester (500 volts dc; to 100 megohms)	Commercially Available
Dielectric Tester. (600 volts rms, 60 Hz; leakage current to 1.5 milliamperes)	Commercially Available

B. General

(1) A preliminary check of parts before initial cleaning may facilitate the location of obvious defects.

(2) Visually check all hardware and piece parts using a strong light and preferably some means of magnification, and note any nicks, cracks, cuts, corrosion, excessive wear (see NOTE), and any other obvious defects that can impair the efficient and proper operation of the valve.

NOTE: Excessive wear shall be defined as any obvious deformation or deterioration of a part which may render the part inoperative. If doubt exists concerning the serviceability of a part, replace the part.

C. Detail Checks (Ref IPL Fig. 1)

(1) Solenoid Assembly (5)

(a) Threads clean and undamaged.

(b) Electrical connector terminals clean and undamaged; no evidence of arc-over or burning.

(c) Apply 600 volts rms at 60 Hz between solenoid housing and connector terminals (bussed together); there shall be no evidence of breakdown or arc-over, and leakage current shall not exceed 1.5 milliamperes.

(d) Apply 500 volts dc between solenoid housing and connector terminals (bussed together); insulation resistance shall be at least 100 megohms.

(e) Check that at 0.025 inch stroke (minimum) of solenoid stem, the solenoid exerts a 16-pound push force (minimum) against the force of the solenoid return spring, with 12 to 13 volts dc applied (at room temperature).

(f) In the solenoid energized condition, the stem shall protrude from the solenoid (measured between the surface that contacts thermal isolator (20) or any installed shim washers and the exterior end of the stem) 0.520 to 0.522 inch.

(2) Thermal Isolator (20).

(a) Not cracked or broken.

(b) No visible burrs.

(3) Seat (25).

(a) Threads clean and undamaged.

(b) Seat for ball (35) lapped to 0.001 to 0.003 inch wide; smooth, and free of nicks, scratches, and corrosion.

(4) Flange (40).

(a) Threads clean and undamaged.

(b) Inside diameter for poppet (45) not worn over 0.9540 inch; smooth to 16 microinch rms finish.

(c) Seating surface for poppet (45) smooth and free of nicks, scratches, and corrosion; smooth to 32 microinch rms finish.

(5) Poppet (45).

(a) Chrome plating on outside diameters that ride inside flange (40) and housing assembly (65) not worn through to bare metal.

(b) Outside diameter that rides inside flange (40) free of nicks, scratches, and corrosion; not worn below 0.9483 inch; smooth to 32 microinch rms finish.

(c) Outside diameter that rides inside housing assembly (65) free of nicks, scratches, and corrosioh; not worn below 1.1545 inch; smooth to 32 microinch rms finish.

(d) Seat on poppet that contacts seating surface in flange (40) free of nicks, scratches, and corrosion; smooth to 32 microinch rms finish.

(6) Spring (50).

(a) Free length approximately 1.29 inches.

(b) Shall compress to 1.13 inches long under a load of 0.79 ±0.10 pound.

(c) Shall compress to 0.80 inch long under a load of 2.44 ±0.20 pounds.

(7) Housing Assembly (65).

(a) Threads clean and undamaged.

(b) Passages from inlet port to pilot valve section and from pilot valve section to poppet valve section clean and unobstructed.

(c) Inside diameter for rings (55) of poppet (45) free of nicks, scratches, and corrosion; not worn over 1.1575 inches; smooth to 16 microinch rms finish.

6. Repair

A. Repair Materials

NOTE: Equivalent substitutes may be used for the items listed below.

Crocus Abrasive Cloth (P-C-458). . . . . (for ferrous materials)	Commercially Available
Aluminum Oxide Abrasive Cloth (P-C-451). . . . . (for aluminum materials)	Commercially Available
Lapping Compound	Commercially Available
Tiodize No. 1175	Tiodize Company Inc. 15701 Industry Lane Huntington Beach, CA
Chrome Acid (Chromium Trioxide). . . . . Technical Grade (Fed Spec O-C-303)	Commercially Available
Sulphuric Acid, Technical Grade. . . . . (Fed Spec O-S-809A)	Commercially Available
Hydrochloric Acid (Muriatic) . . . . . Technical Grade (Fed Spec O-A-86)	Commercially Available
Manganesed-Phosopholine No. 7	Western Reserve Laboratories Cleveland, OH
Trichloroethylene or Perchloroethylene	Commercially Available

B. General Repairs

(1) Minor nicks, scratches, scoring, and corrosion may be removed from parts with the proper abrasive cloths.

(2) Thoroughly clean any repaired parts.

C. Detail Repairs (Ref IPL Fig. 1)

(1) Seat (25).

(a) The seating surface of the pilot seat (25) may be lapped if damaged to remove minor scoring and scratching, using a 0.1562 ±0.0002 inch diameter ball and lapping compound.

(b) If seat surface exceeds 0.004 inch in width, replace with new seat.

NOTE: Original factory-manufacture requirements for the seat are to ball lap to obtain a GITS test value of 22 inches of mercury minimum (gauge reading) for 20 seconds minimum.

(2) Poppet (Ref 45, IPL Fig. 1)

(a) If chrome plated diameters that ride in flange (40) and/or housing assembly (65) are damaged by wear, nicks, scoring, or corrosion, they may be machined down to bare metal and replaced. Chrome plating shall be accomplished as described in paragraph 6D below. Chrome plating shall be 0.0002 to 0.0003 inch thick.

(b) Outside diameter that rides in flange (40) shall be 0.9488 to 0.9493 inch after chrome plating.

(c) Outside diameter that rides in housing assembly (65) shall be 1.1550 to 1.1554 inch after chrome plating.

(d) Apply Tiodize No. 1175 to external surfaces of poppet; internal surfaces are optional.

D. Chrome Plating of Poppet (Ref 45, IPL Fig. 1)

(1) Vapor degrease using trichloroethylene or perchloroethylene.

(2) Descale, when necessary, by dipping in Manganesed-Phosopholine No. 7 (Western Reserve Laboratories, Cleveland, Ohio) or by vapor blast using glass beads.

(3) Alkaline clean, using 8 ounces of Oakite 90 to 1 gallon water at, or above, 190°F.

(4) Rinse thoroughly in water at room temperature.

(5) Dip poppet in an aqueous solution of 5 to 10% muriatic acid for 5 to 10 seconds at room temperature. Solution density will be 4° to 7° Be.

(6) Chromium plate. Plating shall conform to Procedure I or II (step (9) or (10) below). Thickness of plating shall be 0.0002 to 0.0003 inch.

(7) Rinse thoroughly in room temperature water.

(8) Rinse in 160° to 180°F water and allow to dry.

(9) Procedure I

NOTE: Chromium plating in accordance with Procedure I will resist corrosion under both moderate and high temperature (700°F) environmental conditions.

Approved processes:

Microplate No. 2 - Microplate Company, 1013 West Hilcrest, Inglewood, California.

Multichrome No. 2 - Multichrome Company, 11165 Tennesses Avenue, Los Angeles, California.

(a) Plating solution shall be 150°F and shall consist of 35.0 to 46.5 ounces per gallon chromic acid, and 0.12 to 0.125 ounces per gallon sulfate ion (derived from 99% sulfuric acid), and water. Solution density will be 22° to 28° Be.

(b) Current shall be applied gradually at 3.0 to 5.0 amps per square inch.

(c) Plating rate shall be approximately 0.00002 inch per minute and the material shall be evenly distributed over the entire surface on which it is deposited.

(d) Parts to which chromium plate has been applied by this procedure should resist corrosion when subjected to 750°F for one (1) hour followed by a fifty-hour salt spray.

(e) Reference information: Plating should be free of microscopic cracks, and have an approximate superficial rockwell hardness of Rc60 to 62.

(10) Procedure II

NOTE: Chromium plating in accordance with Procedure II will resist corrosion when environmental conditions are moderate. Wear resistance and anti-galling qualities are good.

Approved processes:

Electrolizing - Electrolizing Company, 1947 Hooper Avenue, Los Angeles, California.

Microplate No. 1 - Microplate Company, 1013 West Hilcrest, Inglewood, California.

Multichrome No. 1 - Multichrome Company, 11176 Tennessee Avenue, Los Angeles, California.

NOTE: Processing shall be as outlined in Procedure I with the following exceptions:

(a) Applied current shall be 3 amps per square inch.

(b) Plating rate shall be approximately 0.00003 to 0.00005 inch per minute.

(c) Reference information: Plating should be free of microscopic cracks and have an approximate superficial Rockwell hardness of Rc 70 to 72.

7. Assembly

A. Assembly Materials

NOTE: Equivalent substitutes may be used for the items listed below.

Lockwire MS20995C20 (install per MS33540)	Commercially Available
Tiodize, No. 1175	Tiodize Company, Inc. 15701 Industry Lane Huntington Beach, CA
Lube SS-30	Jet-Lube Inc. Houston, TX
Sealant RTV 106	General Electric Company Silicone Products Business Department Waterford, NY 12188
Thread Lubricant	Parker Hannifin Corp. Cleveland, OH

B. Lubrication (Ref IPL Fig. 1)

(1) Apply Tiodize No. 1175 to external surfaces of poppet (45).

(2) Apply Lube SS-30 sparingly at joint of mating edges of flange (40) and housing assembly (65).

(3) Coat threads of screws (10) with thread lubricant.

C. Assembly Procedure (Ref IPL Fig. 1)

(1) Using two new rings (55), break rings one place only each ring, and install new expander (60) and rings on poppet (45). Orient gaps (broken points) of the two rings 180 degress apart.

(2) Install sopring (50) in housing assembly.

(3) Compress rings (55), and carefully install poppet (45) in housing (65), being careful that rings do not catch or break on housing before poppet is fully installed. Hold poppet in housing assembly against spring pressure.

(4) Carefully install flange (40) over poppet (45), using care to prevent the poppet being forced sufficiently out of housing assembly (65) to expose carbon rings (55), and engage flange threads with threads of housing assembly. Tighten flange into housing assembly to 75 to 100 pound-inches torque.

(5) Using a wooden dowel or other non-metallic device, push on visible end of poppet (45) (end visible through outlet port of flange) and make sure that poppet moves freely in flange and housing assembly, with the only restriction being that of the force of the spring (50). The poppet must move freely without sticking or binding.

(6) Place a new ball (35) on seat (25), and using a depth micrometer inserted through the seat and resting on the top of the ball, measure the distance from the top of the ball to a convenient reference point on the seat.

(7) Remove ball (35) from seat (25), and install the seat in housing assembly (65); torque to 6 to 8 inch-pounds.

(8) Place thermal isolator (20) on housing assembly (65), and using the same reference point on the top of seat (25) as in step (6), measure distance from top of seat to exterior flat surface of thermal isolator.

(9) Energize solenoid (5) with 18 volts dc, and measure distance from flat surface of solenoid housing to extended end of solenoid stem.

(10) Add the two dimensions obtained in steps (6) and (8), and subtract from the dimension obtained in step (9). The difference is the amount of travel of the solenoid stem when it pushes ball (35) off seat (25). Stroke distance should be 0.025 to 0.030 inch. When assembling seat (25) and solenoid assembly (5) on housing assembly (65), use shim washers (15, 16, 17) to decrease the stroke, and shim washers (30, 31, 32) to increase the stroke.

(11) Remove seat (25) and place new ball (35) in pilot valve section of housing assembly (65).

(12) Install selected number of shims (30, 31, 32) on seat (25), coat threads of seat with RTV 106, and install seat in housing assembly (65). Torque seat to 6 to 8 pound-inches.

(13) Install thermal isolator (20) on housing assembly (65).

(14) Install selected number of shim washers (15, 16, 17) on solenoid assembly (5), orient solenoid connector as shown in IPL Fig. 1 (also shown in Fig. 1 of this manual), and secure to housing assembly with four screws (10). Torque screws to 7 to 8 pound-inches, and install lockwire between the screws, in pairs.

CAUTION: DO NOT OVERTORQUE SCREWS (10); EXCESSIVE TIGHTENING MAY CRUSH OR BREAK THERMAL ISOLATOR (20).

(15) Check that identification data has been electro-etched on housing assembly (65) as follows (0.10 to 0.14 inch high letters):

WHITTAKER CONTROLS, A UNIT OF WHITTAKER CORPORATION
VALVE, SHUT-OFF
PART NO. 320295 (latest change letter)
SER NO. (as applicable)
DATE OF MFG: SPEC NO. US:

D. Storage Instructions

(1) Storage Materials

NOTE: Equivalent substitutes may be used for the items listed below.

Shipping Closures	(Ref 70, 75, IPL Fig. 1)
Polyethylene Bag	Commercially Available
Desiccant	Commercially Available

(2) Storage Procedure

(a) Install shipping closures on inlet and outlet ports of valve, and on solenoid electrical connector.

(b) Place valve in polyethylene bag, with desiccant, and seal bag.

(c) Shelf Life: 60 months at room ambient temperature.

8. Fits and Clearances

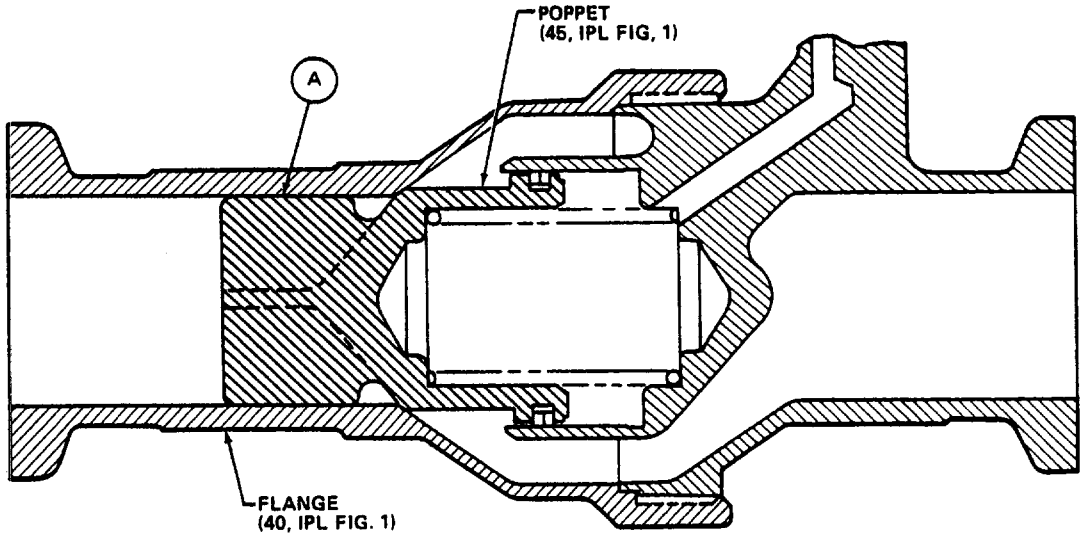
A. Wear Tolerances

FIG. 801 REF LTR	DIA	MATING ITEM (REF IPL FIG. 1)	MANUFACTURING DIMENSIONS (INCHES)				WEAR LIMITS (INCHES)		
			DIMENSION		ASSEMBLY CLEARANCE		DIM. LIMITS		MAX CLEARANCE ALLOWABLE
			MIN	MAX	MIN	MAX	MIN	MAX	
A	OD	45	0.9488	0.9493	0.0037	0.0047	0.9483	---	0.0057
A	ID	40	0.9530	0.9535			---	0.9540	

B. Spring Data

Spring (Ref 50, IPL Fig. 1)

Load at length of 1.13 inches = 0.79 ±0.10 pounds.
Load at length of 0.80 inch = 2.44 ±0.20 pounds.



Fits and Clearances Wear Points
Figure 801

C. Torque Data

ITEM (REF IPL FIG. 1)	NOMENCLATURE	TORQUE REQUREMENTS
10	Screws	7 to 8 pound-inches
25	Seat	6 to 8 pound-inches
40	Flange	75 to 100 pound-inches

9. Special Tools, Fixtures, and Equipment

NOTE: Equivalent substitutes may be used for the items listed below.

A. Special Tools

(None required)

B. Fixtures

(None required)

C. Equipment

(1) Test Equipment: Reference paragraphs 2A and 5A.

10. Illustrated Parts List

A. Introduction

(1) This Illustrated Parts List illustrates and lists parts of the subject equipment.

(2) The identification data stamped on the unit identifies the part number, serial number, and specification data for the unit.

B. Using the Parts List

(1) The Parts List is a breakdown of assemblies, subassemblies, and detail parts of the unit. Item numbers on the accompanying illustrations indicate the order of disassembly of the unit for component maintenance purposes. Component parts are indented to show their relationship to the complete assembly. Attaching parts immediately follow the parts that they attach, and precede any detail components when the attached part is an assembly.

(2) Part numbers and descriptions in the Parts List identify each part. The Item numbers in the Parts List refer to the accompanying illustration, and are used for locating a part in the Parts List after the part has been found on the accompanying illustration.

(3) The Effect Code column of the Parts List shows differences between two or more similar units or assemblies listed together in the same Parts List. Parts not used in all of the units or assemblies bear a code letter for the particular unit or assembly in which the parts are used. When the Effect Code column is blank, the part is used in all of the units or assemblies listed in the Parts List.

(4) The Units Per Assy column of the Parts List indicates the quantity of each part required for the next higher assembly.

C. Identifying Parts

(1) If the part number or the reference designation are not known, refer to the illustration of the unit or assembly in which the part is used. Locate the part in the illustration, and obtain the item number of the part. Refer to the Item number in the Parts List accompanying the illustration. The columns following the Item number give the Part Number, Nomenclature, and Units Per Assy of the particular part.

D. Abbreviations and Symbols

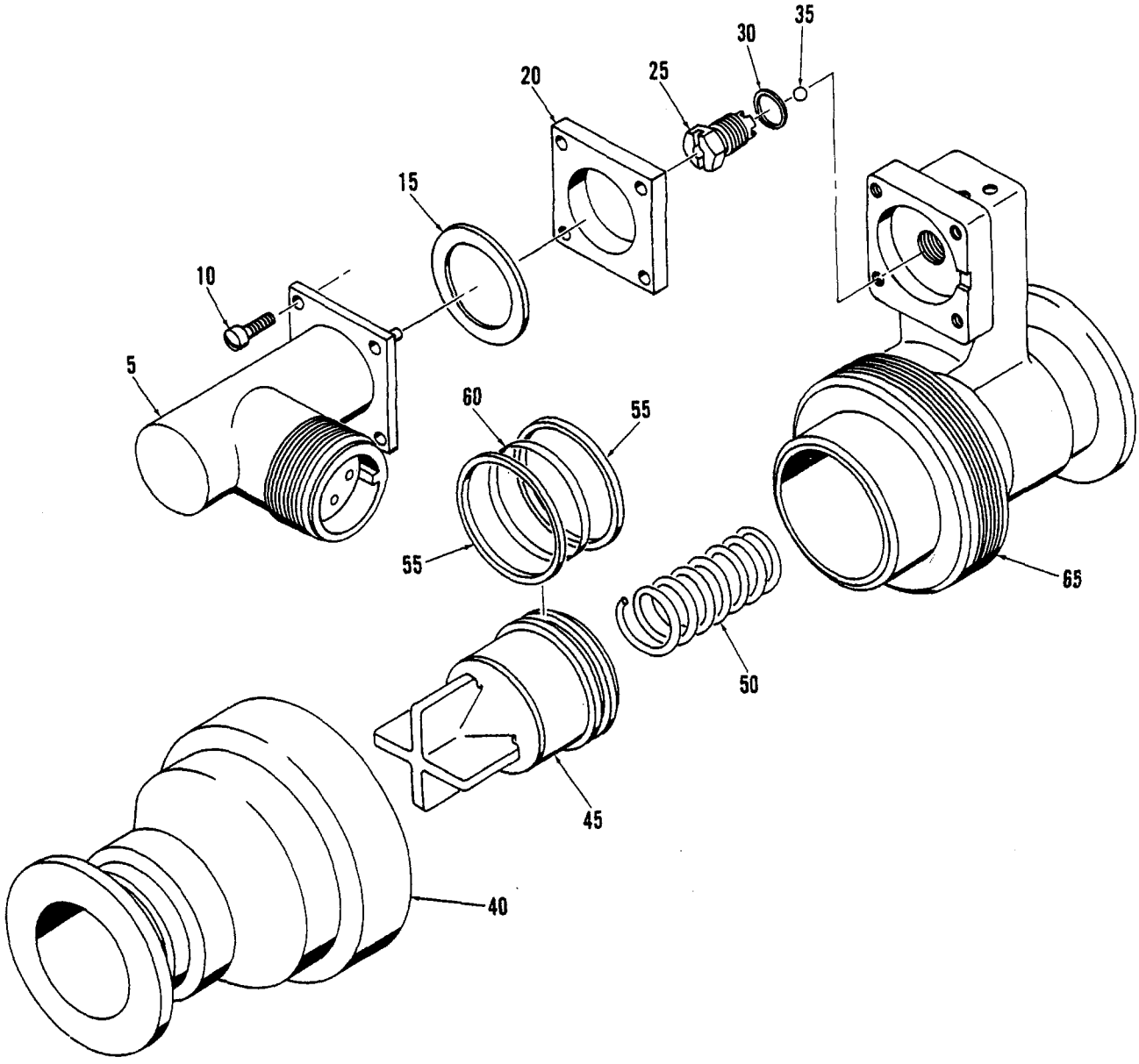
AR	As Required
ASSY	Assembly
CRES	Corrosion-Resistant Steel
NO.	Number
RF or REF	Reference
***	End of Attaching Parts
±	Plus or Minus

E. Vendor Codes

Vendor code numbers, preceded by the letter "V", appear in the Nomenclature column of the parts list. The absence of a vendor code following a part nomenclature (other than a Government standard part), indicates the part number is that of a Whittaker Controls part. The following vendor codes and corresponding manufacturers names and addresses are used in this manual:

V79318	Whittaker Controls A Unit of Whittaker Corporation 12838 Saticoy Street North Hollywood, CA 91605

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Valve - Exploded View
IPL Figure 1

FIG. ITEM	PART NUMBER	AIRLINE PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFF CODE	UNITS PER ASSY
1 -1	320295		VALVE, SOLENOID (V79318)	A	RF
-1A	320295-1		VALVE, SOLENOID (V79318)	B	RF
5	157519		• SOLENOID, PUSH-TYPE		1
			ATTACHING PARTS		
10	MS35275-230		• SCREW, MACHINE		4
			---★---		
15	100168-400		• SHIM (0.002 inch [0.05 mm] thick) (Selected during assembly)		AR
-16	100168-401		• SHIM (0.004 inch [0.10 mm] thick) (Selected during assembly)		AR
-17	100168-402		• SHIM (0.010 inch [0.25 mm] thick) (Selected during assembly)		AR
20	227428		• ISOLATOR, THERMAL		1
25	227427		• SEAT		1
30	100168-60		• SHIM (0.002 inch [0.05 mm] thick) (Selected during assembly)		AR
-31	100168-61		• SHIM (0.004 inch [0.10 mm] thick) (Selected during assembly)		AR
-32	100168-62		• SHIM (0.010 inch [0.25 mm] thick) (Selected during assembly)		AR
35	MS9461-04		• BALL		1
40	228478		• FLANGE	A	1
-40A	228872		• FLANGE	B	1
45	227421		• POPPET		1
50	227429		• SPRING, COMPRESSION		1
55	227472		• RING, CARBON (Superseded by Item 55A)		1
-55A	229001		• RING, CARBON (Supersedes Item 55)		1
60	224637		• EXPANDER		1
65	228477		• HOUSING, VALVE	A	1
-65A	228477		• HOUSING, VALVE	B	1
			PROTECTIVE CLOSURES		
-70	NAS813-12		• CLOSURE (Electrical Connector)		1
-75	200565-8		• CLOSURE (Inlet and Outlet Ports)		2

-ITEM NOT ILLUSTRATED

CHAPTER 23

COMMUNICATIONS

CHAPTER 23 – COMMUNICATIONS

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MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B./T.R.
AirMed a Clement Clark Communication Company	Head sets	1-5850	23-50-03	Sep 4/1967	
DeHavilland	Audio Control Unit	DHC60126 and DHC60206	23-09-01	Feb 1/1969	
Edo-Aire	Audio/Amplifier	1U396-002	10-79-1	Oct 26/1979	

NOTE: Please see the TEMPORARY REVISION that revises this page

BOMBARDIER – Temporary Revision

PSM NO. 1–6–6A AIRCRAFT DHC–6 Twin Otter SERIES ALL

PUBLICATION COMPONENT MAINTENANCE MANUAL TEMPORARY REVISION NO. 23–1

Insert in 23–CONTENTS, facing page 1

CHAPTER 23 – COMMUNICATIONS

REASON FOR ISSUE:

This Temporary Revision adds TR 23–2 and TR 23–3 to Table of Contents.

ACTION:

Ignore existing page 1 and substitute revised page as shown on this Temporary Revision.

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MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B/T.R.
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Edo–Aire	Audio/Amplifier	1U396–002	10–79–1	Oct 26/1979	

RECORDING INSTRUCTIONS:

Record this Temporary Revision No. and the relevant information in the appropriate columns of the TEMPORARY REVISION INDEX provided at the front of the manual.

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OVERHAUL MANUAL

for

AIRLITE 70 HEADSETS

1-5850

This manual complies with British Civil Airworthiness Requirements, Section A, Chapter A6-2. The technical accuracy of this manual has been verified and is certified as correct.

Signed George E. Babb

Date . 19th October 1967 .

A.R.B. Design Approval No. AD/1426/58

Airmed Limited, Edinburgh Way, Harlow, Essex.

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Airlite 70 headset, type 5850	1
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AIRLITE 70 HEADSETS

REVISION RECORD

The introduction of any amendment or revision not verified in accordance with British Civil Airworthiness Requirements Section A, Chapter A6-2, will invalidate the statement of certification on Page i. Amendments or revisions embodied in this manual, which have been certified under an approved authorisation other than that applicable to the initial certification must be recorded on separate record sheets.

REV. NO.	INSERTION DATE	BY	REV. NO.	INSERTION DATE	BY	REV. NO.	INSERTION DATE	BY

DESCRIPTION, OPERATION AND DATA

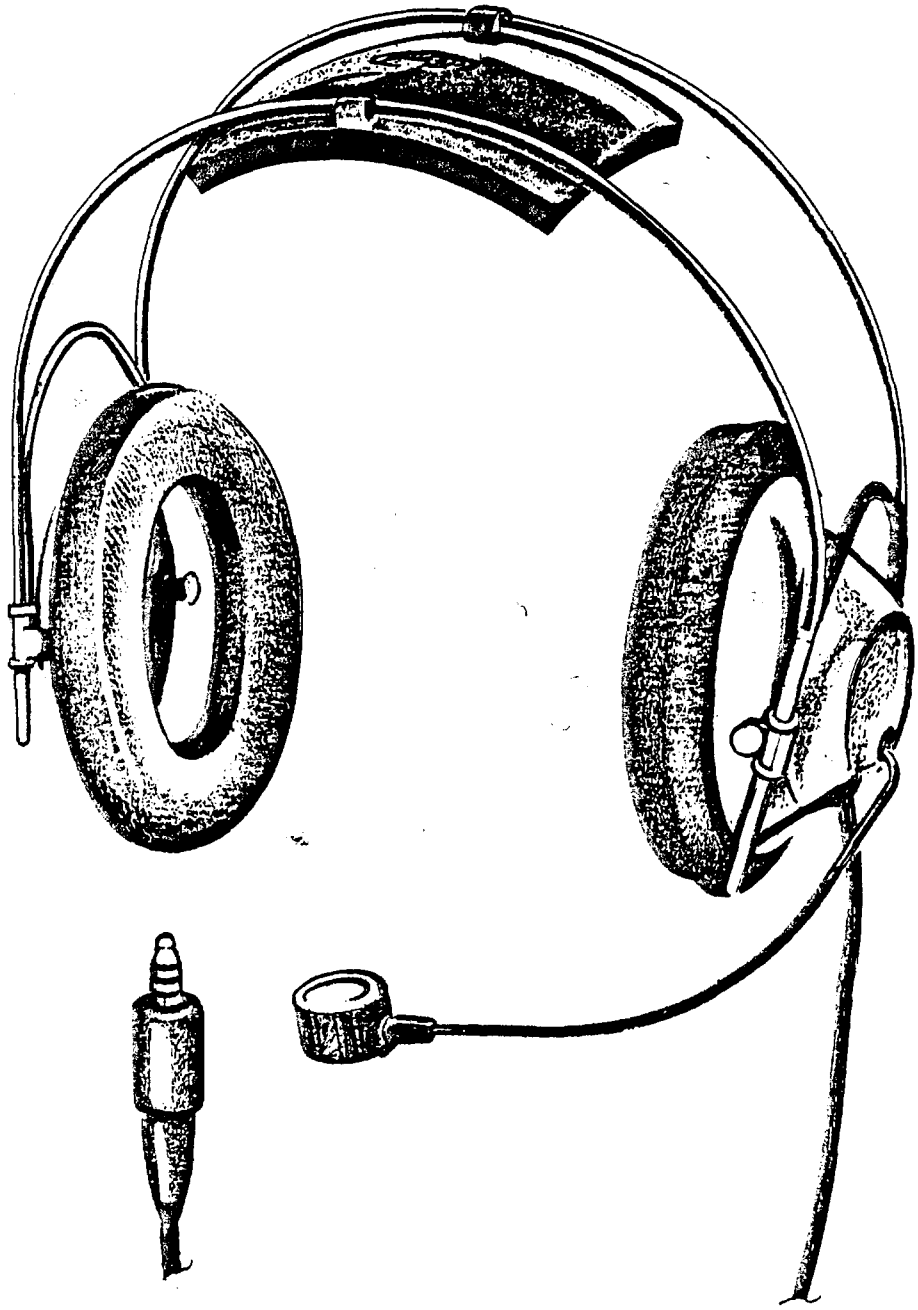
1. Description

The Airlite 70 headset, ref 5850 is the basic model of this headset but several other standards are used. A range of interchangeable microphones, earphone insets and jackplugs identified by a letter coding system enable a large number of variants to be produced. This manual covers the basic headset and makes reference to alternative components where applicable.

The headset incorporates a pair of earphone insets (11) and a moving coil noise cancelling microphone (21). Alternative microphones are electro-magnetic of various impedances, or carbon, and a miniature amplifier may be fitted enabling an electro-magnetic microphone to be used in a carbon microphone circuit. The earphone insets are fitted in plastic earshells (6) and (18) which are provided with detachable earpads (13) and earpad covers (14). The headband (1) which acts as a conductor for the earphones, can be adjusted for length by sliding the earshell assemblies, longitudinally. The headpad (2) which clips onto the headband has a foam cushion for comfort. The microphone is attached to the boom, which is connected to one of the earshells by a ball joint, enabling the microphone to be positioned as required. The main downlead (27) is fitted to the same earshell assembly. The basic headset has a Nato jackplug (34) on the free end of the lead, but alternative jackplugs can be fitted and a switch may be incorporated. All wiring is completely enclosed, connections being made to terminals inside the earshells. Earphones are wired individually and connected to the jackplug in parallel or individually according to the type of plug used. The variations in jackplug impedance reading are obtained by using earphone insets of different impedances.

2. Operation

The headset is brought into use simply by plugging the jackplug into the aircraft jackbox. The downlead may incorporate a switch.



AIRLITE HEADSET REF. AIR 5850
Figure 1

3. Data

A. Basic data

Weight of Air 5850 complete	$7\frac{1}{2}$ ozs.
Earphone impedance	300 ohm each $\pm$ 20% at 1000 c/s
Earphone resistance d.c.	83 ohm $\pm$ 15%
Microphone impedance	300 ohm $\pm$ 20% at 1000 c/s
Microphone resistance d.c.	275 ohm $\pm$ 15%

B. Build standards

Airlite 70 Ref. No.	Microphone	Ear. impedance at Jackplug	Jackplug
Air 5840	300 ohm moving coil with min. pre-amp.	600 ohm	Nato 10H/18575
Air 5850	300 ohm moving coil	150 ohm	Nato 10H/18575
Air 5890	300 ohm moving coil with min. pre-amp.	600 ohm	PL 55 & PL 68
Air 5900	Carbon	600 ohm	Nato 10H/18575
Air 5910	Carbon	600 ohm	PL 55 & PL 68
Air 5920	None	600 ohm	PL 55

C. Variants

Other combinations of alternative components are selected from the following table, using the code letters in the order shown.

Code Letter	Microphone	Earphone	Connecting Plugs	Lead Length	Switches
O	None	None	None	None	None
A		600 ohm			Press-to-talk
B		300 ohm			On-Off
C		60 ohm			PTT key transmit
D	300 ohm moving iron	1200 ohm			On-Off PTT comb
E	50 ohm moving iron	2400 ohm	PL 55 & PL 68 split lead		
F			PL 68	5 ft.	
G	100 ohm carbon		Nato 10H/18575		
H	300 ohm moving coil		RAF 10H/10991		
I	50 ohm moving coil		Deutsch DM 9702-7P		
J	H fitted with pre-amp		Plessey Mk 4 CZ 49017		
K			PL 55		
L			Elcom 8 way PO 8		
M			McMurdo 9 way		
N			Cannon EP/CG/6/15		
P			Cannon EP/CG/8/15		

Headsets are identified by an Airlite 70 reference number as shown on page 3 if applicable, or by the five letter code as shown above. The reference number or five letter code is shown on the nameplate on the outside of the non-boom side earshell. Alternative components which do not appear in the table and have been supplied to special order are coded S, and instructions regarding them are not included in this manual.

DISASSEMBLY

1. General

The earphone insets and microphone are sealed units and no attempt should be made to open them. It is not practicable to dismantle sub-assemblies any further than is described as some components are cemented together and complete replacements are supplied as spares. The jackplug and cord switch, if any, should be opened for inspection but not separated from the main downlead cable unless replacement is necessary.

2. Procedure

A. With microphones D, E, H, I, J.

(1) Remove earpad covers (14) and earpads (13).

(2) Strip off foam discs (12) from inside earshells.

(3) Remove the three Phillips head screws (16) holding earshell cover (20) to earshell (18) and remove cover.

(4) Disconnect and extract earphone inset (11).

(5) Disconnect microphone and downlead cables from amplifier, if fitted, and remove amplifier (42).

(6) Disconnect microphone and downlead cables from terminals.

(7) Unscrew clamping screw (25) and open clamp (26) to release downlead (27).

(8) Unscrew screws (23) and remove microphone (21) or (22) taking care to retain washers (24).

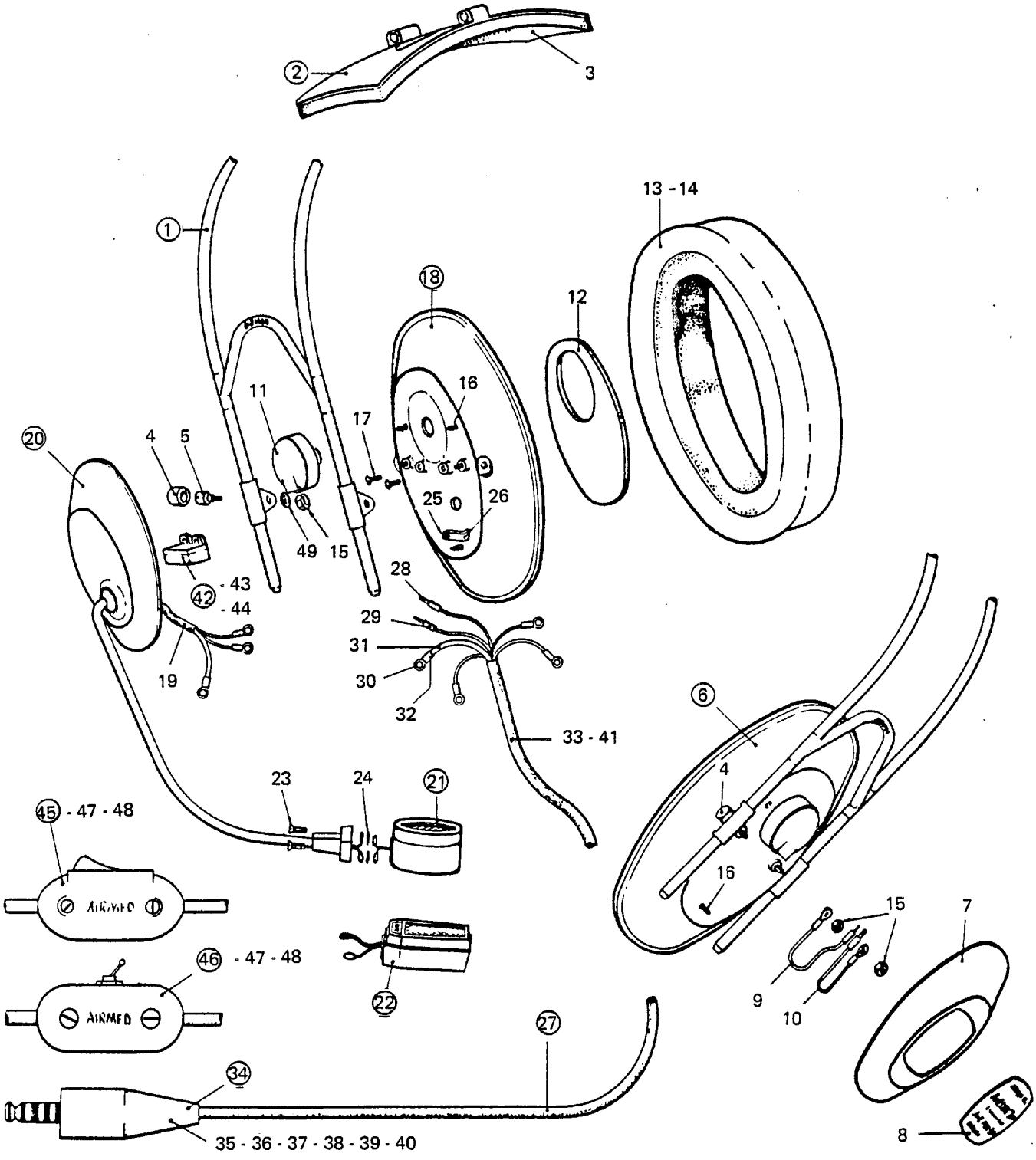
(9) Remove the three Phillips head screws (16) holding earshell cover (7) to earshell (6) and remove cover.

(10) Disconnect connector wires (9) and (10) from terminals and earphone inset (11) and extract earphone inset.

(11) Prise off insulating caps (4).

(12) Unscrew swivel screws (5) and locknuts (15) and remove washers (49) and headband (1).

(13) Remove headpad (2) and strip off headpad cushion (3) if necessary.



EXPLODED VIEW OF HEADSET
Figure 101

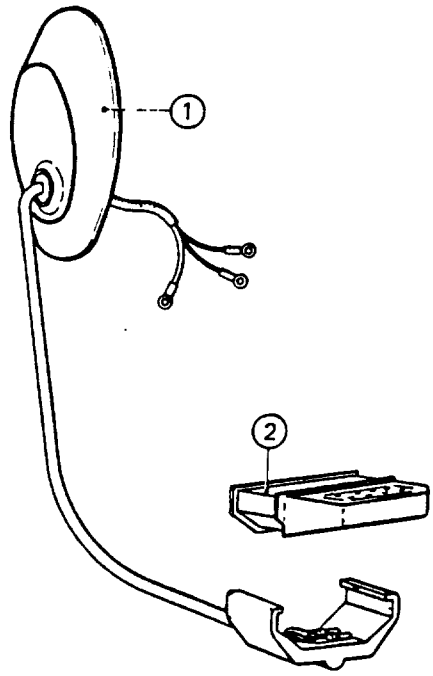
B. With Microphone G (Carbon) Index numbers refer to Fig. 101 unless otherwise stated.

(1) Proceed as for A1-7.

(2) Remove the three Phillips head screws (16) holding earshell cover (Fig. 102 (1)) to earshell (18) and remove cover.

(3) Proceed as for A10, 11, 12, and 13.

(4) Slide microphone (Fig. 102 (2)) from clip.



BOOM, CLUTCH & COVER SUB-ASSEMBLY
CARBON MICROPHONE
Figure 102

CLEANING

1. Plastic and metal parts

The headpad moulding and earshells may be washed in warm soapy water, providing that all wiring has been disconnected and earphone insets removed. It is essential that all parts should be dried carefully, by hot air if possible, paying particular attention to earphone cavities and all metal contacts.

All other plastic and metal parts may be wiped with a cloth slightly damped in a dilute disinfectant solution, ensuring that none of the solution enters the earphone insets, microphone capsule, boom, headband or downlead cable.

NOTE: It is very important that all parts are completely dry before commencing re-assembly.

2. Earpad covers and foam pads

Do not attempt to clean dirty earpad covers. Discard them and the foam headpad and earshell discs and fit new ones when the headset is assembled.

INSPECTION/CHECK

1. Headband sub-assembly (1)

   A. Examine for damage.

   B. Check :-

      (1) That the sliders can be moved along the headband but that there is sufficient friction to maintain headband adjustment.

      (2) That the headband has retained its spring and that reasonable pressure is required to part the ends.

2. Headpad (2), headpad cushion (3) and earpads (13)

   Examine for damage.

3. Earshells (6) and (18)

   A. Examine for damage

   B. Check security of terminals and contacts.

4. Connector wires (9) and (10)

   Check security of pins and tags.

5. Earshell cover, non-boom side (7)

   Examine for damage.

6. Boom, clutch and cover sub-assembly (20) or Fig. 102 (1)

   A. Examine for damage.

   B. Check :-

      (1) Free movement of ball joint rotationally and laterally,

      (2) Security on boom of plastic mounting or clip for microphone.

      (3) Security of tags at headset end of microphone cable.

7. Main downlead sub-assembly (27)

   A. Examine for :-

      (1) Damage.

      (2) Perishing of the rubber sleeve on the jackplug.

(3) Security of the soldered connections to the jackplug, or crimping tags if used. To do so will necessitate drawing the plug sleeve, if any, up the cable and unscrewing the plug cover.

(4) Security of tags and pins at headset end of lead.

8. Main lead switch (45) or (46)

A. Examine for damage.

B. Check:-

(1) Security of electrical connections.

(2) Freedom of action.

9. Small parts

Examine :-

(1) All small parts including microphone capsule, earphone insets, amplifier if any, and small plastic parts for damage.

(2) All threaded parts for damage to threads.

REPAIR

The only practical repair process is to change the defective component for a new spare one. Dismantle and re-assemble the headset as far as is necessary in accordance with the instructions given under Disassembly (page 101) and Assembly (page 501).

ASSEMBLY

1. General

The microphone and earphone insets are sealed units which should not have been dismantled so the original units or new replacements must be available for assembly. All other sub-assemblies if faulty or damaged, are to be replaced by complete units to obviate the need for cementing. A new plug and/or switch can be fitted to the main cable if necessary, the cable alone can be replaced or a new complete downlead assembly may be used. Switch connections are shown on Fig. 502, page 503.

2. Procedure

A. With microphones D, E, H and I

(1) Test the microphone lead as described in para. 3A (1), page 701.

(2) Fit microphone (21) or (22) to boom (20) using screws (23) and washers (24), and connect microphone lead to terminals in earshell (18) in accordance with wiring diagram Fig. 501.

(3) Check as described in para. 3A (2) page 701.

(4) Check downlead as described in para. 3A (3) page 701.

(5) Connect downlead (27) to terminals in earshell (18) in accordance with wiring diagram Fig. 501.

(6) Check as in 3A (4) page 702.

(7) Clamp downlead into position with (25) and (26).

(8) Fit connector wires (9) and (10) to earshell (6) in accordance with wiring diagram Fig. 501.

(9) Check as in 3A (5) page 702.

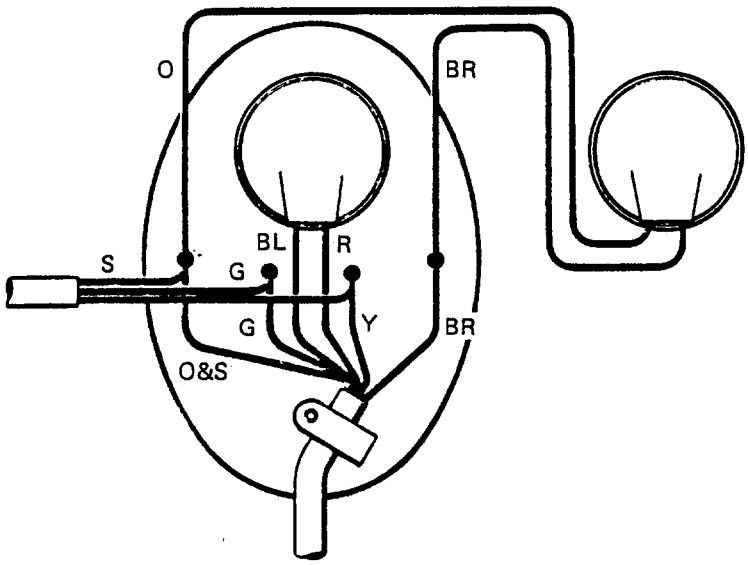
(10) Fit headband (1) to earshell (6) using 2 off screws (5), locknuts (15), and washers (49).

(11) Check as in 3A (6) page 702.

(12) Fit headband to earshell (18) using remaining screws (5), locknuts (15), and washers (49).

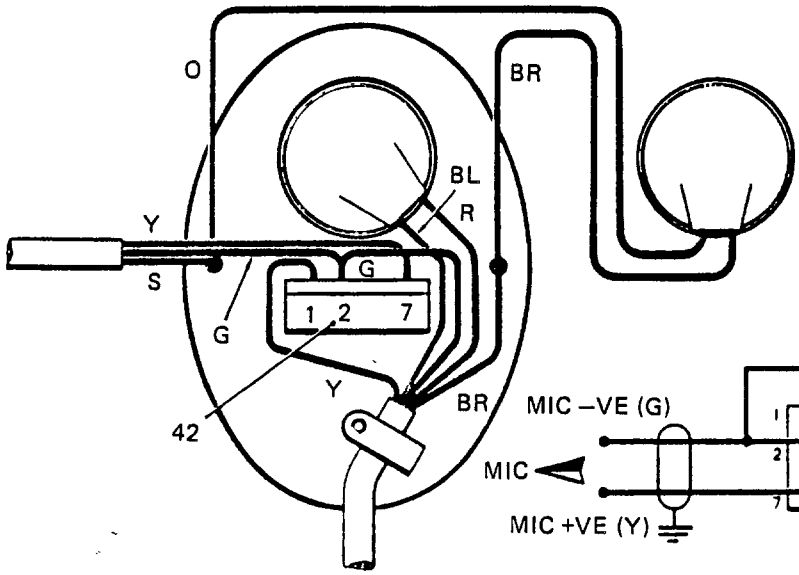
(13) Check as in 3A (7) page 702.

(14) Fit insulating caps (4).

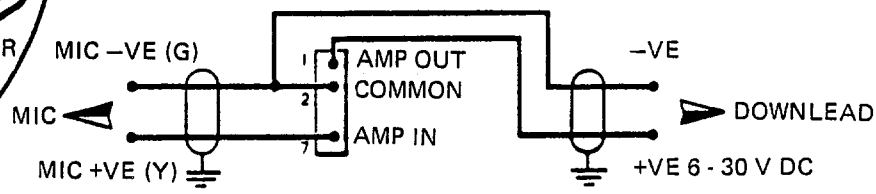


Y – YELLOW
G – GREEN
BR – BROWN
O – ORANGE
R – RED
BL – BLUE
S – SCREENS (BLACK)

SCHEMATIC WIRING LAYOUT FOR STANDARD HEADSETS



Y – YELLOW
G – GREEN
BR – BROWN
O – ORANGE
R – RED
BL – BLUE
S – SCREENS (BLACK)



CIRCUIT DIAGRAM FOR THIN FILM MIC PRE-AMP

SCHEMATIC WIRING LAYOUT FOR HEADSETS FITTED
WITH THIN FILM MIC PRE- AMPLIFIER

SCHEMATIC WIRING LAYOUTS
Figure 501

(15) Insert earphone insets (11) and connect to leads. Pins are of different sizes so will fit only when correctly connected.

(16) Screw earshell covers (7) and (20) to earshells using screws (16).

(17) Test boom clutch as described in paras. 2A and B page 701 and adjust if necessary.

(18) Fit earshell foam discs (12) earpads (13) and earpad covers (14).

B. With microphone and pre-amplifier J

Follow the above procedure where applicable. Test 3A (2) page 701 is to be carried out with the ends of the microphone lead free. Amplifier (42) is to be fitted in accordance with wiring diagram Fig. 501 after testing microphone lead and downlead and before clamping downlead.

NOTE: It is essential that polarity should be observed.

C. With microphone G (carbon) (Index No's. refer to Fig. 101 unless otherwise stated).

(1) Test microphone lead as in 3A (1) page 701.

(2) Connect microphone (Fig. 102 (2)) to boom (Fig. 102 (1)) and microphone lead to terminals in earshell (18) in accordance with wiring diagram Fig. 501.

(3) Proceed as for A3-15.

(4) Screw earshell covers (7) and (Fig. 102 (1)) to earshells (6) and (18) using screws (16).

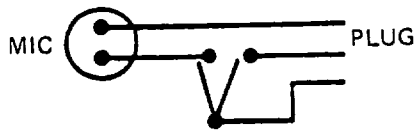
(5) Continue as for A 17 and 18.



ON-OFF & PRESS TO TALK SWITCHES



COMBINED ON-OFF PRESS TO TALK SWITCH



TYPICAL CONNECTIONS FOR TRANSMITTER SWITCHES

DOWNLEAD SWITCH CONNECTIONS
Fig. 502

FITS AND CLEARANCES

Not applicable.

TESTING

1. General

Two mechanical tests and eight electrical tests are necessary. The mechanical tests and seven electrical tests are made during assembly, and one electrical test is made after assembly. An audio test after assembly is desirable if suitable equipment is available.

2. Mechanical tests

Before fitting the earshell foam discs and earpads, check the boom clutch friction as follows: -

A. Lateral movement

The clutch should just support a weight of approximately 1 oz. attached to the end of the boom.

B. Rotational movement

The clutch should just support a weight of approximately 2 oz. attached to the end of the boom.

The clutch can be adjusted by means of the screw which can be seen through a hole inside the earshell, and is easily accessible through this hole.

3. Electrical tests

A. During assembly

(1) Before fitting microphone or connecting microphone lead to terminals in earshell, check the insulation resistance between each of the microphone boom wires, the screen of the lead, and the boom, by means of a 500V. d.c. tester such as a 'Megger'. The resistance should be at least 100 megohm.

(2) With microphone fitted and microphone lead connected to earshell terminals, check the continuity of the microphone lead in the boom by means of a high impedance (20, 000 ohm/V) d.c. test instrument such as an 'Avometer', moving the boom through its full range to check for intermittency. The d.c. resistance through the microphone should be as stated in para. 3B 1 (b).

(3) Check downlead for continuity by means of a high impedance d.c. test meter, and check insulation resistance between leads using a 'Megger', or suitable instrument. The resistance should be at least 100 megohm.

(4) After connecting downlead to earshell, check for continuity through terminals and contacts.

(5) After assembling connector wires to earshell, check for continuity through terminals.

(6) After fitting headband to non-boom side earshell, check for continuity through headband and earphone connections. Slide earshell on headband and swivel earshell through headband while so doing. The d.c. resistance through the headband should not exceed 0.5 ohm.

(7) After fitting headband to boom side earshell, check for continuity right through from connectors in non-boom side earshell to plug, moving earshell as in (6) while so doing.

B. After assembly

(1) Check d.c. resistance of the earphone insets and of the microphone at the jackplug using a 20,000 ohm/volt ohmeter and moving the earshell and microphone boom through their full range meanwhile.

(a) Earphone insets

The d.c. resistance of the earphone inset is liable to variation according to the type used, impedance, whether polarised etc. The d.c. resistance of a 300 ohm impedance earphone inset should be within ± 15% of one of the following figures:- 48 ohms, 83 ohms, 90 ohms.
This would be with earphone insets connected to the jackplug individually. When the earphone insets are connected in parallel to one pair of pins on the jackplug, the figure should be halved.

(b) Microphones

The d.c. resistance of the microphone should be as follows:-

Moving coil 300 ohm impedance	275 ohm
Moving iron 300 ohm impedance	35 ohm

NOTE: No useful purpose is served by measuring the d.c. resistance of carbon microphones.

(2) An audio test is desirable, and if suitable equipment is available test the headset by speaking into the microphone and listening to the earphones. The boom should be moved through its full range to check for intermittency.

4. Testing of Miniature Amplifier

A. General

During the following tests, the output of the amplifier under test should be monitored by an oscilloscope to observe that the output is a smooth sinusoidal wave, with no signs of "clipping" or bad distortion.

The Signal Input reference level of 2 m/v should be finally adjusted when the circuit is operational.

B. (1) To check sensitivity, connect up the amplifier under test as shown in Fig. 701. It is most important to watch polarity, or the Amplifier will be destroyed.

Bearing in mind that:

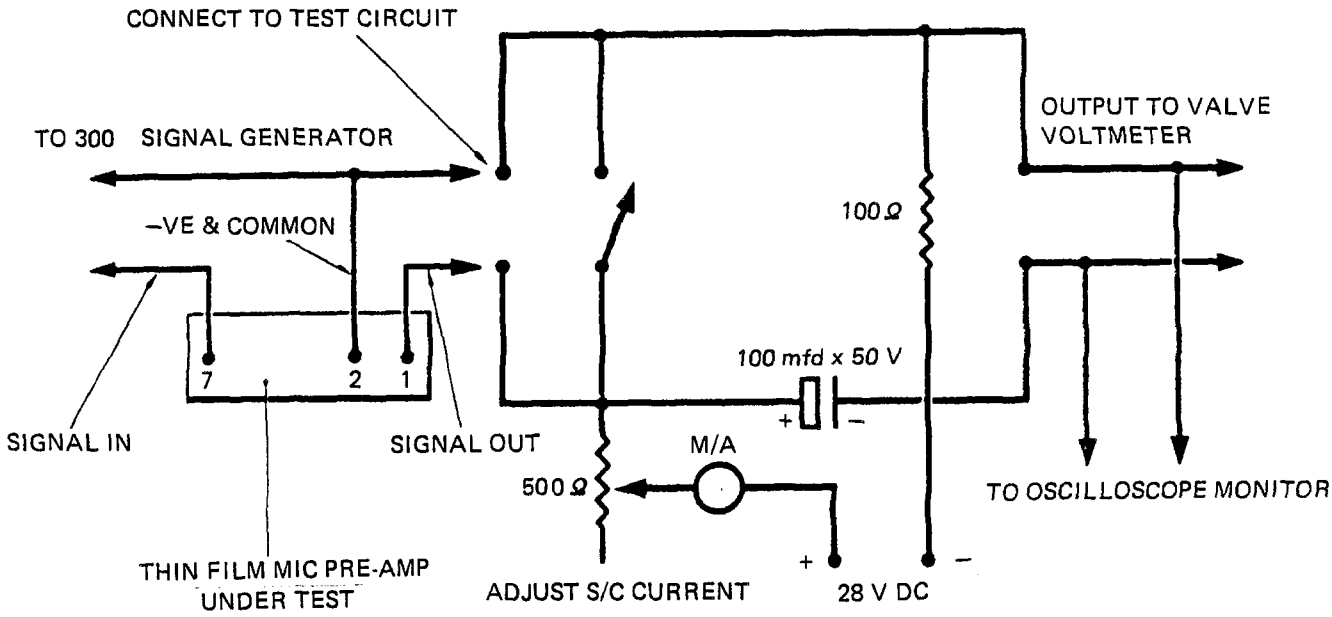
Pin 1. is positive
Pin 2. is common and negative
Pin 7. is signal 'IN'.

Adjust Signal Generator to 2 m/v output as checked with a valve Voltmeter @ frequency of 1K. c/s.
At a d.c. Supply Voltage of 28 V. d.c. with the Amplifier drawing a current of 5 m/a. through the Carbon Microphone Test Circuit (See Fig. 701). The output from the amplifier under test should be between 300-400 m/v (340 m/v. is a good level).

(2) To check response:-

(a) With a d.c. supply of 28V. and an Input Signal to the Amplifier of 2 m/v. the frequency from the Signal Generator should be adjusted to 200 c/s and the output from the Amplifier should not be lower than 2dB below the level obtained @ 1Kc. under the same test conditions.

(b) With the same test conditions, adjust the frequency of the Signal Generator to 5K. c/s and note the output level from the Amplifier under test, which should not be more than 1.5dB lower than the output level @ 1Kc. under the same conditions of test.



STANDARD CARBON MIC TEST CIRCUIT

TEST NOTES
1 ENSURE CORRECT POLARITY
2 ADJUST S/C CURRENT TO 60 M/A
3 ADJUST 2 M/V INPUT REF SIGNAL UNDER LOADED CIRCUIT CONDITIONS POWER ON

TEST LAYOUT FOR THIN FILM MICROPHONE PRE-AMPLIFIER
Figure 701

TROUBLE SHOOTING

Any defects are likely to be simple and obvious. The only way in which a defect may be in the least obscure, is in the location of an electrical fault. In the event of microphone or earphone system failure, the appropriate cores of the main lead should be checked electrically to find out if the defect is in the microphone or earphone unit itself, or in the lead, plug or connections.

STORAGE INSTRUCTIONS

1. Conditions

A. Temperature climates

(1) Wrap the jackplug and pack the earphone housings with tissue paper.

(2) Wrap the complete headset in tissue paper, insert in polythene bag, and pack it in a strong carton (if possible, of the type in which the headset is supplied).

(3) Prepare and affix a label giving the following information :-

(a) Headset type number and letter coding if applicable.

(b) Date of last overhaul if any.

B. Tropical climates

(1) Pack the headset as instructed in A (1) and (2).

(2) Insert the closed carton into a polythene bag or length of polythene tubing, according to the material available: heat-seal the bag or tubing.

(3) Wrap the sealed polythene package in Draft paper, seal it with gummed tape, and attach a label as instructed in A (3).

2. Limiting period

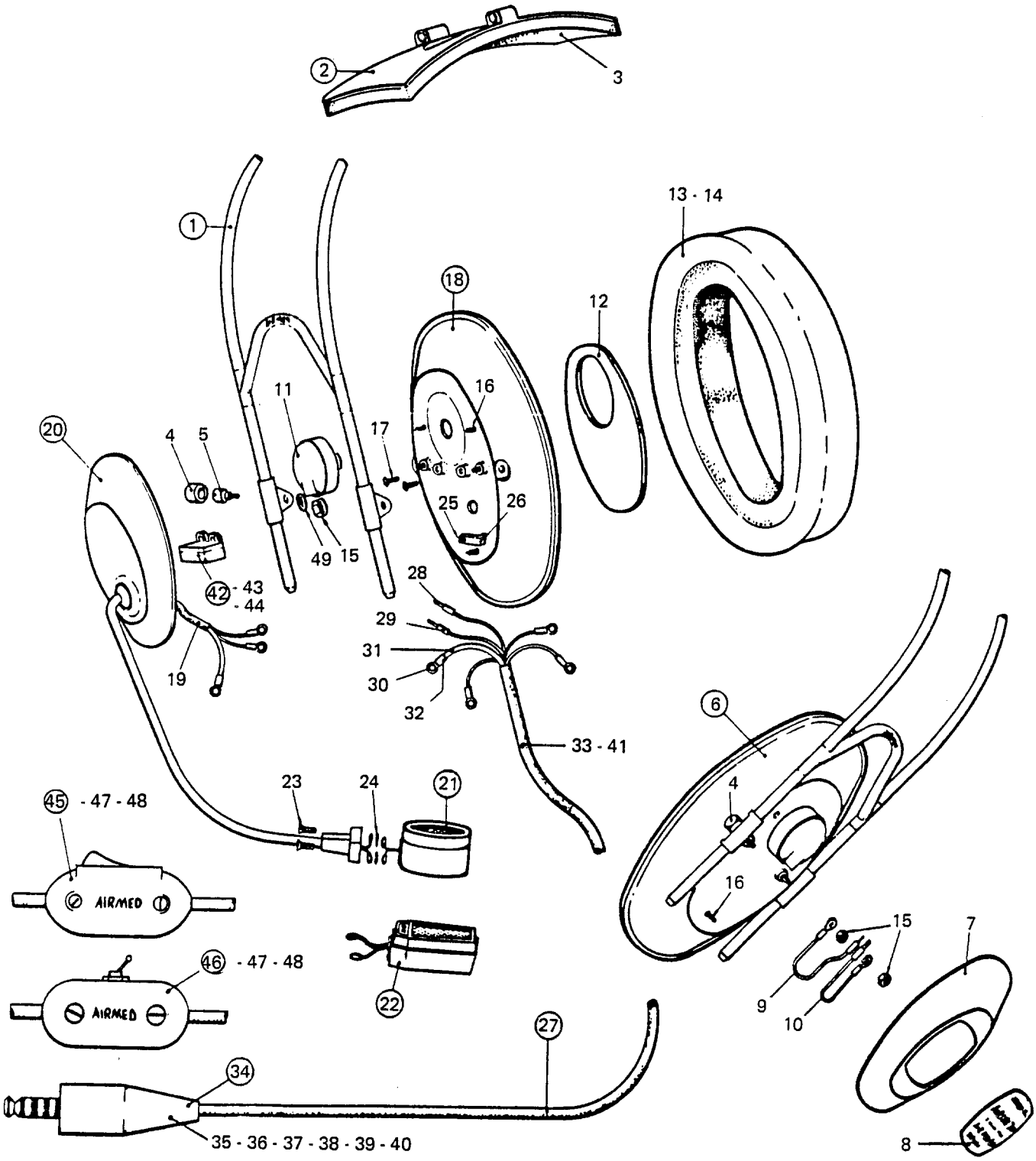
If this headset is stored for long periods it should be overhauled at intervals of three years.

SPECIAL TOOLS, FIXTURES AND EQUIPMENT

The tools, fixtures and equipment normally found in an electrical overhaul workshop will be sufficient to effect the overhaul of this headset.

AIRLITE 70 HEADSETS

ILLUSTRATED PARTS LIST



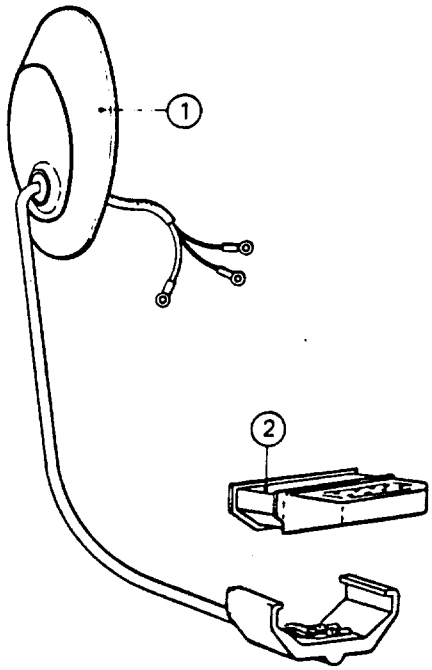
EXPLODED VIEW OF HEADSET
Figure 1101

1. Parts List

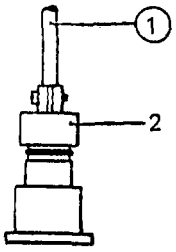
Fig. & Index No.	AIRMED Part Number	Nomenclature 1 2 3 4 5 6 7	Usage Code	Units per Assy.
1101	Air 5850	HEADSET		
- 1	Air 5856	Headband sub-assembly	All	1
- 2	Air 5913	Headpad complete with motif	All	1
- 3	Air 5877	Cushion, headpad	All	1
- 4	Air 5912	Cap, insulating	All	4
- 5	Air 5866	Screw, headband swivel	All	4
- 6	Air 5852	Earshell sub-assembly, non-boom side	All	1
- 7	Air 5863	Cover, earshell	All	1
- 8	Air 5886	Nameplate	All	1
- 9	Air 5854/1	Connector, earphone inset, positive	All	1
-10	Air 5854/2	Connector, earphone inset, negative	All	1
-11	E8/27	Earphone inset, 600 ohms	EarphA	2
	E8/26	Earphone inset, 300 ohms	EarphB	2
	E8/25	Earphone inset, 60 ohm	EarphC	2
	E8/28	Earphone inset, 1200 ohm	EarphD	2
	E8/29	Earphone inset, 2400 ohm	EarphE	2
-12	Air 5878	Disc, earshell, foam	All	2
-13	Air 491	Earpad	All	2
-14	Air 5607	Cover, earpad	All	2
-15	Mat 690	Locknut, 8 B.A. A14/8B	All	8
-16	Mat 826A	Screw, self-tapping, 2G x 3/16 in. (V.GKN. NPK type Z)	All	6
-17	Mat 775C	Screw, 8 B.A. x 5/32 in. round head	All	2
-18	Air 5851	Earshell sub-assembly boom side	All	1
-19	E7/30	Cable, 11 inch length	All	1
-20	Air 5858	Boom, clutch and cover sub-assembly including cable	Mics. DEHIJ	1
-21	E17/31	Microphone, 300 ohm moving coil	Mic.HJ	1
	E17/33	Microphone, 50 ohm moving coil	Mic. I	1
-22	E17/37	Microphone, 300 ohm moving iron	Mic. D	1
	E17/36	Microphone, 50 ohm moving iron	Mic. E	1
-23	Mat 776B	Screw, 8 B.A. x 7/32 in. c/sk.	Mics. DEHIJ	2
-24	Mat 861	Washer, 9 B.A. (V.L.LS 501/11)	Mics. DEHIJ	2
-25	Mat 827A	Screw, self tapping, 4G x 5/16 in. c/sk slot (V. GKN 4230)	All	1
-26	Air 5879	Clamp, downlead	All	1
-27	Air 5887/1	Downlead assembly, with Nato plug	Plug G	1
-28	Air 5746	Pin, earphone inset, positive	All	1
-29	Air 5745	Pin, earphone inset, negative	All	1
-30	E5/5	Tag, crimping, 8 B.A. AGS 1615/29	All	4
-31	E6/8	Sleeve, black, 1 in. (V.H. H12)	All	1
-32	E6/13	Sleeve, orange, ¼ in. (V.H. H12)	All	1
-33	E7/28	Cable, 60 in.	All	1

Fig. & Index No.	AIRMED Part Number	Nomenclature 1 2 3 4 5 6 7	Usage Code	Units per Assy.
1101				
-34	E9/14	Jackplug, Nato, A.M. type 671 R.A.F. stores ref. 10H/18575	Plug G	1
-35	E6/16	Sleeve, black, 1 in. (V.H HH40)	Plug G	½
-36	E6/21	Sleeve	Plug G	1
-37	E6/19	Cap, insulating	Plug G	1
-38	E5/4	Tag, soldering (V. RC P.O. 68)	Plug G	4
-39	Air 436	Ferrule, crimping	Plug G	1
-40	E6/9	Sleeve, black ¾ in. (V.H. H30)	Plug G	2
-41	Air 5883/1	Sleeve	Mics. DEHI	1
	Air 5883/2	Sleeve	Mics.GJ	1
-42	Air 5880	Amplifier sub-assembly, miniature	Mic. J	1
-43	E6/12	Sleeve, green, ¼ in. (V.H H12)	Mic. J	2
-44	E6/11	Sleeve, yellow, ¼ in. (V.H.H12)	Mic. J	1
-45	Air 5680	Switch sub-assembly, press-to-talk	Switch A	1
	Air 5680	Switch sub-assembly, press-to-talk to operate transmitter	Switch C	1
	Air 5650	Switch sub-assembly, on-off	Switch B	1
-46	Air 5705	Switch sub-assembly, on-off and P.T.T. combined	Switch D	1
-47	E5/5	Tag, crimping, 8 B.A. AGS 1615/29	Switches ABC	2
-48	E6/9	Sleeve, black ¾ in. (V.H H30)	Switches ABCD	2
	Air 5915	Cover, earshell sub-assembly with no microphone or boom	Mic. O	1
-49	Mat 856	Washer, 8BA, silver plated	All	4

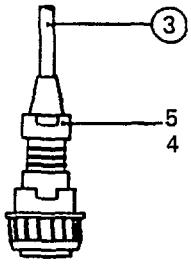
Fig. & Index No.	AIRMED Part Number	Nomenclature 1 2 3 4 5 6 7	Usage Code	Units per Assy.
1102				
- 1	Air 5849	Boom, clutch and cover sub-assembly including cable.	Mic.G	1
- 2	E17/10	Microphone, 100 ohm carbon	Mic.G	1



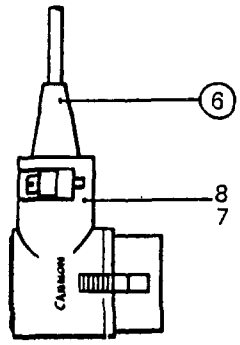
BOOM, CLUTCH AND COVER SUB-ASSEMBLY
CARBON MICROPHONE
Figure 1102



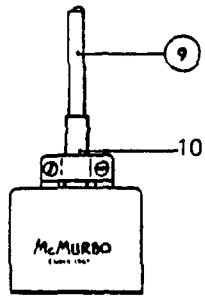
DEUTSCH PLUG



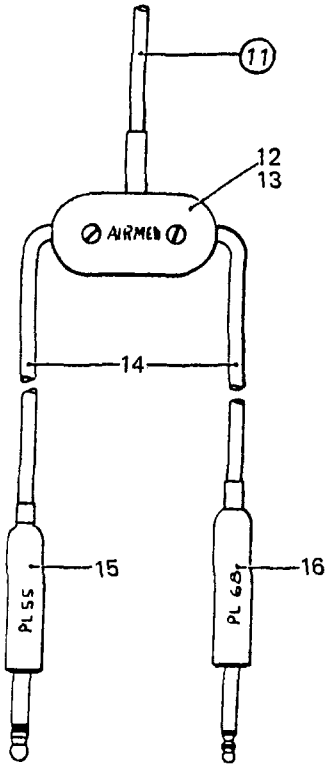
PLESSEY PLUG



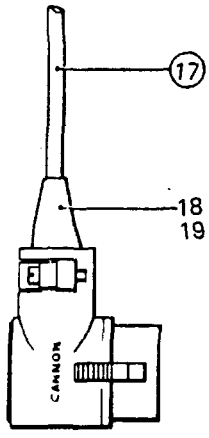
CANNON 8 WAY PLUG



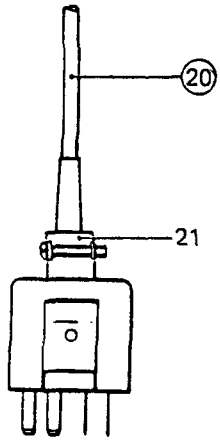
McMURDO 9 WAY PLUG



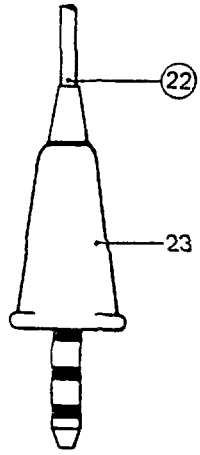
SPLIT LEAD WITH PL 55
AND PL 68 PLUGS



CANNON 6 WAY PLUG



ELCOM PO 8 PLUG



RAF PLUG

MAIN LEAD TERMINATIONS
Figure 1103

Fig. & Index No.	AIRMED Part Number	Nomenclature 1 2 3 4 5 6 7	Usage Code	Units per Assy.
1103- 1	Air 5894/1	Downlead assembly complete with Deutsch plug	Plug I	1
- 2	E9/18	Jackplug, Deutsch DM 9702 - 7P		1
- 3	Air 5896/1	Downlead assembly with Plessey Socket	Plug J	1
- 4	E10/10	Socket MK 4,6-pin (V. P no CZ 49017)		1
- 5	E10/11-16	Outlet accessory set		
- 6	Air 5902/1	Downlead assembly complete with Cannon 8-way plug	Plug P	1
- 7	E9/27	Jackplug, Cannon EP/CG/8/15 AM type 746		1
- 8	Air 5709	Ferrule		1
- 9	Air 5899/1	Downlead assembly complete with McMurdo plug	Plug M	1
-10	E9/33	Micro-connector, McMurdo 9-way		1
-11	Air 5895/1	Downlead assembly complete with junction box, split lead and plugs PL 55 and PL 68	Plug E	1
-12	Air 5914	Box, junction sub-assembly		1
-13	Air 5909	Ferrule		3
-14	E7/28	Cable, 9 in.		2
-15	E9/12	Jackplug, PL 55 or PJ 055		1
-16	E9/13	Jackplug, PL 68 or PJ 068		1
	Air 5897/1	Downlead assembly complete with PL 55 Plug	Plug K	1
-15	E9/12	Jackplug, PL 55 or PJ 055		1
	Air 5884/1	Downlead assembly complete with PL 68 plug	Plug F	1
-16	E9/13	Jackplug, PL 68 or PJ 068		1
-17	Air 5901/1	Downlead assembly with Cannon 6-way plug	Plug N	1
-18	E9/30	Jackplug, Cannon EP/CG/6/15		1
-19	Air 5709	Ferrule		1
-20	Air 5898/1	Downlead assembly complete with Elcom plug	Plug L	1
-21	E9/23	Jackplug, Elcom P.O.8.		1
-22	Air 5889/1	Downlead assembly complete with R.A.F. plug	Plug H	1
-23	E9/15	Jackplug, A.M. type 119 R.A.F. Stores ref. 10H/10991		1

Note:- All the foregoing Downlead assemblies with part numbers ending in /1 are without switches.
If switches are fitted the Airmed part numbers end as follows:-
/2 for Press-to-talk switch A
/3 for On-Off switch B
/4 for Press-to-talk to key transmitter switch C
/5 for combined On-Off Press-to-talk switch D

The above switches are shown on Fig. 1101 are listed on page 1104.

2. Vendors' codes

Code	Vendor
GKN	GKN Screws & Fasteners Ltd., P.O. Box 24, Heath Street, Birmingham 18.
H	Hellermann Ltd., Gatwick Road, Crawley, Sussex.
L	Lewis Spring Co. Ltd., Resilient Works, Redditch, Worcs.
P	The Plessey Co. Ltd., Cheney Manor, Swindon, Wiltshire.
RC	Ross, Courtney & Co. Ltd. 25, Ashbrook Road, Upper Holloway, London, N.19.

SCHEDULE OF OVERHAUL PERIODS

For this headset there is no fixed period between overhauls; it should be overhauled when its condition warrants it.

De Havilland Canada

OVERHAUL MANUAL

AUDIO CONTROL UNITS

TYPE DHC60126 AND DHC60206

THE DE HAVILLAND AIRCRAFT OF CANADA LIMITED
DOWNSVIEW ONTARIO

Feb. 1/69

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De Havilland Canada

OVERHAUL MANUAL

RECORD OF REVISIONS

Retain this record in the front of the manual. On receipt of revisions, insert revised pages in the manual and enter the revision number, revision date, insertion date, and initials of person incorporating the revision, in the appropriate block on the revision record.

Rev. No.	Rev. Date	Insertion Date	By

Rev. No.	Rev. Date	Insertion Date	By

LIST OF EFFECTIVE PAGES

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23-09-01	801	Feb 1/69
23-09-01	901	Feb 1/69
23-09-01	1001	Feb 1/69
23-09-01	1101	Feb 1/69
23-09-01	1102	Feb 1/69
23-09-01	1103	Feb 1/69
23-09-01	1104	Feb 1/69
23-09-01	1105	Feb 1/69
23-09-01	1106	Feb 1/69

INTRODUCTION

This manual contains instructions for the overhaul of the DeHavilland Audio Control Units, Types: DHC60206 and DHC60126. These units are used in DHC-4 and DHC-6 aircraft.

AUDIO CONTROL UNITS (DHC60126 AND DHC60206) - DESCRIPTION AND OPERATION

1. GENERAL

The Audio Control Units (DHC60126 and DHC60206) are the basis of the aircraft audio integrating system, providing intercommunication between pilot and the crew members and the facility to monitor all communication and navigation receivers and microphone transmission over a selected transmitter. The DHC60206 also has provision for a passenger address (PA) system. (See Fig. 1 for typical installation.) A list of the major components of the control units, with locations and part designations is given in the Illustrated Parts List (Ref para L).

A. Description and Operation

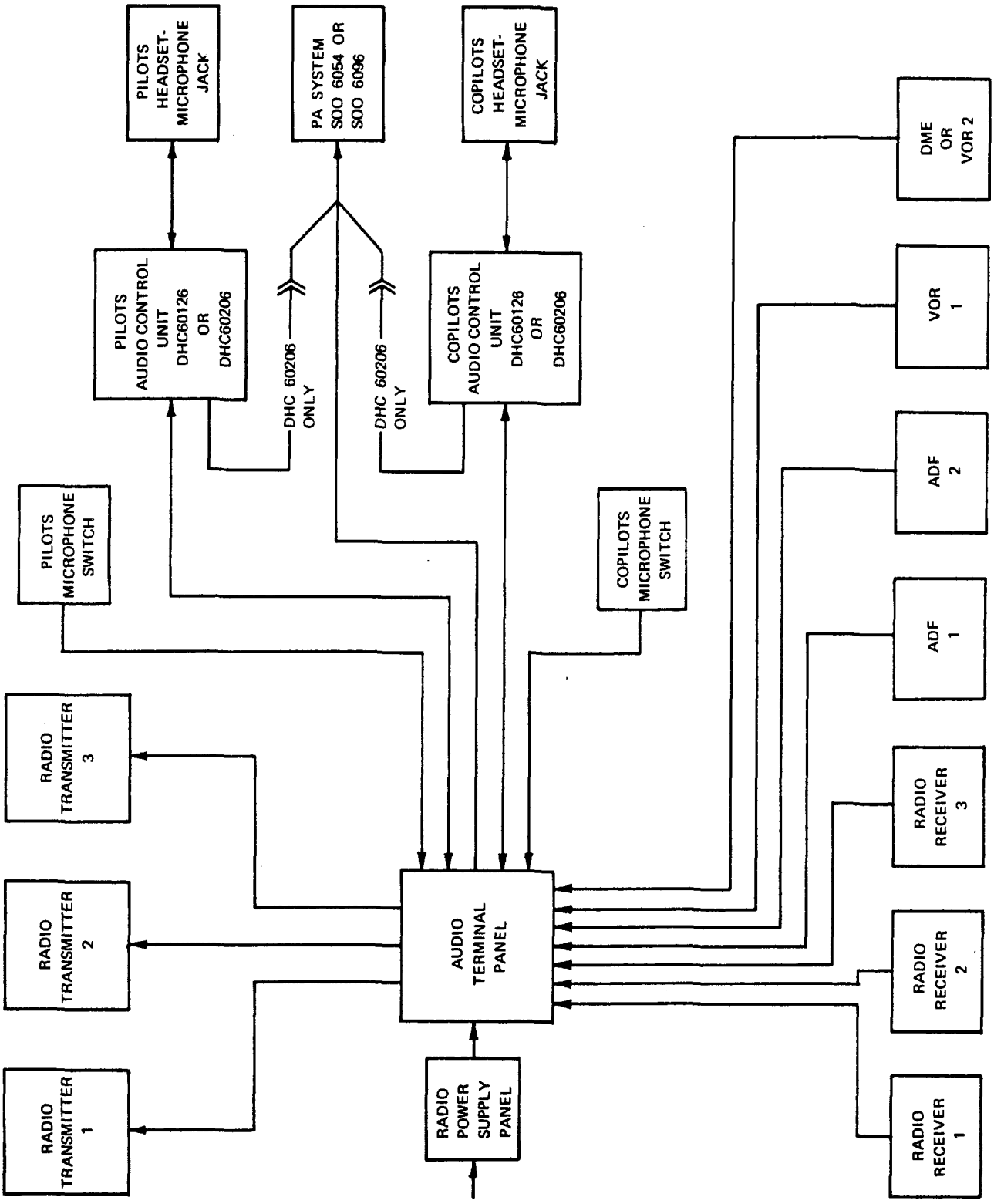
(1) The audio control unit (DHC60126), contains a mike audio (or interphone) amplifier and a receiver audio amplifier, a mike audio and control relay 'K1', interphone audio and 'K1' interlock relay 'K2', a resistor-capacitor network, diodes, switches for receiver audio and microphone selection, volume control for receiver and interphone audio, a loudspeaker - phones select switch and a normal-emergency switch.

(2) The audio control unit (DHC60206), is basically the same unit as the DHC60126 with the following exceptions which provide the added PA facility: The two amplifiers are isolation amplifiers feeding the PA system and a PA audio relay 'K3' is added; also the loudspeaker - phones switch is changed to a three position, loudspeaker-PA-phones switch.

(3) The front panel of the audio control unit (DHC60126, Fig. 2) has controls as follows: seven receiver monitoring toggle switches marked RECEIVERS 1, 2, 3; ADF 1 and 2; and VOR 1 and 2; a rotary transmitter selector switch marked MIKE SELECT 1, 2, 3 and INPH; a VOLUME control and two toggle switches marked SPKR/PHONE and NORM/EMERG.

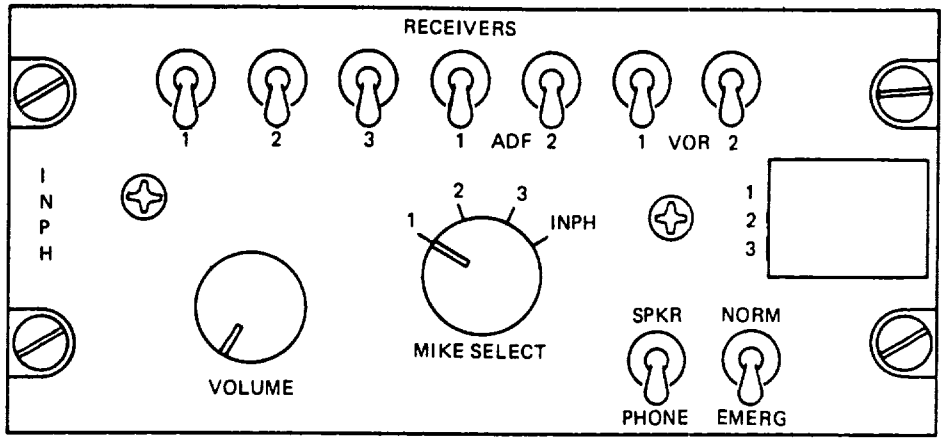
(4) The front panel of the audio control unit (DHC60206, Fig. 2) has controls as follows: seven receiver monitoring toggle switches marked RECEIVERS 1, 2, 3; ADF 1 and 2; and VOR 1 and 2 (-3 configuration) or VOR and DME (-7 configuration); a rotary transmitter selector switch marked MIKE SELECT 1, 2, 3 and INPH; a VOLUME control; a three position rotary switch marked SPKR/PA/PHONE, and a two position rotary switch marked NORM/EMERG.

(5) The DHC60126 circuit functions as follows (see Fig. 701). When the RECEIVERS toggle switches are selected to the ON position, three communications receivers, two automatic direction finding (radio compass) receivers, and one VHF omni-directional range receiver (VOR 1) and a second VOR or a DME receiver connected to VOR 2 switch may be monitored singly or in any combination, provided the NORM/EMERG switch is in the NORM position. The audio level of the received signals can be adjusted by the respective volume controls on the individual receiver control panels, and the combined audio of the receivers can be regulated by the VOLUME control on the audio control unit. Signals received from the marker beacon receiver (if installed) are fed directly through the audio control unit to the headset, the volume again being controlled in a similar manner. Positions 1, 2 and 3 of the MIKE SELECT switch are assigned to three communications receiver-transmitters. When the MIKE SELECT switch is selected to one of these positions, and provided the corresponding facility control panel is set for operation, the receiver sidetone and audio is connected to the headset

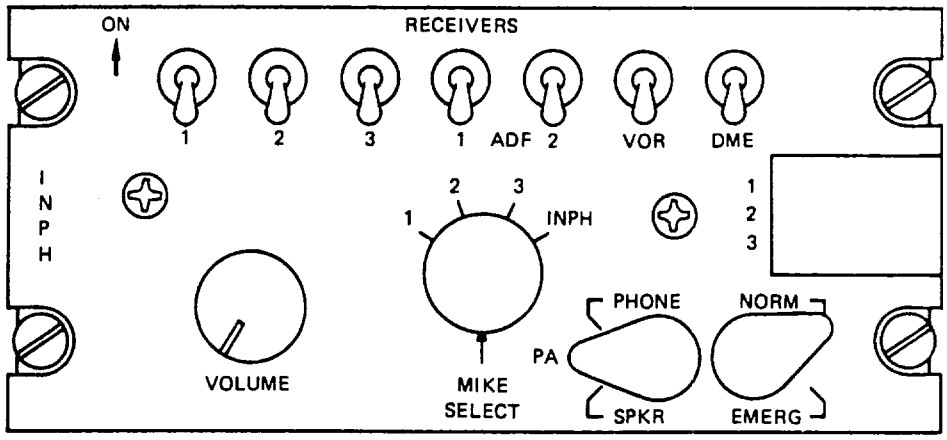


Typical Audio Integrating System - Block Diagram

Figure 1



DHC60126-1



DHC60206-7

Audio Control Units - Panel Layout

Figure 2

automatically, regardless of whether the RECEIVERS toggle switch is set to ON. When the microphone switch is actuated the operator is transmitting directly on the facility selected. If all communications facilities are not installed and connected to positions 1, 2 and 3, the appropriate switches are inactive. The INPH position of the MIKE SELECT switch is for interphone only; when both audio control units are set to INPH the microphone switches are used for direct intercommunication between the pilot and copilot.

The NORM /EMERG switch should always be in the NORM position except in the case of failure of an audio amplifier in the audio control unit. When selected to the EMERG position, the audio amplifier is bypassed, and only individual receiver audio may be selected, by means of the RECEIVERS toggle switches. The marker beacon audio however, is not connected in the EMERG position, and the automatic pick-up of communications receivers audio from the MIKE SELECT switch is rendered inoperative, as is the VOLUME control and the INPH position of the MIKE SELECT switch. The RECEIVERS toggle switches are wired so that the switch furthest to the left which is selected ON is the only one heard, overriding any others which are switched ON. Failure of one audio control unit will not affect the operation of the other.

The SPKR /PHONE switch must be in the PHONE position for normal operation with the headset. If a speaker system is installed in the aircraft, selecting the SPKR /PHONE switch to SPKR, supplies 28 volts dc to the speaker system and also routes all the receivers and interphone audio to the speakers.

(6) The DHC60206 circuit functions as follows (see Fig. 702). When the rotary MIKE SELECT switch is set to positions 1, 2 or 3, the associated microphone switch is connected to operate the selected transmitter, and the audio and sidetone for the corresponding receiver are also switched on automatically, regardless of the toggle switch setting. In all positions including INPH, the interphone positions on the microphone switches provide interphone operation. The NORM /EMERG switch should be maintained in the NORM position. In the event of failure of the isolation amplifier, the EMERG position permits operation of one receiver at a time, using the toggle switches, and one transmitter. The toggle switches are wired so that the one furthest to the left which is turned on is the only one heard, overriding any others which are switched on. The automatic pick-up of a communications receiver from the MIKE SELECT switch is inoperative, as is the VOLUME control, in emergency operations. The PA switch must be maintained at the PHONES position for normal operation with the headsets. When set to the SPKR position, the headphones are disconnected and audio and a 28-volt dc supply are routed to the speaker system. When PA position is selected audio and a 28-volt dc supply are connected via relay 'K3' to the passenger address system. When MIKE SELECT switch is set to INPH, a ground return is completed to energize 'K2' (single button operations only), thus cutting out receiver audio and allowing only interphone through the speaker.

(7) Both control units can be modified as follows: If two button operation is required a jumper between terminals 9 and 10 in the audio control unit must be removed. Provision for dynamic microphone is provided by removing jumpers from terminals 2 and 4; 1 and 3, and installing a microphone preamplifier (DHC60131, DHC60198 or DHC60203, Fig. 1101). For use with a low impedance headset, remove jumpers from terminals 5 and 6; 7 and 8, and install an impedance matching transformer (DHC60132, or DHC60197, Fig. 1102), 'Hot Mike' operation is provided for by adding a jumper between terminals 11 and 36.

(8) The control units require a 28-volt dc power supply, the supply to the amplifier being filtered by an active-type filter network. The supply to the relays is unfiltered.

(9) The receiver audio and interphone audio amplifiers (DHC60126) and the two isolation amplifiers (DHC60206) are Tramm amplifiers (type 1A160). These are transistorized, miniaturized, hermetically sealed units and are serviced by replacement.

(10) The audio control units (DHC60126 and DHC60206) have various configurations which are annotated by dash numbers and Mod status letters at rear of unit. These are shown in Table 1.

Table 1

Audio Control Unit Configurations

DHC60126-1	Aviation red lighting
-3	Aviation white lighting
DHC60206-1	Aviation red lighting
-3	Aviation white lighting
-5	Aviation red lighting) With DME in lieu of VOR 2
-7	Aviation white lighting) With DME in lieu of VOR 2

B. Disassembly

(1) The disassembly procedure for both units (DHC60126 and DHC60206) is basically the same, and is to be carried out as follows:

(a) Release the two snap fasteners at the rear of unit and slide off the outer cover.

(b) Remove control knobs from front panel and undo the two Philips-type retaining screws. Remove facing panel from backing panel.

(c) Undo the four retaining screws on the backing panel and drop the panel to gain access to the rear, taking care not to tension the interconnecting wiring harness.

(2) Steps (1) (a), (b) and (c) give sufficient access for normal maintenance i.e. replacement of resistors, capacitors or diodes. To replace the component board assembly, amplifiers, switches and relays proceed as follows:

(a) Component board assembly - Unsolder the wiring harness from the component board assembly, taking care to identify the wires as necessary. Undo the three Philips-type retaining screws and remove the component board assembly.

(b) Amplifier - Unsolder the wiring to the amplifier units, taking care to identify the wires as necessary. Undo two Philips-type screws holding the amplifier retaining bracket in position. Remove amplifier.

(c) Switches - Unsolder and identify wires as necessary. Undo the associated retaining nut and remove switch.

(d) Relays - Unsolder and identify wires as necessary. Undo MS21042-04 retaining nuts and remove relay.

C. Cleaning

(1) Clean all electrical components, resistors, capacitors and diodes by wiping with lint-free cloth dampened with dry-cleaning solvent. Dry immediately using compressed air.

(2) Remove dust, dirt or other foreign matter from terminals of electrical connector using a soft-bristle brush in conjunction with compressed air. Wipe body of connector with lint-free cloth dampened with dry-cleaning solvent. Wipe dry with clean, dry lint-free cloth.

(3) Clean terminals of relays and terminal plate using a soft-bristle brush moistened with dry-cleaning solvent.

(4) Clean all wiring using a soft-bristle brush in conjunction with compressed air.

D. Inspection /Check

(1) Visual

(a) Check for damage to outer case and front panel.

(b) Check connector assembly for pin damage.

(c) Check chassis for dents and cracks.

(d) Check component board assembly for cracks.

(e) Check for signs of component overheating.

(2) Electrical (Ref para H.).

E. Repair

(1) Replace all defective or damaged components.

(2) When replacing diode components use the proceedure as follows:

(a) Grasp the diode leads with a pair of long-nosed pliers to form a heat sink. Use a pencil-type or other light-duty soldering iron to attach diode leads to points of termination.

CAUTION: NEVER APPLY HEAT TO THE LEADS CLOSE TO THE DIODE BODY. THE SMALL CRYSTALS USED AS P-N JUNCTIONS IN THE CONSTRUCTION OF SEMICONDUCTOR DIODES MAY BE PERMANENTLY DAMAGED BY THE EXCESSIVE AMBIENT TEMPERATURE CONDITION. BE CAREFUL NOT TO PULL THE DIODE LEAD WITH THE PLIERS.

(b) Hold pliers in place after heat is removed and until diode lead is cool enough to touch with hand.

F. Assembly

(1) The assembly procedure of both units (DHC60126 and DHC60206) is basically the same and is to be carried out as follows:

(a) Relays - Locate in position with MS21042-04 retaining nuts; solder wires to relay terminals.

(b) Amplifier - Locate amplifier in position and secure with mounting bracket and two Philips-type screws. Solder wires in position.

(c) Component board assembly - Locate in position and secure with three Philips-type screws. Solder wires in position.

(d) Fit backing panel assembly onto unit and secure with the four retaining screws.

(e) Switches - Locate switch on panel assembly and secure with retaining nut. Place facing panel on backing panel and secure with two Philips-type screws. Solder wires in position.

(f) Slide on outer cover and secure with the two snap fasteners at rear.

G. Fits and Clearances

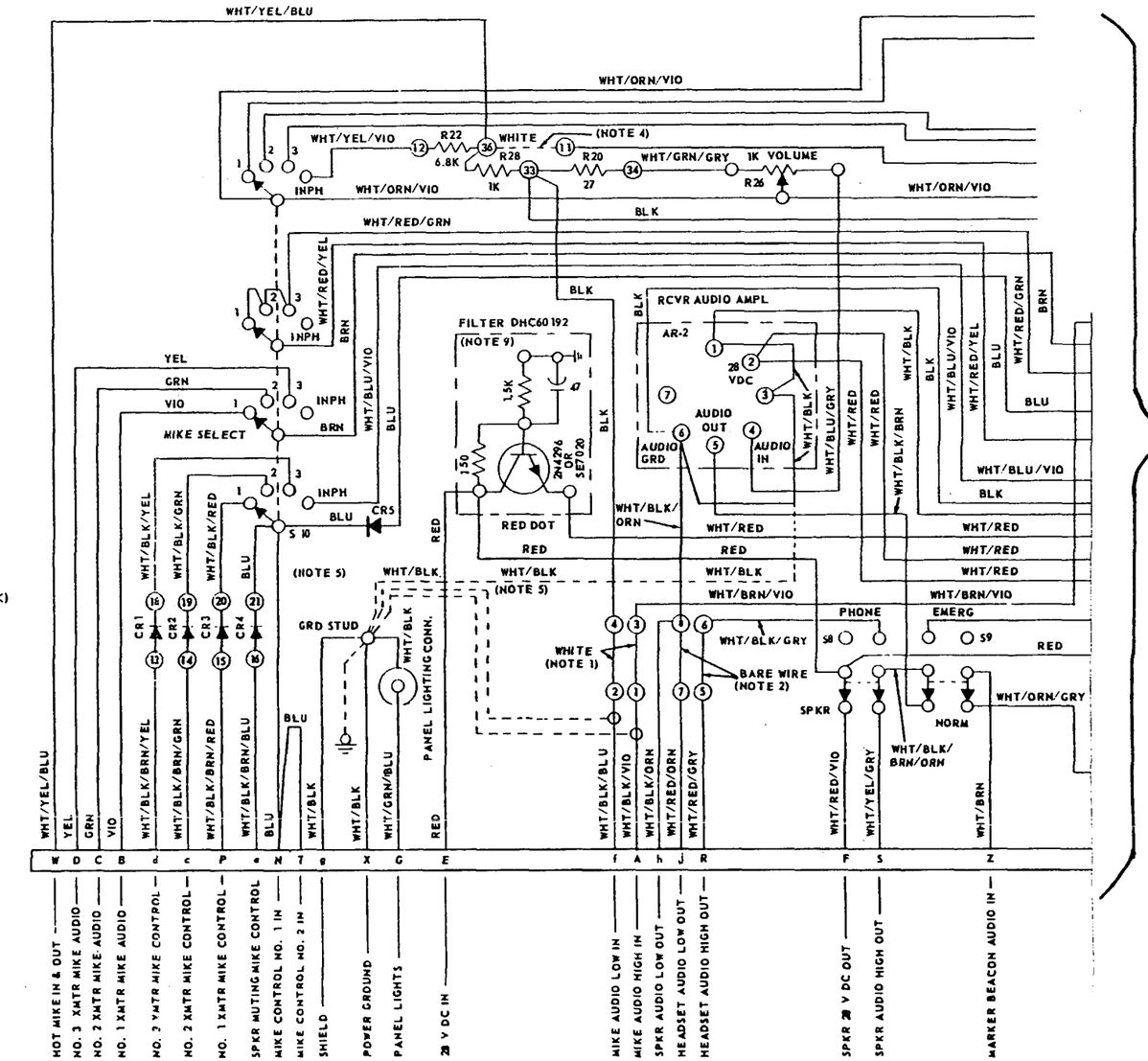
None applicable.

H. Testing

(1) General - Test procedures for the Audio Control Units DHC60126 and DHC60206 consist of a series of continuity tests and resistance measurements using internal wiring and component layout diagrams. (Ref Fig. 703, 704 and 705.)

(2) Continuity checks - Refer to the internal wiring diagrams and check the circuits for continuity for all switch selections. A multimeter, ohmmeter, or low voltage lamp-type continuity checker may be used.

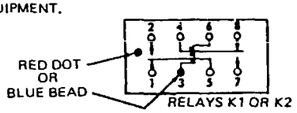
(3) Resistance checks - The resistance checks should be carried out using a multimeter or an ohmmeter with a minimum accuracy of $\pm$ 5%. Resistor values are given on the internal wiring diagrams. (Ref Fig. 701 and 702.)



SEE SHEET 2 OF 2

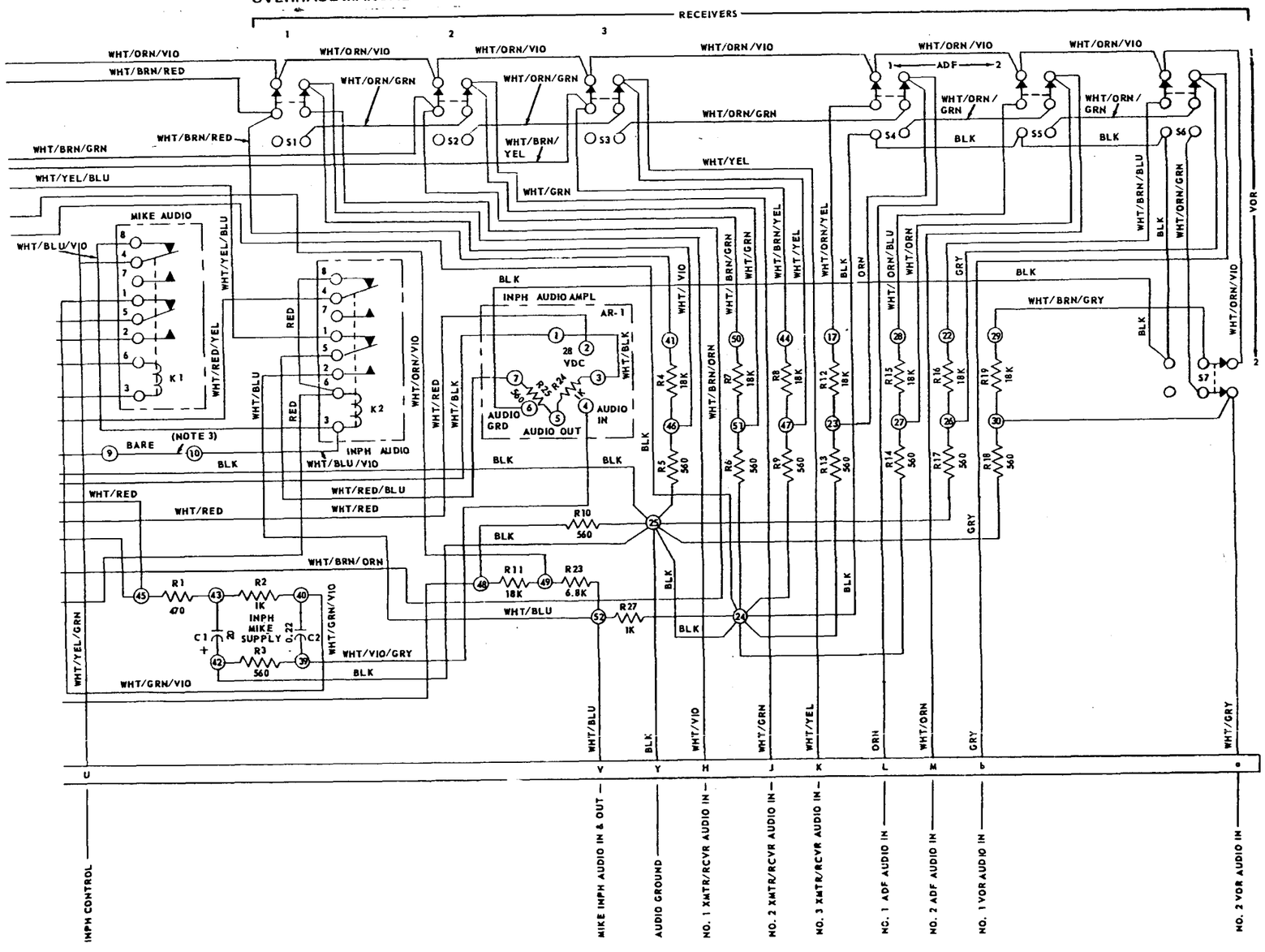
NOTES:

1. JUMPERS BETWEEN TERMINALS 1 AND 3, AND TERMINALS 2 AND 4 TO BE REMOVED, WHEN MICROPHONE REAMPLIFIER (DHC60131; 60198 AND 60203) IS INSTALLED (MODS A, J, K)
2. JUMPERS BETWEEN TERMINALS 5 AND 6, AND TERMINALS 7 AND 8 TO BE REMOVED WHEN HEADSET IMPEDANCE MATCHING TRANSFORMER (DHC60132 AND 60198) IS INSTALLED (MOD B AND H).
3. JUMPER BETWEEN TERMINALS 9 AND 10 TO BE REMOVED IF SEPARATE INTERPHONE SWITCH (TWO BUTTON OPERATION) IS INSTALLED. (MOD C)
4. JUMPER BETWEEN TERMINALS 11 AND 36 TO BE ADDED IF "HOT MIKE" OPERATION IS DESIRED. (MOD D)
5. WHT/BLK WIRE AT AR2, FROM PIN 3 TO PIN 6, WAS TO GROUND STUD. DIODE ADDED IN BLU WIRE FROM K1 (MOD F).
6. RELAY TERMINAL NUMBERS, AS SHOWN BELOW, DO NOT NECESSARILY APPEAR ON EQUIPMENT.

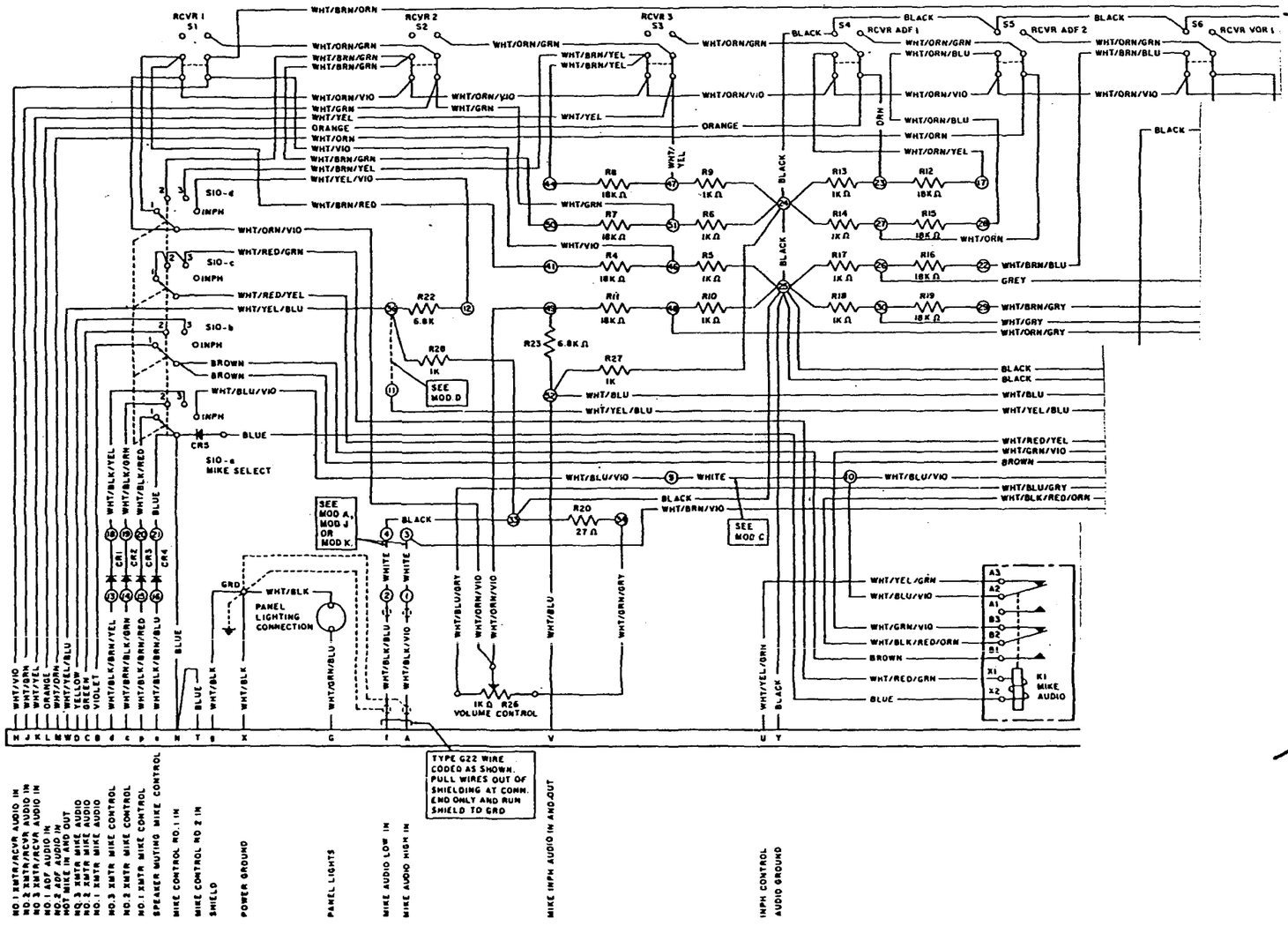


7. ALL RESISTANCE VALUES EXPRESSED IN OHMS.
8. ALL CAPACITANCE VALUES EXPRESSED IN MICROFARADS.
9. FILTER DHC60192 REPLACES DHC60128 (MOD G).

Audio Control Unit - DHC60126 - Internal Wiring
Figure 701



Audio Control Unit - DHC60126 - Internal Wiring
Figure 701

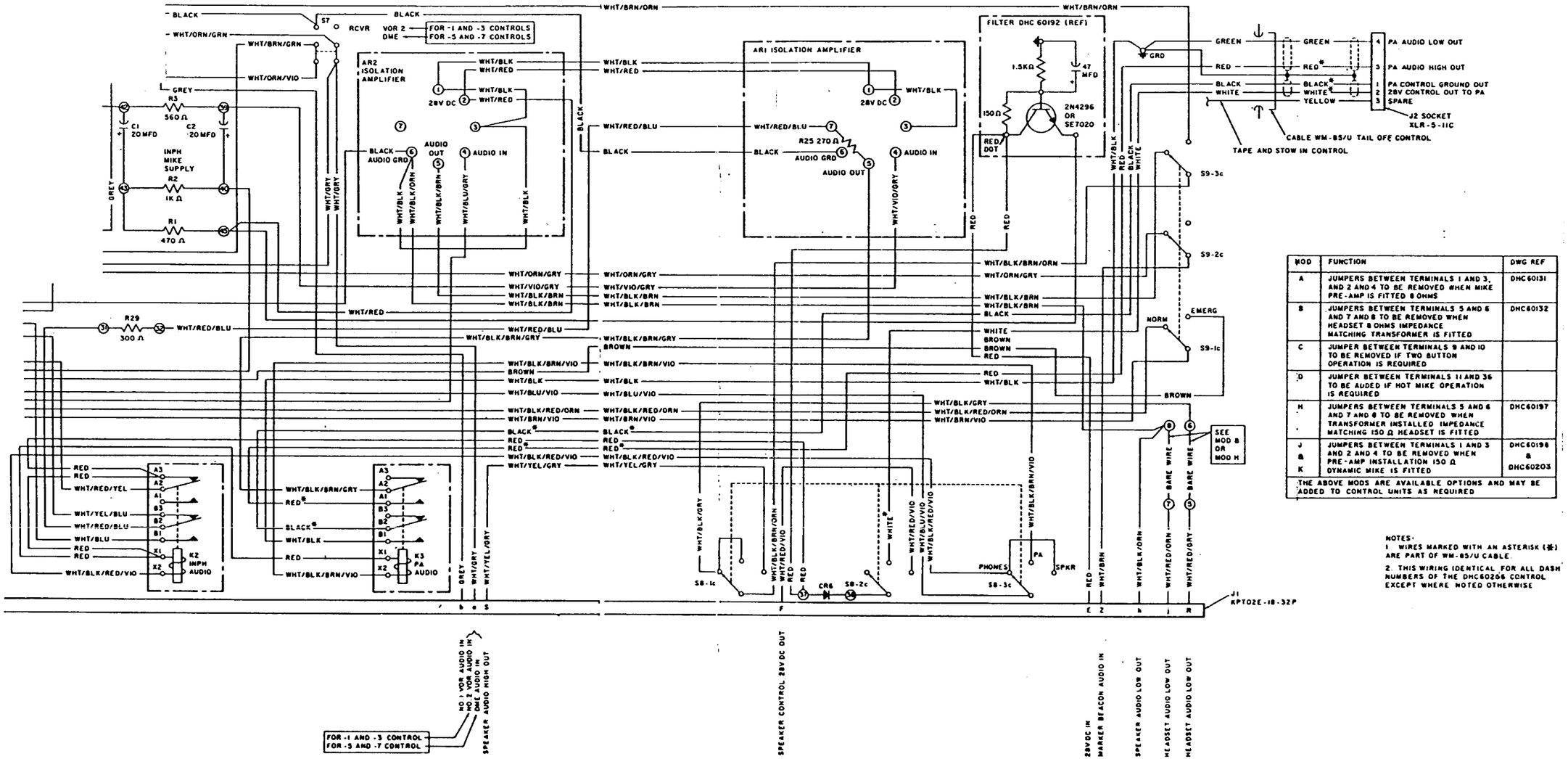


SEE SHEET 2 OF 2

Audio Control Unit - DHC60206 - Internal Wiring

Figure 702

SHEET 1 OF 2



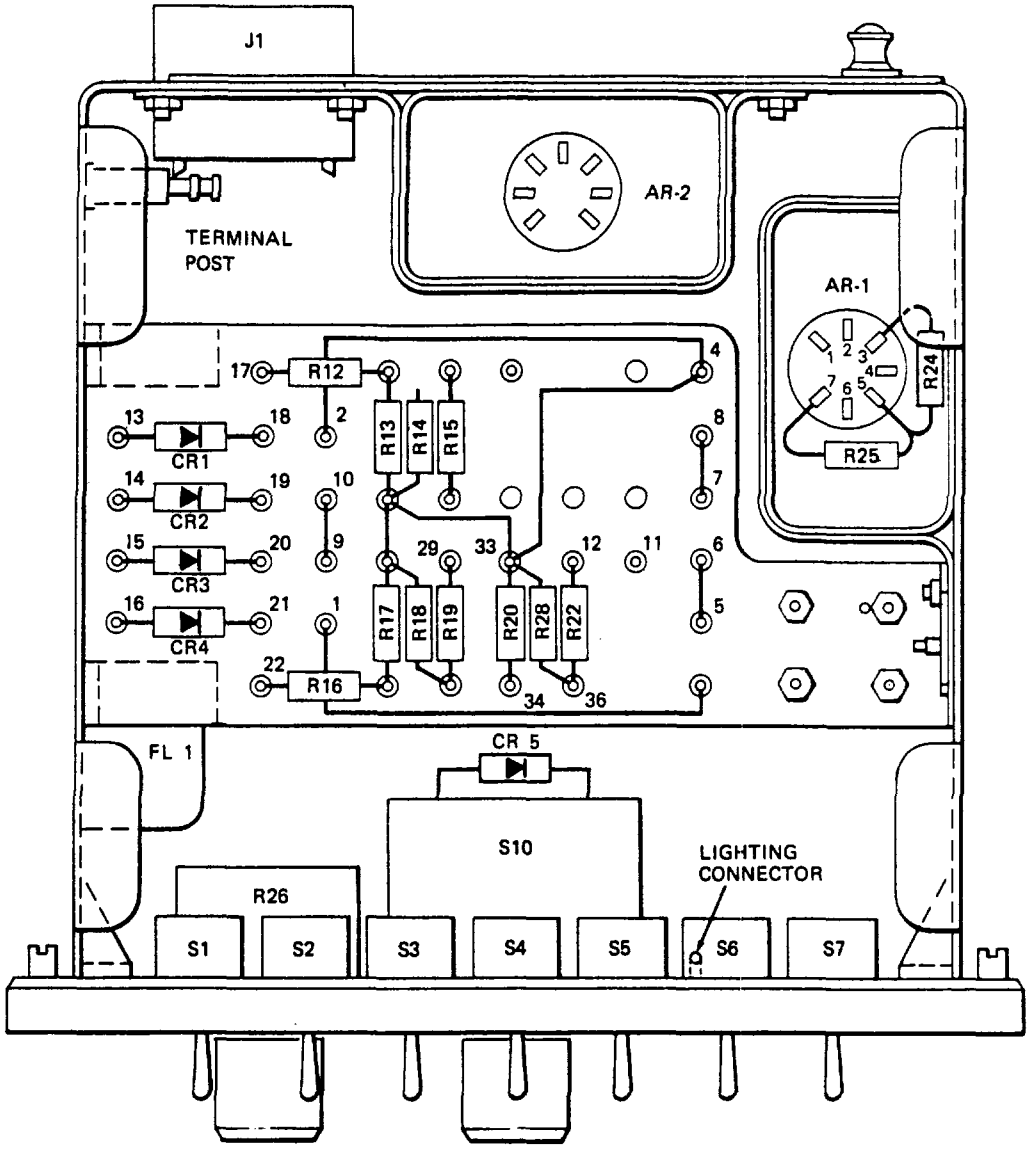
MOD	FUNCTION	DWG REF
A	JUMPERS BETWEEN TERMINALS 1 AND 3, AND 2 AND 4 TO BE REMOVED WHEN MIKE PRE-AMP IS FITTED 8 OHMS	DHC60131
B	JUMPERS BETWEEN TERMINALS 5 AND 6 AND 7 AND 8 TO BE REMOVED WHEN HEADSET 8 OHMS IMPEDANCE MATCHING TRANSFORMER IS FITTED	DHC60132
C	JUMPER BETWEEN TERMINALS 9 AND 10 TO BE REMOVED IF TWO BUTTON OPERATION IS REQUIRED	
D	JUMPER BETWEEN TERMINALS 11 AND 36 TO BE ADDED IF HOT MIKE OPERATION IS REQUIRED	
H	JUMPERS BETWEEN TERMINALS 5 AND 6 AND 7 AND 8 TO BE REMOVED WHEN TRANSFORMER INSTALLED IMPEDANCE MATCHING 150 Ω HEADSET IS FITTED	DHC60197
J & K	JUMPERS BETWEEN TERMINALS 1 AND 3 AND 2 AND 4 TO BE REMOVED WHEN PRE-AMP INSTALLATION 150 Ω DYNAMIC MIKE IS FITTED	DHC60196 & DHC60203

THE ABOVE MODS ARE AVAILABLE OPTIONS AND MAY BE ADDED TO CONTROL UNITS AS REQUIRED

NOTES:
1. WIRES MARKED WITH AN ASTERISK (*) ARE PART OF WM-85/U CABLE.
2. THIS WIRING IDENTICAL FOR ALL DASH NUMBERS OF THE DHC60206 CONTROL EXCEPT WHERE NOTED OTHERWISE

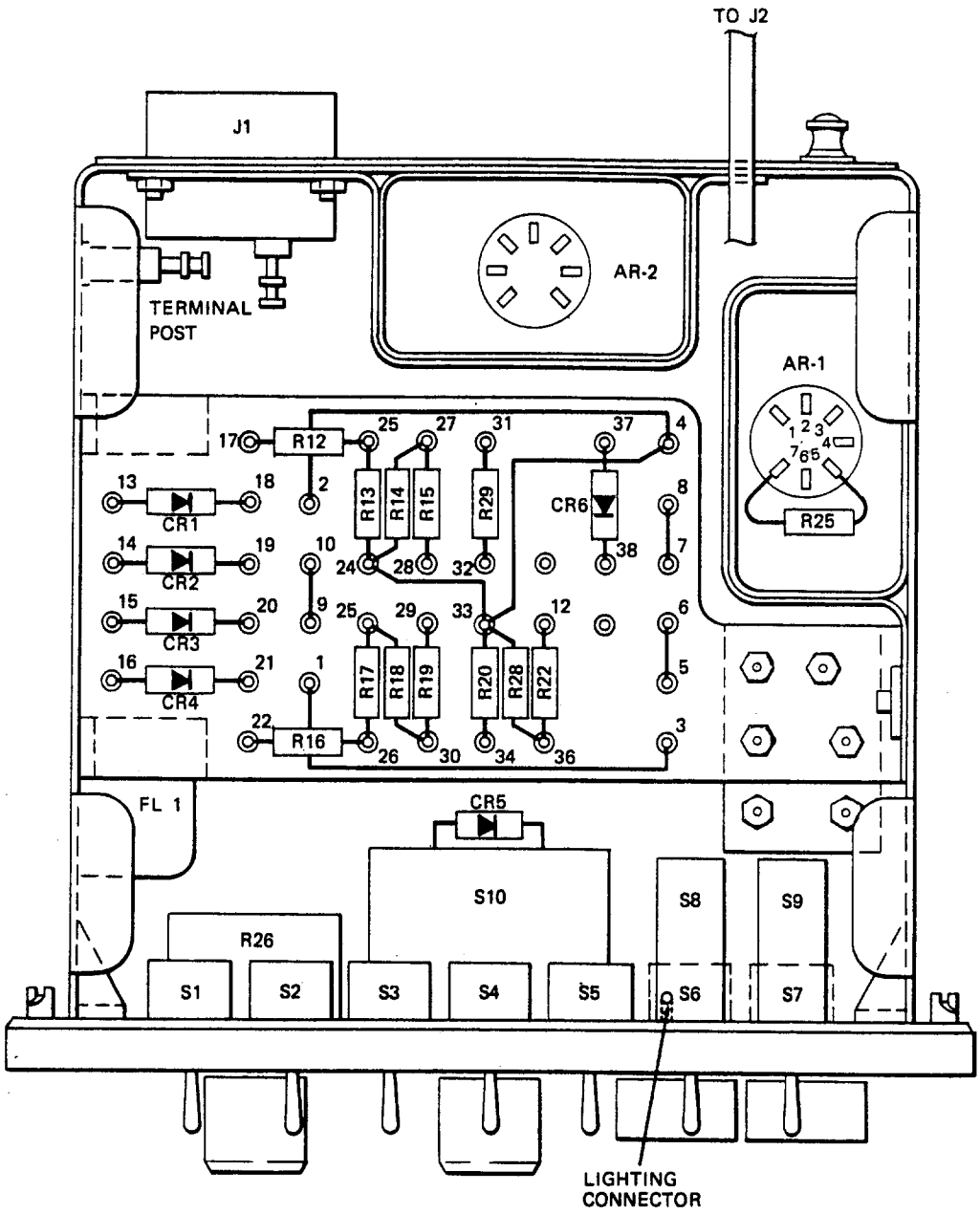
Audio Control Unit - DHC60206 - Internal Wiring

Figure 702



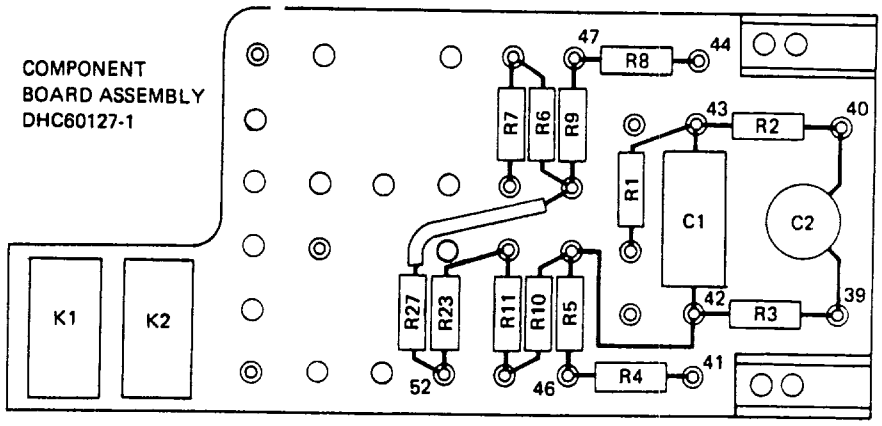
View of Interior (Upper) - Audio Control Unit - DHC60126

Figure 703

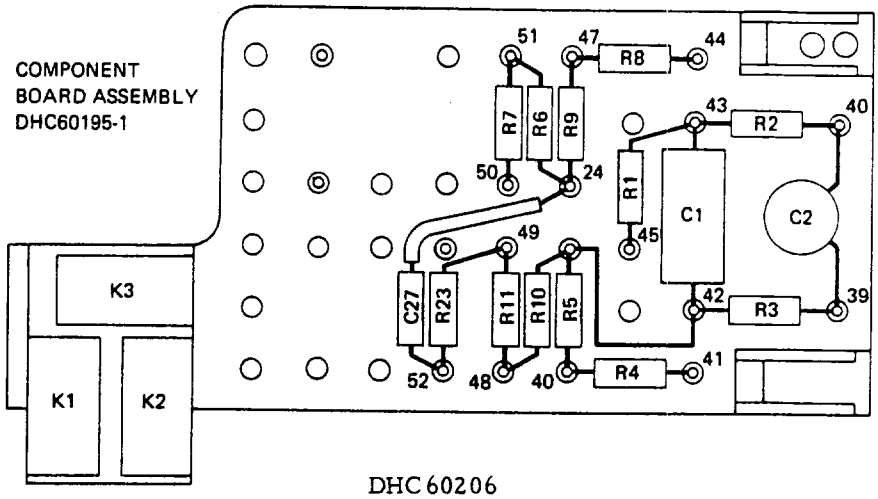


View of Interior (Upper) - Audio Control Unit - DHC60206

Figure 704



DHC60126



DHC60206

Component Board Assembly (Underside) - Audio Control Units

Figure 705

I. Trouble Shooting

The testing instructions given in para H. can be used as a basis for trouble shooting the audio control units. After a malfunction is corrected, repeat the tests which apply to the corrected part of the circuit.

J. Storage Instructions

Cap electrical connector to keep out foreign matter during storage.

K. Special Tools, Fixtures and Equipment

None applicable.

L. Illustrated Parts List

(1, DHC60126 (Fig. 703 and 705)

Fig. Item	Part No.	Mfr	Nomenclature	Units per Assy
703-R22) 705-R23)	RC20GF682K		Resistor, 6.8 K ohm, 1/2 watt, 10%	2
705-R20	RC20GF270K		Resistor, 27 ohm, 1/2 watt, 10%	1
703-R25) 705-R3) 703-R12,) R15, R16) R19) 705-R4,) R7, R8,) R11)	RC20GF561K RC20GF183K		Resistor, 560 ohm, 1/2 watt, 10% Resistor, 18 K ohm, 1/2 watt, 10%	2 8
705-R2	RC32GF102K		Resistor, 1 K ohm, 1 watt, 10%	1
705-R1	RC32GF471K		Resistor, 470 ohm, 1 watt, 10%	1
705-R27) 703-R28)	RC20GF102K		Resistor, 1 K ohm, 1 watt, 10%	2
703-CR1 thru CR5	IN4004	Motorola	Diode	5
705-C1	TE-1305	Sprague	Capacitor, 20 mfd, 50 V	1
705-C2	5815-Y5U-204Z	Erie	Capacitor, 0.2 mfd, 25 V	1
703-	AN526-632R12		Screw	2
703-	AN507-632R6		Screw	4
703-	AN507-440R5		Screw	13
703-	AN507-440R4		Screw	1
703-	AN935-4		Lockwasher	1
703-	MS25036-48		Lug	1
703-	MS25036-4		Lug	1
703-	MS21042-04		Nut	10
703-	#232	Mallory	Nut	2
703-	DK153	Armstrong	Cork Tape, 5/8" wide x 1/32" thick	AR
705-	TFT-200/20	Alphawire	Teflon Tubing, 0.034" ID	AR
703-	Style 20	Gudebrod	Lacing, Gudelace Nylon - Natural	AR
703-	Type B-22		#22 Wire (Color per Mil Std 681)	AR
703-	Type C-22		#22 Wire-Shielded Nylon Jacket	AR
703-	CSP241-3	Fascal	Label	1
703-	CSP147-12		Clamp	2
703-	CSP220-11-2		Sleeve, 3/8" ID x 0.5" long	1
703-AR1/AR2	1A-160	Tramm	Isolation Amplifier	2
703-	107A	Coastal	Connector	1
703-S1 thru S9	2TM18-T	Honeywell	Switch, Toggle	9
703-S10	PA6013	Centralab	Switch, Rotary	1
703-R26	CMU1021	Ohmite	Potentiometer, 1 K ohm	1
703-R26, S10	FNA/1836	Felsenthal	Knob	2
705-K1, K2	DSC-32		Relay	2

NOTE: Please see the TEMPORARY REVISION that revises this page

BOMBARDIER – Temporary Revision

PSM NO. 1–6–6A AIRCRAFT DHC–6 Twin Otter SERIES ALL

PUBLICATION COMPONENT MAINTENANCE MANUAL TEMPORARY REVISION NO. 23–2

Insert in 23–09–01, facing page 1101

AUDIO CONTROL UNITS (DHC–60126 AND DHC60206)

REASON FOR ISSUE:

This Temporary Revision rectifies part number of item 705–K1, K2 of paragraph L., table (1) DHC60126 (Fig. 703 and 705).

ACTION:

On page 1101, paragraph L., table (1) DHC60126 (Fig. 703 and 705), ignore existing Item 705–K1, K2 and substitute revised Item 705–K1, K2 as shown on this Temporary Revision.

L. Illustrated Parts List

(1) DHC60126 (Fig. 703 and 705)

Fig. Item	Part No.	MFR	Nomenclature	Units per Assy
705–K1, K2	DSC32–1		Relay	2

RECORDING INSTRUCTIONS:

Record this Temporary Revision No. and the relevant information in the appropriate columns of the TEMPORARY REVISION INDEX provided at the front of the manual.

Fig. Item	Part No.	Mfr	Nomenclature	Units per Assy
703-	DSC-33-2		Terminal Post	1
703-J1	KPT02E-18-32P	Cannon	Receptacle	1
703-FL1	DHC60192-1		Filter Assembly	1
703/705	DHC60127-1		Component Board Assembly	1
703-	DHC60111-5		Bracket Assembly	1
703-	DHC60108-1		Panel, Facing	1
703-	or -3		Panel, Facing	1
703-	DHC60107-1		Panel, Backing	1
	DHC60113-1		Cover Assembly	1
703-	DHC60126-13	Scotchcal	Label, #3650 White	1

(2) DHC60206 (Fig. 704 and 705)

704-R25	RC20GF271K		Resistor, 270 ohm, 1/2 watt, 10%	1
704-R29	RC20GF301K		Resistor, 300 ohm, 1/2 watt, 10%	1
704-R22) 705-R23)	RC20GF682K		Resistor, 6.8 K ohm, 1/2 watt, 10%	2
704-R20	RC20GF270K		Resistor, 27 ohm, 1/2 watt, 10%	1
705-R3	RC20GF561K		Resistor, 560 ohm, 1/2 watt, 10%	1
705-R2	RC32GF102K		Resistor, 1 K ohm, 1 watt, 10%	1
705-R1	RC32GF471K		Resistor, 470 ohm, 1 watt, 10%	1
704-R12,) R15,) R16,) R19,) 705-R4,) R7, R8,) R11)	RC20GF183K		Resistor, 18 K ohm, 1/2 watt, 10%	8
704-R28) 705-R27)	RC20GF102K		Resistor, 1 K ohm, 1/2 watt, 10%	2
704-CR1 thru CR6	IN4004	Motorola	Diode	6
705-C1	TE-1305	Sprague	Capacitor, 20 mfd, 50 V	1
705-C2	5815-Y5U-204Z	Erie	Capacitor, 0.2 mfd, 25 V	1
704-	AN507-440R4		Screw	2
704-	AN507-440R5		Screw	13
704-	AN507-632R6		Screw	4
704-	AN526-632R10		Screw	2
704-	AN935-4		Lockwasher	2
704-	MS25036-48		Lug	1
704-	MS25036-4		Lug	1
704-	MS21042-04		Nut	10
704-	#232	Mallory	Nut	2
704-	DK153	Armstrong	Cork Tape, 5/8" wide x 1/32" thick	AR
705-	TFT-200/20	Alphawire	Tubing, Teflon 0.934" ID	AR
704-	Style 20	Gudebrod	Lacing, Gudelace Nylon - Natural	AR
704-	WM-85/U		Cable	AR
704-	Type B-22		#22 Wire (Color per Mil Std 681)	AR
704-	Type C-22		#22 Wire, Shielded Nylon Jacket	AR
704-AR1/AR2	1A-160	Tramm	Isolation Amplifier	2

BOMBARDIER – Temporary Revision

PSM NO. 1–6–6A AIRCRAFT DHC–6 Twin Otter SERIES ALL

PUBLICATION COMPONENT MAINTENANCE MANUAL TEMPORARY REVISION NO. 23–3

Insert in 23–09–01, facing page 1103

AUDIO CONTROL UNITS (DHC–60126 AND DHC60206)

REASON FOR ISSUE:

This Temporary Revision rectifies part number of item 705–K1, K2 , K3 of paragraph L., table (2) DHC60206 (Fig. 704 and 705).

ACTION:

On page 1103, paragraph L., table (2) DHC60206 (Fig. 704 and 705), ignore existing Item 705–K1, K2, K3 and substitute revised Item 705–K1, K2, K3 as shown on this Temporary Revision.

L. Illustrated Parts List

(2) DHC60206 (Fig. 704 and 705)

Fig. Item	Part No.	MFR	Nomenclature	Units per Assy
705–K1,) K2, K3)	DSC32–1		Relay	3

RECORDING INSTRUCTIONS:

Record this Temporary Revision No. and the relevant information in the appropriate columns of the TEMPORARY REVISION INDEX provided at the front of the manual.

Fig. Item	Part No.	Mfr	Nomenclature	Units per Assy
704-	107A	Coastal	Connector	1
704-	MS35489-6		Grommet	1
704-S9	MSRE-4-2	Alcoswitch	Switch, Rotary	1
704-S8	MSRE-3-3	Alcoswitch	Switch, Rotary	1
704-S1 thru S7	2TM18-T	Honeywell	Switch, Toggle	7
704-S10	PA6013	Centralab	Switch, Rotary	1
704-R26	CMU1021	Ohmite	Potentiometer, 1 K ohm	1
704-S8,) S9)	MS91528-OP1B		Knob	2
704-R26,) S10)	FNA/1836	Felsenthal	Knob	2
704-J2	XLR-5-11C	Cannon	Socket	1
704-J1	KPT02E-18-32P	Cannon	Receptacle	1
704-	CSP220-11-2		Sleeve, 3/8" ID x 0.5" long	1
704-	CSP147-12		Clamp	2
704-	CSP241-3		Label	1
705-K1,) K2, K3)	DSC-32		Relay	3
704-	DSC-33		Terminal Post	2
704-	DHC60111-7		Bracket	1
704-FL1	DHC60192-1		Filter Assembly	1
704/705	DHC60195-1		Component Board Assembly	1
704-	DHC60107-1		Panel, Backing	1
704-	DHC60200-1		Panel, Facing	1
704-	or -3		Panel, Facing	1
704-	or -5		Panel, Facing	1
704-	or -7		Panel, Facing	1
704-	DHC60206-27	Scotchcal	Label #3650 White	1
704-	or -29	Scotchcal	Label #3650 White	1
704-	or -31	Scotchcal	Label #3650 White	1
704-	or -33	Scotchcal	Label #3650 White	1
-	DHC60196-1		Cover Assembly	1

(3) Pre-amplifier Assembly - Mod DHC60131 (Fig. 1101)
DHC60198
DHC60203

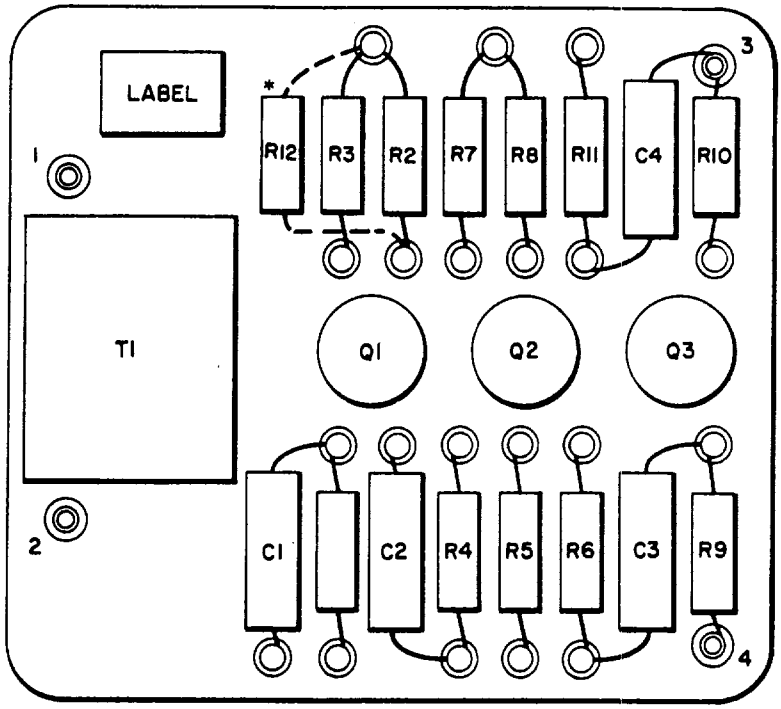
1101-	Type B-22		#22 Wire, Bare, Soft	AR
1101-	TFT-200/22	Alphawire	Tubing, Teflon	AR
1101-	FT-SM-16-TUR	Sealectro	Feed thru	20
1101-	FT-SM-74L2	Sealectro	Feed thru	6
1101-	FT-SM-70L6	Sealectro	Feed thru	4
1101-Q1,) Q2,) Q3)	RTC-300T	Sealectro	Holder, Transistor	3
1101-T1	104R	Hammond	Transformer (DHC60131)	1
1101-T1	104S	Hammond	Transformer (DHC60198 & 60203)	1

NOTE: Please see the TEMPORARY REVISION that revises this page

Fig. Item	Part No.	Mfr	Nomenclature	Units per Assy
1101-C1,) C2,) C3,) C4)	TNT805U050 POB	Mallory	Capacitor	4
1101-R1,) R2)	RC20GF103J		Resistor, 10 K ohm, 1/2 watt	2
1101-R3	RC20GF392J		Resistor, 3.9 K ohm, 1/2 watt	1
1101-R4	RC20GF223J		Resistor, 22 K ohm, 1/2 watt	1
1101-R5	RC20GF154J		Resistor, 150 K ohm, 1/2 watt	1
1101-R6	RC20GF682J		Resistor, 6.8 K ohm, 1/2 watt	1
1101-R7,) R9)	RC20GF272J		Resistor, 2.7 K ohm, 1/2 watt	2
1101-R8	RC20GF333J		Resistor, 33 K ohm, 1/2 watt	1
1101-R10	RC20GF222J		Resistor, 2.2 K ohm, 1/2 watt	1
1101-R11	RC20GF101J		Resistor, 100 ohm, 1/2 watt	1
1101-R12	RC07GF103J		Resistor, 10 K ohm, 1/4 watt	1
1101-Q1,) Q2,) Q3)	2N525		Transistor	3
1101-	DHC60129-27		Mounting Board	1

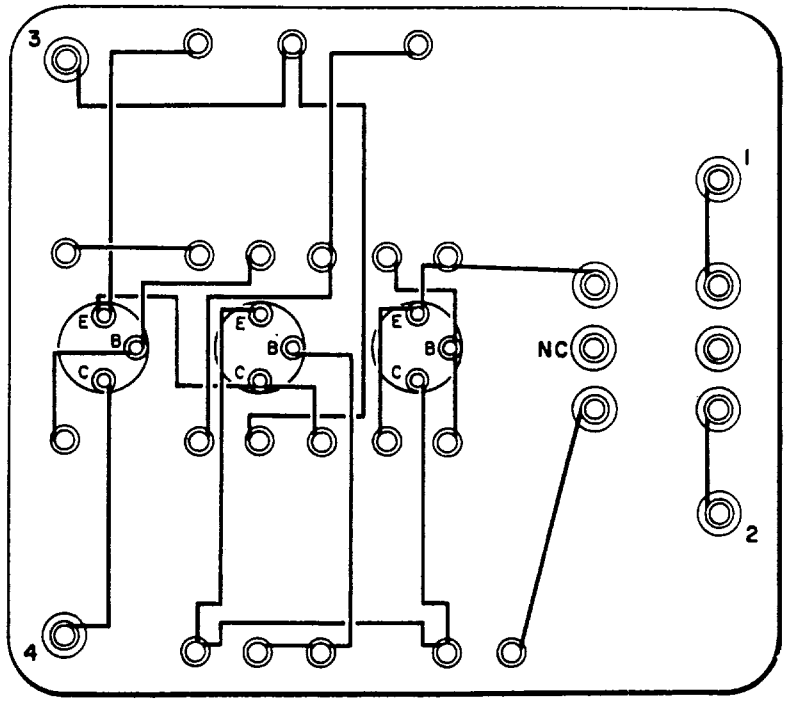
(4) Impedance Matching Transformer - Mod DHC60132 (Fig. 1102)
DHC60197

1102-	Type B-22		#22 Wire	AR
1102-	MS21042-04		Nut	2
1102-	AN507-440R5		Screw	2
1102-T1	104R	Hammond	Transformer (8Ω - 500Ω) (DHC60132)	1
1102-T1	104S	Hammond	Transformer (150Ω - 600Ω) (DHC60197)	1
1102-	CSP147-13		Clamp	1



* DHC60198-1 ONLY

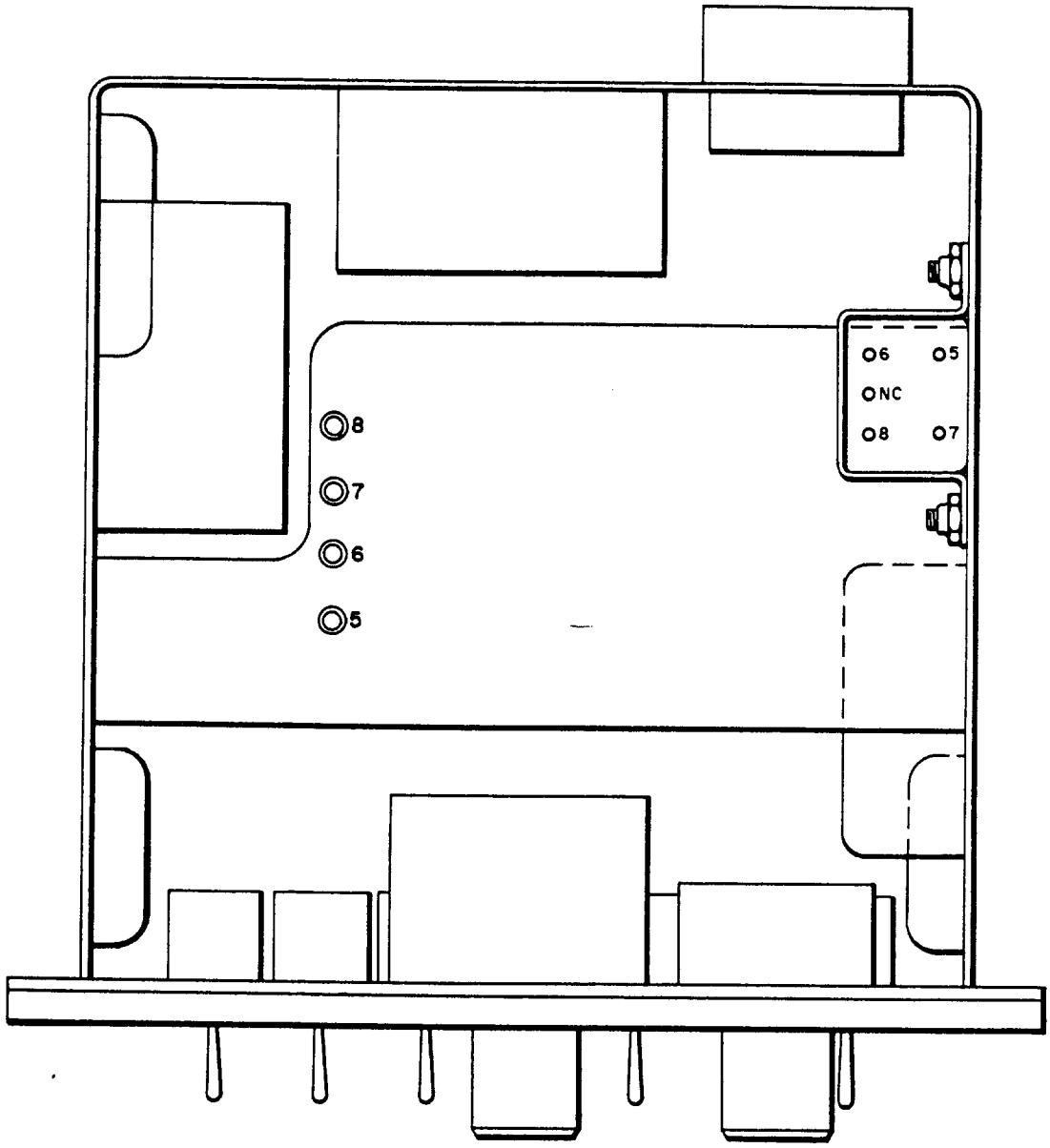
TOP VIEW



BOTTOM VIEW

Dynamic Microphone - Pre-amplifier Assembly (DHC60131; 60198 & 60203)

Figure 1101



Impedance Matching Transformer (MOD DHC60132 & 60197)

Figure 1102

TYPE 1U396-002
AUDIO SELECTOR/AMPLIFIER
OVERHAUL MANUAL
WITH PARTS BREAKDOWN

This manual is intended to facilitate proper overhaul of the Type 1U396-002 Audio Selector/Amplifier; therefore, before proceeding, read this manual carefully and study the drawings and photographs thoroughly. Inspect the components individually to insure a complete understanding of their purpose and proper location. This manual should be supplemented with current Customer Acceptance Specifications and applicable addenda published by EDO-AIRE.

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LIST OF EFFECTIVE PAGES

INSERT LATEST CHANGED PAGES, DESTROY SUPERSEDED PAGES.

The portion of the text affected by the changes is indicated by a vertical line in the margins of the page. Changes to illustrations are indicated by miniature pointing hands. Changes to wiring diagrams are indicated by shaded areas.

Dates of issue for the original and changed pages are:

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2-4	0	3-8	0
2-5	0	3-9	0
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PREFACE

This manual was prepared specifically for use of a trained electrical technician, working in an authorized instrument repair shop. Accordingly, the information included here is based on the following assumptions:

- The user of the manual will be generally familiar with aircraft navigation and communication equipment and standard handling and repair procedures.
- The shop will have available ordinary hand tools and test equipment and will maintain suitable conditions of cleanliness, temperature, humidity, and light for instrument repair work.

Accordingly, the manual contains only specific information about the Type 1U396-002 Audio Selector/Amplifier that would be useful to a trained technician, rather than complete step-by-step procedures. The procedures included either are peculiar to this instrument or have been found significantly better in protecting parts from damage or saving time.

The intent of this approach is to increase the usefulness of the manual by excluding the obvious or familiar and concentrating on new and peculiar items. Thus, information should be more readily assimilated on first reading and more quickly located for reference.

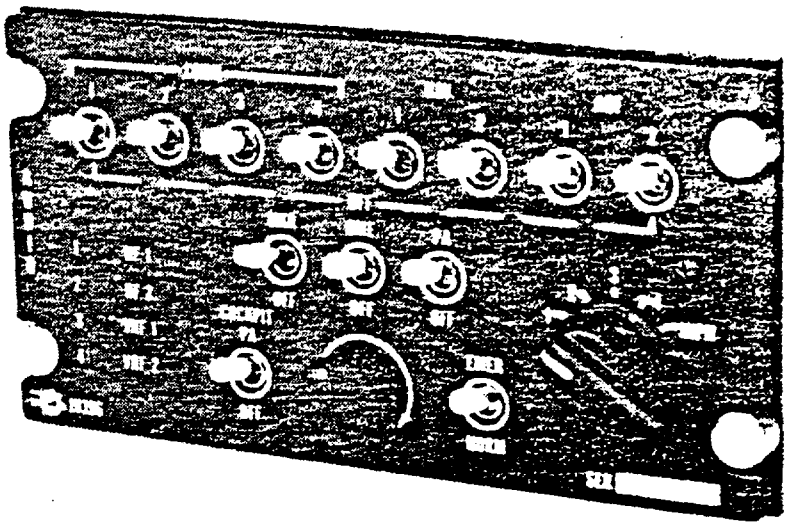


Figure 1-1. Audio Selector/Amplifier

SECTION I

GENERAL INFORMATION

1-1. GENERAL

1-2. This manual provides description and operation information, cleaning procedures, assembly procedures, testing procedures, troubleshooting procedures, and an illustrated parts breakdown for the EDO-AIRE Type 1U396-002 Audio Selector/Amplifier. Refer to figure 1-1.

1-3. PURPOSE OF EQUIPMENT

1-4. The 1U396-002 Audio Selector/Amplifier is a control panel designed to be used in conjunction with up to 10 radio receivers and four radio transmitters. Each audio panel contains a headphone amplifier for monitoring interphone communications on any of the 10 receivers. Provision for an external speaker amplifier for the headphone output is included in the audio panel.

1-5. The 1U396-002 Audio Selector/Amplifier is designed to be used in a system containing from two to six units. An interphone amplifier, with a biased input for a carbon microphone, gives the capability of interphone communication. A microphone select switch offers the option of transmitting on the interphone system or one of four radio transmitters. A public address amplifier produces 10 watts into an eight ohm speaker with less than five percent distortion.

1-6. DESCRIPTION OF FRONT PANEL CONTROLS

1-7. RECEIVER SWITCHES

1-8. The ten radio switches are labeled COM 1, COM 2, COM 3, COM 4, NAV 1, NAV 2, ADF 1, ADF 2, MKR, and DME. Each switch selects one of 10 receivers. With any one switch in the on (up) position, the corresponding receiver signal is heard through the headphones or cockpit speaker (optional). Any of the 10 receivers can be monitored separately or in any combination.

1-9. PA SWITCH

1-10. The PA on-off switch controls the 10 watt amplifier. In the off position, any interphone communication will be heard through the headphones only. When an interphone message originates from a unit with the PA switch on, the message will be heard on the PA speaker and the headphones of all units.

1-11. COCKPIT SPEAKER/HEADPHONE

1-12. This switch allows the choice of monitoring a radio or interphone signal through either the headphones or a cockpit speaker. The 1U396-002 does not contain a cockpit speaker amplifier, therefore, the cockpit speaker mode is not functional without an external amplifier.

1-13. EMERGENCY/NORMAL

1-14. With this switch, it is possible to directly monitor any one of the 10 radio receivers at one time, bypassing all electronics within the 1U396-002. In the emergency position, any one receiver can be monitored by placing the corresponding switch on, all other radio switches off, and the cockpit speaker/headphone switch to headphones. A priority method is used for the 10 receivers when the unit is in the emergency mode. COM 1 has the highest priority, and DME has the lowest. When two or more receiver switches are up in the emergency mode, only the receiver corresponding to the highest priority switch in the up position will be heard.

1-15. MICROPHONE SELECT

1-16. The five position microphone function select switch gives complete control of transmission mode. This switch allows each unit to transmit on any of four communication radios (COM 1, COM 2, COM 3, and COM 4). The interphone position on this switch gives each unit the capability of transmitting on the PA speaker or to the headphones of the other units on the same system.

1-17. VOLUME CONTROL

1-18. The volume control adjusts the loudness of all 10 radio receiver signals. It has no effect on interphone signals or the output level of the PA speaker.

1-19. THEORY OF OPERATION

1-20. The 1U396-002 Audio Selector/Amplifier has two basic modes for communication. Exterior communication radios can be used, or intersystem communication is available. Transmission on four exterior communication radios is accomplished without the use of any electronics within the audio panel itself. The microphone is coupled to one

of the four transmitters through the microphone select switch. To accomplish transmission, the desired transmitter is selected, and the transmit key (MIC PTT button) is pressed. The PTT button will then activate the selected transmitter, and the message can be relayed.

1-21. Each of the 10 receiver inputs has a 1K load to ground. A resistor isolation network provides adequate isolation between each receiver input and mixes all 10 inputs to a single volume control. The output is then fed through another isolation resistor to the headphone amplifier. A toggle switch couples the headphone output to either a set of headphones or an optional speaker amplifier.

1-22. To communicate from one unit to the other units on the same system, the interphone circuit is used. By positioning the microphone select switch to interphone and pressing the PTT button, a relay is activated. Independent of the microphone select switch position, the relay is also activated by grounding the interphone control line. When the relay is activated, the microphone input is fed to the interphone amplifier. An eight volt regulator provides adequate biasing for a carbon microphone. The interphone amplifier produces an output of about 100 mw into 600 ohms (adjustable with level pot).

1-23. The output of the interphone amp is coupled directly to a PA amplifier through a PA select switch. With the PA switch on, the interphone amplifier output will be heard through the PA speaker. The PA amplifier has a level adjust pot for pre-setting the output level.

NOTE

Each 1U396-002 unit contains a 10 watt PA amplifier. If more than one PA amplifier is to be connected to the same speaker, there must be suitable isolation circuitry provided to allow the equivalent of an eight ohm load or greater to each amplifier. Two amplifier outputs cannot be "hard wired" together. It is recommended that all unused PA amplifier outputs be terminated with a 1K, ±5%, 1 watt resistor.

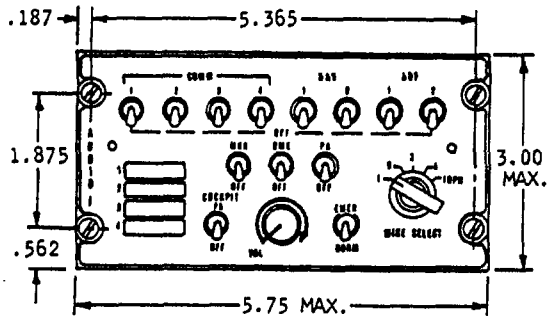
1-24. The interphone amplifier output is also connected to the interphone line. It is this line that interconnects all the units on the system. This common point is then tied to a side tone amplifier that provides isolation between the receiver inputs and the interphone line. Compensation for different numbers of units on the system is also accomplished by the side tone amplifier. A resistor, placed between the interphone amplifier output and the interphone line, assures that an interphone message from one unit will not enter any of the other unit's PA amplifiers.

1-25. An interphone message from any unit in the system is passed through the side tone amplifier to the headphone amplifier. In using the interphone mode on the audio panel, the message will be heard in every unit's headphones. Concurrently, the message can be broadcast on the PA speaker.

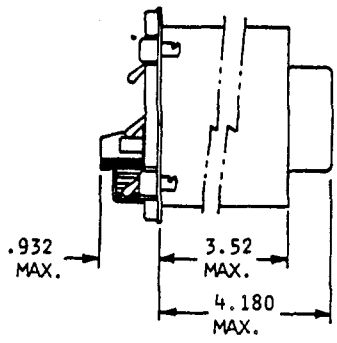
1-26. STORAGE INSTRUCTIONS

1-27. The 1U396-002 Audio Selector/Amplifier can be temporarily stored on the shelf, but should not be exposed to extremes of temperature, humidity, or other environmental conditions without additional protection. The use of a connector cover is recommended.

1-28. For long term storage, it is recommended that the 1U396-002 Audio Selector/Amplifier be placed in the original shipping carton or equivalent, and that a suitable dessicant such as silicagel be placed within the container. Mark packing date plainly on the container. An alternate method is to store the unit in a location having a carefully controlled, low humidity environment. Storage temperature should be maintained between -65°C and +85°C (-85°F and +185°F).



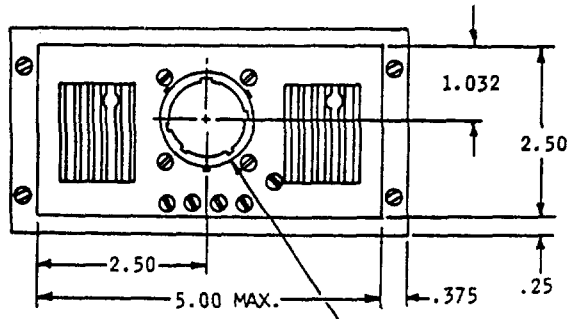
FRONT VIEW



SIDE VIEW

NOTES:

1. PROVIDES CONTROL OF FOUR TRANSMITTERS, TEN RECEIVERS, AND A FLIGHT INTERPHONE WITH INDIVIDUAL OR COLLECTIVE MONITORING ON HEADPHONE.
2. PROVIDES 150 MILLIWATTS TO HEADPHONE WITH LESS THAN 5% DISTORTION.
3. 40 dB MINIMUM ISOLATION PROVIDED BETWEEN INPUT LINES.
4. "EMER-NORM" SWITCH, WHEN IN EMER. POSITION, BY-PASSES ALL ELECTRONICS TO PROVIDE STRAIGHT HEADPHONE OPERATION IN EMERGENCY SITUATIONS.
5. FRONT PLASTIC PANEL TO BE NON-REFLECTING BLACK WITH WHITE MARKINGS, EDGELIGHTED, LACON PROCESS OR EQUAL TO MIL-P-7788.
6. PANEL LIGHTING - 28V BLUE-WHITE.
7. KNOB COLOR - BLACK.
8. OPTIONAL TRANSMITTER DESIGNATORS INCLUDE HF 1, HF 2, VHF 1, VHF 2, UHF 1, UHF 2, FM, & SPARE.



CONNECTOR: CANNON KPT02A20-41P
MATES WITH: CANNON KPT06E20-41S

BACK VIEW

Figure 1-2. Audio Selector/Amplifier Outline/Dimension Drawing

1-29. SPECIFICATIONS

CHARACTERISTICS	LIMITS
Overall Dimensions	Refer to the outline-dimension drawing (figure 1-2) furnished in this manual
Weight	1.8 pounds typical
Mounting	Panel mounted by four Dzus fasteners
Connector	Cannon type KPT02A20-41P (mating connector, Cannon type KPT06E20-41S)
Input Power Requirements	
Electronics	27.5 vdc, 1.4 amps maximum
Lights	27.5 vdc
Environmental Operating Limits	Meets or exceeds TSO C50b, Cat. BBAAAX
Panel Lights	1. Color - blue-white 2. Voltage - 28 vdc
Panel Color	Flat black with white lettering
Panel Marking	White
Knob Color	Flat black with white indice
Input Power Supply Range	Functional - 18 vdc to 30 vdc Meets all specifications - 22 vdc to 30 vdc
Headphone Output Load	600 ohms (Floating)
Cockpit Speaker Output Load	600-1000 ohms, input impedance to optional exterior amplifier (Floating)
Interphone Output Load	Up to 6 Audio/Selector Amplifiers
PA Amplifier Output Load	8 ohms (Floating)
Microphone Input	7 vdc bias for 150 ohm carbon microphone
External Volume Control Range	20 db from minimum (ccw) to maximum (cw) position
Receiver Input Sensitivity	10 mw (into 1K ohms) for rated output (headphone amplifier gain set at maximum)
Microphone Input Sensitivity	60 mv for nominal interphone output of 9.0 vrms
Headphone Amplifier Gain	Up to 10 db, variable (internal)

Table 1-1. Specifications (Page 1 of 2)

1-29. SPECIFICATIONS (Cont.)

CHARACTERISTICS	LIMITS
Headphone Output With Receiver Input	
Power	150 mw
Frequency Response	± 3 db, 300 Hz to 3000 Hz Down 20 db at 20 KHz
Distortion	Less than 5%
Headphone Output With Microphone Input	
Power	120 mv
Frequency Response	± 3 db, 300 Hz to 2850 Hz Down 20 db at 20 KHz
Distortion	Less than 5%
PA Amplifier Output	
Power	10 watts
Frequency Response	± 3 db, 300 Hz to 3000 Hz Down 15 db at 20 KHz
Distortion	Less than 5%
Input Isolation	
Receiver to Receiver	Greater than 40 db
Microphone to Receiver	Greater than 40 db
Ripple Rejection (Interphone Control Not Activated)	Ripple output greater than 50 db below rated headphone and PA outputs (For supply voltage between 23 vdc to 30 vdc)

Table 1-1. Specifications (Page 2 of 2)

SECTION II

REPAIR PROCEDURES

2-1. If an instrument is to be overhauled, a functional test and careful visual inspection should be made before disassembly. The instrument should have a detailed mechanical inspection. All defective parts must be replaced, wherever possible, with current equivalent replacement parts and, in general, the instrument restored to a like-new condition.

2-2. Correction of a specific malfunction, on the other hand, should isolate and correct the cause of the problem with as little disturbance to the rest of the instrument as possible.

2-3. After a malfunction is ascertained, diagnosed, and corrected by replacement of a faulty component, repeat tests that apply to the trouble to ensure correct functional performance of the equipment.

2-4. TROUBLESHOOTING

2-5. The troubleshooting guide that follows contains items noted by factory technicians that are peculiar to this instrument. It assumes that the technician will be familiar with malfunctions common to an audio selector/amplifier, and that such problems already will have been investigated and corrected.

2-6. TROUBLESHOOTING CHART

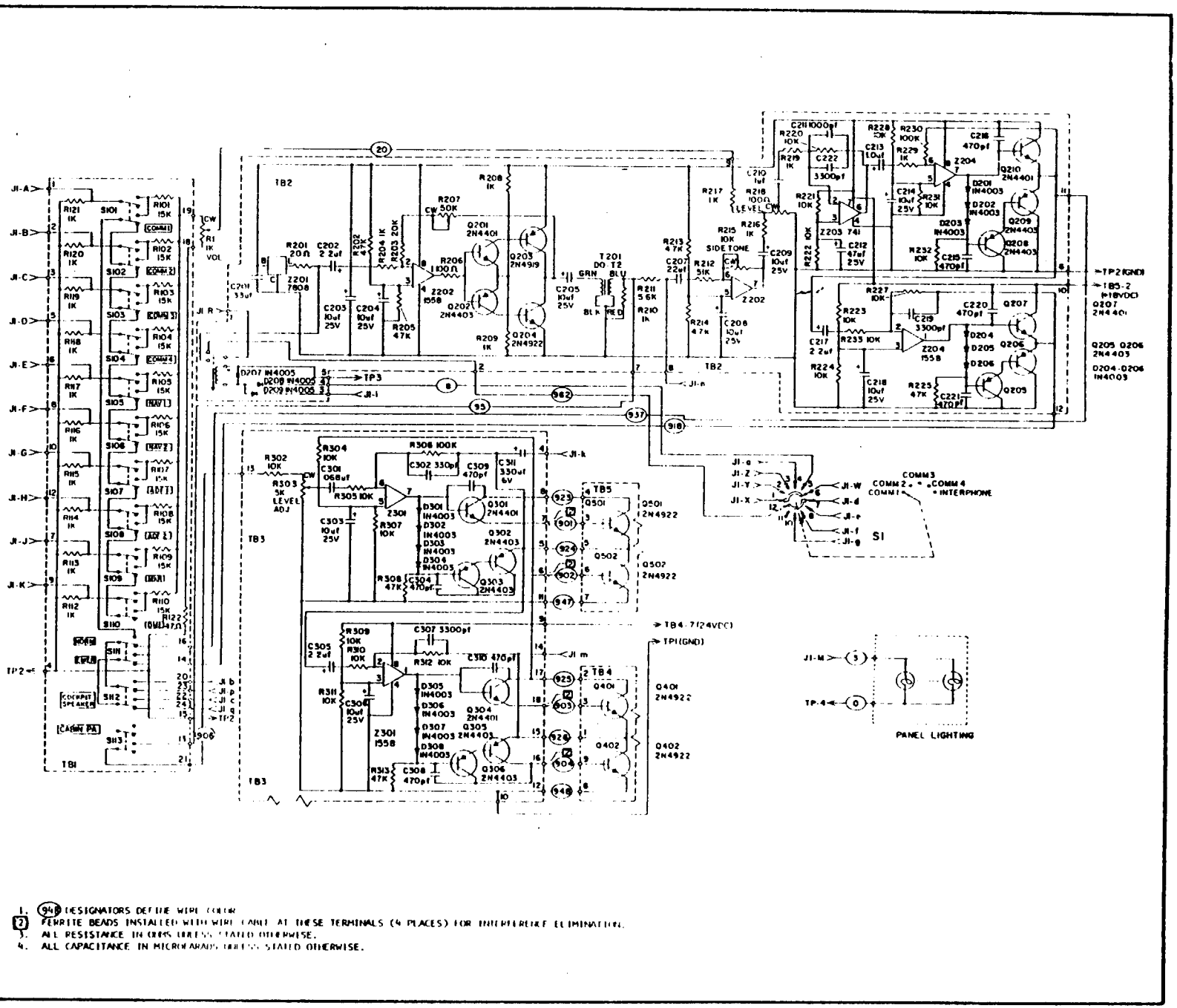
NOTE

Before consulting the following table, verify that the problem exists with the 1U396-002 Audio Selector/Amplifier and not with associated exterior components, such as headphones, speakers, external amplifiers, microphones, and radio equipment. Make certain that control settings are correct. In the following table, the power input voltage is assumed to be +27.5 vdc.

SYMPTOM	CAUSE	REPAIR
1. Cannot obtain correct continuity measurements	A. Incorrect or loose ground on test setup	Check grounding scheme
	B. Faulty switch board	Replace 1V396-991
	C. Faulty microphone function selector switch	Replace switch, 907053-01
2. Panel lamps do not light	A. Faulty light board	Replace 1V396-980
3. Interphone relay does not energize	A. Faulty interphone relay	Replace 1V396-941
4. No headphone output when using a receiver input	A. Faulty switch board	Check continuity measurements
	B. Faulty volume control	Replace volume control, R1
	C. Faulty Inph/Hdph power supply	Replace 1V396-961 if output is not = 18 vdc = 5%
	D. Faulty Inph/Hdph board	Replace 1V396-941
5. Volume of headphone output too low or too high with a receiver input	A. Headphone level pot not adjusted correctly	Adjust headphone level pot per paragraph 2-43
	B. Faulty volume control	Replace volume control R1
	C. Faulty Inph/Hdph board	Replace 1V396-941

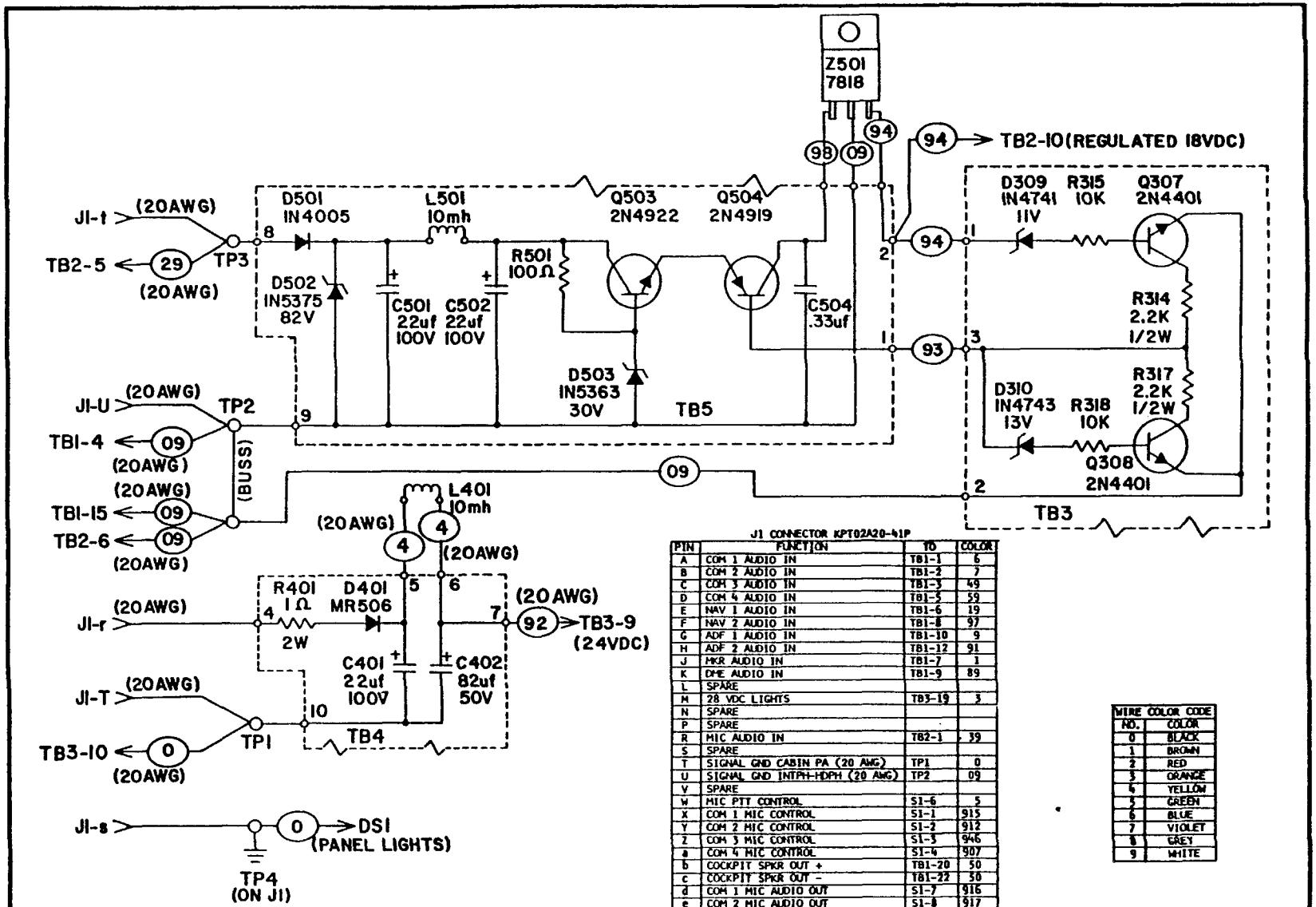
TROUBLESHOOTING CHART (CONTINUED)

SYMPTOM	CAUSE	REPAIR
6. Inadequate headphone frequency response with receiver input	A. Faulty Inph/Hdph board supply	Replace 1V396-941
7. Excessive headphone distortion with receiver input	A. Faulty Inph/Hdph power supply	Replace 1V396-961 if output is not = 18 vdc ± 5%
	B. Faulty Inph/Hdph board	Replace 1V396-941
8. No headphone output when using a microphone input	A. Faulty Inph/Hdph power supply	Replace 1V396-961 if output is not = 18 vdc ± 5%
	B. Faulty Inph/Hdph board	Replace 1V396-941
9. Inadequate headphone frequency response with microphone input	A. Faulty Inph/Hdph board	Replace 1V396-941
10. Excessive headphone distortion with microphone input	A. Interphone level pot adjusted for too much gain	Adjust Interphone level pot per paragraph 2-41
	B. Faulty Inph/Hdph power supply	Replace 1V396-961 if output is not = 18 vdc ± 5%
	C. Faulty Inph/Hdph board	Replace 1V396-941
11. No headphone output with an interphone input from another unit (there is a headphone output with a microphone input)	A. Broken or loose interphone line	Check interphone line in wire harness for broken or loose connection
	B. Problem exists in other unit	Check unit that originated signal for symptom #8
12. No PA output with microphone input	A. Check for symptom #8 Faulty PA power supply	Check symptom #8 Replace 1V396-971 if output is not = 26 vdc ± 5%
	B. Faulty PA Amplifier output transistors	Check voltage between pins J1-m (+) and J1-T (-) with no input signal to PA amplifier. If voltage is not = 13 vdc ± 1 vdc, replace 1V396-971 Check voltage between terminal .5 (TB3) and J1-T with no input signal to PA amplifier. Replace 1V396-961 if voltage is not = 13 vdc ± 1 vdc
	C. Faulty PA amplifier board	Replace 1V396-951
13. Inadequate PA amplifier frequency response	A. Check for symptom #9 faulty PA amplifier board	Check symptom #9 Replace 1V396-951
14. Excessive Pa output distortion	A. Check for symptom #10 faulty PA amplifier board	Check symptom #10 Replace 1V396-951



1. (948) DESIGNATORS DEFINE WIRE COLOR
2. FERRITE BEADS INSTALLED WITH WIRE CAUSE AT THESE TERMINALS (4 PLACES) FOR INTERFERENCE ELIMINATION.
3. ALL RESISTANCE IN OHMS UNLESS STATED OTHERWISE.
4. ALL CAPACITANCE IN MICROFARADS UNLESS STATED OTHERWISE.

Figure 2-1. Audio Selector/Amplifier (Page 1 of 2)



J1 CONNECTOR KPT02A20-41P

PIN	FUNCTION	TO	COLOR
A	COM 1 AUDIO IN	TB1-1	6
B	COM 2 AUDIO IN	TB1-2	7
C	COM 3 AUDIO IN	TB1-3	49
D	COM 4 AUDIO IN	TB1-5	59
E	NAV 1 AUDIO IN	TB1-6	19
F	NAV 2 AUDIO IN	TB1-8	97
G	ADF 1 AUDIO IN	TB1-10	9
H	ADF 2 AUDIO IN	TB1-12	91
J	MKR AUDIO IN	TB1-7	1
K	DME AUDIO IN	TB1-9	89
L	SPARE		
M	28 VDC LIGHTS	TB3-19	3
N	SPARE		
P	SPARE		
R	MIC AUDIO IN	TB2-1	39
S	SPARE		
T	SIGNAL GND CABIN PA (20 AWG)	TP1	0
U	SIGNAL GND INTPH-HDPH (20 AWG)	TP2	09
V	SPARE		
W	MIC PTT CONTROL	S1-6	5
X	COM 1 MIC CONTROL	S1-1	915
Y	COM 2 MIC CONTROL	S1-2	912
Z	COM 3 MIC CONTROL	S1-3	946
a	COM 4 MIC CONTROL	S1-4	907
b	COCKPIT SPKR OUT +	TB1-20	50
c	COCKPIT SPKR OUT -	TB1-22	50
d	COM 1 MIC AUDIO OUT	S1-7	916
e	COM 2 MIC AUDIO OUT	S1-8	917
f	COM 3 MIC AUDIO OUT	S1-9	935
g	COM 4 MIC AUDIO OUT	S1-10	905
h	SPARE		
i	INTERPHONE CONTROL	TB2-3	8
j	SPARE		
k	CABIN PA AUDIO OUT +	TB3-5	96
m	CABIN PA AUDIO OUT -	TB3-14	30
n	INTERPHONE OUT	TB2-8	4
p	HEADPHONE AUDIO OUT +	TB1-23	69
q	HEADPHONE AUDIO OUT -	TB1-24	40
r	+28 VDC A/C PWR PA (20 AWG)	TB4-4	2
s	CHASSIS GND	TP4	0
t	+28 VDC A/C PWR INPH (20 AWG)	TP3	29

WIRE COLOR CODE	
NO.	COLOR
0	BLACK
1	BROWN
2	RED
3	ORANGE
4	YELLOW
5	GREEN
6	BLUE
7	VIOLET
8	GREY
9	WHITE

1. 28VDC POWER LINES TO TB4 AND TB5 ARE ISOLATED FROM EACH OTHER.
2. SIGNAL GROUNDS TO TP1 AND TP2 ARE ISOLATED FROM EACH OTHER.
3. CHASSIS GROUND ISOLATED FROM SIGNAL GROUND.
4. CABIN PA AMP AND HEADPHONE AMP OUTPUTS ARE FLOATING. DO NOT GROUND EITHER OUTPUT.
5. ALL SWITCHES ON TB1 ARE SHOWN IN DOWN POSITION.
6. ALL RESISTORS 1/4W 2% UNLESS OTHERWISE NOTED.
7. 24 GAGE WIRE USED UNLESS OTHERWISE NOTED.
8. FIRST DIGIT OF PART DESIGNATOR NO. INDICATES WHICH BOARD COMP. IS ON (I.E. Z501 IS ON TB5).
9. ALL RESISTANCE IN OHMS.
10. ALL CAPACITANCE IN MICROFARADS.
11. (92) DESIGNATORS DEFINE WIRE COLOR.

Figure 2-1. Audio Sel plifier (Page 2 of 2)

2-7. TEST EQUIPMENT

2-8. Table 2-1 lists the test equipment required to perform the procedures described in this section of the manual. Test equipment, other than that listed in table 2-1 under REPRESENTATIVE TYPE, can be substituted if their specifications fulfill those requirements listed under CHARACTERISTICS REQUIRED.

CAUTION

Do not short headphone or PA outputs to ground, as this will damage the output transistors. Place ground isolation plugs on all test equipment, except power supply.

ITEM	DESCRIPTION	COMMON NAME	CHARACTERISTICS REQUIRED	REPRESENTATIVE TYPE
1	Audio Oscillator	Audio Oscillator	100 through 20,000 cps. At least 11 vrms maximum output	Hewlett-Packard Model 3310B
2	AC Vacuum-Tube Voltmeter	ac vtvm	At least ± 5% accuracy at any point on the scale	Hewlett-Packard Model 400D
3	Output Power Meter	output power meter	Measures power up to 12 w for 8 ohm load; up to 200 mw for 600 ohm load	General Radio Model 583A
4	Distortion Analyzer	distortion analyzer	Measures and indicates percent of audio distortion; incorporates vtvm with decibel scale	Hewlett-Packard Model 331A
5	Power Supply	power supply	0 through 30 vdc variable output, up to 1.4 amps	Power/Mate Corp. Model BP-40D
6	Digital Multimeter	DMM	Measures voltages and resistances, at least 1 Meg ohm input impedance	Hewlett-Packard Model 3476B

Table 2-1. Test Equipment

2-9. To establish that the unit meets minimum performance requirements, the bench tests in this section should be performed. If the unit under test fails to meet the results required for proper operation, that section of the audio selector/amplifier should be investigated using the troubleshooting chart (see paragraph 2-6).

2-10. To assist in the performance of the following tests, it is suggested that a test jig be fabricated for connection to the control so that contact with each terminal pin on the unit's rear connectors will be accessible on a terminal strip. The test jig should use a cable harness terminated at one end with a terminal strip, and at the other end with an electrical connector. Use a type KPT06E20-41S Cannon connector or equivalent to mate with J1 at the rear of the 1U396-002 Audio Selector/Amplifier.

2-11. TESTING

2-12. Testing of the 1U396-002 Audio Selector/Amplifier consists primarily of checking each board which should function according to specifications. Refer to figure 3-1.

2-13. TEST PROCEDURES

2-14. The 1U396-002 Audio Selector/Amplifier consists primarily of three different amplifier sections which are described in detail in the following paragraphs.

2-15. BENCH TESTS AND ADJUSTMENTS

2-16. INITIAL CONTROL SETTINGS

2-17. Set the 1U396-002 Audio Selector/Amplifier controls as shown in table 2-2.

CONTROLS	CONTROL DESIGNATION	POSITION
COM 1	S101	OFF
COM 2	S102	OFF
COM 3	S103	OFF
COM 4	S104	OFF
NAV 1	S105	OFF
NAV 2	S106	OFF
ADF 1	S107	OFF
ADF 2	S108	OFF
MKR	S109	OFF
DME	S110	OFF
PA	S113	OFF
COCKPIT PA	S112	OFF
EMER/NORM	S111	NORM
MICROPHONE FUNCTION SELECTOR	S1	1
VOL CONTROL	R1	FULLY CW

Table 2-2. Initial Switch Settings

2-18. CONTINUITY CHECKS

2-19. Use a digital multimeter to check the continuity of the various 1U396-002 switch configurations and the associated resistance paths referenced in table 2-3.

NOTE

Continuity and resistance checks must be accomplished in sequence. Change switches only as indicated during checks. Refer to applicable schematic diagram.

SWITCH	POSITION	DMM OHMMETER POS (+)	CONNECTION NEG (-)	OHMMETER READINGS ± 5%
ALL	Initial Setting	J1-A	J1-U	1K
ALL	Initial Setting	J1-B	J1-U	1K
ALL	Initial Setting	J1-C	J1-U	1K
ALL	Initial Setting	J1-D	J1-U	1K
ALL	Initial Setting	J1-E	J1-U	1K
ALL	Initial Setting	J1-F	J1-U	1K
ALL	Initial Setting	J1-G	J1-U	1K
ALL	Initial Setting	J1-H	J1-U	1K
ALL	Initial Setting	J1-J	J1-U	1K
ALL	Initial Setting	J1-K	J1-U	1K
ALL	Initial Setting	J1-b	J1-U	inf.
ALL	Initial Setting	J1-c	J1-U	inf.
EMER/NORM	EMER	J1-q	J1-U	0
DME	ON (UP)	J1-K	J1-p	0
Microphone Function Selector	1	J1-R	J1-d	0
Microphone Function Selector	2	J1-R	J1-e	0
Microphone Function Selector	3	J1-R	J1-f	0
Microphone Function Selector	4	J1-R	J1-g	0
Microphone Function Selector	1	J1-W	J1-X	0
Microphone Function Selector	2	J1-W	J1-Y	0
Microphone Function Selector	3	J1-W	J1-Z	0
Microphone Function Selector	4	J1-W	J1-a	0
ALL	Initial Setting	J1-s	J1-T	inf.
ALL	Initial Setting	J1-s	J1-U	inf.

Table 2-3. Resistance Chart

2-20. LIGHTS

2-21. Apply 27.5 vdc to pin J1-M; ground power supply to pin J1-s. Panel lamps should light.

2-22. INTERPHONE RELAY

2-23. Apply 27.5 vdc to pin J1-t, momentarily ground power supply to pin J1-i. Relay K201 should energize.

2-24. *HEADPHONE AMPLIFIER TEST

NOTE

The internal headphone amplifier gain adjustment has been preset by the manufacturer. If the gain is not adequate, it can be changed as described in the Level Potentiometer Adjustments section (see paragraphs 2-39 through 2-46).

A. Set all controls as shown in table 2-2.

B. Connect the power meter and distortion analyzer to pins J1-p and J1-q (see figure 2-1). Set the impedance of the power meter to 600 ohms.

C. Connect the audio oscillator and the vtvm to pin J1-A. Set the oscillator to 1000 cps, 10 vrms.

D. Ground the power supply to pins J1-T and J1-u.

E. Apply 27.5 vdc to pins J1-r and J1-t.

F. Place COM 1 switch in the on (up) position. The power meter should indicate an output of 150 mw, and the distortion should be less than 5%.

G. Slowly tune the audio oscillator to 300 cps ensuring that the oscillator output remains 10 vrms. The power meter indication should not change more than ± 3 db from 150 mw. The distortion should remain below 5%.

H. Slowly tune the audio oscillator to 3000 cps ensuring that the oscillator output remains 10 vrms. The power meter indication should not change more than ± 3 db from 150 mw. The distortion should remain below 5%.

2-25. *INTERPHONE AMPLIFIER TEST

NOTE

The internal interphone and sidetone gain adjustments have been preset by the manufacturer. The interphone level should require no further adjustment. The sidetone gain will require adjustment, dependent on the number of audio panels interconnected in the system. For the purpose of this test, the sidetone gain has been preset for a two unit system (no load on J1-n). Refer to the Level Potentiometer Adjustment section (see paragraph 2-44) for readjusting gains.

A. Set all controls as shown in table 2-2.

B. Connect the power meter and distortion analyzer to pins J1-p and J1-g (see figure 2-1). Set the impedance of the power meter to 600 ohms.

C. Connect audio oscillator and vtvm to the RC network as shown in figure 2-1. Set the oscillator to 1000 cps, 125 vrms.

D. Ground the power supply to pins J1-T and J1-U.

E. Apply 27.5 vdc to pins J1-r and J1-t.

F. Ground pin J1-i to the power supply. The power meter should indicate an output of 120 mw, and the distortion should be less than 5%.

G. Slowly tune the audio oscillator to 300 cps ensuring that the oscillator output remains 125 mvrms. The power meter indication should not change more than ± 3 db from 120 mw. The distortion should remain below 5%.

H. Slowly tune the audio oscillator to 2850 cps ensuring that the oscillator output remains 125 mvrms. The power meter indication should not change more than ± 3 db from 120 mw. The distortion should remain below 5%.

2-26. *PA AMPLIFIER TEST

NOTE

The internal PA amplifier gain adjustment has been preset by the manufacturer. To readjust gain, refer to the Level Potentiometer Adjustment section (see paragraph 2-45).

A. Set all controls as shown in table 2-2.

B. Connect the power meter and distortion analyzer to pins J1-k and J1-m (see figure 2-1). Set the impedance of the power meter to 8 ohms.

C. Connect the audio oscillator and vtvm to the RC network as shown in figure 2-1. Set the oscillator to 1000 cps, 125 mvrms.

D. Ground the power supply to pins J1-T and J1-U.

*See CAUTION on page 2-5.

E. Apply 27.5 vdc to pins J1-r and J1-t.

F. Ground pin J1-i to the power supply.

G. Place PA switch on (up). The power meter should indicate an output of 10 watts, and the distortion should be less than 5%.

H. Slowly tune the audio oscillator to 300 cps ensuring that the oscillator output remains 125 mvrms. The power meter indication should not change more than ± 3 db from 10 watts. The distortion should remain below 5%.

J. Slowly tune the audio oscillator to 3000 cps ensuring that the oscillator output remains 125 mvrms. The power meter indication should not change more than ± 3 db from 10 watts. The distortion should remain below 5%.

2-27. CLEANING

2-28. When deemed necessary (depending upon the environment to which the equipment is exposed, and the intensity the instrument is used) periodic inspection and cleaning should be performed.

CAUTION

Exercise care when inspecting or cleaning the interior of the control unit so that none of the critically positioned components, wires, and adjustments are accidentally disturbed.

2-29. RECOMMENDED CLEANING PROCEDURES

CAUTION

Some cleaning agents will attack and deform plastic parts. Carefully use least amount of cleaning agent required to do the job.

2-30. The exterior of the control unit should be wiped with a lint-free cloth. Remove any foreign matter from the interior of control unit with a soft, clean camel-hair brush and/or a clean, forced-air stream (30 psi maximum). For dirt or other foreign matter that cannot be removed in this manner from surfaces difficult to reach, the equipment may require partial disassembly to clean with a stiff bristle brush. If switch contacts are noticeably dirty and the wafer is suspected of having failed, replace switch.

2-31. DISASSEMBLY

2-32. Disassembly of the 1U396-002 Audio Selector/Amplifier is straightforward and generally obvious. The following steps are to be used as an aid to break down the audio selector/amplifier into more workable assemblies.

2-33. Unless service time or other factors dictate a complete overhaul, disassemble the audio selector/amplifier no further than necessary to make a specific repair.

A. Remove four flat head screws and remove top dust cover.

B. Loosen four set screws and remove both knobs (see figure 2-2).

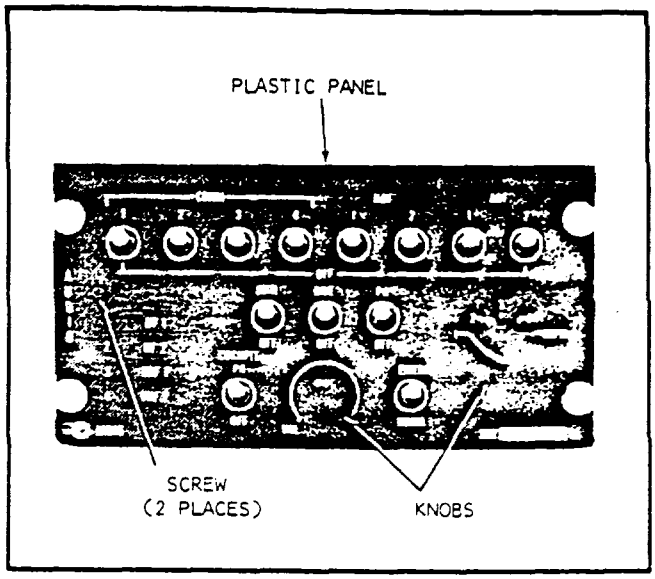


Figure 2-2. Plastic Panel Removal

C. Remove two screws and two lockwashers and lift plastic panel from the unit.

D. Unsolder terminals and remove panel lighting assembly.

E. Unscrew four flat head screws and remove two round posts (see figure 2-3).

F. Remove eight flat head screws and remove two square posts to detach subpanel.

G. Unscrew nut and remove rotary switch from subpanel.

H. Unscrew nut and remove potentiometer from subpanel.

J. Remove two flat head screws from bottom dust cover to release two PCB standoffs (see figure 2-4).

K. Remove four pan head screws, four hex nuts, and four lockwashers to disassemble interphone/headphone amp assembly. Two PCB standoffs and power amp assembly will come apart.

L. Remove two flat head screws, two hex nuts, and two lockwashers to release mounting bracket from bottom dust cover.

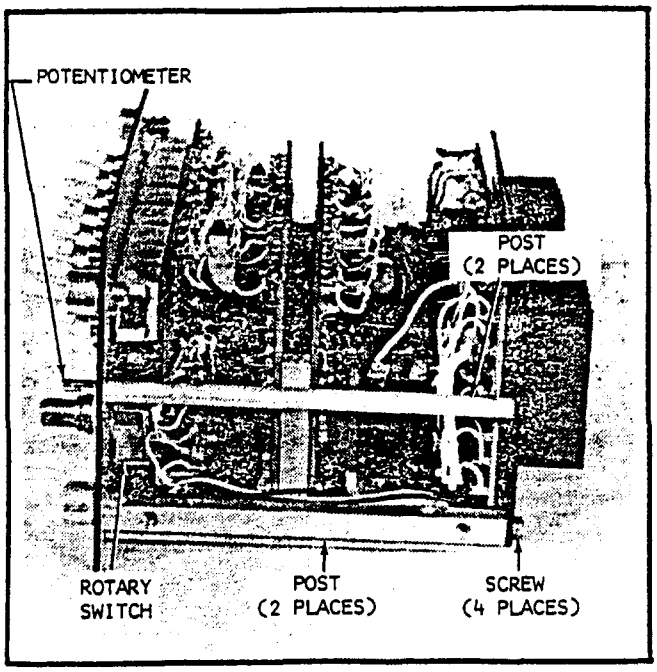


Figure 2-3. Subpanel and Switch Board Assembly Removal

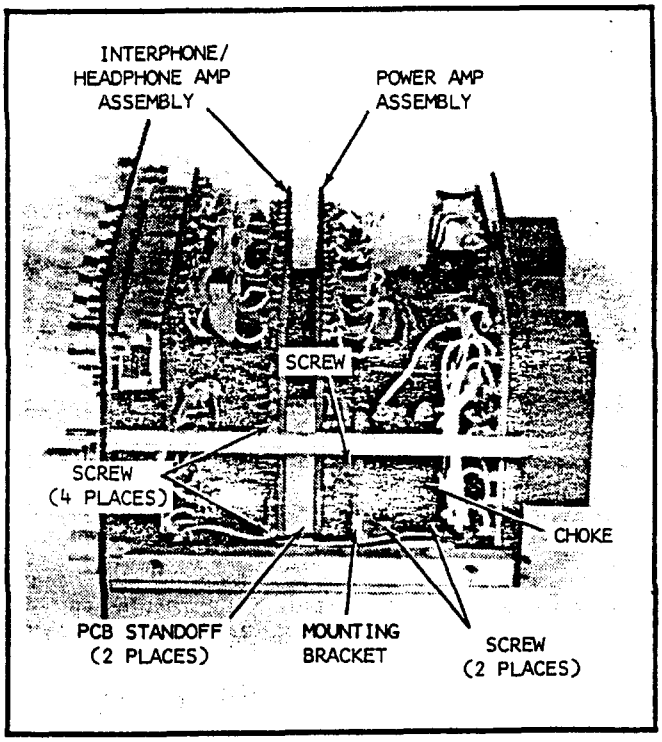


Figure 2-4. Interphone/Headphone Amp and Power Amp Assemblies Removal

M. Remove one pan head screw, one hex nut, and one lockwasher to remove choke from mounting bracket.

NOTE

Unsolder two wires to completely detach choke.

N. Remove one flat head screw from bottom dust cover to detach regulator.

O. Remove two pan head screws and remove PA supply assembly (see figure 2-5).

P. Remove two pan head screws and remove interphone/ headphone assembly.

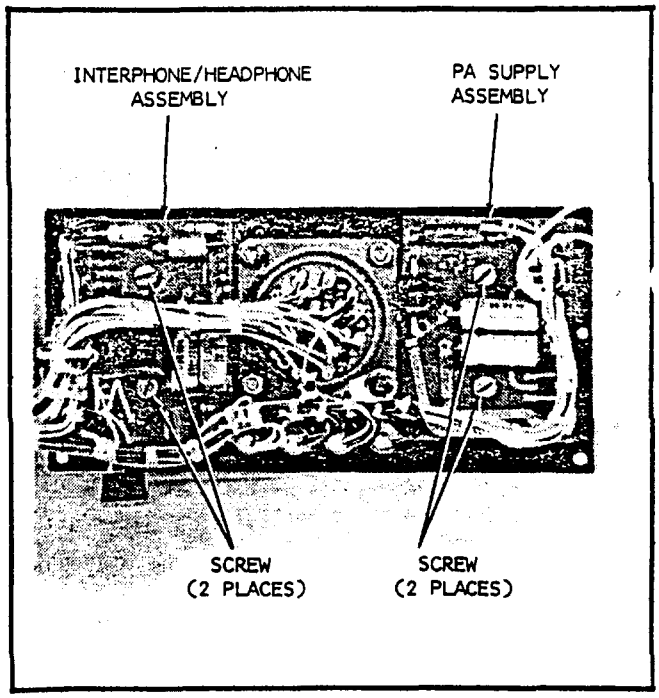


Figure 2-5. PA Supply Assembly and Interphone/Headphone Assembly Removal

Q. Remove four flat head screws and two heatsinks from connector plate assembly (see figure 2-6).

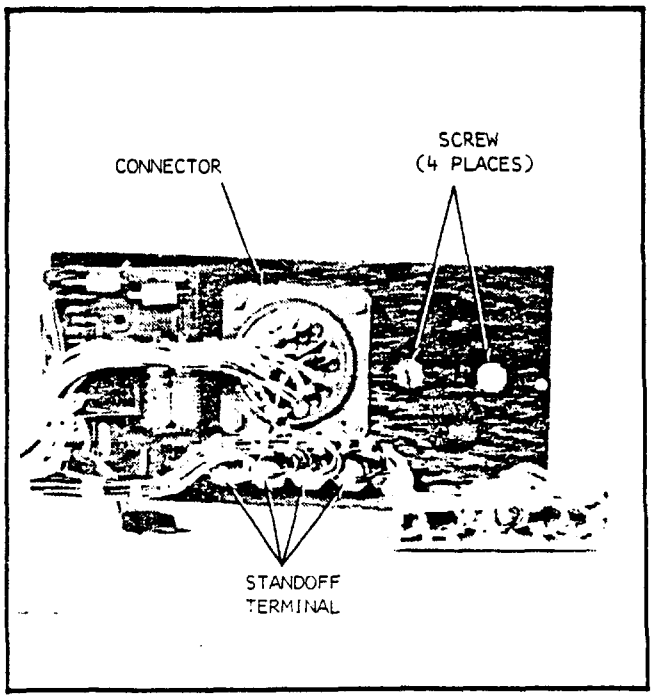


Figure 2-6. Heatsink Removal

R. Remove four flat head screws, four hex nuts, three lockwashers, and one solder lug and slide connector from connector plate assembly (see figure 2-7).

S. Remove four flat head screws and remove four standoff terminals from connector plate assembly.

2-34. INSPECTION AND REPAIR

2-35. GENERAL

2-36. With disassembly completed, there should be easy access to areas for inspection and repair. All parts should be thoroughly examined for any evidence of damage prior to reassembly. Repair of damaged parts is recommended only when it can be done economically and without adversely affecting the proper operation of instrument. If any doubt exists as to the operating condition of any component parts or assembly, refer to the parts list section of this manual, and order replacement parts directly from Edo-Aire through their parts sales department.

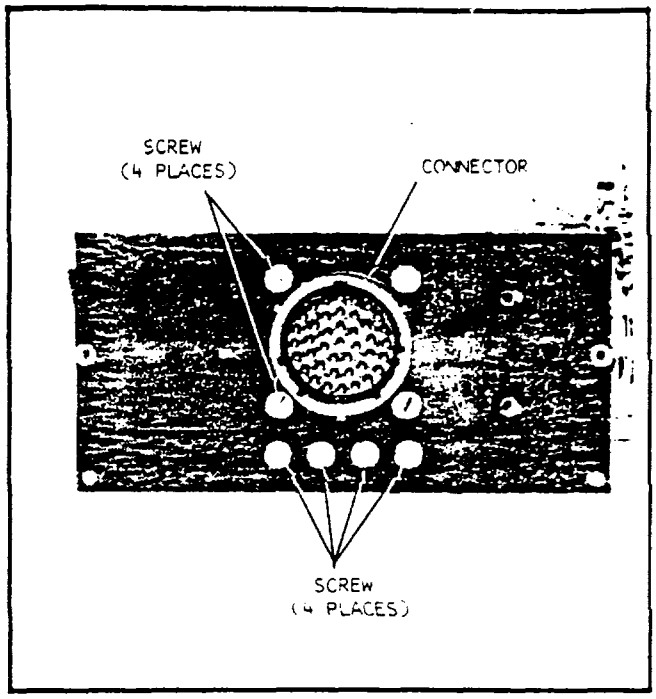


Figure 2-7. Connector Plate Assembly Removal

2-37. REASSEMBLY ROUTINE

2-38. Assembly of the 1U396-002 Audio Selector/Amplifier is straightforward and generally obvious. In general, assembly should be accomplished in the reverse order of disassembly (paragraphs 2-31 through 2-33). For detailed assembly information, use the appropriate exploded-view illustrations provided in the ILLUSTRATED PARTS BREAKDOWN section of this manual.

2-39. LEVEL POTENTIOMETER ADJUSTMENTS

2-40. There are four gain adjustment potentiometers within the audio selector/amplifier. The adjustment of these potentiometers will depend on the equipment used in conjunction with each audio selector/amplifier and on personal taste. When adjusting these level potentiometers, it is best to use the following sequence. This sequence will help avoid any confusing interaction between two or more gain adjustments. Refer to figures 2-8 and 2-9 when adjusting the level potentiometers.

CAUTION

Do not short headphone or PA outputs to ground, as this will damage the output transistors. Place ground isolation plugs on all test equipment, except power supply.

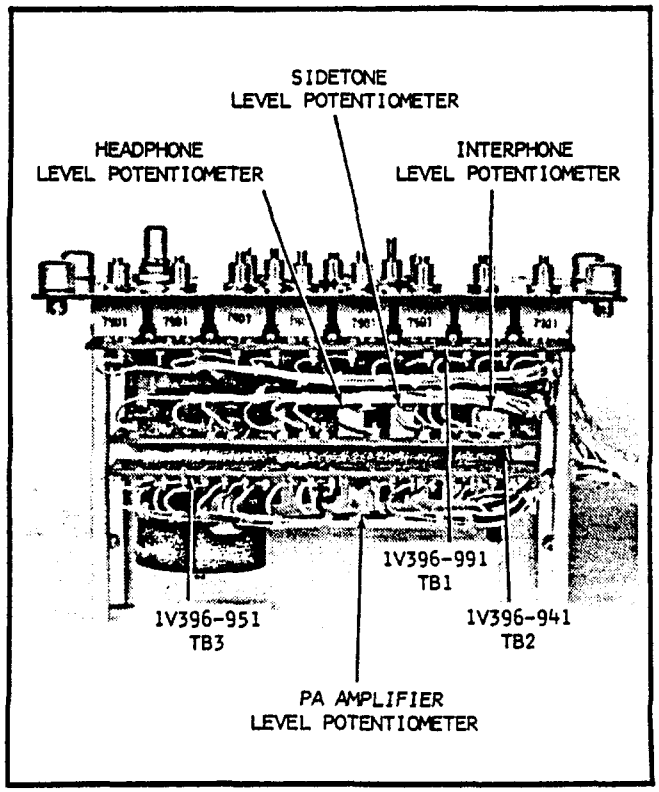


Figure 2-8. Level Potentiometer Locations

2-41. INTERPHONE LEVEL POTENTIOMETER

2-42. This potentiometer is preadjusted and should require no further adjustment. Adjusting this potentiometer for more output than specified may result in a large amount of distortion. If readjustment is necessary, use the following method.

A. Place a 150 ohm, one watt resistor across the microphone input and signal ground (simulates microphone load).

CAUTION

Do not short headphone or PA outputs to ground, as this will damage the output transistors. Place ground isolation plugs on all test equipment, except power supply.

B. Apply a 1000 Hz sine wave to the microphone input (use a 100 uf capacitor between the generator and the microphone input for ac coupling). The amplitude of the input signal will be dependent on the type of microphone used with the audio selector/amplifier. A typical amplitude is 125 mvrms.

C. With no load on the interphone output (adjust each audio selector/amplifier separately with no interconnecting interphone line), adjust the interphone level potentiometer for 9.0 vrms interphone output. A large amount of distortion may result if the output is adjusted for more than 9.0 vrms.

2-43. HEADPHONE LEVEL POTENTIOMETER

A. Apply a 1000 Hz sine wave to any one of the radio inputs (amplitude is dependent on equipment used in conjunction with the audio selector/amplifier, 10 vrms nominal).

B. Adjust the headphone level potentiometer for desired output (150 mw into 600 ohms, nominal with volume control set at maximum, cw).

2-44. SIDETONE LEVEL POT

A. Interconnect all audio selector/amplifiers to be used in the system.

B. Using the same procedure as stated in paragraph 2-42, A, and B, adjust each unit's sidetone level potentiometer for the desired headphone output (120 mw into 600 ohms, nominal).

2-45. PA LEVEL POTENTIOMETER

2-46. Using the same procedure as stated in paragraph 2-42, A, and B, switch on the PA amplifier and adjust the PA amplifier level potentiometer for the desired output (10 watts into eight ohms, nominal).

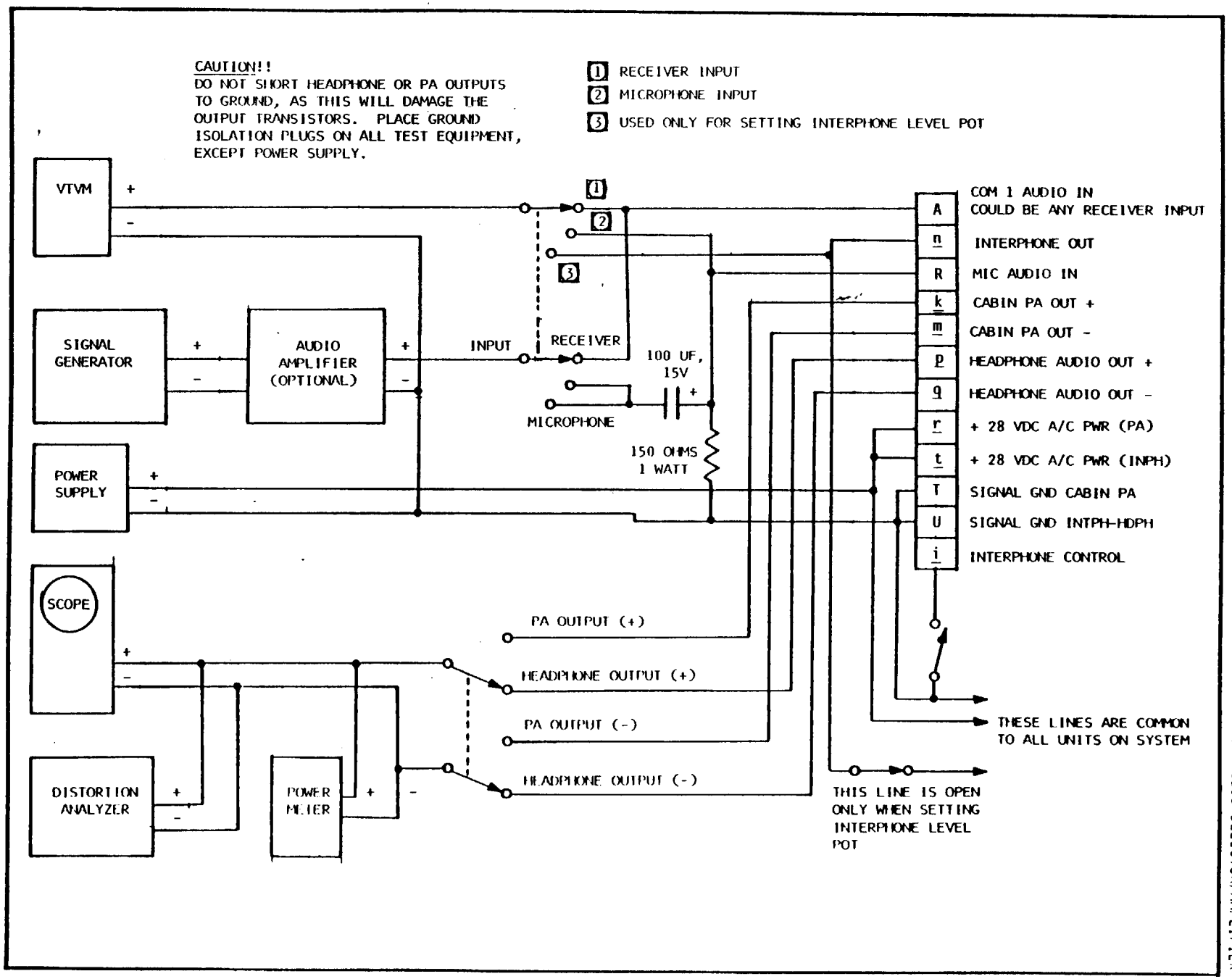


Figure 2-9. Test Equipment Diagram

SECTION III

ILLUSTRATED PARTS BREAKDOWN

3-1. The illustrated parts breakdowns, figures 1 through 3 and their accompanying lists, are arranged in disassembly sequence. Where assemblies can be broken down, the breakdown is indicated by indention in the nomenclature column. If the complete assembly is wanted, order by the assembly part number. When ordering only individual parts in an assembly, order by the individual part numbers. Assemblies that are permanently joined, or for some reason should not be disassembled, are listed and sold only as assemblies.

3-2. Where parts have been changed in production but the new parts are interchangeable with the old in both fit and function, only the current part number is listed and the current part illustrated, since only these items will be supplied as spares. The old part number may be shown as obsolete for clarity. If a new part is not fully interchangeable, the correct part number combinations are explained in notes at the end of each figure.

3-3. Assemblies or parts that are applicable to a specific series or modification (MOD) are identified in the EFF CODE column. The effective code is listed at the end of the text for each figure. When no code is listed, it is assumed that all of the parts or assemblies shown in the illustrated parts breakdown may be used on all of the models or series covered by the manual. The EFF CODE column may also be used to denote any peculiarities about listed assemblies or parts. The codes are unique to each individual figure (code "A" in figure 3-1 has no relationship to code "A" of figure 3-2).

3-4. Fasteners and standard purchased parts are listed by their Edo-Aire part numbers and may be purchased from Edo-Aire; however, the descriptions of these items are adequate for local or distributor purchase as well. Bulk items, such as sealers, are included with either their Edo-Aire part numbers for special materials or sufficient description for local purchase. These items should be kept in stock, and substitutions should be avoided to prevent risking the performance of an untested material.

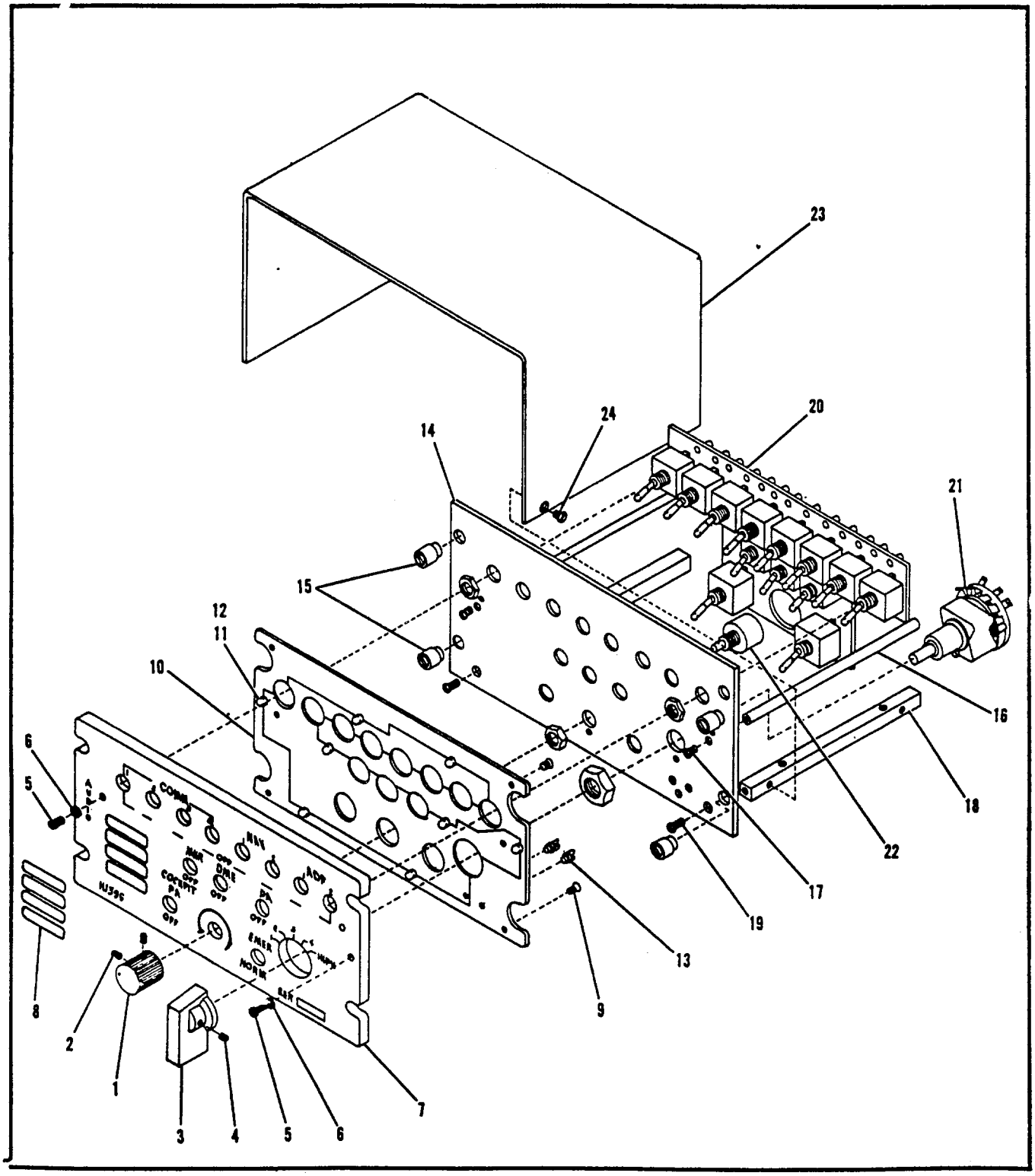


Figure 3-1. Front Panel and Switch Assembly

FIG. ITEM	PART NUMBER	NOMENCLATURE	UNITS PER ASS'Y	EFF CODE
3-1		FRONT PANEL AND SWITCH ASSEMBLY		
-1	700350-03	KNOB, VOLUME	1	
		ATTACHING PARTS		
-2		SET SCREW, 4-40 X 1/8	2	
		---::---		
-3	180079-001	FUNCTION KNOB	1	
		ATTACHING PARTS		
-4		SET SCREW, 6-32 X 1/8	2	
		---::---		
	1V396-981	PLASTIC PANEL ASSEMBLY	1	
		ATTACHING PARTS		
-5	110240-01	SCREW, PLASTIC MOUNTING	2	
-6	110241-01	LOCKWASHER, PLASTIC MOUNTING	2	
		---::---		
-7	67D002-002	. PANEL, EDGELIGHTED	1	
-8	67A004-10	. INLAY, PLASTIC	1	
	1V396-980	. PANEL LIGHTING ASSEMBLY	1	
		ATTACHING PARTS		
-9		. SCREW, 2-56 X 1/8 FLAT HEAD	4	
		---::---		
-10	56B085-001	. . PC BOARD	1	
-11	S21016-001	. . 28V LAMP	8	
-12	S21010-005-7	. . LAMP FILTER	8	
-13	S32005-002	. . TERMINAL	2	
-14	58D190-001	SUBPANEL	1	
		ATTACHING PARTS		
-15	550024-01	FASTENER, DZUS	4	
		---::---		

FIG. ITEM	PART NUMBER	NOMENCLATURE	UNITS PER ASS'Y	EFF CODE
3-1		FRONT PANEL AND SWITCH ASSEMBLY (CONT.)		
-16	907015-01	POST, .187 DIAMETER	2	
		ATTACHING PARTS		
-17		SCREW, 2-56 X 1/4 FLAT HEAD,	2	
		---:---		
-18	907014-01	POST, .250 SQUARE	2	
		ATTACHING PARTS		
-19		SCREW, 4-40 X 1/4 FLAT HEAD, UNDERCUT	2	
		---:---		
-20	1V396-991	SWITCH BOARD ASSEMBLY	1	
-21	907053-01	SWITCH, 2 POLE 5 POSITION ROTARY	1	
-22	550192-01	POTENTIOMETER, VOL 1K	1	
-23	907020-01	DUST COVER, TOP	1	
		ATTACHING PARTS		
-24		SCREW, 4-40 X 1/4 FLAT HEAD, UNDERCUT	4	
		---:---		

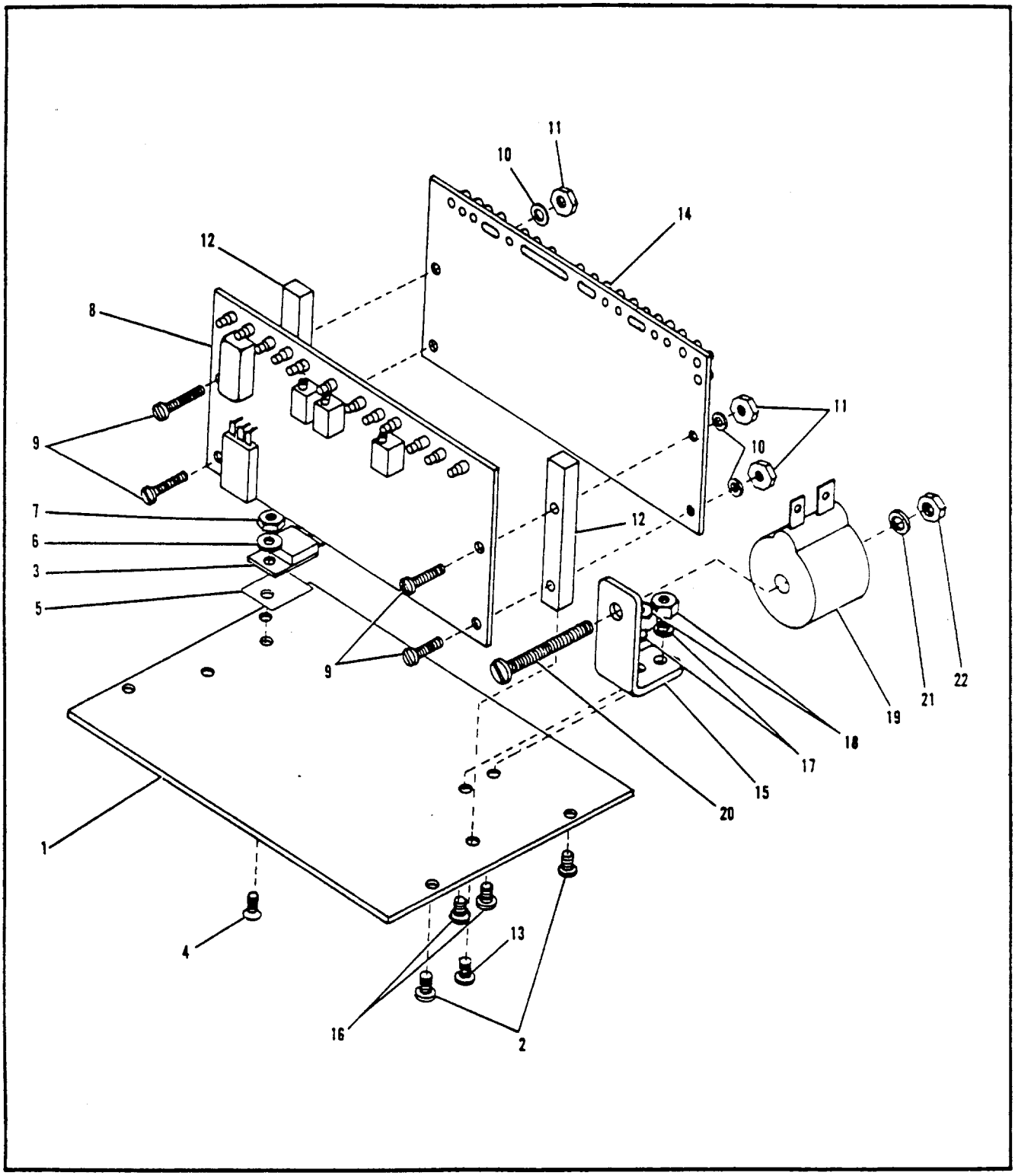


Figure 3-2. Amplifier Board Installation

FIG. ITEM	PART NUMBER	NOMENCLATURE	UNITS PER ASS'Y	EFF CODE
3-2		AMPLIFIER BOARD INSTALLATION		
-1	58B192-001	DUST COVER, BOTTOM	1	
		ATTACHING PARTS		
-2		SCREW, 4-40 X 1/4 FLAT HEAD, UNDERCUT HEAD	4	
		---:---		
-3	S12058-MC7818CT	REGULATOR	1	
		ATTACHING PARTS		
-4		SCREW, 4-40 X 1/4 FLAT HEAD, UNDERCUT HEAD	1	
-5	S36040-43-77-2	THERMA-FILM INSULATOR	1	
-6	S36038-7PPS	INSULATING SHOULDER WASHER	1	
-7		HEX NUT 4-40	1	
		---:---		
-8	1V396-941	INTERPHONE/HEADPHONE AMP ASSEMBLY	1	
		ATTACHING PARTS		
-9		SCREW, 4-40 X 1/2 PAN HEAD	4	
-10		LOCKWASHER, SPLIT #4	4	
-11		HEX NUT 4-40	4	
		---:---		
-12	62A282-001	STANDOFF, PCB	2	
		ATTACHING PARTS		
-13		SCREW, 4-40 X 1/4 FLAT HEAD, UNDERCUT HEAD	2	
		---:---		
-14	1V396-951	POWER AMP ASSEMBLY	1	
-15	943037-01	BRACKET, MOUNTING	1	
		ATTACHING PARTS		
-16		SCREW, 4-40 X 1/4 FLAT HEAD	2	
-17		LOCKWASHER, SPLIT #4	2	
-18		HEX NUT 4-40	2	
		---:---		

FIG. ITEM	PART NUMBER	NOMENCLATURE	UNITS PER ASS'Y	EFF CODE
3-2		AMPLIFIER BOARD INSTALLATION (CONT'D)		
-19	550327-01	CHOKE, 10 MH	1	
		ATTACHING PARTS		
-20		SCREW, 6-32 X 1" PAN HEAD	1	
-21		LOCKWASHER, SPLIT #6	1	
-22		HEX NUT #6-32	1	
		---*---		

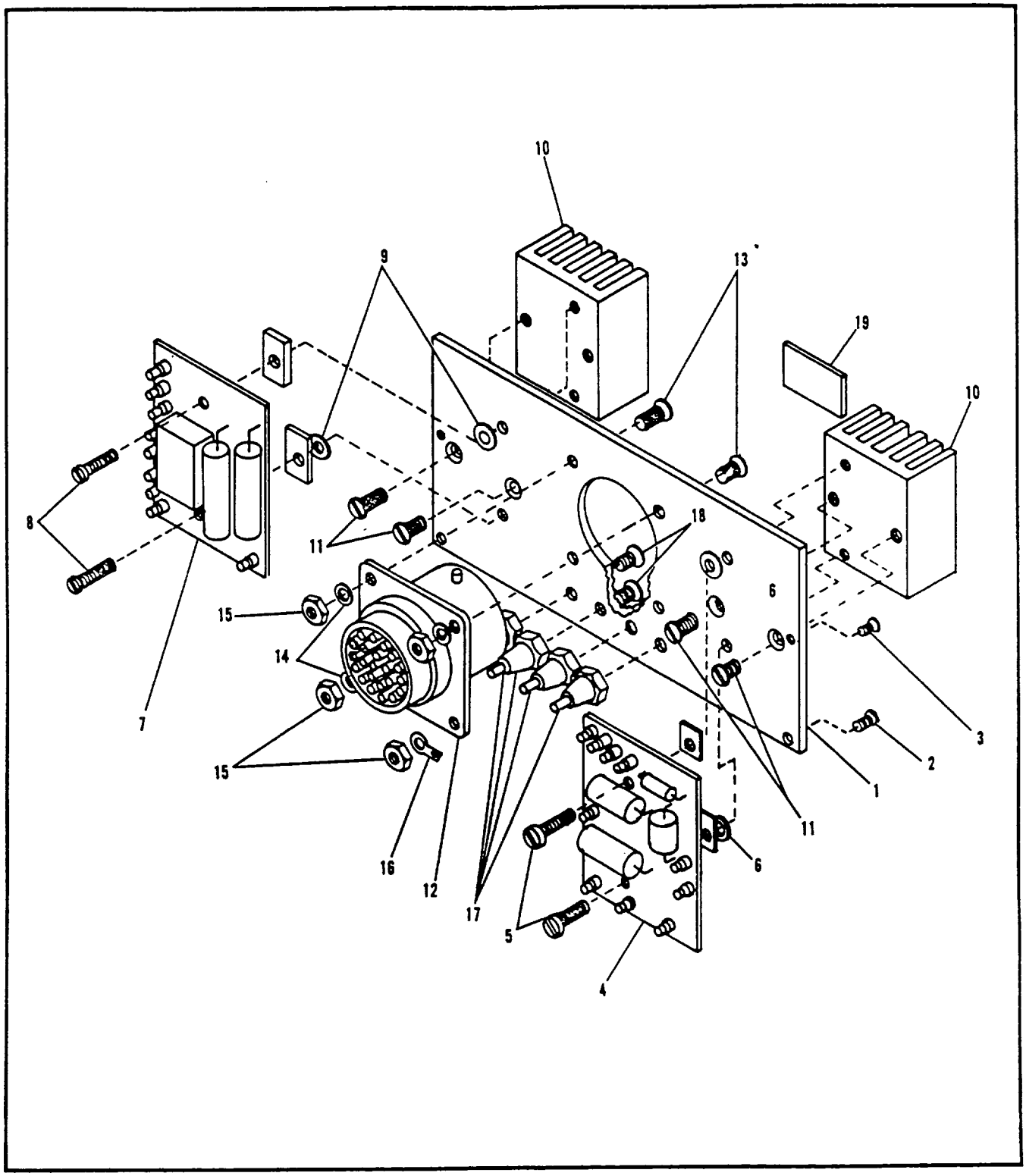


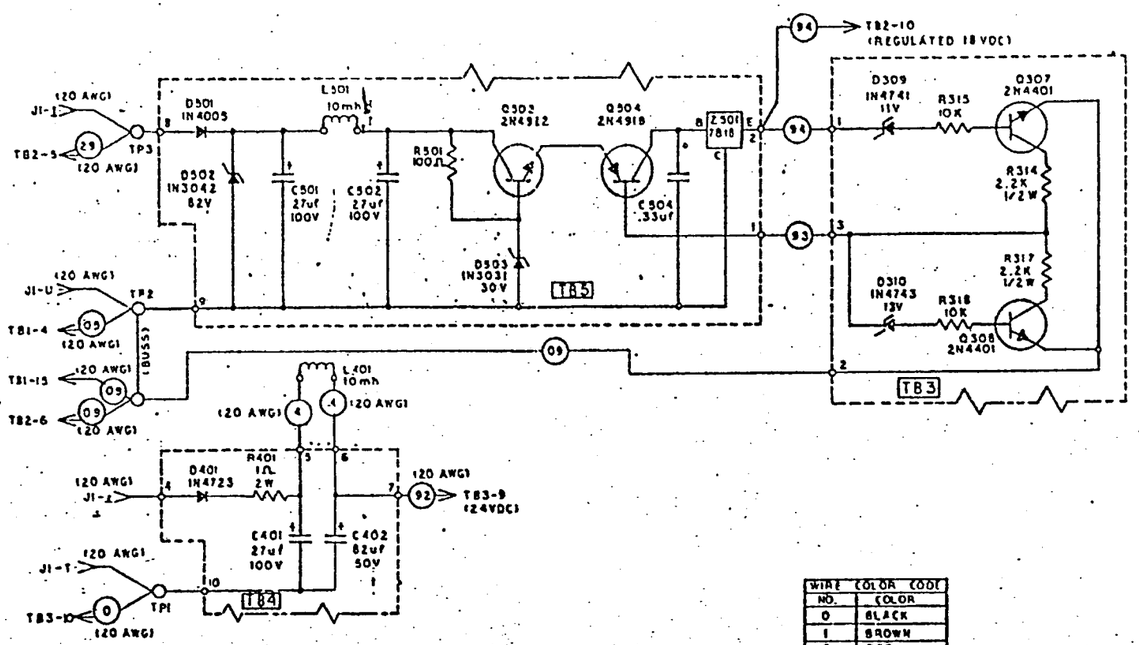
Figure 3-3. Connector Plate Assembly

FIG. ITEM	PART NUMBER	NOMENCLATURE	UNITS PER ASS'Y	EFF CODE
3-3		CONNECTOR PLATE ASSEMBLY		
-1	58B188-001	CONNECTOR PLATE	1	
		ATTACHING PARTS		
-2		SCREW, 4-40 X 1/4 PAN HEAD	2	
-3		SCREW, 2-56 X 1/4 PAN HEAD	2	
		---"---		
-4	1V396-971	PA SUPPLY ASSEMBLY	1	
		ATTACHING PARTS		
-5		SCREW, 4-40 X 1/2 PAN HEAD	1	
-6	S36040-43-02-83	THERMA-FILM INSULATOR	2	
		---"---		
-7	1V396-961	INTERPHONE/HEADPHONE ASSEMBLY	1	
		ATTACHING PARTS		
-8		SCREW, 4-40 X 1/2 PAN HEAD	2	
-9	S36040-43-02-83	THERMA-FILM INSULATOR	2	
		---"---		
-10	55B225-002	HEATSINK	2	
		ATTACHING PARTS		
-11		SCREW, 6-32 X 1/4 FLAT HEAD	4	
		---"---		

FIG. ITEM	PART NUMBER	NOMENCLATURE	UNITS PER ASS'Y	EFF CODE
3-3		CONNECTOR PLATE ASSEMBLY (CONT'D)		
-12	550133-04	CONNECTOR, KPT02A-20-41P	1	
		ATTACHING PARTS		
-13		SCREW, 4-40 X 1/4 FLAT HEAD, UNDERCUT HEAD	4	
-14		HEX NUT 4-40	4	
-15		LOCKWASHER, SPLIT #4	3	
-16	S32011-001	SOLDER LUG	1	
		---:---		
-17	727025-03	TERMINAL, STANDOFF	4	
		ATTACHING PARTS		
-18		SCREW, 6-32 X 1/4 FLAT HEAD	4	
		---:---		
-19	66A083-001	NAMEPLATE	1	

J1 CONNECTOR KPTM02E20-41P

PIN	FUNCTION	TO	COLOR
A	COM 1 AUDIO IN	TB1-1	6
B	COM 2 AUDIO IN	TB1-2	7
C	COM 3 AUDIO IN	TB1-3	49
D	COM 4 AUDIO IN	TB1-5	59
E	NAV 1 AUDIO IN	TB1-6	19
F	NAV 2 AUDIO IN	TB1-8	97
G	ADF 1 AUDIO IN	TB1-10	9
H	ADF 2 AUDIO IN	TB1-12	91
J	MKR AUDIO IN	TB1-7	1
K	DME AUDIO IN	TB1-9	89
L	SPARE		
M	28 VDC LIGHTS	TB3-19	3
N	SPARE		
P	SPARE		
R	MIC AUDIO IN	TB2-1	39
S	SPARE		
T	SIGNAL GND CABIN PA (20 AWG)	TP1	0
U	SIGNAL GND INTPH-HDPH (20 AWG)	TP2	09
V	SPARE		
W	MIC PTT CONTROL	S1-6	5
X	COM 1 MIC CONTROL	S1-1	915
Y	COM 2 MIC CONTROL	S1-2	912
Z	COM 3 MIC CONTROL	S1-3	946
a	COM 4 MIC CONTROL	S1-4	907
b	COCKPIT SPKR OUT +	TB1-20	50
c	COCKPIT SPKR OUT -	TB1-22	50
d	COM 1 MIC AUDIO OUT	S1-7	916
e	COM 2 MIC AUDIO OUT	S1-8	917
f	COM 3 MIC AUDIO OUT	S1-9	935
g	COM 4 MIC AUDIO OUT	S1-10	905
h	SPARE		
i	INTERPHONE CONTROL	TB2-3	8
j	SPARE		
k	CABIN PA AUDIO OUT +	TB3-5	96
m	CABIN PA AUDIO OUT -	TB3-14	30
n	INTERPHONE OUT	TB2-8	4
p	HEADPHONE AUDIO OUT +	TB1-23	69
q	HEADPHONE AUDIO OUT -	TB1-24	40
r	+28 VDC A/C PWR PA (20 AWG)	TB4-4	2
s	CHASSIS GND	TP4	0
t	+28 VDC A/C PWR INPH (20 AWG)	TP3	29



WIRE NO.	COLOR CODE COLOR
0	BLACK
1	BROWN
2	RED
3	ORANGE
4	YELLOW
5	GREEN
6	BLU
7	VIOLET
8	GREY
9	WHITE

1. FIRST DIGIT OF PART DESIGNATOR NO. INDICATES WHICH BOARD COMP. IS ON. EG. Q501 IS ON TB3
2. 24 GAGE WIRE USED UNLESS OTHERWISE NOTED
3. ALL RESISTORS 1/4W 2% UNLESS OTHERWISE NOTED
4. ALL SWITCHES ON TB1 ARE SHOWN IN DOWN POSITION
5. CABIN PA AMP AND HEADPHONE AMP OUTPUTS ARE FLOATING DO NOT GROUND EITHER OUTPUT.
6. CHASSIS GROUND ISOLATED FROM SIGNAL GROUND.
7. SIGNAL GROUNDS TO TP1 AND TP2 ARE ISOLATED FROM EACH OTHER.
8. 28VDC POWER LINES TO TB4 AND TB5 ARE ISOLATED FROM EACH OTHER.

PART NO.	PART DESC.	MODEL	SYSTEM

DO NOT SCALE PRINT

LIST OF PARTS

EDO-AIRE

SCHEMATIC
IU396-002
DEHAVILAND

30160 A

3D160 A

RELEASED

TB1

TB2

TB3

TB4

TB5

J1-A
J1-B
J1-C
J1-D
J1-E
J1-F
J1-G
J1-H
J1-J
J1-K
J1-L
J1-M

R1 1K VOLUME

S101 COMM 1
S102 COMM 2
S103 COMM 3
S104 COMM 4
S105 NAV 1
S106 NAV 2
S107 ADF 1
S108 ADF 2
S109 MKR
S110 DME
S111 HORN
S112 COCKPIT SPKR
S113 CABIN PA

R101 15K
R102 15K
R103 15K
R104 15K
R105 15K
R106 15K
R107 15K
R108 15K
R109 15K
R110 15K
R112 1K
R113 1K
R114 1K
R115 1K
R116 1K
R117 1K
R118 1K
R119 1K
R120 1K
R121 1K
R122 47Ω

Z201 7808
C201 .33uf
R201 300Ω 470
C202 2.2uf
C203 10uf 25V
C204 10uf 25V
R202 4.7K
R203 20K
R204 1K
R205 4.7K
Z202 FMC1558G
R206 100Ω
R207 CW 50K
R208 1K
R209 1K
Q201 2N4401
Q202 2N4403
Q203 2N4919
Q204 2N4922
C205 10uf 25V
R210 110Ω
T201 DO-T2
ORN
BLK RED BLU
R211 5.6K
C206 .22uf
C207 .22uf
R212 51K
R213 4.7K
R214 4.7K
C208 10uf 25V
R215 10K SIDETONE
R216 1K
R217 1K
R218 100Ω LEVEL ADJ
C209 10uf 25V
C210 1uf
C211 1000pf
R219 1K
R220 10K
R221 10K
C212 47uf 25V
C213 .68uf
R222 10K
R223 10K
C214 10uf 25V
R224 10K
R225 47K
R226 10K
R227 10K
R229 1K
R231 10K
R232 10K
R233 10K
C215 470pf
C216 470pf
C217 2.2uf
C218 10uf 25V
C219 3300pf
C220 470pf
C221 470pf
C222 10K
Z203 741MMG
Z204 FMC1558C
Q210 2N4401
Q209 2N4403
Q202 2N4403
Q207 2N4401
Q206 2N4403
Q205 2N4403
D201 IN4003
D202 IN4003
D203 IN4003
D204 IN4003
D205 IN4003
D206 IN4003
D207 IN4005
D208 IN4005
D209 IN4005
K201

R301 620Ω
R302 10K
R303 5K LEVEL ADJ
R304 10K
R305 10K
R306 100K
R307 10K
R308 47K
R309 10K
R310 10K
R311 10K
R312 10K
R313 47K
C301 .22uf
C302 470pf
C303 10uf 25V
C304 470pf
C305 2.2uf
C306 10uf 25V
C307 2700pf
C308 470pf
C309 470pf
C310 470pf
Z301 FMC1558G
D301 IN4003
D302 IN4003
D303 IN4003
D304 IN4003
D305 IN4003
D306 IN4003
D307 IN4003
D308 IN4003
Q301 2N4401
Q302 2N4403
Q303 2N4403
Q304 2N4403
Q305 2N4403
Q306 2N4403
Q401 2N4922
Q402 2N4922
Q501 2N4922
Q502 2N4922

COMM 1 COMM 2 COMM 3 COMM 4 INTERPHONE
S1

DS1 DS2 DS3 DS4 DS5 DS6 DS7
R2 330Ω
TB3
NOTE R2 IS MOUNTED ON TB-3 REFER TO TERMINALS 19 & 20 AS SHOWN.
TP4
PANEL LIGHTING

TP1 (GND)
TP2
TP3
TB4-7 (+24VDC)
TB5-2 (+18VDC)

962 95 937 918 8 925 901 924 902 947 903 926 904 948

CONNECTED TO
CONNECTED TO

1 SEE SHT 1 FOR POWER SUPPLIES AND J1.

3D160 SHEET 2 OF 3 A

SCHEMATIC
IU396-002
DEHAVILAND

EDO-AIRE

3D160 A

CHAPTER 24

ELECTRICAL POWER

de Havilland Inc.
DHC–6 TWIN OTTER
COMPONENT MAINTENANCE MANUAL
CHAPTER 24 – ELECTRICAL POWER

TABLE OF CONTENTS

MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B./T.R.
Eldec a Crane Co.	Proximity Sensor	1–899	24–09–08	Aug 1/01	
Elecro is supported by Eldec a Crane Co.	Proximity Sensor	Switch 2–899 & Sensor 1–899 (Model 899)	24–09–01	Apr 1/1969	
Flite–Tronics Products a Marathon Power Technologies Company	Static Inverter	PC14 and PC14A	–	–	
	Static Inverter	PC15 and PC15B and PC–15BC	–	Jun 1975	
	Static Inverter	PC–15BC	24–20–XX	Dec 1/1976	
	Static Inverter	PC–250	24–20–03	Jun 1/1982	
Honeywell Canada was Garrett Manufacturing	Static Inverter	607742–1–1	6C–198	Nov 1/1966	
General Electric	DC Reverse Current Air Circuit Breaker	XRP12A	–	–	
Hartman Electric	Reverse Current Cutout Relay	A–70ID	–	–	
	Reverse Current Cutout Relay	A–700AP & A718AP	–	–	
Leece–Neville a subsidiary of Phoenix Aerospace Inc.	Voltage Regulator Base	24554	–	–	
Marathon	Nickel Cadmium Batteries	29094			
	Static Inverter	Model PC–250	24–20–03	Jun 1/1982	
Phoenix Aerospace Inc.	DC Voltage Regulator	095001 (VR1010–24–1A)	24–30–X	Apr 16/1980	
	DC Voltage Regulator	095027 (VR1010–24–2A)	24–30–X	Jun 30/1978	
	Solid State Static Inverter (Transverter)	095032 (DH–1030–24–600–CS)	24–20–X	Oct 12/1973	
	Solid State Static Inverter (Transverter)	095165 (DH–1030–24–600–CS, Type IIB)	24–20–X	Jan 3/1992	
Saft	Battery	4076	24–30–22	Jan 30/1986	
Sonotone	Battery	CA–5 & MA 300H	–	–	

MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B./T.R.
Spar Aerospace	Static Power Inverter	5590F1-1 (Model SPS48)	–	Jun 20/1969	
TRW Aeronautical / Lucas Aerospace was Lear Siegler, A Division of Lucas	DC Starter Generator	23048-001 through -028	24-30-74	Dec 15/2000	SB23048-06(4/20/81) SB23048-07(7/17/84) SB23048-0XX-24-01(4/29/94) SB23048-0XX-24-02(4/12/94) SB23048-0XX-24-03(1/24/00) SB132(6/1/67) SB141(15/6/68) SB144(9/5/68) SB160(8/15/69) SB166(3/1/70) SB167-1(3/10/71) SB169-1(6/1/73) SB180-1(9/25/72) SIL02-5600-01 (8/17/92) SIL03-6010-XX-01 (5/2/95) SIL23701(3/5/96) SIL23703(1/24/97) SIL23704(24/08/01) DDS23048-027/28 (7/21/94) TR23048-001-01 (4/24/87) TR23048-001-02 (6/15/87)
Ametek Aerospace was Weston	DC Millivoltmeter	253198 (Model 1511)	F-3542	1968	
	DC Millimeter	253199 (Model 1511)	F-3540	1968	

CRANE ELDEC CORPORATION
A CRANE CO. COMPANY

PROXIMITY SENSOR

PART NO.
1-899-15
1-899-28
1-899-29
1-899-83

ABBREVIATED COMPONENT MAINTENANCE MANUAL WITH ILLUSTRATED PARTS LIST

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RECORD OF REVISIONS

MFG REV NO	DESCRIPTION	ISSUE DATE	ATP REV DATE	INSERTED BY

RECORD OF TEMPORARY REVISIONS

TEMP REV NO	DESCRIPTION	ISSUE DATE	ATP REV DATE	INSERT BY	DATE REMOVED	REV INCOR	REMOVE BY

REVISION TRANSMITTAL

TO: HOLDERS OF ABBREVIATED COMPONENT MAINTENANCE MANUAL WITH ILLUSTRATED PARTS LIST FOR ELDEC 1-899-15, -28, -29, and -83 PROXIMITY SENSOR.

REVISION NUMBER 8, DATED AUG 1/01

HIGHLIGHTS

Revision 7 was printed incorrectly. The entire manual has been reprinted as Revision 8, with no other changes. Discard the old manual and replace with the new copy.

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REVISION TRANSMITTAL

TO: HOLDERS OF ABBREVIATED COMPONENT MAINTENANCE MANUAL WITH ILLUSTRATED PARTS LIST FOR ELDEC 1-899-15, -28, -29, and -83 PROXIMITY SENSOR.

REVISION NUMBER 7, DATED JUL 10/01

HIGHLIGHTS

The pages that have been revised, along with the highlights of the revision, are given below. The entire manual has been reprinted. Discard the old manual and replace with the new copy.

Page No.	Description of Change	Effectivity
Title Page	Updated	All
Table of Contents	Updated	All
18	Changed step (9) and heading in Table 3.	All
22	Removed item 5 (Rigging Test Set, ELDEC PN 38-082-01) from Table 5. The Rigging Test Set is not necessary to test the Proximity Sensor. Added items 5 through 8 to Table 5.	All

REVISION TRANSMITTAL

TO: HOLDERS OF ABBREVIATED COMPONENT MAINTENANCE MANUAL WITH ILLUSTRATED PARTS LIST FOR ELDEC 1-899 **PROXIMITY SENSOR**.

REVISION NUMBER 6, DATED MAY 30/00

HIGHLIGHTS

The pages that have been revised, along with the highlights of the revision, are outlined below. Added sensor part number 1-899-83 and incorporated Service Letter SL1-899-15-01. The entire manual has been reprinted. Discard the old manual and replace with the new copy.

Page No.	Description of Change	Effectivity
Title	Added PN 1-899-83.	All
9	Added PN 1-899-83, added one paragraph description under General, reworded third paragraph, changed paragraph heading "Operation" to "Theory of Operation".	All
10	Added PN 1-899-83 and improved Figure 1.	All
11	Reformatted Table 1. Added 1-899-83 sensor, weights with leads, construction; corrected lead length for -28 and added lead details. Added L1 and R1 nominals; corrected case isolation, corrected ambient temperature info. Added GA and GD, vibration and shock specifications.	All
12	Added note to Testing and Fault Isolation	All
13	Reformatted.	All
16	Added 1-899-83 and improved Figure 4. Removed two notes and replaced with L1, R1 values.	All
17	Improved Figure 5.	All
18	Incorporated Service Letter SL1-899-15-01.	All
19	Added step to resistance test	
20	Added 1-899-83 to Table 4; reformatted.	All
21	Reformatted.	All

SERVICE BULLETIN LIST

Service Bulletins applicable to this manual are listed below. Service Bulletins that affect this manual are shown by the date of incorporation.

SERVICE BULLETIN NUMBER	REVISION NUMBER	DATE BULLETIN INCORPORATED

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INTRODUCTION

CAUTION: UNLESS OTHERWISE NOTED, ALL INTEGRATED CIRCUITS ON CIRCUIT CARDS ARE CMOS AND REQUIRE SPECIAL STATIC HANDLING PRECAUTIONS.

NOTE: All voltages are dc unless otherwise stated.

Instructions in this manual give information to do testing and fault isolation. These instructions do not cover all details and variations in equipment. For further specific information or in case a particular problem cannot be solved using these instructions, contact:

Product Support Representative
ELDEC Corporation
16700 13th Ave W
P.O. Box 97027
Lynnwood, WA 98046-9727

Telephone: (425) 743-8168
Facsimile: (425) 743-8234
Internet: http://www.eldec.com
Email: pubs@eldec.com

Acronyms and abbreviations are listed on the next page.

ACRONYMS AND ABBREVIATIONS

ACRONYM	ASSIGNED MEANING
A	amperes
ac	alternating current
C	Celsius
dc	direct current
F	Fahrenheit
g	gram or gravity
h	henry
Hz	Hertz
k	kilo
M	Mega
m	milli
PN	part number
PSEU	Proximity Switch Electronics Unit
s	seconds
V	Volts
Ω	ohms

ACRONYM	ASSIGNED MEANING

DESCRIPTION AND OPERATION

1. General

Proximity systems use sensors and targets to find the position of parts of an aircraft, such as doors and landing gear. When metal targets come near, the electrical properties of the sensor change. The change in sensor inductance (or impedance) controls the operation of a remote electronic switch.

A. Description

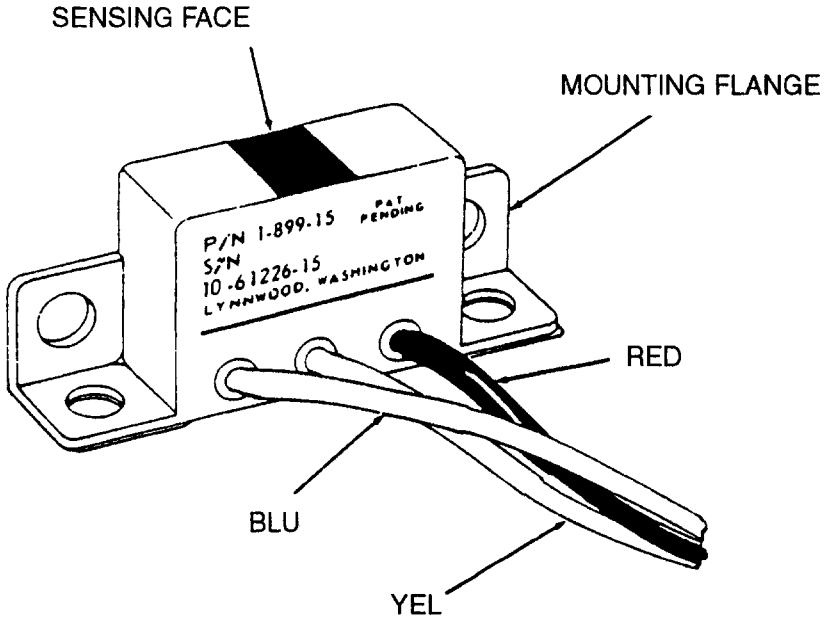
The Proximity Sensors (PN 1-899-15, -29, -28, and -83 shown in Figure 1) are variable reactance sensors. The proximity sensor is an inductor and a temperature compensation resistor contained in a stainless steel case. These remotely installed sensors detect the presence or absence of magnetically permeable targets. Each sensor is an integral part of a proximity switch system. Sensor specifications are shown in Table 1.

B. Theory of Operation

In the system, the sensor is electrically connected to a solid state proximity switch circuit. Figure 2 illustrates the elements of the basic system. Figure 3 shows the sensor schematic diagrams. The sensor forms two legs of a bridge circuit. One leg is a coil; the other is a temperature-compensating resistor. Alternating current flowing through the sensor coil produces a magnetic field around the sensing surface. When a ferromagnetic target is brought near the sensing surface, the magnetic field is intensified, which produces an impedance change across the coil.

Regulated direct current is converted to alternating current by an oscillator and applied across the bridge. When the target is within the actuation range of the sensor, the impedance change unbalances the bridge circuit. The resulting signal is demodulated and compared with a reference voltage. When the signal exceeds the reference, it triggers a flip-flop circuit to change its state. The output of the flip-flop is amplified by a driver stage and applied as a gate voltage to a high current transistor switch.

PROXIMITY SENSOR
1-899-15, -29, -83



PROXIMITY SENSOR
1-899-28

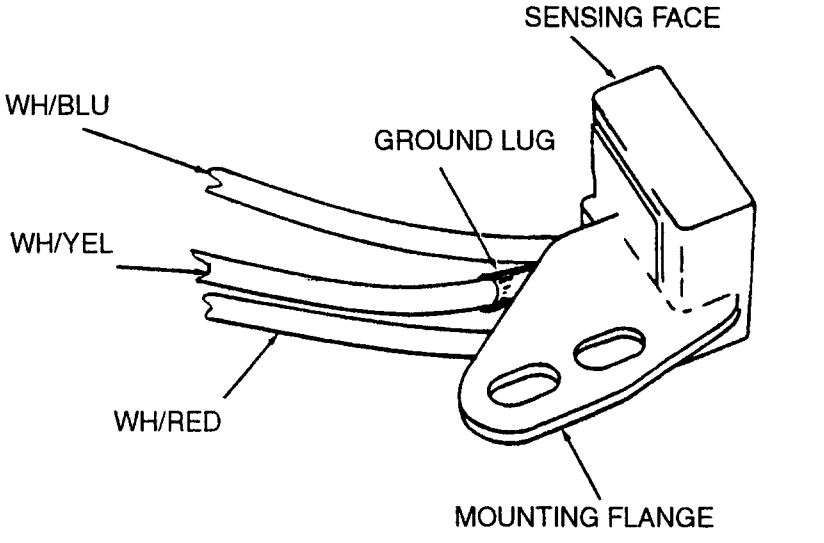
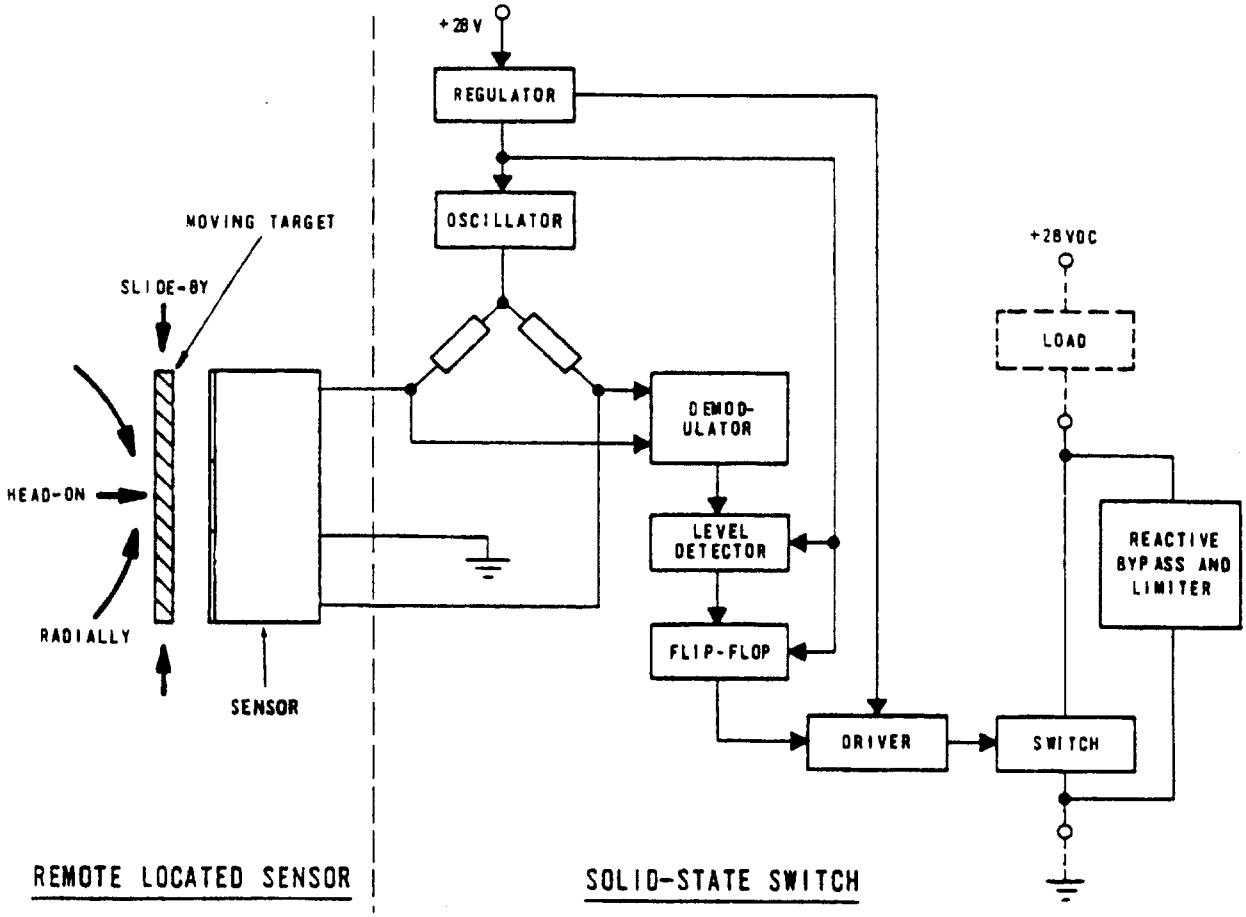


Figure 1
1-899 Proximity Sensors

Table 1
Sensor Specifications

	1-899-15, -29, -83	1-899-28
Weight	2.0 oz. max. without leads (56.7 grams) 7.5 oz. max. with leads (212.6 grams)	4.0 oz. max without leads (113.4 grams) 13.6 oz. max. with leads (385.6 grams)
Construction	Stainless Steel/ Epoxy Resin front cover	Stainless Steel/ Epoxy Resin front cover
Electrical	Twisted Flex Leads 18 AWG per MIL-W-22759/8 120 in. min. (3.05 meters min.)	Flex Leads 16 AWG per BMS 13-8A 96 in. min. (2.44 meters min.)
Power Requirement	4 Watts (28 V dc)	4 Watts (28 V dc)
Compatible Proximity Switch Electronics	8-060-02 2-899-111 2-899-111-3 2-899-113	8-060-02 2-899-111
L1 Resistance R1 Resistance	27–33 Ω 344.5–351.5 Ω	27–39 Ω 314–382 Ω
Case Isolation	>10 MΩ @ 500 V dc	>10 MΩ @ 500 V dc
Ambient Operational Temperature Range	1-899-83 -73 to 93 °C (-100 to 200 °F) 1-899-15, -29 -65 to 85 °C (-85 to 185 °F)	-54 to 177 °C (-65 to 350 °F)
Actuation Gap G_A G_D	0.300 ± 0.015 in. (7.620 ± 0.381 mm.) 0.010–0.030 in. greater than G_A (0.254– 0.762 mm.)	0.228 ± 0.010 in. (5.790 ± 0.254 mm.) 0.005–0.015 in. greater than G_A (0.127– 0.381 mm.)
Vibration	17.6 g_{rms}	17.6 g_{rms}
Shock	1000 g, 1.0 ms duration	1000 g, 1.0 ms duration



1-899\XXB0011.TIF

Figure 2
Proximity Switch System Block Diagram

TESTING AND FAULT ISOLATION

NOTE: ELDEC approved technical data and its referenced test equipment can be used as an alternative to the Testing and Fault Isolation procedures in this section. Only the latest released revision of this data shall be used.

1. General

This section gives the instructions needed to test ELDEC sensors. Sensors are tested in the repair shop with special ELDEC test equipment. Sensors that fail on-aircraft tests must be tested again in the repair shop before they are removed from service. Replace the sensor if it fails the required repair shop tests.

A. Related Publications

(1) ELDEC ATA 32-60-04 – ELDEC Sensor Test System (PN 38-841-01)

(2) ELDEC document 011-2920-603 – Sensor Test Gauge Kit (PN 8-758-01)

B. Test Procedures

There are two methods to test sensors. Method 1 is a return-to-service test that is done on a test bench and uses special ELDEC test equipment. Method 2 uses a commercially available L/C/R meter. This test method is useful on the aircraft as a confidence test. Hi-Pot tests are required to find internal component deterioration.

C. Required Test Equipment

Table 2 shows a list of test equipment needed to test the proximity sensors.

NOTE: Equipment with equivalent specifications can be used.

Table 2
Required Test Equipment

NOMENCLATURE	MODEL/PN	MFR/VENDOR
Hi-Pot Tester	Rod-L-M100AVS	Rod-L-Electronics 923 Hamilton Ave. Menlo Park, CA 94025 (V1K653)
Test Method 1		
Switch Card	8-060-02CP (Center Point Calibrated)	ELDEC 16700 13th Ave W. Lynnwood, WA 98046-9727 (V08748)
Test Stand	3-445-16	ELDEC 16700 13th Ave W. Lynnwood, WA 98046-9727 (V08748)
Connector	3-582553-1	AMP Inc. 2800 Fulling Mill Rd. Harrisburg, PA 17105-3608 (V00779)
Regulated Power Supply, 30 V dc, 2 Amp	PAB32-2A	Kikusui Intl. Corp. 1980 Orizaba Ave. Long Beach, CA 90804 (V61993)
Indicator Lamp	Type 313	Commercial standard

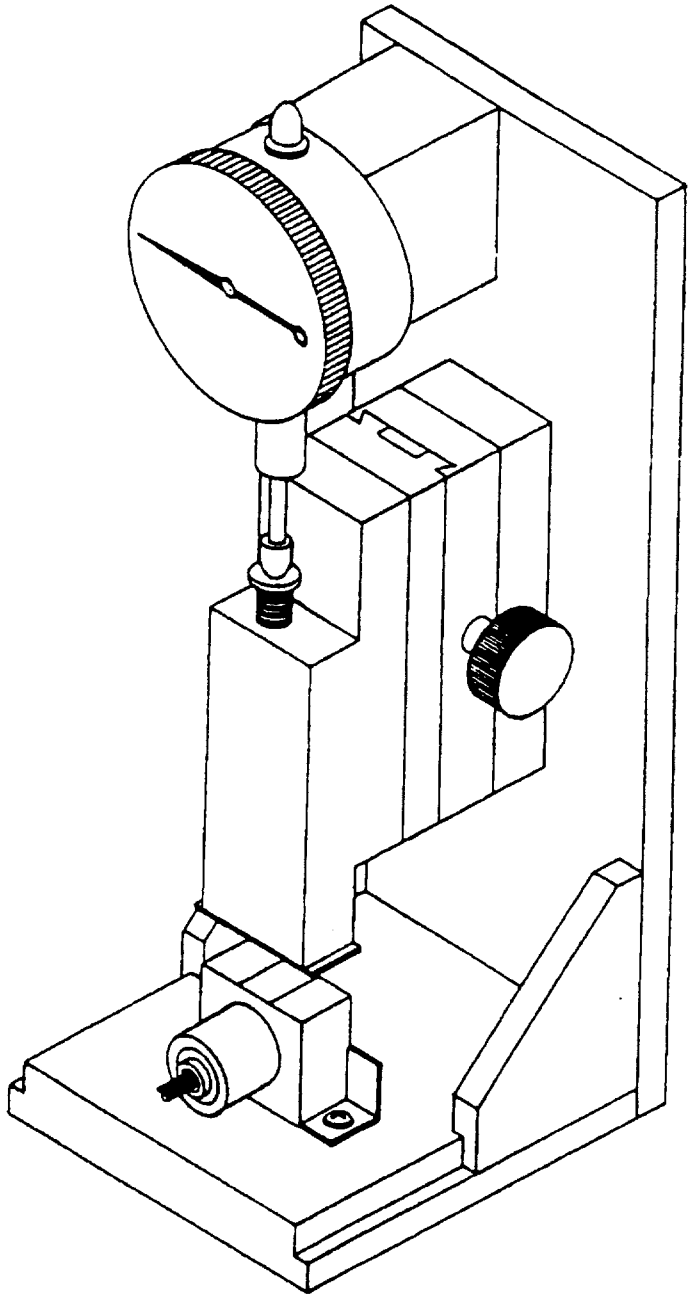
Table 2
Required Test Equipment (Continued)

NOMENCLATURE	MODEL/PN	MFR/VENDOR
Test Method 2		
Sensor Test Gauge Kit (Preferred)	8-758-01	ELDEC Corporation 16700 13th Ave W. Lynnwood, WA 98046-9727 (V08748)
L/C/R Meter	878 or 848	BK Precision Maxtec International Corp. 6470 Cortland St. Chicago, IL 60635-4011 (V0CE78)

D. ELDEC Test Equipment

The Proximity Switch Card, PN 8-060-02CP (see Table 2), has the electronic circuits required to energize a sensor and monitor operation. A lamp is used to show sensor conditions target near and target far. Jacks are used to connect the sensor and 28 V dc operating power.

The Test Stand, PN 3-445-16 (Figure 3) has a target mounted on a movable slide. Slide travel is measured by a dial gauge on the Test Stand. The difference in distance between target on the sensor face (target near) and target far sensor conditions must fall within a go/no-go range.



1-899\XXT0011.TIF

Figure 3
Test Stand 3-455-16

E. Hi-Pot Test

WARNING: Hi-POT VOLTAGES CAN BE LETHAL. BE CAREFUL.

CAUTION: ALTHOUGH HI-POT TESTS ARE POTENTIALLY DESTRUCTIVE, THIS TEST IS REQUIRED TO IDENTIFY INTERNALLY DAMAGED UNITS. MARGINAL OR INTERMITTENT UNITS CAN ESCAPE DETECTION IF NOT TESTED.

CAUTION: DO NOT TEST SENSOR PN 1-899-28 WITH HI-POT. THIS SENSOR HAS AN INTERNAL HARD-WIRED GROUND (SEE FIGURE 4).

NOTE: Units are tested at the maximum specified Hi-Pot during production. Hi-Pot tests gradually degrade the UUT insulation. Reduced voltages are used during return-to-service tests to minimize damage.

(1) Slowly apply 500 V ac, 60 Hz between the yellow lead and case. Keep the voltage on for at least 60 seconds.

(2) If current leakage is greater than 1.0 milliamp during test, the sensor is faulty. If electrical breakdown is heard or seen, the sensor is faulty. Replace any faulty sensor.

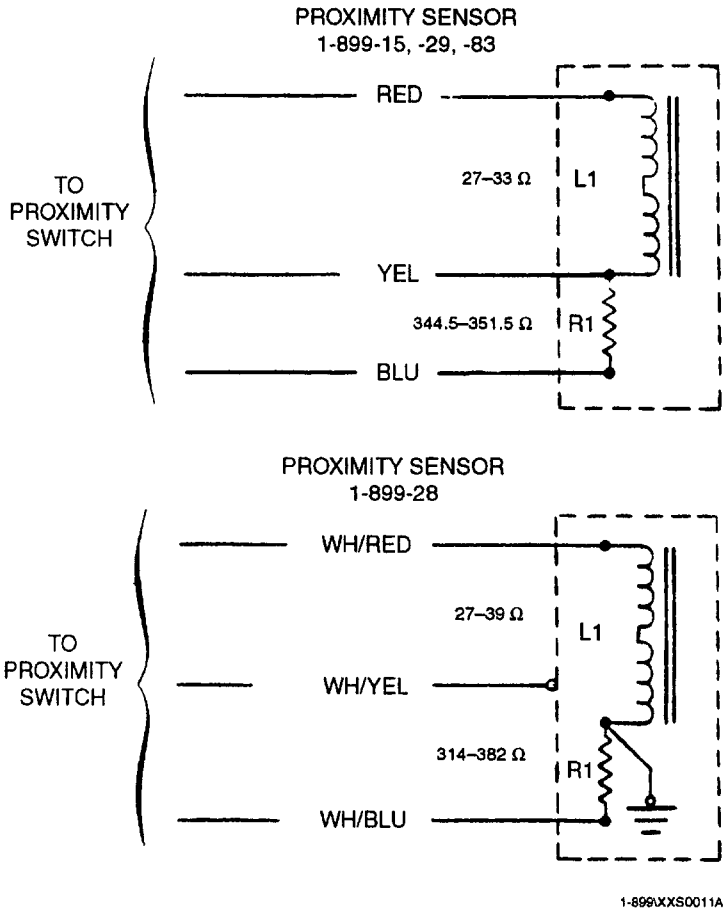


Figure 4
Proximity Sensor Schematics

F. Functional Test – Method 1

Figure 5 shows the test equipment setup to functionally test the sensor for return-to-service.

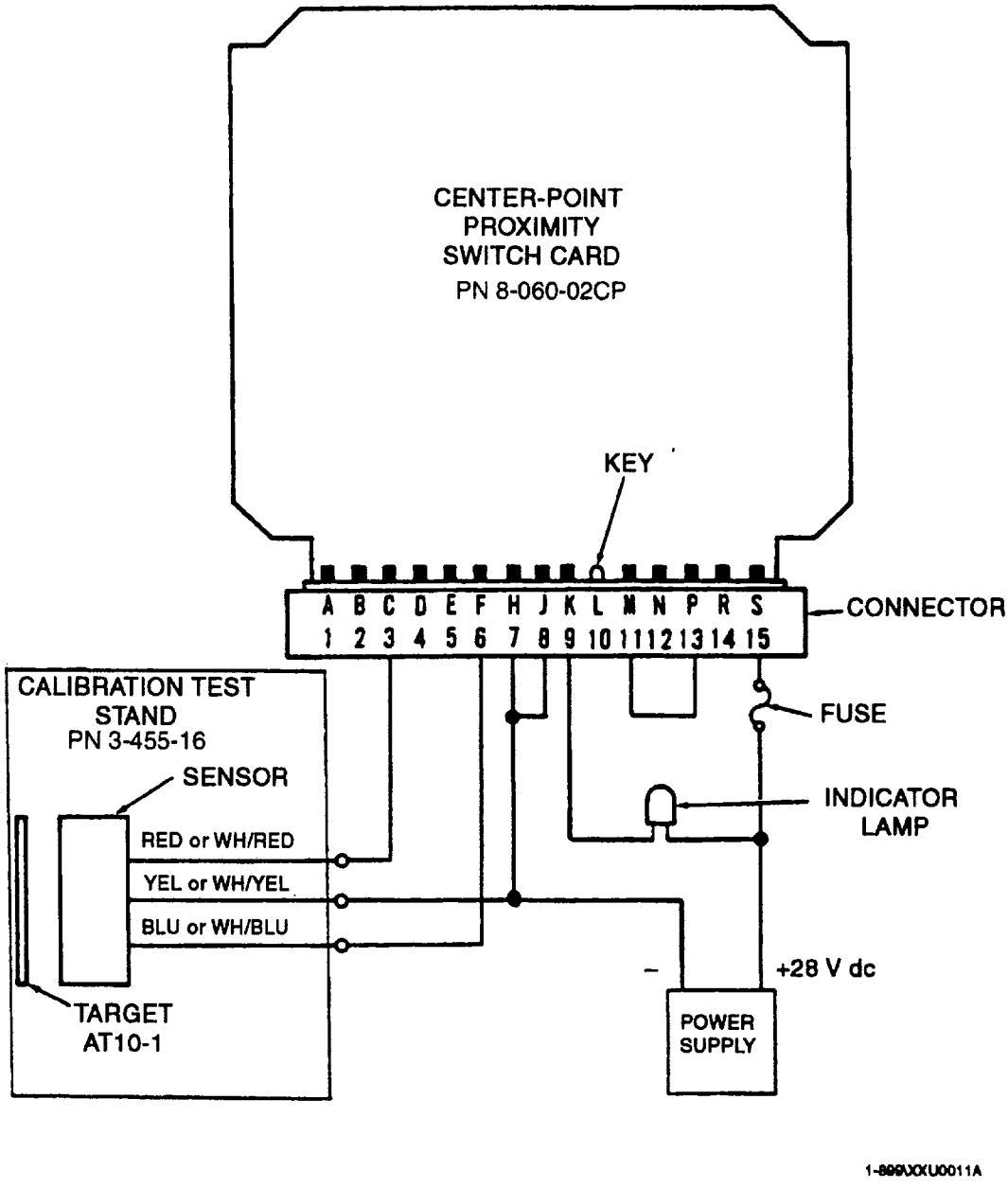


Figure 5
Test Setup, Functional Test – Method 1

CAUTION: DO NOT INSERT OR REMOVE SWITCH CARD FROM CONNECTOR WITH POWER ON. SENSOR MAY BE CONNECTED OR DISCONNECTED WITH POWER ON.

(1) Connect the equipment as shown in Figure 5.

(2) Energize the power supply and adjust output to 28 ± 1 V dc.

(3) Adjust the test stand target position to contact the sensor face.

(4) Adjust the test stand dial indicator to zero.

(5) Make sure the indicator lamp is on.

(6) Adjust the stand to move the target away from sensor.

(7) Record the dial scale indication when the indicator lamp goes off.

(8) Adjust the target toward sensor until the indicator lamp turns on. The dial scale indication must be as shown in Table 3.

(9) Subtract the adjusted dial scale indication in step (8) from the recorded value in step (7). The result must be within the limits shown in Table 3.

Table 3
Functional Test Limits – Method 1

SENSOR	DIAL SCALE INDICATION IN STEP (8)	VALUE OF STEP (8) MINUS STEP (7) MUST BE . . .
1-899-15, -29, -83	0.300 ± 0.015	0.010 to 0.030 inch
1-899-28	0.228 ± 0.010	0.005 to 0.015 inch

(10) If the sensor under test fails any test step, do Paragraph H., Fault Isolation.

G. Functional Test – Method 2

This method uses an L/C/R meter (see Table 2) to check the health of a sensor. Figure 6 shows the Test Method 2 test equipment setup.

NOTE: The sensor to be tested may have specific aircraft interface cables or connectors. A suitable adapter cable to connect the red and blue wires may be required.

(1) On the L/C/R meter, push the POWER button to turn the meter on.

(2) Push the 1 kHz/120 kHz button to select the 1 kHz meter excitation frequency.

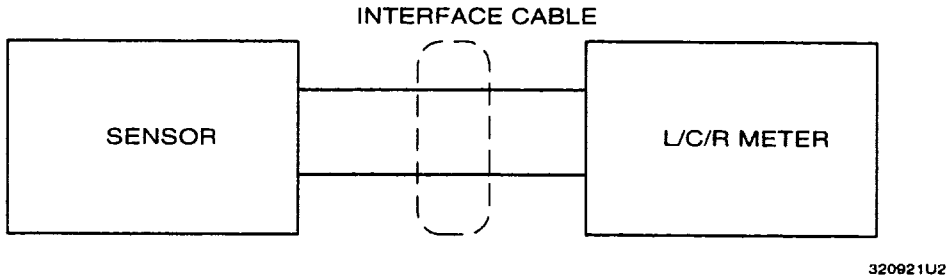


Figure 6
Test Setup, Functional Test – Method 2

(3) Push the L/C/R button to select the H (Henries) measurement mode.

(4) Connect the meter to the red (wht/red) and yellow (wht/yellow) sensor leads of the sensor to be tested.

(5) The meter will show the series inductance of the sensor and associated wires. Write down this value as Target Far. See Table 4 for correct sensor values.

(6) Place the appropriate test gauge from Sensor Test Gauge Kit 8-758-01 directly on the face of the sensor.

(7) The meter will show the series inductance of the sensor and associated wires. Write down this value as Target Near. See Table 4 for correct sensor coil values.

(8) Measure the series resistance of the sensor coil with the instructions below.

(a) Push the L/C/R mode switch to set the L/C/R meter in R (resistance mode).

(b) Push the L/C/R meter DATA HOLD button once.

(c) Push and hold the L/C/R meter D/Q button until the meter changes to the series mode (Ser appears in the upper right corner of the display).

(d) Write down this value. See Table 4 for correct sensor coil resistance values.

(9) Measure the resistance of the fixed resistor with the instructions below.

(a) Connect the meter to the blue (white/blue) and yellow (white/yellow) leads of the sensor under test.

(b) Push the L/C/R mode switch to set the L/C/R meter in R (resistance mode).

(c) Push the L/C/R meter DATA HOLD button once.

(d) Push and hold the L/C/R meter D/Q button until the meter changes to the series mode (Ser appears in the upper right corner of the display).

(e) Write down this value. See Table 4 for correct fixed resistor values.

(10) To check another sensor, push the L/C/R meter DATA HOLD button once, then push the L/C/R button until the desired measurement mode is displayed.

(11) If the sensor under test fails any test step, do Fault Isolation, paragraph H.

Table 4
Functional Test Limits – Method 2

NOMINAL VALUE		SENSOR CONDITION
36.20 mH		Target FAR
38.20 mH		Target NEAR
27–33 Ω	(1-899-15, -29, -83 coil)	Target FAR
27–39 Ω	(1-899-28 coil)	Target FAR
344.5–351.5 Ω	(1-899-15, -29, -83 resistor)	–
314–382 Ω	(1-899-28 resistor)	–

H. Fault Isolation

If Functional Test – Method 1 shows a faulty sensor, degauss the sensor and retest. Make sure that the switch card is correct and in calibration. Make sure the card is operative. Detailed fault isolation is not given because the sensors are not repairable.

Replace any sensor that fails Functional Test – Method 1 or Functional Test – Method 2.

DISASSEMBLY

1. General

Disassembly is not applicable. The proximity sensor is a sealed unit and cannot be disassembled.

CLEANING

1. General

WARNING: VENTILATE WORK AREA WHEN USING SOLVENT. AVOID CONTACT WITH SKIN. WEAR RUBBER GLOVES. OBSERVE ALL SAFETY AND FIRE REGULATIONS.

Clean dirt, oil, or grease from sensor with a commercial degreaser such as Degreasol F99 (Kleer-Flo Company).

CHECK

1. General

Inspect the proximity sensor for damage, wear, corrosion, broken leads, or cracked face surface.

REPAIR

1. General

The proximity sensor is a sealed unit. Replace the sensor if it is defective.

ASSEMBLY

1. General

Assembly is not applicable since the proximity sensor cannot be disassembled. Package the sensor in a polyethylene bag. Seal in a commercial carton and store in a cool, dry place.

FITS AND CLEARANCES

1. General

Special fits and clearances are not required.

SPECIAL TOOLS, FIXTURES, AND EQUIPMENT

1. General

See Table 5 for special tools, fixtures, and equipment. Equivalent replacements can be used for listed items.

Table 5
Special Tools, Fixtures, and Equipment

ITEM	DESCRIPTION	PART NUMBER
1	L/C/R Meter	BK Precision Model 878 or 848
2	Sensor Test Gauge Kit	ELDEC PN 8-758-01
3	Switch Card	ELDEC PN 8-060-02CP (Center Point Calibrated)
4	Test Stand	ELDEC PN 3-445-16
5	Hi-Pot Tester	Rod-L-Electronics Model Rod-L-M100AVS
6	Connector	AMP PN 3-582553-1
7	Regulated Power Supply, 30 V dc, 2 Amp	Kikusui Intl. Corp. PN PAB32-2A
8	Indicator Lamp	Type 313

ILLUSTRATED PARTS LIST

1. General

The Illustrated Parts List is not required because there are no replaceable parts. Discard the proximity sensor if it is defective.

OVERHAUL MANUAL WITH ILLUSTRATED PARTS CATALOG
CHAPTER/SECTION/SUBJECT NUMBER 24-09-01

DOCUMENT NUMBER 660630

PROXIMITY SWITCH

MODEL 899

(SWITCH ASSEMBLY 2-899-111, -111-3, -112, or -113)
and
(SENSOR ASSEMBLY 1-899-15, -18 or -28)

ELECTRO DEVELOPMENT CORPORATION
LYNNWOOD, WASHINGTON

ORIGINALLY ISSUED JUNE 30, 1967
REVISED FEBRUARY 1, 1968
REVISED JANUARY 10, 1969
REVISED APRIL 1, 1969

ELECTRO DEVELOPMENT CORPORATION
LYNNWOOD, WASHINGTON

OVERHAUL MANUAL

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Title	April 1, 1969
1 thru 45	April 1, 1969
Appendix, 1 thru 9	April 1, 1969

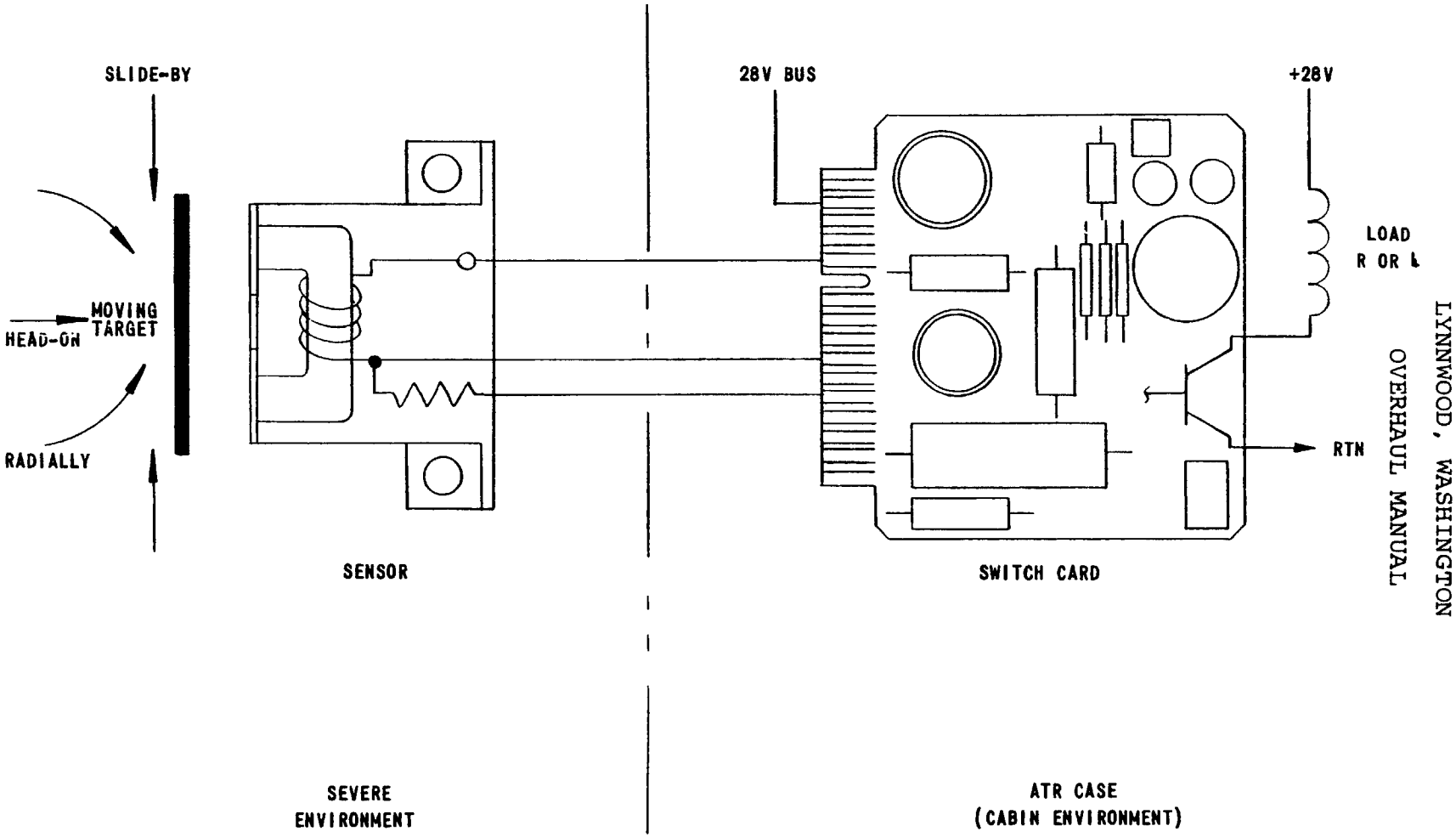
1. INTRODUCTION

A. Description

EDC Proximity Switch Model 899 is an all solid-state system that changes state (switches) when a movable metal target comes within a particular distance of the fixed sensor. The proximity switch performs the same function as a mechanical switch but without physical contact (no moving parts to bend, break, or wear out). EDC switches can be either normally open or normally closed (selected by jumpers at the switch card connector), and they may be connected in parallel or in series (up to six).

B. Operation

Figure 1 illustrates the elements of the basic system. The sensor (located remotely from the switch card) appears as an inductance to the switch card. A change of inductance, caused by the proximity of a metal target, is sensed by the switch card. The switch card then completes (or, in the case of a normally closed switch, interrupts) the circuit to an external load. For specific test actuation distances and other leading particulars of the system, see Figure 2.



EDC SOLID STATE TWO-PART PROXIMITY SWITCH SYSTEM

FIGURE 1

	SYSTEM				
COMPONENT	2-899-111/1-899-15	2-899-112/1-899-18	2-899-113/1-899-15	2-899-111/1-899-28	2-899-111-3/1-899-15
Switch Card P/N	2-899-111	2-899-112	2-899-113	2-899-111	2-899-111-3
Sensor P/N	1-899-15	1-899-18	1-899-15	1-899-28	1-899-15
Weight:					
Switch	2.5 oz.	2.5 oz.	2.5 oz	2.5 oz.	2.5 oz.
Sensor	2.0 oz.	4.0 oz.	2.0 oz.	4.0 oz.	2.0 oz.
Power Requirements	28 vdc at 4w max	28 vdc at 4w max	28 vdc at 4w max	28 vdc at 4w max	28 vdc at 4 max
Temperature Range:					
Sensor	-77°C to +204°C	-77°C to +350°C	-77°C to 204°C	-54°C to +177°C	-77°C to +204°C
Switch	-40°C to + 65°C	-40°C to + 65°C	-40°C to + 65°C	-40°C to + 65°C	-40°C to + 65°C
Switch Rating	0.5 amp	0.5 amp	0.5 amp	0.5 amp	0.5 amp
Test Actuation Point for Isolated HIMU-80	0.275 to 0.325 in.	0.090 to 0.160 in.	0.130 to 0.160 in.	0.215 to 0.265 in.	0.275 to 0.325 in.
Differential Travel	0.005 to 0.030 in.	0.005 to 0.015 in.	0.005 to 0.020 in.	0.005 to 0.030 in.	0.004 to 0.010
Test Gage	8-005100-01	8-005100-04	8-005100-02	8-005100-05	

TABLE OF LEADING PARTICULARS

FIGURE 2

1. INTRODUCTION (Cont.)

C. Interchangeability

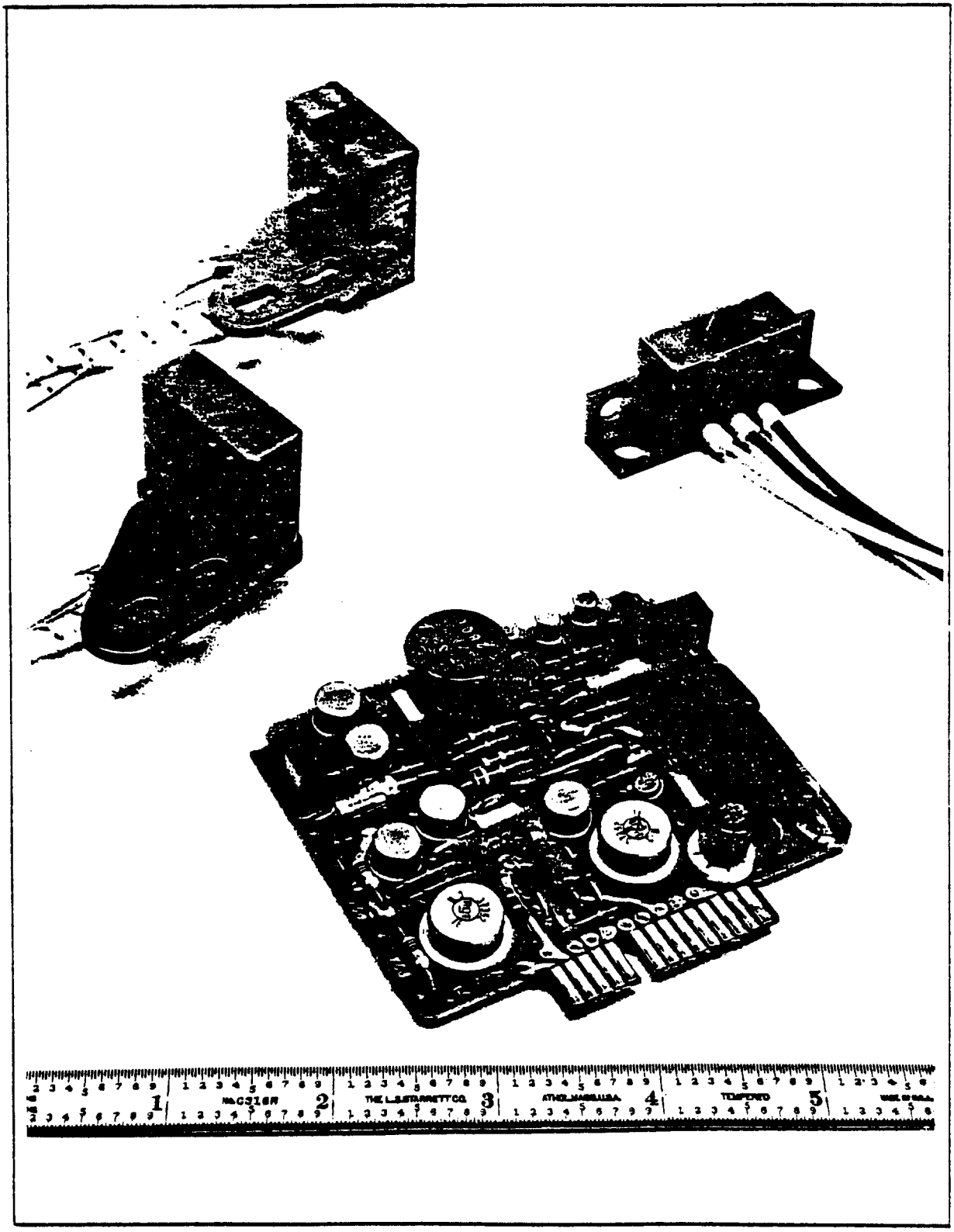
For a given card/sensor system (e.g., 2-899-111/1-899-15) any -111 card will operate with any -15 sensor. A particular pair will have a specific actuation point, but the actuation point of any pair will fall within the test limits specified in Figure 2.

D. Failsafe

The proximity switch was designed so that open or shorted sensor leads will inhibit the actuation of the switch, regardless of the position of the target. Loss of power will cause the output switch to fail open.

E. Illustration

Figure 3 portrays the actual physical construction of the basic elements of the system.



Proximity Switch Model 899
Figure 3

2. THEORY OF OPERATION

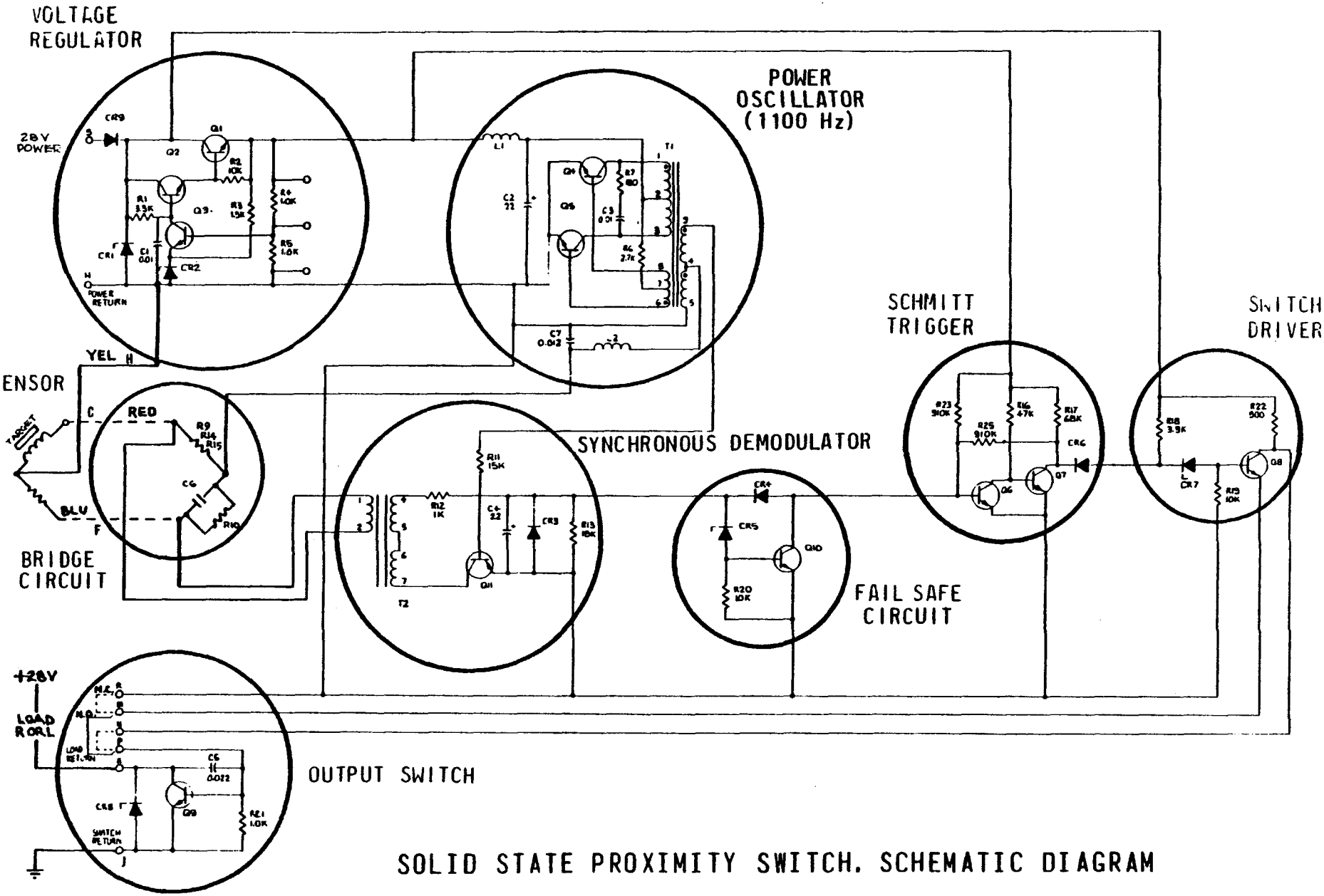
A schematic of the proximity switch, divided into sections, is shown in Figure 4. The sections relate to the following discussion.

(a) Voltage Regulator

The voltage regulator portion of the circuit provides the necessary stable voltage, free of large transient variations, to the other switch circuitry. Diodes CR1 and CR9 provide input protection to the regulator. CR9 protects against a reverse voltage connection while CR1 is a high voltage transient protecting zener. The error voltage amplifier Q3 senses the difference between the output voltage divider (R4, R5) and reference diode CR2. Q3 delivers an error signal to Q2 which provides the current gain necessary to drive series regulator Q1. Fine adjustment of the output voltage is made by placing trimming resistors in parallel with R4 or R5 as required. The combination of L1 and C2 prevents large current spikes from being impressed on the DC line by the oscillator circuit.

(b) Power Oscillator (1100 Hz)

Sensor excitation is provided by a single-transformer



SOLID STATE PROXIMITY SWITCH. SCHEMATIC DIAGRAM

FIGURE 4

2. THEORY OF OPERATION (Cont.)

(b) Power Oscillator (1100 Hz) (Cont.)

Royer oscillator including Q4, Q5, T1 and associated parts. Transistors Q4 and Q5 switch the supply current in opposite directions through the primary winding 1-2-3 of T1. Secondary winding 6-7-8 provides feedback to the bases of switching transistors Q4 and Q5. Secondary winding 4-5-9 provides the drive to the sensor and synchronous detector. The bridge circuit is fed through the waveshaping filter L2, C7 which removes many of the high frequency components from the transformer output.

(c) Bridge Circuit

The bridge circuit includes internally arm R9, R15, R14, and arm R10, C6. The other two arms of the bridge are located remotely in the sensor. The red and blue leads which are attached to the sensor, are also connected to the primary side of transformer T2. An unbalance of the bridge circuit is reflected as a change in voltage between the red and blue leads.

(d) Synchronous Demodulator

The use of T2 as a balanced input to the synchronous

2. THEORY OF OPERATION (Cont.)

(d) Synchronous Demodulator (Cont.)

demodulator greatly increases the common mode rejection of unwanted signals on the sensor lines. The demodulator (Q11, C4, CR3, R12, and R13) samples the bridge unbalance every half cycle of the sensor excitation. The drive signal for the demodulator is taken off a secondary tap on T1 through R11. Capacitor C4 is charged every half cycle by the bridge output signal, but is charged and discharged randomly by any non-synchronous noise. C4 is protected from reverse voltages by diode CR3. The voltage level developed across R13 is sensed through isolation diode CR4. CR4 becomes back-biased when the threshold of the Schmitt Trigger circuit is exceeded, thus the demodulator is isolated from loading effects of the Schmitt Trigger.

(e) Failsafe Circuit

A failsafe circuit is included and is made up of CR5, R20, and Q10. In the event of a failure resulting in a high voltage across R13, CR5 conducts and turns on Q10, which in turn clamps off the Schmitt Trigger.

(f) Schmitt Trigger and Switch Driver

The Schmitt Trigger operates as a high gain feedback

2. THEORY OF OPERATION (Cont.)

(f) Schmitt Trigger and Switch Driver (Cont.)

amplifier circuit with the bias point set by biasing resistor R23 and feedback resistor R25. Exceeding the threshold of the circuit causes Q6 to saturate, which turns off Q7. The Schmitt Trigger is isolated from the switch driver by diode CR6. R18, R19, and CR7 are biasing components for drive transistor Q8.

(g) Output Switch

The output switch Q9, R21, C5, and CR8 is externally jumpered for normally open or normally closed operation. With the connector wired for normally open operation, emitter current of Q8 will provide base drive for Q9.

In the normally closed condition, Q9 is driven through R22. The zener CR8 across Q9 protects against transients. Capacitor C5 is for EMI suppression.

3. DISASSEMBLY

CAUTION: POWER TO THE PROXIMITY SWITCH SYSTEM MUST BE OFF BEFORE REMOVAL OF SWITCH CARD FROM SYSTEM. FAILURE TO DO SO MAY RESULT IN DAMAGE TO UNIT.

A. Sensor

The sensor is a nonrepairable unit and cannot be disassembled.

B. Switch, Component Removal

The switch is disassembled only to the extent necessary to remove defective components. (Component identification is shown in Figure 12.)

(1) Remove plastic coating only from circuit pads requiring replacement.
(2) Touch pad area lightly with soldering iron to remove coating.

CAUTION: USE HEATSINK ATTACHMENT WHEN APPLYING SOLDERING HEAT TO DIODES. USE MINIMUM HEAT REQUIRED TO REMOVE PARTS.

(3) Unsolder part leads from pad.
(4) Apply side pressure to loosen part from circuit board.

4. CLEANING

A. See Figure 5 for required cleaning materials.

CLEANING MATERIAL	SPECIFICATION
Solvent	Stoddard, Commercial
Brush	Small size with soft, nonmetallic bristles

Materials Required for Cleaning Switch

Figure 5

B. Clean printed circuit board with vacuum cleaner (preferred method) or low-pressure compressed air (optional method). Use the small brush to dislodge foreign particles from crevices and surfaces. Dip brush in solvent and wash parts as necessary to remove oily film. Dry with low-pressure compressed air.

WARNING: VENTILATE WORK AREA THOROUGHLY WHEN USING SOLVENT. AVOID CONTACT OF SOLVENT WITH SKIN. OBSERVE ALL SAFETY AND FIRE PRECAUTIONS.

5. INSPECTION

A. Sensor

Inspect sensor for damage, wear, corrosion, and deterioration.

B. Switch Card

Inspect switch card for damage from overheating, cracks, distortion, oxidation, deterioration, displacement, loose mounting, broken leads, and unacceptable solder connections.

NOTE: Switch cards are coated with a conformal coating. Dark brown color of the coating on transistor Q1 and Resistor R22 is acceptable and not cause for rejection.

6. REPAIR

A. Sensor

The sensor is not repairable.

B. Switch Card

The switch card may be repaired by replacement of defective

B. Switch Card (Cont.)

components and/or restoration of damaged solder connections. Defective components are detected by inspection (Section 5) or trouble shooting (Section 10). Remove switch components per Section 3 and install per Section 7.

7. ASSEMBLY

A. Sensor

The sensor cannot be disassembled or assembled.

B. Switch

(1) See Figure 6 for required material.

NAME	SPECIFICATION
Urelane 8267	Furane Plastics, Los Angeles, California
Toluene	Commercially Available

Materials Required for Reassembly

Figure 6

B. Switch (Cont.)

(2) Clean pad areas from which components have been removed. Use toluene.

NOTE: Avoid contamination of gold-plated areas of circuit board.

(3) Install new component using standard commercial practices.

CAUTION: USE HEATSINK ATTACHMENT WHEN APPLYING SOLDERING HEAT TO DIODES. USE MINIMUM HEAT REQUIRED TO SOLDER PARTS.

(4) Dry in oven at 50°C to 60°C for 20 minutes.

(5) Brush coating on uncoated area and air-cure for 30 - 40 minutes. Dry in oven at 50° to 60°C for 2 hours.

8. FITS AND CLEARANCES

No special fits or clearances are required.

9. TESTING

A. Test Setup

This section covers testing of the sensor and switch.

A. Test Setup (Cont.)

Figure 7 shows a test setup.

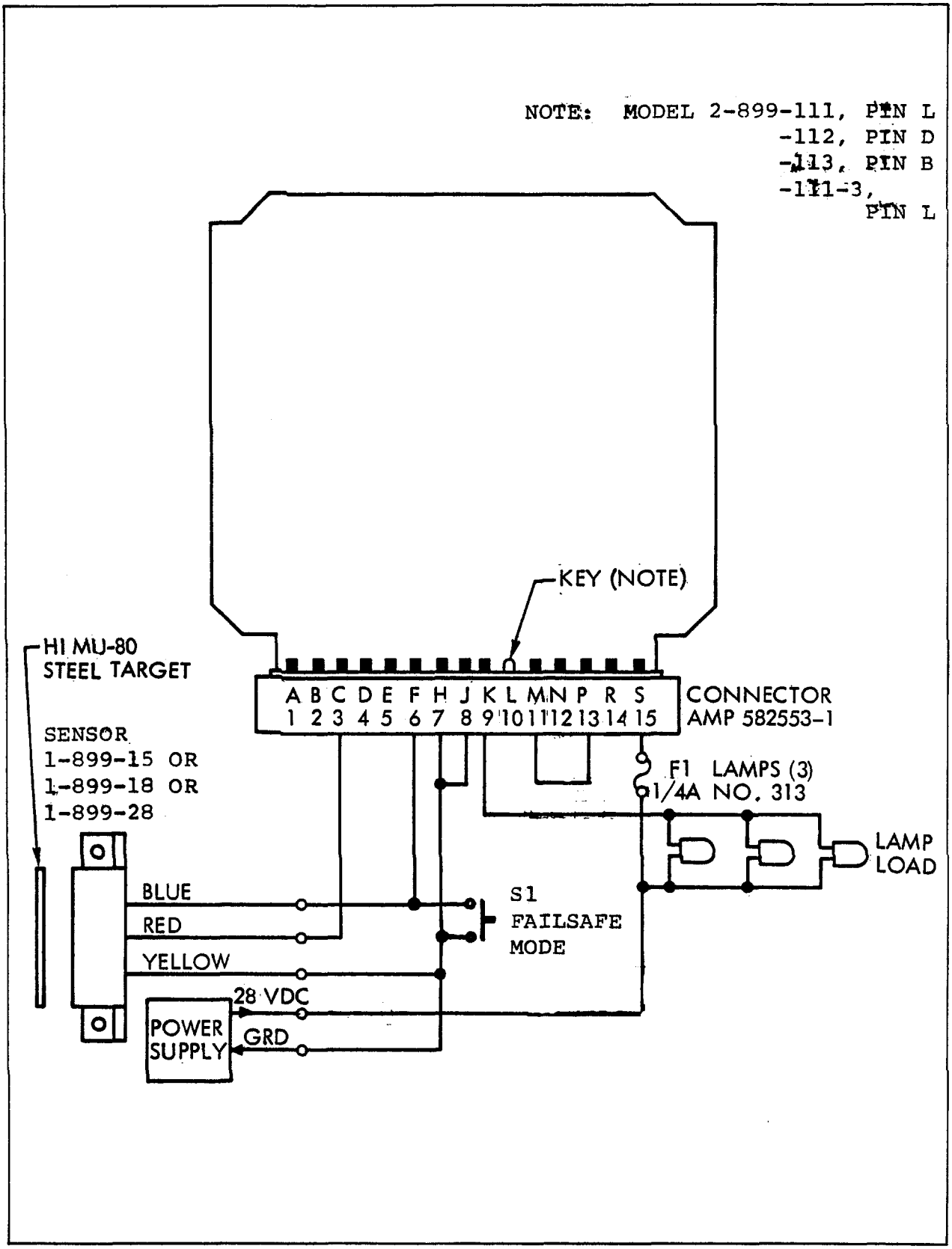
B. Test Equipment

(1) Test set, EDC P/N 8-005-01 (see Appendix), or equivalent (see Figure 7).
(2) Test gage, select the proper test gage from Figure 2.
(3) Actuator Test Target Assembly, EDC P/N 8-005101-02 or equivalent (see Figure 10).

C. Testing Sensors 1-899-15, 1-899-18 and 1-899-28.

CAUTION: DO NOT INSERT OR REMOVE SWITCH CARD FROM CONNECTOR WITH POWER ON. COMPONENT SIDE OF THE SWITCH CARD MUST BE AS NOTED ON THE TEST SET. SENSORS MAY BE CONNECTED OR DISCONNECTED WITH POWER ON.

(1) Insert a known good 2-899-xxx (see Figure 2 for the correct part number) switch card in the connector on the test set.
(2) Plug the line card into 115 VAC 60 to 400 Hz or connect 28 ± 1 VDC to the jacks on the test set.
(3) Insert the sensor to be tested in the mounting clips on the test set (-15 only) or place on non-magnetic surface.
(4) Connect the blue, red and yellow sensor to the binding posts marked BLU, RED and YEL respectively.



TEST SET-UP
FIGURE 7

C. Testing Sensors 1-899-15, 1-899-18 and 1-899-28 (Cont.)

(5) Switch ON/OFF power switch to the applicable ON position. Indicator light should be "OFF".

(6) Select the correct test gage from Figure 2. Place test gage on the sensor with the "ON" side down. Indicator light should go "ON".

(7) Place test gage on the sensor with the "OFF" side down. The indicator shall be "OFF".

D. Testing Switch, All Models

(1) Insert the switch card to be tested in the connector on the test set.

(2) Select a known good sensor, 1-899-xxx, (see Figure 2 for the correct part number).
Connect the blue, red and yellow sensor leads to the binding posts marked BLU, RED and YEL respectively.

(3) Apply power to the test set by means of the line card provided, 110 VAC 60 to 400 Hz, or connect 28 ± 1 VDC to the jacks on the test set.

(4) Switch ON/OFF power switch to the applicable ON position. Indicator light should be "OFF".

(5) Select the correct test gage from Figure 2. Place test gage on the sensor with the "ON" side down. Indicator light should go "ON".

(6) Place test gage on the sensor with the "OFF" side down. The indicator shall be "OFF".

D. Testing Switch, All Models (Cont.)

NOTE: Remove Test Gage.

(7) Press FAILSAFE MODE push button. Indicator light should go "OFF". A brief blink of the indicator light is acceptable.

(8) Place the actuator test target (EDC P/N 8-005101-02) against sensitive face of sensor (zero gap). The light should be on.

NOTE: If switch fails this test, analyze in accordance with procedures in Section 10.

10. TROUBLE SHOOTING

A. General

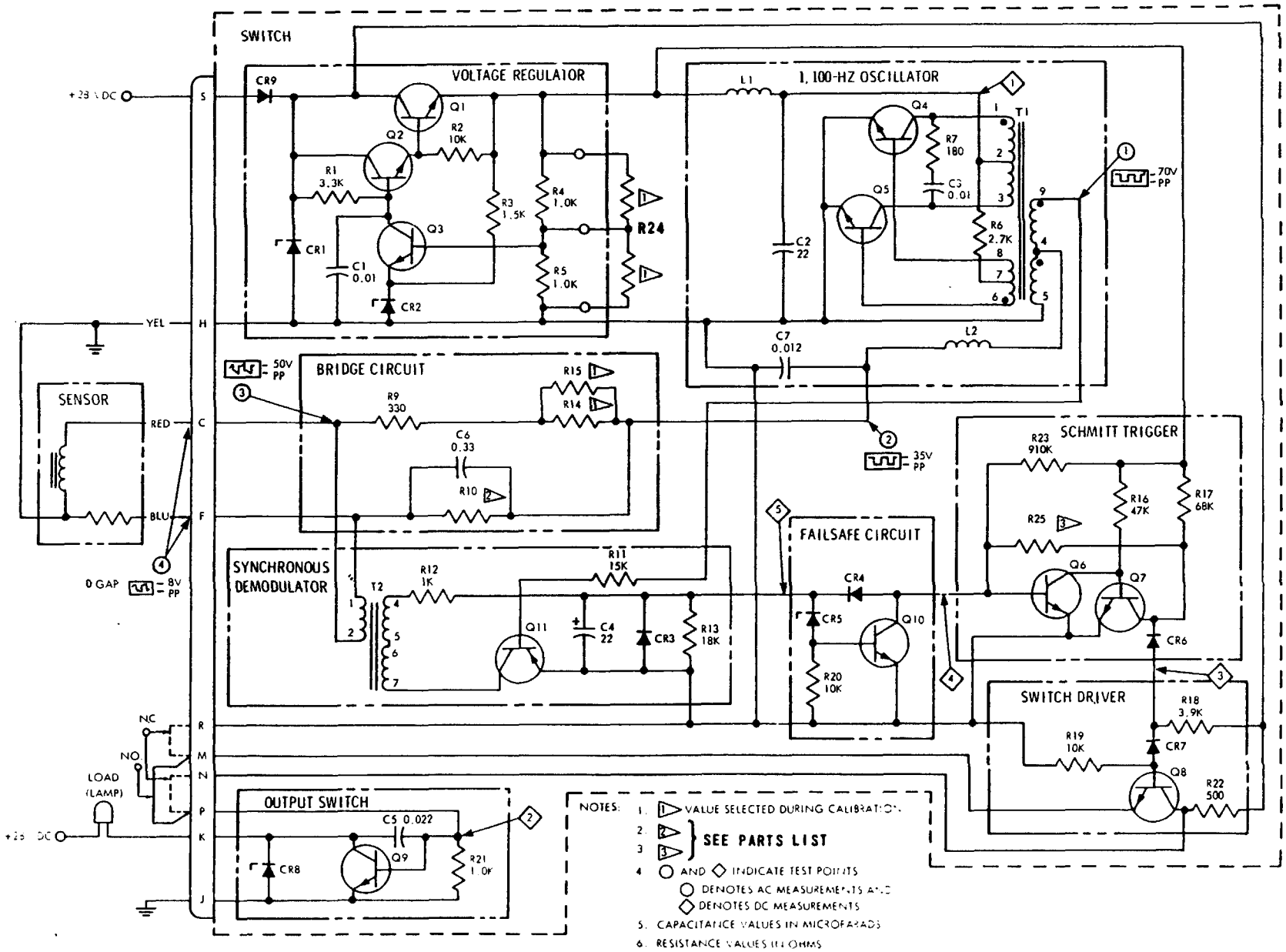
(1) Test Equipment

(a) DC differential voltmeter, John Fluke Model 801 or equivalent.

(b) Oscilloscope, Tektronix type 503 or equivalent.

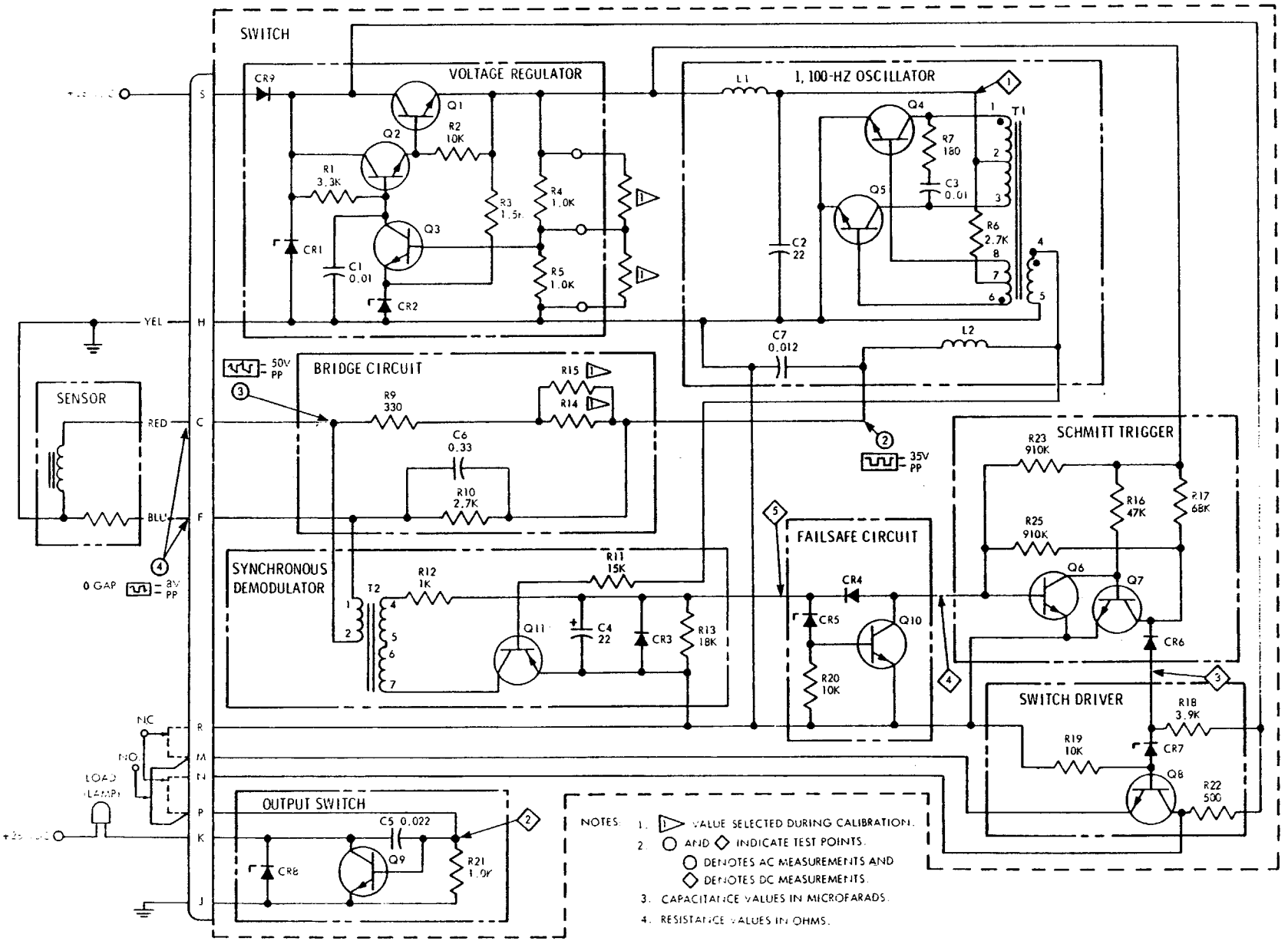
(c) Actuator test target, EDC P/N 8-005101-02 or equivalent (see Figure 10).

(2) Switch troubles can be analyzed and isolated by standard procedures. This section describes the switch circuit in detail. Figures 8 and 9 provide functional block system schematics with waveform and test point data.



Proximity Switch (2-899-111, Serial No. 401 and On, 2-899-111-3, 2-899-112, and 2-899-113) Schematic Diagram

Figure 8



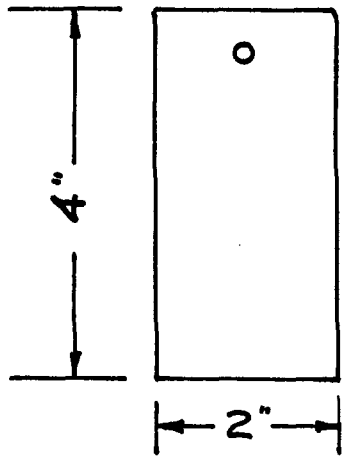
Proximity Switch (2-899-111, Serial No. 1 Through 400 Only), Schematic Diagram

Figure 9

A. General (Cont.)

Actuator/Deactuator Test Target Assembly

P/N 8-005101-01 consists of (1) 8-005101-02 and (1) 8-005101-03



1. 8-005101-02 (Actuator) is made from stainless steel type 430, cold rolled strip, No. 2 bright annealed finish. Thickness = 0.023 ± 0.003 inches.
2. 8-005101-03 (Deactuator) is made from 6061-T6 aluminum per QQ-A-327, and black anodized per MIL-A-8625 after fabrication. Thickness = 0.040 ± 0.003 inches.

FIGURE 10

NOTE: The Deactuator Test Target (8-005101-03) is used to deactuate an 899 switch when a target is within the actuate range. When the test target is inserted between a target and a sensor, the switch should always deactuate.

The term "actuates" denotes a particular change of state in the switch, and should not be confused with closed or open. The switch card circuitry always "actuates" when a target moves through the specified actuation point and is moving toward the sensor. Conversely, the switch "deactuates" when the target is moved away from the sensor. If the switch is jumpered for normally open operation, it will close when the card "actuates". If the switch is jumpered for normally closed operation, it will open when the card "actuates".

B. Switch 2-899-111 Circuit Description (See Figures 8 and 9)

Refer to Section 2 for theory of operation.

C. Switch Trouble Isolation

(1) There are only two major symptoms and one minor symptom that occur with the proximity switch. These symptoms are:

(a) Switch never actuates. (light "OFF")

(b) Switch always actuated. (light "ON")

(c) Switch actuates properly but deactuates at zero gap.

(2) When the system test indicates that the switch never actuates, make the following checks (see Figures 8 or 9). Target not required for (a) through (c).

NOTE: ◯ indicates alternating-current measurements.
◇ indicates direct-current measurements.
Figure 13 defines test points on the circuit. Voltages indicated are approximate and variations from unit to unit are to be expected.

C. Switch Trouble Isolation (Cont.)

(2) (Continued)

card with relation to points on the schematic (see Figures 8 and 9).

(a) Test point ◇1◇ +14.0 (±0.1) VDC. If not 13.9 to 14.1 VDC, the trouble is in the regulation circuit.

(b) Test point (1) is a square wave: 70v peak-to-peak (35 vrms) at 1,100 (±75) Hz. If not, the oscillator circuit is faulty.

(c) Test point (2) is a 30v peak-to-peak version of (b). If not, the L2-C7 filter is faulty or shorted.

NOTE: (1) If the previous tests are normal, place actuate test target EDC P/N 8-005101-02 on the sensor at zero gap and make the following checks.

(2) All voltages referred to GRD (Black banana jack on test set) except test point (3) :

(d) Test point ◇2◇ . +0.8 VDC indicates the output switch is faulty and 0.0 VDC indicates the output switch is not at fault.

C. Switch Trouble Isolation (Cont.)

(2) (Continued)

(e) Test point ◇3◇ . +7 to +8 VDC indicates the fault is in the switch driver; +1 to +2 VDC indicates the switch driver is not at fault.

(f) Test point ◇4◇ . +0.6 VDC indicates the fault is in the Schmitt Trigger; ± 0.1 VDC indicates the Schmitt Trigger is not at fault.

(g) Test point ◇5◇ . +6 to +10 VDC indicates the fault is in the failsafe circuit; -0.3 to -0.5 VDC indicates the failsafe circuit is not at fault. +11 volts would indicate a failsafe fault exists.

(h) Test point (3) . If the voltage across the blue and red binding post on the test set is 6 to 8V peak-to-peak square wave, the trouble is in the detector circuit. If it is near zero, the trouble is in the bridge circuit.

(3) When the system indicates that the switch is always actuated, the same checks as steps (d) through (h) of paragraph 10 C (2) are to be made except that the target is to be greater than 1.0 inch away and the voltage at the test points that indicated a fault would now be normal operation and those that indicated normal operation would now be a fault.

(4) Symptom C (1) (c) is most likely caused by pre-zener leakage of CR5 (activating the failsafe circuit). CR5 must be replaced.

11. CALIBRATION, SWITCH (ALL MODELS)

A. Sensor

The sensor cannot be calibrated.

B. Switch Card Calibration Equipment

(1) Calibration Fixture

NOTE: A special fixture is required to calibrate 2-899-111-3, 2-899-111, 2-899-112 and 2-899-113 switch cards. An example of a suitable fixture is shown in Figure 11. The fixture must be constructed so that the sensor is mounted on a nonmetallic surface with sensing face of the sensor a minimum of .75 inches from any nonmagnetic metal (aluminum) and a minimum of 2 inches from any magnetic material other than the target. The movable target must be parallel to sensing face and cover 100% of sensing face. Target must be able to move from zero gap to a minimum of 1 inch from sensing face.

(2) Standard Sensor

NOTE: Calibrating the switch card with a 1-899-15 sensor selected at random potentially broadens the actuation

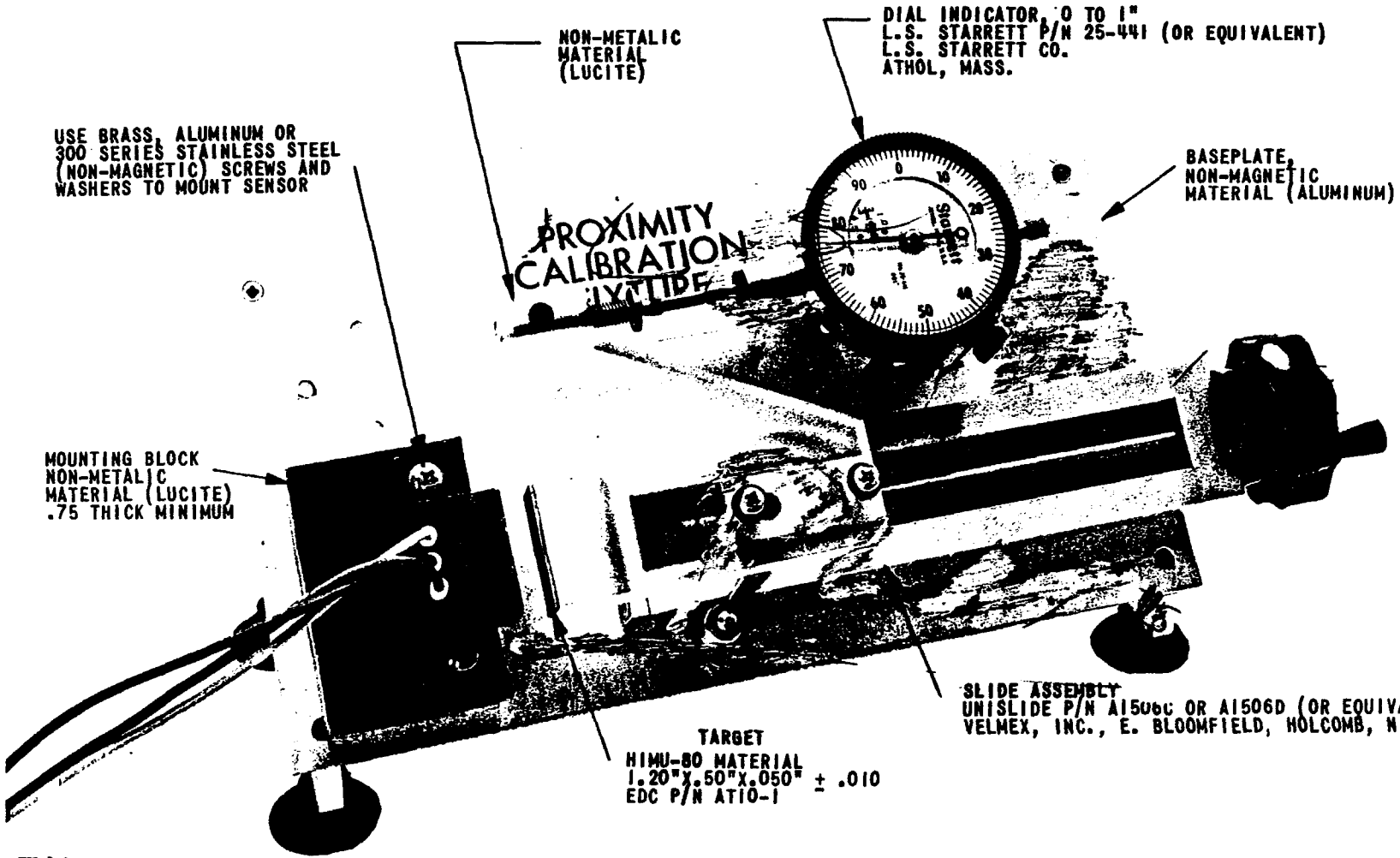


FIGURE 11
PROXIMITY CALIBRATION FIXTURE

B. Switch Card Test Equipment (Cont.)

(2) Standard Sensor (Cont.)

tolerance by a factor of two because of tolerance build up. Therefore it is recommended that a "standard" 1-899-15 sensor be used or the switch card should be returned to manufacturer for calibration.

(3) Test Set, EDC P/N 8-005-01 (see Appendix), or Equivalent (see Figure 7)

(4) Decade Resistor, General Radio Type 1434-N or Equivalent

C. Calibration Test Set-Up

(1) Install standard 1-899-15 sensor in test fixture.

(2) Connect sensor leads to binding posts on test set.

(3) Install switch card to be calibrated in connector on test set.

(4) Target not required for regulator calibration.

D. Regulator Voltage

(1) Apply power, connect the differential voltmeter across C2 of the switch card.

D. Regulator Voltage (Cont.)

(2) If the voltage is below 13.9 VDC, remove any resistors shunting R4 or R5 and select a resistor that (when shunted across R5) will cause a voltage of 14.0 (±0.1) VDC. If the voltage is above 14.1 VDC, remove any resistors shunting R4 or R5 and select a resistor that (when shunted across R4) will cause a voltage of 14.0 (±0.1) VDC. Install the proper resistor onto the board.

E. Gap Calibration

Remove R14 and R15 from switch card. Connect the decade resistor across the R14 terminals.

(1) R14 Selection

(a) Move target to the nominal gap specified in Figure 12.

(b) Adjust decade resistor to 100 ohms or greater. Light should be off. Carefully decrease the decade resistor until the light turns on.

(c) Select a standard resistor value (see parts list for type) that is equal to or greater than the decade resistor setting.

E. Gap Calibration (Cont.)

(1) R14 Selection (Cont.)

(d) Temporarily install the resistor in the R14 position. Adjust the decade box to 10K.

(e) Move target away from sensor beyond deactuation point.

(f) Slowly move target toward sensor until light goes on.

(g) Measure distance of target from sensor's sensing face. If gap is greater than the nominal specified in Figure 12. use the next higher value of resistor for R14, and proceed to Paragraph E.2.a. If the gap is nominal, select a 10K resistor and proceed to Paragraph E.2.d. If the gap is less than nominal, proceed to Paragraph E.2.a.

SWITCH CARD	NOMINAL SWITCH POINT WITH STANDARD 1-899-15 SENSOR	SWITCH POINT DIFFERENTIAL
2-899-111	0.300	0.005 to 0.030
2-899-111-3	0.300	0.004 to 0.010
2-899-112	0.115	0.005 to 0.015
2-899-113	0.145	0.005 to 0.015

Gap Calibration Data

Figure 12

E. Gap Calibration (Cont.)

(2) R15 Selection

(a) Increase this target gap until the light goes out. Move the target to the nominal gap. Light should be off.

(b) Adjust the decade resistor for actuation at the nominal actuation point.

(c) Select a resistor that is closest to the decade box value. (See parts list for type)

(d) Temporarily install selected resistor in parallel with R14 and disconnect decade box.

NOTE: If the actuation point is not within ±0.003 of nominal, select another resistor for R15. When the calibration is within ±0.003, install both R14 and R15 into the card. When the above steps have been performed, calibration is complete.

(3) After calibration, retest per paragraph 9.D.

(4) Apply conformal coating to calibration resistors and solder areas per paragraph 7.B.

12. STORAGE INSTRUCTIONS

Package solid-state switch and sensor in polyethylene bags. Seal in commercial carton and store in dry place.

13. SPECIAL TOOLS, FIXTURES AND EQUIPMENT

A. Test Gages: (See Figure 2)

B. Test Set: EDC P/N 8-005-01 (see Appendix), or equivalent (see Figure 7).

C. Calibration Test Fixture: See Figure 11 (or equivalent)

D. Actuator/Deactuator Test Target Assembly:
EDC P/N 8-005101-01 or equivalent (see Figure 10)

14. ILLUSTRATED PARTS LIST

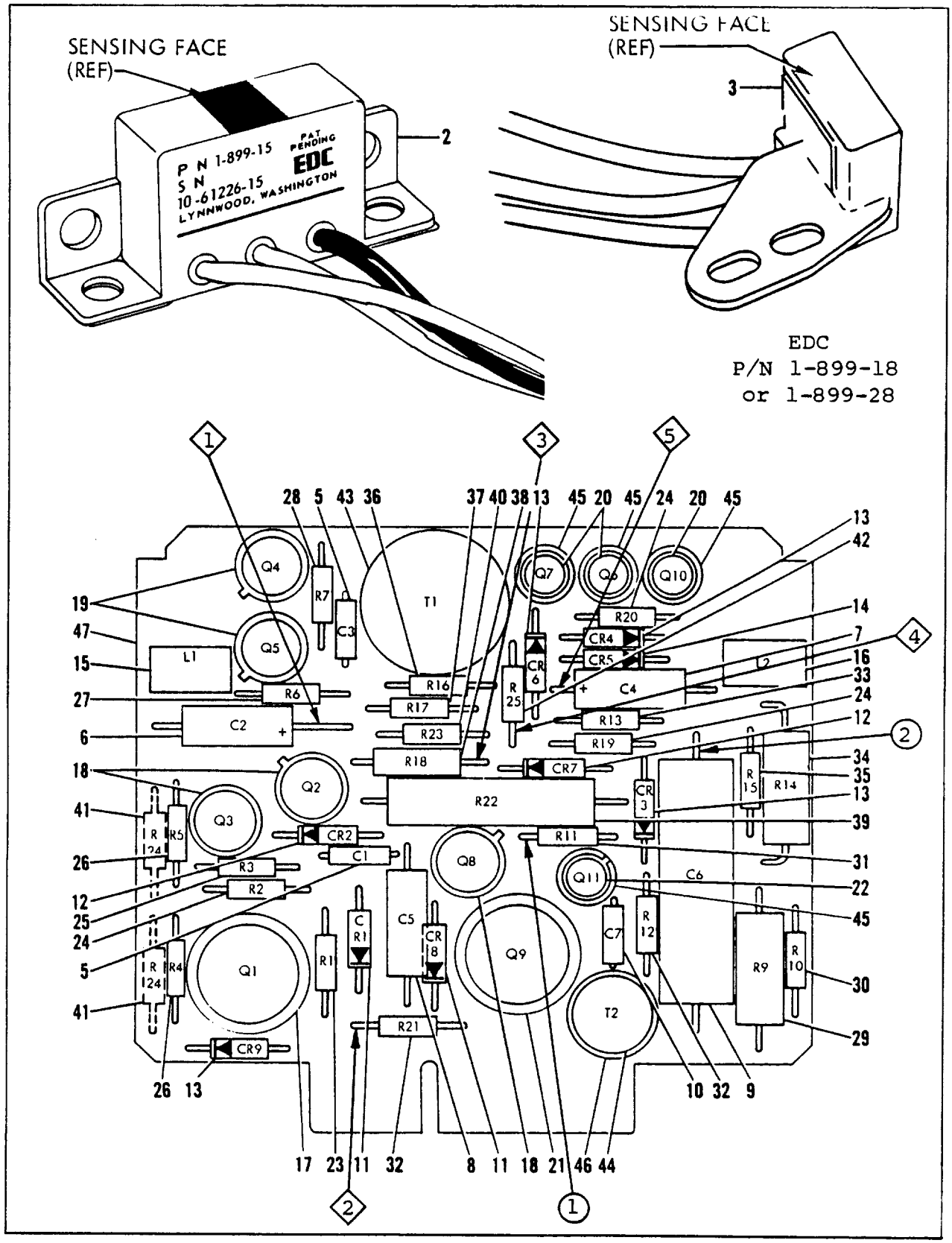
A. Introduction

(1) The Illustrated Parts List provides a breakdown of the Proximity Switch Model 899. All parts are identified by corresponding index number on exploded view illustration, Figure 13.

A. Introduction (Cont.)

(2) All items are assigned an index number. Items listed but not illustrated are identified by a - preceding the index number.

(3) For identification of detail parts and assemblies, the nomenclature column employs the indenture system. Each assembly is listed with its detail parts listed in the next indenture to the right. Conversely the next higher assembly of any detail part may be determined by its location in the indenture to the left.



Proximity Switch Model 899, Component Location
Figure 13

A. Introduction (Cont.)

(4) Vendors' Codes*

CODE	VENDOR'S NAME AND ADDRESS
V07047	ROSS MILTON COMPANY Hatboro, Pennsylvania
V56289	SPRAGUE ELECTRIC COMPANY North Adams, Massachusetts
V96733	SAN FERNANDO ELECTRIC MFG. CO. San Fernando, California

*Unless otherwise indicated by a vendor's code number in parentheses following the part name in the parts list, all parts are either standard military items, registered JEDEC type numbers, or Electro Development Corporation parts. Where there are no optional parts to the EDC parts, the parts are either screened from commercial items by EDC, or produced to an EDC specification. We recommend the customer do not attempt substitution on those parts.

B. Reference Designation Index

The Reference Designation Index contains the reference designations for components shown in the schematic diagrams (ref. Figures 8 & 9). These designations are arranged in alpha-numerical order.

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT FROM TO	UNITS PER ASSY
9 -1	899	SWITCH, Proximity		RF
2	1-899-15	. SENSOR (Used with -111, -113, and -111-3 switch assy)		1
3	1-899-18	. SENSOR (Used with -112 switch assy)		1
3A	1-899-28	. SENSOR (Used with -111 switch assy)		1
4	2-899-111	. SWITCH ASSEMBLY (Used with -15 or -28 sensor)		1
-4A	2-899-112	. SWITCH ASSEMBLY (Used with -18 sensor)		1
-4B	2-899-113	. SWITCH ASSEMBLY (Used with -15 sensor)		1
-4C	2-899-111-3	. SWITCH ASSEMBLY (Used with -15 sensor)		1
5	CK06AW103M	. . . CAPACITOR 0.01 MFD±20%, 200V		2
6	CL65BG220MP3	. . . CAPACITOR 22 MFD±20%, 25V		1
7	CS13BD226M	. . . CAPACITOR 22 MFD±20%, 15V		1
8	192P22302	. . . CAPACITOR (V56289) 0.022 MFD ±20%, 200V		1
9	EDC-C13-2-4E	. . . CAPACITOR 0.33 MFD±5%, 50V		1
10	4M123	. . . CAPACITOR (V96733) 0.012 MFD ±20%, 200V		1
11	EDC-CR6-5-7J	. . . DIODE, Zener 82V±10%, 0.4W		2
12	EDC-CR6-1-Ø	. . . DIODE, Zener 6.2V±10%, 0.4W		2
13	IN645	. . . DIODE		4
14	EDC-CR6-7-Ø	. . . DIODE, Zener 10.5V±5%, 0.25W (Used on -111 and -111-3 switch assy)		1
-14A	EDC-CR6-2-Ø	. . . DIODE, Zener 6.8V±5%, 0.25W (Used on -112 switch assy)		1

FIG ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT FROM TO	UNITS PER ASSY
-14B	EDC-CR6-3-Ø	. . . DIODE, Zener 9.1V±5%, 0.25W (Used on -113 switch assy)		1
15	1-962	. . . INDUCTOR		1
16	1-995	. . . INDUCTOR		1
17	EDC-TR21-1	. . . TRANSISTOR		1
-17A	2N1483	. . . TRANSISTOR (Optional to EDC-TR21-1)		1
-17B	EDC-TR21-2	. . . TRANSISTOR (Optional to EDC-TR21-1)		1
-17C	2N1484	. . . TRANSISTOR (Optional to EDC-TR21-1)		1
18	EDC-TR11-5	. . . TRANSISTOR		3
-18A	2N2102	. . . TRANSISTOR (Optional to EDC-TR11-5)		3
19	EDC-Q11-1-Ø	. . . TRANSISTOR		2
-19A	2N2405	. . . TRANSISTOR (Optional to EDC-Q11-1-Ø		2
20	EDC-TR11-1	. . . TRANSISTOR		3
-20A	2N2483	. . . TRANSISTOR (Optional to EDC-TR11-1)		3
21	EDC-TR21-2	. . . TRANSISTOR		1
-21A	2N1484	. . . TRANSISTOR (Optional to EDC-TR21-2)		1
23	RC07GF332K	. . . RESISTOR 3.3KΩ±10%, 0.25W		1
24	RC07GF103K	. . . RESISTOR 10KΩ±10%, 0.25W		3
25	RC07GF152K	. . . RESISTOR 1.5KΩ±10%, 0.25W		1
26	RL07S102G	. . . RESISTOR 1KΩ±2%, 0.25W		2
27	RC07GF272K	. . . RESISTOR 2.7KΩ±10%, 0.25W		1
28	RC07GF181K	. . . RESISTOR 180Ω±10%, 0.25W		1

FIG ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT FROM TO	UNITS PER ASSY
29	EDC-R3-3-Ø	. . . RESISTOR 330Ω±5% @ 25°C.		1
30	RL07S272G	. . . RESISTOR 2.7KΩ±2%, 0.25W (Used on -111, -111-3, and -113 switch assy)		1
-30A	RL07S152G	. . . RESISTOR 1.5KΩ±2%, 0.25W (Used on -112 switch assy)		1
31	RC07GF153K	. . . RESISTOR 15KΩ±10%, 0.25W		1
32	RC07GF102K	. . . RESISTOR 1KΩ±10%, 0.25W		2
33	RC07GF183K	. . . RESISTOR 18KΩ±10%, 0.25W		1
34	239E---5*	. . . RESISTOR (V56289)±5%, 1.0W		1
-34A	RW70V---*	. . . RESISTOR (Optional to 239E)		1
-34B	RW69V---*	. . . RESISTOR (Optional to 239E)		1
-34C	RW59V---*	. . . RESISTOR (Optional to 239E)		1
35	RL07S---G*	. . . RESISTOR ±2%, 0.25W		1
36	RC07GF473K	. . . RESISTOR 47KΩ±10%, 0.25W		1
37	RC07GF683K	. . . RESISTOR 68KΩ±10%, 0.25W		1
38	RC20GF392K	. . . RESISTOR 3.9KΩ±10%, 0.5W		1
39	EDC-R3-4-Ø	. . . RESISTOR 500Ω±5%, 5.0W		1
-39A	RW67V511	. . . RESISTOR (Optional to EDC-R3-4-Ø		1
-39B	RW57V511	. . . RESISTOR (Optional to EDC-R3-4-Ø		1
40	RC07GF914K	. . . RESISTOR 910KΩ±10%, 0.25W		1
41	RC07GF---K*	. . . RESISTOR ±10%, 0.25W		1
42	RC07GF914K	. . . RESISTOR 910KΩ±10%, 0.25W (Used on -111 and -112 switch assy)		1
-42A	RC07GF394K	. . . RESISTOR 390KΩ±10%, 0.25W (Used on -113 switch assy)		1

*Value selected during calibration.

FIG ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT FROM TO	UNITS PER ASSY
-42B	RC07GF185K	. . . RESISTOR 1.8MΩ±10%, 0.25W (Used on -111-3 switch assy)		1
43	5-130	. . . TRANSFORMER (Used on -111, Ser. No. 401 and on, -112, -113, and -111-3 switch assys)		1
-43A	1-961	. . . TRANSFORMER (Used on -111, Ser. No. 1 to 400, switch assy)		1
44	2-8995	. . . TRANSFORMER, Signal		1
45	7717-44DAP	. . . TRANSIPAD (V07047) (used with Q6, Q7, Q10, & Q11		4
46	7717-107DAP	. . . TRANSIPAD (V07047) (used with T2)		1
47	2-8994-7	. . CIRCUIT BOARD (Used on -111, Ser. No. 401 and on, and -111-3 switch assys)		1
-47A	2-8994	. . CIRCUIT BOARD (Used on -111, Ser. No. 1 to 400, switch assy)		1
-47B	2-8996-2	. . CIRCUIT BOARD (Used on -112 switch assy)		1
-47C	2-8997-2	. . CIRCUIT BOARD (Used on -113 switch assy)		1

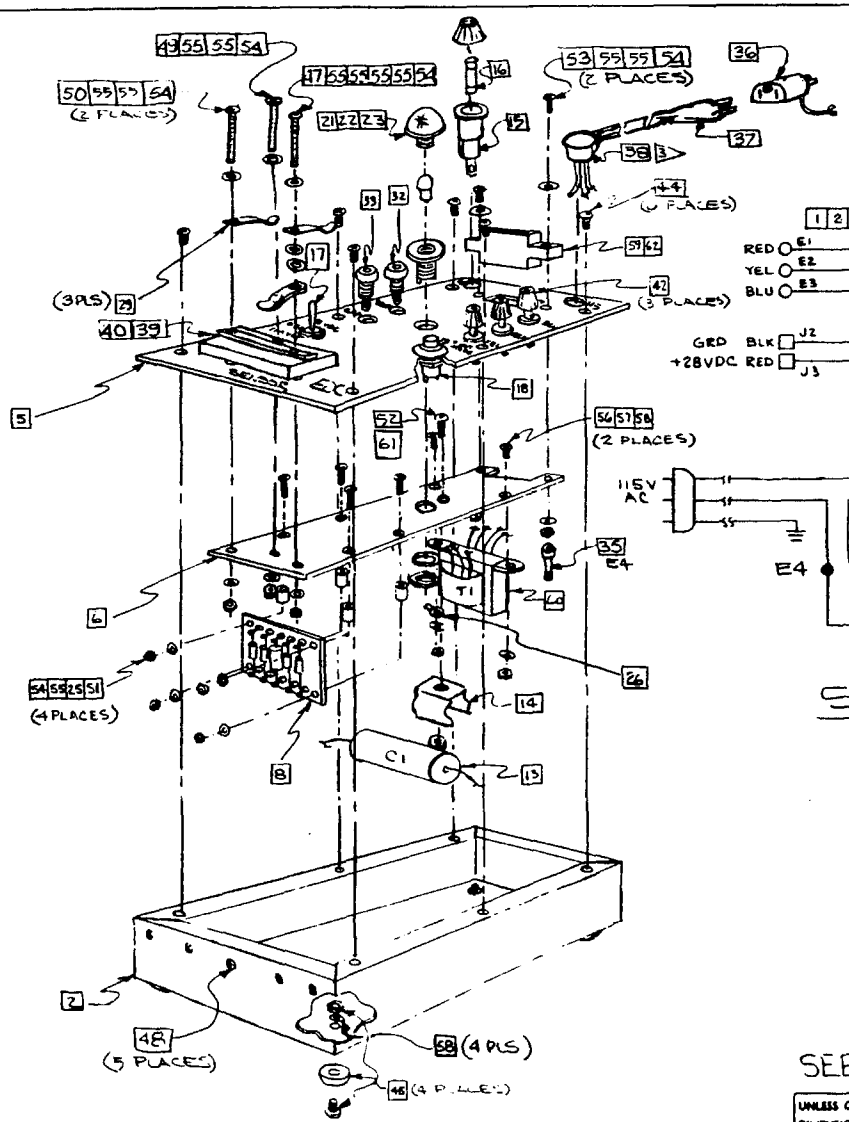
REF DESIG	PART NUMBER	FIG.	ITEM
C1	CK06AW103M	9	5
C2	CL65BG220MP3	9	6
C3	CK06AW103M	9	5
C4	CS13BD226M	9	7
C5	192P22302	9	8
C6	EDC-C13-2-4E	9	9
C7	4M123	9	10
CR1	EDC-CR6-5-7J	9	11
CR2	EDC-CR6-1-Ø	9	12
CR3	IN645	9	13
CR4	IN645	9	13
CR5	EDC-CR6-7-Ø	9	14
	EDC-CR6-2-Ø	9	14A
	EDC-CR6-3-Ø	9	14B
CR6	IN645	9	13
CR7	EDC-CR6-1-Ø	9	12
CR8	EDC-CR6-5-7J	9	11
CR9	IN645	9	13
L1	1-962	9	15
L2	1-995	9	16
Q1	EDC-TR21-1	9	17
	2N1483	9	17A
	EDC-TR21-2	9	17B
	2N1484	9	17C
Q2	EDC-TR11-5	9	18
	2N2102	9	18A
Q3	EDC-TR11-5	9	18
	2N2102	9	18A

REF DESIG	PART NUMBER	FIG.	ITEM
Q4	EDC-Q11-1-Ø	9	19
	2N2405	9	19A
Q5	EDC-Q11-1-Ø	9	19
	2N2405	9	19A
Q6	EDC-TR11-1	9	20
	2N2483	9	20A
Q7	EDC-TR11-1	9	20
	2N2483	9	20A
Q8	EDC-TR11-5	9	18
	2N2102	9	18A
Q9	EDC-TR21-2	9	21
	2N1484	9	21A
Q10	EDC-TR11-1	9	20
	2N2483	9	20A
Q11	EDC-Q3-3-Ø	9	22
R1	RC07GF332K	9	23
R2	RC07GF103K	9	24
R3	RC07GF152K	9	25
R4	RL07S102G	9	26
R5	RL07S102G	9	26
R6	RC07GF272G	9	27
R7	RC07GF181K	9	28
R9	EDC-R3-3-Ø	9	29
R10	RL07S272G	9	30
	RL07S152G	9	30A
R11	RC07GF153K	9	31
R12	RC07GF102K	9	32
R13	RC07GF183K	9	33

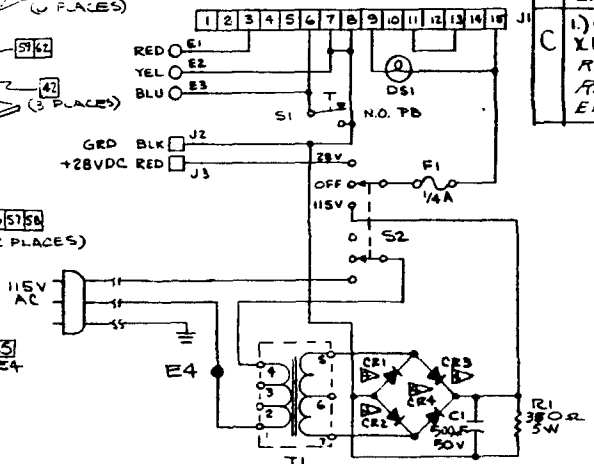
REF DESIG	PART NUMBER	FIG. - ITEM
R14	239E---5*	9 34
	RW70V---*	9 34A
	RW69V---*	9 34B
	RW59V---*	9 34C
R15	RL07S---G*	9 35
R16	RC07GF473K	9 36
R17	RC07GF683K	9 37
R18	RC20GF392K	9 38
R19	RC07GF103K	9 24
R20	RC07GF103K	9 24
R21	RC07GF102K	9 32
R22	EDC-R3-4-Ø	9 39
	RW67V511	9 39A
	RW57V511	9 39B
R23	RC07GF914K	9 40
R24	RC07GF---K*	9 41
R25	RC07GF914K	9 42
	RC07GF394K	9 42A
	RC07GF185K	9 42B
T1	5-130	9 43
	1-961	9 43A
T2	2-8995	9 44

REF DESIG	PART NUMBER	FIG. - ITEM

*Value selected during calibration.



1 ASSEMBLY



SCHEMATIC

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	1) PART NO. WAS 008-0005 2) WAS SHT 1 OF 6	11-25-8 11-11-8 11-15-8 11-18	PC WIELAND
B	1. ADDED 58 2. REMOVED ITEM 50 & 54 (1 PL) 3. ADDED ITEM 47 REASON: DESIGN IMPROVEMENT EFF. PT.: IX-USE	11-25-8 12-1-8 12-13-8	PCW
C	1.) CHANGED: X FORMER TAPS FROM 2-3 TO 1-4 & R1, 350Ω, 5W WAS R1, 500Ω, 3W REASON: DESIGN REQ. EFF PT: IX-USE.	12-10-8 12-11-8 12-12-8 12 13 8	PC WIELAND

1. ASSY TO BE SOLDERED PER EDC 06.06.03
2. INSTALL 27 ON T1 LEADS 1, 4 & 6
3. INSTALL USING HEYCO # R-29 OR #R36 INSTALLATION PLIERS.
4. IN3196 OR IN4383

SEE PL 8-005 FOR PARTS LIST

SERIAL NO.	PART NO.	FINAL ASSY QTY REQD	NEXT ASSY QTY REQD	NEXT ASSY APPLICATION	USED ON APPLICATION

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
LINEAR .XX = ±
.XXX = ±
ANGULAR = °
BREAK ALL SHARP EDGES
ALL ANGLES & BENDS 90°
ALL DIMENSIONS PER MIL-STD-8
PART MARK PER MIL-STD-130
125 ALL MACHINE SURFACES

CONTRACT NUMBER
DRAWN G. HARDEE DATE
CHECKED
ENGR.
PROJ. ENGR.
RELIABILITY
APPROVED
APPROVED

ELECTRO DEVELOPMENT CORPORATION
SEATTLE, WASHINGTON

TEST SET ASSY, PROXIMITY (8-005)

SIZE C | CODE IDENT. NO. 08748 | 8-005

SCALE —— SHEET 1 OF 1

C 8-005 SHT1

PARTS LIST

LYNNWOOD, WASHINGTON **EDC** | REL DATE MD 11-19-68 | PL 8-005 | REV LTR B

PARTS LIST TITLE: TEST SET ASSY, PROXIMITY (8-005-01) | AUTHENTICATION: DW OJY 11-18-8 | CHG CONT NO: | CODE IDENT: 08748 | SH 1 OF 2 SH

ITEM NO.	QTY REQ	QTY REQ	QTY REQ	QTY REQ	CODE IDENT	PART OR IDENTIFICATION NUMBER	NOMENCLATURE OR DESCRIPTION	STOCK SIZE OR VALUE	MATERIAL OR REF DES
1				—		-01	TEST SET ASSY		
2				1		8-005001-01	CHASSIS, ASSY		
3									
4									
5				1		8-005004-01	PANEL		
6				1		8-005005-01	SUB PANEL		
7									
8				1		8-005002-01	TERMINAL BOARD ASSY		TB1
9									
10									
11									
12									
13				1	25243	BR 500-50	CAPACITOR	500μF, 50V	C1
14				1	90201	THIS	CLIP 3/4-13/16		
15				1	71400	HJM	FUSEHOLDER		XF1
16				1	75915	313.250	FUSE	1/4 AMP	F1
17				1	15605	8820K16	SWITCH, TOGGLE	DP.D.T, CTR OFF	S2
18				1	15605	8411K12	SWITCH, PUSH BUTTON	SINGLE POLE, NORM. OPEN	S1
19									
20				<12FT	(2)	#24	FLEXLEAD, WHT		
21				1	71744	327	BULB		DS1
22				1	81640	L5130	BASE, IND LAMP		XDS1
23				1	81640	P124R	LENSE, RED		
25				4		EDC SP13-1	SPACER		
26				1	83330	1416-6	SOLDER LUG		
27				3	00779	328307	WIRE CAP		
28									
29				3	91886	471	TERMINAL, CLIP		
30									
31									

PL 8-005 SHT 1 REV LTR B

REVISIONS

LTR	DESCRIPTION	DATE	APPD
A	1.) ITEM 14 WAS (01364) 43E7984 2.) ITEM 16 WAS AGX-1/4 REASON: DESIGN IMPROVEMENT EFF. PT.: IV-USE	11-25-8 11/26/8 11/26/8 12/5/8	D.C.W [illegible] [illegible] [illegible]
B	1) (2) WAS L5130B 2) (3) WAS 2340, DELETED (4) OPT REASON: TO FACILITATE MFG EFF PT IV-USE	12-5-8 12-5-8 12-5-8 12-5-8	[illegible] [illegible] [illegible] D.W

NOTES

71218	BUD RADIO INC., WILLOUGHBY, OHIO
91886	MALCO MFG. CO., CHICAGO, ILL.
71744	CHICAGO MINIATURE LAMP WORKS, CHICAGO, ILL.
81640	CONTROL SWITCH DIV., CONTROLS CO. OF AMERICA, FOLCROFT, PA.
15605	CUTLER-HAMMER INC., MILWAUKEE, WIS.
90201	MALLORY CAPACITOR CO. 3029 EAST WASH. ST. P.O. BOX 372, INDIANAPOLIS, IND. 46206
25243	CORNELL-DUBLIER ELECTRONICS, DES PLAINES, ILL
56289	SPRAGUE ELECTRIC CO., N. ADAMS, MASS.
75915	LITTELFUSE INC., DES PLAINES, ILL.
83330	H. H. SMITH, BROOKLYN, N.Y.

(1) BLK LTRS ON CLEAR ANODIZED PNL PER PNL ARTWORK PIB-005-01

(2) TEFLON COVERED PER MIL-W-16878, TYPE E.

(4) ANODIZE PER MIL-A-8625, TYPE II, CLASS I, DYED BLK. METAL ETCH FOR SATIN FINISH PRIOR TO ANODIZING.

SAND WITH GRAIN PRIOR TO PHOTO ETCH

PARTS LIST

LYNNWOOD, WASHINGTON **EDC** | REL DATE 11-19-68 | PL 8-005 | REV LTR B

PARTS LIST TITLE: TEST SET ASSY PROXIMITY (8-005-01) | AUTHENTICATION: PW 11-19-68 | CHG CONT NO: | CODE IDENT: 08748 | SH 2 OF SH

ITEM NO.	QTY REQ	QTY REQ	QTY REQ	QTY REQ	CODE IDENT	PART OR IDENTIFICATION NUMBER	NOMENCLATURE OR DESCRIPTION	STOCK SIZE OR VALUE	MATERIAL OR REF DES
32				1	74970	108-902	JACK, RED		J3
33				1	74970	108-903	JACK, BLK		J2
34									
35				1	71279	1510-1-0519	TERMINAL		
36				1	71903	17922	GROUND ADAPTER		
37				1	71903	17236	POWERCORD		
38				1	28520	SR-15-1	STRAIN RELIEF BUSHING		
39				1		8-005005-01	SPACER		
40				1		8-005006-02	SPACER		
41									
42				3	14298	AL2000B	BINDING POST, BLK		E1,2,3
43									
44				6	70318	14721411	SCREW, PHILIPS RECESS ONAL HEAD ⚠	4-40 X 3/8 LONG	TYPE 16-18 STAINLESS STEEL
45				4	83330	2196	RUBBER BUMPERS		
46									
47				1		MS51957-22	SCREW	4-40 X 1 1/4	
48				5		MS51957-14	SCREW	4-40 X 5/16	
49				1		MS51957-18	SCREW	4-40 X 5/8	
50				1		MS51957-21	SCREW	4-40 X 1.0	
51				4		MS24693-C7	SCREW, 100° CSK	4-40 x 5/8	
52				1		MS24693-C1	SCREW FLAT HD (100°)	4-40 x 3/16	
53				2		MS51957-19	SCREW	4-40 x 3/4	
54				10		MS21045-C04	NUT	4-40	
55				18		MS15795-804	WASHER, FLAT	#4	
56				2		MS24693-C26	SCREW FLAT HD (100°)	6-32 x 3/8	
57				2		MS21045-C06	NUT	6-32	
58				6		MS15795-806	WASHER, FLAT	#6	
59				1	00779	582553-1	CONNECTOR BODY		J1
60				1	80223	UTC-FT14	TRANSFORMER		T1
61				2		MS21043-04	NUT	4-40	
62				8	00779	582660-3	PINS, CONNECTOR		

PL 8-005 SHT 2 REV LTR B

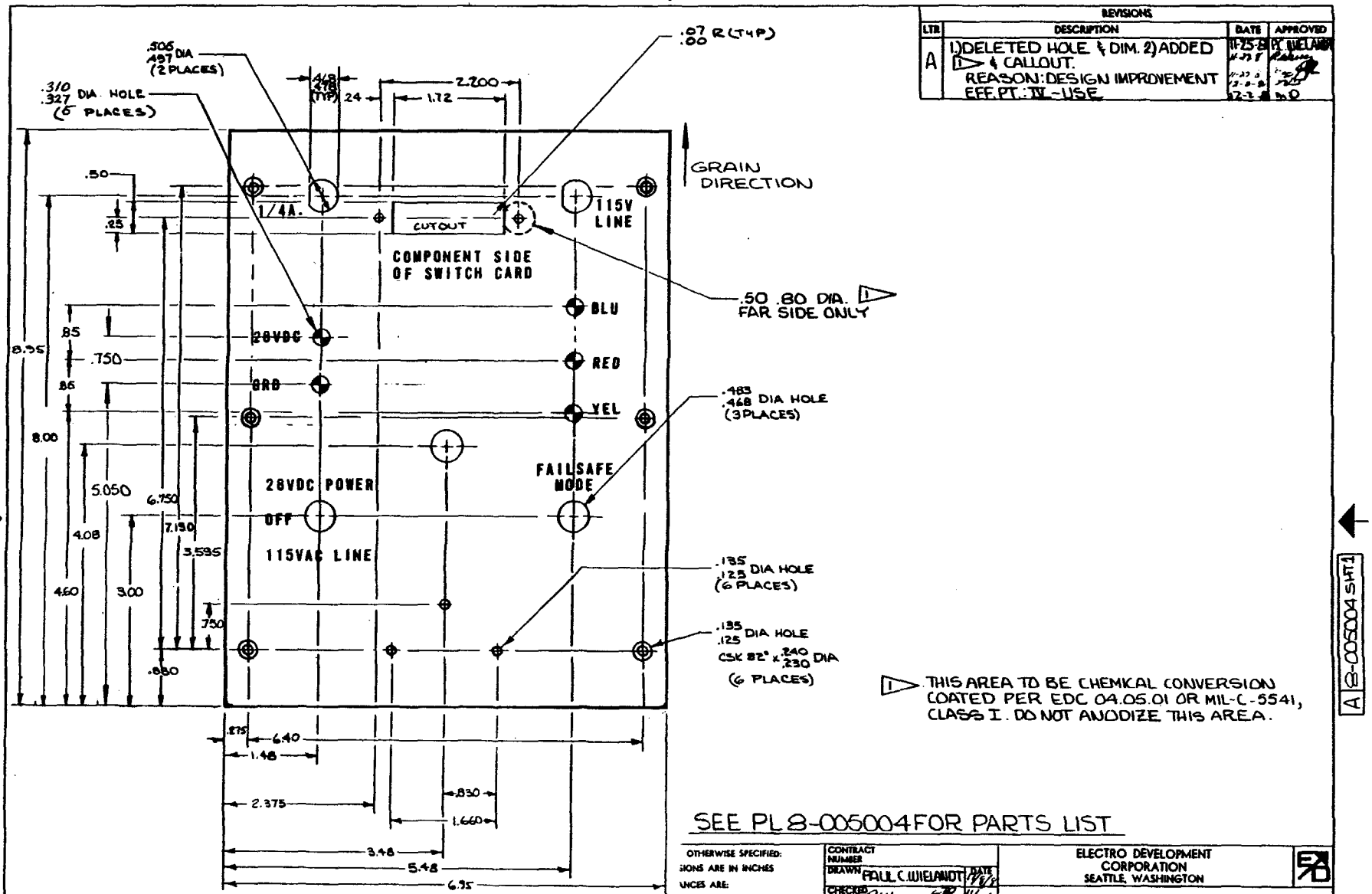
REVISIONS

LTR	DESCRIPTION	DATE	APPD
A	1) EXTENSIVELY REVISED PL REASON: DESIGN IMPROVEMENT EFF. PT.-IV-USE	11-25-68 11/27/68 12-1-68 12-2-68	P.C.W DLR TWB
B	1) ADDED PART NO. TO 44 REASON: TO FACILITATE MFG EFF PT IV-USE	12-5-68 12-5-68 12-5-68	DLR TWB DLW

NOTES

⚠ SLOTTED RECESS ACCEPTABLE BUT NOT FOR NEW PROCUREMENT

71279 CAMBRIDGE THERMIONIC CORP. CAMBRIDGE, MASS.
70903 BELDEN MFG CO. CHICAGO ILL.
28520 HEYMAN MFG CO. KENILWORTH, NEW JERSEY
83330: H.H. SMITH, BROOKLYN, N.Y.
70318 ALL METAL SCREW PRODUCTS INC. GARDEN CITY, N.Y.
80223: UNITED TRANSFORMER CO., N.Y., N.Y.
14298: AMERICAN COMPONENTS INC, CONSHOHOCKEN, PA.
74970: E.F. JOHNSON CO., WASECA, MINN.
00779: AMP. INCORP. HARRISBURG, PA.



REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	1) DELETED HOLE & DIM. 2) ADDED [1] & CALLOUT. REASON: DESIGN IMPROVEMENT EFF. PT.: IN-USE	11-25-68	PC WIELAND

[1] THIS AREA TO BE CHEMICAL CONVERSION COATED PER EDC 04.05.01 OR MIL-C-5541, CLASS I. DO NOT ANODIZE THIS AREA.

A 8-005004 SHT 1

SEE PL 8-005004 FOR PARTS LIST

PANEL [1]

SERIAL NO.	PART NO.	FINAL ASSY QTY REQD	NEXT ASSY QTY REQD	NEXT ASSY APPLICATION	USED ON APPLICATION
	-01	1	1	8-005	8-005

OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
LINEAR .XX = ± .03
.XXX = ± .010
ANGULAR = ± 1°
BREAK ALL SHARP EDGES
ALL ANGLES & BENDS 90°
ALL DIMENSIONS PER MIL-STD-8
PART MARK PER MIL-STD-130
125 ALL MACHINE SURFACES

CONTRACT NUMBER		
DRAWN	PAUL C. WIELANDT	11/7/68
CHECKED	R. Warren	11/11/68
MECH.		
ELEC.		
RELIABILITY		
APPROVED		11/13/68
APPROVED		11/18/68

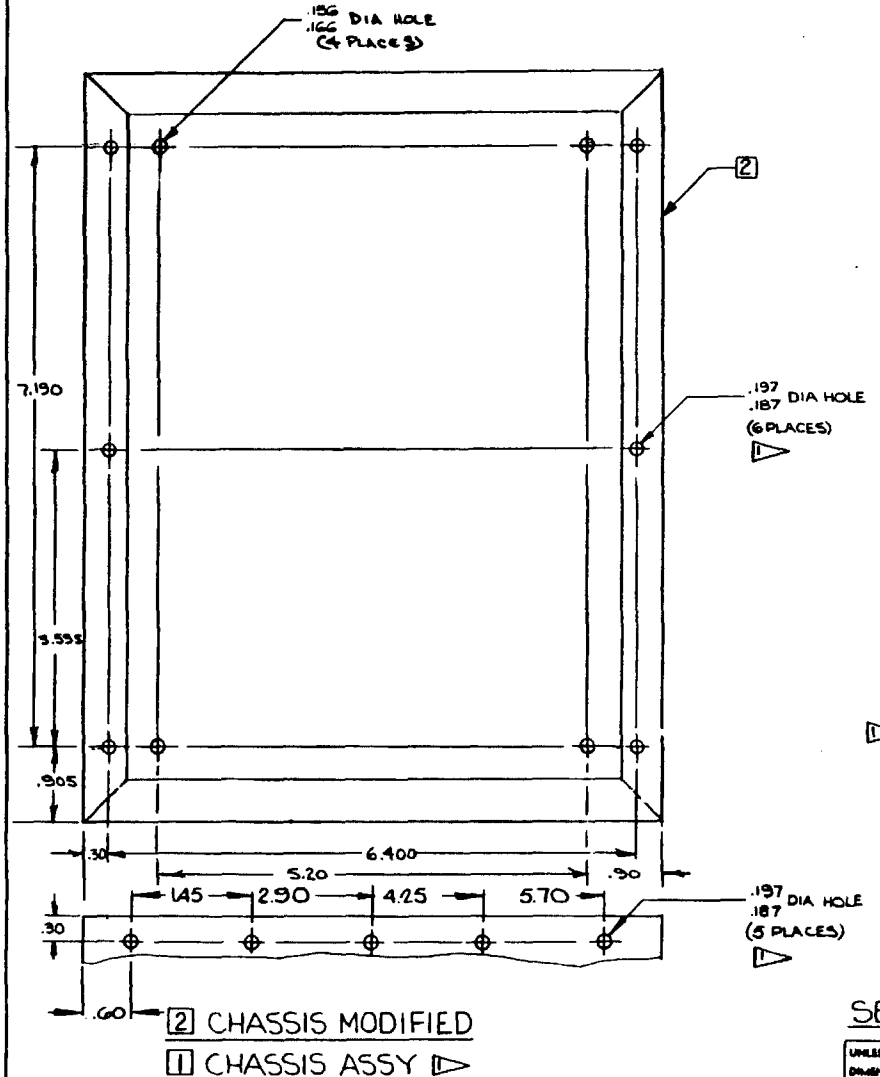
11-19-68 MD

ELECTRO DEVELOPMENT CORPORATION
SEATTLE, WASHINGTON

PANEL, TEST SET

SIZE	CODE IDENT. NO.	
C	08748	8-005004
SCALE 1:1		SHEET 1

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	1) DELETED NOTCH & DIMENSIONS 2) ADDED .60, 1.45 WAS 1.60, 2.90 WAS 3.20, 4.25 WAS 4.80 & 5.70 WAS 6.40. REASON: DESIGN IMPROVEMENT EFF. PT.: IV-USE	11-25-68 12-2-68	P. WIELANDT



2 CHASSIS MODIFIED

1 CHASSIS ASSY ▷

1 ▷ INSTALL 3 PROJECTING TOWARDS INSIDE OF 2 CHASSIS TO MAKE 1 ASSEMBLY.

SEE PL 8-005001 FOR PARTS LIST

A 8-005001 SHT 1

SERIAL NO.	PART NO.	QTY REQD: FINAL ASSY	QTY REQD: NEXT ASSY	APPLICATION: NEXT ASSY	APPLICATION: USED ON
—	-01	1	1	8-005	8-005

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
LINEAR .XX = ± .03
.XXX = ± .015
ANGULAR = ± 1°

BREAK ALL SHARP EDGES
ALL ANGLES & BENDS 90°
ALL DIMENSIONS PER MIL-STD-8
PART MARK PER MIL-STD-130
.187 ALL MACHINE SURFACES

CONTRACT NUMBER

		DATE
DRAWN	P. WIELANDT	11/8
CHECKED	R. WARREN	11/11/68
MECH		
ELEC		
RELIABILITY		
APPROVED		11/14/68
APPROVED		11/20/68

11-20-68 PM 10

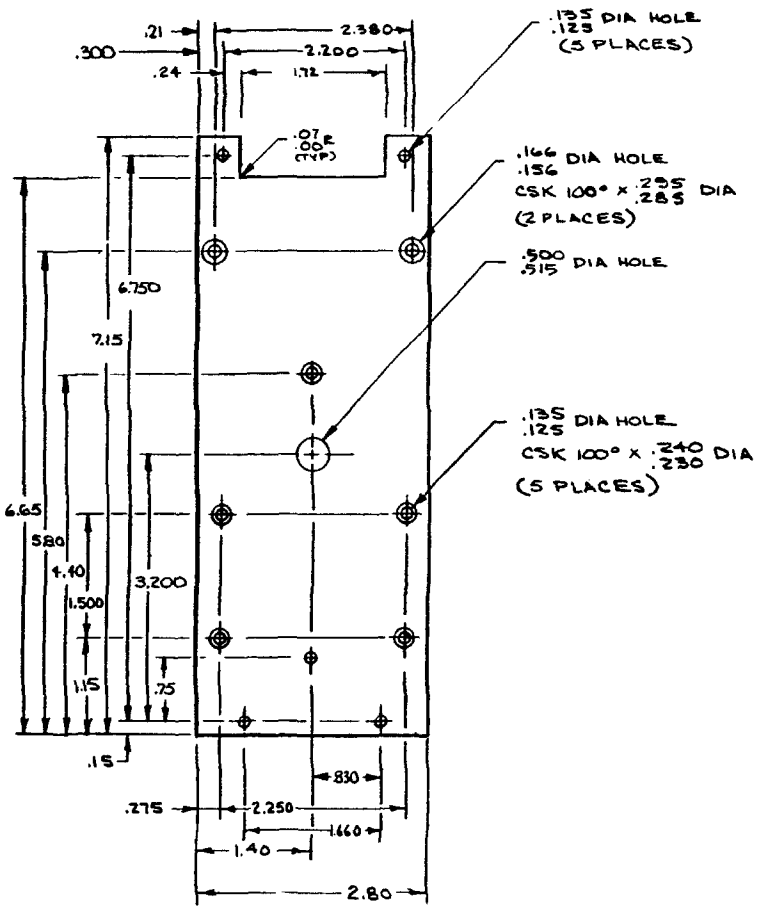
ELECTRO DEVELOPMENT CORPORATION
SEATTLE, WASHINGTON

CHASSIS ASSY

SIZE C | CODE IDENT. NO. 08748 | 8-005001

SCALE 1:1 | SHEET 1 OF 1

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	1) DELETED NOTCH & DIM'S. REASON: DESIGN IMPROVEMENT EFF. PT.: IV-USE.	11-25-87	PC LUELALDT



SEE PL 8-005003 FOR PARTS LIST

SUBPANEL [1]

SERIAL NO.	PART NO.	QTY REQD: FINAL ASSY	QTY REQD: NEXT ASSY	APPLICATION: NEXT ASSY	APPLICATION: USED ON
—	-01	1	1	8-005	8-005

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
LINEAR .XX = ±.03
.XXX = ±.010
ANGULAR = ± 1°
BREAK ALL SHARP EDGES
ALL ANGLES & BENDS 90°
ALL DIMENSIONS PER MIL-STD-8
PART MARK PER MIL-STD-130
125 ALL MACHINE SURFACES

CONTRACT NUMBER
DRAWN PAUL C. LUELALDT DATE 11-7-8
CHECKED R. Warren 11/11/8
MECH.
ELEC.
RELIABILITY
APPROVED 11/20/8
APPROVED 11/19/8
MD11-2068

ELECTRO DEVELOPMENT CORPORATION
SEATTLE, WASHINGTON

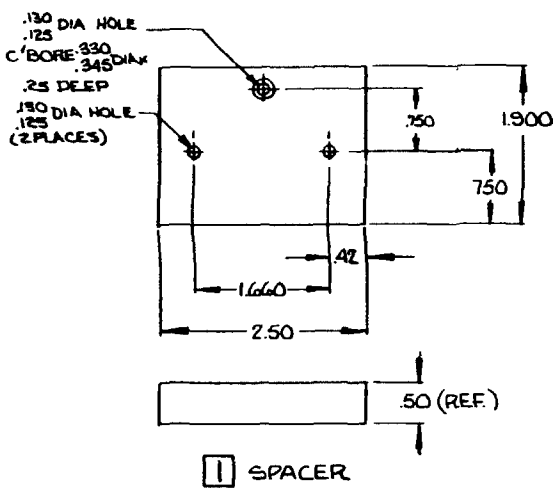
SUB PANEL

SIZE C | CODE IDENT. NO. 08748 | 8-005003

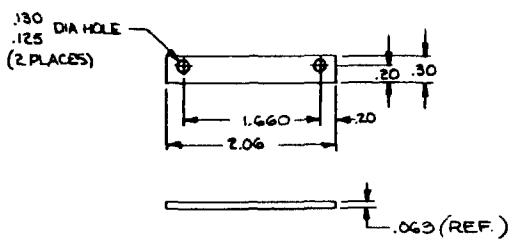
SCALE 1:1 | SHEET 1 OF 1

A 8-005003 SHT 1

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	1) DELETED HOLE & DIM'S. IN [1] & [2] 2) C'BORE DIM WAS .296/.281 DIA. REASON: DESIGN IMPROVEMENT EFF. PT.: IV - USE	11-25-68	P. WIELAND



[1] SPACER



[2] SPACER

SEE PL8-005005 FOR PARTS LIST

SERIAL NO.	PART NO.	FINAL ASSY QTY REQD	NEXT ASSY QTY REQD	NEXT ASSY APPLICATION	USED ON APPLICATION

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
LINEAR .XX = ±.01
.XXX = ±.005
ANGULAR —

BREAK ALL SHARP EDGES
ALL ANGLES & BENDS 90°
ALL DIMENSIONS PER MIL-STD-8
PART MARK PER MIL-STD-130
63 ALL MACHINE SURFACES

CONTRACT NUMBER		
DRAWN	PAUL C WIELAND	11-5-68
CHECKED	R. Warren	11/6/68
MECH.		
MISC.		
RELIABILITY		
APPROVED		11/6/68
APPROVED		11/10/68

11-19-68 810

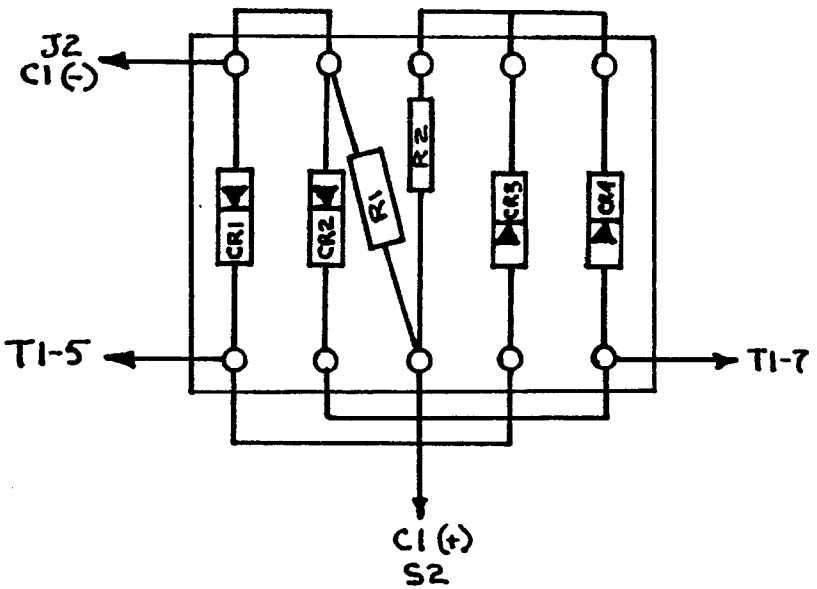
ELECTRO DEVELOPMENT CORPORATION
SEATTLE, WASHINGTON

SPACER

SIZE	CODE IDENT. NO.	
C	08748	8-005005
SCALE FULL		SHEET 1 OF 1

A 8-005005 SHT1

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	1) ADDED DIODE SYMBOLS REASON: DESIGN IMPROVEMENT EFF. PT.: IV - PARTS IN ACCORD	11-25-68	



A 8-005002

SEE PL 8-005002 FOR PARTS LIST

SERIAL NO.	PART NO.	QTY REQD: FINAL ASSY	QTY REQD: NEXT ASSY	APPLICATION: NEXT ASSY	APPLICATION: USED ON
———	-01	1	1	8-005	8-005

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
LINEAR .XX = ——
.XXX = ——
ANGULAR = ——
BREAK ALL SHARP EDGES
ALL ANGLES & BENDS 90°
ALL DIMENSIONS PER MIL-STD-8
PART MARK PER MIL-STD-130
! MACHINE SURFACES

CONTRACT NUMBER
DRAWN: PAUL C LUKELAMDT — DATE 11-7-8
CHECKED: [signature] 11/11/68
MECH.
ELEC.
RELIABILITY
APPROVED: [signature] 11/8/68
APPROVED: [signature] 11/8/68
11-19-68 MD

ELECTRO DEVELOPMENT CORPORATION
SEATTLE, WASHINGTON

TERMINAL BOARD ASSY

SIZE C | CODE IDENT. NO. 08748 | 8-005002
SCALE FULL | SHEET 1

PARTS LIST

LYNNWOOD, WASHINGTON EDC | REL DATE 11-19-68 MD | PL 8-005002 | REV LTR A

PARTS LIST TITLE: TERMINAL BOARD ASSY | AUTHENTICATION P.C.W. 10-30-8 | CHG CONT NO | CODE IDENT 08748 | SH 1 OF 1 SH

ITEM NO.	QTY REQ	QTY REQ	QTY REQ	QTY REQ -01	CODE IDENT	PART OR IDENTIFICATION NUMBER	NOMENCLATURE OR DESCRIPTION	STOCK SIZE OR VALUE	MATERIAL OR REF DES
1				—		-01	TERMINAL BOARD ASSY		TB1
2				4 △1		IN3193	DIODE	200V-750 MA	CR1,2,3,4
2				4 △2		IN3196	DIODE	800V-500MA	CR1,2,3,4
2				4 △2		IN4383	DIODE	200V-1AMP	CR1,2,3,4
5				1	91833	15316	TERMINAL BOARD		
6				1	56289	243E3515	RESISTOR	350Ω, 5W	R1
7				1	56289	242E1005	RESISTOR	10Ω, 3W	R2
8									
9									
10									
11									
12									
13									
14									
15									
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31									

PL8-005002 REV LTR A SHT 1

REVISIONS

LTR	DESCRIPTION	DATE	APPD
A	1) ITEM 6 WAS P N 242E5015 500Ω 3W. REASON: DESIGN IMPROVEMENT EFF. PT.: IV-USE	12-10-8 12-11-8 12-12-8 12-13-8	PCW RHJ KAM-H DAW

NOTES

△1 PREFERRED PART OTHER PARTS OF SAME ITEM NO. OPTIONAL.

△2 OPTIONAL TO OTHER PARTS OF SAME ITEM NUMBER

91833 KEYSTONE ELECTRONICS CORP NEW YORK, NEW YORK

56289 SPRAGUE ELECTRIC CO. NORTH ADAMS, MASS.

AIRCRAFT STATIC INVERTER

MODELS PC-14, PC-14A( ), PC-14C( ) AND PC-14D( )

INSTRUCTION MANUAL

TSO-C73

Marathon Power Technologies
P. O. BOX 8233 • WACO, TEXAS 76714-8233
8301 IMPERIAL DRIVE • WACO, TEXAS 76712-6588
(817) 776-0650 • FAX (817) 776-6558

FLITE-TRONICS STATIC INVERTERS
UNDER MODEL PC-14( ) SERIES

MODEL NUMBER	DESCRIPTIONS
PC-14	Basic 100VA, 400HZ, 115VAC output static inverter. This model is discontinued as of Octorber 1972.
PC-14A	Basic 60VA, 400HZ, 115VAC output static inverter. This model is discontinued as of Octorber 1972.
*PC-14C( )	Currently available 100VA static inverter previously refered to as PC-14.
*PC-14D( )	Currently available 60VA static inverter previously refered to as PC-14A.
PC-14D(4)	PC-14D( ) modified for oscillator phase synchronization. 6 pin connector (MS3102A4S-6P)

* Refer to Rev. 3 for details. This is an identification change of the inverters of current manufacture. Interchangeability of the PC-14C( ) with the PC-14 after serial number 1593 and PC-14D( ) with the PC-14A after serial number 648 is not affected.

Electrical and mechanical specifications of the PC-14C( ) and PC-14D( ) are equal to or superior than the previously manufactured PC-14 and PC-14A respectively. PC-14C( ) serial number effectivity is 1750 and PC-14D( ) serial number effectivity is 700.

REVISION NUMBERS

TO

INSTRUCTION MANUAL PC-14 AND PC-14A

REVISION NUMBERS	DATE	SERIAL NUMBER EFFECTIVITY
Original Publication	September 1965	Not Applicable
Second Printing	March 1969	None
Revision No. 1 Third Printing	May 1971	PC14: S/N 1358 PC14A: S/N 564
Revison No. 2	November 1971	PC14: S/N 1593 PC14A: S/N 648
Revision No. 3 Fourth Printing	August 1972	PC14C( ): S/N 1750 PC14D( ): S/N 700
Fifth Printing Revision No. 4	January 1974	None
Sixth Printing	October 1975	None

NOTE:

This manual includes original publication information and all revisions to date. All changes with serial number effectivity when applicable are compiled under revision section as they occured.

RECORD OF REVISIONS

MFG REV NO	DESCRIPTION	ISSUE DATE	ATP REV DATE	INSERTED BY

RECORD OF TEMPORARY REVISIONS

TEMP REV NO	DESCRIPTION	ISSUE DATE	ATP REV DATE	INSERT BY	DATE REMOVED	REV INCOR	REMOVE BY

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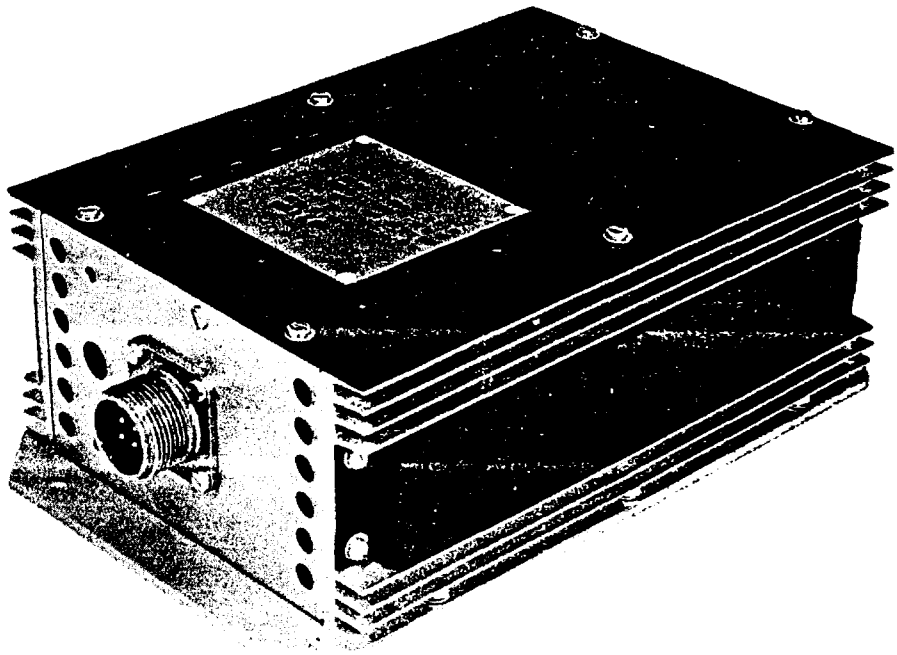


Figure 1.1 Flite-Tronics Model PC14 and PC14A

Section I

General Information

1.1 Introduction

This instruction manual has been prepared to provide information on installation, performance, operation, identification of parts, and maintenance of the Flite-Tronics Model PC14 and PC14A Power Inverters.

1.2 Purpose of Equipment

The PC14 and PC14A shown in figure 1.1 is a transistorized inverter designed to supply 115 VAC at 400 cycles per second. The input power voltage is 28.0 VDC.

The unit is capable of delivering a current overload of 150% for a minimum duration of 5 minutes at full rated output. This permits the PC14 and PC14A to power equipment that requires momentary surges of power during turns on.

1.3 Specifications

Input Voltage.....27.5 VDC
Input Current...
a) 5.2 amperes for PC14 delivering 100 VA.
b) 3.2 amperes for PC14A delivering 60 VA.
c) .75 amperes for PC14 and PC14A with no load.
Input Voltage Range.....26 to 30 VDC normal, will operate down to 20 VDC.

Input Overvoltage..Withstands 130% input overvoltage for 5 minutes while supplying full rated 100 VA output power. Output voltage under this condition 115 VAC +5% -7%.

Output Voltage...115 AC rms +5% -7%

Output Frequency.....400 cps ± 1%

Output Power...100 VA, Model PC14
60 VA, Model PC14A

Output Waveform.....Sine Wave, Single Phase

Harmonic Distortion..Typically 3%

Overload Capacity...Withstands 150% output current overload for at least 5 minutes.

Power Factor..... .8 to 1.0

Input Voltage Protection...
Unit withstands transient of 88 volts lasting 1 millisecond on the 27.5 VDC input line.

Excessive Overload and Output Short Circuit...
Withstands without damage or degradation loads exceeding 150% nominal to an output short circuit. Unit delivers rated output on removal of above condition.

Altitude.....45,000 feet

Efficiency.....72% typical

Temperature..-65° F. to 160° F.

Emission RFI...90 KC to 1000 MC
None measurable

Weight.....4.75 lbs., PC14
4.25 lbs., PC14A

Size: PC14 and PC14A
Width 5"
Length 7"
Height 2-3/4"

Humidity...
Greater than 95% for ten days, temperature cycled between 75° F. to 160° F.

Vibration...
To withstand at least 10 G's from 10 to 500 cycles per second in three directions for 90 minutes each direction.

Shock...
To withstand at least 10 G's for 11 milliseconds in three directions.

1.4 Description

The PC14 and PC14A are transistorized airborne static power inverters. The unit operates from 27.5 VDC aircraft power source and delivers 115 VAC at 400 cps.

An L/C tuned 400 c/s oscillator operating in a class B push-pull mode is used to generate the output voltage.

This signal is amplified by 3 stages of class B push-pull emitter follower amplifiers. Protective circuits for output regulation, output overload, thermal runaway and input voltage transient are incorporated to make the PC14 and PC14A an extremely reliable equipment.

Frequency and output voltage are adjustable. However, once set at the factory they should not require readjusting for the life of the equipment.

SECTION II

INSTALLATION

2.1 General

The PC14 and PC14A 400 c/s Inverters are ready to install when delivered from the factory.

To determine that the unit is operating satisfactorily, a bench test may be made. The external hook-up for such a test is illustrated in figure 4.1.

The PC14 will deliver 100 VA of power to a load having a power factor between .8 lag to 1.0. The PC14 will operate into loads which are more reactive, however, external correcting capacitor will be required.

The capacitance value may be determined by noting what value causes a null in the input current reading. This, of course, should be determined with the equipment the PC14 delivers power to.

2.2 Installation Procedure

The PC14 and PC14A are environmentally designed to mount on a rack with other equipment, or in any suitable location in the aircraft.

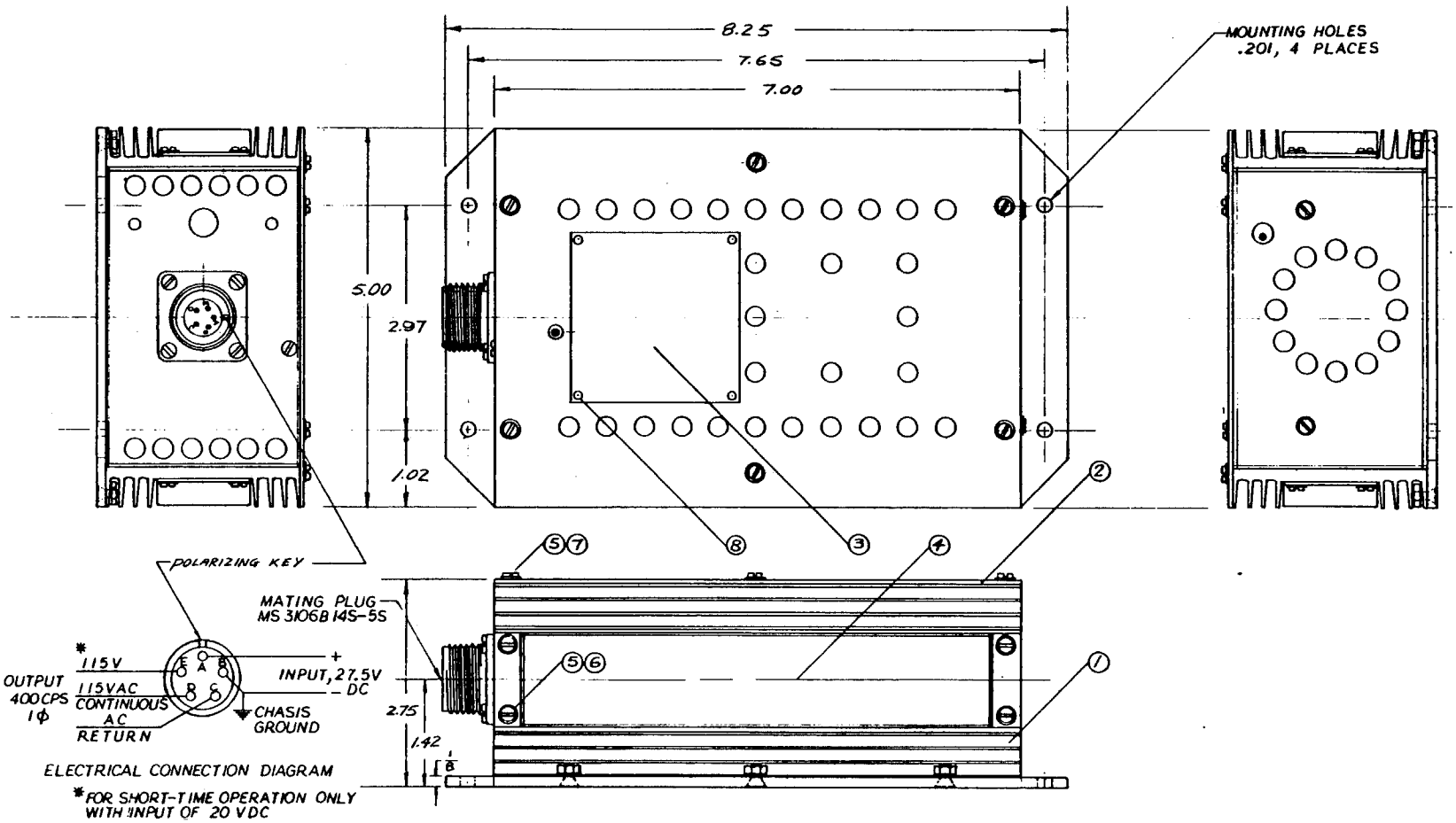
Figure 2.1 illustrates the installation dimensions and mounting centers. Mounting hardware is not normally supplied with the unit. The screw size should be 10-32 and length long enough to have 1-1/2 threads exposed after installing the necessary hardware.

The mating connector plug to the PC14 and PC14A receptacle is MS3106B14S-5S.

A wire size AWG #14 is suggested for the low voltage D.C. input and an AWG size #22 for the A.C. output leads. The low voltage input to the PC14 should be protected with a 12 amp circuit breaker and the PC14A with a 7 amp circuit breaker.

CAUTION

The PC14 and PC14A should not be installed in an area where the ambient air temperature exceeds 172° F. under all weather and operating conditions.



ELECTRICAL CONNECTION DIAGRAM

*FOR SHORT-TIME OPERATION ONLY WITH INPUT OF 20 VDC

ELECTRICAL REQUIREMENTS		
INPUT	VOLTS, DC	27.5
OUTPUT	VOLTS, AC, 400%	115
	POWER, VA	100 **
	POWER FACTOR	.8 TO 1
	PHASES	1
EFFICIENCY	PERCENT AT FULL LOAD	71
WEIGHT	POUNDS	4.75

** 60 VA FOR PC 14A

FIGURE 2.1
INSTALLATION AND
MOUNTING DIMENSIONS

8	AN430		RIVET, ALUM. RD. HD. 1/16 DIA. 3/32 L	4
7	MS35225-13		4-40 SCREW, B. HD. 1/4 LONG	6
6	MS35226-15		4-40 SCREW, B. HD. 3/8 LONG	8
5	AN936-A4		LOCK WASHER	14
4	85175		TRANSISTOR COVER	2
3	85170		NAME PLATE	1
2	85160		DUST COVER	1
1	85025		MAIN ASSEMBLY	1
ITEM	PART NO.	CHANGE REF. NO.	DESCRIPTION	NO. REQ'D

MATL

FLITE-TRONICS, INC.
5018 BURTON AVE., BURBANK, CALIF.

DRAWN 7/20/6
CHK'D 7/21/6
APP'D 7/65
SCALE FULL
MODEL PC14
NEXT ASSY.

TITLE 400 cps STATIC INVERTER MASTER ASSEMBLY & MOUNTING DETAILS

SIZE C DWG. NO. 85000

SECTION III

Principles of Operation

3.1 General

The PC14 converts D.C. energy to A.C. electrical energy.

The nominal output is 115 VAC on pin D for an input of 28 VDC ± 2 VDC. However, in an emergency battery condition of 20 VDC input the output from pin E is 115 VAC working into a 90 VA load. The 400 cps is generated by an L/C tuned push-pull oscillator. The sine wave source is amplified by two stages of class B push-pull amplifier. The final power output stage is also class B, but the transistors are cascoded. This increases the operating temperature and also decreases the collector to emitter operating voltage in half, i.e., eliminates the possibility of an 88 volt peak transient on the 27.5 VDC bus destructing the transistors. A schematic of the PC14 and PC14A are illustrated in figures 3.1 and 3.2 respectively.

3.2 Block Diagram

Figure 3.3 illustrates the PC14 operation in a block diagram form. The block diagram illustrates the time tested and proven circuitry for power amplification of a low level A.C. signal. All the stages are class B push-pull emitter follower configuration. The emitter follower circuitry having inherent negative feedback introduces very little amplitude and phase distortion.

The output signal is sampled by current and voltage transformer. These components yield a signal to operate the output overload and output voltage level circuitry.

They in turn control the push-pull 400 cps oscillator amplitude.

The output overload reduces the output current and voltage when a load excess of 160% is applied to the output. This same circuitry operates in the event of a short circuit on the output.

The automatic level control maintains the output voltage constant for load and temperature variation.

3.3 400 cps Sine Wave Oscillator

Inductor-transformer T1 is the feedback, output and resonant tuning transformer. The center tapped primary winding is 1-2-3. Feedback winding is 4-5-6. The output and resonant tuning winding is 7-8-9.

Capacitor C10 (.47 ufd) resonants with the inductance of the output winding at 400 cps.

Transformer T1 has a tuning slug which is adjusted at the factory for an oscillator frequency of 400 cps.

Transistors Q1 and Q2 are the class B push-pull amplifier to sustain oscillation. Resistors R2 and R3 biases the transistors to cause oscillation to start. Capacitor C9 suppresses any tendency for high frequency mode oscillation. Resistor R4 is the degenerating resistor.

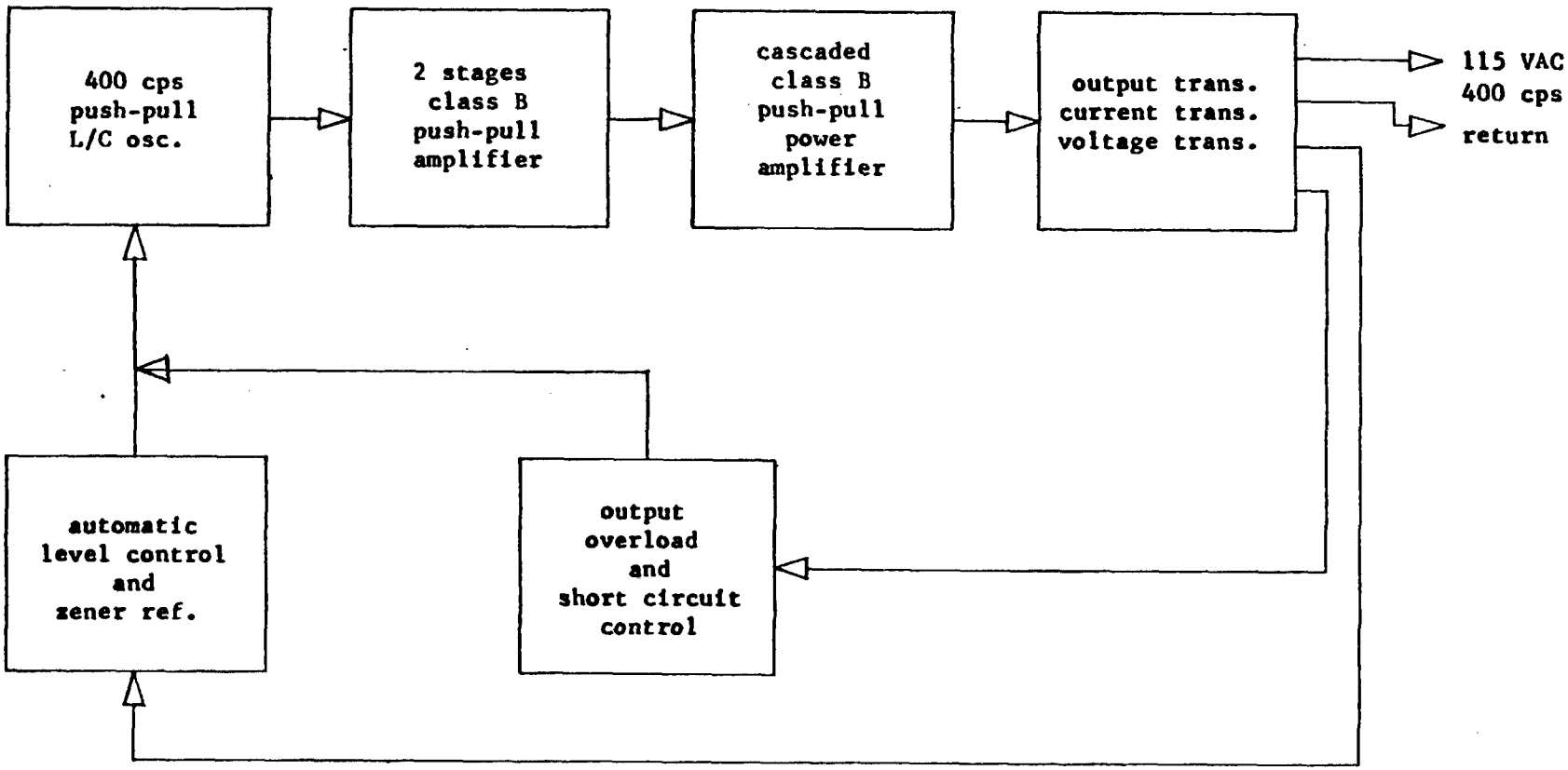


FIGURE 3.3 BLOCK DIAGRAM

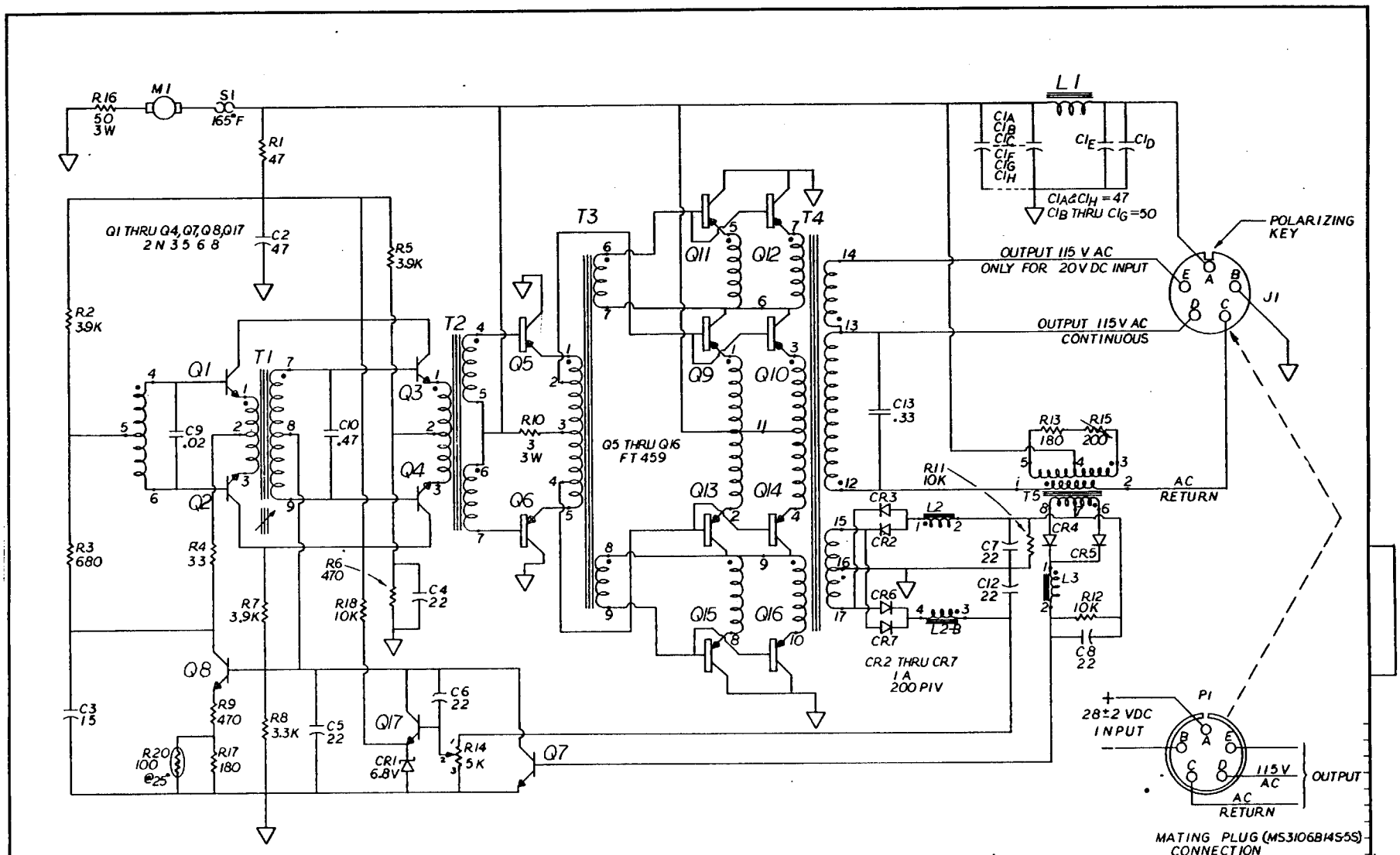


FIGURE 3.1

NOTES

1. RESISTORS IN OHMS: 1/2 W UNLESS OTHERWISE NOTED
2. CAPACITORS IN μF:

					MATL.	DRAWN	7/29/65
						CHK'D	
						APP'D	7/30/65
					FLITE-TRONICS, INC. 5515 BURTON AVE., BURBANK, CALIF.	SCALE	
					TITLE PC14 SCHEMATIC	MODEL PC14	
						NEXT ASSY.	
						SIZE C	DWG. NO. 85003

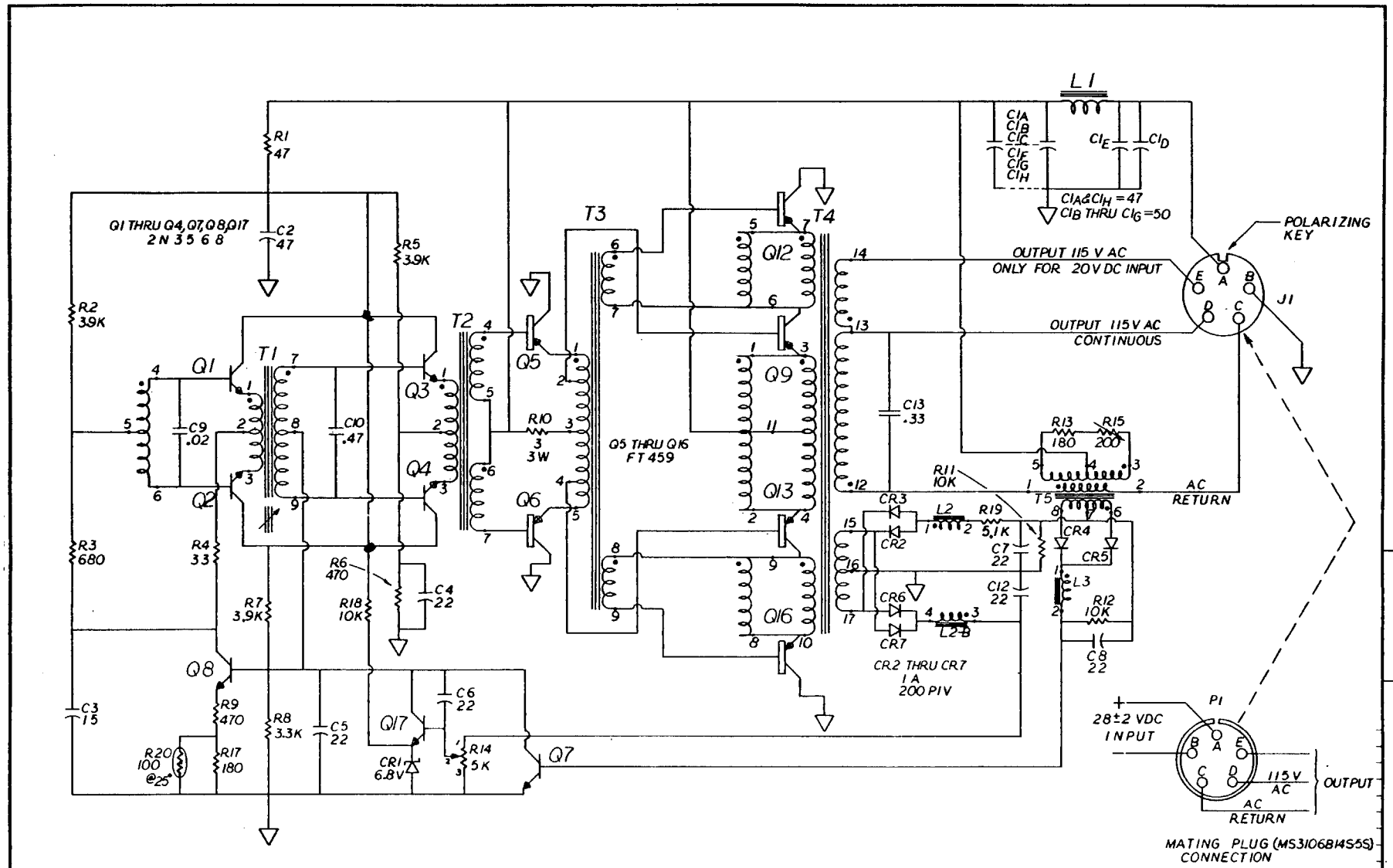


FIGURE 3.2

NOTES

1. RESISTORS IN OHMS: 1/2 W UNLESS OTHERWISE NOTED
2. CAPACITORS IN μF:

The output winding 7-8-9 drives the bases of Q3 and Q4 in opposite phase.

3.4 Low Level Amplifiers

Between the sine wave oscillator and power amplifiers there are two stages of class B push-pull emitter follower amplifiers.

The first stage consists of transistors Q3 and Q4 and the interstage transformer T2. Resistors R5 and R6 biases these transistors operating point.

The output from the transformer T2 drives the bases of Q5 and Q6. Resistor R10 is the emitter degenerating resistor. T3 is a tapped primary and two isolated secondary winding transformer. The unusual configuration is necessitated by the cascaded power output transistor connection.

3.5 Power Amplifier

The power amplifier consists of power transistors connected in cascaded pairs for the PC-14. For the PC14, transistors Q11, Q12, Q9, Q10 and Q13, Q14, Q15, Q16 are driven in alternate half cycles. The multiple winding primary of transformer T4 divides the 27.5 VDC input so the transistors supports only 13.75 peak A.C. signal.

These power transistors are controlled to Flite-Tronics' specification FT459. These devices are inspected for certain minimum breakdown voltage, gain and recovery time. The minimum test for breakdown voltage Vcex is 105 volts. Therefore, an 88 volt peak transient on the 27.5 VDC input will not cause a collector to emitter voltage to exceed 88 volt peak. The primary of the transformer forces this voltage division.

The secondary of T4 has a tapped winding for the 115 VAC output and a center tapped winding for control of output voltage and output current.

The output from terminal 13 of T4 is connected to pin D of connector J1. This output is 115 VAC when the input is 28 VDC ± 2 VDC. To get 115 VAC and up to 90 VA output when the input is 20 VDC emergency condition the load should be connected to pin E of J1. There will exist, however, slight squaring of the peaks of the sine wave in this condition.

Capacitor C13 is the phase compensating capacitor to permit the unit to operate efficiently with a load power factor between .8 lag to 1.0.

3.6 Output Voltage Control

The output voltage sample is realized from the center tapped winding 15-16-17 of T4. Rectifiers CR6 and CR7 converts the A.C. signal to a D.C. output. Filter consisting of L2-B and C12 is the L section choke input to give an average D.C. output which is proportional to the 115 VAC level.

This D.C. output is also applied across a variable resistor R14. The variable portion of the resistor is connected to the base of Q17. In essence this output voltage sample is compared with the zener CR1 in the emitter of Q17. Resistor R18 is the bleeder resistor to the zener to permit operating this zener on its flat portion of its transfer characteristics.

The variable resistor R14 is adjusted for an output of 115 VAC. The load resistor R7 is connected to the collector of Q17. The D.C. current passing these R7 determines the bias

point to transistor Q8. Transistor Q8 is the variable D.C. source for the push-pull 400 cps oscillator.

The push-pull oscillator represents an impedance to the collector circuit of Q8. Hence, the conduction of Q8 will determine the magnitude of D.C. voltage across the oscillator circuit. This in turn determines the voltage amplitude of oscillation, which of course controls the A.C. output level. Resistor R9 and R17 are the degenerating resistors for transistor Q8.

Thermistor R20 is a temperature compensating resistor.

Resistor R8 is the starting resistor for transistor Q8 until the oscillator amplitude builds up sufficiently for the automatic level control circuitry to take over.

Capacitor C6 is a low frequency feedback capacitor to prevent the automatic level control circuitry from motor boating. Capacitor C3 and C5 are simply by-pass capacitors.

3.7 Current Overload Control

The output A.C. current is sampled by the transformer T5. The current flowing thru the winding 1-2 causes a voltage to be developed across the center tapped winding 6-7-8. The magnitude of voltage across this winding is controlled by the variable resistor R15 across the center tapped winding 3-4-5.

The A.C. voltage from winding 6-7-8 is rectified by CR4 and CR5. The averaging choke input filter consisting of L3 and C8 cause a D.C. voltage to be developed across R12 which is proportional to the output current. The D.C. voltage is proportio: to the output current.

To realize an overload action that causes quenching the overload current D.C. voltage is compared with the output D.C. voltage. This tends to give a trigger like action when an overload condition is sustained.

The output voltage sample is taken from winding 15-16-17 of transformer T4. CR2 and CR3 rectifies this voltage. The L section choke input filter consisting of L2 and C7 places across resistor R11 a ripple free D.C. voltage. The voltage across R11 is a negative polarity with respect to ground.

The D.C. voltage across R12 which is proportional to the output current is compared with the voltage across resistor R11. When the output current causes a voltage across R12 to exceed the compared voltage across R11, transistor Q7 will start conducting. The extent of overload determines the magnitude of current Q7 will conduct. As Q7 conducts this tends to cut off Q8 which in turn decreases the voltage across the 400 cps oscillator circuit.

When the load is in excess of 150% of normal the oscillator circuit will exhibit anything from low frequency quenching to almost a complete shut down.

During output short circuit the current overload circuitry will reduce the voltage across the push-pull oscillator until a feeble oscillation is maintained until the overload is removed.

Of course on removal of this condition, the unit will immediately return to normal operating condition.

3.8 Input Filtering and Blower

The input is filtered by a pi section consisting of capacitors C1A thru C1H and choke L1.

Additional filtering for the low level stage is done by the RC filter consisting of R1 and C2.

Blower motor M1 is used only in the PC14, the 100 VA unit. The blower motor turns on when the heat sink temperature has reached 165° fahrenheit.

In normal installation where thermal conduction by the aircraft structure is adequate the blower motor may never come on. Resistor R16 simply reduces the speed slightly.

The PC14A does not use a blower since the heat sink can more than adequately handle the thermal dissipation.

SECTION IV

MAINTENANCE

4.1 General

This section covers the bench check of the PC14 and PC14A to determine conformance to manufacturers specification. Periodic preventative maintenance is not necessary since no moving parts are employed to realize functional electrical performance.

For safety feature only, a thermostatically controlled blower motor is used. It will come on only when the heat sink temperature exceeds 165° F.

The instructions on table 4.2 will aid in localizing the cause of defective operation should any component fail.

4.2 Test Equipment

Table 4.1 lists the components and test equipment recommended to be employed in conducting electrical test per manufacturers test procedures.

Figure 4.1 illustrates the PC14 and PC14A bench test interconnection diagram. The Flite-Tronics Test Set TS14-1 is a unit for readily conducting the test in table 4.2.

TABLE 4.1 COMPONENT AND TEST EQUIPMENT

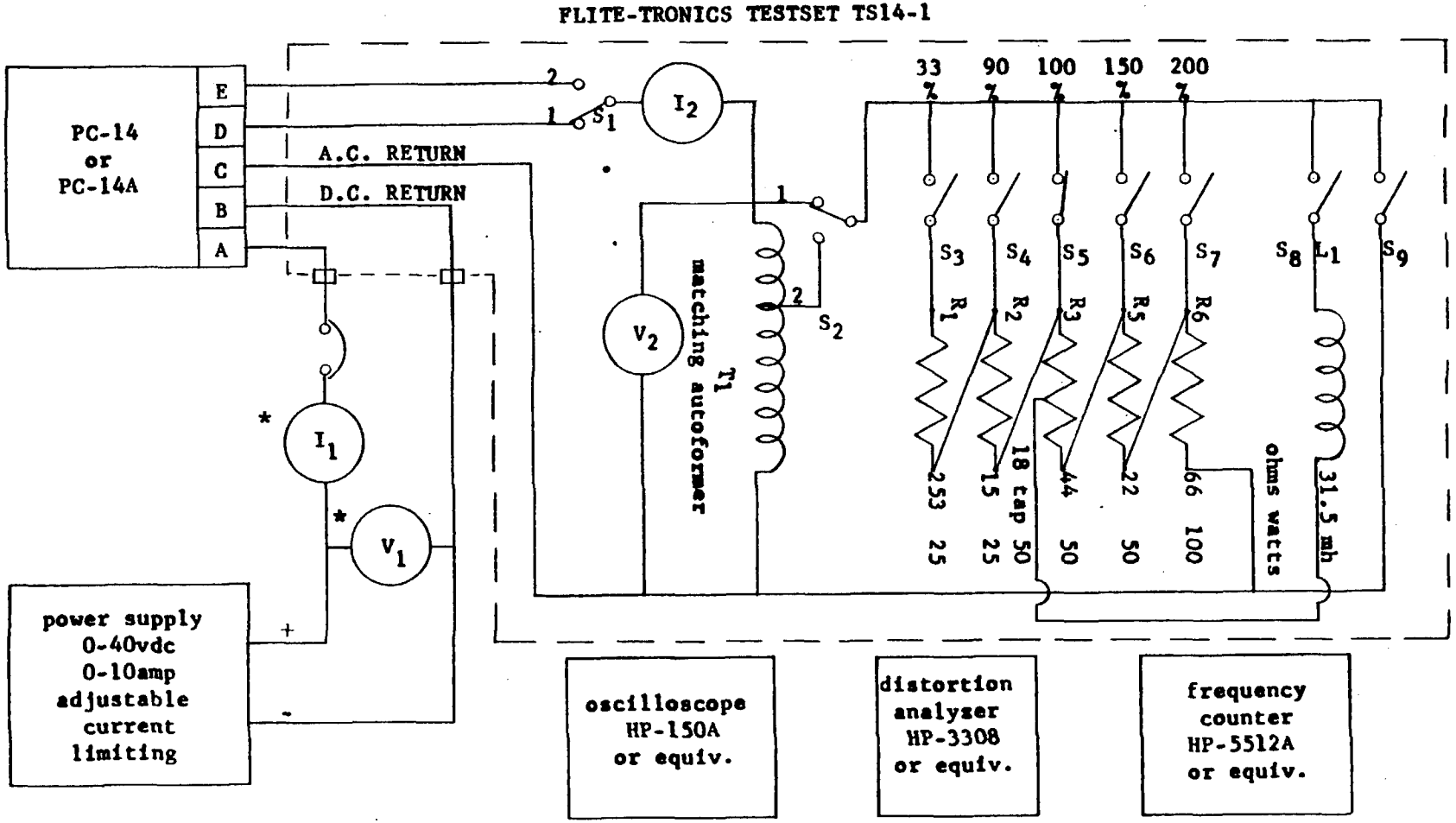
EQUIPMENT	MODEL OR TYPE	FUNCTION
Power Supply	0-40 VDC, 0-10 Amp	Low voltage power source
Oscilloscope	HP122A or equiv.	Visual display
Distortion Analyzer	HP3308 or equiv.	Measure distortion
Frequency Counter	HP5512A or equiv.	Measure frequency
Circuit Breaker	10 Amp Breaker	Protection
Current Meter I2	0-2.0 Amps A.C. 400 c/s	Monitor output I
Voltmeter V2	0-150 VAC 400 c/s	Monitor output voltage
Reactor L1	31.5 Millihenry @ 115 VAC 400 cps	Reactance load simulator
Resistor R1	253 ohm 25 watt	Resistive load
Resistor R2	15 ohm 25 watt	Resistive load
Resistor R3	44 ohm 50 watt	Resistive load
Resistor R4	18 ohm tap on R3	Resistive load
Resistor R5	22 ohm 50 watt	Resistive load
Resistor R6	66 ohm 100 watt	Resistive load
Switch S1	SPDT	PC14/PC14A switch
Switch S2	SPDT	PC14/PC14A switch
Switch S3	SPST	33% load switch
Switch S4	SPST	90% load switch
Switch S5	SPST	100% load switch
Switch S6	SPST	150% load switch
Switch S7	SPST	200% load switch
Switch S8	SPST	.8 power factor switch
Switch S9	SPST	Short circuit switch
Transformer T1	Autoformer tap @ 77% of full output	Matching autoformer to test 60 VA unit

4.3 Performance Test and Localizing Trouble Source

Table 4.2 outlines a step by step procedure to performance test the PC14 and PC14A to localize fault source if troubles exist.

It is suggested the technician acquire familiarity of the unit by studying the principles of operation section prior to attempting this section.

NOTE: Step 1 through 13 is for the PC14 and Step 14 through 24 is for the PC14A.



* These meters are required only if the power supply does not contain them.

FIGURE 4.1 BENCH TEST HOOK-UP

TABLE 4.2 PERFORMANCE TEST AND LOCALIZING TROUBLE

STEP	SET-UP	PROCEDURE	PERFORMANCE READING	POSSIBLE CAUSE OF ABNORMAL READING
1	Interconnect unit per bench test hook-up	a) Turn on power supply, keep input voltage set at zero. b) Turn on all measuring equipment for warm-up. c) Check polarity of power supply. d) Set S1 to No. 1 position. e) Set switch S2 in #1 position for PC14. f) Set switches S3 through S10 in the off position.		
2	S3 through S9 in the off position	a) Gradually increase power supply voltage to 27.5 VDC.	Input D.C. current I1 should not exceed 3/4 amps D.C.	Test set-up incorrectly connected. Capacitor C1A thru C1H shorted. Transistors Q11 thru Q16 shorted C2 shorted.
3	S3 thru S9 in the off position	a) Input voltage set at 27.5 VDC b) Adjust R14 as required so V2 reads 117 VAC if necessary.	V2 should read between 107 VAC to 120.7	Check for following likely defective components: CR6, CR7, C12, R14, C6, CR1, Q17, C3, Q8, and R20

STEP	SET-UP	PROCEDURE	PERFORMANCE READING	POSSIBLE CAUSE OF ABNORMAL READING
4	S3 thru S9 in the off position	a) Input voltage set at 27.5 VDC. b) If frequency is out of tolerance adjust tuning slug on transformer T1.	Frequency meter should read 400 c/s ± 4 c/s I1 = 3/4 A	Defective parts likely to cause abnormal reading: Transformer T1, Capacitor C10.
5	S3 thru S9 in the off position	a) Input voltage set at 27.5 VDC. b) Vary input voltage between 28 to 30 VDC.	Distortion meter should read less than 7%. I1 = 3/4 A	Defective parts likely to cause abnormal reading: Transistors Q3 thru Q6 and Q9 thru Q16. Capacitors C3, C5.
6	Switch S5 on for full load output	a) Input voltage set at 27.5 VDC. b) Resistor R14 may require readjusting, however, if adjusted step 3 should be re-tested. c) Vary input voltage between 28 to 30 VDC.	I2 read .81A to .91 amps A.C. V2 should read between 107 to 120.7 VAC. I1 should read approximately 5.2A	Defective parts likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Transistor Q1 thru Q17.
7	Switch S6 for 150% overload test	a) Input voltage set at 27.5 VDC. b) Resistor R15 may require adjusting if unit tends to motor boat. However, in the event of any adjustment step 3 should be repeated.	I2 should read between 1.25 to 1.4 amp. V2 should read at least 103 VAC. I1 should read approximately 9.0 amps.	Defective parts likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Transistor Q1 thru Q17.
8	Switch S7 on for 200% overload load test.	a) Input voltage set at 27.5 VDC. b) R15 adjust the overload threshold point. The proper setting is at the 165% overload point the unit should start motorboating. However, any adjustment will require re-testing for step 3, 6, and 7.	I1 should read between 1 to 4½ amps. V2 and I2 should indicate output voltage and current motorboating.	Defective component likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Capacitors C7 and C8. Transistors Q7 and Q8.

STEP	SET-UP	PROCEDURE	PERFORMANCE READING	POSSIBLE CAUSE OF ABNORMAL READING
9	Switch S9 on for output short circuit test.	a) Input set anywhere between 26 and 28 VDC. b) If I1 exceeds 4 amps at any time, the unit should be turned off.	I1 less than 4 amps. V2 = zero I2 less than ½ amp.	Defective component likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Capacitors C7 and C8. Transistors Q7 and Q8.
10	Switches S3 thru S6 in the off position switch S8 on 100 VA reactive load and S9 off.	a) Input voltage set at 27.5 VDC. b) Vary input voltage between 28 to 30 VDC.	I2 read .80 to .90 amps A.C. V2 read between 107 to 120.7 VAC.	Defective parts likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Transistor Q1 thru Q17. Capacitor C13.
11	Switch S5 on S3, S4 and S6 thru S9 off position. Full load test.	a) Input voltage set at 27.5 VDC.	Distortion meter should read less than 7%. Frequency meter should read 400 cps ± 4 cps.	Defective parts likely to cause abnormal reading: Transformer T1, Capacitor C3, C5, and C10. Transistors Q3 thru Q6 and Q9 thru Q16.
12	Switch S3 on S4 thru S9 off.	a) Input voltage between 26.0 to 28 VDC.	V2 read 107 to 120.7 VAC I1 reads 2 amps D.C. I2 reads .27 to .34 amps A.C.	Defective parts likely to cause abnormal reading: Diodes CR6, CR7, C12, R14, C6, CR1, Q17, C3, Q8, and R20.
13	Switch S1 to #2 position S4 on, S3 and S5 thru S9 off position	a) Set Input voltage at 20 VDC.	V2 read 105 to 120.7 VAC. I2 read .73 to .82 amps A.C. I1 read approximately 5.3 amps D.C.	Defective parts likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Transistor Q1 thru Q17.

FOLLOWING TEST FOR PC14A:

STEP	SET-UP	PROCEDURE	PERFORMANCE READING	POSSIBLE CAUSE OF ABNORMAL READING
14	Switch S1 to #1 position S2 to #2 position. Switches S3 to S9 in the off position.	a) Gradually increase power supply voltage to 27.5 VDC.	Input D.C. current I1 should not exceed 3/4 amps. D.C.	Test set-up incorrectly connected. Capacitor C1A thru C1H shorted. Transistors Q11 thru Q16 shorted. C2 shorted.
15	S3 thru S9 in the off position	a) Input voltage set at 27.5 VDC. b) Adjust R14 as required so V2 reads 117 VAC.	V2 should read between 107 to 120.7 VAC.	Check for following likely defective components: CR6, CR7, C12, R14, C6, CR1, Q17, C3, Q8, & R20
16	S3 thru S9 in the off position.	a) Input voltage set at 27.5 VDC. b) If frequency is out of tolerance adjust tuning slug on transformer T1.	Frequency meter should read 400 c/s ± 4 c/s I1 = 3/4A	Defective parts likely to cause abnormal reading: Transformer T1, Capacitor C10
17	S3 thru S9 in the off position	a) Input voltage set at 27.5 VDC. b) Vary input voltage between 28 to 30 VDC.	Distortion meter should read less than 7%. I1 = 3/4A	Defective parts likely to cause abnormal reading: Transistors Q3 thru Q6 and Q9 thru Q16. Capacitors C3, C5.
18	Switch S5 on for full load test.	a) Input voltage set at 27.5 VDC. b) Resistor R14 may require re-adjusting, however, if adjusted step 15 should be re-tested.	I2 read .49 to .55 amps. V2 should read between 107 to 120.7 VAC I1 read 3.1 amps.	Defective parts likely to cause abnormal reading: Diodes CR2, CR3, CR4, and CR5. Transistors Q1, thru Q9, Q11, Q13, Q15, and Q17.
19	Switch S6 on for 150% overload test.	a) Input voltage set at 27.5 VDC. b) Resistor R15 may require adjusting if unit tends to motor boat. However, in the event of any adjustment step 15 should be re-tested.	I2 read between .73 to .84 amps. V2 should read at least 103 VAC.	Defective parts likely to cause abnormal reading: Diodes CR2, CR3, CR4, and CR5. Transistors Q1, thru Q9, Q11, Q13, Q15, and Q17.

STEP	SET-UP	PROCEDURE	PERFORMANCE READING	POSSIBLE CAUSE OF ABNORMAL READING
20	Switch S7 on for 200% overload test.	a) Input voltage set at 27.5 VDC. b) R15 adjust the overload threshold point. The proper setting is at the 165% overload point the unit should start motor-boating. However, any adjustment will require re-testing for steps 15, 18 and 19.	I1 should read between 3/4 to 3 amps D.C. V2 and I2 should indicate output voltage and current is motor-boating.	Defective component likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Capacitors C7 and C8. Transistors Q7 and Q8.
21	Switch S9 on for short circuit test.	a) Input set anywhere between 26 and 28 VDC. b) If I1 exceeds 3 amps at any time the unit should be turned off.	I1 less than 3 amps. V2 equal zero. I2 less than ½ amp.	Defective component likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Capacitors C7 and C8. Transistors Q7 and Q8.
22	Switches S3 thru S7 in the off position and S9 off, switch S8 on (60 VA reactive load).	a) Input voltage set at 27.5 VDC. b) Vary input voltage between 28 to 30 VDC.	I2 read .48 to .54 amps A.C. V2 read between 107 to 120.7 VAC	Defective parts likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Transistors Q1 thru Q9, Q11, Q13, Q15 and Q17. Capacitor C13.
23	Switch S5 on S3, S4 and S6 thru S9 off position.	a) Input voltage set between 26 to 30 VDC.	Distortion meter should read less than 7%. Frequency meter should read 400 cps to ± 4 cps.	Defective parts likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Transistors Q1 thru Q9, Q11, Q13, Q15 and Q17.

STEP	SET-UP	PROCEDURE	PERFORMANCE READING	POSSIBLE CAUSE OF ABNORMAL READ
24	Switch S1 to #2 position S3 on, S4 and S5 thru S9 off position.	a) Set input voltage at 20 VDC.	V2 read 105 to 120.7 VAC	Defective parts likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5.
			I2 read .44 to .48 amps.	
			I1 read approximately 3.0 amps.	Transistors Q1 thru Q9, Q11, Q13, Q15 and Q17.

4.4 Voltage Measurement

To enable the technicians to effectively service the PC14 and PC14A, table 4.3 tabulates the typical D.C. and/or A.C. voltage to assist in localizing a fault source.

Table 4.2 indicates the possible component for an abnormal reading. If a voltage other than those listed in table 4.3 is measured this will enable the technician to determine which component is possibly faulty.

TABLE 4.3 PC14 AND PC14A VOLTAGE DISTRIBUTION MEASUREMENT

CONDITION

1. Input 27.5 VDC.
2. Full load with Switch S5 on.
3. Switch S1 in the #1 position.
4. PC14 switch S2 in the #1 position.
5. PC14A switch S2 in the #2 position.
6. DC and AC measurement made with a Simpson 270 or equivalent.
   (Note: Make AC measurement in the output connection to this meter.)

CIRCUIT REF.	TEST POINT	VOLTAGE MEASUREMENT D.C.	VAC RMS	CIRCUIT REF.	TEST POINT	VOLTAGE MEASUREMENT D.C.	VAC RMS
Q1 and Q2	Emitter	8 to 20*	6				
	Base	8 to 20*	6	Q9, Q10	Emitter	27	8
	Collector	26	0	Q13, Q14	Base	27	8
Q3 and Q4	Emitter	8.2	10		Collector	6 to 8	0
	Base	8.2	10	Q11, Q12	Emitter	6 to 8	5-20*
	Collector	26	0	Q15, Q16	Base	6 to 8	5-20*
Q5 and Q6	Emitter	27	16		Collector	0	0
	Base	27	16				
	Collector	0	0	Q17	Emitter	6 to 7.5	0
Q7	Emitter	0	0		Base	6 to 7.5	0
	Base	-1.5 to -6*	0		Collector	8.2 to 9.2	0
	Collector	8 to 10	0	CR2, CR3	Anode	0	10

CIRCUIT REF.	TEST POINT	VOLTAGE MEASUREMENT D.C.	VAC RMS	CIRCUIT REF.	TEST POINT	VOLTAGE MEASUREMENT D.C.	VAC RMS
Q8	Emitter	8 to 9	0	CR6, CR7			
	Base	8.2 to 9.2	0	R11 and R19A	Junction of Resistor	-8.5	0
	Collector	8 to 20	0	CR4,CR5	Anodes	0	0 to 9*

* These voltages are load dependent.

4.5 Servicing Practice and Replacement

Section 5.0 lists the table of replaceable parts. Figures 5.1 thru figure 5.5 illustrates the location of these components.

When installing or removing transistors, semiconductor diodes and heat sensitive components, grasp the lead between the solder joint and the component with a thermal dissipator, such as a spring loaded copper clip or long nose pliers. This will bleed off the heat being applied at the solder joint.

A temperature controlled soldering iron is recommended for such use. The wattage rating of the iron should not be greater than 35 watts. Always work with an iron that the tip is well thinned so the soldering can be done quickly and cleanly.

Power transistors Q9, Q10, Q13 and Q14 are insulated from ground. This insulating is done by means of insulating washers made of fiber and mica. When replacing these transistors, be sure washers are replaced in proper order and coating the washers with a film of silicone fluid is recommended.

After such replacement, check with an ohmmeter to see that the insulation is effective.

SECTION V - TABLE OF REPLACEABLE PARTS

5.1 General

This section illustrates and lists components that can be replaced for repair purposes. It is recommended that parts requiring replacement that are not listed in table 5.1, the unit be returned to the factory for service.

Figures 5.1 through 5.5 illustrates the location of all the components that are listed in the table of replaceable parts.

5.2 Manufacturer's Code

Code	Name and Address
FT	Flite-Tronics Burbank, California
KGS	KGS Electronics Pasadena, California
AB	Allen-Bradley Co. Milwaukee, Wisconsin
BR	Bourns Riverside, California
OHM	Ohmite Chicago, Illinois
GB	General Electric Auburn, New York
SAN	Sangamo Springfield, Illinois
ITT	International Tel and Tel Palo Alto, California
ECI	Electro-Cube Pasadena, California
MOT	Motorola Phoenix, Arizona
FD	Fairchild Mountain View, California
DL	Delco Kokomo, Indiana
STM	Stevens Manufacturing Mansfield, Ohio

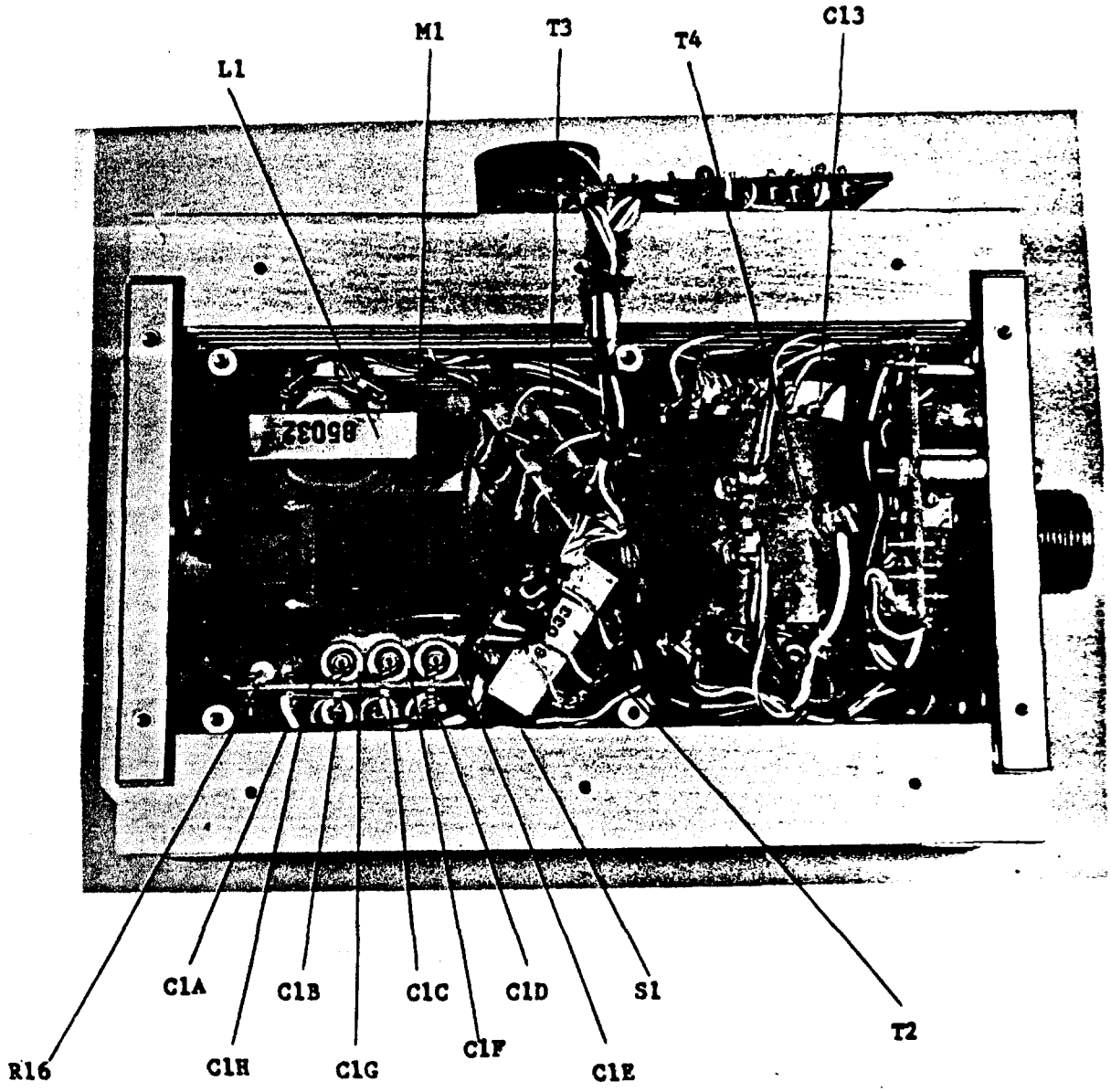


FIGURE 5.1 COMPONENT LAYOUT DUST COVER REMOVED

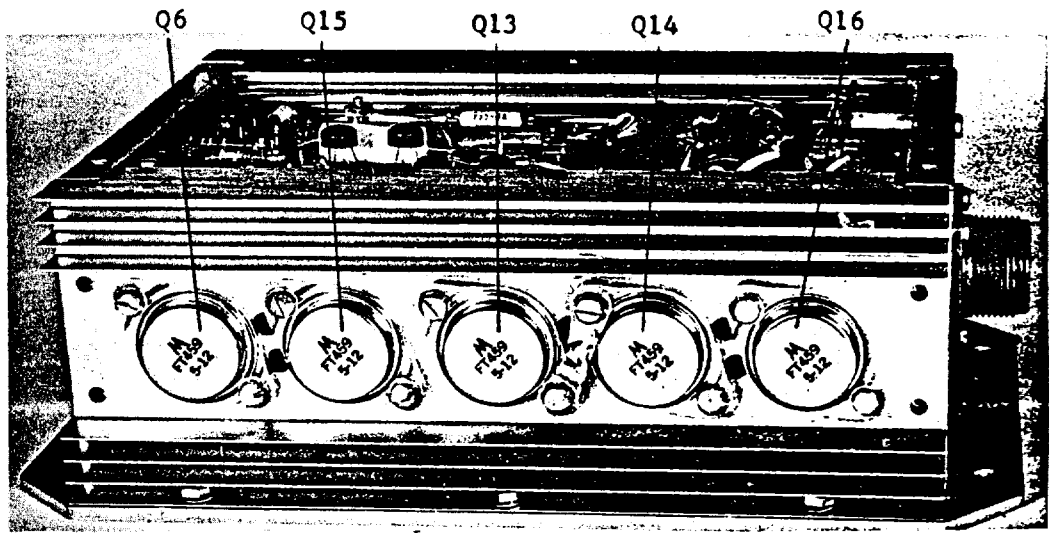


FIGURE 5.2 TRANSISTOR LAYOUT LEFT SIDE

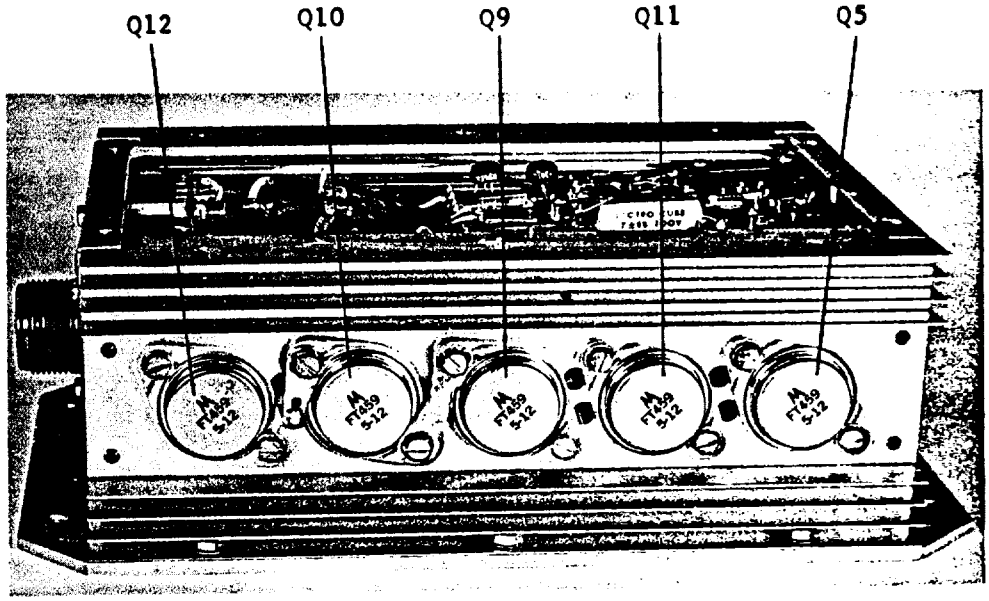


FIGURE 5.3 TRANSISTOR LAYOUT RIGHT SIDE

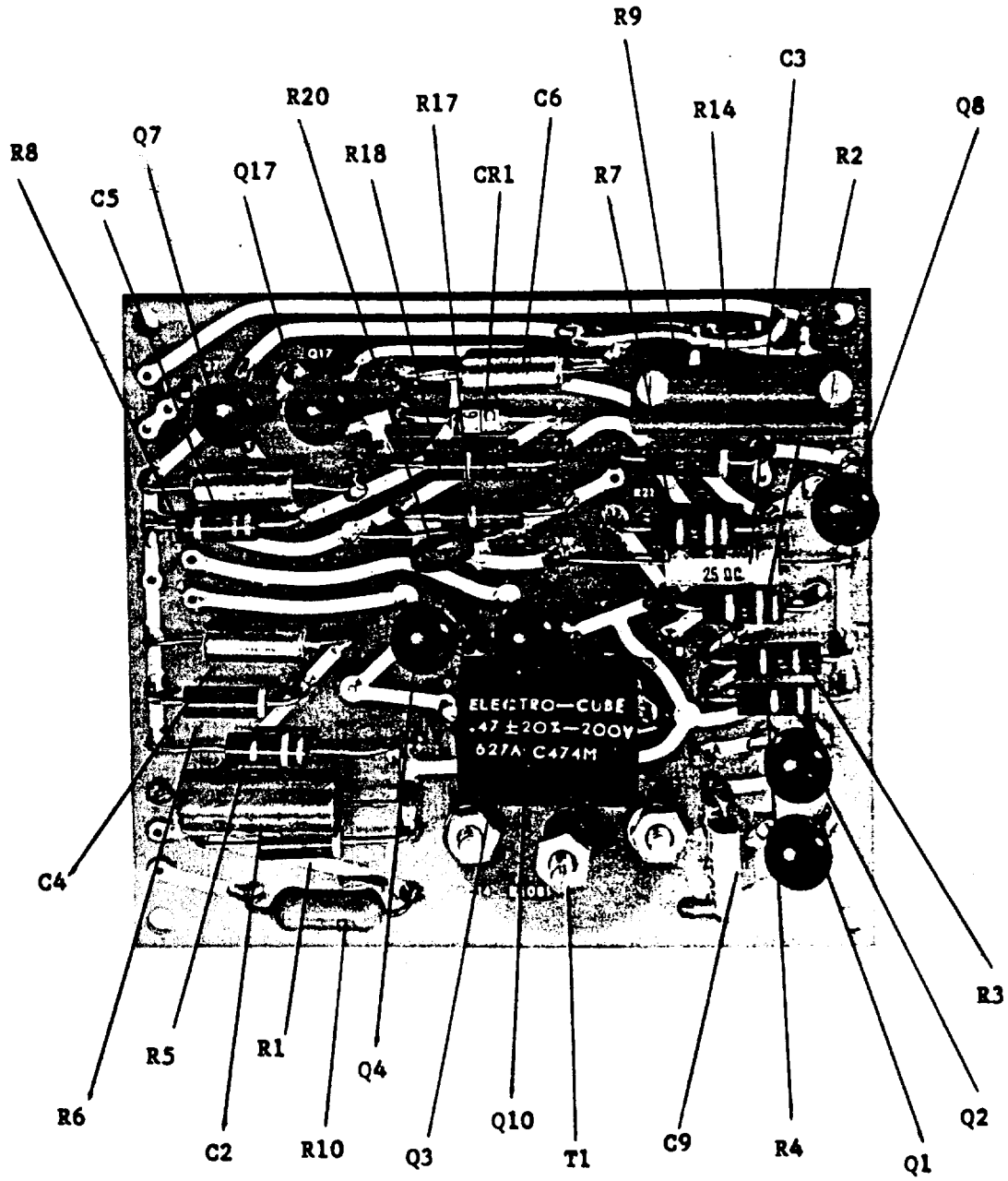


FIGURE 5.4 COMPONENT LAYOUT OSCILLATOR AND LOW LEVEL AMPLIFIER

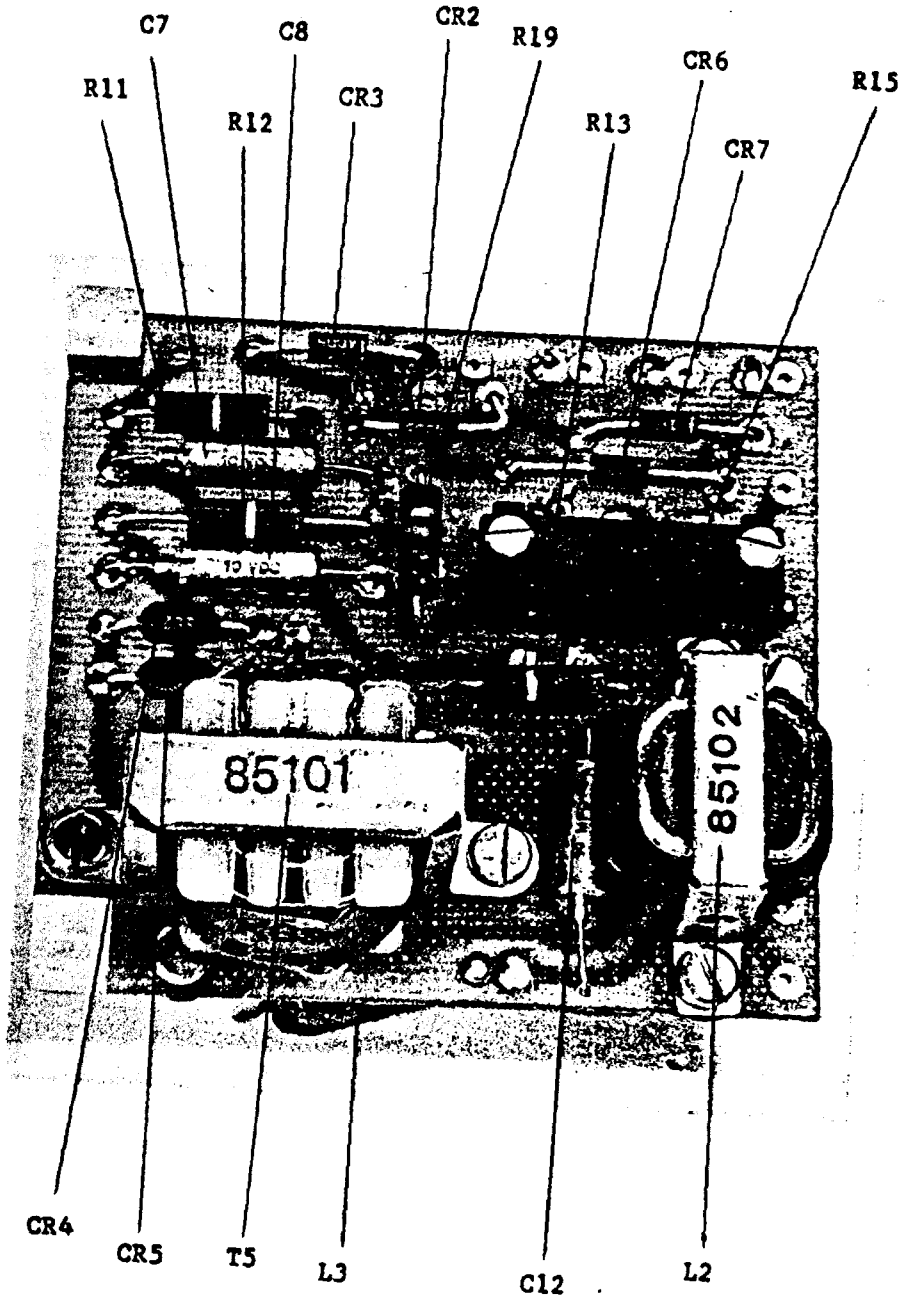


FIGURE 5.5 COMPONENT LAYOUT OL AND ALC CIRCUIT

5.1 TABLE OF REPLACEABLE PARTS

CIRCUIT REFERENCE	QUANTITY	DESCRIPTION	SOURCE	FUNCTION
C1A, C1H, C2	3	Capacitor 47 ufd 50 VDC HM 47QD	ITT	Filter
C1B thru C1G	6	Capacitor 50 mfd 40 VDC 556-1068-01	SAN	Filter
C4, C5, C6, C7, C8, C12	6	Capacitor 22 mfd 22 VDC HM 22LD	ITT	Filter
C3	1	Capacitor 15 ufd 30 VDC HM 15 MD	ITT	Filter
C9	1	Capacitor .02 ufd 100 VDC 210B	ECI	Bypass
C10	1	Capacitor .47 ufd 200 VDC 627A1C474J	ECI	Osc cap.
C13	1	Capacitor .33 ufd 400 VDC 625B1E334M	ECI	Power factor Correction
CR1	1	Zener 6.8 VDC 1 watt 1N4736	MOT	Reference Voltage
CR2, CR3, CR4, CR5, CR6, CR7	6	Silicon diode 200 piv 1N4003 or SC2	MOT SM	Rectifier
L1	1	Inductor FT #85032 KGS #286L	FT	Filter
L2	1	Inductor FT #85102 KGS #287L	FT	Filter
L3	1	Inductor FT #85103 KGS #290L	FT	Filter
J1	1	Connector, receptacle MS3102A14S-5P	CAN	Input Jack
M1	1*	D.C. Motor 5072400	DL	Blower
Q1, Q2, Q3	3	Transistor 2N3568	FAD	Push-Pull Osc.
Q3, Q4	2	Transistor 2N3568	FAD	Low Level Amp Push-Pull
Q7, Q8, Q17	3	Transistor 2N3568	FAD	ALC and OL

CIRCUIT REFERENCE	QUANTITY	DESCRIPTION	SOURCE	FUNCTION
Q5, Q6	2	Transistor FT 459	FT	Push-Pull Driver
Q9, Q11, Q13, Q15	4	Transistor FT 459	FT	Output Push-Pull Power
Q10, Q12, Q14, Q16	4*	Transistor FT 459	FT	Output Push-Pull Power
R1	1	Resistor 47 ohm ± 10% ½ watt	AB	Filter
R2, R5, R7	3	Resistor 3.9 kilohm ± 10% ½ watt	AB	Bias
R3	1	Resistor 680 ohm ± 20% ½ watt	AB	Bias
R4	1	Resistor 33 ohm ± 20% ½ watt	AB	Bias, degenerating
R6, R9	2	Resistor 470 ohm ± 20% ½ watt	AB	Bias, degenerating
R8	1	Resistor 3.3 kilohm ± 20% ½ watt	AB	Bias
R10	1	Resistor 3 ohm 3 watt wire wound #4342	OHM	Filter and degenerating
R11, R12, R18	3	Resistor 10 kilohm ± 20% ½ watt	AB	Loading
R14	1	Variable Pot 5 kilohm ½ watt 3067S-1-502	BR	Level Control
R15	1	Variable Pot 200 ohm ½ watt 3067S-1-201	BR	Output Current Set
R16	1	Resistor 50 ohm 3 watt wire wound #4380	OHM	Speed Reducer
R13, R17	2	Resistor 180 ohm ± 10% ½ watt	AB	R13 Current Control R17 degeneration
R19A	1**	Resistor 5.1 kilohm ± 5% ½ watt selected	AB	Current Ov - load Slope

CIRCUIT REFERENCE	QUANTITY	DESCRIPTION	SOURCE	FUNCTION
R20	1	Thermister 100 ohm @ room temp. 2D304	GE	Temperature Compensating
S1	1	Thermostat 165° F. A-505	STM	Temperature Sensing
T1	1	Transformer Adjustable FT FT 85076 KGS #524T	FT	Transformer Inductor 400 cps
T2	1	Transformer FT 85033 KGS #525T	FT	Interstage
T3	1	Transformer FT 85034 KGS #526T	FT	Driver
T4	1	Transformer FT 85035 KGS #527T	FT	Power Output
T5	1	Transformer FT 85106 KGS 528T	FT	Output Current Sense

* Not used on PC14A.
** Used on PC14A only.

WARRANTY

Flite-Tronics Co., Inc. warrants each item of new equipment manufactured by it to be free from defects in material and workmanship under normal service use for which intended. Flite-Tronics obligates itself under this warranty to replace or repair (at Flite-Tronics' discretion), at its factory, any Flite-Tronics' equipment which shall within one year or 1,000 hours of service, whichever comes first, be returned, transportation charges collect to Flite-Tronics with a statement from an authorized Flite-Tronics Dealer establishing the date equipment was placed in service, which Flite-Tronics examination shall disclose to have been defective in manufacture. This warranty shall not apply to any equipment which, in the judgment of Flite-Tronics, has been repaired or altered in any way so as adversely to affect its performance or reliability, or which has been subject to misuse, negligence or accident. This warranty is in lieu of all other guaranties or warranties expressed or implied. The obligation and responsibility of Flite-Tronics for or with respect to defective equipment shall be limited to that expressly provided herein and Flite-Tronics shall not be liable for consequential or other damage or expense whatsoever therefor or by reason thereof. Flite-Tronics reserves the right to make changes in design or additions to or improvement in its equipment without obligation to install such additions or improvements in equipment theretofore manufactured.

HOW TO ORDER REPLACEMENT PARTS

When ordering replacement parts, you should direct your order as indicated below and furnish the following information insofar as applicable.

ADDRESS: Flite-Tronics Co., Inc., Sales Service Department
3314 Burton Avenue
Burbank, California

INFORMATION NEEDED:

1. Quantity required.
2. Part Number (Obtain from parts list or schematic diagram.)
3. Type number and serial number of equipment.

HOW TO RETURN MATERIALS OR EQUIPMENT

If, for any reason, you should wish to return material or equipment, whether under warranty or otherwise, you should notify us, giving full particulars including the details listed below, insofar as applicable. Upon receipt of such notice, Flite-Tronics Co., Inc. will promptly advise you respecting the return. Failure to secure our advice prior to the forwarding of the goods, or failure to provide full particulars, may cause unnecessary delay in handling of your returned material.

ADDRESS: Flite-Tronics Co., Inc., Sales Service Department
3314 Burton Avenue
Burbank, California

INFORMATION NEEDED:

1. Date of delivery of equipment.
2. Date placed in service.
3. Number of hours in service.
4. Part number (obtain from parts list or schematic diagram.)
5. Type number and serial number of equipment.
6. Nature and cause of failure.
7. Remarks

AIRCRAFT STATIC INVERTER

INSTRUCTION MANUAL

FOR

MODEL PC-15( )

AND

MODEL PC-15B( ) SERIES

AND

MODEL PC-15BC( ) SERIES

TSO-C73

FLITE-TRONICS CO., INC.
3314 BURTON AVENUE
BURBANK, CALIFORNIA

FLITE-TRONICS STATIC INVERTERS
UNDER MODEL PC-15( ) and
MODEL PC-15B( ) SERIES

MODEL SERIES	DESCRIPTION
PC-15	Basic 250VA, 400HZ, 115VAC output inverter 5 pin or 7 pin connectors This model series superseded by Model PC-15B
PC-15A	250VA, 400HZ, 115V & 26VAC outputs, Osc. Sync. output. 7 pin connector This model series superseded by Model PC-15B.
PC-15A with M1 after Serial No.	PC-15A with field modification per Flite-Tronic's Service Bulletin No.1/PC-15A. This model series superseded by Model PC-15B
PC-15A with A after Serial No.	PC-15A with increased fuse-rupture capability per Flite-Tronic's Service Bulletin No.2/PC-15A. This model series superseded by Model PC-15B.
* PC-15B or PC-15A with B after Serial No.	Currently available basic 250VA, 400HZ Static Inverter 115V & 26VAC outputs, Osc. Sync. output. 7 pin connector Refer to Section VII of this Manual for detail
PC-15C	Not Assigned.
*PC-15D	PC15B with 150VA from 26VAC output 100VA from 115VAC output Osc. Sync. output 7 pin connector Refer to Section VII of this Manual for detail.
*PC-15E	PC-15B with remote on & off feature added 9 pin connector. Refer to Section VII of this Manual for detail.
*PC-15F	PC-15B with DC return isolated from chassis Refer to Section VII of this Manual for detail.
*PC-15G	PC-15F with a MS3102A22-15P connector and 115VAC output only. Refer to Section VII of this Manual for detail.

* Refer to Page ii for Model identification changes.

Model identification change has been made as listed below. This is an identification change of the inverters of current manufacture. Interchangeability of the PC-15B( ) with the PC-15B, effective Serial Number 3178, is not affected and the electrical and mechanical specifications are the same.

The electrical and mechanical specifications of the PC-15B( ) are equal to or superior than the PC-15( ) manufactured previously. PC-15B( ) Serial Number effectivity is 3700 except as noted under Revision No. 7.

NEW IDENTIFICATION		PREVIOUS IDENTIFICATION	
MODEL	SERIAL NUMBER EFFECTIVITY	MODEL	SERIAL NUMBER
PC-15B( )	3700	PC-15B	3178 & Up
PC-15B(D)	25	PC-15D	1 & Up
PC-15B(E)	27	PC-15E	9 & Up
PC-15B(F)	3700	PC-15F	3178 & Up
PC-15B(G)	3700	PC-15G	3178 & Up

MODEL	SERIAL NUMBER EFFECTIVITY	DESCRIPTION
PC-15BC( )	5100 and up	This model is a 250VA, 400HZ Static Inverter with 115VAC and 26VAC outputs with a 7 pin connector. The electrical and mechanical specifications for the PC-15BC( ) is equal to or superior than the PC-15B( ). Refer to Revision No.9 page 69 for details of the change and other explanations.

REVISION NUMBERS

TO

INSTRUCTION MANUAL

REVISION NUMBERS	DATE	SERIAL NUMBER EFFECTIVITY
Original Publication	November 1966	Not Applicable
Revision No. 1	March 1968	See Revision No.1
Revision No. 1-5 Pin	March 1968	See Rev. No. 1-5 Pin
Revision No. 2	January 1969	No. 1471 and up
Revision No. 3	September 1969	No. 1934
5th Printing (No change)	September 1970	None
Revision No. 4	April 1971	No. 2779
Revision No. 5	May 1971	None
Revision No. 6	November 1971	No. 3174, 3175, 3178, and up.
Revision No. 7	August 1972	No. 3700 and up
8th Printing	November 1972	None
Revision No. 8	December, 1973	See Revision No. 8
9th Printing	July, 1974	Same as Rev. 8
Revision No. 9	November,1974	5100 and up
10th Printing	June, 1975	Same as Rev. 9

NOTE:
This manual includes original publication information and all revisions to date.
The original publication is kept intact and all changes with serial number effectivity when applicable are compiled under revision section as they occurred.

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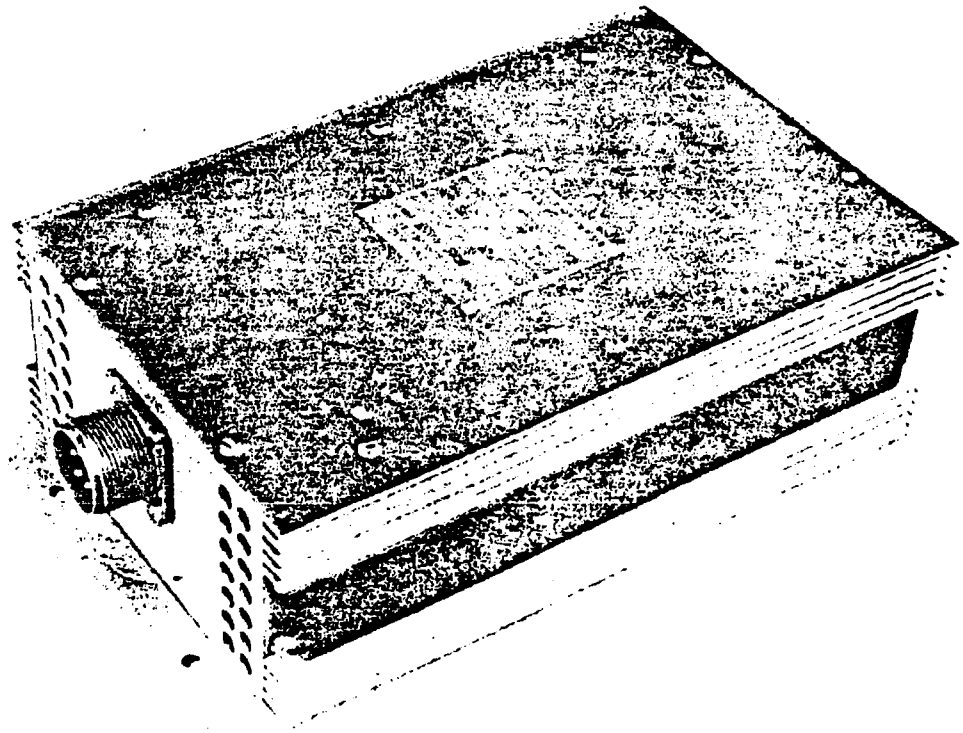


Figure 1.1 Flite-Tronics Model PC-15 and PC-15A

Section I

General Information

1.1 Introduction

This instruction manual has been prepared to provide information in installation, performance, operation, identification of parts, and maintenance of the Flite-Tronics' Model PC-15 and PC-15A Transistorized Power Inverter. PC-15A is identical to PC-15, except it has a 26.0 VAC 400 HZ output.

1.2 Purpose of Equipment

The PC-15 and PC-15A, shown in Figure 1.1, is a transistorized inverter designed to supply AC power at 400 cycles per second.

The unit is capable of delivering a current overload of 150% for a minimum duration of 5 minutes at full rated output. This permits the PC-15 and PC-15A to power equipment that requires momentary surges of power during turn on. When the 26 VAC output from the PC-15A is not used, the PC-15A is identical in performance to the PC-15.

1.3 Specifications for PC-15 and PC-15A

Input Voltage.....: 28.0 VDC

Input Current: Steady state @ 28 VDC

a) 14.2 amperes for PC-15s delivering 250 VA.

b) .75 amperes typical no load.

Input Voltage Range:

22 to 30 VDC
Operate down to 20 VDC

Input Overvoltage:

Withstands 130% input overvoltage for 5 minutes, while supplying full rated 250 VA output power. Output voltage under this condition, +5%, -7%.

Output Voltage:
(PC-15 and PC-15A)
115 VAC rms +5%, -7% 22 to 30 VDC, Greater than 100 VAC down to input of 20 VDC

Pin E Output @ 20 VDC input:
115 VAC @ 90% load.

Output Voltage: (PC-15A only)

26.0 VAC rms +5%, -7%

Output Frequency: 400 HZ ± 1%

Total Maximum Continuous Output Power..... 250 VA

Output Power, PC-15A
26.0 VAC..... 75 VA

Output Waveform:
Sine Wave, Single Phase

For Higher Power Output:

Units may be paralleled for higher power output. (Refer to installation section.)

Amplitude Distortion
Both output..... 7% Max.
26-30 VDC input (Typ. 3%)

Overload Capacity:

Withstands 150% output current overload for at least 5 minutes.

Power Factor..... .8 to 1.0

Input Voltage Protection:

Unit withstands transient of 88 volts lasting 1 millisecond on the 28.0 VDC input line.

Excessive Overload and Output Short Circuit:

Withstands without damage or degradation loads exceeding 150% nominal to an output short circuit. Unit delivers rated output on removal of above condition.

Altitude..... 45,000 feet

Efficiency..... 70% typical

Temperature: -65° F. to 160° F.

Emission RFI:

Radiated & Conducted... 90 KC to 1000 KC

Far below levels specified in Appendix A of RTCA Paper 120-61/DO-108 Category "A", see pages 4 and 5.

Weight..... 8.2 lbs.

Size:

Width	6"
Length	9-3/8" (not incl. mounting flange)
Height	3-3/16"

1.3 Specifications for PC-15B( ) and PC-15BC( )

Input Voltage..... 28.0 VDC

Input Current: Steady state @ 28VDC

a) 14.2 amperes for PC-15s delivering 250 VA.

b) .75 amperes typical no load.

Input Voltage Range:

22 to 30 VDC
Operate down to 20 VDC

Input Overvoltage:

Withstands 130% input overvoltage for 5 minutes, while supplying full rated 250 VA output power. Output voltage under this condition, +5%, -7%.

Output Voltage:

115 VAC rms +5%, -7% 22 to 30 VDC. Greater than 100 VAC down to input of 20 VDC

Output Voltage:
26.0 VAC rms +5%, -7%

Pin E Output @ 20 VDC Input:
115 VAC +5%, -7% @ 90% load

Output Frequency: 400 HZ ± 1%

Total Maximum Continuous Output Power..... 250 VA
(Sum of 115 VAC and 26 VAC outputs)

Output Waveform:
Sine Wave, Single Phase

For Higher Power Output:

Units may be paralleled for higher power output. (Refer to installation section.)

Amplitude Distortion
Both output..... 7% Max.
26-30 VDC input (Typ. 3%)

Overload Capacity:

Withstands 150% output current overload for at least 5 minutes.

Power Factor..... .8 to 1.0

Input Voltage Protection:

Unit withstands transient of 88 volts lasting 1 millisecond on the 28.0 VDC input line.

*Excessive Overload and Output Short Circuit:

Withstands without damage or degradation loads exceeding 150% nominal to an output short circuit. Unit delivers rated output on removal of above condition.

Altitude..... 45,000 feet

Efficiency..... 70% typical

Temperature: -65° F. to 160° F.

Emission RFI:

Radiated & Conducted... 90 KC to 1000 MC

Far below levels specified in Appendix A of RTCA Paper 120-61/DO-108 Category "A", see pages 4 and 5.

Weight. 8.2 lbs. for PC-15B( ).
7.5 lbs. for PC-15BC( ).

Size:

Width	6"
Length	9-3/8" (not incl. mounting flange)
Height	3-3/16"

*See Page A0 for output fault clearance capability

Humidity:

Greater than 95% for ten days, temperature cycled between 75° F. to 160° F.

Vibration:

To withstand in three directions

.08 DA	5-15 HZ
.036 DA	15-70 HZ
10 G's	70-500 HZ

Shock:

To withstand at least 10 G's for 11 milliseconds in three directions.

1.4 Description

The PC-15 and PC-15A is a transistorized airborne static power inverter. The unit operates from 28.0 VDC aircraft power source and delivers 115 VAC at 400 HZ. The Model PC-15A has a 26.0 VAC output. The total continuous power drawn from the two outputs should not exceed 250 VA for the PC-15A.

An L/C tuned 400 HZ oscillator operating in a class B push-pull mode is used to generate the 400 HZ signal.

This signal is amplified by 4 stages of class B push-pull emitter follower amplifiers. Protective circuits for output overload, thermal runaway and input voltage transient are incorporated to make the PC-15s an extremely reliable equipment.

Frequency and output voltage are adjustable. However, once set at the factory, they should not require readjusting for the life of the equipment.

TEST CONDITION: Broadband Radiated
TEST MODE: Steady State Mode
LEGEND: SPECIFICATION ——————
MEASURED LEVEL — - — - —
AMBIENT LEVEL - - - - - - -
No narrow band C.W. detected.

TEST SPECIMEN: Flite-Tronics Co.
Static Inverter M/N PC-15, S/N 100
SPECIFICATION: R.T.C.A. Paper 120-61/
DO-108, Appendix A
DATE: 12 June '66

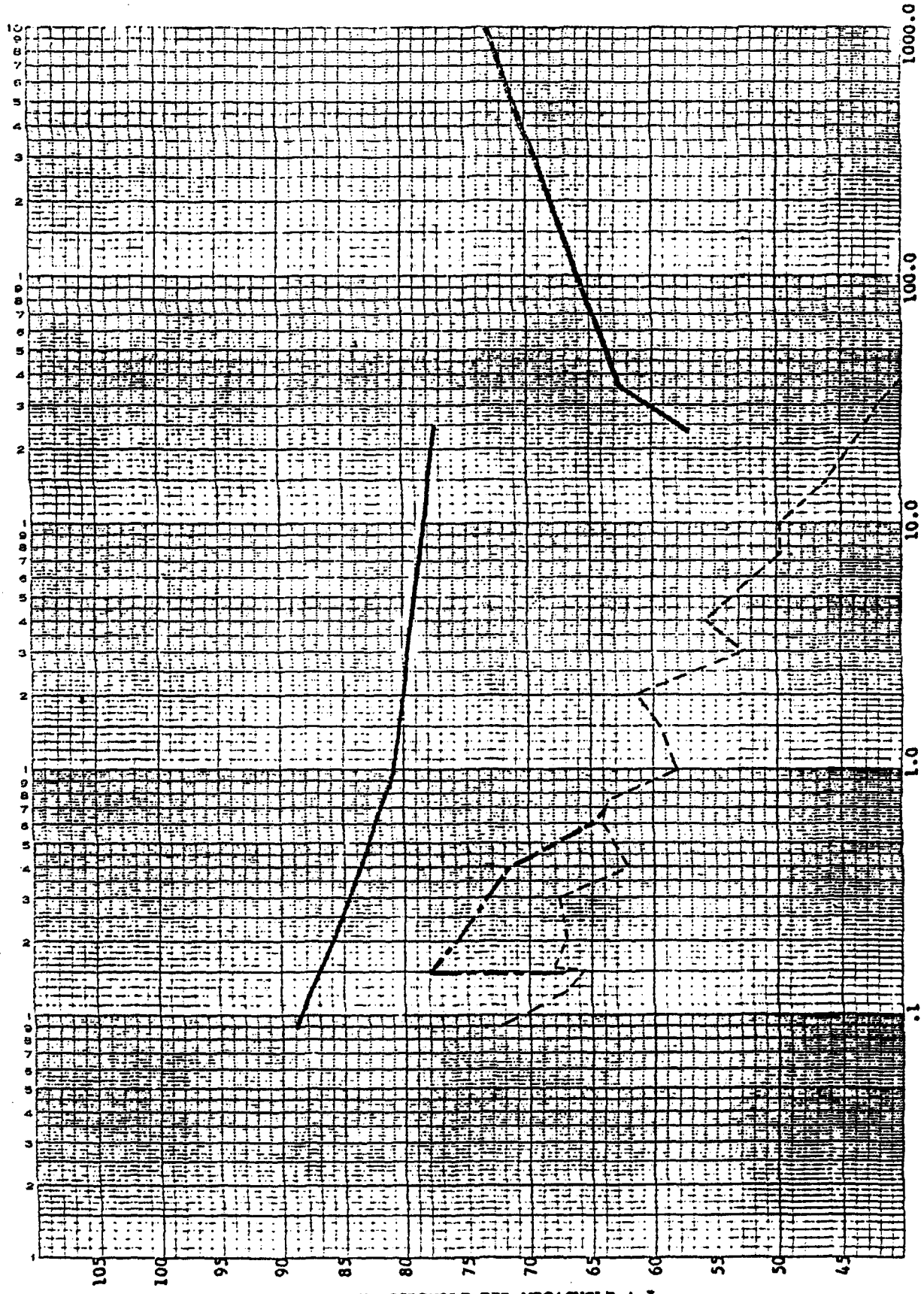


FIGURE 1.2 EMISSION RFI RADIATED

TEST CONDITION: Broadband Conducted
TEST MODE: Steady State Mode
LEGEND: SPECIFICATION ——————
MEASURED LEVEL — - — - —
AMBIENT LEVEL - - - - - - -

TEST SPECIMEN: Flite-Tronics Co.
Static Inverter M/N PC-15, S/N 100
SPECIFICATION: R.T.C.A. Paper 120-61/
DO-108, Appendix A
DATE: 12 June '66

No narrow band C.W. detected.

Statement by Test Lab.; Cornell-Dublier Electronics Division.

Summary of Results for Radiated and Conducted RFI:

The Static Inverter M/N PC-15, S/N 100, was subjected to an electromagnetic interference investigation test program per R.T.C.A. Paper 120-61/DO-108, Appendix A. Upon evaluation of the test data, it was found that the above referenced static inverter generated interference which was below the specification limits of R.T.C.A Paper 120-61/DO-108, Appendix A.

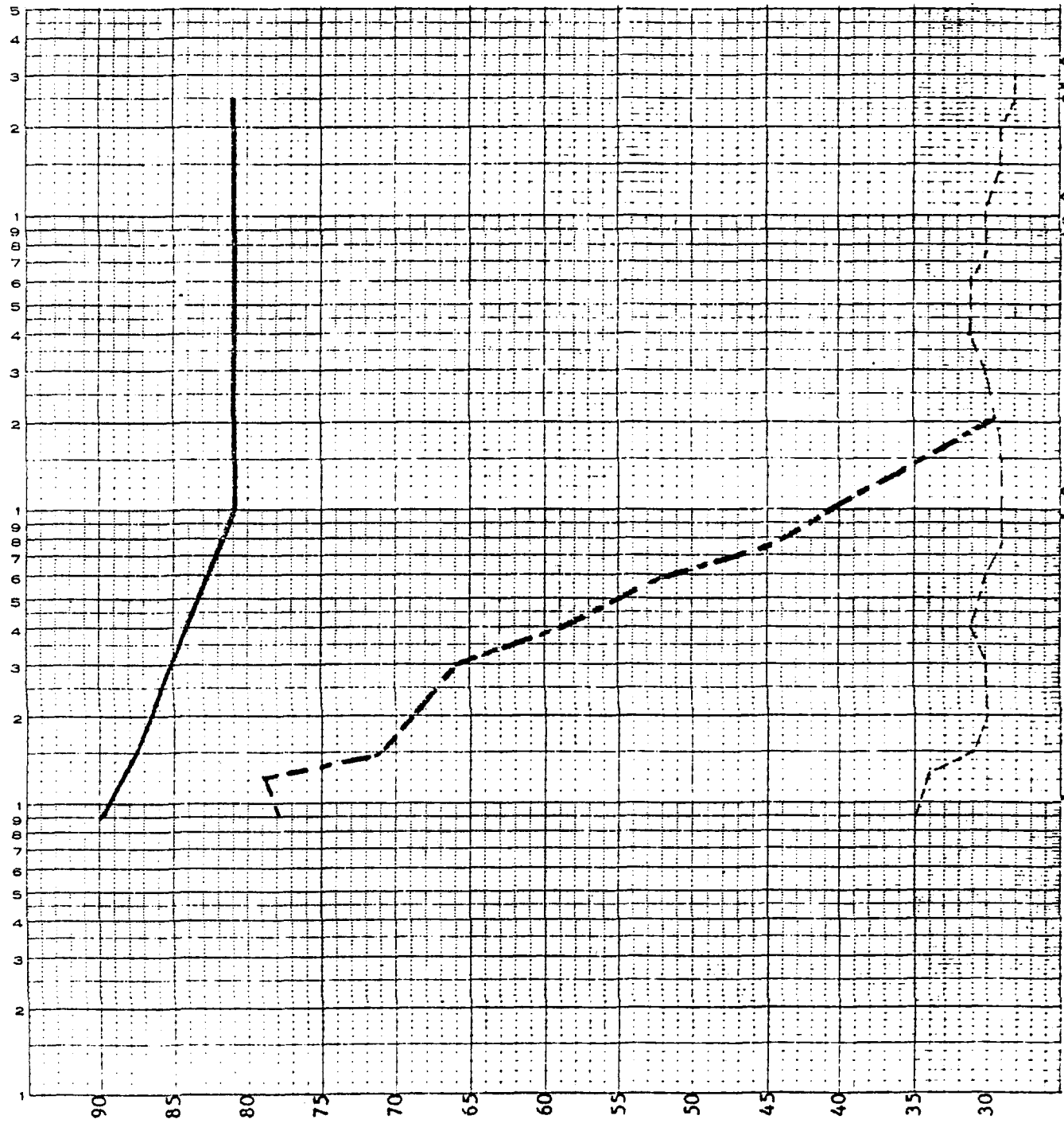


FIGURE 1.3 EMISSION RFI CONDUCTED

NOTE TO SECTION II

N2.1 The installation and mounting dimensions for different model series when applicable in addition to pages 8 and 9 are shown on following pages.

MODEL SERIES	PAGE
PC-15B	A7
PC-15E	A11
PC-15F	A14
PC-15G	A16

N2.2 Addition to N2.1

Rev. 7	63

N2.3 Any reference to PC-15 or PC-15A in this section is applicable to PC-15B( ) unless otherwise noted under Model PC-15B.

Section II

Installation

2.1 General

The Model PC-15 and PC-15A (hereinafter referred to as PC-15s) is a 400 HZ Inverter, ready to install when delivered from the factory.

To determine that the unit is operating satisfactorily, a bench test may be made. The external hook-up for such a test is illustrated in Figure 4.1 page22.

The PC-15s will deliver 250 VA of power to a load having a power factor between .8 lag to 1.0. The PC-15s will operate into loads which are more reactive; however, an external phase correcting capacitor will be required.

The capacitance value may be determined by noting what value causes a null in the input current reading. This, of course, should be determined with the load the PC-15 or PC-15A delivers power to. A poly-carbonate type capacitor having a rating of 300 volts or greater may be used for this phase correcting.

Installation where more than 250 VA of continuous power is required, the PC-15s may be paralleled, as necessary, to double, triple, or even quadruple the power of a single unit.

2.2 Installation Procedure

The PC-15s are environmentally designed to mount on a rack with other equipment, or in any suitable location in the aircraft.

Figure 2.1 illustrates the installation dimensions and mounting centers; see page 8 for PC-15 and page 9 for PC-15A. Mounting hardware should be 10-32 and length long enough to have 1-1/2 threads exposed after installing the necessary hardware.

The mating connector plug to the PC-15s' receptacle is MS3106B18-9S.

A wire size AWG #10 or #12 is suggested for the low voltage DC input and an AWG size #12 for the AC output leads. The low voltage input to the PC-15s should be protected with a 25 amp circuit breaker.

Figure 2.3 page10 illustrates the electrical connection to operate units in parallel for greater output power capability.

Figure 2.4 page11 illustrates the electrical connection to operate units in parallel, not only for greater power, but also switching the PC-15s for parallel or independent operation remotely.

Units operating in parallel must have oscillators phase locked. This is

accomplished by connecting pin F together. To frequency lock the PC-15s to other 400 HZ ± .5%, 115 VAC source, R25 is changed .0047 ufd and pin F is connected to that source.

Frequency locking of PC-15s is only necessary when other 400 HZ ± 2 HZ power sources are in an aircraft and resulting in an undersirable beating effect.

CAUTION

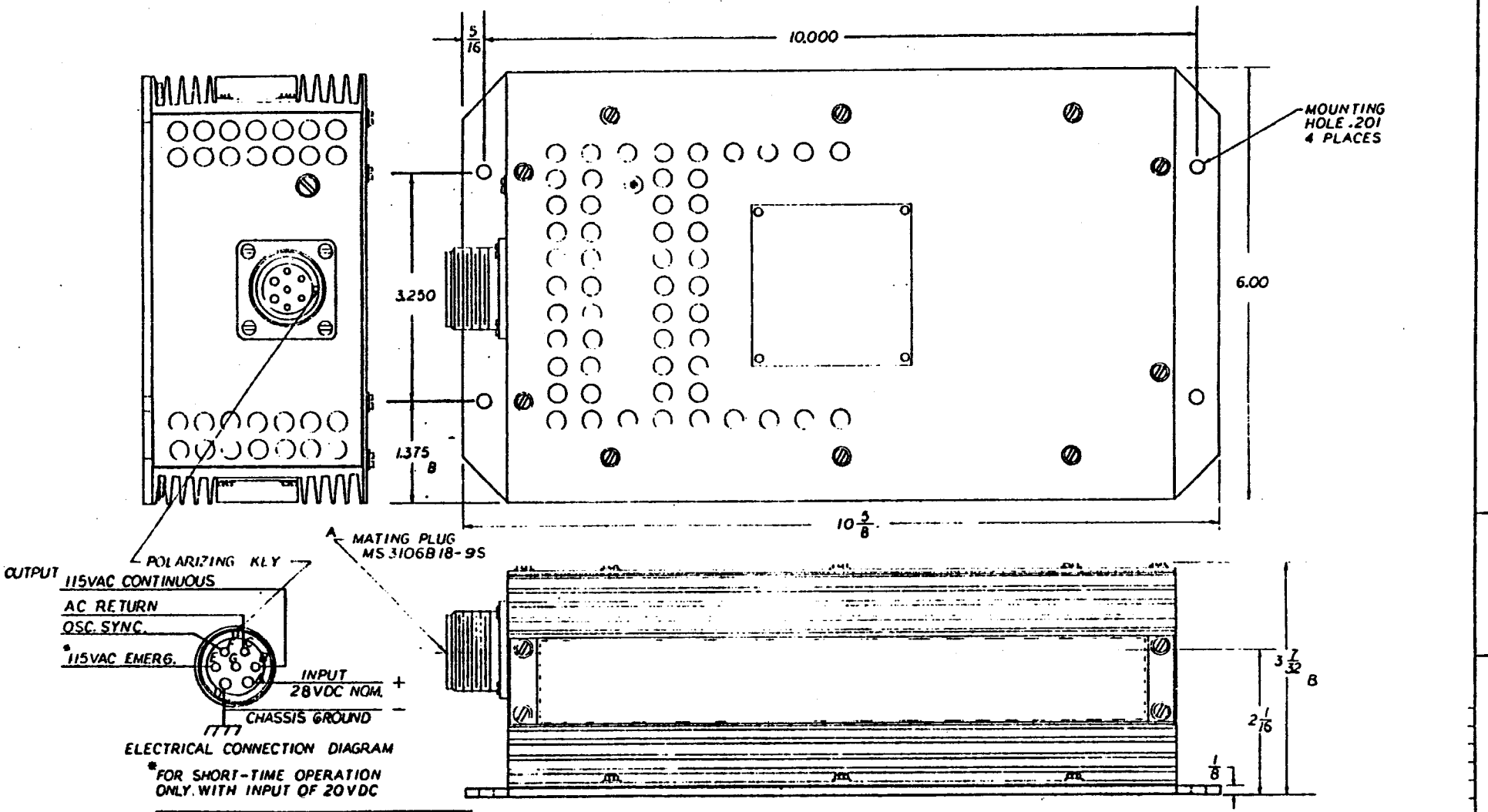
THE PC-15S SHOULD NOT BE INSTALLED IN AN AREA WHERE THE AMBIENT AIR TEMPERATURE EXCEEDS 172° F. UNDER ALL WEATHER AND OPERATING CONDITIONS. THE UNIT MAY BE MOUNTED IN ANY POSITION. IN AN INSTALLATION THE VENT HOLES SHOULD NOT BE RESTRICTED. ALSO, THE PC-15S SHOULD BE MOUNTED DIRECTLY TO METALLIC PLATES OR SUPPORTS.

WHEN PC-15S ARE CONNECTED IN PARALLEL, ALL UNITS MUST BE TURNED ON. OTHERWISE THE PARALLEL CONNECTION SHOULD BE DISCONNECTED TO OPERATE INDEPENDENTLY.

WHEN THE PC-15S ARE OPERATED IN THE FREQUENCY LOCKED MODE TO OTHER 115 VAC 400 HZ ± 2 HZ SOURCE, THE OUTPUT, OF COURSE, SHOULD NOT BE PARALLELED.

WARNING

THE BLOWER MOTOR SHOULD BE INSPECTED AND OVERHAULED EVERY 1000 HOURS OF MOTOR OPERATION.



ELECTRICAL CONNECTION DIAGRAM

*FOR SHORT-TIME OPERATION ONLY. WITH INPUT OF 20VDC

ELECTRICAL REQUIREMENTS		
INPUT	VOLTAGE: DC, NOM.	28
OUTPUT	POWER: VA TOTAL	250
	VOLTAGE: AC	115
	FREQUENCY: HZ	400
	POWER FACTOR	.8 TO 1
	PHASE	1
EFFICIENCY	% AT FULL LOAD	70
ALTITUDE	FEET	45000
WEIGHT	POUNDS	7.75

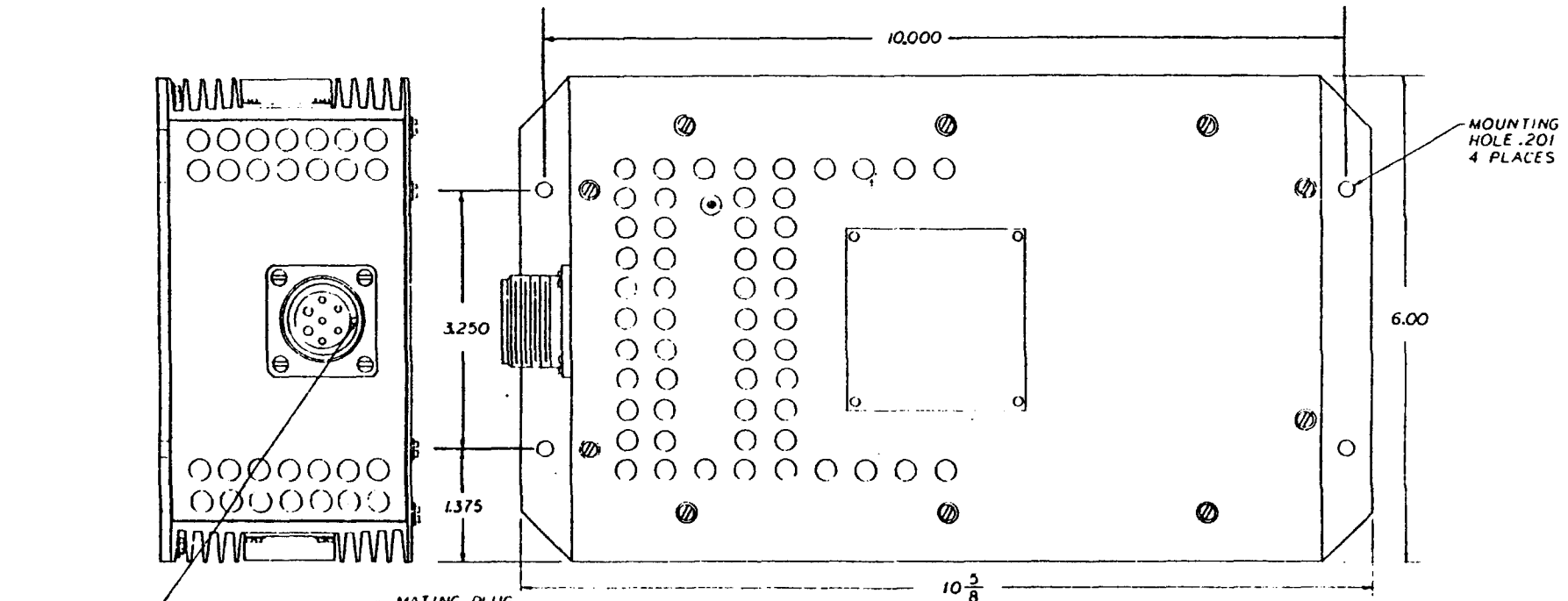
NOTE:
2. PC15 WITH 5 PINS SEE SERVICE BULLETIN No. 1
1. REVISION EFFECTIVE ON S/N 312 & UP, SEE ADDENDUM

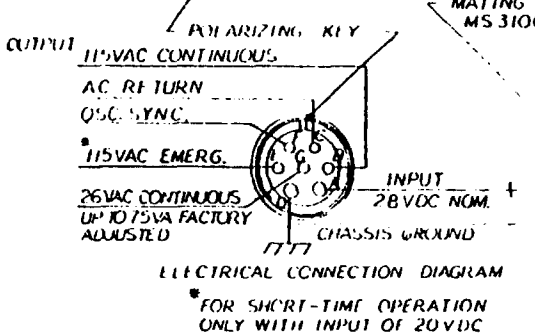
FIGURE 2.1
INSTALLATION AND MOUNTING DIMENSIONS

FLITE-TRONICS, INC.
6515 BURTON AVE., BURBANK, CALIF.

PC15 STATIC INVERTER MOUNTING DETAILS

DRAWN J. Lyon 1/16/62
CHK'D
APP'D J.L. 1/16/62
SCALE FULL
MODEL PC15
NEXT ASS'Y.
SIZE C
DWG NO. 91008





ELECTRICAL CONNECTION DIAGRAM

*FOR SHORT-TIME OPERATION ONLY WITH INPUT OF 20VDC

ELECTRICAL REQUIREMENTS		
INPUT	VOLTAGE: DC. NOM.	28
OUTPUT	POWER: VA TOTAL	250
	VOLTAGE: AC	115 & 26
	FREQUENCY: HZ	400
	POWER FACTOR	.8 TO 1
	PHASE	1
EFFICIENCY	% AT FULL LOAD	70
ALTITUDE	FEET	45000
WEIGHT	POUNDS	7.75

FIGURE 22
INSTALLATION AND
MOUNTING DIMENSIONS

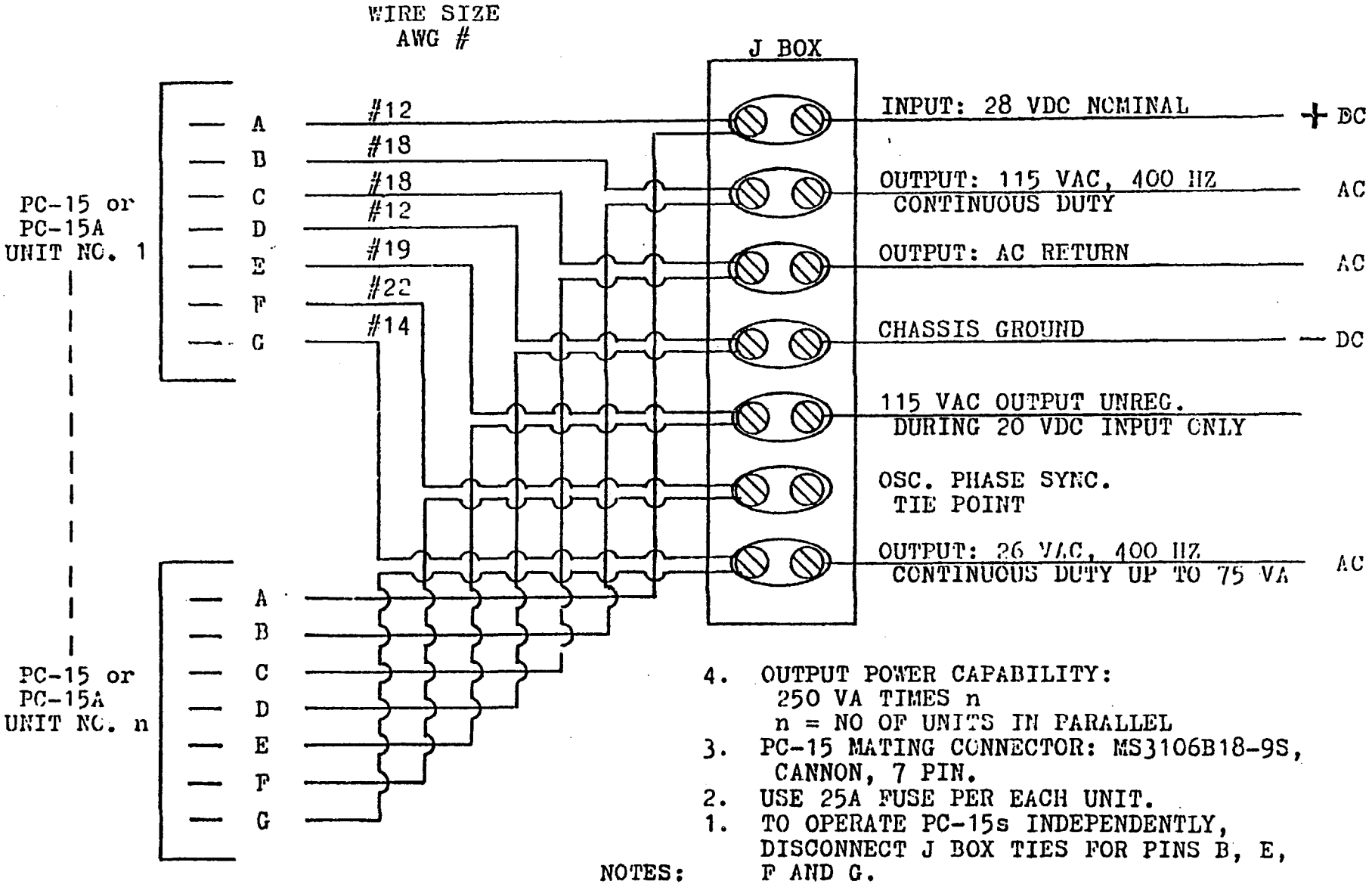
FLITE-TRONICS, INC.
8012 BURTON AVE., BURBANK, CALIF.

DRAWN
CHK'D
APPR'D
SCALE FULL
MODEL PC15A
NEXT ASSY.

TITLE
PC15 STATIC INVERTER
MOUNTING DETAILS

SIZE C
DWG NO. 91008-1

NOTE :

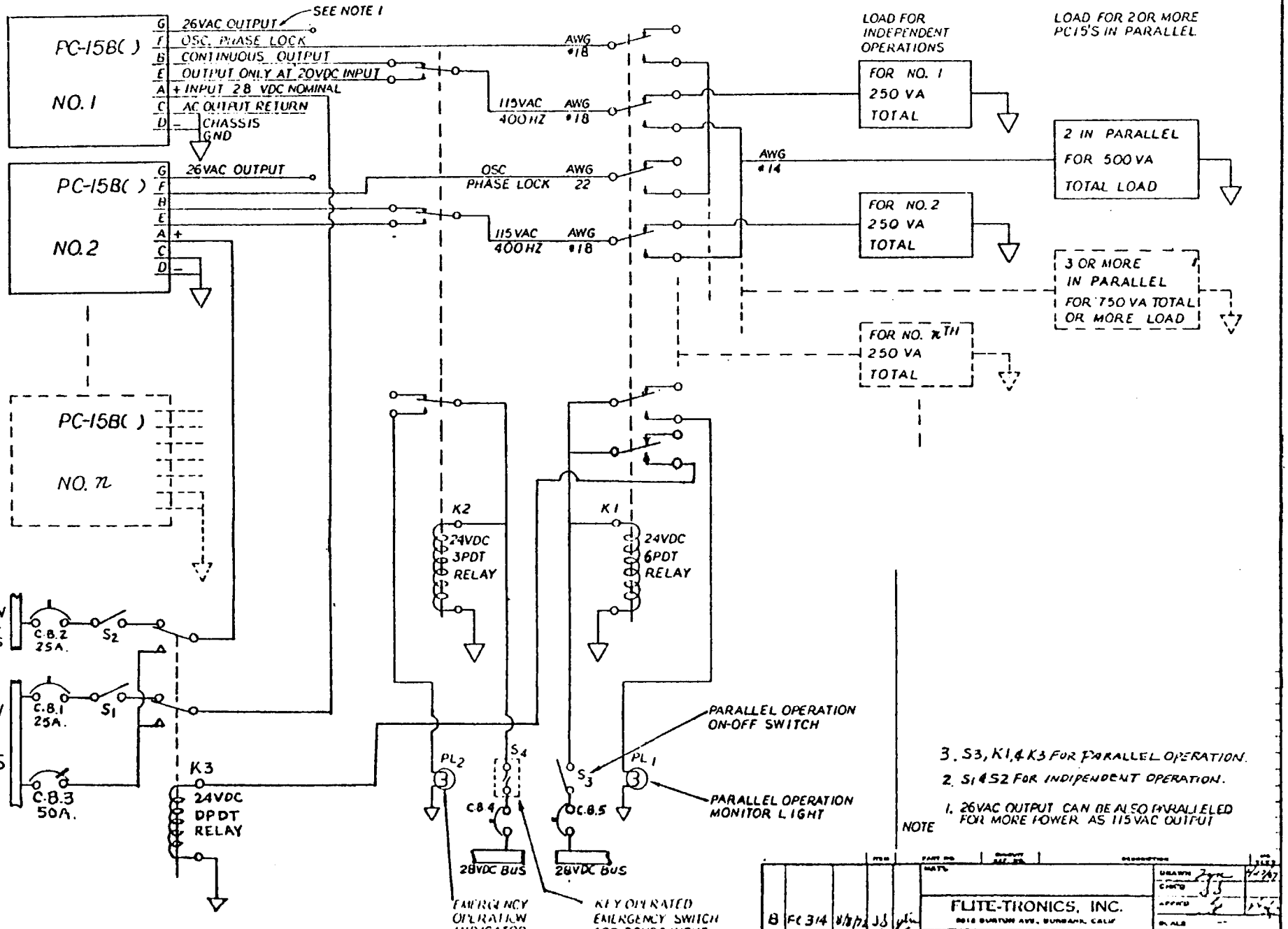


NOTES:

1. TO OPERATE PC-15s INDEPENDENTLY, DISCONNECT J BOX TIES FOR PINS B, E, F AND G.
2. USE 25A FUSE PER EACH UNIT.
3. PC-15 MATING CONNECTOR: MS3106B18-9S, CANNON, 7 PIN.
4. OUTPUT POWER CAPABILITY:
   250 VA TIMES n
   n = NO OF UNITS IN PARALLEL

FIGURE 2.3

CONNECTION TO OPERATE PC-15s IN PARALLEL



NOTE

3. S3, K1, & K3 FOR PARALLEL OPERATION.
2. S1 & S2 FOR INDIPENDENT OPERATION.
1. 26VAC OUTPUT CAN BE ALSO PARALLELED FOR MORE POWER AS 115VAC OUTPUT

FIGURE 2.4
CONNECTION TO OPERATE PC15'S IN PARALLEL WITH REMOTE DISCONNECT

FLITE-TRONICS, INC.
8016 BURTON AVE., BURBANK, CALIF.

SUGGESTED INTERCONNECTION FOR PARALLEL OPERATION OF 2 OR MORE PC15'S AND AUTOMATIC DISCONNECT.

MODEL PC-15B( )

C 91009-28

NOTE TO SECTION III

N3.1 Pages for changes and additions to this section due to revisions and introduction of new model series are listed below for quick reference.

REV. NO/MODEL SERIES	PAGE
Rev. 1, 2, 3	Incorporated
Rev. 4	55, 56
Rev. 5	Incorporated
Rev. 6	58, 61, 62
PC-15B	A1
PC-15D	AO
PC-15E	AO
PC-15F	AO
PC-15G	AO

N3.2 Addition to N3.1

Rev. 7	63
PC-15B( ) Series	63

N3.3 Any reference to PC-15 or PC-15A in this section is applicable to Model PC-15B( ) unless otherwise noted under PC-15B.

Section III

Principles of Operation

3.1 General

The PC-15 and PC-15A (referred to as PC-15s) convert DC energy to AC electrical energy.

The nominal output is 115 VAC on pin B and 26 VAC output from pin G, for Model PC-15A only. However, in an emergency battery condition of 20 VDC input, the output from pin E is 115 VAC working into 90% of full rated load. The output from pin G, the 26 VAC output, will follow the input DC voltage variation below 24.0 VDC. The 400 HZ is generated by an L/C tuned push-pull oscillator. The sine wave signal is amplified by four stages of class B push-pull amplifier. The final power output stage is also class B, but the transistors are cascaded. This permits operating at higher temperature and also decreases the collector to emitter operating voltage in half; i.e., eliminates the possibility of an 88 volt peak transient on the 28.0 VDC buss destructing the transistors. A schematic of the PC-15s is illustrated in Figure 3.2 and 3.3.

3.2 Block Diagram

Figure 3.1 shows the PC-15s' operation in a block diagram form. The block diagram illustrates the time tested and proven circuitry for power amplification of a low level AC signal. All the stages are class B push-pull emitter follower configuration. The emitter follower circuitry having inherent negative feedback introduces very little amplitude and phase distortion.

The output signal is sampled by current and voltage transformers. These components deliver a signal to operate the output overload and output voltage level circuitry.

This output, in turn, controls the push-pull 400 HZ oscillator amplitude.

The output overload reduces the output current and voltage when a load excess of 160% is applied to the output. This same circuitry operates in the event of a short circuit on the output.

The automatic level control maintains the output voltage constant for load and temperature variation.

3.3 400 HZ Sine Wave Oscillator

Inductor-transformer T1 is the feedback, output and resonant tuning transformer. The center tapped primary winding is 1-2-3. Feedback winding is 4-5-6. The output and resonant tuning winding is 7-8-9.

Capacitor C10 (.47 ufd) resonates with the inductance of the output winding at 400 HZ.

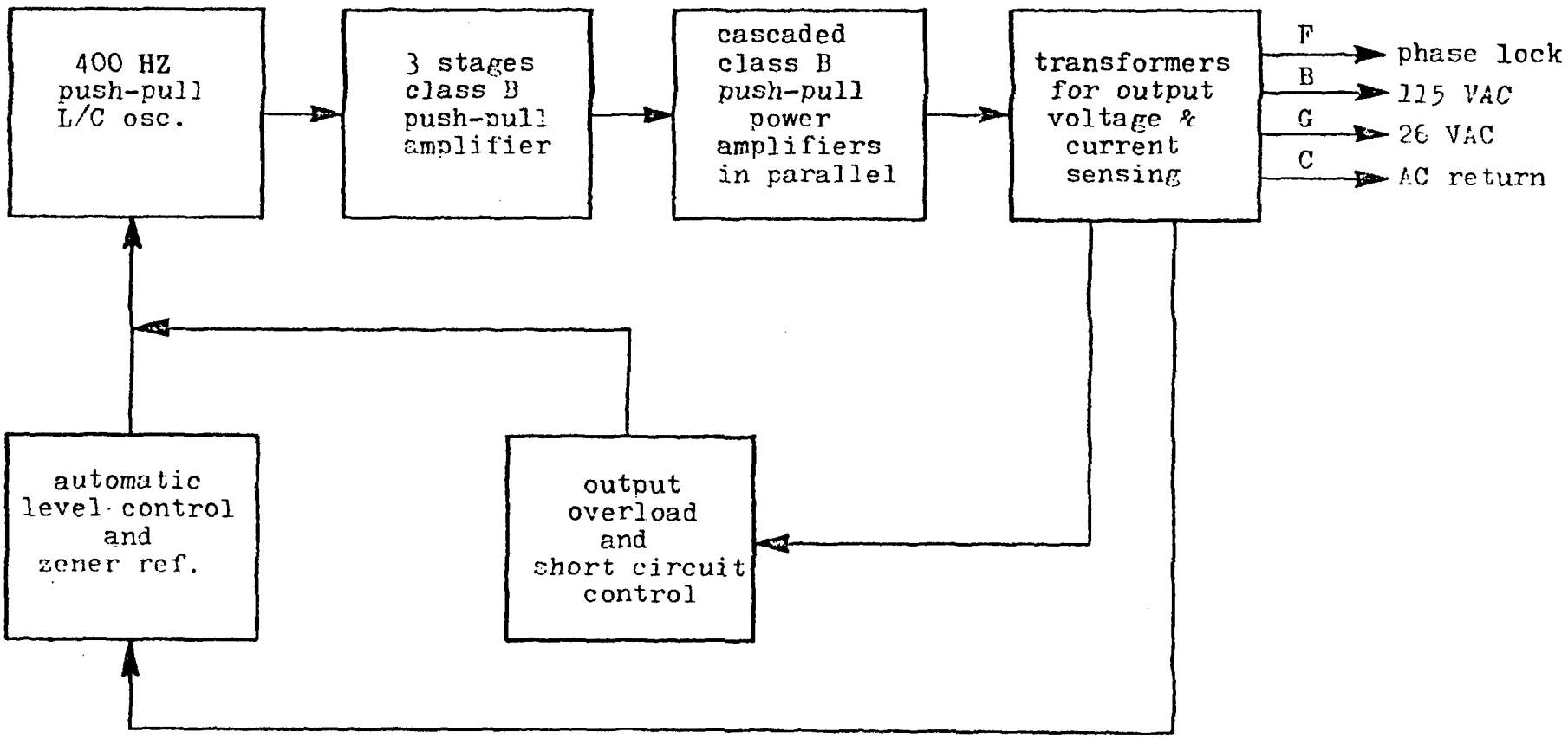
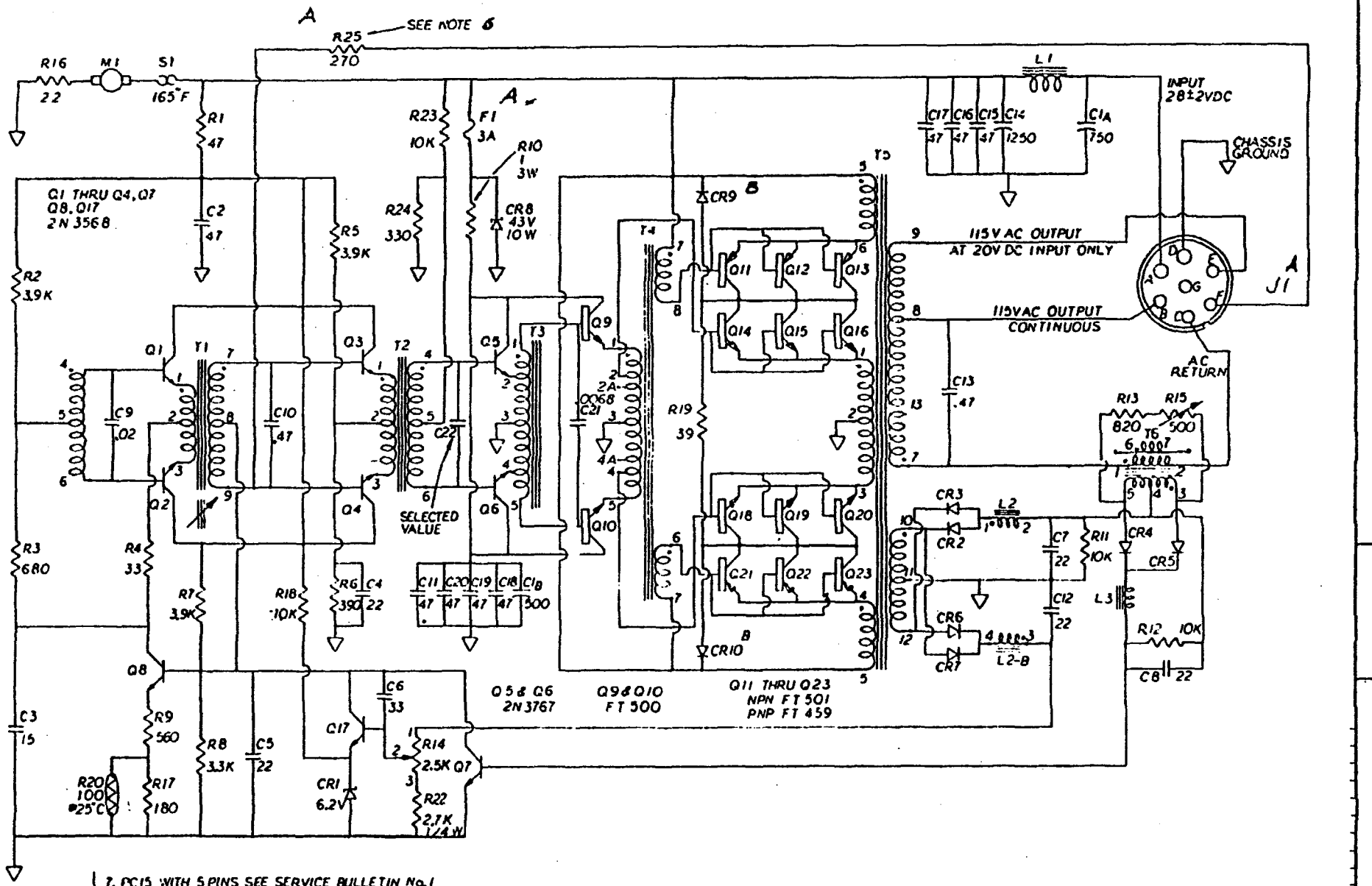


FIGURE 3.1 BLOCK DIAGRAM



7. PC15 WITH 5 PINS SEE SERVICE BULLETIN No. 1
B 6. USE CAPACITOR TO FREQ. LOCK TO OTHER 115VAC, 400HZ LINE (C_{23} TYPICALLY .0047μF, 600V.), PHASE LOCK WITH R25
B 5. CHANGE B EFFECTIVE ON S/N 349 & UP, CR9 & CR10 ADDED
A 4. CHANGE A EFFECTIVE ON S/N 312 & UP, R25 & F1 ADDED
3. MATING PLUG FOR J1: MS 3106B 18-9S, S/N 312 & UP
2. CAPACITORS IN μF: C22 SELECTED AMONG VALUES BETWEEN .002 AND .0068 μF
REV. 1. RESISTORS IN OHMS: 1/2 W UNLESS OTHERWISE NOTED

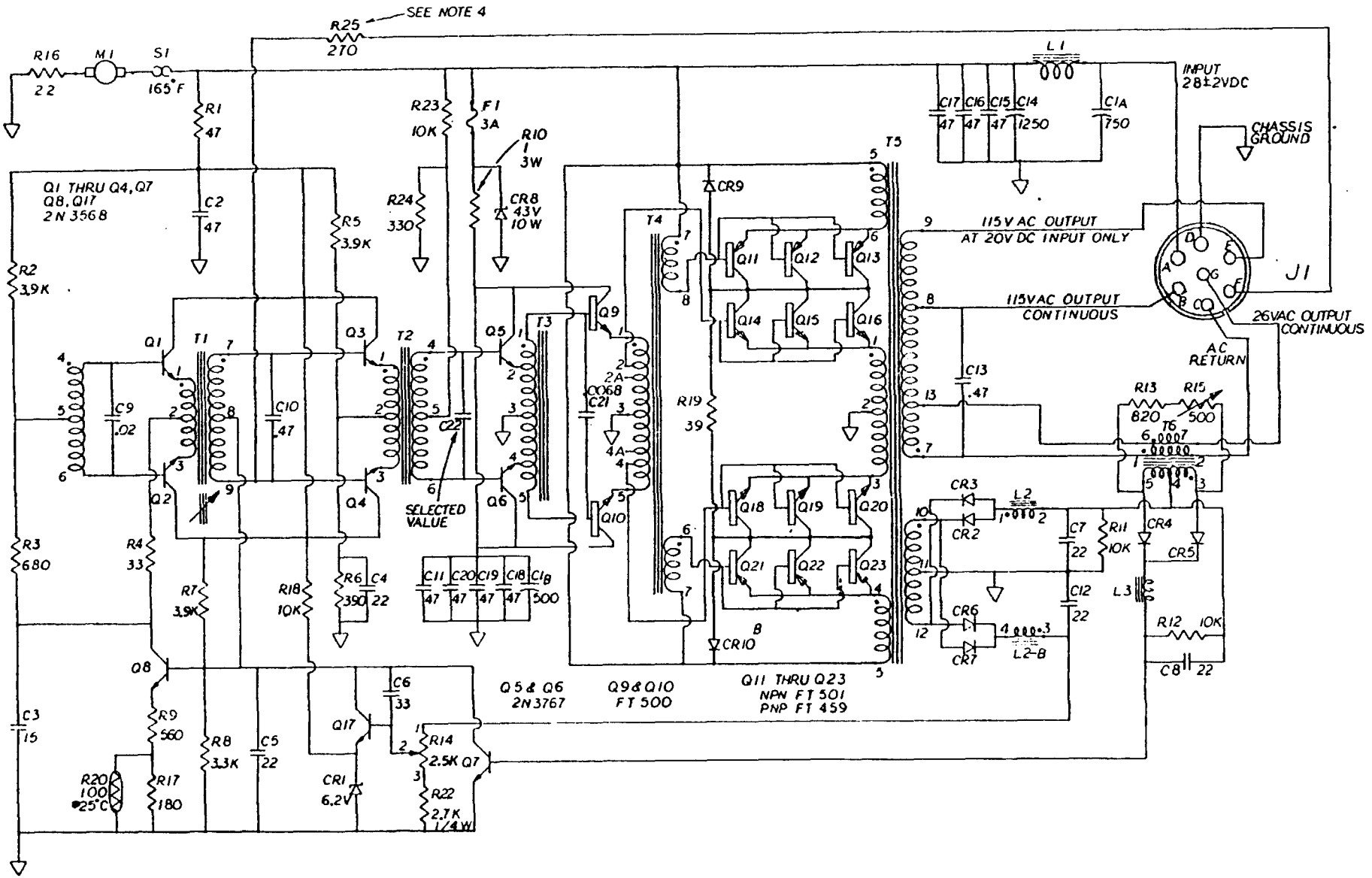
NOTES

FIGURE 3.2

FLITE-TRONICS, INC.
8818 BURTON AVE., BURBANK, CALIF.

PC15 SCHEMATIC

DRAWN 7/1/67
CHK'D
APP'D 7/1/67
SCALE
MODEL PC15
NEXT ASSY.
SIZE C 91003



4. USE CAPACITOR C23 (TYPICALLY .0047 μF, 600V.) TO FREQ. LOCK TO OTHER 115VAC 400 HZ LINE, PHASE LOCK TO OTHER PC15A WITH R25
3. MATING PLUG FOR J1: MS 3106B 18-9S.
2. CAPACITORS IN μF: C22 SELECTED AMONG VALUES BETWEEN .002 AND .0068 μF
1. RESISTORS IN OHMS: 1/2 W UNLESS OTHERWISE NOTED

NOTES

FIGURE 3.3

FLITE-TRONICS, INC.
8816 BURTON AVE., BURBANK, CALIF.

TITLE: PC15A SCHEMATIC

DRAWN
CHK'D
APP'D
SCALE
MODEL PC15A
NEXT ASSY.
SIZE C 91003-1

Transformer T1 has a tuning slug which is adjusted at the factory for an oscillator frequency of 400 HZ.

Transistors Q1 and Q2 are the class B push-pull amplifier to sustain oscillation. Resistors R2 and R3 biases the transistors to cause oscillation to start. Capacitor C9 suppresses any tendency for high frequency mode oscillation. Resistor R4 is the degenerating resistor.

The output winding 7-8-9 drives the bases of Q3 and Q4 in opposite phase.

3.4 Low Level Amplifiers

Between the sine wave oscillator and power amplifiers, there are three stages of class B push-pull emitter follower amplifiers.

The first stage consists of transistors Q3 and Q4 and the interstage transformer T2. Resistors R5 and R6 biases the transistors operating point.

The output from the transformer T2 drives the bases of Q5 and Q6. Resistors R24 and R23 biases transistors Q5 and Q6. Transistors Q5 and Q6 emitters drive the matching autotransformer T3. By using an autoformer connection for T3, the unit is designed compactly and yet permits proper step-up to drive transitors Q9 and Q10. Capacitor C22, a selected value connected across 4 and 6 of T2, is used to suppress ringing.

Capacitor C21 connected to the base of Q9 and Q10 suppresses parasitic oscillation. The emitter of Q9 and Q10 drives transformer T4. Transformer T4 delivers proper voltage and current to the final power output transistors.

Decoupling network for the oscillator stage and first low level amplifier is R1 and C2. Decoupling network for the intermediate stage is R10.

Zener CR8 clips transient voltage above 43 VDC.

3.5 Power Amplifier

The power amplifier consists of power transistors connected in cascaded pairs. Transistors Q11 through Q16 and Q18 through Q23 are driven in alternate half cycles. The multiple winding primary of transformer T5 divides the 28.0 VDC input, so the transistors support 26.75 peak AC signal.

These power transistors are controlled to Flite-Tronics' specifications. These devices are inspected for certain minimum breakdown voltage, gain and recovery time. Therefore, an 88 volt peak transient on the 28.0 VDC input will not cause a collector to emitter voltage to exceed the minimum breakdown voltage. The primaries of the transformer forces this voltage division. In spite of the unusual connection of transistors Q11 through Q23, they are connected for class B push-pull amplifier.

The tapped secondary of T5 delivers 26 VAC from terminal 13, and 115 VAC from terminal 8. (Model PC-15A only)

The output from terminal 9 is 115 VAC working into 90% of rated load, during an input of 20 VDC on the A+ line.

This output is to be used only during emergency 20 VDC input condition and the load should be connected to pin E of J1. There will exist, however, a slight squaring of the peaks of the sine wave in this condition.

Capacitor C13 is the phase compensating capacitor to permit the unit to operate efficiently with a load power factor between .8 lag and 1.0.

3.6 Output Voltage Control

The output voltage sample is realized from the center tapped winding 10-11-12 of T5. Rectifiers CR6 and CR7 converts the AC signal to a DC output. Filter consisting of L2-B and C12 is the L section choke input to give an average DC output which is proportional to the 115 VAC level.

This DC output is also applied across a variable resistor R14 in series with R22. The variable portion of the resistor is connected to the base of Q17. In essence, this output voltage sample is compared with the zener CR1 in the emitter of Q17. Resistor R18 is the bleeder resistor to the zener to permit operating this zener on its flat portion of its transfer characteristics curve.

The variable resistor R14 is adjusted for an output of 115 VAC. A common load resistor R7 is connected to the collector of Q7 and Q17. The DC current passing through R7 determines the bias point for transistor Q8. Transistor Q8 is the variable DC source for the push-pull 400 HZ oscillator.

The push-pull oscillator represents an impedance to the collector circuit of Q8. Hence, the conduction of Q8 will determine the magnitude of DC voltage across the oscillator circuit. This, in turn, determines the amplitude of oscillation, which controls the AC output level. Resistor R9 and R17 are the degenerating resistors for transistor Q8.

Thermistor R20 is a temperature compensating resistor.

Resistor R8 is the starting resistor for transistor Q8 until the oscillator amplitude builds up sufficiently for the automatic level control circuitry to take over.

Capacitor C6 is a low frequency feedback capacitor to prevent the automatic level control circuitry from motor boating. Capacitor C3 and C5 are simply by-pass capacitors.

3.7 Output Overload Control

The output AC current is sampled by the transformer T6. The current flowing through the winding 1-2 causes a voltage to be developed across the center tapped winding 3-4-5. The magnitude of voltage across this winding is controlled by the variable resistor R15 in series with R13.

The AC voltage from winding 3-4-5 is rectified by CR4 and CR5. The averaging choke input filter, consisting of L3 and C8, develops a DC voltage across R12, which is proportional to the output AC current. For the Model PC-15A, the 26 VAC output current is sampled by winding 6-7 of transformer T6.

To realize an overload that causes quenching action, the overload current resulting in DC voltage across R12 is compared with the output DC voltage across R11. This tends to give a trigger-like action when an overload condition is sustained.

The output voltage sample is taken from winding 10-11-12 of transformer T5. CR1 and CR3 rectifies this voltage. The L section choke input filter, consisting of L2 and C7, places across resistor R11 a ripple-free DC voltage. The voltage across R11 is a negative polarity with respect to ground.

The DC voltage across R12, which is proportional to the output current, is compared with the voltage across resistor R11. When the output current causes a voltage across R12 to exceed the compared voltage across R11, transistor Q7 will start conducting. The extent of overload determines the magnitude of current Q7 will conduct. As Q7 conducts, this tends to cut off Q8, which, in turn, decreases the voltage across the 400 HZ oscillator circuit.

When the load is in excess of 165% of 250 VA, the oscillator circuit will exhibit anything from low frequency quenching to almost a complete shut down.

During output short circuit, the current overload circuitry will reduce the voltage across the push-pull oscillator until a feeble oscillation is maintained.

Of course, on removal of the short circuit condition, the unit will immediately return to normal operating condition.

3.8 Input Filtering and Blower

The input is filtered by a pi section filter, consisting of capacitors C1A, C14 through C17 and choke L1.

Additional filtering for the low level stage is done by the RC filter, consisting of R1, C2, and R10, C1B, C11, C18 through C20.

Blower motor M1 is thermostatically controlled and used for protection only. The blower motor turns on when the heat sink temperature exceeds 165° Fahrenheit.

In normal installation where thermal conduction by the aircraft structure is adequate, the blower motor may never come on. Resistor R16 simply reduces the speed slightly to measurably increase the life of the blower.

F1 fuses the intermediate amplifier stages.

3.9 Transient Protection

To eliminate deleterious effects of voltage transients, zener and diodes are used.

Transient voltage passing through the A+ input filter section and exceeding 43 volts are clipped by the zener diode CR8.

Transient voltage occuring at the junctions of the power output transistors exceeding the input voltages are clipped by diodes CR9 and CR10.

3.10 Phase & Frequency Locking

When the PC-15s are paralleled together, it is necessary to phase synchronize the output voltage. Resistor R25 is the coupling resistor to phase lock the oscillator together through pin F of J1.

When the PC-15s are paralleled, it is necessary to have all the parallel units operating. The loading effect of the non-operating unit causes the other parallel unit or units to shut down. Refer to page 11 for remotely disconnecting non-operating unit.

To frequency lock the PC-15s to other 115 VAC sources, resistor R25 is changed to C23. Typically .0047 ufd, as shown in the bill of material may be used.

When PC-15s are frequency locked, the output should not be paralleled to the 115 VAC source.

NOTE TO SECTION IV

N4.1 Pages for changes and additions to this section due to revision and introduction of new model series are listed below for quick reference.

REV. NO/MODEL SERIES	PAGE
Rev. 1, 2, 3	Incorporated
Rev. 4	55, 56
Rev. 5	Incorporated
Rev. 6	58, 61
PC-15B	A1, A2, A3, A4, A5, A6
PC-15D	A6
PC-15E	A6
PC-15F	A13
PC-15G	A13

N4.2 Addition to N4.1

Rev. 7	63
PC-15B( ) Series	63

N4.3 Any reference to PC-15 or PC-15A in this section is applicable to Model PC-15B() unless otherwise noted under Model PC-15B.

N4.4 Additions to N4.2

Rev. 8	66

Section IV

Maintenance

4.1 General

This section covers the bench check of the PC-15s to determine conformance to manufacturers specification. Periodic preventative maintenance is not necessary, since no moving parts are employed to realize functional electrical performance.

For safety feature only, a thermostat is used to control the blower motor. It will come on only when the heat sink temperature exceeds 165°F.

Table 4.2, page 23, is used to functionally check the PC-15s to manufacturers performance.

The instructions on table 4.3 will aid in localizing the cause of defective operation, should any component fail.

4.2 Test Equipment

Table 4.1 lists the recommended components and test equipment to be employed in conducting electrical test per manufacturers test procedures.

Figure 4.1 illustrates the bench test inter-connection diagram. The Flite-Tronics Test Set TS15-1 is a unit for readily conducting the test in table 4.2 and 4.3. Table 4.2 indicates the readings and step-by-step procedure to test PC-15s operating normally. Table 4.3 notes test procedure and possible cause of abnormal reading.

Table 4.1 Component and Test Equipment

EQUIPMENT	MODEL OR TYPE	FUNCTION
Power Supply	0-40 VDC, 0-25 Amp	Low voltage power source
Oscilloscope	HP122A or equiv.	Visual display
Distortion Analyzer	HP330B or equiv.	Measure distortion
Frequency Counter	HP5512A or equiv.	Measure frequency
Components for TS15-1 Test Set		
Circuit Breaker	25 Amp Breaker	Protection
Current Meter 12	0-5.0 Amps AC 400 HZ	Monitor output I
Voltmeter V2	0-50/0-150 VAC 400 HZ	Monitor output voltage
Reactor L1	12.7 Millihenry @115 VAC 400 HZ	Reactance load simulator
Resistor R1	1.16K ohm 25 watt	Resistive load
Resistor R2	100 ohm 100 watt	Resistive load

Component and Test Equipment (continued)

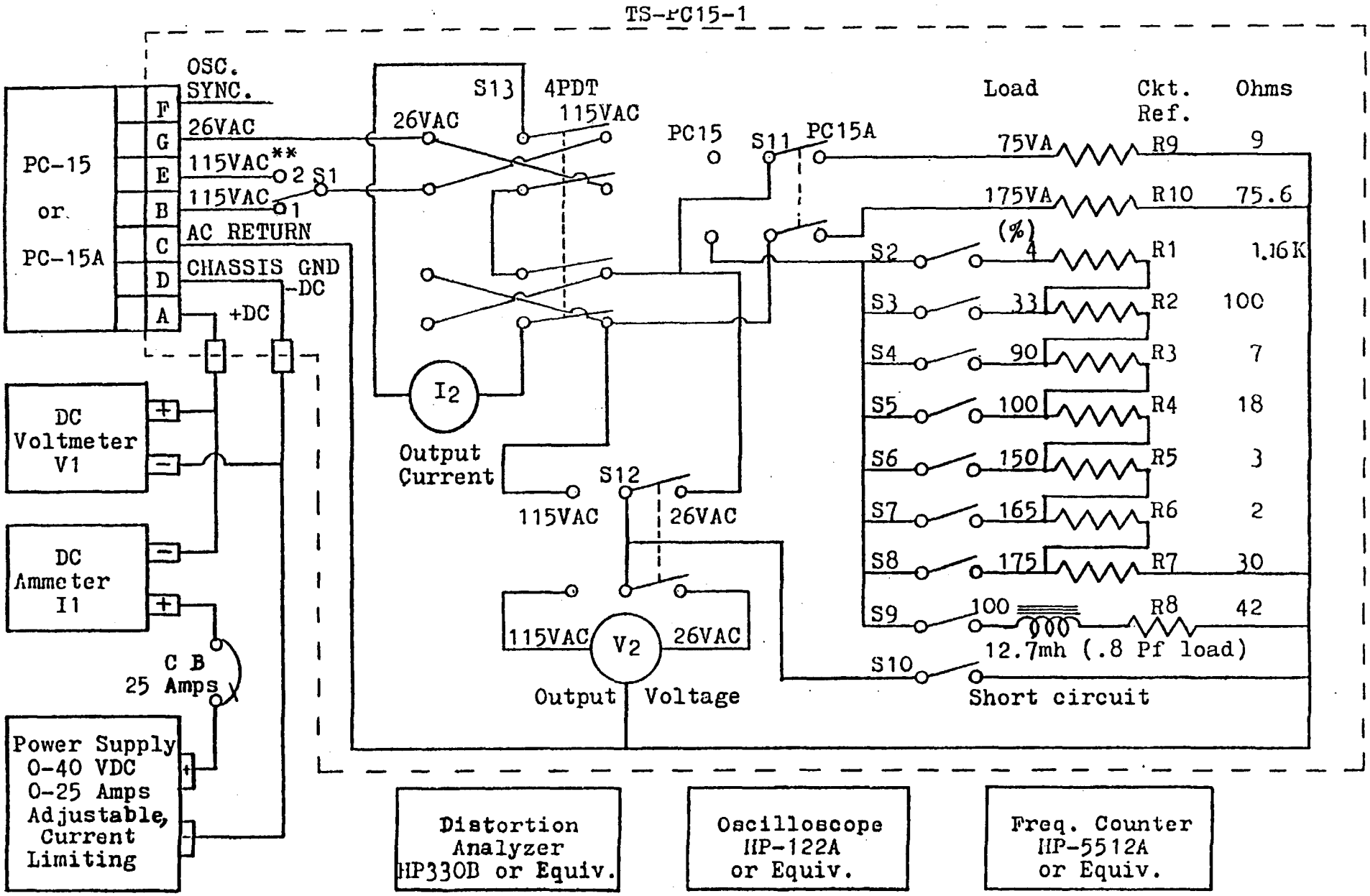
EQUIPMENT	MODEL OR TYPE	FUNCTION
Resistor R3	7 ohm 100 watt	Resistive load
Resistor R4	18 ohm 250 watt	Resistive load
Resistor R5	3 ohm 100 watt	Resistive load
Resistor R6	2 ohm 100 watt	Resistive load
Resistor R7	30 ohm 750 watt or equiv.	Resistive load
Resistor R8	42 ohm 500 watt or equiv.	Resistive load
Resistor R9	9 ohm 150 watt	Resistive load
Resistor R10	75.6 ohm 350 watt or equiv.	Resistive load
Switch S1	SPDT	20 VDC input switch
Switch S2	SPST	4% load switch
Switch S3	SPST	33% load switch
Switch S4	SPST	90% load switch
Switch S5	SPST	100% load switch
Switch S6	SPST	150% load switch
Switch S7	SPST	165% load switch
Switch S8	SPST	175% load switch
Switch S9	SPST	.8 power factor switch
Switch S10	SPST	Short circuit switch
Switch S11	DPDT	PC-15/PC-15A load selector switch
Switch S12	DPDT	Output voltage selector switch
Switch S13	4PDT	Output current selector switch

4.3 Performance Test and Localizing Trouble Source

Table 4.3 outlines a step-by-step procedure to performance test the PC-15s to localize fault source, if troubles exist.

It is suggested the technician acquire familiarity of the unit by studying the principles of operation section prior to attempting this section.

In table 4.3, test 1 through 14 is valid for the Models PC-15 and PC-15A. Test 15 and 16 are for the Model PC-15A only.



*These meters are required only if the power supply does not contain them.
**Emergency output at 20 VDC input only.

FIGURE 4.1 BENCH TEST SET AND HOOK-UP

4.4 Check Procedure for PC-15 and PC-15A

To functionally test Flite-Tronics Static Inverter connect the PC-15 or PC-15A to the test rack TS-PC15-1.

A. Model PC-15: 1 output; 115 VAC, 400 Hz, 250 VA Max.
B. Model PC-15A: 2 outputs; 115 VAC, 400 Hz, *250 VA Max.
26 VAC, 400 Hz, *75 VA Max.
C. Frequency: 400 Hz ± 4 Hz, both Models.
D. Amplitude Distortion: 7% or less under normal operating conditions, both Models.
E. Tests for 115 VAC output of PC-15 and PC-15A are identical.
*Sum of powers from the 115 VAC and 26 VAC outputs should not exceed 250 VA.

*Table 4.2 Test Conditions and Typical Readings

Model	Condition	Switch	Position	** Typical Readings			
				DC Input		AC Output	
				Voltage	Current	Voltage	Current
PC-15 or PC-15A	No load	S1 S2 thru S10 S11 S12 & S13	#1 Off PC15 115 VAC	Set to 28 VDC	.75 Amps or less	120.7 VAC maximum	C Amp
PC-15 or PC-15A	4% load	S1 S2 S3 thru S10 S11 S12 & S13	#1 On Off PC15 115 VAC	Set to 28 VDC	2.0 Amps maximum	Between 115 VAC and 120.7VAC	.1 Amps maximum
PC-15 or PC-15A	33% load	S1 S3 S2 & S4 thru S10 S11 S12 & S13	#1 On Off PC15 115 VAC	Set to 28 VDC	5.0 Amps typical	Between 115 VAC and 120.7VAC	.72 Amps typical
PC-15 or PC-15A	100%	S1 S5 S2 thru S4 & S6 thru S10 S11 S12 & S13	#1 On Off PC15 115 VAC	Set to 28 VDC	14 Amps typical	Between 108 VAC and 120.7VAC	2.17Amps typical
PC-15 or PC-15A	150% overload	S1 S6 S2 thru S5 & S7 thru S10 S11 S12 & S13	#1 On Off PC15 115 VAC	Set to 28 VDC	22 Amps typical	At least 107 VAC	3.3 Amps typical
PC-15 or PC-15A	165% overload	S1 S7 S2 thru S6 & S8 thru S10 S11 S12 & S13	#1 On Off PC15 115 VAC	Set to 28 VDC	24 Amps typical	At least 100 VAC	3.6 Amps typical
PC-15 or PC-15A	175% overload	S1 S8 S2 thru S7 & S9 & S10 S11 S12 & S13	#1 On Off PC15 115 VAC	Set to 28 VDC	Between 5.0 Amps and 13 Amps	Output voltage & current motor-boating typically @ 60 VAC and @ 2.2 Amps	

*Table 4.2 additions for Pc-15B
See page A2

** Readings shown are steady state values unless otherwise noted

4.4 Check Procedure for PC-15 and PC-15A (Continued)

Model	Load Condition	Switch	Position	Typical Readings			
				DC Input		AC Output	
				Voltage	Current	Voltage	Current
PC-15 or PC-15A	100% Reactive Load	S1 S9 S2 thru S8&10 S11 S12 & S13	#1 On Off PC15 115 VAC	Set to 28 VDC	14 Amps typical	Between 107 VAC and 120 VAC	Between 2.2 Amps and 2.5 Amps
PC-15 Only	Output Short Circuit	S1 S10 S2 thru S9 S11 S12 & S13	#1 On Off PC15 115 VAC	Set to 28 VDC	3 Amps or less	0 VAC	1 Amp or less
PC-15 or PC-15A	Pin E Output @20 VDC Input	S4 S1 S5 thru S10 S11 S12 & S13	On #2 Off PC15 115 VAC	Set to 20 VDC	15 Amps typical	Between 107 VAC and 115 VAC	1.95Amps typical
PC-15A Only	*Full load 175 VA @115 VAC	S1 S2 thru S10 S11 S12 & S13	#1 Off PC15A 115 VAC	Set to 28 VDC	14 Amps typical	Between 107 VAC and 120 VAC	1.5 Amps typical
	75 VA @26 VAC	S1 S2 thru S10 S11 S12 & S13	#1 Off PC15A 26 VAC	Set to 28 VDC	14 Amps typical	Between 24.2VAC and 27.3VAC	2.9 Amps typical
	Output Short Circuit Test 26 VAC	S1 S2 thru S10 S11 S12 & S13 S10	#1 Off PC15A 26 VAC On	Set to 28 VDC	3 Amps or less	0 VAC	8 Amps initial transient, 2Amp typical
	115 VAC	S1 S2 thru S10 S11 S12 & S13 S10	#1 Off PC15A 115 VAC On	Set to 28 VDC	3 Amps or less	0 VAC	1 Amp or less

* S11 in PC-15A position, 175 VA resistive load is connected to 115 VAC output and 75 VA resistive load is connected to 26 VAC output.

4.4.1 Switch Nomenclature:

S1 115 VAC normal and emergency output selector switch; position #1 normal, position #2 emergency, when input power is 20 VDC
S2 4% Resistive load switch
S3 33% " " "
S4 90% " " "
S5 100% (250VA) Resistive load switch
S6 150% Resistive load switch
S7 165% " " "
S8 175% " " "
S9 100% Reactive load switch
S10 Output short circuit switch for 115 VAC or 26 VAC - the AC voltmeter indicates output being shorted
S11 PC-15 and PC-15A output selector switch
S12 Output voltage selector switch. 115 VAC or 26 VAC
S13 Output current selector switch. 115 VAC or 26 VAC current

Table 4.3 Performance Test and Localizing Trouble Procedures

STEP	SET-UP	PROCEDURE	PERFORMANCE READING	POSSIBLE CA OF ABNORMAL READING
1	Interconnect unit per bench test hook-up	a) Turn on power supply, keep input voltage set at zero. b) Turn on all measuring equipment for warm-up. c) Check polarity of power supply. d) Set S1 to No. 1 position. e) Set switches S2 through S10 in the Off position.		
2	S2 through S10 in the Off position S11 in the PC-15 position S12 & S13 in the 115V position	a) Gradually increase power supply voltage to 27.5 VDC	Input DC current I1 should not exceed 3/4 amps DC	Test set-up incorrectly connected. Capacitor C1A, C1B, C11, and C14 through C20 may be shorted. Transistors Q9 through Q23 shorted. C2 or CR8 shorted.
3	S2 through S10 in the Off position S11 in the PC-15 position S13 in the 115V position	a) Input voltage set at 27.5 VDC b) Adjust R14 as required, so V2 reads 117 VAC if necessary	V2 should read between 107 VAC to 120.7, with S12 in the 115 VAC position. V2 should read between 24.2 to 27.3 VAC with S12 in the 26.0 VAC position for the PC-15A only.	Check for following likely defective components: CR6, CR7, C12, R14, C6, CR1, Q17, C3, Q8, and R20

STEP	SET-UP	PROCEDURE	PERFORMANCE READING	POSSIBLE CAUSE OF ABNORMAL READING
4	S2 through S10 in the Off position S11 in the PC-15 position S12 and S13 in the 115V position	a) Input voltage set at 27.5 VDC. b) If frequency is out of tolerance, adjust turning slug on transformer T1.	Frequency meter should read 400 HZ ± 4 HZ I1=3/4 A	Defective parts likely to cause abnormal reading: Transformer T1, Capacitor C10 or C9
5	S2 through S10 in the Off position S11 in the PC-15 position S12 and S13 in the 115V position	a) Input voltage set at 27.5 VDC. b) Vary input voltage between 26 to 30 VDC.	Distortion meter should read less than 7%. I1=3/4 A	Defective parts likely to cause abnormal reading: Transistors Q3 through Q6 and Q9 through Q23. Capacitors C3, C5.
6	Switch S5 on for full load output S11 in the PC-15 position S12 and S13 in the 115V position	a) Input voltage set at 27.5 VDC. b) Resistor R14 may require readjusting; however, if adjusted, step 3 should be re-tested. c) Vary input voltage between 26 to 30 VDC.	I2 read 2.17 amps AC V2 should read between 107 to 120.7 VAC. I1 should read approximately 14.2 A. Frequency should be 400 HZ ± 4 HZ Distortion less than 7%.	Defective parts likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Transistor Q1 through Q17.

STEP	SET-UP	PROCEDURE	PERFORMANCE READING	POSSIBLE CAUSE OF ABNORMAL READING
7	Switch S6 for 150% overload test. S11 in the PC-15 position S12 and S13 in the 115V position	a) Input voltage set 27.5 VDC. b) Resistor R15 may require adjusting if unit tends to motor boat. However, in the event of any adjustment, step 3 should be repeated.	I2 should read approximately 3.25 amp. V2 should read at least 107 VAC. I1 should read approximately 22.0 amps.	Defective par. likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Transistor Q1 through Q17.
8	Switch S7 on for 165% overload test S11 in the PC-15 position S12 and S13 in the 115V position	a) Input voltage set at 27.5 VDC. b) R15 adjust the overload threshold point. The proper setting is at the 165% overload point; the unit should almost start motorboating.	I1 should read 24 amps. V2 should read at least 95 VAC. I2 should read approximately 3.6 amps.	Defective components likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Capacitors C7 and C8. Transistors Q7 and Q8.
9	Switch S8 on for 175% overload test S11 in the PC-15 position S12 and S13 in the 115V position	a) Input set at 27.5 VDC. b) R15 adjust the overload threshold point. The proper setting at 175% overload point, the PC-15 should be in the motorboating mode.	I1 should be motorboating between 1.0 to 10 amps. I2 and V2 should indicate output current and voltage is motorboating.	Defective components likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Capacitors C7 and C8. Transistors Q7 and Q8.
10	Switch S10 on for output short circuit test S11 in the PC-15 position S12 and S13 in the 115V position	a) Input set anywhere between 26 and 28 VDC. b) If I1 exceeds 6 amps at anytime, the unit should be turned off.	I1 less than 6 amps. V2 = zero I2 less than 1 amp.	Defective components likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Capacitors C7 and C8. Transistors Q7 and Q8.

STEP	SET-UP	PROCEDURE	PERFORMANCE READING	POSSIBLE CAUSE OF ABNORMAL READING
	Switches S2 through S8 in the Off position Switch S9 on 250 VA S10 in Off position S11 in the PC-15 position S12 and S13 in the 115V position	a) Input voltage set at 27.5 VDC. b) Vary input voltage between 28 to 30 VDC.	I2 read 2.0 to 2.3 amps AC. V2 read between 107 to 120.7 VAC.	Defective parts likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Transistor Q1 through Q17. Capacitor C13.
12	Switch S3 on and S4 through S10 in Off position for 33% load test S11 in the PC-15 position S12 and S13 in the 115V position	a) Input voltage set at 27.5 VDC.	I1 read 5.0 amps. I2 read .72A V2 read between 117 to 120.7 VAC. Distortion meter should read less than 7%. Frequency meter should read 400 HZ ± 4 HZ.	Defective parts likely to cause abnormal reading: Transformer T1. Capacitor C3, CR5 and C10. Transistors Q3 through Q6 and Q9 through Q16.
13	Switch S2 on. Switch S3 through S10 in Off position S11 in the PC-15 position S12 and S13 in the 115V position	a) Input voltage between 26.0 to 28 VDC	Distortion less than 7%. Frequency 400 HZ ± 4 HZ. V2 read 115 to 120.7 VAC. I1 read 2 amps DC. I2 read .20 to .35 amps AC.	Defective parts likely to cause abnormal reading: Diodes CR6, CR7, C12, R14, C6, CR1, Q17, C3, Q8 and R20.

STEP	SET-UP	PROCEDURE	PERFORMANCE READING	POSSIBLE CAUSE OF ABNORMAL READING
14	Switch S1 to #2 position. S4 on, and S5 through S10 in Off position S11 in the PC-15 position S12 and S13 in the 115V position	a) Set input voltage at 20 VDC.	V2 read 107 to 120.7 VAC. I2 read 1.93 to 2.12 amps AC. I1 read approximately 15.0 amps DC.	Defective part likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Transistor Q1 through Q17.
15	Switch S1 to #1 position Switch S11 in the PC-15A position	a) Input voltage set at 28.0 VDC.	I1 should read approximately 14.2 amps. I2 read 1.52 amps, S13 in 115V position. I2 read 2.9 amps, S13 in 26V position. V2 should read between 107 to 120.7 VAC with S12 in 115V position. V2 should read between 24.2 to 27.3 VAC with S12 in 26V position. Distortion for 26 VAC and 115 VAC output should be 7% or less.	Defective parts likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Transistor Q1 through Q17.

STEP	SET-UP	PROCEDURE	PERFORMANCE READING	POSSIBLE CAUSE OF ABNORMAL READING
	Switch S11 in the PC-15A position for output short circuit test S12 in the 26V position S13 in the 26V position	a) S10 switched on after unit is operating normally. b) If I1 exceeds 6.0 amps at anytime, the unit should be turned off.	I1 less than 6.0 amps. V2 reads zero. I2 less than 1.5 amps.	Defective components likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Capacitors C7 and C8. Transistor Q7 and Q5. Resistor R15.

4.5 Voltage Measurement

To enable the technicians to effectively service the PC-15's table 4.4 tabulates the typical D.C. and/or A.C. voltage to assist in localizing a fault source.

Table 4.3 indicates the possible component for an abnormal reading. If a voltage other than those listed in table 4.4 is measured this will enable the technician to determine which component is possibly faulty.

TABLE 4.4 PC-15's VOLTAGE DISTRIBUTION MEASUREMENT CONDITION

1. Input 27.5 VDC.
2. Full load with Switch S5 on.
3. Switch S1 in the #1 position.
4. DC and AC measurement made with a Simpson 270 or equivalent.
   (Note: Make AC measurement in the output connection to this meter.)

CIRCUIT REF.	TEST POINT	VOLTAGE MEASUREMENT D.C.	VAC RMS
Q1 and Q2	Emitter	8 to 20*	6
	Base	8 to 20*	6
	Collector	26	0
Q3 and Q4	Emitter	8.2	10
	Base	8.2	10
	Collector	26	0
Q5 and Q6	Emitter	.5	16
	Base	1.0	16
	Collector	26	0
Q9, Q10	Emitter	.7	16
	Base	1.2	17
	Collector	26	0
Q11, Q12, Q13	Emitter	27	8
Q21, Q22, Q23	Base	26.5	8
	Collector	14	0 to 5
Q14, Q15, Q16	Emitter	1	8
	Base	1	8
Q18, Q19, Q20	Collector	14	0 to 5
Q17	Emitter	6 to 7.5	0

*These voltages are load dependent.

CIRCUIT REF.	VOLTAGE MEASUREMENT POINT	D.C.	VAC RMS	CIRCUIT REF.	TEST VOLTAGE MEASUREMENT POINT	D.C.	VAC RMS
Q7	Emitter	0	0	Q17	Base	6 to 7.5	0
	Base	-1.5 to -6*	0		Collector	8.2to9.2	0
	Collector	8 to 10	0	CR2, CR3	Anode	0	10
				CR6, CR7	Cathode	8	6
Q8	Emitter	8 to 9	0				
	Base	8.2 to 9.2	0	R11 and L2	Junction	-8.5	0
	Collector	8 to 20	0	CR4, CR5	Anodes	0	0 to 9*
					Cathode	-9 to +1	6 to 0

*These voltages are load dependent.

4.6 Servicing Practice and Replacement

Section 5.0 lists the table of replaceable parts. Figures 5.1 thru figure 5.7 illustrates the location of these components.

When installing or removing transistors, semiconductor diodes and heat sensitive components, grasp the lead between the solder joint and the component with a thermal dissipator, such as a spring loaded copper clip or long nose pliers. This will bleed off the heat being applied at the solder joint.

A temperature controlled soldering iron is recommended for such use. The wattage rating of the iron should not be greater than 35 watts. Always work with an iron that the tip is well tinned so the soldering can be done quickly and cleanly.

Power transistors Q5, Q6, Q9, thru Q16 and Q18 thru Q23 are insulated from ground. The insulating is done by means of insulating washers made of fiber and mica. When replacing these transistors, be sure washers are replaced in proper order and coating the washers with a film of silicone grease is recommended.

After such replacement, check with an ohmmeter to see that the insulation is effective.

NOTE TO SECTION V

N5.1 Component changes, additions, and relocations due to revisions and introduction of new model series are listed under each revision number and model series in the addenda section.

Following pages should be consulted for above informations.

REV. NO/MODEL SERIES	PAGE
Rev. 1, 2, 3	Incorporated
Rev. 4	53, 54, 56
Rev. 5	Incorporated
Rev. 6	58, 59, 60, 62
PC-15B	A1, A4, A8
PC-15D	A10
PC-15E	A12
PC-15F	A13, A15
PC-15G	A13, A17

N5.2 Addition to N5.1

Rev. 7	63
PC-15B( ) Series	63

N5.3 Any reference to PC-15 or PC-15A in this section is applicable to Model PC-15B( ) unless otherwise noted under PC-15B.

N5.4 Table 5.1 "Table of Replacable Parts" is updated as to manufacturer and part No. for equivalent or superior parts. Component changes and deletions due to revisions are not made to Table 5.1 in order to retain information on earlier units. Consult the serial number effectivity in the revision section for applicable changes.

Section V

Table of Replaceable Parts

5.1 General

This section illustrates and lists components that can be replaced for repair purposes. It is recommended that PC-15s requiring replacement of parts that are not listed in table 5.1, be returned to the factory for service.

Figures 5.1 through 5.7 illustrates the location of all the components that are listed in the Table of Replaceable Parts.

5.2 *Manufacturer's Code

Code	Name and Address
FT	Flite-Tronics Co., Inc. Burbank, California
KGS	K.G.S. Electronics, Inc. Pasadena, California
AB	Allen-Bradley Co. Milwaukee, Wisconsin
EI	Essex International Inc. Fort Wayne, Indiana
GUL	Gulton Industries, Inc. Metuchen, New Jersey
SAN	Sangamo Springfield, Illinois
NCI	National Capacitor Inc. West Palm Beach, Florida
ECI	Electro-Cube Pasadena, California
MOT	Motorola Phoenix, Arizona
FD	Fairchild Mountain View, California
DL	Diehl Mfg. Co. Finderne, New Jersey

(*Manufacturer may be substitued for equal or superior components.)

5.2 Manufacturer's Code (Continued)

Code	Name and Address
SEM	Semtech Newbury Park, California
W	Westinghouse Youngwood, Pennsylvania
SPG	Sprague Electric North Adams, Massachusetts
OHM	Ohmite Mfg. Co. Skokie, Illinois
BUS	Bussman St. Louis, Missouri
BR	Bourns Riverside, California
HTP	Hughes Semiconductor Newport Beach, California
IMB	IMB Electronic Products Inc. Santa Fe Springs, California
CR	Cal-R, Inc. Santa Monica, California
DLE	Dale Electronics, Inc. Columbus, Nebraska

5.3 Table 5.1 *Table of Replaceable Parts

CIRCUIT REFERENCE	QUANTITY	DESCRIPTION	SOURCE	FUNCTION
C1A, C1B, C14	2	Dual Capacitor 50 VDC 750-500 mfd 505-2052-02	SAN	Filter
C2, C11, C15 through C20	8	Capacitor 47 mfd 50 VDC HM47QD FTCS1697	NCI FT	Filter
C4, C5, C7, C8, C12	5	Capacitor 22 mfd 22 VDC HM22LD FTCS1693	NCI FT	Filter
C3	1	Capactor 15 ufd 30 VDC HM15MD	NCI	Filter
C6	1	Capacitor 33 ufd 15 VDC HM33JD	NCI	Filter
C9	1	Capacitor .02 ufd 200 VDC FT210B1C203M ZA2C203	ECI IMB	Bypass
C10	1	Capacitor .47 ufd 200VDC FT627A1C474J BV7C474J	ECI IMB	Osc. cap.
C13	1	Capacitor .47 ufd 400VDC FT625B1E474M BA2E474	ECI IMB	Power factor Correction
C21	1	Capacitor .0068 to .01 ufd select FT625B- BA7C-	ECI IMB	Bypass
C22	1	Capacitor .00 to .01 ufd select 200 VDCFT625B-,BA7C-	ECI IMB	Bypass
C23	1	When used for frequency lock .0047 ufd 600 VDC 625B	ECI	Freq. lock
CR1	1	Zener 6.2 VDC 1 watt 1N4735	MOT	Reference Voltage
CR2, CR3, CR4, CR5, CR6, CR7, CR9, CR10	8	Silicon diode FT100 200 piv 1N5393 SC2, SI2	W SEM	Rectifier
CR8	1	Zener 43 VDC 10 watt 1N 2993A	MOT	Reference Voltage

*Components may be substituted for equal or superior part.)

CIRCUIT REFERENCE	QUANTITY	DESCRIPTION	SOURCE	FUNCTION
F1	1	Fuse 3A GMT 3	BUS	Fuse
L1	1	Inductor FT #91027 KGS #343L	FT	Filter
L2-A, L2-B	1	Industor FT #85102 KGS #287L	FT	Filter
L3	1	Inductor FT #85103 KGS #290L	FT	Filter
J1	1	Connector, receptacle MS3102A18-9P	CAN	Input Receptacle
M1	1	D.C. Motor Ass'y SSFD6-21 FT3500 FT91038	DL FT	Blower
Q1, Q2	2	Transistor 2N3568/FT600	FAD FT	Push-Pull Osc.
Q3, Q4	2	Transistor 2N3568/FT600	FAD FT	Low Level Amp Push-Pull
Q5, Q6	2	Transistor FT601 2N3767	FT MOT	Push-Pull Interstage Am
Q7, Q8, Q17	3	Transistor 2N3568/FT600	FAD FT	ALC and OL
Q9, Q10	2	Transistor FT500 FT500/501	FT	Push-Pull Driver
Q11, Q12, Q13, Q21, Q22, Q23	6	Transistor FT460 FT459(*)	FT	Output Push-Pull
Q14, Q15, Q16, Q18, Q19, Q20	6	Transistor FT500 FT500/501	FT	Output Push-Pull Power
R1	1	Resistor 47 ohm ± 10% ½ watt	AB	Filter
R2, R5, R7	3	Resistor 3.9 kilohm ± 10% ½ watt	AB	Bias
R3	1	Resistor 680 ohm ± 20% ½ watt	AB	Bias
R4	1	Resistor 33 ohm ± 20% ½ watt	AB	Bias, degenerating
R6	1	Resistor 390 ohm ± 10% ½ watt	AB	Bias, degenerati-

*Revision No. 2

CIRCUIT REFERENCE	QUANTITY	DESCRIPTION	SOURCE	FUNCTION
R8	1	Resistor 3.3 kilohm ± 20% ½ watt	AB	Bias
R9	1	Resistor 560 ohm ± 5% ½ watt	AB	Bias
R10	1	Resistor 1 ohm 5 watt wire wound 995-5B #4530	OHM	Filter and degenerating, decoupling
R11, R12, R23	3	Resistor 10 kilohm ± 20% ½ watt	AB	Loading
R13	1	Resistor 820 ohm ±10% ½ watt	AB	Current Limiting
R14	1	Resistor, variable 2K to 2.5K ½W 2319-106-202 3065S-1-252	DLE BR	Level Control
R15	1	Resistor, variable 500 ohm ½ watt, 2319-501 3065S-1-501	DLE BR	Output Current Set
R16	1	Resistor 22 ohm 3 watt wire wound 242E2205, 4369	SPG OHM	Speed Reducer
R17	1	Resistor 180 ohm ± 10% ½ watt	AB	Degenerating
R19	1	Resistor optional 10 to 47 ohm ± 20% ½ watt	AB	Voltage Divider
R20	1	Thermister 100 ohm @ room temp. 21NE1, ID23	GUL CAL-R	Temperature Compensating
R22	1	Resistor 2.2 kilohm ± 10% ½ watt	AB	Level Control Divider
R24	1	Resistor 330 ohm ± 10% ½ watt	AB	Bias
R25	1	Resistor 270 ohm ± 10% ½ watt	AB	Osc. Phase Lock
S1	1	Thermostat 165° F. 430-545 FT3000	EI	Temperature Sensing
	1	Transformer Adjustable FT 85076A KGS #524T-E	FT	Transformer Inductor 400 HZ
T2	1	Transformer FT91028 KGS #746T	FT	Input

CIRCUIT REFERENCE	QUANTITY	DESCRIPTION	SOURCE	FUNCTION
T3	1	Transformer FT91029 KGS #714T	FT	Interstag
T4	1	Transformer FT91030C KGS #715T-3	FT	Driver
T5	1	Transformer FT91135 KGS #849T-2	FT	Power Output
T6	1	Transformer FT91136 KGS #850T	FT	Output Current Sense

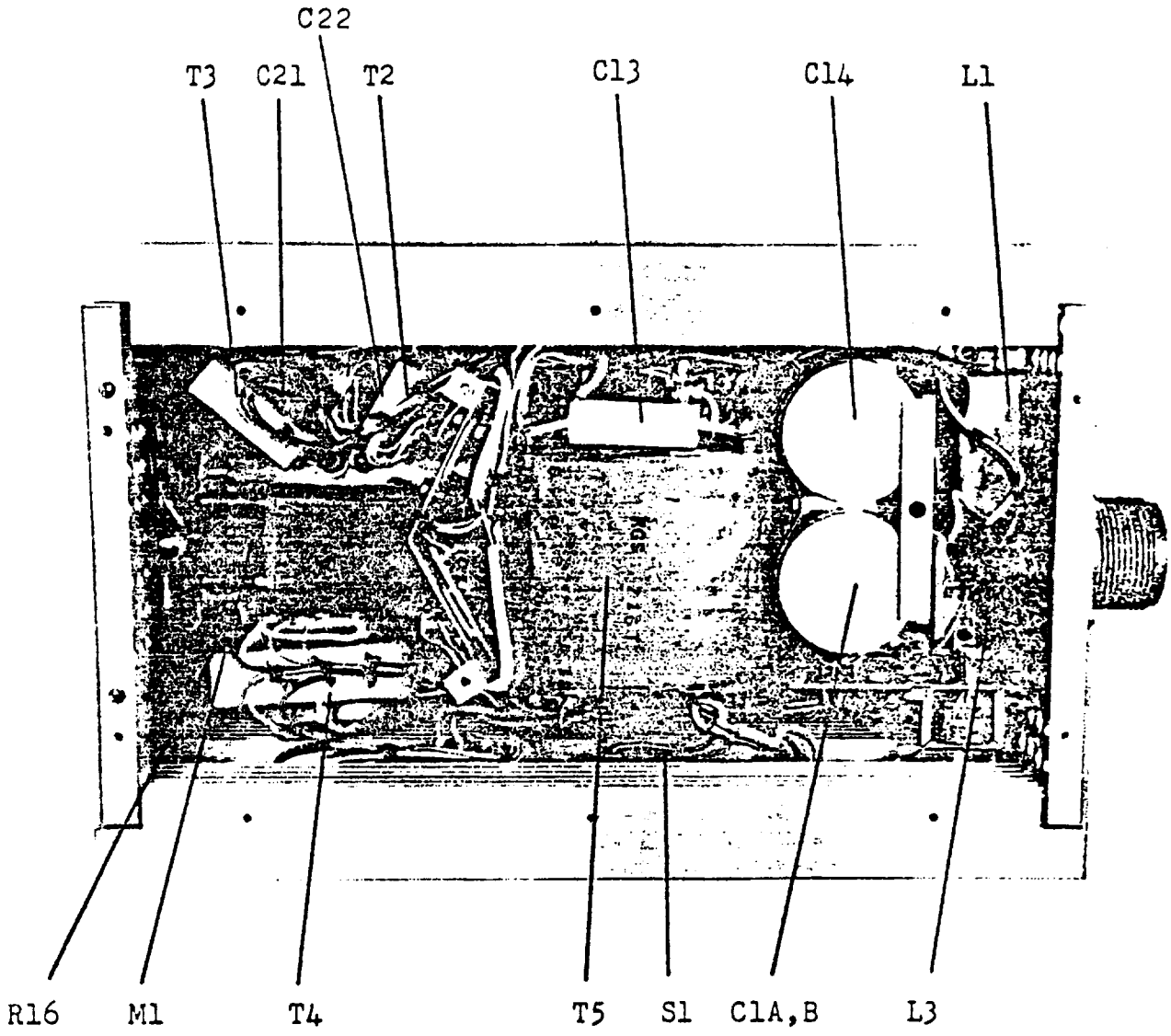


FIGURE 5.1 COMPONENT LAYOUT DUST COVER REMOVED

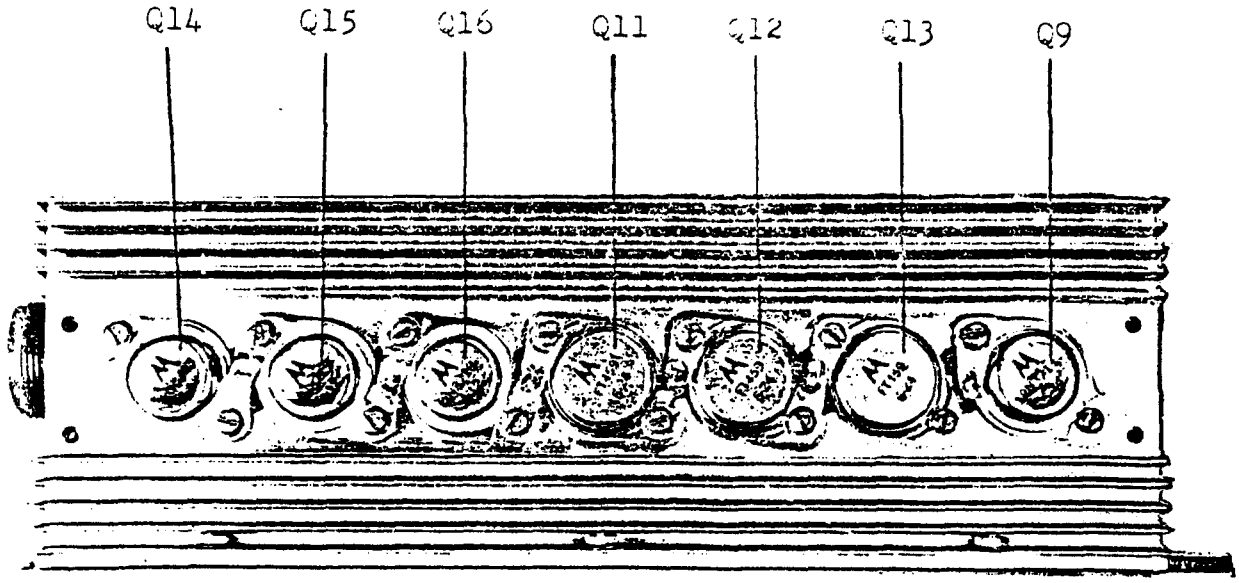


FIGURE 5.2 TRANSISTOR LAYOUT LEFT SIDE

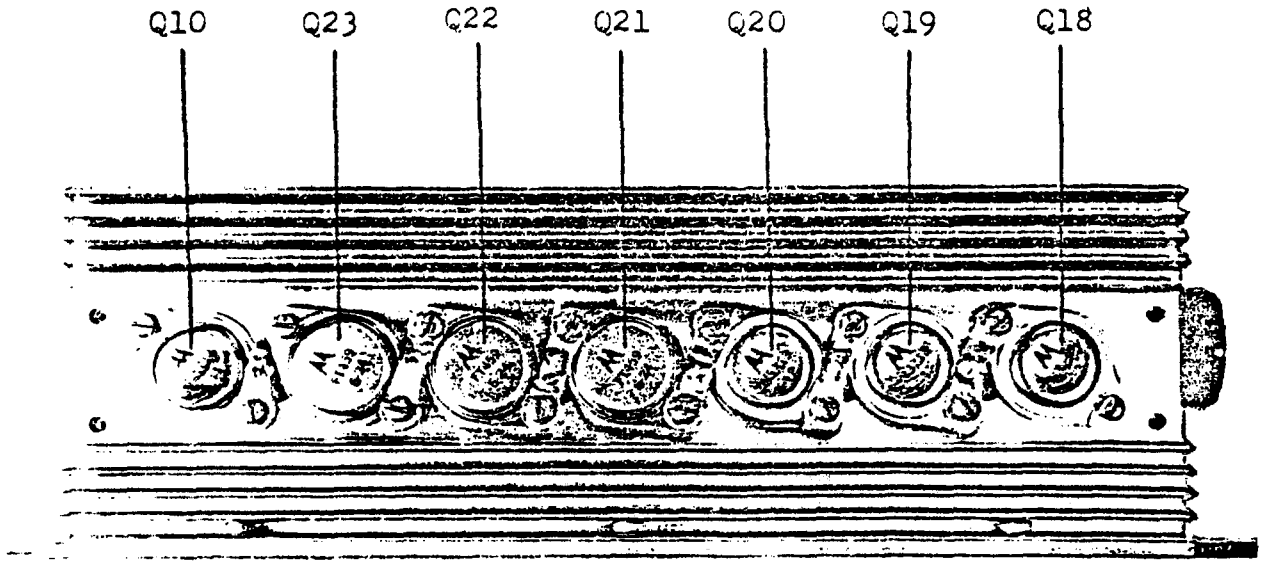


FIGURE 5.3 TRANSISTOR LAYOUT RIGHT SIDE

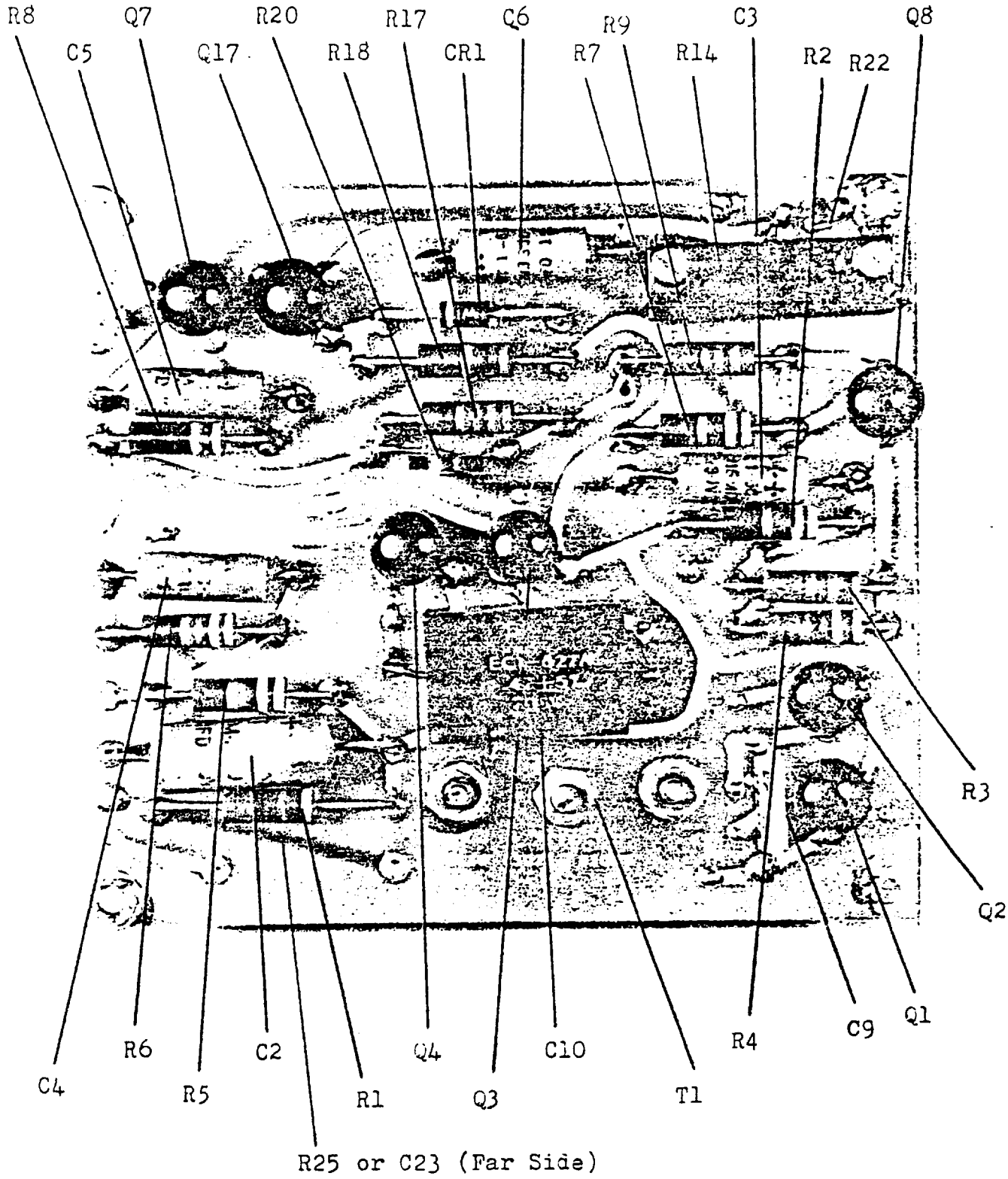


FIGURE 5.4 COMPONENT LAYOUT OSCILLATOR AND LOW LEVEL AMPLIFIER

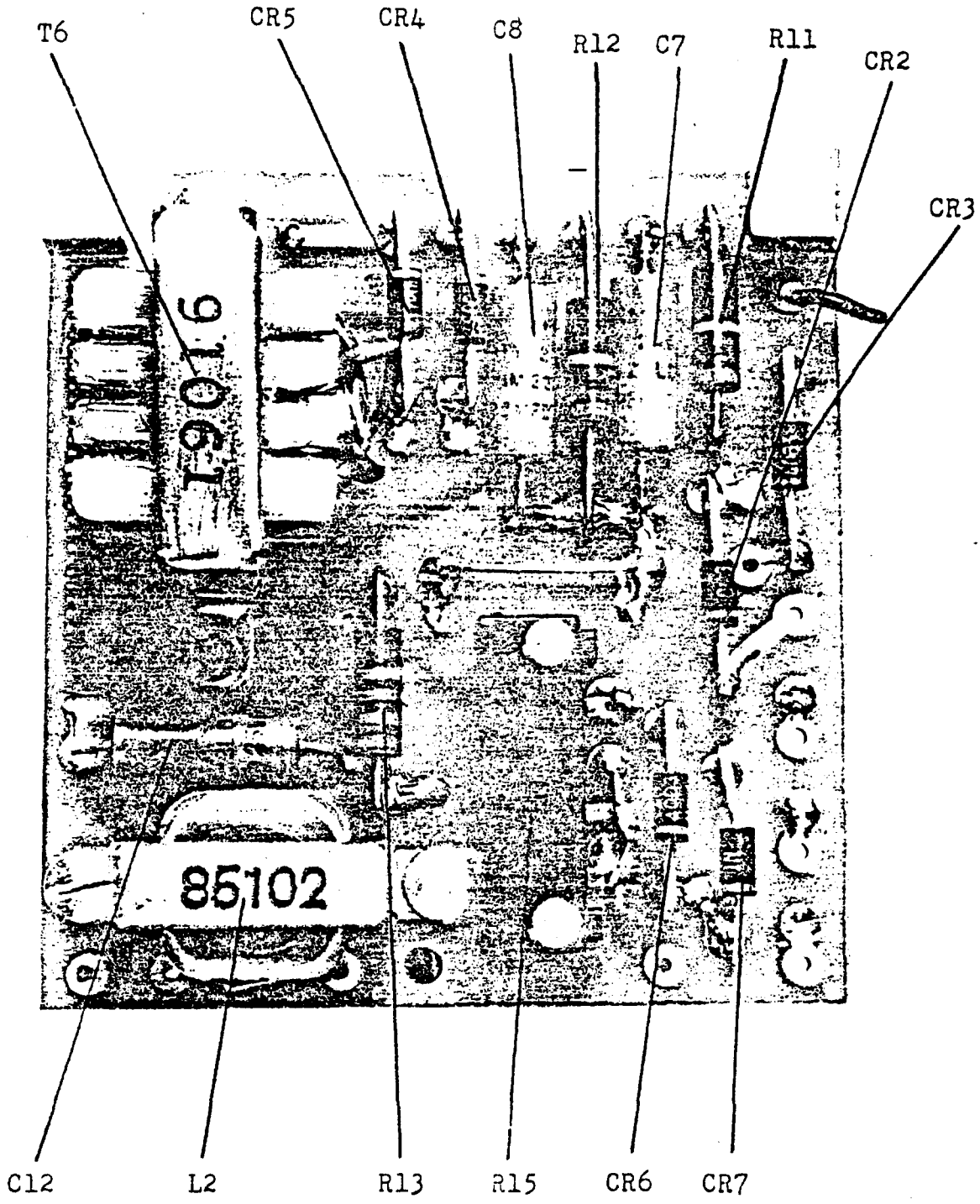


FIGURE 5.5 COMPONENT LAYOUT OL & ALC CIRCUIT

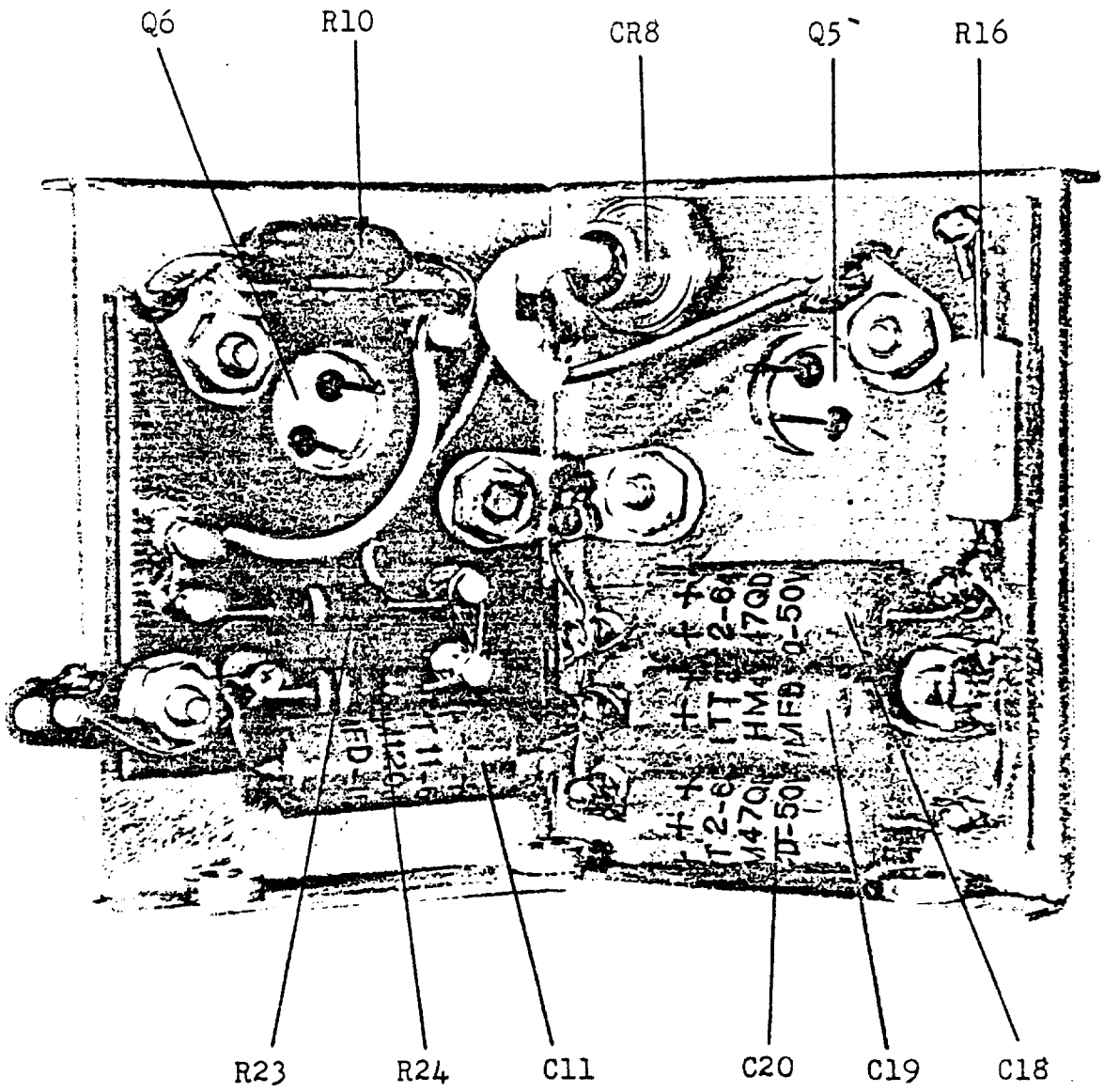


FIGURE 5.6 COMPONENT LAYOUT INTERSTAGE AMPLIFIER
LOCATION ONLY

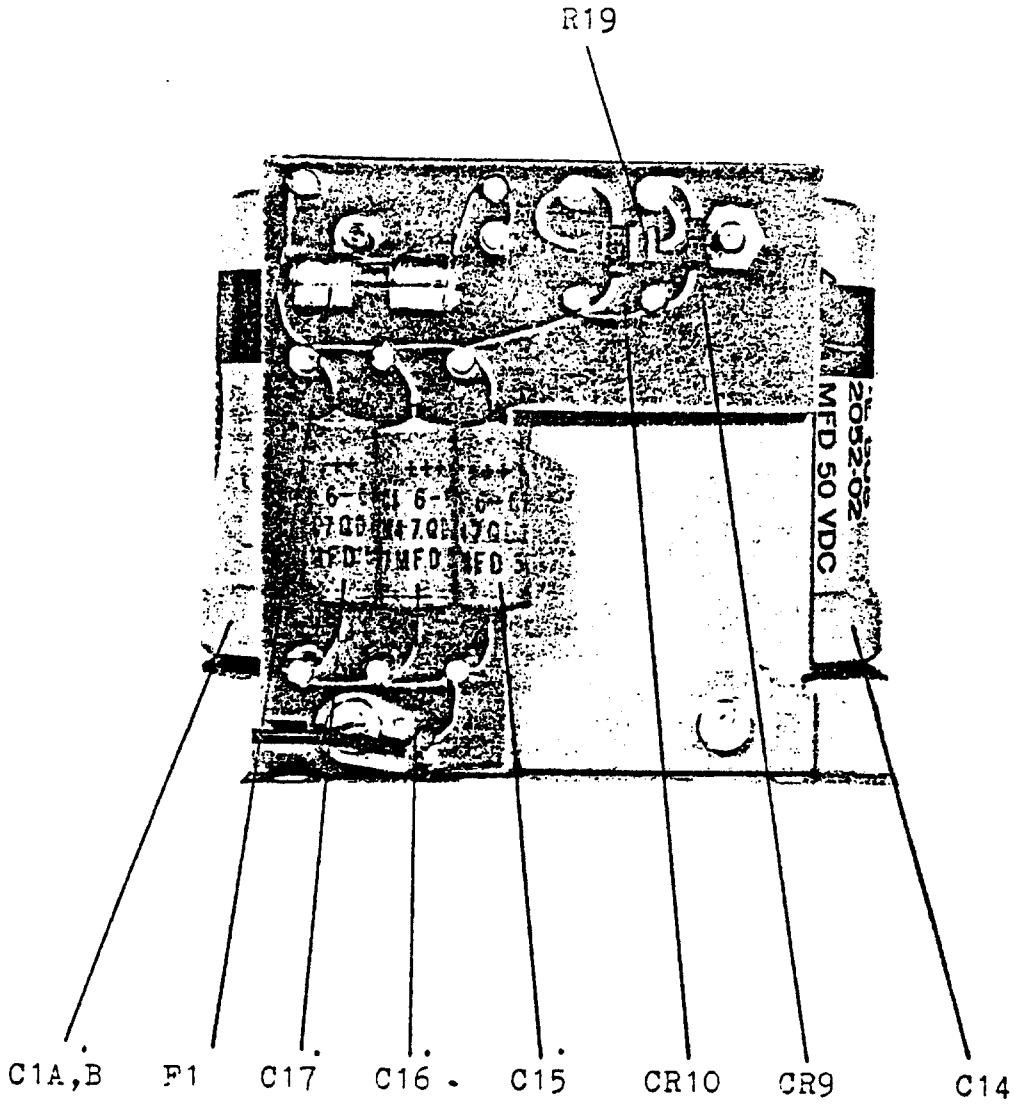


FIGURE 5.7 COMPONENT LAYOUT FILTER CAPACITOR

5.4 HOW TO ORDER REPLACEMENT PARTS

When ordering replacement parts, you should direct your order as indicated below and furnish the following information insofar as applicable.

ADDRESS: Flite-Tronics Co., Inc., Sales Service Department
3314 Burton Avenue
Burbank, California

INFORMATION NEEDED:

1. Quantity required.
2. Part Number (Obtain from parts list or schematic diagram.)
3. Type number and serial number of equipment.

5.5 HOW TO RETURN MATERIALS OR EQUIPMENT

If, for any reason, you should wish to return material or equipment, whether under warranty or otherwise, you should notify us, giving full particulars including the details listed below, insofar as applicable. Upon receipt of such notice, Flite-Tronics Co., Inc. will promptly advise you respecting the return. Failure to secure our advice prior to the forwarding of the goods, or failure to provide full particulars, may cause unnecessary delay in handling of your returned material.

ADDRESS: Flite-Tronics Co., Inc., Sales Service Department
3314 Burton Avenue
Burbank, California

INFORMATION NEEDED:

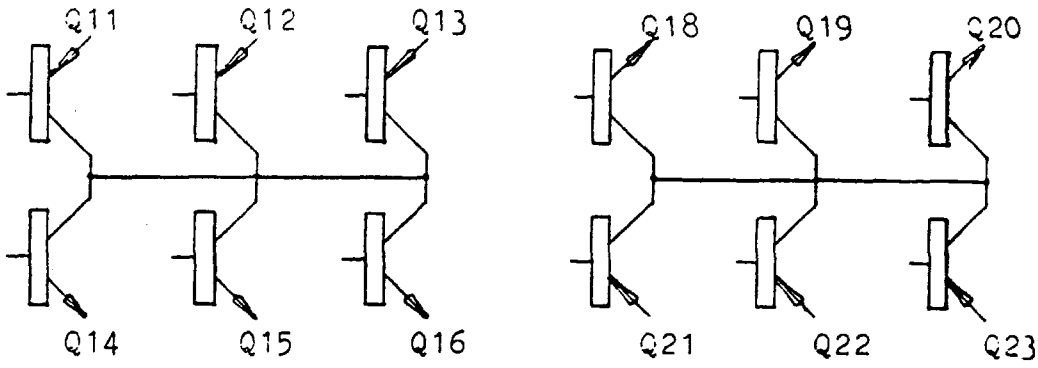
1. Date of delivery of equipment.
2. Date placed in service.
3. Number of hours in service.
4. Part number (obtain from parts list or schematic diagram).
5. Type number and serial number of equipment.
6. Nature and cause of failure.
7. Remarks.

SECTION VI REVISIONS

6.1 Revision No. 1

DESCRIPTION OF CHANGE — PAGE NO.

6.1.1 Electrical connection omission in the original manual. 14



Effectivity All Units

6.1.2 Note 4 Added 14

Resistor R25, Fuse F1
Effectivity
Serial number 312 and up.
Also including nos. 107, 120, 146, 155, 194, 201, 202, 225, 226, 229, 259, 261, 262, 276, 285 & 292.

6.1.3 Note 5 Added 14

Semiconductor diodes CR9 and CR10.
Effectivity
Serial number 349 and up.
Also including nos. 107, 120, 146, 155, 194, 201, 202, 225, 226, 229, 259, 261, 262, 285 & 292.

6.1.4 Note 6 Added 14

Use capacitor to frequency lock.
To other 115 VAC, 400 HZ line.
(C23 typically .0047 uf, 600V)
Phase lock with R25.

6.1.5 Note 7 Added 14

5 pin connector shown on Revision no. 1-5 Pin.

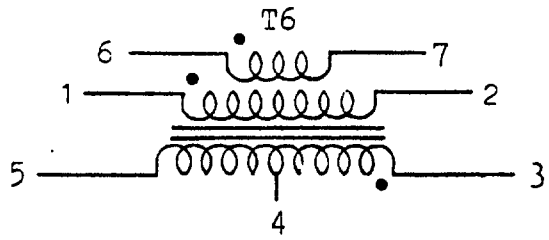
DESCRIPTION OF CHANGE	PAGE NO.

6.1.6 Revised: Call out of transistor type 2N3713 (Q14, Q15, Q16, Q18, Q19 & Q20) changed to FT501. (PC 15s may use either type.) When FT501 is used as a replacement or original installation, transistors Q14, Q15, Q16, Q18, Q19 & Q20 should all be the same device type. Also T4 is replaced with a FT91030B and connected per paragraph 6.1.10. — 14

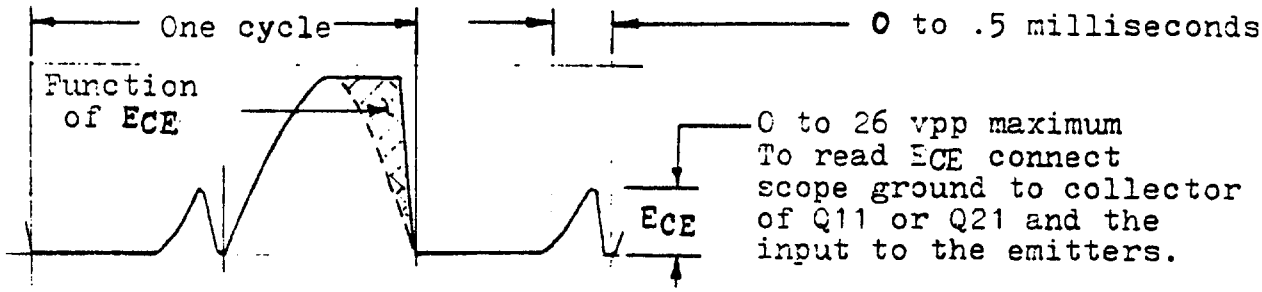
6.1.7 Revised: Call out of transistor type 2N3714 (Q9 & Q10) changed to FT500. (PC 15s may use either type.) When FT500 is used as a replacement or original installation, transistors Q9 & Q10 should be the same device type. — 14

6.1.8 Semiconductor type call out for CR2 thru CR7 deleted. — 14

6.1.9 Added: Schematic for secondary winding 6-7 to T6. Transformer FT91136 is a universal transformer and can be installed in place of FT91061. Winding 6-7 is used to sample the overload current for the 26.0 VAC output for the PC 15A. — 14



6.1.10 Added: Taps 2A and 4A to transformer T4 and designated FT91030B. This tap addition changes this transformer to a universal type. Taps 2A and 4A are used when the h_{FE} of transistors Q14, Q15, Q16, Q18, Q19 & Q20 are high. i.e. greater than 100 @ 2.0 Amps with VCE 2.0 VDC. Tap is selected electrically to give the following collector to emitter (E_{CE}) wave shape across Q11 and Q21. — 14, 39

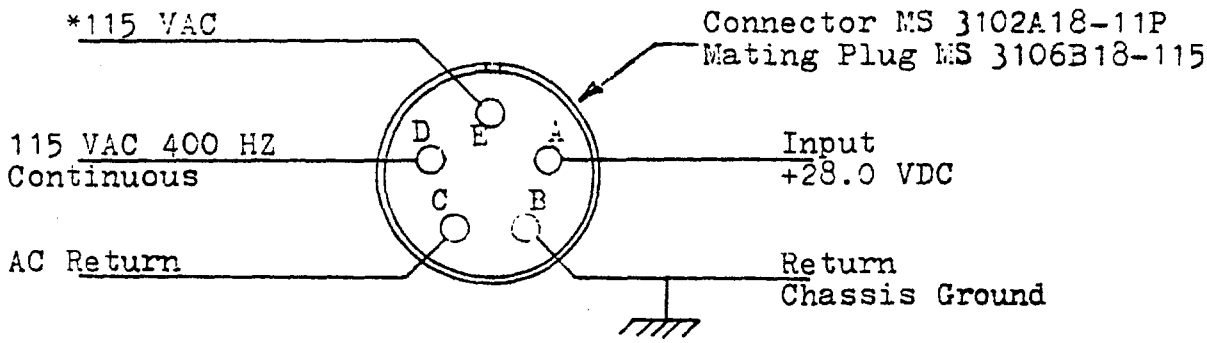


If E_{CE} is greater than 26.0 vpp it is recommended that the tap 2A and 4A be connected. PC 15s using transistor type FT501 will probably require the 2A and 4A connection. E_{CE} is the reading of importance the balance of the waveshape should not exceed 30 VPP.

	DESCRIPTION OF CHANGE	PAGE NO.
6.1.11	Added: Resistor R19, 10 to 47 ohms, ½ watt ± 20%. Optional.	14, 38
6.1.12	Updated regarding installation	7
	Added 1.375 DIM. Note: Correction 3 7/32 was 3 3/16.	8
	Added New Page	9, 10
	" " "	11, 15
	Updated	16, 17
	"	19, 20, 21
	Corrected to include testing of PC 15A	22
	Added New Page	23, 24
	Updated	25, 26
	"	27, 28
	Added Step 15 and Updated	29
	Added Step 16 and Updated	30
	Updated	34, 35, 36
	"	37, 38
	Changed: FT 91030B, KGS 715T-1 (Universal type for FT 91030, KGS 715T)	39
	Changed: FT 91135, KGS 849T (Universal type for FT 91031, KGS 716T)	39
	Changed: FT 91136, KGS 850T (Universal type for FT 91060, KGS 717T)	39
	Updated	41, 42
	Updated - R4 and C9 identification corrected	44
	Added - CR9, CR10, F1 and R19	45

6.2 PC-15 Revision No. 1 - 5 Pin

6.2.1 Electrical connection for the PC-15 having 5 pin. (5 pin connector units do not have paralleling capability)



* For emergency operation only 115 VAC output into a load of 225 VA at an input of 20 VDC.

ELECTRICAL CONNECTION DIAGRAM

6.2.2 Serial Number Effectivity

All PC-15 with serial numbers through 311 have the five pin connectors as shown in 6.2.1. Except units noted in paragraph 6.2.3 seven pin connector revision, which have been converted from five to seven pin.

Also the following units have five pin connectors. Serial Numbers: 423 thru 434, 498, 499, 502 thru 516, 552 thru 568, 498 and 592 thru 599.

6.2.3 Electrical connection for the seven pin connector are shown in the mounting details and schematics on pages 8, 9, 14 and 15 respectively.

PC-15 units with serial number 312 and up are seven pin connectors except those serial numbers shown in paragraph 6.2.2. Also the following units preceding serial number 312 have been converted to seven pin connectors. Serial Numbers: 201, 202, 226, 229, 261, 262 and 292.

6.3 Revision No. 2

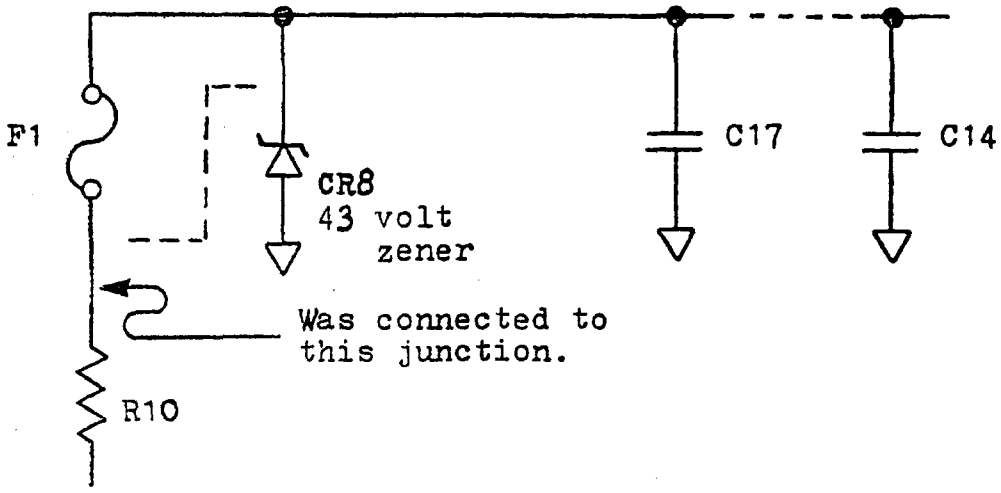
DESCRIPTION OF CHANGE	PAGE NO.
Effective on serial number 1471 and up. Transistors Q11, Q12, Q13, Q21, Q22 and Q23 can be type FT 459 or FT 460.	37

CAUTION: The use of either device type should not be mixed in a given PC-15( ).

6.4 Revision No. 3

Effective immediately and all units manufactured after serial number 1934.

Description of change: Connect zener CR8 as shown.



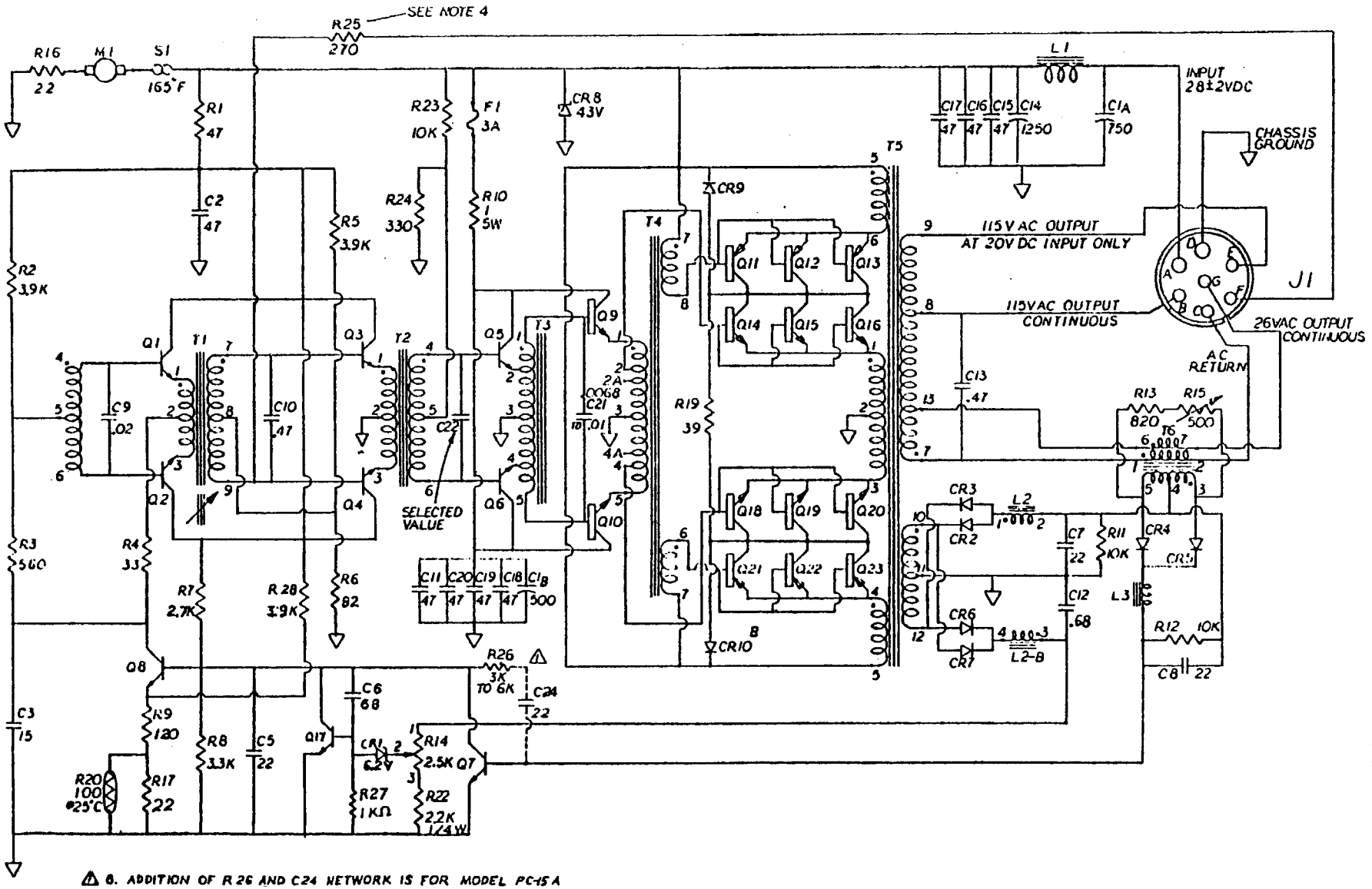
Reason for change: To prevent undesired rupturing of fuse F1 when zener CR8 is forced into conduction by a transient voltage exceeding 43 volts.

6.5 Revision No. 4

6.5.1 The Revision No. 4 applies to static inverter model PC-15( ) Series manufactured starting with serial number 2779. (Refer to Flite-Tronic's supplementary list of lower serial number units corrected to Revision 4). The purpose of this revision is to maintain a minimum output of 115 VAC -7% down to an input of 22 VDC and 100 VAC output down to an input of 20 VDC.

The following Rev. 4 changes are also shown in schematic on page 54 and in Figure 5.4A on page 56.

	DESCRIPTION OF REV. 4 CHANGES	AFFECTED PAGE NO.
6.5.1.1	C4 is deleted was 22 uf 25 VDC	14, 15, 36
6.5.1.2	C6 is 68 uf 6 VDC CL65BB680-UP3 was 33 uf 15 VDC	14, 15, 36
6.5.1.3	C12 is .68 uf 35 VDC A684K035 was 22 uf 25 VDC T310A684Ko35-AS	14, 15, 36
6.5.1.4	CR1 is 1N753A in base of Q17 was 1N4735 1W in emitter of Q17	14, 15, 3
6.5.1.5	R3 is 560 ohms was 680 ohms	14, 15, 37
6.5.1.6	R6 is 82 ohms was 390 ohms	14, 15, 37
6.5.1.7	R7 is 2.7 K ohms was 3.9 K ohms	14, 15, 37
6.5.1.8	R9 is 120 ohms was 560 ohms	14, 15, 38
6.5.1.9	R17 is 22 ohms was 180 ohms	14, 15, 38
6.5.1.10	R18 is deleted was 10 K ohms	14, 15, 38
6.5.1.11	R27 is 1 K ohm, ½ W added	
6.5.1.12	R28 3.9 K ohm, ½ W added	
6.5.1.13	Gray (8) lead wire from T1 is connected to junction of R5 and R6 was connected to the base of Q8	14, 15
6.5.1.14	Terminal 2 of T2 is grounded was connected to junction of R5 and R6	14, 15
6.5.1.15	Emitter of Q17 is grounded was connected to CR1 cathode	14, 15



⚠ 6. ADDITION OF R 26 AND C24 NETWORK IS FOR MODEL PC-15 A WITH LETTER A AFTER SERIAL NUMBER ONLY.

5. REVISION 4 CHANGE: SERIAL NO. EFFECTIVITY, SN 2779.

4. USE CAPACITOR C23 (TYPICALLY .0047 μF, 600V) TO FREQ. LOCK TO OTHER 115VAC 400HZ LINE, PHASE LOCK TO OTHER PC15A WITH R25

⚠ MATING PLUG FOR J1: MS 3106 B 18-9S.

2. CAPACITORS IN μF: C22 SELECTED AMONG VALUES BETWEEN .002 AND .0068 μF

1. RESISTORS IN OHMS: 1/2 W UNLESS OTHERWISE NOTED

NOTES

FIGURE 3.3A

B A	PC 15 A FE 166	4/71 1/71	4	4		DRAWN	7/1/67
						CHK'D	7/1/67
						APP'D	7/1/67

FLITE-TRONICS, INC.
8616 BURTON AVE., BURBANK, CALIF.

TITLE: PC15A SCHEMATIC

SCALE
MODEL PC15A
NEXT ASSY.
C 91003-1B

6.5.2 Description of changes and additions to the manual for Revision 4 modification to the PC-15( )

6.5.2.1 Add the following paragraph under Emergency Output Connections of Sec. II on page 7

The AC voltage from the normal output (Pin B) of the PC-15( ) after serial number 2779 shall be greater than 115 VAC -7% at 22 VDC input and greater than 100 VAC delivering up to 90% of rated load for an input battery condition of 20 VDC.

6.5.2.2 The second paragraph and the first sentence in the third paragraph Sec. 3.5 on page 17 is:
The output from terminal 8 (Pin B) shall be greater than 100 VAC working into 90% of rated load, during an input of 20 VDC and at least 115 VAC -7% with 22 VDC input. The output from terminal 9 is 115 VAC +5% -7% working into 90% of rated load, during an input between 19 VDC and 20 VDC on the A+ line.

This output, if needed, can be used only during emergency 20 VDC input condition and the load should be connected to Pin E of J1.

6.5.2.3 The second and third sentence in the second paragraph Sec. 3.6 is:
The variable portion of the resistor is connected to the base of Q17 via CR1. In essence, this output voltage sample is compared with zener CR1 in the base of Q17. "Resistor R18" of the next sentence is "Resistor R27"

6.5.2.4 Check procedure for Pin E output for Table 4.2, Sec. 4.4, on page 24, is as follows under each heading.

Model: PC-15( )
Load condition:Pin B output at 20 VDC input
Switch position:S4 on; S1 to #1; S5 thru S10 off; S11 to PC-15; S12 and S13 to 115 VAC
Input Voltage:Set to 20 VDC
Input Current:12 Amps typical
Output Voltage: 100 VAC minimum
Output Current: 1.72 Amps typical

6.5.2.5 Step 14, Table 4.3, page 29, is changed as follows:

6.5.2.5.1 Under Set Up
is "Switch S1 to #1"
was "Switch S1 to #2"

6.5.2.5.2 Under Reference reading
is "V2 read 100 VAC minimum"
was "V2 read 107 to 120.7 VAC"

6.5.2.6 DC voltage measurement changes for Q3 and Q4 Sec. 4.5, page 31
is "Emitter .1 to .4" was "Emitter 8.2"
is "Base .55" was "Base 8.2"

6.5.2.7 DC voltage measurement change for Q7, page 32
is "Collector 2.5 to 4" was "Collector 8 to 10"

6.5.2.8 DC voltage measurement change for Q17 page 31 and 32
is "Emitter 0" was "Emitter 6 to 7.5"
is "Base .5 to .7" was "Base 6 to 7.5"
is "Collector 2.5 to 4" was "Collector 8.2 to 9.2"

6.5.2.9 DC voltage measurement change for Q8 page 32
is "Emitter 2 to 3.5" was "Emitter 8 to 9"
is "Base 2.5 to 4" was "Base 8.2 to 9.2"

6.5.2.10 Figure 5.4 on page 42 is Figure 5.4A as shown below

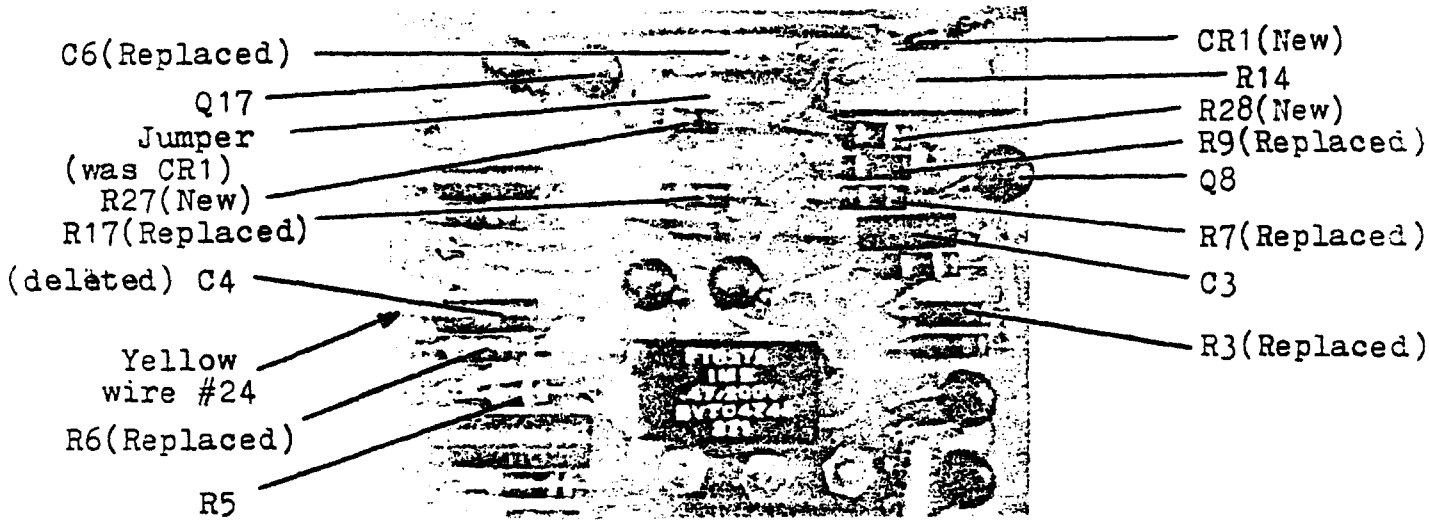


Figure 5.4A component layout changes reflecting Rev. 4

6.6 Revision No. 5

6.6.1 Heading "Service Bulletin" on page 51 is changed to read "Revision". The change is to improve classification.

6.6.2 Heading "PC-15 Service Bulletin No. 1" in Sec. 6.2 is changed to read "PC-15 Revision No. 1-5 Pin". The change is to improve classification.

6.6.3 R22 is 2.2 K ohms was 2.7 K ohms on pages 14, 15 and 38. Typographic error.

6.6.4 R13 is 820 ohms was 560 ohms on page 38. Typographic error.

6.6.5 R1 on page 21 and 22 is 1.16K ohms for 4% load was 1.2K ohms. Serial number effectivity: None

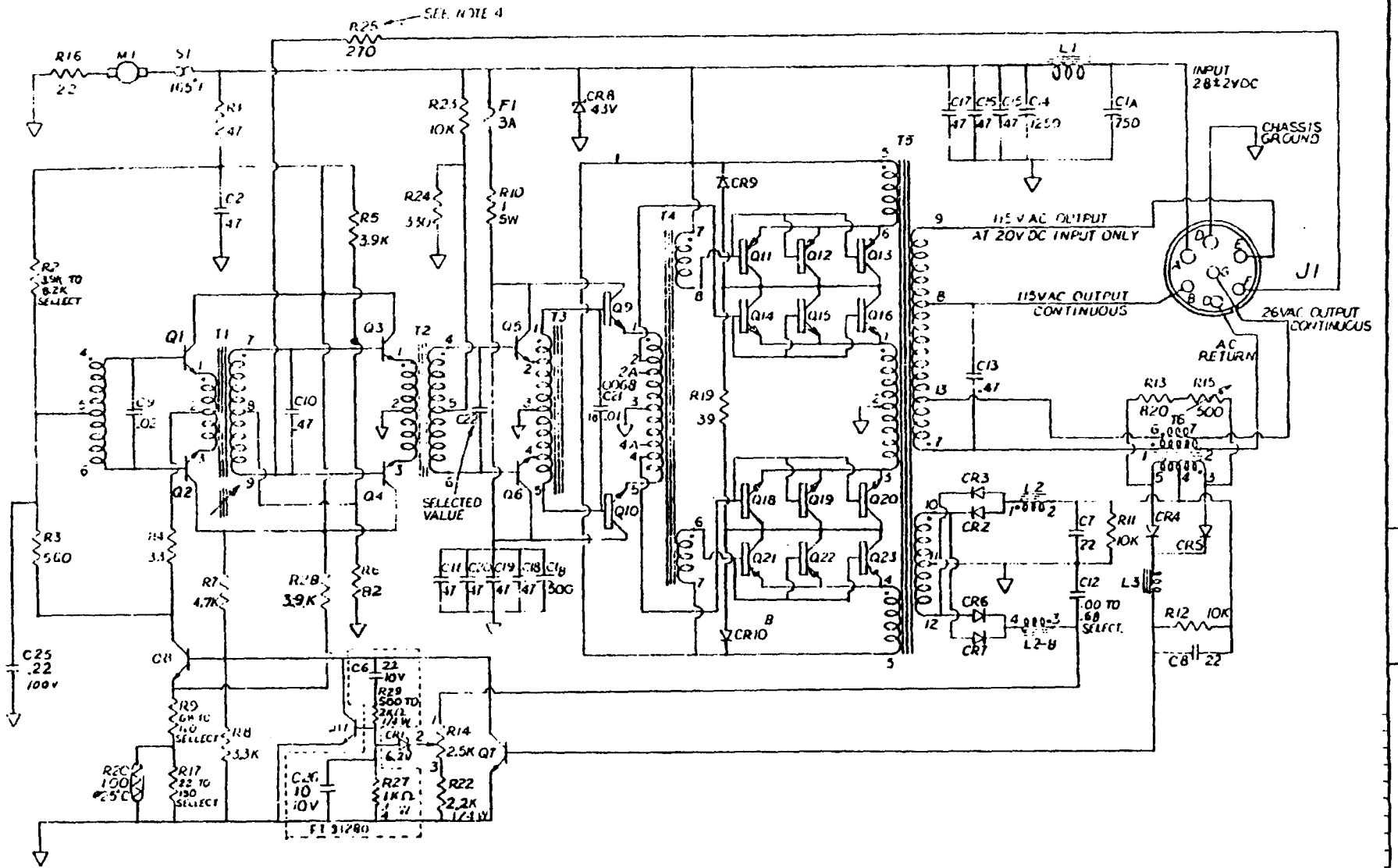
6.7 Revision No. 6

6.7.1 The Revision No. 6 applies to all static inverter model PC-15( ) Series manufactured starting with Serial number 3174 except 3176 and 3177. (Refer to Flite-Tronic's supplementary list of lower serial number units corrected to Revision No. 6)
The purpose of this revision is to improve the frequency response of the unit to decrease the effect of low frequency ripple and transient on the 28VDC bus from appearing on 115VAC output.

The changes for Revision No. 6 are shown in the schematic on page 59 and 60. Figure 5.4B on page 62 is component layout.

6.7.2 Description of Rev. 6 Changes	Affected Page No.
6.7.2.1 C_3 is deleted, was 15uf 50VDC	14, 15, 36, 42, 56 A8, A9, A10, A12
6.7.2.2 C_5 is deleted, was 22uf 25VDC	14, 15, 36, 42, 54, 56, A8, A9, A10, A12
*6.7.2.3 C_6 is 22uf 10Vdc, CS13BC226K CCL-010-226	14, 15, 36, 42, 54, 56, A8 A9 A10, A12
6.7.2.4 C12 is selected between 0 and .68uf, 35VDC, was .68uf 35VDC	14, 15, 36, 42, 54, 56, A8, A9, A10, A12
6.7.2.5 C25, .22uf 100VDC, BA2B224K added DA2B224K	
6.7.2.6 C26 10uf 10VDC. CS13BC106K added CCM-010-106	
6.7.2.7 R_2 is 5.6K ohms selected was 3.9K ohms	14, 15, 37, 42, 54, 56, A8, A9, A10, A12
6.7.2.8 R_7 is 4.7K ohms selected was 2.7K ohms	14, 15, 37, 42, 54, 56, A8, A9, A10, A12
6.7.2.9 R_9 is 82 ohms selected, was 120 ohms	14, 15, 38, 42, 54, 56, A8, A9, A10, A12
6.7.2.10 R_{17} is 75 ohms selected, was 22 ohms	14, 15, 38, 42, 54, 56, A8, A9, A10, A12
*6.7.2.11 R_{29}, $\frac{1}{4}$W 500 ohms to 2K ohms selected, added in series with C_6	
*6.7.2.12 R_{27} is $\frac{1}{4}$W, was $\frac{1}{2}$W	53, 54, 56, A8, A9, A10, A12

*These Components are encapsulated in a module identified as FT 91280 in Model PC-15( ) with serial numbers between 3174 and 3261 inclusive except 3176 and 3177.



5. REV G CHANGE: S/N EFFECTIVITY 3174, 3175, 3178 AND UP.
4. USE CAPACITOR C43 (TYPICALLY .0047 μF, 600V) TO FREQ LOCK TO OTHER 115VAC 400HZ LINE, PHASE LOCK TO OTHER PC15A WITH R25
3. MATING PLUG FOR J1: MS 3106B 18-9S
2. CAPACITORS IN μF. C22 SELECTED AMONG FOUR VALUES FROM .02 TO .0068 μF
1. RESISTORS IN OHMS: 1/2 W UNLESS OTHERWISE NOTED

NOTES

FIGURE 3.3B

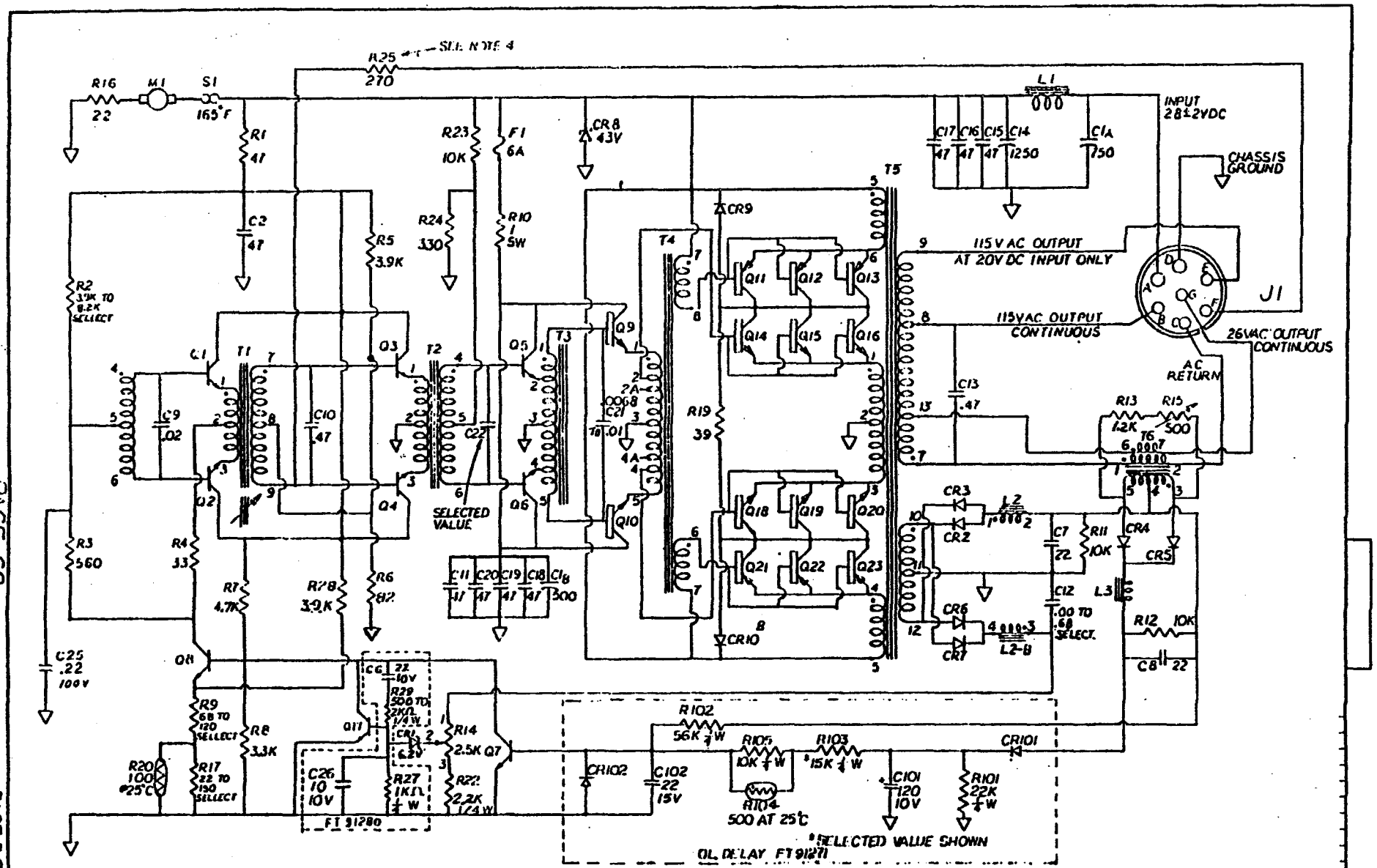
FLITE-TRONICS, INC.
8015 GLENTON AVE., BURBANK, CALIF.

PC15A SCHEMATIC

C 91003-1E

PAGE 59

PAGE 2 OF 5 REV G



NOTES

6. REV G CHANGES S/N EFFECTIVITY, 3174, 3175, 3178 AND UP.
5. PC15B TO TRIP 1A C.B. WITH NORMAL CHARACTERISTIC.
4. USE CAPACITOR C23 (TYPICALLY .0047 μF, 600V.) TO FREQ. LOCK TO OTHER 115VAC 400HZ LINE, PHASE LOCK TO OTHER PC15B WITH R25
3. MATING PLUG FOR J1: MS 3106B 18-9S.
2. CAPACITORS IN μF: C22 SELECTED AMONG VALUES BETWEEN .0012 AND .0068 μF
1. RESISTORS IN OHMS: 1/2 W UNLESS OTHERWISE NOTED

FIGURE 3.3-1B

FLITE-TRONICS, INC.
3818 BURTON AVE., BURBANK, CALIF.

PC15B SCHEMATIC

C 91003-2C

PAGE 60

PAGE 3 OF 5 REV 6

6.7.3 Description of Changes and Additions to the Manual for Revision No. 6 Modifications to the PC-15( ).

6.7.3.1 Add the following sentence at the end of 4th paragraph under Sec. 3.3, Page 16.
Capacitor C25 suppresses any tendency for low frequency motor boating.

6.7.3.2 Add the following sentence at the end of the second paragraph under Sec. 3.6. (Refer also to Rev. 4 changes under Sec. 6.5.2.3, Page 55)
RC network formed by C6, R29 and C26 at the base of Q17 compensate the closed loop circuit gain over operating temperature range and prevents the automatic level control circuitry from motor boating.

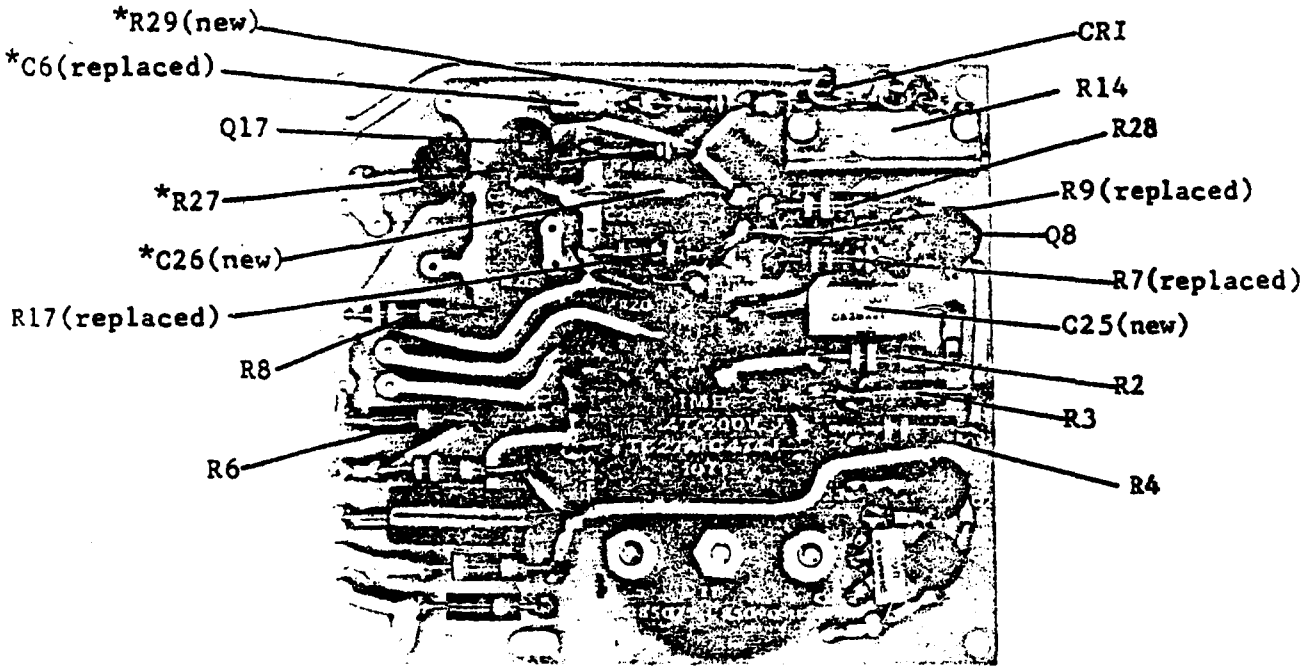
6.7.3.3 Delete the entire seventh paragraph under Sec. 3.6, Page 17.

6.7.3.4 AC voltage measurement change for Q7, Sec. 4.5, Page 32.
is "collector .1 to .2" was "Emitter 0"

6.7.3.5 AC voltage measurement change for Q8, Page 32
is "Emitter .1 to .2" was "Emitter 0"
is "Base .1 to .2" was "Base 0"
is "Collector .2 to.4" was "Collector 0"

6.7.3.6 AC voltage measurement change for Q17, Page 32
is "Collector .1 to .2" was "Collector 0"

6.7.3.7 Figure 5.4 on Page 56 is Figure 5.4B as Shown Below



* Refer to * mark note on page 58 for detail

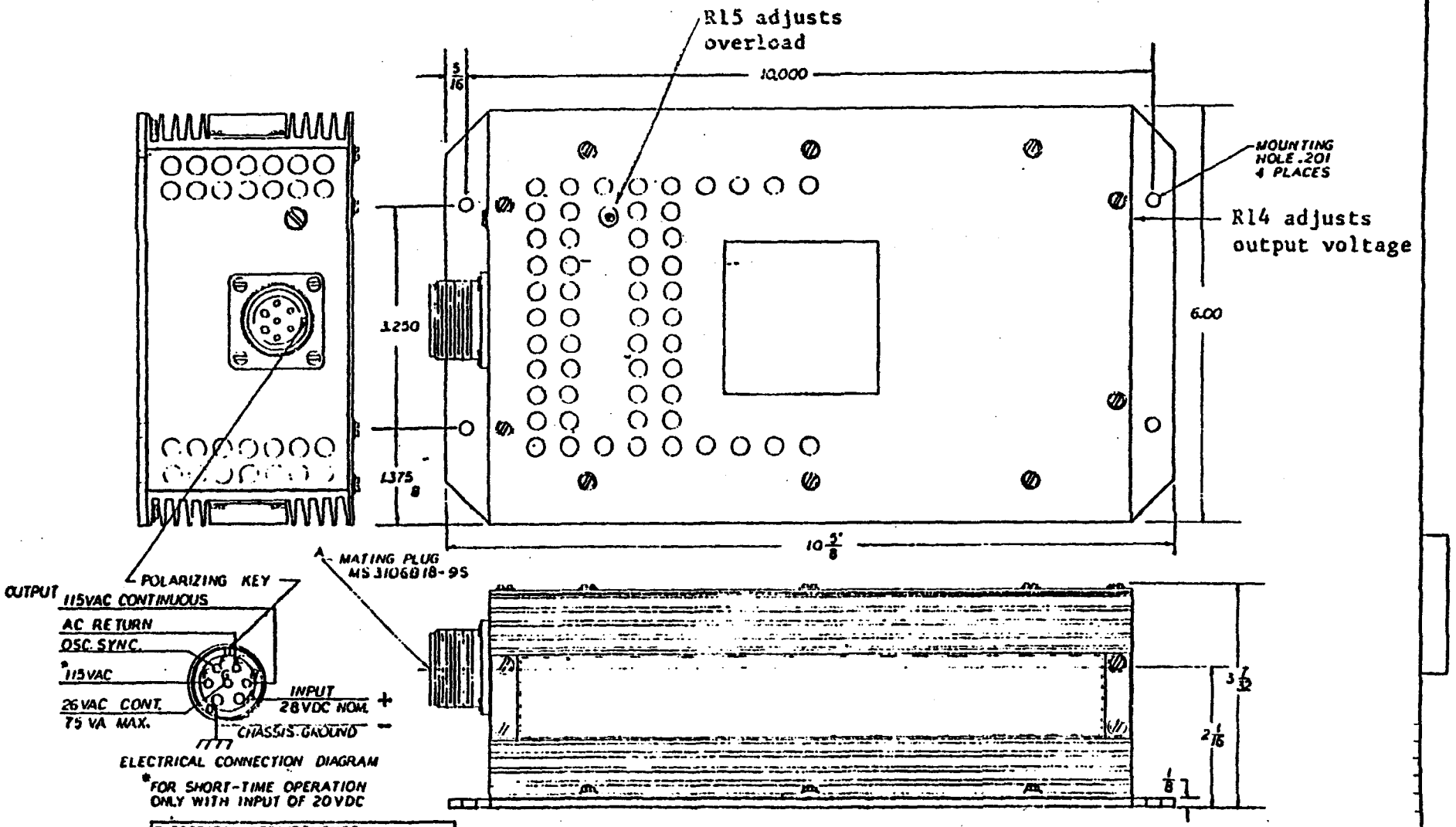
FIGURE 5.4B Component Layout changes reflecting Revision No. 6.

6.8 Revision No. 7

6.8.1 Revision No. 7 applies to all 250 VA static inverter model series manufactured starting with Serial Number 3700

The purpose of this revision is to incorporate model identification change.

MODEL ID IS	MODEL ID WAS
PC-15B( )	PC-15B
PC-15B(D)	PC-15D
PC-15B(E)	PC-15E
PC-15B(F)	PC-15F
PC-15B(G)	PC-15G



ELECTRICAL REQUIREMENTS		
INPUT	VOLTAGE: DC, NOM.	28
OUTPUT	POWER: VA TOTAL	250
	VOLTAGE: AC	115, 26
	FREQUENCY: HZ	400
	POWER FACTOR	.8 TO 1
	PHASE	1
EFFICIENCY	% AT FULL LOAD	70
ALTITUDE	FEET	45000
WEIGHT	POUNDS	8.2

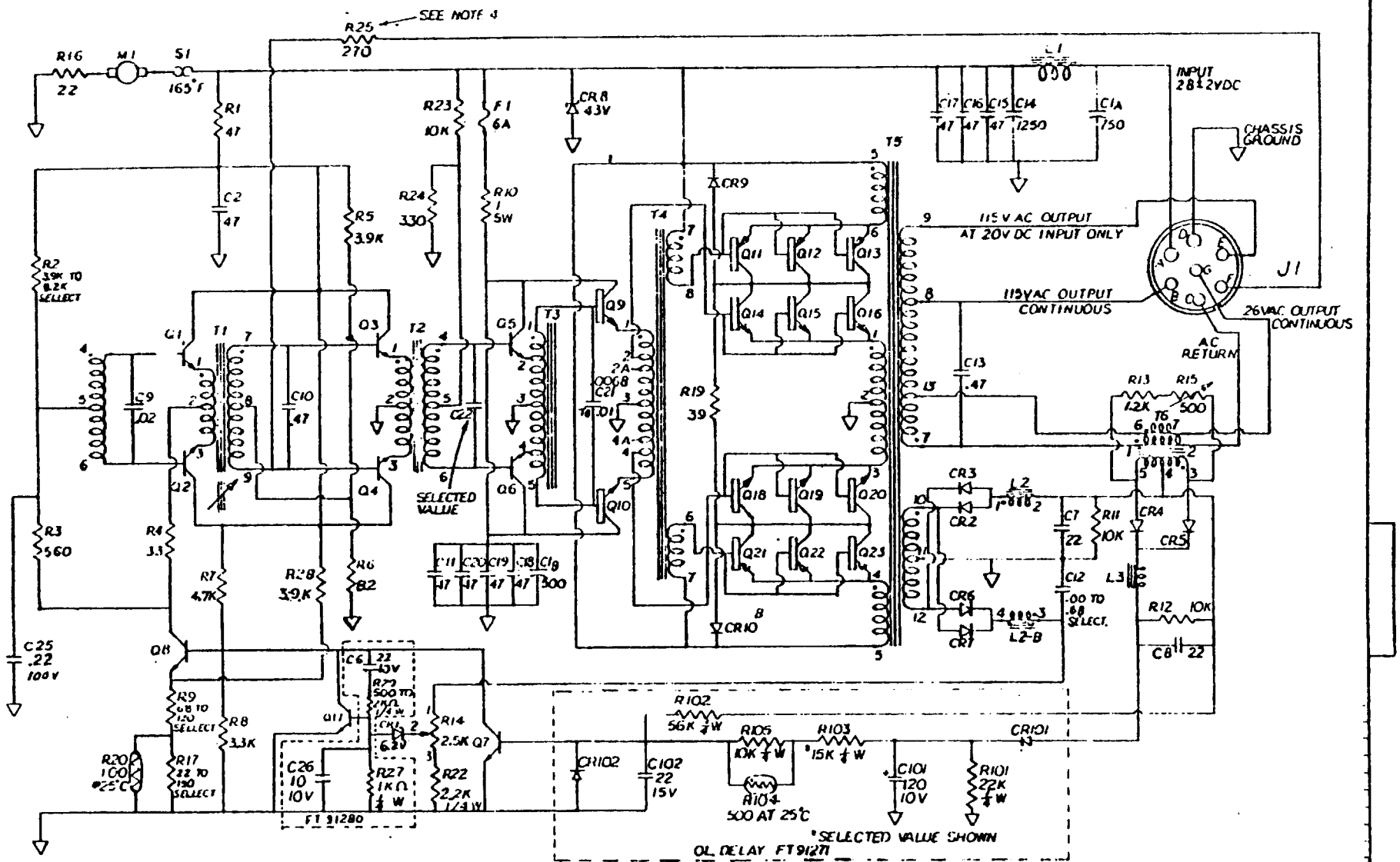
FIGURE 2.2-1A
INSTALLATION AND
MOUNTING DIMENSIONS

FLITE-TRONICS, INC.
8610 SUNLAND AVE., SUNLAND, CALIF.

TITLE: PC15B() STATIC INVERTER MOUNTING DETAILS

SCALE FULL
MODEL PC15B()
NEXT ASSY.
SIZE C
DWG NO 91008-2A

PAGE 9-1A



6. REV. 7 CHANGE: S/N EFFECTIVITY, 3700
5. REV. 6 CHANGE: S/N EFFECTIVITY, 3174, 3175, 3178 AND UP.
4. USE CAPACITOR C23 (TYPICALLY .0047 μF, 600V.) TO FREQ. LOCK TO OTHER 115VAC 400Hz LINE, PHASE LOCK TO OTHER PC15B() WITH R25
3. MATING PLUG FOR J1: MS 3106B 18-9S.
2. CAPACITORS IN μF: C22 SELECTED AMONG VALUES BETWEEN .0012 AND .0068 μF
1. RESISTORS IN OHMS: 1/2 W UNLESS OTHERWISE NOTED

NOTES

FIGURE 3.3-1C

FLITE-TRONICS, INC.

PC15B()
SCHEMATIC

C 91003-2D

PAGE 65

6.9 Revision No. 8

6.9.1 The Revision No. 8 applies when applicable(shown by *) to all 250 VA static inverter model series manufactured starting with following serial numbers.

MODEL	*SERIAL NUMBER EFFECTIVITY
PC-15B( )	4101
PC-15B(D)	40
PC-15B(E)	82
PC-15B(F)	4101
PC-15B(G)	4101

The purpose of this revision is to incorporate improvement changes and correct printing errors.

* Changes are shown in schematics on Page 68 for PC-15B( ) and on Pages A10, A12, A15 and A17 for other model series.

	DESCRIPTION OF REV. 8 CHANGES	AFFECTED PAGE NO.
* 6.9.1.1	CR9 and CR10 deleted	14,15,36,45,48 50,54,59,60,65 A8,A9,
* 6.9.1.2	R14 is 2K to 2.5K ohms was 2.5K	14,15,38,42,56 54,59,60,62,65 A8,A9
* 6.9.1.3	PC-15D schematic on Page A10 is replaced by PC-15B(D) schematic	A0, A6
* 6.9.1.4	PC-15E schematic on Page A12 is replaced by PC-15B(E) schematic	A0, A6
* 6.9.1.5	PC-15F schematic on Page A15 is replaced by PC-15B(F) schematic	A0, A13
* 6.9.1.6	PC-15G schematic on Page A17 is replaced by PC-15B(G) schematic	A0, A13
6.9.1.7	Warranty page deleted from manual, was on page 46	46
6.9.1.8	Step 6, Table 4.3, page 26	
6.9.1.8.1	Under performance reading is: I_2 read typically 2.17 Amps AC was: I_2^2 read 2.17 Amps AC	

6.9.1.9 Step 8, Table 4.3, page 27 under performance reading
is: I_1 should read approximately 24 Amps.
was: I_1 should read 24 Amps

6.9.1.10 Step 10, Table 4.3 page 27 under performance reading
is: I_2 less than 1.4 Amps, was: I_2 less than 1 amp.

6.9.1.11 Step 11, Table 4.3, page 28, under procedure b)
is: 26 to 30VDC
was: 28 to 30 VDC

6.9.1.12 Step 12, Table 4.3, page 28, under performance reading
is: I_1 read 5.5 Amps
was: I_1 read 5.0 Amps

6.9.1.13 Step 14 Table 4.3, page 29 under performance reading
is: I_2 should read 1.80 to 2.12 Amps AC
was: I_2 should read 1.93 to 2.12 Amps AC

6.9.1.14 Paragraph 6.5.2.4 of Rev. 4, page 55 is revised to read as follows:

Check procedure for pin E output for Table 4.2, Sec. 4.4, on page 24 is changed as follows under each heading.

Model:	PC-15( ) after serial number 2779
Load Condition:	Pin B output at 20 VDC and at 22 VDC input
Switch Position:	S4 on; S1 to #1; S5 thru S10 off; S11 to PC-15; S12 and S13 to 115VAC
Input Voltage:	Set to 20VDC and then to 22VDC
Input Current:	Approximately 15Amps @20V and @22VDC
Output Voltage:	100VAC min @20VDC input and 107VAC min at 22VDC input
Output Current:	1.64Amp min. @20 VDC input and 1.80 amp min. at 22VDC input

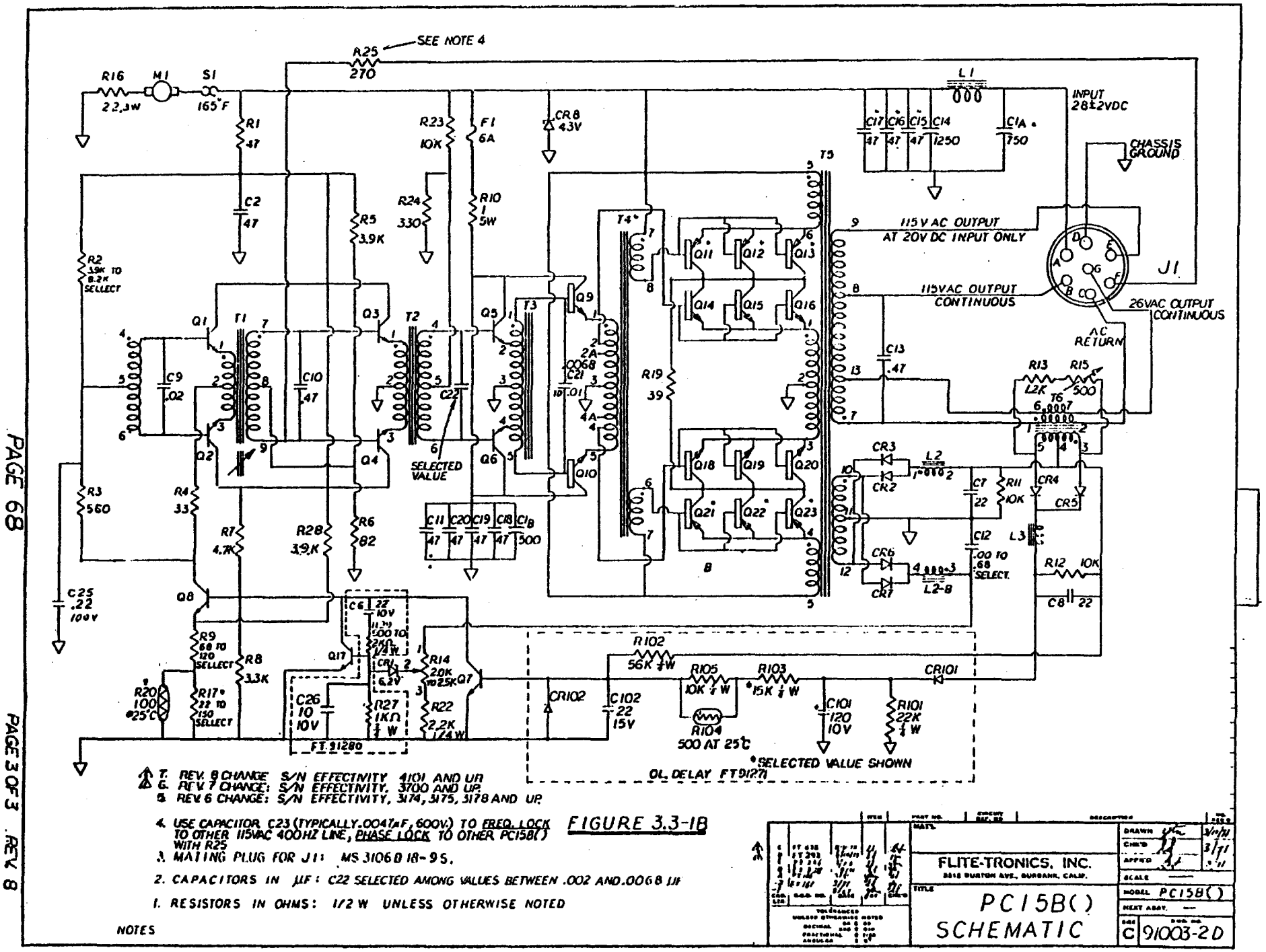
6.9.1.15 Add following to paragraph 6.5.2.5 of Rev. 4, page 55 as paragraph 6.5.2.5.3:

6.5.2.5.3 a) After 20VDC input voltage check is made set input voltage to 22 VDC

b) V_2 should read 107.0 to 120.7VAC

c) I_2 should read 1.8A to 2.12A

d) I_1 should read approximately 14A



⚠7. REV. 8 CHANGE S/N EFFECTIVITY 4101 AND UP.
⚠6. REV 7 CHANGE: S/N EFFECTIVITY, 3700 AND UP.
⚠5. REV 6 CHANGE: S/N EFFECTIVITY, 3174, 3175, 3178 AND UP.

4. USE CAPACITOR C23 (TYPICALLY .0047μF, 600V.) TO FREQ. LOCK TO OTHER 115VAC 400HZ LINE, PHASE LOCK TO OTHER PC15B() WITH R25
3. MATING PLUG FOR J1: MS 3106B 18-9S.
2. CAPACITORS IN μF: C22 SELECTED AMONG VALUES BETWEEN .002 AND .0068 μF
1. RESISTORS IN OHMS: 1/2 W UNLESS OTHERWISE NOTED

NOTES

FIGURE 3.3-1B

FLITE-TRONICS, INC.	DRAWN 3/11/71
8515 BURTON AVE., BURBANK, CALIF.	CHK'D 3/11/71
TITLE PC15B() SCHEMATIC	APP'D
	SCALE —
	MODEL PC15B()
	NEXT ASSY. —
	SIZE C DOC. NO. 91003-2D

6.10 Revision No. 9 is applicable to Model PC-15BC( ). The serial number effectivity for the PC-15BC( ) is 5100 and up. The purpose of this revision is to maintain the reliability using currently available state of the art components. The changes are shown in the schematic on Page 71 and listed below. This change was also necessitated due to the fact that germanium devices are now extremely difficult to purchase and as a result the manufacturers are reluctant to supply these devices to our stringent specifications FT460.

6.10.1 The following components are deleted:

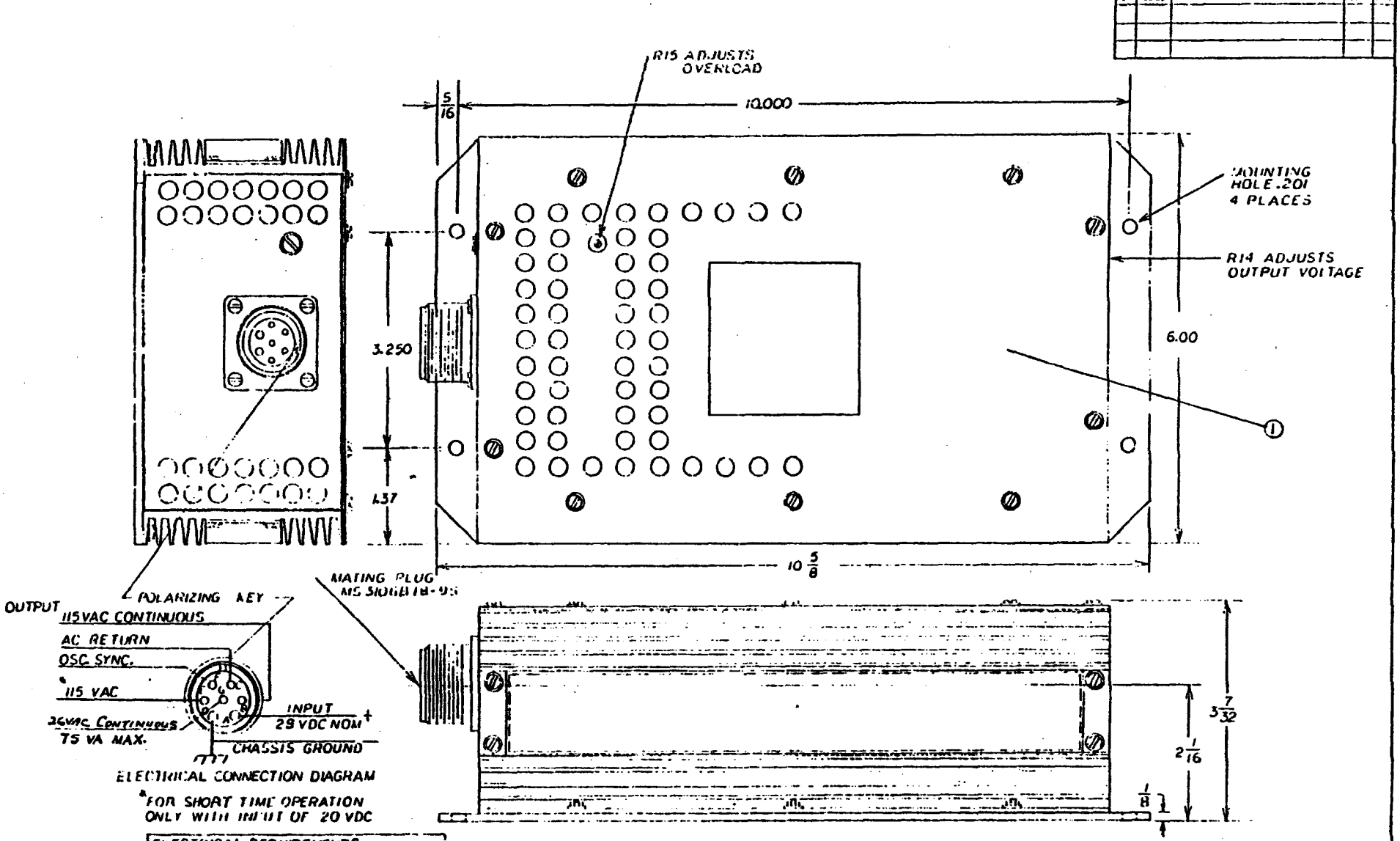
			AFFECTED PAGE NO.
C1B	Capacitor	500 ufd	36,45
C15, C16, C17	Capacitor	47 ufd	36,45
R17	Resistor	75 ohms	38,42,58
R20	Thermistor	100 ohms @ 25°C	38,42
Q11, Q12, Q13 Q21, Q22, Q23	Germanium Transistor	FT 460	37,41,52
T4	Transformer	FT 91030C	39,40

6.10.2 The following components are changed:

	IS	WAS	
C1 Capacitor	1800 ufd, 40 VDC SPG #602D182G040AA2A SAN #100182U040AA2A	750 ufd, 50 VDC	36,45
C14 Capacitor	1800 ufd, 40 VDC SPG #602D182G040AA2A SAN #100182U040AA2A	1250 ufd, 50 VDC	36,45
R19 Resistor	1.2 Kilohms ± 10% ¼W	39 ohms	38,45
R22 Resistor	1 to 2 Kilohms Selected ¼ W	2.2 Kilohms	38,42
Q8 Transistor	FT602	FT600	37,42
T3 Transformer	FT91329	FT91029	39,40

6.10.3 The following components are added:

R18	Resistor	1.2 Kilohms ± 10% ¼ W
R21	Resistor	22 ohms ± 10% ½ W
R38	Resistor	10 ohms ± 10% ¼ W
R39	Resistor	1.8K to 2.2 Kohms ± 10% ¼ W
R40	Thermistor, 25KEI GUL., 1D15 CR	500 ohms 10% @ 25°C
R41, R42	Resistor	100 ohms ± 10% ¼ W
CR11, CR12	Diode	FT100



ELECTRICAL CONNECTION DIAGRAM

*FOR SHORT TIME OPERATION ONLY WITH INPUT OF 20 VDC

ELECTRICAL REQUIREMENTS		
INPUT	VOLTAGE: DC, NOM.	28
OUTPUT	POWER: VA TOTAL	250
	VOLTAGE: AC	115, 26
	FREQUENCY: HZ	400
	POWER FACTOR	.8 TO 1
	PHASE	1
EFFICIENCY	% AT FULL LOAD	70
ALTITUDE	FEET	45000
WEIGHT	POUNDS	7.5

FIGURE 2.2-5
INSTALLATION AND
MOUNTING DIMENSIONS

ITEM	PART NO.	DESCRIPTION	QTY
	91000-T	PC-15BC( ) MASTER ASSEMBLY	1

QUANTITY REQUIRED — LIST OF PARTS

	NAME	DATE
DRAWN		10/8/74
TRACED		11/14/74
ENGR		12/7/74
APPD		12/7/74

DEVICE PC-15BC( )
STATIC INVERTER
MOUNTING DETAILS

PALOMAR ELECTRONICS CO., INC. BURBANK, CA 91504

DWG NO. 91008-T

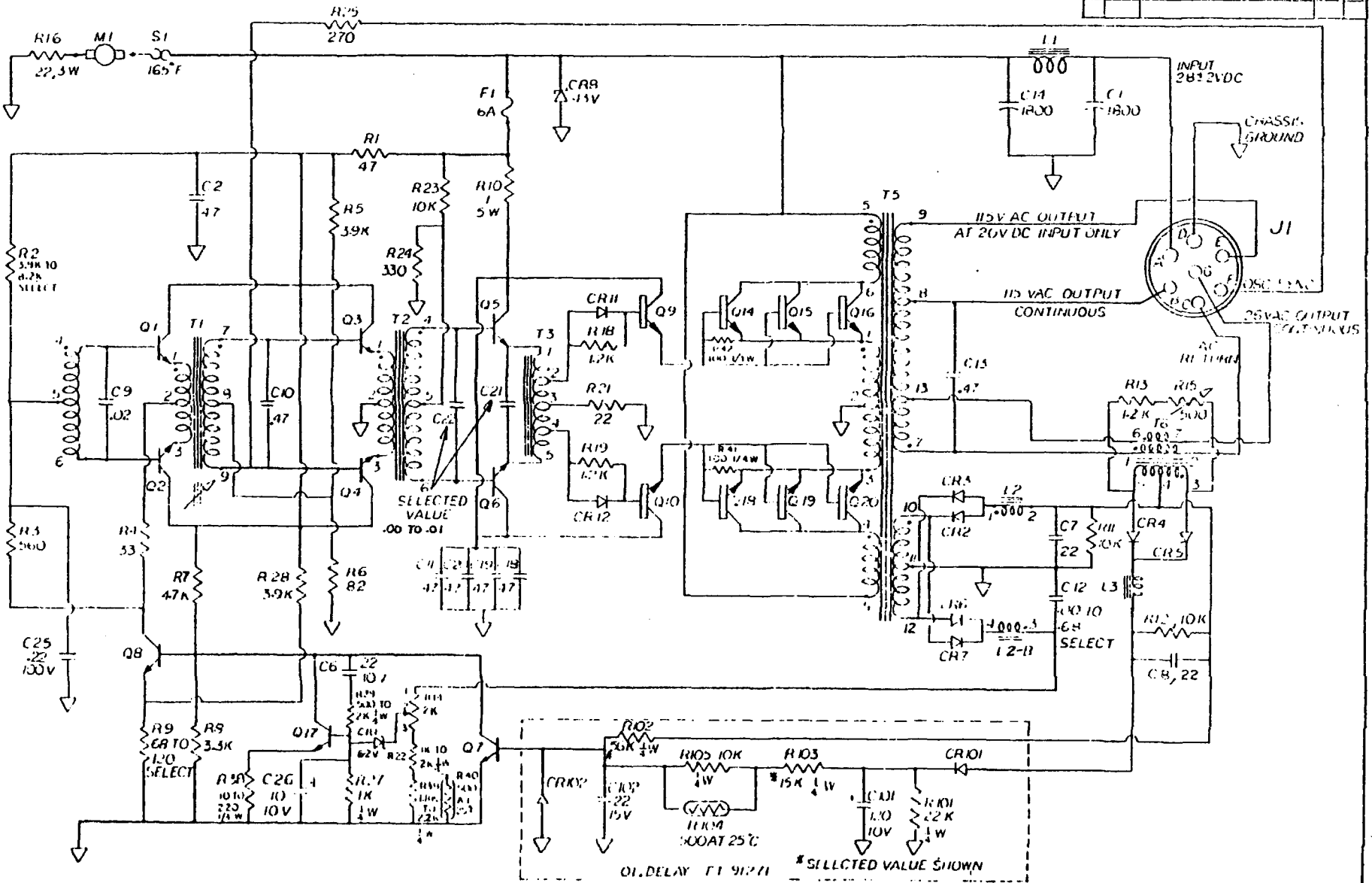


FIGURE 3-3-7

NOTES

1. RESISTORS IN OHMS : 1/2W UNLESS OTHERWISE NOTED
2. CAPACITORS IN μF
3. MATING PLUG FOR J1: MS 3106B 18-9S
4. REV. 9 CHANGE : S/N EFFECTIVITY, 5100 AND UP

PC-15BC( )
SCHEMATIC
91005-7

6.10.4 Table 4.4 of Section 4.5 under voltage measurement is revised as follows for PC-15BC( ) to effectively service the unit in the field. Voltage readings are from a typical production unit under the same test conditions as Table 4.4.

TABLE 4.4A: PC-15BC( ) VOLTAGE DISTRIBUTIONS

CIRCUIT REF.	TEST POINT	DC VOLTS	AC RMS	CIRCUIT REF.	TEST POINT	VDC (VOLTS)	VAC (RMS)
Q1 & Q2	Emitter	8 to 20*	6	Q7	Emitter	0	0
	Base	8 to 20*	6		Base	-.2 to -.5	0
	Collector	26	0		Collector	3	0
Q3 & Q4	Emitter	.2	9	Q8	Emitter	2.5	0
	Base	.5	9		Base	3	0
	Collector	26	0		Collector	8 to 20	.4
Q5 & Q6	Emitter	.7	15	Q17	Emitter	.04	0
	Base	.3	15		Base	.65	0
	Collector	26	0		Collector	3	0
Q9 & Q10	Emitter	.5	9	CR2,CR3	Anode	0	10
	Base	.15	10	CR6,CR7	Cathode	8.5	5
	Collector	27	0	R11 & L2	Junction	-8.5	0
Q14,Q15	Emitter	.1	8.5	CR4,CR5	Anode	0	0 to 15*
Q16,Q18	Base	.5	9		Cathode	-9 to +6*	6 to 0
Q19,Q20	Collector	26	8.5	R12 & L3	Junction	-9 to +5*	0

6.10.5 Blower Motor Maintenance paragraph added. Page 7

6.10.6 Emergency Output Connection paragraph deleted. Page 7

6.10.7 Output Voltage vs Input Voltage graph added. Page 75

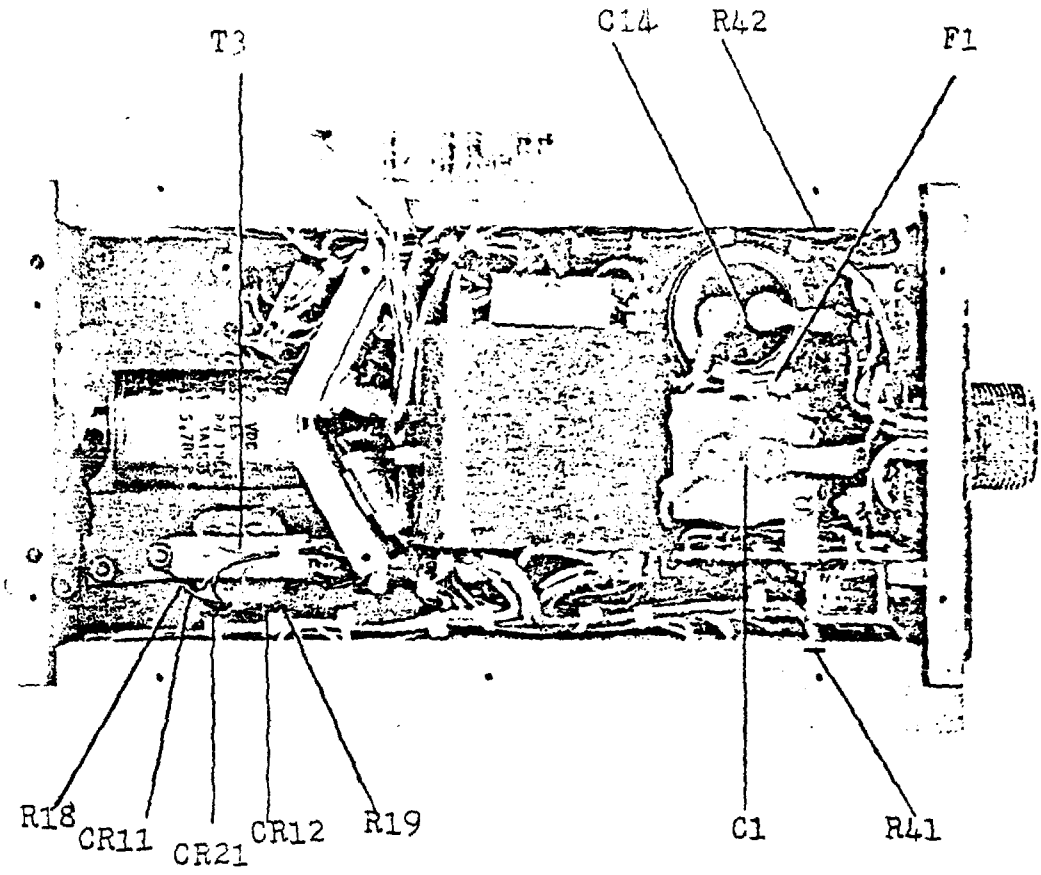


FIGURE 5.1A COMPONENT LAYOUT DUST COVER REMOVED CHANGES REFLECTING REV. 9

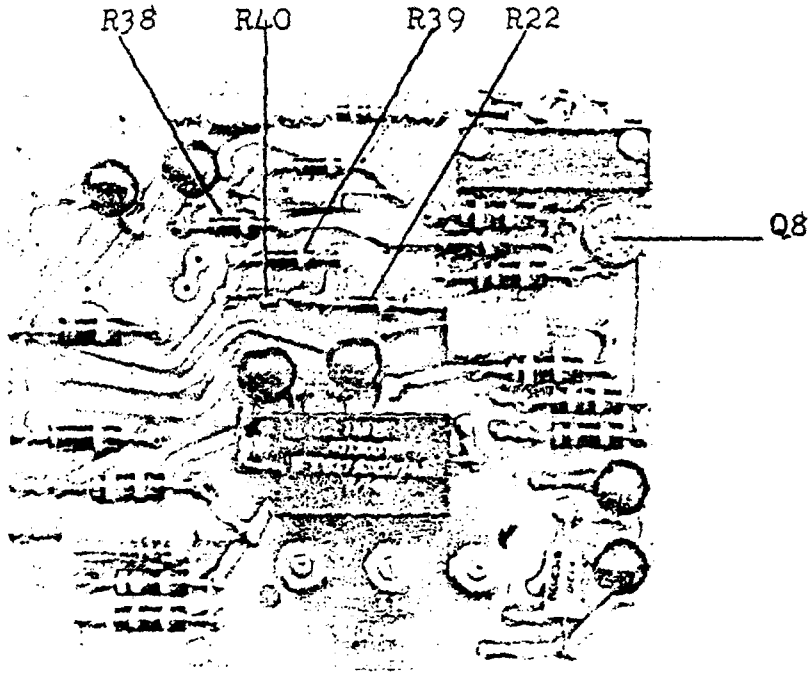


FIGURE 5.4C COMPONENT LAYOUT CHANGES REFLECTING REVISION NO.9

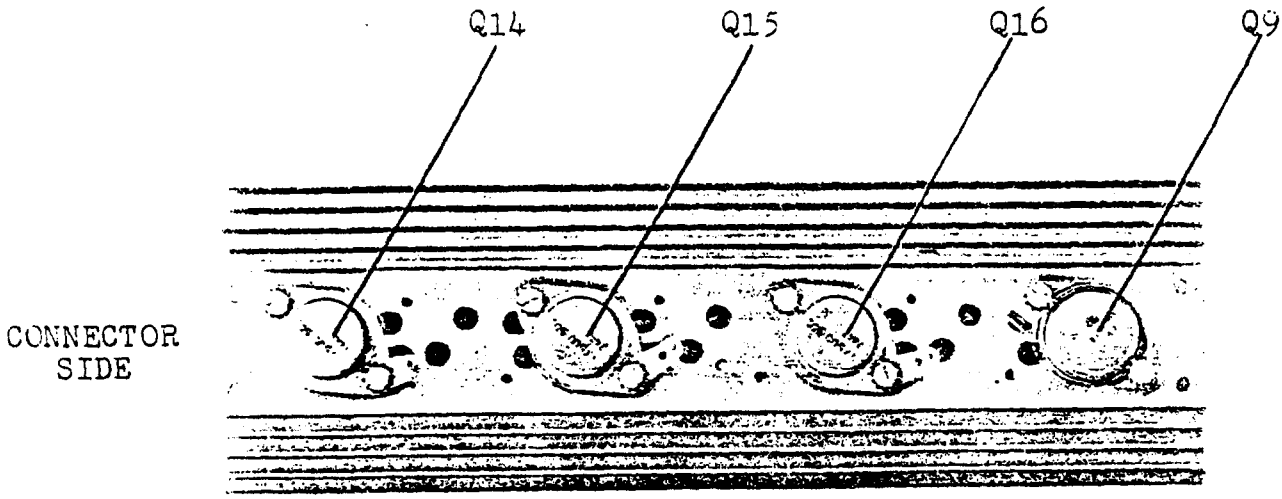


FIGURE 5.2A TRANSISTOR LAYOUT LEFT SIDE
CHANGES REFLECTING REV. 9

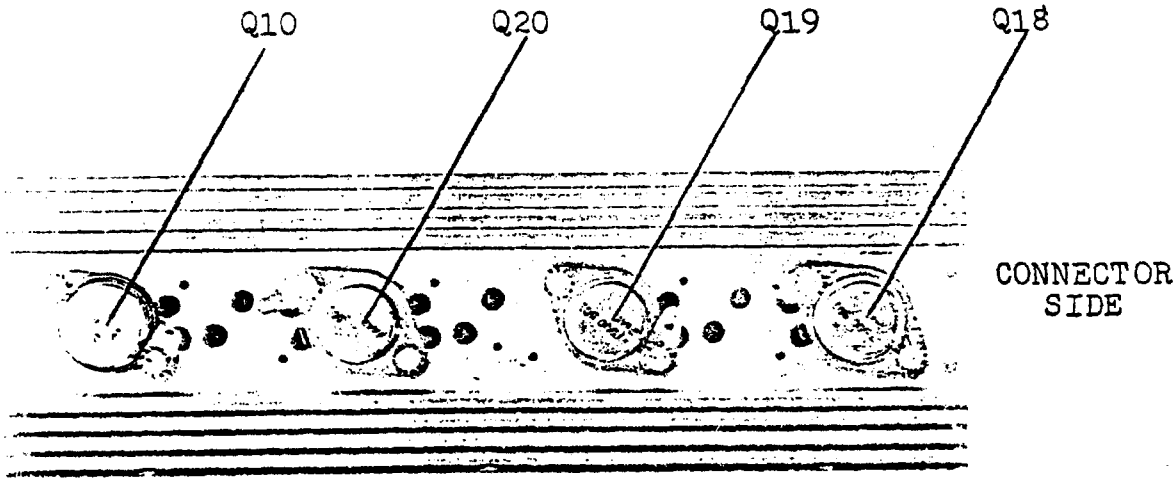


FIGURE 5.3A TRANSISTOR LAYOUT RIGHT SIDE
CHANGES REFLECTING REV. 9

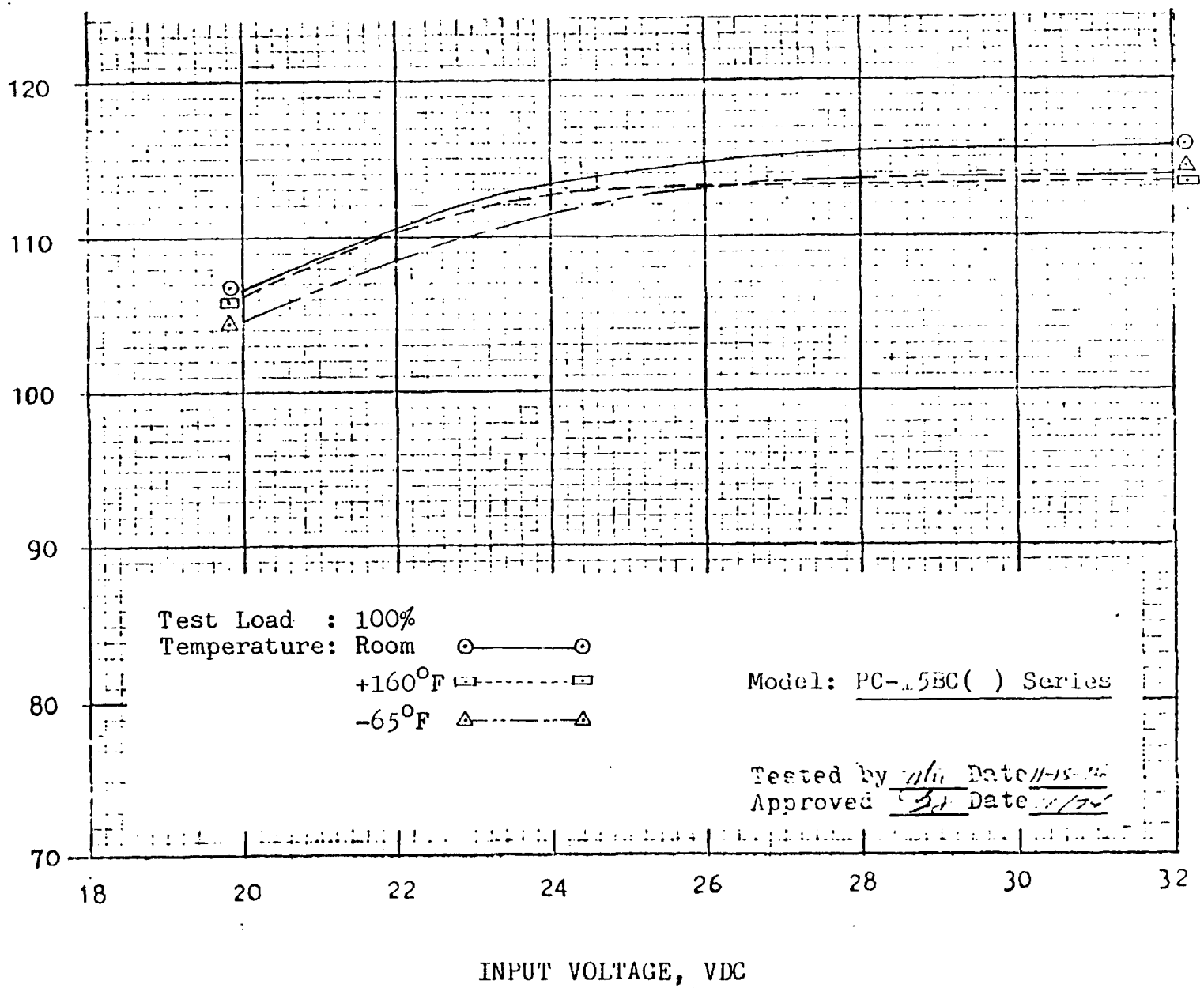


Figure 1.4 : Typical Output AC Voltage vs Input Voltage

7. DESCRIPTION OF ADDENDUMS

7.1 Model PC-15B

7.1.1 Refer to page A7 for PC-15B mounting detail

7.1.2 Refer to page A8 for PC-15B schematic

7.1.3 Refer to figure 7.1.1 on page A4 for FT91271 overload delay module schematic

7.1.4 Refer to figure 7.1.2 on page A4 for FT91271 overload delay module layouts

7.1.5 R13 is 1.2K ohms, was 820 ohms

7.1.6 F1 is 6A, GKN 6

7.1.7 C101 is 120 uf, 10 VDC, CS13BC127K, K22J15KS

7.1.8 C102 is 22 uf, 15 VDC, CS13BD226K, K120J10KS

7.1.9 CR1 is 1 amp, 200 VDC, IN5393 or equiv.

7.1.10 CR2 is same as CR1

7.1.11 R101 is 22K ohms, ¼w, 10%

7.1.12 R102 is 33K to 82K ohms selected, ¼w, 10%

7.1.13 R103 is 10K to 27K ohms selected, ¼w, 10%

7.1.14 R104 is 500 ohms @ 25 °C, 25KE1 ,GUL, or equiv.

7.1.15 R105 is 10K ohms, ½w, 10%

7.1.16 The second sentence of the 4th paragraph, sec. 3.7, on page 18 is "when the output current causes a voltage across R12 to exceed the compared voltage across R11, transistor Q7 will start conducting after a time delay introduced by the overload delay module FT91271.

7.1.17 The DC voltage of base of Q7, Table 4.4, page 32 is -.2 to -.5 , was -1.5 to -6*

7.1.18 The 175% overload and output short-circuit tests of Table 4.2, page 23 and 24 are changed as follows

Table 4.2 Test Conditions and Typical Readings

MODEL	CONDITION	SWITCH	POSITION	TYPICAL READINGS			
				DC INPUT		AC OUTPUT	
				VOLTAGE	CURRENT	VOLTAGE	CURRENT
PC-15B Only	175% Overload	S1 S8 S2-S7 S9&S10 S11 S12&S13 S14&S15	#1 on off off PC-15 115 VAC off	Set to 28 VDC	Meter Deflection Between 0 and 25 amp motorboating	Meter Deflection Between 0 and full scale motorboating	Meter Deflection Between 0 and full scale motorboating
PC-15B See Note 1	Output short CKT 115 VAC Output only Loaded	S1 S2-S9 S11 S12&S13 S14&S15 S10(For Short)	#1 off PC-15 115 VAC on on	Set to 28 VDC	See Note 3 Page A3		
	Full Load 175 VA on 115 VAC and 75 VA on 26 VAC	S1 S2-S10 S11 S12&S13 S14&S15 S12&S13	#1 off PC-15A 115 VAC off 26 VAC	Set to 28 VDC	14 Amps Typical	Between 107 VAC and 120 VAC Between 24.2 VAC and 27.3 VAC	1.5 Amps Typical 2.9 Amps Typical
	26 VAC Ouput Short CKT	S1 S2-S9 S11 S12&S13 S14&S15 S10(For Short)	#1 off PC-15A 26 VAC on on	Set to 28 VDC	See Note 3 Page A3		

Notes: 1. Modify TS-PC-15-1 as follows for the output short circuit test only.

a. Refer to figure 7.1.3, page A5, for TS-PC-15-1 modified per this note 1 for output short circuit test.

b. Add S14 directly across terminals of current meter I_1

c. Add S15 directly across terminals of current meter I_2

d. Replace a wire between low side of S10 and AC return with a resistor R11 2 ohms, 200 watts

e. Above modifications prevent any damage to test-set meters, but effectively test the output short circuit performance of PC-15B

2. For output short circuit test close S10 so that 115 VAC or 26 VAC output is shorted to ground through R11

3. The initial output short circuit current burst is relatively long in duration and high in amplitude. The second and subsequent burst will normally settle down to exhibit anything from quenching burst to motorboating. Refer to reference short circuit wave shape shown in Figure 7.1.4 page A6.

7.1.19 Changes in step 9 of Table 4.3, page 27, are as follows

7.1.19.1 Under procedure; add c) Check that the PC-15B is in a motorboating mode at 175% overload before proceeding to step 10.

7.1.19.2 Under Reference Reading
I_1 will be pulsating from 0 to 25 amps

7.1.19.3 Under Possible Cause of Abnormal Readings; add all the components in the FT91271 overload delay module.

7.1.20 Changes in step 10 of Table 4.3, on page 27, are as follows

7.1.20.1 Under Set-Up
add S14 and S15 position "on"

7.1.20.2 Under Procedure
"b" is deleted

7.1.20.3 Under Reference Reading
I_1 and I_2 both indicate motorboating

7.1.20.4 Under Possible Cause of Abnormal Reading; add all components in FT91271 overload delay module

7.1.21 Changes in step 14 of Table 4.3, on page 29, for PC-15B are the same as changes per paragraph 6.5.2.5 on page 55

7.1.22 Changes in step 16 of Table 4.3 on page 30 are as follows

7.1.22.1 Under Set-Up
Add S14 and S15 position "on"

7.1.22.2 Under Procedure
"b" is deleted

7.1.22.3 Under Reference Reading
I_1 and I_2 both indicate motorboating

7.1.22.4 Under Possible Cause of Abnormal Reading add, all components in FT91271 overload delay module

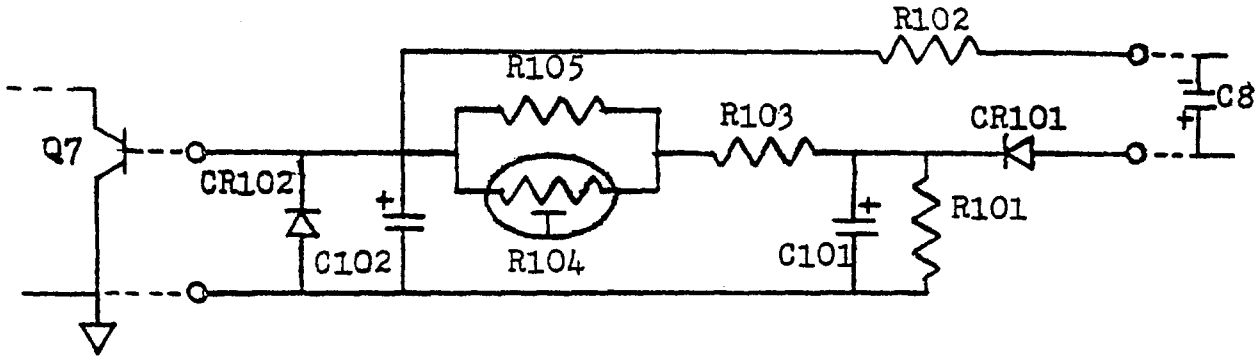


Figure 7.1.1 Overload Delay Module
FT91271 Schematic

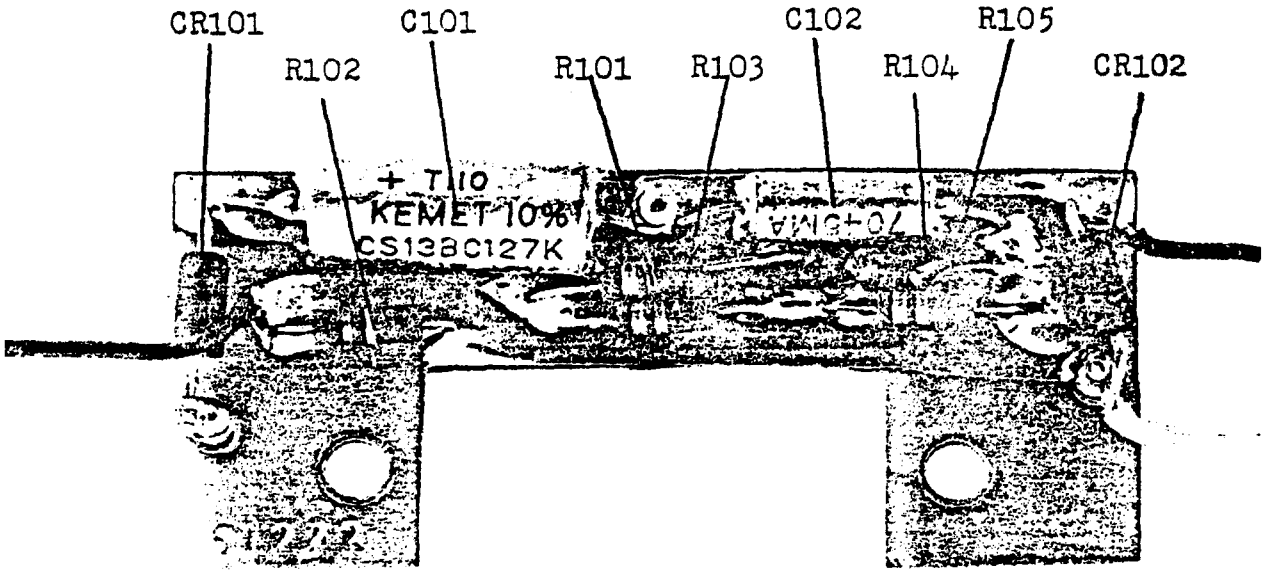
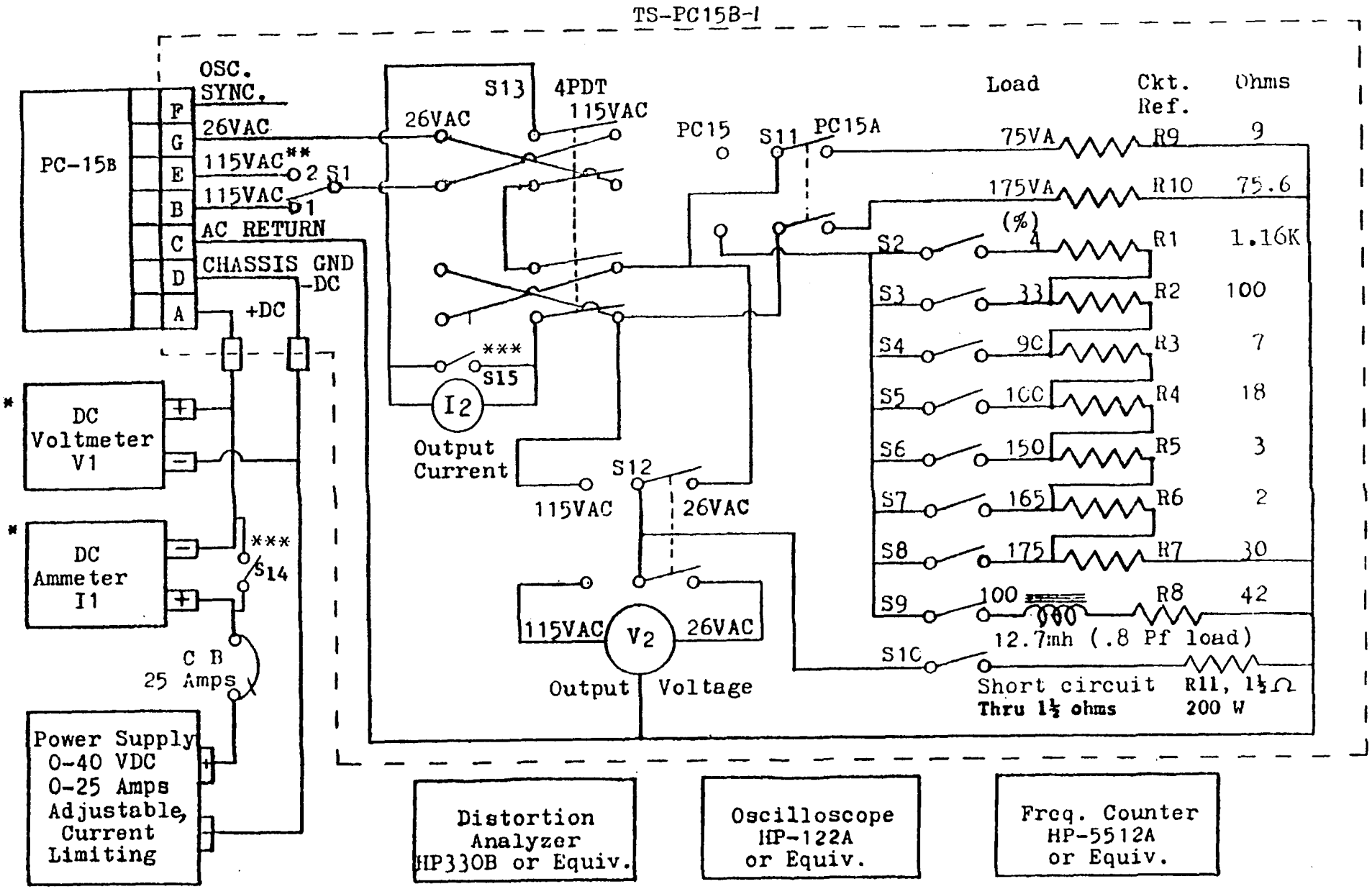


Figure 7.1.2 Overload Delay Module
FT91271 Layouts



*These meters are required only if the power supply does not contain them.

**Emergency output at 20 VDC input only.

***S14 and S15 are closed only during output short circuit test.

FIGURE 7.1.3 BENCH TEST SET AND HOOK-UP

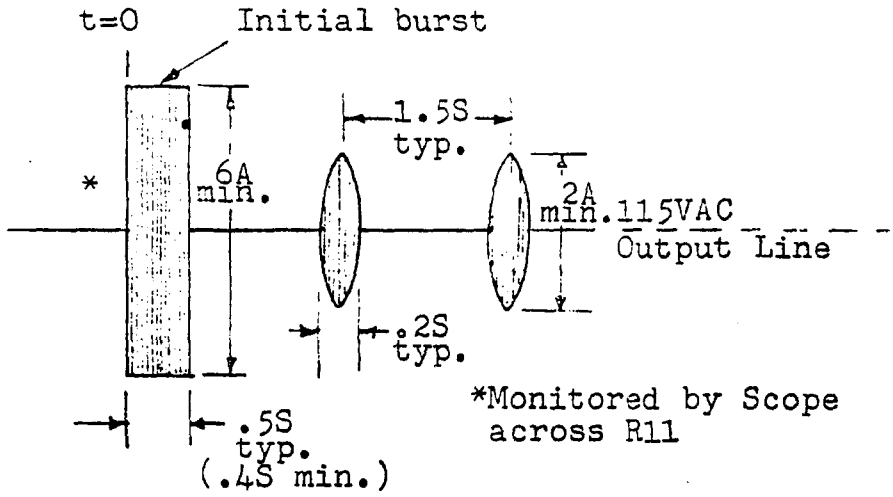


Figure 7.1.4 Reference Short Circuit Waveshape*

7.2 Model PC-15A with letter M1 after serial number.

7.2.1 Refer to Flite-Tronic's Service Bulletin No. 1/PC-15 for field modification. (Readjustment of R15)

7.3 Model PC-15A with letter A after serial number.

7.3.1 R26 and C24 added.

7.3.2 Refer to page A9 for schematic.

7.3.3 Refer to Flite-Tronic's Service Bulletin No. 2/PC-15 for field modification.

7.4 Model PC-15D

7.4.1 Refer to page A10 for schematic.

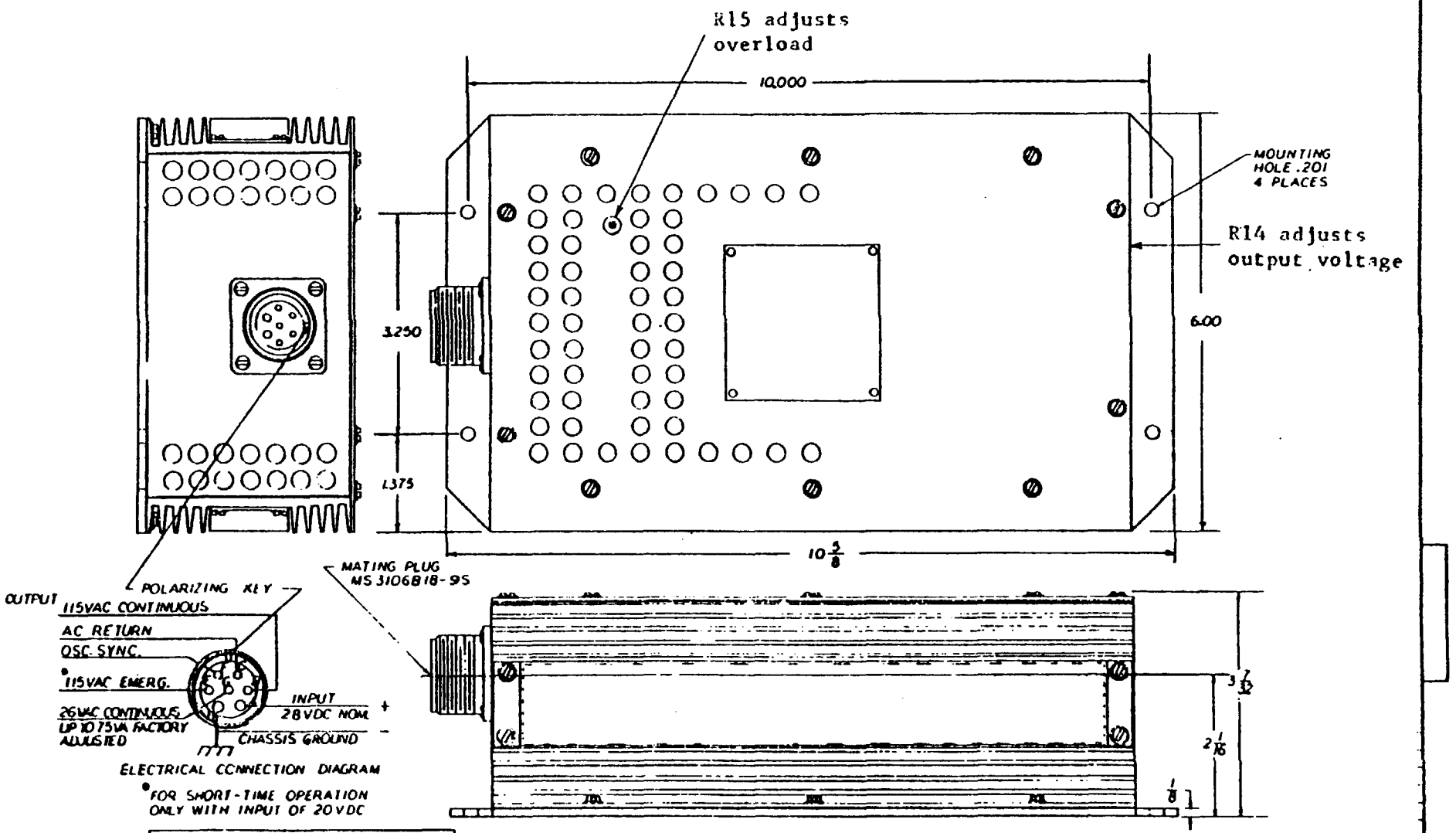
7.4.2 Refer to PC-15D supplemental instruction manual for complete details.

7.5 Model PC-15E

7.5.1 Refer to page A11 for Mounting Detail.

7.5.2 Refer to page A12 for Schematic.

7.5.3 Refer to PC-15E supplemental instruction manual for complete details.



ELECTRICAL CONNECTION DIAGRAM

•FOR SHORT-TIME OPERATION ONLY WITH INPUT OF 20VDC

ELECTRICAL REQUIREMENTS		
INPUT	VOLTAGE: DC, NOM.	28
OUTPUT	POWER: VA TOTAL	250
	VOLTAGE: AC	115±26
	FREQUENCY: HZ	400
	POWER FACTOR	.8 TO 1
	PHASE	1
EFFICIENCY	% AT FULL LOAD	70
ALTITUDE	FEET	45000
WEIGHT	POUNDS	8.2

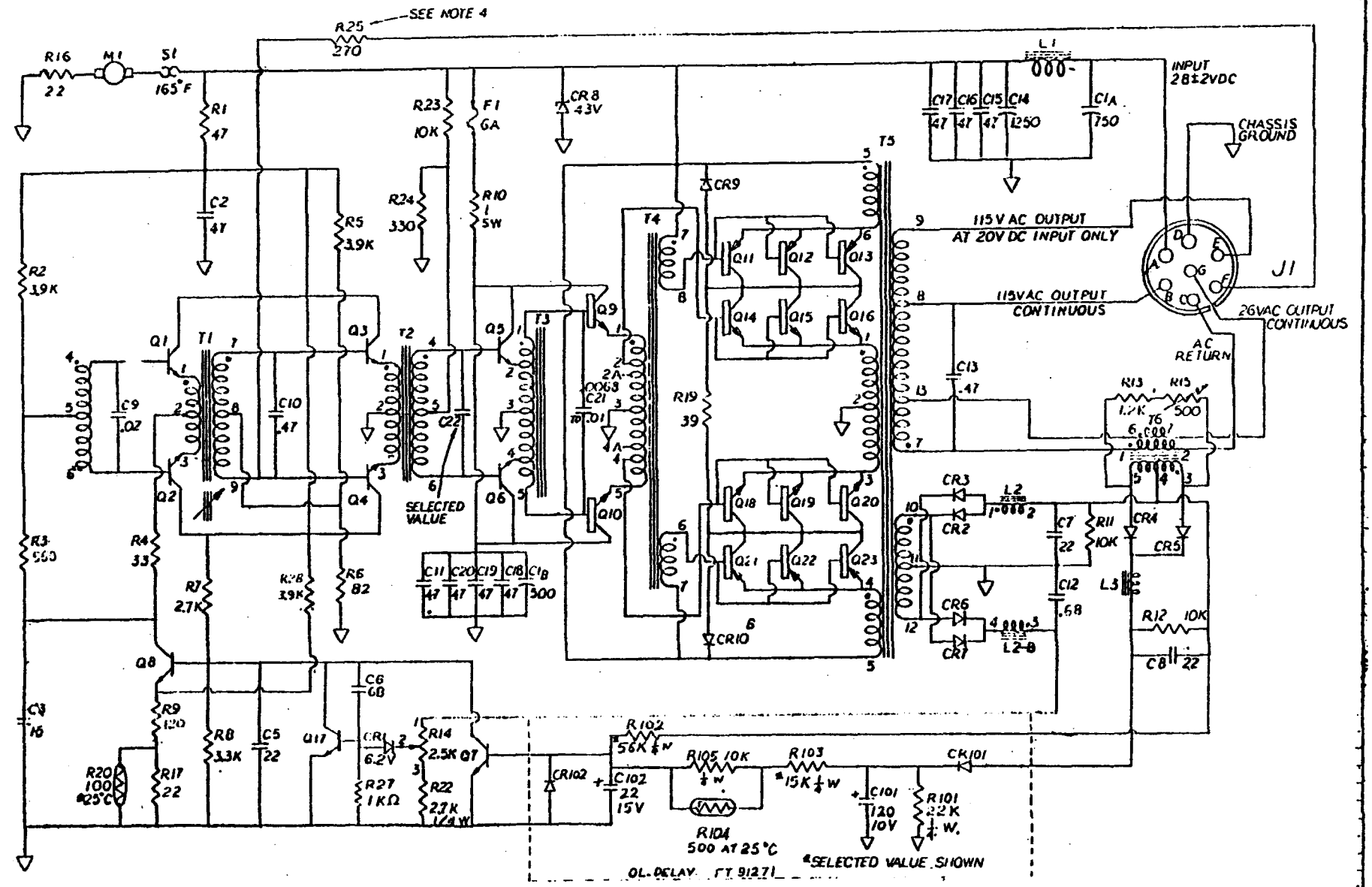
NOTE: 1. PC-15B DESIGNED TO TRIP 1.0 AMPERE THERMAL TYPE CIRCUIT BREAKER WITH NORMAL CHARACTERISTIC.

FIGURE 22-1
INSTALLATION AND
MOUNTING DIMENSIONS

FLITE-TRONICS, INC.
SAN DIEGO, CALIF.

PC15B STATIC INVERTER
MOUNTING DETAILS

C 91008-21



5. PC15B TO TRIP 1A THERMAL C.B. WITH NORMAL CHARACTERISTIC.
4. USE CAPACITOR C23 (TYPICALLY .0047μF, 600V.) TO FREQ. LOCK TO OTHER 115VAC 400HZ LINE, PHASE LOCK TO OTHER PC15A WITH R25
3. MATING PLUG FOR J1: MS3106B 18-9S.
2. CAPACITORS IN μF: C22 SELECTED AMONG VALUES BETWEEN .002 AND .0068 μF
1. RESISTORS IN OHMS: 1/2 W UNLESS OTHERWISE NOTED

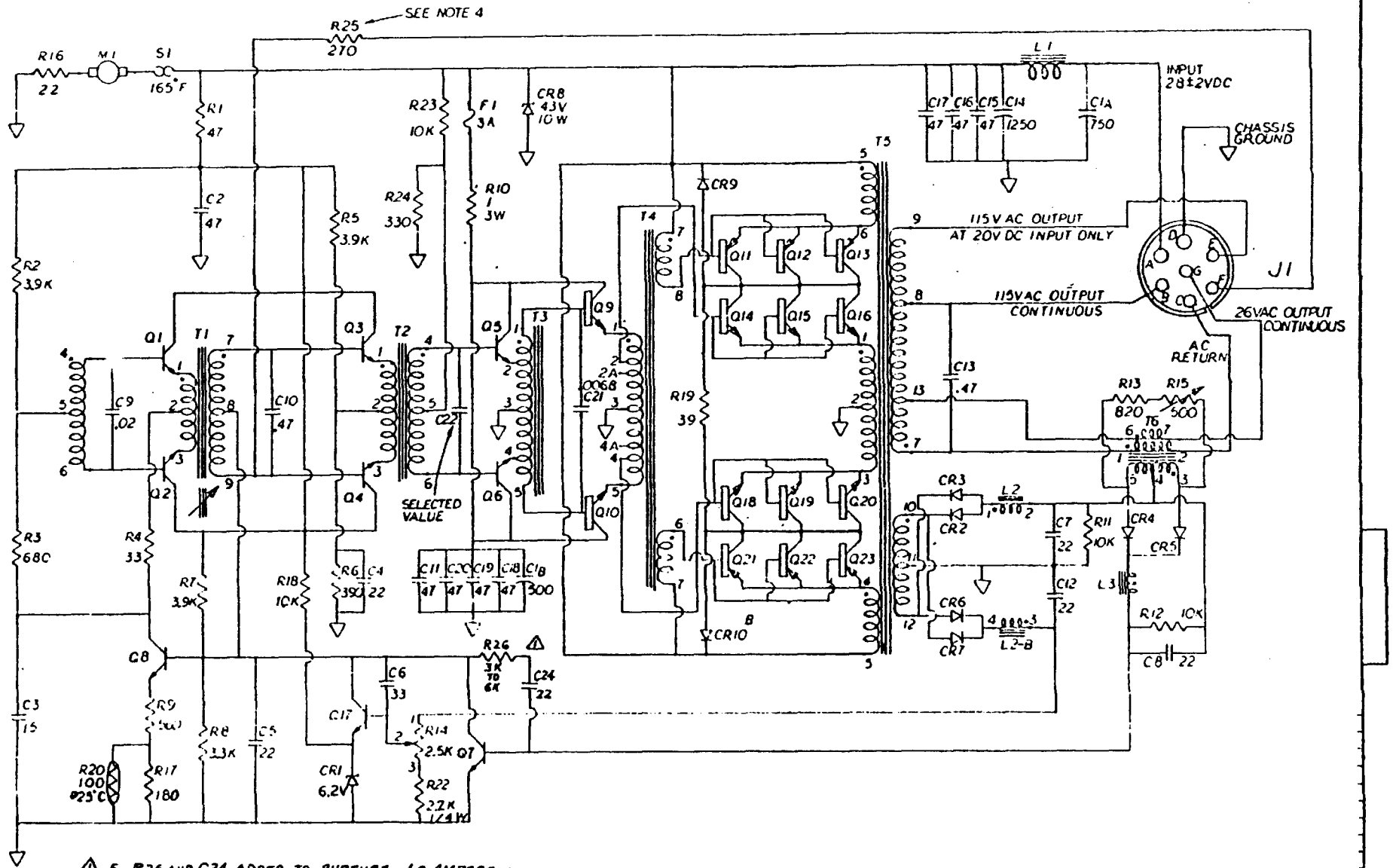
NOTES

FIGURE 3.3-1A

ELITE-TRONICS, INC.
6913 BURTON AVE., BURBANK, CALIF.

PC15B SCHEMATIC

DRAWN
CHKD
APPVD
SCALE
MODEL PC15B
NEXT ASSY.
SIZE C 91003-2B



⚠ 5. R26 AND C24 ADDED TO RUPTURE 1.0 AMPERE MEDIUM SLOW BLOW TYPE FUSE WITH NORMAL CHARACTERISTIC.

4. USE CAPACITOR C23 (TYPICALLY .0047μF, 600V) TO FREQ. LOCK TO OTHER 115VAC 400HZ LINE, PHASE LOCK TO OTHER PC15A ¼mA WITH R25

3. MATING PLUG FOR J1: MS 3106B 18-9S.

2. CAPACITORS IN μF: C22 SELECTED AMONG VALUES BETWEEN .002 AND .0068 μF

1. RESISTORS IN OHMS: 1/2 W UNLESS OTHERWISE NOTED

NOTES

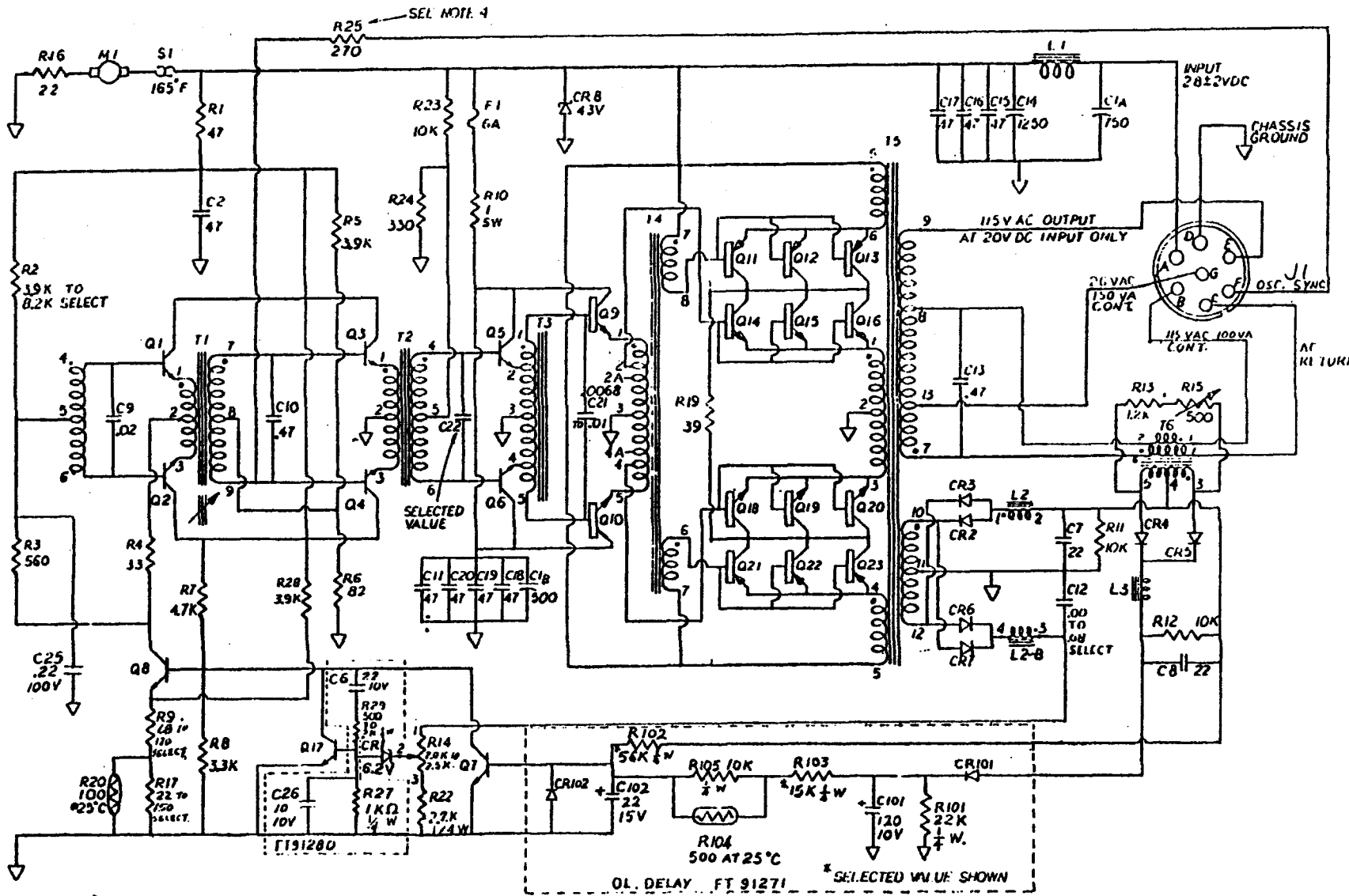
FIGURE 3.3-2

FLITE-TRONICS, INC.
3015 BURTON AVE. BURBANK CALIF.

PC-15A WITH LETTER A AFTER S/N SCHEMATIC

DRAWN
CHK'D
APPR'D
SCALE
NEXT ASSY
USED ON PC15A ¼mA

C 91003-3

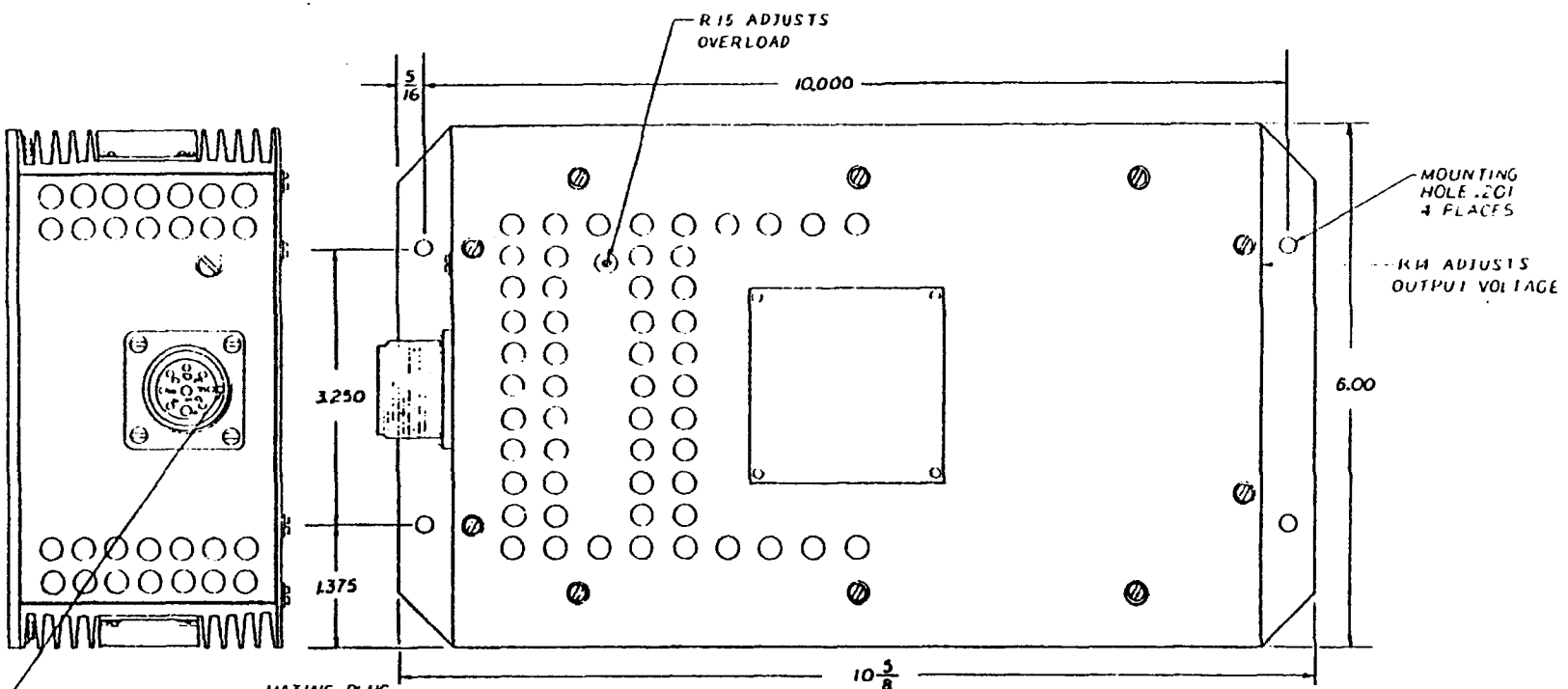


NOTES

1. RESISTORS IN OHMS: 1/2 W UNLESS OTHERWISE NOTED
2. CAPACITORS IN μF: C22 SELECTED AMONG VALUES BETWEEN .0047 AND .0068 1W
3. MATING PLUG FOR J1: MS3106B 18-9S.
4. USE CAPACITOR C23 (TYPICALLY .0047μF, 600V) TO FREQ. LOCK TO OTHER 115VAC 400HZ LINE; PHASE LOCK TO OTHER PC15B'U) WITH R25
5. REV F CHANGE: S/N EFFECTIVITY, 79
6. REV B CHANGE: S/N EFFECTIVITY, 40

FIGURE 3.3-3A

FLITE-TRONICS, INC.
PC-15B(D)
SCHEMATIC
C 91003-4B



ELECTRICAL CONNECTION DIAGRAM

*FOR SHORT-TIME OPERATION ONLY WITH INPUT OF 20 VDC

ELECTRICAL REQUIREMENTS		
INPUT	VOLTAGE: DC, NOM.	28
	POWER: VA TOTAL	250
OUTPUT	VOLTAGE: AC	115&26
	FREQUENCY: HZ	400
	POWER FACTOR	.8 TO 1
	PHASE	1
EFFICIENCY	% AT FULL LOAD	70
ALTITUDE	FEET	45000
WEIGHT	POUNDS	8.2

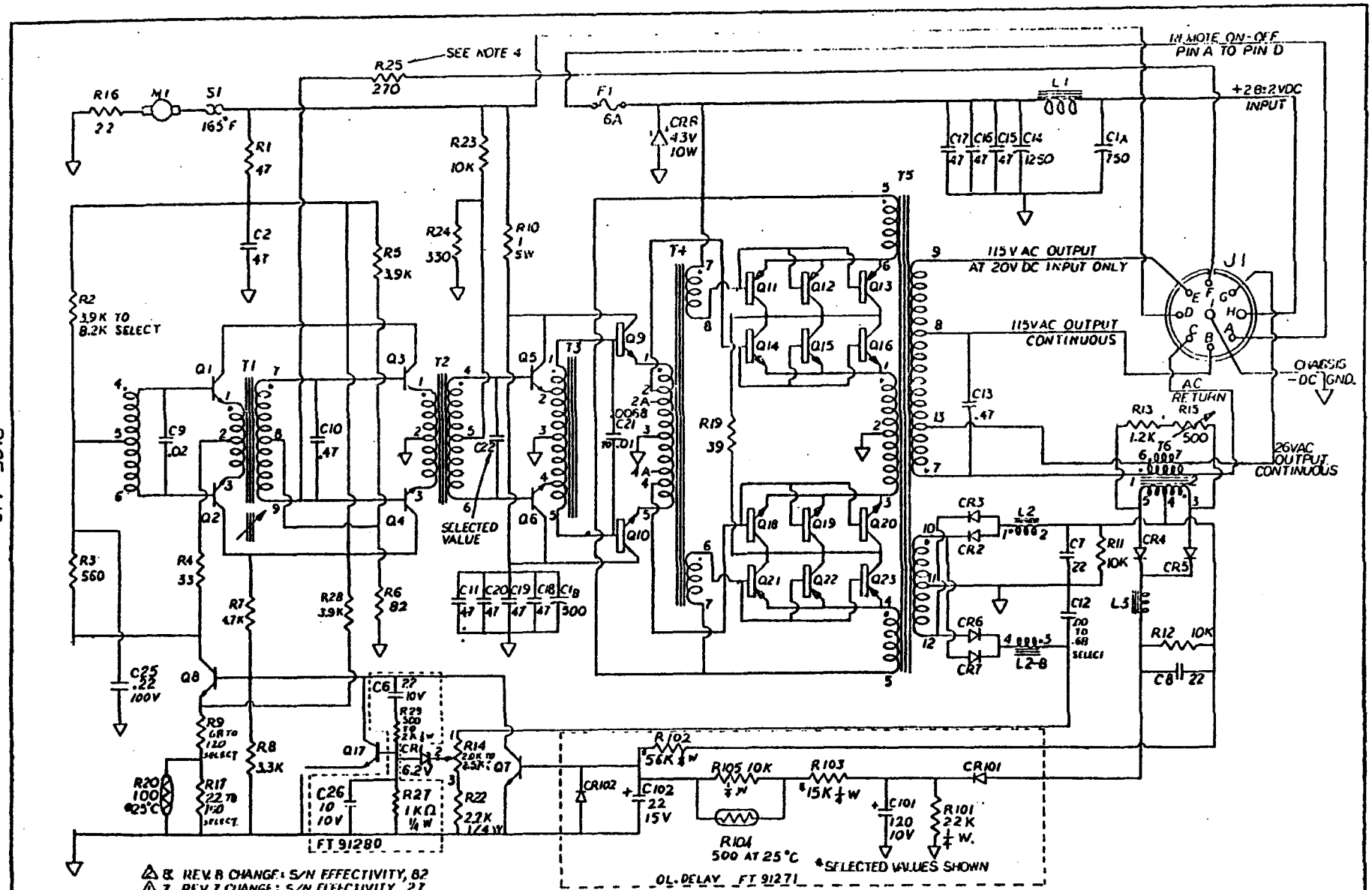
FIGURE 2.2-3A
INSTALLATION AND
MOUNTING DIMENSIONS

NOTE: 1. JUMPER PIN A&D ON MS3106B-20-16S FOR NORMAL OPERATION
2. CONNECT SPST SWITCH BETWEEN PIN A&D FOR REMOTE ON-OFF

FLITE-TRONICS, INC.
6610 BURTON AVE., BURBANK, CALIF.

TITLE: PC-15B(E) STATIC INVERTER MOUNTING DETAILS

DRAWN: J. Fl
CHK'D: J.
APP'D: J.C.
SCALE: FULL
MODEL: PC-15B(E)
SIZE: C
91008-5A



⚠8. REV. B CHANGE: S/N EFFECTIVITY, 82
⚠7. REV. T CHANGE: S/N EFFECTIVITY, 27
6. CONNECT SPST SWITCH BETWEEN PIN A & D FOR REMOTE ON-OFF
5. JUMPER PIN A & D ON MS3106B-20-16S FOR NORMAL OPERATION
4. USE CAPACITOR C23 (TYPICALLY .0047 μF, 600V.) TO FREQ. LOCK TO OTHER 115VAC 400HZ LINE, PHASE LOCK TO OTHER PC15B(E) WITH R25
3. MATING PLUG FOR J1: MS 3106B-20-16S
2. CAPACITORS IN μF: C22 SELECTED AMONG VALUES BETWEEN .002 AND .0068 μF
1. RESISTORS IN OHMS: 1/2 W UNLESS OTHERWISE NOTED

NOTES

FIGURE 3.3-4A

FLITE-TRONICS, INC.
3613 BURTON AVE., BURBANK, CALIF.

⚠ PC-15B(E)
SCHEMATIC

C 91003-5A

7.6 PC-15F

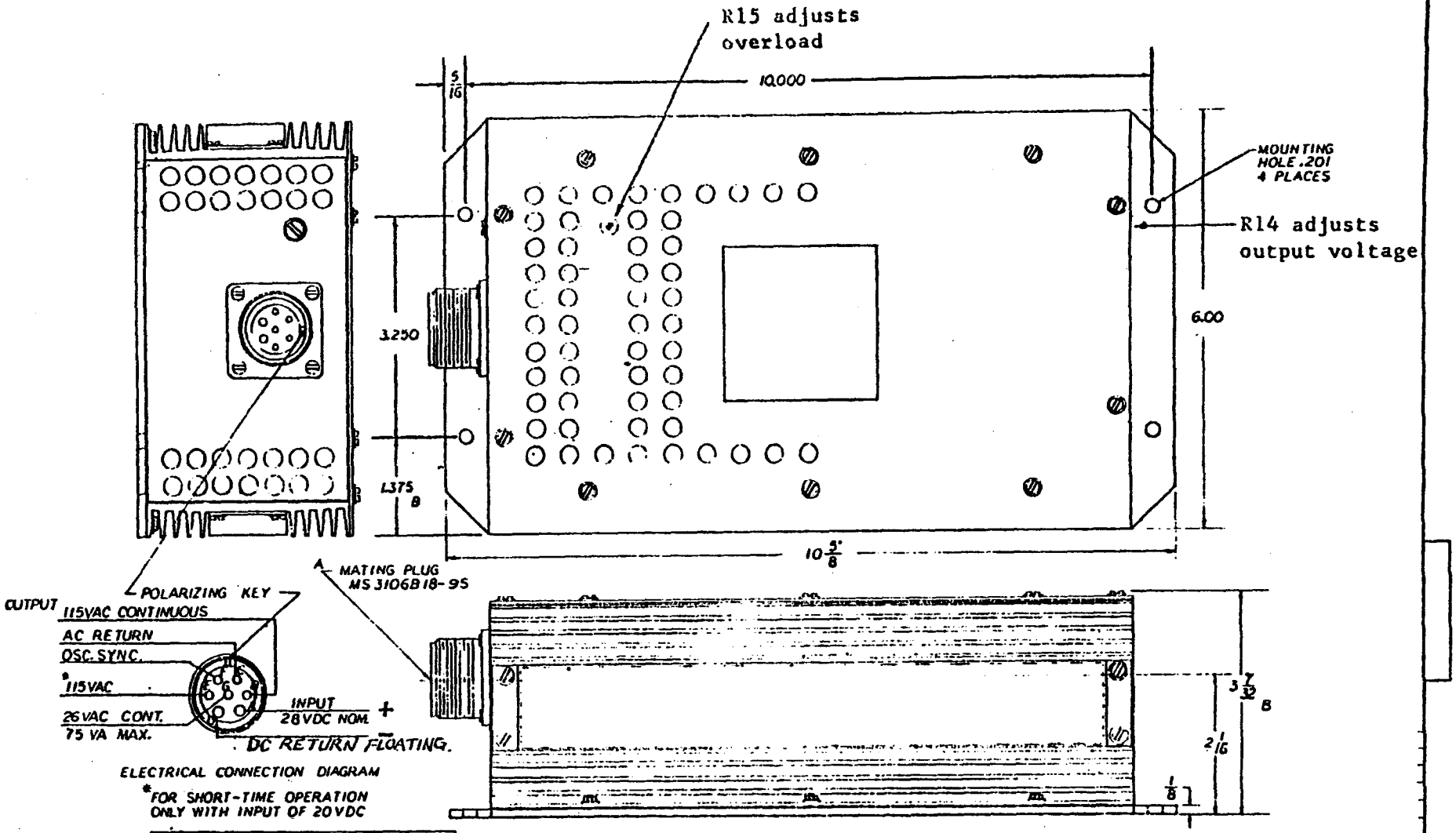
7.6.1 Refer to Page A14 for mounting detail

7.6.2 Refer to Page A15 for schematic

7.7 PC-15G

7.7.1 Refer to Page A16 for mounting detail

7.7.2 Refer to Page A17 for schematic



ELECTRICAL CONNECTION DIAGRAM

*FOR SHORT-TIME OPERATION ONLY WITH INPUT OF 20VDC

ELECTRICAL REQUIREMENTS		
INPUT	VOLTAGE: DC. NOM.	28
OUTPUT	POWER: VA TOTAL	250
	VOLTAGE: AC	115, 26
	FREQUENCY: HZ	400
	POWER FACTOR	.8 TO 1
	PHASE	1
EFFICIENCY	% AT FULL LOAD	70
ALTITUDE	FEET	45000
WEIGHT	POUNDS	8.2

FIGURE 2.2-2
INSTALLATION AND
MOUNTING DIMENSIONS

FLITE-TRONICS, INC.
6515 BURTON AVE., BURBANK, CALIF.

PC-15F STATIC INVERTER
MOUNTING DETAILS

DRAWN
CHK'D
APP'D
SCALE FULL
MODEL PC15F
NEXT ASSY.
SIZE C
DWG NO. 91008-3

PAGE A14

PAGE 9-2

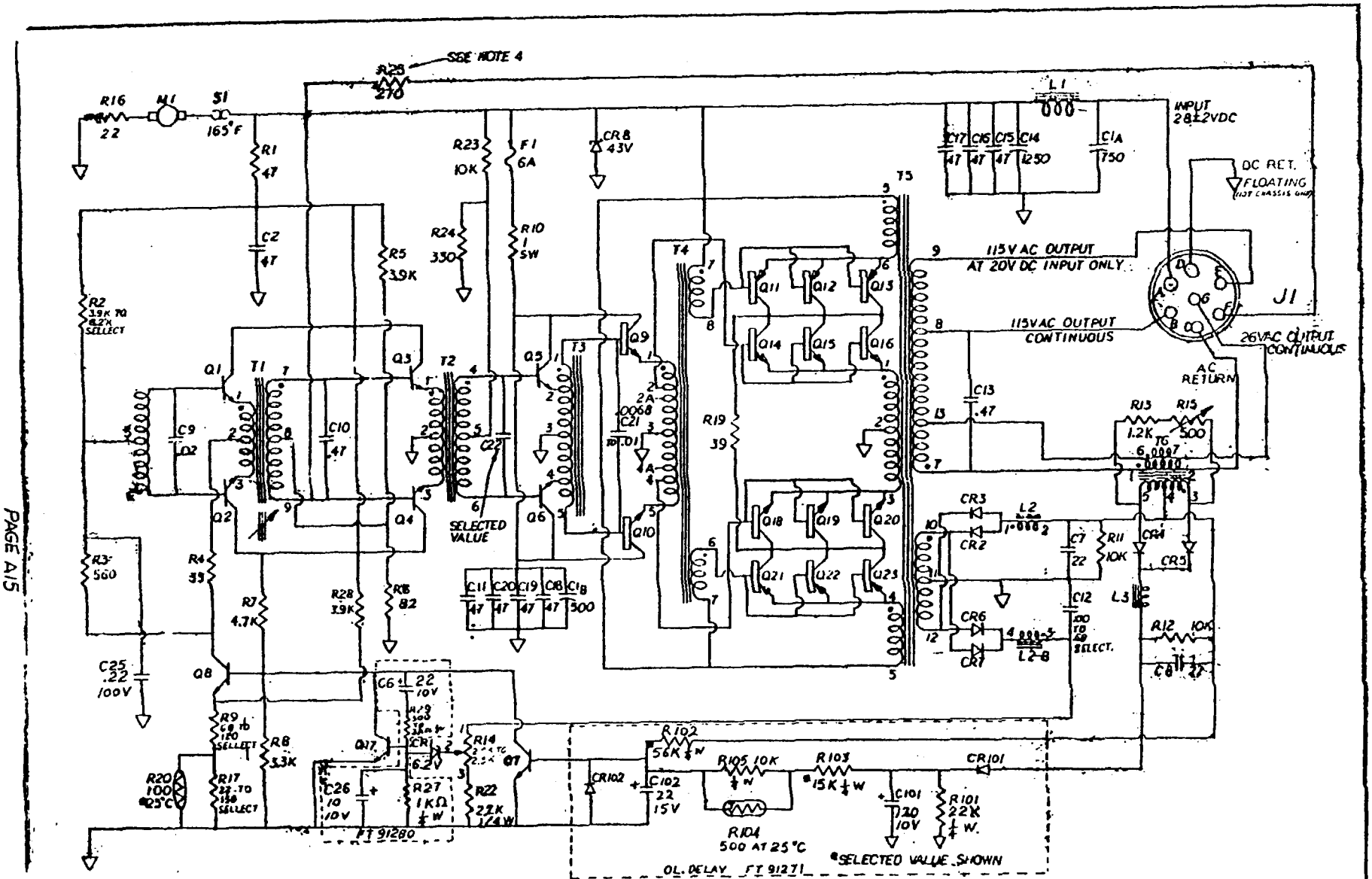


FIGURE 3.3-5A

NOTES:

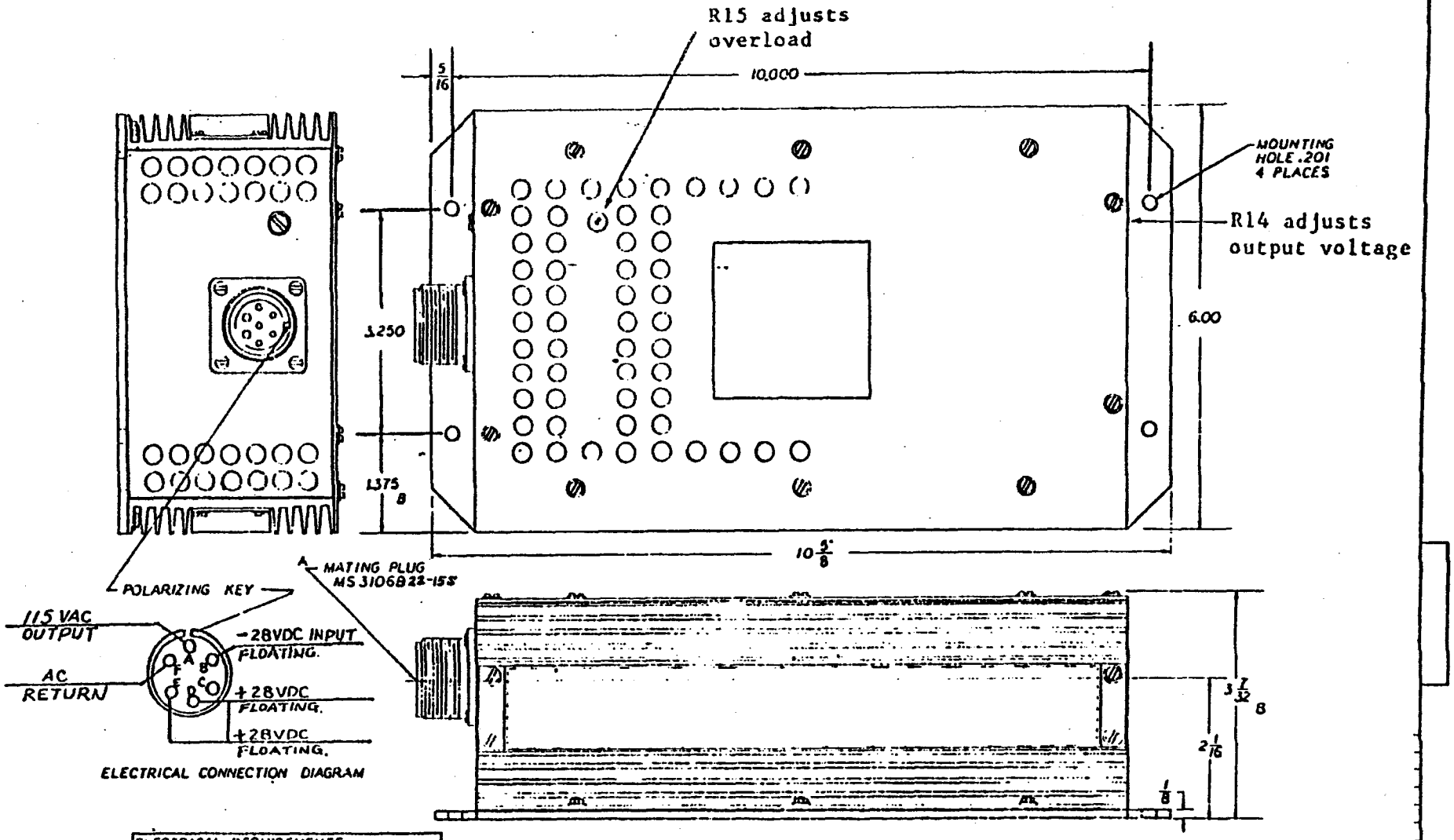
1. REV. 6 CHANGE: SYN EFFECTIVITY, A-C
2. REV. 7 CHANGE: SYN EFFECTIVITY, A-C
3. A- ON JUNCTION C23 (TYPICALLY .0047uF, 500V) TO FREQ. LOCK 30 OTHER WISE
4. MATING PLUG FOR J1: MS3106B 18-9S
5. CAPACITORS IN uF; C22 SELECTED AMONG VALUES BETWEEN .002 AND .0068 uF
6. RESISTORS IN OHMS; 1/2 W UNLESS OTHERWISE NOTED

FLITE-TRONICS, INC.

PC-15B(F)

SCHEMATIC

91003-3D



ELECTRICAL CONNECTION DIAGRAM

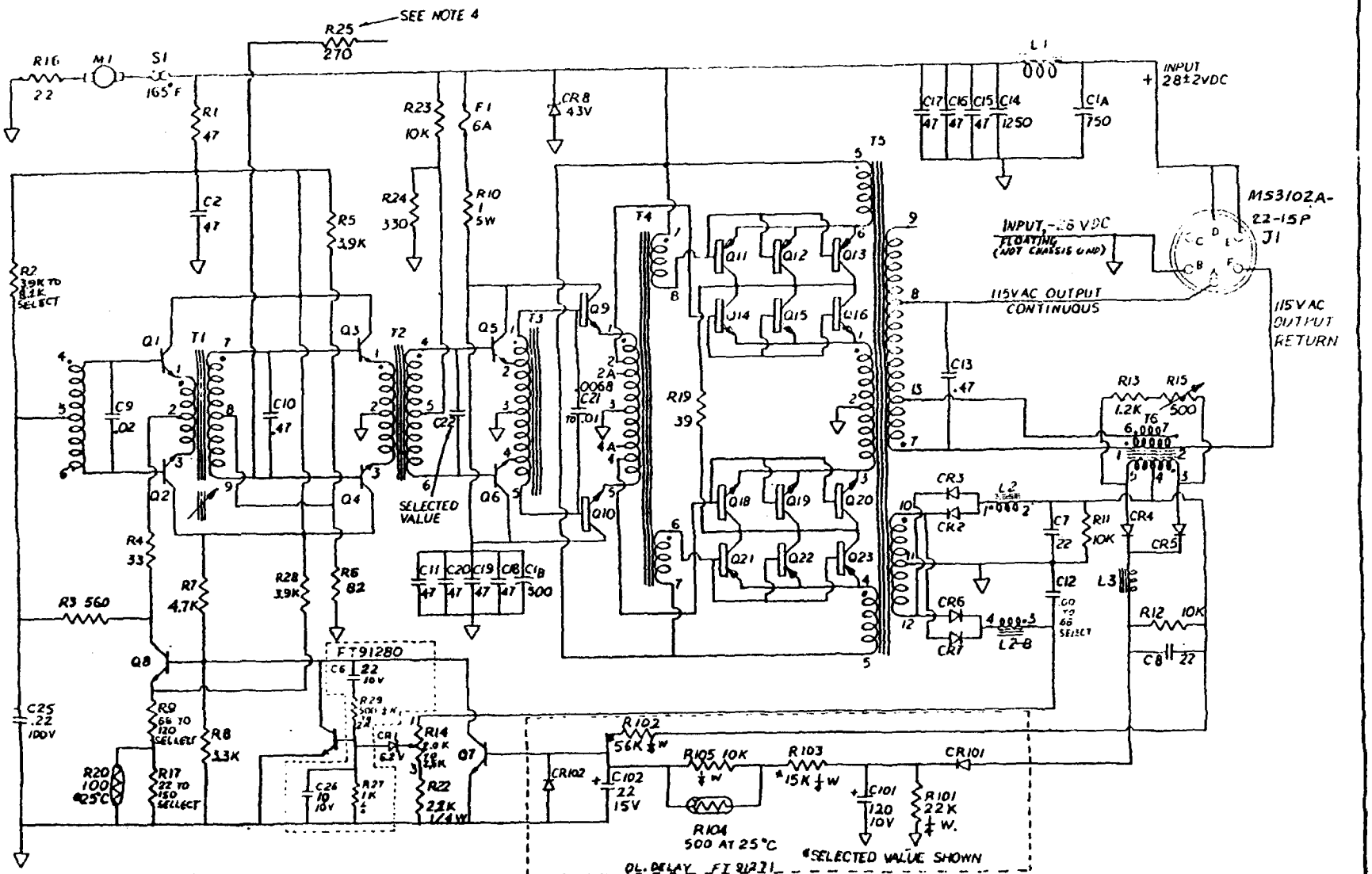
ELECTRICAL REQUIREMENTS		
INPUT	VOLTAGE: DC, NOM.	28
OUTPUT	POWER: VA TOTAL	250
	VOLTAGE: AC	115
	FREQUENCY: HZ	400
	POWER FACTOR	.8 TO 1
	PHASE	1
EFFICIENCY	% AT FULL LOAD	70
ALTITUDE	FEET	45000
WEIGHT	POUNDS	8.2

FIGURE 2.2-4
INSTALLATION AND
MOUNTING DIMENSIONS

FLITE-TRONICS, INC.
DALE DUBLIN AVE., DUBLIN, CALIF.

TITLE
PC-15G STATIC INVERTER
MOUNTING DETAILS

DRAWN 3-
CHK'D
APP'D
SCALE FULL
MODEL PC15G
SIZE C
DWG NO 91008-6



6. REV. B CHANGE: S/N EFFECTIVITY; 4101
5. REV. T CHANGE: S/N EFFECTIVITY; 3700
4. USE CAPACITOR C23 (TYPICALLY .0047 μF, 600V) TO FREQ. LOCK TO OTHER 115VAC 400HZ LINE, PHASE LOCK TO OTHER PC15B(G) WITH R25
3. MATING PLUG FOR J1: MS3106B22-15S
2. CAPACITORS IN μF: C22 SELECTED AMONG VALUES BETWEEN .002 AND .0068 μF
1. RESISTORS IN OHMS: 1/2 W UNLESS OTHERWISE NOTED

NOTES

FIGURE 3.3-6A

FLITE-TRONICS, INC.

PC-15B(G) SCHEMATIC

C 91003-60

AIRCRAFT STATIC INVERTER

MODEL PC-15BC( )

INSTRUCTION MANUAL

TSO-C73

FLITE-TRONICS CO., INC.
3314 BURTON AVENUE
BURBANK, CALIFORNIA

FLITE-TRONICS CO., INC.

STATIC INVERTER
MODEL PC-15BC( ) SERIES INSTRUCTION MANUAL

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FLITE-TRONICS CO., INC.

STATIC INVERTER
MODEL PC-15BC( ) SERIES INSTRUCTION MANUAL

REVISION NUMBERS

TO

INSTRUCTION MANUAL PC-15BC( )

REVISION NUMBERS	DATE	SERIAL NUMBER EFFECTIVITY
Original Publication	December 1976	PC-15BC( ) --- 5100
		PC-15BC(D) --- 500
		PC-15BC(E) --- 1
		PC-15BC(H) --- 1

NOTE:
This manual includes original publication information and all revisions to date for Model PC-15BC( ) series.
The original publication is kept intact and all changes with serial number effectivity when applicable are compiled under revision section as they occur.

MODEL SERIES	DESCRIPTION
PC-15BC( )	Basic 250 VA, 400 HZ, static inverter; 115 VAC and 26 VAC outputs, oscillator synchronization output, 7 pin connector. This unit supersedes Model PC-15B( ) commencing with serial number 5100.
PC-15BC(D)	Modified PC-15BC( ) with 150 VA from 26 VAC output and 100 VA from 115 VAC output commencing with serial number 500.
PC-15BC(E)	Modified PC-15BC( ) with remote ON and OFF feature. Connector used is MS3102A20-16P.
PC-15BC(H)	Modified PC-15BC( ) with the connector KPT02E18-11P.

Information for PC-15B( ) and earlier models refer to the Instruction Manual for PC-15( ), PC-15B( ) and PC-15BC( ) Series. Its latest issue is the 11th printing dated Feburary, 1976.

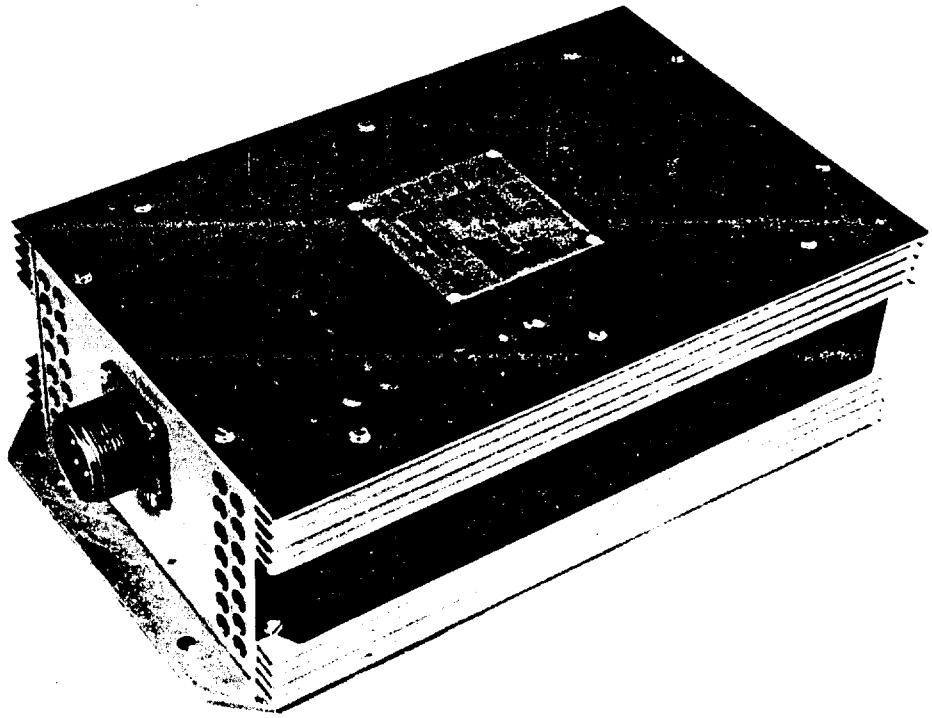


Figure 1.1 Flite-Tronics Model PC-15BC( ) Series

Section I

General Information

1.1 Introduction

This instruction manual has been prepared to provide information on installation, performance, operation, identification of parts, and maintenance of the Flite-Tronics' Model PC-15BC( ) Series Transistorized Power Inverter.

1.2 Purpose of Equipment

The PC-15BC( ) Series shown in Figure 1.1, is a transistorized inverter designed to supply AC power at 400 HZ.

The unit is capable of delivering a current overload of 150% for a minimum duration of 5 minutes at full rated output. This permits the PC-15BC( ) to power equipment that require momentary surges of power during turn on.

1.3 Specifications for PC-15BC( )

Input Voltage..... 28.0 VDC

Input Current: Steady state @ 28 VDC
a) 13.2 amperes typical delivering 250 VA.
b) .75 amperes typical no load.

Input Voltage Range:
22 to 30 VDC
Operate down to 20 VDC

Input Overvoltage:
Withstands 130% input overvoltage for 5 minutes, while supplying full rated 250 VA output power. Output voltage under this condition +5%, -7%.

Output Voltage:
115 VAC rms +5%, -7% 22 to 30 VDC. Greater than 100 VAC down to an input of 20 VDC

Output Voltage: 75 VA maximum
26.0 VAC rms +5%, -7%.

Pin E Output @ 20 VDC Input:
115 VAC +5%, -7%

Output Frequency: 400 HZ ±1%

Total Maximum Continuous Output Power..... 250 VA
(Sum of 115 VAC and 26 VAC outputs)

Output Waveform:
Sine wave, single phase

For Higher Power Output:
Units may be paralleled for higher power output. (Refer to installation section.)

Amplitude Distortion
Both outputs..... 3% (Typ.)
26-30 VDC input

Overload Capacity:
Withstands 150% output current overload for at least 5 minutes.

Power Factor.... .8 to 1.0

Input Voltage Protection:
Unit withstands transient of 88 volts lasting 1 millisecond on the 28.0 VDC input line.

Excessive Overload and Output Short Circuit:
Withstands without damage or degradation loads exceeding 150% nominal to an output short circuit. Unit delivers rated output on removal of above condition. See Page 205 for output fault clearance capability.

Altitude..... 45,000 feet

Efficiency..... 70% typical

Temperature: -65°F to 160°F

Weight: 7.5 lbs.

Size:
Width 6"
Length 9-3/8" (not incl. mounting flange)
Height 3-3/16"

1.3A Specifications for PC-15BC(D)

Input Voltage..... 28.0 VDC

Input Current: Steady state @ 28 VDC
a) 13.2 amperes typical delivering 250 VA.
b) .75 amperes typical no load.

Input voltage range:
22 to 30 VDC
Operate down to 20 VDC

Input Overvoltage:
Withstands 130% input overvoltage for 5 minutes, while supplying full rated 250 VA output power. Output voltage under this condition +5%, -7%.

Output Voltage:
115 VAC rms +5%,-7% 22 to 30 VDC. Greater than 100 VAC down to an input of 20 VDC

Output Voltage:
26.0 VAC rms +5%, -7%

Pin E Output @ 20 VDC Input:
115 VAC +5%, -7%

Output Frequency: 400 HZ ±1%.

Total Maximum Continuous Output Power..... 250 VA
150VA from 26VAC output plus 100VA from 115VAC output

Output Waveform:
Sine wave, single phase.

For Higher Power Output:
Units may be paralleled for higher power output. (Refer to installation section.)

Amplitude Distortion
Both outputs..... 3% (Typ.)
26-30 VDC input

Overload Capacity:
Withstands 150% output current overload for at least 5 minutes.

Power Factor.... .8 to 1.0

Input Voltage Protection:
Unit withstands transient of 88 volts lasting 1 millisecond on the 28.0 VDC input line.

Excessive Overload and Output Short Circuit:
Withstands without damage or degradation loads exceeding 150% nominal to an output short circuit. Unit delivers rated output on removal of above condition. See Page 205 for output fault clearance capability.

Altitude..... 45,000 feet

Efficiency..... 70% typical

Temperature: -65°F to 160°F

Weight: 7.5 lbs.

Size:
Width 6"
Length 9-3/8" (not incl. mounting flange)
Height 3-3/16"

1.3B Specifications for PC-15BC(E)

Input voltage..... 28.0 VDC

Input Current: Steady state @ 28 VDC
a) 13.2 amperes typical delivering 250 VA.
b) .75 amperes typical no load.

Input voltage Range:
22 to 30 VDC
Operate down to 20 VDC

Input Overvoltage:
Withstands 130% input overvoltage for 5 minutes, while supplying full rated 250 VA output power. Output voltage under this condition +5%, -7%.

Output Voltage:
115 VAC rms +5%, -7% 22 to 30 VDC. Greater than 100 VAC down to an input of 20 VDC

Output Voltage: 75 VA maximum
26.0 VAC rms +5%, -7%.

Pin E Output @ 20 VDC Input:
115 VAC +5%, -7%

Output Frequency: 400 HZ ±1%

Total Maximum Continuous Output Power..... 250 VA
(Sum of 115 VAC and 26 VAC outputs)

Output Waveform:
Sine wave, single phase

For Higher Power Output:
Units may be paralleled for higher power output. (Refer to installation section.)

Amplitude Distortion
Both outputs..... 3% (Typ.)
26-30 VDC input

Overload Capacity:
Withstands 150% output current overload for at least 5 minutes.

Power Factor.... .8 to 1.0

Input Voltage Protection:
Unit withstands transient of 88 volts lasting 1 millisecond on the 28.0 VDC input line.

Excessive Overload and Output Short Circuit:
Withstands without damage or degradation loads exceeding 150% nominal to an output short circuit. Unit delivers rated output on removal of above condition. See Page 205 for output fault clearance capability.

Altitude..... 45,000 feet

Efficiency..... 70% typical

Temperature: -65°F to 160°F

Remote-On-Off:
Complete circuit from Pins A to D to turn unit on.

Weight: 7.5 lbs.

Size:
Width 6"
Length 9-3/8" (not incl. mounting flange)
Height 3-3/16"

1.3C Specifications for PC-15BC(H)

Input voltage..... 28.0 VDC

Input Current: Steady state @ 28 VDC
a) 13.2 amperes typical delivering 250 VA.
b) .75 amperes typical no load.

Input Voltage Range:
22 to 30 VDC
Operate down to 20 VDC

Input Overvoltage:
Withstands 130% input overvoltage for 5 minutes, while supplying full rated 250 VA output power. Output voltage under this condition +5%, -7%.

Output Voltage:
115 VAC rms +5%, -7% 22 to 30 VDC. Greater than 100 VAC down to an input of 20 VDC.

Output Voltage: 75 VA maximum
26.0 VAC +5%,-7%.

Output Frequency: 400 HZ ±1%

Total Maximum Continuous Output Power..... 250 VA
(Sum of 115 VAC and 26 VAC outputs)

Output Waveform:
Sine wave, single phase

For Higher Power Output:
Units may be paralleled for higher power output. (Refer to installation section.)

Amplitude Distortion
Both outputs..... 3% (Typ.)
26-30 VDC input

Overload Capacity:
Withstands 150% output current overload for at least 5 minutes.

Power Factor.... .8 to 1.0

Input Voltage Protection:
Unit withstands transient of 88 volts lasting 1 millisecond on the 28.0 VDC input line.

Excessive Overload and Output Short Circuit:
Withstands without damage or degradation loads exceeding 150% nominal to an output short circuit. Unit delivers rated output on removal of above condition. See Page 205 for output fault clearance capability.

Altitude..... 45,000 feet

Efficiency..... 70% typical

Temperature: -65°F to 160°F

Weight: 7.5 lbs.

Size:
Width 6"
Length 9-3/8" (not incl. mounting flange)
Height 3-3/16"

1.3.1 Environmental Specifications Applicable to All Model Series

Emission RFI:
Radiated & Conducted... 90 KC to 1000 MC.
Far below levels specified in Appendix A of RTCA Paper 120-61/DO-108 Category "A", see pages 4 and 5.

Humidity:
Greater than 95% for ten days, temperature cycled between 75°F to 160°F.

Vibration:
To withstand in three directions

.08 DA	5-15 HZ
.036 DA	15-70 HZ
10 G's	70-500 HZ

Shock:
To withstand at least 10 G's for 11 milliseconds in three directions.

1.4 Description

The PC-15BC( ) is a transistorized airborne static power inverter. The unit operates from 28.0 VDC aircraft power source and delivers 115 VAC and 26 VAC @ 400 HZ. The total continuous power drawn from the two outputs should not exceed 250 VA.

An L/C tuned 400 HZ oscillator operating in a class B push-pull mode is used to generate the 400 HZ signal.

This signal is amplified by 3 stages of class B push-pull emitter follower amplifiers. Protective circuits for output overload, thermal runaway and input voltage transient are incorporated to make the PC-15s an extremely reliable equipment.

Frequency and output voltage are adjustable. However, once set at the factory, they sould not require readjusting for the life of the equipment.

TEST CONDITION: Broadband Radiated
TEST MODE: Steady State Mode
LEGEND: SPECIFICATION
MEASURED LEVEL
AMBIENT LEVEL
No narrow band C.W. detected.

TEST SPECIMEN: Flite-Tronics Co.
Static Inverter M/N PC-15, S/N 100
SPECIFICATION: R.T.C.A. Paper 120-61/
DO-108, Appendix A
DATE: 12 June '66

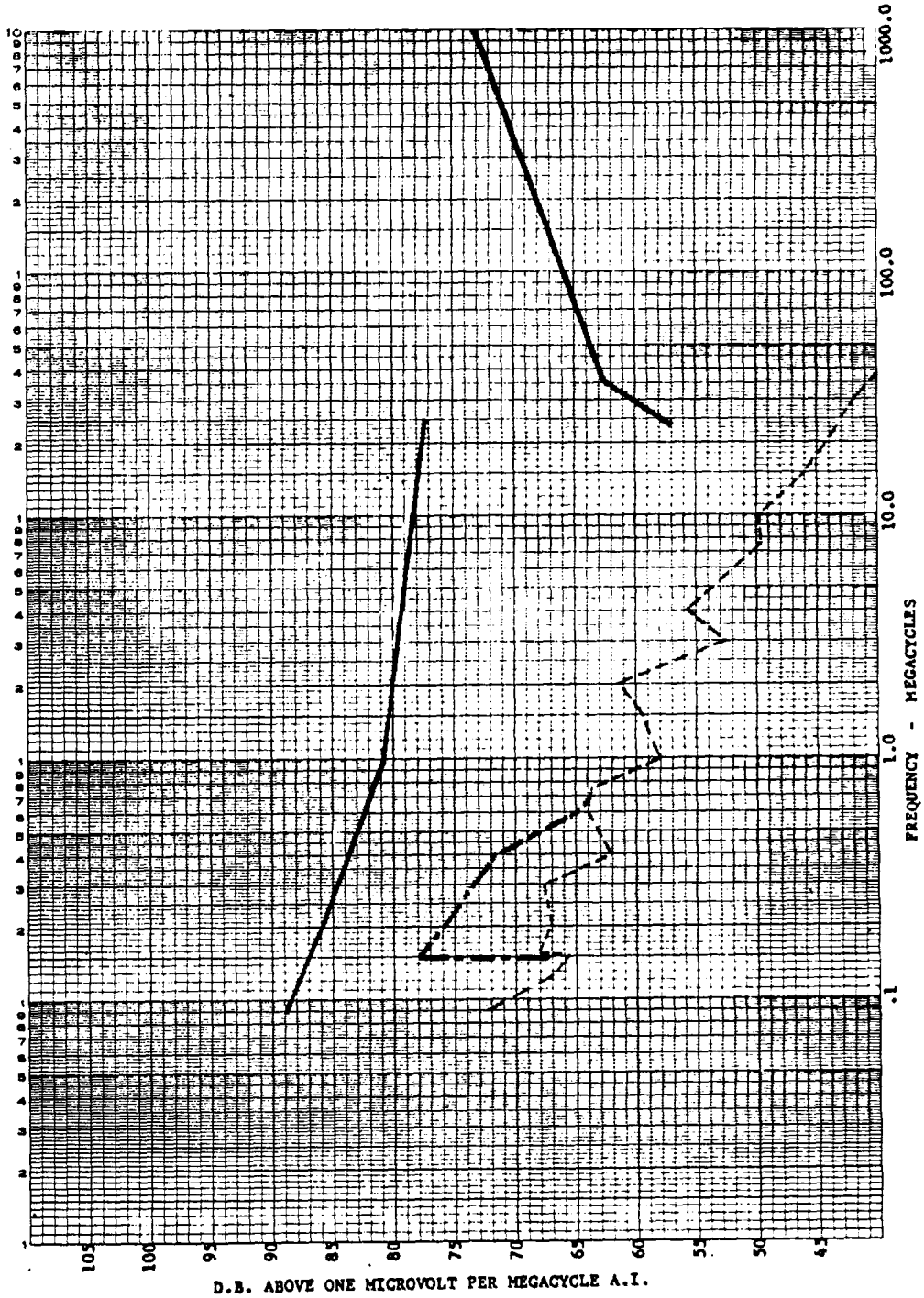


Figure 1.2 EMISSION RFI RADIATED

TEST CONDITION: Broadband Conducted
TEST MODE: Steady State Mode
LEGEND: SPECIFICATION ——————
MEASURED LEVEL — - — - —
AMBIENT LEVEL - - - - - - -
No narrow band C.W. detected.

TEST SPECIMEN: Flite-Tronics Co.
Static Inverter M/N PC-15, S/N 100
SPECIFICATION: R.T.C.A. Paper 120-61/
DO-108, Appendix A
DATE: 12 June '66

Statement by Test Lab.; Cornell-Dublier Electronics Division.
Summary of Results for Radiated and Conducted RFI:
The Static Inverter M/N PC-15, S/N 100, was subjected to an electromagnetic interference investigation test program per R.T.C.A. Paper 120-61/DO-108, Appendix A. Upon evaluation of the test data, it was found that the above referenced static inverter generated interference which was below the specification limits of R.T.C.A Paper 120-61/DO-108, Appendix A.

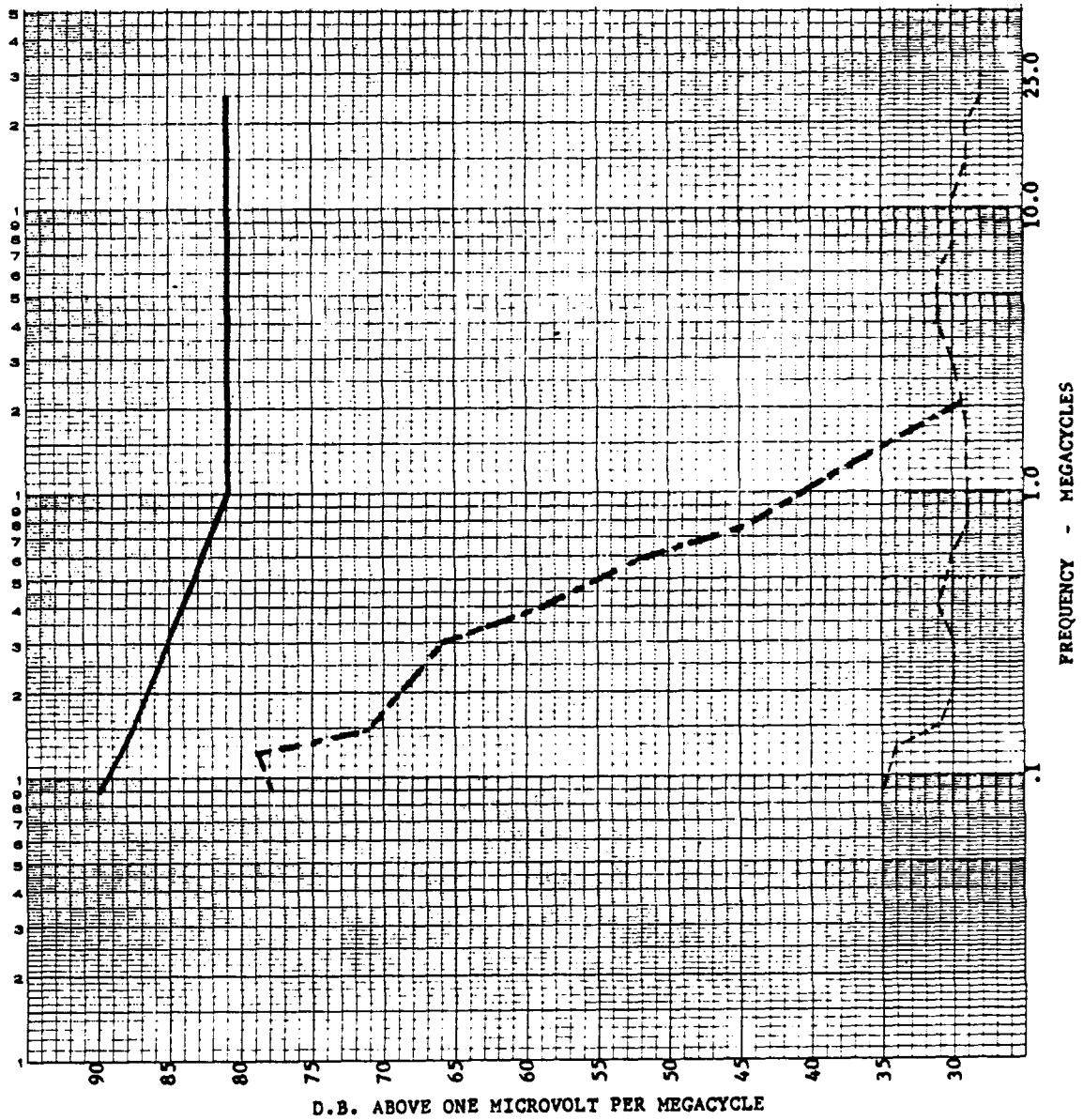


Figure 1.3 EMISSION RFI CONDUCTED

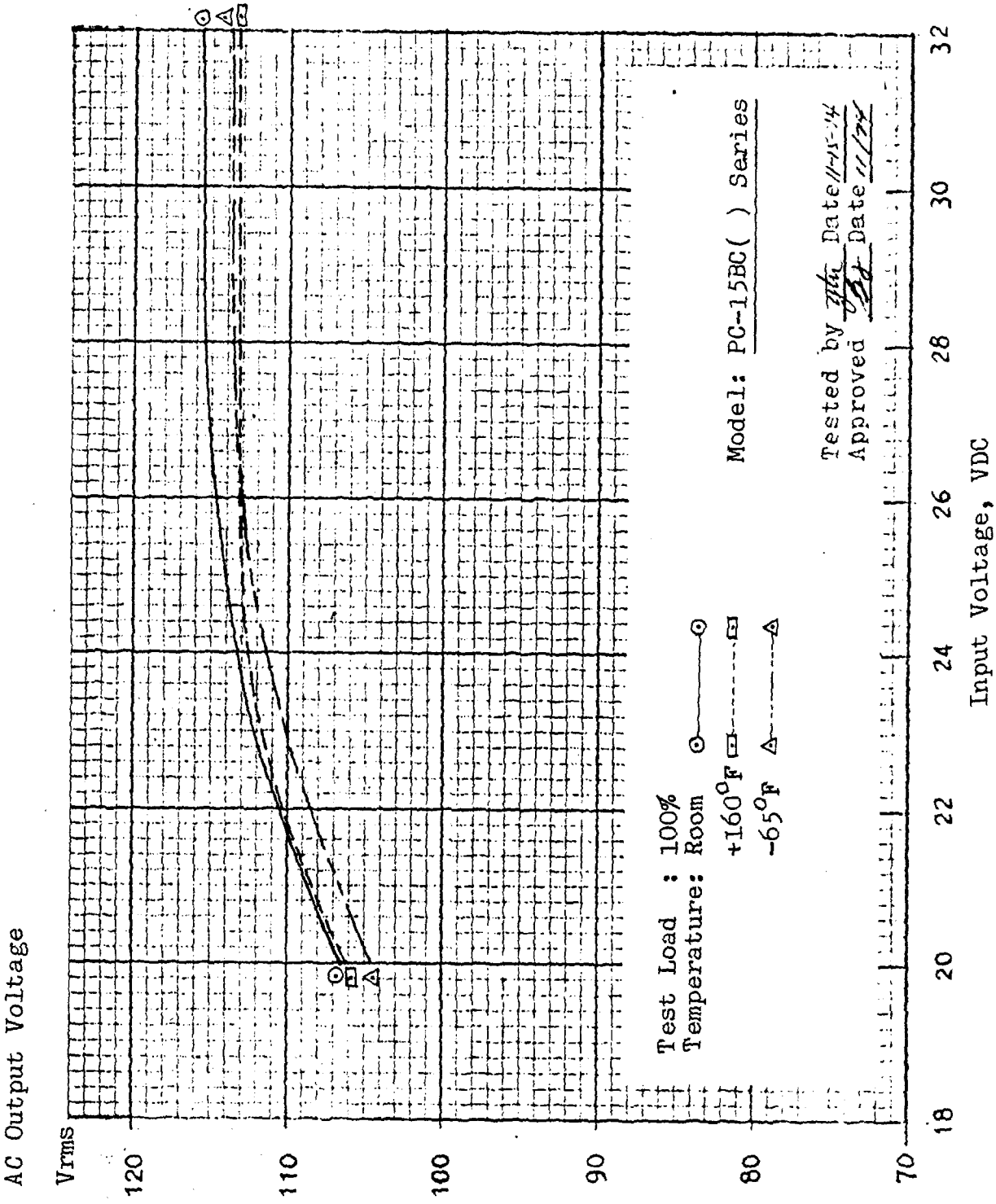


Figure 1.4 Typical Output Performance Curve

Section II

Installation

2.1 General

The Model PC-15BC( ) Series (hereinafter frequently referred to as PC-15s) is a 400 HZ Inverter, ready to install when delivered from the factory.

To determine that the unit is operating satisfactorily, a bench test may be made. The external hook-up for such a test is illustrated in Figure 4.1 page 203.

The PC-15s will deliver 250 VA of power to a load having a power factor between .8 lag to 1.0. The PC-15s will operate into loads which are more reactive; however, an external phase correcting capacitor will be required.

The capacitance value may be determined by noting what value causes a null in the input current reading. This, of course, should be determined with the load the PC-15BC( ) delivers power to. A poly-carbonate type capacitor having a rating of 300 volts or greater may be used for this phase correcting.

Installation where more than 250 VA of continuous power is required, the PC-15s may be paralleled, as necessary, to double, triple, or even quadruple the power of a single unit.

2.2 Installation Procedure

The PC-15s are environmentally designed to mount on a rack with other equipment, or in any suitable location in the aircraft.

Figure 2.1( ) Page 9( ) illustrates the installation dimensions and mounting centers. Mounting hardware should be 10-32 and length long enough to have 1-1/2 threads exposed after installing the necessary hardware.

The mating connector plug to the PC-15s' receptacle is MS3106B18-9S or equivalent.

A wire size AWG #10 or #12 is suggested for the low voltage DC input and an AWG size #18 for the AC output leads. The low voltage input to the PC-15s should be protected with a 25 amp circuit breaker.

Figure 2.2 page 10 illustrates the electrical connection to operate units in parallel for greater output power capability.

Units operating in parallel must have oscillators phase locked. This is

accomplished by connecting pin F together. To frequency lock the PC-15s to other 400 HZ ± .5%, 115 VAC source, R25 is changed .0047 ufd and pin F is connected to that source.

Frequency locking of PC-15s is only necessary when other 400 HZ ± 2 HZ power sources are in an aircraft and resulting in an undersirable beating effect.

CAUTION

THE PC-15s SHOULD NOT BE INSTALLED IN AN AREA WHERE THE AMBIENT AIR TEMPERATURE EXCEEDS 172° F. UNDER ALL WEATHER AND OPERATING CONDITIONS. THE UNIT MAY BE MOUNTED IN ANY POSITION. IN AN INSTALLATION THE VENT HOLES SHOULD NOT BE RESTRICTED. ALSO, THE PC-15s SHOULD BE MOUNTED DIRECTLY TO METALLIC PLATES OR SUPPORTS.

WHEN PC-15s ARE CONNECTED IN PARALLEL, ALL UNITS MUST BE TURNED ON. OTHERWISE THE PARALLEL CONNECTION SHOULD BE DISCONNECTED TO OPERATE INDEPENDENTLY.

WHEN THE PC-15s ARE OPERATED IN THE FREQUENCY LOCKED MODE TO OTHER 115 VAC 400 HZ ± 2 HZ SOURCE, THE OUTPUT, OF COURSE, SHOULD NOT BE PARALLELED.

CAUTION

THE BLOWER MOTOR SHOULD BE INSPECTED AND OVERHAULED EVERY 1000 HOURS OF MOTOR OPERATION.

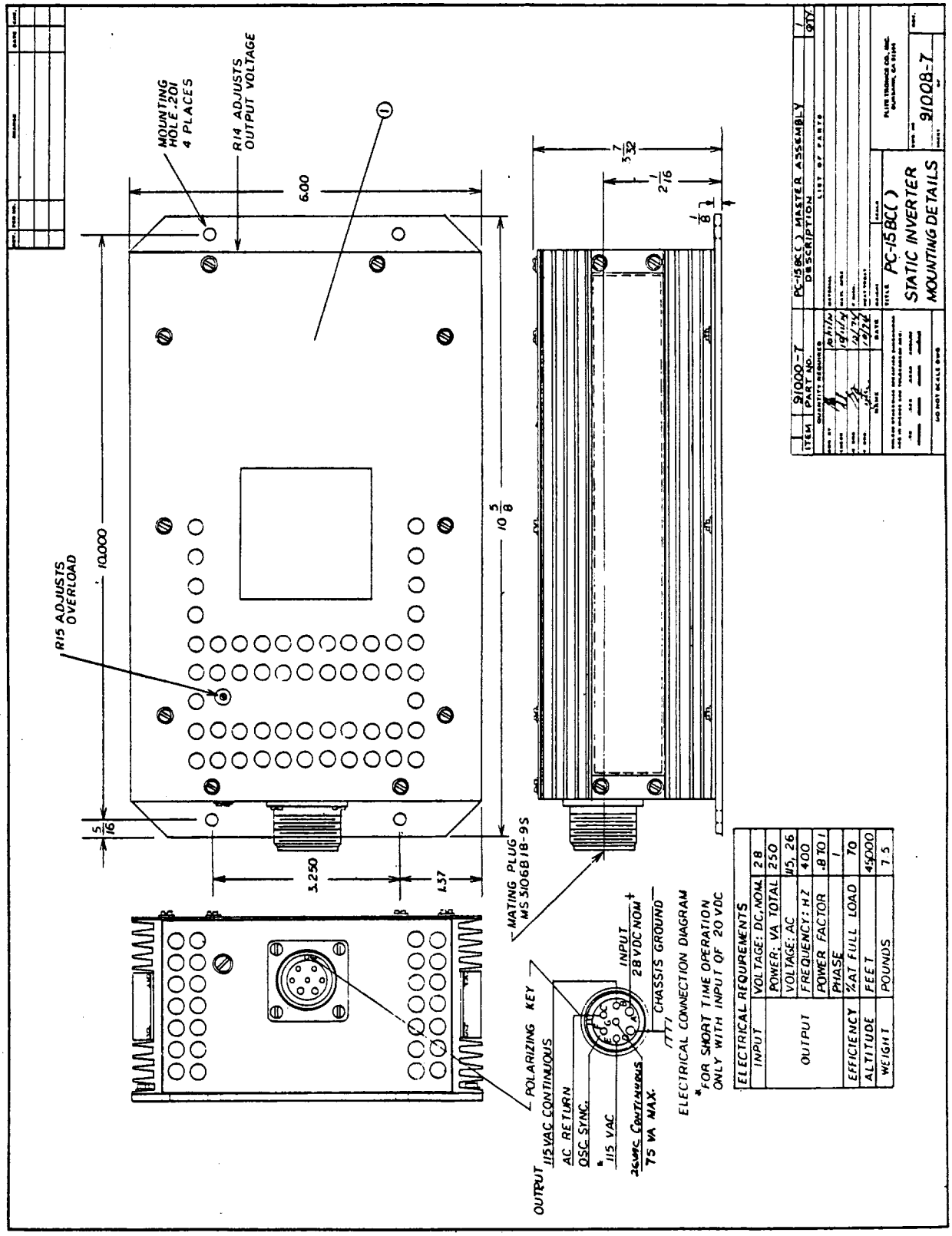
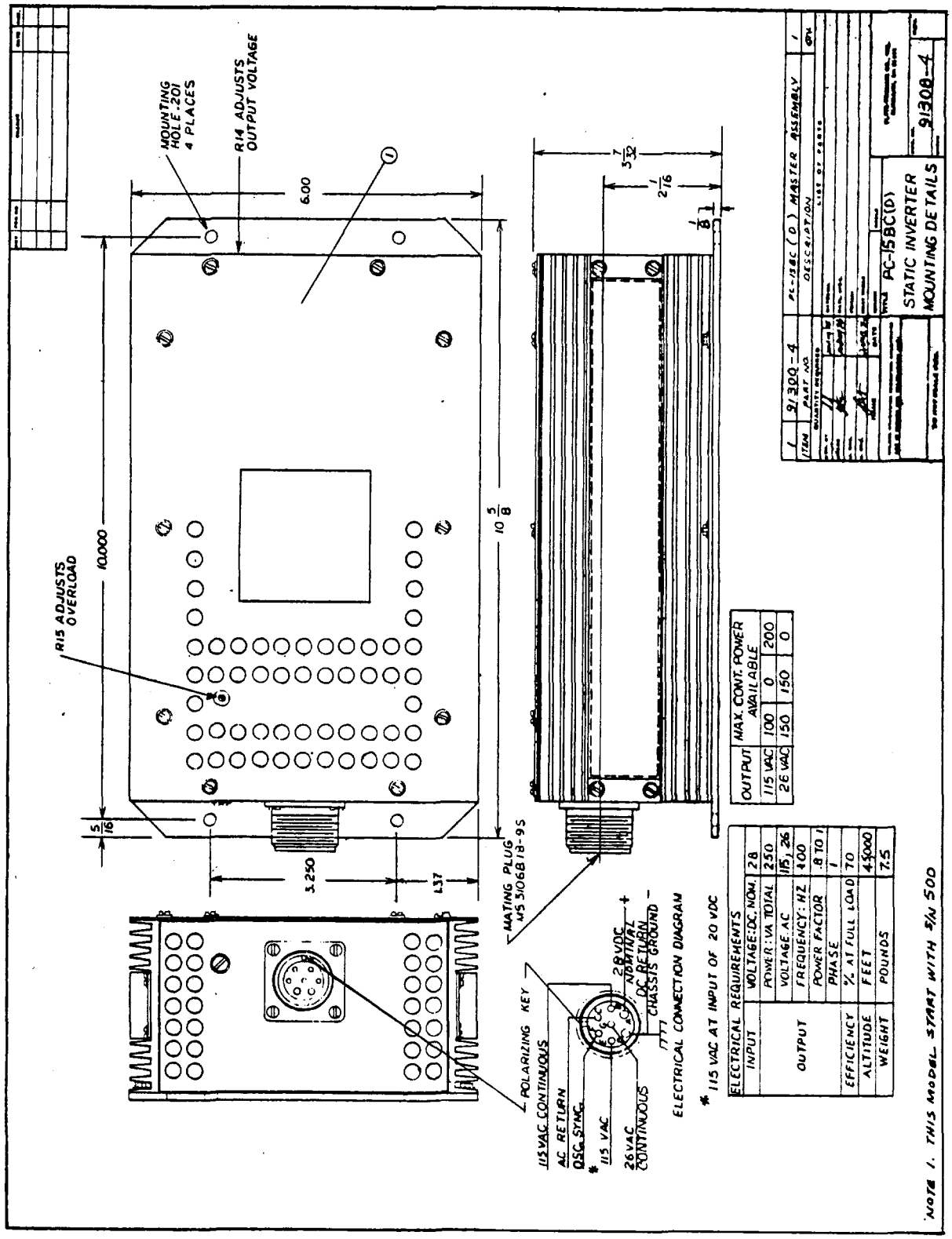


Figure 2.1 INSTALLATION AND MOUNTING DIMENSIONS



OUTPUT	MAX. CONT. POWER AVAILABLE			
115 VAC	100	0	200	
26 VAC	150	150	0	

ELECTRICAL REQUIREMENTS		
INPUT	VOLTAGE: DC: NOM.	28
	POWER: VA TOTAL	250
OUTPUT	VOLTAGE AC	115, 26
	FREQUENCY: HZ	400
	POWER FACTOR	.8 TO 1
	PHASE	1
EFFICIENCY	% AT FULL LOAD	70
ALTITUDE	FEET	45000
WEIGHT	POUNDS	7.5

Figure 2.1-1 INSTALLATION AND MOUNTING DIMENSIONS

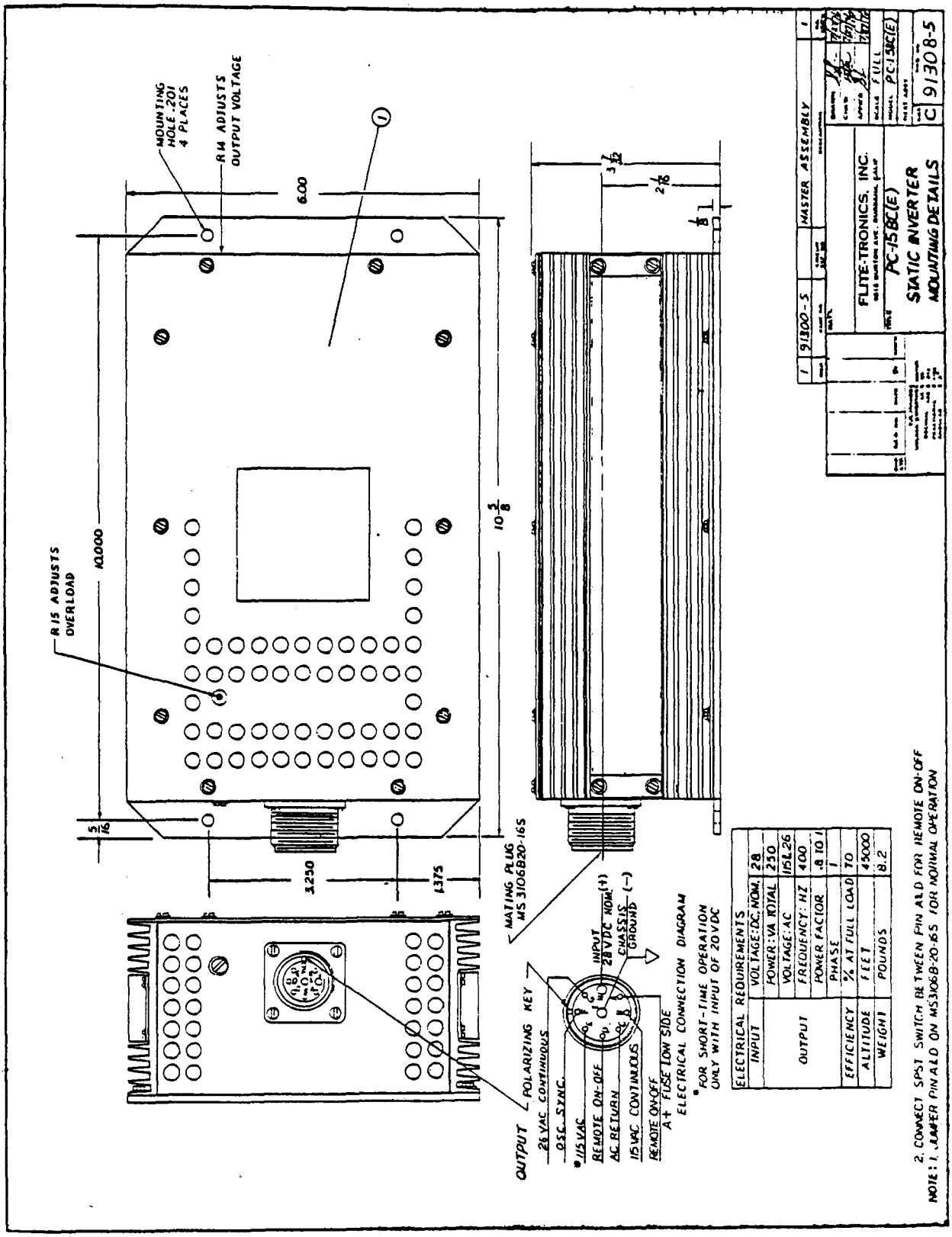


Figure 2.1-2 INSTALLATION AND MOUNTING DIMENSIONS

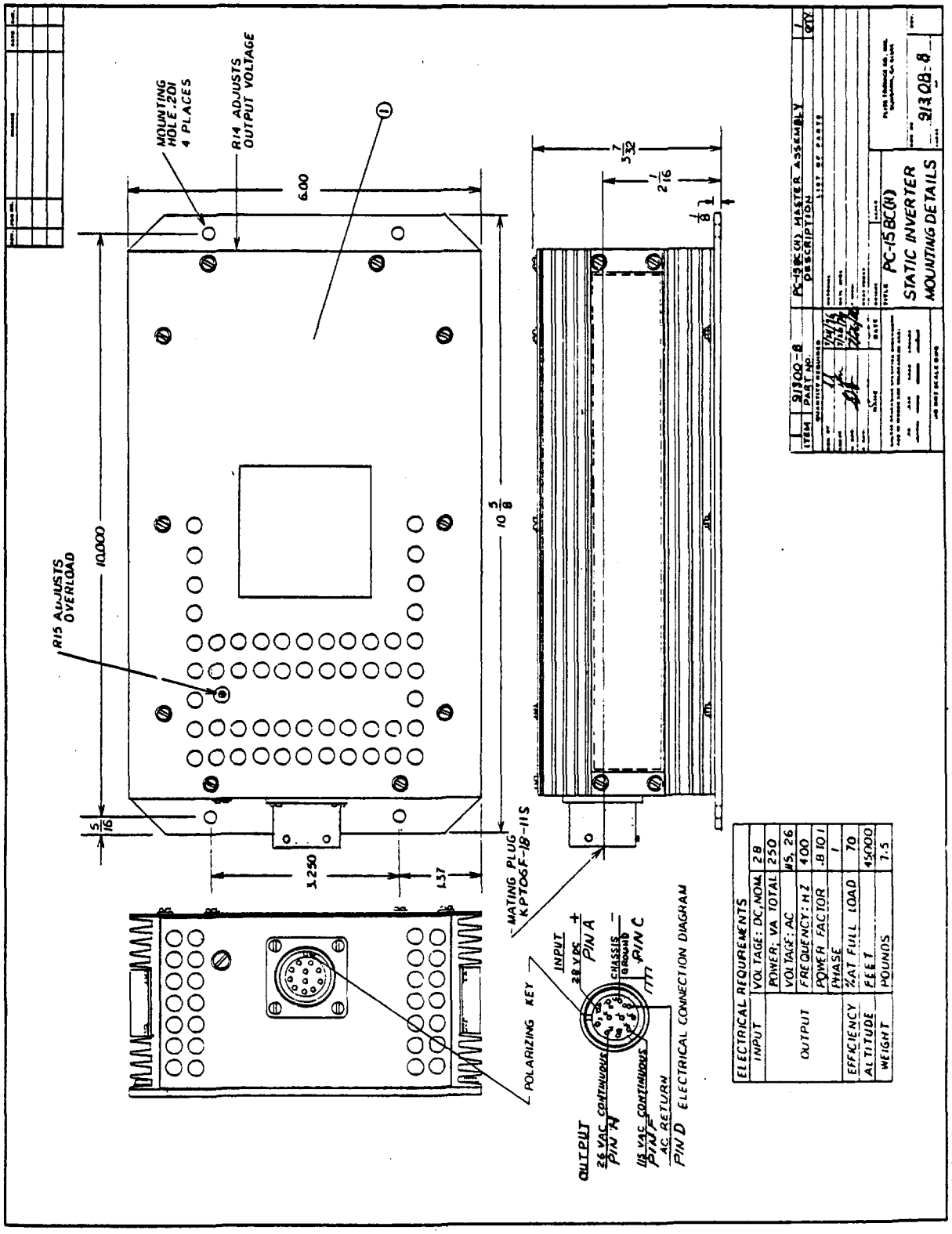


Figure 2.1-3 INSTALLATION AND MOUNTING DIMENSIONS

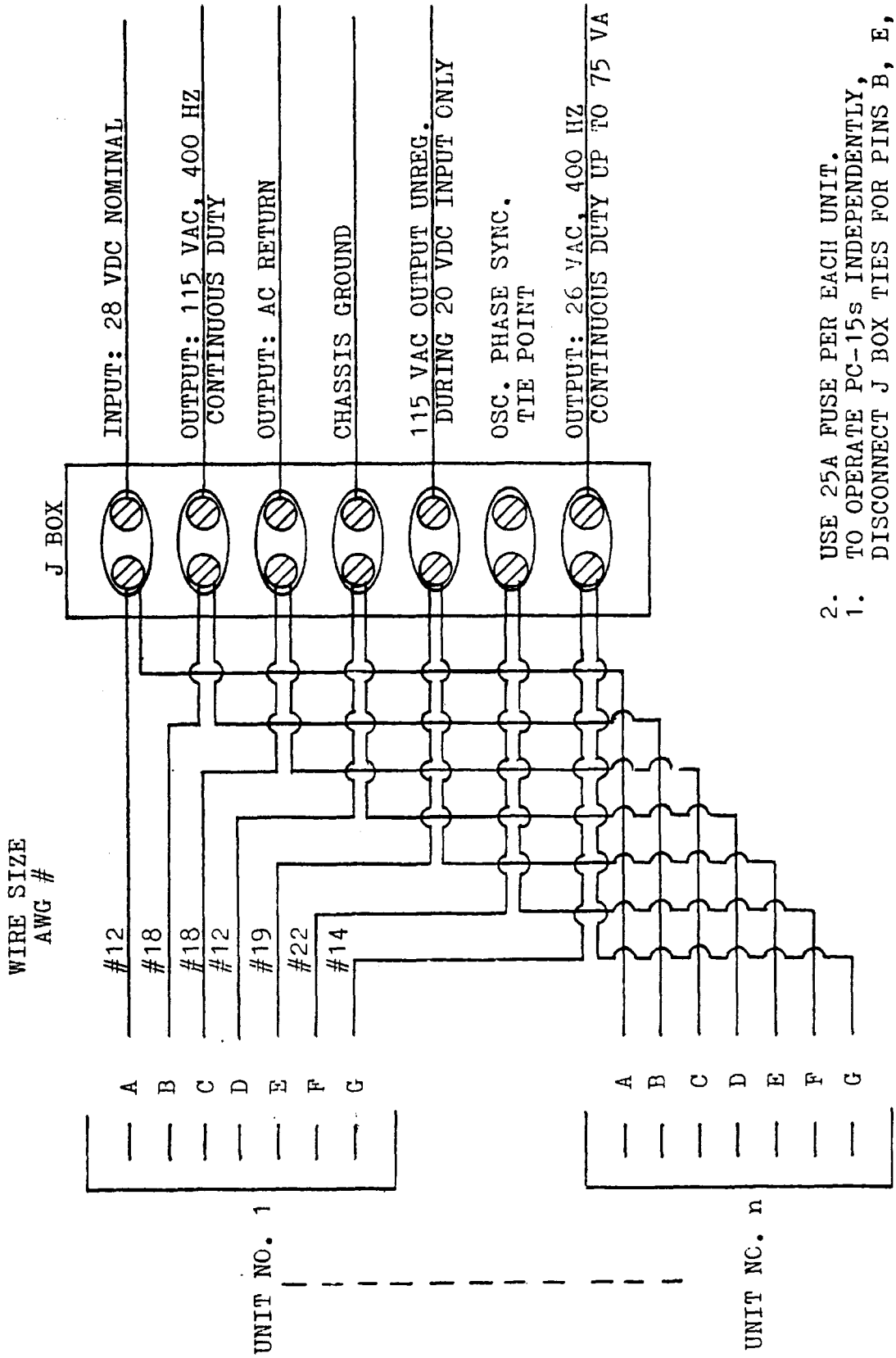


Figure 2.2 CONNECTION TO OPERATE PC-15s IN PARALLEL

Section III

Principles of Operation

3.1 General

The PC-15BC( ) converts DC energy to AC electrical energy.

The nominal output is 115 VAC on pin B and 26 VAC output from pin G. The AC output will follow the input DC voltage variation below 24.0 VDC. The 400 HZ is generated by an L/C tuned push-pull oscillator. The sine wave signal is amplified by three stages of class B push-pull amplifier. The final power output stage is also class B. To minimize the possibility of an 88 volt peak transient on the 28.0 VDC buss destructing the transistors the FT500 are tested to 175 VDC VCEX prior to installation. Schematics of the PC-15s are illustrated in Figure 3.2( ) page 13( ).

3.2 Block Diagram

Figure 3.1 shows the PC-15s' operation in a block diagram form. The block diagram illustrates the time tested and proven circuitry for power amplification of a low level AC signal. All the stages are class B push-pull emitter follower configuration. The emitter follower circuitry having inherent negative feedback introduces very little amplitude and phase distortion.

The output signal is sampled by current and voltage transformers. These components deliver a signal to operate the output overload and output voltage level circuitry.

This output, in turn, controls the push-pull 400 HZ oscillator amplitude.

The output overload reduces the output current and voltage when a load excess of 170% is applied to the output. This same circuitry operates in the event of a short circuit on the output.

The automatic level control maintains the output voltage constant for load and temperature variation.

3.3 400 HZ Sine Wave Oscillator

Inductor-transformer T1 is the feedback, output and resonant tuning transformer. The center tapped primary winding is 1-2-3. Feedback winding is 4-5-6. The output and resonant tuning winding is 7-8-9.

Capacitor C10 (.47 ufd) resonates with the inductance of the output winding at 400 HZ.

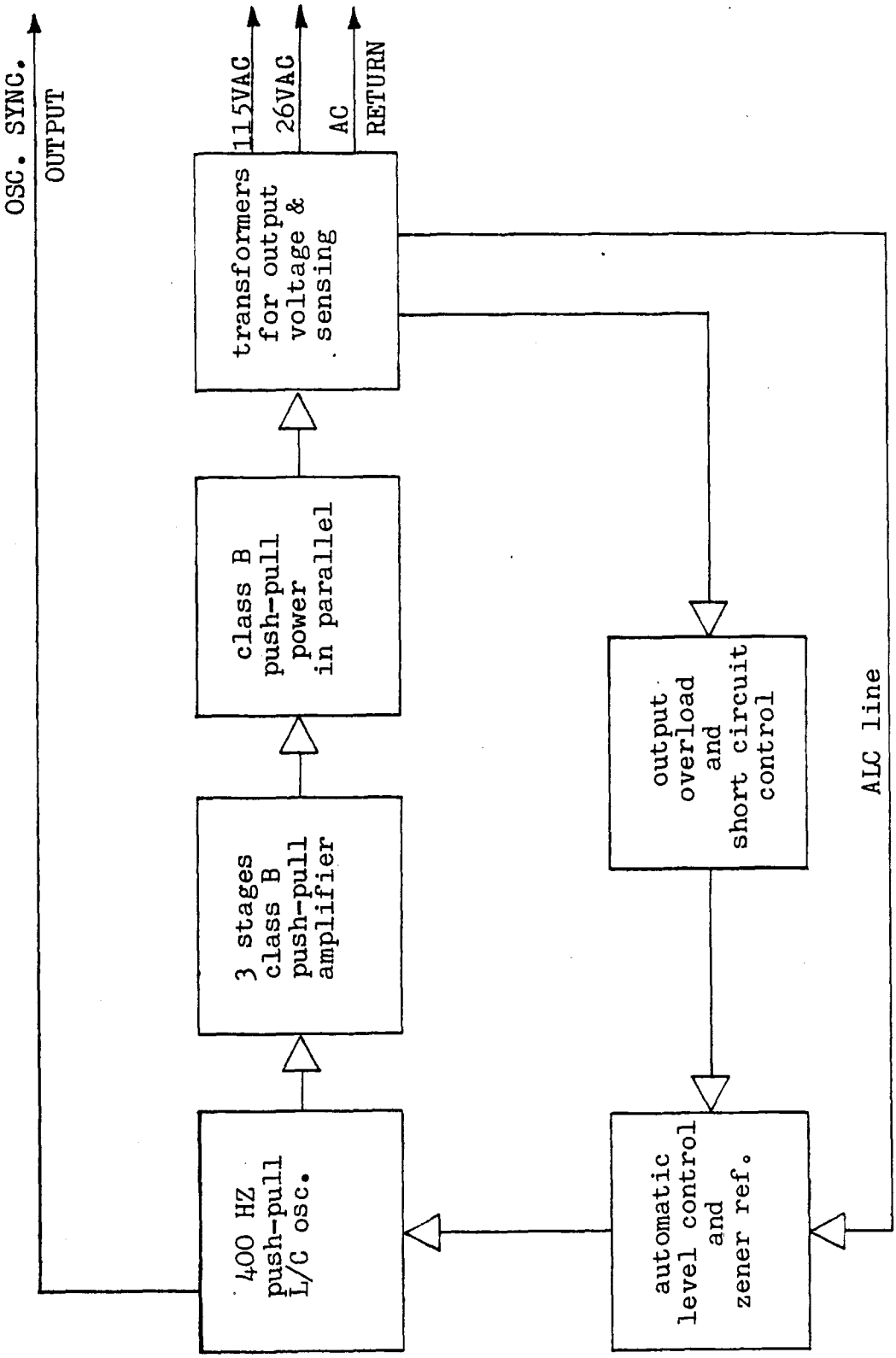


FIGURE 3.1 BLOCK DIAGRAM

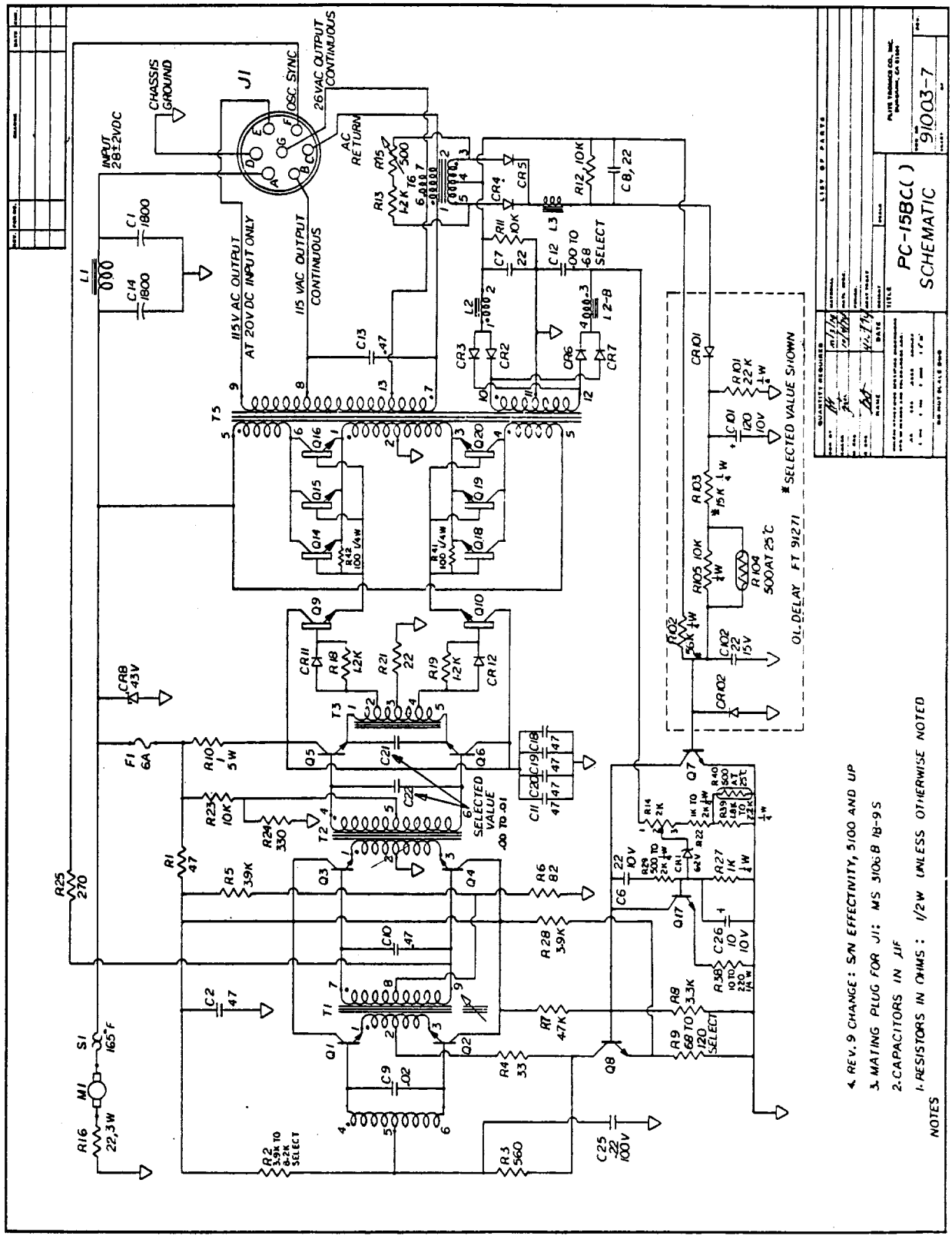


Figure 3.2 PC-15BC( ) SCHEMATIC

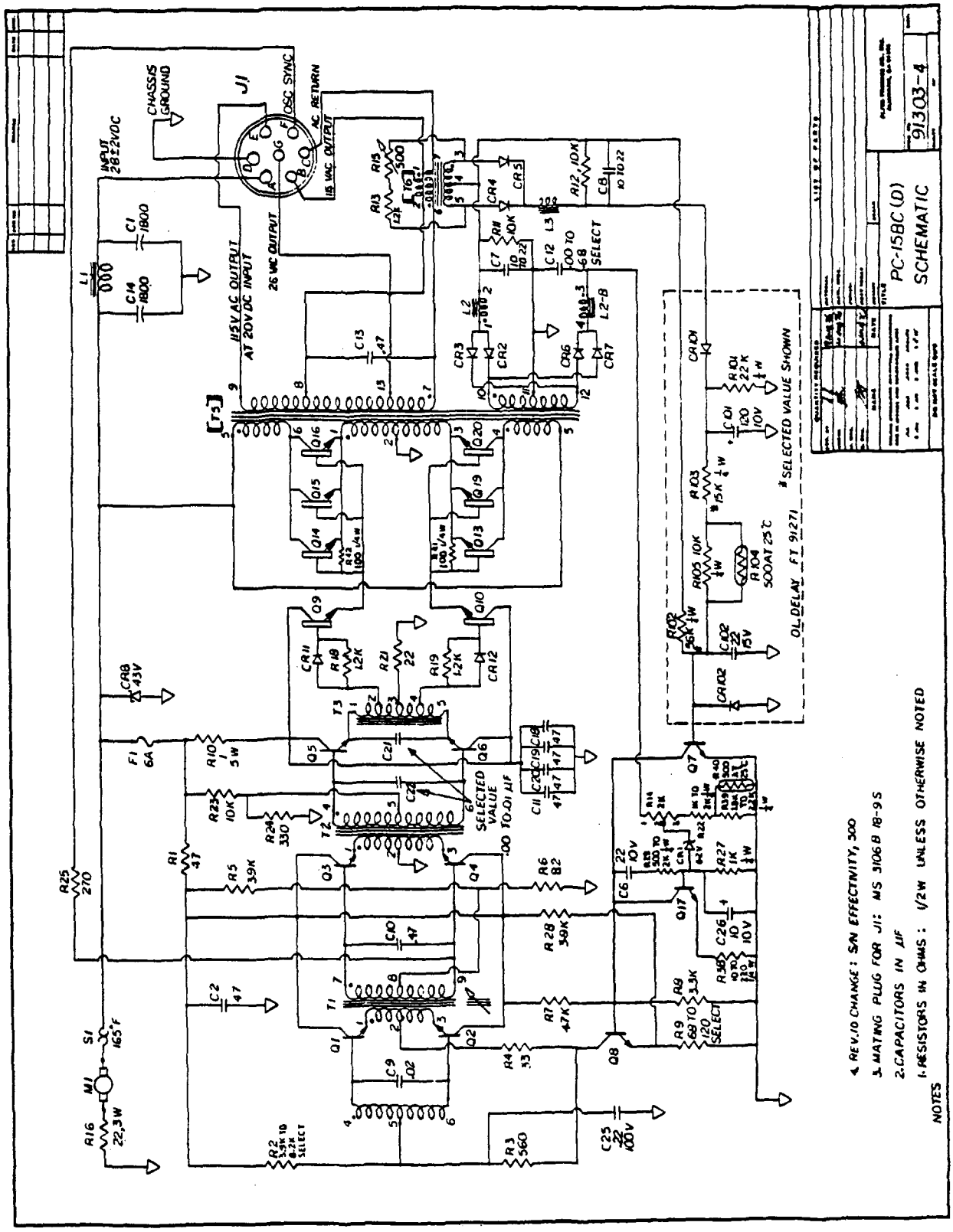


Figure 3.2-1 PC-15BC(D) SCHEMATIC

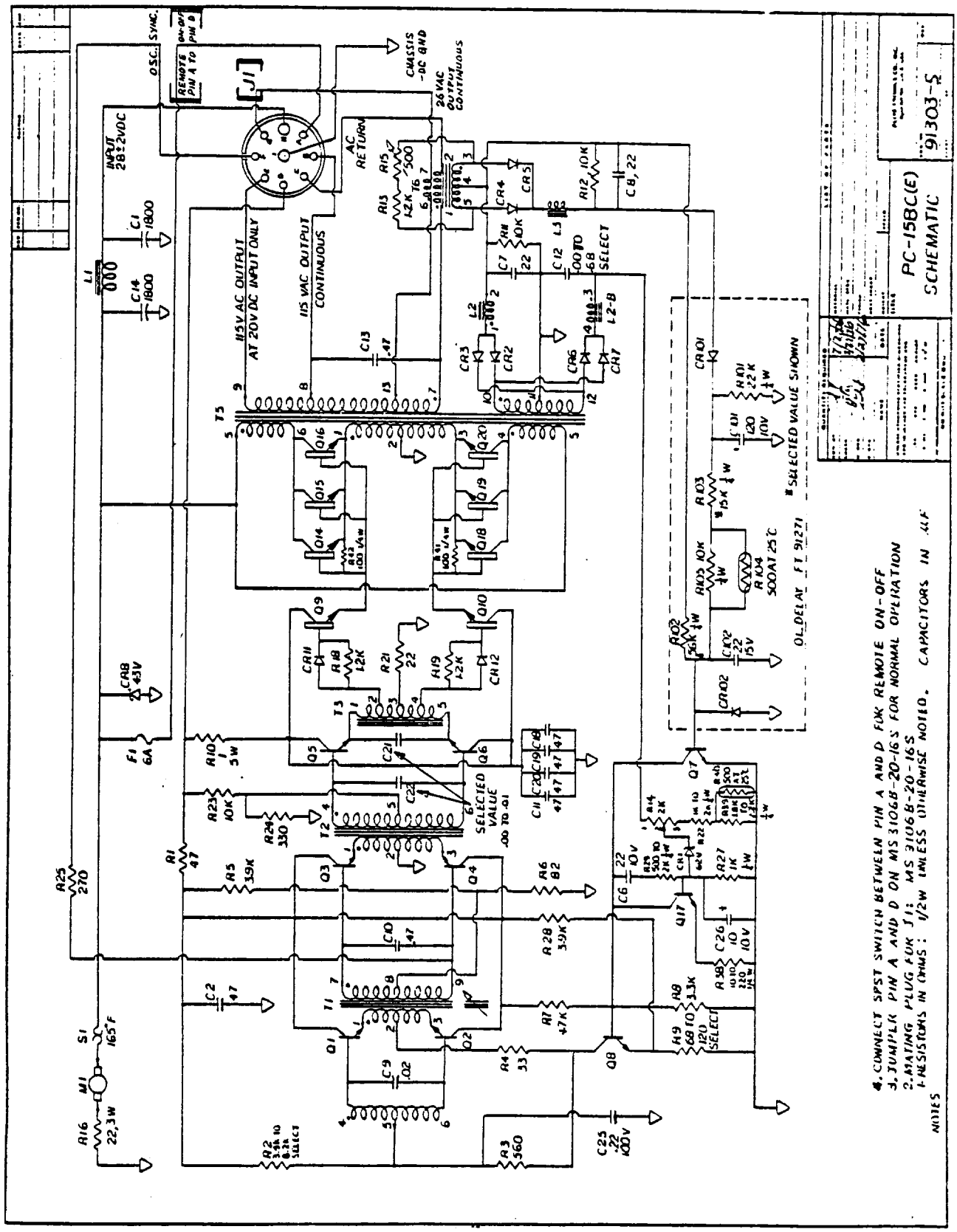


Figure 3.2-2 PC-15BC(E) SCHEMATIC

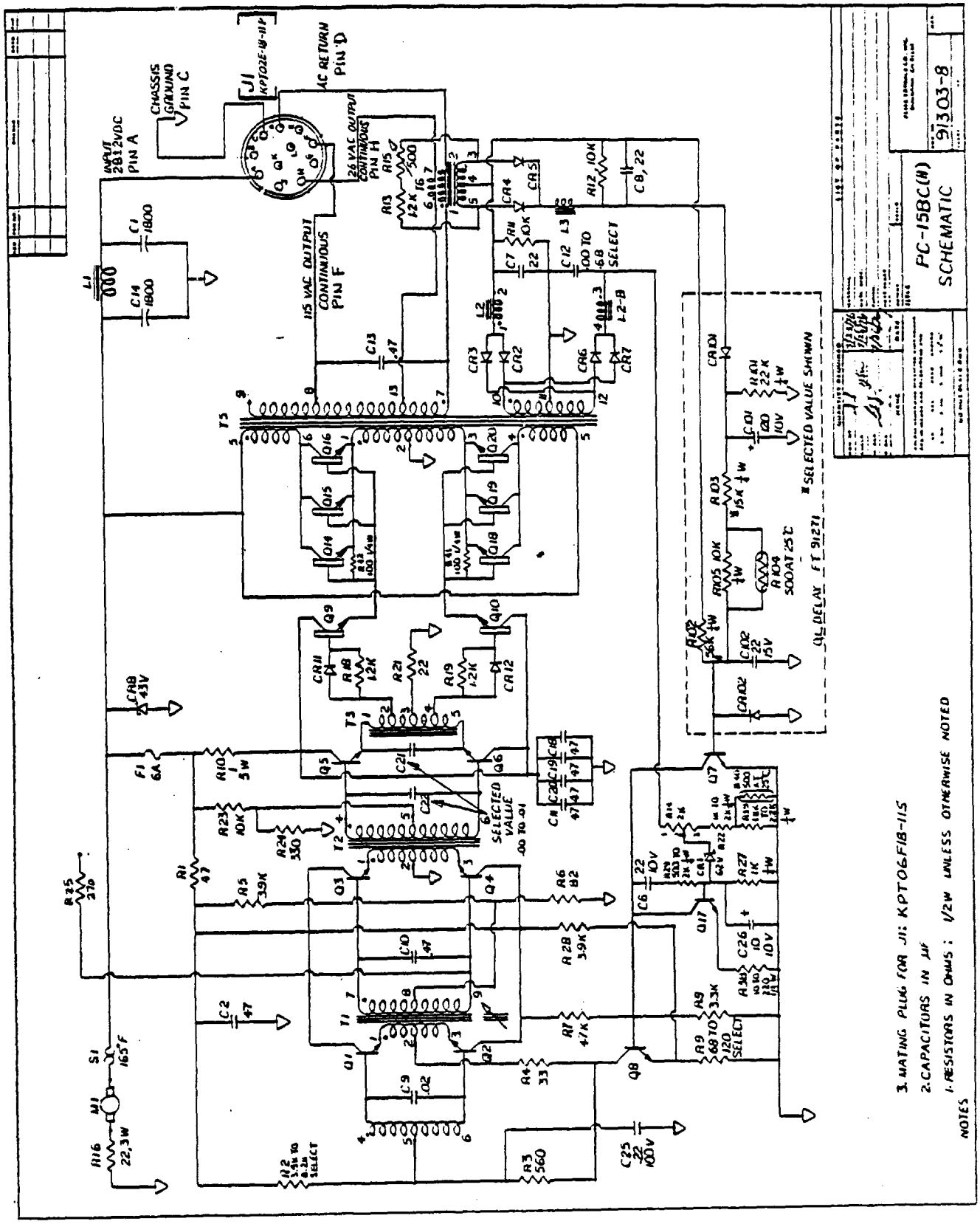


Figure 3.2-3 PC-15BC(H) SCHEMATIC

Transformer T1 has a tuning slug which is adjusted at the factory for an oscillator frequency of 400 HZ.

Transistors Q1 and Q2 are the class B push-pull amplifier to sustain oscillation. Resistors R2 and R3 biases the transistors to cause oscillation to start. Capacitor C9 suppresses any tendency for high frequency mode oscillation. Resistor R4 is the degenerating resistor.

The output winding 7-8-9 drives the bases of Q3 and Q4 in opposite phase.

3.4 Low Level Amplifiers

Between the sine wave oscillator and power amplifiers, there are three stages of class B push-pull emitter follower amplifiers.

The first stage consists of transistors Q3 and Q4 and the interstage transformer T2. Resistors R5 and R6 biases the transistors operating point.

The output from the transformer T2 drives the bases of Q5 and Q6. Resistors R24 and R23 biases transistors Q5 and Q6. Transistors Q5 and Q6 emitters drive the matching autotransformer T3. By using an autoformer connection for T3, the unit is designed compactly and yet permits proper step-down to drive transistors Q9 and Q10. Capacitor C22, a selected value connected across 4 and 6 of T2, is used to suppress ringing.

Capacitor C21 connected to the emitter of Q5 and Q6 suppresses parasitic oscillation. Transformer T3 delivers proper voltage and current to the final power output transistors thru logic network consisting of CR11, R18 and CR12, R19.

Decoupling network for the oscillator stage and first low level amplifier is R1 and C2. Decoupling network for the intermediate stage is R10.

Zener CR8 clips transient voltage above 43 VDC.

3.5 Power Amplifier

The power amplifier consists of silicon power transistors. Transistors Q14 through Q16 and Q18 through Q20 are driven in alternate half cycles. The multiple winding primary of transformer T5 divides the 28.0 VDC input, so the transistors operate in a hybrid grounded emitter and grounded collector configuration.

These power transistors are controlled to Flite-Tronics' specifications. These devices are inspected for certain minimum breakdown voltage, gain and recovery time. Therefore, an 88 volt peak transient on the 28.0 VDC input will not cause a collector to emitter voltage to exceed the minimum breakdown voltage. The primaries of the transformer forces this voltage division.

The tapped secondary of T5 delivers 26 VAC from terminal 13, and 115 VAC from terminal 8.

The output from terminal 9 is 115 VAC working into 90% of rated load, during an input of 20 VDC on the A+ line. There will exist, however, a slight squaring of the peaks of the sine wave in this condition.

Capacitor C13 is the phase compensating capacitor to permit the unit to operate efficiently with a load power factor between .8 lag and 1.0.

3.6 Output Voltage Control

The output voltage sample is realized from the center tapped winding 10-11-12 of T5. Rectifiers CR6 and CR7 converts the AC signal to a DC output. Filter consisting of L2-B and C12 is the L section choke input to give an average DC output which is proportional to the 115 VAC level.

This DC output is also applied across a variable resistor R14 in series with R22 and temperature compensating network R39 and R40 in parallel. The variable portion of the resistor is connected to the base of Q17 thru zener 6.2 VDC CR1. In essence, this output voltage sample is compared with the zener CR1.

The variable resistor R14 is adjusted for an output of 115 VAC. A common load resistor R7 is connected to the collector of Q7 and Q17. The DC current passing through R7 determines the bias point for transistor Q8. Transistor Q8 is the variable DC source for the push-pull 400 HZ oscillator.

The push-pull oscillator represents an impedance to the collector circuit of Q8. Hence, the conduction of Q8 will determine the magnitude of DC voltage across the oscillator circuit. This, in turn, determines the amplitude of oscillation, which controls the AC output level. Resistor R9 is the degenerating resistor for transistor Q8.

Resistor R8 is the starting resistor for transistor Q8 until the oscillator amplitude builds up sufficiently for the automatic level control circuitry to take over.

Capacitor C6 is a low frequency feedback capacitor to prevent the automatic level control circuitry from motor boating. Capacitor C25 and C26 are simply by-pass capacitors.

3.7 Output Overload Control

The output AC current is sampled by the transformer T6. The current flowing through the winding 1-2 causes a voltage to be developed across the center tapped winding 3-4-5. The magnitude of voltage across this winding is controlled by the variable resistor R15 in series with R13.

The AC voltage from winding 3-4-5 is rectified by CR4 and CR5. The averaging choke

input filter, consisting of L3 and C8, develops a DC voltage across R12, which is proportional to the output AC current. The 26 VAC output current is sampled by winding 6-7 of transformer T6.

To realize an overload that causes quenching action, the overload current resulting in DC voltage across R12 is compared with the output DC voltage across R11. This tends to give a trigger-like action when an overload condition is sustained.

The output voltage sample is taken from winding 10-11-12 of transformer T5. CR2 and CR3 rectifies this voltage. The L section choke input filter, consisting of L2 and C7, places across resistor R11 a ripple-free DC voltage. The voltage across R11 is a negative polarity with respect to ground.

The DC voltage across R12, which is proportional to the output current, is compared with the voltage across resistor R11. When the output current causes a voltage across R12 to exceed the compared voltage across R11, transistor Q7 will start conducting when this signal is coupled thru overload (OL) delay network shown as FT91271. The extent of overload determines the magnitude of current Q7 will conduct. As Q7 conducts, this tends to cut off Q8, which, in turn, decreases the voltage across the 400 HZ oscillator circuit.

When the load is in excess of 170% of 250 VA, the oscillator circuit will exhibit anything from low frequency quenching to almost a complete shut down.

During output short circuit, the current overload circuitry will reduce the voltage across the push-pull oscillator until a feeble oscillation is maintained.

Of course, on removal of the short circuit condition, the unit will immediately return to normal operating condition.

3.8 Input Filtering and Blower

The input is filtered by a pi section filter, consisting of capacitors C1, C14 and choke L1.

Additional filtering for the low level stage is done by the RC filter, consisting of R1, C2, and R10, C11, C18, C19 and C20.

Blower motor M1 is thermostatically controlled and used for protection only. The blower motor turns on when the heat sink temperature exceeds 165° Fahrenheit.

In normal installation where thermal conduction by the aircraft structure is adequate, the blower motor may never come on. Resistor R16 simply reduces the speed slightly to measurably increase the life of the blower.

F1 fuses the intermediate amplifier stages.

3.9 Transient Protection

To eliminate deleterious effects of voltage transients a zener diode is used.

Transient voltage passing through the A+ input filter section and exceeding 43 volts are clipped by the zener diode CR8.

3.10 Phase & Frequency Locking

When the PC-15s are paralleled together, it is necessary to phase synchronize the output voltage. Resistor R25 is the coupling resistor to phase lock the oscillator together through pin F of J1.

When the PC-15s are paralleled, it is necessary to have all the parallel units operating. The loading effect of the non-operating unit causes the other parallel unit or units to shut down. However, instead of paralleling PC-15s we suggest using a higher Flite-Tronics' VA inverter.

To frequency lock the PC-15s to other 115 VAC sources, resistor R25 is changed to C23. Typically .0047 ufd, as shown in the bill of material, may be used.

When PC-15s are frequency locked, the output should not be paralleled to the 115 VAC source.

Section IV

Maintenance

4.1 General

This section covers the bench check of the PC-15s to determine conformance to manufacturers specification.

For safety feature only, a thermostat is used to control the blower motor. It will come on only when the heat sink temperature exceeds 165°F.

Table 4.2, page 204, is used to functionally check the PC-15s to manufacturers performance.

The instructions on table 4.3 will aid in localizing the cause of defective operation, should any component fail.

4.2 Test Equipment

Table 4.1 lists the recommended components and test equipment to be employed in conducting electrical test per manufacturers test procedures.

Figure 4.1 illustrates the bench test inter-connection diagram. The Flite-Tronics Test Set TS-PC-15B-1 is a unit for readily conducting the test in Table 4.2 and 4.3. Table 4.2 indicates the readings and step-by-step procedure to test PC-15s operating normally. Table 4.3 notes test procedure and possible cause of abnormal reading.

Table 4.1 Component and Test Equipment

EQUIPMENT	MODEL OR TYPE	FUNCTION
Power Supply	0-40 VDC, 0-25 Amp	Low voltage power source
Oscilloscope	5M HZ or equiv.	Visual display
Distortion Analyzer	HP330B or equiv.	Measure distortion
Frequency Counter	400 HZ ±20 HZ or equiv.	Measure frequency
Components for TS-PC-15B-1 Test Set		
Circuit Breaker	25 Amp Breaker	Protection
Current Meter 12	0-5.0 Amps AC 400 HZ	Monitor output I
Voltmeter V2	0-50/0-150 VAC 400 HZ	Monitor output voltage
Reactor L1	12.7 Millihenry @ 115 VAC 400 HZ	Reactance load simulator
Resistor R1	1.16K ohm 25 watt	Resistive load
Resistor R2	100 ohm 100 watt	Resistive load
Resistor R3	7 ohm 100 watt	Resistive load
Resistor R4	18 ohm 250 watt	Resistive load
Resistor R5	3 ohm 100 watt	Resistive load

Component and Test Equipment (continued)

EQUIPMENT	MODEL OR TYPE	FUNCTION
Resistor R6	2.5 ohm 100 watt	Resistive load
Resistor R7	28.5 ohm 750 watt or equiv.	Resistive load
Resistor R8	42 ohm 500 watt or equiv.	Resistive load
Resistor R9	9 ohm 150 watt	Resistive load
Resistor R10	75.6 ohm 350 watt or equiv.	Resistive load
Resistor R11	1.0 ohm 200 watt	Resistive load
Switch S1	SPDT	20 VDC input switch
Switch S2	SPST	4% load switch
Switch S3	SPST	33% load switch
Switch S4	SPST	90% load switch
Switch S5	SPST	100% load switch
Switch S6	SPST	150% load switch
Switch S7	SPST	170% load switch
Switch S8	SPST	185% load switch
Switch S9	SPST	.8 power factor switch
Switch S10	3PST	Short circuit switch
Switch S11	DPDT	115 V or 115/26 V load selector switch
Switch S12	DPDT	Output voltage selector switch
Switch S13	4PDT	Output current selector switch

4.3 Performance Test and Localizing Trouble Source

Table 4.3 outlines a step-by-step procedure to performance test the PC-15s to localize fault source, if troubles exist.

It is suggested the technician acquire familiarity of the unit by studying the principles of operation section prior to attempting this section.

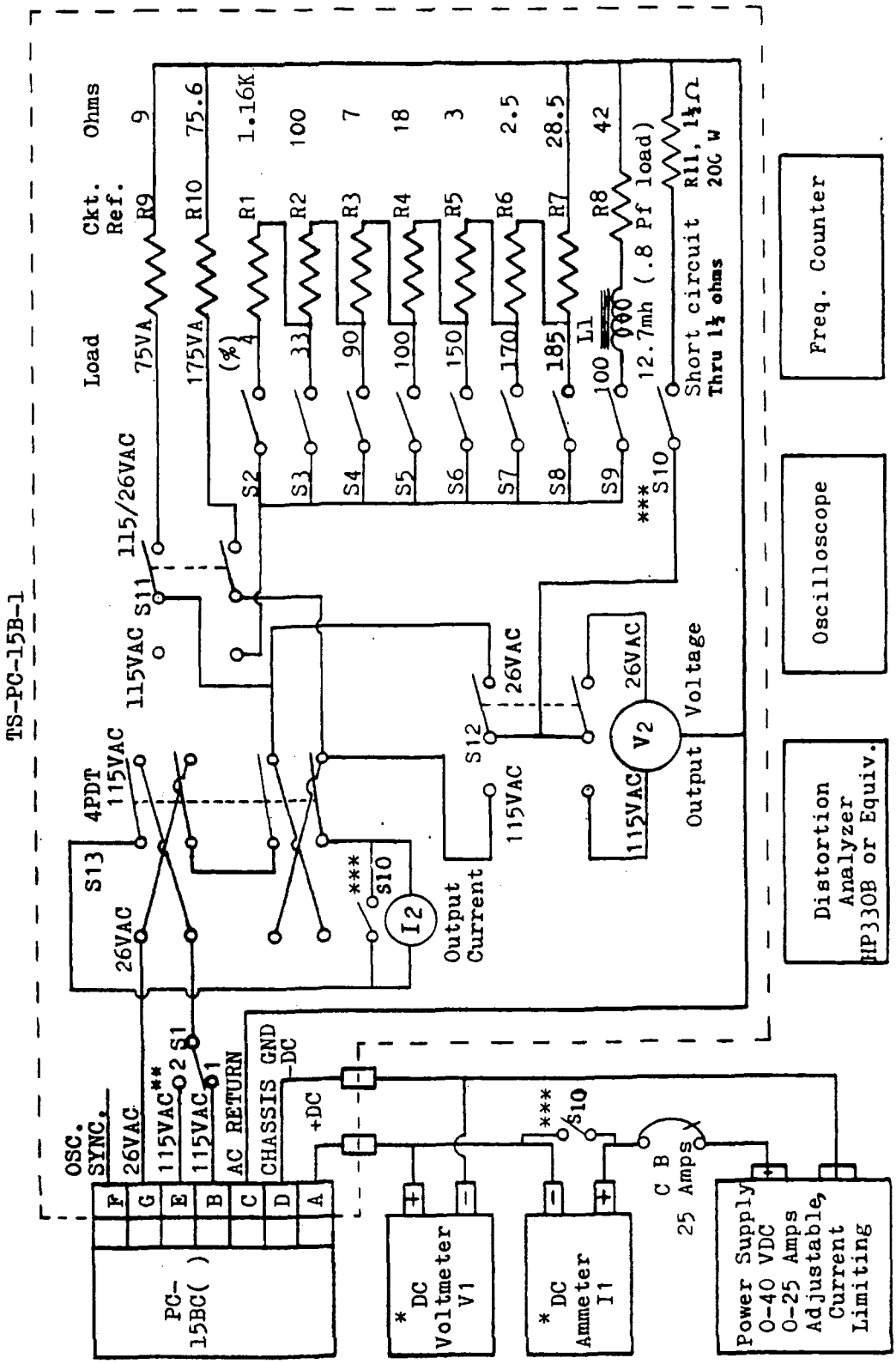


Figure 4.1 BENCH TEST SET AND HOOK-UP TS-PC-15B-1

4.4 Check Out Procedure for PC-15BC( )

To functionally test Flite-Tronics Static Inverter connect the PC-15BC( ) to the test set TS-PC15B-1.

A. Model PC-15BC( ): 2 outputs; 115 VAC, 400 HZ, *250VA Max.
26 VAC, 400 HZ, *75VA Max.

B. Frequency: 400 HZ ± 4 HZ

C. Amplitude Distortion: 7% or less under normal operating conditions.

*Sum of powers from the 115 VAC and 26 VAC output should not exceed 250 VA.

Table 4.2 Test Conditions and Typical Readings

Condition	Switch	Position	** Typical Readings			
			DC Input		AC Output	
			Voltage	Current	Voltage	Current
No load	S1 S2 thru S10 S11 S12 & S13	#1 Off 115 VAC 115 VAC	28 VDC	.75 Amps or less	116 to 120.7 VAC	0 Amp
4% load	S1 S2 S3 thru S10 S11 S12 & S13	#1 On Off 115 VAC 115 VAC	28 VDC	2.0 Amps	Between 115 VAC and 120.7 VAC	.1 Amps
33% load	S1 S3 S2 & S4 thru S10 S11 S12 & S13	#1 On Off 115 VAC 115 VAC	28 VDC	5.0 Amps typical	Between 115 VAC and 120.7 VAC	.72 Amps typical
100%	S1 S5 S2 thru S4 & S6 thru S10 S11 S12 & S13	#1 On Off 115 VAC 115 VAC	28 VDC	14 Amps typical	Between 108 VAC and 120.7 VAC	2.17 Amps Typical
150% overload	S1 S6 S2 thru S5 & S7 thru S10 S11 S12 & S13	#1 On Off 115 VAC 115 VAC	28 VDC	20 Amps typical	At least 107 VAC	3.3 Amps typical
170% overload	S1 S7 S2 thru S6 & S8 thru S10 S11 S12 & S13	#1 On Off 115 VAC 115 VAC	28 VDC	22 Amps typical	At least 100 VAC	3.6 Amps typical

** Readings shown are steady state values unless otherwise noted

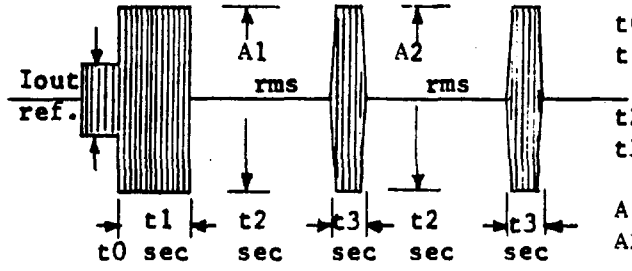
Table 4.2 Test Conditions and Typical Readings (cont'd)

Load Condition	Switch	Position	Typical Readings			
			DC Input		AC Output	
			Voltage	Current	Voltage	Current
185% overload	S1 S8 S2 thru S7 & S9 & S10 S11 S12 & S13	#1 On Off 115 VAC 115 VAC	28 VDC	Between 0 Amps and 23 Amps	Output voltage & current motor-boating	
100 % reactive load	S1 S9 S2 thru S8 &10 S11 S12 & S13	#1 On Off 115 VAC 115 VAC	28 VDC	14 Amps typical	Between 107 VAC and 120 VAC	Between 2.2 Amps and 2.5 Amps
Pin E output @ 20 VDC input	S4 S1 S5 thru S10 S11 S12 & S13	On #2 Off 115 VAC 115 VAC	20 VDC	15 Amps typical	Between 107 VAC and 115 VAC	1.95 Amps typical
See note 1 load 175 VA on 115 VAC	S1 S2 thru S10 S11 S12 & S13	#1 Off 115/26VAC 115 VAC	28 VDC	14 Amps typical	Between 107 VAC and 120 VAC	1.5 Amps typical
75 VA on @ 26 VAC	S1 S2 thru S10 S11 S12 & S13	#1 Off 115/26VAC 26 VAC	28 VDC	14 Amps typical	Between 24.2 VAC and 27.3 VAC	2.9 Amps typical
Output short circuit test: 115 VAC	S1 S2 thru S10 S11 S12 & S13 Turn S10 on	#1 Off 115/26VAC 26 VAC On	28 VDC	See Note 2 Below $A_1=A_2=5$ to 10 amps rms typ $t_1=.35$ to .65 sec typical $t_2=2$ to 3.5 sec typical $t_3=.1$ to .3 sec typical		
26 VAC	S1 S2 thru S10 S11 S12 & S13 Turn S10 on	#1 Off 115/26VAC 115 VAC on	28 VDC	See Note 2 Below for general waveform $A_1=A_2=14$ to 20A rms typ. t_1, t_2, t_3 } Typically same durations as in 115 VAC output short circuit case.		

Note 1. S11 in 115/26 VAC position, 175 VA resistive load is connected to 115 VAC output and 75 VA resistive load is connected to 26 VAC output.

Note 2. The initial output short circuit current burst is relatively long in duration. The second and subsequent bursts keep the same amplitude but less in duration. Typical burst waveform is shown on next page.

Table 4.2 Note 2 (continued)



t0 = Time output fault occurs
t1 = Initial duration of the output current burst
t2 = Duration of no output, repeated
t3 = Duration of second and repeated bursts until fault clears
A1 = Initial rms current burst amplitude
A2 = Second and repeated rms current burst amplitude

4.4.1 Switch Nomenclature:

S1	115 VAC normal and 20 VDC input output selector switch; position #1 normal, position #2, when input voltage is 20 VDC
S2	4% Resistive load switch
S3	33% " " "
S4	90% " " "
S5	100% (250VA) Resistive load switch
S6	150% Resistive load switch
S7	170% " " "
S8	185% " " "
S9	100% Reactive load switch
S10	Output short circuit switch for 115 VAC or 26 VAC- the AC voltmeter indicates output being shorted
S11	115 VAC only and 115/26 VAC output selector switch
S12	Output voltage selector switch. 115 VAC or 26 VAC
S13	Output current selector switch. 115 VAC or 26 VAC current

Table 4.3 Performance Test and Localizing Trouble Procedures

STEP	SET-UP	PROCEDURE	PERFORMANCE READING	POSSIBLE CAUSE OF ABNORMAL READING
1	Interconnect unit per bench test hook-up	a) Turn on power supply, keep input voltage set at zero. b) Turn on all measuring equipment for warm-up c) Check polarity of power supply. d) Set S1 to No. 1 position e) Set switches S2 through S10 in the Off position.		
2	S2 through S10 in the Off position S11 in the 115 VAC only position S12 & S13 in the 115V position	a) Gradually increase power supply voltage to 28 VDC	Input DC current I1 should not exceed 3/4 amps DC	Test set-up incorrectly connected. Capacitor C1, C11,C14 and C18 thru C20 may be shorted. Transistors Q9,Q10,Q14, Q15,Q16,Q18, Q19 & Q20 shorted. C2 or CR8 shorted.
3	S2 thru S10 in the Off position S11 in the 115 VAC only position S13 in the 115V position	a) Input voltage set at 28.0 VDC b) Adjust R14 as required, so V2 reads 117 VAC and then CR1 zener voltage must be checked and confirmed to be 6.2 VDC ±5%.	V2 should read between 107 VAC to 120.7, with S12 in the 115 VAC position and between 24.2 to 27.3 VAC with S12 in 26 VAC position.	Check for following likely defective components: CR6,CR7,C12, R14,C6,CR1, Q17 and Q8.

Table 4.3 (continued)

STEP	SET-UP	PROCEDURE	PERFORMANCE READING	POSSIBLE CAUSE OF ABNORMAL READING
4	S2 through S10 in the Off position S11 in the 115 VAC only position S12 and S13 in the 115V position	a) Input voltage set at 28.0 VDC. b) If frequency is out of tolerance, adjust tuning slug on transformer T1	Frequency meter should read 400 HZ ± 4 HZ I1-3/4 A typical	Defective parts likely to cause abnormal reading: Transformer T1, Capacitor C10 or C9
5	S2 through S10 in the Off position S11 in the 115 VAC only position S12 and S13 in the 115V position	a) Input voltage set at 28.0 VDC. b) Vary input voltage between 26 to 30 VDC.	Distortion meter should read less than 7%. I1-3/4 A typical	Defective parts likely to cause abnormal reading: Transistors Q3 thru Q6,Q9,Q10, Q14,Q15,Q16 Q18 and Q19.
6	Switch S5 on for full load output S11 in the 115 VAC only position S12 and S13 in the 115V position	a) Input voltage set at 28.0 VDC. b) Resistor R14 may require readjusting; however, if adjusted, step 3 should be retested. c) Vary input voltage between 26 to 30 VDC.	I2 read 2.17 amps AC V2 should read between 107 to 120.7 VAC I1 should read approximately 14.2 A. Frequency should be 400 HZ ± 4 HZ Distortion less than 7%.	Defective parts likely to cause abnormal reading: Diodes CR2, CR3,CR4 and CR5. Transistor Q1,Q2,Q8 and Q17.

Table 4.3 (continued)

STEP	SET-UP	PROCEDURE	PERFORMANCE READING	POSSIBLE CAUSE OF ABNORMAL READING
7	Switch S6 for 150% overload test. S11 in the 115 VAC only position S12 and S13 in the 115V position	a) Input voltage set at 28.0 VDC. b) Resistor R15 may require adjusting if unit tends to motor boat. However, in the event of any adjustment, step 3 should be repeated.	I2 should read approximately 3.3 amp. V2 should read at least 107 VAC. I1 should read about 20 amps.	Defective parts likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Transistor Q1, Q2, Q8 and Q17.
8	Switch S7 on for 170% overload test S11 in the 115 VAC only position S12 and S13 in the 115V position	a) Input voltage set at 28.0 VDC. b) R15 adjusts the overload threshold point. The proper setting at the 170% overload point; the unit should almost start motorboating.	I1 should read about 22 amps. V2 should read at least 100 VAC. I2 should read approximately 3.6 amps.	Defective components likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Capacitors C7 and C8. Transistors Q7 and Q8. OL delay. FT91271 components.
9	Switch S8 on for 185% overload test S11 in the 115 VAC only position S12 and S13 in the 115V position	a) Input set at 28.0 VDC. b) R15 adjust the overload threshold point. The proper setting at 185% overload point, the PC-15BC( ) should be in the motorboating mode.	I1 should be motorboating between 0 to 20 amps. I2 and V2 should indicate output current and voltage is motorboating.	Defective components likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Capacitors C7 and C8. Transistors Q7 and Q8.

Table 4.3 (continued)

STEP	SET-UP	PROCEDURE	PERFORMANCE READING	POSSIBLE CAUSE OF ABNORMAL READING
10	Switch S10 on for output short circuit test S11 in the 115 VAC only position S12 and S13 in the 115V position	a) Input set anywhere between 26 and 28 VDC. b) I1 will be pulsating	I1 pulsating. V2≈10 VAC pulsating. I2 bypassed during this test. Scope should measure waveshape shown on page 206.	Defective components likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Capacitors C7 and C8 Transistors Q7 and Q8.
11	Switches S2 through S8 in the Off position Switch S9 on 250 VA S10 in Off position S11 in the 115 VAC only position S12 and S13 in the 115V position	a) Input voltage set at 28.0 VDC. b) Vary input voltage between 26 to 30 VDC.	I2 read 2.0 to 2.3 amps AC. V2 read between 107 to 120.7 VAC.	Defective parts likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Transistor Q1, Q2, Q8 thru Q17. Capacitor C13.

Table 4.3 (continued)

STEP	SET-UP	PROCEDURE	PERFORMANCE READING	POSSIBLE CAUSE OF ABNORMAL READING
12	Switch S3 on and S4 through S10 in Off position for 33% load test S11 in the 115 VAC only position S12 and S13 in the 115V position	a) Input voltage set at 28.0 VDC.	I1 read 5.0 amps. I2 read .72A V2 read between 116 to 120.7 VAC Distortion meter should read less than 7%. Frequency meter should read 400 HZ ± 4 HZ.	Defective parts likely to cause abnormal reading: Transformer T1. Capacitor C10. Transistors Q3 thru Q6,Q9,Q10, Q14,Q15,Q16, Q18,Q19 and Q20.
13	Switch S2 on. Switch S3 through S10 in Off position S11 in the 115 VAC only position S12 and S13 in the 115V position	a) Input voltage between 26.0 to 28 VDC	Distortion less than 7%. Frequency 400 HZ ± 4 HZ. V2 read 115 to 120.7 VAC. I1 read 2 amps DC. I2 read .20 to .35 amps AC.	Defective parts likely to cause abnormal reading: Diodes CR6, CR7,C12,R14, C6,CR1,Q17, and Q8

Table 4.3 (continued)

STEP	SET-UP	PROCEDURE	PERFORMANCE READING	POSSIBLE CAUSE OF ABNORMAL READING
14	Switch S1 to #2 position. S4 on, and S5 through S10 in Off position S11 in the 115 VAC only position S12 and S13 in the 115V position	a) Set input voltage at 20 VDC.	V2 read 107 to 120.7 VAC. I2 read 1.93 to 2.12 amps AC. I1 read approximately 15.0 amps DC.	Defective parts likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Transistor Q1, Q2, Q8 and Q17.
15	Switch S1 to #1 position Switch S11 in the 115/26 VAC position	a) Input voltage set at 28.0 VDC.	I1 should read approximately 14.2 amps I2 read 1.52 amps, with S13 in 115V position. I2 read 2.9 amps, with S13 in 26V position. V2 should read between 107 to 120.7 VAC with S12 in 115V position V2 should read between 24.2 to 27.3 VAC with S12 in 26V position. Distortion for 26 VAC and 115VAC output should be 7% or less.	Defective parts likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Transistor Q1, Q2, Q8 and Q17.

Table 4.3 (continued)

STEP	SET-UP	PROCEDURE	PERFORMANCE READING	POSSIBLE CAUSE OF ABNORMAL READING
16	Switch S11 in the 115/26 VAC position for output short circuit test S12 in the 26V position S13 in the 26V position	a) S10 switched on after unit is operating normally. b) I1 will be pulsating.	I1 pulsating. V2 20 VAC pulsating. I2 bypassed during this test. Scope should measure waveshape shown on page 206.	Defective components likely to cause abnormal reading: Diodes CR2, CR3, CR4 and CR5. Capacitors C7 and C8. Transistor Q7 and Q8. Resistor R15.

4.5 Voltage Measurement

To enable the technicians to effectively service the PC-15's table 4.4 tabulates the typical D.C and/or A.C. voltage to assist in localizing a fault source.

Table 4.3 indicates the possible component for an abnormal reading. If a voltage other than those listed in table 4.4 is measured this will enable the technician to determine which component is possibly faulty.

Table 4.4 PC-15BC( ) Voltage Distributions

Measurement Condition

1. Input 28.0 VDC.
2. Full load with Switch S5 on.
3. Switch S1 in the #1 position.
4. DC and AC measurement made with a Simpson 270 or equivalent.
   (Note: Make AC measurement in the output connection to this meter.)

Table 4.4 PC-15BC( ) Voltage Distributions

CIRCUIT REF.	TEST POINT	DC VOLTS	AC RMS
Q1 & Q2	Emitter	8 to 20*	6
	Base	8 to 20*	6
	Collector	26	0
Q3 & Q4	Emitter	.2	9
	Base	.5	9
	Collector	26	0
Q5 & Q6	Emitter	.7	15
	Base	.3	15
	Collector	26	0
Q9 & Q10	Emitter	.5	9
	Base	.15	10
	Collector	27	0
Q14,Q15 Q16,Q18 Q19,Q20	Emitter	.1	8.5
	Base	.5	9
	Collector	26	8.5

CIRCUIT REF.	TEST POINT	VDC (VOLTS)	VAC (RMS)
Q7	Emitter	0	0
	Base	-.2 to -.5	0
	Collector	3	0
Q8	Emitter	2.5	0
	Base	3	
	Collector	8 to 20	.4
Q17	Emitter	.04	0
	Base	.65	0
	Collector	3	0
CR2,CR3	Anode	0	10
CR6,CR7	Cathode	8.5	5
R11 & L2	Junction	-8.5	0
CR4,CR5	Anode	0	0 to 15*
	Cathode	-9 to +6*	6 to 0
R12 & L3	Junction	-9 to +5*	0

*These voltages are load dependent.

4.6 Servicing Practice and Replacement

Section 5.0 lists the table of replaceable parts. Figures 5.1 thru figure 5.7 illustrates the location of these components.

When installing or removing transistors, semiconductor diodes and heat sensitive components, grasp the lead between the solder joint and the component with a thermal dissipator, such as a spring loaded copper clip or long nose pliers. This will bleed off the heat being applied at the solder joint.

A temperature controlled soldering iron is recommended for such use. The wattage rating of the iron should not be greater than 35 watts. Always work with an iron that the tip is well tinned so the soldering can be done quickly and cleanly.

Power transistors Q5, Q6, Q9, Q10, Q14, Q15, Q16, Q18, Q19 and Q20 are insulated from ground. The insulating is done by means of insulating washers made of fiber and mica. When replacing these transistors, be sure washers are replaced in proper order and coating the washers with a film of silicone grease is recommended.

After such replacement, check with an ohmmeter or 40 VDC leakage tester to determine that the insulation is effective.

Section V

Table of Replaceable Parts

5.1 General

This section illustrates and lists components that can be replaced for repair purposes. It is recommended that PC-15s requiring replacement of parts that are not listed in Table 5.1, be returned to the factory for service.

Figures 5.1 through 5.7 illustrates the location of all the components that are listed in the Table of Replaceable Parts.

5.2 *Manufacturer's Code

Code	Name and Address
FT	Flite-Tronics Co., Inc. Burbank, California
FD	Fairchild Mountain View, California
AB	Allen-Bradley Co. Milwaukee, Wisconsin
EI	Essex International Inc. Fort Wayne, Indiana
GUL	Gulton Industries, Inc. Metuchen, New Jersey
SAN	Sangamo Springlield, Illinois
NCI	National Capacitor Inc. West Palm Beach, Florida
ECI	Electro-Cube Pasadena, California
MOT	Motorola Phoenix, Arizona

(*Manufacturer may be substitued for equal or superior components.)

5.2 Manufacturer's Code (Continued)

Code	Name and Address
SEM	Semtech Newbury Park, California
W	Westinghouse Youngwood, Pennsylvania
SPG	Sprague Electric North Adams, Massachusetts
OHM	Ohmite Mfg. Co. Skokie, Illinois
BUS	Bussman St. Louis, Missouri
BR	Bourns Riverside, California
IMB	IMB Electronic Products Inc. Santa Fe Springs, California
CR	Cal-R, Inc. Santa Monics, California
DLE	Dale Electronics, Inc. Columbus, Nebraska

5.3 Table 5.1 *Table of Replaceable Parts

CIRCUIT REF.	QTY	DESCRIPTION	SOURCE	FUNCTION
C1, C14	2	Capacitor 1800 ufd -10% +75% 100182U040AA2B 602D182G040AA2A	SAN SPG	Filter
C2, C11, C18, C19, C20	5	Capacitor 47 ufd 50 VDC HM47QD FTCS1697	NCI FT	Filter
C6	1	Capacitor 22 ufd ±20% 10 VDC CS13BC226K	NCI	Filter
C7, C8	2	Capacitor 22 ufd -15% +75% 25 VDC HM22LD FTCS1693	NCI FT	Filter
C9	1	Capacitor .02 ufd ±20% 200 VDC FT210B1C203M ZA2C203	ECI	Bypass
C10	1	Capacitor .47 ufd ±5% 200 VDC FT627A1C474J BV7C474J	ECI IMB	Osc. cap.
C12		Not used		Filter
C13	1	Capacitor .47 ufd ±20% 400 VDC FT625B1E474M BA2E474	ECI IMB	Power factor Correction
C21, C22		Not used		Bypass
C25	1	.22 ufd ±20% 100 VDC DA2B224K	IMB	Bypass
C26	1	Capacitor 10 ufd ±20% 10 VDC CS13BC106K	NCI	Divider
C101	1	Capacitor 120 ufd ±20% 10 VDC CS13BC127K	NCI	Time delay
C102	1	Capacitor 22 ufd ±20% 15 VDC CS13BD226K	NCI	Pulse forming
CR1	1	Zener 6.2 VDC IN753A	MOT	Reference voltage

(*Components may be substituted for equal or superior part.)

5.3 Table 5.1 Table of Replaceable Parts (continued)

CIRCUIT REF.	QTY	DESCRIPTION	SOURCE	FUNCTION
CR2, CR3, CR4, CR5, CR6, CR7, CR11, CR12, CR101, CR102	10	Silicon diode 200 piv 1N5393 SC2, SI2	W SEM	Rectifier
CR8	1	Zener 43 VDC 10 watt 1N 2993 A	MOT	Reference voltage
F1	1	Fuse 6A GKN 6	BUS	Fuse
L1	1	Inductor FT91027	FT	Filter
L2-A, L2-B	1	Inductor FT85102	FT	Filter
L3	1	Inductor FT85103	FT	Filter
J1	1	Connector, receptacle MS3101A18-9P	CAN	Input receptacle
M1	1	D.C. Motor 3A1654	FT	Blower
Q1, Q2	2	Transistor 2N3568	FAD	Push-pull Osc.
Q3, Q4	2	Transistor 2N3568	FAD	Low level amp push-pull
Q5, Q6	2	Transistor 2N3767 or 2N3441	MOT	Push-pull Interstage amp
Q8	1	Transistor 40348	RCA	ALC
Q7, Q17	2	Transistor 2N3568	FAD	ALC and OL
Q9, Q10	2	Transistor FT500	FT	Push-pull driver
Q14, Q15, Q16 Q18, Q19, Q20	6	Transistor FT500	FT	Output push-pull power

5.3 Table 5.1 Table of Replaceable Parts (continued)

CIRCUIT REF.	QTY	DESCRIPTION	SOURCE	FUNCTION
R1	1	Resistor 47 ohm ±10% ½ watt	AB	Filter
R2, R5, R28	3	Resistor 3.9 K ohm ±10% ½ watt	AB	Bias
R3	1	Resistor 560 ohm ±10% ½ watt	AB	Bias
R4	1	Resistor 33 ohm ±10% ½ watt	AB	Bias, degenerating
R6	1	Resistor 82 ohm ±10% ½ watt	AB	Bias, degenerating
R7	1	Resistor 4.7 K ohm ± 10% select ½ watt	AB	Bias
R8	1	Resistor 3.3 K ohm ±10% ½ watt	AB	Bias
R9	1	Resistor 68 to 120 ohm select ½ watt	AB	Bias
R10	1	Resistor 1 ohm 5 watt wire wound 995-5B #4530	OHM	Filter and degenerating, decoupling
R11, R12, R23	3	Resistor 10 K ohm ±10% ½ watt	AB	Loading
R13	1	Resistor 820 to 1500 ohm select ½ watt	AB	Current
R14	1	Resistor, variable 2 K ohms ½W 2319-106-202 3065S-1-202	DLE BR	Level control
R15	1	Resistor, variable 500 ohm ½ watt, 2319-501 3065S-1-501	DLE BR	Output current set
R16	1	Resistor 22 ohm 3 watt wire wound 242E2205, 4369	SPG OHM	Speed reducer

5.3 Table 5.1 Table of Replaceable Parts (continued)

CIRCUIT REF.	QTY	DESCRIPTION	SOURCE	FUNCTION
R18, R19	2	Resistor 1.2 K ohm ±10% ¼ watt	AB	Voltage divider
R21	1	Resistor 22 ohm ±10% ½ watt	AB	Degenerating
R22	1	Resistor 1 to 2 K ohm select ¼ watt	AB	Level control divider
R24	1	Resistor 330 ohm ± 10% ½ watt	AB	Bias
R25	1	Resistor 270 ohm ±10% ½ watt	AB	Osc. phase lock
R27	1	Resistor 1000 ohm ±10% ¼ watt		Divider
R29	1	Resistor 500 to 2000 ohm ±5% select ¼ watt	AB	Divider
R38	1	Resistor 10 to 220 ohm select ¼ watt	AB	Degenerating
R39	1	Resistor 1.8K to 2.2 K ohm select ¼ watt	AB	Voltage divider
R40, R104	2	Thermistor 500 ohm 10% @ 25°C 25KEI	GUL	Temperature compensator
R41, R42	2	Resistor 100 ohm ± ±10% ¼ watt	AB	Base return
R101	1	Resistor 22 K ohm ±10% ¼ watt	AB	Discharge
R102	1	Resistor 33 to 82 K ohm select ¼ watt	AB	Divider
R103	1	Resistor 10 to 27 K ohm select ¼ watt	AB	Filter
R105	1	Resistor 10 K ohm ±10% ¼ watt	AB	Divider

5.3 Table 5.1 Table of Replaceable Parts (continued)

CIRCUIT REF.	QTY	DESCRIPTION	SOURCE	FUNCTION
S1	1	Thermostat 165°F 430-545	EI	Temperature Sensing
T1	1	Transformer Adjustable FT85076A	FT	Transformer Inductor 400 HZ
T2	1	Transformer FT91028	FT	Input
T3	1	Transformer FT91329	FT	Interstage
T5	1	Transformer FT91135	FT	Power output
T6	1	Transformer FT91136	FT	Output current sense

Model Series Listing Component Changes and/or Substitutions

1. Model PC-15BC(D) has 150 VA power output from the 26 VAC. The total power output, 115 VAC plus 26 VAC, remains the same.

   1.1 Component Change:

	Is	Was
Transformer T5;	FT91143	FT91135
Transformer T6;	FT91144	FT91136

2. Model PC-15BC(E) has remote on-off feature.

   2.1 Connector Change:

	Is	Was
Receptacle J1;	MS3102A20-16P	MS3102A18-9P

3. Model PC-15BC(H) has different connector type.

   3.1 Connector Change:

	Is	Was
Receptacle J1;	KPT02E18-11P	MS3102A18-9P

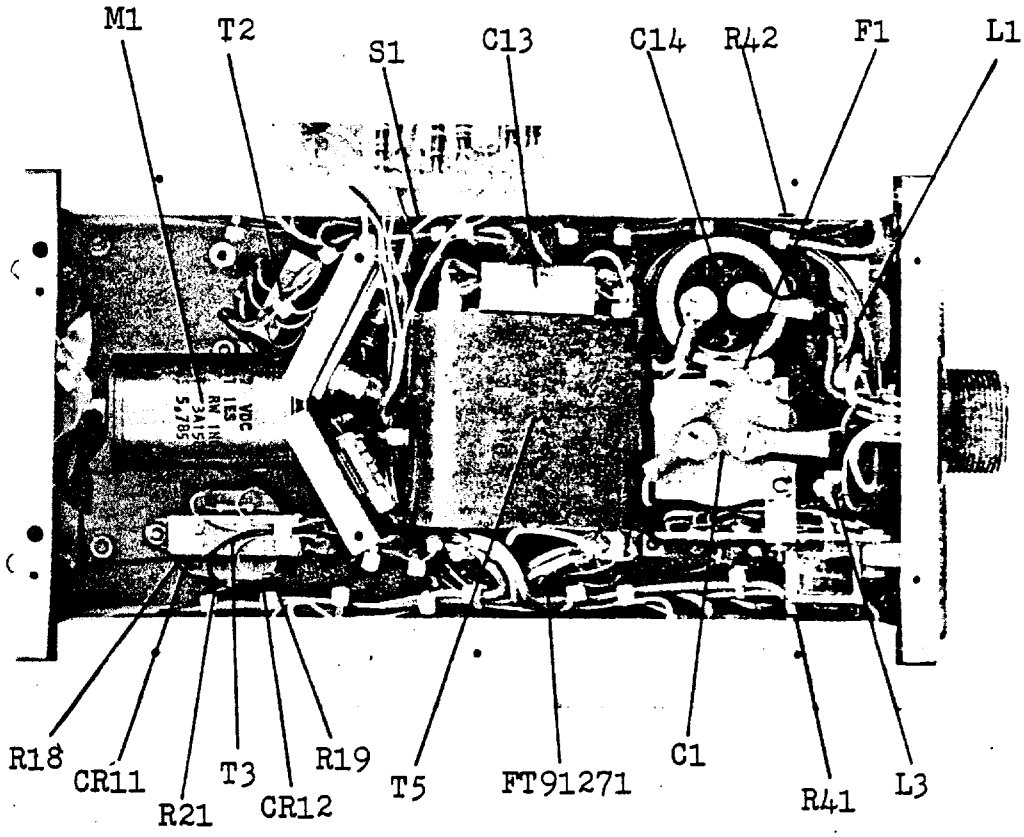


Figure 5.1 COMPONENT LAYOUT DUST COVER REMOVED

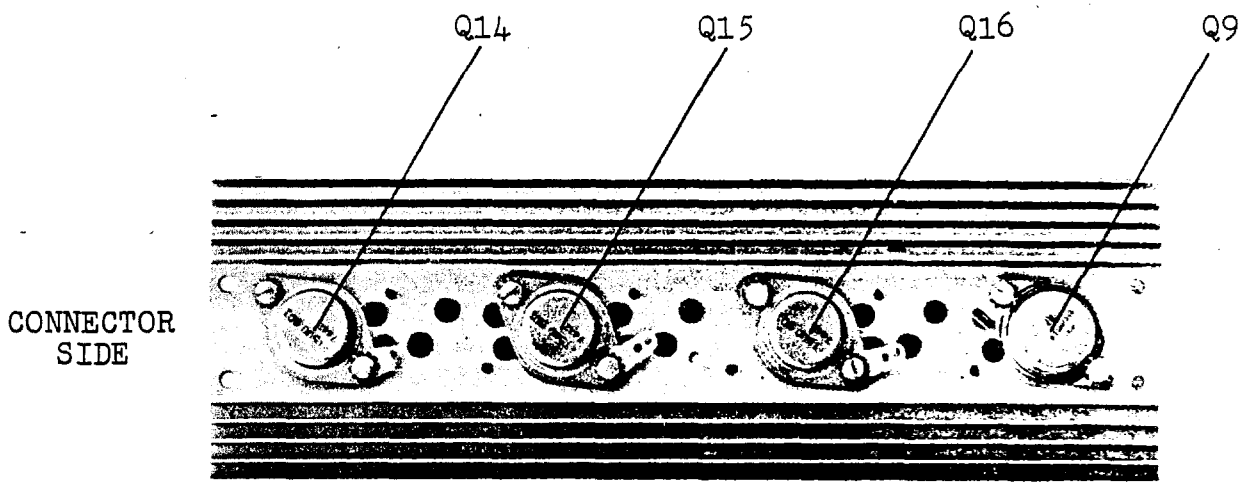


Figure 5.2 TRANSISTOR LAYOUT LEFT SIDE

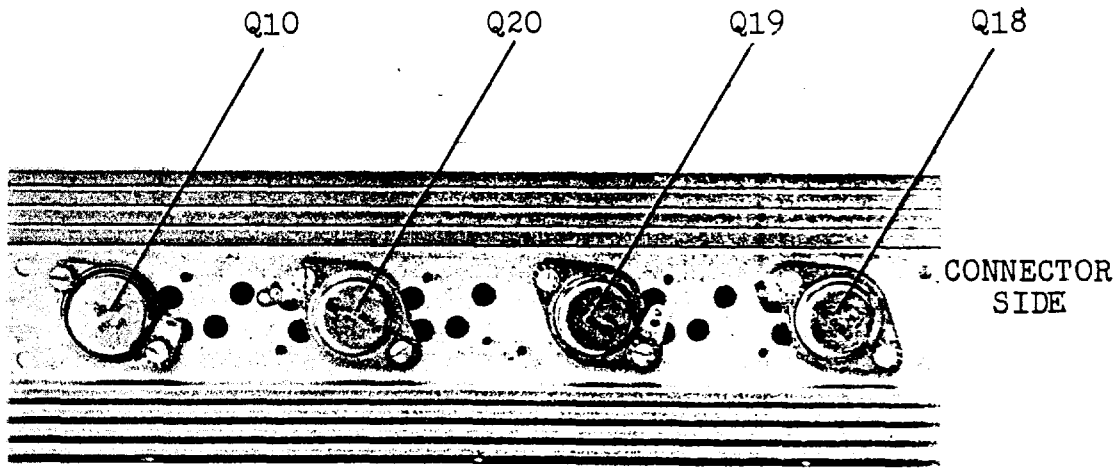


Figure 5.3 TRANSISTOR LAYOUT RIGHT SIDE

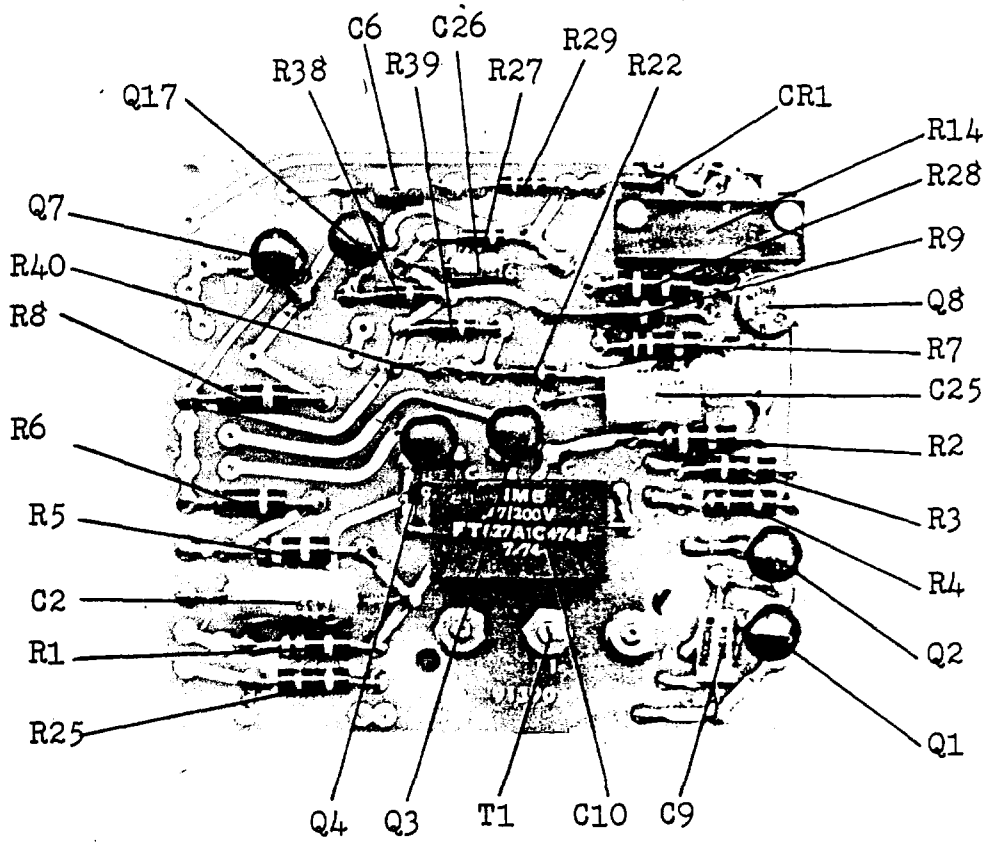


Figure 5.4 COMPONENT LAYOUT OSCILLATOR & LOW LEVEL AMPLIFIER

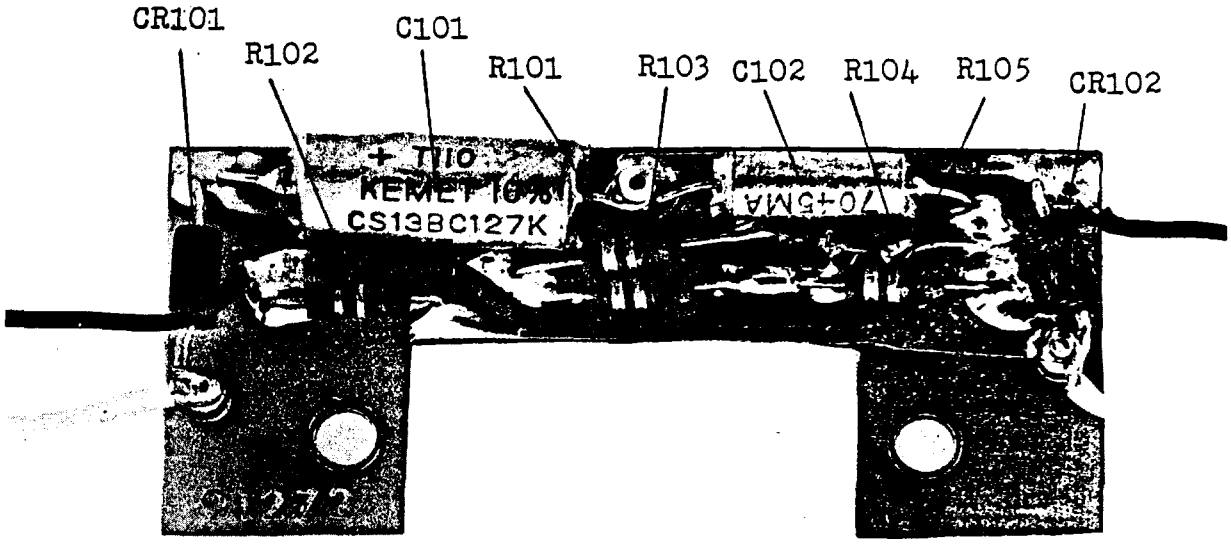


Figure 5.5 COMPONENT LAYOUT OL DELAY MODULE, FT91271

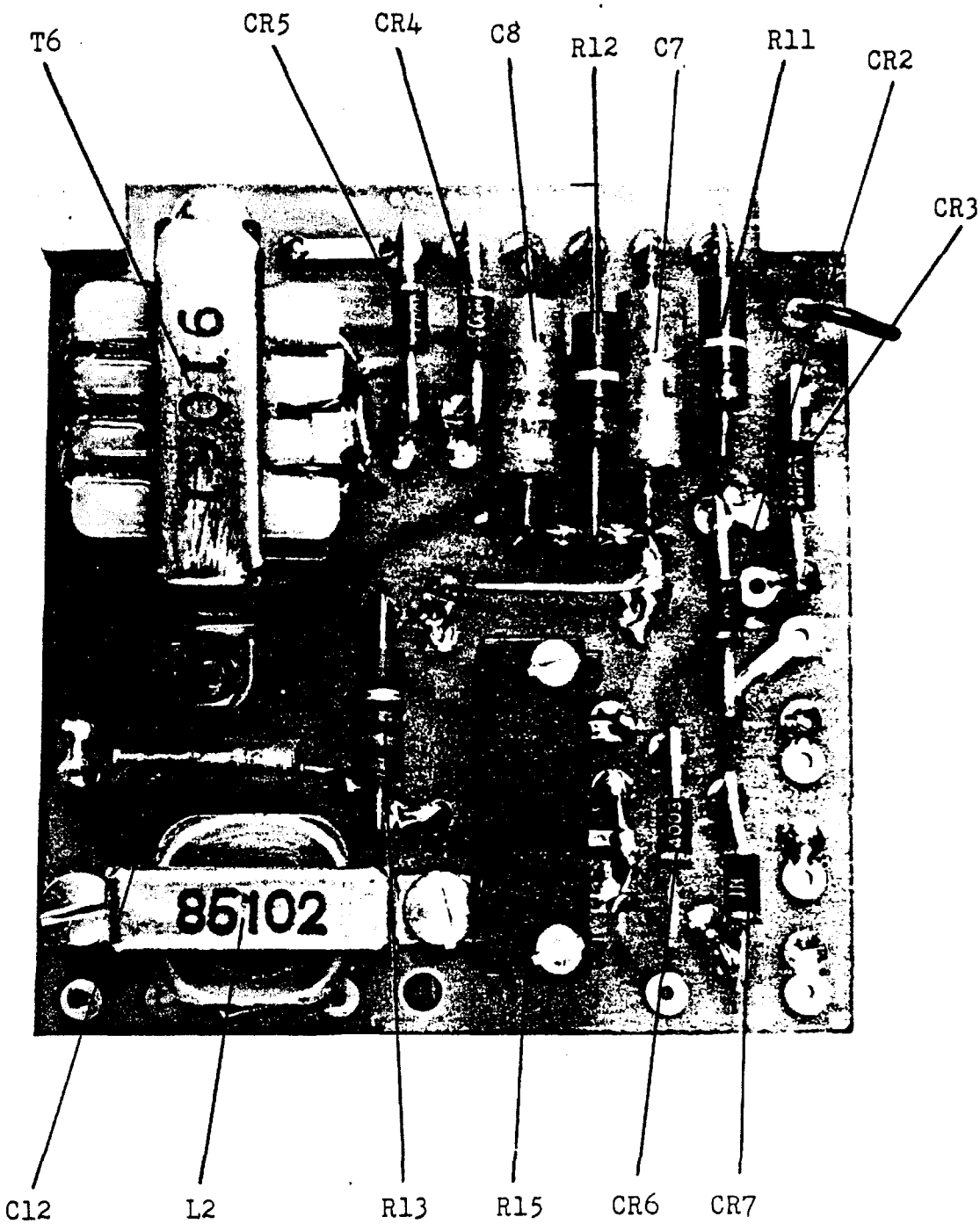


Figure 5.6 COMPONENT LAYOUT OL & ALC CIRCUIT

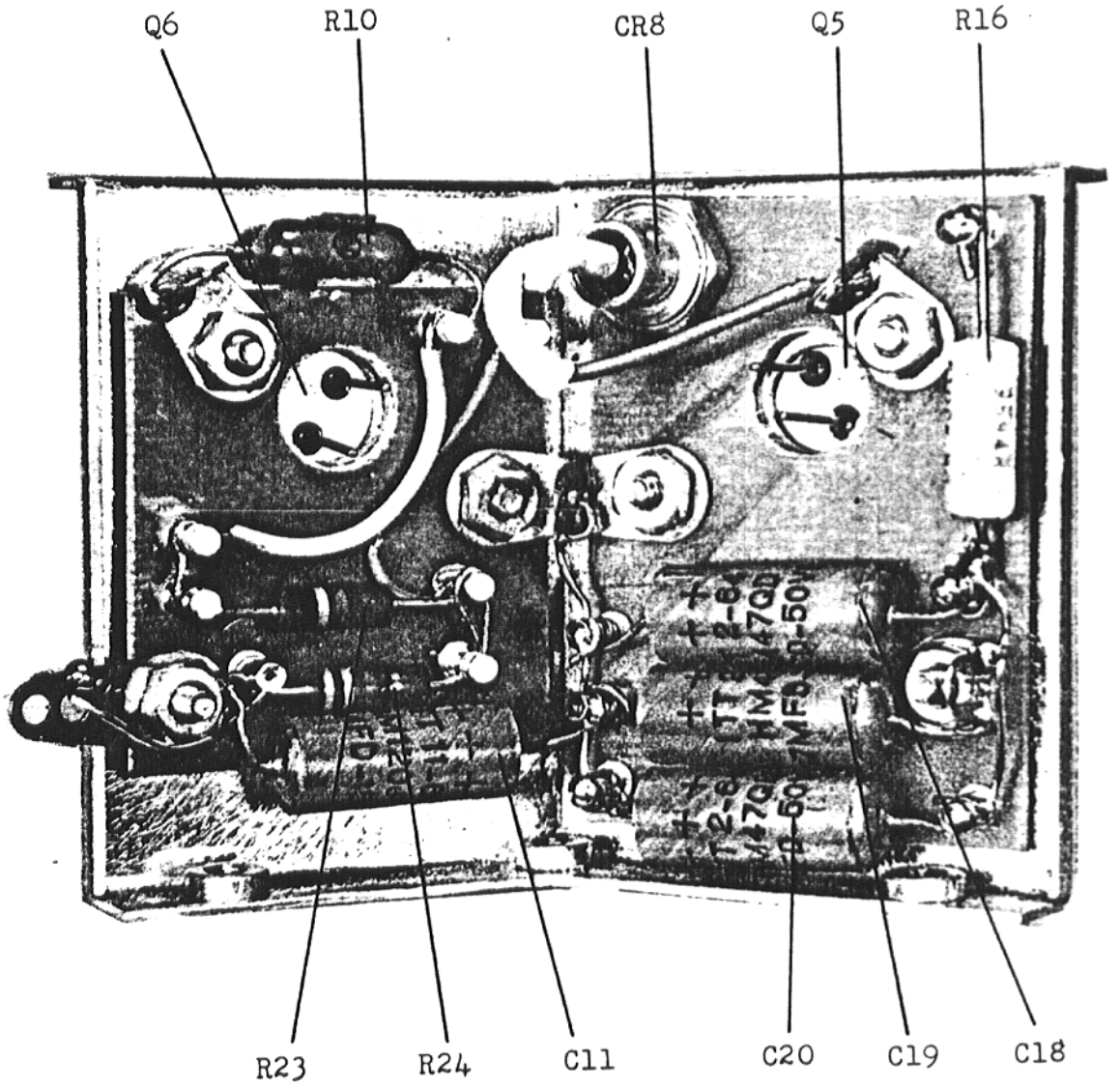


Figure 5.7 COMPONENT LAYOUT INTERSTAGE AMPLIFIER LOCATION ONLY

5.4 How To Order Replacement Parts

When ordering replacement parts, you should direct your order as indicated below and furnish the following information insofar as applicable.

Address: Flite-Tronics Co., Inc.
Sales Service Department
3314 Burton Avenue
Burbank, California, 91504

Infromation Needed:

1. Quantity required.
2. Part Number (Obtain from parts list or schematic diagram.)
3. Type number and serial number of equipment.

5.5 How To Return Materials Or Equipment

If, for any reason, you should wish to return material or equipment, whether under warranty or otherwise, you should notify us, giving full particulars including the details listed below, insofar as applicable. Upon receipt of such notice, Flite-Tronics Co., Inc. will promptly advise you respecting the return. Failure to secure our advice prior to the forwarding of the goods, or failure to provide full particulars, may cause unnecessary delay in handling of your returned material.

Address: Flite-Tronics Co., Inc.
Sales Service Department
3314 Burton Avenue
Burbank, California, 91504

Information Needed:

1. Date of delivery of equipment.
2. Date placed in service.
3. Number of hours in service.
4. Part number (obtain from parts list or schematic diagram.)
5. Type number and serial number of equipment.
6. Nature and cause of failure.
7. Remarks.

Marathon Flite-Tronics Company

PO BOX 8233 (76714-8233)
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WACO, TEXAS

COMPONENT MAINTENANCE MANUAL

250 VA STATIC INVERTER

MODEL PC-250

24-20-03
Jun 1/82

Marathon Flite-Tronics Company

COMPONENT MAINTENANCE MANUAL

MODEL PC-250

RECORD OF REVISIONS

REV NO.	ISSUE DATE	DATE INSERTED	BY	REV. NO.	ISSUE DATE	DATE INSERTED	BY	REV. NO.	ISSUE DATE	DATE INSERTED	BY
1	Sep 25/79										
2	Oct 11/79										
3	Jun 1/82										

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MODEL PC-250

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COMPONENT MAINTENANCE MANUAL

MODEL PC-250

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*LEP-2	Jun 1/82	*16G	Jun 1/82
*Record of Revision	Jun 1/82	16H	BLANK
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Record of Temporary Revision	Feb 1/79	19	Feb 1/79
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*13	Jun 1/82	210	BLANK
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214D	BLANK	*1103	Jun 1/82
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216	Feb 1/79	1105	Feb 1/79
217	Feb 1/79	*1106	Jun 1/82
218	Feb 1/79	1107	Feb 1/79
301	Feb 1/79	*1108	Jun 1/82
302	Feb 1/79	*1109	Jun 1/82
401	Feb 1/79	*1110	Jun 1/82
402	Feb 1/79	*1111	Jun 1/82
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*711	Jun 1/82	1124	BLANK
*712	Jun 1/82		

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COMPONENT MAINTENANCE MANUAL

MODEL PC-250

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COMPONENT MAINTENANCE MANUAL

MODEL PC-250

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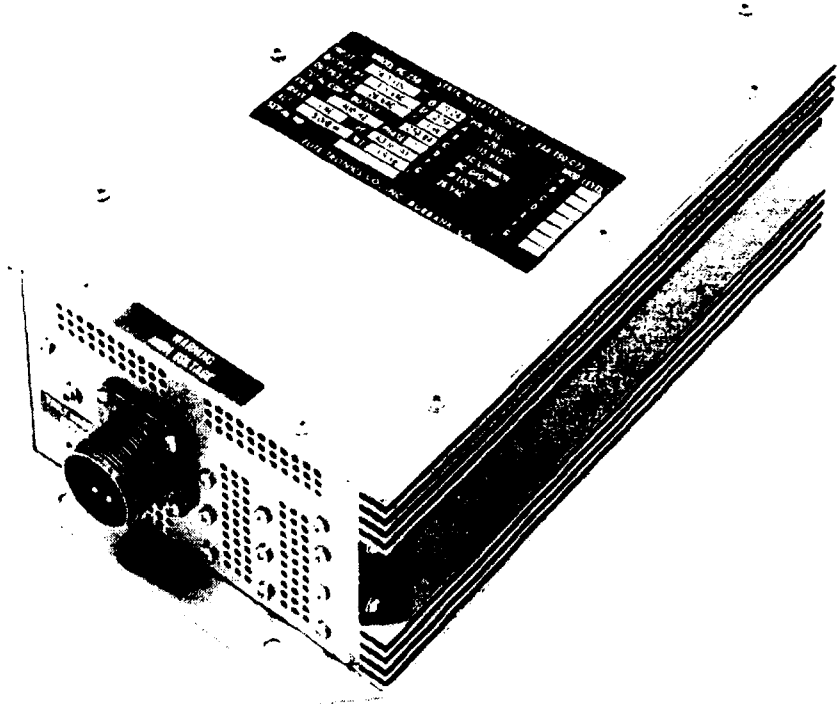
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DESCRIPTION AND OPERATION

1. Description (See Figure 1)

The 250 VA static inverter, Model PC-250 is an enclosed rectangular unit consisting of a base plate, two heat sinks, two end plates, and a dust cover. Electronic components are mounted on the base plate, the heat sinks, the front and rear end plates, and on a printed circuit board and a bracket assembly that are internally installed. A connector is mounted on the front end plate to provide both input and output connections to the static inverter.

Refer to Table 1 for leading particulars of the basic Model PC-250 static inverter. Table 2 lists the differences in the basic PC-250 and the PC-250 (Mod Level A), PC-250-1A (Mod Level A), PC-250-1B, PC-250-1B (Mod Level A), PC-250-1C, and PC-250-1C (Mod Level A).



250 VA Static Inverter, Model PC-250
Figure 1

TABLE 1 (Sheet 1 of 4)
LEADING PARTICULARS

Dimensions	
Length	238 mm (9.375 in.)
Width	152.4 mm (6.0 in.)
Height	81.0 mm (3.188 in.)
Weight	3.6 Kg (8.1 lb.)
Input Power	
Nominal	28 VDC at 11.4 amp
Normal range	24 VDC to 32 VDC
Total range	20 VDC to 37 VDC
No-load current	1 amp
Output Power	
Continuous operation	250 VA at 115 volts RMS with a DC input voltage of 20 through 35 volts
	150 VA at 26 volts RMS with a DC input voltage of 20 through 35 volts

NOTE: The maximum output power available from a combination of 115V output power and 26V output power is 250 VA.

Short time operation	375 VA at 115 volts with an input voltage of 24 through 32 volts for 5 minutes
Output voltage	115 volts RMS ±3% at any combination of 24 to 32 volts and 0 to 125% output load
Output configuration	Monophase
Frequency	400 Hz ±1% under all operating conditions
Distortion	3.25% THD under nominal operating conditions
	7.0% maximum THD under all normal DC inputs and load configurations
Power factor	0.9 leading to 0.8 lagging

TABLE 1 (Sheet 2 of 4)
LEADING PARTICULARS

Efficiency	79% nominal
Overvoltage Protection	Automatically shuts off the inverter should the output voltage rise from 125 to 138 VRMS
Phase Locking	The PC-250 incorporates all necessary circuitry to phase lock two or more inverters for parallel or polyphase operation (consult factory)
Frequency Monitor	The PC-250 incorporates all necessary circuitry to monitor the inverter frequency including automatic shut-off should the frequency drift below 370 Hz or above 430 Hz
Fault Monitor	Provides 27 VDC output at 100 ma to an annunciator device when the inverter is operating normally. PC-250 series: No power is available to the annunciator under overvoltage or frequency fault and off conditions. PC-250 series, mod level A: No power is available to the annunciator under overvoltage, frequency fault, no output, short circuit, or off conditions.
Soft Start	To avoid high in-rush current, the PC-250 will reach its rated output in approximately 500 milliseconds.
Output Short Circuit Current	
115 volts	PC-250 series: Will trip 2.0 amp circuit breaker in less than 1 minute. Short circuit current approximately 3.5 amperes.
26 volts	Will trip a 7.5 amp circuit breaker in less than 1 minute. Short circuit current approximately 14 amperes.

NOTE: An output short circuit for a duration of one minute or less on the 115 volts or 26 volts line will not damage the inverter.

TABLE 1 (Sheet 3 of 4)
LEADING PARTICULARS

115 volts	PC-250 series, mod level A: The inverter will deliver a short circuit current equal to 200% of rated load current for at least 5 seconds after which automatic control will take place to fold back the current to a safe level.
26 volts	The inverter will deliver a short circuit current of approximately 18 amperes for at least 5 seconds, after which automatic control will take place to fold back the current to a safe level.

NOTE: There will be no damage to the inverter should the output short circuit not be cleared by the initial current surge and stay on continuously.

Remote ON/OFF	Controllable by standard TTL circuit
Cooling	Free air convection
Qualification Documents	FAA TSO C-73 RTCA DO160 CAT D2B/RV/EXXXXXAZAZZ

TABLE 1 (Sheet 4 of 4)
LEADING PARTICULARS

Environmental Conditions	
Temperature (continuous operation)	-55°C to 71°C (-67°F to 160°F)
Altitude	Up to 15,000 m (50,000 ft)
RFI Emission	Figures 2 and 3 illustrate the RFI emissions generated by a typical inverter, Model PC-250. The plots indicate the broad band radiated and conducted emission levels in the steady state mode. There was no detectable narrow band CW emissions. The specification limits are set forth in RTCA document D0160, Category Z.

2.0 Operation (See Figure 4) PC-250 Series

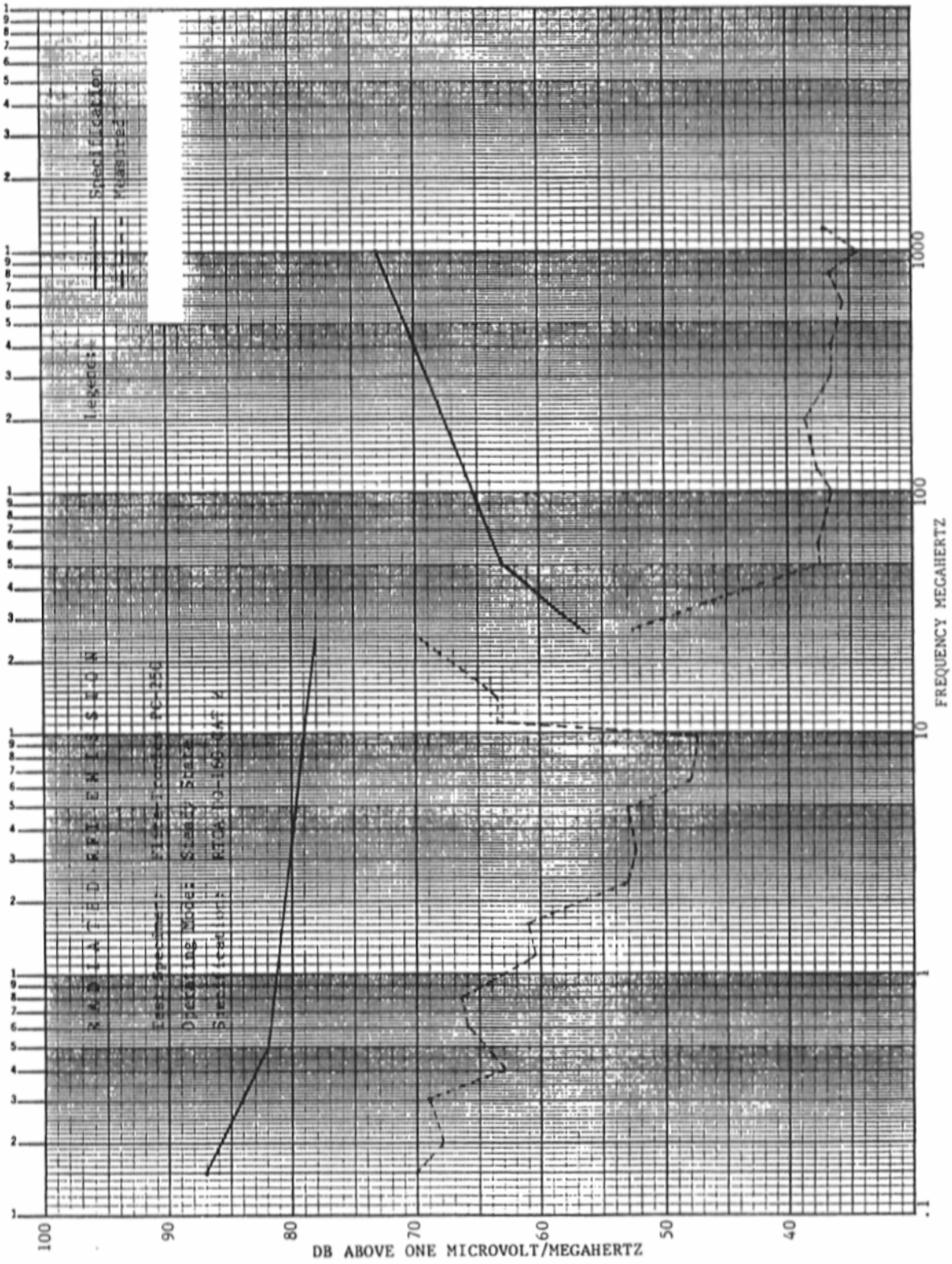
A. The static inverter converts an unregulated DC electrical power into single phase, sinewave, regulated AC electrical power. The nominal input DC power is 28 volts and the nominal outputs of the inverter are 115 VAC and 26 VAC. The generation of the alternating signal and the regulation are accomplished by a single integrated regulating pulse width modulator circuit. The quasi-square wave output of the integrated circuit is amplified and filtered by a tuned transformer to provide a low distortion sinewave output. The output signal is used for both current and voltage sensing circuits to provide the necessary information to the regulating control circuits of the integrated circuit.

B. The conversion of the non-regulated DC electrical energy to regulated, 400 Hz, sinewave AC electrical energy, is achieved by the following steps:

Input DC filtering
400 Hz frequency and pulse generation
Pulse width modulation
Power amplification
Output filtering
Current sensing
Voltage sensing and regulation
Short circuit control
Over voltage control
Frequency monitor
Phase lock control
Fault monitor

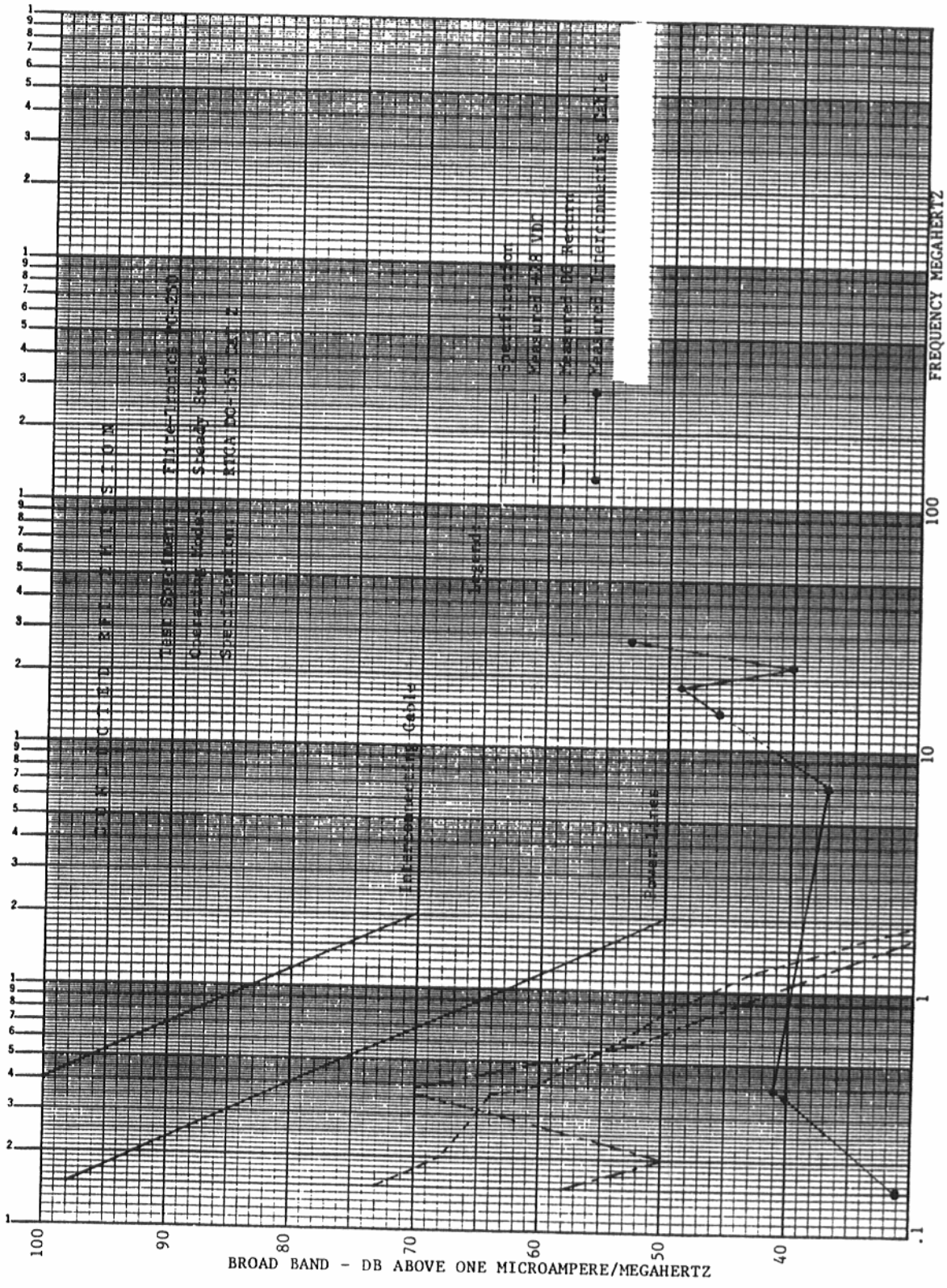
TABLE 2
DIFFERENCES IN MODELS

	PC-250 and Mod Level A	PC-250-1A, Mod Level A	PC-250-1B and Mod Level A	PC-250-1C and Mod Level A
Main Connector	MS3102A18-9P	MS3102R24-20P	KPT02E18-11P	MS3102A20-16P
Mating Connector	MS3106B18-9S	MS3106F24-20S	KPT06F18-11S	MS3106B20-16S
Phase Lock	Yes	No	No	Yes
Remote ON/OFF	No	No	No	Yes
Power at 115 VAC Output	250 VA	250 VA	250 VA	250 VA
Power at 26 VAC Output	150 VA	150 VA	150 VA	150 VA



ORIGINAL
As Received By
ATP

Radiated RFI Emission
Figure 2



Conducted RFI Emission
Figure 3

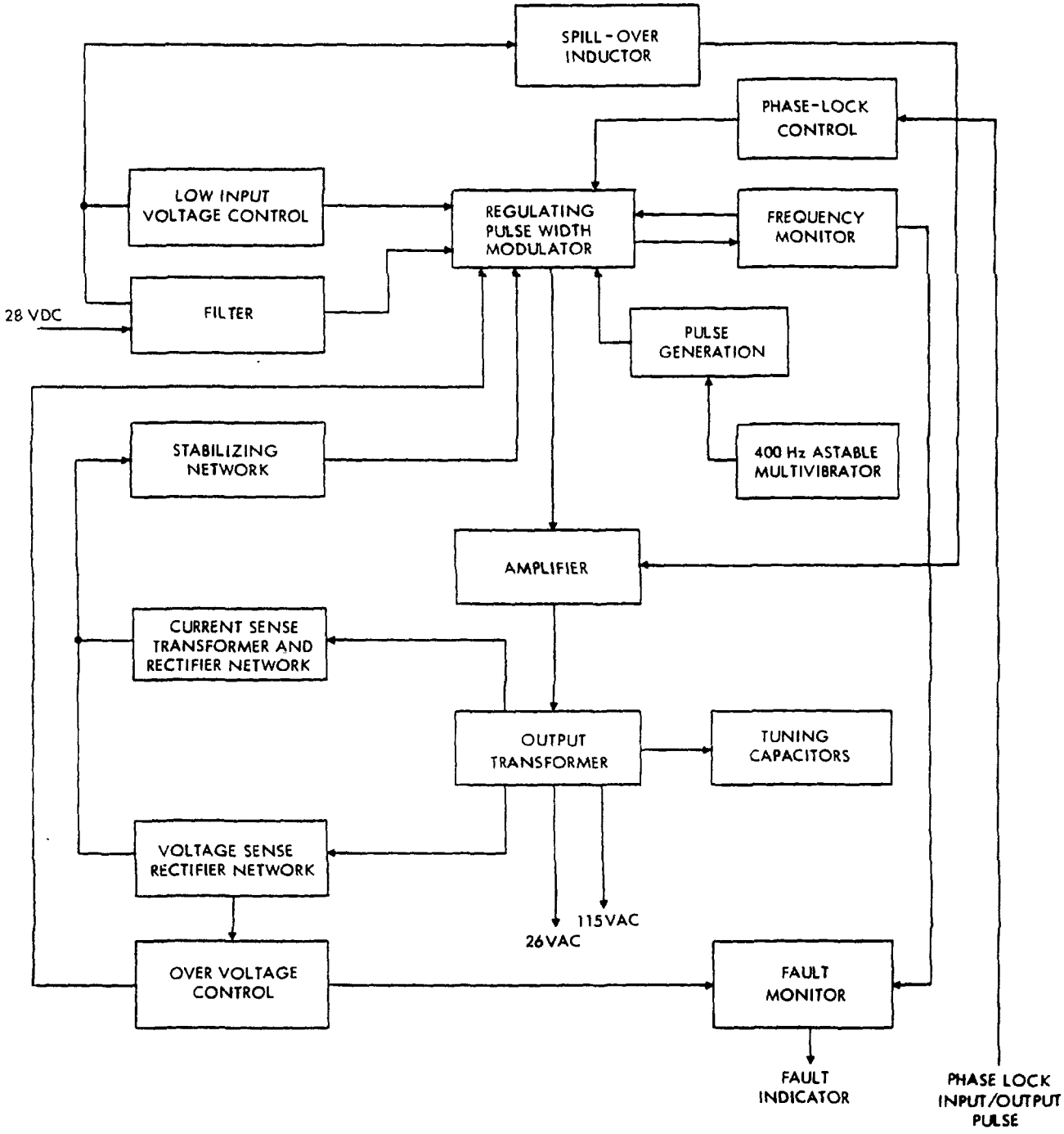
ORIGINAL
As Received By
ATP

C. Input DC Filtering. (See Figure 201.) The 28 VDC input power is applied to the inverter through a DC filtering network composed of L2, C14, C15, C16, C17, C18 and C19. This network prevents DC supply transients from reaching the internal circuitry of the inverter and, also, prevents the internally generated transients and RF from reaching the DC bus. An additional filter consisting of R8 and zener diode CR2, protects the integrated circuit U5 from any surge or transient higher than 40 volts peak.

D. 400 Hz Frequency and Pulse Generation. (See Figure 201.) Two gates (U1C and U1D) of a CMOS "nor" integrated circuit are connected as an astable multivibrator. CMOS gates display very little change in transfer characteristics over the temperature range of -55°C to 125°C (-67°F to 257°F); therefore, the output frequency depends primarily upon the stability of the RC components. Metal film resistors and mica capacitors have been selected for their extreme stability. The integrated circuit is powered from the 5 volts reference available at the pulse width modulator integrated circuit (U5) assuring a stable input to the gates to enhance frequency stability. The output of the multivibrator at U1D is routed, through a power amplifier (U2D), to a pulse shaping network composed of C8, R30, R31, and CR8. C8 and R30 control the pulse width at the input of U1B and at the collector of Q3. The square wave at the output of comparator U2D is differentiated through capacitor C8 and resistor R30. The differentiated square wave is fed to gate U1B, then to Q3, where it is inverted and routed to U5. The pulse repetition rate equals the frequency of the CMOS astable multivibrator. The pulse at the collector of Q3 thus provides a stabilized clock signal to the integrated circuit U5.

E. Pulse Width Modulation. (See Figure 201.) The pulse width modulation capability of integrated circuit U5 provides a method of controlling and regulating the output voltage of the inverter. In essence, this technique controls the voltage by varying the duration of the output voltage pulses depending upon the requirements for the external load. During a high load condition, a high energy level is fed to the output transformer as the duration of time is close to half a cycle for each transistor pair (Q8, Q9 and Q10, Q11). In a low load condition, the transistors are turned on for a much shorter period of time, thus feeding output transformer T3 with a much lower energy level. The process is identical for compensating for high and low DC bus voltage.

F. Power Amplification. (See Figure 201.) The power amplification is achieved in two stages. The pulse width modulator U5 provides a signal to the first stage composed of the push-pull combination of Q4 and Q5. Transformer T1 couples the output of Q4 and Q5 to power stage Q8, Q9, Q10, and Q11. Q8 and Q9, as well as Q10 and Q11, are essentially connected in parallel to handle the power requirement. The output transformer, the power transistors, and the driver transformer are connected



Functional Block Diagram
Figure 4

in such a way that the transistor base drive is proportional to the collector current and, therefore, to the 400 Hz power requirement at the external load. Following the current path for transistor Q8, we see power coming from terminal 2 of the spillover choke L1 going through current sense transformer T2, then, through winding 2-1 of power transformer T3, continuing on through windings 4-5 of transformer T3 and transistor Q8. The polarity of windings 4-5 and 8-9 of T1 are such that as current flow through winding 4-5 increases, the output voltage at 8-9 increases, thus forcing more base current through R44 to base of Q8. Connections and operation of Q9, Q10 and Q11 are identical. Proper base drive and optimum efficiency is thus assured. Resistors R44, R45, R48 and R50 provide equalization of base current through the transistors. Diodes CR13, CR16, CR18, and CR19 provide reverse current paths for reliable operation with inductive loads.

G. Output Filtering. (See Figure 201.) The output of the inverter is required to be a sinewave with less than 7 percent total harmonic distortion. The filtering is accomplished in two steps. Spillover choke (L1) prevents the shorting of the primary of output transformer T2 to the power supply when transistors Q8, Q9, Q10 and Q11 are in saturation, thus allowing tuning of the secondary of output transformer (T3). The tuned secondary of output transformer (T3) provides attenuation of the harmonics commensurate with the system's Q. At low load, the operating Q is higher and the output distortion is lower. L1 also acts as a swinging choke. When the transistors are turned off, current flows through diode CR11, feeding stored power back to the supply and preventing high voltage transients from occuring at the transformer center tap.

H. Voltage Sensing and Regulation. (See Figure 201.) The output voltage is sensed at windings 12-13-14 of output transformer (T3). The 400 Hz signal is rectified in the bridge rectifier (U6). The resultant DC is filtered in RC network R57, R54, R53, R55, C28, and C32, and fed to integrated circuit (U5). The DC voltage at pin 1 is compared to a reference voltage at pin 2 of the integrated circuit (U5) whose comparator circuit regulates the pulse width of the output waveforms at pins 12 and 13 to arrive at a balanced level between the rectified 400 Hz and the reference voltage. A variable resistor, R53, allows calibration of the output voltage to 115 ±1 volts. The R24, C7 network provides frequency compensation to insure stability of the regulation loop.

I. Current Sensing. (See Figure 201.) The current flowing through transistors Q8, Q9, Q10 and Q11, is sensed in current sense transformer (T2). The transformer output is rectified by diodes CR15 and CR16, and the resultant DC is filtered in resistor-capacitor network R49, R51, C27 and fed to pin 1 of integrated circuit (U5). Resistor R46 is selected of such value that the output voltage becomes controlled by the output of the current sensing circuit when the load current increases to more than

160% of rated value. For currents exceeding 160% of rated value, the output voltage of the current sensing circuit exceeds that of the voltage sensing circuit and takes control of the error sensing amplifier within integrated circuit (U5): as the current increases, the output voltage decreases to keep the output power within the limits of safe operation.

J. Short Circuit Control. (See Figure 201.) The center tap of the current sense transformer (T2) is returned to the negative output of the bridge rectifier (U6) connected to the voltage sensing winding of output transformer (T3). Under normal operating conditions, the negative DC output of the bridge rectifier sets a back-bias on diodes CR15 and CR16, and reduces the output voltage of the current sensing circuit such that it does not affect the voltage regulation circuit. Under short circuit conditions, the negative back-bias is removed and the current sensing circuit output voltage is increased substantially at pin 1 of integrated circuit (U5). The high voltage at pin 1 of U5 takes control of the error amplifier circuit, which, in turn, reduces the output pulse width to maintain the power dissipation and the input current to an acceptable and safe level.

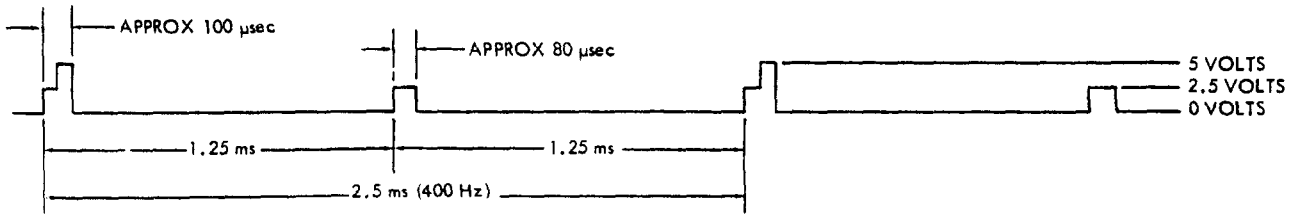
K. Overvoltage Control. (See Figure 201.) The output of rectifier bridge U6 is fed to a resistive divider, R66 and R67. The voltage at the junction of R66 and R67 is compared to a reference voltage into comparator U4D at pins 10 and 9, respectively. In the event of overvoltage from 125 to 138 RMS, the voltage at U4D, pin 10 becomes higher than the reference voltage at U4D pin 9. Voltage at U4D pin 8 and input 12 of OR gate U3C goes high. The U3C (11) and successively U3A (3) go high making transistor Q6 conduct to saturation. U5(9) is grounded and the inverter is turned "off". The high output of comparator U4D at pin 8 is fed back through CR26 and R64 to the positive input at pin 10 and latches the U4D comparator to a high output position keeping the inverter "off" even when the output voltage has dropped to zero. The inverter may be restarted by setting the remote on/off switch to OFF, then ON. Capacitor C30 provides a delay to prevent nuisance activation of the overvoltage circuit when a short overvoltage surge occurs as during sudden unloading of the inverter.

L. Low Voltage Shutoff. (See Figure 201.) The DC power input is fed to U4C pin 6 through a voltage divider R62 and R63. Whenever voltage at U4C pin 6 is lower than the reference voltage applied at U4C pin 5, the output of U4C pin 7 is high. OR gate outputs U3B(4) and U3A(3) are high keeping transistor Q6 conducting to saturation, driving U5 pin 9 to ground and the inverter to the "off" state. Whenever the DC input reaches approximately 15 volts, the output of U4C goes low, gates outputs U3B(4) and U3A(3) go low, Q6 is turned off and the voltage at U5 pin 9 goes high through R28 letting the inverter go through the soft start mode.

M. Frequency Monitor (See Figure 201.) The frequency control circuit monitors the inverter frequency whether it is driven from its own internal oscillator or from an outside source. The master pulse at the collector of Q3 drives pulse width modulator U5 and is also routed through resistor R35 to an active filter composed of operational amplifier U4A, resistors R37, R36,and capacitors C10 and C11. Metal film resistors and mica capacitors are used for their excellent stability over a wide range of temperatures. The filter is tuned at 800 Hz and has a Q of approximately 12. When the pulse repetition rate is between 740 and 860 Hz, the output U4A pin 14 is of high enough amplitude that after rectification through CR9, it will maintain pin 3 of U4B at a lower level than the reference voltage applied at pin 2 of U4B. When U4B pin 3 is low, U4B pin 1 is low and the outputs of OR gates U3C pin 11 and U3A pin 3 are low. Q6 is then turned "off" and the inverter operates. When the pulse repetition rate is outside of the frequency limit of 740-860 Hz, the output at U4A pin 14 is low, the output at U4B pin 1 is high driving U3C pin 11 and U3A pin 3 to the high state. Q6 becomes conductive, maintaining U5 pin 9 to ground potential and the inverter in the "off" mode. R30 is selected to obtain the desired bandwidth.

N. Phase Lock Control (See Figure 201.) The PC-250 may be phase-locked to one or more additional PC-250's for parallel operation, or to an external source for polyphase operation. The phase locking is achieved by means of a multi-level signal fed to the inverter at J1 pin F.

(1) Parallel operation. For a parallel mode of operation, the system will automatically lock onto the highest pulse repetition rate present on the lock line. The lock signal appears on the lock line as shown in Figure 5. To insure proper load distribution, the output voltage of all inverters to be paralleled must be within .20 volt of each other. (Consult factory).



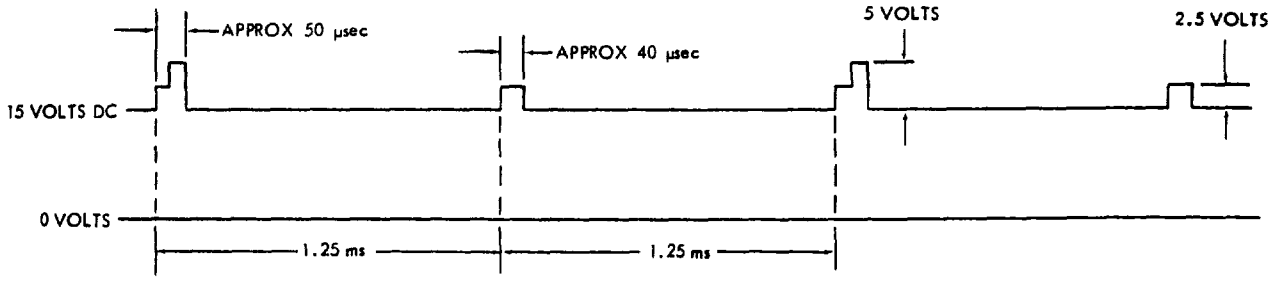
Phase Lock Control Parallel Operation
Figure 5

(2) Polyphase operation. For a polyphase mode of operation, the inverter is phase-locked to a signal generated from an external source such as the three phase adapter PC-3Ø, providing the required waveform and sequencing. A typical signal fed to the lock line of one inverter of a polyphase system is shown in Figure 6.

(3) Phase lock operation. The principle of operation of phase-locking is similar in both parallel and polyphase operation, with the exception that in a polyphase operation, the internal multivibrator of each inverter is inhibited by the 15 volts DC present in the lock signal. The DC signal is divided into R4 and R5 and fed to pin 13 of "NOR" gate U1C where it inhibits the multivibrator action of U1C and U1D, whereas, in the parallel mode, the multivibrator is not inhibited, but synchronizes to the highest repetition rate present on the lock line.

The lock signal entering J1 pin F goes through DC blocking capacitor C1 to a first comparator U2A pin 7. The reference level at pin 6 of U2A is 1.7 volts DC delivered from the voltage divider R22, R23, R25, and R27. All the pulses present on the lock line will appear at pin 1 of U2A, then inverted at pin 10 of "NOR" gate U1D, inverted again at pin 2 of U2D, differentiated through C8 and R30 and on through the normal path to pin 3 of U5. These pulses provide the desired frequency for synchronization, but do not carry phase information.

The lock signal at the negative end of C1 also goes to a second comparator U2B pin 8. The reference level at pin 9 of U2B is 3.75 volts DC. Therefore, only the pulses with a 5 volt amplitude will appear inverted at pin 14 of the comparator U2B. These pulses are fed to pin 2 of "NOR" gate U1A. The 400 Hz signal drive at pin 12 of U5 is fed to pin 1 of "NOR" gate U1A. Whenever



Phase Lock Control Polyphase Operation
Figure 6

the signals at pins 1 and 2 of U1A are such that there are no simultaneous zero levels, the output at pin 3 stays at ground level. If, however, simultaneous zeros appear at pins 1 and 2 of U1A, a pulse will appear at U1A pin 3, then at U1B pin 4, and finally, at U5 pin 3. This pulse, additional to the regular clock pulse, will generate a phase reversal in the pulse width modulator U5 and no more pulse will appear at U1A pin 3.

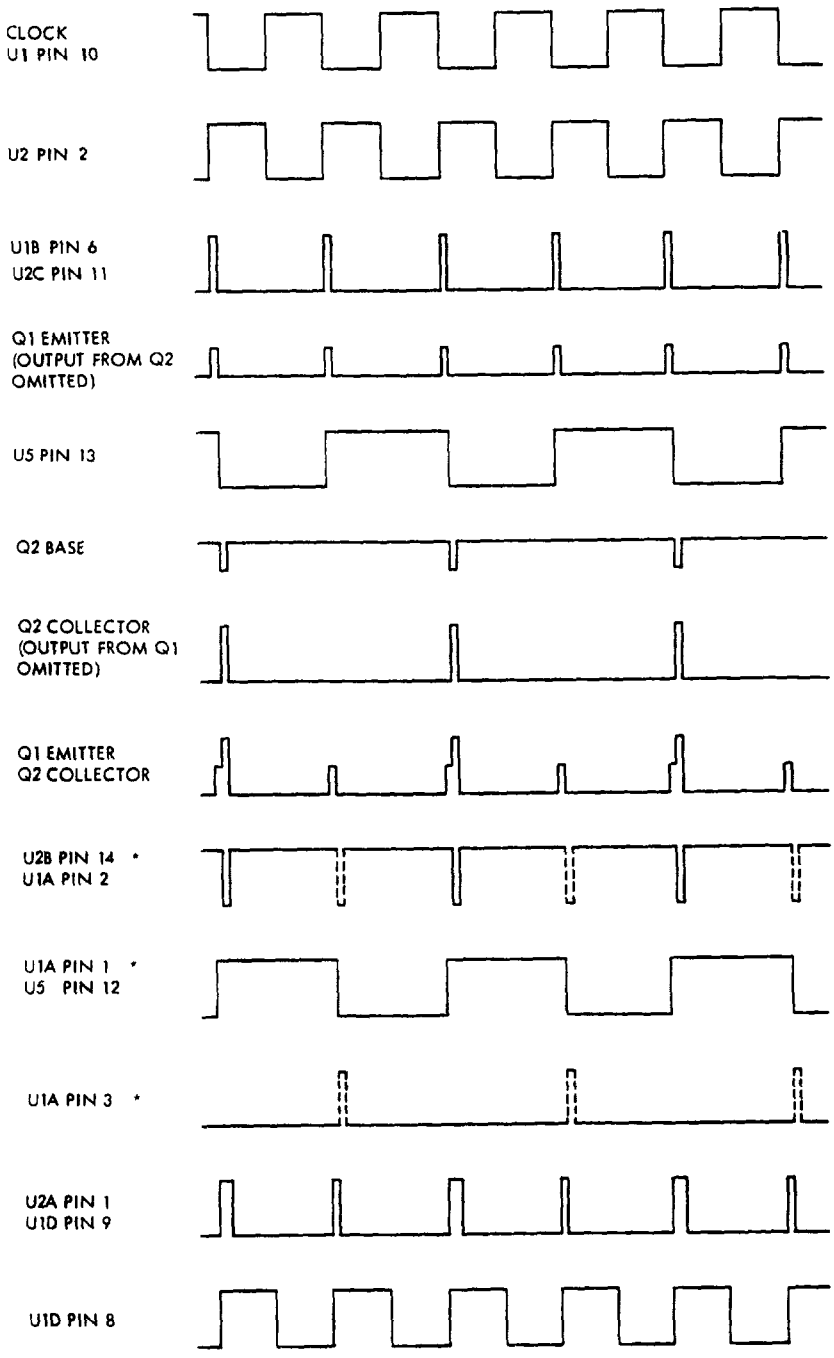
For parallel operation, the lock signal is generated in the inverter as follows: the clock signal at 800 Hz is differentiated through C8 and R30, then fed to comparator U2C pin 11. At the comparator output the pulse is limited to approximately 3 volts amplitude and routed to J1 through emitter follower amplifier Q1 and capacitor C1. Also, the 400 Hz drive signal at pin 13 of U5 is differentiated through C2, R14, R13, and CR4, amplified to a 5 volt level through Q2 and "ANDED" with the pulse from Q1 to form a complete lock signal, then routed to J1 through C1. It should be noted that when lock is achieved, the pulses coming to J1 pin F from the external source and the pulses going out from J1 pin F are coincidental; therefore, one set of pulses only can be seen on an oscilloscope. A timing diagram of the phase lock operation is shown in Figure 7.

O. Fault Monitor (See Figure 201.) Under normal operating conditions, transistor Q6 collector is at 5 volts DC. Gate U3D pin 10 is high causing transistor Q12 to conduct to saturation. 27 volts DC at 100 ma is then available at the collector of Q13 to power an annunciator device. If the frequency of the inverter shifts beyond the preset limits of 370 and 430 Hz, the outputs of gates U3C and U3A go high driving Q6 to saturation and the output of gate U3D goes low, turning transistors Q12 and Q13 "off". No power is then available to the annunciator.

In the event of an overvoltage condition, pin 8 of comparator U4D goes high, driving U3C output pin 11 high and, as in above paragraph, turning transistors Q12 and Q13 "off". Again, no power is then available to the annunciator.

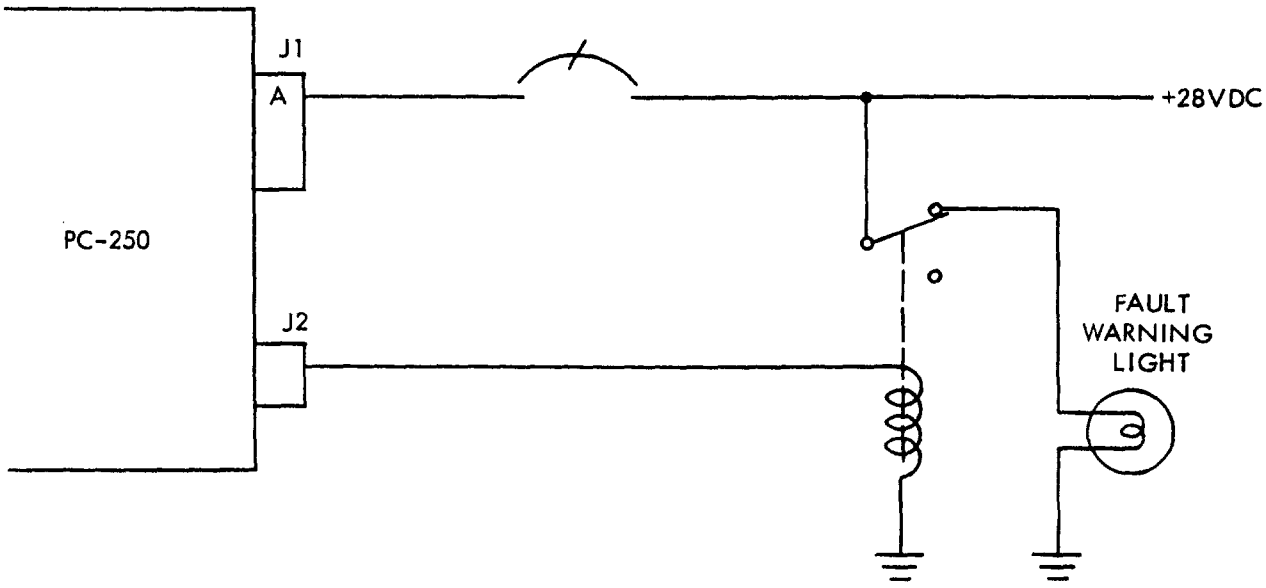
A typical fault warning light installation is shown in Figure 8.

P. Soft Start Control (See Figure 201.) The error amplifier within the integrated U5 is of a transconductance design. The output is a very high impedance and can deliver a limited amount of current (approximately 200 microamps). At first start, C9 maintains the error amplifier. output at pin 9 to ground potential which keeps output at pins 12 and 13 at a high state. As the capacitor charges, the output pulse slowly increases in width resulting in a slow amplitude increase of the output signal voltage until the feedback loop takes over. Diode CR7 isolates U5 pin 9 and the loop stabilizing network R24 and C7 from the



* The "in phase" or locked condition is shown in full lines. If an out of phase condition existed, the pulses would be displaced as shown by the dotted lines. The out of phase condition cannot exist in single unit operation and should not be present for more than 2.5 ms when two inverters are connected in parallel.

Phase Lock Operation Timing Diagram
Figure 7



Fault Warning Light Installation
Figure 8

soft start capacitor C9 whenever capacitor C9 is charged up. Quick discharge of C9 is insured through transistor Q6.

Q. Remote ON/OFF (PC-250-1C) (See Figure 201.) With J1 pin A open, voltage at U3B pin 5 is high, thus U3B pin 4 and U3A pin 3 are high, Q6 is conducting, and U5 pin 9 is in a low state, keeping the inverter turned "off". Grounding J1 pin A puts U3B pin 5 and U3A pin 3 in the low state. Q6 stops conducting, allowing C9 to charge through R28 and the inverter goes through the soft start mode.

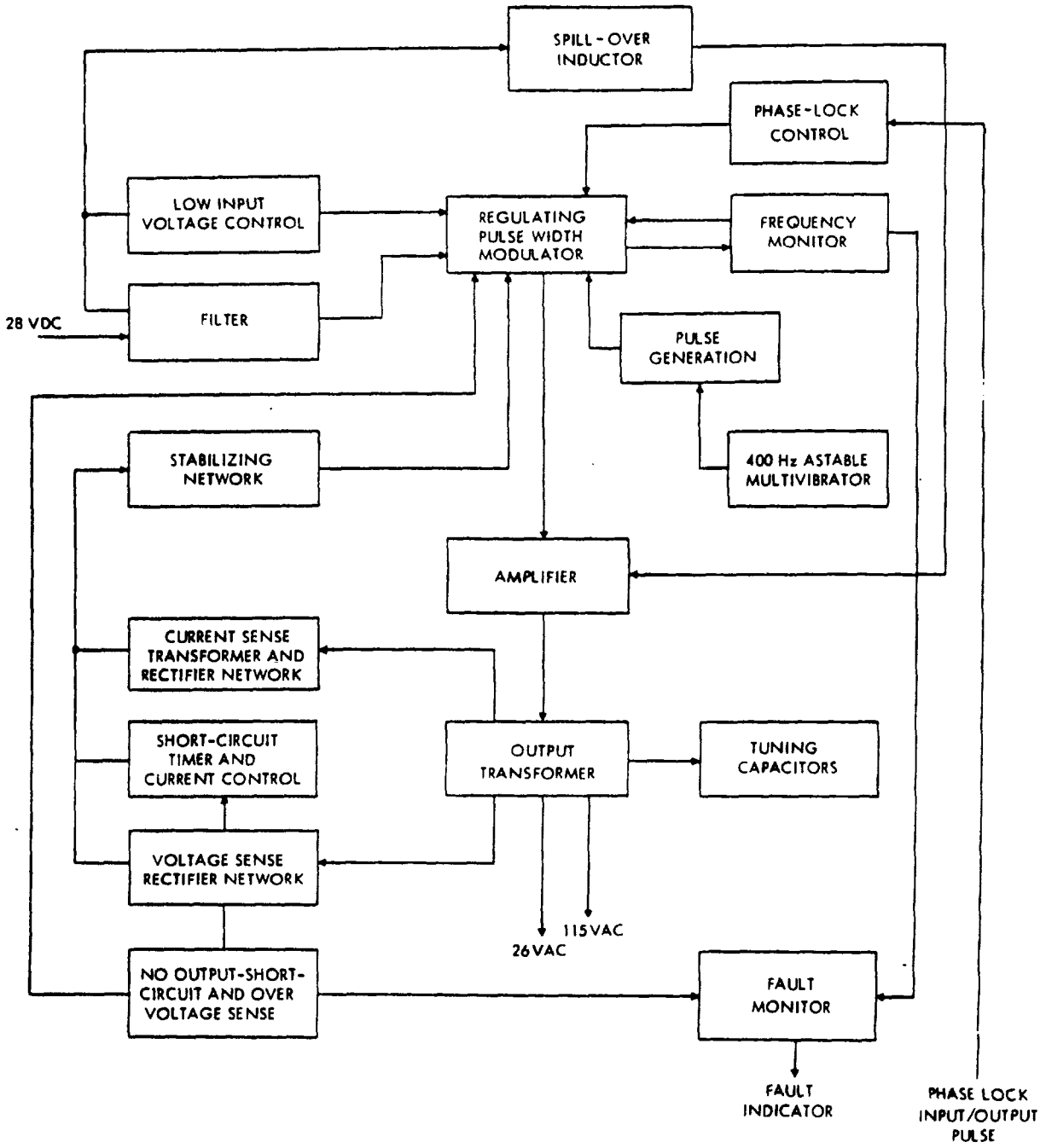
2.1 Operation (See Figure 8A) PC-250 Series, Mod Level A

The operation of the PC-250's incorporating modification level A differs only very slightly from that of the PC-250's. The following paragraphs expand only on those functions whose operation deviates from that described in paragraph 2.0.

Mod Level A
PC-250's identified with "MOD LEVEL A" incorporate a revised printed circuit board assembly including short circuit current fold back feature, a fault monitoring function for frequency drift, overvoltage, no AC or output short circuit condition and no DC power to the inverter.

A. Same as paragraph 2.0A.

B. Same as paragraph 2.0B.



PC-250 Series, Mod Level A Functional Block Diagram
Figure 8A

C. Input DC Filtering. (See Figure 201A.) Same as paragraph 2.0C.

D. 400 Hz Frequency and Pulse Generation. (See Figure 201A.) Same as paragraph 2.0D.

E. Pulse Width Modulation. (See Figure 201A.) Same as paragraph 2.0E.

F. Power Amplification. (See Figure 201A.) Same as paragraph 2.0F.

G. Output Filtering. (See Figure 201A.) Same as paragraph 2.0G.

H. Voltage Sensing and Regulation. (See Figure 201A.) Same as paragraph 2.0H.

I. Current Sensing. (See Figure 201A.) Same as paragraph 2.0I.

J. Short Circuit Current and Fold-Back Control. (See Figure 201A.) The center tap of the current sense transformer (T2) is returned to the negative output of the bridge rectifier (U6) connected to the voltage sensing winding of output transformer (T3). Under normal operating conditions, the negative DC output of the bridge rectifier sets a back-bias on diodes CR15 and CR16, and reduces the output voltage of the current sensing circuit such that it does not affect the voltage regulation circuit. Under short circuit conditions, the back-bias is removed and the current sensing circuit output voltage is increased substantially and fed to pin 1 of integrated circuit (U5). The high voltage at pin 1 of U5 takes control of the error amplifier circuit, which, in turn, reduces the output pulse width to maintain the power dissipation and the output short circuit current to a predetermined value. R46 is adjusted to obtain a short circuit current of 200% of the rated load current.

In addition, under a short circuit condition, the voltage at the junction of R74, R66 and C30 drops to zero, forcing through CR37, the reset input (pin 12) of U10 counter, to a potential below the disable level. The counter then starts dividing the output signal of the integrated oscillator. The oscillator frequency is set at approximately 100 Hz by the C37, R75 time constant.

Five seconds after the start of the counting, pin 15 of U10 goes from a low to a high state. CR35 is then back biased, causing a rise in the voltage at the junction of R49 and R51, and U5 pin 1, thus reducing the pulse width at U5, subsequently decreasing the inverter's short circuit current to a safe level. U10 pin 15 going high, causes pin 10 to go high through CR36, blocking the oscillator, thus forcing the counter to maintain its present state until reset.

The duration of high short circuit current may be changed from 5 seconds to 30 seconds or one minute by connecting the junction of CR35 and CR36 to a higher division output at pins 1 or 3 of the counter; however, the short circuit current must then be decreased to 175% of rated load current.

Removal of the short circuit resets the counter and the inverter automatically returns to normal operation.

K. Overvoltage Control. (See Figure 201A.) The output of rectifier bridge U6 is fed to a resistive divider, R66 and R67. The voltage at the junction of R66 and R67 is compared to a reference voltage into comparator U4D at pins 10 and 9, respectively. In the event of over-voltage from 125 to 138 RMS, the voltage at U4D, pin 10 becomes higher than the reference voltage at U4D pin 9. Voltage at U4D pin 8, and input 5 of OR gate U3C goes high. The U3C (4) and successively U3A (10), go high making transistor Q6 conduct to saturation. U5 (9) is grounded and the inverter is turned "off". The high output of comparator U4D at pin 8 is fed back through CR26 and R64 to the positive input at pin 10 and latches the U4D comparator to a high output position, keeping the inverter "off" even when the output voltage has dropped to zero. The inverter may be restarted by setting the remote on/off switch to OFF, then ON. Capacitor C30 provides a delay to prevent nuisance activation of the overvoltage circuit when a short overvoltage surge occurs, as during sudden unloading of the inverter.

L. *Low Voltage Shutoff.* (See Figure 201A.) The DC power input is fed to U4C pin 6 through a voltage divider R62 and R63. Whenever voltage at U4C pin 6 is lower than the reference voltage applied to U4C pin 5, the output of U4C pin 7 is high. OR gate outputs U3B (11) and U3A (10) are high, keeping transistor Q6 conducting to saturation, driving U5 pin 9 to ground, and the inverter to the "off" state. Whenever the DC input reaches approximately 15 volts, the output of U4C goes low, gates outputs U3B (11) and U3A (10) go low, Q6 is turned off and the voltage at U5 pin 9 goes high through R28, letting the inverter go through the soft start mode.

M. Frequency Monitor (See Figure 201A.) The frequency control circuit monitors the inverter frequency whether it is driven from its own internal oscillator or from an outside source. The master pulse at the collector of Q3 drives pulse width modulator U5 and is also routed through resistor R35 to an active filter composed of operational amplifier U4A, resistors R37, R36, and capacitors C10 and C11. Metal film resistors and mica capacitors are used for their excellent stability over a wide range of temperatures. The filter is tuned at 800 Hz and has a Q of approximately 12. When the pulse repetition rate is between 770 and 830 Hz, the output U4A pin 14 is of high enough amplitude

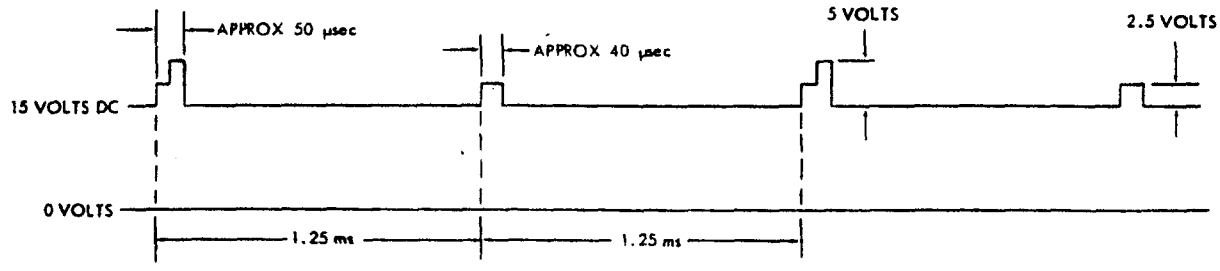
that after rectification through CR9, it will maintain pin 2 of U4B at a higher level than the reference voltage applied at pin 3 of U4B. When U4B pin 2 is high, U4B pin 1 is low and the outputs of OR gates U3C pin 4 and U3A pin 10 are low. Q6 is then turned "off" and the inverter operates. When the pulse repetition rate is outside of the frequency limit of 740 and 860 Hz, the output at U4A pin 14 is low, the output at U4B pin 1 is high driving U3C pin 4 and U3A pin 10 to the high state. Q6 becomes conductive, maintaining U5 pin 9 to ground potential and the inverter in the "off" mode. When U4B pin 1 is high, Q19 base is high and transistor Q19 is turned "off" isolating the faulty inverter phase-lock output line. Calibration of the frequency monitor bandwidth limits is achieved by adjustment of R30.

N. Phase Lock Control (See Figure 201A.) The PC-250 may be phase-locked to one or more additional PC-250's for parallel operation, or to an external means of a multi-level signal fed to the inverter at J1 pin F.

(1) Parallel operation. For a parallel mode of operation, the system will automatically lock onto the highest pulse repetition rate present on the lock line. The lock signal appears on the lock line as shown in Figure 5. To insure proper load distribution, the output voltage of all inverters to be paralleled must be within a .20 volt of each other. (Consult factory.)

(2) Polyphase operation. For a polyphase mode of operation, the inverter is phase-locked to a signal generated from an external source such as the three phase adapter PC-3Ø, providing the required waveform and sequencing. A typical signal fed to the lock line of one inverter of a polyphase system is shown in Figure 8B.

For polyphase operation resistor R71 (10 ohm) must be removed and Q19 emitter to collector junction must be shorted together on the PC board of each inverter. Soldering pads are provided on the PC board.



NOTE: 1. R71 removed from P.C. board.
2. Q19 emitter to collector junction must be shorted.

Phase Lock Control Polyphase Operation (Mod Level A)
Figure 8B

(3) Phase lock operation. The principle of operation of phase-locking is similar in both parallel and polyphase operation, with the exception that in a polyphase operation, the internal multivibrator of each inverter is inhibited by the 15 volts DC present in the lock signal. As R71 has been removed, the DC signal is then divided into R4 and R5 and fed to pin 13 of "NOR" gate U1C where it inhibits the multivibrator action of U1C and U1D, whereas, in the parallel mode, the multivibrator is not inhibited, but synchronizes to the highest repetition rate present on the lock line.

The lock signal entering J1 pin F goes through DC blocking capacitor C1 to a first comparator U2A pin 7. The reference level at pin 6 of U2A is 1.6 volts DC delivered from the voltage divider R22, R23, R25, and R27. All the pulses present on the lock line will appear at pin 1 of U2A, then inverted at pin 10 of "NOR" gate U1D, inverted again at pin 2 of U2D, differentiated through C8 and R30 and on through the normal path to pin 3 of U5. These pulses provide the desired repetition rate for synchronization, but do not carry phase information.

The lock signal at the negative end of C1 also goes to a second comparator U2B pin 8. The reference level at pin 9 of U2B is 3.4 volts DC. Therefore, only the pulses with 5 volts amplitude will appear inverted at pin 14 of the comparator U2B. These pulses are fed to pin 2 of "NOT" gate U1A. The 400 Hz signal drive at pin 12 of U5 is fed to pin 1 of "NOR" gate U1A. Whenever the signals at pins 1 and 2 of U1A are such that there are no simultaneous zero levels, the output at pin 3 stays at ground level. If, however, simultaneous zeros appear at pins 1 and 2 of U1A, a pulse will appear at U1A pin 3, then at U1B pin 4, and, finally, at U5 pin 3. This pulse, additional to the regular clock pulse, will generate a phase reversal in the pulse width modulator U5 and no more pulse will appear at U1A pin 3.

For parallel operation, the lock signal is generated in the inverter as follows: the clock signal at 800 Hz is differentiated through C8 and R30, then fed to comparator U2C pin 11. At the comparator output, the pulse is limited to approximately 3 volts amplitude and routed to J1 through emitter follower amplifier Q1 and capacitor C1. Also, the 400 Hz drive signal at pin 13 of U5 is differentiated through C2, R14, R13, and CR4, amplified to a 5 volt level through Q2 and "ANDED" with the pulse from Q1 to form a complete lock signal, then routed to J1 through C1. It should be noted that when lock is achieved, the pulses coming to J1 pin F from the external source and the pulses going out from J1 pin F are coincidental; therefore, one set of pulses only can be seen on an oscilloscope. A timing diagram of the phase lock operation is shown in Figure 7.

O. Fault Monitor (See Figure 201A.) Under normal operating conditions, transistor Q6 collector is a 5 volts DC. Gate U3D pin 3 is high, causing transistor Q12 to conduct to saturation. 27 volts DC at 100 ma is then available at the collector of Q13 to power an annunciator device. If the frequency of the inverter shifts beyond the preset limits of 370 and 430 Hz, the outputs of gates U3C and U3A go high, driving Q6 to saturation and the output of gate U3D goes low, turning transistors Q12 and Q13 "off". The only power then available to the annunciator is through R78.

During an overvoltage condition, pin 8 of comparator U4D goes high driving U3C output pin 4 high and, as in above paragraph, turning transistors Q12 and Q13 "off". No power is then available to the annunciator. In the event of no output or short-circuit conditions, the junction of CR24, CR23 is at ground potential, holding pin 1 and 2 of U3D to ground through CR33, keeping transistors Q12, Q13 off, thus turning off power to the annunciator except that available through R78.

Resistor R78 (4.7K) provides a constant current of 5 to 6 ma to the fault monitor output jack to insure back biasing of CR28 and subsequent turn on of transistors Q12 and Q13 when the fault monitor output is not shorted to ground. Should accidental ground short be applied at J2, CR28 conducts, turning off Q12 and Q13 thus preventing destruction of the transistors.

If the warning device used in a particular installation is of a high impedance type, it may be necessary to provide additional parallel loadings at the fault monitor output to obtain the desired voltage swing to operate the device.

A typical fault warning light installation is shown in Figure 8.

P. Soft Start Control (See Figure 201A.) Same as paragraph 2.0P.

Q. Remote ON/OFF (PC-250-1C) (See Figure 201A.) With J1 pin A open, voltage at U3B pin 2 if high, thus, U3B pin 11 and U3A pin 10 are high, Q6 is conducting, and U5 pin 9 is in a low state, keeping the inverter turned "off". Grounding J1 pin A puts U3B pin 12 and U3A pin 10 in the low state. Q6 stops conducting, allowing C9 to charge through R28 and the inverter goes through the soft start mode.

3. Installation

A. General. This paragraph provides general guidelines for the installation of the Model PC-250 static inverter. It is not intended to apply to any particular airplane. The Model PC-250 is a single-phase, 115 VRMS, 400-Hz inverter ready to be installed when delivered from the factory. It will deliver 250 VA of power to a load having a power factor between 0.9 leading and 0.8 lagging. It will operate into loads which are more reactive; however, an external power factor correction will be required to maintain regulation and distortion characteristics.

CAUTION: THE SHORT CIRCUIT CURRENT ON THE 26-VOLT OUTPUT WILL INCREASE TO 14 AMPERES. APPLICABLE PRECAUTIONS NEED TO BE TAKEN IN INSTALLATION TO AVOID DAMAGE TO THE INTERCONNECTING CABLE IN CASE OF SHORT CIRCUIT.

To maintain reliability, care must also be taken not to exceed the specified VA delivered by the equipment. The Model PC-250 is suitable for parallel or polyphase operation.

For installations where more than 250 VA of 26-volt and 115-volt, single-phase, 400 Hz power is a continuous requirement, two or more PC-250's may be installed and connected in parallel. All units must be turned on simultaneously at all times. To insure proper load distribution, all units to be paralleled must be calibrated such that their output voltage is within .20 volt of each other. See Figure 9 for typical installation diagram. (Consult factory.)

When two or more PC-250's must operate in phase synchronization, but the AC output is connected to separate busses, each inverter may be controlled by a separate remote ON/OFF control. (See Figure 10 for a typical installation diagram.)

CAUTION: IN A NEW INSTALLATION, IT IS RECOMMENDED THAT THE INVERTER'S PHASE LOCK CONTROL AND OUTPUT VOLTAGE BE CHECKED FOR PROPER OPERATION BEFORE CONNECTING THE INVERTERS IN PARALLEL.

For installations where 2-phase or 3-phase power is required, two or more PC-250's may be installed, along with a Flite-Tronics PC-3Ø External Phase Adapter, or suitable equivalent.

The PC-250 inverter is wired with the case connected to DC ground. In installations where it is desirable to keep the case floating, the jumper connecting DC ground to case may be removed. Consult factory for additional information.

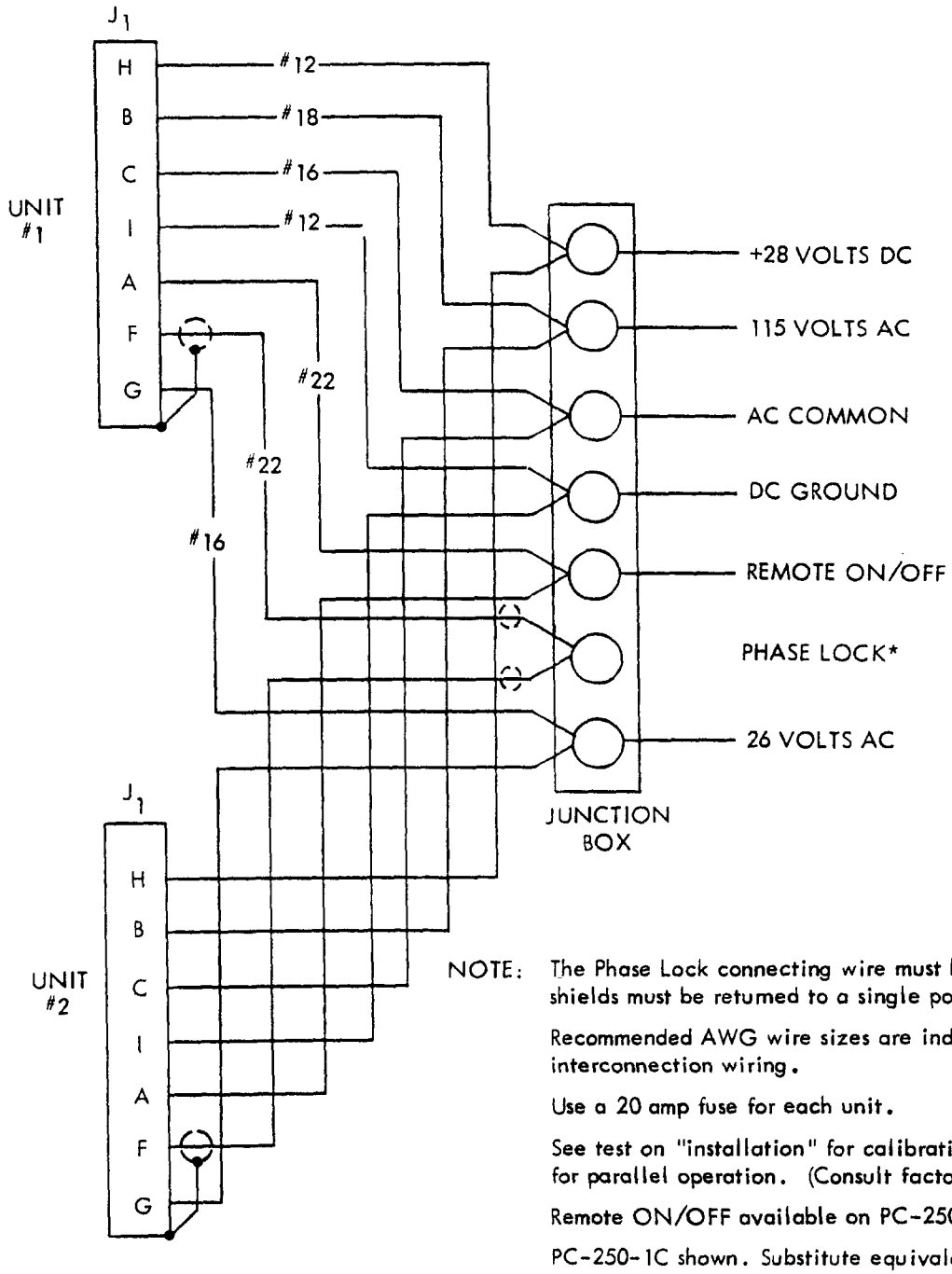
B. Installation Procedure: The Model PC-250 static inverter is designed to mount on an equipment rack or any suitable structure on the aircraft. Consideration must be given to accessibility for inspection and maintenance, as well as protection from environmental stresses, primarily, vibration and temperature.

To preserve the effectiveness of the convection cooling, the PC-250 must be installed in a location allowing free air flow around the inverter.

The Model PC-250 static inverter may be installed in any position; however, to insure optimum reliability, it must be attached directly to a thick metal plate or structure providing heat sinking and conduction cooling.

CAUTION: THE MODEL PC-250 STATIC INVERTER MUST NOT BE INSTALLED IN AN AREA WHERE AMBIENT AIR TEMPERATURE OR MOUNTING SURFACE TEMPERATURE MAY EXCEED 71°C (162°F) AT SEA LEVEL. AT NO TIME SHALL THE OPERATING REQUIREMENTS EXCEED THAT OF CURVE A FOR CLASS 2 EQUIPMENT OF MIL-E-5400.

Forced air cooling must be provided whenever the convection and conduction cooling requirements are not met.



NOTE: The Phase Lock connecting wire must be shielded. The shields must be returned to a single point ground.

Recommended AWG wire sizes are indicated on the interconnection wiring.

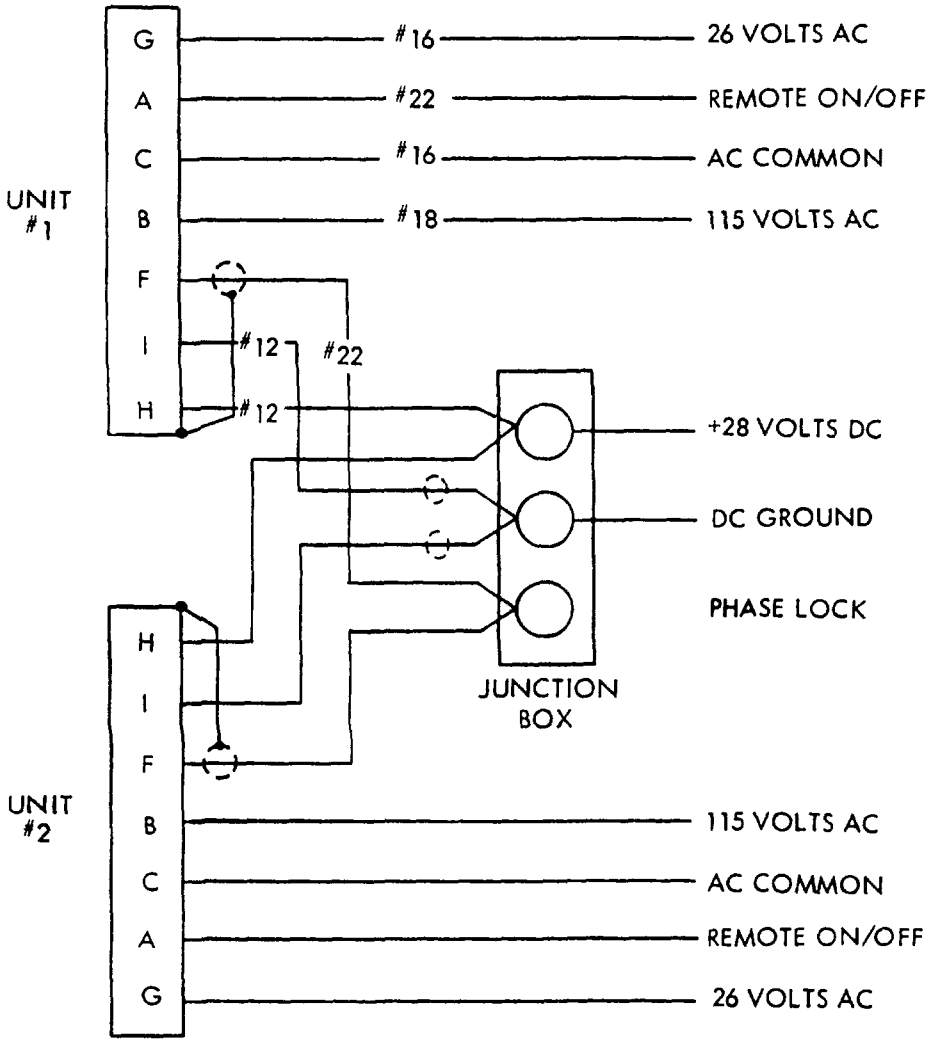
Use a 20 amp fuse for each unit.

See test on "installation" for calibration requirements for parallel operation. (Consult factory)

Remote ON/OFF available on PC-250-1C only.

PC-250-1C shown. Substitute equivalent pins for other models.

Typical Interconnection for Parallel Operation
Figure 9



NOTE: The Phase-lock connecting wire must be shielded. The shields must be returned to a single point ground.

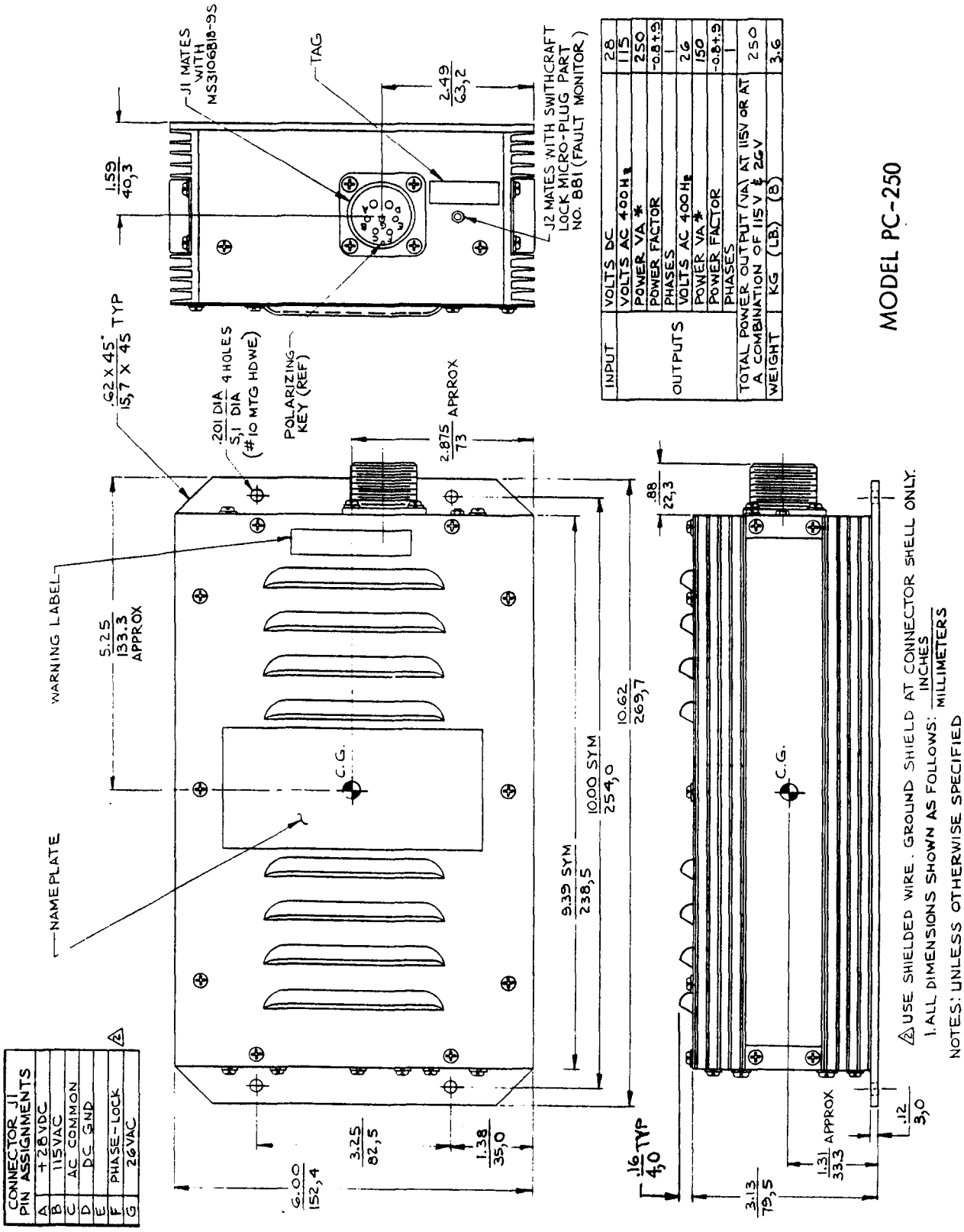
Recommended AWG wire size indicated on the interconnections.

Use a 20 amp fuse for each unit.

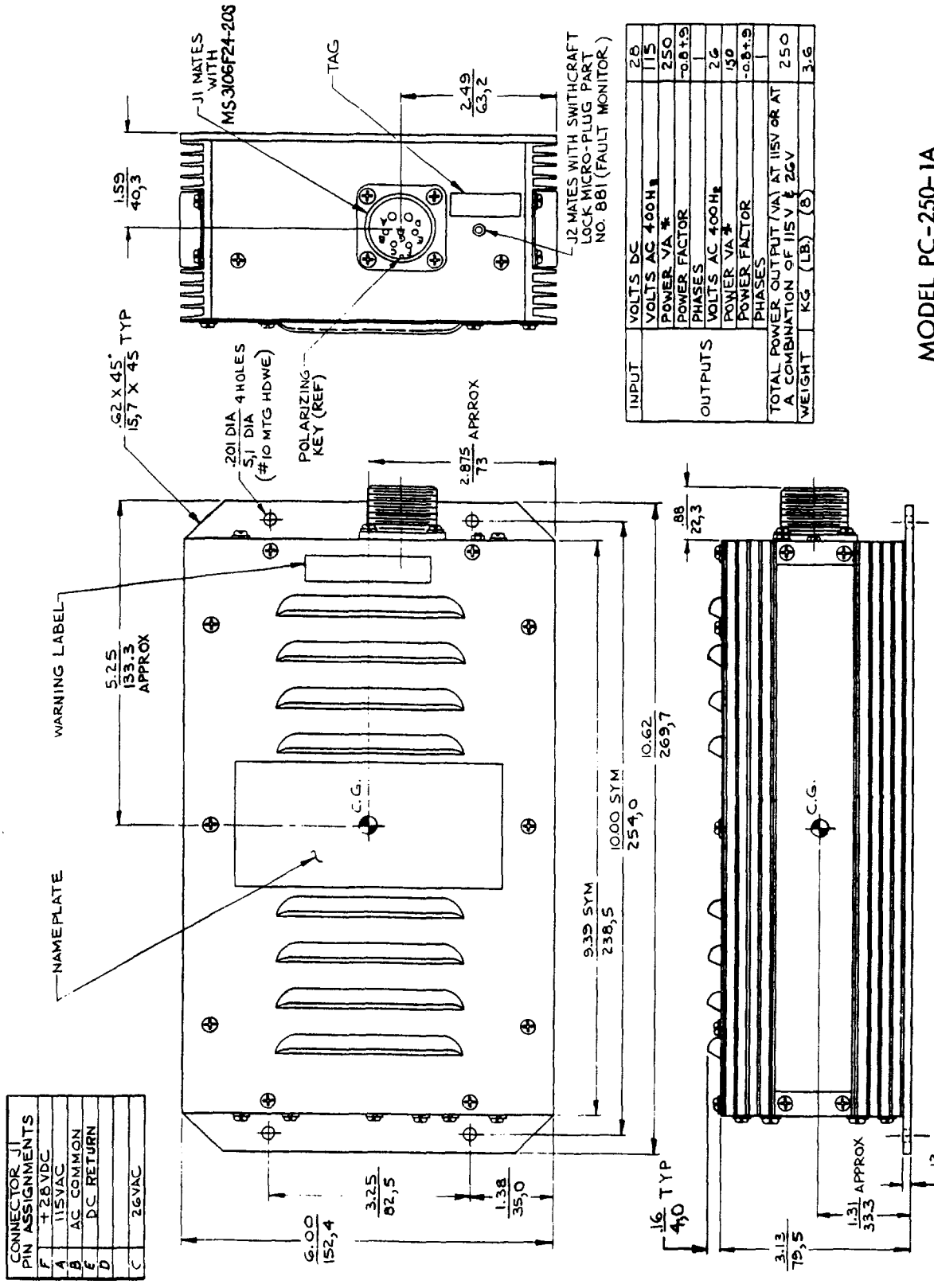
Remote ON/OFF available on PC-250-1C only.

PC-250-1C shown. Substitute equivalent pins for other models.

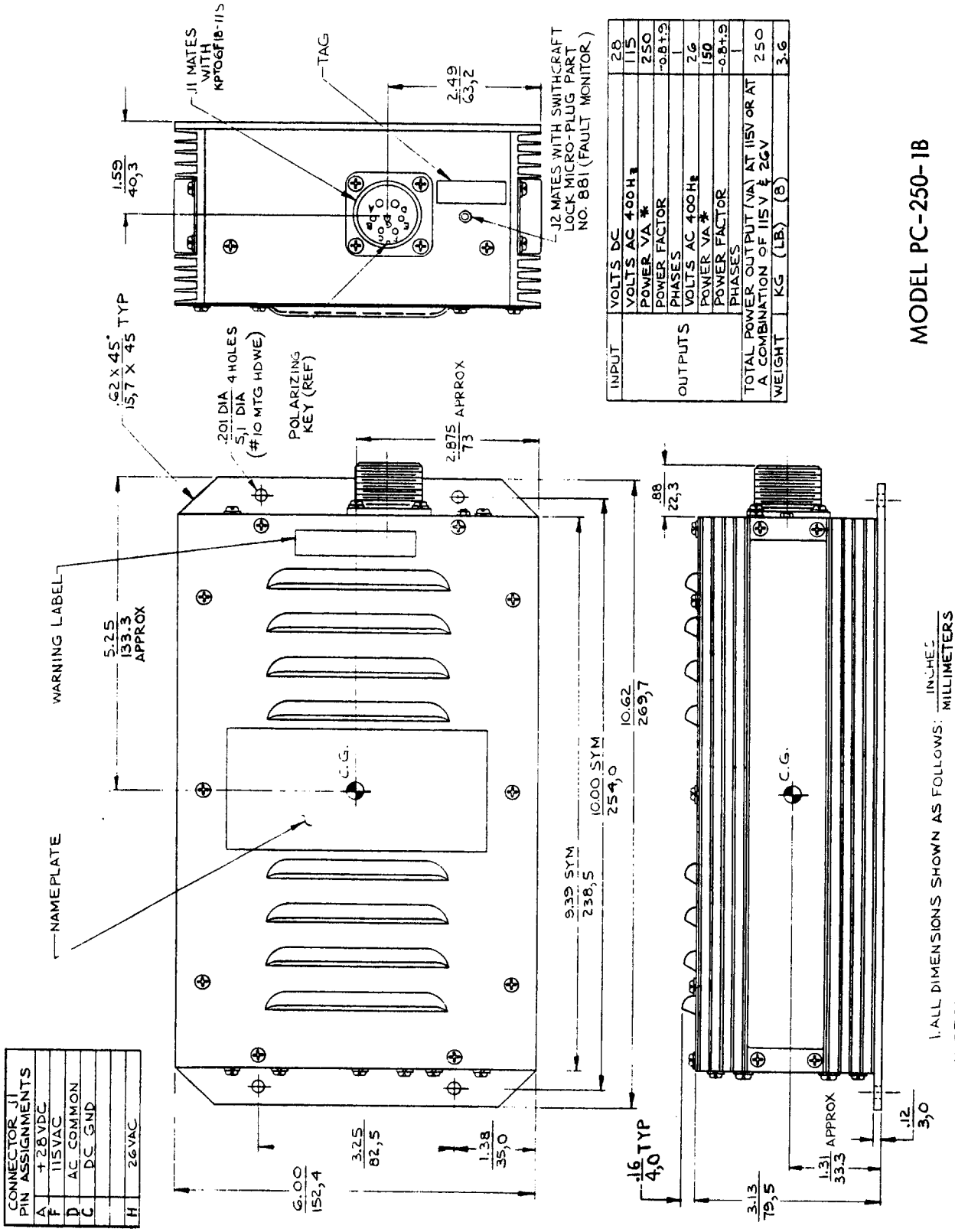
Typical Interconnection for Phase-Locked (But Not Paralleled) Operation
Figure 10



Installation Dimensions
Figure 11 (Sheet 1 of 4)



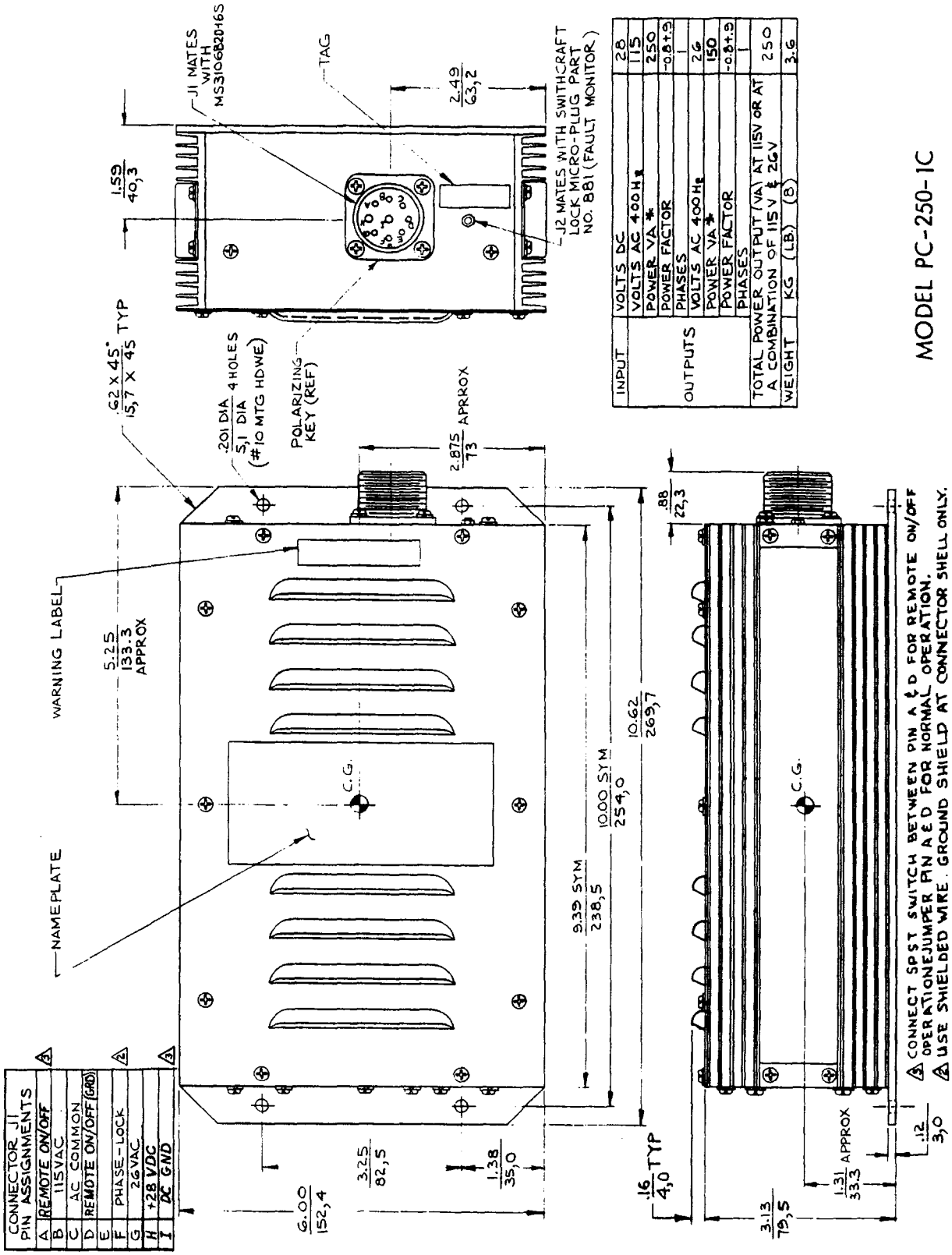
Installation Dimensions
Figure 11 (Sheet 2 of 4)



MODEL PC-250-1B

NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL DIMENSIONS SHOWN AS FOLLOWS: INCHES / MILLIMETERS

Installation Dimensions
Figure 11 (Sheet 3 of 4)



Installation Dimensions
Figure 11 (Sheet 4 of 4)

TESTING

1. General

The test procedures outlined in this section should be performed on a static inverter prior to maintenance in order to determine the extent of maintenance required. The tests should be repeated after maintenance to verify the correct results of the maintenance.

2. Test Equipment

Refer to Table 101 for a list of test equipment required.

TABLE 101
TEST EQUIPMENT

DESCRIPTION	PART/MODEL NO.	SOURCE
Power Supply, 0-37 volts, 20 amperes, adjustable current limiting	Commercial	Local Purchase
Oscilloscope	5440	Tektronix
Amplifier	5A48	Tektronix
Time-base Plug-ins	5B40	Tektronix
Current Probe Amplifier	Type 134	Tektronix
Current Probe	P6021	Tektronix
AC, DC Voltmeter	8040A	Fluke
Current Shunt	80J-10	Fluke
Frequency Counter	5381A	Hewlett-Packard
Distortion Analyzer	334A	Hewlett-Packard
Function Generator	3310A	Hewlett-Packard
DC Ammeter	931-2902001	Weston
AC Ammeter	433-2906005	Weston

TABLE 101
TEST EQUIPMENT

DESCRIPTION	PART/MODEL NO.	SOURCE
Capacitance Decade Box (Suitable for 115 VAC 400 Hz operation)		
0.01 to 1.1 uf	CDB3	Cornell Dubilier
1 to 10 uf	CDC3	Cornell Dubilier
Resistance Decade Box		
0 ohm to 1.11 megohms	Microray Model 7	The Microray Co. 1059 Fernview Drive St. Louis, Mo 63141

NOTE: Equivalent substitutes may be used.

3. Output Voltage Test

A. Install static inverter in test setup shown in Figure 101.

B. Set switch S2 to 100% load position.

C. Set the DC input voltage to 28 volts. Output voltage (pins B and C)* shall be 115 ±2.5 volts RMS, output signal distortion shall be less than 3.25 percent, and DC input current shall be less than 12.0 amperes.

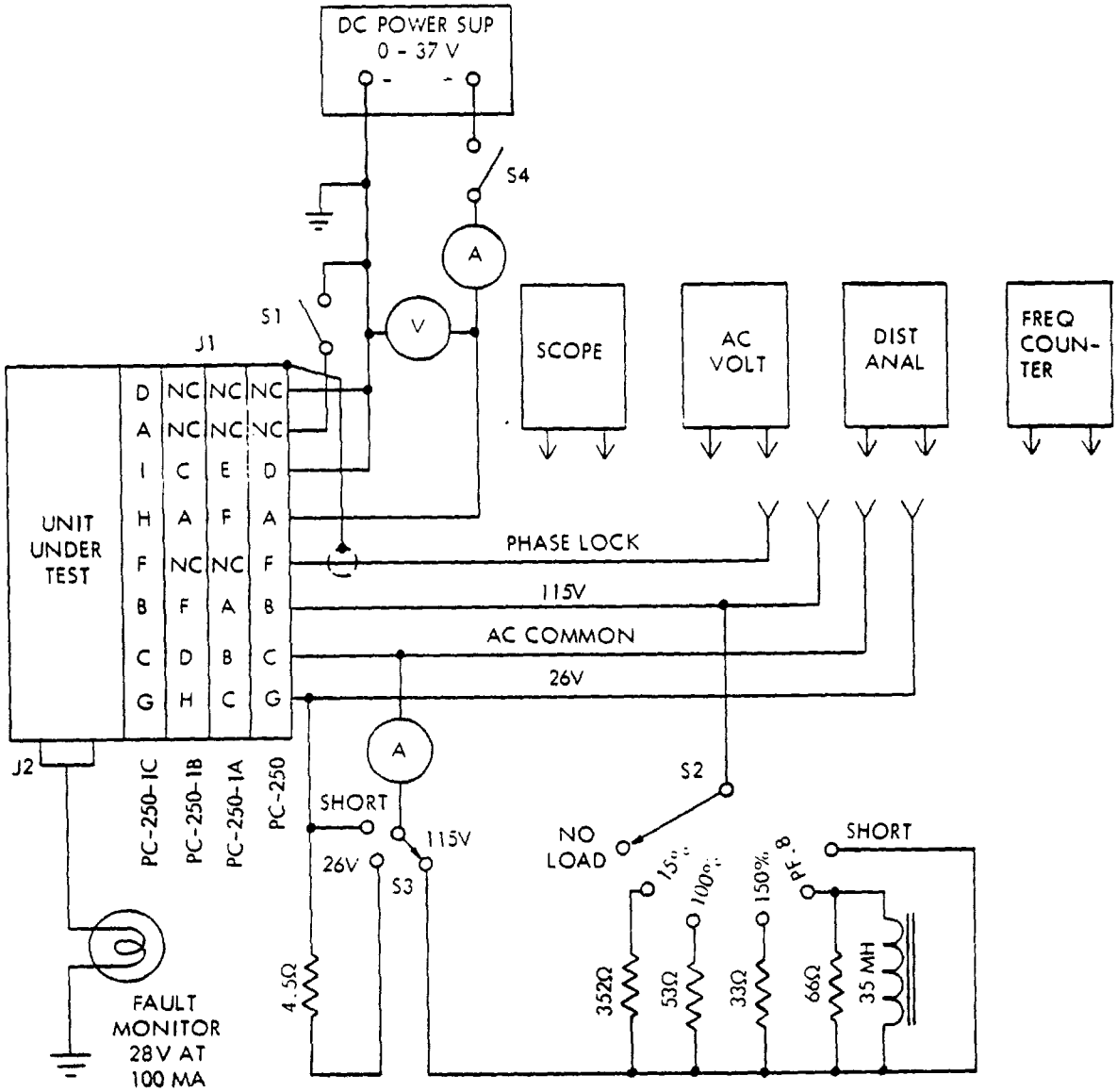
D. Set the DC input voltage to 24 volts. Output voltage (pins B and C) shall be 115 ±3.0 volts RMS, output signal distortion shall be less than 5.0 percent, and DC input current shall be less than 14.0 amperes.

E. Set the DC input voltage to 20 volts. Output voltage (pins B and C) shall be greater than 111 volts RMS output signal distortion shall be less than 8.0 percent, and DC input current shall be less than 16.5 amperes.

F. Set the DC input voltage to 17 volts. Output voltage (pins B and C) shall be at least 100 volts RMS and output signal distortion shall be less than 10 percent.

G. Set the DC voltage to 32 volts. The output voltage (pins B and C) shall be 115 ±3.0 volts, output signal distortion shall be less than 5.0 percent, and DC input current shall be less than 10.7 amperes.

NOTE: *J1 Pin identification is given for the basic PC-250
Substitute equivalent pin identification for other models.



NOTES:

A. USE NO. 12 AWG WIRE OR SMALLER NUMBER FOR CONNECTIONS TO J1, PINS A & D.

B. USE NO. 16 AWG WIRE FOR PINS B, C, & G.

C. USE NO. 22 OR NO. 24 AWG WIRE FOR CONNECTION TO J1, PIN E.

D. USE SHIELDED WIRE #20 OR 22 FOR PHASE-LOCK LINE.

E. NC DENOTES NO CONNECTION.

Test Setup
Figure 101

H. Set the DC input voltage to 37 volts. The output voltage (pins B and C) shall be 115 ±3.5 volts.

I. Vary the DC input voltage from 18 to 36 volts. The output (pins B and C) frequency shall stay within 398.0 and 402.0 Hz.

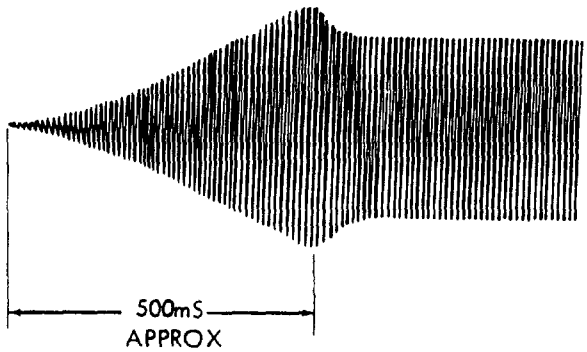
J. Set switch S2 to PF.8 (power factor 0.8) position.

K. Vary the input DC voltage from 22 to 35 volts. The output voltage (pins 3 and 6) shall stay within 112 to 118 volts and the output signal distortion shall be less than 8.0 percent.

L. Set switch S4 to OFF position. Wait until the input voltage is less than 0.25 volts.

M. Set switch S4 to ON position and observe the oscilloscope. The output voltage rise shall be similar to that shown in Figure 102 (soft start).

NOTE: The voltage measurements must be made at the PC-250 connector input.



Soft Start Voltage Rise
Figure 102

N. Set switch S3 to the 26 volts position. Connect the AC voltmeter to the 26 volts output (pins C and F).

O. Set the input DC voltage to 28 volts. The output voltage (pins G and C) shall be 26 ±1 volts RMS.

4. Overvoltage Test

NOTE: Test of the overvoltage function cannot be performed without removing the dust cover. If required, it may be performed as follows:

A. Set switch S2 to 100% load position.

B. Set DC input to 28V.

C. Slowly decrease the resistance value of R53 until the inverter goes to overvoltage mode. The fault monitor light should go off.

D. At the tripping point, the output voltage should be 125 to 138 volts RMS.

E. Reset R53 to maximum resistance value (full CCW). The inverter should stay in the over voltage mode.

F. Restart the PC-250 by setting switch S1 to OFF, then to ON.

G. Set potentiometer R53 to obtain 115 ±0.5 volts at the output.

H. Remove static inverter from test setup and install dust cover.

CAUTION: WHEN PERFORMING THE OVERVOLTAGE TEST, DUE PRECAUTION MUST BE TAKEN THAT NO EQUIPMENT WHICH MAY BE DAMAGED BY THE OVERVOLTAGE CONDITION IS CONNECTED TO THE INVERTER.

5.0 Frequency Control Test (PC-250 Series)

A. Set switch S2 to 15% load position.

B. Apply lock pulse as defined in Figure 103 to J1 pin F.

C. Vary pulse repetition rate from 800 pps to 860 pps, then to 740 pps.

D. The inverter output should drop to zero for frequencies higher than 860 pps or lower than 740 pps and the fault light should go off.

E. Remove the lock pulse from J1 pin F. The inverter should operate normally.

5.1 Frequency Control Test (PC-250 Series, Mod Level A)

A. Set switch S2 to 15% load position.

B. Rotate potentiometer R21 to change the pulse repetition rate at J1(F) from 800 pps to 860 pps, then to 740 pps.

C. The inverter output and the pulses appearing at J1(F) should drop to zero at or before reaching the pulse repetition rate of 860 pps or 740 pps.

NOTE: Due to components and manufacturing tolerances, the pulse repetition rates may not be reached at both the high and the low limits.

5.2 Alternate Method

A. Temporarily remove R71 from the PC board and temporarily short Q19 emitter and collector together (solder pads are provided on the board).

B. Set switch S2 to 15% load position.

C. Apply lock pulse as defined in Figure 103 for J1 pin F.

D. Vary pulse repetition rate from 800 pps to 860 pps, then to 740 pps.

E. The inverter output should drop to zero at or before the pulse rate reaches 860 pps or 740 pps.

F. Remove lock pulse from J1 pin F. The inverter should operate normally.

G. Replace R71 and remove short from Q19 emitter to collector functions.

6.0 Phase Lock Test (PC-250 Series)

A. Apply lock pulse as defined in Figure 103 to J1 pin F.

B. Verify that the output of the inverter is locked in phase with the output of the function generator.

6.1 Phase Lock Test (PC-250 Series, Mod Level A)

A. Proceed as described in paragraphs 5.1.A, 5.1.B, and 5.1.C of the alternate method.

B. Verify that the output of the inverter is locked in phase with the output of the function generator.

C. Remove the lock pulse connection.

D. Replace R71 and remove the shorting jumper from Q19 emitter to collector functions.

7. Output Transistors Load Sharing Test

Under normal operating conditions, the collector current of the output transistors Q8, Q9, Q10, Q11 should be within 30% of each other.

The transistor collector current must be measured using an oscilloscope current probe and amplifier. It is important to insure that the current probe is not driven to saturation or improper measurements will result. A typical collector current waveform is shown in 13 figure 202.

When a transistor needs to be replaced, a part bearing the same code letter must be selected.

8.0 Overload and Short Circuit Test (PC-250 Series)

A. Set switch S2 to 150% load position.

B. Adjust resistor R46 to obtain an output voltage 2 volts lower than that obtained at step 3.C.

C. Place switch S2 to SHORT position.

D. Adjust resistor R46 to obtain a short-circuit AC current of 3.25 to 3.75 amperes.

NOTE: The short-circuit test should be performed in 15 seconds. In no case should the short-circuit test be on for more than one minute.

E. Set switch S2 to the 100% load position.

F. Verify that the output voltage is not more than 0.5 volt lower than that obtained at step 3.C.

8.1 Overload and Short Circuit Test (PC-250 Series, Mod Level A)

A. Set switch S2 to 150% load position.

B. Adjust resistor R46 to obtain an output voltage 2 volts lower than that obtained at step 3.C.

C. Place switch S2 to SHORT position.

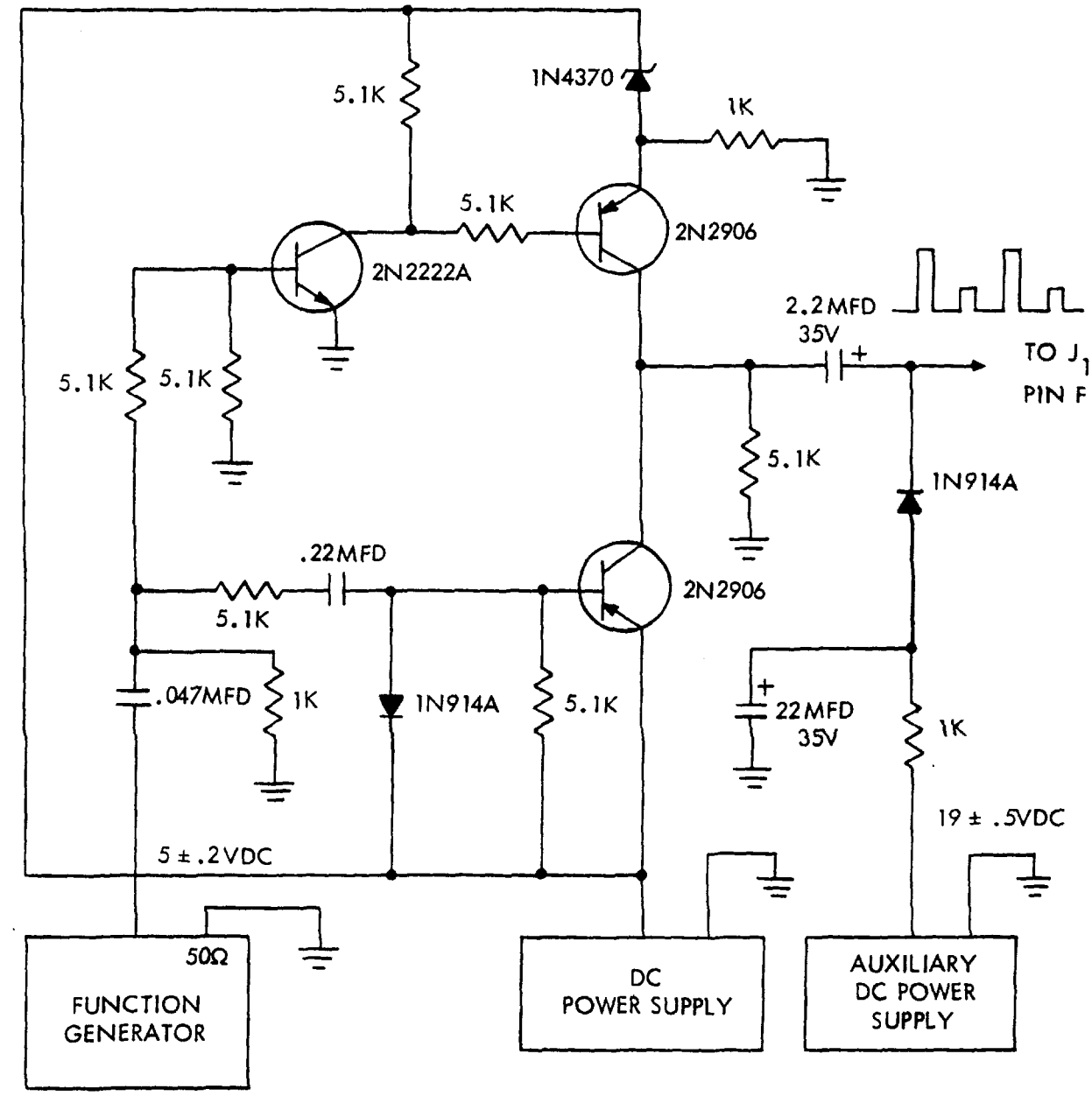
D. Adjust resistor R46 to obtain a short-circuit AC current of 3.75 to 4.0 amperes.

E. Verify that after a short-circuit duration of 5 to 7 seconds the AC current output folds back to not more than 2.0 amperes.

F. Verify that during short-circuit condition the fault lamp is off.

G. Set switch S2 to 100% load position.

H. Verify that the output voltage is not more than 0.5 volt lower than that obtained at step 3.C.



400 ± 4 Hz SQUARE WAVE 5 VOLTS P TO P

LOCK PULSE SPECIFICATION:

WIDTH 30 TO 60 μSEC
AMPLITUDE: ALTERNATING +2.5 VOLTS AND +5 VOLTS
REPETITION RATE: 800 ± 8 pps

Phase Lock Test Setup
Figure 103

TROUBLE SHOOTING

1. General

   A. This section provides guidance for locating malfunction within the PC-250 static inverter. In association with this test, refer to the schematic diagram, Figure 201.

   B. Whenever there is a doubt about the proper operation of the static inverter, it is recommended to start and operate the unit at low DC input (approximately 16 volts) to avoid damaging components. The DC input voltage may be gradually increased to 20 volts where the waveforms are essentially the same as those obtained at nominal input voltage. Note that at low input voltage, the voltage sensing and regulating circuit will not function. When the operation of the inverter at low voltage is satisfactory, the input voltage may be gradually increased to the nominal 28 volts DC.

   C. The DC input to the static inverter must be current-limited or adequately fused to prevent damage to components in case of malfunction.

2. Trouble Shooting Instructions

   Refer to Table 201 for trouble shooting instructions. Refer to Figure 202 for referenced waveforms. J1 pin identification is given for the basic PC-250. Substitute to the equivalent pin identification for other models.

TABLE 201 (Sheet 1 of 6)
TROUBLE SHOOTING

MALFUNCTION	POSSIBLE CAUSE	REMEDY
Short circuit between J1, pins A and D	Input capacitor C14, C15, C16 or C17 shorted to ground	Replace shorted capacitor.
	Diode CR12 shorted to ground	Replace diode.
	Input filter inductor L2 shorted to ground	Replace input filter inductor.
Low voltage and heavy DC current at pin A of J1	Input capacitor C14, C15, C16, C17, C18 or C19 shorted	Replace shorted capacitor.
	CR11 shorted	Replace CR11.
	CR12 shorted	Replace CR12.
	Q8, Q9, Q10 or Q11 damaged	Replace Q8, Q9, Q10 or Q11.

TABLE 201 (Sheet 2 of 6)
TROUBLE SHOOTING

MALFUNCTION	POSSIBLE CAUSE	REMEDY
	Inductors L1, L2 or connecting wires shorted to ground	Replace shorted inductors or connecting wires.
No DC at cathode of CR2	Connecting lead open	Repair open lead.
	R8 open	Repair R8.
Frequency of VAC output at pins B and C of J1 is not within 398 and 402 Hz	Defective or miscalibrated precision astable multivibrator components, U1, C4, C5, R20 or R21	Replace defective parts.
	Coupling capacitor C8 open	Replace C8.
	Defective components Q3, U1, or U2	Replace defective parts.
No output at pins B and C of J1	a. Transistor Q6 is not saturated	
	(1) Defective integrated Circuit U5	Replace integrated circuit U5.
	(2) Defective driver transistors Q4 and Q5	Replace driver transistors Q4 and Q5
	(3) Open connections to T1, T2, Q8, Q9 Q10 or Q11.	Repair open connections.
	(4) Choke L3 open	Replace choke L3.
	b. Transistor Q6 is saturated	
	(1) Defective over-voltage or under-voltage circuits; U4D, U4C, U3B, or U3A	Replace defective components.
	(2) Defective frequency control circuit; U4A, U4B, U3C, or U3A	Replace defective components.
	(3) Defective multivibrator circuit; U1C, U1D, U2D, U1B or Q3	Replace defective components.

TABLE 201 (Sheet 3 of 6)
TROUBLE SHOOTING

MALFUNCTION	POSSIBLE CAUSE	REMEDY
	Defective remote on/off circuit; open connections to J1(E), U3B, or U3A	Repair open connections.
	Defective phase lock circuit; U2C, Q1, Q2, U2B, or U2A	Replace defective components.
Output voltage at pins B and C of J1 out of tolerance	Defective integrated circuit U5	Replace defective integrated circuit.
	Defective resistor network (wrong value of reference voltage at pin 2 of U5 - voltage at pin 16 of U5 is correct)	Replace defective resistor network.
	Miscalibration of voltage control	Reselect resistor R53.
	Miscalibration of current limiting circuit	Reselect resistor R46
	Defective output transformer T3	Replace defective output transformer.
	Defective current transformer T2	Replace defective current transformer.
	Defective spillover inductor L1	Replace defective spillover inductor.
	Defective rectifier bridge U6	Replace defective rectifier bridge.
	Open connections to PC board	Repair open connections.
	Defective tuning capacitors C21, C22, and C23	Replace defective capacitors.

TABLE 201 (Sheet 4 of 6)
TROUBLE SHOOTING

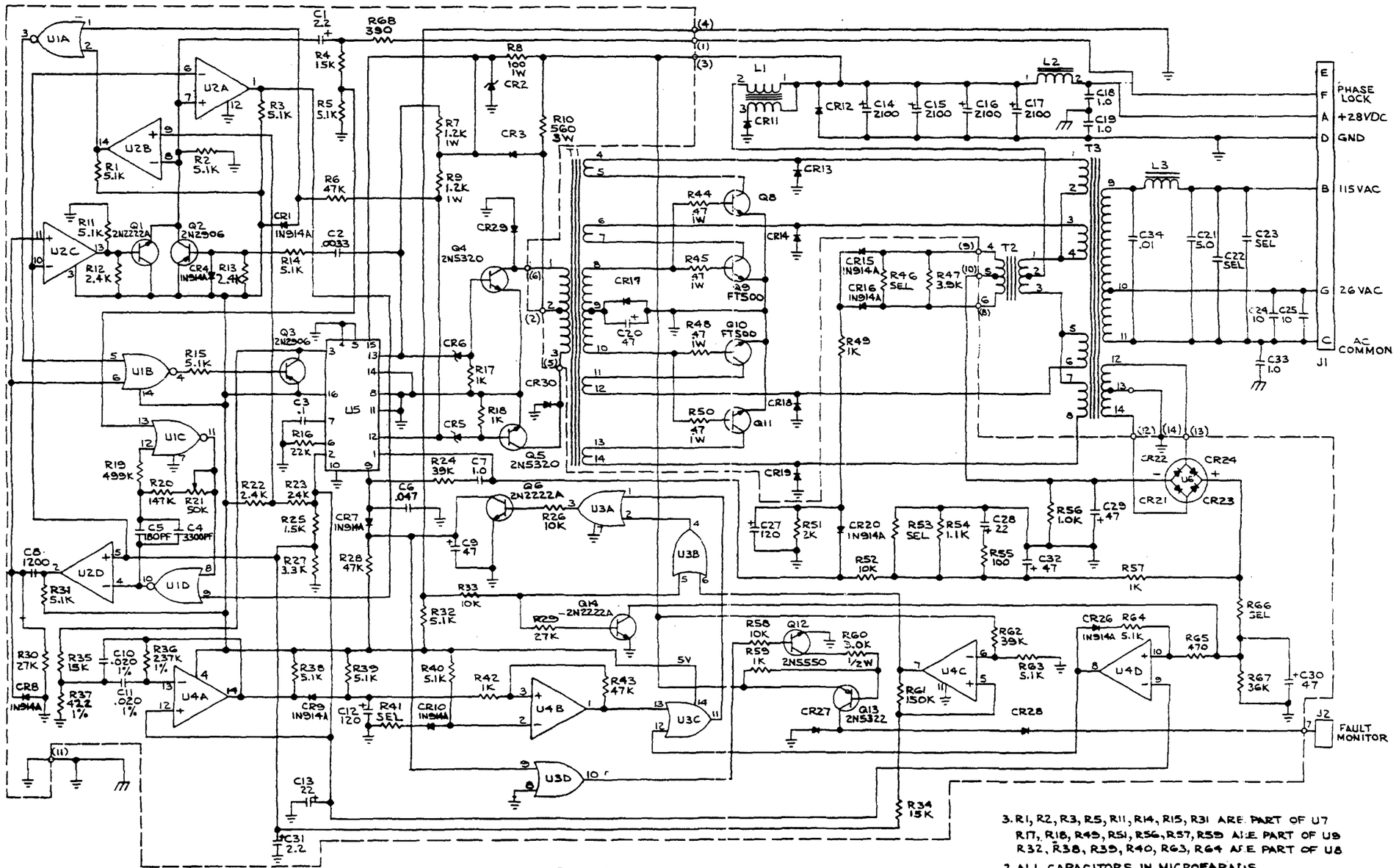
MALFUNCTION	POSSIBLE CAUSE	REMEDY
	Defective transistors Q8, Q9, Q10 and/or Q11	Replace defective transistors.
Transistors Q8, Q9, Q10 and Q11 fail at nominal DC input (See waveforms 4 and 5)	Defective connection to one or more transistors	Repair defective connections.
Current limiting circuit inoperative	Defective current transformer T2	Replace defective current transformer.
	Open connections to PC board	Repair open connections.
	Defective diodes CR15 and CR16	Replace defective diodes.
Output signal distortion at pins B and C of J1 out of tolerance	Defective tuning capacitors C21, C22, and C23	Replace defective capacitors.
	Defective spillover inductor L1	Replace defective spillover inductor.
Output signal at pins G and C of J1 is not 25 to 27 volts	Defective output transformer T3	Replace defective output transformer.
Remote ON/OFF control is inoperative	Defective integrated circuit U3B or U3A	Replace defective components.
	Defective integrated circuit U5	Replace defective component.
	Defective transistor Q6	Replace defective component.
Output at pins B and C of connector J1 is in excess of 118 VAC when input at pins A and D of connector is in excess of 32 VDC	Defective integrated circuit U5	Replace integrated circuit.

TABLE 201 (Sheet 5 of 6)
TROUBLE SHOOTING

MALFUNCTION	POSSIBLE CAUSE	REMEDY
Soft-start is inoperative causing immediate voltage rise at turn-on	Open diode CR7	Replace diode.
	Open capacitor C9	Replace capacitor.
	Defective transistor Q6	Replace transistor.
Inverter locks on overvoltage mode	Defective divider R66 and R67	Replace R66 and/or R67.
	Defective integrated circuit U4	Replace integrated circuit U4.
	Defective transistor Q14	Replace transistor Q14.
	Defective capacitor C30	Replace capacitor C30.
Inverter will not start	Defective low voltage control U4, R62, and R63.	Replace defective components.
	Defective start circuit U3A, U3B, and Q6	Replace defective components.
	Defective multivibrator and coupling circuit U1D, U1C, U2D, C8 and CR8.	Replace defective components.
	Defective frequency control circuit U4A, U4B, U3C, and U3A	Replace defective component.
	Defective pulse drive circuit U1B or Q3	Replace defective components.

TABLE 201 (Sheet 6 of 6)
TROUBLE SHOOTING

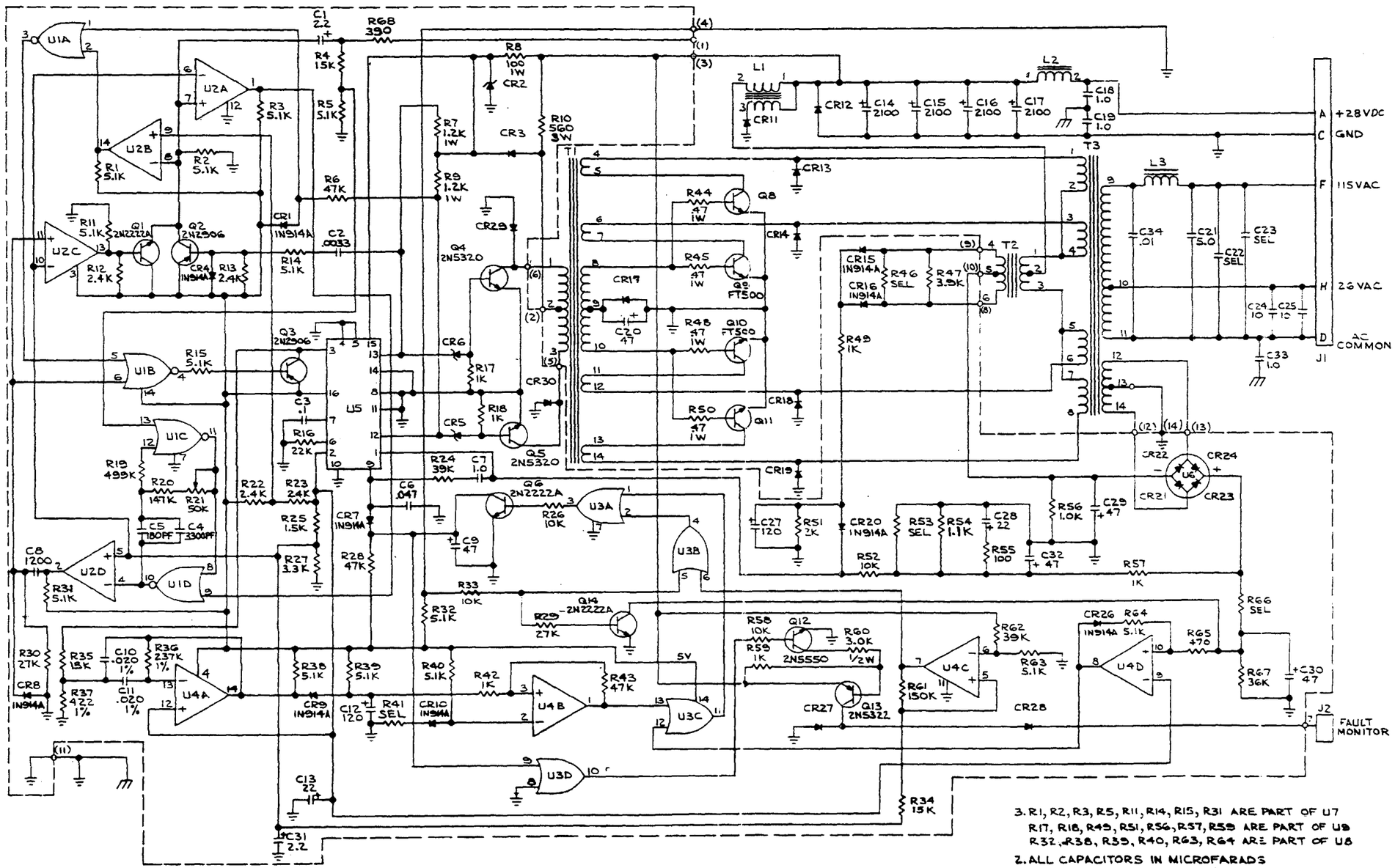
MALFUNCTION	POSSIBLE CAUSE	REMEDY
Inverter will not phase-lock	Defective phase-lock circuit U1A, U1D, U2D, U2A, U2B, U2C, Q1, and Q2	Replace defective components.
Fault monitor (J2) inoperative	Defective gate U3D, transistors Q12, Q13, diode CR28	Replace defective components.
	Improper connection at J2 or defective jack	Replace defective components.
	PC-250 Series (Mod Level A)	
Short circuit current foldback timers delay inaccurate	Defective counter U10	Replace defective component.
	Defective capacitor C37 or resistor R75	Replace defective components.
Short circuit current foldback inoperative	Defective counter U10	Replace defective component.
	Defective diode CR35	Replace defective component.
	Defective diode CR37	Replace defective component.



3. R1, R2, R3, R5, R11, R14, R15, R31 ARE PART OF U7
   R17, R18, R49, R51, R56, R57, R59 ARE PART OF U9
   R32, R38, R39, R40, R63, R64 ARE PART OF U8
2. ALL CAPACITORS IN MICROFARADS
1. ALL RESISTORS IN OHMS, ¼W ±5%
NOTES: UNLESS OTHERWISE SPECIFIED

Schematic Diagram
Figure 2-1 (Sheet 1 of 3)

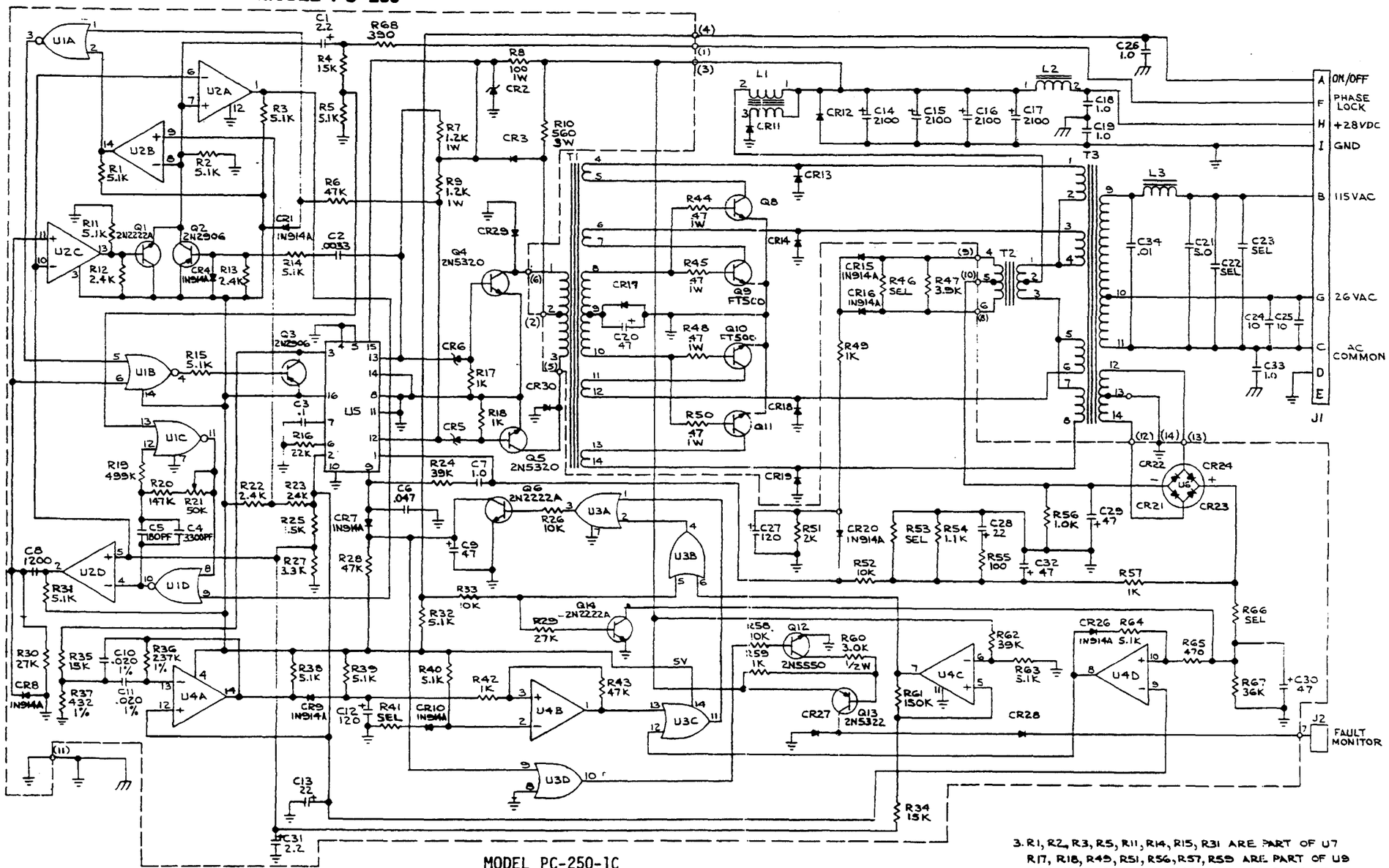
MODEL PC-250
Effective through S/N 1115



3. R1, R2, R3, R5, R11, R14, R15, R31 ARE PART OF U7
R17, R18, R49, R51, R56, R57, R59 ARE PART OF U8
R32, R38, R39, R40, R63, R64 ARE PART OF U8
2. ALL CAPACITORS IN MICROFARADS
1. ALL RESISTORS IN OHMS, ¼W ±5%
NOTES: UNLESS OTHERWISE SPECIFIED

Schematic Diagram
Figure 201 (Sheet 2 of 3)

MODEL PC-250-1B
Effective through S/N 102



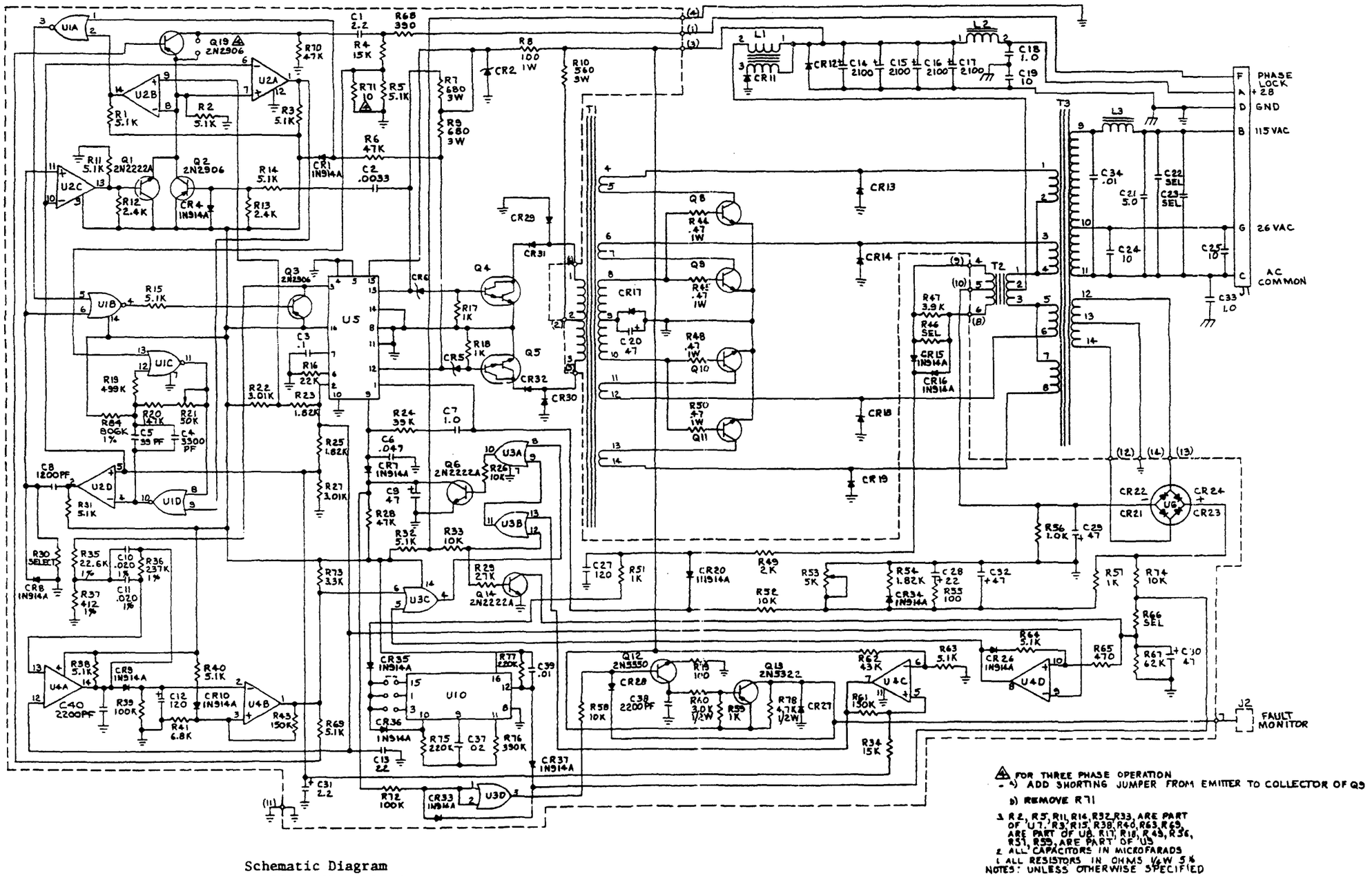
Schematic Diagram
Figure 201 (Sheet 3 of 3)

MODEL PC-250-1C

Effective through S/N 122

3. R1, R2, R3, R5, R11, R14, R15, R31 ARE PART OF U7
R17, R18, R49, R51, R56, R57, R59 ARE PART OF U8
R32, R38, R39, R40, R63, R64 ARE PART OF U8

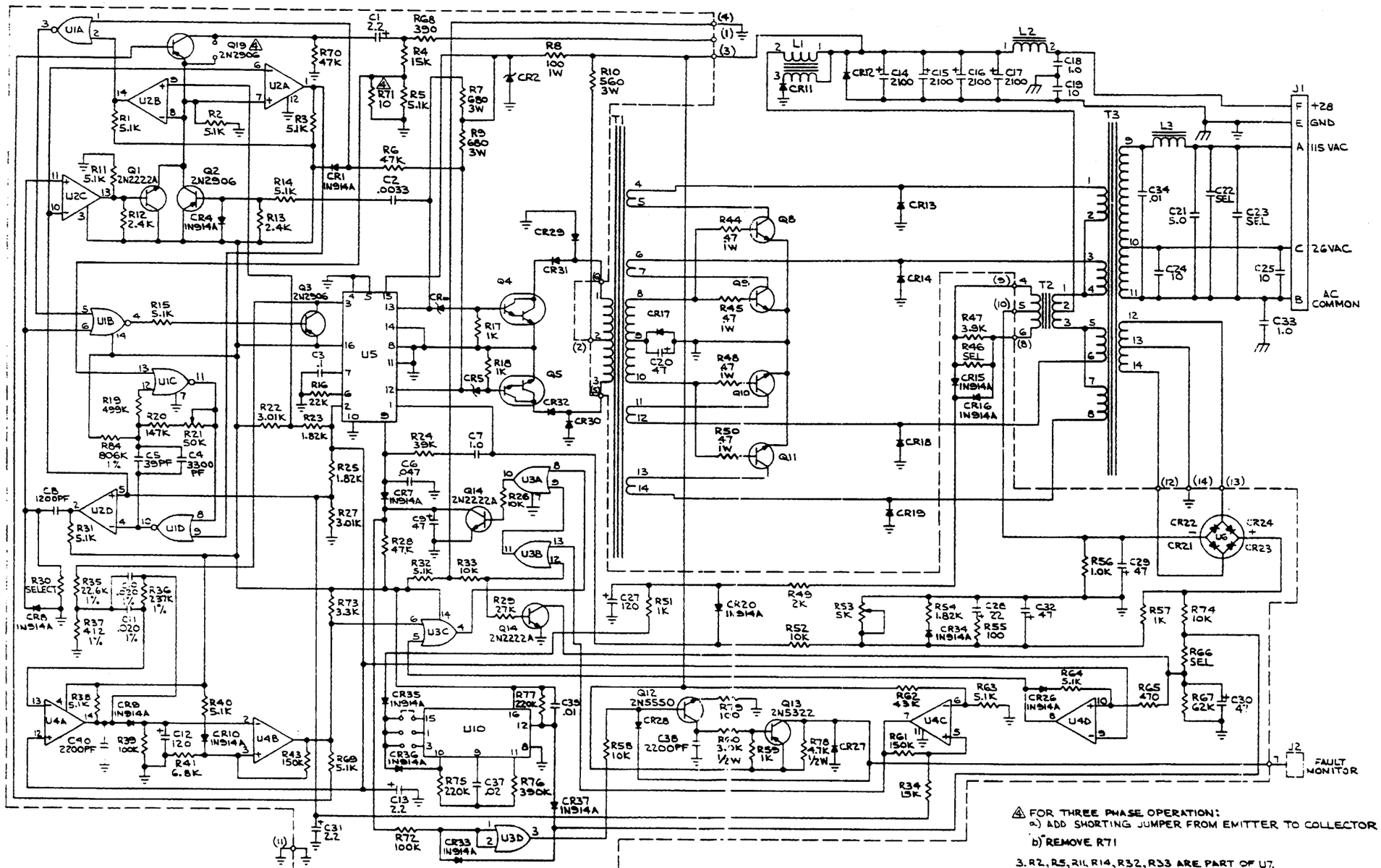
2. ALL CAPACITORS IN MICROFARADS
1. ALL RESISTORS IN OHMS, 1/4W 5%
NOTES: UNLESS OTHERWISE SPECIFIED



Schematic Diagram
Figure 201A (Sheet 1 of 4)

MODEL PC-250, MOD LEVEL A

Effective S/N 1116 and Subsequent

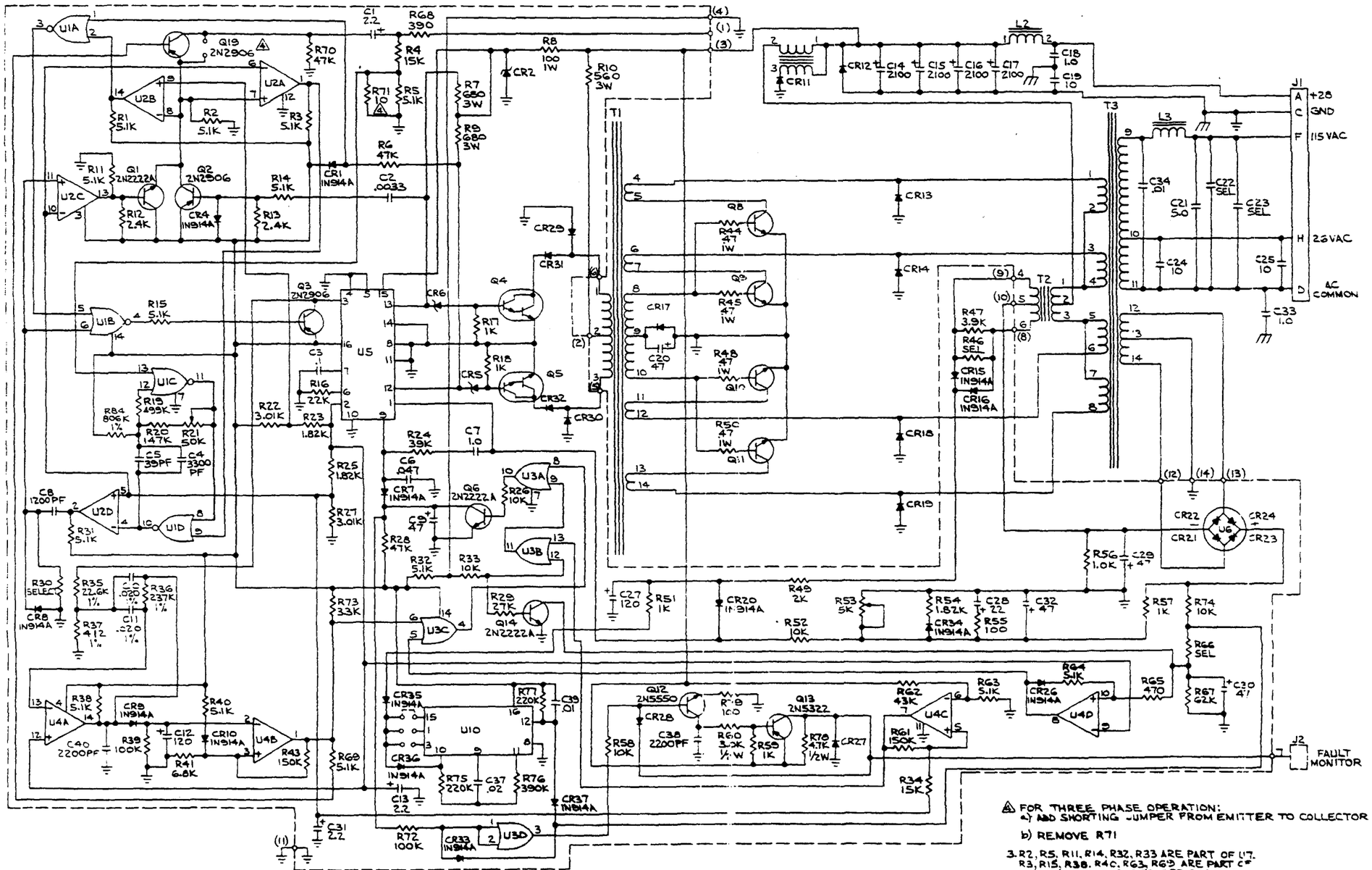


Schematic Diagram
Figure 201A (Sheet 2 of 4)

④ FOR THREE PHASE OPERATION:
a) ADD SHORTING JUMPER FROM EMITTER TO COLLECTOR OF Q19
b) REMOVE R71

3. R2, R5, R11, R14, R32, R33 ARE PART OF U7.
R3, R15, R38, R40, RG3, RG9 ARE PART OF U8, R17, R18, R45, R56, R57, R58 ARE PART OF U9.
2. ALL CAPACITORS IN MICROFARADS
1. ALL RESISTORS IN OHMS, ¼W 5%
NOTES: UNLESS OTHERWISE SPECIFIED

MODEL PC-250-1A, MOD LEVEL A
Effective Original Production



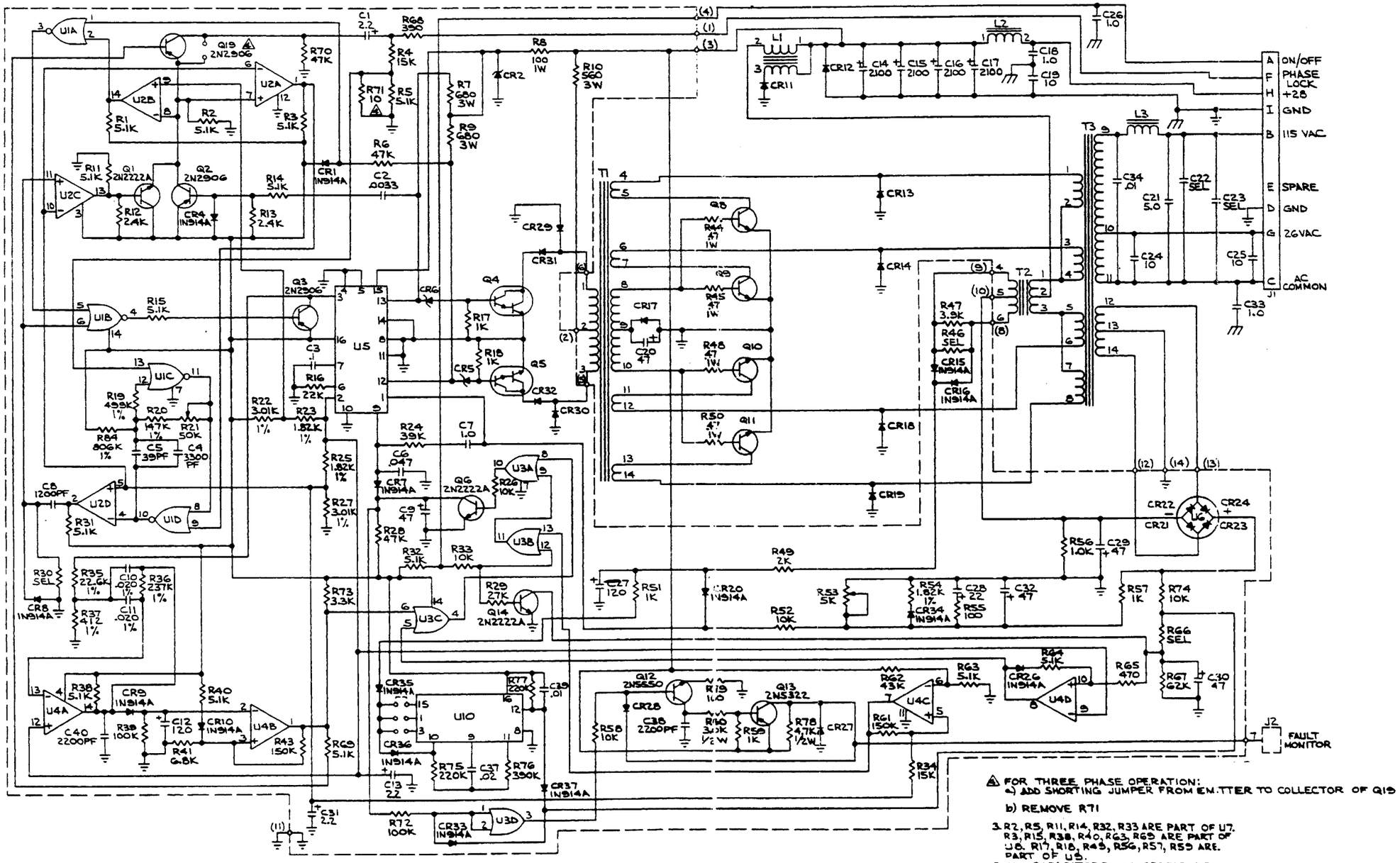
Schematic Diagram
Figure 201A (Sheet 3 of 4)

⚠ FOR THREE PHASE OPERATION:
a) ADD SHORTING JUMPER FROM EMITTER TO COLLECTOR OF Q19
b) REMOVE R71

3. R2, R5, R11, R14, R32, R33 ARE PART OF U7. R3, R15, R38, R40, RG3, RG9 ARE PART OF U6. R17, R18, R49, R56, R57, R59 ARE PART OF U8.
2. ALL CAPACITORS IN MICROFARADS
1. ALL RESISTORS IN OHMS 1/4W 5%
NOTES: UNLESS OTHERWISE SPECIFIED

MODEL PC-250-1B, MOD LEVEL A

Effective S/N 103 and Subsequent



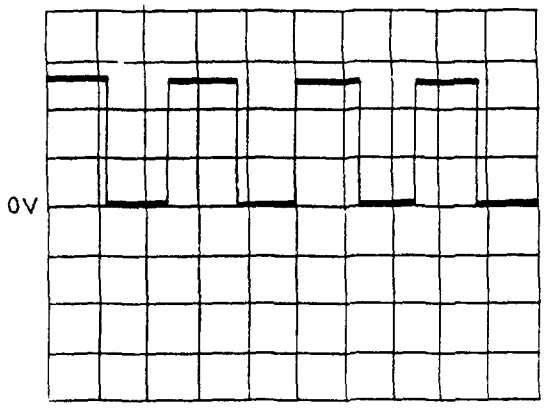
⚠ FOR THREE PHASE OPERATION:
a) ADD SHORTING JUMPER FROM EMITTER TO COLLECTOR OF Q19
b) REMOVE R71

3. R2, R5, R11, R14, R32, R33 ARE PART OF U7. R3, R15, R38, R40, R63, R69 ARE PART OF U6. R17, R18, R43, R56, R57, R59 ARE PART OF U8.
2. ALL CAPACITORS IN MICROFARADS
1. ALL RESISTORS IN OHMS 1/4W 5%
NOTES: UNLESS OTHERWISE SPECIFIED

Schematic Diagram
Figure 201A (Sheet 4 of 4)

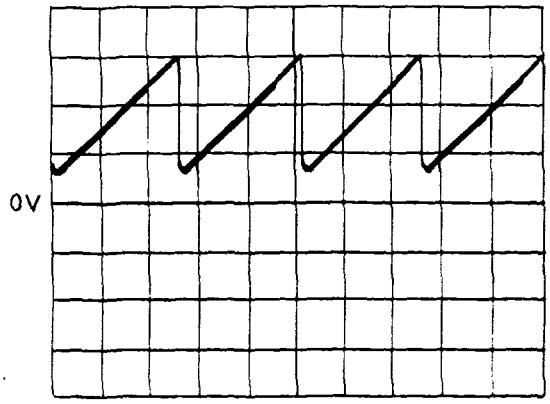
MODEL PC-250-1C, MOD LEVEL A

Effective S/N 123 and Subsequent



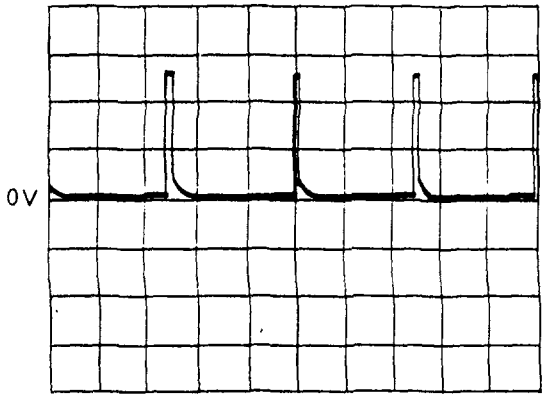
(1) Precision Astable Multibibrator

HOR: .5 ms/div
VERT: 2V/div
UID Pin 10



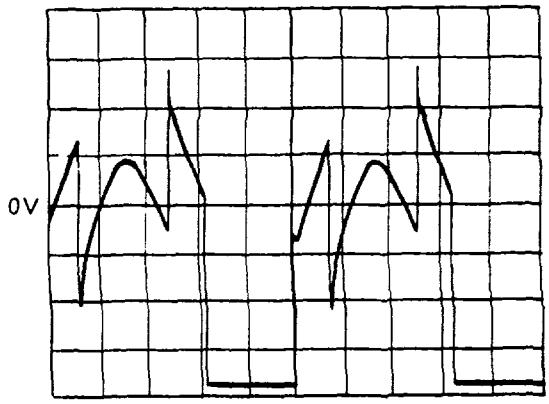
(3) Ramp Voltage

HOR: .5 ms/div
VERT: 1V/div
I.C. U5 Pin 7



(2) Clock Signal to I.C. U5 Pin 3

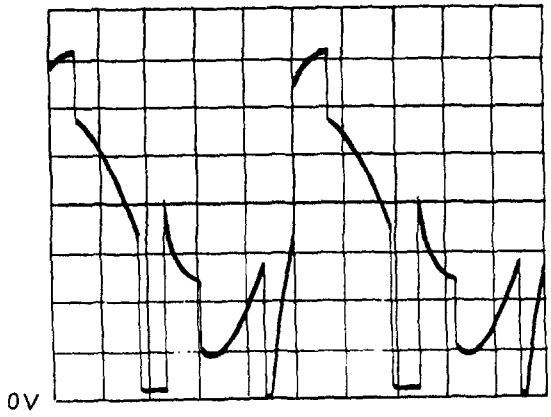
HOR: .5 ms/div
VERT: 2V/div
Q1 Collector



(4) Q8,Q9,Q10,Q11 Collector

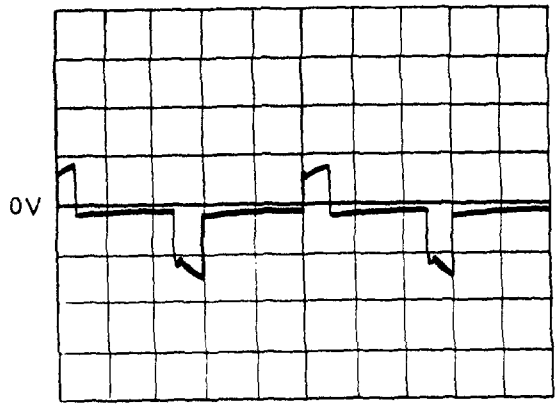
HOR: .5 ms/div
VERT: 10V/cm
100% Load - 28VDC Input
Properly tuned output

Typical Waveforms
Figure 202 (Sheet 1 of 4)



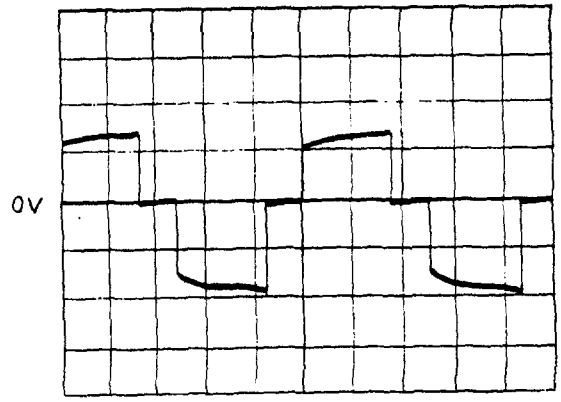
(5) Q8,Q9,Q10,Q11 Collector

HOR: .5 ms/div
VERT: 10V/div
No Load - 28 VDC Input



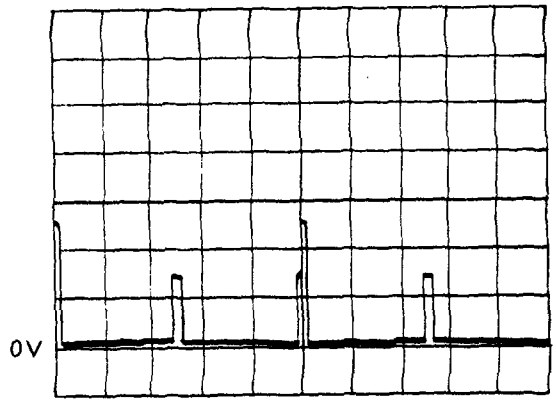
(7) Q8,Q9,Q10,Q11 Base

HOR: .5 ms/div
VERT: 2V/div
No Load - 28 VDC Input



(6) Q8,Q9,Q10,Q11 Base

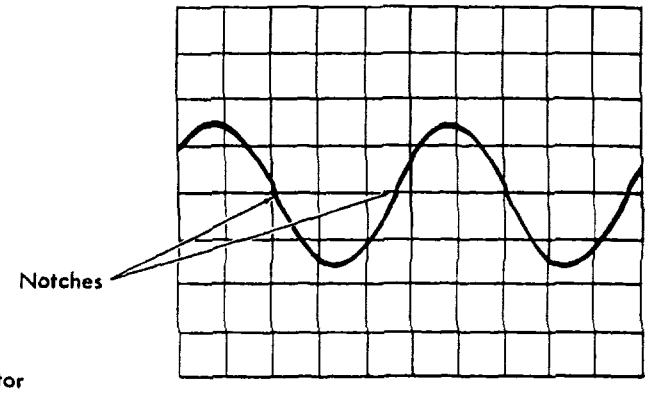
HOR: .5 ms/div
VERT: 2V/div
100% Load - 28 VDC Input



(8) J1 Pin F Lock Pulse

HOR: .5 ms/div
VERT: 2V/div
28 VDC Input

Typical Waveforms
Figure 202 (Sheet 2 of 4)

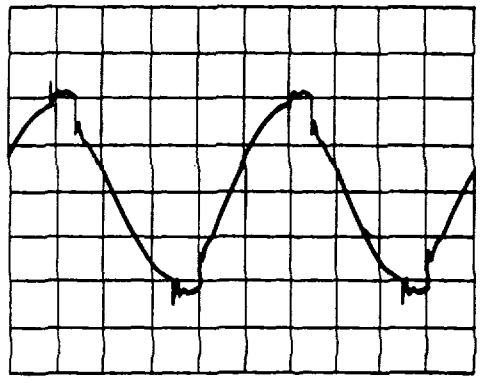


Proper tuning.

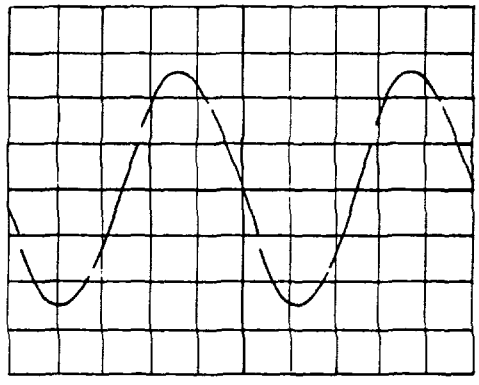
(9) Current Waveform thru Tuning Capacitor

HOR: .5 ms/div

NOTE: Install current probe on one of the tuning capacitors or on the decade box lead.

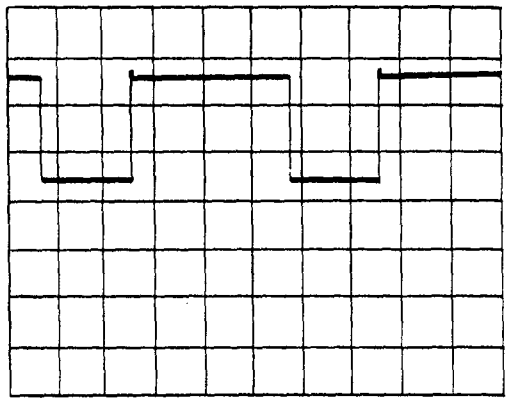


Tuning capacitor too high.



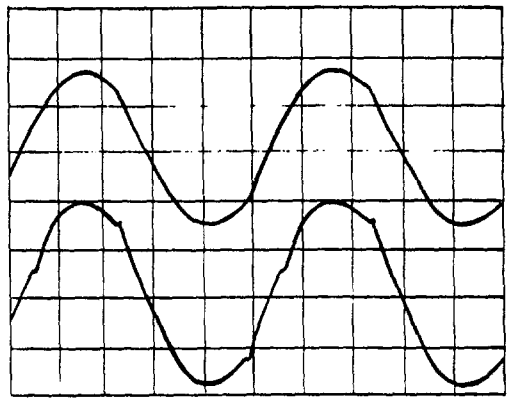
Tuning capacitor too low.

Typical Waveforms
Figure 202 (Sheet 3 of 4)



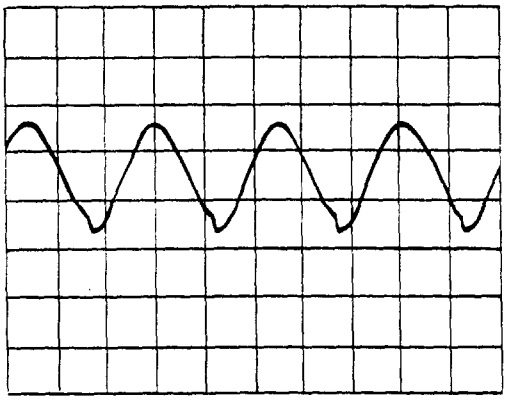
(10) U5 pin 13

HOR: .5 ms/div
VERT: 2V/div
100% Load - 28 VDC Input



(12) Typical Output Waveform
TOP: 115 volts J1 Pin B
BOTTOM: 26 volts J1 Pin G

HOR: .5 ms/cm
VERT: TOP 100V/div
BOTTOM 20V/div
100% Load - 28 VDC Input



(11) U4A Pin 14
(Frequency Control)

HOR: .5 ms/div
VERT: 1V/div
Freq. 400 Hz
28 VDC Input



(13) Q8, Q9, Q10, Q11
Collector Current

HOR: .5 ms/div
VERT: 2 amps/div
100% Load - 28 VDC Input

Typical Waveforms
Figure 202 (Sheet 4 of 4)

DISASSEMBLY

1. General Disassembly Instructions

This section contains complete disassembly instructions for the static inverter. However, disassembly should be initially limited to removal of the dust cover (3, Illustrated Parts List, Fig. 1) and the transistor covers (6). Removal of these parts allows visual inspection of all assemblies and parts of the static inverter. Further disassembly should be limited to removal of only those items required for repair or replacement of worn or defective parts of the unit. Disassembly instructions for removal of assemblies or parts not involved should be disregarded.

2. Specific Disassembly Instructions

Disassemble the static inverter in the sequence of item numbers assigned to IPL Figure 1, observing the following:

A. Do not remove nameplate (2) or warning label (23) from dust cover (3) unless required for replacement.

B. Remove screws (4) and lock washers (5), and separate dust cover (3) from static inverter.

C. Remove screws (7) and lock washers (8), and separate transistor cover (6) from left heat sink assembly (10).

D. Remove screws (11), and nuts (13) and separate left heat sink assembly from base plate assembly (22). Tag and unsolder wire leads from left heat sink assembly (10).

NOTE: Refer to REPAIR for disassembly of left heat sink assembly.

E. Remove screws (7) and lock washers (8), and separate transistor cover (6) from right heat sink assembly (9).

F. Remove screws (11), and nuts (13) and separate right heat sink assembly from base plate assembly (22). Tag and unsolder wire leads from right heat sink assembly (9).

NOTE: Refer to REPAIR for disassembly of right heat sink assembly.

G. Tag and unsolder wire leads from circuit board assembly (14). Remove screws (15), lock washers (16), and flat washers (17) and separate circuit board assembly from front plate assembly (18) and base plate assembly (22).

NOTE: Refer to REPAIR for disassembly of circuit board assembly.

H. Remove screws (19) and separate front plate assembly from base plate assembly (22). Tag and unsolder wire leads from front plate assembly (18).

NOTE: Refer to REPAIR for disassembly of front plate assembly.

I. Remove screws (21) and separate rear plate assembly from base plate assembly (22). Tag and unsolder wire leads from rear plate assembly (20).

NOTE: Refer to REPAIR for disassembly of rear plate assembly.

CLEANING

1. General Cleaning Instructions

Care must be taken during all cleaning operations to avoid damaging parts and electrical wiring. Avoid entrapment of cleaning fluids and, after cleaning, dry all parts in warm air at 38° to 52°C (100° to 125°F). When cleaning diffcult areas, use a soft bristle brush.

2. Specific Cleaning Instructions

A. Clean base plate, end plates, heat sinks, and dust cover as follows:

(1) Clean all surfaces with isopropyl alcohol or a mild detergent (Ref. Table 401) using a soft bristle brush in slots and corners.

(2) Dry parts in warm, clean air.

B. Clean printed circuit board as follows:

(1) Wash printed circuit board with soap and distilled water in areas where a large portion of fungus-proof material has been removed.

(2) Clean components using freon TF (Ref. Table 401) applied with a soft bristle brush. Ensure that all contaminants are removed from electrical wiring.

(3) Dry parts in warm, clean air.

C. Clean electrical connector as follows:

(1) Remove surplus solder from wells of pin inserts in connector using a 25 watt soldering iron and a solder removing tool.

(2) Clean all parts of connector with freon TF (Ref. Table 401) ensuring that all contamination such as flux residue and old solder is removed from contact pin inserts.

(3) Dry connector in warm, clean air.

TABLE 401
CONSUMABLE MATERIALS FOR CLEANING

DESCRIPTION	DESIGNATION	SOURCE
Detergent	Dreft	Proctor and Gamble Co., 5201 Spring Grove Cincinnati, Ohio 45217 Proctor and Gamble Co., of Canada Ltd. Toronto, Ontario
Freon TF (MS180)	MIL-C-81302	Dupont E.I. de Nemours and Co., Inc. Freon Products Division 10th and Orange Sts. Wilmington, Del. 19898 Miller-Stephenson Chemical Co., Inc. P.O. Box 628 16 Sugar Hollow Rd. Danbury, Conn. 06810
Isopropyl Alcohol 99% grade	TT-I-735	Local Purchase

CHECK

1. General

Ensure that all contaminants are removed to provide clean surfaces for adequate inspection and, immediately following cleaning, carry out a thorough visual inspection of all components. Special attention must be given to all signs of corrosion. Reject all parts which fail to meet check requirements except where local repair is permitted (Ref. REPAIR).

2. Plates, Covers, and Heat Sink

Visually check all surfaces for corrosion, cracks, scratches, nicks, scores, gouges, dents and damage caused by impact. Check irridated surfaces for damaged or worn areas exposing bare metal. Check tapped holes for condition of threads. If cracks are suspected after careful visual check, perform fluorescent penetrant check of suspected parts in accordance with latest revision and amendments to Military Specification MIL-I-6866. Cracks are not permitted. Check electrical connector on front plate for damaged threads, cracked or distorted shell and bent or burned pins. Damage beyond the scope of instructions given in REPAIR is cause for rejection of parts.

3. Electrical Wiring

A. Check all interconnecting wires for cuts, breaks, proper lacing, or damaged insulation. Replace wires as required (Ref. REPAIR).

B. Check for security and condition of soldered connections. These shall be bright with no flux, and free of broken or loose strands and corrosion.

C. Check ends of wires, previously unsoldered to remove assemblies or parts, for length and for frayed or missing insulation. These wires shall be replaced if necessary, and cut, stripped, and tinned as described in REPAIR.

4. Electronic Components

Check electronic components for obvious damage, loose or broken terminals or leads, evidence of overheating and for security of mounting. Check circuit board for copper track damage, proper soldering, proper conformal coating, and corroded terminals.

REPAIR

1. General Repair Instructions

A. Repair of the static inverter is normally limited to repair of minor damage to structural parts and to repair and replacement of interconnecting wires and replacement of electronic components.

B. Smooth out nicks, scratches and similar damage sufficiently to remove all sharp edges and raised metal using abrasive cloth (Ref. Table 601), and/or a fine stone. After blending, protect repaired areas by treating with chemical film in accordance with Military Specification MIL-C-5541 (Ref. Table 601).

TABLE 601
CONSUMABLE MATERIALS FOR REPAIR

DESCRIPTION	PART/MODEL NO.	SOURCE
Cloth, Abrasive, No. 400 grit	P-C-451	Local Purchase
Chemical Film	MIL-C-5541	Local Purchase
Flux, Rosin	No. 1545	Kester Solder Co. Chicago, Il 60607
Solder, Tin/Lead	No. 44	Kester Solder Co. Chicago, Il 60607
Isopropyl Alcohol, 99% grade	TT-I-735	Local Purchase
Staking Compound	Loctite Grade H	Loctite Corp. Newington, CT 06111
Silicone Adhesive Clear*	GF2562-01DP	Local Purchase
Silicone Adhesive Gray**	DC-3145	Dow Corning Corp. Midland, MI 48640
Tie Wrap	MS18034	Local Purchase
Sleeving, Nylon, 20 ga	Commercial	Local Purchase
Buss Wire, 20 ga	Commercial	Local Purchase

NOTE: Equivalent substitutes may be used for above items.
* Do not use in circuit areas.
** Use in circuit areas.

C. Clean up surface corrosion by careful polishing with abrasive cloth (Ref. Table 601), removing as little base material as possible. Protect cleaned up areas against further corrosion by treating with Chemical Film in accordance with Military Specification MIL-C-5541.

D. Clean up minor damage to threads by blending out burrs and nicks with a fine stone or file. If necessary, chase threads with appropriate tap or die.

2. Specific Repair Instructions

A. Repair wires, previously unsoldered to allow removal of assemblies or parts as follows:

(1) Remove all existing solder from ends of all wires. If wire requires trimming, remove as little as possible to maintain sufficient length for connection. Replace if necessary.

(2) On all unattached ends of insulated wire, trim insulation back and on 20 gauge bus wire, install nylon sleeving (Ref. Table 601) to expose 0.19 inch of bare wire. Clean exposed ends with isopropyl alcohol (Ref. Table 601) and tin bare wire using 25 watt soldering iron with resin flux and solder (Ref. Table 601). Repeat CLEANING to remove all residue flux.

(3) Solder wires to terminals as tagged at removal with 25-watt soldering iron and solder (Ref. Table 601).

NOTE: Refer to Figure 601, Wiring Diagram.

B. Repair right heat sink assembly as follows (See IPL Figure 2):

(1) Tag and unsolder wire leads and component leads as required.

(2) Remove unserviceable parts and install new parts.

(3) Install new insulators (9 and 10) when installing new transistors (7).

(4) When installing new rectifier (6), use attaching parts supplied with rectifier.

(5) Solder wire leads and component leads to terminals as tagged at removal in accordance with paragraph 2.A.

C. Repair left heat sink assembly as follows (See IPL Figure 3):

(1) Tag and unsolder wire leads and component leads as required.

(2) Remove unserviceable parts and install new parts.

(3) Install new insulators (11 and 12) when installing new transistors (9).

(4) Solder wire leads and component leads to terminals as tagged at removal in accordance with paragraph 2.A.

D. Repair circuit board assembly as follows (See IPL Figure 4):

CAUTION: WHEN REPLACING TRANSISTORS, CARE MUST BE TAKEN TO CONDUCT EXCESSIVE HEAT AWAY FROM SEALS, OTHERWISE HEAT OF SOLDERING IRON MAY CRACK SEALS AND DAMAGE TRANSISTORS.

(1) Heat soldered joints and remove unserviceable part by pulling free with needle nose pliers.

(2) Remove all existing solder from vacated holes in circuit board using a solder removing tool.

(3) Clean area with isopropyl alcohol (Ref. Table 601) applied with a soft brush.

(4) Position new part at same location as removed item and insert contact wires into holes in circuit board.

CAUTION: WHEN INSTALLING DIODES, CARE MUST BE TAKEN TO OBSERVE POLARITY. BLACK BANDS IDENTIFY CATHODE ENDS OF DIODES.

(5) Secure parts to circuit board using a 25 watt soldering iron with rosin flux and solder (Ref. Table 601).

(6) Clean area of soldered points with isopropyl alcohol (Ref. Table 601) and a soft brush to remove all traces of residue flux.

E. Repair front plate assembly as follows (See IPL Figure 5):

(1) Tag and unsolder wire leads and component leads as required.

(2) Remove unserviceable parts and install new parts.

(3) When installing new tie-mounts (7), apply staking compound (Ref. Table 601) to threads of screws (8).

(4) Install capacitors (5 and 6) in tie mounts (7) with tie wraps (Ref. Table 601).

(5) Secure capacitors (5 and 6) to front plate with Silicone adhesive (Ref. Table 601).

(6) Solder wire leads and component leads to terminals as tagged at removal in accordance with paragraph 2.A.

F. Repair rear plate assembly as follows (See IPL Figure 6):

(1) Tag and unsolder wire leads and component leads as required.

(2) Remove unserviceable parts and install new parts.

(3) When installing new tie mounts (8), apply staking compound (Ref. Table 601) to threads of screws (9).

(4) Install capacitors (2, 3, 4, 5, and 6) and choke (7) in tie mounts (8) with tie wraps (Ref. Table 601).

(5) Secure capacitors (2, 3, 4, 5, and 6) and choke (7) to rear end plate with Silicone adhesive (Ref. Table 601).

(6) Solder wire leads and component leads to terminals as tagged at removal in accordance with paragraph 2.A.

G. Repair base plate assembly as follows (See IPL Figure 7):

(1) Tag and unsolder wire leads and component leads as required.

(2) Remove unserviceable parts and install new parts.

(3) When installing mounting posts (14), apply staking compound (Ref. Table 601) to threads of screws (15).

(4) When installing standoff terminals (16), apply staking compound (Ref. Table 601) to threads of screws (17).

(5) Solder wire leads and component leads to terminals as tagged at removal in accordance with paragraph 2.A.

H. Repair bracket assembly as follows (See IPL Figure 8):

(1) Tag and unsolder wire leads and component leads as required.

(2) Remove unserviceable parts and install new parts.

(3) When installing standoff terminals (5) into standoff terminals (4), apply staking compound (Ref. Table 601) to threaded portion of standoff terminals (5).

(4) Install capacitors (2) on mounting bracket (7) with tie wraps (3) and with positive end of all capacitors together.

(5) Secure capacitors (2) to bracket with Silicone adhesive.

(6) Solder wire leads and component leads to terminals as tagged at removal in accordance with paragraph 2.A.

ASSEMBLY

1. General Assembly Instructions

Assembly of the static inverter is essentially the reverse of disassembly. All soldered connections made during assembly must be accomplished with a 25-watt soldering iron using rosin flux and solder (Ref. Table 701) and must be bright and free of flux.

TABLE 701
CONSUMABLE MATERIALS FOR ASSEMBLY

DESCRIPTION	DESIGNATION	SOURCE
Flux, Rosin	No. 1545	Kester Solder Co. Chicago, IL 60607
Solder, Tin/Lead	No. 44	Kester Solder Co. Chicago, IL 60607
Staking Compound	Loctite Grade H	Loctite Corp. Newington, CT 06111
Barrier Material	MIL-B-121	Local Purchase
Plastic Bag	PPP-B-260	Local Purchase

NOTE: Equivalent substitutes may be used for above items.

2. Specific Assembly Instructions

Assemble the static inverter in the reverse sequence of item numbers assigned to IPL Figure 1, observing the following:

A. Apply staking compound (Ref. Table 701) to threads of screws (21). Install rear plate assembly (20) to base plate assembly (22) with screws (21).

B. Apply staking compound (Ref. Table 701) to threads of screws (19). Install front plate assembly (18) to base plate assembly (22) with screws (19).

C. Solder wire leads as tagged during DISASSEMBLY between front plate assembly (18), back plate assembly (20), and base plate assembly (22).

NOTE: Refer to Figure 701, Wiring Diagram.

D. Install right heat sink assembly (9) on base plate assembly (22) with screws (11), and nuts (13). Apply staking compound to screws (11).

E. Install left heat sink assembly (10) on base plate (22) with screws (11), and nuts (13). Apply staking compound to screws (11).

F. Holding circuit board assembly (14) in place above inverter, solder all remaining wire leads as tagged during DISASSEMBLY.

NOTE: Refer to Figure 701, Wiring Diagram.

G. Install circuit board assembly (14) on front plate assembly (18) and base plate assembly (22) with screws (15), lock washers (16), and flat washers (17).

H. After successful completion of paragraph 3, Calibration, and TESTING, install dust cover (3), with screws (4), and lock washers (5), and transistor covers (6) with screws (7) and lock washers (8).

I. If removed, install nameplate (2) and warning label (23) on dust cover (3).

3. Calibration

If major components of the static inverter have been replaced with new components, it may be necessary to install resistors R46 and R53 on the printed circuit board and capacitors C22 and C23 on the rear plate assembly that have been selected for value by test in order to insure correct operation of the static inverter. Proceed as follows:

A. Install the static inverter in test setup shown in Figure 201, using test equipment listed in Table 201.

B. Frequency Calibration

(1) Set the frequency counter gate time at 1 second. Adjust variable resistor R21 to obtain a reading of 400 $\pm$2 Hz.

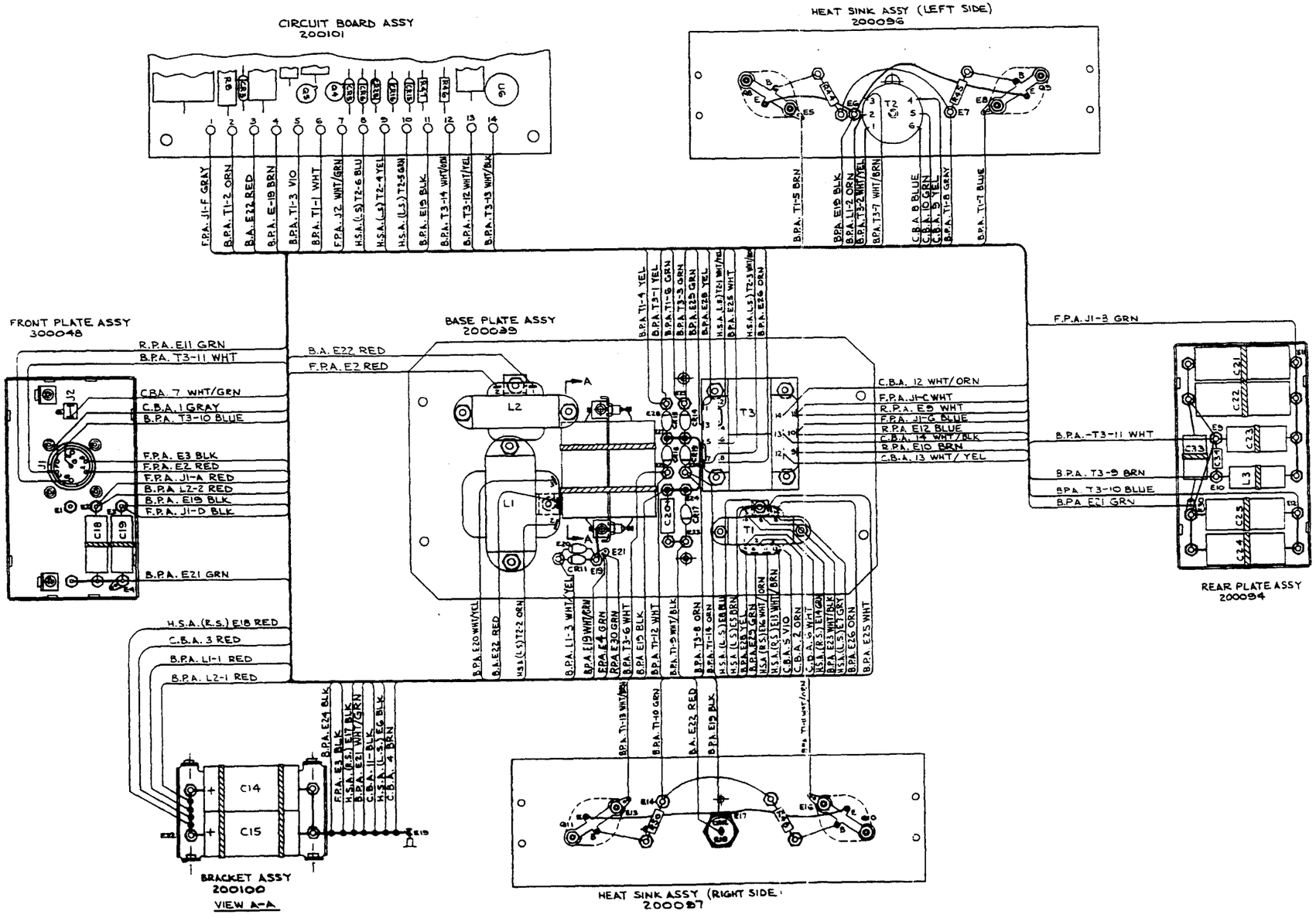
(2) Set the frequency counter gate time at 10 seconds. Adjust variable resistor R21 to obtain a reading of 400 $\pm$1 Hz.

C. Output Transformer Tuning

(1) Disconnect all output loads from inverter.

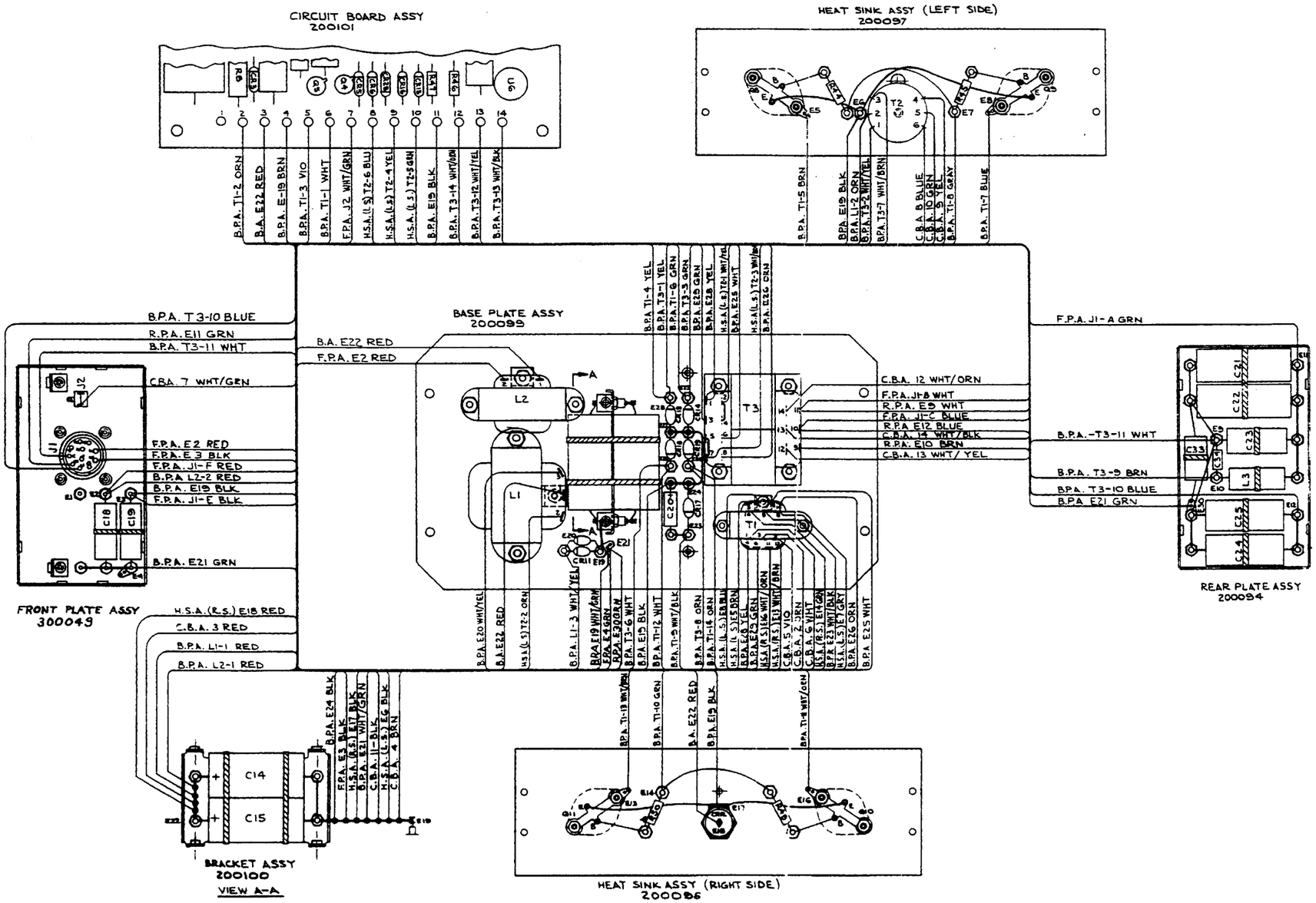
(2) Connect the capacitor decade box across the 115 volts output.

(3) Connect the current probe to the tuning capacitor lead.



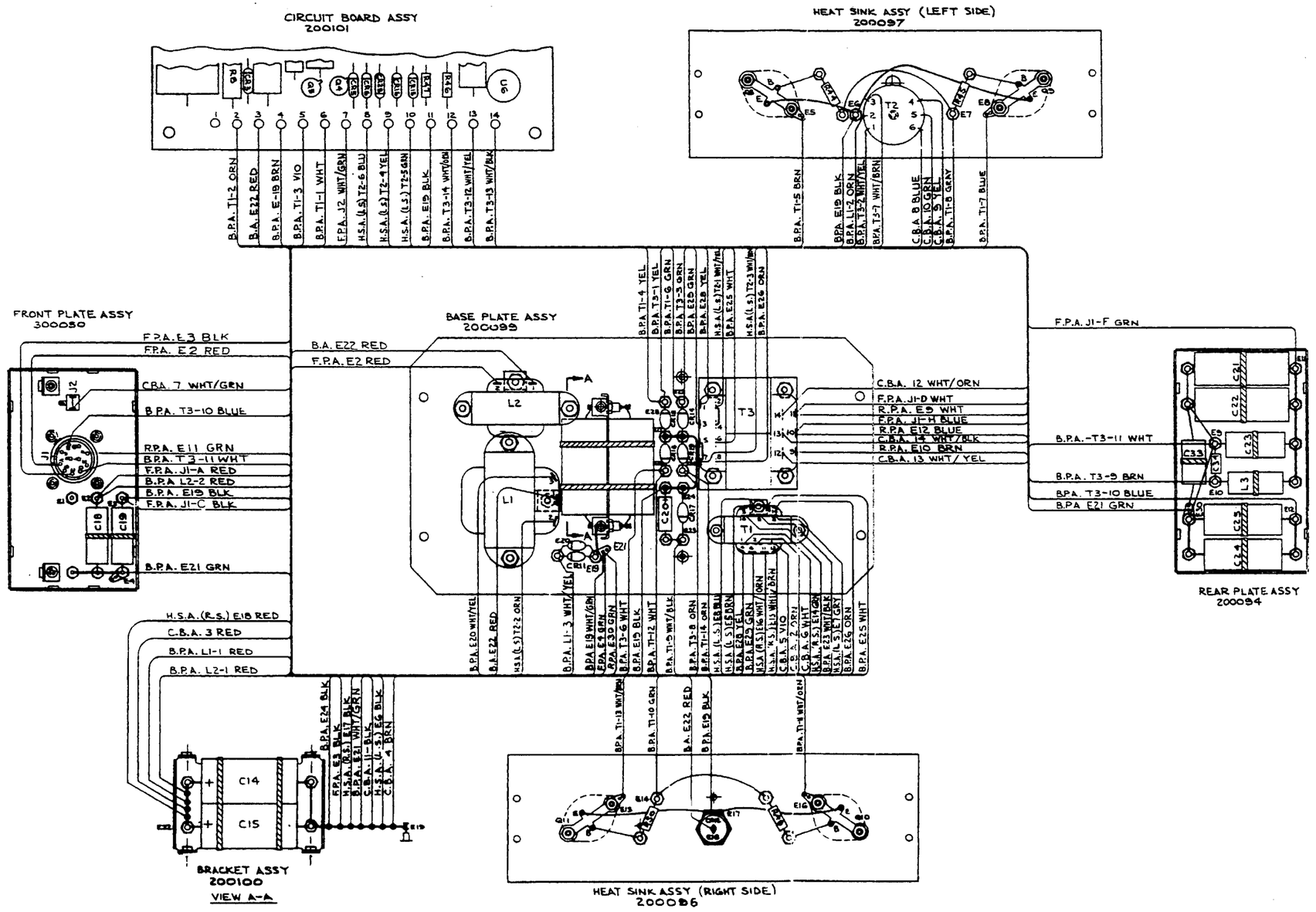
Wiring Diagram
Figure 701 (Sheet 1 of 4)

MODEL PC-250



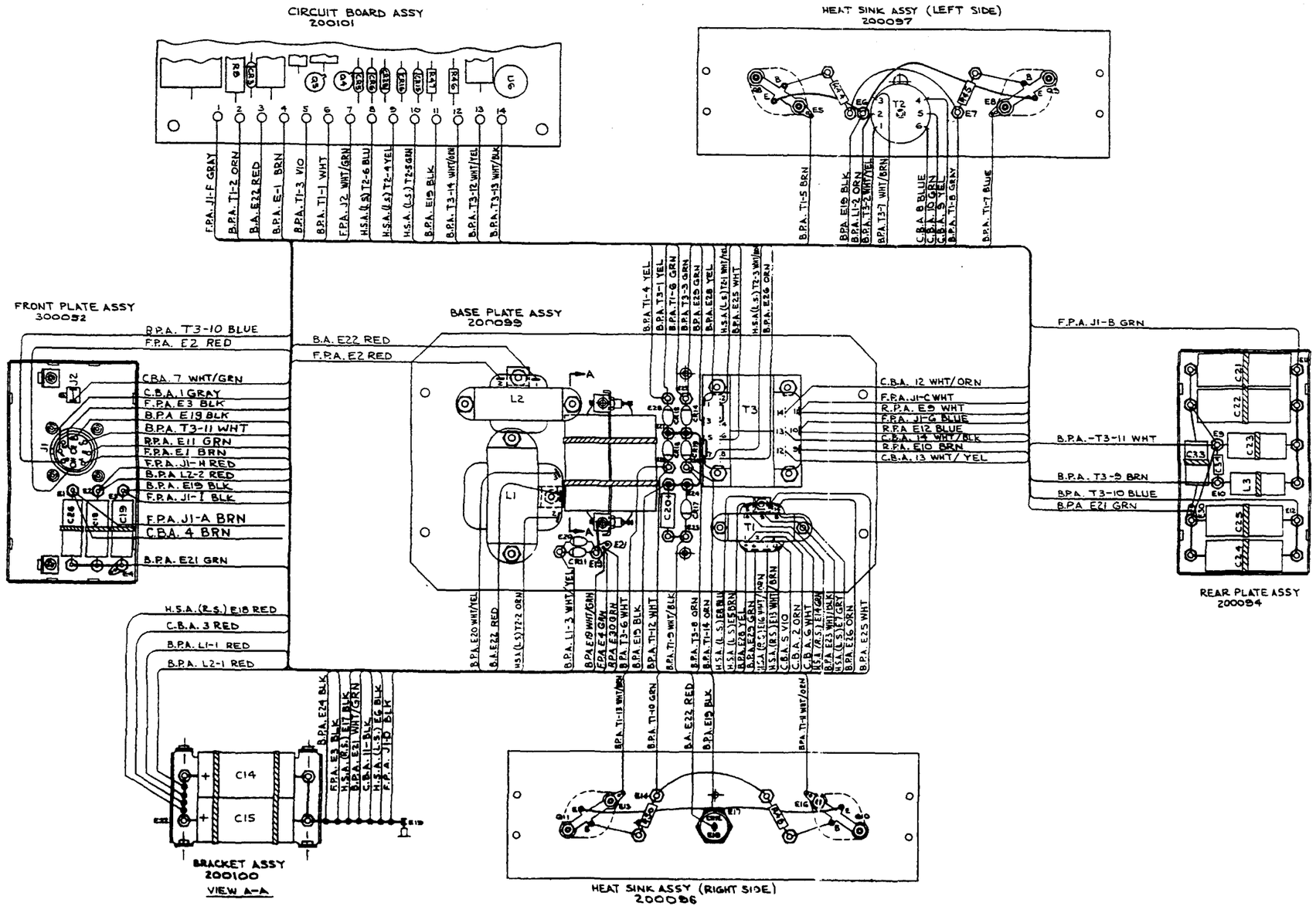
Wiring Diagram
Figure 701 (Sheet 2 of 4)

MODEL PC-250-1A



Wiring Diagram
Figure 701 (Sheet 3 of 4)

MODEL PC-250-1B



Wiring Diagram
Figure 701 (Sheet 4 of 4)

MODEL PC-250-1C

(4) Set switch S3 to 115V position and switch S2 to NO LOAD position.

(5) Adjust capacitor decade box to obtain a sinewave with notches at the zero crossover points. Read capacitance value on decade box.

(6) Install at positions C22 and C23 on rear plate assembly, one or two capacitors totaling the value or the closest higher value of that read on the decade box in step (5).

D. Output Voltage and Overvoltage Adjustment

(1) Install shorting jumper across resistor R46 position.

(2) Set switch S2 to NO LOAD.

(3) Set potentiometer R53 to highest resistance value (full CCW).

(4) Slowly decrease the resistance of R53 to obtain 130 volts RMS at the output.

(5) Select R66 such that the inverter just goes to overvoltage mode. Install R66.

(6) Reset potentiometer R53 to highest value.

(7) Restart inverter by setting switch S1 to "OFF", then to "ON".

(8) Verify overvoltage tripping point to be from 125 to 138 VRMS.

(9) Set potentiometer R53 to obtain 115 ±0.5 volts at the output. Note the resistance value indicated on the decade box.

(10) Remove shorting jumper across R46.

E.0 Current Limiting Adjustment (PC-250 Series)

(1) Connect resistor decade box across R46 position.

(2) Set switch S2 to 150% load position.

(3) Select resistor value on the decade box to obtain an output voltage 1 volt lower than that obtained at step 3.D.(10).

(4) Set switch S2 to SHORT position.

(5) Select resistor value on the decade box to obtain an AC output current between 3.25 and 3.75 amperes RMS.

(6) Remove to the decade box connections and install selected resistor closest to the indication on the decade box.

CAUTION: THE SHORT CIRCUIT TEST SHOULD BE PERFORMED IN LESS THAN 20 SECONDS. THE SHORT CIRCUIT MUST NOT BE LEFT ON FOR MORE THAN 1 MINUTE.

(7) Verify the AC short circuit current to be between 3.25 and 3.75 amperes RMS.

(8) Set switch S2 to 150% load position.

(9) Verify that the output voltage is not more than 2 volts lower than that noted at step 3.D.(10).

E.1 Current Limiting Adjustment (PC-250 Series, Mod Level A)

(1) Set switch S2 to 15% load position.

(2) Adjust potentiometer R46 to obtain an output voltage 1 volt lower than that obtained at step 3.D.(9).

(3) Set switch S2 to SHORT position.

(4) Adjust potentiometer R46 to obtain an AC output current of 3.75 to 4.0 amperes RMS.

(5) Verify that the output voltage is not more than 2 volts lower than that noted at step 3.D.(9).

(6) Verify that after a short-circuit duration of 5 to 7 seconds the AC current output folds back to not more than 2.0 amperes.

F. Inductive Load Check

(1) Set switch S2 to PF .8 (power factor 0.8) position.

(2) Verify that the output voltage is between 112.0 and 117 volts.

(3) Verify that the distortion is less than 9% with a DC input voltage of 24 to 32 VDC.

4. Preparation for Storage or Shipment

A. Place static inverter in a plastic bag (Ref. Table 701) and staple bag closed.

B. Wrap static inverter in barrier material (Ref. Table 701) and place in a suitable corrugated cardboard carton.

Store inverter indoors under normal environmental conditions.

SPECIAL TOOLS, FIXTURES, AND EQUIPMENT

1. Special Tools

No special tools are required.

2. Fixtures

No fixtures are required.

3. Equipment

Refer to Table 901 for equipment required.

TABLE 901
EQUIPMENT

DESCRIPTION	PART/MODEL NO.	SOURCE
Power Supply, 0-37 volts, 15 amperes, adjustable current limiting	Commercial	Local Purchase
Oscilloscope	5440	Tektronix
Amplifier	5A48	Tektronix
Time-base Plug-ins	5B40	Tektronix
Current Probe Amplifier	Type 134	Tektronix
Current Probe	P6021	Tektronix
AC, DC Voltmeter	8040A	Fluke
Current Shunt	80J-10	Fluke
Frequency Counter	5381A	Hewlett-Packard
Distortion Analyzer	334A	Hewlett-Packard
Function Generator	3310A	Hewlett-Packard
DC Ammeter	931-2902001	Weston
AC Ammeter	433-2906005	Weston

TABLE 901
EQUIPMENT (con't)

DESCRIPTION	PART/MODEL NO.	SOURCE
Capacitance Decade Box (Suitable for 115 VAC 400 Hz operation)		
0.01 to 1.1 uf	CDB3	Cornell Dubilier
1 to 10 uf	CDC3	Cornell Dubilier
Resistance Decade Box		
0 ohm to 1.11 megohms	MICRORAY MODEL 7	The Microray Co. 1059 Fernview Drive St Louis, MO 63141

NOTE: Equivalent substitutes may be used.

ILLUSTRATED PARTS LIST

1. The illustrated parts list contains a complete breakdown of replaceable parts for the 250 VA Static Inverters, listed in order of disassembly. Entries in the Nomenclature column are indented to assist in identification of the parts of each assembly or subassembly.

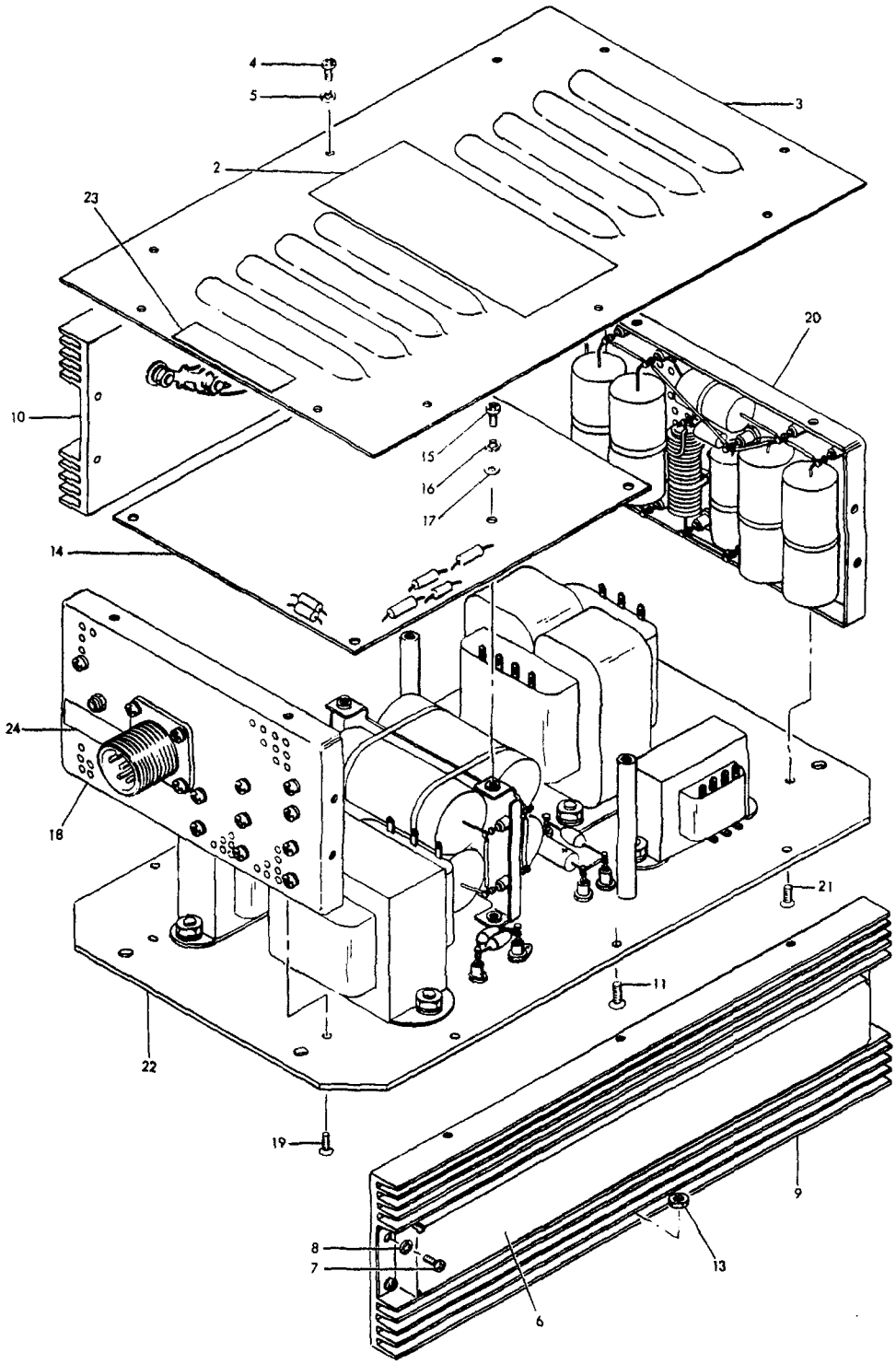
2. Item numbers assigned to each part in the parts list correspond to the item numbers identifying the parts in the respective exploded view illustrations, Figures 1 through 8. Item numbers for parts listed but not illustrated are preceded by a dash.

3. Parts supplied by vendors are identified by the five-digit manufacturers' code, preceded by the letter "V", and listed in parenthesis following the nomenclature of the part. Applicable vendor codes and vendors are listed below.

CODE	VENDOR	CODE	VENDOR
V06383	Panduit Corp. 17301 Ridgeland Tinley Park, IL 60477	V79963	Zierick Mfg. Corp. Radio Circle Mt. Kisco, NY 10549
V08289	The Delbert Blinn Co., Inc. 1678 E. Mission Blvd. P.O. Box 2007 Pomona, CA 91766	V88245	Litton Precision Products, Inc. USECO Div. Litton Industries 13536 Saticoy St. Van Nuys, CA 91409
V71468	ITT Cannon Electric 666 E. Dyer Rd Santa Ana, CA 92702	V95987	Weckesser Co., Inc. 4444 W. Irving Park Rd. Chicago, IL 60641

4. The letters in the EFFECT CODE column indicate usage of parts in specific PC-250 models. Absence of a code indicates the part is used in all models.

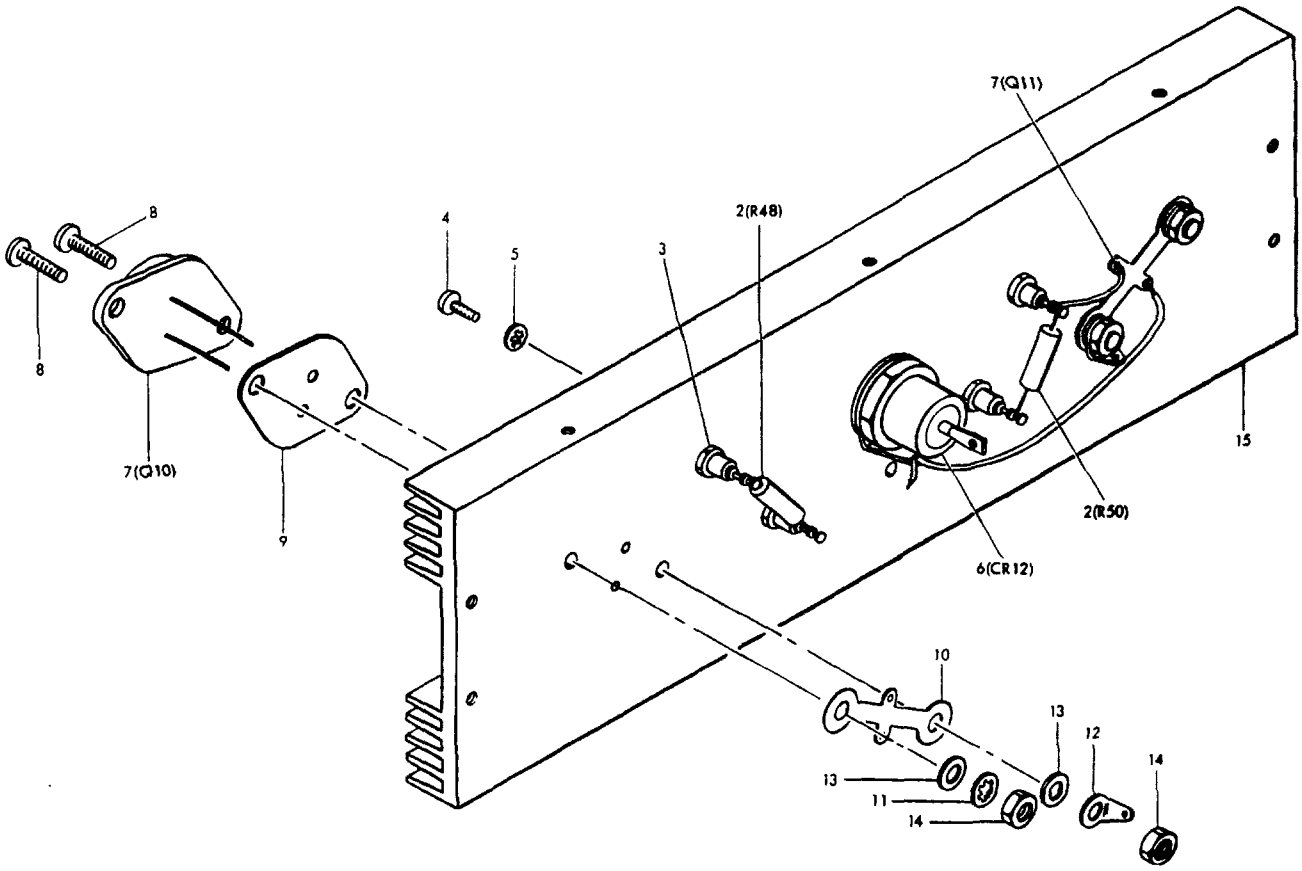
   A Denotes use on basic PC-250 (Effective through S/N 1115)
   B Denotes use on basic PC-250-1A, Mod Level A (Effective original production)
   C Denotes use on basic PC-250-1B (Effective through S/N 102)
   D Denotes use on basic PC-250-1C (Effective through S/N 122)
   E Denotes use on basic PC-250, Mod Level A (Effective S/N 1116 and subsequent)
   F Denotes use on basic PC-250-1B, Mod Level A (Effective S/N 103 and subsequent)
   G Denotes use on basic PC-250-1C, Mod Level A (Effective S/N 123 and subsequent)



Static Inverter, 250 VA
Figure 1

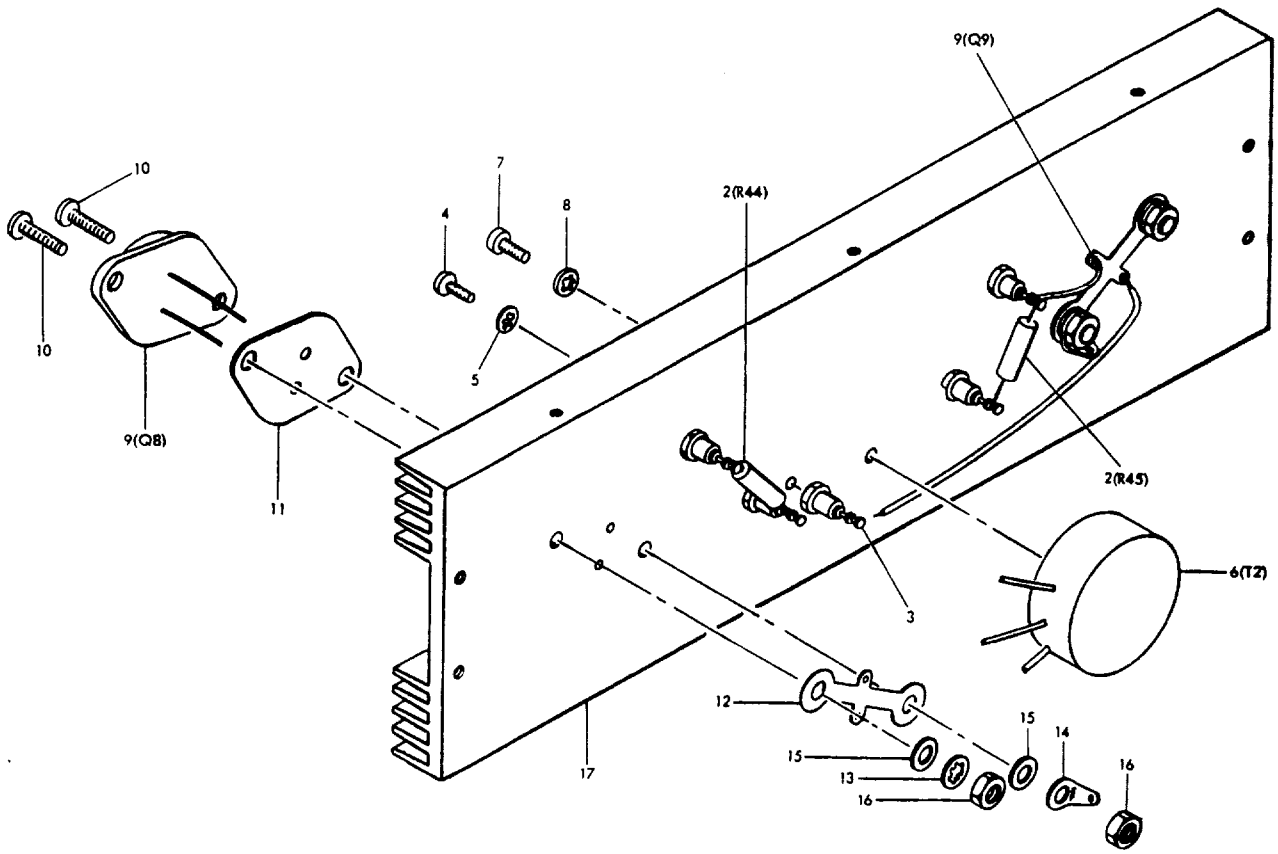
FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY
1- 1	200102	STATIC INVERTER, 250 VA (MODEL PC-250)	A	REF
- 1A	200107-1	STATIC INVERTER, 250 VA (MODEL PC-250 -1A, MOD LEVEL A)	B	REF
- 1B	200129	STATIC INVERTER, 250 VA (MODEL PC-250 -1B)	C	REF
- 1C	200131	STATIC INVERTER, 250 VA (MODEL PC-250 -1C)	D	REF
- 1D	200102-1	STATIC INVERTER, 250 VA (MODEL PC-250, MOD LEVEL A)	E	REF
- 1E	200129-1	STATIC INVERTER, 250 VA (MODEL PC-250 -1B, MOD LEVEL A)	F	REF
- 1F	200131-1	STATIC INVERTER, 250 VA (MODEL PC-250 -1C, MOD LEVEL A)	G	REF
2	400034	. NAMEPLATE	A,E	1
- 2A	400040	. NAMEPLATE	B	1
- 2B	400042	. NAMEPLATE	C,F	1
- 2C	400056	. NAMEPLATE	D,G	1
3	200095	. COVER, Dust		1
		(ATTACHING PARTS)		
4	MS35206-213	. SCREW, Machine, Pan head, No. 4-40 by 1/4 in. lg		10
5	MS35333-36	. WASHER, Lock, No. 4		10
		---*---		
6	91100	. COVER, Transistor		2
		(ATTACHING PARTS)		
7	MS35206-215	. SCREW, Machine, Pan head, No. 4-40 by 3/8 in. lg		8
8	MS35333-36	. WASHER, Lock, No. 4		8
		---*---		
9	200096	. HEATSINK ASSY, RIGHT (See Fig. 2 for details)		1
10	200097	. HEATSINK ASSY, LEFT (See Fig. 3 for details)		1
		(ATTACHING PARTS)		
11	MS24693S24	. SCREW, Machine, Flat head, No. 6-32 by 1/4 in. lg		6
13	NAS671-6	. NUT, Hex, No. 6		6
		---*---		
14	200101-1	. CIRCUIT BOARD ASSY (See Fig. 4 for details)	A,C,D	1
-14A	200101-2	. CIRCUIT BOARD ASSY (See Fig. 4A for details)	B,E,F,G	1
		(ATTACHING PARTS)		
15	MS35206-214	. SCREW, Machine, Pan head, No. 4-40 by 5/16 in. lg		6

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY
1 16	MS35333-36	. WASHER, Lock, No. 4		6
17	NAS620-4	. WASHER, Flat, No. 4		6
		---*---		
18	300048	. PLATE ASSY, Front (See Fig. 5 for details)	A,E	1
-18A	300049	. PLATE ASSY, Front (See Fig. 5 for details)	B	1
-18B	300050	. PLATE ASSY, Front (See Fig. 5 for details)	C,F	1
-18C	300052	. PLATE ASSY, Front (See Fig. 5 for details)	D,G	1
		(ATTACHING PARTS)		
19	MS24693S2	. SCREW, Machine, Flat head, No. 4-40 by 1/4 in. lg		2
		---*---		
20	200094	. PLATE ASSY, Rear (See Fig. 6 for details)		1
		(ATTACHING PARTS)		
21	MS24693S2	. SCREW, Machine, Flat head, No. 4-40 by 1/4 in. lg		2
		---*---		
22	200099	. PLATE ASSY, Base (See Fig. 7 for details)		1
23	400015	. LABEL, Warning		1
24	400038	. TAG, Jack identification		1



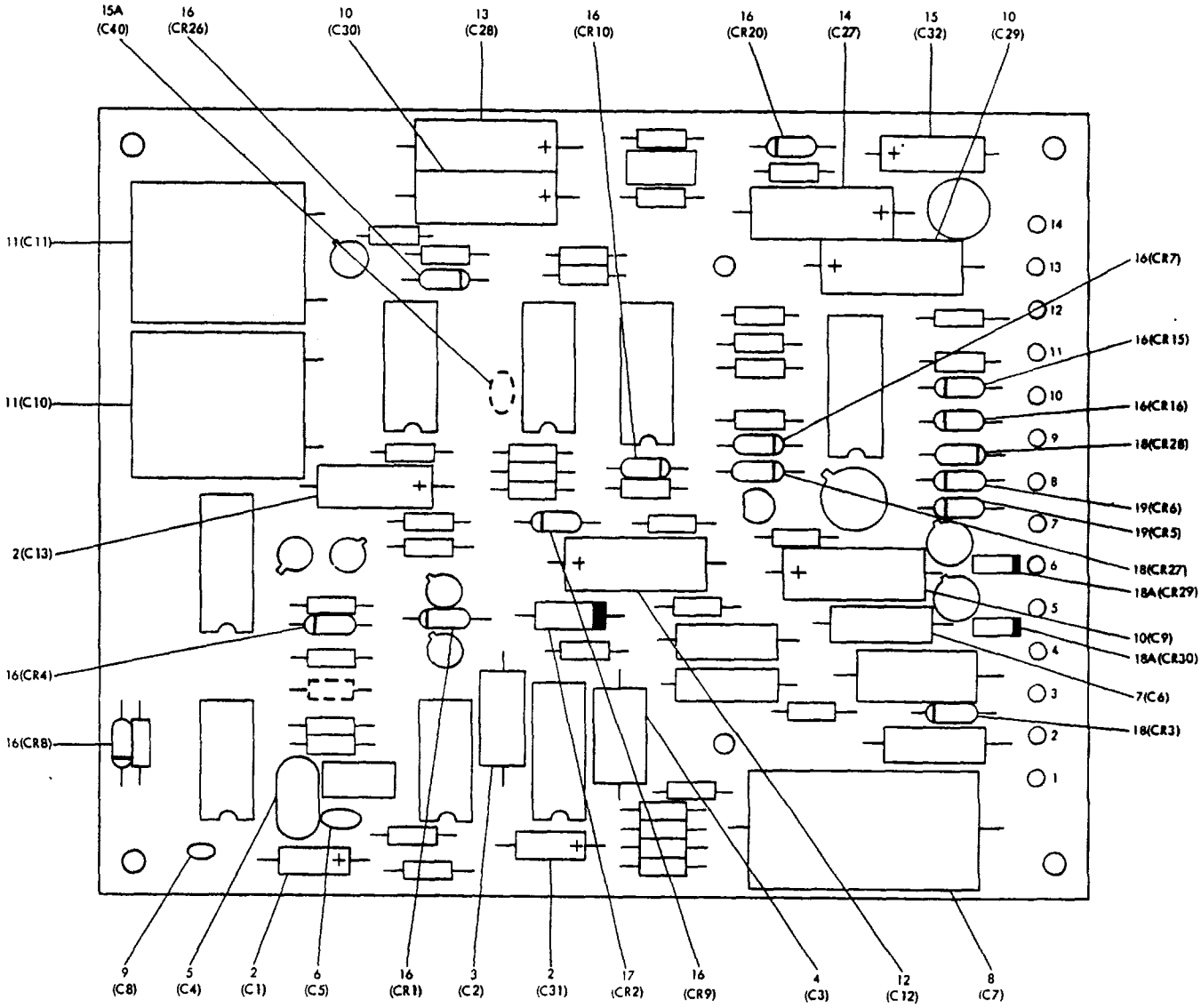
Right Heatsink Assembly
Figure 2

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY
2- 1	200096	HEATSINK ASSY, RIGHT (See IPL Fig. 1, item 9 for NHA)		REF
2	100031-2	. RESISTOR, WW, 0.47 ohm, ±5%, 1/4W (R48, R50)		2
3	1411-B7-11	. TERMINAL, Standoff (V88245) (ATTACHING PARTS)		4
4	MS35206-214	. SCREW, Machine, Pan head, No. 4-40 by 5/16 in. lg		4
5	MS35333-36	. WASHER, Lock, No. 4 ---*---		4
6	100019-3	. RECTIFIER, Silicon power (CR12)		1
7	FT-500	. TRANSISTOR, Power (Q10, Q11) (ATTACHING PARTS)		2
8	MS35206-229	. SCREW, Machine, Pan head, No. 6-32 by 7/16 in. lg		4
9	100042-1	. INSULATOR, Mica (V08289)		2
10	TM-1	. INSULATOR, Nylon transistor mount (V95987)		2
11	MS35333-37	. WASHER, Lock, No. 6		2
12	505-144	. LUG, Terminal (V79963)		2
13	NAS620-6	. WASHER, Flat, No. 6		4
14	NAS671-6	. NUT, Hex, No. 6 ---*---		4
15	200092	. HEATSINK		1

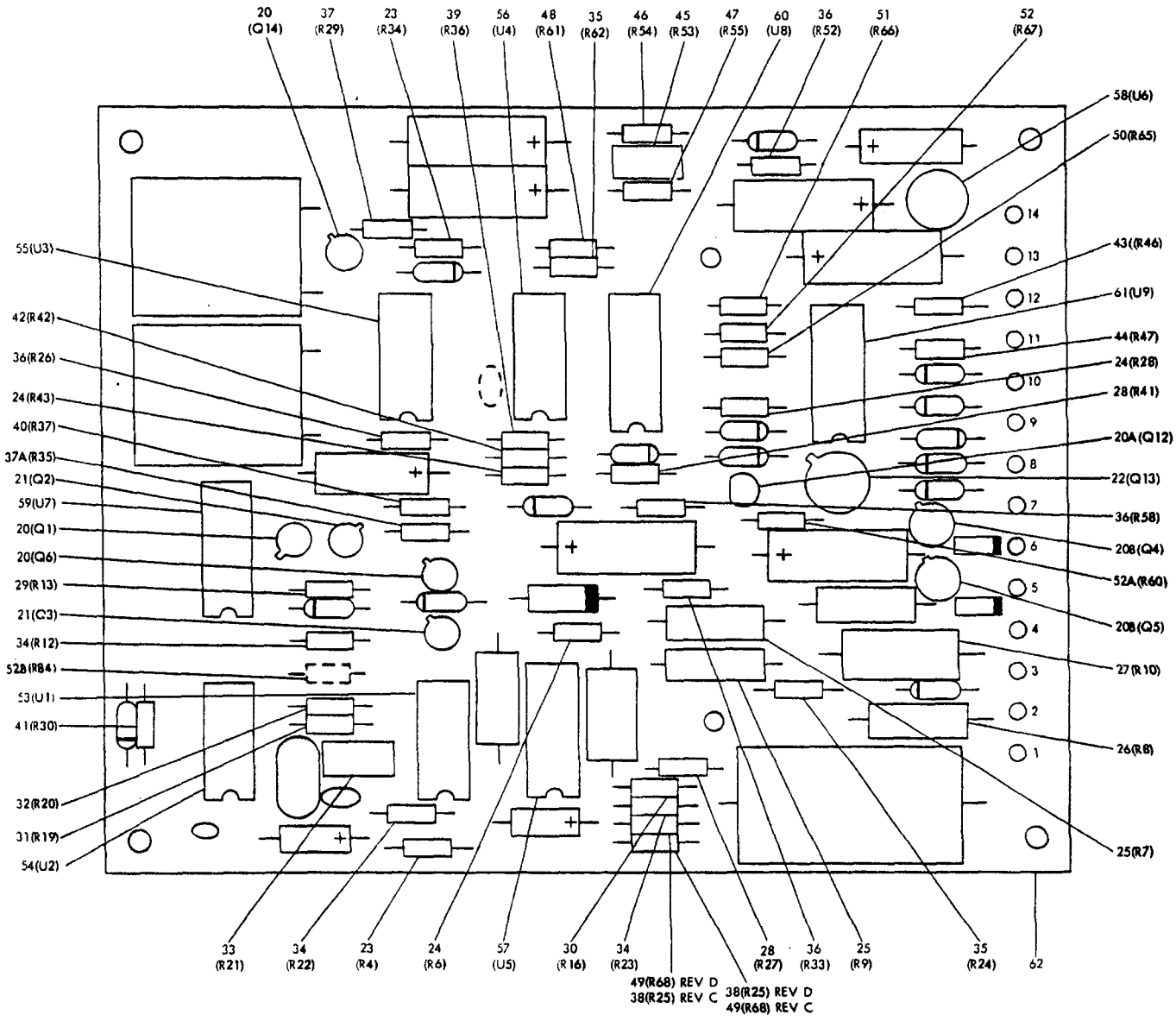


Left Heatsink Assembly
Figure 3

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY
3- 1	200097	HEATSINK ASSY, LEFT (See IPL Fig. 1 item 10, for NHA)		REF
2	100031-2	. RESISTOR, WW, 0.47 ohm, ±5%, 1W (R44, R45)		2
3	1411-B7-11	. TERMINAL, Standoff (V88245) (ATTACHING PARTS)		5
4	MS35206-214	. SCREW, Machine, Pan head, No. 4-40 by 5/16 in. lg		5
5	MS35333-36	. WASHER, Lock, No. 4 ---*---		5
6	100065-1	. TRANSFORMER, Current sensor (T2) (ATTACHING PARTS)		1
7	MS35206-228	. SCREW, Machine, Pan head, No. 6-32 by 3/8 in. lg		1
8	MS35333-37	. WASHER, Lock, No. 6 ---*---		1
9	FT-500	. TRANSISTOR, Power (Q8, Q9) (ATTACHING PARTS)		2
10	MS35206-229	. SCREW, Machine, Pan head, No. 6-32 by 7/16 in. lg		4
11	100042-1	. INSULATOR, Mica (V08289)		2
12	TM-1	. INSULATOR, Nylon transistor mount (V95987)		2
13	MS35333-37	. WASHER, Lock, No. 6		2
14	505-144	. LUG, Terminal (V79963)		2
15	NAS620-6	. WASHER, Flat, No. 6		4
16	NAS671-6	. NUT, Hex, No. 6 ---*---		4
17	200092	. HEATSINK		1



Circuit Board Assembly
Figure 4 (Sheet 1 of 2)

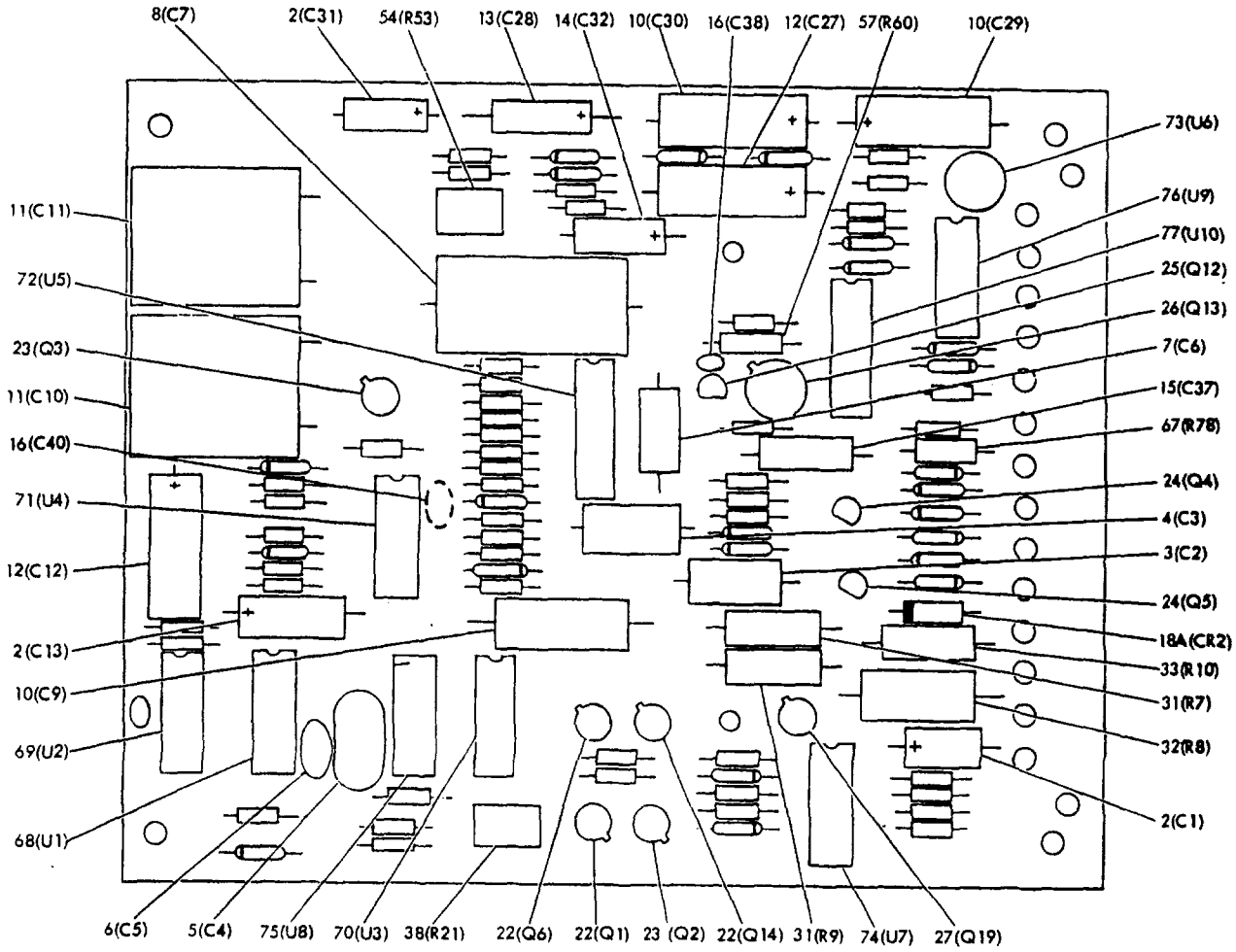


Circuit Board Assembly
Figure 4 (Sheet 2 of 2)

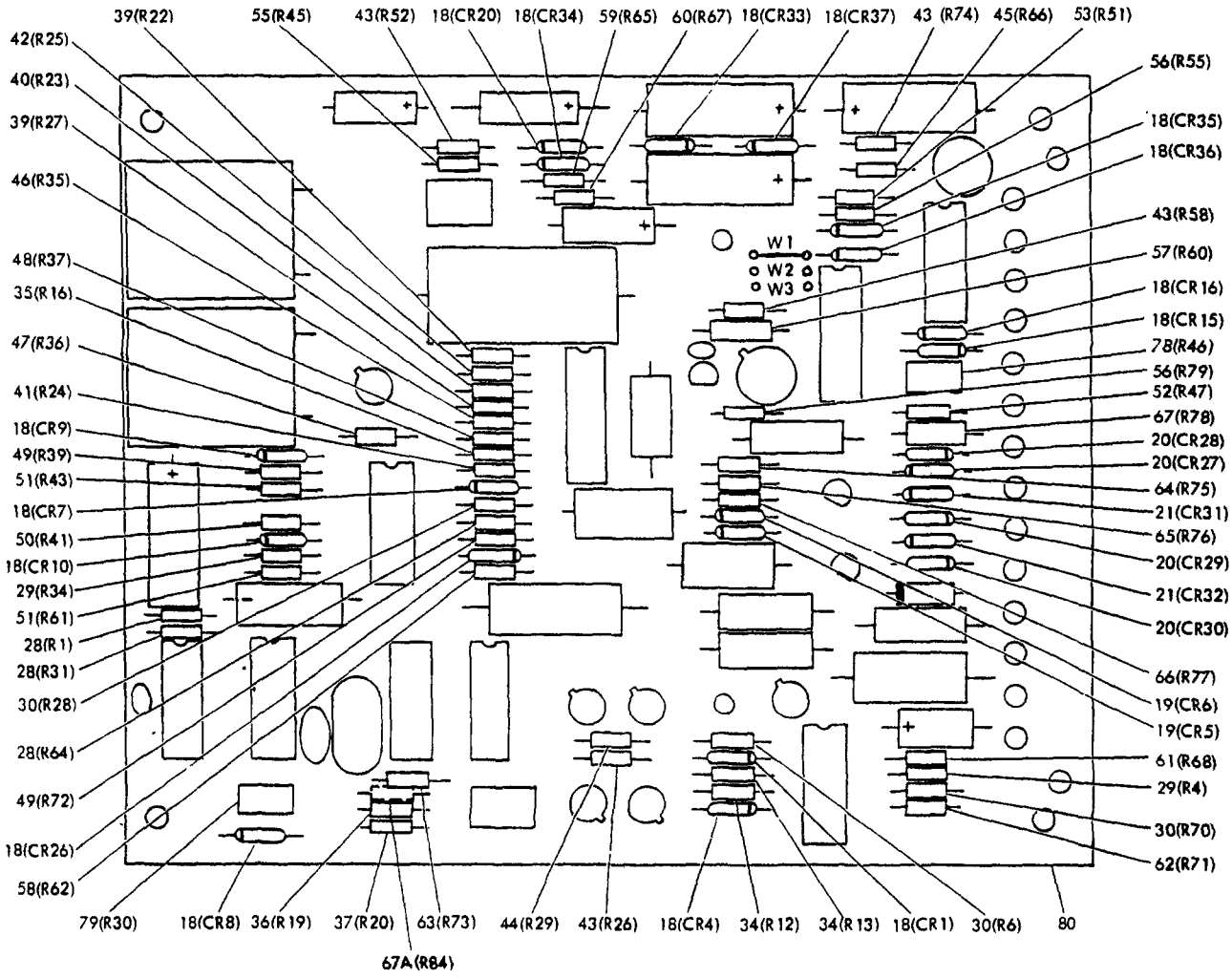
FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY
4- 1	200101-1	CIRCUIT BOARD ASSY (See IPL Fig. 1, item 13 for NHA)	A,C,D	REF
2	100006-8	. CAPACITOR, Solid tantalum, 2.2 mfd, ±20%, 20V (C1, C13, C31)		3
3	100002-11	. CAPACITOR, Metal mylar, 0.0033 mfd, ±20%, 100V (C2)		1
4	100002-2	. CAPACITOR, Metal mylar, 0.1 mfd, ±20%, 100V (C3)		1
5	100007-1	. CAPACITOR, Mica, 3300 pf, ±1%, 500V (C4)		1
6	100004-3	. CAPACITOR, Ceramic, 180 pf, ±10% 100V (C5)		1
7	100002-1	. CAPACITOR, Metal mylar, 0.047 mfd, ±20%, 100V (C6)		1
8	100002-3	. CAPACITOR, Metal mylar, 1.0 mfd, ±20%, 100V (C7)		1
9	100029-7	. CAPACITOR, Ceramic, 1200 pf, ±20%, 100V (C8)		1
10	100006-4	. CAPACITOR, Solid tantalum, 47 mfd, ±20%, 20V (C9, C29, C30)		3
11	100007-4	. CAPACITOR, Mica, 0.020 mfd, ±1% 100V (C10, C11)		2
12	100006-9	. CAPACITOR, Solid tantalum, 120 mfd ±20%, 10V (C12)		1
13	100006-1	. CAPACITOR, Solid tantalum, 22 mfd, ±20%, 15V (C28)		1
14	100006-9	. CAPACITOR, Solid tantalum, 120 mfd, ±20%, 10V (C27)		1
15	100006-7	. CAPACITOR, Solid tantalum, 47 mfd, ±20%, 6V (C32)		1
15A	100029-1	. CAPACITOR, Ceramic, 2200 pf, ±20%, 100V, XR7, (C40)		1
16	1N914A	. DIODE, Silicon (CR1, CR4, CR7, CR8, CR9, CR10, CR15, CR16, CR20, CR26)		10
17	100020-1	. DIODE, Zener, 39V, ±10%, 5W (CR2)		1
18	100038-1	. DIODE, Selicon rectifier (CR3, CR27, CR28)		3
18A	100015-1	. DIODE, Silicon MED. REC. (CR29, CR30)		2
19	100020-2	. DIODE, Zener, 3.9V, ±10%, 500 mw (CR5, CR6)		2
20	2N2222A	. TRANSISTOR, NPN, Silicon (Q1, Q6, Q14)		3
-20A	2N5550	. TRANSISTOR, NPN, Silicon (Q12)		1
-20B	2N5336	. TRANSISTOR, NPN, Silicon (Q4, Q5)		2
21	2N2906	. TRANSISTOR, PNP, Silicon (Q2, Q3)		2
22	2N5322	. TRANSISTOR, PNP, Silicon (Q13)		1
23	RCR07G153JS	. RESISTOR, CC, 15K, 1/4W (R4, R34)		2

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY
4 24	RC07G473JS	. RESISTOR, CC, 47K, ±5%, 1/4W (R6, R28, R43)		3
25	100031-4	. RESISTOR, WW, 680 ohm, ±5%, 3W (R7, R9)		2
26	RCR32G101JS	. RESISTOR, CC, 100 ohm, ±5%, 1W (R8)		1
27	100031-1	. RESISTOR, WW, 560 ohm, ±5%, 3W (R10)		1
28	RCR07G332JS	. RESISTOR, CC, 3.3K, ±5%, 1/4W (R27, R41)		2
29	RCR07G242JS	. RESISTOR, CC, 2.4K, ±5%, 1/4W (R13)		1
30	RCR07G223JS	. RESISTOR, CC, 22K, ±5%, 1/4W (R16)		1
31	RN55C4993F	. RESISTOR, Metal film, 499K, ±1%, (R19)		1
32	RN55E1473F	. RESISTOR, Metal film, 147K, ±1%, (R20)		1
33	100012-7	. RESISTOR, Variable, 50K (R21)		1
34	RCR07G242JS	. RESISTOR, CC, 2.4K, ±5%, 1/4W (R12, R22, R23)		3
35	RCR07G393JS	. RESISTOR, CC, 39K, ±5%, 1/4W (R24, R62)		2
36	RCR07G103JS	. RESISTOR, CC, 10K, ±5%, 1/4W (R26, R33, R52, R58)		4
37	RCR07G273JS	. RESISTOR, CC, 27K, ±5%, 1/4W, (R29)		1
37A	RN55C1502F	. RESISTOR, Metal film 15K, ±1% (R35)		1
38	100040-2	. RESISTOR, Temp Comp, 1.5K, ±5%, 1/20W (R25)		1
39	RN55C2373F	. RESISTOR, Metal film, 237K, ±1%, (R36)		1
40	RN55C4120F	. RESISTOR, Metal film, 412 ohm, ±1%, (R37)		1
41	RCR07G JS	. RESISTOR, Factory Selected Value (R30)		1
42	RCR07G102JS	. RESISTOR, CC, 1.0K, ±5%, 1/4W (R42)		1
43	RCR07G JS	. RESISTOR, CC, Factory selected value (R46)		1
44	RCR07G392JS	. RESISTOR, CC, 3.9K, ±5%, 1/4W (R47)		1
45	100012-7	. RESISTOR, Variable 50K, (R53)		1
46	RCR07G112JS	. RESISTOR, CC, 1.1K, ±5%, 1/4W (R54)		1
47	RCR07G101JS	. RESISTOR, CC, 100 ohm, ±5%, 1/4W (R55)		1
48	RCR07G154JS	. RESISTOR, CC, 150K, ±5%, 1/4W (R61)		1
49	RCR07G391JS	. RESISTOR, CC, 390 ohm, ±5%, 1/4W (R68)		1
50	RCR07G471JS	. RESISTOR, CC, 470 ohm, ±5%, 1/4W (R65)		1
51	RCR07G JS	. RESISTOR, CC, ±5%, 1/4W (R66) Factory Selected		1
52	RCR07G623JS	. RESISTOR, CC, 62K, ±5%, 1/4W (R67)		1
52A	RCR20G302JS	. RESISTOR, CC, 3.0K, ±5%, 1/2W (R60)		1
52B	RN55C8063F	. RESISTOR, Metal film, 806K, ±1%, 1/20W (R84)		1
53	100017-1	. INTEGRATED CIRCUIT, Quad, 2 inputs, CMOS, NOR gate (U1)		1
54	100028-1	. INTEGRATED CIRCUIT, Quad, comparator (U2)		1
55	100017-2	. INTEGRATED CIRCUIT, Quad, 2 inputs, CMOS, OR gate (U3)		1

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY
4 56	100032-1	. INTEGRATED CIRCUIT, Quad, operational amplifier (U4)		1
57	100018-1	. INTEGRATED CIRCUIT, Regulating pulse width modulator (U5)		1
58	100016-1	. BRIDGE, Silicon rectifier molded (Includes CR21, CR22, CR23, CR24) (U6)		1
59	100005-2	. RESISTOR NETWORK, 8 x 5.1K, ±5%, 1/4W (Includes R1, R2, R3, R5, R11, R14, R15, R31) (U7)		1
60	100005-2	. RESISTOR NETWORK, 8 x 5.1K, ±5%, 1/4W, (Includes R32, R38, R39, R40, R63, R64) (U8)		1
61	100005-3	. RESISTOR NETWORK, 8 x 1K, ±5%, 1/4W, (Includes R17, R18, R49, R51, R56, R57, R59) (U9)		1
62	200093	. BOARD, Printed circuit		1



Circuit Board Assembly
Figure 4A (Sheet 1 of 2)

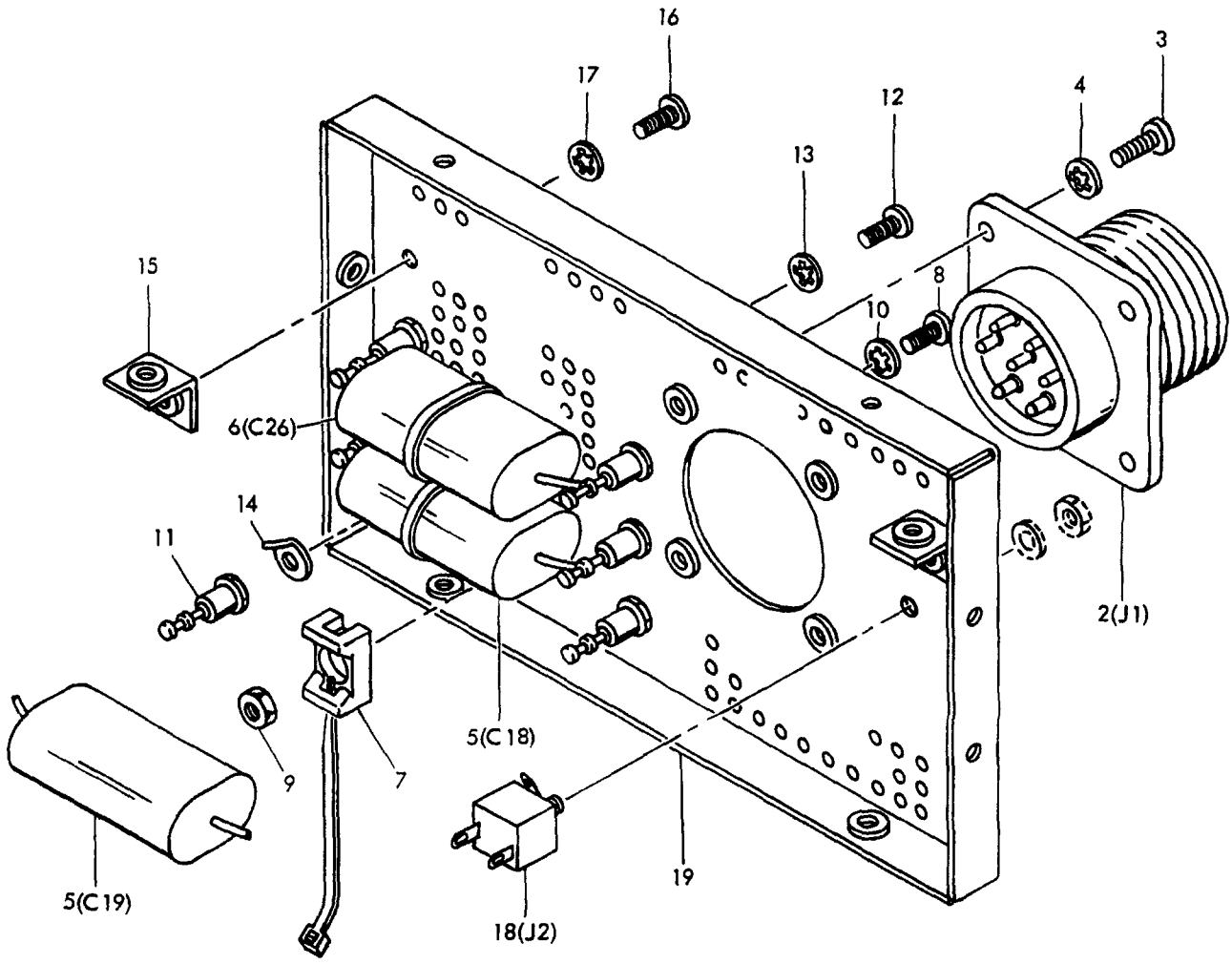


Circuit Board Assembly
Figure 4A (Sheet 2 of 2)

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY
4A-1	200101-2	CIRCUIT BOARD ASSY (See IPL Fig. 1, item 13A for NHA)	B,E,F,G	REF
2	100006-8	. CAPACITOR, Solid tantalum, 2.2 mfd, ±20%, 20V (C1, C13, C31)		3
3	100002-11	. CAPACITOR, Metal mylar, 0.0033 mfd, ±20%, 100V (C2)		1
4	100002-2	. CAPACITOR, Metal mylar, 0.1 mfd, ±20%, 100V (C3)		1
5	100007-1	. CAPACITOR, Mica "F", 3300 PF, ±1%, 500V (C4)		1
6	100004-5	. CAPACITOR, Ceramic N3300, 39 pf, ±10%, 100V (C5)		1
7	100002-1	. CAPACITOR, Metal mylar, 0.047 mfd, ±20%, 100V (C6)		1
8	100002-3	. CAPACITOR, Metal mylar, 1.0 mfd, ±20%, 100V (C7)		1
9	100029-7	. CAPACITOR, Ceramic, 1200 pf, ±20%, 100V, C0G (C8)		1
10	100006-4	. CAPACITOR, Solid tantalum, 47 mfd, ±20%, 20V (C9, C29, C30)		3
11	100007-4	. CAPACITOR, Mica "F", 0.020 mfd, ±1%, 100V (C10, C11)		2
12	100006-9	. CAPACITOR, Solid tantalum, 120 mfd, ±20%, 10V (C12, C27)		2
13	100006-1	. CAPACITOR, Solid tantalum, 22 mfd, ±20%, 15V (C28)		1
14	100006-7	. CAPACITOR, Solid tantalum, 47 mfd, ±20%, 6V (C32)		1
15	100002-15	. CAPACITOR, Metal mylar, 0.020 mfd, ±10%, 100V (C37)		1
16	100029-1	. CAPACITOR, Ceramic, 2200 pf, ±20%, 100V, X7R (C38, C40)		2
17	100029-6	. CAPACITOR, Ceramic, 0.01 mfd, ±20%, 100V, X7R (C39)		1
18	1N914A	. DIODE, Silicon (CR1, CR4, CR7, CR8, CR9, CR10, CR15, CR16, CR20, CR26, CR33, CR34, CR35, CR36, CR37)		15
18A	100020-1	. DIODE, Zener, 39V, ±10%, 5W (CR2)		1
19	100020-2	. DIODE, Zener, 3.9V, ±10%, 500 mw (CR5, CR6)		2
20	100038-1	. DIODE, Silicon rectifier (CR27, CR28, CR29, CR30)		4
21	100015-1	. DIODE, Silicon rectifier (CR31, CR32)		2
22	2N2222A	. TRANSISTOR, NPN, Silicon (Q1, Q6, Q14)		3

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY
4A 23	2N2906	. TRANSISTOR, PNP, Silicon (Q2, Q3)		2
24	100092-1	. TRANSISTOR, Darlington, NPN, Silicon (Q4, Q5)		2
25	2N5550	. TRANSISTOR, NPN, Silicon (Q12)		1
26	2N5322	. TRANSISTOR, PNP, Silicon (Q13)		1
27	2N2906	. TRANSISTOR, PNP, Silicon (Q19)		1
28	RCR07G512JS	. RESISTOR, CC, 5.1K, ±5%, 1/4W (R1, R31, R64)		3
29	RCR07G153JS	. RESISTOR, CC, 15K, ±5%, 1/4W (R4, R34)		2
30	RCR07G473JS	. RESISTOR, CC, 47K, ±5%, 1/4W (R6, R28, R70)		3
31	100031-4	. RESISTOR, WW, 680 ohm, ±5%, 3W (R7, R9)		2
32	RCR32G101JS	. RESISTOR, CC, 100 ohm, ±5%, 1W, (R8)		1
33	100031-1	. RESISTOR, WW, 560 ohm, ±5%, 3W, (R10)		1
34	RCR07G242JS	. RESISTOR, CC, 2.4K, ±5%, 1/4W, (R12, R13)		2
35	RCR07G223JS	. RESISTOR, CC, 22K, ±5%, 1/4W, (R16)		1
36	RN55C4993F	. RESISTOR, Metal Film, 499K, ±1%, (R19)		1
37	RN55C1473F	. RESISTOR, Metal film, 147K, ±1%, (R20)		1
38	100012-7	. RESISTOR, Variable, 50K (R21)		1
39	RN55C3011F	. RESISTOR, Metal film, 3.01K, ±1%, (R22, R27)		2
40	RN55C1821F	. RESISTOR, Metal film, 1.82K, ±1%,(R23)		1
41	RCR07G393JS	. RESISTOR, CC, 39K, ±5%, 1/4W, (R24)		1
42	RN55C1821F	. RESISTOR, Metal film, ±1.82K, ±1% (R25)		1
43	RCR07G103JS	. RESISTOR, CC, 10K, 5%, 1/4W, (R26, R52, R58, R74)		4
44	RCR07G273JS	. RESISTOR, CC, 27K, 15%, 1/4W, (R29)		1
45	RCR07G JS	. RESISTOR, Factory select (R66)		3
46	RN55C2262F	. RESISTOR, Metal film, 22.6K, ±1% (R35)		1
47	RN55C2373F	. RESISTOR, Metal film, 237K, ±1%, (R36)		1
48	RN55C4120F	. RESISTOR, Metal film, 412 ohm, ±1% (R37)		1
49	RCR07G104JS	. RESISTOR, CC, 100K, ±5%, 1/4W, (R39, R72)		2
50	RGR07G682JS	. RESISTOR, CC, 6.8F, ±5%, 1/4W (R41)		1
51	RCR07G154JS	. RESISTOR, CC, 150K, ±5%, 1/4W, (R43, R61)		2
52	RCR07G392JS	. RESISTOR, CC, 3.9K, ±5%, 1/4W (R47)		1
53	RCR07G102JS	. RESISTOR, CC, 1K, 5%, 1/4W, (R51)		1
54	100012-4	. RESISTOR, Variable, 5K (R53)		1

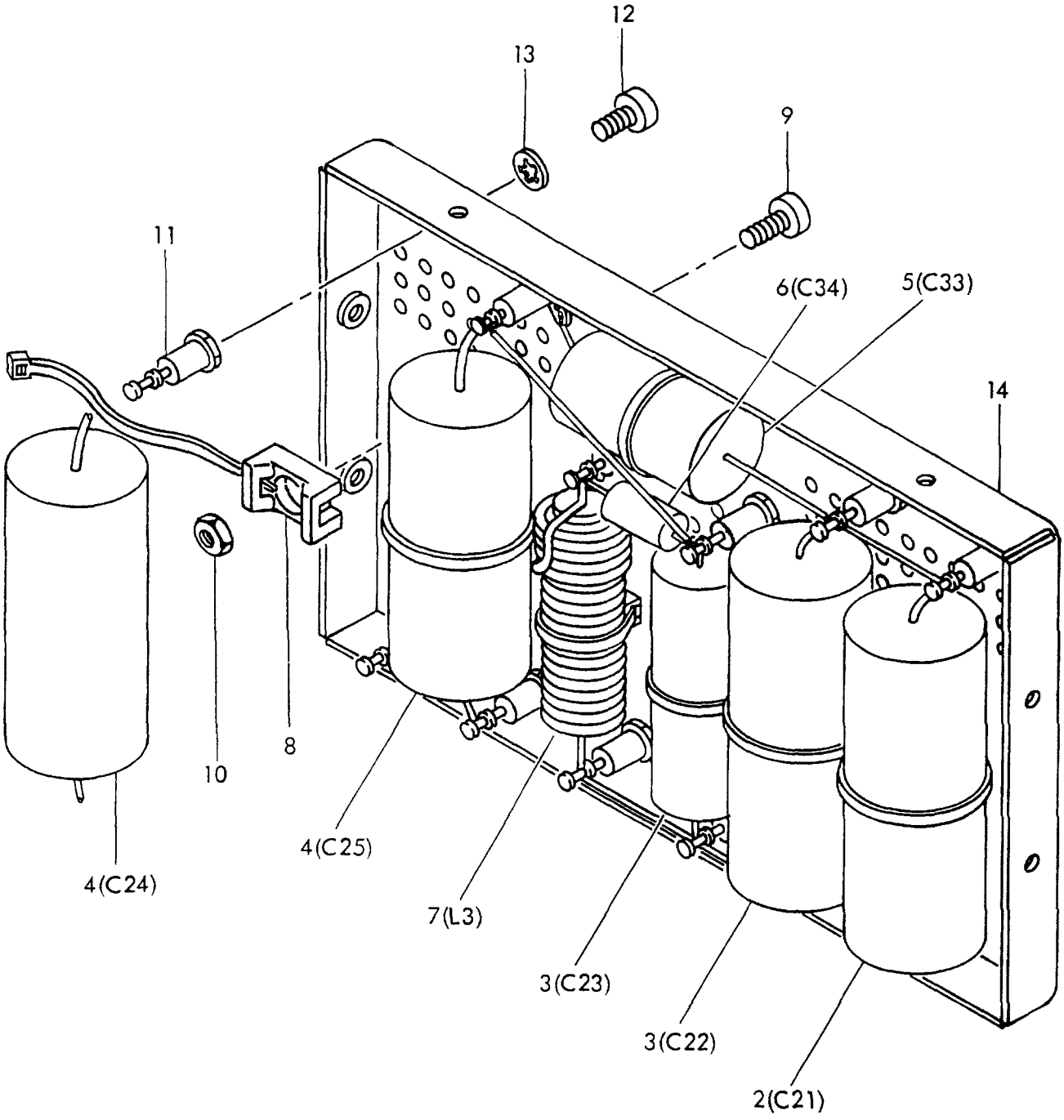
FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY
4A 55	RN55C1821F	. RESISTOR, Metal film, 1.82K, ±1% (R54)		1
56	RCR07G101JS	. RESISTOR, CC, 100 ohm, ±5%, 1/4W (R55, R79)		2
57	RCR20G302JS	. RESISTOR, CC, 3K, ±5%, 1/2W (R60)		1
58	RCR07G433JS	. RESISTOR, CC, 43K, ±5%, 1/4W (R62)		1
59	RCR07G471JS	. RESISTOR, CC, 470 ohm, ±5%, 1/4W (R65)		1
60	RCR07G623JS	. RESISTOR, CC, 62K, ±5%, 1/4W (R67)		1
61	RCR07G391JS	. RESISTOR, CC, 390 ohm, ±5%, 1/4W (R68)		1
62	RCR07G100JS	. RESISTOR, CC, 10 ohm, ±5%, 1/4W (R71)		1
63	RCR07G332JS	. RESISTOR, CC, 3.3K, ±5%, 1/4W (R73)		1
64	100039-4	. RESISTOR, Carbon film, 220K, ±2%, 1/4W (R75)		1
65	RCR07G394JS	. RESISTOR, CC, 390K, ±5%, 1/4W (R76)		1
66	RCR07G224JS	. RESISTOR, CC, 220K, ±5%, 1/4W (R77)		1
67	RCR20G472JS	. RESISTOR, CC, 4.7K, ±5%, 1/2W (R78)		1
67A	RN55C8063F	. RESISTOR, 806K ohm, ±1%, 1/20W (R84)		1
68	100017-1	. INTEGRATED CIRCUIT, Quad, 2 inputs, CMOS, NOR gate (U1)		1
69	100028-1	. INTEGRATED CIRCUIT, Quad, comparator (U2)		1
70	100017-2	. INTEGRATED CIRCUIT, Quad, 2 inputs, CMOS, OR gate (U3)		1
71	100032-1	. INTEGRATED CIRCUIT, Quad, operational amplifier (U4)		1
72	100018-1	. INTEGRATED CIRCUIT, Regulating pulse width modulator (U5)		1
73	100016-1	. BRIDGE, Silicon rectifier, molded (includes CR21, CR22, CR23, CR24) (U6)		1
74	100005-1	. RESISTOR NETWORK, 7 x 5.1K, ±5%, 1/4W (includes R2, R5, R11, R14, R32, R33)(U7)		1
75	1000005-1	. RESISTOR NETWORK, 7 x 5.1K, ±5%, 1/4W (includes R3, R15, R38, R40, R63, R69) (U8)		1
76	100005-4	. RESISTOR NETWORK, 7 x 1K, ±5%, 1/4W (includes R17, R18, R49, R56, R57, R59) (U9)		1
77	100035-2	. INTEGRATED CIRCUIT, Binary divider (U10)		1
78	100012-6	. RESISTOR, Variable 20K (R46)		1
79	100012-8	. RESISTOR, Variable 100K (R30)		1
80	NO NUMBER	. JUMPER, Short circuit timing (W1)		1
81	20093	. BOARD, Printed circuit		1



Front Plate Assembly
Figure 5

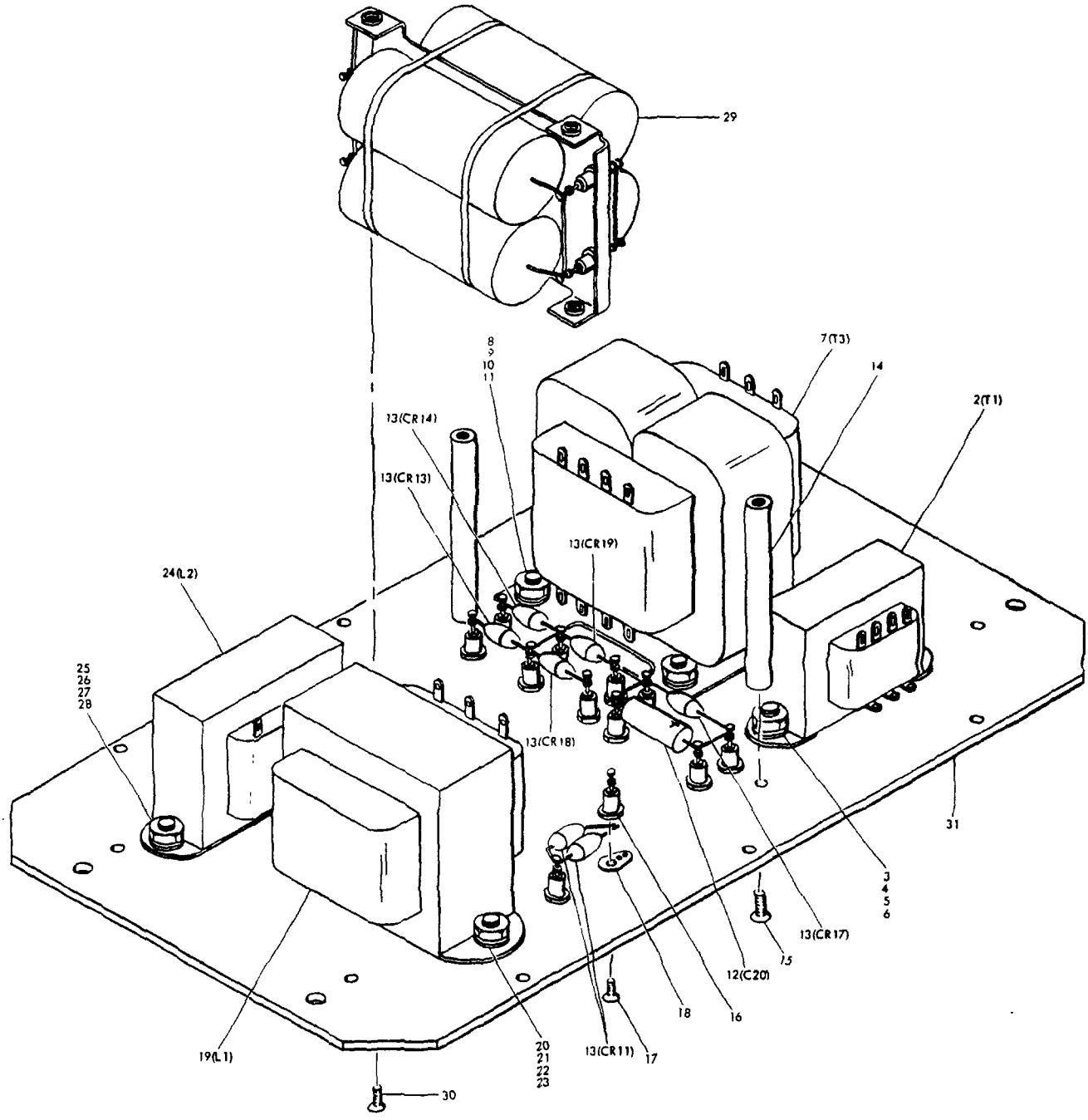
FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY
5- 1	300048	PLATE ASSY, Front (See IPL Fig. 1, item 18, for NHA)	A,E	REF
- 1A	300049	PLATE ASSY, Front (See IPL Fig. 1, item 18A, for NHA)	B	REF
- 1B	300050	PLATE ASSY, Front (See IPL Fig. 1, item 18B, for NHA)	C,F	REF
- 1C	300052	PLATE ASSY, Front (See IPL Fig. 1, item 18C, for NHA)	D,G	REF
- 2	MS3102A18-9P	. CONNECTOR (J1)	A,E	1
- 2A	MS3102R24-20P	. CONNECTOR (J1)	B	1
- 2B	KPT02E18-11P	. CONNECTOR (J1) (V71468)	C,F	1
- 2C	MS3102A20-16P	. CONNECTOR (J1)	D,G	1
		(ATTACHING PARTS)		
3	MS35206-214	. SCREW, Machine, Pan head, No. 4-40 by 5/16 in. lg		4
4	MS35333-36	. WASHER, Lock, No. 4		4
		---*---		
5	100002-9	. CAPACITOR, Metal mylar, 1 uf, 200V (C18, C19)		2
6	100002-9	. CAPACITOR, Metal mylar, 1 uf, 200V (C26)	D,G	1
7	TM1-S4	. TIE MOUNT (V06383)	A,B,C,E,F	2
- 7A	TM1-S4	. TIE MOUNT (V06383)	D,G	3
		(ATTACHING PARTS)		
8	MS35206-212	. SCREW, Machine, Pan head, No. 4-40 by 3/16 in. lg	A,B,C,E,F	2
- 8A	MS35206-212	. SCREW, Machine, Pan head, No. 4-40 by 3/16 in. lg	D,G	3
9	AN340-4	. NUT, Hex, No. 4	A,B,C,E,F	2
- 9A	AN340-4	. NUT, Hex, No. 4	D,G	3
10	MS35333-36	. WASHER, Lock, No. 4	A,B,C,E,F	2
-10A	MS35333-36	. WASHER, Lock, No. 4	D,G	3
		---*---		
11	1411-B7-11	. TERMINAL, Standoff (V88245)	A,B,C,E,F	4
11A	1411-B7-11	. TERMINAL, Standoff (V88245)	D,G	6
		(ATTACHING PARTS)		
12	MS35206-212	. SCREW, Machine, Pan head, No. 4-40 by 3/16 in. lg	A,B,C,E,F	4
-12A	MS35206-212	. SCREW, Machine, Pan Head, No. 4-40 by 3/16 in. lg	D,G	6
13	MS35333-36	. WASHER, Lock, No. 4	A,B,C,E,F	4
-13A	MS35333-36	. WASHER, Lock, No. 4	D,G	6
14	505-120	. LUG, Terminal (V79963)		1
		---*---		

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY
5 15	400020	. BRACKET, Mounting (ATTACHING PARTS)		2
16	MS35206-213	. SCREW, Machine, Pan head,No. 4-40 by 1/4 in. lg		2
17	MS35333-36	. WASHER, Lock, No. 4 ---*---		2
18	100034-1	. JACK, Phone, subminiature		1
19	300046	. PLATE, Front end	A,C,E,F	1
-19A	300051	. PLATE, Front end	B	1
-19B	300051	. PLATE, Front end	D,G	1



Rear Plate Assembly
Figure 6

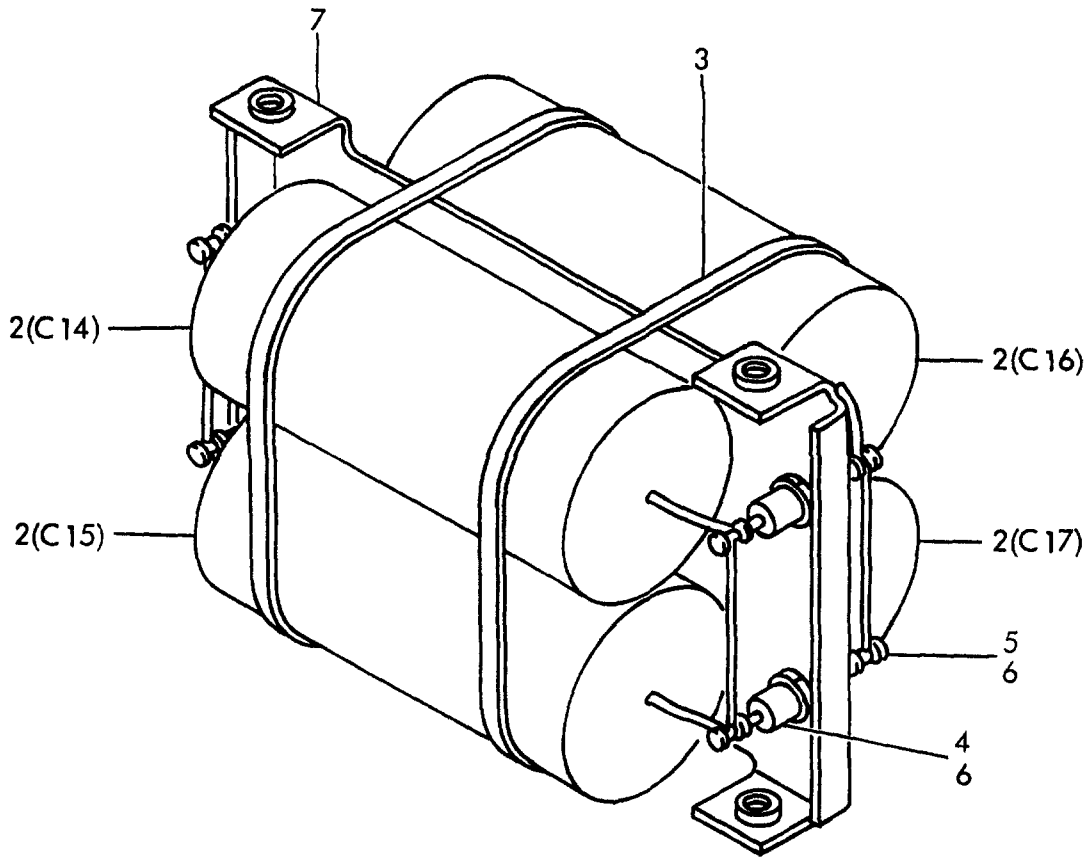
FIG ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY
6- 1	200094	PLATE ASSY, Rear (See IPL Fig. 1, item 20 for NHA)		REF
2	100001-26	. CAPACITOR, Metallized polyc, 5 uf, +10%, 140 VAC (C21)		1
3	100001-	. CAPACITOR, Metallized polyc, factory selected (C22, C23)		1 or 2
4	100030-5	. CAPACITOR, Metallized polyc, 10 uf, +20%, 40 VAC (C24, C25)		2
5	100002-3	. CAPACITOR, Metal mylar, 1.0 uf, +20%, 100 VDC (C33)		1
6	100002-12	. CAPACITOR, Metal mylar, 0.01 uf, +20%, 400 VDC (C34)		1
7	100022-3	. CHOKE, 125 UH, +20% (L3)		1
8	TM1-S4	. TIE MOUNT (V06383) (ATTACHING PARTS)		7
9	MS35206-212	. SCREW, machine, Pan head, No. 4-40 by 3/16 in. lg		7
10	AN340-4	. NUT, Hex, No. 4 ---*---		7
11	1411-B7-11	. TERMINAL, Standoff (V88245) (ATTACHING PARTS)		12
12	MS35206-212	. SCREW, Machine, Pan head, No. 4-40 by 3/16 in. lg		12
13	MS35333-36	. WASHER, Lock, No. 4 ---*---		12
14	300045	. PLATE, Rear end		1



Base Plate Assembly
Figure 7

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY
7- 1	200099	PLATE ASSY, Base (See IPL Fig. 1, item 22 for NHA)		REF
2	100063-1	. TRANSFORMER, Interstage (T1)		1
		(ATTACHING PARTS)		
3	MS24693S47	. SCREW, Machine, Flat head, No. 8-32 by 3/8 in. lg		3
4	NAS620-8	. WASHER, Flat, No. 8		1
5	MS35333-38	. WASHER, Lock, No. 8		3
6	NAS671-8	. NUT, Hex, No. 8		3
		---*---		
7	100066-1	. TRANSFORMER, Output (T3)		1
		(ATTACHING PARTS)		
8	MS24693S47	. SCREW, Machine, Flat head, No. 8-32 by 3/8 in. lg		4
9	NAS620-8	. WASHER, Flat, No. 8		4
10	MS35333-38	. WASHER, Lock, No. 8		4
11	NAS671-8	. NUT, Hex, No. 8		4
		---*---		
12	100006-4	. CAPACITOR, Solid tantalum, 47 uf 20V (C20)		1
13	100015-1	. DIODE, Silicon med rec (2xCR11, CR13, CR14, CR17, CR18, CR19)		7
14	400001-3	. POST, Mounting		2
		(ATTACHING PARTS)		
15	MS24693S26	. SCREW, Machine, Flat head, No. 6-32 by 3/8 in. lg		2
		---*---		
16	1411-B7-11	. TERMINAL, Standoff (V88245)		12
		(ATTACHING PARTS)		
17	MS24693S2	. SCREW, Machine, Flat head, No. 4-40 by 1/4 in. lg		12
18	505-120	. LUG, Terminal (V79963)		1
		---*---		
19	100062-1	. INDUCTOR, Spillover (L1)		1
		(ATTACHING PARTS)		
20	MS24693S47	. SCREW, Machine, Flat head, No. 8-32 by 3/8 in. lg		3
21	NAS620-8	. WASHER, Flat, No. 8		3
22	MS35333-38	. WASHER, Lock, No. 8		3
23	NAS671-8	. NUT, Hex, No. 8		3
		---*---		

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY
7-24	100061-1	. INDUCTOR, Input filter (L2)		1
		(ATTACHING PARTS)		
25	MS24693S47	. SCREW, Machine, Flat head, No. 8-32 by 3/8 in. lg		3
26	NAS620-8	. WASHER, Flat, No. 8		3
27	MS35333-38	. WASHER, Lock, No. 8		3
28	NAS671-8	. NUT, Hex, No. 8		3
		---*---		
29	200100	. BRACKET ASSY (See Fig. 8 for details)		1
		(ATTACHING PARTS)		
30	MS24693S2	. SCREW, Machine, Flat head, No. 4-40 by 1/4 in. lg		2
31	200098	. PLATE, Base		1



Bracket Assembly
Figure 8

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY
8- 1	200100	BRACKET ASSY (See IPL Fig. 7, item 29 for NHA)		REF
2	100003-2	. CAPACITOR, Aluminum electrolytic, 2100 mfd, 40V (C14, C15, C16, C17)		4
3	SST3I	. TIE WRAP (V06383)		2
4	1411-B7-11	. TERMINAL, Standoff (V88245)		4
5	1409-F7-11	. TERMINAL, Standoff (V88245)		4
6	NAS620-4	. WASHER, Flat, No. 4		8
7	300047	. BRACKET, Mounting		1

Report 6C-198

(Twin Otter)

GARRETT MANUFACTURING LIMITED

OPERATION & MAINTENANCE MANUAL

STATIC INVERTER

607742-1-1

GARRETT MANUFACTURING LIMITED
A SUBSIDIARY OF THE GARRETT CORPORATION
19 ATTWELL DRIVE • REXDALE, ONTARIO, CANADA

1st November, 1966

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FOREWORD

Refer to figure 1. The information contained in this publication is applicable to all configurations (variations in second dash number) of the subject equipment as listed in the configuration summary.

CONFIGURATION SUMMARY

Configuration	Remarks
607742-1-1	Original configuration. This is the only identified configuration to date.

Garrett Manufacturing Limited

OPERATION
&
MAINTENANCE MANUAL
(607742-1)

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1. INTRODUCTION

A. GENERAL

This publication provides operation and maintenance instructions for the Static Inverter, Part Number 607742-1-1 manufactured by Garrett Manufacturing Limited (a subsidiary of the Garrett Corporation), Rexdale, Ontario, Canada.

B. IDENTIFICATION

The nameplate of each unit reflects the manufacturer's identification (see figure 1).

2. DESCRIPTION AND OPERATION

A. DESCRIPTION

The Static Inverter has been designed for installation in the Twin Otter aircraft to provide 115 volts 400 cps, square wave, single phase ac power supply. It is a compact solid-state/magnetic device and operates from the aircraft 28 volt dc power supply.

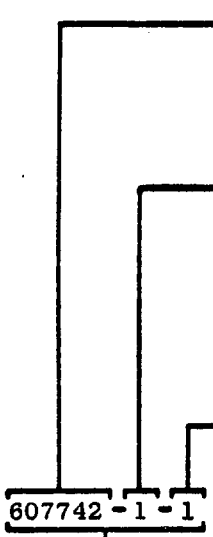
B. OPERATION (See figure 5)

(1) General

The inverter consists of a magnetic multivibrator utilizing two power transistors (Q1 and Q2), two transformers (T1 and T2), and associated components. Short circuit protection is provided by transistors Q3, Q4, and associated components.

(2) Timing and Output Circuit

The dc input is applied between connector pins A(-) and B(+); either transistor Q1 or Q2 will conduct. The supply voltage is applied across one half of the primary of the output transformer T1, and as T1 and T2 primary windings are parallel connected, the same voltage will appear across T2 primary. The applied voltage across the primaries induces voltage into the transformer secondaries, with the polarity as indicated by the dots adjacent to the transformer windings on the schematic, and magnitude proportional to the turns ratio. When one of the transistors is biased on with a negative base voltage, the other transistor will be biased off with a positive base voltage. Timing transformer T2 has a smaller volt/second characteristic than output transformer T1; therefore it will commence to saturate earlier in the cycle, thus reducing the induced secondary voltage and consequently reducing the base drive to the conducting



Indicates a basic design series.

The first dash number denotes a specific configuration within the basic design series, and indicates that all units (within the same basic design series) bearing the same first dash number are interchangeable. Units bearing a different first dash number are not interchangeable. First dash numbers are assigned in numerical order, the first specific configuration being identified with the number "1".

The second dash number classifies the unit with respect to minor differences which do not affect interchangeability of the unit but which do involve a change in spare parts and/or technical data. Second dash numbers are assigned in numerical order (starting with "1") against each specific configuration of unit.

This is the Complete Part Number. It is stamped on the nameplate in the "Part No." slot.

Provision may be made on the nameplate or on a separate modification plate for the identification of retrofitted minor changes. These changes do not affect interchangeability of the unit but may affect spare parts and/or technical data. These changes may be made out of sequence and are therefore separately identified. Accordingly, the notation "2" stamped in the slot would indicate the incorporation of "Change 2" but would not indicate the incorporation of "Change 1" unless the notation "1" also appeared.



This is the Complete Serial Number. It is stamped on the nameplate in the "Serial No." Slot.

Actual serial number, allocated in numerical sequence. The first unit is serialized -101. The dash number quoted in the example would therefore represent the sixteenth unit off the production line.

Scheduled for production during the ninth month of the first year, i.e., September, 1961. The letter code is used to identify the applicable Manufacturing Division within The Garrett Corporation:
No letter — AiResearch, Los Angeles.
P — AiResearch, Phoenix.
C — Garrett Manufacturing Limited.

Manufacturer's Identification
Figure 1

transistor. As one transistor turns off, the induced voltage is reversed, thus causing the other transistor to conduct, this cycle continuing at the frequency determined by the components in the timing circuit and the input voltage. Voltage stabilization to the frequency determining circuit is provided by the rectifier bridge, CR14 through CR17 and Zener diode VR2. The output voltage is determined by the input voltage times the turns ratio of the output transformer T1.

(3) Short-Circuit Protection Circuit

Transistor Q3 operates as an on-off gate controlling the base drive to the power transistors Q1 and Q2. During normal operation of the inverter, Q3 is conducting, but in the event of a short-circuit being detected across the output, Q3 is cut off, removing the drive from Q1 and Q2 thus rendering the inverter inoperative. When the inverter is switched on, the input voltage is applied to the base of transistor Q4 via high resistance R8. Transistor Q4 starts to turn on and applies drive to Q3 which in turn conducts. Now Q3 collector voltage is applied to the base of Q4 via low impedance, R3, C3, driving both transistors Q4 and Q3 full on. This drive however has only a short duration, as when C3 is fully charged it blocks the input voltage from appearing at the base of Q4. If there is no other source of base drive, the transistors Q4 and Q3 cease conducting. With the input voltage still applied to the inverter, the foregoing starting cycle will be repetitive, giving an on-off pulsing condition when the output of the inverter is shorted or for some other reason there is no output voltage. Circuit constants are such that the on time is short compared to the off time thus ensuring that in the event of a short-circuit the transistors and components in the inverter are protected. During normal inverter operation, the output voltage (sensed at the 26 volt tap (connector pin F) on the output transformer) is rectified by CR2 and fed to the base of Q4, via R2, R13 - providing continuous self-drive to maintain inverter output.

Diodes CR5, CR6, in conjunction with R10, R11, form a bias network ensuring safe start and stop at all load and temperature conditions.

(4) Other Protection Devices

Diodes CR8, CR9 are included in the circuit to prevent damaging reverse current flowing to the bases of transistors Q1 and Q2. With a highly inductive load a path must be provided for the lagging currents to bypass Q1 and Q2 when they are switched off. Feedback diodes CR3, CR4 are used for this purpose.

Transient spikes in the input to the inverter, which could be damaging to Q1, Q2, are clipped by Zener diode VR1, capacitor C1 being used as a filter component.

C. LEADING PARTICULARS

The leading particulars of the unit are shown in table I.

TABLE I. LEADING PARTICULARS

Input Voltage	18.5 to 29.5 vdc
Input Voltage Ripple	MIL-STD-704
Input Source	Battery and generator
Output Voltage	115 v nominal between connector pins C & D 26 v nominal between connector pins F & D
Efficiency	70% approx at full load, P.F. = 1.0
Number of Phases	One
Output Frequency	400 cps ±10%
Output Power (normal rating)	65 VA
Power Factor Rating	0.4 lag to unity
Short-circuit Capability	The inverter is self-protected
RFI Suppression	MIL-STD-6181D
Ambient Operating Temperature Range	-62° to 159.8°F (-55° to 71°C)
Electrical Connections:	
Connector J1	MS3112E10-6P
Pin A	dc return
Pin B	28 vdc positive input
Pin C	115 v, 400 cps output
Pin D	ac common ground
Pin E	Not used
Pin F	26 v, 400 cps output
*Mating Connector P1	MS3116E10-6S
Overall Dimensions	5.75 x 4.03 x 3.34 in. (max)
Weight	3.0 lb (approx)

*This information given for test purposes only and is not necessarily connector used on aircraft installation.

3. PERIODIC INSPECTION

A. GENERAL

The inspection schedule detailed herein is a recommendation only. Service experience will dictate actual requirements.

B. PRE-FLIGHT INSPECTION

None.

C. 100 HOUR INSPECTION

Check electrical connections and security of mounting.

D. REPAIR/OVERHAUL

There is no prescribed repair/overhaul period. No adjustment or repair to the inverter can be carried out in the aircraft, but if a malfunction is suspected, the unit should be removed and subjected to the functional test detailed in paragraph 6.

4. LUBRICATION

Not applicable.

5. BENCH SERVICING

A. GENERAL

Repair of the static inverter is limited to replacement of components as detailed in the parts list (paragraph 10) and/or replacement of wiring (see figure 9). If a malfunction is suspected, subject the unit to the functional test detailed in paragraph 6. before disassembly. The unit may not be malfunctioning and may not require servicing.

B. CLEANING

In normal service the internal parts of the static inverter will not require cleaning. If necessary, use a soft brush moistened with solvent (refer to table II).

TABLE II. CLEANING MATERIALS AND COMPOUNDS

Solvent (Inhibited Trichloroethane Solvent M-50, John B. Moore Corp., Nutley, New Jersey, or equivalent)
WARNING: USE SOLVENT IN A WELL-VENTILATED AREA. AVOID BREATHING FUMES OR SKIN CONTACT. DO NOT IMMERSE ELECTRONIC PARTS IN SOLVENT.

C. INSPECTION

(1) Check all components for physical damage.

(2) Check wire insulation and sleeving for deterioration.

(3) Check resistors for discoloration due to overheating.

(4) Check printed wiring board for damage. Examine carefully for hair line cracks in printed wiring.

(5) Examine adjacent components on printed wiring board for shorting due to small metallic particles.

D. REPLACEMENT OF COMPONENTS

(1) Components on Printed Wiring Board (See figure 7)

If a component on the printed wiring board is found to be defective it must be replaced without causing damage to the board. Where the component has wire ends (e.g. a resistor) it is recommended that one wire termination is cut, as close to the body of the component as possible, the component then raised from the board to allow it to be held by pliers, while the remaining wire termination is heated (on the opposite side of the board to the component), allowing removal. If the wire terminations are bent on the underside of the board it may be more convenient to cut both ends and apply the soldering iron to remove the wire ends.

An alternative method is to leave the wire ends in the board and use these as anchor points for the replacement components. With this method there is less possibility of damage to the board but its use depends on available space and length of wires.

When replacing transistor Q3, removal of the heat sink is facilitated by inserting a screwdriver blade into the gap and applying slight pressure to expand the heat sink from the body of the transistor. Do not lever the heat sink with the screwdriver blade between the heat sink and board. Coat the body of the replacement transistor with thermal joint compound before replacing the heat sink. When removing transistors Q3 or Q4, heat must be applied to the electrode connections quickly to allow withdrawal of the transistor from the board. A suitable pencil bit soldering iron with a rating of 25 to 65 watts is recommended. Great care must be taken to ensure that the printed wiring board is not damaged. When the defective components have been removed, the board and particularly the holes must have any excess solder removed. If a soldering iron with a suction attachment is not available, a piece of braiding of the type used on screened connecting wire is useful for removing excess solder. The end of the braiding is dipped in resin flux (acid fluxes should not be used) and applied to the board on the solder to be removed. Applying the soldering iron to the braiding will result in the excess solder being drawn into the braiding. For further application of the

braiding, trim off the end and re-coat with flux. When the holes in the board are cleaned, the serviceable transistor can be installed and soldered. Do not leave the tip of the soldering iron on the transistor connection any longer than necessary to ensure a good soldered joint.

When replacing diodes and capacitors, observe the polarity as marked on the body of the component and the printed wiring board layout (see figure 7).

(2) Power Transistors Q1 and Q2

If it is necessary to replace a power transistor, the following points should be observed:

(a) Use thermal joint compound on the surface of the case (collector) mating with the heat sink. Assemble the transistor to the heat sink using the mica insulator, Teflon insulators, solder tag, washers, screws and nuts as shown in figure 6.

(b) Tighten the two screws evenly to prevent distortion, ensuring that the transistor is seated correctly on the heat sink to give maximum heat transferance.

(c) After soldering the connections but before applying power to the inverter, check the resistance of collector to ground. This should be between 0.3 and 0.5 ohms (with all other components in circuit).

(3) Diode Rectifier, CR1

When replacing this diode, coat with thermal joint compound and fit insulator supplied with replacement diode.

(4) Zener Diode, VR1

When replacing this diode, coat with thermal joint compound but do not fit insulator. Discard the insulator supplied with replacement.

(5) Zener Diode, VR2

When replacing this diode, coat with thermal compound and fit insulator supplied with replacement diode.

NOTE: When reassembling printed wiring board to inverter, secure the four fixing screws with Loctite, Grade E.

TABLE III. REPAIR MATERIALS AND COMPOUNDS
Solder (Federal Specification QQ-S-571, Type Sn63-W-AR-P2).
Thermal Joint Compound (Type 120 Model 128, Wakefield Engineering, Inc., Wakefield, Massachusetts, or equivalent).
Thread-locking Sealant (Loctite Composition E, American Sealants Co., Hartford, Connecticut, or equivalent).

6. FUNCTIONAL TEST

A. POWER SUPPLY

Refer to paragraph 9A.

B. SPECIAL TOOLS AND TEST EQUIPMENT

Refer to paragraph 9B and C.

C. TEST PROCEDURE

The following instructions provide a means of testing the inverter using the test setup shown in figure 2. To facilitate testing, a typical test data recording sheet is shown in figure 3. This figure has been printed on one side only of translucent material to permit reproduction by contact printing or direct copying, such as Xerography.

(1) Short-Circuit Test

(a) Connect test setup as shown in figure 2 but leave load decades and variable transformer disconnected to give a no-load condition.

(b) Set input voltage (M2) to 27.5 vdc and apply a short-circuit across the output. Input current shall not exceed 1.5 amps (M1).

(c) Remove short-circuit. The inverter shall restart into normal operation.

(d) Connect load decades across the output as shown in figure 2. Short-circuit inductance decade and set resistance decade to 33 ohms.

(e) Adjust input to 27.5 vdc (M2) and adjust variable transformer to give full load conditions, 65 watts (M4).

(f) Short-circuit the output of inverter. Input current (M1) shall not exceed 1.5 amps.

(g) Remove short-circuit from output, inverter shall restart into normal operation.

(h) Record on test data sheet that inverter is acceptable or rejected.

(2) Input, Reverse Polarity Test

(a) With the power supply switched off check diode CR1 (see figure 5) with ohmmeter. In the forward direction a reading of approximately 1K shall be obtained and infinity in the reverse direction. If a short-circuit is indicated in either direction do not apply input power until CR1 has been replaced (see paragraph 5.D.(3)).

(b) Apply input power to inverter. Inverter shall operate.

(c) Reverse polarity of power supply to inverter. Inverter shall not operate.

(d) Restore correct polarity and check that inverter operates.

(3) Test No. 1

(a) Disconnect resistance and inductance load decades, and variable transformer to give a no-load condition.

(b) Adjust input voltage to 27.5 volts.

(c) Observe input current (M1) and record on test data sheet (I_{DC}).

(d) Observe output voltage (M3) and record (V_{AC}). This shall be 122 ±5 volts.

(e) Observe frequency (M5) and record (F cps). This shall be 396 ±15 cps. Reconnect load components.

(4) Test No. 2

(a) Set load at 65VA, P.F. = 1, setting resistance decade to 33 ohms and short-circuiting inductance decade. Adjust variable transformer to give a reading of 65 watts (M4).

(b) Observe input current (M1) and record (I_{DC}).

(c) Calculate input power (V_{DC} x I_{DC}) and record (W_{IN}).

(d) Observe output voltage (M3) and record (V_{AC}). This shall be 113 ±5 volts.

(e) Observe frequency (M5) and record (F, cps). This shall be 401 ±15 cps.

(f) Calculate efficiency = $\frac{W_O}{W_I} \times 100$

The efficiency shall not be less than 72%.

(5) Test No. 3

(a) Set load at 65VA, P.F. = 0.4 lag, by setting resistance decade to 33 ohms, removing short-circuit from the inductance decade and setting it to 30 mh. Adjust variable transformer to give a reading of 26 watts (M4).

(b) Observe input current (M1) and record (I_{DC}).

(c) Calculate input power ($V_{DC} \times I_{DC}$) and record (W_{IN}).

(d) Observe output voltage (M3) and record (V_{AC}). This shall be 122 ±4 volts.

(e) Observe frequency (M5) and record (F cps). This shall be 408 ±15 cps.

(f) Calculate efficiency = $\frac{W_O}{W_I} \times 100$

The efficiency shall not be less than 44%.

(6) Test No. 4

(a) Disconnect resistance and inductance load decades, and variable transformer to give a no-load condition. Adjust input voltage to 29.5 volts.

(b) Observe input current (M1) and record (I_{DC}).

(c) Observe output voltage (M3) and record (V_{AC}). This shall be 131 ±5 volts.

(d) Observe frequency (M5) and record (F cps). This shall be 400 ±5 cps.

(e) Reconnect load components.

(7) Test No. 5

(a) Set load at 65 VA, P.F. = 1, by setting resistance decade to 33 ohms and short-circuiting inductance decade. Adjust variable transformer to give a reading of 65 watts (M4).

(b) Observe input current (M1) and record (I_{DC}).

(c) Calculate input power (V_{DC} x I_{DC}) and record (W_{IN}).

(d) Observe output voltage (M3) and record (V_{AC}). This shall be 122 ±5 volts.

(e) Observe frequency (M5) and record (F cps). This shall be 404 ±15 cps.

(f) Calculate efficiency = $\frac{W_O}{W_I}$ x 100

The efficiency shall not be less than 70%.

(8) Test No. 6

(a) Set load at 65 VA, P.F. = 0.4 lag, by setting resistance decade to 33 ohms, removing short circuit from the inductance decade and setting it to 30 mh. Adjust variable transformer to give a reading of 26 watts (M4).

(b) Observe input current (M1) and record (I_{DC}).

(c) Calculate input power (V_{DC} x I_{DC}) and record (W_{IN}).

(d) Observe output voltage (M3) and record (V_{AC}). This shall be 131 ±5 volts.

(e) Observe frequency (M5) and record (F cps). This shall be 410 ±15 cps.

(f) Calculate efficiency = $\frac{W_O}{W_I}$ x 100

The efficiency shall not be less than 42%.

(9) Test No. 7

(a) Adjust input voltage to 18.5 volts. Disconnect resistance and inductance decades, and variable transformer to give a no-load condition.

(b) Observe input current (M1) and record (I_{DC}).

(c) Observe output voltage (M3) and record (V_{AC}). This shall be 79 ±5 volts.

(d) Observe frequency (M5) and record (F cps). This shall be 386 ±15 cps.

(10) Test No. 8

(a) Set load at 65 VA, P.F. = 1, by setting resistance decade to 33 ohms and short-circuiting inductance decade. Adjust variable transformer to give a reading of 65 watts (M4).

(b) Observe input current (M1) and record (I_{DC}).

(c) Calculate input power (V_{DC} x I_{DC}) and record (W_{IN}).

(d) Observe output voltage (M3) and record (V_{AC}). This shall be 61 ±5 volts.

(e) Observe frequency (M5) and record (F cps). This shall be 391 ±15 cps.

(f) Calculate efficiency = $\frac{W_O}{W_I} \times 100$

The efficiency shall not be less than 69%.

(11) Test No. 9

(a) Set load at 65 VA, P.F. = 0.4 lag, by setting resistance decade to 33 ohms, removing short circuit from the inductance decade and setting it to 30 mh. Adjust variable transformer to give a reading of 26 watts (M4).

(b) Observe input current (M1) and record (I_{DC}).

(c) Calculate input power (V_{DC} x I_{DC}) and record (W_{IN}).

(d) Observe output voltage (M3) and record (V_{AC}) this shall be 83 ±5 volts.

(e) Observe frequency (M5) and record (F cps). This shall be 396 ±15 cps.

(f) Calculate efficiency = $\frac{W_O}{W_I} \times 100$

The efficiency shall not be less than 52%.

(12) Test No. 10

(a) Disconnect output load from connector pin C and connect to pin F (26V output tap).

(b) Disconnect resistance and inductance load decades, and variable transformer to give a no-load condition.

(c) Set input voltage to 27.5 volts.

(d) Observe input current (M1) and record (I_{DC}).

(e) Observe output voltage (M3) and record (V_{AC}). This shall be 27 ±3 volts.

(f) Observe frequency (M5) and record (F cps). This shall be 396 ±15 cps.

(g) Reconnect load components.

(13) Test No. 11

(a) Set load at 30 VA, P.F. = 1, by setting resistance decade to 6 ohms and short circuit inductance decade. Adjust variable transformer to give a reading of 30 watts (M4).

(b) Observe output voltage (M3) and record (V_{AC}). This shall be 26 ±3 volts.

(c) Observe frequency (M5) and record (F cps). This shall be 401 ±15 cps.

(14) Test No. 12

(a) Set load at 30 VA, P.F. = 0.4 lag, by setting resistance decade to 6 ohms and inductance decade to 5 mh. Adjust variable transformer to give a reading of 12 watts (M4).

(b) Observe output voltage (M3) and record (V_{AC}). This shall be 27 ±3 volts.

(c) Observe frequency (M5) and record (F cps). This shall be 404 ±15 cps.

(d) Disconnect test setup.

7. TROUBLE SHOOTING

A. GENERAL

In the event of a malfunction, the inverter should be connected to the test setup (see figure 2).

To determine the nature of the malfunction a full-load test should be carried out (see paragraph 6.C.(4) Test No. 2). This will usually show a fault condition which can be placed in one of the following categories:

No output

Low voltage

Incorrect frequency.

B. NO OUTPUT

When power (27.5 v) is applied to the input of the inverter and no output is obtained, providing the input current is not excessive, i.e., power supply tripped or fuses blown, troubleshooting can proceed with power applied, after first removing the cover, secured by three screws.

The first step is to ascertain that the inverter is oscillating. A 400 cps audible signal usually emanates from the output transformer T1 but a visual check can be obtained by connecting an oscilloscope to the collectors of transistors Q1 and Q2 to ground, in turn. The trace obtained, if the transistors are oscillating will be similar to the trace shown in figure 4.

If it is found that the inverter is oscillating, make oscilloscope checks in the secondary circuit of the output transformer (T1) to find the point where the 400 cps signal is lost due to an open circuit condition.

In the majority of "no output" faults, the device will not be oscillating and in this condition proceed by checking the dc input voltage through the reverse polarity protection diode CR1, L1 to the emitters of transistors Q1 and Q2.

Check the base voltage of Q1 and Q2 (Table IV), checking R4, R5, CR8, CR9 and the secondary winding of T2 if no potential exists. If the voltage checks are satisfactory connect a jumper wire from terminal 1 on the printed wiring board to the collector of Q3. If the inverter commences to oscillate, the fault is in the protection circuit (Q3, Q4 or associated components). Remove the jumper wire from terminal 1 to Q3 collector and connect it between the collector and emitter of Q4. This effectively bypasses Q4 and its associated components, if no other fault exists, Q3 will be switched on and the inverter will operate. Remove

the jumper and proceed to locate the fault in the Q4 stage by checking each component. If connecting the jumper wire across Q4 does not produce oscillation, check the components including the transistor in the Q3 stage.

NOTE: A typical waveform of the short-circuit protection pulses is shown in figure 4. This waveform will be produced only under short-circuit conditions.

TABLE IV. VOLTAGE MEASUREMENTS

ELECTRODE	Q1	Q2	Q3	Q4
EMITTER	27.3 V	27.3 V	28.0 V	0.65 V
BASE	27.0 V	27.0 V	27.0 V	1.4 V
COLLECTOR	0.1 V	0.1 V	27.5 V	0.75 V

The above voltages are typical using a Avometer Model 8 connected between the appropriate transistor electrode connection and ground. Input voltage 27.5 V - no load condition.

If the diode CR1 goes open circuit, loss of output will result, requiring the replacement of CR1.

C. LOW OUTPUT

If the output voltage is low, check the transistor voltages as shown in table IV. If any incorrect readings are obtained check the components associated with the particular transistor(s).

Low gain of either Q1 or Q2 will cause low output (see figure 4) as will insufficient drive to the base of Q3. The latter can be confirmed by placing a jumper wire from collector to emitter of Q4.

D. INCORRECT FREQUENCY

If the inverter is producing a low or high frequency output, the following steps should be taken to correct the fault.

(1) Check the voltage stabilization circuit VR2, CR14 through CR17 and ensure that the Zener diode is controlling at 24 volts ±5%.

(2) If VR2 is inoperative, necessitating replacement, it might be found that due to variation in Zener diode characteristics that the frequency is still out of tolerance.

(3) If a supply of Zener diodes is not available to enable selection of a suitable one, the taps on the primary winding of timing transformer T2 can be altered but it is suggested that this method be used only as a last resort to correct the frequency. The black and brown taps on the transformer are fine adjustments and coarse adjustment is given by the blue, green and violet taps.

8. STORAGE INSTRUCTIONS

Pack the unit in a sealed, padded carton for storage or shipment; a dessicant must be included. (Refer to table V.)

The unit may be stored for an indefinite period. Before putting the unit into service, it should be subjected to the functional test as detailed in paragraph 6.

TABLE V. STORAGE MATERIALS AND COMPOUNDS

Desiccant (Military Specification MIL-D-3464)

9. POWER SUPPLY, SPECIAL TOOLS AND TEST EQUIPMENT

A. POWER SUPPLY

The power supply, used during functional test and trouble shooting of the static inverter, must provide 0 to 30 volts dc at 4 amperes (minimum). It is strongly recommended that the power supply be provided with built-in current limiting facilities to protect the inverter during trouble shooting. The power supply unit listed in table VI meets this requirement.

B. SPECIAL TOOLS

Not applicable.

C. TEST EQUIPMENT

Test equipment required for functional testing and trouble shooting is listed in table VI.

TABLE VI. TEST EQUIPMENT

Nomenclature	Part, Model or Type Number	Application
Test Setup	See figure 2.	Functional test.
Oscilloscope	Model 502A, Tektronic Inc., Beaverton, Oregon, or equivalent.	Trouble shooting.
Multimeter	Avometer Model 8, Avnet Instrument Corp., Plainsview, New York, or equivalent.	Trouble shooting.
Power Supply: 0 to 36 volts, 0 to 5 amperes	Model 808A, Harrison Laboratories Inc., Berkeley Heights, New Jersey, or equivalent.	Functional test and trouble shooting.

10. ELECTRONIC PARTS LIST

All electronic components are listed in table VIII, arranged in alpha-numerical sequence by reference designation. Applicable vendor codes are listed in table VII.

TABLE VII. VENDOR CODES

Code	Vendor Name and Address
V07217	Garrett Manufacturing Limited, Rexdale, Ontario, Canada.
V35005	Dale Electronics Canada Ltd., Toronto, Ontario, Canada.
V56289	Sprague Electric Co., North Adams, Massachusetts.
V89869	Delco Radio Division of General Motors Corp., Detroit, Michigan.

TABLE VIII. ELECTRONIC PARTS LIST

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	VENDOR CODE	TYPE OR VALUE
CR1	Diode	1N3209	-	-
CR2 thru CR6	Diode	1N645	-	-
CR8 thru CR10	Diode	1N645	-	-
CR14 thru CR17	Diode	1N645	-	-
C1	Capacitor, Tantalum	CS13BF476M	-	47 µF ±20%, 35 vdcw
C2	Capacitor, Tantalum	CS13BF335M	-	3.3 µF ±20%, 35 vdcw
C3	Capacitor, Tantalum	CS13BJ104M	-	0.1 µF ±20%, 6 vdcw
C4	Capacitor, Plastic	260P47402T12	56289	0.47 µF ±20%, 200 vdcw
C5, C6	Capacitor, Plastic	CP05A1KC473K3	-	0.047 µF ±10% 200 vdcw
J1	Receptacle	MS3112E10-6P	-	-
L1	Inductor, Radio Noise	629622-1	07217	70 µH ±20% at 1000 cps
L2, L3	Inductor, Radio Noise	629689-1	07217	130 µH ±20% at 1000 cps
Q1, Q2	Transistor	DTG2400	89869	-
Q3	Transistor	2N2801	-	-
Q4	Transistor	2N697	-	-
R1, R11	Resistor, Fixed, Film	RL20S102J	-	1K ±5%, 1/2 w

TABLE VIII. ELECTRONIC PARTS LIST (Cont'd)

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER	VENDOR CODE	TYPE OR VALUE
R2	Resistor, Fixed, Film	RL20S222J	-	2.2K ±5%, 1/2 w
R3	Resistor, Fixed, Film	RL20S272J	-	2.7K ±5%, 1/2 w
R4, R5	Resistor, Fixed, Film	RL20S270J	-	27 ohms ±5%, 1/2 w
R6	Resistor, Fixed, Wirewound	RS1A1K	35005	1K ±3%, 1 w
R7	Resistor, Fixed, Film	RL20S103J	-	10K ±5%, 1/2 w
R8	Resistor, Fixed, Film	RL20S104J	-	100K ±5%, 1/2 w
R9	Resistor, Fixed, Wirewound	RH5	35005	180 ohms ±3%, 5 w
R10	Resistor, Fixed, Film	RL20S202J	-	2K ±5%, 1/2 w
R12	Resistor, Fixed, Film	RL20S101J	-	100 ohms ±5%, 1/2 w
R13	Resistor, Fixed, Film	RL20S471J	-	470 ohms ±5%, 1/2 w
T1	Transformer, Output	629624-1	07217	-
T2	Transformer, Timing	629630-1	07217	-
VR1	Diode, Zener	1N2990B	-	33 V_Z ±5%
VR2	Diode, Zener	1N2986B	-	24 V_Z ±5%

11. SUPPLEMENTARY DATA

A. GENERAL

For convenience, all illustrations are printed as throw-out pages (blank aprons) and are located at the end of the manual. This enables an illustration to be viewed at the same time as the applicable text.

B. TEST SETUP

Figure 2 shows the test setup schematically. This illustration is printed on translucent paper and may be diazo copied.

C. TEST DATA RECORDING SHEET

A typical sheet is shown in figure 3. This illustration is printed on translucent paper and may be diazo copied. Note that copies of this sheet can be used for recording actual test results.

D. WAVEFORMS

Typical waveforms are illustrated in figure 4. This illustration is printed on translucent paper and may be diazo copied.

E. SCHEMATIC DIAGRAM

Figure 5 is a schematic diagram for the static inverter. This illustration is printed on translucent paper and may be diazo copied.

F. MAIN CHASSIS COMPONENT LAYOUT

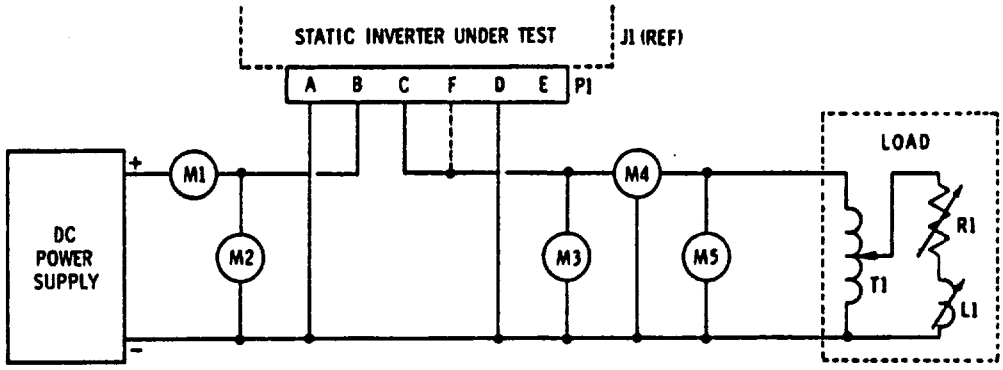
Figure 6 shows the components on the main chassis. This illustration is printed on translucent paper and may be diazo copied.

G. PRINTED WIRING BOARD LAYOUT

Figures 7 and 8 show the component location and printed wiring respectively. Note that these two illustrations are backed up in register so that, by holding the page up to the light, the interconnections can be seen.

H. WIRING DIAGRAM

Figure 9 is a wiring diagram for the static inverter. This illustration is printed on translucent paper and may be diazo copied.



DC POWER SUPPLY..... 0-30 VOLTS, 5 AMPS (SEE TABLE VI)
J1 (REF)..... RECEPTACLE, SEE TABLE I (LEADING PARTICULARS)
L1 ..... INDUCTANCE, DECADE, GENERAL RADIO TYPE 1490C OR EQUIVALENT
M1..... AMMETER, DC, 0-5 AMPS
M2..... VOLTMETER, DC, 0-30 VOLTS
M3..... VOLTMETER, TRUE RMS, 0-150 VOLTS CRITERION MODEL THX1SP OR EQUIVALENT
M4..... WATTMETER, 100 WATT, WESTON MODEL 432 OR EQUIVALENT
M5..... FREQUENCY COUNTER, BERKELEY TYPE 7360 OR EQUIVALENT
P1 ..... CONNECTOR, SEE TABLE I (LEADING PARTICULARS)
R1..... RESISTANCE, DECADE, CLAROSTAT MODEL 240C OR EQUIVALENT
T1..... VARIABLE TRANSFORMER, SUPERIOR ELECTRIC MODEL 117U OR EQUIVALENT

Static Inverter Part Number 607742-1-1
Test Setup
Figure 2

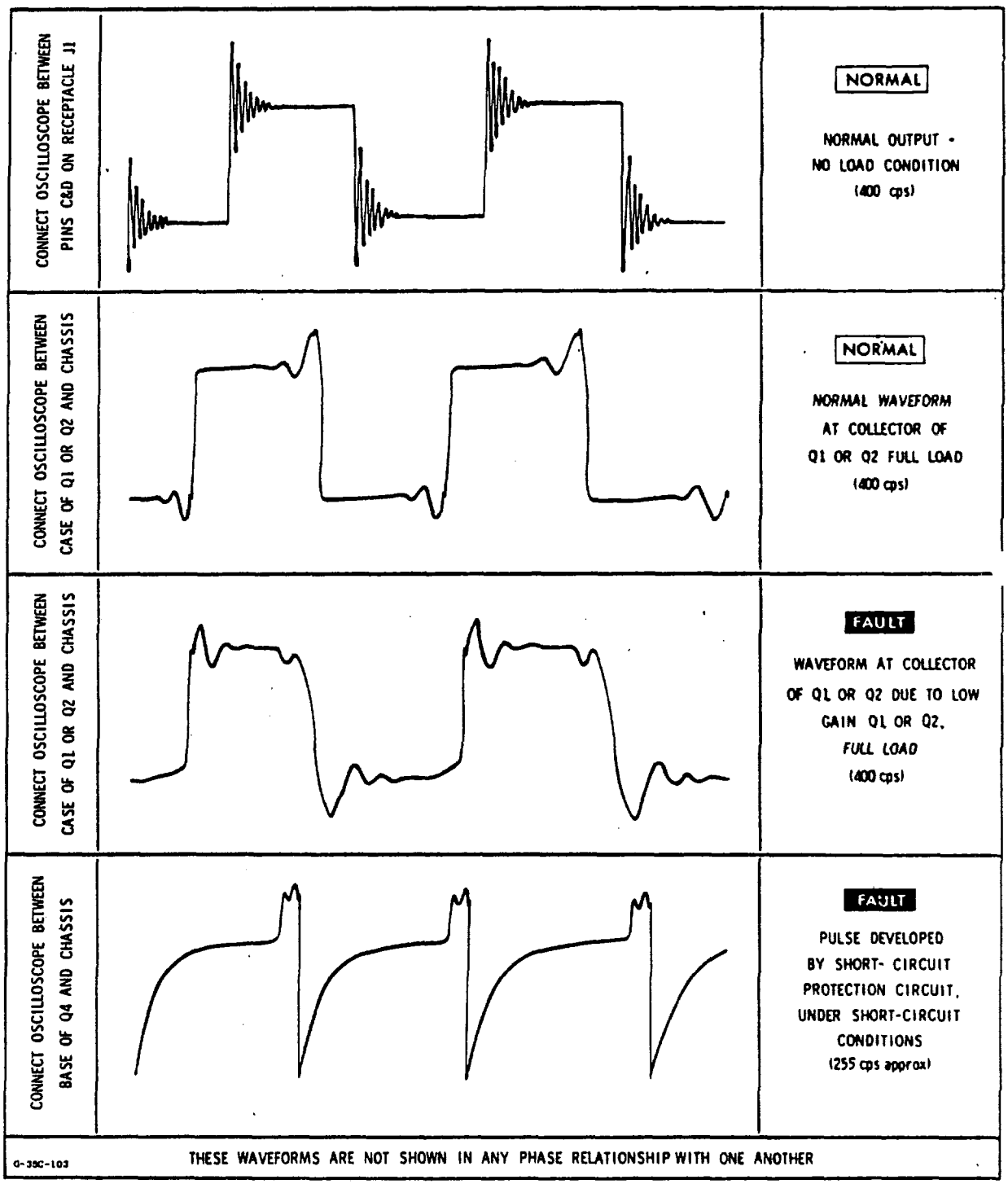
STATIC INVERTER (65VA)

SERIAL NUMBER _____ PART NUMBER 607742-1

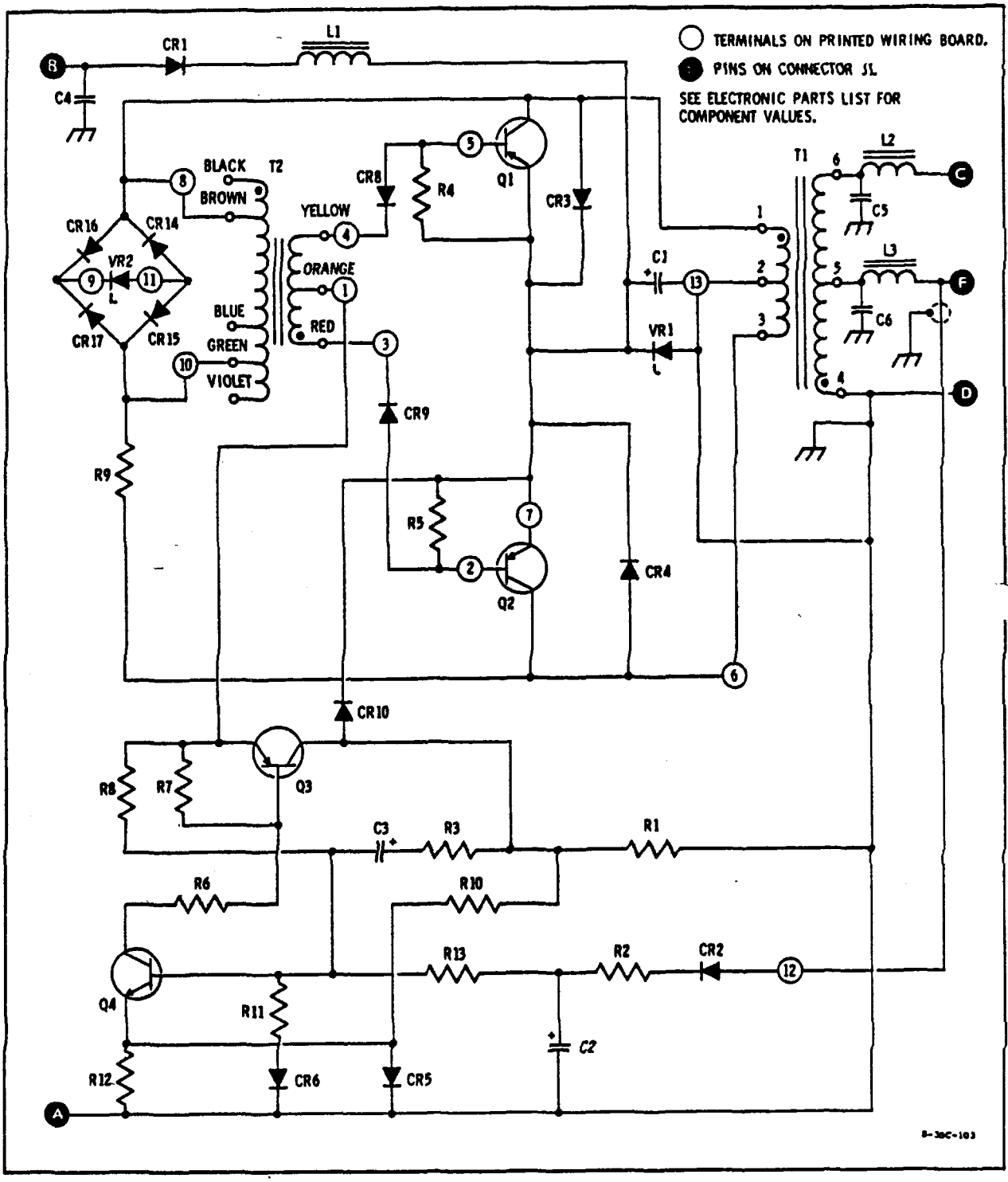
TEST NO.	INPUT VOLTS (M2)	I_{DC} (M1)	W_{IN}	W_O (M4)	P.F.	VA	EFFICIENCY %	V_{AC} (M3)	F CPS (M5)
1	27.5		-	-	-	-	-		
2	27.5			65	1.0	65			
3	27.5			26	0.4	65			
4	29.5		-	-	-	-	-		
5	29.5			65	1.0	65			
6	29.5			26	0.4	65			
7	18.5		-	-	-	-	-		
8	18.5			65	1.0	65			
9	18.5			26	0.4	65			
10	27.5		-	-	-	-	-		
11	27.5			30	1.0	30			
12	27.5			12	0.4	30			

SHORT-CIRCUIT TEST	REVERSE POLARITY TEST
_____	_____

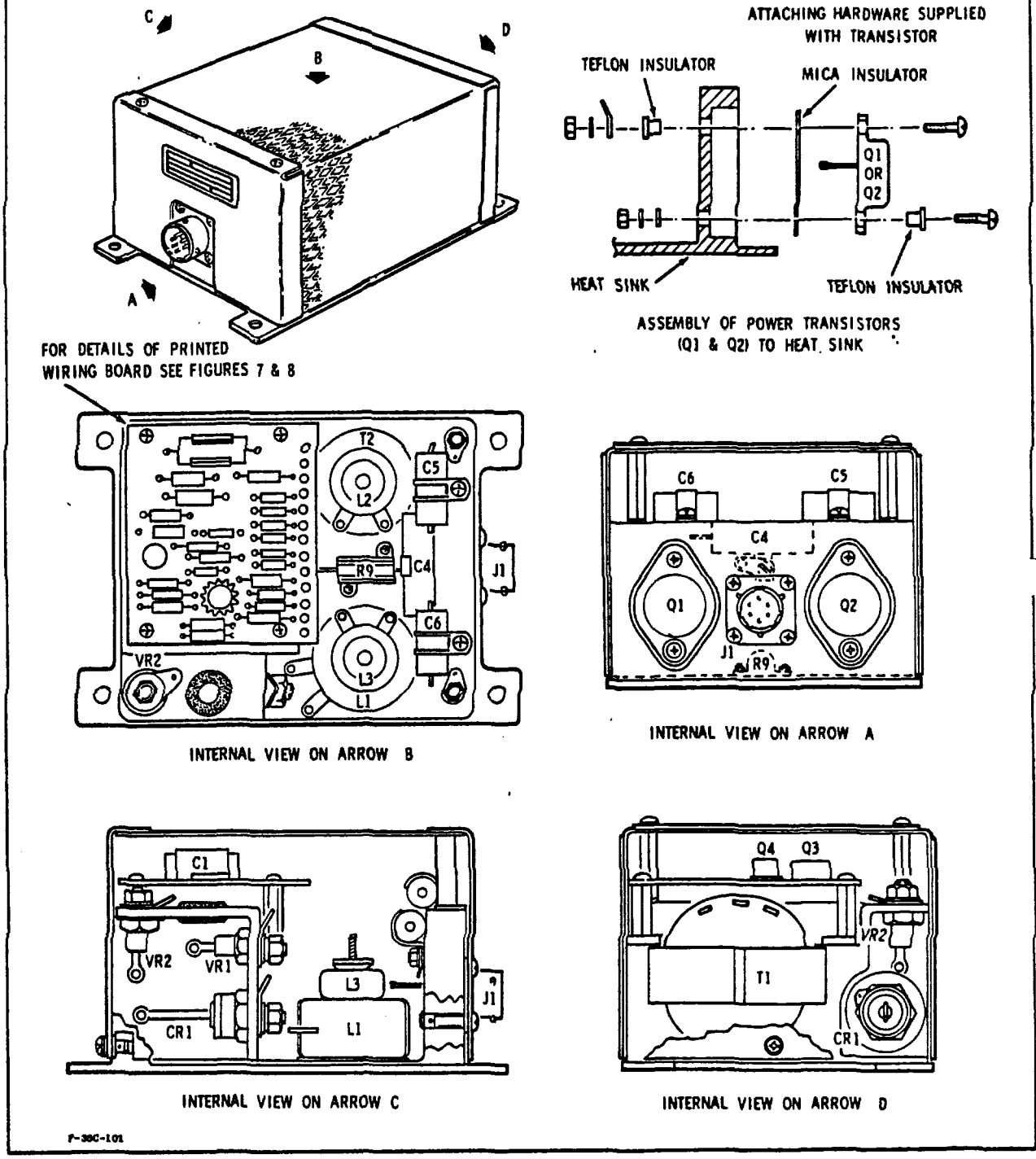
Typical Test Data Recording Sheet
Figure 3



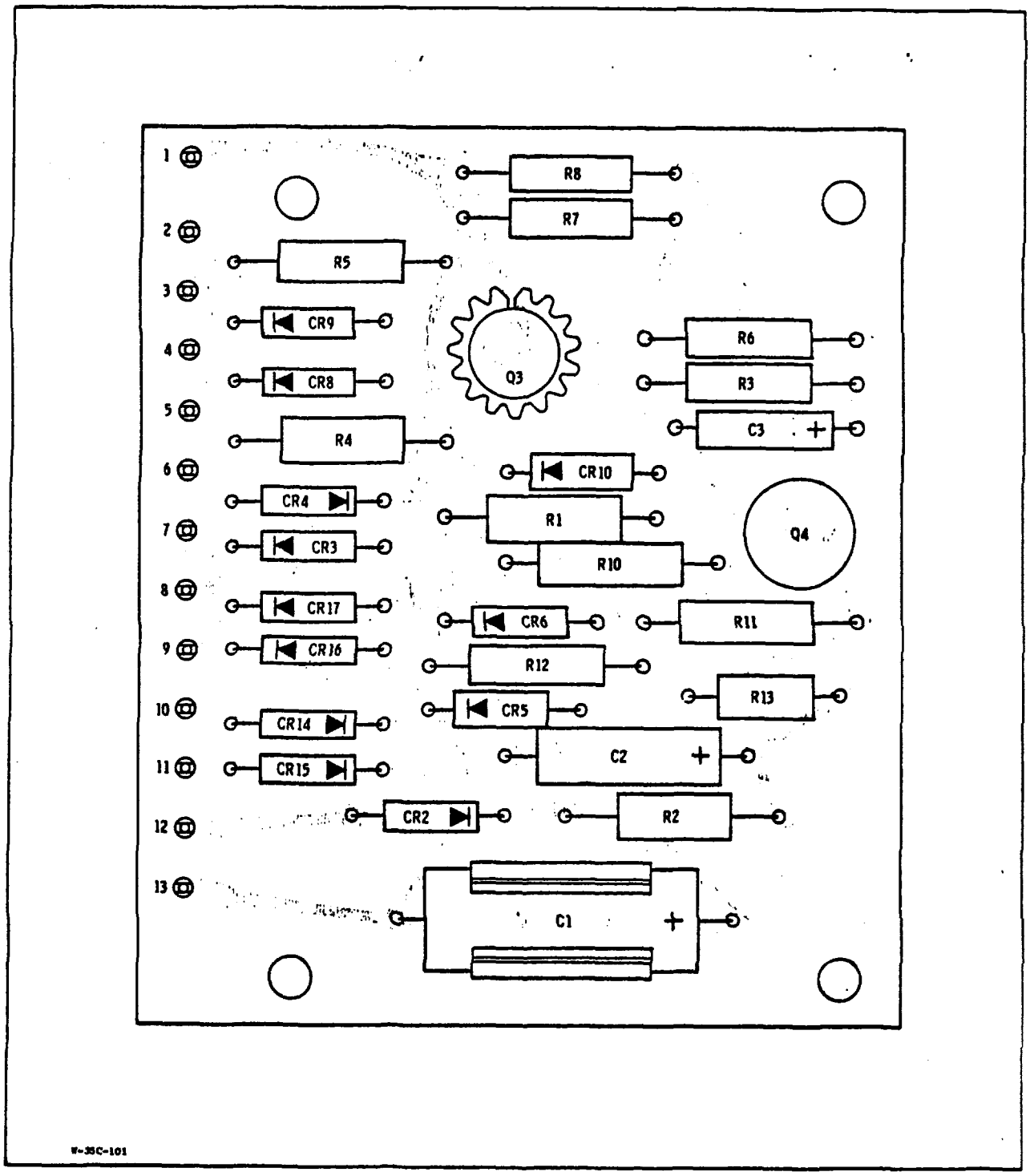
Typical Waveforms
Figure 4



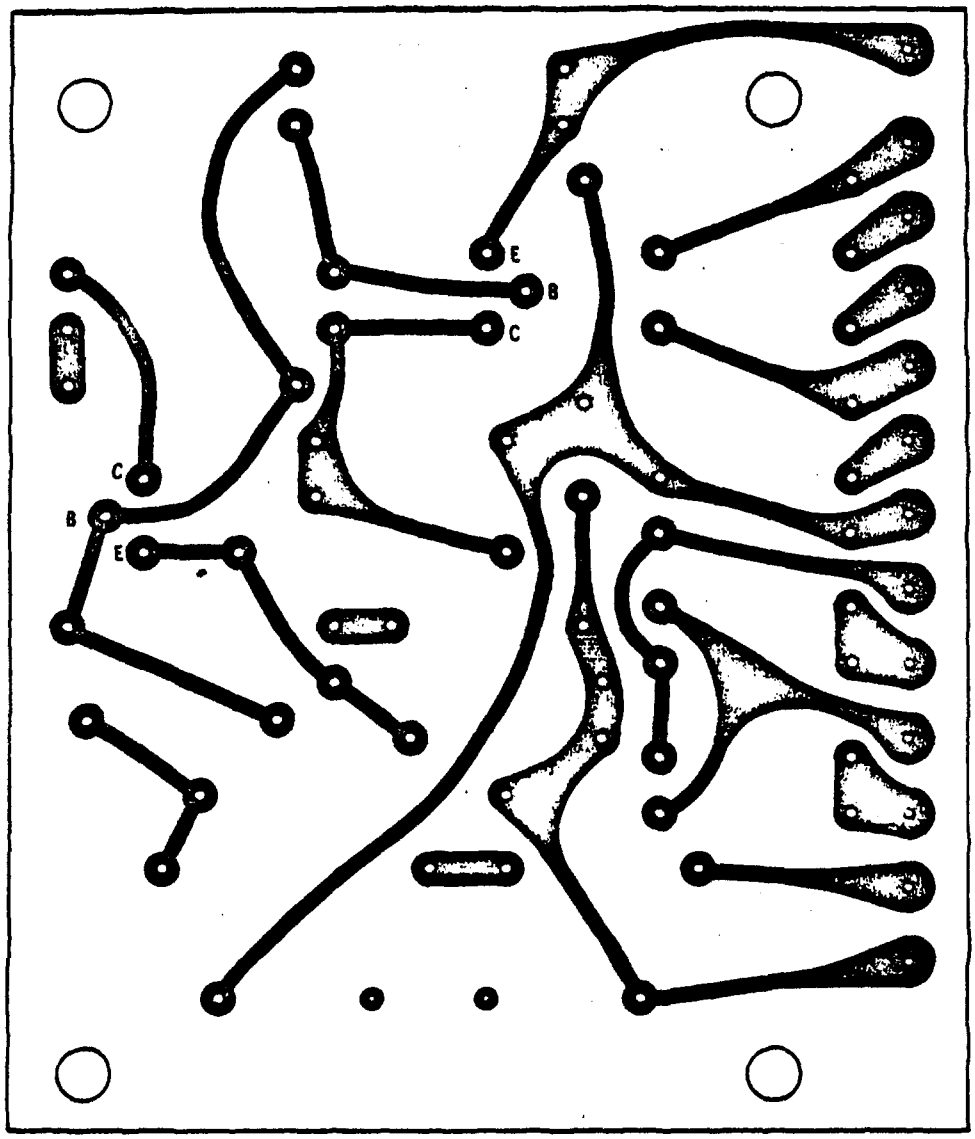
Static Inverter Part Number 607742-1-1
Schematic Diagram
Figure 5



Static Inverter Part Number 607742-1-1
Main Chassis Component Layout
Figure 6

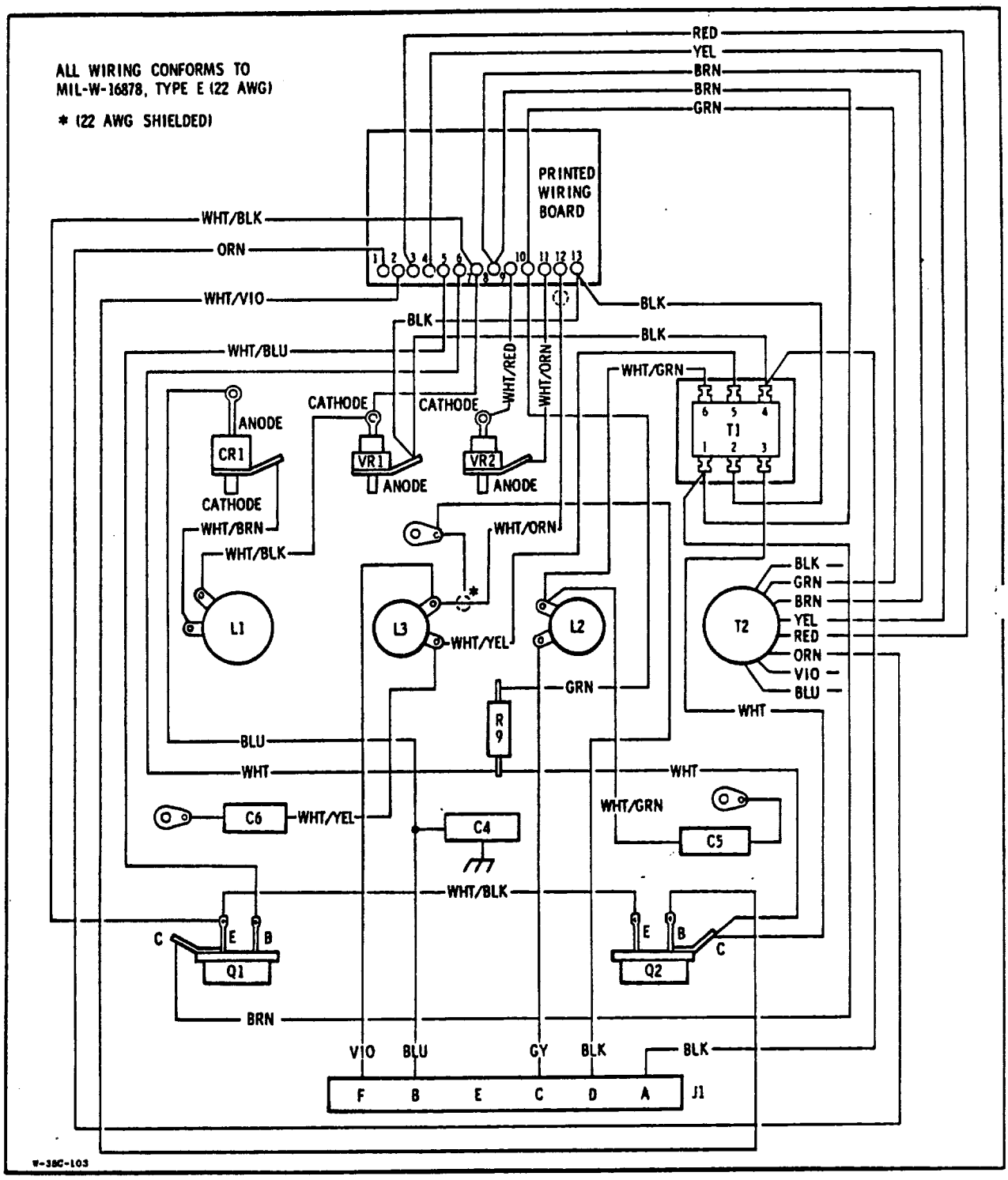


Printed Wiring Board, Components Side A
Component Location
Figure 7



F-36C-102

Printed Wiring Board, Printed Wiring Side B
Printed Wiring
Figure 8



Static Inverter Part Number 607742-1-1
Wiring Diagram
Figure 9

INSTRUCTIONS

GEI-20915C
SUPERSEDES GEI-20915

D-C REVERSE-CURRENT AIR-CIRCUIT BREAKER

TYPE XRP12A

LOW VOLTAGE SWITCHGEAR DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.

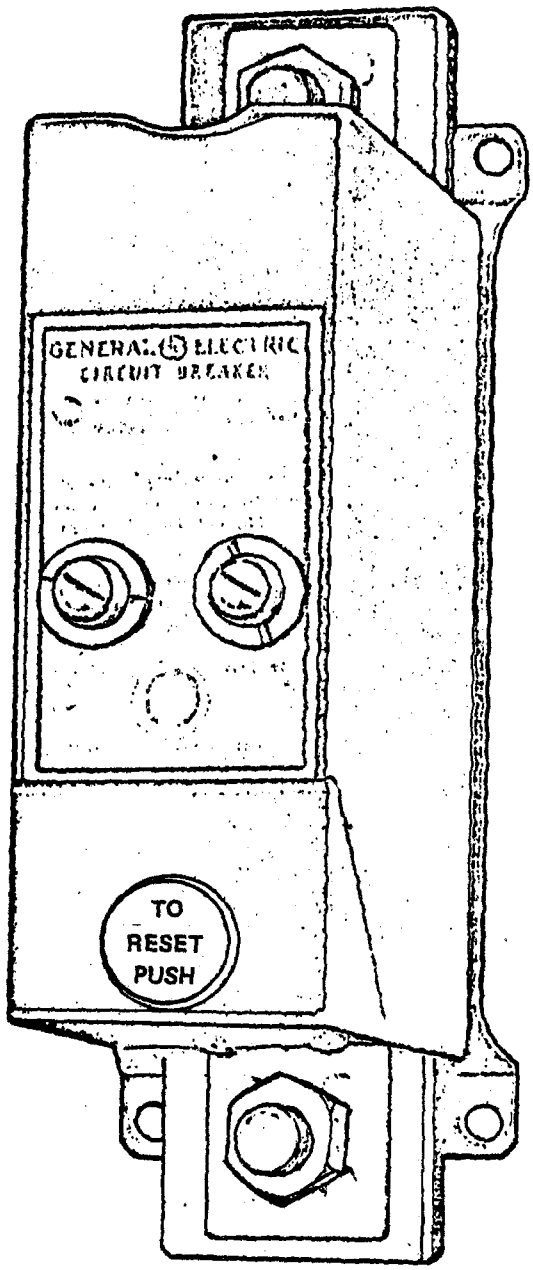


Fig. 1 (8001198) G-E Reverse-Current Circuit Breaker Type XRP12A

D-C REVERSE - CURRENT AIR - CIRCUIT BREAKER TYPE XRP12A

GENERAL INFORMATION

The Type XRP air circuit breaker is a circuit-protective device designed especially for aircraft use. It is connected in the generator circuit between the generator relay and the positive bus. In case of an electrical fault occurring in the generator, the generator relay, or their connecting cables, the Type XRP breaker will trip on the reversed flow of current from the bus. This will interrupt the current, and at the same time, an auxiliary switch on the Type XRP breaker opens the shunt-field circuit of the faulted generator. Interruption of the field "kills" the generator excitation so that it cannot continue to feed current into the fault.

OPERATING CHARACTERISTICS

The standard Type XRP breaker Model 12XRP12A1 shown in Fig. 1 is suitable for use with standard 28.5 volt aircraft generators of either 300 or 400 ampere rating.

The breaker is electrically tripped on reverse current only, and is manually reset after removal of the fault.

Reverse currents occur in normal operation. Large values exceeding the generator rating are experienced during recovery from system faults, by interruption of the field circuit, etc. Small values occur when, for example, the generator speed is reduced to a point at which its generated voltage is lower than the bus voltage. In this case, the generator relay operates to disconnect the generator from the bus. The Type XRP12A does not trip for these normal reverse currents because the reverse current-time characteristic shown in Fig. 2 gives adequate time delay. However, all new system designs should be tested under service conditions to assure that the characteristic of Fig. 2 is satisfactory for that system.

When a fault occurs in the generator circuit, however, the reverse current may rise quickly to values far in excess of the interrupting ability of the generator relay. In such a case, the Type XRP12A device rapidly trips and clears the fault.

A typical external connection diagram, Fig. 3, shows the application of the Type XRP breaker.

RATINGS

The breaker has a continuous rating of 30 volts and 300 amps, a current-interrupting capacity of 15,000 amperes and has a minimum reverse-current trip setting of 300 amperes. The band of operation is given in Fig. 2.

The continuous current rating of the breaker may be increased to 400 amperes on applications where two cables of size 1/0 or larger are used at each terminal of the breaker. The minimum reverse-current trip setting will remain at 300 amperes for this increased rating.

UNPACKING

The breaker should be unpacked and inspected for possible damage in shipment. If injury or rough handling is evident, a damage claim should be filed at once with the transportation company and the nearest General Electric Sales Office should be notified.

INSTALLATION

Outline internal connections and mounting dimensions are shown in Fig. 4. Four holes in the base are provided for mounting the breaker. The mounting can be made in any position on any flat surface.

After mounting, external connection should be made as shown in Fig. 3. Particular attention should be given to insure that the polarities are as indicated, i.e., the generator cable should be connected to the terminal marked "generator" (see Fig. 4) and the positive bus should be connected to the terminal marked " + bus".

OPERATION AND MAINTENANCE

As the breaker only functions to remove a fault in the generator circuit, its operations will be limited in number. In the event of such an operation, the generator circuit should be completely checked and the insulation failure corrected. The operation is indicated by an orange signal appearing through the hole in the nameplate of the breaker. With the insulation failure corrected, the Type XRP breaker should be given a millivolt drop test as outlined below to check the

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

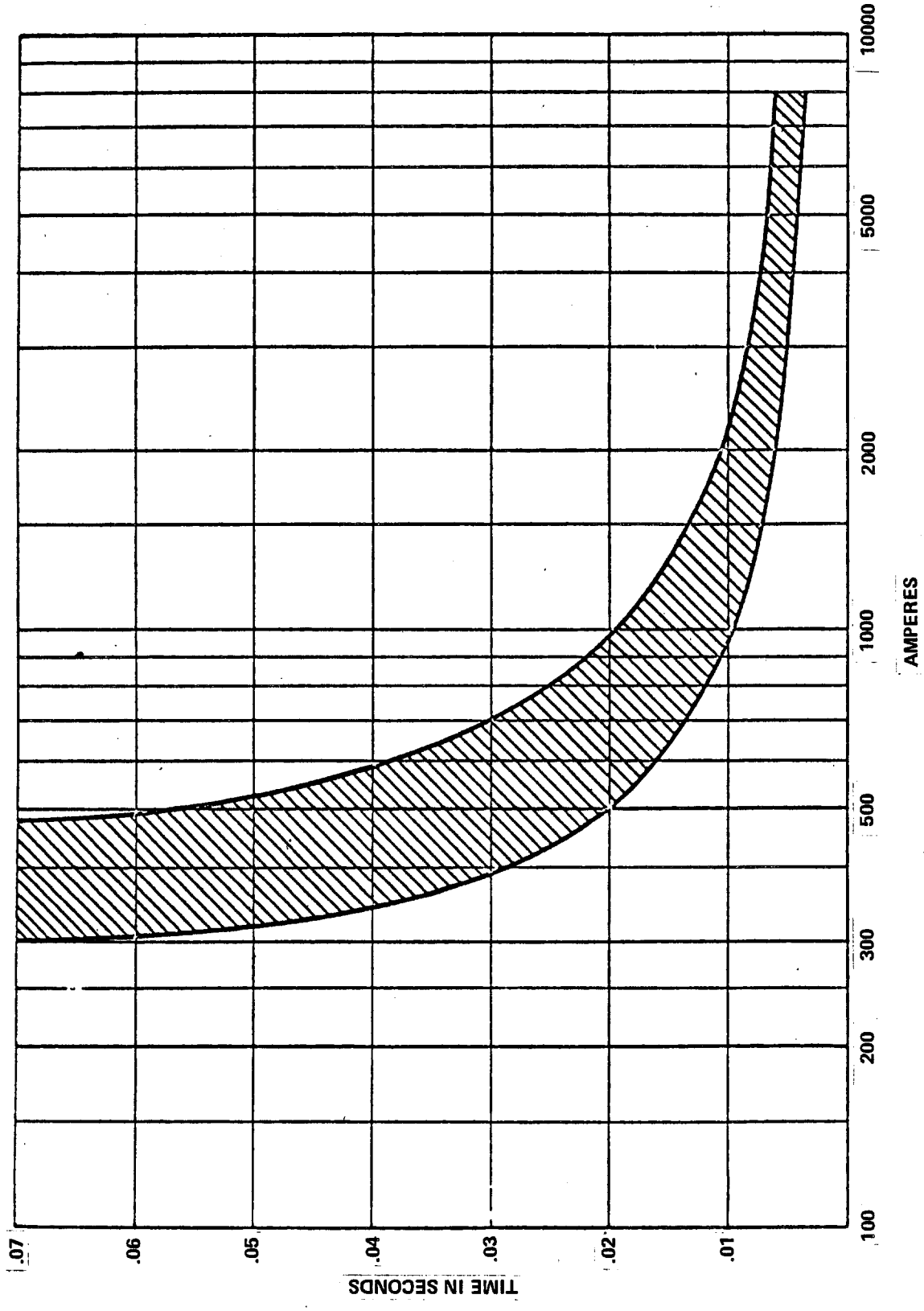


Fig. 2 (K-6400176) Time-Current Characteristic For Type XRP12A Application Showing Time To Release Trip Armature (Time To Interruption Add Approximately .006 Second.)

condition of the main contacts. The millivolt drop after a tripping operation should not exceed 100 millivolts. The breaker can be manually reclosed by pushing on the bell crank (Fig. 6) through the flexible reset cover as indicated in Fig. 5, making the generator available to the system through the generator relay.

The breaker may also serve to remove the generator in such case where the generator relay fails to disconnect the circuit provided that there is sufficient connected system capacity to supply the load and to produce reverse currents to the generator of tripping magnitude.

Should the breaker be damaged or fail to function correctly, it should be replaced. For the safety of equipment and plan, the system should be deenergized when working on the Type XRP breaker.

INSPECTION AND TEST

Being a protective device and not subject to control operation, this breaker should require no more that a general inspection and calibration test after 1000 hours or at the time the plane receives a complete overhaul. A millivolt drop test should be made after each operation of a breaker, to indicate the condition of the contacts.

To test the breaker, a d-c source capable of supplying approximately 400 amperes in increments of 10 amperes or less is required. The positive bus should be connected to the terminal marked " + bus" to produce a reverse current through the breaker. The trip should be within the limits indicated by Fig. 2. The nominal setting is 375 amps.

A millivolt drop test on the breaker gives an electrical check of the main contacts. Applying 400 amps with the positive bus connected to the "generator" terminal the drop through the breaker should not exceed 100 millivolts. (NOTE: If a breaker has been standing for a considerable time with contacts open, its millivolt drop may exceed 100 mv.) This measurement should be made on the contact bar and not through any terminal stud or lugs. In general, it is necessary to switch the positive bus to the generator terminal to prevent its tripping with the 400 amps. The condition of the main contacts will vary the millivolts reading and if the value exceeds the above limits, the breaker is not satisfactory for further use without repair.

The protective case as one of its functions is intended to maintain the armature gap free from foreign materials and should not be removed at any time before or while the breaker is in service. As most repairs will require special tools, it is recommended that the breaker be returned to the factory without removing the protective case.

In Fig. 6, the protective case has been removed to show the internal construction and some of the parts have been marked for identification purposes. Under special conditions where a disassembly is needed and where the techniques used in manufacturing can be applied a partial disassembly showing the main and arcing contacts can be made by removing the four screws from the magnet supports and the four screws from the frame supports. As the mechanism is removed from the base, the latch will be released and the bell crank will operate to the tripped position. An arc shield is located between the frame support post and the base and is assembled with a post to stop the latch armature.

RENEWAL PARTS

The replacement requirements for the Type XRP breaker should be very small and it is recommended that spare breakers be carried in stock rather than several parts requiring special assembly tools for utilization. Orders should be addressed to the nearest sales office of the General Electric Company with quantity required, name or description of part, and complete nameplate data.

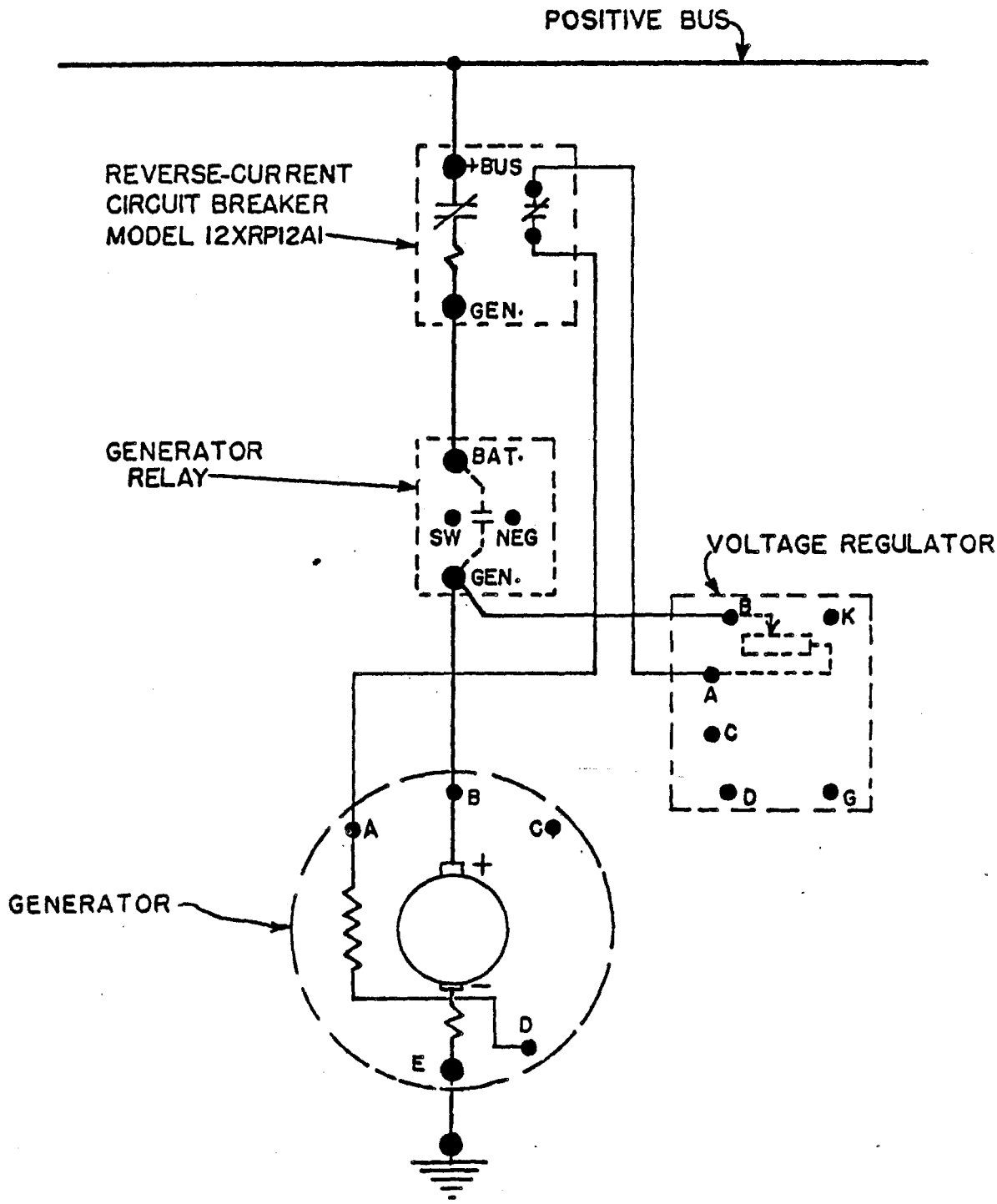


Fig. 3 (K-6306605) External Connection Diagram For Reverse-Current Circuit Breaker Type XRP12A

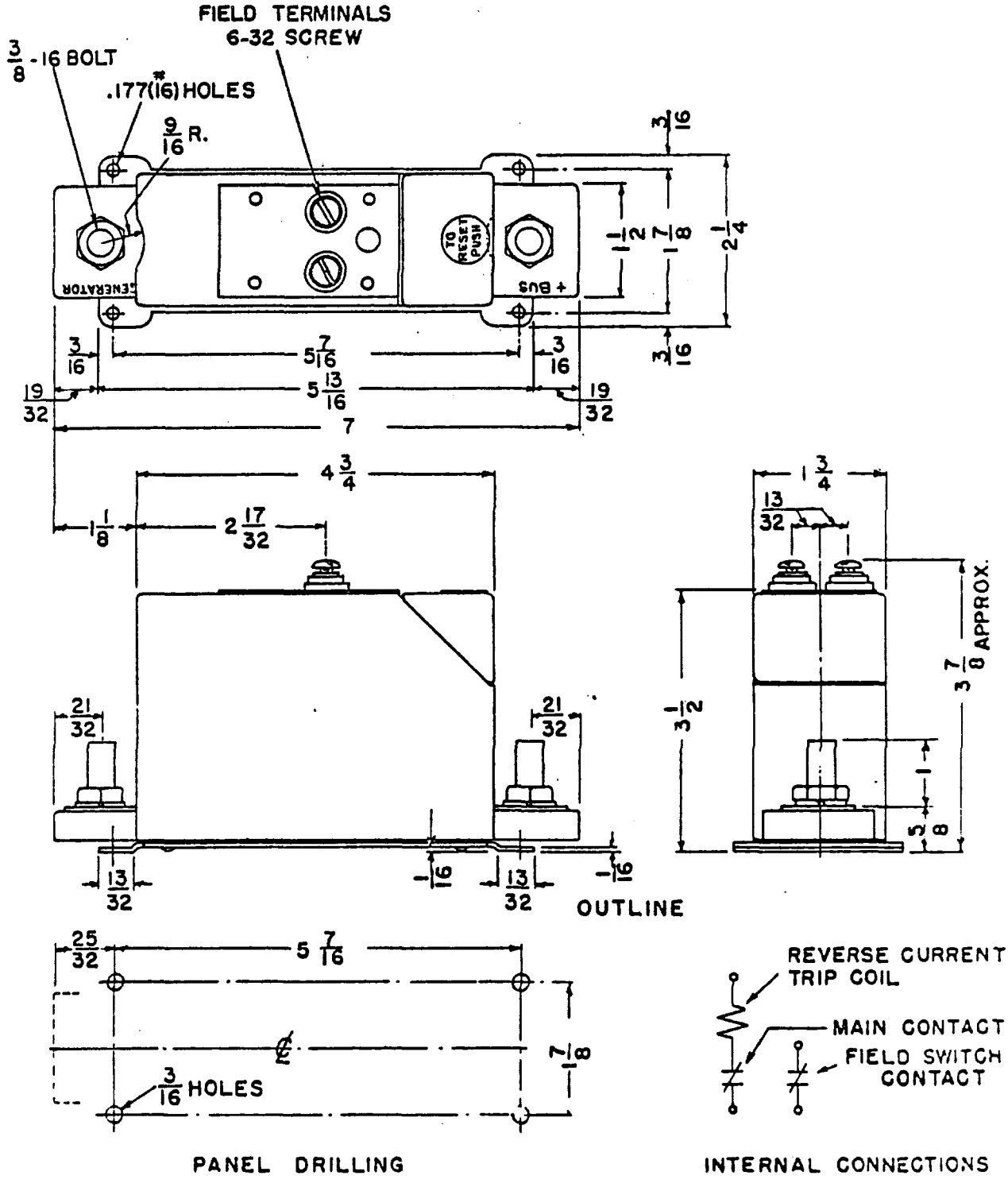


Fig. 4 (K-6400163) Outline, Panel Drilling And Internal Connections For Circuit Breaker Type XRP12A

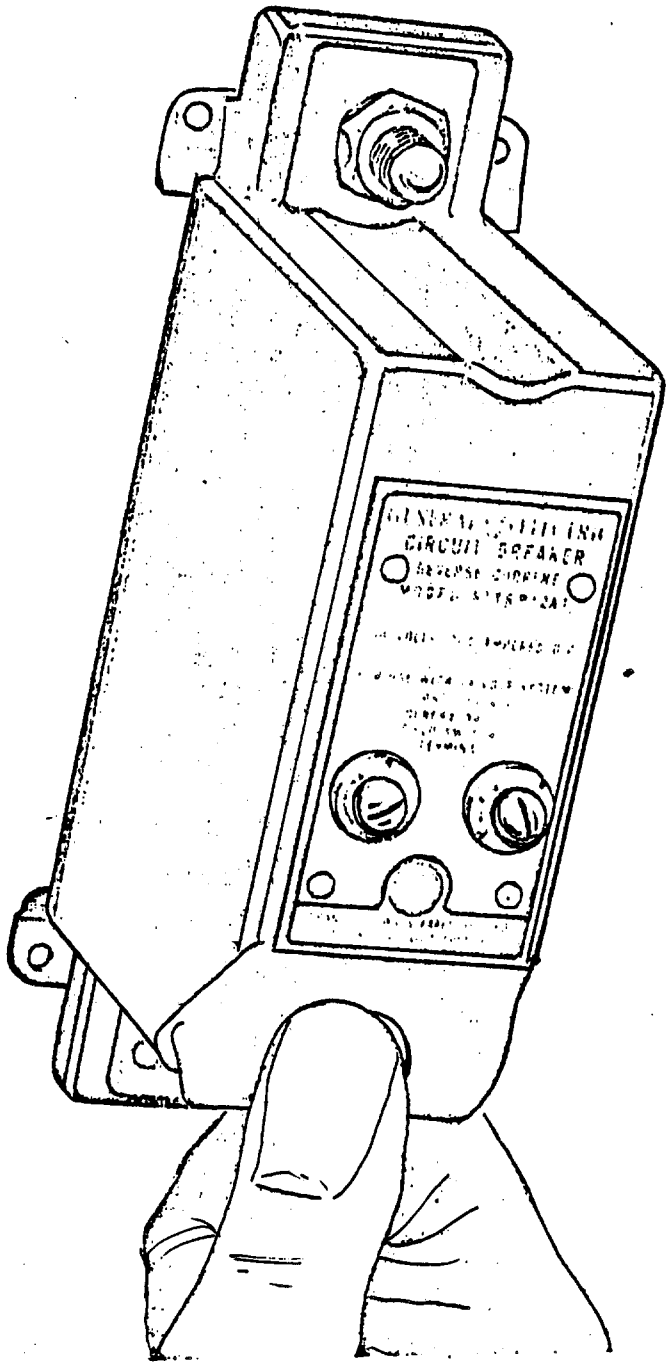


Fig. 5 (355282) G-E Reverse-Current Circuit Breaker Type XRP12A, Illustrating Method of Operating Reset

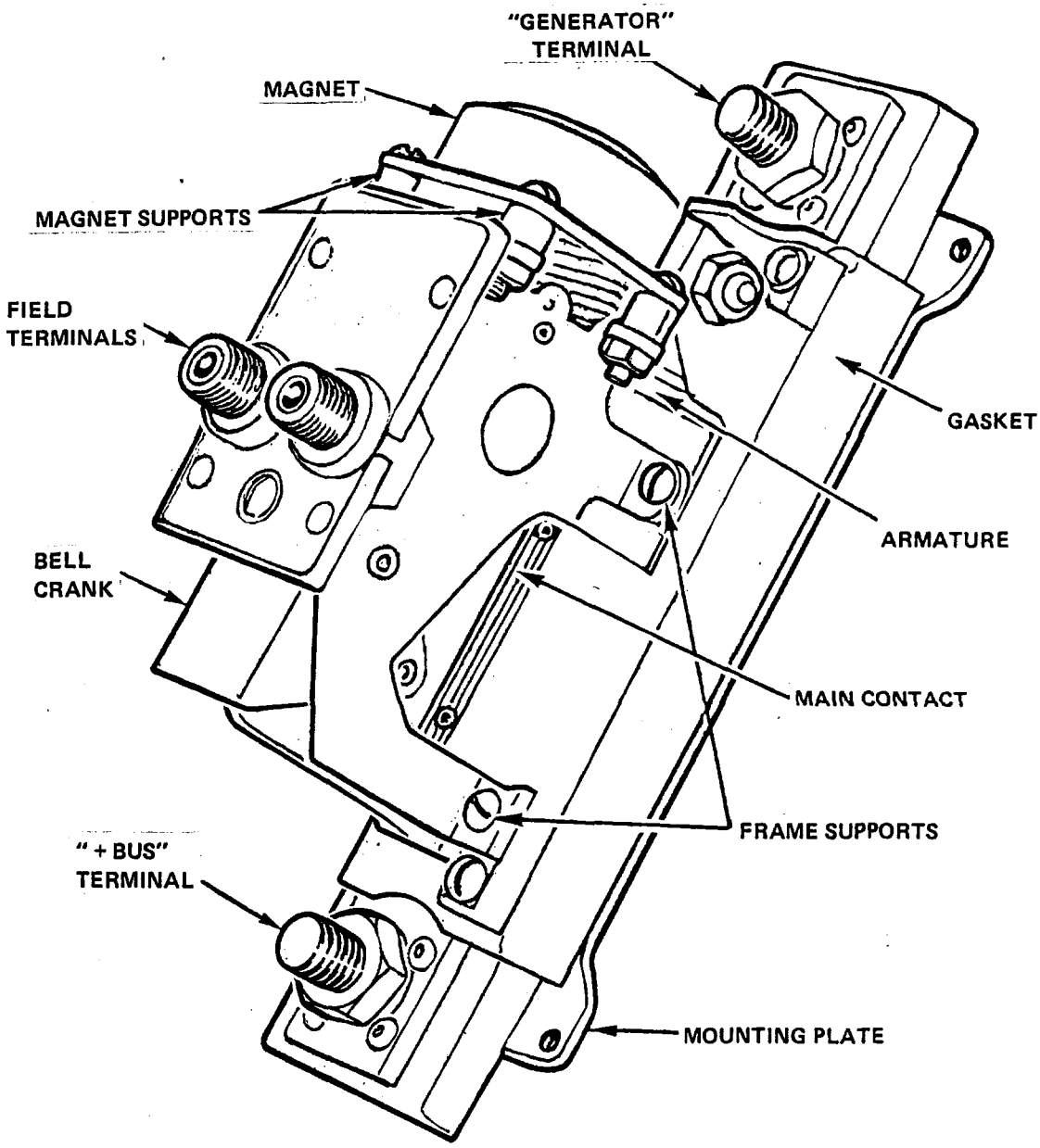


Fig. 6 (355280) G-E Reverse-Current Circuit Breaker Type XRP12A With Protective Case Removed

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OVERHAUL INSTRUCTIONS

REVERSE CURRENT CUTOUT RELAY

PART NUMBERS

A-700AP and A-718AP

The HARTMAN ELECTRICAL MANUFACTURING *Co.*

Mansfield, Ohio

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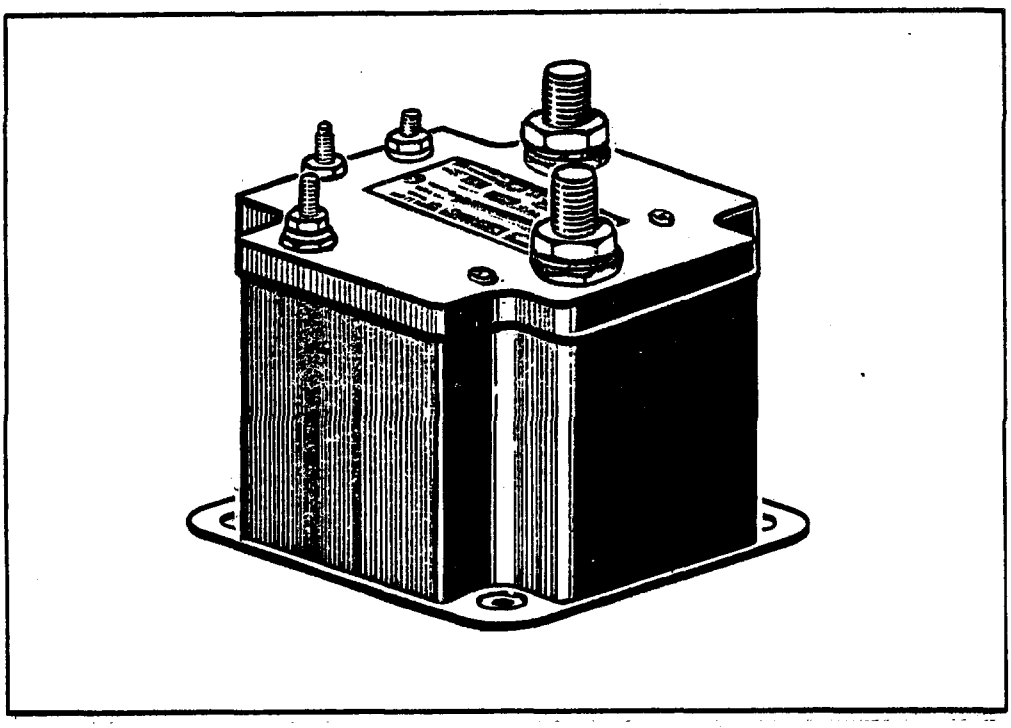


Figure 1-1. Assembled View of Cutout Relay

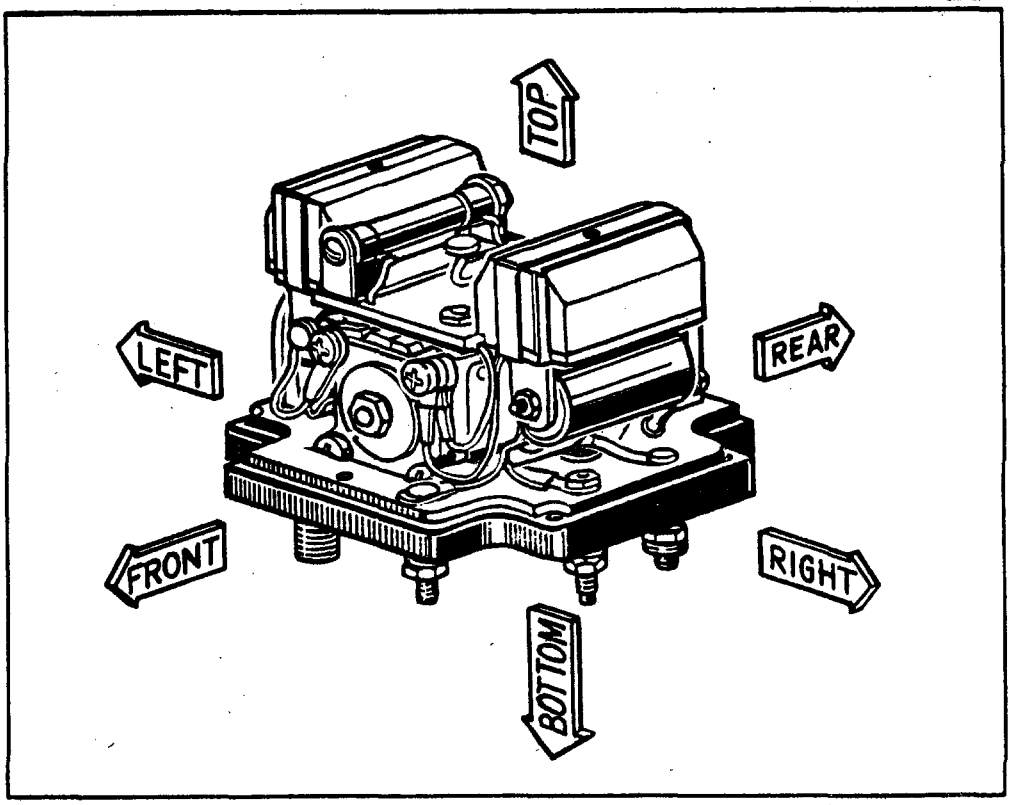


Figure 1-2. Three-Quarter View of Cutout Relay (With Cover Removed and Directional References)

SECTION I

INTRODUCTION

1-1. IDENTIFICATION.

1-2. This handbook provides overhaul instructions and test procedures for the Cutout Relay AN 3025-300, USAF Stock No. 3380-218800-2855: The unit is manufactured by The Hartman Electrical Manufacturing Company, Mansfield, Ohio under their Part Number A-700AP. (See figures 1-1 and 1-2 for identifying views of the basic equipment unit.)

1-3. Sections I, II and III contain a description of the equipment, overhaul instructions and test procedure for the A-700AP Cutout Relay. Overhaul and test instructions for additional models are listed in Section IV by use of Difference Data Sheets. The additional models are listed in the Section IV index.

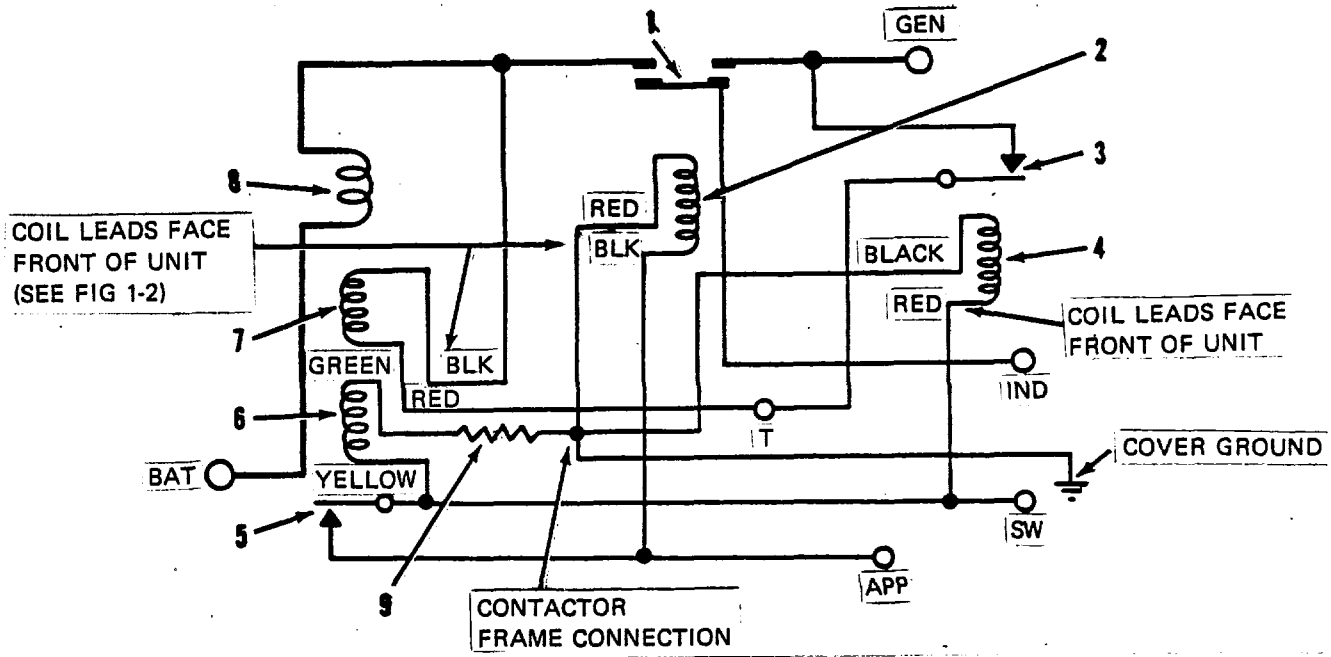
1-4. Overhaul and test procedures for the models included in Section IV are the same as the procedures given in Sections II and III, except for the specified differences noted by the applicable Difference Data Sheets.

1-5. PURPOSE OF EQUIPMENT.

1-6. The purpose of the cutout relay is to connect the generator, supplying the electrical power for the airplane, to the main bus system when the generator voltage builds up sufficiently to exceed the bus voltage. This equipment unit also serves to automatically disconnect the generator from the power bus whenever the generator voltage drops below the bus or system voltage.

1-7. Figure 1-3 is a schematic wiring diagram of the unit and shows the internal connections with the contacts in their normal positions. The sequence of operation is explained by referring to this diagram. The voltage relay coil (4) senses the generator voltage. When the generator voltage reaches between 21 to 24 volts and is of the correct polarity, the voltage relay contacts (3) will close. This energizes the differential voltage coil (7) which is connected across the main contactor contacts (1). At this time, these main contactor contacts are in the open position. The voltage on the differential voltage coil (7) is now the difference between the voltage of the generator and that of the bus or battery. When the generator voltage exceeds the bus voltage by a value between 0.35 and 0.65 volts, the differential relay contacts (5) will close. This applies voltage to the main contactor coil (2) which immediately closes the main contactor contacts (1), thereby connecting the generator to the bus system.

1-8. The generator is disconnected from the bus in a



1	MAIN CONTACTS	4	VOLTAGE RELAY COIL	7	DIFFERENTIAL VOLTAGE COIL
2	MAIN CONTACTOR COIL	5	DIFFERENTIAL RELAY CONTACTS	8	REVERSE CURRENT COIL
3	VOLTAGE RELAY CONTACTS	6	BIASING COIL	9	RESISTOR

Revised Figure 1-3. Schematic Wiring Diagram

similar manner. Whenever the generator voltage decreases below the bus voltage, a reverse current flows from the bus to the generator and through the reverse current coil (8). When the reverse current reaches a value between 16 and 25 amperes, the differential relay contacts (5) open. Voltage is then removed from the main contactor coil (2) which, in turn releases the main contactor contacts (1), disconnecting the generator from the bus.

1-9. The reverse current cutout may be opened by removal of power to the SW terminal as well as by the flow of reverse current. A biasing coil is included for the purpose of causing the differential relay contacts to open if the main contactor coil is de-energized by removal of power to the SW terminal. The differential relay contacts are, therefore, in their proper open position permitting the reverse current cutout to perform its differential voltage sensing function on the next cycle of operation.

1-10. LEADING PARTICULARS.

1-11. The leading particulars for the Cutout Relay A-700AP are listed in Table I.

TABLE I. LEADING PARTICULARS

CHARACTERISTICS	VALUE
Regulated System Voltage (d-c volts)	28
Continuous Duty Load (amperes)	300
Operating Range--Temperature (degrees)	
Minimum	-55°C (-67°F)
Maximum	71°C (158°F)
Performance:	
Operates; Voltage relay closes (volts)	21-24
Differential relay closes (volts)	0.35-0.65
Contactor pickup maximum (volts)	18
Disconnects; Voltage relay opens (volts)	18-20
Differential relay opens--reverse current (amperes)	9-25
Contactor dropout maximum (volts)	5
Terminal Connections:	
Main Terminals; Number	2
Size and thread	3/8-24
Control Terminals; Number	3
Size and thread	10-32
Weight--Approximate net (pounds)	2.7
Dimensions--Overall (inches)	
Length	4
Width	4
Height	4
Mounting Details:	
Number of Holes--0.196-inch diameter	4
Mounting Centers--(inches)	3 x 3

SECTION II

OVERHAUL INSTRUCTIONS

2-1. SPECIAL TOOLS.

2-2. A remagnetizing fixture shown in Table II is the only special tool required for the overhaul of this equipment.

TABLE II. SPECIAL TOOLS

PART NO.	NOMENCLATURE	PROCURING SERVICE STOCK NO.
8175	Remagnetizing Fixture	

2-3. DISASSEMBLY.

2-4. GENERAL. This unit of equipment consists of a number of assemblies, subassemblies, parts and attaching hardware. These are illustrated by means of a series of exploded view illustrations which show the appearance of each assembly, parts and attaching parts. During the disassembly and reassembly operations, frequent reference should be made to these illustrations. Identify all parts with respect to their positions in disassembly to ensure reassembly in the same relative positions if still usable.

LEGEND FOR FIGURE 2-1

1. Name Plate
2. Screw
3. Cover Base Insulating Plate
4. Screw
5. Base Sealing Tape
6. Nut
7. Washer
8. Washer
9. Nut
10. Washer
11. Washer
12. Cover
13. Screw
14. Relay Cover Clamp
15. Relay Cover
16. Voltage Relay Spring
17. Pivot Bridge Assy
18. Screw
19. Magnet Assy
20. Resistor
21. Nut
22. Washer
23. Screw
24. Mica Washer
25. Resistor Mounting Bracket
26. Screw
27. Screw
28. Washer
29. Differential Coil Assy
30. Nut
31. Washer
32. Voltage and Differential Relay Assy
33. Screw
34. Screw
35. Nut
36. Washer
37. Long Terminal Screw
38. SW Terminal Shield
39. Vented Terminal
40. Contactor Assy
41. Screw
42. Negative Base Connector Link
43. Contactor Insulating Plate
44. Main Base Assy
45. Main Base Assy

NOTE

Figure 1-2 is a three-quarter view (with the cover removed) of the cutout relay. Throughout the handbook, all references to left-hand or right-hand, front or rear, top or bottom parts will be when viewing equipment as shown in this illustration.

2-5. DISASSEMBLY OF CUTOUT RELAY. (See figure 2-1.)

CAUTION

Before overhauling any unit of equipment, a visual inspection and complete bench test should be performed in order to determine what parts are defective and in need of replacement. Needless complete teardowns will be avoided if this procedure of inspecting and bench testing the equipment is followed.

a. Remove name plate (1) by removing two screws (2). Take out four screws (4) and lift off the cover base insulating plate (3). Peel off the base sealing tape (5). Remove two nuts (6), washers (7 and 8), three nuts (9) and washers (10 and 11).

b. Slide the cover (12) out after removing four screws (13). Unsnap the two relay cover assemblies and remove them from their respective positions. Disassemble the relay cover clamp (14) from the relay cover (15) if replacement is necessary.

NOTE

Using a suitable tool, remove the sealing compound covering the screws (13) to accomplish removal of the cover.

c. Unhook and remove the voltage relay spring (16) located at the top right-hand side. Take out the four screws (18) and carefully lift off the pivot bridge assemblies (17) and magnet assemblies (19).

CAUTION

Exercise care when removing the pivot bridge assembly to prevent damage to the small copper lead attached to the magnet assembly.

d. Unsolder the lead wires at the terminal points of the resistor (20). Remove the resistor by removing nut (21), washer (22) and screw (23); take off the two mica washers (24).

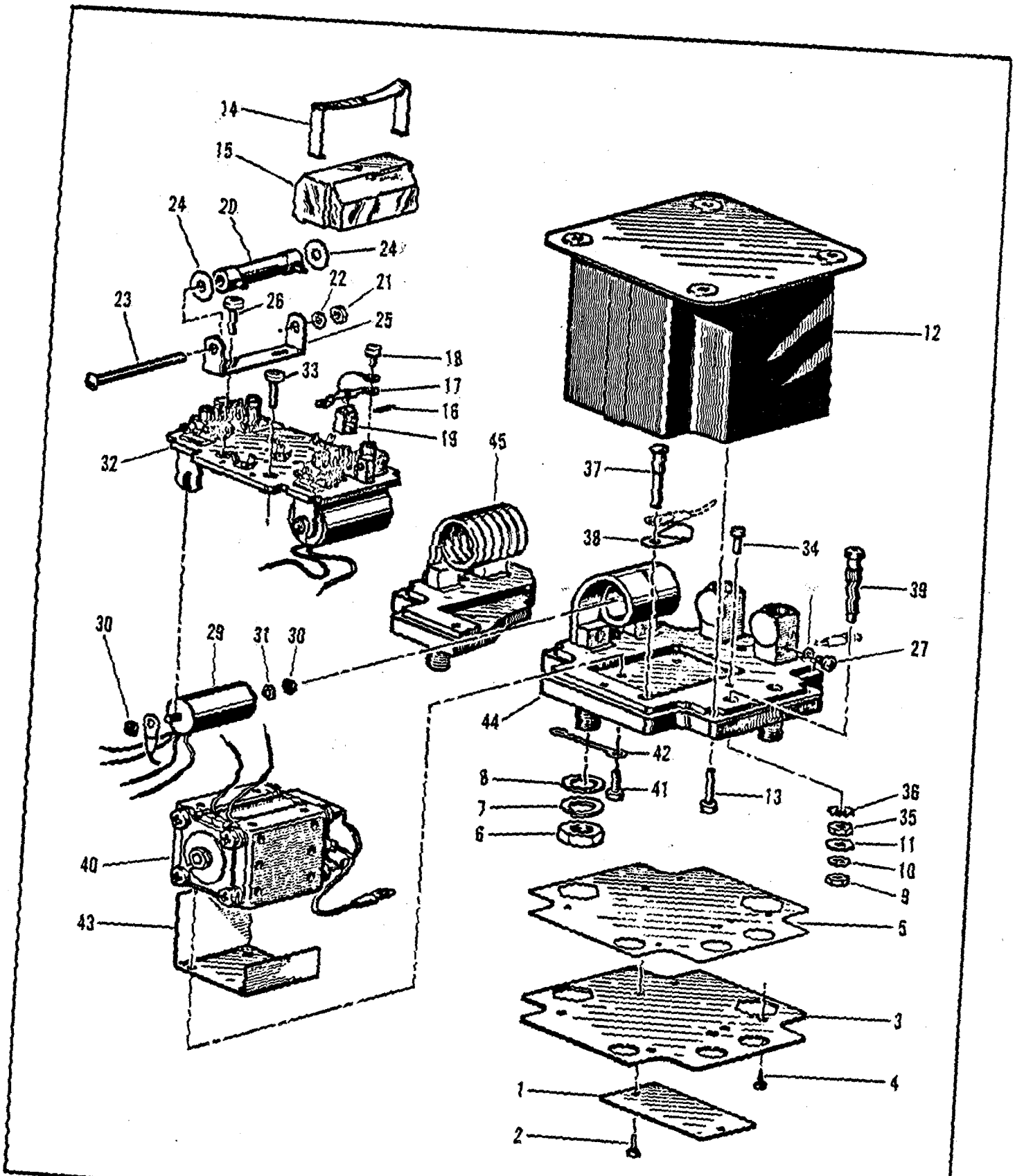


Figure 2-1. *Exploded View* of Cutout Relay Part Number A-700AP and A-718AP

NOTE

During disassembly, unsolder the lead wires of the accessible part at their respective terminal ends at time of removal. Identify the parts and lead wires with respect to their positions to ensure reassembly in the same relative positions.

e. Take out two screws (26) releasing the resistor mounting bracket (25). Remove the two screws (27) and washers (28) attaching the wire lead from the differential coil assembly (29) and voltage coil assembly (1, figure 2-2) to the contact assemblies located in the rear of the cutout relay.

f. Remove two nuts (30, figure 2-1) and one washer (31) securing the differential coil assembly (29) in place. Lift up the voltage and differential relay assembly (32) after removing two screws (33). Slide out the differential coil assembly. Removal of items (29 and 32) is accomplished after unsoldering the proper lead wires.

g. Unscrew and remove screw (34), three nuts (35) and washers (36). Using a suitable arbor, press out two long terminal screws (37) releasing the SW terminal shield (38); also press the vented terminal (39) from the main base assembly (44).

h. Remove the contactor assembly (40) from the main base assembly by removing four screws (41). Take off the two negative base connector links (42) and contactor insulating plate (43).

2-6. DISASSEMBLY OF VOLTAGE AND DIFFERENTIAL RELAY ASSEMBLY. (See figure 2-2.)

a. Take off two nuts (2) and one washer (3) to separate the voltage coil assembly (1) from its attached position, freeing the relay coil head washers (4).

b. Remove two nuts (5) and the relay spring adjusting screw (6). Loosen nuts (8) and remove the magnet adjusting screws (7). Also loosen nuts (10) and remove tipped screw contacts (9).

c. Detach the long round bridge post (11) by removing screw (12). Remove the short round bridge post (13) after taking out screw (14) thus releasing the relay spring bracket (15). Take out the two rectangular bridge posts (16) after removing screws (17). Lift out the four relay frames (18), and push out the relay mounting bushings (19) from the relay mounting plate assembly (20).

2-7. DISASSEMBLY OF CONTACTOR ASSEMBLY. (See figure 2-3.)

a. Insert nail or small drill through notch in movable contactor core (3) and hole of bottom frame tie plate (17), and remove core nut (1) and washer (2). Remove movable contactor core (3) and shims (4).

NOTE

Record the amount of shims removed; this will facilitate the amount needed in reassembly.

b. Withdraw the contact and rod assembly and remove core nut (5), washer (6), contact insulating nut (7), main movable contact assembly (8), indicator terminal lead assembly (9) and main contact loading spring (10) from the core rod and bushing assembly (11).

c. Remove the contactor core spring (12), stationary core locking nut (13) which locks the stationary core assembly (22) to the top frame tie plate (14). Take off the top frame tie plate by removing four screws (15) and two washers (16). Also remove the bottom frame tie plate (17) after removing four screws (18).

d. Disassemble the two contactor frames (19), coil insulating plate (20), coil spring washer (21) and stationary core assembly (22) from the contactor coil assembly (23).

2-8. DISASSEMBLY OF MAIN BASE ASSEMBLY. (See figure 2-4.)

a. Take out the main short stationary contact assembly (1) after removing the special screw (2) and the wide bearing lock washer (3). Remove terminal post locking nut (5) and lift out the main long stationary contact assembly (4).

b. Withdraw the series coil assembly (6) after taking out special screw (8), wide bearing lock washer (9) and terminal post locking nut (10). If necessary to replace the guide base (11), remove it by removing two rivets (12).

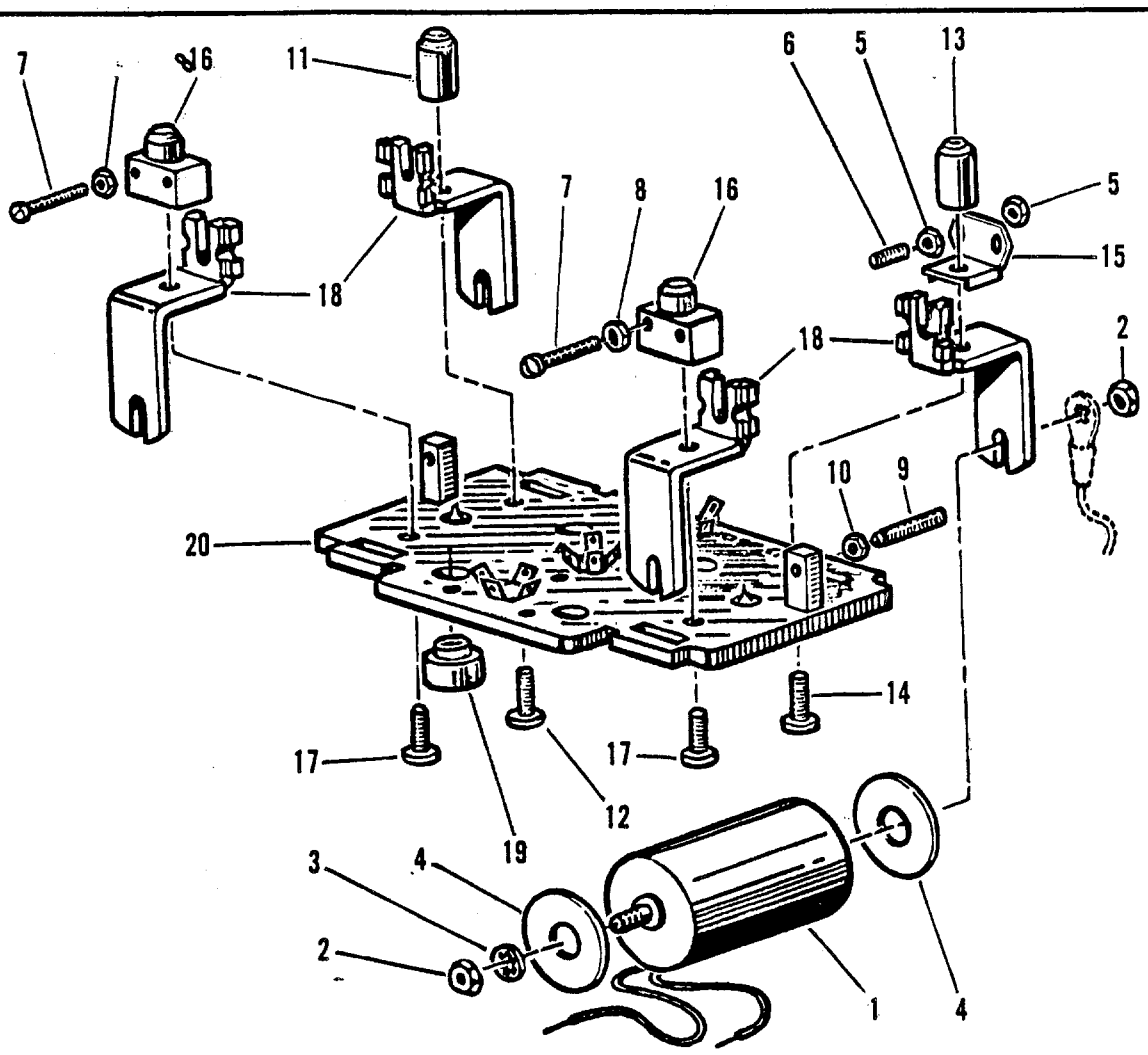
c. Lift out the contact post link (13), two base spacer washers (14) and four large base spacer washers (15). Remove the base gasket (16) and base stud seat washers (17) from the main base (18).

2-9. CLEANING.

2-10. GENERAL. Before reassembling the magnets into the relays which have been torn down, the magnets shall be demagnetized, cleaned of all chips, and remagnetized. All parts, including the relay while magnets are out should be blown clean with compressed air. Hold the air hose about one foot away. The magnets can be remagnetized by means of the remagnetizing fixture Part No. 8175, used with a suitable magnet charger. Care should be taken to remagnetize in the same direction (North and South) as originally magnetized. The contacts may be cleaned by rubbing on paper, or by running paper between the contacts after magnets are assembled in the relay. No cleaning of the large contacts is necessary. Clean the cover with a dry cloth.

CAUTION

Do not permit any two magnets to touch after magnetization.



1 Voltage Coil Assembly	8 Nut	15 Relay Spring Bracket
2 Nut	9 Tipped Screw Contact	16 Rectangular Bridge Post
3 Washer	10 Nut	17 Screw
4 Relay Coil Head Washer	11 Long Round Bridge Post	18 Relay Frame
5 Nut	12 Screw	19 Relay Mounting Bushing
6 Relay Spring Adjusting Screw	13 Short Round Bridge Post	20 Relay Mounting Plate Assy
7 Magnet Adjusting Screw	14 Screw	

Figure 2-2. Exploded View of Voltage and Differential Relay Assembly

2-11. INSPECTION.

2-12. GENERAL. Inspect the voltage relay spring for discoloration from heat. Examine coil leads and wire leads for broken wires or insulation. Check and replace any part which appears to be worn, burned, broken or distorted.

NOTE

Continuity check can be made with an ohmmeter to determine if lead wires or part is intact.

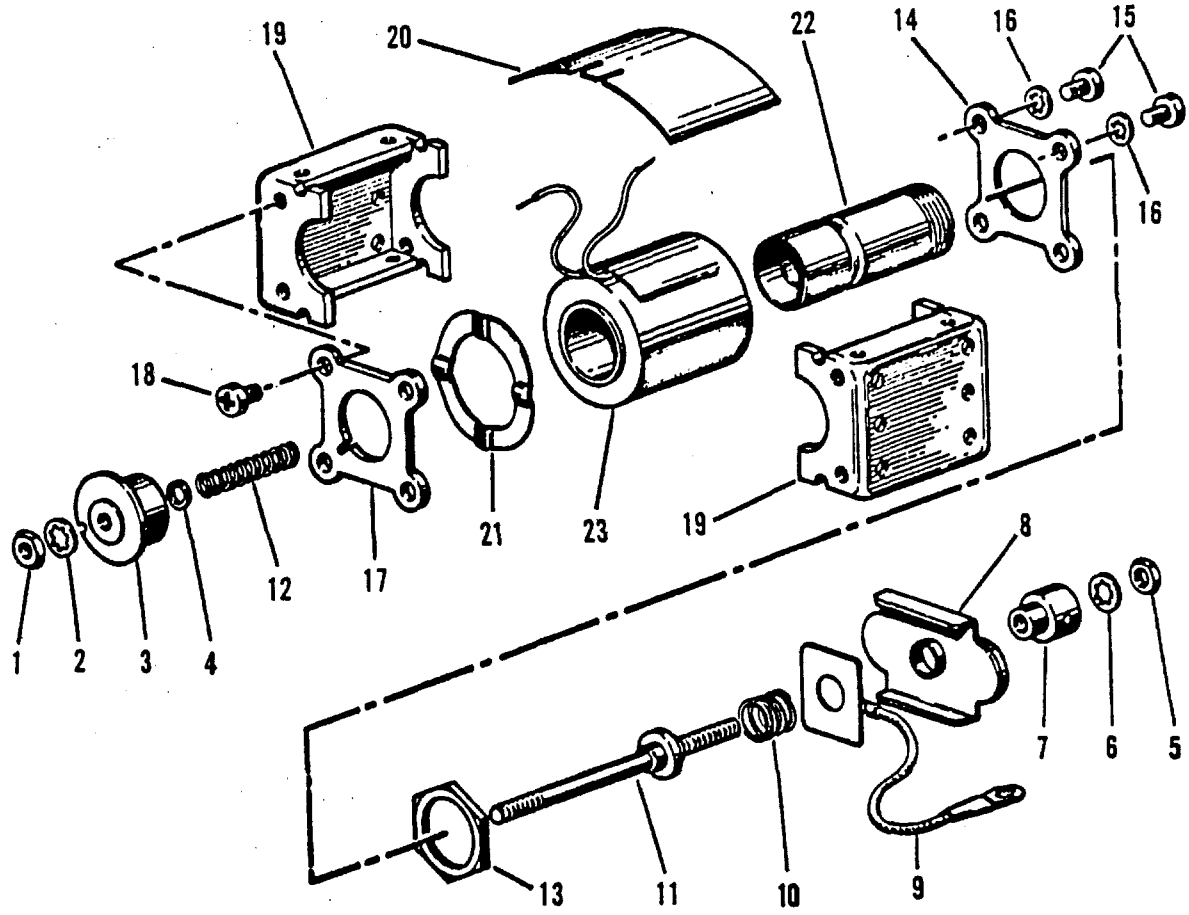
2-13. TESTING.

2-14. GENERAL. Check the resistance of the parts shown in Table III at a temperature of 25°C (77°F). Replace any part which is not within its specified value.

2-15. REPAIR OR REPLACEMENT.

2-16. GENERAL. Any part found to be worn, burned, broken, or distorted should be replaced.

a. Replace all lead wiring having damaged insulation



1. Core Nut
2. Washer
3. Movable Contactor Core
4. Shim
5. Core Nut
6. Washer
7. Contact Insulating Nut
8. Main Movable Contact Assy
9. Indicator Terminal Lead Assy
10. Main Contact Loading Spring
11. Core Rod and Bushing Assy
12. Contactor Core Spring
13. Stationary Core Locking Nut
14. Top Frame Tie Plate
15. Screw
16. Washer
17. Bottom Frame Tie Plate
18. Screw
19. Contactor Frame
20. Coil Insulating Plate
21. Coil Spring Washer
22. Stationary Core Assy
23. Contactor Coil Assy

Figure 2-3. Exploded View of Contactor Assembly

TABLE III. RESISTANCE VALUES

NOMENCLATURE	MAXIMUM OHMS	MINIMUM OHMS
Resistor (20, figure 201)	275	225
Differential Coil Assy (29)		
Yellow and Green Leads	37.2	30.4
Red and Black Leads	6.43	5.27
Voltage Coil Assy (1, figure 2-2)	512	445
Contactor Coil Assy (23, figure 203)	93.2	88.3

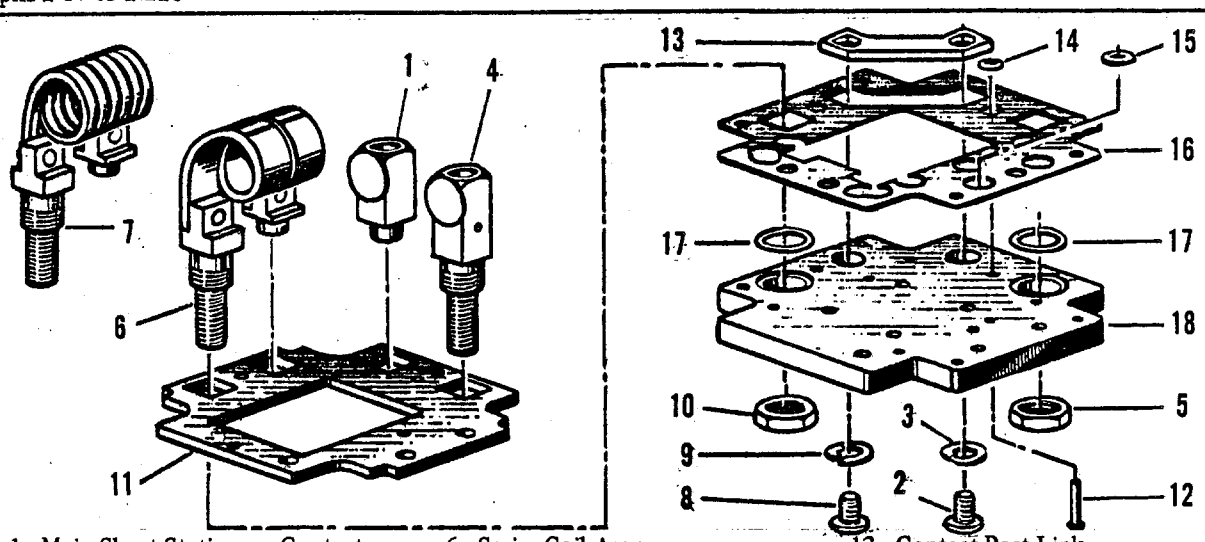
or faulty wire terminal connections.

b. Screws with damaged or unserviceable threads or heads should be replaced, also nuts with damaged threads.

c. Replace the base sealing tape at each overhaul.

d. Replace the voltage relay spring if discolored from heat.

e. Replace resistor or coils if not found within the values as stated in Table III.



1. Main Short Stationary Contact Assy
2. Special Screw
3. Wide Bearing Lock Washer
4. Main Long Stationary Contact Assy
5. Terminal Post Locking Nut
6. Series Coil Assy
7. 6T Series Coil Assy
8. Special Screw
9. Wide Bearing Lock Washer
10. Terminal Post Locking Nut
11. Guide Base
12. Rivet
13. Contact Post Link
14. Base Spacer Washer
15. Large Base Spacer Washer
16. Base Gasket
17. Base Stud Seat Washer
18. Main Base

Figure 2-4. Exploded View of Main Base Assembly

2-17. LUBRICATION.

2-18. No lubrication of the equipment is required.

2-19. REASSEMBLY.

2-20. GENERAL. Refer to the exploded view illustrations and the Schematic wiring diagram (figure 1-3) when reassembling the equipment. Reassembly is essentially the reverse of disassembly and in accordance with the exploded views except for the following instructions.

CAUTION

The rewiring and soldering of the various parts are best accomplished at time of reassembly of the component part or parts. All wires that are not insulated should have a piece of tubing between the connecting points. Excessive flux and solder should be avoided at all connection points.

2-21. REASSEMBLY OF MAIN BASE ASSEMBLY. (See figure 2-4.)

a. Position the two base stud seat washers (17) in the recessed holes provided for in the main base (18). Place the base gasket (16), large base spacer washers (15), base spacer washers (14) and the contact post link (13) into their respective positions on the main base.

b. If the guide base (11) was removed, replace it and secure with two rivets (12). Fasten the series coil assembly (6) to the main base with terminal post locking nut (10), wide bearing lock washer (9) and special screw (8).

c. Insert the main long stationary contact assembly (4) into place and secure with terminal post locking nut (5). Attach the main short stationary contact assembly (1) in position with wide bearing lock washer (3) and special screw (2).

2-22. REASSEMBLY OF CONTACTOR ASSEMBLY. (See figure 2-3.)

a. Thread the stationary core assembly (22) through the top frame tie plate (14). Loosely thread the stationary core locking nut (13) onto the stationary core assembly. Place the contactor coil assembly (23) over the stationary core assembly, position the coil spring washer (21) and coil insulating plate (20) on the contactor coil assembly (23).

b. Position the two contactor frames (19) around the contactor coil assembly with the leads up and through the notches in the coil insulating plate. Loosely fasten the top frame tie plate (14) to the contactor frames with washers (16) and screws (15). Attach the bottom frame tie plate (17) to the contactor frames with the notch pointing to the left and towards the bottom. Pressing frames toward each other, secure bottom frame tie plate with four screws (18). Tighten screws (15).

c. Adjust stationary core assembly (22) by means of the slot at the end until it just touches the movable contactor core (3) held tightly in place with the fingers. Lock with stationary core locking nut (13) and stake to top frame tie plate (14) and on thread of stationary core assembly in this position.

NOTE

A slotted wrench holding a section of hacksaw blade cut to fit the stationary core slot assembly will be helpful in making this adjustment.

d. Place the main contact loading spring (10), indicator terminal lead assembly (9) and main movable contact assembly (8) over the core rod and bushing assembly (11). Then screw the contact insulating nut (7) until the rod extends beyond the contact insulating nut approximately 1/8-inch. Install the washer (6) and core nut (5), tightening the nut while holding the insulating nut with a 3/32-inch rod or drill inserted in the hole of the insulating nut.

e. Insert core rod and bushing assembly (11) through the cavity in the stationary core assembly (22) and position contactor core spring (12) over the core rod and bushing assembly; replace shims (4) which were removed during disassembly. Screw movable contactor core (3) on the core rod and bushing assembly until there is a 0.093-inch gap between shoulder of movable contactor core and bottom frame tie plate (17).

f. The notch in shoulder of the movable contactor core should be aligned with notch in the bottom frame tie plate. Install washer (2) and core nut (1), tighten core nut while holding movable contactor core with nail or small drill inserted through notch in its rim and notch in the bottom frame tie plate.

2-23. REASSEMBLY OF VOLTAGE AND DIFFERENTIAL RELAY ASSEMBLY. (See figure 2-2.)

2-24. Reassembly is in the reverse of disassembly and in accordance with the exploded view figure 2-2, except as follows:

2-25. Do not run in relay spring adjusting screw (6), magnet adjusting screw (7) and tipped screw contact (9) all the way in or tighten the nut until adjusting the relay as described in a later paragraph.

NOTE

The manufacturer recommends that radio service cement, part number 30G, manufactured by the General Cement Mfg. Co., Rockford, Illinois, or equivalent be used to seal the heads of screws (12, 14 and 17) after assembling screws into position.

2-26. REASSEMBLY OF CUTOUT RELAY. (See figure 2-1.)

2-27. Reassembly is in the reverse of disassembly and in accordance with the exploded view figure 2-1, except as follows:

a. Solder lead wires to their respective components as shown in figure 1-3.

NOTE

Use rosin-flux core solder, Composition Sn60, Federal Specification QQ-S-5716.

CAUTION

Exercise care when replacing the pivot bridge so that damage is not caused to the small copper lead of the magnet assembly.

b. Do not assemble the cover (12, figure 2-1) or relay covers (15) until preliminary adjustment procedure has been accomplished as described in paragraph 2-29.

c. Apply radio service cement to adjusting screws and nuts after preliminary adjustments have been completed. Application to be made with a toothpick.

d. The manufacturer of this equipment recommends that the two cover screws (13), which do not have ground links under them and the two rivet heads attaching the cover base (3) to the main base assembly (45) be covered with microstone green gypsum material, or equivalent manufactured by the Whip-Mix Corporation, Louisville, Kentucky.

2-28. IDENTIFICATION. At the completion of the overhaul or repair of an equipment unit, a stamp bearing the name of the overhaul activity and the date of overhaul or repair should be applied to the unit.

2-29. ADJUSTMENT PROCEDURE.

2-30. GENERAL. Adjustments are made after the unit is assembled complete except for unit cover and relay covers. See figures 2-5 and 2-6 for adjustment points and test procedures, respectively.

CAUTION

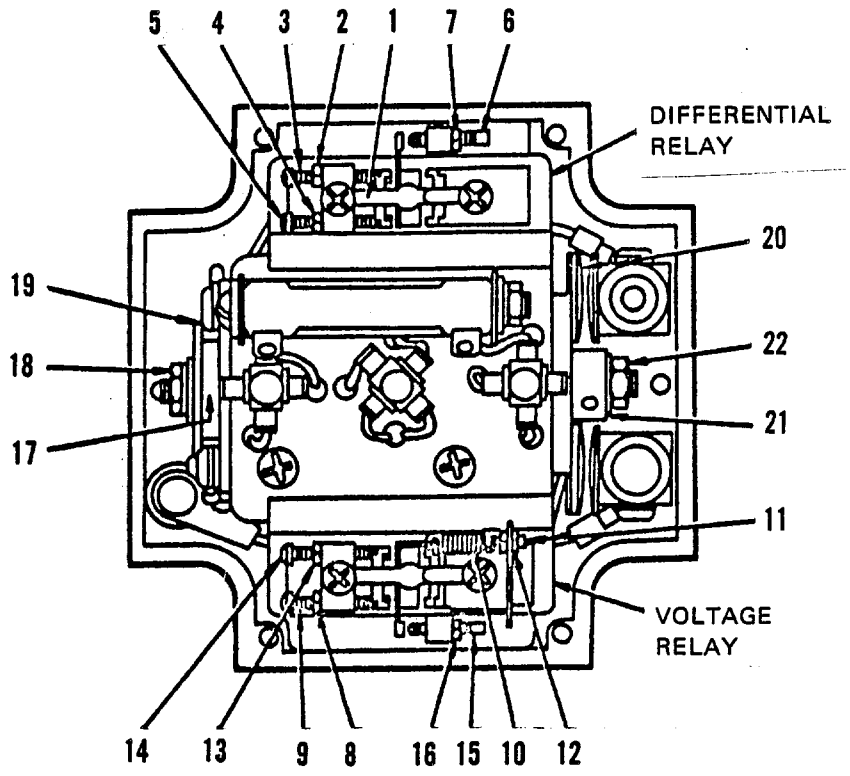
Extreme care must be taken to prevent metal chips from collecting on the armature magnets during adjustments. Any which do collect should be carefully removed with the aid of a sharply pointed pick or scribe.

2-31. DIFFERENTIAL RELAY ADJUSTMENT.

a. Adjust the end play of the magnet assembly to approximately 0.005-inch by loosening the locking nut on the pivot bridge assembly (1, figure 2-5) turning the pivot screw in or out as required. Lock nut on pivot screw.

NOTE

On units which do not have the threaded pivot, adjust the end play of the magnet assembly to approximately 0.005-inch by carefully bending the pivot bridge assembly (1) as required.



1. Pivot Bridge Assembly
2. Nut
3. Screw
4. Nut
5. Screw
6. Contact Screw
7. Nut
8. Nut
9. Screw
10. Spring
11. Spring Screw
12. Nut
13. Nut
14. Screw
15. Contact Screw
16. Nut
17. Cap
18. Core Nut
19. Movable Core
20. Movable Contact
21. Insulating Nut
22. Nut

Figure 2-5. Adjustment Procedure Diagram

b. Connect the unit into the test circuit shown in figure 2-6, placing all switches in the open position.

c. Place switch (1) in position 2, switch (4) in position 1, and close switch (5). Vary voltage by means of potentiometer (7) and read on voltmeter (8).

NOTE

The voltage relay may close, if its adjustment is approximately correct. Place a piece of paper, or other insulation, between the voltage relay contacts, because the contacts should not touch during this adjustment.

d. Loosen lock nut (2, figure 2-5) and adjust screw (3) until relay closes at a voltage between 0.45 and 0.55 volt. Tighten nut (2).

NOTE

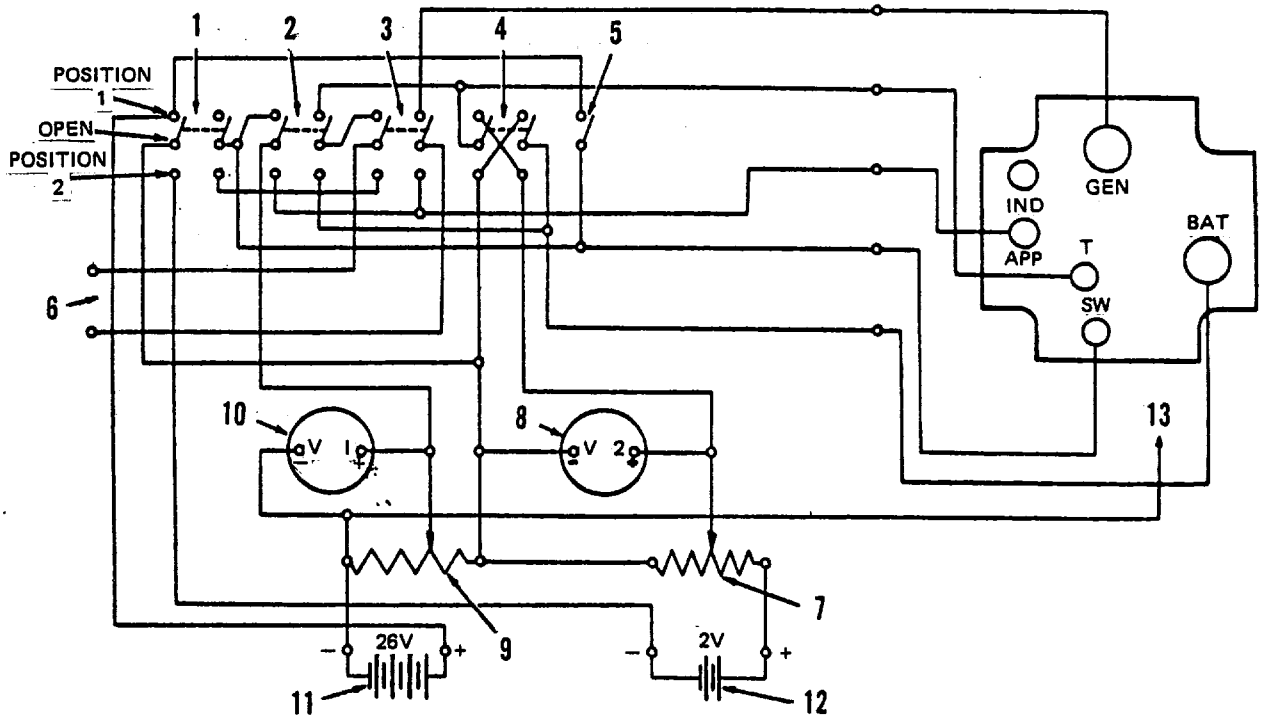
When the differential relay contacts close, the main contactor will close also. After each adjustment is made, the adjusting screw should be held firmly while the lock nut is tightened.

e. Place switch (4, figure 2-6) in position 2, reversing the polarity of the voltage applied to the differential coil.

f. Loosen lock nut (4, figure 2-5) and adjust screw (5) until the relay opens at a voltage between 0.31 and 0.37 volt, and with contact screw (6) set so that when the relay is closed, the contacts would remain engaged for at least one-half turn if screw (6) is backed out. Tighten nut (7) on screw (6).

g. Open switch (5, figure 2-6), place switch (4) in position 1, and remove the insulation from the voltage relay contacts. Vary potentiometer (7) to reclose the differential relay, disregarding the closing voltage reading.

h. Decrease the voltage by means of potentiometer (7) until the relay opens. The relay must open at a voltage above 0.04 volts.



1. DPDT Switch
2. DPDT Switch
3. DPDT Switch
4. DPDT Switch
5. SPST Switch
6. Ohmmeter Connections
7. 0.25 Ampere, 100 Ohms Potentiometer
8. 0-2 Volts DC Voltmeter
9. 1.5 Ampere, 50 Ohms Potentiometer
10. 0-30 Volts DC Voltmeter
11. 26 Volt DC Battery
12. 2 Volt DC Battery
13. Negative Connection to Frame of Contactor Assy

Figure 2-6. Test Circuit Used for Adjustments

NOTE

The above adjustments will result in the differential relay opening when there is a flow of reverse current as well as when the "SW" terminal is de-energized.

i. Open all switches before proceeding with the next adjustment.

2-32. VOLTAGE RELAY ADJUSTMENT.

a. Adjust the end play of the magnet assembly to approximately 0.005-inch by loosening the locking nut on the pivot bridge assembly (1, figure 2-5) turning the pivot screw in or out as required. Lock nut on pivot screw.

NOTE

On units which do not have the threaded pivot, adjust the end play of the magnet assembly to approximately 0.005-inch by carefully bending the pivot bridge assembly (1) as required.

b. Adjust screw (9) until relay armature gaps are approximately equal. Lock screw (9) with nut (8).

c. Place switches (1 and 2, figure 2-6) in position 1 and vary the voltage by means of potentiometer (9).

d. Adjust tension of spring (10, figure 2-5) by means of spring screw (11) and nuts (12) until relay closes at approximately 22 volts. Increasing tension of spring (10) will increase both the closing and opening voltages, while decreasing tension will lower both voltages.

NOTE

Adjust tension of spring (10) by first loosening one nut (12) and then tightening other nut (12). Make adjustments in small steps, each time tightening the nut.

e. Loosen lock nut (13) and adjust screw (14) until relay opens at 19 volts and with contact screw (15) set so that when the relay is closed, the contacts would remain closed for at least one-half turn if screw (15) were backed out. Lock screw (14) with nut (13) and screw (15) with nut (16).

2-33. CONTACTOR ADJUSTMENT.

a. Adjust the gap (17) between the core rim and the contactor frame to 0.093-inch. This gap represents the total movable core travel. To adjust, loosen nut

(18) and screw movable core (19) in or out. The core can be held while tightening nut (18) by inserting a 3/32-inch rod or drill through the notch in the movable core into the hole in the frame.

b. The contact overtravel, which is the distance the core travels after the contacts (20) touch, should be adjusted to approximately 0.020-inch. To make this adjustment, insert a 3/32-inch rod or drill in the hole in insulating nut (21), and hold nut to loosen lock nut (22). Still holding nut (21), rotate entire core and rod assembly. Lock nut (22).

c. Place switch (1, figure 2-6) in position 1 and switch (2) in position 2, and vary the voltage by means of potentiometer (9) to close and open the contactor. It should close between 14 and 15 volts, and open below 5 volts.

NOTE

This test should be conducted before the coil has become heated, and with the contactor in a horizontal position. The position will have some affect on the operating voltage, even though the cutout may be mounted in any position in the aircraft.

d. If the contactor closes below or above the limits, remove the movable core (19, figure 2-5) and add or remove shims, respectively, as required. In no case shall there be more than three shims used. Replace the movable core, readjust, and repeat the test, outlined in paragraph 2-33c, until the contactor closes within the limits.

e. If the contactor picks up, but does not complete its full stroke within the specified voltage limits, reduce the main contact overtravel slightly.

SECTION III

TEST PROCEDURE

3-1. TESTING WITH TEST STAND.

3-2. EQUIPMENT REQUIRED. (See figure 3-1.)

a. Direct Current Generator, 0-28 volts 300 amperes.

b. Voltage Regulator.

c. SPDT Switch.

d. Generator Field Rheostat.

e. SPDT Switch.

f. SPDT Switch.

g. 0-30 Volt DC Voltmeter.

h. SPST Switch.

i. SPDT Switch.

j. 0-5 Volt DC Voltmeter.

k. 300-0-30 Ampere DC Ammeter.

l. 300 Ampere at 28 Volts Load Bank.

m. 0-100 Millivolts DC Millivoltmeter.

n. 26 Volt DC Battery.

3-3. DIFFERENTIAL VOLTAGE AND REVERSE CURRENT OPERATION.

a. Connect the relay as shown in figure 3-1.

b. Place all switches on the "OFF" position.

c. Operate the generator (1) at a speed between 3000 and 4500 revolutions per minute.

d. With the switch (3) in position 1, adjust the generator voltage by means of the rheostat (4) so that the voltage is approximately one volt less than battery voltage.

NOTE

The voltages of the battery (14) and generator (1) can be read and readily compared by means of placing the switch (6) alternately in positions 1 and 2 and noting the reading on voltmeter (7).

e. With the switch (5) in position 1 and switch (8) closed, place switch (9) in position 1 and slowly increase the generator voltage by means of the rheostat (4). When the cutout operates, the voltage indicated on voltmeter (10) will go to zero. The differential voltage is the reading just before the voltmeter reading goes to zero and should be between 0.35 and 0.65 volts.

CAUTION

Switch (9) must be opened before the next test.

f. Measure the reverse current opening by slowly decreasing the generator voltage by means of the rheostat (4) until the cutout opens. The reverse current is read on ammeter (11) just before the reading goes to zero. The reverse current opening should be between 9 and 25 amperes when the generator voltage is at 26 volts. If the generator voltage read on voltmeter (7) with switch (6) in position 2 is not 26 volts, use Table IV to obtain the corresponding reverse current opening for various voltages.

TABLE IV. REVERSE CURRENT OPENING

GENERATOR VOLTAGE (volts)	REVERSE CURRENT (amperes)	
	Min	Max
28	11	27
26	9	25
24	7	23
22	5	21

g. Test for opening of the differential relay due to removal of power to the "SW" terminal, first repeat the procedure steps, paragraphs 3-3c through 3-3e.

h. Decrease the generator voltage by means of rheostat (4) until the current reading on ammeter (11) has decreased to approximately zero, then open switch (18).

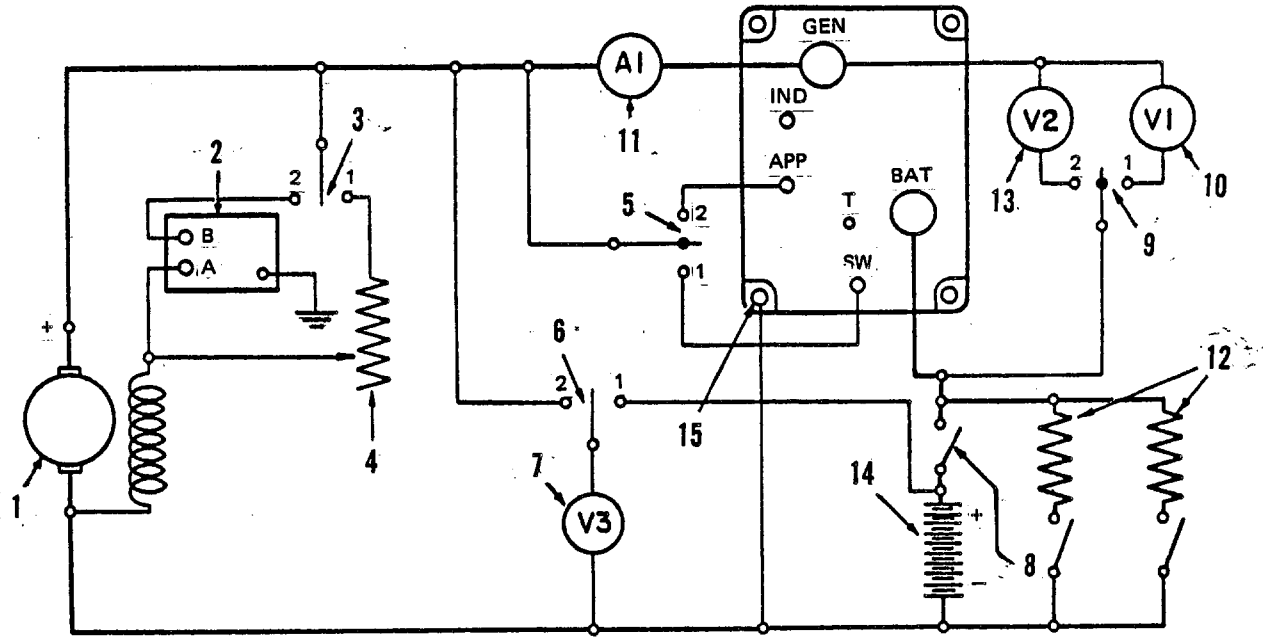
i. Again decrease the generator voltage, dropping out the contactor, then continue to decrease the voltage to the lowest value possible.

j. Open switch (5). The differential contacts now should have opened. To check for open contacts, place an ohmmeter across terminals "SW" and "APP", and note the resistance reading. The ohmmeter should read approximately 200 ohms. If the contacts remained closed, the ohmmeter will read zero resistance.

k. If the cutout does not operate within the specified limits, refer to Table V.

3-4. TESTING VOLTAGE RELAY.

a. Set all switches in the "OFF" position.



1. 28 Volt DC 300 Ampere Generator
2. Voltage Regulator
3. SPDT Switch
4. Generator Field Rheostat
5. SPDT Switch
6. SPDT Switch
7. 0-30 Volts DC Voltmeter
8. SPST Switch
9. SPDT Switch
10. 0-5 Volt DC Voltmeter
11. 300-0-30 Ampere DC Ammeter
12. 300 Amp at 28 Volts Load Bank
13. 0-100 Millivolts DC Millivoltmeter
14. 26 Volt DC Battery
15. Negative Cover Connection

Figure 3-1. Test Circuit with Test Stand

b. Operate the generator at a speed between 3000 and 4500 RPM.

c. Place switches (3 and 5) in position 1, and switch (6) in position 2. Slowly vary the voltage by means of rheostat (4). The closing voltage should be between 20 and 24 volts and is read on voltmeter (7) when the relay operates. The opening voltage should be above 18 volts.

d. Connect an ohmmeter from the "GEN" terminal to the "T" test terminal to indicate when the voltage relay contacts have closed. Remove the name plate and make a connection to terminal "T" by means of a 6-32 screw, 1/2-inch or longer, screwed into the tapped hole. This hole is located approximately midway between terminals "APP" and "SW". File a point on the screw so that you may be sure of a positive connection. After testing, remove the screw and replace the name plate.

3-5. TESTING CONTACTOR.

a. Set all switches in the "OFF" position.

NOTE

This test should be made before the contactor coil has become heated, and with the relay placed such that the four mounting holes are flat on the table. The position of the relay will have some effect on this operating voltage, even though the relay may be mounted in any position in the aircraft.

b. Operate the generator at a speed between 3000 and 4500 rpm.

c. Place switch (3) in position 1, switches (5 and 6) in position 2, then vary the voltage by means of rheostat (4) to close and open the contactor. The closing voltage, read on voltmeter (7), should be between 14 and 15.5 volts. The opening voltage should be 5 volts or below.

3-6. MILLIVOLT DROP TEST.

a. Set all switches in the "OFF" position.

b. Operate the generator at a speed between 4500 and 6000 rpm.

c. Place switch (3) in position 2, and adjust regulator to 28.5 volts.

d. Place switch (5) in position 2, then close load bank switches until a current of 300 amperes is read on ammeter (11).

e. Place switch (9) in position 2 and read the millivolt drop on millivoltmeter (13). The drop should not exceed 100 millivolts.

CAUTION

Place switch (9) in the open position before permitting the relay to open.

f. If the millivolt drop exceeds the allowable limit, refer to Table V, "Trouble Shooting".

3-7. DIELECTRIC TEST.

a. Remove the two screws (13, figure 2-1) which connect the cover (12) and negative base connector links (42) to the main base assembly (44).

b. Using a suitable dielectric tester, apply a voltage of 1250 volts rms, commercial frequency, for a period of one second between the following points: each terminal to cover: "BAT" terminal to terminals "IND", "APP" and "SW"; "GEN" terminal to terminals "IND", "APP" and "SW". No breakdown shall occur as a result of this test.

c. Apply 500 volt rms, commercial frequency, for a period of one second between terminals "GEN" and "BAT". No breakdown shall occur.

3-8. TROUBLE SHOOTING.

3-9. A list of the most common troubles, their probable cause and suggested remedy is shown in Table V.

TABLE V. TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
VOLTAGE RELAY WILL NOT CLOSE	Improperly connected or faulty generator.	Check connection, generator voltage and polarity.
	Relay coil open or leads broken.	Replace coil.
	Relay improperly adjusted.	Readjust relay.
	Chips on permanent magnet.	Remove chips.
VOLTAGE RELAY WILL NOT OPEN	Broken or damaged spring.	Replace spring.
	Relay improperly adjusted.	Readjust relay.
	Chips on permanent magnet.	Remove chips.
DIFFERENTIAL RELAY WILL NOT CLOSE BUT VOLTAGE RELAY IS CLOSED	Relay coil open or leads broken.	Replace coil.
	Voltage relay contacts not touching.	Clean contacts and readjust voltage relay.
	Chips on permanent magnet.	Remove chips.
	Relay improperly adjusted.	Readjust relay.
DIFFERENTIAL RELAY WILL NOT OPEN	Chips on permanent magnet.	Remove chips.
	Relay improperly adjusted.	Readjust relay.
REVERSE CURRENT OPENING TOO LOW	Differential relay improperly adjusted.	Readjust relay.
	Bias winding of differential relay open.	Replace differential coil.
	Resistor open.	Replace resistor.

TABLE V. TROUBLE SHOOTING (Cont)

TROUBLE	PROBABLE CAUSE	REMEDY
CONTACTOR WILL NOT CLOSE BUT VOLTAGE RELAY AND DIFFERENTIAL RELAY ARE CLOSED	Differential relay contacts do not touch.	Clean contacts and readjust differential relay.
	Contactor coil open or leads broken.	Replace coil.
	Excessive friction on movable core.	Replace stationary core.
	Core rod bent.	Replace core rod.
CONTACTOR WILL NOT OPEN BUT DIFFERENTIAL RELAY IS OPEN	External short circuit between "SW" and "APP" terminals.	Correct short circuit.
	Core rod bent.	Replace core rod.
	Contactor contacts out of adjustment.	Readjust contacts.
CONTACT MILLIVOLT DROP ABOVE MAXIMUM LIMIT	Insufficient contact overtravel.	Readjust contacts.
	Insufficient contact spring pressure.	Stretch contact spring slightly.
	Contactor contacts dirty.	Clean contacts.

SECTION IV

DIFFERENCE DATA SHEETS

NOTE

Overhaul and test procedures for the items included in this section are the same as procedures for the cutout relay Part Number A-700AP except for the difference noted by the applicable Difference Data Sheets. Section I through III contain complete overhaul and test information for the cutout relay Part Number A-700AP.

INDEX OF PART NUMBERS

Part Number	Page
A-718AP	19

CUTOUT RELAY — PART NO. A-718AP

THE INSTRUCTIONS CONTAINED IN PRECEDING SECTIONS OF THIS HANDBOOK APPLY EXCEPT FOR THE DIFFERENCES GIVEN IN THIS DATA SHEET.

TABLE VI. LEADING PARTICULARS

CHARACTERISTICS	VALUE
Continuous Duty Load - - (amperes)	100
Disconnects - - Differential relay opens - - reverse current (amperes)	4-10

SPECIAL TOOLS. Same as Part No. A-700AP.

DISASSEMBLY. Same as Part No. A-700AP except as follows:

a. Remove main base assembly (45, figure 2-1) instead of (44). Remove 6T series coil assembly (7, figure 2-4) instead of series coil assembly (6).

CLEANING. Same as Part No. A-700AP.

INSPECTION. Same as Part No. A-700AP.

TESTING (during overhaul). Same as Part No. A-700AP.

LUBRICATION. Same as Part No. A-700AP.

REASSEMBLY. Same as Part No. A-700AP except as follows:

a. Reassembly is the same except as noted in the disassembly portion of this data sheet and as described here.

b. Instead of the adjustment as stated in paragraph 2-31f, it should read as follows: Loosen lock nut (4, figure 2-5) and adjust screw (5) until relay opens at a voltage between 0.37 and 0.43, and with contact screw (6) set so that when the relay is closed the contacts would remain engaged for at least one-half turn if screw (6) is backed out.

TEST PROCEDURE (after overhaul). Same as Part No. A-700AP except as follows:

a. Paragraph 3-3f should read: measure the reverse current opening by slowly decreasing the generator voltage by means of rheostat (4, figure 3-1) until the cutout opens. The reverse current is read on ammeter (11) just before the reading goes to zero. The reverse current opening should be between 4 to 10 amperes when the generator voltage is at 26 volts. If the generator voltage reading on voltmeter (7) with switch (6) in position 2 is not 26 volts use Table VII to obtain the corresponding reverse current opening for various voltages.

b. The following table of reverse current opening values should be used instead of Table IV.

TABLE VII. REVERSE CURRENT OPENING

GENERATOR VOLTAGE (volts)	REVERSE CURRENT (amperes)	
	Min	Max
28	4.75	10.75
26	4	10
24	3.25	9.25
22	2.50	8.50

c. Paragraph 3-6d should read: place switch (5) in position 2, then adjust the current to 100 amperes. The millivolt drop should not exceed 100 millivolts with a current of 100 amperes.

ILLUSTRATED PARTS BREAKDOWN

REVERSE CURRENT CUTOUT RELAY

PART NUMBERS

A-700AP and A-718AP

The HARTMAN ELECTRICAL MANUFACTURING *Co.*

Mansfield, Ohio

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	Exploded View of Contactor Assembly	8
	Exploded View of Main Base Assembly	9
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SECTION I

INTRODUCTION

1-1. GENERAL.

1-2. This Illustrated Parts Breakdown provides complete information necessary to identify and requisition the parts, subassemblies and assemblies for the type AN3025-300 and AN3025-100 Cutout Relays. The Cutout Relays are manufactured by The Hartman Electrical Manufacturing Company, Mansfield, Ohio, under their P/N A-700AP, USAF S/N 3380-218800-2855 and A-718AP, USAF S/N 3380-218800-2755 (See figure 1 for an assembled view of representative equipment.)

1-3. The Table of Contents shows the method of grouping the assemblies and the sequence of the groups and indicates that the handbook is divided into three sections.

1-4. The first column lists the figure and index numbers for all items illustrated in each exploded view. The Part Number and description of the assembly or part are given in the next two columns with the quantity required shown in the fourth column. The last column provides for model variations as applicable. In the Group Assembly Parts List section, all of the assemblies and parts are arranged in the order of disassembly with the exception of the attaching parts which follow immediately after the item to be attached. Subassemblies are indented to indicate their relationship to the complete assembly. Associated with each list is an exploded view illustration. These drawings serve to show the relative positions of the various components and to fully identify all assemblies and parts. Where a subassembly requires an additional illustration to show the breakdown of detail parts, a cross reference is provided in the group assembly listing to locate the details of the subassemblies.

1-5. In this handbook the Hartman part numbers assigned to cover the complete units of equipment are prefixed with the letter "A". Each Hartman number used to identify parts is either a four or five digit number. In some instances, a dash suffix has been assigned as an aid in requisitioning parts so that correct parts can be obtained for maintenance purposes. Air Force and Navy standard parts are prefixed with the letters AN. Commercial parts are identified by the use of the symbol COMM.

1-6. The quantities listed in the "UNITS PER ASSY" column of the Group Assembly Parts List are in the case of assemblies, the total quantity used per unit of equipment at the location indicated, while the component parts indented under the assemblies only show the quantity used per assembly. Therefore, the quantities specified are not necessarily the total used per unit of equipment. Refer to the Numerical Index (Section III) for the total quantities of all items required.

1-7. Overhaul instructions for the Cutout Relay, covered in this Illustrated Parts Breakdown, are contained in T.O. 8R1-3-2-93.

1-8. When the stock number of a listed part does not appear in this Illustrated Parts Breakdown, refer to the Master Numerical Index S-00-1.

1-9. In the Numerical Index (Section III), all parts in the Group Assembly Parts List section are rearranged in alpha-numerical order. The numerical part number filing system is described as follows:

(1) The arrangement sequence of each numbered part begins at the extreme left-hand position and continues left-to-right, one column at a time, until part number numerical arrangement is determined.

(2) The order of precedence in part number numerical arrangement is as follows:

(1) In the first position, letters A through Z, then numerals 0 through 9.

(2) In the second position and in all succeeding positions the order of precedence is as follows:

(1) Space (blank column)
(2) Diagonal (slant) /
(3) Point (period)
(4) Dash (-)
(5) Letters A through Z
(6) Numerals 0 through 9

NOTE

Alphabetic O's shall be considered as numerical zeros. Spaces, diagonals, points and dashes shall not appear in the extreme left-hand position of the part number. However, they may be used in the second and succeeding positions of the part number and shall take precedence over letters and numerals as indicated above.

1-10. The figure and index number is listed for the first appearance only of AN and Hartman standard parts. The total quantities of all parts required for a complete unit are also indicated.

1-11. USABLE ON CODE. Part variations between models are indicated by letter symbols placed in the "USABLE ON CODE" column of the Group Assembly Parts List. Where the same parts are used on both models, the coding column is left blank. The coding used in this parts breakdown is as follows:

PART NUMBER	USABLE ON CODE
A-700AP	A
A-718AP	B

1-12. SOURCE CODING. Source coding as applied to the Numerical Index has been assigned by Department representatives.

1-13. SOURCE CODE DEFINITIONS.

1-14. CODE "P" - PARTS UNDER INVENTORY STOCK CONTROL

(1) Code "P" is applied to parts which are procured in view of relatively high usage. Code "P" parts may be requisitioned and installed

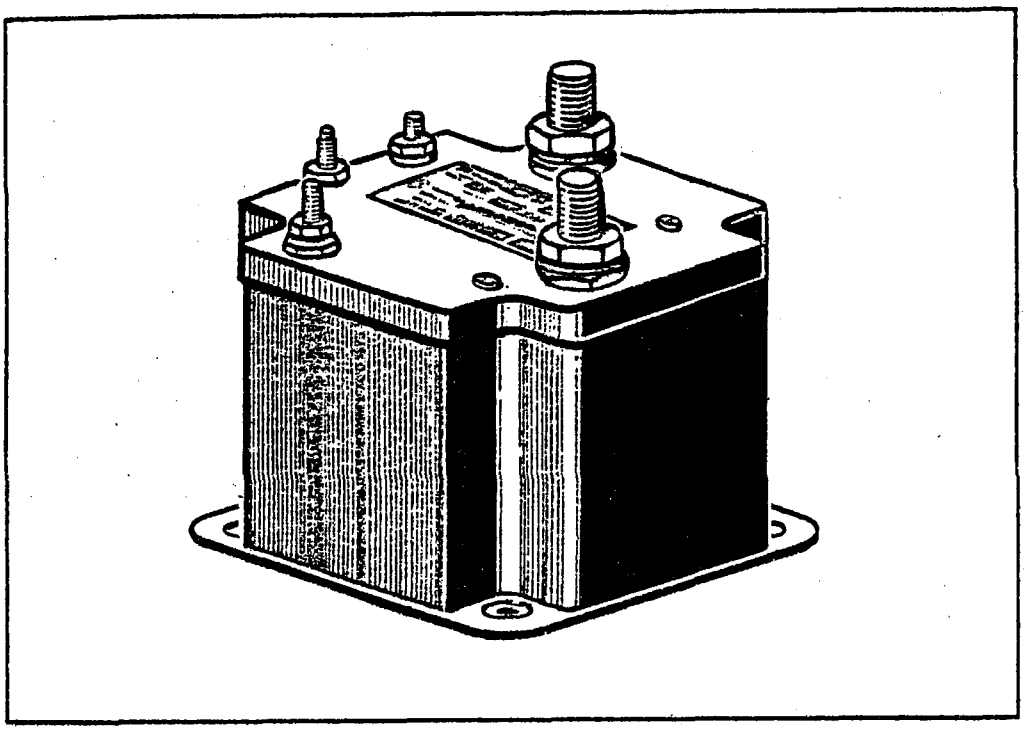


Figure 1. Assembled View of Representative Equipment

by any maintenance level, unless followed by the letter - "O", which restricts requisition and replacement to Depot (O&R) level only. Restricted service manufacture is considered practicable but only after an attempt has been made to procure from Supply Sources. In lieu of Procurement of "P" Coded parts, the Department may designate a Depot (O&R) level activity to manufacture supply requirements for the Program.

(2) CODE "P1" is applied to parts which are very difficult or uneconomical to manufacture. Service manufacture is considered impracticable. Code "P1" parts may be requisitioned and installed by any maintenance level unless followed by the letter "O" which restricts requisition and replacement to Depot (O&R) level only.

1-15. CODE "M" - MANUFACTURE; PARTS NOT PROCURED

(1) CODE "M" is applied to parts which are within the facilities of any activity to manufacture. Procurement and stocking are not justified in view of the relatively low usage, or storage and installation factors, of these parts. Needs are to be met by local manufacture as required.

(2) CODE "M1" is applied to parts which can be manufactured only by utilizing the facilities of the Depot (O&R) activity. Procurement and stocking of these parts are not justified in view of their relatively low usage and installation factors. The needs of all activities are to be met through salvage, or by Depot (O&R) level manufacture.

1-16. CODE "A" - ASSEMBLE; ASSEMBLY NOT PROCURED

(1) CODE "A" is applied to assemblies made up of two or more units each of which carry individual part numbers and description and which may be assembled by any Maintenance level.

(2) CODE "A1" is applied to assemblies made up or two or more parts each of which carry individual part numbers and description which may be assembled only by activities having Depot (O&R) facilities.

1-17. CODE "X" - PARTS CONSIDERED IMPRACTICABLE FOR MANUFACTURE OR PROCUREMENT

(1) CODE "X" is applied to Main Structural Members or similar parts which, if required, would suggest extensive aircraft or equipment reconditioning. The need of a part, or parts, coded "X" (wing spar caps, center section structure) should normally result in a recommendation to retire the aircraft or equipment from Service.

(2) CODE "X1" is applied to parts for which procurement of the next higher assembly is justified; e.g., an integral detail part, such as welded segments, inseparable from its assembly; a part machined in a matched set; or a part of an assembly which, if required, would suggest extensive reconditioning of each assembly.

(3) CODE "X2" as applied to parts which are neither procured nor stocked. Activities requiring such parts shall attempt to obtain from salvage; if not obtainable from salvage, such parts shall be requisitioned through normal supply channels with supporting justification.

1-18. CODE * - PARTS NOT PROCURED, MANUFACTURED OR STOCKED

(1) CODE "*" applies to installation drawings, diagrams, instructions or field service drawings, basic drawing numbers which cannot be procured or manufactured and obsolete parts.

1-19. HOW TO USE THIS ILLUSTRATED PARTS BREAKDOWN

1-20. HOW TO FIND THE PART NUMBER AND DESCRIPTION WHEN THE PART NUMBER IS NOT KNOWN.

(1) When the part number is not known and it is desired to locate the part number and correct description, turn to the Table of Contents to determine to which assembly the part number is applicable.

(2) Locate the illustration from the Table of Contents, then identify the part in question on the exploded view.

(3) Using the index number assigned to the part in the exploded view, locate this number in the "FIG. & INDEX NO." column in the Group Assembly Parts List (Section II). The correct part number, description and quantity required will be found following the index number.

1-21. HOW TO FIND THE ILLUSTRATION AND DESCRIPTION FOR A PART IF THE PART NUMBER IS KNOWN.

(1) Refer to Section III, Numerical Index, and find the part number, and the figure and index number for the part.

(2) Turn to Section II, Group Assembly Parts List, and find the figure and index number indicated in Section III for that part.

(3) Opposite the figure and index number in the Group Assembly Parts List, find the complete description for that part.

(4) On the corresponding illustration, find the index number determined in paragraph 1-20 (2).

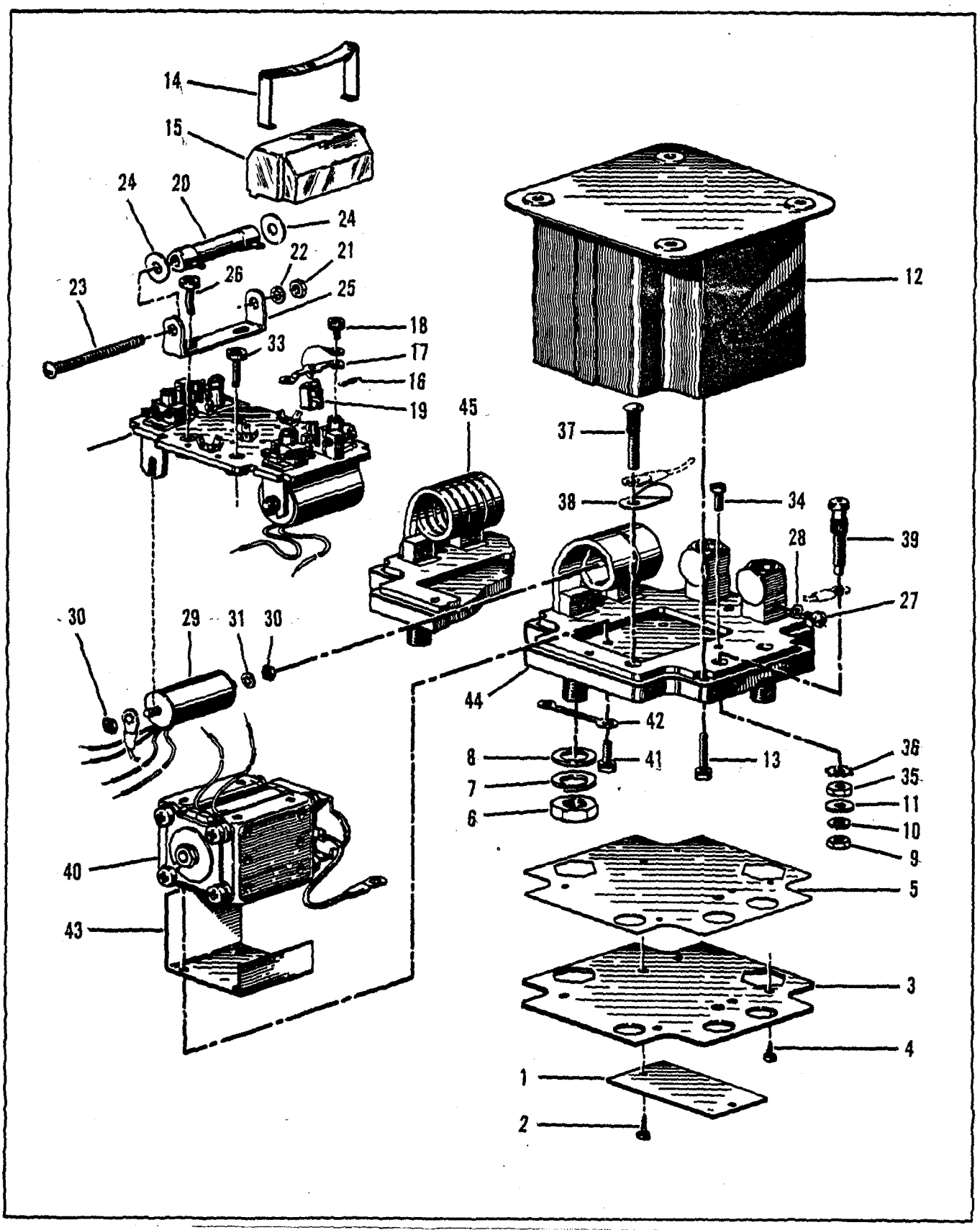


Figure 2 Exploded View of Cutout Relay Part Number A-700AP and A-718AP

SECTION II

GROUP ASSEMBLY PARTS LIST

FIG. & INDEX NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
2-	A-700AP	RELAY, Cutout 300 amperes type AN3025-300	1	A
	A-718AP	RELAY, Cutout 100 amperes type AN3025-100	1	B
-1	13656-1	• PLATE, Name	1	
		(ATTACHING PARTS)		
-2	COMM	• SCREW, Sheet metal binding hd stainless steel No. 4 x 3/8-in.	2	
		---------*---------		
-3	7822	• PLATE, Cover base insulating	1	
		(ATTACHING PARTS)		
-4	COMM	• SCREW, Sheet metal binding hd stainless steel No. 4 x 1/4-in.	4	
		---------*---------		
-5	8298-1	• TAPE, Base sealing	1	
-6	AN341-616	• NUT	2	
-7	AN935-616	• WASHER	2	
-8	AN960-616	• WASHER	2	
-9	COMM	• NUT, Hex brs silver pl No. 10-32 x 5/16 x 9/64-in.	3	
-10	AN935-10	• WASHER	3	
-11	AN960-10L	• WASHER	3	
	13641-10	• CUTOUT ASSY, Primary	1	A
	13641-20	• CUTOUT ASSY, Primary	1	B
-12	12646-10	• • COVER	1	
		(ATTACHING PARTS)		
-13	COMM	• • SCREW, Sems binding hd brs No. 6-32 x 5/8-in.	4	
		---------*---------		
	9747	• • COVER ASSY, Relay	2	
-14	9546	• • • CLAMP, Relay cover	1	
-15	9515	• • • COVER, Relay	1	
-16	7559	• • SPRING, Voltage relay	1	
-17	7541	• • BRIDGE ASSY, Pivot	2	
		(ATTACHING PARTS)		
-18	COMM	• • SCREW, Sems binding hd brs No. 5-40 x 7/32-in.	4	
		---------*---------		
-19	7577	• • MAGNET ASSY	2	
-20	COMM	• • RESISTOR, 250 ohm 10 watt	1	
		(ATTACHING PARTS)		
-21	COMM	• • NUT, Hex brs No. 8-32 x 5/16 x 3/32-in.	1	
-22	AN936A8B	• • WASHER	1	
-23	COMM	• • SCREW, Steel rd hd No. 8-32 x 2-1/8 in.	1	
		---------*---------		
-24	10002	• • WASHER, Mica	2	
-25	9163-1	• • BRACKET, Resistor mounting	1	
		(ATTACHING PARTS)		
-26	COMM	• • SCREW, Binding hd brs No. 8-32 x 1/2-in.	2	
-27	COMM	• • SCREW, Binding hd brs No. 6-32 x 3/16-in.	2	
		---------*---------		
-28	AN935B6L	• • WASHER	2	
-29	13643-1	• • COIL ASSY, Differential	1	
		(ATTACHING PARTS)		
-30	COMM	• • NUT, Hex brs No. 6-32 x 1/4 x 5/64-in.	2	
-31	AN936A6B	• • WASHER	1	
		---------*---------		

FIG. & INDEX NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
		CUTOUT RELAY (Cont)		
2-32	13644-10	. . RELAY ASSY, Voltage and differential . . . . . (See figure 3)	1	
		(ATTACHING PARTS)		
-33	COMM	. . SCREW, Binding hd brs No. 8-32 x 1/2-in.	2	
		---------*---------		
-34	COMM	. . SCREW, Binding hd brs No. 6-32 x 3/8-in.	1	
-35	AN345C10	. . NUT	3	
-36	COMM	. . WASHER, Lock external bronze No. 10	3	
-37	7688	. . SCREW, Terminal long	2	
-38	7534	. . SHIELD, SW terminal	1	
-39	10076	. . TERMINAL, Vented	1	
-40	13647-10	. . CONTACTOR ASSY (See figure 4)	1	
		(ATTACHING PARTS)		
-41	COMM	. . SCREW, Sems binding hd brs No. 8-32 x . . . . . 5/16-in.	4	
		---------*---------		
-42	7529	. . LINK, Negative base connector	2	
-43	7533	. . PLATE, Contactor insulating	1	
-44	13671-10	. . BASE ASSY, Main (See figure 5)	1	A
-45	13671-20	. . BASE ASSY, Main (See figure 5)	1	B

FIG. & INDEX NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
3-	13644-10	RELAY ASSY, Voltage and differential (See item 32, ... figure 2 for next higher assembly)	REF	
-1	10489-1	. COIL ASSY, Voltage	1	
		(ATTACHING PARTS)		
-2	COMM	. NUT, Hex brs No. 6-32 x 1/4 x 5/64-in.	2	
-3	AN936A6B	. WASHER	1	
		---------*---------		
-4	7535	. WASHER, Relay coil head	2	
	8150	. SCREW ASSY, Relay spring adjusting	1	
-5	COMM	. . NUT, Hex brs No. 3-56 x 5/32 x 1/16-in.	2	
-6	7543	. . SCREW, Relay spring adjusting	1	
-7	10990	. SCREW, Magnet adjusting	4	
-8	COMM	. NUT, Hex brs No. 2-56 x 5/32 x 0.050-in.	4	
-9	7540	. CONTACT, Tipped screw	2	
-10	COMM	. NUT, Hex brs No. 5-40 x 3/16 x 1/16-in.	2	
-11	7549	. POST, Long round bridge	1	
		(ATTACHING PARTS)		
-12	COMM	. SCREW, Binding hd brs No. 5-40 x 5/16-in.	1	
		---------*---------		
-13	7551	. POST, Short round bridge	1	
		(ATTACHING PARTS)		
-14	COMM	. SCREW, Binding hd brs No. 5-40 x 5/16-in.	1	
		---------*---------		

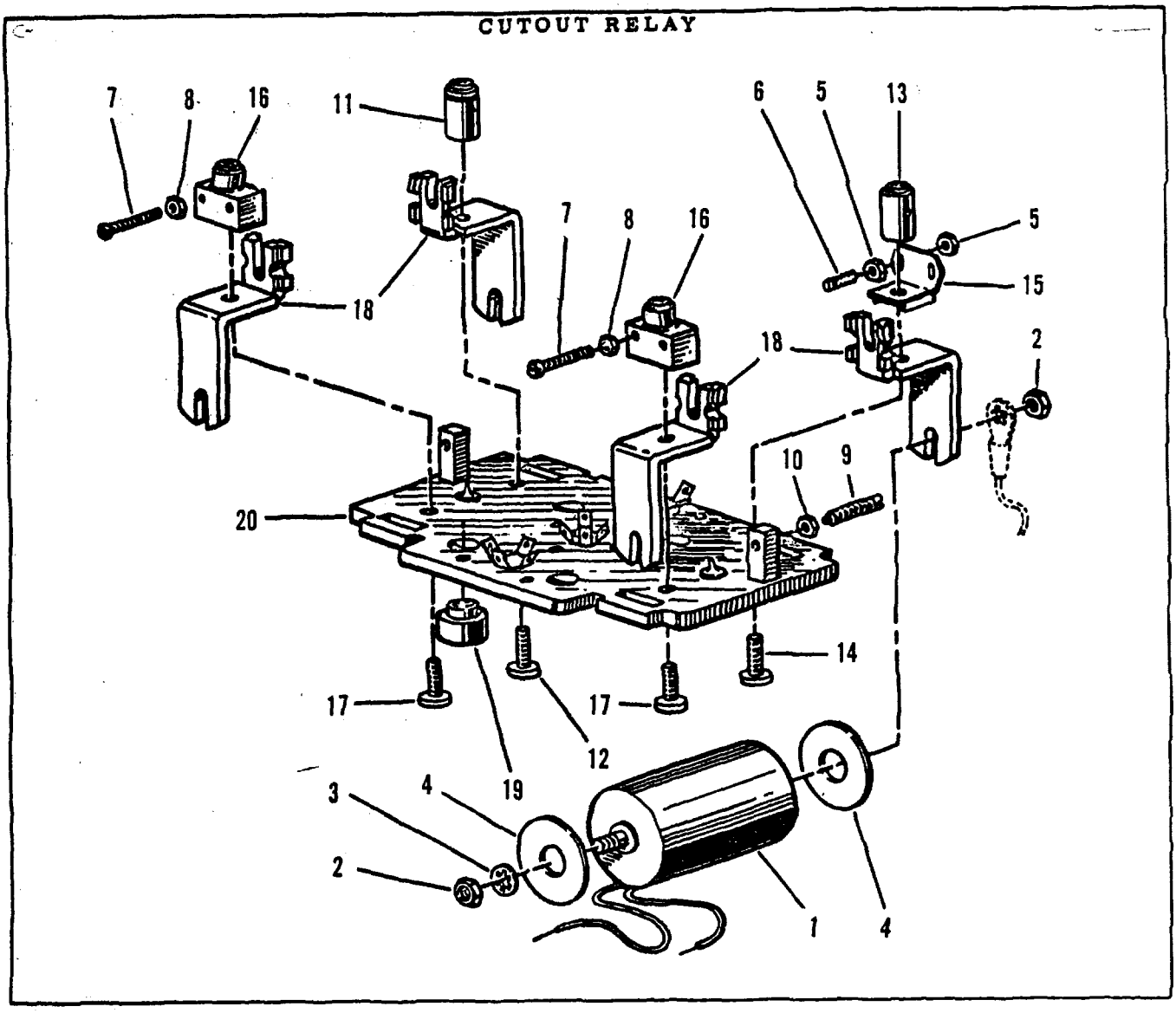


Figure 3. Exploded View of Voltage and Differential Relay Assembly

FIG. & INDEX NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
		RELAY ASSEMBLY (Cont)		
3-15	10011	• BRACKET, Relay spring	1	
-16	7550	• POST, Rectangular bridge	2	
		(ATTACHING PARTS)		
-17	COMM	• SCREW, Binding hd brs No. 5-40 x 5/16-in.	2	
		---------*---------		
-18	7518	• FRAME, Relay	4	
-19	7607	• BUSHING, Relay mounting	4	
-20	11537-10	• PLATE ASSY, Relay mounting	1	

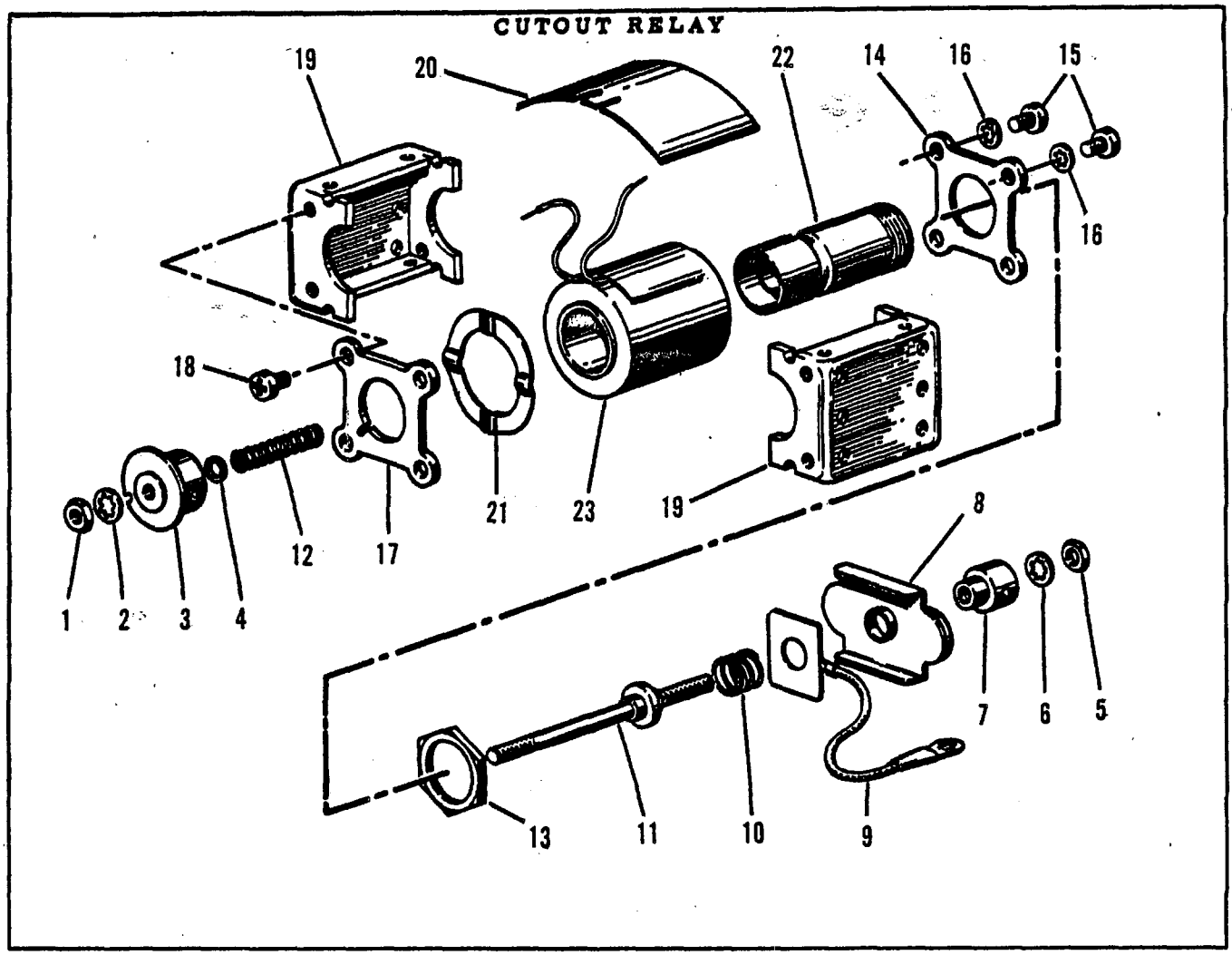


Figure 4. Exploded View of Contactor Assembly

FIG. & INDEX NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
4-	13647-10	CONTACTOR ASSY (See item 40, figure 2 for next higher assembly)	REF	
-1	7560	• NUT, Core	1	
-2	AN936A10B	• WASHER	1	
-3	7509	• CORE, Movable contactor	1	
-4	10127-1	• SHIM, 0.008-in.	AR	
	10127-2	• SHIM, 0.016-in.	AR	
	10491-10	• CONTACT AND ROD ASSY	1	
-5	7560	• • NUT, Core	1	
-6	AN936A10B	• • WASHER	1	
-7	11386-1	• • NUT, Contact insulating	1	
-8	7572	• • CONTACT ASSY, Main movable	1	
-9	7698	• • LEAD ASSY, Indicator terminal	1	
-10	7558	• • SPRING, Main contact loading	1	
-11	11859-10	• • CORE ROD AND BUSHING ASSY	1	
-12	7557	• SPRING, Contactor core	1	
-13	8474	• NUT, Stationary core locking	1	

FIG. & INDEX NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
		CONTACTOR ASSEMBLY (Cont)		
4-14	9670	• PLATE, Top tie frame ..... (ATTACHING PARTS)	1	
-15	COMM	• SCREW, Binding hd brs No. 8-32 x 1/4-in.	4	
-16	AN936A8B	• WASHER	2	
		---------*---------		
-17	7507	• PLATE, Bottom tie frame ..... (ATTACHING PARTS)	1	
-18	COMM	• SCREW, Binding hd brs No. 8-32 x 1/4-in.	4	
		---------*---------		
-19	8645	• FRAME, Contactor	2	
-20	8310	• PLATE, Coil insulating	1	
-21	8996-2	• WASHER, Coil spring	1	
-22	8582	• CORE ASSY, Stationary	1	
-23	4974-1	• COIL ASSY, Contactor	1	

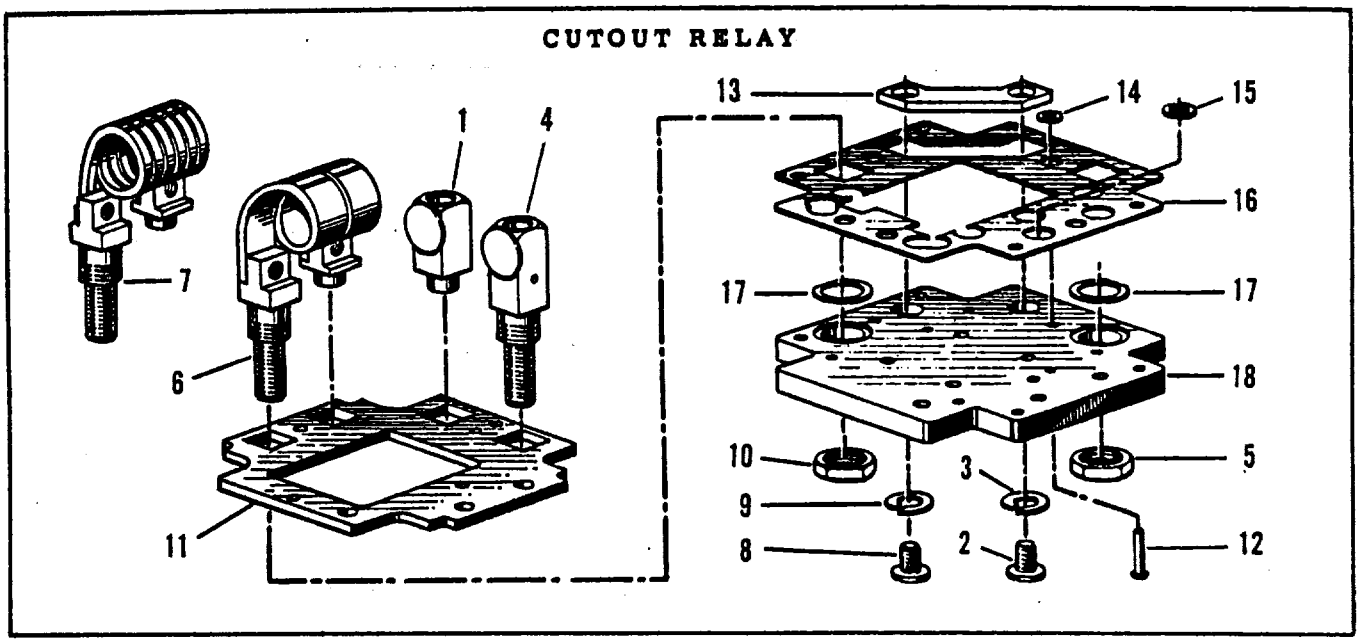


Figure 5. Exploded View of Main Base Assembly

FIG. & INDEX NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
5-	13671-10	BASE ASSY, Main (See item 44, figure 2 ..... for next higher assembly)	REF	A
	13671-20	BASE ASSY, Main (See item 45, figure 2 ..... for next higher assembly)	REF	B
-1	7571	• CONTACT ASSY, Main short stationary ..... (ATTACHING PARTS)	1	
-2	7512	• SCREW, Special binding hd	1	
-3	8542	• WASHER, Wide bearing lock	1	
		---------*---------		

FIG & INDEX NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
		MAIN BASE ASSEMBLY (Cont)		
5-4	7570	• CONTACT ASSY, Main long stationary	1	
		(ATTACHING PARTS)		
-5	7539	• NUT, Terminal post locking	1	
		--------*----------		
-6	7573	• COIL ASSY, Series	1	A
-7	7622	• COIL ASSY 6 T Series	1	B
		(ATTACHING PARTS)		
-8	7512	• SCREW, Special binding hd	1	
-9	8542	• WASHER, Wide bearing lock	1	
-10	7539	• NUT, Terminal post lock	1	
		---------*---------		
-11	7826	• BASE, Guide	1	
		(ATTACHING PARTS)		
-12	AN450C8B14	• RIVET	2	
		---------*---------		
-13	7528	• LINK, Contact post to series coil	1	
-14	7517-1	• WASHER, Base spacer	2	
-15	7628-1	• WASHER, Large base spacer	4	
-16	7503-1	• GASKET, Base	1	
-17	7521	• WASHER, Base stud seat	2	
-18	7827	• BASE, Main	1	

SECTION III

NUMERICAL INDEX

PART NUMBER	SOURCE CODE	FIG. & INDEX NO.	QTY PER ARTICLE
Nut		2-9	3
Nut		2-21	1
Nut		2-30	4
		3-2	
Nut		3-5	2
Nut		3-8	4
Nut		3-10	2
Resistor		2-20	1
Screw		2-2	2
Screw		2-4	4
Screw		2-13	4
Screw		2-18	4
Screw		2-23	1
Screw		2-26	4
		2-33	
Screw		2-27	2
Screw		2-34	1
Screw		2-41	4
Screw		3-12	4
		3-14	
		3-17	
Screw		4-15	8
		4-18	
Washer		2-36	3
A-700AP		2-	1
A-718AP		2-	1
AN341-616		2-6	2
AN345C10		2-35	3
AN450C8B14		5-12	2
AN935-10		2-10	3
AN935-616		2-7	2
AN935B6L		2-28	2
AN936A10B		4-2	2
AN936A6B		2-31	2
AN936A8B		2-22	3
AN960-10L		2-11	3
AN960-616		2-8	2
10002		2-24	2
10011		3-15	1
10076		2-39	1
10127-1		4-4	AR
10127-2		4-4	AR
10489-1		3-1	1
10491		4-	1
10990		3-7	4
11386-1		4-7	1
11537-10		3-20	1
11859-10		4-11	1
12646-10		2-12	1
13641-10		2-	1
13641-20		2-	1

PART NUMBER	SOURCE CODE	FIG. & INDEX NO.	QTY PER ARTICLE
13643-1		2-29	1
13644-10		2-32	1
		3-	
13647-10		2-40	1
		4-	
13656-1		2-1	1
13671-10		2-44	1
		5-	
13671-20		2-45	1
		5-	
4974-1		4-23	1
7503-1		5-16	1
7507		4-17	1
7509		4-3	1
7512		5-2	2
		5-8	
7517-1		5-14	2
7518		3-18	4
7521		5-17	2
7528		5-13	1
7529		2-42	2
7533		2-43	1
7534		2-38	1
7535		3-4	2
7539		5-5	2
		5-10	
7540		3-9	2
7541		2-17	2
7543		3-6	1
7549		3-11	1
7550		3-16	2
7551		3-13	1
7557		4-12	1
7558		4-10	1
7559		2-16	1
7560		4-1	2
		4-5	
7570		5-4	1
7571		5-1	1
7572		4-8	1
7573		5-6	1
7577		2-19	2
7607		3-19	4
7622		5-7	1
7628-1		5-15	4
7688		2-37	2
7698		4-9	1
7822		2-3	1
7826		5-11	1
7827		5-18	1
8150		3-	1

PART NUMBER	SOURCE CODE	FIG. & INDEX NO.	QTY PER ART-ICLE
8298-1		2-5	1
8310		4-20	1
8474		4-13	1
8542		5-3	2
		5-9	
8582		4-22	1
8645		4-19	2

PART NUMBER	SOURCE CODE	FIG. & INDEX NO.	QTY PER ART-ICLE
8996-2		4-21	1
9163-1		2-25	1
9515		2-15	2
9546		2-14	2
9670		4-14	1
9747		2-	2

REVERSE CURRENT CUTOUT RELAY

PART NUMBER

A-701D

THE HARTMAN ELECTRICAL MANUFACTURING CO.
MANSFIELD, OHIO

A-701D

The A-701D is an A-700AP or A-700ZC-7 style cutout with 400 amp contacts incorporating the A-703 battery starting main contactor operation from the APP terminal.

The purpose of the A-700AP or A-700ZC-7 reverse current cutout operation is to provide a connection between the generator and the battery or bus and to provide reverse current protection in the event of generator failure or a loss of generator voltage.

In the case of the A-701D, the values of reverse current and contactor rating differ from A-700ZC-7. The operation is as follows:

In the normal installation the terminals marked GEN and SW are connected to a generator positive, the terminal BAT is connected to battery positive or the positive bus to which a battery is normally connected, and the unit cover provides the ground return circuit. To complete the circuit, of course, the generator negative terminal and the battery negative are tied to common ground.

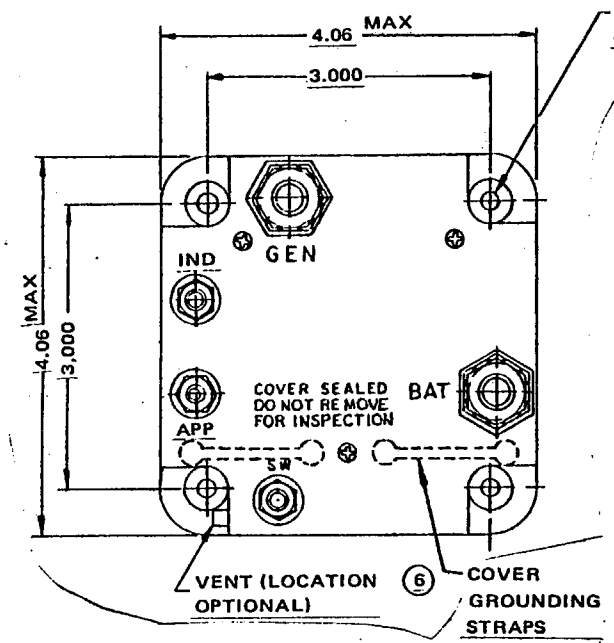
As the generator voltage increases the polarized differential relay senses when the generator is approximately 1/2 volt or more above the battery or bus and closes, applying power to the main contactor coil which closes the main contacts. The generator is now connected to the battery or bus. In the event of an unexcited bus, the differential relay closes the main contactor before the generator exceeds 24 volts.

It will be noted that after the main contacts close differential voltage no longer exists. The differential relay, however, is latching and therefore remains closed.

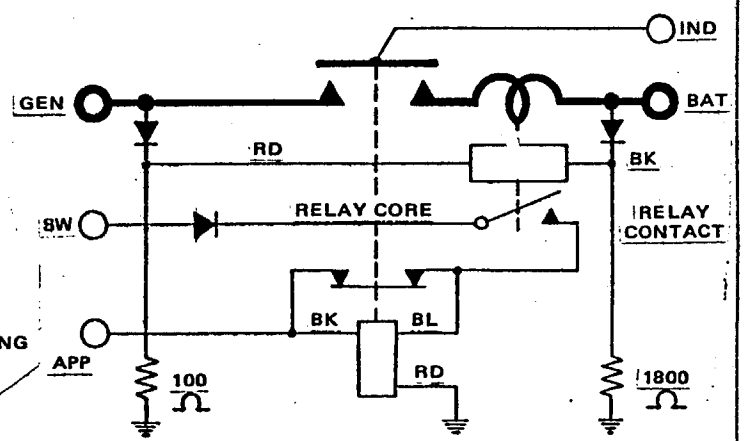
Should there be a loss of generator voltage for any reason, that is whether the generator has failed or whether the system is merely being shut down, the battery or bus will force reverse current to flow back to the generator, through the reverse current coil. When this current reaches a value of 25 to 50 amperes, the differential relay will open, opening the circuit for the main contactor coil, dropping out the main contactors.

Should the generator be shut down without reverse current, from an unexcited bus or by opening the SW, the differential relay will remain closed. Now if the bus is energized by another generator or by battery voltage the reverse differential voltage from battery or bus to the generator will open the differential relay contacts, returning the unit to the original condition. If the generator is restarted without the bus having been excited the main contactor will close when there is sufficient voltage, approximately 18 volts. In this latter case a diode in series with the main contactor coil prevents main contact closure if the generator polarity is reversed.

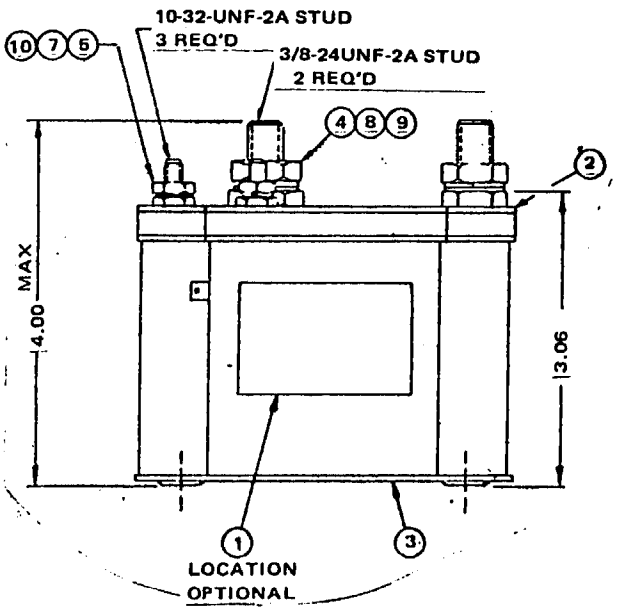
REV	D	REVISIONS 1-30-76		
SYM		DESCRIPTION		APPROVED.
A		DATA 8 WIRING DIAGRAM UPDATED	10-[illegible]-75	
B	3.06	ADDED	10-29-75	
C	3349	-10 & 33254 ADDED	1-30-76	
D	8996	ITEM 6 QTY. 3 WAS 4	3-19-76	



CONSTRUCTION	GASKET SEALED(VENTED)
MAIN CONTACTS	
CONFIGURATION	SPST N.O.
VOLTAGE	28VDC
CURRENT	400 AMP
	1000 AMP FOR 30 SEC
	1500 AMP INRUSH
DIFF. PICKUP	0.5+ 0.15 VDC
REV. 1 DROPOUT	25--50 AMPS
COIL DATA	
VOLTAGE	24 TO 30 VDC
PICKUP	15 VOLTS MAX
PULL THROUGH	7 VOLTS MAX AT 25°C
DROPOUT	0.5 - 7 VOLTS
RESISTANCE AT 25°C	
PICKUP	7.50 OHM ± 20%
HOLDING	80 OHM ± 20%
PEAK INRUSH	3 AMP MAX
DUTY	CONTINUOUS ECONOMIZING
AMBIENT TEMPERATURE	-55° TO + 71°C
LIFE ELECTRICAL	50,000 CYCLES MIN.
WEIGHT	3 LBS. 8 OZS.



REF A-700ZC-7
THEORY OF OPERATION



NOTE:
1. DESIGNED TO MEET MIL-C-5026 AND MIL-R-6106
2. INTERMITTENT COIL DUTY FROM APP, 2 MIN.MAX.

QTY REQD	NOMENCLATURE OR DESCRIPTION	PART OR IDENTIFYING NO.	ITEM NO.
3	WASHER NO. 10 SPLIT TYPE STEEL	51810-031	10
2	WASHER 3/8 SPLIT TYPE STEEL	51807-071	9
2	WASHER 5/8 X .390 X .964 FL. STEEL	51704-161	8
3	WASHER 7/16 X 13/64 X .032 STEEL	51702-851	7
3	SCREW NO. 4 X 1/4 BD. HD. S. STEEL	51200-020	6
3	NUT 10-32 X 3/8 X 1/8 HEX BRASS	50410-086	5
2	NUT 3/8-24X 5/8 X 7/32 HEX BRASS	50407-166	4
1	PRIMARY ASSEMBLY	33491-10	3
1	PLATE-BASE COVER	33254-3	2
1	PLATE-NAME	16043-1	1

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON

2 PL DEC	3 PL DEC	ANGLES
± .06	± .010	± 1°

MATERIAL

DR BY	W.S.S	4-29-75
CHECKED		
ENGINEER		
APPROVED		
APPROVED		

HARTMAN ELECTRICAL MANUFACTURING
DIV OF A-T-O MANSFIELD, OHIO

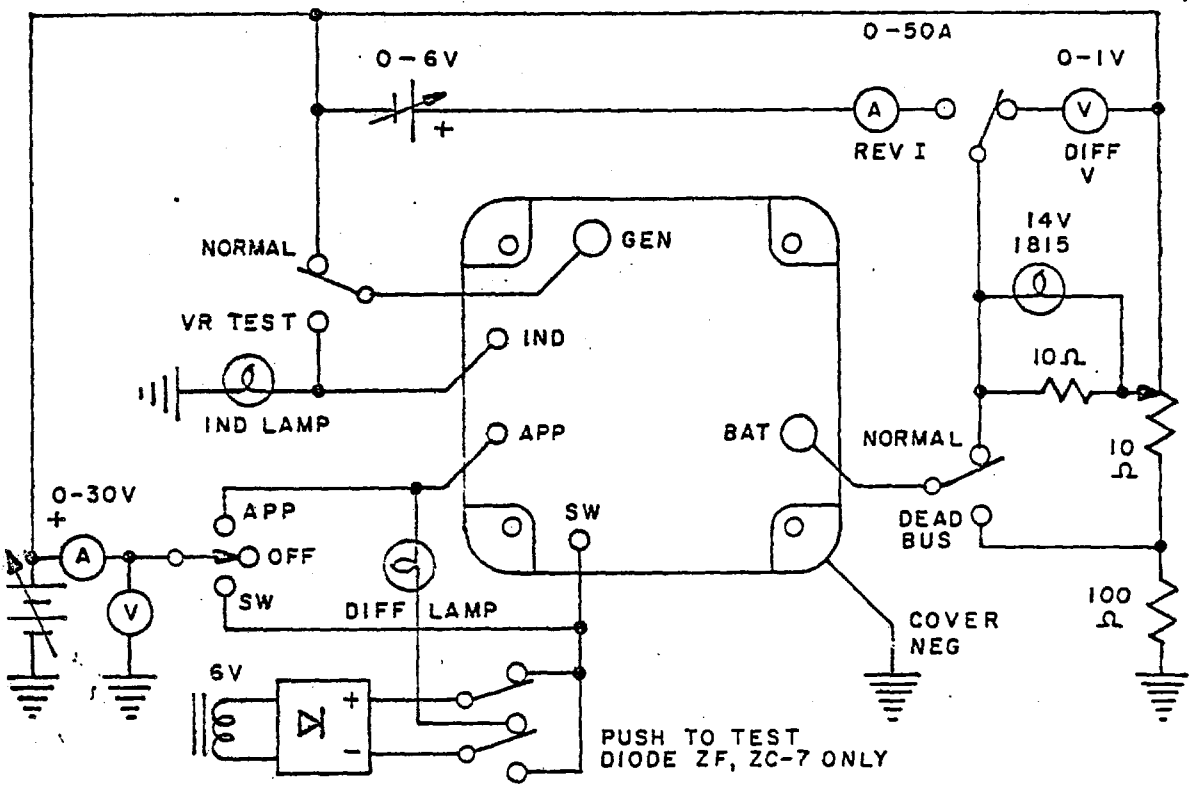
CUTOUT—REVERSE CURRENT
400 AMP, 28 VDC

SIZE	CODE IDENT NO	
C	74063	A-7001D

SCALE 1/1 WEIGHT SHEET

2

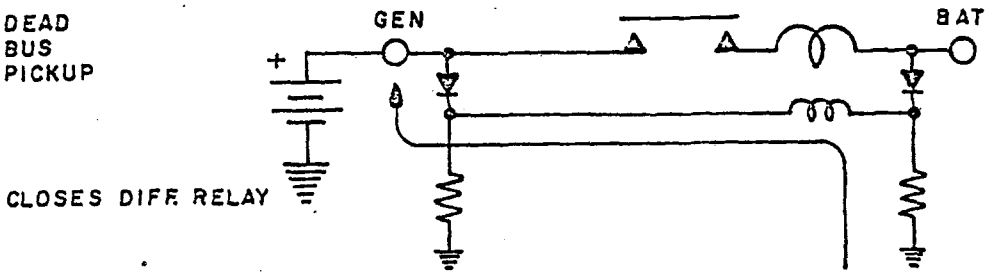
A-701D
TEST CKT.

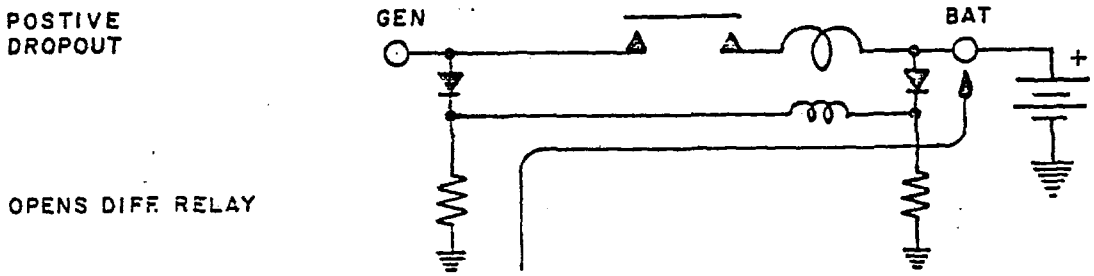


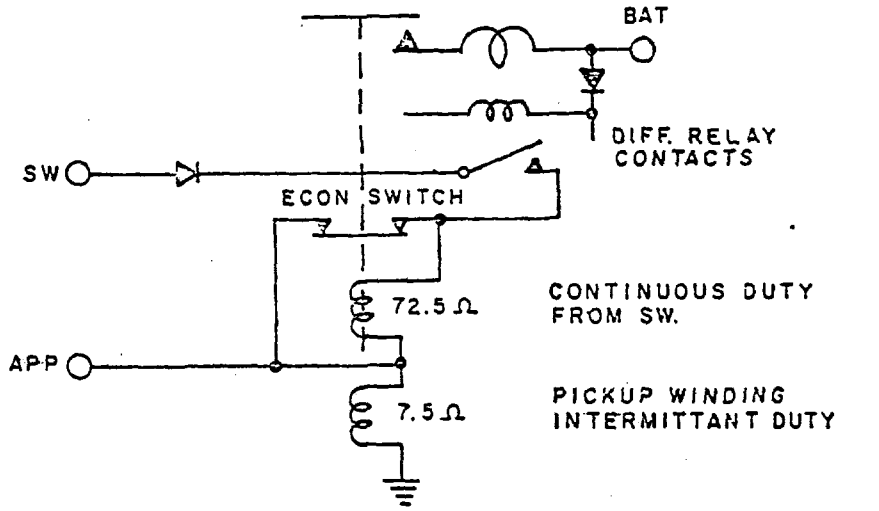
NOTES:

VERIFY ECON SW OPERATION
BY DROP IN COIL CURRENT
WHEN MAIN CONTACTOR CLOSES.

A-701D







NOTE:
FOR 6V PULL THROUGH
MAY NEED TO MOVE THE MAIN CONTACTOR
SOLENOID AS FAR BACKWARD ON BASE
AS HOLES PERMIT.

A-701D

Test Requirements	Test & Calibrate	Ready To Ship Recheck
Main Contactor		
Core Gap		
Main Contacts		
Overtravel-Bushing	.012 - .018	
Air Contact Lead	.008 - .015	
Pick Up	6.5 08.5V	6-9V
Pull Through from Contact Touch	6V Max.	
Drop Out	5.5V Max.	6V Max.
Econo Sw. Snap Point (Core Gap) "Sw. Button Must Not Go Solid"	.007 - .015	
Diff. Closing @ 28V	.4 - .6V	.35 - .65 V
Rev. I Opening @ 28V	30 - 35 A	25 - 50A
Dead Bus Pick Up	19 - 23V	24V Max.
Positive Drop Out	23V Max.	24V Max.
Indicator Lead Test 24V Lamp or Voltmeter		
Sequence Test		
Dead Bus P. U.	19 - 23V	24V Max.
SW P. U. - Reverse V. None @	30V	30V
SW P. U. - Normal V	15 Max.	16V Max.
Positive D. O. - Apply to BAT	23V	24V
SW P. U. - None @	30V	30V
Millivolt Drop at 300A	90MV	90MV
Dielectric All Term's to Cover "Tie All Term's Together" Raise & Lower Voltage Slowly. Ground Strap Cover Screws Must Be Removed.	1250	1250VAC

TEST TO BE RUN	1	4	5	6	9	10	25	33	34	35							A–701D

1. CONTACT OVERTRAVEL
   N.O. .015–.022
   N.C.
2. CONTACT PRESSURE
   N.O.
   N.C.
3. MAGNET PRESSURE
4. ARMATURE GAP .093
5. N.C. PICKUP 6.5–8.5*
6. N.C. DROPOUT 5.5 OR UNDER
7. V.R. PICKUP
8. V.R. DROPOUT
9. DIFF PICKUP .5 + 0.1V, BAT 20–22V
10. REV 1 DROPOUT BAT 27–29V, 30–35A
11. ANTICYCLE PICKUP
12. ANTICYCLE DROPOUT
13. RELAY PICKUP
14. RELAY DROPOUT
15. CURRENT PICKUP
16. CURRENT DROPOUT
17. CURRENT RESET
18. 3 0 P.U.
19. 3 0 D.O.
20. 2 0 P.U.
21. 2 0 D.O.
22. 1 0 D.O.

23. TRIP POINT
24. COIL CURRENT @ V
25. REPEAT FOLLOWING TESTS IN COVER
    5–6–9–10–33–34–35
26. LEAK TEST FINAL/RATE
27. BACK FILL
28. SKIP TEST OPS
29. CYCLE TEST OPS
30. TESTS TO BE RUN IN HEAT
31. TESTS TO BE RUN IN COLD
32. TIME VOLTAGE CURVE

VOLTAGE	TIME

33. AUX CONTACT TEST
    IND TO BAT

DISTRIBUTION PANEL NOs.

34. MILLIVOLT DROP

CONTACTS	CURRENT	M.V.
BAT–GEN	300	90
COIL	20–22V	

35. DIELECTRIC TEST

FROM	TO	VOLTAGE	TIME
ALL TERM	COVER	1250	1 SEC

TIE ALL TERMINALS TOGETHER, RAISE AND LOWER VOLTAGE SLOWLY.

SPECIAL INSTRUCTIONS

1. Main contact touch and final pickup may not exceed 1V, 1/2V desirable.
2. Unexcited bus close under 24V.
3. Positive dropout on D.R. over 1V. If over 13V, re-examine for D.R. chatter.

* Pull through from contact touch – 6V max.

LET.	REVISIONS	DATE	

RELAY NO. A-701D

INSHOP COPY

TEST TO BE RUN: 5 | 6 | 9 | 10 | 33 | 34 | 35

A-701D

1. CONTACT OVERTRAVEL
   N.O. _____
   N.C. _____
2. CONTACT PRESSURE
   N.O. _____
   N.C. _____
3. MAGNET PRESSURE _____
4. ARMATURE GAP _____
5. N.C. PICKUP _____ 6 - 9V
6. N.C. DROPOUT _____ 6V
7. V.R. PICKUP _____
8. V.R. DROPOUT _____
9. DIFF PICKUP _____ .35 – .65V, BAT 18 – 24V
10. REV 1 DROPOUT _____ BAT 27 – 29V, 25 – 50A
11. ANTICYCLE PICKUP _____
12. ANTICYCLE DROPOUT _____
13. _____ RELAY PICKUP _____
14. _____ RELAY DROPOUT _____
15. CURRENT PICKUP _____
16. CURRENT DROPOUT _____
17. CURRENT RESET _____
18. 3 Ø P.U. _____
19. 3 Ø D.O. _____
20. 2 Ø P.U. _____
21. 2 Ø. D.O. _____
22. 1 Ø D.O. _____
23. TRIP POINT _____
24. COIL CURRENT _____ @ _____ V
25. REPEAT FOLLOWING TESTS IN COVER
    5–6–9–10–33–34–35
26. LEAK TEST FINAL/RATE _____
27. BACK FILL _____
28. SKIP TEST _____ OPS.
29. CYCLE TEST _____ OPS.
30. TESTS TO BE RUN IN HEAT
31. TESTS TO BE RUN IN COLD
32. TIME VOLTAGE CURVE

VOLTAGE	TIME

33. AUX CONTACT TEST _____
    IND TO BAT _____

DISTRIBUTION PANEL NOs

34. MILLIVOLT DROP

CONTACTS	CURRENT	M.V.
BAT–GEN	300	90
COIL	20–22V	

35. DIELECTRIC TEST

FROM	TO	VOLTAGE	TIME
ALL TERM	COVER	1250	1 SEC

TIE ALL TERMINALS TOGETHER, RAISE AND LOWER VOLTAGE SLOWLY.

SPECIAL INSTRUCTIONS

1. Main contact touch and final pickup may not exceed 1V, 1/2V desirable.
2. Unexcited bus close under 24V.
3. Positive dropout on D.R. over 1V. If over 13V, re-examine for D.R. chatter.

LET.	REVISIONS	DATE	

RELAY NO. A-701D

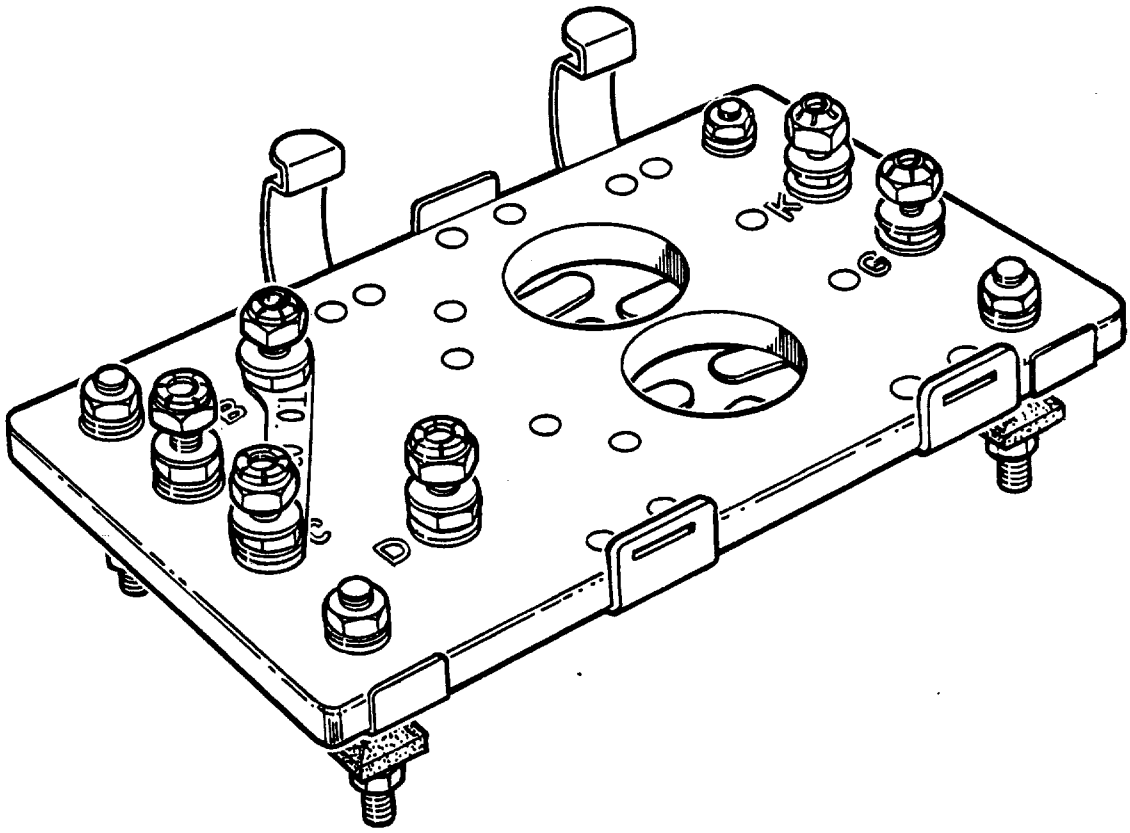
FINAL COPY

The LEECE-NEVILLE Company

INSTALLATION INSTRUCTIONS

NEW HIGHER OUTPUT A.C.-D.C. GENERATING SYSTEM

BASE ASSEMBLY TYPE 24554



AAF. Part Number	40-D-8445-2
Leece-Neville Part Number	24554
Length	6-1/2 Inch
Width	4 Inch
Height	1-15/16 Inch
Weight	0.64 Lb.

INSTALLATION OF VOLTAGE REGULATOR ON TYPE 24554 BASE

STEP 1

Insert the two small ears on the regulator sub-base into the slotted brackets riveted to the bakelite base. These ears must fit the brackets snugly, but without forcing. Make certain that the slotted brackets are not bent away from the side of the base assembly.
(Fig. 1)

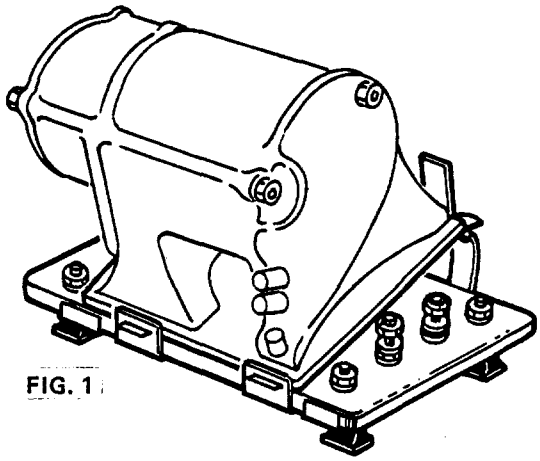


FIG. 1

STEP 2

Press the voltage regulator directly downward into the base. This will force the spring hold-down clips out far enough to admit the long vertical tabs on the voltage regulator. Do not bend these spring clips outward with pliers or a screw driver, as they must exert a pressure both downward on the tabs and across the base toward the slotted brackets.
(Fig. 2)

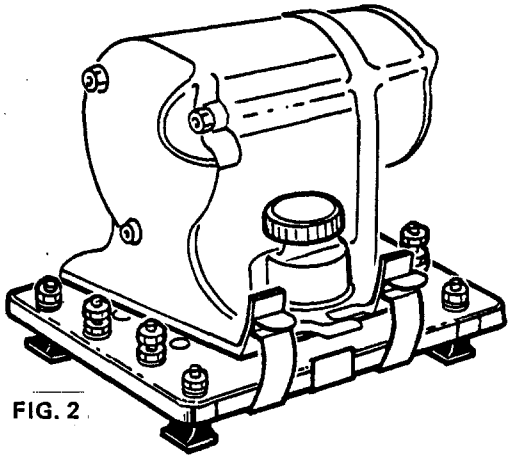


FIG. 2

STEP 3

Holding the voltage regulator tightly against the regulator base, snap the spring clips into position by pressing them against the regulator tabs as illustrated. (Fig. 3) If the spring clips do not pass over the regulator tabs, remove the regulator and examine both regulator and base for foreign objects causing interference.

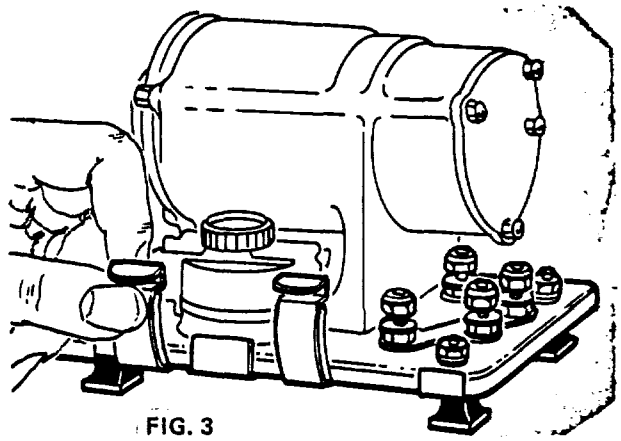


FIG. 3

INSTALLATION OF TYPE 24554 BASE ASSEMBLY

If the vibration mounts are not removed when the regulator base is installed, the following method is used:

Insert the mounting studs of the regulator base in the holes provided for them on the airplane mounting panel, and assemble the guard washers, lockwashers and hexagon nuts.

KEEP WRENCH TIGHT AGAINST MOUNTING PANEL

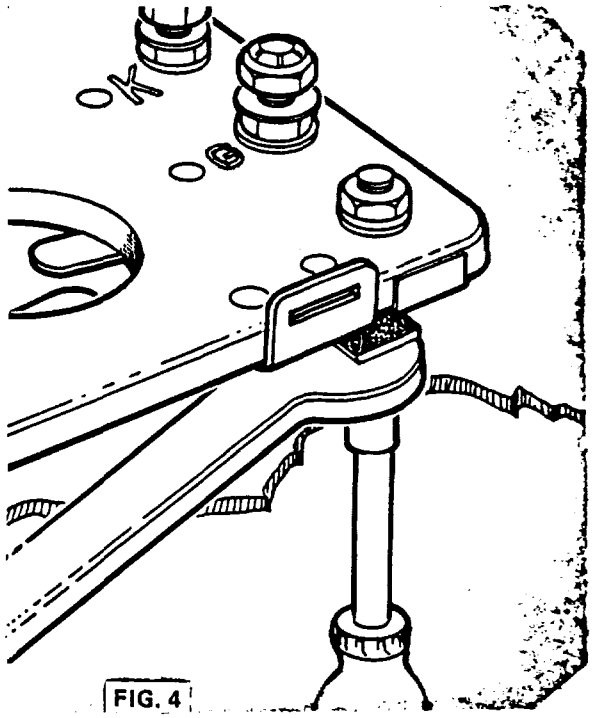


FIG. 4

To tighten, grip the bottom of the vibration mount lightly with an open end wrench, pressing the wrench tightly against the mounting surface. This is necessary in order to make sure that the wrench does not grip the rubber above the square steel insert and cause tearing of the rubber.

If it is necessary to remove the vibration mounts from the base for installation in the airplane, use the following method:

Remove the vibration mounts from the Voltage Regulator Base. Fasten the mounts to the mounting panel of the airplane, using either an open end wrench as in figure 4, or a 1/2 inch square box wrench.

Do not let the wrench slip up onto the rubber while tightening the lower nut. The sides of the rubber mounts must be parallel with the base when it is in position, as shown in fig. 5.

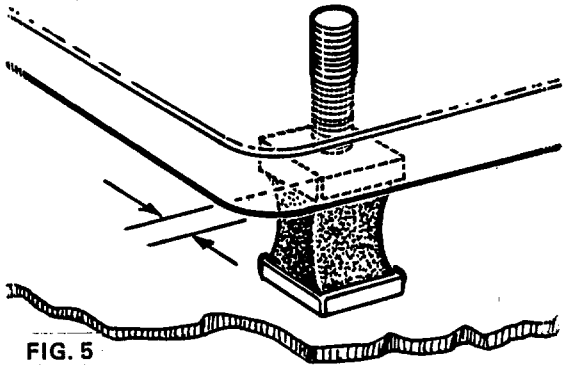


FIG. 5

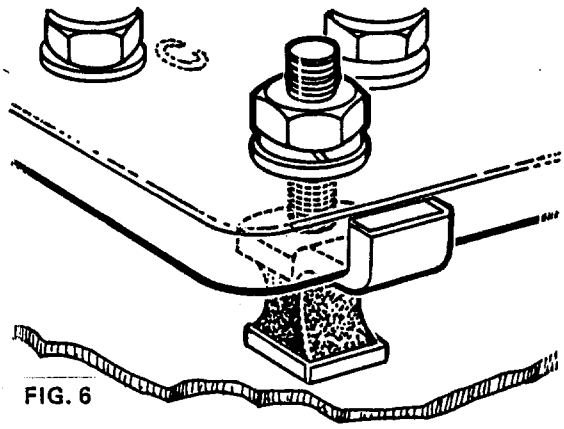


FIG. 6

Place the locking clip over the vibration mount as shown in fig. 6. The long tab must fit up over the long sides of the base.

The locking clips will hold the mount in correct position while the top hexagon nuts are tightened. The elastic stop nuts have been replaced by hexagon nuts, lockwashers and guard washers.

In any case, the mount must not be installed with any amount of twist in the rubber, as shown in fig. 7.

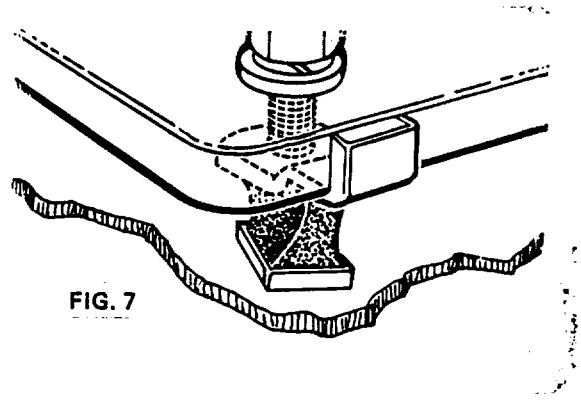


FIG. 7

SERVICE INSPECTION

The voltage regulator base should be inspected each time before a new voltage regulator is installed. The inspection procedure outlined below should be followed.

Inspect the contact blades for cracks, broken blades, corrosion, rust, or loss of tension.

Inspect the vibration absorption mounts for torn rubber or broken and damaged studs.

Inspect the spring clips for cracks or loss of tension.

Inspect the six terminal posts for tightness and damage to threads.

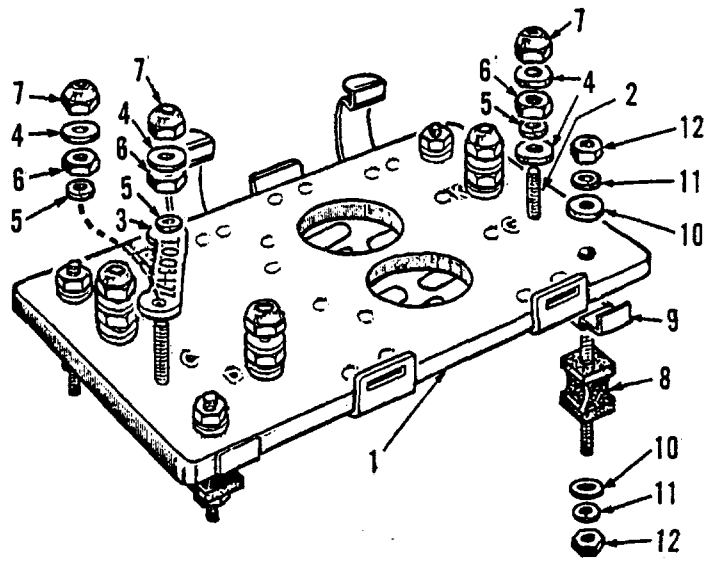
MAINTENANCE

The spring contact blades should be cleaned before the installation of a new voltage regulator. This may be accomplished by the use of crocus cloth to polish the areas at the tip of the blades which make contact with the voltage regulator pins. After cleaning, wipe the blades with a clean cloth moistened with carbon tetrachloride.

CAUTION: Do not use emery cloth or sandpaper on the contact blades. Do not scrape the blades with a sharp object, or the silver plating will be removed.

SERVICE TROUBLES AND REMEDIES

TROUBLE	PROBLEM CAUSE	REMEDY
Poor Contact With Voltage Regulator	Spring contact blades dirty.	Clean as instructed.
	Contact blades have lost tension.	Replace regulator base assembly.
	Loose or dirty connections in the wiring to the base.	Clean and tighten all connections.
No Contact Between Regulator And Base	Contact blades broken.	Replace base assembly.
	Contact blades deformed–not making contact.	Replace base assembly.
Regulator Base Loose In Airplane	Vibration mounts torn or broken.	Replace rubber vibration mounts.
	Nuts fastening base have come loose.	Tighten all mounting nuts.



TYPE 24554 BASE ASSEMBLY

KEY	L.N. CO. PART NO.	PART NAME	QTY.
1	S-25174	Base Assembly V.R.	1
2	33723	Screw 10-32 x 1 in. Rd. Hd. Brass	6
3	26213	Jumper	1
4	6409	Washer, Guard	12
5	2434	Lockwasher No. 10	6
6	33636	Nut Hex. 10-32	6
7	24758	Nut, Elastic Stop 10-32	6
8	26155	Support, Flexible	4
9	26196	Plate, Tabbed Lock	4
10	6409	Washer, Guard	8
11	2435	Lockwasher No. 8	8
12	2525	Nut Hex. 8-32	8

INSTRUCTION MANUAL

SINTERED-PLATE, NICKEL-CADMIUM BATTERIES

BY MARATHON

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INTRODUCTION

This manual has been prepared to acquaint you with the fundamental operating characteristics of MARATHON sintered-plate, nickel-cadmium batteries and to assist you in obtaining maximum performance with minimum maintenance and servicing.

Over a period of years, literally thousands of battery units have been operating in aircraft, missiles, satellites, ground vehicles, communication equipment, marine installations, ground power standby equipment and hundreds of other applications where rechargeability, flexible voltage and reliable power are essential.

Your Marathon battery is manufactured to the highest precision standards. Care has been taken in every step of the manufacture to assure a product of the very highest quality. Your battery has been carefully tested at factory laboratories before being shipped. Proper care and maintenance, as outlined in this manual, will aid you in keeping your battery at peak performance and prolong its useful life.

PART I-PRINCIPLES OF OPERATION

1.0 Electro-Chemical Principles of the Marathon Battery

1.1 DURING CHARGE

The active material of the negative plate is cadmium-oxide. When the charging current is applied. this material gradually loses its oxygen and becomes metallic cadmium. The active material of the positive plate is nickel-oxide. This is brought to a higher state of oxidation by the charging current. As long as this current continues, changes take place until both materials are completely converted.

Toward the end of this charging process, and during overcharge, Marathon cells will gas. This is a result of electrolysis of the water component of the electrolyte. The gas created at the negative plates is hydrogen and that at the positive plates is oxygen. The amount of gas created is dependent upon the temperature and the amount of charging current.

The cells will accept charge at temperatures ranging from −65° to +165° F. However, at extreme temperatures, the length of charge time must be limited. The electrolyte does not enter into any chemical reaction with either the negative or positive plates, but acts merely as a conductor of current between them. There is no significant change in the specific gravity, since the electrolyte acts only as a conductor.

1.2 DURING DISCHARGE

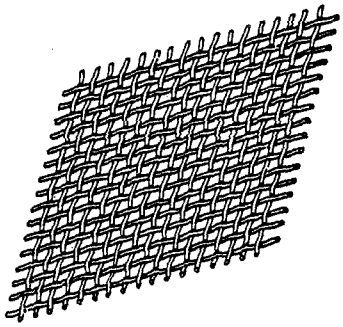
A chemical action in reverse of that which occurs during charge is immediately initiated when electrical energy is withdrawn from the cell. The negative plate gradually gains back oxygen and the positive plate gradually loses oxygen. There is no gassing on normal discharge due to this interchange of oxygen.

This process results in the conversion of the chemical energy of the plates into electrical energy. The rate of which this conversion takes place is primarily determined by the external resistance imposed by the electrical circuit to which the cell is connected. Due to the type of cell construction, there is extremely low internal resistance within the cell. The chemical nature of the electrolyte and its specific gravity remain unchanged during discharge. The relative constancy of the cell voltage during discharge is due mainly to these factors.

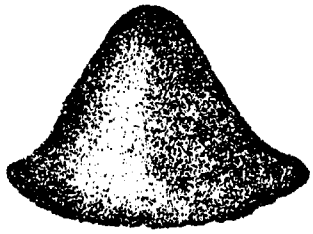
2.0 Construction of the Marathon Battery

2.1 PLAQUES AND PLATES

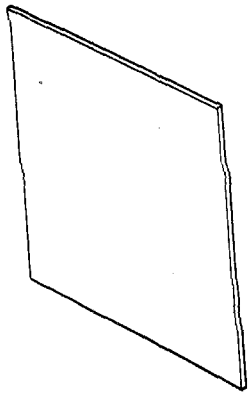
The basic feature of the Marathon battery is its sintered plate, as shown in the series of diagrams below.



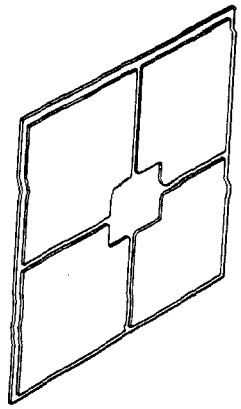
1. Here's how a Marathon battery is made. We start with a nickel screen.



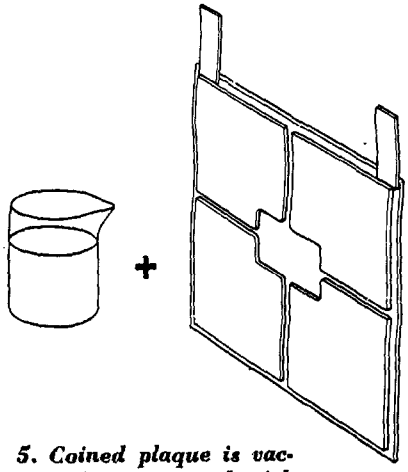
2. Then nickel powder is sintered about screen.



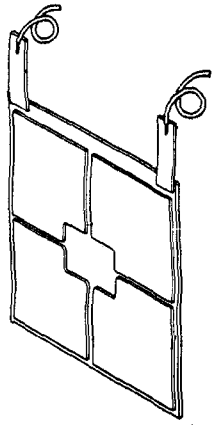
3. This forms a plaque approximately 80% porous at this stage.



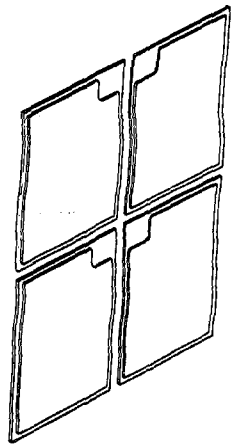
4. Plaque is coined with a plate die.



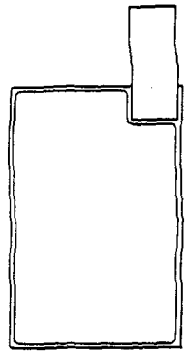
5. Coined plaque is vacuum impregnated with nickel or cadmium salts, electrochemically deposited within pores.



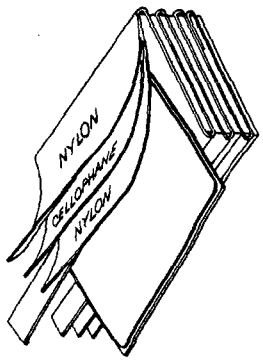
6. Current is passed through plaque in presence of electrolyte, to convert nickel or cadmium salts to final form.



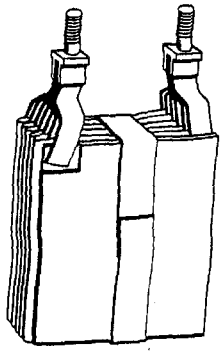
7. After washing and drying, finished plaque is cut into plates.



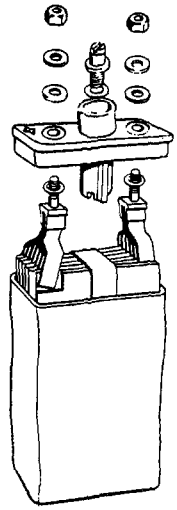
8. A nickel tab is spot welded to plate.



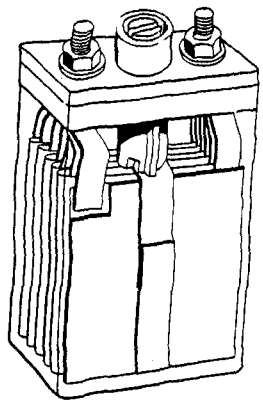
9. "Stackup" is prepared by folding separator material between alternate positive and negative plates.



10. Nickel terminals are welded to completed "stackup," which with its cellophane binder forms the complete assembly of the core.



11. Cover and vent assemblies are attached and sealed to "stackup."



12. Entire unit is inserted in cell case and sealed.

2.2 SINTERED-PLATE CONSTRUCTION METHODS

Sintering is that process by which micro-fine powder is fused together at high temperatures to form a porous plaque structure. The porous structure of the Marathon plaque is obtained by sintering nickel powder to a fine-mesh wire screen. The active material which distinguishes between the negative and positive plates is then electrochemically deposited within the pores of the plaque. Positive plaques are made by depositing nickel-hydroxide, negative plaques by depositing cadmium-hydroxide.

The plaques are then formed, washed, dried and cut into the desired plate size. Nickel connecting tabs are welded to one corner of each plate. Positive and negative plates are then grouped into a core assembly. The connecting tabs of all plates project upward toward the proper terminals, to which they are welded.

The sintered plates are positioned very closely together and are kept from actual physical contact by a thin multi-layer laminate, known as a separator.

While the surface of a sintered plate appears to be relatively smooth, it is actually a maze of tiny hills and valleys *(see Figure 1)*. This physical property multiplies the apparent surface area several hundred times and permits the utilization of a tremendous area of active material. The porosity of the plate permits the absorption of electrolyte. This further increases the volume of active material in direct contact with the electrolyte.

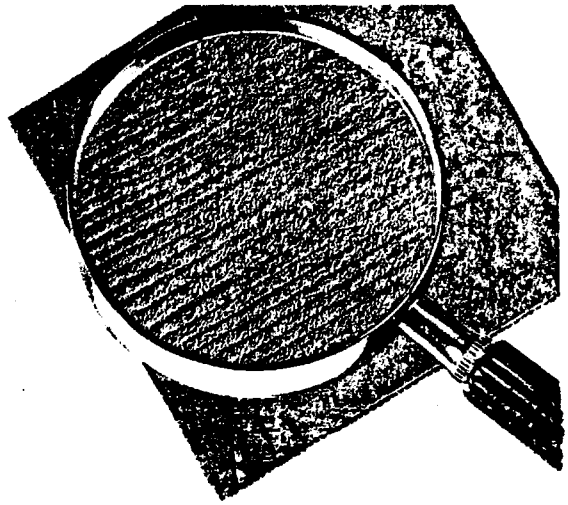


FIGURE 1

The porosity of Marathon plates is created by a partial sintering of the nickel powder. This powder has been carefully selected for particle size and shape. After sintering, the total active surface area of one Marathon nickel-cadmium plate is equal to that of several hundred solid plates of the same size.

2.3 SEPARATORS

A continuous strip of highly specialized fabric and pliable plastic composes the separator. This continuous separator is interposed between the plates as each successive plate is added to the "stackup" in preparing the core assembly. Thus the plates within the core are separated by a porous insulating barrier. This design provides the needed physical strength with minimum bulk and excellent electrical insulation, as well as efficient electrolytic conduction when immersed in the electrolyte. To insure complete insulation, the separator is slightly wider than the dimensions of the plate.

2.4 CELLS

The core assembly in a Marathon battery is firmly affixed to a plastic or metal cover. This integral unit is then fitted snugly within a transparent plastic or metal case and the cover is cemented or welded in position. The cell thus becomes a compact, enclosed unit. The plates extend to the bottom of the cell, since no active material will flake or shed from them. This contributes to the solidity of the cell and gives it the ability to withstand extreme conditions of shock and vibration.

2.5 VENTS

Each cell is provided with a vent plug. This plug consists of a metal or plastic core and an outer collar of rubber. It can be removed for the addition of distilled water or adjustment of the electrolyte. When in place, the rubber expansion collar permits the gas created on charge to escape. Since there is no gassing on discharge, the vent automatically seals the cell, preventing leakage of electrolyte and also preventing entrance of foreign substances into the cell.

2.6 BATTERY ASSEMBLIES

To provide the voltage for a given application, cells are assembled into batteries and are housed in a steel battery case. An individual cell may be replaced in the event of damage, thus eliminating loss of the entire battery.

2.7 ELECTROLYTE

A 30%-by-weight solution of potassium hydroxide (KOH) in distilled or demineralized water is used as the electrolyte in the Marathon battery.

No overall chemical change occurs in the electrolyte during charge or discharge. As a result, no appreciable changes in the specific gravity are observed. The specific gravity of the electrolyte at room temperature remains between 1.24 and 1.30. The electrolyte level, observed through the windows in the side walls of the battery case or by looking into the vent wells, should be at the top of the plate portion of the core assembly. Marathon batteries are normally shipped wet from the factory, since shelf life is not affected.

3.0 Discharge Characteristics of Three Basic Marathon Battery Types

3.1 PLATE THICKNESSES

Marathon batteries of the sintered-plate, nickel-cadmium type are divided into three classes, in accordance with the following discharge requirements:

a. *H-TYPE BATTERIES*—Contain thin plates and are intended for very high current service such as required in turbine engine starting applications, particularly during cold temperature operation.

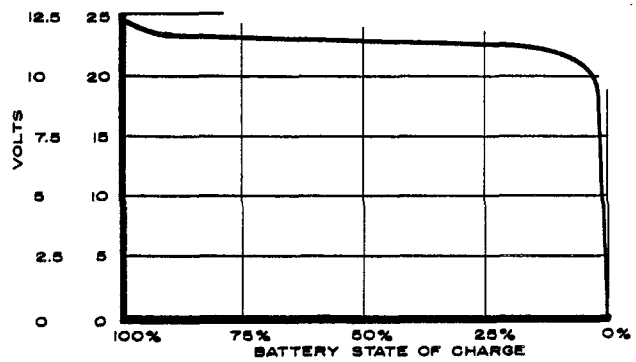
b. *M-TYPE BATTERIES*—Contain medium thick plates and are intended for medium rate current requirements, such as reciprocating engine starting applications. They will perform satisfactorily at all temperature ranges—from sub-zero Antarctic conditions to the blistering tropics.

c. *L-TYPE BATTERIES*—Contain thick plates and are intended for low current drains where great capacity at a low rate is required, such as transistorized power supplies. They will perform satisfactorily at low temperatures at very low current drains.

3.2 TYPICAL DISCHARGE CHARACTERISTICS

All Marathon batteries offer a constant voltage throughout their discharge. Figure 2 illustrates a typical discharge voltage curve under moderate load.

FIGURE 2



TYPICAL DISCHARGE VOLTAGE CURVE UNDER MODERATE LOAD

PART II-INSTALLATION

4.0 Unpacking and Inspection of New Batteries and Cells

4.1 INSPECTION PRIOR TO INSTALLATION

When the battery is unpacked, a thorough inspection should be made to insure that no damage occurred during shipment. Inspect the shipping container, as well as the battery, to make certain that the cells have not been damaged. Before putting your battery in service, follow these points carefully:

4.2 CHECK LIST

a. *CHECK FOR DAMAGE*—See if any liquid has spilled into the shipping container. This may be a sign of a damaged cell.

b. *CHECK ELECTRICAL CONNECTION*—Check all electrical connections for tightness. Test all screws and nuts on all terminals to insure tightness. Poor electrical contact may result in damage to your battery.

c. *CHECK LIQUID LEVEL*—CAUTION: Marathon batteries are shipped with the proper amount of liquid. Do not add liquid until you have first attempted to charge your battery. When a battery has been discharged or allowed to stand unused for a long period of time, the electrolyte becomes absorbed into the plates. Your battery has been shipped discharged, which is the chief reason why the liquid level is low. Charging the battery will cause the liquid level to rise to a point just above the tops of the plates.

d. *CHECK VENTS*—Your battery is equipped with special type vents which permit the gases to escape from the cells. Do not obstruct these vents in any manner which will interfere with their operation. Some batteries are shipped with solid vent plugs which are used as shipping plugs. If these have been used on your battery, the battery will be marked with a tag, "Remove Shipping Plugs." The vent plugs are then inside a small cloth bag tied to the battery. Replace shipping plugs with the vent plugs before charging the battery.

e. *INDIVIDUAL CELLS*—When individual cells have been ordered, care must be exercised in charging. Do not charge individual cells unless the plastic cell case is supported externally in some manner. Gas pressure during charge on unprotected cells may crack the cell case. If no clamping device is available, remove the filler caps or vent screws to prevent a buildup of gas pressure inside the cell during charge *(consult Operation and Maintenance, 5.0)*.

4.3 INSTALLATION OF THE BATTERY

4.3.1 CLEANING COMPARTMENTS

Prior to installation, compartments or battery boxes which have previously housed lead-acid batteries must be washed out, neutralized with ammonia or washing soda solution, allowed to dry thoroughly and then painted with alkaline-resistant paint.

4.3.2 CHARGING NEW BATTERY

Your battery has been discharged prior to shipment. It will therefore need charging before installation *(see Table I)*. If by special order your battery is shipped in a charged state, it is advisable to give it a freshening charge *(consult Charging Methods, 5.3)*.

4.3.3 SECURING BATTERY IN POSITION

When installing the battery in its permanent location, care should be taken to see that all post nuts are drawn down tight and that all electrical connections are made secure. Leads to the battery should be of sufficient size to carry the maximum current encountered without excessive voltage drop. If the battery is in mobile service, such as on an aircraft or other vehicle, it must be secured by holddowns. It is desirable to arrange the compartment so that the battery is either accessible or can be readily removed for servicing.

4.3.4 PROPER AIR CIRCULATION

Stationary batteries consisting of several tray groups should be installed with trays separated from each other to permit some circulation of air. This air space around the trays also serves to break up possible current leakage paths. Tray-to-tray connectors are of proper length to allow a minimum of ⅛" between trays.

4.3.5 VENTING OF GASES

Where the batteries are installed in a confined location, it must be realized that some hydrogen and oxygen gases are evolved during the charging cycle. It is therefore necessary to provide some means of ventilation to remove these gases from this confined area, avoiding accidental ignition of the hydrogen.

There are two types of venting systems to be considered. The first is a battery case containing vent nozzles and the second the battery case containing viewports or cover containing louvers. If the battery case contains vent nozzles, these must be used to vent gases either overboard or into a compartment that will meet the air flow requirements outlined below. If the battery case contains viewports or cover has louvers, the air flow must be of sufficient volume to keep the mixture of air and hydrogen below 5%. In both cases mentioned above, the air flow should be a minimum of 5 cubic feet per minute.

4.3.6 CHECKING POLARITY

Check the polarity of each cell or group of cells to be sure that they are connected in proper series. The polarity of each cell is indicated by a plus sign molded into the cell cover adjacent to the appropriate cell post.

4.3.7 INSULATING BATTERY

Marathon has recently developed a new epoxy coating for its line of aircraft batteries. This epoxy coating is designed to improve the insulation between the cells and the battery container. It will eliminate the small discharge current formerly produced when spillage or spewage of electrolyte was encountered. This is a standard item on certain batteries produced at this time and will be a standard item on most units produced in the future.

Batteries in the field that are not now epoxy coated may have this done by returning the battery to Customer Return Department, Marathon Battery Company, Cold Spring, N.Y. 10516. The cost is determined by the battery type. Where batteries are mounted in groups, it may be necessary to provide insulation from each other and from the trays in which they are mounted *(consult Trouble Shooting, 7.0).*

4.3.8 VOLTAGE REGULATION

Where the battery is being used in a mobile application, such as aircraft or ground vehicles, it will be necessary to make certain that the voltage regulating device is set to the proper limits, *as indicated in Table I.* This is an extremely important phase of your installation, as an improper voltage regulator setting can destroy a Marathon sintered-plate, nickel-cadmium battery in a relatively short period of operation.

4.3.9 QUICK DISCONNECT DEVICES

Should the battery be installed using a multipin quick-disconnect type of plug, it is important to be certain that the connecting half of the plug, which is normally attached to the vehicle or aircraft, is wired correctly with respect to the terminal pins on the battery. A battery installed in an electrical circuit with the polarity reversed will not perform and may become seriously damaged.

4.3.10 SAFETY WIRING

In installations where safety wiring is to be used, be extremely cautious about the use of this wire near or on battery and cell terminals. It is in some instances, possible to completely isolate the metal battery case from the electrical system into which it has been installed and then establish a direct short to ground through the improper use of safety wire.

When installation is completed, be sure that no loose objects, such as screws or tools, have been accidentally left in the battery compartment or inside the battery.

PART III-
OPERATION, MAINTENANCE AND TROUBLE SHOOTING

5.0 Operation and Maintenance

5.1 GENERAL CARE

To obtain continued peak performance, a Marathon battery should be kept in a clean, dry state. Batteries that are subjected to deposits of metallic dust on the cells, such as those in locomotive or steel plant stations, should be covered. The buildup of metallic dust or any other conductive substance will self-discharge the cells more rapidly by providing a conductive path.

Keep open flame and metal objects, such as tools, etc., away from the exposed parts of the battery. If objects are accidentally dropped across the terminals, these might cause a short circuit that could damage a cell or cells.

Should the batteries accumulate dust or a white deposit which sometimes forms around the tops of the cells, it is advisable to flush the tops of the batteries with ordinary tap water.

CAUTION: Do not attempt to clean the battery tops with solvents, acids or any chemical solution. Marathon batteries are primarily constructed with plastic or nylon cells. The plastic may be injured by introducing solvents, etc. While flushing the batteries with tap water—if necessary—it is permissible to use a bristle brush to clean any stubborn dirt particles.

CAUTION: Do not use wire brushes. After cleaning, any excess liquid should be drained and the batteries should be permitted to dry. Where possible, this drying may be accelerated by the use of compressed air.

5.2 CHARGING CHARACTERISTICS

A Marathon nickel-cadmium battery will accept a charge at a much faster rate than a lead acid battery and may be charged at temperatures below −20°F. Charging is more efficient at battery temperatures between +40° and +80°F.

5.3 CHARGING METHODS

As mentioned earlier in the section entitled *Installation*, it will be necessary to charge your battery prior to putting it into service. While in service in many installations, the battery will be charged by the equipment in which it is installed. During particular maintenance and inspection removals, however, it may be necessary to charge the battery in the shop. *IMPORTANT— BATTERIES MUST BE CHARGED IN AN UPRIGHT POSITION.* The construction of the Marathon sintered-plate cell is such that it is readily adaptable to standard charging systems. These include constant voltage, constant current, stepped constant current charge or float charging. Most efficient performance from a constant current will result when the charging rate is such that 140% of the rated capacity of the cell is returned at the rates *indicated in Table I.*

The following material is devoted to various charging methods:

5.3.1 CONSTANT CURRENT CHARGING

The length of time required to charge a battery by the constant current method depends on the size or capacity of the battery, the state of charge of the battery and the magnitude of the charge current. In order to maintain a constant current, it should be noted that the voltage of the system will run from 1.4 volts per cell at the beginning of charge to a maximum of 1.75 volts per cell at the end of charge. In *Table I*, we recommend a constant current rate which is arrived at in the following manner: Take the current output at the 5-hour rate and charge at that current for 7 hours. *Example—the recommended constant current charge for a 40-ampere-hour battery would be computed as follows: 40 ampere hours divided by 5 hours equals 8 amperes.* You would therefore charge this battery at 8 amperes for 7 hours. A typical constant current charging curve *is shown in Figure 3.*

Constant current charging can be accomplished manually by monitoring the charging apparatus and adjusting the voltage periodically to maintain a constant charge rate. Chargers of the self-regulating rectifier type are available to provide constant current without the attention of an operator. Marathon manufactures a Battery Charger/Analyzer designed

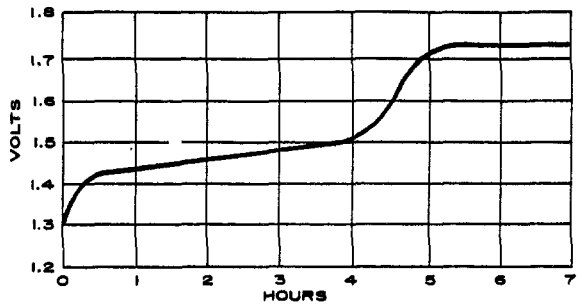


FIGURE 3
TYPICAL VOLTAGE VARIATION DURING CONSTANT CURRENT CHARGE

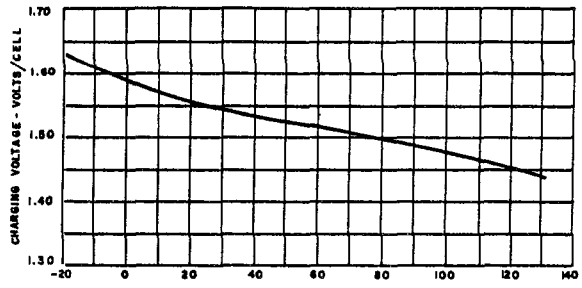


FIGURE 3A
RECOMMENED CONSTANT POTENTIAL CHARGE VOLTAGE AT VARIOUS TEMPERATURES

for this purpose. A complete brochure may be obtained from the Field Service Manager, Marathon Battery Company, Cold Spring, N.Y. 10516. *Request Data Sheet BA-226.*

If a battery is partially discharged, the charge rate *shown in Table I* will still apply. It may not be necessary, however, to charge the battery for the full length of time indicated. To determine whether the battery has reached the full charge state, monitor the battery and note the time that the voltage takes the sharp rise *indicated in Figure 3.* After the sharp voltage rise, it is then necessary to permit the battery to charge for an additional 2 hours at the rate *shown in Table I.* During this 2-hour portion of charge, it is possible to check the cell voltages and determine whether all cells are rising evenly. Should some cells indicate a voltage lower than 1.55 volts, it is advisable to leave the battery on charge until these cells come up to a minimum of 1.55 volts.

Note: During the greater portion of charge, the cell voltages will remain between 1.4 and 1.45 volts. On a conditioned battery, when it has been charged for approximately 70% of the time necessary to charge it fully, the voltage will take the sharp rise mentioned above. Should the individual cell voltage fail to rise to 1.55 volts or more, it may be necessary to replace these cells *(consult Trouble Shooting, 7.0).*

5.3.2 STEPPED CONSTANT CURRENT CHARGING

If it is necessary to obtain a rapid charge, the principles of the previous paragraph still apply—the battery may be permitted to charge at a current equal to its capacity. *Example—a 40-ampere-hour battery at a charging rate of 40 amperes.* At this high rate, the battery should be monitored and when the total battery voltage averages 1.50 volts per cell, the rate should then be reduced to the rate shown on Table I. At the time of reduction, a conditioned battery will have completed approximately 70% of the charge cycle if it was completely discharged to begin with. This method of charging must be monitored, as the high rate will eventually use all the water in the battery if permitted to continue past the gassing point. This loss of water will cause higher concentration of the electrolyte and possible overheating which will damage the cell.

5.3.3 FLOAT CHARGING

Fully charged batteries may be floated across a line voltage of approximately 1.42 volts per cell. Example—a 24-volt aircraft battery which contains 19 cells may be trickle charged at 27.0 volts. A battery floated in this manner will draw about .003 amperes per ampere hour of capacity. *Example—a 40-ampere-hour battery will float at approximately .120 amperes.* This voltage setting will vary slightly with ambient temperature of operation.

5.3.4 CONSTANT VOLTAGE CHARGING

In most applications where Marathon sintered-plate, nickel-cadmium batteries are used, the constant voltage charging method is employed. Aircraft, automobiles, boats, factory equipment and all mobile applications use the voltage-regulated genera-

NOTE: Additional constant current charging instructions when using Marathon Battery BB-449/U at low temperatures—current of 2.8 amperes should be used for a period of 7 hours. Although this method may be used at temperatures below −20°F, it is usually not recommended.

tor charging circuit. The graph *shown in Figure 4 (Page 22)* indicates what happens essentially during this type of charge.

A voltage produced by the generator permits current to flow to the battery. In a discharged battery, the maximum surge of current will be approximately 10 times the rated capacity. The high surge currents are due to the low internal resistance of the battery. Make certain that the charging source is protected against overload in the event of a marginal power supply. As the battery approaches a charged state, the current falls off rapidly and the voltage rises. The recommended voltage setting for the regulator, *shown in Table I*, is computed by multiplying the number of cells in the battery by a factor of 1.5 to 1.55. *Example—a 12-volt automotive battery which contains 10 cells should have the regulator set to cut out between 15.0 and 15.5 volts.*

It should be noted that this type of charging, particularly in applications where the battery is excessively discharged, may produce an unbalance in cell capacity *(consult Trouble Shooting—Apparent Loss of Capacity, 7.1)*. If the battery requires equalization and a constant current charging source is not available, it may be equalized by the method *shown in Reconditioning Service Procedures, 9.3.*

5.4 TEMPERATURE EFFECTS ON GASSING POTENTIAL

If charging is required at high ambient temperatures, adjustments must be made in the charging voltage to be assured that a thermal runaway condition will not exist. In the graph below (see Figure 3A), you will find recommended constant potential charging voltages at various temperatures. Multiply the recommended voltage per cell by the number of cells to obtain the correct voltage setting for charging from a constant potential source.

Nickel-cadmium batteries are capable of sustaining very high current drains and performing well at temperature extremes. However, the effective capacity of a battery will decrease when subjected to high current demands and extreme temperatures. The optimum operating temperature for nickel-cadmium cells ranges from 60° to 90°. An increase or decrease in the above temperatures causes a corresponding reduction in capacity.

At lower temperatures the battery will accept the charge if proper adjustments are made to the regulating source. If the voltage is not corrected, the battery will not deliver its rated capacity. When operating at elevated battery temperatures, the battery is subjected to the danger of thermal runaway due to overcharge. This condition is characterized by continuously increasing current and rising battery temperature during the constant potential charge. (Note: If the battery temperature exceeds 120°F, no charging should be attempted.)

The continual charging above the gassing potential results in excess water loss due to decomposition and heat generation. At high ambient temperatures the heat loss of the battery through radiation and conduction is lower than the heat generating rate. This results in a net increase in the battery's temperature. The increase causes a higher charge current during the constant potential charge. This higher charge current further increases the temperature which continues to drive off water through decomposition. If allowed to continue, the proceeding mode of operation will completely destroy a battery. The cellophane separator will begin to disintegrate resulting in a break down of the gas barrier. If this condition is not detected, it will eventually lead to cells shorting.

For the reason stated above, it is extremely important that the battery be monitored more frequently when operating in high ambient temperatures or when the battery has been subjected to high duty cycles, such as, in aircraft starting.

5.5 DISCHARGING THE BATTERY

You will note, in the section entitled *Replacement of Damaged Cells, 6.1*, that you are instructed to discharge the battery. The following information is designed to help you in this operation.

5.5.1 USING EQUIPMENT AS A LOAD

A battery may be discharged by merely permitting it to operate the equipment in which it is installed without permitting the generator or other charging source to replenish it.

When the battery fails to operate the equipment, it is in a state of partial discharge. It should then be removed from the equipment and discharged through a resistance high enough to permit the current to flow at approximately the 2-hour rate. *Example—a 40-ampere hour battery may be permitted to discharge at 20 amperes or less.* When the voltage has dropped to a sufficiently low point that the current has apparently ceased to flow, the battery can then be considered discharged. Where cells are to be individually shorted *(see Figure 5)*, it is important that the shorting wires or bars be placed in position on the cells while the resistance is still connected to the battery.

Should the battery be permitted to stand after the resistance has been removed, it will recover sufficiently so that the application of the shorting devices will create severe arcing and intense heat. To determine when a battery has been sufficiently discharged and ready for short circuit, the terminal voltage of the entire battery must be less than 10% of the rated voltage. It is then safe to short circuit. *Example—a 12-volt battery having been discharged at a rate equal to or lower than the 2-hour rate may be short circuited when the terminal voltage of the entire battery is 1.2 volts or less.* Where possible, the shorting of individual cells is suggested.

5.5.2 USING A RESISTANCE LOAD BANK

A battery being discharged in the shop may be discharged through a resistance which will permit the current to flow at a rate no higher than its 1-hour rate. Example—a 40-ampere hour battery may be discharged at a rate of 40 amperes. When the battery appears to be discharged and current is no longer flowing, it is then advisable to continue to discharge through a slightly higher resistance, permitting the current to flow at the 2-hour rate or lower. *Example*

(Continued on Page 12)

Table I—Charging Data

MARATHON VEHICULAR & GENERAL PURPOSE BATTERIES

Marathon Type	*Cell Type*	*Volts*	*CAPACITY*			*CHARGING*		
			A. H. 5-Hr. Rate	*20-Min. Amps.*	*5-Min. Amps.*	*Constant Current*		*Constant Voltage*
						Amps.	*Hours*	*Regulator Set*
5-1H120	1H120	6	.8	2	15	.2	7	7.5- 7.75
10-1H120	1H120	12	.8	2	15	.2	7	15.0-15.5
5-2H120	2H120	6	2.0	5	20	.4	7	7.5- 7.75
10-2H120	2H120	12	2.0	5	20	.4	7	15.0-15.5
5-3L420	3L420	6	4.7	10	25	1	7	7.5- 7.75
10-3L420	3L420	12	4.7	10	25	1	7	15.0-15.5
5-3H120	3H120	6	4.0	10	30	.8	7	7.5- 7.75
10-3H120	3H120	12	4.0	10	30	.8	7	15.0-15.5
5-5L420	5L420	6	7.5	12	35	1.5	7	7.5- 7.75
10-5L420	5L420	12	7.5	12	35	1.5	7	15.0-15.5
5-5H120	5H120	6	6.5	15	50	1.2	7	7.5- 7.75
10-5H120	5H120	12	6.5	15	50	1.2	7	15.0-15.5
5-10L420	10L420	6	14	25	75	3	7	7.5- 7.75
10-10L420	10L420	12	14	25	75	3	7	15.0-15.5
5-10H120	10H120	6	13	35	120	2.5	7	7.5- 7.75
10-10H120	10H120	12	13	35	120	2.5	7	15.0-15.5
5-20H120	20H120	6	22	65	200	4.5	7	7.5- 7.75
10-20H120	20H120	12	22	65	200	4.5	7	15.0-15.5
5-20M320	20M320	6	24	60	180	5	7	7.5- 7.75
10-20M320	20M320	12	24	60	180	5	7	15.0-15.5
5-40M320	40M320	6	44	110	350	9	7	7.5- 7.75
10-40M320	40M320	12	44	110	350	9	7	15.0-15.5
5-41H120	41H120	6	41	100	300	8	7	7.5- 7.75
5-60M320	60M320	6	60	150	450	12	7	7.5- 7.75
10-60M320	60M320	12	60	150	450	12	7	15.0-15.5
5-81H120	81H120	6	81	200	600	16	7	7.5- 7.75
5-100M320	100M320	6	125	350	1000	25	7	7.5- 7.75
10-100M320	100M320	12	125	350	1000	25	7	15.0-15.5
5-150M320	150M320	6	171	450	1300	35	7	7.5- 7.75
10-150M320	150M320	12	171	450	1300	35	7	15.0-15.5
5-200M220	200M220	6	200	500	1500	40	7	7.5- 7.75
10-200M220	200M220	12	200	500	1500	40	7	15.0-15.5
5-280M220	280M220	6	280	700	2000	56	7	7.5- 7.75
10-280M220	280M220	12	280	700	2000	56	7	15.0-15.5
MILITARY VEHICULAR BATTERIES								
2HNC*	2HNC	12	35	100	300	8	7	15.0-15.5
6TNC*	6TNC	12	70	200	600	16	7	15.0-15.5

*The 2HNC and 6TNC batteries are approved under military specification No. MIL-B-26509.
NOTE: MIL-B-26509 now superseded by MIL-B-23272.

TABLE I (Continued)

MARATHON FAA-APPROVED COMMERCIAL AIRCRAFT BATTERIES

Marathon Type	Cell Type	Volts	CAPACITY			CHARGING		
			A. H. 5-Hr. Rate	20-Min. Amps.	5-Min. Amps.	Constant Current		Constant Voltage
						Amps.	Hours	Regulator Set
CA-4	24M220	24	25	65	200	5	7	28.0-29.0
CA-5	36M220	24	40	100	320	8	7	28.0-29.0
CA-6	24M220	24	25	65	200	5	7	28.0-29.0
CA-7	12M220	24	13.5	30	100	3	7	28.0-29.0
CA-9	24H120	24	24	75	225	5	7	28.0-29.0
CA-10N	10H120	24	13	35	120	3	7	28.0-29.0
CA-13	36H120	14	40	100	320	8	7	16.5-17.0
CA-15A CA-15B	12M220	24*	15**	30	100	3	7	A=15.0-15.5 A+B=28.0-29.0
CA-20	20M320	24	24	60	180	5	7	28.0-29.0
CA-20H	20H120	24	22	65	200	5	7	28.0-29.0
CA-21H	20H120	24	22	65	200	5	7	28.0-29.0
CA-24A CA-24B	24M220	24*	25	65	200	5	7	A=15.0-15.5 A+B=28.0-29.0
CA-27	24ME220	24	25	65	200	5	7	28.0-29.0
CA-31N	3H120	24	4	10	30	0.8	7	28.0-29.0
CA-40	40M320	24	44	110	350	9	7	28.0-29.0
CA-44A CA-44B	40M320	24*	44	110	350	9	7	A=15.0-15.5 A+B=28.0-29.0
CA-51N	5H120	24	6.5	15	50	1.5	7	28.0-29.0
CA-53N	5H120	24	6.5	15	50	1.5	7	28.0-29.0
CA-54 CA-54-1	5H120	24	6.5	15	50	1.5	7	28.0-29.0
CA-88A CA-88B	60M320	24*	60	150	450	12	7	A=15.0-15.5 A+B=28.0-29.0
CA-101N	10H120	24	13	35	120	3	7	28.0-29.0
CA-106	10H120	24	13	35	120	3	7	28.0-29.0
CA-103	10H120	24	13	35	120	3	7	28.0-29.0
CA-121	12M220	27.5	13.5	30	100	3	7	33.0-34.5
CA-125	3H120	24	4	10	30	0.8	7	28.0-29.0
CA-727-3	24M220	24	25	65	200	5	7	28.0-29.0

*A and B together make up a 24-volt battery.
**At 8-hour rate.

MARATHON MILITARY AIRCRAFT BATTERIES

Marathon Type	Cell Type	Volts	MILITARY CAPACITY				
			A. H. 2-Hr. Rate	Amps. 2 Hr.	Amps. 1 Hr.	Amps. 5 Min.	Amps. Peak Jet
MA-2	65M220	24	60	30	—	500	2000
MA-2-1	65H130	24	60	30	—	500	2000
MA-4	24M220	24	22	11	18.2	150	1000
MA-5	36H120	24	34	17	30	240	1500
MA-7	12M220	24	11	5.5	9.5	75	500
MA-8	24M220	24	22	11	18.2	150	1000
MA-9	24H120	24	22	11	18.2	150	1200
MA-11	24M220	24	22	11	18.2	150	1000
FMA-12	24M220	24	22	11	18.2	150	1000
MA-300H	3H120	24	3.6	1.8	3	30	100
MA-500H	5H120	26	5.7	2.9	5	50	175
MA-510H	5H120	24	5.7	2.9	5	50	175

MILITARY AIRCRAFT BATTERY CROSS-REFERENCE TABLE

Marathon Type	U.S. Air Force Type		U.S. Army Type		U.S. Navy Type	
	MS—	MIL-B—	BB—	SCL—	MS—	MIL-B—
MA-2	MA-2	26026	—	—	90378-6	8565D
MA-2-1	MA-2-1	26026A	—	—	90378-7	8565D
MA-4	24497-1	26220B	434/A	6853	18045-45	8565D
MA-5	24498-1	26220C	433/A	6853	18045-46	8565D
MA-5	24498-2	26220C	—	—	18045-50	8565D
MA-7	24496-1	26220C	432/A	6853	18045-44	8565D
MA-7	24496-2	26220C	—	—	18045-48	8565D
MA-8	24497-4	26220C	—	—	—	—
MA-9	24497-5	26220C	—	—	90365-2	8565D
MA-11	—	—	—	—	90377-1	8565D
20-S102	—	—	—	—	17334-2	8565D

—a 40-ampere-hour battery may be permitted to discharge at 20 amperes.

IMPORTANT—Do not attempt to discharge a Marathon sintered-plate, nickel-cadmium battery at an excessively high rate and then attempt to short circuit each cell at the end of this discharge. Batteries which have been discharged at high rates are not fully discharged. Application of shorting devices to the individual cells at the end of such a high discharge will produce severe arcing and intense heat. To determine when a battery has been sufficiently discharged and ready for short circuit, the terminal voltage of the entire battery must be less than 10% of the rated voltage. It is then safe to short circuit. *Example—a 12-volt battery having been discharged at a rate equal to or lower than the 2-hour rate may be short circuited when the terminal voltage of the entire battery is 1.2 volts or less (consult Description of Reconditioning Service, 9.4).*

5.6 LIQUID LEVEL ADJUSTMENT

During the normal operation of the Marathon sintered-plate, nickel-cadmium battery, it is necessary occasionally to add liquid. The amount of water used is relatively small when compared to the amount used in a lead acid battery. Usage rate will depend upon the application, charging voltage, ambient temperature and several other factors. For this reason, it is advisable to maintain accurate records on particular applications so a realistic water replacement schedule can be established. Use only distilled or demineralized water. Storage batteries are easily contaminated through the use of tap water which contains minerals, chlorines, softening agents and other foreign materials. Water additions to adjust the liquid level should be made immediately after charging or after the battery has been permitted to remain in a state of rest for a minimum of three hours. Never adjust the electrolyte level after discharge unless abnormal high voltage readings (greater than 1.5 volts) are encountered immediately after placing a discharged battery on charge.

WARNING: Do not use acid. Injury may result and equipment damage can occur. Never use tools which have any acid deposit on them.



FIGURE 5

5.6.1 PROPER LIQUID LEVEL

The proper liquid level of all Marathon sintered-plate, nickel-cadmium batteries is just above the tops of the plates or plastic insert (¼" immediately after charge or ⅛" after 3-hour stand). In some Marathon batteries, it is possible to see the liquid level through the ports in the side of the battery can. In Marathon batteries where these ports are not provided, such as certain aircraft types, it is necessary to determine this liquid level by looking down into the vent well after the filler cap has been removed.

If it is not possible to determine the liquid level in this manner, we recommend the use of a polystyrene tube, open on both ends and having approximately ⅛-inch inside diameter about six inches long *(see Figure 6).*

This tube is inserted into the filler opening deep enough to touch the top of the plates or plastic insert. Grasping the tube between the thumb and the middle finger of the right hand, place the index finger over the top open end of the tube and remove the tube from the filler well. If the level in the lower

NOTE: Additional instructions on the liquid level adjustment when using Marathon Battery BB-449/U—the proper electrolyte level is ⅝" above the tops of the plates measured from 3 to 6 hours after charge. An open end glass or preferably a transparent plastic tube ⅛" to ¼" in diameter should be used for this, as described above.

end of the tube is as stated above, the liquid level is adjusted properly. If no liquid is withdrawn, add distilled or demineralized water until the proper level is reached in the polystyrene tube, using the method described above. Adjustments in liquid level may be made by a syringe of the type *pictured in Figure 7.*

5.7 ELECTROLYTE SPECIFIC GRAVITY

The electrolyte is a solution consisting of 70% distilled water and 30% potassium hydroxide, resulting in a specific gravity of 1.3. Cells which have lost electrolyte by accidental overfilling may have a lower specific gravity. Specific gravities after use may range between 1.240 and 1.320 without any appreciable effect on battery operation at normal ambient temperatures. We *do not* recommend that the user attempt to readjust this specific gravity unless it is extremely impractical to remove this battery from service long enough to have it properly adjusted at the factory. Should you find it necessary to make this adjustment, a supply of electrolyte may be purchased from your local Marathon aircraft battery distributor or the Field Service Manager, Marathon Battery Company, Cold Spring, N.Y. 10516.

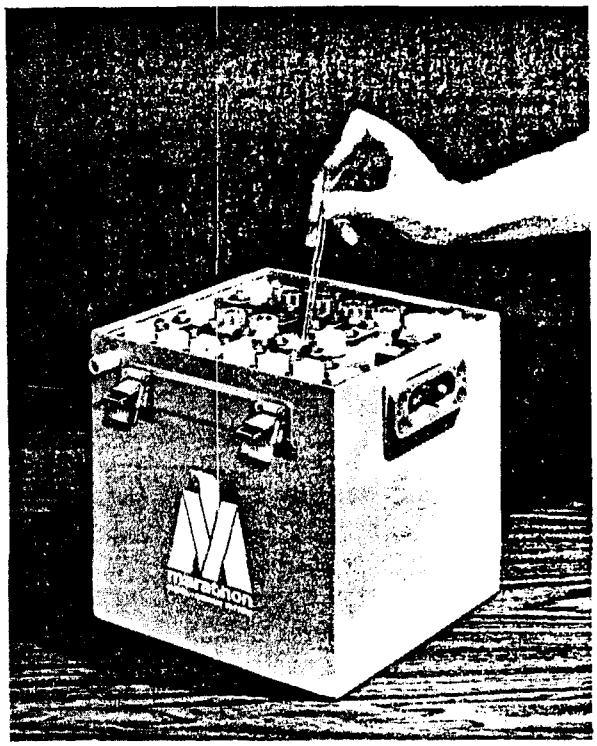


FIGURE 6

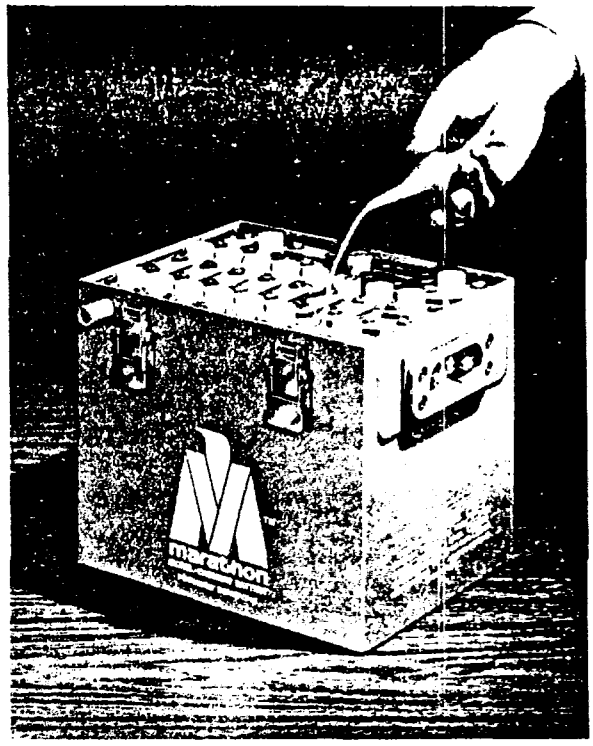


FIGURE 7

NOTE: Additional instructions on the electrolyte specific gravity when using Marathon Battery BB-449/U—for low temperature operation at −40°F, the specific gravity should be 1.280 to 1.320.

6.0 Repair and Replacement

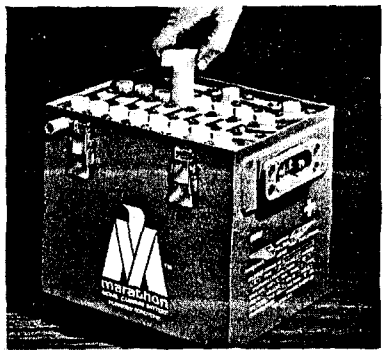


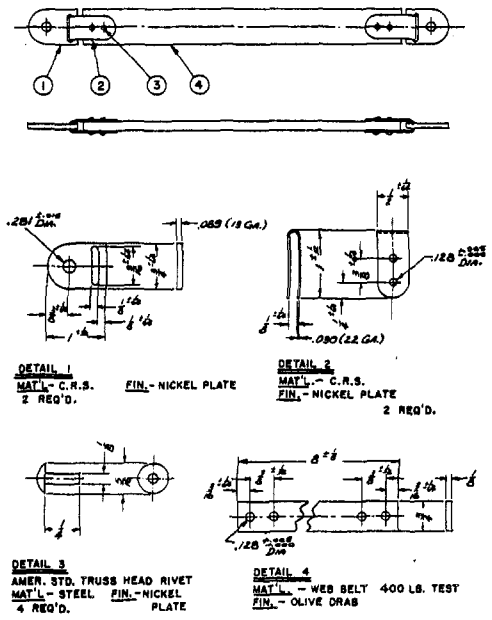
FIGURE 8

6.1 REPLACEMENT OF DAMAGED CELLS

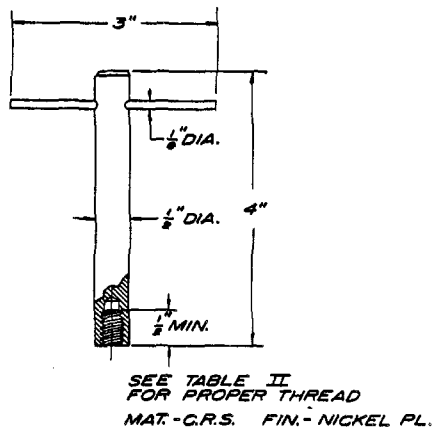
If a cell becomes contaminated or physically damaged and the cell must be replaced, the procedure is as follows:

a. Clean battery *(consult General Care, 5.1).*
b. Remove end terminal connections. Save all the hardware.
c. Remove all vent plugs, using vent wrench *shown in Figure 8.*
d. Remove enough cell connections to permit the cell to be withdrawn from the battery case.
e. Do not withdraw cell from battery unless replacement cell is available immediately.
f. Withdraw cell, using one of the tools *shown in Figure 9. Also see Figure 10.*
g. Replace with new cell, making certain to insert the cell with the polarity symbols in the right direction. Cells are connected plus to minus. If the cell is difficult to insert, apply a light coat of petroleum jelly or silicone grease to the sides of the cell case before reassembly.
h. Replace connectors, assembling hardware finger tight. CAUTION: Do not use "homemade" hardware, as many of these parts are specifically designed to produce an adequate electrical connection. Spare or replacement hardware may be obtained from your local Marathon Aircraft Battery Distributor or Field Service Manager, Marathon Battery Company, Cold Spring, N.Y. 10516.
i. Torque terminal connections to the values *indicated in Table II,* using calibrated torque

The tools shown in Figure 9 are not available from Marathon. They are of simple construction and can be made in any machine shop.



CELL PULLER - CAP SCREW TYPE



CELL PULLER - HEX NUT TYPE

FIGURE 9

wrench. A typical torque wrench *is shown in Figure 11.*

j. Discharge entire battery *(consult Discharging a Battery, 5.4)*. Monitor each cell to determine that all cells are completely discharged. Should some cells reverse and others retain a portion of their charge, it will be necessary to short the cells individually until each cell is completely at zero *(see Figure 5)*.

k. Charge battery by constant current method *(consult Charging Methods, 5.3)*.

l. Adjust liquid level *(consult Liquid Level Adjustment, 5.5)*. The battery is then ready to be put into service.

m. Return damaged cells for analysis and possible repair to Customer Return Department, Marathon Battery Company, Cold Spring, N.Y. 10516.

6.2 REPLACEMENT OF DAMAGED END CONNECTORS

In some battery types, primarily those used in aircraft, the battery is provided with a special quick disconnect receptacle such as a type manufactured by Elcon or Cannon or any of a number of MS type receptacles. Should one of these connectors become damaged, it will be necessary to replace it with a replacement part obtained from your local Marathon aircraft battery distributor or the Field Service Manager, Marathon Battery Company, Cold Spring, N.Y. 10516. Care should be taken in the removal of this connector to preserve all the hardware and gasketing, if possible, so that the new part may be installed properly.

To remove the connector, first remove those connections which go to the end cells in the battery, thus reducing the possibility of a short circuit when the connector body is removed from the battery case *(see Figure 12)*. All Marathon batteries have the same hardware arrangement, attaching the end connector to the battery, as is used on the intercell connectors. When installing the replacement part, it is necessary to *consult Table II* for torque values.

CAUTION: Do not substitute "home-made" hardware. Care must be taken that the polarity of the end connector is carefully observed so that, when the battery is installed in the equipment, the system will function properly.

6.3 MAINTENANCE RECORD KEEPING

In order to provide an accurate source of information on each battery in service, it is advisable to keep

(Continued on Page 17)

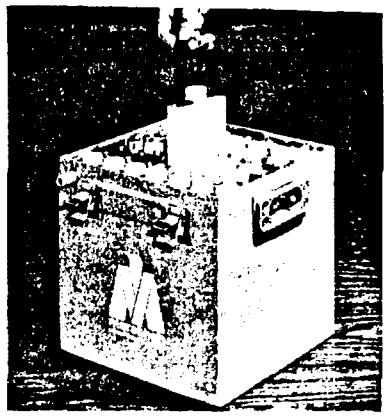


FIGURE 10

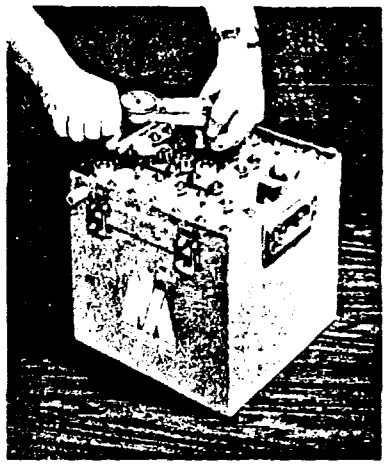


FIGURE 11

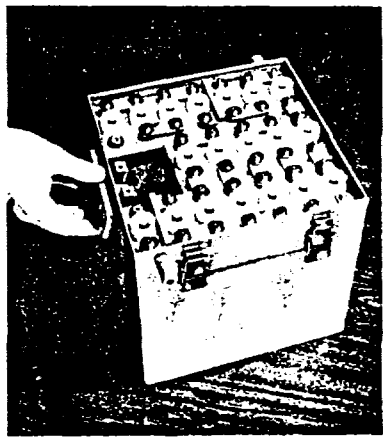


FIGURE 12

TABLE II

BATTERY OR CELL TYPE	THREAD SIZE	SOCKET HEAD CAP SCREW WRENCH SIZE	HEX NUT ACROSS FLATS	IN-LBS TO TIGHTEN
1H120,2H120	#6-32		1/4"	6-8
3H120,3L420 5H120,5L420	#10-32		5/16"	15-18
10L420, 10H120 12M220	#5/16-24		1/2"	20-25
12M220, 10H120	#8-32	9/64"		30-35
20H120,20M320 36H120,36M320 24H120,24M220 24M320,40M320 60M320	#10-32	5/32"		35-50
100M320,150M320 200M220,280M220	#5/16-24	7/32"		180-200
MA-2	#1/4-28	3/16"		100-125
MA-4 MA-5 MA-8	#10-32	5/32"		35-50
MA-7	#5/16-24		1/2"	20-25
MA-300H MA-500H	#10-32		5/16"	15-18

a maintenance log on each. Should a battery malfunction, you will then be able to give the complete history of this specific unit to the Field Service Manager, Marathon Battery Company, Cold Spring, N.Y. 10516, and assist us in the determination of the problem. *A typical battery log is illustrated in Figure 13, inside back cover.*

Following is a list of typical malfunctions encountered in the maintenance and operation of sintered-plate, nickel-cadmium batteries. This list will serve as an index to the preceding information.

7.0 Trouble Shooting

7.1 APPARENT LOSS OF CAPACITY

A characteristic observed in nickel-cadmium batteries is apparent loss or temporary loss of capacity. When this temporary loss occurs, the battery capacity will be lower than the rated capacity. This effect is more common when recharging across a constant potential bus, such as in aircraft, than when recharging by the constant current method. The loss of capacity is normally an indication of imbalance between cells because of differences in temperature, charge efficiency, self discharge rate, etc., in the cells. In applications where lead acid batteries have been used, the serviceman is likely to treat this loss of capacity as a natural aging quality of the battery. Nickel-cadmium battery capacity does not decrease appreciably with age. A loss of capacity is a warning and should not be treated lightly. Periodic deep cycling will be an invaluable aid in alleviating this condition *(consult Reconditioning Service Procedures, 9.3).*

7.2 COMPLETE FAILURE TO OPERATE

Where a battery fails to operate at all, the trouble can usually be traced to an electrical connection. In some instances, the defective connection will be in the circuitry of the equipment in which the battery is installed. This would show up as a broken lead, a relay which fails to operate, improper plug or receptacle installation or similar difficulties. Failure in the battery itself can be caused by an end terminal connector becoming loose or disengaged or perhaps because the charge cycle failed to operate. Should the failure be due to poor intercell connection within the battery, clean and retighten hardware using the proper torque values *(consult Table II).*

7.3 EXCESSIVE SPEWAGE

A battery which has spewed excessively will usually display large crystalline deposits on the tops of the cells. In some cases, a considerable amount of liquid will collect in the bottom of the battery container. A battery in this condition has been subjected to high charge voltages or high ambient temperatures during charging or a combination of the two. The liquid level may also have been improperly adjusted. To correct this condition, clean the battery *(consult General Care, 5.1).* Then charge the battery as required and adjust the electrolyte level *(consult Liquid Level Adjustment, 5.5).* Place battery back into service.

7.4 DISTORTION OF CELL CASES

When a battery has one or more cells with distorted plastic cases, the battery may have been overcharged as described in *Excessive Spewage, 7.3.* This battery must be removed from service and either returned to the factory or sent into the maintenance shop for cell replacement *(consult Replacement of Damaged Cells, 6.1).*

7.5 FAILURE OF ONE OR MORE CELLS TO BALANCE WITH OTHERS

During the charging procedure *(consult Constant Voltage Charging, 5.3.4),* it is sometimes noted that one or more cells fail to rise to the required 1.50 to 1.55 volts at the end of charge. The battery should be treated *as described in Constant Current Charging, 5.3.1.* If these cells still fail to rise to the required voltage they should be removed and replaced according to the procedure *outlined in Replacement of Damaged Cells, 6.1.*

7.6 FOREIGN MATERIAL WITHIN THE CELL CASES

Cells which have been removed because of failure to respond to the normal charging procedures *see preceding paragraph,* may display some evidence of foreign substances within them. This material may be gray, black or brown in color. Such foreign substances are most commonly introduced into the cell through the addition of impure water or water contaminated with acid. Other causes for this dissolution

can be heat generated by extremely high rate charging, charging without sufficient electrolyte in the cell, too high a concentration of electrolyte or a combination of two or more of these conditions.

For instance, a battery has been serviced and electrolyte (potassium hydroxide) has been added to raise the specific gravity. The battery is then permitted to charge at a sufficiently high rate and drive off water. This produces a high concentration of electrolyte, which in turn generates some heat. This set of circumstances will damage the materials in the cell plates and will be indicated by the appearance of black or gray particles in the cell. These cells will usually show up as unbalanced *(consult Apparent Loss of Capacity, 7.1)* and must be removed from service.

7.7 FREQUENT ADDITION OF WATER

If one or more cells require more water than the others, they may be out of balance *(consult Apparent Loss of Capacity, 7.1)*. Discharged cells will always appear low in liquid *(consult Liquid Level Adjustment, 5.5)*.

7.8 CORROSION OF TOP HARDWARE

Excessive rust appearing on the top hardware of a battery may be caused by the presence of acid fumes in the area. This condition will be prevalent where batteries are installed in chemical plants or other places where they are subjected to corrosive fumes, spray or chemical moisture. The battery should be kept clean *(consult General Care, 5.1)* and installed in a compartment which has been cleaned *as per the instructions in Installation of Battery, 4.3.*

7.9 APPEARANCE OF BURN MARKS ON CONNECTORS

When an intercell connector or an end connector shows indication of burning, this usually denotes that the connectors involved have not been properly tightened. For proper torque values, *see Table II.* Burned outer connecting plugs is an indication of plug failure. The battery plug or the mating half should be replaced if necessary *(consult Replacement of Damaged End Connectors, 6.2)*.

7.10 OVERHEATING OF INTERCELL CONNECTORS

If intercell connectors become hot or show signs of overheating, disassemble, clean and reassemble. Torque the connections properly *as specified in Table II.*

7.11 BATTERY CASE LEAKAGE TO GROUND

When a battery has been in an aircraft for a considerable period of time, a voltage can sometimes be detected between either terminal pin or the metal battery case. This voltage is most usually caused by a collection of electrolyte around the cells, usually as a result of spewing from the cell vent caps. The electrolyte is conductive. It is for this reason that voltage can be read. Voltage is merely potential and of itself can do no harm.

The measure of whether or not this potential is affecting battery performance is the amount of current that this leakage path will support. If, for instance, the leakage path will support .050 amperes, this would be the equivalent of a battery self-discharging completely in 500 hours (CA-20 or CA-4). Usually, we consider .050 amperes or less a safe leakage path. Beyond that value, it is advisable to flush the battery vigorously with tap water and permit it to dry in the sun, if possible, or by applying forced warm air. When the battery is completely dried out, this leakage path should no longer be apparent.

The leakage may also be caused by a damaged case-to-cover seal on an individual cell. To determine which cell is damaged, the following method should be applied.

a. Place one probe of the voltmeter on either the positive or negative terminal post and the other against the battery case.
b. Observe the voltage.
c. Leaving the probe on the metal battery case, move the other probe from cell terminal to cell terminal.
d. The indicated voltage should decrease and finally go negative. At this changeover point, you will find the leaking cell.
e. This cell should be removed from service and returned for repair to the Customer Return Department, Marathon Battery Company, Cold Spring, N.Y. 10516.
f. Inspect surrounding cells and hardware for damage.
g. A new cell should be added *in accordance with Repair and Replacement, 6.0.*

7.12 HEATED BATTERIES

In some special applications, Marathon has provided a specially designed battery which incorporates the use of an internal heater blanket and the

accompanying thermostats and input plug necessary to energize the heater. Batteries of this nature are composed of the same type of cells previously discussed in the various sections of this manual and, therefore, these difficulties encountered in cell performance can be handled exactly as though the battery were not equipped with a heater. The heater itself is usually an insulating blanket containing a wire filament. Failure of the blanket to operate can be caused by a break in this filament and is easily detected through the use of a continuity meter. Another cause of heater failure is sometimes centered in the operation of the thermostat. Thermostats can be checked by submitting them to sizeable temperature differences and checking their operation with a continuity meter.

Heater blankets and thermostats cannot be repaired in the field and, should a breakdown be experienced, the material must be returned for replacement to the Customer Return Department, Marathon Battery Company, Cold Spring, N.Y. 10516. Because of the large number of possible variations in heated battery design, it is not possible in this manual to become any more specific on this subject. In applications where heated batteries are used, if other troubles are encountered, contact Field Service Manager, Marathon Battery Company, Cold Spring, N.Y. 10516.

8.0 Storage

8.1 CHARGE RETENTION

Marathon sintered-plate, nickel-cadmium batteries may be stored for long periods of time in any state of charge. The charge retention will depend largely on the ambient temperature of the storage area. A battery stored at 80°F will retain approximately 60% of its rated capacity over a period of one year. A battery stored in an ambient temperature of 0°F will retain approximately 90% of its capacity for a period of one year.

8.2 STORAGE MAINTENANCE

The active materials of the plates are insoluble in the electrolyte and therefore cannot react in any way with the electrolyte when the battery is stored on open circuit. Before placing a battery in storage, the battery should be cleaned *(consult General Care, 5.1)*. If long periods of storage are expected, it is advisable to coat the intercell connectors with a light coat of silicon grease to prevent any corrosion from forming. A battery being placed into service after storage should be given a freshening charge prior to installing it into the equipment *(consult Charging Methods, 5.3)*.

PART IV-SHOP PROCEDURE

9.0 Recommended Shop Procedure to Determine Condition of Aircraft Battery

The information in this part is a condensation of some of the procedures outlined in this manual, plus special information on aircraft batteries.

9.1 SEPARATION OF NICKEL-CADMIUM AND LEAD ACID BATTERY FACILITIES

Nickel-cadmium batteries use potassium hydroxide and distilled water as an electrolyte. Chemically, this electrolyte is an exact opposite of an acid electrolyte.

Anything associated with the lead acid battery (acid fumes included) should never come in contact with the nickel-cadmium battery or its electrolyte. Even traces of sulphuric acid from a lead acid battery entering the electrolyte of a nickel-cadmium battery will result in damage. Also, acid fumes can damage the hardware of the nickel-cadmium battery.

Separate shops are recommended for the two types of batteries. If separate shops are not possible, separate bench facilities shall be provided at opposite ends of the service area. Indicate each area clearly and keep all tools and materials separate and clearly marked.

9.2 VISUAL INSPECTION

A visual inspection of the battery in the aircraft should be made at least once every 50 flight hours on non-epoxy coated batteries and once every 100 hours on epoxy batteries. The battery connector, receptacle and vent lines should be checked for contact failure or damage and the allenhead screws or nuts should be torqued, *as per Table II.*

The cover should be removed to inspect for excess spewage and discoloration or deterioration of intercell hardware. Some slight deposits of potassium carbonates (white in color) may be encountered. If it is excessive, the battery should be removed and cleaned *(see below)*. The electrolyte level in each cell should be checked. If it is below the minimum requirement (consult Liquid Level Adjustment, 5.5), the battery should be removed from service. If this is impractical, the level should be adjusted while in the aircraft. Further inspection and replacement of parts is described in this manual.

9.3 RECONDITIONING SERVICE PROCEDURES

Flight hours are the main factor determining the frequency of reconditioning service procedure, depending on these four variables:

a. Type of starting service.
b. Duty cycle for battery.
c. Ambient operating temperatures.
d. Generator voltage regulator setting.

Therefore, we can only suggest an average time between reconditioning cycles *(Table III)* because of the widely varied flight profiles seen by individual aircraft. The user will eventually apply his experiences and the information gained during the reconditioning service in determining the maximum time. At no time should a battery be allowed to deteriorate to a point where the operation of the battery affects the mission or operation of the aircraft.

TABLE III

Aircraft Type	Approximate Flight Hours Between Reconditioning Cycles
Lear Jet Model 23	100
Jet Commander	100
Grumman Gulfstream I	500
Grumman Gulfstream II	200
Fairchild F-27	200
Fairchild F-227	200
Fan Jet Falcon	100
Boeing 727	400
Boeing 737	400
Grand Commander	500
Beech King Air	100
Beech 99	100

TABLE III (continued)

Aircraft Type	Approximate Flight Hours Between Reconditioning Cycles
North American Sabreliner	200
Lockheed JetStar	150
Turbo Commander	100
MU-2	100
DH-125	150
Hansa Jet	100
Twin Otter	100
Merlin, I & IIB	100

NOTE: In aircraft flying commuter service routes, the battery water level must be checked every 50 hours.

The use of a service log for each battery and aircraft is especially helpful to the user in determining the optimum period between reconditioning. A sample log and check list will be found on the inside back cover of this manual *(Figure 13)*.

9.4 DESCRIPTION OF RECONDITIONING SERVICE

The procedure for removing a battery for a reconditioning cycle should start with a visual inspection in the aircraft *(consult Visual Inspection, 9.2)*. If the battery needs cleaning, it can be performed in the maintenance area. If the spewage is minor, it can be removed with a nylon bristle brush and the battery flushed with water as follows:

9.4.1 FLUSHING OF BATTERY

a. Prior to flushing the battery with water, check the tightness of the vent plugs.
b. Tip battery on side away from battery receptacle.
c. The top of the cells should then be flushed with tap water.
d. Air hose away excess water.

NOTE: If any of the rubber insulation has deteriorated or pulled away from the can, the battery should be disassembled and the rubber recemented.

Use rubber-to-metal cement type 35-2 by G. C. Electronics or equivalent. Replacement can also be made by using neoprene rubber of a 40-60 dryrometer by Minor Rubber Company or equivalent. The rubber thickness is 1/16" to 1/32", depending upon the type of battery.

9.4.2 CHECKING CURRENT FLOW

After flushing and air hose drying, check the current flow between the positive terminal and the case, then the negative terminal and case.

a. First select a meter, such as Simpson 261 or 263, which contains an amperage scale of a minimum of 500 milliamperes. Select the highest current setting on the meter.

b. Take the positive lead of the meter and place on the positive terminal of the battery receptacle and the negative lead on the battery can.
c. Decrease the current setting until a scale is reached where, if any current flow exists, it is readable. Record the current.
d. Move the selector switch on the meter to the highest current setting. Place the negative lead of the meter on the negative terminal of the battery receptacle and the positive lead on the battery can. Proceed as outlined above.
e. If the current flow is more than 100 milliamperes, the unit should be disassembled and cleaned.

NOTE: Do not use the voltage reading between the terminals and the battery can as a criteria for rejection, since current flow is the determining factor.

9.4.3 EPOXY-COATED BATTERIES

Most Marathon nickel-cadmium batteries are now supplied with the battery container and cover epoxy-coated. In this instance, the current flow may be measured by reading from the battery terminals of the receptacle to the snaps that restrain the cover. This is mainly a safety precaution, since in epoxy-coated cans the cells should be completely insulated from the battery case.

9.4.4 CHARGING

The battery should then be charged on a charger/analyzer *(Marathon Model PCA-131—see later reference)* on a constant current source at a 5-hour charge rate or on a constant potential source at 28.5 volts for a 24-volt battery. *(For aircraft batteries of other voltages, use 1.5 volts by the number of cells = constant potential charge volts.)* If the constant current charge is used, continue until the total battery voltage reaches a minimum of 30 volts *(average 1.58 volts/cell).*

9.4.5 USING CONSTANT POTENTIAL

If a constant potential charge is used, continue charge only until the current tapers off and stabilizes.

This simulates the battery's full charge condition as it would appear in the aircraft, making the discharge time recorded an accurate indication of the battery's capacity. It will also allow the adjustment of the electrolyte level to be performed which will prevent the discharge and recharge of a dry battery.

9.4.6 ADJUSTING ELECTROLYTE

At this time the electrolyte level may be adjusted to ¼" above the top of the plates or visible insert. *If the battery is allowed to stand 2 to 4 hours after charge, then the level should be adjusted to ⅛" above the plates or visible insert.*

NOTE: Make adjustments with distilled, deionized or demineralized water. We do not recommend *the addition of potassium hydroxide, as water only* is normally lost due to electrolysis. Potassium hydroxide should be added only on specific instructions from the Field Service Manager, Marathon Battery Company, Cold Spring, N.Y. 10516.

9.4.7 DETERMINING STATE OF CHARGE

Unlike a lead acid battery, the electrolyte in a nickel-cadmium battery acts only as a conductor. Therefore, it is impossible to determine the state of charge from the specific gravity or from open circuit voltage readings. The only way to tell the state of charge is by measured discharge.

9.4.8 DISCHARGE

At this time, the battery is ready for discharge. Select a discharge rate of either the 1 or 2-hour rate *(see Table IV).*

a. The total battery voltage should be monitored until an average of 1.0 volt/cell is reached.
b. At this point, the time should be recorded.
c. A supplemental discharge should be performed on any battery failing the capacity test. If the discharge time is less than 70% of that specified *(see Table IV)*, then a supplemental discharge (deep cycle) must be performed.

TABLE IV

Battery Type	*Rate 1-Hour*	*2-Hour*	*Battery Type*	*Rate 1-Hour*	*2-Hour*
CA-4	20	11	CA-40	38	20
CA-5	34	17	CA-44	38	20
CA-6	20	11	CA-51	5.0	2.5
CA-7	10	5.5	CA-52	5.0	2.5
CA-9	20	11	CA-53	5.0	2.5
CA-10	10	5.0	CA-54	5.0	2.5
CA-15	10	5.5	CA-88	55	30
CA-20	20	11	CA-101	10	5.0
CA-20H	20	11	CA-102	10	5.0
CA-21	20	11	CA-103	10	5.0
CA-24	20	11	CA-121	10	5.5
CA-27	20	11	CA-125	5.0	1.5
CA-31	3.0	1.5	CA-727	20	11

Cutoff voltage of 1.0 volt/cell.

9.4.9 DEEP CYCLING

The deep cycle consists of continuing the discharge listed above.

a. As each individual cell reaches 0.6 volt or less,

a metal shorting strap should be placed across the terminals while the load is still applied. It will be impossible to short out all cells within a battery since, during constant resistance discharge, the current decreases as the voltage decreases. Therefore, when approximately 75% of the cells are shorted with metal straps, a 1.0 ohm resistor of 1 or 2 watts should be placed across each of the remaining cells.

b. The battery should remain shorted as above for a period of 3 or more hours.

c. If the discharge time is 70% or greater than that specified *(see Table 11)*, the supplemental discharge (deep cycle) can be eliminated if time is a factor.

TABLE V

Battery Type	*Time*	*Current*	*Battery Type*	*Time*	*Current*
CA-4	7-hour	5-amp	CA-40	7-hour	8-amp
CA-5	"	8-amp	CA-44	"	8-amp
CA-6	"	5-amp	CA-51	"	1.0-amp
CA-7	"	3-amp	CA-52	"	1.0-amp
CA-9	"	5-amp	CA-53	"	1.0-amp
CA-10	"	3-amp	CA-54	"	1.0-amp
CA-15	"	3-amp	CA-88	"	12-amp
CA-20	"	5-amp	CA-101	"	3-amp
CA-20H-1	"	5-amp	CA-102	"	3-amp
CA-21	"	5-amp	CA-103	"	3-amp
CA-24	"	5-amp	CA-121	"	3-amp
CA-27	"	5-amp	CA-125	"	0.8-amp
CA-31	"	0.8-amp	CA-727-3	"	5-amp
			CA-737	"	5-amp

9.4.10 FINAL CHARGE

The battery is now ready for charge. Charge battery by the constant current method only.

a. Place the battery on charge at the 5-hour rate for 7 hours *(Table V)*. Care should be taken to see that the total ampere-hour charge equals that outlined in Table V. If the charge current decreases during charge, manually adjust current to maintain the proper value.

b. During the final 5 minutes of charge (for automatic chargers that have terminated, reset the charge for 10 additional minutes), the voltage of each individual cell should be read.

c. The minimum voltage should be 1.55 volts/cell and the maximum 1.80 volts/cell at room temperature (70-80°F). If any cell fails to rise to at least 1.55 volts, the constant current charge should be continued for an additional hour. At this time, monitor the cell voltage again.

d. Any cell that fails to rise above 1.55 volts or exceeds 1.75 volts should be removed from service and may be returned for rebuilding or overhaul to Customer Return Department, Marathon Battery Company, Cold Spring, N.Y. 10516.

NOTE: Any battery having a discharge time less than 70% of that specified in Table IV SHOULD be given another discharge and recharge *(per Discharge, 9.4.8, and Deep Cycling, 9.4.9)*.

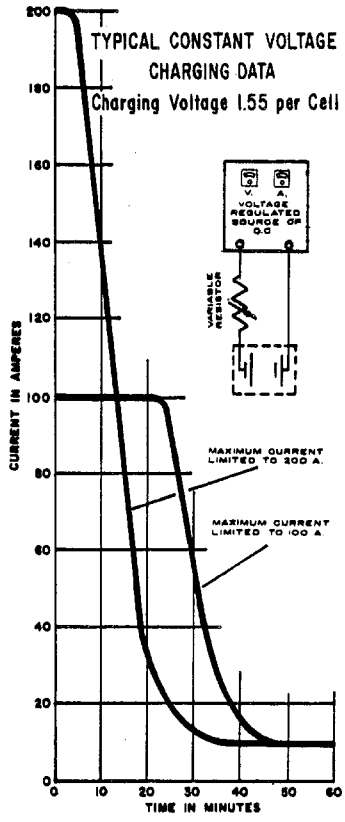
CAUTION: Any battery having a discharge time less than 50% of that specified in Table IV MUST be given another discharge and recharge *(per Discharge, 9.4.8, and Deep Cycling, 9.4.9)*.

9.4.11 COMPLETION OF CHARGE

Following completion of the charge, the electrolyte level should again be checked, using the levels outlined earlier *(consult Adjusting Electrolyte, 9.4.6)*. Torque the nuts or allenhead screws, attached to the intercell connectors *(see Table II for correct torque values)*.

9.4.12 CHECKING CURRENT PATH

The final step now is to recheck the current path between the cell and battery case, using the maximum current outlined previously *(consult Checking Current Flow, 9.4.2)*.



10.0 Marathon Battery Charger/Analyzer PCA-131 Series

10.1 IMPORTANCE OF RECONDITIONING

The data obtained in performing the reconditioning cycle is invaluable for determining the maximum flight hours between reconditioning service. More frequent reconditioning is recommended whenever possible, however.

In aircraft where more than one battery is used, either in series or parallel starting, care should be taken that the batteries are not allowed to become unbalanced. Perform the reconditioning service on both batteries during the same inspection period.

The Marathon Model PCA-131 Series Charger/Analyzer is designed to provide maximum service from nickel-cadmium aircraft batteries. It features a "Go, No-Go" indication of battery condition.

The correct charge and discharge current is preselected with the setting of the switch position. The battery can be left unattended during charge and automatically adjusts for changes in line voltage. It will automatically terminate the discharge if the average battery voltage falls below a preselected end voltage. You can then determine the actual discharge time from the running timer. The discharge percentages discussed previously also apply to the Marathon Charger/Analyzer.

10.2 PCA-131 CHARGER/ANALYZER NICKEL-CADMIUM BATTERY DEEP CYCLING PROCEDURE

a. Clean battery if necessary. Use water only.

b. Check the current flow between positive terminal and case, then negative terminal and case. If the reading is more than 50 milliamps, the battery should be disassembled and cleaned.

c. Connect battery to PCA-131 *before turning on power* and set selector to proper battery type.

d. Turn power on PCA-131 and rotate clock to TOPPING CHARGE.

e. Top charge until battery voltage reaches 30 volts minimum.

f. Check the water level. If it is less than ¼" above the plates, adjust to ¼" immediately after charge. If battery stands 2-4 hours, adjust level ⅛" above plates.

g. Rotate clock to START OF DISCHARGE.

h. (1) If the battery gives the proper capacity, then it will automatically go into the main and over charge modes.

(2) If the capacity is less than the 120 minutes required, the battery LOW LIGHT will light. If this occurs, proceed as follows: Throw the automatic-manual switch to MANUAL DISCHARGE and continue discharge. As cell voltage reaches 0.6 volts, place a short across them. Continue discharge until approximately 75% of the cells are shorted. If possible, short remaining cells prior to disconnecting battery or place a 1 Ohm- 1 Watt resistor across each cell. Disconnect the battery from PCA-131. Leave shorts on for three to 24 hours. Remove shorts, connect battery to PCA-131, throw the automatic-manual switch to AUTOMATIC position, turn unit "on," rotate clock to MAIN CHARGE MODE. The unit will not operate until the voltage builds up to 19 volts. This is accomplished automatically.

i. In reference to h2, the charge is to continue until completion, which includes main and topping charge.

j. During the final five minutes of topping charge (in the event the unit has turned off, reset to TOPPING for five minutes) the voltage of each cell should be checked. Minimum voltage 1.55 volts; maximum voltage at room temperature 1.80 volts. If the voltage is under 1.55 volts, reset the TOPPING CHARGE for one (1) hour and recheck voltage. If it does not rise to 1.55 volts or it decreases below 1.55 volts, the cell or cells should be removed for rebuilding. If the voltage is over 1.80 volts, the cell or cells should also be removed for rebuilding.

k. Check the water level (consult step f).

l. Recheck current flow between terminal and case (consult step b).

m. Where time allows, all batteries failing capacity test should be recycled. Any battery with a discharge time of 50% or less of that specified must be recycled.

Complete information on Marathon's solid state Charger/Analyzer, the Model PCA-131—such as operation instructions and charger/analyzer specifications—may be obtained from the Field Service Manager, Marathon Battery Company, Cold Spring, N.Y. 10516. (request Data Sheet BA-226).

CROSS REFERENCE AND REPLACEMENT DATA ON MARATHON NICKEL-CADMIUM AIRCRAFT BATTERIES

These listings indicate the Marathon battery types used as original equipment, retrofitted and recommended replacement types for corporate, business, private, commercial and helicopter aircraft. To use, simply locate the aircraft and model you are now flying. The Marathon battery or recommended replacement then appears in the extreme right hand column.

BUSINESS and PRIVATE AIRCRAFT
Single Engine

Aircraft Manufacturer	*Aircraft Model*	*Marathon Battery Type*
Beech	Bonanza S35	CA-24
	Debonair C33	CA-24
	Musketeer A23	CA-24
Cessna	Commuter 150	CA-15 or CA-24
	Skyhawk 172	CA-15 or CA-24
	Skylark 175	CA-15 or CA-24
	Skylane 180-182	CA-24
	Skywagon 185	CA-24
	Super Skywagon 205	CA-24
	Centurion 210	CA-24
Helio	Courier	CA-7*
	Stallion	CA-20H*
Lake	LA-4 Amphibian	CA-4
Mooney	Mark 21	CA-4
	Super 21	CA-4
	Mark 22 Mustang	CA-4
Navion	Mark 21	CA-24A & B
Pilatus	Porter	CA-5
Piper	PA-18 Cub	CA-15
	PA-28 Cherokee	CA-15
	PA-32 Cheyenne	CA-15 or CA-24
	PA-24 Commanche	CA-24
	Colt	CA-15 or CA-24
	Papoose	CA-15 or CA-24

COMMERCIAL
Helicopters

Aircraft Manufacturer	*Aircraft Model*	*Marathon Battery Type*
Bell	Jet Ranger	CA-103N*
Bell	47 G/J	CA-7*
Boeing-Vertol	107, 114	CA-5*
Brantly	B-2B, 305	CA-7
Hiller	12-E	CA-10H*
	FH-1100	CA-102
Lockheed	286	CA-104N*
Sikorsky	S-55, 58	CA-5*
	S-61L	CA-11*
	S-62	CA-11*
Sud	Allouette	CA-5

BUSINESS and PRIVATE AIRCRAFT
Twin Engine

Aircraft Manufacturer	*Aircraft Model*	*Marathon Battery Type*
Aero Commander	Grand Commander	CA-4*
	680F	CA-4*
	560F	CA-4*
	500V/B	CA-4*
Beech	Baron B55	CA-24A & B or CA-7
	Queen Air 65	CA-7
	Queen Air A80	CA-7
	Super H18	CA-24A & B or CA-7
	Travel Air D95A	CA-15A & B, CA-24A & B or CA-7
	Twin Bonanza	CA-15A & B, CA-24A & B or CA-7
Cessna	Skynight 320	CA-15A & B, CA-24A & B
	Skymaster	CA-15A & B, CA-24A & B
	310	CA-15A & B, CA-24A & B
	411	CA-4
Piper	Twin Commanche	CA-4 or CA-7
	Apache	CA-4 or CA-7
	Aztec C	CA-4 or CA-7
	PA-31	CA-7
Swearingen	Merlin 1	CA-7, CA-4, CA-24A & B

***Supplied as original equipment.**

CORPORATE and BUSINESS AIRCRAFT
Turbojet and Turboprop Types

Aircraft Manufacturer	*Aircraft Model*	*Marathon Battery Type*
Aero Commander	Jet Commander	CA-4*
Aero Commander	Turbo Commander	CA-9*
Beech	King Air	CA-5*
Beech	99	CA-5*
Dassault	Mystere 20	CA-5
Douglas	DC-9	CA-13
DeHavilland	DH-125	CA-9 or CA-125*
Fairchild-Hiller	F-27 Friendship	CA-20H*
Fairchild-Hiller	F-227 Friendship	CA-20H*
Fairchild-Hiller	Turbo Porter	CA-5*
Grumman	Gulfstream I	CA-5*
Grumman	Gulfstream II	CA-5*
Hansa	HFB-320	CA-9*
Lear	Learjet	CA-21H*
Lockheed	JetStar	CA-5*
Mooney-Mitsubishi	MU-2	CA-21H and CA-31H*
Nihon	YS-11	CA-4 or CA-9
North American	Sabreliner	CA-5 or CA-9*
Piaggio-Douglas	Vespajet	CA-9
Potez	840	CA-5
Swearingen	Merlin 2	CA-5*
Swearingen	*Merlin 2A*	*CA-9**

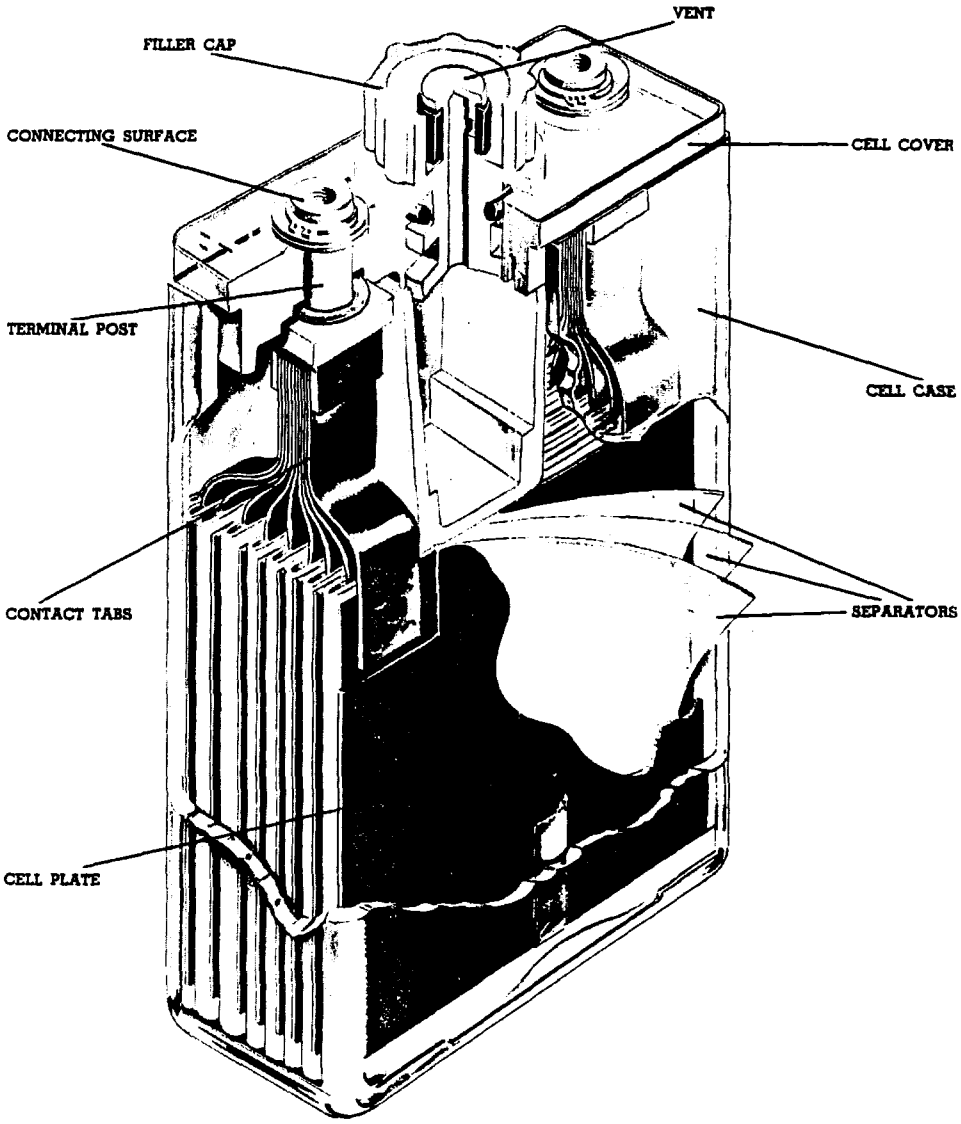
COMMERCIAL AIRLINE
Transports

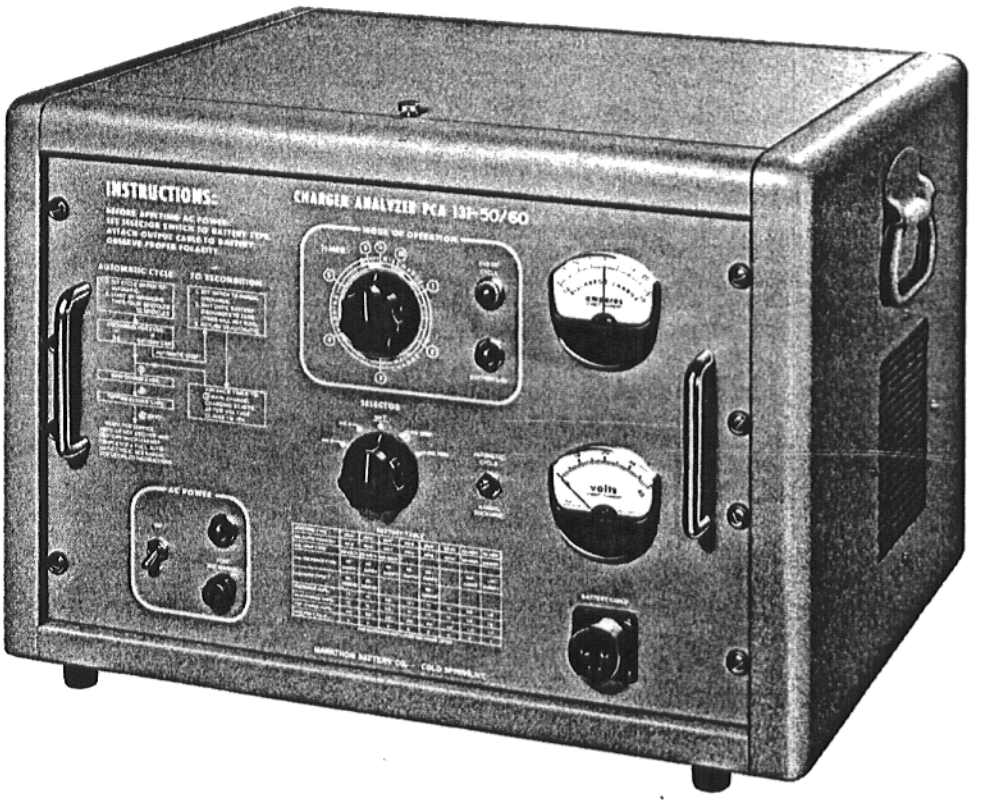
Aircraft Manufacturer	*Aircraft Model*	*Marathon Battery Type*
British Aircraft Corporation	BAC-111	CA-20H
BAC-Vickers	VC-10	CA-4
Bristol	Brittania	CA-5
Boeing	747	CA-54*
Boeing	707/720	CA-4, CA-31H (Pan Am)* CA-53N (Pan Am)*
Boeing	727	CA-727-3* or CA-27
Boeing	737	CA-727-3* or CA-737*
Douglas	DC-3 thru DC-7	CA-88A & B or CA-44A & B
Douglas	DC-8	CA-51N,* CA-53N (Pan Am)*
	DC-8 Eastern Airlines	CA-101N*
Douglas	DC-9	CA-13
DeHavilland	Comet IV	CA-4
Fairchild	F-27 Friendship	CA-20H*
Fokker	F-27 Friendship	CA-5 or CA-20H*
Fokker	F-28	CA-9*
General Dynamics	CV240, 340, 440	CA-88A & B or CA-44A & B
General Dynamics	Dart 600	CA-14
General Dynamics	CV880, CV990	CA-121*
Handley Page	Dart Herald	CA-4
Hawker Siddeley	Trident	CA-4
Lockheed	Constellation 749 thru 1649	CA-5
Lockheed	Electra II	CA-4
Martin	202, 404	CA-40
Vickers	Viscount	CA-20
Vickers	Vanguard	CA-12

COMMERCIAL AIRLINE
Cargo

Aircraft Manufacturer	*Aircraft Model*	*Marathon Battery Type*
Boeing	707-320C	CA-4
Boeing	727C	CA-727-3*
Canadair	CL-44 Yukon	CA-4
Curtis Wright	C-46 Commando	CA-5
Douglas	DC-8F Trader	CA-51H*
Hawker Siddeley	Argosy	CA-4
Lockheed	Constellation	CA-5

CUTAWAY VIEW
OF TYPICAL MARATAHON
NICKEL-CADMIUM
VENTED CELL





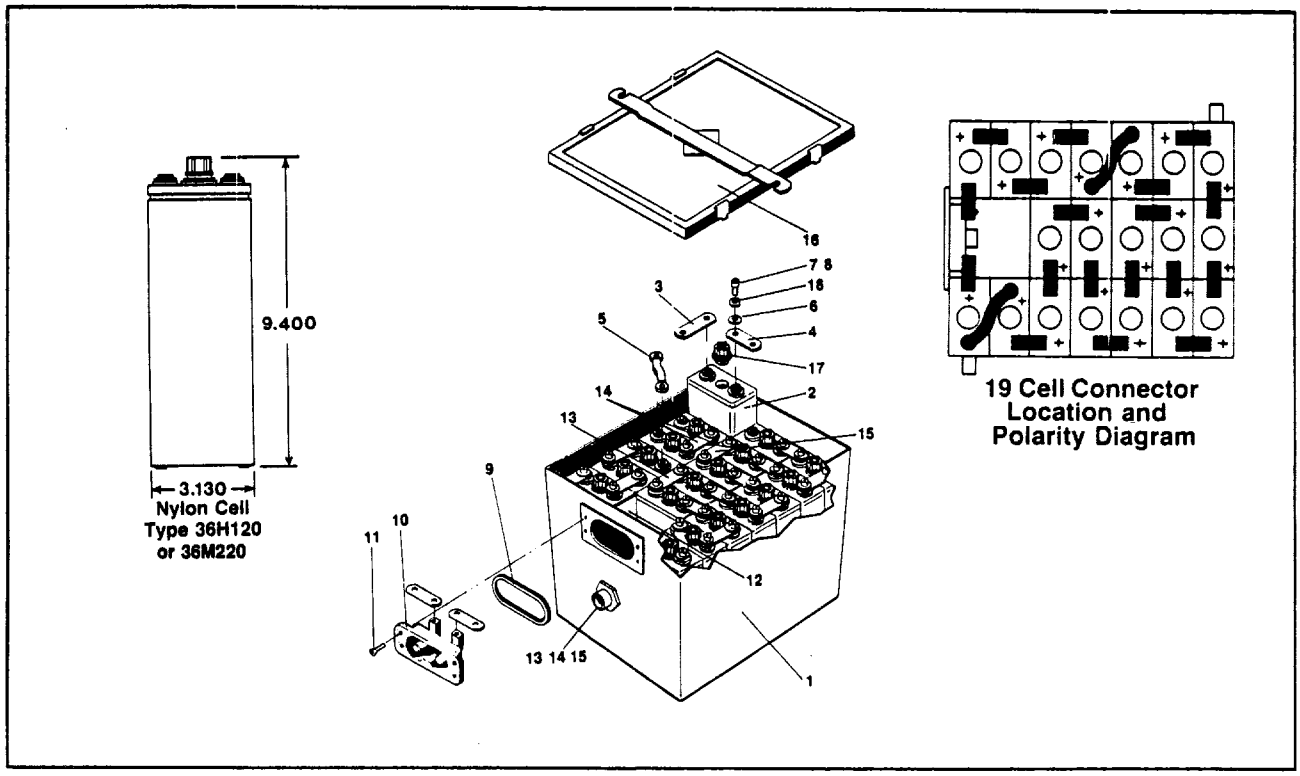
The Marathon PCA-131 Series Battery Charger / Analyzer

Marathon Batteries

Sintered-Plate Nickel-Cadmium Aircraft Batteries

Parts List

TCA-5
BTCA-5
STMA-5



19 Cell Connector Location and Polarity Diagram

Model TCA-5, BTCA-5, STMA-5 Battery Replacement Parts

Item	Description	Part Number TCA-5	Quantity	Part Number BTCA-5	Quantity	Part Number STMA-5	Quantity
1	Can Assembly	28895	1	29134	1	28895	1
2	Can Assembly	36M220	19	36M220	19	36H120	19
3	Connector	16102-6	11	16102-6	10	16102-6	11
4	Connector	16102-52	6	16102-52	6	16102-52	6
5	Connector	16167-3	2	16167-3	2	16167-3	2
6	Belleville Washer	16128-1	40	16128-1	40	16128-1	40
7	Hex Head Screw	—	—	26873-1	40	26873-1	40
8	Socket Head Cap Screw	10488-20	40	—	—	—	—
9	Rectangular Ring	24583	1	24583	1	24583	1
10	Receptacle Assembly	16163-7	1	16163-7	1	16163-7	1
11	Phillip Head Screw	23084-1	4	23084-1	4	23084-1	4
12	Spacer	28896	1	28896	1	28896	1
13	Temperature Switch & Connector Assembly	28900-1	1	—	—	—	—
14	Temperature Switch & Connector Assembly	—	—	29090-1	1	—	—
15	Temperature Switch & Connector Assembly	—	—	—	—	29084	1
16	Cover Assembly	23147-3	1	23147-3	1	23147-3	1
17	Filler Cap & Vent Assembly	18318-1*	19	18318-1*	19	16934-1	19
18	Double "D" Washer	23591-1	40	—	—	—	—

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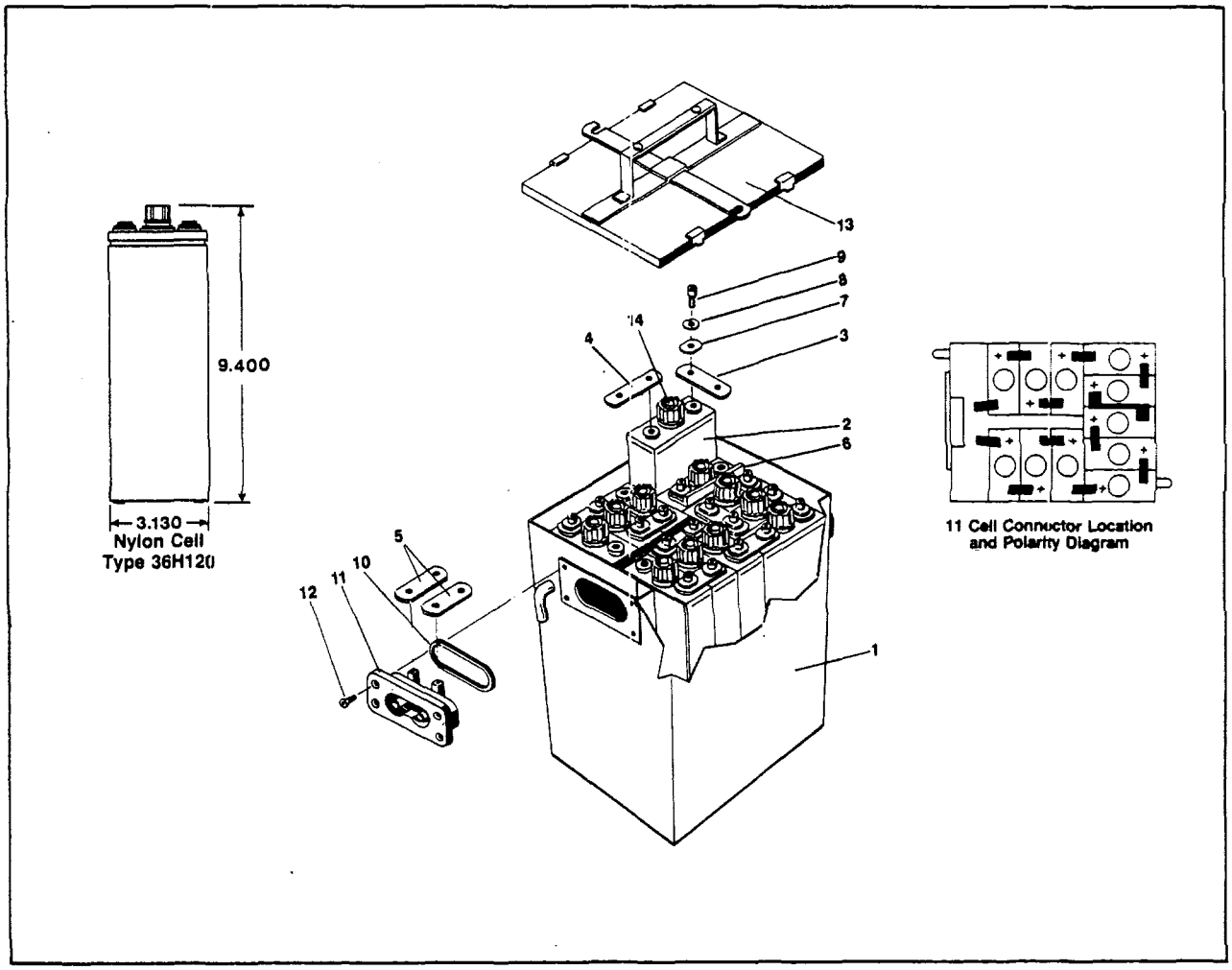
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* The 36M220 cell cover has been modified to use Bayonet Filler Cap, 16934-1 instead of present thread type filler cap 18318-1. Check cell to determine correct vent type. When vent part number 16934-1 is used then the "Z" connectors 16167-1 & 2 may be replaced by "S" connectors 16167-3.

Marathon Batteries

Sintered-Plate Nickel-Cadmium *Aircraft Batteries*

Parts List
CA-13



Model CA-13 Battery Replacement Parts

Item	Description	Part Number	Quantity	Item	Description	Part Number	Quantity
1	Can Assembly	27395	1	8	Split Lockwasher	6560-21	24
2	Cell Assembly	36H120	11	9	Socket Head Cap Screw	10488-20	24
3	Connector	28505-1	7	10	Rectangular Ring	24583	1
4	Connector	28505-2	2	11	Receptacle Assembly	16163-6	1
5	Connector	28505-3	2	12	Phillips Head Screw	23084-1	4
6	Connector	28505-4	1	13	Cover Assembly	27401	1
7	Double "D" Washer	23591-1	24	14	Filler Cap & Vent Assembly	16934-1	11

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Printed in U.S.A.

VR-1010-24-1A
DC VOLTAGE REGULATOR
maintenance manual
and
overhaul manual
with
illustrated parts catalog

Phoenix Aerospace Inc.

PHOENIX, ARIZONA 85034

Phoenix Aerospace Inc.

MAINTENANCE MANUAL

VR-1010-24-1A/P.N. 095001

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List of	*1	Apr. 16/80
Effective Pages	2	Blank
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	2	Aug. 1/77
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24-30-X	1	Aug. 1/67
24-30-X	2	Mar. 31/78
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*The asterisk indicates pages revised or added by the current revision.

PHOENIX AEROSPACE INC. STANDARD WARRANTY

1. Sellers Standard Warranty

(a) Phoenix Aerospace, Inc. herein called Seller, warrants that each unit delivered shall, at the time of delivery thereof to Buyer or Buyer's customers, be free from defects in material and workmanship and from defects or faults in design in view of the state of the art at the time of design thereof. Any defect must have become apparent and Buyer must have notified Seller thereof within twenty-four (24) months after installation in aircraft, not to exceed thirty (30) months after date of manufacture on unit nameplate. The extent of Seller's liability is limited to the repair, replacement, overhaul, or modification of any defective unit.

(b) Seller's obligation hereunder is conditioned upon the return as soon as practicable of the defective unit with all transportation charges prepaid to Seller in Phoenix, Arizona. Returned units must be accompanied by properly authorized Purchase Order, specifying the nature of the defect, if known, and containing reasonable proof to Seller that the defect is due to a matter embraced within Seller's warranty. An allowance will be made for inbound transportation charges in the Continental United States, but inbound transportation charges are the responsibility of Buyer outside the limits of the Continental United States. Overhauled or repaired units will be returned via air, transportation charges prepaid to destination anywhere in the world. Removal of the unit from any aircraft and reinstallation shall be at Buyer's expense.

(c) The warranty hereunder shall not apply to any unit installed in any Aircraft if such Aircraft shall not have been operated in accordance with the Federal Aviation Regulations issued by the Federal Aviation Administration, or if such unit shall not have been operated or maintained in accordance with Seller's instructions applicable to such unit, or if such unit shall have been repaired, altered or modified without Seller's approval, or operated with an accessory or part not authorized for use therewith, or if such unit shall have been operated subsequent to its involvement in an accident, or if the unit shall have been subject in any way to improper operation, maintenance, repair, alteration or modification.

(d) THE WARRANTY AND THE OBLIGATIONS AND LIABILITIES OF SELLER HEREUNDER ARE EXCLUSIVE AND IN SUBSTITUTION FOR AND BUYER HEREBY WAIVES ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, ARISING BY LAW OR OTHERWISE (INCLUDING, WITHOUT LIMITATION, THE IMPLIED WARRANTY OR MERCHANTABILITY, ANY IMPLIED WARRANTY ARISING FROM COURSE OF PERFORMANCE, COURSE OF DEALING OR USAGE OF TRADE, ANY IMPLIED WARRANTY OF FITNESS, AND ANY OBLIGATION OF SELLER WITH RESPECT TO INCIDENTAL OR CONSEQUENTIAL DAMAGES), AND SHALL NOT BE EXTENDED, ALTERED OR VARIED EXCEPT BY A WRITTEN INSTRUMENT SIGNED BY SELLER AND BUYER.

2. General Instructions

(a) Overhaul, modification or repair of all Phoenix Aerospace units is authorized only at Seller's facility. Any overhaul, repair, alteration or modification without Seller's approval will negate or void the terms of Seller's Standard Warranty stated herein. Units in need of repair should be shipped directly to:

Phoenix Aerospace Inc.
1022 South 23rd Street
P. O. Box 20804
Phoenix, Arizona 85036

Units in warranty are repaired at the factory under the terms and conditions of Seller's Standard Warranty at no charge. There will be a charge imposed for Units returned within the warranty period which are found not to be defective or for a defect found not to be included within Seller's Standard Warranty or which have been removed or returned as a result of any program of preventive maintenance.

(b) Units out of warranty are repaired at the factory at Seller's standard charge in effect at the time of receipt of unit. Inbound and outbound transportation charges are the responsibility of the Buyer.

PHOENIX AEROSPACE INC.

VR-1010-24-1A/P.N. 095001

INTRODUCTION

In conformance with A.T.A. Specification No. 100 for Manufacturers' Technical Data, two manuals have been prepared concerning the Model VR-1010-24-1A DC Voltage Regulator. These manuals, if used as intended, will facilitate the effective, continued operation of the equipment. Technical data is grouped according to usage in the manual as described.

MAINTENANCE MANUAL

This manual is intended for use by flight line and hangar maintenance personnel. A detailed description and operation procedures, including a table of leading particulars are presented for reference. Mounting information and cabling information are presented as an aid to installation. Trouble-shooting information is limited to procedures required to trace a trouble to the overall unit for replacement.

OVERHAUL MANUAL WITH ILLUSTRATED PARTS CATALOG

The Overhaul Manual contains all the information required for shop testing, replacement of defective parts, alignment and adjustment, mechanical disassembly, inspection, and reassembly. Detailed circuit theory is given with emphasis on theory that will be especially helpful for effective trouble-shooting. Performance tests as well as functional (go/no-go) checks, which may be used to determine condition of equipment and for retesting after repairs.

The Illustrated Parts Catalog provides a means to determine the manufacturer's part number and the physical location on the equipment of a part if the reference designation is known, or to determine the reference designation and the manufacturer's part number when the physical location of the part is known but no other information is available.

DESCRIPTION AND OPERATION

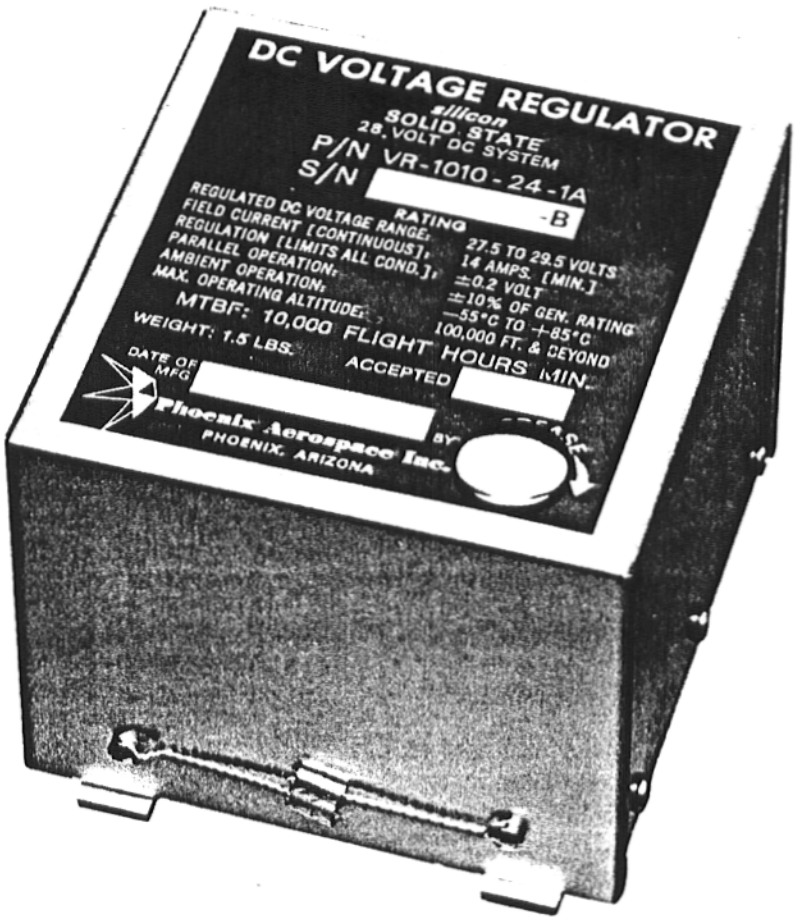
1. GENERAL.

A. Purpose of Manual.

This manual contains maintenance and installation procedures for the Model VR-1010-24-1A, DC Voltage Regulator, Silicon Solid-State, illustrated in Fig. 1.

B. Purpose of Equipment.

The Model VR-1010-24-1A, DC Voltage Regulator is used to control all 28 volt direct current generators and starter generators conforming to FAA TSO-C56 and/or Military Specification MIL-G-6162. The regulator performs the function of maintaining constant output voltage under varying speed and load conditions in single generator or multiple generator systems.



Model VR-1010-24-1A, DC Voltage Regulator
Figure 1

2. DESCRIPTION.

A. The Model VR-1010-24-1A, DC Voltage Regulator is a compact self-contained unit utilizing state-of-the-art solid-state techniques. The regulated voltage is adjustable through access hole in top cover, by removing chrome plug button, and resetting mechanically locked potentiometer. Operating power for the regulator is obtained from the regulated generator. The regulator automatically adjusts field current to produce a constant voltage at the generator output under varying speeds and loads. The unit mounts in several military and commercial type mounts for ease in installation and retrofit operations.

B. The primary characteristics, capabilities, overall weight, and dimensions are listed in Table of Leading Particulars, Table 1.

GENERAL:

Duty: Continuous, unattended.

Temperature Rise: 15° C (maximum).

Cooling: Self-cooled by natural convection, conduction, and radiation.

Ambient Temperature Range: −85° to +85° C.

Maximum Operating Altitude: 100,000 feet and beyond.

Reliability: 10,000 hours MTBF (minimum).

ELECTRICAL:

Regulated DC Voltage Range: 27.5 to 29.5 VDC, no load to full load, over rated generator speed and temp/alt. operating range.

Field Current (Continuous): 14 Amperes (minimum).

Regulation: ±0.2 Volts, no load to full load, over rated generator speed and temp/alt. operating range.

Voltage Adjustment Limits: 26 VDC to 31 VDC, continuously variable.

Equalizer Circuit: ±2.5 Volts, minimum change, no load to full load, at minimum rated speed for regulation, when 0.25 volts is applied to equalizer bus terminals.

Parallel Operation: ±10 per cent equal division of load, two or more generators operated in parallel, no load to full load, over rated generator speed range.

Table of Leading Particulars
Table 1

ELECTRICAL (cont):

Regulator Equivalent Resistance: High Value—More than 100 ohms.
Low Value—Less than 0.5 ohms.

Current Regulation: Regulation for balancing current between parallel generators in multiple generator systems.

Recovery Time: 0.05 Seconds, full load switched ON-OFF-ON, controlled voltage recovers to and remains within 10 per cent of steady state condition.

Overload Current: 14 Amperes (minimum) for one hour.

Induced Ripple: Less than 1.5 volts peak to peak.

Transient Protection: ±80 volts for 40 milliseconds,
±600 volts for 10 microseconds.

MECHANICAL:

Weight: 1.6 pounds (729.6 grams).

Overall Dimensions: 3-1/2 in. wide (8.89 cm) by
3-3/4 in. long (9.425 cm) by
3 in. high (7.62 cm).

Electrical Connections: Connections made through contactors of associated mounting base, positive spring loaded in base.

Mounting: Unit plugs into MS Bases: AC40D-8445-2, AF49C-7573 and AN3204, Commercial Bases: Bendix Types 1700, 19E04, and 32E04. New applications permit use of Bendix Type 1B38-1 when desired.

Cooling: Self-cooled by natural convection, conduction, and radiation.

Installation: Mounts in any position, without degradation of regulation, heating, operating life, or other operating characteristics.

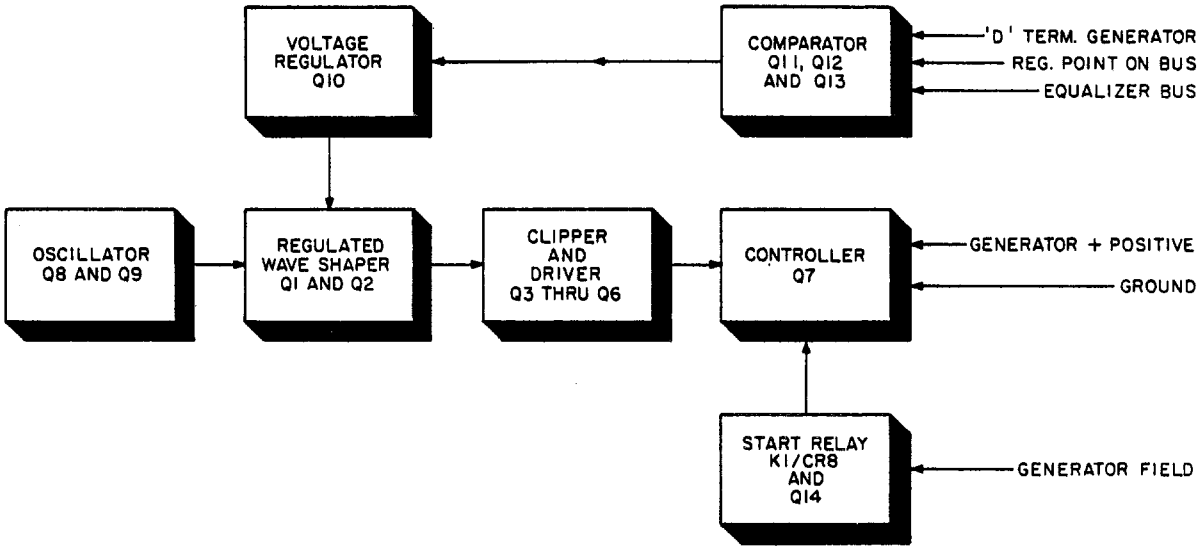
Adjustment: Voltage set potentiometer, INCREASE, adjusts voltage and paralleling in a single operation, located under removable plug button at top of unit.

3. OPERATION.

The subsequent paragraphs cover the theory of operation for the Model VR-1010-24-1A, DC Voltage Regulator. The Block Diagram Theory will aid in conveying the overall circuit operation to non-technical oriented personnel, while the Detailed Circuit Theory will enable the technician to understand in detail the operation of equipment.

A. Block Diagram Theory.

The subsequent paragraphs together with the block diagram of Fig. 2, cover in concise form the signal flow and circuit operation for the Model VR-1010-24-1A, DC Voltage Regulator.



Model VR-1010-24-1A, DC Voltage Regulator
Block Diagram
Figure 2

(1) Generator Start Relay. Relay K1 in the de-energized condition, contacts closed, completes the generator field circuit, until operating speed and voltage output are attained. Relay K1 energizes at a voltage of approximately 20 volts, when Zener diode ZR3 conducts and biases transistor Q14 to turn-on. Relay K1 contacts open, and the generator field circuit is completed through the controller circuit of the regulator, transistor Q7. Operating power for the regulator circuit is obtained from the generator output.

(2) Stabilized Oscillator. Transistors Q8 and Q9 generate a sine wave signal at a frequency of approximately 400 Hertz. The sine wave signal is coupled through auxiliary windings of oscillator transformer T1 to the input of the regulated wave shaper circuits.

(3) Regulated Wave Shaper. Transistors Q1 and Q2 in a push-pull circuit receive the sine wave signal from the stabilized oscillator. Voltage applied from the voltage regulator circuit determines the shaping operation to control duty cycle and regulator operation. The shaped output is coupled to the input of the clipper circuit.

(4) Clipper and Driver. Transistors Q3, Q4, Q5, and Q6 in cascaded push-pull stages provide additional shaping and amplification of the 400 Hertz signal. The amplified signal is applied to the controller circuits.

(5) Controller. Transistor Q7 and diodes CR2 and CR3 comprise the controller circuitry. Transistor Q7 switches the generator field current at a rate of approximately 800 pulses per second, derived by rectification of the 400 Hertz signal by diodes CR2 and CR3. Variation in the width, duty cycle, determines the amount of field current. Clamp diode CR4 maintains continuous field current.

(6) Voltage Regulator. Transistor Q10 delivers the regulating bias to control pulse width of the regulated wave shaper circuit. Reference and control signals are derived from the voltage comparator circuit.

(7) Voltage Comparator. Transistors Q12 and Q13 are operating as a voltage comparator circuit with temperature stabilized reference voltages and an adjustable set point. Transistor Q11 is a current comparator circuit for paralleling operation.

B. Detailed Circuit Theory.

The following sub-paragraphs cover the individual circuits and their operation. Occasional reference to the overall schematic diagram of the equipment, Fig. 3, will be necessary to determine circuit configuration.

(1) Generator Start Relay. The generator start relay K1 with normally closed contacts in the de-energized condition allows maximum field current to flow during start-up of generator. When the generator voltage reaches approximately 20 volts, Zener diode ZR3 conducts and biases transistor Q14 to 'turn-on' and permits relay K1 to energize, opening the field current by-passing contacts. The generator field current path is now passing through the controller circuit through transistor Q7. Operating power is supplied from the generator (+), to the control circuits. Diode CR8 across the coil of relay K1 functions as a suppressor diode. Resistors R39 and R40 determine the maximum base current flow of transistor Q14.

(2) Stabilized Oscillator. The stabilized oscillator utilizes transistors Q8 and Q9 in a Hartley oscillator circuit. Toroidal transformer T1 with multiple windings provides the tuned circuit, feedback, and output windings for the oscillator. The tuned circuit is tuned by capacitor C3 to approximately 400 Hertz. Capacitor C8 provides parasitic suppression in the oscillator tank circuit. The feedback winding provides sustained oscillation to the base-collector circuit. Resistors R21 and R22 provide the bias to the base circuits of the transistors to insure starting and sustained oscillation. Resistor R15 provides degeneration for improved stability of the oscillator circuit. Output to the regulated wave shaper circuit is through remaining winding on transformer T1.

(3) Regulated Wave Shaper. The regulated wave shaper receives the 400 Hertz sinusoidal signal from transformer T1. The input signal applied to the bases of transistors Q1 and Q2 is through resistors R1 and R2 to limit the amount of base current. Transistors Q1 and Q2 conduct alternately on positive half-cycles of the input signal. The point of conduction and duration, resultant increase or decrease in duty cycle is determined by the bias supplied to the emitter circuits from transistor Q10, voltage regulator. Diode CR1 serves as a clamp diode to set bias level of transistors Q1 and Q2. The output across the collectors is a quasi-square wave signal and is applied to the input of the clipper circuit.

(4) Clipper and Driver. The clipper and driver circuit provide additional shaping of the signal and amplification for application to the controller circuit. The clipper circuit consists of transistors Q3 and Q4 in a push-pull circuit. The quasi-square wave signal is coupled to the base circuits of

transistors Q3 and Q4 through limiting resistors R3 and R5, respectively. The output of the clipper circuit is a quasi-square wave with improved rise time. The output is coupled to the base circuits of the driver transistors Q5 and Q6 through resistors R7 and R8, respectively. Resistors R9 and R10 provide a low impedance return for leakage currents. Output in the collector circuit is developed across toroidal transformer T2 and coupled to the controller circuit. Zener diode ZR1 and resistor R14 provide voltage regulation to the clipper and driver circuits.

(5) Controller. The controller circuit comprised of transistor Q7 and diodes CR2 and CR3 control the generator field current to regulate the output voltage of the generator. The quasi-square wave output across transformer T2 is converted to a uni-directional positive voltage by rectification circuit comprised of diodes CR2 and CR3. The positive pulses with a nominal pulse rate of 800 per second are applied to the base of transistor Q7 to control turn on and turn off. Variation of the pulse width, varies in step with the voltage adjustment setting of variable resistor R35, effectively controlling duty cycle. The results of this variation in duty cycle determines the on-off time of transistor Q7 and subsequent variations in generator field current to achieve voltage regulation at the generator output. The regulator operating at a nominal rate of 800 pulses per second in the controller section is adequate to provide proper smoothing of the current to the generator field. The predominate AC component on the DC output of the generator is due primarily to commutator ripple and not from the contribution of the field excitation. RF filter L1 in the collector circuit of transistor Q7 and in series with pin C of the regulator, provides additional filtering of the 800 pulse per second controller output and harmonics of the fundamental frequency. Since the generator field is highly inductive, continuous field current is achieved by the action of clamp diode CR4. The voltage waveform at pin A of the regulator, emitter of transistor Q7, is a positive pulse with an excursion from ground to a positive value approximating generator voltage, typically 27.5 to 29.5 volts. The current flowing in the generator field is constant due to the action of clamp diode CR4. Capacitor C2 and resistor R13 provide a series path for high speed transients which might appear across the collector to emitter circuit of transistor Q7.

(6) Voltage Regulator. The voltage regulator consists of transistor Q10, and associated biasing and time constant circuitry. Resistors R18 and R19 comprise a voltage divider and bias network for the emitter while resistor R17 and capacitor C4 establish the time constant of regulation. Control is applied to the base circuit from the voltage comparator. Output at the collector is applied to the emitter and base circuit of transistors Q1 and Q2, across clamp diode CR1.

(7) Voltage Comparator. The voltage comparator circuit comprised of transistors Q12 and Q13 samples the voltage on the generator bus, pin B of the regulator. The circuit operates as a differential comparator. The base of transistor Q13 receives the voltage from regulation point on generator bus, as adjusted by setting of voltage adjustment increase-EADJ, variable resistor R35, while the base of transistor Q12 is referenced to the temperature compensated Zener voltage at the collector of transistor Q11. Any change in voltage at the regulation point on bus of the generator develops a voltage across resistor R23 in the base of transistor Q10 to apply a change in bias to the voltage regulator. Parallel generator operation is achieved by sampling the voltage between the equalizer bus, pin K of the regulator, and the equalizer sense point, terminal D on generator, pin D of the regulator. The change in voltage appears across resistor R27 and causes a change in the voltage drop across resistor R28 in the collector circuit, and adds in series with the reference voltage derived from temperature compensating diode CR5, CR6, and CR7 in series with Zener diode ZR2. Diode CR9 and resistor R26 establish a reference voltage at the base of transistor Q11. Unequal generator currents cause a change in generator voltage output in a direction to equalize generator currents.

REVISION REFERENCE SHEET

REVISION CODE	REVISION DESCRIPTION	SERIAL NO. EFFECTIVITY
A	RESISTOR R38 CHANGED TO 33 OHMS, ±10%, 1/2W FROM 5.6 OHMS, ±10%, 1/2W.	15 DEC 1967
B	MODIFICATION TO IMPROVE TEMPERATURE COMPENSATION: RESISTOR R24 CHANGED TO 6,810 OHMS, ±1%, 1/8W FROM SELECTED *(3,900-5,100 OHMS); RESISTOR R25 DELETED; RESISTOR R43 ADDED. 1,800 OHMS, ±10%, 1/2W; RESISTOR R26 CHANGED TO 909 OHMS, ±1%, 1/8W FROM 270 OHMS, ±10%, 1/2W; RESISTOR R28 CHANGED TO 2,050 OHMS, ±1%, 1/8W FROM 2,200 OHMS, ±10%, 1/2W; RESISTOR R29 CHANGED TO 604 OHMS, ±1% FROM 620 OHMS, ±10%, 1/2W; RESISTORS R30 AND R33 CHANGED TO 750 OHMS, ±5%, 1/2W FROM 1,000 OHMS, ±10%, 1/2W; RESISTOR R34 CHANGED TO 13K OHMS, ±1% FROM 20K OHMS, ±5%, 1/2W; RESISTORS R36 AND R37 CHANGED TO 28K OHMS, ±1%, 1/8W FROM 16.2K OHMS, ±1%, 1/8W; ZENER DIODE Z2 CHANGED TO 1N4465 FROM 1N4740A.	22 NOV 1968
C	DIODES CR2 AND CR3 CHANGED TO 1N5402 FROM 1N4721. TRANSISTOR Q7 CHANGED TO RCA TYPE NO. 60234 FROM RCA TYPE NO. 2N3772.	10 OCT 1969
D	DIODES CR2 AND CR3 CHANGED TO 1N5624 FROM 1N5402.	22 SEP 1971
E	DIODE CR8 CHANGED TO 1N3611 FROM 1N4002. TRANSISTOR Q7 CHANGED TO RCA TYPE NO. 64497 FROM RCA TYPE NO. 60234. ZENER DIODE Z3 CHANGED TO 1N4473 FROM 1N4748A.	22 JUN 1973
F	RF FILTER L1 ADDED IN SERIES WITH PIN C, GENERATOR POSITIVE, OF RECEPTACLE J1.	7 JUN 1974
G	TRANSISTOR Q7 CHANGED TO RCA TYPE NO. 66090 FROM RCA TYPE NO. 64497.	5 MAR 1975

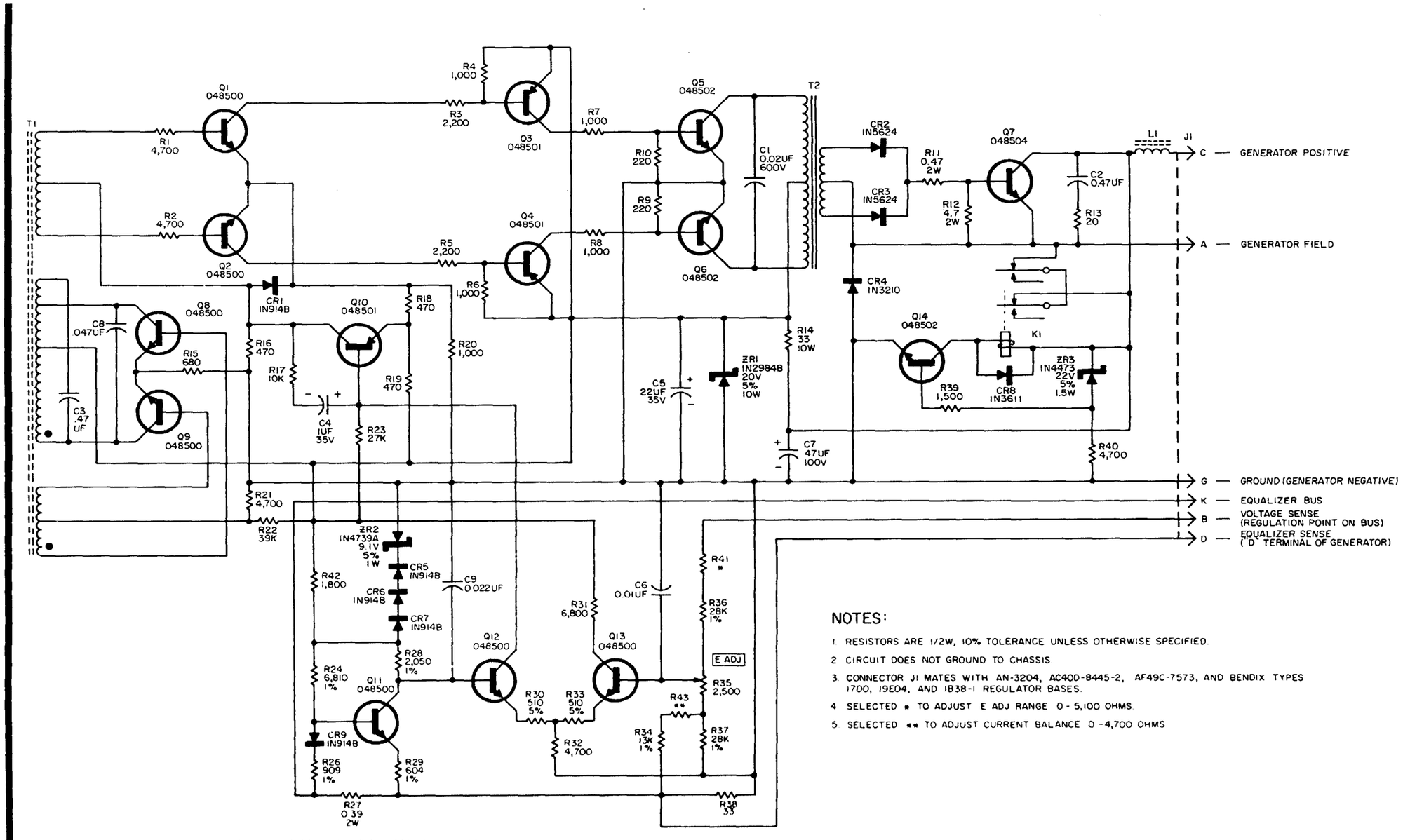
VR-1010-24-1A/P.N. 095001

REVISION REFERENCE SHEET

REVISION CODE	REVISION DESCRIPTION	SERIAL NO. EFFECTIVITY
H	TRANSISTOR Q7 CHANGED TO PAI P.N. 048504 FROM RCA TYPE NO. 66090. TRANSISTORS Q5, Q6, AND Q14 CHANGED TO PAI P.N. 048502 FROM RCA TYPE NO. 40348.	1 DEC 1975
I	TRANSISTORS Q1, Q2, Q8, Q9, Q11, Q12, AND Q13 CHANGED TO PAI P.N. 048500 FROM TYPE 2N3565; TRANSISTORS Q3, Q4, AND Q10 CHANGED TO PAI P.N. 048501 FROM TYPE NO. 2N3638; ZENER DIODE SYMBOLS CHANGED Z1, Z2, AND Z3, TO ZR1, ZR2, AND ZR3; TYPOGRAPHICAL ERROR AS READS 1/4W CHANGED TO 1/8W, AS READS 10K CHANGED TO 13K IN REV. B.	1 AUG 1977
J	CAPACITOR C7 CHANGED TO 47UF FROM 50 UF. RELAY K1 CONTACTS CORRECTED TO FORM 'C.'	31 MAR 1978
K	ZENER DIODE ZR2 CHANGED TO 1N4739A-9.1V±5%, 1W FROM 1N4465-10V±5%, 1.5W.	30 JUN 1978

Model VR-1010-24-1A, DC Voltage Regulator,
Revision Reference Sheet, Schematic Diagram,
Figure 3 (Sheet 2 of 3)

SCHEMATIC DIAGRAM



NOTES:

1. RESISTORS ARE 1/2W, 10% TOLERANCE UNLESS OTHERWISE SPECIFIED.
2. CIRCUIT DOES NOT GROUND TO CHASSIS.
3. CONNECTOR J1 MATES WITH AN-3204, AC40D-8445-2, AF49C-7573, AND BENDIX TYPES 1700, 19E04, AND 1B38-1 REGULATOR BASES.
4. SELECTED * TO ADJUST E ADJ RANGE 0 - 5,100 OHMS.
5. SELECTED ** TO ADJUST CURRENT BALANCE 0 - 4,700 OHMS.

Model VR-1010-24-1A, DC Voltage Regulator,
Schematic Diagram
Figure 3 (Sheet 3 of 3)

TROUBLE SHOOTING

1. GENERAL.

The following paragraphs define procedures suitable for determining that a fault exists in the DC Voltage Regulator. These procedures do not cover trouble shooting within the regulator or associated generator. For equipment trouble shooting procedures refer to the overhaul manual and perform only in an overhaul shop.

2. PRELIMINARY SYSTEM CHECK.

Refer to the airframe wiring diagram and the cabling information given in Fig. 205 or 206 as applicable, and check wiring between generator/s and regulator/s for continuity and proper connection.

3. OPERATIONAL CHECK.

After preliminary checks have been completed an operational check may be made to determine the malfunctioning component of the system. All checks are made with the generator operating at or above minimum rated speed. When performing checks in a parallel system, check one generator and its associated equipment at a time. The remaining generator/s in the system should be off the line.

NOTE: Observe the engine manufacturers' instructions carefully to prevent overheating when operating the engine on the ground. As soon as checks are completed the engine should be throttled down.

Proceed with checks as outlined in Table 101 to determine malfunction.

CAUTION: UNDER NO CIRCUMSTANCES SHOULD THE REGULATOR BE DISASSEMBLED IN THE FIELD FOR REPAIRS. ANY REGULATOR FOUND TO BE DEFECTIVE MUST BE RETURNED TO AN OVERHAUL REPAIR SHOP FOR REPAIR AND RECONDITIONING.

Trouble Shooting Chart
Table 101 (Sheet 1 of 4)

SYMPTOM	PROBABLE CAUSE	CHECK	REMEDY
Generator ammeter reads zero.	Mounting base contact springs making poor contact with pins in regulator base.	Remove regulator from mount, check tension of contact springs and condition of pins and springs.	Clean and polish contact springs on mount and pins on regulator. Reinstall regulator.
	DC Voltage Regulator not adjusted properly or malfunctioning.		Remove regulator and install tested and properly adjusted regulator. Return malfunctioning unit to overhaul repair shop.
	Defective or damaged generator.	Check and inspect in accordance with generator manufacturer's instructions.	Remove defective generator and install operative unit. Return defective unit to overhaul repair shop.
	Damaged wiring between generator and regulator.	Inspect wiring for shorts and continuity using airframe manufacturer's installation drawings.	Replace defective wiring, check, and secure all connections.
	Defective ammeter.	Check operation and calibration in accordance with manufacturer's instructions.	Replace defective ammeter. Return defective parts to overhaul repair shop.
	Generator main power switch open, fusible link or battery relay open.	Check circuit for continuity and malfunctions.	Replace defective or malfunctioning unit. Return defective unit to overhaul repair shop.
Generator voltage zero.	DC Voltage Regulator malfunctioning.		Remove regulator and install tested and properly adjusted regulator. Return malfunctioning unit to overhaul repair shop.

Trouble Shooting Chart
Table 101 (Sheet 2 of 4)

SYMPTOM	PROBABLE CAUSE	CHECK	REMEDY
Generator voltage zero (cont).	Damaged wiring between generator and regulator.	Inspect wiring for shorts and continuity using airframe manufacturer's installation drawings.	Replace defective wiring, check, and secure all connections.
	Defective or damaged generator.	Check and inspect in accordance with generator manufacturer's instructions.	Remove defective generator and install operative unit. Return defective unit to overhaul repair shop.
Output voltage too high.	DC Voltage Regulator not adjusted properly or malfunctioning.		Remove regulator and install tested and properly adjusted regulator. Return malfunctioning unit to overhaul repair shop.
	Mounting base contact springs making poor contact with pins in regulator base.	Remove regulator from mount, check tension of contact springs and condition of pins and springs.	Clean and polish contact springs on mount and pins on regulator. Reinstall regulator.
	Damaged wiring between generator and regulator.	Inspect wiring for shorts and continuity using airframe manufacturer's installation drawings.	Replace defective wiring check, and secure all connections.
Output voltage too low.	DC Voltage Regulator not adjusted properly or malfunctioning.		Remove regulator and install tested and properly adjusted regulator. Return malfunctioning unit to overhaul repair shop.
	Mounting base contact springs making poor contact with pins in regulator base.	Remove regulator from mount, check tension of contact springs and condition of pins and springs.	Clean and polish contact springs on mount and pins on regulator. Reinstall regulator.
	Damaged wiring between generator and regulator.	Inspect wiring for shorts and continuity using airframe manufacturer's installation drawings.	Replace defective wiring, check, and secure all connections.

Trouble Shooting Chart
Table 101 (Sheet 3 of 4)

SYMPTOM	PROBABLE CAUSE	CHECK	REMEDY
Voltmeter or ammeter fluctuates rapidly under steady load conditions.	Malfunctioning DC Voltage Regulator.		Remove regulator and install tested and properly adjusted regulator. Return malfunctioning unit to overhaul repair shop.
Output voltage varies with application or removal of load.	Malfunctioning DC Voltage Regulator.		Remove regulator and install tested and properly adjusted regulator. Return malfunctioning unit to overhaul repair shop.
Load division in a parallel system out of limits.	Defective ammeter.	Check operation and calibration in accordance with manufacturer's instructions.	Replace defective ammeter. Return defective parts to overhaul repair shop.
	DC voltage regulator not adjusted properly or malfunctioning.		Remove regulator and install tested and properly adjusted regulator. Return malfunctioning unit to overhaul repair shop.
	Damaged wiring between generator and regulator.	Inspect wiring for shorts and continuity using airframe manufacturer's installation drawings.	Replace defective wiring, check, and secure all connections.
	Generator grounding straps not secured.	Check grounding of generator per airframe and generator manufacturer's instructions, and value of resistance specified.	Secure and ground strap generator properly.
	Equalizer switch/relay open-circuited or grounded.	Check switch/relay in accordance with manufacturer's instructions.	Replace defective switch/relay.
	Equalizer switch/relay wiring shorted or open.	Check wiring in accordance with manufacturer's instructions.	Replace defective wiring and secure all connections.

SYMPTOM	PROBABLE CAUSE	CHECK	REMEDY
System voltage drops when a generator in the parallel system is removed from line.	Equalizer switch/relay shorted.	Check switch/relay in accordance with manufacturer's instructions.	Replace defective switch/ relay.
	Equalizer switch/relay wiring shorted.	Check wiring in accordance with airframe manufacturer's drawings.	Replace defective wiring and secure all connections.

Trouble Shooting Chart
Table 101 (Sheet 4 of 4)

MAINTENANCE PRACTICES

1. GENERAL.

The following paragraphs cover in detail operations associated with maintenance, installation/removal, etc. of the Model VR-1010-24-1A DC Voltage Regulator.

2. SERVICING.

Periodic servicing or maintenance of the (solid-state) DC Voltage Regulator is not required or recommended. The equipment should not be removed from the airframe unless required by maintenance practices observed by the using agency. The use of solid state devices in a completely transistorized circuit eliminates the major causes of failures and periodic maintenance procedures. In the event a failure occurs refer to the Installation/Removal procedures and remove unit for repair by the overhaul shop or for return to vendor.

3. INSTALLATION/REMOVAL.

The following sub-paragraphs outline the installation and removal procedures for the DC Voltage Regulator.

A. Installation.

(1) Refer to Fig. 201, Fig. 202 and Fig. 203 to determine clearance requirements for DC Voltage Regulator and the selected mounting base. In the event types other than shown in Fig. 202 and Fig. 203 are used, care must be taken to insure clearance. Modification of installation instructions to accommodate other types will be obvious.

CAUTION: USE CARE IN DRILLING OPERATION OF SUBSEQUENT PARAGRAPH, TO PREVENT DAMAGE TO AIRFRAME STRUCTURE, WIRING, OR CONTROLS.

(2) Refer to Fig. 202 or Fig. 203, mark and drill mounting holes for the selected mounting base. Typical drilling information is given on Fig. 202 and Fig. 203.

(3) Install selected regulator mounting base and secure to airframe in conformance with manufacturer's instructions supplied with the mounting base. All hardware shall meet or exceed applicable MS or AN specification. Length of screws must be determined at time of installation and screw must have at least one and one-half threads showing after installed and securely tightened.

(4) Refer to Fig. 204 and connect wiring to mounting base in accordance with information given on wiring diagram. For single generator system connection refer to Fig. 205. For parallel generator system connection refer to Fig. 206. During wiring operations, reference to the airframe manufacturer's installation and wiring diagrams will aid in checking and completing the wiring operation.

NOTE: In most cases the mounting base will be installed and wired properly for the system with which regulator is to be used.

(5) Install regulator in mounting base and secure as follows:

(a) Insert the two small tabs on the DC Voltage Regulator into the slotted brackets on the mounting base. The tabs should fit snug, but without forcing. Check to see the brackets are not bent out from the mounting base, which would permit the tabs to slip up and out.

(b) Press the voltage regulator downward to the base, forcing the spring hold-down clips out far enough to admit the two vertical tabs on the voltage regulator. DO NOT bend these spring clips outward with pliers or a screwdriver, as they must exert pressure both downward and across the base toward the slotted brackets.

(c) Holding the voltage regulator firmly against the regulator base, snap the spring clips into position by pressing them against the vertical tabs on the regulator. In the event spring clips will not pass over the vertical tabs on regulator, remove regulator and examine both regulator and base for foreign objects causing interference.

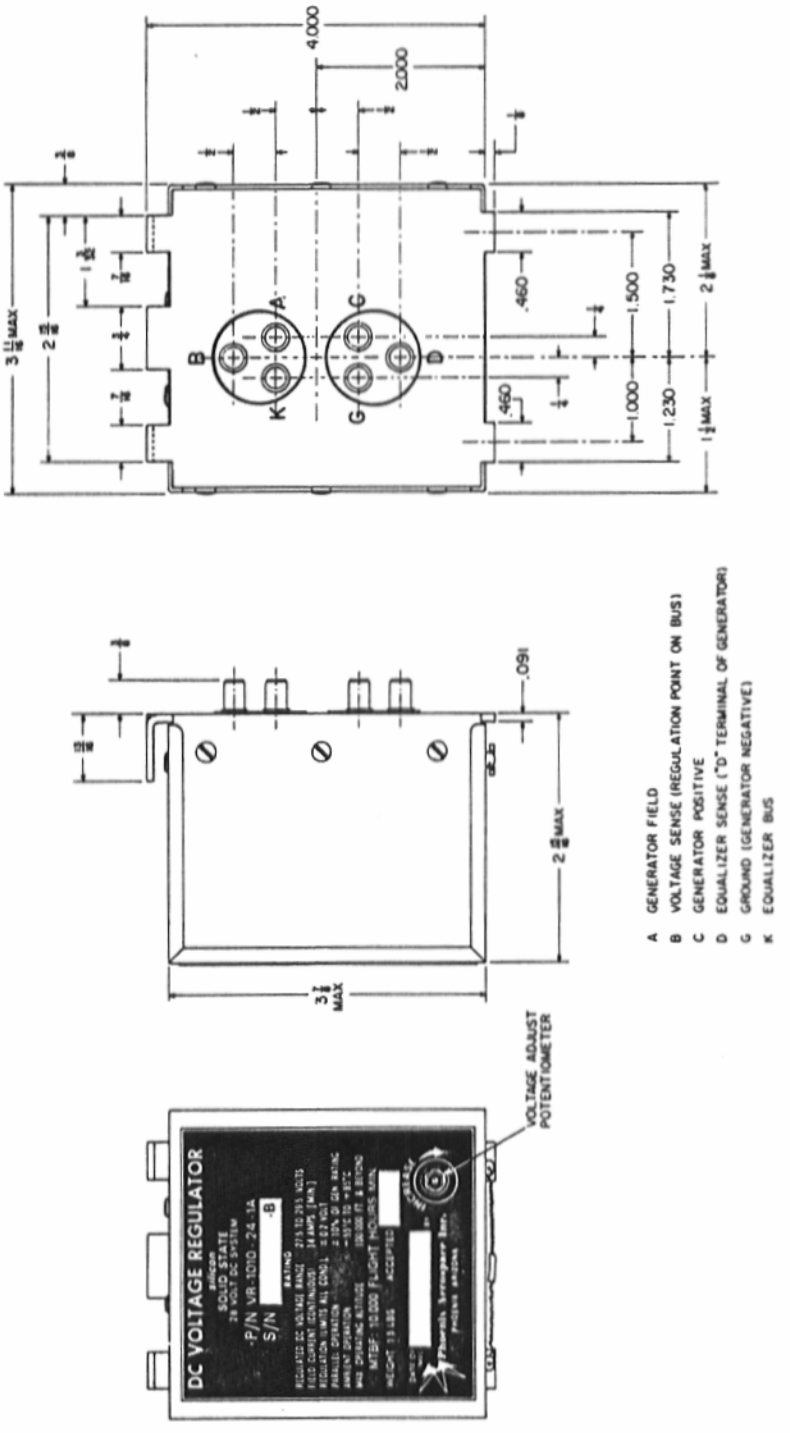
(6) Refer to Fig. 204, Fig. 205, and Fig. 206 and prepare wiring in accordance with system wiring diagrams. Refer to Fig. 205 and Fig. 206 for typical single and dual generator system wiring diagrams, respectively. Figure 207 shows typical retrofit information for typical installation.

(7) After installation and wiring have been completed check to insure that all switches or circuit breakers are in their off positions.

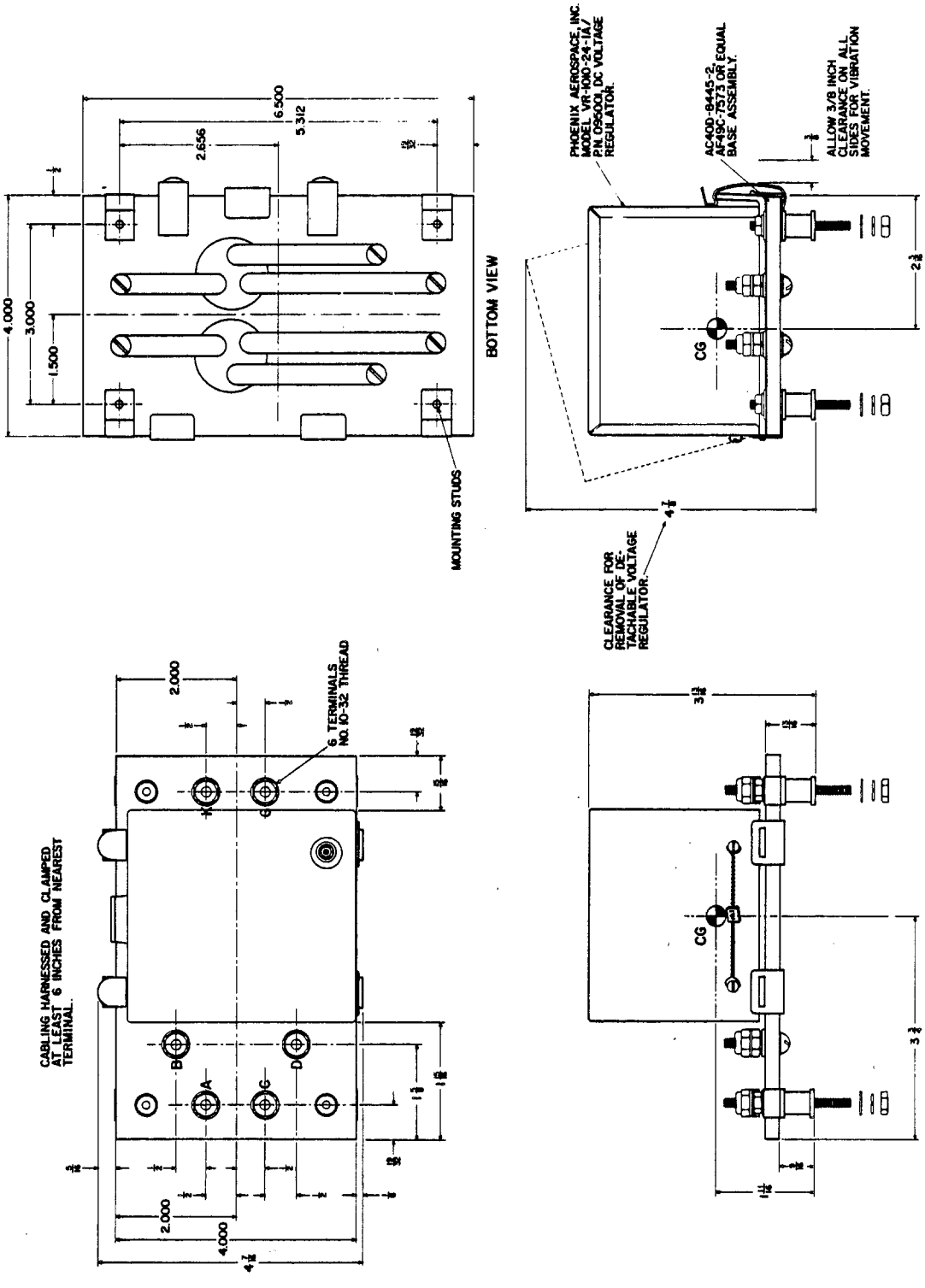
B. Removal.

(1) Place all switches or circuit breakers in their off positions.

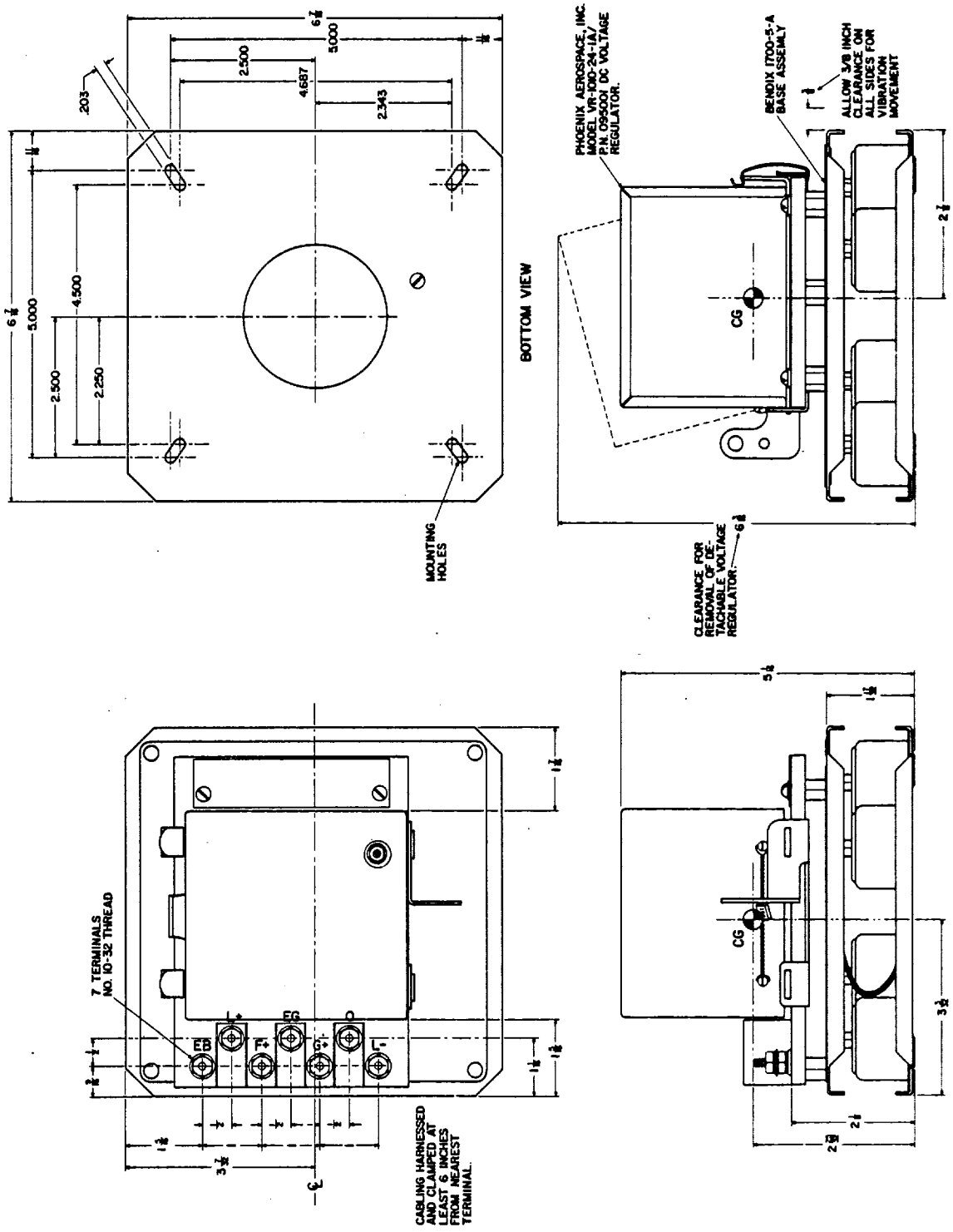
(2) Remove unit in reverse order of procedures given in paragraphs 3.A(1) thru (5).



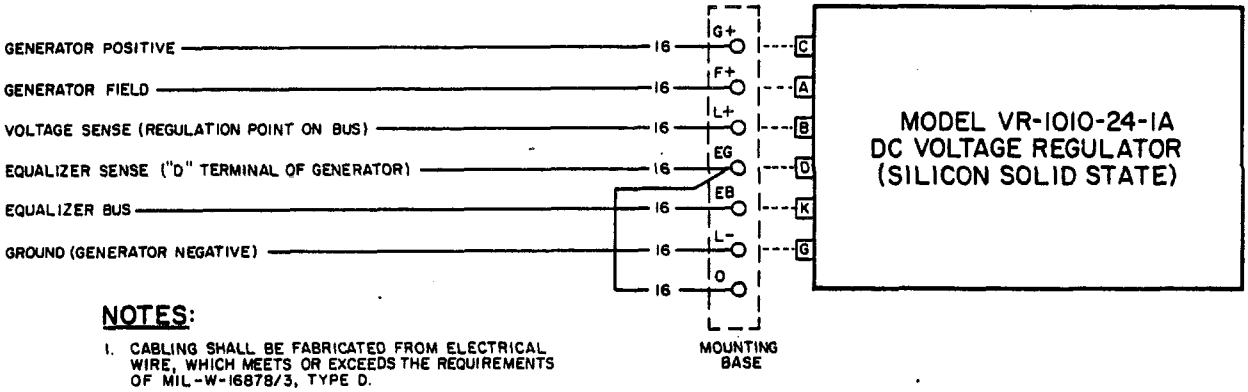
Outline Dimensions, Model VR-1010-24-1A
DC Voltage Regulator
Figure 201



Mounting Clearances/Outline Dimensions, Model VR-1010-24-1A DC Voltage Regulator with Typical AC40D-8445-2 Mounting Base
Figure 202



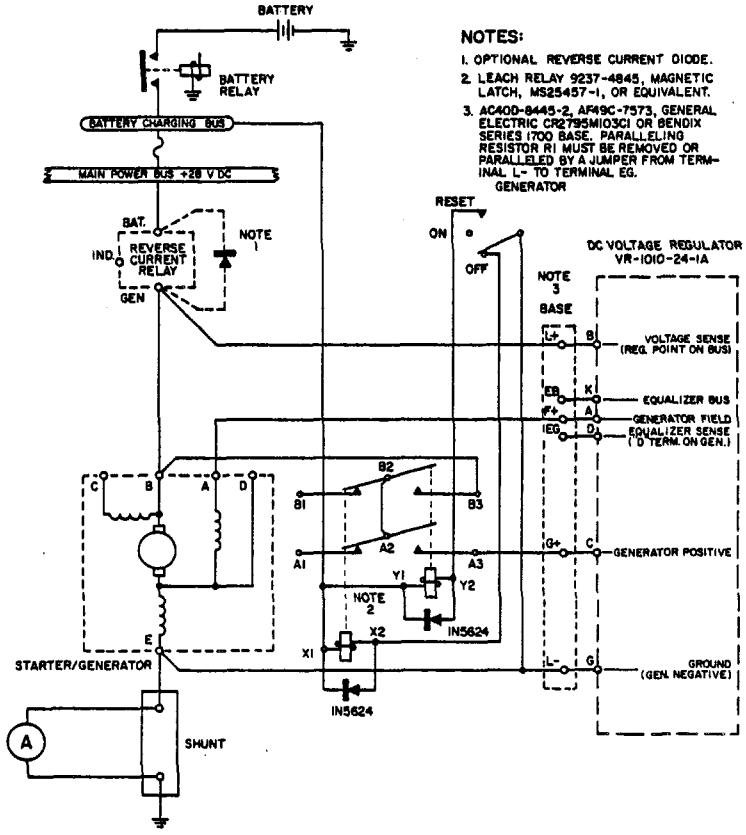
Mounting Clearances/Outline Dimensions, Model VR-1010-24-1A DC Voltage Regulator with Typical Series 1700 (Bendix) Mounting Base
Figure 203



NOTES:

1. CABLING SHALL BE FABRICATED FROM ELECTRICAL WIRE, WHICH MEETS OR EXCEEDS THE REQUIREMENTS OF MIL-W-16878/3, TYPE D.
2. WIRING SHALL MEET OR EXCEED SIZE AS SHOWN.
3. MOUNTING BASE NOT SUPPLIED.

Cabling Diagram, Model VR-1010-24-1A,
DC Voltage Regulator
Figure 204

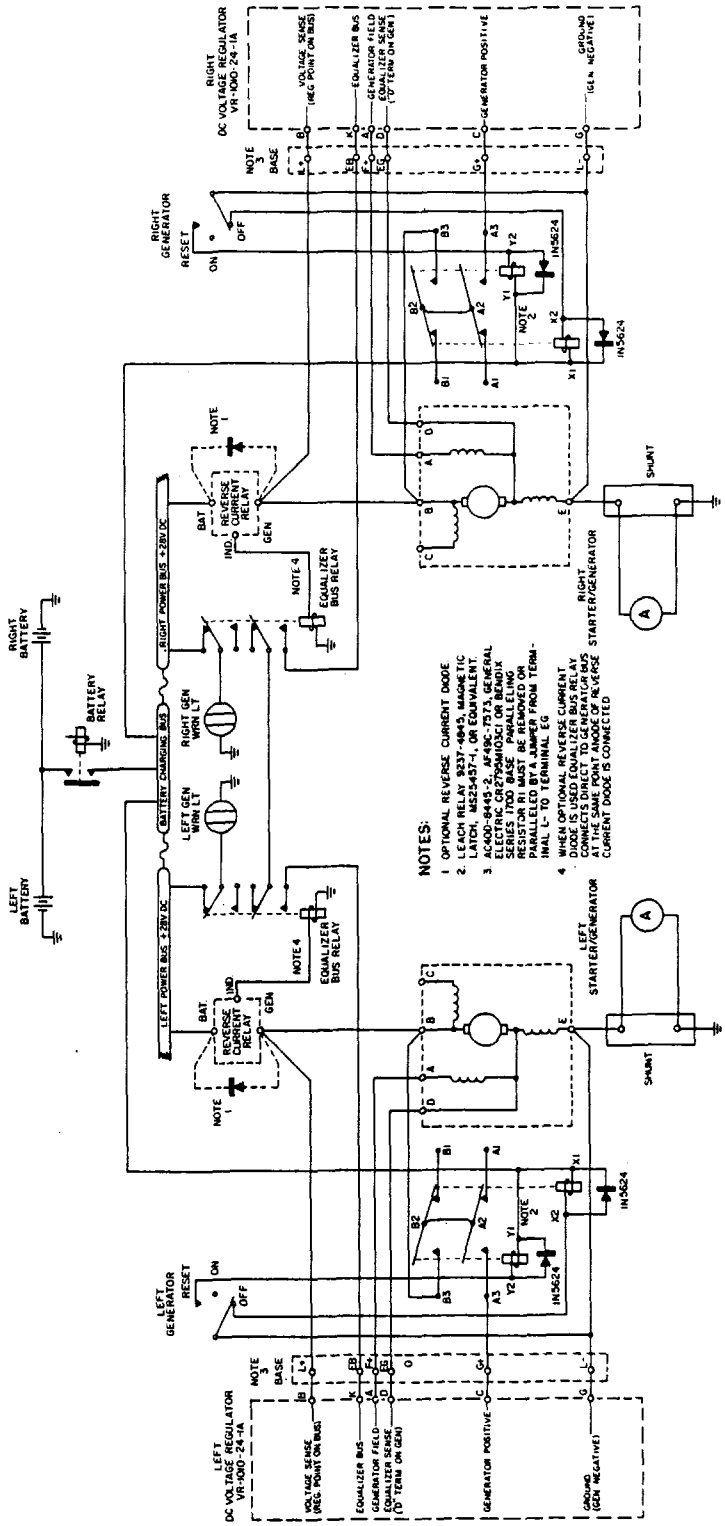


NOTES:

1. OPTIONAL REVERSE CURRENT DIODE.
2. LEACH RELAY 9237-4845, MAGNETIC LATCH, MS25457-1, OR EQUIVALENT.
3. AC400-8445-2, AF49C-7573, GENERAL ELECTRIC CR2795M103CI OR BENDIX SERIES 1700 BASE. PARALLELING RESISTOR R1 MUST BE REMOVED OR PARALLELED BY A JUMPER FROM TERMINAL L- TO TERMINAL EG. GENERATOR

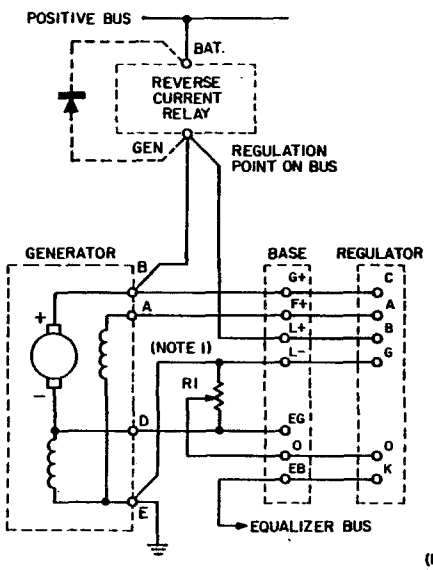
Typical Wiring Diagram for Single Generator System to
Model VR-1010-24-1A, DC Voltage Regulator
Figure 205

VR-1010-24-1A/P.N. 095001

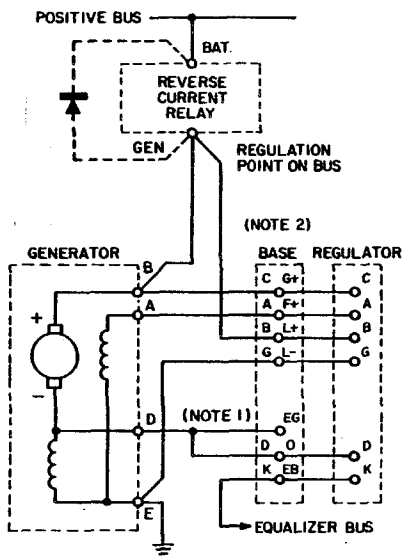


Typical Wiring Diagram for Dual Generator System to Model VR-1010-24-1A, DC Voltage Regulator
Figure 206

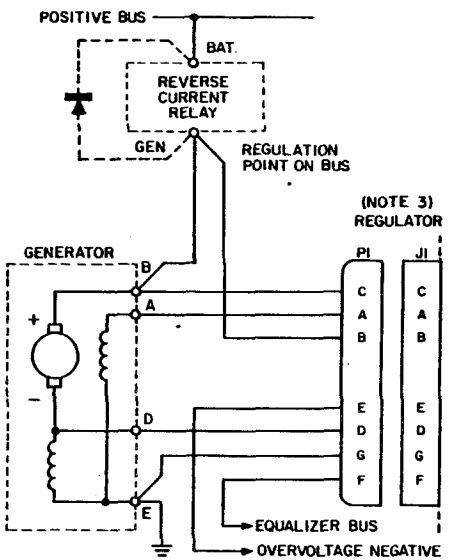
AN3206-1 OR EQUIVALENT
DC VOLTAGE REGULATOR, PLUG-IN UNIT
CARBON PILE
BENDIX OR GENERAL ELECTRIC BASE



MODEL VR-1010-24-1A
DC VOLTAGE REGULATOR, PLUG-IN UNIT
SILICON SOLID-STATE
AC40D-8445-2/AF49C-7573, OR
MODIFIED BENDIX OR GENERAL ELECTRIC BASE



MODEL VR-1010-24-2A
DC VOLTAGE REGULATOR
SOLID MOUNTING
SILICON SOLID-STATE



(NOTE 4)

VR-1010-24-1A DC VOLTAGE REGULATOR CONTACT	CONNECTION	SERIES 1700 BENDIX BASE TERMINAL	AC40D-8445-2 OR AF49C-7573 BASE TERMINAL	CR2795M103C1 GENERAL ELECTRIC VIBRATION MOUNT TERMINAL	VR-1010-24-2A DC VOLTAGE REGULATOR PIN
A	GENERATOR FIELD	F+	A	F+	A
B	VOLTAGE SENSE (REGULATION POINT ON BUS)	L+	B	L+	B
C	GENERATOR POSITIVE	G+	C	G+	C
D	EQUALIZER SENSE ("D" TERMINAL OF GENERATOR)	O-EG	D	O-EG	D
NONE	OVERVOLTAGE NEGATIVE	–	–	–	E
K	EQUALIZER BUS	EB	K	EB	F
G	GROUND (GENERATOR NEGATIVE)	L-	G	L-	G

NOTES:

1. REMOVE PARALLELING RESISTOR RI. IF PARALLELING RESISTOR RI IS NOT REMOVED, DISCONNECT RESISTOR LEADS AT TAPS L- AND EG, AND CONNECT JUMPER WIRE BETWEEN TAPS EG AND O.
2. PAI MODEL VR-1010-24-1A DC VOLTAGE REGULATOR ON THE DESIRED TYPE OF MOUNTING BASE.
3. PAI MODEL VR-1010-24-2A DC VOLTAGE REGULATOR CONNECTS TO THE SYSTEM THROUGH A TYPE MS3106F-16S-1S, OR EQUIVALENT CONNECTOR PLUG.
4. TABLE OF VOLTAGE REGULATOR MOUNTING BASE CONNECTIONS.

Typical DC Voltage Regulator Retrofit Data
Figure 207

4. ADJUSTMENT/TEST.

The following paragraphs outline test procedures for both installation check-out and a pre-installation bench test if desired or required by maintenance policies.

A. Installation Test.

Complete the following steps to determine that the DC Voltage Regulator and associated generator operate properly.

NOTE: The following checks are performed with the generator operating at, or above minimum rated speed. Observe the engine manufacturer's instructions carefully to prevent overheating when operating the engine on the ground. Upon completion of checking procedure, throttle engine down.

(1) Voltage Check.

(a) Connect a voltmeter with a range of 0 to 30 volts across terminals E and B of the generator, ground and positive terminals, respectively.

(b) Accelerate the engine until the generator is operating, at or above the minimum rated speed as given in the applicable generator manufacturer's handbook. Generator switch and master battery switches are open, OFF.

NOTE: Proper engine speed is determined by dividing the minimum rated generator speed by the ratio of generator speed to engine crankshaft speed as given in the manufacturer's handbook.

(c) Close the generator switch and place all load switches in their OFF positions.

(d) No-load or minimum-load voltage should be between 28.3 and 28.7 volts. In the event limits are exceeded, the regulator is not operating properly and should be removed for repair by the overhaul shop.

(e) The DC Voltage Regulator is preset at the factory for 28.5 volts with generator operating at full load and at MID-RANGE speed (6,000 RPM). In the event adjustment is required at flight line level, perform steps (f) through (h).

(f) Identify the Voltage Set potentiometer, INCREASE, under the plug button on right corner of regulator. Using a 5/16 inch hex nut driver with hollow shaft, loosen the regulation adjustment control locking nut.

(g) Using a small screwdriver, approximately 1/8 inch blade, rotate slotted control shaft to obtain desired voltage on regulated bus.

(h) Using the 5/16 inch hex nut driver, tighten control locking nut. DO NOT overtighten, replace plug button over control access hole.

(i) Operate the generator at minimum rated speed with regulator under test for at least 15 minutes and recheck no-load and full-load voltage, to insure temperature rise does not affect the regulation.

NOTE: The Model VR-1010-24-1A DC Voltage Regulator does not exhibit the characteristic droop of carbon pile regulators when cold. The regulation will be flat over the specified temperature-altitude operating range.

(j) Close Master Battery switch and switch on a DC load to the system.

(k) The generator ammeter should indicate a reading equivalent to the load applied and the voltage reading on the voltmeter connected at the point of regulation on the positive DC bus and negative (ground) Terminal E of generator should indicate 28.5 volts DC.

(l) Switch OFF DC load, Master Battery switch, Generator switch, and engine.

CAUTION: DO NOT ATTEMPT TO DISCONNECT VOLTAGE REGULATOR FROM THE SYSTEM UNLESS GENERATOR IS STOPPED OR THE FIELD IS OPEN. FAILURE TO OBSERVE THIS CAUTION WILL RESULT IN PITTED OR BURNED CONTACT SURFACES.

(m) In the event trouble was experienced, remove the voltage regulator and return to the overhaul shop for repair.

(2) Paralleling Check.

NOTE: Each generator and regulator combination should be checked as outlined in preceding Voltage Check procedure, steps (a) through (m), and adjusted for exactly the same no-load or minimum-load voltage by completion of steps (f) through (h) of the Voltage Check procedure of sub paragraph (1).

(a) Operate all generators at or above minimum rated speed.

(b) Check accuracy of the system ammeters by switching on one generator at a time while a constant load (approximately equal to the full-load rating of one generator) is switched on. Record the ammeter reading of each generator. If ammeter readings are equal, the ammeters are considered to be accurate.

(c) Close all generator switches, all equalizer switches, and with all generators operating at or above minimum rated speed, apply a load approximately equal to the full load rating of any one generator in the parallel system.

(d) Check the individual ammeters for indication that each generator is sharing the load with ±10 per cent of rated output.

NOTE: In the event load sharing does not meet specification of ±10 per cent, switch regulators and repeat preceding steps. If this fails to correct trouble, refer to manufacturer's handbook for the generator and check resistance in equalizing circuits for balance.

B. Pre-installation Test.

Complete the following steps to determine that the DC Voltage Regulator is operating properly before installation in the airframe.

NOTE: The subsequent steps are to be used only in determining proper operation of the DC Voltage Regulator prior to installation in the airframe. The following steps do not authorize flight line repairs to the DC Voltage Regulator other than resetting the voltage regulation point. Tests are performed on a motor driven generator test set similar to the Sun Model AGT-2 Generator Test Set or equivalent and a voltage and metering source as described in subsequent steps.

(1) Refer to Fig. 208 and connect the DC Voltage Regulator to the associated test equipment and the Generator Test Set.

CAUTION: DO NOT ATTEMPT TO CONNECT VOLTAGE REGULATOR TO THE GENERATOR TEST SET WITH THE GENERATOR TEST SET OPERATING.

(2) Proceed as follows to complete pre-installation tests.

(a) Start Generator Test Set and run generator speed up to LOW RANGE (approx. 4,500 RPM) Master Battery and Load switches open, OFF.

CAUTION: DO NOT OPERATE GENERATOR TEST SET WITHOUT AIRBLAST TO GENERATOR TO PREVENT SERIOUS OVERHEATING OF THE GENERATOR.

(b) No-load or minimum-load voltage should not vary more than ±0.2 volts from the regulated point setting, standard factory setting is 28.5 volts DC. In the event adjustment is required, perform steps (c) through (e).

(c) Identify the Voltage Set potentiometer INCREASE at the lower right corner of regulator under the plug button. Using a 5/16 inch hex nut driver with hollow shaft, loosen the regulation adjustment control locking nut.

(d) Using a small screwdriver, approximately 1/8 inch blade, rotate slotted control shaft to obtain desired voltage on regulated bus, terminal B of the generator.

(e) Using the 5/16 inch hex nut driver, tighten control locking nut. DO NOT overtighten, replace plug button over control access hole.

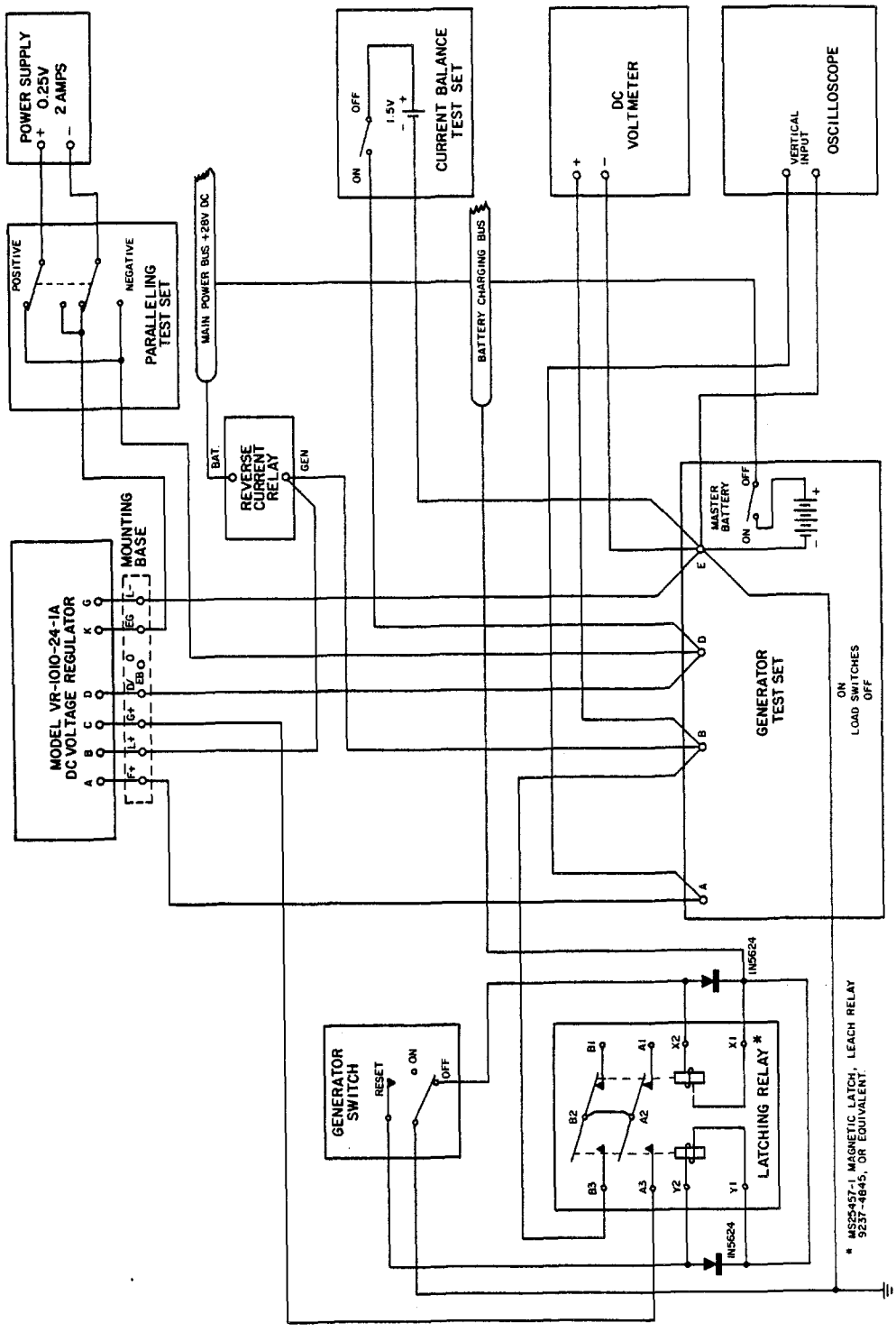
(f) Close Master Battery switch and Load switches to apply a load of 50 to 100 percent to the system.

(g) Place all Load switches in their OFF positions and Master Battery switch in the OFF position and increase Generator Test Set speed to MID RANGE (approx. 6,000 RPM).

(h) No-load or minimum load voltage should not vary more than ±0.2 volts from the regulated point as determined in preceding step (b).

(i) Close Master Battery switch and Load switches to apply a load of 50 to 100 per cent to the system.

(j) Place all Load switches in their OFF positions and Master Battery switch in the OFF position and increase Generator Test Set speed to HIGH RANGE (approx. 8,000 RPM).



Test Set-Up
Model VR-1010-24-1A, DC Voltage Regulator
Figure 208

(k) No-load or minimum load voltage should not vary more than ±0.2 volts from the regulated point as determined in preceding steps (b) and (h).

(l) Close Master Battery switch and Load switches to apply 50 percent and 100 per cent loads to the generator.

(m) Place all Load switches in their OFF positions and Master Battery switch in the OFF position and decrease Generator Test Set speed to required speed preparatory to stopping Generator Test Set. Stop Generator Test Set completely.

NOTE: Each Voltage Regulator should be checked as outlined in preceding steps and adjusted for exactly the same no-load or minimum-load voltage by completion of steps (c) through (e).

(n) Complete steps (o) throught (t) to check parallel operation.

(o) Start Generator Test Set and run generator speed up to LOW RANGE (approx. 4,500 RPM). Close Master Battery switch and Load switches to apply a 100 per cent load to the system.

(p) Operate Paralleling Test Set switch to NEGATIVE, applying the positive 0.25 volts DC to the equalizer bus, Pin K, of the regulator and the negative 0.25 volts DC to terminal D of the Generator Test Set. Voltmeter reading across the generator output should decrease by at least 2.5 volts. Return switch to the center OFF position.

(q) Place all Load switches in their OFF positions disconnecting all load. Operate Paralleling Test Set switch to NEGATIVE, applying the positive 0.25 volts DC to the equalizer bus, Pin K, of the regulator and the negative 0.25 volts DC to terminal D of the Generator Test Set. Voltmeter reading across the generator output should decrease by at least 2.5 volts. Return switch to center OFF position.

(r) Close Load switches to apply a 100 per cent load to the generator. Operate Paralleling Test Set switch to POSITIVE, applying the negative 0.25 volts DC to the equalizer bus, Pin K, of the regulator and the positive 0.25 volts DC to terminal D of the Generator Test Set. Voltmeter reading across the generator output should increase by at least 2.5 volts. Return switch to the center OFF position.

(s) Place all Load switches in their OFF positions, disconnecting all loads. Operate Paralleling Test Set switch to POSITIVE, applying the negative 0.25 volts DC to the equalizer bus, Pin K, of the regulator and the positive 0.25 volts DC to terminal D of the Generator Test Set. Voltmeter reading across the generator output should increase by at least 2.5 volts. Return switch to center OFF position.

(t) Operate Current Balance Test Set switch to the ON position applying −1.5 volts DC to terminal D on Generator Test Set and +1.5 volts DC to terminal G on Generator Test Set. Voltmeter across the generator output should not indicate a change greater than ±0.15 volts. Return Current Balance Test Set switch to the OFF position.

(u) Place all Load switches in their OFF positions, disconnecting all loads.

(v) Open Master Battery switch and decrease Generator Test Set speed required preparatory to stopping generator. Stop Generator Test Set completely.

CAUTION: DO NOT ATTEMPT TO DISCONNECT VOLTAGE REGULATOR FROM THE GENERATOR TEST SET UNTIL GENERATOR IS STOPPED AND ALL VOLTAGES ARE OFF. FAILURE TO OBSERVE THIS CAUTION WILL RESULT IN POSSIBLE DAMAGE TO THE REGULATOR.

(w) In the event trouble was experienced, remove the voltage regulator and return to overhaul shop for repair.

5. INSPECTION/CHECK.

Visual inspection of external cabling for breaks, and for proper connection at mating connectors, are the only authorized inspection checks. For inspection/check procedures of associated generator refer to the generator manufacturer's handbook. No authority is given for visual or other checks internally or removal of the sealed cover at flight line maintenance levels.

6. CLEANING/PAINTING.

The DC Voltage Regulator requires no periodic cleaning operations under the sealed cover. If readily accessible, exterior dust or dirt may be brushed or wiped off the exterior surfaces.

7. APPROVED REPAIRS.

The only repairs approved for flight line maintenance are those associated with external cabling. No repairs are authorized or approved for flight line maintenance requiring removal of the sealed cover.

8. GENERATOR TEST SET.

The Generator Test Set referenced in preceding paragraph 4B is only one of many types available. Other accessories, such as metering and switching arrangements are fabricated by the user to operate with the test setup as suggested. Test setup may be modified at user's discretion provided tests are completed.

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PHOENIX AEROSPACE INC. STANDARD WARRANTY

1. Sellers Standard Warranty

(a) Phoenix Aerospace, Inc. herein called Seller, warrants that each unit delivered shall, at the time of delivery thereof to Buyer or Buyer's customers, be free from defects in material and workmanship and from defects or faults in design in view of the state of the art at the time of design thereof. Any defect must have become apparent and Buyer must have notified Seller thereof within twenty-four (24) months after installation in aircraft, not to exceed thirty (30) months after date of manufacture on unit nameplate. The extent of Seller's liability is limited to the repair, replacement, overhaul, or modification of any defective unit.

(b) Seller's obligation hereunder is conditioned upon the return as soon as practicable of the defective unit with all transportation charges prepaid to Seller in Phoenix, Arizona. Returned units must be accompanied by properly authorized Purchase Order, specifying the nature of the defect, if known, and containing reasonable proof to Seller that the defect is due to a matter embraced within Seller's warranty. An allowance will be made for inbound transportation charges in the Continental United States, but inbound transportation charges are the responsibility of Buyer outside the limits of the Continental United States. Overhauled or repaired units will be returned via air, transportation charges prepaid to destination anywhere in the world. Removal of the unit from any aircraft and reinstallation shall be at Buyer's expense.

(c) The warranty hereunder shall not apply to any unit installed in any Aircraft if such Aircraft shall not have been operated in accordance with the Federal Aviation Regulations issued by the Federal Aviation Administration, or if such unit shall not have been operated or maintained in accordance with Seller's instructions applicable to such unit, or if such unit shall have been repaired, altered or modified without Seller's approval, or operated with an accessory or part not authorized for use therewith, or if such unit shall have been operated subsequent to its involvement in an accident, or if the unit shall have been subject in any way to improper operation, maintenance, repair, alteration or modification.

(d) THE WARRANTY AND THE OBLIGATIONS AND LIABILITIES OF SELLER HEREUNDER ARE EXCLUSIVE AND IN SUBSTITUTION FOR AND BUYER HEREBY WAIVES ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, ARISING BY LAW OR OTHERWISE (INCLUDING, WITHOUT LIMITATION, THE IMPLIED WARRANTY OR MERCHANTABILITY, ANY IMPLIED WARRANTY ARISING FROM COURSE OF PERFORMANCE, COURSE OF DEALING OR USAGE OF TRADE, ANY IMPLIED WARRANTY OF FITNESS, AND ANY OBLIGATION OF SELLER WITH RESPECT TO INCIDENTAL OR CONSEQUENTIAL DAMAGES), AND SHALL NOT BE EXTENDED, ALTERED OR VARIED EXCEPT BY A WRITTEN INSTRUMENT SIGNED BY SELLER AND BUYER.

2. General Instructions

(a) Overhaul, modification or repair of all Phoenix Aerospace units is authorized only at Seller's facility. Any overhaul, repair, alteration or modification without Seller's approval will negate or void the terms of Seller's Standard Warranty stated herein. Units in need of repair should be shipped directly to:

Phoenix Aerospace Inc.
1022 South 23rd Street
P. O. Box 20804
Phoenix, Arizona 85036

Units in warranty are repaired at the factory under the terms and conditions of Seller's Standard Warranty at no charge. There will be a charge imposed for Units returned within the warranty period which are found not to be defective or for a defect found not to be included within Seller's Standard Warranty or which have been removed or returned as a result of any program of preventive maintenance.

(b) Units out of warranty are repaired at the factory at Seller's standard charge in effect at the time of receipt of unit. Inbound and outbound transportation charges are the responsibility of the Buyer.

PHOENIX AEROSPACE INC.

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VR-1010-24-1A/P.N. 095001

INTRODUCTION

In conformance with A.T.A. Specification No. 100 for Manufacturers' Technical Data, two manuals have been prepared concerning the Model VR-1010-24-1A, DC Voltage Regulator (Solid-State Silicon). These manuals, if used as intended, will facilitate the effective, continued operation of the equipment. Technical data is grouped according to usage in the manual as described.

OVERHAUL MANUAL WITH ILLUSTRATED PARTS CATALOG

This manual contains all the information required for shop testing, replacement of defective parts, alignment and adjustment, mechanical disassembly, inspection, and reassembly. Detailed circuit theory is given with emphasis on theory that will be especially helpful for effective trouble-shooting. Performance tests as well as functional (go/no-go) checks, which may be used to determine condition of equipment and for retesting after repairs.

The Illustrated Parts Catalog provides a means to determine the manufacturer's part number and the physical location on the equipment of a part if the reference designation is known, or to determine the reference designation and the manufacturer's part number when the physical location of the part is known but no other information is available.

MAINTENANCE MANUAL

This Maintenance Manual is intended for use by flight line and hangar maintenance personnel. A detailed description and operation procedures, including a table of leading particulars are presented for reference. Mounting information and cabling information are presented as an aid to installation. Trouble-shooting information is limited to procedures required to trace a trouble to the overall unit for replacement.

DESCRIPTION AND OPERATION

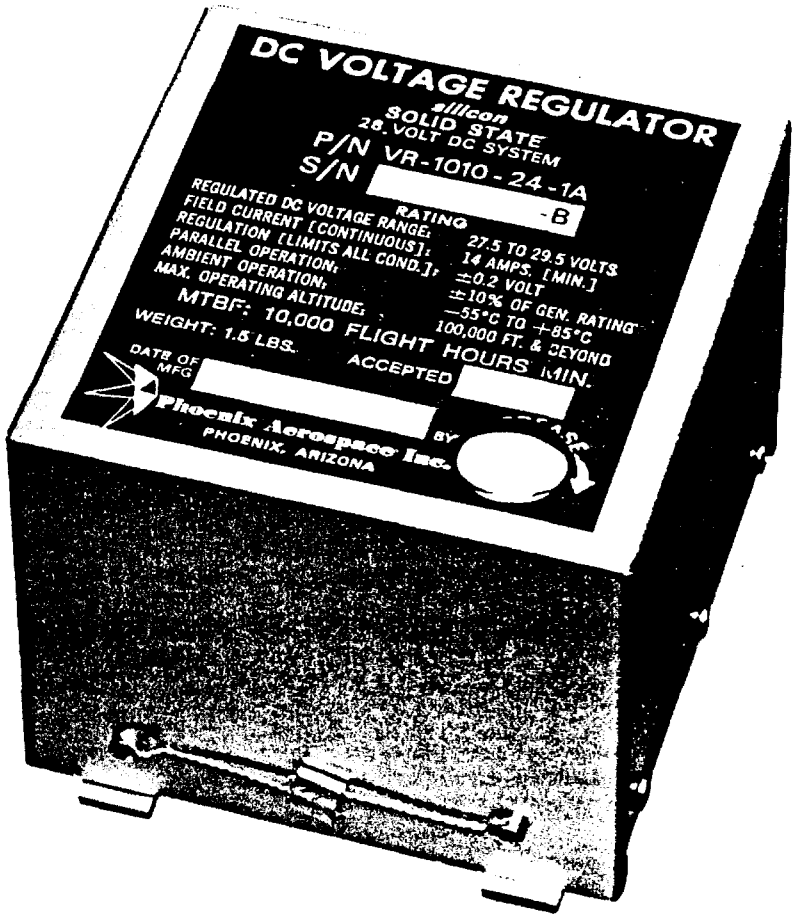
1. GENERAL.

A. Purpose of Manual.

This manual contains information required for shop testing, replacement of defective parts, adjustment and alignment, mechanical disassembly, inspection, reassembly, and illustrated parts catalog, for the Model VR-1010-24-1A, DC Voltage Regulator, silicon solid-state, illustrated in Fig. 1.

B. Purpose of Equipment

The Model VR-1010-24-1A, DC Voltage Regulator is used to control all 28 volt direct current generators and starter generators conforming to FAA TSO-C56 and/or Military Specification MIL-G-6162. The regulator performs the function of maintaining constant output voltage under varying speed and load conditions in single generator or multiple generator systems.



Model VR-1010-24-1A, DC Voltage Regulator
Figure 1

2. DESCRIPTION.

A. The Model VR-1010-24-1A, DC Voltage Regulator is a compact self-contained unit utilizing state-of-the-art solid-state techniques. The regulated voltage is adjustable through access hole in top cover, by removing chrome plug button, and resetting mechanically locked potentiometer. Operating power for the regulator is obtained from the regulated generator. The regulator automatically adjusts field current to produce a constant voltage at the generator output under varying speeds and loads. The unit mounts in several military and commercial type mounts for ease in installation and retrofit operations.

B. The primary characteristics, capabilities, overall weight, and dimensions are listed in Table of Leading Particulars, Table 1.

GENERAL:

Duty: Continuous, unattended.

Temperature Rise: 15° C (maximum).

Cooling: Self-cooled by natural convection, conduction, and radiation.

Ambient Temperature Range: −85° to +85° C.

Maximum Operating Altitude: 100,000 feet and beyond.

Reliability: 10,000 hours MTBF (minimum).

ELECTRICAL:

Regulated DC Voltage Range: 27.5 to 29.5 VDC, no load to full load, over rated generator speed and temp/alt. operating range.

Field Current (Continuous): 14 Amperes (minimum).

Regulation: ±0.2 Volts, no load to full load, over rated generator speed and temp/alt. operating range.

Voltage Adjustment Limits: 26 VDC to 31 VDC, continuously variable.

Equalizer Circuit: ±2.5 Volts, minimum change, no load to full load, at minimum rated speed for regulation, when 0.25 volts is applied to equalizer bus terminals.

Parallel Operation: ±10 per cent equal division of load, two or more generators operated in parallel, no load to full load, over rated generator speed range.

Table of Leading Particulars
Table 1

ELECTRICAL (cont):

Regulator Equivalent Resistance: High Value—More than 100 ohms.
Low Value—Less than 0.5 ohms.

Current Regulation: Regulation for balancing current between parallel generators in multiple generator systems.

Recovery Time: 0.05 Seconds, full load switched ON-OFF-ON, controlled voltage recovers to and remains within 10 per cent of steady state condition.

Overload Current: 14 Amperes (minimum) for one hour.

Induced Ripple: Less than 1.5 volts peak to peak.

Transient Protection: ±80 volts for 40 milliseconds,
±600 volts for 10 microseconds.

MECHANICAL:

Weight: 1.6 pounds (729.6 grams).

Overall Dimensions: 3-1/2 in. wide (8.89 cm) by
3-3/4 in. long (9.425 cm) by
3 in. high (7.62 cm).

Electrical Connections: Connections made through contactors of associated mounting base, positive spring loaded in base.

Mounting: Unit plugs into MS Bases: AC40D-8445-2, AF49C-7573 and AN3204, Commercial Bases: Bendix Types 1700, 19E04, and 32E04. New applications permit use of Bendix Type 1B38-1 when desired.

Cooling: Self-cooled by natural convection, conduction, and radiation.

Installation: Mounts in any position, without degradation of regulation, heating, operating life, or other operating characteristics.

Adjustment: Voltage set potentiometer, INCREASE, adjusts voltage and paralleling in a single operation, located under removable plug button at top of unit.

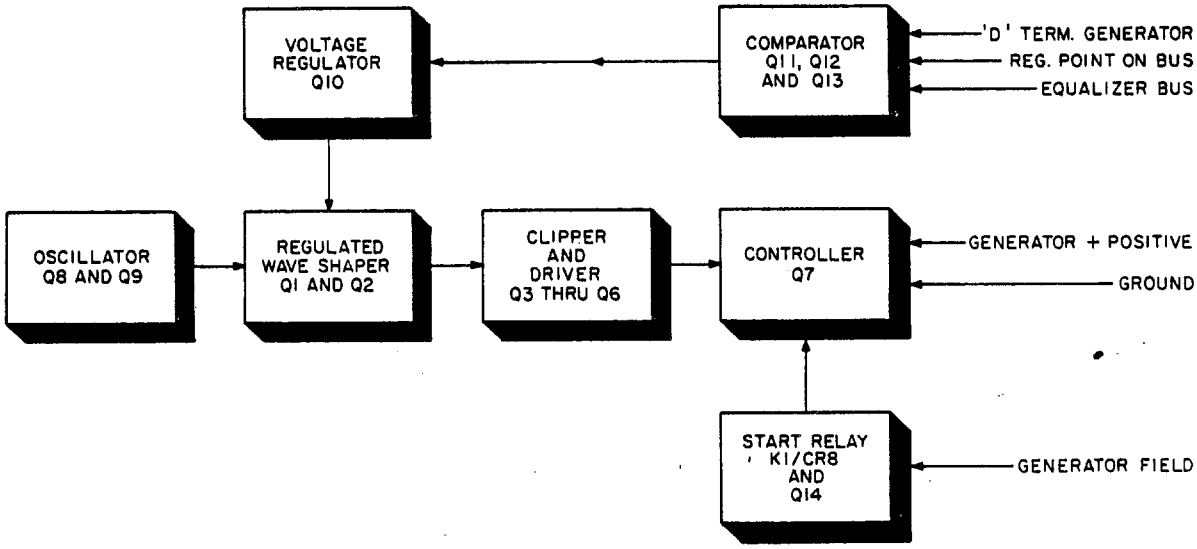
Table of Leading Particulars (cont)
Table 1 (cont)

3. OPERATION.

The subsequent paragraphs cover the theory of operation for the Model VR-1010-24-1A, DC Voltage Regulator. The Block Diagram Theory will aid in conveying the overall circuit operation to non-technical oriented personnel, while the Detailed Circuit Theory will enable the technician to understand in detail the operation of equipment.

A. Block Diagram Theory.

The subsequent paragraphs together with the block diagram of Fig. 2, cover in concise form the signal flow and circuit operation for the Model VR-1010-24-1A, DC Voltage Regulator.



Model VR-1010-24-1A, DC Voltage Regulator
Block Diagram
Figure 2

(1) Generator Start Relay. Relay K1 in the de-energized condition, contacts closed, completes the generator field circuit, until operating speed and voltage output are attained. Relay K1 energizes at a voltage of approximately 20 volts, when Zener diode ZR3 conducts and biases transistor Q14 to turn-on. Relay K1 contacts open, and the generator field circuit is now completed through the controller circuit of the regulator, transistor Q7. Operating power for the regulator circuit is obtained from the generator output.

(2) Stabilized Oscillator. Transistors Q8 and Q9 generate a sine wave signal at a frequency of approximately 400 Hertz. The sine wave signal is coupled through auxiliary windings of oscillator transformer T1 to the input of the regulated wave shaper circuits.

(3) Regulated Wave Shaper. Transistors Q1 and Q2 in a push-pull circuit receive the sine wave signal from the stabilized oscillator. Voltage applied from the voltage regulator circuit determines the shaping operation to control duty cycle and regulator operation. The shaped output is coupled to the input of the clipper circuit.

(4) Clipper and Driver. Transistors Q3, Q4, Q5, and Q6 in cascaded push-pull stages provide additional shaping and amplification of the 400 Hertz signal. The amplified signal is applied to the controller circuits.

(5) Controller. Transistor Q7 and diodes CR2 and CR3 comprise the controller circuitry. Transistor Q7 switches the generator field current at a rate of approximately 800 pulses per second, derived by rectification of the 400 Hertz signal by diodes CR2 and CR3. Variation in the width, duty cycle, determines the amount of field current. Clamp diode CR4 maintains continuous field current.

(6) Voltage Regulator. Transistor Q10 delivers the regulating bias to control pulse width of the regulated wave shaper circuit. Reference and control signals are derived from the voltage comparator circuit.

(7) Voltage Comparator. Transistors Q12 and Q13 are operating as a voltage comparator circuit with temperature stabilized reference voltages and an adjustable set point. Transistor Q11 is a current comparator circuit for paralleling operation.

B. Detailed Circuit Theory.

The following sub-paragraphs cover the individual circuits and their operation. Occasional reference to the overall schematic diagram of the equipment, Fig. 1201, will be necessary to determine circuit configuration.

(1) Generator Start Relay. The generator start relay K1 with normally closed contacts in the de-energized condition allows maximum field current to flow during start-up of generator. When the generator voltage reaches approximately 20 volts, Zener diode ZR3 conducts and biases transistor Q14 to 'turn-on' and permits relay K1 to energize, opening the field current by-passing contacts. The generator field current path is now passing through the controller circuit through transistor Q7. Operating power is supplied from the generator (+), to the control circuits. Diode CR8 across the coil of relay K1 functions as a suppressor diode. Resistors R39 and R40 determine the maximum base current flow of transistor Q14.

(2) Stabilized Oscillator. The stabilized oscillator utilizes transistors Q8 and Q9 in a Hartley oscillator circuit. Toroidal transformer T1 with multiple windings provides the tuned circuit, feedback, and output windings for the oscillator. The tuned circuit is tuned by capacitor C3 to approximately 400 Hertz. Capacitor C8 provides parasitic suppression in the oscillator tank circuit. The feedback winding provides sustained oscillation to the base-collector circuit. Resistors R21 and R22 provide the bias to the base circuits of the transistors to insure starting and sustained oscillation. Resistor R15 provides degeneration for improved stability of the oscillator circuit. Output to the regulated wave shaper circuit is through remaining winding on transformer T1.

(3) Regulated Wave Shaper. The regulated wave shaper receives the 400 Hertz sinusoidal signal from transformer T1. The input signal applied to the bases of transistors Q1 and Q2 is through resistors R1 and R2 to limit the amount of base current. Transistors Q1 and Q2 conduct alternately on positive half-cycles of the input signal. The point of conduction and duration, resultant increase or decrease in duty cycle is determined by the bias supplied to the emitter circuits from transistor Q10, voltage regulator. Diode CR1 serves as a clamp diode to set bias level of transistors Q1 and Q2. The output across the collectors is a quasi-square wave signal and is applied to the input of the clipper circuit.

(4) Clipper and Driver. The clipper and driver circuit provide additional shaping of the signal and amplification for application to the controller circuit. The clipper circuit consists of transistors Q3 and Q4 in a push-pull circuit. The quasi-square wave signal is coupled to the base circuits of transistors Q3 and Q4 through limiting resistors R3 and R5, respectively. The output of the clip-

per circuit is a quasi-square wave with improved rise time. The output is coupled to the base circuits of the driver transistors Q5 and Q6 through resistors R7 and R8, respectively. Resistors R9 and R10 provide a low impedance return for leakage currents. Output in the collector circuit is developed across toroidal transformer T2 and coupled to the controller circuit. Zener diode ZR1 and resistor R14 provide voltage regulation to the clipper and driver circuits.

(5) Controller. The controller circuit comprised of transistor Q7 and diodes CR2 and CR3 control the generator field current to regulate the output voltage of the generator. The quasi-square wave output across transformer T2 is converted to a uni-directional positive voltage by rectification circuit comprised of diodes CR2 and CR3. The positive pulses with a nominal pulse rate of 800 per second are applied to the base of transistor Q7 to control turn on and turn off. Variation of the pulse width, varies in step with the voltage adjustment setting of variable resistor R35, effectively controlling duty cycle. The results of this variation in duty cycle determines the on-off time of transistor Q7 and subsequent variations in generator field current to achieve voltage regulation at the generator output. The regulator operating at a nominal rate of 800 pulses per second in the controller section is adequate to provide proper smoothing of the current to the generator field. The predominate AC component on the DC output of the generator is due primarily to commutator ripple and not from the contribution of the field excitation. RF filter L1 in the collector circuit of transistor Q7 and in series with pin C of the regulator, provides additional filtering of the 800 pulse per second controller output and harmonics of the fundamental frequency. Since the generator field is highly inductive, continuous field current is achieved by the action of clamp diode CR4. The voltage waveform at pin A of the regulator, emitter of transistor Q7, is a positive pulse with an excursion from ground to a positive value approximating generator voltage, typically 27.5 to 29.5 volts. The current flowing in the generator field is constant due to the action of clamp diode CR4. Capacitor C2 and resistor R13 provide a series path for high speed transients which might appear across the collector to emitter circuit of transistor Q7.

(6) Voltage Regulator. The voltage regulator consists of transistor Q10, and associated biasing and time constant circuitry. Resistors R18 and R19 comprise a voltage divider and bias network for the emitter while resistor R17 and capacitor C4 establish the time constant of regulation. Control is applied to the base circuit from the voltage comparator. Output at the collector is applied to the emitter and base circuit of transistors Q1 and Q2, across clamp diode CR1.

(7) Voltage Comparator. The voltage comparator circuit comprised of transistors Q12 and Q13 samples the voltage on the generator bus, pin B of the regulator. The circuit operates as a differential comparator. The base of transistor Q13 receives the voltage from regulation point on generator bus, as adjusted by setting of voltage adjustment increase-EADJ, variable resistor R35, while the base of transistor Q12 is referenced to the temperature compensated Zener voltage at the collector of transistor Q11. Any change in voltage at the regulation point on bus of the generator develops a voltage across resistor R23 in the base of transistor Q10 to apply a change in bias to the voltage regulator. Parallel generator operation is achieved by sampling the voltage between the equalizer bus, pin K of the regulator, and the equalizer sense point, terminal D on generator, pin D of the regulator. The change in voltage appears across resistor R27 and causes a change in the voltage drop across resistor R28 in the collector circuit, and adds in series with the reference voltage derived from temperature compensating diode CR5, CR6, and CR7 in series with Zener diode ZR2. Diode CR9 and resistor R26 establish a reference voltage at the base of transistor Q11. Unequal generator currents cause a change in generator voltage output in a direction to equalize generator currents.

DISASSEMBLY

1. GENERAL.

This section outlines procedures for disassembly of the DC Voltage Regulator. These procedures should be followed in the event it becomes necessary to repair the unit after a malfunction or part failure. Electrical wiring should not be disconnected except when required for complete removal of a component or subassembly or when wiring is found to be defective. When wiring is disconnected, tag each wire and note connection point for ease in identification during reassembly.

2. COVER REMOVAL.

A. Break Phoenix Aerospace, Inc. seal, (7) Fig. 1101, by cutting wire, and remove.

NOTE: In the event DC Voltage Regulator is in warranty, breaking of seal may void warranty unless covered by other contractual agreement.

B. Remove the four screws, (-5 and -6) Fig. 1101, securing cover, (4) Fig. 1101, and remove cover by lifting straight up from regulator. Place hardware and cover aside for reassembly.

3. REMOVAL OF CIRCUIT MODULE, OSCILLATOR/SWITCHING CIRCUITS SUB-ASSEMBLY.

A. GENERAL.

Removal of oscillator/switching circuits sub-assembly, (2) Fig. 1101, is accomplished to gain access to components on the bottom side and connections to contact pins in the base plate and chassis with connector sub-assembly, (1) Fig. 1101. Unless complete oscillator/switching circuit sub-assembly replacement is required or base plate and connector subassembly replacement is required, interconnecting wires should never be disconnected. Proceed as follows to gain access to the under side of sub-assembly.

B. REMOVAL PROCEDURES.

(1) Loosen and remove the three No. 4-40 x 3/8 inch long pan head machine screws, (-3) Fig. 1101, at each side of the base plate and connector sub-assembly.

(2) Carefully swing sub-assembly up to expose the underside of oscillator/switching circuit sub-assembly. DO NOT disconnect wiring unless removal of entire sub-assembly is required.

4. DISASSEMBLY OF OSCILLATOR/SWITCHING CIRCUIT SUB-ASSEMBLY.

A. GENERAL.

Disassembly of the oscillator/switching circuit sub-assembly is required to gain access to components on the oscillator/driver circuit board sub-assembly (1) Fig. 1102, and components on top of switching circuits chassis (4) Fig. 1102. Unless replacement of complete oscillator/driver circuit board sub-assembly is required, interconnecting wires should never be disconnected. Proceed as follows to gain access to components on oscillator/driver circuit board sub-assembly and top of switching circuits chassis.

B. DISASSEMBLY PROCEDURE.

(1) Remove the four No. 4-40 x 1-3/4 inch long round head machine screws, (-2) Fig. 1102, and the four round spacers, (-3) Fig. 1102 at the corners of oscillator/driver circuit board sub-assembly.

(2) Carefully lift board and fold back to expose components and interconnect wiring. DO NOT disconnect wiring between the oscillator/driver circuit board sub-assembly and switching circuits chassis unless complete replacement of either component is necessary.

CLEANING

1. GENERAL.

This section outlines procedures for cleaning the components of the DC Voltage Regulator while disassembled. Cleaning materials are listed in Table 201.

WARNING: PERFORM OPERATION INVOLVING SOLVENT ONLY IN A WELL VENTILATED AREA. AVOID BREATHING OF SOLVENT VAPOR AND CONTINUOUS CONTACT WITH SOLVENT.

Reference to air jet refers to a hand-operated air nozzle supplied with clean, dry, compressed air at a maximum pressure of 28 psi.

WARNING: GOGGLES SHOULD BE WORN WHEN USING AIR JET TO BLOW DUST AND DIRT FROM EQUIPMENT. OTHER PERSONS SHOULD BE WARNED AWAY FROM HAZARDOUS AREA OR WORKING ENCLOSURE.

MATERIAL
Trichloroethylene Solvent
Soft-bristled Brush
Stiff-bristled Brush
Soft, Clean Cloth

List of Cleaning Materials
Table 201

2. PRINTED CIRCUIT BOARDS-WIRED CHASSIS.

Remove dust and dirt from all surfaces with a soft-bristled brush in conjunction with an air jet.

NOTE: When the dress of wiring is disturbed, dressing should be noted, and when cleaning is finished, wiring should be restored to proper dress or position.

3. METAL SURFACES.

Clean with soft cloth moistened in trichloroethylene solvent, and dry with clean, dry cloth.

4. CONNECTORS.

A. Wipe dust and dirt from contacts using trichloroethylene solvent and a soft cloth. Wipe dry with clean, dry cloth.

B. Remove dust from contacts and insulator areas using small, soft-bristled brush in conjunction with air jet.

INSPECTION/CHECK

1. GENERAL.

   This section contains procedures to determine the condition of the DC Voltage Regulator.

2. COVER.

   Inspect cover for deformations, dents, punctures or surfaces which might be wearing due to interference with other components.

3. CONNECTORS.

   A. Inspect for broken parts or other abnormal condition.

   B. Inspect for contacts which are broken, deformed or out of alignment. Check for corrosion and signs of arcing at the contacts and for poorly soldered connections.

4. RESISTORS.

   Inspect resistors for signs of overheating; cracked, broken, or charred insulation; loose, poorly soldered, or corroded terminal connections; and loose mountings.

5. METAL SURFACES AND MECHANICAL.

   Inspect metal surfaces for signs of corrosion. Also check component mountings for mechanical tightness.

6. WIRES.

   Check wires for damaged insulation and for proper dress.

REPAIR

1. GENERAL.

This section outlines instructions for the repair or replacement of damaged or defective parts. Faulty parts are usually detected by inspection, cleaning or trouble shooting. The repair or replacement of damaged or defective parts involves standard repair techniques. Identify each wire before removal of any part requiring unsoldering of several lead wires.

2. COVER AND METAL PARTS.

Straighten any deformation, and retouch scratched or worn surfaces as required.

3. PRINTED CIRCUIT BOARD AND TERMINAL STRIPS.

Remove all traces of corrosion and recoat with clear epoxy resin where broken or removed during repairs.

Before attempting to solder connections, peel away epoxy resin using a sharp knife.

NOTE: The clear epoxy resin is Armstrong Products Inc. Type T-600 or equivalent. Any time the epoxy coating is disturbed, recoating is advised.

4. CONNECTORS.

Check and resolder connections and check insulation. If badly damaged, replace contactor or contact plate (base plate and chassis sub-assembly).

5. SOLDER CONNECTIONS.

Resolder any defective solder joints. Remove all traces of corrosion.

6. WIRING.

Replace any wiring with damaged insulation or broken strands.

7. RESISTORS.

Replace resistors that show signs of overheating or with cracked or broken bodies. Resolder loose, broken or corroded connections.

ASSEMBLY

1. GENERAL.

This section outlines the instructions for assembly of the DC Voltage Regulator. Before assembly of the unit, the Cleaning, Inspection/Check, and Repair Sections should be consulted to determine if all components are properly cleaned and in proper physical and operating condition. Where wiring must be reconnected, good practices must be followed in dressing of wires and soldering connections. Refer to Figures 1101 through 1103 for identification and location of sub-assemblies and component parts.

2. ASSEMBLY OF OSCILLATOR/SWITCHING CIRCUIT SUB-ASSEMBLY.

A. GENERAL.

Assembly of the oscillator/switching circuit sub-assembly requires reference to Figure 1102 for component identification and reference to the schematic diagram, Figure 1201, in the event complete disassembly was necessary and it is necessary to reconnect interwiring. Proceed as follows, eliminating steps where necessary.

B. ASSEMBLY PROCEDURES.

(1) Identify disconnected leads and reconnect to points indicated. Reference to the overall schematic diagram, Figure 1201, should be made for all connections as well as reference to Figures 1102 and 1103 for component identification.

(2) Dress wires and assemble oscillator/driver circuit board sub-assembly, (1) Fig. 1102, to switching circuits chassis, (4) Fig. 1102. Use the four No. 4-40 x 1-3/4 inch long round head machine screws, (-2) Fig. 1102, and the four round spacers, (-3) Fig. 1102.

3. INSTALLATION OF CIRCUIT MODULE, OSCILLATOR/SWITCHING CIRCUITS SUB-ASSEMBLY.

A. GENERAL.

Installation of the oscillator/switching circuits, sub-assembly (2) Fig. 1101 requires reference to the overall schematic diagram, Figure 1201, in the event lead wires between the contact pins in the base plate and chassis with connector sub-assembly, (1) Fig. 1101, were disconnected. Proceed as follows eliminating steps not applicable.

B. INSTALLATION PROCEDURES.

(1) Identify disconnect leads and reconnect to points as tagged. Refer to the overall schematic diagram, Fig. 1201, to insure accuracy of connections and to Figure 1102 for component identification.

(2) Dress wiring to prevent interference with oscillator/switching circuits sub-assembly and return sub-assembly to position at bottom of base plate and chassis with connector sub-assembly.

(3) Secure with the six No. 4-40 x 3/8 inch long pan head screws, (-3) Fig. 1101, three on each side.

4. INSTALLATION OF COVER.

A. Reposition cover over DC Voltage Regulator by sliding cover over unit. Check to see that adjustment screw is accessible under plug button.

B. Secure cover with two No. 4-40 x 3/8 inch long pan head screws, (-5) Fig. 1101, at the end opposite the adjustment access hole.

C. Secure cover with two No. 4-40 x 5/8 inch long (drilled) fillister head screws, (-6) Fig. 1101, at end nearest to adjustment access hole.

D. Place tie wire through drilled holes of fillister head screws and seal with lead seal, (7) Fig. 1101, if available.

VR-1010-24-1A/P.N. 095001

FITS AND CLEARANCES

Not Applicable to Solid State DC Voltage Regulator.
No moving parts required.

TESTING

1. GENERAL.

This section defines test procedures for the Model VR-1010-24-1A DC Voltage Regulator. The procedures given are in sequential step form and test the unit completely. When the results of any step or test are not achieved the Trouble Shooting of this manual should be consulted.

2. PERFORMANCE TESTS.

Performance tests are designed to provide a fast efficient method for complete check-out of the voltage regulator. Subsequent paragraphs contain a list of test equipment required. Minimum performance requirements, and interconnect diagrams to facilitate testing.

A. Test Equipment Required.

The test equipment required to accomplish the performance tests consists of the following: generator test set, oscilloscope, volt-meter, insulation resistance tester and interconnect cabling. This equipment is listed and described in the Special Tools, Fixtures, and Equipment section of this manual.

B. Minimum Performance Requirements.

The minimum performance requirements of the Model VR-1010-24-1A DC Voltage Regulator is to provide regulation of generator field current such that the output voltage of generator is maintained constant. Regulation level is maintained at ±0.2 volts DC at any preset value in the 27.5 to 29.5 volts DC range. Regulation at this preset value is maintained at no load to full load operation and under varying generator speeds, at or above the minimum rated generator speed and temperature-altitude operating range.

C. Preparation for Testing.

(1) Chassis Isolation Test. Perform the following steps using an Associated Research Model 2956, Insulation Resistance Tester to determine unit meets applicable specifications for chassis isolation.

WARNING: The recommended Insulation Resistance Tester produces potentially dangerous voltages. Care in operation must be exercised to prevent possible electrical shock.

(a) Place POWER ON/OFF switch on Insulation Tester in the OFF position and connect line cord, three wire grounding type, to source of 115 volts AC, 60 Hz. Identify VOLTAGE ADJUST control and rotate to the extreme counter-clockwise position. Connect the black lead with a spade lug to the GROUND terminal and connect clip to chassis at one of the screws with tie wire securing the cover in place on the Voltage Regulator. Identify MEGOHM MULTIPLIER control and position to the 100 position. Identify the HIGH VOLTAGE connection and connect test lead for use in subsequent paragraphs.

CAUTION: The Insulation Tester must be connected and operated in accordance with the following procedures to insure accurate testing and adequate protection to the equipment under test. Under no circumstances should the probes be connected to any point other than that specifically directed in the procedures given. In all cases the GROUND lead clip must be connected to the chassis of the unit being tested, (hardware securing cover on Voltage Regulator).

(b) Identify HIGH VOLTAGE clip lead and connect to terminal A, GENERATOR FIELD, on Voltage Regulator. GROUND switch is in the METERED RETURN position. Identify HIGH VOLTAGE CIRCUIT—ENERGIZE switch and operate to the ON position, red HIGH VOLTAGE lamp will light. Identify VOLTAGE ADJUST control and rotate clock-

wise until KILOVOLTS meter indicates .5 KILOVOLT (500 volts). Note reading of the MEGOHM-METER and multiply by the KILOVOLTS meter reading multiplied by the multiplying factor of 1, multiplied by the MEGOHMS MULTIPLIER to obtain reading in Megohms. Return VOLTAGE ADJUST control to the extreme counter-clockwise position and place the HIGH VOLTAGE CIRCUIT—ENERGIZE switch in the OFF position. Disconnect the HIGH VOLTAGE test lead from the unit after metering indicates voltage has dropped to zero. Isolation of terminal A on Voltage Regulator to chassis ground must measure 10,000 megohms, minimum.

(c) Repeat procedures of paragraph (b) connecting HIGH VOLTAGE clip lead to terminal B, VOLTAGE SENSE (Regulation Point on Bus), on Voltage Regulator. Isolation of terminal B on Voltage Regulator to chassis ground must measure 10,000 megohms, minimum.

(d) Repeat procedures of paragraph (b) connecting HIGH VOLTAGE clip lead to terminal C, GENERATOR POSITIVE, on Voltage Regulator. Isolation of terminal C on Voltage Regulator to chassis ground must measure 10,000 megohms, minimum.

(e) Repeat procedures of paragraph (b) connecting HIGH VOLTAGE clip lead to terminal D, EQUALIZER SENSE ("D" terminal of Generator) on Voltage Regulator. Isolation of terminal D on Voltage Regulator to chassis ground must measure 10,000 megohms, minimum.

(f) Repeat procedures of paragraph (b) connecting HIGH VOLTAGE clip lead to terminal G, GROUND (Generator Negative), on Voltage Regulator. Isolation of terminal G on Voltage Regulator to chassis ground must measure 10,000 megohms, minimum.

(g) Repeat procedures of paragraph (b) connecting HIGH VOLTAGE clip lead to terminal K, on Voltage Regulator. Isolation of terminal K on Voltage Regulator to chassis ground must measure 10,000 megohms, minimum.

(h) Place POWER switch on the Insulation Tester in the OFF position and disconnect Insulation Tester before proceeding with subsequent performance testing.

(2) Connect the voltmeter across the positive and negative, terminals B and E of the generator, respectively. Set voltmeter to the range required to measure 0 to 30 volts DC.

(3) Connect the Paralleling Test Set, comprised of a polarity reversing switch and appropriate interconnect wiring to an auxiliary power supply to terminal D on the generator and the equalizer bus or pin F of regulator. Set the three position, POSITIVE-OFF-NEGATIVE, switch to the OFF position.

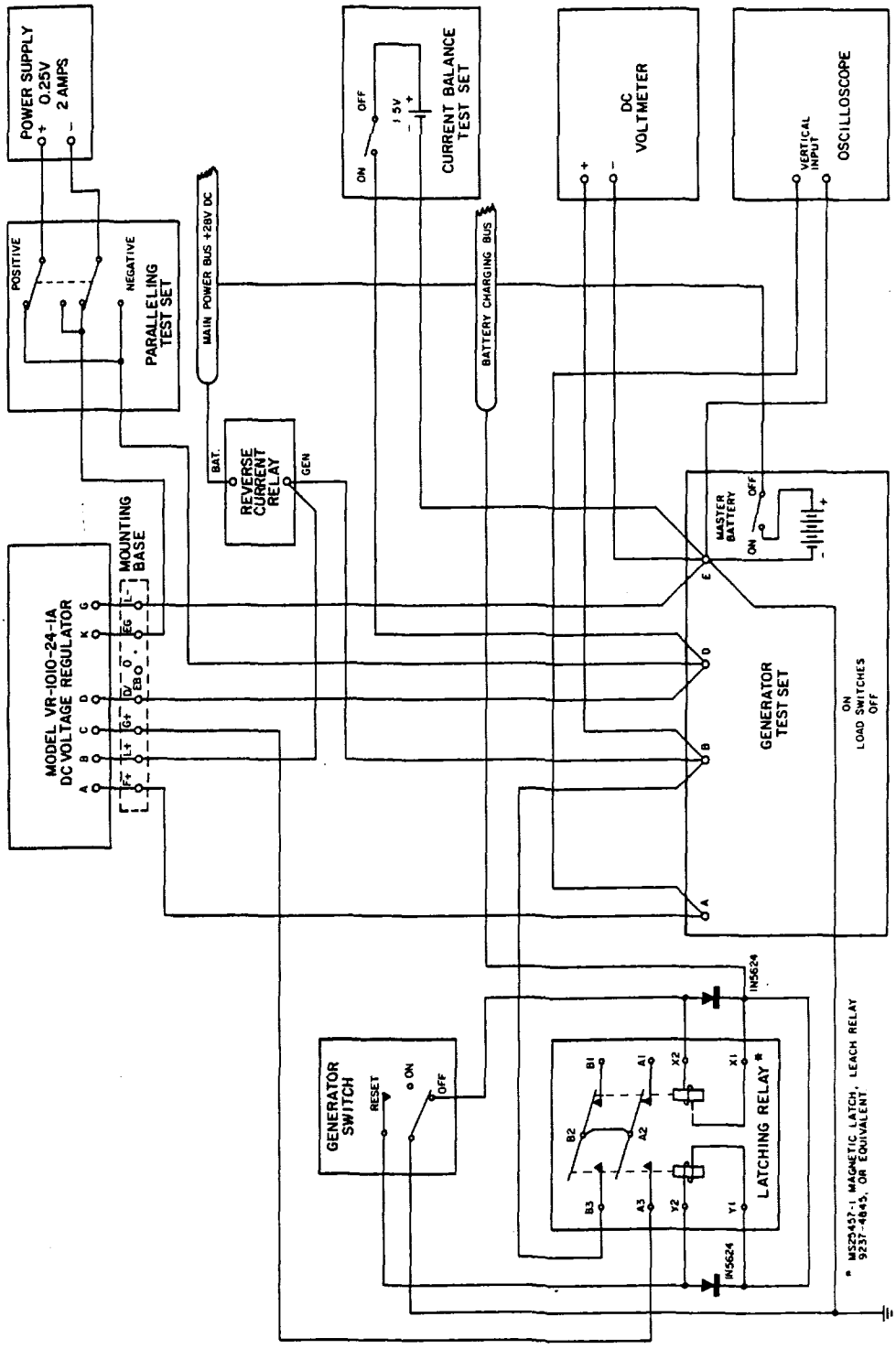
(4) Connect a DC power supply capable of supplying 0.25 volts DC at 2.0 amperes to the input terminals of the Paralleling Test Set. Set output level of supply to 0.25 volts using meter on supply or an accurate voltmeter.

(5) Connect the Current Balance Test Set, comprised of a −1.5 volt DC source and a single pole single throw (ON-OFF) switch, to terminals D and E on the generator. Set the switch on the Current Balance Test Set the OFF position. Check voltage source for accuracy with a suitable meter.

(6) Connect the oscilloscope to terminals A and E on the generator.

D. Performance Test.

The procedures of the performance test listed in numbered steps of Table 701 should be accomplished in the sequence presented. In the event the required result is not obtained, the trouble shooting section should be consulted and the malfunction corrected before proceeding to the next step.



Test Set-up, Model VR-1010-24-1A
DC Voltage Regulator
Figure 701

STEP	SET-UP	PROCEDURE	RESULT
1	Interconnect per Fig. 701 and para. 2.C., (2) Generator Test Set 'stopped' OFF.	(a) Apply power to all measuring equipment and auxiliary power supplies. (b) Check and set accuracy of the .025 volt and −1.5 volt DC sources.	
2	Generator Test Set load switches, and Master Battery switch in OFF positions. Paralleling Test Set, and Current Balance Test switches in their OFF position. Overvoltage Test Set switch in the NORMAL position.	Start Generator Test Set and run speed up to MID-RANGE (approx. 6,000 RPM).	Voltmeter across output indicates regulated voltage at point of regulation on the DC bus. Standard factory setting is 28.5 volts DC after final test.
3	Generator Test Set operating at MID-RANGE (6,000 RPM), Master Battery switch, Paralleling Test Set, and Current Balance Test Set switches in their OFF position. Overvoltage Test Set switch in the NORMAL position.	(a) Operate Generator Test Set LOAD switches to apply a 100 per cent load. (b) Identify the Voltage Set potentiometer, INCREASE, under plug button on the regulator. (c) Using a 5/16 inch hollow shaft nut driver, loosen adjustment locking nut. (d) Using a small screwdriver, approximately 1/8 inch blade, rotate slotted control shaft and set voltage to 28.0 volts DC prior to performing subsequent tests.	Voltmeter indicates regulated voltage point, and adjustment limits. Point of regulation as set becomes reference for subsequent tests. Voltmeter indicates 28.0 volts DC and becomes reference for subsequent tests.
4	Generator Test Set operating at MID-RANGE (approx. 6,000 RPM), Master Battery switch, Paralleling Test Set and Current Balance Test Set switches in their off position. Overvoltage Test Set switch in the NORMAL position.	Operate Generator Test Set Load switches to apply a 50 per cent load.	Voltmeter reading should not vary by an amount greater than plus or minus 0.2 volt from regulation point. Ammeter on Generator Test Set indicates a current equal to 50 per cent of generator full load current rating (typically 200 amperes).
5	Generator Test Set operating at MID-RANGE (approx. 6,000 RPM). Master Battery switch, Paralleling Test Set and Current Balance Test Set switches in their off position. Overvoltage Test Set switch in the NORMAL position.	Operate Generator Test Set Load switches to apply a 100 per cent load.	Voltmeter readings should not vary by an amount greater than plus or minus 0.2 volt from regulation point. Ammeter on Generator Test Set indicates a current equal to 100 per cent of generator full load current rating (typically 400 amperes).

STEP	SET-UP	PROCEDURE	RESULT
6	Generator Test Set operating at MID-RANGE (approx. 6,000 RPM), Paralleling Test Set and Current Balance Test Set switches in their OFF Position. Overvoltage Test Set switch in the NORMAL position. Load switches in 100 per cent Load position.	Close Master Battery switch placing battery across generator output.	Voltmeter reading should be stable at regulation point.
7	RANGE (approx. 6,000 RPM), Paralleling Test Set and Current Balance Test Set switches in their OFF position. Overvoltage Test Set switch in the NORMAL position. Load switches in 100 per cent load position and Master Battery switch ON.	(a) Place Master Battery switch to the OFF position removing battery from circuit. (b) Operate Generator Test Set Load switches to disconnect all load. (c) Increase Generator Test Set speed to HIGH RANGE (approx. 8,000 RPM).	Voltmeter reading should not vary by an amount greater than plus or minus 0.2 volt from regulation point.
8	Generator Test Set operating at HIGH RANGE (approx. 8,000 RPM). Master Battery, Paralleling Test Set, and Current Balance Test Set switches in their OFF Position. Overvoltage Test Set switch in the NORMAL position.	Operate Generator Test Set Load switches to apply a 50 per cent load.	Voltmeter reading should not vary by an amount greater than plus or minus 0.2 volt from regulation point. Ammeter on Generator Test Set indicates a current equal to 100 per cent of generator full load current rating (typically 200 amperes).
9	Generator Test Set operating at HIGH RANGE (approx. 8,000 RPM), Master Battery, Paralleling Test Set and Current Balance Test Set switches in their OFF Position. Overvoltage Test Set in the NORMAL position.	Operate Generator Test Set Load switches to apply a 100 per cent load.	Voltmeter reading should not vary by an amount greater than plus or minus 0.2 volt from regulation point. Ammeter on Generator Test Set indicates a current equal to 100 per cent of generator full load current rating (typically 400 amperes).
10	Generator Test Set operating at HIGH RANGE (approx. 8,000 RPM), Master Battery, Paralleling Test Set and Current Balance Test Set switches in their OFF Position, Overvoltage Test Set in the NORMAL position.	(a) Operate Generator Test Set Load switches to disconnect all load. (b) Decrease Generator Test Set speed to LOW RANGE (approx. 4,500 RPM) by braking.	Voltmeter reading should not vary by an amount greater than plus or minus 0.2 volt from regulation point.

Performance Test Procedure
Table 701 (Sheet 3 of 5)

STEP	SET-UP	PROCEDURE	RESULT
11	Generator Test Set operating at LOW RANGE (approx. 4,500 RPM) Master Battery, Paralleling Test Set and Current Balance Test Set switches in their OFF position. Overvoltage Test Set in the NORMAL position.	Operate Generator Test Set Load switches to apply a 50 per cent load.	Voltmeter reading should not vary by an amount greater than plus or minus 0.2 volt from regulation point. Ammeter on Generator Test Set indicates a current equal to 50 per cent of generator full load current rating (typical 200 amperes).
12	Generator Test Set operating at LOW RANGE (approx. 4,500 RPM) Master Batter, Paralleling Test Set and Current Balance Test Set switches in their OFF position. Overvoltage Test Set in the NORMAL position.	Operate Generator Test Set Load switches to apply a 100 per cent load.	Voltmeter reading should not vary by an amount greater than plus or minus 0.2 volt from regulation point. Ammeter on Generator Test Set indicates a current on Generator Test Set indicates a current equal to 100 per cent of generator full load current rating (typical 400 amperes).
13	Generator Test Set operating at LOW RANGE (approx. 4,500 RPM) Master Battery, Paralleling Test Set, and Current Balance Test Set switches in their OFF position. Overvoltge Test Set in the NORMAL position.	Operate Generator Test Set Load switches to disconnect load.	Voltmeter reading should not vary by an amount greater than plus or minus 0.2 volt from regulation point.
14	Generator Test Set load switches, and Master Battery Switch in OFF position. Paralleling Test Set, and Current Balance Test switches in their OFF position. Overvoltage Test Set switch in the NORMAL position.	Start Generator Test Set and run speed up to MID-RANGE (approx. 6,000 RPM).	Voltmeter across output indicates regulated voltage at point of regulation on the DC bus.
15	Generator Test Set operating at MID-RANGE (6,000 RPM), Master Battery switch, Paralleling Test Set, and Current Balance Test Set switches in their OFF position. Overvoltage Test Set switch in the NORMAL position.	(a) Operate Generator Test Set LOAD switches to apply a 100 per cent load. (b) Identify the Voltage Adjustment control adjacent to connector J1 on the regulator. (c) Using a 5/16 inch hollow shaft nut driver, loosen adjustment locking nut. (d) Using a small screwdriver, approximately 1/8 inch blade, rotate slotted control shaft and set voltage to 28.5 volts DC.	Voltmeter indicates 28.5 volts DC and returns unit to factory setting of 28.5 volts DC.

STEP	SET-UP	PROCEDURE	RESULT
16	Generator Test Set operating at LOW RANGE (approx. 4,500 RPM) Master Battery, Paralleling Test Set, and Current Balance Test Set, switches in their OFF position. Overvoltage Test Set in the NORMAL position.	(a) Operate Paralleling Test Set switch to NEGATIVE position applying the positive 0.25 volts DC to the equalizer bus, pin F, connector J1 of the regulator and the negative 0.25 volts DC to terminal D of the Generator Test Set. (b) Return Paralleling Test Set switch to center OFF position.	Voltmeter reading should decrease by at least 2.5 volts.
17	Generator Test Set operating at MID-RANGE (approx. 4,500 RPM), Master Battery switch, Paralleling Test Set, and Current Balance Test Set, switches in their OFF position. Overvoltage Test Set switch in the NORMAL position.	(a) Operate Generator Test Set Load switches to apply 100 per cent load. (b) Operate Paralleling Test Set switches to NEGATIVE applying the positive 0.25 volts DC to equalizer bus, contact K, of the regulator and the negative 0.25 volts DC to terminal D of the Generator Test Set. (c) Return Paralleling Test Set switch to center OFF position. (d) Operate Generator Test Set Load switches to disconnect load.	Voltmeter reading should decrease by at least 2.5 volts.
18	Generator Test Set operating at LOW RANGE approx. 4,500 RPM), Master Battery switch, Paralleling Test Set, and Current Balance Test Set switches in their OFF position. Overvoltage Test Set switch in the NORMAL Position. Generator Test Set Load switches set to NO LOAD positions.	(a) Operate Paralleling Test Set switch to POSITIVE applying the negative 0.25 volts DC to equalizer bus, contact K, of the regulator and the positive 0.25 volts DC to terminal D of the Generator Test Set. (b) Return Paralleling Test Set switch to center OFF position.	Voltmeter reading should increase by at least 2.5 volts.

STEP	SET-UP	PROCEDURE	RESULT
19	Generator Test Set operating at LOW RANGE (approx. 4,500 RPM), Master Battery switch, Paralleling Test Set, and Current Balance Test Set, switches in their OFF position. Overvoltage Test Set switch in the NORMAL position.	(a) Operate Generator Test Set Load switches to apply 100 per cent load. (b) Operate Paralleling Test Set switches to POSITIVE applying the negative 0.25 volts DC to equalizer bus, contact K, of the regulator and the positive 0.25 volts DC to terminal D of the Generator Test Set. (c) Return Paralleling Test Set switch to center OFF position.	Voltmeter reading should increase by at least 2.5 volts.
20	Generator Test Set operating at LOW RANGE (approx. 4,500 RPM) Master Battery switch, Paralleling Test Set, and Current Balance Test Set, switches in their OFF position. Overvoltage Test Set switch in the NORMAL position. Generator Test Set Load switches set to 100 per cent load.	(a) Operate Current Balance Test Set switch to ON position applying the negative 1.5 volts to terminal D of the Generator Test Set and the positive 1.5 volts to terminal E of the Generator Test Set. (b) Return Current Balance Test Set switch to the OFF position. (c) Operate Generator Test Set Load switches to disconnect Load.	Voltmeter should not indicate a change greater than ±0.15 volts.

TROUBLE SHOOTING

1. GENERAL.

This section outlines in tabular form information for use in localization and isolation of trouble in the Model VR-1010-24-1A DC Voltage Regulator. The trouble shooting procedures, Table 801, together with the information given in preceding section on Testing will in most cases localize and isolate the trouble. Reference to the schematic diagram, Fig. 1201, and the section on Detailed Theory will be necessary and helpful. The voltage measurements of Table 802 in conjunction with the waveforms illustrated in Fig. 801 will aid in isolation of trouble.

2. TROUBLE SHOOTING.

A. Localization.

The trouble shooting table, Table 801, provides a means of localizing malfunctions to a replaceable component or sub-assembly. The table is arranged in the same order of precedence as the performance test, Table 701, in the preceding section. The applicable step of the performance test is shown in parentheses next to the trouble shooting step in the STEP column, in Table 801.

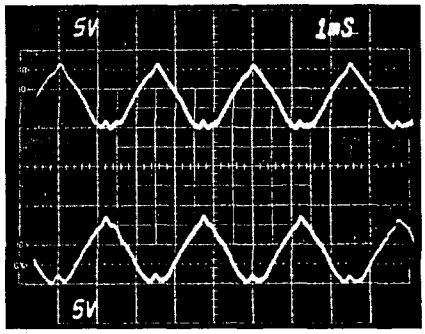
B. Isolation.

The voltage measurements of Table 802 are made using the voltohmmeter described in the Special Tools section of this manual. Reference to the schematic diagram, Fig. 1201, while making voltage measurements will aid in isolation of trouble within the unit.

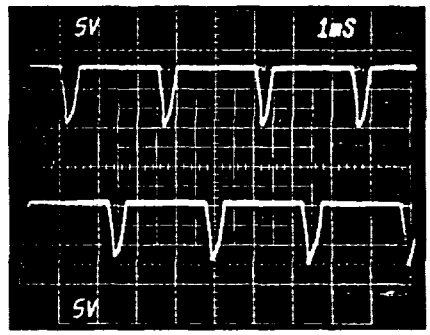
C. Analysis.

The waveforms pictured in Fig. 801 were made using the oscilloscope described in the Special Tools section of this manual, and will aid in analyzing the equipment performance when trouble shooting procedures are being performed.

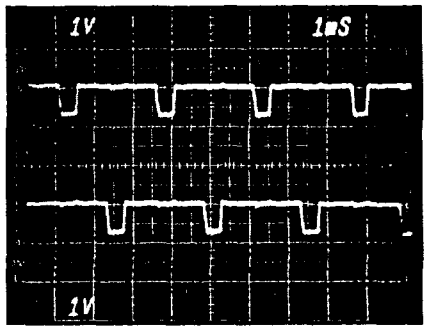
STEP	SYMPTOM	PROBABLE CAUSE	CHECK	REMEDY
1	Generator voltage continues to increase.	Relay K1 failed to open, defective transistor Q14, Zener diode ZR3 or diode CR8.	Check transistor Q14, zener diode ZR3, diode CR8, or relay K1.	Replace defective component.
2	Generator output voltage zero, erratic regulation, or erratic paralleling operation.	Open or defective wiring at contactor/base of regulator or at generator terminals.	Continuity of input/output wiring at contactor/base and generator.	Repair or replace. Clean and burnish contacts carefully.
3	Generator output voltage increases to 20 volts and starts dropping to zero causing relay chatter.	Defective drive signal.	Check operation of oscillator transistor Q8 and Q9, and following stages of shaping and amplification, transistors Q1 through Q7.	Replace defective component.
4	Generator output voltage control adjustment on regulator, resistor R35, out of limits.	Defective reference in voltage comparator circuit.	Check zener diode ZR2, resistors R35, R28 and R29, diodes CR5, CR6, and CR7, and transistor Q12.	Replace defective component.
5	Generator will not operate in parallel service within specifications.	Defective reference in current comparator circuit.	Check resistors R26 and R27, and transistor Q11.	Replace defective component.
6	Generator (hunts) voltage rises and falls erractically.	Defective time constant in voltage regulator circuit.	Check capacitors C4 and C5 and zener diode ZR1.	Replace defective component.



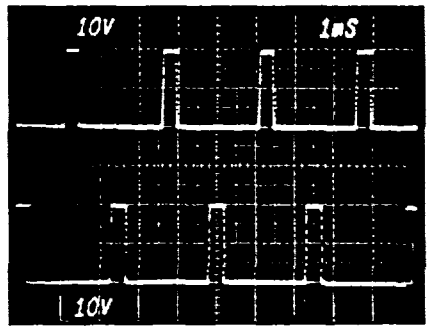
A. WAVEFORMS AT BASE OF TRANSISTORS Q1 AND Q2 GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM), 100 AMP LOAD
VERTICAL SENSITIVITY: 5.0 VOLTS/DIVISION
TIME BASE: 1.0 MILLISECONDS/DIVISION



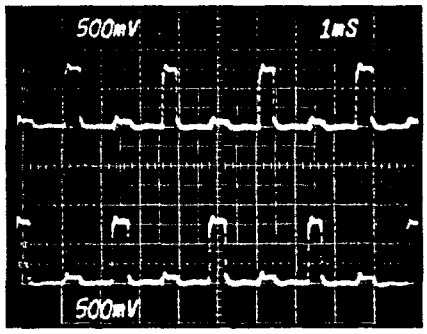
B. WAVEFORMS AT COLLECTOR OF TRANSISTORS Q1 AND Q2 GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM), 100 AMP LOAD
VERTICAL SENSITIVITY: 5.0 VOLTS/DIVISION
TIME BASE: 1.0 MILLISECONDS/DIVISION



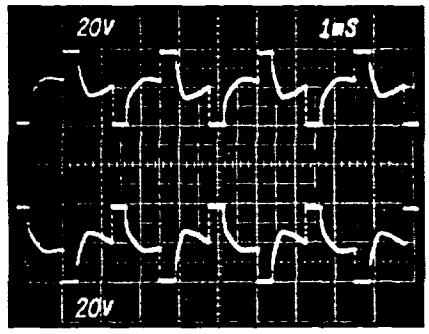
C. WAVEFORMS AT BASE OF TRANSISTORS Q3 AND Q4 GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM), 100 AMP LOAD
VERTICAL SENSITIVITY: 1.0 VOLTS/DIVISION
TIME BASE: 1.0 MILLISECONDS/DIVISION



D. WAVEFORMS AT COLLECTOR OF TRANSISTORS Q3 AND Q4 GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM), 100 AMP LOAD
VERTICAL SENSITIVITY: 10.0 VOLTS/DIVISION
TIME BASE: 1.0 MILLISECONDS/DIVISION

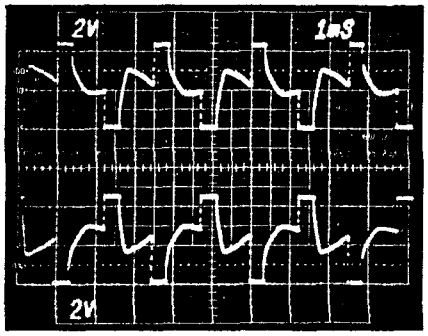


E. WAVEFORMS AT BASE OF TRANSISTORS Q5 AND Q6 GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM), 100 AMP LOAD
VERTICAL SENSITIVITY: 0.5 VOLTS/DIVISION
TIME BASE: 1.0 MILLISECONDS/DIVISION

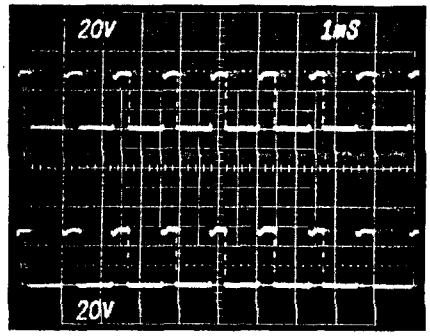


F. WAVEFORMS AT COLLECTOR OF TRANSISTORS Q5 AND Q6 GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM), 100 AMP LOAD
VERTICAL SENSITIVITY: 20.0 VOLTS/DIVISION
TIME BASE: 1.0 MILLISECONDS/DIVISION

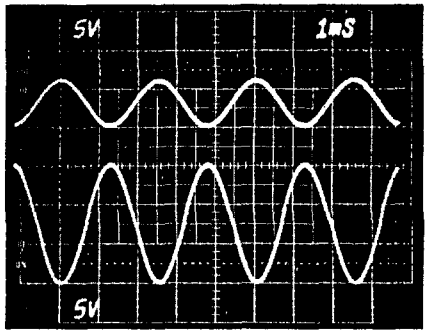
Waveform Measurements, Model VR-1010-24-1A,
DC Voltage Regulator
Figure 801 (Sheet 1 of 2)



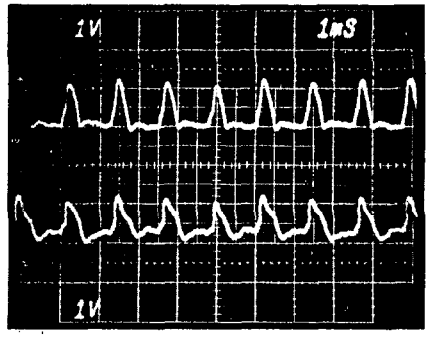
G. WAVEFORM AT INPUT TO DIODE CR2, TOP; WAVEFORM AT INPUT TO DIODE CR3, BOTTOM; REFERENCED TO CENTER TAP OF TRANSFORMER T2, GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM), 100 AMP LOAD
VERTICAL SENSITIVITY: 2.0 VOLTS/DIVISION
TIME BASE: 1.0 MILLISECONDS/DIVISION



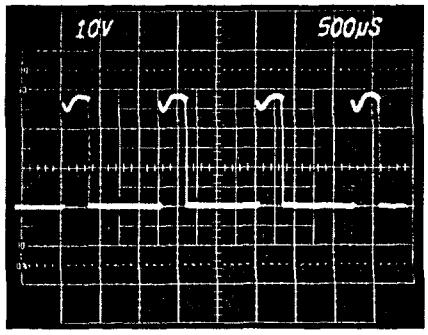
H. WAVEFORM AT JUNCTION OF DIODES CR2 AND CR3, TOP: WAVEFORM AT BASE OF TRANSISTOR Q7, BOTTOM; GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM), 100 AMP LOAD
VERTICAL SENSITIVITY: 20. VOLTS/DIVISION
TIME BASE: 1.0 MILLISECONDS/DIVISION



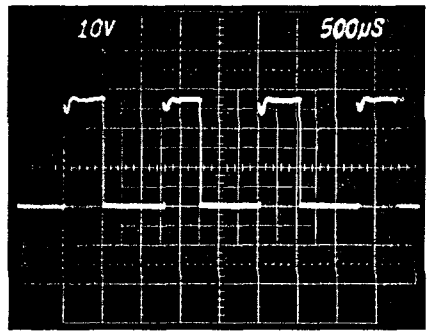
I. WAVEFORM AT BASE OF TRANSISTOR Q8, TOP: WAVEFORM AT COLLECTOR OF TRANSISTOR Q8, BOTTOM; GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM), 100 AMP LOAD
VERTICAL SENSITIVITY: 5.0 VOLTS/DIVISION
TIME BASE: 1.0 MILLISECONDS/DIVISION



J. WAVEFORM AT EMITTER OF TRANSISTORS Q1 AND Q2, TOP: WAVEFORM AT COLLECTOR OF TRANSISTOR Q10, BOTTOM; GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM), 100 AMP LOAD
VERTICAL SENSITIVITY: 1.0 VOLTS/DIVISION
TIME BASE: 1.0 MILLISECONDS/DIVISION

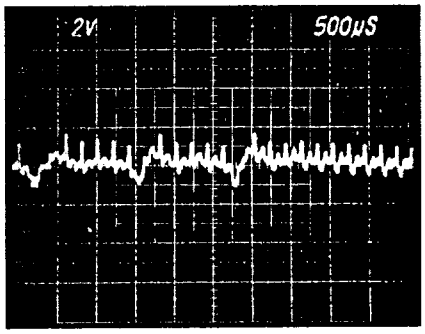


K. WAVEFORM AT TERMINAL A, GENERATOR FIELD, SWITCHING-WAVEFORM NO-LOAD, GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM)
VERTICAL SENSITIVITY: 10.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION

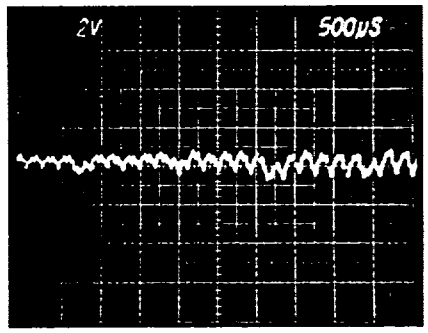


L. WAVEFORM AT TERMINAL A, GENERATOR FIELD, SWITCHING WAVEFORM FULL-LOAD; GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM)
VERTICAL SENSITIVITY: 10.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION

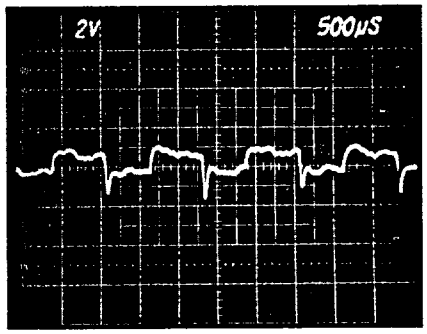
Waveform Measurements, Model VR-1010-24-1A,
DC Voltage Regulator
Figure 801 (Sheet 2 of 3)



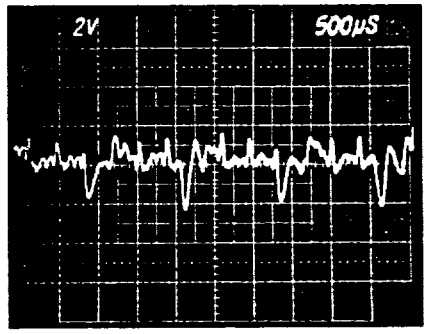
M. WAVEFORM AT TERMINAL C, GENERATOR +, REGULATOR SWITCHED IN, NO-LOAD GENERATOR OPERATING AT HIGH RANGE (APPROX. 8,000 RPM)
VERTICAL SENSITIVITY: 2.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



N. WAVEFORM AT TERMINAL C, GENERATOR +, REGULATOR SWITCHED IN, FULL-LOAD, GENERATOR OPERATING AT HIGH RANGE (APPROX. 8,000 RPM)
VERTICAL SENSITIVITY: 2.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



O. WAVEFORM AT TERMINAL C, GENERATOR +, FULL-LOAD, REGULATOR SWITCHED IN, GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM)
VERTICAL SENSITIVITY: 2.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



P. WAVEFORM AT TERMINAL C, GENERATOR +, NO-LOAD, REGULATOR SWITCHED IN, GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM)
VERTICAL SENSITIVITY: 2.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION

Waveform Measurements, Model VR-1010-24-1A,
DC Voltage Regulator
Figure 801 (Sheet 3 of 3)

VR-1010-24-1A/P.N. 095001

TRANSISTOR	BASE	COLLECTOR	EMITTER
Q1	5.40V	20.30V	*8.20V
Q2	5.40V	20.30V	*8.20V
Q3	20.76V	2.20V	20.90V
Q4	20.76V	2.20V	20.90V
Q5	0.07V	20.70V	0.00V
Q6	0.07V	20.70V	0.00V
Q7	5.80V	27.90V	**6.00V
Q8	2.10V	20.80V	3.34V
Q9	2.10V	20.80V	3.34V
Q10	11.30V	5.40V	11.79V
Q11	1.90V	6.90V	1.20V
Q12	6.90V	11.30V	6.30V
Q13	7.20V	14.20V	6.50V
Q14	***0.64V	***0.06V	***0.00V

TEST POINT	VOLTAGE
Terminal B on regulator (Regulation point on Bus)	28.00V
Terminal C on regulator (Generator + terminal)	28.00V
Junction of Zener diode Z1, resistor R14, and capacitor C5	20.91V

NOTES: Voltage measurements with Triplett VOM Model 800 or equivalent.

All voltages are DC.

Voltage measurements between referenced point and terminal G of regulator (Generator ground terminal).

Regulator adjusted for 28.0 volts regulated output.

Regulator connected generator test set and operating at or above minimum rated generator speed, (6,000 RPM).

*Voltage measurement at emitter will vary with load. Measured value applies to operating regulator on generator test set with 100% load.

**Voltage measurement at this point will vary with DC load on system approximately 4 to 1.

***Voltage measurements at these points taken with Relay K1 energized.

Voltage Measurements, Model VR-1010-24-1A
DC Voltage Regulator
Table 802

VR-1010-24-1A/P.N. 095001

STORAGE INSTRUCTIONS

1. GENERAL.

This section provides information preparing the Model VR-1010-24-1A DC Voltage Regulator, for use from a shipped or stored condition and for packing the unit for storage or shipment.

2. PREPARATION FOR USE.

The Voltage Regulator, when shipped from the factory, is wrapped in cellulose wadding, PPP-C-843, and inserted in a poly bag, LP-278, and enclosed in a corrugated shipping carton, PPP-B-636. To unpack the unit, cut sealing tape and open top of carton by lifting flaps to break adhesive. Remove unit from carton, remove poly bag and cellulose wadding. Visually examine the unit for damage which might have occurred during shipment or storage.

3. PREPARATION FOR STORAGE OR SHIPMENT.

The Voltage Regulator may be stored for short periods of time without packing. If the unit is to be stored for extended periods or is to be shipped, carefullly wrap unit with cellulose wadding, insert in poly bag and place equipment in a corrugated carton. The carton should then be sealed and labeled for storage.

SPECIAL TOOLS, FIXTURES, AND EQUIPMENT

1. GENERAL.

This section provides information on the special tools and test equipment required for overhaul of the Model VR-1010-24-1A, DC Voltage Regulator.

2. STANDARD TEST EQUIPMENT.

Listed in Table 1001 are the items of standard test equipment required for overhaul of the voltage regulator. The listed item or a suitable equivalent may be used if procedures are modified when references to test equipment and setting of test equipment are made.

EQUIPMENT	MANUFACTURER AND MODEL NUMBER
GENERATOR TEST SET	SUN AGT-2 OR EQUIVALENT
OSCILLOSCOPE	HEWLETT-PACKARD MODEL 132A
VOLTOHMMETER	TRIPLETT ELECT. INST. MODEL 800, OR EQUIVALENT. or JOHN FLUKE MODEL 8040A, OR EQUIVALENT.
GENERATOR	PER MIL-G-6162 or EQUIVALENT.
INSULATION RESISTANCE TESTER	ASSOCIATED RESEARCH MODEL 2956

Standard Test Equipment
Table 1001

3. SPECIAL TEST EQUIPMENT.

None required.

VR-1010-24-1A/P.N. 095001

ILLUSTRATED PARTS CATALOG SECTION

1. INTRODUCTION.

This section of the Overhaul Manual provides a complete listing of parts for the Model VR-1010-24-1A DC Voltage Regulator (Solid-State Silicon), as manufactured by Phoenix Aerospace, Inc.

2. PURPOSE.

The information contained in this section is supplied to aid in provisioning, requisitioning, storing, and issuing of the replaceable parts, and to aid in identification of new and reclaimed parts.

3. APPLICATION.

The Illustrated Parts Catalog Section contains three separate listings; Numerical Index, Symbol Index, and Detailed Parts List. The subsequent paragraphs define the content and application of each listing.

A. Numerical Index.

The Numerical Index provides an alpha-numerical listing of the parts listed in the Detailed Parts List. The prime function being to aid in rapid location using the information contained in the various columns.

(1) Part Number Column.

The PART NUMBER column lists part numbers of procurable parts and assemblies as listed in the Detailed Parts List. Parts are listed in alpha-numerical order of precedence starting at the first letter extreme left and reading to the right as follows:

Letters A through Z
Numeral 0 through 9
(Alphabetical 0's are considered as Numerical zeros).

Second and succeeding positions of the part number appear in the order of precedence as follows:

Space (Blank column)
Diagonal (Slant) /
Point (Period)
Dash (-)
Letters A through Z
Numerical 0 through 9
(Alphabetical 0's are considered as numerical zeros).

(2) Airline Part Number Column.

The AIRLINE PART NO. Column is provided to allow insertion where applicable, of the users own part number where available and desired.

(3) Chapter-Section-Unit-Figure-Item Column.

The CH-SECT-UNIT-FIG-ITEM column contains the specific location data where the listed part first appears in the Detailed Parts List and other pertinent data. Example: 24-20-X-1101-18 is indicative of the following:

24 is significant of the Chapter (derived from system identification numbers).
20 is significant of the Section (derived from sub-system identification numbers).
X is significant of the Unit (derived from the application of particular unit).
1101 is significant of the Figure number.
18 is significant of the Item number.

(4) Total Required Column.

The TTL REQ. Column is the total of each item required in the unit whether it be piece part or sub-assembly.

B. Symbol Index.

The Symbol Index enables the location of component parts referenced from the schematic diagram by the reference symbol to a specific Figure and Item number.

(1) Symbol Column.

The SYMBOL column contains an alpha-numerical listing of every component part which carries a reference symbol on the schematic diagram.

(2) Part Number Column.

The PART NUMBER column lists the vendor part number of the symbolized item.

(3) Chapter-Section-Unit-Figure-Item Column./a

The CH-SECT-UNIT-FIG-ITEM column contains the specific location data where the listed part first appears in the Detailed Parts List and other pertinent data. Example: 24-20-X-1101-18 is indicative of the following:

C. Detailed Parts List.

The Detailed Parts List, is a breakdown of the complete unit into sub-assemblies and detailed parts. Each sub-assembly is listed in its order of disassembly and is followed immediately by its component parts properly indented to show its relationship to the assembly.

(1) Figure Item Column.

The FIG. ITEM Column entries key the parts breakdown to the applicable illustration. Items numbered on the Detailed Parts List preceded by a dash (example -1) do not appear on the illustration.

(2) Part Number Column.

The PART NUMBER column lists the applicable Standard part number MS, AN, NAS, etc., vendor part number or Phoenix Aerospace, Inc. part numbers. When more than one part number is assigned to an item the preference shall be Standard MS, AN, NAS, Etc., vendor, or Phoenix Aerospace, Inc., in that order. Vendor part numbers listed in the PART NUMBER Column are subject to change without notice.

(3) Nomenclature Column.

The NOMENCLATURE column describes the assembly, sub-assembly, or component part in a short form description, with the identifying Noun as the first word, followed by the modifiers as required. The indentations denote parts relation to next higher assembly (NHA) or sub-assembly, as applicable. The ATTACHING PARTS entries are listed immediately following the component which they attach.

If a part is purchased by Phoenix Aerospace, Inc. from a vendor, the Federal Supply Code number, preceded by the letter V, is listed in this column, and set off by parentheses. The vendors part number appears in the PART NUMBER column and the Phoenix Aerospace, Inc. part number follows the vendor, FSC number, and is set off in parentheses. If a part number of FSC number does not appear in the NOMENCLATURE column the part number listed in the PART NUMBER column is a Phoenix Aerospace, Inc. number.

(4) Effect From To Column.

The EFFECT FROM TO column provides for entries regarding usage on different models or for field service bulletin entries as applicable. If this column is left blank, parts apply to all models until otherwise noted by revision.

(5) Units Per Assembly Column.

The UNITS PER ASSY Column lists the quantity of sub-assemblies or parts required in the next higher assembly (NHA). The quantities specified, therefore, are not necessarily the total used per equipment. The letters RF denote that the item listed appears on another list and illustration and is referenced for aid in identification only.

4. VENDOR FEDERAL SUPPLY CODE AND NAME INDEX.

The following list is derived by extraction from the Federal Supply Catalog Handbook H4-1. The information is supplied to aid in procurement and identification of the various vendors.

FSC NO. OR CODE	VENDORS NAME AND ADDRESS
01121	Allen Bradley Co. 1201 South 2nd St. Milwaukee, Wisconsin 53204
05277	Westinghouse Electric Corp. Semiconductor Div. Armbrust Road Youngwood, PA 15697
08530	Reliance Mica Corp. 342 39th Street Brooklyn, NY 11232
09214	General Electric Co. Semiconductor Products Dept. Power Semiconductor Products Opn. Sec. W. Genesee St. Suburn, NY 13021
11502	TRW Electronic Components IRC Fixed Resistors Greenway Road Boone, NC 28607
13715	Fairchild Semiconductor, a Div. of Fairchild Camera and Instrument Corp 4300 Redwood Highway San Rafael, CA 94903
14552	Microsemiconductor Corp. 2830 S. Fairview Street Santa Ana, CA 92704
24444	General Semiconductors Industries, Inc. 230 W. 5th Street P. O. Box 3078 Tempe, AZ 85281
25088	Siemens Corp. 186 Wood Ave. S Iselin, NJ 08830
27556	IMB Electronic Products Inc. 15401 E. Carmenita Road Santa Fe Springs, CA 90670
28520	Heyman Manufacturing Co. 147 N. Michigan Ave. Kenilworth, NJ 07033
29632	Phoenix Aerospace, Inc. 1022 South 23rd Street P. O. Box 20804 Phoenix, AZ 85036
44655	Ohmite Manufacturing Co. 3601 W. Howard Street Skokie, IL 60076
56289	Sprague Electric Co. Beaver Street North North Adams, MA 01247
71785	Cinch Mfg. Co., Div. of United Carr-Fastener Corp. Chicago, IL

4. VENDOR FEDERAL SUPPLY CODE AND NAME INDEX. (cont).

FSC NO. OR CODE	VENDORS NAME AND ADDRESS
75042	TRW Electronic Components IRC Fixted Resistors Philadelphia Division 401 N. Broadstreet Philadelphia, PA 19108
78290	Struthers-Dunn Pitman, NJ
83108	Teledyne-Ansonia A Div. of Teledyne Mid-America Corp. One Riverside Drive P. O. Box 67 Ansonia, CT 06041
83827	Resistors, Inc. 5228 W. 26th Street Chicago, IL 60650
84411	TRW Electronic Components TRW Capacitors 112 W. First Street Ogallala, NE 69153
86928	Seastrom Mfg. Co. Inc. 701 Sonova Ave. Glendale, CA 91201
88245	USECO Div., Litton Ind. 13536 Saticoy Street Van Nuys, CA 91409
91418	Radio Materials Company 4242 W. Bryn Mawr Chicago, IL 60646
91637	Dale Electronics, Inc. P. O. Box 609 Columbus, NE 68601
91833	Electronic Essentials, Inc. 210 Elizabeth Street New York City, NY 10012

PART NUMBER	AIRLINE PART NUMBER	CH-SECT-UNIT-FIG-ITEM	TTL REQ.
AN515C4-28		24 -30 -X 1102 - 2	4
AN520UB6-8		24 -30 -X 1102 -25	2
AN960-C10L		24 -30 -X 1102 -20	1
AN960-C4		24 -30 -X 1102 -30A	1
AN960-C416L		24 -30 -X 1102 14	1
BWH .39		24 -30 -X 1103 35	1
BWH .47		24 -30 -X 1102 36	1
BWH 4.7		24 -30 -X 1102 10	1
DF3D		24 -30 -X 1102 -18A	1
DF6B		24 -30 -X 1102 -12	2
DF6C		24 -30 -X 1102 -18	2
FC-215		24 -30 -X 1102 32	1
GA2L040S252UL		24 -30 -X 1103 64	1
MS35233-13		24 -30 -X 1102 -41	1
			2
MS35233-15		24 -30 -X 1101 - 3	6
		- 5	2
		- 6	4
		-33	2
MS35233-21		24 -30 -X 1102 -29	1
MS35276A-216		24 -30 -X 1101 - 6	2
MS35333-70		24 -30 -X 1102 -6A	4
		-30	1
		-34	2
		-42	1
MS35333-73		24 -30 -X 1102 -21	1
MS35333-74		24 -30 -X 1102 -15	1
		-65	1
MS35649-44		24 -30 -X 1102 -6B	4
		-31	1
		-35	2
MS35649-204		24 -30 -X 1102 -22	1
MS35650-3254		24 -30 -X 1102 -16	1
M4721		24 -30 -X 1103 -66	1
M4748		24 -30 -X 1103 -65A	1
M4761		24 -30 -X 1103 -66A	1
RC20GF102K		24 -30 -X 1103 11	1
		12	1
		13	1
		14	1
		15	1

PART NUMBER	AIRLINE PART NUMBER	CH-SECT-UNIT-FIG-ITEM	TTL REQ.
RC20GF103K		24 -30 -X 1103 29	1
*RC20GF		24 -30 -X 1103 18A	1*
RC20GF152K		24 -30 -X 1103 18	1
RC20GF182K		24 -30 -X 1103 15A	1
*RC20GF		19B	1*
RC20GF200J		24 -30 -X 1102 9	1
RC20GF221K		24 -30 -X 1103 3	1
		4	1
RC20GF222K		24 -30 -X 1103 19	1
		20	1
RC20GF273K		24 -30 -X 1103 30	1
RC20GF330K		24 -30 -X 1103 2	1
RC20GF393K		24 -30 -X 1103 31	1
RC20GF471K		24 -30 -X 1103 6	1
		7	1
		8	1
RC20GF472K		24 -30 -X 1103 23	1
		24	1
		25	1
		26	1
		27	1
RC20GF511J		24 -30 -X 1103 16	1
		17	1
RC20GF681K		24 -30 -X 1103 10	1
RC20GF682K		24 -30 -X 1103 28	1
RN60D1302F		24 -30 -X 1103 34	1
RN60D2051F		24 -30 -X 1103 22	1
RN60D2802F		24 -30 -X 1103 32	1
		33	1
RN60D6040F		24 -30 -X 1103 9	1
RN60D6811F		24 -30 -X 1103 36	1
RN60D9090F		24 -30 -X 1103 5	1
R1A-10		24 -30 -X 1102 -19	1
R1C-14		24 -30 -X 1102 -13	1
SM.02±20%		24 -30 -X 1103 41	1
XA3359J		24 -30 -X 1102 38	1

-Item not illustrated
*Selected or optional

PART NUMBER	AIRLINE PART NUMBER	CH-SECT-UNIT-FIG-ITEM	TTL REQ.
026013		24 -30 -X 1103 -68	2
026014		24 -30 -X 1103 -69	1
031501		24 -30 -X 1102 - 5	1
038021		24 -30 -X 1102 43	1
043002		24 -30 -X 1102 28	1
043003		24 -30 -X 1103 67	1
048500		24 -30 -X 1103 44	1
		45	1
		46	1
		47	1
		48	1
		49	1
		50	1
048501		24 -30 -X 1103 51	1
		52	1
		53	1
048502		24 -30 -X 1103 54	1
		55	1
		56	1
048504		24 -30 -X 1102 24	1
058023		24 -30 -X 1103 1	1
066002		24 -30 -X 1101 8	1
067502		24 -30 -X 1101 - 7	1
070004		24 -30 -X 1102 - 3	4
080012		24 -30 -X 1102 4	1
088514		24 -30 -X 1101 4	1
095001		24 -30 -X 1101 -	RF
1N2984B		24 -30 -X 1102 17	1
1N3210		24 -30 -X 1102 11	1
1N3611		24 -30 -X 1103 37	1
1N4473		24 -30 -X 1103 63	1
1N4739A		24 -30 -X 1103 62	1
1N5624		24 -30 -X 1102 7	1
		8	1

PART NUMBER	AIRLINE PART NUMBER	CH-SECT-UNIT-FIG-ITEM	TTL REQ.
1N914B		24 -30 -X 1103 57	1
		58	1
		59	1
		60	1
		61	1
*10AX33		24 -30 -X 1102 37	1*
116004		24 -30 -X 1101 1	1
116005		24 -30 -X 1101 2	1
		1102 -	RF
116006		24 -30 -X 1102 1	1
		1103 -	RF
116052		24 -30 -X 1102 -44	1
150D105X9035A2		24 -30 -X 1103 42	1
150D226X9035R2		24 -30 -X 1103 43	1
3306-3/8-N		24 -30 -X 1102 27	1
41-C		24 -30 -X 1101 9	1
4602		24 -30 -X 1102 23	1
*4774		24 -30 -X 1102 37	1*
5610-122-062		24 -30 -X 1102 -12A	1
600D476F100DL4		24 -30 -X 1102 39	1
601PE .01		24 -30 -X 1103 38	1
601PE .022		24 -30 -X 1103 41A	1
601PE .047		24 -30 -X 1103 39	1
732-73YA		24 -30 -X 1102 026	1
756		24 -30 -X 1102 -40	1

-Item not illustrated
*Selected or optional

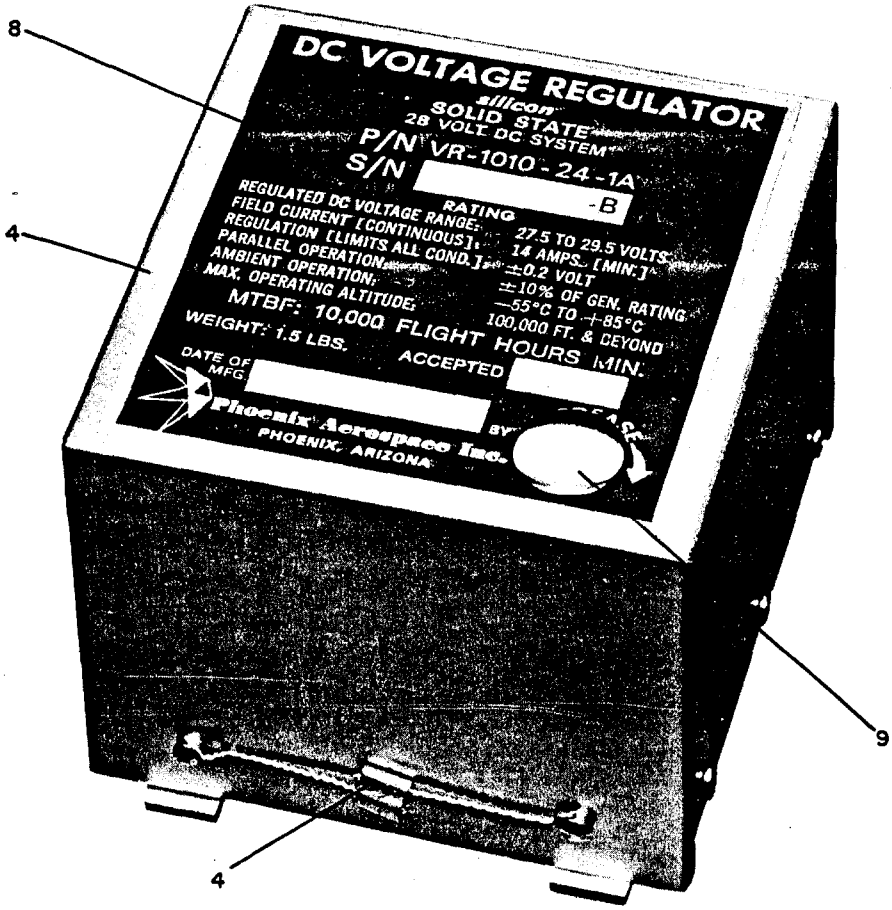
VR-1010-24-1A/P.N. 095001

SYMBOL INDEX

SYM	PART NUMBER	CH-SECT-UNIT-FIG-ITEM
CR1	1N914B	24 -30 -X 1103 57
CR2	1N5624	24 -30 -X 1102 7
CR3	1N5624	8
CR4	1N3210	24 -30 -X 1102 11
CR5	1N914B	24 -30 -X 1103 58
CR6	1N914B	59
CR7	1N914B	60
CR8	1N3611	24 -30 -X 1103 37
CR9	1N914B	24 -30 -X 1103 61
C1	SM .02±20%	24 -30 -X 1103 41
C2	XA3359J	24 -30 -X 1102 38
C3	XA3359J	24 -30 -X 1103 40
C4	150D105X9035A2	24 -30 -X 1103 42
C5	150D226X9035R2	24 -30 -X 1103 43
C6	601PE .01	24 -30 -X 1103 38
C7	600D47F100DLA	24 -30 -X 1102 39
C8	601PE .047	24 -30 -X 1103 39
C9	601PE .022	24 -30 -X 1103 41A
K1	FC-215	24 -30 -X 1102 32
L1	038021	24 -30 -X 1102 43
Q1	048500	24 -30 -X 1103 44
Q2	048500	45
Q3	048501	24 -30 -X 1103 51
Q4	048501	52
Q5	048502	24 30 -X 1103 54
Q6	048502	55
Q7	048504	24 -30 -X 1102 24
Q8	048500	24 -30 -X 1103 46
Q9	048500	47
Q10	048501	24 -30 -X 1103 53
Q11	048500	24 -30 -X 1103 48
Q12	048500	49
Q13	048500	50
Q14	048502	24 -30 -X 1103 56
R1	RC20GF472K	24 -30 -X 1103 23
R2	RC20GF472K	24
R3	RC20GF222K	24 -30 -X 1103 19
R4	RC20GF102K	24 -30 -X 1103 11
R5	RC20GF222K	24 -30 -X 1103 20
R6	RC20GF102K	24 -30 -X 1103 12
R7	RC20GF102K	13
R8	RC20GF102K	14

SYM	PART NUMBER	CH-SECT-UNIT-FIG-ITEM
R9	RC20GF221K	24 -30 -X 1103 3
R10	RC20GF221K	4
R11	BWH .47	24 -30 -X 1102 36
R12	BWH 4.7	24 -30 -X 1102 10
R13	RC20GF200J	24 -30 -X 1102 9
R14	4774-10AX33	24 -30 -X 1102 37
R15	RC20GF681K	24 -30 -X 1103 10
R16	RC20GF471K	24 -30 -X 1103 6
R17	RC20GF103K	24 -30 -X 1103 29
R18	RC20GF471K	24 -30 -X 1103 7
R19	RC20GF471K	8
R20	RC20GF102K	24 -30 -X 1103 15
R21	RC20GF472K	24 -30 -X 1103 25
R22	RC20GF393K	24 -30 -X 1103 31
R23	RC20GF273K	24 -30 -X 1103 30
R24	RN60D6811F	24 -30 -X 1103 36
R25	Not Assigned	
R26	RN60D9090F	24 -30 -X 1103 5
R27	BWH .39	24 -30 -X 1103 35
R28	RN60D2051F	24 -30 -X 1103 22
R29	RN60D6040F	24 -30 -X 1103 9
R30	RC20GF511J	24 -30 -X 1103 16
R31	RC20GF682K	24 -30 -X 1103 18
R32	RC20GF472K	24 -30 -X 1103 16
R33	RC20GF511J	24 -30 -X 1103 17
R34	RN60D1302F	24 -30 -X 1103 34
R35	GAL040S252UL	24 -30 -X 1103 64
R36	RN60D2802F	24 -30 -X 1103 32
R37	RN60D2802F	33
R38	RC20GF330K	24 -30 -X 1103 2
R39	RC20GF152K	24 -30 -X 1103 18
R40	RC20GF472K	24 -30 -X 1103 127
R41	RC20GF*	24 -30 -X 1103 19A
R42	RC20GF182K	24 -30 -X 1103 15A
R43	RC20GF*	24 -30 -X 1103 18A
T1	043003	24 -30 -X 1103 67
T2	043002	24 -30 -X 1102 28
XQ7	4602	24 -30 -X 1102 23
ZR1	1N2984B	24 -30 -X 1102 17
ZR2	1N4739A	24 -30 -X 1103 62
ZR3	1N4473	24 -30 -X 1103 63

VR-1010-24-1A/P.N. 095001
DETAILED PARTS LIST

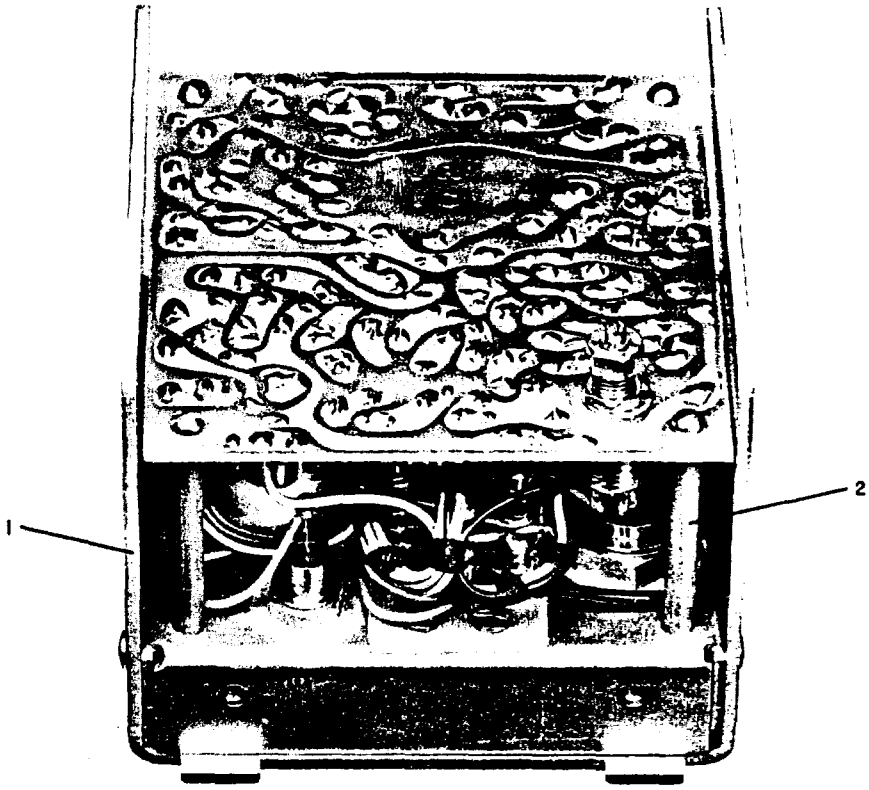


DC Voltage Regulator Model VR-1010-24-1A
(Solid-State Silicon)
Figure 1101 (Sheet 1 of 2)

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM-TO	UNITS PER ASSY
1101	095001	ASSEMBLY, DC VOLTAGE REGULATOR, MODEL VR-1010-24-1A SILICON SOLID-STATE		RF
1	116004	SUB-ASSY, BASE, DC VOLTAGE REGULATOR, VR-1010-24-1A, WITH CONTACTOR PINS		1
2	116005	. SUB-ASSY, CIRCUIT MODULE, OSCILLATOR/ SWITCHING CIRCUITS (ATTACHING PARTS)		1
- 3	MS35233-15	. SCREW, PHM, S. STL, 4-40 X 3/8 IN. LG. (101004)		6
		---★---		
4	088514	. COVER, DC VOLTAGE REGULATOR, MODEL VR-1010-24-1A		1

-Item not Illustrated

VR-1010-24-1A/P.N. 095001
DETAILED PARTS LIST

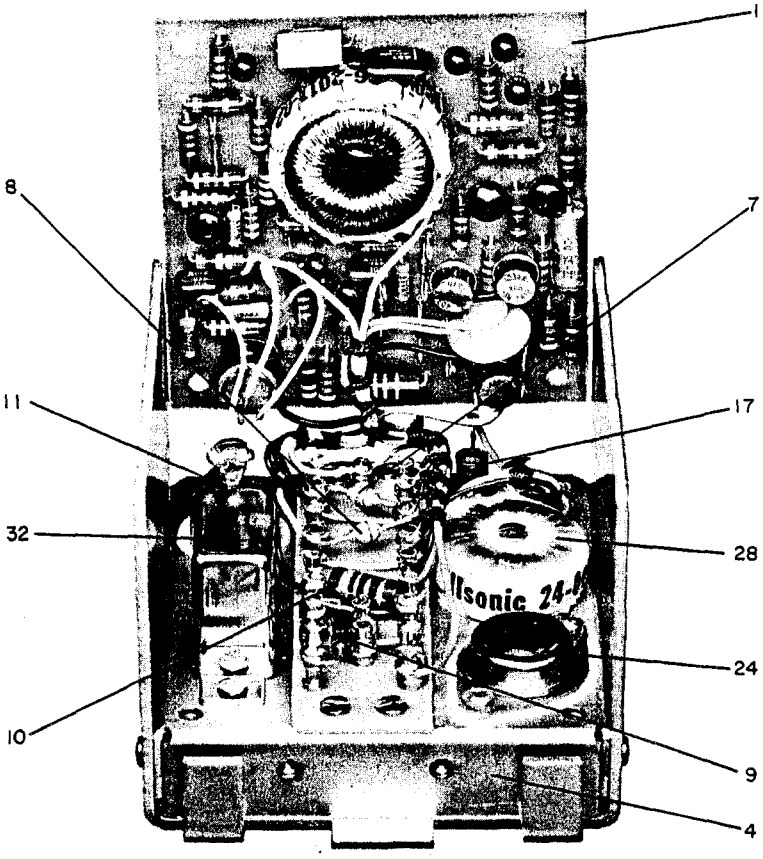


DC Voltage Regulator Model VR-1010-24-1A
(Solid-State Silicon)
Figure 1101 (Sheet 2 of 2)

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM-TO	UNITS PER ASSY
		(ATTACHING PARTS)		
1101- 5	MS35233-15	. SCREW, PHM, S. STL, 4-40 X 3/8 IN. LG (101004)		2
- 6	MS35276A-218	. SCREW FILISTER HEAD, DRILLED, S. STL, 4-40 X 5/8 IN. LG (101200)		2
		---★---		
7	067502	. SEAL, ALUM, PAI WARRANTY		1
8	066002	. NAMEPLATE, MODEL AND SERIAL NO. MODEL VR-1010-24-1A, SELF-ADHERING		1
9	41-C	. BUTTON, PLUG, N1PL, 1/2 IN. (V71785) (067501)		1

-Item Not Illustrated

VR-1010-24-1A/P.N. 095001
DETAILED PARTS LIST



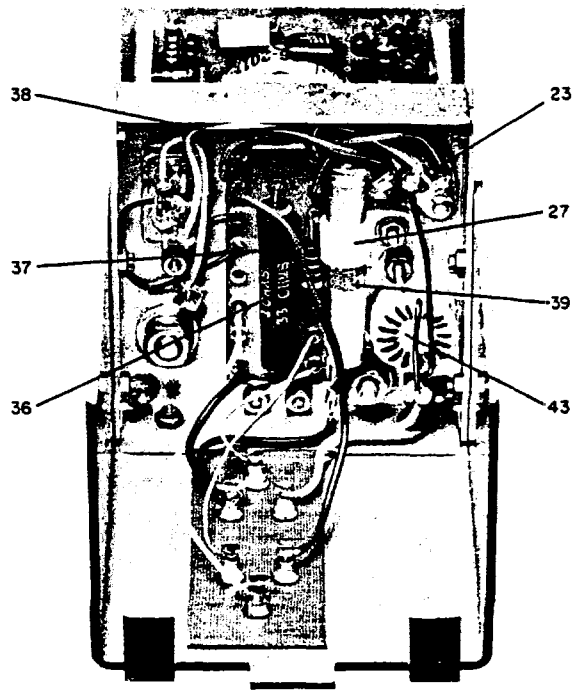
Oscillator/Switching Circuit Module, Sub-Assembly
Model VR-1010-24-1A
Figure 1102 (Sheet 1 of 2)

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM-TO	UNITS PER ASSY
1102-	116005	SUB-ASSY, CIRCUIT MODULE, OSCILLATOR/ SWITCHING CIRCUITS (SEE FIG. 1101 FOR NHA)		RF
1	116006	. SUB-ASSY, OSCILLATOR/DRIVER CIRCUIT BOARD (ATTACHING PARTS)		1
- 2	AN515C4-28	. SCREW, RHM, S. STL, 4-40 X 1-3/4 IN. (101008)		4
- 3	070004	. SPACER, RD, ALUM, 0.1875 IN. O.D. X 1-7/16 IN. LG. CLR NO. 4 SCREW		4
		---★---		
4	080012	CHASSIS, SWITCHING CIRCUITS, DC VOLTAGE REGULATOR, MODEL VR-1010-24-1A		1

-Item Not Illustrated

VR-1010-24-1A/P.N. 095001
DETAILED PARTS LIST

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM-TO	UNITS PER ASSY
1102 5	031501	. STRIP, TERMINAL, MULTIPLE POINT (ATTACHING PARTS)		1
- 6	MS35233-15	. SCREW, PHM, S., STL, 4-40 X 3/8 IN. LG (101004)		4
- 6A	MS35333-70	. WASHER, INT TOOTH LOCK, S. STL, NO. 4 (076001)		4
- 6B	MS35649-44	. NUT, HEX, S. STL, NO. 4-40 (100002)		4
		---★---		
7	1N5624	. SEMICONDUCTOR, DIODE, SILICON, POWER, (V09214) (046015)		1
8	1N5624	. SEMICONDUCTOR, DIODE, SILICON, POWER, (V09214) (046015)		1
9	RC20GF200J	. RESISTOR, FIXED, COMP, 20 OHMS, ±5%, 1/2W (050088)		1
10	BWH 4.7	. RESISTOR, FIXED, 4.7 OHMS ±10%, 2W (V75042) (050301)		1
11	1N3210	. SEMICONDUCTOR, DIODE, SILICON, POWER, (V05277) (046003) (ATTACHING PARTS)		1



Oscillator/Switching Circuits Module, Sub-Assembly
Model VR-1010-24-1A
Figure 1102 (Sheet 2 of 2)

-Item Not Illustrated

VR-1010-24-1A/P.N. 095001
DETAILED PARTS LIST

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM-TO	UNITS PER ASSY
1102-12	DF6B	. WASHER, MICA, DIODE MTG. (V08530) (064503)		2
-12A	5610-122-.062	. BUSHING, NYLON, INSULATING, DIODE MTG, 1/4 IN. 0.260 I.D. X 0.344 IN. O.D. X 0.062 IN. THK (V86928) (064507)		1
-13	R1C-14	. LUG, SOLDER, FLAT, 1/4 IN. I.D. H.D. (V83108) (025002)		1
-14	AN90-C416L	. WASHER, FLAT, STL, 1/4 IN. (076029)		1
-15	MS35333-74	. WASHER, INT TOOTH LOCK, S. STL, 1/4 (076018)		1
-16	MS35650-3254	. NUT, HEX, STL, CAD PL, 1/4-28 (100024)		1
		---★---		
17	1N2984B	. SEMICONDUCTOR, DIODE, ZENER, SILICON, 20V, ±5%, 10W (V24444) (046021)		1
		(ATTACHING PARTS)		
-18	DF6C	. WASHER, MICA, DIODE MTG, (V08530) (064502)		1
-18A	DF3D	. BUSHING, NYLON, INSULATING, DIODE MTG, CLR NO. 10 (V86928) (064513)		1
-19	R1A-10	. LUG, SOLDER, (025001)		1
-20	AN960-C10L	. WASHER, FLAT, S. STL, NO. 10 (076014)		1
-21	MS35333-73	. WASHER, INT. TOOTH LOCK, S. STL, NO. 10 (076014)		1
-22	MS35649-204	. NUT, HEX, S. STL, 10-24 (100013)		1
		---★---		
23	4602	. SOCKET, TRANSISTOR, MTG, T0-3 (V91833) (029002)		1
24	048504	. SEMICONDUCTOR, TRANSISTOR, SILICON, POWER		1
		(ATTACHING PARTS)		2
-25	AN52OUB6-8	. SCREW, RHM, BRASS, 6-32 X 1/2 IN. LG. (101009)		1
-26	732-73YA	. WASHER, MICA, INSULATING TRANSISTOR MTG TO-3 (V08530) (064500)		1
27	3306-3/8-N	. CLAMP, CABLE, NYLON, 3/8 IN. ---★--- (V28520) (068005)		1
28	043002	. TRANSFORMER, POWER, DRIVER, TOROIDAL (ATTACHING PARTS)		1
-29	MS35233-20	. SCREW, PHM, S. STL, 4-40 X 1 IN. LG (101065)		1
-30	MS35333-70	. WASHER, INT TOOTH LOCK, S. STL, NO. 4 (076001)		1
-30A	AN960-C4	. WASHER, FLAT, S. STL, NO. 4 (076019)		1
-31	MS35649-44	. NUT, HEX, S. STL, NO. 4-40 (100002)		
		---★---		

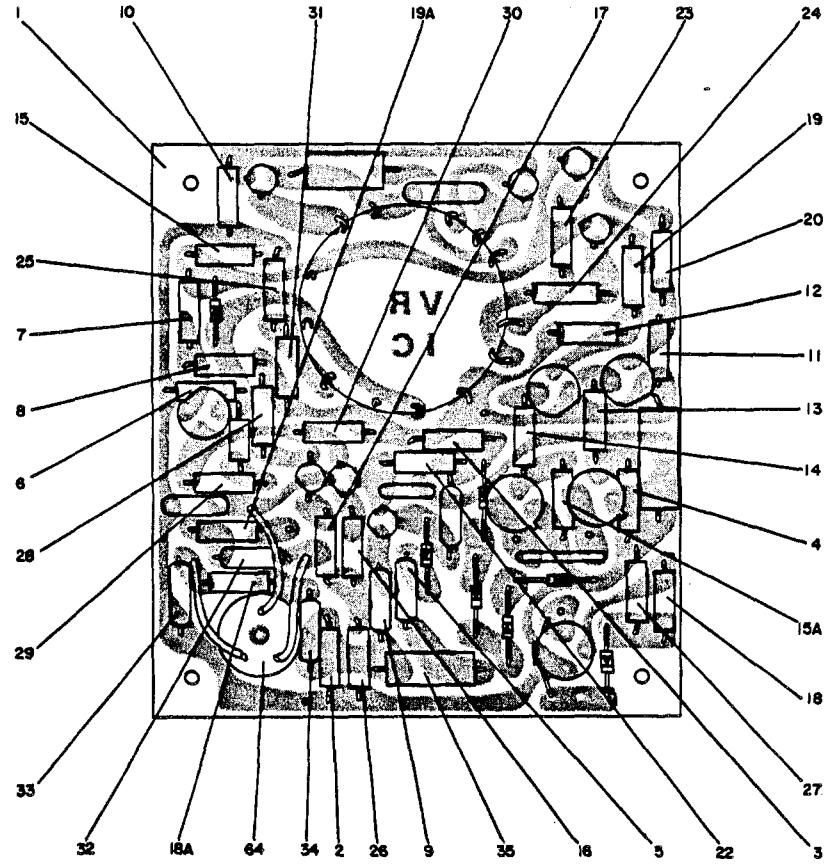
-Item Not Illustrated
*Selected or Alternate

VR-1010-24-1A/P.N. 095001
DETAILED PARTS LIST

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM-TO	UNITS PER ASSY
1102 32	FC-215	. RELAY, ARMATURE, 2 FORM (C) CONTACTS, 10 AMPS, 26.5 VDC, 26.5 VDC COIL, 300 OHMS (V78290) (011500)		1
		(ATTACHING PARTS)		
-33	MS35233-15	. SCREW, PHM, S. STL, 4-40 X 3/8 IN. LG (101004)		2
-34	MS35333-70	. WASHER, INT. TOOTH LOCK, S. STL, NO. 4 (076001)		2
-35	MS35649-44	. NUT, HEX, S. STL, NO. 4-40 (100002)		2
		---★---		
36	BWH .47	. RESISTOR, FIXED, WW, .47 OHMS, ±10%, 2W (V75042) (050300)		1
	4774	. RESISTOR, FIXED WW, 33 OHMS, 11 W (V44655) (052002)		
37	or	. OR		1
	10AX	. RESISTOR, FIXED WW, 33 OHMS, 10W (V83827) (052002)		
38	XA3359J	. CAPACITOR, MET. MYLAR, 0.47UF, ±5%, 100 VDCW (V27556) (019005)		1
39	600D476F100DL4	. CAPACITOR, ELECTROLYTIC, 47 UF, 100 VDCW (V56289) (021007)		1
-40	756	. STANDOFF, TERMINAL LUG (V88245) (031510)		1
		(ATTACHING PARTS)		
-41	MS35233-13	. SCREW, PHM, S. STL, 4-40 X 1/4 IN. LG (101033)		1
-42	MS35333-70	. WASHER, INT. TOOTH LOCK, S. STL, NO. 4 (076001)		1
		---★---		
43	038021	. REACTOR, TOROIDAL, RF FILTER		1

-Item Not Illustrated

VR-1010-24-1A/P.N. 095001
DETAILED PARTS LIST



Oscillator/Driver Circuit Board Sub-Assembly
Model VR-1010-24-1A
Figure 1103 (Sheet 1 of 3)

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM-TO	UNITS PER ASSY
1103-	116006	SUB-ASSEMBLY, OSCILLATOR/DRIVER CIRCUIT BOARD		RF
1	058023	BOARD, PRINTED CIRCUIT, OSC/DRIVER		1
2	RC20GF330K	. RESISTOR, FIXED, COMP, 33 OHMS, ±10%, 1/2 W (050014)		1
3	RC20GF221K	. RESISTOR, FIXED, COMP, 220 OHMS, ±10%, 1/2W (050023)		1
4	RC20GF221K	. RESISTOR, FIXED, COMP, 220 OHMS, ±10%, 1/2W (050023)		1
5	RN60D9090F	. RESISTOR, FIXED, FILM, 909 OHMS, ±1%, 1/8W (V91637) (050502)		1
6	RC20GF471K	. RESISTOR, FIXED, COMP, 470 OHMS, ±10%, 1/2W (050027)		1

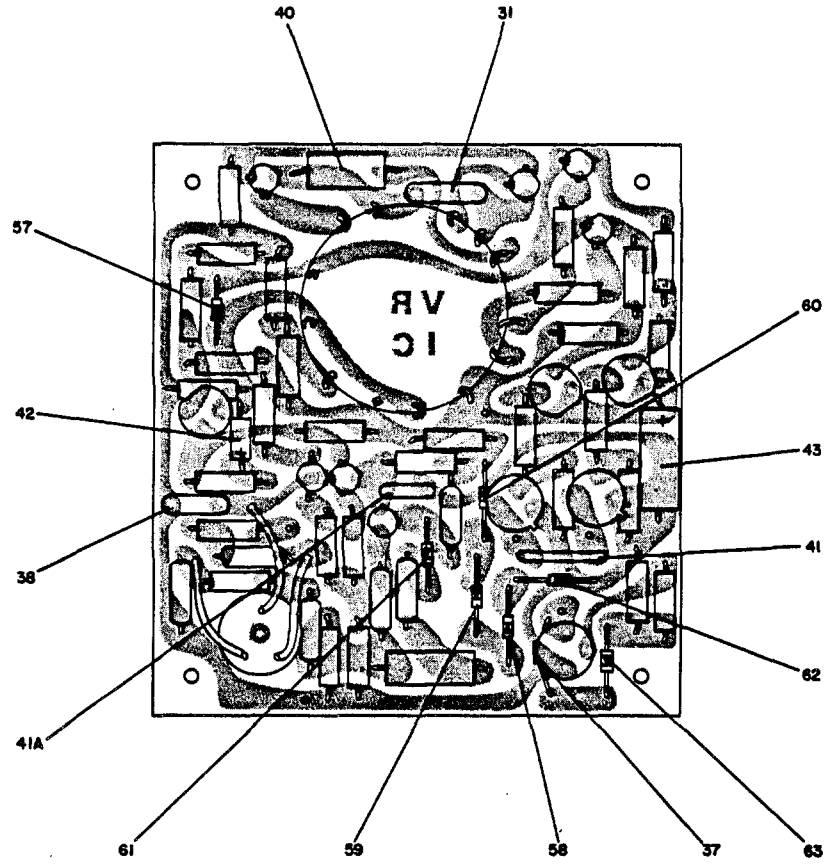
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VR-1010-24-1A/P.N. 095001
DETAILED PARTS LIST

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM-TO	UNITS PER ASSY
1103 7	RC20GF471K	. RESISTOR, FIXED, COMP, 470 OHMS, ±10%, 1/2W (050027)		1
8	RC20GF681K	. RESISTOR, FIXED, COMP, 680 OHMS, ±10%, 1/2W (050029)		1
9	RN60D6040F	. RESISTOR, FIXED, FILM, 640OHMS, ±1%, 1/8W (V91637) (050503)		1
10	RC20GF681K	. RESISTOR, FIXED, COMP, 680 OHMS, ±10%, 1/2W (050029)		1
11	RC20GF102K	. RESISTOR, FIXED, COMP, 1,000 OHMS, ±10%, 1/2W (050031)		1
12	RC20GF102K	. RESISTOR, FIXED, COMP, 1,000 OHMS, ±10%, 1/2W (050031)		1
13	RC20GF102K	. RESISTOR, FIXED, COMP, 1,000 OHMS, ±10%, 1/2W (050031)		1
14	RC20GF102K	. RESISTOR, FIXED, COMP, 1,000 OHMS, ±10%, 1/2W (050031)		1
15	RC20GF182K	. RESISTOR, FIXED, COMP, 1,000 OHMS, ±10%, 1/2W (050031)		1
15A	RC20GF182K	. RESISTOR, FIXED, COMP, 1,800 OHMS, ±10%, 1/2W (050034)		1
16	RC20GF511J	. RESISTOR, FIXED, COMP, 510 OHMS, ±5%, 1/2W (050083)		1
17	RC20GF511J	. RESISTOR, FIXED, COMP, 510 OHMS, ±5%, 1/2W (050083)		1
18	RC20GF152K	. RESISTOR, FIXED, COMP, 1,500 OHMS ±10%, 1/2W (050033)		1
18A	RC20GF*	. RESISTOR, FIXED, COMP, (SELECTED*) ±10%, 1/2W		1
18B	RC20GF*	. RESISTOR, FIXED, COMP, (SELECTED*) ±10%, 1/2W		1
19	RC20GF222K	. RESISTOR, FIXED, COMP, 2,200 OHMS ±10%, 1/2W (050035)		1
20	RC20GF222K	. RESISTOR, FIXED, COMP, 2,200 OHMS, ±10%, 1/2W (050035)		1
21	Not Assigned	.		
22	RN60D2051F	. RESISTOR, FIXED, FILM, 2,050 OHMS, ±1%, 1/8W (V91637) (050507)		1
23	RC20GF472K	. RESISTOR, FIXED, COMP, 4,700 OHMS, ±10%, 1/2W (050039)		1
24	RC20GF472K	. RESISTOR, FIXED, COMP, 4,700 OHMS, ±10%, 1/2W (050039)		1
25	RC20GF472K	. RESISTOR, FIXED, COMP, 4,700 OHMS, ±10%, 1/2W (050039)		1
26	RC20GF103K	. RESISTOR, FIXED, COMP, 4,700 OHMS, ±10%, 1/2W (050039)		1
27	RC20GF273K	. RESISTOR, FIXED, COMP, 4,700 OHMS, ±10%, 1/2W (050039)		1

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*Selected or Alternate

VR-1010-24-1A/P.N. 095001
DETAILED PARTS LIST

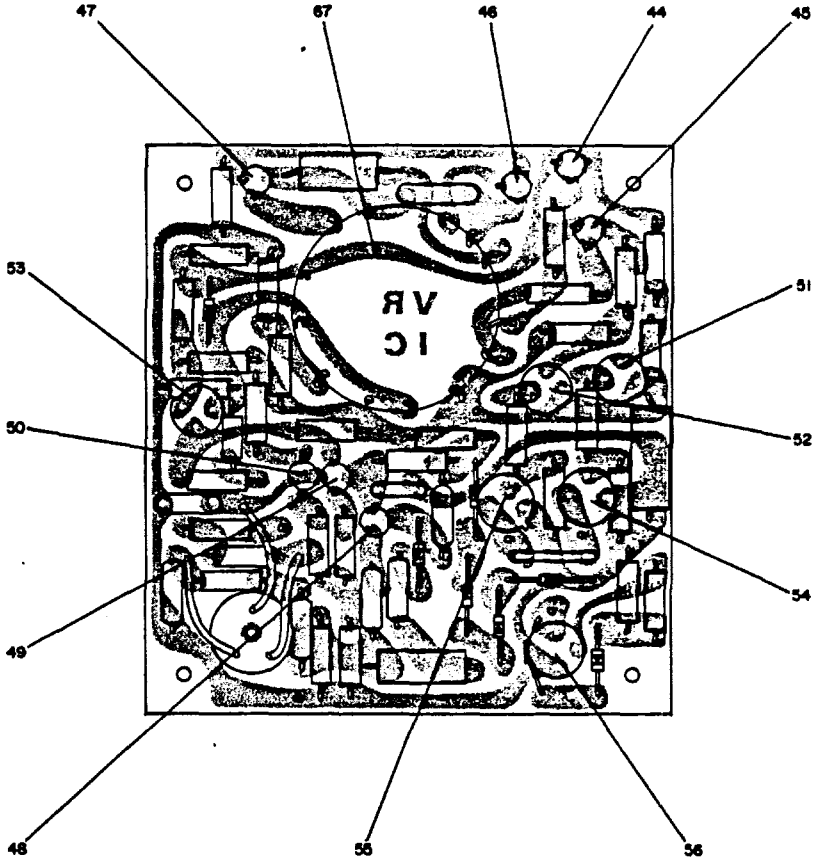


Oscillator/Driver Circuit Board Sub-Assembly
Model VR-1010-24-1A
Figure 1103 (Sheet 2 of 3)

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM-TO	UNITS PER ASSY
1103 28	RC20GF393K	. RESISTOR, FIXED, COMP, 6,800 OHMS, ±10%, 1/2W (050041)		1
29	RC20GF103K	. RESISTOR, FIXED, COMP, 10K OHMS, ±10%, 1/2W (050043)		1
30	RC20GF273K	. RESISTOR, FIXED, COMP, 27K OHMS, ±5%, 1/2W (050048)		1
31	RC20GF393K	. RESISTOR, FIXED, COMP, 39K OHMS, ±5%, 1/2W (050050)		1
32	RN60D2802F	. RESISTOR, FIXED, FILM, 28K OHMS, ±1%, 1/8W (V91637) (050506)		1
33	RN60D2802F	. RESISTOR, FIXED, FILM, 28K OHMS, ± 1%, 1/8W (V91637) (050506)		1
34	RN60D1302F	. RESISTOR, FIXED, FILM, 13K OHMS, ±1%, 1/8W (V91637) (050505)		1

VR-1010-24-1A/P.N. 095001
DETAILED PARTS LIST

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT FROM-TO	UNITS PER ASSY
1103 35	BWH .39	. RESISTOR, FIXED, WW, 0.39 OHMS, ±1%, 1/8W (V75042) (050302)		1
36	RN60D6811F	. RESISTOR, FIXED, FILM, 6,810 OHMS, ±1%, 1/8W (V91637) (050508)		1
37	1N3611	. SEMICONDUCTOR, DIODE, SILICON, (V28520) (046011)		1
38	601PE.01	. CAPACITOR, DIPPED MYLAR, 0.01UF ±10%, 50VDCW (V84411) (019003)		1
39	601PE.047	. CAPACITOR, DIPPED MYLAR 0.047UF ±10%, 50VDCW (V84411) (019004)		1
40	XA3359J	. CAPACITOR, MET. MYLAR, 0.47UF, ±5%, 100VDCW (V27556) (019005)		1
41A	601PE .022	. CAPACITOR, DIPPED MYLAR, 0.022 UF, ±10%, 50VDCW (V84411) (019018)		1
41	SM ..02±20%	. CAPACITOR, CER. DISC, 0.02 UF, ±20%, 500VDCW (V91418) (02300)		1



Oscillator/Driver Circuit Board Sub-Assembly
Model VR-1010-24-1A
Figure 1103 (Sheet 3 of 3)

VR-1010-24-1A/P.N. 095001
DETAILED PARTS LIST

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM-TO	UNITS PER ASSY
1103 42	150D105X9035A2	. CAPACITOR, ELECTROLYTIC, TANTALUM 1UF, ±10%, 35VDCW (V56289) (021501)		1
43	150D226X9035R2	. CAPACITOR, ELECTROLYTIC, TANTALUM, 22UF, ±10%, 35VDCW (V56289) (021502)		1
44	048500	. SEMICONDUCTOR, TRANSISTOR, SILICON, NPN,		1
45	048500	. SEMICONDUCTOR, TRANSISTOR, SILICON, NPN,		1
46	048500	. SEMICONDUCTOR, TRANSISTOR, SILICON, NPN,		1
47	048500	. SEMICONDUCTOR, TRANSISTOR, SILICON, NPN,		1
48	048500	. SEMICONDUCTOR, TRANSISTOR, SILICON, NPN,		1
49	048500	. SEMICONDUCTOR, TRANSISTOR, SILICON, NPN,		1
50	048500	. SEMICONDUCTOR, TRANSISTOR, SILICON, NPN,		1
51	048501	. SEMICONDUCTOR, TRANSISTOR, SILICON, PNP,		1
52	048501	. SEMICONDUCTOR, TRANSISTOR, SILICON, PNP,		1
53	048501	. SEMICONDUCTOR, TRANSISTOR, SILICON, PNP,		1
54	048502	. SEMICONDUCTOR, TRANSISTOR, SILICON, NPN		1
55	048502	. SEMICONDUCTOR, TRANSISTOR, SILICON, NPN		1
56	048502	. SEMICONDUCTOR, TRANSISTOR, SILICON, NPN		1
57	1N914B	. SEMICONDUCTOR, DIODE, SILICON (V13715) (046006)		1
58	1N914B	. SEMICONDUCTOR, DIODE, SILICON (V13715) (046006)		1
59	1N914B	. SEMICONDUCTOR, DIODE, SILICON (V13715) (046006)		1
60	1N914B	. SEMICONDUCTOR, DIODE, SILICON (V13715) (046006)		1
61	1N914B	. SEMICONDUCTOR, DIODE, SILICON (V13715) (046006)		1
62	1N4739A	. SEMICONDUCTOR, DIODE, ZENER, SILICON, 9.1V, ±5%, 1W (V13715) (046030)		1
63	1N4473	. SEMICONDUCTOR, DIODE, ZENER, SILICON, 22V, ±5%, 1.5W (V14552) (046017)		1

VR-1010-24-1A/P.N. 095501
DETAILED PARTS LIST

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT FROM-TO	UNITS PER ASSY
1103 64	GA2L040S252UL	. RESISTOR, VARIABLE, WW, 2,500 OHMS, 1/4W (V01121) (054001)		1
		(ATTACHING PARTS)		
-65	MS35333-74	. WASHER, INT. TOOTH LOCK, S. STL, 1/4 IN. (076018)		1
-65A	M4748	. WASHER, FLAT, STL, NIPL, 1/4 IN. I.D. X 3/8 IN. O.D. X 0.032 IN. THK (V01121) (076031)		1
-66	M4721	. NUT, HEX, STL, NIPL, SPL 1/4-32 (V01121) (100007)		1
-66A	M4761	. NUT, HEX, BRASS, NIPL, SPL, LOCKING, 1/4-32 (V01121) (100032)		1
		---★---		
67	043003	. TRANSFORMER, TOROIDAL, OSCILLATOR		
-68	026013	. LEAD, ELECTRICAL, GRAY TEFLON, 1-1/2 IN. LG		2
-69	026014	. LEAD, ELECTRICAL, WHITE TEFLON, 1-1/2 IN. LG		1

-Item Not Illustrated

VR-1010-24-1A/P.N. 095001

REVISION REFERENCE SHEET

REVISION CODE	REVISION DESCRIPTION	SERIAL NO. EFFECTIVITY
A	RESISTOR R38 CHANGED TO 33 OHMS, ±10%, 1/2W FROM 5.6 OHMS, ±10%, 1/2W.	15 DEC 1967
B	MODIFICATION TO IMPROVE TEMPERATURE COMPENSATION: RESISTOR R24 CHANGED TO 6,810 OHMS, ±1%, 1/8W FROM SELECTED *(3,900-5,100 OHMS); RESISTOR R25 DELETED; RESISTOR R45 ADDED. 1,800 OHMS, ±10%, 1/2W; RESISTOR R26 CHANGED TO 909 OHMS, ±1%, 1/8W FROM 270 OHMS, ±10%, 1/2W; RESISTOR R28 CHANGED TO 2,050 OHMS, ±1%, 1/8W FROM 2,200 OHMS, ±10%, 1/2W; RESISTOR R29 CHANGED TO 604 OHMS, ±1% FROM 620 OHMS, ±10%, 1/2W; RESISTORS R30 AND R33 CHANGED TO 750 OHMS, ±5%, 1/2W FROM 1,000 OHMS, ±10%, 1/2W; RESISTOR R34 CHANGED TO 13K OHMS, ±1% FROM 20K OHMS, ±5%, 1/2W; RESISTORS R36 AND R37 CHANGED TO 28K OHMS, ±1%, 1/8W FROM 16.2K OHMS, ±1%, 1/8W; ZENER DIODE Z2 CHANGED TO 1N4465 FROM 1N4740A.	22 NOV 1968
C	DIODES CR2 AND DR3 CHANGED TO 1N5402 FROM 1N4721. TRANSISTOR Q7 CHANGED TO RCA TYPE NO. 60234 FROM RCA TYPE NO. 2N3772.	10 OCT 1969
D	DIODES CR2 AND CR3 CHANGED TO 1N5624 FROM 1N5402.	22 SEP 1971
E	DIODE CR8 CHANGED TO 1N3611 FROM 1N4002. TRANSISTOR Q7 CHANGED TO RCA TYPE NO. 64497 FROM RCA TYPE NO. 60234. ZENER DIODE Z3 & Z4 CHANGED TO 1N4473 FROM 1N4748A.	22 JUN 1973
F	RF FILTER L1 ADDED IN SERIES WITH PIN C, GENERATOR POSITIVE, OF RECEPTACLE J1.	7 JUN 1974
G	TRANSISTOR Q7 CHANGED TO RCA TYPE NO. 66090 FROM RCA TYPE NO. 64497.	5 MAR 1975

Model VR-1010-24-1A, DC Voltage Regulator,
Revision Reference Sheet, Schematic Diagram,
Figure 1201 (Sheet 1 of 3)

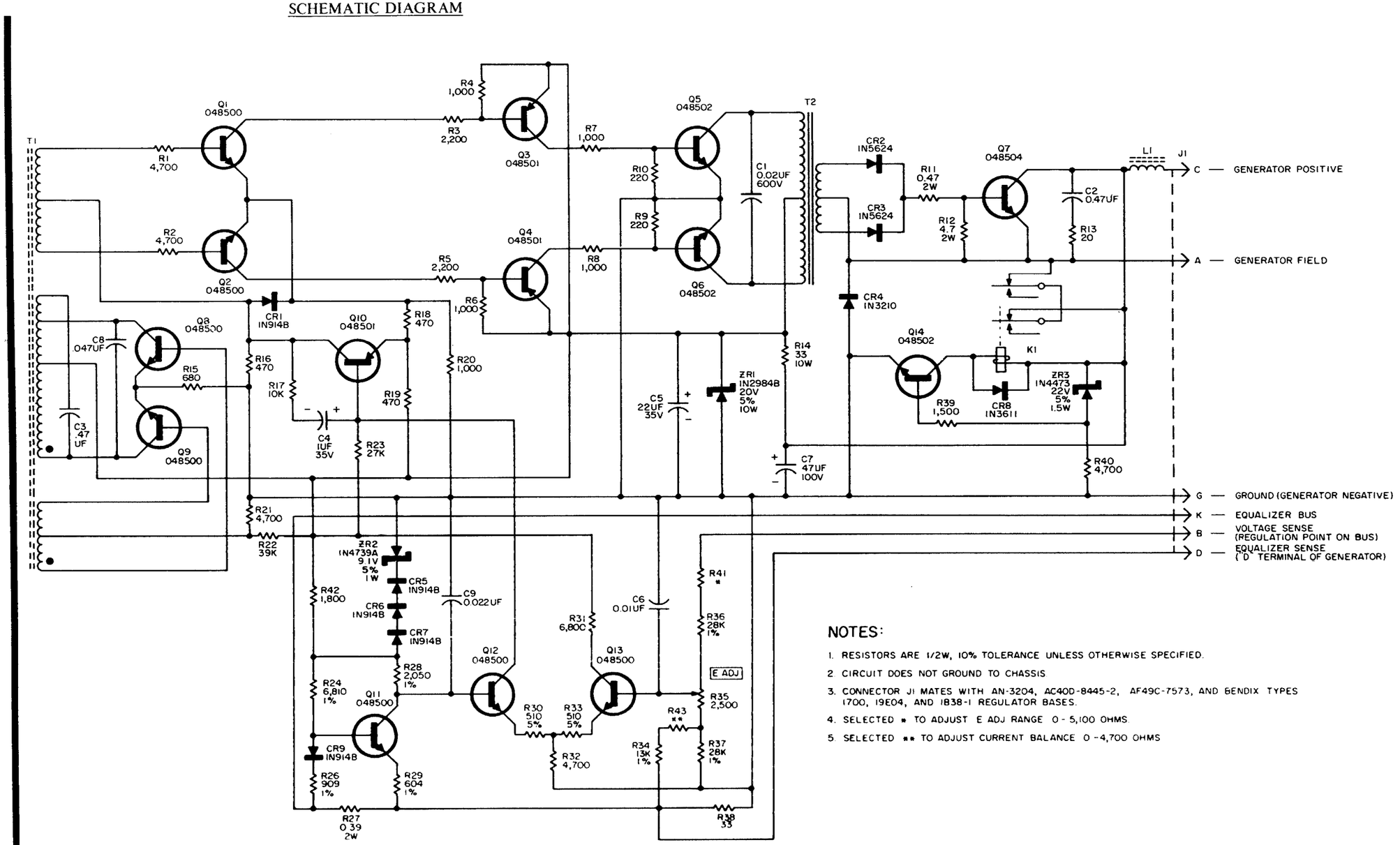
VR-1010-24-1A/P.N. 095001

REVISION REFERENCE SHEET

REVISION CODE	REVISION DESCRIPTION	SERIAL NO. EFFECTIVITY
H	TRANSISTOR Q7 CHANGED TO PAI P.N. 048504 FROM RCA TYPE NO. 66090. TRANSISTORS Q5, Q6, AND Q15 CHANGED TO PAI P.N. 048502 FROM RCA TYPE NO. 40348.	1 DEC 1975
I	TRANSISTORS Q1, Q2, Q8, Q9, Q11, Q12, AND Q13 CHANGED TO PAI P.N. 048500 FROM TYPE 2N3565; TRANSISTORS Q3, Q4, AND Q10 CHANGED TO PAI P.N. 048501 FROM TYPE NO. 2N3638; ZENER DIODE SYMBOLS CHANGED Z1, Z2, AND Z3, TO ZR1, ZR2, AND ZR3; TYPOGRAHICAL ERROR AS READS 1/4W CHANGED TO 1/8W, AS READS 10K CHANGED TO 13K IN REV. B.	1 AUG 1977
J	CAPACITOR C7 CHANGED TO 47UF FROM 50UF. RELAY K1 CONTACTS CORRECTED TO FORM 'C.'	31 MAR 1978
K	ZENER DIODE ZR2 CHANGED TO 1N4739A-9.1V±5%, 1W FROM 1N4465-10V±5%, 1.5W.	30 JUN 1978

Model VR-1010-24-1A, DC Voltage Regulator,
Revision Reference Sheet, Schematic Diagram,
Figure 1201 (Sheet 2 of 3)

SCHEMATIC DIAGRAM



NOTES:

1. RESISTORS ARE 1/2W, 10% TOLERANCE UNLESS OTHERWISE SPECIFIED.
2. CIRCUIT DOES NOT GROUND TO CHASSIS.
3. CONNECTOR J1 MATES WITH AN-3204, AC40D-8445-2, AF49C-7573, AND BENDIX TYPES 1700, 19E04, AND 1838-1 REGULATOR BASES.
4. SELECTED * TO ADJUST E ADJ RANGE 0 - 5,100 OHMS.
5. SELECTED ** TO ADJUST CURRENT BALANCE 0 -4,700 OHMS.

Model VR-1010-24-1A, DC Voltage Regulator,
Revision Reference Sheet, Schematic Diagram,
Figure 1201 (Sheet 2 of 3)

VR-1010-24-2A
DC VOLTAGE REGULATOR
maintenance manual
and
overhaul manual
with
illustrated parts catalog

Phoenix Aerospace Inc.

PHOENIX, ARIZONA 85034

Phoenix Aerospace Inc.

MAINTENANCE MANUAL

VR-1010-24-2A/P.N. 095027

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LIST OF EFFECTIVE PAGES

CHAPTER/SECTION	PAGE	DATE
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Contents	1	Mar. 31/78
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Introduction	1	Dec. 1/67
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24-30-X	*1	Jun. 30/78
24-30-X	2	Mar. 31/78
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24-30-X	4	Dec. 1/67
24-30-X	5	Dec. 1/67
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24-30-X	8	Blank
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24-30-X	*10	Jun. 30/78
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*The asterisk indicates pages revised or added by the current revision.

VR-1010-24-2A/P.N. 095027

INTRODUCTION

In conformance with A.T.A. Specification No. 100 for Manufacturers' Technical Data, two manuals have been prepared concerning the Model VR-1010-24-2A DC Voltage Regulator. These manuals, if used as intended, will facilitate the effective, continued operation of the equipment. Technical data is grouped according to usage in the manual as described.

MAINTENANCE MANUAL

This manual is intended for use by flight line and hangar maintenance personnel. A detailed description and operation procedures, including a table of leading particulars are presented for reference. Mounting information and cabling information are presented as an aid to installation. Trouble-shooting information is limited to procedures required to trace a trouble to the overall unit for replacement.

OVERHAUL MANUAL WITH ILLUSTRATED PARTS CATALOG

The Overhaul Manual contains all the information required for shop testing, replacement of defective parts, alignment and adjustment, mechanical disassembly, inspection, and reassembly. Detailed circuit theory is given with emphasis on theory that will be especially helpful for effective trouble-shooting. Performance tests as well as functional (go/no-go) checks, which may be used to determine condition of equipment and for retesting after repairs.

The Illustrated Parts Catalog provides a means to determine the manufacturer's part number and the physical location on the equipment of a part if the reference designation is known, or to determine the reference designation and the manufacturer's part number when the physical location of the part is known but no other information is available.

DESCRIPTION AND OPERATION

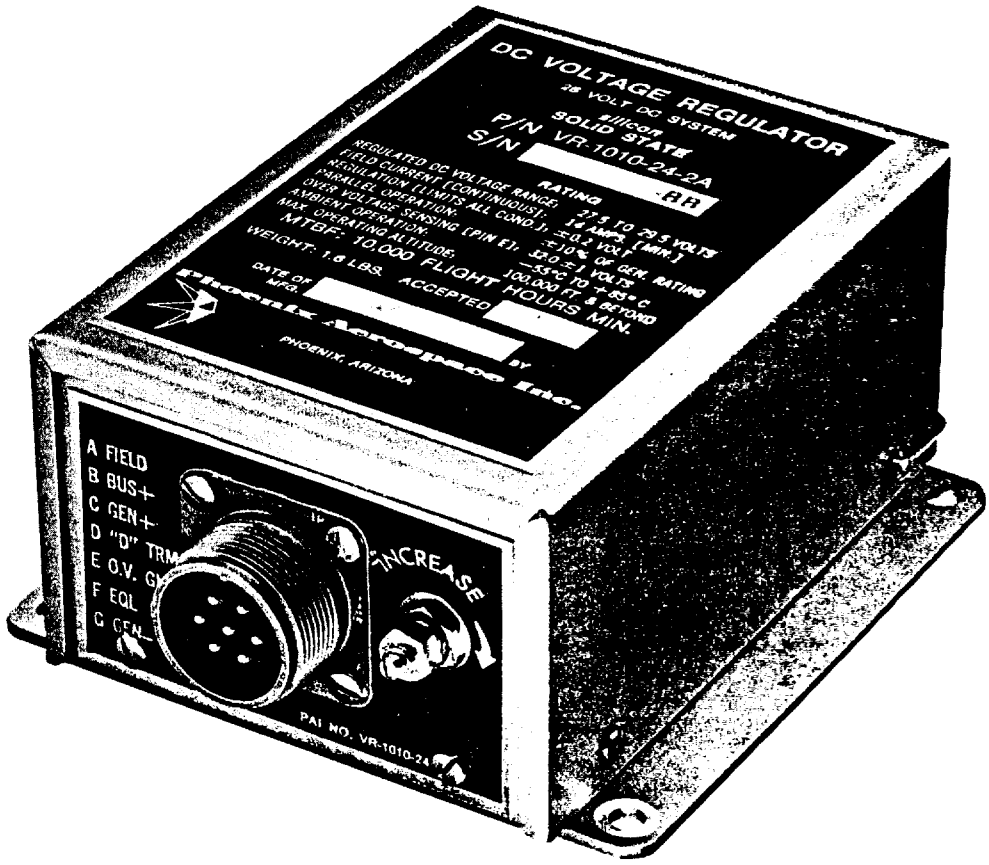
1. GENERAL.

A. Purpose of Manual.

This manual contains maintenance and installation procedures for the Model VR-1010-24-2A, DC Voltage Regulator (Solid-State), illustrated in Fig. 1.

B. Purpose of Equipment.

The Model VR-1010-24-2A, DC Voltage Regulator is used to control all 28 volt direct current generators and starter generators conforming to FAA TSO-C56 and/or Military Specification MIL-G-6162. The regulator performs the function of maintaining constant output voltage under varying speed and load conditions in single generator or multiple generator systems.



Model VR-1010-24-2A, DC Voltage Regulator
Figure 1

2. DESCRIPTION.

A. The Model VR-1010-24-2A, DC Voltage Regulator is a compact self-contained unit utilizing state-of-the-art solid-state techniques. The regulated voltage is adjustable at a mechanically locked potentiometer adjacent to the input/output connector on the end of unit. Operating power for the regulator is obtained from the regulated generator. The regulator automatically adjusts field current to produce a constant voltage at the generator output under varying speeds and loads. The unit mounts directly on a bulkhead or other structural member, equipment rack, or equipment drawer. The unit is compactly packaged to facilitate placement in the aircraft and requires only a single, multi-pin, input/output connector between the unit and the aircraft wiring system.

B. The primary characteristics, capabilities, overall weight, and dimensions are listed in Table of Leading Particulars, Table 1.

GENERAL:

Duty: Continuous, unattended.

Temperature Rise: 15° C (maximum).

Cooling: Self-cooled by natural convection, conduction, and radiation.

Ambient Temperature Range: −85° to +85° C.

Maximum Operating Altitude: 100,000 feet and beyond.

Reliability: 10,000 hours MTBF (minimum).

ELECTRICAL:

Regulated DC Voltage Range: 27.5 to 29.5 VDC, no load to full load, over rated generator speed and temp/alt. operating range.

Field Current (Continuous): 14 Amperes (minimum).

Regulation: ±0.2 Volts, no load to full load, over rated generator speed and temp/alt. operating range.

Voltage Adjustment Limits: 26 VDC to 31 VDC, continuously variable.

Equalizer Circuit: ±2.5 Volts, minimum change, no load to full load, at minimum rated speed for regulation, when 0.25 volts is applied to equalizer bus terminals.

Parallel Operation: ±10 per cent equal division of load, two or more generators operated in parallel, no load to full load, over rated generator speed range.

Table of Leading Particulars
Table 1

Overvoltage Sensing: Overvoltage sensing circuit trips at 32.0 ±1.0 volts independent of the external field relay, placing a ground on pin E of connector J1 to operate an external relay.

Regulator Equivalent Resistance: High Value — More than 100 ohms.
Low Value — Less than 0.5 ohms.

Current Regulation: Regulation for balancing current between parallel generators in multiple generator systems.

Recovery Time: 0.05 Seconds, full load switched ON-OFF-ON, controlled voltage recovers to and remains within 10 per cent of steady state condition.

Overload Current: 14 Amperes (minimum) for one hour.

Induced Ripple: Less than 1.5 volts peak to peak.

Transient Protection: ±80 volts for 40 milliseconds,
±600 volts for 10 microseconds.

MECHANICAL:

Weight: 1.6 pounds (729.6 grams).

Overall Dimensions: 3-1/2 in. wide (8.89 cm) by
5 in. long (12.7 cm) by
2-3/8 in. high (6.03 cm).

Mounting Base Dimensions: 4-5/8 in. long (11.748 cm) by
4-1/2 in. wide (11.43 cm).

Mounting Centers: 4 in. long (10.16 cm) by 4 in. wide (10.16 cm).

Electrical Connectors: Input/Output: MS3102R-16S-1P mating MS3106F-16S-1S.

Cooling: Self-cooled by natural convection, conduction, and radiation.

Installation: Mounts in any position, without degradation of power output, heating, operating life, or other operating characteristics.

Adjustment: Voltage set potentiometer, INCREASE, adjusts voltage and paralleling in a single operation, located adjacent to input/output connector on regulator.

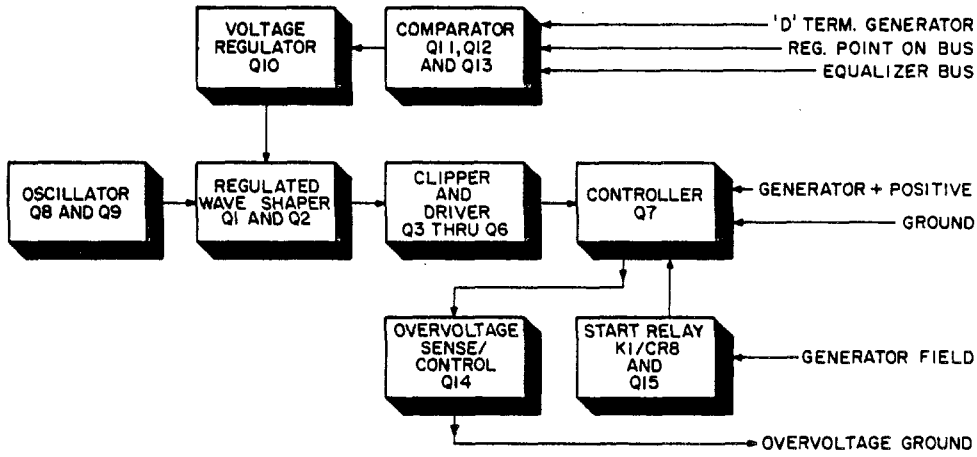
Table of Leading Particulars (Cont)
Table 1 (Cont)

3. OPERATION.

The subsequent paragraphs cover the theory of operation for the Model VR-1010-24-2A, DC Voltage Regulator. The Block Diagram Theory will aid in conveying the overall circuit operation to non-technical oriented personnel, while the Detailed Circuit Theory will enable the technician to understand in detail the operation of equipment.

A. Block Diagram Theory.

The subsequent paragraphs together with the block diagram of Fig. 2, cover in concise form the signal flow and circuit operation for the Model VR-1010-24-2A, DC Voltage Regulator.



Model VR-1010-24-2A, DC Voltage Regulator
Block Diagram
Figure 2

(1) Generator Start Relay. Relay K1 in the de-energized condition, contacts closed, completes the generator field circuit, until operating speed and voltage output are attained. Relay K1 energizes at a voltage of approximately 20 volts, when Zener diode ZR4 conducts and biases transistor Q15 to turn-on. Relay K1 contacts open by-passing the regulator controller circuits and permits the control circuits to function as controller. Operating power for the regulator circuit is obtained from the generator output.

(2) Stabilized Oscillator. Transistors Q8 and Q9 generate a sine wave signal at a frequency of approximately 400 Hertz. The sine wave signal is coupled through auxiliary windings of oscillator transformer T1 to the input of the regulated wave shaper circuits.

(3) Regulated Wave Shaper. Transistors Q1 and Q2 in a push-pull circuit receive the sine wave signal from the stabilized oscillator. Voltage applied from the voltage regulator circuit determines the shaping operation to control duty cycle and regulator operation. The shaped output is coupled to the input of the clipper circuit.

(4) Clipper and Driver. Transistors Q3, Q4, Q5, and Q6 in cascaded push-pull stages provide additional shaping and amplification of the 400 Hertz signal. The amplified signal is applied to the controller circuits.

(5) Controller. Transistor Q7 and diodes CR2 and CR3 comprise the controller circuitry. Transistor Q7 switches the generator field current at a rate of approximately 800 pulses per second, derived by rectification of the 400 Hertz signal by diodes CR2 and CR3. Variation in the width, duty cycle, determines the amount of field current. Clamp diode CR4 maintains continuous field current.

(6) Overvoltage Sense/Control. Transistor Q14 and Zener Diode ZR3 provide a sense and control circuit to operate an external relay to open the positive 28 volts DC supplied to the regulator or the generator Field line to provide overvoltage protection for the generator.

(7) Voltage Regulator. Transistor Q10 delivers the regulating bias to control pulse width of the regulated wave shaper circuit. Reference and control signals are derived from the voltage comparator circuit.

(8) Voltage Comparator. Transistors Q12 and Q13 are operating as a voltage comparator circuit with temperature stabilized reference voltages and an adjustable set point. Transistor Q11 is a current comparator circuit for paralleling operation.

B. Detailed Circuit Theory.

The following sub-paragraphs cover the individual circuits and their operation. Occasional reference to the overall schematic diagram of the equipment, Fig. 3, will be necessary to determine circuit configuration.

(1) Generator Start Relay. The generator start relay K1 with normally closed contacts in the de-energized condition allows maximum field current to flow during start-up of generator. When the generator voltage reaches approximately 20 volts, Zener diode ZR4 conducts and biases transistor Q15 to 'turn-on' and permits relay K1 to energize, opening the field current by-passing contacts. The generator field current path is now passing through the controller circuit through transistor Q7. Operating power is supplied from the generator (+), to the control circuits. Diode CR8 across the coil of relay K1 functions as a suppressor diode. Resistors R39 and R40 determine the maximum base current flow of transistor Q15.

(2) Stabilized Oscillator. The stabilized oscillator utilizes transistors Q8 and Q9 in a Hartley oscillator circuit. Toroidal transformer T1 with multiple windings provides the tuned circuit, feedback, and output windings for the oscillator. The tuned circuit is tuned by capacitor C3 to approximately 400 Hertz. Capacitor C8 provides parasitic suppression in the oscillator tank circuit. The feedback winding provides sustained oscillation to the base-collector circuit. Resistors R21 and R22 provide the bias to the base circuits of the transistors to insure starting and sustained oscillation. Resistor R15 provides degeneration for improved stability of the oscillator circuit. Output to the regulated wave shaper circuit is through remaining winding on transformer T1.

(3) Regulated Wave Shaper. The regulated wave shaper receives the 400 Hertz sinusoidal signal from transformer T1. The input signal applied to the bases of transistors Q1 and Q2 is through resistors R1 and R2 to limit the amount of base current. Transistors Q1 and Q2 conduct alternately on positive half-cycles of the input signal. The point of conduction and duration, resultant increase or decrease in duty cycle is determined by the bias supplied to the emitter circuits from transistor Q10, voltage regulator. Diode CR1 serves as a clamp

diode to set bias level of transistors Q1 and Q2. The output across the collectors is a quasi-square wave signal and is applied to the input of the clipper circuit.

(4) Clipper and Driver. The clipper and driver circuit provide additional shaping of the signal and amplification for application to the controller circuit. The clipper circuit consists of transistors Q3 and Q4 in a push-pull circuit. The quasi-square wave signal is coupled to the base circuits of transistors Q3 and Q4 through limiting resistors R3 and R5, respectively. The output of the clipper circuit is a quasi-square wave with improved rise time. The output is coupled to the base circuits of the driver transistors Q5 and Q6 through resistors R7 and R8, respectively. Resistors R9 and R10 provide a low impedance return for leakage currents. Output in the collector circuit is developed across toroidal transformer T2 and coupled to the controller circuit. Zener diode ZR1 and resistor R14 provide voltage regulation to the clipper and driver circuits.

(5) Controller. The controller circuit comprised of transistor Q7 and diodes CR2 and CR3 control the generator field current to regulate the output voltage of the generator. The quasi-square wave output across transformer T2 is converted to a uni-directional positive voltage by rectification circuit comprised of diodes CR2 and CR3. The positive pulses with a nominal pulse rate of 800 per second are applied to the base of transistor Q7 to control turn on and turn off. Variation of the pulse width, varies in step with the voltage adjustment setting of variable resistor R35, effectively controlling duty cycle. The results of this variation in duty cycle determines the on-off time of transistor Q7 and subsequent variations in generator field current to achieve voltage regulation at the generator output. The regulator operating at a nominal rate of 800 pulses per second in the controller section is adequate to provide proper smoothing of the current to the generator field. The predominate AC component on the DC output of the generator is due primarily to commutator ripple and not from the contribution of the field excitation. RF filter L1 in the collector circuit of transistor Q7 and in series with pin C of connector J1, provides additional filtering of the 800 pulse per second controller output and harmonics of the fundamental frequency. Since the generator field is highly inductive, continuous field current is achieved by the action of clamp diode CR4. The voltage waveform at pin A of connector J1, emitter of transistor Q7, is a positive pulse with an excursion from ground to a positive value approximating generator voltage, typically 27.5 to 29.5 volts. The current flowing in the generator field is constant due to the action of clamp diode CR4. Capacitor C2 and resistor R13 provide a series path for high speed transients which might appear across the collector to emitter circuit of transistor Q7.

(6) Overvoltage Sensing and Control. Transistor Q14 and Zener diode ZR3 provide a sensing and control circuit for overvoltage protection of the generator. If the generator voltage at pin C of connector J1 should rise to 32 volts DC ± 1 volt, Zener diode ZR3 will conduct and bias transistor Q14 to turn on. Transistor Q14 conducts and provides a ground return through pin E of connector J1 and series current limiting resistor R44. The coil of a latching relay, type MS25457-1, Leach No. 9237-4845, or equivalent, connected between pin E of connector J1 and the positive 28 volt DC source, with a coil rating of 1 Ampere or less, will operate instantly to interrupt the positive 28 volts DC to the voltage regulator or the current through the generator field lead, pins C and A, respectively, on connector J1. Reset of the latching relay is accomplished by application of 28 volts DC to the reset winding on the relay coil.

(7) Voltage Regulator. The voltage regulator consists of transistor Q10, and associated biasing and time constant circuitry. Resistors R18 and R19 comprise a voltage divider and

bias network for the emitter while resistor R17 and capacitor C4 establish the time constant of regulation. Control is applied to the base circuit from the voltage comparator. Output at the collector is applied to the emitter and base circuit of transistors Q1 and Q2, across clamp diode CR1.

(8) Voltage Comparator. The voltage comparator circuit comprised of transistors Q12 and Q13 samples the voltage on the generator bus, pin B of connector J1. The circuit operates as a differential comparator. The base of transistor Q13 receives the voltage from regulation point on generator bus, as adjusted by setting of voltage adjustment, variable resistor R35, while the base of transistor Q12 is referenced to the temperature compensated Zener voltage at the collector of transistor Q11. Any change in voltage at the regulation point on bus of the generator develops a voltage across resistor R23 in the base of transistor Q10 to apply a change in bias to the voltage regulator. Parallel generator operation is achieved by sampling the voltage between the equalizer bus, pin F of connector J1, and the equalizer sense point, terminal D on generator, pin D of connector J1. The change in voltage appears across resistor R27 and causes a change in the voltage drop across resistor R28 in the collector circuit, and adds in series with the reference voltage derived from temperature compensating diode CR5, CR6, and CR7 in series with Zener diode ZR2. Diode CR9 and resistor R26 establish a reference voltage at the base of transistor Q11. Unequal generator currents cause a change in generator voltage output in a direction to equalize generator currents.

REVISION REFERENCE SHEET

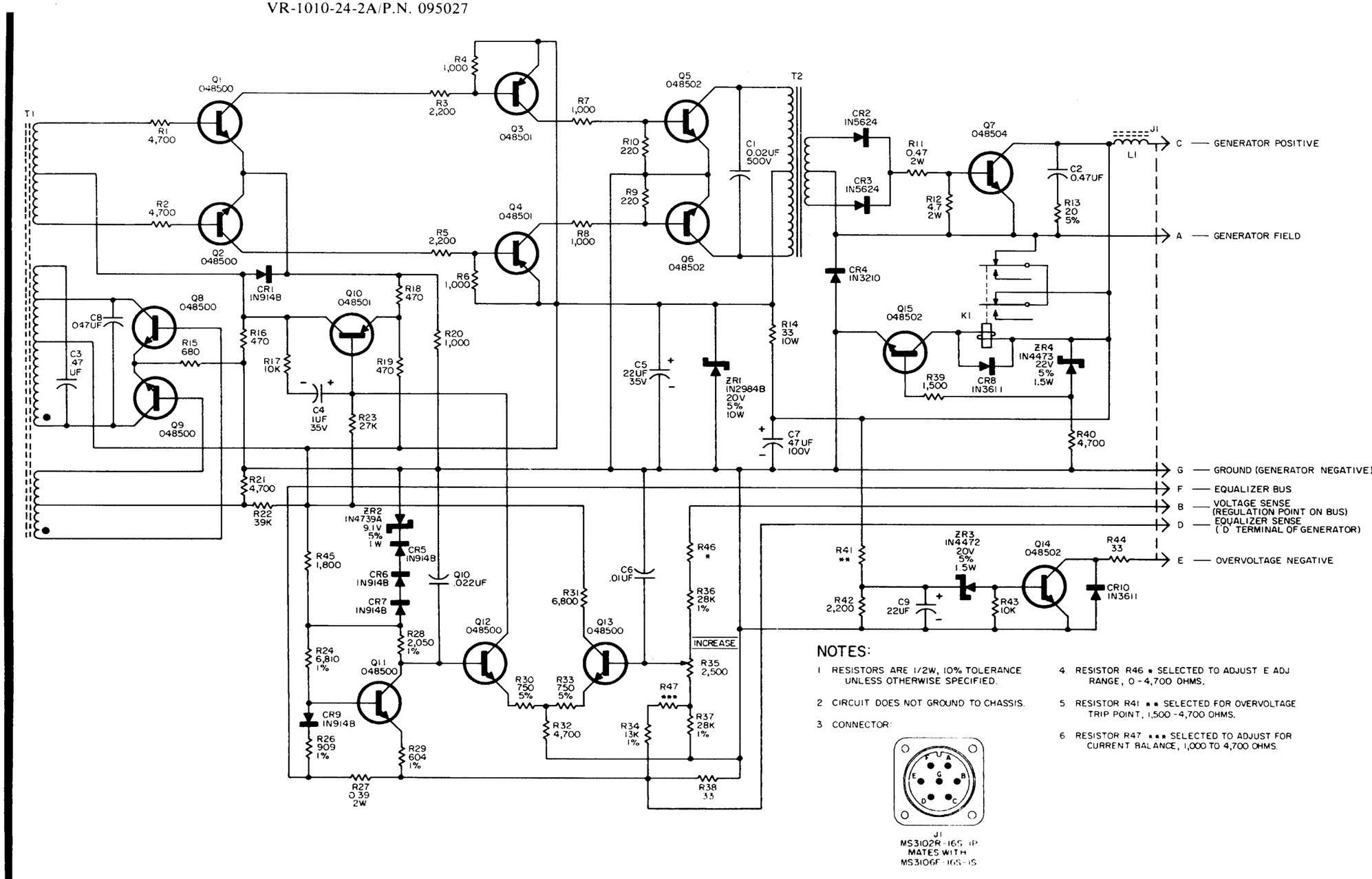
REVISION CODE	REVISION DESCRIPTION	SERIAL NO. EFFECTIVITY
A	RESISTOR R38 CHANGED TO 33 OHMS, ±10%, 1/2W FROM 5.6 OHMS, ±10%, 1/2W.	15 DEC 1967
B	MODIFICATION TO IMPROVE TEMPERATURE COMPENSATION: RESISTOR R24 CHANGED TO 6,810 OHMS, ±1%, 1/8W FROM SELECTED *(3,900-5,100 OHMS); RESISTOR R25 DELETED; RESISTOR R45 ADDED. 1,800 OHMS, ±10%, 1/2W; RESISTOR R26 CHANGED TO 909 OHMS, ±1%, 1/8W FROM 270 OHMS, ±10%, 1/2W; RESISTOR R28 CHANGED TO 2,050 OHMS, ±1%, 1/8W FROM 2,200 OHMS, ±10%, 1/2W; RESISTOR R29 CHANGED TO 604 OHMS, ±1% FROM 620 OHMS, ±10%, 1/2W; RESISTORS R30 AND R33 CHANGED TO 750 OHMS, ±5%, 1/2W FROM 1,000 OHMS, ±10%, 1/2W; RESISTOR R34 CHANGED TO 13K OHMS, ±1% FROM 20K OHMS, ±5%, 1/2W; RESISTORS R36 AND R37 CHANGED TO 28K OHMS, ±1%, 1/8W FROM 16.2K OHMS, ±1%, 1/8W; ZENER DIODE Z2 CHANGED TO 1N4465 FROM 1N4740A.	22 NOV 1968
C	DIODES CR2 AND DR3 CHANGED TO 1N5402 FROM 1N4721. TRANSISTOR Q7 CHANGED TO RCA TYPE NO. 60234 FROM RCA TYPE NO. 2N3772.	10 OCT 1969
D	DIODES CR2 AND CR3 CHANGED TO 1N5624 FROM 1N5402.	22 SEP 1971
E	DIODE CR8 CHANGED TO 1N3611 FROM 1N4002. TRANSISTOR Q7 CHANGED TO RCA TYPE NO. 64497 FROM RCA TYPE NO. 60234. ZENER DIODE Z3 & Z4 CHANGED TO 1N4473 FROM 1N4748A.	22 JUN 1973
F	RF FILTER L1 ADDED IN SERIES WITH PIN C, GENERATOR POSITIVE, OF RECEPTACLE J1.	7 JUN 1974
G	TRANSISTOR Q7 CHANGED TO RCA TYPE NO. 66090 FROM RCA TYPE NO. 64497.	5 MAR 1975

Model VR-1010-24-2A, DC Voltage Regulator,
Revision Reference Sheet, Schematic Diagram,
Figure 3 (Sheet 1 of 3)

VR-1010-24-2A/P.N. 095027

REVISION REFERENCE SHEET

REVISION CODE	REVISION DESCRIPTION	SERIAL NO. EFFECTIVITY
H	TRANSISTOR Q7 CHANGED TO PAI P.N. 048504 FROM RCA TYPE NO. 66090. TRANSISTORS Q5, Q6, AND Q15 CHANGED TO PAI P.N. 048502 FROM RCA TYPE NO. 40348.	1 DEC 1975
I	TRANSISTORS Q1, Q2, Q8, Q9, Q11, Q12, AND Q13 CHANGED TO PAI P.N. 048500 FROM TYPE 2N3565; TRANSISTORS Q3, Q4, AND Q10 CHANGED TO PAI P.N. 048501 FROM TYPE NO. 2N3638; ZENER DIODE SYMBOLS CHANGED Z1, Z2, Z3, AND Z4 TO ZR1, ZR2, ZR3, AND ZR4; TYPOGRAHICAL ERROR AS READS 1/4W CHANGED TO 1/8W, AS READS 10K CHANGED TO 13K IN REV. B.	1 AUG 1977
J	RELAY K1 CONTACTS CORRECTED TO FORM 'C.'	31 MAR 1978
K	ZENER DIODE ZR2 CHANGED TO 1N4739A-9.1V±5%, 1W FROM 1N4465-10V±5%, 1.5W.	30 JUN 1978



NOTES:

1. RESISTORS ARE 1/2W, 10% TOLERANCE UNLESS OTHERWISE SPECIFIED.
2. CIRCUIT DOES NOT GROUND TO CHASSIS.
3. CONNECTOR:

J1
MS3102R-16S-1P
MATES WITH
MS3106F-16S-1S

4. RESISTOR R46 * SELECTED TO ADJUST E ADJ RANGE, 0 - 4,700 OHMS.
5. RESISTOR R41 ** SELECTED FOR OVERVOLTAGE TRIP POINT, 1,500 - 4,700 OHMS.
6. RESISTOR R47 *** SELECTED TO ADJUST FOR CURRENT BALANCE, 1,000 TO 4,700 OHMS.

Model VR-1010-24-2A, DC Voltage Regulator,
Schematic Diagram
Figure 3 (Sheet 3 of 3)

TROUBLE SHOOTING

1. GENERAL.

The following paragraphs define procedures suitable for determining that a fault exists in the DC Voltage Regulator. These procedures do not cover trouble shooting within the regulator or associated generator. For equipment trouble shooting procedures refer to the overhaul manual and perform only in an overhaul shop.

2. PRELIMINARY SYSTEM CHECK.

Refer to the airframe wiring diagram and the cabling information given in Fig. 203 or 204 as applicable, and check wiring between generator/s and regulator for continuity and proper connection.

3. OPERATIONAL CHECK.

After preliminary checks have been completed an operational check may be made to determine the malfunctioning component of the system. All checks are made with the generator operating at or above minimum rated speed. When performing checks in a parallel system, check one generator and its associated equipment at a time. The remaining generator/s in the system should be off the line.

NOTE: Observe the engine manufacturers' instructions carefully to prevent overheating when operating the engine on the ground. As soon as checks are completed the engine should be throttled down.

Proceed with checks as outlined in Table 101 to determine malfunction.

CAUTION: UNDER NO CIRCUMSTANCES SHOULD THE REGULATOR BE DISASSEMBLED IN THE FIELD FOR REPAIRS. ANY REGULATOR FOUND TO BE DEFECTIVE MUST BE RETURNED TO AN OVERHAUL REPAIR SHOP FOR REPAIR AND RECONDITIONING.

Trouble Shooting Chart
Table 101 (Sheet 1 of 3)

SYMPTOM	PROBABLE CAUSE	CHECK	REMEDY
Generator ammeter reads zero.	Mating connector not connected properly, or open wiring at connector.	Disconnect input/output connector and inspect for defects.	Clean and/or replace defective connector or wiring.
	DC Voltage Regulator not adjusted properly or malfunctioning.		Remove regulator and install tested and properly adjusted regulator. Return malfunctioning unit to overhaul repair chop.
	Defective or damaged generator.	Check and inspect in accordance with generator manufacturer's instructions.	Remove defective generator and install operative unit. Return defective unit to overhaul repair shop.
	Damaged wiring between generator and regulator.	Inspect wiring for shorts and continuity using airframe manufacturer's installation drawings.	Replace defective wiring, check, and secure all connections.
	Defective ammeter.	Check operation and calibration in accordance with manufacturer's instructions.	Replace defective ammeter. Return defective parts to overhaul repair shop.
	Generator cutout open by overvoltage trip circuit action.	Check continuity of cutout by resistance checks.	Operate generator switch to reset position restoring continuity through generator cutout.
		Check cutout in accordance with manufacturer's instructions.	Replace defective generator cutout. Return defective unit to overhaul repair shop.
	Generator main power switch open, fusible link or battery relay open.	Check circuit for continuity and malfunctions.	Replace defective or malfunctioning unit. Return defective unit to overhaul repair shop.
Generator voltage zero.	DC Voltage Regulator malfunctioning.		Remove regulator and install tested and properly adjusted regulator. Return malfunctioning unit to overhaul repair shop.

SYMPTOM	PROBABLE CAUSE	CHECK	REMEDY
Generator voltage zero (cont.).	Damaged wiring between generator and regulator.	Inspect wiring for shorts and continuity using airframe manufacturer's installation drawings.	Replace defective wiring, check, and secure all connections.
	Defective or damaged generator.	Check and inspect in accordance with generator manufacturer's instructions.	Remove defective generator and install operative unit. Return defective unit to overhaul repair shop.
Output voltage too high.	DC Voltage Regulator not adjusted properly or malfunctioning.		Remove regulator and install tested and properly adjusted regulator. Return malfunctioning unit to overhaul repair shop.
	Damaged wiring between generator and regulator.	Inspect wiring for shorts and continuity using airframe manufacturer's installation drawings.	Replace defective wiring check, and secure all connections.
Output voltage too low.	DC Voltage Regulator not adjusted properly or malfunctioning.		Remove regulator and install tested and properly adjusted regulator. Return malfunctioning unit to overhaul repair shop.
	Damaged wiring between generator and regulator.	Inspect wiring for shorts and continuity using airframe manufacturer's installation drawings.	Replace defective wiring, check, and secure all connections.
Voltmeter or ammeter fluctuates rapidly under steady load conditions.	Malfunctioning DC Voltage Regulator.		Remove regulator and install tested and properly adjusted regulator. Return malfunctioning unit to overhaul repair shop.
Output voltage varies with application or removal of load.	Malfunctioning DC Voltage Regulator.		Remove regulator and install tested and properly adjusted regulator. Return malfunctioning unit to overhaul repair shop.
Load division in a parallel system out of limits.	Defective ammeter.	Check operation and calibration in accordance with manufacturer's instructions.	Replace defective ammeter. Return defective parts to overhaul repair shop.

Trouble Shooting Chart
Table 101 (Sheet 2 of 3)

SYMPTOM	PROBABLE CAUSE	CHECK	REMEDY
Load division in a parallel system out of limits (Cont.)	DC voltage regulator not adjusted properly or malfunctioning.		Remove regulator and install tested and properly adjusted regulator. Return malfunctioning unit to overhaul repair shop.
	Damaged wiring between generator and regulator.	Inspect wiring for shorts and continuity using airframe manufacturer's installation drawings.	Replace defective wiring, check, and secure all connections.
	Generator grounding straps not secured.	Check grounding of generator per airframe and generator manufacturer's instructions, and value of resistance specified.	Secure and ground strap generator properly.
	Equalizer switch/relay open-circuited or grounded.	Check switch/relay in accordance with manufacturer's instructions.	Replace defective switch/ relay.
	Equalizer switch/relay wiring shorted or open.	Check wiring in accordance with manufacturer's instructions.	Replace defective wiring and secure all connections.
System voltage drops when a generator in the parallel system is removed from line.	Equalizer switch/relay shorted.	Check switch/relay in accordance with manufacturer's instructions.	Replace defective switch.
	Equalizer switch/relay wiring shorted.	Check wiring in accordance with airframe manufacturer's drawings.	Replace defective wiring and secure all connections.

MAINTENANCE PRACTICES

1. GENERAL.

The following paragraphs cover in detail operations associated with maintenance, installation/removal, etc. of the Model VR-1010-24-2A DC Voltage Regulator.

2. SERVICING.

Periodic servicing or maintenance of the (solid-state) DC Voltage Regulator is not required or recommended. The equipment should not be removed from the airframe unless required by maintenance practices observed by the using agency. The use of solid state devices in a completely transistorized circuit eliminates the major causes of failures and periodic maintenance procedures. In the event a failure occurs refer to the Installation/Removal procedures and remove unit for repair by the overhaul shop or for return to vendor.

3. INSTALLATION/REMOVAL.

The following sub-paragraphs outline the installation and removal procedures for the DC Voltage Regulator.

A. Installation.

(1) Refer to Fig. 201 and Fig. 202 to determine clearance and mounting requirements for the DC Voltage Regulator.

CAUTION: USE CARE IN DRILLING OPERATION OF SUBSEQUENT PARAGRAPH, TO PREVENT DAMAGE TO AIRFRAME STRUCTURE, WIRING, OR CONTROLS.

(2) Refer to Fig. 202, mark and drill mounting holes for mounting, typical drilling information is given on Fig. 202.

(3) Install regulator using four, AN3-XXA, 10-32 aircraft hex head bolts, four, AN960-C10L, No. 10 flat washers, and four MS20365-1032C, aircraft self-locking hex nuts or equivalent AN or MS hardware. Length of bolts must be selected for the specific installation for length of grip area, and thread area to insure that at least one and one-half threads showing after installed and securely tightened.

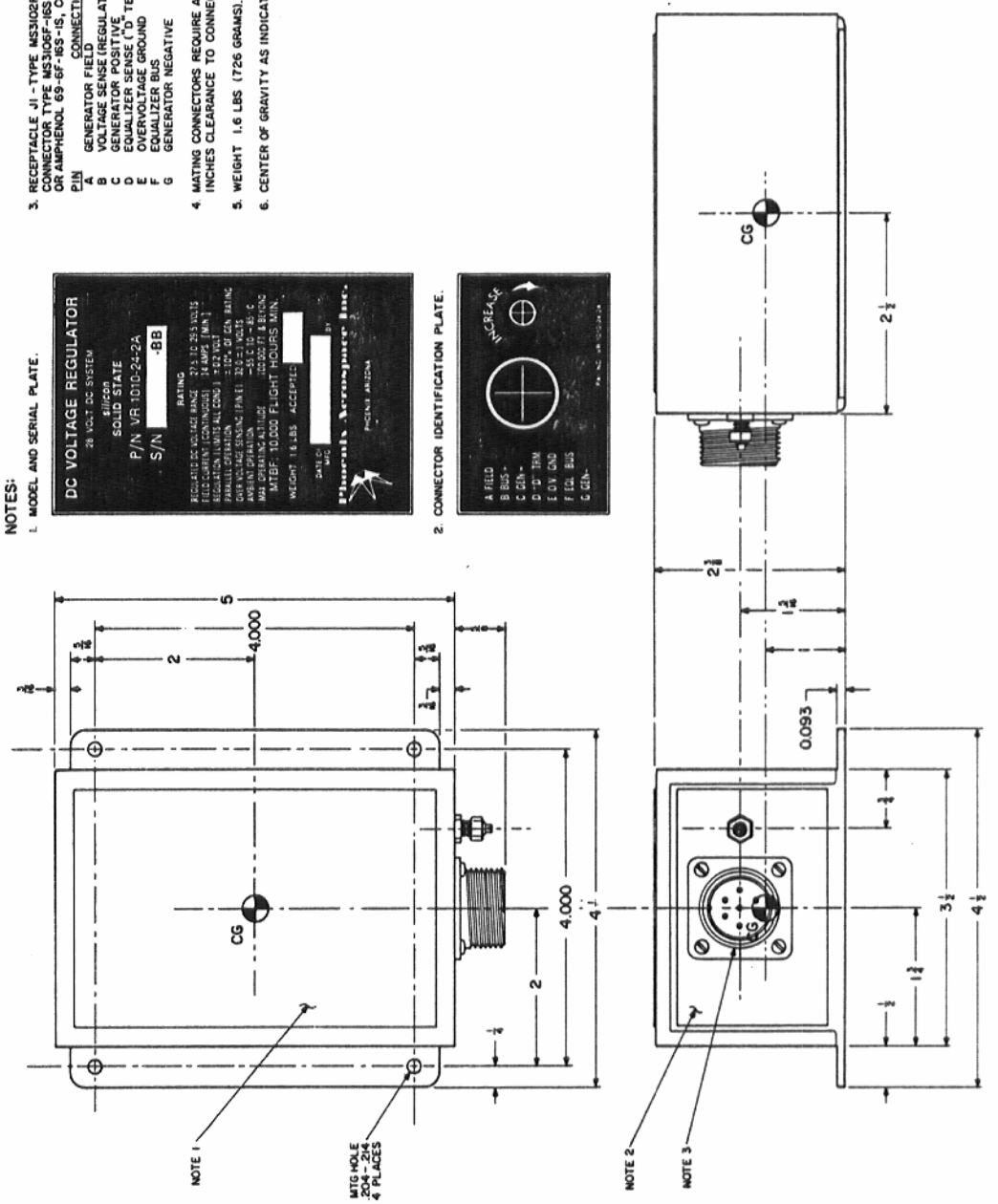
(4) Refer to Fig. 203, Fig. 204, and Fig. 205 and prepare wiring in accordance with system wiring diagrams. Refer to Fig. 204 and Fig. 205 for typical single and dual generator system wiring diagrams, respectively.

(5) After installation and wiring have been completed check to insure that all switches or circuit breakers are in their off positions.

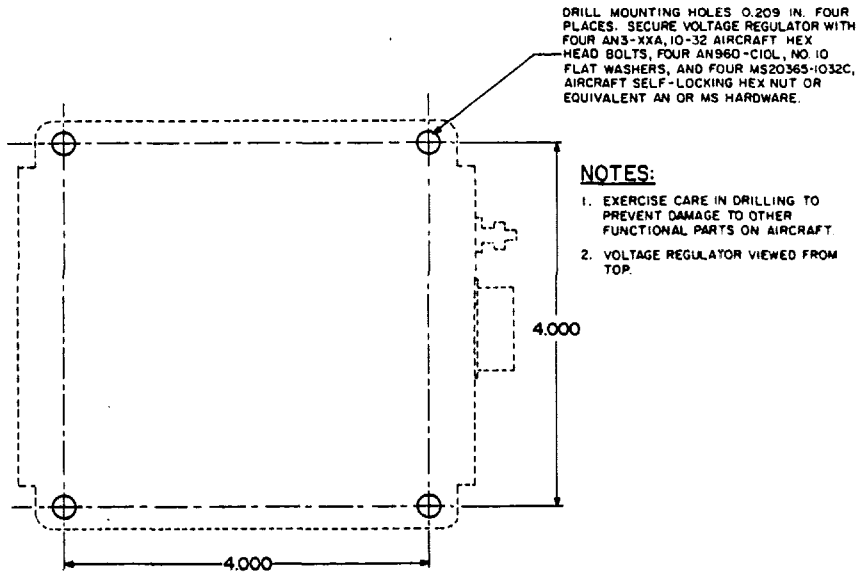
B. Removal.

(1) Place all switches or circuit breakers in their off positions.

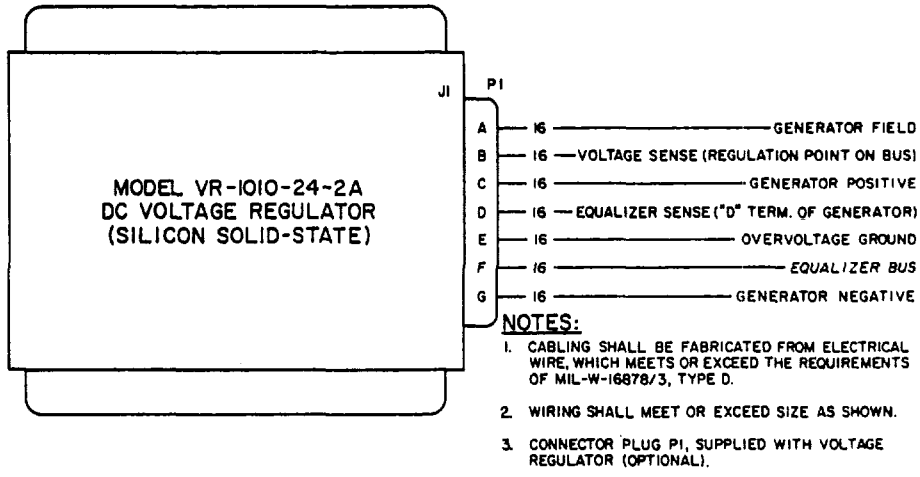
(2) Remove unit in reverse order of procedures given in paragraphs 3.A(1) thru (4).



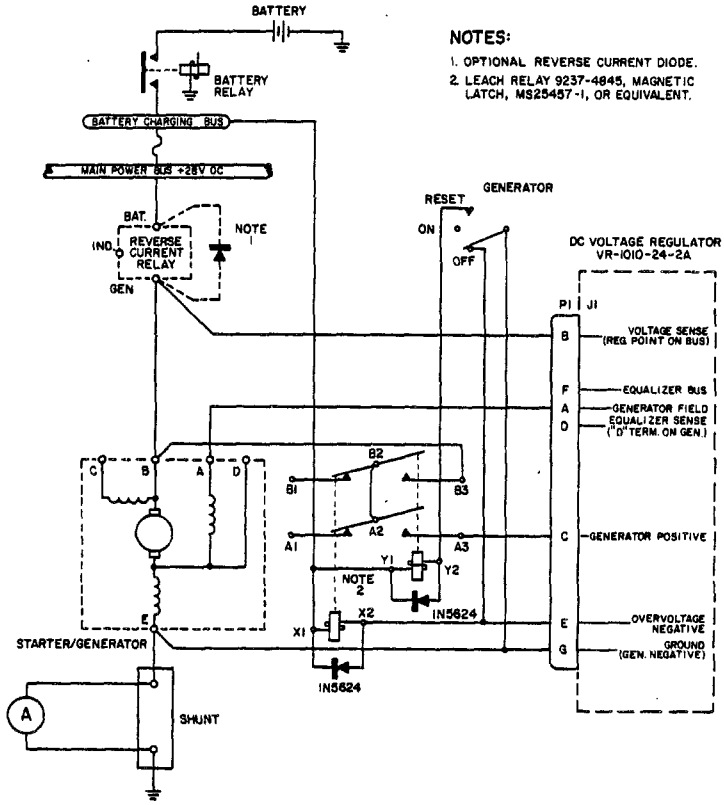
Outline Dimensions, Model VR-1010-24-2A
DC Voltage Regulator
Figure 201



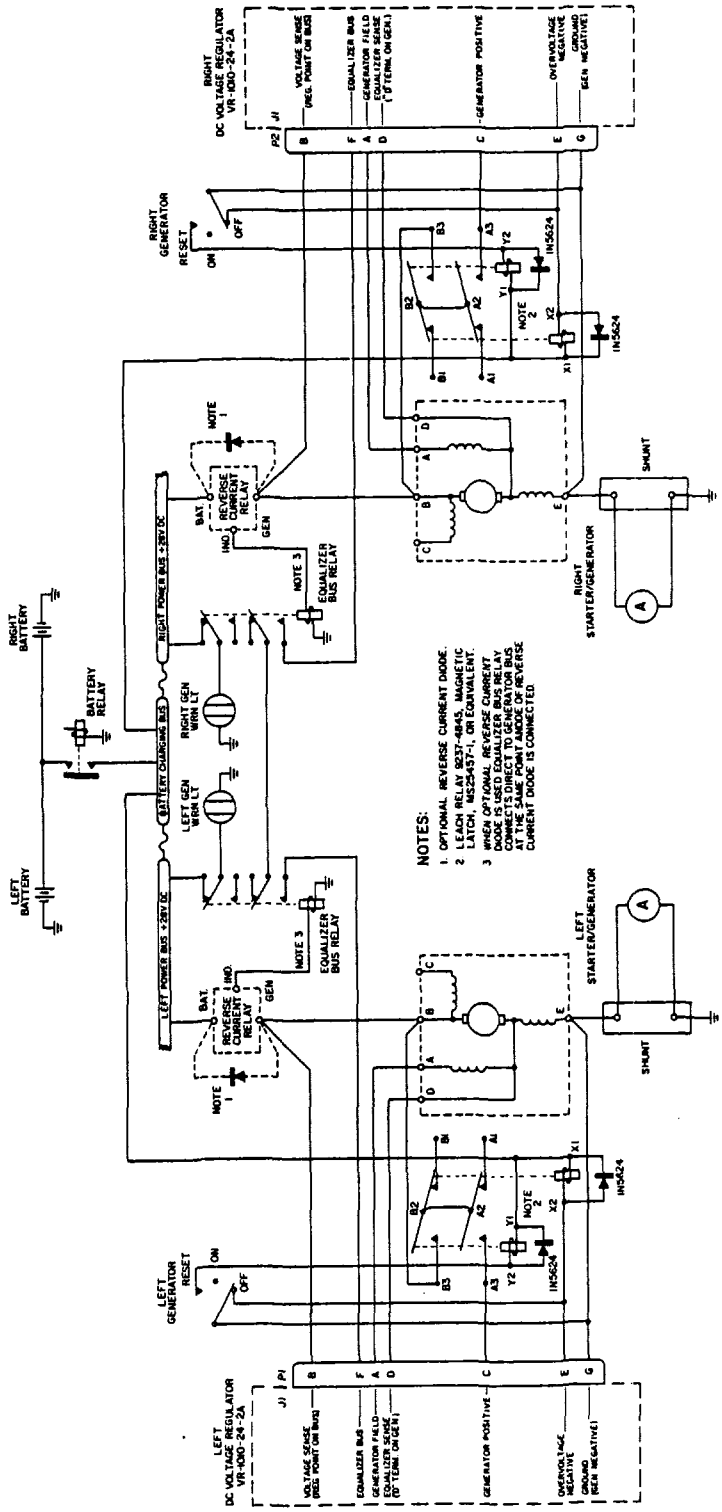
Drilling Template, Mounting Holes,
Model VR-1010-24-2A, DC Voltage
Regulator
Figure 202



Cabling Diagram, Model VR-1010-24-2A,
DC Voltage Regulator
Figure 203

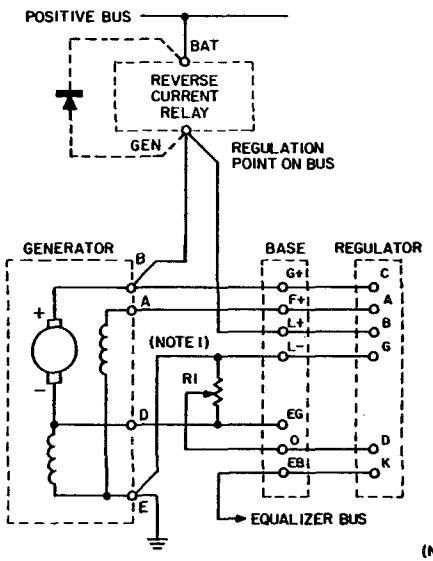


Typical Wiring Diagram for Single Generator System to Model VR-1010-24-2A, DC Voltage Regulator
Figure 204

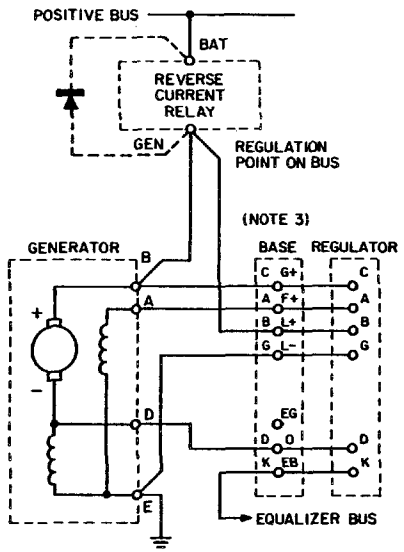


Typical Wiring Diagram for Dual Generator System to Model VR-1010-24-2A, DC Voltage Regulator
Figure 205

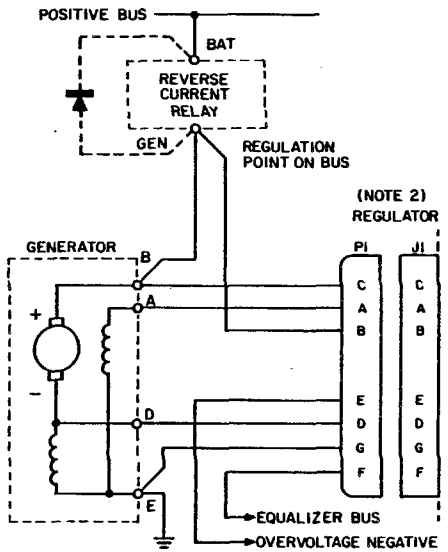
AN3206-1 OR EQUIVALENT
DC VOLTAGE REGULATOR, PLUG-IN UNIT
CARBON PILE
BENDIX OR GENERAL ELECTRIC BASE



MODEL VR-1010-24-1A
DC VOLTAGE REGULATOR, PLUG-IN UNIT
SILICON SOLID-STATE
AC40D-8445-2/AF49C-7573, OR
MODIFIED BENDIX OR GENERAL ELECTRIC BASE



MODEL VR-1010-24-2A
DC VOLTAGE REGULATOR
SOLID MOUNTING
SILICON SOLID-STATE



(NOTE 3)

VR-1010-24-2A DC VOLTAGE REGULATOR PIN	CONNECTION	VR-1010-24-1A DC VOLTAGE REGULATOR CONTACT	SERIES 1700 BENDIX BASE TERMINAL	AC40D-8445-2 OR AF49C-7573 BASE TERMINAL	CR2795MK03CI GENERAL ELECTRIC VIBRATION MOUNT TERMINAL
A	GENERATOR FIELD	A	F+	A	F+
B	VOLTAGE SENSE (REGULATION POINT ON BUS)	B	L+	B	L+
C	GENERATOR POSITIVE	C	G+	C	G+
D	EQUALIZER SENSE ("D" TERMINAL OF GENERATOR)	D	O-EG	D	O-EG
E	OVERVOLTAGE NEGATIVE	NONE	—	—	—
F	EQUALIZER BUS	K	EB	K	EB
G	GROUND (GENERATOR NEGATIVE)	G	L-	G	L-

NOTES:

1. REMOVE PARALLELING RESISTOR RI. IF PARALLELING RESISTOR RI IS NOT REMOVED, DISCONNECT RESISTOR LEADS AT TAPS L- AND EG, AND CONNECT JUMPER WIRE BETWEEN TAPS EG AND O.
2. PAI MODEL VR-1010-24-2A DC VOLTAGE REGULATOR CONNECTS TO THE SYSTEM THROUGH A TYPE MS3106F-16S-1S, OR EQUIVALENT CONNECTOR PLUG.
3. TABLE OF VOLTAGE REGULATOR MOUNTING BASE AND CONNECTOR PIN TERMINATIONS.

Typical DC Voltage Regulator Retrofit Data
Figure 206

4. ADJUSTMENT/TEST.

The following paragraphs outline test procedures for both installation check-out and a pre-installation bench test if desired or required by maintenance policies.

A. Installation Test.

Complete the following steps to determine that the DC Voltage Regulator and associated generator operate properly.

NOTE: The following checks are performed with the generator operating at, or above minimum rated speed. Observe the engine manufacturer's instructions carefully to prevent overheating when operating the engine on the ground. Upon completion of checking procedure, throttle engine down.

(1) Voltage Check.

(a) Connect a voltmeter with a range of 0 to 30 volts across terminals E and B of the generator, ground and positive terminals, respectively.

(b) Accelerate the engine until the generator is operating, at or above the minimum rated speed as given in the applicable generator manufacturer's handbook. Generator switch and master battery switches are open, OFF.

NOTE: Proper engine speed is determined by dividing the minimum rated generator speed by the ratio of generator speed to engine crankshaft speed as given in the manufacturer's handbook.

(c) Close the generator switch and place all load switches in their OFF positions.

(d) No-load or minimum-load voltage should be between 28.3 and 28.7 volts. In the event limits are exceeded, the regulator is not operating properly and should be removed for repair by the overhaul shop.

(e) The DC Voltage Regulator is preset at the factory for 28.5 volts with generator operating at full load and at MID-RANGE speed (6,000 RPM). In the event adjustment is required at flight line level, perform steps (f) through (h).

(f) Identify the Voltage Set potentiometer, INCREASE, adjacent to the Input/Output connector J1. Using a 5/16 inch hex nut driver with hollow shaft, loosen the regulation adjustment control locking nut.

(g) Using a small screwdriver, approximately 1/8 inch blade, rotate slotted control shaft to obtain desired voltage on regulated bus.

(h) Using the 5/16 inch hex nut driver, tighten control locking nut. DO NOT overtighten.

(i) Operate the generator at minimum rated speed with regulator under test for at least 15 minutes and recheck no-load and full-load voltage, to insure temperature rise does not affect the regulation.

NOTE: The Model VR-1010-24-2A DC Voltage Regulator does not exhibit the characteristic droop of carbon pile regulators when cold. The regulation will be flat over the specified temperature-altitude operating range.

(j) Close Master Battery switch and switch on a DC load to the system.

(k) The generator ammeter should indicate a reading equivalent to the load applied and the voltage reading on the voltmeter connected at the point of regulation on the positive DC bus and negative (ground) Terminal E of generator should indicate 28.5 volts DC.

(l) Switch OFF DC load, Master Battery switch, Generator switch, and engine.

CAUTION: DO NOT ATTEMPT TO DISCONNECT VOLTAGE REGULATOR FROM THE SYSTEM UNLESS GENERATOR IS STOPPED OR THE FIELD IS OPEN. FAILURE TO OBSERVE THIS CAUTION WILL RESULT IN PITTED OR BURNED CONTACT SURFACES.

(m) In the event trouble was experienced, remove the voltage regulator and return to the overhaul shop for repair.

(2) Paralleling Check.

NOTE: Each generator and regulator combination should be checked as outlined in preceding Voltage Check procedure, steps (a) through (m), and adjusted for exactly the same no-load or minimum-load voltage by completion of steps (f) through (h) of the Voltage Check procedure.

(a) Operate all generators at or above minimum rated speed.

(b) Check accuracy of the system ammeters by switching on one generator at a time while a constant load (approximately equal to the full-load rating of one generator) is switched on. Record the ammeter reading of each generator. If ammeter readings are equal, the ammeters are considered to be accurate.

(c) Close all generator switches, all equalizer switches, and with all generators operating at or above minimum rated speed, apply a load approximately equal to the full load rating of any one generator in the parallel system.

(d) Check the individual ammeters for indication that each generator is sharing the load with ± 10 per cent of rated output.

NOTE: In the event load sharing does not meet specification of ± 10 per cent, switch regulators and repeat preceding steps. If this fails to correct trouble, refer to manufacturer's handbook for the generator and check resistance in equalizing circuits for balance.

B. Pre-installation Test.

Complete the following steps to determine that the DC Voltage Regulator is operating properly before installation in the airframe.

NOTE: The subsequent steps are to be used only in determining proper operation of the DC Voltage Regulator prior to installation in the airframe. The following steps do not authorize flight line repairs to the DC Voltage Regulator other than resetting the voltage regulation point. Tests are performed on a motor driven generator test set similar to the Sun Model AGT-2 Generator Test Set or equivalent and a voltage and metering source as described in subsequent steps.

(1) Refer to Fig. 207 and connect the DC Voltage Regulator to the associated test equipment and the Generator Test Set.

CAUTION: DO NOT ATTEMPT TO CONNECT VOLTAGE REGULATOR TO THE GENERATOR TEST SET WITH THE GENERATOR TEST SET OPERATING.

(2) Proceed as follows to complete pre-installation tests.

(a) Start Generator Test Set and run generator speed up to LOW RANGE (approx. 4,500 RPM) Master Battery and Load switches open, OFF.

CAUTION: DO NOT OPERATE GENERATOR TEST SET WITHOUT AIRBLAST TO GENERATOR TO PREVENT SERIOUS OVERHEATING OF THE GENERATOR.

(b) No-load or minimum-load voltage should not vary more than ±0.2 volts from the regulated point setting, standard factory setting is 28.5 volts DC. In the event adjustment is required, perform steps (c) through (x).

(c) Identify the Voltage Set potentiometer INCREASE at the connector end of unit. Using a 5/16 inch hex nut driver with hollow shaft, loosen the regulation adjustment control locking nut.

(d) Using a small screwdriver, approximately 1/8 inch blade, rotate slotted control shaft to obtain desired voltage on regulated bus, Pin B of connector J1.

(e) Using the 5/16 inch hex nut driver, tighten control locking nut. DO NOT overtighten.

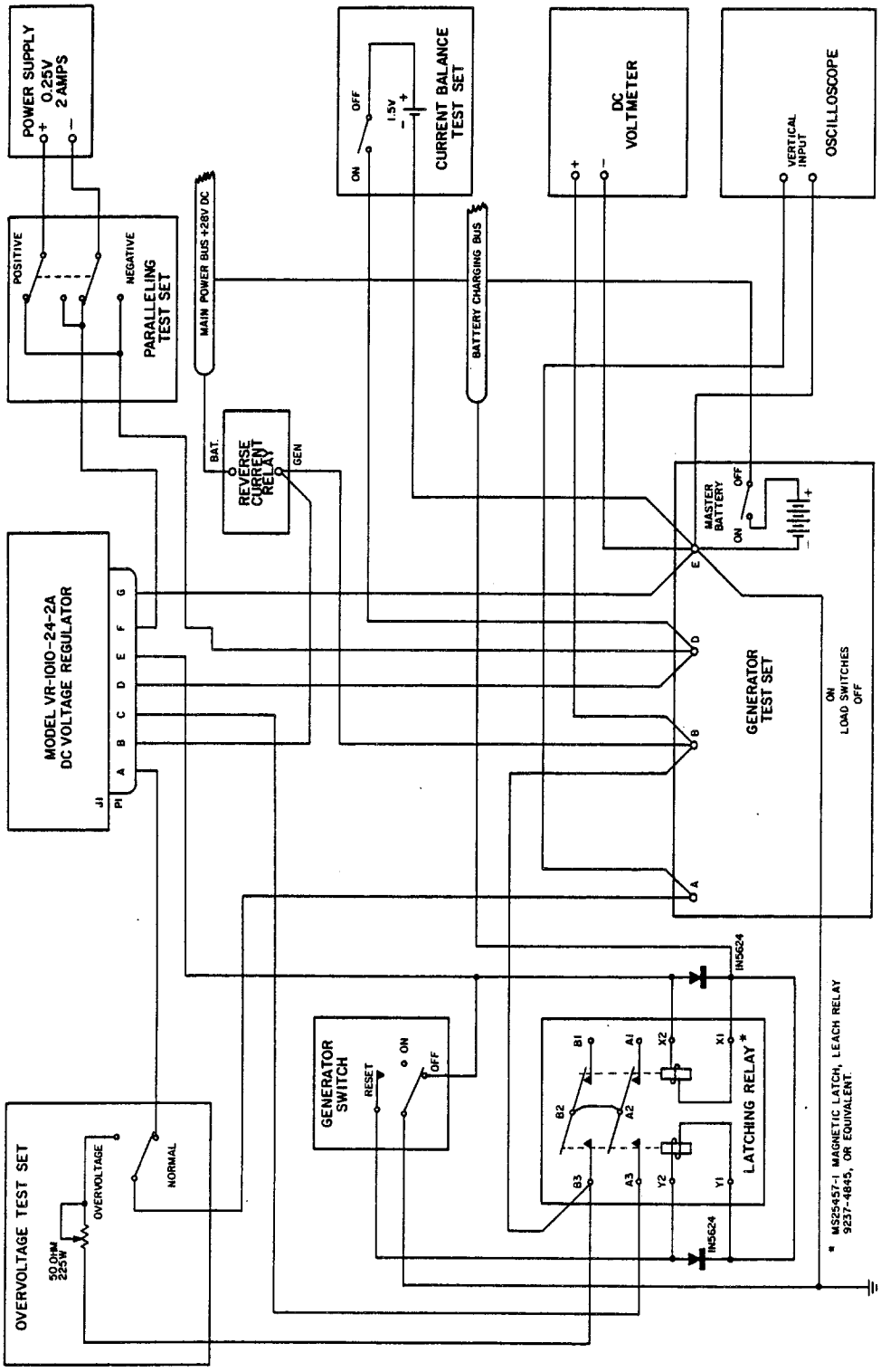
(f) Close Master Battery switch and Load switches to apply a load of 50 to 100 percent to the generator.

(g) Place all Load switches in their OFF positions and Master Battery switch in the OFF position and increase Generator Test Set speed to MID RANGE (approx. 6,000 RPM).

(h) No-load or minimum load voltage should not vary more than ±0.2 volts from the regulated point as determined in preceding step (b).

(i) Close Master Battery switch and Load switches to apply a load of 50 to 100 per cent to the system.

(j) Place all Load switches in their OFF positions and Master Battery switch in the OFF position and increase Generator Test Set speed to HIGH RANGE (approx. 8,000 RPM).



Generator Test Set Connections to
Model VR-1010-24-2A, DC Voltage Regulator
Figure 207

(k) No-load or minimum load voltage should not vary more than ±0.2 volts from the regulated point as determined in preceding steps (b) and (h).

(l) Close Master Battery switch and Load switches to apply 50 percent and 100 per cent loads to the generator.

(m) Place all Load switches in their OFF positions and Master Battery switch in the OFF position and decrease Generator Test Set speed to required speed preparatory to stopping Generator Test Set. Stop Generator Test Set completely.

NOTE: Each Voltage Regulator should be checked as outlined in preceding steps and adjusted for exactly the same no-load or minimum-load voltage by completion of steps (c) through (e).

(n) Complete steps (o) through (t) to check parallel operation.

(o) Start Generator Test Set and run generator speed up to LOW RANGE (approx. 4,500 RPM). Close Master Battery switch and Load switches to apply a 100 per cent load to the system.

(p) Operate Paralleling Test Set switch to NEGATIVE, applying the positive 0.25 volts DC to the equalizer bus, Pin F, connector J1 of the regulator and the negative 0.25 volts DC to terminal D of the Generator Test Set. Voltmeter reading across the generator output should decrease by at least 2.5 volts. Return switch to the center OFF position.

(q) Place all Load switches in their OFF positions disconnecting all load. Operate Paralleling Test Set switch to NEGATIVE, applying the positive 0.25 volts DC to the equalizer bus, Pin F, connector J1 of the regulator and the negative 0.25 volts DC to terminal D of the Generator Test Set. Voltmeter reading across the generator output should decrease by at least 2.5 volts. Return switch to center OFF position.

(r) Close Load switches to apply a 100 per cent load to the generator. Operate Paralleling Test Set switch to POSITIVE, applying the negative 0.25 volts DC to the equalizer bus, Pin F, connector J1 of the regulator and the positive 0.25 volts DC to terminal D of the Generator Test Set. Voltmeter reading across the generator output should increase by at least 2.5 volts. Return switch to the center OFF position.

(s) Place all Load switches in their OFF positions, disconnecting all loads. Operate Paralleling Test Set switch to POSITIVE, applying the negative 0.25 volts DC to the equalizer bus, Pin F, connector J1 of the regulator and the positive 0.25 volts DC to terminal D of the Generator Test Set. Voltmeter reading across the generator output should increase by at least 2.5 volts. Return switch to center OFF position.

(t) Operate Current Balance Test Set switch to the ON position applying −1.5 volts DC to terminal D on Generator Test Set and +1.5 volts DC to terminal G on Generator Test Set. Voltmeter across the generator output should not indicate a change greater than ±0.15 volts. Return Current Balance Test Set switch to the OFF position.

(u) Close Load switches to apply a 100 per cent load to the system. Operate Overvoltage Test Set switch NORMAL—OVERVOLTAGE by placing switch in the OVERVOLTAGE posi-

tion and adjust field current by varying setting of variable resistor to cause generator output voltage to increase, when the generator voltage reaches 32.0 volts ±1 volt DC the circuit operates a magnetic latching relay opening the field circuit and dropping generator output to zero. Application of 28 volts DC through the RESET switch to the magnetic latching relay restores generator field circuit and generator output, provided field current is returned to normal by resetting of variable resistor.

(v) Place all Load switches in their OFF positions, disconnecting all loads. Operate Overvoltage Test Set switch NORMAL—OVERVOLTAGE by placing switch in the OVERVOLTAGE position and adjust field current by varying setting of variable resistor to cause generator output voltage to increase, when the generator voltages reaches 32.0 volts ±1 volt DC the circuit operates a magnetic latching relay opening the field circuit and dropping generator output to zero. Application of 28 volts DC through the RESET switch to the magnetic latching relay restores generator field circuit and generator output, provided field current is returned to normal by resetting of variable resistor.

(w) Open Master Battery switch and decrease Generator Test Set speed required preparatory to stopping generator. Stop Generator Test Set completely.

CAUTION: DO NOT ATTEMPT TO DISCONNECT VOLTAGE REGULATOR FROM THE GENERATOR TEST SET UNTIL GENERATOR IS STOPPED AND ALL VOLTAGES ARE OFF. FAILURE TO OBSERVE THIS CAUTION WILL RESULT IN POSSIBLE DAMAGE TO THE REGULATOR.

(x) In the event trouble was experienced, remove the voltage regulator and return to overhaul shop for repair.

5. INSPECTION/CHECK.

Visual inspection of external cabling for breaks, and for proper connection at mating connectors, are the only authorized inspection checks. For inspection/check procedures of associated generator refer to the generator manufacturer's handbook. No authority is given for visual or other checks internally or removal of the sealed cover at flight line maintenance levels.

6. CLEANING/PAINTING.

The DC Voltage Regulator requires no periodic cleaning operations under the sealed cover. If readily accessible, exterior dust or dirt may be brushed or wiped off the exterior surfaces.

7. APPROVED REPAIRS.

The only repairs approved for flight line maintenance are those associated with external cabling. No repairs are authorized or approved for flight line maintenance requiring removal of the sealed cover.

8. GENERATOR TEST SET.

The Generator Test Set referenced in preceding paragraph 4B is only one of many types available. Other accessories, such as metering and switching arrangements are fabricated by the user to operate with the test setup as suggested. Test setup may be modified at user's discretion provided tests are completed.

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INTRODUCTION

In conformance with A.T.A. Specification No. 100 for Manufacturers' Technical Data, two manuals have been prepared concerning the Model VR-1010-24-2A DC Voltage Regulator. These manuals, if used as intended, will facilitate the effective, continued operation of the equipment. Technical data is grouped according to usage in the manual as described.

OVERHAUL MANUAL WITH ILLUSTRATED PARTS CATALOG

The Overhaul Manual contains all the information required for shop testing, replacement of defective parts, alignment and adjustment, mechanical disassembly, inspection, and reassembly. Detailed circuit theory is given with emphasis on theory that will be especially helpful for effective trouble-shooting. Performance tests as well as functional (go/no-go) checks, which may be used to determine condition of equipment and for retesting after repairs.

The Illustrated Parts Catalog provides a means to determine the manufacturer's part number and the physical location on the equipment of a part if the reference designation is known, or to determine the reference designation and the manufacturer's part number when the physical location of the part is known but no other information is available.

MAINTENANCE MANUAL

This manual is intended for use by flight line and hangar maintenance personnel. A detailed description and operation procedures, including a table of leading particulars are presented for reference. Mounting information and cabling information are presented as an aid to installation. Trouble-shooting information is limited to procedures required to trace a trouble to the overall unit for replacement.

VR-1010-24-2A/P.N. 095027

DESCRIPTION AND OPERATION

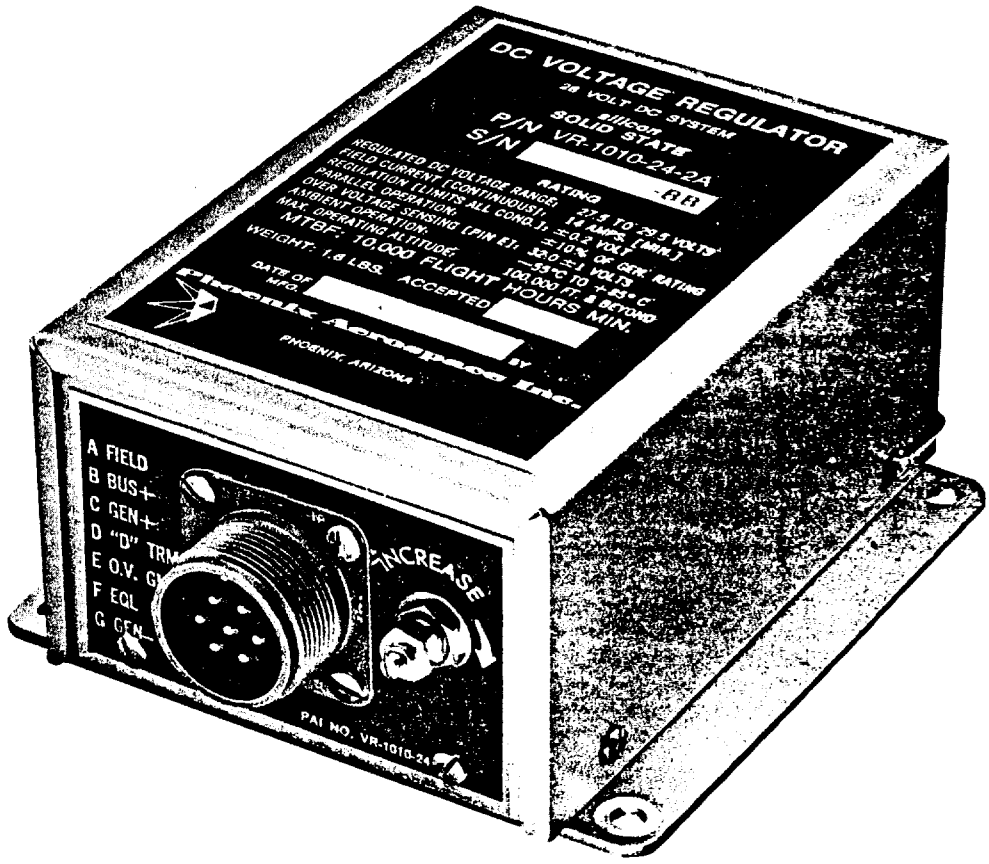
1. GENERAL.

A. Purpose of Manual.

This manual contains overhaul procedures and the illustrated parts catalog for the Model VR-1010-24-2A, DC Voltage Regulator (Solid-State), illustrated in Fig. 1.

B. Purpose of Equipment

The Model VR-1010-24-2A, DC Voltage Regulator is used to control all 28 volt direct current generators and starter generators conforming to FAA TSO-C56 and/or Military Specification MIL-G-6162. The regulator performs the function of maintaining constant output voltage under varying speed and load conditions in single generator or multiple generator systems.



Model VR-1010-24-2A, DC Voltage Regulator
Figure 1

2. DESCRIPTION.

A. The Model VR-1010-24-2A, DC Voltage Regulator is a compact self-contained unit utilizing state-of-the-art solid-state techniques. The regulated voltage is adjustable at a mechanically locked potentiometer adjacent to the input/output connector on the end of unit. Operating power for the regulator is obtained from the regulated generator. The regulator automatically adjusts field current to produce a constant voltage at the generator output under varying speeds and loads. The unit mounts directly on a bulkhead or other structural member, equipment rack, or equipment drawer. The unit is compactly packaged to facilitate placement in the aircraft and requires only a single, multi-pin, input/output connector between the unit and the aircraft wiring system.

B. The primary characteristics, capabilities, overall weight, and dimensions are listed in Table of Leading Particulars, Table 1.

GENERAL:

Duty: Continuous, unattended.

Temperature Rise: 15° C (maximum).

Cooling: Self-cooled by natural convection, conduction, and radiation.

Ambient Temperature Range: −85° to +85° C.

Maximum Operating Altitude: 100,000 feet and beyond.

Reliability: 10,000 hours MTBF (minimum).

ELECTRICAL:

Regulated DC Voltage Range: 27.5 to 29.5 VDC, no load to full load, over rated generator speed and temp/alt. operating range.

Field Current (Continuous): 14 Amperes (minimum).

Regulation: ±0.2 Volts, no load to full load, over rated generator speed and temp/alt. operating range.

Voltage Adjustment Limits: 26 VDC to 31 VDC, continuously variable.

Equalizer Circuit: ±2.5 Volts, minimum change, no load to full load, at minimum rated speed for regulation, when 0.25 volts is applied to equalizer bus terminals.

Parallel Operation: ±10 per cent equal division of load, two or more generators operated in parallel, no load to full load, over rated generator speed range.

Table of Leading Particulars
Table 1

Overvoltage Sensing: Overvoltage sensing circuit trips at 32.0 ±1.0 volts independent of the external field relay, placing a ground on pin E of connector J1 to operate an external relay.

Regulator Equivalent Resistance: High Value — More than 100 ohms.
Low Value — Less than 0.5 ohms.

Current Regulation: Regulation for balancing current between parallel generators in multiple generator systems.

Recovery Time: 0.05 Seconds, full load switched ON-OFF-ON, controlled voltage recovers to and remains within 10 per cent of steady state condition.

Overload Current: 14 Amperes (minimum) for one hour.

Induced Ripple: Less than 1.5 volts peak to peak.

Transient Protection: ±80 volts for 40 milliseconds,
±600 volts for 10 microseconds.

MECHANICAL:

Weight: 1.6 pounds (729.6 grams).

Overall Dimensions: 3-1/2 in. wide (8.89 cm) by
5 in. long (12.7 cm) by
2-3/8 in. high (6.03 cm).

Mounting Base Dimensions: 4-5/8 in. long (11.748 cm) by
4-1/2 in. wide (11.43 cm).

Mounting Centers: 4 in. long (10.16 cm) by 4 in. wide (10.16 cm).

Electrical Connectors: Input/Output: MS3102R-16S-1P mating MS3106F-16S-1S.

Cooling: Self-cooled by natural convection, conduction, and radiation.

Installation: Mounts in any position, without degradation of power output, heating, operating life, or other operating characteristics.

Adjustment: Voltage set potentiometer, INCREASE, adjusts voltage and paralleling in a single operation, located adjacent to input/output connector on regulator.

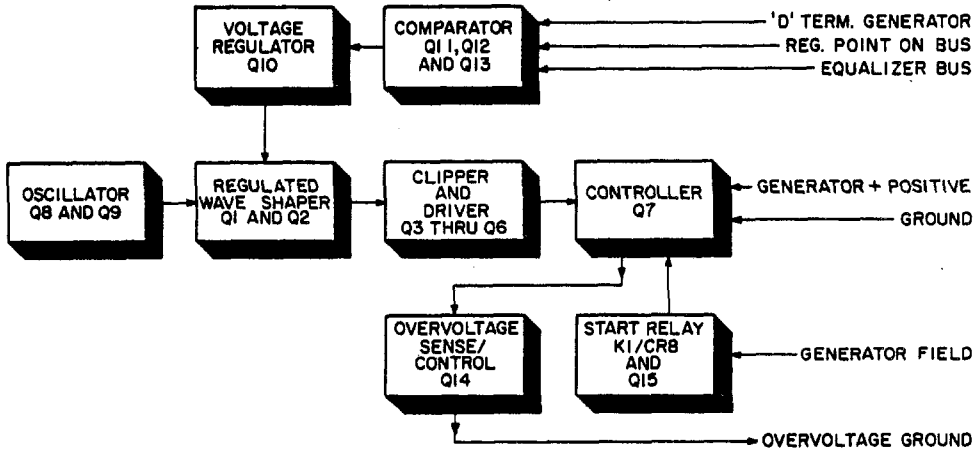
Table of Leading Particulars (Cont)
Table 1 (Cont)

3. OPERATION.

The subsequent paragraphs cover the theory of operation for the Model VR-1010-24-2A, DC Voltage Regulator. The Block Diagram Theory will aid in conveying the overall circuit operation to non-technical oriented personnel, while the Detailed Circuit Theory will enable the technician to understand in detail the operation of equipment.

A. Block Diagram Theory.

The subsequent paragraphs together with the block diagram of Fig. 2, cover in concise form the signal flow and circuit operation for the Model VR-1010-24-2A, DC Voltage Regulator.



Model VR-1010-24-2A, DC Voltage Regulator
Block Diagram
Figure 2

(1) Generator Start Relay. Relay K1 in the de-energized condition, contacts closed, completes the generator field circuit, until operating speed and voltage output are attained. Relay K1 energizes at a voltage of approximately 20 volts, when Zener diode ZR4 conducts and biases transistor Q15 to turn-on. Relay K1 contacts open by-passing the regulator controller circuits and permits the control circuits to function as controller. Operating power for the regulator circuit is obtained from the generator output.

(2) Stabilized Oscillator. Transistors Q8 and Q9 generate a sine wave signal at a frequency of approximately 400 Hertz. The sine wave signal is coupled through auxiliary windings of oscillator transformer T1 to the input of the regulated wave shaper circuits.

(3) Regulated Wave Shaper. Transistors Q1 and Q2 in a push-pull circuit receive the sine wave signal from the stabilized oscillator. Voltage applied from the voltage regulator circuit determines the shaping operation to control duty cycle and regulator operation. The shaped output is coupled to the input of the clipper circuit.

(4) Clipper and Driver. Transistors Q3, Q4, Q5, and Q6 in cascaded push-pull stages provide additional shaping and amplification of the 400 Hertz signal. The amplified signal is applied to the controller circuits.

(5) Controller. Transistor Q7 and diodes CR2 and CR3 comprise the controller circuitry. Transistor Q7 switches the generator field current at a rate of approximately 800 pulses per second, derived by rectification of the 400 Hertz signal by diodes CR2 and CR3. Variation in the width, duty cycle, determines the amount of field current. Clamp diode CR4 maintains continuous field current.

(6) Overvoltage Sense/Control. Transistor Q14 and Zener Diode ZR3 provide a sense and control circuit to operate an external relay to open the positive 28 volts DC supplied to the regulator or the generator Field line to provide overvoltage protection for the generator.

(7) Voltage Regulator. Transistor Q10 delivers the regulating bias to control pulse width of the regulated wave shaper circuit. Reference and control signals are derived from the voltage comparator circuit.

(8) Voltage Comparator. Transistors Q12 and Q13 are operating as a voltage comparator circuit with temperature stabilized reference voltages and an adjustable set point. Transistor Q11 is a current comparator circuit for paralleling operation.

B. Detailed Circuit Theory.

The following sub-paragraphs cover the individual circuits and their operation. Occasional reference to the overall schematic diagram of the equipment, Fig. 1201, will be necessary to determine circuit configuration.

(1) Generator Start Relay. The generator start relay K1 with normally closed contacts in the de-energized condition allows maximum field current to flow during start-up of generator. When the generator voltage reaches approximately 20 volts, Zener diode ZR4 conducts and biases transistor Q15 to 'turn-on' and permits relay K1 to energize, opening the field current by-passing contacts. The generator field current path is now passing through the controller circuit through transistor Q7. Operating power is supplied from the generator (+), to the control circuits. Diode CR8 across the coil of relay K1 functions as a suppressor diode. Resistors R39 and R40 determine the maximum base current flow of transistor Q15.

(2) Stabilized Oscillator. The stabilized oscillator utilizes transistors Q8 and Q9 in a Hartley oscillator circuit. Toroidal transformer T1 with multiple windings provides the tuned circuit, feedback, and output windings for the oscillator. The tuned circuit is tuned by capacitor C3 to approximately 400 Hertz. Capacitor C8 provides parasitic suppression in the oscillator tank circuit. The feedback winding provides sustained oscillation to the base-collector circuit. Resistors R21 and R22 provide the bias to the base circuits of the transistors to insure starting and sustained oscillation. Resistor R15 provides degeneration for improved stability of the oscillator circuit. Output to the regulated wave shaper circuit is through remaining winding on transformer T1.

(3) Regulated Wave Shaper. The regulated wave shaper receives the 400 Hertz sinusoidal signal from transformer T1. The input signal applied to the bases of transistors Q1 and Q2 is through resistors R1 and R2 to limit the amount of base current. Transistors Q1 and Q2 conduct alternately on positive half-cycles of the input signal. The point of conduction and duration, resultant increase or decrease in duty cycle is determined by the bias supplied to the emitter circuits from transistor Q10, voltage regulator. Diode CR1 serves as a clamp

diode to set bias level of transistors Q1 and Q2. The output across the collectors is a quasi-square wave signal and is applied to the input of the clipper circuit.

(4) Clipper and Driver. The clipper and driver circuit provide additional shaping of the signal and amplification for application to the controller circuit. The clipper circuit consists of transistors Q3 and Q4 in a push-pull circuit. The quasi-square wave signal is coupled to the base circuits of transistors Q3 and Q4 through limiting resistors R3 and R5, respectively. The output of the clipper circuit is a quasi-square wave with improved rise time. The output is coupled to the base circuits of the driver transistors Q5 and Q6 through resistors R7 and R8, respectively. Resistors R9 and R10 provide a low impedance return for leakage currents. Output in the collector circuit is developed across toroidal transformer T2 and coupled to the controller circuit. Zener diode ZR1 and resistor R14 provide voltage regulation to the clipper and driver circuits.

(5) Controller. The controller circuit comprised of transistor Q7 and diodes CR2 and CR3 control the generator field current to regulate the output voltage of the generator. The quasi-square wave output across transformer T2 is converted to a uni-directional positive voltage by rectification circuit comprised of diodes CR2 and CR3. The positive pulses with a nominal pulse rate of 800 per second are applied to the base of transistor Q7 to control turn on and turn off. Variation of the pulse width, varies in step with the voltage adjustment setting of variable resistor R35, effectively controlling duty cycle. The results of this variation in duty cycle determines the on-off time of transistor Q7 and subsequent variations in generator field current to achieve voltage regulation at the generator output. The regulator operating at a nominal rate of 800 pulses per second in the controller section is adequate to provide proper smoothing of the current to the generator field. The predominate AC component on the DC output of the generator is due primarily to commutator ripple and not from the contribution of the field excitation. RF filter L1 in the collector circuit of transistor Q7 and in series with pin C of connector J1, provides additional filtering of the 800 pulse per second controller output and harmonics of the fundamental frequency. Since the generator field is highly inductive, continuous field current is achieved by the action of clamp diode CR4. The voltage waveform at pin A of connector J1, emitter of transistor Q7, is a positive pulse with an excursion from ground to a positive value approximating generator voltage, typically 27.5 to 29.5 volts. The current flowing in the generator field is constant due to the action of clamp diode CR4. Capacitor C2 and resistor R13 provide a series path for high speed transients which might appear across the collector to emitter circuit of transistor Q7.

(6) Overvoltage Sensing and Control. Transistor Q14 and Zener diode ZR3 provide a sensing and control circuit for overvoltage protection of the generator. If the generator voltage at pin C of connector J1 should rise to 32 volts DC ± 1 volt, Zener diode ZR3 will conduct and bias transistor Q14 to turn on. Transistor Q14 conducts and provides a ground return through pin E of connector J1 and series current limiting resistor R44. The coil of a latching relay, type MS25457-1, Leach No. 9237-4845, or equivalent, connected between pin E of connector J1 and the positive 28 volt DC source, with a coil rating of 1 Ampere or less, will operate instantly to interrupt the positive 28 volts DC to the voltage regulator or the current through the generator field lead, pins C and A, respectively, on connector J1. Reset of the latching relay is accomplished by application of 28 volts DC to the reset winding on the relay coil.

(7) Voltage Regulator. The voltage regulator consists of transistor Q10, and associated biasing and time constant circuitry. Resistors R18 and R19 comprise a voltage divider and bias network for the emitter while resistor R17 and capacitor C4 establish the time constant of regulation. Control is applied to the base circuit from the voltage comparator. Output at the collector is applied to the emitter and base circuit of transistors Q1 and Q2, across clamp diode CR1.

(8) Voltage Comparator. The voltage comparator circuit comprised of transistors Q12 and Q13 samples the voltage on the generator bus, pin B of connector J1. The circuit operates as a differential comparator. The base of transistor Q13 receives the voltage from regulation point on generator bus, as adjusted by setting of voltage adjustment, variable resistor R35, while the base of transistor Q12 is referenced to the temperature compensated Zener voltage at the collector of transistor Q11. Any change in voltage at the regulation point on bus of the generator develops a voltage across resistor R23 in the base of transistor Q10 to apply a change in bias to the voltage regulator. Parallel generator operation is achieved by sampling the voltage between the equalizer bus, pin F of connector J1, and the equalizer sense point, terminal D on generator, pin D of connector J1. The change in voltage appears across resistor R27 and causes a change in the voltage drop across resistor R28 in the collector circuit, and adds in series with the reference voltage derived from temperature compensating diode CR5, CR6, and CR7 in series with Zener diode ZR2. Diode CR9 and resistor R26 establish a reference voltage at the base of transistor Q11. Unequal generator currents cause a change in generator voltage output in a direction to equalize generator currents.

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DISASSEMBLY

1. GENERAL.

This section outlines procedures for disassembly of the DC Voltage Regulator. These procedures should be followed in the event it becomes necessary to repair the unit after a malfunction or part failure. Electrical wiring should not be disconnected except when required for complete removal of a sub-assembly or when wiring is damaged or defective. When wiring is disconnected, tag each wire and note connection point for ease in identification during reassembly.

2. COVER REMOVAL.

A. Break Phoenix Aerospace, Inc. seal, (-19) Fig. 1101, by cutting wire, and remove.

NOTE: In the event DC Voltage Regulator is in warranty, breaking of seal may void warranty, unless covered by other contractual agreement.

B. Remove the four screws securing cover, (-17) and (-18) Fig. 1101, and remove cover, (16) Fig. 1101, by lifting straight up from base of regulator. Place hardware and cover aside for reassembly.

3. REMOVAL OF OSCILLATOR/AMPLIFIER BOARD AND SWITCHING CIRCUITS CHASSIS SUB-ASSEMBLY.

A. General.

Removal of oscillator/amplifier board and switching circuits chassis subassembly, (12) Fig. 1101, is accomplished to gain access to components on the circuit board, switching chassis, top and bottom sides. Unless an entire board or switching chassis replacement is necessary, interconnecting wires should never be disconnected. Proceed as follows to gain access to the components in the sub-assemblies.

B. Removal Procedures.

(1) Remove the four 4-40 x 1-3/4 inch long, (-14) Fig. 1101, round head machine screws and four .1875 inch O.D. round aluminum spacers, (-15) Fig. 1101, securing oscillator/amplifier circuit board sub-assembly, (40) Fig. 1102. Place hardware aside for reassembly.

(2) Carefully lift oscillator/amplifier circuit board sub-assembly, (40) Fig. 1101, and fold back to expose component side of circuit board and top side of switching circuits chassis pan, (1) Fig. 1102.

(3) Remove the four 4-40 x 7/16 inch long, (-13) Fig. 1101, pan head machine screws securing the switching circuits chassis pan, (1) Fig. 1102, to the regulator base, (2) Fig. 1101. Place hardware aside for reassembly.

(4) Remove switching circuits chassis pan sub-assembly, (1) Fig. 1102, by lifting out of voltage regulator base by grasping sub-assembly at rear edge and lifting out and up to clear connector and voltage adjust potentiometer. Fold back carefully to expose components on underside of sub-assembly.

(5) Carefully swing sub-assemblies into position necessary to gain access to components to be tested or replaced. DO NOT disconnect wiring unless removal of entire sub-assembly is required.

CLEANING

1. GENERAL.

This section outlines procedures for cleaning the components of the DC Voltage Regulator while disassembled. Cleaning materials are listed in Table 201.

WARNING: PERFORM OPERATION INVOLVING SOLVENT ONLY IN A WELL VENTILATED AREA. AVOID BREATHING OF SOLVENT VAPOR AND CONTINUOUS CONTACT WITH SOLVENT.

Reference to air jet refers to a hand-operated air nozzle supplied with clean, dry, compressed air at a maximum pressure of 28 psi.

WARNING: GOGGLES SHOULD BE WORN WHEN USING AIR JET TO BLOW DUST AND DIRT FROM EQUIPMENT. OTHER PERSONS SHOULD BE WARNED AWAY FROM HAZARDOUS AREA OR WORKING ENCLOSURE.

MATERIAL
Trichloroethylene Solvent
Soft-bristled Brush
Stiff-bristled Brush
Soft, Clean Cloth

List of Cleaning Materials
Table 201

2. PRINTED CIRCUIT BOARDS-WIRED CHASSIS.

Remove dust and dirt from all surfaces with a soft-bristled brush in conjunction with an air jet.

NOTE: When the dress of wiring is disturbed, dressing should be noted, and when cleaning is finished, wiring should be restored to proper dress or position.

3. METAL SURFACES.

Clean with soft cloth moistened in trichloroethylene solvent, and dry with clean, dry cloth.

4. CONNECTORS.

A. Wipe dust and dirt from contacts using trichloroethylene solvent and a soft cloth. Wipe dry with clean, dry cloth.

B. Remove dust from connectors using small, soft-bristled brush in conjunction with air jet.

INSPECTION/CHECK

1. GENERAL.

   This section contains procedures to determine the condition of the DC Voltage Regulator.

2. COVER.

   Inspect cover for deformations, dents, punctures or surfaces which might be wearing due to interference with other components.

3. CONNECTORS.

   A. Inspect for broken parts or other abnormal condition.

   B. Inspect for contacts which are broken, deformed or out of alignment. Check for corrosion and signs of arcing at the contacts and for poorly soldered connections.

4. RESISTORS.

   Inspect resistors for signs of overheating; cracked, broken, or charred insulation; loose, poorly soldered, or corroded terminal connections; and loose mountings.

5. METAL SURFACES AND MECHANICAL.

   Inspect metal surfaces for signs of corrosion. Also check component mountings for mechanical tightness.

6. WIRES.

   Check wires for damaged insulation and for proper dress.

REPAIR

1. GENERAL.

This section outlines instructions for the repair or replacement of damaged or defective parts. Faulty parts are usually detected by inspection, cleaning or trouble shooting. The repair or replacement of damaged or defective parts involves standard repair techniques. Identify each wire before removal of any part requiring unsoldering of several lead wires.

2. COVER AND METAL PARTS.

Straighten any deformation, and retouch scratched or worn surfaces as required.

3. PRINTED CIRCUIT BOARD AND TERMINAL STRIPS.

Remove all traces of corrosion and recoat with clear epoxy resin where broken or removed during repairs.

Before attempting to solder connections, peel away epoxy resin using a sharp knife.

NOTE: The clear epoxy resin is Armstrong Products Inc. Type T-600 or equivalent. Any time the epoxy coating is disturbed, recoating is advised.

4. CONNECTORS.

Check and resolder connections and check insulation. If badly damaged, replace connector or contact pin.

5. SOLDER CONNECTIONS.

Resolder any defective solder joints. Remove all traces of corrosion.

6. WIRING.

Replace any wiring with damaged insulation or broken strands.

7. RESISTORS.

Replace resistors that show signs of overheating or with cracked or broken bodies. Resolder loose, broken or corroded connections.

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ASSEMBLY

1. GENERAL.

This section outlines the instructions for assembly of the DC Voltage Regulator. Before assembly of the unit, the Cleaning, Inspection/Check, and Repair Sections should be consulted to determine if all components are properly cleaned and in proper physical and operating condition. Where wiring must be reconnected, good practices must be followed in dressing of wires and soldering connections. Refer to Figures 1101 through 1103 for identification and location of sub-assemblies and component parts.

2. ASSEMBLY OF OSCILLATOR/AMPLIFIER BOARD AND SWITCHING CIRCUITS CHASSIS SUB-ASSEMBLY.

A. General.

Assembly of the oscillator/amplifier board and switching circuits chassis sub-assembly requires reference to Figures 1101 through 1103 for component identification and reference to the schematic diagram, Figure 1201, in the event complete disassembly was necessary and it is necessary to reconnect interwiring. Proceed as follows, eliminating steps where necessary.

B. Assembly Procedures.

(1) Identify disconnected leads and reconnect to points indicated. Reference to the overall schematic diagram, Figure 1201, should be made for all connections as well as references to Figures 1101 through 1103 for component identification.

(2) Dress wires and replace switching circuits chassis pan, (1) Fig. 1101, by inserting front edge under connector and voltage adjustment potentiometer, and pushing gently down and forward to seat chassis pan in base of regulator, (2) Fig. 1101. Secure with four 4-40 x 7/16 inch long pan head machine screws (-13) Fig. 1101.

(3) Dress wires and replace oscillator/amplifier circuit board sub-assembly, (40) Fig. 1101, using four 4-40 x 1-3/4 inch long round head machine screws. (-14) Fig. 1101, and four .1875 inch O.D. round aluminum spacers, (-15) Fig. 1101, tighten securely.

3. INSTALLATION OF COVER.

A. Reposition cover (16) Fig. 1101, over regulator base (2) Fig. 1101, and slide cover into position.

B. Secure cover with two 4-40 x 3/8 inch long pan head machine screws, (-17) Fig. 1101, at the end nearest the connector and voltage adjustment potentiometer.

C. Secure cover with two 4-40 x 3/8 inch long (drilled) fillister head machine screws, (-18) Fig. 1101, at rear of unit, end opposite connector.

D. Place tie wire through drilled holes of fillister head screws and reseal with aluminum or lead seal, (-19) Fig. 1101, if available.

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FITS AND CLEARANCES

Not Applicable to Solid State DC Voltage Regulator.
No moving parts required.

TESTING

1. GENERAL.

This section defines test procedures for the Model VR-1010-24-2A DC Voltage Regulator. The procedures given are in sequential step form and test the unit completely. When the results of any step or test are not achieved the Trouble Shooting of this manual should be consulted.

2. PERFORMANCE TESTS.

Performance tests are designed to provide a fast efficient method for complete check-out of the voltage regulator. Subsequent paragraphs contain a list of test equipment required. Minimum performance requirements, and interconnect diagrams to facilitate testing.

A. Test Equipment Required.

The test equipment required to accomplish the performance tests consists of the following: generator test set, oscilloscope, volt-meter, and interconnect cabling. This equipment is listed and described in the Special Tools, Fixtures, and Equipment Section of this manual.

B. Minimum Performance Requirements.

The minimum performance requirements of the Model VR-1010-24-2A DC Voltage Regulator are as follows:

(1) The regulator provides regulation of generator field current such that the output voltage of generator is maintained constant. Regulation level is maintained at ±0.2 volts DC at any preset value in the 27.5 to 29.5 volts DC range. Regulation at this preset value is maintained at no load to full load operation and under varying generator speeds, at or above the minimum rated generator speed and temperature-altitude operating range.

(2) The regulator provides an overvoltage sense and control, overvoltage trip, which operates at 32 volts DC, ±1.0 volt DC. The circuit operates an external relay, magnetic, latching type, (MS25457-1, Leach Type 9237-48455, or equivalent), which opens the generator field circuit until reset by application of 28 volts DC from the battery bus through a reset startup. Time to trip for a typical aircraft system is shown in Fig. 701. The information given is time versus voltage, and approximates the rise in generator voltage after a malfunction causing loss or regulation. The overvoltage circuit operates instantly however when specified overvoltage is sensed, and opens the generator field within .002 seconds by relay action.

C. Preparation for Testing.

(1) Chassis Isolation Test. Perform the following steps using an Associated Research Model 2956, Insulation Resistance Tester to determine unit meets applicable specifications for chassis isolation.

WARNING: The recommended Insulation Tester produces potentially dangerous voltages. Care in operation must be exercised to prevent possible electrical shock.

(a) Place POWER ON/OFF Switch on Insulation Tester in the OFF Position and connect line cord, three wire grounding type, to source of 115 volts AC, 60 Hz. Identify VOLTAGE ADJUST control and rotate to the extreme counter-clockwise position. Connect the black lead with a spade lug to the GROUND terminal and connect clip to chassis at the spot faced mounting hole on the Voltage Regulator mounting flange. Identify MEGOHM MULTIPLIER control and position to the 100 position. Identify the HIGH VOLTAGE connection and connect test lead for use in subsequent paragraphs.

CAUTION: The Insulation Tester must be connected and operated in accordance with the following procedures to insure accurate testing and adequate protection to the equipment under test. Under no circumstances should the probes be connected to any point other than that specifically directed in the procedures given. In all cases the GROUND lead clip must be connected to the chassis of the unit being tested, (spot faced mounting hole or shell of connector J1).

(b) Identify HIGH VOLTAGE clip lead and connect to pin A of connector J1, GENERATOR FIELD, GROUND switch is in the METERED RETURN position. Identify HIGH VOLTAGE CIRCUIT—ENERGIZE switch and operate to the ON position, red HIGH VOLTAGE lamp will light. Identify VOLTAGE ADJUST control and rotate clockwise until KILOVOLTS meter indicates .5 KILOVOLT (500 volts). Note reading of the MEGOHMMETER and multiply by the KILOVOLTS meter reading multiplied by the multiplying factor of 1, multiplied by the MEGOHMS MULTIPLIER to obtain reading in Megohms. Return VOLTAGE ADJUST control to the extreme counter-clockwise position and place the HIGH VOLTAGE CIRCUIT—ENERGIZE switch in the OFF position. Disconnect the HIGH VOLTAGE test lead from the unit after metering indicates voltage has dropped to zero. Isolation of pin A of connector J1 to chassis ground must measure 10,000 megohms, minimum.

(c) Repeat procedures of paragraph (b) connecting HIGH VOLTAGE clip lead to pin B of connector, J1. Isolation of pin B of connector J1, VOLTAGE SENSE (Regulation Point on Bus), to chassis ground must measure 10,000 megohms, minimum.

(d) Repeat procedures of paragraph (b) connecting HIGH VOLTAGE clip lead to pin C of connector, J1. Isolation of pin C of connector J1, GENERATOR POSITIVE, to chassis ground must measure 10,000 megohms, minimum.

(e) Repeat procedures of paragraph (b) connecting HIGH VOLTAGE clip lead to pin D of connector, J1. Isolation of pin D of connector J1, EQUALIZER SENSE ("D" Terminal of Generator), to chassis ground must measure 10,000 megohms, minimum.

(f) Repeat procedures of paragraph (b) connecting HIGH VOLTAGE clip lead to pin E of connector, J1. Isolation of pin E of connector J1, OVERVOLTAGE GROUND, to chassis ground must measure 10,000 megohms, minimum.

(g) Repeat procedures of paragraph (b) connecting HIGH VOLTAGE clip lead to pin F of connector, J1. Isolation of pin F of connector J1, EQUALIZER BUS, to chassis ground must measure 10,000 megohms, minimum.

(h) Repeat procedures of paragraph (b) connecting HIGH VOLTAGE clip lead to pin G of connector, J1. Isolation of pin G of connector J1, GENERATOR NEGATIVE, to chassis ground must measure 10,000 megohms, minimum.

(i) Place POWER Switch on the Insulation Tester in the OFF Position and disconnect Insulation Tester before proceeding with subsequent performance testing.

(2) Complete the following steps to prepare the voltage regulator for testing. Refer to Fig. 702 for equipment interconnection and referenced test points.

CAUTION: DO NOT ATTEMPT TO CONNECT REGULATOR UNLESS GENERATOR TEST SET IS STOPPED OR THE FIELD IS OPEN. FAILURE TO OBSERVE THIS CAUTION WILL RESULT IN PITTED OR BURNED CONNECTOR PINS.

(a) Connect the DC Voltage Regulator to the generator test set through pendant cable and plug P1 to connector J1 on regulator.

(b) Connect the voltmeter across the positive and negative, terminals B and E on the generator, respectively. Set voltmeter to the range required to measure 0 to 30 volts DC.

(c) Connect the Paralleling Test Set, comprised of a polarity reversing switch and appropriate interconnect wiring to an auxiliary power supply to terminal D on the generator and the equalizer bus or pin F of connector P1/J1. Set the three position, POSITIVE-OFF-NEGATIVE, switch to the OFF position.

(d) Connect a DC power supply capable of supplying 0.25 volts DC at 2.0 amperes to the input terminals of the Paralleling Test Set. Set output level of supply to 0.25 volts using meter on supply or an accurate voltmeter.

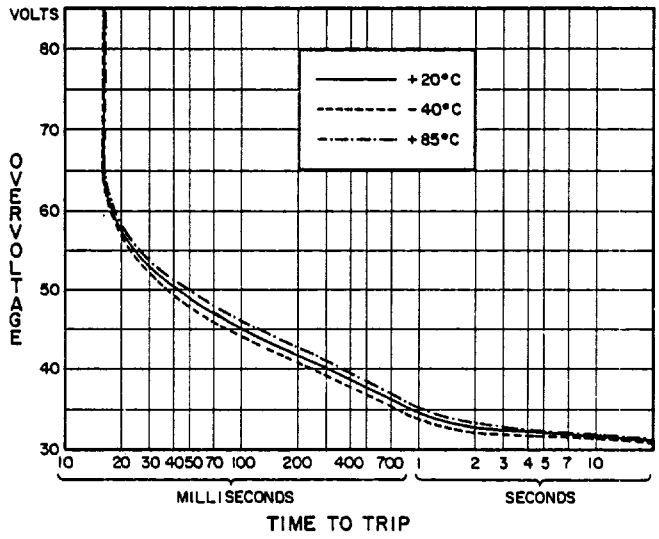
(e) Connect the Current Balance Test Set, comprised of a −1.5 volt DC source and a single pole single throw (ON-OFF) switch, to terminals D and E on the generator. Set the switch on the Current Balance Test Set the OFF position. Check voltage source for accuracy with a suitable meter.

(f) Connect the Overvoltage Test Set, comprised of a variable resistor, and a single pole double throw (NORMAL-OVERVOLTAGE) switch, to terminal B3 of the magnetic latching relay and the overvoltage terminal of the single pole double throw switch, and the remaining two terminals on the Test Set, in series with terminal A of the generator and Pin A of connector P1/J1 on the regulator. Place switch in the NORMAL position.

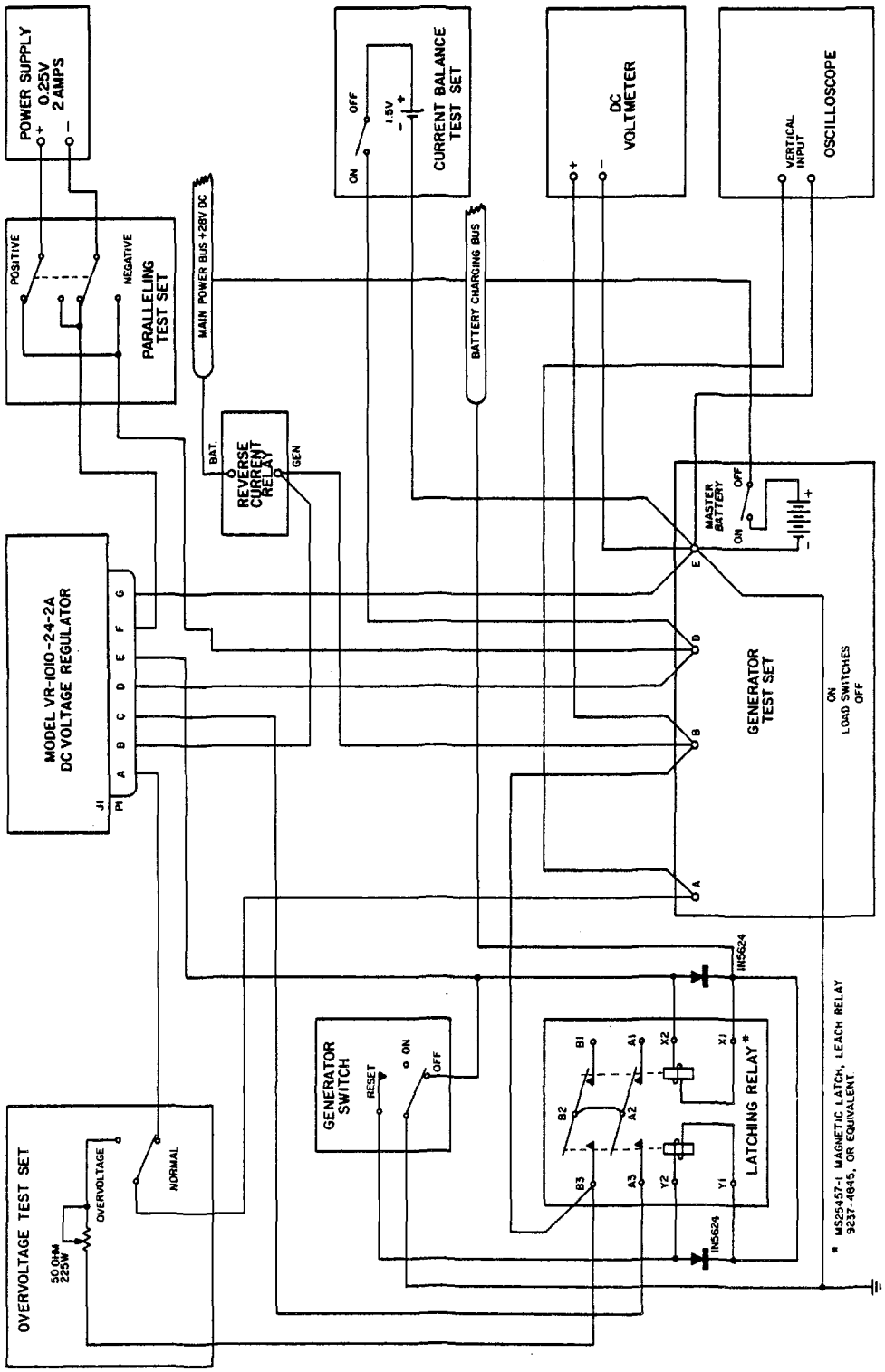
(g) Connect the oscilloscope to terminals A and E on the generator.

D. Performance Test.

The procedures of the performance test listed in numbered steps of Table 701 should be accomplished in the sequence presented. In the event the required result is not obtained, the trouble shooting section should be consulted and the malfunction corrected before proceeding to the next step.



Overvoltage Protector Trip
Charactistic in a Typical
Aircraft System
Figure 701



Test Set-up, Model VR-1010-24-2A
DC Voltage Regulator
Figure 702

STEP	SET-UP	PROCEDURE	RESULT
1	Interconnect per Fig. 702 and para. 2.C., Generator Test Set 'stopped' OFF.	(a) Apply power to all measuring equipment and auxiliary power supplies. (b) Check and set accuracy of the .025 volt and −1.5 volt DC sources.	
2	Generator Test Set load switches, and Master Battery switch in OFF positions. Paralleling Test Set, and Current Balance Test switches in their OFF position. Overvoltage Test Set switch in the NORMAL position.	Start Generator Test Set and run speed up to MID-RANGE (approx. 6,000 RPM).	Voltmeter across output indicates regulated voltage at point of regulation on the DC bus. Standard factory setting is 28.5 volts DC after final test.
3	Generator Test Set operating at MID-RANGE (6,000 RPM), Master Battery switch, Paralleling Test Set, and Current Balance Test Set switches in their OFF position. Overvoltage Test Set switch in the NORMAL position.	(a) Operate Generator Test Set LOAD switches to apply a 100 per cent load. (b) Identify the Voltage Set potentiometer, INCREASE, adjacent to connector J1 on the regulator. (c) Using a 5/16 inch hollow shaft nut driver, loosen adjustment locking nut. (d) Using a small screwdriver, approximately 1/8 inch blade, rotate slotted control shaft and set voltage to 28.0 volts DC prior to performing subsequent tests.	Voltmeter indicates regulated voltage point, and adjustment limits. Point of regulation as set becomes reference for subsequent tests. Voltmeter indicates 28.0 volts DC and becomes reference for subsequent tests.
4	Generator Test Set operating at MID-RANGE (approx. 6,000 RPM), Master Battery switch, Paralleling Test Set and Current Balance Test Set switches in their off position. Overvoltage Test Set switch in the NORMAL position.	Operate Generator Test Set Load switches to apply a 50 per cent load.	Voltmeter reading should not vary by an amount greater than plus or minus 0.2 volt from regulation point. Ammeter on Generator Test Set indicates a current equal to 50 per cent of generator full load current rating (typically 200 amperes).

STEP	SET-UP	PROCEDURE	RESULT
5	Generator Test Set operating at MID-RANGE (approx. 6,000 RPM). Master Battery switch, Paralleling Test Set and Current Balance Test Set switches in their off position. Overvoltage Test Set switch in the NORMAL position.	Operate Generator Test Set Load switches to apply a 100 per cent load.	Voltmeter readings should not vary by an amount greater than plus or minus 0.2 volt from regulation point. Ammeter on Generator Test Set indicates a current equal to 100 per cent of generator full load current rating (typically 400 amperes).
6	Generator Test Set operating at MID-RANGE (approx. 6,000 RPM), Paralleling Test Set and Current Balance Test Set switches in their OFF position. Overvoltage Test Set switch in the NORMAL position. Load switches in 100 per cent Load position.	Close Master Battery switch placing battery across generator output.	Voltmeter should not indicate in an oscillating manner, reading should remain stable.
7	RANGE (approx. 6,000 RPM), Paralleling Test Set and Current Balance Test Set switches in their OFF Position. Overvoltage Test Set switch in the NORMAL position. Load switches in 100 per cent load position and Master Battery switch ON.	(a) Place Master Battery switch to the OFF position removing battery from circuit. (b) Operate Generator Test Set Load switches to disconnect all load. (c) Increase Generator Test Set speed to HIGH RANGE (approx. 8,000 RPM).	Voltmeter reading should not vary by an amount greater than plus or minus 0.2 volt from regulation point.
8	Generator Test Set operating at HIGH RANGE (approx. 8,000 RPM). Master Battery, Paralleling Test Set, and Current Balance Test Set switches in their OFF position. Overvoltage Test Set switch in the NORMAL position.	Operate Generator Test Set Load switches to apply a 50 per cent load.	Voltmeter reading should not vary by an amount greater than plus or minus 0.2 volt from regulation point.
9	Generator Test Set operating at HIGH RANGE (approx. 8,000 RPM), Master Battery, Paralleling Test Set and Current Balance Test Set switches in their OFF position. Overvoltage Test Set in the NORMAL position.	Operate Generator Test Set Load switches to apply a 100 per cent load.	Ammeter on Generator Test Set indicates a current equal to 50 per cent of generator full load current rating (typically 200 amperes). Voltmeter reading should not vary by an amount greater than plus or minus 0.2 volt from regulation point. Ammeter on Generator Test Set indicates a current equal to 100 per cent of generator full load current rating (typically 400 amperes).

STEP	SET-UP	PROCEDURE	RESULT
10	Generator Test Set operating at HIGH RANGE (approx. 8,000 RPM), Master Battery, Paralleling Test Set and Current Balance Test Set switches in their OFF position, Overvoltage Test Set in the NORMAL position.	(a) Operate Generator Test Set Load switches to disconnect all load. (b) Decrease Generator Test Set speed to LOW RANGE (approx. 4,500 RPM) by braking.	Voltmeter reading should not vary by an amount greater than plus or minus 0.2 volt from regulation point.
11	Generator Test Set operating at LOW RANGE (approx. 4,500 RPM) Master Battery, Paralleling Test Set and Current Balance Test Set switches in their OFF position. Overvoltage Test Set in the NORMAL position.	Operate Generator Test Set Load switches to apply a 50 per cent load.	Voltmeter reading should not vary by an amount greater than plus or minus 0.2 volt from regulation point. Ammeter on Generator Test Set indicates a current equal to 50 per cent of generator full load current rating (typical 200 amperes).
12	Generator Test Set operating at LOW RANGE (approx. 4,500 RPM) Master Battery, Paralleling Test Set and Current Balance Test Set switches in their OFF position. Overvoltage Test Set in the NORMAL position.	Operate Generator Test Set Load switches to apply a 100 per cent load.	Voltmeter reading should not vary by an amount greater than plus or minus 0.2 volt from regulation point. Ammeter on Generator Test Set indicates a current equal to 100 per cent of generator full load current rating (typical 400 amperes).
13	Generator Test Set operating at LOW RANGE (approx. 4,500 RPM) Master Battery, Paralleling Test Set, and Current Balance Test Set switches in their OFF position. Overvoltge Test Set in the NORMAL position.	Operate Generator Test Set Load switches to disconnect load.	Voltmeter reading should not vary by an amount greater than plus or minus 0.2 volt from regulation point.
14	Generator Test Set load switches, and Master Battery switch in OFF positions, Paralleling Test Set, and Current Balance Test switches in their OFF position. Overvoltage Test Set switch in the NORMAL position.	Start Generator Test Set and run speed up to MID-RANGE (approx. 6,000 RPM).	Voltmeter across output indicates regulated voltage at point of regulation on the DC bus.

STEP	SET-UP	PROCEDURE	RESULT
15	Generator Test Set operating at MID-RANGE (6,000 RPM), Master Battery switch, Paralleling Test Set, and Current Balance Test Set switches in their OFF position. Overvoltage Test Set switch in the NORMAL position.	(a) Operate Generator Test Set LOAD switches to apply a 100 per cent load. (b) Identify the Voltage Adjustment control adjacent to connector J1 on the regulator. (c) Using a 5/16 inch hollow shaft nut driver, loosen adjustment locking nut. (d) Using a small screwdriver, approximately 1/8 inch blade, rotate slotted control shaft and set voltage to 28.5 volts DC.	Voltmeter indicates 28.5 volts DC and returns unit to factory setting of 28.5 volts DC.
16	Generator Test Set operating at LOW RANGE (approx. 4,500 RPM) Master Battery, Paralleling Test Set, and Current Balance Test Set, switches in their OFF position. Overvoltage Test Set in the NORMAL position.	(a) Operate Paralleling Test Set switch to NEGATIVE position applying the positive 0.25 volts DC to the equalizer bus, pin F, connector J1 of the regulator and the negative 0.25 volts DC to terminal D of the Generator Test Set. (b) Return Paralleling Test Set switch to center OFF position.	Voltmeter reading should decrease by at least 2.5 volts.
17	Generator Test Set operating at MID-RANGE (approx. 4,500 RPM), Master Battery switch, Paralleling Test Set, and Current Balance Test Set, switches in their OFF position. Overvoltage Test Set switch in the NORMAL position.	(a) Operate Generator Test Set Load switches to apply 100 per cent load. (b) Operate Paralleling Test Set switches to NEGATIVE applying the positive 0.25 volts DC to equalizer bus, pin F, connector J1 of the regulator and the negative 0.25 volts DC to terminal D of the Generator Test Set. (c) Return Paralleling Test Set switch to center OFF position. (d) Operate Generator Test Set Load switches to disconnect load.	Voltmeter reading should decrease by at least 2.5 volts.

STEP	SET-UP	PROCEDURE	RESULT
18	Generator Test Set operating at LOW RANGE (approx. 4,500 RPM), Master Battery switch, Paralleling Test Set, and Current Balance Test Set switches in their OFF position. Overvoltage Test Set switch in the NORMAL position. Generator Test Set Load switches set to NO LOAD positions.	(a) Operate Paralleling Test Set switch to POSITIVE applying the negative 0.25 volts DC to equalizer bus, pin F, connector J1 of the regulator and the positive 0.25 volts DC to terminal D of the Generator Test Set. (b) Return Paralleling Test Set switch to center OFF position.	Voltmeter reading should increase by at least 2.5 volts.
19	Generator Test Set operating at LOW RANGE (approx. 4,500 RPM), Master Battery switch, Paralleling Test Set, and Current Balance Test Set, switches in their OFF position. Overvoltage Test Set switch in the NORMAL position.	(a) Operate Generator Test Set Load switches to apply 100 per cent load. (b) Operate Paralleling Test Set switches to POSITIVE applying the negative 0.25 volts DC to equalizer bus, Pin F, connector J1 of the regulator and the positive 0.25 volts DC to terminal D of the Generator Test Set. (c) Return Paralleling Test Set switch to center OFF position.	Voltmeter reading should increase by at least 2.5 volts.
20	Generator Test Set operating at LOW RANGE (approx. 4,500 RPM) Master Battery switch, Paralleling Test Set, and Current Balance Test Set, switches in their OFF position. Overvoltage Test Set switch in the NORMAL position. Generator Test Set Load switches set to 100 per cent load.	(a) Operate Current Balance Test Set switch to ON position applying the negative 1.5 volts to terminal D of the Generator Test Set and the positive 1.5 volts to terminal E of the Generator Test Set. (b) Return Current Balance Test Set switch to the OFF position. (c) Operate Generator Test Set Load switches to disconnect Load.	Voltmeter should not indicate a change greater than ±0.15 volts.

STEP	SET-UP	PROCEDURE	RESULT
21	Generator Test Set operating at LOW RANGE (approx. 4,500 RPM) Master Battery switch, Paralleling Test Set, and Current Balance Test Set switches in their OFF position. Overvoltage Test Set switch in the NORMAL position.	(a) Operate Overvoltage Test Set placing NORMAL—OVER-VOLTAGE switch to the OVER-VOLTAGE position and rotate ADJUSTMENT potentiometer on Test Set to increase field current to the field of the Generator Test Set. (b) Reduce Generator Test Set speed by braking preparatory to stopping generator. (c) Stop generator Test Set and disconnect the DC Voltage Regulator.	Voltmeter reading will increase in direct relation with change in field current. Generator Test Set output will drop to zero when the voltage rises to 32 volts DC ±1 volt DC.

VR-1010-24-2A/P.N. 095027

TROUBLE SHOOTING

1. GENERAL.

This section outlines in tabular form information for use in localization and isolation of trouble in the Model VR-1010-24-1A DC Voltage Regulator. The trouble shooting procedures, Table 801, together with the information given in preceding section on Testing will in most cases localize and isolate the trouble. Reference to the schematic diagram, Fig. 1201, and the section on Detailed Theory will be necessary and helpful. The voltage measurements of Table 802 in conjunction with the waveforms illustrated in Fig. 801 will aid in isolation of trouble.

2. TROUBLE SHOOTING.

A. Localization.

The trouble shooting table, Table 801, provides a means of localizing malfunctions to a replaceable component or sub-assembly. The table is arranged in the same order of precedence as the performance tests, Table 701, in the preceding section. The applicable step of the performance test is shown in parentheses next to the trouble shooting step in the STEP column, in Table 801.

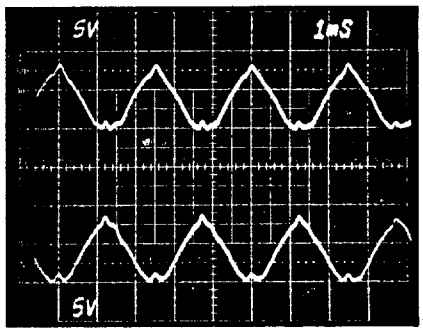
B. Isolation.

The voltage measurements of Table 802 are made using the voltohmmeter described in the Special Tools section of this manual. Reference to the schematic diagram, Fig. 1201, while making voltage measurements will aid in isolation of trouble within the unit.

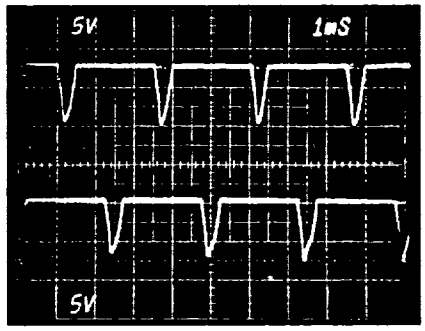
C. Analysis.

The waveforms pictured in Fig. 801 were made using the oscilloscope described in the Special Tools section of this manual, and will aid in analyzing the equipment performance when trouble shooting procedures are being performed.

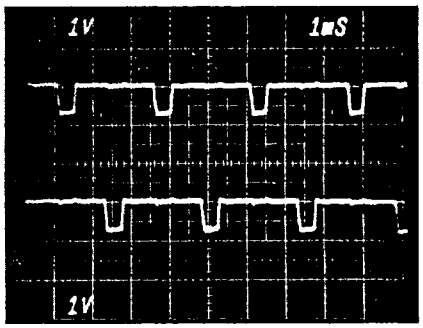
STEP	SYMPTOM	PROBABLE CAUSE	CHECK	REMEDY
1	Generator voltage continues to increase.	Relay K1 failed to open, defective transistor Q15, Zener diode ZR4 or diode CR8.	Check transistor Q15, zener diode ZR4, diode CR8, or relay K1.	Replace defective component.
2	Generator output voltage zero, erratic regulation, or erratic paralleling operation.	Open or defective wiring at connector P1/J1 of regulator or at generator terminals.	Continuity of input/output wiring and connector P1/J1 and generator.	Repair or replace.
3	Generator output voltage increases to 20 volts and starts dropping to zero causing relay chatter.	Defective drive signal.	Check operation of oscillator transistor Q8 and Q9, and following stages of shaping and amplification, transistors Q1 through Q7.	Replace defective component.
4	Generator output voltage control adjustment on regulator, resistor R35, out of limits.	Defective reference in voltage comparator circuit.	Check zener diode ZR2, resistors R35, R28 and R29, diodes CR5, CR6, and CR7, and transistor Q12.	Replace defective component.
5	Generator will not operate in parallel service within specifications.	Defective reference in current comparator circuit.	Check resistors R26 and R27, and transistor Q11.	Replace defective component.
6	Generator (hunts) voltage rises and falls erractically.	Defective time constant in voltage regulator circuit.	Check capacitors C4 and C5 and zener diode ZR1.	Replace defective component.
7	Overvoltage relay cuts generator off line repeatedly.	Defective overvoltage control circuit or defective output circuit, control transistor.	Check transistor Q14, Zener diode ZR3, diode CR10 and transistor Q7.	Replace defective component.



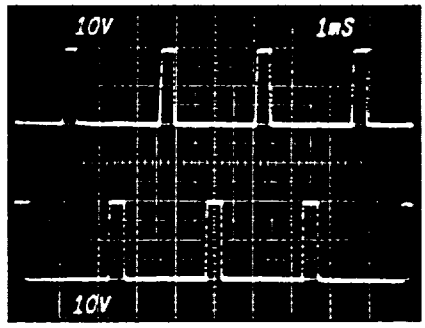
A. WAVEFORMS AT BASE OF TRANSISTORS Q1 AND Q2
GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM),
100 AMP LOAD
VERTICAL SENSITIVITY: 5.0 VOLTS/DIVISION
TIME BASE: 1.0 MILLISECONDS/DIVISION



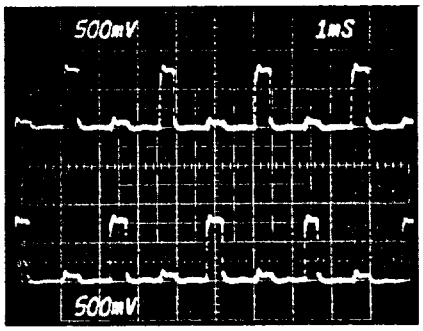
B. WAVEFORMS AT COLLECTOR OF TRANSISTORS Q1 AND Q2
GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM),
100 AMP LOAD
VERTICAL SENSITIVITY: 5.0 VOLTS/DIVISION
TIME BASE: 1.0 MILLISECONDS/DIVISION



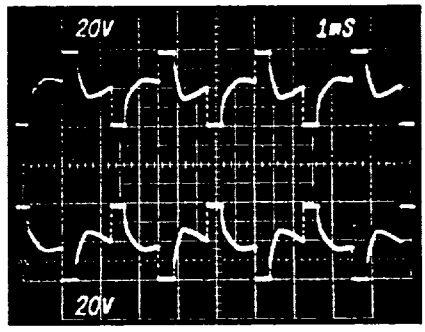
C. WAVEFORMS AT BASE OF TRANSISTORS Q3 AND Q4
GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM),
100 AMP LOAD
VERTICAL SENSITIVITY: 1.0 VOLTS/DIVISION
TIME BASE: 1.0 MILLISECONDS/DIVISION



D. WAVEFORMS AT COLLECTOR OF TRANSISTORS Q3 AND Q4
GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM),
100 AMP LOAD
VERTICAL SENSITIVITY: 10.0 VOLTS/DIVISION
TIME BASE: 1.0 MILLISECONDS/DIVISION

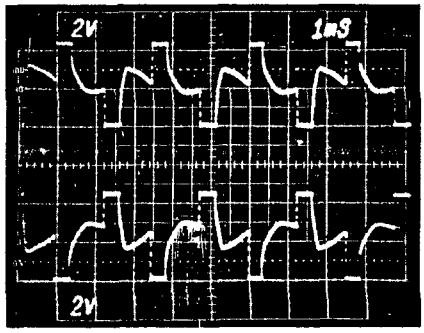


E. WAVEFORMS AT BASE OF TRANSISTORS Q5 AND Q6
GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM),
100 AMP LOAD
VERTICAL SENSITIVITY: 0.5 VOLTS/DIVISION
TIME BASE: 1.0 MILLISECONDS/DIVISION

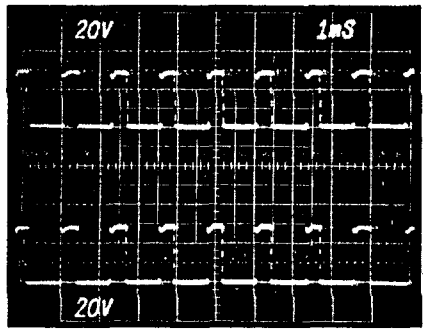


F. WAVEFORMS AT COLLECTOR OF TRANSISTORS Q5 AND Q6
GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM),
100 AMP LOAD
VERTICAL SENSITIVITY: 20.0 VOLTS/DIVISION
TIME BASE: 1.0 MILLISECONDS/DIVISION

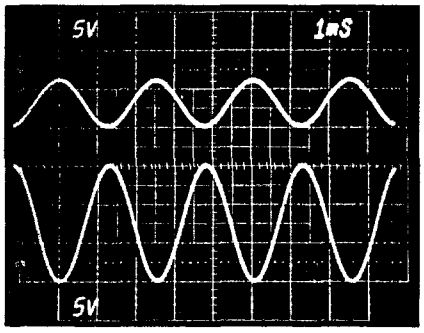
Waveform Measurements, Model VR-1010-24-2A,
DC Voltage Regulator
Figure 801 (Sheet 1 of 3)



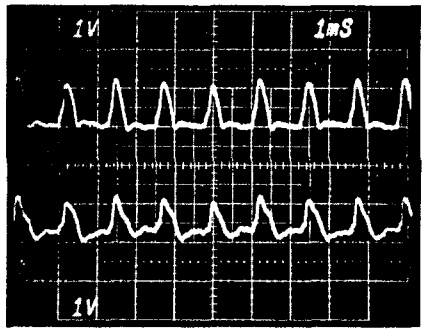
G. WAVEFORM AT INPUT TO DIODE CR2, TOP; WAVEFORM AT INPUT TO DIODE CR3, BOTTOM; REFERENCED TO CENTER TAP OF TRANSFORMER T2, GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM), 100 AMP LOAD
VERTICAL SENSITIVITY: 2.0 VOLTS/DIVISION
TIME BASE: 1.0 MILLISECONDS/DIVISION



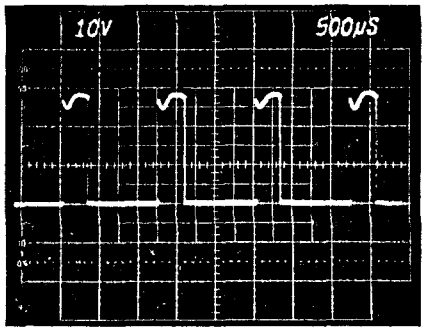
H. WAVEFORM AT JUNCTION OF DIODES CR2 AND CR3, TOP: WAVEFORM AT BASE OF TRANSISTOR Q7, BOTTOM; GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM), 100 AMP LOAD
VERTICAL SENSITIVITY: 20. VOLTS/DIVISION
TIME BASE: 1.0 MILLISECONDS/DIVISION



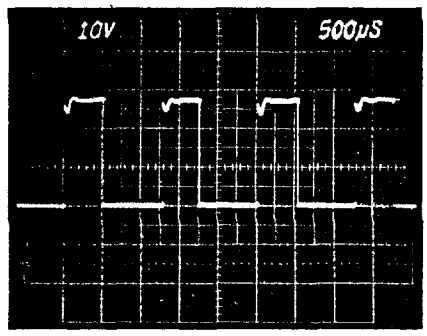
I. WAVEFORM AT BASE OF TRANSISTOR Q8, TOP: WAVEFORM AT COLLECTOR OF TRANSISTOR Q8, BOTTOM; GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM), 100 AMP LOAD
VERTICAL SENSITIVITY: 5.0 VOLTS/DIVISION
TIME BASE: 1.0 MILLISECONDS/DIVISION



J. WAVEFORM AT EMITTER OF TRANSISTORS Q1 AND Q2, TOP: WAVEFORM AT COLLECTOR OF TRANSISTOR Q10, BOTTOM; GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM), 100 AMP LOAD
VERTICAL SENSITIVITY: 1.0 VOLTS/DIVISION
TIME BASE: 1.0 MILLISECONDS/DIVISION

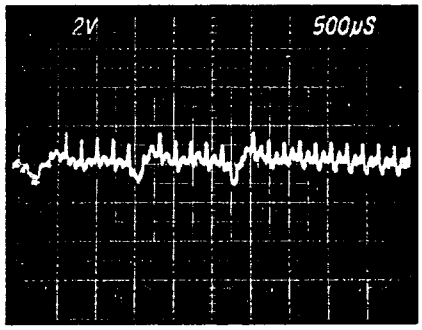


K. WAVEFORM AT PIN A, CONNECTOR J1, GENERATOR FIELD, SWITCHING-WAVEFORM NO-LOAD, GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM)
VERTICAL SENSITIVITY: 10.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION

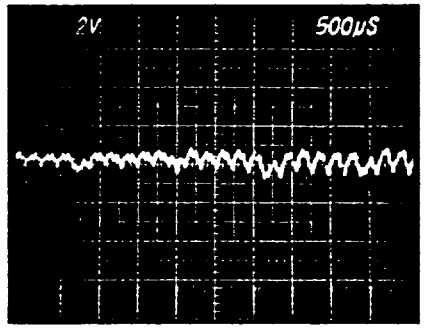


L. WAVEFORM AT PIN A, CONNECTOR J1, GENERATOR FIELD, SWITCHING WAVEFORM FULL-LOAD; GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM)
VERTICAL SENSITIVITY: 10.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION

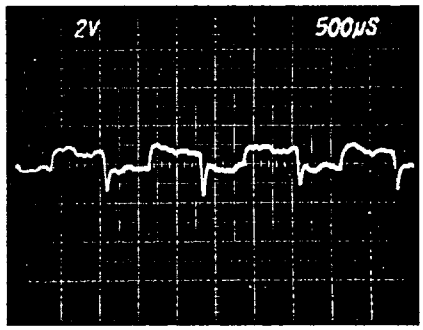
Waveform Measurements, Model VR-1010-24-2A,
DC Voltage Regulator
Figure 801 (Sheet 2 of 3)



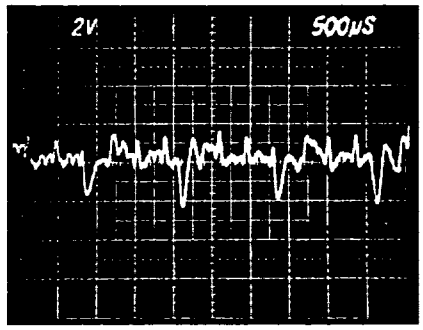
M. WAVEFORM AT PIN C, CONNECTOR J1, GENERATOR +, REGULATOR SWITCHED IN, NO-LOAD GENERATOR OPERATING AT HIGH RANGE (APPROX. 8,000 RPM)
VERTICAL SENSITIVITY: 2.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



N. WAVEFORM AT PIN C, CONNECTOR J1, GENERATOR +, REGULATOR SWITCHED IN, FULL-LOAD, GENERATOR OPERATING AT HIGH RANGE (APPROX. 8,000 RPM)
VERTICAL SENSITIVITY: 2.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



O. WAVEFORM AT PIN C, CONNECTOR J1, GENERATOR +, FULL-LOAD, REGULATOR SWITCHED IN, GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM)
VERTICAL SENSITIVITY: 2.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



P. WAVEFORM AT PIN C, CONNECTOR J1, GENERATOR +, NO-LOAD, REGULATOR SWITCHED IN, GENERATOR OPERATING AT LOW RANGE (APPROX. 4,500 RPM)
VERTICAL SENSITIVITY: 2.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION

Waveform Measurements, Model VR-1010-24-2A,
DC Voltage Regulator
Figure 801 (Sheet 3 of 3)

TRANSISTOR	BASE	COLLECTOR	EMITTER
Q1	5.00V	19.40V	*7.6V
Q2	5.00V	19.40V	*7.6V
Q3	19.80V	2.20V	19.9V
Q4	19.80V	2.20V	19.9V
Q5	0.04V	19.80V	0.0V
Q6	0.04V	19.80V	0.0V
Q7	6.70V	27.80V	**6.6V
Q8	1.90V	19.90V	3.1V
Q9	1.90V	19.90V	3.1V
Q10	10.50V	5.00V	11.2V
Q11	1.80V	6.80V	1.2V
Q12	6.80V	10.50V	6.2V
Q13	7.10V	13.70V	6.5V
Q14	0.04V	***28.00V	0.0V
Q15	****0.60V	****0.02V	****0.0V

TEST POINT	VOLTAGE
Pin B, Connector J1 (Regulation point on Bus)	28.0V
Pin C, Connector J1 (Generator + B terminal)	27.85V
Junction of Zener diode ZR1, resistor R14, and capacitor C5	19.9V

NOTES: Voltage measurements with Triplett VOM Model 800 or equivalent.

All voltages are DC.

Voltage measurements between referenced point and terminal G of regulator (Generator ground terminal).

Regulator adjusted for 28.0 volts regulated output.

Regulator connected to generator test set and operating at or above minimum rated generator speed. (6,000 RPM)

*Voltage measurement at emitter will vary with load. Measured value applies to operating regulator on generator test set with 100% load.

**Voltage measurement at this point will vary with DC load on system approximately 4 to 1.

***Voltage measurement when connected to external overvoltage relay.

****Voltage measurements at these points taken with Relay K1 energized.

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STORAGE INSTRUCTIONS

1. GENERAL.

This section provides information preparing the Model VR-1010-24-2A DC Voltage Regulator, for use from a shipped or stored condition and for packing the unit for storage or shipment.

2. PREPARATION FOR USE.

The Voltage Regulator, when shipped from the factory, is wrapped in cellulose wadding, PPP-C-843, and inserted in a poly bag, LP-278, and enclosed in a corrugated shipping carton, PPP-B-636. To unpack the unit, cut sealing tape and open top of carton by lifting flaps to break adhesive. Remove unit from carton, remove poly bag and cellulose wadding. Visually examine the unit for damage which might have occurred during shipment or storage.

3. PREPARATION FOR STORAGE OR SHIPMENT.

The Voltage Regulator may be stored for short periods of time without packing. If the unit is to be stored for extended periods or is to be shipped, carefully wrap unit with cellulose wadding, insert in poly bag and place equipment in a corrugated carton. The carton should then be sealed and labeled for storage.

SPECIAL TOOLS, FIXTURES, AND EQUIPMENT

1. GENERAL.

This section provides information on the special tools and test equipment required for overhaul of the Model VR-1010-24-2A, DC Voltage Regulator.

2. STANDARD TEST EQUIPMENT.

Listed in Table 1001 are the items of standard test equipment required for overhaul of the voltage regulator. The listed item or a suitable equivalent may be used if procedures are modified when references to test equipment and setting of test equipment are made.

EQUIPMENT	MANUFACTURER AND MODEL NUMBER
GENERATOR TEST SET	SUN AGT-2 OR EQUIVALENT
OSCILLOSCOPE	HEWLETT-PACKARD MODEL 132A
VOLTOHMMETER	TRIPLETT ELECT. INST. MODEL 800 OR EQUIVALENT, or JOHN FLUKE MODEL 8040A, OR EQUIVALENT.
GENERATOR	PER MIL-G-6162 or EQUIVALENT.
INSULATION RESISTANCE TESTER	ASSOCIATED RESEARCH MODEL 2956

Standard Test Equipment
Table 1001

3. SPECIAL TEST EQUIPMENT.

None required.

VR-1010-24-2A/P.N. 095027

ILLUSTRATED PARTS CATALOG SECTION

1. INTRODUCTION.

This section of the Overhaul Manual provides a complete listing of parts for the Model VR-1010-24-2A DC Voltage Regulator (Solid-State Silicon), as manufactured by Phoenix Aerospace, Inc.

2. PURPOSE.

The information contained in this section is supplied to aid in provisioning, requisitioning, storing, and issuing of the replaceable parts, and to aid in identification of new and reclaimed parts.

3. APPLICATION.

The Illustrated Parts Catalog Section contains three separate listings; Numerical Index, Symbol Index, and Detailed Parts List. The subsequent paragraphs define the content and application of each listing.

A. Numerical Index.

The Numerical Index provides an alpha-numerical listing of the parts listed in the Detailed Parts List. The prime function being to aid in rapid location using the information contained in the various columns.

(1) Part Number Column.

The PART NUMBER column lists part numbers of procurable parts and assemblies as listed in the Detailed Parts List. Parts are listed in alpha-numerical order of precedence starting at the first letter extreme left and reading to the right as follows:

Letters A through Z
Numerals 0 through 9
(Alphabetical 0's are considered as Numerical zeros).

Second and succeeding positions of the part number appear in the order of precedence as follows:

Space (Blank column)
Diagonal (Slant) /
Point (Period)
Dash (-)
Letters A through Z
Numerical 0 through 9
(Alphabetical 0's are considered as numerical zeros).

(2) Airline Part Number Column.

The AIRLINE PART NO. column is provided to allow insertion where applicable, of the users own part number where available and desired.

24 is significant of the Chapter (derived from system identification numbers).
30 is significant of the Section (derived from sub-system identification numbers).
X is significant of the Unit (derived from the application of particular unit).
1101 is significant of the Figure number.
18 is significant of the Item number.

(4) Total Required Column.

The TTL REQ. column is the total of each item required in the unit whether it be piece part or sub-assembly.

B. Symbol Index.

The Symbol Index enables the location of component parts referenced from the schematic diagram by the reference symbol to a specific Figure and Item number.

(1) Symbol Column.

The SYMBOL column contains an alpha-numerical listing of every component part which carries a reference symbol on the schematic diagram.

(2) Part Number Column.

The PART NUMBER column lists the vendor part number of the symbolized item.

(3) Chapter-Section-Unit-Figure-Item Column.

The CH-SECT-UNIT-FIG-ITEM column contains the specific location data where the listed part appears in the Detailed Parts List and other pertinent data. (See preceding para. 3.A.(3) for example of information.

C. Detailed Parts List.

The Detailed Parts List, is a breakdown of the complete unit into sub-assemblies and detailed parts. Each sub-assembly is listed in its order of disassembly and is followed immediately by its component parts properly indented to show its relationship to the assembly.

(1) Figure Item Column.

The FIG. ITEM Column entries key the parts breakdown to the applicable illustration. Items numbered on the Detailed Parts List preceded by a dash (example -1) do not appear on the illustration.

(2) Part Number Column.

The PART NUMBER column lists the applicable Standard part number NS, AN, NAS, etc., vendor part number or Phoenix Aerospace, Inc. part numbers. When more than one part number is assigned to an item the preference shall be Standard MS, AN, NAS, etc., vendor, or Phoenix Aerospace, Inc., in that order. Vendor part numbers listed in the PART NUMBER column are subject to change without notice.

(2) Part Number Column.

The PART NUMBER column lists the applicable Standard part number MS, AN, NAS, etc., vendor part number or Phoenix Aerospace, Inc. part numbers. When more than one part number is assigned to an item the preference shall be Standard MS, AN, NAS, etc., vendor, or Phoenix Aerospace, Inc., in that order. Vendor part numbers listed in the PART NUMBER column are subject to change without notice.

(3) Nomenclature Column.

The NOMENCLATURE column describes the assembly, sub-assembly, or component part in a short form description, with the identifying Noun as the first word, followed by the modifiers as required. The indentations denote parts relation to next higher assembly (NHA) or sub-assembly, as applicable. the ATTACHING PARTS entries are listed immediately following the component which they attach.

If a part is purchased by Phoenix Aerospace, Inc. from a vendor, the Federal Supply Code number, preceded by the letter V, is listed in this column, and set off by parentheses. The vendors part number appears in the PART NUMBER column and the Phoenix Aerospace, Inc. part number follows the vendor, FSC number, and is set off in parentheses. If a part number or FSC number does not appear in the NOMENCLATURE column the part number listed in the PART NUMBER column is a Phoenix Aerospace, Inc. number.

(4) Effect From To Column.

The EFFECT FROM TO column provides for entries regarding usage on different models or for field service bulletin entries as applicable. If this column is left blank, parts apply to all models until otherwise noted by revision.

(5) Units Per Assembly Column.

The UNITS PER ASSY column lists the quantity of sub-assemblies or parts required in the next higher assembly (NHA). The quantities specified, therefore, are not necessarily tht total used per equipment. The letters RF denote that the item listed appears on another list and illustration and is referenced for aid in identification only.

4. VENDOR FEDERAL SUPPLY CODE AND NAME INDEX.

The following list is derived by extraction from the Federal Supply Catalog Handbook H4-1. The information is supplied to aid in procurement and identification of the various vendors.

FSC NO. OR CODE	VENDORS NAME AND ADDRESS	FSC NO. OR CODE	VENDORS NAME AND ADDRESS
01121	Allen Bradley Co. 1201 South 2nd St. Milwaukee, Wisconsin 53204	05277	Westinghouse Electric Corp. Semiconductor Div. Armburst Road Youngwood, PA 15697

4. VENDOR FEDERAL SUPPLY CODE AND NAME INDEX. (Cont.).

FSC NO. OR CODE	VENDORS NAME AND ADDRESS
24444	General Semiconductors Industries, Inc. 230 W. 5th Street P. O. Box 3078 Tempe, AZ 85281
25088	Siemens Corp. 186 Wood Ave. S Iselin, NJ 08830
27556	IMB Electronic Products Inc. 15401 E. Carmenita Road Santa Fe Springs, CA 90670
28520	Heyman Manufacturing Co. 147 N. Michigan Ave. Kenilworth, N.J. 07033
29632	Phoenix Aerospace, Inc. 1022 South 23rd Street P. O. Box 20804 Phoenix, AZ 85036
44655	Ohmite Manufacturing Co. 3601 W. Howard Street Skokie, IL 60076
56289	Sprague Electric Co. Beaver Street North North Adams, MA 01247
56878	Standard Pressed Steel Co. Benson East Jenkintown, PA 19046
71785	Cinch Mfg. Co., Div. of United Carr-Fastener Corp. Chicago, IL
73734	Federal Screw Products, Inc. 3917 Kedzie Ave. Chicago, IL 60618
75042	TRW Electronic Components IRC Fixed Resistors Philadelphia Division 401 N. Broad Street Philadelphia, PA 19108
78290	Struthers-Dunn Pitman, NJ
83108	Teledyne-Ansonia A Div. of Teledyne Mid-America Corp. One Riverside Drive P. O. Box 67 Ansonia, CT 06401
83827	Resistors, Inc. 5228 W. 26th Street Chicago, IL 60650
84411	TRW Electronic Components TRW Capacitors 112 W. First Street Ogallala, NE 69153
86928	Seastrom Mfg. Co. Inc. 701 Sonova Ave. Glendale, CA 91201
88245	USECO Div., Litton Ind. 13536 Saticoy Street Van Nuys, CA 91409
91418	Radio Materials Company 4242 W. Bryn Mawr Chicago, IL 60646
91637	Dale Electronics, Inc. P. O. Box 609 Columbus, NE 68601
91833	Electronic Essentials, Inc. 210 Elizabeth Street New York City, NY 10012

-Item not illustrated
*Selected or optional

PART NUMBER	AIRLINE PART NUMBER	CH-SECT-UNIT-FIG-ITEM	TTL REQ.
AN515C4-28		24 -30 -X 1101 -14	4
AN520B6-60		24 -30 -X 1102 -27	2
BWH .39		24 -30 -X 1103 32	1
BWH .47		24 -30 -X 1102 9	1
BWH 4.7		24 -30 -X 1102 11	1
FC-215		24 -30 -X 1102 35	1
GA2L040S252UL		24 -30 -X 1101 7	1
MS3102R-16S-1P		24 -30 -X 1101 4	1
MS3106F-16S-1S		24 -30 -X 1101 - 1	1
MS35233-14		24 -30 -X 1102 - 3	4
		-36	2
MS35233-15		24 -30 -X 1101 -17	2
MS35233-16		24 -30 -X 1101 - 5	4
		-13	4
MS35233-20		24 -30 -X 1102 -32	1
MS35276A-216		24 -30 -X 1101 -18	2
MS35333-70		24 -30 -X 1102 - 4	4
		-33	1
		-37	2
MS35649-44		24 -30 -X 1102 - 5	4
		-34	1
		-38	2
RC20GF102K		24 -30 -X 1103 10	1
		11	1
		12	1
		13	1
		14	1
RC20GF103K		24 -30 -X 1103 28	1
		29	1
*RC20GF122K		24 -30 -X 1103 15	1*
RC20GF152K		24 -30 -X 1103 16	1
RC20GF182K		24 -30 -X 1103 17	1
*		18	1*
RC20GF200J		24 -30 -X 1102 8	1
RC20GF221K		24 -30 -X 1103 4	1
		5	1
RC20GF222K		24 -30 -X 1103 19	1
		20	1
		21	1
RC20GF273K		24 -30 -X 1103 30	1

PART NUMBER	AIRLINE PART NUMBER	CH-SECT-UNIT-FIG-ITEM	TTL REQ.
RC20GF330K		24 -30 -X 1103 2	1
		3	1
*RC20GF392K		24 -30 -X 1103 42	1
RC20GF393K		24 -30 -X 1103 31	1
RC20GF471K		24 -30 -X 1103 6	1
		7	1
		8	1
RC20GF472K		24 -30 -X 1103 22	1
		23	1
		24	1
		25	1
		26	1
RC20GF681K		24 -30 -X 1103 9	1
RC20GF682K		24 -30 -X 1103 27	1
RC20GF751J		24 -30 -X 1103 33	1
		34	1
RN60D1302F		24 -30 -X 1103 39	1
RN60D2051F		24 -30 -X 1103 37	1
RN60D2802F		24 -30 -X 1103 40	1
		41	1
RN60D6040F		24 -30 -X 1103 35	1
RN60D6811F		24 -30 -X 1103 38	1
RN60D9090F		24 -30 -X 1103 36	1
SM .02±20%		24 -30 -X 1103 43	1
XA3359J		24 -30 -X 1102 10	1
		1103 44	1
*025001		24 -30 -X 1102 -15	1*
025002		24 -30 -X 1102 -21	1
*025010		24 -30 -X 1102 -15	1*
031501		24 -30 -X 1102 - 2	1
038021		24 -30 -X 1102 30	1
043002		24 -30 -X 1102 31	1
043003		24 -30 -X 1103 75	1
048500		24 -30 -X 1103 61	1
		62	1
		63	1
		64	1
		65	1
		66	1
		67	1

PART NUMBER	AIRLINE PART NUMBER	CH-SECT-UNIT-FIG-ITEM	TTL REQ.
031501		24 -30 -X 1102 - 2	1
038021		24 -30 -X 1102 30	1
043002		24 -30 -X 1102 31	1
043003		24 -30 -X 1103 75	1
048500		24 -30 -X 1103 61	1
		62	1
		63	1
		64	1
		65	1
		66	1
		67	1
048501		24 -30 -X 1103 68	1
		69	1
		70	1
048502		24 -30 -X 1103 71	1
		72	1
		73	1
		74	1
048504		24 -30 -X 1102 26	1
058029		24 -30 -X 1103 1	1
066041		24 -30 -X 1101 3	1
066042		24 -30 -X 1101 20	1
067502		24 -30 -X 1101 -19	1
070004		24 -30 -X 1101 -15	4
080015		24 -30 -X 1102 1	1
088019		24 -30 -X 1101 2	1
088517		24 -30 -X 1101 16	1
095027		24 -30 -X 1101 -	RF
1N2984B		24 -30 -X 1102 13	1
1N3210		24 -30 -X 1102 19	1
1N3611		24 -30 -X 1103 56	1
		57	1
1N4472		24 -30 -X 1103 59	1
1N4473		24 -30 -X 1103 60	1
1N4739A		24 -30 -X 1103 58	1
1N5624		24 -30 -X 1102 6	1
		7	1

PART NUMBER	AIRLINE PART NUMBER	CH-SECT-UNIT-FIG-ITEM	TTL REQ.
1N914B		24 -30 -X 1103 51	1
		52	1
		53	1
		54	1
		55	1
*10AX		24 -30 -X 1102 12	1*
116054		24 -30 -X 1101 12	1
		1102 -	RF
116055		24 -30 -X 1102 -39	1
116056		24 -30 -X 1102 40	1
		1103 -	RF
150D105X9035A2		24 -30 -X 1103 45	1
150D226X9035R2		24 -30 -X 1103 46	1
		47	1
3306-3/8-N		24 -30 -X 1102 32A	1
4602		24 -30 -X 1102 25	1
*4774		24 -30 -X 1102 12	1*
50FA-440		24 -30 -X 1102 - 6	4
600D476F100DL4		24 -30 -X 1102 30	1
601PE .01		24 -30 -X 1103 48	1
601PE .022		24 -30 -X 1103 49	1
601PE .047		24 -30 -X 1103 50	1
732-73Y2		24 -30 -X 1102 -28	1
9000		24 -30 -X 1101 -10	1
97100		24 -30 -X 1101 - 9	1

-Item not illustrated
*Selected or optional

VR-1010-24-2A/P.N. 095027
SYMBOL INDEX

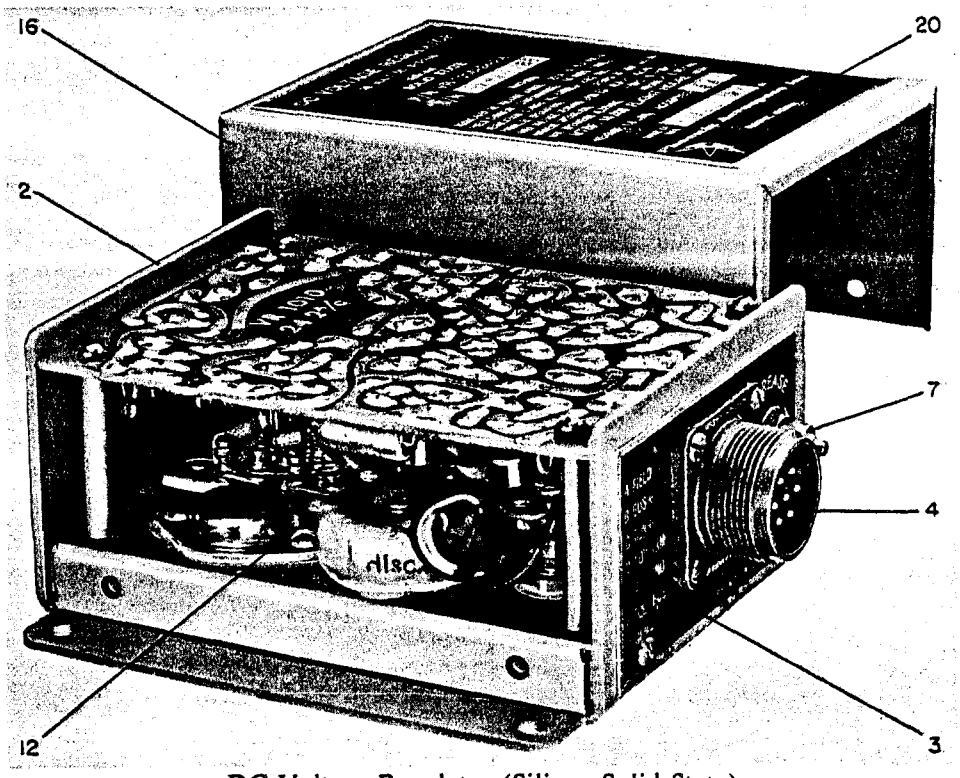
SYM	PART NUMBER	CH-SECT-UNIT-FIG-ITEM
CR1	1N914B	24 -30 -X 1103 51
CR2	1N5624	24 -30 -X 1102 6
CR3	1N5624	7
CR4	1N3210	24 -30 -X 1102 19
CR5	1N914B	24 -30 -X 1103 52
CR6	1N914B	53
CR7	1N914B	54
CR8	1N3611	24 -30 -X 1103 56
CR9	1N914B	1103 55
CR10	1N3611	24 -30 -X 1103 57
C1	SM .02±20%	24 -30 -X 1103 43
C2	XA3359J	24 -30 -X 1102 10
C3	XA3359J	24 -30 -X 1103 44
C4	150D105X9035A2	24 -30 -X 1103 45
C5	150D226X9035R2	24 -30 -X 1103 46
C6	601PE .01	24 -30 -X 1103 48
C7	600D476F100DL4	24 -30 -X 1102 29
C8	601PE .047	24 -30 -X 1103 50
C9	150D226X9035R2	24 -30 -X 1103 47
C10	601PE .022	24 -30 -X 1103 49
J1	MS3102R-16S-1P	24 -30 -X 1101 4
K1	FC-215	24 -30 -X 1102 35
L1	038021	24 -30 -X 1102 30
P1	MS3106R-16S-1S	24 -30 -X 1101 - 1
Q1	048500	24 -30 -X 1103 61
Q2	048500	62
Q3	048501	24 -30 -X 1103 68
Q4	048501	69
Q5	048502	24 -30 -X 1103 71
Q6	048502	72
Q7	048504	
Q8	048500	24 -30 -X 1103 63
Q9	048500	64
Q10	048501	24 -30 -X 1103 70
Q11	048500	24 -30 -X 1103 65
Q12	048500	66
Q13	048500	67
Q14	048502	24 -30 -X 1103 73
Q15	048502	24 -30 -X 74
R1	RC20GF472K	24 -30 -X 1103 22
R2	RC20GF472K	24 -30 -X 23
R3	RC20GF222K	24 -30 -X 1103 19
R4	RC20GF102K	24 -30 -X 1103 10
R5	RC20GF222K	24 -30 -X 1103 20
R6	RC20GF102K	24 -30 -X 1103 11
R7	RC20GF102K	12
R8	RC20GF102K	13
R9	RC20GF221K	24 -30 -X 1103 4
R10	RC20GF221K	5
R11	BWH 0.47	24 -30 -X 1102 9
R12	BWH 4.7	24 -30 -X 1102 11
R13	RC20GF200J	24 -30 -X 1102 8
R14	4774 or 10AX	24 -30 -X 1102 12
R15	RC20GF681K	24 -30 -X 1103 9
R16	RC20GF471K	24 -30 -X 1103 6
R17	RC20GF103K	24 -30 -X 1103 28
R18	RC20GF471K	24 -30 -X 1103 7

SYM	PART NUMBER	CH-SECT-UNIT-GIF-ITEM
R19	RC20GF471K	8
R20	RC20GF102K	24 -30 -X 1103 14
R21	RC20GF472K	24 -30 -X 1103 24
R22	RC20GF393K	24 -30 -X 1103 31
R23	RC20GF273K	24 -30 -X 1103 30
R24	RN60D6811F	24 -30 -X 1103 38
R25	NOT ASSIGNED	
R26	RN60D9090F	24 -30 -X 1103 36
R27	BWH 0.39	24 -30 -X 1103 32
R28	RN60D2051F	24 -30 -X 1103 37
R29	RN60D6040F	24 -30 -X 1103 35
R30	RC20GF751J	24 -30 -X 1103 33
R31	RC20GF682K	24 -30 -X 1103 27
R32	RC20GF472K	24 -30 -X 1103 25
R33	RC20GF751J	24 -30 -X 1103 34
R34	RN60D1302F	24 -30 -X 1103 39
R35	GA2L040S252UL	24 -30 -X 1101 7
R36	RN60D2802F	24 -30 -X 1103 40
R37	RN60D2802F	24 -30 -X 41
R38	RC20GF330K	24 -30 -X 1103 2
R39	RC20GF152K	24 -30 -X 1103 16
R40	RC20GF472K	24 -30 -X 1103 26
*R41	RC20GF122K	24 -30 -X 1103 15
R42	RC20GF222K	24 -30 -X 1103 21
R43	RC20GF103K	24 -30 -X 1103 29
R44	RC20GF330K	24 -30 -X 1103 3
R45	RC20GF182K	24 -30 -X 1103 17
*R46	RC20GF392K	24 -30 -X 1103 42
*R47	RC20GF182K	24 -30 -X 1103 18
T1	04300	24 -30 -X 1103 75
T2	043002	24 -30 -X 1102 31
XQ7	4602	24 -30 -X 1102 25
ZR1	1N2984B	24 -30 -X 1102 13
ZR2	1N4465	24 -30 -X 1103 58
ZR3	1N4472	24 -30 -X 1103 59
ZR4	1N4473	24 -30 -X 1103 60

-Item not illustrated
*Selected or optional

VR-1010-24-2A/P.N. 095027

DETAILED PARTS LIST



DC Voltage Regulator (Silicon Solid-State)
Model VR-1010-24-2A
Figure 1101

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM-TO	UNITS PER ASSY
1101-	095027	ASSEMBLY, DC VOLTAGE REGULATOR, MODEL VR-1010-24-2A (SILICON SOLID-STATE)		RF
- 1	MS3106F-16S-1S	CONNECTOR, PLUG, STRAIGHT, (MATES WITH MS3102R-16S-1P) (028012)		1
2	088019	. BASE, DC VOLTAGE REGULATOR, MODEL VR-1010-24-2A		1
3	066041	. . NAMEPLATE, INPUT/OUTPUT CONNECTION, CONTROL IDENTIFICATIONS, SELF-ADHERING MODEL VR-1010-24-2A		1
4	MS3102R-16S-1P	. . CONNECTOR, RECEPTACLE (029018) (ATTACHING PARTS)		1
- 5	MS35233-16	. . SCREW, PHM, S. STL, 4-40 xX 7/16 IN. LG, (101030)		4
- 6	50FA-440	. . NUT, HEX, S. STL, LOCKING, 4-40 (V03680) (100001)		4
		---★---		
7	GA2L040S252UL	. . RESISTOR, VAR, 2,500 OHMS, 1/4W, LOCKING (V01121) (054001)		1

-Item Not Illustrated

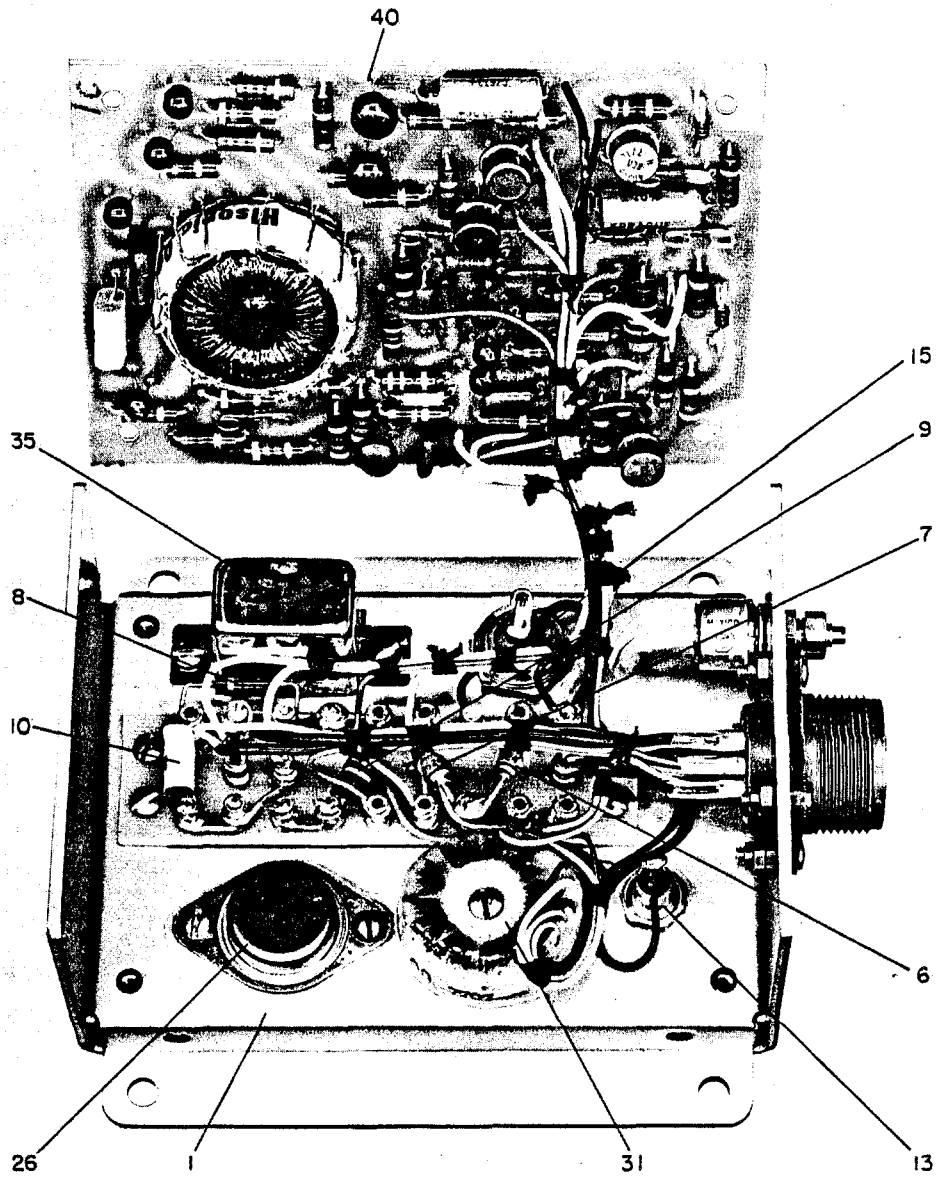
VR-1010-24-2A/P.N. 095027

DETAILED PARTS LIST

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT FROM-TO	UNITS PER ASSY
		(ATTACHING PARTS)		
1101- 8	076007	. . WASHER, INT. TOOTH LOCK, S. STL, 1/4 IN. (V01121) (076007) (P/O Item 7)		1
- 9	076010	. . WASHER, FLAT, STL, 1/4 IN. I.D. X 1/2 IN. O.D. N1PL (V01121) (076010) (P/O Item 7)		1
-10	100007	. . NUT, HEX, BRASS, N1PL, SPL 1/4-28 (V01121) (100007) (P/O Item 7)		1
		---★ ---		
-11	100027	. . NUT, HEX, BRASS, N1PL, SPL, LOCKING 1/4-28 (V01121) (100027) (P/O Item 7)		1
12	116054	. . SUB-ASSY, OSC/AMPL BOARD AND SWITCHING CIRCUITS CHASSIS		1
		(ATTACHING PARTS)		
-13	MS35233-16	. . SCREW, PHM, S. STL, 4-40 X 7/16 IN. LG (101030)		4
-14	AN515C4-28	. . SCREW, RHM, S. STL, 4-40 X 1-3/4 IN. LG (101008)		4
-15	070004	. . SPACER, RD, ALUM, 3/16 IN. O.D. X 1-7/16 IN. LG CLR NO. 4 SCREW		4
		---★ ---		
16	088517	. COVER, DC VOLTAGE REGULATOR, MODEL VR-1010-24-2A		1
		(ATTACHING PARTS)		
-17	MS35233-15	. SCREW, PHM, S. STL, 4-40 X 3/8 IN. LG (101004)		2
-18	MS35276A-216	. SCREW, FILLISTER HEAD, DRILLED, S. STL, 4-40 X 3/8 IN. LG (101201)		2
		---★ ---		
-19	067502	. SEAL, ALUM, PAI WARRANTY		1
-20	066042	. NAMEPLATE, MODEL AND SERIAL NO. SELF-ADHERING, MODEL VR-1010-24-2A		1

-Item Not Illustrated

DETAILED PARTS LIST



Oscillator/Amplifier Board and Switching
Circuits Chassis Sub-Assembly
Figure 1102 (Sheet 1 of 2)

VR-1010-24-2A/P.N. 095027

DETAILED PARTS LIST

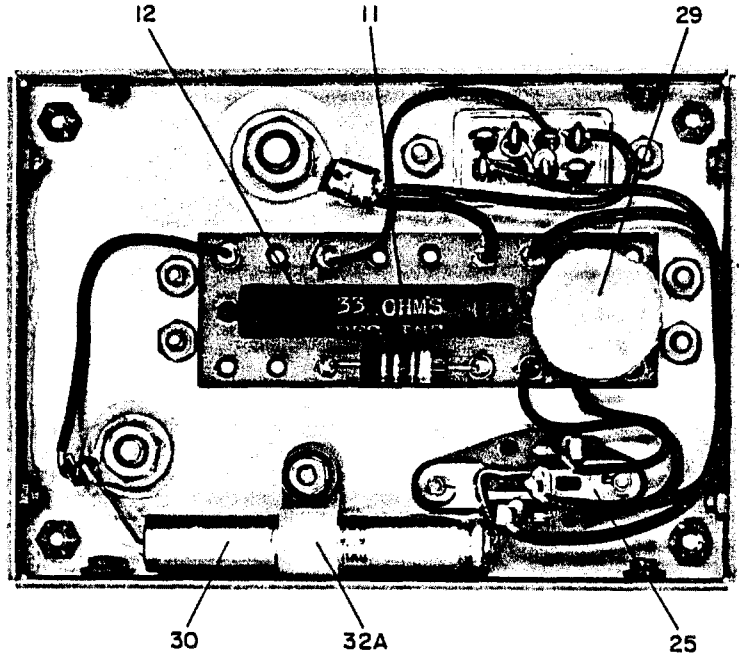
FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM-TO	UNITS PER ASSY
1102-	116054	SUB-ASSY, OSC/AMPL BOARD AND SWITCHING CIRCUITS CHASSIS (SEE FIG. 1101 FOR NHA)		RF
1	080015	. CHASSIS, PAN, SWITCHING CIRCUITS, DC VOLTAGE REGULATOR MODEL VR-1010-24-2A		1
- 2	031501	. STRIP, TERMINAL, MULTIPLE POINT (ATTACHING PARTS)		1
- 3	MS35233-14	. SCREW, PHM, S. STL, 4-40 x 5/16 IN. LG (101040)		4
- 4	MS35333-70	. WASHER, INT. TOOTH LOCK, S. STL, NO. 4 (076001)		4
- 5	MS35649-44	. NUT, HEX, S. STL, 4-40		4
		---★---		
6	1N5624	. SEMICONDUCTOR, DIODE, SILICON, (V09214) (046015)		1
7	1N5624	. SEMICONDUCTOR, DIODE, SILICON, (V09214) (046015)		1
8	RC20GF200J	. RESISTOR, FIXED, COMP, 20 OHMS, ±5%, 1/2W (050088)		1
9	BWH 4.7	. RESISTOR, FIXED, WW, 4.7 OHMS, ±10%, 2W (V75042) (050301)		1
10	XA3359J	. CAPACITOR, FIXED, MYLAR, 0.47 UF, ±5%, 100 VDCW (V27556) (019005)		1
11	BWH .47	. RESISTOR, FIXED, WW, 0.47 OHMS, ±10%, 2W (V75042) (050300)		1
	4774	. RESISTOR, FIXED, WW, 33 OHMS, 11W (V44655) (052002)		
12	OR	OR		
	10AX	. RESISTOR, FIXED, WW, 33 OHMS, 10W (V83827) (052002)		
13	1N2984B	. SEMICONDUCTOR, DIODE, ZENER, SILICON, 20V, ±5%, 10W (V24444) (046021)		1
		(ATTACHING PARTS)		
-14	DF6C	. WASHER, MICA, INSULATING, DIODE MTG, CLR NO. 10 (V08530) (064502)		2
-14A	DF3D	. BUSHING, NYLON, INSULATING, DIODE MTG, CLR NO. 10 (V86928) (064513)		1
-15	R1A-10	. LUG, SOLDER/CRIMP, FLAT, RING TERMINAL NO. 10 #18-20 WIRE (V83108) (025010)		1
-16	AN960-C10L	. WASHER, FLAT, S. STL, NO. 10 (076021)		1
-17	MS35333-73	. WASHER, INT. TOOTH LOCK, S. STL, NO. 10 (076014)		1

-Item Not Illustrated

VR-1010-2*-2A/P.N. 095027

DETAILED PARTS LIST

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT FROM-TO	UNITS PER ASSY
		(ATTACHING PARTS) (CONT.)		
1102-18	MS35650-304	. NUT, HEX, S. STL, 10-32 (100013)		1
		---★---		
19	1N3210	. SEMICONDUCTOR, DIODE, SILICON POWER (V05277) (046003)		1
		(ATTACHING PARTS)		
-20	DF6B	. WASHER, MICA, INSULATING, DIODE MTG, CLR 1/4 IN. (V08530) (064503)		2
-20A	5610-122-.062	. BUSHING, NYLON, INSULATING, 0.260 IN. I.D. (V86928) (064507)		1
-21	R1C-14	. LUG, SOLDER/CRIMP, FLAT, RING TERMINAL, 1/4 IN #10-12 WIRE (V83108) (025002)		
-22	AN960-C416L	. WASHER, FLAT, S. STL, 1/4 IN. (076029)		1
-23	MS35333-74	. WASHER, INT. TOOTH LOCK, S. STL, 1/4 IN. (076018)		1
-24	MS35650-3254	. NUT, HEX, S. STL, 1/4-28 (100024)		1
		---★---		



Oscillator/Amplifier Board and Switching Circuits Chassis Sub-Assembly
Figure 1102 (Sheet 2 of 2)

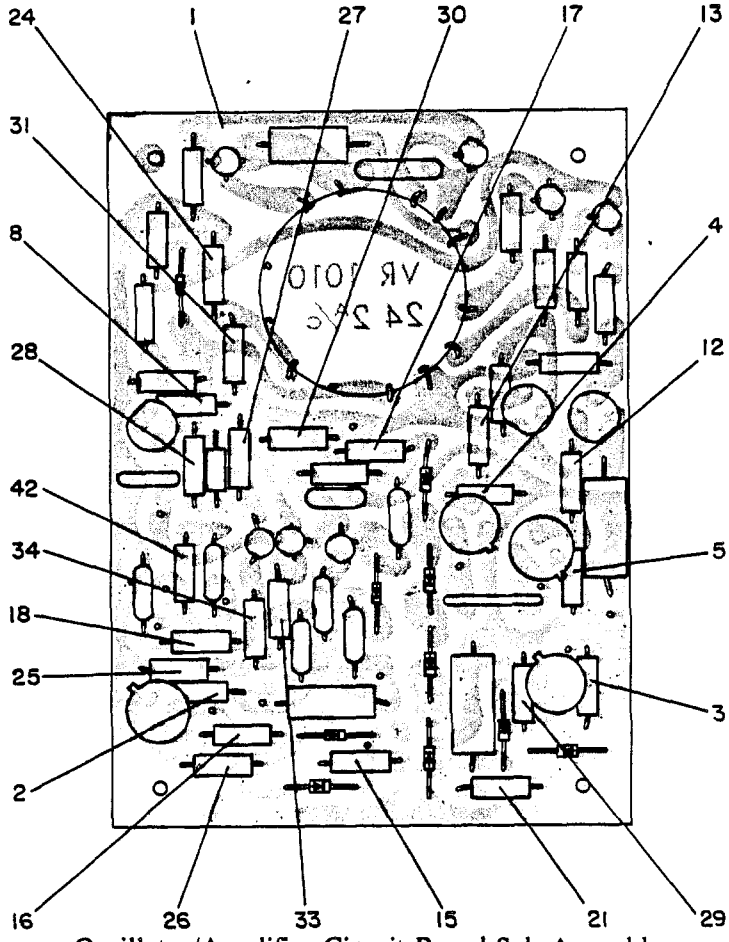
-Item Not Illustrated

DETAILED PARTS LIST

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM-TO	UNITS PER ASSY
1102 25	4602	. SOCKET, TRANSISTOR MTG, TO-3 (V91833) (029002)		1
26	048504	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON, POWER (ATTACHING PARTS)		1
-27	AN520UB6-6	. SCREW, RHM, BRASS, 6-32 X 3/8 IN. LG. (101012)		2
-28	732-73Y2	. WASHER, MICA, INSULATING, TO-3 TRANSISTOR, (V08530) (064500)		1
		---★---		
29	038021	. REACTOR, TOROIDAL, RF-FILTER		1
30	600D476F100DL4	. CAPACITOR, ELECTROLYTIC, 47 UF, 100VDCW (V56289) (021007)		1
31	043002	. TRANSFORMER, TOROIDAL, DRIVER (ATTACHING PARTS)		1
-32	MS35233-20	. SCREW, PHM, S. STL, 4-40 X 7/8 IN. LG. (101007)		1
32A	3306-3/8-N	. CLAMP, CABLE, NYLON, 3/8 IN. (V28520) (068005)		1
-32B	AN960-C4	. WASHER, FLAT, S. STL, NO. 4 (076019)		1
-33	MS35333-70	. WASHER, INT. TOOTH LOCK, S. STL, NO. 4 (076001)		1
-34	MS35649-44	. NUT, HEX, S. STL, 4-40 (100002)		1
		---★---		
35	FC-215	. RELAY, ARMATURE, SEALED, 2 FORM 'C' CONTACTS, RATED 10 AMPS, 26.5VDC, 26.5VDC COIL, 300 OHMS (V78290) (011500) (ATTACHING PARTS)		1
-36	MS35233-14	. SCREW, PHM, S. STL, 4-40X 5/16 IN. LG. (101040)		2
-37	MS35333-70	. WASHER, INT. TOOTH LOCK, S. STL, NO. 4 (076001)		2
-38	MS35649-44	. NUT, HEX, S. STL, 4-40 (100002)		2
		---★---		
-39	116055	SUB-ASSY, WIRING, HARNESS, SPECIAL		1
40	116056	SUB-ASSY, CIRCUIT BOARD, OSC/AMPL		1

-Item Not Illustrated

DETAILED PARTS LIST



Oscillator/Amplifier Circuit Board Sub-Assembly
Figure 1103 (Sheet 1 of 3)

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM-TO	UNITS PER ASSY
1103-	116056	SUB-ASSY, CIRCUIT BOARD, OSC/AMPL (SEE FIG. 1101 FOR NHA)		RF
1	058029	. BOARD, PRINTED CIRCUIT, OSC/AMPL		1
2	RC20GF330K	. RESISTOR, FIXED, COMP, 33 OHMS, ±10%, 1/2W (050014)		1
3	RC20GF330K	. RESISTOR, FIXED, COMP, 33 OHMS, ±10%, 1/2W (050014)		1
4	RC20GF221K	. RESISTOR, FIXED, COMP, 220 OHMS, ±10%, 1/2W (050023)		1
5	RC20GF221K	. RESISTOR, FIXED, COMP, 220 OHMS, ±10%, 1/2W (050023)		1

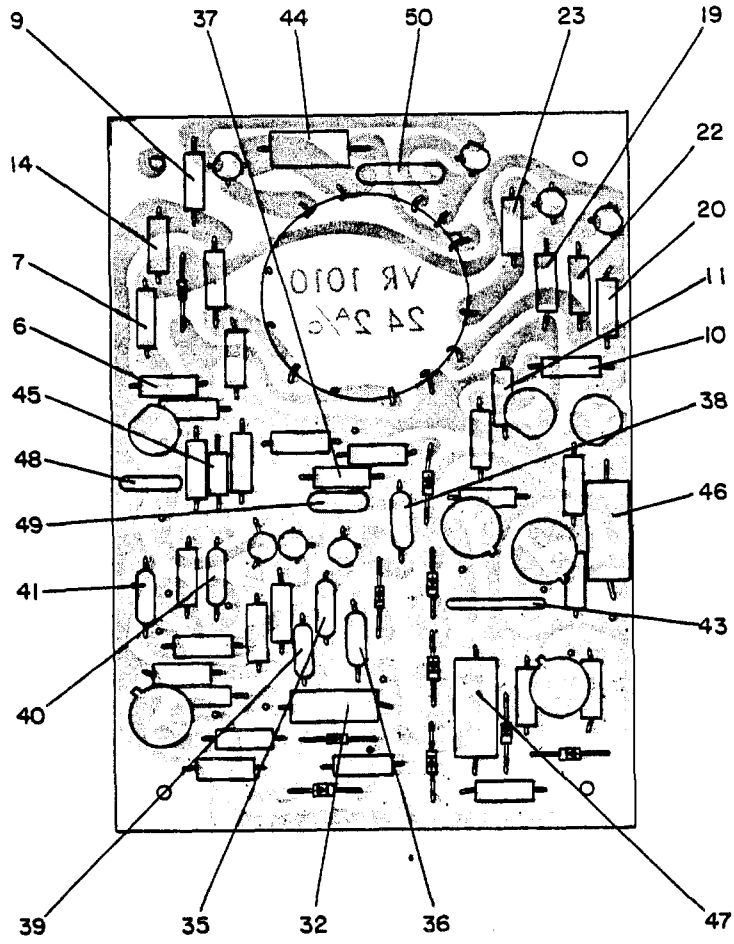
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DETAILED PARTS LIST

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM-TO	UNITS PER ASSY
1103 6	RC20GF471K	. RESISTOR, FIXED, COMP, 470 OHMS, ±10%, 1/2W (050027)		1
7	RC20GF471K	. RESISTOR, FIXED, COMP, 470 OHMS, ±10%, 1/2W (050027)		1
8	RC20GF471K	. RESISTOR, FIXED, COMP, 470 OHMS, ±10%, 1/2W (050027)		1
9	RC20GF681K	. RESISTOR, FIXED, COMP, 680 OHMS, ±10%, 1/2W (050029)		1
10	RC20GF102K	. RESISTOR, FIXED, COMP, 1,000 OHMS, ±10%, 1/2W (050031)		1
11	RC20GF102K	. RESISTOR, FIXED, COMP, 1,000 OHMS, ±10%, 1/2W (050031)		1
12	RC20GF102K	. RESISTOR, FIXED, COMP, 1,000 OHMS, ±10%, 1/2W (050031)		1
13	RC20GF102K	. RESISTOR, FIXED, COMP, 1,000 OHMS, ±10%, 1/2W (050031)		1
14	RC20GF102K	. RESISTOR, FIXED, COMP, 1,000 OHMS, ±10%, 1/2W (050031)		1
15	RC20GF122K	. RESISTOR, FIXED, COMP, 1,200 OHMS, ±10%, 1/2W (050032)		1
16	RC20GF152K	. RESISTOR, FIXED, COMP, 1,500 OHMS, ±10%, 1/2W (050033)		1
17	RC20GF182K	. RESISTOR, FIXED, COMP, 1,800 OHMS, ±10%, 1/2W (050034)		1
18	RC20GF182K	. RESISTOR, FIXED, COMP, 1,800 OHMS, ±10%, 1/2W (050034)		1
19	RC20GF222K	. RESISTOR, FIXED, COMP, 2,200 OHMS, ±10%, 1/2W (050035)		1
20	RC20GF222K	. RESISTOR, FIXED, COMP, 2,200 OHMS, ±10%, 1/2W (050035)		1
21	RC20GF222K	. RESISTOR, FIXED, COMP, 2,200 OHMS, ±10%, 1/2W (050035)		1
22	RC20GF472K	. RESISTOR, FIXED, COMP, 4,700 OHMS, ±10%, 1/2W (050039)		1
23	RC20GF472K	. RESISTOR, FIXED, COMP, 4,700 OHMS, ±10%, 1/2W (050039)		1
24	RC20GF472K	. RESISTOR, FIXED, COMP, 4,700 OHMS, ±10%, 1/2W (050039)		1
25	RC20GF472K	. RESISTOR, FIXED, COMP, 4,700 OHMS, ±10%, 1/2W (050039)		1
26	RC20GF472K	. RESISTOR, FIXED, COMP, 4,700 OHMS, ±10%, 1/2W (050039)		1
27	RC20GF682K	. RESISTOR, FIXED, COMP, 6,800 OHMS, ±10%, 1/2W (050041)		1
28	RC20GF103K	. RESISTOR, FIXED, COMP, 10K OHMS, ±10%, 1/2W (050043)		1

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DETAILED PARTS LIST



Oscillator/Amplifier Circuit Board Sub-Assembly
Figure 1103 (Sheet 2 of 3)

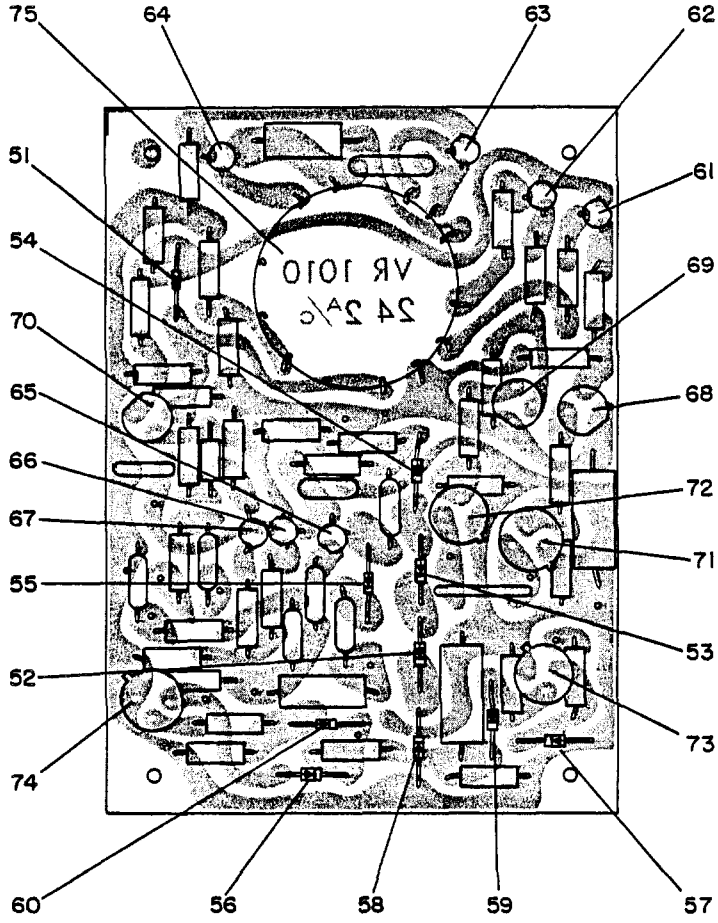
FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM-TO	UNITS PER ASSY
1103 29	RC20GF103K	. RESISTOR, FIXED, COMP, 10K OHMS, ±10%, 1/2W (050043)		1
30	RC20GF273K	. RESISTOR, FIXED, COMP, 27K OHMS, ±10%, 1/2W (050048)		1
31	RC20GF393K	. RESISTOR, FIXED, COMP, 39K OHMS, ±10%, 1/2W (050050)		1
32	BWH .39	. RESISTOR, FIXED, WW, 0.39 OHMS, ±10%, 2W (V11502) (050302)		1
33	RC20GF751J	. RESISTOR, FIXED, COMP, 750 OHMS, ±5%, 1/2W (050087)		1
34	RC20GF751J	. RESISTOR, FIXED, COMP, 750 OHMS, ±5%, 1/2W (050087)		1

-Item Not Illustrated

DETAILED PARTS LIST

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM-TO	UNITS PER ASSY
1103 35	RN60D6040F	. RESISTOR, FIXED, PREC, 604 OHMS, ±1% 1/4W (V91637) (050503)		1
36	RN60D9090F	. RESISTOR, FIXED, PREC, 909 OHMS, ±1%, 1/4W (V91637) (050502)		1
37	RN60D2051F	. RESISTOR, FIXED, PREC, 2,050 OHMS, ±1%, 1/4W (V91637) (050507)		1
38	RN60D6811F	. RESISTOR, FIXED, PREC, 6,810 OHMS, ±1%, 1/4W (V91637) (050508)		1
39	RN60D1302F	. RESISTOR FIXED, PREC, 13K OHMS, ±1% 1/4W (V91637) (050505)		1
40	RN60D2802F	. RESISTOR, FIXED, PREC, 28K OHMS, ±1%, 1/4W (V91637) (050506)		1
41	RN60D2802F	. RESISTOR, FIXED, PREC, 28K OHMS, ±1%, 1/4W (V91637) (050506)		1
42	RC20GF392K	. RESISTOR, FIXED, COMP, 3,900 OHMS, ±10%, 1/2W (050038)		1
43	SM .02±20%	. CAPACITOR, CERAMIC, DISC, 0.02 UF, ±20%, 500 VDCW (V91418) (023000)		1
44	XA3359J	. CAPACITOR, FIXED, MYLAR, 0.47 UF, ±5%, 100 VDCW (V27556) (019005)		1
45	150D105X9035A2	. CAPACITOR, ELECTROLYTIC, TANTALUM, 1 UF, ±10%, 35VDCW (V56289) (021501)		1
46	150D226X9035R2	. CAPACITOR, ELECTROLYTIC, TANTALUM, 22 UF, ±10%, 35VDCW (V56289) (021502)		1
47	150D226X9035R2	. CAPACITOR, ELECTROLYTIC, TANTALUM, 22 UF, ±10%, 35VDCW (V56289) (021502)		1
48	601 PE .01	. CAPACITOR, FIXED, MYLAR, 0.01 UF, ±10%, 50VDCW (V84411) (019003)		1
49	601 PE .022	. CAPACITOR, FIXED, MYLAR, 0.022UF, ±10%, 50VDCW (V84411) (019018)		1
50	601 PE .047	. CAPACITOR, FIXED, MYLAR, 0.047UF, ±10%, 50VDCW (V84411) (019004)		1
51	1N914B	. SEMICONDUCTOR, DIODE, SILICON (V13715) (046006)		1
52	1N914B	. SEMICONDUCTOR, DIODE, SILICON, (V13715) (046006)		1
53	1N914B	. SEMICONDUCTOR, DIODE, SILICON, (V13715) (046006)		1
54	1N914B	. SEMICONDUCTOR, DIODE, SILICON, (V13715) (046006)		1
55	1N914B	. SEMICONDUCTOR, DIODE, SILICON (V13715) (046006)		1
56	1N3611	. SEMICONDUCTOR, DIODE, SILICON, POWER (V25088) (046011)		1
57	1N3611	. SEMICONDUCTOR, DIODE, SILICON, POWER (V25088) (046011)		1

DETAILED PARTS LIST



Oscillator/Amplifier Circuit Board Sub-Assembly
Figure 1103 (Sheet 3 of 3)

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM-TO	UNITS PER ASSY
1103 58	1N4739A	. SEMICONDUCTOR, DIODE, ZENER, SILICON, 9.1V, ±5%, 1W (V13715) (046030)		1
59	1N4472	. SEMICONDUCTOR, DIODE, ZENER, SILICON, 20V, ±5%, 1.5W (V14552) (046019)		1
60	1N4473	. SEMICONDUCTOR, DIODE, ZENER, SILICON, 22V, ±5%, 1.5W (V14552) (046017)		1
61	048500	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON		1
62	048500	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON		1
63	048500	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON		1

DETAILED PARTS LIST

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM-TO	UNITS PER ASSY
1103 64	048500	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON		1
65	048500	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON		1
66	048500	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON		1
67	048500	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON		1
68	048501	. SEMICONDUCTOR, TRANSISTOR, PNP, SILICON		1
69	048501	. SEMICONDUCTOR, TRANSISTOR, PNP, SILICON		1
70	048501	. SEMICONDUCTOR, TRANSISTOR, PNP, SILICON		1
71	048502	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON		1
72	048502	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON		1
73	048502	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON		1
74	048502	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON		1
75	043003	. TRANSFORMER, TOROIDAL, OSCILLATOR		1

-Item Not Illustrated

VR-1010-24-2A/P.N. 095027

REVISION REFERENCE SHEET

REVISION CODE	REVISION DESCRIPTION	SERIAL NO. EFFECTIVITY
A	RESISTOR R38 CHANGED TO 33 OHMS, ±10%, 1/2W FROM 5.6 OHMS, ±10%, 1/2W.	15 DEC 1967
B	MODIFICATION TO IMPROVE TEMPERATURE COMPENSATION: RESISTOR R24 CHANGED TO 6,810 OHMS, ±1%, 1/8W FROM SELECTED *(3,900-5,100 OHMS); RESISTOR R25 DELETED; RESISTOR R45 ADDED. 1,800 OHMS, ±10%, 1/2W; RESISTOR R26 CHANGED TO 909 OHMS, ±1%, 1/8W FROM 270 OHMS, ±10%, 1/2W; RESISTOR R28 CHANGED TO 2,050 OHMS, ±1%, 1/8W FROM 2,200 OHMS, ±10%, 1/2W; RESISTOR R29 CHANGED TO 604 OHMS, ±1% FROM 620 OHMS, ±10%, 1/2W; RESISTORS R30 AND R33 CHANGED TO 750 OHMS, ±5%, 1/2W FROM 1,000 OHMS, ±10%, 1/2W; RESISTOR R34 CHANGED TO 13K OHMS, ±1% FROM 20K OHMS, ±5%, 1/2W; RESISTORS R36 AND R37 CHANGED TO 28K OHMS, ±1%, 1/8W FROM 16.2K OHMS, ±1%, 1/8W; ZENER DIODE Z2 CHANGED TO 1N4465 FROM 1N4740A.	22 NOV 1968
C	DIODES CR2 AND DR3 CHANGED TO 1N5402 FROM 1N4721. TRANSISTOR Q7 CHANGED TO RCA TYPE NO. 60234 FROM RCA TYPE NO. 2N3772.	10 OCT 1969
D	DIODES CR2 AND CR3 CHANGED TO 1N5624 FROM 1N5402.	22 SEP 1971
E	DIODE CR8 CHANGED TO 1N3611 FROM 1N4002. TRANSISTOR Q7 CHANGED TO RCA TYPE NO. 64497 FROM RCA TYPE NO. 60234. ZENER DIODE Z3 & Z4 CHANGED TO 1N4473 FROM 1N4748A.	22 JUN 1973
F	RF FILTER L1 ADDED IN SERIES WITH PIN C, GENERATOR POSITIVE, OF RECEPTACLE J1.	7 JUN 1974
G	TRANSISTOR Q7 CHANGED TO RCA TYPE NO. 66090 FROM RCA TYPE NO. 64497.	5 MAR 1975

VR-1010-24-2A/P.N. 095027

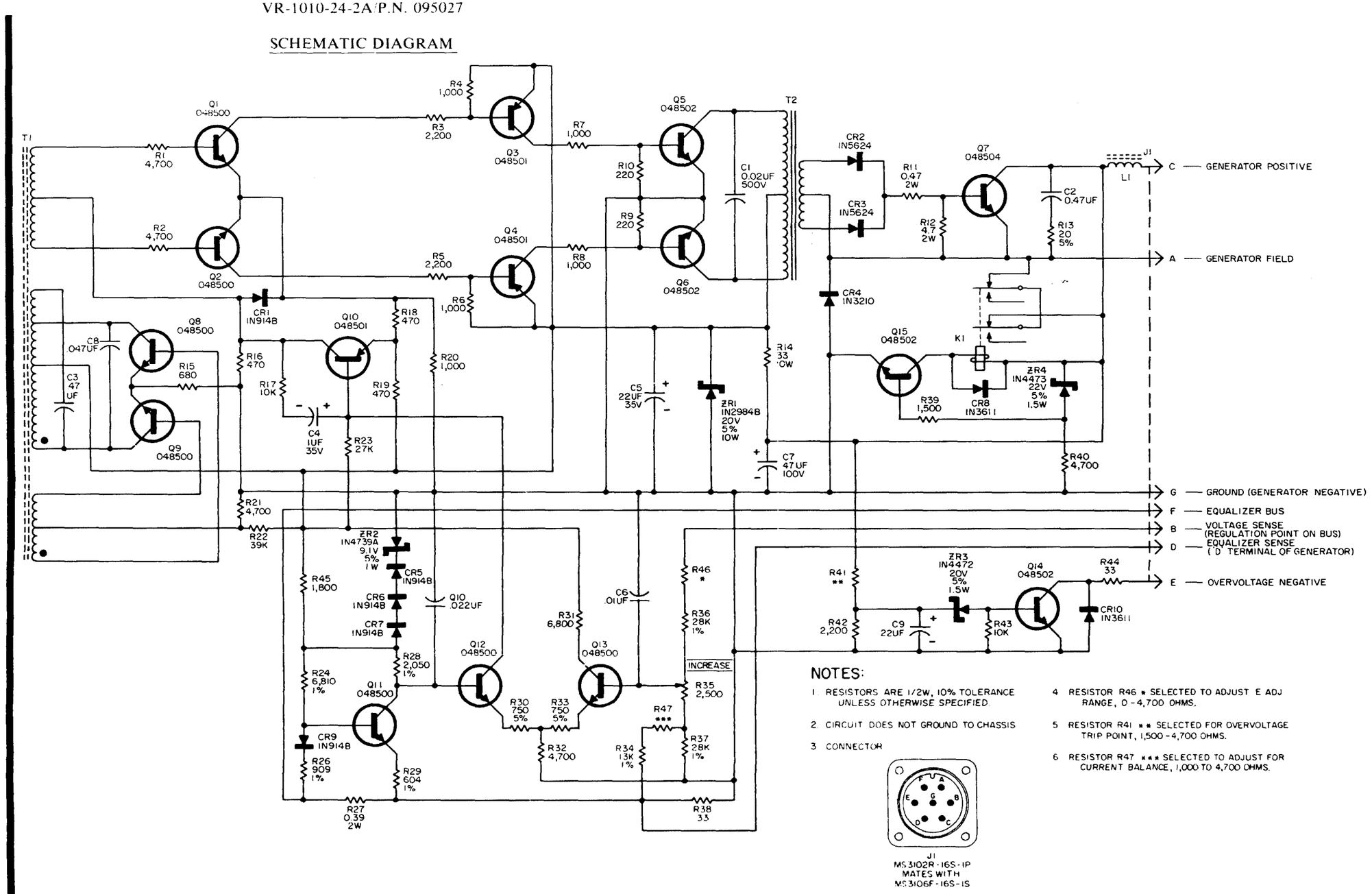
REVISION REFERENCE SHEET

REVISION CODE	REVISION DESCRIPTION	SERIAL NO. EFFECTIVITY
H	TRANSISTOR Q7 CHANGED TO PAI P.N. 048504 FROM RCA TYPE NO. 66090. TRANSISTORS Q5, Q6, AND Q15 CHANGED TO PAI P.N. 048502 FROM RCA TYPE NO. 40348.	1 DEC 1975
I	TRANSISTORS Q1, Q2, Q8, Q9, Q11, Q12, AND Q13 CHANGED TO PAI P.N. 048500 FROM TYPE 2N3565; TRANSISTORS Q3, Q4, AND Q10 CHANGED TO PAI P.N. 048501 FROM TYPE NO. 2N3638; ZENER DIODE SYMBOLS CHANGED Z1, Z2, Z3, AND Z4 TO ZR1, ZR2, ZR3, AND ZR4; TYPOGRAHICAL ERROR AS READS 1/4W CHANGED TO 1/8W, AS READS 10K CHANGED TO 13K IN REV. B.	1 AUG 1977
J	RELAY K1 CONTACTS CORRECTED TO FORM 'C.'	31 MAR 1978
K	ZENER DIODE ZR2 CHANGED TO 1N4739A-9.1V±5%, 1W FROM 1N4465-10V±5%, 1.5W.	30 JUN 1978

Model VR-1010-24-2A, DC Voltage Regulator,
Revision Reference Sheet, Schematic Diagram,
Figure 1201 (Sheet 2 of 3)

VR-1010-24-2A/P.N. 095027

SCHEMATIC DIAGRAM



NOTES:

1. RESISTORS ARE 1/2W, 10% TOLERANCE UNLESS OTHERWISE SPECIFIED.
2. CIRCUIT DOES NOT GROUND TO CHASSIS
3. CONNECTOR

J1
MS3102R-16S-1P
MATES WITH
MS3106F-16S-1S

4. RESISTOR R46 * SELECTED TO ADJUST E ADJ RANGE, 0-4,700 OHMS.
5. RESISTOR R41 ** SELECTED FOR OVERVOLTAGE TRIP POINT, 1,500-4,700 OHMS.
6. RESISTOR R47 *** SELECTED TO ADJUST FOR CURRENT BALANCE, 1,000 TO 4,700 OHMS.

Model VR-1010-24-2A, DC Voltage Regulator,
Schematic Diagram
Figure 1201 (Sheet 3 of 3)

Phoenix Aerospace Inc.

MAINTENANCE MANUAL

Solid-State Static Inverter (Transverter)
DH-1030-24-600-CS/P.N. 095032

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Solid-State Static Inverter (Transverter)
DH-1030-24-600-CS/P.N. 095032

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Effective Pages	2	Blank
Contents	1	Aug. 20/68
	2	Aug. 20/68
Introduction	1	Aug. 20/68
	2	Blank
24-20-X	1	Aug. 20/68
24-20-X	2	Aug. 20/68
24-20-X	3	Aug. 20/68
24-20-X	4	Aug. 20/68
24-20-X	5	Aug. 20/68
24-20-X	6	Aug. 20/68
24-20-X	7	Aug. 20/68
24-20-X	8	Blank
24-20-X	9	Oct. 12/73
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24-20-X	206	Aug. 20/68

*The asterisk indicates pages revised or added by the current revision.

DH-1030-24-600-CS/P.N. 095032

INTRODUCTION

In conformance with A.T.A. Specification No. 100 for Manufacturers' Technical Data, two manuals have been prepared concerning the Model DH-1030-24-600-CS Solid-State Static Inverter (Transverter). These manuals, if used as intended, will facilitate the effective, continued operation of the equipment. Technical data is grouped according to usage in the manual as described.

MAINTENANCE MANUAL

This manual is intended for use by flight line and hangar maintenance personnel. A detailed description and operation procedures, including a table of leading particulars are presented for reference. Mounting information, and cabling information are presented as an aid to installation. Trouble-shooting information is limited to procedures required to trace a trouble to the overall unit for replacement.

OVERHAUL MANUAL WITH ILLUSTRATED PARTS CATALOG

The Overhaul Manual contains all the information required for shop testing, replacement of defective parts, alignment and adjustment, mechanical disassembly, inspection, and reassembly. Detailed circuit theory is given with emphasis on theory that will be especially helpful for effective trouble-shooting. Performance tests as well as functional (go/no-go) checks, which may be used to determine condition of equipment and for retesting after repairs.

The Illustrated Parts Catalog provides a means to determine the manufacturer's part number and the physical location on the equipment of a part if the reference designation is known, or to determine the reference designation and the manufacturer's part number when the physical location of the part is known but no other information is available.

DH-1030-24-600-CS/P.N. 095032

DESCRIPTION AND OPERATION

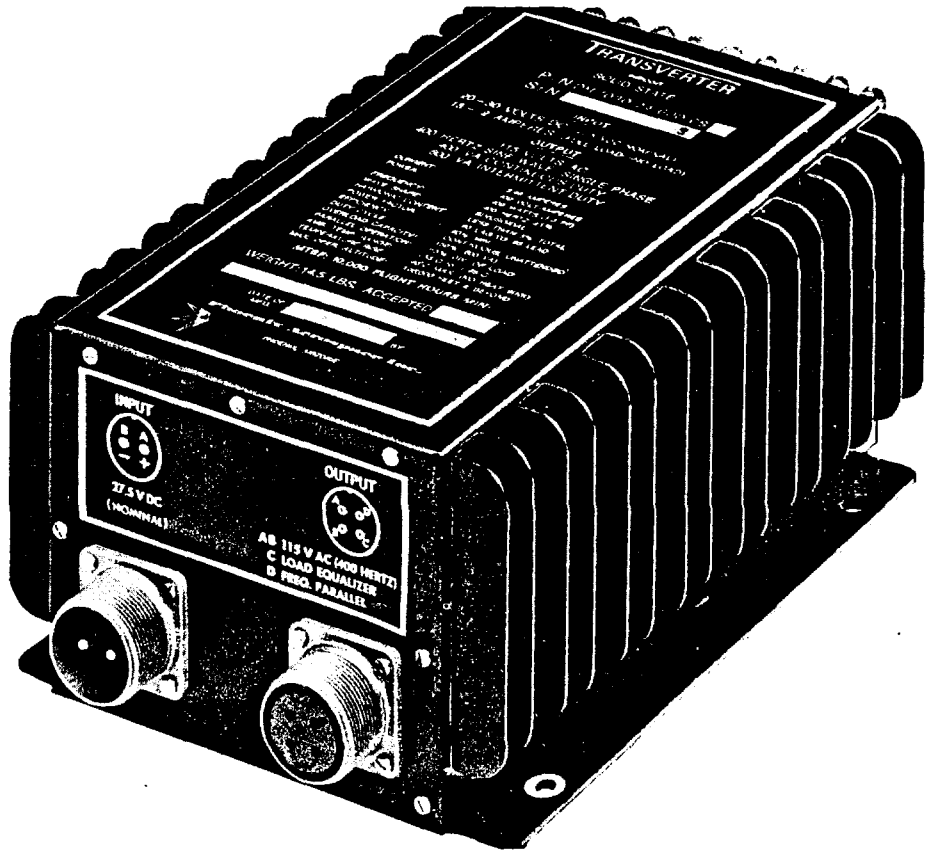
1. GENERAL.

A. Purpose of Manual.

This manual contains maintenance procedures for the Model DH-1030-24-600-CS, Solid-State Static Inverter (Transverter), illustrated in Fig. 1.

B. Purpose of Equipment.

The Model DH-1030-24-600-CS Solid-State Static Inverter (Transverter) is used for conversion of electrical power in aircraft for operation of airborne instrumentation and other electrical equipment. The unit provides a continuous source of frequency and voltage regulated, single phase, sine wave, alternating current power from a direct current voltage source. The stable output insures the highest degree of operational reliability under the most adverse service conditions.



Model DH-1030-24-600-CS, Solid-State Static Inverter (Transverter)
Figure 1

2. DESCRIPTION.

A. The Model DH-1030-24-600-CS Solid-State Static Inverter (Transverter) is a self-contained DC to AC inverter using state-of-the-art-solid state techniques. Power from the DC source is changed to a highly stable alternating current power source. The unit is compactly packaged with only input and output connections externally accessible.

B. The primary characteristics, capabilities, overall weight, and dimensions are listed in Table of Leading Particulars, Table 1.

GENERAL:

Input: 20-30 VDC (27.5 VDC nominal), 18.0 - 2.0 Amperes (full load - no load, 27.5 VDC Input).

Output: 115 VAC, 400 Hertz Sine Wave, 1 Phase, 400 VA Continuous Duty, 600 VA Intermittent Duty.

Ambient Temperature Range: −55°C to +85°C.

Temperature Rise: 40°C maximum (no heat sink).

Maximum Operating Altitude: 100,000 feet and beyond.

Reliability: 10,000 hours MTBF (minimum).

ELECTRICAL:

Output:

Volts: 115 VAC ±5% — No load to full load over input and temperature/altitude operating range.

Current: 3.48 Amperes.

Power: 400 Volt-Amperes (Continuous Duty), 600 Volt-Amperes (Intermittent Duty).

Frequency: 400 Hertz ±1% — No load to full load over input and temperature/altitude operating range (frequency is maintained to 10 VDC input, and below).

Wave Shape: Sinusoidal

Harmonic Content: Less than 5% total, (3% typical).

Power Factor: .80° lag to .95° lead.

Efficiency: 80% minimum.

Table of Leading Particulars
Table 1

ELECTRICAL (Cont):

Output (Cont):

Duty Cycle: Continuous, unattended.

Short Circuit Protection: Automatic — Restarts when normal load is restored (No damage, output shorted for 1 minute).

Overload Capacity: 150% for 5 minutes (No damage), (600 VA).

Input:

Volts: 20 - 30 VDC (27.5 VDC nominal) 0 - 36 Volts (No damage).

Current: 18.0 - 1.25 Amperes (full load - no load). Operating at rated load, 27.5 VDC Input, 18.0 Amperes.

Induced Ripple: Less than 1.5 Volts peak to peak.

Overvoltage Protection: 130% for 5 minutes (No damage).

Transient Protection: ±80 volts for 40 milliseconds,
±600 volts for 10 microseconds.

Reverse Polarity Protection: Polarity protect diode.

MECHANICAL:

Weight: 14.5 pounds (6,577 grams).

Overall Dimensions: 10-7/8 in. long (27.623 cm) by
7-3/4 in. wide (19.685 cm) by
5 in. high (12.7 cm).

Mounting Base Dimensions: 10-7/8 in. long (27.623 cm) by
7-3/4 in. wide (19.685 cm).

Mounting Centers: 7 in. long (17.780 cm) by 7 in. wide (17.780 cm).

Electrical Connectors: Input: MS3102R-22-1P mating MS3106F-22-1S.
Output: MS3102R-22-10S mating MS3106F-22-10P.

Cooling: Self-cooled by natural convection, conduction and radiation.

Installation: Mounts in any position, without deterioration of power output, heating, operating life, or other operating characteristics.

3. OPERATION.

The subsequent paragraphs cover the theory of operation for the Model DH-1030-24-600-CS Solid-State Static Inverter (Transverter). The Block Diagram Theory will aid in conveying the overall circuit operation to non-technical oriented personnel, while the Detail Circuit Theory will enable the technician to understand in detail the operation of equipment.

A. Block Diagram Theory.

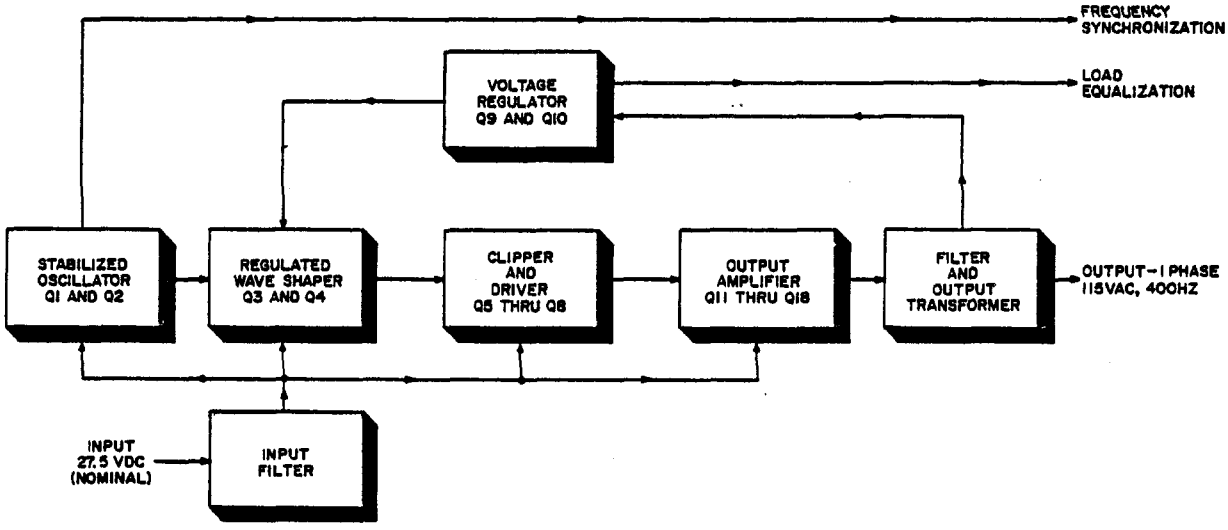
The subsequent paragraphs together with the block diagram of Fig. 2, cover in concise form the signal flow and circuit operation for the Model DH-1030-24-600-CS Solid-State Static Inverter (Transverter).

(1) Input Filter. Power applied through the input filter is free of transients and provided with reverse polarity protection for application to circuits of the Transverter.

(2) Stabilized Oscillator. Transistors Q1 and Q2 generate a 400 Hertz sine wave signal of high stability. The sine wave signal is coupled through auxiliary windings of the oscillator transformer T1 to the input of the regulated wave shaper.

(3) Regulated Wave Shaper. Transistors Q3 and Q4 in a push-pull circuit receive the sine wave signal developed by the stabilized oscillator. Voltage applied from the voltage regulator circuit determines the shaping operation for optimum efficiency, duty cycle and regulation of the output signal. The shaped output is coupled to the input of clipper circuit.

(4) Clipper and Driver. Transistors Q5, Q6, Q7 and Q8 in cascaded push-pull stages provide additional shaping and amplification of the 400 Hertz signal. The amplified signal is applied to the output amplifier.



Model DH-1030-24-600-CS, Solid-State Static Inverter (Transverter), Block Diagram
Figure 2

(5) Output Amplifier. Transistors Q11 through Q18 in a push-pull parallel circuit amplify the 400 Hertz signal to the required level across the output transformers for application to the output filter.

(6) Output Transformers and Filter. The output transformers and associated filter circuitry provide matching and shaping to return the amplified signal to a sinusoidal signal.

(7) Voltage Regulator. Transistors Q9 and Q10 develop the regulating bias by comparison of the rectified negative DC voltage supplied from the output, and adjusted by setting of resistor R22, controlling the Zener controlled voltage to the base of Transistor Q9.

B. Detailed Circuit Theory

The following sub-paragraphs cover the individual circuits and their operation. Occasional reference to the overall schematic diagram of the Transverter, Fig. 3, will be necessary to determine circuit configuration.

(1) Input Filter. The input filter consists of series reactor L2 and shunt capacitors C17, and C18 providing high speed transient and ripple suppression to the input line. Diode CR19 provides reverse polarity protection for the Transverter circuitry. The input filter and reverse polarity protect diode pass the input current required to maintain rated power output and provide operating voltage and power to Transverter circuits. Over voltage protection for low speed transients is provided by Zener diode. ZR3, resistor R15, and diodes CR2, CR3, CR4, and CR5. If the input voltage exceeds 42 volts, Zener diode ZR3 conducts and applies back bias to transistors Q5 and Q6 through diodes CR3 and CR4, respectively. This bias inhibits switching during over voltage periods and prevents a high voltage from being developed which could damage subsequent amplifier circuits or the output circuit. Diodes CR2 and CR5 protect the base circuits of transistors Q5 and Q6, respectively. Resistor R16 and Zener diode ZR1 provide transient suppression and regulation for the low level stages.

(2) Stabilized Oscillator. The stabilized oscillator utilizes transistors Q1 and Q2 in a Hartley oscillator circuit. Toroidal transformer T1, with multiple windings provides the tuned circuit, feedback, and output windings for the oscillator. The tuned circuit portion is tuned by capacitor C2 to 400 Hertz. Capacitor C1 provides parasitic suppression in the tuned collector circuit. A feedback winding provides the coupling between base-collector circuit to sustain oscillations, resistors R18 and R19 provide bias to the base circuit of transistors Q1 and Q2 to insure positive start and sustained oscillations. Resistor R17 provides degeneration for improved stability of the oscillator circuit. Output to the regulated wave shaper circuit is through the remaining winding on transformer T1. Output direct from the collector of transistor Q1 and tuned circuit is terminated at Pin D of connector J2 for Frequency Synchronization in a multiple inverter system.

(3) Regulated Wave Shaper. The regulated wave shaper receives the 400 Hertz sinusoidal signal from transformer T1 output winding. The input signal is applied to the base circuits of transistors Q3 and Q4 through resistors R1 and R2, respectively, limiting base current which flows in the base circuit. Transistors Q3 and Q4 conduct on alternate half cycles, with the point of conduction determined by the amount of bias supplied by transistor Q10, voltage regulator, to the emitter circuit. The output of this stage is a quasi-square wave and is applied to the input of the clipper circuit.

(4) Clipper and Driver. The clipper and driver circuits provide additional shaping of the signal and amplification for application to the output amplifier circuits. The clipper circuit consists of transistors Q5 and Q6 in a push-pull circuit. The quasi-square wave is applied to the base circuits of transistors Q5 and Q6 through limiting resistors R6 and R7, respectively. The output of the clipper circuit results in a quasi-square wave with improved rise time. The output is coupled to the base circuits of the driver transistors Q7 and Q8 through resistors R11 and R12, respectively. Resistors R13 and R14 provide low impedance return for leakage currents. Output of the collector circuits is developed across toroidal driver transformer T2 and coupled to the output amplifier circuits.

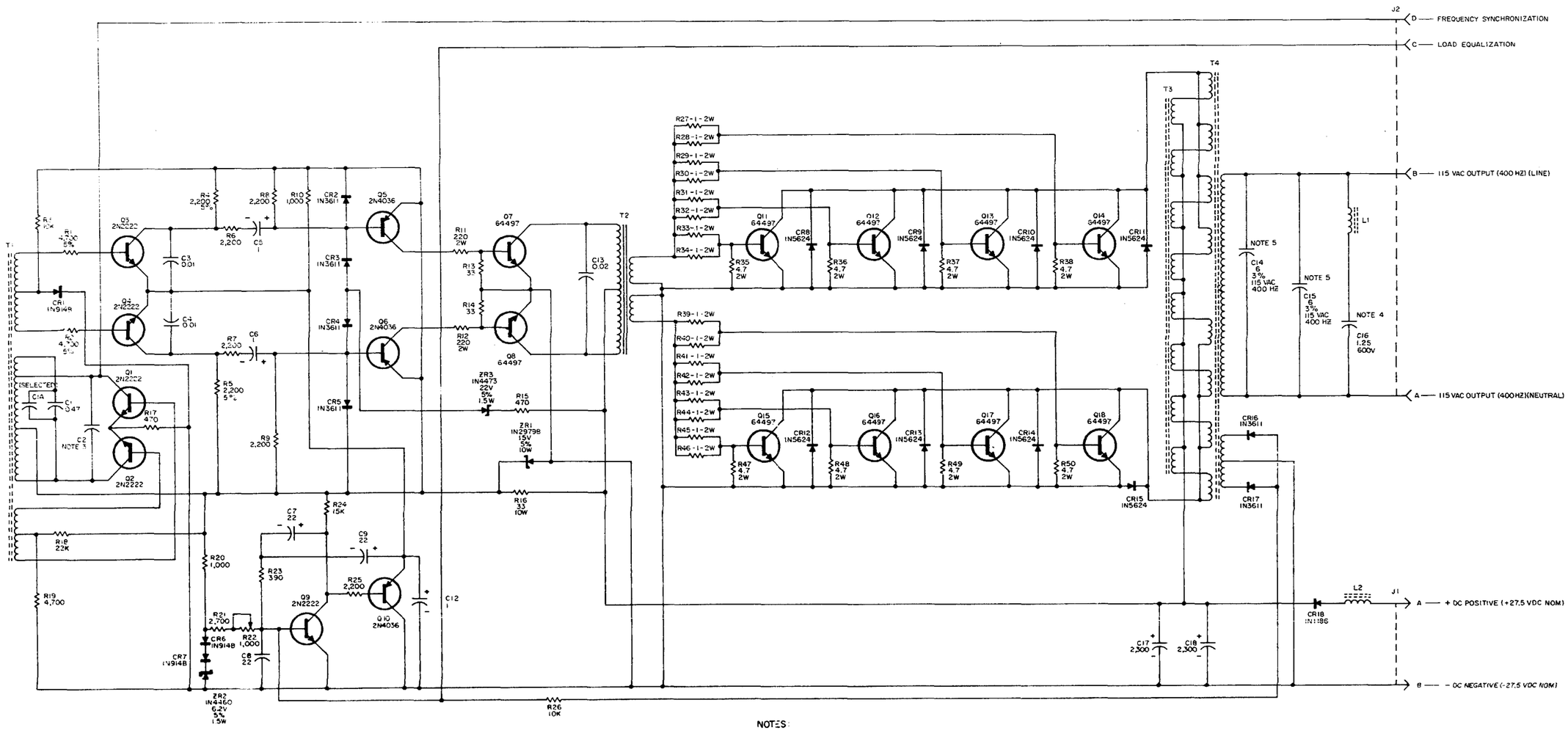
(5) Output Amplifiers. The output amplifiers receive the signal through toroidal driver transformer T2. Two output windings are connected in parallel to provide two outputs which drive the eight output transistors Q11 through Q18. Input to the base circuit of each output transistor is through two parallel connected 1 ohm, 2 watt, resistors, providing current limiting to the input. A 4.7 ohm, 2 watt resistor between the base and emitter of each output transistor reduces the impedance during the non-conduction period. The collectors of transistors Q11 through Q18 are parallel connected in groups of four, Q11, Q12, Q13 and Q14 so connected are connected to the high side of transformer T4 while transistors Q15, Q16, Q17, and Q18 are connected to the low side of transformer T4. Diodes CR8 through CR15 connected in parallel with the emitter collector junction of each power transistor provides the path for reverse current flow from the load back to the DC power source under conditions of high reactive loading. Toroidal series reactor transformer T3 is connected across the output transformer T4. The secondary winding of output transformer T4 is connected to the filter circuit.

(6) Output Transformer and Filter. The 400 Hertz quasi-square wave signal developed across toroidal output transformer T4 is high in content of odd order harmonics. Toroidal series reactor transformer T3 in conjunction with the output transformer T4, and the output filter circuit reduce these odd order harmonics. The impedance of the series reactor transformers is low at the 400 Hertz fundamental frequency, but sufficiently high at the frequency of the harmonics to enable the reactor-transformer combination to reduce the harmonic output. The output transformers T4 and T6 appear as a high impedance to the fundamental 400 Hertz signal and a low impedance to the harmonics, thus resulting in optimum power transfer at the fundamental frequency of 400 Hertz. The secondary winding of transformer T4 is tuned to the 400 Hertz fundamental by parallel capacitors C14, and C15, forming a parallel tuned circuit, which reflects a high impedance to the fundamental 400 Hertz signal and a low impedance path to the harmonics. The series tuned circuit comprised of capacitor C16 and toroidal reactor L1 is tuned to the third order harmonic 1200 Hertz, providing a shunting effect to the most predominant harmonic present in the output. The additional winding on transformer T4 is used to derive feedback voltage for the voltage regulator circuit. The derived voltage is rectified by diodes CR16 and CR17 to provide a negative DC potential to the voltage regulator circuit. The filtered output is 115 volts AC at a frequency of 400 Hertz and is available at pins A and B of connector J2.

(7) Voltage Regulator. The voltage regulator consists of transistors Q9 and Q10 and Zener diode ZR2. The positive voltage from Zener diode ZR2 and the negative voltage from diodes CR16 and CR17 are applied to the summing resistors R20, R21, and R22 to derive an error voltage at the base of transistor Q9. A change in output voltage, after the setting of resistor R22 has been determined, causes a change in the voltage applied to the summing circuit, developing an error voltage which is amplified by transistors Q9 and Q10. Output at the collector of transistor Q10 results in a proportional voltage change which is the bias applied to transistors Q3 and Q4. This change in bias controls duty cycle and output voltage by limiting action at the input wave shaper circuit. Output direct from the base of Q9 is terminated at Pin C for load equalization in a multiple inverter system.

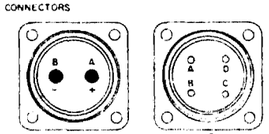
REVISION CODE	REVISION DESCRIPTION	SERIAL NO. EFFECTIVITY
A	CR8 THROUGH CR15 CHANGED TO 1N5624	22 SEP 71
B	CHANGED CAPACITOR C16 TO MYLAR FOIL WRAP AND FILL 1.25 UF 600VDC.	18 DEC 71
C	Q7, Q8, Q11, Q12, Q13, Q14, Q15, Q16, Q17 AND Q18 CHANGED TO RCA 64497. REMOVED CAPACITOR C-11 0.1 UF. CHANGED CAPACITORS C14 AND C15 TO 6 UF, ±3%, 115 VAC, 400 HZ, METALIZED POLYCARBONATE.	22 JUN 73
D	REMOVED CAPACITOR C10 1 UF. REMOVED CAPACITOR C19 1400 UF. CHANGED VALUE OF CAPACITORS C17 AND C18 TO 2300 UF. ADDED CAPACITOR C1A (SELECTED).	12 OCT 73

Model DH-1030-24-600-CS, Solid-State Static Inverter (Transverter), Revision Reference Sheet
Figure 3 (Sheet 1 of 2)



NOTES:

1. RESISTORS ARE 1/2W, 10% TOLERANCE UNLESS OTHERWISE SPECIFIED. CAPACITOR VALUES ARE IN UF (MICROFARADS) UNLESS OTHERWISE SPECIFIED.
2. CIRCUIT DOES NOT GROUND TO CHASSIS.
3. CAPACITOR C2 SELECTED TO TUNE OSCILLATOR TO 400 HZ. VALUE FROM 0.02 TO 0.047 UF.
4. CAPACITOR C16 IS MYLAR FOIL WRAP AND F... DO NOT SUBSTITUTE.
5. CAPACITORS C14, C15 ARE 6.0 UF ± 3% 115 VAC, 400 HZ, METALIZED POLYCARBONATE.
6. CONNECTORS



Model DH-1030-24-600-CS, Solid-State Static Inverter (Transverter), Schematic Diagram
Figure 3 (Sheet 2 of 2)

TROUBLE SHOOTING

1. GENERAL.

The following paragraphs define procedures suitable for determining that a fault exists in the Solid-State Static Inverter (Transverter). These procedures do not cover trouble shooting within the Transverter. For equipment trouble shooting procedures refer to the overhaul manual and perform only in overhaul shops.

2. PRELIMINARY SYSTEM CHECK.

Refer to the airframe wiring diagram and the cabling information given in figure 203 in this manual and perform the following checks:

A. Check for input power at primary power source, breaker or fuse, and at pins A and B of input power connector P1. Use a DC voltmeter with a measuring range of 0 to 40 volts. Nominal input voltage of 27.5 volts should be measured between pins A and B.

B. Check for output at connector J2, pins A and B, series breaker or fuse, and at the input of device to which power is supplied. NOTE: When checking for output, check for shorted output at load by opening breaker or removing fuse and rechecking output present at connector J2. Use an AC voltmeter capable of measuring 0 to 150 volts AC at 400 Hertz. Measured voltage should be 115 volts AC between pins A and B plus or minus 5%.

C. Check output current to the load using an AC ammeter to determine that output current is not in excess of 3.48 Amperes on pin B of connector J2.

MAINTENANCE PRACTICES

1. GENERAL.

The following paragraphs cover in detail operations associated with maintenance, installation/removal, etc., of the Model DH-1030-24-600-CS Solid-State Static Inverter (Transverter).

2. SERVICING.

Periodic servicing or maintenance of the Transverter is not required or recommended. The equipment should not be removed from the airframe unless required by maintenance practices observed by the using agency. The use of solid state devices in a completely transistorized circuit, eliminates all moving parts, including relays or contactors. The design therefore eliminates the major cause of failure and maintenance points. In the event failure occurs, refer to the Installation/Removal paragraphs and remove unit for repair by overhaul shop or return to vendor.

3. INSTALLATION/REMOVAL.

The following sub-paragraphs outline installation and removal procedures.

A. Installation.

(1) Refer to Fig. 201 and determine the clearance requirements for equipment and the associated cabling at selected installation point.

CAUTION: USE CARE IN DRILLING OPERATION OF SUBSEQUENT PARAGRAPH, TO PREVENT DAMAGE TO AIRFRAME STRUCTURE, OTHER WIRING, OR CONTROLS.

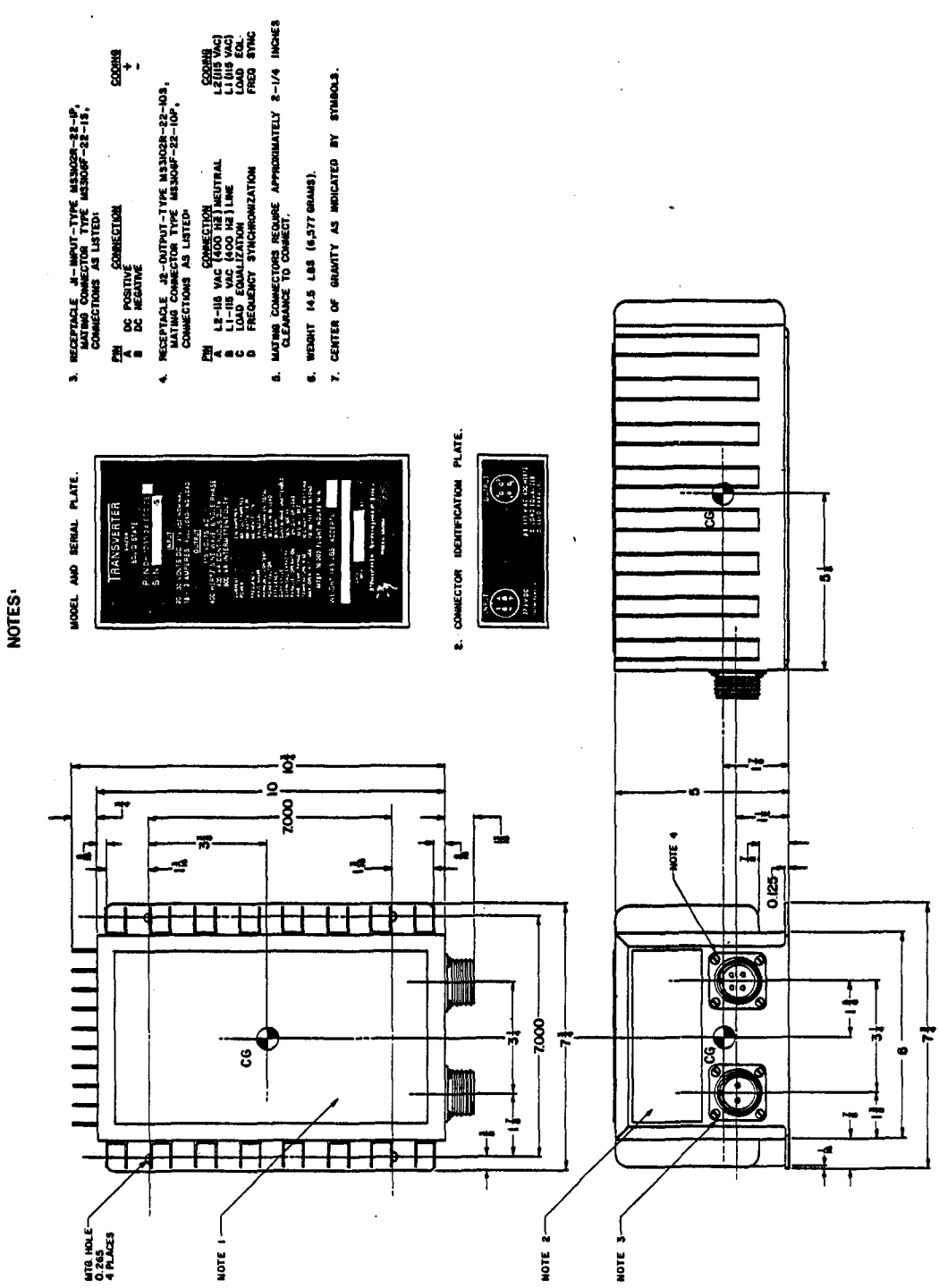
(2) Refer to Fig. 202, mark and drill four .265 inch diameter holes to mount equipment to airframe.

NOTE: Paint removal is not required, however, better heat transfer is accomplished if the mounting surface is clean and free from paint. A light coating of Dow Corning #340 Silicone compound applied to the base prior to installation improves the heat transfer from equipment to airframe.

(3) Install Transverter, securing in place with four 1/4-28 hex head cap screws, four 1/4 inch internal tooth lock washers, and four 1/4-28 self-locking hex nuts. All hardware shall meet or exceed applicable MS or AN Specification. Length of screws must be selected at installation and must have at least one and one-half threads showing after installed and tightened securely in place.

(4) Using the two mating connectors supplied, refer to Fig. 203 and prepare input and output cabling between the Transverter and circuit breaker/fuse panel and the powered device.

(5) After completion of cabling, open circuit breakers or remove fuses at power panel and connect the input power cable plug P1, MS3106F-22-1S to input receptacle J1, MS3102R-22-1P. Connect output power cable plug P2, MS3106F-22-10P to output receptacle J2, MS3102R-22-10S.



Outline Dimensions, Model DH-1030-24-600-CS
Solid-State Static Inverter (Transverter)
Figure 201

B. Removal.

(1) Identify circuit breakers or fuses at power panel and place circuit breakers in off position or remove fuses.

(2) Refer to cabling diagram Fig. 203 and disconnect input and output connectors P1 and P2, respectively.

(3) Remove the four 1/4-28 hex head screws, 1/4 inch internal tooth lock washers, and 1/4-28 self-locking hex nuts securing the Transverter to airframe.

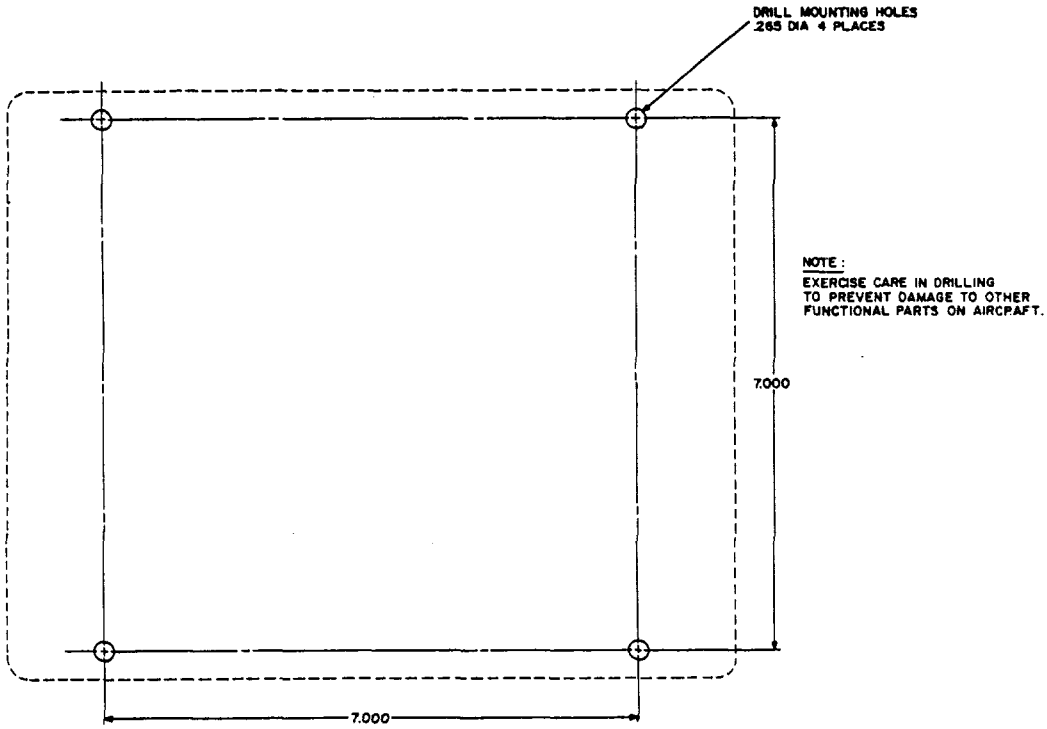
4. ADJUSTMENT/TEST.

The following paragraphs outline test procedures for both installation check out and a pre-installation bench test if desired or required by maintenance policies. Adjustments are not authorized at flight line maintenance level.

A. Installation Test.

Complete the following steps to determine if Transverter and associated load are operating properly.

(1) Place circuit breakers in the on position or install fuses at power panel in the input circuit.



Drilling Template Mounting Holes,
Model DH-1030-24-600-CS
Solid-State Static Inverter (Transverter)
Figure 202

(2) Operate control to apply power to input of device while observing aircraft metering of the DC voltage for any abrupt change in voltage or current. In the event any abrupt change occurs, remove power and check wiring for shorted condition.

(3) Place circuit breakers in the on position or install fuses at power panel in the output circuit.

(4) Operate control or connect device or load to output of Transverter, observing operation of powered device and aircraft metering of the DC voltage for any change in voltage or current. In the event any appreciable change occurs, remove power at input and check output wiring and the associated load for short or other malfunction.

B. Pre-installation Check.

Complete the following steps to determine that Transverter is operable and capable of supplying power to a specific load.

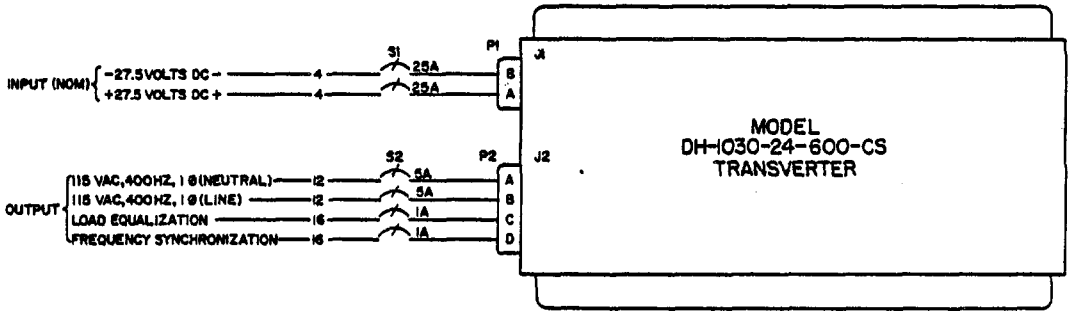
(1) Refer to Fig. 204 and connect Transverter to the Test Set and associated DC Power Supply.

(2) Place selector switch on Test Set to 400 WATTS 1.0-UNITY position.

(3) Connect output of DC Power Supply to input of Test Set observing the polarity carefully.

(4) Adjust output of DC Power Supply to 27.5 volts DC and observe current meters in both the input and output circuits for proper operation.

Input Current: 18.0 Amperes Input Voltage: 27.5 VDC
Output Current: 3.48 Amperes Output Voltage: 115 VAC±5%



NOTES:

1. CIRCUIT BREAKER S1 AND S2 ARE NOT SUPPLIED. THE BREAKERS MAY BE REPLACED WITH FUSES IF DESIRED. THE INPUT POWER LINE REQUIRES PROTECTION OF 25 AMPERES, S1 WHILE THE OUTPUT LINE REQUIRES PROTECTION OF 5 AMPERES, S2 CONTROL LINES MAY BE PROTECTED BY 1 AMPERE BREAKERS OR FUSES.
2. CABLING SHALL BE FABRICATED FROM ELECTRICAL WIRE WHICH MEETS OR EXCEEDS REQUIREMENTS OF MIL-W-16878/3, TYPE D.
3. WIRING SHALL MEET OR EXCEED THE FOLLOWING SIZE REQUIREMENTS:

INPUT P1/J1		OUTPUT P2/J2	
PIN A	#4	PIN A	#12
PIN B	#4	PIN B	#12
		PIN C	#16
		PIN D	#16

4. CONNECTOR PLUGS, P1 AND P2 ARE SUPPLIED WITH TRANSVERTER (OPTIONAL).

Cabling Diagram, Model DH-1030-24-600-CS
Solid-State Static Inverter (Transverter)
Figure 203

(5) Change input voltage from DC Power Supply varying between 20 and 30 volts and note stability of output voltage and current, no change is indicative of proper operation.

(6) Return input voltage to zero and disconnect Transverter from Test Set, completing pre-installation or bench tests.

NOTE: In the event Transverter under test does not meet requirements outlined in step (5), unit should be returned to stores for replacement and forwarded to overhaul or returned to vendor for repairs.

5. INSPECTION/CHECK.

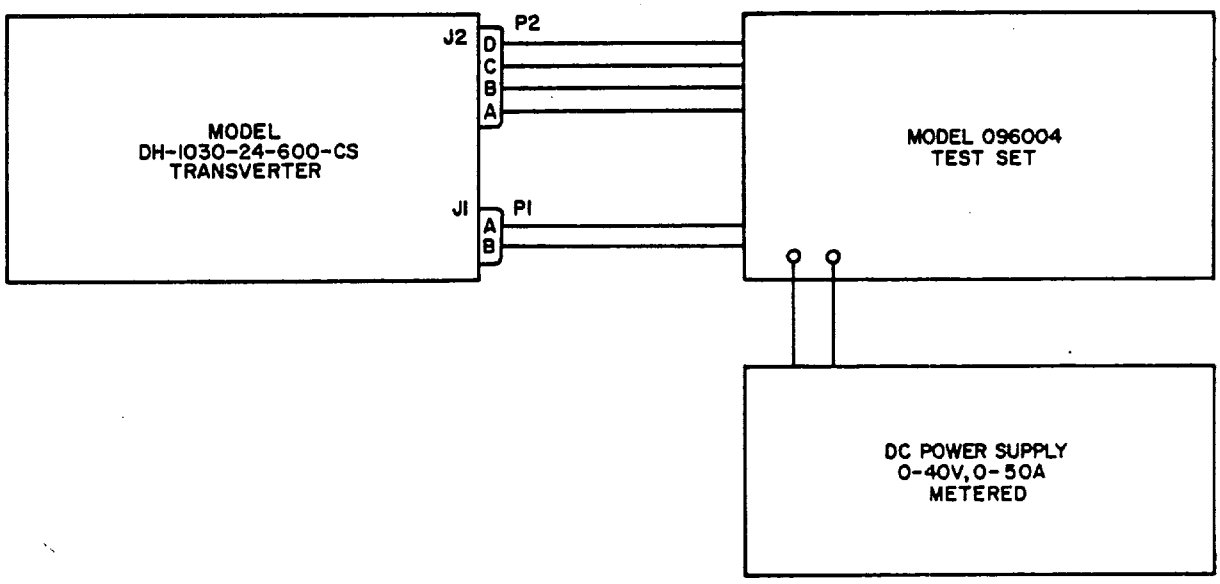
Visual inspection of external cabling for arcing at contacts of connectors, and associated load are the only authorized inspection/checks. No authority is given for visual or other checks internally or even removal of the sealed cover at flight line maintenance levels.

6. CLEANING/PAINTING.

The Transverter requires no periodic cleaning operations under the sealed cover. If readily accessible, exterior dirt may be removed with a brush or cloth and the connector pins may be burnished if corrosion should be apparent during visual inspection check of paragraph 5.

7. APPROVED REPAIRS.

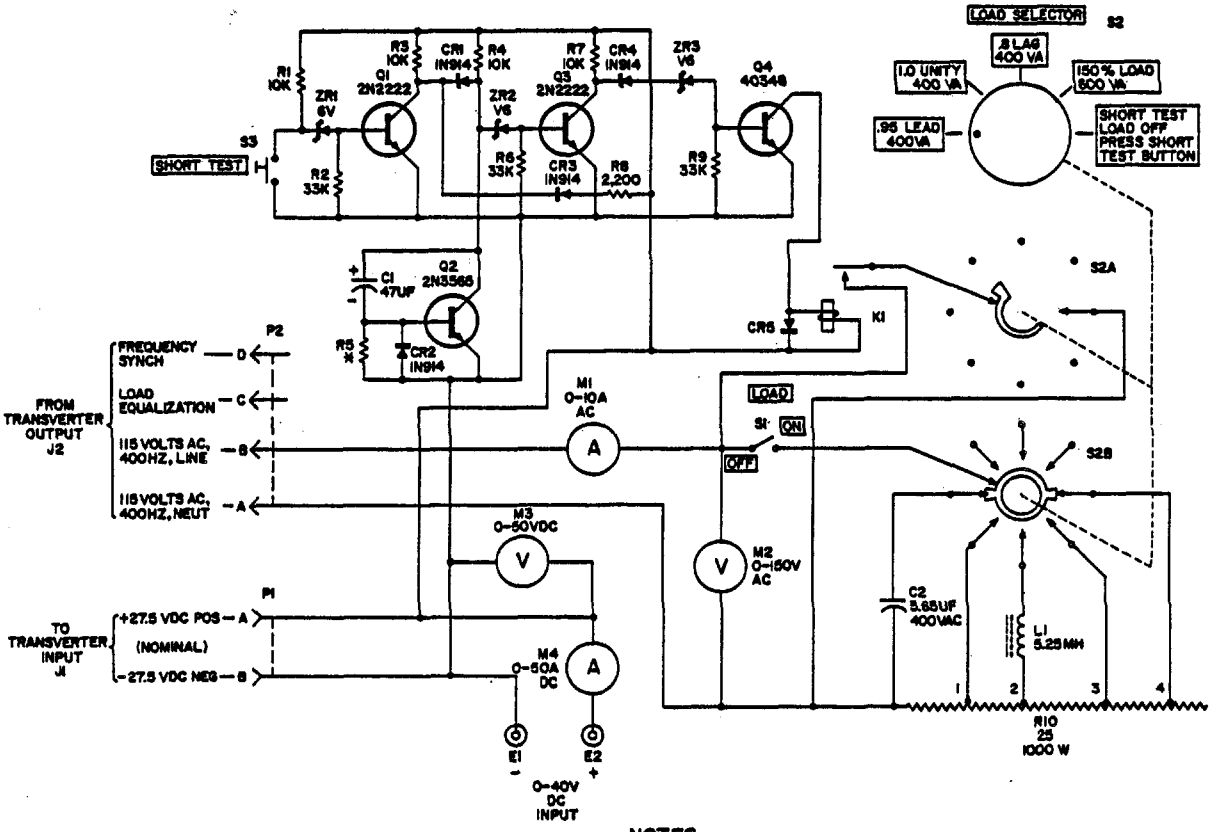
The only repairs approved for flight line maintenance are those associated with external cabling. No repairs are authorized or approved for flight line maintenance requiring removal of the sealed cover.



Bench Test Set-Up, Model DH-1030-24-600-CS
Solid-State Static Inverter (Transverter)
Figure 204

8. ACCESSORY TEST SET, MODEL 096004

The Test Set referenced in preceding paragraph 4.B is available from Phoenix Aerospace as a complete unit or in part as desired by the user. All parts other than the toroidal power reactor are available from local parts jobbers. The schematic diagram for the Test Set is shown in Fig. 205.



NOTES

1. RESISTOR R10 TAP#1 = 14.55Ω; TAP#2 = 17.6Ω; TAP#3 = 22.0Ω; TAP#4 = 23.15Ω.
2. P1, PENDANT CONNECTOR PLUG MS3106F-24-9S MATES WITH RECEPTACLE J1, MS3102R-24-9P.
3. P2, PENDANT CONNECTOR PLUG, MS3106F-24-22P, MATES WITH RECEPTACLE J2, MS3102R-24-22S.
4. INDUCTOR L1, PHOENIX AEROSPACE, INC. PART NO. 038014, REACTOR, POWER, TOROIDIAL.

Schematic Diagram, Model DH-1030-24-600-CS
Solid-State Static Inverter (Transverter),
Model 096004 Test Set
Figure 205

Solid-State Static Inverter (Transverter)
DH-1030-24-600-CS/P.N. 095032

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DH-1030-24-600-CS/P.N. 095032

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INTRODUCTION

In conformance with A.T.A. Specification No. 100 for Manufacturers' Technical Data, two manuals have been prepared concerning the Model DH-1030-24-600-CS Solid-State Static Inverter (Transverter). These manuals, if used as intended, will facilitate the effective, continued operation of the equipment. Technical data is grouped according to usage in the manual as described.

OVERHAUL MANUAL WITH ILLUSTRATED PARTS CATALOG

The Overhaul Manual contains all the information required for shop testing, replacement of defective parts, alignment and adjustment, mechanical disassembly, inspection, and reassembly. Detailed circuit theory is given with emphasis on theory that will be especially helpful for effective trouble-shooting. Performance tests as well as functional (go/no-go) checks, which may be used to determine condition of equipment and for retesting after repairs.

The Illustrated Parts Catalog provides a means to determine the manufacturer's part number and the physical location on the equipment of a part if the reference designation is known, or to determine the reference designation and the manufacturer's part number when the physical location of the part is known but no other information is available.

MAINTENANCE MANUAL

This manual is intended for use by flight line and hangar maintenance personnel. A detailed description and operation procedures, including a table of leading particulars are presented for reference. Mounting information, and cabling information are presented as an aid to installation. Trouble-shooting information is limited to procedures required to trace a trouble to the overall unit for replacement.

DH-1030-24-600-CS/P.N. 095032

DESCRIPTION AND OPERATION

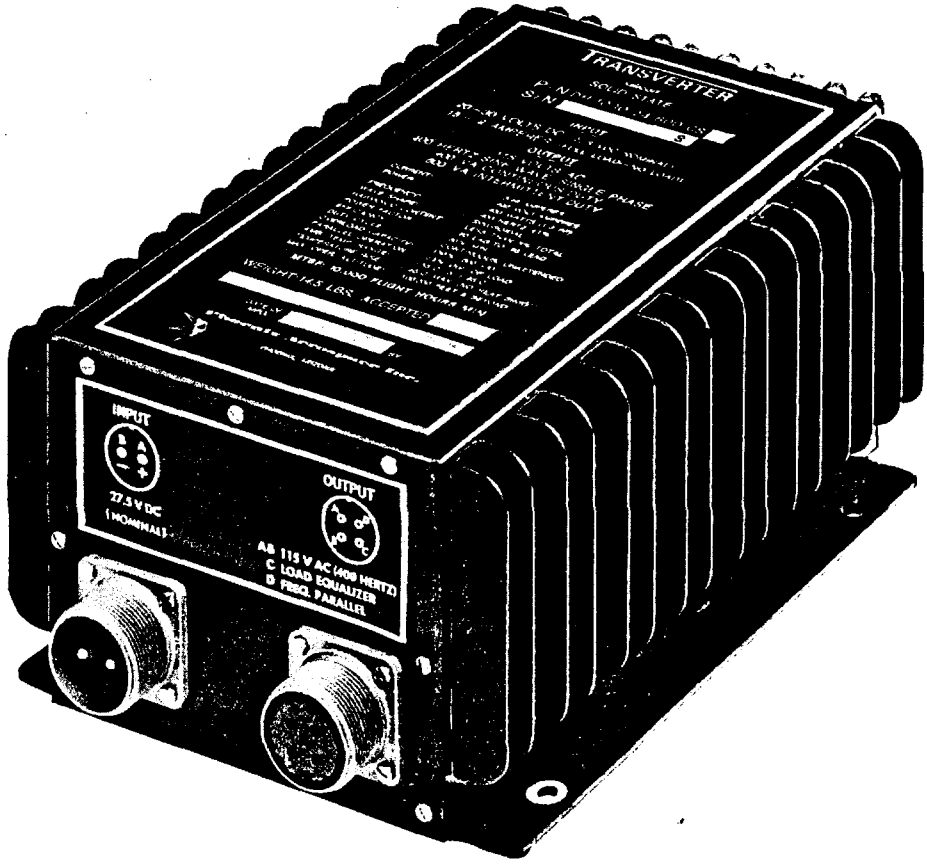
1. GENERAL.

A. Purpose of Manual.

This manual contains instructions covering overhaul, and the illustrated parts catalog for the Model DH-1030-24-600-CS, Solid-State Static Inverter (Transverter), illustrated in Fig. 1.

B. Purpose of Equipment.

The Model DH-1030-24-600-CS, Solid-State Static Inverter (Transverter), is used for conversion of electrical power in aircraft for operation of airborne instrumentation and other electrical equipment. The unit provides a continuous source of frequency and voltage regulated, single phase, sine wave, alternating current power from a direct current voltage source. The stable output insures the highest degree of operational reliability under the most adverse service conditions.



Model DH-1030-24-600-CS, Solid-State Static Inverter (Transverter)
Figure 1

2. DESCRIPTION.

A. The Model DH-1030-24-600-CS Solid-State Static Inverter (Transverter) is a self-contained DC to AC inverter using state-of-the-art-solid state techniques. Power from the DC source is changed to a highly stable alternating current power source. The unit is compactly packaged with only input and output connections externally accessible.

B. The primary characteristics, capabilities, overall weight, and dimensions are listed in Table of Leading Particulars, Table 1.

GENERAL:

Input: 20 - 30 VDC (27.5 VDC nominal), 18.0 - 2.0 Amperes (full load - no load, 27.5 VDC Input).

Output: 115 VAC, 400 Hertz Sine Wave, 1 Phase, 400 VA Continuous Duty, 600 VA Intermittent Duty.

Ambient Temperature Range: −55°C to +85°C.

Temperature Rise: 40°C maximum (no heat sink).

Maximum Operating Altitude: 100,000 feet and beyond.

Reliability: 10,000 hours MTBF (minimum).

ELECTRICAL:

Output:

Volts: 115 VAC ±5% — No load to full load over input and temperature altitude operating range.

Current: 3.48 Amperes.

Power: 400 Volt-Amperes (Continuous Duty), 600 Volt-Amperes (Intermittent Duty)

Frequency: 400 Hertz ±1% — No load to full load over input and temperature/altitude operating range (frequency is maintained to 10 VDC input, and below).

Wave Shape: Sinusoidal

Harmonic Content: Less than 5% total, (3% typical).

Power Factor: .80° lag to .95° lead.

Efficiency: 80% minimum.

Table of Leading Particulars
Table 1

ELECTRICAL (Cont):

Output (Cont):

Duty Cycle: Continuous, unattended.

Short Circuit Protection: Automatic — Restarts when normal load is restored (No damage, output shorted for 1 minute).

Overload Capacity: 150% for 5 minutes (No damage), 600 VA.

Input:

Volts: 20 - 30 VDC (27.5 VDC nominal) 0 - 36 Volts (No damage).

Current: 18.0 - 2.0 Amperes (full load - no load). Operating at rated load, 27.5 VDC Input, 18.0 Amperes.

Induced Ripple: Less than 1.5 Volts peak to peak.

Overvoltage Protection: 130% for 5 minutes (No damage).

Transient Protection: ±80 volts for 40 milliseconds,
±600 volts for 10 microseconds.

Reverse Polarity Protection: Polarity protect diode.

MECHANICAL:

Weight: 14.5 pounds (6,577 grams).

Overall Dimensions: 10-7/8 in. long (27.623 cm) by
7-3/4 in. wide (19.685 cm) by
5 in. high (12.700 cm).

Mounting Base Dimensions: 10-7/8 in. long (27.623 cm) by
7-3/4 in. wide (19.685 cm).

Mounting Centers: 7 in. long (17.780 cm) by 7 in. wide (17.780 cm).

Electrical Connectors: Input: MS3102R-22-1P mating MS3106F-22-1S.
Output: MS3102R-22-10S mating MS3106F-22-10P.

Cooling: Self-cooled by natural convection, conduction and radiation.

Installation: Mounts in any position, without deterioration of power output, heating, operating life, or other operating characteristics.

3. OPERATION.

The subsequent paragraphs cover the theory of operation for the Model DH-1030-24-600-CS Solid-State Static Inverter (Transverter). The Block Diagram Theory will aid in conveying the overall circuit operation to non-technical oriented personnel, while the Detail Circuit Theory will enable the technician to understand in detail the operation of equipment.

A. Block Diagram Theory.

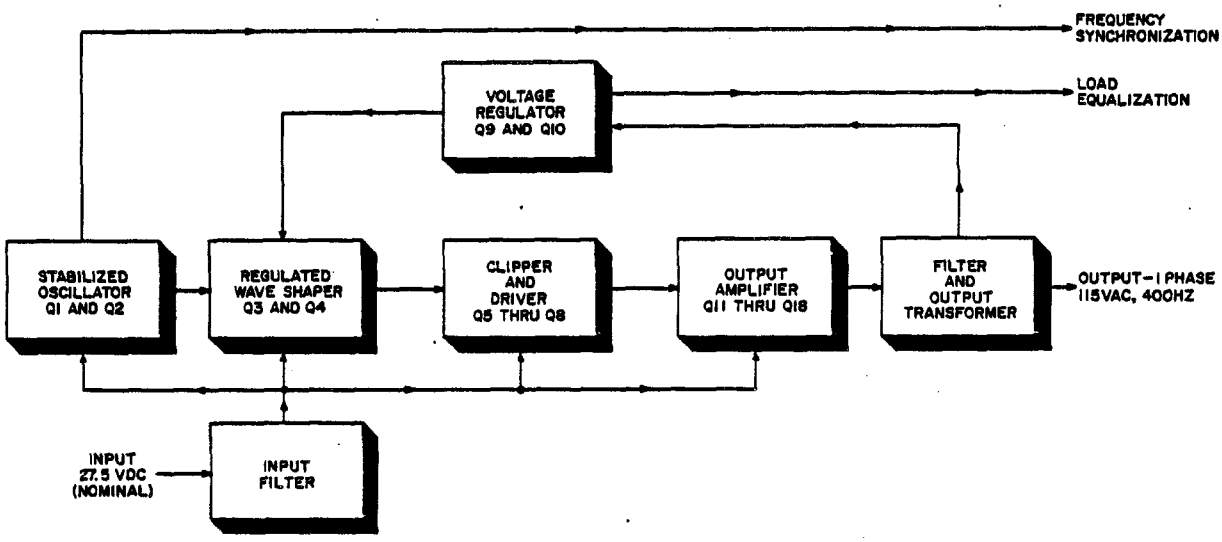
The subsequent paragraphs together with the block diagram of Fig. 2, cover in concise form the signal flow and circuit operation for the Model DH-1030-24-600-CS Solid-State Static Inverter (Transverter).

(1) Input Filter. Power applied through the input filter is free of transients and provided with reverse polarity protection for application to circuits of the Transverter.

(2) Stabilized Oscillator. Transistors Q1 and Q2 generate a 400 Hertz sine wave signal of high stability. The sine wave signal is coupled through auxiliary windings of the oscillator transformer T1 to the input of the regulated wave shaper.

(3) Regulated Wave Shaper. Transistors Q3 and Q4 in a push-pull circuit receive the sine wave signal developed by the stabilized oscillator. Voltage applied from the voltage applied from the voltage regulator circuit determines the shaping operation for optimum efficiency, duty cycle and regulation of the output signal. The shaped output is coupled to the input of clipper circuit.

(4) Clipper and Driver. Transistors Q5, Q6, Q7 and Q8 in cascaded push-pull stages provide additional shaping and amplification of the 400 Hertz signal. The amplified signal is applied to the output amplifier.



Model DH-1030-24-1200-CS, Solid-State Static Inverter (Transverter), Block Diagram
Figure 2

(5) Output Amplifier. Transistors Q11 through Q18 in a push-pull parallel circuit amplify the 400 Hertz signal to the required level across the output transformers for application to the output filter.

(6) Output Transformers and Filter. The output transformers and associated filter circuitry provide matching and shaping to return the amplified signal to a sinusoidal signal.

(7) Voltage Regulator. Transistors Q9 and Q10 develop the regulating bias by comparison of the rectified negative DC voltage supplied from the output, and adjusted by setting of resistor R22, controlling the Zener controlled voltage to the base of transistor Q9.

B. Detailed Circuit Theory

The following sub-paragraphs cover the individual circuits and their operation. Occasional reference to the overall schematic diagram of the Transverter, Fig. 3, will be necessary to determine circuit configuration.

(1) Input Filter. The input filter consists of series reactor L2 and shunt capacitors C17, and C18 providing high speed transient and ripple suppression to the input line. Diode CR19 provides reverse polarity protection for the Transverter circuitry. The input filter and reverse polarity protect diode passes the input current required to maintain rated power output and provide operating voltage and power to Transverter circuits. Over voltage protection for low speed transients is provided by Zener diode. ZR3, resistor R15, and diodes CR2, CR3, CR4, and CR5. If the input voltage exceeds 42 volts, Zener diode ZR3 conducts and applies back bias to transistors Q5 and Q6 through diodes CR3 and CR4, respectively. This bias inhibits switching during over voltage periods and prevents a high voltage from being developed which could damage subsequent amplifier circuits or the output circuit. Diodes CR2 and CR5 protect the base circuits of transistors Q5 and Q6, respectively. Resistor R16 and Zener diode ZR1 provide transient suppression and regulation for the low level stages.

(2) Stabilized Oscillator. The stabilized oscillator utilizes transistors Q1 and Q2 in a Hartley oscillator circuit. Toroidal transformer T1, with multiple windings provides the tuned circuit, feedback, and output windings for the oscillator. The tuned circuit portion is tuned by capacitor C2 to 400 Hertz. Capacitor C1 provides parasitic suppression in the tuned collector circuit. A feedback winding provides the coupling between base-collector circuit to sustain oscillations, resistors R18 and R19 provide bias to the base circuit of transistors Q1 and Q2 to insure positive start and sustained oscillations. Resistor R17 provides degeneration for improved stability of the oscillator circuit. Output to the regulated wave shaper circuit is through the remaining winding on transformer T1. Output direct from the collector of transistor Q1 and tuned circuit is terminated at Pin D of connector J2 for Frequency Synchronization in a multiple inverter system.

(3) Regulated Wave Shaper. The regulated wave shaper receives the 400 Hertz sinusoidal signal from transformer T1 output winding. The input signal is applied to the base circuits of transistors Q3 and Q4 through resistors R1 and R2, respectively, limiting base current which flows in the base circuit. Transistors Q3 and Q4 conduct on alternate half cycles, with the point of conduction determined by the amount of bias supplied by transistor Q10, voltage regulator, to the emitter circuit. The output of this stage is a quasi-square wave and is applied to the input of the clipper circuit.

(4) Clipper and Driver. The clipper and driver circuits provide additional shaping of the signal and amplification for application to the output amplifier circuits. The clipper circuit consists of transistors Q5 and Q6 in a push-pull circuit. The quasi-square wave is applied to the base circuits of transistors Q5 and Q6 through limiting resistors R6 and R7, respectively. The output of the clipper circuit results in a quasi-square wave with improved rise time. The output is coupled to the base circuits of the driver transistors Q7 and Q8 through resistors R11 and R12, respectively. Resistors R13 and R14, provide low impedance return for leakage currents. Output of the collector circuits is developed across toroidal driver transformer T2 and coupled to the output amplifier circuits.

(5) Output Amplifiers. The output amplifiers receive the signal through toroidal driver transformer T2. Four output windings are connected in parallel to provide two outputs which drive the sixteen output transistors Q11 through Q18. Input to the base circuit of each output transistor is through two parallel connected 1 ohm, 2 watt, resistors, providing current limiting to the input. A 4.7 ohm, 2 watt resistor between the base and emitter of each output transistor reduces the impedance during the non-conduction period. The collectors of transistors Q11 through Q18 are parallel connected in groups of four. Q11, Q12, Q13, and Q14 so connected are connected to the high side of transformer T4 while transistors Q15, Q16, Q17, and Q18 are connected to the low side of transformer T4. Diodes CR8 through CR15 connected in parallel with the emitter collector junction of each power transistor provides the path for reverse current flow from the load back to the DC power source under conditions of high reactive loading. Toroidal series reactor transformer T3 is connected across the output transformer T4. The secondary winding of output transformer T4 is connected to the filter circuit.

(6) Output Transformer and Filter. The 400 Hertz quasi-square wave signal developed across toroidal output transformer T4 is high in content of odd order harmonics. Toroidal series reactor transformer T3 in conjunction with the output transformer T4, and the output filter circuit reduce these odd order harmonics. The impedance of the series reactor transformers is low at the 400 Hertz fundamental frequency, but sufficiently high at the frequency of the harmonics to enable the reactor-transformer combination to reduce the harmonic output. The output transformer T4 appears as a high impedance to the fundamental 400 Hertz signal and a low impedance to the harmonics, thus resulting in optimum power transfer at the fundamental frequency of 400 Hertz. The secondary winding of transformer T4 is tuned to the 400 Hertz fundamental by parallel capacitors C14, and C15, forming a parallel tuned circuit, which reflects a high impedance to the fundamental 400 Hertz signal and a low impedance path to the harmonics. The series tuned circuit comprised of capacitor C16 and toroidal reactor L1 is tuned to the third order harmonic 1200 Hertz, providing a shunting effect to the most predominant harmonic present in the output. The additional winding on transformer T4 is used to derive feedback voltage for the voltage regulator circuit. The derived voltage is rectified by diodes CR16 and CR17 to provide a negative DC potential to the voltage regulator circuit. The filtered output is 115 volts AC at a frequency of 400 Hertz and is available at pins A and B of connector J2.

(7) Voltage Regulator. The voltage regulator consists of transistors Q9 and Q10 and Zener diode ZR2. The positive voltage from Zener diode ZR2 and the negative voltage from diodes CR16 and CR17 are applied to the summing resistors R20, R21, and R22 to derive an error voltage at the base of transistor Q9. A change in output voltage, after the setting of resistor R22 has been determined, causes a change in the voltage applied to the summing circuit, developing an error voltage which is amplified by transistors Q9 and Q10. Output at the collector of transistor Q10 results in a proportional voltage change which is the bias applied to transistors Q3 and Q4. This change in bias controls duty cycle and output voltage by limiting action at the input wave shaper circuit. Output direct from the base of Q9 is terminated at Pin C for load equalization in a multiple inverter system.

DISASSEMBLY

1. GENERAL.

This section outlines procedures for disassembly of the Transverter. The procedures should be followed in the event it becomes necessary to repair the unit after a malfunction or part failure. Electrical wiring should not be disconnected except when required for complete removal of a component or sub-assembly or when wiring is found to be defective. When wiring is disconnected, tag each wire and note connection point for ease in identification during reassembly.

2. COVER AND INPUT AND OUTPUT CONNECTIONS NAMEPLATE REMOVAL.

A. Break Phoenix Aerospace, Inc. seal wire, (-65) Fig. 1101, by cutting and remove.

NOTE: In the event Transverter is in warranty, breaking of seal may void warranty unless covered by other contractual agreement.

B. Remove the twenty-eight screws securing cover, (-61), (-62), (-63) Fig. 1101, and remove cover by lifting straight up from base. Place hardware aside for reassembly.

NOTE: Careful attention should be given to the length of screws removed, particularly the lower row on both sides, which are 5/8 inch long. The remaining 20 screws are 3/8 inches long, while the two fillister head screws are 3/8 inches long.

C. Remove input and output connections nameplate, (59) Fig. 1101, lifting at edge of plate, not at the corners, to release adhesive. Place aside for reassembly operation.

CAUTION: DO NOT PLACE NAMEPLATE WITH ADHESIVE SIDE TOWARD PAPER OR AN OILY SURFACE.

3. REMOVAL OF CIRCUIT MODULE-OSCILLATOR/AMPLIFIER/DRIVER SUB-ASSEMBLY.

A. General.

Removal of the Oscillator/Amplifier/Driver Sub-assembly, (52) Fig. 1101, is accomplished to gain access to component side of circuit board or other sub-assemblies of the Transverter Unless board replacement is required interconnecting wires should never be disconnected. Proceed as follows to gain access to the component side of sub-assembly.

B. Removal Procedure.

(1) Loosen and remove the five No. 4-40 x 1/2 inch long flat head, 82° countersink, machine screws, (-53) Fig. 1101, at the connector end of Transverter.

NOTE: These screws were concealed by the Input and Output Connection Nameplate removed in preceding paragraph 2.

(2) Loosen and remove the five No. 4-40 x 1/2 inch long pan head machine screws, (-54) Fig. 1101, at the opposite end of Transverter.

(3) Carefully swing loosened sub-assembly up and over to the side to expose component side of circuit board. DO NOT disconnect wiring unless removal of entire sub-assembly is required.

4. DISASSEMBLY OF OSCILLATOR/AMPLIFIER/DRIVER SUB-ASSEMBLY.

A. General.

Disassembly of the Oscillator/Amplifier/Driber Sub-Assembly is not required unless a printed circuit board, (44) Fig. 1103, is damaged beyond repair and necessitates removal and replacement.

B. Disassembly Procedure.

(1) Carefully identify, disconnect, and tag all wires leading to or from the printed circuit board, (44) Fig. 1103.

(2) Remove the printed circuit board, (44) Fig. 1103, by loosening and removing the four No. 4-40 x 1/2 inch long pan head machine screws, four 5/16 inch long aluminum spacers, four No. 4 internal tooth lock washers, and four No. 4-40 hex nuts, (-45), (-46), (-47), and (-48), Fig. 1103. Place hardware removed aside for use during reassembly.

5. REMOVAL OF INPUT AND OUTPUT FILTER CIRCUIT BOARD SUB-ASSEMBLY.

A. General.

Removal of the Input and Output Filter Circuit Board Sub-Assembly (49) Fig. 1101, is required to gain access to the underside of printed circuit board when parts removal and replacement is required. It is not necessary to remove board completely, therefore, DO NOT disconnect wiring unless board is physically damaged beyond repair.

B. Removal Procedure.

(1) Loosen and remove the four No. 6-32 x 1/2 inch long pan head machine screws, and six No. 6 internal tooth lock washers, (-50), and (-51) Fig. 1101, securing sub-assembly in place. Place hardware aside for use during reassembly.

(2) Carefully lift board to expose underside of printed circuit for component removal and replacement. DO NOT disconnect wiring to board unless sub-assembly removal is required.

6. REMOVAL OF TRANSFORMERS AND REACTORS, TRANSFORMER MOUNTING CHASSIS PAN.

A. General.

Removal of transformers and reactors, (8), (11), (14), and (17) Fig. 1101, should never be accomplished unless replacement is required. In the event replacement is required,

recommended practice would be to replace all four devices and to return the defective part or parts to the factory for repair.

B. Removal Procedure.

(1) Identify and remove Input and Output Filter Circuit Board Sub-Assembly, (49) Fig. 1101, following procedures of preceding paragraph 5.

(2) Disconnect all leads and tag for aid in identification of terminals during reassembly.

(3) Identify and remove the two terminal strips (-37) Fig. 1101, disconnect leads necessary only to remove defective part, identifying carefully all terminals with tags for aid in reassembly.

(4) Identify and remove the six No. 6-32 x 3/8 inch long flat head, 82° countersink, machine screws, (-31), (-33), Fig. 1101, securing the Transformer Mounting Chassis Pan. (4) Fig. 1101, to the Static Inverter (Transverter) Base, (3) Fig. 1101.

(5) Identify the transformer or reactor mounting screw, (-5), (-6), and (-7), Fig. 1101, washer, (-9), (-12), (-15) and (-18), Fig. 1101, and nut (-10), (-13), (-16) and (-19), Fig. 1101, and remove to permit removal from the potting compound.

NOTE: To remove transformers or reactors, potting compound must be broken away before device will separate from Transformer Mounting Chassis Pan. Use care to prevent damage to components not requiring replacement.

CLEANING

1. GENERAL.

This section outlines procedures for cleaning the components of the Transverter while disassembled. Cleaning materials are listed in Table 201.

WARNING: PERFORM OPERATION INVOLVING SOLVENT ONLY IN A WELL VENTILATED AREA. AVOID BREATHING OF SOLVENT VAPOR AND CONTINUOUS CONTACT WITH SOLVENT.

Reference to air jet refers to a hand-operated air nozzle supplied with clean, dry, compressed air at a maximum pressure of 28 psi.

WARNING: GOGGLES SHOULD BE WORN WHEN USING AIR JET TO BLOW DUST AND DIRT FROM EQUIPMENT. OTHER PERSONS SHOULD BE AWARNED AWAY FROM HAZARDOUS AREA OR WORKING ENCLOSURE.

MATERIAL
Trichloroethylene Solvent
Soft-bristled Brush
Stiff-bristled Brush
Soft, Clean Cloth

List of Cleaning Materials
Table 201

2. PRINTED CIRCUIT BOARDS-WIRED CHASSIS.

Remove dust and dirt from all surfaces with a soft-bristled brush in conjunction with an air jet.

NOTE: When the dress of wiring is disturbed, dressing should be noted, and when cleaning is finished, wiring should be restored to proper dress or position.

3. METAL SURFACES.

Clean with soft cloth moistened in trichloroethylene solvent, and dry with clean, dry cloth.

4. CONNECTORS.

A. Wipe dust and dirt from shells using trichloroethylene solvent and a soft cloth. Wipe dry with clean, dry cloth.

B. Remove dust from inserts using small, soft-bristled brush in conjunction with air jet.

INSPECTION/CHECK

1. GENERAL.

This section contains procedures to determine the condition of Transverter.

2. COVER.

Inspect cover for deformations, dents, punctures or surfaces which might be wearing due to interference with other components.

3. CONNECTORS.

A. Inspect for broken parts, damaged shell, and any other abnormal condition.

B. Inspect for broken, cracked, or damaged inserts and for contacts which are broken, deformed, out of alignment. Check for corrosion and signs of arcing at the contacts and for poorly soldered connections.

4. RESISTORS.

Inspect resistors for signs of overheating; cracked, broken, or charred insulation; loose, poorly soldered, or corroded terminal connections; and loose mountings.

5. METAL SURFACES AND MECHANICAL.

Inspect metal surfaces for signs of corrosion. Also check component mountings for mechanical tightness.

6. WIRES.

Check wires for damaged insulation and for proper dress.

REPAIR

1. GENERAL.

This section outlines instructions for the repair or replacement of damaged or defective parts. Faulty parts are usually detected by inspection, cleaning or trouble shooting. The repair or replacement of damaged or defective parts involves standard repair techniques. Identify each wire before removal of any part requiring unsoldering of several lead wires.

2. COVER.

Straighten any deformation, and retouch scratched or worn surfaces.

3. CHASSIS.

Remove all traces of corrosion and recoat with clear epoxy resin where broken or removed during repairs.

Before attempting to solder connections, peel away epoxy resin using a sharp knife.

NOTE: The clear epoxy resin is Armstrong Products Inc. Type T-600 or equivalent. Any time the epoxy coating is disturbed, recoating is advised.

4. CONNECTORS.

Straighten bent pins. Resolder connection and check insulation. If badly damaged, replace connector or insert.

5. SOLDER CONNECTIONS.

Resolder any defective solder joints. Remove all traces of corrosion.

6. WIRING.

Replace any wiring with damaged insulation or broken strands.

7. RESISTORS.

Replace resistors that show signs of overheating or with cracked or broken bodies. Resolder loose, broken or corroded connections.

ASSEMBLY

1. GENERAL.

This section outlines the instructions for assembly of the Transverter. Before assembly of the unit, the Cleaning, Inspection/Check, and Repair Sections should be consulted to determine if all components are properly cleaned and in proper physical and operating condition. Where wiring must be reconnected, good practices must be followed in dressing of wires and soldering connections. Refer to Fig. 1101 for identification and location of sub-assemblies and component parts.

2. INSTALLATION OF TRANSFORMERS AND REACTORS, TRANSFORMER MOUNTING CHASSIS PAN.

A. General.

Assembly of transformers and reactors (8), (11), (14) and (17) Fig. 1101, requires the use of epoxy resin similar to Dow Corning Type D.E.R. 330 with aluminum oxide filler and Dow Corning curing agent. The epoxy resin replaces any removed during the removal of transformers or reactors, and must be replaced to properly heat sink the unit and the transformers and reactors. In the event complete removal was not necessitated, disregard those steps not applicable and complete assembly procedures.

B. Assembly Procedures.

(1) Identify the appropriate mounting screw for the transformer and/or reactor and mount through chassis pan. Secure in place using the No. 10 internal tooth lock washer and No. 10-32 hex nut or No. 8 internal tooth lock washer and No. 8-32 hex nut. DO NOT overtighten hardware.

(2) Replace epoxy resin by preparing the resin in accordance with manufacturer's instructions and adding the aluminum oxide filler in a ratio of 30% by weight. Block ends of Transformer Mounting Chassis Pan to prevent compound from running out and fill to approximately 1/4 inch deep with potting compound. Allow curing to take place and proceed with subsequent steps.

(3) Assemble Transformer Mounting Chassis Pan to Static Inverter (Transverter) Base. Place a thin layer of Dow Corning No. 4 Compound, silicone lubricant between chassis pan and base. Secure, using the six No. 6-32 x 3/8 inch long flat head, 82° countersink, machine screws into the spacer blocks on the chassis pan.

(4) Identify the two terminal strips and position over the 1-1/16 inch high aluminum spacer posts. These units are secured by hardware which will be installed in subsequent paragraphs.

(5) Identify the Input and Output Filter Circuit Board Sub-Assembly, (49) Fig. 1101, and reinstall per procedures of subsequent paragraph 3. B.

(6) Identify leads disconnected during removal procedures and carefully reconnect and solder at the proper points.

3. INSTALLATION OF INPUT AND OUTPUT FILTER CIRCUIT BOARD SUB-ASSEMBLY.

A. General.

Installation of Input and Output Filter Circuit Board Sub-Assembly, (67) Fig. 1101, requires care in reconnecting of leads disconnected during disassembly procedures.

B. Assembly Procedures.

(1) Carefully reconnect leads disconnected during disassembly or removal.

(2) Identify the four No. 6-32 x 3/8 inch long pan head machine screws, four No. 6 internal tooth lock washers, (-50), and (-51) Fig. 1101, align with holes in the two terminal strips positioned in preceding paragraph 2B.(4), (-37) Fig. 1101, and secure to aluminum spacers on Transformer Mounting Chassis Pan.

4. ASSEMBLY OF OSCILLATOR/AMPLIFIER/DRIVER SUB-ASSEMBLY.

A. General.

Assembly of the Oscillator/Amplifier/Driver Sub-Assembly, (53) Fig. 1101, consists of mounting the Oscillator/Amplifier/Driver Circuit Board Sub-Assembly, (Fig. 1103, and reconnection of the leads disconnected during removal procedures.

B. Assembly Procedures.

(1) Identify the four No. 4-40 x 1/2 inch long pan head machine screws, four .1875 inch x 5/16 inch long aluminum spacers, four No. 4 internal tooth lock washers, and four No. 4-40 hex nuts, (-45), (-46), (-47), and (-48), Fig. 1103, and use to secure the Oscillator/Amplifier/Driver Circuit Board Sub-Assembly, (52) Fig. 1101.

(2) Identify and reconnect leads disconnected at time of disassembly.

5. INSTALLATION OF CIRCUIT MODULE OSCILLATOR/AMPLIFIER/DRIVER SUB ASSEMBLY.

A. General.

Reinstallation of the Circuit Module-Oscillator/Amplifier/Driver Sub-Assembly, (52) Fig. 1101, is completed as follows.

B. Assembly Procedures.

(1) Reconnect any wires removed during disassembly and restore lead dress.

(2) Carefully swing sub-assembly over and down between ends of Transverter Base, (3) Fig. 1101, with components on circuit board toward interior of Transverter, and the exterior of transistors up toward cover.

(3) Identify the five No. 4-40 x 1/2 inch long flat head, 82° countersink, machine screws, (-53) Fig. 1101, and secure sub-assembly from connector end, tighten securely.

(4) Identify the five No. 4-40 x 1/2 inch long pan head machine screws, (-54) Fig. 1101, and secure sub-assembly from opposite end of unit, tighten securely.

INSTALLATION OF INPUT AND OUTPUT CONNECTIONS NAMEPLATE.

A. Carefully center Input and Output Connections Nameplate above the input and output connectors and press firmly in place to cause adhesive to stick to metal surface.

B. Place cover over unit and secure in place with hardware removed during disassembly in the following sequence:

(1) Identify the six No. 4-40 x 5/8 inch long pan head machine screws and install at the bottom edge of cover.

(2) Identify the two No. 4-40 x 3/8 inch long fillister head (drilled) machine screws at the front, connector end, lower edge left and right.

(3) Identify the twenty No. 4-40 x 3/8 inch long pan head machine screws and completely secure cover to Transverter base.

CAUTION: UNDER NO CIRCUMSTANCES SHOULD HARDWARE LONGER THAN 3/8 INCH BE USED AT THE CENTER ROW, LEFT AND RIGHT SIDE, TO SECURE COVER.

(4) Place new PAI Warranty Lead Seal tie wire through the drilled holes on fillister head screws and seal by crimping.

FITS AND CLEARANCES

Not Applicable to Solid-State Static Inverter.

No moving parts required.

TESTING

1. GENERAL.

This section defines test procedures for the Model DH-1030-24-600-CS Solid-State Static Inverter (Transverter). The procedures given are in sequential step form and test the unit completely. When the results of any step or test are not achieved the trouble shooting section of this manual should be consulted.

2. PERFORMANCE TESTS.

Performance tests are designed to provide a fast efficient method for complete check-out of the Transverter. Included in this paragraph is a list of test equipment required, the minimum performance requirements of the unit and procedures for connecting the unit for test.

A. Test Equipment Required.

The test equipment required to accomplish the performance tests consist of the following: Specially designed Test Set; 0-40 volt, 50 Ampere DC Power Supply; Oscilloscope; Distortion Analyzer; Frequency Counter; and Voltohmmeter. This equipment is listed and described in the Special Tools Section of this manual.

B. Minimum Performance Requirements.

The minimum performance requirements of the Model DH-1030-24-600-CS Solid-State Static Inverter (Transverter) is to supply 115 volts, 400 Hertz sine wave, single phase, alternating current at 400 VA to operate aircraft instrumentation devices. Input power of 27.5 volts DC (nominal) is obtained from the aircraft's storage battery.

C. Preparation for Testing.

Complete the following steps to prepare Transverter for testing. Refer to Fig. 701 for equipment and interconnection.

(1) Connect Test Set to Transverter, LOAD switch in OFF position on Test Set. LOAD SELECTOR switch in 400 VA 1.0 - UNITY position.

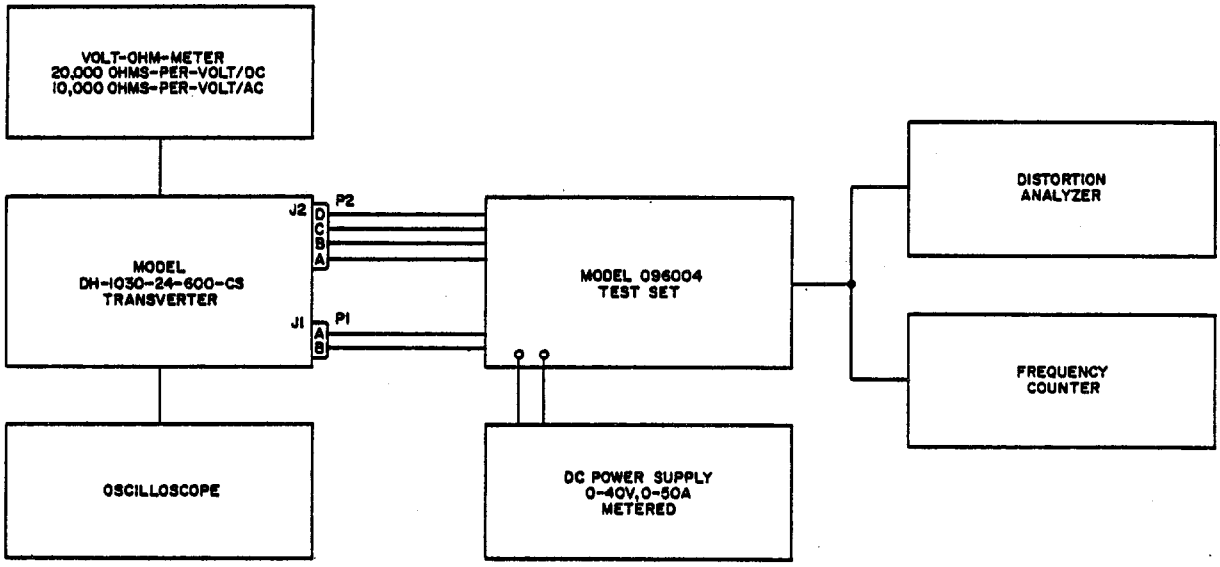
(2) Connect DC Power Supply to Test Set terminals E1 and E2, output set to zero. Note polarity when connecting.

(3) Connect Distortion Analyzer to Test Set, connecting across AC voltmeter M2. FUNCTION switch at DISTORTION, FREQUENCY RANGE at X10 position, METER RANGE as required to read distortion level, FREQUENCY, COARSE at 40.

(4) Connect Frequency Counter to Test Set, connecting across AC voltmeter M2. Set to measure frequency of 400 Hertz ±4 Hertz per second.

D. Performance Test.

The procedures of the performance test listed in numbered steps in Table 701 should be accomplished in the sequence presented. In the event the required result is not obtained, the trouble shooting section should be consulted and the malfunction corrected before proceeding to the next step.



Test Set-up, Model DH-1030-24-600-CS
Solid-State Static Inverter (Transverter)
Figure 701

STEP	SET-UP	PROCEDURE	RESULT
1	Interconnect per Fig. 701 and para. 2.C. LOAD switch in OFF position on test set.	(a) Apply power to all measuring equipment for warm-up. (b) Check polarity of DC Power Supply and connection to Test Set.	
2	LOAD switch in OFF position on Test Set.	Increase DC Power Supply Voltage to 27.5 volts DC as indicated on DC VOLTS meter M3 on Test Set.	Input current as indicated by DC AMPERES meter M4 on Test Set should not exceed 2.0 Amperes.
3	LOAD SELECTOR switch set to 1.0 UNITY-400 WATTS position. LOAD switch in ON position on Test Set.	(a) Input voltage set at 27.5 volts DC. (b) Adjust resistor R22 as required for reading 115 volts AC. (c) Vary input voltage from 20 to 30 volts DC.	Input current as indicated by DC AMPERES meter M4 on Test Set should not exceed 18.0 Amperes. Output voltage of pins A and B as indicated by AC VOLTS meter M2 on Test Set should be 115 volts AC. Output current of pin B as indicated by AC AMPERES meter M1 on Test Set should be approximately 3.48 Amperes. Input current as indicated by DC AMPERES meter M4 should vary from 16.0 to 18.0 Amperes with changing input voltage.
4	LOAD SELECTOR switch set to 1.0 UNITY-400 WATTS position. LOAD switch in ON position on Test Set. Frequency counter across AC VOLTS meter M2 on Test Set per para. 2.C.(4).	(a) Input voltage set at 27.5 volts DC. (b) Adjust frequency by selection of capacitor C5 in oscillator circuit.	Input current as indicated by DC AMPERES meter M4 on Test Set should not exceed 18.0 Amperes. Frequency Counter should read 400 Hertz ±4 Hertz.
5	LOAD SELECTOR switch set to 1.0 UNITY-400 WATTS position. LOAD switch in ON position on Test Set. Distortion Analyzer across AC VOLTS meter M2 on Test Set per para. 2.C.(3).	(a) Input voltage set at 27.5 volts DC. (b) Vary input voltage from 20 to 30 volts DC. Take readings at 20, 22, 24, 26, 28 and 30 volts DC.	Distortion Analyzer should read less than 5% distortion with changing input voltage, typical reading 2.0 to 3.9%. Distortion Analyzer should always read less than 5% distortion with changing input voltage, typical reading 2.0 to 3.9%.

STEP	SET-UP	PROCEDURE	RESULT
6	LOAD switch in OFF position on Test Set.	Input voltage set at 27.5 volts DC.	Input current as indicated by DC AMPERES meter M4 should not exceed 2.0 Amperes. Output voltage as indicated by AC VOLTS meter M2 should not exceed 120 volts AC. Frequency Counter should read 400 Hertz ±4 Hertz. Distortion Analyzer should read less than 5% distortion, typical reading 2.5 to 3.5%.
7	LOAD SELECTOR switch set to .8 LAG-400 VA position. LOAD switch in ON position on Test Set. Frequency Counter and Distortion Analyzer connected as in preceding steps 4 and 5.	Input voltage set at 27.5 volts DC.	Input current as indicated by DC AMPERES meter M4 should not exceed 15.0 Amperes. Output voltage as indicated by AC VOLTS meter M2 should be 115 volts AC ±2 volts, typical reading 114 to 115 volts AC. Frequency Counter should read 400 Hertz ±4 Hertz. Distortion Analyzer should indicate less than 5% distortion, typical reading 2.5%.
8	LOAD SELECTOR switch set to .95 LEAD-400 VA position. LOAD switch in ON position on Test Set. Frequency Counter and Distortion Analyzer connected as in preceding steps 4 and 5.	Input voltage set at 27.5 volts DC.	Input current as indicated by DC AMPERES meter M4 should not exceed 18.0 Amperes. Output voltage as indicated by AC VOLTS meter M2 should be 115 volts AC ±2 volts, typical reading 116 volts to 117 volts AC. Frequency Counter should read 400 Hertz ±4 Hertz. Distortion Analyzer should indicate less than 5% distortion, typical reading 3.0%.
9	LOAD SELECTOR switch set to 150% LOAD-600 WATTS position. LOAD switch in ON position on Test Set. Frequency Counter and Distortion Analyzer connected as in preceding steps 4 and 5.	Input voltage set at 27.5 volts DC.	Input current as indicated by DC AMPERES meter M4 should not exceed 25.0 Amperes. Output voltage as indicated by AC VOLTS meter M2 should drop to approximately 110 volts AC, typical reading 109 to 112 volts AC. AC AMPERES meter M1 on Test should not exceed 5.5 Amperes. Frequency Counter should read 400 Hertz ±4 Hertz. Distortion Analyzer should indicate less than 5% distortion, typical reading 3.5%.
10	LOAD SELECTOR switch set to 115V AC SHORT 5 SEC MAX. LOAD switch in ON position on Test Set.	Input voltage set at 27.5 volts DC. Press SHORT button and release.	Input current as indicated by DC AMPERES meter M4 should indicate between 30 to 40 Amperes. AC Amperes should be between 6 to 9 Amperes on AC AMPERES meter M1.

TROUBLE SHOOTING

1. GENERAL.

This section outlines in tabular form information for use in localization and isolation of trouble in the Model DH-1030-24-600-CS Solid-State Static Inverter (Transverter). The trouble shooting procedures, Table 801, together with the information given in preceding section on Testing will in most cases localize and isolate the trouble. Reference to the schematic diagram, Fig. 1201, and the section on Detailed Theory will be necessary and helpful. The voltage measurements of Table 802 in conjunction with the waveforms illustrated in Fig. 801 will aid in isolation of trouble.

TROUBLE SHOOTING.

A. Localization.

The trouble shooting table, Table 801, provides a means of localizing malfunctions to a replaceable component or sub-assembly. The table is arranged in the same order of precedence as the performance tests, Table 701, in the preceding section. The applicable step of the performance test is shown in parentheses next to the trouble shooting step in the STEP column, in Table 801.

B. Isolation.

The voltage measurements of Table 802 are made using the voltohmmeter described in the Special Tools Section of this manual. Reference to the schematic diagram while making voltage measurements will aid in isolation of trouble within the unit.

C. Analysis.

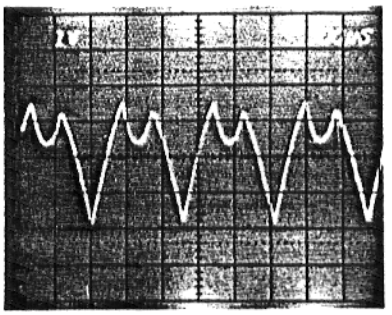
The waveforms pictured in Fig. 801 were made using the oscilloscope described in the Special Tools Section of this manual, and will aid in analyzing the equipment performance when trouble shooting procedures are being performed.

Trouble Shooting Chart
Table 801 (Sheet 1 of 2)

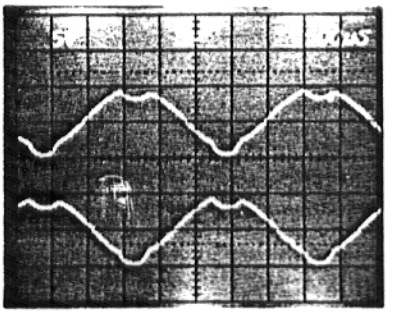
STEP	SYMPTOM	PROBABLE CAUSE	CHECK	REMEDY
1(2)	No current drain.	Transistor Q1 or Q2 inoperative.	Check voltage at base, collector, and emitter of Transistors Q1 and Q2 for proper voltage.	Replace defective transistors.
		Input polarity reversed.	Check connection of DC Power Supply and polarity of output.	Reverse input connection.
		Polarity protect Diode CR18 open.	Check continuity of circuit through Diode CR19 and Reactor L2.	Replace defective diode.
2(2)	High current drain.	Transistors Q7 or Q8 defective, shorted.	Check voltages at base, collector, and emitter of Transistors Q7 and Q8 for proper voltage.	Replace defective transistors.
3(3)	AC output voltage high or low, no load.	Resistor R20 not adjusted.	Check operation of Resistor R22 by adjustment noting change in output voltage.	Adjust Resistor R22 to obtain proper output.
		Transistor Q9 or Q10 defective.	Check voltages at base, collector, and emitter of Transistors Q9 and Q10 for proper voltage.	Replace defective transistor.
		Zener Diode ZR2 defective.	Check voltage at Zener Diode ZR2.	Replace defective Zener diode.
		Diodes CR16 and CR17 defective.	Check for presence of negative voltage at junction of Diodes CR16 and CR17 and Resistor R22.	Replace defective diode.
4(4)	Frequency high or low.	Capacitor C1 defective or of improperly selected value.	Check value and test by substitution for proper value.	Replace defective capacitor.
5(5)	Distortion above 5%.	Zener Diode ZR1, or Capacitors C14, C15, or C16 defective.	Check voltage at junction of Zener Diode ZR1, and Resistors R20, R21, and R22 for proper value 15 volts ±5%.	Replace defective Zener diode.
			Check capacitors for excess leakage or open condition.	Replace defective capacitor.
6(6)	AC output voltage high or low, with 800 VA 1.0-UNITY P.F. Load.	Repeat preceding step 3(3).	Repeat preceding step 3(3).	Repeat preceding step 3(3).

STEP	SYMPTOM	PROBABLE CAUSE	CHECK	REMEDY
7	AC output voltage cannot be increased to 115 volts AC.	Defect in control circuit, Transistor Q10, Resistor R22, Diodes CR16 and CR17, or Zener Diode ZR3.	Short emitter of Q3 and Q4 to negative buss or -27.5 volt DC point, voltage will increase to approximately 135 volts AC.	Replace defective component in control circuit.
8	Transistors Q7 and/or Q8 operate with high heat rise.	Transistors Q5 and/or Q6 low output or inoperative.	Check voltages and waveforms at transistor elements.	Replace defective transistor or pair of transistors.
9	Transverter output drops off when input voltage exceeds 26 to 28 volts DC.	Zener Diode ZR3 shorted.	Check voltages at Zener Diode ZR3 and resistor network associated with diode.	Replace defective Zener diode.
10	Transverter operates on pre-installation check, will not operate in aircraft.	Defect in aircraft wiring.	Check for voltage at breaker and primary power source in aircraft.	Correct wiring defect.
			Check for shorted load by opening breaker to AC load in aircraft while power is applied to input.	Correct short in line or load.
		Defective Transformer T4 shorted primary to secondary.	Check transformer for short between primary and secondary winding.	Replace defective transformer.

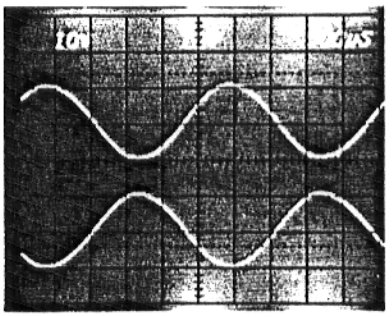
Trouble Shooting Chart
Table 801 (Sheet 2 of 2)



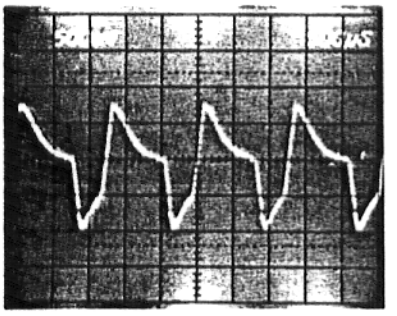
A. WAVEFORM AT EMITTER OF TRANSISTORS Q1 and Q2
28 VOLTS DC INPUT, 400 WATT LOAD, 1.0 UNITY P.F.
VERTICAL SENSITIVITY: 1.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



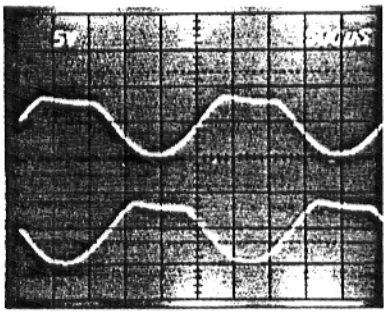
B. WAVEFORMS AT BASE OF TRANSISTORS Q1 AND Q2
28 VOLTS DC INPUT.
400 WATT LOAD, 1.0 UNITY P.F.
VERTICAL SENSITIVITY: 5.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



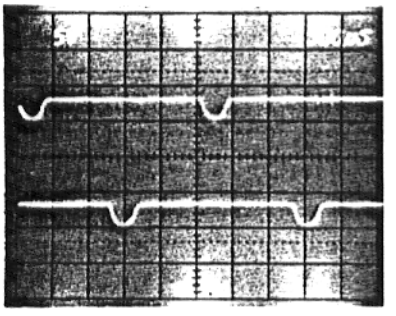
C. WAVEFORMS AT COLLECTOR OF TRANSISTORS Q1 and Q2
28 VOLTS DC INPUT, 400 WATT LOAD, 1.0 UNITY P.F.
VERTICAL SENSITIVITY: 10.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



D. WAVEFORM AT EMITTER OF TRANSISTORS Q3 AND Q4
28 VOLTS DC INPUT, 400 WATT LOAD, 1.0 UNITY P.F.
VERTICAL SENSITIVITY: 500 MILLIVOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION

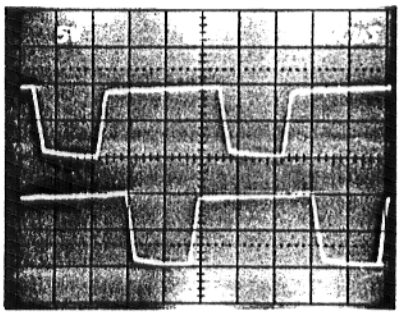


E. WAVEFORMS AT BASE OF TRANSISTORS Q3 AND Q4
28 VOLTS DC INPUT 400 WATT LOAD, 1.0 UNITY P.F.
VERTICAL SENSITIVITY: 5 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION

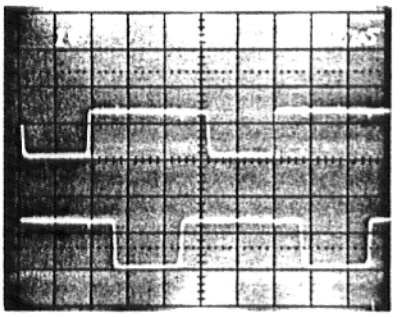


F. WAVEFORMS AT COLLECTORS OF TRANSISTORS Q3 AND Q4
28 VOLTS DC INPUT, NO LOAD.
VERTICAL SENSITIVITY: 5 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION

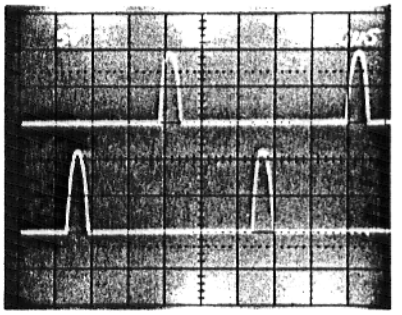
Waveform Measurements, Model DH-1030-24-600-CS
Solid-State Static Inverter (Transverter)
Figure 801 (Sheet 1 of 3)



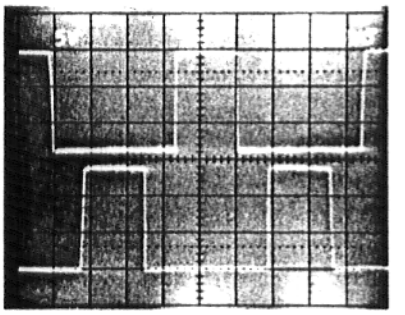
G. WAVEFORMS AT COLLECTOR OF TRANSISTORS Q3 AND Q4
28 VOLTS DC INPUT, 400 WATT LOAD, 1.0 UNITY P.F.
VERTICAL SENSITIVITY: 5.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



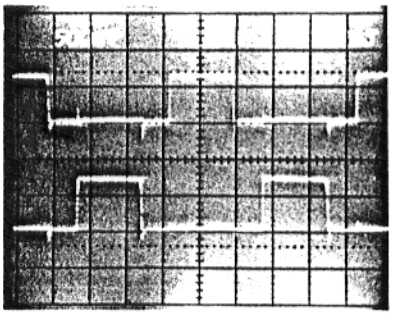
H. WAVEFORMS AT BASE OF TRANSISTORS Q5 AND Q6
28 VOLTS DC INPUT, 400 WATT LOAD, 1.0 UNITY P.F.
VERTICAL SENSITIVITY: 1.0 VOLTS DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



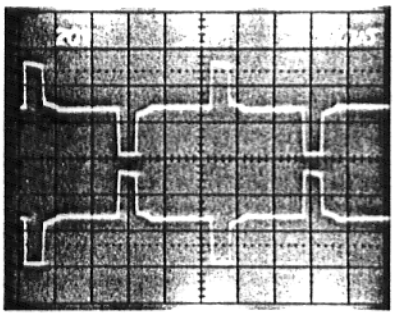
I. WAVEFORMS AT COLLECTORS OF TRANSISTORS Q5 AND Q6
28 VOLTS DC INPUT, NO LOAD
VERTICAL SENSITIVITY: 5.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



J. WAVEFORMS AT COLLECTOR OF TRANSISTORS Q5 AND Q6
28 VOLTS DC INPUT, 400 WATT LOAD, 1.0 UNITY P.F.
VERTICAL SENSITIVITY: 5.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION

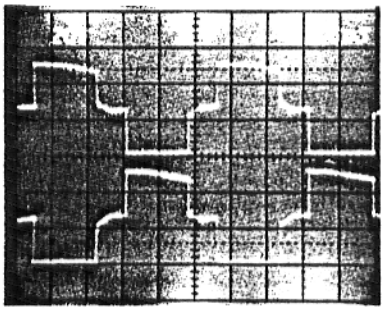


K. WAVEFORM AT BASE OF TRANSISTORS Q7 AND Q8
28 VOLTS DC INPUT, 400 WATT LOAD, 1.0 UNITY P.F.
VERTICAL SENSITIVITY: 500 MILLIVOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION

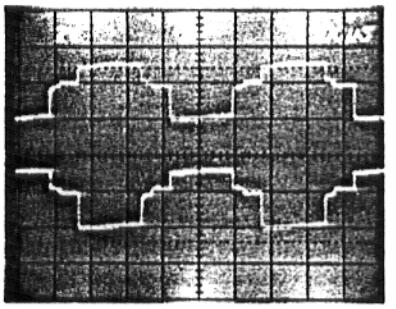


L. WAVEFORMS AT EMITTERS OF TRANSISTORS Q11 THRU Q18
28 VOLTS DC INPUT, NO LOAD
VERTICAL SENSITIVITY: 20.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION

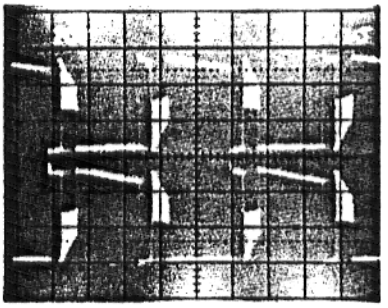
Waveform Measurements, Model DH-1030-24-600-CS
Solid-State Static Inverter (Transverter)
Figure 801 (Sheet 2 of 3)



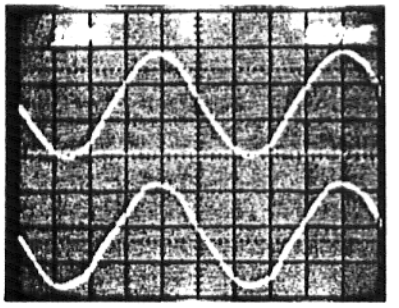
M. WAVEFORMS AT COLLECTORS OF TRANSISTORS Q7 AND Q8
28 VOLTS DC INPUT, 400 WATT LOAD, 1.0 UNITY P.F.
VERTICAL SENSITIVITY: 20.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



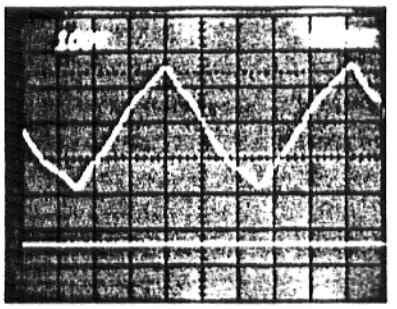
N. WAVEFORMS AT BASES OF TRANSISTORS Q11 THRU Q26
28 VOLTS DC INPUT, 400 WATT LOAD, 1.0 UNITY P.F.
VERTICAL SENSITIVITY: 2.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



O. WAVEFORMS AT COLLECTORS OF TRANSISTORS Q11 THRU Q26
28 VOLTS DC INPUT, 400 WATT LOAD, 1.0 UNITY P.F.
VERTICAL SENSITIVITY: 20.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



P. WAVEFORMS AT OUTPUT CONNECTOR J1 (PINS A-B)
TOP-WAVEFORM 400 WATT LOAD, 24 VOLTS DC INPUT
BOTTOM-WAVEFORM 600 WATT LOAD, 28 VOLTS DC INPUT
VERTICAL SENSITIVITY: 100 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



Q. WAVEFORMS AT OUTPUT CONNECTOR J1 (PINS A-B)
TOP-WAVEFORM 400 WATT LOAD, 36 VOLTS DC INPUT:
BOTTOM-WAVEFORM 600 WATT LOAD, 42 VOLTS DC
INPUT — 115 VOLTS AC TURNS OFF WITH OVERVOLTAGE.
VERTICAL SENSITIVITY: 100 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION

Waveform Measurements, Model DH-1030-24-600-CS
Solid-State Static Inverter (Transverter)
Figure 801 (Sheet 3 of 3)

TRANSISTOR	BASE	COLLECTOR	EMITTER
Q1	2.0V	15.5V	4.3V
Q2	2.0V	15.5V	4.3V
Q3	0.1V	9.1V	2.7V
Q4	0.1V	9.1V	2.7V
Q5	15.8V	5.4V	15.6V
Q6	15.8V	5.4V	15.6V
Q7	0.5V	26.1V	0.2V
Q8	0.5V	26.1V	0.2V
Q9	0.6V	1.4V	0
Q10	1.7V	0	2.5V
Q11	0.1V	26.0V	0.2V
Q12	0.1V	26.0V	0.2V
Q13	0.1V	26.0V	0.2V
Q14	0.1V	26.0V	0.2V
Q15	0.1V	26.0V	0.2V
Q16	0.1V	26.0V	0.2V
Q17	0.1V	26.0V	0.2V
Q18	0.1V	26.0V	0.2V

TEST POINT	VOLTAGE
Junction of Diode CR19, Capacitor C17, C18 and Resistor R16.	26.5V
Junction of Resistors R16, R22, and Zener Diode ZR1.	15.0V
Junction of Resistors R20, R21, and Diode CR6.	7.4V
Junction of Diodes CR16, CR17 and Resistor R26.	25.7V

NOTES:

Model 096004 Test Set connected to Transverter.

LOAD switch ON.

LOAD SELECTOR switch in 400 VA 1.0-UNITY position.

Input from DC Power Supply

Voltage 28.0 Volts DC

Current 16.0 Amperes DC (±2.0A)

Voltage measurements between reference point and (-) negative side of primary power.

All voltages are DC.

Measured with Triplett VOM Model 800.

Voltage Measurements, Model DH-1030-24-600-CS
Solid-State Static Inverter (Transverter)
Table 802

DH-1030-24-600-CS/P.N. 095032

STORAGE INSTRUCTIONS

1. GENERAL.

This section provides information preparing the Model DH-1030-24-600-CS Solid-State Static Inverter Transverter) for use from a shipped or stored condition and for packing the unit for storage or shipment.

2. PREPARATION FOR USE.

The Transverter, when shipped from the factory, is wrapped in cellulose wadding, PPP-C-843, and inserted in a poly bag, LP-378, and enclosed in a corrugated shipping carton, PPP-B-636. To unpack the unit, cut sealing tape and open top of carton by lifting flaps to break adhesive. Remove unit from carton, remove poly bag and cellulose wadding. Visually examine the unit for damage which might have occurred during shipment or storage.

3. PREPARATION FOR STORAGE OR SHIPMENT.

The Transverter may be stored for short periods of time without packing. If the unit is to be stored for extended periods or is to be shipped, carefully wrap unit with cellulose wadding, insert in poly bag and place equipment in a corrugated carton. The carton should then be sealed and labeled for storage.

SPECIAL TOOLS, FIXTURES AND EQUIPMENT

1. GENERAL.

This section provides information on the special tools and test equipment required for overhaul of the Model DH-1030-24-600-CS Solid-State Static Inverter (Transverter).

2. STANDARD TEST EQUIPMENT.

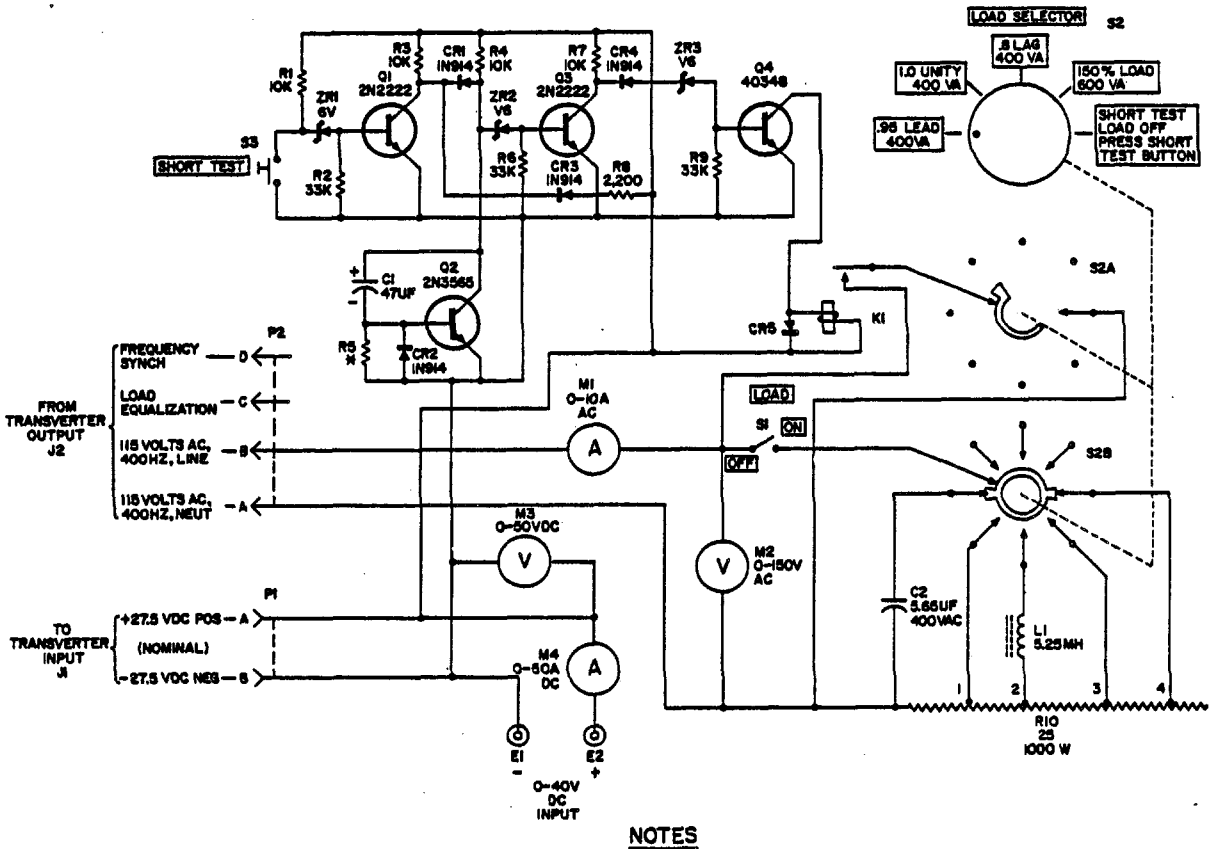
Listed in Table 1001 are the items of standard test equipment required for overhaul of the Transverter. The listed item or suitable equivalent may be used if procedures are modified when references to test equipment are made.

EQUIPMENT	MANUFACTURER AND MODEL NUMBER	
OSCILLOSCOPE	HEWLETT-PACKARD	MODEL 132A
DISTORTION ANALYZER	HEWLETT-PACKARD	MODEL 333A
FREQUENCY COUNTER	HEWLETT-PACKARD	MODEL 5512A
VOLTOHMMETER	TRIPLETT ELECT. INST.	MODEL 800
DC POWER SUPPLY	0-40 VOLTS DC 0-50 AMPERES	

Standard Test Equipment
Table 1001

3. SPECIAL TEST EQUIPMENT.

The special test equipment consists of only one item. This is a Test Set available either from Phoenix Aerospace, Inc. or readily fabricated locally. The toroidal reactor is available separately from Phoenix Aerospace, Inc. when the user desires to fabricate the Test Set. The schematic diagram is shown in Fig. 1001. All parts are listed with values and ratings to aid in local procurement for fabrication.



NOTES

1. RESISTOR R10 TAP#1 = 14.55Ω; TAP#2 = 17.6Ω; TAP#3 = 22.0Ω; TAP#4 = 23.15Ω.
2. P1, PENDANT CONNECTOR PLUG MS3106F-24-9S MATES WITH RECEPTACLE J1, MS3102R-24-9P.
3. P2, PENDANT CONNECTOR PLUG, MS3106F-24-22P, MATES WITH RECEPTACLE J2, MS3102R-24-22S.
4. INDUCTOR L1, PHOENIX AEROSPACE, INC. PART NO. 038014, REACTOR, POWER, TOROIDIAL.

Model 096004, Test Set, for Model DH-1030-24-600-CS
Solid-State Static Inverter (Transverter)
Figure 1001

ILLUSTRATED PARTS CATALOG SECTION

1. INTRODUCTION.

This section of the Overhaul Manual provides a complete listing of parts for the Model DH-1030-24-600-CS Solid-State Static Inverter (Transverter), as manufactured by Phoenix Aerospace, Inc.

2. PURPOSE.

The information contained in this section is supplied to aid in provisioning, requisitioning, storing, and issuing of the replaceable parts, and to aid in identification of new and reclaimed parts.

3. APPLICATION.

The Illustrated Parts Catalog Section contains three separate listings; Numerical Index, Symbol Index, and Detailed Parts List. The subsequent paragraphs define the content and application of each listing.

A. Numerical Index.

The Numerical Index provides an alpha-numerical listing of the parts listed in the Detailed Parts List. The prime function being to aid in rapid location using the information contained in the various columns.

(1) Part Number Column.

The PART NUMBER column lists part numbers of procurable parts and assemblies as listed in the Detailed Parts List. Parts are listed in alpha-numerical order of precedence starting at the first letter extreme left and reading to the right as follows:

Letters A through Z
Numerals 0 through 9
(Alphabetical 0's are considered as Numerical zeros).

Second and succeeding positions of the part number appear in the order of precedence as follows:

Space (Blank column)
Diagonal (Slant) /
Point (Period)
Dash (-)
Letters A through Z
Numerical 0 through 9
(Alphabetical 0's are considered as numerical zeros).

(2) Airline Part Number Column.

The AIRLINE PART NO. column is provided to allow insertion where applicable, of the users own part number where available and desired.

(3) Chapter-Section-Unit-Figure-Item Column.

The CH-SECT-UNIT-FIG-ITEM column contains the specific location data where the listed part first appears in the Detailed Parts List and other pertinent data. Example: 24-20-X-1101-18 is indicative of the following:

24 is significant of the Chapter (derived from system identification numbers).
20 is significant of the Section (derived from sub-system identification numbers).
X is significant of the Unit (derived from the application of particular unit).
1101 is significant of the Figure number.
18 is significant of the Item number.

(4) Total Required Column.

The TTL REQ. column is the total of each item required in the unit whether it be piece part or sub-assembly.

B. Symbol Index.

The Symbol Index enables the location of component parts referenced from the schematic diagram by the reference symbol to a specific Figure and Item number.

(1) Symbol Column.

The SYMBOL column contains an alpha-numerical listing of every component part which carries a reference symbol on the schematic diagram.

(2) Part Number Column.

The PART NUMBER column lists the vendor part number of the symbolized item.

(3) Chapter-Section-Unit-Figure-Item Column.

The CH-SECT-UNIT-FIG-ITEM column contains the specific location data where the listed part appears in the Detailed Parts List and other pertinent data. (See preceding para. 3.A.(3) for example of information.

C. Detailed Parts List.

The Detailed Parts List, is a breakdown of the complete unit into sub-assemblies and detailed parts. Each sub-assembly is listed in its order of disassembly and is followed immediately by its component parts properly indented to show its relationship to the assembly.

(1) Figure Item Column.

The FIG. ITEM Column entries key the parts breakdown to the applicable illustration. Items numbered on the Detailed Parts List preceded by a dash (example -1) do not appear on the illustration.

(2) Part Number Column.

The PART NUMBER column lists the applicable Standard part number MS, AN, NAS, etc., vendor part number or Phoenix Aerospace, Inc. part numbers. When more than one part number is assigned to an item the preference shall be Standard MS, AN, NAS, etc., vendor, or Phoenix Aerospace, Inc., in that order. Vendor part numbers listed in the PART NUMBER column are subject to change without notice.

(3) Nomenclature Column.

The NOMENCLATURE column describes the assembly, sub-assembly, or component part in a short form description, with the identifying Noun as the first word, followed by the modifiers as required. The indentations denote parts relation to next higher assembly (NHA) or sub-assembly, as applicable. The ATTACHING PARTS entries are listed immediately following the component which they attach.

If a part is purchased by Phoenix Aerospace, Inc. from a vendor, the Federal Supply Code number, preceded by the letter V, is listed in this column, and set off by parentheses. The vendors part number appears in the PART NUMBER column and the Phoenix Aerospace, Inc. part number follows the vendor, FSC number, and is set off in parentheses. If a part number or FSC number does not appear in the NOMENCLATURE column the part number listed in the PART NUMBER column is a Phoenix Aerospace, Inc. number.

(4) Effect From To Column.

The EFFECT FROM TO column provides for entries regarding usage on different models or for field service bulletin entries as applicable. If this column is left blank, parts apply to all models until otherwise noted by revision.

(5) Units Per Assembly Column.

The UNITS PER ASSY column lists the quantity of sub-assemblies or parts required in the next higher assembly (NHA). The quantities specified, therefore, are not necessarily the total used per equipment. The letters RF denote that the item listed appears on another list and illustration and is referenced for aid in identification only.

4. VENDOR FEDERAL SUPPLY CODE AND NAME INDEX.

The following list is derived by extraction from the Federal Supply Catalog Handbook H4-1. The information is supplied to aid in procurement and identification of the various vendors.

FSC NO. OR CODE	VENDORS NAME AND ADDRESS
01121	Allen Bradley Co. 1201 South 2nd St. Milwaukee, Wisconsin 53204
01281	Electronics Components TRW Semiconductors, Div. 14520 Aviation Blvd. Lawndale, California 90260

4. VENDOR FEDERAL SUPPLY CODE AND NAME INDEX. (Cont.).

FSC NO. OR CODE	VENDORS NAME AND ADDRESS
01295	Texas Instruments, Inc. Semi-Cond-Comp Div. 13500 North Central Expressway Dallas, Texas 75231
02735	RCA Corp., Solid State Div. Route 202 Sommerville, N. J. 08876
07263	Fairchild Semiconductor, A Div. of Fairchild Camera & Instr. Corp. 4300 Redwood Highway San Rafael, California 94903
08530	Reliance Mica Co. 342 - 39th Street Brooklyn, N. Y. 11232
09134	Texas Capacitor Company 7830 Westglen Drive P. O. Box 36560 Houston, Texas 77036
09214	General Electric Co. Semiconductor Products Dept Power Semiconductor Products W. Genesee Street Auburn, N. Y. 13021
11502	International Resistance Co. Boone Div. Greenway Road Boone, N. C. 28607
14552	Micro Semiconductor Corp. 11250 Playa Court Culver City, California
14752	Electro Cube, Inc. 1710 S. Delmar San Gabriel, California 91776
24444	General Semiconductors 230 W. 5th Street Tempe, Arizona 85281
27566	IMB Electronics Products, Inc. 15401 E Carmenita Road Santa Fe Springs, California 90670
28520	Heyman Manufacturing Co. 147 N. Michigan Ave. Kenilworth, N. J. 07033
29632	Phoenix Aerospace, Inc. 1022 South 23rd Street Phoenix, Arizona 85034
44655	Ohmite Manufacturing Co. 3601 W. Howard Skokie, Illinois 60076
53021	Sangamo Electric Co. 1301 N. 11th Springfield, Illinois 62705
56289	Sprague Electric, Co. Beaver Street North North Adams, Mass. 01247
83827	Resistors, Inc. 5228 W. 26th St. Chicago, Ill. 60650
84411	TRW Capacitor Division 112 W. First Street Ogallala, Nebraska 69153
91418	Radio Materials Company 4242 W. Bryn Mawr Ave. Chicago, Illinois 60646
91506	Augat, Inc. 33 Perry Ave. Atteboro, Mass. 02703
99942	Globe Union, Inc. Centralab Semiconductor Division 4501 N. Arden Drive El Monte, California 91734

PART NUMBER	AIRLINE PART NUMBER	CH-SECT-UNIT-FIG-ITEM	TTL REQ.
AN510C1034		24 -20 -X 1101 - 5	1
AN510C1044		24 -20 -X 1101 - 6	2
AN510C834		24 -20 -X 1101 - 7	1
AN520B680		24 -20 -X 1101 -37	20
AN520C618		24 -20 -X 1101 -41	1
BA3778H		24 -20 -X 1102 - 4*	1*
		24 -20 -X 1102 - 5*	1*
BWH 1		24 -20 -X 1104 2	1
		3	1
		4	1
		5	1
		6	1
		7	1
		8	1
		9	1
		10	1
		11	1
		12	1
		13	1
		14	1
		15	1
		16	1
		17	1
BWH 220		24 -20 -X 1104 18	1
		19	1
BWH 4.7		24 -20 -X 1103 14	1
		17	1
		20	1
		23	1
		26	1
		29	1
		32	1
		35	1
MA3819J		24 -20 -X 1102 6	1
MS3102R-22-1P		24 -20 -X 1101 34	1
MS3102R-22-10S		24 -20 -X 1101 35	1
MS3106F-22-1S		24 -20 -X 1101 - 1	1
MS3106F-22-10P		24 -20 -X 1101 - 2	1
MS35233-15		24 -20 -X 1101 -62	20
MS35233-17		24 -20 -X 1101 -36	8

PART NUMBER	AIRLINE PART NUMBER	CH-SECT-UNIT-FIG-ITEM	TTL REQ.
MS35233-17		24 -20 -X 1101 -45	4
		-54	5
MS35233-18		24 -20 -X 1101 -61	6
MS35233-30		24 -20 -X 1101 -46	2
		-50	4
MS35237-15		24 -20 -X 1101 -21	2
		-56	1
MS35237-16		24 -20 -X 1101 -53	5
MS35237-28		24 -20 -X 1101 -31	2
		-33	4
MS35276A-216		24 -20 -X 1101 -63	2
MS35333-71		24 -20 -X 1101 -47	2
		-51	4
			1
MS35333-72		24 -20 -X 1101 -18	1
MS35333-74		24 -20 -X 1101 - 9	1
		-12	1
		-15	1
MS35337-70		24 -20 -X 1101 -22	2
		-57	1
		1103 -47	4
MS35649-244		24 -20 -X 1101 -23	2
		-58	1
		1103 -48	4
MS35649-264		24 -20 -X 1103 -43	1
MS35690-72		24 -20 -X 1101 -19	1
MS35690-74		24 -20 -X 1101 -10	1
		-13	1
		-16	1
		1103 - 7	1
RC20GF102K		24 -20 -X 1104 25	1
		26	1
RC20GF103K		24 -20 -X 1104 38	1
		39	1
RC20GF153K		24 -20 -X 1104 40	1
RC20GF222J		24 -20 -X 1104 27	1
		28	1
RC20GF222K		24 -20 -X 1104 29	1
		30	1
		31	1

-Item not illustrated
*Selected

PART NUMBER	AIRLINE PART NUMBER	CH-SECT-UNIT-FIG-ITEM	TTL REQ.
RC20GF222K		24 -20 -X 1104 32	1
		33	1
RC20GF223K		24 -20 -X 1104 41	1
RC20GF272K		24 -20 -X 1104 34	1
RC20GF330K		24 -20 -X 1104 20	1
		21	1
RC20GF391K		24 -20 -X 1104 22	1
RC20GF471K		24 -20 -X 1104 23	1
		24	1
RC20GF472J		24 -20 -X 1104 35	1
		36	1
RC20GF472K		24 -20 -X 1104 37	1
SM .02±20		24 -20 -X 1103 9	1
YC102U		24 -20 -X 1104 42	1
025001		24 -20 -X 1103 - 4	1
025002		24 -20 -X 1101 -26	1
026006		24 -20 -X 1104 75	1
031507		24 -20 -X 1101 -37	2
038010		24 -20 -X 1101 14	1
038011		24 -20 -X 1101 17	1
043003		24 -20 -X 1104 66	1
043010		24 -20 -X 1103 40	1
043011		24 -20 -X 1101 11	1
043012		24 -20 -X 1101 8	1
058010		24 -20 -X 1102 1	1
058011		24 -20 -X 1104 1	1
064502		24 -20 -X 1103 3	2
064503		24 -20 -X 1101 -25	2
066011		24 -20 -X 1101 59	1
066012		24 -20 -X 1101 65	1
067500		24 -20 -X 1101 -64	1
070009		24 -20 -X 1103 -46	4
070010		24 -20 -X 1101 -30	2
070011		24 -20 -X 1101 -32	4
076004		24 -20 -X 1103 - 5	1
076005		24 -20 -X 1103 - 6	1
076006		24 -20 -X 1101 -27	1
076013		24 -20 -X 1101 -28	1
080008		24 -20 -X 1101 4	1
080009		24 -20 -X 1103 1	1
088006		24 -20 -X 1101 3	1

PART NUMBER	AIRLINE PART NUMBER	CH-SECT-UNIT-FIG-ITEM	TTL REQ.
088507		24 -20 -X 1101 60	1
090010		24 -20 -X 1101 20	1
095032		24 -20 -X 1101	RF
IN1186		24 -20 -X 1101 24	1
IN2979B		24 -20 -X 1103 2	1
IN3611		24 -20 -X 1104 55	1
		56	1
		57	1
		58	1
		59	1
		60	1
IN4460		24 -20 -X 1104 -65	1
IN4473		24 -20 -X 1104 64	1
IN5624		24 -20 -X 1101 38	1
		39	1
		40	1
		41	1
		42	1
		43	1
		44	1
		45	1
IN914B		24 -20 -X 1104 61	1
		24 -20 -X 1104 -62	1
		24 -20 -X 1104 -63	1
10AX*		24 -20 -X 1102 7*	1*
100005		24 -20 -X 1101 -29	1
116027		24 -20 -X 1101 -48	1
116028		24 -20 -X 1101 49	1
		1102	RF
116029		24 -20 -X 1101 52	1
		1103	RF
116030		24 -20 -X 1103 -39	1
116031		24 -20 -X 1103 44	1
		1104	RF
1347		24 -20 -X 1104 43	1
150D105X9035A2		24 -20 -X 1104 48	1
		49	1
		50	1
		51	1
150D226X9015B2		24 -20 -X 1104 52	1
		54	1

-Item not illustrated
*Selected or alternate

PART NUMBER	AIRLINE PART NUMBER	CH-SECT-UNIT-FIG-ITEM	TTL REQ.
2N2222		24 -20 -X 1104 67	1
		68	1
		69	1
		70	1
		71	1
2N4036		24 -20 -X 1104 72	1
		73	1
		74	1
3305-5/16-N		24 -20 -X 1101 -55	1
4774		24 -20 -X 1102 7*	1*
601*		24 -20 -X 1104 46	1
		47	1
601.01		24 -20 -X 1104 44	1
		45	1
601D238G040JT4		24 -20 -X 1102 2	1
		3	1
637B1D605H		24 -20 -X 1102 4*	1*
		5*	1*
64497		24 -20 -X 1103 10	1
		12	1

PART NUMBER	AIRLINE PART NUMBER	CH-SECT-UNIT-FIG-ITEM	TTL REQ.
64497		24 -20 -X 1103 15	1
		18	1
		21	1
		24	1
		27	1
		30	1
		33	1
		36	1
761		24 -20 -X 1103 -38	10
8080-161		24 -20 -X 1103 8	1
		11	1
		13	1
		16	1
		19	1
		22	1
		25	1
		28	1
		31	1
		34	1

-Item not illustrated
*Selected or alternate

DH-1030-24-600-CS/P.N. 095032
SYMBOL INDEX

SYM	PART NUMBER	CH-SECT-UNIT-FIG-ITEM
CR1	IN914B	24 -20 -X 1104 61
CR2	IN3611	24 -20 -X 1104 55
CR3	IN3611	56
CR4	IN3611	57
CR5	IN3611	58
CR6	IN914B	24 -20 -X 1104 62
CR7	IN914B	63
CR8	IN5624	24 -20 -X 1101 38
CR9	IN5624	24 -20 -X 1101 39
CR10	IN5624	24 -20 -X 1101 40
CR11	IN5624	24 -20 -X 1101 41
CR12	IN5624	24 -20 -X 1101 42
CR13	IN5624	24 -20 -X 1101 43
CR14	IN5624	24 -20 -X 1101 44
CR15	IN5624	24 -20 -X 1101 45
CR16	IN3611	24 -20 -X 1104 59
CR17	IN3611	60
CR18	IN1186	24 -20 -X 1101 24
C1	1347	24 -20 -X 1104 43
C1A	601*	24 -20 -X 1104 46
C2	601*	47
C3	601.01	24 -20 -X 1104 44
C4	601.01	-45
C5	150D105X9035A2	24 -20 -X 1104 48
C6	150D105X9035A2	49
C7	150D226X9015B2	24 -20 -X 1104 52
C8	150D226X9015B2	53
C9	150D226X9015B2	54
C10	NOT ASSIGNED	
C11	NOT ASSIGNED	
C12	150D105X9035A2	24 -20 -X 1104 51
C13	SM .02±20	24 -20 -X 1103 9
C1A	BA3778H	24 -20 -X 1102 4
	or	
	637B1D605H	
C15	BA3778H	24 -20 -X 1102 5
	or	
	637B1D605H	
C16	MA3819J	24 -20 -X 1002 6
C17	601D238G040JT4	24 -20 -X 1102 2
C18	601D238G040JT4	24 -20 -X 1102 3
E1	026006	24 -20 -X 1104 75
J1	MS3102R-22-1P	24 -20 -X 1101 34
J2	MS3102R-22-10S	24 -20 -X 1101 35
L1	038009	24 -20 -X 1101 17
L2	038010	24 -20 -X 1101 14
P1	MS3106F-22-1S	24 -20 -X 1101 - 1
P2	MS3106F-22-10P	24 -20 -X 1101 - 2
Q1	2N2222	24 -20 -X 1104 67
Q2	2N2222	24 -20 -X 1104 68
Q3	2N2222	24 -20 -X 1104 69
Q4	2N2222	24 -20 -X 1104 70
Q5	2N4036	24 -20 -X 1104 72
Q6	2N4036	24 -20 -X 1104 73
Q7	64497	24 -20 -X 1103 10
Q8	64497	24 -20 -X 1103 12
Q9	2N2222	24 -20 -X 1104 71
Q10	2N4036	24 -20 -X 1104 74

SYM	PART NUMBER	CH-SECT-UNIT-FIG-ITEM
Q11	64497	24 -20 -X 1103 15
Q12	64497	24 -20 -X 1103 18
Q13	64497	24 -20 -X 1103 21
Q14	64497	24 -20 -X 1103 24
Q15	64497	24 -20 -X 1103 27
Q16	64497	24 -20 -X 1103 30
Q17	64497	24 -20 -X 1103 33
Q18	64497	24 -20 -X 1103 36
R2	RC20GF472J	24 -20 -X 1104 35
Rs	RC20GF472J	24 -20 -X 1104 36
R3	RC20GF103K	24 -20 -X 1104 38
R4	RC20GF222J	24 -20 -X 1104 27
R5	RC20GF222J	24 -20 -X 1104 28
R6	RC20GF222K	24 -20 -X 1104 29
R7	RC20GF222K	24 -20 -X 1104 30
R8	RC20GF222K	24 -20 -X 1104 31
R9	RC20GF222K	24 -20 -X 1104 32
R10	RC20GF102K	24 -20 -X 1104 25
R11	BWH 220	24 -20 -X 1104 18
R12	BWH 220	24 -20 -X 1104 19
R13	RC20GF330K	24 -20 -X 1104 20
R14	RC20GF330K	24 -20 -X 1104 21
R15	RC20GF471K	24 -20 -X 1104 23
R16	10AX	24 -20 -X 1102 7
	or	
	4774	
R17	RC20GF471K	24 -20 -X 1104 24
R18	RC20GF223K	24 -20 -X 1104 41
R19	RC20GF472K	24 -20 -X 1104 37
R20	RC20GF102K	24 -20 -X 1104 26
R21	RC20GF272K	24 -20 -X 1104 34
R22	YC102U	24 -20 -X 1104 42
R23	RC20GF391K	24 -20 -X 1104 22
R24	RC20GF153K	24 -20 -X 1104 40
R25	RC20GF222K	24 -20 -X 1104 33
R26	R20GF103K	24 -20 -X 1104 39
R27	BWH 1	24 -20 -X 1104 2
R28	BWH 1	24 -20 -X 1104 3
R29	BWH 1	24 -20 -X 1104 4
R30	BWH 1	24 -20 -X 1104 5
R31	BWH 1	24 -20 -X 1104 6
R32	BWH 1	24 -20 -X 1104 7
R33	BWH 1	24 -20 -X 1104 8
R34	BWH 1	24 -20 -X 1104 9
R35	BWH 4.7	24 -20 -X 1103 14
R36	BWH 4.7	24 -20 -X 1103 17
R37	BWH 4.7	24 -20 -X 1103 20
R38	BWH 4.7	24 -20 -X 1103 23
R39	BWH 1	24 -20 -X 1104 10
R40	BWH 1	24 -20 -X 1104 11
R41	BWH 1	24 -20 -X 1104 12
R42	BWH 1	24 -20 -X 1104 13
R43	BWH 1	24 -20 -X 1104 14
R44	BWH 1	24 -20 -X 1104 15
R45	BWH 1	24 -20 -X 1104 16
R46	BWH 1	24 -20 -X 1104 17
R47	BWH 4.7	24 -20 -X 1103 26
R48	BWH 4.7	24 -20 -X 1103 29

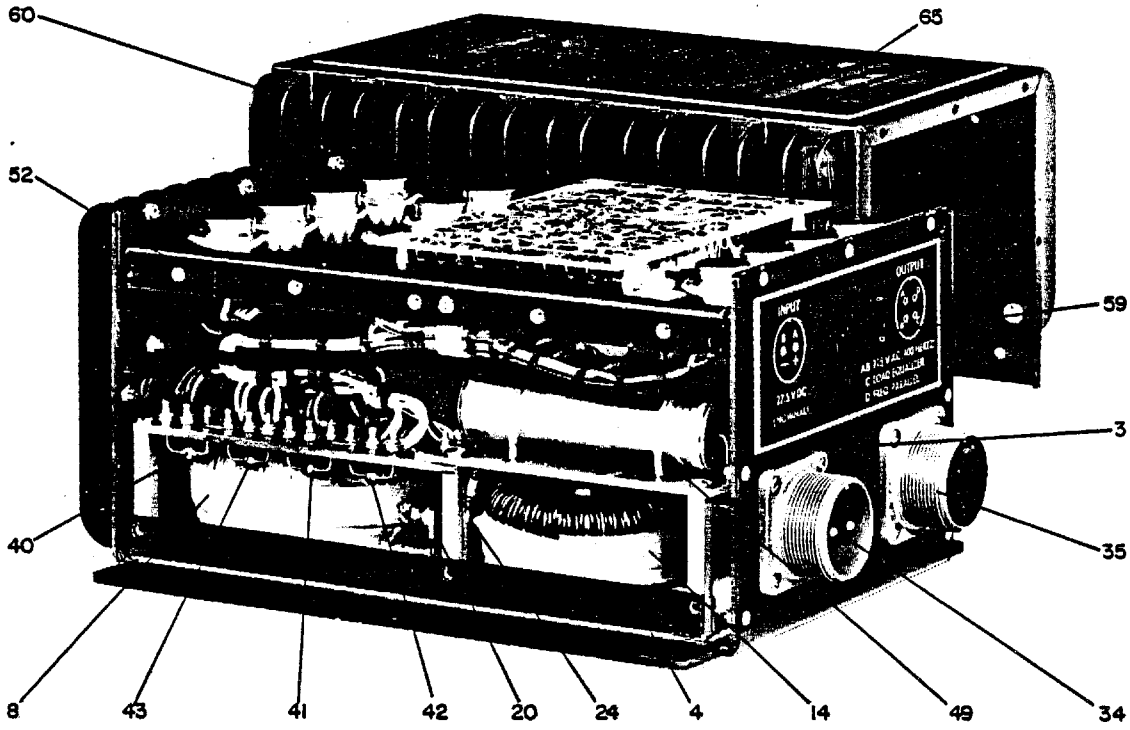
-Item not illustrated
*Selected

DH-1030-24-600-CS/P.N. 095032
SYMBOL INDEX

SYM	PART NUMBER	CH-SECT-UNIT-FIG-ITEM
R49	BWH 4.7	24 -20 -X 1103 32
R50	BWH 4.7	24 -20 -X 1103 35
T1	043003	24 -20 -X 1104 66
T2	043010	24 -20 -X 1103 40
T3	043011	24 -20 -X 1101 11
T4	043012	24 -20 -X 1101 8
XQ7	8080-161	24 -20 -X 1103 8
XQ8	8080-161	24 -20 -X 1103 11
XQ11	8080-161	24 -20 -X 1103 13
XQ12	8080-161	24 -20 -X 1103 16
XQ13	8080-161	24 -20 -X 1103 19
XQ14	8080-161	24 -20 -X 1103 22
XQ15	8080-161	24 -20 -X 1103 25
XQ16	8080-161	24 -20 -X 1103 28
XQ17	8080-161	24 -20 -X 1103 31
XQ18	8080-161	24 -20 -X 1103 34
ZR1	IW2979B	24 -20 -X 1103 2
ZR2	IN4460	24 -20 -X 1104 65
ZR3	IN4473	24 -20 -X 1104 64

-Item not illustrated
*Selected

DH-1030-24-600-CS/P.N. 095032
DETAILED PARTS LIST



Solid-State Static Inverter (Transverter) Model DH-1030-24-600-CS
Figure 1101 (Sheet 1 of 2)

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT FROM-TO	UNITS PER ASSY
1101	095032	ASSEMBLY, STATIC INVERTER, SOLID STATE, SILICON, (TRANSVERTER) MODEL DH-1030-24-600-CS (See Fig. 1)		RF
				1
- 1	MS3106F-22-1S	CONNECTOR, PLUG, STRAIGHT (MATES WITH MS3102R-22-1P) (028005)		1
- 2	MS3106F-22-10P	CONNECTOR, PLUG, STRAIGHT (MATES WITH MS3102R-22-10S) (028006)		1
3	088006	. BASE, STATIC INVERTER (TRANSVERTER) MODEL DH-1030-24-600-CS		1
4	080008	. . CHASSIS, PAN, TRANSFORMER MTG.		1
- 5	AN510C1034	. . SCREW, FHM, 82° CSK, STL, CAD PL, 10-32 X 2-1/8 IN. LG. (101020)		1
- 6	AN510C1044	. . SCREW, FHM, 82° CSK, STL, CAD PL, 10-32 X 1-3/4 IN. LG. (101021)		2
- 7	AN510C834	. . SCREW, FHM, 82° CSK, STL, CAD PL, 8-32 X 1-1/8 IN. LG (101023)		1

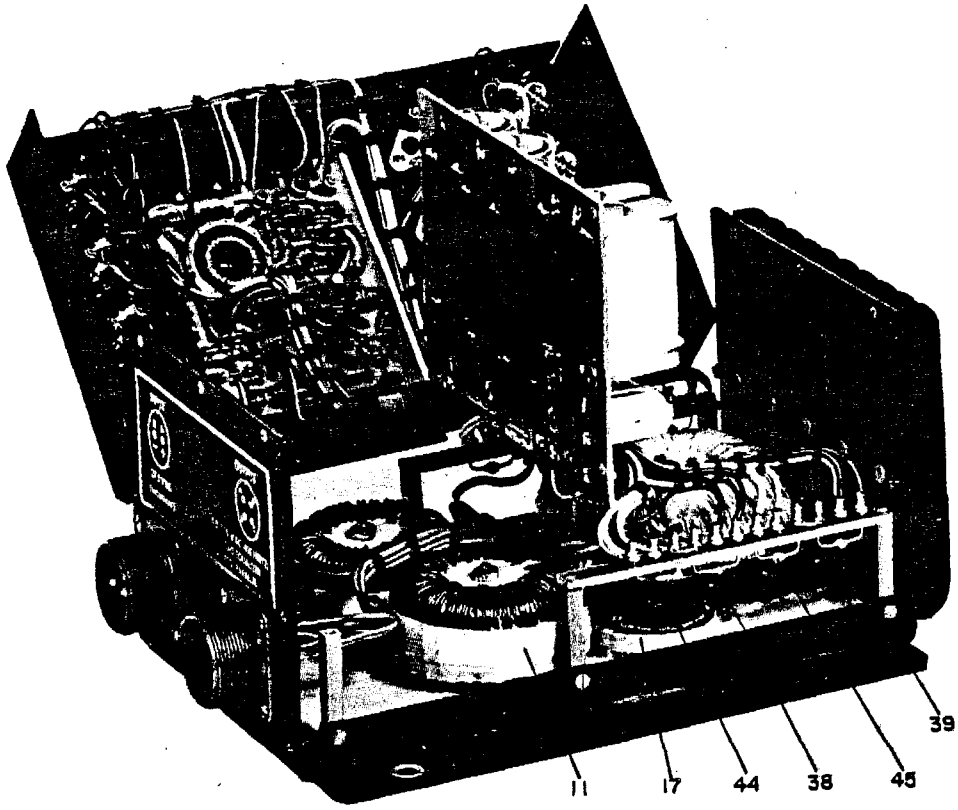
-Item not illustrated
*Selected or alternate

DH-1030-24-600-CS/P.N. 095032
DETAILED PARTS LIST

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM-TO	UNITS PER ASSY
1101 8	043012	. . TRANSFORMER, POWER, OUTPUT TOROIDAL		1
		(ATTACHING PARTS)		
- 9	MS35333-74	. . WASHER, INT. TOOTH LOCK, S. STL NO. 10 (076005)		1
-10	MS35690-74	. . NUT, HEX, STL, CAD PL, NO. 10-32 (100004)		1
		---*---		
11	043011	. . TRANSFORMER, SERIES REACTOR TOROIDAL		1
		(ATTACHING PARTS)		
-12	MS35333-74	. . WASHER, INT. TOOTH LOCK, S. STL, NO. 10 (076005)		1
-13	MS35690-74	. . NUT, HEX, STL, CAD PL, NO. 10-32 (100004)		1
		---*---		
14	038010	. . REACTOR, INPUT, TOROIDAL		1
		(ATTACHING PARTS)		
-15	MS35333-74	. . WASHER, INT. TOOTH LOCK, S. STL, NO. 10 (076005)		1
-16	MS35690-74	. . NUT, HEX, STL, CAD PL, NO. 10-32 (100004)		1
		---*---		
17	038011	. . REACTOR, SHUNT, TOROIDAL		1
		(ATTACHING PARTS)		
-18	MS35333-72	. . WASHER, INT. TOOTH LOCK, S. STL, NO. 8 (076000)		1
-19	MS35690-72	. . NUT, HEX, STL, CAD PL, NO. 8-32 (100000)		1
		---*---		
20	090010	. . BRACKET, DIODE MTG.		1
		(ATTACHING PARTS)		
-21	MS35237-15	. . SCREW, FHM, 82° CSK, S. STL, 4-40 X 3/8 IN. LG. (101003)		2
-22	MS35333-70	. . WASHER, INT. TOOTH LOCK, S. STL, NO. 4 (076001)		2
-23	MS35649-244	. . NUT, HEX, S. STL, 4-40 (100002)		2
		---*---		
24	1N1186	. . SEMICONDUCTOR, DIODE, SILICON, POWER, (V09214) (046018)		1
		(ATTACHING PARTS)		
-25	064503	. . WASHER, MICA, DIODE MTG. (V09214) (064503) (P/O ITEM 24)		2

-ITEM NOT ILLUSTRATED

DH-1030-24-CS/P.N. 095032
DETAILED PARTS LIST



Solid-State Static Inverter (Transverter) Model DH-1030-24-600-CS
Figure 1101 (Sheet 2 of 2)

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT FROM-TO	UNITS PER ASSY
1101-26	025002	. . LUG, SOLDER, 1/4 IN. CLR NO. 10 WIRE (V09214) (025002) (P/O ITEM 24)		1
-27	076006	. . WASHER, FLAT, STL, CAD PL, 1/4 IN. I.D. 9/16 IN. O.D. (V09214) (076006) (P/O ITEM 24)		1
-28	076013	. . WASHER, EXT. TOOTH LOCK, STL, CAD PL 1/4 IN. (V09214) (076013) P/O ITEM 24)		1
-29	100005	. . NUT, HEX, STL, CAD PL, 1/4-20 (V09214) (100005) (P/O ITEM 24) ---★---		1

-ITEM NOT ILLUSTRATED

DH-1030-24-CS/P.N. 095032
DETAILED PARTS LIST

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT FROM-TO	UNITS PER ASSY
1101-30	070010	. . SPACER, POST, ALUM. 1/4 IN. SQ. X 1-13/16 IN. LG. TAPPED 6-32 EACH END W/4-40 S. STL CLINCH NUT INSERT ONE SIDE		2
		(ATTACHING PARTS)		
-31	MS35237-28	. . SCREW, FHM, 82° CSK, S. STL, 6-32 X 3/8 IN. LG (101024)		2
		---*---		
-32	070011	. . SPACER, POST, ALUM. 1/4 IN. SQ. X 1-11/16 IN. LG. TAPPED 6-32 EACH END W/4-40 S. STL CLINCH NUT INSERT ONE SIDE		4
		(ATTACHING PARTS)		
-33	MS35237-28	. . SCREW, FHM, 82° CSK, S. STL, 6-32 X 3/8 IN. LG. (101024)		4
		---*---		
34	MS3102R-22-1P	. . CONNECTOR, RECEPTACLE (029009)		1
35	MS3102R-22-10S	. . CONNECTOR, RECEPTACLE (029010)		1
		(ATTACHING PARTS)		
-36	MS35233-17	. . SCREW, PHM, S. STL, 4-40 X 1/2 IN. LG. (101005)		8
		---*---		
-37	031507	. . STRIP, TIE POINT, 12 POINT		2
38	1N5624	. . SEMICONDUCTOR, DIODE, SILICON, POWER (V09214) (046015)		1
39	1N5624	. . SEMICONDUCTOR, DIODE, SILICON, POWER (V09214) (046015)		1
40	1N5624	. . SEMICONDUCTOR, DIODE, SILICON, POWER (V09214) (046015)		1
41	1N5624	. . SEMICONDUCTOR, DIODE, SILICON, POWER (V09214) (046015)		1
42	1N5624	. . SEMICONDUCTOR, DIODE, SILICON, POWER (V09214) (046015)		1
43	1N5624	. . SEMICONDUCTOR, DIODE, SILICON, POWER (V09214) (046015)		1
44	1N5624	. . SEMICONDUCTOR, DIODE, SILICON, POWER (V09214) (046015)		1
45	1N5624	. . SEMICONDUCTOR, DIODE, SILICON POWER (V09214) (046015)		1
		(ATTACHING PARTS)		
-46	MS35233-30	. . SCREW, PHM, S. STL, 6-32 X 1/2 IN. LG. (101009)		2
-47	MS35333-71	. . WASHER, INT. TOOTH LOCK, S. STL, NO. 6 (076012)		2
		---*---		
-48	116027	. . SUB-ASSY, HARNESS, WIRING, SPECIAL PURPOSE		1

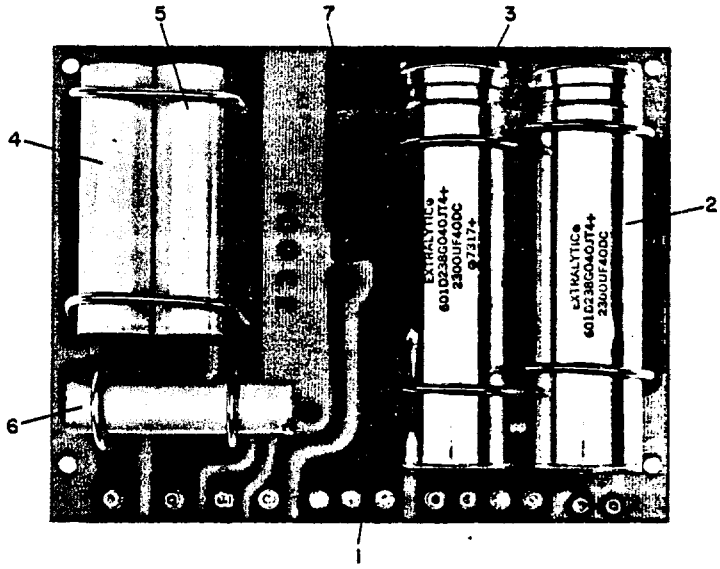
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DH-1030-24-600-CS/P.N. 095032
DETAILED PARTS LIST

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT FROM-TO	UNITS PER ASSY
1101 49	116028	. . SUB-ASSY, CIRCUIT BOARD, INPUT AND OUTPUT FILTERS		1
		(ATTACHING PARTS)		
-50	MS35233-30	. . SCREW, PHM, S. STL, 6-32 X 1/2 IN. LG. (101009)		4
-51	MS35333-71	. . WASHER, INT. TOOTH LOCK, S. STL, NO. 6 (076012)		4
		---★---		
52	116029	. . SUB-ASSY, CIRCUIT MODULE, OSC/AMPL/DRIVER		1
		(ATTACHING PARTS)		
-53	MS35237-16	. . SCREW, FHM, 82° CSK, S. STL, 4-40 X 1/2 IN. LG. (101016)		5
-54	MS35233-17	. . SCREW, PHM, S. STL, 4-40 X 1/2 IN. LG (101005)		5
		---★---		
-55	3305-5/16-N	. . CLAMP, CABLE, NYLON 5/16 IN. (V28520) (068000)		1
		(ATTACHING PARTS)		
-56	MS35237-15	. . SCREW, FHM, 82° CSK, S. STL, 4-40 X 3/8 IN. LG. (101003)		1
-57	MS35333-70	. . WASHER, INT. TOOTH LOCK, S. STL, NO. 4 (076001)		1
-58	MS35649-244	. . NUT, HEX, S. STL, 4-40 (100002)		1
		---★---		
59	066011	. . NAMEPLATE, INPUT AND OUTPUT CONNECTIONS, SELF-ADHERING		1
60	088507	. COVER, STATIC, INVERTER		1
		(ATTACHING PARTS)		
-61	MS35233-18	. SCREW, PHM, S. STL, 4-40 X 5/8 IN. LG. (101017)		6
-62	MS35233-15	. SCREW, PHM, S. STL, 4-40 X 3/8 IN. LG (101004)		20
-63	MS35276A-216	. SCREW, FILLISTER HEAD, DRILLED, S. STL, 4-40 X 3/8 IN. LG (101201)		2
		---★---		
-64	067500	. SEAL, LEAD PAI WARRANTY		1
65	066012	. NAMEPLATE, MODEL AND SERIAL NO. MODEL DH-1030-24-600-CS, SELF-ADHERING		1

-ITEM NOT ILLUSTRATED

DH-1030-24-600-CS/P.N. 095032
DETAILED PARTS LIST



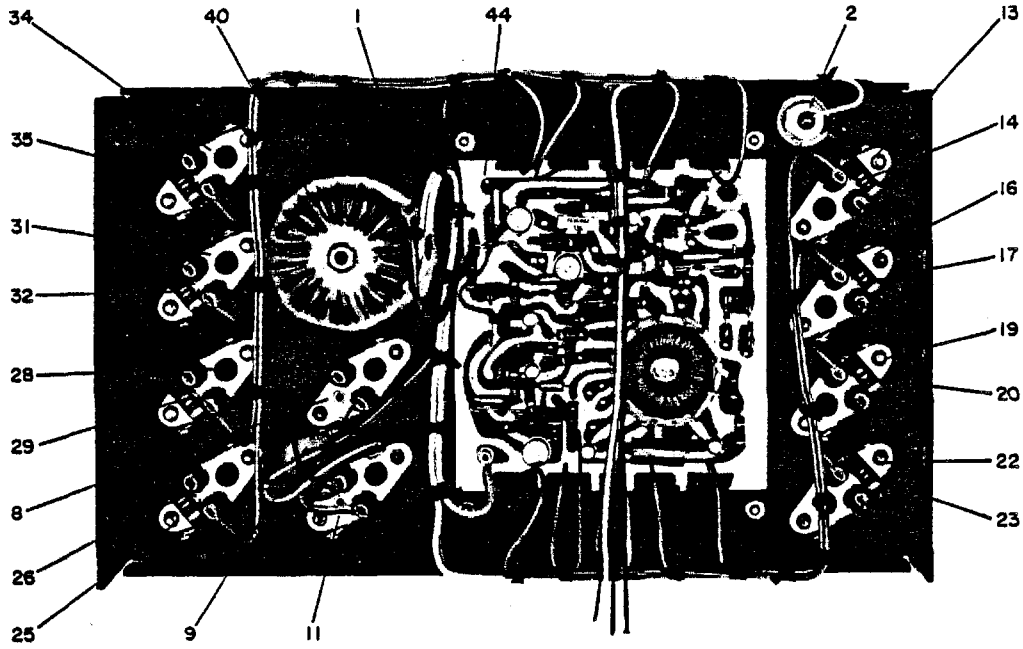
Input and Output Filter Circuit Board Sub-Assembly
Figure 1102

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT FROM-TO	UNITS PER ASSY
1102	116028	SUB-ASSY, CIRCUIT BOARD, INPUT AND OUTPUT FILTERS (SEE FIG. 1101 FOR NHA)		RF
1	058010	. BOARD, PRINTED CIRCUIT, INPUT AND OUTPUT FILTERS		1
2	601D238G040JT4	. CAPACITOR, ELECTROLYTIC, 2300 UF, 40VDCW (V56289) (021004)		1
3	601D238G040JT4	. CAPACITOR, ELECTROLYTIC, 2300 UF, 40 VDCW (V56289) (021004)		1
4	BA3778H	. CAPACITOR, FIXED, POLYCARBONATE, 6 UF, ±3%, 115V AC, 400 HZ (V14752) (019015)		1
	or	OR		
	637B1D605H	. CAPACITOR, FIXED, POLYCARBONATE, 6 UF, ±3%, 115V AC, 400 HZ (V27566) (019015)		1
5	BA3778H	. CAPACITOR, FIXED, POLYCARBONATE, 6 UF, ±3%, 115V AC, 400 HZ (V14752) (019015)		1
	or	OR		
	637B1D605H	. CAPACITOR, FIXED, POLYCARBONATE, 6 UF, ±3%, 115V AC, 400 HZ (V27566) (019015)		1
6	MA3819J	. CAPACITOR, FIXED, MYLAR FOIL, 1.25 UF, ±3%, 600 VDCW (V27566) (019017)		1

-ITEM NOT ILLUSTRATED
*Selected or alternate

DH-1030-24-600-CS/P.N. 095032
DETAILED PARTS LIST

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM-TO	UNITS PER ASSY
1102 7	10AX	. RESISTOR, FIXED, WW, 33 OHMS, 10W (V83827) (052002)		1
	or	OR		
	4774	. RESISTOR, FIXED, WW, 33 OHMS, 10W (V44655) (052002)		1



Oscillator/Amplifier/Driver Circuit Module Sub-Assembly
Figure 1103 (Sheet 1 of 2)

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM-TO	UNITS PER ASSY
1103	116029	SUB-ASSY, CIRCUIT MODULE, OSC/AMPL/ DRIVER (SEE FIG. 1101 FOR NHA)		RF
1	080009	. CHASSIS, CIRCUIT MODULE, OSC/AMPL/DRIVER		1
2	1N2979B	. SEMICONDUCTOR, DIODE, ZENER, 15V, 5%, 10W (V24444) (046016)		1

DH-1030-24-600-CS/P.N. 095032
DETAILED PARTS LIST

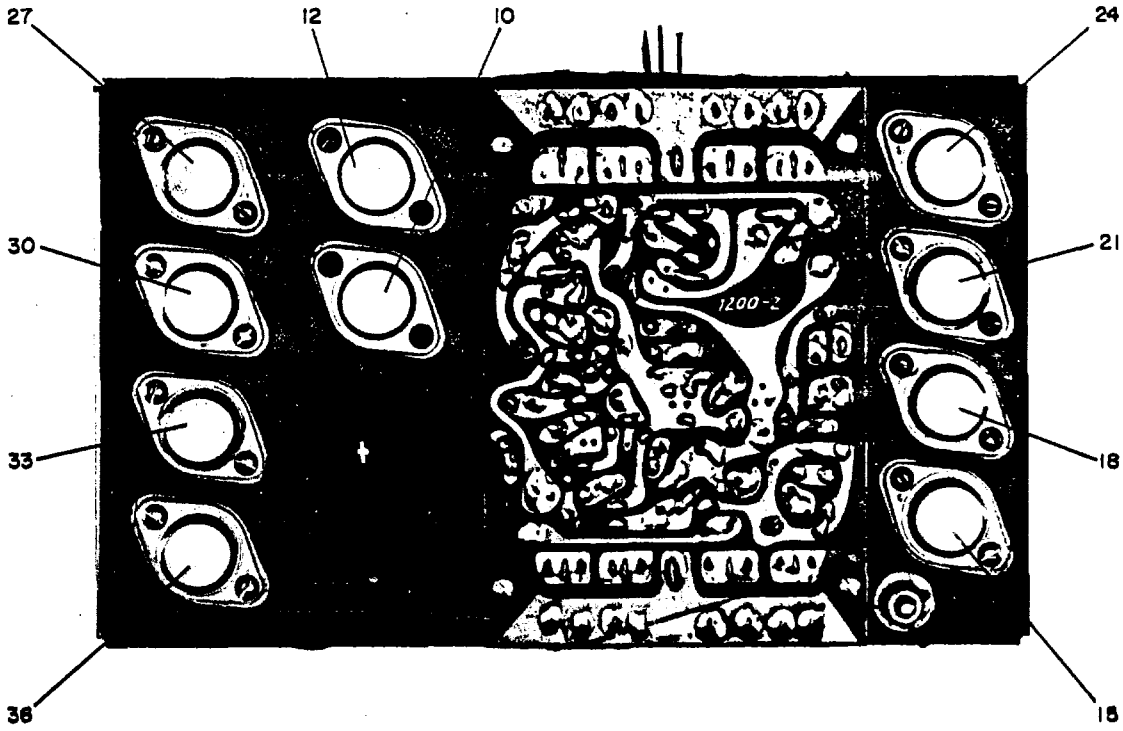
FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM-TO	UNITS PER ASSY
1103		(ATTACHING PARTS)		
- 3	064502	. WASHER, MICA, DIODE MTG (V24444) (064502) (P/O ITEM 2)		2
- 4	025001	. LUG, SOLDER, NO. 10, FLAT (V24444) (025001) (P/O ITEM 2)		1
- 5	076004	. WASHER, FLAT, NO. 10 (V24444) (076004) (P/O ITEM 2)		1
- 6	076005	. WASHER, INT. TOOTH LOCK, NO. 10 (V24444) (076005) (P/O ITEM 2)		1
- 7	MS35690-74	. NUT, HEX, STL, CAD PL, 10-32 (V24444) (100004) (P/O ITEM 2)		1
		---★---		
8	8080-161	. SOCKET, TRANSISTOR MTG, TO-3 (V91506) (029008)		1
9	SM. 02±20	. CAPACITOR, CERAMIC DISC, 0.02 UF, ±20%, 500 VDCW (V91418) (023000)		1
10	64497	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON (V02735) (048505)		1
11	8080-161	. SOCKET, TRANSISTOR MTG, TO-3 (V91506) (029008)		1
12	64497	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON (V02735) (048505)		1
13	8080-161	. SOCKET, TRANSISTOR MTG, TO-3 (V91506) (029008)		1
14	BWH 4.7	. RESISTOR, FIXED, WW, 4.7 OHMS, ±10%, 2W (V11502) (050301)		1
15	64497	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON (V02735) (048505)		1
16	8080-161	. SOCKET, TRANSISTOR, MTG, TO-3(V91506) (029008)		1
17	BWH 4.7	. RESISTOR, FIXED, WW, 4.7 OHMS, ±10%, 2W (V11502) (050301)		1
18	64497	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON (V02735) (048505)		1
19	8080-161	. SOCKET, TRANSISTOR MTG, TO-3 (V91506) (029008)		1
20	BWH 4.7	. RESISTOR, FIXED, WW, 4.7 OHMS, ±10%, 2W (V11502) (050301)		1
21	64497	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON (V02735) (048505)		1
22	8080-161	. SOCKET, TRANSISTOR MTG, TO-3 (V91506) (029008)		1
23	BWH 4.7	. RESISTOR, FIXED, WW, 4.7 OHMS, ±10%, 2W (V11502) (050301)		1

-ITEM NOT ILLUSTRATED

DH-1030-24-600-CS/P.N. 095032
DETAILED PARTS LIST

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT FROM-TO	UNITS PER ASSY
1103 24	64497	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON (V02735) (048505)		1
25	8080-161	. SOCKET, TRANSISTOR MTG, TO-3 (V91506) (029008)		1
26	BWH 4.7	. RESISTOR, FIXED, WW, 4.7 OHMS, ±10%, 2W (V11502) (050301)		1
27	64497	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON (V02735) (048505)		1
28	8080-161	. SOCKET, TRANSISTOR MTG, TO-3 (V91506) (029008)		1
29	BWH 4.7	. RESISTOR, FIXED, WW, 4.7 OHMS, ±10%, 2W (V11502) (050301)		1
30	64497	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON (V02735) (048505)		1
31	8080-161	. SOCKET, TRANSISTOR MTG, TO-3 (V91506) (029008)		1
32	BWH 4.7	. RESISTOR, FIXED, WW, 4.7 OHMS, ±10%, 2W (V11502) (050301)		1
33	64497	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON (V02735) (048505)		1
34	8080-161	. SOCKET, TRANSISTOR MTG, TO-3 (V91506) (029008)		1
35	BWH 4.7	. RESISTOR, FIXED, WW, 4.7 OHMS, ±10%, 2W (V11502) (050301)		1
36	64497	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON (V02735) (048505)		1
		(ATTACHING PARTS)		
-37	AN520B680	. SCREW, RHM, BRASS, 6-32 X 1/2 IN. LG. (101019)		20
-38	761	. WASHER, MICA, INSULATING, TO-3 TRANSISTOR (V08530) (064500)		10
		---★---		
-39	116030	. SUB-ASSY, HARNESS, WIRING, SPECIAL PURPOSE		1
40	043010	. TRANSFORMER, POWER DRIVER, TOROIDAL		1
		(ATTACHING PARTS)		
-41	AN520C618	. SCREW; RHM, S. STL, 6-32 X 1-1/4 IN. LG. (101018)		1
-42	MS35333-71	. WASHER, INT. TOOTH LOCK, S. STL, NO. 6 (076012)		1
-43	MS35649-264	. NUT, HEX, S. STL, 6-32 (100009)		
		---★---		
44	116031	. SUB-ASSY, CIRCUIT BOARD, OSC/AMPL /DRIVER		1

-ITEM NOT ILLUSTRATED



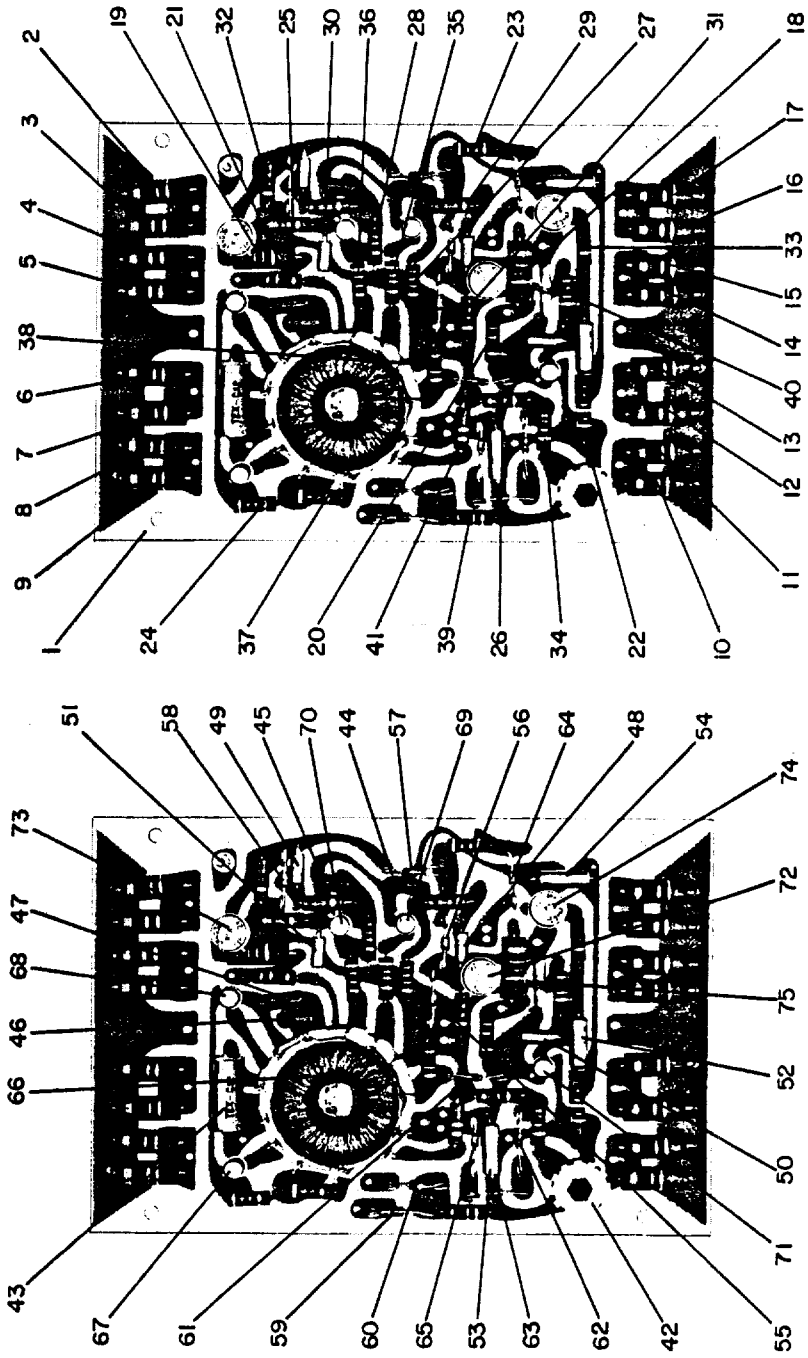
Oscillator/Amplifier/Driver Circuit Module Sub-Assembly
Figure 1103 (Sheet 2 of 2)

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM-TO	UNITS PER ASSY
1103		(ATTACHING PARTS)		
-45	MS35233-17	. SCREW, PHM, S. STL, 4-40 X 1/2 IN. LG. (101005)		4
-46	070009	. SPACER, RD, ALUM, .1875 IN. ID X 5/16 IN. LG. CLR NO. 4 (070009)		4
-47	MS35333-70	. WASHER, INT. TOOTH LOCK, S. STL, NO. 4 (076001)		4
-48	MS35649-244	. NUT, HEX, S. STL, 4-40 (100002)		4
		---*---		

-ITEM NOT ILLUSTRATED

DH-1030-24-600-CS/P.N. 095032
DETAILED PARTS LIST

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT FROM-TO	UNITS PER ASSY
1104	116031	SUB-ASSY, CIRCUIT BOARD, OSC/AMPL/DRIVER		RF
1	058009	. BOARD, PRINTED CIRCUIT, OSC/AMPL/DRIVER		1
2	BWH 1	. RESISTOR, FIXED, WW, 1 OHM, ±10%, 2W (V11502) (050304)		1
3	BWH 1	. RESISTOR, FIXED, WW, 1 OHM, ±10%, 2W (V11502) (050304)		1
4	BWH 1	. RESISTOR, FIXED, WW, 1 OHM, ±10%, 2W (V11502) (050304)		1
5	BWH 1	. RESISTOR, FIXED, WW, 1 OHM, ±10%, 2W (V11502) (050304)		1
6	BWH 1	. RESISTOR, FIXED, WW, 1 OHM, ±10%, 2W (V11502) (050304)		1
7	BWH 1	. RESISTOR, FIXED, WW, 1 OHM, ±10%, 2W (V11502) (050304)		1
8	BWH 1	. RESISTOR, FIXED, WW, 1 OHM, ±10%, 2W (V11502) (050304)		1
9	BWH 1	. RESISTOR, FIXED, WW, 1 OHM, ±10%, 2W (V11502) (050304)		1
10	BWH 1	. RESISTOR, FIXED, WW, 1 OHM, ±10%, 2W (V11502) (050304)		1
11	BWH 1	. RESISTOR, FIXED, WW, 1 OHM, ±10%, 2W (V11502) (050304)		1
12	BWH 1	. RESISTOR, FIXED, WW, 1 OHM, ±10%, 2W (V11502) (050304)		1
13	BWH 1	. RESISTOR, FIXED, WW, 1 OHM, ±10%, 2W (V11502) (050304)		1
14	BWH 1	. RESISTOR, FIXED, WW, 1 OHM, ±10%, 2W (V11502) (050304)		1
15	BWH 1	. RESISTOR, FIXED, WW, 1 OHM, ±10%, 2W (V11502) (050304)		1
16	BWH 1	. RESISTOR, FIXED, WW, 1 OHM, ±10%, 2W (V11502) (050304)		1
17	BWH 1	. RESISTOR, FIXED, WW, 1 OHM, ±10%, 2W (V11502) (050304)		1
18	BWH 220	. RESISTOR, FIXED, WW, 220 OHMS, ±10%, 2W (V11502) (050305)		1
19	BWH 220	. RESISTOR, FIXED, WW, 220 OHMS, ±10%, 2W (V11502) (050305)		1
20	RC20GF330K	. RESISTOR, FIXED, COMP, 33 OHMS, ±10%, 1/2W (050014)		1
21	RC20GF330K	. RESISTOR, FIXED, COMP, 33 OHMS, ±10%, 1/2W (050014)		1



Oscillator/Amplifier/Driver Circuit Board Sub-Assembly
Figure 1104

DH-1030-24-600-CS/P.N. 095032
DETAILED PARTS LIST

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM-TO	UNITS PER ASSY
1104 22	RC20GF391K	. RESISTOR, FIXED, COMP, 390 OHMS, ±10%, 1/2W (050026)		1
23	RC20GF471K	. RESISTOR, FIXED, COMP, 470 OHMS, ±10%, 1/2W (050027)		1
24	RC20GF471K	. RESISTOR, FIXED, COMP, 470 OHMS, ±10%, 1/2W (050027)		1
25	RC20GF102K	. RESISTOR, FIXED, COMP, 1,000 OHMS, ±10%, 1/2W (050031)		1
26	RC20GF102K	. RESISTOR, FIXED, COMP, 1,000 OHMS, ±10%, 1/2 W (050031)		1
27	RC20GF222J	. RESISTOR, FIXED, COMP, 2,200 OHMS, ±5%, 1/2W (050091)		1
28	RC20GF222J	. RESISTOR, FIXED, COMP, 2,200 OHMS, ±5%, 1/2W (050091)		1
29	RC20GF222K	. RESISTOR, FIXED, COMP, 2,200 OHMS, ±10%, 1/2W (050035)		1
30	RC20GF222K	. RESISTOR, FIXED, COMP, 2,200 OHMS, ±10%, 1/2W (050035)		1
31	RC20GF222K	. RESISTOR, FIXED, COMP, 2,200 OHMS, ±10%, 1/2W (050035)		1
32	RC20GF222K	. RESISTOR, FIXED, COMP, 2,200 OHMS, ±10%, 1/2W (050035)		1
33	RC20GF222K	. RESISTOR, FIXED, COMP, 2,200 OHMS, ±10%, 1/2W (050035)		1
34	RC20GF272K	. RESISTOR, FIXED, COMP, 2,700 OHMS, ±10%, 1/2W (050036)		1
35	RC20GF472J	. RESISTOR, FIXED, COMP, 4,700 OHMS, ±5%, 1/2W (050092)		1
36	RC20GF472J	. RESISTOR, FIXED, COMP, 4,700 OHMS, ±5%, 1/2W (050092)		1
37	RC20GF472K	. RESISTOR, FIXED, COMP, 4,700 OHMS, ±10%, 1/2W (050039)		1
38	RC20GF103K	. RESISTOR, FIXED, COMP, 10K OHMS, ±10%, 1/2W (050043)		1
39	RC20GF103K	. RESISTOR, FIXED, COMP, 10K OHMS, ±10%, 1/2W (050043)		1
40	RC20GF153K	. RESISTOR, FIXED, COMP, 15K OHMS, ±10%, 1/2W (050045)		1
41	RC20GF223K	. RESISTOR, FIXED, COMP, 22K OHMS, ±10%, 1/2W (050047)		1
42	YC102U	. RESISTOR, VAR, VV, 1,000 OHMS, 1/4W (V01121) (054002)		1
43	1347	. CAPACITOR, POLYCARBONATE, 0.47 UF, ±3%, 50VDCW (V09134) (019009)		1

DH-1030-24-600-CS/P.N. 095032
DETAILED PARTS LIST

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM-TO	UNITS PER ASSY
1104 44	601.01	. CAPACITOR, MYLAR, DIPPED, 0.01 UF, ±10%. 50 VDCW (V84411) (019003)		1
45	601.01	. CAPACITOR, MYLAR, DIPPED, 0.01 UF, ±10%, 50 VDCW (V84411) (019003)		1
46	601*	. CAPACITOR, MYLAR, DIPPED* (SELECTED) (V84411) (*VALUE FROM 0.01 TO 0.47 UF)		1
47	601*	. CAPACITOR, MYLAR, DIPPED* (SELECTED) (V84411) (*VALUE FROM 0.01 TO 0.047 UF)		1
48	150D105X9035A2	. CAPACITOR, ELECTROLYTIC, TANTALUM, 1UF, ±10%, 35 VDCW (V56289) (021501)		1
49	150D105X9035A2	. CAPACITOR, ELECTROLYTIC, TANTALUM, 1UF, ±10%, 35 VDCW (V56289) (021501)		1
50	150D105X9035A2	. CAPACITOR, ELECTROLYTIC, TANTALUM, 1UF, ±10%, 35 VDCW (V56289) (021501)		1
51	150D105X9035A2	. CAPACITOR, ELECTROLYTIC, TANTALUM, 1UF, ±10%, 35 VDCW (V56289) (021501)		1
52	150D226X9015B2	. CAPACITOR, ELECTROLYTIC, TANTALUM, 22UF, ±10%, 15 VDCW, (V56289) (021502)		1
53	150D226X9015B2	. CAPACITOR, ELECTROLYTIC, TANTALUM, 22UF, ±10%, 15 VDCW, (V56289) (021502)		1
54	150D226X9015B2	. CAPACITOR, ELECTROLYTIC, TANTALUM, 22UF, ±10%, 15 VDCW, (V56289) (021502)		1
55	1N3611	. SEMICONDUCTOR, DIODE, SILICON, POWER, (V99942) (046011)		1
56	1N3611	. SEMICONDUCTOR, DIODE, SILICON, POWER, (V99942) (046011)		1
57	1N3611	. SEMICONDUCTOR, DIODE, SILICON, POWER, (V99942) (046011)		1
58	1N3611	. SEMICONDUCTOR, DIODE, SILICON, POWER, (V99942) (056011)		1
59	1N3611	. SEMICONDUCTOR, DIODE, SILICON, POWER, (V99942) (046011)		1
60	1N3611	. SEMICONDUCTOR, DIODE, SILICON, POWER, (V99942) (046011)		1
61	1N914B	. SEMICONDUCTOR, DIODE, SILICON, (V01295) (046006)		1
62	1N914B	. SEMICONDUCTOR, DIODE, SILICON, (V01295) (046006)		1
63	1N914B	. SEMICONDUCTOR, DIODE, SILICON, (V01295) (046006)		1
64	1N4473	. SEMICONDUCTOR, DIODE, ZENER, SILICON, 22V, ±5%, 1.5W (V99942 or V14552) (046017)		1
65	1N4460	. SEMICONDUCTOR, DIODE, ZENER, SILICON, 6.2V, ±5%, 1.5W (V99942 or V14552) (046013)		1

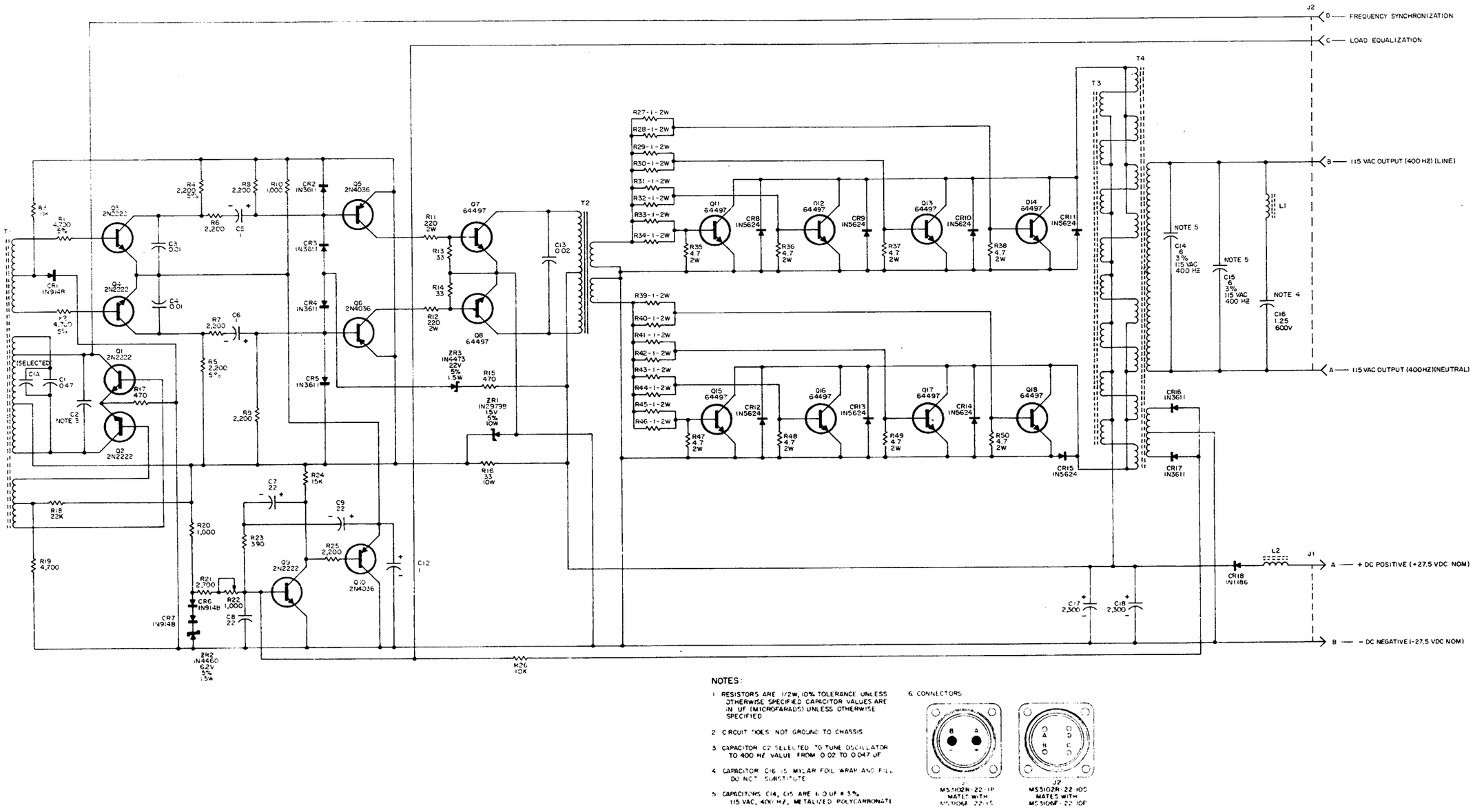
*Selected or alternate

DH-1030-24-600-CS/P.N. 095032
DETAILED PARTS LIST

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT FROM-TO	UNITS PER ASSY
1104 66	043003	. TRANSFORMER, OSCILLATOR, TOROIDAL		1
67	2N2222	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON, (V07263) (048506)		1
68	2N2222	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON, (V07263) (048506)		1
69	2N2222	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON, (V07263) (048506)		1
70	2N2222	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON, (V07263) (048506)		1
71	2N2222	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON, (V07263) (048506)		1
72	2N4036	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON, (V02735) (048507)		1
73	2N4036	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON, (V02735) (048507)		1
74	2N4036	. SEMICONDUCTOR, TRANSISTOR, NPN, SILICON, (V02735) (048507)		1
75	026006	. JUMPER, ELECTRICAL, 1 IN. LG. #22 AWG, TINNED COPPER SIRE		1

REVISION CODE	REVISION DESCRIPTION	SERIAL NO. EFFECTIVITY
A	CR8 THROUGH CR15 CHANGED TO 1N5624	22 SEP 71
B	CHANGED CAPACITOR C16 TO MYLAR FOIL WRAP AND FILL 1.25 UF 600VDC.	18 DEC 71
C	Q7, Q8, Q11, Q12, Q13, Q14, Q15, Q16, Q17 AND Q18 CHANGED TO RCA 64497. REMOVED CAPACITOR C-11 0.1 UF. CHANGED CAPACITORS C14 AND C15 TO 6 UF, ±3%, 115 VAC, 400 HZ, METALIZED POLYCARBONATE.	22 JUN 73
D	REMOVED CAPACITOR C10 1 UF. REMOVED CAPACITOR C19 1400 UF. CHANGED VALUE OF CAPACITORS C17 AND C18 TO 2300 UF. ADDED CAPACITOR C1A (SELECTED).	12 OCT 73

Model DH-1030-24-600-CS, Solid-State Static Inverter
(Transverter) Revision Reference Sheet
Figure 1201 (Sheet 1 of 2)



NOTES:

1. RESISTORS ARE 1/2W, 10% TOLERANCE UNLESS OTHERWISE SPECIFIED. CAPACITOR VALUES ARE IN UF (MICROFARADS) UNLESS OTHERWISE SPECIFIED.
2. CIRCUIT DOES NOT GROUND TO CHASSIS.
3. CAPACITOR C2 SELECTED TO TUNE OSCILLATOR TO 400 HZ. VALUE FROM 0.02 TO 0.047 UF.
4. CAPACITOR C16 IS MYLAR FOIL WRAP AND FILL. DO NOT SUBSTITUTE.
5. CAPACITORS C14, C15 ARE 6.0 UF ± 3%, 115 VAC, 400 HZ, METALIZED POLYCARBONATE.
6. CONNECTORS

J1 MS3102R-22-11P MATES WITH MS3106F-22-11S

J2 MS3102R-22-10S MATES WITH MS3106F-22-10P

Model DH-1030-24-600-CS, Solid-State Static Inverter (Transverter) Schematic Diagram
Figure 1201 (Sheet 2 of 2)

DH-1030-24-600-CS TYPE II B TRANSVERTER

maintenance manual and overhaul manual with illustrated parts catalog

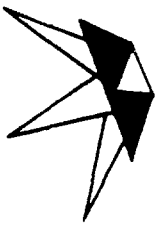
Phoenix Aerospace Inc.

KANSAS CITY, MO 64114

DH-1030-24-600-CS TYPE IIB

TRANSVERTER

maintenance manual



Phoenix Aerospace Inc.

KANSAS CITY, MO 64114

PHOENIX AEROSPACE INC. STANDARD WARRANTY

1. Sellers Standard Warranty

(a) Phoenix Aerospace, Inc. herein called Seller, warrants that each unit delivered shall, at the time of delivery thereof to Buyer or Buyer's customers, be free from defects in material and workmanship and from defects or faults in design in view of the state of the art at the time of design thereof. Any defect must have become apparent and Buyer must have notified Seller thereof within twenty-four (24) months after installation in aircraft, not to exceed thirty (30) months after date of manufacture on unit nameplate. The extent of Seller's liability is limited to the repair, replacement, overhaul, or modification of any defective unit.

(b) Seller's obligation hereunder is conditioned upon the return as soon as practicable of the defective unit with all transportation charges prepaid to Seller in Kansas City, Missouri. Returned units must be accompanied by properly authorized Purchase Order, specifying the nature of the defect, if known, and containing reasonable proof to Seller that the defect is due to a matter embraced within Seller's warranty. An allowance will be made for inbound transportation charges in the Continental United States, but inbound transportation charges are the responsibility of Buyer outside the limits of the Continental United States. Overhauled or repaired units will be returned via air, transportation charges prepaid to destination anywhere in the world. Removal of the unit from any aircraft and reinstallation shall be at Buyer's expense.

(c) The warranty hereunder shall not apply to any unit installed in any Aircraft if such Aircraft shall not have been operated in accordance with the Federal Aviation regulations issued by the Federal Aviation Administration, or if such unit shall not have been operated or maintained in accordance with seller's instructions applicable to such unit, or if such unit shall have been repaired, altered or modified without Seller's approval, or operated with an accessory or part not authorized for use therewith, or if such unit shall have been operated subsequent to its involvement in an accident, or if the unit shall have been subject in any way to improper operation, maintenance, repair, alteration or modification.

(d) THE WARRANTY AND THE OBLIGATIONS AND LIABILITIES OF SELLER HEREUNDER ARE EXCLUSIVE AND IN SUBSTITUTION FOR AND BUYER HEREBY WAIVES ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, ARISING BY LAW OR OTHERWISE (INCLUDING, WITHOUT LIMITATION, THE IMPLIED WARRANTY OR MERCHANTABILITY, ANY IMPLIED WARRANTY ARISING FROM COURSE OF PERFORMANCE, COURSE OF DEALING OR USAGE OF TRADE, ANY IMPLIED WARRANTY OF FITNESS, AND ANY OBLIGATION OF SELLER WITH RESPECT TO INCIDENTAL OR CONSEQUENTIAL DAMAGES). AND SHALL NOT BE EXTENDED, ALTERED OR VARIED EXCEPT BY A WRITTEN INSTRUMENT SIGNED BY SELLER AND BUYER.

2. General Instructions

(a) Overhaul, modification or repair of all Phoenix Aerospace units is authorized only at Seller's facility. Any overhaul, repair, alteration or modification without Seller's approval will negate or void the terms of Seller's Standard Warranty stated herein. Units in need of repair should be shipped directly to:

Phoenix Aerospace Inc.
220 West 80th Terrace
Kansas City, Missouri 64114
U.S.A.

Units in warranty are repaired at the factory under the terms and conditions of Seller's Standard Warranty at no charge. There will be a charge imposed for Units returned within the warranty period which are found not to be defective or for a defect found not to be included within Seller's Standard Warranty or which have been removed or returned as a result of any program of preventive maintenance.

(b) Units out of warranty are repaired at the factory at Seller's standard charge in effect at the time of receipt of unit. Inbound and outbound transportation charges are the responsibility of the Buyer.

PHOENIX AEROSPACE INC.

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24-20-X	2	Aug. 20/68
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24-20-X	6*	Jan. 3/92
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24-20-X	207*	Jan. 3/92
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24-20-X	209	Aug. 12/83
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INTRODUCTION

In conformance with A.T.A. Specification No. 100 for Manufacturers' Technical Data, two manuals have been prepared concerning the PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter). These manuals, if used as intended, will facilitate the effective, continued operation of the equipment. Technical data is grouped according to usage in the manual as described.

MAINTENANCE MANUAL

This manual is intended for use by flight line and hangar maintenance personnel. A detailed description and operation, including a table of leading particulars are presented for reference. Mounting and cabling information are presented as an aid to installation. Troubleshooting information is limited to procedures required to trace a trouble to the overall unit for replacement,

OVERHAUL MANUAL WITH ILLUSTRATED PARTS CATALOG

The Overhaul Manual contains all the information required for shop testing, replacement of defective parts, adjustment, mechanical disassembly, inspection, and reassembly. Detailed circuit theory is given with emphasis on theory that will be especially helpful for effective troubleshooting. Performance tests as well as functional (go/no-go) checks, which may be used to determine condition of equipment and for retesting after repairs.

The Illustrated Parts Catalog provides a means to determine the manufacturer's part number and the physical location on the equipment of a part if the reference designation is known, or to determine the reference designation and the manufacturer's part number when the physical location of the part is known but no other information is available.

DESCRIPTION AND OPERATION

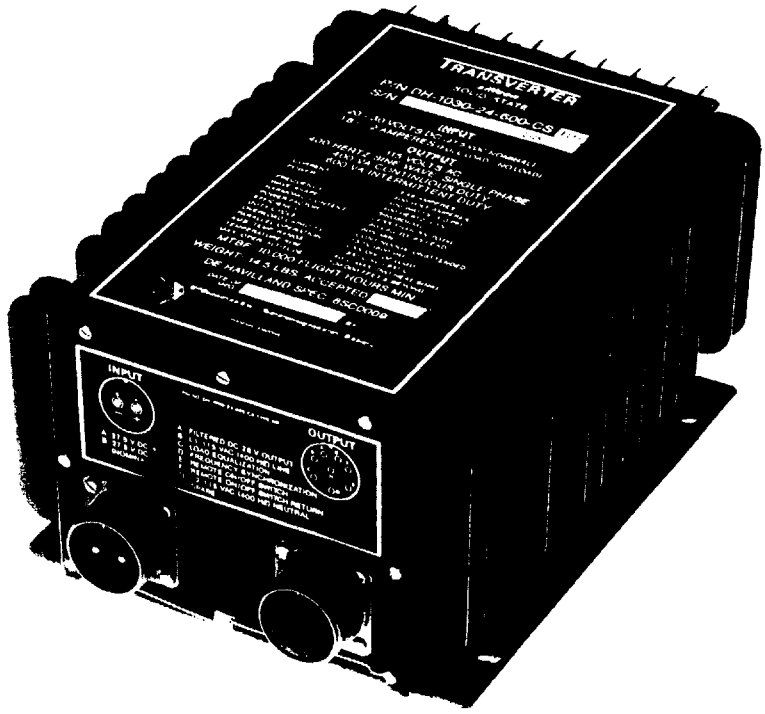
1. GENERAL.

A. Purpose of Manual.

This manual contains maintenance procedures, installation procedures, and basic system troubleshooting procedures for use by flight line and hangar maintenance personnel for the PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter), illustrated in Figure 1.

B. Purpose of Equipment.

The PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter) is used for conversion of electrical power in aircraft for operation of airborne instrumentation and other electrical equipment. The unit provides a continuous source of frequency and voltage regulated, single phase, sine wave, alternating current power from a direct current voltage source. The stable output insures the highest degree of operational reliability under the most adverse service conditions.



PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter)
Figure 1

2. DESCRIPTION.

A. The PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter) is a self-contained DC to AC inverter using state-of-the-art-solid state techniques. Power from the DC source is changed to a highly stable alternating current power source. The unit is compactly packaged with only input and output connections externally accessible.

B. The primary characteristics, capabilities, overall weight, and dimensions are listed in Table of Leading Particulars, Table 1.

GENERAL:	
Input:	20-30 VDC (27.5 VDC nominal), 18.0 - 2.0 Amperes (full load - no load, 27.5 VDC Input)
Output:	115 VAC, 400 Hertz Sine Wave, 1 Phase, 400 VA Continuous Duty, 600 VA Intermittent Duty.
Ambient Temperature Range:	-85°C to +85°C
Temperature Rise:	40°C maximum (no heat sink).
Parallel Operation:	±5% equal division of load, multiple inverters operated in parallel mode, no load to full load over input and temperature/altitude operating range
Maximum Operating Altitude:	100,000 feet and beyond.
Reliability:	10,000 hours MTBF (minimum).
ELECTRICAL:	
Output:	
Volts:	115 VAC ±5% (24 - 30V DC) ± 20% (20 - 24V DC) No load to full load over input and temperature/altitude operating range.
Current:	3.48 Amperes.
Power:	400 Volt-Amperes (Continuous Duty) - 115 VAC, 600 Volt-Amperes (Intermittent Duty),
Frequency:	400 Hertz ±1% -No load to full load over input and temperature/altitude operating range (frequency is maintained to 10 VDC input, and below).

Table of Leading Particulars
Table 1

ELECTRICAL (Cont):	
Output (Cont):	
Wave Shape:	Sinusoidal
Harmonic Content:	Less than 5% total, (3% typical).
Power Factor:	.80 lagging to .95 leading.
Efficiency:	75% minimum.
Duty Cycle:	Continuous, unattended.
Short Circuit Current:	2.0 times full load current (min).
Short Circuit Protection:	Automatic - Restarts when normal load is restored (No damage, output shorted for 1 minute).
Overload Capacity:	150% for 5 minutes (No damage), (600 VA), (no heat sink) 110% for 2 hours (no damage), (440 VA), (no heat sink)
Input:	
Volts:	20 - 30 VDC (27.5 VDC nominal) 0 - 36 Volts (No damage).
Current:	18.0 - 2.0 Amperes (full load - no load). Operating at rated load, 27.5 VDC Input.
Induced Ripple:	Less than 1.5 Volts peak to peak, (50 millivolts typical).
Short Circuit Current:	36 - 50 Amperes (typical 45.0 Amperes).
Overvoltage Protection:	130% for 5 minutes (No damage).
Transient Protection:	±80 volts for 40 milliseconds, ±600 volts for 10 microseconds.
Reverse Polarity Protection	Polarity protect diode.
MECHANICAL:	
Weight:	14.5 pounds (6,577 grams).

Table of Leading Particulars (Cont)
Table 1 (Cont)

MECHANICAL (Cont):	
Overall Dimensions:	10-3/4 in. long (27.305 cm) by 7-3/4 in. wide (19.685 cm) by 5 in. high (12.700 cm).
Mounting Base Dimensions:	9-3/8 in. long (23,813 cm) by 7-3/4 in. wide (19.685 cm).
Mounting Centers:	7 in. long (17.780 cm) by 7 in. wide (17.780 cm)
Electrical Connectors: Input/Output:	Input: MS3102R-22-1P mating MS3106F-24-11S. Output:MS3102-R-22-18S mating MS3106F-22-18P
Cooling:	Self-cooled by natural convection, conduction and radiation.
Installation:	Mounts in any position, without deterioration of power output, heating, operating life, or other operating characteristics.

Table of Leading Particulars (Cont)
Table I (Cont)

3. OPERATION

The subsequent paragraphs cover the theory of operation for the PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter). The Block Diagram Theory will aid in conveying the overall circuit operation to non-technical oriented personnel, while the Detailed Circuit Theory will enable the technician to understand in detail the operation of equipment.

A. Block Diagram Theory

The subsequent paragraphs together with the block diagram of Fig. 2, cover in concise form the signal flow and circuit operation for the DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter).

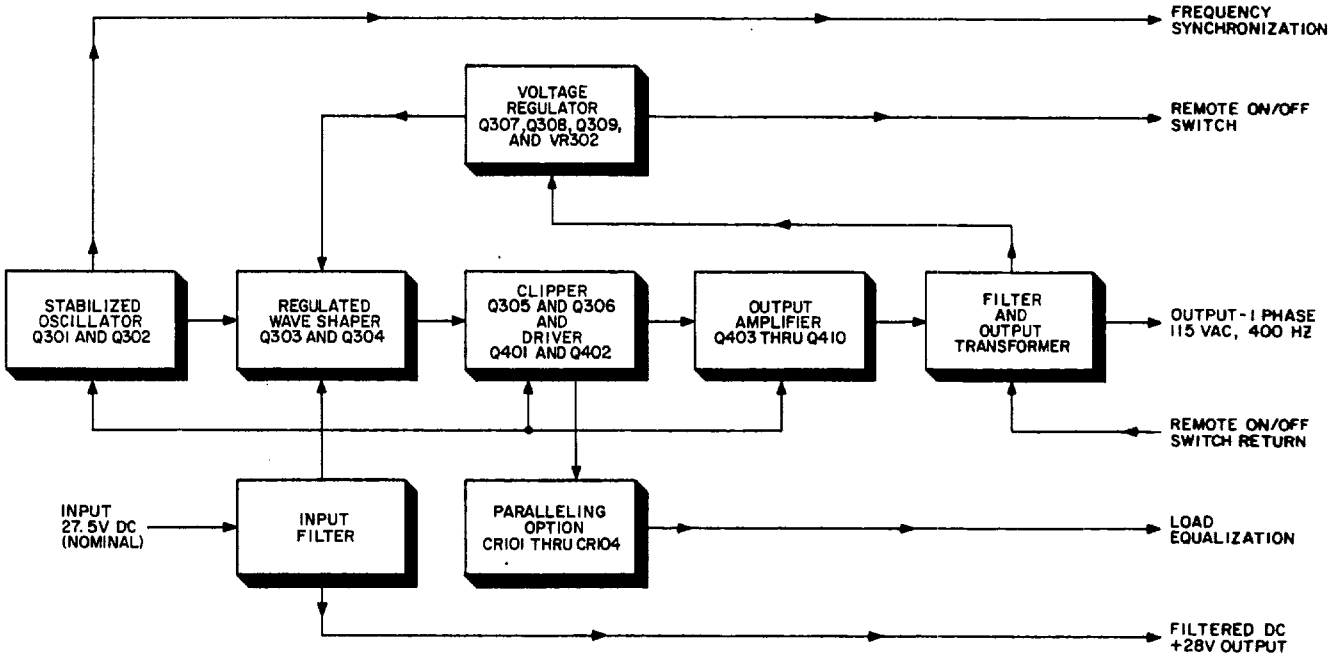
(1) Input Filter. Power applied through the input filter is free of transients and is provided with reverse polarity protection for application to circuits of the Transverter. A filtered +28V DC output connection is also provided for use in parallel operation of the inverter.

(2) Stabilized Oscillator. Transistors Q301 and Q302 generate a 400 Hertz sine wave signal of high stability. The sine wave signal is coupled through auxiliary windings of the oscillator transformer T301 to the input of the regulated wave shaper.

(3) Regulated Wave Shaper. Transistors Q303 and Q304 in a push-pull circuit receive the sine wave signal developed by the stabilized oscillator. Voltage applied from

the voltage regulator circuit determines the shaping operation for control of duty cycle and regulation of the output voltage. The shaped quasi-square wave output is coupled to the input of the clipper and driver circuit.

(4) Clipper and Driver. Transistors Q305, Q306, Q401, and Q402 in cascaded push-pull stages provide additional shaping and amplification of the 400 Hertz signal. The amplified quasi-square wave signal is applied to the output amplifier.



PAI P.N.DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter), Block Diagram
Figure 2

(5) Output Amplifier. Transistors Q403 through Q410 in a push-pull parallel circuit amplify the 400 Hertz signal to the required level across the output transformers for application to the output filter.

(6) Output Transformers and Filter. The output transformers and associated filter circuitry provide matching and shaping to return the amplified signal to a sinusoidal waveform.

(7) Voltage Regulator. Transistors Q308 and Q309 develop the regulating bias by comparison of the rectified negative DC voltage supplied from the output, and adjusted by setting of resistor R324, controlling the Zener regulated voltage to the base of Transistor Q308.

(8) Paralleling Circuit. Coupling transformer T101 provides a voltage to diodes CR101 through CR104 from the collector circuit of transistors Q401 and Q402. The rectified signal is adjusted to provide an output voltage for load equalization when operating inverter in a parallel system.

(9) Remote Turn-On/Turn-Off. Remote turn-on/turn-off of the inverter is accomplished by external control of the collector circuit of transistor Q309, ground return.

B. Detailed Circuit Theory.

The following sub-paragraphs cover the individual circuits and their operation. Occasional reference to the overall schematic diagram of the Transverter, Fig. 3, will be necessary to determine circuit configuration.

(1) Input Filter. The input filter consists of series reactor L2 and shunt capacitors C201, C202, and C203 providing high speed transient and ripple suppression to the input line. Diode CR9 provides reverse polarity protection for the Transverter circuitry. The input filter and reverse polarity protect diode passes the input current required to maintain rated power output and provide operating voltage to Transverter circuits. Over-voltage protection for low speed transients is provided by Zener diode VR301, resistor R313, and diodes CR302, CR303, and CR304. If the input voltage exceeds 39 volts, ±2 volts, Zener diode VR301 conducts and applies back bias to transistors Q305 and Q306 through diodes CR303 and CR304, respectively. This bias inhibits switching during over voltage periods and prevents a high voltage from being developed which could damage subsequent amplifier circuits or the output circuit. Diode CR302 protects the base circuits of transistors Q305 and Q306. Resistor R201 and Zener diode VR401 provide transient suppression and regulation for the low level stages. Diode CR105 located on the Paralleling Circuit Board, across terminals E101 and E102, provides filtered, positive 28 volts DC output at pin A of connector J2.

(2) Stabilized Oscillator. The stabilized oscillator utilizes transistors Q301 and Q302 in a Hartley oscillator circuit. Toroidal transformer T301, with multiple windings provides the tuned circuit, feedback, and output windings for the oscillator. The tuned circuit portion is tuned by capacitors C301, C302, and C303 to 400 Hertz. Capacitor C303 provides parasitic suppression in the tuned collector circuit. A feedback winding provides the coupling between base- collector circuit to sustain oscillations, resistors R318 and R319 provide bias to the base circuit of transistors Q301 and Q302 to insure positive start and sustained oscillations. Resistor R304 provides degeneration for improved stability of the oscillator circuit. Output to the regulated wave shaper circuit is through the remaining winding on transformer T301. Output from the collector of transistor Q302 and tuned circuit is terminated at Pin D of connector J2 for Frequency Synchronization in a multiple inverter system.

(3) Regulated Wave Shaper. The regulated wave shaper receives the 400 Hertz sinusoidal signal from transformer T301 output winding. The input signal is applied to the base circuits of transistors Q303 and Q304 through resistors R301 and R302, respectively, limiting base current which flows in the base circuit. Transistors Q303 and Q304 conduct on alternate half cycles, with the point of conduction determined by the amount of bias supplied by transistor Q309, voltage regulator, to the emitter circuit. Resistor R307 adjusts the output of transistors Q303 and Q304 for minimum second harmonic content in the inverter output. The output of this stage is a quasi-square wave and is applied to the input of the clipper circuit.

(4) Clipper and Driver. The clipper and driver circuits provide additional shaping of the signal and amplification for application to the output amplifier circuits. The clipper circuit consists of transistors Q305 and Q306 in a push-pull circuit. The quasi-square wave is applied to the base circuits of transistors Q305 and Q306 through current limiting resistors R308 and R309 and coupling capacitors C307 and C308, respectively. The output of the clipper circuit results in a quasi-square wave with improved rise time. The output is coupled to the base circuits of the driver transistors Q401 and Q402 through resistors R314 and R315, respectively. Resistors R316 and R317 provide a low impedance return for leakage currents. Output of the collector circuits is developed across toroidal driver transformer T401 and coupled to the output amplifier circuits. Capacitor C401 across the primary winding suppresses transients which might appear across the output.

(5) Output Amplifiers. The output amplifiers receive the quasi-square wave signal through toroidal driver transformer T401. Four output windings are connected in parallel to provide two outputs which drive the eight output transistors Q403 through Q410. Input to the base circuit of each output transistor is through two paralleled 1 Ohm, 2 Watt, resistors, providing current limiting to the input. A 4.7 Ohm, 2 watt resistor between the base and emitter of each output transistor reduces the impedance during the non-conduction period. The collectors of transistors Q403 through Q410 are parallel connected in groups of four, Q403, Q404, Q405, and Q406 are connected to the high side of transformer T2, terminals E1-14, E1-8, E2-14, and E2-8, respectively, while transistors Q407, Q408, Q409, and Q410 are connected to the low side of transformer T2 terminals E2-3, E2-9, E1-3, and E1-9, respectively. Diodes CR1 through CR8 connected in parallel with the emitter and collector terminals of each power transistor provide the reverse current flow from the load back to the DC power source under conditions of high reactive loading. Toroidal series reactor transformer T1 is connected in series with the primary windings of the output transformer T2. The secondary winding of output transformer T2 is connected to the filter circuit.

(6) Output Transformer and Filter. The 400 Hertz quasi-square wave signal developed across toroidal output transformer T2 is high in content of odd order harmonics. Toroidal series reactor transformer T1 in conjunction with the output transformer T2, and the output filter circuit reduce these odd order harmonics. The impedance of the series reactor transformer T1 is low at the 400 Hertz fundamental frequency, but sufficiently high at the frequency of the harmonics to enable the reactor-transformer combination to filter the harmonic content. The output filter appears as a high impedance to the fundamental 400 Hertz signal and a low impedance to the harmonics, thus resulting in optimum power transfer at the fundamental frequency of 400 Hertz. The secondary winding of transformer T2 is tuned to the 400 Hertz fundamental by parallel capacitors C204 and C205, forming a parallel tuned circuit, which reflects a high impedance to the fundamental 400 Hertz signal and a low impedance path to the harmonics. The series tuned circuit comprised of capacitor C206 and toroidal reactor L1 is tuned to the third order harmonic 1,200 Hertz, providing a shunting effect to the most predominant harmonic present in the output. The filtered output is 115 volts AC at a frequency of 400 Hertz and is available at pins B and G of connector J2. The additional winding on transformer T2 is used to derive feedback voltage for the voltage regulator circuit. The derived voltage is rectified by diodes CR305 and CR306 to provide a negative DC potential to the voltage regulator circuit.

(7) Voltage Regulator. The voltage regulator consists of transistors Q307, Q308, and Q309, and Zener diode VR302. The positive voltage from Zener diode VR302 through temperature compensating transistor Q307 and the negative voltage from diodes CR305 and CR306 are applied to the summing resistors R323, R324, R325, and R347 to derive an error voltage at the base of transistor Q308. A change in output voltage, after the setting of resistor R324 has been determined, causes a change in the current applied to the summing circuit, developing an error voltage which is amplified by transistors Q308 and Q309. Output at the emitter of transistor Q309 results in a proportional voltage change which is the bias applied to transistors Q303 and Q304. This change in bias controls duty cycle and output voltage by limiting action in the regulated wave shaper circuit.

(8) Paralleling Circuit. The paralleling circuit operates from voltages derived in the collector circuits of transistors Q401 and Q402, Driver Transistors, conducting on alternate half-cycles. The derived output is applied to a step-down coupling transformer for application to a bridge rectifier circuit comprised of diodes CR101 through CR104. The rectified output voltage developed across load resistor R102 and filter capacitor C101, together with the summed voltage from the base circuit of transistor Q308, applied to connection point B, is adjusted to desired level by variable resistor R103. The preset level becomes the reference voltage which is

delivered from connection point A on the Paralleling Circuit Board to pin C of connector J2 for application to load equalization circuits for automatic control of multiple inverter systems.

(9) Remote Turn-On/Turn-Off. Remote turn-on/turn-off of the inverter is accomplished by external control of the collector return of transistor Q309. to ground. This control requires completion of the circuit between pins E and F of connector J2 through an ancillary switch.

SCHEMATIC DIAGRAM - REVISION REFERENCE SHEET

REV	REVISION	EFFECTIVITY
A	DIODES: CR6/CR1 THRU CR15/CR8 CHANGED TO SEMICONDUCTOR,DIODE,SILICON, TYPE 1N5624,PAI P.N. 046015,FROM TYPE 1N5402,PAI P.N.046010.	22 SEP 71
B	CAPACITOR: C16/C206 CHANGED TO CAPACITOR,FIXED,POLYESTER, 1.25UF 3%,600VDCW, PAI P.N. 019017, FROM CAPACITOR,FIXED,POLYESTER, 1.0UF 3%, 400VDCW, PAI P.N. 019023. ADDED NOTE 4 TO SCHEMATIC DIAGRAM. SEMICONDUCTOR,DIODE,SILICON,PWR CR2/CR302, 1N3611, RELOCATED FROM BASE OF TRANSISTOR Q5 TO 15 VOLT BUS, TO JUNCTION OF CR3/CR303, CR4/CR304,AND ZR3/VR301 AND 15 VOLT BUS. DELETED CR5, SEMICONDUCTOR,DIODE,SILICON,PWR, 1N3611, PAI P.N. 046011.	18 DEC 71
C	TRANSISTORS: CHANGED-Q7/Q401,Q8/Q402,Q11/Q403 THRU Q18/Q410, SEMICONDUCTOR, TRANSISTOR, SILICON,POWER,NPN RCA TYPE 64497, PAI P.N. 048505,REV A, FROM RCA TYPE 60234, PAI P.N. 048505. DELETED CAPACITOR C11 0.1UF 10%,50VDCW, PAI P.N.019008. CHANGED-C14/C204 AND C15/C205. CAPACITOR,FIXED,POLYCARBONATE, 6UF 3%,115VAC,400 HZ, PAI P.N. 019015 REV A. ADDED NOTE REGARDING CAPACITOR VOLTAGE CHANGE.	22 JUN 73
D	DELETED CAPACITORS: C10-CAPACITOR,ELECTROLYTIC,TANTALUM, 1.0UF 10%, 35VDCW, PAI P.N. 021501; C19-CAPACITOR,ELECTROYTIC,ALUM., 1,400UF 40VDCW, PAI P.N. 021005. CHANGED CAPACITORS C17/C201 AND C18/C202 - CAPACITOR,ELECTROLYTIC,ALUM., 2,200UF, 40VDCW, PAI P.N. 021003, FROM CAPACITOR,ELECTROLYTIC,ALUM., 1,400, 40VDCW, PAI P.N. 021005. ADDED CAPACITOR C1A/C302-CAPACITOR,FIXED,POLYESTER, VALUE SELECTED TO TRIM OSCILLATOR, VALUE FROM 0.01UF TO 0.047UF, ADDED NOTE 7 TO SCHEMATIC DIAGRAM.	12 OCT 73
E	ADDED CAPACITOR C19/C203-CAPACITOR,ELECTROLYTIC,ALUM., 1,400UF,40VDCW, PAI P.N.021005. CHANGED CAPACITORS: C17/C201 AND C18/C202-CAPACITOR, ELECTROLYTIC,ALUM., 1,400UF,40VDCW, PAI P.N.021005 FROM CAPACITOR,ELECTROLYTIC,ALUM.,2,200UF 40VDCW,PAI P.N. 21003.	30 JAN 74
F	ADDED RESISTOR: R54/R307-RESISTOR,VAR,CERMET, 500 OHM,1/4W, PAI P.N. 054003, AND RELOCATE RESISTORS, R4/R305 AND R5/R306-RESISTOR,FIXED, COMP, 2,200 OHMS 5%,1/2W, PAI P.M. 050091 FROM 15 V BUS TO SERIES CONNECT WITH RESISTOR R54/R307, ARM/WIPER CONNECTS TO 15 V BUS.	30 JAN 75
G	CHANGED TRANSISTORS: Q1/Q301 AND Q2/Q302-SEMICONDUCTOR,TRANSISTOR, SILICON,NPN, CHANGED TO TYPE 2N2484, PAI P.N. 048513, FROM TYPE 2N2222, PAI P.N. 048506; Q3/Q303 AND Q4/Q304- SEMICONDUCTOR, TRANSISTOR,SILICON,NPN, CHANGED TO TYPE 2N2222A, PAI P.N. 048512, FROM TYPE 2N2222, PAI P.N.048506; Q7/Q401,Q8/Q402,Q11/0403 THRU Q18/Q410, SEMICONDUCTOR,TRANSISTOR SILICON,PWR,NPN, CHANGED TO TYPE 66090 RCA, PAI P.N. 048505, REV B, FROM TYPE 64497 RCA, PAI P.N. 048505, REV A; Q9/Q308-SEMICONDUCTOR,TRANSISTOR,SILICON,NPN, CHANGED TO TYPE 2N3117, PAI P.N. 048514, FROM TYPE 2N2222, PAI P.N. 048506; Q10/Q306-SEMICONDUCTOR,TRANSISTOR,SILICON,PNP, CHANGED TO TYPE 2N3505, PAI P.N. 048515, FROM TYPE 2N4036, PAI P.N. 048507.	5 FEB 75
H	CHANGED R51/R102-RESISTOR,FIXED,COMP, 4,300 OHMS 5%,1/2W, PAI P.N. 050090, FROM RESISTOR,FIXED COMP, 4,700 OHMS 10%,1/2W, PAI P.N. 050039	21 NOV 75
I	ADDED CAPACITORS: C21/C313 AND C22/C314-CAPACITOR,FIXED,POLYESTER, 0.1UF 10%,50VDCW,PAI P.N.019008; C23/C315-CAPACITOR,FIXED,POLYESTER, (SELECTED VALUE FROM 0.027 TO 0.047UF. ADDED NOTE 8 TO SCHEMATIC DIAGRAM.CHANGED CAPACITORS: C8/C309-CAPACITOR,ELECTROLYTIC,TANTALUM, 47UF 10%,20VDCW. PAI P.N. 021506, FROM CAPACITOR,ELECTROLYTIC, TANTALUM, 22UF 10%,15VDCW, PAI P.N. 021503; C9/C311-CAPACITOR,ELECTROLYTIC,TANTALUM, 4.7UF 10%,35VDCW, PAI P.N. 021504, FROM CAPACITOR, ELECTROLYTIC, 22UF 10%,15VDCW, PAI P.N. 021503; C7/C310-CAPACITOR, ELECTROLYTIC, 4.7UF 10%,35VDCW, PAI P.N. 021504, FROM CAPACITOR, ELECTROLYTIC, 22UF 10%,15VDCW. PAI P.N. 021503. ADDED RESISTORS: R55/R320-RESISTOR,FIXED,COMP, 2,200 OHMS 10%,1/2W, PAI P.N. 050035;	2 JUL 76

Schematic Diagram - Revision Reference Sheet,
PAI P.N. DH-1030-24-600-CS, Type IIB,
Solid-State, Static Inverter (Transverter)
Figure 3 (Sheet 1 of 4)

SCHEMATIC DIAGRAM - REVISION REFERENCE SHEET

REV	REVISION	EFFECTIVITY
I (Cont)	R56/R321,R57/R329, AND R59/R330-RESISTOR,FIXED,COMP, 2,700 OHMS 10%, 1/2W, PAI P.N. 050036. CHANGED R26/R328-RESISTOR,FIXED,FILM,PREC., 6,810 OHMS 1%,1/8W, PAI P.N. 050508, FROM RESISTOR,FIXED,COMP, 10K OHMS 10%,1/2W, PAI P.N. 050045. ADDED Q19/Q307-SEMICONDUCTOR,TRANSISTOR,NPN, TYPE 2N3117,PAI P.N.048514. DELETED DIODES: CR6 AND CR7 - SEMICONDUCTOR,DIODE, SILICON, TYPE 1N914B, PAI P.N. 046006.	2 JUL 76
J	CHANGED SEMICONDUCTOR,TRANSISTORS AS FOLLOWS: IDENTIFICATION FROM JEDEC NUMBER TO PHOENIX AEROSPACE INC PART NUMBER AS FOLLOWS: Q1/0301 AND Q2/Q302 TO PAI P.N. 048513 FROM TYPE 2N2484; Q3/Q303 AND Q4/Q304 TO PAI P.N. 048514 FROM TYPE 2N2222A; Q5/Q305 AND Q6/Q306 TO PAI P.N. 048507 FROM TYPE 2N4036; Q7/Q401, Q8/Q402, Q11/Q403 THRU Q18/Q410 TO PAI P.N. 048505 REV B, FROM TYPE 66090, RCA; Q9/0308 AND Q19/Q307 TO PAI P.N. 048514 FROM TYPE 2N3117; Q10/Q309 TO PAI P.N. 048515 FROM TYPE 2N3505.	14 SEP 76
K	CHANGED CAPACITORS: C17/C201, C18/C202, AND C19/C203-CAPACITOR,ELECTROLYTIC,ALUM., 1,400UF 50VDCW, PAI P.N.021011, FROM CAPACITOR,ELECTROLYTIC,ALUM., 1,400UF 40VDCW, PAI P.N.021005.	15 JUN 77
L	CHANGE CAPACITOR: C7/C310-CAPACITOR,ELECTROLYTIC,TANTALUM, 22UF 10%, 15VDCW PAI P.N. 021503 FROM CAPACITOR,ELECTROLYTIC,TANTALUM, 4.7UF 10%,35VDCW, PAI P.N. 021504	30 OCT 77
M	CHANGE RESISTOR: R51/R102-RESISTOR,FIXED,COMP, 4,700 OHMS 5%,1/2W, PAI P.N. 050092 FROM RESISTOR,FIXED,COMP, 4,300 OHMS 5%,1/2W, PAI P.N. 050090.	23 MAR 78
N	CHANGED RESISTORS: R21/R323-RESISTOR,FIXED,FILM,PREC., 3,010 OHMS 1%, 1/8W, PAI P.N. 050511 FROM RESISTOR,FIXED,COMP, 2,200 OHMS 10%,1/2W, PAI P.N. 050035; R22/R324-RESISTOR,VAR,COMP, 1,000 OHMS,1/2W, PAI P.N. 054002 FROM RESISTOR,VAR,COMP, 500 OHMS,1/4W, PAI P.N.054003.	22 APR 80
0	CHANGED RESISTORS: R57/R329 AND R58/R330-RESISTOR,FIXED,FILM,PREC 2,670 OHMS 1%,1/8W, PAI P.N.050548, FROM RESISTOR,FIXED,COMP, 2,700 OHMS 10%,1/2W, PAI P.N.050036.	29 OCT 80
P	CHANGED RESISTOR: R21/R323-RESISTOR,FIXED,FILM,PREC., 3,010 OHMS 1%, 1/8W, PAI P.N. 050511, FROM RESISTOR,FIXED,COMP, 3,000 OHMS 5%,1/2W,PAI P.N. 050097.	10 DEC 80
Q	CHANGED RESISTORS: R21/R323-RESISTOR,FIXED,FILM,PREC,2,670 OHMS,1%, 1/8W, PAI P.N.050548, FROM RESISTOR,FIXED,FILM,PREC., 3,010 OHMS 1%, 1/8W, PAI P.N. 050511; R61/R321 RESISTOR,FIXED, FILM,PREC., 2,670 OHMS 1%,1/8W, PAI P.N. 050548, FROM RESISTOR,FIXED,COMP, 2,700 OHMS 10% 1/2W, PAI P.N.050036.	12 FEB 81
R	CHANGED CAPACITORS: C3/C304 AND C4/C305-CAPACITOR,FIXED,POLYESTER, 0.022UF,50VDCW, PAI P.N.019018, FROM CAPACITOR,FIXED,POLYESTER, 0.01UF 10%,50VDCW, PAI P.N. 019003. CHANGED, Q11/0403 THRU Q18/Q410 SEMICONDUCTOR,TRANSISTOR,SILICON,POWER,NPN, PAI P.N. 048530, FROM SEMICONDUCTOR,TRANSISTOR,SILICON,POWER,NPN. PAI P.N. 048505 REV B.	7 JAN 83
S	REDRAWN - REFERENCE SYMBOLS CHANGED TO DENOTE LOCATION OF COMPONENTS ON APPROPRIATE CIRCUIT BOARD OR MODULE. NOTES REVISED AND RENUMBERED -PREVIOUS REVISION NOTES REVISED TO CORRECT VARIATION IN REFERENCE SYMBOLS. ADDED CIRCUIT MODULE OR CIRCUIT BOARD SUB-ASSY P.N. TO SCHEMATIC.	12 AUG 83
T	CHANGED RESISTORS: R331 THRU R346- RESISTOR,FIXED,WW, 1 OHM 10%, 2W, PAI P.M.050321 (BWF 1). FROM PAI P.N.050301 (BWH 1); R401 THRU R408 RESISTOR,FIXED,WW, 4.7 OHMS 10%,2W PAI P.N .050324 (BWF 4.7), FROM PAI P.N. 050304 (BWH 4.7); R326-RESISTOR,FIXED,COMP, 4,700 OHMS 10%, 1/2W, PAI P.N.050039, FROM RESISTOR,FIXED,COMP, 15K OHMS 10%,1/2W, PAI P.N.050045. ADDED CAPACITOR: C316-CAPACITOR,ELECTROLYTIC,TANTALUM, 1.0UF 10%,35VDCW, PAI P.N.021501.	23 DEC 83

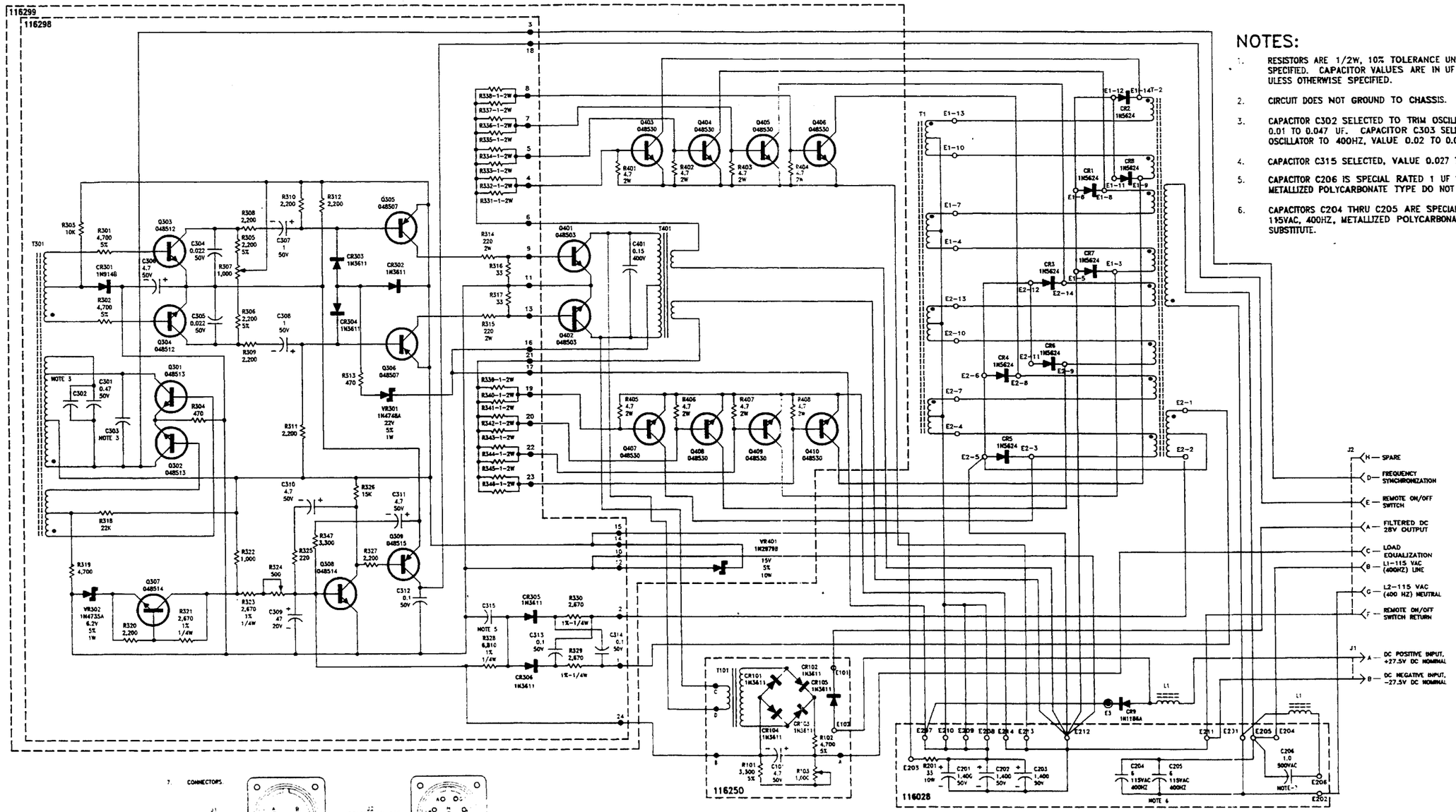
Schematic Diagram - Revision Reference Sheet,
PAI P.N. DH-1030-24-600-CS, Type IIB,
Solid-State, Static Inverter (Transverter)
Figure 3 (Sheet 2 of 4)

REVISION REFERENCE SHEET-SCHEMATIC DIAGRAM

REV	REVISION	EFFECTIVITY
U	CHANGED RESISTORS: R307 AND R324-RESISTOR,VAR,CERMET 1,000 OHMS,1/4W, PAI P.N. 054012, FROM RESISTOR,VAR,COMP, 1,000 OHMS,1/4W, PAI P.N 054002	2 DEC 85
V	CHANGED RESISTOR: R103-RESISTOR,VARIABLE, 1,000 OHMS,1/4W, PAI P.N. 054007, FROM RESISTOR,VAR,COMP, 1,000 OHMS,1/4W, PAI P.N 054002.	25 APR 86
W	CHANGED CAPACITOR: C401-CAPACITOR,FIXED,POLYCARBONATE, 0.15UF 3%,400VDCW, PAI P.N. 019074, FROM CAPACITOR,FIXED,CERAMIC,DISC, 0.02UF 20%,1000VDCW,PAI P.N.023000	2 JUN 86
X	CHANGED TRANSISTORS: 0401 AND Q402-SEMICONDUCTOR,TRAMSISTOR,SILICON, POWER,NPN, PAI P.N. 048503, FROM SEMICONDUCTOR,TRANSISTOR,SILICON, POWER, NPN, PAI P.N. 048505, REV B.	6 OCT 86
Y	CHANGED CAPAITOR: C316-CAPACITOR,ELECTROLYTIC,TANTALUM, 3.3UF 10%, 15VDCW, PAI P.N. 021529, FROM CAPACITOR,ELECTROLYTIC,TANTALUM, 1.0UF 10%,35VDCW, PAI P.N.021501. CHANGED RESISTOR: R325-RESISTOR,FIXED,COMP, 270 OHMS 10%,1/2W, PAI P.N. 050024, FROM RESISTOR,FIXED,COMP, 560 OHMS 10%,1/2W, PAI P.N. 050028.	2 DEC 88
Z	CHANGED RESISTORS: R325-RESISTOR,FIXED,COMP, 820 OHMS 5%,1/2W, PAI P.N.050117, FROM RESISTOR,FIXED,COMP, 270 OHMS 10%,1/2W, PAI P.N. 050024; R326-RESISTOR,FIXED,COMP, 15K OHMS 10%,1/2W, PAI P.N.050045, FROM RESISTOR,FIXED,COMP, 4,700 OHMS 10%,1/2W, PAI P.N. 050039. R324-RESISTOR,VAR,CERMET, 500 OHMS,1/4W, PAI P.N. 054021, FROM RESISTOR,VAR,CERMET, 1,000 OHMS,1/4W, PAI P.N.054012; R312-RESISTOR, FIXED,COMP, 2,200 OHMS 10%,1/2W, PAI P.N. 050035, FROM RESISTOR, FIXED,COMP, 1,000 OHMS 10%,1/2W, PAI P.N. 050031. ADDED RESISTOR: R347-RESISTOR,FIXED,COMP, 3,300 OHMS 10%,1/2W, PAI P.N. 050038. CHANGED CAPACITORS: C306-CAPACITOR, ELECTROLYTIC,TANTALUM, 4.7UF 10%, 50VDCW, PAI P.N. 021525, FROM CAPACITOR,ELECTROLYTIC, TANTALUM, 1.0UF 10%,35VDCW, PAI P.N. 021501; C310-CAPACITOR,ELECTROLYTIC,TANTALUM, 4.7UF 10%,50VDCW, PAI P.N. 021525, FROM CAPACITOR,ELECTROLYTIC, TANTALUM, 22UF 10%,15VDCW, PAI P.N. 021503; C307 AND C308-CAPACITOR ELECTROLYTIC,TANTALUM, 1.0UF 10%,50VDCW, PAI P.N. 021524, FROM CAPACITOR,ELECTROLYTIC,TANTALUM, 1.0UF 10%,35VDCW, PAI P.N.021501; C101 AND C311-CAPACITOR, ELECTROLYTIC,TANTALUM, 4.7UF 10%,50VDCW, PAI P.N. 021524, FROM CAPACITOR,ELECTROLYTIC,TANTALUM, 4.7UF 10%,35VDCW, PAI P.N. 021504. DELETED CAPACITOR C316-CAPACITOR,ELECTROLYTIC, TANTALUM, 3.3UF 10%,15VDCW, PAI P.N.021529.	20 JAN 89
AA	CHANGED RESISTOR: R325-RESISTOR,FIXED,COMP, 220 OHMS 10%,1/2W, PAI 050023, FROM RESISTOR,FIXED, COMP, 820 OHMS 5%,1/2W, PAI P.N. 050117	1 DEC 89
AB	CAPACITORS: CHANGED, C302-CAPACITOR,FIXED,POLYESTER, (SELECTED-0.010.0047UF) 10%,50VDCW (JP2AXXX) STYLE, PAI P.N. 0190XX, FROM CAPACITOR,FIXED,POLYESTER,DIPPED (601PEXXX) STYLE, PAI P.N. 019XXX; C303-CAPACITOR,FIXED,POLYESTER, (SELECTED-0.02 - 0.047UF) 10%,50VDCW (JP2AXXX) STYLE PAI P.N. 019XXX, FROM CAPACITOR,FIXED,POLYESTER, DIPPED, (601PEXXX) STYLE PAI P.N. 019XXX; C315-CAPACIOR,FIXED,POLYESTER, (SELECTED-0.027 - 0.047UF) 10%,50VDCW (JP2AXXX) STYLE PAI P.N. 019XXX, FROM CAPACITOR,FIXED,POLYESTER,DIPPED, (601PEXXX) STYLE PAI P.N. 019XXX; C304 AND C305 - CAPACITOR,FIXED,POLYESTER, 0.022UF 10%,50VDCW, PAI P.N. 019089, FROM CAPACITOR, FIXED,POLYESTER, DIPPED, 0.022UF 10%,50VDCW PAI P.N. 019018.	3 JAN 92

Schematic Diagram - Revision Reference Sheet,
PAI P.N. DH-1030-24-600-CS, Type IIB,
Solid-State, Static Inverter (Transverter)
Figure 3 (Sheet 3 of 4)

SCHEMATIC DIAGRAM



NOTES:

1. RESISTORS ARE 1/2W, 10% TOLERANCE UNLESS OTHERWISE SPECIFIED. CAPACITOR VALUES ARE IN UF (MICROFARADS) ULESS OTHERWISE SPECIFIED.
2. CIRCUIT DOES NOT GROUND TO CHASSIS.
3. CAPACITOR C302 SELECTED TO TRIM OSCILLATOR, VALUE 0.01 TO 0.047 UF. CAPACITOR C303 SELECTED TO TUNE OSCILLATOR TO 400HZ, VALUE 0.02 TO 0.047 UF.
4. CAPACITOR C315 SELECTED, VALUE 0.027 TO 0.047.
5. CAPACITOR C206 IS SPECIAL RATED 1 UF ?5%, 500VAC, METALLIZED POLYCARBONATE TYPE DO NOT SUBSTITUTE.
6. CAPACITORS C204 THRU C205 ARE SPECIAL RATED 6UF ?3%, 115VAC, 400HZ, METALLIZED POLYCARBONATE TYPE, NO NOT SUBSTITUTE.

PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter), Schematic Diagram
Figure 3 (Sheet 4 of 4)

TROUBLESHOOTING

1. GENERAL.

The following paragraphs define procedures suitable for determining that a fault exists in the Solid-State Static Inverter (Transverter). These procedures do not cover troubleshooting within the Transverter. For equipment troubleshooting procedures refer to the overhaul manual and perform only in overhaul shops.

2. PRELIMINARY SYSTEM CHECK.

Refer to the airframe wiring diagram and the cabling information given in Figure 203 and 204 in this manual and perform the following checks:

A. Check for input power at primary power source, breaker or fuse, and at positive pin A, and negative at pin B of input power connector J1. Use a DC voltmeter with a measuring range of 0 to 40 volts. Nominal input voltage of 27.5 volts should be measured across the positive and negative leads at connector J1.

B. Check for output at connector J2, pins B and G, series breaker or fuse, and at the input of device to which power is supplied.

NOTE

When checking for output, check for shorted output at load by opening breaker or removing fuse and rechecking output present at connector J2.

Use an AC voltmeter capable of measuring 0 to 150 volts AC at 400 Hertz. Measured voltage should be 115 volts AC ±5%, between pins B and G.

NOTE

A jumper Is required between pins E and F, Remote ON/OFF switch, of connector J2 to permit inverter (Transverter) to operate, if J2 measurements are being made at output of connector

C. Check output current to the load using an AC ammeter to determine that output current is not in excess of 3.48 Amperes on pin B of connector J2.

MAINTENANCE PRACTICES

1. GENERAL.

The following paragraphs cover in detail operations associated with maintenance, installation/removal, etc., of the PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter).

2. SERVICING.

Periodic servicing or maintenance of the Transverter is not required or recommended. The equipment should not be removed from the airframe unless required by maintenance practices observed by the using agency. The use of solid state devices in a completely transistorized circuit, eliminates all moving parts, including relays or contactors. The design therefore eliminates the major cause of failure and maintenance points. In the event failure occurs, refer to the Installation/Removal paragraphs and remove unit for repair by overhaul shop or return to vendor.

3. INSTALLATION/REMOVAL.

The following sub-paragraphs outline installation and removal procedures.

A. Installation.

(1) Refer to Fig. 201 and determine the clearance requirements for equipment and the associated cabling at selected installation point.

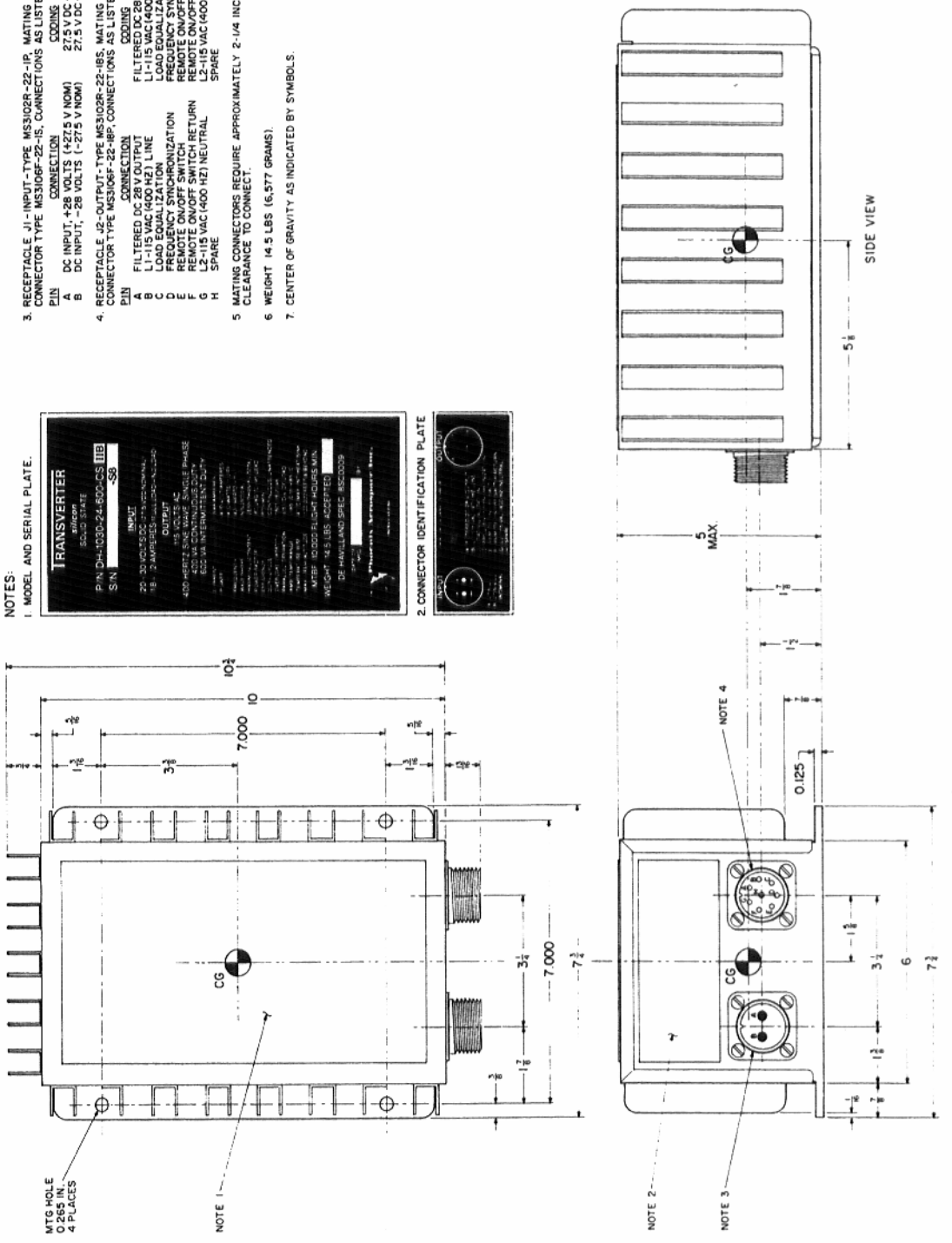
CAUTION

USE CARE IN DRILLING OPERATION OF SUBSEQUENT PARAGRAPH, TO PREVENT DAMAGE TO AIRFRAME STRUCTURE, OTHER WIRING, OR CONTROLS.

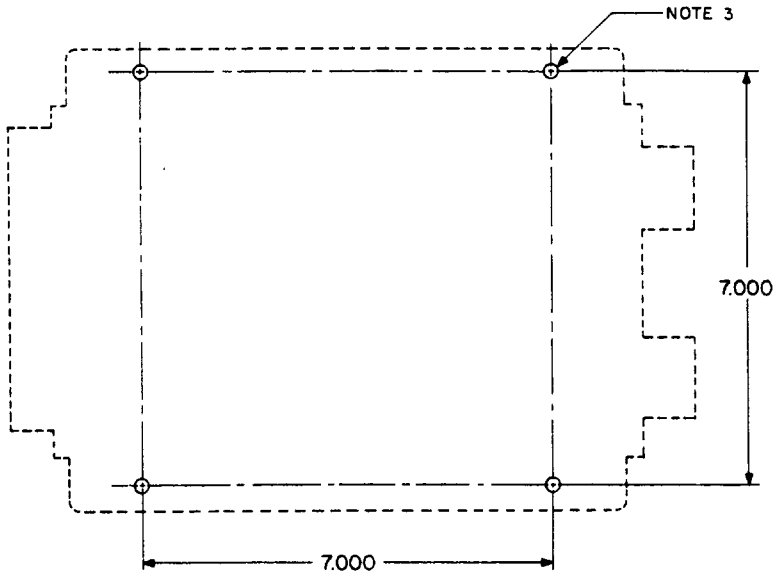
(2) Refer to Fig. 202, mark and drill four .265 inch diameter holes to mount equipment to airframe.

NOTE

Paint removal is not required, however, better heat transfer is accomplished if the mounting surface is clean and free from paint. A light coating of Dow Corning #340 Silicone compound applied to the base prior to installation improves the heat transfer from equipment to airframe.



Outline Dimensions, PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter)
Figure 201



1. EXERCISE CARE IN DRILLING TO PREVENT DAMAGE TO OTHER FUNCTIONAL PARTS ON AIRCRAFT.
2. PAINT REMOVAL IS NOT REQUIRED, HOWEVER, BETTER HEAT TRANSFER IS ASSURED IF THE MOUNTING SURFACE IS CLEAN AND FREE OF PAINT.
3. DRILL FOUR 0.265 IN DIA MOUNTING HOLES.
4. A LIGHT COATING OF GENERAL ELECTRIC # G641 OR #G635 SILICONE COMPOUND APPLIED TO THE BASE PRIOR TO INSTALLATION IMPROVES THE HEAT TRANSFER FROM THE INVERTER TO THE AIRFRAME.
5. SECURE INVERTER (TRANSVERTER) AT THE FOUR MOUNTING HOLES WITH AN4-XXA, 1/4-28, AIRCRAFT, HEX HEAD BOLT; AN960-416, 1/4 IN. FLAT WASHER, AND MS20365-428C, 1/4-28, AIRCRAFT, SELF-LOCKING HEX NUT, OR EQUIVALENT AN OR MS HARDWARE.
6. LENGTH OF BOLTS -XX MUST BE SELECTED FOR THE SPECIFIC INSTALLATION, DETERMINING - LENGTH OF GRIP AREA AND LENGTH OF THREADS TO INSURE AT LEAST ONE AND ONE-HALF THREADS AND NOT MORE THAN THREE THREADS ARE SHOWING AFTER TIGHTENED.

Drilling Template Mounting Holes,
PAI P.N. DH-1030-24-600-CS, Type IIB
Solid-State Static Inverter (Transverter)
Figure 202

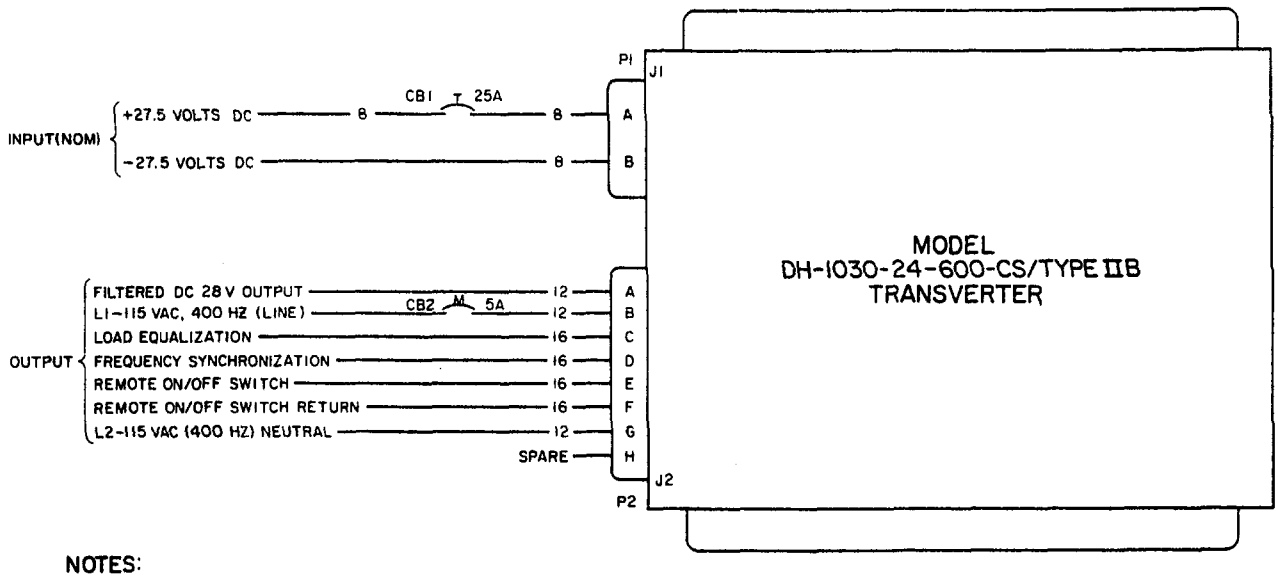
(3) Install Transverter using four, AN4-XXA, 1/4-28 aircraft hex head bolts, four, AN960-416, 1/4 in. flat washers, and four MS20365-428C, aircraft self-locking hex nuts, or equivalent AN or MS hardware. Length of bolts must be selected for the specific installation for length of grip area, and thread area to insure that at least one and one-half threads and not more than three threads are showing after the hardware is securely tightened.

(4) Using the two recommended mating connectors P1, MS3106F-22-1S and P2, MS3106F-22-18P, refer to Fig. 203 and prepare input and output cabling between the Transverter and circuit breaker/fuse panel and the powered device. Typical Wiring Diagrams of an AC Power Distribution System utilizing three Phoenix Aerospace Inc. Transverters (Static Inverters) in parallel operation are shown in Figures 204 and 205.

(5) After completion of cabling, open circuit breakers or remove fuses at power panel and connect the input power cable plug P1, MS3106F-22-1S to input receptacle J1, MS3102R-22-1P. Connect output power cable plug P2, MS3106F-22-18P to output receptacle J2, MS3102R-22-18S.

B. Removal.

(1) Identify circuit breakers or fuses at power panel and place circuit breakers in off position or remove fuses.



NOTES:

1. CIRCUIT BREAKER CB1 IS NOT SUPPLIED, USE KLIXON 7235-1-25, 25 AMPERES, THERMAL BREAKER, OR EQUIVALENT.
2. CIRCUIT BREAKER CB2 IS NOT SUPPLIED, USE KLIXON 7MC1-201-5, 5 AMPERES, MAGNETIC BREAKER, OR EQUIVALENT.
3. INVERTER REMOTE ON/OFF SWITCH IS NOT SUPPLIED, USE SPST SWITCH, MAXIMUM CURRENT 1 AMPERE, TO OPEN OR CLOSE CIRCUIT BETWEEN PINS E AND F, CONNECTOR PLUG P2/J2.
4. CABLING SHALL BE FABRICATED FROM ELECTRICAL WIRE WHICH MEETS OR EXCEEDS THE REQUIREMENTS OF MIL-W-16878/3, TYPE D.
5. WIRING SHALL MEET OR EXCEED SIZES SHOWN.
6. CONNECTOR PLUGS: P1 - MS3106F-22-1S - INPUT; P2 - MS3106F-22-18P - OUTPUT; ARE NOT SUPPLIED WITH THE INVERTER (TRANSVERTER).

Cabling Diagram, PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter)
Figure 203

(2) Refer to cabling diagram Fig. 203 and disconnect input and output connectors P1 and P2, respectively.

(3) Remove the four AN4-XXA 1/4-28 aircraft hex head bolts, AN960-416 1/4 inch flat washers, and MS20365-428 1/4-28 self-locking hex nuts securing the Transverter to airframe.

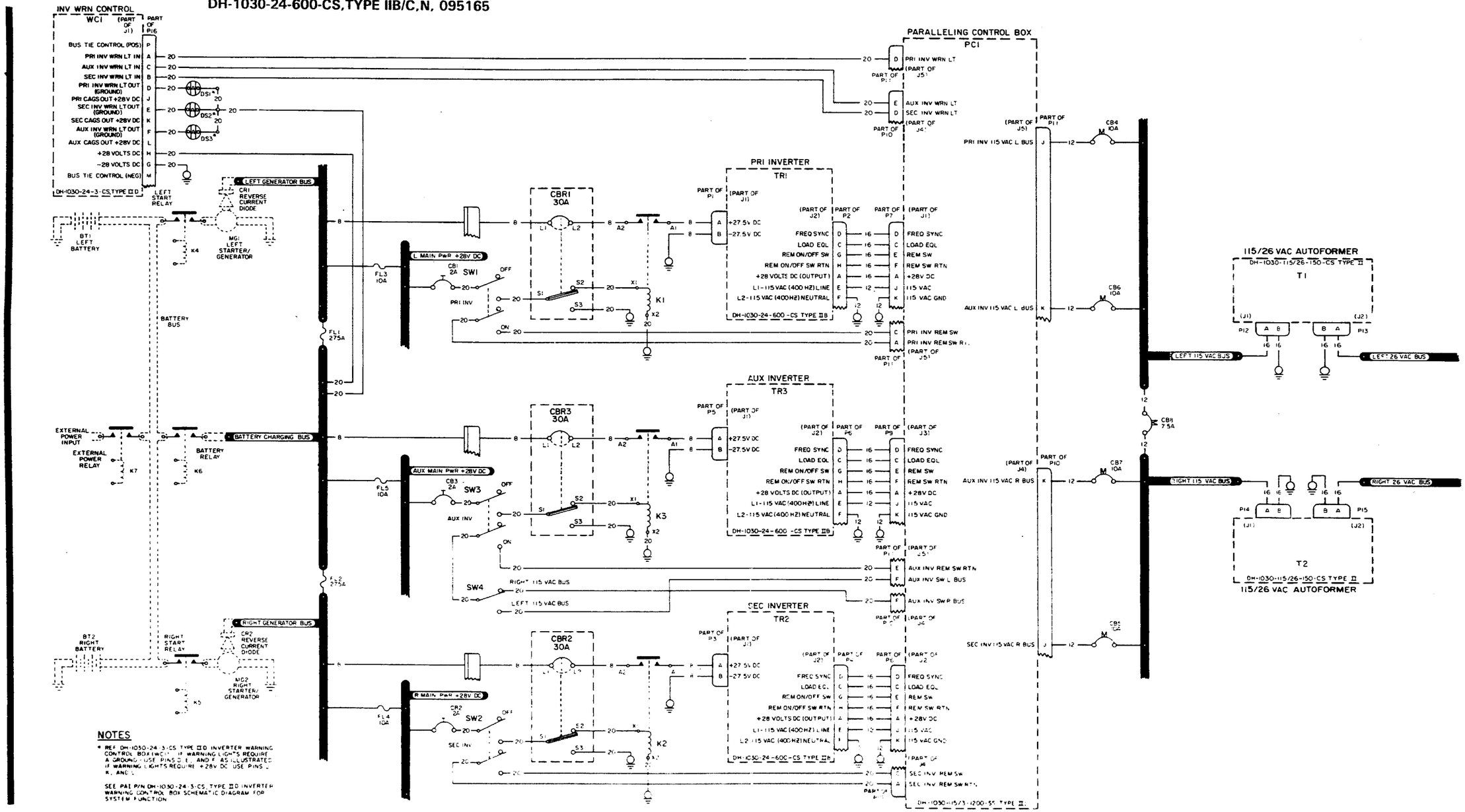
4. ADJUSTMENT/TEST.

The following paragraphs outline test procedures for both installation check out and a pre-installation bench test if desired or required by maintenance policies. Adjustments are not authorized at flight line maintenance level.

A. Installation Test.

Complete the following steps to determine if Transverter and associated load are operating properly.

(1) Place circuit breakers in the on position or install fuses at power panel in the input circuit.

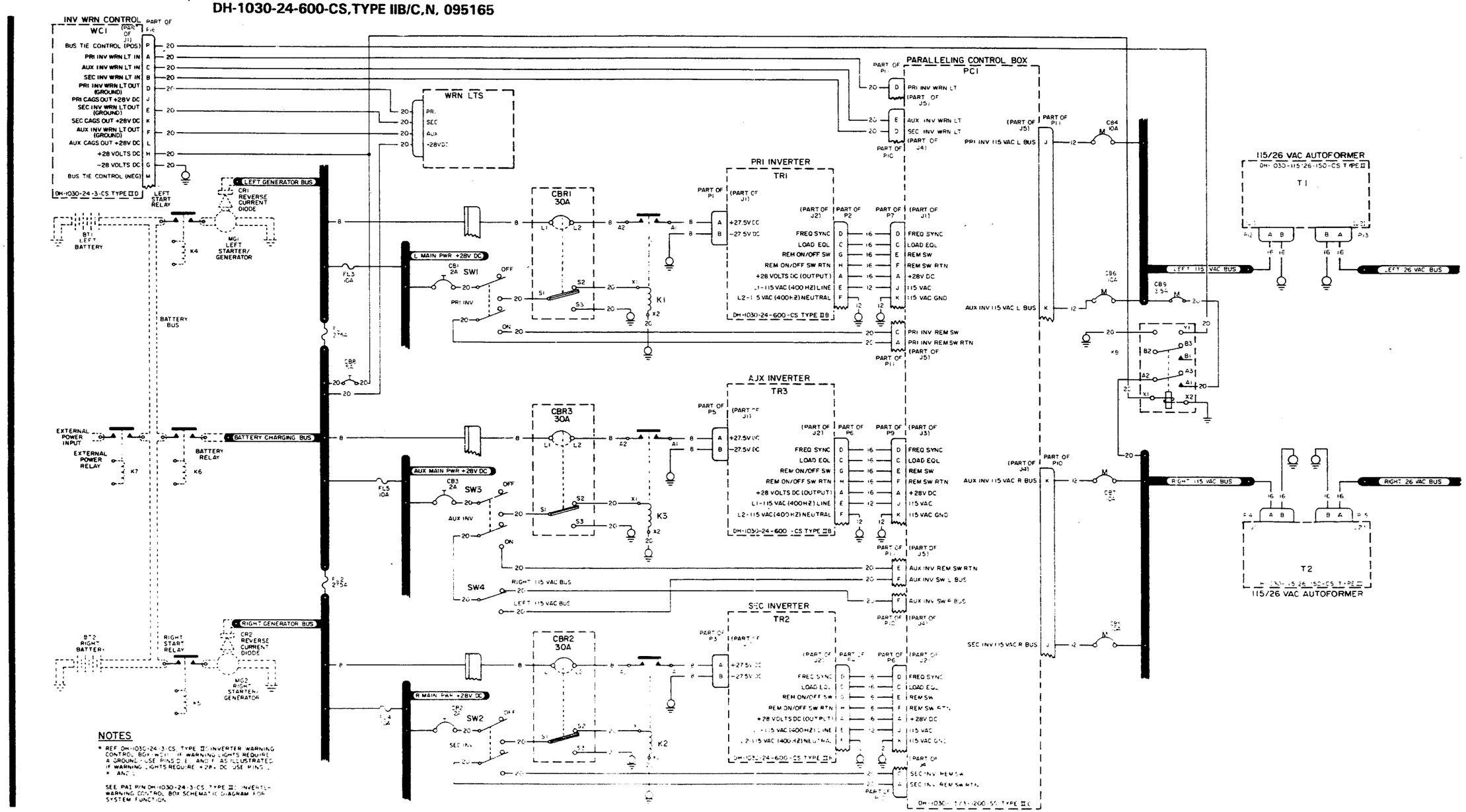


NOTES

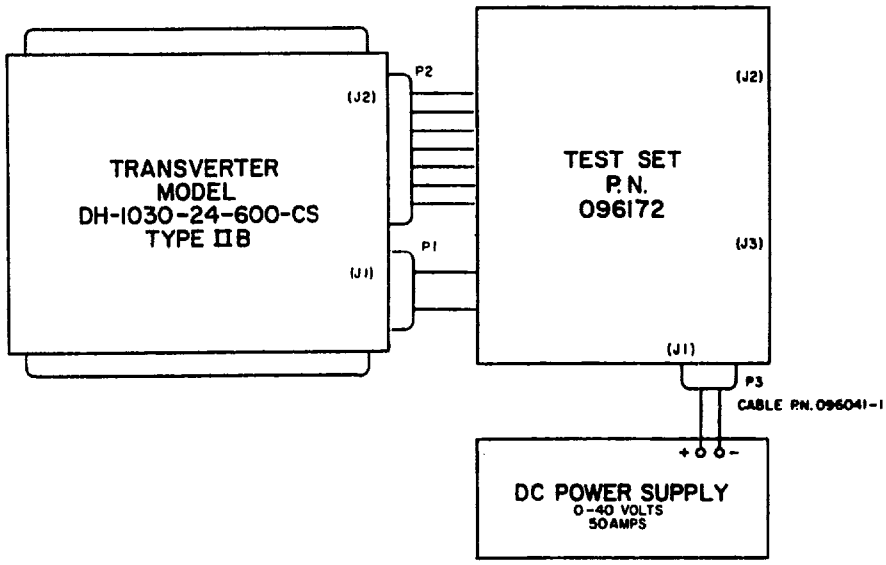
* REF DH-1030-24-3-CS TYPE IID INVERTER WARNING CONTROL BOX (WC1). IF WARNING LIGHTS REQUIRE A GROUND, USE PINS D, E, AND F AS ILLUSTRATED. IF WARNING LIGHTS REQUIRE +28V DC USE PINS J, K, AND L.

SEE PAT P/N DH-1030-24-3-CS, TYPE IID INVERTER WARNING CONTROL BOX SCHEMATIC DIAGRAM FOR SYSTEM FUNCTION.

Wiring Diagram, Typical AC Power Distribution System, Utilizing Three Phoenix Aerospace Inc. Transverters (Static Inverters) in Parallel Operation
Figure 204



Wiring Diagram, Typical AC Power Distribution System, Utilizing Three Phoenix Aerospace Inc. Transverters (Static Inverters) in Parallel Operation, Delayed Bus-Tie
Figure 205



Bench Test Set-Up, PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter)
Figure 206

(2) Operate control to apply power to input of device while observing aircraft metering of the DC voltage for any abrupt change in voltage or current. In the event any abrupt change occurs, remove power and check wiring for shorted condition.

(3) Place circuit breakers in the on position or install fuses at power panel in the output circuit.

(4) Operate control and/or connect device or load to output of Transverter, observing operation of powered device and aircraft metering of the DC voltage for any change in voltage or current. In the event any appreciable change occurs, remove power at input and check output wiring and the associated load for short circuit or other malfunction.

B. Pre-installation Check.

Complete the following steps to determine that Transverter is operable and capable of supplying power to a specific load.

(1) Refer to Fig. 207 and the Inverter Test Set, PAI P.N. 096172, and place push button A in the OFF position, pressed.

(2) Place ON/OFF switch on the DC Power Supply in the OFF position.

(3) Identify the Accessory Interconnect Cable P.N. 096172-1, attaching positive lead to the positive terminal and the negative lead to the negative terminal on the DC Power Supply.

(4) Place ON/OFF switch on the DC Power Supply in the ON position, and increase output of DC Power Supply to 27.5 volts DC.

(5) Press push button D - 400 VA UNITY - lamp DS4 will light and observe DC AMPERES meter M4, DC VOLTS meter M3, AC AMPERES meter M1, and AC VOLTS meter M2 for voltages as noted below

Input Current: 18.0 Amperes (nominal)
Output Current: 3.48 Amperes (nominal)

Input Voltage: 27.5 VDC
Output Voltage: 115 VAC ±5%

(6) Change input voltage from DC Power Supply varying between 20 and 30 volts and note stability of output voltage and current, indicative of proper operation.

(7) Return input voltage to zero and place ON/OFF switch on the DC Power Supply in the OFF position.

(8) Disconnect the Inverter (Transverter) from the Inverter Test Set completing the pre-installation or bench tests.

NOTE

In the event Transverter under test does not perform as outlined in step (5), unit should be returned to stores for replacement and forwarded to overhaul or returned to vendor for repairs.

5. INSPECTION/CHECK.

Visual inspection of external cabling for arcing at contacts of connectors, and associated load are the only authorized inspection/checks. No authority is given for visual or other checks internally or even removal of the sealed cover at flight line maintenance levels.

6. CLEANING/PAINTING.

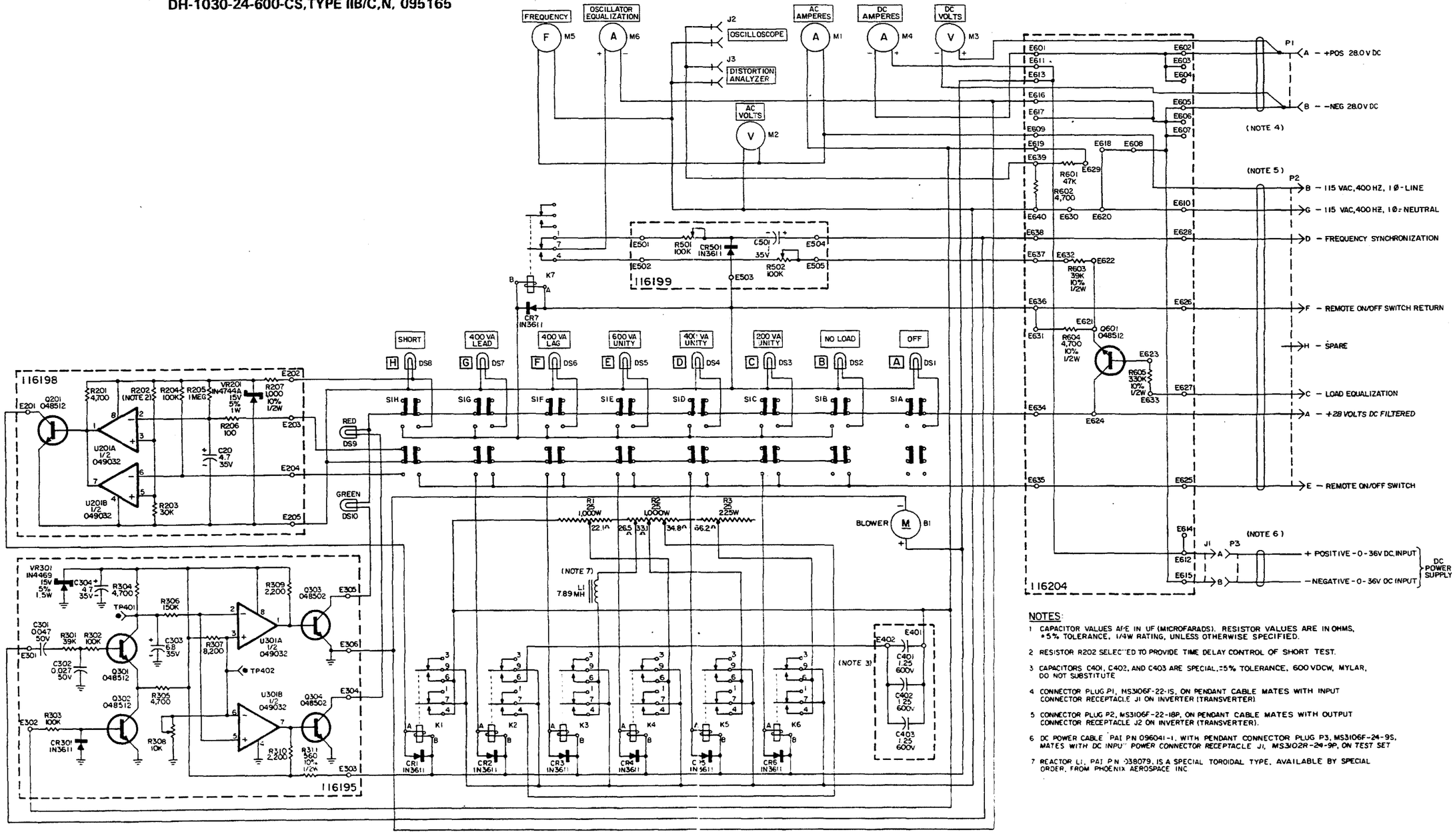
The Transverter requires no periodic cleaning operations under the sealed cover. If readily accessible, exterior dirt may be removed with a brush or cloth and the connector pins may be burnished if corrosion should be apparent during visual inspection check of paragraph 5.

7. APPROVED REPAIRS.

The only repairs approved for flight line maintenance are those associated with external cabling. No repairs are authorized or approved for flight line maintenance requiring removal of the sealed cover.

8. INVERTER TEST SET, PAI P.N.096172.

The Inverter Test Set referenced in preceding paragraph 4.B. is available from Phoenix Aerospace Inc. as a complete unit. The schematic diagram for the Test Set is shown in Fig. 207.



NOTES:

1. CAPACITOR VALUES ARE IN UF (MICROFARADS). RESISTOR VALUES ARE IN OHMS, ±5% TOLERANCE, 1/4W RATING, UNLESS OTHERWISE SPECIFIED.
2. RESISTOR R202 SELECTED TO PROVIDE TIME DELAY CONTROL OF SHORT TEST.
3. CAPACITORS C401, C402, AND C403 ARE SPECIAL, ±5% TOLERANCE, 600 VDCW, MYLAR, DO NOT SUBSTITUTE
4. CONNECTOR PLUG P1, MS3106F-22-1S, ON PENDANT CABLE MATES WITH INPUT CONNECTOR RECEPTACLE J1 ON INVERTER (TRANSVERTER).
5. CONNECTOR PLUG P2, MS3106F-22-18P, ON PENDANT CABLE MATES WITH OUTPUT CONNECTOR RECEPTACLE J2 ON INVERTER (TRANSVERTER).
6. DC POWER CABLE PAI P/N 096041-1, WITH PENDANT CONNECTOR PLUG P3, MS3106F-24-9S, MATES WITH DC INPUT POWER CONNECTOR RECEPTACLE J1, MS3102R-24-9P, ON TEST SET
7. REACTOR L1, PAI P/N 038079, IS A SPECIAL TOROIDAL TYPE, AVAILABLE BY SPECIAL ORDER, FROM PHOENIX AEROSPACE INC

Schematic Diagram, Inverter Test Set
PAI P.N. 096172
Figure 207

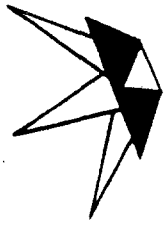
DH-1030-24-600-CS TYPE IIB

TRANSVERTER

overhaul manual

with

illustrated parts catalog



Phoenix Aerospace Inc.

KANSAS CITY, MO 64114



Phoenix Aerospace Inc.

PHOENIX AEROSPACE INC. STANDARD WARRANTY

1. Sellers Standard Warranty

(a) Phoenix Aerospace, Inc. herein called Seller, warrants that each unit delivered shall, at the time of delivery thereof to Buyer or Buyer's customers, be free from defects in material and workmanship and from defects or faults in design in view of the state of the art at the time of design thereof. Any defect must have become apparent and Buyer must have notified Seller thereof within twenty-four (24) months after installation in aircraft, not to exceed thirty (30) months after date of manufacture on unit nameplate. The extent of Seller's liability is limited to the repair, replacement, overhaul, or modification of any defective unit.

(b) Seller's obligation hereunder is conditioned upon the return as soon as practicable of the defective unit with all transportation charges prepaid to Seller in Kansas City, Missouri. Returned units must be accompanied by properly authorized Purchase Order, specifying the nature of the defect, if known, and containing reasonable proof to Seller that the defect is due to a matter embraced within Seller's warranty. An allowance will be made for inbound transportation charges in the Continental United States, but inbound transportation charges are the responsibility of Buyer outside the limits of the Continental United States. Overhauled or repaired units will be returned via air, transportation charges prepaid to destination anywhere in the world. Removal of the unit from any aircraft and reinstallation shall be at Buyer's expense.

(c) The warranty hereunder shall not apply to any unit installed in any Aircraft if such Aircraft shall not have been operated in accordance with the Federal Aviation regulations issued by the Federal Aviation Administration, or if such unit shall not have been operated or maintained in accordance with seller's instructions applicable to such unit, or if such unit shall have been repaired, altered or modified without Seller's approval, or operated with an accessory or part not authorized for use therewith, or if such unit shall have been operated subsequent to its involvement in an accident, or if the unit shall have been subject in any way to improper operation, maintenance, repair, alteration or modification.

(d) THE WARRANTY AND THE OBLIGATIONS AND LIABILITIES OF SELLER HEREUNDER ARE EXCLUSIVE AND IN SUBSTITUTION FOR AND BUYER HEREBY WAIVES ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, ARISING BY LAW OR OTHERWISE (INCLUDING, WITHOUT LIMITATION, THE IMPLIED WARRANTY OR MERCHANTABILITY, ANY IMPLIED WARRANTY ARISING FROM COURSE OF PERFORMANCE, COURSE OF DEALING OR USAGE OF TRADE, ANY IMPLIED WARRANTY OF FITNESS, AND ANY OBLIGATION OF SELLER WITH RESPECT TO INCIDENTAL OR CONSEQUENTIAL DAMAGES), AND SHALL NOT BE EXTENDED, ALTERED OR VARIED EXCEPT BY A WRITTEN INSTRUMENT SIGNED BY SELLER AND BUYER.

2. General Instructions

(a) Overhaul, modification or repair of all Phoenix Aerospace units is authorized only at Seller's facility. Any overhaul, repair, alteration or modification without Seller's approval will negate or void the terms of Seller's Standard Warranty stated herein. Units in need of repair should be shipped directly to:

Phoenix Aerospace Inc.
220 West 80th Terrace
Kansas City, Missouri 64114
U.S.A.

Units in warranty are repaired at the factory under the terms and conditions of Seller's Standard Warranty at no charge. There will be a charge imposed for Units returned within the warranty period which are found not to be defective or for a defect found not to be included within Seller's Standard Warranty or which have been removed or returned as a result of any program of preventive maintenance.

(b) Units out of warranty are repaired at the factory at Seller's standard charge in effect at the time of receipt of unit. Inbound and outbound transportation charges are the responsibility of the Buyer.

PHOENIX AEROSPACE INC.

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	7*	Jan. 3/92
	8	Blank
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24-20-X	1107*	Jan. 3/92
24-20-X	1108*	Jan. 3/92
24-20-X	1109*	Jan. 3/92
24-20-X	1110*	Jan. 3/92
24-20-X	1111*	Jan. 3/92
24-20-X	1112	Blank
24-20-X	1113*	Jan. 3/92
24-20-X	1114*	Jan. 3/92
24-20-X	1115*	Jan. 3/92
24-20-X	1116*	Jan. 3/92
24-20-X	1117*	Jan. 3/92
24-20-X	1118*	Jan. 3/92
24-20-X	1119*	Jan. 3/92
24-20-X	1120*	Jan. 3/92
24-20-X	1121*	Jan. 3/92
24-20-X	1122*	Jan. 3/92
24-20-X	1123*	Jan. 3/92
24-20-X	1124*	Jan. 3/92
24-20-X	1125*	Jan. 3/92
24-20-X	1126	Blank
24-20-X	1201*	Jan. 3/92
24-20-X	1202*	Jan. 3/92
24-20-X	1203*	Jan. 3/92
24-20-X	1204	Blank
24-20-X	1205*	Jan. 3/92
	1206	Blank

*The asterisk indicates pages changed, added, or deleted by the current change.

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INTRODUCTION

In conformance with A.T.A. Specification No. 100 for Manufacturers' Technical Data, two manuals have been prepared concerning the PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter). These manuals, if used as intended, will facilitate the effective, continued operation of the equipment. Technical data is grouped according to usage in the manual as described.

OVERHAUL MANUAL WITH ILLUSTRATED PARTS CATALOG

The Overhaul Manual contains all the information required for shop testing, replacement of defective parts, adjustment, mechanical disassembly, inspection, and reassembly. Detailed circuit theory is given with emphasis on theory that will be especially helpful for effective troubleshooting. Performance tests as well as functional (go/no-go) checks, which may be used to determine condition of equipment and for retesting after repairs.

The Illustrated Parts Catalog provides a means to determine the manufacturer's part number and the physical location on the equipment of a part if the reference designation is known, or to determine the reference designation and the manufacturer's part number when the physical location of the part is known but no other information is available.

MAINTENANCE MANUAL

This manual is intended for use by flight line and hangar maintenance personnel. A detailed description and operation, including a table of leading particulars are presented for reference. Mounting and cabling information are presented as an aid to installation. Troubleshooting information is limited to procedures required to trace a trouble to the overall unit for replacement,

DESCRIPTION AND OPERATION

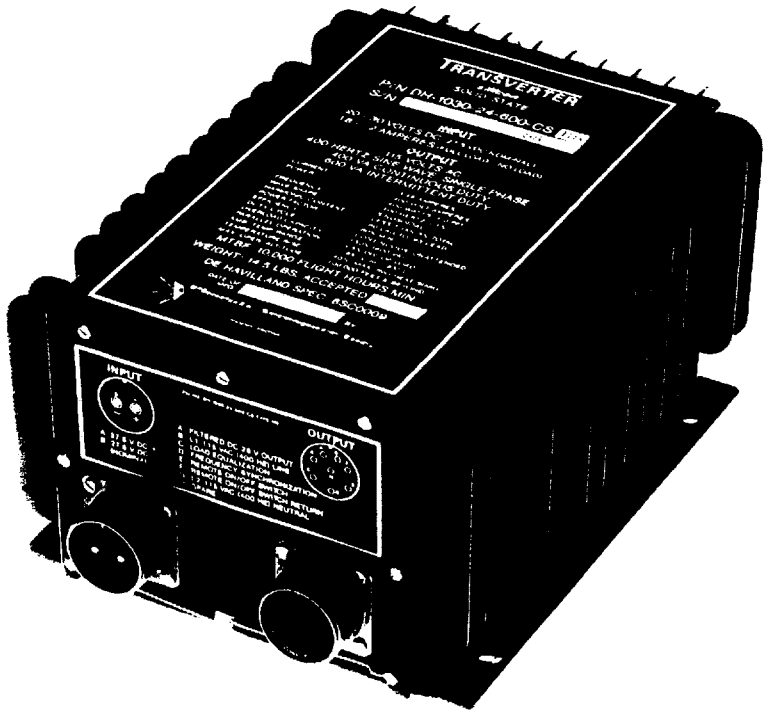
1. GENERAL.

A. Purpose of Manual.

This manual contains information for shop testing, replacement of defective parts, adjustment and alignment, mechanical disassembly, inspection, reassembly, and the Illustrated Parts Catalog for the PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter), illustrated in Figure 1.

B. Purpose of Equipment.

The PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter) is used for conversion of electrical power in aircraft for operation of airborne instrumentation and other electrical equipment. The unit provides a continuous source of frequency and voltage regulated, single phase, sine wave, alternating current power from a direct current voltage source. The stable output insures the highest degree of operational reliability under the most adverse service conditions.



PAI P.N. DH-1030-24-600-CS, Type IIB,
Solid-State Static Inverter (Transverter)
Figure 1

2. DESCRIPTION.

A. The PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter) is a self-contained DC to AC inverter using state-of-the-art-solid state techniques. Power from the DC source is changed to a highly stable alternating current power source. The unit is compactly packaged with only input and output connections externally accessible.

B. The primary characteristics, capabilities, overall weight, and dimensions are listed in Table of Leading Particulars, Table 1.

GENERAL:	
Input:	20-30 VDC (27.5 VDC nominal), 18.0 - 2.0 Amperes (full load - no load, 27.5 VDC Input)
Output:	115 VAC, 400 Hertz Sine Wave, 1 Phase, 400 VA Continuous Duty, 600 VA Intermittent Duty.
Ambient Temperature Range:	-85°C to +85°C
Temperature Rise:	40°C maximum (no heat sink).
Parallel Operation:	±5% equal division of load, multiple inverters operated in parallel mode, no load to full load over input and temperature/altitude operating range
Maximum Operating Altitude:	100,000 feet and beyond.
Reliability:	10,000 hours MTBF (minimum).
ELECTRICAL:	
Output:	
Volts:	115 VAC ±5% (24 - 30V DC) ± 20% (20 - 24V DC) No load to full load over input and temperature/altitude operating range.
Current:	3.48 Amperes.
Power:	400 Volt-Amperes (Continuous Duty) - 115 VAC, 600 Volt-Amperes (Intermittent Duty),
Frequency:	400 Hertz ±1% -No load to full load over input and temperature/altitude operating range (frequency is maintained to 10 VDC input, and below).

Table of Leading Particulars
Table 1

ELECTRICAL (Cont):	
Output (Cont):	
Wave Shape:	Sinusoidal
Harmonic Content:	Less than 5% total, (3% typical).
Power Factor:	.80 lagging to .95 leading.
Efficiency:	75% minimum.
Duty Cycle:	Continuous, unattended.
Short Circuit Current:	2.0 times full load current (min).
Short Circuit Protection:	Automatic - Restarts when normal load is restored (No damage, output shorted for 1 minute).
Overload Capacity:	150% for 5 minutes (No damage), (600 VA), (no heat sink) 110% for 2 hours (no damage), (440 VA), (no heat sink)
Input:	
Volts:	20 - 30 VDC (27.5 VDC nominal) 0 - 36 Volts (No damage).
Current:	18.0 - 2.0 Amperes (full load - no load). Operating at rated load, 27.5 VDC Input.
Induced Ripple:	Less than 1.5 Volts peak to peak, (50 millivolts typical).
Short Circuit Current:	36 - 50 Amperes (typically 45 Amperes).
Overvoltage Protection:	130% for 5 minutes (No damage).
Transient Protection:	±80 volts for 40 milliseconds, ±600 volts for 10 microseconds.
Reverse Polarity Protection	Polarity protect diode.
MECHANICAL:	
Weight:	14.5 pounds (6,577 grams).

Table of Leading Particulars (Cont)
Table 1 (Cont)

MECHANICAL (Cont):	
Overall Dimensions:	10-3/4 in. long (27.305 cm) by 7-3/4 in. wide (19.685 cm) by 5 in. high (12.700 cm).
Mounting Base Dimensions:	9-3/8 in. long (23,813 cm) by 7-3/4 in. wide (19.685 cm).
Mounting Centers:	7 in. long (17.780 cm) by 7 in. wide (17.780 cm)
Electrical Connectors: Input/Output:	Input: MS3102R-22-1P mating MS3106F-24-11S. Output: MS3102-R-22-18S mating MS3106F-22-18P
Cooling:	Self-cooled by natural convection, conduction and radiation.
Installation:	Mounts in any position, without deterioration of power output, heating, operating life, or other operating characteristics.

Table of Leading Particulars (Cont)
Table I (Cont)

3. OPERATION

The subsequent paragraphs cover the theory of operation for the PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter). The Block Diagram Theory will aid in conveying the overall circuit operation to non-technical oriented personnel, while the Detailed Circuit Theory will enable the technician to understand in detail the operation of equipment.

A. Block Diagram Theory

The subsequent paragraphs together with the block diagram of Fig. 2, cover in concise form the signal flow and circuit operation for the DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter).

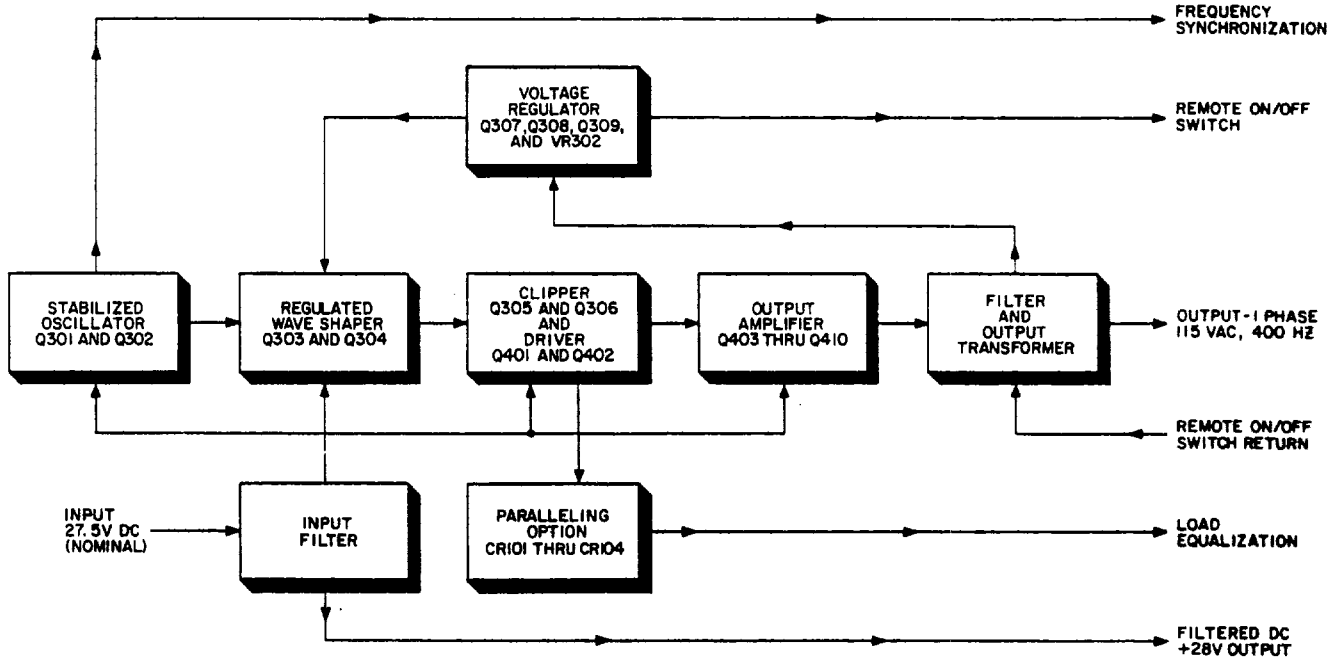
(1) Input Filter. Power applied through the input filter is free of transients and is provided with reverse polarity protection for application to circuits of the Transverter. A filtered +28V DC output connection is also provided for use in parallel operation of the inverter.

(2) Stabilized Oscillator. Transistors Q301 and Q302 generate a 400 Hertz sine wave signal of high stability. The sine wave signal is coupled through auxiliary windings of the oscillator transformer T301 to the input of the regulated wave shaper.

(3) Regulated Wave Shaper. Transistors Q303 and Q304 in a push-pull circuit receive the sine wave signal developed by the stabilized oscillator. Voltage applied from

the voltage regulator circuit determines the shaping operation for control of duty cycle and regulation of the output voltage. The shaped quasi-square wave output is coupled to the input of the clipper and driver circuit.

(4) Clipper and Driver. Transistors Q305, Q306, Q401, and Q402 in cascaded push-pull stages provide additional shaping and amplification of the 400 Hertz signal. The amplified quasi-square wave signal is applied to the output amplifier.



PAI P.N.DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter), Block Diagram
Figure 2

(5) Output Amplifier. Transistors Q403 through Q410 in a push-pull parallel circuit amplify the 400 Hertz signal to the required level across the output transformers for application to the output filter.

(6) Output Transformers and Filter. The output transformers and associated filter circuitry provide matching and shaping to return the amplified signal to a sinusoidal waveform.

(7) Voltage Regulator. Transistors Q308 and Q309 develop the regulating bias by comparison of the rectified negative DC voltage supplied from the output, and adjusted by setting of resistor R324, controlling the Zener regulated voltage to the base of Transistor Q308.

(8) Paralleling Circuit. Coupling transformer T101 provides a voltage to diodes CR101 through CR104 from the collector circuit of transistors Q401 and Q402. The rectified signal is adjusted to provide an output voltage for load equalization when operating inverter in a parallel system.

(9) Remote Turn-On/Turn-Off. Remote turn-on/turn-off of the inverter is accomplished by external control of the collector circuit of transistor Q309, ground, return.

B. Detailed Circuit Theory.

The following sub-paragraphs cover the individual circuits and their operation. Occasional reference to the overall schematic diagram of the Transverter, Fig. 1201, will be necessary to determine circuit configuration.

(1) Input Filter. The input filter consists of series reactor L2 and shunt capacitors C201, C202, and C203 providing high speed transient and ripple suppression to the input line. Diode CR9 provides reverse polarity protection for the Transverter circuitry. The input filter and reverse polarity protect diode passes the input current required to maintain rated power output and provide operating voltage to Transverter circuits. Over-voltage protection for low speed transients is provided by Zener diode VR301, resistor R313, and diodes CR302, CR303, and CR304. If the input voltage exceeds 39volts ±2 volts, Zener diode VR301 conducts and applies back bias to transistors Q305 and Q306 through diodes CR303 and CR304, respectively. This bias inhibits switching during over voltage periods and prevents a high voltage from being developed which could damage subsequent amplifier circuits or the output circuit. Diode CR302 protects the base circuits of transistors Q305 and Q306. Resistor R201 and Zener diode VR401 provide transient suppression and regulation for the low level stages. Diode CR105 located on the Paralleling Circuit Board, across terminals E101 and E102, provides filtered, positive 28 volts DC output at pin A of connector J2.

(2) Stabilized Oscillator. The stabilized oscillator utilizes transistors Q301 and Q302 in a Hartley oscillator circuit. Toroidal transformer T301, with multiple windings provides the tuned circuit, feedback, and output windings for the oscillator. The tuned circuit portion is tuned by capacitors C301, C302, and C303 to 400 Hertz. Capacitor C303 provides parasitic suppression in the tuned collector circuit. A feedback winding provides the coupling between base- collector circuit to sustain oscillations, resistors R318 and R319 provide bias to the base circuit of transistors Q301 and Q302 to insure positive start and sustained oscillations. Resistor R304 provides degeneration for improved stability of the oscillator circuit. Output to the regulated wave shaper circuit is through the remaining winding on transformer T301. Output from the collector of transistor Q302 and tuned circuit is terminated at Pin D of connector J2 for Frequency Synchronization in a multiple inverter system.

(3) Regulated Wave Shaper. The regulated wave shaper receives the 400 Hertz sinusoidal signal from transformer T301 output winding. The input signal is applied to the base circuits of transistors Q303 and Q304 through resistors R301 and R302, respectively, limiting base current which flows in the base circuit. Transistors Q303 and Q304 conduct on alternate half cycles, with the point of conduction determined by the amount of bias supplied by transistor Q309, voltage regulator, to the emitter circuit. Resistor R307 adjusts the output of transistors Q303 and Q304 for minimum second harmonic content in the inverter output. The output of this stage is a quasi-square wave and is applied to the input of the clipper circuit.

(4) Clipper and Driver. The clipper and driver circuits provide additional shaping of the signal and amplification for application to the output amplifier circuits. The clipper circuit consists of transistors Q305 and Q306 in a push-pull circuit. The quasi-square wave is applied to the base circuits of transistors Q305 and Q306 through current limiting resistors R308 and R309 and coupling capacitors C307 and C308, respectively. The output of the clipper circuit results in a quasi-square wave with improved rise time. The output is coupled to the base circuits of the driver transistors Q401 and Q402 through resistors R314 and R315, respectively. Resistors R316 and R317 provide a low impedance return for leakage currents. Output of the collector circuits is developed across toroidal driver transformer T401 and coupled to the output amplifier circuits. Capacitor C401 across the primary winding suppresses transients which might appear across the output.

(5) Output Amplifiers. The output amplifiers receive the quasi-square wave signal through toroidal driver transformer T401. Four output windings are connected in parallel to provide two outputs which drive the eight output transistors Q403 through Q410. Input to the base circuit of each output transistor is through two paralleled 1 Ohm, 2 Watt, resistors, providing current limiting to the input. A 4.7 Ohm, 2 watt resistor between the base and emitter of each output transistor reduces the impedance during the non-conduction period. The collectors of transistors Q403 through Q410 are parallel connected in groups of four, Q403, Q404, Q405, and Q406 are connected to the high side of transformer T2, terminals E1-14, E1-8, E2-14, and E2-8, respectively, while transistors Q407, Q408, Q409, and Q410 are connected to the low side of transformer T2 terminals E2-3, E2-9, E1-3, and E1-9, respectively. Diodes CR1 through CR8 connected in parallel with the emitter and collector terminals of each power transistor provide the reverse current flow from the load back to the DC power source under conditions of high reactive loading. Toroidal series reactor transformer T1 is connected in series with the primary windings of the output transformer T2. The secondary winding of output transformer T2 is connected to the filter circuit.

(6) Output Transformer and Filter. The 400 Hertz quasi-square wave signal developed across toroidal output transformer T2 is high in content of odd order harmonics. Toroidal series reactor transformer T1 in conjunction with the output transformer T2, and the output filter circuit reduce these odd order harmonics. The impedance of the series reactor transformer T1 is low at the 400 Hertz fundamental frequency, but sufficiently high at the frequency of the harmonics to enable the reactor-transformer combination to filter the harmonic content. The output filter appears as a high impedance to the fundamental 400 Hertz signal and a low impedance to the harmonics, thus resulting in optimum power transfer at the fundamental frequency of 400 Hertz. The secondary winding of transformer T2 is tuned to the 400 Hertz fundamental by parallel capacitors C204 and C205, forming a parallel tuned circuit, which reflects a high impedance to the fundamental 400 Hertz signal and a low impedance path to the harmonics. The series tuned circuit comprised of capacitor C206 and toroidal reactor L1 is tuned to the third order harmonic 1,200 Hertz, providing a shunting effect to the most predominant harmonic present in the output. The filtered output is 115 volts AC at a frequency of 400 Hertz and is available at pins B and G of connector J2. The additional winding on transformer T2 is used to derive feedback voltage for the voltage regulator circuit. The derived voltage is rectified by diodes CR305 and CR306 to provide a negative DC potential to the voltage regulator circuit

(7) Voltage Regulator. The voltage regulator consists of transistors Q307, Q308, and Q309, and Zener diode VR302. The positive voltage from Zener diode VR302 through temperature compensating transistor Q307 and the negative voltage from diodes CR305 and CR306 are applied to the summing resistors R323, R324, R325, and R347 to derive an error voltage at the base of transistor Q308. A change in output voltage, after the setting of resistor R324 has been determined, causes a change in the current applied to the summing circuit, developing an error voltage which is amplified by transistors Q308 and Q309. Output at the emitter of transistor Q309 results in a proportional voltage change which is the bias applied to transistors Q303 and Q304. This change in bias controls duty cycle and output voltage by limiting action in the regulated wave shaper circuit.

(8) Paralleling Circuit. The paralleling circuit operates from voltages derived in the collector circuits of transistors Q401 and Q402, Driver Transistors, conducting on alternate half-cycles. The derived output is applied to a step-down coupling transformer for application to a bridge rectifier circuit comprised of diodes CR101 through CR104. The rectified output voltage developed across load resistor R102 and filter capacitor C101, together with the summed voltage from the base circuit of transistor Q308, applied to connection point B. is adjusted to desired level by

variable resistor R103. The preset level becomes the reference voltage which is delivered for application to load equalization circuits for automatic control of multiple inverter systems.

(9) Remote Turn-On/Turn-Off. Remote turn-on/turn-off of the inverter is accomplished by external control of the collector return of transistor Q309, to ground. This control requires completion of the circuit between pins E and F of connector J2 through an ancillary switch.

DISASSEMBLY

1. GENERAL.

This section outlines procedures for disassembly of the Transverter. The procedures should be followed in the event it becomes necessary to repair the unit after a malfunction or part failure. Electrical wiring should not be disconnected except when required for complete removal of a component or sub-assembly or when wiring is found to be defective. When wiring is disconnected, tag each wire and note connection point for ease in identification during reassembly.

2. COVER AND INPUT AND OUTPUT CONNECTIONS NAMEPLATE REMOVAL.

A. Break Phoenix Aerospace, Inc. safety tie wire (seal), (-26) Fig. 1101, by cutting and remove.

NOTE

In the event Transverter is in warranty, breaking of seal may void warranty unless covered by other contractual agreement.

B. Remove the twenty-eight screws securing cover, (-23), (-24), and (-25) Fig. 1101, and remove cover by lifting straight up from base. Place hardware aside for reassembly.

NOTE

Careful attention should be given to the length of screws removed, particularly the lower row on both sides, are 5/8 inch long, the remaining 22 screws are 3/8 inches long.

C. Remove input and output connections nameplate, (21) Fig. 1101, lifting at edge of plate, not at the corners, to release adhesive. Place aside for reassembly operation.

CAUTION

DO NOT PLACE NAMEPLATE WITH ADHESIVE SIDE TOWARD PAPER OR AN OILY SURFACE.

3. REMOVAL OF OSCILLATOR/AMPLIFIER/DRIVER CIRCUIT MODULE SUB-ASSEMBLY

A. General.

Removal of the Oscillator/Amplifier/Driver Circuit Module Sub-assembly, (13) Fig. 1101, is accomplished to gain access to component side of circuit board or other sub-assemblies

of the Transverter. Unless board replacement is required interconnecting wires should never be disconnected. Proceed as follows to gain access to the component side of sub-assembly.

B. Removal Procedure.

(1) Loosen and remove the five No. 4-40 x 1/2 inch long flat head, 82° countersink, machine screws, (-14) Fig. 1101, at the connector end of Transverter.

NOTE

These screws were concealed by the Input and Output Connections Nameplate removed in preceding paragraph 2.

(2) Loosen and remove the five No. 4-40 x 1/2 inch long binder head machine screws, (-15) Fig. 1101, at the opposite end of Transverter.

(3) Carefully swing loosened sub-assembly up and over to the side to expose component side of circuit board. DO NOT disconnect wiring unless removal of entire sub-assembly is required.

4. DISASSEMBLY OF OSCILLATOR/AMPLIFIER/DRIVER CIRCUIT MODULE SUB-ASSEMBLY.

A. General.

Disassembly of the Oscillator/Amplifier/Driver Circuit Module Sub-assembly is not required unless a printed circuit board, (45) Fig. 1107, is damaged beyond repair and necessitates removal and replacement.

B. Disassembly Procedure.

(1) Carefully identify, disconnect, and tag all wires leading to or from the Oscillator/Amplifier/Driver Circuuit Board Sub-assembly, (45) Fig. 1107.

(2) Remove the Oscillator/Amplifier/Driver Circuit Board Sub-assembly, (45) Fig. 1107, by loosening and removing the four No. 4-40 x 1/2 inch long binder head machine screws, four .1875 inch O.D. x 1/4 inch long aluminum spacers, four No. 4 internal tooth lock washers, and four No. 4-40 hex nuts, (-46), (-47), (-48), and (-49) Fig. 1107. Place hardware removed aside for use during reassembly.

5. REMOVAL OF INPUT AND OUTPUT FILTER CIRCUIT BOARD SUB-ASSEMBLY.

A. General.

Removal of the Input and Output Filter Circuit Board Sub-assembly (9) Fig. 1101, is required to gain access to the underside of printed circuit board when parts removal and replacement is required. **It is not necessary to remove board completely, therefore, DO NOT disconnect wiring unless board is physically damaged beyond repair.**

B. Removal Procedure.

(1) Loosen and remove the two No. 6-32 x 1/2 inch long binder head machine screws, two No. 6-32 x 3/8 inch long binder head machine screws, and four No. 6 internal tooth lock washers, (-10), (-11), and (-12) Fig. 1101, securing sub-assembly in place. Place hardware aside for use during reassembly.

(2) Carefully lift board to expose underside of printed circuit for component removal and replacement. **DO NOT disconnect wiring to board unless sub-assembly removal is required.**

6. REMOVAL OF PARALLELING CIRCUIT BOARD SUB-ASSEMBLY.

A. General.

Removal of the Paralleling Circuit Board Sub-Assembly (10) Fig. 1104, is required to gain access to both sides of the printed circuit board when parts replacement is required. It is not necessary to remove board completely, therefore, DO NOT disconnect wiring unless board is damaged beyond repair. The Parallelling Circuit Board Mounting (Bracket (-6), Fig. 1104, should not be removed unless it is necessary to complete procedures of paragraphs 7 or 8.

B. Removal Procedure.

(1) Identify the three No. 4-40 X 3/8 in. long, binder head, machine screws, (-11) Fig. 1104, securing the Paralleling Control Circuit Board to the circuit board mounting Bracket, (-6), Fig. 1104, remove the hardware to permit circuit board to swing free. Place hardware aside for use during reassembly.

(2) Should removal be necessary, tag and identify leads during removal to facilitate reinstallation.

7. REMOVAL OF TRANSFORMER MOUNTING CHASSIS PAN SUB-ASSEMBLY.

A. General.

Removal of the Transformer Mounting Chassis Pan Sub-Assembly (7), Fig 1101, is required only when it should become necessary to relace a transformer or reactor mounted on this sub-assembly.

B. Removal Procedure.

(1) Identify and remove Input and Output Filter Circuit Board Sub-Assembly, (9), Fig. 1101, following procedures of preceding paragraph 5.

(2) Disconnect all leads and tag for aid in identification during reassembly.

(3) Identify the six No. 6-32 X 3/8 inch long flat head 82° countersink, machine screws, (-8), Fig. 1101, securing the Transformer Mounting Chassis Pan Sub-Assembly to the Static Inverter Base (1), Fig. 1101, and remove.

8. REMOVAL OF TRANSFORMERS AND REACTOR, TRANSFORMER MOUNTING CHASSIS PAN.

A. General.

Removal of transformers and reactor, (12), (17), (22), and (27) Fig. 1104, should never be accomplished unless replacement is required. In the event replacement is required, recommended practice would be to return unit to the factory for repair. If field repairs are to be made proceed as follows.

B. Removal Procedure.

(1) Identify and remove Input/Output Filter Circuit Board Sub-Assembly, (9) Fig. 1101, following procedures of preceding paragraph 5.

(2) Identify and remove the two terminal strips (34) and (35) Fig. 1104, secured in place by two No. 6-32 x 3/8 inch long binder head machine screws,and two No. 6 internal tooth lock washers (-36) and (-37), Fig. 1104, disconnect leads necessary only to remove defective part, identifying carefully all terminals with tags for aid in reassembly.

(3) Identify and remove the six No. 6-32 x 3/8 inch long flat head, 82° countersink, machine screws, (-8), Fig. 1101, securing the Transformer Mounting Chassis Pan, (7) Fig. 1101, to the Static Inverter (Transverter) Base, (1) Fig. 1101.

(4) Identify the transformer or reactor mounting screw, (-14), (-19), (-24), and (-29), Fig. 1104, washer,(-15), (-20), (-25), and (-30), Fig. 1104, and nut (-16), (-21), (-26), and(-31), Fig. 1104, and remove to permit removal from the potting compound.

NOTE

To remove transformers or reactor potting compound must be broken away before device will separate from Transformer Mounting Chassis Pan. Use care to prevent damage to components not requiring replacement.

CLEANING

1. GENERAL.

This section outlines procedures for cleaning the components of the Transverter while disassembled. Cleaning materials are listed in Table 201.

WARNING

PERFORM OPERATION INVOLVING SOLVENT ONLY IN A WELL VENTILATED AREA. AVOID BREATHING OF SOLVENT VAPOR AND CONTINUOUS CONTACT WITH SOLVENT.

Reference to air jet refers to a hand-operated air nozzle supplied with clean, dry, compressed air at a maximum pressure of 28 psi.

WARNING

GOGGLES SHOULD BE WORN WHEN USING AIR JET TO BLOW DUST AND DIRT FROM EQUIPMENT. OTHER PERSONS SHOULD BE WARNED AWAY FROM HAZARDOUS AREA OR WORKING ENCLOSURE.

MATERIAL
Perchloroethylene Solvent/Non-Aqueous
Soft-bristled Brush
Soft, Clean Cloth

List of Cleaning Materials
Table 201

2. PRINTED CIRCUIT BOARDS-WIRED CHASSIS.

Remove dust and dirt from all surfaces with a soft-bristled brush in conjunction with an air jet.

NOTE

When the dress of wiring is disturbed, dressing should be noted, and when cleaning is finished, wiring should be restored to proper dress or position.

3. METAL SURFACES.

Clean with soft cloth moistened in trichloroethylene solvent, and dry with clean, dry cloth.

4. CONNECTORS.

A. Wipe dust and dirt from shell using trichloroethylene solvent and a soft cloth. Wipe dry with clean, dry cloth.

B. Remove dust from insert using small, soft-bristled brush in conjunction with air jet.

INSPECTION/CHECK

1. GENERAL.

This section contains procedures to determine the condition of Transverter.

2. COVER.

Inspect cover for deformations, dents, punctures or surfaces which might be wearing due to interference with other components.

3. CONNECTORS.

A. Inspect for broken parts, damaged shell, and any other abnormal condition.

B. Inspect for broken, cracked, or damaged insert and for contacts which are broken, deformed, out of alignment. Check for corrosion and signs of arcing at the contacts and for poorly soldered connections.

4. RESISTORS.

Inspect resistors for signs of overheating; cracked, broken, or charred insulation; loose, poorly soldered, or corroded terminal connections; and loose mountings.

5. METAL SURFACES AND MECHANICAL.

Inspect metal surfaces for signs of corrosion. Also check component mountings for mechanical tightness.

6. WIRES.

Check wires for damaged insulation and for proper dress.

REPAIR

1. GENERAL.

This section outlines instructions for the repair or replacement of damaged or defective parts. Faulty parts are usually detected by inspection, cleaning or troubleshooting. The repair or replacement of damaged or defective parts involves standard repair techniques. Identify each wire before removal of any part requiring unsoldering of several lead wires.

2. COVER.

Straighten any deformation, and retouch scratched or worn surfaces.

3. CHASSIS.

Remove all traces of corrosion and recoat with clear epoxy resin where broken or removed during repairs.

Before attempting to solder connections, peel away epoxy resin using a sharp knife.

NOTE

The clear epoxy resin is Armstrong Products Inc. Type T-600 or equivalent. Any time the epoxy coating is disturbed, recoating is advised.

4. CONNECTORS.

Straighten bent pins. Resolder connection and check insulation. If badly damaged, replace connector.

5. SOLDER CONNECTIONS.

Resolder any defective solder joints. Remove all traces of corrosion.

6. WIRING.

Replace any wiring with damaged insulation or broken strands.

7. RESISTORS.

Replace resistors that show signs of overheating or with cracked or broken bodies. Resolder loose, broken or corroded connections.

ASSEMBLY

1. GENERAL.

This section outlines the instructions for assembly of the Transverter. Before assembly of the unit, the Cleaning, Inspection/Check, and Repair Sections should be consulted to determine if all components are properly cleaned and in proper physical and operating condition. Where wiring must be reconnected, good practices must be followed in dressing of wires and soldering connections. Refer to Figures 1101, 1103, 1104, 1105, 1106 and 1107 for identification and location of sub-assemblies and component parts. Refer to Figures 501, 502, and 503, for wiring information.

2. INSTALLATION OF TRANSFORMERS AND REACTOR, ON TRANSFORMER MOUNTING CHASSIS PAN SUB-ASSEMBLY.

A. General.

Assembly of transformers and reactor (12), (17), (22) and (27) Fig. 1104, requires the use of epoxy resin similar to Dow Corning Type D.E.R. 330 with aluminum oxide filler and Dow Corning curing agent. The epoxy resin replaces any removed during the removal of transformers or reactors, and must be replaced to properly heat sink the unit and the transformers and reactors. In the event complete removal was not necessitated, disregard those steps not applicable and complete assembly procedures.

NOTE

Insulating disks, (-13), (-18), (-23), and (-28), Fig. 1104, must be replaced if damaged. Insulating Disks are used between the Chassis Pan and transformer or reactor.

B. Assembly Procedure.

(1) Identify the appropriate mounting screw for the transformer and/or reactor and mount through chassis pan. Secure in place using the No. 10 internal tooth lock washer and No. 10-24 hex nut. **DO NOT overtighten hardware.**

(2) The Polarity Protect Diode Sub-Assembly, (2) Fig. 1104, would not be replaced unless bracket has been damaged. Replacement of the diode, (2) Fig. 1102, is easily accomplished by reference to Fig. 1102 and Fig. 501.

(3) Replace epoxy resin by preparing the resin in a ratio of 1 to 1 by weight in accordance with manufacturer's instructions, and adding the aluminum oxide filler in a ratio of 30% by weight. Block ends of Transformer Mounting Chassis Pan to prevent compound from running out and fill to approximately 1/4 inch deep with potting compound. Allow curing to take place and proceed with subsequent steps.

(4) Assemble Transformer Mounting Chassis Pan to Static Inverter (Transverter) Base. Place a thin layer of Dow Corning No. 4 Compound, silicone lubricant between chassis pan and base. Secure, using the eight No. 6-32 x 3/8 inch long flat head, 82° countersink, machine screws, (-8) Fig. 1101, into the spacer blocks on the chassis pan.

(5) Identify the two terminal strips, (34) and (35) Fig. 1104, and position over the position over the 1-11/16 inch high aluminum spacer posts (32) Fig. 1104, and secure by hardware using one No. 6-32 X 3/8 inch long, binder head, machine screw (-36) Fig. 1104, and one No. 6 internal tooth lock washer, (-37) Fig. 1104, at the rear end of the Transverter Mounting Chassis Pan Sub-Assembly, the two other screws retaining the terminal strips will be installed in subsequent paragraphs.

(6) Identify leads disconnected during removal procedures and carefully reconnect and solder at the proper points. Reference to Fig. 501 will aid in identifying and reconnecting leads.

3. INSTALLATION OF TRANSFORMER MOUNTING CHASSIS PAN SUB-ASSEMBLY.

A. General.

Refer to Fig. 1101 and Fig. 501 for aid in installation of the Transformer Mounting Chassis Pan Sub-Assembly, (9) Fig. 1101, to the Static Inverter Base, (1) Fig. 1101.

B. Installation Procedure.

(1) Place a thin layer of Dow Corning, No 4 Compound, silicone lubricant on the bottom of the Transformer Mounting Chassis Pan Sub-Assembly and the Static Inverter Base.

(2) Identify the six No. 6-32 X 3/8 inch long 82° countersink, machine screws, (-8) Fig. 1101, and secure through the Static Inverter Base into the aluminum spacer posts, (-32), and (-33) Fig. 1104, on the Transformer Mounting Chassis Pan Sub-Assembly.

(3) Install all leads disconnected during disassembly and restore lead dress. Reference to Fig. 501 will aid in reconnecting the various leads along with the identification tags used during disassembly.

4. INSTALLATION OF PARALLELING CONTROL CIRCUIT BOARD SUB-ASSEMBLY.

A. General.

Refer to Fig. 1104 and Fig. 501 for aid in reinstallation of the Paralleling Control Circuit Board Sub-Assembly, (10) Fig. 1104, and complete as follows:

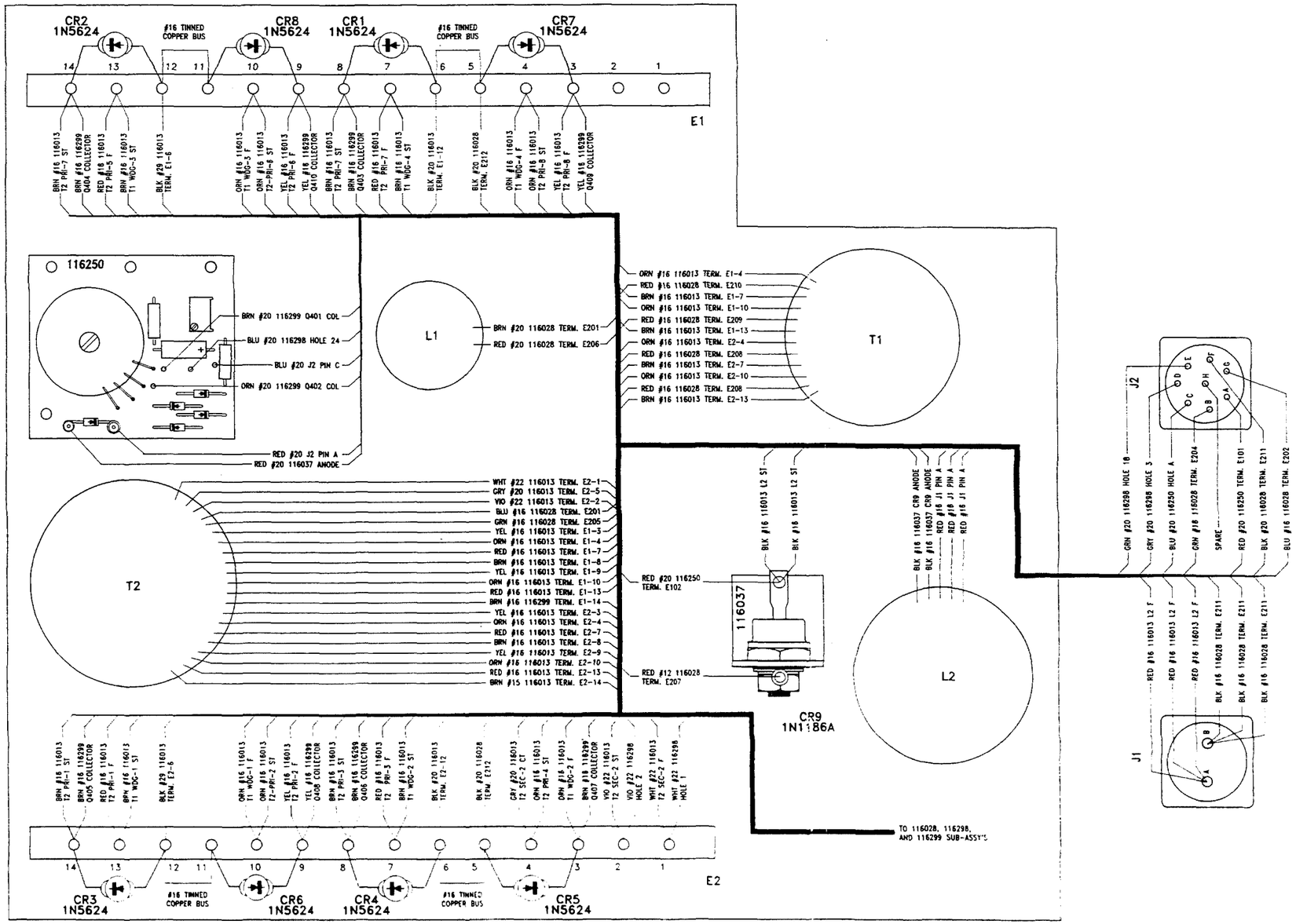


Figure 501. Wiring Diagram, Transformers and Reactors Mounting Chassis Pan Sub-Assembly
Figure 501

B. Installation Procedure.

(1) Refer to Fig. 501 for identification of wire leads and reconnect any wires removed during disassembly and restore lead dress.

(2) Carefully position Paralleling Control Circuit Board Sub-Assembly, (10) Fig. 1104, over mounting bracket, (-6) Fig. 1104. Reinstall using three No. 4-40 X 3/8 inch long, binder head, machine screws, (-11) Fig. 1104.

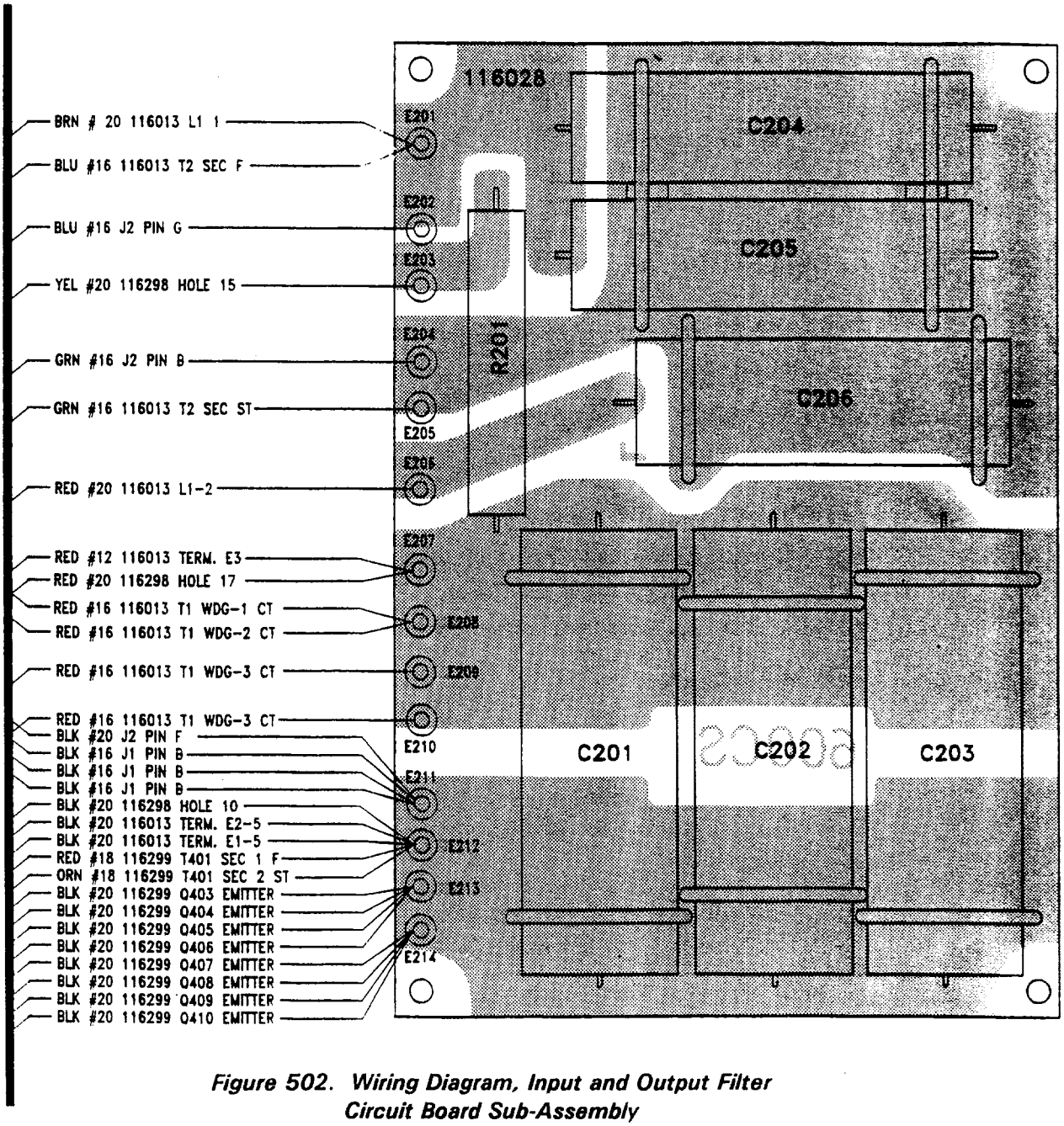


Figure 502. Wiring Diagram, Input and Output Filter Circuit Board Sub-Assembly
Figure 502

5. INSTALLATION OF INPUT AND OUTPUT FILTER CIRCUIT BOARD SUB-ASSEMBLY.

A. General.

Installation of Input and Output Filter Circuit Board Sub-Assembly, (9) Fig. 1101, requires care in reconnecting of leads disconnected during disassembly procedures.

B. Assembly Procedure.

(1) Carefully reconnect leads disconnected during disassembly or removal. Reference to Fig. 502 will aid in reconnecting and identifying leads.

(2) Identify the two No. 6-32 X 1 /2 inch long binder head machine screws, two No. 6-32 x 3/8 inch long binder head machine screws, and four No. 6 internal tooth lock washers, (-10), (-11), and (-12) Fig. 1101, align circuit board with holes in the two terminal strips positioned in preceding paragraph 2B.(4), (34) and (35) Fig. 1104, and using the two 6-32 x 1/2 inch long screws at the board edge over the two terminal strips and the two 6-32 x 3/8 inch long screws at the edge of board over the two aluminum spacers and secure to Transformer Mounting Chassis Pan.

6. ASSEMBLY OF OSCILLATOR/AMPLIFIER/DRIVER CIRCUIT MODULE SUB-ASSEMBLY.

A. General.

Assembly of the Oscillator/Amplifier/Driver Circuit Module Sub-Assembly, (13) Fig. 1101, consists of mounting the Oscillator/Amplifier/Driver Circuit Board Sub-Assembly, (45) Fig. 1107, and reconnection of the leads disconnected during removal procedures.

B. Assembly Procedure.

(1) Identify the four No. 4-40 x 5/8 inch long binder head machine screws, four .0.1875 inch O.D.x 1/4 inch long aluminum spacers, four No. 4 internal tooth lock washers, and four No. 4-40 hex nuts. (-46), (-47), (-48), and (-49) Fig. 1107, and use to secure the Oscillator/Amplifier/Driver Circuit Board Sub-Assembly, (45) Fig. 1107.

(2) Identify and reconnect leads disconnected at time of disassembly. Refer to Figures 502 and 503 for help in reconnecting wires disconnected during disassembly.

7. INSTALLATION OF CIRCUIT MODULE OSCILLATOR/AMPLIFIER/DRIVER SUB-ASSEMBLY.

A. General.

Reinstallation of the Circuit Module-Oscillator/Amplifier/Driver Sub-Assembly, (13) Fig. 1101, is completed as follows.

B. Assembly Procedure.

(1) Reconnect any wires removed during disassembly and restore lead dress. Reference to Figures 501,502, and 503 will be helpful in reconnecting the wires and restoring lead dress.

(2) Carefully swing sub-assembly over and down between ends of Transverter Base, (1) Fig. 1101, with components on circuit board toward interior of Transverter.

(3) Identify the five No. 4-40 x 1/2 inch long flat head, 82° countersink, machine screws, (-14) Fig. 1101, and secure sub-assembly from connector end, tighten securely.

(4) Identify the five No. 4-40 x 1/2 inch long binder head machine screws, (-15) Fig. 1101, and secure sub-assembly from opposite end of unit, tighten securely.

8. INSTALLATION OF INPUT AND OUTPUT CONNECTIONS NAMEPLATE

Carefully center Input and Output Connections Nameplate, (21) Fig. 1101, above the input and output connectors and press firmly in place to cause adhesive to stick to metal surface.

9. INSTALLATION OF COVER.

A. General.

Refer to Fig. 1101 and proceed as follows:

B. Installation Procedure.

(1) Places a thin coating of Dow Corning , No. 4 Compound, silicone lubricant on the edges of the Oscillator/Amplifier/Driver Circuit Module Sub-Assembly and the Transformer Mounting Chassis Pan Sub-Assembly.

(2) Place cover over unit and secure in place with hardware removed during disassembly in the following sequence.

(3) Identify the six No. 4-40 x 5/8 inch long binder head machine screws, (-23) Fig. 1101, and install at the bottom edge of cover.

CAUTION

UNDER NO CIRCUMSTANCES SHOULD HARDWARE LONGER THAN 3/8 INCH BE USED AT UPPER ROW, LEFT AND RIGHT SIDE, TO SECURE COVER.

(2) Identify the two No. 4-40 x 3/8 inch long fillister head (drilled) screws, (-25) Fig. 1101, and install at the front, connector end, lower, left and right edge of cover.

(3) Identify the twenty No. 4-40 x 3/8 inch long binder head machine screws, (-24) Fig. 1101, and completely secure cover to Transverter base.

(4) Place new PAI Warranty Seal, (-27) and Safety Tie Wire, (-26), Fig. 1101, through the drilled holes on No. 4-40 X 3/8 inch long, fillister head (drilled) screws, (-25) Fig 1101, and seal by crimping the Warranty Seal..

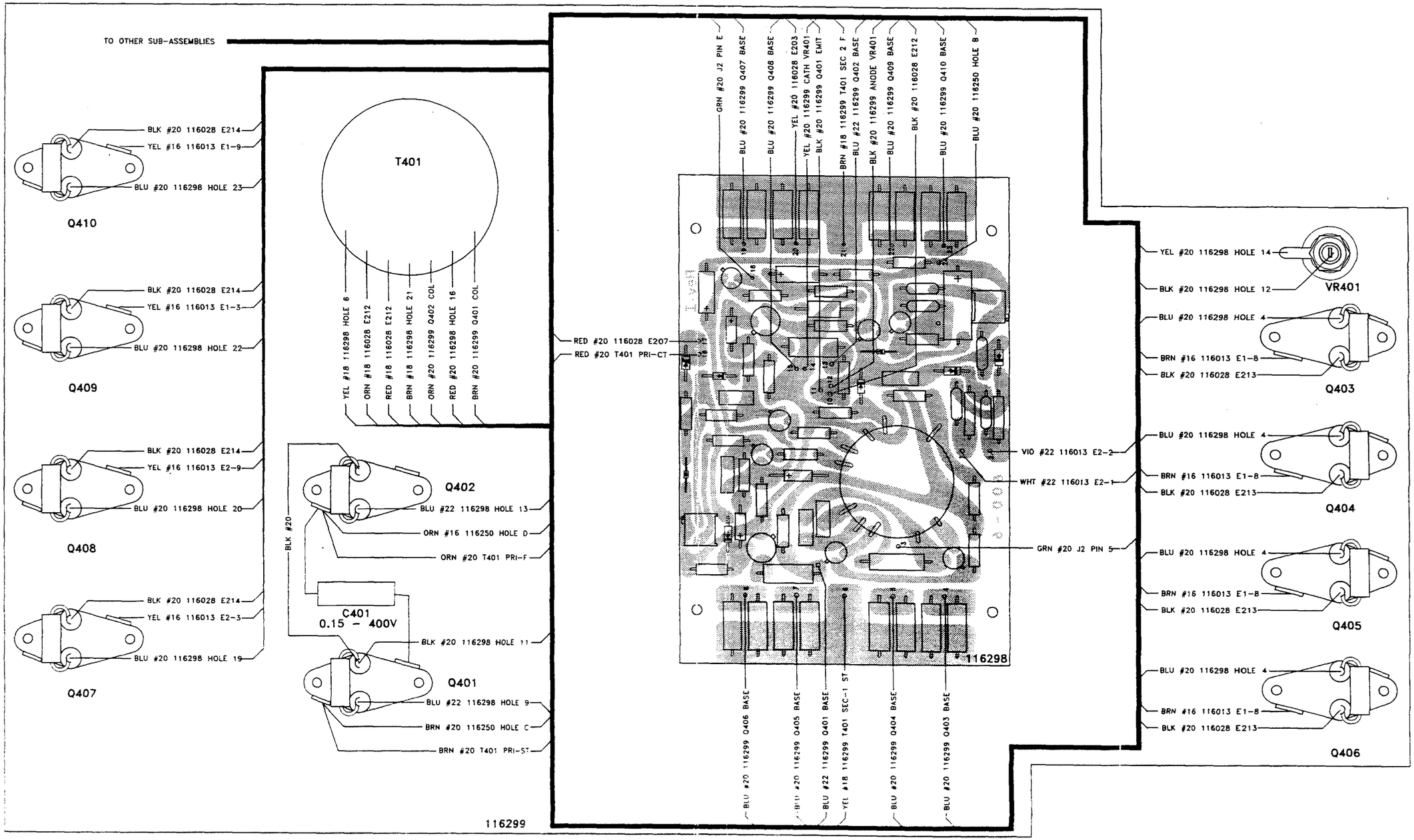


Figure 503. Wiring Diagram, Oscillator/Amplifier/Driver Circuit Module Sub-Assembly Figure 503

FITS AND CLEARANCES

Not Applicable to Solid-State Static Inverter.

No moving parts.

TESTING

1. GENERAL.

This section defines test procedures for the PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter). The procedures given are in sequential step form and test the unit completely. When the results of any step or test are not achieved the troubleshooting section of this manual should be consulted.

2. PERFORMANCE TESTS.

Performance tests are designed to provide a fast efficient method for complete check-out of the Transverter. Included in this paragraph is a list of test equipment required, the minimum performance requirements of the unit and procedures for connecting the unit for test.

A. Test Equipment Required.

The test equipment required to accomplish the performance tests consist of the following: Specially designed Test Set; 0-40 volt, 100 Ampere DC Power Supply; Oscilloscope; Insulation Resistance Tester; Distortion Analyzer; Frequency Counter; and Voltohmmeter. This equipment is listed and described in the Special Tools Section of this manual.

B. Minimum Performance Requirements.

The minimum performance requirement of the PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter) is to supply 115 volts, 400 Hertz sine wave, single phase, alternating current at 400 VA to operate aircraft instrumentation devices. Input power of 27.5 volts DC (nominal) is obtained from the aircraft's main DC power bus. The Performance Test Procedure of Fig. 701 defines the manufacturer's performance specifications with varying input, power factor, and load.

C. Preparation for Testing.

(1) Chassis Isolation Test. Perform the following steps to determine unit meets applicable specifications for chassis isolation.

WARNING

THE RECOMMENDED INSULATION TESTER PRODUCES POTENTIALLY DANGEROUS VOLTAGES. CARE IN OPERATION MUST BE EXERCISED TO PREVENT POSSIBLE ELECTRICAL SHOCK.

(a) Place POWER ON/OFF switch on Insulation Tester in the OFF position and connect line cord, three wire grounding type, to source of 115 volts AC, 60 Hz. Identify VOLTAGE ADJUST control and rotate to the extreme counterclockwise position. Connect the black lead with a spade mounting hole on the Transverter mounting flange. Identify MEGOHM MULTIPLIER control and position to the 100 position. Identify the HIGH VOLTAGE connection and connect test lead for use in subsequent paragraphs.

CAUTION

The Insulation Resistance Tester must be connected and operated in accordance with the following procedures to insure accurate testing and adequate protection to the equipment under test. Under no circumstances should the probes be connected to any point other than that specifically directed in the procedures given. In all cases the GROUND lead clip must be connected to the chassis of the unit being tested, (spot faced mounting hole on base or shell of connector).

(b) Identify HIGH VOLTAGE clip lead and connect to pin A of connector J1, +DC POSITIVE (+27.5V DC NOM), GROUND switch on Tester in the METERED RETURN position. Identify HIGH VOLTAGE CIRCUIT-ENERGIZE switch and operate to the ON position, red HIGH VOLTAGE lamp will light. Identify VOLTAGE ADJUST control and rotate clockwise until KILOVOLTS meter indicates .5 KILOVOLT (500 volts). Note reading of the MEGOHMMETER and multiply by the KILOVOLTS meter multiplied by the multiplying factor of 1, multiplied by the MEGOHMS MULTIPLIER to obtain reading in megohms. Return VOLTAGE ADJUST control to the extreme counter-clockwise position and place the HIGH VOLTAGE CIRCUIT-ENERGIZE switch in the OFF position. Disconnect the HIGH VOLTAGE test lead from the unit after metering indicates voltage has dropped to zero. Isolation of pin A of connector J1 to chassis ground must measure 5,000 megohms, minimum.

(c) Repeat procedures of paragraph (b) connecting HIGH VOLTAGE clip lead to pin B of connector J1. Isolation of pin B of connector J1, -DC NEGATIVE (-27.5V DC NOM), to chassis ground must measure 5,000 megohms, minimum.

(d) Repeat procedures of paragraph (b) connecting HIGH VOLTAGE clip lead to pin A of connector J2. Isolation of pin A of connector J2, FILTERED DC +28V OUTPUT, to chassis ground must measure 5,000 megohms, minimum.

(e) Repeat procedures of paragraph (b) connecting HIGH VOLTAGE clip lead to pin B of connector J2. Isolation of pin B of connector J2, L1-115 VAC (400 HZ) LINE, to chassis ground must measure 5,000 megohms, minimum.

(f) Repeat procedures of paragraph (b) connecting HIGH VOLTAGE clip lead to pin C of connector J2. Isolation of pin C of connector J2, LOAD EQUALIZATION to chassis ground must measure 5,000 megohms, minimum.

(g) Repeat procedures of paragraph (b) connecting HIGH VOLTAGE clip lead to pin D of connector J2. Isolation of pin D of connector J2, FREQUENCY SYNCHRONIZATION, to chassis ground must measure 5,000 megohms, minimum.

(h) Repeat procedures of paragraph (b) connecting HIGH VOLTAGE clip lead to pin E of connector J2. Isolation of pin E of connector J2, REMOTE ON/OFF SWITCH, to chassis ground must measure 5,000 megohms, minimum.

(i) Repeat procedures of paragraph (b) connecting HIGH VOLTAGE clip lead to pin F of connector J2. Isolation of pin F of connector J2, REMOTE ON/OFF SWITCH RETURN, to chassis ground must measure 5,000 megohms, minimum.

(j) Repeat procedures of paragraph (b) connecting HIGH VOLTAGE clip lead to pin G of connector J2. Isolation of pin G of connector J2, L2-115 VAC (400 HZ) NEUTRAL, to chassis ground must measure 5,000 megohms, minimum.

(k) Repeat procedures of paragraph (b) connecting HIGH VOLTAGE clip lead to pin H of connector J2. Isolation of pin H of connector J2, SPARE, to chassis ground must measure 5,000 megohms, minimum.

(l) Place POWER switch on the Insulation Tester in the OFF position and disconnect Insulation Resistance Tester before proceding with subsequent performance testing..

(2) Complete the following steps to prepare Transverter for performance testing. Refer to Fig. 701 for equipment and interconnection.

(a) Place ON/OFF switch on the DC Power Supply in the OFF position.

(b) Identify DC Power Cable P.N. 096172-1 and connect positive lead to the positive terminal on the DC Power Supply and the negative lead to the negative terminal of the DC Power Supply. Connect the Pendant connector plug P3 to receptacle J1 on the Inverter Test Set.

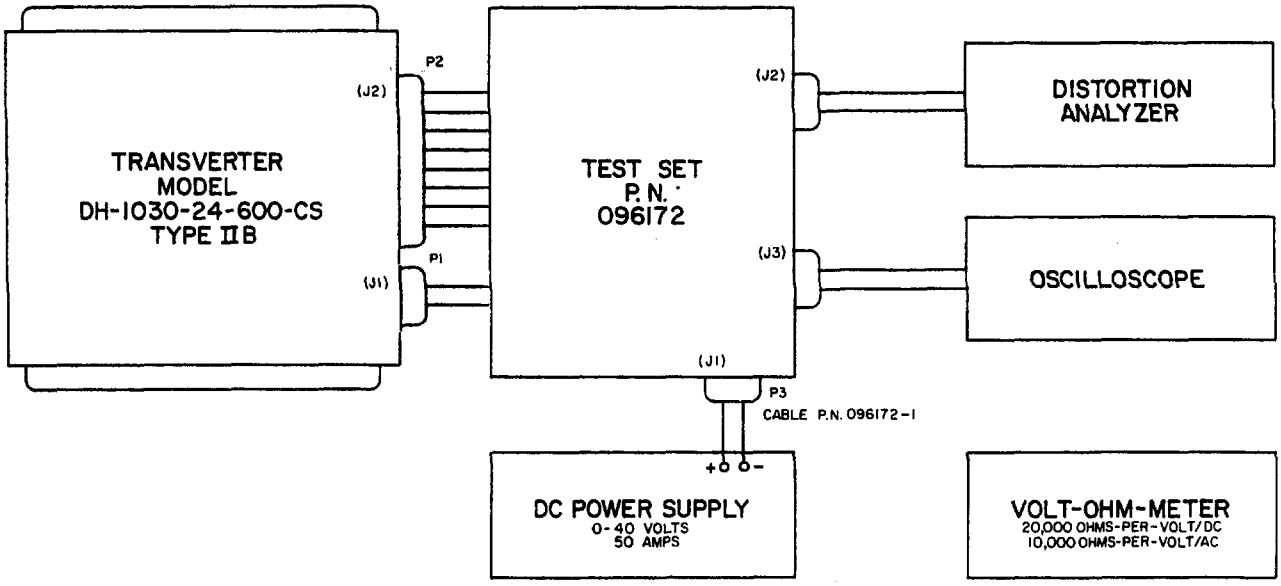
(c) Refer to Table 701 and proceed with performance tests noting carefully the interconnection of additional test equipment as required to complete the performance tests.

D. Performance Test.

NOTE

REMOVE COVER TO PERFORM ADJUSTMENTS AS INDICATED IN THE TEST PROCEDURES.

The procedures of the performance test listed in numbered steps in Table 701 should be accomplished in the sequence presented. In the event the required result is not obtained, the troubleshooting section should be consulted and the malfunction corrected before proceeding to the next step.



Test Set-up, PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter)
Figure 701

STEP	SET-UP	PROCEDURE	RESULT
1.	Interconnect per Fig. 701 and par. 2.c. Test Button A, OFF,on Inverter Test Set, depressed. Button is illuminated by lamp DS1, S1A.	(a) Apply power to all measuring equipment for warm-up. (b) Check polarity of DC Power Supply and connect to Test Set.	
2.	OFF Button A on Inverter Test Set depressed, Button is illuminated by lamp DS1, S1A.	Apply power to DC Power Supply and increase voltage to 28.0 volts DC as indicated on DC VOLTS Meter M3 on Inverter Test Set.	Input current as indicated by DC AMPERES Meter M4 on Inverter Test Set should not exceed1.0 Ampere. OSCILLATOR/EQUALIZATION Meter M6 on Inverter Test Set should indicate 110 microamperes ± 15 microamperes.
3.	NO LOAD Button B on Inverter Test Set depressed, Button is illuminated by lamp DS2, S1B.	(a) Input voltage set at 28.0 volts DC. (b) Adjust Transverter resistor R324 as required for a reading of 115 volts AC. (c) Adjust frequency by selection of capacitor C302 and/or C303 in oscillator circuit of Transverter	Input current as indicated by DC AMPERES Meter M4 on Inverter Test Set should not exceed 3.0 Amperes. Output voltage as indicated by AC VOLTS Meter M2 on Inverter Test Set should be 115 volts. FREQUENCY Meter M5 should read 400 Hertz, ± 4 Hertz. OSCILLATOR/EQUALIZATION Meter M6 indicates 110 microamperes ± 15 micro-amperes.
4.	400 VA UNITY Button D on Inverter Test Set depressed, Button is illuminated by lamp DS4, S1d. Distortion Analyzer con-nected to J3, DISTORTION ANALYZER Output on Inverter Test Set.	(a) Input voltage set at 28.0 volts DC. (b) Adjust Transverter resistor R324 as required for a reading of 115 volts AC. (c) Adjust balance resistor R307 for minimum harmonic distortion. (d) Adjust load equalizer resistor R103 as required.	Input current as indicated by DC AMPERES Meter M4 on Inverter Test Set should not exceed 20 Amperes Output current as indicated by AC AMPERES Meter M1 on Inverter Test Set should be approximately 3.5 Amperes. Output voltage as indicated by AC VOLTS Meter M2 on Inverter Test Set should be 115 volts. Distortion Analyzer should read less that 5% distortion, typical reading 2.5 to 3.5%. OSCILLATOR/EQUALIZATION Meter M6 should indicate 150 microamperes.
5.	NO LOAD Button B on Inverter Test Set depressed, Button is illuminated by lamp DS2, S1B. Distortion Analyzer connected as in preceding Step 4.	Input voltage set at 28.0 volts DC.	Input current as indicated by DC AMPERES Meter M4 on Inverter Test Set should not exceed 3.0 Amperes. Output voltage as indicated by AC VOLTS Meter M2 on Inverter Test Set should be 115 volts. FREQUENCY Meter M5 should indicate 400 Hertz, ± 4 Hertz.

Performance Test Procedure
Table 701 (sheet 1 of 3)

STEP	SET-UP	PROCEDURE	RESULT
5. (Cont)			Distortion Analyzer should read less that 7% distortion, typical reading 4.6 to 6.0%.
6.	200 VA UNITY Button C on Inverter Test Set depressed, Button is illuminated by lamp DS3, S1C. Distortion Analyzer connected as in preceding Step 4.	(a) Reduce input voltage to 16.0 volts DC.	Output voltage as indicated by AC VOLTS Meter M2 on Inverter Test Set should indicate 100 volts AC,minimum.
		(b) Increase input voltage towards 40 volts DC.	Inverter should shut down as indicated by AC VOLTS Meter M2 indicating 0 volts at input voltage of 39 volts DC ± 2 volts.
		(c) Reduce input voltage to 28.0 volts DC.	
7.	400 VA UNITY Button D on Inverter Test Set depressed, Button is illuminated by lamp DS4, S1D. Distortion Analyzer connected as in preceding Step 4.	(a) Input voltage set at 28.0 volts DC.	Input current as indicated by DC AMPERES Meter M4 on Inverter Test Set should not exceed 20.0 Amperes Output voltage as indicated by AC VOLTS Meter M2 on Inverter Test Set should indicate 115 volts AC ± 5 volts. FREQUENCY Meter M5 should indicate 400 Hertz, ± 4. Distortion Analyzer should read less that 5% distortion, typical reading 2.5 to 3.5%.
		(b) Vary input voltage from 18-36 volts DC, taking readings at 2 volt intervals from 18-30 volts and at 36 volts.	Distortion Analyzer should read less than 5% from 18-30 volts DC (over 30 volts distortion will normally exceed 5%).
8.	600 VA UNITY Button E on Inverter Test Set depressed, Button is illuminated by lamp DS5, S1E. Distortion Analyzer connected as in preceding Step 4.	Input voltage set at 28.0 volts DC.	Input current as indicated by DC AMPERES Meter M4 on Inverter Test Set should not exceed 30.0 Amperes Output voltage as indicated by AC VOLTS Meter M2 on Inverter Test Set should read 115 volts AC ± 5 volts. FREQUENCY Meter M5 should indicate 400 Hertz, ± 4 Hertz Distortion Analyzer should read less that 5% distortion, typical reading 3.0 to 4.0%.
9.	400 VA .80 LAG Button F on Inverter Test Set depressed, Button is illuminated by lamp DS6, S1F. Distortion Analyzer and Frequency Meter connected as in preceding Step 3.	Input voltage set at 28.0 volts DC.	Input current as indicated by DC AMPERES Meter M4 on Inverter Test Set should not exceed 17.0 Amperes Output voltage as indicated by AC VOLTS Meter M2 on Inverter Test Set should indicate 115 volts AC ± 5 volts. FREQUENCY Meter M5 should indicate 400 Hertz, ± 4 Hertz Distortion Analyzer should read less that 5% distortion, typical reading 3.0 to 4.0%.

Performance Test Procedure
Table 701 (Sheet 2 of 3)

STEP	SET-UP	PROCEDURE	RESULT
10.	400 VA .95 LEAD Button G on Inverter Test Set depressed, Button is illuminated by lamp DS7, S1G. Distortion Analyzer connected as in preceding Step 4.	(a) Input voltage set at 28.0 volts DC. (b) Adjust balance resistor R307, if necessary, to obtain minimum distortion.	Input current as indicated by DC AMPERES Meter M4 on Inverter Test Set should not exceed 20.0 Amperes Output voltage as indicated by AC VOLTS Meter M2 on Inverter Test Set should read 115 volts AC ± 5 volts. Frequency Meter M5 should indicate 400 Hertz, ± 4.
11.	SHORT Button H on Inverter Test Set is depressed, starting automatic 5 second, timed short circuit of AC output of Transverter, Button is illuminated by lamp DS8, S1H.	Input voltage set at 28.0 volts DC.	Input current as indicated by DC AMPERES Meter M4 on Inverter Test Set should not exceed 35.0 to 50.0 Amperes Output current as indicated by AC AMPERES Meter M1 on Inverter Test Set should be 7.0 Amperes, (min), typical reading 8.0 - 9.0 Amperes
12.	400 VA UNITY Button D on Inverter Test Set depressed, Button is illuminated by lamp DS4, S1D. Distortion Analyzer connected as in preceding Step 4.	(a) Input voltage set at 28.0 volts DC. (b) Final check of output voltage, frequency, equalization, and distortion. (c) Check parallel phasing by observing phasing indicator.	Input current as indicated by DC AMPERES Meter M4 on Inverter Test Set should not exceed 20.0 Amperes Output voltage as indicated by AC VOLTS Meter M2 on Inverter Test Set should indicate 115 volts AC ± 2 volts. FREQUENCY Meter M5 should indicate 400 Hertz, ± 4. Distortion Analyzer should read less that 5% distortion, typical reading 2.5 to 3.5%. OSCILLATOR/EQUALIZATION Meter M6 should indicate 150 microamperes. Phasing indicator DS10, green.
13.	OFF Button A on Inverter Test Set depressed, Button is illuminated by lamp DS1, S1A. Test procedures are completed.	(a) Input voltage from external DC Power Supply returned to zero. ON/OFF switch on DC Power Supply in the OFF position. (b) Disconnect DC Power Supply from Inverter Test Set. (c) Disconnect Transverter from Inverter Test Set and replace cover per applicable assembly instructions.	

Performance Test Procedure
Table 701 (Sheet 3 of 3)

TROUBLESHOOTING

1. GENERAL.

This section outlines in tabular form information for use in localization and isolation of trouble in the PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter). The troubleshooting procedures, Table 801, together with the information given in preceding section on Testing will in most cases localize and isolate the trouble. Reference to the schematic diagram, Fig. 1201, and the section on Detailed Theory will be necessary and helpful. The voltage measurements of Table 802 in conjunction with the waveforms illustrated in Fig. 801 will aid in isolation of trouble.

2. TROUBLESHOOTING.

A. Localization.

The troubleshooting table, Table 801, provides a means of localizing malfunctions to a replaceable component or sub-assembly. The table is arranged in the same order of precedence as the performance tests, Table 701, in the preceding section. The applicable step of the performance test is shown in parentheses next to the trouble shooting step in the STEP column, in Table 801.

B. Isolation.

The voltage measurements of Table 802 are made using the volt-ohmmeter described in the Special Tools Section of this manual. Reference to the schematic diagram while making voltage measurements will aid in isolation of trouble within the unit.

C. Analysis.

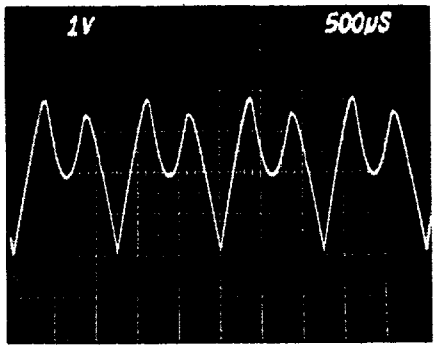
The waveforms pictured in Fig. 801 were made using the oscilloscope described in the Special Tools Section of this manual, and will aid in analyzing the equipment performance when troubleshooting procedures are being performed.

STEP	SYMPTOM	PROBABLE CAUSE	CHECK	REMEDY
1(2)	No current drain.	Transistor Q301 or Q302 inoperative.	Check voltage at base, collector, and emitter of Transistors Q301 and Q302 for proper voltage.	Replace defective transistor/s.
		Input polarity reversed.	Check connection of DC Power Supply and polarity of output.	Reverse output connection.
		Polarity protect Diode CR9 open.	Check continuity of circuit through Diode CR9 and Reactor L2.	Replace defective diode.
2(2)	High current drain.	Transistors Q401 and Q402 defective, shorted.	Check voltages at base, collector, and emitter of Transistors Q401 and Q402 for proper voltage.	Replace defective transistor.
		Transistor Q403 thru Q410 defective.	Check base drive resistors and transistor voltages.	Replace defective component
		Capacitor C206 shorted.	Check Capacitor C206 for short.	Replace defective capacitor.
3(3)	AC output voltage high or low, no load.	Resistor R324 not adjusted.	Check operation of Resistor R324 by adjustment noting change in output voltage.	Adjust Resistor R324 to obtain proper output voltage.
		Transistor Q308 or Q309 defective.	Check voltages at base, collector, and emitter of Transistors Q308 and Q309 for proper voltage.	Replace defective transistor.
		Zener Diode VR302 defective.	Check voltages at Zener Diode VR302.	Replace defective Zener diode.
		Diodes CR205 or CR206 defective.	Check for presence of negative voltage at junction of diodes CR205 and CR206, and Resistor R229.	Replace defective diode.
4(3)	Frequency high or low.	Capacitor C301, C302, or C303 defective or of improperly selected value.	Check value and test by substitution for proper value	Replace defective capacitor.
5(4)	Distortion above 5%	Zener Diode VR401, or Capacitors C201, C202, or C203 defective	Check VR401 voltage at junction of Zener diode VR401 and resistor R201, for proper value, -15 volts ± 5%,	Replace defective Zener diode.
			Check Capacitors for excess leakage or open condition.	Replace defective capacitor.
6(4)	AC output voltage high or low, with 400 VA 1.0 UNITY P,F. Load.	Repeat preceding step 3(3).	Repeat preceding step 3(3).	Repeat preceding step 3(3).
7(4)	AC output voltage cannot be increased to 115 volts AC.	Defect in control circuit, Transistor Q309, resistor R324, or Zener diode VR301.	Short emitter of Q303 and Q304 to negative bus at -27.5 volt DC point, voltage will increase to approximately 135 volts AC.	Replace defective component in control circuit

Trouble Shooting Chart
Table 801 (Sheet 1 of 2)

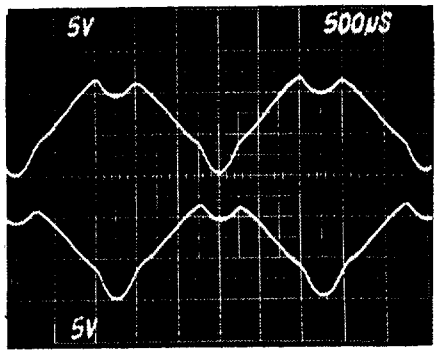
STEP	SYMPTOM	PROBABLE CAUSE	CHECK	REMEDY
8(4)	Transistors Q401 and /or Q402 operate with high heat rise.	Transistors Q305 and/or Q306 low output or inoperative.	Check voltages and waveforms at transistor base,colloector and emitter.	Replace defective transistor or pair of transistors.
9(4)	Transverter output drops off when input voltage exceeds 26 to 28 volts DC.	Zener Diode VR301 breaking down.	Check voltages at Zener diode VR301 and resistor R313.	Replace defective Zener diode.
10	Transverter operates on preinstallation check, will not operate in aircraft.	Defect in aircraft wiring.	Check for voltage at breakers and primary power source in aircraft.	Correct wiring defect.
			Check for shorted load by opening breaker to AC load in aircraft while power is applied to input of Transverter.	Correct short in line or load.

Trouble Shooting Chart
Table 801 (Sheet 2 of 2)

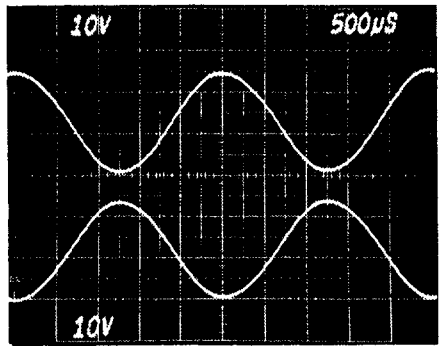


A. WAVEFORM AT EMITTER OF TRANSISTORS Q301 AND Q302
28 VOLTS DC INPUT, 400 WATT LOAD, 1.0 UNITY P.F.
VERTICAL SENSITIVITY: 1.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION

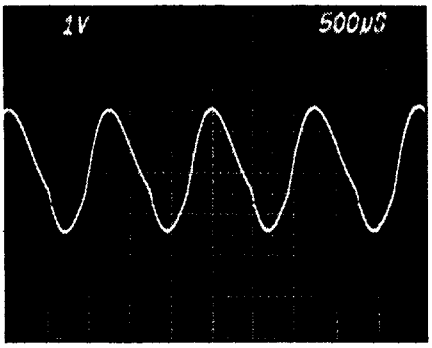
Waveform Measurements, PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter)
Figure 801 (Sheet 1 of 4)



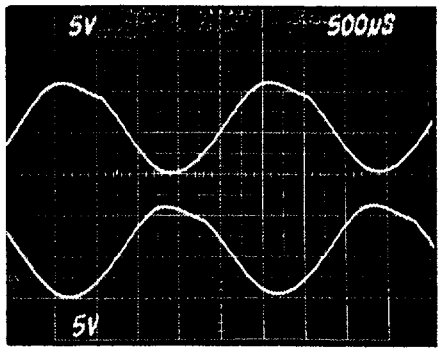
B. WAVEFORMS AT BASE OF TRANSISTORS Q301 AND Q302
28 VOLTS DC INPUT, 400 WATT LOAD, 1.0 UNITY P.F.
VERTICAL SENSITIVITY: 5.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



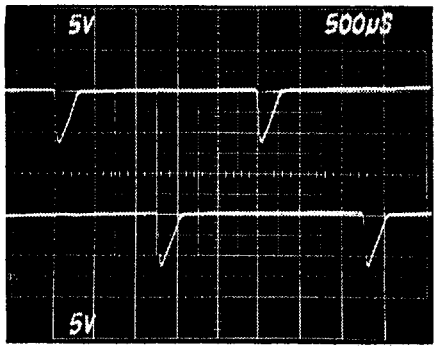
C. WAVEFORMS AT COLLECTOR OF TRANSISTORS Q301 AND Q302
28 VOLTS DC INPUT, 400 WATT LOAD, 1.0 UNITY P.F.
VERTICAL SENSITIVITY: 10.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



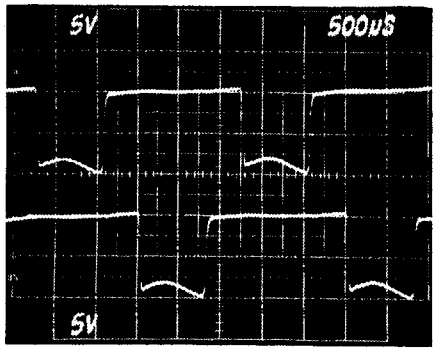
D. WAVEFORM AT EMITTER OF TRANSISTORS Q303 AND Q304
28 VOLTS DC INPUT, 400 WATT LOAD, 1.0 UNITY P.F.
VERTICAL SENSITIVITY: 1.0 VOLT/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



E. WAVEFORMS AT BASE OF TRANSISTORS Q303 AND Q304
28 VOLTS DC INPUT, 400 WATT LOAD, 1.0 UNITY P.F.
VERTICAL SENSITIVITY: 5 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION

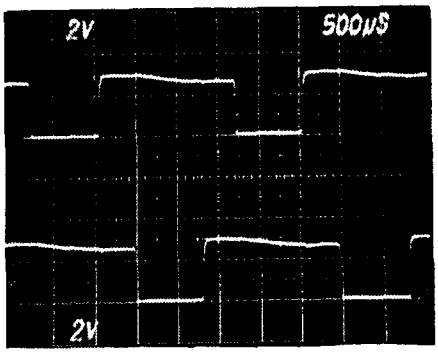


F. WAVEFORMS AT COLLECTORS OF TRANSISTORS Q303 AND Q304
28 VOLTS DC INPUT, NO LOAD.
VERTICAL SENSITIVITY: 5 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION

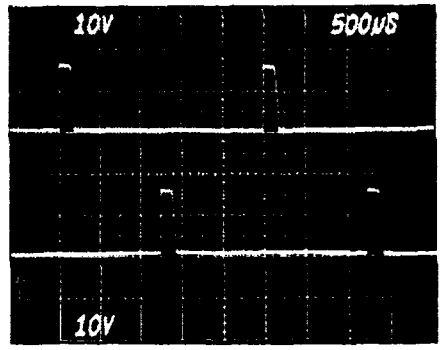


G. WAVEFORMS AT COLLECTOR OF TRANSISTORS Q303 AND Q304
28 VOLTS DC INPUT, 400 WATT LOAD, 1.0 UNITY P.F.
VERTICAL SENSITIVITY: 5.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION

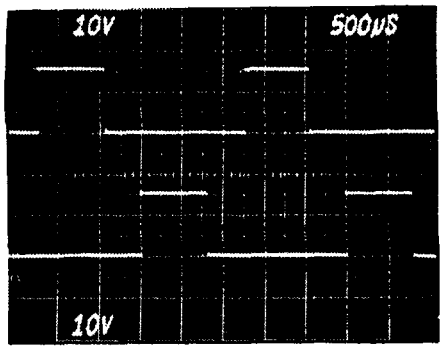
Waveform Measurements, PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter) Figure 801 (Sheet 2 of 4)



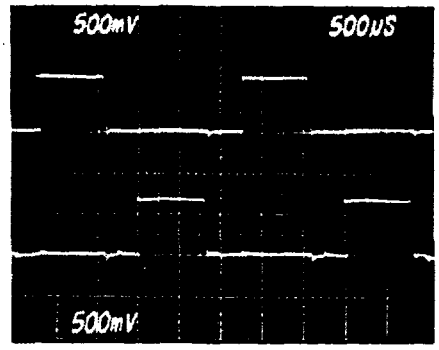
H. WAVEFORMS AT BASE OF TRANSISTORS Q305 AND Q306
28 VOLTS DC INPUT, 400 WATT LOAD, 1.0 UNITY P.F.
VERTICAL SENSITIVITY: 2.0 VOLTS DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



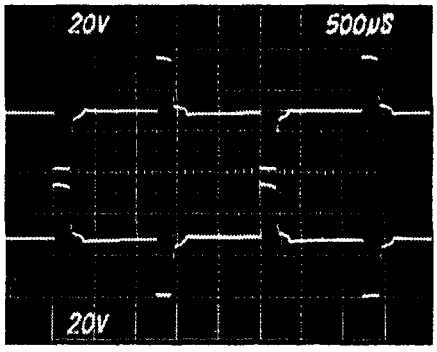
I. WAVEFORMS AT COLLECTORS OF TRANSISTORS Q305 AND Q306
28 VOLTS DC INPUT, NO LOAD
VERTICAL SENSITIVITY: 10.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



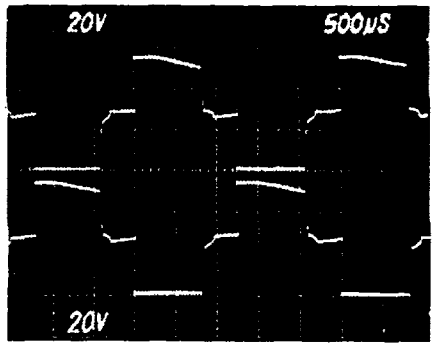
J. WAVEFORMS AT COLLECTOR OF TRANSISTORS Q305 AND Q306
28 VOLTS DC INPUT, 400 WATT LOAD, 1.0 UNITY P.F.
VERTICAL SENSITIVITY: 5.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



K. WAVEFORM AT BASE OF TRANSISTORS Q401 AND Q402
28 VOLTS DC INPUT, 400 WATT LOAD, 1.0 UNITY P.F.
VERTICAL SENSITIVITY: 500 MILLIVOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION

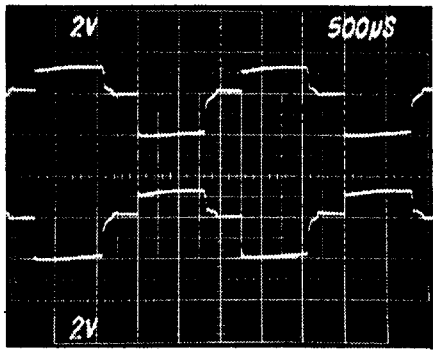


L. WAVEFORMS AT COLLECTORS OF TRANSISTORS Q401 AND Q402
28 VOLTS DC INPUT, NO LOAD
VERTICAL SENSITIVITY: 20.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION

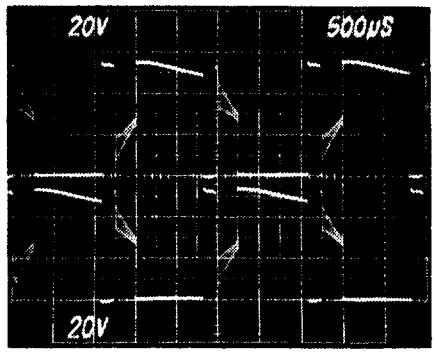


M. WAVEFORMS AT COLLECTORS OF TRANSISTORS Q401 AND Q402
28 VOLTS DC INPUT, 400 WATT LOAD, 1.0 UNITY P.F.
VERTICAL SENSITIVITY: 20.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION

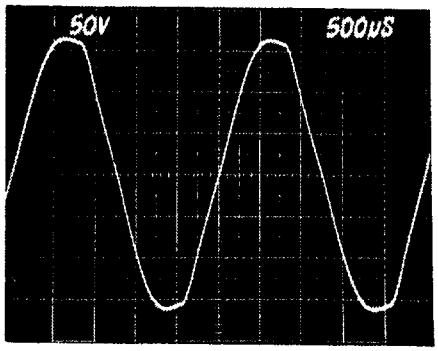
Waveform Measurements, PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter)
Figure 801 (Sheet 3 of 4)



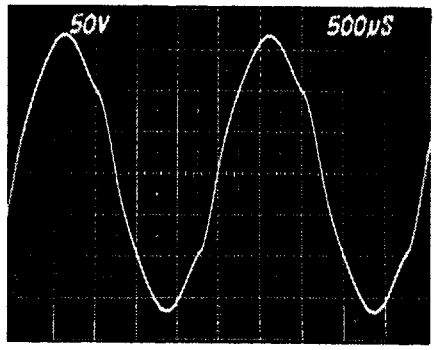
N. WAVEFORMS AT BASES OF TRANSISTORS Q403 THRU Q410
28 VOLTS DC INPUT, 400 WATT LOAD, 1.0 UNITY P.F.
VERTICAL SENSITIVITY: 2.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



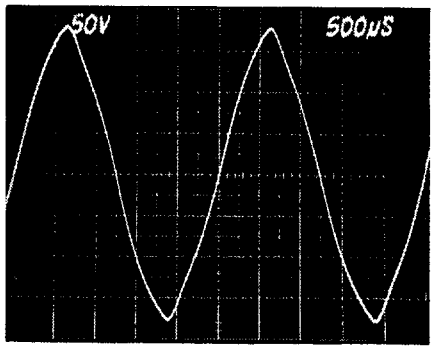
O. WAVEFORMS AT COLLECTORS OF TRANSISTORS Q403 THRU Q410
28 VOLTS DC INPUT, 400 WATT LOAD, 1.0 UNITY P.F.
VERTICAL SENSITIVITY: 20.0 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



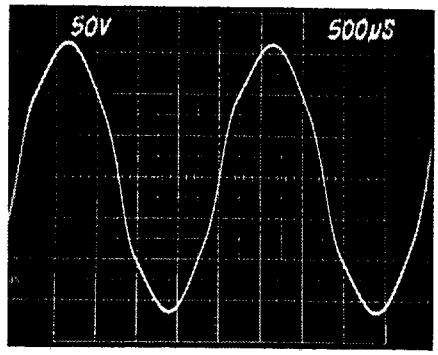
P. WAVEFORM AT OUTPUT CONNECTOR J2 (PINS B-G)
28 VOLTS DC INPUT, 400 WATT LOAD, 1.0 UNITY P.F.
VERTICAL SENSITIVITY: 50 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



Q. WAVEFORM AT OUTPUT CONNECTOR J2 (PINS B-G)
28 VOLTS DC INPUT, 400 WATT LOAD, 0.8 LAGGING P.F.
VERTICAL SENSITIVITY: 50 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



R. WAVEFORM AT OUTPUT CONNECTOR J2 (PINS B-G)
28 VOLTS DC INPUT, 400 WATT LOAD, 0.95 LEADING P.F.
VERTICAL SENSITIVITY: 50 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION



S. WAVEFORM AT OUTPUT CONNECTOR J2 (PINS B-G)
28 VOLTS DC INPUT, NO LOAD
VERTICAL SENSITIVITY: 50 VOLTS/DIVISION
TIME BASE: 500 MICROSECONDS/DIVISION

Waveform Measurements, PAI P.N. DH-1030-24-600-CS, Type IIB,
Solid-State Static Inverter (Transverter)
Figure 801 (Sheet 4 of 4)

TRANSISTOR	BASE	COLLECTOR	EMITTER
Q301	1.60V	14.78V	3.87V
Q302	1.60V	14.78V	3.87V
Q303	0.40V	10.28V	3.63V
Q304	0.40V	10.28V	3.63V
Q305	16.16V	4.62V	15.12V
Q306	16.16V	4.62V	15.12V
Q307	6.65V	7.46V	5.98V
Q308	0.63V	2.75V	0.0V
Q309	2.94V	0.0V	3.63V
Q401	0.21V	26.46V	0.01V
Q402	0.21V	26.46V	0.01V
Q403	-0.23V	26.28V	0.04V
Q404	-0.23V	26.28V	0.04V
Q405	-0.23V	26.28V	0.04V
Q406	-0.23V	26.28V	0.04V
Q407	-0.23V	26.28V	0.04V
Q408	-0.23V	26.28V	0.04V
Q409	-0.23V	26.28V	0.04V
Q410	-0.23V	26.28V	0.04V

TEST POINT	VOLTAGE
Junction of anode of diode CR9, reactor L2 and terminal E102, paralleling control circuit board.	27.48V
Junction of resistors R102 and R103, paralleling control circuit board, hole A and pin C of connector J2.	10.10V
Terminal E203, cathode of VR401, junction of resistors R326, R318, R322, R303, R310, R311, R312, and cathode of diode CR302.	15.12V
Junction of diodes CR305, CR306, and Resistor R328.	-15.52V
Junction of terminal E207 and cathode of diode CR9 (E3)	26.61V

NOTES:
Phoenix Aerospace Inc. Inverter Test Set P.N. 096172 connected to Transverter.
Test Button D 400 VA UNITY pressed..
Input from DC Power Supply
Voltage 28.0 Volts DC
Current 18.0 Amperes ± 2.0 A.
Voltage measurements between reference point and (–) negative side of primary power.
All voltages are DC.
Measured with digital Volt-ohmmeter, Fluke Model 8040A, or equivalent.

Voltage Measurements, PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter) Table 802

STORAGE INSTRUCTIONS

1. GENERAL.

This section provides information preparing the PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter) for use from a shipped or stored condition and for packing the unit for storage or shipment.

2. PREPARATION FOR USE.

The Transverter, when shipped from the factory, is mounted on a wood composition board, secured with 1/4-20 hardware, surrounded by 2 inch high density foam inserts, and enclosed in a corrugated shipping carton, PPP-B-636. To unpack the unit, cut sealing tape and open top of carton by lifting flaps to break adhesive. Remove foam inserts and remove unit from carton, and remove hardware securing unit to wood composition board. Visually examine the unit for damage which might have occurred during shipment or storage.

3. PREPARATION FOR STORAGE OR SHIPMENT.

The Transverter may be stored for short periods of time without packing. If the unit is to be stored for extended periods or is to be shipped, it is recommended that the unit be returned to the original shipping carton.. The carton should then be sealed and labeled for storage.

SPECIAL TOOLS, FIXTURES, AND EQUIPMENT

1. GENERAL.

This section provides information on the special tools and test equipment required for overhaul of the PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter).

2. STANDARD TEST EQUIPMENT.

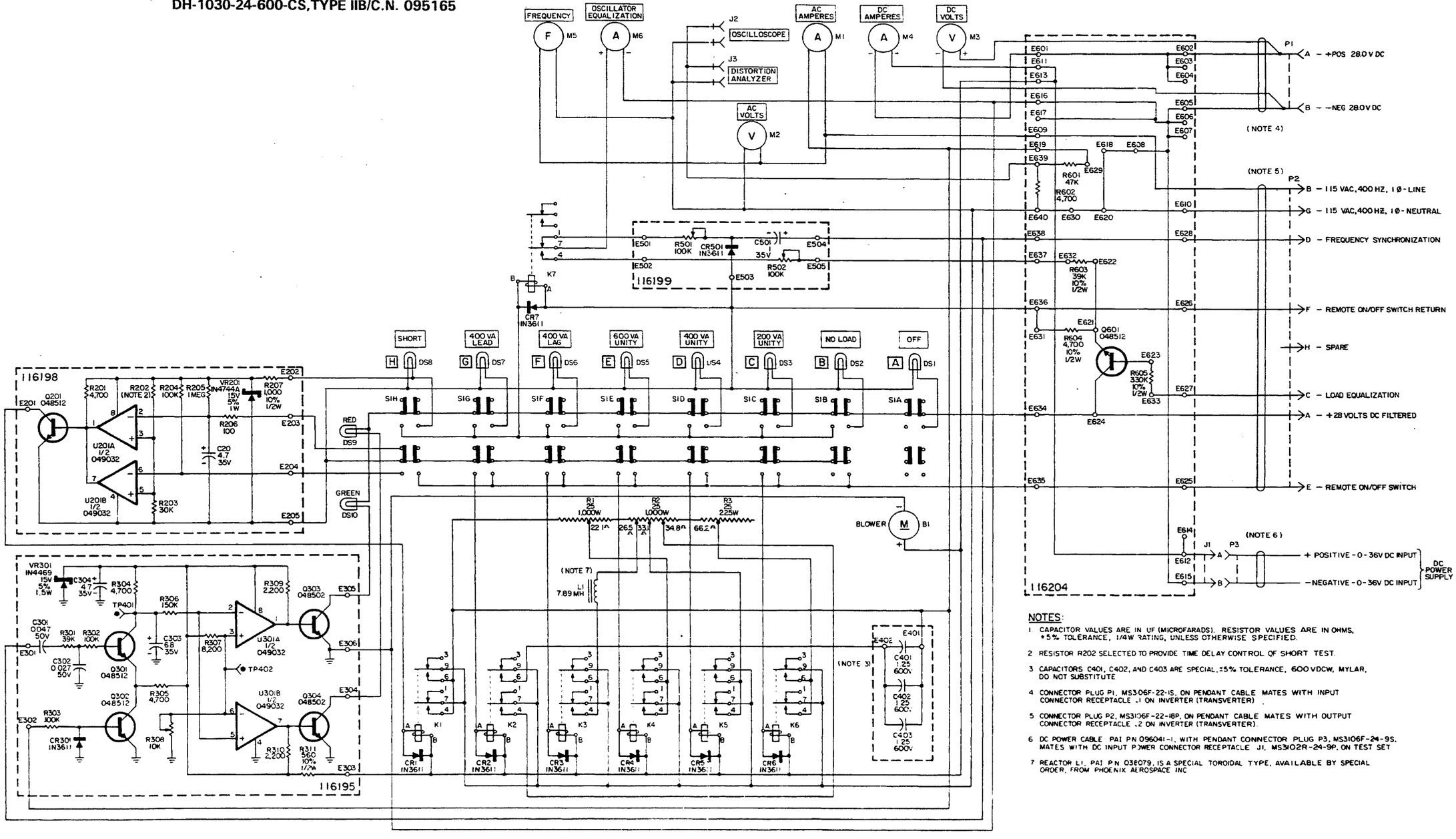
Listed in Table 1001 are the items of standard test equipment required for overhaul of the Transverter. The listed item or suitable equivalent may be used if procedures are modified when references to test equipment are made.

EQUIPMENT	MANUFACTURER	MODEL NUMBER
OSCILLOSCOPE	HEWLETT-PACKARD	MODEL 132A
DISTORTION ANALYZER	HEWLETT-PACKARD	MODEL 333A
FREQUENCY COUNTER	HEWLETT-PACKARD	MODEL 5512A
DIGITAL VOLT-OHMMETER	JOHN F. FLUKE	MODEL 8040A
DC POWER SUPPLY	0-40 VOLTS DC 0-100 AMPERES	
INSULATION RESISTANCE TESTER	ASSOCIATED RESEARCH	MODEL 2956

Standard Test Equipment
Table 1001

3. SPECIAL TEST EQUIPMENT:

The special test equipment consists of only one item. This is a Test Set available either from Phoenix Aerospace, Inc. or readily fabricated locally. The toroidal reactor is available separately from Phoenix Aerospace, Inc. when the user desires to fabricate the Test Set. The schematic diagram is shown in Fig. 1001. All parts are listed with values and ratings to aid in local procurement for fabrication.



NOTES:

1. CAPACITOR VALUES ARE IN UF (MICROFARADS). RESISTOR VALUES ARE IN OHMS, ±5% TOLERANCE, 1/4W RATING, UNLESS OTHERWISE SPECIFIED.
2. RESISTOR R202 SELECTED TO PROVIDE TIME DELAY CONTROL OF SHORT TEST.
3. CAPACITORS C401, C402, AND C403 ARE SPECIAL, ±5% TOLERANCE, 600 VDCW, MYLAR, DO NOT SUBSTITUTE
4. CONNECTOR PLUG P1, MS3106F-22-1S, ON PENDANT CABLE MATES WITH INPUT CONNECTOR RECEPTACLE J1 ON INVERTER (TRANSVERTER)
5. CONNECTOR PLUG P2, MS3106F-22-18P, ON PENDANT CABLE MATES WITH OUTPUT CONNECTOR RECEPTACLE J2 ON INVERTER (TRANSVERTER).
6. DC POWER CABLE PAI P/N 096041-1, WITH PENDANT CONNECTOR PLUG P3, MS3106F-24-9S, MATES WITH DC INPUT POWER CONNECTOR RECEPTACLE J1, MS3102R-24-9P, ON TEST SET
7. REACTOR L1, PAI P/N 036079, IS A SPECIAL TOROIDAL TYPE, AVAILABLE BY SPECIAL ORDER, FROM PHOENIX AEROSPACE INC

Schematic Diagram,
PAI P.N. 096172, Inverter Test Set, for PAI P./N. DH-1030-24-600-CS, Type IIB,
Solid-State Static Inverter (Transverter)
Figure 1001

ILLUSTRATED PARTS CATALOG SECTION

1. INTRODUCTION.

This section of the Overhaul Manual provides a complete listing of parts for the PAI P.N. DH-1030-24-600-CS/Type IIB Solid-State Static Inverter (Transverter) as manufactured by Phoenix Aerospace Inc.

2. PURPOSE.

The information contained in this section is supplied to aid in provisioning, requisitioning, storing, and issuing of the replaceable parts, and to aid in identification of new and reclaimed parts.

3. APPLICATION.

The Illustrated Parts Catalog Section contains three separate listings: Numerical Index, Symbol Index, and Detailed Parts List. The subsequent paragraphs define the content and application of each listing.

A. Numerical Index.

The Numerical Index provides an alphanumerical listing of the parts listed in the Detailed Parts List. The prime function being to aid in rapid location using the information contained in the various columns.

(1) The PAI PART NUMBER column lists part numbers of procurable parts and assemblies as listed in the Detailed Parts List. Parts are listed in - alphanumerical order of precedence starting at the first letter extreme left and reading to the right as follows:

Letters A through Z
Numerals 0 through 9
(Alphabetical O's are considered as numerical zeros).

Second and succeeding positions of the part number appear in the order of precedence as follows:

Space (Blank column)
Diagonal (Slant) /
Point (Period)
Dash (-)
Letters A through Z
Numerical 0 through 9
(Alphabetical O's are considered as numerical zeros).

(2) Vendor Part Number Column.

The VENDOR PART NO. column lists the actual part number of the manufacturer supplying the part to Phoenix Aerospace Inc.

(3) Chapter-Section-Unit-Figure-Item Column.

The CH-SECT-UNIT-FIG.-ITEM column contains the specific location data where the listed part first appears in the Detailed Parts List and other pertinent data. Example: 24-20-00-1101-18 is indicative of the following:

24 is significant of the Chapter (derived from system identification numbers).
20 is significant of the Section (derived from sub-system identification numbers).
00 is significant of the Unit (derived from the application of particular unit).
1101 is significant of the Figure number.
18 is significant of the Item number

(4) Total Required Column.

The TTL REQ. column is the total of each item required in the unit whether it be piece part or sub-assembly.

B. Symbol Index.

The Symbol Index enables the location of component parts referenced from the schematic diagram by the reference symbol to a specific Figure and Item Number.

(1) Symbol Column.

The SYMBOL column contains an alpha-numerical listing of every component part which carries a reference symbol on the schematic diagram.

(2) PAI Part Number Column.

The PAI PART NUMBER column lists the vendor part number of the symbolized item.

(3) Chapter-Section-Unit-Figure-Item Column.

The CH-SECT-UNIT-FIG.-ITEM column contains the specific location data where the listed part appears in the Detailed Parts List and other pertinent data. (See preceding para. 3.A.(3) for example of information.

C. Detailed Parts List.

The Detailed Parts List is a breakdown of the complete unit into sub-assemblies and detailed parts. Each sub-assembly is listed in its order of disassembly and is followed immediately by its component parts properly indented to show its relationship to the assembly.

(1) Figure Item Column.

The FIG. ITEM column entries, key the parts breakdown to the applicable illustration. Items numbered on the Detailed Parts List preceded by a dash (Example: -1) do not appear on the illustration.

(2) PAI Part Number Column.

The PAI PART NUMBER column lists the applicable Phoenix Aerospace Inc part number.

(3) Nomenclature Column.

The NOMENCLATURE column describes the assembly, sub-assembly, or component part in a short form description, with the identifying Noun as the first word, followed by the modifiers as required. The indentions denote parts relation to the next higher assembly (NHA) or sub-assembly, applicable. The ATTACHING PARTS entries are listed immediately following the component which they attach.

(4) Vendor Part Number Column.

If a part is purchased by Phoenix Aerospace Inc from a vendor the part number appears in the VENDOR PART NUMBER column.

(5) Cage Code Column.

The CAGE CODE (Commercial and Government Entity Code) column lists the Manufacturer's Code (formerly referred to as the FSC No.), a five-digit number. Parts having part numbers assigned under MIL Standards, NAS, etc., will not have a code number in this column. Traceability is provided by Phoenix Aerospace Inc upon request.

(6) Units Per Assembly Column.

The UNITS PER ASSY column lists the quantity of sub-assemblies or parts required in the next higher assembly (NHA). The quantities specified, therefore, are not necessarily the total used per equipment. The letters RF denote that the item listed appears on another list and illustration and is referenced for aid in identification only.

4. VENDOR CAGE CODE AND NAME INDEX.

The following list is derived by extraction from the Federal Supply Catalog Handbook H4-1. The information is supplied to aid in procurement and identification of the various vendors.

CAGE CODE	VENDOR'S NAME AND ADDRESS
00853	Sangamo Capacitor Division Cornell-Dubilier Corporation Sangamo Road, P.O. Box 128 Pickens, SC 29671-9716
01019	Stoffel Seals Corporation 400 High Avenue Nyack, NY 10707
01121	Allen Bradley Company 1414 Allen Bradley Drive El Paso, TX 79936
04713	Motorola, Incorporated Semiconductor Product Sector 5005 McDowell Road Phoenix, AZ 85008-4229
08530	Reliance Mica Company, Inc. 342-351 39th Street Brooklyn, NY 11232
11502	International Resistive Company, Inc. Greenway Road P.O. Box 1860 Boone, NC 28607-1860
14552	Micro Semi Corporation 2830 S. Fairview Street Santa Ana, CA 92704-5948
16428	Belden Wire and Cable Div of Cooper Industries 350 NW N Street Richmond, IN 47374
19724	Teledyne-Ansonia Solderless Connector Divison 1 Riverside Drive Ansonia, CT 06401
24444	General Semiconductor Inc. 2001 W. 10th Place Tempe, AZ 85281
27014	National Semiconductor Corporation 2900 Semiconductor Drive Santa Clara, CA 95051-0606
27556	IMB Electronic Products, Inc. 15401 Carmenita Road Santa Fe Springs, CA 90670-5607
28520	Heyco Molded Products 750 Boulevard P.O. Box 160 Kenilworth, NJ 07033-1721
29632	Phoenix Aerospace Inc 220 W. 80th Terrace P.O. Box 8744 Kansas City, MO 64114-8744
32953	Powertech, Inc. 0 - 02 Fairlawn Ave Fairlawn, NJ 07410-1225
32997	Bourns, Incorporated Trimpot Division 1200 Columbia Avenue Riverside, CA 92507-2114

4. VENDOR CAGE CODE AND NAME INDEX (Cont).

CAGE CODE	VENDOR'S NAME AND ADDRESS
34371	Harris Corp Semiconductor Sector Military and Aerospace Div 200 Palm Bay Blvd, P.O.Box 883 Melbourne, FL 32902-0883
48979	National Standard Company Specialty Products Division 601 N 8th Street Niles, MI 49120
56289	Sprague-Vishay Solid Tantalum Division Beaver Street North North Adams, MA 01247
56352	Cole-Flex Corporation 91 Cabot Street Wesy Babylon, NY 11704-1101
66844	Powerex, Incorporated Power Products Division Willis Street Youngwood, PA 15697-1176
71468	ITT Cannon 666 E. Dyer Road P.O. Box 929 Santa Ana, CA 92702-0929
83827	Resistors, Incorporated 5228 W. 26th Street Chicago, IL 60650
81843	International Rectifier Semiconductor Division 233 Kansas Street El Segundo, CA 90245
86928	Seastrom Manufacturing Co., Inc. 701 Sonora Avenue Glendale, CA 91201
88245	Winchester Electronics. Litton Systems, USECO Division 13536 Saticoy Street Van Nuys, CA 91409
91506	Augat, Incorporated 452 John Dietsch Blvd P.O. Box 2510 Attleboro Falls, MA 02763
91637	Dale-Electronics Incorporated 1122 23rd Street P.O. Box 609 Columbus, NE 68601-3632
91833	Keystone Electronics Corporation 31-07 20th Road Astoria, NY 11105-2017
92219	Waldom Electronics Incorporated 4301 W. 69th Street Chicago, IL 60629-5719
99742	Permacel Tape Division & Avery Co. US Highway 1, P.O. Box 671 New Brunswick, NJ 08903

NUMERICAL INDEX

PAI PART NUMBER	VENDOR PART NUMBER	CH-SEC-UNIT	FIG. NO.	ITEM NO.	TTL REQ
019XXX	JP2AXXXK	24 -20 -X	1106	52	1
019XXX	JP2AXXXK	24 -20 -X	1106	53	1
019XXX	JP2AXXXK	24 -20 -X	1106	54	1
019008	XA2A104J	24 -20 -X	1106	55	1
019008	XA2A104J	24 -20 -X	1106	56	1
019008	XA2A104J	24 -20 -X	1106	57	1
019015	BA3778H	24 -20 -X	1105	7	1
019015	BA3778H	24 -20 -X	1105	8	1
019018	JP2A223K	24 -20 -X	1106	50	1
019018	JP2A223K	24 -20 -X	1106	51	1
019020	BA4502H	24 -20 -X	1106	49	1
019063	BA6708J	24 -20 -X	1105	9	1
019074	BA2E154H	24 -20 -X	1107	10	1
021011	057JP142W050B	24 -20 -X	1105	2	1
021011	057JP142W050B	24 -20 -X	1105	3	1
021011	057JP142W050B	24 -20 -X	1105	4	1
021506	150D476X902082	24 -20 -X	1106	63	1
021524	M39003/01-2596	24 -20 -X	1106	58	1
021524	M39003/01-2596	24 -20 -X	1106	59	1
021525	M39003/01-2608	24 -20 -X	1103	2	1
021525	M39003/01-2608	24 -20 -X	1106	60	1
021525	M39003/01-2608	24 -20 -X	1106	61	1
021525	M39003/01-2608	24 -20 -X	1106	62	1
025001	T-153	24 -20 -X	1107	-5	1
025002	R1C-14S	24 -20 -X	1102	5	1
029008	8080-1G1	24 -20 -X	1107	9	1
029008	8080-1G1	24 -20 -X	1107	12	1
029009	MS3102R-22-1P	24 -20 -X	1101	2	1
029056	MS3102R-22-18S	24 -20 -X	1101	3	1
029079	8080-1G15	24 -20 -X	1107	14	1
029079	8080-1G15	24 -20 -X	1107	17	1
029079	8080-1G15	24 -20 -X	1107	20	1
029079	8080-1G15	24 -20 -X	1107	23	1
029079	8080-1G15	24 -20 -X	1107	26	1
029079	8080-1G15	24 -20 -X	1107	29	1
029079	8080-1G15	24 -20 -X	1107	32	1
029079	8080-1G15	24 -20 -X	1107	35	1
031518		24 -20 -X	1104	34	1
031518		24 -20 -X	1104	35	1
031600	1509-3HTD (P/O 058010	24 -20 -X	1105	-11	1
031600	1509-3HTD (P/O 058010	24 -20 -X	1105	-12	1
031600	1509-3HTD (P/O 058010	24 -20 -X	1105	-13	1
031600	1509-3HTD (P/O 058010	24 -20 -X	1105	-14	1
031600	1509-3HTD (P/O 058010	24 -20 -X	1105	-15	1
031600	1509-3HTD (P/O 058010	24 -20 -X	1105	-16	1
031600	1509-3HTD (P/O 058010	24 -20 -X	1105	-17	1
031600	1509-3HTD (P/O 058010	24 -20 -X	1105	-18	1
031600	1509-3HTD (P/O 058010	24 -20 -X	1105	-19	1
031600	1509-3HTD (P/O 058010	24 -20 -X	1105	-20	1
031600	1509-3HTD (P/O 058010	24 -20 -X	1105	-21	1
031600	1509-3HTD (P/O 058010	24 -20 -X	1105	-22	1
031600	1509-3HTD (P/O 058010	24 -20 -X	1105	-23	1
031600	1509-3HTD (P/O 058010	24 -20 -X	1105	-24	1
031601	2011C-1 (P/O 058015)	24 -20 -X	1103	-15	1
031601	2011C-1 (P/O 058015)	24 -20 -X	1103	-16	1
038010		24 -20 -X	1104	22	1
038044		24 -20 -X	1104	27	1
043003		24 -20 -X	1104	72	1
043011		24 -20 -X	1104	17	1
043012		24 -20 -X	1104	12	1
043013		24 -20 -X	1103	11	1
043016		24 -20 -X	1107	41	1
046001	1N4735A	24 -20 -X	1106	71	1
046006	1N914B	24 -20 -X	1106	69	1
046007	1N4748A	24 -20 -X	1106	70	1
046011	1N3611	24 -20 -X	1103	6	1
046011	1N3611	24 -20 -X	1103	7	1
046011	1N3611	24 -20 -X	1103	8	1
046011	1N3611	24 -20 -X	1103	9	1
046011	1N3611	24 -20 -X	1103	10	1
046011	1N3611	24 -20 -X	1106	64	1
046011	1N3611	24 -20 -X	1106	65	1
046011	1N3611	24 -20 -X	1106	66	1
046011	1N3611	24 -20 -X	1106	67	1
046011	1N3611	24 -20 -X	1106	68	1
046015	1N5624	24 -20 -X	1104	38	1
046015	1N5624	24 -20 -X	1104	39	1
046015	1N5624	24 -20 -X	1104	40	1
046015	1N5624	24 -20 -X	1104	41	1
046015	1N5624	24 -20 -X	1104	42	1
046015	1N5624	24 -20 -X	1104	43	1
046015	1N5624	24 -20 -X	1104	44	1
046015	1N5624	24 -20 -X	1104	45	1
046016	1N2979B	24 -20 -X	1107	2	1
046018	1N1186A	24 -20 -X	1102	2	1
048503	2N3055	24 -20 -X	1107	11	1

NUMERICAL INDEX (Cont)

PAI PART NUMBER	VENDOR PART NUMBER	CH-SEC-UNIT	FIG. NO.	ITEM NO.	TTL REQ
048503	2N3055	24 -20 -X	1107	13	1
048507	2N4036	24 -20 -X	1106	77	1
048507	2N4036	24 -20 -X	1106	78	1
048513	2N2484	24 -20 -X	1106	73	1
048513	2N2484	24 -20 -X	1106	74	1
048514	2N3117	24 -20 -X	1106	75	1
048514	2N3117	24 -20 -X	1106	76	1
048514	2N3117	24 -20 -X	1106	79	1
048514	2N3117	24 -20 -X	1106	80	1
048515	2N2907A	24 -20 -X	1106	81	1
048530	MJ14002	24 -20 -X	1107	16	1
048530	MJ14002	24 -20 -X	1107	19	1
048530	MJ14002	24 -20 -X	1107	22	1
048530	MJ14002	24 -20 -X	1107	25	1
048530	MJ14002	24 -20 -X	1107	28	1
048530	MJ14002	24 -20 -X	1107	31	1
048530	MJ14002	24 -20 -X	1107	34	1
048530	MJ14002	24 -20 -X	1107	37	1
050014	RCR20G330KS	24 -20 -X	1106	21	1
050014	RCR20G330KS	24 -20 -X	1106	22	1
050023	RCR20G221KS	24 -20 -X	1106	20	1
050027	RCR20G471KS	24 -20 -X	1106	23	1
050027	RCR20G471KS	24 -20 -X	1106	24	1
050031	RCR20G102KS	24 -20 -X	1106	25	1
050035	RCR20G222KS	24 -20 -X	1106	28	1
050035	RCR20G222KS	24 -20 -X	1106	29	1
050035	RCR20G222KS	24 -20 -X	1106	30	1
050035	RCR20G222KS	24 -20 -X	1106	31	1
050035	RCR20G222KS	24 -20 -X	1106	32	1
050035	RCR20G222KS	24 -20 -X	1106	33	1
050035	RCR20G222KS	24 -20 -X	1106	34	1
050037	RCR20G332KS	24 -20 -X	1106	35	1
050039	RCR20G472KS	24 -20 -X	1106	38	1
050043	RCR20G103KS	24 -20 -X	1106	39	1
050045	RCR20G153KS	24 -20 -X	1106	40	1
050047	RCR20G223KS	24 -20 -X	1106	41	1
050091	RCR20G222JS	24 -20 -X	1106	26	1
050091	RCR20G222JS	24 -20 -X	1106	27	1
050092	RCR20G472JS	24 -20 -X	1103	4	1
050092	RCR20G472JS	24 -20 -X	1106	36	1
050092	RCR20G472JS	24 -20 -X	1106	37	1
050098	RCR20G362JS	24 -20 -X	1103	3	1
050305	SPF 220	24 -20 -X	1106	18	1
050305	SPF 220	24 -20 -X	1106	19	1
050321	SPF 4.7	24 -20 -X	1107	15	1
050321	SPF 4.7	24 -20 -X	1107	18	1
050321	SPF 4.7	24 -20 -X	1107	21	1
050321	SPF 4.7	24 -20 -X	1107	24	1
050321	SPF 4.7	24 -20 -X	1107	27	1
050321	SPF 4.7	24 -20 -X	1107	30	1
050321	SPF 4.7	24 -20 -X	1107	33	1
050321	SPF 4.7	24 -20 -X	1107	36	1
050324	SPF 1	24 -20 -X	1106	2	1
050324	SPF 1	24 -20 -X	1106	3	1
050324	SPF 1	24 -20 -X	1106	4	1
050324	SPF 1	24 -20 -X	1106	5	1
050324	SPF 1	24 -20 -X	1106	6	1
050324	SPF 1	24 -20 -X	1106	7	1
050324	SPF 1	24 -20 -X	1106	8	1
050324	SPF 1	24 -20 -X	1106	9	1
050324	SPF 1	24 -20 -X	1106	10	1
050324	SPF 1	24 -20 -X	1106	11	1
050324	SPF 1	24 -20 -X	1106	12	1
050324	SPF 1	24 -20 -X	1106	13	1
050324	SPF 1	24 -20 -X	1106	14	1
050324	SPF 1	24 -20 -X	1106	15	1
050324	SPF 1	24 -20 -X	1106	16	1
050324	SPF 1	24 -20 -X	1106	17	1
050508	RN60D6811F	24 -20 -X	1106	46	1
050548	RN60D2671F	24 -20 -X	1106	42	1
050548	RN60D2671F	24 -20 -X	1106	43	1
050548	RN60D2671F	24 -20 -X	1106	44	1
050548	RN60D2671F	24 -20 -X	1106	45	1
052002	10AX33	24 -20 -X	1105	10	1
054007	3299Y-1-102	24 -20 -X	1103	5	1
054012	3299P-1-102	24 -20 -X	1106	47	1
054021	3299P-1-501	24 -20 -X	1106	48	1
058010		24 -20 -X	1105	1	1
058011		24 -20 -X	1106	1	1
058015		24 -20 -X	1103	1	1
064500	732-734A	24 -20 -X	1107	-38	2
064502	DF6C	24 -20 -X	1107	-3	2
064503	DF6B	24 -20 -X	1102	3	2
064507	5610-122-.062	24 -20 -X	1102	4	1
064513	5610-105-.040	24 -20 -X	1107	-4	1
064517		24 -20 -X	1104	-28	1

NUMERICAL INDEX (Cont)

PAI PART NUMBER	VENDOR PART NUMBER	CH-SEC-UNIT	FIG. NO.	ITEM NO.	TTL REQ
100009	MS35649-264	24 -20 -X	1107	-44	1
100011	MS35649-284	24 -20 -X	1104	-31	1
100013	MS35650-304	24 -20 -X	1107	-8	1
100020	MS35649-204	24 -20 -X	1104	-16	1
100020	MS35649-204	24 -20 -X	1104	-21	1
100020	MS35649-204	24 -20 -X	1104	-26	1
100024	MS35650-3254	24 -20 -X	1102	8	1
101003	MS35237-15	24 -20 -X	1101	-17	1
101004		24 -20 -X	1101	-24	20
101004		24 -20 -X	1104	-11	3
101005		24 -20 -X	1101	-4	8
101005		24 -20 -X	1101	-15	5
101009		24 -20 -X	1101	-10	2
101016	MS35237-16	24 -20 -X	1101	-14	5
101017		24 -20 -X	1101	-23	6
101017		24 -20 -X	1103	-12	1
101017		24 -20 -X	1107	-46	4
101018	AN520C618	24 -20 -X	1107	-43	1
101019	AN520B680	24 -20 -X	1107	-40	20
101024		24 -20 -X	1101	-8	6
101042		24 -20 -X	1101	-11	2
101042		24 -20 -X	1104	-36	2
101051	MS35249-77	24 -20 -X	1104	-14	1
101051	MS35249-77	24 -20 -X	1104	-19	1
101052	MS35249-76	24 -20 -X	1104	-24	1
101071	MS35237-14	24 -20 -X	1104	-3	2
101071	MS35237-14	24 -20 -X	1104	-7	2
101074	MS35249-58	24 -20 -X	1104	-29	1
101201	MS35275-15	24 -20 -X	1101	-25	2
113016		24 -20 -X	1105	-5	18
113030	MS20995C .025	24 -20 -X	1101	-26	24
116013		24 -20 -X	1101	7	1
116013		24 -20 -X	1104	-	RF
116028		24 -20 -X	1101	9	1
116028		24 -20 -X	1105	-	RF
116037		24 -20 -X	1104	2	1
116037		24 -20 -X	1102	-	RF
116250		24 -20 -X	1104	10	1
116250		24 -20 -X	1103	-	RF
116298		24 -20 -X	1106	-	RF
116298		24 -20 -X	1107	45	1
116299		24 -20 -X	1101	13	1
116299		24 -20 -X	1107	-	RF

PAI PART NUMBER	VENDOR PART NUMBER	CH-SEC-UNIT	FIG. NO.	ITEM NO.	TTL REQ
064517		24 -20 -X	1107	-42	1
064518		24 -20 -X	1104	-18	1
064518		24 -20 -X	1104	-23	1
064519		24 -20 -X	1104	-13	1
064541	DF377A	24 -20 -X	1107	-39	8
065166		24 -20 -X	1105	-6	15
066213		24 -20 -X	1101	21	1
066214		24 -20 -X	1101	28	1
067502	#67	24 -20 -X	1101	-27	1
068000	3305-5/16-N	24 -20 -X	1101	-16	1
070003		24 -20 -X	1107	-47	4
070010		24 -20 -X	1104	-33	2
070034		24 -20 -X	1104	-32	4
076000	MS35333-72	24 -20 -X	1104	-30	1
076001	MS35333-70	24 -20 -X	1101	-5	8
076001	MS35333-70	24 -20 -X	1101	-19	1
076001	MS35333-70	24 -20 -X	1104	-4	2
076001	MS35333-70	24 -20 -X	1104	8	2
076001	MS35333-70	24 -20 -X	1103	-13	1
076001	MS35333-70	24 -20 -X	1107	-48	4
076012	MS35333-71	24 -20 -X	1101	-12	4
076012	MS35333-71	24 -20 -X	1104	-37	2
076014	MS35333-73	24 -20 -X	1104	-15	1
076014	MS35333-73	24 -20 -X	1104	-20	1
076014	MS35333-73	24 -20 -X	1104	-25	1
076014	MS35333-73	24 -20 -X	1107	-7	1
076019		24 -20 -X	1101	-18	1
076021	MS15795-808	24 -20 -X	1107	-6	1
076028	MS35333-74	24 -20 -X	1102	7	1
076044	97100	24 -20 -X	1102	6	1
080008		24 -20 -X	1104	1	1
080009		24 -20 -X	1107	1	1
088006		24 -20 -X	1101	1	1
088547		24 -20 -X	1101	22	1
090010		24 -20 -X	1102	1	1
090012		24 -20 -X	1104	6	1
095165		24 -20 -X	1101	-	RF
100002	MS35649-244	24 -20 -X	1101	-6	8
100002	MS35649-244	24 -20 -X	1101	-20	1
100002	MS35649-244	24 -20 -X	1104	-5	2
100002	MS35649-244	24 -20 -X	1104	-9	2
100002	MS35649-244	24 -20 -X	1103	-14	1
100002	MS35649-244	24 -20 -X	1107	-49	4

SYMBOL INDEX

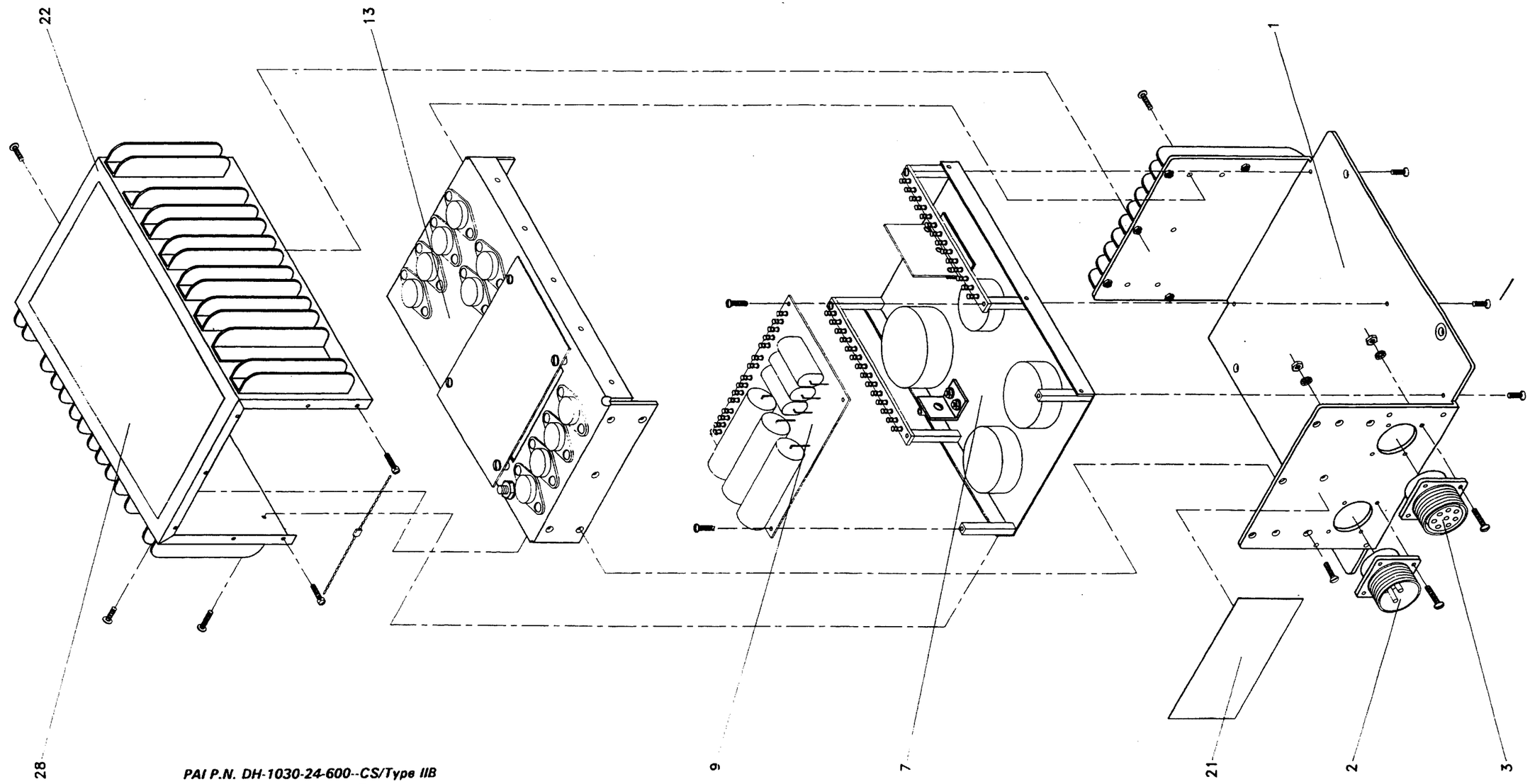
REF SYMBOL	PAI PART NUMBER	VENDOR PART NUMBER	CH-SEC-UNIT	FIG. NO.	ITEM NO.
CR1	046015	1N5624	24 -20 -X	1104	38
CR101	046011	1N3611	24 -20 -X	1103	6
CR102	046011	1N3611	24 -20 -X	1103	7
CR103	046011	1N3611	24 -20 -X	1103	8
CR104	046011	1N3611	24 -20 -X	1103	9
CR105	046011	1N3611	24 -20 -X	1103	10
CR2	046015	1N5624	24 -20 -X	1104	39
CR3	046015	1N5624	24 -20 -X	1104	40
CR301	046006	1N914B	24 -20 -X	1106	69
CR302	046011	1N3611	24 -20 -X	1106	64
CR303	046011	1N3611	24 -20 -X	1106	65
CR304	046011	1N3611	24 -20 -X	1106	66
CR305	046011	1N3611	24 -20 -X	1106	67
CR306	046011	1N3611	24 -20 -X	1106	68
CR4	046015	1N5624	24 -20 -X	1104	41
CR5	046015	1N5624	24 -20 -X	1104	42
CR6	046015	1N5624	24 -20 -X	1104	43
CR7	046015	1N5624	24 -20 -X	1104	44
CR8	046015	1N5624	24 -20 -X	1104	45
CR9	046018	1N1186A	24 -20 -X	1104	2
C101	021525	M39003/01-2608	24 -20 -X	1103	2
C201	021011	057JP142W050B	24 -20 -X	1105	2
C202	021011	057JP142W050B	24 -20 -X	1105	3
C203	021011	057JP142W050B	24 -20 -X	1105	4
C204	019015	BA3778H	24 -20 -X	1105	7
C205	019015	BA3778H	24 -20 -X	1105	8
C206	019063	BA6708J	24 -20 -X	1105	9
C301	019020	BA4502H	24 -20 -X	1106	49
C302	019XXX	JP2AXXXK	24 -20 -X	1106	52
C303	019XXX	JP2AXXXK	24 -20 -X	1106	53
C304	019018	JP2A223K	24 -20 -X	1106	50
C305	019018	JP2A223K	24 -20 -X	1106	51
C306	021525	M39003/01-2608	24 -20 -X	1106	60
C307	021524	M39003/01-2596	24 -20 -X	1106	58
C308	021524	M39003/01-2596	24 -20 -X	1106	59
C309	021506	1500476X9020B2	24 -20 -X	1106	63
C310	021525	M39003/01-2608	24 -20 -X	1106	62
C311	021525	M39003/01-2608	24 -20 -X	1106	61
C312	019008	XA2A104J	24 -20 -X	1106	55
C313	019008	XA2A104J	24 -20 -X	1106	56
C314	019008	XA2A104J	24 -20 -X	1106	57

REF SYMBOL	PAI PART NUMBER	VENDOR PART NUMBER	CH-SEC-UNIT	FIG. NO.	ITEM NO.
C315	019XXX	JP2AXXXK	24 -20 -X	1106	54
C401	019074	BAZE154H	24 -20 -X	1107	10
E1	031518		24 -20 -X	1104	34
E101	031601	2011C-1 (P/O 058015)	24 -20 -X	1103	-15
E102	031601	2011C-1 (P/O 058015)	24 -20 -X	1103	-16
E2	031518		24 -20 -X	1104	35
E201	031600	1509-3HTD (P/O 058010)	24 -20 -X	1105	-11
E202	031600	1509-3HTD (P/O 058010)	24 -20 -X	1105	-12
E203	031600	1509-3HTD (P/O 058010)	24 -20 -X	1105	-13
E204	031600	1509-3HTD (P/O 058010)	24 -20 -X	1105	-14
E205	031600	1509-3HTD (P/O 058010)	24 -20 -X	1105	-15
E206	031600	1509-3HTD (P/O 058010)	24 -20 -X	1105	-16
E207	031600	1509-3HTD (P/O 058010)	24 -20 -X	1105	-17
E208	031600	1509-3HTD (P/O 058010)	24 -20 -X	1105	-18
E209	031600	1509-3HTD (P/O 058010)	24 -20 -X	1105	-19
E210	031600	1509-3HTD (P/O 058010)	24 -20 -X	1105	-20
E211	031600	1509-3HTD (P/O 058010)	24 -20 -X	1105	-21
E212	031600	1509-3HTD (P/O 058010)	24 -20 -X	1105	-22
E213	031600	1509-3HTD (P/O 058010)	24 -20 -X	1105	-23
E214	031600	1509-3HTD (P/O 058010)	24 -20 -X	1105	-24
E3	025002	R1C-14S	24 -20 -X	1102	5
J1	029009	MS3102R-22-1P	24 -20 -X	1101	2
J2	029056	MS3102R-22-18S	24 -20 -X	1101	3
L1	038044		24 -20 -X	1104	27
L2	038010		24 -20 -X	1104	22
Q301	048513	2N2484	24 -20 -X	1106	73
Q302	048513	2N2484	24 -20 -X	1106	74
Q303	048514	2N3117	24 -20 -X	1106	75
Q304	048514	2N3117	24 -20 -X	1106	76
Q305	048507	2N4036	24 -20 -X	1106	77
Q306	048507	2N4036	24 -20 -X	1106	78
Q307	048514	2N3117	24 -20 -X	1106	79
Q308	048514	2N3117	24 -20 -X	1106	80
Q309	048515	2N2907A	24 -20 -X	1106	81
Q401	048503	2N3055	24 -20 -X	1107	11
Q402	048503	2N3055	24 -20 -X	1107	13
Q403	048530	MJ14002	24 -20 -X	1107	16
Q404	048530	MJ14002	24 -20 -X	1107	19
Q405	048530	MJ14002	24 -20 -X	1107	22
Q406	048530	MJ14002	24 -20 -X	1107	25
Q407	048530	MJ14002	24 -20 -X	1107	28

SYMBOL INDEX (Cont)

REF SYMBOL	PAI PART NUMBER	VENDOR PART NUMBER	CH-SEC-UNIT	FIG. NO.	ITEM NO.
Q408	048530	MJ14002	24 -20 -X	1107	31
Q409	048530	MJ14002	24 -20 -X	1107	34
Q410	048530	MJ14002	24 -20 -X	1107	37
R101	050098	RCR20G362JS	24 -20 -X	1103	3
R102	050092	RCR20G472JS	24 -20 -X	1103	4
R103	054007	3299Y-1-102	24 -20 -X	1103	5
R201	052002	10AX33	24 -20 -X	1105	10
R301	050092	RCR20G472JS	24 -20 -X	1106	36
R302	050092	RCR20G472JS	24 -20 -X	1106	37
R303	050043	RCR20G103KS	24 -20 -X	1106	39
R304	050027	RCR20G471KS	24 -20 -X	1106	24
R305	050091	RCR20G222JS	24 -20 -X	1106	26
R306	050091	RCR20G222JS	24 -20 -X	1106	27
R307	054012	3299P-1-102	24 -20 -X	1106	47
R308	050035	RCR20G222KS	24 -20 -X	1106	29
R309	050035	RCR20G222KS	24 -20 -X	1106	30
R310	050035	RCR20G222KS	24 -20 -X	1106	31
R311	050035	RCR20G222KS	24 -20 -X	1106	32
R312	050035	RCR20G222KS	24 -20 -X	1106	28
R313	050027	RCR20G471KS	24 -20 -X	1106	23
R314	050305	SPF 220	24 -20 -X	1106	18
R315	050305	SPF 220	24 -20 -X	1106	19
R316	050014	RCR20G330KS	24 -20 -X	1106	21
R317	050014	RCR20G330KS	24 -20 -X	1106	22
R318	050047	RCR20G223KS	24 -20 -X	1106	41
R319	050039	RCR20G472KS	24 -20 -X	1106	38
R320	050035	RCR20G222KS	24 -20 -X	1106	33
R321	050548	RN60D2671F	24 -20 -X	1106	42
R322	050031	RCR20G102KS	24 -20 -X	1106	25
R323	050548	RN60D2671F	24 -20 -X	1106	43
R324	054021	3299P-1-501	24 -20 -X	1106	48
R325	050023	RCR20G221KS	24 -20 -X	1106	20
R326	050045	RCR20G153KS	24 -20 -X	1106	40
R327	050035	RCR20G222KS	24 -20 -X	1106	34
R328	050508	RN60D6811F	24 -20 -X	1106	46
R329	050548	RN60D2671F	24 -20 -X	1106	44
R330	050548	RN60D2671F	24 -20 -X	1106	45
R331	050324	SPF 1	24 -20 -X	1106	2
R332	050324	SPF 1	24 -20 -X	1106	3
R333	050324	SPF 1	24 -20 -X	1106	4
R334	050324	SPF 1	24 -20 -X	1106	5
R335	050324	SPF 1	24 -20 -X	1106	6
R336	050324	SPF 1	24 -20 -X	1106	7
R337	050324	SPF 1	24 -20 -X	1106	8
R338	050324	SPF 1	24 -20 -X	1106	9
R339	050324	SPF 1	24 -20 -X	1106	10
R340	050324	SPF 1	24 -20 -X	1106	11
R341	050324	SPF 1	24 -20 -X	1106	12
R342	050324	SPF 1	24 -20 -X	1106	13
R343	050324	SPF 1	24 -20 -X	1106	14
R344	050324	SPF 1	24 -20 -X	1106	15
R345	050324	SPF 1	24 -20 -X	1106	16
R346	050324	SPF 1	24 -20 -X	1106	17
R347	050037	RCR20G332KS	24 -20 -X	1106	35
R401	050321	SPF 4.7	24 -20 -X	1107	15
R402	050321	SPF 4.7	24 -20 -X	1107	18
R403	050321	SPF 4.7	24 -20 -X	1107	21
R404	050321	SPF 4.7	24 -20 -X	1107	24
R405	050321	SPF 4.7	24 -20 -X	1107	27
R406	050321	SPF 4.7	24 -20 -X	1107	30
R407	050321	SPF 4.7	24 -20 -X	1107	33
R408	050321	SPF 4.7	24 -20 -X	1107	36
T1	043011		24 -20 -X	1104	17
T101	043013		24 -20 -X	1103	11
T2	043012		24 -20 -X	1104	12
T301	043003		24 -20 -X	1106	72
T401	043016		24 -20 -X	1107	41
VR301	046007	1N4748A	24 -20 -X	1106	70
VR302	046001	1N4735A	24 -20 -X	1106	71
VR401	046016	1N2979B	24 -20 -X	1107	2
XQ401	029008	8080-1G1	24 -20 -X	1107	9
XQ402	029008	8080-1G1	24 -20 -X	1107	12
XQ403	029079	8080-1G15	24 -20 -X	1107	14
XQ404	029079	8080-1G15	24 -20 -X	1107	17
XQ405	029079	8080-1G15	24 -20 -X	1107	20
XQ406	029079	8080-1G15	24 -20 -X	1107	23
XQ407	029079	8080-1G15	24 -20 -X	1107	26
XQ408	029079	8080-1G15	24 -20 -X	1107	29
XQ409	029079	8080-1G15	24 -20 -X	1107	32
XQ410	029079	8080-1G15	24 -20 -X	1107	35

DETAILED PARTS LIST



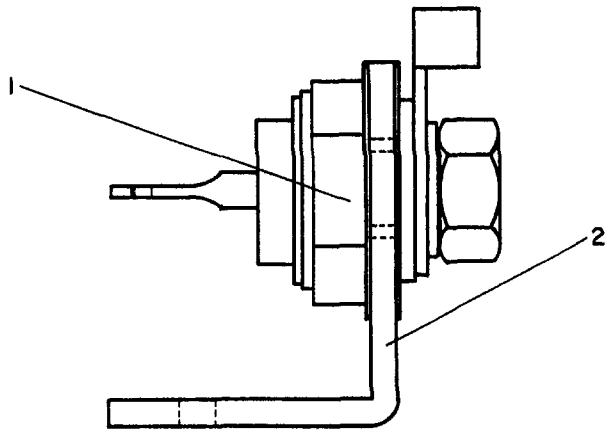
PAI P.N. DH-1030-24-600--CS/Type IIB
Solid-State Static Inverter (Transverter)
Figure 1101

DETAILED PARTS LIST

FIG. NO.	ITEM NO.	PAI PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	VENDOR PART NUMBER	CAGE CODE	TTL REQ
1101		095165	ASSEMBLY,STATIC INVERTER (TRANSVERTER),SILICON,SOLID-STATE PAI P.N.DH-1030-24-600-CS/TYPE IIB, DEHAVILLAND SPEC 8SC0009		29632	RF
	1	088093	. BASE,STATIC INVERTER (TRANSVERTER),PAI P.N.DH-1030-24-600-CS		29632	1
	2	029009	. . CONNECTOR,RECEPTACLE,MALE,2 PIN	MS3102R-22-1P	71468	1
	3	029056	. . CONNECTOR,RECEPTACLE,MALE,8 PIN	MS3102R-22-18S	71468	1
			(ATTACHING PARTS)			
	-4	101005	. . . SCREW,BHM,S.STL, 4-40 X 1/2 IN.LG		29632	8
	-5	076001	. . . WASHER,INT TOOTH LOCK,S.STL, #4 X .255-.265 IN. O.D. X .015 IN.THK	MS35333-70		8
	-6	100002	. . . NUT,HEX,S.STL 4-40	MS35649-244		8
			. . . * . . .			
	7	116013	. . SUB-ASSY,CHASSIS PAN,TRANSFORMER MTG		29632	1
			(ATTACHING PARTS)			
	-8	101024	. . . SCREW,FHM,82 CSK,S.STL, 6-32 X 3/8 IN.LG		29632	6
			. . . * . . .			
	9	116028	. . SUB-ASSY,CIRCUIT BOARD,INPUT AND OUTPUT FILTER		29632	1
			(ATTACHING PARTS)			
	-10	101009	. . . SCREW,BHM,S.STL, 6-32 X 1/2 IN.LG		29632	2
	-11	101042	. . . SCREW,BHM,S.STL, 6-32 X 3/8 IN.LG		29632	2
	-12	076012	. . . WASHER,INT TOOTH LOCK,S.STL, #6 X .288-.278 IN. O.D. X .018 IN.THK	MS35333-71		4
			. . . * . . .			
	13	116299	. . SUB-ASSY,CIRCUIT MODULE,OSC/AMPL/DRIVER		29632	1
			(ATTACHING PARTS)			
	-14	101016	. . . SCREW,FHM,82 CSK,S.STL, 4-40 X 1/2 IN.LG	MS35237-16		5
	-15	101005	. . . SCREW,BHM,S.STL, 4-40 X 1/2 IN.LG		29632	5
			. . . * . . .			
	-16	068000	. . CLAMP,CABLE,NYLON,5/16 IN.	3305-5/16-N	28520	1
			(ATTACHING PARTS)			
	-17	101003	. . . SCREW,FHM,82 CSK,S.STL, 4-40 X 3/8 IN.LG	MS35237-15		1
	-18	076019	. . . WASHER,FLAT,S.STL,#4 X 3/8 IN.O.D. X .025 IN.THK	AN960-C4		1
	-19	076001	. . . WASHER,INT TOOTH LOCK,S.STL, #4 X .255-.265 IN. O.D. X .015 IN.THK	MS35333-70		1
	-20	100002	. . . NUT,HEX,S.STL 4-40	MS35649-244		1
			. . . * . . .			
	21	066213	. . NAMEPLATE,INPUT AND OUTPUT CONNECTIONS, PAI P.N.DH-1030-24-600-CS/IIB,DEHAVILLAND SPEC 8SC0009		29632	1
	22	088547	. . COVER,STATIC INVERTER (TRANSVERTER)		29632	1
			(ATTACHING PARTS)			
	-23	101017	. . . SCREW,BHM,S.STL, 4-40 X 5/8 IN.LG		29632	6
	-24	101004	. . . SCREW,BHM,S.STL, 4-40 X 3/8 IN.LG		29632	20
	-25	101201	. . . SCREW,FILLISTER HEAD,DRILLED,S.STL, 4-40 X 3/8 IN.LG	MS35275-215		2
			. . . * . . .			
	-26	113030	. . WIRE,TIE,SAFETY,S.STL,302-304,.025 IN.DIA (INCHES)	MS20995C .025	48979	24
	-27	067502	. . SEAL,ALUM.,PAI WARRANTY	#67	01019	1
	28	066214	. . NAMEPLATE,MODEL AND SERIAL NO. PAI P.N.DH-1030-24-600-CS/IIB DEHAVILLAND SPEC 8SC0009		29632	1

DETAILED PARTS LIST

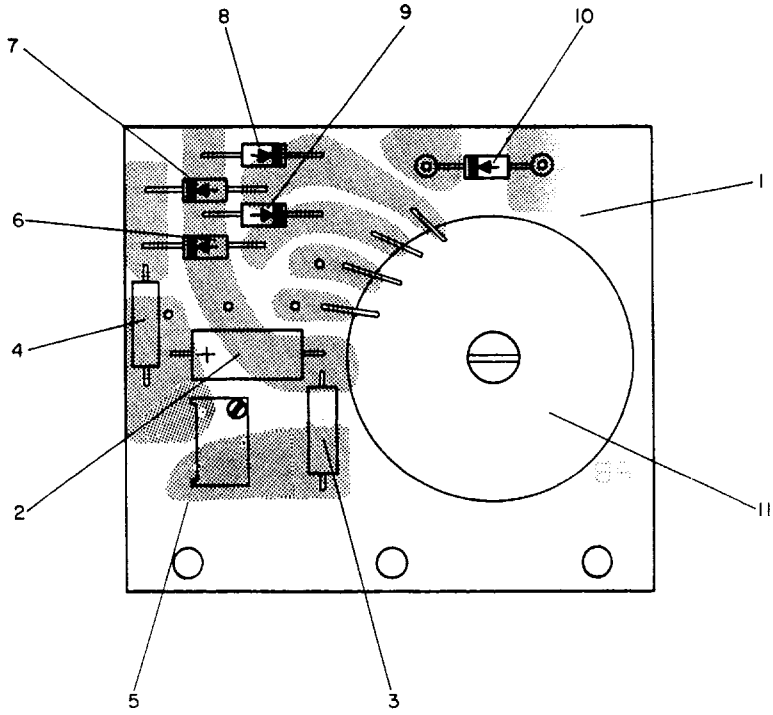
FIG. NO.	ITEM NO.	PAI PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	VENDOR PART NUMBER	CAGE CODE	TTL REQ
1102		116037	SUB-ASSY,POLARITY PROTECT DIODE		29632	RF
	1	090010	. BRACKET,DIODE,MTG-		29632	1
	2	046018	. . SEMICONDUCTOR,DIODE,SILICON,POWER	1N1186A	81483	1
			(ATTACHING PARTS)			
	-3	064503	. . . WASHER,MICA,INSULATING,DIODE MTG		08530	2
	-4	064507	. . . BUSHING,NYLON,INSULATING, 1/4 IN.I.D.X.345 IN.O.D. X .062 IN.THK	5610-122-.062	86928	1
	5	025002	. . . LUG,SOLDER/CRIMP,FLAT OVAL RING TERM.,1/4 IN., #10-12 WIRE	R1C-14S	19724	1
	-6	076044	. . . WASHER,FLAT,BRASS,NIPL, 1/4 IN.I.D. X 1/2 IN.O.D. X .032 IN. THK		29632	1
	-7	076018	. . . WASHER,INT TOOTH LOCK,S.STL, 1/4 IN.I.D.x.478-.466 IN.O.D. X .022 IN. THK	MS35333-74		1
	-8	100024	. . . NUT,HEX,S/STL, 1/4-28	MS35650-3254		1
			. . . * . . .			
	-9	006802	. . . . TAPE,GUMMED,1/2 IN. X .007 IN.THK (INCHES)	P21-1/2.007	99742	



Polarity Protect Diode Sub-Assembly
Figure 1102

DETAILED PARTS LIST

FIG. NO.	ITEM NO.	PAI PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	VENDOR PART NUMBER	CAGE CODE	TTL REQ
1103		116250	SUB-ASSY,CIRCUIT BOARD,PARALLELING CONTROL		29632	RF
	1	058015	. BOARD,PRINTED CIRCUIT,PARALLELING CONTROL		29632	1
	2	021525	. . CAPACITOR,ELETROLYTIC,TANTALUM, 4.7UF 10%,50VDCW	M39003/01-2608	56289	1
	3	050098	. . RESISTOR,FIXED,COMP, 3,600 OHMS 5%,1/2W	RCR20G362JS	01121	1
	4	050092	. . RESISTOR,FIXED,COMP, 4.700 OHMS 5%,1/2W	RCR20G472JS	01121	1
	5	054007	. . RESISTOR,VAR,CERMET, 1,000 OHMS, 1/4W	33299Y-1-102	32997	1
	6	046011	. . SEMICONDUCTOR,DIODE,SILICON,POWER	1N3611	14552	1
	7	046011	. . SEMICONDUCTOR,DIODE,SILICON,POWER	1N3611	14552	1
	8	046011	. . SEMICONDUCTOR,DIODE,SILICON,POWER	1N3611	14552	1
	9	046011	. . SEMICONDUCTOR,DIODE,SILICON,POWER	1N3611	14552	1
	10	046011	. . SEMICONDUCTOR,DIODE,SILICON,POWER	1N3611	14552	1
	11	043013	. . TRANSFORMER,TOROIDAL,PARALLELING SENSE		29632	1
			(ATTACHING PARTS)			
	-12	101017	. . . SCREW,BHM,S.STL, 4-40 X 5/8 IN.LG		29632	1
	-13	076001	. . . WASHER,INT TOOTH LOCK,S.STL, #4 X .265-.255 IN. O.D. X .015 IN. THK	MS35333-70		1
	-14	100002	. . . NUT,HEX,S.STL 4-40	MS35649-244		1
			. . . * . . .			
	-15	031601	. . TERMINAL,TAKE-ON,TURRET TYPE,.362 IN.LG,.073 IN.DIA SHANK X .114 IN.LG FOR .094 IN.BOARD	2011C-1 (P/O 058015)	88245	1
	-16	031601	. . TERMINAL,TAKE-ON,TURRET TYPE,.362 IN.LG,.073 IN.DIA SHANK X .114 IN.LG FOR .094 IN.BOARD	2011C-1 (P/O 058015)		1

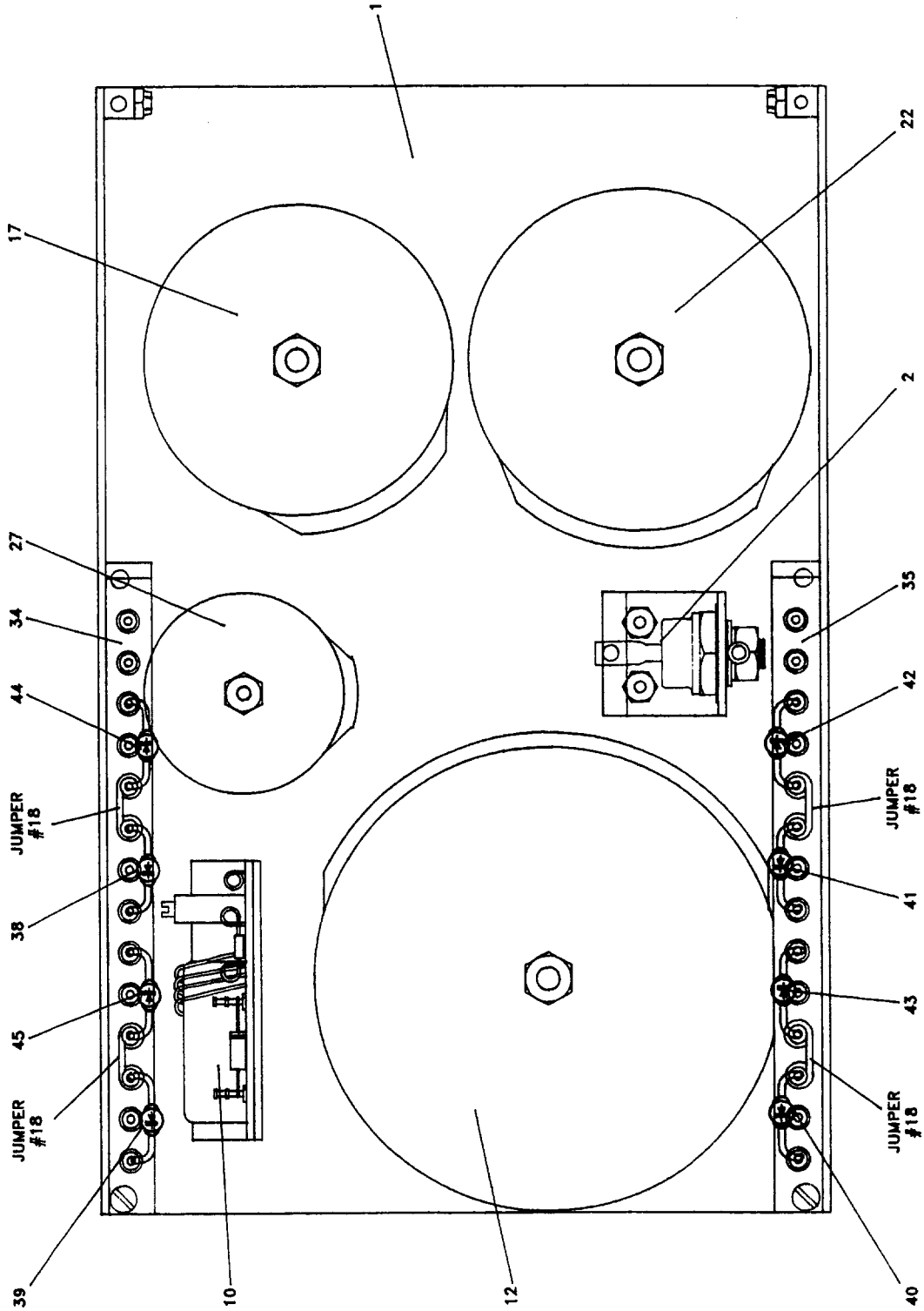


Paralleling Control Circuit Board Sub-Assembly
Figure 1103

DETAILED PARTS LIST

FIG. NO.	ITEM NO.	PAI PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	VENDOR PART NUMBER	CAGE CODE	TTL REQ
1104		116013	SUB-ASSY,CHASSIS PAN,TRANSFORMER MTG		29632	RF
	1	080008	. CHASSIS PAN,TRANSFORMER MTG DH-1030-24-600-CS		29632	1
	2	116037	. . SUB-ASSY,DIODE,POLARITY PROTECT		29632	1
			(ATTACHING PARTS)			
	-3	101071	. . . SCREW,FHM,82 CSK,S/STL, 4-40 X 5/16 IN.LG	MS35237-14		2
	-4	076001	. . . WASHER,INT TOOTH LOCK,S.STL, #4 X .265-.255 IN. O.D. X .015 IN. THK	MS35333-70		2
	-5	100002	. . . NUT,HEX,S.STL 4-40	MS35649-244		2
			. . . * . . .			
	-6	090012	. . BRACKET,MOUNTING,PARALLEL CONTROL CIRCUIT BOARD		29632	1
			(ATTACHING PARTS)			
	-7	101071	. . . SCREW,FHM,82 CSK,S/STL, 4-40 X 5/16 IN.LG	MS35237-14		2
	-8	076001	. . . WASHER,INT TOOTH LOCK,S.STL, #4 X. 265-.255 IN. O.D. X .015 IN. THK	MS35333-70		2
	-9	100002	. . . NUT,HEX,S.STL 4-40	MS35649-244		2
			. . . * . . .			
	10	116250	. . . SUB-ASSY,CIRCUIT BOARD PARALLELING CONTROL		29632	1
			(ATTACHING PARTS)			
	-11	101004	. . . SCREW,BHM,S/STL, 4-40 X 3/8 IN.LG			3
			. . . * . . .			
	12	043012	. . TRANSFORMER,TOROIDAL,POWER OUTPUT		29632	1
	-13	064519	. . DISC,INSULATING, 3 IN.O.D. X .010 IN.THK		29632	1
			(ATTACHING PARTS)			
	-14	101051	. . . SCREW,FHM,82 CSK,S.STL, 10-24 X 1-3/4 IN.LG	MS35249-77		1
	-15	076014	. . . WASHER,INT TOOTH LOCK,S.STL, #10 X .381-.370 IN. O.D. X .022 IN. THK	MS35333-73		1
	-16	100020	. . . NUT,HEX,S.STL 10-24	MS35649-204		1
			. . . * . . .			
	17	043011	. . TRANSFORMER,TOROIDAL,SERIES		29632	1
	-18	064518	. . DISC,INSULATING,2 IN.O.D. X .010 IN.THK		29632	1
			(ATTACHING PARTS)			
	-19	101051	. . . SCREW,FHM,82 CSK,S.STL, 10-24 X 1-3/4 IN.LG	MS35249-77		1
	-20	076014	. . . WASHER,INT TOOTH LOCK,S.STL, #10 X .381-.370 IN. O.D. X .022 IN. THK	MS35333-73		1
	-21	100020	. . . NUT,HEX,S.STL 10-24	MS35649-204		1
			. . . * . . .			
	22	038008	. . REACTOR,TOROIDAL,INPUT		29632	1
	-23	064518	. . DISC,INSULATING, 2 IN. O.D. X .010 IN. THK			2
			(ATTACHING PARTS)			
	-24	101074	. . . SCREW,FHM,82 CSK,S.STL, 8-32 X 1-1/2 IN.LG	MS35248-58		1
	-25	076000	. . . WASHER,INT TOOTH LOCK,S.STL, #8 X .336-.325 IN. O.D. X .020 IN. THK	MS35333-72		1
	-26	100011	. . . NUT,HEX,S.STL 8-32	MS35649-284		1
			. . . * . . .			
	27	038044	. . REACTOR,TOROIDAL,SHUNT		29632	1
	-28	064517	. . DISC,INSULATING, 1 IN. O.D. X .010 IN.THK		29632	1
			(ATTACHING PARTS)			
	-29	101074	. . . SCREW,FHM,82 CSK,S.STL, 8-32 X 1-11/16 IN.LG	MS35249-58		1
	-30	076000	. . . WASHER,INT TOOTH LOCK,S.STL, #8 X .356-.325 IN. O.D. X .020 IN. THK	MS35333-72		1
	-31	100011	. . . NUT,HEX,S.STL 8-32	MS35649-284		1
			. . . * . . .			

DETAILED PARTS LIST



Transformer Mounting Chassis Pan Sub-Assembly
Figure 1104

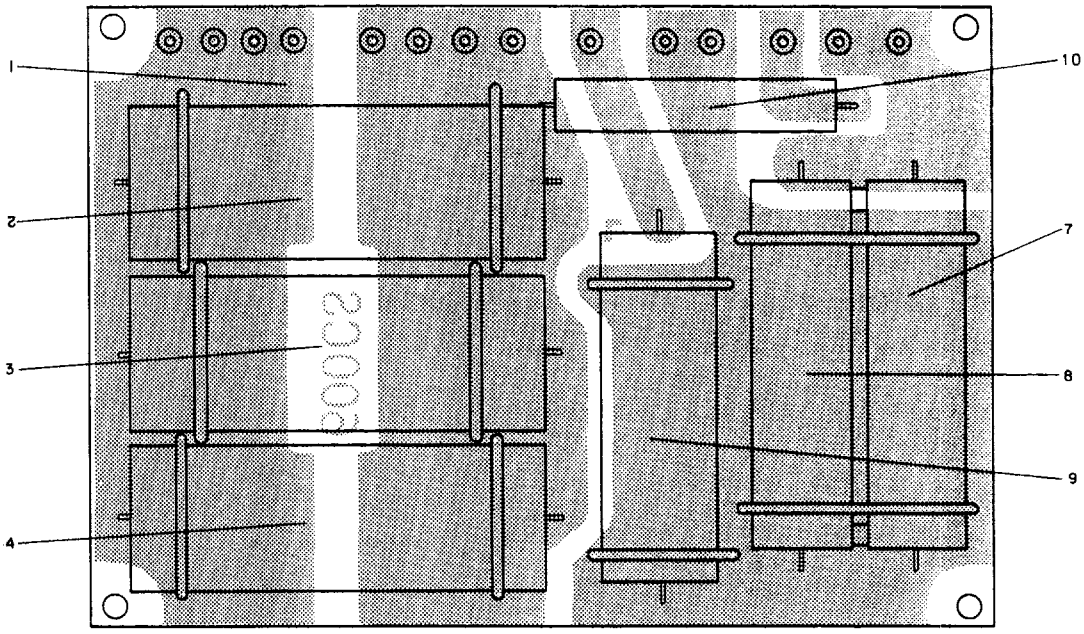
DETAILED PARTS LIST

FIG. NO.	ITEM NO.	PAI PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	VENDOR PART NUMBER	CAGE CODE	TTL REQ
1104	-32	070034	. . SPACER,POST,ALUM.,1/4 IN.SQ X 1-11/16 IN.LG,TAPPED 6-32 EACH END,W/4-40 CLINCH NUT INSERT		29532	4
	-33	070010	. . SPACER,POST,ALUM.,1/4 IN.SQ X 1-13/16 IN.LG,TAPPED 6-32 EACH END,W/4-40 CLINCH NUT INSERT		29632	2
	34	031518	. . STRIP,TERMINAL,5-1/4 IN.LG,14 PT		29632	1
	35	031518	. . STRIP,TERMINAL,5-1/4 IN.LG,14 PT		29632	1
			(ATTACHING PARTS)			
	-36	101042	. . . SCREW,BHM,S,STL, 6-32 X 3/8 IN. LG			
	-37	076012	. . . WASHER,INT TOOTH LOCK,S.STL #8 X .336-.325 IN. O.D. X .020 IN. THK	MS35333-72		1
			. . . .* . . .			
	38	046015	. . SEMICONDUCTOR,DIODE,SILICON,POWER	1N5624	34371	1
	39	046015	. . SEMICONDUCTOR,DIODE,SILICON,POWER	1N5624	34371	1
	40	046015	. . SEMICONDUCTOR,DIODE,SILICON,POWER	1N5624	34371	1
	41	046015	. . SEMICONDUCTOR,DIODE,SILICON,POWER	1N5624	34371	1
	42	046015	. . SEMICONDUCTOR,DIODE,SILICON,POWER	1N5624	34371	1
	43	046015	. . SEMICONDUCTOR,DIODE,SILICON,POWER	1N5624	34371	1
	44	046015	. . SEMICONDUCTOR,DIODE,SILICON,POWER	1N5624	34371	1
	45	046015	. . SEMICONDUCTOR,DIODE,SILICON,POWER	1N5624	34371	1

FIG. NO.	ITEM NO.	PAI PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	VENDOR PART NUMBER	CAGE CODE	TTL REQ
1105		116028	SUB-ASSY,CIRCUIT BOARD,INPUT/OUTPUT FILTER		29632	RF
	1	058010	. BOARD,PRINTED CIRCUIT,INPUT/OUTPUT FILTER		29632	1
	2	021011	. . CAPACITOR,ELECTROLYTIC,ALUM., 1,400UF,50VDCW	057JT142W050B	08530	1
	3	021011	. . CAPACITOR,ELECTROLYTIC,ALUM., 1,400UF,50VDCW	057JT142W050B	08530	1
	4	021011	. . CAPACITOR,ELECTROLYTIC,ALUM., 1,400UF,50VDCW	057JT142W050B	08530	1
	5	019015	. . CAPACITOR,FIXED,POLYCARBONATE, 6.0UF 3%,115VAC,400HZ	BA3778H	27556	1
	6	019015	. . CAPACITOR,FIXED,POLYCARBONATE, 6.0UF 3%,115VAC,400HZ	BA3778H	27556	1
	7	019063	. . CAPACITOR,FIXED,POLYCARBONATE, 1.0UF 3%,500VAC,400HZ	BA6708J	27556	1
			(ATTACHING PARTS)			
	-8	113016	. . . WIRE,#16 AWG,SOLID,TINNED COPPER (INCHES)		16428	18
	-9	065166	. . . TUBING,TEFLON,CLEAR, #16 (.053 IN.I.D.) (INCHES)		56352	15
			. . . * . . .			
	10	052002	. . RESISTOR,FIXED,WW, 33 OHMS 5%,10W	10AX33	83827	1
	-11	031600	. . TERMINAL,STAKE-ON,TURRET TYPE,5/16 IN.LG TURRET,109 IN.DIA SHANK X 5/32 IN.LG	1509-3HTD (P/O 058243)	91833	1
	-12	031600	. . TERMINAL,STAKE-ON,TURRET TYPE,5/16 IN.LG TURRET,109 IN.DIA SHANK X 5/32 IN.LG	1509-3HTD (P/O 058243)	91833	1
	-13	031600	. . TERMINAL,STAKE-ON,TURRET TYPE,5/16 IN.LG TURRET,109 IN.DIA SHANK X 5/32 IN.LG	1509-3HTD (P/O 058243)	91833	1
	-14	031600	. . TERMINAL,STAKE-ON,TURRET TYPE,5/16 IN.LG TURRET,109 IN.DIA SHANK X 5/32 IN.LG	1509-3HTD (P/O 058243)	91833	1
	-15	031600	. . TERMINAL,STAKE-ON,TURRET TYPE,5/16 IN.LG TURRET,109 IN.DIA SHANK X 5/32 IN.LG	1509-3HTD (P/O 058243)	91833	1
	-16	031600	. . TERMINAL,STAKE-ON,TURRET TYPE,5/16 IN.LG TURRET,109 IN.DIA SHANK X 5/32 IN.LG	1509-3HTD (P/O 058243)	91833	1
	-17	031600	. . TERMINAL,STAKE-ON,TURRET TYPE,5/16 IN.LG TURRET,109 IN.DIA SHANK X 5/32 IN.LG	1509-3HTD (P/O 058243)	91833	1
	-18	031600	. . TERMINAL,STAKE-ON,TURRET TYPE,5/16 IN.LG TURRET,109 IN.DIA SHANK X 5/32 IN.LG	1509-3HTD (P/O 058243)	91833	1

DETAILED PARTS LIST

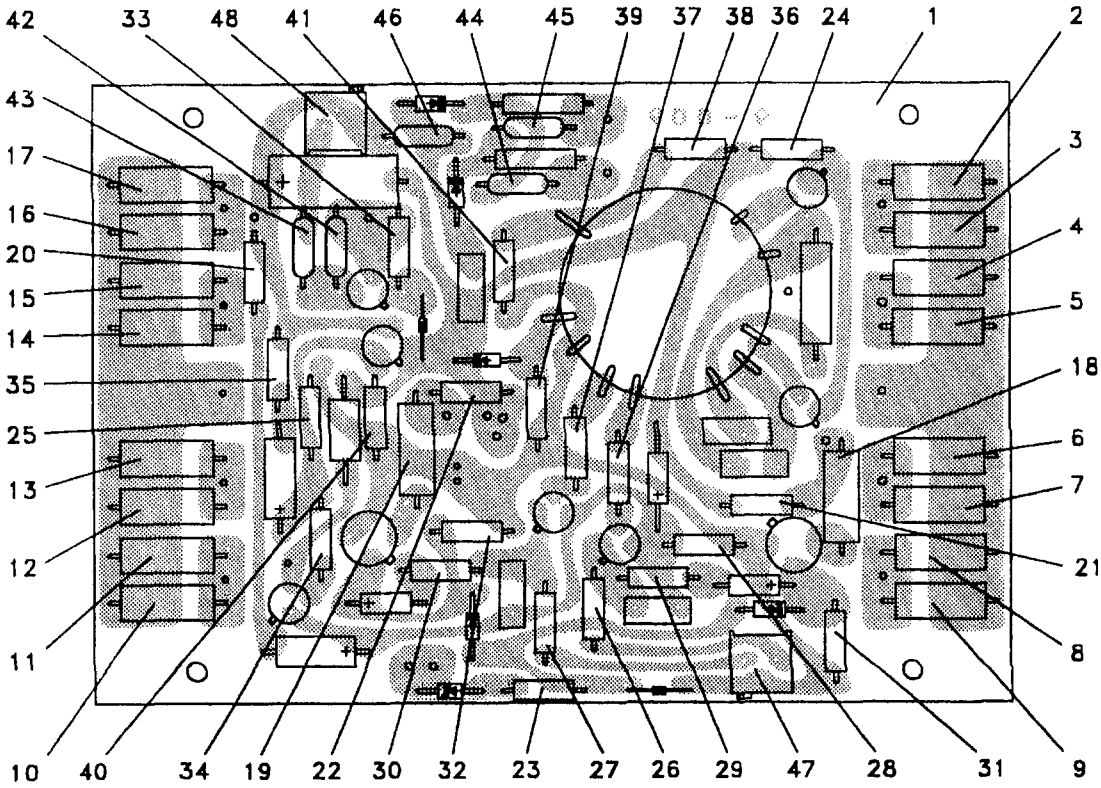
FIG. NO.	ITEM NO.	PAI PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	VENDOR PART NUMBER	CAGE CODE	TTL REQ
1105	-19	031600	. . TERMINAL,STAKE-ON,TURRET TYPE,5/16 IN.LG TURRET,109 IN.DIA SHANK X 5/32 IN.LG	1509-3HTD (P/O 058243)	91833	1
	-20	031600	. . TERMINAL,STAKE-ON,TURRET TYPE,5/16 IN.LG TURRET,109 IN.DIA SHANK X 5/32 IN.LG	1509-3HTD (P/O 058243)	91833	1
	-21	031600	. . TERMINAL,STAKE-ON,TURRET TYPE,5/16 IN.LG TURRET,109 IN.DIA SHANK X 5/32 IN.LG	1509-3HTD (P/O 058243)	91833	1
	-22	031600	. . TERMINAL,STAKE-ON,TURRET TYPE,5/16 IN.LG TURRET,109 IN.DIA SHANK X 5/32 IN.LG	1509-3HTD (P/O 058243)	91833	1
	-23	031600	. . TERMINAL,STAKE-ON,TURRET TYPE,5/16 IN.LG TURRET,109 IN.DIA SHANK X 5/32 IN.LG	1509-3HTD (P/O 058243)	91833	1
	-24	031600	. . TERMINAL,STAKE-ON,TURRET TYPE,5/16 IN.LG TURRET,109 IN.DIA SHANK X 5/32 IN.LG	1509-3HTD (P/O 058243)	91833	1



Input/Output Filter, Circuit Board Sub-Assemby
Figure 1105

FIG. NO.	ITEM NO.	PAI PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	VENDOR PART NUMBER	CAGE CODE	TTL REQ
1106		116298	SUB-ASSY,CIRCUIT BOARD,OSC/AMPL/DRIVER		29632	RF
	1	058011	. BOARD,PRINTED CIRCUIT,OSC/AMPL/DRIVER		29632	1
	2	050324	. . RESISTOR,FIXED,WW, 1 OHM 10%,2W	SPF 1	11502	1
	3	050324	. . RESISTOR,FIXED,WW, 1 OHM 10%,2W	SPF 1	11502	1
	4	050324	. . RESISTOR,FIXED,WW, 1 OHM 10%,2W	SPF 1	11502	1
	5	050324	. . RESISTOR,FIXED,WW, 1 OHM 10%,2W	SPF 1	11502	1
	6	050324	. . RESISTOR,FIXED,WW, 1 OHM 10%,2W	SPF 1	11502	1
	7	050324	. . RESISTOR,FIXED,WW, 1 OHM 10%,2W	SPF 1	11502	1
	8	050324	. . RESISTOR,FIXED,WW, 1 OHM 10%,2W	SPF 1	11502	1

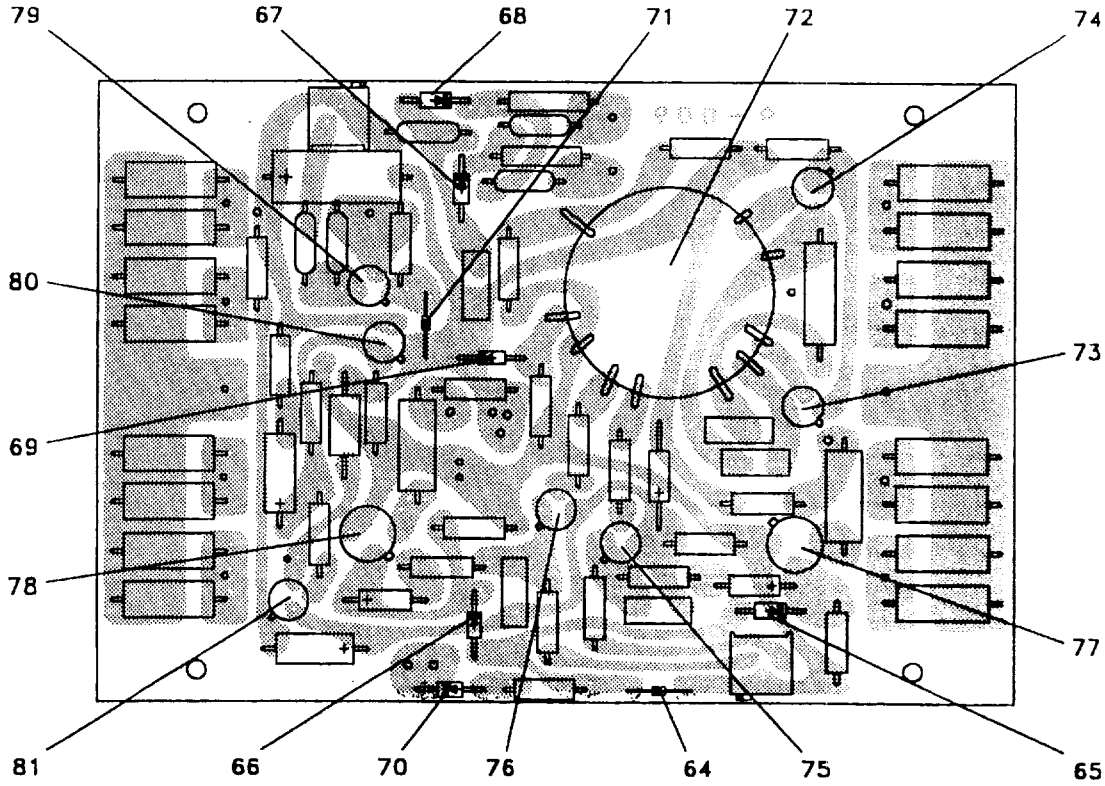
DETAILED PARTS LIST



Oscillator/Amplifier/Driver Circuit Board Sub-Assembly
Figure 1106 (Sheet 1 of 3)

FIG. NO	ITEM NO.	PAI PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	VENDOR PART NUMBER	CAGE CODE	TTL REQ
1106	9	050324	. . RESISTOR,FIXED,WW, 1 OHM 10%,2W	SPF 1	11502	1
	10	050324	. . RESISTOR,FIXED,WW, 1 OHM 10%,2W	SPF 1	11502	1
	11	050324	. . RESISTOR,FIXED,WW, 1 OHM 10%,2W	SPF 1	11502	1
	12	050324	. . RESISTOR,FIXED,WW, 1 OHM 10%,2W	SPF 1	11502	1
	13	050324	. . RESISTOR,FIXED,WW, 1 OHM 10%,2W	SPF 1	11502	1
	14	050324	. . RESISTOR,FIXED,WW, 1 OHM 10%,2W	SPF 1	11502	1
	15	050324	. . RESISTOR,FIXED,WW, 1 OHM 10%,2W	SPF 1	11502	1
	16	050324	. . RESISTOR,FIXED,WW, 1 OHM 10%,2W	SPF 1	11502	1
	17	050324	. . RESISTOR,FIXED,WW, 1 OHM 10%,2W	SPF 1	11502	1
	18	050305	. . RESISTOR,FIXED,WW, 220 OHMS 10%,2W	SPF 220	11502	1
	19	050305	. . RESISTOR,FIXED,WW, 220 OHMS 10%,2W	SPF 220	11502	1
	20	050023	. . RESISTOR,FIXED,COMP, 220 OHMS 10%,1/2W	RCR20G221KS	01121	1
	21	050014	. . RESISTOR,FIXED,COMP, 33 OHMS 10%,1/2W	RCR20G330KS	01121	1
	22	050014	. . RESISTOR,FIXED,COMP, 33 OHMS 10%,1/2W	RCR20G330KS	01121	1
	23	050027	. . RESISTOR,FIXED,COMP, 470 OHMS 10%,1/2W	RCR20G471KS	01121	1
	24	050027	. . RESISTOR,FIXED,COMP, 470 OHMS 10%,1/2W,	RCR20G471KS	01121	1
	25	050031	. . RESISTOR,FIXED,COMP, 1,000 OHMS 10%,1/2W	RCR20G102KS	01121	1
	26	050091	. . RESISTOR,FIXED,COMP, 2,200 OHMS 5%,1/2W	RCR20G222JS	01121	1
	27	050091	. . RESISTOR,FIXED,COMP, 2,200 OHMS 5%,1/2W	RCR20G222JS	01121	1
	28	050035	. . RESISTOR,FIXED,COMP, 2,200 OHMS 10%,1/2W	RCR20G222KS	01121	1
	29	050035	. . RESISTOR,FIXED,COMP, 2,200 OHMS 10%,1/2W	RCR20G222KS	01121	1
	30	050035	. . RESISTOR,FIXED,COMP, 2,200 OHMS 10%,1/2W	RCR20G222KS	01121	1

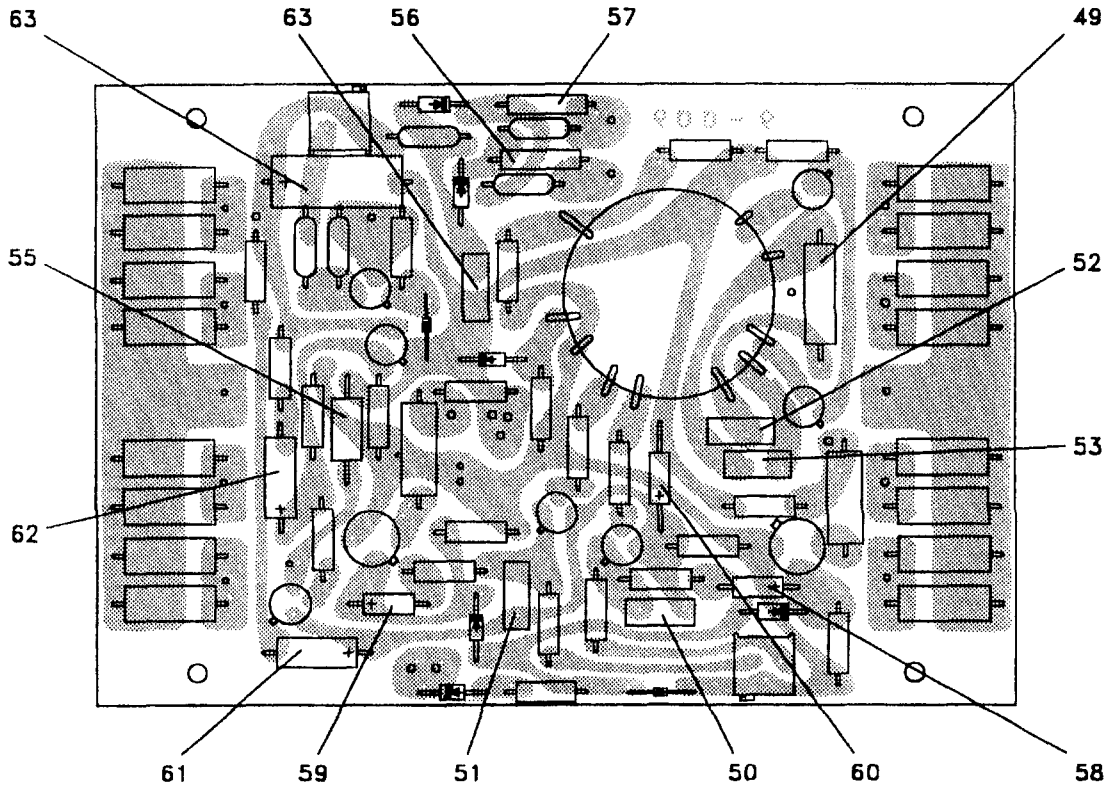
DETAILED PARTS LIST



Oscillator/Amplifier/Driver Circuit Board Sub-Assembly
Figure 1106 (Sheet 2 of 3)

FIG. NO	ITEM NO.	PAI PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	VENDOR PART NUMBER	CAGE CODE	TTL REQ
1106	31	050035	. . RESISTOR,FIXED,COMP, 2,200 OHMS 10%,1/2W	RCR20G222KS	01121	1
	32	050035	. . RESISTOR,FIXED,COMP, 2,200 OHMS 10%,1/2W	RCR20G222KS	01121	1
	33	050035	. . RESISTOR,FIXED,COMP, 2,200 OHMS 10%,1/2W	RCR20G222KS	01121	1
	34	050035	. . RESISTOR,FIXED,COMP, 2,200 OHMS 10%,1/2W	RCR20G222KS	01121	1
	35	050037	. . RESISTOR,FIXED,COMP, 3,300 OHMS 10%,1/2W	RCR20G332KS	01121	1
	36	050092	. . RESISTOR,FIXED,COMP, 4,700 OHMS 5%,1/2W	RCR20G472JS	01121	1
	37	050092	. . RESISTOR,FIXED,COMP, 4,700 OHMS 5%,1/2W	RCR20G472JS	01121	1
	38	050039	. . RESISTOR,FIXED,COMP, 4,700 OHMS 10%,1/2W	RCR20G472KS	01121	1
	39	050043	. . RESISTOR,FIXED,COMP, 10K OHMS 10%,1/2W	RCR20G103KS	01121	1
	40	050045	. . RESISTOR,FIXED,COMP, 15K OHMS 10%,1/2W	RCR20G153KS	01121	1
	41	050047	. . RESISTOR,FIXED,COMP, 22K OHMS 10%,1/2W	RCR20G223KS	01121	1
	42	050548	. . RESISTOR,FIXED,FILM,PREC. 2,670 OHMS 1%,1/8W	RN60D2671F	91637	1
	43	050548	. . RESISTOR,FIXED,FILM,PREC. 2,670 OHMS 1%,1/8W	RN60D2671F	91637	1
	44	050548	. . RESISTOR,FIXED,FILM,PREC. 2,670 OHMS 1%,1/8W	RN60D2671F	91637	1
	45	050548	. . RESISTOR,FIXED,FILM,PREC. 2,670 OHMS 1%,1/8W	RN60D2671F	91637	1
	46	050508	. . RESISTOR,FIXED,FILM,PREC. 6,810 OHMS 1%,1/8W	RN60D6811F	91637	1
	47	054012	. . RESISTOR,VAR,CERMET, 1,000 OHMS,1/4W	3299P-1-102	32997	1
	48	054021	. . RESISTOR,VAR,CERMET, 500 OHMS,1/4W	3299P-1-501	32997	1
	49	019020	. . CAPACITOR,FIXED,POLYCARBONATE, 0.47UF 3%,50VDCW	BA4502H	27556	1
	50	019089	. . CAPACITOR,FIXED,POLYESTER, 0.022UF 10%,50VDCW	JP2A223K	27556	1
	51	019089	. . CAPACITOR,FIXED,POLYESTER, 0.022UF 10%,50VDCW	JP2A223K	27556	1
	52	019xxx	. . CAPACITOR,FIXED,POLYESTER,(SELECTED)0.01- 0.039UF 10%,50VDCW	JP2AXXXK	27556	1

DETAILED PARTS LIST



Oscillator/Amplifier/Driver Circuit Board Sub-Assembly
Figure 1106 (Sheet 3 of 3)

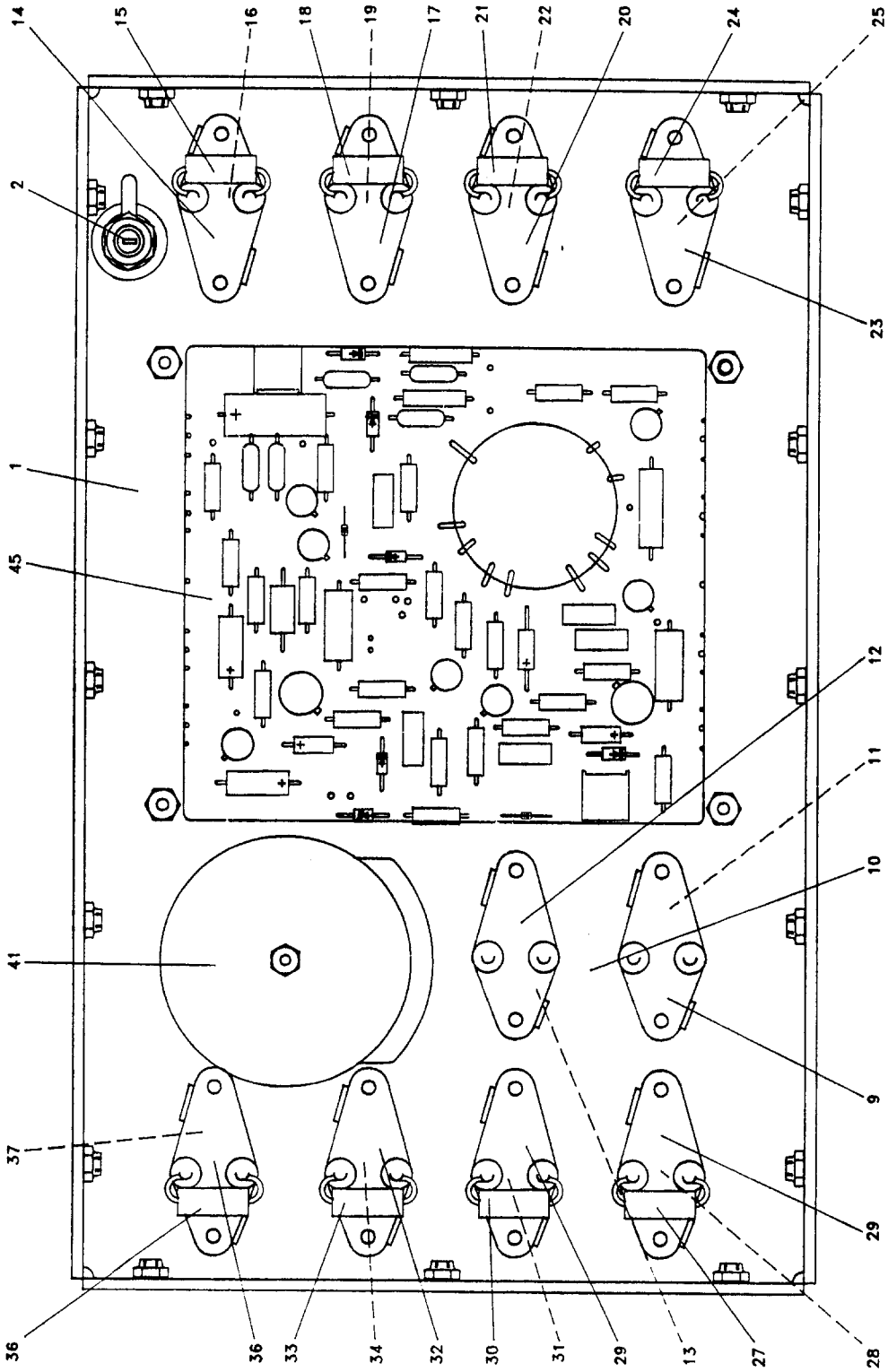
FIG. NO	ITEM NO.	PAI PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	VENDOR PART NUMBER	CAGE CODE	TTL REQ
1106	53	019xxx	. . CAPACITOR,FIXED,POLYESTER,(SELECTED)0.01- 0.047UF 10%,50VDCW	JP2AXXXK	27556	1
	54	019xxx	. . CAPACITOR,FIXED,POLYESTER,(SELECTED)0.01- 0.047UF 10%,50VDCW	XA2AXXXX	27556	
	55	019008	. . CAPACITOR,FIXED,POLYESTER, 0.1UF 5%,50VDCW	XA2A104J	27556	1
	56	019008	. . CAPACITOR,FIXED,POLYESTER, 0.1UF 5%,50VDCW	XA2A104J	27556	1
	57	019008	. . CAPACITOR,FIXED,POLYESTER, 0.1UF 5%,50VDCW	XA2A104J	27556	1
	58	021524	. . CAPACITOR,ELECTROLYTIC,TANTALUM, 1.0UF 10%,50VDCW	M39003/01-2596	56289	
	59	021524	. . CAPACITOR,ELECTROLYTIC,TANTALUM, 1.0UF 10%,50VDCW	M39003/01-2596	56289	1
	60	021525	. . CAPACITOR,ELECTROLYTIC,TANTALUM, 4.7UF 10%,50VDCW	M39003/01-2608	56289	1
	61	021525	. . CAPACITOR,ELECTROLYTIC,TANTALUM, 4.7UF 10%,50VDCW	M39003/01-2608	56289	1
	62	021525	. . CAPACITOR,ELECTROLYTIC,TANTALUM, 4.7UF 10%,50VDCW	M39003/01-2608	56289	1
	63	021506	. . CAPACITOR,ELECTROLYTIC,TANTALUM, 47UF 10%,20VDCW	150D476X9020B2	56289	1
	64	046011	. . SEMICONDUCTOR,DIODE,SILICON,POWER	1N3611	14552	1
	65	046011	. . SEMICONDUCTOR,DIODE,SILICON,POWER	1N3611	14552	1
	66	046011	. . SEMICONDUCTOR,DIODE,SILICON,POWER	1N3611	14552	1
	67	046011	. . SEMICONDUCTOR,DIODE,SILICON,POWER	1N3611	14552	1
	68	046011	. . SEMICONDUCTOR,DIODE,SILICON,POWER	1N3611	14552	1
	69	046006	. . SEMICONDUCTOR,DIODE,SILICON	1N914B	27014	1
	70	046007	. . SEMICONDUCTOR,DIODE,SILICON,ZENER, 22V 5%,1W	1N4748A	04713	
	71	046001	. . SEMICONDUCTOR,DIODE,SILICON,ZENER, 6.2V 5%,1W	1N4735A	04713	
	72	043003	. . TRANSFORMER,TOROIDAL,OSCILLATOR	MS35649-244	29632	
	73	048513	. . SEMICONDUCTOR,TRANSISTOR,SILICON,NPN	2N2484	27014	

DETAILED PARTS LIST

FIG. NO	ITEM NO.	PAI PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	VENDOR PART NUMBER	CAGE CODE	TTL REQ
1106	74	048513	. . SEMICONDUCTOR,TRANSISTOR,SILICON,NPN	2N2484	27014	
	75	048514	. . SEMICONDUCTOR,TRANSISTOR,SILICON,NPN	2N3117	27014	
	76	048514	. . SEMICONDUCTOR,TRANSISTOR,SILICON,NPN	2N3117	27014	
	77	048507	. . SEMICONDUCTOR,TRANSISTOR,SILICON,NPN	2N4036	34371	
	78	048507	. . SEMICONDUCTOR,TRANSISTOR,SILICON,NPN	2N4036	34371	
	79	048514	. . SEMICONDUCTOR,TRANSISTOR,SILICON,NPN	2N3117	27014	
	80	048514	. . SEMICONDUCTOR,TRANSISTOR,SILICON,NPN	2N3117	27014	
	81	048515	. . SEMICONDUCTOR,TRANSISTOR,SILICON,PNP	2N2907A	04713	

FIG. NO.	ITEM NO.	PAI PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	VENDOR PART NUMBER	CAGE CODE	TTL REQ
1107		116299	SUB-ASSY,CIRCUIT MODULE,OSC/AMPL/DRIVER		29632	RF
	1	080007	. CHASSIS,CIRCUIT MODULE,OSC/AMPL/DRIVER		29632	1
	2	046016	. . SEMICONDUCTOR,DIODE,SILICON,ZENER, 15V 5%,10W	1N2979B	24444	1
			(ATTACHING PARTS)			
	-3	064502	. . . WASHER,MICA,INSULATING,DIODE MTG,#10	DF6C	08530	2
	-4	064513	. . . BUSHING,NYLON,INSULATING,DIODE MTG, 0.200 IN. I.D. X 0.280 IN. O.D. X 0.0450 IN. THK	5610-105-.040	86298	1
	-5	025001	. . . LUG,SOLDER,FLAT,CLR #10	T-153	92219	1
	-6	076021	. . . WASHER,FLAT,S.STL,#10 X 7/16 IN.O.D. X .049 IN.THK	MS15795-808		1
	-7	076014	. . . WASHER,INT TOOTH LOCK,S.STL,#10 X.381-.370 IN.O.D.X.022 IN.	MS35333-73		1
	-8	100013	. . . NUT,HEX,S.STL 10-32	MS35650-304		1
			. . . * . .			
	9	029008	. . SOCKET,TRANSISTOR MTG,TO-3	8080-1G1	91506	1
	10	019010	. . CAPACITOR,FIXED,MET.POLYCARBONATE, 0.22UF 3%,400VDCW	BA2E224H	27556	1
	11	048503	. . SEMICONDUCTOR,TRANSISTOR,SILICON,POWER,NPN	2N3055	34371	1
	12	029008	. . SOCKET,TRANSISTOR MTG,TO-3	8080-1G1	91506	1
	13	048503	. . SEMICONDUCTOR,TRANSISTOR,SILICON,POWER,NPN	2N3055	34371	1
	14	029079	. . SOCKET,TRANSISTOR MTG,TO-3	8080-1G15	91506	1
	15	050321	. . RESISTOR,FIXED,WW, 4.7 OHMS 10%,2W	SPF 4.7	11502	1
	16	048530	. . SEMICONDUCTOR,TRANSISTOR,SILICON,POWER,NPN	MJ14002	04713	1
	17	029079	. . SOCKET,TRANSISTOR MTG,TO-3	8080-1G15	91506	1
	18	050321	. . RESISTOR,FIXED,WW, 4.7 OHMS 10%,2W	SPF 4.7	11502	1
	19	048530	. . SEMICONDUCTOR,TRANSISTOR,SILICON,POWER,NPN	MJ14002	04713	1
	20	029079	. . SOCKET,TRANSISTOR MTG,TO-3	8080-1G15	91506	1
	21	050321	. . RESISTOR,FIXED,WW, 4.7 OHMS 10%,2W	SPF 4.7	11502	1
	22	048530	. . SEMICONDUCTOR,TRANSISTOR,SILICON,POWER,NPN	MJ14002	04713	1
	23	029079	. . SOCKET,TRANSISTOR MTG,TO-3	8080-1G15	91506	1
	24	050321	. . RESISTOR,FIXED,WW, 4.7 OHMS 10%,2W	SPF 4.7	11502	1
	25	048530	. . SEMICONDUCTOR,TRANSISTOR,SILICON,POWER,NPN	MJ14002	04713	1
	26	029079	. . SOCKET,TRANSISTOR MTG,TO-3	8080-1G15	91506	1
	27	050321	. . RESISTOR,FIXED,WW, 4.7 OHMS 10%,2W	SPF 4.7	11502	1
	28	048530	. . SEMICONDUCTOR,TRANSISTOR,SILICON,POWER,NPN	MJ14002	04713	1
	29	029079	. . SOCKET,TRANSISTOR MTG,TO-3	8080-1G15	91506	1
	30	050321	. . RESISTOR,FIXED,WW, 4.7 OHMS 10%,2W	SPF 4.7	11502	1
	31	048530	. . SEMICONDUCTOR,TRANSISTOR,SILICON,POWER,NPN	MJ14002	04713	1
	32	029079	. . SOCKET,TRANSISTOR MTG,TO-3	8080-1G15	91506	1
	33	050321	. . RESISTOR,FIXED,WW, 4.7 OHMS 10%,2W	SPF 4.7	11502	1
	34	048530	. . SEMICONDUCTOR,TRANSISTOR,SILICON,POWER,NPN	MJ14002	04713	1

DETAILED PARTS LIST



Oscillator/Amplifier/Driver Circuit Module Sub-Assembly
Figure 1107

DETAILED PARTS LIST

FIG. NO.	ITEM NO.	PAI PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	VENDOR PART NUMBER	CAGE CODE	TTL REQ
1107	35	029079	. . SOCKET,TRANSISTOR MTG,TO-3	8080-1G15	91506	1
	36	050321	. . RESISTOR,FIXED,WW, 4.7 OHMS 10%,2W	SPF 4.7	11502	1
	37	048530	. . SEMICONDUCTOR,TRANSISTOR,SILICON,POWER,NPN	MJ14002	04713	1
	-38	064500	, , WASHER,MICA,INSULATING,TO-3 TRANSISTOR	732-734A	08530	2
	-39	064541	, , WASHER,MICA,INSULATING,TO-3 TRANSISTOR	DF377A	08530	8
			(ATTACHING PARTS)			
	-40	101019	. . . SCREW,RHM,BRASS, 6-32 X 1/2 IN.LG	AN520B680		20
			.. . . * . . .			
	41	043016	. . TRANSFORMER,TOROIDAL,DRIVER		29632	1
	-42	064518	. . . DISC,INSULATING, 2 IN.O.D.X .010 IN.THK		29632	1
			(ATTACHING PARTS)			
	-43	101018	. . . SCREW,RHM,S.STL, 6-32 X 1-1/4 IN.LG	AN520C618		1
	-44	100009	. . . NUT,HEX,S.STL 6-32	MS35649-264		1
			. . . .* . . .			
	45	116298	. . SUB-ASSY,CIRCUIT BOARD,OSC/AMPL/DRIVER		29632	1
			(ATTACHING PARTS)			
	-46	101017	. . . SCREW,BHM,S.STL, 4-40 X 5/8 IN.LG		29632	4
	-47	070003	. . . SPACER,RD,ALUM.,O.1875 IN.I.D.X 1/4 IN.LG, CLR #4		29632	4
	-48	076001	. . . WASHER,INT TOOTH LOCK,S.STL, #4 X .265-.255 IN. O.D. X .015 IN. THK	MS35333-70		4
	-49	100002	. . . NUT,HEX,S.STL, 4-40	MS35649-244		4
			. . . * . . .			

SCHEMATIC DIAGRAM - REVISION REFERENCE SHEET

REV	REVISION	EFFECTIVITY
A	DIODES: CR6/CR1 THRU CR15/CR8 CHANGED TO SEMICONDUCTOR,DIODE,SILICON, TYPE 1N5624,PAI P.N. 046015,FROM TYPE 1N5402,PAI P.N.046010.	22 SEP 71
B	CAPACITOR: C16/C206 CHANGED TO CAPACITOR,FIXED,POLYESTER, 1.25UF 3%,600VDCW, PAI P.N. 019017, FROM CAPACITOR,FIXED,POLYESTER, 1.0UF 3%, 400VDCW, PAI P.N. 019023. ADDED NOTE 4 TO SCHEMATIC DIAGRAM. SEMICONDUCTOR,DIODE,SILICON,PWR CR2/CR302, 1N3611, RELOCATED FROM BASE OF TRANSISTOR Q5 TO 15 VOLT BUS, TO JUNCTION OF CR3/CR303, CR4/CR304,AND ZR3/VR301 AND 15 VOLT BUS. DELETED CR5, SEMICONDUCTOR,DIODE,SILICON,PWR, 1N3611, PAI P.N. 046011.	18 DEC 71
C	TRANSISTORS: CHANGED-Q7/Q401,Q8/Q402,Q11/Q403 THRU Q18/Q410, SEMICONDUCTOR, TRANSISTOR, SILICON,POWER,NPN RCA TYPE 64497, PAI P.N. 048505,REV A, FROM RCA TYPE 60234, PAI P.N. 048505. DELETED CAPACITOR C11 0.1UF 10%,50VDCW, PAI P.N.019008. CHANGED-C14/C204 AND C15/C205, CAPACITOR,FIXED,POLYCARBONATE, 6UF 3%,115VAC,400 HZ, PAI P.N. 019015 REV A. ADDED NOTE REGARDING CAPACITOR VOLTAGE CHANGE.	22 JUN 73
D	DELETED CAPACITORS: C10-CAPACITOR,ELECTROLYTIC,TANTALUM, 1.0UF 10%, 35VDCW, PAI P.N. 021501; C19-CAPACITOR,ELECTROYTIC,ALUM., 1,400UF 40VDCW, PAI P.N. 021005. CHANGED CAPACITORS C17/C201 AND C18/C202 - CAPACITOR,ELECTROLYTIC,ALUM., 2,200UF, 40VDCW, PAI P.N. 021003, FROM CAPACITOR,ELECTROLYTIC,ALUM., 1,400, 40VDCW, PAI P.N. 021005. ADDED CAPACITOR C1A/C302-CAPACITOR,FIXED,POLYESTER, VALUE SELECTED TO TRIM OSCILLATOR, VALUE FROM 0.01UF TO 0.047UF, ADDED NOTE 7 TO SCHEMATIC DIAGRAM.	12 OCT 73
E	ADDED CAPACITOR C19/C203-CAPACITOR,ELECTROLYTIC,ALUM., 1,400UF,40VDCW, PAI P.N.021005. CHANGED CAPACITORS: C17/C201 AND C18/C202-CAPACITOR, ELECTROLYTIC,ALUM., 1,400UF,40VDCW, PAI P.N.021005 FROM CAPACITOR,ELECTROLYTIC,ALUM.,2,200UF 40VDCW,PAI P.N. 21003.	30 JAN 74
F	ADDED RESISTOR: R54/R307-RESISTOR,VAR,CERMET, 500 OHM,1/4W, PAI P.N. 054003, AND RELOCATE RESISTORS, R4/R305 AND R5/R306-RESISTOR,FIXED, COMP, 2,200 OHMS 5%,1/2W, PAI P.M. 050091 FROM 15 V BUS TO SERIES CONNECT WITH RESISTOR R54/R307, ARM/WIPER CONNECTS TO 15 V BUS.	30 JAN 75
G	CHANGED TRANSISTORS: Q1/Q301 AND Q2/Q302-SEMICONDUCTOR,TRANSISTOR, SILICON,NPN, CHANGED TO TYPE 2N2484, PAI P.N. 048513, FROM TYPE 2N2222, PAI P.N. 048506; Q3/Q303 AND Q4/Q304- SEMICONDUCTOR, TRANSISTOR,SILICON,NPN, CHANGED TO TYPE 2N2222A, PAI P.N. 048512, FROM TYPE 2N2222, PAI P.N.048506; Q7/Q401,Q8/Q402,Q11/0403 THRU Q18/Q410, SEMICONDUCTOR,TRANSISTOR SILICON,PWR,NPN, CHANGED TO TYPE 66090 RCA, PAI P.N. 048505, REV B, FROM TYPE 64497 RCA, PAI P.N. 048505, REV A; Q9/Q308-SEMICONDUCTOR,TRANSISTOR,SILICON,NPN, CHANGED TO TYPE 2N3117, PAI P.N. 048514, FROM TYPE 2N2222, PAI P.N. 048506; Q10/Q306-SEMICONDUCTOR,TRANSISTOR,SILICON,PNP, CHANGED TO TYPE 2N3505, PAI P.N. 048515, FROM TYPE 2N4036, PAI P.N. 048507.	5 FEB 75
H	CHANGED R51/R102-RESISTOR,FIXED,COMP, 4,300 OHMS 5%,1/2W, PAI P.N. 050090, FROM RESISTOR,FIXED COMP, 4,700 OHMS 10%,1/2W, PAI P.N. 050039	21 NOV 75
I	ADDED CAPACITORS: C21/C313 AND C22/C314-CAPACITOR,FIXED,POLYESTER, 0.1UF 10%,50VDCW,PAI P.N.019008; C23/C315-CAPACITOR,FIXED,POLYESTER, (SELECTED VALUE FROM 0.027 TO 0.047UF. ADDED NOTE 8 TO SCHEMATIC DIAGRAM.CHANGED CAPACITORS: C8/C309-CAPACITOR,ELECTROLYTIC,TANTALUM, 47UF 10%,20VDCW, PAI P.N. 021506, FROM CAPACITOR,ELECTROLYTIC, TANTALUM, 22UF 10%,15VDCW, PAI P.N. 021503; C9/C311-CAPACITOR,ELECTROLYTIC,TANTALUM, 4.7UF 10%,35VDCW, PAI P.N. 021504, FROM CAPACITOR, ELECTROLYTIC, 22UF 10%,15VDCW, PAI P.N. 021503; C7/C310-CAPACITOR, ELECTROLYTIC, 4.7UF 10%,35VDCW, PAI P.N. 021504, FROM CAPACITOR, ELECTROLYTIC, 22UF 10%,15VDCW, PAI P.N. 021503. ADDED RESISTORS: R55/R320-RESISTOR,FIXED,COMP, 2,200 OHMS 10%,1/2W, PAI P.N. 050035;	2 JUL 76

Schematic Diagram - Revision Reference Sheet,
PAI P.N. DH-1030-24-600-CS, Type IIB,
Solid-State, Static Inverter (Transverter)
Figure 1201 (Sheet 1 of 4)

SCHEMATIC DIAGRAM - REVISION REFERENCE SHEET

REV	REVISION	EFFECTIVITY
I (Cont)	R56/R321,R57/R329, AND R59/R330-RESISTOR,FIXED,COMP, 2,700 OHMS 10%, 1/2W, PAI P.N. 050036. CHANGED R26/R328-RESISTOR,FIXED,FILM,PREC., 6,810 OHMS 1%,1/8W, PAI P.N. 050508, FROM RESISTOR,FIXED,COMP, 10K OHMS 10%,1/2W, PAI P.N. 050045. ADDED Q19/Q307-SEMICONDUCTOR,TRANSISTOR,NPN, TYPE 2N3117,PAI P.N.048514. DELETED DIODES: CR6 AND CR7 - SEMICONDUCTOR,DIODE, SILICON, TYPE 1N914B, PAI P.N. 046006.	2 JUL 76
J	CHANGED SEMICONDUCTOR,TRANSISTORS AS FOLLOWS: IDENTIFICATION FROM JEDEC NUMBER TO PHOENIX AEROSPACE INC PART NUMBER AS FOLLOWS: Q1/0301 AND Q2/Q302 TO PAI P.N. 048513 FROM TYPE 2N2484; Q3/Q303 AND Q4/Q304 TO PAI P.N. 048514 FROM TYPE 2N2222A; Q5/Q305 AND Q6/Q306 TO PAI P.N. 048507 FROM TYPE 2N4036; Q7/Q401, Q8/Q402, Q11/Q403 THRU Q18/Q410 TO PAI P.N. 048505 REV B, FROM TYPE 66090, RCA; Q9/0308 AND Q19/Q307 TO PAI P.N. 048514 FROM TYPE 2N3117; Q10/Q309 TO PAI P.N. 048515 FROM TYPE 2N3505.	14 SEP 76
K	CHANGED CAPACITORS: C17/C201, C18/C202, AND C19/C203-CAPACITOR,ELECTROLYTIC,ALUM., 1,400UF 50VDCW, PAI P.N.021011, FROM CAPACITOR,ELECTROLYTIC,ALUM., 1,400UF 40VDCW, PAI P.N.021005.	15 JUN 77
L	CHANGE CAPACITOR: C7/C310-CAPACITOR,ELECTROLYTIC,TANTALUM, 22UF 10%, 15VDCW PAI P.N. 021503 FROM CAPACITOR,ELECTROLYTIC,TANTALUM, 4.7UF 10%,35VDCW, PAI P.N. 021504	30 OCT 77
M	CHANGE RESISTOR: R51/R102-RESISTOR,FIXED,COMP, 4,700 OHMS 5%,1/2W, PAI P.N. 050092 FROM RESISTOR,FIXED,COMP, 4,300 OHMS 5%,1/2W, PAI P.N. 050090.	23 MAR 78
N	CHANGED RESISTORS: R21/R323-RESISTOR,FIXED,FILM,PREC., 3,010 OHMS 1%, 1/8W, PAI P.N. 050511 FROM RESISTOR,FIXED,COMP, 2,200 OHMS 10%,1/2W, PAI P.N. 050035; R22/R324-RESISTOR,VAR,COMP, 1,000 OHMS,1/2W, PAI P.N. 054002 FROM RESISTOR,VAR,COMP, 500 OHMS,1/4W, PAI P.N.054003.	22 APR 80
0	CHANGED RESISTORS: R57/R329 AND R58/R330-RESISTOR,FIXED,FILM,PREC 2,670 OHMS 1%,1/8W, PAI P.N.050548, FROM RESISTOR,FIXED,COMP, 2,700 OHMS 10%,1/2W, PAI P.N.050036.	29 OCT 80
P	. CHANGED RESISTOR: R21/R323-RESISTOR,FIXED,FILM,PREC., 3,010 OHMS 1%, 1/8W, PAI P.N. 050511, FROM RESISTOR,FIXED,COMP, 3,000 OHMS 5%,1/2W,PAI P.N. 050097.	10 DEC 80
Q	CHANGED RESISTORS: R21/R323-RESISTOR,FIXED,FILM,PREC,2,670 OHMS,1%, 1/8W, PAI P.N.050548, FROM RESISTOR,FIXED,FILM,PREC., 3,010 OHMS 1%, 1/BW, PAI P.N. 050511; R61/R321-RESISTOR. FIXED, FILM,PREC., 2,670 OHMS 1%,1/8W, PAI P.N. 050548, FROM RESISTOR,FIXED,COMP, 2,700 OHMS 10% 1/2W, PAI P.N.050036.	12 FEB 81
R	CHANGED CAPACITORS: C3/C304 AND C4/C305-CAPACITOR,FIXED,POLYESTER, 0.022UF,50VDCW, PAI P.N.019018, FROM CAPACITOR,FIXED,POLYESTER, 0.01UF 10%,50VDCW, PAI P.N. 019003. CHANGED, Q11/0403 THRU Q18/Q410 SEMICONDUCTOR,TRANSISTOR,SILICON,POWER,NPN, PAI P.N. 048530, FROM SEMICONDUCTOR,TRANSISTOR,SILICON,POWER,NPN. PAI P.N. 048505 REV B.	7 JAN 83
S	REDRAWN - REFERENCE SYMBOLS CHANGED TO DENOTE LOCATION OF COMPONENTS ON APPROPRIATE CIRCUIT BOARD OR MODULE. NOTES REVISED AND RENUMBERED -PREVIOUS REVISION NOTES REVISED TO CORRECT VARIATION IN REFERENCE SYMBOLS. ADDED CIRCUIT MODULE OR CIRCUIT BOARD SUB-ASSY P.N. TO SCHEMATIC.	12 AUG 83
T	CHANGED RESISTORS: R331 THRU R346- RESISTOR,FIXED,WW, 1 OHM 10%, 2W, PAI P.M.050321 (BWF 1), FROM PAI P.N.050301 (BWH 1); R401 THRU R408 RESISTOR,FIXED,WW, 4.7 OHMS 10%,2W PAI P.N .050324 (BWF 4.7), FROM PAI P.N. 050304 (BWH 4.7); R326-RESISTOR,FIXED,COMP, 4,700 OHMS 10%, 1/2W, PAI P.N.050039, FROM RESISTOR,FIXED,COMP, 15K OHMS 10%,1/2W, PAI P.N.050045. ADDED CAPACITOR: C316-CAPACITOR,ELECTROLYTIC,TANTALUM, 1.0UF 10%,35VDCW, PAI P.N.021501.	23 DEC 83

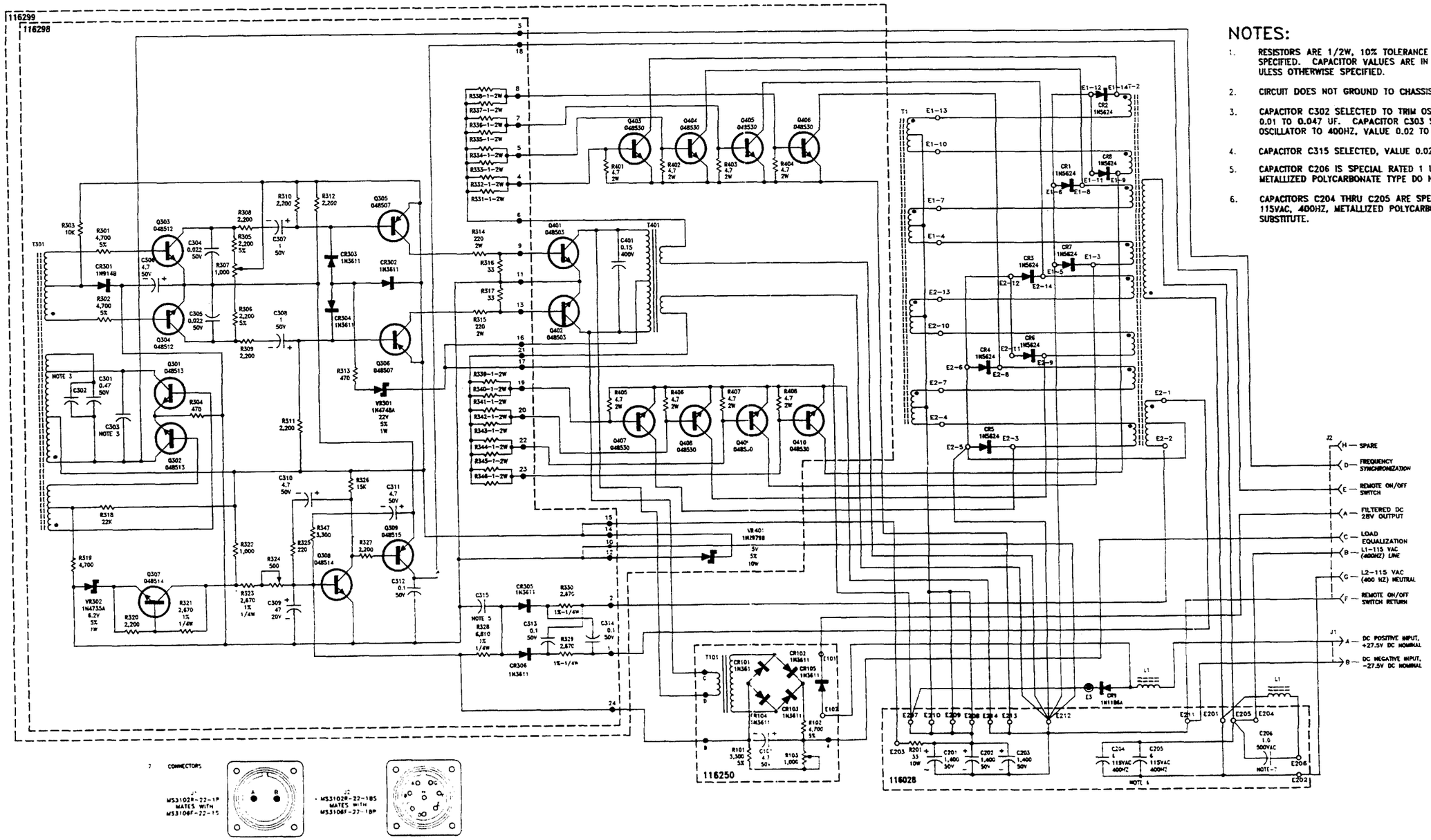
Schematic Diagram - Revision Reference Sheet,
PAI P.N. DH-1030-24-600-CS, Type IIB,
Solid-State, Static Inverter (Transverter)
Figure 1201 (Sheet 2 of 4)

REVISION REFERENCE SHEET-SCHEMATIC DIAGRAM

REV	REVISION	EFFECTIVITY
U	CHANGED RESISTORS: R307 AND R324-RESISTOR,VAR,CERMET 1,000 OHMS,1/4W, PAI P.N. 054012, FROM RESISTOR,VAR,COMP, 1,000 OHMS,1/4W, PAI P.N 054002	2 DEC 85
V	CHANGED RESISTOR: R103-RESISTOR,VARIABLE, 1,000 OHMS,1/4W, PAI P.N. 054007, FROM RESISTOR,VAR,COMP, 1,000 OHMS,1/4W, PAI P.N 054002.	25 APR 86
W	CHANGED CAPACITOR: C401-CAPACITOR,FIXED,POLYCARBONATE, 0.15UF 3%,400VDCW, PAI P.N. 019074, FROM CAPACITOR,FIXED,CERAMIC,DISC, 0.02UF 20%,1000VDCW,PAI P.N.023000	2 JUN 86
X	CHANGED TRANSISTORS: 0401 AND Q402-SEMICONDUCTOR,TRAMSISTOR,SILICON, POWER,NPN, PAI P.N. 048503, FROM SEMICONDUCTOR,TRANSISTOR,SILICON, POWER, NPN, PAI P.N. 048505, REV B.	6 OCT 86
Y	CHANGED CAPAITOR: C316-CAPACITOR,ELECTROLYTIC,TANTALUM, 3.3UF 10%, 15VDCW, PAI P.N. 021529, FROM CAPACITOR,ELECTROLYTIC,TANTALUM, 1.0UF 10%,35VDCW, PAI P.N.021501. CHANGED RESISTOR: R325-RESISTOR,FIXED,COMP, 270 OHMS 10%,1/2W, PAI P.N. 050024, FROM RESISTOR,FIXED,COMP, 560 OHMS 10%,1/2W, PAI P.N. 050028.	2 DEC 88
Z	CHANGED RESISTORS: R325-RESISTOR,FIXED,COMP, 820 OHMS 5%,1/2W, PAI P.N.050117, FROM RESISTOR,FIXED,COMP, 270 OHMS 10%,1/2W, PAI P.N. 050024; R326-RESISTOR,FIXED,COMP, 15K OHMS 10%,1/2W, PAI P.N.050045, FROM RESISTOR,FIXED,COMP, 4,700 OHMS 10%,1/2W, PAI P.N. 050039. R324-RESISTOR,VAR,CERMET, 500 OHMS,1/4W, PAI P.N. 054021, FROM RESISTOR,VAR,CERMET, 1,000 OHMS,1/4W, PAI P.N.054012; R312-RESISTOR, FIXED,COMP, 2,200 OHMS 10%,1/2W, PAI P.N. 050035, FROM RESISTOR, FIXED,COMP, 1,000 OHMS 10%,1/2W, PAI P.N. 050031. ADDED RESISTOR: R347-RESISTOR,FIXED,COMP, 3,300 OHMS 10%,1/2W, PAI P.N. 050038. CHANGED CAPACITORS: C306-CAPACITOR, ELECTROLYTIC,TANTALUM, 4.7UF 10%, 50VDCW, PAI P.N. 021525, FROM CAPACITOR, ELECTROLYTIC, TANTALUM, 1.0UF 10%,35VDCW, PAI P.N. 021501; C310-CAPACITOR,ELECTROLYTIC,TANTALUM, 4.7UF 10%,50VDCW, PAI P.N. 021525, FROM CAPACITOR,ELECTROLYTIC, TANTALUM, 22UF 10%,15VDCW, PAI P.N. 021503; C307 AND C308-CAPACITOR ELECTROLYTIC,TANTALUM, 1.0UF 10%,50VDCW, PAI P.N. 021524, FROM CAPACITOR,ELECTROLYTIC,TANTALUM, 1.0UF 10%,35VDCW, PAI P.N.021501; C101 AND C311-CAPACITOR, ELECTROLYTIC,TANTALUM, 4.7UF 10%,50VDCW, PAI P.N. 021524, FROM CAPACITOR,ELECTROLYTIC,TANTALUM, 4.7UF 10%,35VDCW, PAI P.N. 021504. DELETED CAPACITOR C316-CAPACITOR,ELECTROLYTIC, TANTALUM, 3.3UF 10%,15VDCW, PAI P.N.021529.	20 JAN 89
AA	CHANGED RESISTOR: R325-RESISTOR,FIXED,COMP, 220 OHMS 10%,1/2W, PAI 050023, FROM RESISTOR,FIXED, COMP, 820 OHMS 5%,1/2W, PAI P.N. 050117	1 DEC 89
AB	CAPACITORS: CHANGED, C302-CAPACITOR,FIXED,POLYESTER, (SELECTED-0.010.0047UF) 10%,50VDCW (JP2AXXX) STYLE, PAI P.N. 0190XX, FROM CAPACITOR,FIXED,POLYESTER,DIPPED (601PEXXX) STYLE, PAI P.N. 019XXX; C303-CAPACITOR,FIXED,POLYESTER, (SELECTED-0.02 - 0.047UF) 10%,50VDCW (JP2AXXX) STYLE PAI P.N. 019XXX, FROM CAPACITOR,FIXED,POLYESTER, DIPPED, (601PEXXX) STYLE PAI P.N. 019XXX; C315-CAPACIOR,FIXED,POLYESTER, (SELECTED-0.027 - 0.047UF) 10%,50VDCW (JP2AXXX) STYLE PAI P.N. 019XXX, FROM CAPACITOR,FIXED,POLYESTER,DIPPED, (601PEXXX) STYLE PAI P.N. 019XXX; C304 AND C305 - CAPACITOR,FIXED,POLYESTER, 0.022UF 10%,50VDCW, PAI P.N. 019089, FROM CAPACITOR. FIXED,POLYESTER, DIPPED, 0.022UF 10%,50VDCW PAI P.N. 019018.	3 JAN 92

Schematic Diagram - Revision Reference Sheet,
PAI P.N. DH-1030-24-600-CS, Type IIB,
Solid-State, Static Inverter (Transverter)
Figure 1201 (Sheet 3 of 4)

SCHEMATIC DIAGRAM



NOTES:

1. RESISTORS ARE 1/2W, 10% TOLERANCE UNLESS OTHERWISE SPECIFIED. CAPACITOR VALUES ARE IN UF (MICROFARADS) ULESS OTHERWISE SPECIFIED.
2. CIRCUIT DOES NOT GROUND TO CHASSIS.
3. CAPACITOR C302 SELECTED TO TRIM OSCILLATOR, VALUE 0.01 TO 0.047 UF. CAPACITOR C303 SELECTED TO TUNE OSCILLATOR TO 400HZ, VALUE 0.02 TO 0.047 UF.
4. CAPACITOR C315 SELECTED, VALUE 0.027 TO 0.047.
5. CAPACITOR C206 IS SPECIAL RATED 1 UF ?5%, 500VAC, METALLIZED POLYCARBONATE TYPE DO NOT SUBSTITUTE.
6. CAPACITORS C204 THRU C205 ARE SPECIAL RATED 6UF ?3% 115VAC, 400HZ, METALLIZED POLYCARBONATE TYPE, NO NOT SUBSTITUTE.

PAI P.N. DH-1030-24-600-CS, Type IIB, Solid-State Static Inverter (Transverter), Schematic Diagram
Figure 1201 (Sheet 4 of 4)

SAFT

F6177

ELECTRICAL STORAGE BATTERY

P/N

4076, 4076-1

COMPONENT MAINTENANCE MANUAL

WITH

ILLUSTRATED PARTS LIST

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NOTICE OF MISSING INFORMATION

Issue\Section 24-30-22

Page Number(s) Record of Revisions

The above has been ordered from the source.
As soon as it is received, ATP will reissue
this fiche to include the above.

RECORD OF TEMPORARY REVISIONS

TEMPORARY REVISION No.	PAGE NUMBER	ISSUE DATE	BY	DATE REMOVED	BY
1	504	JAN 30/86	AMD-BA		

LIST OF EFFECTIVE PAGES

	DESCRIPTION	PAGE	DATE
R	Title page	1/2	NOV 30/84
R	Record of revisions	1/2	NOV 30/84
R	List of effective pages	1/2	NOV 30/84
R	Table of contents	1	NOV 30/84
R		2	NOV 30/84
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R		111	NOV 30/84
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	Disassembly	301/302	SEP 15/79
	Cleaning	401	SEP 15/79
		402	SEP 15/79
	Inspection	501	SEP 15/79
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		504	NOV 30/84 R
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INTRODUCTION

1. General

This equipment maintenance manual has been prepared in compliance with ATA specification No.100 by the (AIR TRANSPORT ASSOCIATION OF AMERICA). Its purpose is to describe the procedures, applied in the manufacturer's shops to enable a mechanic, unfamiliar with the equipment, to set it back to operating condition or overhaul it.

The operations described must be carried out in maintenance shops using special tools and test benches.

This manual does not cover standard techniques, maintenance intervals nor details which are likely to vary depending on the shop facilities available.

2. Format

A. The page numbering system of the manual consists in using a page number block for each section as follows. As concerns small basic items of equipment, more than one section can be covered on the same page.

1-100	DESCRIPTION AND OPERATION
101-200	TESTING AND TROUBLESHOOTING
201-300	(NOT ASSIGNED)
301-400	DISASSEMBLY
401-500	CLEANING
501-600	INSPECTION
601-700	REPAIR
701-800	ASSEMBLY AND STORAGE
801-900	FITS AND CLEARANCES
901-1000	TOOLS AND SPECIAL EQUIPMENT
1001-1100	ILLUSTRATED PARTS LIST

B. In general, all values are expressed in units of International System (meter, kilogram, second) or multiples and sub-multiples of same.

In some particular cases more appropriate units are employed.

3. Revision

With each revision issued for the manual, detailed instructions are supplied cross-referring to the page numbers concerned for insertion and deletion. The revised, added or deleted material is indicated by the letter R printed in the margin.

LIST OF PRODUCTS

NOTE : Equivalent products may be used in place of those listed.

DESCRIPTION PART NUMBER OR SPECIFICATIONS	SUPPLIER NAME ADDRESS	USE					
		TESTING	DISASSEMBLY	CLEANING	INSPECTION	REPAIR	ASSEMBLY STORAGE
Petrolatum AIR 3565 (VVP-236)	NYCO 159, rue de Rome 75017 Paris (France)						X

LIST OF EQUIPMENT MODIFICATIONS

AMDT	BRIEF DESCRIPTION	APPLICABLE TO VERSION
	BASIC ISSUE	ALL VERSIONS

DESCRIPTION AND OPERATION

1. Description

A. General

The electrical storage battery supplies the aircraft with 24 V D.C. until the generators operate or in case of generator output drop.

It also enables direct or indirect starting of the propulsion engine(s).

The battery comprises 20 cadmium-nickel series-mounted storage cells contained in a metallic box which accommodates a connector receptacle.

The box of battery P/N 4076-1 accommodates an additional connector receptacle which is connected to the thermostat.

B. Characteristics

(1) Dimensions and weight

	OVERALL DIMENSIONS IN mm (in.)			WEIGHT IN kg (lb)
	LENGTH	WIDTH	HEIGHT	
Box assembly	301.5 (11.87)	267.4 (10.53)	260.4 (10.25)	5 (11.02)
Storage cell VP 400 KH	79 (3.11)	34.7 (1.37)	236 (9.29)	1.525 (3.36)

Weight of the complete battery, ready for use : 37 kg (81.55 lb) ± 2%.

(2) Technical features

- Alkaline, spill-proof, cadmium-nickel battery, 24 V D.C., 36 Ah.

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- Connector receptacle complying with MS18093 and NFL56205 specifications.

- Very thin, sintered, cadmium-hydrate impregnated negative plates, and nickel-hydrate impregnated positive plates.

- Composite separator made of synthetic fibre. Alkaline electrolyte (chemically pure potassium hydroxide aqueous solution. Specific gravity 1.30).

- Polyamid boxes and covers assembled by thermowelding.

R - Nickel-plated cuprochromium output terminals.
R Sealing around the therminals is provided by packing
R glands fitted with preformed packings.

- Polyamid safety valve screwed in a housing located in the center of the cover.

- Dimensional specification : NFL56135 with connector receptacle NFL56205.

DISCHARGE RATE	36A (+25°C) (+77°F)	360A (+25°C) (+77°F)	540A (+25°C) (+77°F)	180A (-15°C) (+5°F)	360A (-15°C) (+5°F)
Discharge duration	1 hr.	5 min.	3 min.	10 min. 40 sec.	4 min. 40 sec.
End-of-discharge voltage	21 V D.C.	18 V D.C.	16 V D.C.	18 V D.C.	15 V D.C.
Capacity	36 Ah	30 Ah	27 Ah	32 Ah	28 Ah

R - Nominal capacity C1 = 36 Ah (at discharge rate for 1 hour).

- Maximum instantaneous power (at + 25°C (+ 77°F)) : 18 kW (1380 A - 13 V).

- Service life : minimum of 100 cycles as per regulation AIR 8421.

- Charging in flight at 28.5 V D.C. or in a workshop (see "Testing and Troubleshooting", para. 1. B.).

R Special characteristics applicable to battery P/N 4076-1.

- Thermostat fitted to a special link and connected to a connector receptacle located under the main connector receptacle.

R - Operating temperature (closing) : 71 + 3°C (160
R + 5°F) increasing temperature).

- Thermostat connector receptacle : complying with MIL-C26482 specifications (CANNON : KPTM07-E-10-6-P).

C. Detailed description (See Fig. 1)

(1) Complete box

This comprises :

- a box assembly (10),

- a complete cover (20) with an insulating gasket (30) made of silicone elastomer bonded to the inner face.

(a) Box

The box is laterally provided with two vent pipes and four spring fasteners.

An identification plate (310), a filling instruction plate (300) and a modification plate (320) are affixed onto the front face which supports the connector receptacle base plate.

The front face of battery P/N 4076-1 also supports the base plate of the connector receptacle connected to the thermostat.

(b) Cover

The cover is laterally provided with four catches intended for attachment to the box, and with a bar notched at both ends and intended for battery attachment through tie-rods secured to a rack.

An instruction plate (300) is also affixed onto the cover.

(2) Storage cells

The twenty electrical storage cells (40) are arranged in two rows of seven and one row of six.

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Each storage cell is equipped with a safety valve (120) fitted with a preformed packing (130).

The storage cell terminals are made up of two threaded rods. Each rod is fitted with :

- a preformed packing (50),

- a flat washer (60),

- a spring washer (70),

- a spacer ring indicating polarity (-) (80) or (+) (90),

- a terminal lower nut (100),

- a spring washer (110),

- a terminal nut (100).

(3) Accessories

The accessories are used to secure the storage cells. There are :

- six endplates (240 and 250),

- two notched sideplates (260),

- four intermediate insulator plates (270 and 280) inserted between the three rows of storage cells,

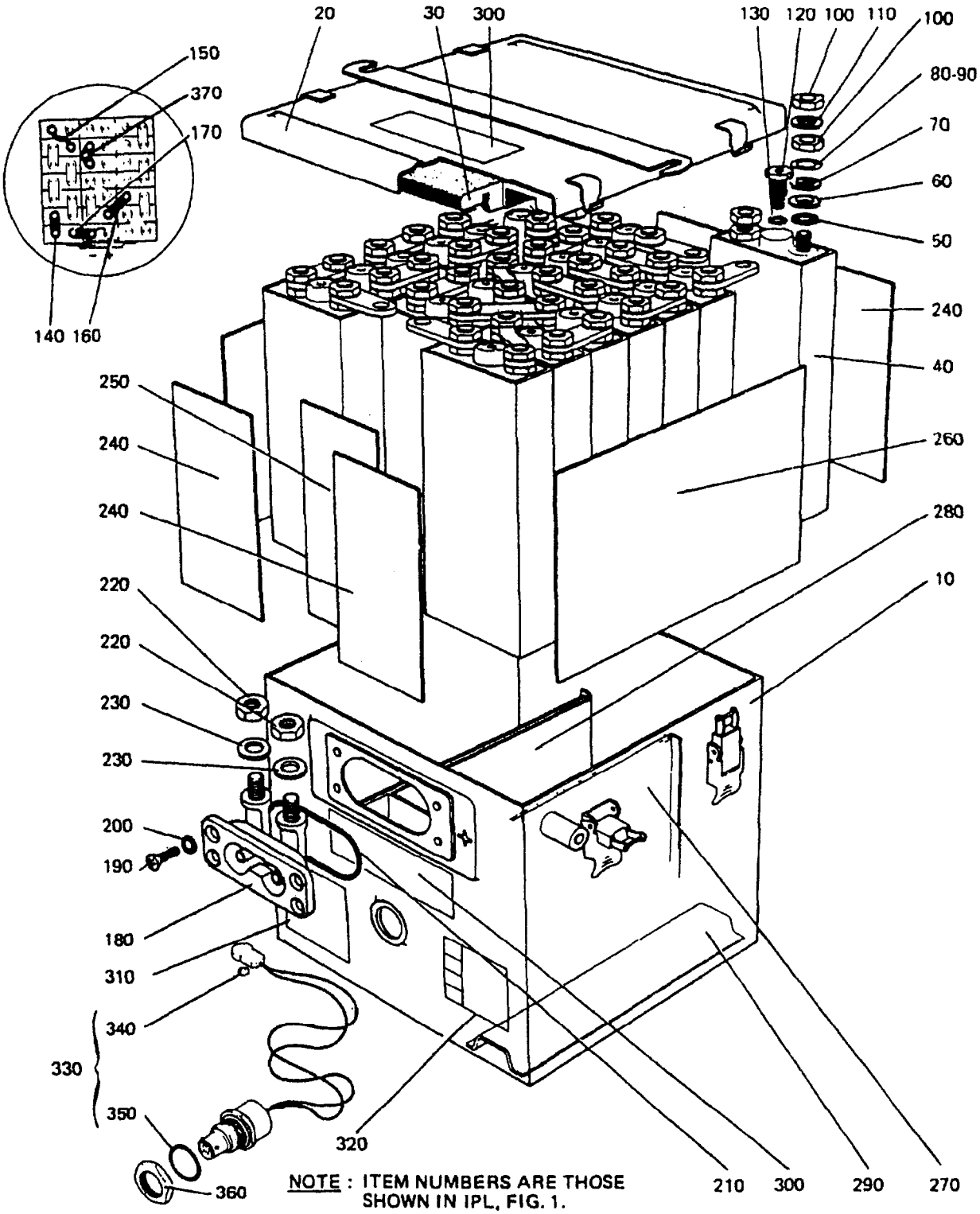
- twenty-one links (140, 150, 160 and 170) ensuring series-connection of storage cells and connection to the connector receptacle.

Battery P/N 4071-1 is provided with a special link (370) (to which the thermostat is secured) instead of a link (140).

(4) Connector receptacle

Main connector receptacle (180) is secured to the box by four screws (190) and washers (200).

On battery P/N 4071-1, the thermostat connector receptacle is secured to the box by a preformed packing (350) and locking nut (360).



NOTE : ITEM NUMBERS ARE THOSE SHOWN IN IPL, FIG. 1.

DESCRIPTION
FIGURE 1

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2. Operation

A. Principle of operation

The battery plates store electrical power supplied by a charging source, and supply power when the battery is connected to a load circuit, i.e. when it discharges.

During charge, nickel hydroxide Ni $(OH)_2$ of the positive plates is oxidized and is transformed into superior hydroxide Ni O OH ; cadmium hydroxide Cd $(OH)_2$ of the negative plates is reduced and is transformed into cadmium metal (Cd). Reverse reactions take place during discharge and active materials return to their initial state. The electrolyte (potassium solution) does not undergo any chemical change.

For a battery with a given volume, the nominal capacity of the battery discharged in 1 hour is determined by the quantity of electricity (Ah) the battery can supply.

The efficiency of the battery, in terms of quantity of electricity, is 71.5%. This means that, in order for a 36 Ah battery to supply 100% of its capacity, it must store a quantity of electricity of 50 Ah, i.e. 140% of Cl (case of recycling, see "Testing and Troubleshooting", para. 1. B.).

It is only on this condition that complete chemical transformation of the active materials will take place.

B. Operation in normal use

(1) Charging

Charging the battery on an aircraft is ensured by connecting it in parallel, at 28.5 ± 0.5 V D.C., with the aircraft generator(s), or with one (or several) transformer-rectifier(s) supplied by one (or several) A.C. generator(s).

In the case where the charging sources are not accurately regulated, it is advisable to particularly check the water consumption in the storage cells, at least at the beginning of the operating period. Moreover, it is advisable to regularly check that the charging voltage supplied by the different systems does not exceed 28.5 ± 0.5 V D.C. at a constant rate (for a temperature of 20 ± 5°C (68 ± 9°F)). R

NOTE : - When a battery, in which the active materials have been fully transformed, is subjected to an extended charging operation, the battery becomes overcharged and the current which passes through it can only give rise to the decomposition of the electrolyte water content into its two elements : oxygen and hydrogen (the rate of decomposition is 1 cm^3 (0.061 cu.in.) of water for an overcharge of 3 Ah). Water consumption in overcharging conditions is proportional to the value of the overcharging current.

- When a battery is charged from a constant voltage supply, the value of the end-of-charge current depends only on the voltage of this supply and the temperature of the battery.

Without exceeding the limits laid down in AIR 2021 specifications, the charging network voltage should be dropped when the internal temperature of the cells frequently remains high for long periods.

The rule to be followed consists in dropping the charging voltage by 1 V D.C. each time the stabilized temperature of the twenty storage cells increases by 15°C (27°F) (from + 25°C (+ 77°F)).

R

- The battery is designed to withstand, for short periods of time, large accidental fluctuations of the overcharge current, providing the electrolyte levels within the cells are correct.

(2) Discharging

The nominal capacity C1 of the battery corresponds to a 1 hr rate of charge ; that is, the battery can supply a 36-amp current for 1 hour, when it is 100% charged.

However, the battery can, without danger, supply currents greatly exceeding the nominal discharge current. For instance, a battery with a 36 Ah nominal capacity can supply, in peak conditions, currents about twenty times its nominal rating, i.e. 720 A under 19.5 ± 0.5 V D.C. at + 25°C (+ 77°F).

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The battery is designed to withstand complete discharge (for instance, as much as 3 Cl, at an emergency rate). However, at the end of discharge, the current supported by the least charged cells can reverse their polarities (unbalance) (see "Testing and Troubleshooting", para. 1. B. (2) (b)).

TESTING AND TROUBLESHOOTING

NOTE : Tools and special equipment to be used are listed under "Tools and Special Equipment".

1. Testing

A. Setting into service

(1) Ground maintenance

(a) Operating voltage

The nominal charging voltage for 20-cell batteries is 28.5 V D.C. at 20°C (68°F). An end-of-charge current matching the water consumption is obtained.

In case the water consumption is excessive, i.e. more than 25 cm^3 (1.53 cu.in.) per cell (see para. B. (3) (b)), check the voltage above, or the usual temperature of the batteries in service (see aircraft Maintenance Manual).

(b) Insulation

Electrolyte condensation or overflowing may reduce the value of the insulation between the battery electrical circuit (connector receptacle disconnected) and the box.

The value of the insulation under 45 V D.C. should be greater than 10 megohms.

(c) Charge condition

The battery can be charged in flight up to 90%. When this state is reached, the open-circuit voltage is about 26 V D.C.

When the off-load voltage of the battery after an idle period is greater than 25.5 V D.C., it can be deemed at least 50% charged. If required (see aircraft maintenance manual), perform fast-charging (see para. (2) (c)).

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(d) Maintenance periods

Maintenance on the aircraft is defined by the corresponding specifications. The workshop maintenance periods and removal conditions are covered in the aircraft manuals and determined by the users, taking account of the operating conditions.

The maintenance operations can be broken down as follows :

- the complementary fast-charging operations above,

R - charging and topping up of the electrolyte
R level including :
R - residual discharge (see para. B. (2) (a)),
R - fast charging as per the procedure mentioned
R in paragraph A. (2) (c) 1st method,
R - topping up of the electrolyte level and valve
R cleaning (see para. B. (3) (b)),
R - visual inspection of the thermostat (see "Inspection"),

- recycling, including :
  - residual discharge,
  - balancing as required,
  - complete charging and topping up of the electrolyte levels,
  - valve cleaning,
R - checking the thermostat for operation,
  - checking the capacity (discharge and complementary checks as required),
  - final charging after checking the insulation,

- reconditioning, including :
  - disassembling the battery,
  - cleaning,
  - inspection,
  - assembling the battery.

This operation is to be performed during recycling, after the capacity check and before the final charging.

It is either scheduled or to be performed when cells are to be replaced.

(2) Charging in workshop

(a) General conditions

Equipment required :

- battery charger,

- valve wrench.

CAUTION : - CHARGING SHOULD BE PERFORMED ONLY IN CLEAN AND VENTILATED PREMISES WHICH ARE NOT USED FOR LEAD BATTERIES (ACID ATMOSPHERE).

- REMOVE THE COVER OF THE BATTERY AND UNSCREW, BUT DO NOT REMOVE, THE VALVES (USING THE VALVE WRENCH), IN ORDER TO ALLOW THE GASES PRODUCED BY THE ELECTROLYTE TO BE EVACUATED WITHOUT PLACING THE ELECTROLYTE IN CONTACT WITH THE AMBIANT AIR (RISKS OF CARBONATION).

NOTE : - After charging a discharged battery for 5 min., add 10 to 15 cm^3 (0.61 to 0.92 cu.in.) of distilled water to very dry cells if their voltage is greater than 1.5 V D.C. (see para. B. (3)).

When this can be foreseen, it is advisable to check the voltages of each cell at the beginning of the charging operation.

- During charge, and particularly near the end of the charging period, a production of foam may occur. This phenomenon is generally due to :
  - the presence of greasy matter inside the cell (for instance, grease or oil which could have accidentally ingressed through the valve clearing hole),
  - excessive reduction of the specific gravity of the free electrolyte above the plates. This can happen particularly when distilled water is added to a cell having consumed all (or even more than) its content of free electrolyte.

R
R

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In this case, it is necessary to add a large volume of distilled water, which does not immediately mix with the concentrated electrolyte remaining in the cell.

To stop this phenomenon, it is generally sufficient to interrupt the charging operation and to perform a discharge allowing the electrolyte to mix. The next charging operation will further improve electrolyte homogeneisation, and the phenomenon should then disappear.

In the case where the foam is formed by the contact with greasy matter inside the cell, practically nothing can be done except preventing the foam from spreading over the covers and flowing between the cells. This can easily be performed by fitting a water-absorbent cotton pad in place of the valve.

(b) Slow-rate low-current charging

On the first time the battery is set into service (new battery), after important balancing operations and after removing the discharged batteries from storage, this type of charging is advisable to ensure homogeneous charging of all cells.

Charge the battery at 3.6 A constant current up to 30 V D.C. as measured across the terminals, then continue with the same rate of 3.6 A for 4 hr.

Charging can be performed in two periods provided that the first period lasts at least 8 hr.

Do not interrupt the charging operation for the last 5 hr. (to ensure normal topping up of the electrolyte levels).

(c) Fast-rate charging (discharged battery)

This charging operation is performed at two successive regulated current rates :

- First method

R First charge at 18 A up to 31 V D.C. (2 hr. 40 min. maximum depending on the actual capacity of the battery), then charge at 3.6 A for 4 hr. (the voltage is then about 32 V D.C.).

- Second method

First charge at 36 A up to 31.4 V D.C. (1 hr. 15 min. max. depending on the actual capacity of the battery), then charge at 3.6 A for 4 hr. (the voltage is then about 32 V D.C.).

NOTE : The high current phase is limited by the voltage, in order not to overload (or underload) batteries with excessively different capacities and to completely charge the battery in about 6 hr.

(d) Charging a battery whose charge is unknown

Applicable when a complement of charge is needed, or if the battery has not been used for a period of less than 2 months, if it is not possible to perform complete recycling :

- charge at 3.6 A until the voltage reaches 29 to 30 V D.C.,

- or charge at 18 A until the voltage reaches 30 to 31 V D.C.,

- or charge at 36 A until the voltage reaches 31 to 31.4 V D.C.

B. Recycling

(1) Equipment and product required

(a) Equipment

- Battery charger.

- D.C. voltmeter, 0 to 3 V/0 to 35 V, class 0.5.

- Stopwatch.

- 20 resistors (1 ohm approx. - 1 W min. each) fitted at both ends with "crocodile" clips.

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- Plastic syringe fitted with a cylindrical adaptor and a stop.

- Valve wrench.

(b) Product

- Distilled water.

R (2) Residual discharge and rebalancing
R
R (a) Residual discharge

After removing the battery for normal charging operation in flight (scheduled removal) or after detecting a fault, make sure that the discharge value is practically nil after removal.

Discharge 85% of C1 at a constant current, i.e. 30 A, and note the time necessary to obtain a voltage of 20 V D.C. across the battery terminals. The current should automatically or manually be regulated.

When the voltage across the terminals passes between 22 and 21 V D.C. (in other words, if sudden voltage drops occur), measure the voltage of each cell in order to detect and localize unbalance. If the unbalance is practically nil (normal battery), let the battery cool down before performing a new charging operation and topping up of levels (see para. (3)).

(b) Rebalancing

As soon as the voltage of one or several cell(s) drops below 1 V D.C. or, as a limit, when the voltage across the terminals of the battery reaches 20 V D.C., stop discharging (and note the discharge duration). Use a 1-ohm resistor to shunt each cell and keep the resistors in place for 16 to 24 hr. (for instance, one night).

In these conditions, each cell will discharge at a slow rate through its individual resistor without danger of reversing the polarities.

NOTE : The complementary checks covered in paragraph (4) (b) provide a means of classifying the cells after their capacity ; this is not covered at this stage.

R (3) Complete charging and topping up of the electrolyte level

(a) Charging

Charge the battery as per paragraph A. (2) (b) or A. (2) (c) to ensure complete charging to 100% of the available capacity.

This charging provides a quantity of electricity equal to 140% of the capacity of the battery. During the final stage, a certain quantity of water from the electrolyte is decomposed and will have to be replaced as per the following operation.

At the end of the charge, the electrolyte is at its maximum level (presence of H_2 and O bubbles on and between the plates) and the voltage of the battery is 31.5 to 32 V D.C. (between 15 and 25°C (59 and 77°F)). The individual voltages of the cells should be homogeneous and about 1.6 V D.C.

R (b) Topping up the electrolyte level

During the last charging hour, as close as possible to the end of charge, and keeping the charge at 3.6 A, add distilled water to top up the level of the liquid in each cell.

NOTE : In the case of simultaneous recharging of several batteries, take account of the R time required to top up their levels. If necessary, extend the charging time by a few minutes so as to complete this operation.

R Checking the level as described below is valid only if it is performed at the end of charging, while the current flows.

CAUTION : IF THIS ADJUSTMENT IS NOT PERFORMED AS PER THESE SPECIFICATIONS, THE CELLS WILL OVERFLOW.

The level of the electrolyte should be at 20 mm (0.79 in.) below the valve seat (the valve and valve seal should be removed).

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To adjust the level, after removing each valve (see "Disassembly"), use a plastic syringe whose adaptor is provided with a tube and a stop ; the end of the syringe should be at 20 mm (0.79 in.) below the valve seat (see Fig. 101).

By maintaining the stop shoulder in contact with the valve seat, and by pulling the syringe piston, checking for correct topping up is immediate.

- if the level is too low, the syringe piston will come up "dry",

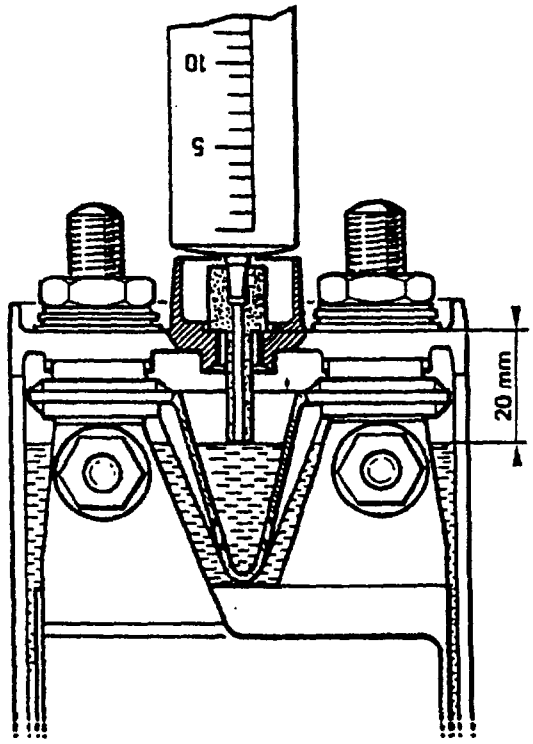
- any excess fluid will be sucked into the syringe until the level coincides with the tip of the tube.

If the volume of water added to any cell is greater than 25 cm^3 (1.53 cu.in.), check the conditions of use (see para. A. (1) (a)). For new batteries with a normally correct level, the volume of added water should not exceed 10 cm^3 (0.61 cu.in.).

NOTE : Clean the valves (see "Cleaning", para. 1) while the levels are being adjusted. Leave the cells unplugged for as short a time as possible.

CAUTION : NEVER USE ACID OR A SOLUTION OF ACID AND WATER TO ADJUST CELL LEVELS IN NICKEL-CADMIUM BATTERIES. ANY TRACE OF ACID, HOWEVER SMALL, WILL IRREMEDIABLY DAMAGE THE BATTERY. ONLY USE EQUIPMENT WHICH HAS NEVER BEEN USED FOR LEAD BATTERIES. AVOID USING CHEMICALLY PURIFIED WATER WHICH CONTAINS ACID OR CHLORINATED ELEMENTS.

R (4) Checking the thermostat for operation (see
R "Inspection").



TOPPING UP WITH A SYRINGE FITTED WITH A CALIBRATED ADAPTOR
FIGURE 101

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R (5) Capacity check

(a) Discharge

R Within 24 hours after charging and topping up the level, discharge the battery down to 30 A (see para. (2) (a)). Note the discharge duration and the time when some cells drop below 1 V D.C. Stop discharging when reaching 20 V D.C. across the battery terminals.

Conclusions to be drawn from the above test :

- the battery is correct if the duration of the first discharge of the battery (see para. (2) (a)). is greater than 30 min., and the duration the second discharge is at least equal to 1 hr. (84% charge),

- if the duration of the first discharge is less than 30 min., and the duration of the second discharge is correct (1 hr. minimum), the condition of the battery is correct, but it is not completely charged (less than 15 Ah) and the operating conditions should be checked,

- if some cells remain shorted during discharge, discard them (see para. (c)),

R - if the duration of the second discharge is less than 1 hr., or if the voltage of some cells is less than 1 V D.C. within 1 hour of discharge, the battery should undergo a more complete overhaul. Perform the complementary checks (see para. (b)).

(b) Complementary checks

The capacity supplied by the battery is :

$$35 \text{ A} \times \frac{\text{number of minutes before 20 V D.C.}}{60}$$

= Number of Ampere-hours (Ah)

If the capacity is not greater than 30 Ah, or if the voltage of each cell rises too quickly during charging, drops, or is excessively low at the end of charge, some cells may have been insufficiently balanced, the volume of added water is insufficient, or the cell separators are damaged.

- Repeat the balancing operations more accurately by discharging at 10 A.

Meanwhile, regularly measure and note the voltage of each cell, observing the sequence of measurement. Locate and shunt the cells whose voltage drops below 1 to 0.9 V D.C. using a 1-ohm (1 W) resistor.

Stop discharging at the latest when the voltage reaches 10 V across the battery terminals. Keep the shunts in place as described in paragraph (2) (b).

Repeat the remaining operations : slow-rate charging (see para. A. (2) (b)), checking the levels (see para. (3) (b)) and a new test discharge (see para. (a)).

Regularly check the voltage of each cell during the first and last hour of charging.

At the end of this test, discard the following cells whose operation is defective :

- cells not reaching 1.2 V D.C. after 5 min. charging,

- cells whose voltage is less than 1.5 V D.C. at the end of 3.6 A charging,

- cells whose voltage is greater than 1.7 V D.C. at the end of charging (at 20°C (68°F)),

- cells whose voltage still falls below 1 V D.C. before 1 hr's. discharge, when the last test discharge is performed.

NOTE : A more accurate procedure intended to discard the defective cells consists in extending the end of charge described in paragraph A. (2) (b) for 4 to 5 hr. under 3.6 A and localizing the cells whose voltage falls after reaching 1.6 V D.C.

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(c) Replacing cells

Replacing cells requires disassembly and reconditioning of the battery. After replacing the cells, perform a fast-rate charging (see para. A. (2) (c)).

The capacity of the replacement cells and remaining cells should be approximately the same, to avoid creating new unbalance. Only a small number of new cells can be installed in a battery comprised of average cells. It is advisable to series-connect average cells to obtain homogeneous batteries.

The tests as described in paragraph (b), together with an accurate control of the voltage rise of the cells during charging, allow for qualitative classification and thus economical use of the cells.

R (6) Final charging

Check for insulation (see para. A. (1) (b)) before performing this charging operation prior to setting into service. Perform a fast-rage charging (see para. A. (2) (a) and A. (2) (c)).

NOTE : For batteries actually in use, it is not necessary to perform the last phase of 4 hr. at 3.6 A, as electrolyte is being consumed at this stage.

DISASSEMBLY

NOTE : - See "Testing and Troubleshooting" to determine the condition of the unit or the most likely cause of faulty operation.

- Tools and special equipment to be used are listed under "Tools and Special Equipment".

1. Disassembly (See IPL, Fig. 1)

- Remove cover (20).

CAUTION : MAKE SURE THAT THE BATTERY IS COMPLETELY DISCHARGED BEFORE PERFORMING THE FOLLOWING OPERATIONS.

- Remove terminal nuts (100), spring washers (110), washers (220), washers (230) and rigid links (140, 150, 160 and 170) interconnecting cells (40).

NOTE : For battery P/N 4076-1, clear link (370), to which the thermostat is secured, without exerting any tractive force on the leads connecting the link to the thermostat connector receptacle.

- Extract each cell using wrench 13169.

- Remove the two sideplates (260), intermediate insulator plates (270 and 280) and endplates (240 and 250).

- Unscrew the four attaching screws (190), fitted with washers (200), and remove connector receptacle (180) ; recover preformed packing (210).

- Remove cell valves (120) using wrench 15528 (use the two lugs provided to facilitate unlocking) ; recover preformed packing (130).

- Remove thermostat (330) (battery P/N 4076-1) :
  - unscrew self-locking nut (340) securing the thermostat to link (370),
  - unscrew connector receptacle holding nut (360), recover preformed packing (350) and take out the assembly.

CLEANING

1. Cleaning the valves

CAUTION : THE USE OF GASOLINE, CHLORINATED SOLVENT OR ANY OTHER SOLVENT IS STRICTLY PROHIBITED.

Remove the valves and dip them for several hours (one night, for instance) in a container filled with distilled water or, if not available, with very clean and non-acid water.

The purpose of this dipping operation is to dissolve the salts likely to accumulate within the valve clearing ports.

While the valves are immersed, take all appropriate precautions to prevent foreign matter from falling inside the cells, and to avoid the reaction of the electrolyte in contact with the ambient air.

Before fitting back the valves on the cells, check them for operation (see "Inspection").

2. Cleaning the cells

Two cleaning procedures can be used :

- cleaning with well-filtered compressed air,

- cleaning by washing.

A. Cleaning with compressed air

NOTE : To avoid any short-circuit, blow with a rubber hose or a pipe fitted with an insulating adaptor.

Thoroughly blow on the cell covers, in order to expel outside the box the dust and the salts likely to have accumulated on the covers.

B. Cleaning by washing (cells removed)

- This procedure is more rational and consists in washing the terminals, covers and cell walls with warm water and a smooth non-metallic brush, in order to remove any trace of potassium or salts.

- Beforehand make sure that the cell valves are installed.
- Never immerse the cells in water.
- Wipe each cell, then let in dry in ambient air.

3. Cleaning the box

Wash with water and let dry in the ambient air after wiping.

4. Cleaning the nuts, links, spring washers, endplates and sideplates

- Clean with warm water and a brush, and let dry in ambient air.
- Discard any corroded or mechanically defective part.

INSPECTION

NOTE : Tools and special equipment to be used are listed under "Tools and Special Equipment".

1. Visual inspection

- Inspect the box on the outside and make sure that it does not show any trace of impact.

- Check the cells for condition, in order to detect any electrolyte seepage around the terminals, traces of shorting, corrosion by potassium, cover lifting, cracked cells, etc.

- Localize the corroded or damaged parts, if any.

2. Checking a valve

- Remove the valve.

- Screw the valve fitted with its seal on a metallic tube fitted with an appropriate adaptor.

- Connect this tube to an adjustable pressure reducing valve and then to a compressed air line or a compressed air cylinder.

- Adjust the pressure to 0.5 bar (7.25 psi) and dip the valve in a container filled with water. If the valve is in good condition, air bubbles should come off.

- If there are no bubbles, increase pressure until the air escapes, then gradually decrease pressure to 0.5 bar (7.25 psi) and note the value for which the air stops escaping.

- Discard any valve whose operating pressure is greater than 0.7 bar (10 psi) after this "lifting" operation is performed, and replace the valve by a duly tested spare valve. Also discard any valve whose operating pressure is less than 0.14 bar (2 psi).

- Install the valve using only the knurled upper part of the valve wrench.

- Check the packing for condition.

3. Checking the nuts for tightness

Check that all nuts are correctly tightened :

R - terminal lower nuts ; torque : 0.5 ± 0.1 daN.m (3.69 ± 0.738 ft.lb),

R - terminal nuts ; torque after assembly : 1.3 ± 0.1 daN.m (9.594 ± 0.738 ft.lb).

4. Checking the connector receptacle

Check the connector receptacle pins for condition ; replace the connector receptacle if the pins show any trace of arcing or excessive oxidization.

R 5. Visual inspection of the thermostat (battery P/N 4076-1)

R Visually check the thermostat and the thermostat connector receptacle for condition.

R Check in particular that :

R - the thermostat is secured to the battery link,

R - the connecting leads or cable between the connector receptacle and the thermostat are not damaged.

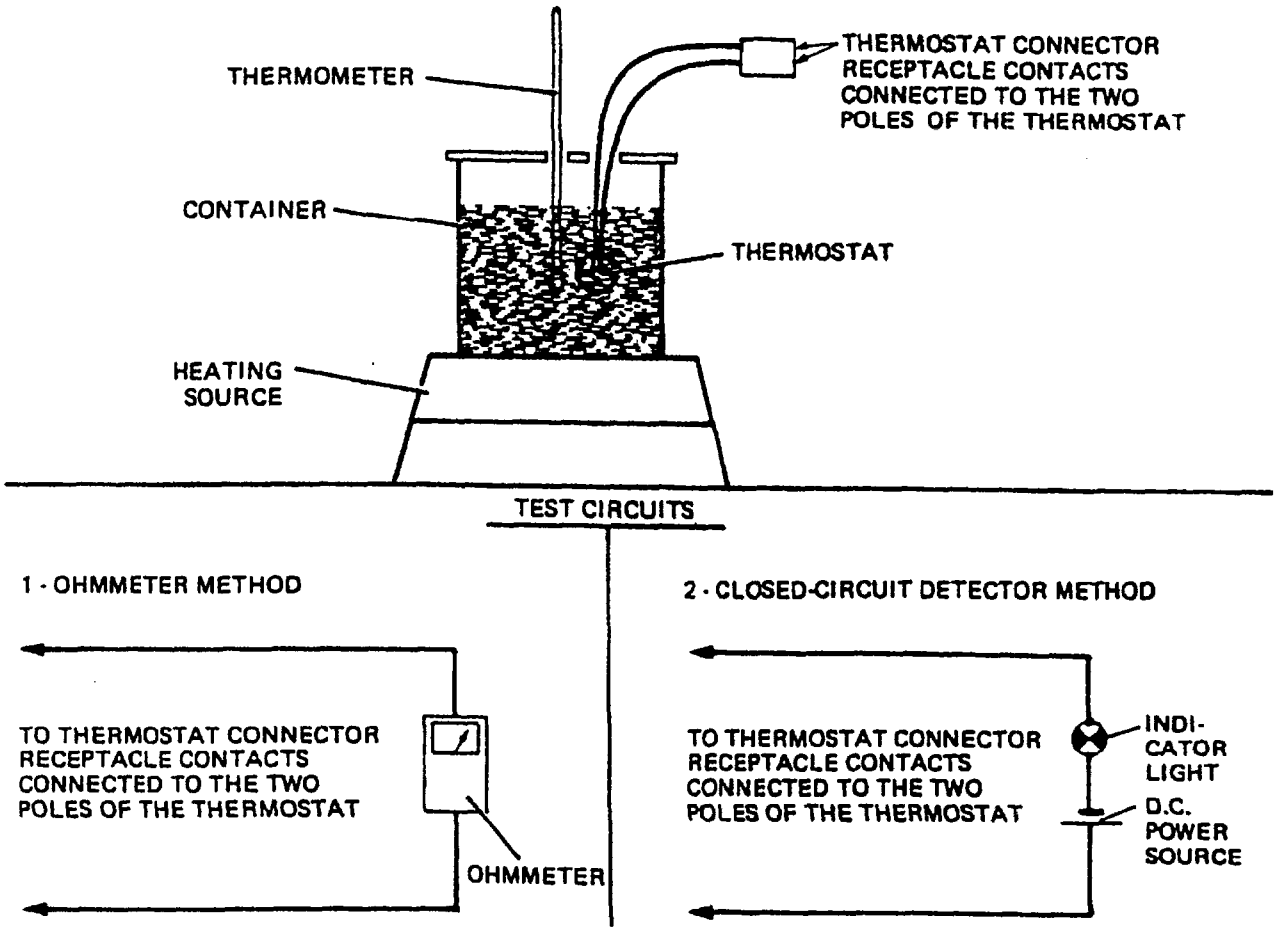
R 6. Checking the thermostat (battery P/N 4076-1)

CAUTION : MAKE SURE THAT THE BATTERY IS COMPLETELY DISCHARGED BEFORE PERFORMING THESE CHECKS.

A. Functional check (See Fig. 501)

- Dip the thermostat in a 0.5 l (0.109 Imp. Gal. ; 0.132 US Gal.) container, three-quarters filled with water. Make sure that the thermostat is not in contact with the container walls.

- Dip a thermometer in the container, being careful to place the bulb of the thermometer in the immediate vicinity of the thermostat.



CHECKING THE THERMOSTAT
FIGURE 501

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- Connect the test circuit (ohmmeter or closed-circuit detector) to the two connector receptacle contacts C and D of the thermostat assembly.

- Gradually heat the container water, being careful to maintain the water at a temperature close to 60°C (140°F) for about 10 min. This is necessary to bring all thermostat components to the same temperature as the water.

- Continue to heat the water gradually and note on the thermometer the temperature at which the thermostat operates (rising temperature).

Thermostat closing is indicated by the ohmmeter pointer moving from the "infinite" position to the zero position, or by the illumination of the closed-circuit detector indicator light.

Thermostat operation is correct if the temperature noted is within 68 to 74°C (154.4 to 165.2°F).

- As soon as thermostat closing is noted, stop heating the water and place the 0.5 l (0.109 Imp. Gal. ; 0.132 US Gal.) container in a 1 l (0.219 Imp. Gal. ; 0.264 US Gal.) container.

Pour cold water into the larger container until the water level is the same in the two containers.

- Note the temperature at which the thermostat contacts will open (falling temperature). When the contacts open, the ohmmeter pointer resumes the "infinite" position or the closed-circuit detector indicator light goes out.

Thermostat operation is correct if the difference between closing and opening temperatures is between 4 and 10°C
R (7.2 and 18°F).

- In the case where the operating temperatures recorded are not within tolerance limits, perform the above tests again.

- Remove the thermostat and link assembly from the container and dry thoroughly.

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B. Insulation test

- Using an ohmmeter, measure the insulation of each pole of the thermostat with respect to its metallic box.

- The insulation value obtained should be greater than or
R equal to 30 Mohm under 45 V D.C.

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REPAIR

1. Box

Straighten out the sides of the box and remove any dents which have been produced following impact.

2. Cells

Repair essentially consists in the replacement of cells acknowledged defective (see "Testing and Troubleshooting", para. 1. B. (4) (c)). New cells must first be discharged (see "Testing and Troubleshooting", para. 1. B. (2) (a)).

ASSEMBLY AND STORAGE

NOTE : - The products to be used are listed under "List of Products".

- Tools and special equipment to be used are listed under "Tools and Special Equipment".

1. Assembly (See IPL, Fig. 1)

NOTE : In case cells must be replaced, see "Testing and Troubleshooting", paragraph 1. B. (4) (c).

- Install connector receptacle (180), fitted with its preformed packing (210), and secure it with four screws (190) and washers (200).

- Install the thermostat connector receptacle from the inside of the box and secure it with nut (360) fitted with preformed packing (350). Place the thermostat outside the box (battery P/N 4076-1).

- Install cells (40), stricIty complying with polarities (see Fig. 701) and inserting :
  - the two sideplates (260) and intermediate insulator plates (270 and 280) between the three rows of cells,
  - endplates (240 and 250).

- Secure the thermostat to link (370) with nut (340), and install link (370) (battery P/N 4076-1).

- Install links (140, 150, 160 and 170).

- Secure the links with nuts (100), washers (110), nuts (220) and washers (230).

- Tighten the nuts using a torque wrench (torque : 1.3 ± 0.1 mdaN (9.595 ± 0.738 ft.lb)).

- Lightly smear the terminals, nuts and rigid links with petrolatum or neutral light machine oil (non acid).

- Measure the insulation resistance value (see "Testing and Troubleshooting", para. 1. A. (1) (b)).

- Charge the battery (see "Testing and Troubleshooting", para. 1. B. (5)).

2. Storage

A. Preparing the battery for storage

- After topping up the levels (see "Testing and Troubleshooting", para. 1. B. (3)), discharge the battery with a constant current of 18 A until the voltage across the terminals falls to 20 V D.C.

- Using petrolatum or neutral light machine oil, lightly smear the terminals, nuts, links, connector receptacle contacts, and the metal parts which are likely to be damaged by atmospheric agents.

- Install the cover and place the battery in its normal vertical position.

B. Storage premises

Store the equipment is dust-free and dry premises.

C. Temperature requirements

The battery can be stored between - 60 and + 60°C (- 76 and + 140°F).

However, the optimum storage temperature range is between 0 and + 30°C (+ 32 and + 86°F).

D. Storage life

Unlimited.

E. Packing

The battery is usually wrapped in waxed paper and placed in a wooden case.

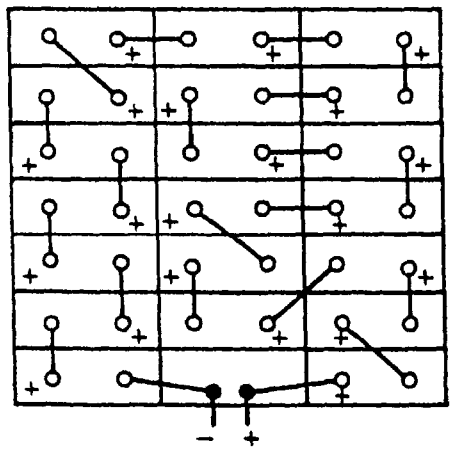
For long-term storage or overseas transportation, it is advisable to enclose the equipment in a plastic sealed or "cocooned" envelope.

F. Transportation

It is important that all required precautions should be taken to transport the battery in its normal position. To this effect, the wrapping should bear the inscriptions "TOP" and "BOTTOM".

G. Removal from storage

Charge the battery at a slow or fast rate, as required (see "Testing and Troubleshooting").

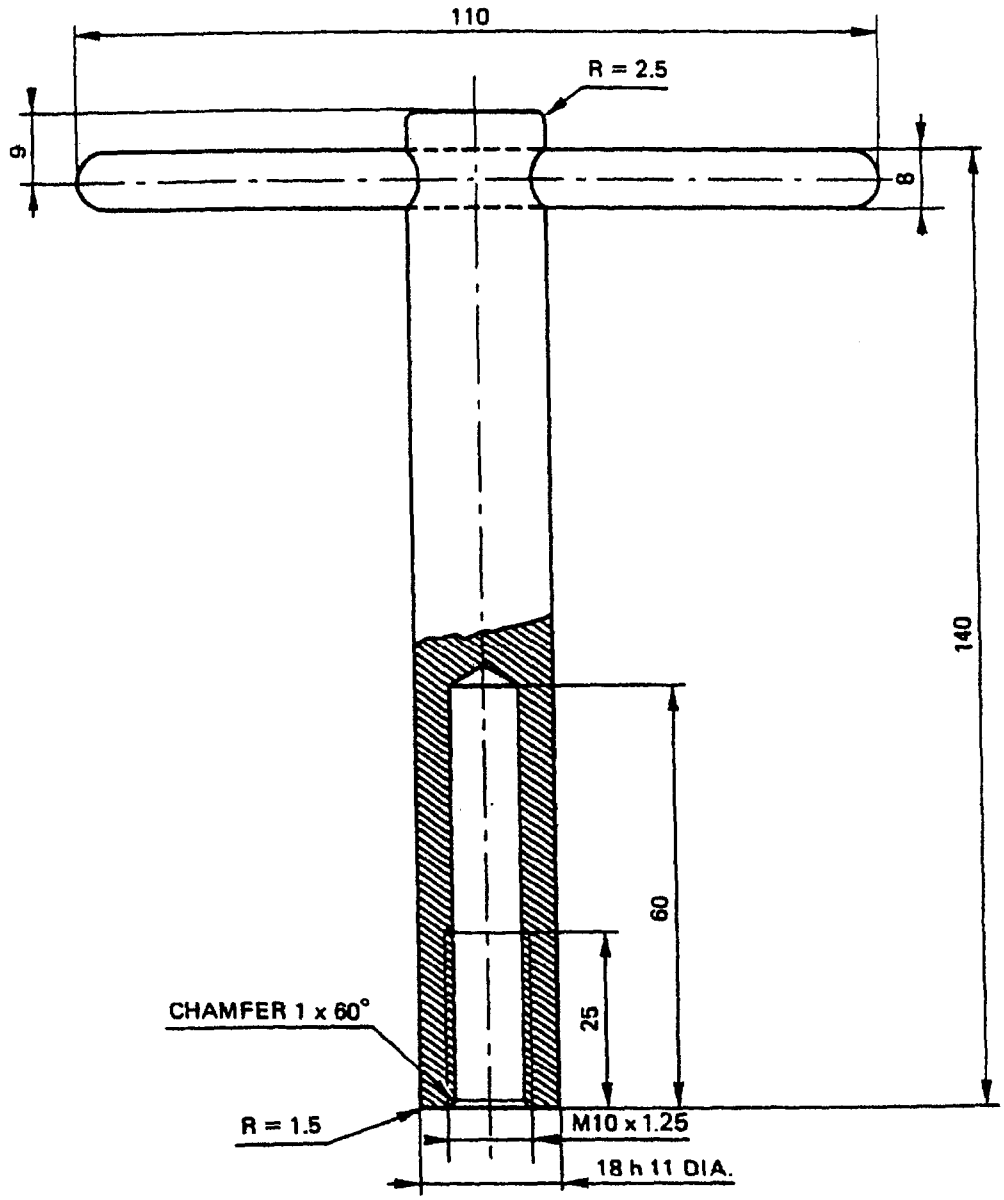


CONNECTION DIAGRAM
FIGURE 701

TOOLS AND SPECIAL EQUIPMENT

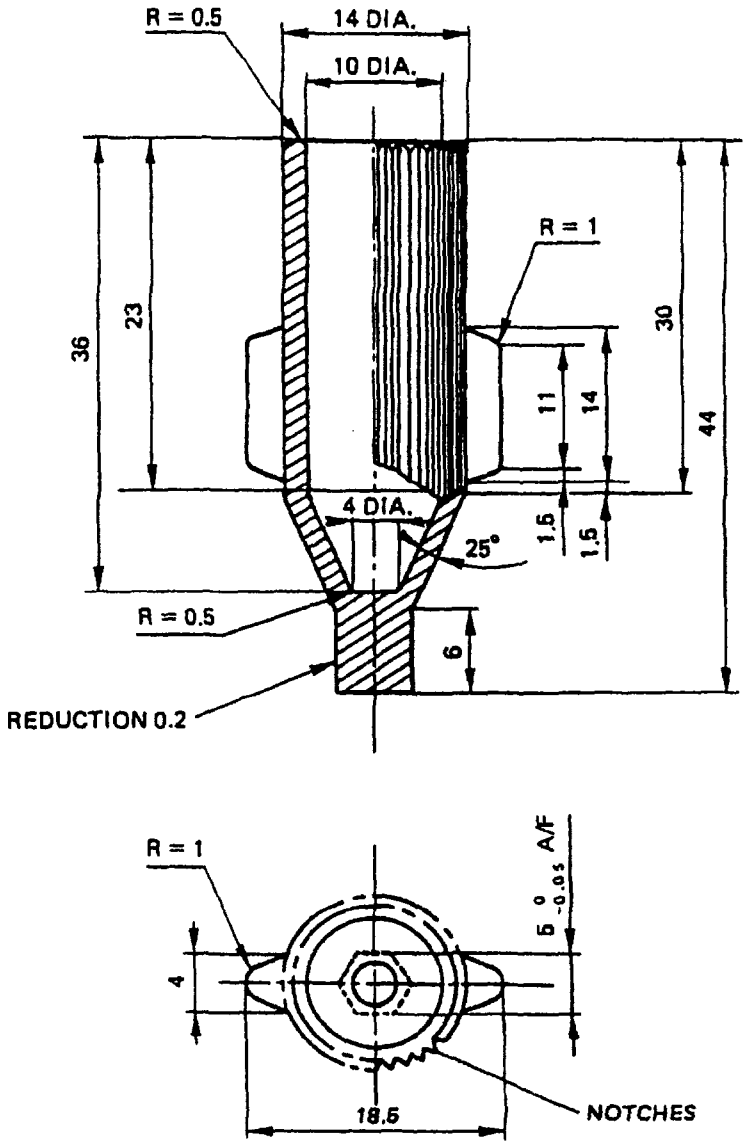
NOTE : Equivalent items of equipment may be used in place of those listed.

PART NUMBER	DESCRIPTION	USE					
		TESTING	DISASSEMBLY	CLEANING	INSPECTION	REPAIR	ASSEMBLY STORAGE
13169	Cell extracting wrench (see Fig. 901)		X				X
15528	Valve wrench (see Fig. 902)	X	X		X		



NOTE : ALL DIMENSIONS ARE IN mm.

CELL EXTRACTING WRENCH
FIGURE 901



NOTE : ALL DIMENSIONS ARE IN mm.

VALVE WRENCH
FIGURE 902

ILLUSTRATED PARTS LIST

INTRODUCTION

1. General

The Illustrated Parts List (IPL) is prepared in compliance with ATA 100. The IPL is intended to identify all the components of the unit.

The Illustrated Parts List contains the following sections :

- Introduction
- Vendors Code List
- List of Circuit Symbols (if applicable)
- Alphanumeric Index of Manufacturer's Part Numbers
- Detailed Parts List

2. How to use Detailed Parts List

The Detailed Parts List includes the nomenclature and illustrations of the unit components.

The Detailed Parts List columns are arranged as follows :

- 1st column : Fig. Item - Figure and Item number.
- 2nd column : Part Number - Manufacturer's part number.
- 3rd column : Nomenclature.
- 4th column : Usage code - Effectivity.
- 5th column : Units per Assy. - Quantity per next higher assembly.

A. Figure and Item numbers

The figure number, covering items listed, is indicated on the first line at the top of each page.

Each part-numbered assembly, sub-assembly or item listed in the parts list is assigned an item number followed by a letter identifying the variant. The basic variant is lettered A.

Assemblies, sub-assemblies and parts listed, but not illustrated, are identified by a dash (-) preceding the corresponding item numbers.

A "lettered index" appearing before the item number is a cross reference to the illustration of the variant called out from the corresponding main figure.

B. Manufacturer's part number

Each of the assemblies, sub-assemblies and detail parts, illustrated or not, is assigned a manufacturer's part number.

When the manufacturer's actual part number exceeds 15 characters, an equivalent assigned part number is listed in the "Part Number" column preceded by the following annotation :

ORDER OVERLGTH... MADE BY V...

Both part numbers are listed in the Alphanumeric Index in their logical order ; the actual overlength part number is cross-referenced to the assigned part number preceded by the annotation, "SEE...".

C. Nomenclature

The nomenclature is indented to show the relationship between the parts listed, as follows :

1 2 3 4 5 6 7

Assembly
. Detail parts for assembly
. Sub-assembly
. Attaching parts and/or storage parts for sub-assembly
+ + +
. . Detail parts for sub-assembly
. . Sub-sub-assembly
. . Attaching parts and/or storage parts for sub-sub-assembly
+ + +
. . . Detail parts for sub-sub-assembly
etc.

A vendor code is indicated for all items or articles not made by the prime manufacturer of the assembly.

This vendor code or the abbreviation "NP" (nonprocurable) is placed at the extreme right-hand side of the 1st line of the nomenclature.

D. Effectivity (Usage code)

An alphanumeric usage code indicates the applicability of sub-assemblies and detail parts to the next higher assembly(ies) or sub-assembly(ies).

When the applicability is general, the usage code column is left blank.

The usage code corresponds to the figure/item number of the next higher assembly(ies) or sub-assembly(ies). e.g., effectivity 1A, 1B, 1C is written 1ABC.

E. Units per assembly

The Units per Assy column shows the number of units required for the next higher assembly.
In some cases this information is replaced by the letters REF (reference) or AR (as required).

3. Terms and abbreviations used

- AR : As required
- ATTACHING PARTS
- DELETED
- DET : Detail
- LH and RH : Left and right
- MADE BY
- MADE FROM
- MATCHED PART
- MODIFIED FROM
- NHA : Next higher assembly
- NP : Nonprocurable
- OPT TO : Optional parts
- ORDER OVERLGTH MPN : Actual part number exceeding 15 characters

- OVERSIZE : Oversize repair parts
- POST SB : After applying Service Bulletin instructions
- R : Modified
- REF : For reference
- SEE
- SEL FROM : Select from parts
- STORAGE PARTS
- SUPSD BY : Superseded by
- SUPSDS : Supersedes
- UNDERSIZE : Undersize repair parts

4. Updating

When an item is revised, added or deleted, the letter "R" is shown in the RH margin (the page date of issue changes).

The letter "R" appears in the RH margin opposite the page number when all the item numbers are changed.

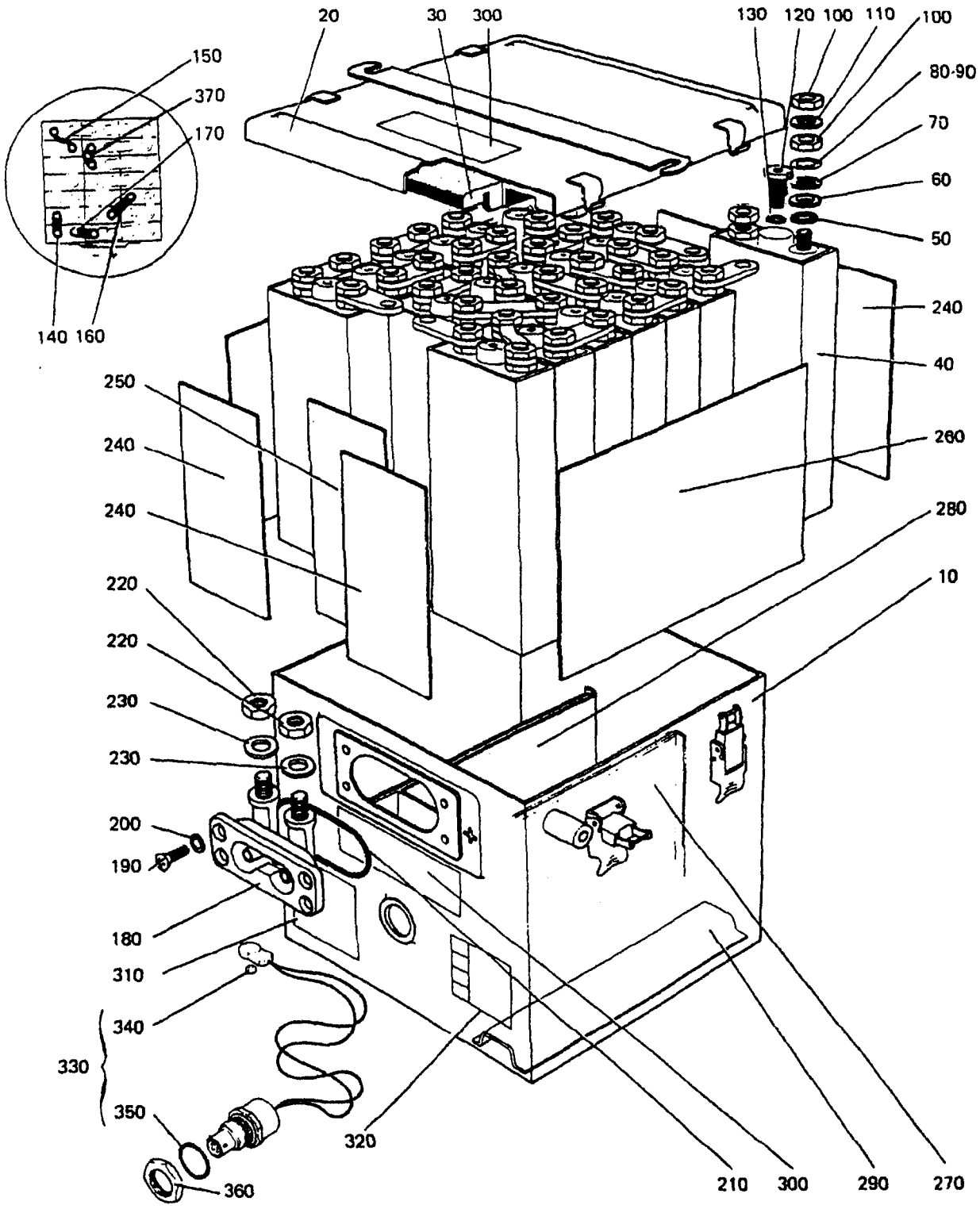
SAFT

VENDOR CODE	NAME-ADDRESS
F6177	SAFT (STE DES ACCUMULATEURS FIXES ET DE TRACTION) SA DPT ACCUMULATEURS 156,AVENUE DE METZ 93230-ROMAINVILLE FRANCE

PART NUMBER	AIRLINE PART NUMBER	FIG.	ITEM	TTL REQ
100078		01	060A	40
100094		01	070A	40
		01	110A	40
		01	230A	2
100430		01	200A	4
100431		01	190A	4
100593		01	130A	20
100594		01	050A	40
100693		01	080A	20
100694		01	090A	20
100713		01	210A	1
102148		01	250A	1
102307		01	260A	2
102391		01	010A	1
102392		01	180A	1
102394		01	290A	3
102396		01	280A	2
102397		01	270A	2
105148		01	240A	5
105405		01	340A	1
113605		01	030A	1
114300		01	020A	1
114722		01	330A	1
114767		01	370A	1
115732		01	010B	1
115763		01	360A	1
115764		01	350A	1
116390		01	310A	1
12374		01	140A	15
15266		01	160A	1
15539		01	170A	2
31282		01	300A	2
34031		01	320A	1
4076		01	-001A	RF
4076-1		01	-001B	RF
57014		01	150A	3
62007		01	100A	80
		01	220A	2
63412		01	040A	20
80004		01	120A	20

- ITEM NOT ILLUSTRATED

ILLUSTRATED PARTS LIST



BATTERY, STORAGE
FIGURE 1

FIG. ITEM	PART NUMBER	NOMENCLATURE 1234567	USAGE CODE	UNITS PER ASSY
1 -001A	4076	BATTERY,STORAGE.		RF
-001B	4076-1	BATTERY,STORAGE.		RF
010A	102391	.BATTERY BOX	1A	1
010B	115732	.BATTERY BOX	1B	1
020A	114300	.COVER,ACCESS.		1
030A	113605	..GASKET		1
040A	63412	.BATTERY,STORAGE		20
050A	100594	..PACKING,PREFORMED.		2
060A	100078	..WASHER,FLAT.		2
070A	100094	..WASHER,SPRING TENSION. . . .		2
080A	100693	..SPACER,RING.		1
090A	100694	..SPACER,RING.		1
100A	62007	..NUT,PLAIN,HEXAGON.		4
110A	100094	..WASHER,SPRING TENSION. . . .		2
120A	80004	..FILLER CAP,BATTERY		1
130A	100593	..PACKING,PREFORMED.		1
140A	12374	.LINK,BATTERY TERMINAL		15
150A	57014	.LINK,BATTERY TERMINAL		3
160A	15266	.LINK,BATTERY TERMINAL		1
170A	15539	.LINK,BATTERY TERMINAL		2
180A	102392	.CONNECTOR,RECEPTACLE, ... ELECTRICAL ATTACHING PARTS		1
190A	100431	.SCREW		4
200A	100430	.WASHER,LOCK . . . . . * * *		4
210A	100713	..PACKING,PREFORMED.		1
220A	62007	.NUT,PLAIN,HEXAGON		2
230A	100094	.WASHER,SPRING TENSION		2
240A	105148	.INSULATOR,PLATE		5
250A	102148	.INSULATOR,PLATE		1
260A	102307	.INSULATOR,PLATE		2
270A	102397	.INSULATOR,PLATE		2
280A	102396	.INSULATOR,PLATE		2
290A	102394	.SUPPORT,INSULATOR		3
300A	31282	.LABEL		2
310A	116390	.PLATE,INSTRUCTION		1
320A	34031	.LABEL		1
330A	114722	.SWITCH,THERMOSTATIC	1B	1
340A	105405	..NUT,SELF-LOCKING,HEXAGON . .		1
350A	115764	..PACKING,PREFORMED.		1
360A	115763	..NUT,PLAIN,HEXAGON.		1
370A	114767	.LINK,BATTERY TERMINAL	1B	1

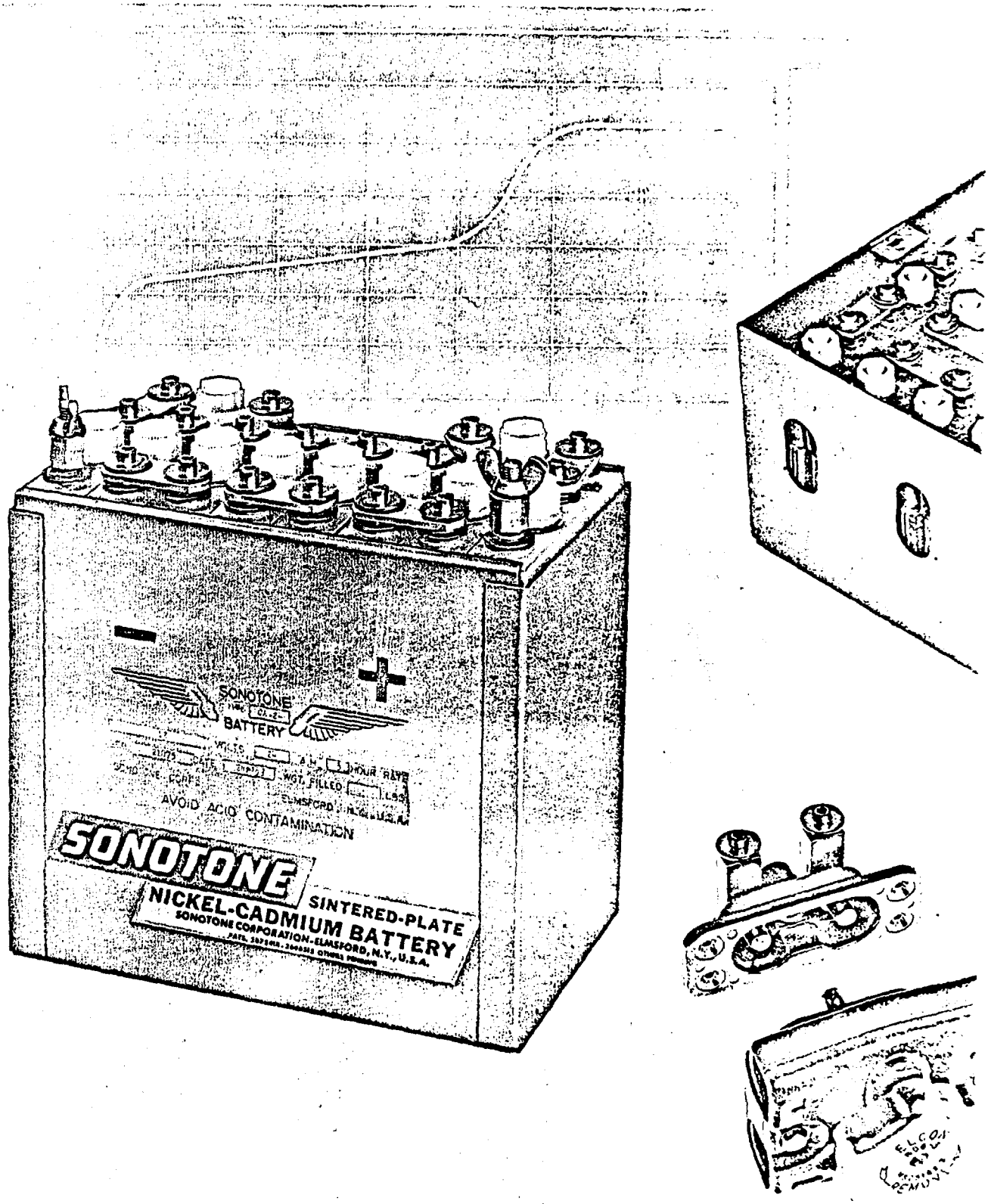
- ITEM NOT ILLUSTRATED

Sonotone Batteries

portable power for progress

BATTERY DIVISION, SONOTONE CORPORATION, ELMSFORD, NEW YORK 10523

PART NOs. CA-5 & MA 300H

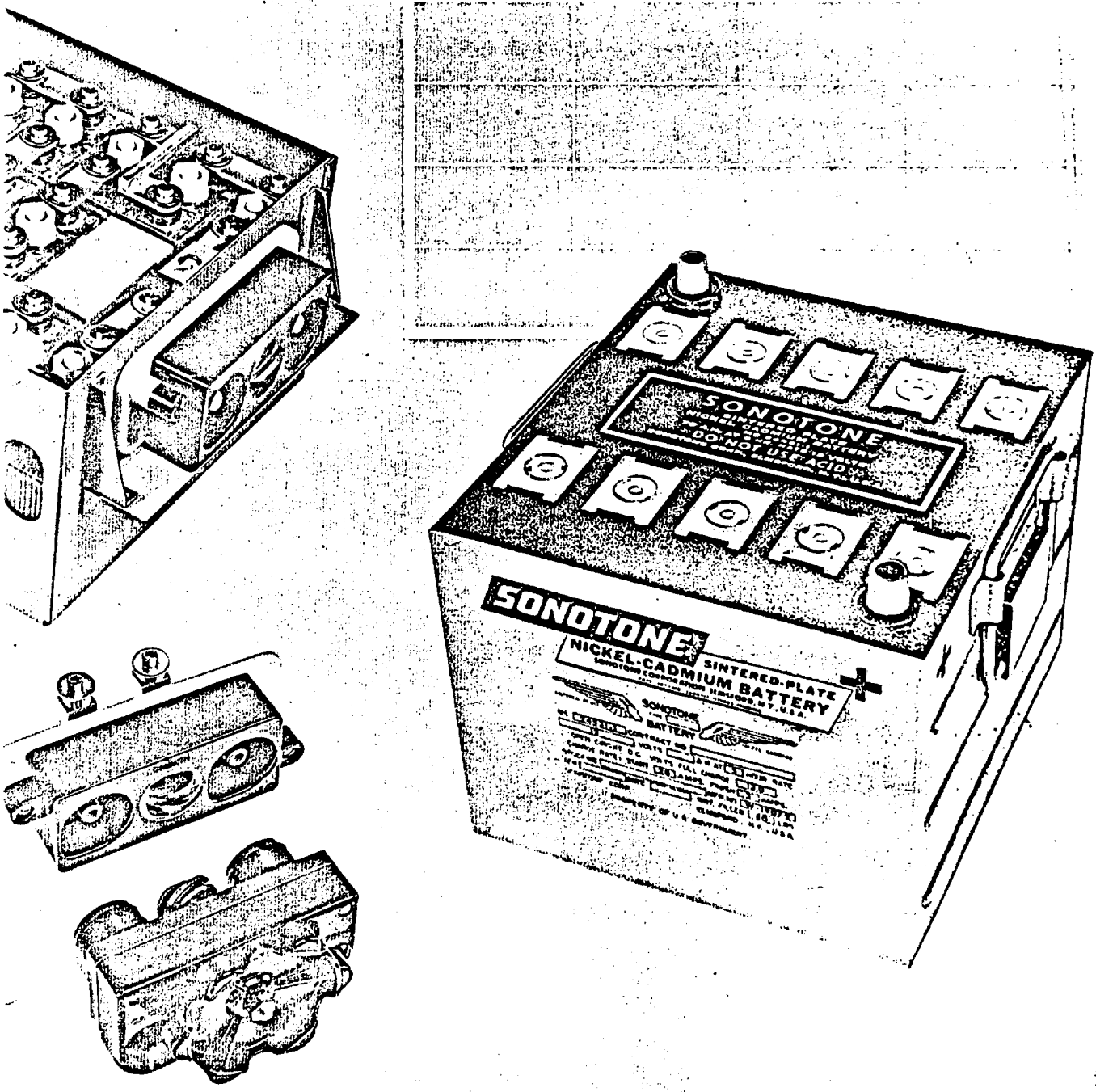


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SONOTONE BATTERY INSTRUCTION MANUAL

SINTERED-PLATE, NICKEL-CADMIUM BATTERIES



INSTRUCTION MANUAL

SONO-CAD*

SINTERED-PLATE, NICKEL-CADMIUM BATTERIES

BY SONOTONE®

*SONO-CAD is a trademark of Sonotone Corporation, Elmsford, N.Y. 10523.

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INTRODUCTION

This manual has been prepared to acquaint you with the fundamental operating characteristics of SONOTONE® sintered-plate, nickel-cadmium batteries and to assist you in obtaining maximum performance with minimum maintenance and servicing.

Over a period of years, literally thousands of SONO-CAD™ battery units have been operating in aircraft, missiles, satellites, ground vehicles, communication equipment, marine installations, ground power standby equipment and hundreds of other applications where rechargeability, flexible voltag and reliable power are essential.

Your Sonotone battery is manufactured to th highest precision standards. Care has been taken i every step of the manufacture to assure a produ of the very highest quality. Your battery has bee carefully tested at factory laboratories before bein shipped. Proper care and maintenance, as outline in this manual, will aid you in keeping your batter at peak performance and prolong its useful life.

PART I–PRINCIPLES OF OPERATION

1.0 Electro-Chemical Principles of the Sonotone Battery

1.1 DURING CHARGE

The active material of the negative plate is cadmium-oxide. When the charging current is applied, this material gradually loses its oxygen and becomes metallic cadmium. The active material of the positive plate is nickel-oxide. This is brought to a higher state of oxidation by the charging current. As long as this current continues, changes take place until both materials are completely converted.

Toward the end of this charging process, and during overcharge, Sonotone cells will gas. This is a result of electrolysis of the water component of the electrolyte. The gas created at the negative plates is hydrogen and that at the positive plates is oxygen. The amount of gas created is dependent upon the temperature and the amount of charging current.

The cells will accept charge at temperatures ranging from —65° to +165°F. The electrolyte does not enter into any chemical reaction with either the negative or positive plates, but acts merely as a conductor of current between them. There is no significant change in the specific gravity, since the electrolyte acts only as a conductor.

1.2 DURING DISCHARGE

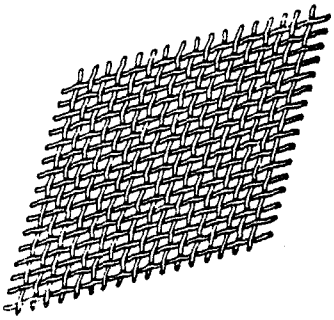
A chemical action in reverse of that which occu during charge is immediately initiated when ele trical energy is withdrawn from the cell. The neg tive plate gradually gains back oxygen and th positive plate gradually loses oxygen. There is n gassing on normal discharge due to this interchan of oxygen.

This process results in the conversion of th chemical energy of the plates into electrical energ The rate of which this conversion takes place is pr marily determined by the external resistance im posed by the electrical circuit to which the cell connected. Due to the type of cell construction, the is extremely low internal resistance within the cel The chemical nature of the electrolyte and its sp cific gravity remain unchanged during discharg The relative constancy of the cell voltage durin discharge is due mainly to these factors.

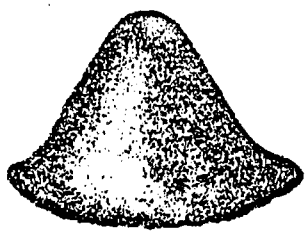
2.0 Construction of the Sonotone Battery

2.1 PLAQUES AND PLATES

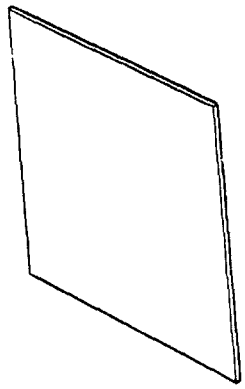
The basic feature of the Sonotone battery is its sintered plate, as shown in the series of diagrams below.



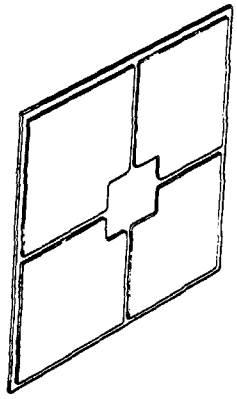
1. Here's how a Sonotone battery is made. We start with a nickel screen.



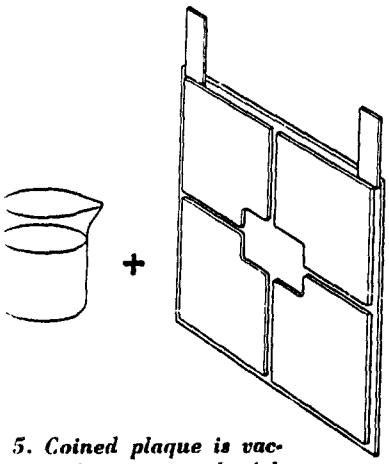
2. Then nickel powder is sintered about screen.



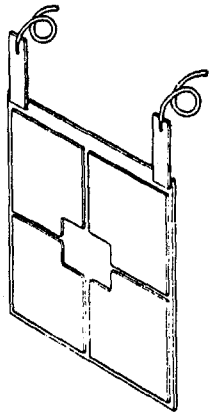
3. This forms a plaque approximately 80% porous at this stage.



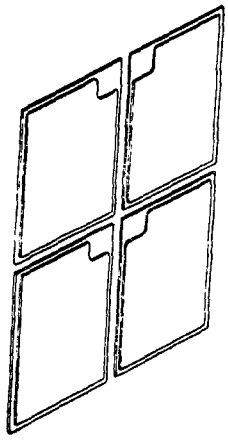
4. Plaque is coined with a plate die.



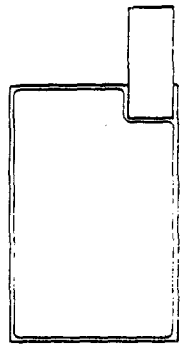
5. Coined plaque is vacuum impregnated with nickel or cadmium salts, electrochemically deposited within pores.



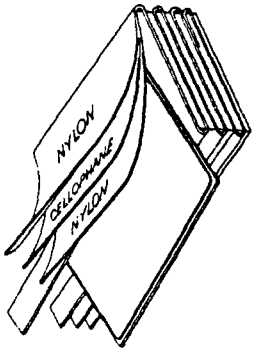
6. Current is passed through plaque in presence of electrolyte, to convert nickel or cadmium salts to final form.



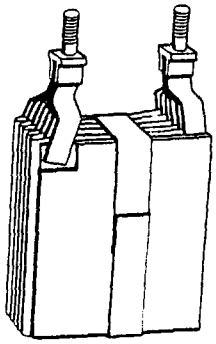
7. After washing and drying, finished plaque is cut into plates.



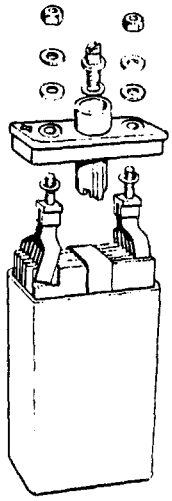
8. A nickel tab is spot welded to plate.



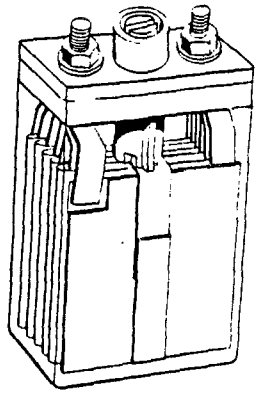
9. "Stackup" is prepared by folding separator material between alternate positive and negative plates.



10. Nickel terminals are welded to completed "stackup," which with its cellophane binder forms the complete assembly of the core.



11. Cover and vent assemblies are attached and sealed to "stackup."



12. Entire unit is inserted in cell case and sealed.

2.2 SINTERED-PLATE CONSTRUCTION METHODS

Sintering is that process by which micro-fine powder is fused together at high temperatures to form a porous plaque structure. The porous structure of the Sonotone plaque is obtained by sintering nickel powder to a fine-mesh wire screen. The active material which distinguishes between the negative and positive plates is then electrochemically deposited within the pores of the plaque. Positive plaques are made by depositing nickel-hydroxide, negative plaques by depositing cadmium-hydroxide.

The plaques are then formed, washed, dried and cut into the desired plate size. Nickel connecting tabs are welded to one corner of each plate. Positive and negative plates are then grouped into a core assembly. The connecting tabs of all plates project upward toward the proper terminals, to which they are welded.

The sintered plates are positioned very closely together and are kept from actual physical contact by a thin multi-layer laminate, known as a separator.

While the surface of a sintered plate appears to be relatively smooth, it is actually a maze of tiny hills and valleys *(see Figure 1)*. This physical property multiplies the apparent surface area several hundred times and permits the utilization of a tremendous area of active material. The porosity of the plate permits the absorption of electrolyte. This further increases the volume of active material in direct contact with the electrolyte.

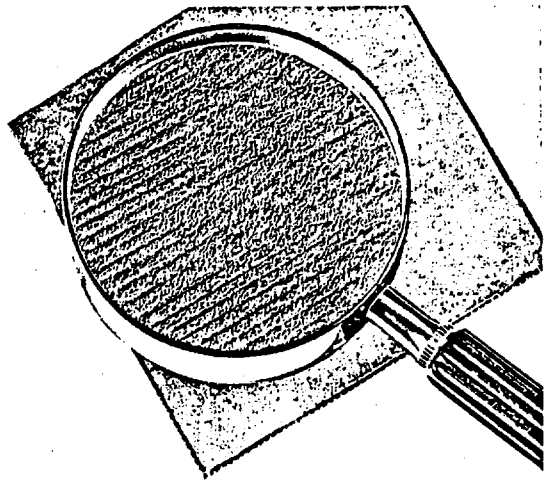


FIGURE 1

The porosity of Sonotone plates is created by a partial sintering of the nickel powder. This powder has been carefully selected for particle size and shape. After sintering, the total active surface area of one Sonotone nickel-cadmium plate is equal to that of several hundred solid plates of the same size.

2.3 SEPARATORS

A continuous strip of highly specialized fabric and pliable plastic composes the separator. This continuous separator is interposed between the plates as each successive plate is added to the "stackup" in preparing the core assembly. Thus the plates within the core are separated by a porous insulating barrier. This design provides the needed physical strength with minimum bulk and excellent electrical insulation, as well as efficient electrolytic conduction when immersed in the electrolyte. To insure complete insulation, the separator is slightly wider than the dimensions of the plate.

2.4 CELLS

The core assembly in a Sonotone battery is firmly affixed to a plastic or metal cover. This integral unit is then fitted snugly within a transparent plastic or metal case and the cover is cemented or welded in position. The cell thus becomes a compact, enclosed unit. The plates extend to the bottom of the cell, since no active material will flake or shed from them. This contributes to the solidity of the cell and gives it the ability to withstand extreme conditions of shock and vibration.

2.5 VENTS

Each cell is provided with a vent plug. This plug consists of a metal or plastic core and an outer collar of rubber. It can be removed for the addition of distilled water or adjustment of the electrolyte. When in place, the rubber expansion collar permits the gas created on charge to escape. Since there is no gassing on discharge, the vent automatically seals the cell, preventing leakage of electrolyte and also preventing entrance of foreign substances into the cell.

2.6 BATTERY ASSEMBLIES

To provide the voltage for a given application, cells are assembled into batteries and are housed in a steel battery case. An individual cell may be replaced in the event of damage, thus eliminating loss of the entire battery.

2.7 ELECTROLYTE

A 30%-by-weight solution of potassium hydroxide (KOH) in distilled or demineralized water is used as the electrolyte in the Sonotone battery.

No overall chemical change occurs in the electrolyte during charge or discharge. As a result, no appreciable changes in the specific gravity are observed. The specific gravity of the electrolyte at room temperature remains between 1.24 and 1.32. The electrolyte level, observed through the windows in the side walls of the battery case or by looking into the vent wells, should be at the top of the plate portion of the core assembly. Sonotone batteries are normally shipped wet from the factory, since shelf life is not affected.

3.0 Discharge Characteristics of Three Basic Sonotone Battery Types

3.1 PLATE THICKNESSES

Sonotone batteries of the sintered-plate, nickel-cadmium type are divided into three classes, in accordance with the following discharge requirements:

a. H-TYPE BATTERIES—Contain thin plates and are intended for very high current service such as required in turbine engine-starting applications, particularly during cold-temperature operation.

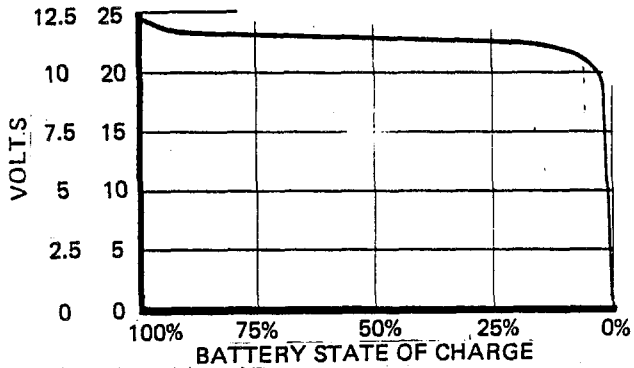
b. M-TYPE BATTERIES—Contain medium thick plates and are intended for medium rate current requirements, such as reciprocating engine starting applications. They will perform satisfactorily at all temperature ranges—from sub-zero Antarctic conditions to the blistering tropics.

c. L-TYPE BATTERIES—Contain thick plates and are intended for low current drains where great capacity at a low rate is required, such as transistorized power supplies. They will perform satisfactorily at low temperatures at very low current drains.

3.2 TYPICAL DISCHARGE CHARACTERISTICS

All Sonotone batteries offer a constant voltage throughout their discharge. Figure 2 illustrates a typical discharge voltage curve under moderate load.

FIGURE 2



TYPICAL DISCHARGE VOLTAGE CURVE UNDER MODERATE LOAD

PART II-INSTALLATION

4.0 Unpacking and Inspection of New Batteries and Cells

4.1 INSPECTION PRIOR TO INSTALLATION

When the battery is unpacked, a thorough inspection should be made to insure that no damage occurred during shipment. Inspect the shipping container, as well as the battery, to make certain that the cells have not been damaged. Before putting your battery in service, follow these points carefully:

4.2 CHECK LIST

a. *CHECK FOR DAMAGE*—See if any liquid has spilled into the shipping container. This may be a sign of a damaged cell.

b. *CHECK ELECTRICAL CONNECTION*—Check all electrical connections for tightness. Test all screws and nuts on all terminals to insure tightness. Poor electrical contact may result in damage to your battery.

c. *CHECK LIQUID LEVEL*—CAUTION: Sonotone batteries are shipped with the proper amount of liquid. Do not add liquid until you have first attempted to charge your battery. When a battery has been discharged or allowed to stand unused for a long period of time. the electrolyte becomes absorbed into the plates. Your battery has been shipped discharged, which is the chief reason why the liquid level is low. Charging the battery will cause the liquid level to rise to a point just above the tops of the plates.

d. *CHECK VENTS*—Your battery is equipped with special type vents which permit the gases to escape from the cells. Do not obstruct these vents in any manner which will interfere with their operation. Some batteries are shipped with solid vent plugs which are used as shipping plugs. If these have been used on your battery, the battery will be marked with a tag, "Remove Shipping Plugs." The vent plugs are then inside a small cloth bag tied to the battery. Replace shipping plugs with the vent plugs before charging the battery.

e. *INDIVIDUAL CELLS*—When individual cells have been ordered, care must be exercised in charging. Do not charge individual cells unless the plastic cell case is supported externally in some manner. Gas pressure during charge on unprotected cells may crack the cell case. If no clamping device is available, remove the filler caps or vent screws to prevent a buildup of gas pressure inside the cell during charge *(consult Operation and Maintenance, 5.0)*.

4.3 INSTALLATION OF THE BATTERY

4.3.1 CLEANING COMPARTMENTS

Prior to installation, compartments or battery boxes which have previously housed lead-acid batteries must be washed out, neutralized with ammonia or washing soda solution, allowed to dry thoroughly and then painted with alkaline-resistant paint.

4.3.2 CHARGING NEW BATTERY

Your battery has been discharged prior to shipment. It will therefore need charging before installation *(see Table I)*. If by special order your battery is shipped in a charged state, it is advisable to give it a freshening charge *(consult Charging Methods 5.3)*.

4.3.3 SECURING BATTERY IN POSITION

When installing the battery in its permanent location, care should be taken to see that all post nuts are drawn down tight and that all electrical connections are made secure. Leads to the battery should be of sufficient size to carry the maximum current encountered without excessive voltage drop. If the battery is in mobile service, such as on an aircraft or other vehicle, it must be secured by holddowns. It is desirable to arrange the compartment so that the battery is either accessible or can be readily removed for servicing.

4.3.4 PROPER AIR CIRCULATION

Stationary batteries consisting of several tray groups should be installed with trays separated from each other to permit some circulation of air. This air space around the trays also serves to break up possible current leakage paths. Tray-to-tray connectors are of proper length to allow a minimum of ½" between trays.

4.3.5 VENTING OF GASES

Where the batteries are installed in a confined location, it must be realized that some hydrogen and oxygen gases are evolved during the charging cycle. It is therefore necessary to provide some means of ventilation to remove these gases from this confined area, avoiding accidental ignition of the hydrogen.

There are two types of venting systems to be considered. The first is a battery case containing vent nozzles and the second the battery case containing viewports or cover containing louvers. If the battery case contains vent nozzles, these must be used to vent gases either overboard or into a compartment that will meet the air flow requirements outlined below. If the battery case contains viewports or cover has louvers, the air flow must be of sufficient volume to keep the mixture of air and hydrogen below 5%. In both cases mentioned above, the air flow should be a minimum of 5 cubic feet per minute.

4.3.6 CHECKING POLARITY

Check the polarity of each cell or group of cells to be sure that they are connected in proper series. The polarity of each cell is indicated by a plus sign molded into the cell cover adjacent to the appropriate cell post.

4.3.7 INSULATING BATTERY

Sonotone has recently developed a new epoxy coating for its line of aircraft batteries. This epoxy coating is designed to improve the insulation between the cells and the battery container. It will eliminate the small discharge current formerly produced when spillage or spewage of electrolyte was encountered. This is a standard item on certain batteries produced at this time and will be a standard item on most units produced in the future.

Batteries in the field that are not now epoxy coated may have this done by returning the battery to Customer Return Department, Battery Division, Sonotone Corporation, Cold Spring, N. Y. 10516. The cost is determined by the battery type. Where batteries are mounted in groups, it may be necessary to provide insulation from each other and from the trays in which they are mounted *(consult Trouble Shooting, 7.0)*.

4.3.8 VOLTAGE REGULATION

Where the battery is being used in a mobile application, such as aircraft or ground vehicles, it will be necessary to make certain that the voltage regulating device is set to the proper limits, *as indicated in Table I.* This is an extremely important phase of your installation, as an improper voltage regulator setting can destroy a Sonotone sintered-plate, nickel-cadmium battery in a relatively short period of operation.

4.3.9 QUICK DISCONNECT DEVICES

Should the battery be installed using a multipin quick-disconnect type of plug, it is important to be certain that the connecting half of the plug, which is normally attached to the vehicle or aircraft, is wired correctly with respect to the terminal pins on the battery. A battery installed in an electrical circuit with the polarity reversed will not perform and may become seriously damaged.

4.3.10 SAFETY WIRING

In installations where safety wiring is to be used, be extremely cautious about the use of this wire near or on battery and cell terminals. It is in some instances, possible to completely isolate the metal battery case from the electrical system into which it has been installed and then establish a direct short to ground through the improper use of safety wire.

When installation is completed, be sure that no loose objects, such as screws or tools, have been accidentally left in the battery compartment or inside the battery.

PART III-
OPERATION, MAINTENANCE AND TROUBLE SHOOTING

5.0 Operation and Maintenance

5.1 GENERAL CARE

To obtain continued peak performance, a Sonotone battery should be kept in a clean, dry state. Batteries that are subjected to deposits of metallic dust on the cells, such as those in locomotive or steel plant stations, should be covered. The buildup of metallic dust or any other conductive substance will self-discharge the cells more rapidly by providing a conductive path.

Keep open flame and metal objects, such as tools, etc., away from the exposed parts of the battery. If objects are accidentally dropped across the terminals, these might cause a short circuit that could damage a cell or cells.

Should the batteries accumulate dust or a white deposit which sometimes forms around the tops of the cells, it is advisable to flush the tops of the batteries with ordinary tap water.

CAUTION: Do not attempt to clean the battery tops with solvents, acids or any chemical solution. Sonotone batteries are primarily constructed with plastic or nylon cells. The plastic may be injured by introducing solvents, etc. While flushing the batteries with tap water—if necessary—it is permissible to use a bristle brush to clean any stubborn dirt particles.

CAUTION: Do not use wire brushes. After cleaning, any excess liquid should be drained and the batteries should be permitted to dry. Where possible, this drying may be accelerated by the use of compressed air.

5.2 CHARGING CHARACTERISTICS

A Sonotone nickel-cadmium battery will accept a charge at a much faster rate than a lead acid battery and may be charged at temperatures below −20°F. Charging is more efficient at battery temperatures between +40° and +80°F.

5.3 CHARGING METHODS

As mentioned earlier in the section entitled *Installation*, it will be necessary to charge your battery prior to putting it into service. While in service in many installations, the battery will be charged by the equipment in which it is installed. During particular maintenance and inspection removals, however, it may be necessary to charge the battery in the shop. *IMPORTANT— BATTERIES MUST BE CHARGED IN AN UPRIGHT POSITION.* The construction of the Sonotone sintered-plate cell is such that it is readily adaptable to standard charging systems. These include constant voltage, constant current, stepped constant current charge or float charging. Most efficient performance from a constant current will result when the charging rate is such that 140% of the rated capacity of the cell is returned at the rates *indicated in Table I.*

The following material is devoted to various charging methods:

5.3.1 CONSTANT CURRENT CHARGING

The length of time required to charge a battery by the constant current method depends on the size or capacity of the battery, the state of charge of the battery and the magnitude of the charge current. In order to maintain a constant current, it should be noted that the voltage of the system will run from 1.4 volts per cell at the beginning of charge to a maximum of 1.75 volts per cell at the end of charge. In *Table I*, we recommend a constant current rate which is arrived at in the following manner: Take the current output at the 5-hour rate and charge at that current for 7 hours. *Example—the recommended constant current charge for a 40-ampere-hour battery would be computed as follows: 40 ampere hours divided by 5 hours equals 8 amperes.* You would therefore charge this battery at 8 amperes for 7 hours. A typical constant current charging curve *is shown in Figure 3.*

Constant current charging can be accomplished manually by monitoring the charging apparatus and adjusting the voltage periodically to maintain a constant charge rate. Chargers of the self-regulating rectifier type are available to provide constant current without the attention of an operator. Sonotone Corporation manufactures a Battery Charger/Ana

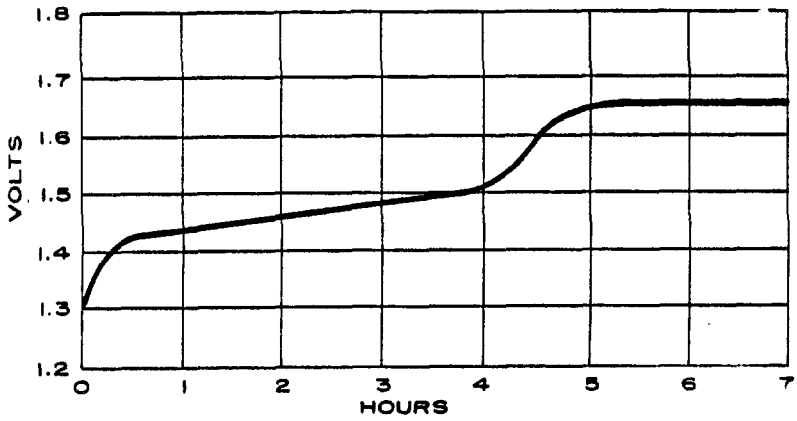


FIGURE 3

TYPICAL VOLTAGE VARIATION DURING CONSTANT CURRENT CHARGE

lyzer designed for this purpose. A complete brochure may be obtained from the Field Service Manager, Battery Division, Sonotone Corporation, Elmsford, N. Y. 10523. *Request Data Sheet BA-166.*

If a battery is partially discharged, the charge rate *shown in Table I* will still apply. It may not be necessary, however, to charge the battery for the full length of time indicated. To determine whether the battery has reached the full charge state, monitor the battery and note the time that the voltage takes the sharp rise *indicated in Figure 3.* After the sharp voltage rise, it is then necessary to permit the battery to charge for an additional 2 hours at the rate *shown in Table I.* During this 2-hour portion of charge, it is possible to check the cell voltages and determine whether all cells are rising evenly. Should some cells indicate a voltage lower than 1.55 volts, it is advisable to leave the battery on charge until these cells come up to a minimum of 1.55 volts.

Note: During the greater portion of charge, the cell voltages will remain between 1.4 and 1.45 volts. On a conditioned battery, when it has been charged for approximately 70% of the time necessary to charge it fully, the voltage will take the sharp rise mentioned above. Should the individual cell voltage fail to rise to 1.55 volts or more, it may be necessary to replace these cells *(consult Trouble Shooting, 7.0).*

5.3.2 STEPPED CONSTANT CURRENT CHARGING

If it is necessary to obtain a rapid charge, the principles of the previous paragraph still apply—the battery may be permitted to charge at a current equal to its capacity. *Example—a 40-ampere-hour battery at a charging rate of 40 amperes.* At this high rate, the battery should be monitored and when the total battery voltage averages 1.50 volts per cell, the rate should then be reduced to the rate shown on Table I. At the time of reduction, a conditioned battery will have completed approximately 70% of the charge cycle if it was completely discharged to begin with. This method of charging must be monitored, as the high rate will eventually use all the water in the battery if permitted to continue past the gassing point. This loss of water will cause higher concentration of the electrolyte and possible overheating which will damage the cell.

5.3.3 FLOAT CHARGING

Fully charged batteries may be floated across a line voltage of approximately 1.42 volts per cell. Example—a 24-volt aircraft battery which contains 19 cells may be trickle charged at 27.0 volts. A battery floated in this manner will draw about .003 amperes per ampere hour of capacity. *Example—a 40-ampere-hour battery will float at approximately .120 amperes.* This voltage setting will vary slightly with ambient temperature of operation.

5.3.4 CONSTANT VOLTAGE CHARGING

In most applications where Sonotone sintered-plate, nickel-cadmium batteries are used, the constant voltage charging method is employed. Aircraft, automobiles, boats, factory equipment and all mobile applications use the voltage-regulated genera-

NOTE: Additional constant current charging instructions when using Sonotone Battery BB-449/U at low temperatures—current of 2.8 amperes should be used for a period of 7 hours. Although this method may be used at temperatures below −20°F, it is usually not recommended.

tor charging circuit. The graph *shown in Figure 4 (Page 22)* indicates what happens essentially during this type of charge.

A voltage produced by the generator permits current to flow to the battery. In a discharged battery, the maximum surge of current will be approximately 10 times the rated capacity. The high surge currents are due to the low internal resistance of the battery. Make certain that the charging source is protected against overload in the event of a marginal power supply. As the battery approaches a charged state, the current falls off rapidly and the voltage rises. The recommended voltage setting for the regulator, *shown in Table I*, is computed by multiplying the number of cells in the battery by a factor of 1.5 to 1.55. *Example—a 12-volt automotive battery which contains 10 cells should have the regulator set to cut out between 15.0 and 15.5 volts.*

It should be noted that this type of charging, particularly in applications where the battery is excessively discharged, may produce an unbalance in cell capacity *(consult Trouble Shooting—Apparent Loss of Capacity, 7.1)*. If the battery requires equalization and a constant current charging source is not available, it may be equalized by the method *shown in Reconditioning Service Procedures, 9.3.*

5.4 DISCHARGING THE BATTERY

You will note, in the section entitled *Replacement of Damaged Cells, 6.1*, that you are instructed to discharge the battery. The following information is designed to help you in this operation.

5.4.1 USING EQUIPMENT AS A LOAD

A battery may be discharged by merely permitting it to operate the equipment in which it is installed without permitting the generator or other charging source to replenish it.

When the battery fails to operate the equipme it is in a state of partial discharge. It should th be removed from the equipment and discharg through a resistance high enough to permit the c rent to flow at approximately the 2-hour rate. *I ample—a 40-ampere hour battery may be permit to discharge at 20 amperes or less.* When the volt has dropped to a sufficiently low point that the c rent has apparently ceased to flow, the battery then be considered discharged. Where cells are be individually shorted *(see Figure 5)*, it is imp tant that the shorting wires or bars be placed position on the cells while the resistance is still c nected to the battery.

Should the battery be permitted to stand after resistance has been removed, it will recover su ciently so that the application of the shorting devi will create severe arcing and intense heat. To termine when a battery has been sufficiently charged and ready for short circuit, the termi voltage of the entire battery must be less than 1(of the rated voltage. It is then safe to short circ *Example—a 12-volt battery having been dischar at a rate equal to or lower than the 2-hour rate n be short circuited when the terminal voltage of entire battery is 1.2 volts or less.* Where possi the shorting of individual cells is suggested.

5.4.2 USING A RESISTANCE LOAD BANK

A battery being discharged in the shop may discharged through a resistance which will per the current to flow at a rate no higher than its 1-h rate. Example—a 40-ampere hour battery may discharged at a rate of 40 amperes. When the batt appears to be discharged and current is no lon flowing, it is then advisable to continue to discha through a slightly higher resistance, permitting current to flow at the 2-hour rate or lower. *Exam*

(Continued on Page

NOTE: Additional constant voltage charging instructions when using Sonotone Battery BB-449/U—this method may be used at all temperatures. The recommended voltage settings are as follows:

Temperature	*Voltage*
90 to 110°F	*29 ± 1*
50 to 90°F	*30 ± 1*
0°F	*32 ± 1*
—20°F	*33 ± 1*
—40°F	*35 ± 1*

The maximum current delivered by the charger should be 30 to 100 amperes.

Table I—Charging Data

SONOTONE VEHICULAR & GENERAL PURPOSE BATTERIES

Sonotone Type	*Cell Type*	*Volts*	*CAPACITY*			*CHARGING*		
			A. H. 5-Hr. Rate	*20-Min. Amps.*	*5-Min. Amps.*	*Constant Current*		*Constant Voltage*
						Amps.	*Hours*	*Regulator Set*
5-1H120	1H120	6	.8	2	15	.2	7	7.5- 7.75
10-1H120	1H120	12	.8	2	15	.2	7	15.0-15.5
5-2H120	2H120	6	2.0	5	20	.4	7	7.5- 7.75
10-2H120	2H120	12	2.0	5	20	.4	7	15.0-15.5
5-3L420	3L420	6	4.7	10	25	1	7	7.5- 7.75
10-3L420	3L420	12	4.7	10	25	1	7	15.0-15.5
5-3H120	3H120	6	4.0	10	30	.8	7	7.5- 7.75
10-3H120	3H120	12	4.0	10	30	.8	7	15.0-15.5
5-5L420	5L420	6	7.5	12	35	1.5	7	7.5- 7.75
10-5L420	5L420	12	7.5	12	35	1.5	7	15.0-15.5
5-5H120	5H120	6	6.5	15	50	1.2	7	7.5- 7.75
10-5H120	5H120	12	6.5	15	50	1.2	7	15.0-15.5
5-10L420	10L420	6	14	25	75	3	7	7.5- 7.75
10-10L420	10L420	12	14	25	75	3	7	15.0-15.5
5-10H120	10H120	6	13	35	120	2.5	7	7.5- 7.75
10-10H120	10H120	12	13	35	120	2.5	7	15.0-15.5
5-20H120	20H120	6	22	65	200	4.5	7	7.5- 7.75
10-20H120	20H120	12	22	65	200	4.5	7	15.0-15.5
5-20M320	20M320	6	24	60	180	5	7	7.5- 7.75
10-20M320	20M320	12	24	60	180	5	7	15.0-15.5
5-40M320	40M320	6	44	110	350	9	7	7.5- 7.75
10-40M320	40M320	12	44	110	350	9	7	15.0-15.5
5-41H120	41H120	6	41	110	350	8	7	7.5- 7.75
5-60M320	60M320	6	60	150	450	12	7	7.5- 7.75
10-60M320	60M320	12	60	150	450	12	7	15.0-15.5
5-81H120	81H120	6	81	200	600	16	7	7.5- 7.75
5-100M320	100M320	6	125	350	1000	25	7	7.5- 7.75
10-100M320	100M320	12	125	350	1000	25	7	15.0-15.5
5-150M320	150M320	6	171	450	1300	35	7	7.5- 7.75
10-150M320	150M320	12	171	450	1300	35	7	15.0-15.5
5-200M220	200M220	6	200	500	1500	40	7	7.5- 7.75
10-200M220	200M220	12	200	500	1500	40	7	15.0-15.5
5-280M220	280M220	6	280	700	2000	56	7	7.5- 7.75
10-280M220	280M220	12	280	700	2000	56	7	15.0-15.5
MILITARY VEHICULAR BATTERIES								
2HNC*	2HNC	12	35	30	300	8	7	15.0-15.5
6TNC*	6TNC	12	70	60	600	16	7	15.0-15.5

*The 2HNC and 6TNC batteries are approved under military specification No. MIL-B-26509.
NOTE: MIL-B-26509 now superseded by MIL-B-23272.

SONOTONE FAA-APPROVED COMMERCIAL AIRCRAFT BATTERIES

Sonotone Type	Cell Type	Volts	CAPACITY A. H. 5-Hr. Rate	CAPACITY 20-Min. Amps.	CAPACITY 5-Min. Amps.	CHARGING Constant Current Amps.	CHARGING Constant Current Hours	CHARGING Constant Voltage Regulator Set
CA-4	24M220	24	25	65	200	5	7	28.0-29.0
CA-5	36M220	24	40	100	320	8	7	28.0-29.0
CA-6	24M220	24	25	65	200	5	7	28.0-29.0
CA-7	12M220	24	13.5	30	100	3	7	28.0-29.0
CA-9	24H120	24	24	75	225	5	7	28.0-29.0
CA-10N	10H120	24	13	35	120	3	7	28.0-29.0
CA-13	36H120	14	40	100	320	8	7	16.5-17.0
CA-15A / CA-15B	12M220	24*	15**	30	100	3	7	A 15.0-15. / A+B 28.0-29.
CA-20	20M320	24	24	60	180	5	7	28.0-29.0
CA-20H	20H120	24	22	65	200	5	7	28.0-29.0
CA-21H	20H120	24	22	65	200	5	7	28.0-29.0
CA-24A / CA-24B	24M220	24*	25	65	200	5	7	A 15.0-15. / A+B 28.0-29.
CA-31N	3H120	24	4	10	30	0.8	7	28.0-29.0
CA-40	40M320	24	44	110	350	9	7	28.0-29.0
CA-44A / CA-44B	40M320	24*	44	110	350	9	7	A 15.0-15. / A+B 28.0-29.
CA-51N	5H120	24	6.5	15	50	1.5	7	28.0-29.0
CA-53N	5H120	24	6.5	15	50	1.5	7	28.0-29.0
CA-88A / CA-88B	60M320	24*	60	150	450	12	7	A 15.0-15. / A+B 28.0-29.
CA-101N	10H120	24	13	35	120	3	7	28.0-29.0
CA-121	12M220	27.5	13.5	30	100	3	7	33.0-34.5
CA-727-3	24M220	24	25	65	200	5	7	28.0-29.0

*A and B together make up a 24-volt battery.
**At 8-hour rate.

SONOTONE MILITARY AIRCRAFT BATTERIES

Sonotone Type	Cell Type	Volts	MILITARY CAPACITY A. H. 2-Hr. Rate	Amps. 2 Hr.	Amps. 1 Hr.	Amps. 5 Min.	Amps. Peak Jet
MA-2	65M220	24	60	30	—	500	2000
MA-2-1	65H130	24	60	30	—	500	2000
MA-4	24M220	24	22	11	18.2	150	1000
MA-5	36H120	24	34	17	30	240	1500
MA-7	12M220	24	11	5.5	9.5	75	500
MA-8	24M220	24	22	11	18.2	150	1000
MA-9	24H120	24	22	11	18.2	150	1200
MA-11	24M220	24	22	11	18.2	150	1000
FMA-12	24M220	24	22	11	18.2	150	1000
MA-300H	3H120	24	3.6	1.8	3	30	100
MA-500H	5H120	26	5.7	2.9	5	50	175
MA-510H	5H120	24	5.7	2.9	5	50	175

MILITARY AIRCRAFT BATTERY CROSS-REFERENCE TABLE

Sonotone Type	U.S. Air Force Type MS—	U.S. Air Force Type MIL-B—	U.S. Army Type BB—	U.S. Army Type SCL—	U.S. Navy Type MS—	U.S. Navy Type MIL-B—
MA-2	MA-2	26026	—	—	90378-6	8565D
MA-2-1	MA-2-1	26026A	—	—	90378-7	8565D
MA-4	24497-1	26220B	434/A	6853	18045-45	8565D
MA-5	24498-1	26220C	433/A	6853	18045-46	8565D
MA-5	24498-2	26220C	—	—	18045-50	8565D
MA-7	24496-1	26220C	432/A	6853	18045-44	8565D
MA-7	24496-2	26220C	—	—	18045-48	8565D
MA-8	24497-4	26220C	—	—	—	—
MA-9	24497-5	26220C	—	—	90365-2	8565D
MA-11	—	—	—	—	90377-1	8565D
20-S102	—	—	—	—	17334-2	8565D

—a 40-ampere-hour battery may be permitted to discharge at 20 amperes.

IMPORTANT—Do not attempt to discharge a Sonotone sintered-plate, nickel-cadmium battery at an excessively high rate and then attempt to short circuit each cell at the end of this discharge. Batteries which have been discharged at high rates are not fully discharged. Application of shorting devices to the individual cells at the end of such a high discharge will produce severe arcing and intense heat. To determine when a battery has been sufficiently discharged and ready for short circuit, the terminal voltage of the entire battery must be less than 10% of the rated voltage. It is then safe to short circuit. *Example—a 12-volt battery having been discharged at a rate equal to or lower than the 2-hour rate may be short circuited when the terminal voltage of the entire battery is 1.2 volts or less (consult Description of Reconditioning Service, 9.4).*

5.5 LIQUID LEVEL ADJUSTMENT

During the normal operation of the Sonotone sintered-plate, nickel-cadmium battery, it is necessary occasionally to add liquid. The amount of water used is relatively small when compared to the amount used in a lead acid battery. Usage rate will depend upon the application, charging voltage, ambient temperature and several other factors. For this reason, it is advisable to maintain accurate records on particular applications so a realistic water replacement schedule can be established. Use only distilled or demineralized water. Storage batteries are easily contaminated through the use of tap water which contains minerals, chlorines, softening agents and other foreign materials. Water additions to adjust the liquid level should be made immediately after charging or after the battery has been permitted to remain in a state of rest for a minimum of three hours. Never adjust the electrolyte level after discharge unless abnormal high voltage readings (greater than 1.5 volts) are encountered immediately after placing a discharged battery on charge.

WARNING: Do not use acid. Injury may result and equipment damage can occur. Never use tools which have any acid deposit on them.

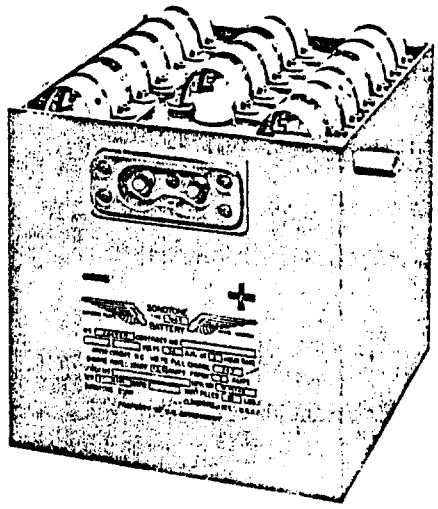


FIGURE 5

5.5.1 PROPER LIQUID LEVEL

The proper liquid level of all Sonotone sintered-plate, nickel-cadmium batteries is just above the tops of the plates or plastic insert (¼" immediately after charge or ⅛" after 3-hour stand). In some Sonotone batteries, it is possible to see the liquid level through the ports in the side of the battery can. In Sonotone batteries where these ports are not provided, such as certain aircraft types, it is necessary to determine this liquid level by looking down into the vent well after the filler cap has been removed.

If it is not possible to determine the liquid level in this manner, we recommend the use of a polystyrene tube, open on both ends and having approximately ⅛-inch inside diameter about six inches long *(see Figure 6).*

This tube is inserted into the filler opening deep enough to touch the top of the plates or plastic insert. Grasping the tube between the thumb and the middle finger of the right hand, place the index finger over the top open end of the tube and remove the tube from the filler well. If the level in the lower

NOTE: Additional instructions on the liquid level adjustment when using Sonotone Battery BB-449/U—the proper electrolyte level is ⅝" above the tops of the plates measured from 3 to 6 hours after charge. An open end glass or preferably a transparent plastic tube ⅛" to ¼" in diameter should be used for this, as described above.

end of the tube is as stated above, the liquid level is adjusted properly. If no liquid is withdrawn, add distilled or demineralized water until the proper level is reached in the polystyrene tube, using the method described above. Adjustments in liquid level may be made by a syringe of the type *pictured in Figure 7.*

5.6 ELECTROLYTE SPECIFIC GRAVITY

The electrolyte is a solution consisting of 70% distilled water and 30% potassium hydroxide, resulting in a specific gravity of 1.3. Cells which have lost electrolyte by accidental overfilling may have a lower specific gravity. Specific gravities after use may range between 1.240 and 1.320 without an appreciable effect on battery operation at normal ambient temperatures. We *do not* recommend that the user attempt to readjust this specific gravity unless it is extremely impractical to remove the battery from service long enough to have it properly adjusted at the factory. Should you find it necessary to make this adjustment, a supply of electrolyte may be purchased from your local Sonotone aircraft battery distributor or the Field Service Manager, Battery Division, Sonotone Corporation, Elmsford, N. Y. 10523.

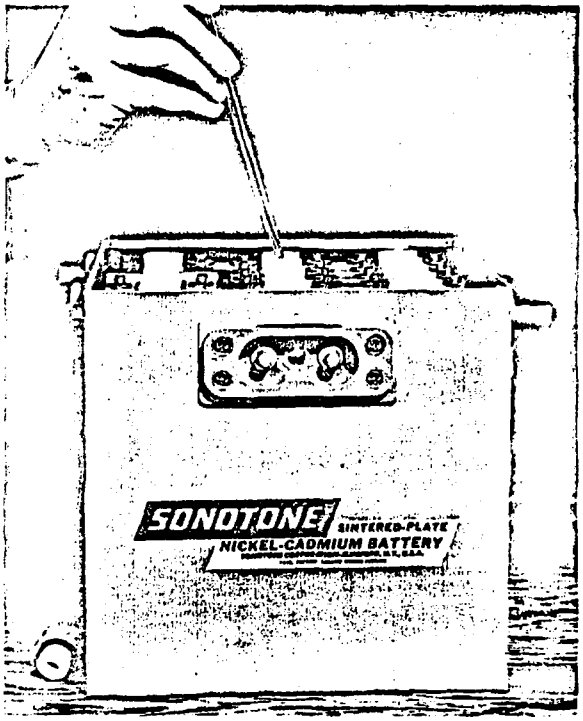


FIGURE 6

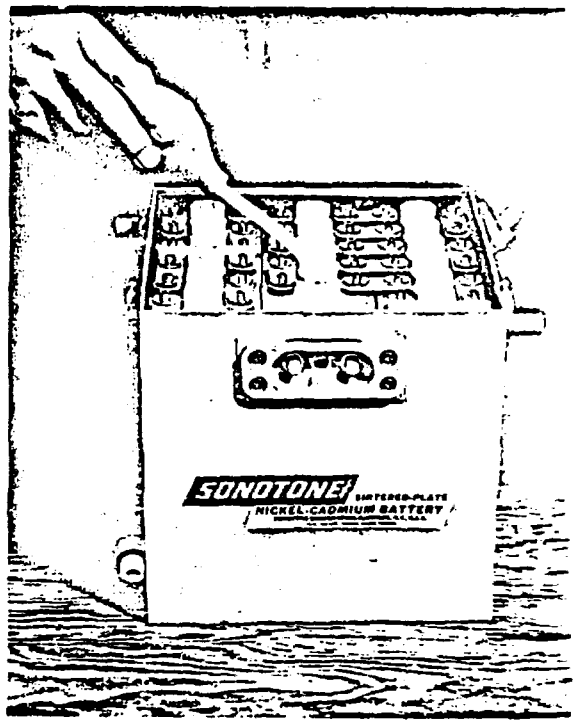


FIGURE 7

NOTE: Additional instructions on the electrolyte specific gravity when using Sonotone Battery BB-449/U—for low temperature operation at −40°F, the specific gravity should be 1.280 to 1.320.

6.0 Repair and Replacement

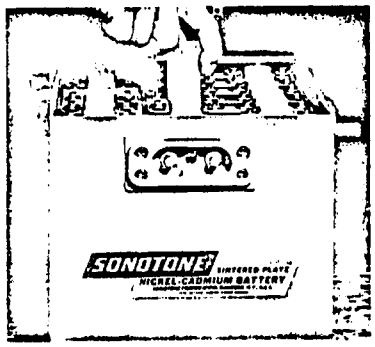


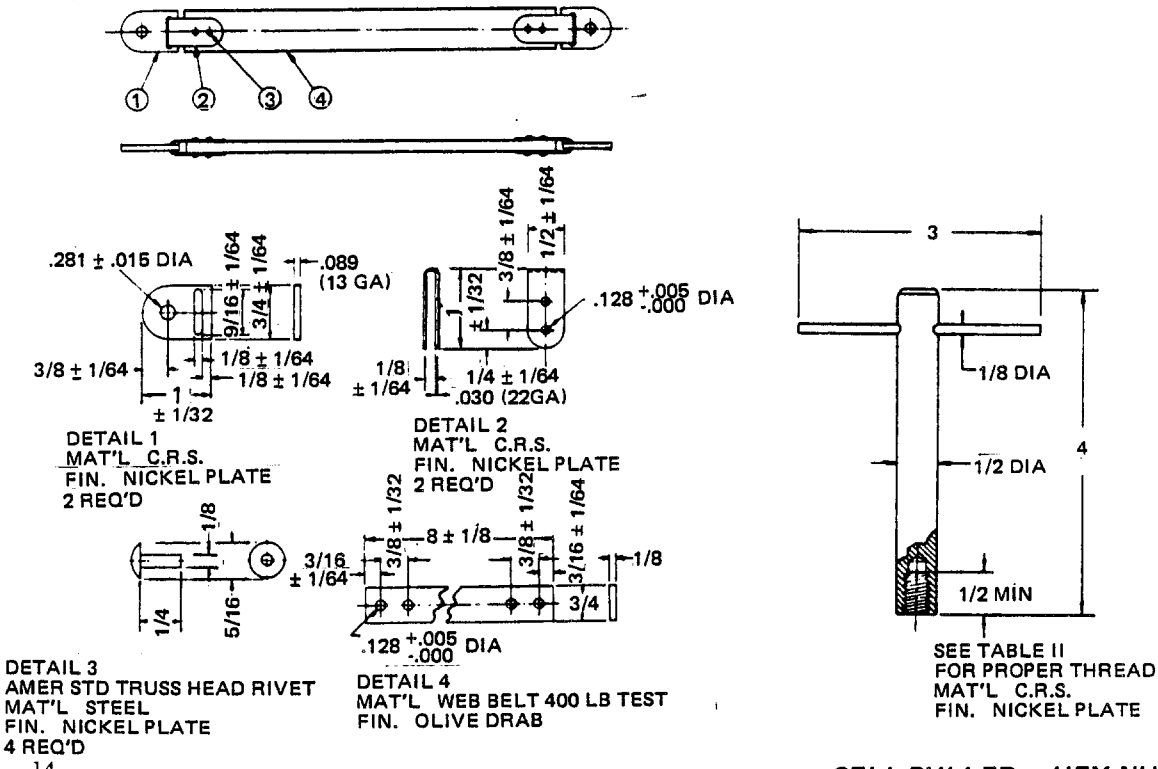
FIGURE 8

6.1 REPLACEMENT OF DAMAGED CELLS

If a cell becomes contaminated or physically damaged and the cell must be replaced, the procedure is as follows:

a. Clean battery *(consult General Care, 5.1).*
b. Remove end terminal connections. Save all the hardware.
c. Remove all vent plugs, using vent wrench *shown in Figure 8.*
d. Remove enough cell connections to permit the cell to be withdrawn from the battery case.
e. Do not withdraw cell from battery unless replacement cell is available immediately.
f. Withdraw cell, using one of the tools *shown in Figure 9. Also see Figure 10.*
g. Replace with new cell, making certain to insert the cell with the polarity symbols in the right direction. Cells are connected plus to minus. If the cell is difficult to insert, apply a light coat of petroleum jelly or silicone grease to the sides of the cell case before reassembly.
h. Replace connectors, assembling hardware finger tight. CAUTION: Do not use "homemade" hardware, as many of these parts are specifically designed to produce an adequate electrical connection. Spare or replacement hardware may be obtained from your local Sonotone Aircraft Battery Distributor or Field Service Manager, Battery Division, Sonotone Corporation, Elmsford, N. Y. 10523.
i. Torque terminal connections to the values *indicated in Table II,* using calibrated torque

The tools shown in Figure 9 are not available from Sonotone. They are of simple construction and can be made in any machine shop.



CELL PULLER – CAP SCREW TYPE

CELL PULLER – HEX NUT TYPE

FIGURE 9

wrench. A typical torque wrench *is shown in Figure 11.*

j. Discharge entire battery *(consult Discharging a Battery, 5.4)*. Monitor each cell to determine that all cells are completely discharged. Should some cells reverse and others retain a portion of their charge, it will be necessary to short the cells individually until each cell is completely at zero *(see Figure 5)*.

k. Charge battery by constant current method *(consult Charging Methods, 5.3)*.

l. Adjust liquid level *(consult Liquid Level Adjustment, 5.5)*. The battery is then ready to be put into service.

m. Return damaged cells for analysis and possible repair to Customer Return Department, Battery Division, Sonotone Corporation, Cold Spring, N. Y. 10516.

6.2 REPLACEMENT OF DAMAGED END CONNECTORS

In some battery types, primarily those used in aircraft, the battery is provided with a special quick disconnect receptacle such as a type manufactured by Elcon or Cannon or any of a number of MS type receptacles. Should one of these connectors become damaged, it will be necessary to replace it with a replacement part obtained from your local Sonotone aircraft battery distributor or the Field Service Manager, Battery Division, Sonotone Corporation, Elmsford, N. Y. 10523. Care should be taken in the removal of this connector to preserve all the hardware and gasketing, if possible, so that the new part may be installed properly.

To remove the connector, first remove those connections which go to the end cells in the battery, thus reducing the possibility of a short circuit when the connector body is removed from the battery case *(see Figure 12)*. All Sonotone batteries have the same hardware arrangement, attaching the end connector to the battery, as is used on the intercell connectors. When installing the replacement part, it is necessary to *consult Table II* for torque values.

CAUTION: Do not substitute "home-made" hardware. Care must be taken that the polarity of the end connector is carefully observed so that, when the battery is installed in the equipment, the system will function properly.

6.3 MAINTENANCE RECORD KEEPING

In order to provide an accurate source of information on each battery in service, it is advisable to keep

(Continued on Page 17)

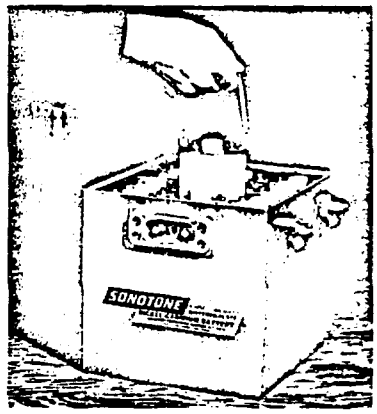


FIGURE 10

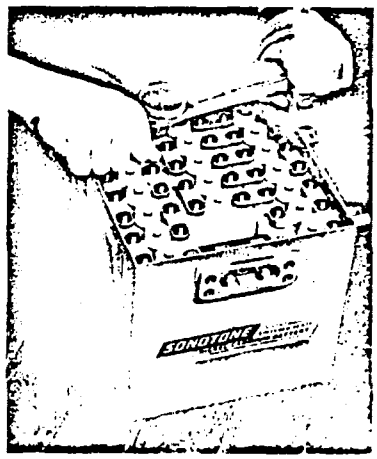


FIGURE 11

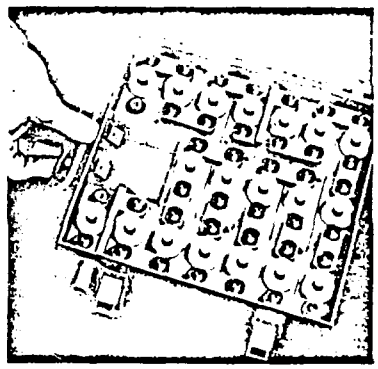


FIGURE 12

TABLE II

BATTERY OR CELL TYPE	THREAD SIZE	SOCKET HEAD CAP SCREW WRENCH SIZE	HEX NUT ACROSS FLATS	IN-LBS TO TIGHTEN
1H120, 2H120	#6-32		1/4"	6-8
3H120, 3L420 5H120, 5L420	#10-32		5/16"	15-18
10L420, 10H120 12M220	#5/16-24		1/2"	20-25
20H120, 20M320 36H120, 36M320 24H120, 24M220 24M320, 40M320 60M320	#10-32	5/32"		35-50
100M320, 150M320 200M220, 280M220	#5/16-24	7/32"		180-200
MA-2	#1/4-28	3/16"		100-125
MA-4 MA-5 MA-8	#10-32	5/32"		35-50
MA-7	#5/16-24		1/2"	20-25
MA-300H MA-500H	#10-32		5/16"	15-18

a maintenance log on each. Should a battery malfunction, you will then be able to give the complete history of this specific unit to the Field Service Manager, Battery Division, Sonotone Corporation, Elmsford, N. Y. 10523, and assist us in the determination of the problem. *A typical battery log is illustrated in Figure 13, inside back cover.*

Following is a list of typical malfunctions encountered in the maintenance and operation of sintered plate, nickel-cadmium batteries. This list will serve as an index to the preceding information.

7.0 Trouble Shooting

7.1 APPARENT LOSS OF CAPACITY

A characteristic observed in nickel-cadmium batteries is apparent loss or temporary loss of capacity. When this temporary loss occurs, the battery capacity will be lower than the rated capacity. This effect is more common when recharging across a constant potential bus, such as in aircraft, than when recharging by the constant current method. The loss of capacity is normally an indication of imbalance between cells because of differences in temperature, charge efficiency, self discharge rate, etc., in the cells. In applications where lead acid batteries have been used, the serviceman is likely to treat this loss of capacity as a natural aging quality of the battery. Nickel-cadmium battery capacity does not decrease appreciably with age. A loss of capacity is a warning and should not be treated lightly. Periodic deep cycling will be an invaluable aid in alleviating this condition *(consult Reconditioning Service Procedures, 9.3).*

7.2 COMPLETE FAILURE TO OPERATE

Where a battery fails to operate at all, the trouble can usually be traced to an electrical connection. In some instances, the defective connection will be in the circuitry of the equipment in which the battery is installed. This would show up as a broken lead, a relay which fails to operate, improper plug or receptacle installation or similar difficulties. Failure in the battery itself can be caused by an end terminal connector becoming loose or disengaged or perhaps because the charge cycle failed to operate. Should the failure be due to poor intercell connection within the battery, clean and retighten hardware using the proper torque values *(consult Table II).*

7.3 EXCESSIVE SPEWAGE

A battery which has spewed excessively will usually display large crystalline deposits on the tops of the cells. In some cases, a considerable amount of liquid will collect in the bottom of the battery container. A battery in this condition has been subjected to high charge voltages or high ambient temperatures during charging or a combination of the two. The liquid level may also have been improperly adjusted. To correct this condition, clean the battery *(consult General Care, 5.1).* Then charge the battery as required and adjust the electrolyte level *(consult Liquid Level Adjustment, 5.5).* Place battery back into service.

7.4 DISTORTION OF CELL CASES

When a battery has one or more cells with distorted plastic cases, the battery may have been overcharged as described in *Excessive Spewage, 7.3.* This battery must be removed from service and either returned to the factory or sent into the maintenance shop for cell replacement *(consult Replacement of Damaged Cells, 6.1).*

7.5 FAILURE OF ONE OR MORE CELLS TO BALANCE WITH OTHERS

During the charging procedure *(consult Constant Voltage Charging, 5.3.4),* it is sometimes noted that one or more cells fail to rise to the required 1.5 to 1.55 volts at the end of charge. The battery should be treated *as described in Constant Current Charging, 5.3.1.* If these cells still fail to rise to the required voltage they should be removed and replaced according to the procedure *outlined in Replacement of Damaged Cells, 6.1.*

7.6 FOREIGN MATERIAL WITHIN THE CELL CASES

Cells which have been removed because of failure to respond to the normal charging procedures *see preceding paragraph,* may display some evidence of foreign substances within them. This material may be gray, black or brown in color. Such foreign substances are most commonly introduced into the cell through the addition of impure water or water contaminated with acid. Other causes for this dissolution

can be heat generated by extremely high rate charging, charging without sufficient electrolyte in the cell, too high a concentration of electrolyte or a combination of two or more of these conditions.

For instance, a battery has been serviced and electrolyte (potassium hydroxide) has been added to raise the specific gravity. The battery is then permitted to charge at a sufficiently high rate and drive off water. This produces a high concentration of electrolyte, which in turn generates some heat. This set of circumstances will damage the materials in the cell plates and will be indicated by the appearance of black or gray particles in the cell. These cells will usually show up as unbalanced *(consult Apparent Loss of Capacity, 7.1)* and must be removed from service.

7.7 FREQUENT ADDITION OF WATER

If one or more cells require more water than the others, they may be out of balance *(consult Apparent Loss of Capacity, 7.1)*. Discharged cells will always appear low in liquid *(consult Liquid Level Adjustment, 5.5)*.

7.8 CORROSION OF TOP HARDWARE

Excessive rust appearing on the top hardware of a battery may be caused by the presence of acid fumes in the area. This condition will be prevalent where batteries are installed in chemical plants or other places where they are subjected to corrosive fumes, spray or chemical moisture. The battery should be kept clean *(consult General Care, 5.1)* and installed in a compartment which has been cleaned *as per the instructions in Installation of Battery, 4.3.*

7.9 APPEARANCE OF BURN MARKS ON CONNECTORS

When an intercell connector or an end connector shows indication of burning, this usually denotes that the connectors involved have not been properly tightened. For proper torque values, *see Table II.* Burned outer connecting plugs is an indication of plug failure. The battery plug or the mating half should be replaced if necessary *(consult Replacement of Damaged End Connectors, 6.2)*.

7.10 OVERHEATING OF INTERCELL CONNECTORS

If intercell connectors become hot or show signs of overheating, disassemble, clean and reassemble. Torque the connections properly *as specified in Table II.*

7.11 BATTERY CASE LEAKAGE TO GROUND

When a battery has been in an aircraft for a considerable period of time, a voltage can sometimes be detected between either terminal pin or the metal battery case. This voltage is most usually caused by a collection of electrolyte around the cells, usually as a result of spewing from the cell vent caps. The electrolyte is conductive. It is for this reason that voltage can be read. Voltage is merely potential and of itself can do no harm.

The measure of whether or not this potential is affecting battery performance is the amount of current that this leakage path will support. If, for instance, the leakage path will support .050 amperes, this would be the equivalent of a battery self-discharging completely in 500 hours (CA-20 or CA-4). Usually, we consider .050 amperes or less a safe leakage path. Beyond that value, it is advisable to flush the battery vigorously with tap water and permit it to dry in the sun, if possible, or by applying forced warm air. When the battery is completely dried out, this leakage path should no longer be apparent.

The leakage may also be caused by a damaged case-to-cover seal on an individual cell. To determine which cell is damaged, the following method should be applied.

a. Place one probe of the voltmeter on either the positive or negative terminal post and the other against the battery case.
b. Observe the voltage.
c. Leaving the probe on the metal battery case, move the other probe from cell terminal to cell terminal.
d. The indicated voltage should decrease and finally go negative. At this changeover point, you will find the leaking cell.
e. This cell should be removed from service and returned for repair to the Customer Return Department, Battery Division, Sonotone Corporation, Cold Spring, N. Y. 10516.
f. Inspect surrounding cells and hardware for damage.
g. A new cell should be added *in accordance with Repair and Replacement, 6.0.*

7.12 HEATED BATTERIES

In some special applications, Sonotone has provided a specially designed battery which incorporates the use of an internal heater blanket and the

accompanying thermostats and input plug necessary to energize the heater. Batteries of this nature are composed of the same type of cells previously discussed in the various sections of this manual and, therefore, these difficulties encountered in cell performance can be handled exactly as though the battery were not equipped with a heater. The heater itself is usually an insulating blanket containing a wire filament. Failure of the blanket to operate can be caused by a break in this filament and is easily detected through the use of a continuity meter. Another cause of heater failure is sometimes centered in the operation of the thermostat. Thermostats can be checked by submitting them to sizeable temperature differences and checking their operation with a continuity meter.

Heater blankets and thermostats cannot be repaired in the field and, should a breakdown be experienced, the material must be returned for replacement to the Customer Return Department, Battery Division, Sonotone Corporation, Cold Spring, N. Y. 10516. Because of the large number of possible variations in heated battery design, it is not possible in this manual to become any more specific on this subject. In applications where heated batteries are used, if other troubles are encountered, contact Field Service Manager, Battery Division, Sonotone Corporation, Elmsford, N. Y. 10523.

8.0 Storage

8.1 CHARGE RETENTION

Sonotone sintered-plate, nickel-cadmium batteries may be stored for long periods of time in any state of charge. The charge retention will depend largely on the ambient temperature of the storage area. A battery stored at 80°F will retain approximately 60% of its rated capacity over a period of one year. A battery stored in an ambient temperature of 0°F will retain approximately 90% of its capacity for a period of one year.

8.2 STORAGE MAINTENANCE

The active materials of the plates are insoluble in the electrolyte and therefore cannot react in any way with the electrolyte when the battery is stored on open circuit. Before placing a battery in storage, the battery should be cleaned *(consult General Care, 5.1)*. If long periods of storage are expected, it is advisable to coat the intercell connectors with a light coat of silicon grease to prevent any corrosion from forming. A battery being placed into service after storage should be given a freshening charge prior to installing it into the equipment *(consult Charging Methods, 5.3)*.

PART IV-SHOP PROCEDURE

9.0 Recommended Shop Procedure to Determine Condition of Aircraft Battery

The information in this part is a condensation of some of the procedures outlined in this manual, plus special information on aircraft batteries.

9.1 SEPARATION OF NICKEL-CADMIUM AND LEAD ACID BATTERY FACILITIES

Nickel-cadmium batteries use potassium hydroxide and distilled water as an electrolyte. Chemically, this electrolyte is an exact opposite of an acid electrolyte.

Anything associated with the lead acid battery (acid fumes included) should never come in contact with the nickel-cadmium battery or its electrolyte. Even traces of sulphuric acid from a lead acid battery entering the electrolyte of a nickel-cadmium battery will result in damage. Also, acid fumes can damage the hardware of the nickel-cadmium battery.

Separate shops are recommended for the two types of batteries. If separate shops are not possible, separate bench facilities shall be provided at opposite ends of the service area. Indicate each area clearly and keep all tools and materials separate and clearly marked.

9.2 VISUAL INSPECTION

A visual inspection of the battery in the aircraft should be made at least once every 50 flight hours on non-epoxy coated batteries and once every 100 hours on epoxy batteries. The battery connector, receptacle and vent lines should be checked for contact failure or damage and the allenhead screws or nuts should be torqued, *as per Table II.*

The cover should be removed to inspect for excess spewage and discoloration or deterioration of intercell hardware. Some slight deposits of potassium carbonates (white in color) may be encountered. If it is excessive, the battery should be removed and cleaned *(see below).* Further inspection and replacement of parts is described in this manual.

9.3 RECONDITIONING SERVICE PROCEDURES

Flight hours are the main factor determining the frequency of reconditioning service procedure, depending on these four variables:

a. Type of starting service.

b. Duty cycle for battery.

c. Ambient operating temperatures.

d. Generator voltage regulator setting.

Therefore, we can only suggest an average time between reconditioning cycles *(Table III)* because of the widely varied flight profiles seen by individual aircraft. The user will eventually apply his experiences and the information gained during the reconditioning service in determining the maximum time. At no time should a battery be allowed to deteriorate to a point where the operation of the battery affects the mission or operation of the aircraft.

TABLE III

Aircraft Type	Approximate Flight Hours Between Reconditioning Cycles
Lear Jet Model 23	100
Jet Commander	100
Grumman Gulfstream I	500
Fairchild F-27	200
Boeing 727	400
Grand Commander	500
North American Sabreliner	200
Lockheed JetStar	150
Turbo Commander	200
MU-2	200

The use of a service log for each battery and aircraft is especially helpful to the user in determining the optimum period between reconditioning. A sample log and check list will be found on the inside back cover of this manual *(Figure 13).*

9.4 DESCRIPTION OF RECONDITIONING SERVICE

The procedure for removing a battery for a reconditioning cycle should start with a visual inspection in the aircraft *(consult Visual Inspection, 9.2).* If the battery needs cleaning, it can be performed in the maintenance area. If the spewage is minor, it can be removed with a nylon bristle brush and the battery flushed with water as follows:

9.4.1 *FLUSHING OF BATTERY*

a. Prior to flushing the battery with water, check the tightness of the vent plugs.

b. Tip battery on side away from battery receptacle.

c. The top of the cells should then be flushed with tap water.

d. Air hose away excess water.

NOTE: If any of the rubber insulation has deteriorated or pulled away from the can, the battery should be disassembled and the rubber recemented.

Use rubber-to-metal cement type 35-2 by G. C. Electronics or equivalent. Replacement can also be made by using neoprene rubber of a 40-60 dryrometer by Minor Rubber Company or equivalent. The rubber thickness is 1/16" to 1/32", depending upon the type of battery.

9.4.2 *CHECKING CURRENT FLOW*

After flushing and air hose drying, check the current flow between the positive terminal and the case, then the negative terminal and case.

a. First select a meter, such as Simpson 261 or 263, which contains an amperage scale of a minimum of 500 milliamperes. Select the highest current setting on the meter.

b. Take the positive lead of the meter and place on the positive terminal of the battery receptacle and the negative lead on the battery can.

c. Decrease the current setting until a scale is reached where, if any current flow exists, it is readable. Record the current.

d. Move the selector switch on the meter to the highest current setting. Place the negative lead of the meter on the negative terminal of the battery receptacle and the positive lead on the battery can. Proceed as outlined above.

e. If the current flow is more than 50 milliamperes, the unit should be disassembled and cleaned.

NOTE: Do not use the voltage reading between the terminals and the battery can as a criteria for rejection, since current flow is the determining factor.

9.4.3 EPOXY-COATED BATTERIES

Some Sonotone nickel-cadmium batteries are now supplied with the battery container and cover epoxy-coated. In this instance, the current flow may be measured by reading from the battery terminals of the receptacle to the snaps that restrain the cover. This is mainly a safety precaution, since in epoxy-coated cans the cells should be completely insulated from the battery case.

9.4.4 CHARGING

The battery should then be charged on a charger/analyzer *(Sonotone Model PCA-131—see later reference)* on a constant current source at a 5-hour charge rate or on a constant potential source at 28.5 volts for a 24-volt battery. *(For aircraft batteries of other voltages, use 1.5 volts by the number of cells = constant potential charge volts.)* If the constant current charge is used, continue until the total battery voltage reaches 30 volts *(average 1.58 volts/cell).*

9.4.5 USING CONSTANT POTENTIAL

If a constant potential charge is used, continue charge only until the current tapers off and stabilizes.

9.4.6 ADJUSTING ELECTROLYTE

At this time the electrolyte level may be adjusted to ¼" above the top of the plates or visible insert. If the battery is allowed to stand 2 to 4 hours after charge, then the level should be adjusted to ⅛" above the plates or visible insert.

NOTE: Make adjustments with distilled, deionized or demineralized water. We do not recommend the addition of potassium hydroxide, as water only is normally lost due to electrolysis. Potassium hydroxide can be added only on specific instructions from the Field Service Manager, Battery Division, Sonotone Corporation, Elmsford, N. Y. 10523.

9.4.7 DETERMINING STATE OF CHARGE

Unlike a lead acid battery, the electrolyte in a nickel-cadmium battery acts only as a conductor. Therefore, it is impossible to determine the state of charge from the specific gravity or from open circuit voltage readings. **The only way to tell the state of charge is by a measured discharge.**

9.4.8 DISCHARGE

At this time, the battery is ready for discharge. Select a discharge rate of either the 1 or 2-hour rate *(see Table IV).*

a. The total battery voltage should be monitored until an average of 1.0 volt/cell is reached.
b. At this point, the time should be recorded.
c. If the discharge time is less than 70% of that specified *(see Table IV)*, then a supplemental discharge (deep cycle) should be performed.

TABLE IV

Battery Type	*Rate 1-Hour*	*2-Hour*	*Battery Type*	*Rate 1-Hour*	*2-Hour*
CA-4	20	11	CA-40	38	20
CA-5	34	17	CA-44	38	20
CA-6	20	11	CA-51	5.0	2.5
CA-7	10	5.5	CA-52	5.0	2.5
CA-9	20	11	CA-53	5.0	2.5
CA-10	10	5.0	CA-88	55	30
CA-15	10	5.5	CA-101	10	5.0
CA-20	20	11	CA-102	10	5.0
CA-20H	20	11	CA-121	10	5.5
CA-21	20	11	CA-727	20	11
CA-24	20	11			
CA-31	3.0	1.5			

Cutoff voltage of 1.0 volt/cell.

9.4.9 DEEP CYCLING

The deep cycle consists of continuing the discharge listed above.

a. As each individual cell reaches 0.6 volt, a metal shorting strap should be placed across the terminals while the load is still applied. It will be impossible to short out all cells within a battery since, during constant resistance discharge, the current decreases as the voltage decreases. Therefore, when approximately 75% of the cells are shorted with metal straps, a 1.0 ohm resistor of 1 or 2 watts should be placed across each of the remaining cells.
b. The battery should remain shorted as above for a period of 3 or more hours.
c. If the discharge time is 70% or greater than that specified *(see Table II)*, the supplemental discharge (deep cycle) can be eliminated.

TABLE V

Battery Type	*Time*	*Current*	*Battery Type*	*Time*	*Current*
CA-4	7-hour	5-amp	CA-40	7-hour	8-amp
CA-5	"	8-amp	CA-44	"	8-amp
CA-6	"	5-amp	CA-51	"	1.0-amp
CA-7	"	3-amp	CA-52	"	1.0-amp
CA-9	"	5-amp	CA-53	"	1.0-amp
CA-10	"	3-amp	CA-88	"	12-amp
CA-15	"	3-amp	CA-101	"	3-amp
CA-20	"	5-amp	CA-102	"	3-amp
CA-20H	"	5-amp	CA-121	"	3-amp
CA-21	"	5-amp	CA-727-3	"	5-amp
CA-24	"	5-amp			
CA-31	"	0.8-amp			

9.4.10 FINAL CHARGE

The battery is now ready for charge. Charge battery by the constant current method only.

a. Place the battery on charge at the 5-hour rate for 7 hours *(Table V)*. Care should be taken to see that the total ampere-hour charge equals that outlined in Table V. If the charge current decreases during charge, manually adjust current to maintain the proper value.

b. During the final 5 minutes of charge (for automatic chargers that have terminated, reset the charge for 10 additional minutes), the voltage of each individual cell should be read.

c. The minimum voltage should be 1.55 volts/cell and the maximum 1.75 volts/cell at room temperature (70-80°F). If any cell fails to rise to at least 1.55 volts, the constant current charge should be continued for an additional hour. At this time, monitor the cell voltage again.

d. Any cell that fails to rise above 1.55 volts or exceeds 1.75 volts should be removed from service and may be returned for rebuilding or overhaul to Customer Return Department, Battery Division, Sonotone Corporation, Cold Spring, N. Y. 10516.

NOTE: Any battery having a discharge time less than 70% of that specified in Table IV SHOULD be given another discharge and recharge *(per Discharge, 9.4.8, and Deep Cycling, 9.4.10)*.

CAUTION: Any battery having a discharge time less than 30% of that specified in Table IV MUST be given another discharge and recharge *(per Discharge, 9.4.8, and Deep Cycling, 9.4.10)*.

9.4.11 COMPLETION OF CHARGE

Following completion of the charge, the electrolyte level should again be checked, using the levels outlined earlier *(consult Adjusting Electrolyte, 9.4.6)*. Torque the nuts or allenhead screws, attached to the intercell connectors *(see Table II for correct torque values)*.

9.4.12 CHECKING CURRENT PATH

The final step now is to recheck the current path between the cell and battery case, using the maximum current outlined previously *(consult Checking Current Flow, 9.4.2)*.

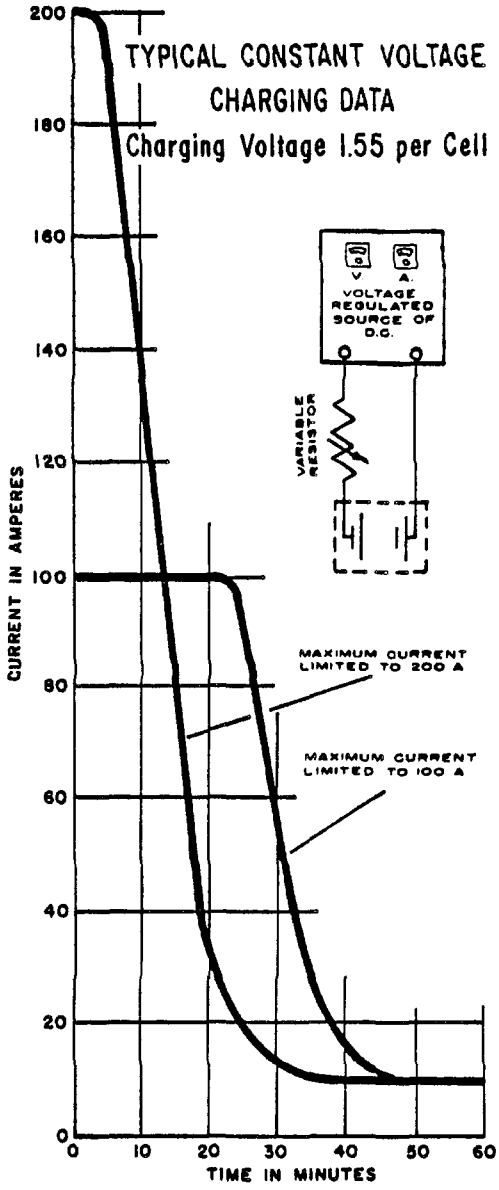


FIGURE 4

10.0 Sonotone Battery Charger/Analyzer PCA-131

10.1 IMPORTANCE OF RECONDITIONING

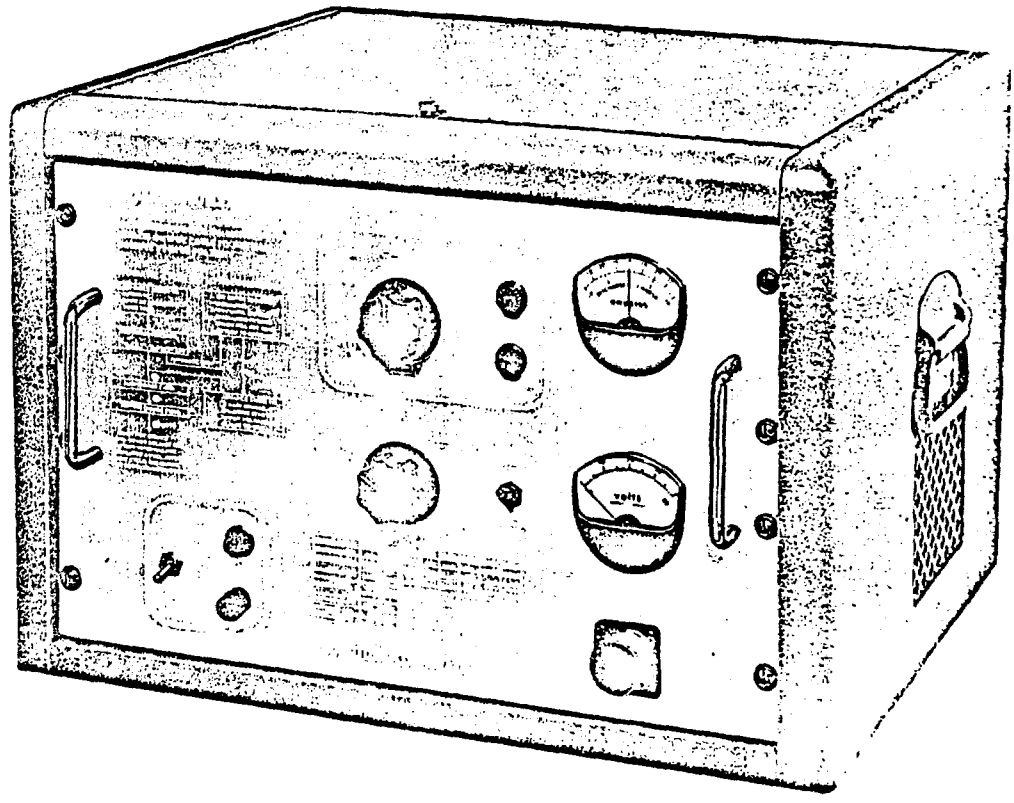
The data obtained in performing the reconditioning cycle is invaluable for determining the maximum flight hours between reconditioning service. More frequent reconditioning is recommended whenever possible, however.

In aircraft where more than one battery is used, either in series or parallel starting, care should be taken that the batteries are not allowed to become unbalanced. Perform the reconditioning service on both batteries during the same inspection period.

The Sonotone Model PCA-131 Charger/Analyzer is designed to provide maximum service from nickel-cadmium aircraft batteries. It features a "Go, No-Go" indication of battery condition.

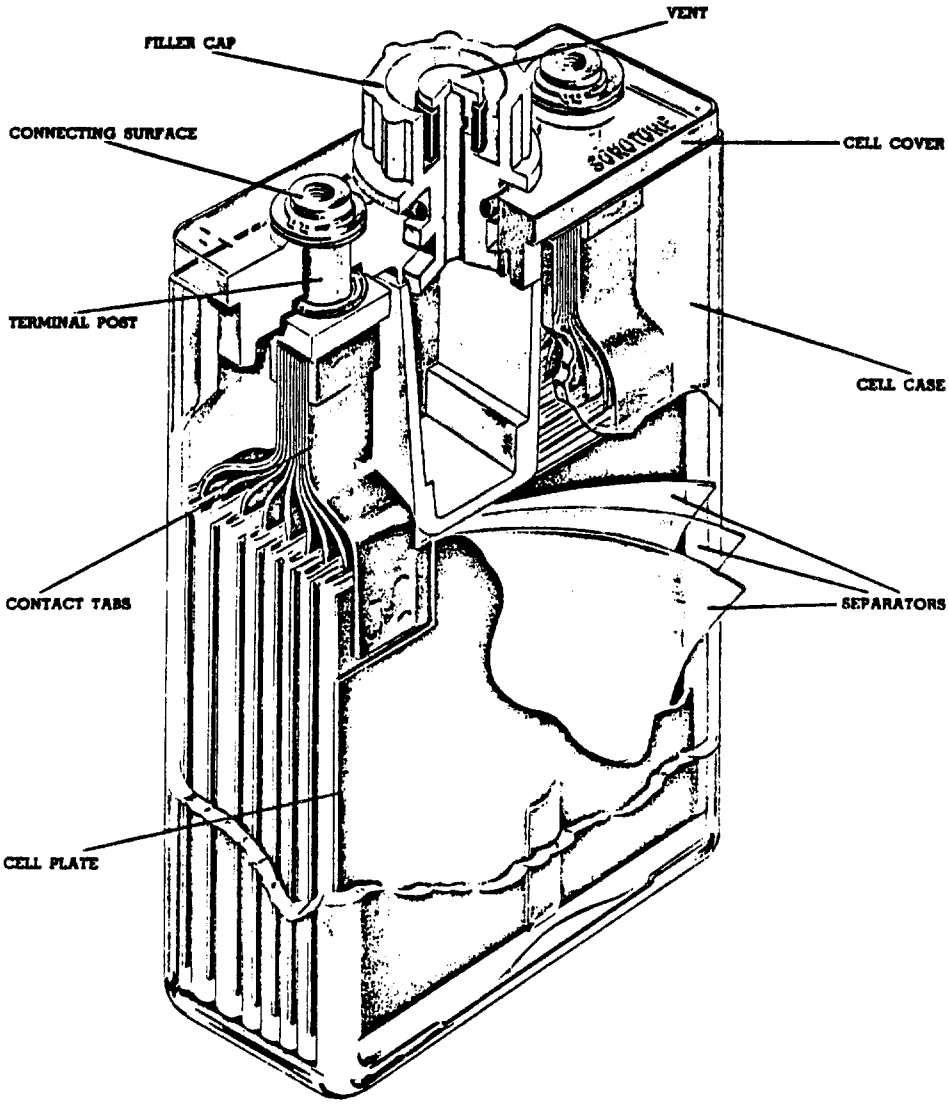
The correct charge and discharge current is preselected with the setting of the switch position. The battery can be left unattended during charge and automatically adjusts for changes in line voltage. It will automatically terminate the discharge if the average battery voltage falls below a preselected end voltage. You can then determine the actual discharge time from the running timer. The discharge percentages discussed also apply to the Sonotone Charger/Analyzer.

Complete information on Sonotone's solid state Charger/Analyzer, the Model PCA-131—such as operation instructions and charger/analyzer specifications—may be obtained from the Field Service Manager, Battery Division, Sonotone Corporation, Elmsford, N. Y. 10523 *(request Data Sheet BA-166)*.



The Sonotone PCA-131 Battery Charger/Analyzer

CUTAWAY VIEW
OF TYPICAL SONOTONE
NICKEL-CADMIUM
VENTED CELL



SONOTONE CORPORATION

FIGURE 13

BATTERY LOG & CHECK LIST

BATTERY TYPE _____ S/N _____ DATE INSTALLED _____

CHECK THESE ITEMS

DATE	CONDITION OF OUTER CASE OR COVER	CONDITION OF OUTPUT CONNECTOR	CLEANLINESS OF CELLS AND HARDWARE	CONDITION OF FILLER CAPS	TIGHTNESS OF INTERCELL CONNECTOR HARDWARE	TIGHTNESS OF END CONNECTOR HARDWARE	AVERAGE SPEC. GRAVITY	ELECTROLYTE LEVEL	CELL VOLTAGE AT END OF CHARGE	HOT SPOTS	REMARKS WATER ADDITION CELL REPLACEMENT ETC.

SPAR TM 621

TECHNICAL MANUAL

MAINTENANCE

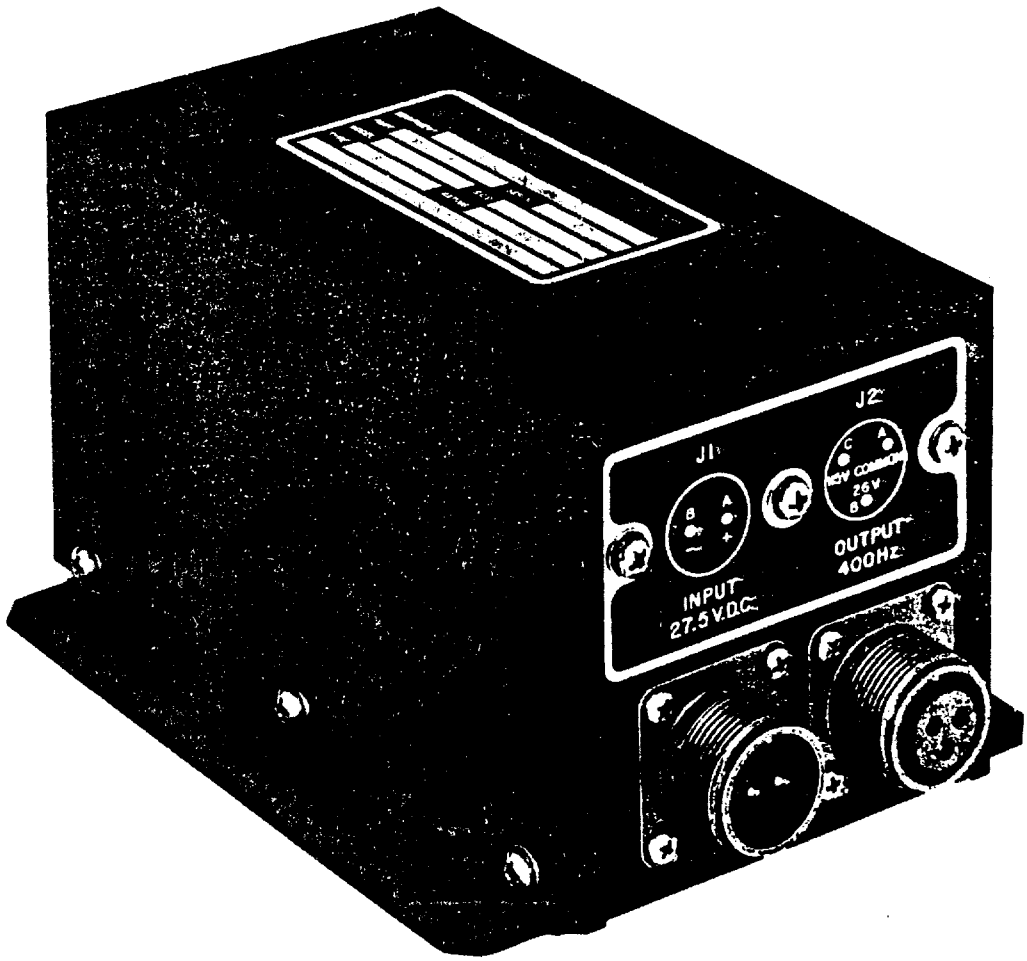
STATIC POWER INVERTER

PART NO. 5590F1-1

MODEL SPS48

Spar Aerospace Products Limited
Box 6022, Toronto International Airport
Ontario, Canada/Phone (416) 676-3333
Telex 02-29362 Sparmalt Tor/Cable Sparmalton Tor

15 APRIL 1968
(Revised 20 June 1969)



Frontispiece: Static Power Inverter, Model No. SPS48

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*The asterisk indicates pages changed, added, or deleted by the current change.

SECTION 1

GENERAL DESCRIPTION

SCOPE OF PUBLICATION

1-1. This manual pertains to the static power inverter, Model No. SPS48, Part No. 5590F1-1, manufactured by Spar Aerospace Products Limited, Box 6022, Toronto International Airport, Ontario, Canada. The information is for the benefit of personnel responsible for operation and service of the equipment and includes operating theory, fault analysis, maintenance and a part listing of electronic components.

1-2. The information reflects a single configuration of the SPS48 inverter.

EQUIPMENT DESCRIPTION

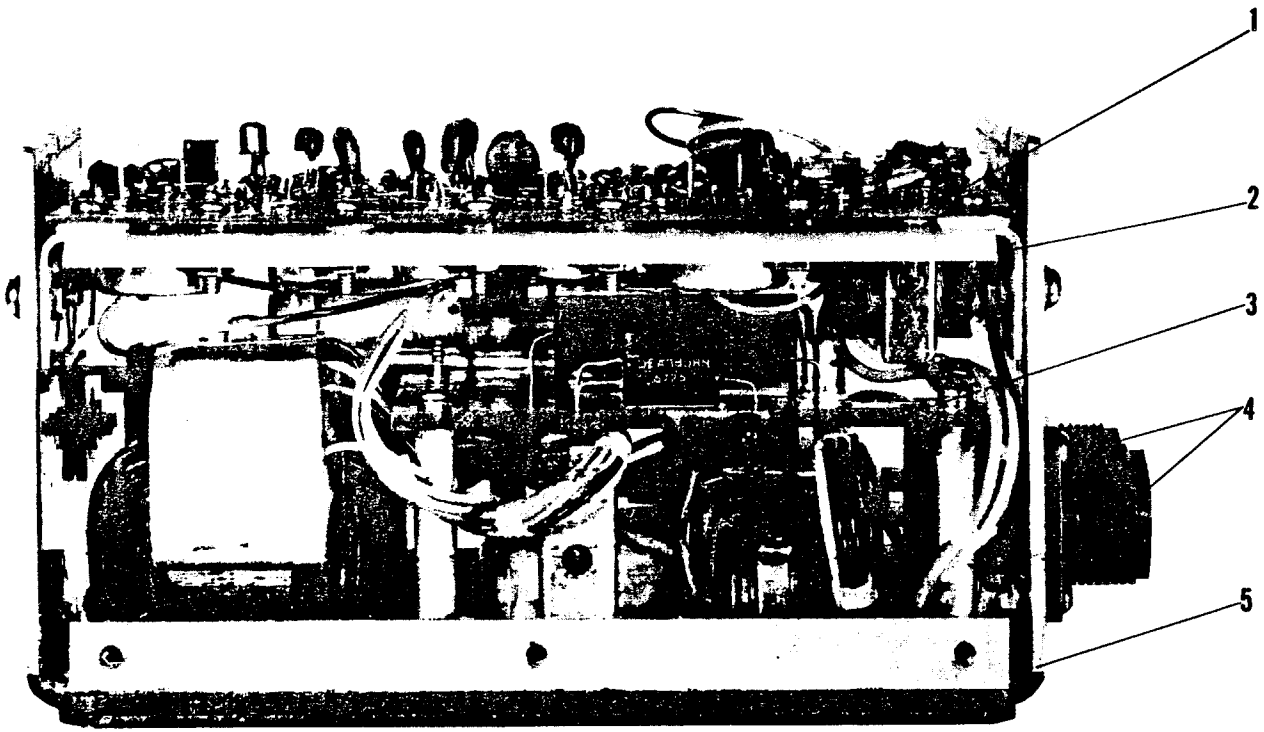
1-3. The SPS48 is a 65va, single phase inverter which operates from an input of 20 to 30 vdc and provides single phase outputs of either 26 or 115 vac at 400 Hz or a combination of both, at less than 5% total harmonic distortion. The equipment is used in airborne and ground application where a 400 Hz source of power is required.

1-4. The SPS48 is of solid state design with the components mounted on boards suspended across a U-shaped chassis. See figure 1-1. The chassis is enclosed by an inverted U-shaped cover secured by six screws and lock washers. A pair of flanges protrude from the base of the chassis to provide a rectangular mounting hole pattern.

1-5. The base of the chassis houses the large transformer, T3, and inductors, L1 through L3. An intermediate component board assembly, containing capacitors C12 through C16 is supported on tubular pillars. The top component assembly consists of a heat sink tray upon which is mount the logic component board. The heat sink tray incorporates five transistors Q1, Q10 thru Q13, the silicon rectifier CR28 and the two driver transformers T1 and T2.

1-6. The input and output power connectors, J1 and J2 respectively, are mounted externally on the forward vertical face of the chassis.

1-7. The unit can be installed in any desired orientation.



Legend

1. Logic Component Assembly Printed Circuit Board
2. Heat Sink Assembly, Power Dissipating Components and Output Drive Transformers
3. Intermediate Component Board Assembly - Capacitors
4. Input and Output Connectors
5. Main Chassis

Figure 1-1. Static Power Inverter SPS48 - Cover Removed

Dimensions:	4.7 in. high 6.7 in. long (including connectors) 3.4 in. wide
Weight:	3.25 lbs.
Input Power Requirements:	
Voltage Range:	20 to 30vdc
Transients:	80 volts per MIL-STD-704
Input Protection:	Reverse polarity protected
Output Power:	
Voltage:	115v rms, single phase 26v rms, single phase
Frequency:	400 Hz ± 1%
Voltage Regulation:	± 2%
Power Output:	65va
Power Factor:	0.7 pf lag to 0.9 pf lead
Overload Capability:	200% short circuit current, 5 seconds 150% power overload for 5 minutes
Efficiency:	65% minimum
Total Harmonic Distortion:	5%
Environmental Specifications:	
Designed to the requirements of TSO-C73	
Temperature:	-55°C to +71°C
Altitude:	To 45,000 ft.
Humidity:	MIL-E-5272C Procedure I
Shock:	MIL-E-5272C Procedure V
Vibration:	MIL-E-5272C Procedure XII
RFI Interference:	MIL-I-6181D

Figure 1-2. Leading Particulars

SECTION 2

THEORY OF OPERATION

INTRODUCTION

2-1. This section contains a functional description of the SPS48 circuitry. Refer to the overall schematic diagram, Figure 5-1.

CIRCUIT DESCRIPTION

2-2. The SPS48 operates from a d-c source of 20 to 30 volts applied across pins A and B of the input connector J1. The unit can accommodate a wide range of input voltages as specified in Figure 1-2, and provides a regulated output voltage by means of a pulse-width modulating technique.

INPUT PROTECTION

2-3. The input line incorporates an input filter comprising L1 and C12. CR28 and CR2 provides reverse polarity protection in the event that the input voltage is reversed accidentally. Zener CR1 and resistor R1 are incorporated to shut down the inverter to protect the equipment if an overload transient in excess of 40v is experienced.

REGULATED 15 VOLT SUPPLY

2-4. Following the input filter and transient protection is a series regulator circuit comprising CR7, R2, Q1 and C17. This circuit provides a regulated 15-volt input to the inverter logic circuitry. Resistor R2 supplies a current to keep zener diode CR7 turned on, maintaining the reference voltage. C17 provides additional filtering to ensure that noise is eliminated since the presence of ripple in the reference voltage would cause undesirable ripple at the output of Q1.

OSCILLATOR CIRCUIT

2-5. Q3, in conjunction with R7, R8, R10, R11 and C1 represent a unijunction oscillator which provides a stable 800 Hz output. The oscillator is capable of maintaining a 1% accuracy in frequency over the total operating temperature range. Trim potentiometer R10 permits accurate adjustment of the frequency to 800 Hz to compensate for variations in component values.

2-6. When Q3 fires, a positive pulse is coupled through C2 and turns transistor Q5 on. The pulse is coupled simultaneously to Q8 via R26 and CR12, in order to set the Schmitt trigger, Q6 and Q8.

RAMP AND CLAMP CIRCUIT

2-7. The circuit comprising Q5, CR11, C4 and the associated resistors form a ramp and clamp circuit. R20 and C4 form a simple RC circuit, connected across the regulated 15 volt supply. The capacitor charge builds up exponentially while Q5 is turned off. When Q5 is turned on, diode CR11, which is at a positive voltage established by the RC charging rate, is clamped to ground. The output, used as a reference point in the pulse-modulation circuit, is connected to the base of Q6 via R19.

2-8. There is, therefore, a simultaneous condition in which Q6 and Q8 are turned on, and the pulse occurring at R18 (collector of Q5) triggers the flip-flop, Q7 and Q9 from one state to the other. The flip-flop cycles at the output rate of 400 Hz.

FLIP-FLOP CIRCUIT

2-9. In the condition when Q9 is triggered on by the pulse from Q5, the output of Q7 is high, current cannot flow via R40 and CR17 to ground. A second path would be through CR23 and R41 to turn on Q11. However, the Schmitt trigger Q8 is on, therefore the current flows through R40, CR19, CR14 and the collector-emitter circuit of Q8 to ground. Hence, no base drive voltage is developed on Q11 and it remains off.

2-10. The ramp voltage across C4, is compared with the voltage at the emitter of Q4, via R19 and R17. If this voltage turns Q6 off, its collector is at ground potential. This removes the base drive via Q6 and R22 to Q8. Therefore Q8, deprived of its base drive, is turned off and the voltage at CR14 is raised to the d-c supply level. The current can now flow via R40, and diode CR23, thereby developing a voltage across R41 and turning Q11 on.

2-11. The time at which Q11 turns on, the left hand edge of the pulse, (i.e. the pulse-width modulated input to Q11) varies in time depending upon the regulation requirements of the inverter.

2-12. During this sequence Q7 is off and Q9 is on with its collector at ground potential. This completes a path for the current via R38, CR16 and through Q9 which ensures that during this half cycle, (1.25 milliseconds), Q10 is kept off.

2-13. On the next half cycle, Q7 is triggered on, thereby turning Q9 off. The sequence is now repeated for the alternate flip-flop state with Q11 being held off and Q10 supplied with a pulse-width controlled signal to its base. The right hand edge of the pulse is fixed in time, occurring when the flip-flop switches its state.

INVERTER OUTPUT

2-14. The pulse-width modulated waveform at the bases of Q10 and Q11 drives the transistors from off to on. These transistors provide drive signals to Q12 and Q13 via T1 and T2. Transistors Q12 and Q13 supply a variable pulse-width square wave to T3, the output transformer. In addition, inductor L3A and L3B, which is bifilar wound to reduce leakage inductance, is included in the collector circuits and forms part of the output filter. This inductor is effectively reflected into the secondary of T3 to create an LC filter comprising L3A, L3B, C15 and C14. Therefore, the basic configuration of the filter is a series inductance and a shunt capacitance across the output which attenuates the high frequency harmonics above 400 Hz. The inductor does not appear physically in the output but is reflected into the secondary winding, permitting the output winding, XY, which samples the output voltage, to be a secondary winding on the output transformer.

2-15. Capacitor C13 and inductor L2 are connected in series across the output. They provide a trap for the third harmonic voltages occurring in the output voltage.

SAMPLED OUTPUT

2-16. The a-c signal from the XY winding of transformer T3 represents a sample of the inverter output which is used as an input to the regulating circuitry. The output is fed back to a full-wave diode bridge comprising CR3, CR4, CR5 and CR6. The bridge feeds a voltage divider network comprising R3, R4, R5 and diodes CR8 and CR9. These diodes provide temperature compensation

for the bridge diodes. Potentiometer R4 allows adjustment over a limited range to set the inverter output voltage to 115 vac.

MILLER INTEGRATOR

2-17. The voltage across the divider network is applied to a high gain Miller integrator consisting of Q2, Q4 and the Miller capacitance C3. The integrator functions as a low-pass filter which converts the full-wave input into smooth d-c so that it can be compared with the ramp voltage. The voltage that appears at the potentiometer side of R6 is compared with the voltage across CR10. Diode CR10 is a temperature-compensated zener reference voltage which is fed a fixed, specified current from the d-c supply via resistor R12.

2-18. A filtered sample of the output voltage appears at the emitter of Q4. The emitter of Q4 is at a voltage which is proportional to the sample voltage which appears at XY. The emitter voltage increases and decreases as the voltage sample is compared with the voltage across CR10, which is the reference for the regulation system.

SCHMITT TRIGGER

2-19. There are two inputs to the Schmitt trigger; one from the Miller integrator via R17, the other from the ramp circuit, C4 and R20, via R19. Reference paragraph 2-6, Q6 is turned on by a pulse from the oscillator Q3, via R26 and CR12. This ensures that the Schmitt trigger is on and keeps the collector of Q8 at ground potential at the commencement of each half cycle, thereby permitting pulse-width modulation on the left hand edge of the pulse.

2-20. At this instant there is a positive voltage at the Q4 emitter end of R17, but its magnitude is not sufficient to turn Q6 off. However, the other input to the Schmitt trigger from the ramp, via R19 increases to a level which eventually turns Q6 off. When Q6 is turned off, Q8 is also turned off and CR14 returns to ground through a high impedance path via R30. This allows either Q10 or Q11 to turn on and provide a pulse to the output.

DRIVER CIRCUIT

2-21. VDR1 and VDR2 are voltage dependent resistors. They are used to clip the inductive voltage swings on T1 and T2 when Q10 and Q11 are turned off. The resistors absorb inductive voltage transients thus protecting the associated transistor.

2-22. Diodes CR29 and CR30 provide transient protection for Q12 and Q13. Resistors R42 and R43 provide base returns for Q12 and Q13.

OUTPUT CIRCUIT

2-23. The transformer T3 provides an output waveform of the required rms voltage which is sinusoidal with a maximum total harmonic distortion of 5%. The 115 vac, 400 Hz output is available at pin J2-C; 26 vac, 400 Hz at pin J2-B; with pin J2-A common.

2-25. The transformer ensures that the outputs are isolated electrically from the input and ground.

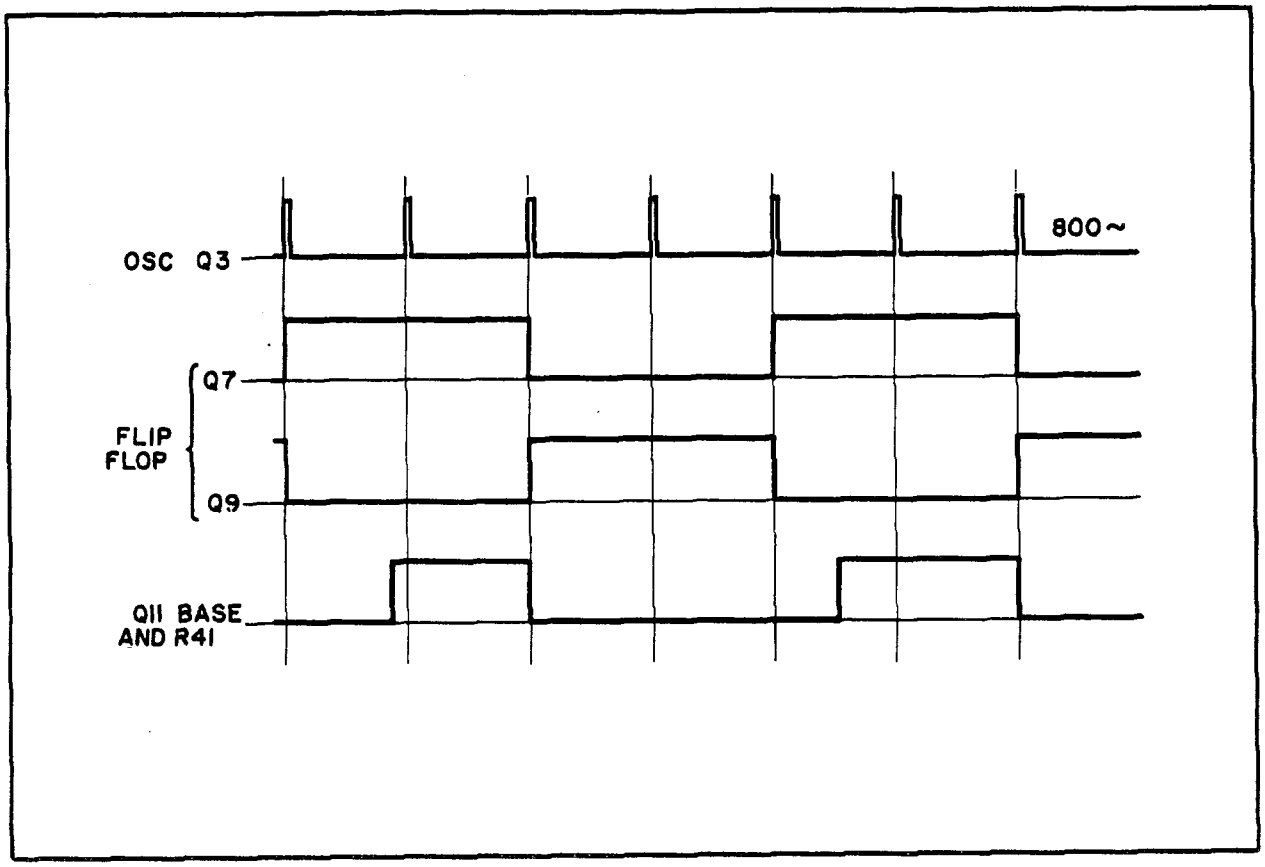


Figure 2-1. Circuit Waveforms

SECTION 3

MAINTENANCE

INTRODUCTION

3-1. This section describes briefly the scope of maintenance which is applicable to the SPS48 inverter. Maintenance is limited to a functional test procedure, and a descriptive analysis of possible malfunction conditions. The section also includes internal photographs of the unit identifying pertinent electronic components.

VISUAL EXAMINATION

3-2. Before the inverter is connected to any test equipment or power supply, remove the cover and carry out a visual examination paying particular attention to the following points:

(a) Ensure that there is no dirt, dust or other foreign matter inside the unit.

(b) Ensure that all securing and locking screws are tight.

(c) Ensure that all solder joints are visually good, without excess solder and are clear of flux.

(d) Check the wiring for any sign of damage.

(e) Check the electrical connectors for signs of damage.

(f) Check electrical components for signs of overheating.

(g) Check the cover assembly for signs of damage and chipped paint.

EQUIPMENT TEST

3-3. The following test procedure ensures that a unit is functioning satisfactorily within the specified performance tolerances. The test may also be used to isolate faults at the field maintenance level based on malfunction reports in operation.

TEST EQUIPMENT

3-4. The following test equipment is required:

(a) Load test panel, Spar Part No. V1695 or equivalent.

(b) Avometer, Model 8 or equivalent (Qty 3).

(c) Frequency counter, Hewlett Packard Model 5500C or equivalent.

(d) Distortion analyzer, Hewlett Packard Type HP331A.

(e) Power supply, variable 20 to 30 vdc, 5 amp capacity or better.

TEST PROCEDURE

3-5. Under steady state conditions, the nominal load of 65 va is equally divided between the 115v and 26v outputs. In the following test procedure all a-c voltmeter readings are rms values. Connect the inverter to be tested as shown in the test set-up, Figure 3-1.

3-6. No load performance. Proceed as follows:

(a) Set the load switch to the no-load position and the output selector switch to the 115v position.

(b) With the avometer (2) set to a suitable a-c volts range, adjust the input voltage to 25 vdc.

(c) Switch the test panel ON and check that the outputs fall within the following tolerances: voltage, 105 to 121 vac; frequency, 396 to 404 Hz; harmonic distortion, 5% or less. Record the readings.

NOTE

The output voltage can be varied over a limited range by adjusting trim potentiometer R4. The oscillator frequency is adjusted by means of variable resistor R10.

(d) Switch the output selector switch to the 26v position.

(e) Set the avometer (2) to a suitable a-c volts range.

(f) Check that the outputs fall within the following tolerances: voltage, 24.2 to 27.3 vac; frequency, 396 to 404 Hz; harmonic distortion, 5% or less. Record the readings.

(g) Repeat steps (a) through (e) with input voltages of 27.5 vdc and 29.5 vdc. Record the readings. Do not disconnect the test equipment.

3-7. Full Load Performance. Proceed as follows:

Set the load switch to the full load position and repeat the performance test specified in paragraph 3-6. Check that the output current falls within the following tolerances: 115 vac output, 0.263 to 0.303 amps; 26v output, 1.17 to 1.35 amps.

CLEANING

3-8. The following paragraphs describe the procedures for cleaning the interior and exterior of the inverter.

CLEANING MATERIALS

3-9. The SPS48 may be cleaned with a stream of filtered, compressed, dry air at a pressure of less than 30 psi. Remove any grease spots with a high quality cleaning fluid, used sparingly, and then dust with a lint-free cloth and cleaning brush. Water may be used for cleaning the metallic parts of the cover assembly. For general cleaning purposes, the following mixed solution is recommended: 70 percent dry cleaning solvent, 5 percent chlorethylene, and 25 percent methylene chloride.

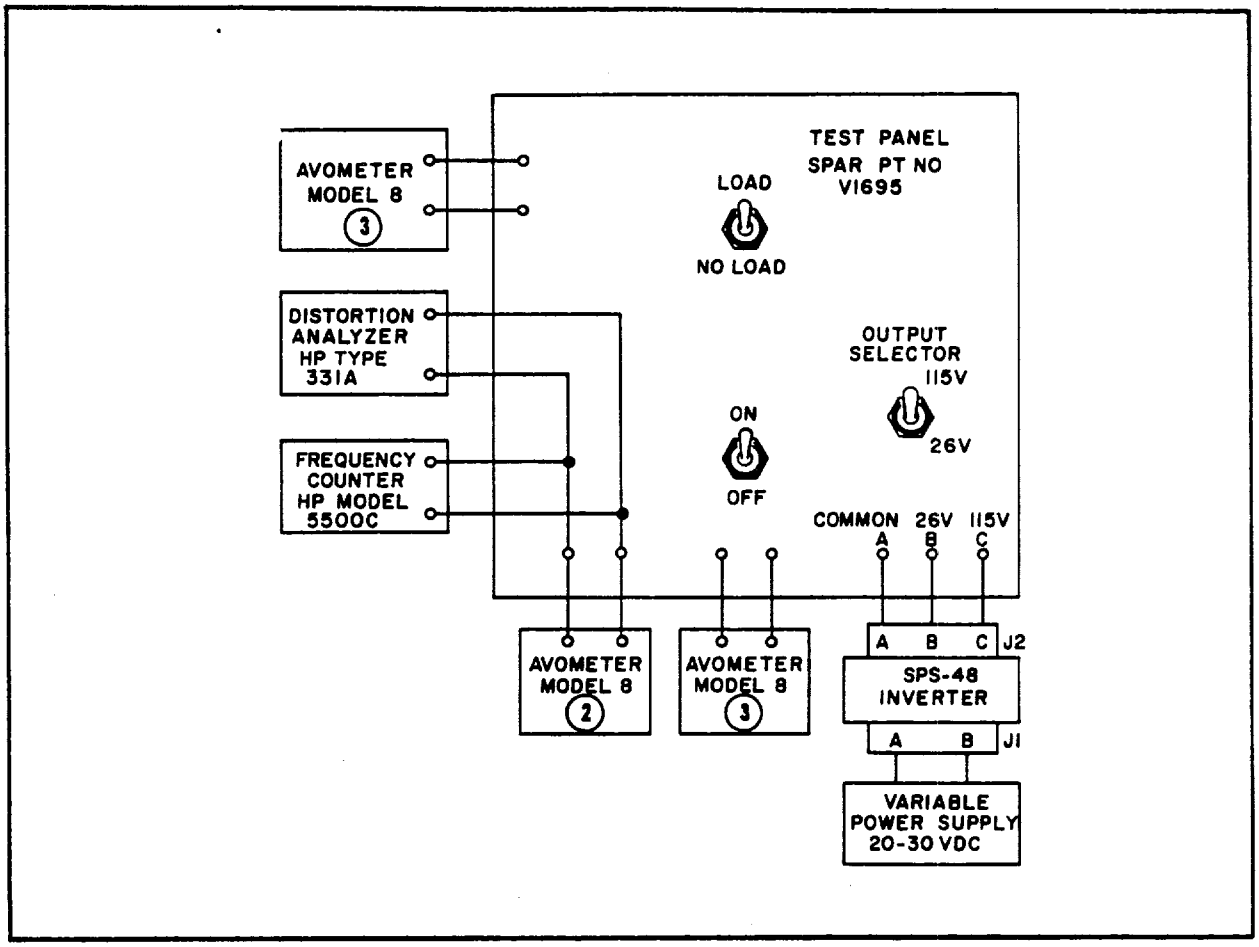


Figure 3-1. SPS48 Static Power Inverter - Test Set-up

WARNING

This mixture, although considerably less toxic than carbontetrachloride, must be used only in a well ventilated room.

CAPACITORS, RESISTORS, INDUCTORS AND TRANSFORMERS

3-10. Clean capacitors, resistors, inductors and transformers with a soft cloth moistened with the general cleaning solution, described in paragraph 3-9. Where possible, remove corrosion on metallic parts with crocus cloth. Remove any resulting particles with a fine brush and vacuum source. Refinish printed circuit boards with a clear epoxy coating, such as Fullers Resiweld No. 7200.

TERMINAL BOARDS

3-11. Clean terminal boards with a stiff brush and soft cloth moistened with the general cleaning solution described in paragraph 3-9. Carefully remove any corrosion with crocus cloth or No. 0000 sandpaper, afterwards cleaning with the general cleaning solution.

CABLE CONNECTORS

3-12. Clean dirty cable connectors with a fine brush or soft, lint-free cloth moistened with the general cleaning solution described in paragraph 3-9. Clean corroded contacts with crocus cloth or No. 0000 sandpaper.

FAULT ANALYSIS

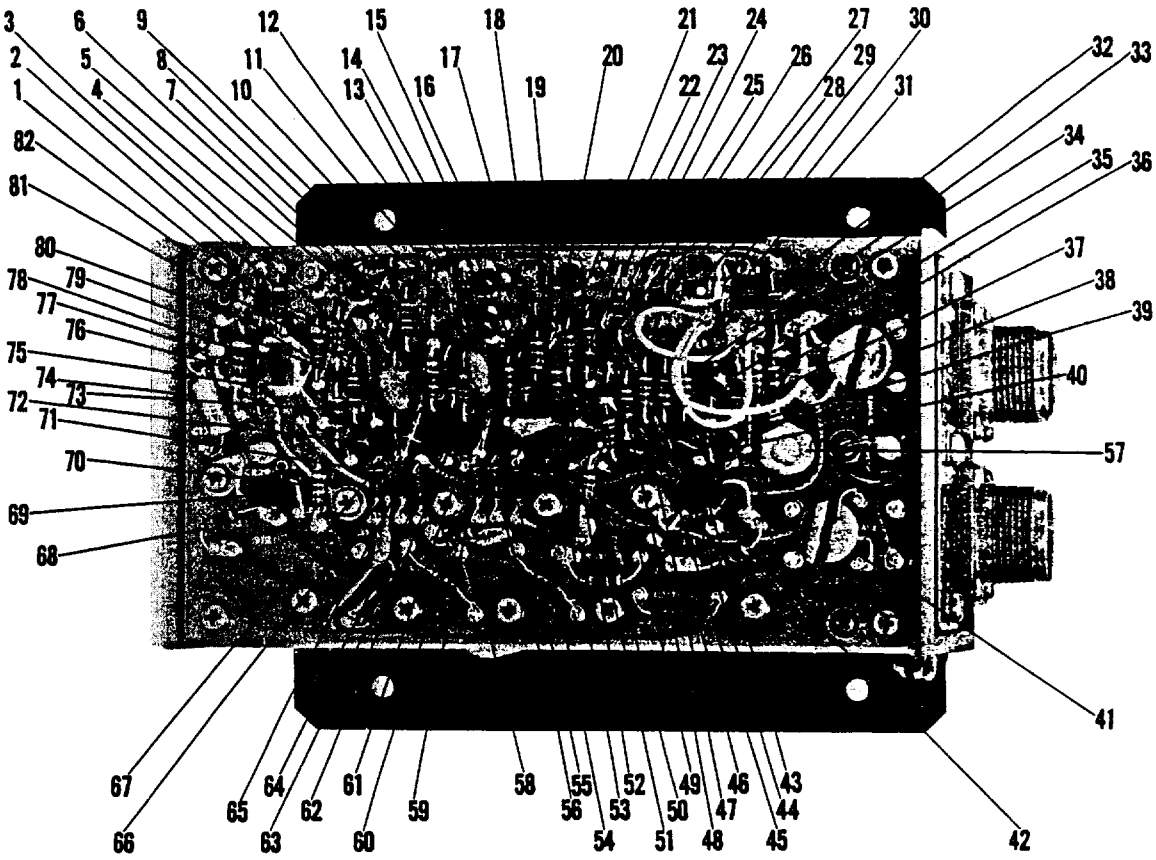
3-13. Symptoms of malfunctions will normally be detected by erroneous output conditions. The fault analysis is therefore confined to examinations of the output voltage, frequency and waveform.

3-14. FREQUENCY. If the frequency of the output is incorrect the unijunction oscillator, Q3, should be suspected. Limited adjustment of the frequency can be accomplished by means of potentiometer R10, located on the top panel remote from the connectors. If the output frequency is considerably out of tolerance, check the input voltage, the regulated supply potential and the regulator Q1, R2 and CR7 output. Ensure that all leads are connected properly.

3-15. OUTPUT VOLTAGE, HIGH OR LOW. Out-of-tolerance voltage output could be caused by a fault in any of the regulation circuit comprising the diode bridge, CR3 through CR6; the divider network, or the Miller integrator Q2 and Q4.

3-16. DISTORTED WAVEFORM. Distortion of the output waveform could indicate problems in the output filtering network. The primary filter comprises inductor L3A and L3B and capacitor C14 and C15. Improper drive to Q10, Q11 or Q12, Q13 resulting in an extremely narrow pulse would cause excessive distortion. There would be insufficient energy in the pulse to provide an acceptable sine wave even under no load conditions, due to losses in the transformer and filter.

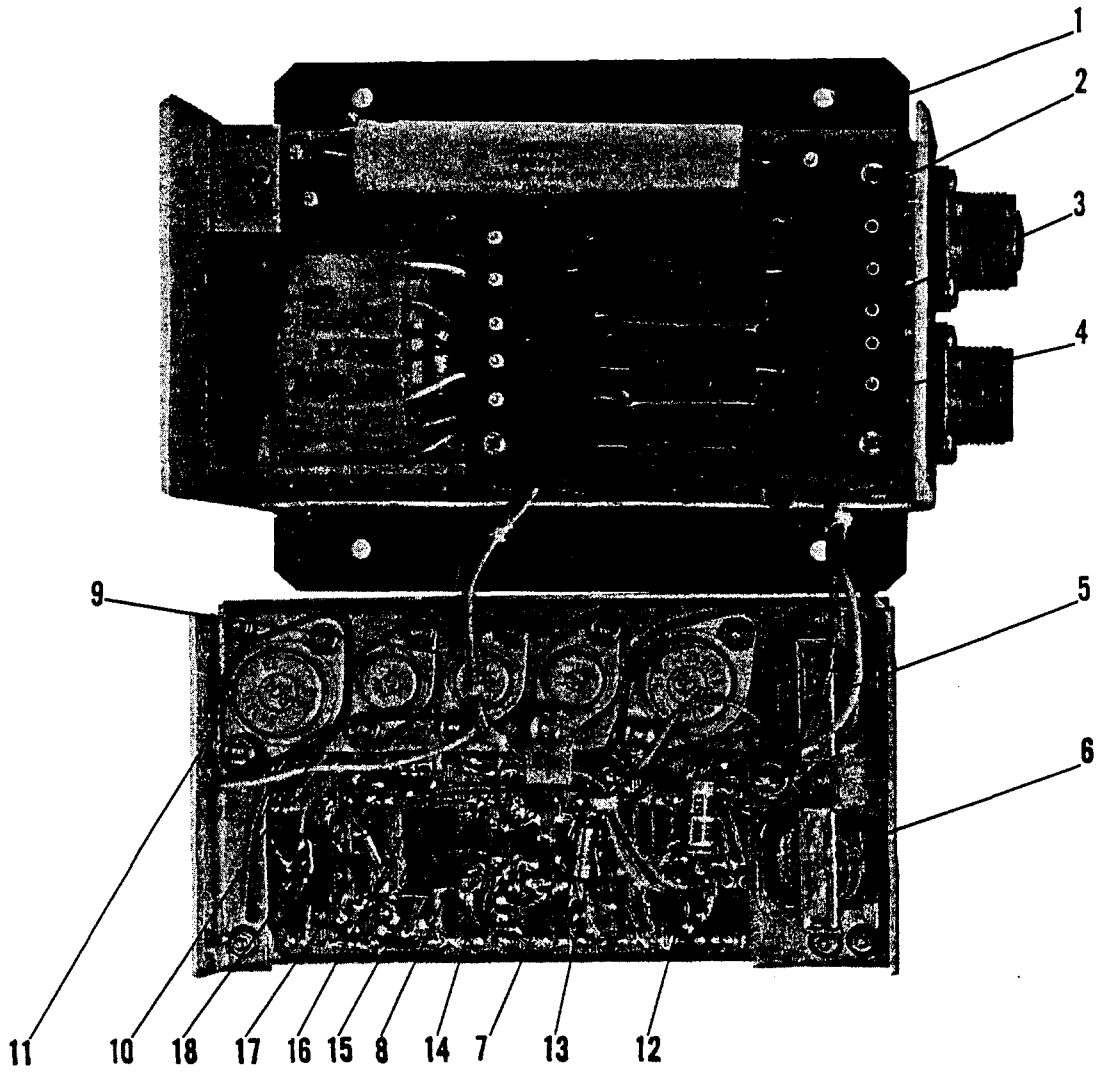
3-17. NO OUTPUT. In the event of no output a complete signal trace would be required. Malfunctions or component breakdown in virtually any part of the circuit could result in a no output condition.



Legend

1. R8	15. CR15	29. R4	43. CR30	57. CR28	71. CR21
2. R7	16. R34	30. R3	44. R24	58. R41	72. CR19
3. C7	17. R33	31. CR3	45. R22	59. CR16	73. R26
4. Q3	18. C9	32. CR1	46. R38	60. CR23	74. C17
5. Q5	19. R35	33. R30	47. CR12	61. C8	75. CR7
6. CR11	20. Q2	34. Q6	48. R17	62. R31	76. R2
7. R20	21. R13	35. R21	49. R16	63. R40	77. CR2
8. R18	22. R9	36. R29	50. R39	64. CR20	78. R10
9. R25	23. R12	37. R1	51. R36	65. CR13	79. R15
10. R28	24. CR10	38. VDR1	52. Q4	66. CR17	80. R11
11. C6	25.. R6	39. R23	53. C18	67. R28	81. R19
12. R32	26. CR9	40. Q8	54. CR22	68. R43	82. R14
13. Q9	27. CR8	41. VDR2	55. CR18	69. CR29	
14. Q7	28. R5	42. R42	56. CR17	70. R37	

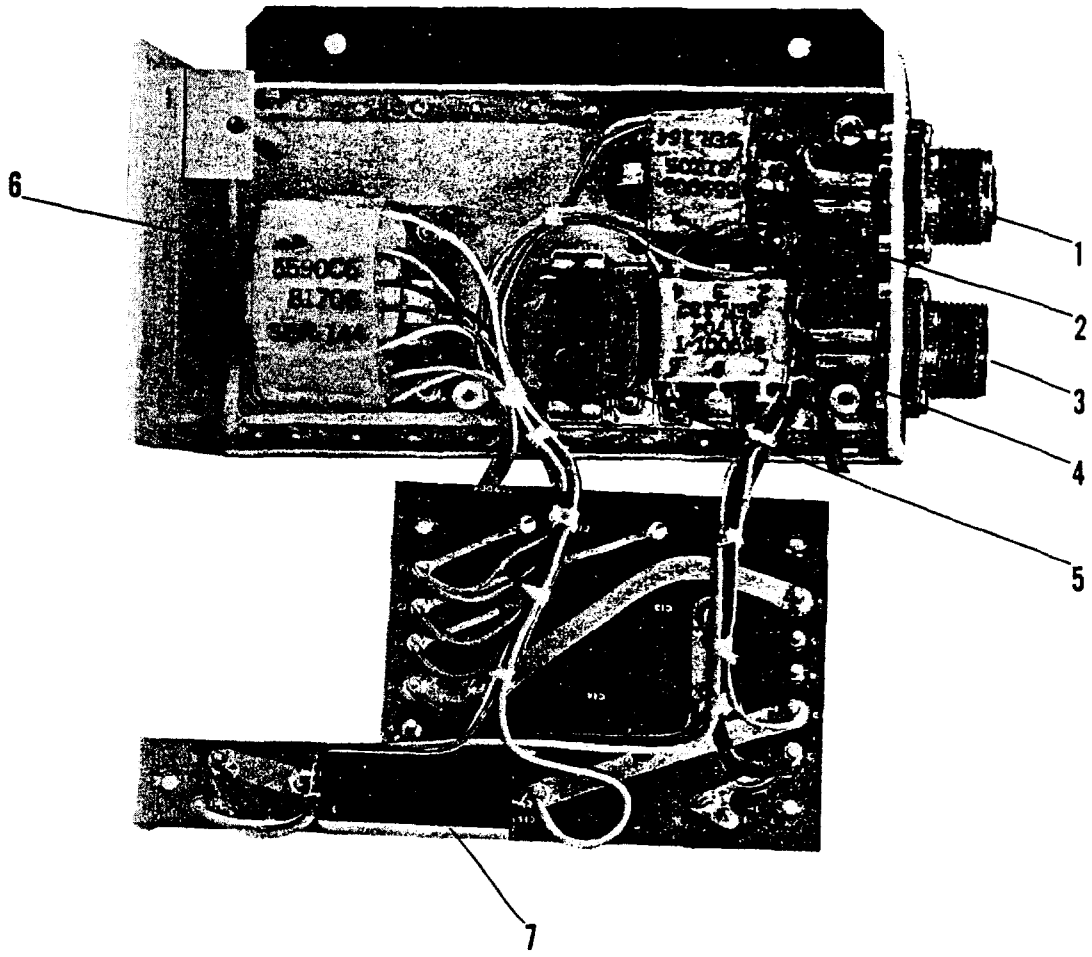
Figure 3-2 Logic Component Assembly Board - Top



Legend

1. C12	7. Q13	13. C3
2. C14	8. Q10	14. C10
3. C13	9. Q11	15. C4
4. C16	10. Q1	16. C11
5. T1	11. Q12	17. C2
6. T2	12. C5	18. C1

Figure 3-3. Logic Component Assembly Board - Bottom; Component Assembly, Heatsink, Intermediate Component Board Assembly, Capacitor - Top



Legend

1.	J2	4.	L2
2.	L3	5.	L1
3.	J1	6.	T3

7. C15

Figure 3-4. Intermediate Component Board Assembly, Capacitor, Bottom; and Lower Chassis Assembly

SECTION 4

REPLACEMENT PART LIST

4-1. This section contains a replacement part list for the components within the static power inverter SPS 48. The electronic components are listed with their reference designators arranged in alpha-numeric (computer) sequence.

4-2. The locations of components are shown in Section 3. Parts manufactured by Spar Aerospac Products Limited or parts for which Spar retains specification control are identified by the Spar vendor code. Parts not manufactured by Spar Aerospace Products Limited are identified by the appropriate vendor code derived from the Federal Supply Code for Manufacturers, H4-1. A cross reference list of the vendor codes and the vendor's name and address is given below.

Code	Vendor's Name and Address
01884	Dearborn Electronics Inc., P.O. Box 530, Orlando, Fla. 32802
05397	Union Carbide Corp., Linde Division, Kemet Dept., Cleveland, Ohio.
08466	General Instruments of Canada Ltd., 151 Weber St. S., Waterloo, Ontario, Canada.
09488	Canadian Motorola Electronics Inc., Toronto, Ontario, Canada.
09817	Canadian General Electric Co. Ltd., Electronic and Defense Products Dept., Toronto, Ontario, Canada.
14655	Cornell-Dubilier Electric Corp., 50 Paris St., Newark, N.J.
14674	Corning Glass Works, Houghton Park, Corning, N.Y. 16701
35005	Dale Electronics Canada Ltd., Scarborough, Ontario, Canada.
35009	I.R.C. Resistor Division of Renfrew Electric Co. Ltd., Toronto, Ontario, Canada.
36480	Spar Aerospace Products Ltd., Box 6022, Toronto International Airport, Ontario, Canada.
56289	Sprague Electric Co., North Adams, Mass.
65092	Weston Instruments Inc., 614 Frelinghuysen Ave., Newark, N.J. 07114
95093	Canadian Westinghouse Co. Ltd., Hamilton, Ontario, Canada.
95311	RCA Victor Co. Ltd., Montreal, Quebec, Canada.

Reference Designation	Description	Part Number	Vendor Code	Type or Value
CR1	Silicon Zener Diode	1N975A	-	39V, ± 10%, 400 mw
CR10	Silicon Zener Diode	1N753A	-	6.2V, ±5%, 400 mw
CR11 thru CR19	Silicon Diode	1N914B	-	-
CR2	Silicon Rectifier	1N5061	09817	-
CR20 and CR21	Silicon Diode	1N914B	-	-
CR22 and CR23	Multi-pellet Diode	MPD400	09817	-
CR26 and CR27	Not Used			
CR28	Silicon Rectifier, c/w insulating hardware	368M	95093	-
CR29	Silicon Rectifier	1N4818	95093	-
CR30	Silicon Rectifier	1N4818	95093	-
CR3 thru CR6	Multiple Diode Assembly	MDA920A-2	09488	-
CR7	Silicon Zener Diode	1N965B	-	15V, ±5%, 400 mw
CR8 and CR9	Silicon Diode	1N914B	-	-
C1	Capacitor, Parylene Dielectric	KA4702FK50K	05397	.047 mf, 10%, 50V at 85°C
C10 and C11	Capacitor	WMF1D33	14655	.0033 mf, 10%, 100 vdc
C12	Capacitor	601D507G050SF4	56289	500 mf, 50 vdc
C13	Capacitor	LP7A1C564G	01884	.56 mf, 2%, 200 vdc
C14 and C15	Capacitor	LP7A1C205J	01884	2 mf, 5%, 200 vdc
C16	Capacitor	LM7A1C104M	01884	.1 mf, 20%, 200 vdc
C17	Capacitor	CS13BF685M	-	6.8 mf, 20%, 35 wvdc
C18	Capacitor	CK61BX221M	-	220 mmf,
C19	Not Used			
C2	Capacitor	CS13BE155M	-	1.5 mf, 20%, 20 vdc

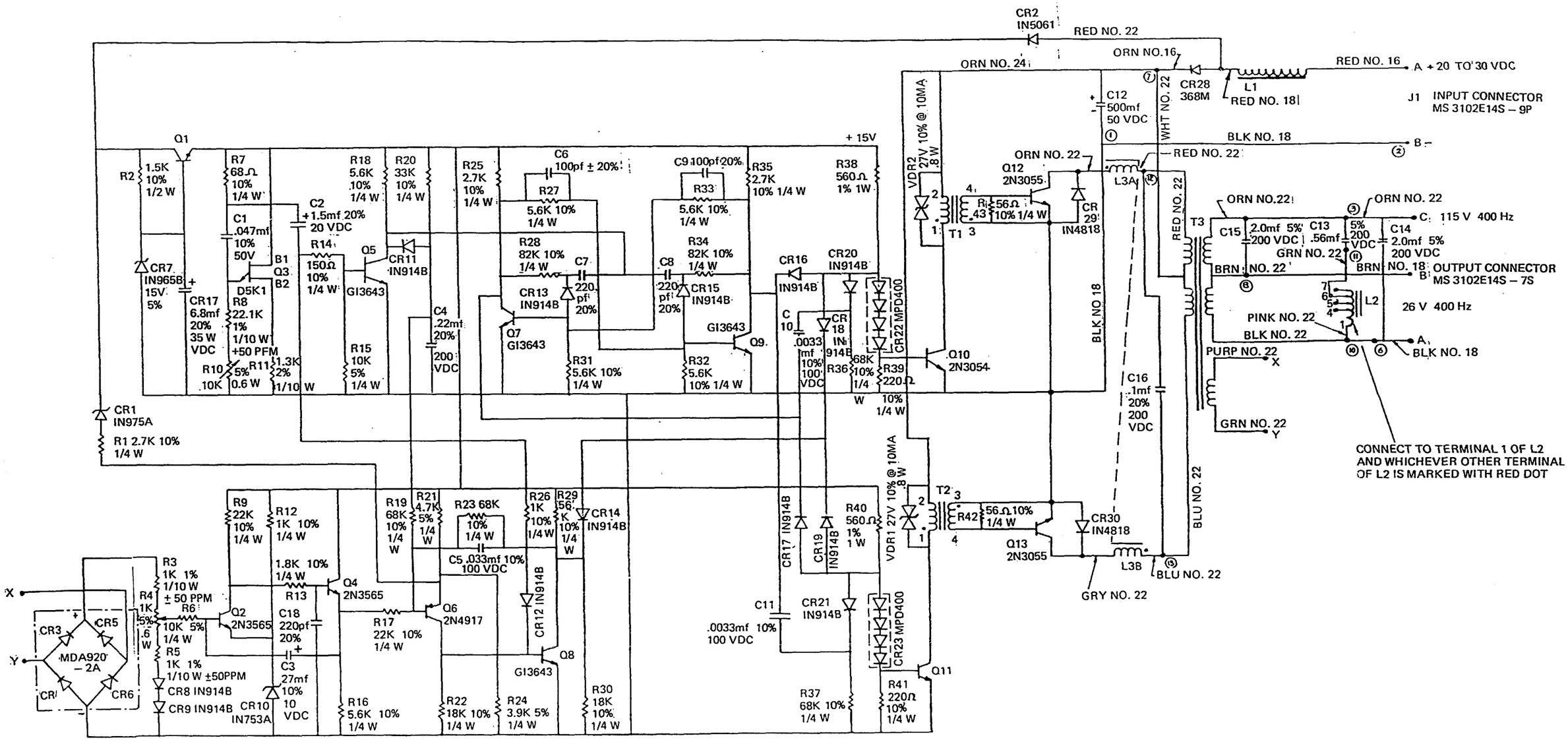
Reference Designation	Description	Part Number	Vendor Code	Type or Value
C3	Capacitor	CS13BC276K	-	27 mf, 10%, 10 vdc
C4	Capacitor	LM7A1C224M	01884	.22 mf, 20%, 200 vdc
C5	Capacitor	WMF1S33	14655	.033 mf, 10%, 100 vdc
C6	Capacitor	CK60BX101M	-	100 mmf, 20%
C7 and C8	Capacitor	CK61BX221M	-	220 mmf, 20%
C9	Capacitor	CK60BX101M	-	100 mmf, 20%
J1	Connector, input	MS3102E14S-9P	-	-
J2	Connector, output	MS3102E14S-7S	-	-
L1	Choke, D.C.	5590C2-1	36480	-
L2	Choke, Third Harmonic	5590C1-1	36480	-
L3	Choke, Primary	5590C3-1	36480	-
Q1, Q10, Q11	Silicon Transistor NPN c/w insulating hardware	2N3054	95311	-
Q12 and Q13	Silicon Power Transistor NPN c/w insulating hardware	2N3055	95311	-
Q2	Silicon Transistor NPN	2N3565	-	-
Q3	Silicon Complementary Unijunction Transistor	D5K1	09817	-
Q4	Silicon Transistor NPN	2N3565	-	-
Q5	Silicon Transistor NPN	GI3643	08466	-
Q6	Silicon Transistor PNP	2N4917	-	-
Q7, Q8, Q9	Silicon Transistor NPN	GI3643	08466	-
R1	Resistor	RC07GF272K	-	2.7K, 10%, 1/4 w
R10	Potentiometer	502-00S	65092	20K, ±5%, .6 w at 70°C
R11	Resistor	C4	14674	1.3K, 2%, 1/10 w at 125°C, temp. coeff. ± 100 ppm/°C max
R12	Resistor	RC07GF102K	-	1K, 10%, 1/4 w
R13	Resistor	RC07GF182K	-	1.8K, 10%, 1/4 w
R14	Resistor	RC07GF151K	-	150 ohm, 10%, 1/4 w

Reference Designation	Description	Part Number	Vendor Code	Type or Value
R15	Resistor	RC07GF103J	-	10K, 5%, 1/4 w
R16	Resistor	RC07GF562K	-	5.6K, 10%, 1/4 w
R17	Resistor	RC07GF223K	-	22K, 10%, 1/4 w
R18	Resistor	RC07GF562K	-	5.6K, 10%, 1/4 w
R19	Resistor	RC07GF683K	-	68K, 10%, 1/4 w
R2	Resistor	RC20GF152K	-	1.5K, 10%, 1/2 w
R20	Resistor	RC07GF333K	-	33K, 10%, 1/4 w
R21	Resistor	RC07GF472J	-	4.7K, 5%, 1/4 w
R22	Resistor	RC07GF183K	-	18K, 10%, 1/4 w
R23	Resistor	RC07GF683K	-	68K, 10%, 1/4 w
R24	Resistor	RC07GF392J	-	3.9K, 5%, 1/4 w
R25	Resistor	RC07GF272K	-	2.7K, 10%, 1/4 w
R26	Resistor	RC07GF102K	-	1K, 10%, 1/4 w
R27	Resistor	RC07GF562K	-	5.6K, 10%, 1/4 w
R28	Resistor	RC07GF823K	-	82K, 10%, 1/4 w
R29	Resistor	RC07GF563K	-	56K, 10%, 1/4 w
R3	Resistor	RN55C1001F	-	1K, 1%, 1/10 w temp coeff ± 50 ppm/ ^{o}C max
R30	Resistor	RC07GF183K	-	18K, 10%, 1/4 w
R31, R32, R33	Resistor	RC07GF562K	-	5.6K, 10%, 1/4 w
R34	Resistor	RC07GF832K	-	82K, 10%, 1/4 w
R35	Resistor	RC07GF272K	-	2.7K, 10%, 1/4 w
R36 and R37	Resistor	RC07GF683K	-	68K, 10%, 1/4 w
R38	Resistor	AS1	35009	560 ohms, 1%, 1 w
R39	Resistor	RC07GF221K	-	220 ohms, 10%, 1/4 w
R4	Potentiometer	502-00S	65092	1K ± 5%, .6 w at 70^{o}C
R40	Resistor	RS1A	35005	560 ohms, 1%, 1 w
R41	Resistor	RC07GF221K	-	220 ohms, 10%, 1/4 w

Reference Designation	Description	Part Number	Vendor Code	Type or Value
R42 and R43	Resistor	RC07GF560K	-	56 ohms, 10%, 1/4 w
R5	Resistor	RN55C1001F	-	1K, 1%, 1/10 w temp coeff ± 50 ppm/ °C max
R6	Resistor	RC07GF103J	-	10K, 5%, 1/4 w
R7	Resistor	RC07GF680K	-	68 ohms, 10%, 1/4 w
R8	Resistor	RN55C2212F	-	22.1K, 1%, 1/10 w temp coeff ± 50 ppm/ °C max
R9	Resistor	RC07GF223K	-	22K, 10%, 1/4 w
T1 and T2	Transformer, Driver	5590C5-1	36480	-
T3	Transformer, Output	5590C6-1	36480	-
VDR1 and VDR2	Voltage Dependent Resistor	E299DD/P230	-	33V ± 20% at 10 ma 8 watts, 14.5 mm diam.

SECTION 5

ILLUSTRATIONS



NOTES:

1 ⑧ SYMBOL INDICATES TERMINALS ON CAPACITOR (LOWER) COMPONENT BOARD P/N 5590D4 - 1

2 INTERCONNECTING WIRE TO BE STRANDED TEFLON COVERED EQUIVALENT TO MIL-W-16878 TYPE E OR EE. SIZES AND COLORS AS SHOWN

Figure 5-1. Static Power Inverter, SPS-48, Schematic Diagram

TRW Aeronautical Systems, Lucas Aerospace

OVERHAUL MANUAL WITH ILLUSTRATED PARTS LIST

DC STARTER-GENERATOR 23048 SERIES 23048-001A, 23048-004, 23048-004T, 23048-004M, 23048-004TM, 23048-006, 23048-008, 23048-012, 23048-014, 23048-015, 23048-016, 23048-017, 23048-018, 23048-020, 23048-021, 23048-022, 23048-023, 23048-027 23048-028

Revision 16 Dec 15/00
Original Issue December 15, 1964

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Service Bulletin Number	Status	Rev	Date Issued	Service Bulletin Number	Status	Rev	Date Issued
23048-06	incorporated	N/C	4/20/81				
23048-07	incorporated	N/C	7/17/84				
23048-0XX-24-01	invalid	1	4/1/94				
223048-0XX-24-02	incorporated	N/C	4/12/94				
23048-0XX-24-03	incorporated	1	1/24/00				

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INTRODUCTION

1. Purpose

This Component Maintenance Manual (CMM) provides detailed instructions for the servicing of TRW Aeronautical Systems, Lucas Aerospace 23048 Series of DC Starter-Generators. Servicing of a DC Starter-Generator is dependent upon the extent of disassembly and repair instructions listed herein:

(1) Replacement of non-reusable parts such as bearings and miscellaneous hardware.

(2) Cleaning of subassemblies.

(3) Detailed inspection of parts, electrical check of all electromagnetic parts (including; insulation integrity check), Non-Destructive Test (NDT) inspections, and complete acceptance testing.

(4) Reconditioning of housing finishes as required.

(5) Repair/rework of parts as required.

(6) Recertification including final assembly, records, and release tags.

Servicing or selected equipment repairs do not affect the Technical Standards Order (TSO) and the equipment is released on a continue time basis.

An illustrated parts list is included at the back of this CMM for component identification and ordering of approved replacement parts. The structure and content of this manual is in general accordance with the requirements established by the Air Transportation Association (ATA) for aircraft CMMs. This manual is formatted to conform to iSpec 2200 (ATA Specification 2200) Information Standards for Aircraft Maintenance.

Your are advised to become thoroughly familiar with the equipment and the contents of this CMM. Give careful attention to applicable warnings and cautions. Before performing any servicing procedure, become thoroughly familiar with the capabilities and limitations of the equipment. Make sure all necessary safety equipment, test equipment, repair materials, special tools, and fixtures are on hand.

If you find an error, omission, or other technical discrepancy, please fill out a copy of the Technical Publication Comment Form found at the back of this manual and send a copy to the Technical Publications Supervisor at TRW Aeronautical Systems, Lucas Aerospace in Aurora, Ohio.

2. User Qualification and Certification Requirements

The information contained in this manual is intended for use by persons properly trained and certified in the repair and service of aircraft electrical accessories. Eligibility and certification of service technicians shall be in accordance with guidelines established by the U.S. Federal Aviation Administration or an equivalent regulatory authority. Refer to U.S. Code of Federal Regulations 14 CFR, parts 65.101 through 65.103 and part 145.33.

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Where special processes are included by reference to military or commercial standards, the qualifications and certification of personnel performing the process shall be as indicated in the cited standard. Strictly follow the detailed requirements of all cited military or commercial standards used in the repair of this equipment.

3. Quality Assurance Requirements

The repair station's quality assurance activity is responsible for the correct performance of all tests and inspections specified in this manual. The quality assurance activity shall also be responsible for maintaining all necessary test, inspection, and maintenance records for each unit received for service.

All instrumentation and inspection equipment used shall be calibrated and controlled in accordance with ISO 10012-1, with all standards traceable to the National Bureau of Standards or an equivalent standards regulatory authority.

The quality assurance activity shall be responsible for certifying that personnel, skills, and materials meet the requirements of the work to be performed. Components of the generator undergoing servicing that are recovered as products of disassembly shall be examined 100% to determine serviceability.

The quality assurance activity shall maintain documented evidence that specifications applicable to special processes such as soldering, non-destructive testing, plating, etc.; have been complied with during servicing and/or repair of the generator.

4. Safety Advisory

This manual describes physical and chemical processes that require the use of chemicals or other commercially available materials that require precautionary attention.

The user of this manual should obtain material safety data sheets and Occupational Safety and Health Act (OSHA) Form 20 or equivalent from the manufacturers or suppliers of materials to be used. The user must become completely familiar with and follow all manufacturer/supplier procedures, recommendations, warnings, and cautions for the safe use, handling, storage, and disposal of the materials. User of this manual are also advised to refer to applicable safety information contained in the "NIOSH Occupational Guideline for Chemical Hazards" published by the United States Department of Labor.

WARNING: **ALERT OPERATING AND MAINTENANCE PERSONNEL TO POTENTIAL HAZARDS THAT COULD RESULT IN PERSONAL INJURY; THEY DO NOT REPLACE THE MANUFACTURER'S RECOMMENDATIONS.**

CAUTION: Alert operating and maintenance personnel to conditions that could result in equipment damage.

5. Materials List

The materials listed in this paragraph are required for processes throughout this manual. Warnings and/or cautions will precede the use of the materials listed in Table 1.

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WARNING: BEFORE HANDLING ANY OF THE FOLLOWING MATERIALS, BE AWARE OF ALL HANDLING, STORAGE, AND DISPOSAL PRECAUTIONS RECOMMENDED BY THE MANUFACTURER OR SUPPLIER. FAILURE TO COMPLY WITH MANUFACTURER OR SUPPLIER RECOMMENDATIONS CAN RESULT IN SERIOUS INJURY, PHYSICAL DISORDER, OR DEATH.

Material	Used in...
Chem film, chromate	REPAIR, ASSEMBLY
Cleaning solvent	CLEANING, ASSEMBLY
Isopropyl alcohol	CLEANING, CHECK, REPAIR, ASSEMBLY
Lubricating oil	ASSEMBLY
Thread locking compound	REPAIR, ASSEMBLY
Trichloroethane	CLEANING, ASSEMBLY
Zinc chromate primer	REPAIR, ASSEMBLY

Table i - Hazardous Materials

6. Non-TRW Aeronautical Systems, Lucas Aerospace Authorized Components and Processes Policy

TRW Aeronautical Systems, Lucas Aerospace authorizes the use of genuine TRW Aeronautical Systems, Lucas Aerospace spare parts which meet engineering design specifications and quality standards, and have traceability to having been procured and certified to these specifications by the TRW Aeronautical Systems, Lucas Aerospace, Aurora Quality Assurance incoming and inprocess inspection systems. The TRW Aeronautical Systems, Lucas Aerospace Equipment Service Centers are the only authorized distributors of genuine TRW Aeronautical Systems, Lucas Aerospace replacement parts and complete units.

It is the obligation of all repair and service facilities to provide the FAA, or any other in-country air authority, with proper traceability documentation indicating approval of all spare parts, materials, and processes to ensure configuration compliance and continued air worthiness.

The use of any non-TRW Aeronautical Systems, Lucas Aerospace parts, or any parts not having been submitted to TRW Aeronautical Systems, Lucas Aerospace Quality Assurance inspection systems will invalidate any and all factory warranties. All TRW Aeronautical Systems, Lucas Aerospace warranties are automatically voided on any TRW Aeronautical Systems, Lucas Aerospace designed unit that has been modified by the installation of any unauthorized parts, materials, or unapproved processes supplied by other outside services. The repair station's quality assurance activity shall assume produce liability for all units that have been modified in this fashion.

Damage resulting from the use of non-TRW Aeronautical Systems, Lucas Aerospace, replacement parts, materials, or processes is not covered by the warranty or service policy for any product or any application.

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7. Abbreviations & Acronyms

The following is a list of the abbreviations & acronyms used in this document.

A	Ampere
AC	Alternating Current
AR	As Required
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
AWG	American Wire Gauge
C	Centigrade
CMM	Component Maintenance Manual
DC	Direct Current
F	Farenheight
FAA	Federal Aviation Administration
Hz	Hertz
in. lbs	Inch pounds
IPL	Illustrated Parts List
ISO	International Organization for Standardization
IAW	In Accordance With
kg	Kilograms
kPa	Kilopascals
L	Liter
lbs	Pounds
MIL	Military Specification
mm	Millimeter
MS	Military Standard
NA	Not Applicable

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NAS	National Aerospace Standard
Nm	Newton-meters
NPT	National Pipe Thread
OSHA	Occupational Safety and Health Administration
P/N	Part Number
psig	Pounds per Square Inch Gauge
QAD	Quick Attach-Detach
RF	Reference
rms	Root Mean Square
rpm	Revolutions Per Minute
SI	Systeme Internationale
SPD	Standard Practice Document
STD	Standard
TSO	Time Since Overhaul
V	Volt or Voltage

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DESCRIPTION AND OPERATION

1. Equipment Description

The 23048 series of DC Starter-Generators are designed to provide torque for engine starting and to generate 30 volts DC electrical power. Refer to the ILLUSTRATED PARTS LIST section for an illustration and parts breakdown of the Starter-Generator.

The 23048 DC Starter-Generator is an air-cooled, self-excited, brush-type unit that consists of a stator and housing assembly incorporating four main poles and four interpoles, an armature assembly attached to a dampening type drive shaft, end bell bearing supports, brush assembly, fan assembly, and terminal block assembly.

The drive shaft is splined on both ends; at the drive end for engaging the engine gearbox, and at the anti-drive end for coupling to the armature shaft. The anti-drive end also contains a mounting surface and threaded end for attaching the fan assembly. The drive shaft is provided in either dry or wet spline styles depending on the starter-generator model; the wet spline style uses a preformed packing on the drive end spline. The drive shaft and attached armature assembly are supported by bearings mounted in the in the drive and anti-drive end bells. At the drive end of the drive shaft is a clutch-type dampener assembly that absorbs torsional vibration generated by changes in engine gearbox speed and electrical load conditions.

Electrical connection to the Starter-Generator is made at the terminal block assembly. Internally, electrical power passes through the armature and stators via a radio noise filter in the terminal block assembly and the commutator brush assemblies attached to the anti-drive end bell.

Unit cooling at all rated conditions is achieved by either of two methods: (1) by air blast with supplemental air provided by the fan assembly at the the anti-drive end, or (2) by self-cooling with the air provided by the fan assembly. The fan is protected by a screen cover on self-cooled models..

The Starter-Generator is mounted on the engine mounting pad by using an appropriate Quick Attach-Detach (QAD) kit, as specified in the ILLUSTRATED PARTS LIST. The QAD kit, which consists of a drive-end pad end-bell and a rim clenching clamp, is only supplied with certain models of the Starter-Generator. For all other models, the QAD kit must be ordered separately.

2. Operation

CAUTION: The starter function should not be activated for more than the few seconds needed for a normal engine start. Large start currents and long start times create excessive temperatures that can damage the Starter-Generator.

When used as an engine starter, the Starter-Generator can be energized either by batteries or by ground-power units. The Starter-Generator uses a series starting field that should only be be activated with the shunt field de-energized.

When operating as a generator, the Starter-Generator provides rated DC output at a rotational speeds within the rated speed range.

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The generator will operate satisfactorily with either a carbon-pile or static type regulator conforming to BuWep Drawing E-1597-1 and MIL-R-6809. A reverse-current relay is normally used for automatically disconnecting the generator from the load bus, if generator voltage drops below a pre-determined minimum.

Electrical and mechanical characteristics of the 23048 series of DC Starter-Generators are provided in Tables 1 and 2.

Characteristics	Specification
Rated Power Output	6.0 kW (200 Amp models), 7.5 kW (250 Amp models)
Rated Voltage	30 VDC nominal; 26-30 VDC over speed range
Speed Range:	See Table 2.
Continuous Load in Speed Range	See Table 2.
Operating Altitude	35,000 ft. (10.668 km) maximum
Cooling	Blast air with fan supplement (all except self-cooled models) Self-cooled (23048-004, 23048-008, 23048-012, 23048-014, 23048-015, 23048-018 only)
Air Opening (Diameter)	3.0 in. (114.3 mm) - Blast air cooled models 5.2 in. (132.1 mm) - Self-cooled models
Direction of Rotation	Counterclockwise (viewing drive-end)
Weight (Less QAD kit)	See Table 2.
Overhung Moment	See Table 2.
Mounting Pad	AND 10261 XI-B, AND 10262 Type XII-A, or MS3331-1. See IPL for appropriate QAD mounting kit.
Drive Spline	12 Teeth; 0.600 in. pitch diameter (all except 23048-023) 16 Teeth; 0.800 in. pitch diameter (23048-023 only)
Terminal Designations: B + E – A + D C +	Positive Negative Positive field Equalizer Starting
External Start Power	28 VDC, 800 A max. - (All except 1000 Amp models) 28 VDC, 1000 A max. -(23048-018, 23048-021, 23048-023, 23048-027, 23048-028)
Overall Length (Less spline drive)	See Table 2.
Housing Diameter (over clamp)	6.22 in (157.98 mm).

Table 1 - Equipment Specifications

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23048 Model (*QAD Kit included)	Speed Range	Load	Overhung Moment In-Lb (Nm)	Overall Length In. (mm)	Weight Lbs (Kg)
23048-001	5800-12000	200	150 (16.95)	11.65 (295.91)	33.0 (12.32)
23048-004 (All)	5800-12000	200	138 (15.59)	10.26 (193.55)	30.5 (11.38)
23048-006	5800-12000	200	150 (16.95)	11.65 (295.91)	31.9 (11.91)
23048-008	5800-12000	200	138 (15.59)	10.26 (193.55)	30.5 (11.38)
23048-012	6200-12000	250	140 (15.82)	10.55 (267.97)	31.6 (11.79)
23048-014	6200-12000	250	140 (15.82)	10.55 (267.97)	30.5 (11.38
23048-015	6200-12000	250	140 (15.82)	10.55 (267.97)	30.5 (11.38)
23048-016	6200-12000	250	150 (16.95)	10.55 (267.97)	31.2 (11.65)
23048-017	6200-12000	250	158.7 (17.93)	11.65 (295.91)	32.1 (11.98)
23048-018	6200-12000	250	148 (16.72)	10.55 (267.97)	31.1 (11.61)
23048-020	6200-12000	250	159.7 (18.05)	11.65 (295.91)	32.1 (11.98)
23048-021	6200-12000	250	154 (17.40)	10.55 (267.97)	31.2 (11.65)
23048-022	6200-12000	250	150 (16.95)	11.65 (295.91)	33.0 (12.32)
23048-023	6200-12000	250	148 (16.72)	10.55 (267.97)	31.2 (11.65)
23048-027*	6200-12000	250	154 (17.40)	10.55 (267.97)	31.2 (11.65)
23048-028	6200-12000	250	154 (17.40)	10.55 (267.97)	31.2 (11.65)

Table 2 - Equipment Specification Details

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TESTING AND FAULT ISOLATION

1. Introduction

The procedures provided in this section are performance tests and are classified as either verification tests or acceptance tests. A verification test is conducted to assist in fault isolation or to confirm the cause for removal before the repair or overhaul of the DC Starter-Generator. An acceptance test is conducted after the repair or overhaul of the unit. Record all test results on a photocopy of the data sheet(s) provided at the end of this section.

Verification Testing: A starter-generator requiring confirmation of the cause for removal or qualification for continued service must be inspected as detailed in paragraph 3 of the CHECK section before testing can begin. A unit that passes initial inspections may be tested in accordance with this section to determine performance or to isolate a particular fault. When a fault is identified during testing, refer to the fault isolation tables in this section to determine the probable cause.

Acceptance Testing: A unit that has been overhauled or repaired and is ready to be returned to service must be tested in accordance with this section to verify minimum performance standards. Only when an acceptance test is fully completed, and in the order presented in this section, can zero operating hours time since overhaul (TSO) be assigned to an overhauled unit.

2. Test Conditions

Parameter	Operating Condition
Ambient Temperature	50° to 104°F (10° to 40°C)
Barometric Pressure	27 to 33 in. (690 to 840 mm) of mercury
Mounting	Drive shaft (rotational axis) horizontal
Forced Air Cooling is required for models: 23048-001, 23048-006, 23048-017, 23048-020, 23048-022, 23048-012*, 23048-014*, 23048-015*, 23048-016*, 23048-018*, 23048-021*, 23048-023*, 23048-027*, 23048-028*	Cooling air shall be supplied through a tube that is straight for a length of 3 ft. (0.9 m) and has an inner diameter of: 3.0 in. (76.2 mm) (models without asterisks) or 5.2 in. (132.1 mm) (models with asterisks).

Table 1001 - Performance Test Conditions

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Parameter	Operating Condition
Models 23048-004/M/T/TM and 23048-008 are self-cooled	A static pressure of 6.0 in/H_2O, measured 12 in. (305 mm) upstream from the air inlet, is required for all models except models 23048-001 and 23048-006), which require 0.5 in/H_2O static pressure.
Brush Seating NOTE: Refer to REPAIR Section for brush seating procedures. Careful brush sanding ensures that all brushes are in proper contact with commutator, and makes prolonged running prior to test unnecessary	Before test measurements are made: For all models, brushes shall be seated 100% in the direction of rotation. For all models except 23048 -017, 23048-020, and 23048-022, brushes shall be seated at least 90% in the axial direction. For models 23048-017, 23048-020, and 23048-022, brushes shall be seated at least 75% in the axial direction..

Table 1001 - Performance Test Conditions (Continued)

WARNING: DURING GENERATOR OPERATION, THE STARTER- GENERATOR CAN PRODUCE A HIGH OUTPUT CURRENT THAT CAN CAUSE SEVERE SHOCK OR DEATH. MAKE SURE ALL POWER IS SHUT OFF TO THE STARTER-GENERATOR BEFORE REMOVING OR REPLACING TEST EQUIPMENT, INSTRUMENTS, OR ASSEMBLIES. TAKE EXTREME CARE WHEN PERFORMING "LIVE CIRCUIT" TESTS AND FAULT ISOLATION PROCEDURES.

3. Required Test Equipment

Use instruments with accuracy and calibration in compliance with ISO-10012-1.

Equipment Type (Quantity)	Range and Accuracy or Equipment Rating	Generator Test Wiring Diagram Reference
Ammeter, DC (1)	0-500A	DC Ammeter
Drive Test Stand	Capable of driving starter-generator 5500 to 14,000 rpm, and suitable metering to measure speed, voltage, current, and temperature	
HI-Pot Tester(1)	250 VAC rms, 50/60 Hz	
Load Bank, Variable	30 V, 0-160 A	Load Bank
Ohmmeter (1)		

Table 1002 - Test Equipment Requirements and Specifications

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Equipment Type (Quantity)	Range and Accuracy or Equipment Rating	Generator Test Wiring Diagram Reference
Power Supply, DC, Variable (1)	0-30 VDC	Power Supply
QAD Mounting Kit	(See IPL for appropraite kit no.)	
Regulator		Regulator
Resistor	1.25 Ohm,	
Shunt , Precision (1)	100 V	
Starter Test Stand	Capable of measuring a locked rotor torque of 20 lb-ft and having a power supply capacity of not less than 500 amperes at 13 VDC.	
Voltmeter, DC (1)	0-3 V	DC Voltmeter, 0-3
Voltmeter, DC (1)	0-30 V	DC Voltmeter, 0-30
Commutation Viewing Adapter		Figure 9007

Table 1002 - Test Equipment Requirements and Specifications (Continued)

4. Test Preparation

Unless otherwise specified, numbers in parentheses () refer to item numbers given in Figure 10001 of the ILLUSTRATED PARTS LIST.

A. Perform an initial inspection.

Perform an initial inspection of the starter-generator in a brightly lit work area to determine its overall condition. Parameters for this initial inspection are given in the CHECK section.

B. Install the starter-generator onto the drive stand.

(1) Turn off all power to the drive stand.

(2) Install the appropriate QAD kit mounting adapter onto the drive stand. Refer to the ILLUSTRATED PARTS LIST for the kit number required.

(3) While supporting the anti-drive end of the starter-generator, align and install the drive end to the mounting adapter.

(4) Make sure that the drive stand and the starter-generator mating splines are correctly engaged.

(5) Install the rim clenching clamp and tighten the self-locking hex nut to 70 in. lbs. (7.9 Nm).

(6) Replace the brush cover IPL 10001 (50) with the Commutation Viewing Adapter, Figure 9007.

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(7) Connect cooling equipment for all models requiring external cooling. See Table 1001.

(8) Connect the starter-generator to the test circuit as shown in Figure 1001.

(9) Figure 1002 shows, in schematic diagram form, the electrical connections to the starter-generator.

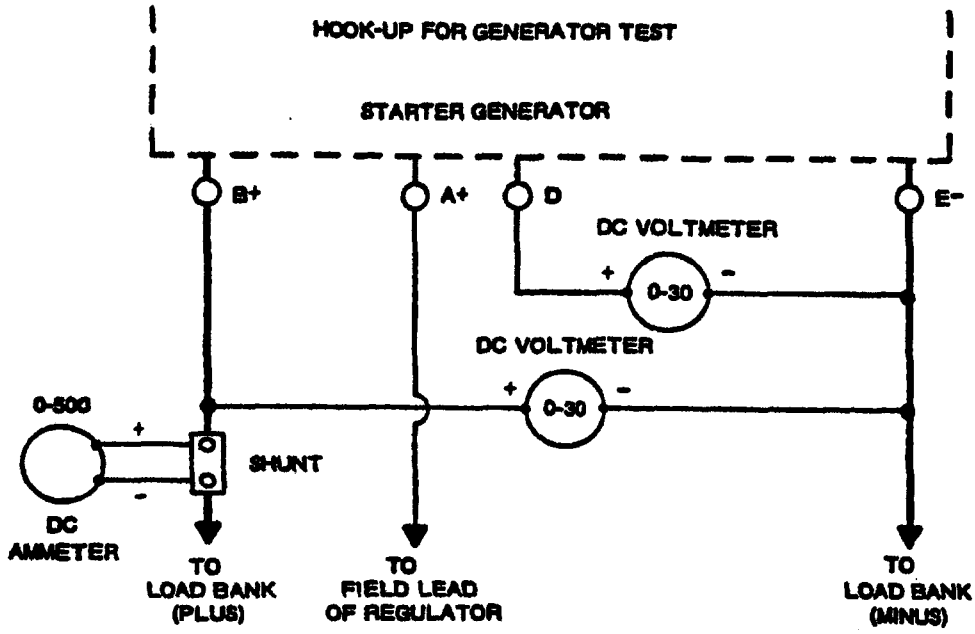


Figure 1001 - 23048 Series DC Starter-Generator Test Set-Up

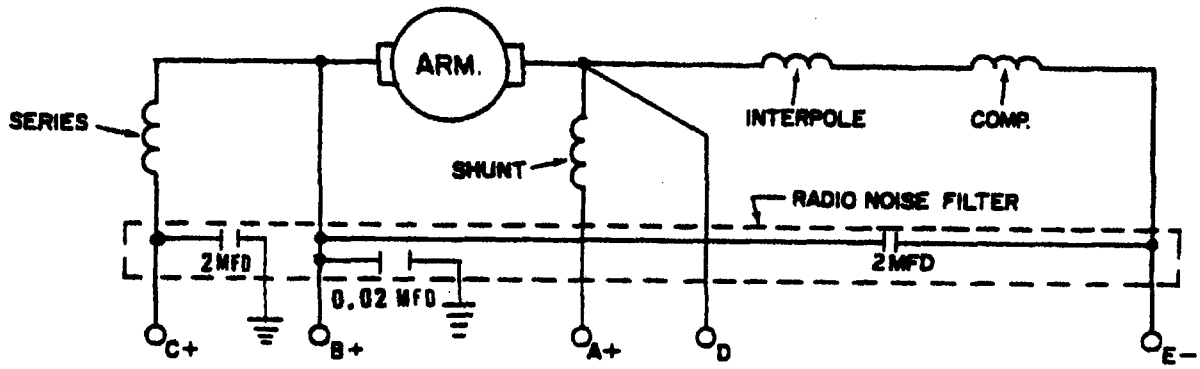


Figure 1002 - Electrical Connections

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5. Test Procedures

This paragraph contains the required performance tests and the sequence in which they are to be accomplished.

WARNING: DURING OPERATION, THE STARTER-GENERATOR PRODUCES A VERY HIGH AMPERAGE OUTPUT THAT CAN CAUSE SEVERE SHOCK OR DEATH. MAKE SURE THAT ALL POWER IS SHUT OFF TO THE STARTER-GENERATOR BEFORE REMOVING OR REPLACING COMPONENTS OR ASSEMBLIES. TAKE EXTREME CARE WHEN PERFORMING "LIVE" CIRCUIT TESTS AND TROUBLESHOOTING PROCEDURES.

A. Maximum Speed for Regulation (All models except 23048-017, 23048-020, 23048-022).

NOTE: Perform this test without operational warm-up.

(1) With regulator connected to the starter-generator, operate the starter-generator self-excited with no load, at 13,000 rpm and 30 VDC.

(2) Record the following:

- field current
- commutation
- frame temerature

(3) Shunt field current shall not be less than 0.81 amperes.

(4) Commutation shall be black.

B. Maximum Speed for Regulation (Models 23048-017, 23048-020, 23048-022 only).

NOTE: Perform this test without operational warm-up.

(1) With regulator connected to the starter-generator, operate the starter-generator self-excited with no load, at 13,000 rpm and 30 VDC.

(2) Record the following:

- field current
- B to A voltage
- commutation

(3) Calculate resistance between terminals B and A.

$$\text{B to A Resistance} = \frac{\text{B to A Voltage}}{\text{Field Current}}$$

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(4) B to A resistance shall not be greater than 35 ohms.

(5) Commutation shall be black.

C. Continuous Operating Speed and Equalizing Voltage.

(1) With regulator connected to the starter-generator, operate the starter-generator self-excited with no load, at the following RPM and voltage until the frame temperature shows no more than 2°F rise in five (5) minutes.

23048 Model	RPM	VDC	Amp Load	D-E Max.
23048-001, 23048-006	12,000	30	200	Fig. 1003
23048 -004/M/T/TM, 23048-008	12,000	30	200	Fig. 1004
23048-012, 23048-014, 23048-015, 23048-016, 23048-018, 23048-021, 23048-023, 23048-027 and 23048-028	12,000	30	250	Fig. 1005
23048-017	12,000	30	250	Fig. 1006
23048-020	12,000	30	250	Fig. 1007
23048-022	12,000	30	250	Fig. 1008

(2) Record the following

- voltage between terminals D and E,
- field current
- air inlet temperature,
- winding or frame temperature.

(3) Frame temperature shall not exceed air inlet temperature by more than 175 °F (97.2 °C).

(4) The equalizing voltage between terminals D and E shall be a value between lines in figures referenced in table above.

NOTE: In Figures 1003 thru 1008, the left-most graph line is minimum range and the right-most line is maximum range. An acceptable voltage falls between the two lines on the graph.

(5) Commutation should be no more than pinpoints on the edges of the brushes.

(6) If voltage is not within the limits, refer to Table 1009, Fault Isolation Table for possible remedies.

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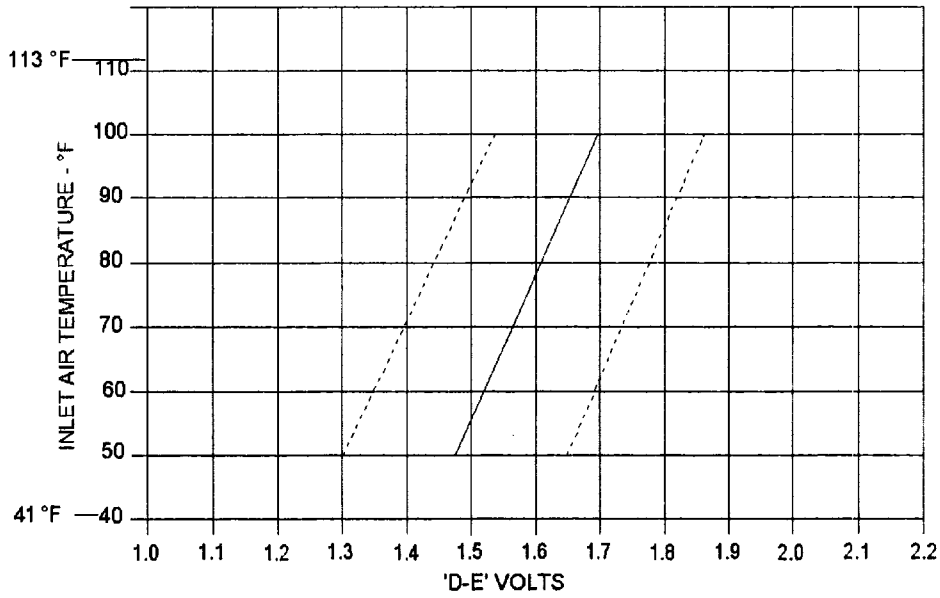


Figure 1003 - Equalizing Voltage (Models 23048-001 and 23048-006)

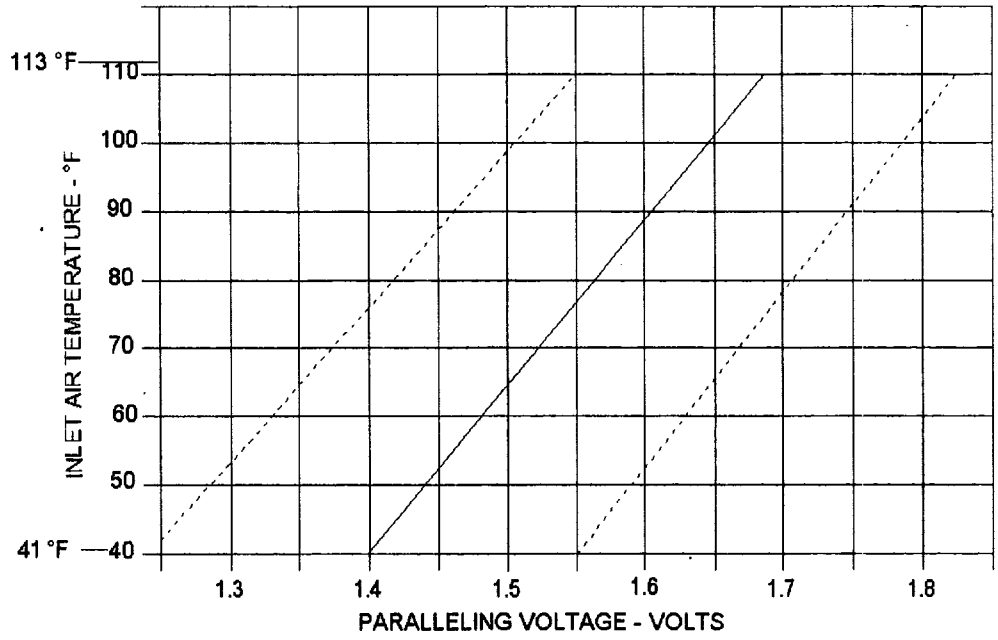


Figure 1004 - Equalizing Voltage (Models 23048-004 and 23048-008)

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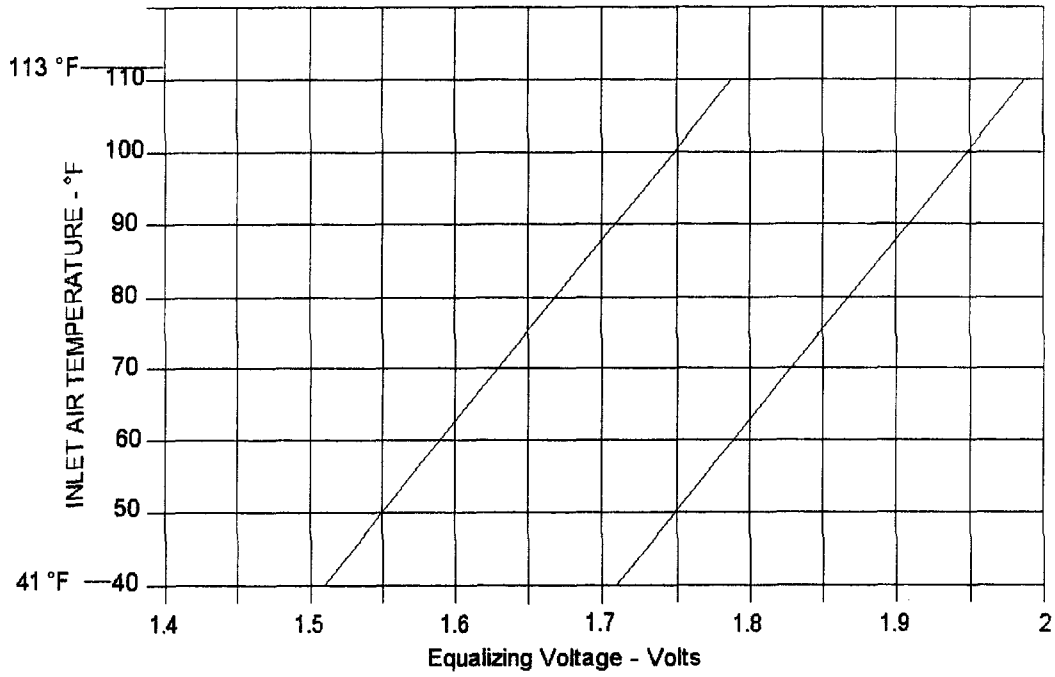


Figure 1005 - Equalizing Voltage (Models 23048-012, 23048-014, 23048-015, 23048-016, 23048-018, 23048-021, 23048-023, 23048-027 and 23048-028)

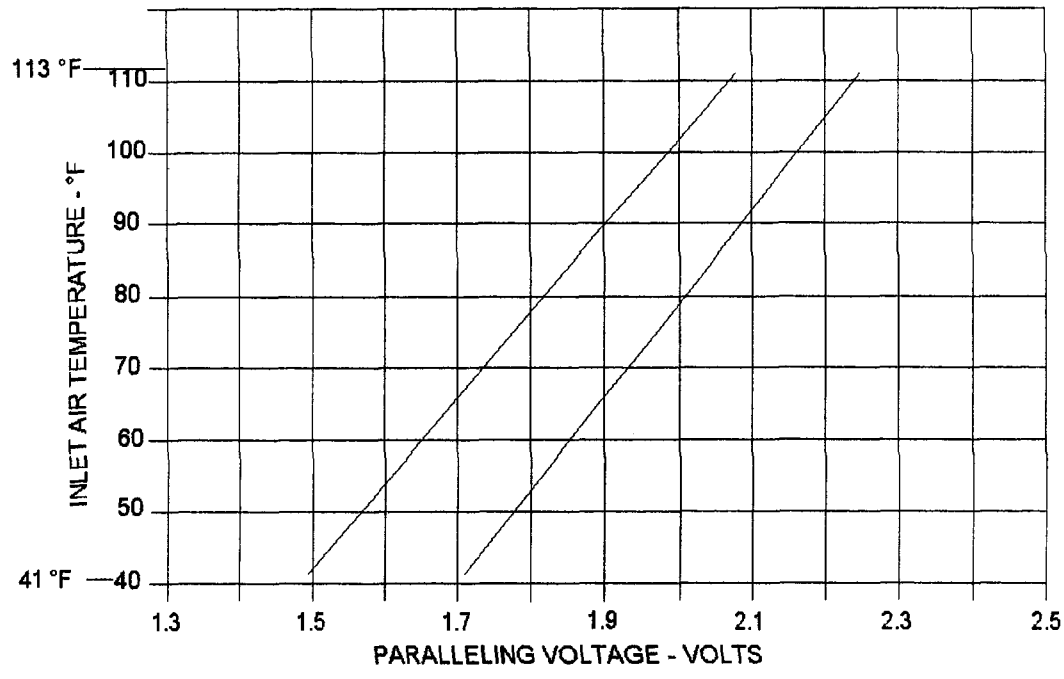


Figure 1006 - Equalizing Voltage (Model 23048-017)

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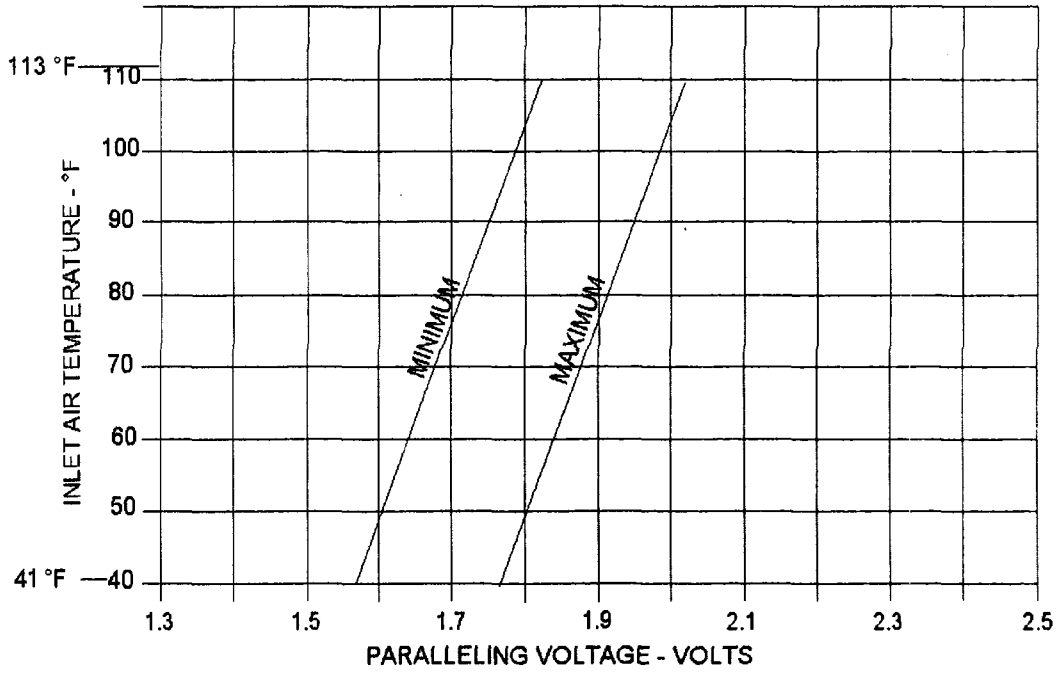


Figure 1007 - Equalizing Voltage (Model 23048-020)

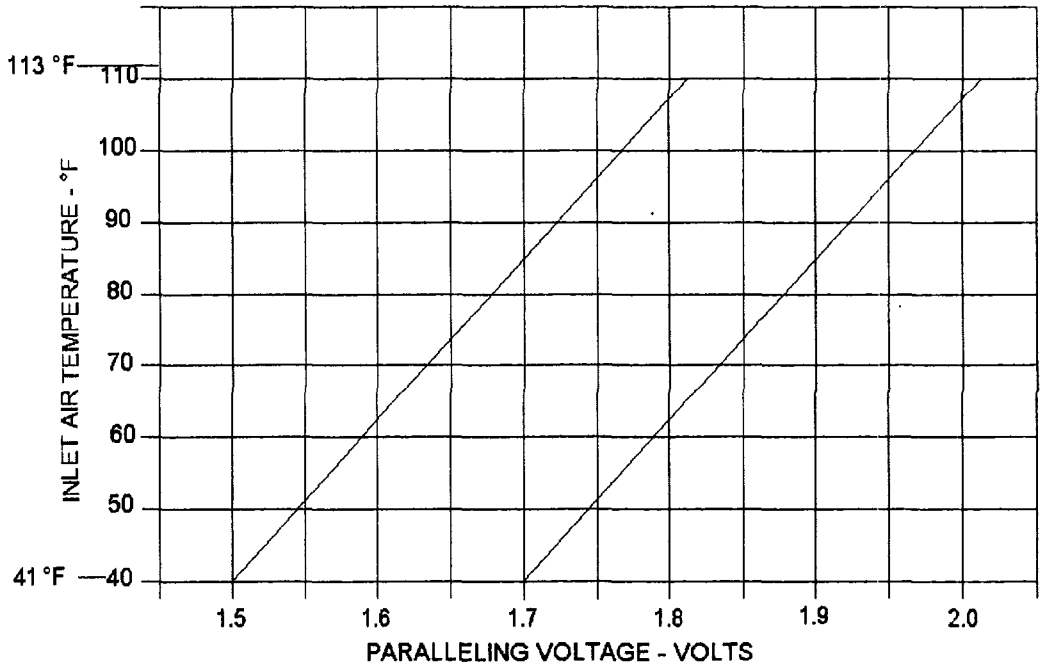


Figure 1008 - Equalizing Voltage (Model 23048-022)

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D. Compounding.

(1) Operate starter-generator with the regulator connected, at the following RPM and voltage.

Model	RPM	VDC	Ampere Loads
23048-001, 23048-004/M/T/TM, 23048-006, 23048-008	12,000	30	0, 50, 100, 150, 200
23048-012, 23048-014, 23048-015, 23048-016, 23048-018, 23048-021, 23048-023, 23048-027, 23048-028	NA	NA	NA
23048-017, 23048-020, 23048-022	12,000	30	0, 62.5, 125, 187.5, 250

(2) Apply ampere loads as noted in the table above

(3) Record field current for each load.

(4) Field current must rise with increasing load.

(5) Commutation shall not exceed pinpoint sparking.

E. Minimum Speed for Regulation.

(1) Disconnect forced air supply tube, if used.

(2) Operate the starter-generator for 15 minutes with no load, at the following RPM, voltage, and ampere load (stabilization not required).

Model	RPM	VDC	Amp Load
23048-001, 23048-004/M/T/TM, 23048-006, 23048-008	6500	30	200
All others except 23048-17, 23048-20, 23048-22	6900	30	250
23048-17, 23048-20, 23048-22	NA	NA	NA

(3) Record the following:

- field current
- frame temperature
- voltage between B and A

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(4) Field current shall not exceed 8 amperes.

(5) Frame temerature must not exceed air inlet temperature by more than 280°F (155.6°C) for models 23048-012, 23048-014, 23048-015, 23048-016, 23048-018, 23048-021, 23048-023, 23048-027, 23048-028.

(6) Calculate resistance between terminals B and A.

$$\text{B to A Resistance} = \frac{\text{B to A Voltage}}{\text{Field Current}}$$

(7) B to A resistance shall be a minimum of 1.25 ohms.

(8) Commutation shall not exceed pinpoint sparking.

F. Minimum Speed

(1) With regulator connected to the starter-generator, operate the starter-generator self-cooled for 15 minutes, with no load and at the following RPM and voltage.

Model	RPM	VDC	Amp Load
23048-006, 23048-001, 23048-008, 23048-004/M/T/TM, 23048-20	5800	26	200
23048-017	6200	26	200
23048-012, 23048-014, 23048-015, 23048-016, 23048-018, 23048-021, 23048-023, 23048-027, 23048-028	6200	26	250
23048-022	NA	NA	NA

(2) Record the following:

- field current
- frame temperature
- voltage between B and A

(3) Field current shall not exceed 8 amperes.

(4) Calculate resistance between terminals B and A.

$$\text{B to A Resistance} = \frac{\text{B to A Voltage}}{\text{Field Current}}$$

(5) B to A resistance shall be a minimum of 1.25 ohms.

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G. Overspeed Test (Models 23048-001, 23048-004/M/T/TM, 24038-006, 24038-008)

(1) With starter-generator hot and field circuit open, operate at 14,000 RPM for five (5) minutes.

(2) Reduce speed to 12,000 RPM at 30 VDC and 200 amperes.

(3) Record the following:

- field current
- frame temperature
- commutation

(4) Commutation shall not exceed pinpoint sparking.

H. Overspeed Test (All models except 23048-001, 23048-004/M/T/TM, 23048-006, 23048-008)

(1) With starter-generator hot and field circuit open, operate at 14,000 RPM for five (5) minutes.

(2) Reduce speed to 12,000 RPM at 30 VDC and 250 amperes.

(3) Record the following:

- field current
- frame temperature
- commutation

(4) Commutation shall not exceed pinpoint sparking.

I. Commutation Test

(1) With forced air supply and regulator connected, operate the generator at 30 VDC for speeds of 6500, 10,000, and 12,000 RPM, and at the following loads.

(a) 0.0 amps, 100 amps, and 200 amps. (Models 23048-001, 23048-004, 23048-006, 23048-008)

(b) 0.0 amps, 125 amps, and 250 amps. (All other models)

(2) Record the worst condition for commutation.

(3) Commutation shall not exceed pinpoint sparking.

J. Dielectric Test.

This test is to be done only to a clean machine after overhaul.

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WARNING: **FAILURE TO USE NECESSARY SAFETY PRECAUTIONS WHEN HANDLING HIGH VOLTAGE ELECTRICAL EQUIPMENT DURING HIGH POTENTIAL TESTING CAN CAUSE SERIOUS INJURY OR DEATH TO THE OPERATOR.**

CAUTION: Failure to turn OFF the high potential tester power before connecting or disconnecting high voltage electrical leads can cause serious damage to the generator.

CAUTION: Capacitors imbedded in radio noise filters in terminal block will be damaged if subjected to dielectric test. Always disconnect stator leads from terminal block when conducting dielectric test.

(1) Remove power from tester and remove starter-generator from test stand.

(2) Disconnect starter-generator stator leads from starter-generator terminal block.

(3) Reconnect stator leads to a dummy terminal block.

(4) While still hot from testing, conduct a hi-potential-to-ground test as follows.

(a) Test is performed by connecting hi-pot leads between each terminal block terminal and starter-generator frame.

(b) At each terminal, apply 250 VAC rms, 60 Hz to test connection for one minute, or apply 600 VAC rms, 60 Hz for one (1) second.

(c) No evidence of insulation break-down shall occur as a result of this test.

(5) Disconnect dummy terminal block and reconnect stator leads to starter-generator terminal block.

(6) Install starter-generator onto starter test stand.

K. Starter Tests

(1) Remove power from tester.

(2) Connect starter-generator as shown in Figure 1009.

NOTE: Make sure starter-generator is properly mounted by its flange.

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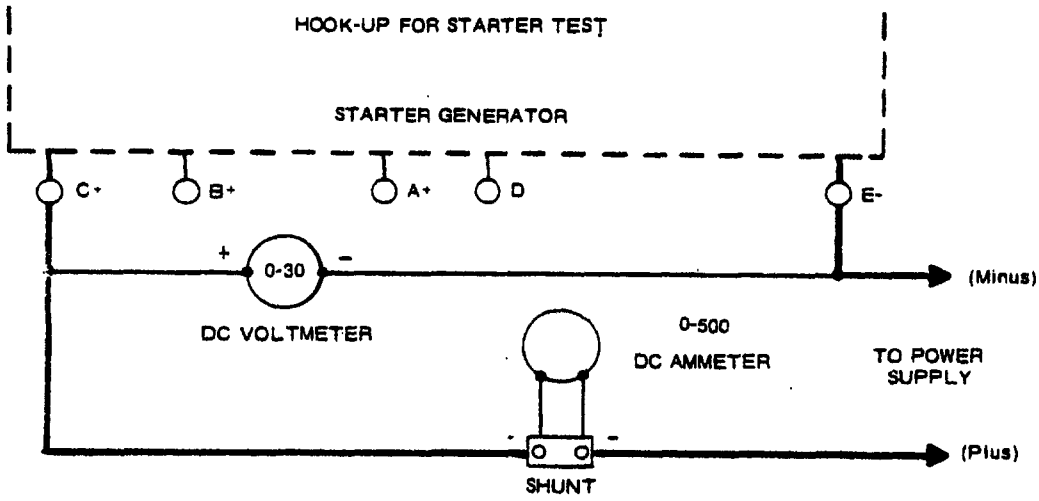


Figure 1009 - Starter Test Set-Up

(3) If applicable in the following table, connect a 1.25 ohm resistor between terminals A and B. Otherwise the A terminal is left open.

(4) Before turning on power supply, set power supply output to minimum.

(5) Turn on power supply.

(6) With no load, gradually increase starter voltage between terminals C and E until voltage reaches values in the following table.

Model	A to B Load Resistor	VDC	Minimum RPM
23048-001, 23048-004/M/T/TM, 23048-006, 23048-008	1.25 Ω	24	3500
23048-012, 23048-014, 23048-015, 23048-016, 23048-017, 23048-020, 23048-021, 23048-022, 23048-023, 23048-027, 23048-028,	None	15	4800

(7) At voltage specified, no-load speed shall be equal to or greater than associated RPM value.

L. Locked Rotor Test

(1) Remove power from tester.

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(2) Make sure the starter-generator is securely mounted on the test stand and the rotor is locked.

NOTE: Shunt field (A+) is must be open (no connection) for this test, except for models 23048-001 and 23048-006, which require a 1.25Ω resistor be placed between the A and B terminals.

(3) If testing a model 23048-001 or 23048-006, install a 1.25Ω resistor between the A and B terminals.

(4) Before turning on power supply, set power supply output to minimum.

(5) Turn on power supply.

NOTE: Do not energize generator for more than five (5) seconds.

(6) With no load, gradually increase voltage between terminals C and E until the output torque is 20 ft-lb.

(7) At 20 ft-lb of torque, C-to-E voltage shall not exceed 13 VDC and current shall not exceed 500 amps.

(8) If testing a model 23048-001 or 23048-006, remove the 1.25Ω resistor between the A and B terminals and repeat steps (6) and (7) with the A terminal open. The test results must be the same.

M. Commutator Run-Out.

(1) Remove test stand power and remove the starter-generator from the test stand.

(2) Rotate armature of starter-generator on its own bearings and record commutator total indicated run-out and the maximum bar-to-bar difference.

(a) Total indicated run-out shall not exceed 0.0008 inch.

(b) Bar-to-bar run-out shall not exceed 0.0002 inch (0,0051 mm).

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6. Fault Isolation Table

Table 1003 lists faults that may occur during acceptance testing, performance testing, or while in service. For each fault, probable causes are listed along with related corrective actions. When a fault is detected, perform the corrective actions necessary to return the starter-generator to a serviceable condition. A complete acceptance test is required after the corrective action is accomplished.

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
Unit fails to operate or does not attain normal speed.	Low voltage power source.	Check the power source to make certain that full voltage is being applied to starter-generator terminals.
	Defective switch in power supply line.	Replace switch.
	Damaged armature.	Replace the armature.
	Short circuited or open stator windings.	Replace the stator and housing assembly.
	Improperly seated brushes.	Check brush seats and accomplish brush seating. Refer to REPAIR section for brush seating instructions.
	Eccentric commutator.	Refinish commutator. Refer to REPAIR section.
Excessive sparking at brushes.	Short circuited or grounded field windings.	Replace stator assembly.
	Excessive clearance in bearings or rough bearing races.	Replace bearings.
	Damaged or eccentric commutator	Refinish commutator. Refer to REPAIR section for commutator refinishing instructions.
	Armature out of balance	Balance or replace armature.
	Short circuit in armature windings.	Replace armature.
	Brushes incorrectly installed with top bevel reversed.	Reverse and reseat brushes. Refer to REPAIR section for brush seating instructions..
	Severe overload or short circuit in electrical system.	Locate and correct fault.

Table 1003 - Fault Isolation Table

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FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
Excessive sparking at brushes. (Continued)	Brushes sticking in holders.	Free-up brushes. Refer to REPAIR section for brush spring tension checks and brush repacement instructions.
	Weak brush springs.	Replace brush springs.
Noisy operation.	Rough bearings.	Replace bearings.
	Scored or worn drive splines.	Replace drive shaft.
	Armature rubbing in stator.	Repair or replace defective parts.
	Fan blades bent and rubbing.	Replace fan assembly.
Unit vibrates.	Unbalanced armature.	Balance or replace armature. Refer to REPAIR section for armature balancing instructions..
	Excessive run-out of armature bearings.	Replace armature bearings.
	Fan blades rubbing or damaged.	Check and replace fan or fan cover if necessary.
Starter-Generator produces full voltage, but with reversed polarity.	Voltmeter leads reversed.	Connect voltmeter correctly. See Figure 1001.
	Residual magnetism in field poles creates wrong polarity.	Flash the field. Refer to REPAIR section for field flashing instructions.
Starter-Generator overheats (frame temperature 175 degrees F. (97.2°C) in excess of inlet air temperature.	Continuous overload or restricted air inlet.	Check electrical test set-up for grounds, etc. Make corrections as necessary. See Figure 1002.
D to E equalizing voltage not within limits specified in 5.C.(4)	Insufficient cooling air.	Check for air inlet temperature as required per Table 1001.
	Air flow obstruction.	Dirt accumulation in generator ducting. Check ducting and generator air inlet.
	Wrong load applied during testing.	Check testing procedure and correct condition.
Starter-generator fails starting test.	Short circuited or open stator winding.	Replace stator and housing assembly.
	Open circuit in armature.	Replace armature.

Table 1003 - Fault Isolation Table (Continued)

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Verification/Final Acceptance Data Sheet

Model Number: 23048 - Inspected by: _____

Serial Number: _____ Date: _____

Inspection/Test	Requirements/Limits	Meas.	Accept	Reject
Visual Inspection	Check for physical damage			
Brush Seating	Brushes shall be seated 100% in the direction of rotation, and at least the percentage (75% or 90%) specified in Table 1001 in the axial direction.			
Max. Speed for Regulation Test (* Models 23048-017, All models except 23048-020, 23048-022 only)	Shunt field current shall not be less than 0.81 A.**	A		
	* B-to-A resistance shall not exceed 35Ω.	Ω		
	Commutation shall be black.			
Continuous Operating Speed and Equaizing Voltage Test	Frame temperature shall not exceed air inlet temperature by more than 175° F (97.2° C).	T		
	Equalizing voltage shall be within the limits specified in para. 5.C.(4).	V T		
Min. Speed for Regulation Test (* Models 23048-012, 23048-014, 23048-015, 23048-016, 23048-018, 23048-021 23048-023, 23048-027, 23048-028 only)	Field current shall not exceed 8.0 A.	A		
	* Frame temerature must not exceed air inlet temperature by more than 280°F (155.6°C).	T		
	(B to A) resistance shall be a minimum of 1.25 Ω.	Ω		
Min. Speed Test	Field current shall not exceed 8.0 A.	A		
	(B to A) resistance shall be a minimum of 1.25 Ω.	Ω		
Compounding	Field current rises as load increases.	A		
Commutation Test	Commutation shall not exceed pinpoints at all test speeds and loads.			
Dielectric Test	No evidence of insulation breakdown.			

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Inspection/Test	Requirements/Limits	Meas.	Accept	Reject
Starter Test (* Models 23048-001, 23048-004/M/T/TM, 23048-006, 23048-008 only)	* At 24 VDC, no load starter speed shall not be less than 3500 rpm.	rpm		
	At 15 VDC, no load starter speed shall not be less than 4800 rpm.	rpm		
Locked Rotor Test	At 20 ft-lb of torque, C-to-E voltage shall not exceed 13 VDC and current shall not exceed 500 amps.	V A		
Commutator Runout	Total indicated runout shall not exceed 0.0008 in. (0.02032 mm)	in. (mm)		
	Bar-to-bar runout shall not exceed 0.0002 in. (0.00508 mm)	in. (mm)		

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SCHEMATICS AND WIRING DIAGRAMS

1. Introduction

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DISASSEMBLY

1. Introduction

This section gives the disassembly instructions for Model 23048 family of DC Starter-Generators. Additional disassembly of major components is not necessary unless further disassembly is indicated in the CHECK or TESTING AND FAULT ISOLATION sections. Do not open or desolder permanent connections unless you need to replace worn, damaged or defective parts.

2. Disassembly Tools

In addition to normal shop tools, the tools and materials listed in Table 3001 are needed for generator disassembly

WARNING: BEFORE USING ANY OF THE FOLLOWING MATERIALS, BE AWARE OF ALL HANDLING, STORAGE, AND DISPOSAL PRECAUTIONS RECOMMENDED BY THE MANUFACTURER OR SUPPLIER. FAILURE TO COMPLY WITH THE RECOMMENDATIONS MAY RESULT IN SERIOUS INJURY, PHYSICAL DISORDER, OR DEATH.

Tool Description	Reference
Arbor press	Not illustrated
Anti-drive end end bell hub support	Figure 9002
Dampener hub driver	Figure 9003
Inner race bearing driver	Figure 9006
Leather or plastic mallet	Commercially available
Retaining ring pliers	Commercially available
Bearing puller	Commercially available
Spline Wrench	Figure 9001
Drive end armature shaft adapter	Figure 9004
Anti-drive end armature shaft adapter	Figure 9005

Table 3001 - Disassembly Tools

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3. Disassembly

The following procedures detail the basic disassembly of the DC Starter-Generator. Numbers in parentheses () refer to item numbers in Figure 10001 of the ILLUSTRATED PARTS LIST unless otherwise specified.

Do not remove the identification plate (345) or decals (335 or 340) unless damaged or unreadable.

Do not disassemble any of the following components unless they are damaged.

- Bearing and brush support assembly (200)
- Drive-end end bell assembly (115)
- Housing and stator assembly (275)

During disassembly, inspect component parts in accordance with procedures in the CHECK section of this manual.

A. If used, remove preformed packing (90) from drive shaft and discard. (Models 23048-016 and 23048-020)

B. If used, remove air inlet assembly (5) and fan cover (25). (Models 23048-001, 23048-006, 23048-017, 23048-020, 23048-022, 23048-027, 23048-028)

(1) Loosen and remove rim clenching clamp (10) and remove air linlet from end bell.

(2) Twist fan cover (25) to unlock and remove from fan.

NOTE: Do not disassemble air inlet unless damaged. Screws (15) and washers (20) allow disassembly of the air inlet.

C. If used, remove fan cover assembly (30). (Models 23048-004/M/T/TM, 23048-008, 23048-012, 23048-014, 23048-015, 23048-016, 23048-018, 23048-021, 23048-023, 23048-027, 23048-028)

(1) Loosen and remove four screws (40) and remove fan cover from end bell.

D. Remove brush cover (50) from housing (275).

(1) Loosen screw (55) and separate from slot.

(2) Slide brush cover off of anti-drive end of unit.

E. Remove brushes (60) from brush holders (255).

(1) Remove four screws (65) that secure brush and field leads.

(2) Remove four brushes (60) from brush holders.

F. Remove fan assembly (70) from drive shaft (85).

(1) Use a suitable spline wrench (Figure 9001) to hold drive shaft (85).

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(2) Remove nut (75) and washer (80).

(3) Remove fan assembly (70) from drive shaft.

G. Remove drive shaft (85) and associated dampener parts.

(1) Tap drive shaft (85) out of driven end of stator and housing assembly by using a plastic or leather hammer.

(2) Remove dampener plate (95) and friction ring (105).

NOTE: Remove dampener hub (100) from drive shaft only if damaged and replacement is necessary.

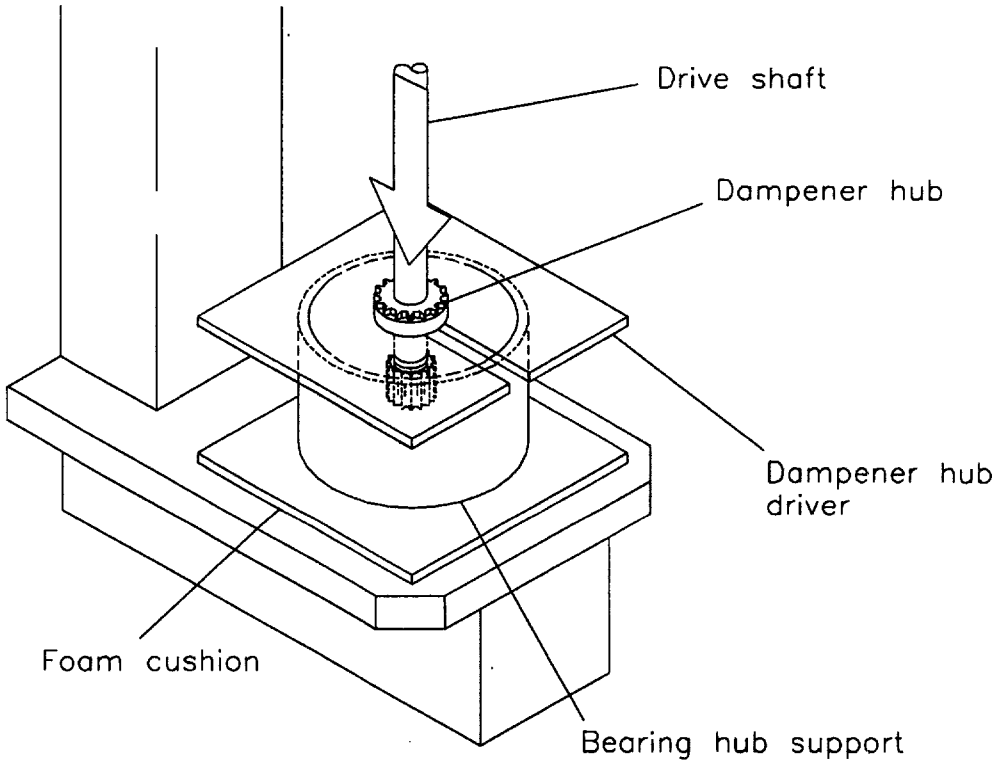


Figure 3001 - Dampener Hub Removal

CAUTION: Put a foam cushion under the drive shaft to prevent the drive shaft from being damaged.

(a) Put a foam cushion and a anti drive end hub support (Figure 9002) on the table of an arbor press.

(b) Position a dampener hub driver (Figure 9003) on the flat side of the dampener hub.

(c) Insert the drive spline through the center of the bearing hub support until the dampener hub driver rests on the bearing hub support.

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(d) Press down gently on the anti-drive end of the drive shaft with the arbor press until the dampener hub disengages from the drive shaft.

CAUTION: Tape jaws of bearing puller to prevent damage to chamfered face of back plate during removal.

Figure 3002 - Dampener Backplate Removal

(3) Using a suitable bearing puller, and drive end armature shaft adapter (Figure 9004) carefully remove dampener back plate (110) from armature shaft.

H. Remove drive-end end bell assembly (150) or (155)).

(1) End Bell (150). Remove eight screws (120), washers (125), and lock washers (130) and carefully remove drive-end end bell assembly from stator and housing assembly (275).

(2) End Bell (155). Remove 12 screws (120) and carefully remove drive-end end bell assembly from stator and housing assembly (275).

(3) If repair of end bell is necessary, remove four drive screws (140), four washers (145), and screen (135) from end bell (105).

I. Remove brush holder support assembly (220).

(1) Remove eight screws (205), washers (210), and lock washers (215).

(2) With armature (175) attached, carefully remove armature and bearing and brush holder support assembly from stator and housing assembly.

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J. Separate and remove support assembly end bell (270) from armature (175)

(1) Using a hub support, place armature, drive end down, into support until bearing and brush support rest on top of support.

(2) Using a anti-drive end armature shaft adapter, (Figure 9005) press armature (175) out of bearing (190).

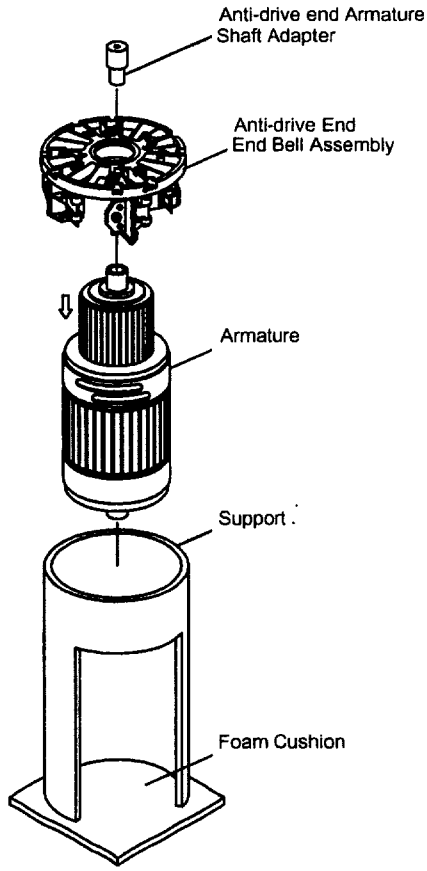


Figure 3003 - Removing the Armature from the Anti-drive End End Bell

K. Disassemble bearing from the armature (175).

(1) At drive end of armature, remove retaining ring (160) and baffle disc (165) from armature shaft.

(2) Using a suitable bearing puller, and drive end armature shaft adapter, remove bearing (170) from armature shaft.

(3) Remove remaining baffle disc (165) from armature shaft.

L. Disassemble brush support assembly (220).

(1) Remove four screws (185) and remove bearing retainer (180).

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(2) Using hub support (Figure 9002) and an inner race bearing driver (Figure 9006), press ball bearing (190) out of end bell (270).

(3) Do not remove brush holder assemblies (255) and springs (245) from support assembly unless inspection reveals that replacement of parts is required. If necessary, disassembly is performed as follows.

NOTE: There are studded and studless styles of brush holder. The studded type contains threaded studs (250) that go through the end bell and are secured with a nut (230) on the fan side of the end bell. The studless type uses a mounting bolt (225) that screws into the brush holder through the end bell.

(a) Remove brush holder assemblies (255) by removing bolts (225) or nuts (230), washers (235), non-metallic washers (240), insulation sleeves (260), and insulation plates (265).

(b) Unclip and remove brush springs (245) from brush holder.

M. Disassemble the stator and housing assembly (275).

NOTE: Do not disassemble stator and housing assembly beyond removing the terminal block assembly (280).

(1) If removal of terminal block (190) is necessary, proceed as follows.

(a) Remove the large terminal stud nuts (300) and washers (305) from terminal studs B, C, and E.

(b) Remove the small terminal stud nuts (310) and washers (315) from terminal studs A and D.

(c) Remove two terminal block mounting bolts (285), washers (290), and lock washers (295).

(d) Carefully disconnect stator lead wires from the terminal block studs and position out of the way to allow removal of the terminal block.

N. If damaged, remove decal (335) or identification plate (345).

(1) Remove plate (345) by removing four drive screws (350).

(2) Remove decal (335) using an appropriate scraper and cleaning gum residue with isopropyl alcohol.

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CLEANING

1. Introduction

This section provides cleaning procedures for the 23048 Series of DC Starter-Generators.

2. Cleaning Materials

WARNING: BEFORE USING ANY OF THE FOLLOWING MATERIALS, BE AWARE OF ALL HANDLING, STORAGE, AND DISPOSAL PRECAUTIONS RECOMMENDED BY THE MANUFACTURER OR SUPPLIER. FAILURE TO COMPLY WITH THE RECOMMENDATIONS MAY RESULT IN SERIOUS INJURY, PHYSICAL DISORDER, OR DEATH.

Table 4001 lists the materials required to clean the generator.

NOTE: Equivalent materials may be used for those listed in Table 4001.

Material	Description/Specification	Source
Brush	Non-metallic, soft bristle	Commercially available
Cleaning pads/Wiping cloths	Lint-free, soft fabric	Commercially available
Detergent Refer to the material technical data sheet for recommended dilution and application temperature.	Formula 815 GD Applications: (1) Hot tanks - aluminum safe (2) Steam cleaning (3) Pressure sprayers (4) Ultrasonic cleaning	The Brulin Corporation Indianapolis, IN
The detergent used must not be destructive to the finish or material of the part.	Formula 1990 GD Application: (1) Spray wash cleaning	The Brulin Corporation Indianapolis, IN
Isopropyl alcohol	TT-I-735, Grade A See the **WARNING** above before using this material. Flash point: 53°F (11.7°C), flammable Refer to the material safety data sheet for the material for additional safety information.	Commercially available

Table 4001 - Cleaning Materials

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Material	Description/Specification	Source
Cleaning solvent	Fed. Spec P-D-680 Type I - Stoddard Solvent Type II - 140°F Solvent See the **WARNING** above before using this material. Flash Point: Type I, 100°F Type II, 138°F Refer to the material safety data sheet for the material for additional safety information.	Commercially available

Table 4001 - Cleaning Materials (Continued)

3. Cleaning Procedures

Before performing the CHECK, REPAIR, ASSEMBLY, acceptance testing, and final inspection procedures, the components of the generator must be cleaned, rinsed, and dried. All signs of moisture, oil, and other contamination must be removed from the internal structure of the generator to make sure all parts and circuits function correctly. Clean the starter-generator according to the following procedures.

WARNING: WHEN USING COMPRESSED AIR FOR CLEANING OR DRYING, DO NOT EXCEED 30 PSIG (207 kPa). WEAR GOGGLES OR A FACE SHIELD TO PROTECT EYES. DO NOT AIM COMPRESSED AIR AGAINST SKIN OR BODILY OPENINGS. CARELESS USE OF COMPRESSED AIR CAN RESULT IN SERIOUS INJURY OR DEATH.

A. Blow out dirt particles.

(1) Put the air inlet, metal dampener components, drive shaft, armature assembly, drive-end and anti-drive-end end bells, and the stator and housing assembly into a ventilated air spray booth.

(2) Blow away all evidence of dirt with clean, dry, compressed air.

B. Clean the parts and assemblies.

(1) With the exception of the armature and the stator and housing, wash the parts using one or more of the approved cleaning procedures outlined in Table 4002.

CAUTION: DO NOT SOAK ALUMINUM OR IVD COATED PARTS FOR MORE THAN 30 MINUTES. A CHEMICAL REACTION MAY RESULT THAT WILL LEAVE THE PART IN AN UNSERVICEABLE CONDITION.

NOTE: Remove brushes before cleaning.

Procedure	Instruction
Spray	**CAUTION:** Make sure to limit the pressure used to clean parts. High pressure may remove or damage surface coatings, connections, and insulation.
	(1) Put the parts into a high pressure spray wash booth.
	(2) Spray the parts with a solution of detergent and water. Refer to the material technical data sheet for the recommended dilution of water and detergent and solution temperature.
Ultrasonic	**CAUTION:** Do not put aluminum parts into an ultrasonic tank. Plating, black oxide coatings, and dimensional tolerances can be damaged by ultrasonic cleaning.
	(1) Put the parts into the ultrasonic cleaning tank.
	(2) Allow the parts to soak for 15 to 20 minutes maximum. NOTE: Restrict immersion time of armature and stator to 10 minutes.
	(3) Remove all evidence of dirt with a soft bristle brush or cleaning rag.
Agitation	(1) Put all the parts in an agitation tank. NOTE: Restrict immersion time of armature and stator to 10 minutes.
	(2) Agitate until all evidence of dirt can be removed from the parts with a soft bristle brush or cleaning rag.
Soak	(1) Put all the parts into a soaking tank. NOTE: Restrict immersion time of armature and stator to 10 minutes.
	(2) Soak the parts until all evidence of dirt can be removed with a soft bristle brush or cleaning rag.

Table 4002 - Cleaning Procedures

(2) Rinse the parts.

NOTE: Use minimal pressure to rinse the parts.

(a) Put the parts into a pressure spray wash booth.

(b) Use soft bristle brush to clean foreign material from slots between commutator bars.

(c) Flush the parts using hot water or steam.

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(3) Repeat the applicable cleaning procedure as necessary until the parts are clean and free of dirt.

(4) Dry the parts.

WARNING: WEAR INSULATED GLOVES AND OBSERVE ALL SAFETY PRECAUTIONS WHEN HANDLING HEATED PARTS TO AVOID PERSONAL INJURY.

(a) Put the cleaned parts into an oven at a temperature of 200°F (93.3°C) for 2 hours.

(b) Remove any remaining moisture from the parts with a dry, lint-free cloth.

WARNING: ISOPROPYL ALCOHOL IS TOXIC AND FLAMMABLE; DO NOT USE NEAR OPEN FLAMES, WELDING AREAS, OR ON HOT SURFACES. INHALATION OF VAPORS CAN CAUSE DROWSINESS, DIZZINESS, AND HEADACHE. CONTACT WITH SKIN CAN CAUSE IRRITATION. USE IN A WELL- VENTILATED AREA IF HANDLING LARGE QUANTITIES [1 GALLON (3.79L) OR MORE].

(c) Check each part for dirt by wiping with isopropyl alcohol on a clean, lint-free cloth.

C. Clean the armature and stator and housing.

(1) Use isopropyl alcohol with a soft bristle brush to remove oily film from the armature and stator and housingl components. A spray mist application is acceptable if immediately followed by wiping and drying.

WARNING: WHEN USING COMPRESSED AIR FOR CLEANING OR DRYING, DO NOT EXCEED 30 PSIG (207 KPA). WEAR GOGGLES OR A FACE SHIELD TO PROTECT EYES. DO NOT AIM COMPRESSED AIR AGAINST SKIN OR OTHER BODILY OPENINGS. CARELESS USE OF COMPRESSED AIR CAN RESULT IN SERIOUS INJURY OR DEATH.

(2) Dry the parts with cleaning cloths or clean, dry, low velocity, filtered compressed air, 30 psig (207 kPa) maximum pressure.

(3) Put the cleaned parts into an oven at a temperature of 200°F (93.3°C) for 2 hours.

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CHECK

1. Introduction

This section provides initial and detailed component inspection procedures for generators returning from service for scheduled and unscheduled maintenance. Complete an initial inspection of the starter-generator before beginning any testing or disassembly. The results of this inspection will determine if a starter-generator is in satisfactory condition for a verification test or if it will need further disassembly, inspection, and/or replacement of parts.

This section provides figures and tables with information that is needed to perform a satisfactory inspection of the starter-generator components. During an overhaul of the starter-generator, you must examine all primary components to find out if they are serviceable.

A part must be rejected if wear or damage is outside the acceptance limits of if the part is not serviceable.

2. Inspection Tools and Materials

WARNING: BEFORE USING ANY OF THE FOLLOWING MATERIALS, BE AWARE OF ALL HANDLING, STORAGE, AND DISPOSAL PRECAUTIONS RECOMMENDED BY THE MANUFACTURER OR SUPPLIER. FAILURE TO COMPLY WITH THE RECOMMENDATIONS MAY RESULT IN SERIOUS INJURY, PHYSICAL DISORDER, OR DEATH.

The following tools and materials are needed to examine the starter-generator.

Tool/Material Description	Reference
Dynamic Balancer (TRW Aeronautical Systems, Lucas Aerospace SPD 1001)	Commercially available
Gauge Block	Commercially available
High Potential Tester	Table 1002
Isopropyl Alcohol	Table 4001
Lint-Free Cloth	Commercially available
Ohmmeter	Table 1002
Soft Bristle Brush	Commercially available
Surface Plate	Commercially available

Table 5001 - Inspection Tools

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3. General Information

Check acceptance limits for individual components are found in the FITS AND CLEARANCES section. Parts that do not meet the acceptance limits are to be discarded. Use the following procedures for all inspections.

A. Inspect the generator and it's components for:

- signs of corrosion
- chipped enamel
- nicks, cracks, dents, scratches
- loose or defective attaching parts
- distortion
- discoloration due to heat or friction
- crossed or stripped threads
- rounded, stripped, or uneven wear of drive shaft spline
- loose or damaged air inlet or fan assembly

B. Inspect electrical connections and wiring for:

- loose or defective attaching parts
- chafing, cracking, or burning of wire insulation
- corroded contacts or terminals
- signs of electrical arcing

4. Initial Inspection

NOTE: If damage is found during inspection, stop the inspection immediately and begin further disassembly of the generator using the instructions in the DISASSEMBLY section.

A. Visually inspect the starter-generator in a brightly lit work area per paragraph 3A.

(1) If shipping or handling damage is evident, stop the inspection immediately and notify your supervisor.

(2) If operational damage is found, record which components need to be repaired or replaced and continue the inspection.

B. Clean the exterior of the starter-generator.

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WARNING: **ISOPROPYL ALCOHOL IS TOXIC AND FLAMMABLE; DO NOT USE NEAR OPEN FLAMES, WELDING AREAS, OR ON HOT SURFACES. INHALATION OF VAPORS CAN CAUSE DROWSINESS, DIZZINESS, AND HEADACHE. CONTACT WITH SKIN CAN CAUSE IRRITATION. USE IN A WELL-VENTILATED AREA IF HANDLING LARGE QUANTITIES [1 GALLON (3.79L) OR MORE].**

(1) Clean the surfaces of the generator using a lint-free cleaning cloth moistened with isopropyl alcohol.

(2) If needed, loosen any dust particles or grease with a soft bristle brush.

C. Inspect the starter-generator per paragraphs 3A and 3B.

(1) If drive shaft spline is visibly damaged, discontinue inspection and proceed to DISASSEMBLY.

D. While facing the drive end, turn the drive shaft counterclockwise.

(1) The armature assembly should rotate with no scraping or bearing noise.

(2) If armature assembly will not turn, or if indications of internal damage can be heard, discontinue inspection and proceed to DISASSEMBLY.

E. Examine the seating between the housing and the brush support (270) and drive-end end bell.

(1) Make sure that the brush support (270) and end bell (115) are fully seated with the housing and stator assembly.

(2) Make sure that all attaching hardware is in place and tight.

5. Replacing Service Parts and Common Hardware

A. Service Parts

CAUTION: Failure to replace armature shaft bearings during overhaul may result in premature starter-generator failure.

Always replace the armature shaft bearings during overhaul, regardless of their condition.

B. Common Hardware

(1) During repair and overhaul, replace all exposed hardware and flat washers that are damaged, deformed, corroded, or have other apparent defects.

(2) Always replace retaining rings and lock washers, when removed during overhaul.

6. Inspection of Generator Parts and Assemblies

A. Overhaul Inspection

At overhaul, examine all primary components of the starter-generator.

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B. Repair Inspection

For repair, examine only those components that have been disassembled for repair. Do not disassemble any component for inspection unless given instructions to do so in this section or in the TESTING AND FAULT ISOLATION section.

C. The following terms are referenced in this section.

- DISCARD
  If damage to the part is found or the part is outside of the acceptance limits in the FITS AND CLEARANCES section, the part must be removed and replaced with a new one.

- REPAIR
  If damage to the part is found or the part is outside of the acceptance limits in the FITS AND CLEARANCES section, the part can be replaced by a procedure found in the REPAIR section.

- DISASSEMBLE
  If damage to the part is found or part of the assembly is outside of the acceptance limits in the FITS AND CLEARANCES section, you can disassemble the part from the assembly and repair or replace the damaged part(s).

- REPLACE
  If damage that causes a part to be outside of the acceptance limits in the FITS AND CLEARANCES section or there is no repair procedure for that part, replace the part. Retain the following parts to submit for remanufacture: armature assembly and stator and housing assembly.

7. Inspection of Parts and Assemblies

The following procedures are the basic instructions for examining parts and assemblies of the starter-generator. Perform visual inspections under high-intensity lighting and 7 to 10 power magnification. Refer to FITS AND CLEARANCES for applicable component wear tolerances.

Unless otherwise specified, numbers in parentheses ( ) after assembly or component names refer to item numbers found in figure 10001 in the ILLUSTRATED PARTS LIST. Qualify individual parts and subassemblies according to the following procedures.

- Repair or replace defective components as instructed.
- Inspect only those components that are products of disassembly for repair.
- Do not perform disassembly for inspection, unless further disassembly is indicated through testing, troubleshooting, and fault isolation.

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A. Identification plate (50)

(1) Visually examine the plate for cracks, dents, nicks, and scratches. Transfer the information from the old identification plate to a replacement identification plate. DISCARD the damaged identification plate.

(2) Make sure that you can read all information on the identification plate. Retain the identification plate if information is difficult to read. Transfer the information from the old identification plate to a replacement identification plate. DISCARD the old identification plate.

(3) Make sure the drive screws (350) are tight and in place. Remove and discard the loose drive screws.

B. Fan Covers (25) or (30) and Brush Cover (50)

(1) Visually examine all surfaces for dents or broken welds. DISCARD if damage is found.

(2) (Models 23048-012, 23048-014, 23048-015, 23048-016, 23048-018, 23048-023 only) Inspect gasket (45) in fan cover (30) for being missing or damaged. Replace gasket if necessary IAW instructions in the REPAIR section.

C. Brushes (45) and Brush Holder Assemblies (195)

(1) Visually examine the brush holders for cracks, warpage, and broken springs.

(a) REPLACE broken springs and damaged brush holders.

(2) Visually examine the brushes for cracks, chips, frayed leads, and loose rivets or loose connections. DISCARD brushes if damaged.

(3) REPLACE brushes if remaining allowable wear will be exceeded before the next overhaul. (See Figure 5001.) Seat new brushes in accordance with instructions in the REPAIR section.

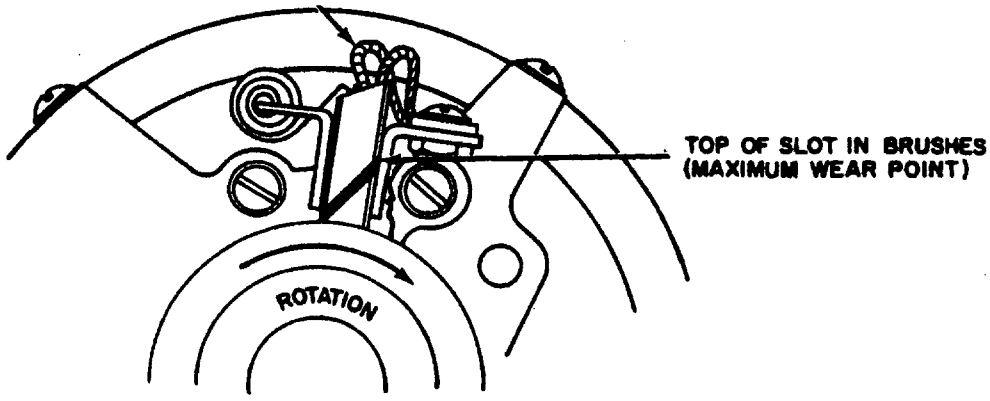


Figure 5001 - Brush Wear Check

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(4) Check brush spring tension.

(a) Insert a small loop of wire under tang of spring.

(b) Attach a tension gauge to the wire loop.

(c) Pulling up on the tension gauge, raise the brush until the position of spring tang approximates distance it would be raised if lower end of brush were flush with lower end of brush holder assembly.

(d) In this position, the spring tension should be between 40 and 55 ounces.

(e) Take an average of several readings. If spring tension is not within this range, REPLACE the spring.

(f) Measure brush spring tension in remaining brush holders for uniformity.

D. Air Inlet (5)

(1) Visually examine all surfaces for dents, nicks, and scratches that reduce the clearance between the sidewall and fan cover (25).

(a) REPAIR the air inlet if damage is found.

(b) DISCARD the air inlet if damage extends to the mounting or inlet flanges.

(2) Visually examine the mounting and inlet flanges for gouging, scoring, or glazing.

(a) REPAIR the flange(s) if damage is found.

(b) DISCARD the air inlet if damage cannot be repaired.

E. Fan Assembly (70)

(1) Visually examine for cracks or a bent condition. If single piece die cast fan is used, inspect for chipped, damaged, or broken blades.

(a) DISCARD the fan if damage is found.

(2) Visually examine that trailing edge of blade(s) do not protrude beyond locating shoulder of fan hub more than limits in FITS AND CLEARANCES.

(a) DISCARD fan if protrusion is excessive.

F. Drive shaft (85) and Dampener hub (100)

(1) Visually examine all surfaces for cracks.

(a) DISASSEMBLE the drive shaft and dampener hub if damage is found.

(b) DISCARD the damaged part(s).

(2) Visually examine all surfaces for dents, nicks, and scratches.

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(a) REPAIR the drive shaft and dampener hub if minor damage is found.

(3) Visually examine the drive spline and the dampener hub for rounding, stripping, or uneven wear (Figure 5002).

(a) DISASSEMBLE the drive shaft and dampener hub if damage is found.

(b) DISCARD the damaged part(s).

(4) Visually examine the screw threads for crossed or stripped threads.

(a) REPAIR the threads if two or less threads are damaged.

(b) DISASSEMBLE the drive shaft and dampener hub if two or more threads are damaged and DISCARD the drive shaft.

(5) Measure the drive spline diameter over two gauge pins. DISASSEMBLE the drive shaft and dampener hub if the diameter is not within the limits in the FITS AND CLEARANCES section. DISCARD the drive shaft.

(6) Perform a magnetic particle inspection per ASTM-E1444.

(a) DISCARD the drive shaft and dampener hub if damage is found.

NOTE: Examine the drive shaft and dampener hub mating surfaces only if the dampener hub was removed from the drive shaft.

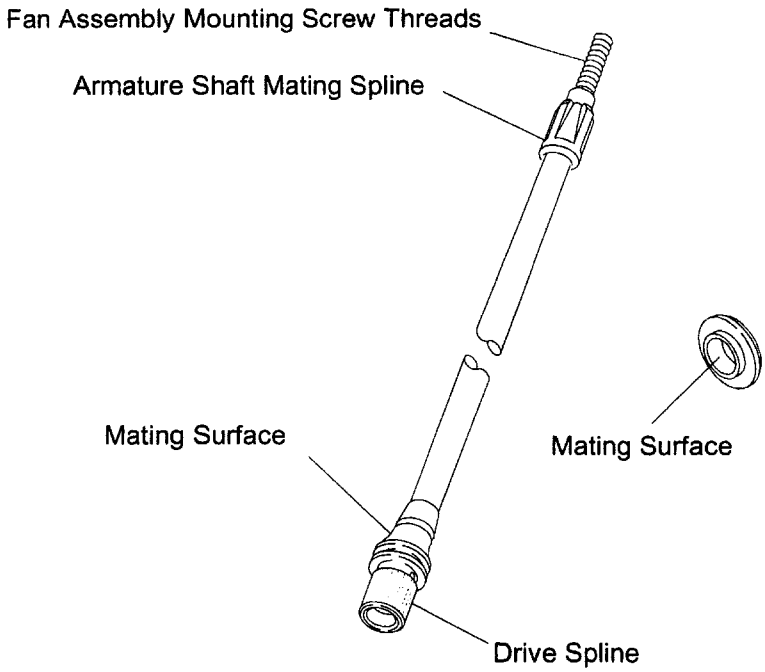


Figure 5002 - Drive Shaft and Dampener Hub

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(7) Visually examine the mating surfaces for gouging, scoring, or glazing.

(a) DISCARD the drive shaft and dampener hub if damage is found.

G. Friction Ring (105)

(1) Visually examine all surfaces for cracks.

(a) DISCARD the friction ring if damage is found.

(2) Measure the friction ring (Figure 5003).

(a) DISCARD the friction ring if the thickness is not within the limits in the FITS AND CLEARANCES section.

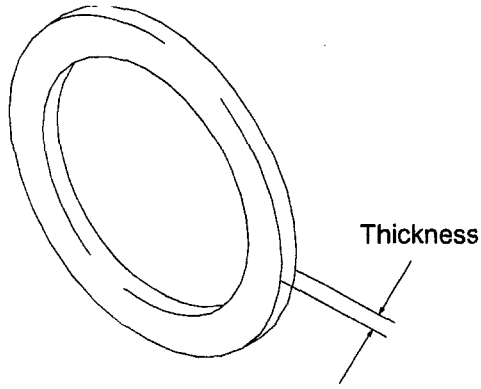


Figure 5003 - Friction Ring Thickness Check

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H. Dampener Plate (95)

(1) See Figure 5004. Visually examine all surfaces for cracks or warpage.

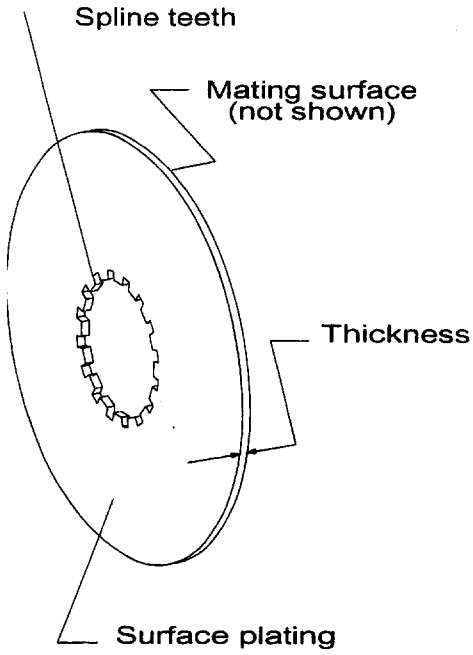


Figure 5004 - Dampener Plate Checks

(a) DISCARD the dampener plate if damage is found.

(2) Visually examine all surfaces for dents, nicks, and scratches.

(a) REPAIR the dampener plate if minor damage is found.

(3) Visually examine the mating surfaces for gouging, scoring, or glazing.

(a) REPAIR the dampener plate if minor damage is found.

(4) Visually examine the spline teeth for rounding, stripping, or uneven wear.

(a) DISCARD the dampener plate if damage is found.

(5) Measure the dampener plate thickness.

(a) DISCARD the dampener plate if it is not within acceptance limits in the FITS AND CLEARANCES section.

(6) Measure the distance between the pins of the spline teeth.

(a) DISCARD the dampener plate if the distance between pins exceeds the acceptance limits in the FITS AND CLEARANCES section.

(7) Perform a magnetic particle inspection per ASTM-E-1444.

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(a) DISCARD the dampener plate if damage is found.

I. Dampener Backplate (110)

(1) See Figure 5005. Visually examine all surfaces for cracks.

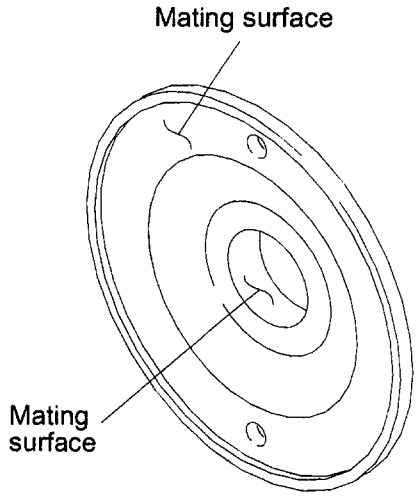


Figure 5005 - Dampener Backplate Checks

(a) DISCARD the dampener backplate if damage is found.

(2) Visually examine all surfaces for dents, nicks, and scratches.

(a) REPAIR the dampener backplate if minor damage is found.

(3) Visually examine the mating surfaces for gouging, scoring, or glazing.

(a) DISCARD the dampener backplate if damage is found.

(4) Perform a magnetic particle inspection per ASTM-E-1444.

(a) DISCARD the dampener plate if damage is found.

J. Drive-End End Bell Assembly (21 and 21A)

(1) Visually examine all end bell surfaces for cracks, warpage, dents, nicks, and scratches.

(a) DISASSEMBLE the bearing support assembly if damage is excessive.

(b) DISCARD the damaged part(s).

(2) Visually examine the following end bell mating surfaces for gouging, scoring, glazing, and fretting.

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- Bearing liner
- Mating with the stator and housing assembly
- Mating with the mounting adapter

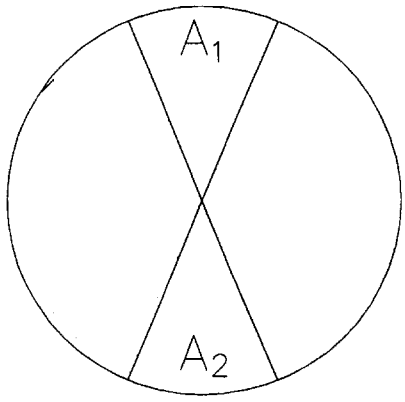
(a) REPAIR the end bell if damage is found.

(b) DISCARD the damaged end bell if repair is not possible.

(3) Measure the bearing liner diameter 'A' using a gage and equipment with an accuracy of 0.00004 in. (1 micron).

(a) REPAIR the drive-end end bell if the liner diameter exceeds 0.0001 in. (0.0025 mm) above the maximum limit in the FITS AND CLEARANCES section.

(b) REPLACE the end bell assembly if the bearing liner cannot be repaired.



$A_1 + A_2$ = 25% of circumference

During overhaul inspection, a bearing liner may be considered to be acceptable if up to 25% of the circumference is 0.0001 in. (0.0025 mm) above the maximum limit in the FITS AND CLEARANCES section. This criteria does not apply to new or repaired bearing liners.

K. Baffle Discs (165)

(1) Visually examine all surfaces for dents, nicks, and scratches.

(a) REPAIR the baffle disc if minor damage is found.

(2) Visually examine the mating surfaces for wear, gouging, scoring, or glazing.

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(a) DISCARD the baffle disc if damage is found.

L. Armature Assembly (175)

(1) Visually inspect for worn, pitted or burned commutator bars.

(a) REPAIR commutator in accordance with commutator refinishing instructions in REPAIR section, if necessary.

(2) Visually inspect commutator for bar to bar concentricity and concentricity to the armature shaft.

(a) REPAIR commutator in accordance with commutator refinishing instructions in REPAIR section if concentricity is not within limits in FITS AND CLEARANCES.

(3) Visually inspect for the following indications of damage or overheating:

- lamellar coating of exposed windings cracked or flaking;
- missing, melted, or deformed insulators.

(a) REPLACE armature assembly if indications of damage or overheating are found.

(4) Check winding retainer bands for damage and tightness of fit.

(a) REPLACE armature assembly if damaged or movement of retainer bands can be detected.

(5) Visually inspect bearing journals for galling, spalling, scoring, discoloration, or other indications of bearing spin on shaft.

(a) If indications are found, check surface roughness with your fingernail.

(b) REPLACE armature assembly if surface roughness can be felt.

(6) Measure bearing journal diameters.

(a) REPLACE armature assembly If journal diameters are not within limits of FITS AND CLEARANCES.

(7) Magnetic particle inspect exposed ends of armature shaft per ASTM-E-1444.

(a) REPLACE armature assembly If indications of cracks are found.

(8) Check armature assembly balance.

(a) If balance measurements exceed limits of FITS AND CLEARANCES, balance armature assembly per applicable REPAIR instructions.

(9) Conduct a high potential test between the armature shaft and the commutator risers as follows.

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WARNING: **FAILURE TO USE NECESSARY SAFETY PRECAUTIONS WHEN HANDLING HIGH VOLTAGE ELECTRICAL EQUIPMENT DURING HIGH POTENTIAL TESTING CAN CAUSE SERIOUS INJURY OR DEATH TO THE OPERATOR.**

CAUTION: Failure to turn OFF the high potential tester power before connecting or disconnecting high voltage electrical leads can cause serious damage to the starter-generator.

(a) Connect one hi-pot lead to the armature shaft and the other lead to a commutator risers.

(b) Apply 220 VAC rms, 60 Hz to test connection for 5 seconds.

(c) No evidence of insulation breakdown shall occur as a result of this test.

(d) REPLACE armature assembly If breakdown is evident.

(10) Conduct a high potential test between each of the two winding retaining bands and a commutator riser as follows.

(a) Connect one hi-pot lead to one of the armature winding retaining bands and the other lead to a commutator risers.

(b) Apply 220 VAC rms, 60 Hz to test connection for 5 seconds.

(c) No evidence of insulation breakdown shall occur as a result of this test.

(d) REPLACE armature If breakdown is evident.

(e) Repeat the procedure for the other retaining band.

M. Stator and Housing Assembly (275)

(1) Visually inspect exposed housing surfaces for cracks, chips, and dents.

(a) REPLACE assembly if cracks, chips, or dents cause loss or permanent deformation of base material.

(2) Visually inspect for the following indications of overheating:

- varnish coating of exposed windings cracked or flaking;
- missing, melted, or deformed insulators.

(a) REPLACE assembly if indications of overheating are found.

(3) Check for tight fit of pole shoes and damage to windings in housing.

(a) REPLACE assembly if stator parts are loose or windings are damaged.

(4) Check terminal block for cracks, and loose or damaged terminal studs.

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(a) REPLACE terminal block if damaged.

CAUTION: Capacitors imbedded in radio noise filters in the operational terminal block will be damaged if subjected to dielectric test. Always disconnect stator leads from the operational terminal block and connect to a dummy terminal block when conducting dielectric test.

(5) Disconnect starter-generator stator leads from stator and housing terminal block.

(6) Reconnect stator leads to a dummy terminal block.

(7) Conduct a hi-potential test between frame and terminal A on the dummy terminal block as follows.

WARNING: FAILURE TO USE NECESSARY SAFETY PRECAUTIONS WHEN HANDLING HIGH VOLTAGE ELECTRICAL EQUIPMENT DURING HIGH POTENTIAL TESTING CAN CAUSE SERIOUS INJURY OR DEATH TO THE OPERATOR.

CAUTION: Failure to turn OFF the high potential tester power before connecting or disconnecting high voltage electrical leads can cause serious damage to the starter-generator.

(a) Connect hi-pot leads between terminal A and starter-generator frame.

(b) Apply 220 VAC rms, 60 Hz to test connection for 5 seconds.

(c) No evidence of insulation break-down shall occur as a result of this test.

(d) REPLACE stator and housing assembly if breakdown is evident.

(8) Disconnect hi-pot tester.

(9) Use an ohmmeter to check for an open circuit between negative field lead E and positive terminal A.

(a) REPLACE stator and housing assembly if continuity is not indicated.

(10) Disconnect dummy terminal block and reconnect stator leads to starter-generator terminal block.

N. Brush Holder Support Assembly (220)

(1) Visually examine all brush holder support (220) surfaces for cracks, warpage, dents, nicks, and scratches.

(a) DISASSEMBLE the brush holder support assembly if damage is excessive.

(b) DISCARD the damaged part(s).

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(2) Visually examine the following brush holder support mating surfaces for gouging, scoring, glazing, and fretting.

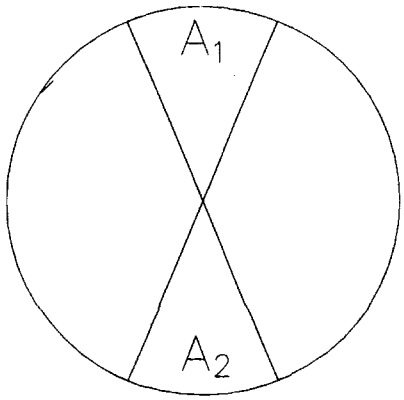
- Bearing liner
- Mating with the stator and housing assembly

(a) REPAIR the brush holder support if damage is found.

(b) DISCARD the damaged brush holder support if repair is not possible.

(3) Measure the bearing liner diameter 'A' using a gage and equipment with an accuracy of 0.00004 in. (1 micron).

(a) REPAIR the drive end bearing support if the liner diameter exceeds 0.0001 in. (0.0025 mm) above the maximum limit in the FITS AND CLEARANCES section.



$A_1 + A_2$ = 25% of circumference

During overhaul inspection, a bearing liner may be considered to be acceptable if up to 25% of the circumference is 0.0001 in. (0.0025 mm) above the maximum limit in the FITS AND CLEARANCES section. This criteria does not apply to new or repaired bearing liners.

(b) REPLACE the brush holder support assembly if the bearing liner cannot be repaired.

(4) Conduct a high potential test between the end bell casting and each brush holder assembly as follows.

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WARNING: **FAILURE TO USE NECESSARY SAFETY PRECAUTIONS WHEN HANDLING HIGH VOLTAGE ELECTRICAL EQUIPMENT DURING HIGH POTENTIAL TESTING CAN CAUSE SERIOUS INJURY OR DEATH TO THE OPERATOR.**

CAUTION: Failure to turn OFF the high potential tester power before connecting or disconnecting high voltage electrical leads can cause serious damage to the starter-generator.

(a) Connect hi-pot leads between end bell casting (270) and each brush holder assembly (255).

(b) Apply 220 VAC rms, 60 Hz to test connection for 5 seconds.

(c) No evidence of insulation break-down shall occur as a result of this test.

(d) DISASSEMBLE and inspect non-metallic washer (240), insulation sleeve (260), and insulation plate (265) if breakdown occurs.

(e) REPLACE defective parts as necessary.

O. Bearing Retainer (180)

(1) Visually inspect bearing retainer for cracks, chips, and dents.

(a) DISCARD retainer if cracks, chips, or dents cause permanent deformation.

(2) Place bearing retainer on surface plate to check for warping.

(a) DISCARD retainer if warpage is indicated.

P. QAD Kit End Bell (365)

(1) Measure the height of the three locating dowels.

(a) Replace pin if not to the height in the FITS AND CLEARANCES.

8. Terminology

Table 5002 lists the definitions of terms used to describe damage conditions.

Term	Definition	Probable Cause
Crack	A break in material	Severe stress from overloading or shock; possible extension of a scratch
Dent	A small, smoothly rounded depression	A sharp blow or excessive pressure

Table 5002 - Terminology

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Term	Definition	Probable Cause
Fretting/ Corrosion	Surface chemical reaction that results in discoloration, a layer of oxide, or rust	Vibration between mating surfaces
Galling	Transfer of metal from one surface to another	Result of localized lubrication breakdown between sliding surfaces
Glazing	Smoothing and creep of a surface	Result of localized lubrication breakdown between sliding surfaces
Gouging	Removal of surface metal, typified by rough and deep depressions	Protruding objects, incorrectly aligned
Nick	A sharp bottomed depression that may have rough outer edges	Dropping, banging
Rounding	Removal of surface metal at corners or dulling of edges	Result of abrasion, vibration, or incorrect tolerances
Scoring	Deep scratch following a path of part travel	Result of localized lubrication breakdown between sliding surfaces
Scratch	A very shallow furrow or irregularity, usually longer than wide	Movement of a sharp object across the surface
Short	Evidence of sparking, arcing, or high current	The result when two current carrying conductors are connected by a path of negligible resistance
Stripped Thread	Thread of a nut, stud, bolt, or screw damaged by tearing away parts of the thread	Incorrect installation of thread pitch or size
Tear	Parting of material	Excessive tension, caused by an external force
Wear	Slow removal of parent material, wear may not be visible to the naked eye	Result of abrasive substances contacting rolling surfaces and acting as a lapping compound

Table 5002 - Terminology (Continued)

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REPAIR

1. Introduction

This section provides authorized repair instructions for the 23048 family of DC Starter-Generators. Repairs are limited to:

- Repairing damaged surfaces
- Restoring the surface coatings of parts and assemblies
- Repairing damaged threads
- Restoring bearing liners and journals
- Repairing and refinishing the armature commutator
- Balancing the armature
- Brush seating
- Replacing fan cover gasket

Authorized repairs also include approved procedures by reference. Repair operations not referring to instructions given in this section are not authorized by TRW Aeronautical Systems, Lucas Aerospace.

CAUTION: The use of parts, materials, or processes not authorized by TRW Aeronautical Systems, Lucas Aerospace for the maintenance or overhaul of the starter-generator may affect continued flightworthiness or invalidate its certification.

2. Repair Tools

In addition to normal shop tools, the following tools are needed for starter-generator repair.

CAUTION: Steel wool and abrasives containing iron or iron oxide shall not be used at any time during repair operations.

Tool Description	Reference
Dynamic balancer	TRW Aeronautical Systems, Lucas Aerospace, SPD 1001
End mill [0.25 in (6.4 mm) diameter]	Commercially available
India stone	Commercially available
Tension gauge	Commercially available
Thread chasers	Commercially available

Table 6001 - Repair Tools

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3. Repair Materials

Materials used for repair are listed in Table 6002. Equivalent materials may be used.

WARNING: BEFORE USING ANY OF THE FOLLOWING MATERIALS, BE AWARE OF ALL HANDLING, STORAGE, AND DISPOSAL PRECAUTIONS RECOMMENDED BY THE MANUFACTURER OR SUPPLIER. FAILURE TO COMPLY WITH THE RECOMMENDATIONS MAY RESULT IN SERIOUS INJURY, PHYSICAL DISORDER, OR DEATH.

Item	Description/Specification	Source
Alcohol, Isopropyl	TT-I-735, Grade A	Commercially available
Brush, Soft Bristle	N/A	Commercially available
Coating, Acrylic	MIL-I-406058/HumiSeal 1B31, Type AR	Chase Corp. Woodside, NY
Coating, Conversion	MIL-C-5541, Class 3 Alodine 1200 or equivalent	Commercially available
Compound, Thread Locking	Loctite, Grade D (MIL-S-22473).	Loctite Corporation Aurora, IL
Enamel, Red Insulating, Baking	Synthite ER-41	John C. Dolph Co. Box 41 Monmouth, NJ 08852
Oil, Lubricating	MIL-L-6085	Commercially available
Pads, Cleaning	Lint-free cotton	Commercially available
Paint, Gloss Enamel	Urethane per MIL-C-85285B Amendment 2 Type 1	Commercially available
Primer, Zinc Chromate	TT-P-1757, Composition G, Color Y	Commercially available
Sandpaper	5/0 or finer	Commercially available
Sandpaper	400/600 grit	Commercially available
Sealing Compound, Pipe Joint and Thread, Lead Free	Gasoila, Soft Set	Federal Process Co. Cleveland, OH
Solvent, Cleaning	MIL-PRF-680 Type I - Stoddard Solvent Type II -140°F Solvent	Commercially available
EnSolve, Cleaning Solvent	Ensolve Cleaning Solvent	Enviro Tech International, Inc. Alameda, CA 94501

Table 6002 - Repair Materials

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4. Surface Repair

Repair corroded or damaged surfaces of parts that have qualified for repair according to the inspection criteria in the CHECK section.

A. Retreating

WARNING: ISOPROPYL ALCOHOL IS TOXIC AND FLAMMABLE; DO NOT USE NEAR OPEN FLAMES, WELDING AREAS, OR ON HOT SURFACES. INHALATION OF VAPORS CAN CAUSE DROWSINESS, DIZZINESS, AND HEADACHE. CONTACT WITH SKIN CAN CAUSE IRRITATION. USE IN A WELL-VENTILATED AREA.

(1) Thoroughly clean all surfaces to be retreated or repainted with isopropyl alcohol.

WARNING: CHEMICAL CONVERSION MATERIALS ARE EXTREMELY DANGEROUS. OBSERVE FIRE AND SAFETY PRECAUTIONS. CONTACT WITH COMBUSTIBLE MATERIALS MAY CAUSE EXPLOSION OR FIRE. ALWAYS WEAR RESPIRATORY PROTECTION, PROTECTIVE APRON, GLOVES, AND SAFETY GLASSES. AVOID DIRECT CONTACT WITH SKIN OR EYES. USE IN A WELL-VENTILATED AREA.

(2) Chemical film treat all previously painted bare metal surfaces with chemical film solution MIL-C-5541.

(3) Rinse thoroughly with hot water and dry with filtered and dried compressed air.

WARNING: ZINC CHROMATE PRIMER IS FLAMMABLE. DO NOT USE NEAR OPEN FLAMES, NEAR OPEN WELDING AREAS, OR ON HOT SURFACES. CONTACT WITH SKIN CAN CAUSE IRRITATION. VAPORS CAN CAUSE EYE IRRITATION, DIZZINESS, AND HEADACHE. USE IN A WELL-VENTILATED AREA.

(4) Apply a thin wet coat of zinc chromate primer.

(a) The coating should be smooth and semi-transparent.

(b) A full hiding coat is too heavy.

(c) Dry film thickness should be 0.3 to 0.6 mil.

(5) Air dry until tack-free.

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B. Repainting

WARNING: GLOSS ENAMEL IS FLAMMABLE AND TOXIC. DO NOT USE NEAR OPEN FLAMES, WELDING AREAS, OR ON HOT SURFACES. CONTACT WITH LIQUIDS OR VAPOR CAN CAUSE SKIN OR EYE IRRITATION, DIZZINESS, AND HEADACHE. WEAR RESPIRATORY PROTECTION AND RUBBER GLOVES. USE IN A WELL-VENTILATED AREA.

(1) Apply gloss black enamel to a dry film thickness of 0.75 to 1.25 mils.

(2) Oven cure at 300°F for one hour.

5. Thread Repair

CAUTION: Do not use a thread cutting die. Unrepairable damage can result from using a thread cutting die.

(1) Repair damaged threads with a thread chaser.

(2) Remove any remaining sharp edges or burrs with an india stone.

WARNING: LUBRICATING OIL IS FLAMMABLE AND CAN BE HARMFUL IF SWALLOWED. DO NOT USE NEAR OPEN FLAMES OR SPARKS. USE IN A WELL VENTILATED AREA.

(3) Apply a light coating of lubricating oil to repaired threads to prevent corrosion.

6. Bearing Liner and Journal Restoration

A. Bearing Support (Drive End) and End Bell (Anti-Drive End) Bearing Liner Restoration

(1) If the bearing liner is worn beyond the limits in the FITS AND CLEARANCES section, restoration may be possible by electro deposition plating in accordance with TRW Aeronautical Systems, Lucas Aerospace Standard Practice Document (SPD) 1000.

NOTE: If bearing liner is out of concentricity, machine the liner within concentricity before plating.

(2) Maximum allowable single thickness of plating shall be 0.01 in. (0.254 mm), or 0.02 in. (0.508 mm) measured across a diameter.

(3) After plating, the bearing liner diameter must be ground to dimensions listed in the FITS AND CLEARANCES section.

(4) Liquid penetrant inspect the bearing support assemblies in accordance with (IAW) MIL-STD-6866, method A or B, sensitivity level 2 or higher. Acceptance criteria shall be IAW MIL-STD-1907, Table II, Grade C.

(5) Replacement of the drive end bearing support bearing liner is permitted if restoration is not possible. Refer to paragraph 7.

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(6) If bearing liner cannot be repaired IAW these instructions, the entire end bell assembly must be replaced.

(7) Return the faulty end bell assembly to TRW Aeronautical Systems, Lucas Aerospace in Aurora, Ohio for examination and possible repair.

B. Bearing Journals

(1) If the armature shaft bearing journals are worn beyond the limits in the FITS AND CLEARANCES section, restoration may be possible by electro deposition plating in accordance with TRW Aeronautical Systems, Lucas Aerospace Standard Practice Document (SPD) 1000.

NOTE: If armature shaft is out of concentricity, machine the shaft within concentricity before plating.

(2) Maximum allowable thickness of plating shall be 0.01 in. (0.254 mm), or 0.02 in. (0.508 mm) measured across a diameter.

(3) Armature shaft bearing journals may be plated to final dimensions, or overplated then ground to final dimensions listed in the FITS AND CLEARANCES section.

(4) Liquid penetrant inspect the armature journals IAW MIL-STD-6866, method A or B, sensitivity level 2 or higher. Acceptance criteria shall be IAW MIL-STD-1907, Table II, Grade C.

7. Repair Procedures

A. Repairing Armature Commutator.

If inspection reveals that commutator is rough, pitted, scored, or burned, refinish in a lathe that is accurately set up and adjusted. Install 03-6010-18 bearing (170) into commutator turning fixture (Figure 9008).

(1) Remove only the material necessary to clean and true-up the commutator surface.

(2) To ensure uniformity of surface finish, a diamond tipped cutting tool with a maximum tool tip radius of 0.006 in. (0.1524 mm), including tool wear, is recommended for making the final surface cut on the commutator.

(3) Replace armature if commutator diameter must be refinished to a diameter of less than 2.055 in (52.197 mm).

(4) Hold commutator diameter concentric with bearing journals within 0.0008 in. (0.02032 mm) T.I.R., with bar-to-bar concentricity within 0.0002 in. (0.00508 mm).

B. Undercutting the Mica.

If the depth of undercut remaining after the turning operation has been completed is less than 0.045 in. (1.143 mm), the mica between the commutator bars should be undercut to 0.035 to 0.045 in. (0.889 to 1.143 mm) wide, by 0.060 in. (1.524 mm) ± .005 (0,127 mm) deep.

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(1) Use a triangular scraper to remove all excess mica, sharp edges, and burrs from between the commutator bars.

(2) Use a bristle brush to remove metal chips and mica particles from the slots between the commutator bars.

(3) Check for concentricity as described in Paragraph 7A.

C. Armature Balancing.

After commutator refinishing, check the armature for proper balance as specified in the FITS AND CLEARANCES section. If a balance correction is required, mill the stainless steel retaining bands at each end of the lamination stack until the proper degree of balance is obtained.

(1) Use lathe setup or vee-blocks.

(2) Inspect the armature assembly as instructed in the CHECK section.

(3) Check the armature assembly balance in two planes (one plane at each bearing journal) on a balancing machine.

(4) Record balance measurements and compare to the maximum out of balance condition in the FITS AND CLEARANCES section.

(5) If the recorded armature balance is greater than the maximum out of balance condition, use the following procedure to achieve proper armature balance.

NOTE: Although balance measurements are acquired at the bearing journals, proper armature balance is achieved by removing material from the retaining bands.

(a) Clean up the armature shaft centers with a steel wire brush to ensure proper centering of the armature on the machine setup.

(b) Install the armature assembly onto the vertical mill machine setup.

WARNING: THE MACHINE OPERATOR MUST BE FULLY TRAINED IN THE SAFE OPERATION OF A VERTICAL MILL. THIS INCLUDES THE USE OF ALL SAFETY DEVICES AND PRECAUTIONS. THE USE OF APPROVED EYE PROTECTION DURING MACHINE OPERATION IS REQUIRED.

(c) Make mill cuts in retaining bands of the armature to achieve proper balance.

1 Mill cut specifications are 0.031 in. (0.7874 mm) deep maximum, and 0.25 in. (0.635 mm) wide.

2 Drive end retaining band cuts shall be at least 0.120 in. (3.048 mm) from the band edge

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3 Only two 0.25 in. (0.635 mm) wide cuts are permitted in each band to maintain adequate hoop strength.

4 Existing cuts may be extended, or new cuts may be added in line with existing cuts.

(d) Heat the armature assembly from 350°F to 450°F (177°C to 232°C) for 2 hours minimum.

WARNING: USE EXTREME CAUTION WHEN HANDLING HOT PARTS. USE THE APPROPRIATE SAFETY AND HANDLING EQUIPMENT WHEN HANDLING HOT PARTS. CONTACT BETWEEN EXPOSED SKIN AND HOT PARTS CAN CAUSE SEVERE BURNING.

(e) While the armature assembly is still hot, overspeed the armature assembly for 5 minutes at 14,000 rpm.

(f) Re-balance the assembly if required.

(6) Replace the armature assembly if proper balance cannot be achieved.

D. Brush Seating.

NOTE: New brushes must be properly seated on the commutator surface before starting the performance tests. Failure to properly seat the brushes can affect the results obtained during test after overhaul.

New brushes installed at overhaul should be sanded to seat them properly on the commutator surface. Seating the brushes using the following procedure.

(1) See Figure 6001. Make sure that brush leads are arranged over the brush springs as shown to prevent brush hang-up.

(2) Using a stiff wire hook, lift each brush spring far enough to allow the brush to be pulled from holder.

(3) Raise the brush in the holder until the brush spring comes in contract with the side of the brush and can hold the brush in position off of commutator.

(4) Place a strip of 5/0 or finer sandpaper, slightly wider than the width of the brush, around the commutator with the sand side out.

(5) Cut the sandpaper strip to one inch longer than the commutator circumference.

(6) Secure one end of the sandpaper strip to the commutator surface with masking tape so that the taped end leads in the direction of rotation. The other end remains loose and overlaps taped end.

(7) Lower the brushes in place against the sandpaper, and carefully hand-rotate the armature counterclockwise, as viewed from the drive end.

(a) Continue to rotate until a full seat is obtained on each brush.

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(b) Do not sand excessively.

(8) Remove the sandpaper.

(9) Remove all carbon dust with dry, compressed air.

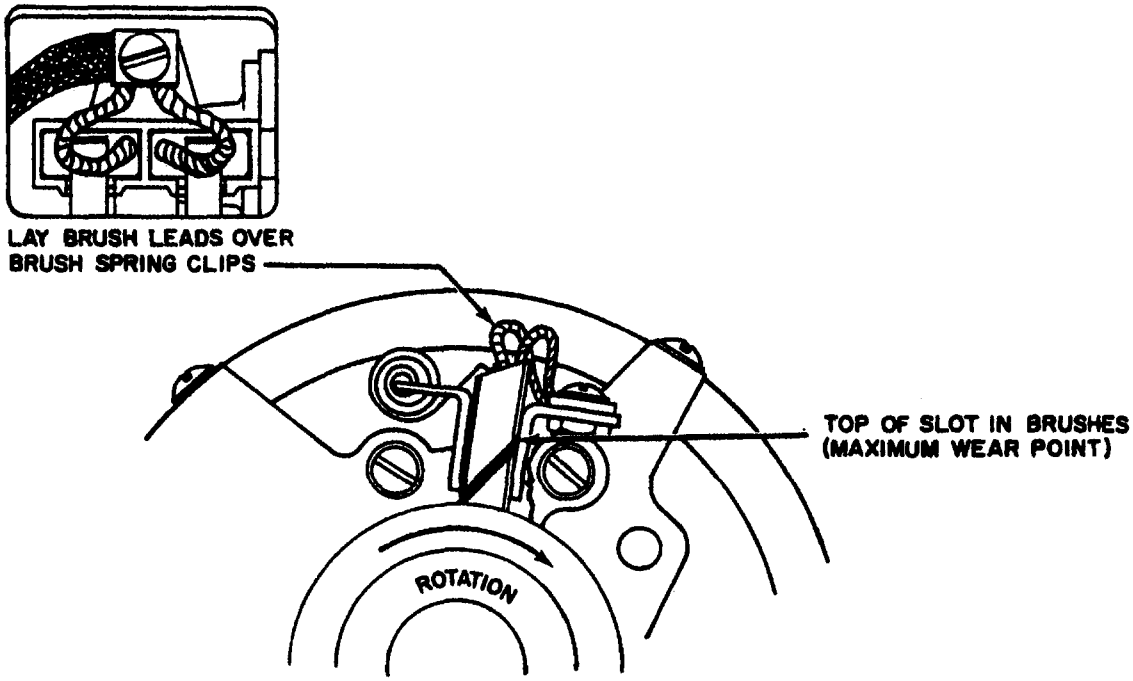


Figure 6001 - Correct Position of Brushes and Springs

E. Flashing the Field.

Starter-Generators with reversed polarity in the output voltage may be corrected by flashing the field as outlined below.

CAUTION: Do not flash the field while starter-generator is in operation.

(1) Disconnect leads to external voltage regulator.

(2) Connect negative terminal of a 1.5-to-6.0 VDC battery to terminal "E".

(3) Connect the positive terminal of battery to one side of a knife switch.

(4) Connect the other side of knife switch to terminal "A".

(5) Close the knife switch for 5 seconds.

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(6) Open the switch and disconnect it from battery.

NOTE: If flashing the field fails to correct generator polarity, check for incorrect connections or defective field circuit.

F. Replacing Fan Cover Gasket (45).

NOTE: In this procedure, all surfaces to be bonded shall be clean and free of grease, oil, and other contaminants. All solvent must be completely evaporated before applying adhesives or primers.

(1) Remove old gasket bonding residue from fan cover (30) using a stiff wire brush.

WARNING: ENSOLVE SOLVENT CAN PRODUCE EYE AND SKIN IRRITATION. HIGH CONCENTRATIONS ARE IRRITATING TO THE RESPIRATORY TRACT AND EYES. MAINTAIN ADEQUATE VENTILATION. WEAR NEOPRENE GLOVES AND SAFETY GOGGLES/FULL FACE SHIELD. DO NOT USE NATURAL RUBBER GLOVES.

(2) Clean gasket area on fan cover using EnSolve and a lint-free cloth.

(3) Apply a thin coat of silicone adhesive primer to gasket area of fan cover. Allow to dry for 30 to 45 minutes at room temperature.

(4) Lightly coat mounting surface of gasket with silicone rubber sealant.

(5) Place gasket on fan cover.

NOTE: Only contact pressure between the gasket and fan cover is required for bonding. Best adhesion is obtained with a glue line of 15 mm (approximately).

(6) Clean excess sealant from fan cover before curing, using EnSolve and a lint-free cloth.

(7) Allow sealant to cure for 24 hours at room temperature with a minimum of 20% relative humidity.

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ASSEMBLY

1. Introduction

This section gives the assembly instructions of 23048 Series of DC Starter-Generators. Assemble the Starter-Generator in a clean work area, away from machining or other metal removing operations. Make sure to clean all parts in accordance with the procedures in the CLEANING section before final assembly.

2. Assembly Tools

In addition to normal shop tools, the tools listed in Table 7001 are needed for unit assembly.

Tool Descriptions	Reference
Arbor press	Not illustrated
Support, Anti-Drive End End Bell	Figure 9002
Dampener plate driver	Figure 9010
Inner race bearing driver	Figure 9006
Outer race bearing driver	Figure 9006
Leather or plastic mallet	Commercially available
Retaining ring pliers	Commercially available
Spline Wrench	Figure 9001
Armature Support	Figure 9009
Driver, Dampener Backplate	Figure 9010
Support Stator, Vertical	Figure 9011
Support Stator, Horizontal	Figure 9012

Table 7001 - Assembly Tools

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3. Assembly Materials

Table 7002 lists the materials required to assemble the generator. Equivalent materials may be used

WARNING: BEFORE USING ANY OF THE FOLLOWING MATERIALS, BE AWARE OF ALL HANDLING, STORAGE, AND DISPOSAL PRECAUTIONS RECOMMENDED BY THE MANUFACTURER OR SUPPLIER. FAILURE TO COMPLY WITH THE RECOMMENDATIONS MAY RESULT IN SERIOUS INJURY, PHYSICAL DISORDER, OR DEATH.

Item	Description/Specification	Source
EnSolve Solvent	EnSolve Solvent	Enviro Tech International Inc. Alameda, CA 94501
Alcohol, Isopropyl	TT-I-735, Grade A	Commercially Available
Coating, Acrylic	MIL-I-406058/HumiSeal 1B31, Type AR	Chase Corp. Woodside, NY
Coating, Conversion	Alodine 1200 or equivalent MIL-C-5541, Class 3	Commercially Available
Compound, Thread Locking	Loctite, Grade D (MIL-S-22473).	Loctite Corporation Aurora, IL
Enamel, Red Insulating, Baking	Synthite ER-41	John C. Dolph Co. Box 41 Monmouth, NJ 08852
Paper	Protective/MIL-B-121A, grade A, type II, class I	National Paper Walton Hills, OH United Packaging Cleveland, OH
Primer, Silicone Adhesive	A-4094	Dow Corning Corp. Midland, MI
Primer, Zinc Chromate	TT-P-1757, Composition G, Color Y	Commercially Available
Sealant, Silicone Rubber	Silastic RTV 732, Black	Dow Corning Corp. Midland, MI
Compound, Thread Sealing	Gasoila	Federal Process Co. Cleveland, OH

Table 7002 - Assembly Materials

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4. Assemble Stator and Housing Assembly (275)

The following procedure details the assembly of the stator and housing assembly. Numbers in parentheses () refer to item numbers given in Figure 10002 of the ILLUSTRATED PARTS LIST unless otherwise specified.

A. Install terminal block assembly (280) if it was removed at disassembly.

(1) Position terminal block on stator housing (275) with stator leads positioned on terminal block studs.

(2) Install two bolts (285), lock washers (290) and flat washers (295) to secure terminal block to stator housing.

(3) Secure stator leads B, C, and E to large terminals with washers (305) and nuts (300).

(4) Secure stator leads A and D to small terminals with washers (315) and nuts (310).

5. Assemble Brush Holder Support Assembly (200)

The following procedure details the assembly of the brush holder support assembly. Numbers in parentheses () refer to item numbers given in Figure 10001 of the ILLUSTRATED PARTS LIST unless otherwise specified.

A. Install new bearing into end bell (270).

NOTE: When installing new bearings, make sure that the part mark on the outer race faces in toward the armature.

(1) Using an arbor press, hub support (Figure 9002), and outer race bearing driver (Figure 9006), press new ball bearing (190) into end bell (270).

WARNING: THREAD SEALING COMPOUND IS FLAMMABLE. DO NOT USE NEAR OPEN FLAMES OR SPARKS. USE IN A WELL-VENTILATED AREA.

(2) Apply thread sealing compound to threads of four screws (185).

(3) Install bearing retainer (180) over bearing (190) in end bell and secure with screws (185).

B. Install brush holder (255) on end bell (270).

NOTE: There are studded and studless styles of brush holder. The studded type contains threaded studs (250) that go through the end bell and are secured with a nut (230) on the fan side of the end bell. The studless type uses a mounting bolt (225) that screws into the brush holder through the end bell.

CAUTION: Do not wind spring further than necessary to install in position, or spring may take a permanent set, and produce insufficient pressure on brush.

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(1) Install two brush springs (245) on brush holder assembly (255). Each spring must be wound approximately 3/4 turn before installation on brush holder spring support bar.

(2) Insert insulation sleeve (260) into each of two brush holder mounting holes in end bell (270).

(3) If using the studless brush holder, place a flat washer (235), and non-metallic washer (240) on each of two bolts (225) and insert bolts through insulation sleeves in end bell (270).

(4) Install insulation plate (265).

(a) For studded brush holders, position insulation plate (265) on brush holder studs and position brush holder studs into insulation sleeves in end bell. Place a non-metallic washer (240) and flat washer (235) on each of the studs and secure brush holder with nut (230). Tighten nuts 25 to 30 in-lbs (2.83 to 3.39 Nm).

(b) For studless brush holders, position insulation plate on mounting bolts (205) coming through the end bell.

WARNING: THREAD LOCKING COMPOUND IS HIGHLY FLAMMABLE AND TOXIC. DO NOT USE NEAR OPEN FLAMES OR SPARKS. USE IN A WELL-VENTILATED AREA.

(5) Coat threads of bolts (225) with thread locking compound.

(6) Position brush holder assembly (255) against insulation plate (265) and thread bolts (225) into brush holder assembly.

(7) Align (rotate) brush support assembly in alignment fixture per SPD 1004.

(8) Tighten bolts 25 to 30 in-lbs (2.83 to 3.39 Nm).

C. Verify insulation of brush holders by performing hi-pot test.

WARNING: FAILURE TO USE NECESSARY SAFETY PRECAUTIONS WHEN HANDLING HIGH VOLTAGE ELECTRICAL EQUIPMENT DURING HIGH POTENTIAL TESTING CAN CAUSE SERIOUS INJURY OR DEATH TO THE OPERATOR.

(1) Electrically connect all brush holders together.

(2) Connect hi-pot test leads between brush holders and end bell.

(3) Apply 250 volts for one minute.

(4) No evidence of insulation breakdown, arcing or sparking is acceptable. Failure can be detected by fluctuations and/or steady increase in leakage current.

(5) Turn off and disconnect hi-pot tester.

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D. Coat brush holder components with red insulating enamel.

- edge of base on brush holder assembly (255),
- non-metallic washers (240),
- head of bolts (225), or nuts (230)
- washers (235),
- insulation plate (265),
- and any chipped area of end bell (270) .

(1) Permit red insulating enamel to air dry, or bake support assembly in an oven for one hour at a temperature of 150°F (66°C).

WARNING: WEAR INSULATED GLOVES AND OBSERVE ALL SAFETY PRECAUTIONS WHEN HANDLING HEATED PARTS TO AVOID PERSONAL INJURY.

(2) Remove support assembly from oven and allow to cool to room temperature.

6. Final Assembly of DC Starter Generator

The following procedure details the final assembly of the starter-generator. Numbers in parentheses () refer to item numbers in Figure 10001 of the ILLUSTRATED PARTS LIST unless otherwise specified.

A. Install baffle discs (165), bearing (170),and retaining ring (160) on armature shaft (175).

(1) Install baffle disc (165) on drive end of armature shaft, with recessed area of baffle disc facing the armature.

(2) Support armature in an arbor press using an armature support (FIgure 9009).

NOTE: In the following step, make sure the bearing part mark on the outer race faces toward the armature windings.

(3) Using a armature support (Figure 9009) and inner race bearing driver (Figure 9006), press a new bearing (170) onto drive end of armature shaft. Bearing must be fully engaged against baffle disc (160). Refer to Figure 7001.

(4) Install remaining baffle disc (165) on drive end of armature shaft, with recessed area of baffle disc facing away from armature.

(5) Install and fully seat retaining ring (160) into groove on armature shaft. Refer to Figure 7002

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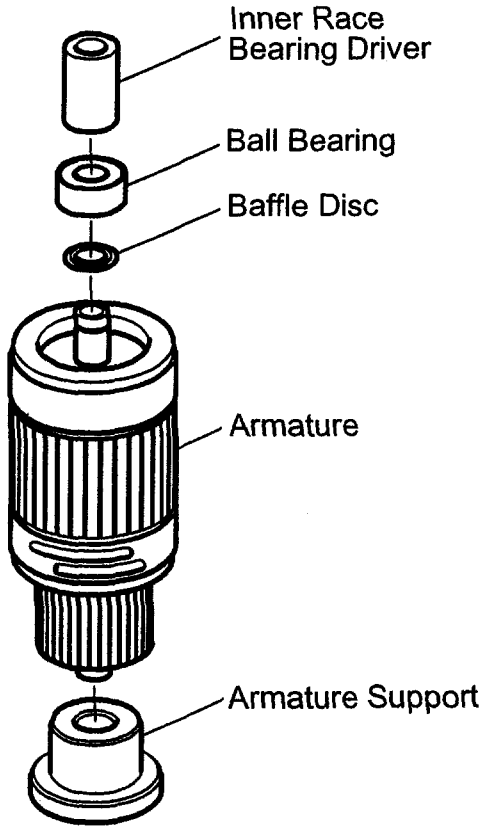


Figure 7001 - Baffle Disc and Ball Bearing Installation

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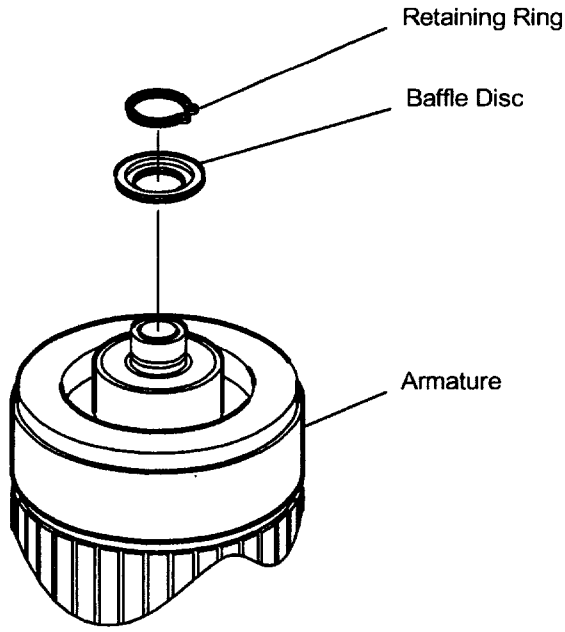


Figure 7002 - Baffle Disc, Spacer, Retaining Ring Installation

B. Press a ball bearing (190) into the bearing and brush support assembly (200).

(1) Set an anti-drive end hub support on the arbor press table.

(2) Set the bearing and brush support assembly, brush holder side down, on the anti-drive end hub support.

(3) Set a ball bearing onto the bearing liner of the bearing and brush support assembly.

(4) Set an outer race bearing driver onto the ball bearing.

(5) Press the ball bearing into the bearing liner of the bearing and brush support assembly.

(6) Make sure that the ball bearing is fully seated against the inner lip of the bearing liner.

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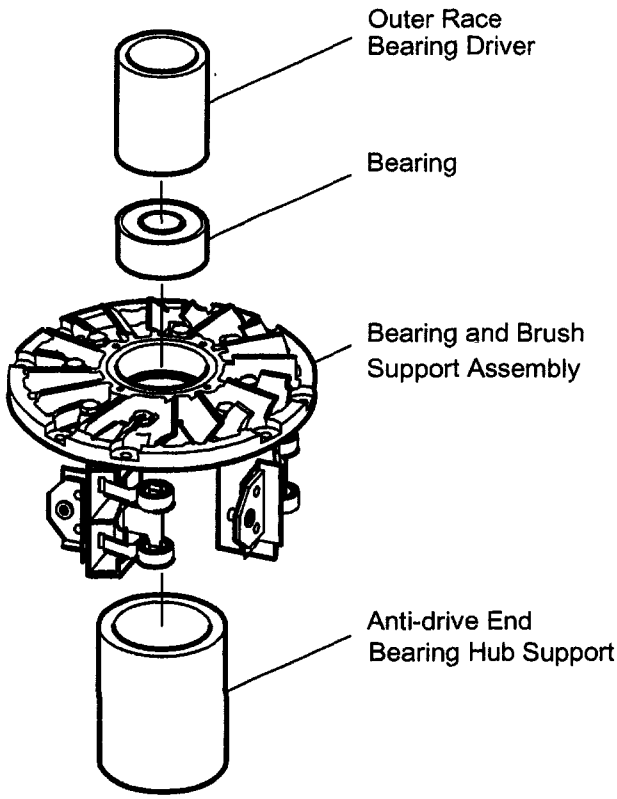


Figure 7003 - Install Bearing in Bearing and Brush Support Assembly

C. Attach the bearing retainer (180) to the bearing and brush support assembly (200).

WARNING: SEALING COMPOUND IS FLAMMABLE. DO NOT USE NEAR OPEN FLAMES, NEAR WELDING AREAS, OR ON HOT SURFACES.

(1) Apply sealing compound to the threads of the screws (185).

(2) Attach the bearing retainer to the bearing and brush support assembly using the attaching screws. See Figure 7004.

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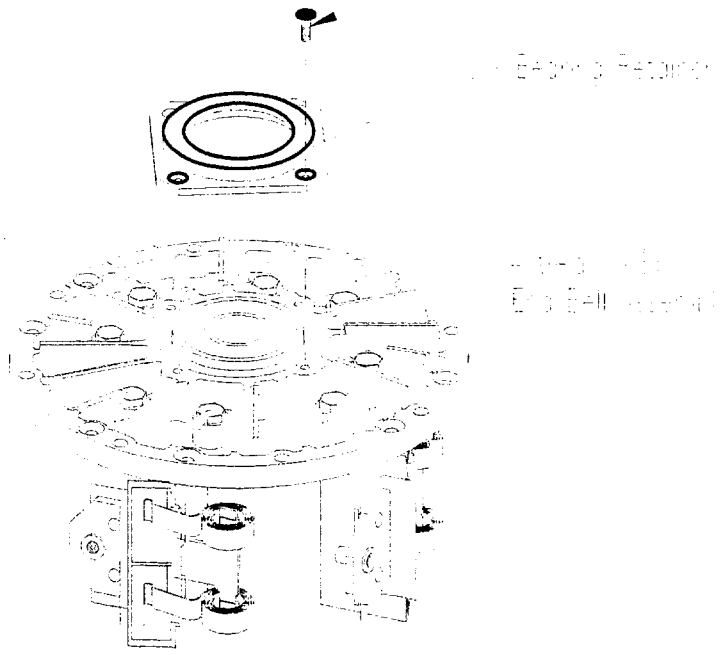


Figure 7004 - Attach Bearing Retainer to Bearing and Brush Support Assembly

D. Attach the bearing and brush support assembly (200) to the armature (175).

CAUTION: Do not touch the polished surface of the commutator with bare hands. Skin acids and oils can contaminate conducting surfaces causing corrosion and/or poor electrical contact.

(1) Set an armature support on the arbor press table. See Figure 7005.

(2) Set the armature, drive end down, onto the armature support.

(3) Set the bearing and brush support assembly, brush holder side down, onto the commutator end of the armature shaft.

(4) Set an inner race bearing driver onto the anti-drive end ball bearing installed in the bearing and brush support assembly.

(5) Press the ball bearing in the bearing and brush support assembly onto the armature shaft.

(6) Make sure that the ball bearing is fully seated against the shoulder of the armature shaft.

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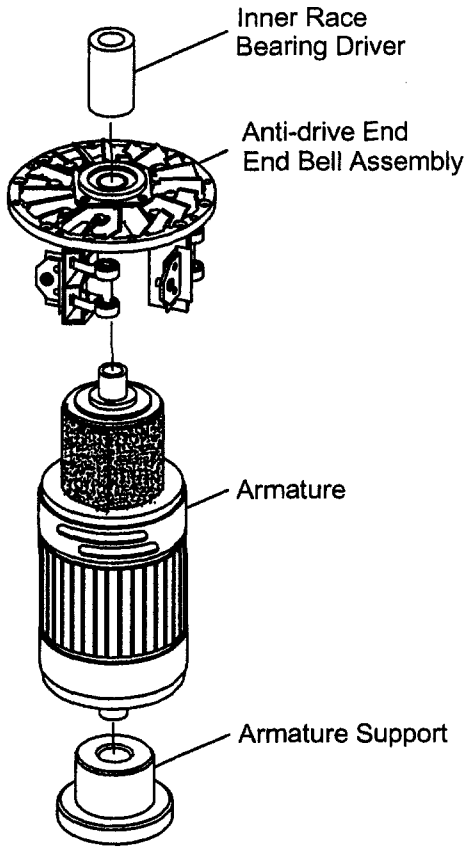


Figure 7005 - Attach Bearing and Brush Support Assembly to Armature

E. Install armature (175) and bearing and brush support assembly (200) into stator and housing assembly.

(1) Set the stator and housing assembly (275) stator end down on a vertical stator support. See Figure 7006.

(2) Set the bearing and brush support assembly (200) with its attached armature (175) into the stator and housing assembly (275) lining up the eight screw holes for attachment with screws.

(3) Apply thread sealing compound on each of the eight screws (205).

(4) Place a lock washer (210) and flat washer (215) on each of the eight screws (205) and attach them through the bearing and brush support assembly to the stator and housing assembly.

(5) Torque screws to 18-24 in. lb. (2.0 to 2.7 N·m)

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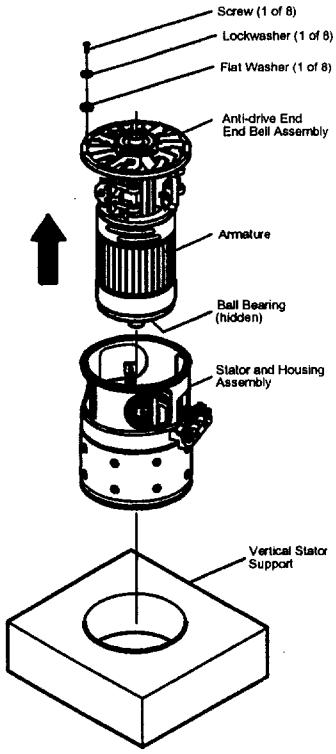


Figure 7006 - Install Armature and Bearing and Brush Support Assembly

F. Install drive-end end bell assembly (115) end bell (150) or (155) on stator and housing assembly (275).

(1) Set stator and housing assembly with armature and brush support on a horizontal stator support.

(2) Position drive end end bell assembly (150) or (155 - see note) on stator assembly Fig 9012.

NOTE: On the following models with the rounded end bell configuration (155), a dowel pin hole in the end bell must be aligned with the terminal block in a specific way for proper installation.

(Models 23048-004/M/T/TM, 23048-006, 23048-008) Looking from the drive end, a dowel pin hole must be positioned 180° away (directly opposite) from the terminal block.

(Models 23048-014 thru 23048-018, 23048-021, 23048-023, 23048-027, 23048-028) Looking from the drive end, a dowel pin hole must be positioned directly in line with the terminal block.

(3) Ensure that end bell assembly is fully seated on bearing (170).

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WARNING: THREAD SEALING COMPOUND IS FLAMMABLE. DO NOT USE NEAR OPEN FLAMES OR SPARKS. USE IN A WELL-VENTILATED AREA.

(4) Apply thread sealing compound to threads of screws (120). Install screws (120), lock washers (125), and flat washers (130).

NOTE: End bell (150) uses eight screws with no washers and end bell (155) uses twelve screws with washers.

G. Place the dampener backplate (110) and friction ring (105) onto armature shaft.

CAUTION: Do not use the arbor press to force the dampener backplate onto the armature shaft.

(1) Hand twist the dampener backplate (110) onto the drive end of the armature shaft until it is fully seated on shaft taper. Refer to Figure 7007.

(2) Check runout of backplate radial surface while rotating armature on its bearings. Runout shall not exceed 0.003 inch T.I.R.

(3) Hand press the friction ring (105) into the recess of the dampener backplate.

(4) Place friction ring in dampener backplate.

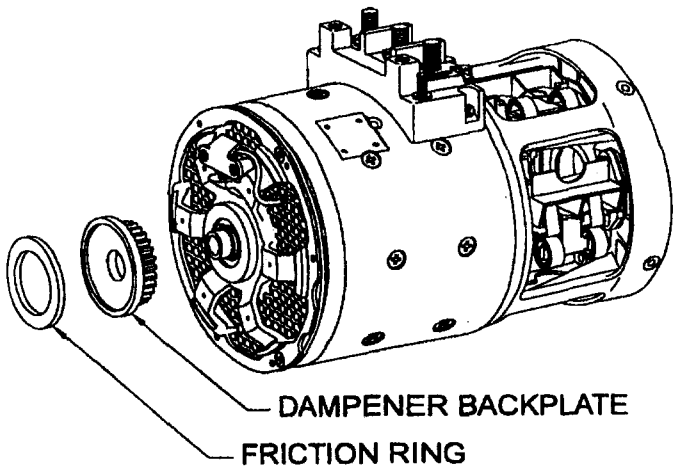


Figure 7007 - Installing Dampener Backplate

H. Assemble the dampener hub (100) and dampener plate (95) onto the drive shaft (85).

CAUTION: Do not force the dampener hub onto the mating taper of the drive shaft. The hub can fracture if excessive pressure is used.

(1) If the dampener hub (100) was removed from the drive shaft, hand twist the dampener hub onto the drive shaft taper and make sure it is fully seated.

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(2) Put Dampener Plate into dampener plate driver. FIgure 9010. Refer to Figure 7008.

(3) Insert the drive shaft (85) through the dampener plate, while aligning the dampener plate and dampener hub splines.

(4) Lightly tap the drive end of the drive shaft using a leather or plastic mallet to seat the dampener plate onto the dampener hub.

(5) Make certain that spline on plate engages with spline on hub and fully bottoms on shoulder of hub.

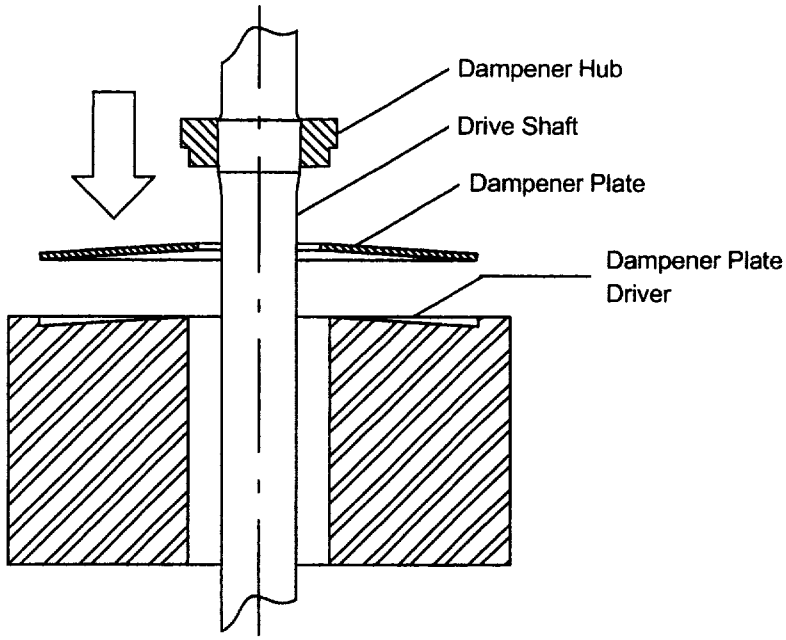


Figure 7008 - Assembling Dampener Hub and Plate

I. Install drive shaft (85) and fan assembly (70).

(1) Insert drive shaft (85) through drive end of armature, making certain that drive shaft splines fully engage armature shaft splines. Refer to Figure 7009.

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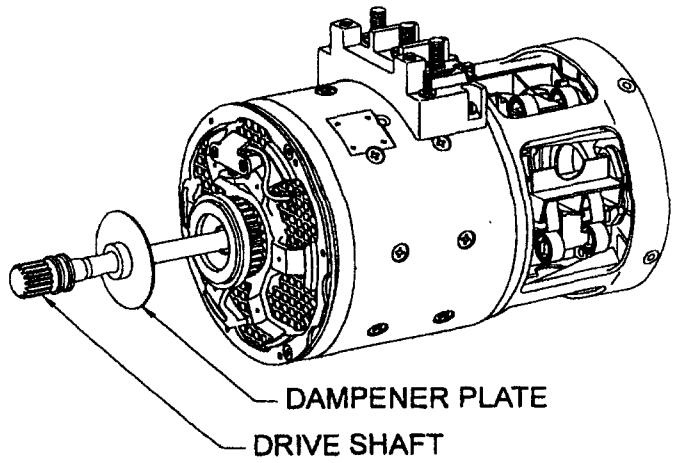


Figure 7009 - Inserting Drive Shaft into Armature Shaft

(2) Position fan assembly (70) on drive shaft and secure with washer (80) and self-locking nut (75). Refer to Figure 7010.

(3) Use a suitable spline wrench to hold drive shaft (85) and tighten nut (75) 100 to 120 in-lbs (11.3 to 13.6 Nm).

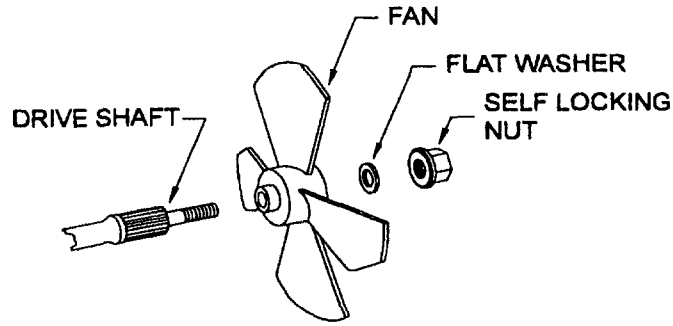


Figure 7010 - Attaching Fan to Drive Shaft

J. Install four brushes (60) and brush access cover (50).

NOTE: See REPAIR section for correct position of brush wire leads and for proper seating of brushes.

(1) Install brushes (60) into brush holders and secure brush and field leads with four screws (65).

NOTE: In the following step, the cover air bleed holes must be toward the terminal block.

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(2) Looking from fan end, position brush access cover (50) on housing with clamp screw (55) located 90° counterclockwise from center terminal on terminal block. Secure cover with screw (55).

K. Install fan cover (25) or (30).

(1) Fan cover (25) Installation.

(a) Position fan cover on support assembly in a manner that allows grooves in cover to accomplish a locking effect.

(b) Rotate cover either clockwise or counterclockwise to lock in place.

(2) Fan cover (30) Installation.

NOTE: If installing fan cover that uses a gasket, check that gasket (45) is in place, secure, and undamaged. If missing, loose, or damaged, replace gasket IAW instruction in the REPAIR section.

(a) Position fan cover on support assembly and align screw holes in cover with screw holes in support assembly.

(b) Install four screws (40) to secure cover.

L. Attach air inlet (5), if used.

(1) Position air inlet (5) on stator housing in the correct orientation.

(2) Install rim clenching clamp (10) on air inlet and tighten nut to 25 in-lb (2.83 Nm).

M. If removed, attach the modification status label (340) and identification plate (345).

CAUTION: Do not stamp information directly onto any part of the stator and housing

NOTE: Full re-identification instructions are given in the applicable service bulletins.

(1) If the starter-generator has been modified:

(a) Put a blank modification status label on a wooden work surface.

(b) Stamp the letter "X" under the applicable letter on the modification status label.

(c) Apply the modification status label to the stator and housing assembly next to the identification plate.

(2) If the original identification plate was damaged:

(a) Put a replacement identification plate on a wooden work surface.

(b) Transfer all of the information from the original identification plate to the replacement identification plate using a 1/8-inch (3.18 mm) letter punch set and a light hammer.

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(c) Attach the identification plate to the stator and housing assembly.

(d) Apply a coating of acrylic to the replacement identification plate.

7. Mandatory Acceptance Testing

Test the starter-generator according to the procedures in the TESTING AND FAULT ISOLATION section before it is returned to service or stored.

8. Preparation for Shipment/Storage

After mandatory acceptance testing is completed, prepare the starter-generator for shipment or storage.

A. Package the generator for shipment or storage.

(1) Wrap the drive spline with protective paper according to MIL-B-121A, Grade A, Type II, Class 1.

(2) For shipment or storage, seal starter-generator unit in suitable plastic container to protect against corrosion and airborne contaminants. Refer to STORAGE section in this manual for packing materials.

(3) For shipment, package the unit in its original shipping container if possible. Include applicable inspection, test, repair, and installation documents. Otherwise, package sealed unit in accordance with best commercial practices. Refer to STORAGE section in this manual for packing materials.

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FITS AND CLEARANCES

1. Torque Values

Refer to Table 8001 for torque values to be used during repair and assembly.

IPL Figure and Item Number	Item	Torque lb-in (Nm)
10001-11	Fan Nut	100 to 120 (11.3 to 13.6)
10001-30	Brush Holder Bolt	25 to 30 (2.83 to 3.39)

Table 8001 - Torque Values

2. Component Acceptance Limits

Refer to Table 8002 for the acceptance limits applicable to starter-generator components and subassemblies. Paragraph designations in the CHECK column refer to the applicable inspection procedures found in the CHECK section, except where noted. Item numbers in parentheses () refer to a figure and an item number in the ILLUSTRATED PARTS LIST.

CHECK section	Item Description	Inspect for...	Acceptance Limits
7.E.	Fan assembly (10001-70) for models 23048-004/M/T/TM and 23048-008	Protrusion toward the unit locating shoulder of fan hub	0.050 in. (1.27 mm) maximum
7.F.(5)	Drive shaft - 12 tooth (10001-85) used on all models except Model 23048-023	Drive end spline dia. over two 0.1094 in. (2.7788 mm) dia. pins	0.757 in. (19.2278 mm) minimum
	Drive shaft - 16 tooth (10001-85) used on models 23048-023	Drive end spline dia. over two 0.1094 in. (2.7788 mm) dia. pins	0.958 in. (24.3332 mm) minimum
7.G.	Friction ring (10001-13B)	Thickness	0.063 in. (1.52 mm) minimum
7.H.	Dampener plate (10001-90)	Thickness	0.038 in. (0.97 mm) minimum
		Internal spline dia. over two 0.090 in. (2.28 mm) dia. pins	0.6550 in. (16.637 mm) maximum

Table 8002 - Acceptance Limits

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CHECK section	Item Description	Inspect for...	Acceptance Limits
7.J.(3)	Drive-end end bell (10001-21)	Bearing liner diameter	1.8501 in. (46.9925 mm) minimum 1.8504 in. (47.0002 mm) maximum
7.N.(3)	Brush support endbell (10001-37)	Bearing liner diameter	1.8501 in. (46.9925 mm) minimum 1.8504 in. (47.0002 mm) maximum
7.L.(2)	Armature assy (10001-25)	Commutator bar-to-bar concentricity	Within 0.0002 in. (0.0051 mm)
		Commutator concentricity with shaft	Within 0.0008 in. (0.0203 mm) T.I.R.
		Commutator diameter	Not less than 2.055 in. (52.197 mm)
7.L.(6)	Armature assy (10001-25)	Bearing journal diameter (Both ends)	0.7872 to 0.7875 in. (19.9948 to 20.0025 mm)
7.P.(1)	QAD Kit End Bell (366)	Dowel Pin Projection	.115 (2.921 mm) minimum
REPAIR 7.B.	Armature Assembly (10001-175)	Mica Undercut	0.045 (1.143 mm) minimum
REPAIR 8.C.	Armature assy (10001-25)	Armature assy balance	5 grain inches (8.2 gr mm) max. (each end)

Table 8002 - Acceptance Limits

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SPECIAL TOOLS, FIXTURES, AND EQUIPMENT

1. Introduction

Table 9001 lists items that are approved for use during repair and overhaul of all 23048 Series DC Starter-Generators.

Reference Standard Practice Document (SPD) 1004 for the 23048 Series Brush Holder Alignment Fixtures.

Item	Figure No.
Wrench, Spline	9001
Support, Anti-Drive End, End Bell Assembly	9002
Driver, Dampener Hub	9003
Adapter, Armature Shaft (Drive End)	9004
Adapter, Armature Shaft (Anti Drive End)	9005
Drivers, Bearing (Inner Race and Outer Race)	9006
Adapter, Commutator Viewing	9007
Fixture, Commutator Turning	9008
Support, Armature	9009
Driver, Dampener Plate	9010
Support, Stator, Vertical	9011
Support, Stator, Horizontal	9012
Support, Anti-Drive End, End Bell Assembly Support	9013
Brush Holder, Alignment Fixture	SPD 1004

Table 9001 - Special Tools, Fixtures, and Equipment

2. Illustrated Description of Tools

Drawings in this section provide material and fabrication instructions for making tools or fixtures listed in Table 9001. Where dimensions and fabrication instructions are provided, the tool or fixture is approved for local manufacture. Unless otherwise specified, all dimensions are in inches.

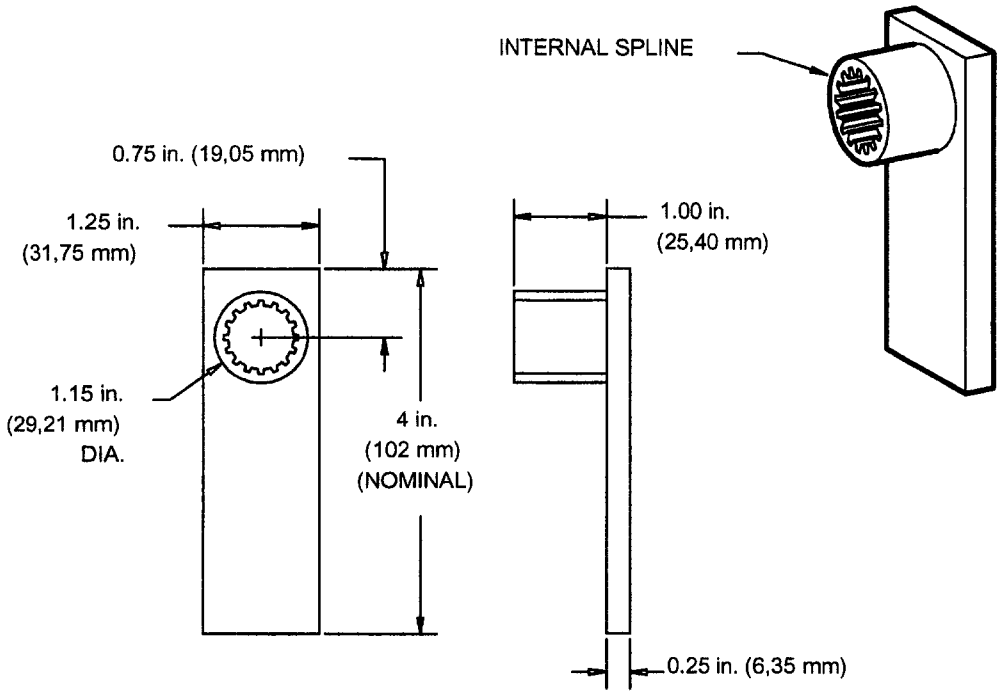
The tools and fixtures cannot be procured from TRW Aeronautical Systems, TRW Lucas Aerospace. Equivalent tooling and fixture requirements meeting with TRW Aeronautical Systems, TRW Lucas Aerospace specifications can be used.

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A. Spline Wrench

Material: Spline socket - AISI-01 tool steelor equivalent.
Hardened to Rockwell C 55-60
Handle: C.R.S.

Tolerances on: Decimals 0.XX ± 0.01 (0,25 mm)
0.XXX ± 0.005 (1,27 mm)



FOR ALL MODELS EXCEPT 23048-023

Internal Involute Spline Data Fillet Root Side Fit	inch	mm
Number of Teeth	12	
Diametral Pitch	20 / 40	
Pressure Angle	30 DEG.	
Pitch Diameter	0.6000	15,240
Minor Diameter (min.)	0.5550	14,097
Major Diameter (min.)	0.6500	16,510
Chord Space (min.)	0.0730	1,853
Pin Diameter	0.0720	1,829
Between three .072 Pins (min.)	0.5095	12,941

MODEL 23048-023 ONLY

Internal Involute Spline Data Fillet Root Side Fit	inch	mm
Number of Teeth	16	
Diametral Pitch	20 / 40	
Pressure Angle	30 DEG.	
Pitch Diameter	0.8000	20,320
Minor Diameter (min.)	0.7270	18,590
Major Diameter (min.)	0.8640	21,946
Chord Space (min.)	0.0728	1,849
Pin Diameter	0.0720	1,829
Between three .072 Pins (min.)	0.7096	18,024

Figure 9001 - Spline Wrench

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B. Anti-Drive End Hub Support

Material: AISI-01 tool steel or equivalent
Harden to Rockwell C 35-40

Tolerances on: Decimals .XX ± 0.01 (0.25 mm)
.XXX ± 0.005 (0,127)

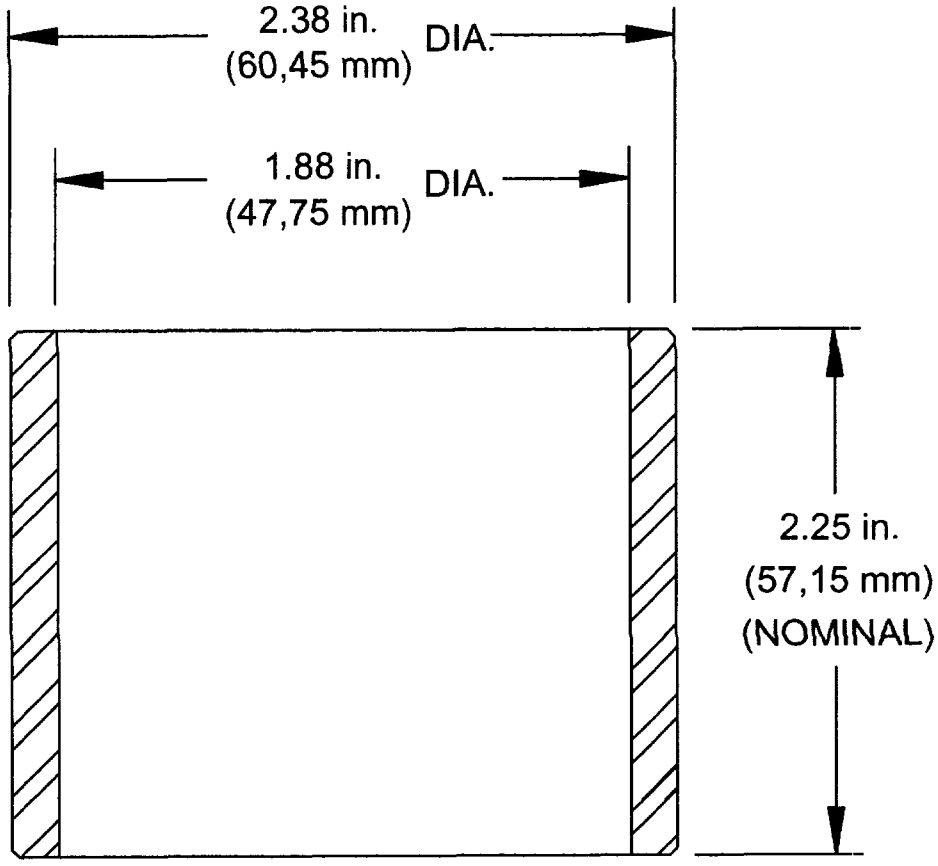


Figure 9002 - Anti-Drive End Hub Support

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C. Dampener Hub Driver

Material: AISI-01 tool steel or equivalent

Tolerances on: Decimals .XX ± 0.01 (0.25 mm)
.XXX ± 0.005 (0,127)

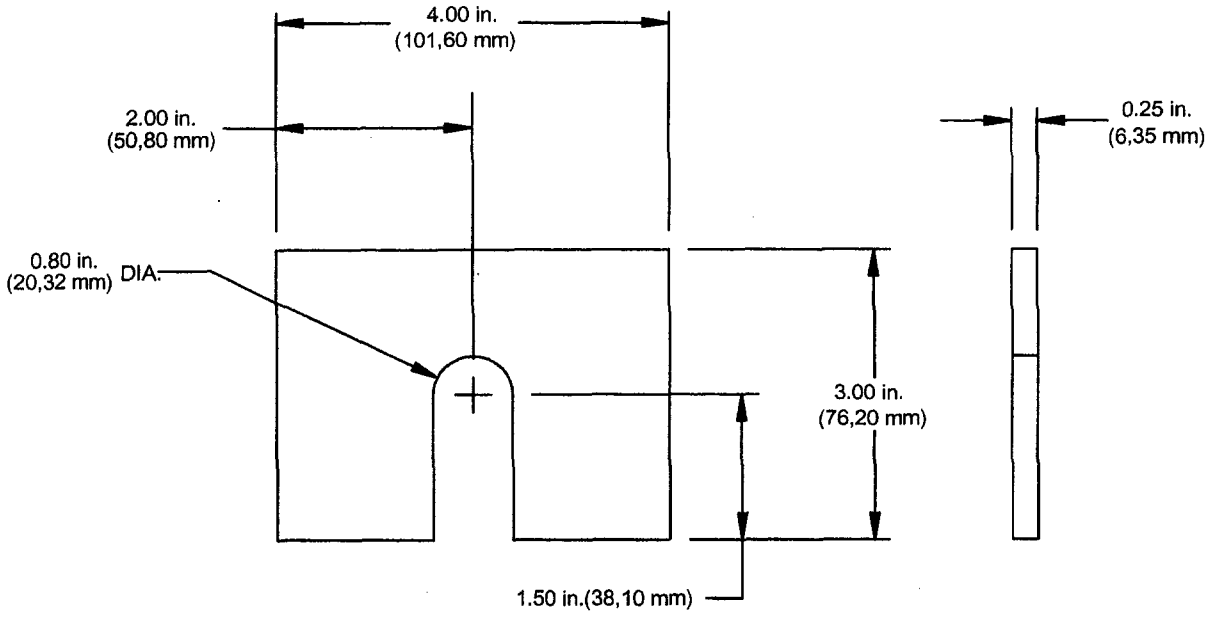


Figure 9003 - Dampener Hub Driver

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D. Armature Shaft Adapter

Tolerances on decimals 0.XX ± 0.01 (0,25), 0.XXX ± 0.005 (0,127). Machined ends to be parallel to within 0.001 in. (0,025) and square with sidewalls within ±0.05 degree, Materials: Brass CD-260

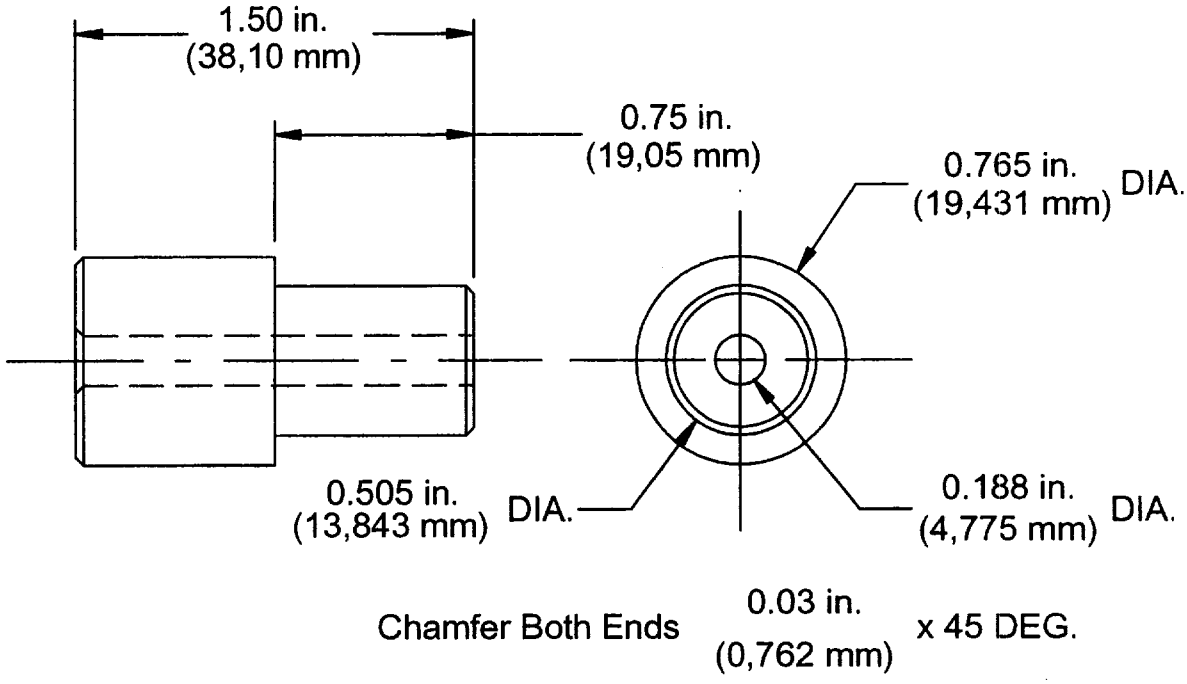


Figure 9004 - Drive End Armature Shaft Adapter

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E. Armature Shaft Adapters

Tolerances on decimals 0.XX ± 0.01 (0,25), 0.XXX ± 0.005 (0,127). Machined ends to be parallel to within 0.001 in. (0,025) and square with sidewalls within ±0.05 degree. Materials: Brass, CD-260

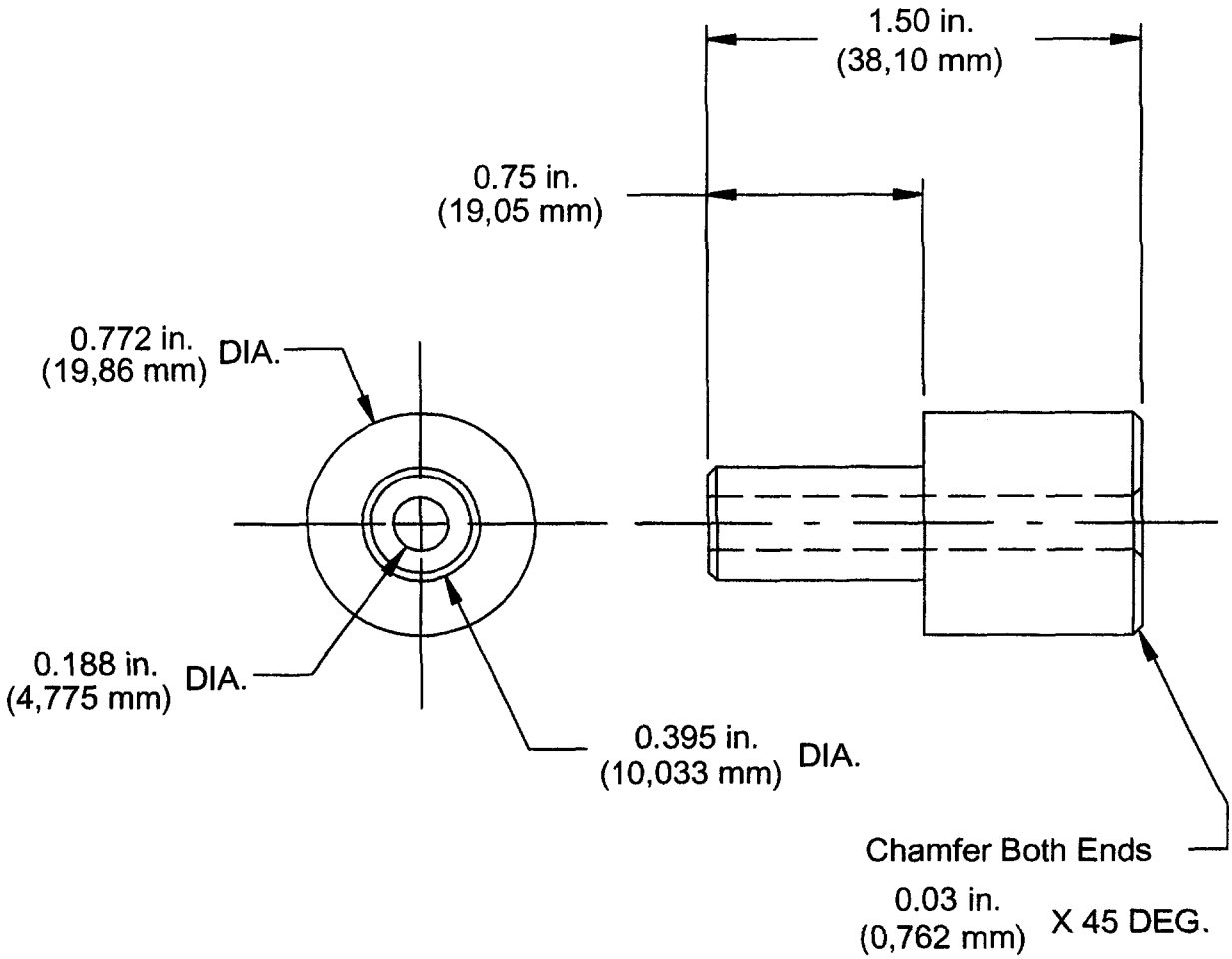


Figure 9005 - Anti-Drive End Armature Shaft Adapter

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F. Bearing Drivers (Inner Race and Outer Race)

Material: O1 tool steel or equivalent

Stock Size: 2.00 diameter (50,8 mm)

Tolerances on: Decimals .XX ± 0.01 (0,25)
.XXX ± 0.005 (0,127)

Angles: ±5°

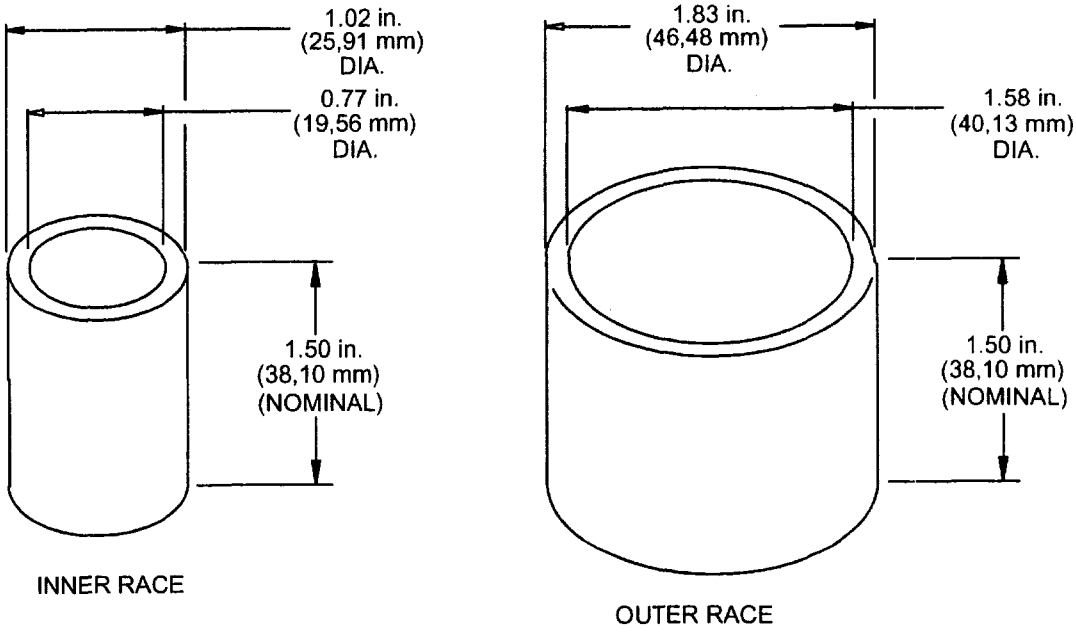


Figure 9006 - Bearing Drivers

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G. Commutator Viewing Adapter (Figure 9007)

Clear acrylic viewing adapter fabrication

Required Materials: Clear acrylic, 0.125 in. (3,175) thick, A dummy brush access cover, Adhesive

(1) Cut acrylic to size, 19 x 2.6 in. (482,6 x 66,04)

(2) Remove brackets from a dummy brush access cover.

(3) Apply adhesive to ends of acrylic.

(4) Attach brackets to acrylic.

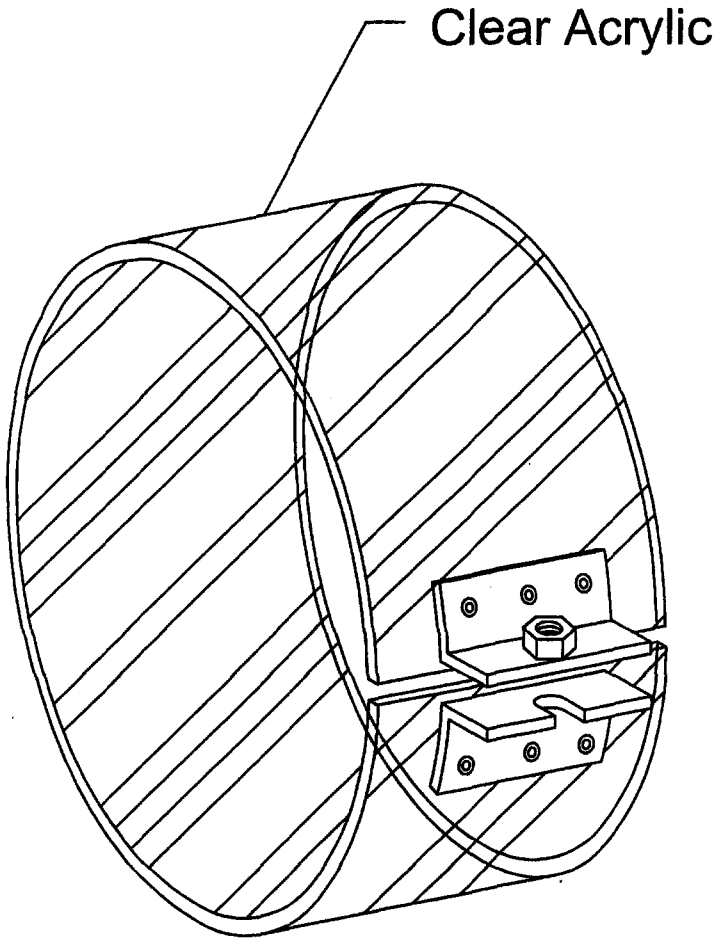


Figure 9007 - Commutator Viewing Adapter

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H. Commutator Turning Fixture (Figure 9008)

Tolerances on decimals 0.XX ± 0.01 (0,25), 0.XXX ± 0.005 (0,127). Machined ends to be parallel to within 0.001 in. (0,025) and square with sidewalls within ±0.05 degree. Harden steel to Rockwell C 35-40. Material: 1040 Steel, Stock size: 2.50 in. (63,5) diameter

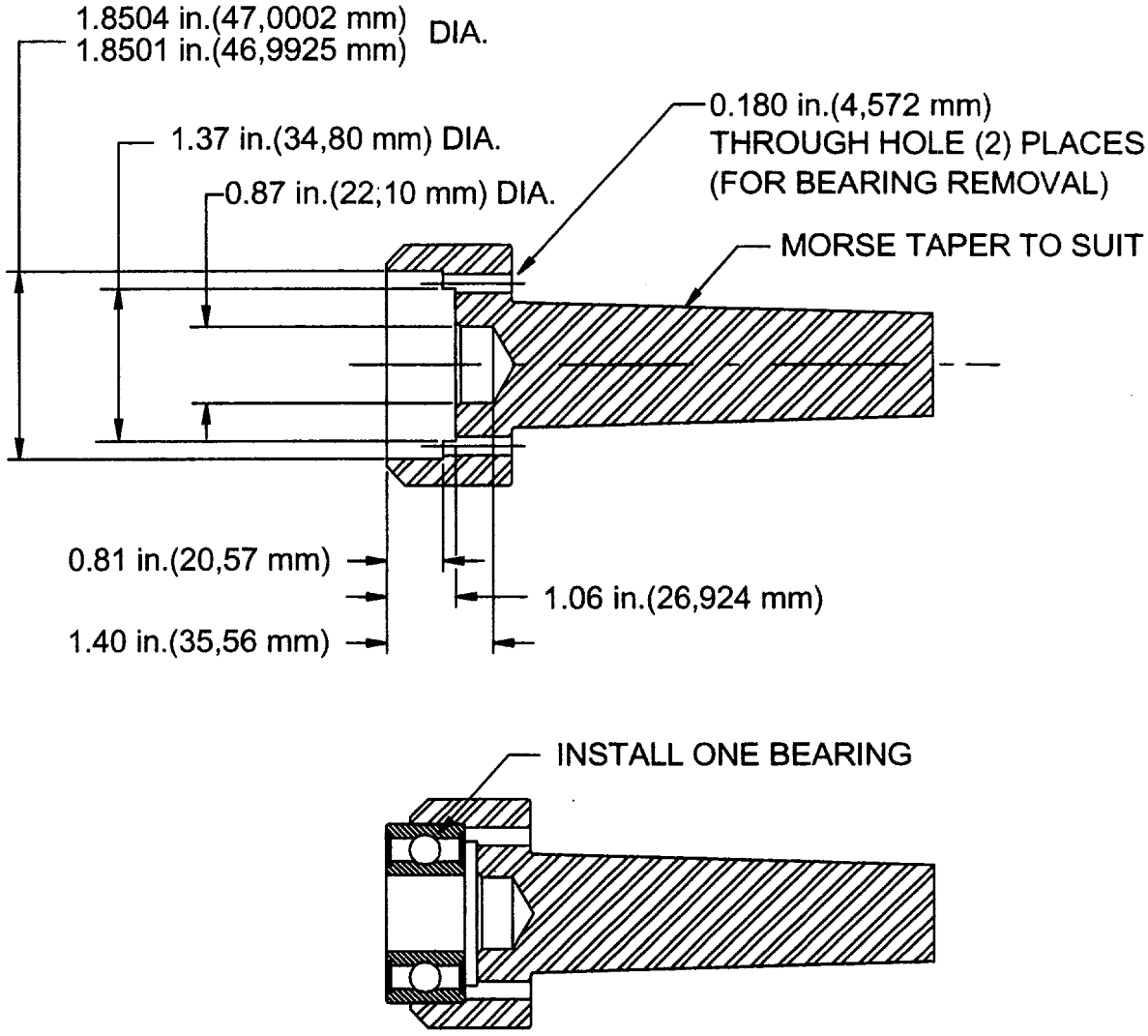


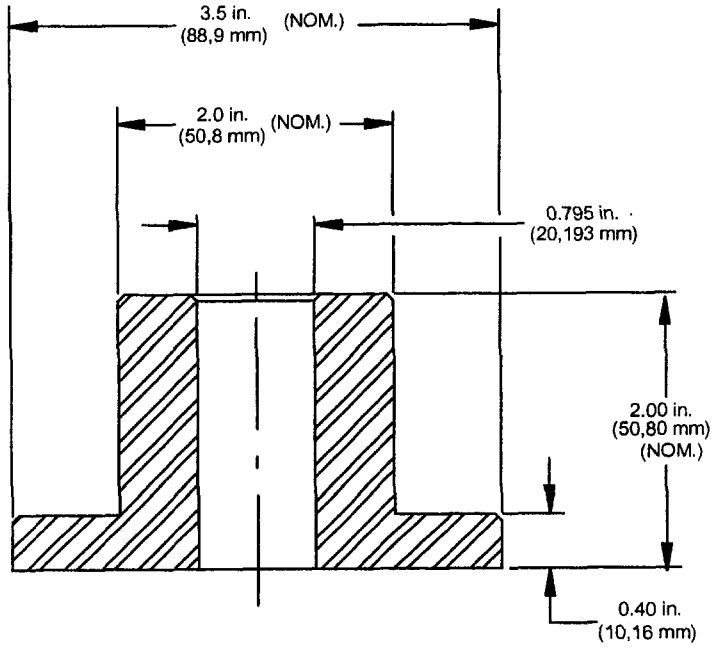
Figure 9008 - Commutator Turning Fixture

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I. Armature Support

Material: O-1 tool steel, 35-40

Tolerances on: Decimals 0.XX ± 0.01 (0,25)
0.XXX ± 0.005 (0,127)



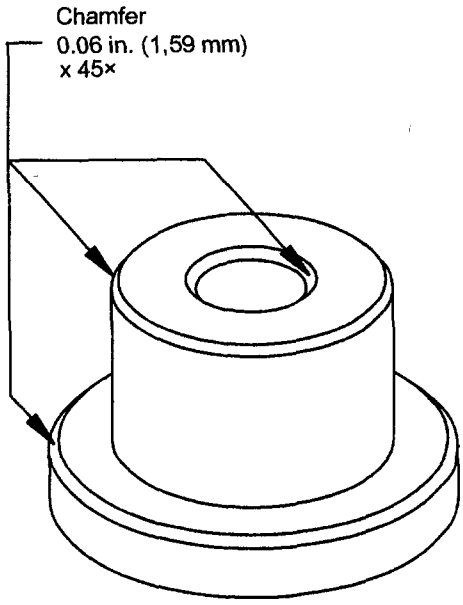


Figure 9009 - Armature Support

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J. Dampener Plate Driver

Material:	O1 tool steel or equivalent Harden to Rockwell C 55-60.
Stock Size:	3.0 diameter (76,2 mm)
Tolerances on:	.XX ± 0.01 (0,25) .XXX ± 0.005 (0,127)
Angles:	±1°

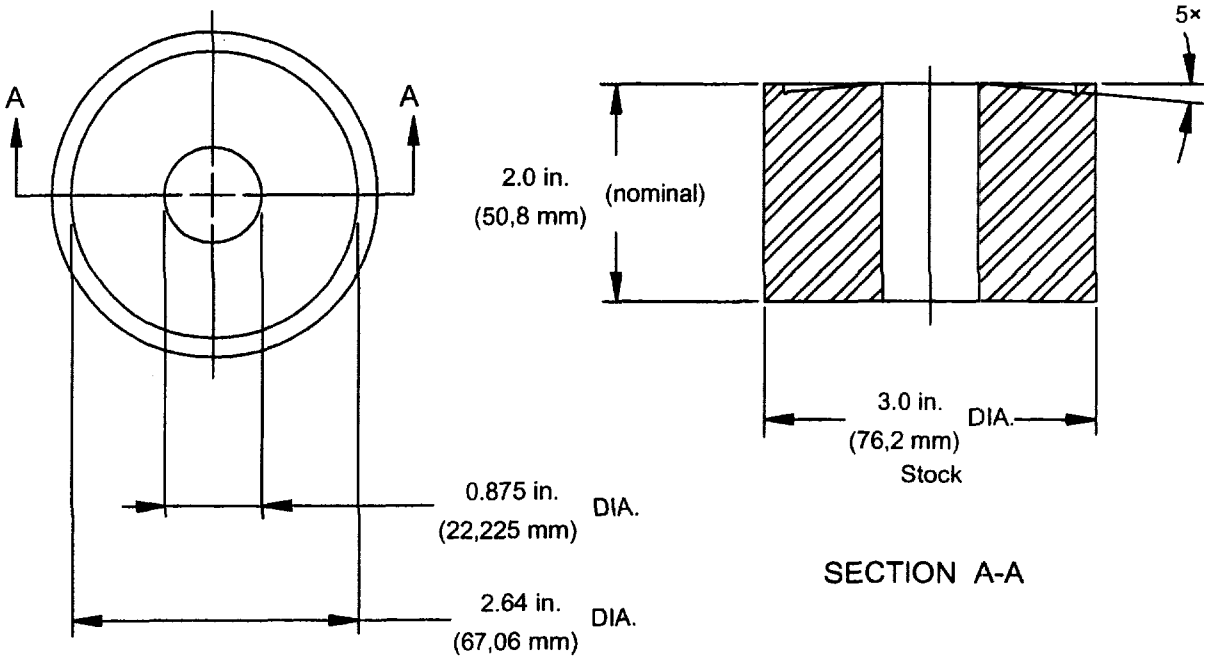


Figure 9010 - Dampener Plate Driver

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K. Vertical Stator Support

All dimensions are nominal. The material is any suitable hardwood.

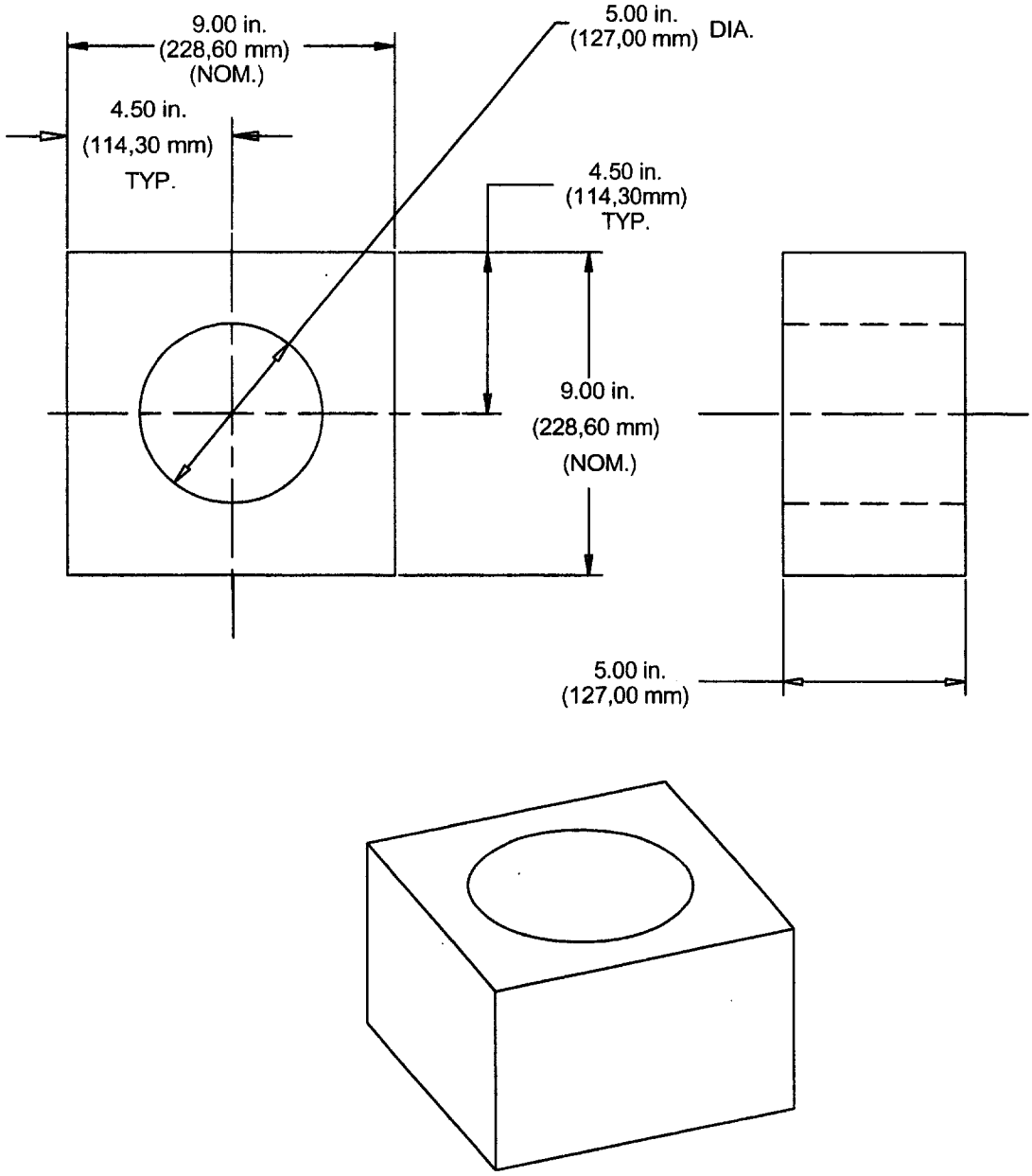


Figure 9011 - Vertical Stator Support

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L. Horizontal Stator Support

Material:	Hardwood	
Stock Size:	7 x 4 x 3 (177,8 x 101,6 x 76.2)	
Tolerances on:	Decimals	.XX ± 0.01 (0.25 mm) .XXX ± 0.005 (0,127)
Angles:	±5°	

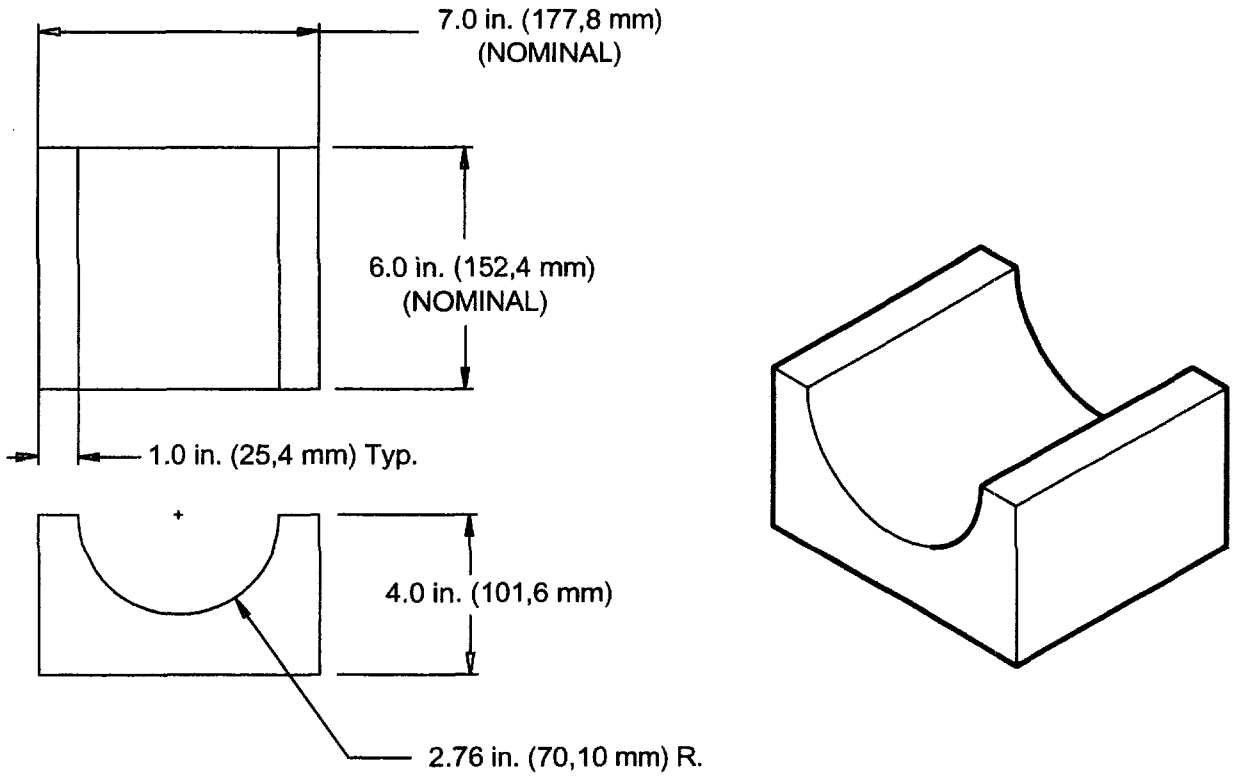


Figure 9012 - Horizontal Stator Support

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M. Anti-drive End End Bell Assembly Support

Material: O1 tool steel or equivalent

Stock Size: 6.0 diameter (152,4 mm)

Tolerances on: Decimals .XX ± 0.01 (0.25 mm)
.XXX ± 0.005 (0,127)

Angles: ±5°

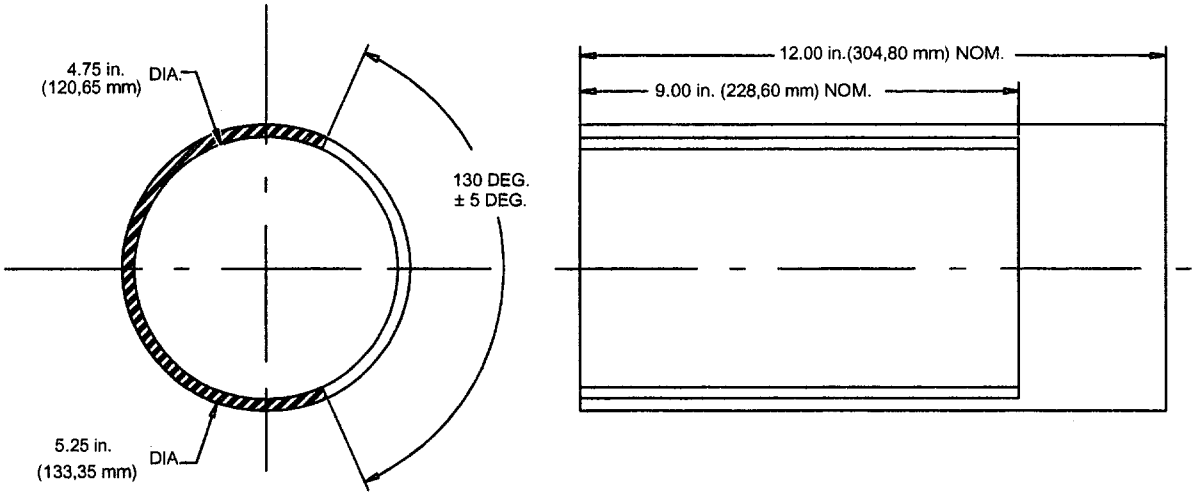


Figure 9013 - Anti-drive End, End Bell Assembly Support

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ILLUSTRATED PARTS LIST

1. Introduction

This illustrated parts list provides a detailed listing of assemblies, subassemblies, and components for the 23048 Series of DC Starter-Generators. Figure 10001 illustrates the starter-generator top-assembly breakdown. The item number sequence in Figure 10001 reflects the order of disassembly in the DISASSEMBLY section. Attaching parts/hardware is listed immediately after the parts they attach.

All replacement parts are manufactured or source-controlled by TRW Aeronautical Systems, Lucas Aerospace, Aurora, OH with the exception of those parts assigned a military standard (MS), and Army Navy (AN), or a National Aerospace Standard (NAS) part number.

CAUTION: The use of parts, materials, or processes not authorized by TRW Aeronautical Systems, Lucas Aerospace for the maintenance or overhaul of the DC starter-generator may affect the continued flight worthiness of the unit and may invalidate it's certification.

2. Arrangement of the Parts List

A. Figure and Item Number

The figure number indicates the figure where the part is illustrated. Each item number corresponds to the part illustrated in the figure. Several item numbers may have a letter following the number (e.g., 10A). This letter designation indicates the part corresponds to the base item number and is the same in function and location as the base part number (e.g., 10) but may differ in form or material.

B. Part Number

The part numbers listed in this document are the only authorized parts for replacement and overhaul of the DC starter-generator. This list mainly consists of TRW Aeronautical Systems, Lucas Aerospace part numbers but does include military standards (MS), Army Navy (AN) standard, and National Aerospace Standard (NAS) part numbers.

C. Nomenclature

The correct name of each item is listed in this column. Parts are listed in the general order of disassembly with the exception of attaching hardware. When necessary, a part description or reference note is provided such as:

Replaced by:	The part number listed is discontinued and should be replaced by the new part number. The original part may be used until the current stock is depleted, and then it must be replaced by the new part listed.
Replaces:	The part number listed should be used in place of the discontinued part after the original part stock is depleted.
Alternate:	Either part may be used.

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Superseded by:	The part number listed is obsolete and must be replaced by the new part number during the next repair or overhaul of the generator. The superseded part is not to be installed or re-installed.
Supersedes:	The part number listed must replace the obsolete part number during the next repair or overhaul of the generator.
Order separately:	The part is not furnished as part of the generator as defined in this parts list.

D. Effect Code

Each generator model is assigned a unique effectivity code (A through Z). Subsequent items within the parts list pertaining to Figure 10001 will refer to the effectivity codes that correspond to a particular model. In subsequent figures, the effectivity code is redefined for each major subassembly and remains independent of all other main assembly and subassemblies defined in figures within this section. In cases where a part is used on all assemblies, the effect code is left blank.

E. Units Per Assembly

This column indicates the quantity of parts used at the location shown. For bulk items, the abbreviation AR indicates that the part is used on an "as required" basis. The abbreviation RF indicates that the item is listed for "reference only".

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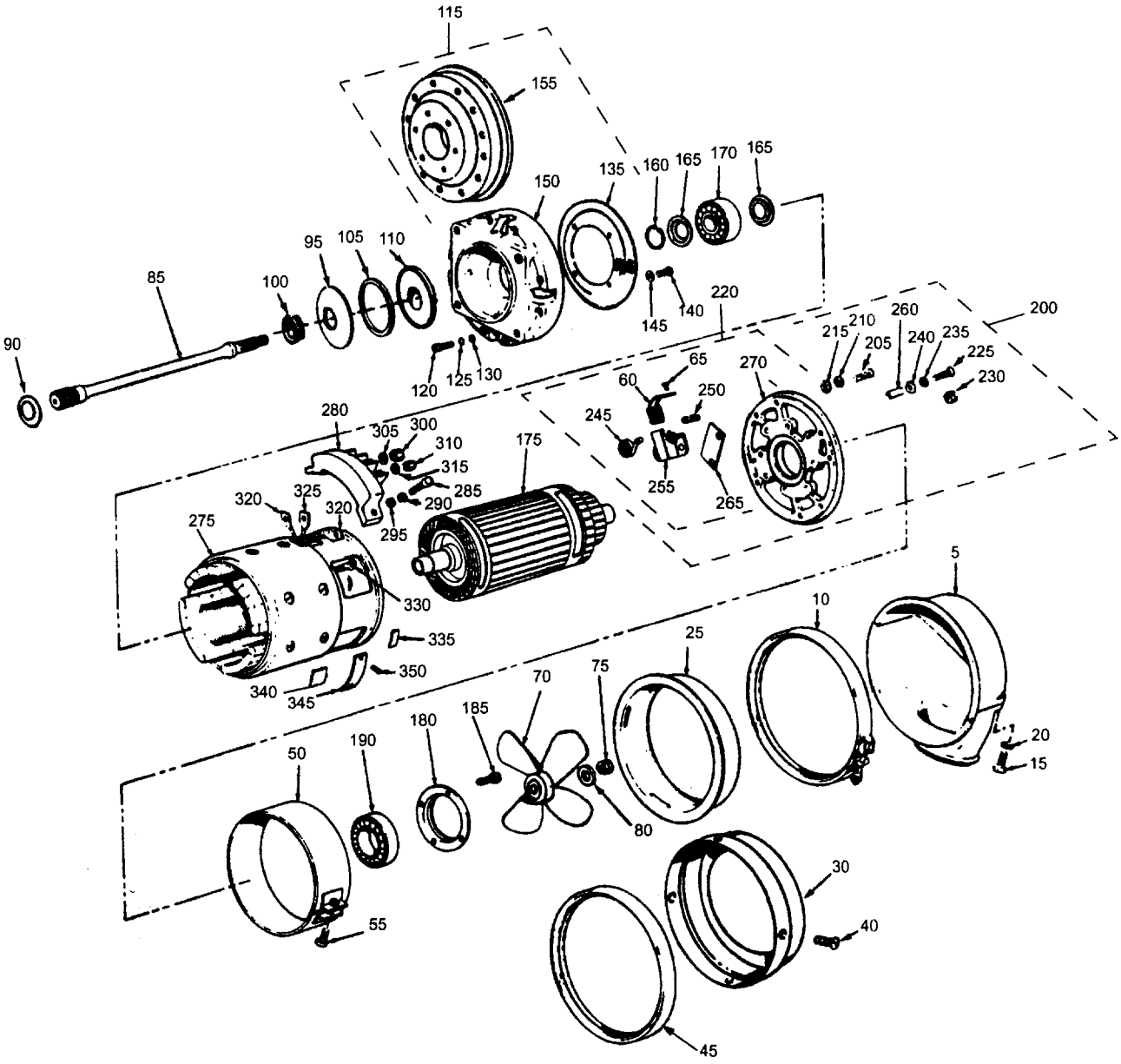


Figure 10001 - D.C. Starter-Generator

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FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-	23048-001	STARTER-GENERATOR . . . . . (Direct mount. No QAD kit required.)	A	RF
	23048-004	STARTER-GENERATOR . . . . . (Requires QAD kit 23048-511 for mounting. QAD kit must be ordered separately.)	B	RF
	23048-006	STARTER-GENERATOR . . . . . (Requires QAD kit 23048-520 for mounting. QAD kit must be ordered separately.)	C	RF
	23048-008	STARTER-GENERATOR . . . . . (Requires QAD kit 23048-511 for mounting. QAD kit must be ordered separately.)	D	RF
	23048-012	STARTER-GENERATOR . . . . . (Direct mount. No QAD kit required.)	E	RF
	23048-014	STARTER-GENERATOR . . . . . (Requires QAD kit 23048-512 for mounting. QAD kit must be ordered separately.)	F	RF
	23048-015	STARTER-GENERATOR . . . . . (Requires QAD kit 23048-512 for mounting. QAD kit must be ordered separately.)	G	RF
	23048-016	STARTER-GENERATOR . . . . . (Requires QAD kit 23048-521 for mounting. QAD kit must be ordered separately.)	H	RF
	23048-017	STARTER-GENERATOR . . . . . (Requires QAD kit 23048-512 for mounting. QAD kit must be ordered separately.)	I	RF
	23048-018	STARTER-GENERATOR . . . . . (Requires QAD kit 23048-520 for mounting. QAD kit must be ordered separately.	J	RF
	23048-020	STARTER-GENERATOR . . . . . (Requires QAD kit 23048-521 for mounting. QAD kit must be ordered separately.)	K	RF
	23048-021	STARTER-GENERATOR . . . . . (Requires QAD kit 23048-512 for mounting. QAD kit must be ordered separately.)	L	RF

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FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
	23048-023	STARTER-GENERATOR . . . . . (Requires QAD kit 23048-510 for mounting. QAD kit must be ordered separately.)	M	RF
	23048-022	STARTER-GENERATOR . . . . . ((Direct mount. No QAD kit required.)	N	RF
	23048-004T	STARTER-GENERATOR . . . . . (Requires QAD kit 23048-511 for mounting. QAD kit must be ordered separately.)	O	RF
	23048-004M	STARTER-GENERATOR . . . . . (Requires QAD kit 23048-511 for mounting. QAD kit must be ordered separately.)	P	RF
	23048-004TM	STARTER-GENERATOR . . . . . (Requires QAD kit 23048-511 for mounting. QAD kit must be ordered separately.)	Q	RF
	23048-027	STARTER-GENERATOR . . . . . (This model is provided with QAD kit 23046-521)	R	RF
	23048-028	STARTER-GENERATOR . . . . . (Requires QAD kit 23048-521 for mounting. QAD kit must be ordered separately.)	S	RF
5	23048-1040	• INLET ASSY, Air (Matched Set) . . . . . (ATTACHING PARTS)	ACIKN	1
10	23032-1586	• CLAMP, Rim Clenching	ACIKN	1
	23032-1580	• CLAMP, Rim Clenching . . . . . (Alternate for 23032-1586)	ACIKN	1
15	MS35266-65	• SCREW	ACIKN	2
20	AN960-10	• WASHER	ACIKN	2
25	23048-1000	• COVER ASSY, Fan	ACIKN	1
30	23048-1220	• COVER ASSY, Fan	BDOPQ	1
	23048-1250	• COVER ASSY, Fan (Superseded by 23048-1101)	EFGHJM	RF
	23046-1090	• COVER ASSY, Fan	LRS	1
35	23048-1101	• COVER ASSY, Fan . . . . . (Supersedes 23048-1250) (Requires gasket 23048-1260) (ATTACHING PARTS)	EFGHJM	1
40	05-340122	• • SCREW	BDEFGH JLMOPQ RS	4

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FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
45	23048-1260	• • GASKET, Fan cover (Used with Fan Cover 23048-1101) ---------- * ----------	EFGHJM	1
50	23048-1121	• COVER, Brush	ABCKOPQ	1
	23048-1270	• COVER, Brush	D	1
	23048-1360	• COVER, Brush (ATTACHING PARTS)	EFGHIJLMN	1
55	AN502-10-14	• • SCREW		1
60	30010-1026	• BRUSH	ABCDOPQ	4
	30300-1282	• BRUSH	FGIN	4
	30300-1285	• BRUSH	E	4
	30300-1284	• BRUSH (Superseded by 30300-1286)	H	4
	30300-1286	• BRUSH (Supersedes 30300-1284) (ATTACHING PARTS)	HJKLMRS	4
65	05-340201	• • SCREW ---------- * ----------		4
70	23046-1020	• FAN ASSY (Superseded by 23048-1480)	ACEFGHJKL	1
	23048-1480	• FAN, Axial (Supersedes 23045-1020)	ACEFGHIJKLMNRS	1
	23048-1490	• FAN, Axial	BDOPQ	1
	23048-1240	• FAN ASSY (Alternate. for 23048-1490) (ATTACHING PARTS)	BDOPQ	1
75	02-4107-01	• • NUT, Self Locking		1
80	AN960-416L	• • WASHER, Flat (Use with Axial Fan 23048-1480 and 23048-1490)		1
85	23046-1121	• SHAFT, Drive	ACEFGIJLN	1
	23046-1125	• SHAFT, Drive	BDO	1
	02-6100-02	• SHAFT, Drive	HKRS	1
	23046-1129	• SHAFT, Drive	M	1
	23046-2153	• SHAFT, Drive	PQ	1
90	MS29561-113	• PACKING, Preformed (Superseded by MS83248/1-113)	HKRS	1

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FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
	MS83248/1-113	• PACKING, Preformed ..... (Supersedes MS29561-113)	HKRS	1
95	23032-1910	• PLATE, Dampener		1
100	23032-1900	• HUB, Dampener		1
105	02-5600-13	• RING, Friction ..... (Supersedes 02-5600-05		1
	02-5600-05	• RING, Friction ..... (Si[erseded by 02-5600-13)		RF
110	23032-2710	• BACK PLATE, Dampener		1
115	23046-1171	• END BELL ASSY, Drive End	AEN	1
	23048-1470	• END BELL ASSY, Drive End	BCDFGH IJKLMOP Q	1
	23046-1670	• END BELL ASSY, Drive End ..... (Alternate for 23048-1470) (ATTACHING PARTS)	BCDFGH IJKLMOP QRS	1
120	05-341309	• SCREW	AEN	8
	NAS1189-08-P16KW	• SCREW	BCDFGH IJKLMOP QRS	12
125	MS35338-42	• WASHER, Lock	AEN	8
130	05-370176	• WASHER, Flat	AEN	8
		--------- * ---------		
135	23046-1180	• • SCREEN ..... (ATTACHING PARTS)		1
140	MS21318-15	• • SCREW, Drive	AEN	4
	MS21318-15	• • SCREW, Drive	BCDFGH IJKLMOP QRS	6
145	AN960-4L	• • WASHER	AEN	4
	AN960-4L	• • WASHER	BCDFGH IJKLMOP QRS	6
		--------- * ---------		
150	23046-1191	• • END BELL, Drive End	AEN	1
155	23048-1460	• • END BELL, Drive End ..... (Used on 23048-1470)	BCDFGH IJKLMOP QRS	1
	23046-1630	• • END BELL, Drive End ..... (Used on alternate 23046-1670)	BCDFGH IJKLMOP QRS	1
160	MS16628-1078	• RING, Retaining		1
165	G128-178	• DISC, Baffle		2

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FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
170	07-111253	• BEARING, Ball (Superseded by 03-6010-18)	ABCDFO PQ	RF
	03-6010-08	• BEARING, Ball (Superseded by 03-6010-18)	EGHIJKL MN	RF
	03-6010-18	• BEARING, Ball. . . . . (Supesedes all above per SB 23048-0XX-24-02 for MOD B)		1
175	23048-1031	• ARMATURE (Superseded by 23048-1032)		RF
	23048-1030	• ARMATURE (Superseded by 23048-1032)		RF
	23048-1032	• ARMATURE . . . . . (Supersedes all above per SB 23048-0XX-24-03)		1
180	23046-1110	• RETAINER, Bearing	ACEFGH IJKLMNR S	1
	23046-1111	• RETAINER, Bearing . . . . . (ATTACHING PARTS)	BDOPQ	1
185	MS35265-43	• SCREW	ACEFGH IJKLMNR S	4
	MS24694-S3	• SCREW . . . . . ---------- * ----------	BDOPQ	4
190	07-111253	• BEARING, Ball. . . . . (Superseded by 03-6010-18)	ABCDFO PQ	RF
	03-6010-08	• BEARING, Ball. . . . . (Superseded by 03-6010-18)	EGHIJKL MN	RF
	03-6010-15	• BEARING, Ball. . . . . (Superseded by 03-6010-18)		RF
	03-6010-18	• BEARING, Ball. . . . . (Supesedes all above per SB 23048-0XX-24-02 for MOD B)		1
200	23046-372	• SUPPORT ASSY.	AC	1
	23046-301	• SUPPORT ASSY. . . . . (Alternate for 23046-372)	AC	1
	23046-364	• SUPPORT ASSY. . . . . (Superseded by 23046-372)	AC	1
	23046-308	• SUPPORT ASSY.	BDOPQ	1
	23046-378	• SUPPORT ASSY. . . . . (Alternate for 23046-308)	BDOPQ	1
	23046-370	• SUPPORT ASSY.	EFGHJL MRS	1

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FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
	23046-307	• SUPPORT ASSY. . . . . (Alternate for 23046-370)	EFGHJL MRS	1
200 (cont)	23046-304	• SUPPORT ASSY. . . . . (Alternate for 23046-370)	EFGHJL MRS	1
	23046-377	• SUPPORT ASSY. . . . . (Alternate for 23046-370)	EFGHJL M	1
	23046-376	• SUPPORT ASSY. . . . . (Alternate for 23046-370)	HJM	1
	23048-1440	• SUPPORT ASSY. . . . . (Superseded by 23046-370)	HJ	1
	23046-366	• SUPPORT ASSY.	IN	1
	23046-371	• SUPPORT ASSY. . . . . (For alternate use 23046-366)	K	1
	23046-340	• SUPPORT ASSY. . . . . (Alternate for 23046-366 and 23046-371)	IKN	1
	23046-379	• SUPPORT ASSY. . . . . (Alternate for 23046-366 and 23046-371) (ATTACHING PARTS)	IKN	1
205	05-350206	• SCREW	ACIKN	8
	05-341303	• SCREW	BDEFGH JLMOPQ RS	8
210	MS35338-42	• WASHER, Lock	BDEFGH JLMOPQ RS	8
215	05-370232	• WASHER, Flat . . . . . ---------- * ----------	BDEFGH JLMOPQ RS	8
220	23046-1133	• • HOLDER ASSY,Brush . . . . . (Used on 23046-372, 23046-308 and 23046-378)	ABCDOP Q	4
	23046-1132	• • HOLDER ASSY,Brush . . . . . (Used on 23046-301)	AC	4
	23048-1420	• • HOLDER ASSY,Brush . . . . . (Used on 23046-370, 23046-371 and 23046-376)	EFGHJK LMRS	4
	23064-1284	• • HOLDER ASSY,Brush . . . . . (Used on 23046-307, 23046-377, 23046-366, and 23046-379)	EFGHIJK LMRS	4
	23064-1283	• • HOLDER ASSY, Brush. . . . . (Used on 23046-304 and 23046-340) (ATTACHING PARTS)	EFGHIJK LMRS	4

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FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
225	AN3-7A	• • BOLT ..... (Used on 23046-307, 23046-308, and 23046-366)	BDEFGH IJKLMNO PQRS	8
225 (cont)	AN3-10A	• • BOLT ..... (Used on 23046-370, 23046-371, 23046-376, 23046-377, 23046-378, and 23046-379)	BDEFGH IJKLMNO PQRS	8
230	MS20364-1032C	• • NUT ..... (Used on 23046-301, 23046-304 and 23046-340)	ACEFGH IJKLMNR S	8
235	AN960-10L	• • WASHER, Plain		8
240	05-374094	• • WASHER, Non-Metallic		8
245	23033-1121	• • • SPRING		1
250	05-360013	• • • STUD, Lok-Thred ..... (Used on 23046-1132 and 23046-1283)	ACEFGH IJKLMNR S	2
255	30010-1025	• • • HOLDER, Brush ..... (Used on 23046-1132 and 23046-1133)	ABCDOP Q	1
	23064-1180	• • • HOLDER, Brush ..... (Used on 23064-1283 and 23064-1284)	EFGHIJK LMNRS	1
	23048-1380	• • • HOLDER, Brush ..... (Used on 23048-1420)	EFGHJK LMRS	1
260	05-631145	• • SLEEVE, Insulation		8
265	23014-1039	• • PLATE,Insulation		4
270	23048-1010	• • SUPPORT ..... (Used on 23046-301, 23046-340 and 23046-366)	ACIKN	1
	23046-1141	• • SUPPORT ..... (Used on 23046-304, 23046-307, 23046-308 and 23046-376)	BDEFGH JLMOPQ RS	1
	23048-1410	• • SUPPORT ..... (Used on 23046-370, 23046-377 and 23046-378)	BDEFGH JLMOPQ RS	1
	23048-1430	• • SUPPORT ..... (Used on 23046-371, 23046-372 and 23046-379)	ACIKN	1
275	23046-311	• STATOR AND HOUSING ASSY	ABCDEF GHIJKLM NPRS	1
	23046-318	• STATOR AND HOUSING ASSY	OQ	1
280	23032-1512	• • BLOCK, Terminal ..... (ATTACHING PARTS)		1

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FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
285	MS35265-65	• • SCREW		2
290	MS35338-43	• • WASHER, Lock		2
295	AN960-10L	• • WASHER, Plain ---------- * ----------		2
300	MS21042-6	• • NUT, Terminal, Large		3
305	AN960-C616	• • WASHER, Lock		3
310	MS210442-3	• • NUT, Terminal, Small		2
315	AN960C10	• • WASHER, Lock		2
320	23046-1360	• • LUG, Terminal		2
325	23046-1310	• • LUG, Terminal		1
330	05-652015	• • LUG, Terminal		3
335	06-201020	• DECAL, Instruction		1
340	06-201100	• LABEL, Modification Status		1
345	06-209286	• PLATE, Identification	ABC	1
	06-209285	• PLATE, Identification	EFGHIJK MNnnOP QRS	1
	06-209285	• PLATE, Identification (ATTACHING PARTS)	RS	1
350	MS21318-14	• SCREW, Drive	ABCDEF GHJKLM NOPQ	4
	MS21318-13	• SCREW, Drive ---------- * ----------	IRS	4
-360	23046-510	KIT, Quick Attach-Detach	M	1
	23046-511	KIT, Quick Attach-Detach	BDOPQ	1
	23046-512	KIT, Quick Attach-Detach	FGIL	1
	23046-512	KIT, Quick Attach-Detach (Alternate for 23046-520)	J	1
	23046-513	KIT, Quick Attach-Detach (Alternate for 23046-521)	H	1
	23046-520	KIT, Quick Attach-Detach	CJ	1
	23046-521	KIT, Quick Attach-Detach (Kit is provided with model 23048-027)	HKRS	1
-365	23046-1760	• END BELL, Drive End Pad (Used on 23046-511)	BDOPQ	1
	23046-1764	• END BELL, Drive End Pad (Used on 23046-520)	CJ	1
	23046-1761	• END BELL, Drive End Pad (Used on 23046-512 &23046-520)	FGIJL	1

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FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
	23046-1763	• END BELL, Drive End Pad . . . . . (Used on 23046-521)	HKRS	1
	23046-1660	• END BELL, Drive End Pad . . . . . (Used on 23046-510)	M	1
-366	02-4412-03	• • PIN, Grooved, Headless, Dowell		3
-370	23032-1585	• CLAMP, Rim Clenching . . . . . (Used on 23046-510, 23046-511, 23046-512 and 23046-513)	BDFGIJL MOPQ	1
	23032-1581	• CLAMP, Rim Clenching . . . . . (Alternate for 23032-1585)	BDFGHIJ LMOPQ	1
	23072-1125	• CLAMP, Rim Clenching . . . . . (Used on 23046-520 and 23046-521)	CHJKRS	1
	23072-1325	• CLAMP, Rim Clenching . . . . . (Alternate for 23072-1125)	CHJK	1

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SPECIAL PROCEDURES

1. Introduction

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REMOVAL

1. Introduction

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INSTALLATION

1. Introduction

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SERVICING

1. Introduction

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STORAGE

1. Introduction

Materials required to pack the generator for storage or shipment are listed in Table 5001.

Description	Specification	Quantity
Tag	Commercially available.	1 (Domestic) 2 (Internat'l)
Bag - waterproof, vapor-proof.	Commercially available. Bag must totally enclose O-ring and instructions for installation and then be sealed.	1
Bag - waterproof, vapor-proof.	Kraft-foil or suitable equivalent. Bag must totally enclose generator and then be sealed.	1
Cushioning Material - shock absorbing, one-inch thick.	Commercially available	AR
Box - domestic class, single wall, corrugated cardboard.	PPP-B-636 or suitable equivalent. Box must be large enough to totally enclose and restrain bagged and cushioned generator.	1
Tape - waterproof, pressure sensitive.	Commercially available.	AR
Box - WC5 overseas shipping container.	PPP-B-636 or suitable equivalent. Box must be large enough to completely enclose domestic class packaging.	1

Table 15001 - Packaging Material

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REWORK

1. Introduction

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LEAR SIEGLER, INC.
POWER EQUIPMENT DIVISION
MAPLE HEIGHTS, OHIO 44137

SERVICE BULLETIN

ELECTRICAL POWER - STARTER GENERATOR - MODIFICATION OF MODEL 23048-017 to MODEL 23048-021.

1. PLANNING INFORMATION

A. Effectivity

All Lear Siegler, Inc., Power Equipment Division (LSI/PED) Starter-Generator, Models 23048-017.

B. Reason

To increase air flow through Starter-Generator and associated generator output capability.

C. Description

This Service Bulletin provides the procedures for conversion of Starter-Generator Model 23048-017 to Model 23048-021. Modification consists of the following:

1) Replacement of Fan Cover Assembly PN 23048-1000 with PN 23046-1090.

2) Replacement of Support PN 23048-1010 with PN 23046-1141.

3) Replacement of Brushes PN 30300-1282 with PN 30300-1286.

4) Reidentification of Starter-Generator.

D. Compliance

The Starter-Generator modification described in this Service Bulletin is optional and may be accomplished at the convenience of the operator.

E. Approval

This Service Bulletin has the approval of Lear Siegler, Inc., Power Equipment Division.

F. Manpower

An estimated 2 manhours, excluding oven heating time, are required to accomplish this Service Bulletin.

April 20, 1981

SERVICE BULLETIN

G. Material - Cost and Availability

1) Modification Kit, LSI/PED Part No. 52-000119, required for the accomplishment of this Service Bulletin, can be obtained from LSI/PED distributors:

Avitron International Division
P.O. Box 567
Rye, New York 10580

Canadian Customers Contact:

Aircraft Appliances & Equipment
152 East Drive
Bramalea, Ontario, Canada L6T-1E1

Cost and Delivery:

Contact LSI/PED distributor (see paragraph 3A for kit contents)

2) Industry standard parts and materials required for the accomplishment of this Service Bulletin are commercially available, part numbers, material specifications, and vendor information are described in paragraph 3B. Industry standard parts and materials are to be provided by the operators overhaul shop.

H. Tooling - Price and Availability

Tools normally used in overhaul shops are required for the accomplishment of this Service Bulletin.

I. Weight and Balance

Weight --- None
Balance --- None

J. Reference

Overhaul Manual with IPL (LSI/PED File No. 23202) for Starter-Generator Models 23048-001, 23048-004, 23048-006, 23048-008, 23048-012, 23048-014, 23048-015, 23048-016, 23048-017, 23048-018, 23048-020, and 23048-021.

K. Other Publications Affected

None

SERVICE BULLETIN

2. ACCOMPLISHMENT INSTRUCTIONS

A. Preparation

Figure and item numbers in this Service Bulletin are the same as the identical item shown in the reference publication, Overhaul Manual with IPL (LSI/PED File No. 23202).

B. Disassembly (Ref IPL,Figure 1)

1) Disassemble the Starter-Generator in accordance with procedures in DISASSEMBLY in reference Overhaul Manual to obtain support assembly, PN 23046-366.

2) Remove eight bolts (30), eight flat washers (31), eight non-metallic washers (32), and eight nuts (30A) from support assembly.

3) Remove four brush holder assemblies, PN 23064-1283, from support assembly. Remove four insulation plates (36A) and insulation sleeves (36) from support (37).

4) Remove bearing (28) from support (37) by removing bearing retainer (26) and four screws (27) and pressing bearing from support.

C. Cleaning

Clean the Starter-Generator in accordance with the CLEANING procedures in the reference Overhaul Manual.

D. Modification and Assembly

Use Modification Kit, Part No. 52-000119.

1) Obtain new support (37), PN 23046-1141, and press new ball bearing (28), PN 03-6010-08, into support. Apply anti-sieze compound, JC-30, to threads of four screws (27). Secure bearing in support by installing bearing retainer (26) and four screws (27).

2) Insert a new insulation sleeve (36), PN 05-631145, into each of eight brush holder assembly mounting holes in the support.

3) Place a new flat washer (31), PN AN960-10L, and new non-metallic washer (32), PN 05-374094, on each of eight brush holder bolts (30) and insert bolts in support (37). Position new insulation plate (36A), PN 23014-1039, on bolts (30). Ensure that insulation plate fits over end of insulation sleeves.

SERVICE BULLETIN

4) Coat threads of bolts with Loctite, Grade D.

5) Position brush holder assemblies against new insulation plates (36A) in accordance with ASSEMBLY procedures in Overhaul Manual. Secure brush holder assemblies on support (37) by tightening bolts (30) 25 to 30 in-lbs.

6) Test bearing and brush holder support assembly in accordance with procedures in TESTING, Paragraph D(1), in reference Overhaul Manual.

7) Coat edge of base on four brush holder assemblies, non-metallic washers (32), heads of bolts (30), flat washers (31), insulation plate (36A), and brush holder area of support (37) with red insulating enamel, Part No. ER-41.

8) Permit red insulating enamel to air dry, or bake bearing and brush holder support assembly in an oven for one hour at a temperature of 150°F (66°C). Remove from oven and allow to cool to room temperature.

9) Install armature (25) and position holder support assembly on stator and housing assembly in accordance with procedures in ASSEMBLY in reference Overhaul Manual. Secure support assembly with eight new flat washers (29B), PN 05-370232, eight new lock washers (29A), PN MS35338-42, and eight new screws (29), PN 05-341303.

10) In accordance with ASSEMBLY procedures in reference Overhaul Manual, complete assembly of the Starter-Generator installing new brushes (8), PN 30300-1286, and securing new fan cover assembly (5A), PN 23046-1090, with four new screws (5B), PN 05-340122.

E. Testing

Test Starter-Generator in accordance with procedures for Acceptance Tests (after overhaul) on the DIFFERENCE DATA SHEET for model 23048-021 in reference Overhaul Manual.

F. Reidentification

Identify converted Starter-Generator as follows:

1) Remove four drive screws (51) and remove identification plate (50) from Starter-Generator.

2) Obtain new identification plate, PN 06-109264, from kit and stamp with new model number (23048-021) in MODEL NO. block.

SERVICE BULLETIN

3) In EXTERNAL START POWER block, stamp 1000 under AMPS MAX.

4) Transfer serial number, date of manufacture, and all other remaining information from old identification plate to new identification plate. Discard old identification plate.

5) Use four new drive screws (51), PN MS21318-14, to secure new identification plate to Starter-Generator.

6) Coat identification plate with MIL-V-173 varnish. Permit varnish to air dry.

SERVICE BULLETIN

3. MATERIAL INFORMATION

Modification Kit, industry standard parts, and material required per Starter-Generator to accomplish this Service Bulletin are:

A. Modification Kit No. 52-000119 consists of the following:

NEW PN	QUAN	UNIT LIST PRICE	KEYWORD	OLD PN	INSTRUCTIONS/ DISPOSITION
23046-1090	1	---	Fan Cover Assembly	23048-1000	Install
05-340122	4	---	Screw	05-340122	Install/ Discard old part
23046-1141	1	---	Support	23048-1010	Install
03-6010-08	1	---	Bearing	03-6010-08	Install/Discard old part
23014-1039	4	---	Plate, Insulation	23014-1039	Install/Discard old part
05-631145	8	---	Sleeve, Insulation	05-631145	Install/Discard old part
05-374094	8	---	Washer, Non-Metallic	05-374094	Install/Discard old part
AN960-10L	8	---	Washer	AN960-10L	Install/Discard old part
30300-1286	4	---	Brush, Electrical	30300-1282	Install/Discard old part
05-370232	8	---	Washer	05-370232	Install/Discard old part
MS35338-42	8	---	Washer, Lock	MS35338-42	Install/Discard old part
05-341303	8	---	Screw	05-341303	Install/Discard old part

SERVICE BULLETIN

NEW PN	QUAN	UNIT LIST PRICE	KEYWORD	OLD PN	INSTRUCTIONS/ DISPOSITION
06-109264	1	---	Plate, Identification	06-123038	Install/Discard old part
MS21318-14	4	---	Screws, drive	MS21318-4	Install/Discard old part

B. Industry Standard Parts and Materials

To be provided by the operators overhaul shop.

NOTE: Unless otherwise specified, equivalent substitutes may be used for listed items.

NEW PN	QUAN	UNIT LIST PRICE	KEYWORD	OLD PN	INSTRUCTIONS/ DISPOSITION
MIL-V-173	AR	NA	Varnish	MIL-V-173	Coat I.D. Plate
Loctite, Grade D American Sealants Co. Hartford, Conn.	AR	NA	Loctite	Loctite, Grade D	Coat screw threads
Synthite ER-41 John C. Dolph Co. Monmouth Junction, N.J. 08852	AR	NA	Red Insulating Enamel	ER-41	Coat support/ brush holder assy
JC-30 Pipe Thread Sealer, Crane Packing Co. Morton Grove, Ill.	AR	NA	Compound, Anti-Seize	JC-30	Coat screw threads

PN = Part Number
AR = As Required
NA = Not Applicable

LEAR SIEGLER, INC.
POWER EQUIPMENT DIVISION
MAPLE HEIGHTS, OHIO 44137

SERVICE BULLETIN

ELECTRICAL POWER - STARTER GENERATOR - MODIFICATION OF MODEL 23048-004 TO MODEL 23048-004M AND MODEL 23048-004T TO MODEL 23048-004TM.

1. PLANNING INFORMATION

A. Effectivity

All Lear Siegler, Inc., Power Equipment Division (LSI/PED) Starter-Generator, Models 23048-004 and 23048-004T.

B. Reason

Increase service life of Starter-Generator by providing a new drive shaft with increased spline engagement.

C. Description

This Service Bulletin provides the procedures for modification of Starter-Generator Model 23048-004 to Model 23048-004M, and Model 23048-004T to Model 23048-004TM. Modification consists of the following:

(1) Replacement of Drive Shaft Part No. 23046-1125 with Drive Shaft Part No. 23046-2153.

(2) Reidentification of Starter-Generator.

D. Compliance

The Starter-Generator modification described in this Service Bulletin is optional and may be accomplished at the next Starter-Generator repair and/or overhaul.

E. Approval

This Service Bulletin has the approval of Lear Siegler, Inc., Power Equipment Division.

F. Manpower

No additional man hours are required when this Service Bulletin is accomplished at time of Starter-Generator repair or overhaul.

SERVICE BULLETIN

G. Material - Cost and Availability

(1) Parts required for the accomplishment of this Service Bulletin can be obtained from LSI/PED distributors:

Lear Siegler, Inc.
International Division
P.O. Box 567
Rye, New York 10580
TEL: (914)937-5300
TELEX: 137330
Cable: LEARINCDIV/RYE
Telecopier 400

Canadian Customers Contact:

Aircraft Appliances & Equipment
152 East Drive
Bramalea, Ontario, Canada LC6-T-1E1
TEL: (416)791-1666
TWX: (610)492-4396
TELEX: 069-7540

Cost and Delivery:

Contact LSI/PED distributor

(2) Industry standard parts and materials required for the accomplishment of this Service Bulletin are commercially available. Part numbers, material specifications, and vendor information are described in paragraph 3B. Industry standard parts and materials are to be provided by the operators overhaul shop.

H. Tooling - Price and Availability

Tools normally used in overhaul shops are required for the accomplishment of this Service Bulletin.

I. Weight and Balance

Weight --- None
Balance --- None

SERVICE BULLETIN

J. Reference

Overhaul Manual with IPL (LSI/PED File No. 23202) for Starter-Generator Models 23048-001, 23048-004, 23048-006, 23048-008, 23048-012, 23048-014, 23048-015, 23048-016, 23048-017, 23048-018, 23048-020, 23048-021, 23048-022, and 23048-023.

K. Other Publications Affected

Overhaul Manual with IPL (LSI/PED File No. 23202) for Starter-Generator Models, 23048-001, 23048-004, 23048-006, 23048-008, 23048-012, 23048-014, 23048-015, 23048-016, 23048-017, 23048-018, 23048-020, 23048-021, 23048-022, and 23048-023.

SERVICE BULLETIN

2. ACCOMPLISHMENT INSTRUCTIONS

A. Preparation

Figure and item numbers in this Service Bulletin are the same as the identical item shown in the reference publication, Overhaul Manual with IPL (LSI/PED File No. 23202).

B. Disassembly (Ref IPL, Figure 1)

Disassemble Starter-Generator in accordance with procedures in DISASSEMBLY, on the DIFFERENCE DATA SHEET for Model 23048-004 in reference Overhaul Manual, to obtain drive shaft (12), Part No. 23046-1125.

C. Cleaning

Clean Starter-Generator in accordance with procedures in CLEANING in reference Overhaul Manual.

D. Modification and Assembly

Obtain new drive shaft (12), Part No. 23046-2153 and install in Starter-Generator in accordance with procedures in ASSEMBLY, on the DIFFERENCE DATA SHEET for Model 23048-004 in reference Overhaul Manual.

E. Testing

Test Starter-Generator in accordance with procedures for Acceptance Tests (after overhaul) on the DIFFERENCE DATA SHEET for Model 23048-004 in reference Overhaul Manual.

F. Reidentification

(1) Reidentify modified Starter-Generator by metal stamping the letter M after Model No. 23048-004 or 23048-004T (as applicable) in the model number block on identification plate (50).

(2) Use MIL-V-173 varnish to lightly coat area of identification plate (50) where letter M was stamped. Permit varnish to air dry.

SERVICE BULLETIN

3. MATERIAL INFORMATION

CAUTION

ANY USE OF PARTS, MATERIALS, OR PROCESSES NOT AUTHORIZED BY LEAR SIEGLER INC. FOR MAINTENANCE OR OVERHAUL OF THIS UNIT MAY AFFECT CONTINUED FLIGHTWORTHINESS OR INVALIDATE ITS CERTIFICATION

LSI/PED parts, industry standard parts, and materials required per Starter-Generator to accomplish this Service Bulletin are:

A. LSI/PED Parts

NEW PN	QUAN	UNIT LIST PRICE	KEYWORD	OLD PN	INSTRUCTIONS/ DISPOSITION
23046-2153	1	---	Shaft, Drive	23046-1125	Install new part

B. Industry Standard Parts and Materials

To be provided by the operators overhaul shop.

NOTE: Unless otherwise specified, equivalent substitutes may be used for listed items.

NEW PN	QUAN	UNIT LIST PRICE	KEYWORD	OLD PN	INSTRUCTIONS/ DISPOSITION
MIL-V-173	AR	NA	Varnish	MIL-V-173	Coat I.D. Plate
Fed Spec P-D-680	AR	NA	Solvent, Stoddard	None	Cleaning

PN = Part Number
AR = As Required
NA = Not Applicable
I.D. = Identification

Lucas Aerospace

Lucas Aerospace Power Equipment Corporation

REVISION TRANSMITTAL SHEET

This page transmits revision 1 to service bulletin 23048-0XX-24-01 in its entirety. Discard all previously issued copies of service bulletin 23048-0XX-24-01.

Page 1 - Paragraph 1.A. - Changed to provide notification that LAPEC service bulletin 23048-0XX-24-01 is invalid and superseded by service bulletin 23048-0XX-24-02.

Lucas Aerospace

Lucas Aerospace Power Equipment Corporation

SERVICE BULLETIN

ELECTRICAL POWER - DC STARTER-GENERATOR - BEARING CHANGE - CONVERSION OF MODEL 23048-0XX TO 23048-0XX MOD A.

1. PLANNING INFORMATION

A. Effectivity

Note: Revision 1 renders this service bulletin invalid. LAPEC service bulletin number 23048-0XX-24-02, issued April 12, 1994, supersedes the information formerly contained in this document.

Lucas Aerospace

Lucas Aerospace Power Equipment Corporation

SERVICE BULLETIN

ELECTRICAL POWER - DC STARTER-GENERATOR - BEARING CHANGE -

Note: This service bulletin supersedes Lucas Aerospace Power Equipment Corporation publications 23048-0XX-24-01, dated January 9, 1990.

1. PLANNING INFORMATION

A. Effectivity

All Lucas Aerospace Power Equipment Corporation (LAPEC) (formerly Lear Siegler Power Equipment Division) DC Starter-generators in table 1 of this service bulletin without the modification status as listed.

LAPEC Model Number		Without Mod Status
23048-001	23048-004	B
23048-004M	23048-004T	
23048-004TM	23048-006	
23048-008	23048-012	
23048-014	23048-015	
23048-016	23048-017	
23048-018	23048-020	
23048-021	23048-022	
23048-023		

Table 1 - Modification Status Effectivity

B. Reason

Introduce an improved bearing to increase reliability and reduce cost of ownership of the DC Starter-generators listed in Table 1 of this service bulletin.

C. Description

This service bulletin provides instructions for converting starter-generators to the modification status as listed in Table 1 of this service bulletin. The modification consists of replacing two bearings and identifying the applicable modification status to indicate the accomplishment of this product improvement.

D. Compliance

Lucas Aerospace Power Equipment Corporation recommends that the modification in this service bulletin be accomplished during the next overhaul of the starter-generator.

E. Approval

This service bulletin has the approval of Lucas Aerospace Power Equipment Corporation. This service bulletin contains no information that revises the approved configuration of the starter-generator and therefore does not require governmental or other regulatory agency approval.

F. Manpower

When implemented at overhaul, no additional man-power is required to accomplish the modification in this service bulletin.

SERVICE BULLETIN

I. Material Cost and Availability

Refer to paragraph 3, MATERIAL INFORMATION, for a listing of parts and material required for the modification in this service bulletin. Required parts and pricing information are available from the following Lucas Aerospace Customer Service Centers:

AMERICAS: LUCAS AEROSPACE
Customer Service Center - Americas

Mailing Address	**Shipping Address**
P. O. Box 120039	One Circle West
Stamford, CT 06912, USA	Stamford, CT 06902, USA
TELEPHONE:	1 (203) 351-8400
AOG EMERGENCY SERVICE:	1 (203) 351-8400 (24 HOURS, 7 DAYS A WEEK)
TELEX:	475-0339 (Answer Back - "AVTR UI")
FACSIMILE:	1 (203) 351-8444 (Omnifax G55 & G77)
SITA:	BDRLU7X

EUROPE - MIDEAST - AFRICA: LUCAS AEROSPACE LTD.
Customer Service Center - Europe
Birmingham Road
West Bromwich
West Midlands B71 4JR, UK

TELEPHONE:	(44) 21 627-6767
AOG EMERGENCY SERVICE:	(44) 21 779-6531
TELEX:	333174
FACSIMILE:	(44) 21 500-6405
SITA:	BHXLW7X
EDI SITA:	LPLLUCR

ASIA - PACIFIC: LUCAS AEROSPACE SINGAPORE (PTE.) LTD.
Customer Service Center - Asia/Pacific
35 & 37 Loyang Way
Singapore 1750

TELEPHONE:	(65) 545-9975
AOG EMERGENCY SERVICE:	(65) 545-6253
FACSIMILE:	(65) 545-9965
SITA:	SINLU7X

H. Tooling Cost and Availability

No special tooling is required to accomplish the modification in this service bulletin.

SERVICE BULLETIN

I. **Weight and Balance**

Effect on weight: none.

Effect on balance: none.

J. **Electrical Load Data**

Not affected.

K. **References**

The 23048 Series DC Starter-generator Component Maintenance Manual (CMM) with Illustrated Parts List (IPL).

L. **Publications Affected**

The 23048 Series DC Starter-generator CMM with IPL will be revised to reflect the modification in this service bulletin.

2. ACCOMPLISHMENT INSTRUCTIONS

Note: Numbers in parentheses ( ) refer to item numbers given in the 23048 Series DC Starter-generator CMM with IPL, figure 1.

A. Preparation

The starter-generator modification in this service bulletin, shall be performed in a clean, dry area free of oil, dirt, moisture, and other contamination. The starter-generator must be kept clean to ensure the operating effectiveness of the unit.

B. Disassembly

Disassemble the starter-generator to the extent necessary to remove bearings (24 and 28). Discard removed bearings.

C. Cleaning and Inspection

(1) Thoroughly clean the starter-generator according to the instructions in the 23048 Series CMM.

(2) Inspect all disassembled parts according to the instructions in the 23048 Series CMM.

CAUTION: STRICT COMPLIANCE WITH THE INSPECTION SECTION MUST BE OBSERVED WITH REGARD TO BEARING LINER AND ARMATURE BEARING JOURNAL DIMENSIONS. OUT OF TOLERANCE BEARING LINERS OR ARMATURE BEARING JOURNALS, AS WELL AS AN UNBALANCED ARMATURE, MAY LEAD TO PREMATURE BEARING FAILURE.

(3) The following tolerances are relevant to this service bulletin.

Nomenclature (IPL Item Number)	Tolerance
END BELL, Drive End (21)	Bearing liner must be within: 1.8501 to 1.8504 inches (46.993 to 47.000 mm)
SUPPORT (37)	Bearing liner must be within: 1.8501 to 1.8504 inches (46.993 to 47.000 mm)
ARMATURE (25)	Bearing Journals (both ends) must be within: 0.7872 to 0.7875 inches (19.995 to 20.003 mm)
	Balance to within 5 grain inches (8.2 gram mm) each end

D. Modification

Modification of parts is not required. Modification occurs upon bearing replacement.

E. Assembly

Assemble the starter-generator according to the procedures in the 23048 Series CMM using bearings P/N 03-6010-18.

Note: The two seals fitted to the P/N 03-6010-18 bearing are identical and therefore special attention to orientation is not required during bearing installation.

F. Testing

Test the starter-generator according to the instructions in the 23048 Series CMM.

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SERVICE BULLETIN

G. Reidentification

Reidentification is accomplished by one of the two methods in this section.

Note: If the original nameplate is damaged and requires replacement proceed to paragraph 2.G.(2).

(1) Use a Modification Status Label (figure 1) to identify the accomplishment of this product improvement.

(a) Use an 1/8" letter punch set and a light hammer to stamp information onto the modification status label and to stamp through information on the original nameplate.

(b) Place a modification status label on a wooden work surface.

(c) Identify the starter-generator with the MOD status for the product improvement in this service bulletin. Stamp the letter "X" in the block under the letter 'B' on the modification status label.

(d) Clean the area of the stator housing below the identification plate thoroughly.

(e) Affix the modification status label to the stator housing directly below the nameplate. Press label firmly with a hard faced roller to ensure good adhesion.

(f) Insert a stainless steel strip under the nameplate to absorb impact and avoid puncture.

(g) Stamp the letter "X" through all modification status information in the MOD block on the nameplate (figure 2A or 2B).

Note: It is not required to paint over the modification status label with acrylic coating.

(h) Using HumiSeal type 1B31 acrylic coating (or equivalent), paint the MOD block area (or the serial number area) of the nameplate.

(i) Allow the coating to air dry.

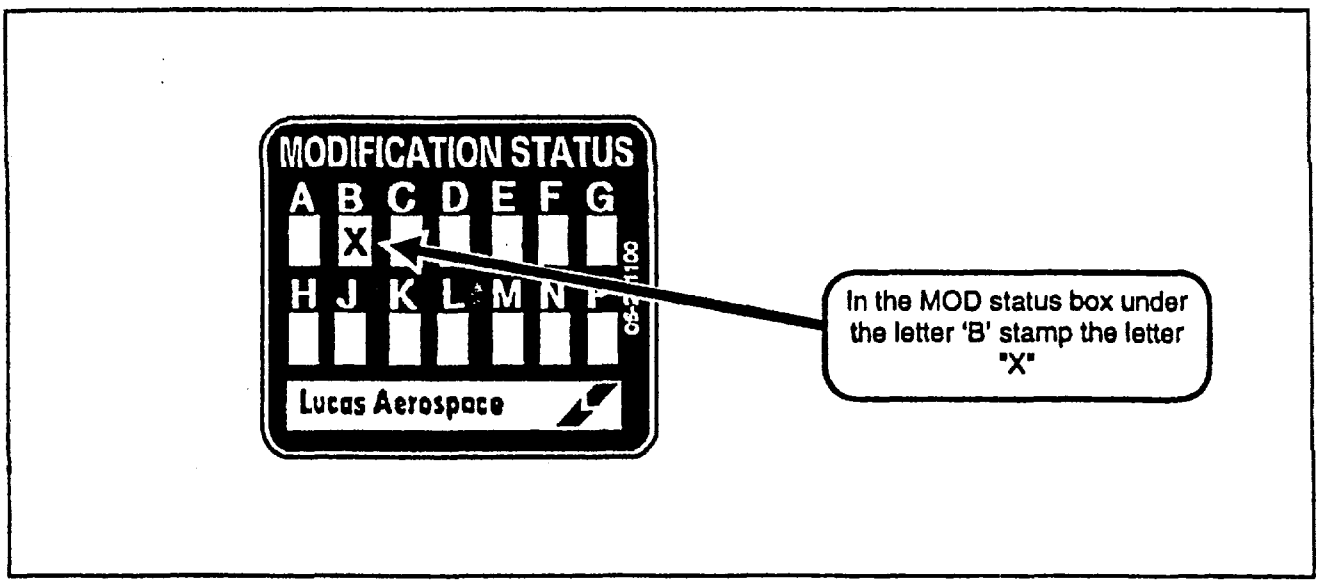


Figure 1 - Modification Status Label

SERVICE BULLETIN

(2) Use a LAPEC style replacement nameplate to identify the accomplishment of this product improvement.

Note: A modification status label is not required when using a LAPEC style replacement nameplate.

(a) Use an 1/8" letter punch set and a light hammer to stamp information onto the replacement nameplate.

(b) Position a replacement nameplate (figure 2) on a wooden work surface.

(c) Identify the starter-generator with the MOD status for the product improvement in this service bulletin. Stamp the letter "X" in the block under the letter 'B' on the replacement nameplate.

(d) Transfer all other information from the original nameplate to the replacement nameplate.

(e) Attach the replacement nameplate to the stator housing using four drive screws (51).

(f) Using HumiSeal type 1B31 acrylic coating (or equivalent), paint the entire replacement nameplate.

(g) Allow the coating to air dry.

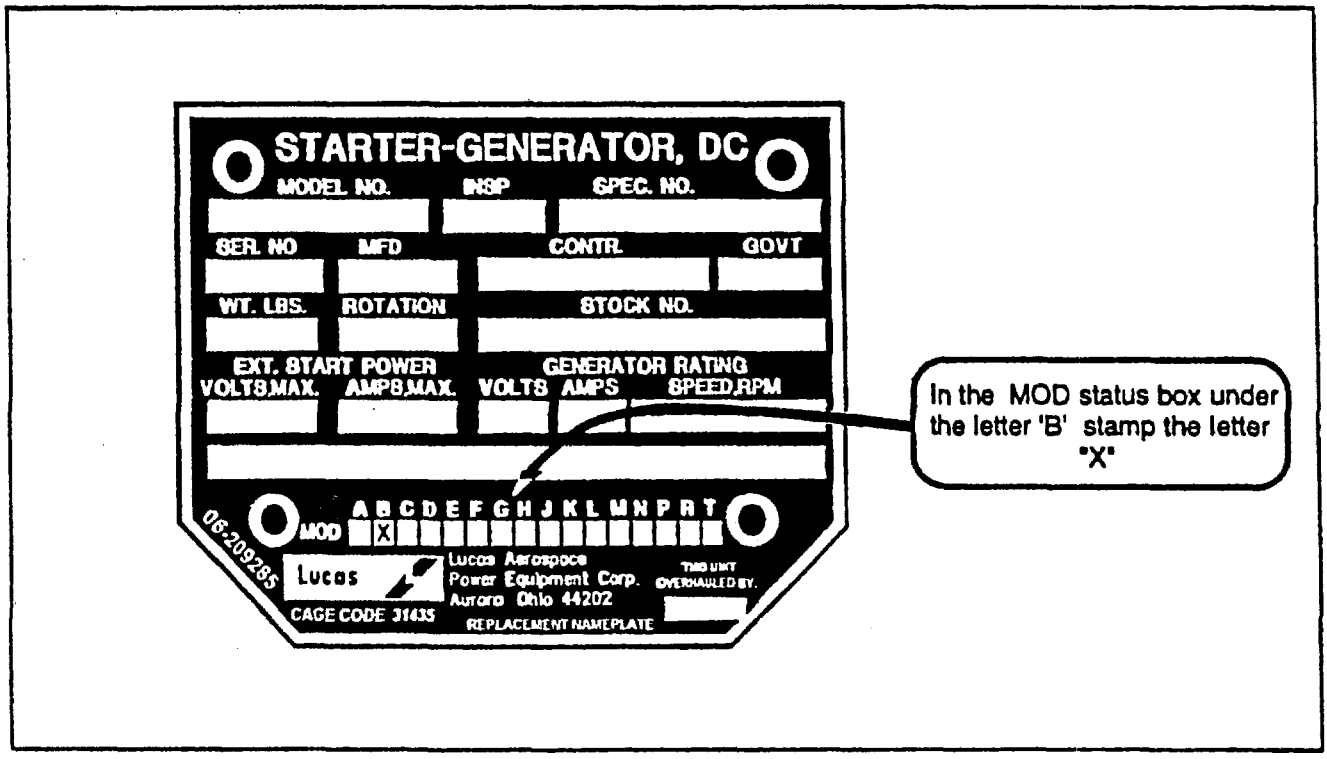


Figure 2 - Mod Status Location (LAPEC Replacement)

SERVICE BULLETIN

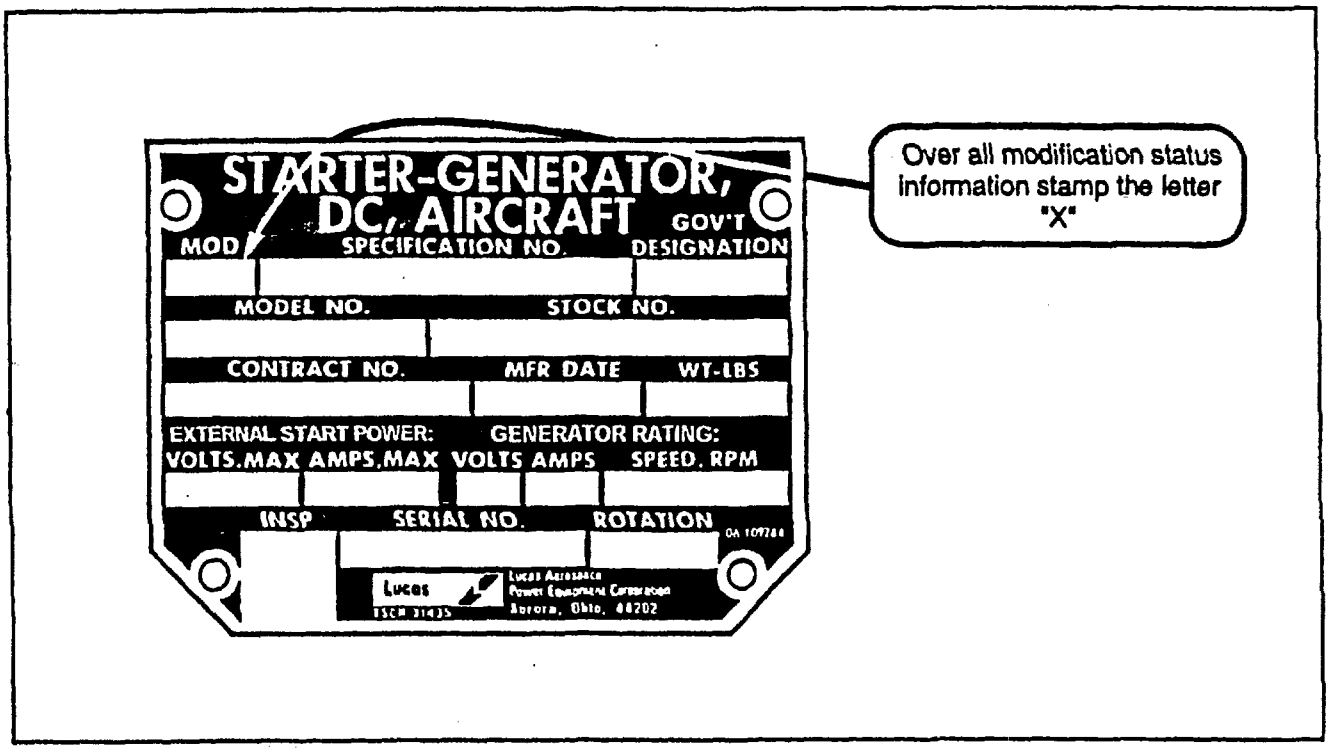


Figure 2A - Mod Status Location (LAPEC Style)

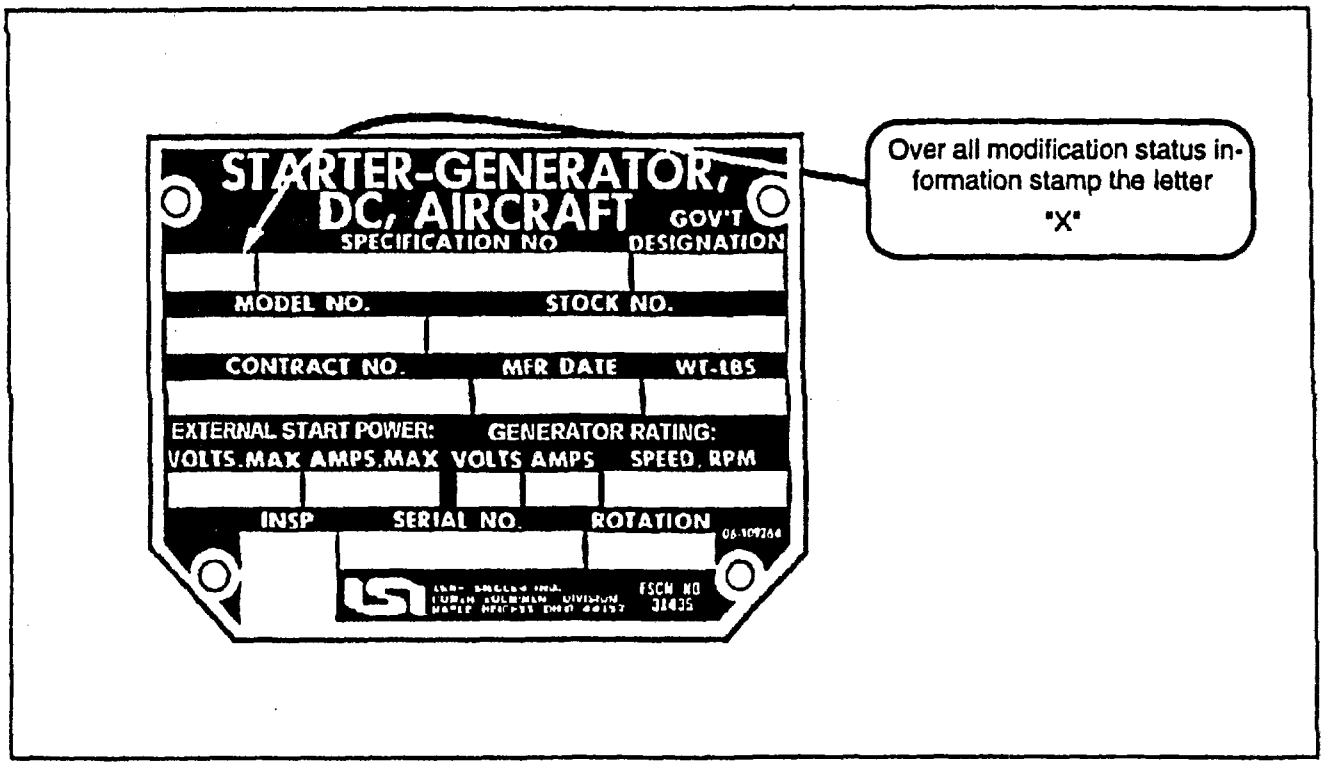


Figure 2B - Mod Status Location (LSI Style)

SERVICE BULLETIN

3. MATERIAL INFORMATION

LAPEC parts and materials required to modify the starter-generators listed in table 1 of this service bulletin are provided below. Quantities listed are for one starter-generator.

New Part Number	Quantity	Nomenclature	Old Part Number	Instruction / Disposition
03-6010-18	2	BEARING, Ball	03-6010-15 or 03-6010-08	Discard old parts
06-209285	1	PLATE, Replacement Identification	N/A	Use if required Discard old part
06-201100	1	LABEL, Modification Status	N/A	Use if required
MS21318-13	4	SCREW, Drive	MS21318-14	For attaching replacement nameplate (if required)
HumiSeal type 1B31	A/R	COATING, Acrylic	N/A	Paint nameplate Procure from: HumiSeal Division Chase Corporation Woodside, New York Telephone: (718) 932-0800 CAGE Code 38360

TRW Aeronautical Systems, Lucas Aerospace

Service Bulletin

NUMBER 23048-0XX-24-03

ELECTRICAL POWER – 23048 DC STARTER-GENERATOR ARMATURE CHANGE

1. Planning Information

A. Effectivity

This Service Bulletin applies to all TRW Aeronautical Systems, Lucas Aerospace, DC Starter-Generators listed in Table 1.

23048-004	23048-004T	23048-004M	23048-004TM	23048-016
23048-018	23048-021	23048-023	23048-28	

Table 1 – Model Number Effectivity

B. Concurrent Requirements

The modification described in Service Bulletin 23048-0XX-24-02 must be accomplished in conjunction with the modification in this Service Bulletin for the models listed in Table 1.

C. Reason

This Service Bulletin introduces armature P/N 23048-1032 as a replacement for armature P/N 23048-1030 or P/N 23048-1031 which are no longer manufactured.

D. Description

This Service Bulletin provides instructions for using armature P/N 23048-1032 in the Starter-Generators listed in Table 1.

E. Compliance

RECOMMENDED

TRW Aeronautical Systems, Lucas Aerospace, recommends that the armature change in this Service Bulletin be performed during overhaul and after existing inventory of P/N 23048-1030 and 23048-1031 armatures have been depleted or at the discretion of the customer.

F. Approval

This Service Bulletin has the approval of TRW Aeronautical Systems, Lucas Aerospace.

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G. Manpower

When the armature change provided by this Service Bulletin is implemented at overhaul, no additional man-hours are required.

H. Weight and Balance

Effect on weight: None
Effect on balance: None

I. Electrical Load Data

Not Changed

J. References

Refer to the 23048 Series DC Starter-Generator Overhaul Manual (OM) with Illustrated Parts List (IPL).

K. Publications Affected

The 23048 Series DC Starter-Generator OM with IPL will be revised to reflect the contents of this Service Bulletin.

2. MATERIAL INFORMATION

A. Material - Price and Availability

Required parts and pricing information are available from TRW Aeronautical Systems, Lucas Aerospace Customer Service Centers, as listed in paragraph 2.B of this Service Bulletin.

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Service Bulletin

B. Support Information

Support Information is available from the following locations:

REGION	ADDRESS	COMMUNICATIONS	
AMERICAS:	TRW Aeronautical Systems, Lucas Aerospace CSA 30 Van Nostrand Avenue Englewood, NJ 07631-4396 USA	PHONE AOG FAX SITA/ARINC	(1) 201 567 6400 (1) 201 567 6411 (1) 201 541 7610 BDRLU7X
EUROPE/MIDEAST / AFRICA:	TRW Aeronautical Systems, Lucas Aerospace CSE Stratford Road Solihul B90 4LA United Kingdom	PHONE AOG FAX	44 (0) 121 451 5999 44 (0) 121 451 5904 44 (0) 121 451 5881
ASIA/PACIFIC:	TRW Aeronautical Systems, Lucas Aerospace CSP 35 & 37 Loyang Way Singapore 1750	PHONE AOG FAX SITA/ARINC	(65) 545 9975 (65) 545 6253 (65) 545 9965 SINLU7X

Part Number 23048-1030 and 23048-1031 armatures may be submitted for re-manufacture to the following:

TRW Aeronautical Systems,
Lucas Aerospace
Repair and Overhaul (R&O)
777 Lena Drive
Aurora, OH 44202
USA

PHONE (1) 330 995-1000
FAX (1) 330 995-1117

NOTE: While the P/N 23048-1030 and P/N 23048-1031 armatures can be re-manufactured, they can not be modified to the 23048-1032 configuration.

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C. Material Requirements

TRW Aeronautical Systems, Lucas Aerospace parts and materials required are listed below:

New Part Number	Qty	Nomenclature	Old Part Number	Instruction/ Disposition
23048-1032	1	Armature	23048-1030 23048-1031	Discard the old part

D. Tooling

No special tooling is required.

E. Re-identified Parts

Re-identification of parts is not required to accomplish the modification in this Service Bulletin.

3. ACCOMPLISHMENT INSTRUCTIONS

A. Preparation

The Starter-Generator armature change shall be performed in a clean, dry area free of oil, dirt, moisture, and other contamination. The Starter-Generator must be kept clean to ensure the operating effectiveness of the unit.

B. Disassembly

Disassemble the Starter-Generator according to the instructions provided in the 23048 Overhaul Manual and to the extent required to remove the armature. Discard the armature or submit it for remanufacture to the TRW Aeronautical Systems, Lucas Aerospace Repair and Overhaul (R&O) facility.

C. Cleaning

Fully clean all disassembled parts according to the instructions in the 23048 Overhaul Manual.

D. Inspection

Fully inspect all disassembled parts according to the instructions in the 23048 Overhaul Manual.

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Service Bulletin

E. Modification

Modification of parts is not required.

F. Assembly

Assemble the Starter-Generator according to the instructions in the 23048 Overhaul Manual using a P/N 23048-1032 armature.

G. Testing

A complete acceptance test is required according to the instructions in the 23048 Overhaul Manual.

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P. O. BOX 6719
CLEVELAND 1, OHIO

SERVICE BULLETIN

NO. 132

ELECTRICAL POWER----INCREASED ELECTRICAL BRUSH-COMMUTATION LIFE BY USING NEW SPRINGS ON LSI/PED MODELS 23048-004, -008 STARTER GENERATORS.

1. PLANNING INFORMATION

A. Effectivity

This Service Bulletin is applicable to LSI/PED Models 23048-004, and -008 Starter Generators used on the DeHavilland Twin Otter and Turbo Beaver airplanes.

B. Reason

To provide brush springs that have lower specified pressure thus alleviating brush and commutator wear.
Old brush spring pressure (23033-1120) 45 to 63 oz.
New brush spring pressure (23033-1121) 40 to 55 oz.

C. Description

This Service Bulletin outlines service instructions for installing new brush springs, P/N 23033-1121 in the LSI/PED Starter Generator Models 23048-004 and 23048-008.

D. Compliance

Procedures outlined in this bulletin are recommended for replacement at next overhaul.

E. Approval

None required.

F. Manpower

Approximately 1/2 man-hour per unit is required to perform the change outlined in this bulletin.

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SERVICE BULLETIN

NO. 132

1. PLANNING INFORMATION (Continued)

G. Material - Cost and Availability

The material required to perform this change is available through your LSI/PED distributor, or may be obtained direct from Lear Siegler, Inc., Power Equipment Division, P.O. Box 6719, Cleveland, Ohio 44101.

H. Tooling

No special tooling is required to perform this change.

I. Reference

Lear Siegler Overhaul Manual File No. 23202.

2. ACCOMPLISHMENT INSTRUCTIONS

A. Removal of old springs and replacement with new should be accomplished by referring to instructions contained in above referenced overhaul manual. See paragraphs 2B through 2C on page 2, with reference to Figure 5 therein.

B. After new brushes are installed, run-in in accordance with instructions in overhaul manual as indicated in paragraphs 5F through 5H.

CAUTION: Do not mix brush springs removed with new brush springs. (New springs identified with blue dye).

3. MATERIAL INFORMATION

A. Parts Required

Part No.	Item	Qty/Unit
23033-1121	Spring	8

File No. 23404
June 1, 1967

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P. O. BOX 6719
CLEVELAND 1, OHIO

SERVICE BULLETIN

NO. 132

3. MATERIAL INFORMATION (Continued)

B. Parts Removed

Part No.	Item	Qty/Unit
23033-1120	Spring	8

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POWER EQUIPMENT DIVISION
P. O. BOX 6719
CLEVELAND 1, OHIO

SERVICE BULLETIN

NO. 141

ELECTRICAL POWER--MODIFICATION OF MODEL 23048-001, STARTER GENERATOR TO MODEL 23048-006.

1. Planning Information

A. Effectivity

This Service Bulletin is applicable to LSI/PED (Lear Siegler, Inc. - Power Equipment Division) Model 23048-001 Starter Generator. Employment of the modification described herein effects a model change to 23048-006.

B. Reason

To modify the 23048-001 to accommodate the quick-attach-detach mounting.

C. Description

This bulletin provides instructions for:

1. Modifying the 23048-001 to the 23048-006 quick-attach-detach configuration.

2. Installation of the 23046-512 quick-attach-detach kit and starter generator on the aircraft.

D. Compliance

Compliance with this bulletin is optional for operators using LSI/PED Starter Generator Model 23048-001.

E. Approval

None required.

F. Manpower

When this modification is accomplished at the time of overhaul, no additional man-hours are required.

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CLEVELAND 1, OHIO

SERVICE BULLETIN

NO. 141

1. Planning Information (Continued)

G. Material - Cost and Availability

The materials required to perform this modification are available through your LSI/PED distributor and prices will be quoted upon request. Material required per unit -

Part No.	Description	Quantity
52-000069	Kit, Modification, consisting of:	1
23046-1670	End Bell	1
05-350208	Screw	12
23046-512	QAD Kit	1

NOTE: The 23046-512 Kit is not furnished as part of Model 23048-006.

H. Tooling

No special tooling required.

I. Weight and Balance

Additional weight - 0.6 lbs., when QAD Kit is included.

J. Reference

Lear Siegler, Inc., Overhaul Manual File No. 23202.

2. Accomplishment Instructions

A. Disassembly (See Figure 1 in this bulletin)

1. Loosen clamp (2) sufficiently, then remove air inlet assembly. Twist fan

File No. 23411
June 15, 1968

SERVICE BULLETIN

NO. 141

2. Accomplishment Instructions (Continued)

cover either clockwise or counter-clockwise to unlock, then drop off from around fan. If necessary to separate air inlet castings, remove screws (3) and washers (4).

2. Loosen screw (7) and separate from slot and remove brush cover (6) from housing.

3. Remove the two-piece lock nut (11) and fan (10) from drive-shaft.

4. Tap out drive-shaft (12) using a plastic hammer, then remove clutch-dampener (13) and dampener back-plate (14).

5. Remove screws (15), lock washers (16) and washers (17), then remove drive-end end-bell assembly (21). Discard these parts.

B. Reassembly (See Figure 2 in this bulletin)

1. Install drive-end end-bell assembly (1) against stator, secure with screws (2). Make certain end-bell is fully seated on bearing.

2. See Figure 1. Install dampener back-plate (14) on armature and make certain back-plate taper is fully seated on drive-shaft taper.

3. Install clutch-dampener (13) over small spline end of drive-shaft (12), and make certain dampener taper is fully seated on drive-shaft taper.

4. Install drive-shaft through armature, making certain splines of drive-shaft are fully engaged with splines of armature.

5. Install fan (10) and secure with two-piece nut (11). Tighten inner nut to 70-80 inch-pounds and outer nut to 70-80 inch-pounds.

6. Install brush cover (6) and secure with screw (7). Cover may be assembled in any angular position.

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NO. 141

2. Accomplishment Instructions (Continued)

7. Install fan cover (5), then position so that grooves will accomplish a locking effect. Turn clockwise or counter-clockwise to lock.

   NOTE: Do not assemble air inlet to unit until Starter Generator is installed in the aircraft.

8. After installing air inlet (1), secure with clamp (2). Torque nut to 25 inch pounds.

9. On nameplate carefully stamp a "6" over the "1" on the Model No. 23048-001.

C. Installing Unit On Aircraft

1. From QAD Kit 23046-512 remove drive-end pad, end-bell, Item 3B, Figure 2 and install on engine using standard mounting bolts.

2. With the "T" bolt on "V" band Item 3A, Figure 2, unlatched place the "V" band on the Starter Generator between the mounting flange and the terminal block.

3. Holding the Starter Generator flush up against the drive-end pad end-bell, Item 3B, Figure 2, position the "V" band over the mating flanges and securely latch with "T" bolt. Tighten latch firmly in preparation to torquing.

4. Tap "V" band at several places around circumference with soft mallet to accomplish true alignment and tighten nut to 2/3 recommended final torque - approximately 30 inch pounds.

5. Repeat tapping around circumference of "V" band and tighten to final recommended torque of 50 inch pounds.

   CAUTION: Keep Starter Generator flush up against drive-end pad end-bell, Item 3B, Figure 2, during installation. Do not permit the Starter Generator to hang loosely or without "V" band being tightened. This will cause undue bending force on drive-shaft shear section, resulting in damage and possible in-flight failure.

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SERVICE BULLETIN

NO. 141

D. Material Planning Information

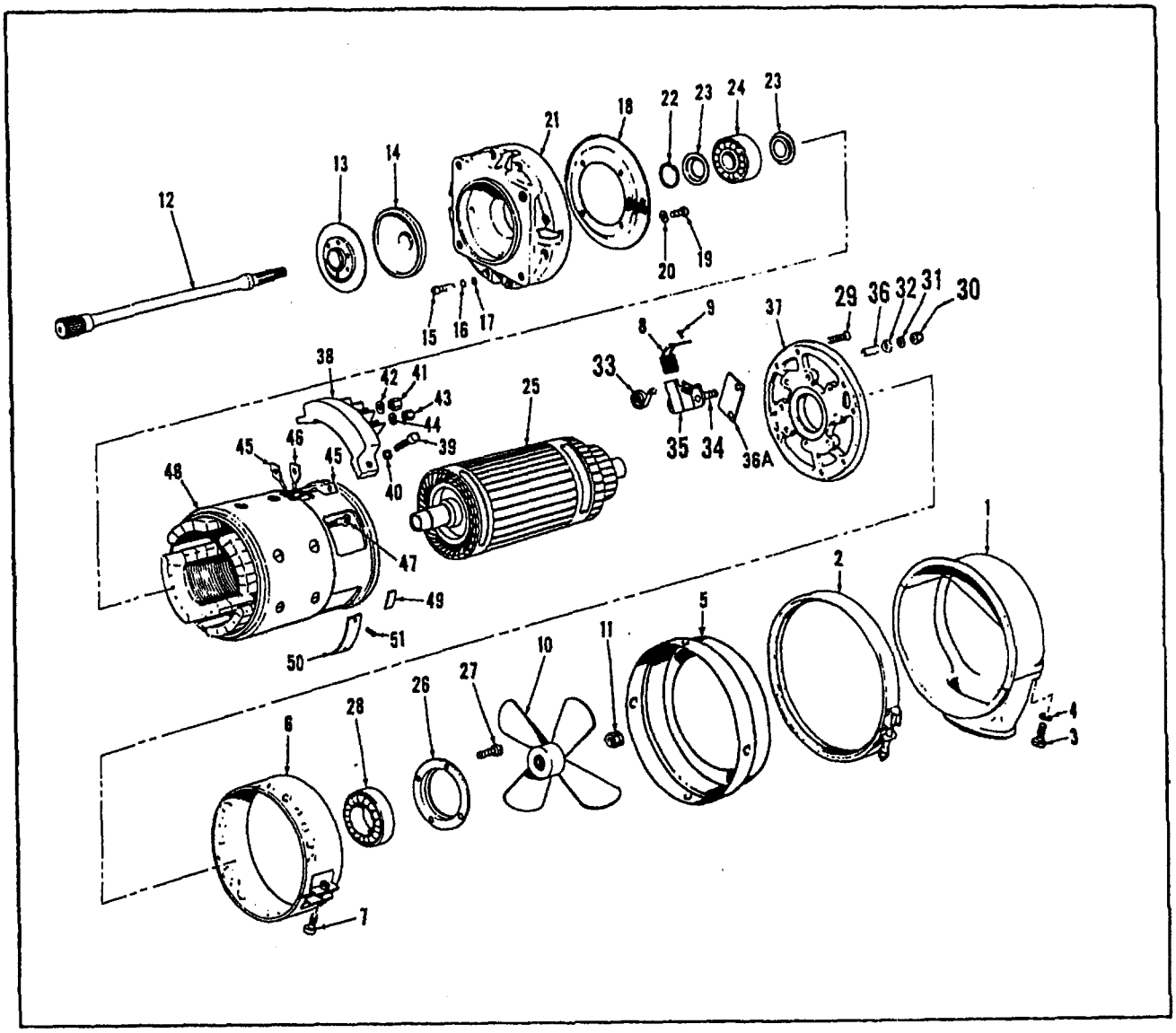


Figure 1. Exploded View of Starter Generator

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POWER EQUIPMENT DIVISION
P. O. BOX 6719
CLEVELAND 1, OHIO

SERVICE BULLETIN

NO. 141

D. Material Planning Information (Continued)

Parts to be removed and discarded -

Item	Part No.	Description	Quantity
1-15	05-341309	Screw	8
1-16	AN935-8L	Washer, Lock	8
1-17	05-370176	Washer	8
1-21	23046-1171	End-Bell Assembly, Drive-End	1

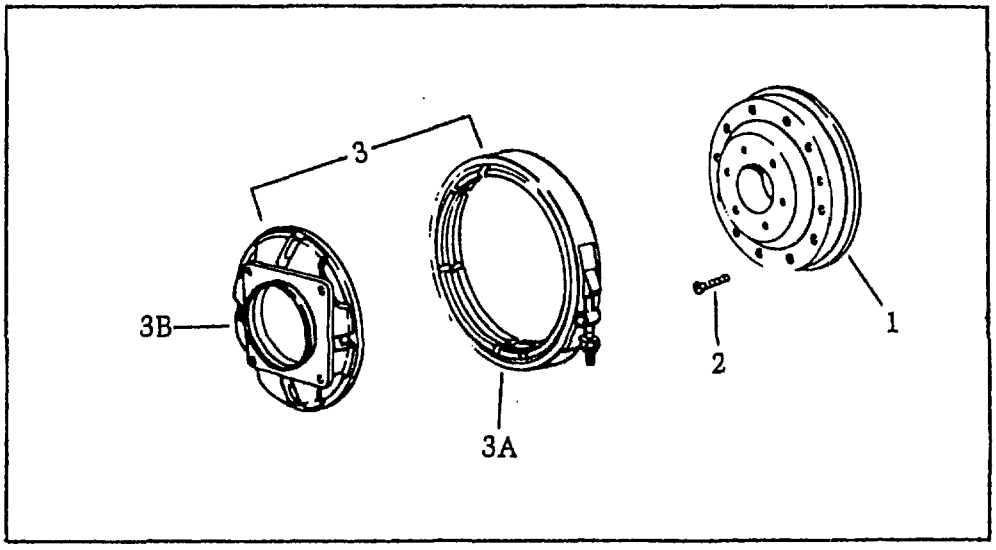


Figure 2. Exploded View of QAD Modification

File No. 23411
June 15, 1968

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P. O. BOX 6719
CLEVELAND 1, OHIO

SERVICE BULLETIN

NO. 141

D. Material Planning Information (Continued)

Parts to be assembled to Starter Generator -

Item	Part No.	Description	Quantity
2-1	23046-1670	End-Bell Assembly, Drive-End	1
2-2	05-350208	Screw	12
2-3	23046-512	QAD Kit	1
2-3A	23032-1585	. "V" Band Clamp	1
2-3B	23046-1761	. End-Bell, Drive-End Pad	1

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CLEVELAND 1, OHIO

SERVICE BULLETIN

NO. 144

ELECTRICAL POWER---INCREASED ELECTRICAL BRUSH-COMMUTATION LIFE BY USING NEW SPRINGS ON LSI/PED MODELS 23048-001, -006 STARTER GENERATORS

1. PLANNING INFORMATION

A. Effectivity

This Service Bulletin is applicable to LSI/PED Models 23048-001, and -006 Starter Generators.

B. Reason

To provide brush springs that have lower specified pressure thus alleviating brush and commutator wear.
Old brush spring pressure (23033-1120) 45 to 63 oz.
New brush spring pressure (23033-1121) 40 to 55 oz.

C. Description

This Service Bulletin outlines service instructions for installing new brush springs, P/N 23033-1121 in the LSI/PED Starter Generator Models 23048-001 and 23048-006.

D. Compliance

Procedures outlined in this bulletin are recommended for replacement at next overhaul.

E. Approval

None required.

F. Manpower

Approximately 1/2 man-hour per unit is required to perform the change outlined in this bulletin.

LEAR SIEGLER, INC. / POWER EQUIPMENT DIVISION
P. O. BOX 6719
CLEVELAND 1, OHIO

SERVICE BULLETIN

NO. 144

1. PLANNING INFORMATION (Continued)

G. Material - Cost and Availability

The material required to perform this change is available through your LSI/PED distributor, or may be obtained direct from Lear Siegler, Inc., Power Equipment Division, P.O. Box 6719, Cleveland, Ohio 44101.

H. Tooling

No special tooling is required to perform this change.

I. Reference

Lear Siegler Overhaul Manual File No. 23202.

2. ACCOMPLISHMENT INSTRUCTIONS

A. Removal of old springs and replacement with new should be accomplished by referring to instructions contained in above referenced overhaul manual. See paragraphs 2B through 2C on page 2, with reference to Figure 5 therein.

B. After new brushes are installed, run-in in accordance with instructions in overhaul manual as indicated in paragraphs 5F through 5H.

CAUTION: Do not mix brush springs removed with new brush springs. (New springs identified with blue dye).

3. MATERIAL INFORMATION

A. Parts Required

Part No.	Item	Qty/Unit
23033-1121	Spring	8

File No. 23412
September 5, 1968

LEAR SIEGLER, INC. / POWER EQUIPMENT DIVISION
P. O. BOX 6719
CLEVELAND 1, OHIO

SERVICE BULLETIN

NO. 144

3. MATERIAL INFORMATION (Continued)

B. Parts Removed

Part No.	Item	Qty/Unit
23033-1120	Spring	8

FILE NO 23416

SERVICE BULLETIN

NO. 160

ELECTRICAL POWER---D.C. GENERATORS AND STARTER GENERATORS, INSTRUCTIONS FOR ASSEMBLING THE DRIVE SHAFT AND DAMPENER ASSEMBLY.

1. PLANNING INFORMATION

A. Effectivity

This service bulletin is applicable to the following Lear Siegler, Inc., Power Equipment Division (LSI/PED) Starter Generator Models:

23032-007, -010, -011, -012, -020, -022
23046-001, -004, -006, -007, -009, -012, -014, -015, -016, -040
23048-001, -004, -006, -008, -012, -014
23064-001, -002
30059-001, -002, -010, -011

B. Reason

Various service-overhaul personnel have expressed a need for explicit instructions detailing the assembly of dampener, and backplate to the drive shaft for the models listed above. This service bulletin is issued to further clarify the procedures thus precluding possible misalignment of assembly.

C. Description

This service bulletin provides supplementary information to the instructions appearing in LSI/PED overhaul manuals for the LSI/PED starter generators also generator models listed above. This information is presented herein as tabular data and references usage of special tools in illustrations, for assembly of dampener and for assembly of backplate.

"IN SERVICE TO THE AIRLINES"

D. Compliance

The use of "homemade" tools or, guessing at the relative mating faces of the drive shaft dampener assembly parts, is very uncertain and should not be attempted.

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POWER EQUIPMENT DIVISION
P.O. BOX 6719
Cleveland, Ohio 44101

August 15, 1969

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P. O. BOX 6719
CLEVELAND 1, OHIO

SERVICE BULLETIN

NO. 160

1. PLANNING INFORMATION (Continued)

D. Compliance (Continued)

The special tools described in this service bulletin were designed not only to facilitate the installation of the dampener backplate on the armature and the clutch dampener on the drive shaft, but to remove any "guess-work" that may be employed in their assembly.

Lear Siegler earnestly recommends these tools be employed to assure proper relationship between these parts when accomplishing overhaul. Future revisions of service manuals affecting these models will reflect the instructions contained herein.

E. Approval

None required.

F. Manpower

When replacement of dampener and backplate is accomplished at overhaul, no additional manhours are required.

G. Material - Cost and Availability

The tools required for each LSI/PED model are referenced in the tables on pages 6 and 7.

Prices for the tools can be obtained from either the D. C. Product Support Manager of LSI/PED or their authorized distributors listed below. (A set of tool drawings may be purchased from LSI/PED at $250.00 net).

Aircraft Appliances & Equipment, Ltd.
American Avitron, Inc.
Airwork Corporation
Pacific Airmotive Corporation

Delivery will be 180 days or less.

File No. 23416
August 15, 1969

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CLEVELAND 1, OHIO

SERVICE BULLETIN

NO. 160

1. PLANNING INFORMATION (Continued)

H. Tooling

No tooling, other than those listed on pages 6 & 7 , are required to properly install the dampener backplate and clutch dampener.

I. Weight and Balance

No change.

J. References

Applicable service manuals for models referenced in tables are Files 23202, 23203, 23206, 23207 and 30203.

2. ACCOMPLISHMENT INSTRUCTIONS

A. Installing the Dampener Backplate.

Refer to Figure 1 and Table of Special Tools/Installing Backplate.

1. Mount the Lower Adaptor in the base of an arbor press that provides frim support.

2. Mount the Ram Adaptor securely in the arbor press head, making certain it is aligned with the Lower Adaptor.

3. Place the starter generator or generator in proper position in the arbor with the anti-drive end down and with bearing resting flush upon the base of the Lower Adaptor.

4. Insert the Set Gage into hollow armature shaft with small O. D. end of the tool downward and in alignment with anti-drive end ball bearing.

5. Carefully position the dampener backplate on the armature assembly. MAKE CERTAIN THAT THE BACKPLATE IS EVENLY SEATED ON THE TAPERED SHAFT OF THE ARMATURE.

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CLEVELAND 1, OHIO

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2. ACCOMPLISHMENT INSTRUCTIONS (Continued)

6. Lower the arbor press until the Ram Adaptor contacts the backplate, then continue the seating operation until the Ram Adaptor rests solidly on the end of the Set Gage.

CAUTION: The pressure on the Ram Adaptor should be applied steadily and without sudden jerk of press handle. Discontinue pressure on Ram Adaptor as soon as Set Gage is felt to "bottom" on ID of armature.

NOTE: Before proceeding to install the clutch dampener on drive shaft, replace the Lower Adaptor with appropriate tool referenced in table.

B. Installing the Clutch Dampener on the Drive Shaft

CAUTION: The installation of the clutch dampener on drive shaft requires precise positioning, otherwise proper mating with the backplate cannot be attained.

1. Refer to Figure 2 a and b also Table of Special Tools/Installing Clutch Dampener.

2. Mount the Lower Adaptor in the base of an arbor press that provides firm support. If not already in place, mount the Ram Adaptor securely in the arbor press head, making certain it is aligned with the Lower Adaptor.

3. Place the Set Gage on the Lower Adaptor so that it is positioned over the hole in the Lower Adaptor.

4. Slide the clutch dampener over the small end of drive shaft making certain the taper of the clutch dampener is set properly on the taper of the drive shaft. (Apply light film of oil to tapered surface).

5. Insert the clutch dampener and shaft through the Set Gage so that the clutch dampener rests upon the Set Gage, and the anti-drive end of drive shaft is either centered within hole of Lower Adaptor (See Figure 2 a) or that tapered spline is

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2. ACCOMPLISHMENT INSTRUCTIONS (Continued)

properly fitted into the Lower Adaptor as in Figure 2 b.

NOTE: Recheck alignment of parts and tools to be sure of their correct position when pressure is applied with the arbor.

6. Lower arbor press slowly until it contacts the drive shaft, then continue seating operation until drive shaft "bottoms" and rests solidly on or in the Lower Adaptor. tool.

7. Remove the assembled shaft and clutch dampener and install it in the starter generator, or generator, as outlined in the applicable overhaul manual.

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TABLE OF SPECIAL TOOLS/INSTALLING BACKPLATE

Starter Generator Model	Backplate Part No.	Ass'y Dim."A"	Tooling			Armature Part No.
			Lower Adaptor	Set Gage	Ram Adaptor	
23032-005	None	None	---	---	---	---
23032-006	None	None	---	---	---	---
23032-007	23032-1280	None	T3-0505-65	T4-0411-68	T13-0128-65	23032-1104
23032-010	23032-1280	5.460	" " "	" " "	" " "	23032-1920
23032-011	23032-1280	5.460	" " "	T6-1101-68	" " "	23032-1920
23032-012	23032-1280	5.460	" " "	T6-1101-68	" " "	23032-1920
23032-020 Made From 23032-022	23032-1280	5.100	" " "	T4-0411-68	" " "	23032-2111
23046-001	23032-1281	7.450	T2-0505-65	T1-0415-66	T13-0128-65	23046-1030
23046-004	23032-1281	7.450	" " "	" " "	" " "	23046-1030
23046-006	23032-1281	None	" " "	" " "	" " "	23046-1030
23046-007	23032-1281	7.450	" " "	" " "	" " "	23046-1030
23046-009	23032-1281	7.450	" " "	" " "	" " "	23046-1030
23046-012	23032-1281	7.450	" " "	" " "	" " "	23046-1030
23046-014	23032-1281	7.450				23046-1030
23046-015	23032-1281	7.450	T2-0505-65	T1-0415-66	T13-0128-65	23046-1030
23046-016	23032-1281	7.450	" " "	" " "	" " "	23046-1030
23046-040 Made From 23046-006	23032-1281	None	" " "	" " "	" " "	23046-1030
23048-001	23032-1281	8.150	T2-0505-65	T1-0328-67	T13-0128-65	23048-1030
23048-004	23032-1281	8.150	" " "	" " "	" " "	23048-1030
23048-006	23032-1281	8.150	" " "	" " "	" " "	23048-1030
23048-008	23032-1281	8.150	" " "	" " "	" " "	23048-1030
23048-012	23032-1281	8.150	" " "	" " "	" " "	23048-1030
23048-014	23032-1281	8.150	" " "	" " "	" " "	23048-1030
23064-001	31228-1095	9.009	T2-0505-65	T6-1014-68	T13-0128-65	23047-1052
23064-002	31228-1095	9.009	" " "	" " "	" " "	23047-1052
30059-000	30059-1041	None	T2-0505-65	T2-1110-66	T13-0128-65	30059-302
30059-001	30059-1041	7.230	" " "	" " "	" " "	30059-302
30059-002	30059-1041	7.230	" " "	" " "	" " "	30059-302
30059-010	30059-1041	7.230	" " "	" " "	" " "	30059-310
30059-011	30059-1041	7.230	" " "	" " "	" " "	30059-311

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TABLE OF SPECIAL TOOLS/INSTALLING CLUTCH DAMPENER

Starter Generator Model	Clutch Part No.	Ass'y Dim."B"	Tooling			
			Lower Adaptor	Set Gage	Ram Adaptor	Drive Shaft No.
23032-005	None	None	---	---	---	---
23032-006	None	None	---	---	---	---
23032-007	23032-1240	None	T2-0411-68	T3-0411-68	T13-0128-65	23032-1690
23032-010	23032-1240	5.380	" " "	T7-1101-68	" " "	23032-1297
23032-011	23032-1240	5.380	" " "	T7-1101-68	" " "	23032-1297
23032-012	23032-1240	5.380	" " "	T7-1101-68	" " "	23032-1970
23032-020 Made From 23032-022	23032-1240	5.020	" " "	T3-0411-68	T13-0128-65	23032-1692
23046-001	23032-1240	7.375	T2-0415-66	T3-0415-66	T13-0128-65	23046-1120
23046-004	23032-1240	7.375	" " "	" " "	" " "	23046-1122
23046-006	23032-1240	None	" " "	" " "	" " "	23046-1124
23046-007	23032-1240	7.375	" " "	" " "	" " "	23046-1124
23046-009	23032-1240	7.375	" " "	" " "	" " "	23046-1120
23046-012	23032-1240	7.375	" " "	" " "	" " "	23046-1127
23046-014	23032-1240	7.375				23046-1860
23046-015	23032-1240	7.375	T2-0415-66	T3-0416-66	T13-0128-65	23046-1120
23046-016	23032-1240	7.375	" " "	" " "	" " "	23046-1124
23046-040 Made From 23046-006	23032-1240	None	" " "	" " "	" " "	23046-1124
23048-001	23032-1240	8.075	T2-0415-66	T2-0328-67	T13-0128-65	23046-1121
23048-004	23032-1240	8.075	" " "	" " "	" " "	23046-1125
23048-006	23032-1240	8.075	" " "	" " "	" " "	23046-1121
23048-008	23032-1240	8.075	" " "	" " "	" " "	23046-1125
23048-012	23032-1240	8.075	" " "	" " "	" " "	23046-1121
23048-014	23032-1240	8.075	" " "	" " "	" " "	23046-1121
23064-001	30059-1040	8.822	T2-0415-68	T7-1014-68	T13-0128-65	23064-1011
23064-002	30059-1040	8.822	" " "	" " "	" " "	23064-1011
30059-000	30059-1040	None	T2-0415-66	T1-1110-66	T13-0128-65	30059-1017
30059-001	30059-1040	7.430	T2-0415-66	T1-1110-66	T13-0128-65	30059-1017
30059-002	30059-1040	7.430	" " "	" " "	" " "	30059-1017
30059-010	30059-1040	7.430	" " "	" " "	" " "	30059-1017
30059-011	30059-1040	7.430	" " "	" " "	" " "	30059-1017

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CLEVELAND 1, OHIO

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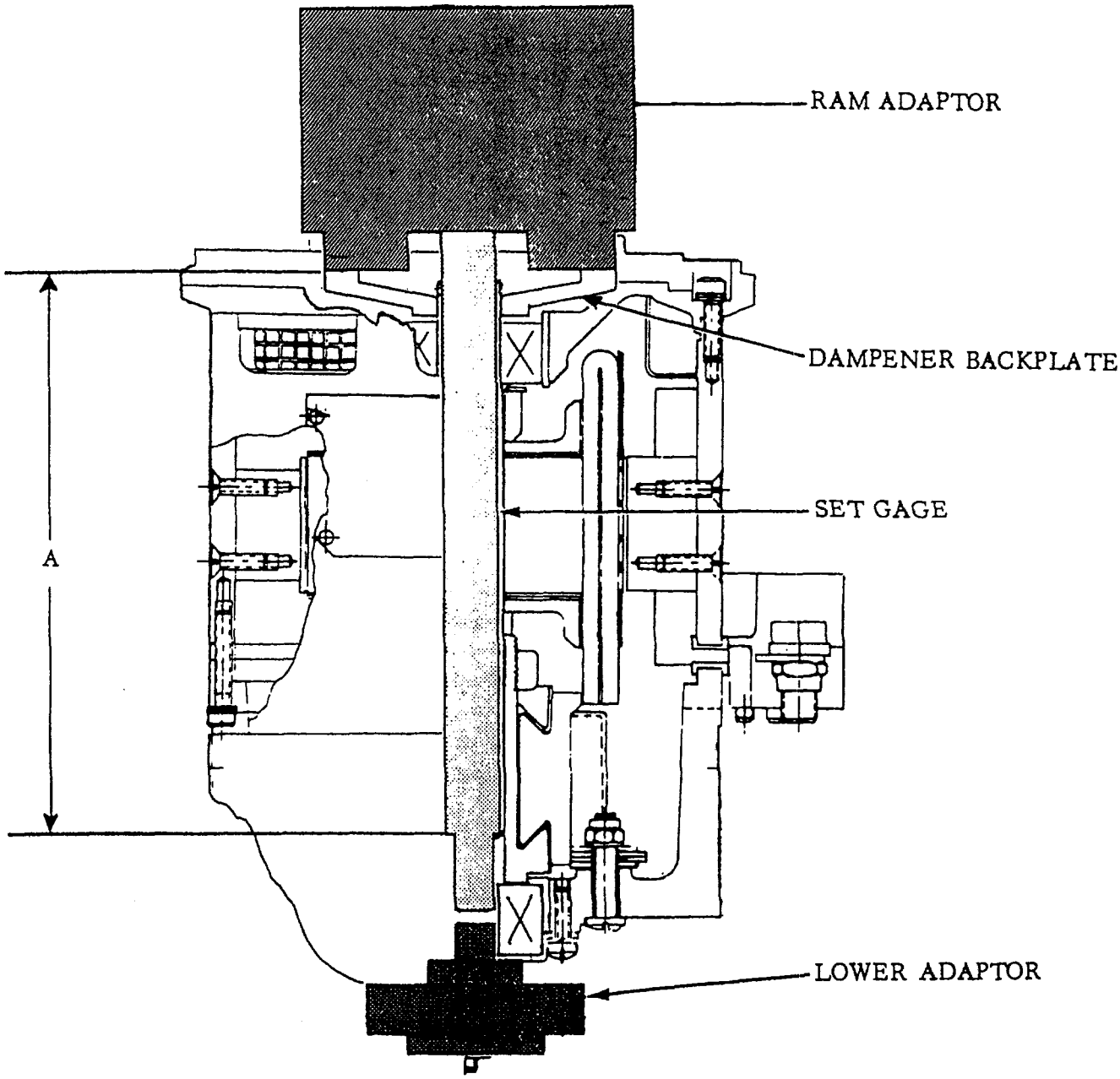


Figure 1. Installing Dampener Backplate.

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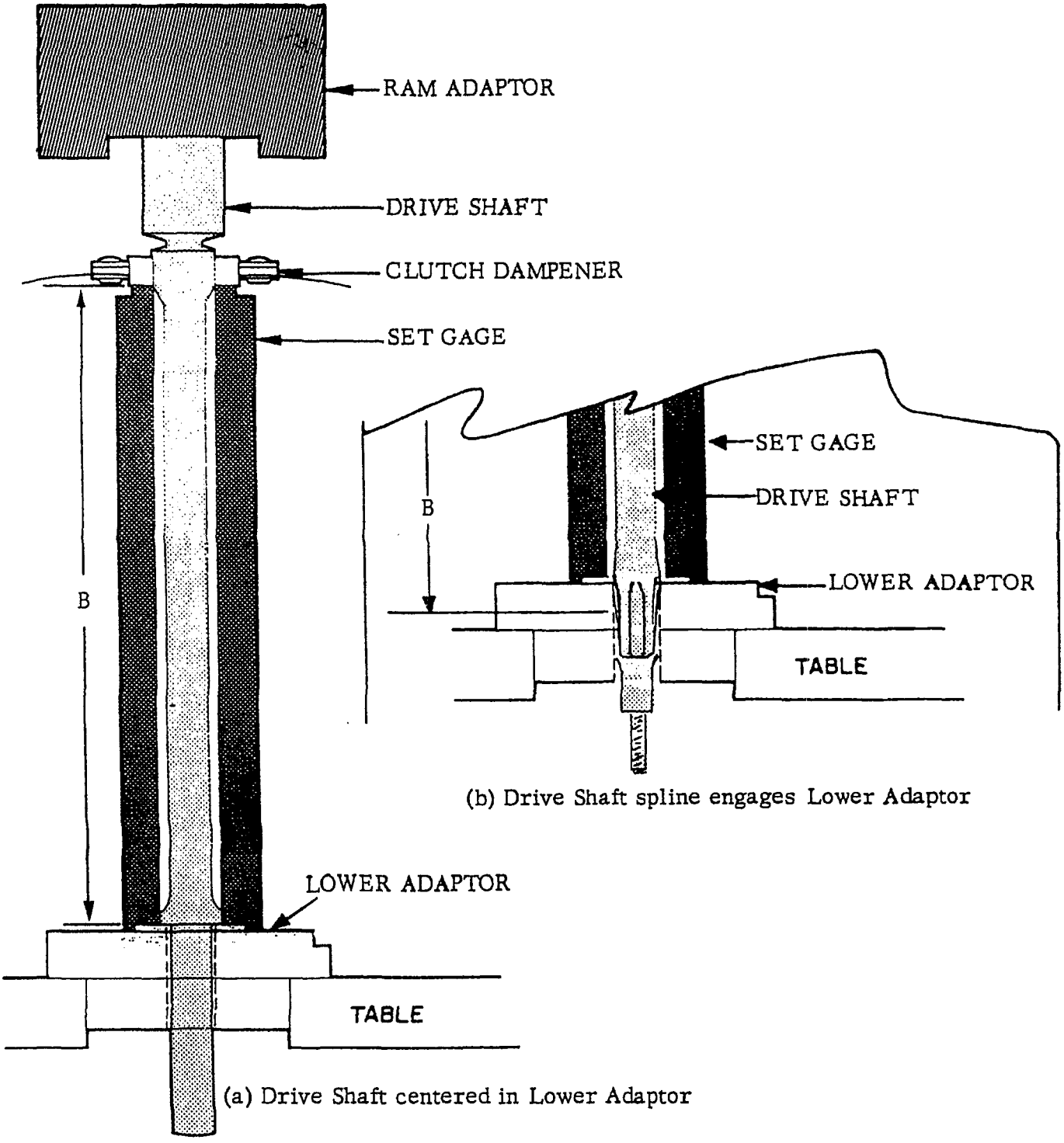


Figure 2. Installing Clutch Dampener

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SERVICE BULLETIN

NO. 166

ELECTRICAL POWER---STARTER GENERATOR LSi/PED MODEL 23048-014, MODIFICATION TO MODEL 23048-015.

1. PLANNING INFORMATION

A. Effectivity

This service bulletin is applicable to all LSi/PED Starter Generators, Model 23048-014 manufactured by Lear Siegler, Inc., Cleveland, Ohio.

B. Reason

To provide increased allowable operating temperature.

C. Description

This service bulletin contains instructions for replacing the ball bearings P/N 03-6010-08 in the modification of the 23048-014 Starter Generator.

D. Compliance

It is recommended that the new ball bearings, P/N 03-6010-08, be installed at the next scheduled overhaul or as soon as practicable.

E. Approval

Not required.

"IN SERVICE TO THE AIRLINES"

LEAR SIEGLER, INC.
POWER EQUIPMENT DIVISION
P.O. Box 6719
Cleveland, Ohio 44101

March 1, 1970

LEAR SIEGLER, INC. / LSi
POWER EQUIPMENT DIVISION
P. O. BOX 6719
CLEVELAND 1, OHIO

SERVICE BULLETIN

NO. 166

1. PLANNING INFORMATION (Continued)

F. Manpower

No additional man hours required when performed at overhaul.

G. Material - Cost and Availability

The new ball bearings are available through your LSi/PED distributor at $21.18 per set, list price. Price is subject to change.

H. Tooling

No special tools are required.

I. Weight and Balance

Not affected.

J. Reference

LSi/PED Overhaul Manual File No. 23202.

2. ACCOMPLISHMENT INSTRUCTIONS

Install new ball bearings, P/N 03-6010-08, during overhaul of unit in accordance with paragraphs 6B, 6C and 6D in LSi/PED Overhaul Manual File No. 23203.

3. MATERIAL INFORMATION

New Part No.	Quantity	Description	Old Part No.	Disposition
03-6010-08	2	Bearings, Ball	07-111253	Discard

Restamp Identification Nameplate from 23048-014 to 23048-015.

File No. 23419
March 1, 1970

LEAR SIEGLER, INC.

POWER EQUIPMENT DIVISION

P. O. BOX 6719
CLEVELAND 1, OHIO

File No. 23420

CHANGE NOTICE

The attached pages supersede the entire previous issue. Discard the basic bulletin and replace with this reprinted issue.

SB 167-1

Page No.	Issue Date	Nature of Change	Reason
1	3/10/71	Paragraph 1.C has been changed to read, "The depth of mica undercut has been changed from .032 inches max width by .032 inches deep, to .037/.045 width by .064 + .005 deep."	Revised dimensions are compatible with actual practice.
3	3/10/71	Paragraph 2A & 2B changed by deleting note under 2A and rewording 2B to be consistent with changes on page 1.	Simplify wording of instructions.

SERVICE BULLETIN

NO. 167-1

ELECTRICAL POWER - D. C. STARTER GENERATORS - MODELS 23046, 23048 SERIES AND 23070-001 - REPAIR OF ARMATURE COMMUTATOR

1. PLANNING INFORMATION

A. Effectivity

This service bulletin affects Lear Siegler (LSI/PED) starter-generators employing armatures P/N 23046-1030, 23048-1030, and 23069-342.

B. Reason

A new minimum commutator diameter has been established for overhaul to provide longer useful armature life. The mica undercut dimension has been increased also to accommodate in-service brush change.

Compliance with this bulletin will result in increased useful life of armature and reduced service costs.

C. Description

The minimum serviceable commutator diameter is reduced from 2.135 inches to 2.055. The depth of mica undercut has been changed from .032 inches maximum width by .032 inches deep,.. to .037/.045 width by .064+.005 deep. (See ACCOMPLISHMENT INSTRUCTIONS in this bulletin for complete details.)

D. Compliance

LSI/PED recommends the changes provided in this bulletin be accomplished at the next scheduled overhaul of these starter-generators.

"IN SERVICE TO THE AIRLINES"

LEAR SIEGLER, INC.
POWER EQUIPMENT DIVISION
17600 Broadway Ave.
Maple Heights, Ohio 44137

Revised March 10, 1971
July 15, 1970

LEAR SIEGLER, INC. / POWER EQUIPMENT DIVISION
P. O. BOX 6719
CLEVELAND 1, OHIO

SERVICE BULLETIN

NO. 167-1

1. PLANNING INFORMATION (Continued)

E. Approval

Not applicable

F. Manpower

One-half man-hour.

G. Material-Cost and Availability

Not applicable

H. Tooling

No special tools required other than normal shop equipment.

I. Weight and Balance

Not affected

J. References

File No.	Model
23202	23048 - series
23203	23046 - series
23208	23070-001

File No. 23420
July 15, 1970
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LEAR SIEGLER, INC. / POWER EQUIPMENT DIVISION
P. O. BOX 6719
CLEVELAND 1, OHIO

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2. ACCOMPLISHMENT INSTRUCTIONS

Refer to the above listed overhaul manuals, under References, for disassembly cleaning, reassembly and testing of units. The instructions in this bulletin are to be used in lieu of those in these manuals for Inspection also Repair and Replacement.

A. Repair Armature Commutator

If inspection reveals that commutator is rough, pitted, scored, or burned, refinish in a lathe that is accurately set up and adjusted. REMOVE ONLY THE MATERIAL NECESSARY TO CLEAN AND TRUE-UP THE COMMUTATOR SURFACE. Replace armature that necessitates turning of commutator to less than a minimum diameter of 2.055 inches. Concentricity of commutator with bearing journals must be maintained within 0.0005 inch T. I. R.

CAUTION: When the armature has been cut to 2.055 + .005-.000 it is mandatory that new brushes be installed.

B. When the commutator is turned down on the lathe, the mica between the commutator bars should be undercut to .037/.045 width, by .064 $\pm$ .005 deep.

Use a triangular scraper and a bristle brush to remove all excess mica, sharp edges and burrs from between commutator bars. Check for commutator concentricity.

C. Mount the armature in a lathe and operate at a speed of 500 to 600 RPM. Polish commutator by applying 5°0 sandpaper (not emery paper) adequately contoured and supported over entire length of commutator and one-third of its periphery. Remove dust with a bristle brush.

D. Balance the armature as indicated in the appropriate overhaul manual.

E. Proceed with scheduled overhaul and testing of unit as indicated in the appropriate overhaul manual.

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July 15, 1970
Revised March 10, 1971

LEAR SIEGLER, INC.
POWER EQUIPMENT DIVISION
17600 BROADWAY AVE.
MAPLE HEIGHTS, OHIO 44137

File No. 23421

S.B. 169-1

CHANGE NOTICE

IMPORTANT: This bulletin has been reprinted in order to provide sufficient quantities for current requirements. A slight correction has been made on page 7. Replace all copies with this revised bulletin dated June 1, 1973.

Page No.	Issue Date	Nature of Change	Reason
T	6/1/73	Revise to show new date.	Properly identify latest changed bulletin.
7	6/1/73	Change illustration to show clutch hub farther away from a flush position on tapered drive shaft.	Show the importance of clutch hub not to be forced too hard onto draft shaft taper.

FILE NO 23421

SERVICE BULLETIN

NO. 169-1

ELECTRICAL POWER---DC GENERATORS AND STARTER GENERATORS, USAGE OF NEW CLUTCH DAMPENER AND BACK PLATE ASSEMBLIES.

1. PLANNING INFORMATION

A. Effectivity

This service bulletin is applicable to the following Lear Siegler, Inc., Power Equipment Division (LSI/PED) Starter Generator and Generator Models:

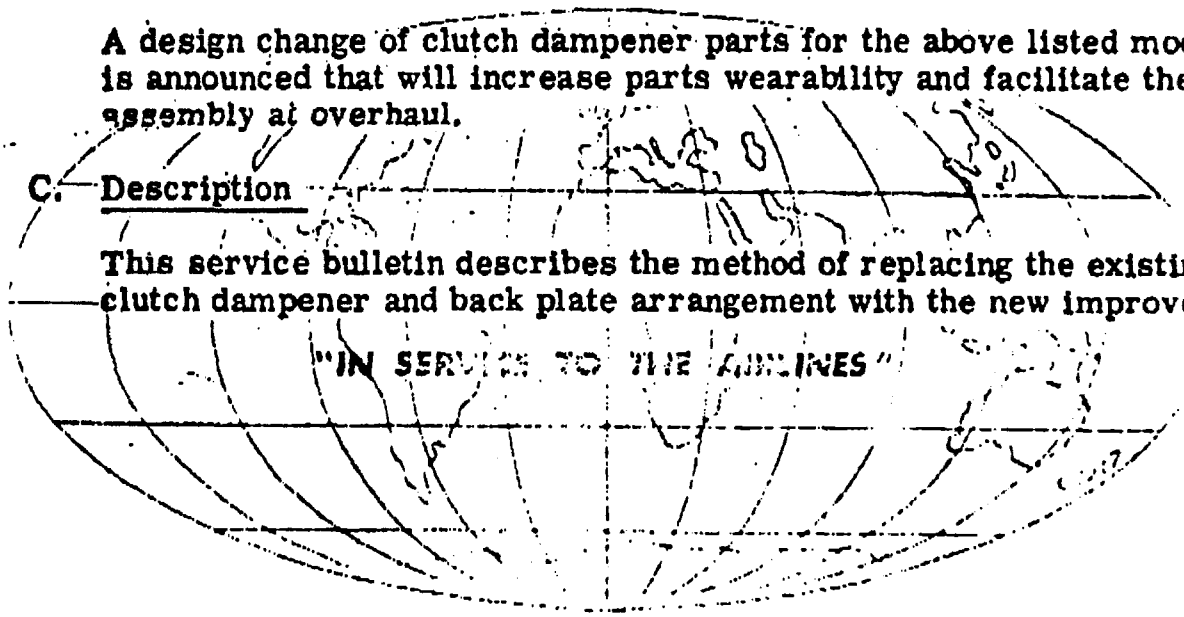
23032-007, -010, -011, -012, -020, -022, -032; 23033-002;
23046-001, -004, -006, -007, -009, -012, -014, -015, -016, -017, -019, -040;
23048-001, -004, -006, -008, -012, -013, -014, -015, -016, -018;
23065-003, -004, -005, -006, -009;
23069-012, -013, -014, -016;
23064-001, -002, -003, -005;
30059-000, -001, -002, -003, -010, -011.

B. Reason

A design change of clutch dampener parts for the above listed models is announced that will increase parts wearability and facilitate their assembly at overhaul.

C. Description

This service bulletin describes the method of replacing the existing clutch dampener and back plate arrangement with the new improved



LEAR SIEGLER, INC. / POWER EQUIPMENT DIVISION
17600 Broadway Avenue
Maple Heights, Ohio 44137

Revised June 1, 1973
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1. PLANNING INFORMATION (Continued)

design. The new clutch dampener consists of an individual clutch plate and a splined hub, also, a clutch back plate and a replaceable friction disc. The employment of the new arrangement simplifies the assembly of these parts and obsoletes File 23414 (S.B. 153) and File 23416 (S.B. 160); previously issued to explain clutch dampener assembly method of existing production units. See Figure 1, Cross Sectional View of new dampener assembly for parts relationship and assembly method.

D. Compliance

Compliance with this bulletin is optional, based upon individual requirements of operators. LSI recommends that the new improved design parts be ordered and installed, using interchangeably with old parts in stock as necessary for attrition. The existing design (old type) of clutch dampener and back plate has been discontinued and all parts orders will be accomplished by shipment of the new design parts. See Table I for cross reference between old and new type parts. The interchangeability of parts is described under "Material Information."

E. Approval

None required.

F. Manpower

When replacement of parts is accomplished at overhaul no additional man-hours are required.

G. Material - Cost and Availability

New parts and prices can be obtained from the following LSI/PED authorized distributors.

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1. PLANNING INFORMATION (Continued)

Aircraft Appliances and Equipment, Ltd.
152 East Drive
Bramalea, Ontario, Canada Phone 416-249-8411

American Avitron, Inc.
160 Midland Avenue
Rye, New York 10580 Phone 914-937-5300

Delivery 180 days or less

H. Tooling

None required when installing the improved clutch dampener parts covered in this bulletin. The special tools listed in LSI/PED Service Bulletin No. 160 are no longer required and should be disregarded, unless old parts still in stock are employed.

I. Weight and Balance

No change.

J. References

Applicable service manuals for models referenced in tables are File. Nos: 23201, 23202, 23203, 23206, 23207, and 30203.

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NO. 169-1

2. ACCOMPLISHMENT INSTRUCTIONS

1. Removal of Old Parts. (Refer to Figure 2)

A. Disassemble the starter generator, or generator, in accordance with the instructions provided in the applicable overhaul manual.

B. Remove and discard old clutch dampener (14) and old clutch back plate (15), as referenced by index numbers in Figure 2.

2. Installation of New Parts. (Refer to Figure 1)

A. Assemble the starter generator, or generator, in accordance with the instructions provided in the applicable overhaul manual.

NOTE: For the purpose of this service bulletin disassemble only to the extent necessary to remove clutch dampener and back plate.

CAUTION: DO NOT USE AN ARBOR PRESS TO FORCE DRIVE SHAFT TAPER INTO TAPERED HOLE OF CLUTCH HUB DURING ASSEMBLY.

B. Install the new clutch back plate on the armature making sure the new back plate is properly seated on the shaft taper.

C. Install the new clutch hub over small spline end of the drive shaft, making certain the hub taper is fully seated on the taper of drive shaft.

D. Install the new clutch plate over small spline end of drive shaft making certain it engages with the spline on the new clutch hub and fully bottoms on the shoulder of the clutch hub.

E. Install the new friction disc in the recess on the clutch back plate. Hold the friction disc in place while installing the drive shaft through the armature, making certain splines of drive shaft are fully engaged with splines of armature and the clutch plate captures and holds the friction disc in place.

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2. ACCOMPLISHMENT INSTRUCTIONS (Continued)

F. Complete the assembly of the starter generator or generators in accordance with instructions provided in the applicable overhaul manual.

NOTE: Make certain that friction disc does not slip out of its recess in the clutch back plate and remains captured as illustrated in Figure 1.

NOTE: Tightening of the nut (12, Figure 2) on drive shaft will cause tapered fit of drive-shaft to clutch-hub, also armature-shaft to back-plate to seat properly.

G. Test the starter generators, or generator, in accordance with instructions in the applicable overhaul manual.

NOTE: There are no manuals for Models 23065 Series or 23069 Series Starter Generators. These models are tested generally the same as Model 23046 Series except as follows:

	23046 Series	23065 Series	23069 Series
Max Speed for Regulation	Same	Same	Same
Compounding	Same	Same	Same
Min Speed for Regulation (with following conditions)	7900 rpm	7470 rpm	6650 rpm
External Resistance in Shunt Field	1.25 ohm	1.25 ohm	0.2 ohm
Max Field Current	8 amp	8 amp	10 amp

3. MATERIAL INFORMATION

The new clutch dampener parts are interchangeable with existing (old type) parts. Complete information for replacement and interchangeability of parts is provided in Table I. The new clutch dampener assembly consists of four parts, viz: clutch-

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3. MATERIAL INFORMATION (Continued)

plate, hub, clutch back plate, and function disc.
These parts are all illustrated and identified in their relative assembly positions in Figure 1.

TABLE I

Model Numbers and Dampener Assembly
Parts Supersedures

	CLUTCH DAMPENER			CLUTCH BACK PLATE		
	Old	New		Old	New	
	Clutch Dampener	Clutch Hub	Clutch Plate	Back Plate	Back Plate	Friction Disc
23032-007/010/011 012/020/032	23032-1240	23032-1900	23032-1910	23032-1280	23032-2711	02-5600-05
23046-001 004/007/009 014/015/016 017/018/019	23032-1240	23032-1900	23032-1910	23032-1281	23032-2710	02-5600-05
23033-002	23032-1240	23032-1900	23032-1910	23032-1281	23032-2710	02-5600-05
23048-001 004/006/008 012/013/014 015/016/018	23032-1240	23032-1900	23032-1910	23032-1281	23032-2710	02-5600-05
23065-003 004/005/006 009	23032-1241	23032-1900	23032-1910	23032-1281	23032-2710	02-5600-05
23069-012 013/014/016	23032-1241	23032-1900	23032-1910	23032-1285	23032-2710	02-5600-05
23064-001 002	30059-1040	23032-1901	30059-1480	31228-1095	30059-1470	02-5600-06
30059-010 000/001/002 011/012	30059-1040	23032-1901	30059-1480	30059-1041	30059-1471	02-5600-06

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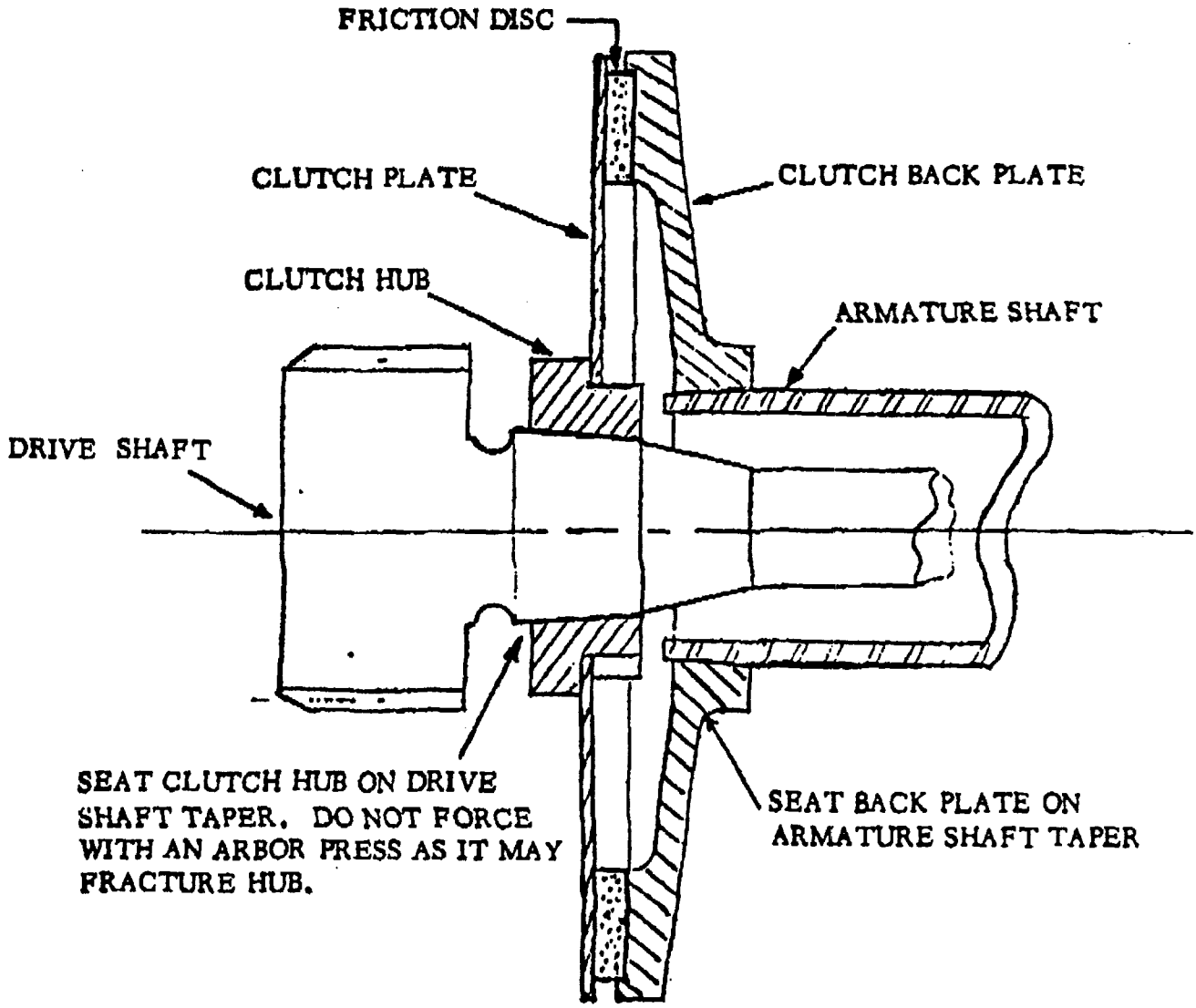


Figure 1. New Dampener Assembly

SERVICE BULLETIN

NO. 169-1

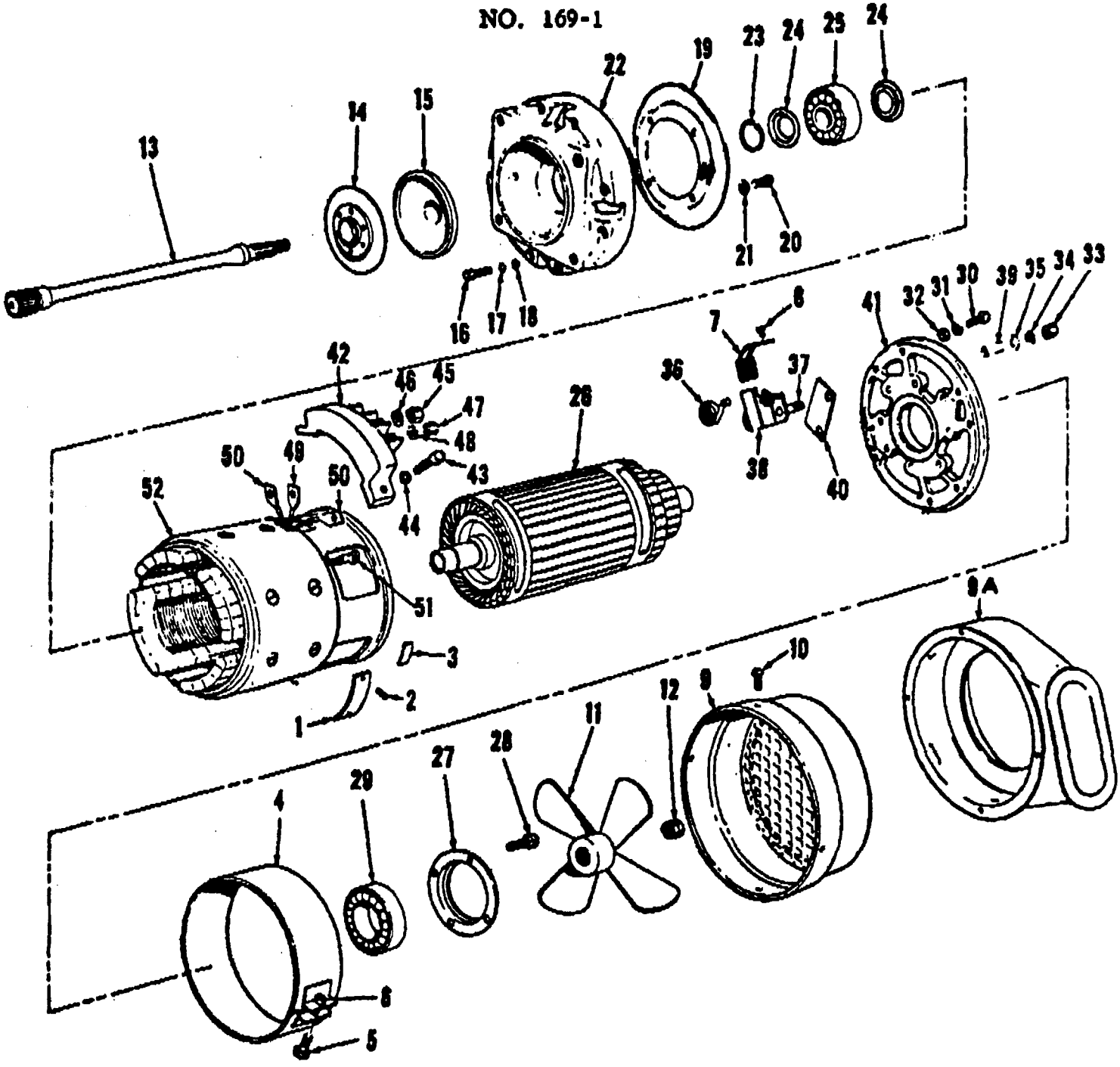


Figure 2. Typical Representation of Starter Generator

File No. 23421
November 1, 1970
Revised March 5, 1971

FILE NO. 23423

SERVICE BULLETIN

NO. 180-1

ELECTRICAL POWER --- STARTER GENERATOR LSI/PED MODELS 23048-014, 23048-015 MODIFICATION TO MODEL 23048-018

1. Planning Information

A. Effectivity

This service bulletin is applicable to (LSI/PED) Starter Generators Model 23048-014 and 23048-015 manufactured by Lear Siegler, Inc., Power Equipment Division, Maple Heights, Ohio.

B. Reason

To provide one compatible unit to operate on all Beech Series C90, E90, 99A and A100 series aircraft.

C. Description

This service bulletin, in conformity with Service Bulletin No. 166, contains instructions for replacing the ball bearings P/N 03-6010-08, and brushes P/N 30300-1284 in the modification of the 23048-014 and 23048-015 starter generators.

D. Compliance

It is very necessary that the new ball bearings P/N 03-6010-08 and new brushes P/N 30300-1284 be installed immediately on any 23048-014 or 23048-015 starter generator to be installed on Beech series "100" aircraft.

Other units may be modified at the next scheduled overhaul or as soon as practicable.

E. Approval

Not required

(Rev. Sept. 25/72)
August 15, 1972

17600 Broadway Avenue
Maple Heights, Ohio 44137

F. Manpower

No additional man hours required when performed at overhaul.

G. Material - Cost and Availability

The new ball bearings and brushes are available through your LSI/PED distributor.

H. Tooling

No special tools are required

I. Weight & Balance

Not affected.

J. Reference

LSI/PED Overhaul Manual File No. 23202

2. Accomplishment Instructions

Install new ball bearing. P/N 03-6010-08 in accordance with paragraphs 6B, 6C, 6D and follow brush procedure in paragraphs 5F, 5G and 5H in LSI/PED Overhaul Manual, File No. 23202.

3. Material Information

New Part No.	Quantity	Description	Old Part No.	Disposition
03-6010-08	2	Bearings Ball	07-111253	Discard
30300-1284	4	Brushes	30300-1282	Discard

Restamp identification nameplate from 23048-014 and 23048-015 to 23048-018 starter generator and mark the nameplate 200/250 amps.

Beech part number on nameplate must be changed from 115-389004-1 and 97-389001-1 to 100-389005-11 after modification.

On the Model 23048-014, P/N is 115-389004-1; change to a 100-389005-11.

On the Model 23048-015, P/N is 97-389001-1; change to a 100-389005-11.

SERVICE INFORMATION LETTER 02-5600-01, Revision 1

Generators - Dampener Friction Ring Replacement

1. PLANNING INFORMATION

A. Effectivity

All Lucas Aerospace Power Equipment Corporation (LAPEC) (formerly Lear Siegler Power Equipment Corporation) Generators.

B. Reason

The original service information letter dated December 21, 1988 contained an incomplete/incorrect list of generators affected by this change.

C. Description

This service information letter provides a complete list of replacement dampener friction ring part numbers.

D. Compliance

LAPEC recommends that the modifications outlined in this service information letter be accomplished when any part of the dampener assembly (dampener plate or backplate) are replaced or when the existing friction ring is damaged.

E. Approval

This service information letter has the approval of LAPEC.

F. Manpower

No additional manhours are required for this modification when it is done during overhaul or repair of the generator.

G. Material Cost and Part Availability

Model	Old Friction Ring P/ N	New Friction Ring P/ N
23032-Series	02-5600-05	02-5600-13
23033-Series		
23046-Series		
23048-Series		
23064-Series	02-5600-06	02-5600-14
23065-Series (excluding -013/013-1)	02-5600-05	02-5600-13
23065-013/013-1	02-5600-06	02-5600-14
23069-Series	02-5600-05	02-5600-13
23075-Series	02-5600-06	02-5600-14
23076-Series	02-5600-05	02-5600-13
23078-Series (excluding -006/007/011/012/013/017)		
23078-006/007/011/012/013/017	02-5600-11	02-5600-15
23079-Series	02-5600-06	02-5600-14
23080-Series	02-5600-05	02-5600-13
23081-Series		
23085-Series (excluding -002/004/009/011)		
23085-002/004/009/011	02-5600-11	02-5600-15
23088-Series		
23090-Series	02-5600-05	02-5600-13
23091-Series		
23092-Series		
23095-Series		
30076-Series		
30071-001	02-5600-06	02-5600-14
30081-001	02-5600-05	02-5600-13
31342-001		

The required parts and pricing information are available from the following distributors:

AMERICAS: **LUCAS AEROSPACE**
Customer Service Center - Americas

Mailing Address	**Shipping Address**
P. O. Box 120039	One Circle West
Stamford, CT 06912	Stamford, CT 06902

TELEPHONE:	(203) 351-8400
AOG EMERGENCY SERVICE:	(203) 351-8400 (24 Hours, 7 Days a Week)
TELEX:	475-0339 (Answer Back - "AVTR UI")
TELECOPIER:	(203) 351-8444 (Omnifax G55 & G77)
SITA:	BDRLRCR

EUROPE - MIDEAST - AFRICA: **LUCAS AEROSPACE LTD.**
Customer Service Center - Europe
Birmingham Road
West Bromwich
West Midlands B71 4JR, UK

TELEPHONE:	(44) 21 627-6767
AOG EMERGENCY SERVICE:	(44) 21 779-6531
TELEX:	333174
TELECOPIER:	(44) 21 500-6405
SITA:	BHXLUCR
EDI SITA:	LPLLUCR

ASIA - PACIFIC: **LUCAS AEROSPACE SINGAPORE (PTE.) LTD.**
Customer Service Center - Asia/Pacific
35 & 37 Loyang Way
Singapore 1750

TELEPHONE:	(65) 545-9975
AOG EMERGENCY SERVICE:	(65) 545-6253
TELEX:	TBA
TELECOPIER:	(65) 545-9965
SITA:	SINLUXD

H. Tooling and Cost Availability

No special tools are required to accomplish the contents of this service information letter.

I. Weight and Balance

Not affected.

J. Electrical Load Data

Not affected.

K. References

Refer to the applicable Component Maintenance Manual (CMM) with Illustrated Parts List for your generator.

L. Publications Affected

All Component Maintenance Manuals with Illustrated Parts List for each generator is affected by the issuance of this service information letter through a revision to the parts list.

2. ACCOMPLISHMENT INSTRUCTIONS

A. Disassembly

Disassemble the generator to the extent necessary to remove the original friction ring as detailed in the DISASSEMBLY section of the CMM.

B. Repair

Not applicable.

C. Assembly

Assemble the generator as outlined in the ASSEMBLY section of the CMM.

D. Testing

Test the generator according to the procedures provided in the TEST section of the CMM.

3. REIDENTIFICATION

Not required.

SERVICE INFORMATION LETTER

NUMBER 03-6010-XX-01

- VENTED BEARING SEALS -

A. Effectivity

All Lucas Aerospace Power Systems, Aurora (LAPSA) (formerly Lear Siegler Power Equipment Division) starter-generators and generators that use 03-6010-10, 03-6010-14 or 03-6010-18 bearings.

B. Reason

This service information letter is being issued to provide a physical description of a new bearing seal. This seal is used with the bearings listed in Paragraph A of this service information letter.

C. Description

A small vent-hole that is visible on the surface of the bearing seal allows the air pressure inside and outside the bearing to equalize as the operating temperature of the bearing changes. When the air pressure is equalized, seal wear is reduced.

D. Weight and Balance

Effect on weight: None.

Effect on balance: None.

E. Electrical Load Data

Not affected.

F. References

There are no references for this service information letter.

G. Publications Affected

No publications are affected by this service information letter.

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SERVICE INFORMATION LETTER

NUMBER 23701

ION VAPOR DEPOSITION ALUMINUM COATING

1. PLANNING INFORMATION

A. Effectivity

This service information letter is applicable to all Lucas Aerospace Power Systems, Aurora (LAPSA) (formerly Lear Siegler Power Equipment Division) generators and starter-generators with ion vapor deposition (IVD) coated parts and assemblies.

B. Reason

The introduction of IVD aluminum coatings for exterior generator and starter-generator parts and assemblies will reduce the need for and the cost of repairing exterior surfaces.

C. Description

This service information letter provides information on the superior performance characteristics of the IVD aluminum coating. It also provides information relevant to the cleaning of IVD aluminum coated parts and assemblies during overhaul.

IVD aluminum is a protective coating applied to ferrous metal parts. The IVD process was developed as a replacement for cadmium plating of steel. It is a vacuum deposition process which deposits pure aluminum on most metal substrates. It is extremely durable and is resistant to scratching and corrosion. The IVD coating is non-toxic and non-hazardous and provides excellent "sacrificial" corrosion resistance on steel with no hydrogen embrittlement. This coating is capable of withstanding high operating temperatures (see Table 1). It also provides improved electrical bonding by reducing the electrical resistance between parts and assemblies.

LAPSA has changed from the painted coating finishes of many steel exterior generator parts, including stator housings, air inlets, brush access covers, endbells, and QAD mounting adapters to IVD aluminum coating. While IVD coatings are pure aluminum which would generally appear silver or gray, LAPSA generators with IVD coated parts will have a gold appearance. This is the result of a supplementary chemical conversion coating which provides additional corrosion protection to the aluminum coating.

Coating Thickness	.001 - .002 in. (.03 - .05 mm)
Hours Tested	672 hours in 5% neutral salt
Operating Temperature Limits	925°F (495°C) maximum

Table 1 - IVD Coating Attributes

D. Compliance

Generators with IVD aluminum coatings successfully completed environmental and electrical testing with no physical or functional degradation. All IVD aluminum coated parts are manufactured in accordance with LAPSA approved drawings, specifications, instructions, and processes.

E. References

Refer to the applicable Component Maintenance Manual (CMM) with Illustrated Parts List (IPL) for all exterior starter-generator parts and assemblies.

F. Other Publications Affected

All affected CMMs will be revised to include the contents of this service information letter.

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2. MATERIAL INFORMATION

A. Material Requirements

Materials needed for cleaning of IVD coated parts and assemblies are listed below.

Material	Description/Specification	Instruction/Disposition
Brush	Non-metallic, soft bristle	Commercially available.
Cleaning pads/Wiping cloth	Lint free, soft fabric	Commercially available.
Compressed Air	30 PSIG (207 kPa)	Commercially available.
Detergent (see **NOTE** below)	Formula 815 GD Formula 1990 GD	Clean the parts. Procure from: The Brulin Company P.O. Box 270 Indianapolis, IN 46206
Isopropyl Alcohol	TT-I-735	Commercially available.

Table 2 - Cleaning Materials

NOTE: Formula 815 GD is for use with aluminum-safe hot tanks, steam cleaning, and ultrasonic cleaning. Formula 1990 GD is for use with pressure sprayers and spray wash cleaning.

B. Cleaning

Fully clean and rinse the IVD parts with water and recommended detergent until a water-break free surface is attained. Use of the following cleaning procedure will ensure the durability of IVD aluminum coated parts and assemblies.

CAUTION: It is strongly recommended that the detergents listed in Table 2 be used when cleaning IVD coated parts. The use of improper cleaning solutions may damage the IVD coating. Parts should not be exposed to cleaning solutions longer than is necessary to remove dirt and other particles. Follow the manufacturer's recommended dilution and cleaning times.

(1) Before any surface coatings are applied, all parts are to be fully cleaned and dried. Wash the parts using one or more of the approved cleaning methods listed below.

Method	Instructions
Spray wash the parts.	**CAUTION:** Make sure to limit the pressure used to clean parts. High pressure may remove or damage surface coatings.
	(a) Put the parts into a pressure spray wash booth.
	(b) Spray the parts with a solution of detergent and water.
Clean the parts ultrasonically.	**CAUTION:** Ultrasonic cleaning tanks can remove plating from metal surfaces. Extended exposure to ultrasonic cleaning can cause parts to lose their dimensional tolerances.
	(a) Put the parts into an ultrasonic soaking tank.
	(b) Allow the parts to be ultrasonically cleaned for no more than 20 minutes.
	(c) Remove all evidence of oil, dirt and carbon residue with a soft bristle brush or a cleaning rag.

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Method	Instructions
Soak the parts in an agitation tank.	(a) Put the parts into an agitation tank.
	(b) Remove all evidence of oil, dirt and carbon residue with a soft bristle brush or a cleaning rag.
Soak the parts and clean them by hand.	(a) Put all the parts into a soaking tank.
	(b) Remove all evidence of oil, dirt and carbon residue with a soft bristle brush or a cleaning rag.

Table 3 - Cleaning Methods

(2) Flush the parts.

NOTE: Use only minimal pressure to rinse the parts.

(a) Put the parts into a pressure spray wash booth.

(b) Flush the parts using hot water or steam.

(c) Repeat the appropriate cleaning procedure where necessary, until the parts are clean and free of dirt and carbon residue.

(3) Dry the parts.

(a) Put the parts in an oven at a temperature of 250°F (121°C) for 2 1/2 hours.

(b) Remove any moisture from the remaining parts with a dry lint free cloth.

WARNING: ISOPROPYL ALCOHOL IS FLAMMABLE AND TOXIC. VAPORS CAN CAUSE DIZZINESS, HEADACHE, AND INTOXICATION. USE RESPIRATORY PROTECTION WHEN HANDLING LARGE QUANTITIES.

(c) Check each part for carbon particles by wiping the assemblies with isopropyl alcohol using a clean, lint-free cloth.

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SERVICE INFORMATION LETTER

NUMBER 23703

ELECTRICAL POWER - DC STARTER-GENERATOR REPLACEMENT OF THE NUT ATTACHING THE FAN

1. PLANNING INFORMATION

A. Effectivity

This service information letter applies to all Lucas Aerospace Power Systems, Aurora (LAPSA) DC Starter-Generators listed below.

23032-006	23032-007	23032-010	23032-011	23032-020	23032-022
23032-025	23032-026	23032-027	23032-028	23032-042	23032-043
23032-044	23032-048	23032-049	23046-001	23046-004	23046-006
23046-007	23046-007M	23046-009	23046-012	23046-014	23046-015
23046-019	23046-020	23046-021	23046-022	23046-027	23046-028
23048-001	23048-004	23048-004T	23048-004M	23048-004TM	23048-006
23048-008	23048-012	23048-014	23048-015	23048-016	23048-018
23048-020	23048-021	23048-022	23048-023	23065-009	23065-013
23065-013-1	23065-015	23065-015-1	23065-015-2	23065-015-3	23065-016
23065-016-1	23065-018	23065-018-1	23069-020	23069-020-1	23069-021
23070-001	23075-002	23075-003	23075-004	23075-005	23075-006
23075-008	23075-009	23076-001	23076-001-1	23076-004	23076-004-1
23076-005	23076-005-1	23076-008	23078-003	23078-003-1	23078-005
23078-005-1	23078-006	23078-007	23078-008	23078-009	23078-010
23078-013	23078-019	23079-000	23079-000-1	23079-002	23079-002-1
23079-003	23079-004	23079-005	23079-006	23079-007	23079-009
23080-001	23080-001-1	23080-002	23080-003	23080-004	23080-005
23080-006	23080-011	23080-012	23080-013	23080-014	23080-014A
23080-015	23080-018	23080-019	23080-020	23080-023	23080-025
23080-050	23080-031	23080-032	23081-007	23081-008	23081-009
23081-010	23081-011	23081-011-1	23081-012	23081-012-1	23081-017
23081-017A	23081-018	23081-018A	23081-019	23081-022	23081-022A
23081-023	23081-023A	23081-024	23081-025	23081-026	23081-029
23081-042	23081-043	23081-046	23081-047	23085-001	23085-002
23085-004	23085-006	23088-001	23088-002	23090-001	23090-002
23090-003	23090-004	23091-002	23095-002		

B. Reason

LAPSA has replaced the P/N 02-4107-01 double hex self locking nut that attaches the fan to the drive shaft of most of its starter-generators with a P/N MS21042-4 single hex self locking nut. Replacement of the P/N 02-4107-01 nut with the P/N MS21042-4 nut will reduce the cost of repair and overhaul of the starter-generators listed above.

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SERVICE INFORMATION LETTER

C. Description

This service information letter provides authorization for the use of P/N MS21042-4 self locking nut in the starter-generators listed on page 1. The change to the part number of the self locking nut establishes the P/N MS21042-4 self locking nut as the "standard" part for use in the starter-generators listed on page 1. This covers most LAPSA starter-generators.

D. Compliance

LAPSA recommends that the part introduction described by this service information letter be accomplished when the P/N 02-4107-01 double hex self locking nut requires replacement.

E. Approval

This service information letter has the approval of LAPSA and contains no modification information that revises the approved configuration of affected starter-generators and therefore does not require governmental or other regulatory agency approval.

F. Manpower

No additional man-hours are required during repair or overhaul of the starter-generator.

G. Weight and Balance

Effect on weight: None.

Effect on balance: None.

H. Electrical Load Data

Not changed.

I. References

Refer to the applicable Component Maintenance Manuals (CMMs) with Illustrated Parts Lists (IPLs) for the starter-generators listed on page 1 of this service information letter.

J. Other Publications Affected

The applicable CMMs with IPLs for the affected starter-generators will be revised to reflect the part change described in this service information letter.

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SERVICE INFORMATION LETTER

2. MATERIAL INFORMATION

A. Material - Price and Availability

Required parts and pricing information are available from the following Lucas Aerospace Customer Service Centers:

REGION	ADDRESS	COMMUNICATION	
AMERICAS:	LUCAS AEROSPACE CSA 30 Van Nostrand Avenue Englewood, NJ 07631-4396 USA	PHONE AOG FAX SITA/ARINC	(1) 201-567-6400 (1) 201-567-6411 (1) 201-541-7610 (1) 201-894-1965 BDRLU7X
EUROPE/MIDEAST/ AFRICA:	LUCAS AEROSPACE CSE Brueton House New Road Solihull West Midlands B91 3TX United Kingdom	PHONE/AOG TELEX FAX SITA/ARINC	(44) 121-627-6767 334174 (44) 121-500-6405 BHXLW7X
ASIA/PACIFIC:	LUCAS AEROSPACE CSP 35 & 37 Loyang Way Singapore 1750	PHONE AOG FAX SITA/ARINC	(65) 545-9975 (65) 545-6253 (65) 545-9965 SINLU7X

B. Support Information

Support information is not required to accomplish the part replacement described in this service information letter.

C. Material Requirements

Parts and materials required to modify the starter-generators listed on page 1 are provided below. Quantities listed are for one starter-generator.

New Part Number	Nomenclature	Old Part Number	Quantity
MS21042-4	NUT, Reduced Hex, Self Locking	02-4107-01	1

D. Re-Identified Parts

Re-identification of parts on the starter-generators listed on page 1 is not required.

3. ACCOMPLISHMENT INSTRUCTIONS

A. Preparation

The nut replacement shall be performed in a clean, dry area free of oil, dirt, moisture, and other contamination. The starter-generator must be kept clean to ensure satisfactory operation of the unit.

B. Disassembly

The starter-generator shall be fully disassembled according to the instructions in the applicable CMM with IPL and to the extent necessary to remove the P/N 02-4107-01 double hex self locking nut.

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SERVICE INFORMATION LETTER

C. Cleaning

Fully clean the starter-generator according to the instructions in the applicable CMM with IPL.

D. Inspection

Fully inspect the starter-generator according to the instructions in the applicable CMM with IPL.

E. Modification

Modification of the starter-generator, parts, or assemblies is not required to accomplish the part number change described in this service information letter.

F. Assembly

Assemble the starter-generator according to the instructions in the applicable CMM with IPL with the exception that the P/N MS21042-4 single hex self locking nut shall be installed in place of the P/N 02-4107-01 double hex self locking nut.

G. Testing

During overhaul, a complete acceptance test is required before the starter-generator is released to the aircraft operator. A complete acceptance test is recommended, but not required, when only the P/N MS21042-4 self locking nut is installed in a starter-generator.

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SERVICE INFORMATION LETTER

Number 23704

ELECTRICAL POWER - DC GENERATORS/STARTER-GENERATORS

THIS DOCUMENT CONTAINS INFORMATION PROPRIETARY TO TRW LUCAS AEROSPACE AND IS FURNISHED UPON THE EXPRESS CONDITION THAT THE INFORMATION CONTAINED HEREIN WILL NOT BE USED DIRECTLY OR INDIRECTLY IN ANYWAY DETRIMENTAL TO THE INTEREST OF TRW LUCAS AEROSPACE.

1. PLANNING INFORMATION

A. Effectivity

This service information letter is applicable to all TRW Aeronautical Systems, Lucas Aerospace, DC Generators and DC Starter-Generators that use bolt, P/N AN3-7A with vendor identification letters "AFC" on the head as shown in Figure 1. See Table 1 that lists the DC Generator or DC Starter-Generator models that use this part.

B. Reason

The P/N AN3-7A bolts with vendor identification "AFC" has been identified by TRW Aeronautical Systems, Lucas Aerospace engineering as inferior and below the MIL standard specification. Small cracks in the threaded surface of the bolt and a poor cadmium layer that does not meet MIL Standard Specifications that could lead to fatigue of the bolt were found. The TRW engineering evaluation resulted in the recommendation for removal and replacement of these bolts.

C. Description

At the next repair or overhaul of the DC Generators or DC Starter-Generators listed in Table 1, check the head of the AN3-7A bolts for the vendor code "AFC". Refer to the applicable parts list of the CMM to determine the location and usage of the AN3-7A bolts. For all AN3-7A bolts with the vendor code "AFC", replace the bolt with a new one with a different vendor code. If the bolt is used for attachment of the brush holders, refer to the applicable CMM for use of special brush alignment tools. If the alignment tool is not available, contact a service facility that can offer this service. Full acceptance testing is required for the DC Generator or DC Starter-Generator.

D. Compliance

RECOMMENDED

E. Manpower

No additional manpower is required when done at the next overhaul unless special alignment of the brush holder is required after the replacement procedure.

F. Weight and Balance

Not changed.

G. Electrical Load Data

Not changed.

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H. References

(1) Reference the Component Maintenance Manual (CMM) specific to the model.

(2) Reference the Special Practices Document 1004, Brush Holder Alignment Fixtures, dated September 30, 1999.

2. MATERIAL INFORMATION

A. Support Information

Replacement AN3-7A bolts can be obtained commercially or from TRW Aeronautical Systems, Lucas Aerospace.

3. ACCOMPLISHMENT INSTRUCTIONS

A. Replacement of AN3-7A with Vendor Code "AFC".

(1) Disassemble the unit as specified in the applicable CMM.

(2) Look at the head of each bolt with part number AN3-7A for a vendor code of "AFC" as shown in Figure 1. If the vendor code is "AFC", the bolt is recommended to be replaced.

NOTE: Replace the bolt with a vendor code other than "AFC".

(3) Use the CMM applicable to the specific model for the disassembly and assembly procedures. The brush holder assemblies require a precision alignment procedure. Use a special alignment tool if specified in the applicable CMM.

(4) Apply Loctite to the threads of the bolt when specified in the applicable CMM.

(5) Apply protective coatings (such as glyptol) to the area when specified in the applicable CMM.

(6) Do an acceptance test on the DC Generators or DC Starter-Generator as specified in the CMM.

B. Support Information

Support information is available from the following:

REGION	ADDRESS	COMMUNICATION
ALL	**TRW Aeronautical Systems,** Lucas Aerospace Repair & Overhaul 777 Lena Drive Aurora, Ohio 44202 USA	PHONE: (1) 330 995-1000 FAX: (1) 330 995-1117

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SERVICE INFORMATION LETTER

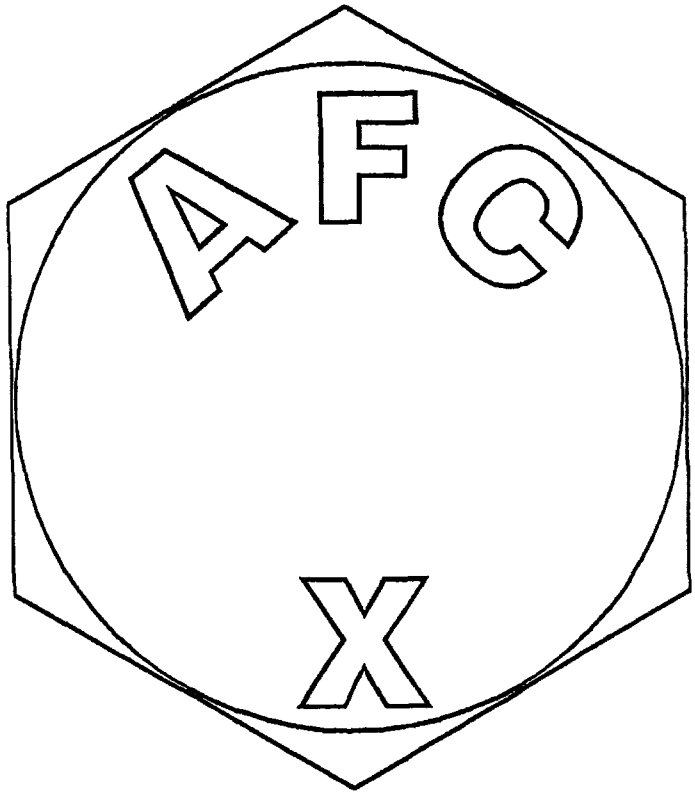


Figure 1 - Vendor Code on Head of AN3-7A Bolt

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SERVICE INFORMATION LETTER

C. Replacement of AN3-7A with Vendor Code "AFC".

Model	Model	Model	Model	Model
23048-004	23069-014	23078-012	23080-025-1	23090-004
23048-004M	23069-014-1	23078-020	23080-050	23090-007
23048-004T	23069-015	23079-000	23080-050A	23090-009
23048-004TM	23069-015-1	23079-000-1	23085-001	23091-001
23048-008	23069-016	23079-002	23085-002	23091-002
23048-012	23069-016-1	23079-002-1	23085-003	23091-003
23048-014	23069-020	23079-003	23085-004	23091-004
23048-015	23069-020-1	23079-004	23085-004-1	23091-004TC
23048-016	23069-021	23079-005	23085-006	23095-002
23048-016	23075-002	23079-006	23085-009	30010-000
23048-017	23075-003	23079-007	23085-012	30068-001
23048-018	23075-004	23079-009	23085-013	30068-001M
23048-020	23075-005	23079-010	23085-014	30068-002
23048-021	23075-006	23080-001	23085-015	G29-7BT
23048-022	23075-008	23080-001-1	23088-001	G29-7BT-1
23048-023	23075-009	23080-003	23088-001A	---*---
23048-027	23076-001	23080-003-1	23088-001B	---*---
23048-028	23076-001-1	23080-005	23088-002	---*---
23065-009	23076-004	23080-005-1	23088-002A	---*---
23065-013	23076-004-1	23080-006	23088-002B	---*---
23065-013-1	23076-005	23080-013	23088-003	---*---
23065-015	23077-002	23080-014	23088-003A	---*---
23065-015-1	23078-003	23080-014A	23088-003B	---*---
23065-015-2	23078-003-1	23080-015	23088-004	---*---
~~23065-015-3~~	~~23078-005~~	~~23080-020~~	~~23088-004A~~	---*---
23065-016	23078-005-1	23080-021	23088-004B	---*---
23065-016-1	23078-006	23080-023	23088-006	---*---
23065-018	23078-007	23080-023A	23088-006A	---*---
23065-018-1	23078-008	23080-023ATC	23088-006B	---*---
23069-013	23078-009	23080-023B	23090-001	---*---
23069-013-1	23078-010	23080-024	23090-002	---*---

Table 1 - Models that use Bolt AN3-7A

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Lucas Aerospace

Lucas Aerospace Power
Equipment Corporation
777 Lena Drive
Aurora, Ohio 44202

Telephone: (216) 995-1000
Fax: (216) 995-1116
Telex 1: 98-5488
Telex 11: (810) 422-2213

July 21, 1994
Ref: CMLT007

Dave Anderson
Lucas Aerospace, Customer Service,Center
P.O. Box 120039
Stamford, CT 06912

Ref: CMM with IPL for the 23048-027/028 Generators.

The 23048-XXX DC Starter-Generator Component Maintenance Manual with Illustrated Parts List, Revised March 1, 1985 may be used to repair the 23048-027 and -028 DC Starter-Generators. All the sections of the manual that apply to the 23048-021 model also apply to the 23048-027 and -028 models.

The 23048-027 and -028 have the same components as the 23048-021 with the following exceptions:

Component	IPL Item No	23048-021	23048-027	23048-028
Drive Shaft	12	23046-1121	02-6100-02	02-6100-02
Preformed Packing	12A	None	M83248/1-113	M83248/1-113
Kit, Quick Attach-Detach	Not numbered	23046-512 Ordered Separately	23046-521 Included in unit	None

Please use this letter as authorization for overhaul and support activities until such time as the 23048- series manual is revised and reissued.

Iain M Wasson
Configuration Manager

OPERATION AND MAINTENANCE INSTRUCTIONS

with

PARTS LIST

for

WESTON®
MODEL 1511 DC MILLIVOLTMETER

Part Number 253198

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WESTON INSTRUMENTS DIVISION
WESTON INSTRUMENTS, INC.
614 FRELINGHUYSEN AVENUE, NEWARK, N. J. 07114
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F-3542

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GENERAL

This manual contains operating, maintenance, testing and calibration instructions with replacement parts list for the Weston Model 1511 DC Millivoltmeter, part number 253198, manufactured by Weston Instruments Division, Weston Instruments, Inc., Newark, N.J.

This millivoltmeter is a sealed, ruggedized, permanent magnet, moving coil type instrument designed for use in the vicinity of shock or vibration. It is provided with a special slotted bezel to allow for external edge lighting.

The meter is calibrated and tested as a millivoltmeter but indicates Load DC, +1 to -1.

TABLE OF SPECIFICATIONS

Range	50/0/50 Millivolts DC
Scale	-1/0/+1 Load DC
Sensitivity	5 Milliamperes
Accuracy	± 2% of full scale
Case	1.5 inch dia steel barrel with rubber shock mountings

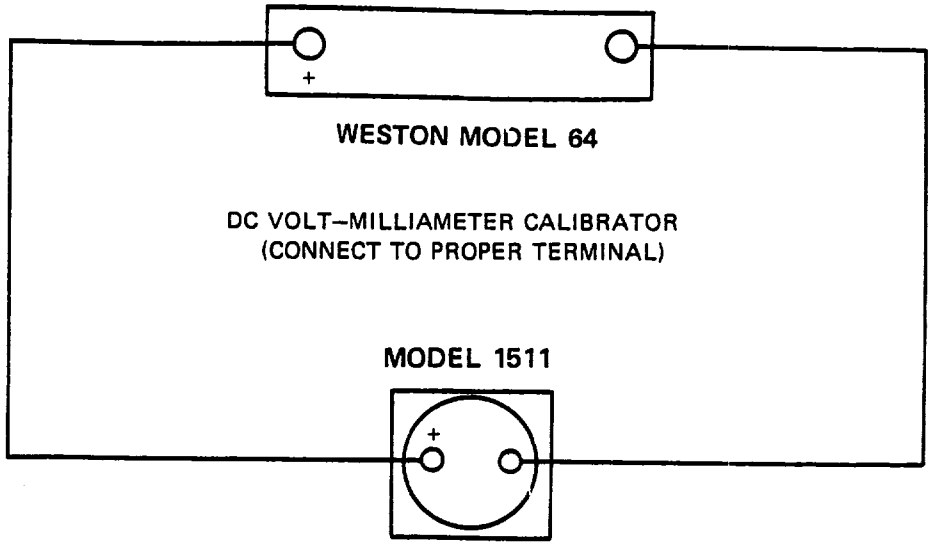
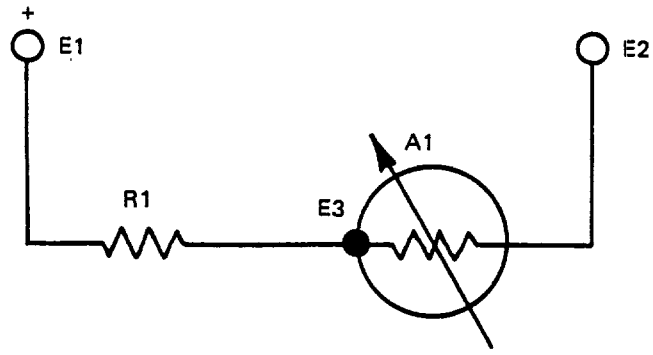


Figure 1. Calibration Circuit



A1 - Instrument Mech Assy (Resistance 2 ohms ± 20%)
E1 - Case Positive Back Connection Terminal
E2 - Case Negative Back Connection Terminal
E3 - Bracket Insulated Top Terminal
R1 - Resistance Coil (7.5 ohms ± 5%)

Figure 2. Internal Wiring Diagram.

OPERATING AND INSTALLATION INSTRUCTIONS

a. Mount the instrument on a vertical panel prepared in accordance with the drilling plan. (See Figure 3.) The panel material may be steel or a nonmagnetic material since the case provides magnetic shielding.

b. Connect the circuit lead wires to the back connection terminals, observing proper polarity.

MAINTENANCE INSTRUCTIONS

a. It is recommended that the instrument be tested for proper performance at twelve month intervals. It should always meet the requirements as stated in the Test Procedure and Calibration Check.

b. No lubrication is required of this instrument.

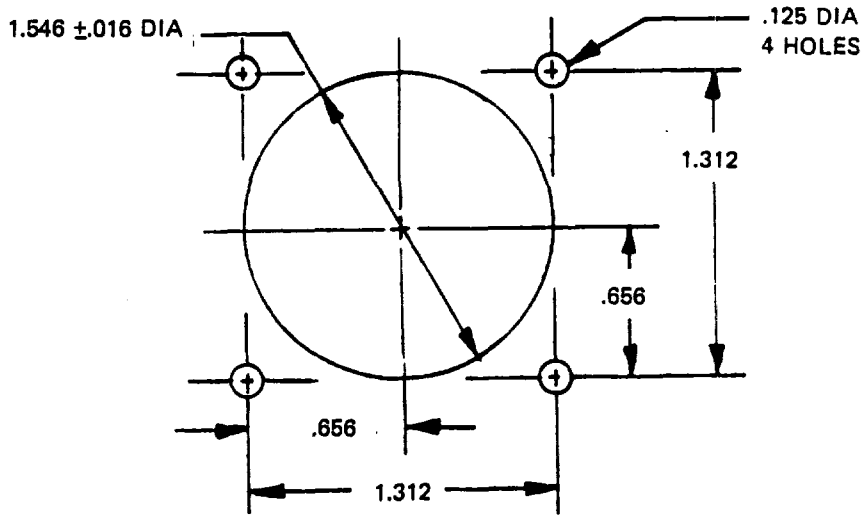


Figure 3. Panel Drilling Plan

CALIBRATION CHECK

a. Connect the instrument in circuit as illustrated in Figure 1.

b. Energize the instrument and check each cardinal point on the scale from 0 to end scale mark.

c. Each indication must be accurate to within 2% of full scale.

d. If the indications are not within the accuracy limits, refer to the following trouble shooting chart and test procedures to determine the probable cause of calibration error.

TEST PROCEDURES

If the instrument does not meet the requirements of each of the following tests it is to be considered defective and should be repaired. Tests should be conducted at ambient room temperature 25°C (77°F). The instrument must be baked and resealed if opened. The instrument should be tapped lightly when test readings are taken.

BALANCE TEST

a. With the instrument in its normal operating position, scale vertical and upright, pivot axis horizontal, the pointer shall be on the center of the zero mark on the scale.

b. Tilt the instrument from this position 60 degrees to the left, to the right, and forward or backward. The pointer shall not deviate more than one-half the pointer tip width from its original position when checked in any of the aforementioned positions. If it does it will be necessary to rebalance the moving element assembly.

TROUBLE SHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
FRICTION	Damaged pivots or jewel screws. Foreign particle in air gap. Fuzz on moving coil. Moving coil touching core. Distorted spring. Jewel screws too tight.	Replace pivots or jewel screws. Remove particle. Remove fuzz. Readjust jewel screws for proper moving coil clearance. Replace moving coil if it is bent or distorted. Realign spring with fine tweezers or replace it entirely. Readjust jewel screws.
NO INDICATION	Open moving coil. Poor solder connection.	Replace moving coil. Resolder connection.
VARIABLE READING	Poor connections. Friction. Loose balance weight. Distorted spring in moving element.	Tighten or resolder connections. See FRICTION section above. Replace balance weight and rebalance. Realign spring with fine tweezers or replace it entirely.
INDICATES LOW	Friction. Loose connections. Spring test too high. Shorted turns on moving coil or incorrect moving coil. Incorrect resistance. Insufficient magnet strength.	See FRICTION above. Tighten or resolder connections. Replace springs. Replace moving coil. Replace or adjust resistor. Recharge and treat magnet.
INDICATES HIGH	Spring test too low. Incorrect moving coil. Excessive magnet strength. Incorrect resistance.	Replace springs. Replace moving coil. Treat magnet. Replace resistor.
CALIBRATION ERROR IN EXCESS	Moving element poorly balanced. Distorted spring.	Rebalance moving element. Realign spring with fine tweezers or replace it entirely.

DIELECTRIC TEST

a. Gradually apply 1500 Volts RMS, sinusoidal 60 cycles, for five seconds between the back connection terminals, connected together, and the case. Gradually reduce the voltage at the end of the five second test.

b. If breakdown occurs check the instrument internally for loose metal particles.

WATERTIGHTNESS

a. Immerse the instrument in water and apply a vacuum equivalent to an absolute pressure of two inches of mercury for two minutes. There shall be no stream of bubbles from the instrument. Bubbles from the water or clustered around the instrument may be ignored.

b. After releasing the vacuum and removing the instrument from the water there shall be no evidence of water within the case.

c. If moisture is found within the case replace the gasket and reseal.

ADJUSTMENT PROCEDURES

FINAL JEWEL ADJUSTMENT

a. Make the final jewel adjustment under open circuit conditions. Alternately adjust the top and bottom jewel screws until the distance from the core to the top and bottom of the moving coil is equal.

b. Deflect the pointer from its original rest position and let the pointer oscillate. Tighten the top jewel screw slowly until a slight damping is detected. Back off from this point one-eighth to one-quarter of a turn.

c. Apply red butyl methacrylate cement, Weston SND 23317-001, to the top and bottom jewel screws.

MAGNET CHARGING

a. If the mechanism assembly was disassembled the magnet must be recharged on a suitable magnet charger having a capacity of at least 33,000 ampere turns DC.

b. After charging, the pointer must deflect in a clockwise direction with positive polarity applied to the bracket top insulated solder abutment.

c. *If the pointer deflects to the opposite direction, reverse* the charge on the magnet.

BALANCING MOVING ELEMENT

Before attempting to balance the moving element make sure that the pointer is straight and swings parallel to and between 0.05 and 0.10 inch from the scale plate. The moving element must be well balanced about the axis of rotation in order that the calibration will check in the normal operating position as well as when tilted. Adjustable balance weights are provided on the pointer arms for balancing purposes. The general procedure for balancing the instrument moving element is as follows:

a. Hold the instrument so that the scale plate is in horizontal position and adjust the pointer to 0 by means of the bracket top abutment.

b. Turn the instrument so that the scale is in a vertical position and the pointer is parallel to the floor.

c. Adjust the tail weight, in or out, until the pointer rests at the 0 mark and is parallel to the floor.

d. Rotate the instrument until the pointer is perpendicular to the floor.

e. Adjust the side arm weights until the pointer rests at the 0 mark and is perpendicular to the floor.

f. Repeat steps b. thru e. until proper balance is achieved. (See Balance Test.)

INSTRUMENT SEALING

NOTE

Perform Calibration Procedure, if necessary, prior to sealing.

a. The instrument window, flange, gasket, and bezel must be clean before sealing. Never use alcohols, petroleums, or similar solvents on the window.

b. Dampen a soft cotton pad with Weston anti-static solution "Statnul" ® and apply to the inside and outside surfaces of the window. Allow a slight haze to form by air drying. Polish with a soft clean cotton pad until haze is just visible.

c. Insert a dirt free metal spacer (such as a paper clip) between case flange and window for ventilation during next step.

d. Bake instrument in an oven, free of dirt and lint, for 2 hours at 145° -165° F.

e. Upon removal from oven, remove metal spacer and immediately press window tightly against case flange with palm of hand to provide a temporary seal while completing following steps.

f. Place the instrument with the bezel and window face down on a flat soft surface and align the holes on the bezel with the holes of the case flange.

g. Tighten all four case to bezel screws lightly initially to hold bezel in place, then proceed to tighten screws at a torque of 5 to 6 in. lbs. When tightening screws, tighten screws directly opposite one previously tightened.

h. When sealed, the instrument must pass the aforementioned watertightness test.

CALIBRATION PROCEDURE

a. Prior to instrument calibration wire resistor coil in series with the mechanism, as shown in Figure 2.

b. Connect the instrument to the standard calibrator as shown in Figure 1, using leads with 0.065 ohms resistance. Apply end scale voltage. If the pointer does not go beyond the end scale mark the spring test is too high, the moving coil has an insufficient number of turns, or the magnet is not fully charged.

c. Position the mechanism between the jaws of an energized demagnetizing coil. Increase the voltage to the demagnetizing coil slowly until the pointer rests at the end scale mark with end scale voltage applied.

d. Exercise care not to over-treat as the magnet will then have to be recharged.

PECULIAR REPLACEMENT PARTS LIST
MODEL 1511 DC MILLIVOLTMETER
P/N 253198

In order to formulate the complete replacement parts list for this millivoltmeter insert the following line item information into the common parts list. Upon transposition, the common parts list will become a complete and specific replacement parts list for part number 253198.

ITEM NO.	PART NUMBER	DESCRIPTION	QTY PER ASSY
1	253198	Millivoltmeter, Model 1511, range 50-0-50 mv Scale -1/0/+1, Caption DC LOAD	-
3	249613-302	Bezel, Dial, illumination	1
10	254139-901	Scale Plate, Dial, -1/0/+1 DC LOAD	1
18	60239-001	Resistor Coil, 7.5 ohms ±5%	1
25	264940-901	Moving Element Assembly	1
27	137624-901	Paired Springs	1 pr.
28	150889-145	Pointer	1
31	7089-234	Pivot	1
32	264939-001	Moving Coil, 0.65 ohms ±20%	1
		ACCESSORIES	
	172588-901	External Scale Plate	1
	187205-915	Instrument Mounting Hardware Package	1

MODEL 1511
COMMON PARTS LIST
(To be used with Peculiar Parts List)

ITEM NO.	PART NUMBER	DESCRIPTION	QTY PER ASSY
1	*	INSTRUMENT ASSEMBLY, Model 1511 (See peculiar parts list for range)	-
2	133340-172	Screw (Case to Bezel)	4
3	*	Bezel	1
4	148207-001	Gasket (Bezel to Window)	1
5	148188-001	Window	1
6	148187-001	Gasket (Window to Case)	1
7	148213-001	Cushion Pointer Stop, left	1
8	148212-001	Cushion Pointer Stop, right	1
9	154430-024	Screw (Mounting Stops)	2
10	*	Scale Plate, Dial	1
11	148196-001	Screw, Special (Mounting Magnet Retainer)	1
12	148195-001	Locking Terminal (Scale Mounting)	1
13	148197-001	Stud (Mounting Magnet)	2
14	ND37005-024	Lock Washer (Mounting Magnet)	2
15	125027-024	Washer (Mounting Magnet)	1
16	ND37880-033	Terminal, Solder Lug	1
17	148198-001	Retainer (Magnet Mounting)	1
18	*	Resistor	1
19	148201-001	Retaining Stud (Mounting BC Terminals)	2
20	148199-001	Back Connection Terminal (E1 & E2)	2
21	148208-302	Case Assembly	1
22	152648-001	Screw (Mounting Magnet to Bracket)	2
23	148190-045	Magnet	1
24	150741-001 ##	Jewel and Screw Assembly	2
25	*	Moving Element Assembly (A1)	1
26	22960-001 ≠	Nut	2
27	* ≠	Paired Springs	1 Pr.

NOTE: Parts marked with ≠ are part of Moving Element Assembly
Parts marked with ## are part of Bracket Assembled.
See peculiar parts list for description of parts marked *.

MODEL 1511 Base B - Single range, zero left

ITEM NO.	PART NUMBER	DESCRIPTION	QTY PER ASSY
28	* ≠	Pointer	1
29	107381-001 ≠	Weight, Spiral, 4 turns } Select 2 for pointer side arm	AR
29	107382-001 ≠	Weight, Spiral, 6 turns } Select 2 for pointer side arm	AR
29	106356-001 ≠	Weight, Spiral, 8 turns } Select 2 for pointer side arm	AR
30	81041-001 ≠	Weight, Spiral, 12 turns } Select 1 for pointer tail	AR
30	106355-001 ≠	Weight, Spiral, 20 turns } Select 1 for pointer tail	AR
31	* ≠	Pivot	2
32	* ≠	Moving Coil	1
33	148210-001 ≠≠	Screw (Mounting Core)	1
34	ND20520-024 ≠≠	Nut (Mounting Core)	1
35	148214-045 ≠≠	Core	1
36	159070-901	Bracket Assembled	1

NOTE: Parts marked with ≠ are part of Moving Element Assembly.
Parts marked with ≠≠ are part of Bracket Assembled.
See peculiar parts list for description of parts marked *.

OPERATION AND MAINTENANCE INSTRUCTIONS

with

PARTS LIST

for

WESTON®

MODEL 1511 DC MILLIAMMETER

Part Number 253199

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WESTON INSTRUMENTS, INC.
614 FRELINGHUYSEN AVENUE, NEWARK, N. J. 07114
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GENERAL

This manual contains operating, maintenance, testing and calibration instructions with replacement parts list for the Weston Model 1511 DC Milliammeter, part number 253199, manufactured by Weston Instruments Division, Weston Instruments, Inc., Newark, New Jersey.

This milliammeter is a sealed, ruggedized, permanent magnet, moving coil type instrument designed for use in the vicinity of shock or vibration. It is provided with a special slotted bezel to allow for external edge lighting.

The meter is calibrated and tested as a milliammeter but indicates Volts, DC. It is intended for use with an external 30,000 ohm resistor.

TABLE OF SPECIFICATIONS

Range	0 to 1 Milliampere DC
Scale	0 to 30 Volts DC
Resistance	100 ohms $\pm$ 1%
Accuracy	$\pm$ 2% of full scale
Case	1.5 inch dia steel barrel with rubber shock mountings.

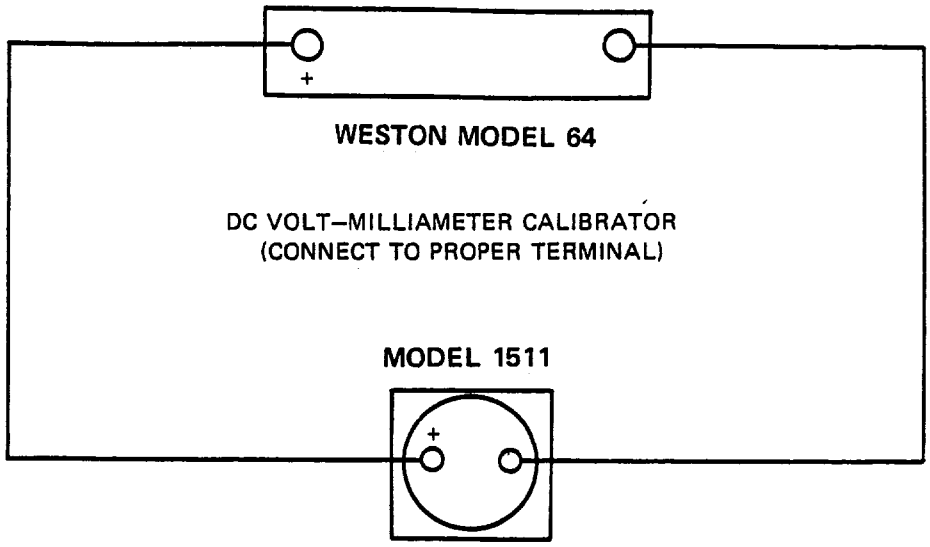
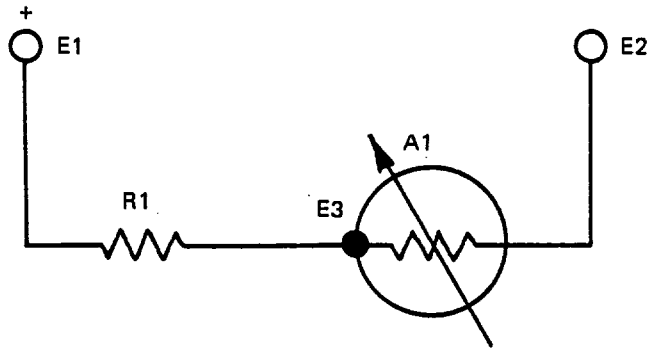


Figure 1. Calibration Circuit



A1 - Instrument Mech Assy (Resistance 17 ohms ± 20%).
E1 - Case Positive Back Connection Terminal.
E2 - Case Negative Back Connection Terminal.
E3 - Bracket Insulated Top Terminal.
R1 - Resistance Coil (94.0 ohms +15% - 0%).

Figure 2. Internal Wiring Diagram.

OPERATING AND INSTALLATION INSTRUCTIONS

a. Mount the instrument on a vertical panel prepared in accordance with the drilling plan. (See Figure 3.) The panel material may be steel or a nonmagnetic material since the case provides magnetic shielding.

b. Connect the circuit lead wires to the back connection terminals, observing proper polarity.

MAINTENANCE INSTRUCTIONS

a. It is recommended that the instrument be tested for proper performance at twelve month intervals. It should always meet the requirements as stated in the Test Procedure and Calibration Check.

b. No lubrication is required of this instrument.

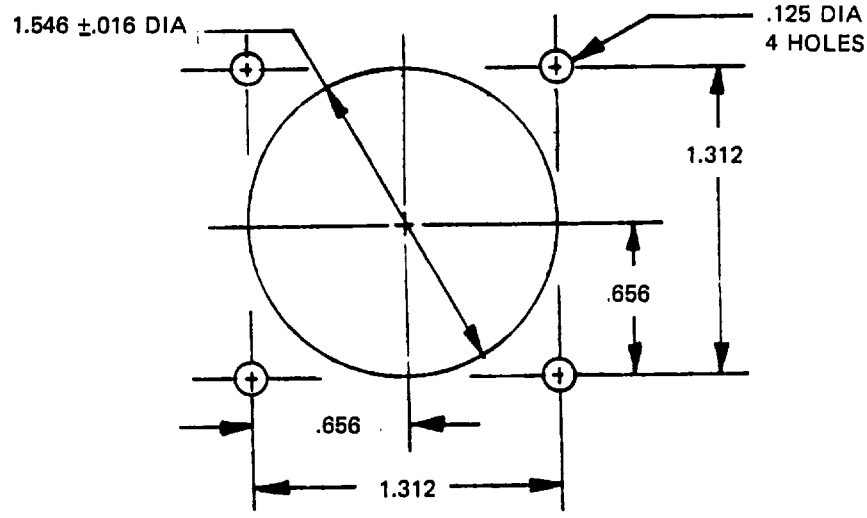


Figure 3. Panel Drilling Plan

CALIBRATION CHECK

a. Connect the instrument in circuit as illustrated in Figure 1.

b. Energize the instrument and check each cardinal point on the scale from 0 to end scale mark.

c. Each indication must be accurate to within 2% of full scale.

d. If the indications are not within the accuracy limits, refer to the following trouble shooting chart and test procedures to determine the probable cause of calibration error.

TEST PROCEDURES

If the instrument does not meet the requirements of each of the following tests it is to be considered defective and should be repaired. Tests should be conducted at ambient room temperature 25°C (77°F). The instrument must be baked and resealed if opened. The instrument should be tapped lightly when test readings are taken.

BALANCE TEST

a. With the instrument in its normal operating position, scale vertical and upright, pivot axis horizontal, the pointer shall be on the center of the zero mark on the scale.

b. Tilt the instrument from this position 60 degrees to the left, to the right, and forward or backward. The pointer shall not deviate more than one-half the pointer tip width from its original position when checked in any of the aforementioned positions. If it does it will be necessary to rebalance the moving element assembly.

TROUBLE SHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
FRICTION	Damaged pivots or jewel screws. Foreign particle in air gap. Fuzz on moving coil. Moving coil touching core. Distorted spring. Jewel screws too tight.	Replace pivots or jewel screws. Remove particle. Remove fuzz. Readjust jewel screws for proper moving coil clearance. Replace moving coil if it is bent or distorted. Realign spring with fine tweezers or replace it entirely. Readjust jewel screws.
NO INDICATION	Open moving coil. Poor solder connection.	Replace moving coil. Resolder connection.
VARIABLE READING	Poor connections. Friction. Loose balance weight. Distorted spring in moving element.	Tighten or resolder connections. See FRICTION section above. Replace balance weight and rebalance. Realign spring with fine tweezers or replace it entirely.
INDICATES LOW	Friction. Loose connections. Spring test too high. Shorted turns on moving coil or incorrect moving coil. Incorrect resistance. Insufficient magnet strength.	See FRICTION above. Tighten or resolder connections. Replace springs. Replace moving coil. Replace or adjust resistor. Recharge and treat magnet.
INDICATES HIGH	Spring test too low. Incorrect moving coil. Excessive magnet strength. Incorrect resistance.	Replace springs. Replace moving coil. Treat magnet. Replace resistor.
CALIBRATION ERROR IN EXCESS	Moving element poorly balanced. Distorted spring.	Rebalance moving element. Realign spring with fine tweezers or replace it entirely.

DIELECTRIC TEST

a. Gradually apply 1500 Volts RMS, sinusoidal 60 cycles, for five seconds between the back connection terminals, connected together, and the case. Gradually reduce the voltage at the end of the five second test.

b. If breakdown occurs check the instrument internally for loose metal particles.

WATERTIGHTNESS

a. Immerse the instrument in water and apply a vacuum equivalent to an absolute pressure of two inches of mercury for two minutes. There shall be no stream of bubbles from the instrument. Bubbles from the water or clustered around the instrument may be ignored.

b. After releasing the vacuum and removing the instrument from the water there shall be no evidence of water within the case.

c. If moisture is found within the case replace the gasket and reseal.

ADJUSTMENT PROCEDURES

FINAL JEWEL ADJUSTMENT

a. Make the final jewel adjustment under open circuit conditions. Alternately adjust the top and bottom jewel screws until the distance from the core to the top and bottom of the moving coil is equal.

b. Deflect the pointer from its original rest position and let the pointer oscillate. Tighten the top jewel screw slowly until a slight damping is detected. Back off from this point one-eighth to one-quarter of a turn.

c. Apply red butyl methacrylate cement, Weston SND 23317-001, to the top and bottom jewel screws.

MAGNET CHARGING

a. If the mechanism assembly was disassembled the magnet must be recharged on a suitable magnet charger having a capacity of at least 33,000 ampere turns DC.

b. After charging, the pointer must deflect in a clockwise direction with positive polarity applied to the bracket top insulated solder abutment.

c. If the pointer deflects to the opposite direction, reverse the charge on the magnet.

BALANCING MOVING ELEMENT

Before attempting to balance the moving element make sure that the pointer is straight and swings parallel to and between 0.05 and 0.10 inch from the scale plate. The moving element must be well balanced about the axis of rotation in order that the calibration will check in the normal operating position as well as when tilted. Adjustable balance weights are provided on the pointer arms for balancing purposes. The general procedure for balancing the instrument moving element is as follows:

a. Hold the instrument so that the scale plate is in horizontal position and adjust the pointer to 0 by means of the bracket top abutment.

b. Turn the instrument so that the scale is in a vertical position and the pointer is parallel to the floor.

c. Adjust the tail weight, in or out, until the pointer rests at the 0 mark and is parallel to the floor.

d. Rotate the instrument until the pointer is perpendicular to the floor.

e. Adjust the side arm weights until the pointer rests at the 0 mark and is perpendicular to the floor.

f. Repeat steps b. thru e. until proper balance is achieved. (See Balance Test.)

INSTRUMENT SEALING

NOTE

Perform Calibration Procedure, if necessary, prior to sealing.

a. The instrument window, flange, gasket, and bezel must be clean before sealing. Never use alcohols, petroleums, or similar solvents on the window.

b. Dampen a soft cotton pad with Weston anti-static solution "Statnul"® and apply to the inside and outside surfaces of the window. Allow a slight haze to form by air drying. Polish with a soft clean cotton pad until haze is just visible.

c. Insert a dirt free metal spacer (such as a paper clip) between case flange and window for ventilation during next step.

d. Bake instrument in an oven, free of dirt and lint, for 2 hours at 145° -165° F.

e. Upon removal from oven, remove metal spacer and immediately press window tightly against case flange with palm of hand to provide a temporary seal while completing following steps.

f. Place the instrument with the bezel and window face down on a flat soft surface and align the holes on the bezel with the holes of the case flange.

g. Tighten all four case to bezel screws lightly initially to hold bezel in place, then proceed to tighten screws at a torque of 5 to 6 in. lbs. When tightening screws, tighten screws directly opposite one previously tightened.

h. When sealed, the instrument must pass the aforementioned watertightness test.

CALIBRATION PROCEDURE

a. Prior to instrument calibration wire resistor coil in series with the mechanism, as shown in Figure 2. The resistance of the coil shall be adjusted to allow for instrument terminal resistance as given in Table of Specifications.

b. Connect the instrument to the standard calibrator as shown in Figure 1. Apply full scale current. If the pointer does not go beyond the end scale mark the spring test is too high, the moving coil has an insufficient number of turns, or the magnet is not fully charged.

c. Position the mechanism between the jaws of an energized demagnetizing coil. Increase the voltage to the demagnetizing coil slowly until the pointer rests at the end scale mark with full scale current applied.

d. Exercise care not to over-treat as the magnet will then have to be recharged.

PECULIAR REPLACEMENT PARTS LIST
MODEL 1511 DC MILLIAMMETER
P/N 253199

In order to formulate the complete replacement parts list for this milliammeter insert the following line item information into the common parts list. Upon transposition, the common parts list will become a complete and specific replacement parts list for part number 253199.

ITEM NO.	PART NUMBER	DESCRIPTION	QTY PER ASSY
1	253199	MILLIAMMETER, DC, Model 1511, range 0 to 1 MA, Scale 0 to 30 volts.	-
3	249613-302	Bezel, Dial, illumination	1
10	254140-901	Scale Plate, Dial, 0 to 30 Volts	1
18	250737-001	Resistor Coil, 94.0 ohms +15%-0% (R1)	1
25	157904-903	Moving Element Assembly	1
27	137623-901	Paired Springs	1 Pr
28	150889-145	Pointer	1
31	7089-234	Pivot	2
32	257848-001	Moving Coil, 17 ohms ±20%	1
		ACCESSORIES	
-	172588-901	External Scale Plate	1
	187205-915	Instrument Mounting Hardware Package	1

MODEL 1511
COMMON PARTS LIST
(To be used with Peculiar Parts List)

ITEM NO.	PART NUMBER	DESCRIPTION	QTY PER ASSY
1	*	INSTRUMENT ASSEMBLY, Model 1511 (See peculiar parts list for range)	-
2	133340-172	Screw (Case to Bezel)	4
3	*	Bezel	1
4	148207-001	Gasket (Bezel to Window)	1
5	148188-001	Window	1
6	148187-001	Gasket (Window to Case)	1
7	148213-001	Cushion Pointer Stop, left	1
8	148212-001	Cushion Pointer Stop, right	1
9	154430-024	Screw (Mounting Stops)	2
10	*	Scale Plate, Dial	1
11	148196-001	Screw, Special (Mounting Magnet Retainer)	1
12	148195-001	Locking Terminal (Scale Mounting)	1
13	148197-001	Stud (Mounting Magnet)	2
14	ND37005-024	Lock Washer (Mounting Magnet)	2
15	125027-024	Washer (Mounting Magnet)	1
16	ND37880-033	Terminal, Solder Lug	1
17	148198-001	Retainer (Magnet Mounting)	1
18	*	Resistor	1
19	148201-001	Retaining Stud (Mounting BC Terminals)	2
20	148199-001	Back Connection Terminal (E1 & E2)	2
21	148208-302	Case Assembly	1
22	152648-001	Screw (Mounting Magnet to Bracket)	2
23	148190-045	Magnet	1
24	150741-001 ##	Jewel and Screw Assembly	2
25	*	Moving Element Assembly (A1)	1
26	22960-001 ≠	Nut	2
27	* ≠	Paired Springs	1 Pr.

NOTE: Parts marked with ≠ are part of Moving Element Assembly
Parts marked with ## are part of Bracket Assembled.
See peculiar parts list for description of parts marked *.

MODEL 1511 Base B - [illegible] range, zero left

//

ITEM NO.	PART NUMBER	DESCRIPTION	QTY PER ASSY
28	* ≠	Pointer	1
29	107381-001 ≠	Weight, Spiral, 4 turns } Select 2 for pointer side arm	AR
29	107382-001 ≠	Weight, Spiral, 6 turns } Select 2 for pointer side arm	AR
29	106356-001 ≠	Weight, Spiral, 8 turns } Select 2 for pointer side arm	AR
30	81041-001 ≠	Weight, Spiral, 12 turns } Select 1 for pointer tail	AR
30	106355-001 ≠	Weight, Spiral, 20 turns } Select 1 for pointer tail	AR
31	* ≠	Pivot	2
32	* ≠	Moving Coil	1
33	148210-001 ≠*	Screw (Mounting Core)	1
34	ND20520-024 ≠*	Nut (Mounting Core)	1
35	148214-045 ≠*	Core	1
36	159070-901	Bracket Assembled	1

NOTE: Parts marked with ≠ are part of Moving Element Assembly.
Parts marked with ≠* are part of Bracket Assembled.
See peculiar parts list for description of parts marked *.

CHAPTER 25

EQUIPMENT/ FURNISHINGS

de Havilland Inc.
DHC–6 TWIN OTTER
COMPONENT MAINTENANCE MANUAL
CHAPTER 25 – EQUIPMENT/FURNISHINGS

TABLE OF CONTENTS

MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B./T.R.
*B/E Aerospace	Liquid Container	Model No. 306	25–32–03	–	
Teleflex Products	Shoulder Harness	136879/80 (C6FS2244)		Oct 1965	
TUL Safety Equipment	Life preserver (Aircrew)	TUL 6111		Jan 16/1982	
	Life preserver	TUL 6174		Dec 2/1991	

* This listing provided for reference only; technical data will be sent directly from Vendor. Any requests for data should be directed to:

* B/E Aerospace
Galley Products Group
P.O. Drawer 130
Delray Beach, Florida
U.S.A.
33447–0130

Contact: Mr. Wally Klus

Telephone: (561) 276–6083
Facsimile: (561) 278–8031
Telex: 497–5073
Cage No.: 63367

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OVERHAUL MANUAL

-FOR-

AIRCREW HARNESS TYPE E. 136879/80

This manual complies with British Civil Airworthiness Requirements Chapter A6-2. The technical accuracy of this manual has been verified and is certified as correct.

Signed 

Date October 1965 . . . . . .

A.R.B. Design Approval No. AD/1369/59

Publication No. OAH - 11

TELEFLEX PRODUCTS LTD : BASILDON : ESSEX : ENGLAND.

OVERHAUL MANUAL

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10. SPECIAL TOOLS, FIXTURES AND EQUIPMENT

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The introduction of any amendment or revision not certified in accordance with British Civil Airworthiness Requirements Chapter A6-2 will invalidate the statement of certification on the previous page.

Amendments or revisions embodied in this manual, which have been certified under an approval authorization other than that applicable to the initial certification must be recorded on separate record sheets.

RECORD OF REVISIONS

OVERHAUL MANUAL			LOCATION					
AIRCREW HARNESS TYPE E. 136879/80								
REV. NO.	INSERTION DATE	BY	REV. NO.	INSERTION DATE	BY	REV. NO.	INSERTION DATE	

OVERHAUL MANUAL

AIRCREW SEAT HARNESS TYPE E. 136879/80

1. DESCRIPTION AND OPERATION

A. DESCRIPTION

The seat harness consists of the following parts:

(1) Shoulder strap assembly.

(2) Right and left-hand lap belts.

(3) Release buckle.

(4) Harness reel.

Shoulder Strap Assembly (See figure 1).

This strap assembly is a Y-shaped harness made from nylon webbing. The single strap of the harness is attached to the harness reel, and another strap is stitched in position to form 'arms' of equal length. Metal buckle plug-in fittings are stitch into folds on each end of the strap 'arms'.

Lap Belts (See figure 1).

The lap belts, which are made in left and right hand parts, are also made in nylon webbing. The belts have metal snap hook attachment plates on one end and plug-in fittings on the other end. The snap hook attachment plates secure the belts to the seat and the plug-in fittings engage in the release buckle. The plug-in fitting on one belt is permanently anchored to the release buckle. Both lap belts are fitted with adjustment buckles.

Release Buckle.

The release buckle is a cylindrical housing in which the plug-in fittings on the shoulder straps and free lap belt are inserted and automatically secured. The buckle contains mechanism which, when operated, immediately releases the shoulder straps separately, or the shoulder straps and lap belts simultaneously.

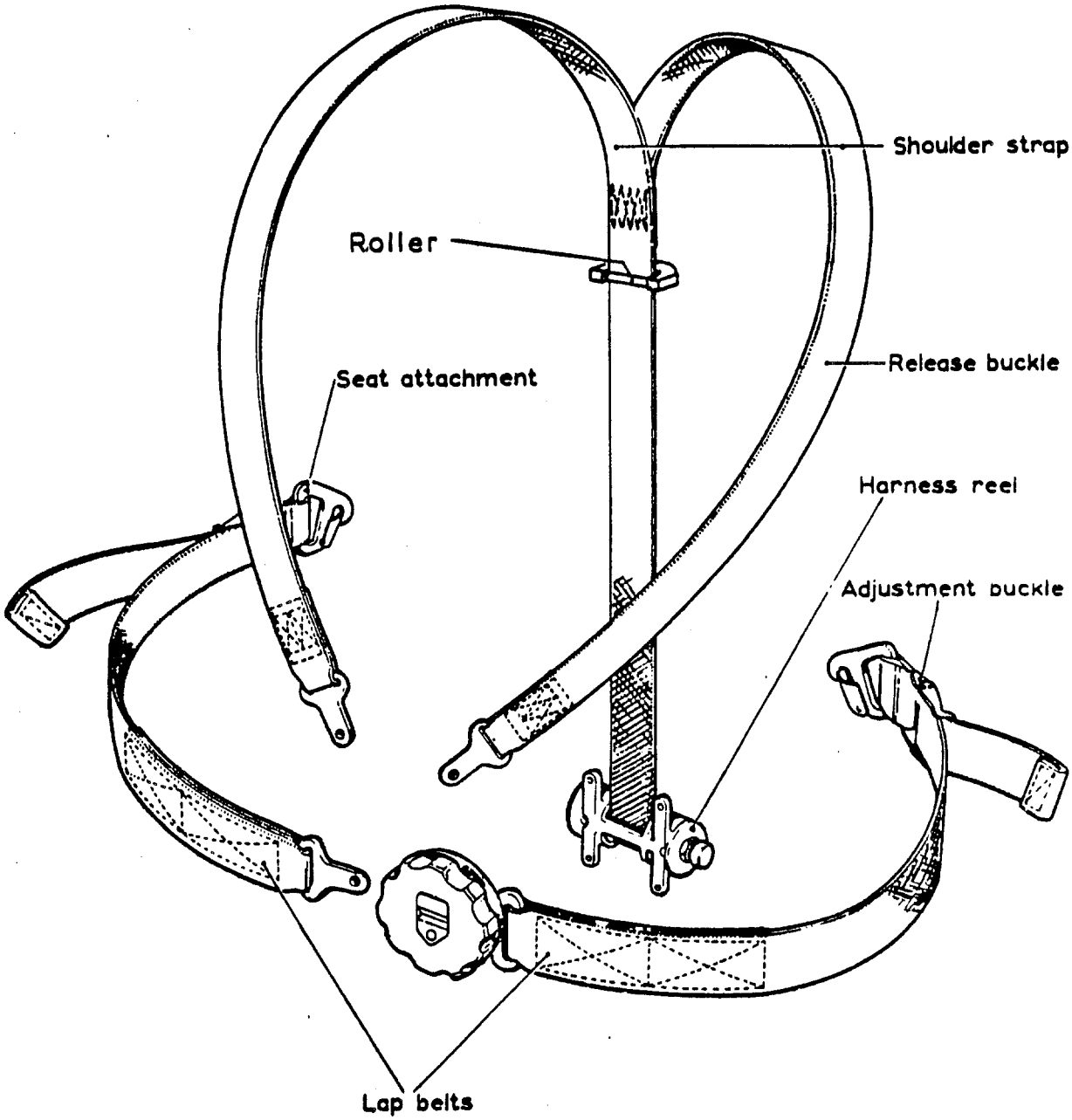


Figure 1. Harness Assembly

Harness Reel Assembly (See figure 2)

The Reel is a cylindrical body with integral mounting lugs which houses the harness spool. The spool, which consists of a central drive shaft with a guide disc at each end, is mounted in bearing plates. The drive shaft has a square end for engagement with a helical torsion spring, and it has a flange formed on the opposite end. This flange has three tracks machined in it to accommodate three steel balls.

Adjacent to the drive shaft flange, and mounted on a shaft protruding from the centre bore in the drive shaft, there is an inertia plate. The inertia plate also has three tracks machined in one face for engagement with the steel balls, and it has teeth machined in the opposite face.

Fixed to the end of the reel body is a brake plate which has teeth machined in the face opposite the inertia plate. In the centre bore of the brake plate there is a damper assembly. The damper has an outer shaft with teeth formed on its face and a hollow shaft which slides in the bore of an adaptor. The hollow shaft accommodates a spring loaded plunger and the adaptor is threaded to suit the nut on the operator unit assembly.

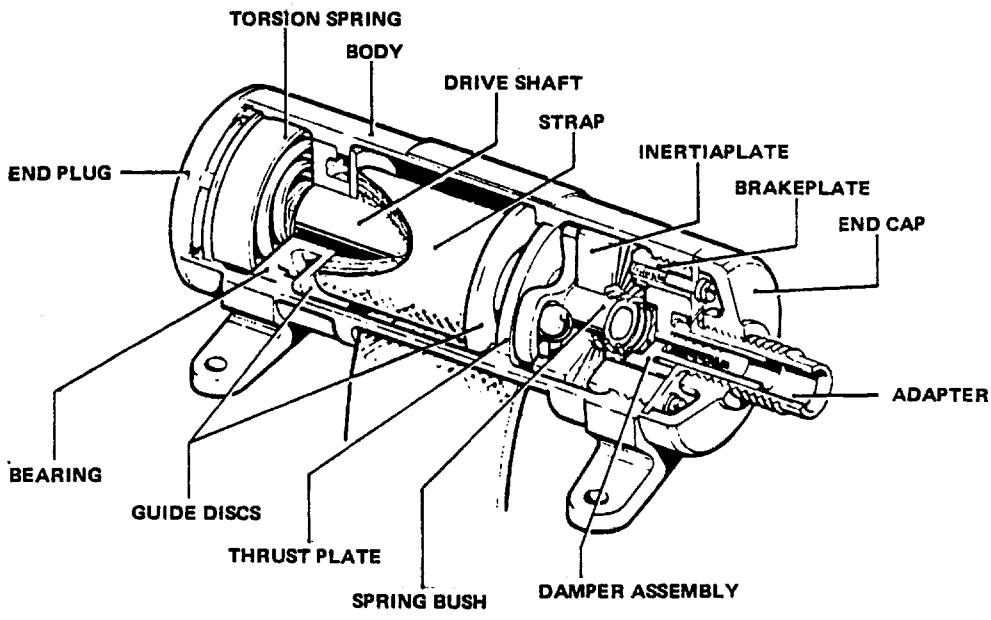


Figure 2. Harness Reel

B. Operation

With the shoulder straps and the lap belts connected to the buckle, the crew member is able to move forward without restriction to the limit of the shoulder strap reel-out. As the crew member moves backward and forwards the shoulder harness strap reels-in and out of the harness reel under the control of the helical torsion spring. While this easy movement is in progress the drive shaft and inertia plate move in harmony through the agency of the steel balls.

When the shoulder harness is drawn from the reel at accelerations in excess of 1 to 1.5 G, the drive shaft rotates too rapidly for the steel balls to transmit the drive to the inertia plate. This lag causes the balls to ride up the sloping tracks thus moving the inertia plates away from the drive shaft, causing the teeth in the inertia plate to engage with the teeth in the brake plate preventing further rotation of the drive shaft and, consequently, no further reel-out of the shoulder harness.

The reel will remain locked until the load in the shoulder harness falls below that exerted by the helical torsion spring. The drive shaft will then rotate, reeling in the reel strap, at the same time allowing the balls and inertia plate, under pressure from the inertia plate spring, to return to their original retracted position against the drive shaft. Free movement can then again take place.

The shoulder harness can be released independently by depressing and releasing the pawl in the front cover of the release buckle. The whole harness can be released by turning the front cover in any direction.

C. DATA

Acceleration of reel strap to produce locking	1.0 to 1.5 G
Movement of wearers shoulders sideways or forward with lap belt fastened	180 degrees
Maximum movement when locking at 1.5 G	1.5 in.
Maximum movement when locking at 15 G	0.5 in.
Ultimate strength of shoulder straps as a pair	2,400 lb. Min.
Ultimate strength of lap strap	2,400 lb. Min.
Weight of complete harness	3 lb. 6 oz. Approx.

2. DISASSEMBLY.

(A) Shoulder Strap Assembly.

(B) Lap Belts.

(C) Release Buckle.

CAUTION: THESE ASSEMBLIES MUST NOT BE DISMANTLED. IF IT IS FOUND, AS THE RESULTS OF CHECKS OR SERVICE EXPERIENCE THAT THEY ARE DEFECTIVE, THEY SHOULD BE REJECTED.

(D) Harness Reel (See figure 3).

Check that the work bench and all tools are absolutely clean. Obtain key part number B. 74435 and proceed as follows:

(1) Remove snap-on end plug (1).

(2) Pull out strap (2) to full extent, insert key part number B. 74435 and engage sliding end with body.

(3) Release straps (2) by screwing Extractor Key Part No. A. 74699 onto strap retaining pin (3) and easing the strap retaining pin out through the end of the shaft.

(4) Disengage the sliding end and allow the drive shaft to unwind slowly in a clockwise direction and remove the key.

(5) Remove Anderton clip (4) and retaining plate (5).

(6) Carefully remove spring (6) by withdrawing it from the centre.

(7) Recoil the spring and tie with locking wire or string.

(8) Unscrew end cap (7).

(9) Cut locking wire (8) and loosen screws (9).

(10) Remove screw (9) and collect washers (10).

(11) Remove adaptor (11), damper assembly (23) and spring (12).

(12) Unscrew locking peg (13) and brake plate (14).

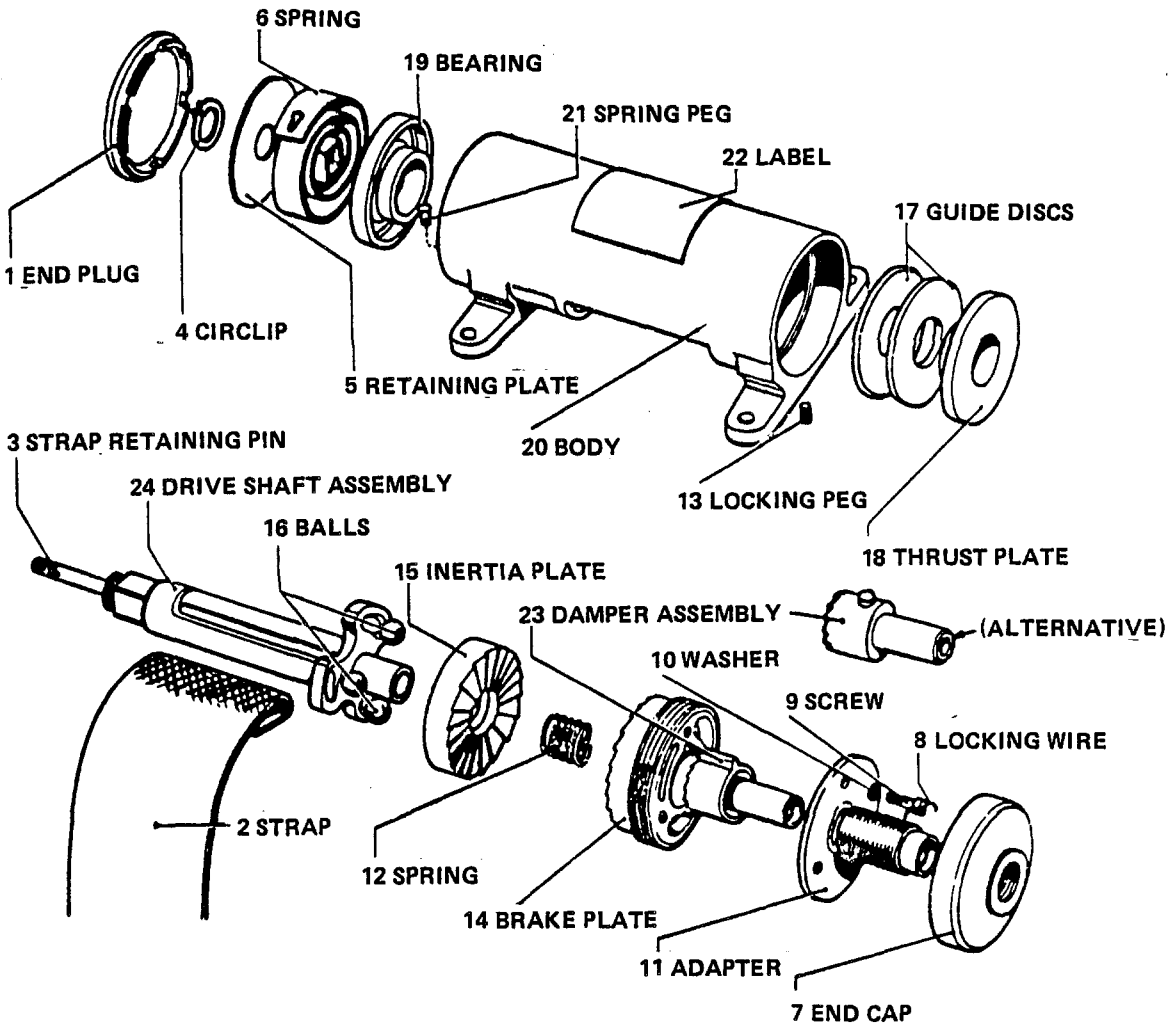


Figure 3. Exploded View of Harness Reel

(13) Withdraw inertia plate (15) and collect steel balls (16).

(14) Draw out drive shaft assembly (24).

(15) Collect guide discs (17) through slot in body (20).

(16) Draw out thrust plate (18) and bearing (19).

NOTE: Dismantling of the damper assembly (23) and drive shaft assembly (24) is not recommended. The spring peg (21) should only be removed if it is damaged.

3. CLEANING.

A. Shoulder Strap and Lap Belts.

Clean the webbing with a soft brush using pure soap and clean water.

CAUTION: DO NOT USE CAUSTIC SOLUTIONS FOR CLEANING PURPOSES.

B. Release Buckle.

Clean exterior with a clean, dry cloth and blow out dust and dirt with a jet of clean dry air.

C. Harness Reel.

Clean all unpainted metal parts with carbon tetra-chloride.

4. INSPECTION.

A. Shoulder Strap and Lap Belts.

(1) Check webbing for cleanliness, fraying, opening of weave, evide of deterioration, security of stitching and attachments.

(2) Inspect attachments for distortion, cracks, corrosion and other damage.

(3) Apply proof load test described in 'Testing'.

B. Release Buckle.

(1) Check buckle cover and casing for signs of distortion, corrosion and damage.

(2) Check correct operation.

(3) Apply proof load test described in 'Testing'.

C. Harness Reel.

(1) Check all parts for cleanliness, signs of distortion, corrosion and damage.

(2) Check all plastic parts for cleanliness, tears, dents and abrasio

(3) Examine torsion spring for set, cracks, damage and distortion c centre square.

(4) Check that spring moment equals 2.5 lb/in. approx.

(5) Inspect spring peg for security, and signs of damage or corrosic

(6) Check steel balls for corrosion, cracks and chips.

(7) Examine ball tracks for severe burrs, distortion, signs of seve wear and jamming.

NOTE: The ball tracks become indented during normal use and during inspection the severity should be gauged.

(8) Check all face teeth for burrs, severe breaks, chipping and other damage.

NOTE: The top of the teeth become worn during normal use. The purpose of inspection is to gauge the severity of wear.

(9) Check that inertia plate spring will compress to 0.35 in. under a load of 0.75 lb. approx.

(10) Check integrity of damper key and keyway in brake plate.

(11) Check that the damper spring retaining pin moves freely and returns immediately the load is relieved.

(12) Check that the internal bore in the adaptor is clean and free of burrs, and that there are no signs of malfunctioning.

(13) Check serviceability of all threads.

(14) Check that parts are not worn beyond the limits specified in the table of Fits and Clearances.

5. REPAIR.

A. Shoulder Strap and Lap Belts.

(1) If any parts of this assembly fail to pass the inspection or proof tests, they should be renewed.

CAUTION: AFTER RENEWING A PART, THE WHOLE ASSEMBLY MUST BE SUBJECTED TO A PROOF TEST (See 'Testing').

B. Release Buckle.

(1) If the release buckle fails to pass the inspection or proof tests, it should be returned to the manufacturer.

C. Harness Reel.

(1) Renew all metal parts which are distorted worn, damaged or corroded.

(2) Renew the inertia plate if the teeth or ball tracks are severely worn or damaged.

(3) Renew the drive shaft assembly if the ball tracks are severely worn or damaged.

(4) If the teeth on the brake plate are severely worn or damaged:

(i) Fit the adaptor to the new plate and secure with the three screws and washers.

(ii) Screw this assembly firmly into the reel body.

(iii) Check to see that the peg hole in the body is not coincident with one of the adaptor screws.

(iv) Unscrew, if necessary, sufficiently to clear adaptor screw

(v) Using a No. 21 (0.159 in.) drill, bore through until drill breaks into a brake plate cavity.

CAUTION: DO NOT DRILL BEYOND BRAKE PLATE CAVITY AND ENSURE THAT DRILL FOLLOWS TH CENTRE OF LOCKING PEG HOLE.

(vi) Tap hole 10-32 U.N.F.

(vii) Disassemble parts and remove all swarf.

(5) Renew all plastic parts which are worn, torn, deformed or otherwise damaged.

(6) Renew the steel balls if they are cracked, chipped, corroded or otherwise damaged.

(7) Renew the torsion spring if it fails to pass the inspection checks.

(8) If the spring peg is damaged:

(i) Carefully drill out existing peg.

(ii) Fit new peg and rivet carefully.

(9) Renew the damper assembly if it fails to pass the inspection checks.

(10) Rectify slight damage to external threads with a fine file.

(11) Renew all parts which are worn beyond the specified limit.

6. ASSEMBLY.

A. Harness Reel (See figure 3).

CAUTION: IT IS ABSOLUTELY ESSENTIAL THAT ASSEMBLY OPERATIONS SHOULD BE CARRIED OUT IN CONDITIONS OF SCRUPULOUS CLEANLINESS.

NOTE: The following instructions assume that all the necessary repairs have been carried out.

(1) Insert bearing (19) and thrust plate (18) squarely into body (20) and retain with Loctite grade 'C'.

CAUTION: DO NOT ASSEMBLE DRIVE SHAFT ASSEMBLY (24) UNTIL THE LOCTITE HAS FULLY HARDENED (4 HOURS MINIMUM

(2) Apply grease (Spec. DTD 825) to the bearing surfaces of thrust plate (18) and bearing (19).

(3) Insert guide discs (17) through slot in body.

(4) Slide drive shaft assembly (24) through thrust plate, guide discs and bearing.

NOTE: When performing the above operation ensure that the radiused edges of the guide discs face each other.

(5) Lightly smear balls (16) with grease (Spec. DTD 825) and drop them in the tracks in the drive shaft flange.

(6) Slide on inertia plate (15) and engage its tracks with the balls.

(7) Unite adaptor (11) and brake plate (14) and secure with screws (9) and washers (10).

NOTE: Do not tighten screws at this stage.

(8) Slide in damper assembly (23) and check that it moves freely.

(9) Tighten screws (9) and repeat check for free movement of the damper assembly.

(10) Apply grease (Spec. DTD 825) to spring (12) and fit it over bush protruding through inertia plate.

(11) Taking great care, screw the brake plate and the damper assembly into the body (20).

(12) Adjust the brake plate until the tapped hole is aligned with the peg hole in underside of body.

(13) Insert locking peg (13) and tighten firmly.

(14) Lightly apply grease (Spec. DTD 825) to torsion spring (6).

(15) Hook the spring over its peg with the short end of the spring to the left.

NOTE: In its assembled position, anti-clockwise rotation, viewed from this end, should tighten spring.

(16) Slide square in centre of spring over the end of the drive shaft.

(17) Fit retaining plate (5) and Anderton clip (4).

(18) APPLY TESTS DESCRIBED IN 8.0 TESTING.

NOTE: After satisfactory completion of tests proceed with the following:

(19) Wire-lock screws (9).

(20) Screw on end cap (7).

(21) If the harness reel is not to be fitted with a harness (i.e. the reel is to be used as a spare) proceed as follows:

(i) Insert reel in polythene bag together with strap retaining pin (3) and end plug (1).

(22) If a harness is to be fitted to the reel, proceed as follows:

(i) Insert key (Part No. B. 74435) into shaft and turn in an anti-clockwise direction until the spring becomes solid, then slacken off one complete turn.

(ii) Slide handle to engage with body.

(iii) Fold over end of reel strap (2) to about 3/8 in.

(iv) With a steel rule or similar instrument, push the fold on strap firmly into the slot in drive shaft, ensuring that the folded over portion of the reel strap, where it joins the shoulder strap, is toward the centre of the reel and that the reel strap passes through the correct hole in the body. (See figure 1).

NOTE: When finally inserted, the end of the reel straps should be flush with or very slightly below the outer surface of the drive shaft.

(v) Screw Extractor Key (Part No. A. 74699) on retaining pin (3) and insert it through the end of the shaft, checking that the strap does not bunch up at one end of the slot.

(vi) Pull firmly on the strap to wedge the retaining pin.

(vii) Remove the key and allow the strap to reel-in SLOWLY.

(viii) Check that the strap reels-in and out freely.

(ix) Snap on end cap.

NOTE: If the harness assembly is not to be returned to service immediately, insert it, together with the associated lap belts into a polythene bag and pack in a suitable carton.

B. Materials

The following grease is to be used during assembly.

Grease DTD 825 American Spec. MIL. G. 3278A.

7. FITS & CLEARANCES (See figure 4)

A. Harness Reel.

Ref. No. Fig. 5 (1)	Description (2)	Dimension new (inches) (3)	Clearance new (inches) (4)	Permissible worn Clearance (inches) (5)	Remarks (6)
1	Bearing, B73564 i/d Drive Shaft, C73900 o/d	.7596/.7602 .757/.755	.0026/ .0048	.008	
2	Drive Shaft, C73900 o/d Thrust Plate, B73563 i/d	.757/.755 .7596/.7602	.0026/ .0048	.008	
3	Spring Bush, B73572 o/d Inertia Plate, B73901 i/d	.498/.496 .4995/.5000	.0015 .0040	.010	
4	Damper Assembly, C73778 o/d Adaptor, B73568 i/d	.4335/.4310 .4355/.4365	.002/ .0055	.010	

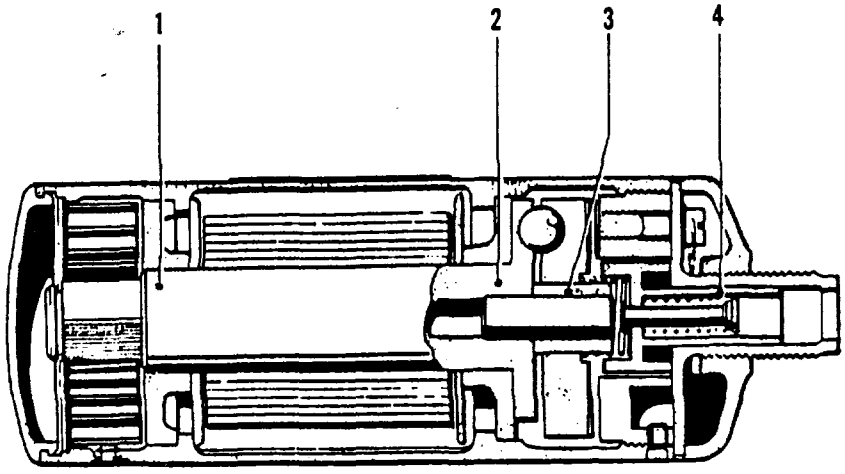


Figure 4. Key Diagram - Fits and Clearances

8. TESTING.

A. Harness and Release Buckle.

(1) Unite harness and release buckle.

(2) Attach lap belts and reel strap as shown in Figure 5.

(3) Apply a load of 650 lb. approx. to shoulder harness.

(4) Reduce load to 110 lb. and operate release buckle.

(5) Check that the load applied at the rim to release the buckle does not exceed 20 lb.

NOTE: If the release buckle fails to pass the specified test, or if any part of the harness is found to be defective, they should be renewed.

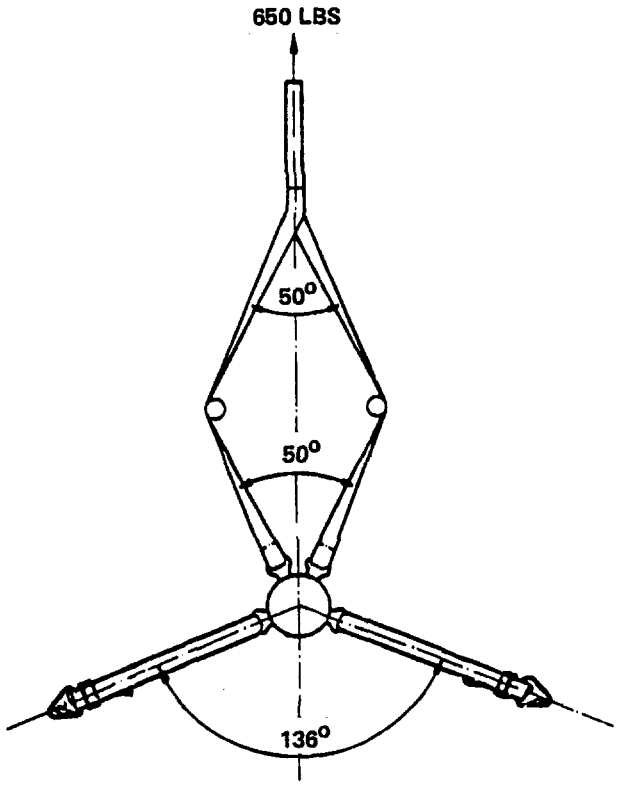


Figure 5. Proof Loading Diagram

B. Harness Reel.

(1) Using key (Part No. B74435) pre-load torsion spring by turning approximately five turns in an ANTI-CLOCKWISE direction.

(2) Fit test strap (Part No. B74407) as described in Assembly 6.22.

(3) Check that the test strap reels-in and out freely.

(4) Fit reel on test rig (Part No. E74467) raise beam and attach the strap (See figure 6).

(5) Set the weight to the 1G position.

(6) Release the beam.

(7) Raise and release beam six times and check locking.

(8) If the reel consistently locks in the 1G position (more than four times out of six):

(i) Remove the three adaptor screws and collect their washers.

(ii) Withdraw the adaptor and the damper assembly taking care not to drop spring.

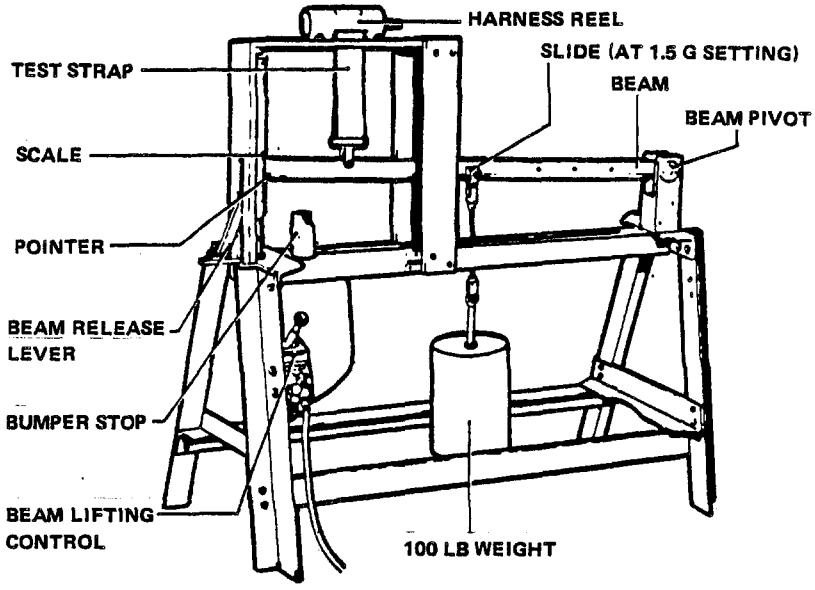


Figure 6. Test Rig

(iii) Insert shims (Part No. B74408) into the front recess of the damper.

(iv) Reassemble and repeat the above test.

(v) Fit additional shims, if necessary, until reel locks above 1G.

(9) Slide the weight to the 1.5G position on beam.

(10) Release the beam sharply and check that the reel locks within 1.5 in. movement of the strap.

(11) Repeat the test six times to check for consistent functioning.

(12) After satisfactory completion of tests, complete assembly and preparation for service or store as instructed in Assembly 6.21 and 6.22.

9. TROUBLE SHOOTING

FAULT	PROBABLE CAUSE	REMEDY
Reel consistently locks at 1G loading.	'G' setting too low.	Dismantle and add shims.
Reel does not lock at 1.5G.	Too many shims added.	Dismantle and reduce number of shims.
Reel locks when strap is fully retracted.	Torsion spring load too high.	Remove strap and slacken off spring.

10. SPECIAL TOOLS, FIXTURES AND EQUIPMENT.

ITEM	DESCRIPTION	PART NUMBER
1	Test Key	Teleflex - B 74435
2	Extractor Key	Teleflex - A 74699
3	Test Strap	Teleflex - B 74407
4	Test Rig ('G' Setting)	Teleflex - E 74467
5		

11. STORAGE.

A. Preparation

(1) If the original packing is not available, prepare the following:

(a) Packing in temperate areas:

(i) Cartons with suitable supports.

(ii) A label giving the following information:

(a) Type, mark and serial number of component.

(b) Date of removal from aircraft.

(c) Date of last overhaul.

(d) Note of any change of part.

(e) Reason for return of component.

(b) Packing in tropical areas:

(i) Items listed above.

(ii) Sufficient water resistant paper to completely enwrap components.

(iii) Polythene bag large enough to contain component and its paper wrapping.

(iv) Wrap component in the paper, insert in polythene bag and heat seal bag.

(v) Place component in the carton, secure it, enclose label described above and seal carton.

(2) If the original packing is available this should be used, and a label described above, should be included.

12. SPARE PARTS SCHEDULE

FIG. & INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	USAGE CODE	UNITS PER ASSEM-BLY
7-	D.73766	HARNESS REEL Assy-Complete		
1	B.73570	Plug end		1
2		Strap - dummy		1
3	A.73721	Pin - retaining - strap		1
4	1400-7-17ths	Clip (V. Anderton)		1
5	B.73566	Plate-retaining		1
6	B.73574	Spring-torsion		1
7	B.73567	Cap-end		1
8	DTD189	Wire-locking		A. R.

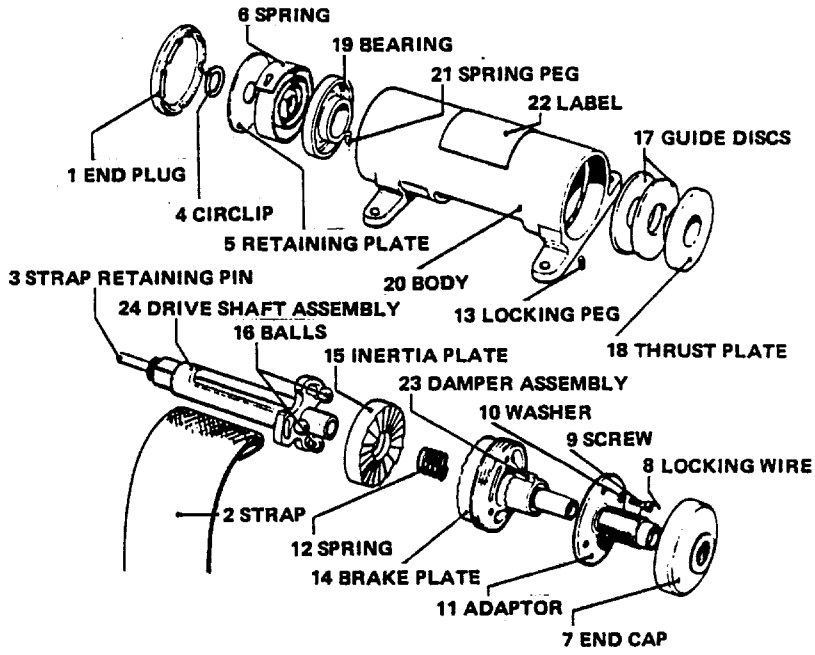


Figure 7. Harness Reel Spare Parts.

SPARE PARTS SCHEDULE (Cont'd)

FIG. & INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	USAGE CODE	UNITS PER ASSEM-BLY
7- 9	B.73589	Screw (8-32 UNC)		3
10	A.72902	Washer		3
11	B.73568	Adaptor		1
12	B.79912	Spring		1
13	B.73575	Peg-locking		1
14	C.73677	Plate-brake		1
15	B.73901	Plate-inertia		1
16		Ball (5/16 in. dia) (V. Hoffman)		3
17	B.73565	Disc-guide		2
18	B.73563	Plate-thrust		1
19	B.73564	Bearing		1
20	D.73661	Body		1
21	B.73573	Peg-spring		1
22	B.74227	Label		1
23	C.73778	DAMPER-assy		1
24	C.73900	DRIVE SHAFT-assy		1

OVERHAUL MANUAL

AIRCREW SEAT HARNESS TYPE E. 136879/80

The pages in Chapter 25-10-205 together with the following Spare Parts Schedule, contain complete instructions for the overhaul of Type E. 136879/80.

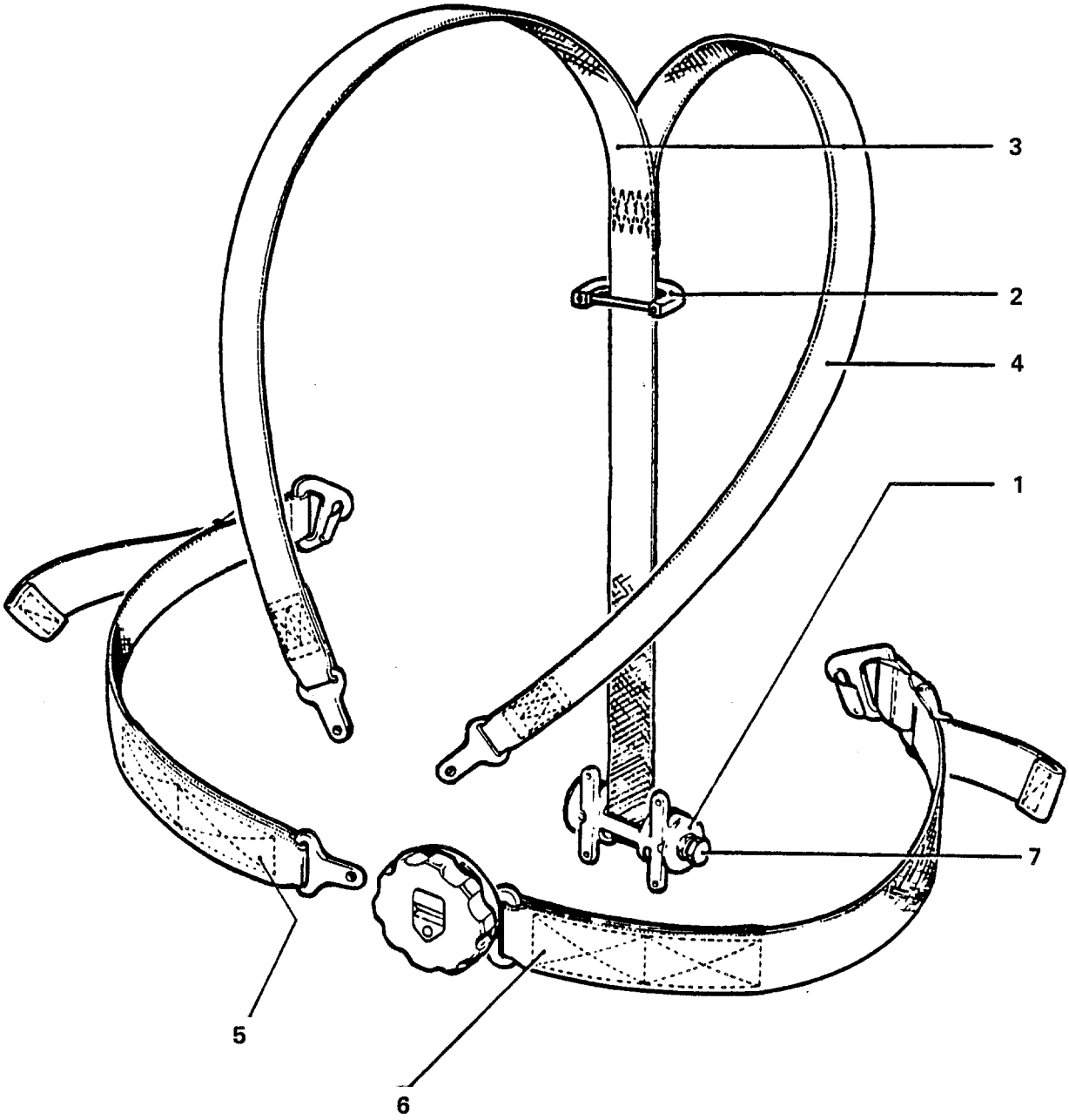


Figure 1 Harness E.136879/80

AIRCREW SEAT HARNESS TYPE E.136879

SPARE PARTS SCHEDULE

FIG. & INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	USAGE CODE	UNITS PER ASSY
1 -	E.136879	SEAT HARNESS - Complete		
1	D.73766	HARNESS REEL - assy.		1
2	D.79470	ROLLER - assy.		1
3	H.4136 SHT 1	HARNESS - assy.		1
4	H.4136 SHT 2	SHOULDER STRAP - assy.		1
5	H.4136 SHT 3 RH	LAP BELT - assy.		1
6	H.4136 SHT 4 RLH	LAP BELT AND RELEASE BOX - assy.		1
7	A.18/GREY	PLASTIC FERRULE		1

AIRCREW SEAT HARNESS TYPE E.136880

SPARE PARTS SCHEDULE

FIG. & INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	USAGE CODE	UNITS PER ASSY
1 -	E.136880	SEAT HARNESS - complete		
1	D.73766	HARNESS REEL - assy.		1
2	D.79470	ROLLER - assy.		1
3	H.~~4137~~ 4190 SHT 1	HARNESS - assy.		1
4	H.~~4137~~ 4190 SHT 2	SHOULDER STRAP - assy.		1
5	H.4136 SHT 3 RH	LAP BELT - assy.		1
6	H.4136 SHT 4 RLH	LAP BELT AND RELEASE BOX - assy.		1
7	A.18/GREY	PLASTIC FERRULE		1

TUL SAFETY EQUIPMENT LTD.

LIFE PRESERVER, TYPE "TUL AIRCREW"

PART NUMBER: TUL-6111

D.O.T. CIVIL AIR APPROVAL NUMBER:

5012 L3 (SRL)

COMPONENT MAINTENANCE MANUAL

with

ILLUSTRATED PARTS LIST

(MANUAL PART NO/ 25-60-01)

TUL SAFETY EQUIPMENT LTD.

LIFE PRESERVER, TYPE "TUL AIRCREW"; P/N TUL-6111

MAINTENANCE MANUAL; P/N 25-60-01

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A	Jan. 16/82		
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1105	Jan. 16/82		

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MAINTENANCE MANUAL; P/N 25-60-01

RECORD OF REVISIONS

Rev. No.	Issue Date	Date Inserted	By -	Rev. No.	Issue Date	Date Inserted	By -	Rev. No.	Issue Date	Date Inserted	B -

Retain this record in the front of the Manual or chapter.
On receipt of Revisions, alter the Manual or chapter according to each revision instruction and record the appropriate information above.

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LIFE PRESERVER, TYPE "TUL AIRCREW"; P/N TUL-6111

MAINTENANCE MANUAL; P/N 25-60-01

LIST OF ASSOCIATED PUBLICATIONS

Halkey Roberts Corporation	Inflation Components
Sparklet Devices Inc.	CO_2 Cylinders
BB Chemicals Co. Ltd.	Adhesives
Shore Chemicals Co. Ltd.	

C

TUL SAFETY EQUIPMENT LTD.

LIFE PRESERVER, TYPE "TUL AIRCREW"; P/N TUL-6111

MAINTENANCE MANUAL: P/N 25-60-01

CHAPTER 25 - EQUIPMENT/FURNISHINGS

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Maintenance Practices	201
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TUL SAFETY EQUIPMENT LTD.

LIFE PRESERVER, TYPE "TUL AIRCREW"; P/N TUL-6111

MAINTENANCE MANUAL; P/N 25-60-01

INTRODUCTION

1. Intended Use

This Maintenance Manual has been prepared for intended use by holders of the Type "Tul-Aircrew" Life Preserver. It outlines Inspection, Testing, and Repair Procedures. The Illustrated Parts List Section will prove helpful in ordering spare parts or components.

2. Format

The format of this Manual complies with the requirements of ATA Specification No. 100. The page number blocks allocation is as follows:

Pages 1 - 100	Description and Operation
Pages 201 - 300	Maintenance Practices
Pages 1101 - 1200	Illustrated Parts List

3. Manufacturer's Certification

This Manual complies with the Canadian Ministry of Transport Airworthiness Requirements.

4. Quality Assurance

All manufacturing, standard of quality in materials and workmanship, is controlled by an approved Quality Assurance System.

5. Approval

D.O.T. Civil Air Approval Number: 5012 L3 (SRL)

TUL SAFETY EQUIPMENT LTD.

LIFE PRESERVER, TYPE "TUL AIRCREW"; P/N TUL-6111

MAINTENANCE MANUAL; P/N 25-60-01

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DESCRIPTION AND OPERATION

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TUL SAFETY EQUIPMENT LTD.

LIFE PRESERVER, TYPE "TUL AIRCREW"; P/N TUL-6111

MAINTENANCE MANUAL; P/N 25-60-01

SECTION 1

DESCRIPTION AND OPERATION

1. Introduction

A. This publication is issued as the Maintenance Manual for the Type "Tul Aircrew" Life Preserver, Part No. TUL-6111.

B. This Maintenance Manual is prepared to the requirements of A.T.A. Specification No. 100.

2. Description

A. General

i. This Life Preserver, shown in Fig. 1, consists of a stole, or buoyancy chamber, fitted with a nylon zippered front closure and webbing waist tie straps; CO_2 and oral inflation systems, and peripheral press-stud fasteners to retain compact folding of the preserver when worn in the deflated state.

B. Detail

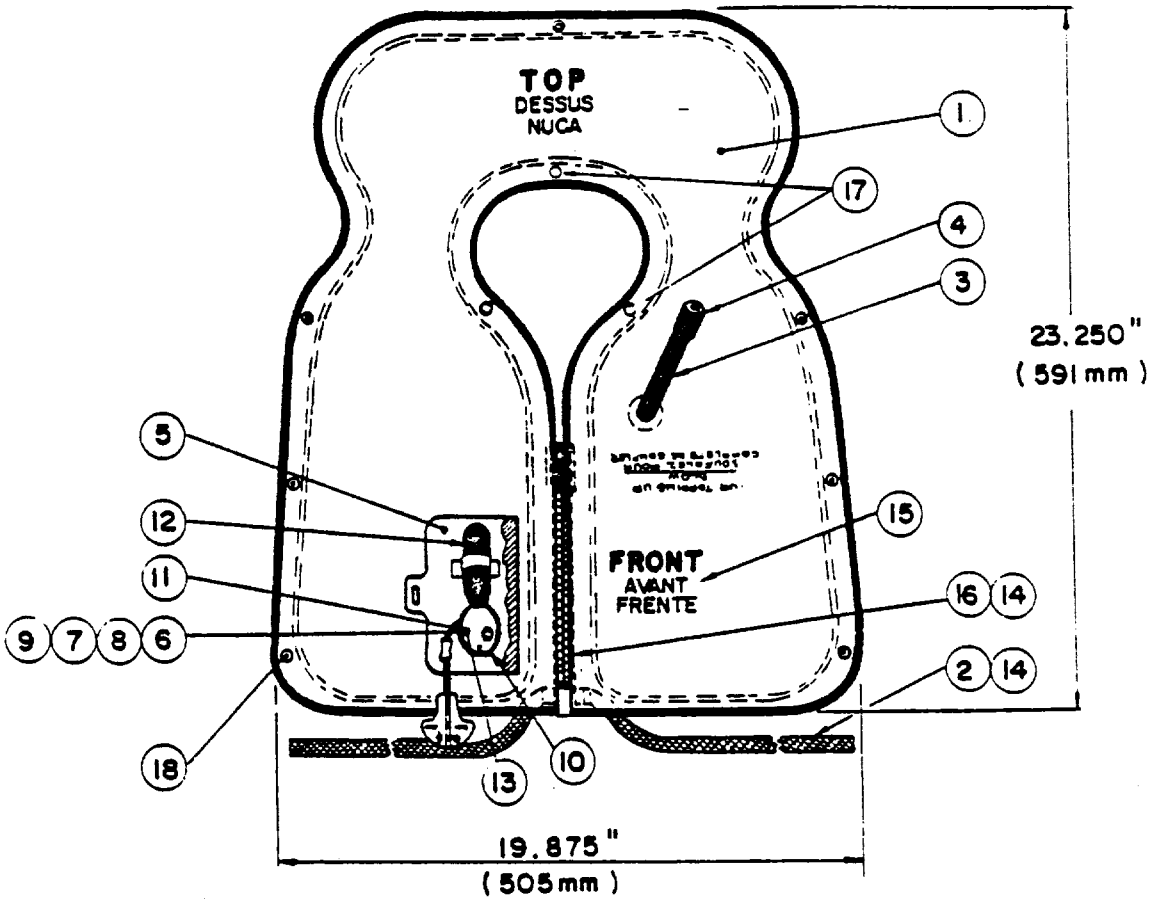
i. The buoyancy chamber is constructed of single ply nylon fabric coated on one side with urethane.

ii. All seams (of the buoyancy chamber) are joined by a di-electric welding process employing a radio frequency sealing press.

iii. Initial inflation of the chamber is achieved by a CO_2 cylinder housed into the body of a manually activated operating head. (See list of Associated Publications for Manufacturer's Data).

iv. An oral inflation tube, fitted with a spring-loaded non-return valve, provides a means of 'topping-up' or deflating the preserver, as required.

v. The deflated preserver is packed in a plastic pouch (P/N TUL-6136).



ITEM	DESCRIPTION
9	WASHER, LOWER
8	WASHER, UPPER
7	AIR - CHECK VALVE
6	MANIFOLD, POLYURETHANE BASE
5	COVER, INFLATOR
4	VALVE, ORAL INFLATION
3	TUBE, POLYURETHANE, 4"(102mm) LONG, RED
2	WEBBING, COTTON, 1"(25mm) BLACK
1	BUOYANCY CHAMBER ASS'Y

ITEM	DESCRIPTION
18	STUD & EYELET
17	SOCKET & RING
16	ZIPPER, NYLON
15	STENCILLING DETAILS
14	THREAD, NYLON, Natural
13	SAFETY PIN
12	CYLINDER, CO2, 16 grams
11	CAP - NUT, HEX N/P.
10	INFLATOR, TYPE 840 AM

LIFE PRESERVER, TYPE "TUL AIRCREW"
FIGURE 1

3. Operation

A. Donning the Preserver

i. The preserver is donned over the head, with the zipper fully open; and the oral tube and CO_2 cylinder facing outwards.

ii. The zipper is fully closed.

iii. The waist tie straps are passed around the back and tied snugly at the front.

B. Inflating the Preserver

i. The inflator toggle is jerked sharply downward, as indicated on the attached instruction tag, to inflate the chamber.

ii. To inflate the chamber harder, the red oral inflation tube is used.

iii. To release air from the chamber, the valve in the end of the inflation tube is depressed with the tip of a finger; and the air is squeezed out of the preserver.

4. Technical Data

A. Service Capacity.....1 Person

B. Minimum Effective Displacement....23 lbs.(10.43 Kg)

C. Gas Inflation Assembly

i. Inflator.....840 AM

ii. CO_2 Gas Charge.....12 grams

D. Weight Data

i. Life Preserver (Less Pouch Container)... 10 oz.(283 gr)

ii. Life Preserver (Packed in Pouch, P/N TUL-6136)... 10-1/2 oz.(298 gr)

E. Recommended Service Life.....6 yrs.(See Note)

NOTE: Statistics indicate that coated fabrics which are subject to gas pressures must be limited to a certain "life". This life is dependent upon the climatic, storage and operational conditions to which the material might be exposed. It is therefore recommended that the type "Tul Aircrew" Life Preserver be limited to a service life of six years from date of manufacture.

TUL SAFETY EQUIPMENT LTD.

LIFE PRESERVER, TYPE "TUL AIRCREW"; P/N TUL-6111

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MAINTENANCE PRACTICES

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2	Testing Procedures	202 - 204
3	Repair Procedures	205 - 207
4	Folding and Packing Procedure	207 - 208
5	Components List and Recommended Spares	210

LIST OF ILLUSTRATIONS

FIGURE	TITLE	PAGE
201	Component Removal/Installation	203
202	Folding Procedure	209

SECTION 2

MAINTENANCE PRACTICES

1. Inspection

A. General

i. Inspections should normally be carried out on a monthly basis; however, if life preservers are stowed in an aircraft, they may be inspected in accordance with the relevant aircraft maintenance/ inspection schedule.

ii. Inspections should also be conducted when unusual circumstances dictate, such as:

(a) when the preserver has been immersed in water,

(b) when it has been inadvertently inflated,

(c) if it is suspected of having been contaminated with POL products or acid,

(d) if it shows signs of having been unduly mishandled,

(e) when the container shows signs of damage such as rips, tears, or contamination,

(f) when the technician feels that an inspection is warranted for any reason.

iii. A record card or log book should be maintained for each preserver to indicate what inspection or maintenance work has been conducted, when and by whom.

B. Detail

i. Inflate the buoyancy chamber and inspect for wear, holes, contamination or any other visible signs of damage.

ii. Ensure that all printing is legible and free of smudges.

B. Detail - Continued

iii. Examine the inflator to ensure that the safety pin has not been broken; and that the body, lanyard and pull toggle show no evidence of surface damage.

iv. Check the oral inflation tube for wear or damage.

v. Check the zipper for damage and proper operation.

vi. Check the press fasteners for evidence of damage or corrosion and proper operation.

vii. Inspect all sewing for loose threads, broken or missing stitches.

viii. Inspect plastic container for damage and operation of press fastener.

2. Testing Procedures

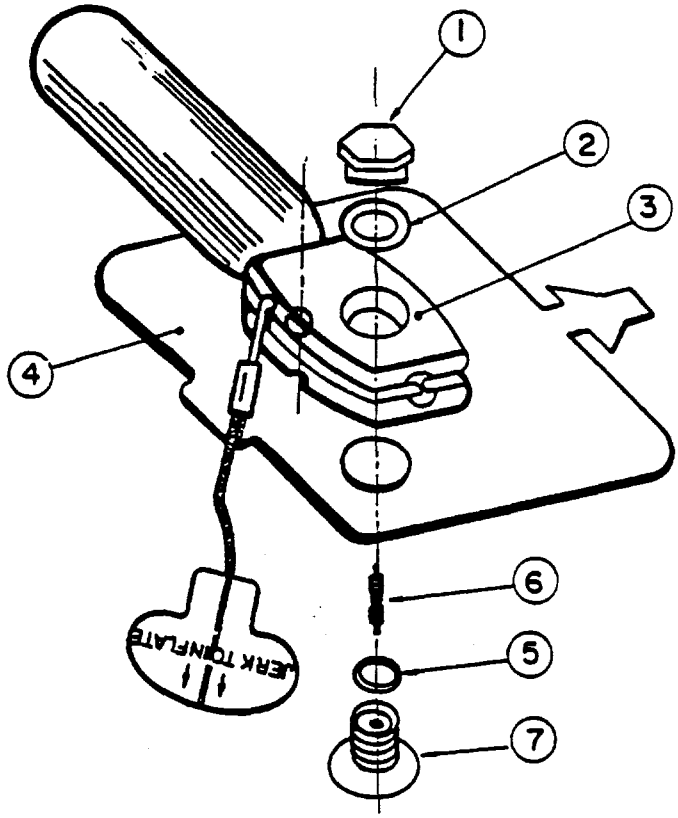
A. Buoyancy Chamber (24 hour test)

i. Inflate the chamber to 1 1/2 psig (0.105 kg/cm^2).

CAUTION: DO NOT EXCEED THIS PRESSURE.

Chamber should not have lost its shape or firmness after a 24 hour period.

NOTE: A reasonably constant room temperature should be maintained throughout the test.



REMOVAL PROCEDURE

a) Remove Cap Nut (1),
b) Remove and discard Upper Seal Washer (2),
c) Remove Inflator/Cylinder assembly (3),
d) Remove Inflator Cover (4),
e) Remove and discard Lower Seal Washer (5),
f) Valve Core (6) is left into Stem (7) for test purposes; if leaking, replace Core.

INSTALLATION PROCEDURE

Reverse removal procedure; install new Items 2 & 5. Secure Cap Nut (1) wrench tight.

COMPONENTS REMOVAL/INSTALLATION

FIGURE 201

A. Buoyancy Chamber - Continued

ii. Should the chamber loose its shape within 24 hrs., strip the preserver of its removable accessories and immerse the inflated preserver in water to detect the leak. See Figure 201 for component removal/installation.

NOTE: Repair procedures are covered in Para. 3 of this Section.

B. CO_2 Cylinder and Inflator

i. The CO_2 cylinder is tested for weight only. Weigh the cylinder on a gram scale; weight must conform to that stamped on the cylinder, otherwise replace cylinder.

ii. The operating lever pull-off load is approx. 1 1/2 lbs. (0.68 kg). This amount of pressure is required tc break the safety-pin and overcome the spring pressure on the cam lever.

iii. With the cylinder removed, pull the "Jerk to Inflate" toggle and observe the travel of the CO_2 cylinder seal piercing pin inside the inflator. Ensure the pin raises and retracts as the lever is pulled through its full travel.

iv. Reset the lever and install a new safety-pin.

CAUTION: ENSURE HEAD IS RESET BEFORE REPLACING CYLINDER.

C. Oral Inflation Valve

i. Blow air through the oral inflation valve to ensure free passage and ease of operation.

3. Repair Procedures

A. General

i. The room or section wherein repairs are carried out must provide protection from direct sunlight, be isolated from areas where POL products are used or stored, be dust and dirt free, and be of an even temperature.

ii. Refer to Components List and Recommended Spares (Para. 5) for procurement of bulk materials and component parts used for repairs.

iii. Refer to Section 3, Illustrated Parts List for components description and specification data.

B. Buoyancy Chamber

i. Patch material must be the same as that used in the manufacture of the preserver.

ii. The adhesive used for repair must be compatible with the chamber fabric coating, i.e. urethane base.

NOTE: For mixing ratios and storage requirements, for adhesives, refer to the manufacturer's data sheet.

iii. As a general rule, a patch must extend at least 1 inch (25 mm) beyond the perimeter of the hole or tear; e.g. if the diameter of a jagged hole is 1 inch (25 mm), the patch should be 3 inches (76 mm) in diameter. If a tear is 1 inch (25 mm) long, the patch should be 3 inches (76 mm) long by 2 inches (50 mm) wide. L-shaped tears are to be treated as round holes reckoning the distance between the ends of the tear as the diameter.

NOTE: Patches should be either circular or rectangular with rounded corners. Odd shapes such as triangular or eliptical should not be used.

B. Buoyancy Chamber - Continued

iv. To apply a patch, follow these steps:

(a) Cut patch to size,

(b) Clean fabric around the damaged area with soapy water,

(c) Dry area with clean dry cloth,

(d) Rub area with a pad dampened sparingly with solvent,

(e) Brush on two coats of adhesive solution, allowing the first coat to become tacky before applying the second,

(f) When second coats on both the patch and the chamber have become tacky, place patch in position,

(g) Roll the patch with a hand roller,

(h) Work out any air bubbles with a wooden spatula,

(j) Dust area with french chalk (to prevent sticking of over-solutioned areas when preserver is folded later).

v. Repairs are limited as follows:

(a) Damaged areas must not exceed 1 inch (25 mm) thus patches are limited in size to 3 inches (76 mm) in diameter or in length.

(b) Do not apply more than two patches to each side of each chamber.

(c) Do not apply patches in seam areas; if a seam is damaged, the preserver must be discarded.

vi. The following Special Tools, Fixtures, Materials and Equipment are required for chamber repair:

(a) Single ply, urethane coated nylon material,
(b) Inflation and vacuum pump,
(c) Steel roller,
(d) Scissors,

B. Buoyancy Chamber - Continued

vi. (e) 1/2 inch (13mm) round brush (for adhesive),
(f) Wooden spatula,
(g) Urethane adhesive,
(h) Solvent,
(j) Polyethylene sheeting (to cover work table),
(k) Valve core removing tool (Schrader),
(l) 9/16 box end spanner (hexagon)

C. Components

i. No repairs are to be carried out on components such as Operating Heads, CO_2 Cylinders, Press-Studs, Zipper, etc. Defective items are to be replaced.

4. Folding and Packing Procedures

A. General

i. In order to provide comfort to the wearer and also minimize the perimeter of the deflated preserver when worn, a folding procedure has been implemented to satisfy both conditions.

ii. When folded, as outlined below and illustrated in Fig. 202, Steps 1 to 4, the Life Preserver becomes quite comfortable to wear.

iii. Steps 5 to 8 illustrate the packing procedure.

B. Folding Detail (Refer to Fig. 202, Steps 1 to 4)

i. Deflate the preserver and lay it face down as per Step 1,

ii. Fold right and left lower lobes of preserver, approx. 45^{o}, and slightly below the mid-lateral male press-stud; as per Step 2,

iii. Fold right side in half in order to fasten press-stud assemblies at "A" and "B" as shown in Step 3,

iv. Repeat Step 3 on left side of preserver and complete folding top section as per Step 4,

B. Folding Detail - Continued

v. Fold upper section of preserver downwards and fasten the upper press stud assembly as per Step 5.

C. Packing Detail (Refer to Fig. 202, Steps 5 to 8)

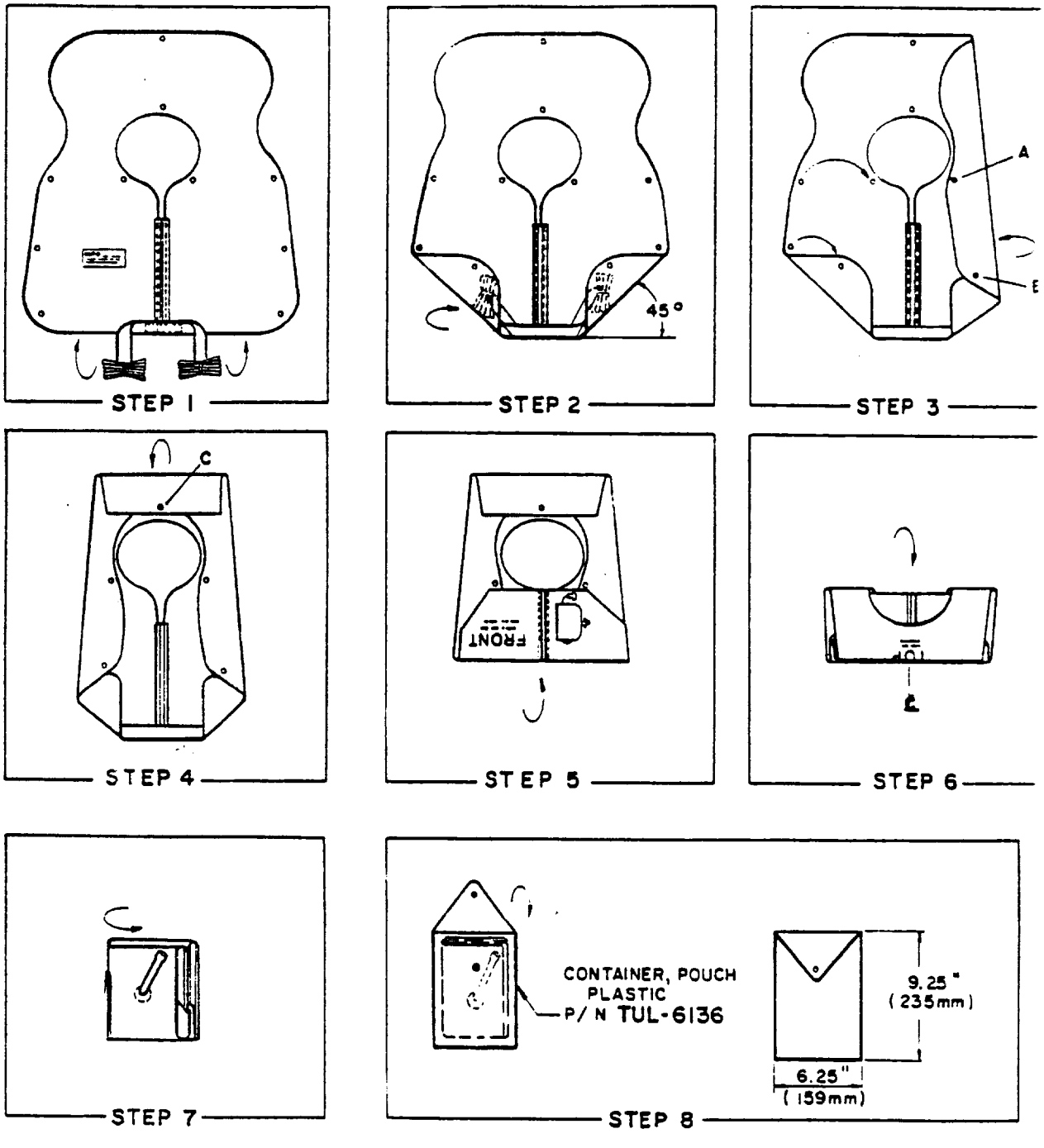
i. Fold lower half of preserver towards center, as per Step 5,

ii. Fold upper half of preserver on top of previous fold, as per Step 6,

iii. Fold unit in half, oral tube facing uppermost, as shown in Step 7,

iv. Place unit in pouch and fasten flap to complete packing, as per Step 8.

4. Folding and Packing Procedures



FOLDING AND PACKING PROCEDURES

FIGURE 202

5. Components List and Recommended Spares

TUL P/N	DESCRIPTION	QTY.REQ'D. PER UNIT	MIN.STOCK % AGE.
	MAJOR ASSEMBLY		
6111	Life Preserver, Type "Tul Aircrew"	Ref.	-
6136	Container Pouch, Plastic	1	5%
	BULK MATERIALS		
1439	Fabric, Nylon, Single Ply, Urethane Coated, Spanish Yellow	1.0 yard	2%
	Webbing	2.90 yds.	5%
2518	Thread, Nylon, Nat., VT-295	A/R	6 oz. Spool
7104	Adhesive Solution, Urethane VR1008	A/R	1 Quart
	DETACHABLE/REPLACEABLE COMPONENTS		
3104	Cylinder, CO_2, 16 grams	1	100%
3209	Inflator, 840 AM	1	5%
3309	Air-Check Valve, Schrader	1	5%
3310	Valve, "Oral-Matic", 720 ROA	1	10%
3504	Washer, Upper	1	10%
3505	Washer, Lower	1	10%
3714	Cap-Nut, Hexagonal, N/P	1	5%
3739	Cover, Inflator	1	15%
3211	Safety Pin, Plastic, for 840 AM Inflator	1	100%

TUL SAFETY EQUIPMENT LTD.

LIFE PRESERVER, TYPE "TUL AIRCREW"; P/N TUL-6111

MAINTENANCE MANUAL; P/N 25-60-01

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2	Parts List (Ref. Fig. 1101)	1102
3	Parts List (Ref. Fig. 1102)	1104

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1102	Inflation Assembly Components	1105

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LIFE PRESERVER, TYPE "TUL AIRCREW"; P/N TUL-6111

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SECTION 3

ILLUSTRATED PARTS LIST

1. Introduction

A. Purpose

This Illustrated Parts List is intended for use as a supplement to the Components List and Recommended Spares Schedule, found in Section 2 of this Manual.

B. Detail

Item Numbers in the Parts List are keyed to corresponding item numbers in the related illustration.

2. ILLUSTRATED PARTS LIST (Ref. Fig. 1101)

FIG. AND INDEX NO.	PART OR DWG. NO.	NOMENCLATURE	UNITS PER ASS'Y.
1101	TUL-6111	Life Preserver, Type "Tul Aircrew"	Ref.
-1	TA-75E-00023	Buoyancy Chamber Assembly	1 (Ref.
-2	TUL-2208	Webbing, Nylon, 1 inch, Black	
-3	TUL-3409	Tube, Oral, Polyurethane, 4 1/2 inch, Red	1(Ref.)
-4	Sub.Assy. TUL-3409	Valve, Oral Inflation, 720 ROA	1
-5	TUL-3739	Cover, Inflator	1
-6	TUL-3728	Manifold, Polyurethane, 831 AOE	1 (Ref.
-7	TUL-3326	Air-Check Valve	1
-8	TUL-3504	Washer, Upper	1
-9	TUL-3505	Washer, Lower	1
-10	TUL-3209	Inflator, 840 AM	1
-11	TUL-3714	Cap-Nut, Hexagonal, N/P	1
-12	TUL-3104	Cylinder, 16 grams, CO_2	1
-13	TUL-3211	Safety Pin, Plastic, Used on P/N 3209	1
-14	TUL-2518	Thread, Nylon, Nat., VT-295	A/R
-15	TA-75B-00027	Stencilling Details	Ref.
-16	TUL-4502	Zipper, Nylon, 8 inch length, Black	1
-17	TUL-4210/11	Socket and Ring	5
-18	TUL-4212/13	Stud and Eyelet	5

TUL SAFETY EQUIPMENT LTD.

LIFE PRESERVER, ADULT, TYPE 35 MK IV (-2) and (-3)

P/N TUL - 6174

MAINTENANCE MANUAL P/N 25-60-05

ADDENDUM TO ORIGINAL LETTER OF TRANSMITTAL

For:

REVISION 5 Dated Dec. 2/91

REVISION INSTRUCTIONS:

1. **Add this Addendum to Original Letter of Transmittal dated November 30, 1984.**

2. **Remove and Destroy following pages:**
   A - 4 - 201 - 202 - 204 - 209 and 210

3. **Add the following pages:**
   A - 4 - 201 - 202 - 204 - 209 and 210

4. **Annotate Record of Revisions at Front of the Manual.**

Issued by: Tul Safety Equipment Ltd.

Per: _____

M. Paquin
Engineering Manager

Date: Dec. 2/91

TUL SAFETY EQUIPMENT LTD
LIFE PRESERVER, ADULT, TYPES 35 MK IV (-2) AND (-3)
P/N TUL-6174
MAINTENANCE MANUAL, P/N 25-60-05

NOTE: Please see the **TEMPORARY REVISION** that revises this page.

LETTER OF TRANSMITTAL

FOR:

BASIC COPY

OF MAINTENANCE MANUAL

ISSUED - NOV.30/84

The pages accompanying this letter represent the First Issue of the Maintenance Manual, applicable to the TUL adult Life Preserver, Types 35 MK IV (-2) and 35 MK IV (-3). All pages contained herein are dated Nov30/84, and reflect the Manufacturer's Recommendations for Maintenance and repair of the above items.

Signed: _____

M.Paquin

Position: Engineering Manager

Date: Nov.30/84

(NOTE: RETAIN THIS LETTER OF TRANSMITTAL)

Remove Existing Page (s)	Insert New Page (s)	Reason for Change
N/A	N/A	Re-Issue of Basic Manual in Conformance to TSO C13d

N/A=Not Applicable

TUL SAFETY EQUIPMENT LTD.

LIFE PRESERVER, ADULT

TYPES 35 MK IV (-2) AND 35 MK IV (-3)

PART NUMBER TUL-6174

COMPONENT MAINTENANCE MANUAL

WITH

ILLUSTRATED PARTS LIST

(MANUAL PART NO: 25-60-05)

(TO A.T.A. SPECIFICATION NUMBER 100, REVISION 18)

NOV.30/84

TUL SAFETY EQUIPMENT LTD

LIFE PRESERVER, ADULT, TYPES 35 MK IV (-2) AND (-3)

P/N TUL-6174

MAINTENANCE MANUAL, P/N 25-60-05

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1 of 1	0	Nov. 30/84
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5	4	Apr. 15/91
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202	5	Dec. 2/91
203	0	Nov. 30/84
204	5	Dec. 2/91
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207	0	Nov. 30/84
208	0	Nov. 30/84
209	5	Dec. 2/91
210	5	Dec. 2/91
Contents (3)	0	Nov. 30/84
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1103	0	Nov. 30/84
1104	3	Oct. 27/89
1105	0	Nov. 30/84
1106	3	Oct. 27/89
1107	0	Nov. 30/84

* Zero in this column, denotes an original page.

TUL SAFETY EQUIPMENT LTD

LIFE PRESERVER, ADULT, TYPES 35 MK IV (-2) AND (-3)

P/N TUL-6174

MAINTENANCE MANUAL, P/N 25-60-05

RECORD OF REVISIONS

REV. NO.	ISSUE DATE	DATE INSERTED	BY	REV. NO.	ISSUE DATE	DATE INSERTED	BY	REV. NO.	ISSUE DATE	DATE INSERTED	BY
1	JUN 24/86	JUN 24/86	[illegible]								
2	10 Sep 87	10 Sep 87	[illegible]								
3	27 OCT 89	27 OCT 89	[illegible]								
4	26 APR. 91	26 APR. 91	[illegible]								
5	DEC 7/91	2 DEC 91	[illegible]								

Retain this record in the front of the Manual or chapter. On receipt of Revisions, alter the Manual or chapter according to each revision instruction and record the appropriate information above.

LIST OF ASSOCIATED PUBLICATIONS

A.C.R Electronics Inc.....Survivor Light

Halkey Roberts Ltd.....Inflator Valves, Oral Tube

Shore Chemicals Co. Ltd.....Adhesives

Sparklet Devices Inc.....CO^2 Cylinders

CHAPTER 25 - EQUIPMENT/FURNISHINGS

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TUL SAFETY EQUIPMENT LTD
LIFE PRESERVER, ADULT, TYPES 35 MK IV (-2) AND (-3)
P/N TUL-6174
MAINTENANCE MANUAL, P/N 25-60-05

INTRODUCTION

1. Intended Use

This Maintenance Manual has been prepared for intended use by holders of the TUL Types 35 MK IV (-2) and (-3) Adult Life Preserver. It Outlines inspection, testing, repair and packing procedures. The Illustrated Parts List section will prove helpful in ordering spare parts or components.

2. Format

The format of this Manual complies with the requirements of ATA Specification No. 100, Revision 18. The page number blocks allocation is as follows:

Pages 1 - 100	Description and Operation
Pages 201 - 300	Maintenance Practices
Pages 1101 - 1200	Illustrated Parts List

3. Manufacturer's Certification

The Life Preserver is manufactured in compliance with TSO-C13d, Minimum Performance Requirements.

4. Quality Assurance

All manufacturing standard of quality in materials and workmanship, is controlled by an approved Quality Assurance System.

5. Effectivity

This Manual is applicable to Type 35 MK IV (-2) and Type 35 MK IV (-3). Where effectivity only applies to either one or the other, type, such will be stated in the effectivity block at the bottom of the applicable page (s).

TUL SAFETY EQUIPMENT LTD
LIFE PRESERVER, ADULT, TYPES 35 MK IV (-2) AND (-3)
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TUL SAFETY EQUIPMENT LTD
LIFE PRESERVER, ADULT, TYPES 35 MK IV (-2) AND (-3)
P/N TUL-6174
MAINTENANCE MANUAL, P/N 25-60-05

SECTION 1

DESCRIPTION AND OPERATION

1. INTRODUCTION

A. This publication is issued as the Maintenance Manual for the TUL, TYPES 35 MK IV (-2) and (-3) Adult Life Preservers P/N TUL-6174.

B. This Maintenance Manual is prepared to the requirements of A.T.A. Specification 100, Revision NO.18.

2. DESCRIPTION

A. General

(1) The life preservers shown in Figures 1 and 2 consists of two superimposed stoles or buoyancy chambers, fitted with an adjustable quick donning-waist belt, CO^2 and oral inflation systems, a water activated light/s and a whistle.

(2) The Type 35 MK IV (-3), (Ref. Fig.2) used by crew members only, is flame orange in colour; has 2 sea-lights relocated on the upper portion of the chambers; and has strips of Retro-Reflective Tape at the front.

B. DETAIL

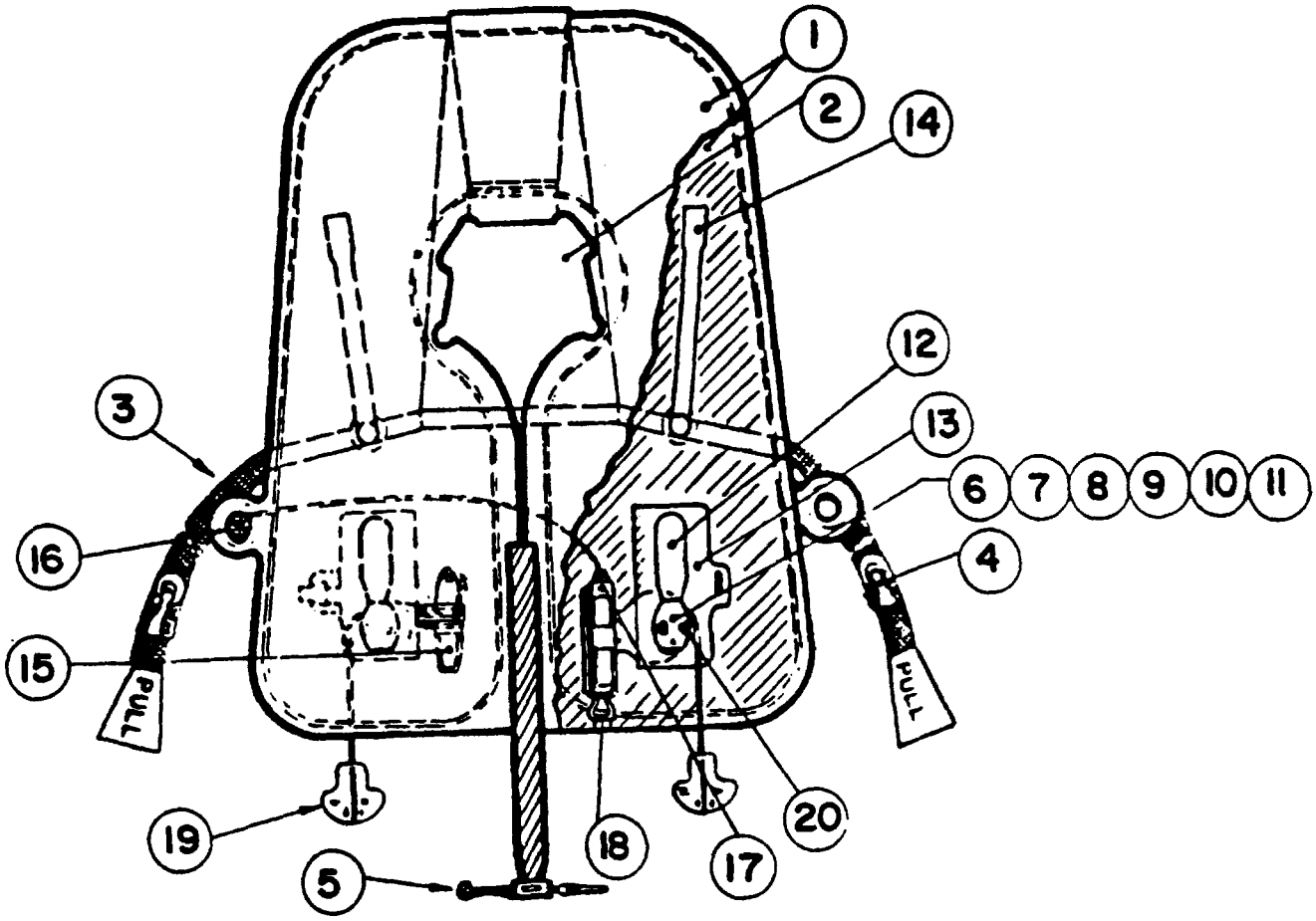
(1) The buoyancy chambers are constructed of single ply nylon fabric coated on one side with urethane.

(2) All seams (of the chambers) are joined by a dielectric welding process employing a radio frequency sealing press.

(3) Initial inflations of each chamber is achieved by a CO^2 cylinder attached to a mamually activated operating head. (See list of Associated Publications for Manufacturer's data.)

(4) An oral inflation tube, fitted with a spring loaded non-return valve, provides a means of 'topping up' or deflating the preserver as required.

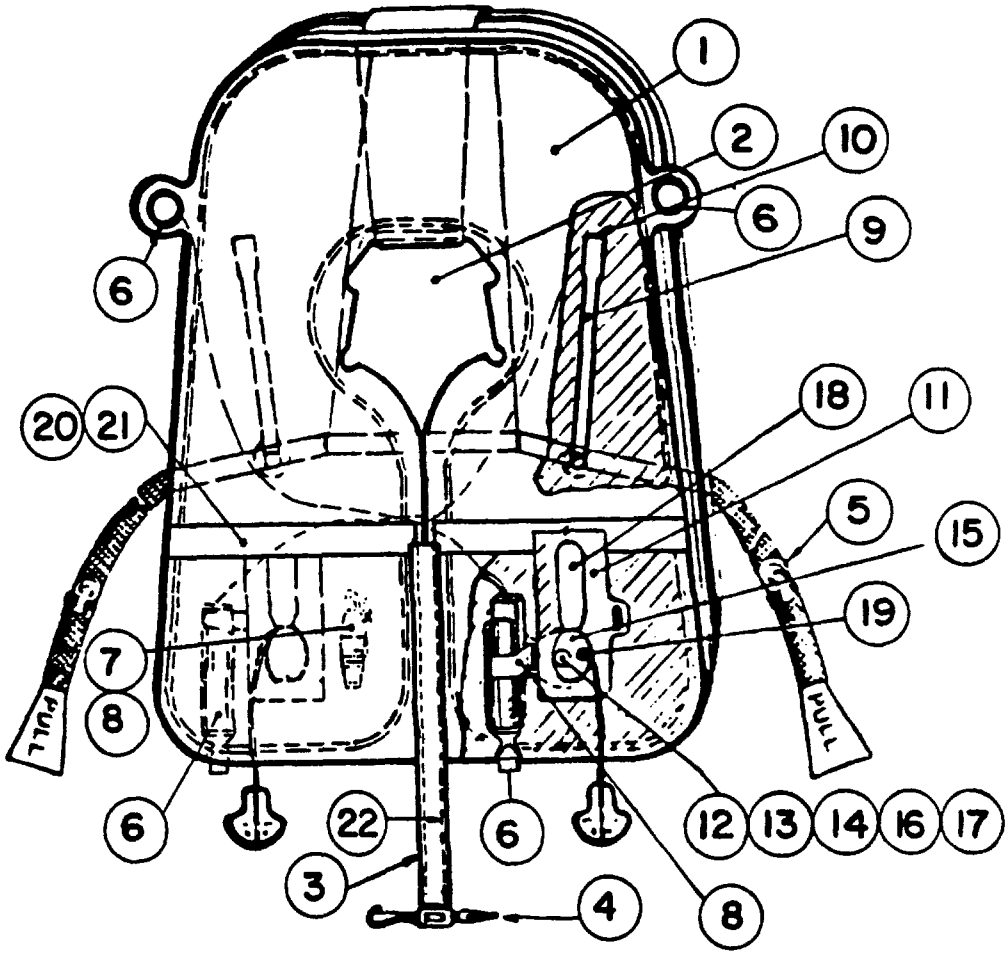
(5) The whistle (normally used as an audible attention getting device in all survival kits) is constructed of high impact plastic and is attached to the preserver with a short length of cord.



1-Buoyancy Chambers
2-Back Flap Assembly
3-Waist Belt
4-"D" Ring Adjustment Device
5-Double End Snaps
6-Manifold Stem
7-Air-Check Valve
8-Washer, Lower
9-Inflator, Type 840 AM
10-Washer, Upper
11-Cap-Nut, Hexagonal
12-Cylinder, CO^2, 16 grams
13-Cover, Inflator
14-Tube, Oral Inflation, c/w Valve
15-Whistle & Cord
16-Sea-Light Assembly
17-Sea-Cell Battery
18-Battery Pull-Tab
19-Inflator Pull-Toggle
20-Safety Pin

TYPE 35 MK IV (-2) ADULT LIFE PRESERVER

FIGURE 1



1-Buoyancy Chamber Ass'y.
2-Back Flap Ass'y.
3-Webbing, Cotton 1", Indian Orange
4-Double End Snaps
5-"D" Ring Adjustment Device
6-Sea-Light Ass'y. Complete
7-Whistle & Cord
8-Battery & Whistle Retainer
9-Tube, Oral-Inflation
10-Valve, Oral-Inflation
11-Cover, Inflator
12-Manifold Stem
13-Air-Check Valve
14-Washer, Lower
15-Inflator, Type 840 AM
16-Washer, Upper
17-Cap-Nut, Hexagonal
18-Cylinder, CO^2, 16 Grams
19-Safety-Pin
20-Adhesive, PartsA & B
21-Tape, Retro-Reflective
22-Thread, Nylon, Natural

LIFE PRESERVER, TYPE 35 MK IV (-3)

FIGURE 2

2. DESCRIPTION - Cont....

B. Detail

(6) The survivor light, which facilitates the location of survivors of an emergency landing in water, is attached to one chamber of the preserver with a detachable tab. (For further information on this item, see the list of Associated Publications for Manufacturer's data.)

(7) The life preserver is normally supplied packed in carrying case P/N TUL- 6108 or 6108H ; however, packaging to customer's specifications is also available.

3. OPERATION

A. Donning the Preserver

(1) The preserver is donned over the head with the back piece behind the wearer.

(2) The straps are pulled around the body and the D Rings are engaged in the snap hooks on the front strap.

(3) The free ends of the straps, (marked Pull) are pulled through the adjustment buckles until snug.

B. Inflating the Preserver

(1) The red toggles marked 'Jerk to Inflate' are jerked sharply downward to inflate the chambers.

NOTE: If, for some reason, one chamber is damaged and fails to inflate, one chamber will provide the support necessary for safe flotation.

(2) To inflate the chambers harder, the red oral inflation tube is used.

(3) To release air from chamber, the valve in the end of the inflation tube is depressed with the tip of a finger.

3. OPERATION - Cont'd. ....

C. Activating the Survivor Light

(1) The light will remain in operation until the battery plugs are removed to allow ingress of water. Plugs are removed by pulling on the plastic toggle marked "Pull to Light".

4. TECHNICAL DATA

A. Service Capacity ..... 1 Person

B. Minimum Effective Displacement..15.87 kg (35lbs.)

C. Gas Inflation Assembly (2 req'd.)

(1) Inflator ..... Halkey Roberts, 840 AM

(2) CO2 Gas Charge ..... 16 grams

D. WEIGHT DATA

(1) Life Preserver (less container)....0.65kg (1lb.7oz) (2) Life Preserver (packed in container P/N)
TUL-6101 .....0.71kg (1lb.9oz)

E. RECOMMENDED SERVICE LIFE

Statistics indicate that coated fabrics which are subject to gas pressure must be limited to a certain 'life'. This 'life' is dependent upon the climatic, storage and operational conditions to which the material might be exposed. It is therefore recommended that the TUL Types 35 Life Preservers over 10 years of age, which do not pass the leakage test or that require repair, be removed from service and disposed of.

TUL SAFETY EQUIPMENT LTD
LIFE PRESERVER, ADULT, TYPES 35 MK IV (-2) AND (-3)
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ADDENDUM TO MAINTENANCE MANUAL 25-60-05

Packing Procedure for Life Preserver,
Type 35 Mk IV (-2) and (-3)
in Constant Wear Container, P/N TUL-6137

Issued by: Tul Safety Equipment Ltd.

Per: M. Paquin
Engineering Manager

Date: August 21, 1986

ADDENDUM TO MAINTENANCE MANUAL 25-60-05

Packing Procedure for Life Preserver, Type 35 Mk IV (-2) and (-3) in Constant Wear Container

A- General

Subsequent to satisfactory inspection/repair and testing of the life preserver as per Section 2 of Maintenance Manual; the following Packing Procedure shall apply:

B- Detail (Refer to Appendix "A")

1. Thoroughly deflate the buoyancy chambers
2. Lay the constant wear container on table, "Tul" logo facing uppermost
3. Insert the life preserver on top of the container back panel, as shown in Diagram 1; back flap extended, nylon face uppermost; double-end snaps and toggles exposed
4. Accordion fold sides of buoyancy chambers and fasten velcro closure on left and right sides of container
5. Accordion fold upper and lower top sections of buoyancy chambers, over and under back flap and fasten container velcro closure as per Diagram 3.
6. Tuck in lower half of preserver inside container and complete closure as per Diagram 4, ensuring both inflator toggles (Jerk to Inflate) are readily accessible for operation.
7. Diagram 5 depicts waist belt attachment configuration when life preserver is worn.

Issued by: Tul Safety Equipment Ltd.
Per: M. Paquin
Engineering Manager
Date: August 21, 1986

NOTE: Please see the TEMPORARY REVISION that revises this page.

ADDENDUM TO MAINTENANCE MANUAL 25-60-05

Procedure for Packing Life Preserver, Type 35 Mk IV (-2) and (-3) in Constant Wear Container

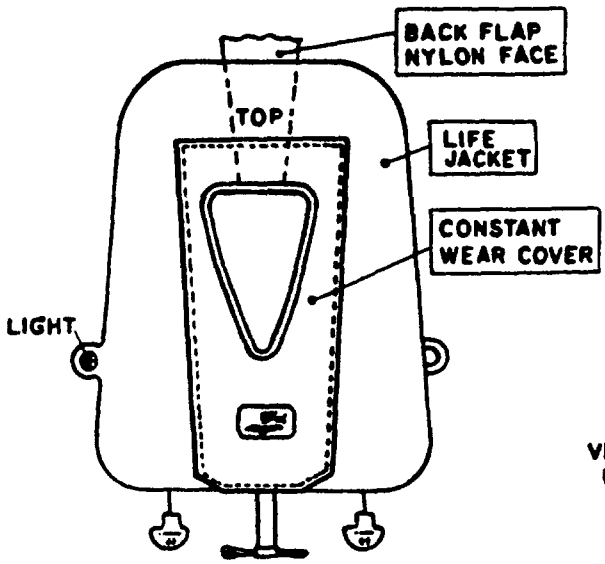


Diagram # 1.

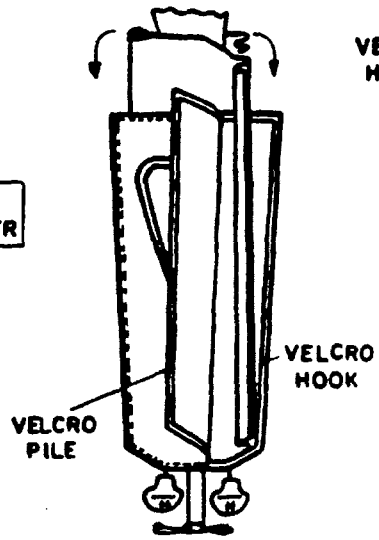


Diagram # 2.

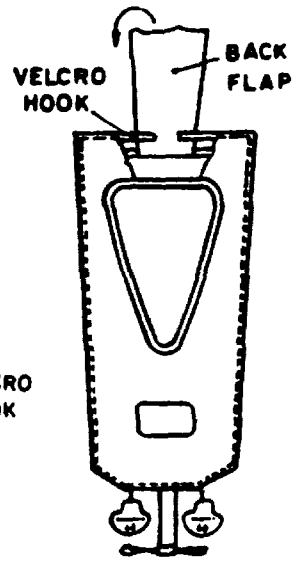


Diagram # 3.

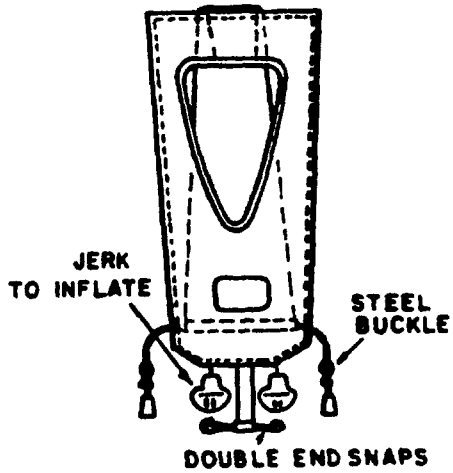


Diagram # 4.

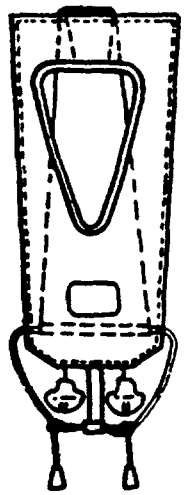


Diagram # 5

Packing Procedure

APPENDIX "A"

SECTION 2

MAINTENANCE PRACTICES

1. INSPECTION

A. General

1. Life preservers should be inspected at regular intervals. The intervals between inspections are not to exceed 12 months.

2. Life preservers should be withdrawn from the aircraft whenever the plane is undergoing servicing or maintenance. The life preservers should be inspected at this time and re-issued.

3. Inspection should also be conducted when unusual circumstances dictate, such as:
   (a) when the preserver has been immersed in water,
   (b) when it has been inadvertently inflated,
   (c) if it is suspected of having been contaminated with POL products or acid,
   (d) if it shows signs of having been unduly mishandled,
   (e) when the container shows signs of damage such as rips, tears, or contamination.

4. A record card or log book should be maintained for each preserver to indicate what inspection or maintenance work has been conducted, when and by whom.

B. Detail

(1) Inflate the buoyancy chambers and inspect for wear, holes, contamination or any other visible signs of damage including broken stitches in the neck area.

(2) Examine the operating heads to ensure that the cord is securely fastened to the operating lever and is not frayed. The toggle should be free of cracks and the printing legible. Remove the CO2 cylinder from the heads; and visually check all metal parts for damaged threads, nicks, burrs or corrosion.

(3) Check the oral inflation tubes for wear or damage.

(4) Examine the survivor light base, lens and bulb for cracks or other damage. Check the lead wire for damage and security.

Inspect the battery casing for swelling, splits, or other damage. Ensure the battery plates do not show evidence of corrosion or incrustations.
Measure battery case thickness; if more than 7/16" replace light assembly.

NOTE: The service life of the survival light/battery ass'y. is indefinite provided it meets the I/I inspection criteria; otherwise the defective assembly must be replaced.

B. Detail-- continued

(5) Check the harness system for broken stitches, fraying or contamination and the metal parts for rust, corrosion or damage. Ensure snap hook and D-ring adjustment device spring action is positive.

(6) Inspect the back piece for security and ensure that all printing is legible.

(7) Examine whistle for damage.

(8) Examine the container or pouch for damage and contamination with particular emphasis on the operation of the snap fasteners.

2. TESTING PROCEDURES

A. FUNCTIONAL TEST

(a) Perform this test when the life jacket is five years old.

(b) With the jacket fully assembled, discharge the CO2 cylinders into the cells. The cells should fully inflate with no loss of CO2.

(c) Exhaust all CO2 thoroughly prior to conducting the Integrity Test.

B. INTEGRITY (OVERPRESSURE) TEST

(a) Perform this test every five years of service life, or following any repairs to fabric cells.

(b) Inflate each cell with oil- and water-free shop air to 5 psig for a period of not less than 5 minutes or more than 10 minutes.

(c) There shall be no evidence of fabric or seam failure. Following successful completion of this test, perform the Leakage Test.

C. LEAKAGE TEST

(a) Perform this test following each inspection prior to folding and storing the jacket whether or not repairs were necessary.

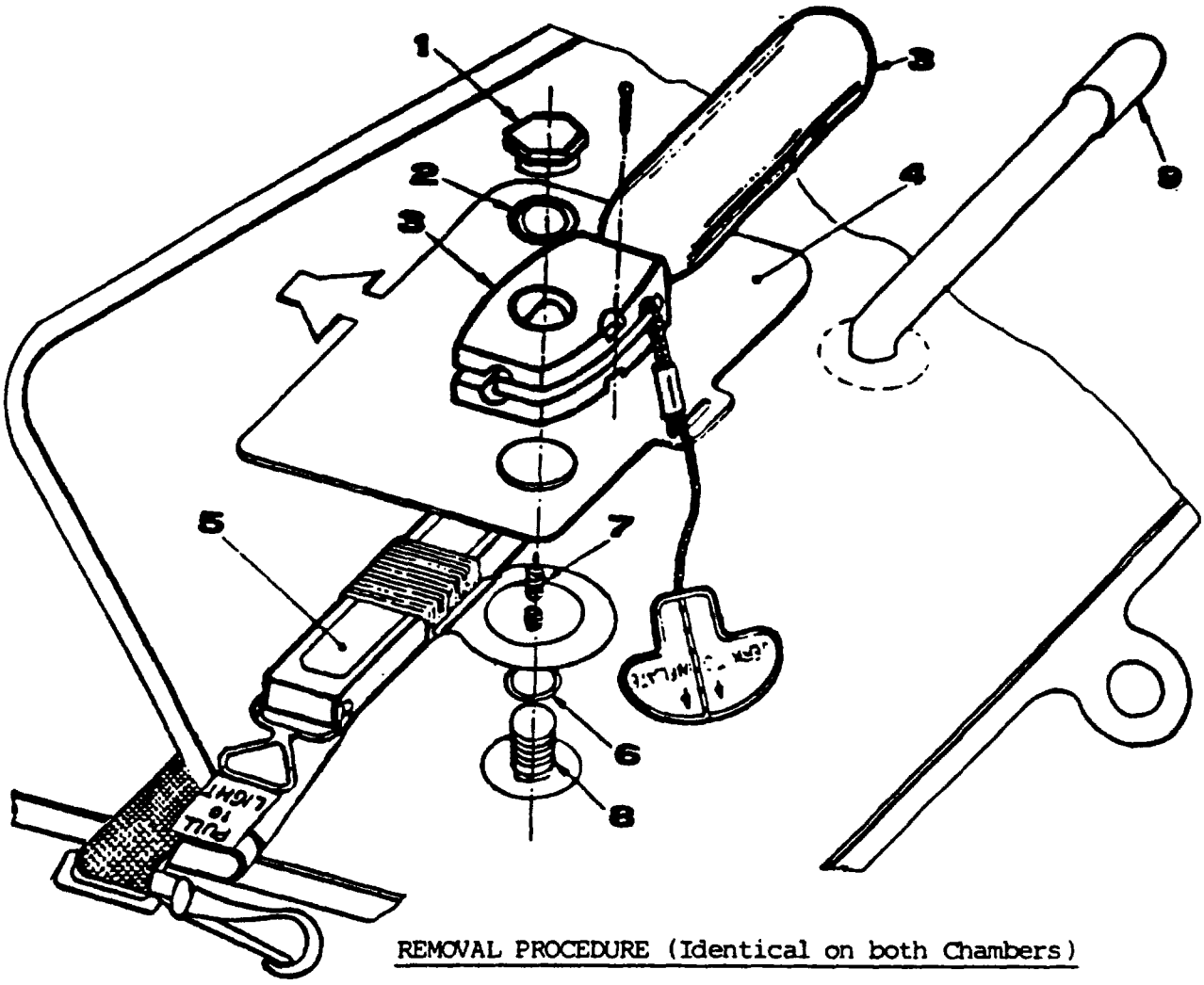
(i) Slowly inflate both life jacket cells to not more than 3 psig. After 5 minutes, readjust pressure to 2 psig.

(ii) The life preservers will pass if any one of the following time-leak checks are met:

Time Intervals	Pressure	Time Intervals	Pressure
4 hours	1.8 psi	18 hours	1.4 psi
6 hours	1.7 psi	24 hours	1.3 psi
12 hours	1.5 psi		

(iii) A life preserver with any cell that fails the time-leak check will be rejected and set aside to determine the cause and the required repair.

(b) Life preservers that pass the Leakage Test should be deflated, and the CO2 cylinders should be reinstalled.



REMOVAL PROCEDURE (Identical on both Chambers)

a) Remove cap nut (1)
b) Remove and discard upper seal washer (2)
c) Remove inflator/cylinder assembly (3)
d) Remove inflator cover (4)
e) Remove battery and sea-light assembly (5)
   Remove whistle on opposite chamber.
f) Remove and discard lower seal washer (6)
g) Valve Core (7) is left into stem (8) for test purposes;
   if leaking, replace core.
h) If leaking, check valve (9) shall be replaced.

INSTALLATION PROCEDURE

Reverse removal procedures, install new items 2 & 6, secure cap nut (1) wrench tight.

COMPONENT REMOVAL/INSTALLATION
Figure 201

D. CO2 CYLINDERS AND OPERATING HEADS (Test at Each Inspection)

(1) CO2 Cylinders are tested for weight only. Weigh the cylinder on a gram scale. Gross weight stamped on the cylinder is the minimum allowable for that cylinder; and the maximum allowable gross weight is + 2.5 grams. Cylinders not meeting this criteria are to be rejected.

(2) With the cylinder removed, pull the operating head toggle; and observe the travel of the cylinder piercing pin beyond the sealing gasket inside the head. Ensure pin raises and retracts as the lever is pulled through its full travel. Check gasket seal for condition; replace faulty gasket with new one.
Reset the lever against the head body and reinstall red safety clip (or a new rivet) as applicable.

(3) CAUTION: Ensure head is reset before replacing cylinder.

E. ORAL INFLATION VALVE (Test at Each Inspection)

(1) Blow air through oral inflation valve to ensure free air passage and ease of operation.

F. WHISTLE: (if applicable) (Test at Each Inspection)

(1) Operate to ensure proper function; if faulty, reject and replace with new unit.

3. REPAIR PROCEDURES

A. GENERAL

The following condition preservers are considered non-repairable and shall be removed from service and disposed of:

(1) Preservers over 10 yeafs of age which fail the leakage test; or require repair;

(2) Preservers where any oral tube is cut or split open.

(3) Preservers on which oil, grease, or any other foreign substance has caused a deterioration of the coated fabric;

(4) Preservers of which any cell has become porous.

(5) Preservers of which any cell has more than two punctures.

(6) Preservers with holes where patches must overlap seams, other patches, or the seal area of the oral tube, or inflator stems.

B. BUOYANCY CHAMBERS

(1) Patch material must be the same as that used in the manufacture of the preserver.

(2) The adhesive used for repair must be compatible with the chamber fabric coating, i.e. urethane base.

NOTE: For mixing ratios and storage requirements for adhesives, refer to the manufacturer's data sheet.

(3) As a general rule, a patch must extend at least 25 mm (1 inch) beyond the perimeter of the hole or tear; e.g. if the diameter of a jagged hole is 25 mm (1 inch), the patch should be 76 mm (3 inches) in diameter. If a tear is 25 mm (1 inch) long, the patch should be 76 mm (3 inches) long by 50 mm (2 inches) wide. L-Shaped tears are to be treated as round holes reckoning the distance between the ends of the tear as the diameter.

NOTE: Patches should be either circular or rectangular with rounded corners. Odd shapes such as triangular or elliptical should not be used.

(4) To apply a patch, follow these steps:

(a) Cut patch to size.

(b) Clean fabric around the damaged area with soapy water.

(c) Dry area with clean dry cloth.

B. Buoyancy Chambers

(4) Cont'd.....

(d) Rub area with a pad dampened sparingly with solvent.
(e) Brush on two coats of adhesive solution, allowing the first coat to become tacky before applying the second.

(f) When second coats on both the patch and the chamber have become tacky, place patch in position.

(g) Roll the patch with a hand roller.
(h) Work out any air bubbles with a wooden spatula.
(j) Dust area with french chalk (to prevent sticking of over-solutioned areas when preserver is folded later.)

(5) Repairs are limited as follows:

(a) Damaged areas must not exceed 1 in. (25mm), thus patches are limited in size to 3 ins.(75mm) in Diameter or in length.

(b) Do not apply more than two patches to each side of each chamber.

(c) Do not apply patches in seam areas, if a seam is damaged, the preserver must be discarded.

(6) The following Special Tools, Fixtures, Materials and Equipment are required for chamber repair:

(a) Single ply, urethane coated, nylon material
(b) Inflation and vacuum pump
(c) Steel roller
(d) Scissors
(e) 1-2 inch (13mm) round brush (for adhesive)
(f) Wooden spatula
(g) Urethane adhesive
(h) Solvent
(j) Polethylene sheeting (to cover work table)
(k) Valve core removing tool (Schrader)
(L) 9/16 Box-end spanner (hexagon)

C. Harness Tie Tapes and Back Piece

(1) Damaged webbing may be replaced as follows:

(a) Carefully remove existing stitching.
(b) Cut New webbing of same type using removed webbing as a pattern.
(c) Stitch new webbing as per the original.

(2) Broken or missing stitches should be re-sewn with matching thread.

C. Harness Tie Tapes and Back Piece - Cont'd.....

(3) The complete backpiece may be replaced if required.

(4) Broken or frayed stitching between the chambers may be re-sewn if the chamber flanges are not damaged.

D. Components

(1) No repairs are to be carried out on components such as Survivor Light Assemblies, Operating Heads, CO^2 Cylinders, Whistles, Buckles, Retainers, Washers, etc. Defective items are to be replaced.

4. PACKING PROCEDURES (Applicable to Preservers furnished with carrying case P/N TUL-601, or Plastic Pouch, P/N TUL-6176.

A. General

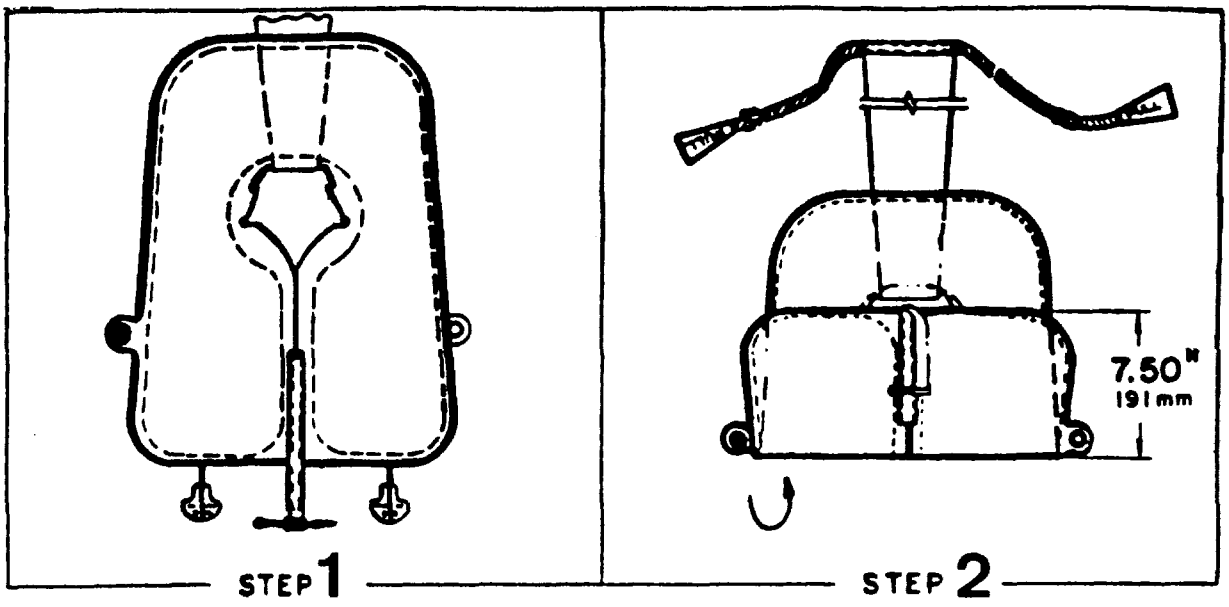
(1) In order to ensure safe storage of the preserver in its container, and to provide for immediate exposure of the donning and operating instructions when the container is opened by a potential user in an emergency, a sequential or step-by-step packing technique is used. Each event of this sequence is important and should be adhered to for maximum effect. Packing steps shown in Figure 202 are suitable for either type of container.

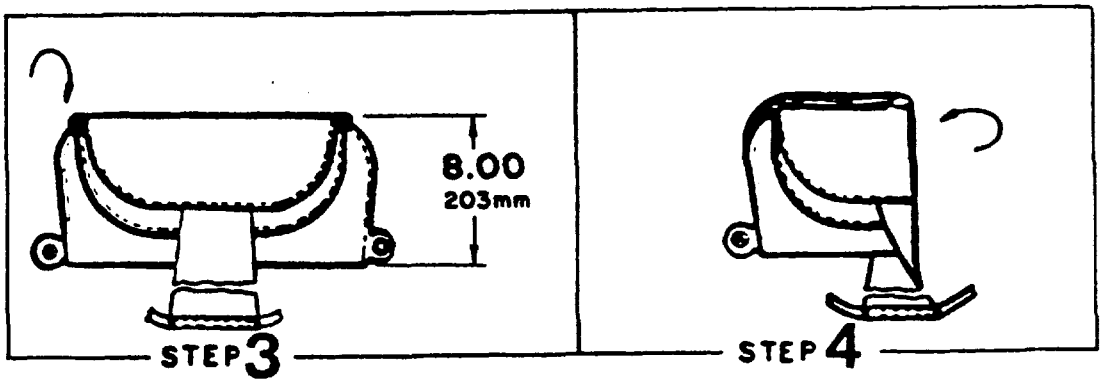
B. Detail

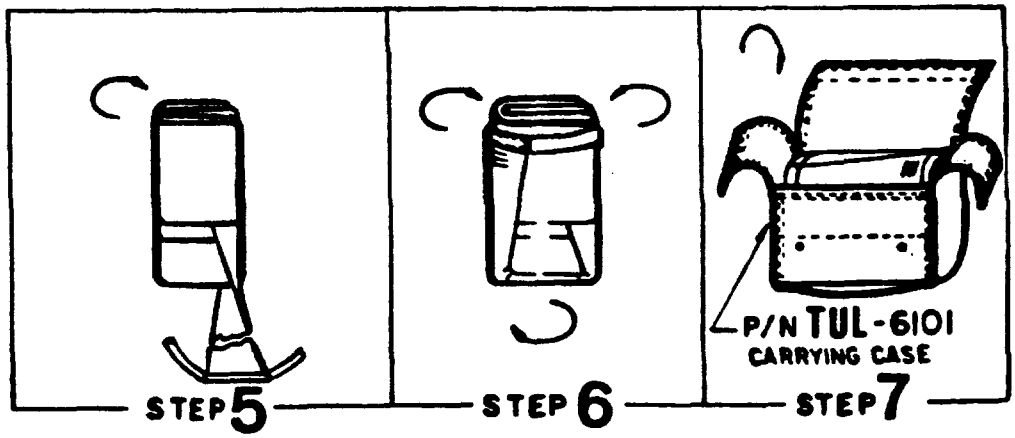
(1) Deflate the preserver and lay it out as per Step 1
(2) Fold the bottom up and locate the swivel snap hooks as shown in Step 2
(3) Fold the top down over the bottom - Step 3

CAUTION: AVOID BENDING THE ORAL INFLATION TUBES

(4) Fold in half, as illustrated in Step 4
(5) Fold in half again, as per Step 5
(6) Wrap the back piece around the folded preserver in a clock-wise direction, tucking in straps, D-ring/Adjusting devices and the lens and tab, as shown in Step 6
(7) Insert the preserver into the container with the instructions facing up as illustrated in Step 7
(8) Fasten the side and top flaps (in that order) of the container to complete the packing sequence. (Heat seal if pouch PN TUL-6176 is used)
(9) Complete control card or log book entries as applicable.







PACKING PROCEDURES
FIGURE 202

Effectivity:
SERIAL NOS. 5001 AND SUBSEQUENT
TYPES 35 MK IV (-2) AND 35 MK IV (-3) TO TSO-C13d

5. COMPONENTS LIST AND RECOMMENDED SPARES.

TYPE 35 MK IV (-2)

TUL P/N	DESCRIPTION	QTY REQ'D PER UNIT	MIN STOCK O/O AGE
	MAJOR ASSEMBLIES		
6174	Life Preserver, Type 35 MK IV (-2)	Ref.	-
6108	Carrying Case, Coated Nylon	Optional	25%
6108-H	Carrying Case, Coated Nylon, c/w Handle	Optional	25%
	BULK MATERIALS		
1465	Fabric, Nylon, Single Ply, Urethane Coated, Spanish Yellow	2 Yds.	2%
2518	Thread, Nylon, Natural, VT-295	A/R	6 oz. Spool
2202	Webbing, Cotton, 1 in. Yellow	2 Yds.	5%
7104	Adhesive Solution, Urethane, UR 1008	-	1 Qt.
	DETACHABLE/RELPACEABLE COMPONENTS		
3118	Cylinder, CO^2, 16 gram. MIL-C-601G, TY.III	2	100%
3209	Inflator, Type 840 AM	2	5%
3211	Safety Pin, Plastic (Used on Inflator 3209)	2	100%
3357	Valve, Oral-Matic, 730-ROA	2	10%
3326	Air Check Valve, 832 ACE	2	5%
3504	Washer, Upper A-130/10	2	10%
3505	Washer, Lower A-136/B	2	10%
3739	Cover, Inflator, Anti-Chafing	2	15%
3714	Cap-Nut, Hexagonal, 830 AOE	2	5%
4101	3/4" Steel Buckle, Adjustable, Cad.Plated	2	5%
4403	Double-end Snap, 3/4 x 3/8, Cad. Plated	1	2%
5519	Whistle, Plastic, Blue, Acme No.649	1	10%
5536	Survivor Light Ass'y.Complete ACR/LB-1(A)	1	25%
5553	Survivor Light Battery c/w Pull Tab	1	25%
5554	Survivor Light Battery Pull Tab	1	25%
5555	Survivor Light Lens c/w 18 inch Lead Wire	1	25%
6207	Retainer, Battery & Whistle	2	10%

6. COMPONENTS LIST AND RECOMMENDED SPARES

TYPE 35 MK IV (-3)

TUL PART NUMBER	DESCRIPTION	QTY PER UNIT	MIN STOCK O/O AGE
	MAJOR ASSEMBLIES		
6174	Life Preserver. Type 35 MK IV (-3)	Ref.	-
6108	Carrying Case. Coated Nylon	Optional	25%
6108-H	Carrying Case, Coated Nylon, c/w Handle	Optional	25%
	BULK MATERIALS		
2424	Tape, Retro-Reflective 2" (51mm) CGSB 62-GP12	1 Yd.	5%
1469	Fabric, Nylon, Single Ply, Urethane Coated, Flame Orange	2 Yds.	2%
2518	Thread, Nylon, Nat. VT-295	A/R	6 oz. Spool
2261	Webbing, Cotton 1 In. (25mm) Indian Orange	2 Yds.	5%
7104	Adhesive Solution, Urethane, UR 1008	-	1 Qt.
7101	Adhesive Solution, A-B, Mil-C-5540	-	1 Qt.
	DETACHABLE/REPLACEABLE COMPONENTS		
3118	Cylinder, CO^2, 16 gram	2	100%
3209	Inflator, Type 840 AM	2	5%
3211	Safety Pin . Plastic (Used on Inflator)	2	100%
3357	Valve, Oral-Matic, 730- ROA	2	10%
3326	Air Check Valve, 832 AOE	2	5%
3504	Washer, Upper, MIL-I-23145B(AS)	2	10%
3505	Washer, Lower, MIL-I-23145B (AS)	2	10%
3739	Cover, Inflator	2	15%
3714	Cap-Nut, Hexagonal, 830 AOE	2	5%
4101	3/4" Steel Buckle, Adjustable, P/N-0107 Cad Plated	2	5%
4403	Double-End Snap, 3/4 x 3/8, Cad. Plated, P/N-2437	1	2%
5519	Whistle, Plastic, Blue, Acme No.649	1	10%
5536	Survivor Light Ass'y. Complete ACR/L8-1	2	25%
5553	Survivor Light Battery c/w Pull Tab (A)	1 (Sub-5536)	25%
5554	Survivor Light Battery Pull Tab	1 (Sub-5536)	25%
5555	Survivor Light Lens c/w 18 Inch Lead Wire	1 (Sub-5536)	25%
6207	Retainer, Battery & Whistle	3	10%

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SECTION 3

ILLUSTRATED PARTS LIST

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1103	Inflation Ass'y components	1107

SECTION 3

ILLUSTRATED PARTS LIST

1. INTRODUCTION

A. Purpose

This Illustrated Parts List is intended for use as a supplement to the Components List and Recommended Spares Schedule, found in Section 2 of this Manual.

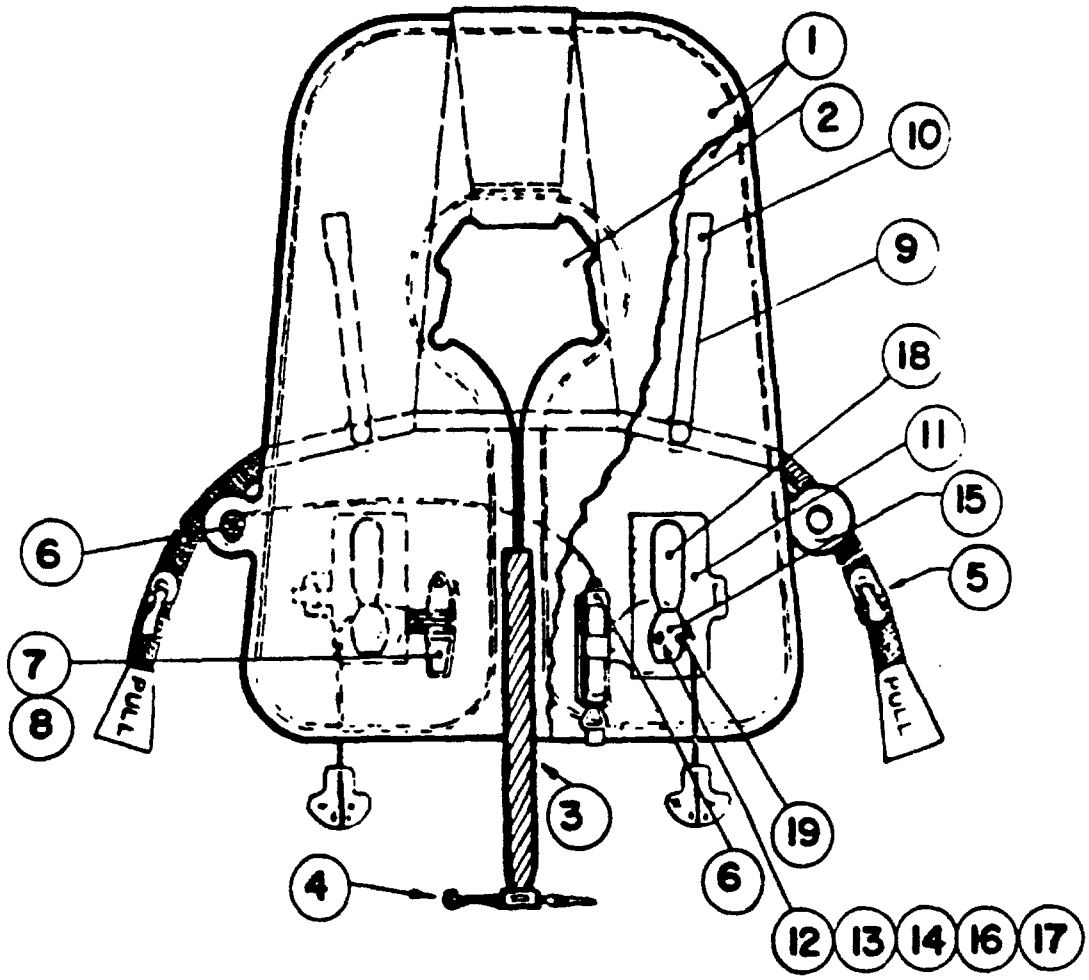
B. Detail

Item numbers in the Parts List are keyed to corresponding item numbers in the related Illustration.

2. PARTS LIST (REF. FIG. 1101)

FIG & ITEM	PART OR DRAWING NO.	NOMENCLATURE	EFF	UNITS PER ASS'Y
1101	TG-75E-00005	Life Preserver, Type 35 MK IV (-2)		Ref. 2
-1	TA-75F-00004	Buoyancy Chamber Ass'y.		Ref. 1
-2	TA-75C-00015	Back Flap Ass'y.		Ref. 1
-3	2202	Webbing, Cotton, Yellow, 1", MIL-W-530, TY 11A		1
-4	4403	Double End Snaps, 3/4"x3/8", Cad. plated, P/N 2437		1
-5	4101	3/4" Steel Buckle, Cad. Plated, P/N-0107		2
-6	5536	Survivor Light Ass'y. ACR/L8-1 (A)		1
-7	5519	Whistle, Plastic, Blue, Acme No. 649		1
-8	TA-75B-00020 6207	Retainer, Battery & Whistle		2
-9	3358	Tube, Vinyl, 6-3/4, 737 ACU-66		2 (Ref.)
-10	3357	Valve, Oral Inflation, 730- ROA		2
-11	TA-75B-0021 3739	Cover, Inflator		2
-12	3728	Manifold, Polyurethane Base, 831AOE		Ref.)
-13	3326	Air-Check Valve, 832 AOE		2
-14	3505	Washer, Lower, MIL-I-23145B (AS)		2
-15	3209	Inflator, 840 AM		2
-16	3504	Washer, Upper, MIL-I-23145B (AS)		2
-17	3714	Cap-Nut, 830 AOE, Nickel Plated		2
-18	3118	Cylinder, CO^2, 16 grams, MIL-C-601G TY. III		2
-19	3211	Safety-Pin, Used on 840 AM Inflator		2
	NOTE:	Items, Nos. 1,2,7,10 & 13, are shown for ref. purposes only. No repairs or replacement allowed, except as specified under "Repair Procedures."		

ILLUSTRATED PARTS LIST



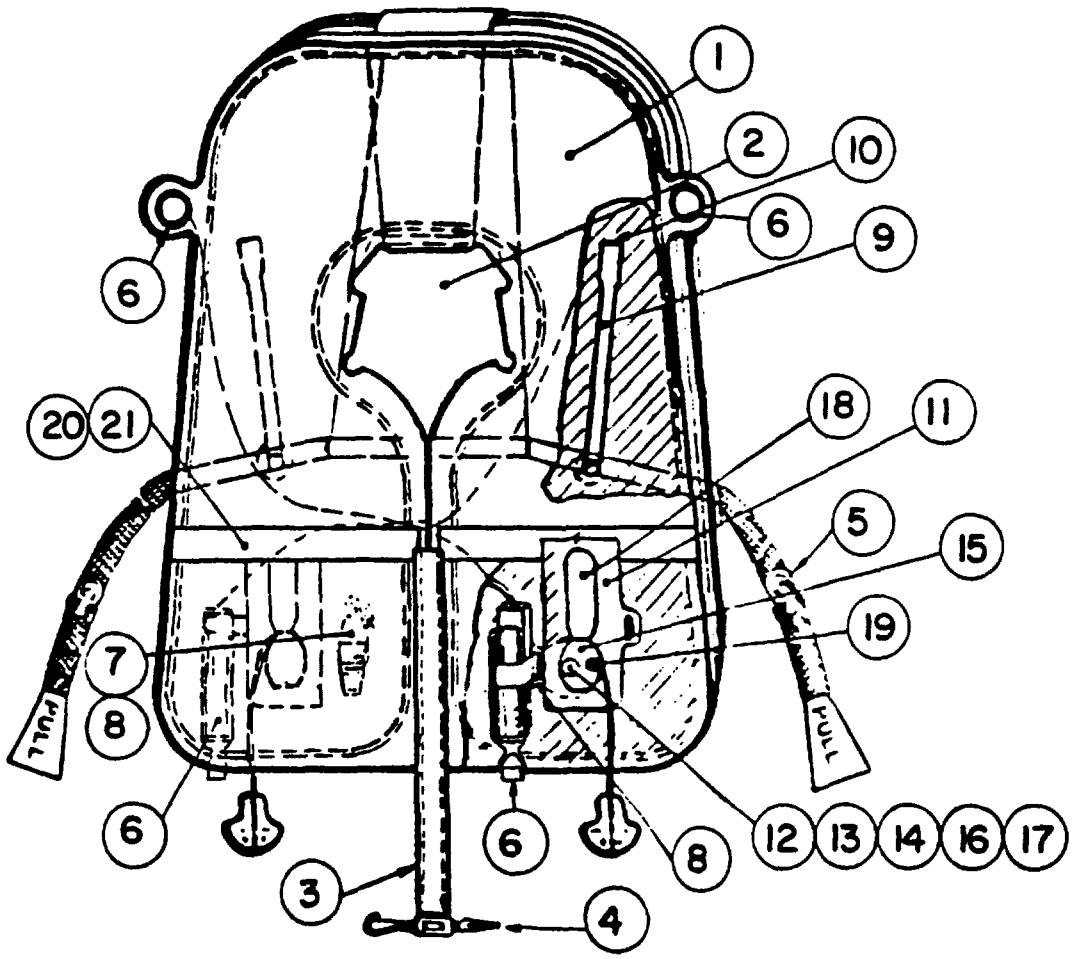
LIFE PRESERVER, TYPE 35 MK IV (-2)

FIGURE 1101

3. PARTS LIST (REF.FIG.1102)

FIG & ITEM	PART OR DRAWING NO.	NOMENCLATURE	EFF	UNITS PER ASS'Y
1102	TG-80E-00001	Life Preserver, Type 35 MK IV (-3)		Ref.
-1	TA-80F-00001	Buoyancy Chamber Ass'y.		Ref.(2)
-2	TA-75C-00015	Back Flap Ass'y.		Ref.(1)
-3	2261	Webbing Cotton, 1" Indian Otange to Mil-W-530 Ty. II A		1
-4	4403	Double End Snaps, 3/4" x 3/8", Cad. Plated P/N 2437		1
-5	4101	3/4" Steel Buckle, Cad.Plated, P/N-0107		2
-6	5536	Survivor Light Ass'y. ACR/L8-1 (A)		2
-7	5519	Whistle,Plastic,Blue, Acme P/N-649		1
-8	TA-75B-00020 6207	Retainer, Battery & Whistle		3
-9	3358	Tube, Vinyl, 6-3/4", 737 ACU-66		2 (Ref.)
-10	3357	Valve, Oral, Inflation 730 -ROA		2
-11	TA-75B-00021 3739	Cover, Inflator		2
-12	3728	Manifold, Polyurethane Base, 831-AOE		2 (Ref.)
-13	3326	Air-Check Valve, 832-AOE		2
-14	3505	Washer, Lower, MIL-I-23145B (AS)		2
-15	3209	Inflator, 840AM		2
-16	3504	Washer, Upper,Mil-I-23145B (AS)		2
-17	3714	Cap-Nut, 830-AOE, Nickel Plated		2
-18	3118	Cyl. CO^2, 16 grams,MIL-C-601G,Ty.III		2
-19	3211	Safety-Pin, Used on 840AM Inflator		2
-20	2424	Tape,Retro-Reflective,2" to CGSB Spec.62-GP12. (Cut Length 8-1/4")		4
-21	7101	Adhesive, Parts A & B, MIL-A-5540 Spec.		A/R

ILLUSTRATED PARTS LIST



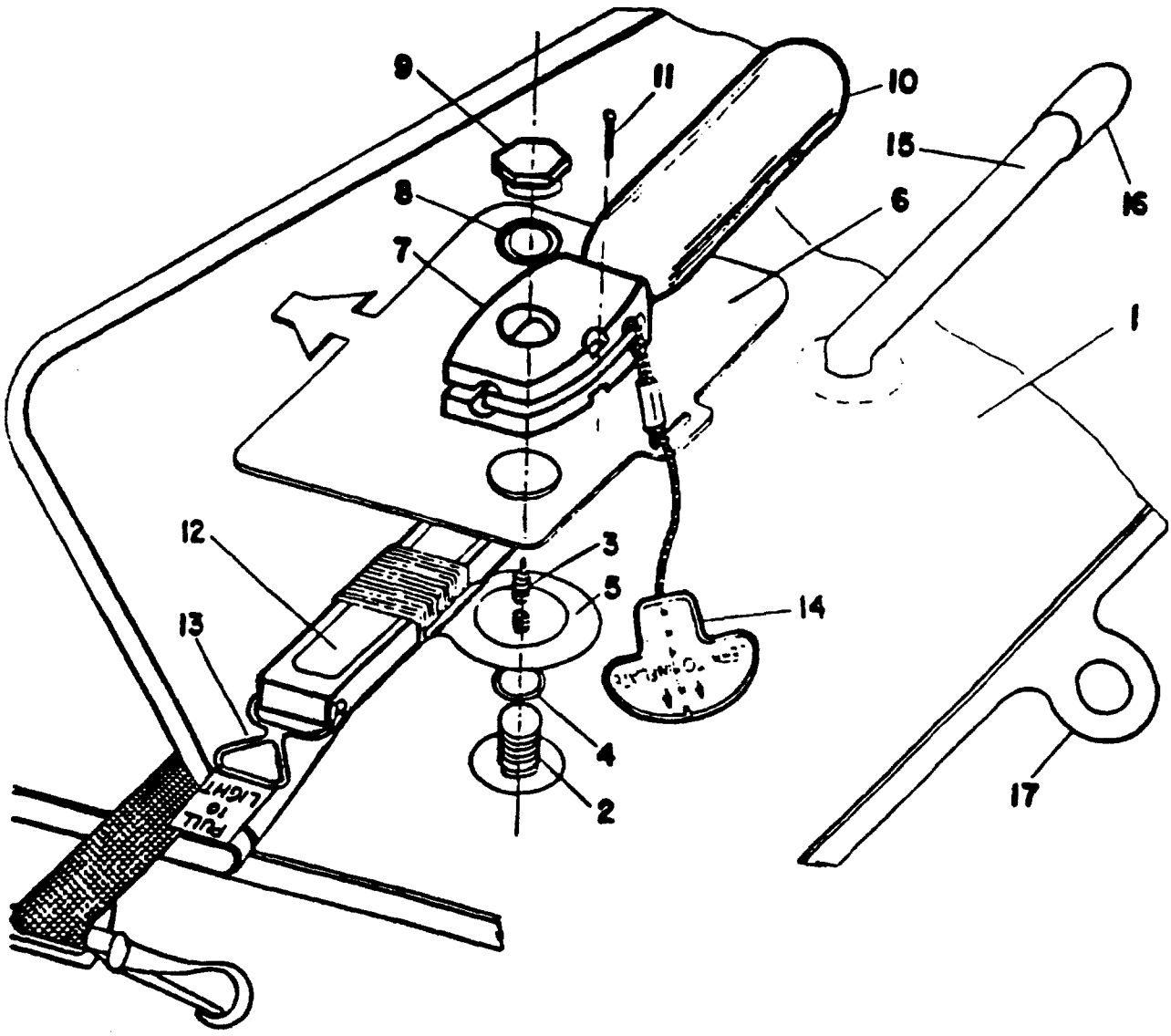
LIFE PRESERVER, TYPE 35 MK IV (-3)

FIGURE 1102

4. PARTS LIST (REF. FIG 1103)

FIG & ITEM	PART OR DRAWING NO.	NOMENCLATURE	EFF	UNITS PER ASS'Y
1103	-	Inflation Ass'y. Components		Ref.
-1	-	Buoyancy Chamber Ass'y.		Ref.
-2	3728	Manifold, Polyurethane Base, 831AOE		Ref.
-3	3326	Air-Check Valve, 832 AOE		1
-4	3505	Washer, Lower, MIL-I-23145 (AS)		1
-5	TA-75B-00020 6207	Retainer, Battery & Whistle		1
-6	TA-75B-00021 3739	Cover, Inflator		1
-7	3209	Inflator, 840AM		1
-8	3504	Washer, Upper, MIL-I-23145B (AS)		1
-9	3714	Cap-Nut, 830AOE, Nickel Plated		1
-10	3118	Cyl. CO^2, 16 grams, MIL-C-601G, Ty. III		1
-11	3211	Safety-Pin, Used on 840AM, Inflator P/N-3209		1
-12	5536	Survivor Light Ass'y. ACR/L8-1 (A)		1 (2)
-13	-	Pull Tab, Part of 5536 Ass'y.		1
-14	-	Pull Toggle, Part of 840AM Inflator (P/N-3209)		1 Ref.
-15	3358	Tube, Vinyl, 6-3/4", 737 ACU-66		1 Ref.
-16	3357	Valve, Oral, Inflation, 730-ROA		1
-17	-	Attachment Tab for 5536 Ass'y.		Ref.
		NOTE: Items, Nos. 1,2,14,15 and 17, are shown for ref. purposes only. No repairs or replacement allowed, except as specified under "Repair Procedures".		

ILLUSTRATED PARTS LIST



INFLATION ASS'Y COMPONENTS

FIGURE 1103

CHAPTER

26

FIRE PROTECTION

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MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B./T.R.
American Standard	Extinguisher Bottle				Bulletin No. 601-004-100 dated Feb 20/1966
Flag	Portable Fire Extinguisher & Bracket	Model HAL-035-AVH	26-25-02	Jan 4/1994	
Graviner	Fire Extinguisher	25H, 26H, 30H, 31H, 34H, 35H, and 38H	26-20-108	Nov/1968	
Walter Kidde/ HTL	Fire Extinguisher	17300/17400	26-20-200	Mar 15/1999	SB P/N 17310 (Rev A dated 5-22-1980) SB P/N 17400 SB P/N 30100010 (Rev A dated 2-2-1976) S/B 31000010-26-2 (Rev dated 12-9-1983) S/B P/N 30700002
	O-Ring Bottle Extinguisher	37 Cubic Inch to 988 Cubic Inch	26-20-202	Jul 15/1999	Supplement 30100043 dated Jul 15/1999
	Discharge Indicator & Overboard Discharge Connectors	424074 through 922315 & 800036, 802722, 841556			
	Discharge Indicator & Connectors	800495, 843787, 843969 & 922315	26-20-50 was 26-20-00	Nov 30/1995	
	Control Unit, Fire Detection Cont. Type DC with Discriminator	893229-0350 through -0500-01	26-10-30	Sep 15/1998	
	Power Device Cartridges		26-21-34	May 15/1996	

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FIRE EQUIPMENT LTD.

HWY. #2 & PATILLO RD.

R.R. #1

TECUMSEH, ONTARIO

N8N 2L9

OPERATING AND MAINTENANCE MANUAL

MODEL: HAL-035-AVH

3-1/2 LB. (1.6 KG) STORED PRESSURE

PORTABLE FIRE EXTINGUISHER

AND AVIATION BRACKET

26-25-02

JAN.4, 1994 REV. 2
SUPERSEDING
NOV. 20, 1990

FIRE EQUIPMENT LTD.

HWY. #2 & PATTILO RD

R.R. #1

TECUMSEH, ONTARIO

N8N 2L9

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7.0	HYDROSTATIC TESTING	PAGE 2 & 3
8.0	DISASSEMBLY	PAGE 3 & 4
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1.0 GENERAL DESCRIPTIONS

1.1 The HAL-035-AVH model is a hand held fire extinguisher that consists of an extinguisher assembly (part# 100-9750) and an aviation bracket (part # 200-9770). This unit employs bromochlorodifluoromethane as the extinguishing agent which is ejected through a hose and nozzle by means of nitrogen at a pressure of approximately 100 PSI (689 KPA). Both the agent and expellant gas is contained in the cylinder. The extinguisher is suitable for use at temperatures above -40 F (-40 C). This extinguisher also has an approved rating for the three types of fires.

PAPER, WOOD, CLOTH, RUBBISH, COMBUSTIBLES

VOLATILE LIQUIDS, GAS, OIL, PAINTS

ELECTRICAL EQUIPMENT, MOTORS

2.0 OPERATING INSTRUCTIONS

2.1 To operate, hold extinguisher upright.

2.2 Pull locking pin, breaking nylon tie.

2.3 Stand at least 6 feet (2 meters) away from fire and aim discharge hose at base of flame.

2.4 Squeeze lever and use a sweeping motion from side to side at the base of fire.

3.0 INSPECTION

3.1 Normally a quick check monthly to ensure that unit is available and operable.

3.2 Monthly inspection:

A) Pressure Gauge indicator within operational limits.

B) Break seal intact.

C) Hose unobstructed and properly attached.

D) Operating instructions legible and facing outward.

E) No obvious physical damage or corrosion present.

3.3 Yearly Inspection:

A) All the aforementioned monthly.

B) Unit weight ensuring its not below the minimum recorded on label.

NOTE: ANY DEFICIENCY FROM THE ABOVE INSPECTIONS IS CAUSE FOR IMMEDIATE CORRECTIVE ACTION.

4.0 MAINTENANCE

4.1 A thorough examination of the unit.

4.2 Frequency: Every six years.

A) All mechanical parts to ensure functional.

B) Expelling agent to ensure intact.

C) No obvious physical damage or corrosion present.

NOTE: REPLACE ANY PARTS FOUND TO BE DEFICIENT.

5.0 USE

5.1 Recharge immediately after use.

6.0 RECORDS

6.1 Record all maintenance and recharge dates on a tag and securely attach to extinguisher.

7.0 HYDROSTATIC TESTING

7.1 Hydrostatic testing of the HAL-035-AVH model shall be performed by persons having a practical knowledge of pressure testing procedures, safeguards and having available suitable testing equipment and facilities.

7.2 If, at any time, an extinguisher shows evidence of corrosion or mechanical injury, it shall be hydrostatically tested.

7.3 During examination, when an extinguisher cylinder or shell has one or more conditions listed in this subdivision, it shall not be hydrostatically tested but shall be destroyed by the owner.

7.3 (A) When there exists repairs by soldering, welding, brazing, or use of patching compounds.

7.3 (B) When the cylinder or shell threads are damaged.

7.3 (C) When there exists corrosion that has caused pitting, including under removable name plate band assemblies.

7.3 (D) When the extinguisher has been burned in a fire.

7.4 The frequency of hydrostatic testing of this extinguisher as specified in the standard for portable fire extinguishers (NFPA-10) is a maximum of twelve years or sooner as determined by inspection.

WARNING: THE EQUIPMENT FOR HYDROSTATICALLY TESTING CYLINDERS SHALL BE OF THE WATER JACKET TYPE THAT MEETS THE SPECIFICATIONS OF THE C.G.A. PAMPHLET C-1.

NFPA-10: THE NATIONAL FIRE PROTECTION ASSOCIATION STANDARD FOR PORTABLE FIRE EXTINGUISHERS (NFPA-10) IS CONSIDERED PART OF THIS MANUAL. THE NFPA-10 STANDARD PROVISIONS APPLY TO THE SELECTION, INSTALLATION, INSPECTION, MAINTENANCE AND TESTING OF PORTABLE FIRE EXTINGUISHING EQUIPMENT. NFPA-10 MAY BE PURCHASED FROM THE NATIONAL FIRE PROTECTION ASSOCIATION, BATTERYMARCH PARK, QUINCY, MA 02269.

CGA: COMPRESSED GAS ASSOCIATION (CCA) PAMPHLETS C-1, C-6, AND P-1 ARE CONSIDERED PART OF THIS MANUAL. THE CGA RECOMMENDATIONS APPLY TO HYDROSTATIC TESTING, VISUAL INSPECTION AND HANDLING OF COMPRESSED GAS CONTAINERS. CGA PAMPHLETS CAN BE OBTAINED FROM THE COMPRESSED GAS ASSOCIATION, 500 5TH AVENUE, NEW YORK, NEW YORK 10036.

8.0 DISASSEMBLY

WARNING: OBSERVE PRESSURE GAUGE BEFORE DISASSEMBLY. RELEASE ANY PRESSURE THRU AN APPROVED RECHARGE/RECOVERY SYSTEM FOR HALON 1211 ONLY.

NOTE: SEE 13.0, FIG. 1 FOR ILLUSTRATED PARTS.

8.1 Disassemble hose assembly (25) from valve body (15) by turnincounterclockwise.

8.2 Remove valve assembly from shell (4) by turning counterclockwise.

8.3 Unscrew plastic tubing (7) from valve body by turning counterclockwise.

8.4 To remove plunger assembly (14), use a vise-grip type wrench. Squeeze and lock onto the leaf spring (17). Remove leaf spring and push plunger down.

9.0 REPAIR

9.1 Clean all parts thoroughly prior to inspection.

9.2 Any parts that must be replaced should be with Flag replacement components to ensure proper sizes and material are used.

10.0 ASSEMBLY

10.1 Use 13.0, Fig. 1 as reference.

10.2 Lubricate plunger assembly (14) at the "O" rings (10) (13). Use Dow Corning #230 silicone or equivalent. Also apply lubricant to "O" ring (8) and threads of valve body (15) where they will meet with shell threads.

10.3 Insert plunger into valve body. Using the vise-grip wrench, squeeze the leaf spring and replace the spring into the handle notch and into the plunger groove.

10.4 Squeeze lever (19) to ensure proper working action.

10.5 Rethread plastic pickup tube (7) into valve body (15) in a clockwise rotation.

10.6 Thread valve assembly into shell in a clockwise rotation (4). Be sure not to rip or tear "O" ring (8) while tightening valve assembly.

10.7 Extinguisher is ready to be recharged at this point before adding the hose assembly. See recharge instructions (12.0).

11.0 FITS AND CLEARANCES

11.1 When servicing this extinguisher examine all moving mechanical parts for a free or unobstructed fit.

12.0 RECHARGE INSTRUCTIONS

WARNING: BEFORE RECHARGING OR SERVICING ANY HALON 1211 FIRE EXTINGUISHER OR APPARATUS, THE EQUIPMENT TO BE USED SHALL COMPLY WITH ONE OR MORE OF THE FOLLOWING STANDARDS AND SPECIFICATIONS.
UL 2006 HALON 1211 RECOVERY/RECHARGE EQUIPMENT.
ULC/ORD-C1058.5 HALON RECOVERY/RECONDITIONING EQUIPMENT.
ULC/ORD-C1058.18 SERVICING OF HALON EXTINGUISHING SYSTEMS.
ISO 7201 FIRE EXTINGUISHING MEDIA-HALOGENATED HYDROCARBONS.

12.1 Servicing extinguishers should be performed by qualified, experienced personnel only.

12.2 Extinguisher to be recharged after use or as indicated by a thorough inspection or when servicing a unit.

12.3 Check extinguisher label for correct weight of Halon 1211 agent and for proper recharging pressure prior to recharging.

12.4 Pressurize Halon 1211 recharge tank to 100 PSI (689 KPA) with nitrogen through gas inlet connection. Do not over pressurize. If several extinguishers are to be recharged at the same time, it becomes necessary to add more nitrogen to keep pressure at 100 PSI (689 KPA).

12.5 Remove hose assembly (25) if attached and replace it with charging adaptor (3/8 - 24 thread connection).

12.6 Place extinguisher on a scale and clamp extinguisher valve open with "U" clamp under handle.

12.7 Fill unit with the required amount of Halon 1211 and pressurize to 100 PSI (689 KPA) with nitrogen.

12.8 Shake extinguisher and re-pressurize if necessary.

12.9 Vent any line pressure before removing "U" clamp from extinguisher valve.

12.10 Remove charging adaptor and replace hose assembly.

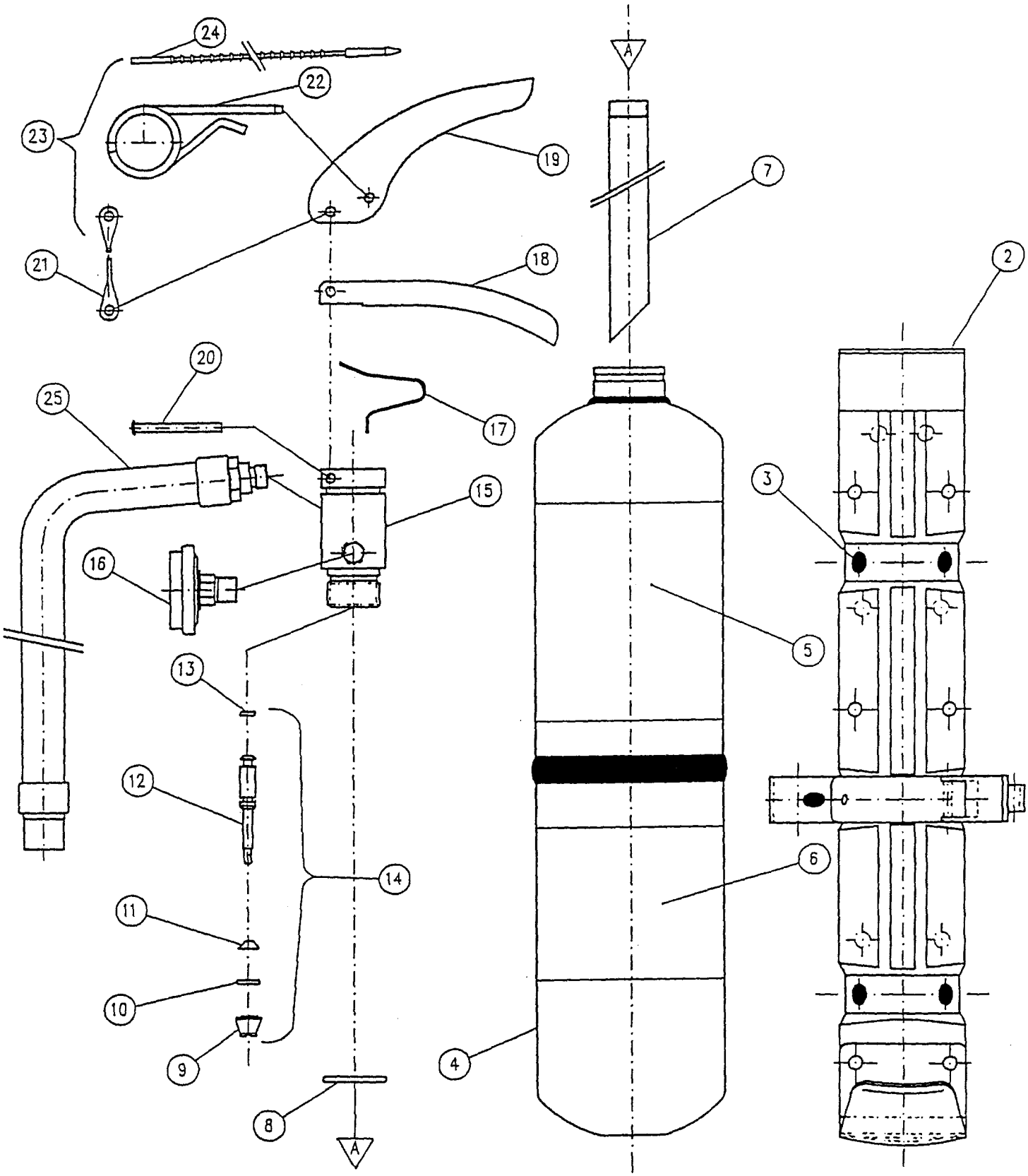
NOTE: AFTER RECHARGING HAS BEEN COMPLETED, CLOSE NITROGEN VALVE AND CLOSE HALON VALVE. OPEN ALL OTHER LINES AND VENT INTO A RECHARGE/RECOVERY SYSTEM.

12.11 After recharging extinguisher apply a soap and water solution to all possible leakage points. No bubbles should form at these points.

12.12 Dry extinguisher off making sure no water remains inside valve. Use air hose if possible.

12.13 Record all maintenance information performed on each extinguisher before being returned for use.

12.14 When returning an extinguisher for use make sure the extinguisher is placed securely into or onto the accompanying bracket.



13.0, FIGURE 1

ILLUSTRATED PARTS
(MODEL HAL-035-AVH)

ITEM	PART NO.	DESCRIPTION	AIRLINE STOCK NO.	ASS'Y	PARTS PER ASSY
1	100-9750	3-1/2 Lb. (1.6 KG) GENERAL ASSY FIRE EXTINGUISHER (NOT SHOWN)		1	
2	200-9770	AVIATION BRACKET ASSEMBLY		1	
3	400-10459	RUBBER GROMETS			7
4	200-10940	SHELL ASSY			1
5	400-1675	OPERATING LABEL			1
6	400-11113	WARNING LABEL			1
7	400-10465	PICKUP TUBE			1
8	400-10364	"O" RING			1
9	400-10425	PLUNGER			1
10	400-10367	"O" RING			1
11	400-10424	WASHER			1
12	400-10468	STEM			1
13	400-10365	"O" RING			1
14	200-11570	PLUNGER ASSY			1
15	400-10741	VALVE BODY			1
16	400-10362	PRESSURE GAUGE			1
17	400-10426	LEAF SPRING			1
18	400-10784	HANDLE			1
19	400-10785	LEVER			1
20	400-10964	RIVET			1
21	400-10369	NYLON TIE			1
22	400-11114	PULL PIN			1
23	300-9780	PULL PIN AND TIE ASSY			1
24	400-1674	NYLON SEAL			1
25	200-9760	HOSE ASS'Y			1
26	200-13440	RECHARGE ADAPTER - NOT SHOWN			

GRAVINER

COLNBROOK, BUCKS, ENGLAND

OVERHAUL MANUAL

OM. 108

HAND-OPERATED FIRE EXTINGUISHERS

Type 25H, 26H, 30H, 31H, 34H, 35H, and 38H

(First issued - December, 1963
as Provisional Manual No. 26-9-5)

This manual complies with British Civil Airworthiness Requirements Section A, Chapter A6-2. The technical accuracy of this manual has been verified and is certified as correct.

Signed. Nov/68

GRAVINER

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	E. Repair Cap Assembly	6
	F. Pressure Test Container	6
	G. Prepare Container for Re-filling	6
	H. Fit New Siphon Tube Assembly	7
	I. Fill Container	7
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	K. Identify Extinguishant Batch	7
	L. Re-assemble Extinguisher	7
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GRAVINER

REVISION RECORD

The introduction of data by revision or amendment not certificated in accordance with British Civil Airworthiness Requirements, Chapter A6-2, will invalidate the initial certification on the title page of this Manual relative to the part revised. Revisions or amendments embodied in this Manual which have been certificated by an approved Design Organisation other than that applicable to the initial certification, must be recorded on separate record sheets.

PUBLICATION TITLE						AIRCRAFT OR LOCATION		
REV. No.	INSERTION DATE	BY	REV. No.	INSERTION DATE	BY	REV. No.	INSERTION DATE	BY

RETAIN THIS RECORD IN THE FRONT OF THE MANUAL. ON RECEIPT OF REVISIONS INSERT REVISED SHEET(S) OR ALTER TEXT IN ACCORDANCE WITH INSTRUCTIONS SUPPLIED. ENTER REVISION NUMBER, DATE INSERTED AND INITIAL.

OVERHAUL MANUAL

for

HAND-OPERATED FIRE EXTINGUISHERS

Type 25H, 26H, 30H, 31H, 34H, 35H and 38H

1. DESCRIPTION, OPERATION AND DATA

A. Description

These hand extinguishers all have the same type of lever operated head; use one of two sizes of seamless copper container; and are filled with one of three different kinds of liquefied extinguishant. Dry nitrogen gas is used as a pressurising agent. The design ensures that leakage is virtually impossible before the frangible annulus is fractured by the action of the operating lever.

When the extinguisher is operated, a jet or spray of extinguishant is discharged from a nozzle. Releasing the lever operates a valve which checks the flow of extinguishant and retains the remainder of the charge for further use.

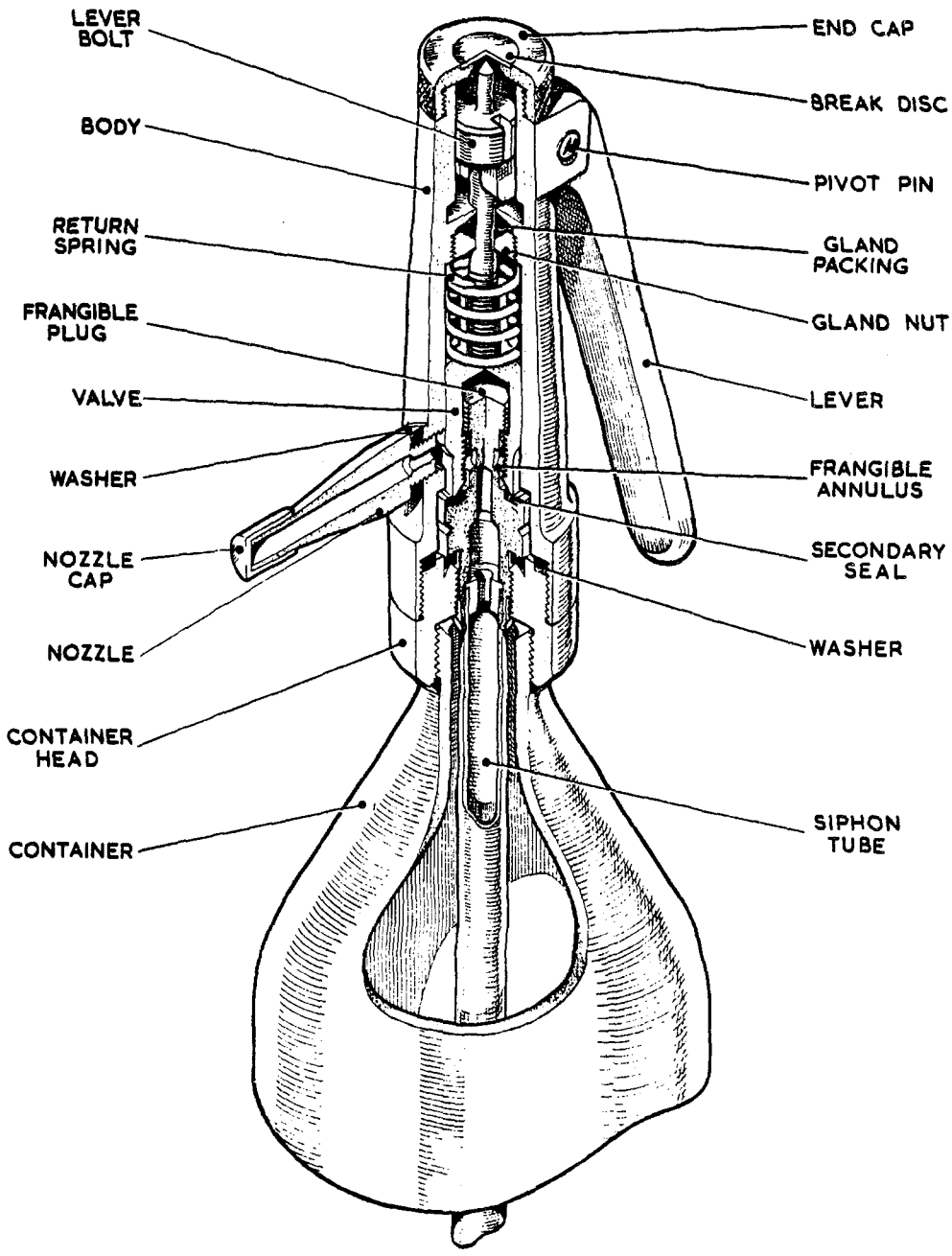
B. Operation

Pressure on the operating lever fractures the frangible annulus, allowing the pressurised extinguishant to discharge through a nozzle. When the lever is released a spring forces a cylindrical valve onto a secondary seal, thus interrupting the flow of extinguishant and preventing leakage. Operation of the lever to initiate discharge also causes a pin to pierce a disc at the end of the body to provide a clear visual indication that the extinguisher has been operated.

C. Data

Details of the main differences between the different types of extinguishers are listed in Table 1.

FP0073



Cutaway View of Extinguisher
Figure 1

EXTINGUISHER TYPE	EXTINGUISHANT	CONTAINER FINISH	EXTINGUISHER LENGTH (in) MAX.	EXTINGUISHER DIAMETER (in) MAX.	EXTINGUISHER FULL WEIGHT (± 4 oz)
25H	M.B.	Polished Copper	14.75	3.0	5 lb 3 oz
26H	M.B	Polished Copper	12.53	2.5	3 lb 15 oz
30H	CB	Aluminium Paint	14.75	3.0	5 lb 9 oz
31H	CB	Aluminium Paint	12.53	2.5	4 lb 3 oz
34H	BCF	Signal Red Paint	14.75	3.0	5 lb 7 oz
35H	BCF	Signal Red Paint	12.53	2.5	3 lb 15 oz
38H	BCF	Signal Red Paint	14.75	3.0	5 lb 7 oz

M.B. - methyl bromide
CB - chlorobromomethane
BCF - bromochlorodifluoromethane

Brief Details of Extinguishers

Table 1.

CHAPTER 26

38H

2. OVERHAUL OF TIME-EXPIRED EXTINGUISHER

NOTE: The overhaul of extinguishers should be undertaken only by a Graviner approved organisation. Details of the filling plant and other special equipment necessary for the repairs of extinguishers can be obtained from Graviner (Colnbrook) Limited.

A. Cleaning

Clean exterior of extinguisher with 'white spirit' or similar hydrocarbon solvent. Dry with compressed air jet and a clean dry cloth.

B. Inspection

(1) Inspect container for damage such as chafing, scoring or dents.

(2) If any damage is found likely to weaken a container, the extinguisher should be emptied, disassembled, and the container scrapped.

(3) If damage is restricted to protective finish, remove remaining paint or lacquer and re-spray as detailed in section 3.

(4) If the container is free from the faults in (1), or its condition is as (3) above, check that extinguisher weight is within one ounce of that stamped on the body. If weight is low, extinguisher should be examined to locate leak, then emptied and disassembled.

(5) If weight check is satisfactory, remove nozzle cap (21), lightly smear end of nozzle (19) with grease (Item M.2) then fit new nozzle cap.

3. OVERHAUL OF DISCHARGED EXTINGUISHER

NOTES: (1) Overhaul of extinguishers should be undertaken only by a Graviner approved organisation. Details of filling plant and special equipment necessary can be obtained from Graviner (Colnbrook) Limited.

(2) 'Item' numbers in the following text refer to special tools, equipment and materials necessary for overhaul. Special tools and equipment (prefix 'A' or 'B') are listed in Section 5 of this manual, and materials (prefix 'M') are listed in the Illustrated Spare Parts Catalogue.

WARNING: ENSURE THAT EXTINGUISHER IS FULLY DISCHARGED BEFORE DISASSEMBLING.

A. Clean Extinguisher

Clean exterior of extinguisher with 'white spirit' or similar hydrocarbon solvent. Dry with compressed air jet and a clean dry cloth.

B. Disassemble Extinguisher

(1) Remove nozzle cap (21), nozzle (19) and washer (20); scrap washer and nozzle cap.

(2) Unscrew cap assembly (16) using tool (Item A. 1.).

(3) Remove lever bolt (8) with fork screwdrive. Scrap lever bolt.

(4) Extract pivot pin (14), remove lever (13) and spacing washers (15). Scrap pivot pin and washers.

(5) Screw tool (Item A. 3) into nozzle bore and use it to unscrew the body (7) from container head (2).

(6) Withdraw valve (12) spring (11) and sealing washer (22) from body. Scrap sealing washer, valve and spring.

(7) Unscrew and scrap frangible plug (6) from bore of valve (12).

(8) Unscrew gland nut (10) using tool (Item A. 2), remove and scrap gland packing (9) and gland nut (10).

(9) Unscrew and scrap siphon tube assembly (3) from container (1).

C. Remove protective finish

(1) Container

(a) Immerse container, head uppermost, in paint stripper solution (Ite M. 3), up to container/head joint.

(b) Remove after 10 minutes in solution and brush off any paint still adhering to the container.

(c) Rinse container thoroughly in clean running water and place, neck down, in rack to dry.

(2) Body and Nozzle

(a) Prepare caustic soda solution:

Sodium hydroxide	1 lb. 9 oz.
Sodium cyanide	11 oz.
Water	5 gal.

Use solution at 50° C to 70° C

WARNING: THIS SOLUTION IS BOTH CAUSTIC AND POISONOUS. IT SHOULD NOT BE ALLOWED TO ENTER EYES OR MOUTH. HANDS SHOULD BE WASHED THOROUGHLY AFTER ITS USE ESPECIALLY WHERE THE SKIN IS BROKEN.

(b) Submerge body and nozzle in caustic soda solution.

(c) Remove components from solution after 15 - 20 minutes and brush off loosely adhering lacquer.

(d) Wash components in clean running water and allow to dry.

D. Inspect Extinguisher Components

(1) Inspect container exterior for damage such as chafing, scoring or dents. If the container is damaged in any way that is likely to weaken it, it should be scrapped.

(2) Inspect container interior for corrosion.

(3) Inspect the following reclaimable components for serviceability and condition of screw threads where applicable:-

(a) Body

(b) Lever

(c) Nozzle

(4) Obliterate date and weight stamped on body.

E. Repair Cap Assembly

(1) Inspect cap assembly (16) for damage and serviceability of screw threads.

(2) Heat cap assembly (16) until solder is fluid then remove break disc and excess solder from cap recess. Scrap break disc.

(3) Coat recess in cap with solder paint (Item M.10). Place new break disc (17) in recess and heat assembly until solder is fluid (230° C approximately). Remove heat and allow solder to set. Neutralise in soda solution (4 oz. sodium carbonate to 1 gallon of water), then rinse assembly in clean water.

F. Pressure Test Container

Test container to 750 lb/in^2 using hydraulic test rig. (Item B.3 with adaptor Item B.4.) Use washer H.143 (item 22) as seal between adaptor and container head for this test.

G. Prepare Container for Re-filling

(1) Prepare an acid cleaning solution consisting of the following:-

(a) Chromium trioxide (commercial)	10 lb.
(b) Sulphuric acid, concentrated (commercial)	$4\frac{1}{2}$ pints.
(c) Water	10 gal.

(2) Immerse container in this cleaning solution so that solution flows into and fills the container, then stand container vertically in the solution. The level of solution should come up to the neck joint.

(3) Remove container from solution after suitable immersion time (see Note), and rinse exterior and interior of container thoroughly in clean running water.

NOTE: Cleaning should be effective in 2 - 3 minutes in fresh cleaning solution, but the solution can be used until 5 minutes immersion is required for satisfactory cleaning. At this point fresh solution should be used.

(4) Finally, rinse in hot water, and then place vertically, neck downwards, in rack to dry.

WARNING: SUITABLE RUBBER GLOVES AND PROTECTIVE CLOTHING SHOULD BE WORN DURING ACID CLEANING OPERATIONS.

(5) Buff and polish container. (Types 25H and 26H only).

H. Fit New Siphon Tube Assembly

Fit a new siphon tube assembly (3) to container head (2). Screw in three or four threads only.

NOTE: Do not fit sealing washer (5) at this stage.

I. Fill Container

Fill container with extinguishant and pressurise with dry nitrogen in accordance with filling plant instructions. The type and amount of extinguishant and the nitrogen pressure are listed in Table 2.

TYPE	EXTINGUISHANT	WEIGHT (± 1 oz)	NITROGEN PRESSURE (lb/in^2 at 20° C)
25H	M.B. (Item M.11)	2 lb 9 oz	65
26H	M.B. (Item M.11)	1 lb 9 oz	65
30H	CB (Item M.12)	2 lb 15 oz	100
31H	CB (Item M.12)	1 lb 13 oz	100
34H	BCF (Item M.13)	2 lb 9 oz	65
35H	BCF (Item M.13)	1 lb 9 oz	65
38H	BCF (Item M.13)	2 lb 9 oz	100

Extinguisher Filling Data
Table 2

J. Test for Leaks

Immediately after removal from filling plant, submerge container head uppermost in hot water (35° C to 80° C) for 15 minutes. Watch for stream of bubble indicating leakage. Use container leakage test rig (Item B.2) for this test.

K. Identify Extinguishant Batch

If container is free from leaks, obliterate original extinguishant batch number from container head (2) and metal stamp new extinguishant batch number. Stamp letter 'R' as suffix to container serial number to indicate that it has been overhauled.

L. Re-assemble Extinguisher

(1) Soak new gland packing (9) in fluid (Item C.1) for at least 30 minutes.

(2) Insert gland packing in body (7) and screw in gland nut (10) one or two threads only with tool (Item A.2.)

(3) Fit lever (13) to body with spacing washers (15) and screw in pivot pin (14). Do not tighten pivot pin.

(4) Fit lever bolt (8) into body, passing screwed end of bolt carefully through gland packing. Tighten gland nut with tool (Item A.2.)

(5) Fit spring (11) and valve (12) to lever bolt. Using a fork screwdriver, screw lever bolt onto valve a few threads only.

(6) Screw up lever bolt until base of valve is 3/4 inch inside body, measured from outside edge of screwed bore of body.

(7) Fit washer (22) into body.

(8) Fit sealing washer (5) to groove machined in frangible plug assembly (6).

(9) Assemble body to container in the following way:-

(a) Compress lever hard to body and carefully rotate container whilst entering frangible plug into body.

(b) Feel carefully for outward pressure on lever while slowly rotating container. This pressure will indicate that thread on frangible plug is screwing into valve. Ensure that container head engages properly with bore of body.

(c) While rotating, ease lever back gradually to compensate for pressure until lever is felt to be free and is in normal ready-to-operate position.

CAUTION: LACK OF CARE IN PERFORMING THIS OPERATION CAN BREAK THE FRANGIBLE PLUG AND DISCHARGE THE EXTINGUISHER.

(10) Screw tool (Item A.3) into nozzle bore in body and tighten body to container. Remove tool.

(11) Remove pivot pin, lever and spacing washers.

(12) Fit wash (20) to nozzle (19). Screw nozzle into body and tighten. Fit new sealing cap (21) to nozzle.

(13) Fit cap assembly (16) to body. Hand tighten only.

(14) Use revolving wire brush to give bright metal finish to copper plating of container head (2), body (7) and nozzle (19).

(15) Coat container head, body and nozzle with clear lacquer (M.8) using brush. Allow lacquer to dry.

(16) Cover container head, body and nozzle. Spray container with protective finish as follows:-

Types 25H and 26H	.....	Item M.8
Types 30H and 31H	.....	Item M.5 then Item M.7
Types 34H, 35H and 38H	.....	Item M.4 then Item M.6

(17) Types 35H and 38H only - apply extinguisher indentification to container using stencil (Item B.6) and white paint (Item M 9.)

(18) Fix label (23) to container.

(19) Fit lever (13) to body using new spacing washers (15) and new pivot pin (14). Tighten pivot pin and stake to secure.

(20) Remove cap assembly (16). Adjust lever bolt (8), using fork screwdriver to give approximately .030 inch free movement at outer end of lever (13). Replace cap assembly, tighten with tool (Item A.1), and stake to secure.

(21) Remove nozzle cap (21), smear end of nozzle with grease (Item C.2), re-cap.

(22) Check weigh extinguisher, and ensure that the weights are within the limits listed in Table 3.

TYPE	WEIGHT
25H	5 lb 3 oz (± 4 oz)
26H	3 lb 15 oz (± 4 oz)
30H	5 lb 9 oz (± 4 oz)
31H	4 lb 3 oz (± 4 oz)
34H	5 lb 7 oz (± 4 oz)
35H	3 lb 15 oz (± 4 oz)
38H	5 lb 7 oz (± 4 oz)

Filled Weights of Extinguishers
Table 3

(23) Metal stamp on body:-

(a) Weight of complete extinguisher.

(b) Date of overhaul suffixed by 'R' to indicate that it has been over-hauled (repaired).

(24) Brush clear lacquer (Item M.8) over stamping on body and allow to dry.

(25) Use leak detector (Item B.5) to check for leaks at all joints.

4. STORAGE INSTRUCTIONS

A. Storage Conditions

(1) Store extinguishers horizontally, in a cool dry atmosphere, away from corrosive fumes.

(2) Check weigh extinguishers at periods of approximately 12 months during storage and ensure that the weight is within one ounce of that stamped on the extinguisher body.

B. Storage Period

The maximum storage life of one of these extinguishers is five years from the date of original manufacture, or last overhaul. At the end of this period an extinguisher should be sent to the manufacturer, or to an approved organisation, for overhaul.

5. OVERHAUL PERIOD

Extinguishers, whether in service or in storage, should be sent for overhaul five years after the date of manufacture, or last overhaul.

6. SPECIAL TOOLS AND EQUIPMENT

A. Special Tools

Item	Description	Graviner Part No.
A.1	Cap assembly spanner	T.1916
A.2	Gland nut spanner and gland balancer	T.1917
A.3	Body spanner	T.1918

B. Special Equipment

Item	Description	Graviner Part No.
B.1	Filling plant	T.863 or T.1260
B.2	Container Leakage Test Rig	T.866
B.3	Container Pressure Test Rig	T.865/J65D
B.4	Adaptor for Pressure Test Rig	T.2158
B.5	Leak Detector (A.E.I. Type FB. 24A1)	----------
B.6	Extinguisher data stencil (Type 35H)	T.1929
B.6	Extinguisher data stencil (Type 38H)	249/381

ILLUSTRATED SPARE PARTS CATALOGUE

SECTION 1: ALPHABETICAL TABLE OF CONTENTS

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Introduction	(Section II)	14
Vendors Code/Name Index	(Section V)	-

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Exploded view of Extinguisher (Fig. 2)	16

ILLUSTRATED SPARE PARTS CATALOGUE

SECTION II: INTRODUCTION

This Illustrated Spare Parts Catalogue has been prepared in accordance with the basic requirements of the ATA Specification 100 (Revision 14) for Manufacturers Technical Data. Its purpose is to enable parts to be clearly identified and/or replacement parts to be properly ordered. It is composed of the following five separate sections, of which this INTRODUCTION section is one:-

SECTION I	Alphabetical Table of Contents
SECTION II	Introduction
SECTION III	Group Assembly Parts List
SECTION IV	Alpha/Numerical Parts List Index
SECTION V	Vendors Code/Name Index

An explanation of each individual section follows, together with the detailed notes for general use.

Alphabetical Table of Contents

This section (Section I) contains a guide, in alphabetical sequence, to the contents of the various sections contained within the Illustrated Spare Parts Catalogue. A list of all the illustrations is also given.

Group Assembly Parts List

This section (Section III) is compiled strictly in accordance with the ATA Specification No. 100 for Manufacturers Technical Data. The relevant Chapter (Chapter 26, which covers Aircraft Fire Protection Systems) is divided into the three subsidiary subjects of Detection (26.10) Extinguishing (26.20) and Explosion Suppression (26.30). Each assembly within the Subject(s) is suitably cross-referenced by Chapter No., Subject No., Item No. and Figure No.

Alpha/Numerical Parts Index

Section IV contains all part numbers listed in Section III. It is arranged in alpha/numerical sequence and refers to Chapter No., Subject No., Item No., and Figure No.

Parts with no identification number are listed in the beginning of the index in alphabetical order. Part number arrangement begins in the extreme left-hand position from left to right, one position at a time, until all parts are arranged in sequence. The order of precedence in the beginning of the part number arrangement on the extreme left-hand positions is as follows:-

Letters A through Z
Numerals 0 through 9

The alpha '0' is considered as numeric 'zero'.

Vendor's Code-Name Index

Section V contains a list of manufacturers names, addresses, code names or Federal Suppliers codes (where applicable) and is arranged in alpha/numerical sequence. The prefix V is used to indicate the Federal Supplier's code (where applicable) the prefix VG being used to indicate manufacturers who do not have a Federal Suppliers codification number.

Illustrations

All illustrations are, as far as possible, located on left-hand pages and the relevant listings on the facing right-hand page. If there is more than one page of listings, the first page will be the facing right-hand page, with other pages following in proper sequence. A view of each assembly and sub-assembly, exploded as necessary to show the component parts thereof, is provided to illustate each part included in the Parts List, and to show their assembly/disassembly relationship for overhaul purposes.

All illustrated parts are allocated an item number which corresponds to an iten number of the parts list page(s), in the column provided. Continuity of illustra and relevant breakdown parts is maintained by cross-reference of figure numbers.

Vendor items are assigned a parenthesized Federal Supplier's codification number (prefixed V) or a Graviner's vendor code number (prefixed VG) followir the nomenclature.

Units Per Assembly

This column shows the number of units per 1 off 'next higher assembly'. Requirements that vary on installation(s) shown as 'AR' to indicate 'As Require

Assembly Order

The assembly order is maintained by a system of indentation of part titles to show true generation breakdown sequence. Attaching parts are listed immediately following the part they attach, and are terminated by the symbol *** as shown below:-

1 2 3 4 5 6 7
Assembly
Attaching Parts for Assembly
* * *
. Details of Assembly
.. Sub-assembly
.. Attaching Parts for Sub-assembly
* * *
... Details of Parts for Sub-assembly
... Etc.

Unit per assembly must be multiplied by sub-assembly and sub sub-assembly quantities to provide total quantity per highest assembly listed. When two or more assemblies are made up of a large number of identical parts, they are 'mirrored' and the details combined. Details not common to all assemblies ar suitably annotated by reference to the Part No. of the assembly.

Example:

ITEM No.	PART NUMBER	1 2 3 4 5 6 7	USAGE CODE
1-	34H	Assembly	A
1-	38H	Assembly	B
1	H153	. Container	A
1	H151	. Container	B
2	H137/1	. Head container	A & B
3	H178	. Assy, frangible plug and siphon tube	A
3	H294	. Assy, frangible plug and siphon tube	A
4	H403	.. Washer, sealing	A & B
5	H138	.. Plug, frangible	A
		.. etc.	

The example given shows the applicability of the various sub-assemblies to the particular assemblies, the usage code column being used to clearly indicate which particular part is used on any particular type of an otherwise fundamentally similar unit.

Item Numbers

Parts not illustrated in detail are designated by means of a hyphenated item number.

Summary of Materials and Adhesives

This summary, located at the back of the Illustrated Parts List, contains a list of standard parts, materials and adhesives required in conjunction with the changing of parts.

Modifications

To ensure that the information in this Illustrated Parts List is compatible with the equipment, no retrospective Graviner Design Modifications will be incorporated into this list without the written assurance of the customer that he intends to install a particular modification. The exception to the above will be incorporation of 'Spares Replacement' and/or 'Mandatory' Modifications.

Revisions

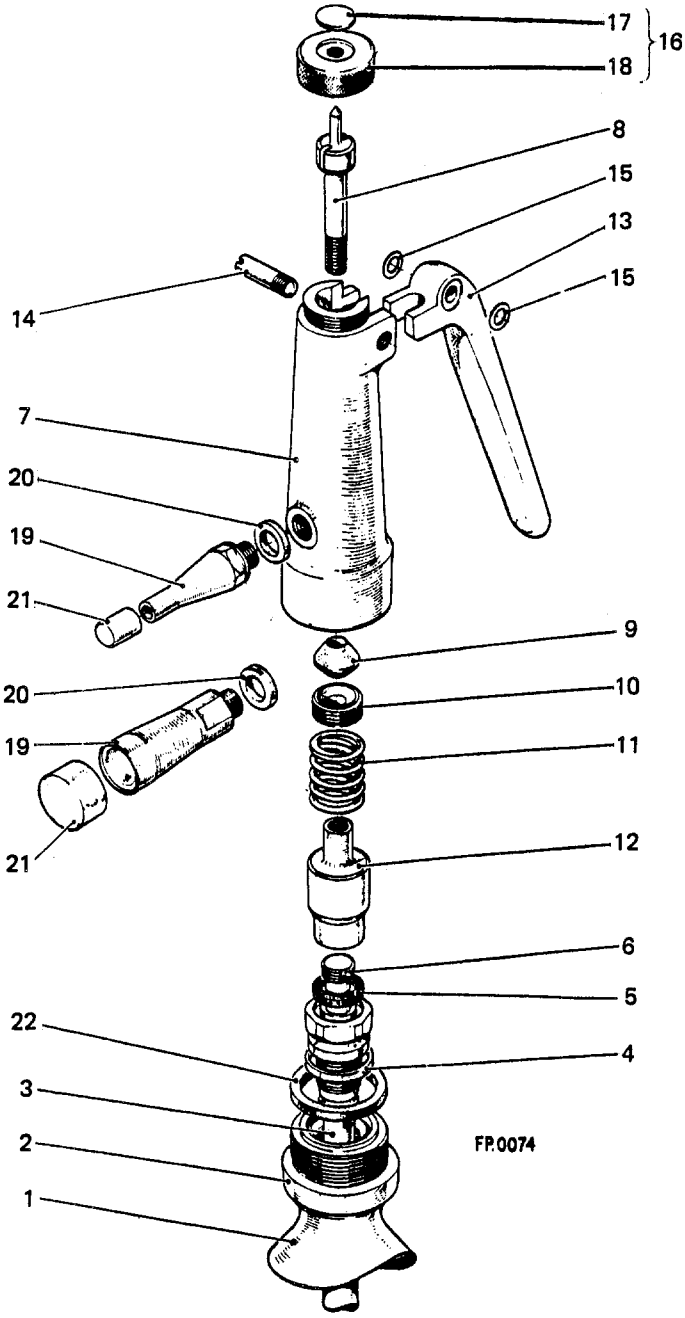
Revisions will be issued periodically. A record sheet for Revisions incorporated in the Illustrated Parts List is provided behind the Revision marker card.

A revision to the catalogue consists of a Transmittal Sheet together with the new or revised replacement pages. This Transmittal Sheet lists the Chapter, Subject, Item and Pages affected, with instructions to remove existing pages and insert pages where applicable. The transmittal sheets should be filed behind the Revision Record.

Abbreviations

The following standard abbreviations are used throughout this Manual:-

AC	-	Alternating Current
Amp	-	Ampere
AR	-	As Required
assy.	-	Assembly
BA	-	British Association
BSF	-	British Standard Fine
ch. hd.	-	Cheese Head
csk. hd.	-	Countersunk Head
c/w	-	Complete With
dia.	-	Diameter
DC	-	Direct Current
hx. hd.	-	Hexagonal Head
instln.	-	Installation
L/H	-	Left Hand
mF	-	Micro Farad
msh. hd	-	Mushroom Head
NA	-	Not Applicable
NHA	-	Next Highest Assembly
No.	-	Number
NP	-	Nonprocurable
pF	-	Pico Farad
Ref.	-	Reference
rd. hd.	-	Round Head
R/H	-	Right Hand
UNF	-	Unified Fine Thread
V	-	Vendor (on Federal Supplier's Code list)
VG	-	Vendor (Graviner's Supplier's Code)



Exploded View of Extinguisher

Figure 2

Illustrated Parts List

Fig. Item	Part Number	Nomenclature 1 2 3 4 5 6 7	Usage Code	Units/ Assy.
2 -	25H	2½ lb. MB Hand Extinguisher	A	REF
2 -	26H	1½ lb. MB Hand Extinguisher	B	REF
2 -	30H	3 lb. CB Hand Extinguisher	C	REF
2 -	31H	1¾ lb. CB Hand Extinguisher	D	REF
2 -	34H	2½ lb. BCF Hand Extinguisher	E	REF
2 -	35H	1½ lb. BCF Hand Extinguisher	F	REF
2 -	38H	2½ lb. BCF Hand Extinguisher	G	REF
1	H.151	. Container	B,D,F	NP
1	H.153	. Container	A,C,E,G	NP
2	H.137/1	. Head, container	A,B,E,F,G	NP
2	H.137/2	. Head, container	C,D	NP
3	H.177	. Assembly, frangible plug and siphon tube	B,D,F	1
3	H.178	. Assembly, frangible plug and siphon tube	A,C,E	1
3	H.294	. Assembly, frangible plug and siphon tube	G	1
4	H.156	.. Washer, sealing	All	1
5	H.403	.. Washer, sealing	All	1
6	H.138	.. Plug, frangible	A,B,C,D,E,F	NP
6	H.293	.. Plug, frangible	G	NP
7	H.135/1	. Body	A,B,E,F,G	1
7	H.135/2	. Body	C,D	1
8	H.140	. Bolt, lever	All	1
9	H.149	. Packing, gland	All	1
10	H.141	. Nut, gland	All	1
11	H.144	. Spring	All	1
12	H.139	. Valve	All	1
13	H.133	. Lever	All	1
14	H.147	. Pin, pivot	All	1
15	H.148	. Washer, spacing	All	2
16	H.142/1	. Assembly, cap	A,B,E,F,G	1
16	H.142/2	. Assembly, cap	C,D	1
17	H.172	.. Disc, break	All	1
18	H.223	.. Cap	All	1
19	H.145/1	. Nozzle	A	1
19	H.109/1	. Nozzle	B	1
19	H.145/2	. Nozzle	C	1
19	H.109/2	. Nozzle	D	1
19	H.224	. Nozzle	E, F	1
19	H.272	. Nozzle	G	1

Illustrated Parts List (Cont'd)

Fig. Item	Part Number	Nomenclature	Usage Code	Units/ Assy.
20	H.152	. Washer, sealing, nozzle	A,B,E,F,G	1
20	H.152/1	. Washer, sealing, nozzle	C,D	1
21	H.222	. Cap, sealing, nozzle	A,B,C.D	1
21	H.221	. Cap, sealing, nozzle	E,F	1
21	H.274	. Cap, sealing, nozzle (Hall and Hall Ltd.)	G	1
22	H.143	. Washer, sealing	All	1
- 23	249/14	. Label	A,B	1
- 23	249/308	. Label	C,D	1
- 23	249/327	. Label	E,F,G	1

Materials

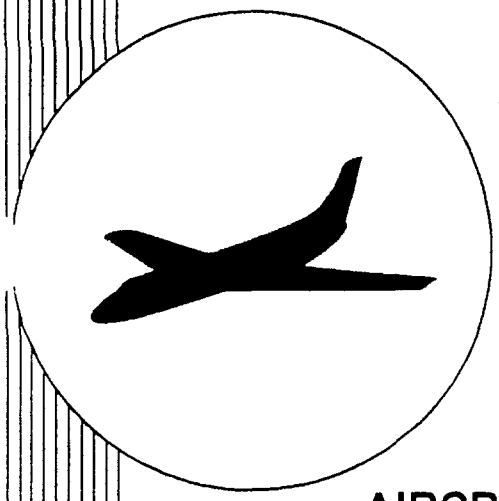
Item	Description	Specification	Vendor
M. 1	Silicone fluid	M.S.200/10 or M.S.200/20	Midland Silicones Ltd., Cardiff Road, Barry, Glamorgan, Wales.
M. 2	Silicone grease	M.S.4	Midland Silicones Ltd., Cardiff Road, Barry, Glamorgan, Wales.
M. 3	Paint stripper ('Chemiclene' No. 415)		Grant and West Ltd., Stoke Mill, Guildford, Surrey, England.
M. 4	Primer, etchant 'Mettac' epoxy / polyamide. (Used on 34H, 35H and 38H)		Hadfields (Merton) Ltd. Western Road, Mitcham, Surrey, England.
M. 5	Primer, etchant (Used on 30H and 31H)	PA.10	Federated Paints Ltd., Glasgow, Scotland.
M. 6	Paint, polyurethane, signal red. 'Mettac' solvent resisting enamel finish. (Used on 34H, 35H and 38H)	B.S.381 Colour 449	Hadfields (Merton) Ltd. Western Road, Mitcham, Surrey, England.
M. 7	Paint, aluminium 'Alkalad' isocyanate. (Used on 30H and 31H)		Federated Paints Ltd., Glasgow, Scotland.
M. 8	Lacquer, clear		Hadfields (Merton) Ltd. Western Road, Mitcham, Surrey, England.
M. 9	Paint, stencil, white	Y.2045	Bryce Weir Ltd., Watford, Herts., England.
M.10	Paint, solder, 'Fryolux'	Standard grade	Fry's Metal Foundries, Merton Abbey, London, S.W.19., England.
M.11	Extinguishant, methyl bromide (MB)	BS.2710	May & Baker Ltd., Dagenham, Essex, England.

Item	Description	Specification	Vendor
M.12	Extinguishant, chlorobromomethane (CB)	BS.1721	Albright & Wilson Ltd., Canning Road, Stratford, London, E.15. England.
M.13	Extinguishant, bromochlorodi-fluoromethane (BCF)	AFS.692	ICI Ltd., Mond Division, General Chemicals Group, The Heath, Runcorn, Cheshire, England.
M.14	Nitrogen gas, dry	No.152	Air Products Limited Derby Road, Edmonton, London, N.18., England.

PACIFIC SCIENTIFIC®

HTL/Kin-Tech Division

Component Maintenance Manual with Illustrated Parts List



86 CUBIC INCH FIRE EXTINGUISHER

AIRCRAFT MODEL	CUSTOMER PART NUMBER	HTL PART NUMBER
BOEING VERTROL	---	17300
BOEING VERTROL	---	17400

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Rev. No.	Revision Date	Date Filed	By

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RECORD OF TEMPORARY REVISIONS

Rev. No.	Issue Date	Date Inserted	By	Date Removed	By

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TO ALL HOLDERS OF PACIFIC SCIENTIFIC HTL/KIN-TECH DIVISION
COMPONENT MAINTENANCE MANUAL ATA 26-20-200
FOR P/N 17300 AND P/N 17400
DATED MAR 1/95

APPLICABILITY: BOEING VERTROL

THIS SHEET TRANSMITS REVISION NO. 3

DATED MAR 15/99

HIGHLIGHTS

We reprinted this manual in its entirety. Please replace all of the pages of your manual with this revision. We made many general format and layout changes in addition to technical changes.

Chapter/Section and Page No.	Description of Change
Title Page	Listed the revision date and added airline part numbers with customer part number cross-reference.
Record of Revisions	Listed the revision number and date.
Service Bulletin List	Revised date.
List of Effective Pages	Listed the revision date for the affected pages.
All Sections	Updated procedures and reformatted entire manual.

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TO: HOLDERS OF THE FIRE EXTINGUISHER COMPONENT MAINTENANCE MANUAL ATA 26-20-200 FOR P/N 17300 AND P/N 17400 DATED JUN 1/73.

REVISION NO. 2 DATED MAR 1/95
HIGHLIGHTS

THIS PUBLICATION HAS BEEN REPRINTED IN ITS ENTIRETY DUE TO THE NUMBER OF PAGES AFFECTED BY THIS REVISION. REPLACE ALL THE PREVIOUSLY ISSUED COPIES OF THE MANUAL.

The highlights of the revision are outlined below. All pages have been revised to the format of ATA 100, Revision 30 and the AECMA Simplified English guidelines.

Chapter/Section and Page No.	Description of Change	Effectivity
Title Page	Listed the revision date.	All Models
Record of Revisions	Listed the revision number and date.	All Models
Service Bulletin List	Revised date.	All Models
List of Effective Pages	Listed the revision date for the affected pages.	All Models
Introduction	Added a list of the part numbers with a customer part number cross-reference. Added a Product Support Services paragraph. Added an Abbreviations and Unit Symbols paragraph.	All Models
Page 1 thru 4	Added electrical schematics for the cartridge to Figure 1. Revised Table 1.	All Models
Page 101 thru 108	Upgraded the Test Equipment list. Added a ground strap/circuit tester for personnel safety while handling the cartridges. Revised the Hydrostatic Test Requisites and upgraded the tooling. Added paragraph AA for a weldment drying procedure.	All Models
Page 301 thru 304	Added a Disassembly Sequence Chart. Upgraded the Disassembly Equipment list, replaced the discharge tool with the discharge recovery tool and added a recovery/ recycle system. Added a ground strap/circuit tester for personnel safety while handling the cartridges. Revised the discharge method to capture the Halon 1301 fire extinguishing agent.	All Models
Page 401 and 402	Updated the Cleaning Materials list. Added a cleaning description for the weldment. Removed usage of Methyl-Ethyl-Ketone solvent.	All Models

Chapter/Section and Page No.	Description of Change	Effectivity
Page 501 thru 504	Added a Check Tools and Equipment list. Upgraded the Weight Check procedure and added a Maximum Weight list. Added the cartridge life limits and a ground strap/circuit tester for personnel safety while handling the cartridges. Added a cartridge disposal procedure and the Cartridge Disposal Setup figure.	All Models
Page 601 and 602	Removed usage of Methyl-Ethyl-Ketone solvent. Added the Replacement of Bonded Plates procedure - removed the spot weld method.	All Models
Page 701 thru 709	Upgraded the Assembly Equipment list. Revised the pressure switch assembly procedure. Upgraded the charging procedure and added the Nitrogen Charge Pressure Versus Temperature chart. Added a ground strap/circuit tester for personnel safety while handling the cartridges. Added a Storage Materials list, the storage marking data, and the storage temperatures.	All Models
Page 801	Added a Torque Limits list.	All Models
Page 901 thru 903	Added a Special Tools, Fixtures, and Equipment list; removed the tool illustrations.	All Models
Page 1001 thru 1011	Added to the list of manufacturer's. Added a Numerical Index. Revised the item number assignment to reflect the order of disassembly.	All Models

SERVICE BULLETIN LIST

Service Bulletin	Issue Date	Date Incorporated

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Revised 1999

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INTRODUCTION

1. Scope

   A. This Checkout and Component Maintenance Manual (CMM) contains the maintenance instructions and an illustrated parts list for the 86 Cubic Inch Fire Extinguisher. The fire extinguisher is manufactured by Pacific Scientific Company, HTL/Kin-Tech Division, Duarte, California.

2. Usage Guide

   A. Refer to the Table of Contents to find the necessary procedures or maintenance data. This Manual is written to ATA 100, Revision 30 and AECMA Simplified English guidelines.

      (1) **Description and Operation** gives the function, primary components, and technical properties of the fire extinguisher.

      (2) **Testing and Fault Isolation** contains the test and fault isolation procedures.

      (3) **Disassembly** contains the procedures to discharge the extinguishing agent and disassemble the fire extinguisher before repair or part replacement.

      (4) **Cleaning** contains procedures to clean the fire extinguisher and components.

      (5) **Check** contains the procedures to check the parts for too much wear, corrosion, and other damage.

      (6) **Repair** contains the repair procedures.

      (7) **Assembly** contains the procedures to reassemble, refill, and store the fire extinguisher.

      (8) **Fits and Clearances** contains the assembly torque ranges and the minimum height dimensions for the fill, discharge, and switch bosses (as applicable).

      (9) **Special Tools, Fixtures, and Equipment** describes the recommended special tools, fixtures, and test equipment.

      (10) **Illustrated Parts List** contains the information needed to order spare parts. A numerical index and an exploded-view drawing are provided to help identify the parts.

   B. The recommended tools and materials are given in each section. Equivalent items can be used.

3. Product Support Services

   A. Product support services for the fire extinguisher are available from Pacific Scientific Company.

   B. For technical documentation, please contact:

PACIFIC SCIENTIFIC COMPANY
6805 NW 87 Avenue
Miami, Florida 33178 U.S.A.

Telephone: (305) 477-4711
FAX: (305) 477-9799
SITA: MIAPSXD

C. For repair and overhaul, and spare parts please contact:

PACIFIC SCIENTIFIC COMPANY	Telephone:	(305) 477-4711
6805 NW 87 Avenue	FAX:	(305) 477-9799
Miami, Florida 33178 U.S.A.	SITA:	MIAPSXD
PACIFIC SCIENTIFIC LIMITED	Telephone:	44 (1628) 810252
Seven Centre Bourne End	24 Hours:	44 (1836) 228480
Buckinghamshire	FAX:	44 (1628) 810124
England SL8 5YS	SITA:	LHRPSCR

4. Verification Dates

Procedure	Date
Testing/Fault Isolation	Feb 15/99
Disassembly	Feb 15/99
Assembly	Feb 15/99

5. Revision Service

A. Revised pages will be issued when necessary throughout the service life of the fire extinguisher. The revised part of the page will be identified by a change bar or capital **R** in the left margin.

6. Abbreviations and Unit Symbols

A. Abbreviations and unit symbols which may be used in this manual are defined below. All weights and measurements are given first in the English standard units followed by the metric equivalent in parentheses.

Assy - Assembly
ATA - Air Transport Association
cfh - Cubic feet per hour
CAGE - Commercial and Government Entity
cm - Centimeter (1 cm = 0.394 inch)
DC - Direct Current
DOT - Department of Transportation
EFF - Effectivity
FAA - Federal Aviation Administration
FIG. - Figure
ID - Inside Diameter
IPL - Illustrated Parts List
kg - Kilogram (1 kg = 2.205 pounds)
kPag - Kilo Pascal-gauge (1 kPag = 0.15 psig)
m^3/hr - Cubic meter per hour
m - Meter (1 m = 3.281 feet)
mA - Milliampere
mm - Millimeter (1 mm = 0.0394 inch)
N·m - Newton-meter (1 N·m = 8.3 in-lb)
NHA - Next Higher Assembly
No. - Number
OD - Outside Diameter
Para. - Paragraph
P/N - Part Number
psig - Pounds per square inch-gauge
RF - Reference
rpm - Revolutions per minute
SB - Service Bulletin
sccs - Standard cubic centimeter per second
V - Volt
VDC - Voltage - Direct Current

DESCRIPTION AND OPERATION

A. The fire extinguisher stores fire extinguishing agent under high pressure. When the sensors indicate smoke, the pilot operates a control switch sending an electrical signal to the cartridge mounted in the discharge outlet (see Figure 1). This causes the cartridge to detonate, which fractures a valve plug and releases extinguishing agent to extinguish the fire.

1. Description

A. The fire extinguisher is a spherical, stainless steel container (see Figure 2). Its primary components include:

- Container weldment
- Fill fitting
- Pressure gauge
- Discharge outlets (two on some units)
- Cartridges (two on some units)

B. The weldment is an all-welded stainless steel shell, which includes fill, discharge, and gauge bosses.

C. An electrically actuated cartridge (see Figure 1) is installed in the housing assembly. The cartridge can be removed or installed (even when the fire extinguisher is pressurized). The cartridge is safety wired to the discharge outlet and caution tagged for safety.

D. The fill fitting is a combination filling device and safety relief assembly. If the ambient temperature should rise abnormally, a fusible check valve within the fill fitting melts. This relieves the contents of the container through the fill fitting.

E. The discharge outlet is a flow path for the extinguishing agent. The discharge outlet is safety wired to the weldment to a secure installation. The discharge outlet consists of a valve plug that is held securely by a destructible housing assembly and stem assembly. A discharge outlet capable of rotating 360° (even when the fire extinguisher is pressurized) is installed between the housing assembly and discharge boss.

F. The fire extinguisher is equipped with a pressure gauge and guard.

G. The fire extinguisher is shipped with protective caps to cover the discharge outlet and the fill fitting. The shunt wire/caution tag installed on the cartridge, protects the firing circuit from detonating with electromagnetic interference.

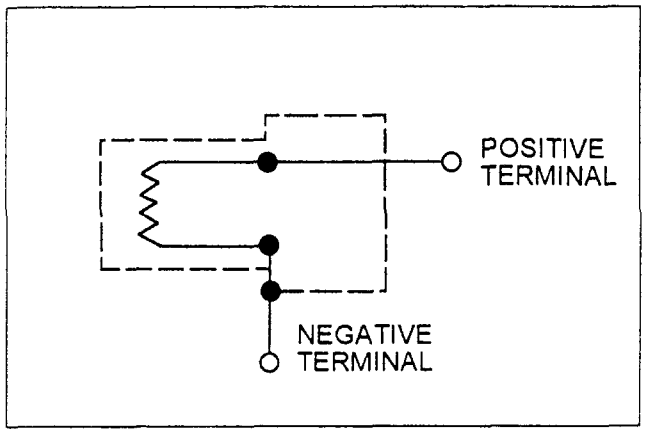


Figure 1. Cartridge Schematic

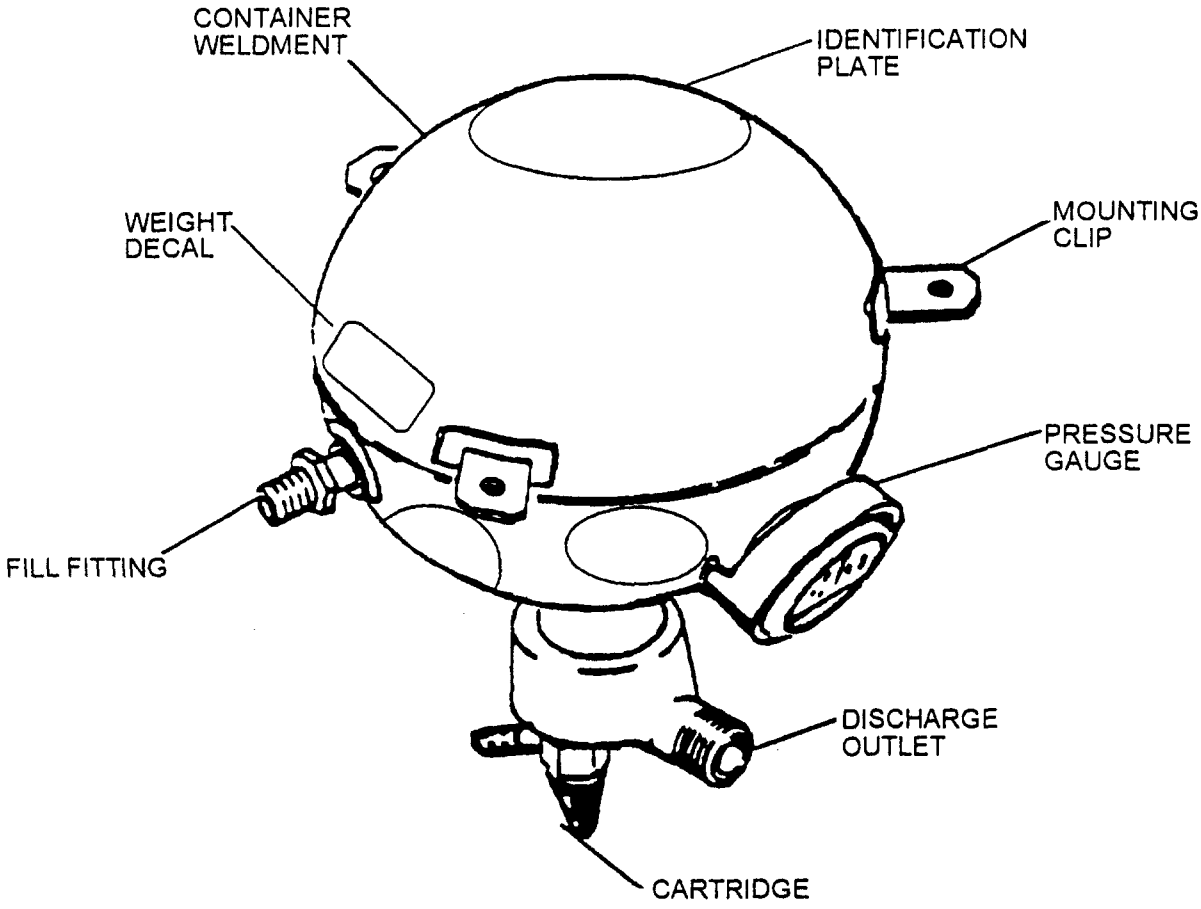


Figure 2. Primary Components

2. Operation of Fire Extinguisher

A. To release the extinguishing agent, the pilot operates a control switch, applying 18 to 30 VDC, 3.0 amperes current to the cartridge terminals. The current detonates the explosive charge in the cartridge (Figure 1). The explosion breaks the end of the housing assembly, removing the mechanical locking force against the valve plug. The pressurized extinguishing agent forces the valve plug outward. The extinguishing agent is discharged through the discharge outlet into the distribution network.

B. The pressure gauge indicator should be checked regularly to make sure that the fire extinguisher is charged.

3. Technical Properties

A. The technical properties of the fire extinguisher are given in Table 1.

Table 1. Technical Properties for Fire Extinguisher

Property	Specifications
Description	
Manufacturer	Pacific Scientific, HTL/Kin-Tech Division
Part Number	P/N 17300 and P/N 17400
Nomenclature	Fire Extinguisher, 86 Cubic Inch
Functional Properties	
Internal Volume	86 cubic inches (1,5 liter)
Extinguishing Agent	Bromotrifluoromethane ($CBrF_3$)
Pressurizing Gas	Nitrogen (N_2)
Pressure Data at 70°F (21°C)	
Charge Pressure	600 to 625 psig (4137 to 4309 kPag)
Hydrostatic Pressure Test	1650 psig (11377 kPag) minimum
Burst Pressure	
P/N 17300	3000 psig (20685 kPag) minimum
P/N 17400	2700 psig (18617 kPag) minimum
Safety Relief Temperature Range	215°F to 226°F (101°C to 108°C)
Ambient Temperature Range	-65°F to +165°F (-54°C to +74°C)
Weight Data	
P/N 17300	
Empty Fire Extinguisher	3.60 pounds (1,63 kg) maximum
Extinguishing Agent (full charge)	2.00 to 2.12 pounds (0,91 to 0,96 kg)
Nitrogen Charge	0.11 pound (0,05 kg) maximum
Charged Fire Extinguisher	5.83 pounds (2,64 kg) maximum
P/N 17400	
Empty Fire Extinguisher	2.76 pounds (1,25 kg) maximum
Extinguishing Agent (full charge)	1.00 to 1.25 pounds (0,45 to 0,57 kg)
Nitrogen Charge	0.11 pound (0,05 kg) maximum
Charged Fire Extinguisher	4.12 pounds (1,87 kg) maximum
Allowable Weight Deviation - actual weight versus weight marked on identification plate	Minus 0.10 pound (0,05 kg)

Table 1. Technical Properties for Fire Extinguisher (Continued)

Property	Specifications
Cartridge Data	
Voltage	18 to 30 VDC
Current Rating	
All Fire	3.0 amperes minimum
No Fire	0.5 ampere, 1.0 Watt for five minutes
Test Current	50 mA maximum
Bridgewire Resistance	0.9 to 1.4 ohm per each bridge
Service Life	4 years
Maximum Life (service and storage)	6 years
Mating Terminal Size	
Positive Terminal	8-32UNC-2A
Negative Terminal	8-32UNC-2A
Fusible Valve	
Code Color	Blue
Relief Temperature	215°F to 226°F (102°C to 108°C)
Fill Fitting End	MS33656-4
Discharge Outlet End	MS33656-16

TESTING AND FAULT ISOLATION

1. General

A. This section contains the testing and fault isolation procedures. Perform the leak test and cartridge test, before disassembly to identify the quantity of maintenance.

B. The recommended test equipment and materials are given in Table 101.

NOTE: Equivalent items can be used.

Table 101. Test Equipment and Materials

Nomenclature	Part or Specification Number	Source (CAGE)*
Bag, Plastic (large enough to enclose weldment)	---	Commercially available
Cap, Hydrotest	83330165	Pacific Scientific (05167)
Cradle, Fire Extinguisher	83000242	Pacific Scientific (05167)
Digital Multimeter	79	John Fluke (89536)
Fitting, Hydrotest 0.750-16 UNJF Thread	---	Commercially available
Ground Strap & Circuit Tester	WT25	Walter G. Legge Co. (84832)
Hydrotest Test Stand	---	Commercially available
Leak Detector	HLD 4000-310 Series C	Inficon (56507)
Oven or Heater, 250°F (121°C)	---	Commercially available
Plug, Gauge Boss 1/4-18 NPT Thread	---	Commercially available
Protective Caps		
Cartridge Cover	5/8-SC	CaPlugs (99017)
Cartridge Port	PD-50	CaPlugs (99017)
Cartridge Thread	1/2-SC	CaPlugs (99017)
Discharge Boss	PD-200	CaPlugs (99017)
Discharge Outlet End	CD-22	CaPlugs (99017)
Fill Boss	PD-40	CaPlugs (99017)
Fill Fitting End	CD-4	CaPlugs (99017)
Pressure Gauge Fitting	WW-O	CaPlugs (99017)
Safety Chamber, Cartridge	83330118	Pacific Scientific (05167)
Tank, Gaseous Nitrogen (GN_2) 1000 psig (6900 kPag)	---	Commercially available

* Refer to the IPL, paragraph 2, for the address.

Table 101. Test Equipment and Materials (Continued)

Nomenclature	Part or Specification Number	Source (CAGE)*
Test Fitting 1/8-27 NPT	---	Commercially available
Vacuum Source	---	Commercially available
Weighing Scale ±0.01 pound (0,005 kg) 0 to 120 pounds (55 kg)	Series 3000/3000E	Pennsylvania Scale Company (03964)

* Refer to the IPL, paragraph 2, for the address.

2. Leak Test

WARNING: THE CARTRIDGES (5, IPL FIGURE 1) ARE EXPLOSIVE DEVICES. INADVERTENT DETONATION OF A CARTRIDGE CAN CAUSE INJURY. FOR SAFE HANDLING, PERSONNEL MUST BE GROUNDED AND THE PROTECTIVE CAPS (10) AND SHUNT WIRE/CAUTION TAGS (-15) MUST BE INSTALLED ON THE ELECTRICAL CONNECTOR.

A. Wind the ground strap around your wrist, and connect the strap to the circuit tester (Table 101). Test the ground circuit.

B. Verify the shunt wire/caution tags (-15) is installed on the cartridges (5) between the positive and negative terminals.

C. Remove the cartridges (5) from the housing assemblies (25). Refer to Disassembly section, paragraph 2.

CAUTION: DO NOT USE COMPRESSED AIR TO BLOW CONTAMINANTS FROM THE DISCHARGE BOSS. COMPRESSED AIR CAN DAMAGE THE RUPTURE DISC.

D. Use a cotton swab or vacuum (Table 101) to clean dirt and other contamination from the discharge bosses.

E. Separate the fire extinguisher from other filled fire extinguishers. Use shop air to blow away any extinguishing agent in the air immediately around the fire extinguisher.

F. Wait two hours for any leakage to collect.

G. Set the sensitivity scale on the leak detector (Table 101) to 1×10^{-6} sccs.

H. Hold the detector probe 1/4 inch above the surface of the unit to light touching of the unit and check each discharge boss, the pressure gauge (80), and the fill fitting (60) for a minimum of 60 seconds each, then slowly move the probe over the weld joints.

I. If leak detection indicates no leak, proceed to paragraph N.

J. If leak detection indicates a leak, place the fire extinguisher in a large plastic bag (Table 101) and close the bag.

K. Wait 2 hours, then probe the air inside the plastic bag (Table 101) and check each discharge boss, the pressure gauge (80), and the fill fitting (60) for a minimum of 60 seconds each, then slowly move the probe over the weld joints. Record the leakage at each test point.

L. Calculate the leakage rate, as follows:

$$L_r = \frac{L_i \times V}{T \times F}$$

Where:
- L_r = Leakage rate (sccs)
- L_i = Detector reading (sccs)
- V = Volume of plastic bag, less weldment volume
- T = Time (in seconds) of weldment inside plastic bag
- F = Flow rate of leak detector (5 sccs) for Inficon 3000 *

* Refer to equivalent leak detector manual for flow rate.

M. If the leakage rate exceeds 1×10^{-6} sccs, repair or replace the fill fitting (60) and pressure gauge (80) as applicable, and repeat leak test.

N. If the leakage rate is less than 1×10^{-6} sccs, reinstall the cartridges (5) (refer to Assembly section, paragraph 6).

O. Install the protective caps (Table 101).

3. Cartridge Test

WARNING: THE CARTRIDGES (5, IPL FIGURE 1) ARE EXPLOSIVE DEVICES. INADVERTENT DETONATION OF A CARTRIDGE CAN CAUSE INJURY. FOR SAFE HANDLING, PERSONNEL MUST BE GROUNDED AND THE PROTECTIVE CAPS (10) AND SHUNT WIRE/CAUTION TAGS (-15) MUST BE INSTALLED ON THE ELECTRICAL CONNECTORS (EXCEPT WHEN SPECIFIED IN THE PROCEDURE).

A. Wind the ground strap around your wrist, and connect the strap to the circuit tester (Table 101). Test the ground circuit. Refer to Figure 101.

B. Ground the safety chamber (Table 101).

C. Verify that the shunt wire/caution tags (-15, IPL Figure 1) are installed on the cartridges (5).

WARNING: THE CARTRIDGE MUST BE TESTED IN A FIXTURE THAT PROVIDES PROTECTION FOR PERSONNEL. THE SAFETY CHAMBER IS DESIGNED FOR THIS PURPOSE.

D. Thread the cartridges (5), with the shunt wire/caution tags (-15) and o-rings (20) installed, into the safety chamber (Table 101).

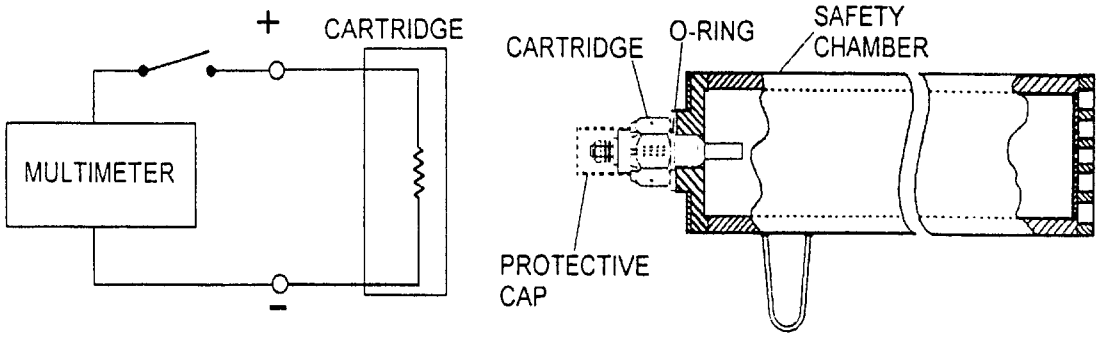


Figure 101. Cartridge Test Setup

CAUTION: TEST DEVICES THAT PASS MORE THAN 50 MILLIAMPERES CURRENT CAN AFFECT THE USEFUL LIFE AND RELIABILITY OF THE CARTRIDGE. DO NOT USE A VOLTMETER, FLASHLIGHT BATTERY, CONTINUITY LIGHT, OR SIMILAR DEVICE.

E. Set up the digital multimeter (Table 101), as follows:

(1) Disconnect the test leads from the digital multimeter.

(2) Connect the digital multimeter to a power source.

(3) Press the green button to turn on the digital multimeter power.

(4) Press the V and mA buttons at the same time to select the low display range.

(5) Ensure that the digital multimeter is set to measure DC power.

(6) Press the gray button (second from the left) to select the 2 ohm range.

(7) Plug the black test lead into the COMMON terminal. Plug the red test lead into the LOW RANGE terminal.

(8) Hold the probe ends together and adjust the ZERO control until the display reads zero.

F. Remove the shunt wire/caution tag (-15, IPL Figure 1) from the cartridge (5).

CAUTION: DO NOT BEND THE CARTRIDGE CONNECTOR PINS.

G. Measure the bridgewire resistance across the cartridge connector positive terminal to the negative terminal.

REQUIREMENT: EACH BRIDGEWIRE RESISTANCE MUST BE 0.9 TO 1.4 OHM.

H. Dispose of the cartridge that fails this test (refer to Check section, paragraph 7).

I. Disconnect the digital multimeter. Reinstall the shunt wire/caution tags (-15) on the cartridges (5).

J. Remove the cartridge from the safety chamber.

4. Hydrostatic Pressure Test Requisites

A. The DOT requires these units to be hydrostatically tested at five year intervals. FAA, CAA, and DOT rules may impose other requirements.

B. The approved method of testing is by water jacket volumetric expansion, which uses high internal water pressure to determine total volumetric expansion.

5. Hydrostatic Test Procedure

A. Set up the hydrostatic test equipment.

B. Prepare the fire extinguisher for the hydrostatic test, as follows:

(1) Disassemble the fire extinguisher to remove the cartridges (5), housing assemblies (25), discharge outlets (35), fill fitting (60), and pressure gauge (80). Refer to the Disassembly section.

(2) Install plugs and caps (Table 101) in the boss locations.

C. Perform hydrostatic test per test stand (Table 101) manufacturer's instructions.

REQUIREMENT: THE PERMANENT VOLUMETRIC EXPANSION MUST NOT EXCEED 10 PERCENT OF THE TOTAL VOLUMETRIC EXPANSION.

NOTE: If the test pressure cannot be maintained due to a failure of the test apparatus, the test may be repeated at a pressure increase of 10 percent or 100 psig (690 kPag), whichever is the lower value.

D. Repeat the test once if system error is suspected. Replace the weldment if the weldment fails both tests.

E. Remove the caps and plugs (Table 101) from the weldment. Drain the water from the weldment.

F. Heat in an oven or heater (Table 101) to 225°F to 250°F (107°C to 121°C). Heat the weldment for one hour or until completely dry.

G. Inspect the weldment (refer to the Check section, paragraph 3).

H. Stamp the hydrostatic test date and DOT identification number next to the pressure stamp on the mounting lug.

6. Pressure Gauge Functional Test

A. Install the pressure gauge (80) into the test fitting (Table 101).

B. Using an adjustable, calibrated source of dry nitrogen (Table 101), apply gradually increasing pressure to the gauge while monitoring and recording gauge and source pressure indications.

C. Accuracy of recorded pressure gauge indications are as follows:

PRESSURE GAUGE	MASTER GAUGE
1000 psig (6895 kPag), 1500 psig (10343 kPag)	±40 psig (±276 kPag)
600 psig (4137 kPag)	±20 psig (±138 kPag)
300 psig (2069 kPag), 500 psig (3448 kPag), 900 psig (6206 kPag)	+40 psig (+276 kPag) -20 psig (-138 kPag)

D. Failure of the pressure gauge to perform as described above is cause for rejection. Remove and replace gauge (80) (refer to Check section, paragraph 8).

DISASSEMBLY

1. General

NOTE: Refer to the Testing and Fault Isolation section to establish the condition of the fire extinguisher or most probable cause of a malfunction. This determines the extent of disassembly required.

CAUTION: REMOVE THE PROTECTIVE CAPS (TABLE 301) ONLY WHEN NECESSARY FOR MAINTENANCE. THE CONNECTORS AND BOSSES MUST BE COVERED AT ALL OTHER TIMES TO PREVENT CONTAMINATION AND DAMAGE.

A. This section contains the fire extinguisher discharge and disassembly instructions. Skip the unnecessary steps, if only partial disassembly is necessary. Refer to Figure 301 for a disassembly sequence chart.

NOTE: Refer to the Repair section to replace the identification plate (95, IPL Figure 1), caution plate (90), and pressure plate (85).

B. The recommended tools and materials are given in Table 301.

NOTE: Equivalent items can be used.

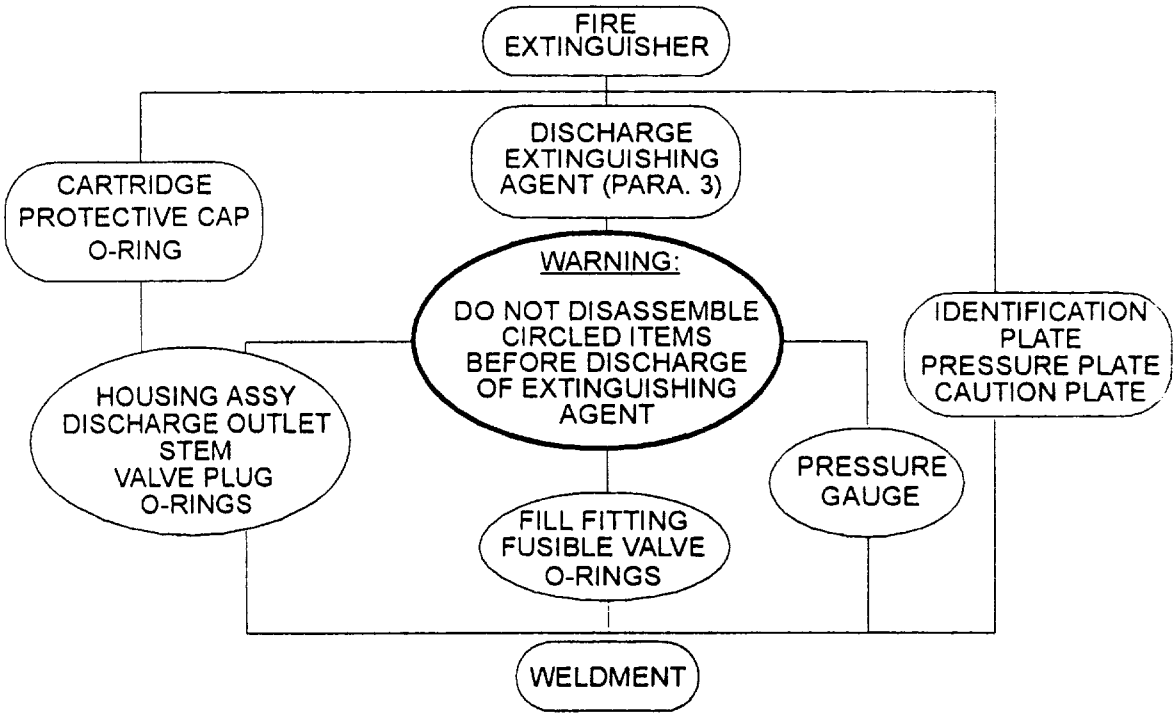


Figure 301. Disassembly Sequence Chart

Table 301. Disassembly Tools and Materials

Nomenclature	Part or Specification Number	Source (CAGE)*
Bar Tool (4 inch length x 1/2 inch width x 1/8 inch thickness)	---	User furnish
Cradle, Fire Extinguisher	83000242	Pacific Scientific (05167)
Discharge Recovery Tool	59000059	Pacific Scientific (05167)
Ground Strap and Circuit Tester	WT25	Walter G. Legge Co. (84832)
Halon Recovery Recycle System	A6-06-2000-75-0 (Model H 1301)	Neutronics Inc. (5R712)
Protective Caps		
Cartridge Cover	5/8-SC	CaPlugs (99017)
Cartridge Port	PD-50	CaPlugs (99017)
Cartridge Thread	1/2-SC	CaPlugs (99017)
Discharge Boss	PD-200	CaPlugs (99017)
Discharge Outlet End	CD-22	CaPlugs (99017)
Fill Boss	PD-40	CaPlugs (99017)
Fill Fitting End	CD-4	CaPlugs (99017)
Pressure Gauge Fitting	WW-O	CaPlugs (99017)
Safety Bag, Heat Sealable Electrostatic	22024509	Noland Paper Co. (OAZM2)
Stem Holding Tool	13254	Pacific Scientific (05167)
Wrench, Open End 5/8, 9/16, and 1-1/4 inch	---	Commercially available

* Refer to the IPL, paragraph 2, for the address.

CAUTION: DO NOT USE METAL TOOLS TO REMOVE THE O-RINGS. METAL TOOLS CAN SCRATCH THE O-RING GROOVES, CAUSING LEAKAGE AND POSSIBLE CORROSION.

C. Note the procedure and locations of safety wiring to help reassembly. Replace the o-rings at each overhaul.

2. Cartridge

WARNING: THE CARTRIDGE (5, IPL FIGURE 1) IS AN EXPLOSIVE DEVICE. ACCIDENTAL DETONATION OF A CARTRIDGE CAN CAUSE INJURY. FOR SAFE HANDLING, PERSONNEL MUST BE GROUNDED AND THE PROTECTIVE CAP (10) AND SHUNT WIRE/CAUTION TAG (-15) MUST BE INSTALLED ON THE ELECTRICAL CONNECTOR.

A. Wind the ground strap around your wrist, and connect the strap to the circuit tester (Table 301). Test the ground circuit.

B. Verify the shunt wire/caution tags (-15, IPL Figure 1) are installed on the cartridges (5) between the positive and negative terminals.

C. Put the weldment (105) in the cradle (Table 301). Cut the safety wire and remove the cartridges (5) from the housing assemblies (25).

D. Remove the cartridges (5) from the housing assemblies (25) by unscrewing the cartridge, while holding the hexagonal head of the housing assembly with at wrench (Table 301), to prevent accidental discharge.

E. Put the cartridges (5) in electrostatic safety bags (Table 301).

WARNING: DO NOT DISASSEMBLE THE FIRE EXTINGUISHER FURTHER UNTIL THE EXTINGUISHING AGENT HAS BEEN DISCHARGED. REFER TO PARAGRAPH 3 BELOW.

3. Discharge Procedure

NOTE: Use this procedure to discharge the extinguishing agent before removing the housing assemblies (25, IPL Figure 1), fill fitting (60), or pressure gauge (80).

WARNING: DO NOT DISCHARGE THE EXTINGUISHING AGENT INTO THE ATMOSPHERE. THE EXTINGUISHING AGENT MUST BE RECLAIMED AND RECYCLED. DO NOT HOLD THE FIRE EXTINGUISHER DURING DISCHARGE, THE DISCHARGE RECOVERY TOOL, DISCHARGE BOSS, AND WELDMENT WILL ICE OVER.

A. Remove the cartridges (refer to paragraph 2 above).

B. Thread the discharge recovery tool (Table 301) on the fill fitting (60). Connect the discharge recovery tool to a recovery tank or a Halon recovery system (Table 301). See Figure 302.

C. Turn the plunger in to depress the fusible valve (75) inside the fill fitting (60). After the extinguishing agent has fully discharged, remove the discharge recovery tool.

4. Discharge Outlets

A. Remove the cartridges (refer to paragraph 2 above).

B. Put the weldment (105, IPL Figure 1) in the cradle (Table 301).

C. Using the wrench (Table 301), remove the housing assemblies (25) from the discharge outlets (35), then lift the discharge outlet from the discharge boss. Remove and discard the o-rings (30).

NOTE: If the discharge outlets (35) and stems (40) do not separate from the housing assemblies (25), use the stem holding tool (Table 301) fastened to a table.

D. Unscrew and remove the stems (40), using a bar tool (Table 301) inserted through the largest exposed holes of the stems (40).

E. Remove the discharge outlets from the discharge bosses.

DISCHARGE SETUP
FOR FILL FITTING
(PREFERRED METHOD)

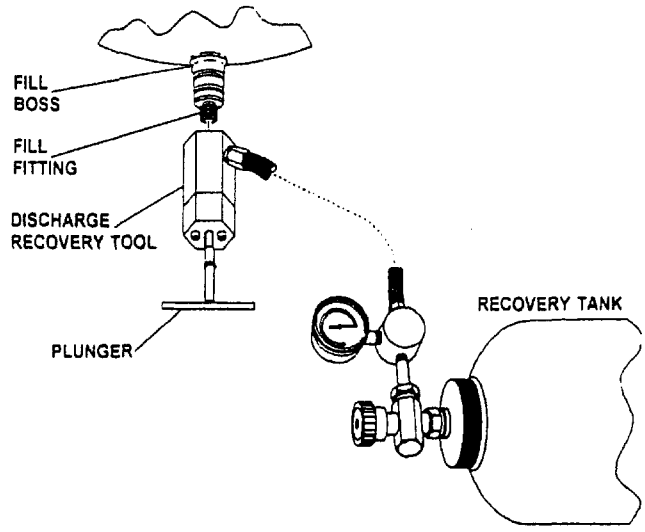


Figure 302. Discharge and Recovery Setup

F. Remove the valve plugs (50), then remove and discard the o-rings (55). If the valve plugs (50) and the o-rings (55) are not unseated, remove the valve plugs (50) and the o-rings (55), as follows:

(1) Hold the fire extinguisher with the discharge boss downward over an open box containing suitable cushioning material or install the stems (40) before proceeding, for safety purposes.

(2) Connect an external source of compressed air or gaseous nitrogen to the fill fitting (60).

(3) Slowly pressurize the fire extinguisher to approximately 50 psig (75 psig maximum) or until the valve plugs (50) and the o-rings (55) are blown out.

(4) Remove external pressure.

5. Fill Fitting

A. Discharge the extinguishing agent (refer to paragraph 3 above).

B. Put the weldment (105, IPL Figure 1) in the cradle (Table 301).

C. Using a wrench (Table 301) slowly remove the fill fitting (60) from the fill boss. Remove and discard the o-ring (65) from the fill fitting (60).

D. Remove the fusible valve (75) from the fill boss. Remove and discard the o-ring (70).

6. Pressure Gauge

A. Discharge the extinguishing agent (refer to paragraph 3 above).

B. Put the weldment (105, IPL Figure 1) in the cradle (Table 301).

C. To remove the pressure gauge (80), proceed as follows:

(1) Loosen the pressure gauge using a wrench (Table 301).

(2) Unscrew the pressure gauge (80) from the weldment (105) and remove the pressure gauge from within the gauge guard enclosure.

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CLEANING

1. Cleaning Materials

A. The recommended cleaning materials are given in Table 401.

NOTE: Equivalent items can be used.

Table 401. Cleaning Materials

Nomenclature	Part or Specification Number	Source (CAGE)*
Alcohol, Isopropyl	Federal Specification TT-I-735	Commercially available
Cloth, Lint-free	---	Commercially available
Light Probe	---	Commercially available
Oven or Heater, 250°F (121°C)	---	Commercially available
Protective Caps		
Cartridge Cover	5/8-SC	CaPlugs (99017)
Cartridge Port	PD-50	CaPlugs (99017)
Cartridge Thread	1/2-SC	CaPlugs (99017)
Discharge Boss	PD-200	CaPlugs (99017)
Discharge Outlet End	CD-22	CaPlugs (99017)
Fill Boss	PD-40	CaPlugs (99017)
Fill Fitting End	CD-4	CaPlugs (99017)
Pressure Gauge Fitting	WW-O	CaPlugs (99017)
Tape, Duct	---	Commercially available
Vacuum Source	---	Commercially available

* Refer to the IPL, paragraph 2, for the address.

2. Metal Parts

WARNING: INCORRECT HANDLING OF A CHARGED FIRE EXTINGUISHER CAN CAUSE ACCIDENTAL DISCHARGE OF THE EXTINGUISHING AGENT AND POSSIBLE INJURY. DO NOT APPLY PRESSURE TO, OR INSERT ANYTHING INTO THE DISCHARGE BOSS. THE CLEANING SOLVENT IS FLAMMABLE AND AN IRRITANT TO THE EYES AND NOSE. USE SOLVENT ONLY IN A WELL VENTILATED AREA AWAY FROM OPEN FLAMES. IF EYES BECOME IRRITATED, FLUSH WITH WATER.

CAUTION: ANY SCRATCHES OR DENTS ON THE SURFACE OF A RUPTURE DISC WILL CHANGE ITS CALIBRATION. SCRATCHED OR DENTED RUPTURE DISCS MUST BE REPLACED.

A. Clean all the metal parts with lint-free cloths and isopropyl alcohol (Table 401).

B. Dry all parts thoroughly with clean, lint-free cloths.

3. Weldment

A. Clean the inside of the weldment (105, IPL Figure 1) as follows:

(1) Pour 1/4 to 1/2 cup of isopropyl alcohol (Table 401) into the weldment.

(2) Shake the weldment in a circular movement, and drain the alcohol into a disposal container.

(3) Repeat the procedure until no further metal chips or filings are evident in the alcohol. Use a light probe (Table 401) and inspect the inside of the weldment.

(4) Heat an oven or heater (Table 401) 225°F to 250°F (107°C to 121°C). Heat the weldment for one hour or until completely dry.

B. Vapor hone unwanted discoloration from the outside of the weldment, as follows:

(1) Install the protective caps (Table 401).

(2) Cover the data plates with duct tape (Table 401).

(3) Vapor hone the weldment (wet or dry glass bead). Do not vapor hone the protected threads on the fill, discharge, and switch bosses.

(4) Remove the duct tape and protective caps, then clean the weldment completely (refer to paragraph 3.A above).

CHECK

1. Tools and Equipment

A. The recommended tools and equipment are given in Table 501.

NOTE: Equivalent items can be used.

Table 501. Check Tools and Equipment

Nomenclature	Part or Specification Number	Source (CAGE)*
Cradle, Fire Extinguisher	83000242	Pacific Scientific (05167)
Depth Micrometer or Indicator	---	Commercially available
Ground Strap and Circuit Tester	WT25	Walter G. Legge Co. (84832)
Light Probe	---	Commercially available
Power Supply or Battery, 30 VDC, 3.5 Amperes	---	Commercially available
Protective Caps		
Cartridge Cover	5/8-SC	CaPlugs (99017)
Cartridge Port	PD-50	CaPlugs (99017)
Cartridge Thread	1/2-SC	CaPlugs (99017)
Discharge Boss	PD-200	CaPlugs (99017)
Discharge Outlet End	CD-22	CaPlugs (99017)
Fill Boss	PD-40	CaPlugs (99017)
Fill Fitting End	CD-4	CaPlugs (99017)
Pressure Gauge Fitting	WW-O	CaPlugs (99017)
Safety Chamber, Cartridge	83330118	Pacific Scientific (05167)
Weighing Scale, ±0.01 pound (0,005 kg) 0 to 120 pounds (55 kg)	Series 3000/3000E	Pennsylvania Scale Company (03964)

* Refer to the IPL, paragraph 2, for the address.

2. Fire Extinguisher Weight Check

WARNING: INCORRECT HANDLING OF A CHARGED FIRE EXTINGUISHER CAN CAUSE ACCIDENTAL DISCHARGE OF THE EXTINGUISHING AGENT AND POSSIBLE INJURY. DO NOT APPLY PRESSURE TO, OR INSERT ANYTHING INTO THE DISCHARGE BOSS OR FILL FITTING.

A. Remove the protective caps (501).

NOTE: The weight marked on the identification plate (95, IPL Figure 1) does not include the protective caps (Table 501).

B. Put the cradle (Table 501) on the weighing scale (Table 501). Adjust the weighing scale to zero.

C. Put the fire extinguisher in the cradle.

D. Weigh the fire extinguisher. Record the weight to the nearest 0.01 pound (0,005 kg).

REQUIREMENT: MAXIMUM WEIGHT WITH THE CARTRIDGES (5) AND THE SHUNT WIRE/CAUTION TAGS (-15) AND WITHOUT THE PROTECTIVE CAPS (TABLE 501) IS SHOWN IN TABLE 502.

Table 502. Maximum Fire Extinguisher Weight

Fire Extinguisher	Maximum Weight	Allowable Deviation
P/N 17300	5.83 pounds (2,64 kg)	0.10 pound (0,05 kg)
P/N 17400	4.12 pounds (1,87 kg)	0.10 pound (0,05 kg)

E. Compare the current weight of the fire extinguisher to the last weight etched on the identification plate (95). Per the requirements above, if the fire extinguisher is more than 0.10 pound (0,05 kg) below the last recorded weight, test the fire extinguisher for leakage (refer to the Testing and Fault Isolation section, paragraph 2).

F. Install the protective caps (Table 501).

3. Container Weldment

A. Inspect the weldment (105, IPL Figure 1) for scratches or dents that could reduce its strength as a pressure vessel. Replace the weldment if the dents are deeper than 1/16 inch/inch (0,06 mm/mm) of average dent diameter, or the scratches are deeper than 0.004 inch (0,10 mm) or longer than 2 inches (5,08 cm).

B. Inspect all welded joints for cracks, breaks, or tears, especially at the mounting lugs.

4. Discharge Outlet

A. Under strong light, and preferably under magnification, inspect the discharge outlet (35, IPL Figure 1) for cracks, corrosion, crossed threads, stripped threads, chafing, scoring, and any other damage that might decrease operation. Dark stains on inside surfaces, caused by previous firing of the cartridge, are acceptable. Replace the discharge outlets that are not acceptable.

5. Fill Fitting

A. Check the fill fitting (60, IPL Figure 1). Replace the fill fitting if it is not acceptable.

6. Cartridge

WARNING: THE CARTRIDGES (5, IPL FIGURE 1) ARE EXPLOSIVE DEVICES. ACCIDENTAL DETONATION OF A CARTRIDGE CAN CAUSE INJURY. FOR SAFE HANDLING, PERSONNEL MUST BE GROUNDED AND THE PROTECTIVE CAPS (10) AND SHUNT WIRE/CAUTION TAGS (-15) MUST BE INSTALLED ON THE ELECTRICAL CONNECTORS (EXCEPT WHEN SPECIFIED IN THE PROCEDURE).

A. Wind the ground strap around your wrist, and connect the strap to the circuit tester (Table 501). Test the ground circuit.

B. Verify the shunt wire/caution tags (-15) are connected between the positive and negative terminals of the cartridges (5).

C. Check the service date (month/year) etched on the wrench flats of the cartridges (5). Dispose of the cartridge (as specified in paragraph 7, below) if its service life or combined life (service and storage) exceeds the limits.

REQUIREMENT: THE CARTRIDGES (5) HAVE A MAXIMUM INSTALLED SERVICE LIFE OF 4 YEARS AND A COMBINED SERVICE/STORAGE LIFE OF 6 YEARS.

7. Cartridge Disposal

WARNING: THE CARTRIDGE MUST BE DETONATED IN A FIXTURE THAT GIVES PROTECTION FOR PERSONNEL. THE SAFETY CHAMBER IS DESIGNED FOR THIS PURPOSE.

A. Ground the safety chamber (Table 501). The ground strap must be connected and grounded.

B. Make sure that the shunt wire/caution tags (-15) are installed on the cartridges (5) between the positive and negative terminals.

C. Cut the safety wire and remove the cartridges (5) from the housing assemblies (25). Refer to Disassembly Section, paragraph 2.D. Leave the o-ring (20) installed on the cartridge.

D. Thread the cartridges (5), with the shunt wire/caution tags (-15) installed, tightly into the safety chamber (Table 501). See Figure 501.

E. Remove the shunt wire/caution tags (-15) and connect electrical wires terminated with alligator clips to the cartridge terminals.

F. Connect the wire leads to a 30 VDC power supply or battery (Table 501). Stand back five feet (1.5 meters) minimum, and close the switch to detonate the cartridge.

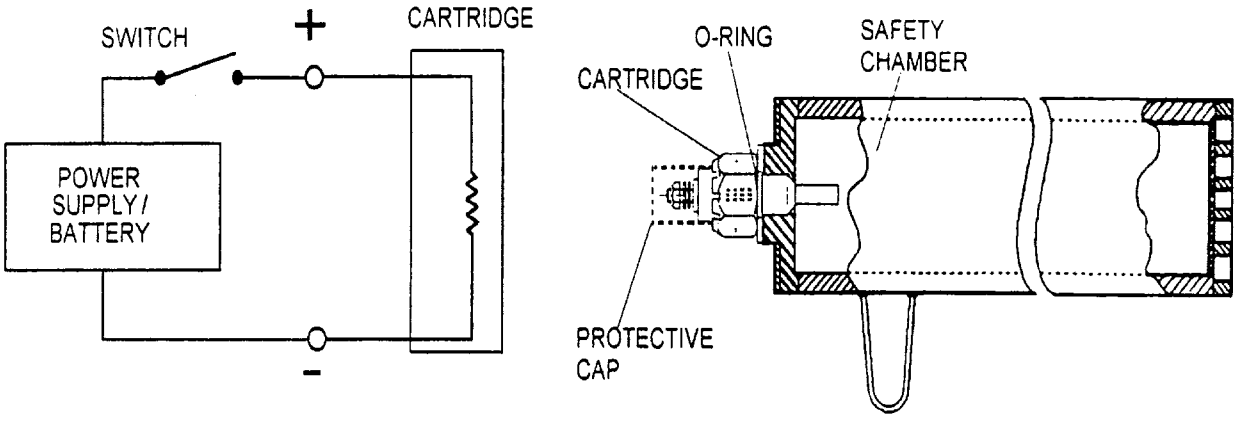


Figure 501. Cartridge Disposal Setup

8. Pressure Gauge

A. Verify that the pressure gauge functional test has been successfully completed (refer to Testing and Fault Isolation section, paragraph 6).

REPAIR

1. General

A. The repair instructions are limited to replacement of a damaged pressure, caution, and identification plate (85, 90, and 95, IPL Figure 1). Refer to the Disassembly and Assembly sections to replace all other components.

B. The recommended tools and materials are given in Table 601.

NOTE: Equivalent items can be used.

Table 601. Repair Tools and Materials

Nomenclature	Part or Specification Number	Source (CAGE)*
Adhesive, Epoxy	Scotchweld 1838 A/B	The 3M Company (04633)
Alcohol, Isopropyl	Federal Specification TT-I-735	Commercially available
Sandpaper, 240 grit	---	Commercially available

* Refer to the IPL, paragraph 2, for the address.

C. Repairs that require welding, except those covered in the Assembly section of this manual, are not permitted unless authorized in writing by Pacific Scientific Company.

D. After Pacific Scientific Company approval, repairs that require welding must be made in accordance with the latest FAA directives and under the supervision of a certified FAA mechanic with an airframe rating. If any doubt exists regarding penetration of the weld, inspect the welded part in accordance with MIL-STD-453.

2. Replacement of Bonded Plates

A. Copy the information from the old identification plate (95, IPL Figure 1) to the new identification plate.

B. Use 240 grit sandpaper (Table 601) to roughen the face of the old plates and the back of the new plate (85, 90, or 95).

C. Clean the plate using isopropyl alcohol (Table 601). Let dry.

D. Mix the two-part epoxy adhesive (Table 601) 5 parts A to 4 parts B, until the adhesive has a uniform color.

NOTE: The working life of the adhesive is 60 minutes at 75°F (24°C).

E. Apply an even coat of adhesive to the plate, and press the new plate on the old plate from the center out.

F. Remove all excessive adhesive. Make sure the bond line around the plate is smooth and even. Fill any voids along the edge with adhesive.

G. Cure the adhesive for 12 hours at 75°F (24°C). Tape, clamps, or other devices can be used to hold the plate in place until the adhesive cures.

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ASSEMBLY (INCLUDING STORAGE)

1. General

A. This section contains the fire extinguisher reassembly, refill, and storage instructions. Skip unnecessary steps if the fire extinguisher is partially assembled.

NOTE: Refer to the Repair section, paragraph 2, to replace the pressure, caution, and identification plate, (85, 90, and 95, IPL Figure 1).

B. The recommended tools and materials are given in Table 701.

NOTE: Equivalent items can be used.

Table 701. Assembly Tools and Materials

Nomenclature	Part or Specification Number	Source (CAGE)*
Alcohol, Isopropyl	TT-I-735	Commercially available
Bar Tool (4 inch length x 1/2 inch width x 1/8 inch thickness)	---	User furnish
Charging Fixture	83000148	Pacific Scientific (05167)
Cradle, Fire Extinguisher	83000242	Pacific Scientific (05167)
Ground Strap & Circuit Tester	WT25	Walter G. Legge Co. (84832)
Hoist	---	Commercially available
Lubricant	822 (Spec MMS-N306A)	Dri Lube Company (06186)
Protective Caps		
Cartridge Cover	5/8-SC	CaPlugs (99017)
Cartridge Port	PD-50	CaPlugs (99017)
Cartridge Thread	1/2-SC	CaPlugs (99017)
Discharge Boss	PD-200	CaPlugs (99017)
Discharge Outlet End	CD-22	CaPlugs (99017)
Fill Boss	PD-40	CaPlugs (99017)
Fill Fitting End	CD-4	CaPlugs (99017)
Pressure Gauge Fitting	WW-O	CaPlugs (99017)
Recharge Stand	8126300	Pacific Scientific (05167)
Safety Wire	MS20995C32	Commercially available
Safety Bag, Heat Sealable, Electrostatic	22024509	Noland Paper Co. (OAZM2)
Sling	---	Commercially available

* Refer to the IPL, paragraph 2, for the address.

Table 701. Assembly Tools and Materials (Continued)

Nomenclature	Part or Specification Number	Source (CAGE)*
Tank, Extinguishing Agent with Stand, 150 pounds (68 kg)	---	Commercially available
Tank, Gaseous Nitrogen (GN_2), 2000 psig (13800 kPag)	---	Commercially available
Tape, Foam Insulated (1/2 inch wide and 1/4 inch thick)	---	The 3M Company (04633)
Thermocouple	---	Commercially available
Thread Tape, Teflon (1/2 inch wide)	---	Commercially available
Valve Plug, Insertion Tool	13253	Pacific Scientific (05167)
Weighing Scale, ±0.01 pound (0,005 kg) 0 to 120 pounds (55 kg)	Series 3000/3000E	Pennsylvania Scale Company (03964)
Wrench, Open End 5/8, 9/16, and 1-1/4 inch	---	Commercially available

* Refer to the IPL, paragraph 2, for the address.

2. Pressure Gauge

A. Put the fire extinguisher in the cradle with the gauge boss up. Wrap the pressure gauge (80) thread with the thread tape (Table 701).

B. Insert the pressure gauge (80) inside the gauge guard on the weldment (105) and screw the pressure gauge fitting into the gauge boss until finger tight.

C. Using a wrench (Table 701) on the pressure gauge wrench flats, full tighten the pressure gauge in place.

3. Discharge Outlet

A. Using lubricant (Table 701), lubricate the o-rings (30, 45, and 55).

B. Install the o-rings (55) on the valve plugs (50). Position the valve plugs (50) in the discharge boss, screw the valve plug insertion tool (Table 701) into the discharge boss to seat the valve plugs (50). Remove the valve plug insertion tool.

C. Install the o-rings (45) on the stems (40). Lubricate the threads of the stems (40) and install in the discharge boss. Using bar tool (Table 701), tighten the stems (40) into the discharge boss.

D. Position the discharge outlets (35) on the stems (40).

E. Install the o-rings (30) on the housing assemblies (25). Lubricate the threads of the housing assemblies (25) and install in the stems (40), torque 145 to 155 inch-pounds (16 to 18 N•m).

4. Fill Fitting

A. Using lubricant (Table 701), lubricate the o-rings (65 and 70, IPL Figure 1).

B. Install the o-ring (70) on the fusible valve (75).

C. Insert the fusible valve (75) into the fill boss.

D. Install the o-ring (65) on the fill fitting (60).

E. Install the fill fitting (60) into the fill boss.

F. Torque the fill fitting (60) 90 to 100 inch-pounds (10 to 11 N•m).

5. Extinguisher Recharge

NOTE: See Figure 701 to set up the recharge stand and related equipment. Write the recharge data on a copy of Table 703.

A. Put the cradle (Table 701) on the weighing scale (Table 701). Adjust the weighing scale to zero.

B. Put the fire extinguisher in the cradle. Write the weight in entry 1 of Table 703.

NOTE: Weigh the fire extinguisher with the cartridges (5), and shunt wire/caution tags (-15) on the weighing scale. Remove the protective caps (Table 701).

C. Thread the charging fixture (Table 701) onto the fill fitting.

D. Add entry 1 of Table 703 to the charge weight given in entry 3. Write the sum in entry 5. Add entry 1 to the charge weight given in entry 2. Write the sum in entry 3.

E. Open the manifold valve (6) and agent valve (10), to allow the fire extinguishing agent to flow from the tank (11) into the fire extinguisher. Do not move the fire extinguisher, cradle, or hose.

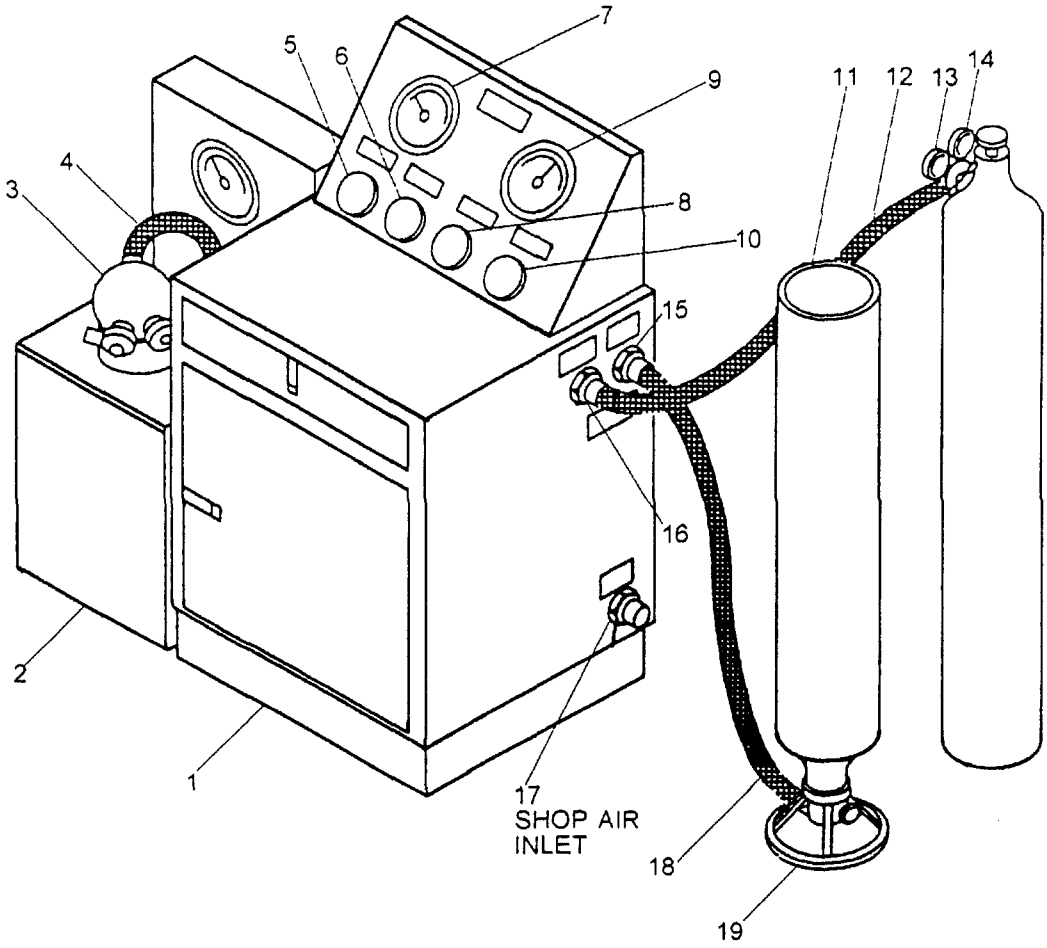
F. Close the agent valve (10) at the charge weight given in entry 3. Disconnect the charging fixture and charging hose (4). Write the weight of the filled fire extinguisher in entry 4.

G. Connect the charging hose (4) and the charging fixture to the fill fitting. Close the vent valve (5).

H. Write the thermocouple temperature in entry 5. Find the minimum and maximum nitrogen charge pressure from Table 704 for the thermocouple temperature recorded in entry 5 of Table 703. Write the minimum and maximum pressure in entry 6.

I. Adjust the regulator (13) on the nitrogen tank (14), using the nitrogen pressure gauge (9), to a pressure within the charge pressure range given in entry 6.

J. Open the nitrogen valve (8) and the charging fixture valve, then charge the fire extinguisher to the required pressure, as shown by the manifold pressure gauge (7, Figure 701).



LEGEND:

1. CONTAINER RECHARGE STAND (INCLUDES COMPRESSOR ASSEMBLY)
2. WEIGHING SCALE*
3. FIRE EXTINGUISHER IN CRADLE*
4. 1/4 - INCH FLEXIBLE CHARGING HOSE
5. VENT VALVE
6. MANIFOLD VALVE
7. MANIFOLD PRESSURE GAUGE
8. NITROGEN VALVE
9. NITROGEN PRESSURE GAUGE
10. AGENT VALVE
11. EXTINGUISHING AGENT TANK*
12. 1/4 - INCH FLEXIBLE NITROGEN HOSE
13. REGULATOR
14. NITROGEN TANK
15. AGENT INLET
16. NITROGEN INLET
17. AIR INLET
18. 1/4 - INCH FLEXIBLE HALON HOSE
19. AGENT TANK STAND

* INDICATES ITEMS NOT SUPPLIED WITH RECHARGE STAND

Figure 701. Fire Extinguisher Refill Setup (Sheet 1 of 2)

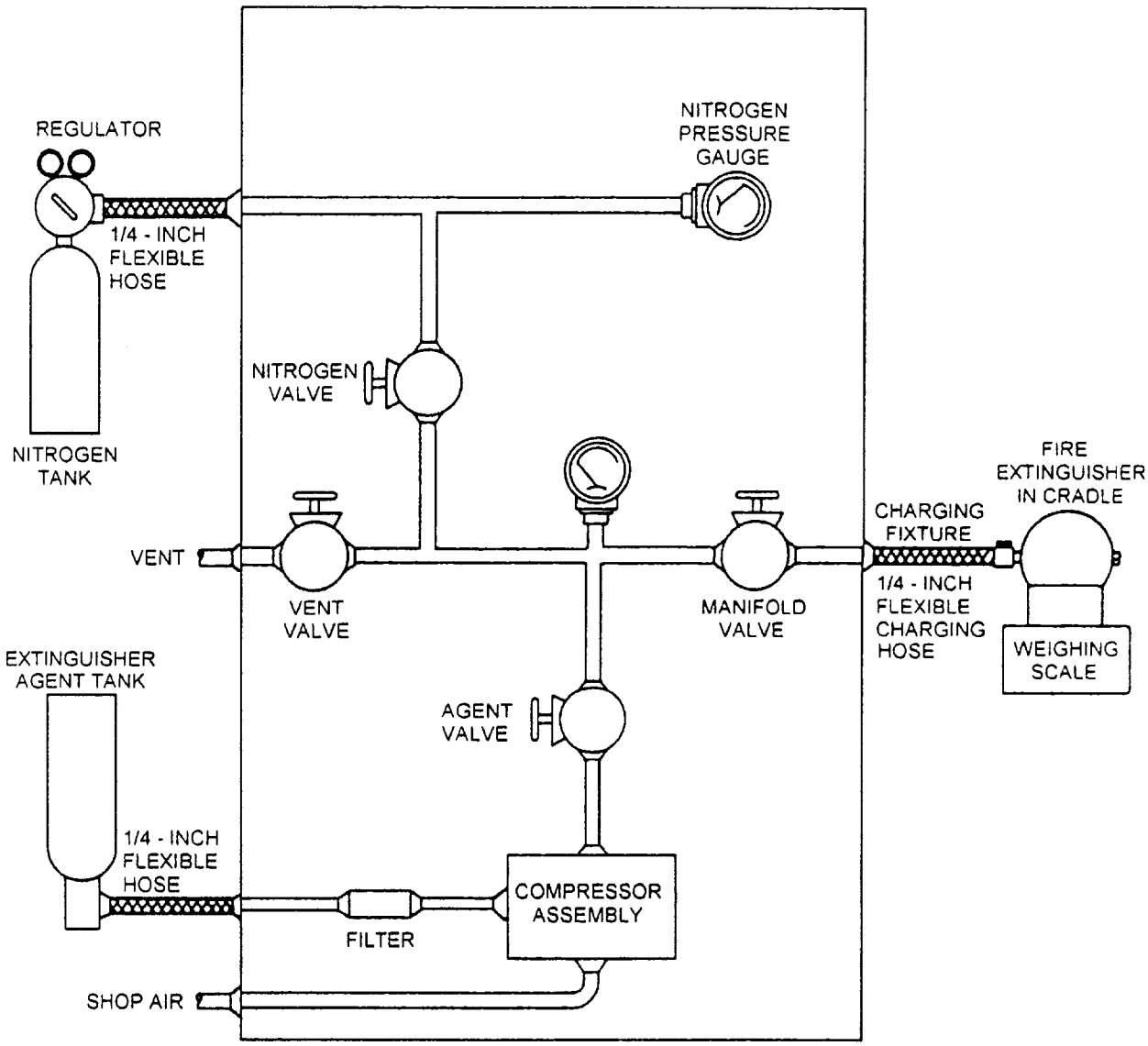


Figure 701. Fire Extinguisher Refill Setup (Sheet 2 of 2)

Table 702. Fire Extinguisher Refill Record

Part Number: _____ **Serial No:** _____	
Date of Refill: _____ **Pressure Switch Ser. No:** _____	
Weight Certified By: _____ **Hydrostatic Test Date:** _____	
Item	As Noted
1. Empty fire extinguisher on cradle (charging hose disconnected)	_____ pounds (kg) Actual
2. Required weight of extinguishing agent P/N 17300 P/N 17400	Pounds (kg) 2.00 to 2.12 pounds (0,91 to 0,96 kg) 1.00 to 1.25 pounds (0,45 to 0,57 kg)
3. Desired fill weight of fire extinguisher on cradle (charging fixture and hose disconnected) (entry 1 plus entry 2)	_____ pounds (kg) (Calculated)
4. Fire extinguisher filled with extinguishing agent on cradle (charging fixture and hose disconnected)	_____ pounds (kg) (Actual. Must meet entry 3 requirement)
5. Thermocouple temperature	_____ °F (°C)
6. Required nitrogen charge pressure at thermocouple temperature	_____ Psig (kPag) Minimum _____ Psig (kPag) Maximum
7. Actual nitrogen charge pressure (from manifold gauge)	_____ Psig (kPag
8. Filled fire extinguisher on cradle after nitrogen charge (charging fixture and hose disconnected)	_____ pounds (kg)
9. Calculated nitrogen weight (subtract entry 4 from entry 10)	_____ pounds (kg) (Calculated)
10. Actual weight of filled fire extinguisher with the cartridges and without the protective caps (Table 701)	_____ pounds (kg)

K. Close the charging fixture valve. Hold the fire extinguisher at arm's length and pressure gauge facing away from body. Shake the fire extinguisher until the nitrogen charge pressure stabilizes. Write the actual charge pressure from the manifold pressure gauge (7) in entry 7. Add nitrogen, if necessary, to raise the pressure to the minimum required pressure, repeat until pressure is stabilized.

Table 703. Nitrogen Charge Pressure Versus Temperature

Temperature (°F)	Pressure		Temperature (°F)	Pressure		Temperature (°F)	Pressure	
	Min	Max		Min	Max		Min	Max
60	567	587	74	617	637	88	669	689
62	574	594	76	624	644	90	677	697
64	581	601	78	632	652	92	686	706
66	588	608	80	639	659	94	694	714
68	595	615	82	647	667	96	703	723
70	602	622	84	654	674	98	713	733
72	609	629	86	662	682	100	720	740

NOTE: If the measured temperature is not in the table, use the higher temperature listed for the required pressure.

L. Close the nitrogen valve (8, Figure 701) and turn the fill fitting (60, IPL Figure 1) into the fill boss. Open the vent valve (5, Figure 701) and disconnect the charging fixture and charging hose (4).

M. Remove the fire extinguisher and the cradle from the weighing scale.

N. Check for leakage (refer to Testing and Fault Isolation section, paragraph 2).

O. Calculate the nitrogen charge weight. Write the result in entry 9.

P. Weigh the charged fire extinguisher (Table 704). Write the weight in entry 10.

Table 704. Charged Fire Extinguisher Weight

Fire Extinguisher	Maximum Charged Weight	Fire Extinguisher	Maximum Charged Weight
P/N 17300	5.83 pounds (2,64 kg)	P/N 17400	4.12 pounds (1,87 kg)

Q. Vibratech the charge weight (entry 10 of Table 703) and recharge date on the identification plate (95, IPL Figure 1). Do not use an impression or ink stamp.

R. Install the cartridges (refer to paragraph 6 below).

6. Cartridges

WARNING: THE CARTRIDGES (5, IPL FIGURE 1) ARE EXPLOSIVE DEVICES. ACCIDENTAL DETONATION OF A CARTRIDGE CAN CAUSE INJURY. FOR SAFE HANDLING, PERSONNEL MUST BE GROUNDED AND THE PROTECTIVE CAPS (-10) AND SHUNT WIRE/ CAUTION TAGS (-15) MUST BE INSTALLED ON THE ELECTRICAL CONNECTIONS.

A. Wind the ground strap around your wrist, and connect the strap to the circuit tester (Table 701). Test the ground circuit.

B. Make sure the protective caps (-10) and shunt wire/caution tags (-15) are installed on the cartridges (5) between the positive and negative terminals.

C. Lubricate the o-ring (20) (refer to Table 701). Install the o-rings (20) on the cartridges (5), then install the cartridge in the housing assemblies (25). Torque the cartridge 90 to 100 inch-pounds (10 to 11 N•m).

D. Install safety wire (Table 701) and connect the cartridge to the discharge outlet. Refer to MS33540.

7. Storage Instructions

A. The recommended materials are given in Table 705.

NOTE: Equivalent items can be used

Table 705. Storage Materials

Nomenclature	Part or Specification Number	Source (CAGE)*
Cardboard Container	12 inch x 12 inch x 12 inch (30 cm x 30 cm x 30 cm)	Commercially available
Packing Material	---	Commercially available
Plastic Bag	18 inch x 12 inch (45 cm x 30 cm)	Commercially available
Safety Bag, Heat Sealable, Electrostatic	22024509	Noland Paper Co. (OAZM2)
Wooden Box	Large enough for each cartridge, compartmented for multiple cartridges if required	User supply

* Refer to the IPL, paragraph 2, for the address.

B. Fire Extinguisher

NOTE: With protective caps (10) and shunt wire/caution tags (-15) installed on the cartridges (5), it is safer to store the fire extinguisher with the cartridge installed in the discharge outlet.

(1) Install the protective caps (Table 701) on the discharge outlets. Make sure the shunt wire/caution tags (-15) are installed on the cartridges (5).

(2) Insert the fire extinguisher into a plastic bag (Table 705). Put the fire extinguisher in a cardboard container (Table 705). Fill the cardboard container with packing material (Table 705), as needed to prevent damage to the components.

(3) Write the fire extinguisher part number, date of last hydrostatic test, and overhaul date on the outside of the cardboard container. Also, write the cartridge part numbers and the dates of their Service/Storage Life.

(4) Attach the following warning/caution stickers to the outside of the cardboard container.

(a) Non-Flammable Gas

(b) Compressed Gases, N.O.S. (Bromotrifluoromethane, Nitrogen), UN195

(c) Fragile - **DO NOT DROP**

(d) Storage temperatures are +40°F to +100°F (+4°C to +38°C).

C. Cartridge

WARNING: THE CARTRIDGES (5, IPL FIGURE 1) ARE EXPLOSIVE DEVICES. ACCIDENTAL DETONATION OF A CARTRIDGE CAN CAUSE INJURY. FOR SAFE HANDLING, PERSONNEL MUST BE GROUNDED AND THE PROTECTIVE CAPS (-10) AND THE SHUNT WIRE/CAUTION TAGS (-15) MUST BE INSTALLED.

(1) Wind the ground strap around your wrist, and connect the strap to the circuit tester (Table 701). Test the ground circuit.

(2) Make sure the protective cap (10) and shunt wire/caution tag (15) is installed on the cartridge (5).

(3) Put the cartridge in an electrostatic safety bag (Table 705), then into a correctly sized wooden box (Table 705), and seal.

(4) Write the cartridge part number and the Service/Storage dates on the outside of the wooden box. Mark the wooden box with Pyrotechnic, UN0367.

(5) Storage temperatures are +40°F to +100°F (+4°C to +38°C).

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FITS AND CLEARANCES

1. Torque Limits

A. Assembly torque limits are given in Table 801.

Table 801. Torque Limits

IPL Figure 1 Item Number	Nomenclature	Torque Range
5	*Cartridges*	*90 to 100 inch-pounds* (10 to 11 N·m)
25	Housing Assemblies	145 to 155 inch-pounds (16 to 18 N·m)

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SPECIAL TOOLS, FIXTURES, AND TEST EQUIPMENT

1. Special Tools, Fixtures, and Equipment

A. The special tools, fixtures, and test equipment recommended for maintenance of the fire extinguishers are given in Table 901. Item numbers listed in Table 901 refer to IPL Figure 1.

NOTE: Equivalent items can be used.

Table 901. Special Tools, Fixtures, and Equipment

Nomenclature	Part No.	Source (CAGE)*	Use
Bar Tool (4 inch length x 1/2 inch width x 1/8 inch thickness)	---	User furnish	To remove and install stems (40)
Cap, Hydrotest	83330165	Pacific Scientific (05167)	To cap the discharge boss for the hydrostatic test
Charging Fixture	83000148	Pacific Scientific (05167)	To connect the extinguishing agent and nitrogen tanks to the fill fitting (60) to refill the fire extinguisher
Cradle, Fire Extinguisher	83000242	Pacific Scientific (05167)	To support the fire extinguisher for maintenance and testing
Digital Multimeter	79	John Fluke (89536)	To check the cartridges (5)
Discharge Recovery Tool	59000059	Pacific Scientific (05167)	To connect the fire extinguisher to the recovery tank, and to depress the fusible valve (75) in the fill fitting (60)
Fitting, Hydrotest 0.750-16 UNJF Thread	---	Commercially available	To plug the fill boss for the hydrostatic test
Ground Strap & Circuit Tester	WT25	Walter G. Legge Co. (84832)	To ground the technicians for safe handling of the explosive cartridges (5)
Halon Recovery Recycle System	A6-06-2000-75-0 (Model H 1301)	Neutronics Inc. (5R712)	To recover and recycle Halon

* Refer to the IPL, paragraph 2, for the address.

Table 901. Special Tools, Fixtures, and Equipment (Continued)

Nomenclature	Part No.	Source (CAGE)*	Use
Hydrotest Test Stand	---	Commercially available	To pressurize the weldment (105) for the hydrostatic test
Leak Detector	HLD 4000-310 Series C	Inficon (56507)	To check for leakage of the extinguishing agent
Light Probe	---	Commercially available	To check the inside of the weldment (105) for unwanted materials and damage
Oven or Heater 250°F (121°C)	---	Commercially available	To dry the weldment (105) after the hydrostatic test and cleaning
Plug, Gauge Boss 1/4-18 NPT Thread	---	Commerically available	To plug the gauge boss for the hydrostatic test
Power Supply or Battery 28 VDC, 3.5 Amperes	---	Commercially available	To detonate cartridges (5) that have exceeded the maximum service and/or storage life
Protective Caps			To prevent contamination and damage
Cartridge Cover	5/8-SC	CaPlugs (99017)	
Cartridge Port	PD-50	CaPlugs (99017)	
Cartridge Thread	1/2-SC	CaPlugs (99017)	
Discharge Boss	PD-200	CaPlugs (99017)	
Discharge Outlet End	CD-22	CaPlugs (99017)	
Fill Boss	PD-40	CaPlugs (99017)	
Fill Fitting End	CD-4	CaPlugs (99017)	
Pressure Gauge Fitting	WW-O	CaPlugs (99017)	
Recharge Stand	8126300	Pacific Scientific (05167)	To fill the weldment (105) with extinguishing agent and Nitrogen
Safety Chamber, Cartridge	83330118	Pacific Scientific (05167)	To safely enclose the cartridges (5) for testing and for detonating before disposal
Stem Holding Tool	13254	Pacific Scientific (05167)	To hold the stems (40)

* Refer to the IPL, paragraph 2, for the address.

Table 901. Special Tools, Fixtures, and Equipment (Continued)

Nomenclature	Part No.	Source (CAGE)*	Use
Tank, Extinguishing Agent with Stand, 150 pounds (68 kg)	---	Commercially available	The extinguishing agent source for fire extinguisher recharge
Tank, Gaseous Nitrogen (GN_2) 2000 psig (13800 kPag)	---	Commercially available	The Nitrogen source for fire extinguisher recharge
Tank, Gaseous Nitrogen (GN_2) 1000 psig (6900 kPag)	---	Commercially available	The source for pressure tests
Tape, Foam Insulated (1/2" wide x 1/4" thick)	---	The 3M Company (04633)	To tape thermocouple to the fire extinguisher
Test Fitting, 1/8-27 NPT	---	Commercially available	To test the pressure gauge
Thermocouple	---	Commercially available	To test the temperature during recharge
Valve Plug Insertion Tool	13253	Pacific Scientific (05167)	To assemble the valve plugs (50)
Weighing Scale, ±0.01 pound (0,005 kg) 0 to 120 pounds (55 kg)	Series 3000/3000E	Pennsylvania Scale Company (03964)	To check the fire extinguisher charge weight and the recharge weight
Wrench, Open End 5/8, 9/16, 1-1/4 inch	---	Commercially available	To remove and install the housing assemblies (25), fill fitting (60), and pressure gauge (80)

* Refer to the IPL, paragraph 2, for the address.

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ILLUSTRATED PARTS LIST

1. Introduction

A. Purpose

(1) This IPL illustrates and lists the spare parts with attaching hardware.

B. Guide to use of the IPL

(1) If the part number is not known:

(a) Find the part in the illustration for the IPL Figure.

(b) Note the item number assigned to the part.

(c) Refer to the parts list and find the item number in the **Fig & Item** column.

(2) If the part number is known:

(a) Refer to the numerical index or parts list and find the part in the **Part Number** column.

(b) Note the figure number and item number assigned to the part.

(c) Refer to the illustration to find attaching hardware and related assembly parts.

2. Manufacturer Names and Address

A. The CAGE codes for the manufacturers of the parts, materials, special tools, and test equipment which may be referenced in this CMM are given below. The codes are taken from Cataloging Handbook H4/H8. The absence of a code in the **Nomenclature** column of the Detail Parts List means the part is manufactured or modified by the HTL/Kin-Tech Division of Pacific Scientific Company.

Code	Name and Address
OAZM2	Noland Paper Company 6600 Valley View Street Buena Park, California 90620 U.S.A.
03990	The ARO Corporation One ARO Center Bryan, Ohio 43506 U.S.A.
03964	Pennsylvania Scale Company 21 Graybill Road Leola, Pennsylvania 17540 U.S.A.
04633	The 3M Company Adhesives Coatings & Sealers Division 3M Center St. Paul, Minnesota 55101-1428 U.S.A.

Code	Name and Address
05167	Pacific Scientific Company HTL/Kin-Tech Division 1800 Highland Avenue Duarte, California 91010 U.S.A. Tel: (626) 359-9317 (626) 357-2102 FAX (626) 359-7013 SITA LAXPSCR
06186	DriLube Company 711 West Broadway Glendale, California 91204 U.S.A.
09669	Stanley Proto 1764 Oxford Street P.O. Box 5595, Terminal A London, Ontario, Canada N6A 4R6
10836	Greif Bros. Corp. Fibre Drum Division P.O. Box 398 Lindenhurst, New York 11767 U.S.A.
18675	Marking Methods Inc. 301 S. Raymond Ave. Alhambra, California 91803-1531 U.S.A.
3A054	McMaster-Carr Supply Co. 9630 Norwalk Blvd. Whittier, California 90670-2932 U.S.A. Tel: (562) 695-2449
5R712	Neutronics Inc. 456 Creameny Way Exton, Pennsylvania 19341-2532 U.S.A. Tel: (610) 524-8800 FAX (610) 524-8807
54636	Sherwin-Williams Company 101 Prospect Avenue N.W. Cleveland, Ohio 44115 U.S.A.
56507	Inficon, Leybold-Heraeus,Inc. 6500 Fly Road East Syracuse, New York 13057 U.S.A.
84832	Walter G. Legge Co., Inc 444 Central Avenue P.O. Box 591 Peekskill, New York 10566 U.S.A.
89536	John Fluke Mfg. Company 6920 Seaway Boulevard Everett, Washington 98206 U.S.A.
99017	Protective Closures Co., Inc. CaPlugs Division 2150 Elmwood Avenue Buffalo, New York 14207 U.S.A.

3. Explanation of Numerical Index Entries

A. The Numerical Index is provided to help find parts in the Detail Parts List by part number. The figure number, item number, and total quantity required are given for each entry.

B. The part numbers are arranged from left to right, one character at a time. The order of precedence is: (1) dash, (2) letter A through Z, and (3) numerals 0 through 9.

4. Explanation of Detail Parts List Entries

A. The Detail Parts List is arranged in general sequence of disassembly. The parts are illustrated in an exploded-view illustration and listed in the related parts list.

(1) **Fig & Item** Column

(a) The first number at the top of each **Fig & Item** column is the figure number of the corresponding illustration. The number given opposite each part number is the item number assigned to the part in the illustration.

(b) A dash (-) in front of an item number means the part is not illustrated.

(c) Alpha-variants A through Z (except I and O) are assigned to item numbers, when necessary to identify:

- Added parts
- Alternate parts
- Service bulletin modified parts

(2) **Part Number** Column

(a) This column contains the manufacturer's part number for each part, as modified to meet the requirements of ATA 200/2000. These modifications can include:

1 Removal of blank spaces and special characters, with the possible exception of dashes. Dashes are permitted only between numeric characters.

2 Insertion of a reference part number compatible with ATA 200/2000 if the manufacturer's part number exceeds 15 characters. In these cases, the manufacturer's part number is given in the **Nomenclature** column.

(3) **Nomenclature** Column

(a) This column contains descriptive nomenclature for each part, the manufacturer's CAGE code (if the part is not manufactured by Pacific Scientific Company, HTL/ Kin-Tech Division), part number (if longer than 15 characters or modified per ATA 200/2000), service bulletins affecting the part, and obsolete part numbers.

(b) The indenture system used in the **Nomenclature** column indicates the relationship of one part to another, as follows:

1 2 3
End Item or Major Assembly
ATTACHING PARTS
Attaching Parts for End Item or Major Assembly
* * *
. Detail Parts for End Item or Major Assembly
. Subassemblies
ATTACHING PARTS
. Attaching Parts for Subassemblies
* * *
. . Detail Parts for Subassemblies
ATTACHING PARTS
. . Attaching Parts for Detail Parts
* * *

(c) Assemblies, subassemblies, and detail parts subject to modification, deletion, addition, or replacement by an issued service bulletin, are annotated to indicate both pre- and post-service bulletin configurations. The term (PRE SB XXXX) in the **Nomenclature** column designates the original configuration, and the term (POST SB XXXX) identifies assemblies and parts after the modification has been completed.

(d) The terms defined below are used when applicable to indicate the interchangeability of parts.

Term	Abbreviation	Definition
Alternate	ALT	The listed part is alternate to, and interchangeable with, other parts within the same item number variant group or other item numbers if designated.
Superseded By	SUPSD BY	The part is replaced by and is not interchangeable with the item number designated in the notation.
Supersedes	SUPSDS	The part replaces and is not interchangeable with the item number designated in the notation.
Replaced By	REPLD BY	The part is replaced by and is interchangeable with the item number designated in the notation.
Replaces	REPLS	The part replaces and is interchangeable with the item number designated in the notation.

(4) **Eff Code** (Effectivity Code) Column

(a) This column contains effectivity codes (A, B, etc) to indicate the alternate models or configurations of the end item to which the parts apply. This column is left blank when the parts apply to all models or configurations, included in the parts list.

(5) **UPA** (Units Per Assembly) Column

(a) The quantity shown in this column represents the units required for one NHA or, when referring to attaching parts, the quantity to attach one such item. The abbreviation RF (reference) indicates that the end item assembly is listed for reference purposes.

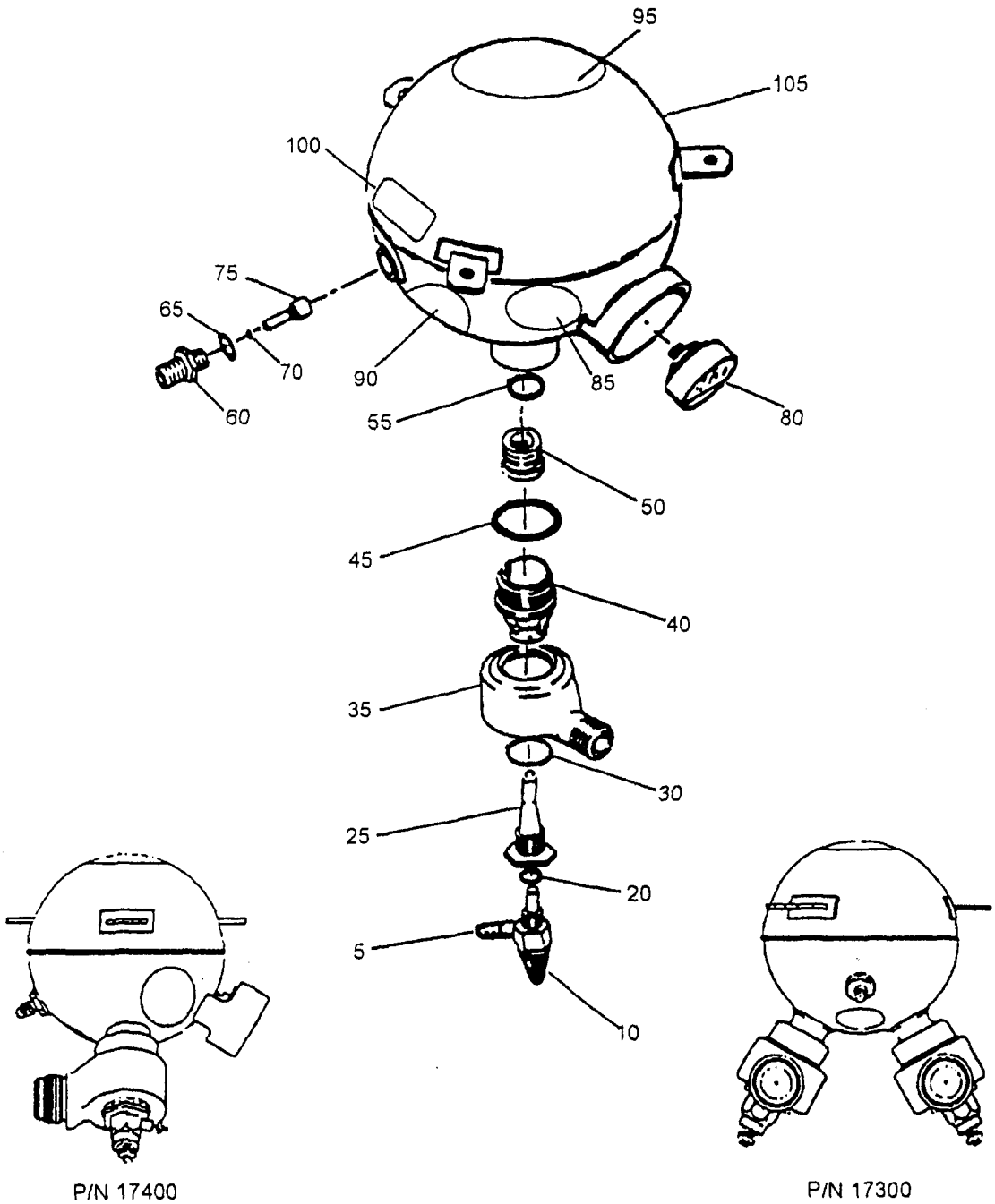
5. Numerical Index

Part Number	Airline Part Number	Fig - Item	Total Req.
AS568-910		1 - 55A	1
		1 - 55D	2
MS28775-007		1 - 70A	1
MS28775-021		1 - 30A	1
		1 - 30C	2
MS28775-128		1 - 45A	1
		1 - 45D	2
MS28778-4		1 - 65A	1
MS28778-5		1 - 20A	1
		1 - 20C	2
13004		1 - 45	1
		1 - 45C	2
13014		1 - 75	1
13024		1 - 30	1
		1 - 30B	2
13026		1 - 70	1
13028		1 - 60	1
13034		1 - 40	1
		1 - 40B	2
13037		1 - 65	1
13038		1 - 50	1
		1 - 50A	2
13045-2		1 - 105	1
13051		1 - 55	1
		1 - 55C	2
13059-2		1 - 35	1
		1 - 35A	2
13066		1 - 20	1
		1 - 20B	2
13077		1 - 110	A/R
13083-5		1 - 5	1
		1 - 5A	2
13088		1 - 105A	1
13114		1 - 100	1
13146		1 - 25	1
		1 - 25A	2
13177		1 - 115	A/R
17300		1 - 1A	RF
17400		1 - 1	RF
2725-709		1 - 80	1
31575000		1 - 100A	1
31575600		1 - 15	1
		1 - 15A	2
31576505		1 - 90	1
31576515		1 - 95	1
31576517		1 - 85	1
31840000		1 - 40A	1
		1 - 40C	2
32000405		1 - 120	A/R
5/8-SC		1 - 10A	1
		1 - 10C	2
90802020		1 - 10	1
		1 - 10B	2

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6. Detailed Parts List

NOTE: The items in this list are made or supplied by the HTL/Kin-Tech Division of Pacific Scientific, or by the suppliers shown in this list. Pacific Scientific does not give approval for items that are procured from suppliers who are not shown in this list. Approval from Pacific Scientific is not necessary for government and industry standard parts.



IPL Figure 1. 86 Cubic Inch Fire Extinguisher

Fig & Item	Part Number	Airline Part Number	1234567Nomenclature	Eff Code	UPA
1 - 1	17400		FIRE EXTINGUISHER, 86 CUBIC INCH SINGLE OUTLET	A	RF
- 1A	17300		FIRE EXTINGUISHER, 86 CUBIC INCH DUAL OUTLET	B	RF
5	13083-5		.CARTRIDGE***	A	1
- 5A	13083-5		.CARTRIDGE***	B	2
10	90802020		..CAP, PROTECTIVE	A	1
- 10A	5/8-SC		..CAP, PROTECTIVE (ALT)	A	1
- 10B	90802020		..CAP, PROTECTIVE	B	2
- 10C	5/8-SC		..CAP, PROTECTIVE (ALT)	B	2
- 15	31575600		..TAG,SHUNT WIRE/CAUTION	A	1
- 15A	31575600		..TAG, SHUNT WIRE/CAUTION	B	2
20	13066		..O-RING	A	1
- 20A	MS28778-5		..O-RING (ALT)	A	1
- 20B	13066		..O-RING	B	2
- 20C	MS28778-5		..O-RING (ALT)	B	2
25	13146		.HOUSING ASSEMBLY***	A	1
- 25A	13146		.HOUSING ASSEMBLY**	B	2
30	13024		.O-RING***	A	1
- 30A	MS28775-021		.O-RING (ALT)	A	1
- 30B	13024		.O-RING***	B	2
- 30C	MS28775-021		.O-RING (ALT)	B	2
35	13059-2		.OUTLET, DISCHARGE (SWIVEL)	A	1
- 35A	13059-2		.OUTLET, DISCHARGE (SWIVEL)	B	2
40	13034		.STEM (SUPSD BY ITEM -40A)	A	1
- 40A	31840000		.STEM (SUPSDS ITEM 40)	A	1
- 40B	13034		.STEM (SUPSD BY ITEM -40C)	B	2
- 40C	31840000		.STEM (SUPSDS ITEM -40B)	B	2
45	13004		.O-RING***	A	1
- 45A	MS28775-128		.O-RING (ALT)	A	1
- 45C	13004		.O-RING***	B	2
- 45D	MS28775-128		.O-RING (ALT)	B	2
50	13038		.PLUG, VALVE***	A	1
- 50A	13038		.PLUG, VALVE	B	2
55	13051		.O-RING***	A	1
- 55A	AS568-910		.O-RING (ALT)	A	1
- 55C	13051		.O-RING	B	2

- ITEM NOT ILLUSTRATED
* THE PARTS INCLUDED IN THE RECHARGE KIT P/N 13177 REFURBISH ONE DISCHARGE VALVE.
** THE PARTS INLUDED IN THE RECHARGE KIT P/N 32000405 REFURBISH ONE DISCHARGE VALVE.
*** THE CARTRIDGE INCLUDE O-RING ITEM 20 AND SHUNT WIRE/CAUTION TAG ITEM -15.

Fig & Item	Part Number	Airline Part Number	1234567Nomenclature	Eff Code	UPA
- 55D	AS568-910		.O-RING (ALT)	B	2
60	13028		.FITTING, FILL		1
65	13037		.O-RING***		1
- 65A	MS28778-4		.O-RING (ALT)		1
70	13026		.O-RING***		1
- 70A	MS28775-007		.O-RING (ALT)		1
75	13014		.VALVE, FUSIBLE***		1
80	2725-709		.GAUGE, PRESSURE		1
85	31576517		.PLATE, PRESSURE		1
90	31576505		.PLATE, CAUTION		1
95	31576515		.PLATE, IDENTIFICATION		1
100	13114		.DECAL, WEIGHT*	A	1
- 100A	31575000		.DECAL, WEIGHT	B	1
105	13045-2		.WELDMENT (NOT PROCURABLE, ORDER NHA ITEM 1)	A	1
- 105A	13088		.WELDMENT (NOT PROCURABLE, ORDER NHA ITEM 1A)	B	1
- 110	13077		.KIT, RECHARGE (SUPSD BY P/N 13177)	A	A/R
- 115	13177		.KIT, RECHARGE (SUPSDS P/N 13077)	A	A/R
- 120	32000405		.KIT, RECHARGE NOTE: THE RECHARGE KIT INCLUDES ONE EACH OF O-RINGS (30, 45, 55, AND 65).	B	A/R

- ITEM NOT ILLUSTRATED
* THE PARTS INCLUDED IN THE RECHARGE KIT P/N 13177 REFURBISH ONE DISCHARGE VALVE.
** THE PARTS INLUDED IN THE RECHARGE KIT P/N 32000405 REFURBISH ONE DISCHARGE VALVE.
*** THE CARTRIDGE INCLUDE O-RING ITEM 20 AND SHUNT WIRE/CAUTION TAG ITEM -15.

NOTE: THE FIRE EXTINGUISHER IS MANUFACTURED WITH METAL PLATES (85, 90, AND 95). ORIGINALLY, THE FIRE EXTINGUISHER WAS MANUFACTURED WITH THE FOLLOWING DECALS:

Part Number	Description
13093	Fill Decal
13200	Swivel Decal
13206	Nameplate Decal
13218-2	Pressure Temperature Decal
13287	Safety Decal
31575100	Nameplate Decal

SUPPLEMENT

1. Scope

A. This Supplement contains the technical properties, the spare parts information, and an exploded-view drawing to help identify the parts that can be ordered. The fire extinguisher is manufactured by Pacific Scientific Company, HTL/Kin-Tech Division, Duarte, California.

B. The testing and fault isolation procedures, the disassembly, repair, check, cleaning, fits and clearances, and assembly instructions are contained in Component Maintenance Manual 26-20-202.

2. Technical Properties

A. The technical properties of the o-ring bottle fire extinguishers are given in the table below.

Table 1. Technical Properties for Fire Extinguisher

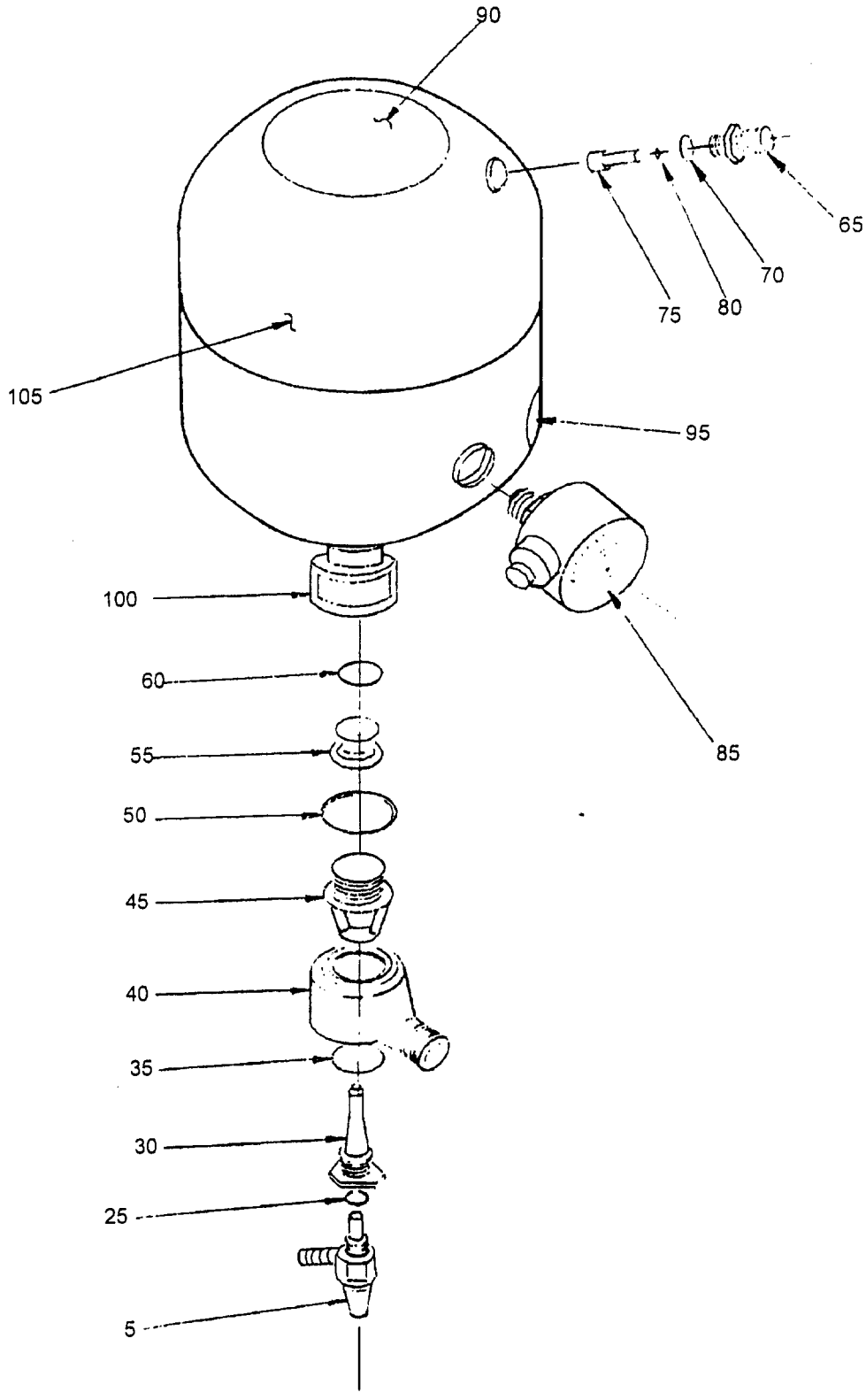
Property	Specifications
Description	
Manufacturer	Pacific Scientific, HTL/Kin-Tech Division
Part Number	P/N 30100043
Nomenclature	Fire Extinguisher, 60 Cubic Inch
Functional Properties	
Internal Volume	60 cubic inches (1,0 liters)
Extinguishing Agent	Bromotrifluoromethane ($CBrF_3$)
Pressurizing Gas	Nitrogen (N_2)
Ambient Temperature Range	-65°F to +160°F (-54°C to +71°C)
Pressure Data at 70°F (21°C)	
Charge Pressure	600 to 625 psig (4137 to 4309 kPag)
Hydrostatic Pressure Test	1800 psig (12411 kPag) minimum
Burst Pressure	2400 psig (16548 kPag) minimum
Weight Data	
Empty Fire Extinguisher	2.25 pounds (1,02 kg) maximum
Extinguishing Agent (full charge)	2.00 to 2.10 pounds (0,91 to 0,96 kg)
Nitrogen Charge	0.07 pound (0,03 kg) maximum
Charged Fire Extinguisher	4.42 pounds (2,01 kg) maximum
Allowable Weight Deviation - actual weight versus the last weight marked on data plate	Minus 0.10 pound (0,05 kg)

Table 1. Technical Properties for Fire Extinguisher (Continued)

Property	Specifications
Cartridge Data	
Voltage	18 to 30 VDC
Current Rating	
All Fire	3.0 amperes minimum
No Fire	0.5 ampere, 1.0 Watt for five minutes
Test Current	50 mA maximum
Bridgewire Resistance	0.9 to 1.4 ohm
Service Life	6 years
Maximum Life (service and storage)	9 years
Mating Receptacle	MS3106-10SL-4S
Pressure Data	
Maxing Switch Current	1.0 amp Lamb Load at 28 VDC
Temperature Range	-65°F to +220°F (-53°C to +104°C)
Burst Pressure	3750 psig (26576 kPag)
Increasing Pressure, Switch Closes	265 to 400 psig (1827 to 2758 kPag)
Decreasing Pressure, Switch Opens	265 to 200 psig (1827 to 1379 kPag)
Pressure Range Data at 70°F (21°C)	0 to 1500 psig (0 to 10343 kPag)
500 to 700 psig (4137 kPag)	±35 (±241 kPag)
Balance of Scale	±50 (±345 kPag)
Rupture Disc Valve	
Code	-22
Fill Fitting End	MS33656-4
Discharge Outlet End	MS33656-12

3. Detailed Parts List

NOTE: The items in the detailed parts list are made or supplied by the HTL/Kin-Tech Division of Pacific Scientific, or by the suppliers shown in this list. Pacific Scientific does not give approval for items that are procured from suppliers who are not shown in this list. Approval from Pacific Scientific is not necessary for government and industry standard parts.



IPL Figure 1. 60 Cubic Inch Fire Extinguisher

Fig &	Item	Part Number	Airline Part Number	1234567Nomenclature	Eff Code	UPA
1	1	30100043		FIRE EXTINGUISHER 60 CU IN		RF
	5	13083-25		.CARTRIDGE		1
-	10	90801005		..CAP, PROTECTIVE		1
-	15	31575600		..TAG, CAUTION		1
-	20	31040000		..SHUNT, TERMINAL		1
	25	13066		.O-RING		1
	30	13146		.HOUSING ASSEMBLY		1
	35	13024		.O-RING		1
	40	35240255		.OUTLET, DISCHARGE		1
	45	31840000		.STEM		1
	50	13004		.O-RING		1
	55	13038		.PLUG, VALVE		1
	60	13051		.O-RING		1
	65	13028		.FITTING, FILL		1
	70	13037		.O-RING		1
	75	33440005-5		.VALVE, RUPTURE DISC		1
	80	13026		.O-RING		1
	85	19915403-2		.GAUGE, PRESSURE		1
	90	31576515		.PLATE, IDENTIFICATION		1
	95	31576532		.PLATE, DATA		1
	100	31576523		.PLATE, CAUTION		1
	105	32197942		.WELDMENT (NOT PROCURABLE, ORDER NHA ITEM 1)		1
-	110	30180089		.KIT, MOUNTING *		1
-	115	13265-1		..CLIP, MOUNTING R.H.		2
-	120	13265		..CLIP, MOUNTING L.H.		2
-	125	38-701		..CLAMP		2

- ITEM NOT ILLUSTRATED
* MOUNTING KIT IS NOT INCLUDED WITH FIRE EXTINGUISHER AND MUST BE ORDERED SEPARATELY.

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HTL | ADVANCED TECHNOLOGY DUARTE, CA.

SERVICE BULLETIN

FIRE EXTINGUISHER

PN 17310

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PAGE 3/4 OF MANUAL 26-20-200
SUBSTITUTE THE FOLLOWING:

LEADING PARTICULARS	A	5-22-80	35007
	REV.	DATE	DCN

Internal Volume	86 Cu. In.
Extinguishing Agent	$CBrF_3$ (Bromotrifluormethane per MIL-B-12218)
Number of Outlets	2
Operating Temperature Range	-65° F to +185° F
Pressure Data:	
Charge Pressure	600^{+25}_{-0} PSIG @ 70° F (21.1° C)
Test (Proof) Pressure	1650 PSIG @ 70° F (21.1° C)
Burst Pressure	3000 PSIG @ 70° F (21.1° C)
Safety Relief	215° F to 226° F (101° C to 107.7°C)
Electrical Data:	
Cartridge:	
Voltage	18 to 30 VDC
Resistance	1.15 ± .25 ohms
Current, All Fire, (Recom. Min.)	3.0 amps
Current, Test, (Max.)	50 ma
Fitting Ends:	
Outlet	Per MS 33656-16
Fill and Relief	Per MS 33656-4
Weight:	
Agent	2.50^{+12}_{-0} lbs
Total Weight (Max.)	6.33 lbs

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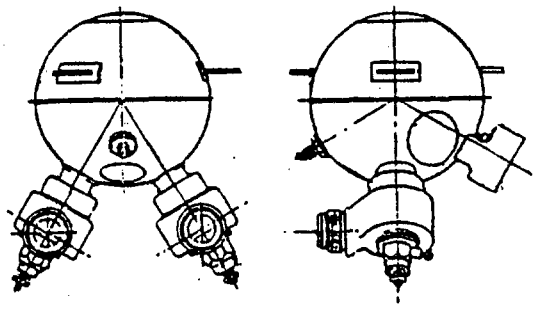
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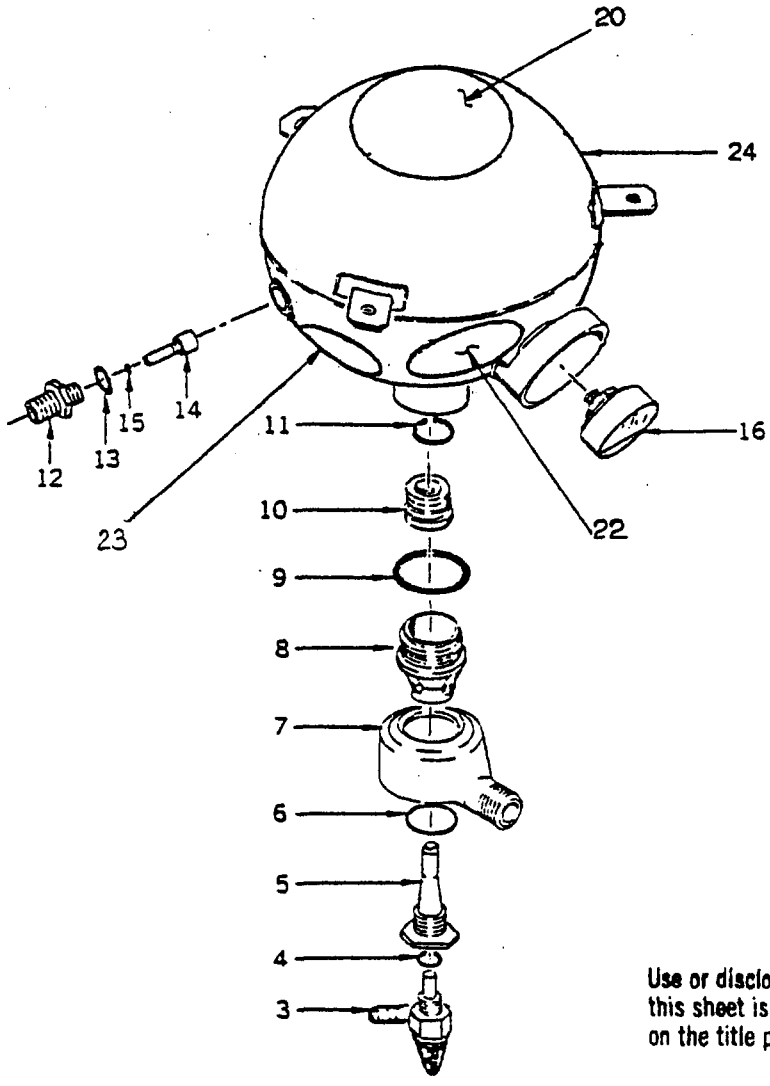
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SERVICE BULLETIN

FIRE EXTINGUISHER

PN 17310





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Container Assembly
FIGURE 1101

HTL | ADVANCED TECHNOLOGY DUARTE, CA.

SERVICE BULLETIN

FIRE EXTINGUISHER

PN 17310

PAGE 25 OF MANUAL 26-20-200
SUBSTITUTE THE FOLLOWING:

FIGURE & INDEX NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSEMBLY	INCLUDED IN RECHARGE KIT
1101-	17310	CONTAINER ASSEMBLY, fire extinguisher	1	
-3	13083-5	. CARTRIDGE	2	
-4	AN6290-5 (13066)	. SEAL.	2	
-5	13146	. HOUSING ASSEMBLY . . .	2	1
-6	MS28775-021 (13024)	. SEAL.	2	1
-7	13059-2	. DISCHARGE OUTLET. . . .	2	
-8	31840000	. STEM.	2	
-9	MS28775-128 (13004)	. SEAL.	2	1
-10	13038	. PLUG, Valve	2	1
-11	13051	. SEAL.	2	1
-12	13028	. FITTING	1	
-13	AN6290-4 (13037)	. SEAL	1	1
-14	13014	. VALVE, Fusible.	1	1
-15	MS29513-007 (13026)	. SEAL	1	1
-16	2725-709	. GAGE, Pressure.	1	
-17		.		
-18		.		
-19	13114	. DECAL, Weight Data . .		1
-20	31576515	. PLATE, Identification .	1	
-22	31576517	. DATAPLATE, Temp./Press.	1	
-23	31576505	. PLATE, Caution	1	
-24	13088-2	. WELD ASSEMBLY, Sphere .	1	
1101-	13077	KIT, Recharge.	1	

NOTES:
1. Recharge Kit refurbishes one valve only.
2. Cartridge (supplied with seal, item 4) must be ordered separately.
3. For containers equipped with metal plates, enter new charge date and gross weight in space provided on nameplate. Discard decal furnished in Recharge Kit.

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SERVICE BULLETIN

FIRE EXTINGUISHER

PN 17400

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PAGE 3/4 OF MANUAL 26-20-200
SUBSTITUTE THE FOLLOWING

LEADING PARTICULARS

Internal Volume	86 Cu. In.
Extinguishing Agent	$CBrF_3$ (Bromotrifluoromethane per MIL-B-12218)
No. of Outlets	1
Operating Temperature Range	-65° F to +180° F
Pressure Data:	
Charge Pressure	$600\ ^{+25}_{-0}$ PSIG @ 70° F (21.1° C)
Proof Pressure	1600 PSIG @ 70° F (21.1° C)
Burst Pressure	2700 PSIG @ 70° F (21.1° C)
Safety Relief Temperature Range	215° F to 226° F (101° C to 107.7° C)
Electrical Data:	
Voltage	18 to 30 VDC
Resistance	1.15 ± .25 ohms
Current (All Fire):	
Recommended Minimum	3.0 amps
Maximum Test Current	50 ma
Fitting Ends:	
Outlet	Per MS 33656-16
Fill and Relief	Per MS 33656-4
Weight:	
Agent	$1.00\ ^{+.25}_{-.00}$ lbs
Total Weight (Max.)	4.21 lbs

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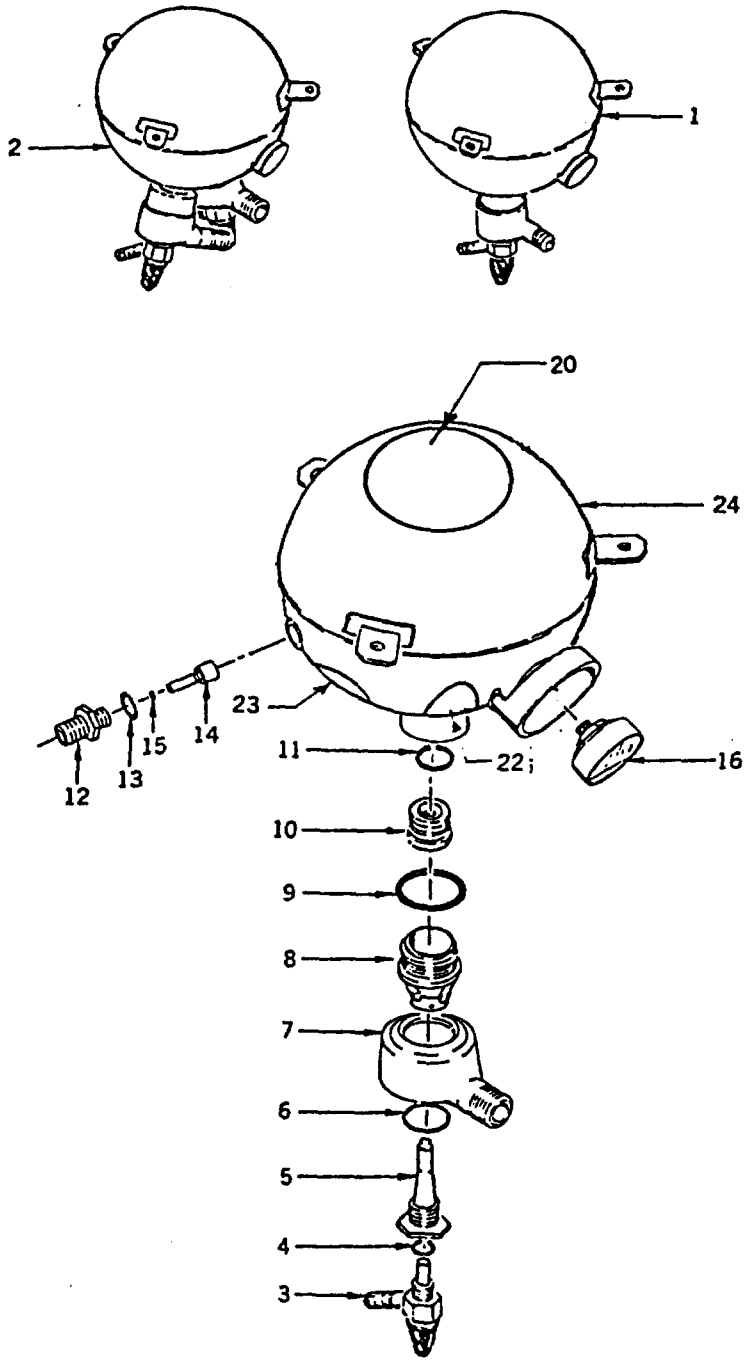
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SERVICE BULLETIN

FIRE EXTINGUISHER

PN 17400



Container Assembly

FIGURE 1101

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SERVICE BULLETIN

FIRE EXTINGUISHER

PN 17400

PAGE 25 OF MANUAL 26-20-200
SUBSTITUTE THE FOLLOWING

FIG. & INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY.
1101-	17400	CONTAINER ASSEMBLY, fire extinguisher	1
-3	**13083-5	. CARTRIDGE	1
-4	**AN6290-5 (13066)	. SEAL	1
-5	*13146	. HOUSING ASSEMBLY	1
-6	*MS28775-021 (13024)	. SEAL	1
-7	13059-2	. SWIVEL	1
-8	31840000	. STEM	1
-9	*MS28775-128 (13004)	. SEAL	1
-10	*13038	. PLUG, Valve	1
-11	*13051	. SEAL	1
-12	13028	. FITTING	1
-13	*AN6290-4 (13037)	. SEAL	1
-14	*13014	. VALVE, Check	1
-15	*MS29513-007 (13026)	. SEAL	1
-16	2725-709	. GAGE, Pressure	1
-17		.	
-18		.	
-19	*13114	. DECAL, Weight Data	1
-20	31576515	. PLATE, Identification. . . .	1
-22	31576517	. DATAPLATE, Temp./Press . . .	1
-23	31576505	. PLATE, Caution.	1
-24	13045-2	. WELD ASSEMBLY, Sphere	1
1101-	***13077	KIT, Recharge	1

* Parts included in Recharge Kit
** Parts not included in Recharge Kit. Cartridge (supplied with seal, item 4) must be ordered separately.
*** Parts to refurbish one valve only.
**** For containers equipped with metal plates, enter new charge date and gross weight in space provided on nameplate. Discard decal furnished in Recharge Kit.

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SERVICE BULLETIN

FIRE EXTINGUISHER

PN 30100010

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PAGE 3/4 OF MANUAL 26-20-200
SUBSTITUTE THE FOLLOWING

LEADING PARTICULARS

Internal Volume	65 Cu. In.
Extinguishing Agent	$CBrF_3$ (Bromotrifluoromethane per MIL-B-12218)
No. of Outlets	1
Operating Temperature Range	-65°F to $+160^{\circ}$F (54°C to 71° C)
Pressure Data:	
Charge Pressure	$600^{+.25}_{-.00}$ PSIG @ 70° F (21.1° C)
Proof Pressure	3000 PSIG @ 70° F (21.1° C)
Burst Pressure	3900 PSIG @ 70° F (21.1° C)
Safety Relief Temperature Range	215° F to 226° F (101° C to 107.7° C)
Electrical Data:	
Voltage	18 to 30 VDC
Resistance	$1.15 \pm .25$ ohms
Current (All Fire):	
Recommended Minimum	3.0 amps
Maximum Test Current	50 ma
Fitting Ends:	
Outlet,	Per MS 33656-10
Fill and Relief	Per MS 33656-4
Weight:	
Agent	$2.50^{+.15}_{-.00}$ lbs
Total Weight (Max.)	6.08 lbs

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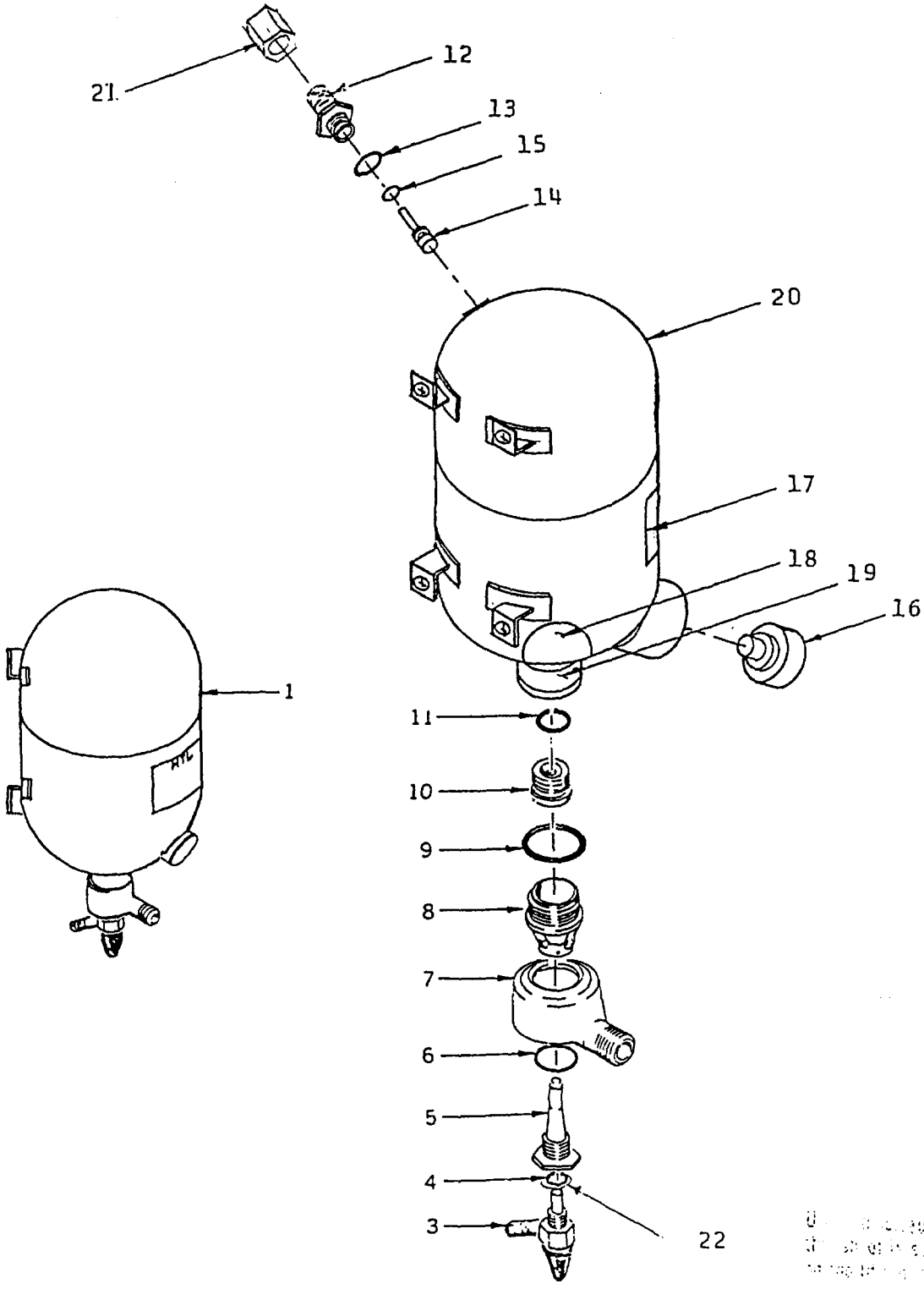
2-2-76 REV. A E.O. #31479

HTL ADVANCED TECHNOLOGY MONROVIA, CA.

SERVICE BULLETIN

FIRE EXTINGUISHER

PN 30100010



Container Assembly
Figure 1101

2-2-76 Rev. A, E.O. #31479

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SERVICE BULLETIN

FIRE EXTINGUISHER

PN 30100010

PAGE 25 OF MANUAL 26-20-200
SUBSTITUTE THE FOLLOWING

FIG. & INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY.
1101-1	30100010	CONTAINER ASSEMBLY, fire extinguisher	1
-3	**30903823	. CARTRIDGE	1
-4	**AN6290-5 (13066)	. SEAL	1
-5	*13146	. HOUSING ASSEMBLY	1
-6	*MS28775-021 (13024)	. SEAL	1
-7	35240072	. SWIVEL	1
-8	13034	. STEM ASSEMBLY	1
-9	*MS28775-128 (13004)	. SEAL	1
-10	*13038	. PLUG, Valve	1
-11	*13051	. SEAL	1
-12	13028	. FITTING	1
-13	*AN6290-4 (13037)	. SEAL	1
-14	*13014	. VALVE, Check	1
-15	*MS29513-007 (13026)	. SEAL	1
-16	18215901	. GAGE, Pressure	1
-17	31576546	. PLATE, Ident	1
-18	31576532	. PLATE, Data	1
-19	31576523	. PLATE, Caution	1
-20	35297512	. WELD ASSY.	1
-21	30840010	. COVER, Protection.	1
-22	**94202200	. SHIM WASHER	1
1101-	32000410	KIT, Recharge	1

* Parts included in Recharge Kit

** Parts Not Included in Recharge Kit
Cartridge(supplied with Seal, Item 4) must be ordered separately.
Shim washer (Item 22) to be used on cartridge when ground stud clocking is required. Must be ordered separately.

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2-2-76 Rev. A, E.O. #31479

HTL | ADVANCED TECHNOLOGY DUARTE, CA.

SERVICE BULLETIN

P/N 31000010

1. PLANNING INFORMATION

A. EFFECTIVITY

This Service Bulletin is applicable only to the HTL Fire Extinguisher, Part Number 31000010.

B. REASON

This Service Bulletin is issued to revise HTL Overhaul Manual 26-20-200 by adding the Fire Extinguisher, Part Number 31000010 configuration.

Except for the pages identified in this Bulletin, HTL Overhaul Manual 26-20-200 shall apply in its entirety.

C. DESCRIPTION

HTL Fire Extinguisher, Part Number 31000010 is 378 cubic inches in volume and contains $9.00^{+.10}_{-.00}$ pounds of agent. ($CBrF_3$). It contains an electrical switch integral with the pressure gauge which will signal low pressure between 265 and 200 psig.

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REV.	DESCRIPTION	DATE	APPD
-2	SEE DCN 37181	12-9-83	

December 16, 1982

31000010-26-2

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SERVICE BULLETIN

PAGE 3/4 OF MANUAL 26-20-200
SUBSTITUTE THE FOLLOWING:

TABLE I

LEADING PARTICULARS

Internal Volume	378 cu. in.
Ambient Temperature	-65°F to +160°F
Agent	$CBrF_3$*
Pressurizing Medium	Nitrogen
Charge Pressure	600^{+25}_{-0} psig at 70°F
Proof Pressure	1650 psig at 70°F
Safety Outlet Discharge	1300 to 1450 psig (177°F to 196°F)
Electrical Data	
Voltage	17-31 VDC
Current (All Fire) Recommended Minimum	3.0 amps
Resistance	1.15±.25 ohms
Maximum Test Current	50 ma
Pressure Switch Data	
Contacts close with increasing pressure between 265 and 400 psig	
Contacts open with decreasing pressure between 265 and 200 psig	
Load rating - 1.0 amp at 28 VDC (resistive)	
Electrical Connections	
Pressure Switch	Mates with MS3476L8-33S
Cartridge	Mates with MS3106R10SL-4S
Fitting Ends	
Outlet	Per MS33656-16
Fill and Relief	Per MS33656-4
Agent Weight	$9.0^{+0.10}_{-0.00}$ lbs.
Total Weight	15.28 lbs. Max.
Allowable Deviation-Actual container weight verses weight marked on container	±0.1 lb.

*Bromotrifluoromethane

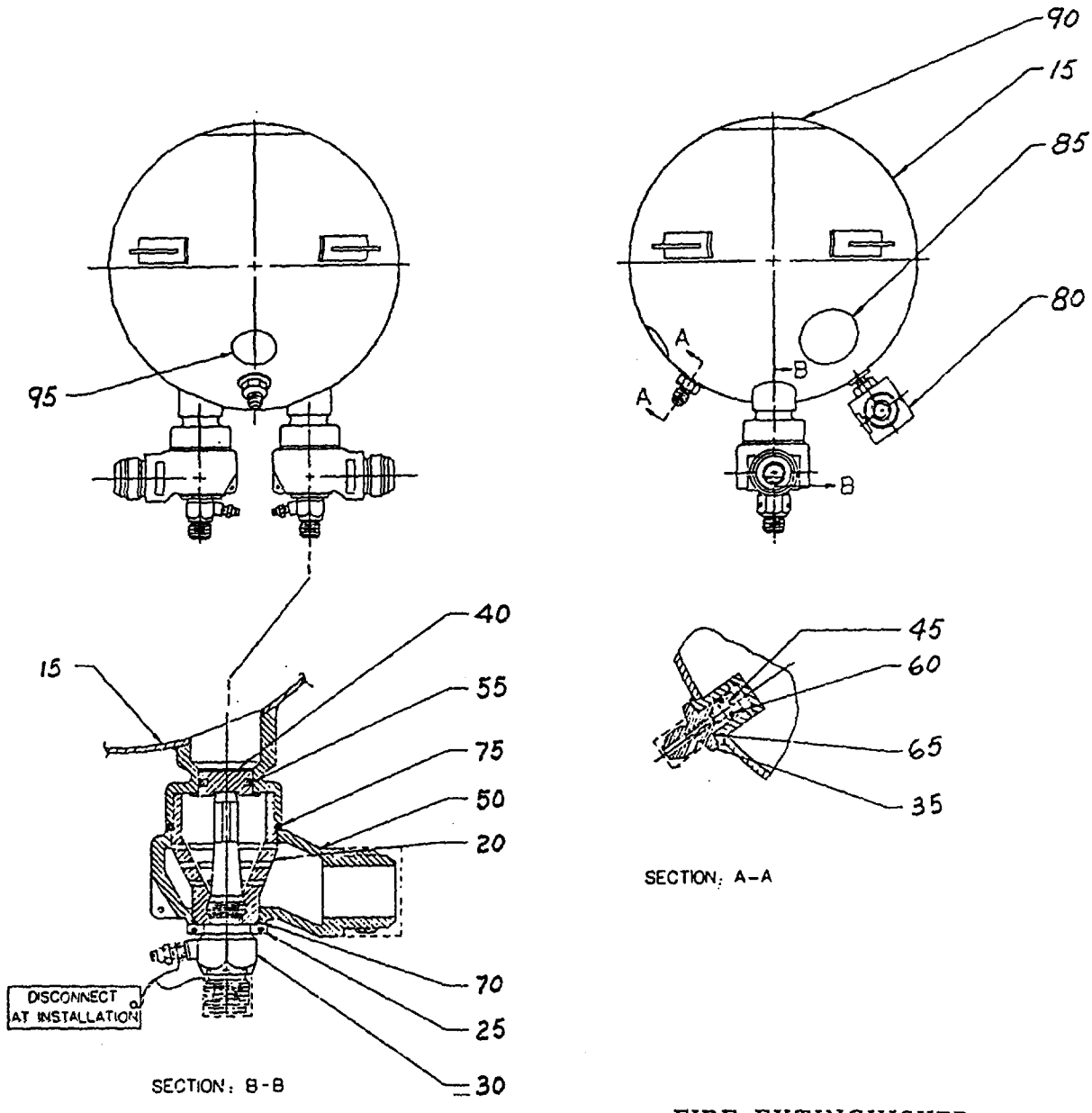
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31000010-26-2

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PAGE 24 OF MANUAL 26-20-200 SUBSTITUTE THE FOLLOWING:



FIRE EXTINGUISHER
FIGURE 1101

December 16, 1982

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HTL ADVANCED TECHNOLOGY DUARTE, CA.

SERVICE BULLETIN

PAGE 25 OF MANUAL 26-20-200
SUBSTITUTE THE FOLLOWING:

FIG/ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	UNITS PER ASSY.
1101 10	31000010	FIRE EXTINGUISHER -378 CU. IN.	REF
15	32197843	. CONTAINER WELDMENT	1
20	31840000	. STEM, VALVE	2
25	13146	. HOUSING ASSEMBLY	2
30	13083-25	. CARTRIDGE ASSEMBLY	2
35	13028	. FILL FITTING	1
40	13038	. PLUG VALVE	2
45	14014	. VALVE, FUSIBLE	1
50	13059-1	. DISCHARGE OUTLET	2
55	13051	. O-RING	2
60	13026	. O-RING	1
65	13037	. O-RING	1
70	13024	. O-RING	2
75	13004	. O-RING	2
80	19915403-2	. GAUGE	1
85	31576517-1	. DATA PLATE	1
90	31576515-2	. IDENTIFICATION PLATE	1
95	31576505-1	. CAUTION PLATE	1

D. APPROVAL
Government approval not required.

E. MANPOWER
Not applicable.

F. MATERIAL
Not applicable.

G. TOOLING
Not applicable.

H. WEIGHT AND BALANCE
The max weight of Fire Extinguisher P/N31000010 is 15.28 pounds.

I. ELECTRICAL LOAD
Refer to Table I of leading particulars Page 2 of this Service Bulletin.

J. REFERENCES
HTL Overhaul Manual 26-20-200.

K. OTHER PUBLICATIONS AFFECTED
HTL Overhaul Manual 26-20-200.

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SERVICE BULLETIN

FIRE EXTINGUISHER

PN 30700002

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LEADING PARTICULARS

Internal Volume	224 Cu. In.
Extinguishing Agent	$CBrF_3$ (Bromotrifluoromethane per MIL-B-12218)
No. of Outlets	2
Operating Temperature Range	− 65° F TO 160° F (-53. 9° C TO 71.1° C)
Pressure Data:	
Charge Pressure	600 PSIG @ 70° F (21.1° C)
Proof Pressure	1800 PSIG @ 70° F (21.1° C)
Burst Pressure	2400 PSIG @ 70° F (21.1° C)
Safety Relief Temperature Range	215° F to 226° F (101° C to 107.7° C)
Electrical Data:	
Voltage	18 to 30 VDC
Resistance	1.15 ± .25 ohms
Current (All Fire):	
Recommended Minimum	3.0 amps
Maximum Test Current	50 ma
Fitting Ends:	
Outlet	Per MS 33656-16
Fill and Relief	Per MS 33656-4
Weight:	
Agent	6.0 LB $\pm \frac{.15}{.00}$
Total Weight (Max.)	12.10 LB

HTL ADVANCED TECHNOLOGY MONROVIA, CA.

SERVICE BULLETIN

FIRE EXTINGUISHER

PN 30700002

PAGE 25 OF MANUAL 26-20-200
SUBSTITUTE THE FOLLOWING

FIG. & INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY.
1101-	30700002	CONTAINER ASSEMBLY, fire extinguisher	1
-3	**13083-25 (not part of assembly)	CARTRIDGE	2
-4	**AN6290-5 (13066)	SEAL	2
-5	*13146	HOUSING ASSEMBLY	2
-6	*MS28775-021 (13024)	SEAL	2
-7	13059	SWIVEL	2
-8	31840000	STEM	2
-9	*MS28775-128 (13004)	SEAL	2
-10	*13038	PLUG, Valve	2
-11	*13051	SEAL	2
-12	13028	FITTING	1
-13	*AN6290-4 (13037)	SEAL	1
-14	*13014	VALVE, Check	1
-15	*MS29513-007 (13026)	SEAL	1
-16	18215901	GAGE, Pressure	1
-17			
-18			
-19			
-20	31576515	Plate Identification	1
-22	31576517	Plate Data	1
-23	31576505	Plate Caution	1
-24	32193504	WELD ASSEMBLY, Sphere	1
1101-	*** 32000410	KIT, Recharge	1

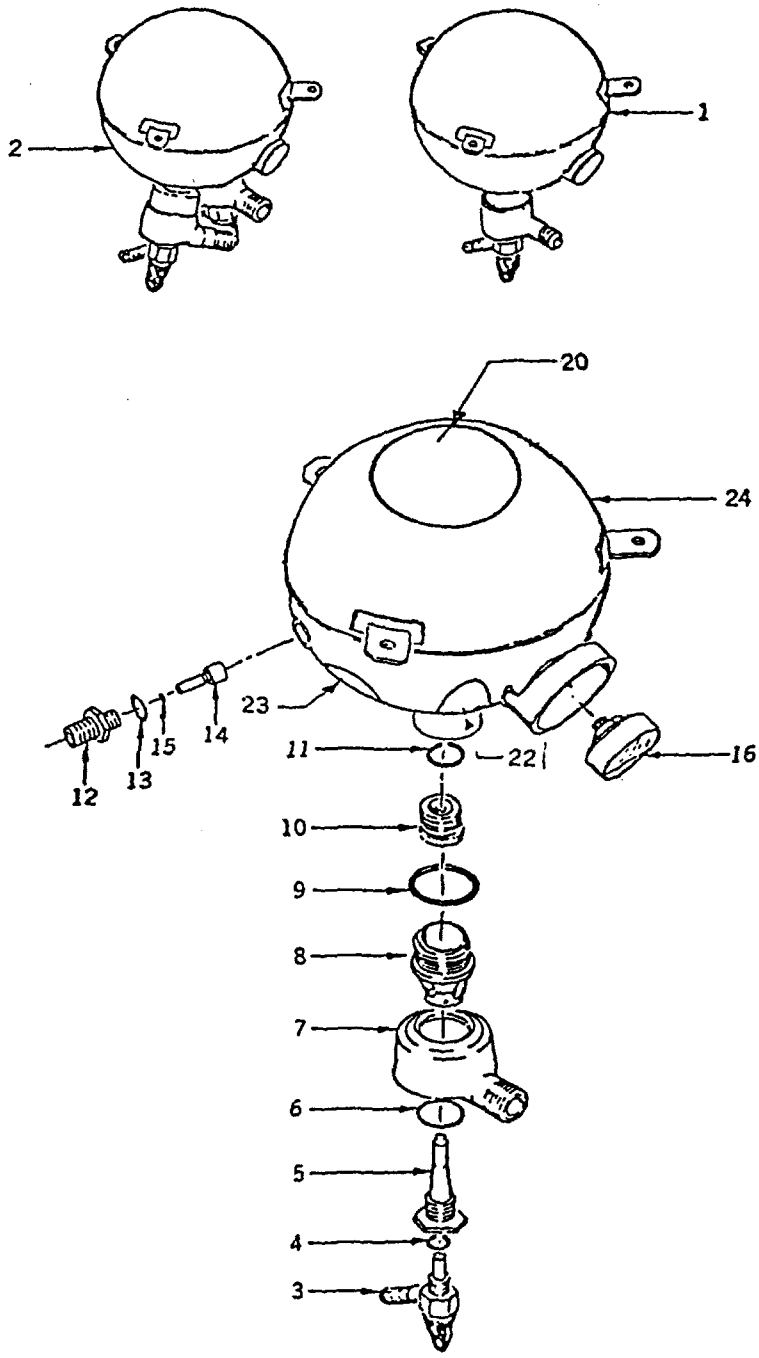
* Parts included in Recharge Kit
** Parts not included in recharge kit. Cartridge (supplied with seal, item 4) must be ordered separately.
*** Parts to refurbish one valve only.
**** For containers equipped with metal plates, enter new charge date and gross weight in space provided on nameplate. Discard decal furnished in Recharge Kit.

HTL | ADVANCED TECHNOLOGY MONROVIA, CA.

SERVICE BULLETIN

FIRE EXTINGUISHER

PN 30700002



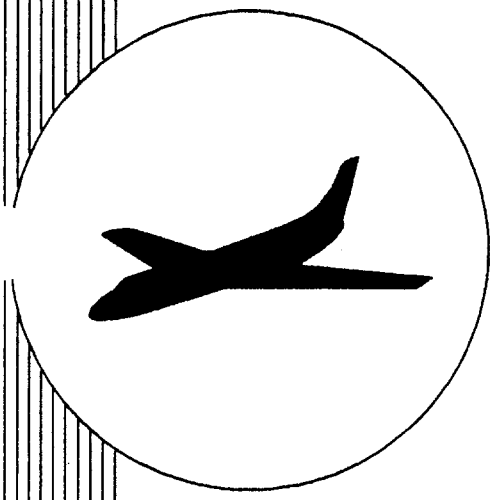
Container Assembly

FIGURE 1101

PACIFIC SCIENTIFIC®

HTL/Kin-Tech Division

Component Maintenance Manual with Illustrated Parts List



O-RING BOTTLE FIRE EXTINGUISHERS

37 CUBIC INCH, 60 CUBIC INCH
65 CUBIC INCH, 86 CUBIC INCH
110 CUBIC INCH, 125 CUBIC INCH
150 CUBIC INCH, 224 CUBIC INCH
378 CUBIC INCH OR 988 CUBIC INCH

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RECORD OF REVISIONS

BASIC ISSUE: Jul 15, 1999

Rev. No.	Revision Date	Date Filed	By
1	7/15/99	8/21/02	ATP/MG

Rev. No.	Revision Date	Date Filed	By

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RECORD OF TEMPORARY REVISIONS

Rev. No.	Issue Date	Date Inserted	By	Date Removed	By

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SERVICE BULLETIN LIST

Service Bulletin	Issue Date	Date Incorporated

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Revised 1999

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Record of Temporary Revisions	RTR-1	Jul 15/99
	RTR-2	Jul 15/99
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INTRODUCTION

1. Scope
   A. This Component Maintenance Manual (CMM) contains the maintenance instructions for the O-ring Bottle Fire Extinguishers. The fire extinguishers are manufactured by Pacific Scientific Company, HTL/Kin-Tech Division, Duarte, California.
   B. The technical properties, an exploded-view, and the detailed parts list for the O-ring Bottle Fire Extinguishers are contained in separate Supplements.
2. Usage Guide
   A. Refer to the Table of Contents to find the necessary procedures or maintenance data. This Manual is written to ATA 100, Revision 30 and AECMA Simplified English guidelines.
      (1) **Description and Operation** gives the function, primary components of the o-ring bottle fire extinguishers. The technical properties are contained in Supplements.
      (2) **Testing and Fault Isolation** contains the test and fault isolation procedures.
      (3) **Disassembly** contains the procedures to discharge the extinguishing agent and disassemble the o-ring bottle fire extinguishers before repair or part replacement.
      (4) **Cleaning** contains procedures to clean the o-ring bottle fire extinguishers and components.
      (5) **Check** contains the procedures to check the parts for too much wear, corrosion, and other damage.
      (6) **Repair** contains the repair procedures.
      (7) **Assembly** contains the procedures to reassemble, refill, and store the o-ring bottle fire extinguishers.
      (8) **Fits and Clearances** contains the assembly torque ranges and the minimum height dimensions for the fill, discharge, and switch bosses (as applicable).
      (9) **Special Tools, Fixtures, and Equipment** describes the recommended special tools, fixtures, and test equipment.
      (10) **Illustrated Parts List** contains the introduction to the detailed parts list. The corresponding Supplement contains an exploded-view drawing and a detailed parts list. The information in the Supplement is used identify and to order spare parts.
   B. The recommended tools and materials are given in each section. Equivalent items can be used.
3. Product Support Services
   A. Product support services for the o-ring bottle fire extinguishers are available from Pacific Scientific Company.
   B. For technical documentation, please contact:

PACIFIC SCIENTIFIC COMPANY
6805 NW 87 Avenue
Miami, Florida 33178 U.S.A.

Telephone: (305) 477-4711
FAX: (305) 477-9799
SITA: MIAPSXD

C. For repair and overhaul, and spare parts please contact:

PACIFIC SCIENTIFIC COMPANY	Telephone:	(305) 477-4711
6805 NW 87 Avenue	FAX:	(305) 477-9799
Miami, Florida 33178 U.S.A.	SITA:	MIAPSXD
PACIFIC SCIENTIFIC LIMITED	Telephone:	44 (1628) 810252
Seven Centre Bourne End	24 Hours:	44 (1836) 228480
Buckinghamshire	FAX:	44 (1628) 810124
England SL8 5YS	SITA:	LHRPSCR

4. Verification Dates

Procedure	Date
Testing/Fault Isolation	---
Disassembly	---
Assembly	---

5. Revision Service

A. Revised pages will be issued when necessary throughout the service life of the o-ring bottle fire extinguishers. The revised part of the page will be identified by a change bar or capital **R** in the left margin.

6. Abbreviations and Unit Symbols

A. Abbreviations and unit symbols which may be used in this manual are defined below. All weights and measurements are given first in the English standard units followed by the metric equivalent in parentheses.

Assy - Assembly
ATA - Air Transport Association
cfh - Cubic feet per hour
CAGE - Commercial and Government Entity
cm - Centimeter (1 cm = 0.394 inch)
DC - Direct Current
DOT - Department of Transportation
EFF - Effectivity
FAA - Federal Aviation Administration
FIG. - Figure
ID - Inside Diameter
IPL - Illustrated Parts List
kg - Kilogram (1 kg = 2.205 pounds)
kPag - Kilo Pascal-gauge (1 kPag = 0.15 psig)
m^3/hr - Cubic meter per hour
m - Meter (1 m = 3.281 feet)
mA - Milliampere
mm - Millimeter (1 mm = 0.0394 inch)
N·m - Newton-meter (1 N·m = 8.3 in-lb)
NHA - Next Higher Assembly
No. - Number
OD - Outside Diameter
Para. - Paragraph
P/N - Part Number
psig - Pounds per square inch-gauge
RF - Reference
rpm - Revolutions per minute
SB - Service Bulletin
sccs - Standard cubic centimeter per second
V - Volt
VDC - Voltage - Direct Current

DESCRIPTION AND OPERATION

A. The o-ring bottle fire extinguisher stores fire extinguishing agent under high pressure. When the sensors indicate smoke, the pilot operates a control switch sending an electrical signal to the cartridge mounted in the discharge outlet (see Figure 1). This causes the cartridge to detonate, which fractures a housing assembly and releases extinguishing agent to extinguish the fire.

1. Description

A. The o-ring bottle fire extinguishers (see Figure 2) primary components may include:

- Container weldment
- Fill fitting
- Pressure devices
  - Pressure gauge, pressure switch, or temperature compensated pressure switch (depending on the unit)
- Gauge guard (on some units)
- Fusible valve or rupture disc valve
- Discharge outlet (more than one on some units)
- Cartridge (more than one some units)

B. The weldment is an all-welded stainless steel shell, which includes fill, discharge, and gauge bosses.

C. An electrically actuated cartridge (see Figure 1) is installed in the housing assembly. The cartridge can be removed or installed (even when the o-ring bottle fire extinguisher is pressurized). The cartridge is safety wired to the discharge outlet and caution tagged for safety.

D. The fill fitting is a combination filling device and safety relief assembly. If the ambient temperature should rise abnormally, an eutectic metal within the fill fitting melts. This relieves the contents of the container through the fill fitting.

E. The discharge outlet is a flow path for the extinguishing agent. The discharge outlet is safety wired to the weldment to a secure installation. The discharge outlet consists of a valve plug that is held securely by a destructible housing assembly and stem assembly. A discharge outlet capable of rotating 360° (even when the o-ring bottle fire extinguisher is pressurized) is installed between the housing assembly and discharge boss.

F. Most o-ring fire extinguishers are equipped with a pressure device (pressure gauge, pressure switch, or temperature compensated pressure switch). Some o-ring fire extinguishers are also equipped with a gauge guard.

G. The o-ring bottle fire extinguishers are shipped with protective caps to cover the discharge outlet and the fill fitting. The shunt wire/caution tag installed on the cartridge, protects the firing circuit from detonating with electromagnetic interference.

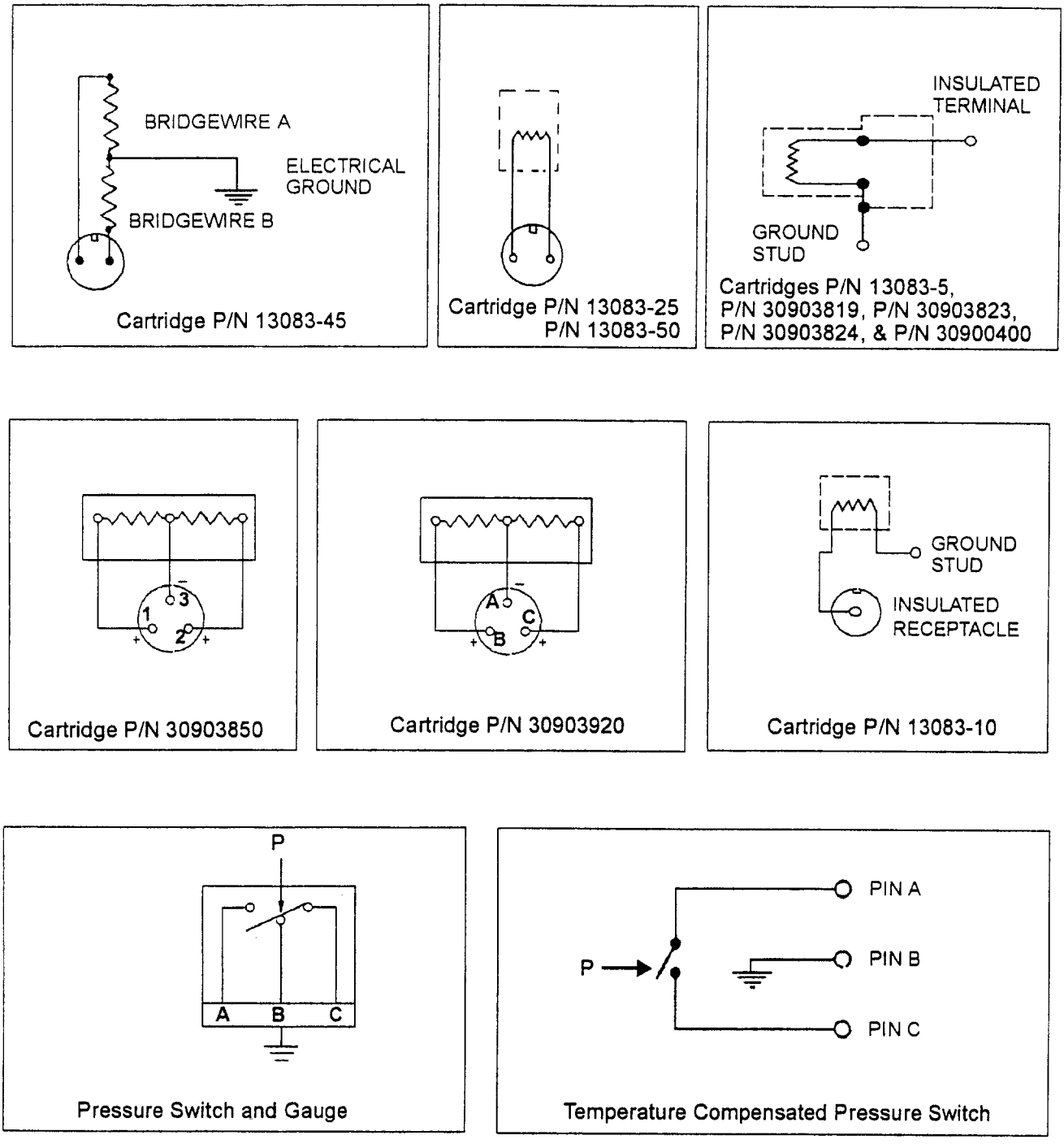


Figure 1. Cartridge and Pressure Device Schematics

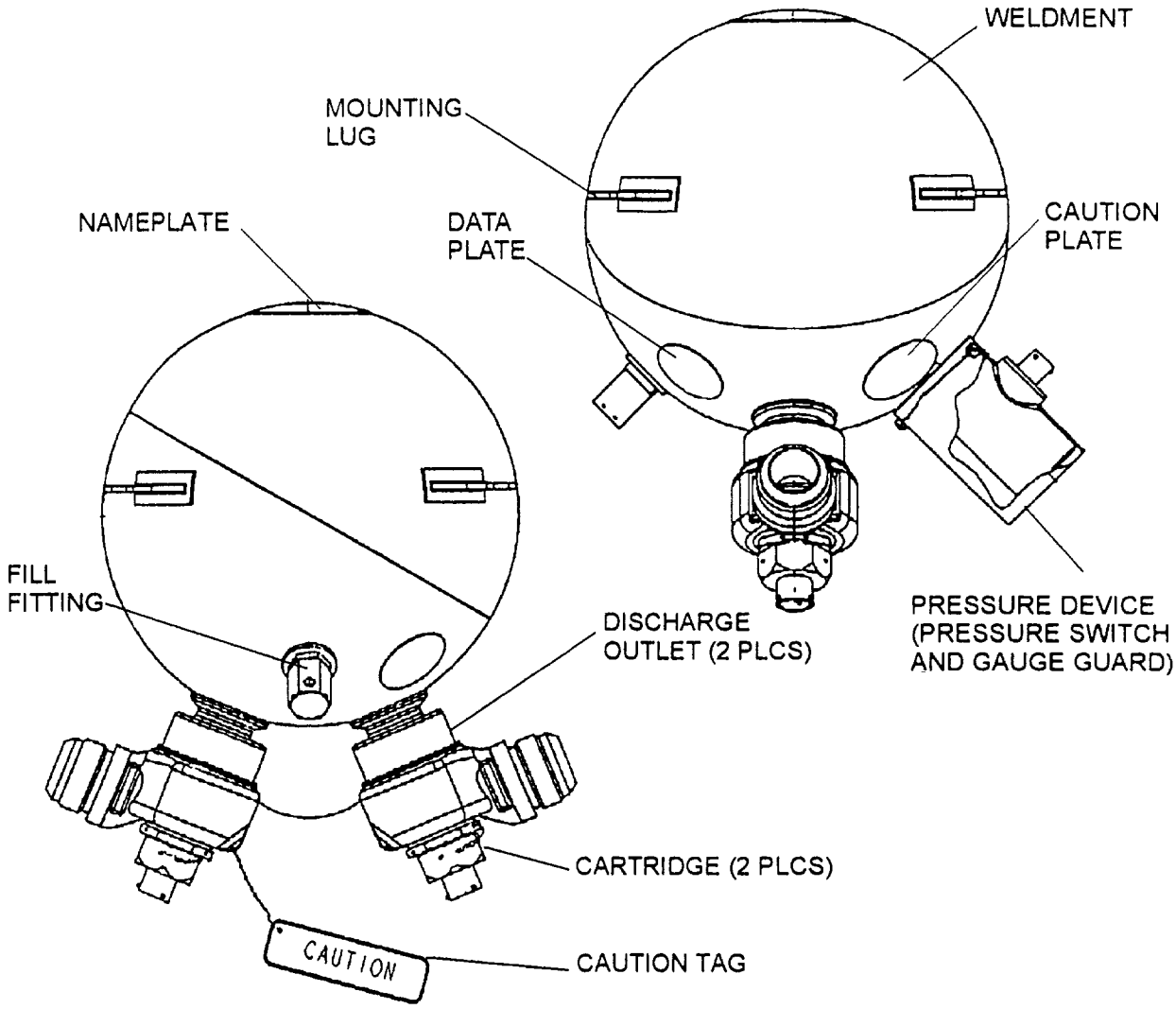


Figure 2. Typical Components

2. Operation of Fire Extinguisher

A. To release the extinguishing agent, the pilot operates a control switch, applying 18 to 30 VDC, 3.0 amperes current to the cartridge terminals. The current detonates the explosive charge in the cartridge (Figure 1). The explosion breaks the end of the housing assembly, removing the mechanical locking force against the valve plug. The pressurized extinguishing agent forces the valve plug outward. The extinguishing agent is discharged through the discharge outlet into the distribution network.

B. The pressure device indicator should be checked regularly to make sure that the o-ring bottle fire extinguishers is charged.

3. Technical Properties

A. The technical properties of the o-ring bottle fire extinguishers are contained in separate 26-20-202 Supplements.

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TESTING AND FAULT ISOLATION

1. General

A. This section contains the testing and fault isolation procedures. Perform the leak test and cartridge test, before disassembly to identify the quantity of maintenance.

B. The recommended test equipment and materials are given in Table 101.

NOTE: Equivalent items can be used.

Table 101. Test Equipment and Materials

Nomenclature	Part or Specification Number	Source (CAGE)*
Bag, Plastic (large enough to enclose weldment)	---	Commercially available
Cap, Hydrotest	83330165	Pacific Scientific (05167)
Digital Multimeter	79	John Fluke (89536)
Fitting, Hydrotest 0.750-16 UNJF Thread	---	Commercially available
Ground Strap & Circuit Tester	WT25	Walter G. Legge Co. (84832)
Hydrotest Test Stand	---	Commercially available
Leak Detector	HLD 4000-310 Series C	Inficon (56507)
Magnet	83330001	Pacific Scientific (05167)
Oven or Heater, 250°F (121°C)	---	Commercially available
Plug, Gauge Boss 1/4-18 NPT Thread	---	Commercially available
Plug, Hydrotest	83330670-2	Pacific Scientific (05167)
Plug, Switch Boss	MS51840-27	Commerically available
Protective Caps		
Cartridge Cover	5/8-SC	CaPlugs (99017)
Cartridge Port	PD-50	CaPlugs (99017)
Cartridge Thread	1/2-SC	CaPlugs (99017)
Discharge Boss	PD-200	CaPlugs (99017)
Discharge Outlet End	CD-22	CaPlugs (99017)
Fill Boss	PD-40	CaPlugs (99017)
Fill Fitting End	CD-4	CaPlugs (99017)

* Refer to the IPL, paragraph 2, for the address.

Table 101. Test Equipment and Materials (Continued)

Nomenclature	Part or Specification Number	Source (CAGE)*
Protective Caps (Continued)		
Pressure Gauge Fitting	WW-O	CaPlugs (99017)
Pressure Switch Boss	PD-100	CaPlugs (99017)
Pressure Switch Connector	RC-14	CaPlugs (99017)
Pressure Switch Sleeve	31670509	Pacific Scientific (05167)
Safety Chamber, Cartridge	83330118	Pacific Scientific (05167)
Tank, Gaseous Nitrogen (GN_2) 1000 psig (6900 kPag)	---	Commercially available
Tape, Foam Insulated (1/2" wide x 1/4" thick)	---	3M Corporation (04633)
Test Fitting, Banjo	59000015-1	Pacific Scientific (05167)
Test Fitting 1/8-27 NPT	---	Commercially available
Thermcouple	---	Commercially available
Vacuum Source	---	Commercially available
Weighing Scale ±0.01 pound (0,005 kg) 0 to 120 pounds (55 kg)	---	Commercially available

* Refer to the IPL, paragraph 2, for the address.

2. Leak Test

WARNING: THE CARTRIDGE IS AN EXPLOSIVE DEVICE. INADVERTENT DETONATION OF A CARTRIDGE CAN CAUSE INJURY. FOR SAFE HANDLING, PERSONNEL MUST BE GROUNDED AND THE PROTECTIVE CAP AND SHUNT WIRE/CAUTION TAG MUST BE INSTALLED ON THE ELECTRICAL CONNECTOR.

A. Wind the ground strap around your wrist, and connect the strap to the circuit tester (Table 101). Test the ground circuit.

B. Verify the shunt wire/caution tags is installed on the cartridge between the positive and negative terminals.

C. Remove the cartridge from the housing assembly. Refer to Disassembly section, paragraph 2.

D. Use a cotton swab or vacuum (Table 101) to clean dirt and other contamination from the discharge bosses.

E. Separate the o-ring bottle fire extinguisher from other filled fire extinguishers. Use shop air to blow away any extinguishing agent in the air immediately around the o-ring bottle fire extinguisher.

F. Wait two hours for any leakage to collect.

G. Set the sensitivity scale on the leak detector (Table 101) to 1 x 10^{-6} sccs.

H. Hold the detector probe 1/4 inch above the surface of the unit to light touching of the unit and check each discharge boss, the pressure device, and the fill fitting for a minimum of 60 seconds each, then slowly move the probe over the weld joints.

I. If leak detection indicates no leak, proceed to paragraph N.

J. If leak detection indicates a leak, place the o-ring bottle fire extinguisher in a large plastic bag (Table 101) and close the bag.

K. Wait 2 hours, then probe the air inside the plastic bag (Table 101) and check each discharge boss, the pressure device, and the fill fitting for a minimum of 60 seconds each, then slowly move the probe over the weld joints. Record the leakage at each test point.

L. Calculate the leakage rate, as follows:

$$L_r = \frac{L_i \times V}{T \times F}$$

Where:
L_r = Leakage rate (sccs)
L_i = Detector reading (sccs)
V = Volume of plastic bag, less weldment volume
T = Time (in seconds) of weldment inside plastic bag
F = Flow rate of leak detector (5 sccs) for Inficon 3000 *

* Refer to equivalent leak detector manual for flow rate.

M. If the leakage rate exceeds 1 x 10^{-6} sccs, repair or replace the fill fitting and pressure device as applicable, and repeat leak test.

N. If the leakage rate is less than 1 x 10^{-6} sccs, reinstall the cartridges (refer to Assembly section, paragraph 6).

O. Install the protective caps (Table 101).

3. Cartridge Test

WARNING: THE CARTRIDGE IS AN EXPLOSIVE DEVICE. INADVERTENT DETONATION OF A CARTRIDGE CAN CAUSE INJURY. FOR SAFE HANDLING, PERSONNEL MUST BE GROUNDED AND THE PROTECTIVE CAP AND SHUNT WIRE/CAUTION TAG (-15) MUST BE INSTALLED ON THE ELECTRICAL CONNECTOR (EXCEPT WHEN SPECIFIED IN THE PROCEDURE).

A. Wind the ground strap around your wrist, and connect the strap to the circuit tester (Table 101). Test the ground circuit. Refer to Figure 101.

B. Ground the safety chamber (Table 101).

C. Verify that the shunt wire/caution tag is installed on the cartridge.

WARNING: THE CARTRIDGE MUST BE TESTED IN A FIXTURE THAT PROVIDES PROTECTION FOR PERSONNEL. THE SAFETY CHAMBER IS DESIGNED FOR THIS PURPOSE.

D. Thread the cartridge, with the shunt wire/caution tag and o-ring installed, into the safety chamber (Table 101).

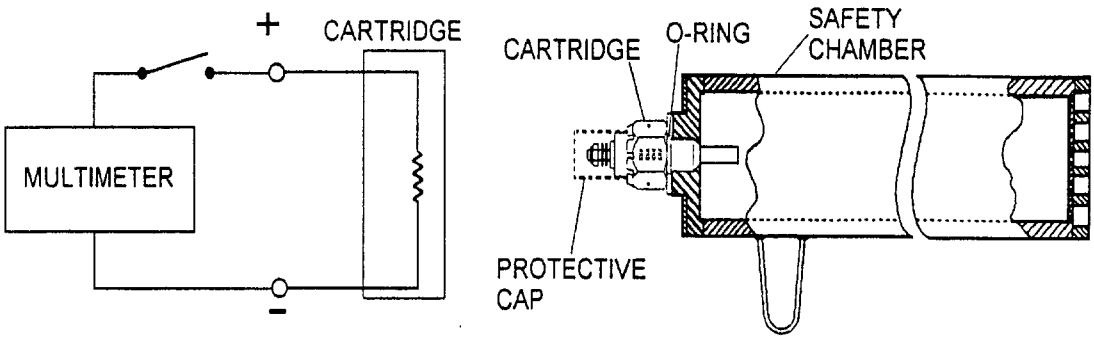


Figure 101. Cartridge Test Setup

CAUTION: TEST DEVICES THAT PASS MORE THAN 50 MILLIAMPERES CURRENT CAN AFFECT THE USEFUL LIFE AND RELIABILITY OF THE CARTRIDGE. DO NOT USE A VOLTMETER, FLASHLIGHT BATTERY, CONTINUITY LIGHT, OR SIMILAR DEVICE.

E. Set up the digital multimeter (Table 101), as follows:

(1) Disconnect the test leads from the digital multimeter.

(2) Connect the digital multimeter to a power source.

(3) Press the green button to turn on the digital multimeter power.

(4) Press the V and mA buttons at the same time to select the low display range.

(5) Ensure that the digital multimeter is set to measure DC power.

(6) Press the gray button (second from the left) to select the 2 ohm range.

(7) Plug the black test lead into the COMMON terminal. Plug the red test lead into the LOW RANGE terminal.

(8) Hold the probe ends together and adjust the ZERO control until the display reads zero.

F. Remove the shunt wire/caution tag from the cartridge.

CAUTION: DO NOT BEND THE CARTRIDGE CONNECTOR PINS.

G. Measure the bridgewire resistance across the cartridge connector positive terminal to the negative terminal.

REQUIREMENT: EACH BRIDGEWIRE RESISTANCE MUST BE 0.9 TO 1.4 OHM.

H. Dispose of the cartridge that fails this test (refer to Check section, paragraph 7).

I. Disconnect the digital multimeter. Reinstall the shunt wire/caution tag on the cartridge.

J. Remove the cartridge from the safety chamber.

4. Hydrostatic Pressure Test Requisites

A. The DOT requires these units to be hydrostatically tested at five year intervals. FAA, CAA, and DOT rules may impose other requirements.

B. The approved method of testing is by water jacket volumetric expansion, which uses high internal water pressure to determine total volumetric expansion.

5. Hydrostatic Test Procedure

A. Set up the hydrostatic test equipment.

B. Prepare the o-ring bottle fire extinguisher for the hydrostatic test, as follows:

(1) Disassemble the o-ring bottle fire extinguisher to remove the cartridge, housing assembly, discharge outlet, fill fitting, and pressure device. Refer to the Disassembly section.

(2) Install plugs and caps (Table 101) in the boss locations.

C. Perform hydrostatic test per test stand (Table 101) manufacturer's instructions.

REQUIREMENT: THE PERMANENT VOLUMETRIC EXPANSION MUST NOT EXCEED 10 PERCENT OF THE TOTAL VOLUMETRIC EXPANSION.

NOTE: If the test pressure cannot be maintained due to a failure of the test apparatus, the test may be repeated at a pressure increase of 10 percent or 100 psig (690 kPag), whichever is the lower value.

D. Repeat the test once if system error is suspected. Replace the weldment if the weldment fails both tests.

E. Remove the caps and plugs (Table 101) from the weldment. Drain the water from the weldment.

F. Heat in an oven or heater (Table 101) to 225°F to 250°F (107°C to 121°C). Heat the weldment for one hour or until completely dry.

G. Inspect the weldment (refer to the Check section, paragraph 3).

H. Stamp the hydrostatic test date and DOT identification number next to the pressure stamp on the mounting lug.

6. Pressure Device Functional Tests

A. Pressure Gauge

(1) Install the pressure gauge into the test fitting (Table 101).

(2) Using an adjustable, calibrated source of dry nitrogen (Table 101), apply gradually increasing pressure to the device while monitoring and recording device and source pressure indications.

(3) Accuracy of recorded pressure gauge indications can be found in the Technical Properties table of the appropriate 26-20-202 Supplement.

(4) Failure of the pressure gauge to perform as described in the Technical Properties table of the 26-20-202 Supplement is cause for rejection. Remove and replace gauge (refer to Check section, paragraph 8).

B. Pressure Switch

(1) Install the pressure switch into the test fitting (Table 101).

(2) Attach a digital multimeter (Table 101) to connector pins 1 and 2. The digital multimeter should indicate continuity, showing contacts closed. Attach a digital multimeter (Table 101) to connector pins 2 and 3. The multimeter should indicate no continuity, showing contacts open.

(3) Using the nitrogen source (Table 101), slowly apply pressure until switch contacts 2 and 3 close. The maximum closing pressure is 500 psig at 70°F (3448 kPag at 21°C). The digital multimeter should indicate continuity, showing contacts closed.

(4) Slowly decrease pressure until switch contacts 2 and 3 open. The minimum opening pressure is 230 psig at 70°F (1586 kPag at 21°C). The digital multimeter should indicate no continuity, showing contacts open.

(5) Remove pressure switch from the test fitting. Install the protective covers (Table 101).

C. Pressure Gauge and Switch

(1) Install the pressure gauge and switch into the gauge test fitting (Table 101).

(2) Attach a digital multimeter (Table 101) to connector pins A and B. The digital multimeter should indicate continuity, showing contacts closed.

(3) Using the nitrogen source (Table 101), slowly apply pressure to 500 psig until switch contacts open. The digital multimeter should indicate no continuity, showing contacts open.

(4) Slowly decrease pressure to 300 psig until switch contacts close. The digital multimeter should indicate continuity, showing contacts closed, at low pressure switch point.

(5) Apply pressure to the pressure gauge and switch and compare dial readings for the accuracy the Technical Properties table of the appropriate 26-20-202 Supplement.

(6) Failure of the pressure gauge and switch to perform as described in the Technical Properties table of the 26-20-202 Supplement is cause for rejection (refer to Check section, paragraph 8).

(7) Remove pressure gauge and switch from the gauge test fitting. Install protective covers (Table 101).

D. Temperature Compensated Pressure Switch

(1) Install the temperature compensated pressure switch (TCPS) into the banjo test fitting (Table 101). Tape a thermocouple (Table 101) to the reference chamber of the TCPS. See Figure 102.

(2) Attach a digital multimeter (Table 101) to connector pins 1 and 3. The digital multimeter should indicate continuity, showing contacts closed.

(3) Slowly apply pressure until switch contacts 1 and 3 open, ususally 10 to 20 psig (69 to 138 kPag) above the maximum contacts closed switch point. See Table 102 for the maximum increasing pressure. The multimeter should indicate no continuity, showing contacts open.

(4) Push the Press-to-Test button or apply the magnet (Table 101) on the top of the TCPS. Verify that the multimeter indicates continuity, showing the switch contacts closed. Release the Press-to-Test button or remove the magnet and verify that the multimeter indicates no continuity, showing switch contacts open.

(5) Slowly decrease pressure until switch contacts close. The digital multimeter should indicate continuity, showing contacts closed. The maximum and minimum decreasing pressure switch points are shown in Table 102.

(6) Disconnect the thermocouple and the digital multimeter. Remove TCPS from the banjo test fitting. Install the protective covers (Table 101).

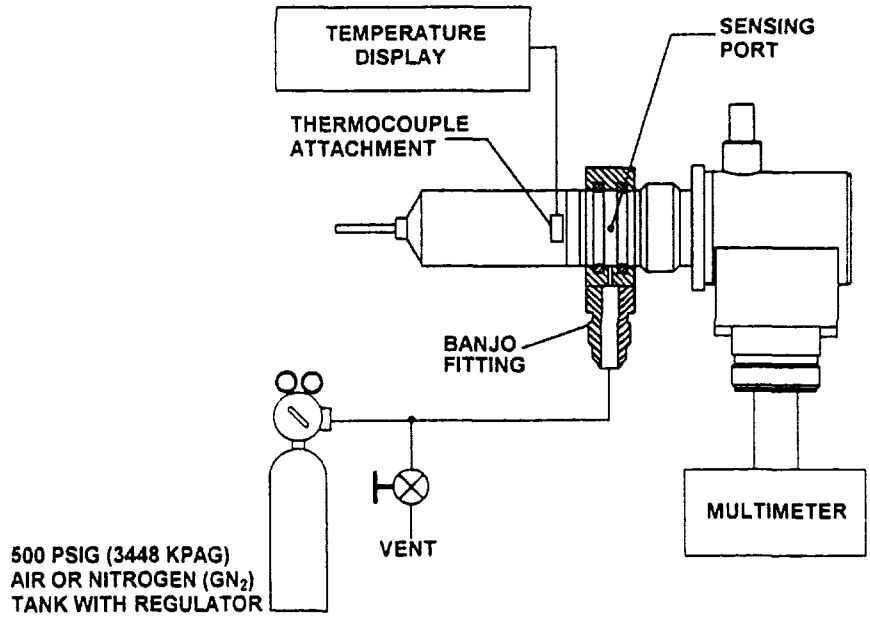


Figure 102. TCPS Test Setup

Table 102. Pressure Versus Temperature

Temperature °F (°C)	Decreasing Pressure Maximum psig (kPag)	Decreasing Pressure Minimum psig (kPag)	Temperature °F (°C)	Decreasing Pressure Maximum psig (kPag)	Decreasing Pressure Minimum psig (kPag)
60 (13)	303 (2089)	243 (1676)	76 (24)	350 (2413)	290 (2000)
62 (15)	308 (2124)	248 (1710)	78 (28)	353 (2434)	293 (2020)
64 (17)	313 (2158)	253 (1744)	80 (27)	360 (2482)	300 (2069)
66 (19)	320 (2206)	260 (1793)	82 (28)	367 (2531)	307 (2117)
68 (20)	325 (2241)	265 (1827)	84 (29)	375 (2586)	315 (2172)
70 (21)	330 (2275)	270 (1862)	86 (30)	383 (2641)	323 (2227)
72 (22)	337 (2324)	277 (1910)	88 (31)	390 (2689)	330 (2275)
74 (23)	343 (2365)	283 (1951)	90 (32)	397 (2737)	337 (2324)

DISASSEMBLY

1. General

NOTE: Refer to the Testing and Fault Isolation section to establish the condition of the o-ring bottle fire extinguisher or most probable cause of a malfunction. This determines the extent of disassembly required.

CAUTION: REMOVE THE PROTECTIVE CAPS (TABLE 301) ONLY WHEN NECESSARY FOR MAINTENANCE. THE CONNECTORS AND BOSSES MUST BE COVERED AT ALL OTHER TIMES TO PREVENT CONTAMINATION AND DAMAGE.

A. This section contains the o-ring bottle fire extinguisher discharge and disassembly instructions. Skip the unnecessary steps, if only partial disassembly is necessary. Refer to Figure 301 for a disassembly sequence chart.

NOTE: Refer to the Repair section to replace the identification plate or nameplate, caution plate, and data plates.

B. The recommended tools and materials are given in Table 301.

NOTE: Equivalent items can be used.

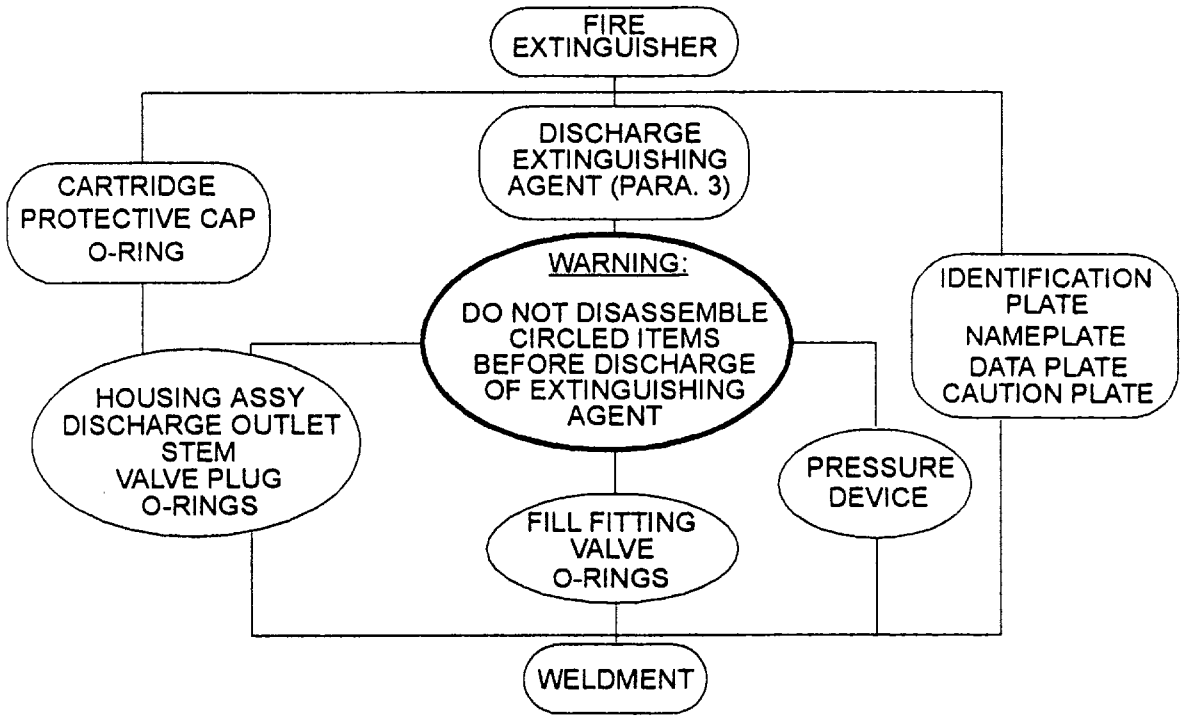


Figure 301. Disassembly Sequence Chart

Table 301. Disassembly Tools and Materials

Nomenclature	Part or Specification Number	Source (CAGE)*
Bar Tool (4 inch length x 1/2 inch width x 1/8 inch thickness)	---	User furnish
Discharge Recovery Tool	59000059	Pacific Scientific (05167)
Flat File		
Mill Smooth	---	Commercially available
Second Cut	---	Commercially available
Ground Strap and Circuit Tester	WT25	Walter G. Legge Co. (84832)
Halon Recovery Recycle System	A6-06-2000-75-0 (Model H 1301)	Neutronics Inc. (5R712)
Protective Caps		
Cartridge Cover	5/8-SC	CaPlugs (99017)
Cartridge Port	PD-50	CaPlugs (99017)
Cartridge Thread	1/2-SC	CaPlugs (99017)
Discharge Boss	PD-200	CaPlugs (99017)
Discharge Outlet End	CD-22	CaPlugs (99017)
Fill Boss	PD-40	CaPlugs (99017)
Fill Fitting End	CD-4	CaPlugs (99017)
Pressure Gauge Fitting	WW-O	CaPlugs (99017)
Pressure Switch Boss	PD-100	CaPlugs (99017)
Pressure Switch Connector	RC-14	CaPlugs (99017)
Pressure Switch Sleeve	31670509	Pacific Scientific (05167)
Safety Bag, Heat Sealable Electrostatic	22024509	Noland Paper Co. (OAZM2)
Stem Holding Tool	13254	Pacific Scientific (05167)
Wrench, Open End 5/8, 11/16, and 1-1/4 inch	---	Commercially available

* Refer to the IPL, paragraph 2, for the address.

CAUTION: DO NOT USE METAL TOOLS TO REMOVE THE O-RINGS. METAL TOOLS CAN SCRATCH THE O-RING GROOVES, CAUSING LEAKAGE AND POSSIBLE CORROSION.

C. Note the procedure and locations of safety wiring to help reassembly.

2. Cartridge

WARNING: THE CARTRIDGE IS AN EXPLOSIVE DEVICE. ACCIDENTAL DETONATION OF A CARTRIDGE CAN CAUSE INJURY. FOR SAFE HANDLING, PERSONNEL MUST BE GROUNDED AND THE PROTECTIVE CAP AND SHUNT WIRE/CAUTION TAG MUST BE INSTALLED ON THE ELECTRICAL CONNECTOR.

A. Wind the ground strap around your wrist, and connect the strap to the circuit tester (Table 301). Test the ground circuit.

B. Verify the shunt wire/caution tag is installed on the cartridge between the positive and negative terminals.

C. Put the weldment in the cradle. Cut the safety wire and remove the cartridge from the housing assembly.

D. Remove the cartridge from the housing assembly by unscrewing the cartridge, while holding the hexagonal head of the housing assembly with a wrench , to prevent accidental discharge.

E. Put the cartridge in electrostatic safety bags (Table 301).

WARNING: DO NOT DISASSEMBLE THE O-RING BOTTLE FIRE EXTINGUISHER FURTHER UNTIL THE EXTINGUISHING AGENT HAS BEEN DISCHARGED. REFER TO PARAGRAPH 3 BELOW.

3. Discharge Procedure

NOTE: Use this procedure to discharge the extinguishing agent before removing the housing assembly, fill fitting, or pressure device.

WARNING: DO NOT DISCHARGE THE EXTINGUISHING AGENT INTO THE ATMOSPHERE. THE EXTINGUISHING AGENT MUST BE RECLAIMED AND RECYCLED. DO NOT HOLD THE O-RING BOTTLE FIRE EXTINGUISHER DURING DISCHARGE, THE DISCHARGE RECOVERY TOOL, DISCHARGE BOSS, AND WELDMENT WILL ICE OVER.

A. Remove the cartridges (refer to paragraph 2 above).

B. Thread the discharge recovery tool (Table 301) on the fill fitting. Connect the discharge recovery tool to a recovery tank or a Halon recovery system (Table 301). See Figure 302.

C. Turn the plunger in to depress the valve inside the fill fitting. After the extinguishing agent has fully discharged, remove the discharge recovery tool.

4. Discharge Outlet

A. Remove the cartridge (refer to paragraph 2 above).

B. Put the weldment in the cradle.

C. Using the a wrench, remove the housing assembly from the discharge outlet, then lift the discharge outlet from the discharge boss. Remove and discard the o-rings .

NOTE: If the discharge outlet and stems do not separate from the housing assembly, use the stem holding tool (Table 301) fastened to a table.

D. Unscrew and remove the stem, using a bar tool (Table 301) inserted through the largest exposed holes of the stem.

E. Remove the discharge outlets from the discharge bosses.

DISCHARGE SETUP
FOR FILL FITTING
(PREFERRED METHOD)

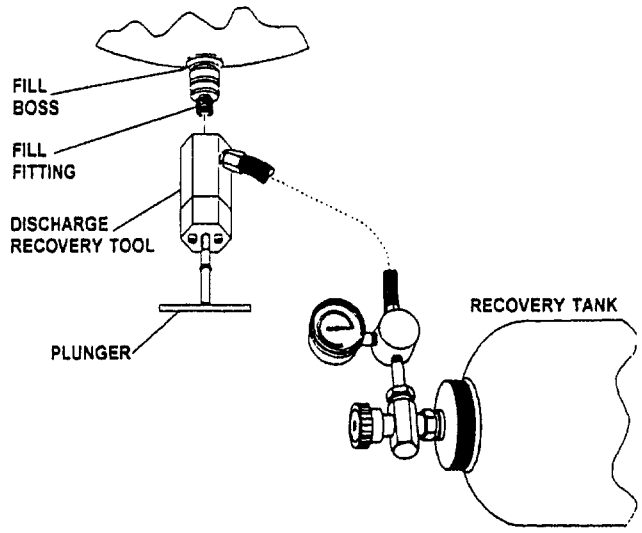


Figure 302. Discharge and Recovery Setup

F. Remove the valve plugs, then remove and discard the o-rings. If the valve plugs and the o-rings are not unseated, remove the valve plugs and the o-rings, as follows:

(1) Hold the o-ring bottle fire extinguisher with the discharge boss downward over an open box containing suitable cushioning material or install the stems before proceeding, for safety purposes.

(2) Connect an external source of compressed air or gaseous nitrogen to the fill fitting.

(3) Slowly pressurize the o-ring bottle fire extinguisher to approximately 50 psig (75 psig maximum) or until the valve plugs and the o-rings are blown out.

(4) Remove external pressure.

5. Fill Fitting

A. Discharge the extinguishing agent (refer to paragraph 3 above).

B. Put the weldment in the cradle.

C. Using a wrench slowly remove the fill fitting from the fill boss. Remove and discard the o-ring from the fill fitting (60).

D. Remove the fusible or rupture disc valve from the fill boss. Remove and discard the o-ring.

6. Pressure Devices

A. Pressure Gauge

(1) Discharge the extinguishing agent (refer to paragraph 3 above).

(2) Put the weldment in the cradle.

(3) To remove the pressure gauge, proceed as follows:

(a) Loosen the pressure gauge using a wrench.

(b) Unscrew the pressure gauge from the weldmen and remove the pressure gauge from within the gauge guard enclosure.

B. Presure Gauge and Switch

(1) Discharge the extinguishing agent (refer to paragraph 4 above).

(2) Attach the cradle to a work surface.

(3) Put the weldment in the cradle.

(4) To remove the pressure gauge, proceed as follows:

WARNING: MAKE SURE THE O-RING BOTTLE FIRE EXTINGUISHER HAS BEEN DISCHARGED BEFORE LOOSENING THE PRESSURE GAUGE.

(a) Loosen the pressure gauge fitting using an 11/16 inch open end wrench (Table 301) across fitting flats.

(b) Unscrew the pressure gauge from the weldment and remove the pressure gauge from within the gauge guard enclosure.

C. Pressure Switch and Gauge

(1) Discharge the extinguishing agent (refer to paragraph 4 above).

(2) Loosen the nut, then turn the pressure gauge and switch from the switch boss. Check the pressure switch using the Testing and Fault Isolation procedure, paragraph 6.

(3) Remove and discard retainer (if any) and o-ring.

D. Temperature Compensated Pressure Switch

(1) Discharge the extinguishing agent (refer to paragraph 4 above).

(2) Attach the cradleto a work surface.

(3) Put the weldment in the cradle.

(4) Install a 0.020 inch (0,51 mm) saw cutter in the spindle of a hand held cutter (Table 301). Align the cutting edge along the circumference of the weld between the switch flange and the switch boss.

NOTE: Use a fixed machine as an alternate for the hand held cutter, if required.

(5) Carefully move the cutter into the weld until it cuts through the weld (approximately 0.060 inch or 1,52 mm).

(6) Turn the weldment around 360 degrees to cut the full circumference of the weld.

(7) Turn off the power to the hand held cutter (Table 301).

(8) Turn the pressure switch from the switch boss. Check the pressure switch using the Testing and Fault Isolation procedure, paragraph 6. If the pressure switch is acceptable, install after successful completion of hydrostatic test of the weldment (75).

(9) Remove burrs and maintain the chamfer, 0.007 to 0.010 inch (0,18 to 0,25 mm) by 45 degrees, inside the switch boss.

NOTE: Limited surface roughness around the switch boss is acceptable.

(10) Remove all unwanted material from the outer surface of the switch boss and machined surface. Use a second cut flat file (Table 301) and smooth the machined surface. Square the edge between the outside of the switch boss and the machined surface using a mill smooth flat file (Table 301).

NOTE: The machined surface must be perpendicular to the inside diameter.

(11) Clean the weldment to remove the chips (refer to Cleaning section, paragraph 3).

(12) Machine the mounting flange of the pressure switch flat, as required.

CLEANING

1. Cleaning Materials

A. The recommended cleaning materials are given in Table 401.

NOTE: Equivalent items can be used.

Table 401. Cleaning Materials

Nomenclature	Part or Specification Number	Source (CAGE)*
Alcohol, Isopropyl	Federal Specification TT-I-735	Commercially available
Cloth, Lint-free	---	Commercially available
Light Probe	---	Commercially available
Oven or Heater, 250°F (121°C)	---	Commercially available
Protective Caps		
Cartridge Cover	5/8-SC	CaPlugs (99017)
Cartridge Port	PD-50	CaPlugs (99017)
Cartridge Thread	1/2-SC	CaPlugs (99017)
Discharge Boss	PD-200	CaPlugs (99017)
Discharge Outlet End	CD-22	CaPlugs (99017)
Fill Boss	PD-40	CaPlugs (99017)
Fill Fitting End	CD-4	CaPlugs (99017)
Pressure Gauge Fitting	WW-O	CaPlugs (99017)
Pressure Switch Boss	PD-100	CaPlugs (99017)
Pressure Switch Connector	RC-14	CaPlugs (99017)
Pressure Switch Sleeve	31670509	Pacific Scientific (05167)
Tape, Duct	---	Commercially available
Vacuum Source	---	Commercially available

* Refer to the IPL, paragraph 2, for the address.

2. Metal Parts

WARNING: INCORRECT HANDLING OF A CHARGED O-RING BOTTLE FIRE EXTINGUISHER CAN CAUSE ACCIDENTAL DISCHARGE OF THE EXTINGUISHING AGENT AND POSSIBLE INJURY. DO NOT APPLY PRESSURE TO, OR INSERT ANYTHING INTO THE DISCHARGE BOSS. THE CLEANING SOLVENT IS FLAMMABLE AND AN IRRITANT TO THE EYES AND NOSE. USE SOLVENT ONLY IN A WELL VENTILATED AREA AWAY FROM OPEN FLAMES. IF EYES BECOME IRRITATED, FLUSH WITH WATER.

A. Clean all the metal parts with lint-free cloths and isopropyl alcohol (Table 401).

B. Dry all parts thoroughly with clean, lint-free cloths.

3. Weldment

A. Clean the inside of the weldment as follows:

(1) Pour 1/4 to 1/2 cup of isopropyl alcohol (Table 401) into the weldment.

(2) Shake the weldment in a circular movement, and drain the alcohol into a disposal container.

(3) Repeat the procedure until no further metal chips or filings are evident in the alcohol. Use a light probe (Table 401) and inspect the inside of the weldment.

(4) Heat an oven or heater (Table 401) 225°F to 250°F (107°C to 121°C). Heat the weldment for one hour or until completely dry.

B. Vapor hone unwanted discoloration from the outside of the weldment, as follows:

(1) Install the protective caps (Table 401).

(2) Cover the data plates with duct tape (Table 401).

(3) Vapor hone the weldment (wet or dry glass bead). Do not vapor hone the protected threads on the fill, discharge, and switch bosses.

(4) Remove the duct tape and protective caps, then clean the weldment completely (refer to paragraph 3.A above).

CHECK

1. Tools and Equipment

A. The recommended tools and equipment are given in Table 501.

NOTE: Equivalent items can be used.

Table 501. Check Tools and Equipment

Nomenclature	Part or Specification Number	Source (CAGE)*
Cradle, Fire Extinguisher	83000242	Pacific Scientific (05167)
Ground Strap and Circuit Tester	WT25	Walter G. Legge Co. (84832)
Light Probe	---	Commercially available
Power Supply or Battery, 30 VDC, 3.5 Amperes	---	Commercially available
Protective Caps		
Cartridge Cover	5/8-SC	CaPlugs (99017)
Cartridge Port	PD-50	CaPlugs (99017)
Cartridge Thread	1/2-SC	CaPlugs (99017)
Discharge Boss	PD-200	CaPlugs (99017)
Discharge Outlet End	CD-22	CaPlugs (99017)
Fill Boss	PD-40	CaPlugs (99017)
Fill Fitting End	CD-4	CaPlugs (99017)
Pressure Gauge Fitting	WW-O	CaPlugs (99017)
Pressure Switch Boss	PD-100	CaPlugs (99017)
Pressure Switch Connector	RC-14	CaPlugs (99017)
Pressure Switch Sleeve	31670509	Pacific Scientific (05167)
Safety Chamber, Cartridge	83330118	Pacific Scientific (05167)
Weighing Scale, ±0.01 pound (0,005 kg) 0 to 120 pounds (55 kg)	---	Commercially available

* Refer to the IPL, paragraph 2, for the address.

2. O-Ring Bottle Fire Extinguisher Weight Check

WARNING: INCORRECT HANDLING OF A CHARGED O-RING BOTTLE FIRE EXTINGUISHER CAN CAUSE ACCIDENTAL DISCHARGE OF THE EXTINGUISHING AGENT AND POSSIBLE INJURY. DO NOT APPLY PRESSURE TO, OR INSERT ANYTHING INTO THE DISCHARGE BOSS OR FILL FITTING.

A. Remove the protective caps (501).

B. Put the cradle (Table 501) on the weighing scale (Table 501). Adjust the weighing scale to zero.

C. Put the o-ring bottle fire extinguisher in the cradle.

D. Weigh the fire extinguisher. Record the weight to the nearest 0.01 pound (0,005 kg).

E. Compare the current weight of the fire extinguisher to the last weight etched on the identification plate or nameplate. Per the requirements above, if the fire extinguisher is more than 0.10 pound (0,05 kg) below the last recorded weight, test the fire extinguisher for leakage (refer to the Testing and Fault Isolation section, paragraph 2).

F. Install the protective caps (Table 501).

3. Container Weldment

A. Inspect the weldment for scratches or dents that could reduce its strength as a pressure vessel. Replace the weldment if the dents are deeper than 1/16 inch/inch (0,06 mm) of average dent diameter, or the scratches are deeper than 0.004 inch (0,10 mm) or longer than 2 inches (5,08 cm).

B. Inspect all welded joints for cracks, breaks, or tears, especially at the mounting lugs.

4. Discharge Outlet

A. Under strong light, and preferably under magnification, inspect the discharge outlet for cracks, corrosion, crossed threads, stripped threads, chafing, scoring, and any other damage that might decrease operation. Dark stains on inside surfaces, caused by previous firing of the cartridge, are acceptable. Replace the discharge outlets that are not acceptable.

5. Fill Fitting

A. Check the fill fitting. Replace the fill fitting if it is not acceptable.

6. Cartridge

WARNING: THE CARTRIDGE IS AN EXPLOSIVE DEVICE. ACCIDENTAL DETONATION OF A CARTRIDGE CAN CAUSE INJURY. FOR SAFE HANDLING, PERSONNEL MUST BE GROUNDED AND THE PROTECTIVE CAP (10) AND SHUNT WIRE/CAUTION TAG (-15) MUST BE INSTALLED ON THE ELECTRICAL CONNECTOR (EXCEPT WHEN SPECIFIED IN THE PROCEDURE).

A. Wind the ground strap around your wrist, and connect the strap to the circuit tester (Table 501). Test the ground circuit.

B. Verify the shunt wire/caution tag is connected between the positive and negative terminals of the cartridges.

C. Check the service date (month/year) etched on the wrench flats of the cartridges. Dispose of the cartridge (as specified in paragraph 7, below) if its service life or combined life (service and storage) exceeds the limits.

REQUIREMENT: THE CARTRIDGES HAS A MAXIMUM INSTALLED SERVICE LIFE OF 4 YEARS AND A COMBINED SERVICE/STORAGE LIFE OF 6 YEARS.

7. Cartridge Disposal

WARNING: THE CARTRIDGE MUST BE DETONATED IN A FIXTURE THAT GIVES PROTECTION FOR PERSONNEL. THE SAFETY CHAMBER IS DESIGNED FOR THIS PURPOSE.

A. Ground the safety chamber (Table 501). The ground strap must be connected and grounded.

B. Make sure that the shunt wire/caution tag is installed on the cartridge between the positive and negative terminals.

C. Cut the safety wire and remove the cartridge from the housing assembly. Refer to Disassembly Section, paragraph 2.D. Leave the o-ring installed on the cartridge.

D. Thread the cartridge, with the shunt wire/caution tag installed, tightly into the safety chamber (Table 501). See Figure 501.

E. Remove the shunt wire/caution tag and connect electrical wires terminated with alligator clips to the cartridge terminals.

F. Connect the wire leads to a 30 VDC power supply or battery (Table 501). Stand back five feet (1.5 meters) minimum, and close the switch to detonate the cartridge.

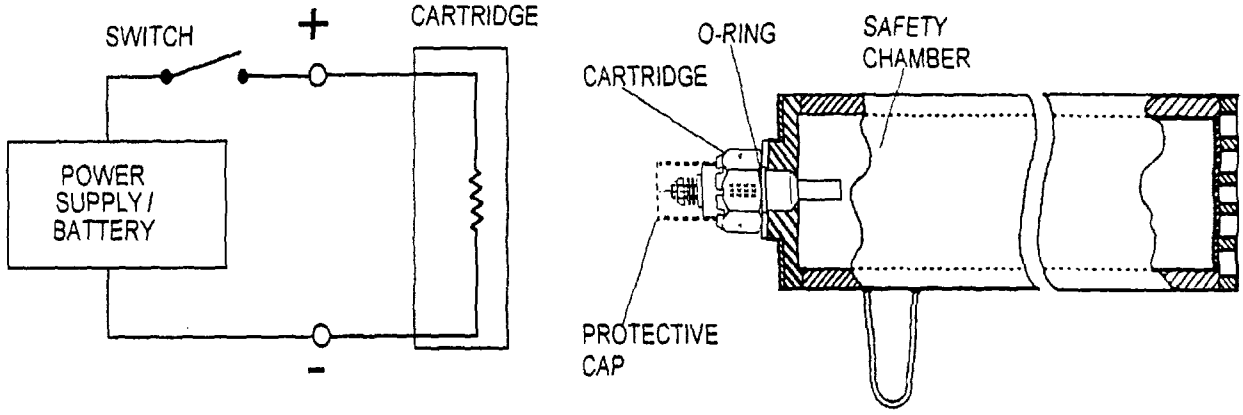


Figure 501. Cartridge Disposal Setup

8. Pressure Devices

A. Verify that the pressure device functional test has been successfully completed (refer to Testing and Fault Isolation section, paragraph 6).

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REPAIR

1. General

A. The repair instructions are limited to replacement of a damaged data plate, caution plate identification plate or nameplate. Refer to the Disassembly and Assembly sections to replace all other components.

B. The recommended tools and materials are given in Table 601.

NOTE: Equivalent items can be used.

Table 601. Repair Tools and Materials

Nomenclature	Part or Specification Number	Source (CAGE)*
Adhesive, Epoxy	Scotchweld 1838 A/B	The 3M Company (04633)
Alcohol, Isopropyl	Federal Specification TT-I-735	Commercially available
Sandpaper, 240 grit	---	Commercially available

* Refer to the IPL, paragraph 2, for the address.

C. Repairs that require welding, except those covered in the Assembly section of this manual, are not permitted unless authorized in writing by Pacific Scientific Company.

D. After Pacific Scientific Company approval, repairs that require welding must be made in accordance with the latest FAA directives and under the supervision of a certified FAA mechanic with an airframe rating. If any doubt exists regarding penetration of the weld, inspect the welded part in accordance with MIL-STD-453.

2. Replacement of Bonded Plates

A. Copy the information from the old identification plate or nameplate to the new identification plate or nameplate.

B. Use 240 grit sandpaper (Table 601) to roughen the face of the old plates and the back of the new plate.

C. Clean the plate using isopropyl alcohol (Table 601). Let dry.

D. Mix the two-part epoxy adhesive (Table 601) 5 parts A to 4 parts B, until the adhesive has a uniform color.

NOTE: The working life of the adhesive is 60 minutes at 75°F (24°C).

E. Apply an even coat of adhesive to the plate, and press the new plate on the old plate from the center out.

F. Remove all excessive adhesive. Make sure the bond line around the plate is smooth and even. Fill any voids along the edge with adhesive.

G. Cure the adhesive for 12 hours at 75°F (24°C). Tape, clamps, or other devices can be used to hold the plate in place until the adhesive cures.

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ASSEMBLY (INCLUDING STORAGE)

1. General

A. This section contains the o-ring bottle fire extinguisher reassembly, refill, and storage instructions. Skip unnecessary steps if the o-ring bottle fire extinguisher is partially assembled.

NOTE: Refer to the Repair section, paragraph 2, to replace the data plate, caution plate, identification plate or nameplate.

B. The recommended tools and materials are given in Table 701.

NOTE: Equivalent items can be used.

Table 701. Assembly Tools and Materials

Nomenclature	Part or Specification Number	Source (CAGE)*
Alcohol, Isopropyl	TT-I-735	Commercially available
Bar Tool (4 inch length x 1/2 inch width x 1/8 inch thickness)	---	User furnish
Ground Strap & Circuit Tester	WT25	Walter G. Legge Co. (84832)
Lubricant	822 (Spec MMS-N306A)	Dri Lube Company (06186)
Protective Caps		
Cartridge Cover	5/8-SC	CaPlugs (99017)
Cartridge Port	PD-50	CaPlugs (99017)
Cartridge Thread	1/2-SC	CaPlugs (99017)
Discharge Boss	PD-200	CaPlugs (99017)
Discharge Outlet End	CD-22	CaPlugs (99017)
Fill Boss	PD-40	CaPlugs (99017)
Fill Fitting End	CD-4	CaPlugs (99017)
Pressure Gauge Fitting	WW-O	CaPlugs (99017)
Pressure Switch Boss	PD-100	CaPlugs (99017)
Pressure Switch Connector	RC-14	CaPlugs (99017)
Pressure Switch Sleeve	31670509	Pacific Scientific (05167)
Recharge Stand	8126300	Pacific Scientific (05167)
Safety Wire	MS20995C32	Commercially available
Safety Bag, Heat Sealable, Electrostatic	22024509	Noland Paper Co. (OAZM2)
Shim, Washer	94202200	Pacific Scientific (05167)
Tank, Extinguishing Agent with Stand, 150 pounds (68 kg)	---	Commercially available

* Refer to the IPL, paragraph 2, for the address.

Table 701. Assembly Tools and Materials (Continued)

Nomenclature	Part or Specification Number	Source (CAGE)*
Tank, Gaseous Nitrogen (GN_2), 2000 psig (13800 kPag)	---	Commercially available
Tape, Foam Insulated (1/2 inch wide and 1/4 inch thick)	---	The 3M Company (04633)
Thermocouple	---	Commercially available
Thread Tape, Teflon (1/2 inch wide)	---	Commercially available
Valve Plug, Insertion Tool	13253	Pacific Scientific (05167)
Weighing Scale, ±0.01 pound (0,005 kg) 0 to 120 pounds (55 kg)	---	Commercially available
Wrench, Open End 5/8, 11/16, and 1-1/4 inch	---	Commercially available

* Refer to the IPL, paragraph 2, for the address.

2. Pressure Devices

A. Pressure Gauge

(1) Put the fire extinguisher in the cradle with the gauge boss up. Wrap the pressure gauge thread with the thread tape (Table 701).

(2) Insert the pressure gauge inside the gauge guard on the weldment and screw the pressure gauge fitting into the gauge boss until finger tight.

(3) Using a wrench on the pressure gauge wrench flats, full tighten the pressure gauge in place.

B. Pressure Gauge and Switch

(1) Put the fire extinguisher in the cradle with the switch boss up.

(2) Insert the pressure gaugeinside the gauge guard on the weldment and screw the pressure gauge fitting into the port boss until finger tight.

(3) Using an 11/16 inch open end wrench (Table 701) on the gauge fitting flats, fully tighten the pressure gauge in place.

C. Pressure Switch and Gauge

(1) Put the fire extinguisher in the cradle with the switch gauge boss up.

(2) Install one of the retainers finger tight against the back of the pressure switch and and switch.

(3) Lubricate (Table 701) the o-rings, then install the o-ring, the other retainer, and the second o-ring on the pressure switch and gauge.

(4) Install the pressure switch and gauge finger tight into the switch boss. Orient the electrical connector as shown in Figure 701.

NOTE: Do not turn the pressure switch counterclockwise more than one turn.

(5) Torque the nut 90 to 100 inch-pounds (10 to 11 N·m). Install the safety wire (Table 701) per the specification MS33540.

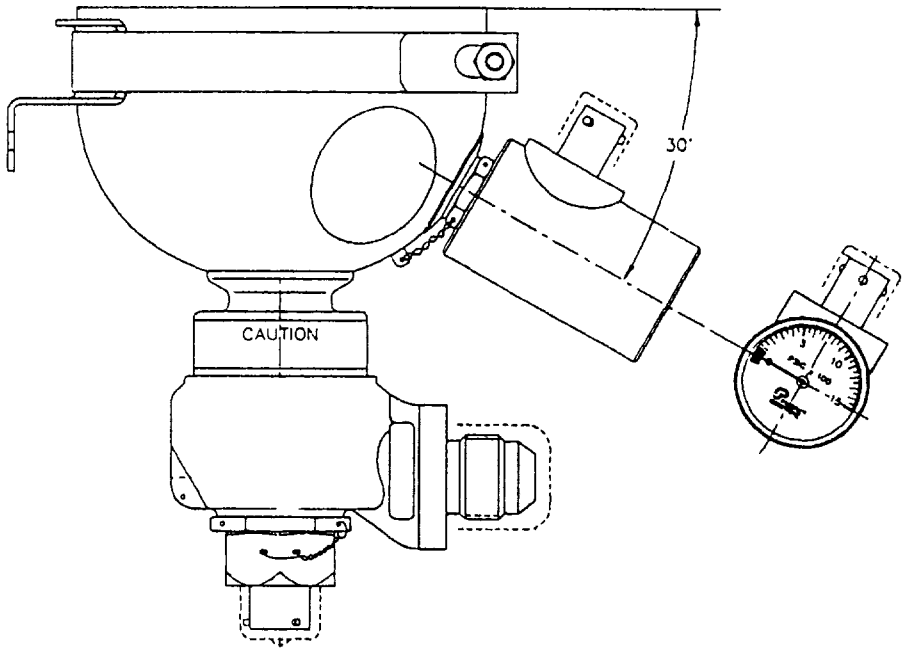


Figure 701. Pressure Switch and Gauge Orientation

D. Pressure Switch

(1) Attach the cradle to a rotary table on a machine tool (Table 701). Put the fire extinguisher in the cradle with the switch boss up.

(2) Clean all surfaces to be welded, the pressure switch and the switch boss. Refer to the Cleaning section, paragraph 2.A.

(3) Turn the pressure switch into the switch boss until tight. See Figure 702.

CAUTION: OVERHEATING THE PRESSURE SWITCH CAN DESTROY ITS PRESSURE SENSING ELEMENT.

(4) Attach a ground wire to the machine tool. Hold the electrode manually, and weld the pressure switch to the switch boss in six rapid pass sections. Cool the pressure switch with shop air to room temperature between each rapid pass section. Convection cooling can be used. Refer to Table 702 for the welding schedule.

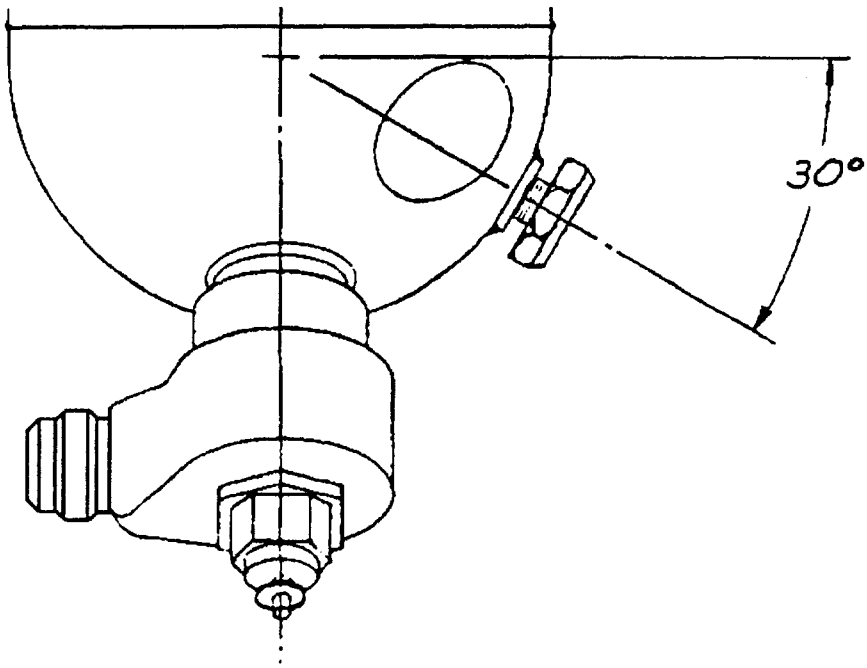


Figure 702. Pressure Switch Orientation

E. Temperature Compensated Pressure Switch

(1) Attach a cradle (Table 701) to a rotary table on a machine tool (Table 701). Put the fire extinguisher in the cradle with the switch boss up.

(2) Clean all surfaces to be welded, the temperature compensated pressure switch and the switch boss. Refer to the Cleaning section, paragraph 2.A.

(3) Turn the temperature compensated pressure switch into the switch boss until tight. See Figure 703.

CAUTION: OVERHEATING THE PRESSURE SWITCH CAN DESTROY ITS PRESSURE SENSING ELEMENT.

F. Attach a ground wire to the machine tool. Hold the electrode manually, and weld the temperature compensated pressure switch to the switch boss in six rapid pass sections. Cool the temperature compensated pressure switch to room temperature with shop air between each rapid pass section. Convection cooling can be used. Refer to Table 702 for the welding schedule.

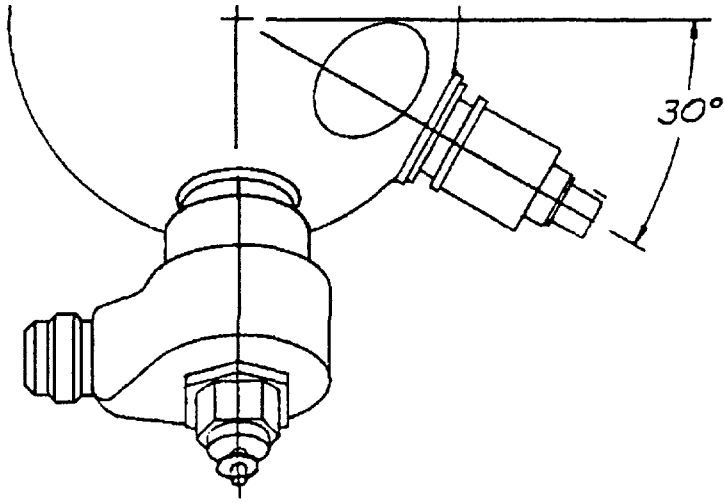


Figure 703. Temperature Compensated Pressure Switch Orientation

G. Specifications for welding the temperature compensated pressure switch are given in Table 702.

Table 702. Welding Schedule

Item	Characteristic
Argon Cup Size	1/4 inch (6,4 mm) ID
Argon Flow Rate	15 cfh (0,425 m^3/hr)
Current Setting	30 to 35 amperes for the temperature compensated pressure switch
Electrode	1/16 inch (1,6 mm) OD tungsten, ground to a sharp, tapered point
Electrode Gap	0.025 inch (0,64 mm)
Turntable Speed	2 rpm approximately (may be decreased down to 1.5 rpm or increased up to 3.5 rpm)

3. Discharge Outlet

A. Using lubricant (Table 701), lubricate the o-rings.

B. Install the o-rings on the valve plug. Position the valve plug in the discharge boss, screw the valve plug insertion tool (Table 701) into the discharge boss to seat the valve plug. Remove the valve plug insertion tool.

C. Install the o-ring on the stem. Lubricate the threads of the stem and install in the discharge boss. Using bar tool (Table 701), tighten the stem into the discharge boss.

D. Position the discharge outlet on the stem.

E. Install the o-ring on the housing assembly. Lubricate the threads of the housing assembly and install in the stem, torque 145 to 155 inch-pounds (16 to 18 N•m).

4. Fill Fitting

A. Using lubricant (Table 701), lubricate the o-rings.

B. Install the o-ring on the fusible or rupture disc valve.

C. Insert the fusible or rupture disc valve into the fill boss.

D. Install the o-ring on the fill fitting.

E. Install the fill fitting into the fill boss.

F. Torque the fill fitting 90 to 100 inch-pounds (10 to 11 N•m).

5. Extinguisher Recharge

NOTE: See Figure 704 to set up the recharge stand and related equipment. Write the recharge data on a copy of Table 703.

A. Put the cradle on the weighing scale (Table 701). Adjust the weighing scale to zero.

B. Put the fire extinguisher in the cradle. Write the weight in entry 1 of Table 703.

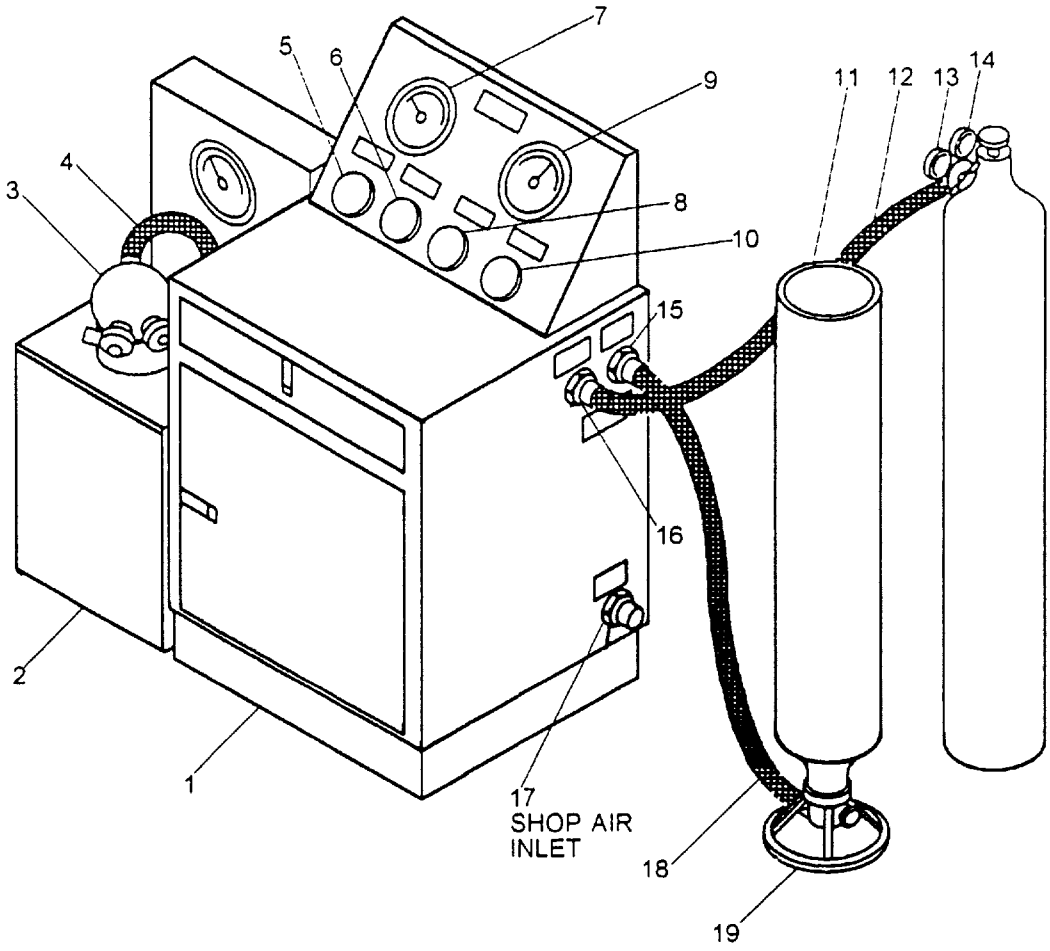
NOTE: Weigh the fire extinguisher with the cartridge, and shunt wire/caution tags on the weighing scale. Remove the protective caps (Table 701).

C. Thread the charging fixture onto the fill fitting.

D. Add entry 1 of Table 703 to the charge weight given in entry 3. Write the sum in entry 5. Add entry 1 to the charge weight given in entry 2 (refer to Description and Operation, Technical Properties). Write the sum in entry 3.

E. Open the manifold valve (6) and agent valve (10), to allow the fire extinguishing agent to flow from the tank (11) into the fire extinguisher. Do not move the fire extinguisher, cradle, or hose.

F. Close the agent valve (10) at the charge weight given in entry 3. Disconnect the charging fixture and charging hose (4). Write the weight of the filled fire extinguisher in entry 4.



LEGEND:

1. CONTAINER RECHARGE STAND (INCLUDES COMPRESSOR ASSEMBLY)
2. WEIGHING SCALE*
3. FIRE EXTINGUISHER IN CRADLE*
4. 1/4 - INCH FLEXIBLE CHARGING HOSE
5. VENT VALVE
6. MANIFOLD VALVE
7. MANIFOLD PRESSURE GAUGE
8. NITROGEN VALVE
9. NITROGEN PRESSURE GAUGE
10. AGENT VALVE
11. EXTINGUISHING AGENT TANK*
12. 1/4 - INCH FLEXIBLE NITROGEN HOSE
13. REGULATOR
14. NITROGEN TANK
15. AGENT INLET
16. NITROGEN INLET
17. AIR INLET
18. 1/4 - INCH FLEXIBLE HALON HOSE
19. AGENT TANK STAND

* INDICATES ITEMS NOT SUPPLIED WITH RECHARGE STAND

Figure 704. Fire Extinguisher Refill Setup (Sheet 1 of 2)

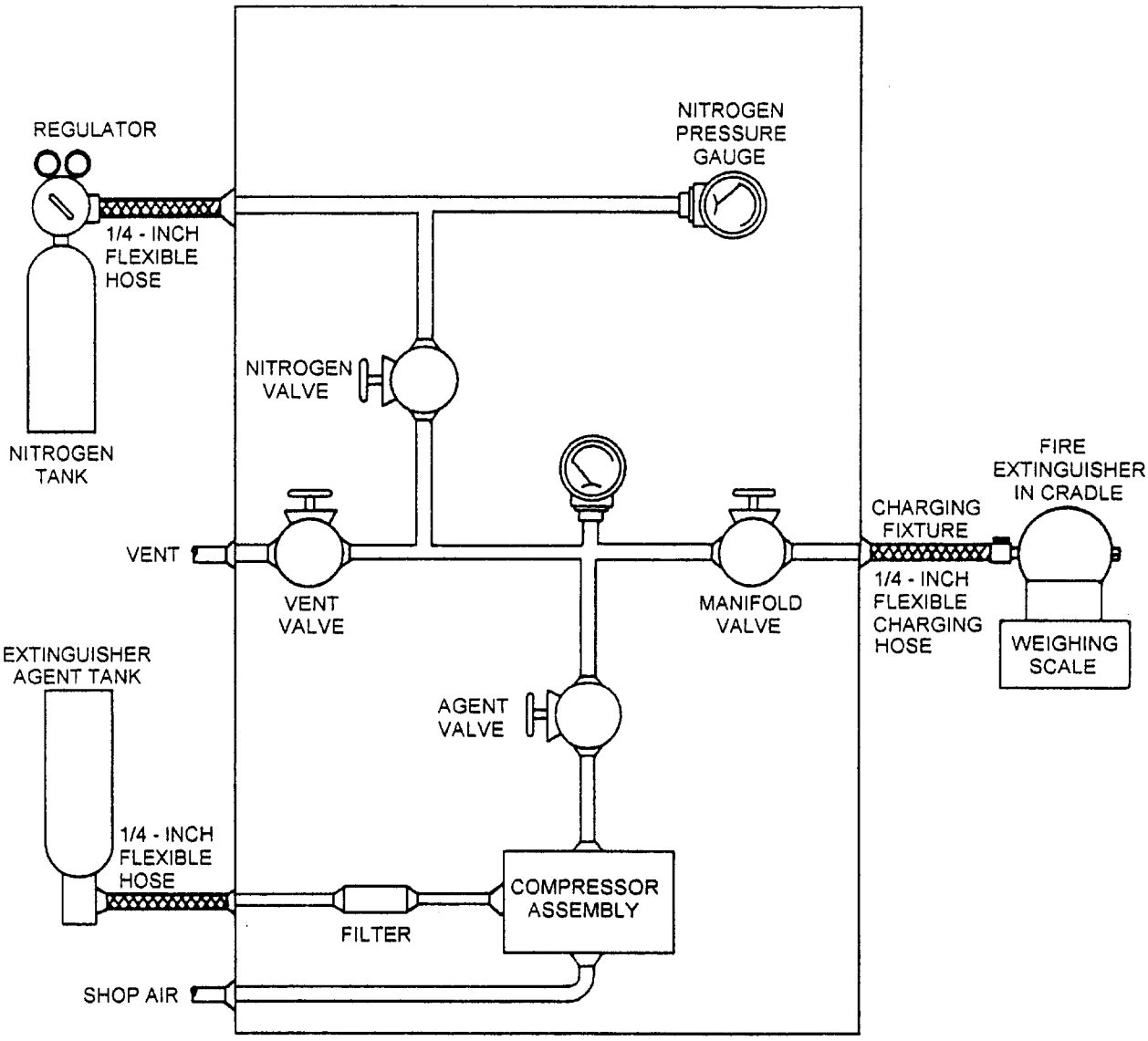


Figure 704. Fire Extinguisher Refill Setup (Sheet 2 of 2)

Table 703. Fire Extinguisher Refill Record

Part Number: _____ **Serial No:** _____	
Date of Refill: _____ **Pressure Switch Ser. No:** _____	
Weight Certified By: _____ **Hydrostatic Test Date:** _____	
Item	As Noted
1. Empty fire extinguisher on cradle (charging hose disconnected)	_____ pounds (kg) Actual
2. Required weight of extinguishing agent	Pounds (kg)
3. Desired fill weight of fire extinguisher on cradle (charging fixture and hose disconnected) (entry 1 plus entry 2)	_____ pounds (kg) (Calculated)
4. Fire extinguisher filled with extinguishing agent on cradle (charging fixture and hose disconnected)	_____ pounds (kg) (Actual. Must meet entry 3 requirement)
5. Thermocouple temperature	_____ °F (°C)
6. Required nitrogen charge pressure at thermocouple temperature	_____ Psig (kPag) Minimum _____ Psig (kPag) Maximum
7. Actual nitrogen charge pressure (from manifold gauge)	_____ Psig (kPag
8. Filled fire extinguisher on cradle after nitrogen charge (charging fixture and hose disconnected)	_____ pounds (kg)
9. Calculated nitrogen weight (subtract entry 4 from entry 10)	_____ pounds (kg) (Calculated)
10. Actual weight of filled fire extinguisher with the cartridges and without the protective caps (Table 701)	_____ pounds (kg)

G. Connect the charging hose (4) and the charging fixture to the fill fitting. Close the vent valve (5).

H. Write the thermocouple temperature in entry 5. Find the minimum and maximum nitrogen charge pressure from Table 704 through Table 710 for the thermocouple temperature recorded in entry 5 of Table 703. Write the minimum and maximum pressure in entry 6.

I. Adjust the regulator (13) on the nitrogen tank (14), using the nitrogen pressure gauge (9), to a pressure within the charge pressure range given in entry 6.

J. Open the nitrogen valve (8) and the charging fixture valve, then charge the fire extinguisher to the required pressure, as shown by the manifold pressure gauge (7, Figure 704).

K. Close the charging fixture valve. Hold the fire extinguisher at arm's length and pressure gauge facing away from body. Shake the fire extinguisher until the nitrogen charge pressure stabilizes. Write the actual charge pressure from the manifold pressure gauge (7) in entry 7. Add nitrogen, if necessary, to raise the pressure to the minimum required pressure, repeat until pressure is stabilized.

L. Close the nitrogen valve (8, Figure 704) and turn the fill fitting into the fill boss. Open the vent valve (5, Figure 701) and disconnect the charging fixture and charging hose (4).

M. Remove the fire extinguisher and the cradle from the weighing scale.

N. Check for leakage (refer to Testing and Fault Isolation section, paragraph 2).

O. Calculate the nitrogen charge weight. Write the result in entry 9.

P. Install the cartridges (refer to paragraph 6 below).

Q. Weigh the charged fire extinguisher (refer to Description and Operation, Technical Properties). Write the weight in entry 10.

R. Vibratech the charge weight (entry 10 of Table 703) and recharge date on the identification plate or nameplate. Do not use an impression or ink stamp.

Table 704. Nitrogen Charge Pressure Versus Temperature (300 to 325 psig)

Temperature (°F)	Pressure		Temperature (°F)	Pressure		Temperature (°F)	Pressure	
	Min	Max		Min	Max		Min	Max
60	272	292	74	315	335	88	363	383
62	278	298	76	321	341	90	370	390
64	284	304	78	328	348	92	377	397
66	290	310	80	334	354	94	385	405
68	296	316	82	341	361	96	392	412
70	302	322	84	349	369	98	400	420
72	308	328	86	356	376	100	407	427

NOTE: *If the temperature is not in the table, use the higher temperature listed for the required pressure.*

Table 705. Nitrogen Charge Pressure Versus Temperature (360 to 385 psig)

Temperature (°F)	Pressure		Temperature (°F)	Pressure		Temperature (°F)	Pressure	
	Min	Max		Min	Max		Min	Max
60	332	355	74	375	398	88	423	447
62	338	360	76	382	405	90	430	454
64	344	366	78	388	411	92	438	461
66	350	373	80	395	418	94	446	467
68	356	379	82	402	425	96	453	474
70	362	380	84	409	432	98	461	481
72	369	391	86	416	440	100	469	488

NOTE: If the temperature is not in the table, use the higher temperature listed for the required pressure.

Table 706. Nitrogen Charge Pressure Versus Temperature (400 to 425 psig)

Temperature (°F)	Pressure		Temperature (°F)	Pressure		Temperature (°F)	Pressure	
	Min	Max		Min	Max		Min	Max
60	371	391	74	416	436	88	465	485
62	378	398	76	422	442	90	472	492
64	383	403	78	429	449	92	480	500
66	390	410	80	434	454	94	488	508
68	396	416	82	443	463	96	496	516
70	402	422	84	450	470	98	504	524
72	409	429	86	458	478	100	512	532

NOTE: If the temperature is not in the table, use the higher temperature listed for the required pressure.

Table 707. Nitrogen Charge Pressure Versus Temperature (600 to 625 psig)

Temperature (°F)	Pressure		Temperature (°F)	Pressure		Temperature (°F)	Pressure	
	Min	Max		Min	Max		Min	Max
60	567	587	74	617	637	88	669	689
62	574	594	76	624	644	90	677	697
64	581	601	78	632	652	92	686	706
66	588	608	80	639	659	94	694	714
68	595	615	82	647	667	96	703	723
70	602	622	84	654	674	98	713	733
72	609	629	86	662	682	100	720	740

NOTE: If the temperature is not in the table, use the higher temperature listed for the required pressure.

Table 708. Nitrogen Charge Pressure Versus Temperature (625 to 650 psig)

Temperature (°F)	Pressure		Temperature (°F)	Pressure		Temperature (°F)	Pressure	
	Min	Max		Min	Max		Min	Max
60	592	612	74	641	661	88	694	704
62	599	619	76	649	669	90	702	712
64	606	626	78	656	676	92	710	720
66	613	633	80	663	683	94	718	728
68	620	640	82	671	691	96	726	736
70	627	647	84	679	699	98	734	744
72	634	654	86	686	706	100	742	752

NOTE: If the temperature is not in the table, use the higher temperature listed for the required pressure.

Table 709. Nitrogen Charge Pressure Versus Temperature (800 to 825 psig)

Temperature (°F)	Pressure		Temperature (°F)	Pressure		Temperature (°F)	Pressure	
	Min	Max		Min	Max		Min	Max
60	767	787	74	823	843	88	882	902
62	775	795	76	830	850	90	891	911
64	783	803	78	837	857	92	900	920
66	790	810	80	846	864	94	910	930
68	802	822	82	855	875	96	920	940
70	809	829	84	864	884	98	930	950
72	816	836	86	873	893	100	939	959

NOTE: If the temperature is not in the table, use the higher temperature listed for the required pressure.

Table 710. Nitrogen Charge Pressure Versus Temperature (825 to 850 psig)

Temperature (°F)	Pressure		Temperature (°F)	Pressure		Temperature (°F)	Pressure	
	Min	Max		Min	Max		Min	Max
60	786	806	74	845	865	88	908	928
62	794	804	76	853	873	90	917	937
64	802	822	78	862	882	92	927	947
66	811	831	80	871	891	94	938	958
68	819	839	82	880	900	96	948	968
70	827	847	84	889	909	98	959	979
72	836	856	86	899	919	100	969	989

NOTE: If the temperature is not in the table, use the higher temperature listed for the required pressure.

6. Cartridge and Thermal Relief Sensor

WARNING: THE CARTRIDGE IS AN EXPLOSIVE DEVICE. ACCIDENTAL DETONATION OF A CARTRIDGE CAN CAUSE INJURY. FOR SAFE HANDLING, PERSONNEL MUST BE GROUNDED AND THE PROTECTIVE CAP AND SHUNT WIRE/ CAUTION TAG MUST BE INSTALLED ON THE ELECTRICAL CONNECTIONS.

A. Wind the ground strap around your wrist, and connect the strap to the circuit tester (Table 701). Test the ground circuit.

B. Make sure the protective cap and shunt wire/caution tag is installed on the cartridge between the positive and negative terminals.

C. Lubricate the o-ring (refer to Table 701). Install the o-ring on the cartridge.

D. Use the shim washers (refer to Table 701) (if needed) to insure the cartridge ground stud does not fall within the discharge area of the cartridge.

E. Install the cartridge in the housing assembly. Torque the cartridge 90 to 100 inch-pounds (10 to 11 N•m).

F. Install safety wire (Table 701) and connect the cartridge to the discharge outlet. Refer to MS33540.

G. Install thermal relief sensor and torque 90 to 100 inch-pounds (10 to 11 N•m).

H. Connect one leadwire of the thermal relief sensor to one leadwire of the housing assembly. Connect the remaining leadwire of the housing assembly to negative terminal of the cartridge. See Figure 1.

7. Storage Instructions

A. The recommended materials are given in Table 711.

NOTE: Equivalent items can be used

Table 711. Storage Materials

Nomenclature	Part or Specification Number	Source (CAGE)*
Cardboard Container 60 to 224 Cubic Inch 378 to 400 Cubic Inch 536 to 1050 Cubic Inch 1400 Cubic Inch	 12 inch x 12 inch x 12 inch (30 cm x 30 cm x 30 cm) 14 inch x 14 inch x 14 inch (36 cm x 36 cm x 36 cm) 18 inch x 18 inch x 18 inch (46 cm x 46 cm x 46 cm) 22 inch x 22 inch x 18 inch (56 cm x 56 cm x 36 cm)	Commercially available
Fibre Drum 1600 to 2500 Cubic Inch	23 inch dia, 26.5 inch high (58 cm dia, 67 cm high)	Commercially available
Packing Material	---	Commercially available
Plastic Bag	18 inch x 12 inch (45 cm x 30 cm)	Commercially available
Safety Bag, Heat Sealable, Electrostatic	22024509	Noland Paper Co. (OAZM2)
Wooden Box	Large enough for each cartridge, compartmented for multiple cartridges if required	User supply

* Refer to the IPL, paragraph 2, for the address.

B. Fire Extinguisher

NOTE: With protective cap and shunt wire/caution tag installed on the cartridge, it is safer to store the fire extinguisher with the cartridge installed in the discharge outlet.

(1) Install the protective caps (Table 701) on the discharge outlets. Make sure the shunt wire/caution tag is installed on the cartridge.

(2) Insert the fire extinguisher into a plastic bag (Table 711). Put the fire extinguisher in a cardboard container or fibre drum (Table 711). Fill the cardboard container or fibre drum with packing material (Table 711), as needed to prevent damage to the components.

(3) Write the fire extinguisher part number, date of last hydrostatic test, and overhaul date on the outside of the cardboard container or fibre drum. Also, write the cartridge part numbers and the dates of their Service/Storage Life.

(4) Attach the following warning/caution stickers to the outside of the cardboard container or fibre drum.

(a) Non-Flammable Gas

(b) Compressed Gases, N.O.S. (Bromotrifluoromethane, Nitrogen), UN1956

(c) Fragile - **DO NOT DROP**

(d) Storage temperatures are +40°F to +100°F (+4°C to +38°C).

C. Cartridge

WARNING: THE CARTRIDGE IS AN EXPLOSIVE DEVICE. ACCIDENTAL DETONATION OF A CARTRIDGE CAN CAUSE INJURY. FOR SAFE HANDLING, PERSONNEL MUST BE GROUNDED AND THE PROTECTIVE CAP AND THE SHUNT WIRE/CAUTION TAG MUST BE INSTALLED.

(1) Wind the ground strap around your wrist, and connect the strap to the circuit tester (Table 701). Test the ground circuit.

(2) Make sure the protective cap and shunt wire/caution tag is installed on the cartridge (5).

(3) Put the cartridge in an electrostatic safety bag (Table 711), then into a correctly sized wooden box (Table 711), and seal.

(4) Write the cartridge part number and the Service/Storage dates on the outside of the wooden box. Mark the wooden box with Pyrotechnic, UN0323.

(5) Storage temperatures are +40°F to +100°F (+4°C to +38°C).

FITS AND CLEARANCES

1. Torque Limits

A. Assembly torque limits are given in Table 801.

Table 801. Torque Limits

Nomenclature	Torque Range
Cartridge	90 to 100 inch-pounds (10 to 11 N·m)
Housing Assembly	145 to 155 inch-pounds (16 to 18 N·m)
Fill Fitting	95 to 105 inch-pounds (11 to 12 N·m)
Switch Gauge (Jam Nut)	210 to 230 inch-pounds (24 to 26 N·m)
Mounting Clamp (Nut)	30 to 35 inch-pounds (3 to 4 N·m)

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SPECIAL TOOLS, FIXTURES, AND TEST EQUIPMENT

1. Special Tools, Fixtures, and Equipment

A. The special tools, fixtures, and test equipment recommended for maintenance of the fire extinguishers are given in Table 901. See the IPL for the appropriate item numbers.

NOTE: Equivalent items can be used.

Table 901. Special Tools, Fixtures, and Equipment

Nomenclature	Part No.	Source (CAGE)*	Use
Bar Tool (4 inch length x 1/2 inch width x 1/8 inch thickness)	---	User furnish	To remove and install stem
Cap, Hydrotest	83330165	Pacific Scientific (05167)	To cap the discharge boss for the hydrostatic test
Digital Multimeter	79	John Fluke (89536)	To check the cartridges
Discharge Recovery Tool	59000059	Pacific Scientific (05167)	To connect the fire extinguisher to the recovery tank, and to depress the fusible valve in the fill fitting
Flat File			
Mill Smooth	---	Commercially available	To square the edge of the discharge boss
Second Cut	---	Commercially available	To deburr the discharge boss
Fitting, Hydrotest 0.750-16 UNJF Thread	---	Commercially available	To plug the fill boss for the hydrostatic test
Ground Strap & Circuit Tester	WT25	Walter G. Legge Co. (84832)	To ground the technicians for safe handling of the explosive cartridges
Halon Recovery Recycle System	A6-06-2000-75-0 (Model H 1301)	Neutronics Inc. (5R712)	To recover and recycle Halon
Hydrotest Test Stand	---	Commercially available	To pressurize the weldmentfor the hydrostatic test
Leak Detector	HLD 4000-310 Series C	Inficon (56507)	To check for leakage of the extinguishing agent

* Refer to the IPL, paragraph 2, for the address.

Table 901. Special Tools, Fixtures, and Equipment (Continued)

Nomenclature	Part No.	Source (CAGE)*	Use
Light Probe	---	Commercially available	To check the inside of the weldment for unwanted materials and damage
Magnet	83330001	Pacific Scientific (05167)	To verify the mulitimeter indicates no continuity, showing the switch contacts open on the pressure device
Oven or Heater 250°F (121°C)	---	Commercially available	To dry the weldment after the hydrostatic test and cleaning
Plug, Gauge Boss 1/4-18 NPT Thread	---	Commerically available	To plug the gauge boss for the hydrostatic test
Plug, Hydrotest	83330670-2	Pacific Scientific (05167)	To plug the hydrotest caps for the hydrostatic test
Plug, Switch Boss	MS51840-27	Commerically available	To plug the switch boss for the hydrostatic test
Power Supply or Battery 30 VDC, 3.5 Amperes	---	Commercially available	To detonate cartridges that have exceeded the maximum service and/or storage life
Protective Caps			To prevent contamination and damage
Cartridge Cover	5/8-SC	CaPlugs (99017)	
Cartridge Port	PD-50	CaPlugs (99017)	
Cartridge Thread	1/2-SC	CaPlugs (99017)	
Discharge Boss	PD-200	CaPlugs (99017)	
Discharge Outlet End	CD-22	CaPlugs (99017)	
Fill Boss	PD-40	CaPlugs (99017)	
Fill Fitting End	CD-4	CaPlugs (99017)	
Pressure Gauge Fitting	WW-O	CaPlugs (99017)	
Pressure Switch Boss	PD-100	CaPlugs (99017)	
Pressure Switch Connector	RC-14	CaPlugs (99017)	
Pressure Switch Sleeve	31670509	Pacific Scientific (05167)	

* Refer to the IPL, paragraph 2, for the address.

Table 901. Special Tools, Fixtures, and Equipment (Continued)

Nomenclature	Part No.	Source (CAGE)*	Use
Recharge Stand	8126300	Pacific Scientific (05167)	To fill the weldment with extinguishing agent and Nitrogen
Safety Chamber, Cartridge	83330118	Pacific Scientific (05167)	To safely enclose the cartridges for testing and for detonating before disposal
Stem Holding Tool	13254	Pacific Scientific (05167)	To hold the stem
Tank, Extinguishing Agent with Stand, 150 pounds (68 kg)	---	Commercially available	The extinguishing agent source for fire extinguisher recharge
Tank, Gaseous Nitrogen (GN_2) 2000 psig (13800 kPag)	---	Commercially available	The Nitrogen source for fire extinguisher recharge
Tank, Gaseous Nitrogen (GN_2) 1000 psig (6900 kPag)	---	Commercially available	The source for pressure tests
Tape, Foam Insulated (1/2" wide x 1/4" thick)	---	The 3M Company (04633)	To tape thermocouple to the fire extinguisher
Test Fitting, Banjo	59000015-1	Pacific Scientific (05167)	To connect the test plumbing to the pressure device
Test Fitting, 1/8-27 NPT	---	Pacific Scientific (05167)	To test the pressure device
Thermocouple	---	Commercially available	To test the temperature during recharge
Valve Plug Insertion Tool	13253	Pacific Scientific (05167)	To assemble the valve plugs
Weighing Scale, ±0.01 pound (0,005 kg) 0 to 120 pounds (55 kg)	---	Commercially available	To check the fire extinguisher charge weight and the recharge weight

* Refer to the IPL, paragraph 2, for the address.

Table 901. Special Tools, Fixtures, and Equipment (Continued)

Nomenclature	Part No.	Source (CAGE)*	Use
Wrench, Open End 5/8, 11/16, 1-1/4 inch	---	Commercially available	To remove and install the housing assembly, fill fitting, and pressure device

* Refer to the IPL, paragraph 2, for the address.

ILLUSTRATED PARTS LIST

1. Introduction

A. Purpose

(1) This section of the manual explains the components of an illustrated parts list (IPL). The actual exploded-view and detailed spare parts listing can be found in the 26-20-202 Supplements.

B. Guide to use of the IPL

(1) If the part number is not known:

(a) Find the part in the illustration for the IPL Figure.

(b) Note the item number assigned to the part.

(c) Refer to the parts list and find the item number in the **Fig & Item** column.

(2) If the part number is known:

(a) Refer to the parts list and find the part in the **Part Number** column.

(b) Note the figure number and item number assigned to the part.

(c) Refer to the illustration to find attaching hardware and related assembly parts.

2. Manufacturer Names and Address

A. The CAGE codes for the manufacturers of the parts, materials, special tools, and test equipment which may be referenced in this CMM are given below. The codes are taken from Cataloging Handbook H4/H8. The absence of a code in the **Nomenclature** column of the Detail Parts List means the part is manufactured or modified by the HTL/Kin-Tech Division of Pacific Scientific Company.

Code	Name and Address
OAZM2	Noland Paper Company 6600 Valley View Street Buena Park, California 90620 U.S.A.
03990	The ARO Corporation One ARO Center Bryan, Ohio 43506 U.S.A.
03964	Pennsylvania Scale Company 21 Graybill Road Leola, Pennsylvania 17540 U.S.A.
04633	The 3M Company Adhesives Coatings & Sealers Division 3M Center St. Paul, Minnesota 55101-1428 U.S.A.

Code	Name and Address
05167	Pacific Scientific Company HTL/Kin-Tech Division 1800 Highland Avenue Duarte, California 91010 U.S.A. Tel: (626) 359-9317 (626) 357-2102 FAX (626) 359-7013 SITA LAXPSCR
06186	DriLube Company 711 West Broadway Glendale, California 91204 U.S.A.
09669	Stanley Proto 1764 Oxford Street P.O. Box 5595, Terminal A London, Ontario, Canada N6A 4R6
10836	Greif Bros. Corp. Fibre Drum Division P.O. Box 398 Lindenhurst, New York 11767 U.S.A.
18675	Marking Methods Inc. 301 S. Raymond Ave. Alhambra, California 91803-1531 U.S.A.
3A054	McMaster-Carr Supply Co. 9630 Norwalk Blvd. Whittier, California 90670-2932 U.S.A. Tel: (562) 695-2449
5R712	Neutronics Inc. 456 Creameny Way Exton, Pennsylvania 19341-2532 U.S.A. Tel: (610) 524-8800 FAX (610) 524-8807
54636	Sherwin-Williams Company 101 Prospect Avenue N.W. Cleveland, Ohio 44115 U.S.A.
56507	Inficon, Leybold-Heraeus,Inc. 6500 Fly Road East Syracuse, New York 13057 U.S.A.
84832	Walter G. Legge Co., Inc 444 Central Avenue P.O. Box 591 Peekskill, New York 10566 U.S.A.
89536	John Fluke Mfg. Company 6920 Seaway Boulevard Everett, Washington 98206 U.S.A.
99017	Protective Closures Co., Inc. CaPlugs Division 2150 Elmwood Avenue Buffalo, New York 14207 U.S.A.

3. Explanation of Detail Parts List Entries

A. The Detail Parts List is arranged in general sequence of disassembly. The parts are illustrated in an exploded-view illustration and listed in the related parts list.

(1) **Fig & Item** Column

(a) The first number at the top of each **Fig & Item** column is the figure number of the corresponding illustration. The number given opposite each part number is the item number assigned to the part in the illustration.

(b) A dash (-) in front of an item number means the part is not illustrated.

(c) Alpha-variants A through Z (except I and O) are assigned to item numbers, when necessary to identify:

- Added parts
- Alternate parts
- Service bulletin modified parts

(2) **Part Number** Column

(a) This column contains the manufacturer's part number for each part, as modified to meet the requirements of ATA 200/2000. These modifications can include:

1 Removal of blank spaces and special characters, with the possible exception of dashes. Dashes are permitted only between numeric characters.

2 Insertion of a reference part number compatible with ATA 200/2000 if the manufacturer's part number exceeds 15 characters. In these cases, the manufacturer's part number is given in the **Nomenclature** column.

(3) **Nomenclature** Column

(a) This column contains descriptive nomenclature for each part, the manufacturer's CAGE code (if the part is not manufactured by Pacific Scientific Company, HTL/ Kin-Tech Division), part number (if longer than 15 characters or modified per ATA 200/2000), service bulletins affecting the part, and obsolete part numbers.

(b) The indenture system used in the **Nomenclature** column indicates the relationship of one part to another, as follows:

1 2 3
End Item or Major Assembly
ATTACHING PARTS
Attaching Parts for End Item or Major Assembly
* * *
. Detail Parts for End Item or Major Assembly
. Subassemblies
ATTACHING PARTS
. Attaching Parts for Subassemblies
* * *
. . Detail Parts for Subassemblies
ATTACHING PARTS
. . Attaching Parts for Detail Parts
* * *

(c) Assemblies, subassemblies, and detail parts subject to modification, deletion, addition, or replacement by an issued service bulletin, are annotated to indicate both pre- and post-service bulletin configurations. The term (PRE SB XXXX) in the **Nomenclature** column designates the original configuration, and the term (POST SB XXXX) identifies assemblies and parts after the modification has been completed.

(d) The terms defined below are used when applicable to indicate the interchangeability of parts.

Term	Abbreviation	Definition
Alternate	ALT	The listed part is alternate to, and interchangeable with, other parts within the same item number variant group or other item numbers if designated.
Superseded By	SUPSD BY	The part is replaced by and is not interchangeable with the item number designated in the notation.
Supersedes	SUPSDS	The part replaces and is not interchangeable with the item number designated in the notation.
Replaced By	REPLD BY	The part is replaced by and is interchangeable with the item number designated in the notation.
Replaces	REPLS	The part replaces and is interchangeable with the item number designated in the notation.

(4) **Eff Code** (Effectivity Code) Column

(a) This column contains effectivity codes (A, B, etc) to indicate the alternate models or configurations of the end item to which the parts apply. This column is left blank when the parts apply to all models or configurations, included in the parts list.

(5) **UPA** (Units Per Assembly) Column

(a) The quantity shown in this column represents the units required for one NHA or, when referring to attaching parts, the quantity to attach one such item. The abbreviation RF (reference) indicates that the end item assembly is listed for reference purposes.

WALTER KIDDE Aerospace
Division of KIDDE Technologies, Inc.
4200 Airport Drive N.W.
Wilson, North Carolina 27896-9643 U.S.A.

DISCHARGE INDICATORS

PART NUMBERS

424074, 446398, 800495, 800964, 802504, 802642, 802681, 802682, 841520, 841995, 841996, 841997, 842203, 843787, 843787-1, 843969, 843969-1, 844458, 844673, 844674, 844674-1, 875578, 877292, 877292-01, 877493, 878210, 921937, 922315

AND

OVERBOARD DISCHARGE CONNECTORS

PART NUMBERS

800036, 802722, 841556

COMPONENT MAINTENANCE MANUAL

WITH

ILLUSTRATED PARTS LIST

WALTER KIDDE Aerospace
COMPONENT MAINTENANCE MANUAL (CMM)
DISCHARGE INDICATORS AND CONNECTORS

TO: HOLDERS OF DISCHARGE INDICATORS AND CONNECTORS COMPONENT MAINTENANCE MANUAL

REVISION NO. 8 DATED NOV 30/95

HIGHLIGHTS

This is Revision 8 to the manual dated May 31/94. The purpose of this revision is to correct a part number in the illustrated parts list. Replace the revised pages with the pages included in this revision.

Chapter/Section and Page No.	Description of Change	Effectivity
Title Page	Revised revision level and date.	All models
List of Effective Pages	Revised to show revised pages and dates.	
26-20-50, Page 16	Corrected a part number; showed the incorrect part number as "DELETED".	

RECORD OF REVISIONS

Retain this record in front of manual. Upon receipt of revision, insert revised pages in the manual, and enter revision number, date inserted, and initial.

REVISION NUMBER	REVISION DATE	DATE FILED	BY	REVISION NUMBER	REVISION DATE	DATE FILED	BY
5	Mar 15/80	Mar 15/80	WK				
6	May 31/94	May 31/94	WK				
7	May 31/94	May 31/94	WK				
8	Nov 30/95	Aug 21/02	ATP				

RECORD OF TEMPORARY REVISIONS

REV. NO.	ISSUE DATE	DATE INSERTED	REMOVAL DATE	INCORPORATOR'S INITIALS	REMOVER'S INITIALS

SERVICE BULLETIN LIST

SERVICE BULLETIN NO.	DATE INCORPORATED	BY	SERVICE BULLETIN NO.	DATE INCORPORATED	BY
26-20-239	Mar 15/80	WK			

DISCHARGE INDICATORS AND CONNECTORS

LIST OF EFFECTIVE PAGES

SUBJECT	PAGE	DATE
Title	T-1	Nov 30/95
Record of Revisions	RR-1	May 31/94
	RR-2	Blank
Record of Temporary Revisions	RTR-1	May 31/94
	RTR-2	Blank
Service Bulletin List	SBL-1	May 31/94
	SBL-2	Blank
List of Effective Pages	LEP-1	Nov 30/95
	LEP-2	Blank
Table of Contents	T/C-1	May 31/94
	T/C-2	Blank
Introduction	1	May 31/94
Description and Operation	1	May 31/94
Disassembly	2	May 31/94
	3	May 31/94
Cleaning	3	May 31/94
Inspection/Check	3	May 31/94
Repair	4	May 31/94
Assembly	4	May 31/94
	5	May 31/94
Testing	5	May 31/94
	6	May 31/94
Illustrated Parts List (IPL)	7	May 31/94
	8	May 31/94
	9	May 31/94
	10	May 31/94
	11	May 31/94
	12	May 31/94
	13	May 31/94
	14	May 31/94
Illustrated Parts List (IPL)	15	May 31/94
	16	Nov 30/95

DISCHARGE INDICATORS AND CONNECTORS

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Cleaning and Assembly Materials	2	3

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Overboard Discharge Connectors	1C	15
Thermal Relief Discharge Indicator	1D	16

DISCHARGE INDICATORS AND CONNECTORS

1. INTRODUCTION

A. This manual provides operational checkout and field maintenance instructions for the discharge indicators and connectors.

B. Verification

Testing and Fault Isolation - January 29, 1991
Disassembly - January 29, 1991
Assembly - January 29, 1991

2. DESCRIPTION AND OPERATION

A. Description and Operation.

System discharge indicators, which are either skin or panel mounted, are connected by tubing to extinguishing systems. When pressure in the system is sufficient to move the piston in the indicator against the force of the spring, a yellow disc is ejected from the face of the indicator to give a visual indication that the system has been discharged.

Thermal discharge indicators are skin mounted and are connected by tubing to the thermal relief ports of extinguisher containers or oxygen cylinders. Pressure in the tubing, caused by the relief of the container safety device, ejects a colored plastic disc from the face of the indicator, which then serves as an overboard discharge outlet for the container contents.

Overboard discharge connectors provide a means of attaching tubing to the thermal relief ports of fire extinguisher containers.

Table 1. Leading Particulars

PART NUMBER	OPERATING TEMPERATURE RANGE	OPERATING PRESSURE	THREADS
424074			M14 X 1.5-4h
446398			M14 X 1.5-4h
800036			.4375-20UNJF-3A
800495	-65°F to +160°F (-54°C to +71°C)	Below 60 psi (414 kPa)	1/8 ANPT
800964			1/8 ANPT
802504			1/8 ANPT
802642			1/2-20UNJF-3A
802681	-65°F to +160°F (-54°C to +71°C)	60 to 130 psi (414 to 896 kPa)	.4375-20UNJF-3A
802682			7/16-20UNJF-3A
802722			.4375-20UNJF-3A
841520			.125 ANPT
841556			.4375-20UNF-3B
841995			1/8 ANPT

Table 1. Leading Particulars(Continued)

PART NUMBER	OPERATING TEMPERATURE RANGE	OPERATING PRESSURE	THREADS
841996	-65°F to +160°F (-54°C to +71°C)	70 to 130 psi (483 to 896 kPa)	1/8 ANPT
841997			1/8 ANPT
842203			.5000-20UNJF-3A
843787 Series		500 psi (3792 kPa)	1/8 ANPT
843969 Series	-65°F to +160°F (-54°C to +71°C)	60 to 130 psi (414 to 896 kPa)	1/8 ANPT
844458		500 to 550 psi (3447 to 3792 kPa)	.4375-20UNJF-3A
844673	-65° to +250°F (-54°C to +121°C)		.4375-20UNJF-3A
844674 Series	-65°F to +250°F (-54°C to +121°C)	70 to 130 psi (483 to 896 kPa)	.4375-20UNJF-3A
875578			.4375-20-UNF-3A
877292 Series		500 to 550 psi (3447 to 3792 kPa)	.4375-20-UNF-3A
877493	-65°F to +160°F (-54°C to +71°C)	60 to 130 psi (414 to 896 kPa)	.4375-20UNJF-3B
878210		500 to 550 psi (3447 to 3792 kPa)	.500-20-UNJF-3A
921937		70 to 130 psi (483 to 896 kPa)	7/8-24-NS-3
922315		550 psi (3792 kPa)	1/8 ANPT

3. DISASSEMBLY

A. Part No. 800495, 802681, 841996, 843969, 844674 and 877493. (See Figure 1).

1. Remove split ring (5) and lift out disc and retainer assembly (10).

2. Remove retaining ring (15). Invert the indicator and pull the stem of piston (30) to allow the remaining components to drop out of body (40). Remove washer (20), spring (25), and preformed packing (35) from piston (30).

3. Remove nameplate (45) only if replacement is necessary.

B. Part No. 921937. (See Figure 1A).

1. If it was not removed in dismounting the indicator, remove mounting nut (25) from the indicator.

2. Remove split ring (5) and lift out disc and retainer assembly (10).

3. Pull adhesive-backed gasket (15) out of body and piston assembly (20). Further disassembly of this indicator is not possible.

C. Part No. 424074, 800964, 802504, 802642, 802682, 841520, 841995, 841997, 842203, 843787, 844458, 844673, 875578, 877292 or 877292-01, 922315. (See Figure 1B).

1. Remove split ring (5) and lift out disc (10) from body (15).

D. Part No. 800036, 802722, or 841556. (See Figure 1C).

1. Unscrew adapter (5) from connector (10).

E. Part No. 446398. (See Figure 1D).

1. Remove split ring (5) and lift out disc (10) from body (15).

4. CLEANING

1. Clean components of discharge indicators and connectors.
2. Clean all metallic parts using Chlorethene SM.
3. Dry with lint free cleaning cloth.

NOTE: Equivalent substitutes may be used for listed items.

Table 2. Cleaning and Assembly Materials

MATERIAL	PART NUMBER	SPECIFICATION/SOURCE
Cement	5141	Palm Bros. Decalcomania Co. Cincinnati, Ohio
Grease, Pneumatic, High Temperature		MIL-G-4343
Nitrogen		BB-N-411
Permatex No. 1		Loctite Corporation Automotive and Consumer Group Cleveland, OH
Chlorethene SM		Dow Corning Co.
Alcohol, Isopropyl		Commercial
Cleaning Cloth		CCC-C-46

5. INSPECTION/CHECK

A. Inspect and check components of system discharge indicators (Figure 1) as follows:

1. Check spring (25) for distortion and deformation. Inspect the mating surfaces of piston (30) and body (40) for scoring and wear. Check preformed packing (35) for wear and damage. Replace worn, damaged or deformed components.

B. Inspect and check components of outboard discharge indicators (Figure 1C) as follows:

1. Inspect the threads of adapter (5) and connector (10) for burring or damage. Deburr or replace damaged components.

6. REPAIR

A. Repair of the detail parts of the assemblies is not practical and is not recommended.

B. Replacement of Components

1. In system discharge indicators, replace preformed packing, disc and retainer assemblies and adhesive-backed gasket as applicable.

NOTE: If the indicator is located in the airplane wheel well, replacement disc Part No. 24429 is needed.

2. In thermal discharge indicators, replace disc.

7. ASSEMBLY

A. Part No. 800495, 802681, 841996, 843969, 844674 and 877493 (See Figure 1).

1. Apply grease per MIL-G-4343 to the wall of body (40) and to preformed packing (35).

2. Slip the preformed packing (35) into the external groove in piston (30) and insert both components into body (40).

3. Assemble spring (25) and washer (20) over the stem of piston (30).

4. Assemble retaining ring (15), making certain that it is properly seated in the groove in body (40).

5. Test assembly per paragraph 8.A before proceeding to step 6.

6. Assemble disc and retainer assembly (10) and split ring (5), making certain that the split ring is properly seated in the groove in body (40).

7. If nameplate (45) was removed in disassembly, use Chlorethene SM to clean the surface of the body (40) where the nameplate will be applied. Apply nameplate (45) as follows:

(a) Apply a thin coat of Palm Bros. Decalcomania Co., Cincinnati, Ohio, Cement No. 5141 to the body (40) surface and allow the cement to dry until it will adhere but not transfer to the finger when touched (approximately one to two minutes).

(b) Moisten the nameplate (45) in lukewarm water until it will slide off the backing, then slide it from the backing to the proper position on the body (40).

(c) Use a wet felt roller to roll the nameplate (45) until all water and air have been removed.

(d) Allow the cement to set for five minutes, then use alcohol to clean off the excess cement around the nameplate (45).

B. Part No. 921937. (See Figure 1A)

1. Prior to assembly, test body and piston assembly (Figure 1A, 20) per paragraph 8.B.

2. Assemble adhesive-backed gasket (15) to body and piston assembly (20) with the adhesive side against the body.

3. Assemble disc and retainer assembly (10) and split ring (5) to body and piston assembly (20). Make certain that the split ring is properly seated in the groove in the body and piston assembly.

4. Screw mounting nut (25) on the body and piston assembly (20).

C. Part No. 424074, 800964, 802504, 802642, 802682, 841520, 841995, 841997, 842203, 843787, 844458, 844673, 875578, 877292 or 877292-01, 878210, 922315. (See Figure 1B).

1. Assemble disc (10) and split ring (5) to body (15) making certain that the split ring is properly seated in the groove in the body.

D. Part No. 800036, 802722, or 841556. (See Figure 1C).

1. Apply Permatex No. 1 to the threads of adapter (5) and assemble the adapter to connector (10).

E. Part No. 446398. (See Figure 1D).

1. Assemble disc (10) and split ring (5) to body (15) making certain that the split ring is properly seated in the groove in the body.

8. TESTING

A. Test System Discharge Indicator, Part No. 800495, 802681, 841996, 843969, 844674 and 877493 as follows:

WARNING: PERSONNEL SHOULD BE PROTECTED TO PREVENT INJURY IN THE EVENT THAT THE PISTON SHOULD BE EJECTED FROM THE BODY.

WARNING: PERFORM THE FOLLOWING STEPS IN A PROOF BOOTH OR BEHIND A SUBSTANTIAL BARRICADE.

1. Apply 1800 psi (12411 kPa) air or nitrogen pressure to the inlet for 30 seconds. Check for failure of the retaining ring (15).

2. Apply 30 psi (207 kPa) air or nitrogen pressure to the inlet; check that piston (30) operates. Remove the pressure; check that spring (25) causes piston (30) to return to its original position.

3. Apply 30 psi (207 kPa) air or nitrogen pressure to the inlet and immerse the assembly in water. The maximum permissible leakage from the outlet is 1 cc/minute.

4. Dry assembly with air or nitrogen pressure not to exceed 30 psi (207 kPa).

B. Test System Discharge Indicator, Part No. 921937 as follows:

WARNING: PERSONNEL SHOULD BE PROTECTED TO PREVENT INJURY IN THE EVENT THAT THE PISTON SHOULD BE EJECTED FROM THE BODY.

WARNING: PERFORM THE FOLLOWING STEPS IN A PROOF BOOTH OR BEHIND A SUBSTANTIAL BARRICADE.

1. Apply 30 psi (207 kPa) air pressure to the inlet of body and piston assembly (20); check that the piston in the body and piston assembly operates. Remove the pressure; check that the piston returns to its original position.

2. Apply 30 psi (207 kPa) air pressure to the inlet body and piston assembly (20) and immerse the assembly in water. The maximum permissible leakage from the outlet is 1 cc/minute.

9. ILLUSTRATED PARTS LIST

A. Purpose

1. This section provides illustrations and parts breakdown of all parts of the assembly shown on the title page which can be disassembled, repaired or replaced and reassembled.

B. Explanation and Usage of Section

1. Assembly Order Indenture System

(a) The indenture system used in the parts list shows the relationship of one part to another. For a given item, the number of indentures depicts the relationship of the item to the next higher assembly as follows:

1 2 3 4
Assembly
Attaching parts for assembly
***
. Detail parts for assembly
. Subassembly
. Attaching parts for subassembly
***
. . Detail parts for subassembly
. . Sub-subassembly
. . Attaching parts for sub-subassembly
***
. . . Detail parts for sub-subassembly
(Included only if installation parts may be returned to shop as part of the assembly).

2. Effectivity Code

(a) Reference letters (A, B, C etc.) are assigned in the EFF CODE column to each top assembly. The reference letter of the applicable top assembly is also shown in the EFF CODE for each detail part and subassembly except that no reference letter is shown for detail parts and subassemblies used on all top assemblies.

3. Units Per Assembly

(a) The UNITS PER ASSY column shows the total number of units required per assembly, per subassembly, and per sub-subassembly, as applicable. For bulk items, the letters AR indicate "as required". The letters RF indicate the item is listed for reference purposes.

4. Parts Replacement Data

(a) The interchangeability relationship between parts is identified in the NOMENCLATURE column of the parts list. A list of the terms used to show interchangeability and their definitions is as follows:

TERM	PARTS LIST ABBREVIATION	DEFINITION
Optional	OPT	This part is optional to and interchangeable with other parts in the same item number variant group or other item number if designated.
Superseded by	SUPSD BY	The part in the part number column is replaced by and is not interchangeable with the item number shown in the notation.
Supersedes	SUPSDS	The part in the part number column replaces and is not interchangeable with the item number shown in the notation.
Replaced by	REPLD BY	The part in the part number column is replaced by and interchangeable with the item number shown in the notation.
Replaces	REPLS	The part in the part number column replaces and is interchangeable with the item number shown in the notation.

5. Service Bulletin Incorporation

(a) Except as indicated, the following assemblies, subassemblies and detail parts subject to modification, deletion, addition or replacement by an issued service bulletin are annotated to show both pre- and post- service bulletin configuration, and the term (PRE SB XXXX) in the NOMENCLATURE column designates the original configuration, and the term (POST SB XXXX) identifies assemblies and parts after the service bulletin modification has been completed.

(b) Subassemblies and detail parts used on assemblies bearing the pre- or post-service bulletin notation will not carry the same notation themselves if the use code(s) assigned to them clearly reflects their pre-or post-service bulletin status.

(c) Top assemblies subject to modification by a service bulletin without assignment of a new part number (no production equivalent of the modified assembly) are not annotated with pre-or post-service bulletin information.

6. Items Not Illustrated

(a) Items not illustrated are indicated by a dash (–) preceding the item number in the FIG & ITEM NO. column.

7. Alpha Variant Item Numbers

   (a) Alpha variants A-Z (except I and O) are assigned to existing item numbers when necessary to show:

      1 Added Items

      2 Service bulletin modifications

      3 Configuration differences

      4 Optional parts

      5 Product improvement part (non-service bulletin)

   (b) Alpha variant item numbers are not shown on the exploded view when the appearance and location of the alpha variant item is the same as the basic item.

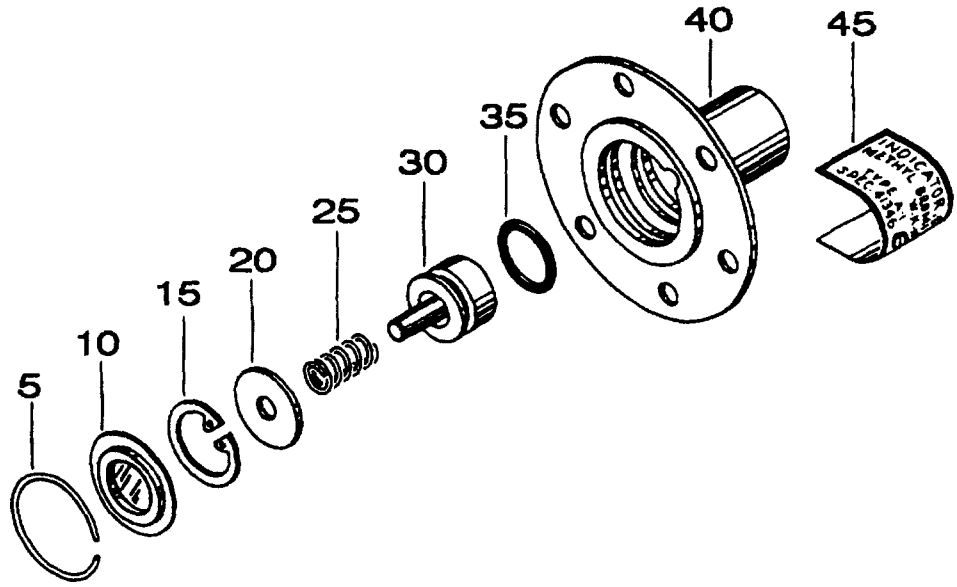
8. Parts Identification

   (a) When a standard part or another vendor's part number is shown in the PART NO. column, the vendor code, preceded by the letter "V", is shown following the item description in the NOMENCLATURE column. The Walter Kidde part number follows the vendor code. When requesting parts from Walter Kidde, use the Walter Kidde part number.

C. Vendors

CAGE	Mfg. Name and Address
V81352	Air Force-Navy Aeronautical Specification promulgated by the Aeronautical Standards Group
V96906	Military Standards

DISCHARGE INDICATORS AND CONNECTORS



System Discharge Indicators
Figure 1

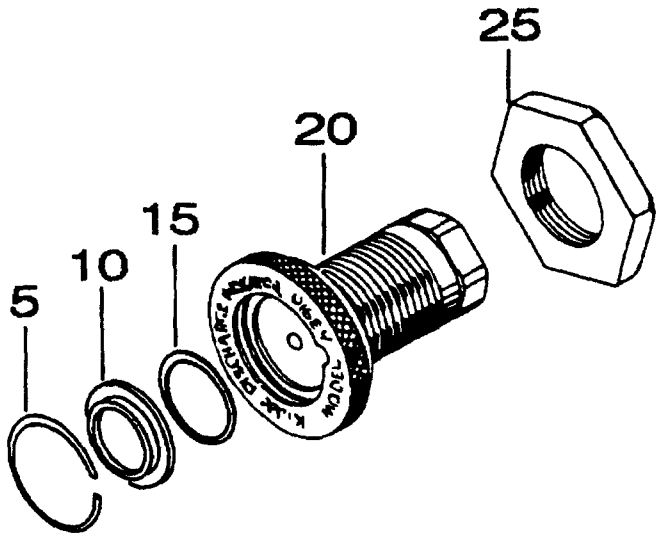
FIG. & ITEM NO.	PART NO.	AIRLINE PART NUMBER	NOMENCLATURE 12 34 5 67	EFF CODE	UNITS PER ASSY
1- 1	800495		INDICATOR, DISCHARGE, CARBON DIOXIDE, METHYL BROMIDE, BROMOCHLOROMETHANE	A	RF
1A	802681		INDICATOR, DISCHARGE, FIRE EXTINGUISHING SYSTEM	B	RF
1B	841996		INDICATOR, DISCHARGE, FIRE EXTINGUISHING AGENT	C	RF
1C	843969		INDICATOR, DISCHARGE, FIRE EXTINGUISHING AGENT	D	RF
1D	843969-1		INDICATOR, DISCHARGE, FIRE EXTINGUISHING AGENT	E	RF
1E	844674		INDICATOR, DISCHARGE, FIRE EXTINGUISHING SYSTEM	F	RF
1F	844674-1		INDICATOR, DISCHARGE, FIRE EXTINGUISHING SYSTEM	G	RF
1G	877493		INDICATOR, DISCHARGE, FIRE EXTINGUISHING SYSTEM	H	RF
5	17917		. RING, SPLIT		1
10	24429		. DISC	A	1
10A	255649		. DISC, YELLOW	D, E	1
10B	801786		. DISC AND RETAINER ASSEMBLY	B,C,F,G, H	1

– ITEM NOT ILLUSTRATED

FIG. & ITEM NO.	PART NO.	AIRLINE PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFF CODE	UNITS PER ASSY
1- 10C	24429		. DISC, YELLOW NOTE: ORDER THIS DISC IF INDICATOR IS MOUNTED IN WHEEL WELL, OTHERWISE ORDER ITEM 10B	C	1
15	1848-0010		. RING, RETAINING, STL. CAD. PL., 0.62 IN., O.D.		1
20	202000		. WASHER	A, B, D, E, G, H	1
20A	211854		. WASHER	C	1
25	201679		. SPRING		1
30	201999		. PISTON		1
35	AN6227-7		. PACKING, PREFORMED (V81352) (1970-0700) (REPLD BY ITEM 35A)		1
35A	MS28775-012		. PACKING, PREFORMED (V96906) (5661-0012) (RPLS ITEM 35)		1
40	840450		. BODY	A, D	1
40A	840450-1		. BODY	E	1
40B	841337		. BODY	B, F	1
40C	841337-1		. BODY	G	1
40D	841853		. BODY	C	1
40E	877492		. BODY	H	1
45	202001		. DECAL, NAMEPLATE	A	1
45A	211857		. DECAL, NAMEPLATE	C	1
	932420		DELETED		

– ITEM NOT ILLUSTRATED

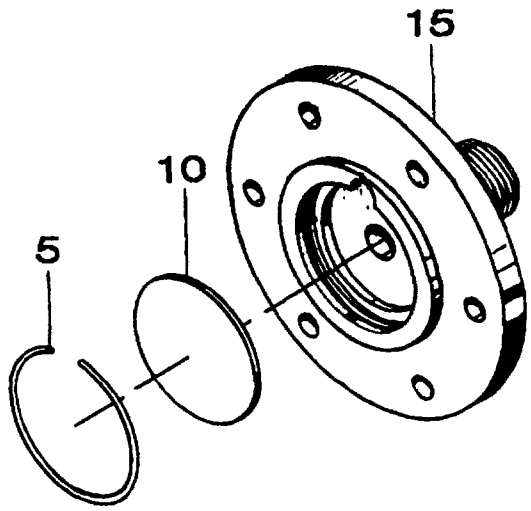
DISCHARGE INDICATORS AND CONNECTORS



System Discharge Indicator
Figure 1A

FIG. & ITEM NO.	PART NO.	AIRLINE PART NUMBER	NOMENCLATURE 12 34 5 6 7	EFF CODE	UNITS PER ASSY
1A- 1	921937		INDICATOR, DISCHARGE, PANEL MOUNTED		RF
5	17917		. RING, SPLIT		1
10	801786		. DISC AND RETAINER ASSEMBLY (RPLD BY ITEM 10A)		1
10A	801523		. DISC AND RETAINER ASSEMBLY (RPLS ITEM 10)		1
15	204945		. GASKET, ADHESIVE BACKED		1
20	No Number		. BODY AND PISTON ASSY, CONSISTS OF:		1
	21950		. . BODY		RF
	1970-0700		. . PACKING, PREFORMED		RF
	23298		. . WASHER		RF
	21951		. . RETAINER		RF
	20018		. . GROOV-PIN		RF
	201999		. . PISTON		RF
	201679		. . SPRING		RF
25	21954		. . NUT, MOUNTING		1

– ITEM NOT ILLUSTRATED



Thermal Discharge Indicators
Figure 1B

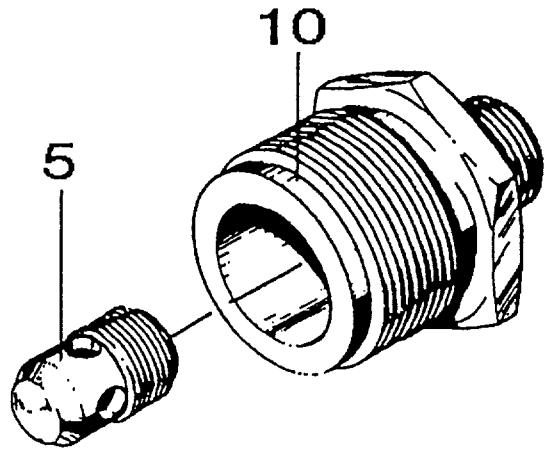
FIG. & ITEM NO.	PART NO.	AIRLINE PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFF CODE	UNITS PER ASSY
1B- 1	424074		INDICATOR, DISCHARGE, THERMAL RELIEF	A	RF
1A	800964		INDICATOR, OVERBOARD DISCHARGE, OXYGEN	B	RF
1B	802504		INDICATOR, OVERBOARD DISCHARGE, CB	C	RF
1C	802642		INDICATOR, OVERBOARD DISCHARGE, OXYGEN	D	RF
1D	802682		INDICATOR, OVERBOARD DISCHARGE, THERMAL RELIEF	E	RF
1E	841520		INDICATOR, OVERBOARD DISCHARGE, OXYGEN	F	RF
1F	841995		INDICATOR, OVERBOARD DISCHARGE	G	RF
1G	841997		INDICATOR, OVERBOARD DISCHARGE, OXYGEN	H	RF
1H	842203		INDICATOR, OVERBOARD DISCHARGE, OXYGEN	I	RF
1J	843787		INDICATOR, OVERBOARD DISCHARGE, HIGH TEMPERATURE	J	RF
1K	843787-1		INDICATOR, OVERBOARD DISCHARGE, HIGH TEMPERATURE	K	RF
1L	844458		INDICATOR, OVERBOARD DISCHARGE	L	RF
1M	844673		INDICATOR, DISCHARGE, THERMAL RELIEF	M	RF

– ITEM NOT ILLUSTRATED

DISCHARGE INDICATORS AND CONNECTORS

FIG. & ITEM NO.	PART NO.	AIRLINE PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFF CODE	UNITS PER ASSY
1B- 1N	875578		INDICATOR, OVERBOARD DISCHARGE	N	RF
1P	877292		INDICATOR, OVERBOARD DISCHARGE (RPLD BY ITEM 1Q)	O	RF
1Q	877292-01		INDICATOR, OVERBOARD DISCHARGE (RPLS ITEM 1P)	P	RF
1R	878210		INDICATOR, OVERBOARD DISCHARGE, OXYGEN	Q	RF
1S	922315		INDICATOR, OVERBOARD DISCHARGE	R	RF
5	17917		. RING, RETAINING		1
10	17919		. DISC, RED	C, E, L, N, R	1
10A	24429		. DISC, YELLOW	A	1
10B	203337		. DISC, GREEN	B, D, F, H, I, Q	1
10C	211852		. DISC, YELLOW	G	1
10D	255648		. DISC, RED	K, M	1
10E	255648-01		. DISC, RED	O, P	1
15	64088		. BODY	B, J, R	1
15A	64088-1		. BODY	K	1
15B	241453		. BODY	C	1
15C	241731		. BODY	D, I	1
15D	241816		. BODY	E, M	1
15E	271288		. BODY	F	1
15F	244084		. BODY	G,H	1
15G	277291		. BODY	N, O, P	1
15H	281795		. BODY	L	1
15J	282460		. BODY	Q	1
15K	346127		. BODY	A	1
-20	MS9068-016		. PACKING, PREFORMED (V96906) (5278-0016)	I	1

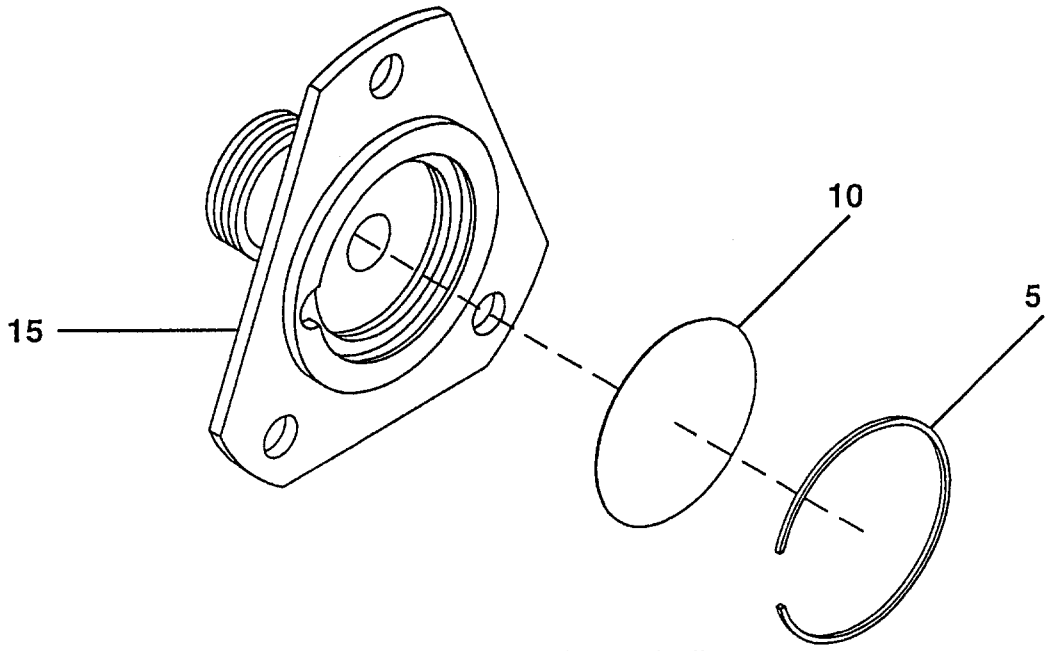
– ITEM NOT ILLUSTRATED



Overboard Discharge Connectors
Figure 1C

FIG. & ITEM NO.	PART NO.	AIRLINE PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFF CODE	UNITS PER ASSY
1C- 1	800036		CONNECTOR, OVERBOARD DISCHARGE	A	RF
1A	802722		CONNECTOR, OVERBOARD DISCHARGE	B	RF
1B	841556		CONNECTOR, OVERBOARD DISCHARGE	C	RF
5	242128		. ADAPTER		1
10	200151		. CONNECTOR	A	1
10B	241919		. CONNECTOR	B	1
10C	242951		. CONNECTOR	C	1

– ITEM NOT ILLUSTRATED



Thermal Discharge Indicator
Figure 1D

FIG. & ITEM NO.	PART NO.	AIRLINE PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFF CODE	UNITS PER ASSY
1D- 1	446398		INDICATOR, DISCHARGE, THERMAL RELIEF		RF
5	17917		. RING, RETAINING		1
10	325346		. DISC, WHITE		1
15	346922		. BODY		1
	346992		DELETED		

– ITEM NOT ILLUSTRATED

WALTER KIDDE Aerospace
Division of KIDDE Technologies, Inc.
4200 Airport Drive NW
Wilson, North Carolina 27896-9643 U.S.A.
CAGE: 61423

CONTROL UNIT,

FIRE DETECTING SYSTEM, CONTINUOUS TYPE DC

WITH SHORT DISCRIMINATOR CIRCUIT

PART NUMBERS

893229-0350, 893229-0350-01, 893229-0450,

893229-0450-01, 893229-0500, 893229-0500-01

COMPONENT MAINTENANCE MANUAL

WITH

ILLUSTRATED PARTS LIST

WALTER KIDDE Aerospace
COMPONENT MAINTENANCE MANUAL (CMM)
893229

TO: HOLDERS OF CONTROL UNIT, PART NUMBER 893229, OVERHAUL MANUAL WITH ILLUSTRATED PARTS LIST

REVISION NO. 3 DATED SEP15/98

HIGHLIGHTS

This is a complete revision to the manual dated Nov 1/66, with Revision 2, dated Jan 15/73. The purpose of this revision is to improve the complete manual, add Service Bulletin 893229-26-374 data, and to update the Illustrated Parts List. Destroy all previous editions of the manual when you receive this revision.

Chapter/Section and Page No.	Description of Change	Effectivity
26-10-30		All
Title, Page T-1	Revised page date and revision level.	
Record of Revisions, Page RR-1	Entered this revision. Revised page date.	
Record of Temporary Revisions, Page RTR-1	Entered Temporary Revision No. 1. Revised page date.	
Service Bulletin List, Page SBL-1	Added SB 893229-26-374. Revised page date.	
List of Effective Pages, Page LEP-1	Revised to reflect added/changed pages. Revised page date.	
Introduction, Page INTRO-1	Added an introduction page.	
Table of Contents, Page T/C-1	Revised to show changed pages. Revised page date.	
Description and Operation, Pages 1 thru 4	Rewrote text in Simplified English. Revised control unit schematic. Revised page dates.	
Testing and Fault Isolation, Pages 4 thru 18	Added test equipment and materials table. Revised test set schematic. Added tables for test set parts, materials and vendors. Added insulation resistance test cable and test setups. Put test procedures in tables. Updated troubleshooting procedures and test voltage table. Added a control unit wiring diagram. Revised page dates.	
Disassembly, Pages 19 thru 21	Revised procedures and added materials table for disassembly. Revised page dates.	
Cleaning, Pages 22 and 23	Added procedures and materials. Revised page dates.	
Check, Pages 23 and 24	Added procedure. Revised page dates.	

Chapter/Section and Page No.	Description of Change	Effectivity
Assembly, Pages 26 thru 31	Revised procedures, added table for equipment and materials, added figure for evacuation and backfill setup. Revised page dates.	
Special Tools, Fixtures and Equipment, Page 31	Added Table 14 for necessary equipment. Revised page date.	
Illustrated Parts List, Pages 33 thru 45	Revised parts list to add effectivity codes to IPL Figure 1. Added IPL Figure 2. Added and deleted part numbers as necessary. Added part numbers 893229-0350-01, 893229-0450-01, and 893229-0500-01. Revised page dates.	

RECORD OF REVISIONS

Keep this record in the front of this manual. When you receive a revision, put the revised pages into the manual, and write the revision number and date. Then write the date you put the pages in and your initials in the area given below.

REVISION NUMBER	REVISION DATE	DATE FILED	BY	REVISION NUMBER	REVISION DATE	DATE FILED	BY
1	Aug 15/72	Aug 15/72	WK				
2	Jan 15/73	Jan 15/73	WK				
3	Sep 15/98	Sep 15/98	WK				

RECORD OF TEMPORARY REVISIONS

REV. NO.	ISSUE DATE	DATE INSERTED	REMOVAL DATE	INCORPORATOR'S INITIALS	REMOVER'S INITIALS
1	UNK	UNK	Aug 15/72	WK	WK

SERVICE BULLETIN LIST

SERVICE BULLETIN	ISSUE DATE	DATE INCOR-PORATED	BY	SERVICE BULLETIN	ISSUE DATE	DATE INCOR-PORATED	BY
893229-26-374	Jul 15/97	Sep 15/98	WK				

LIST OF EFFECTIVE PAGES

SUBJECT	PAGE	DATE
Title	T-1	Sep 15/98
Record of Revisions	RR-1	Sep 15/98
	RR-2	Blank
Record of Temporary Revisions	RTR-1	Sep 15/98
	RTR-2	Blank
Service Bulletin List	SBL-1	Sep 15/98
	SBL-2	Blank
List of Effective Pages	LEP-1	Sep 15/98
	LEP-2	Blank
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	T/C-2	Blank
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	INTRO-2	Blank
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	3	Sep 15/98
	4	Sep 15/98
Testing and Fault Isolation	4	Sep 15/98
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Illustrated Parts List (IPL)	33	Sep 15/98
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	43	Sep 15/98
	44	Sep 15/98
	45	Sep 15/98
	46	Blank

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Cleaning	22
Check	23
Repair	24
Assembly	26
Fits and Clearances	Not Applicable
Special Tools, Fixtures, and Equipment	31
Illustrated Parts List	33

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Test Set Parts and Materials	3	5
Test Set Parts and Materials Vendors	4	6
Functional Test	5	10
Insulation Resistance Test	6	13
Test Point Voltages and Conditions	7	18
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Insulation-Resistance Test Cable	4	8
Test Setup No. 1	5	9
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Control Unit, Fire Detecting System, Continuous Type DC with Short Discriminator Circuit	IPL 1	37
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INTRODUCTION

1. Introduction

   A. This manual gives the necessary maintenance instructions for the control unit.

   B. Section 1 gives control unit data and tells how it operates.

   C. Section 2 gives the instructions to do tests to make sure that the control unit operates satisfactorily and find the defective components.

   D. Section 3 is not used.

   E. Section 4 gives the procedures to disassemble the control unit.

   F. Section 5 gives the instructions and the materials to clean the control unit.

   G. Section 6 gives the inspection and check procedures to examine the condition of the control unit before and after maintenance or repairs are done.

   H. Section 7 gives the instructions to repair the control unit.

   I. Section 8 gives the procedures to assemble and do a leak test of the control unit.

   J. Section 9 is not used.

   K. Section 10 gives the special tools, fixtures and test equipment necessary for maintenance of the control unit.

   L. Section 11 is an illustrated parts list that gives the replacement parts and shows their location on the control unit.

2. Verification

   A. Testing and Fault Isolation - Sep 29/98 (Simulation)

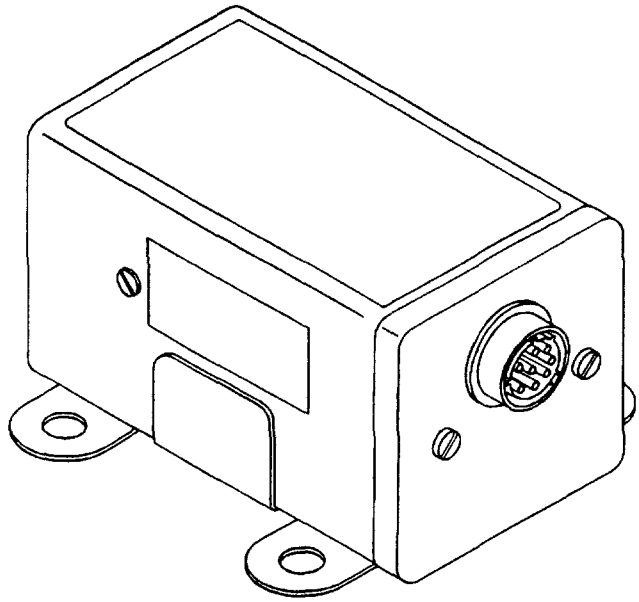
   B. Disassembly - Sep 29/98 (Simulation)

   C. Assembly - Sep 29/98 (Simulation)

1. DESCRIPTION AND OPERATION

A. Description

(1) The Fire Detecting System Control Unit, Continuous Type DC With Short Discriminator Circuit, Figure 1, is called Fire Detecting System Control Unit, control unit, or unit in the pages that follow. The control unit gives a fire warning if an overheat condition or a fire occurs. The unit continuously monitors the resistance of a heat-sensing thermistor element loop. The resistance of the element center conductor to ground decreases as its temperature increases. When the resistance decreases to an approximate specified value, as a result of an overheat condition or a fire, the control unit gives alarm signals to the related equipment.

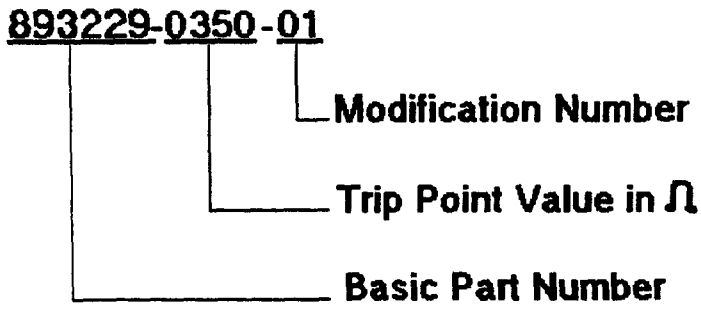


Fire Detecting System Control Unit
Figure 1

(2) The control unit is a hermetically sealed unit. It has a case with a cover assembly attached to it. A connector is installed in the cover assembly for electrical interface. Inside the control unit is a chassis with relays and a component board assembly installed on it. Electronic components are installed on the component board assembly. Wires are used to connect the electrical connector, relays, and component board assembly.

(3) The control unit can be set to operate at different resistance values for a different type or value of sensing element loop. The specified resistance (or fire trip-point) that the unit operates at is written on the unit nameplate in the

four numbers that follow the basic part number. If there is a modification to the control unit, two more numbers follow the specified trip resistance value. An example is shown below:



(4) Units manufactured before serial number 3618 used a 2.5 KΩ coil K1 and K2 relay. Units, serial number 3618 and subsequent (P/N 893229-XXXX-01) and units changed with Service Bulletin 893229-26-374 contain a 1.03 KΩ coil K1 and K2 relay because the relays with the 2.5KΩ coil were no longer available. The R3, R4, R7, and R10 resistor values changed to adjust for the lower resistance of the relay coil. In addition, transistors Q1 thru Q4 and diodes CR1 thru CR3 were changed. The transistors changed because the ones installed were difficult to get. The new transistors and diodes give a more stable alarm-trip-resistance over the complete temperature range for operation. The specified data for the control unit is given in Table 1.

Table 1. Specified Data

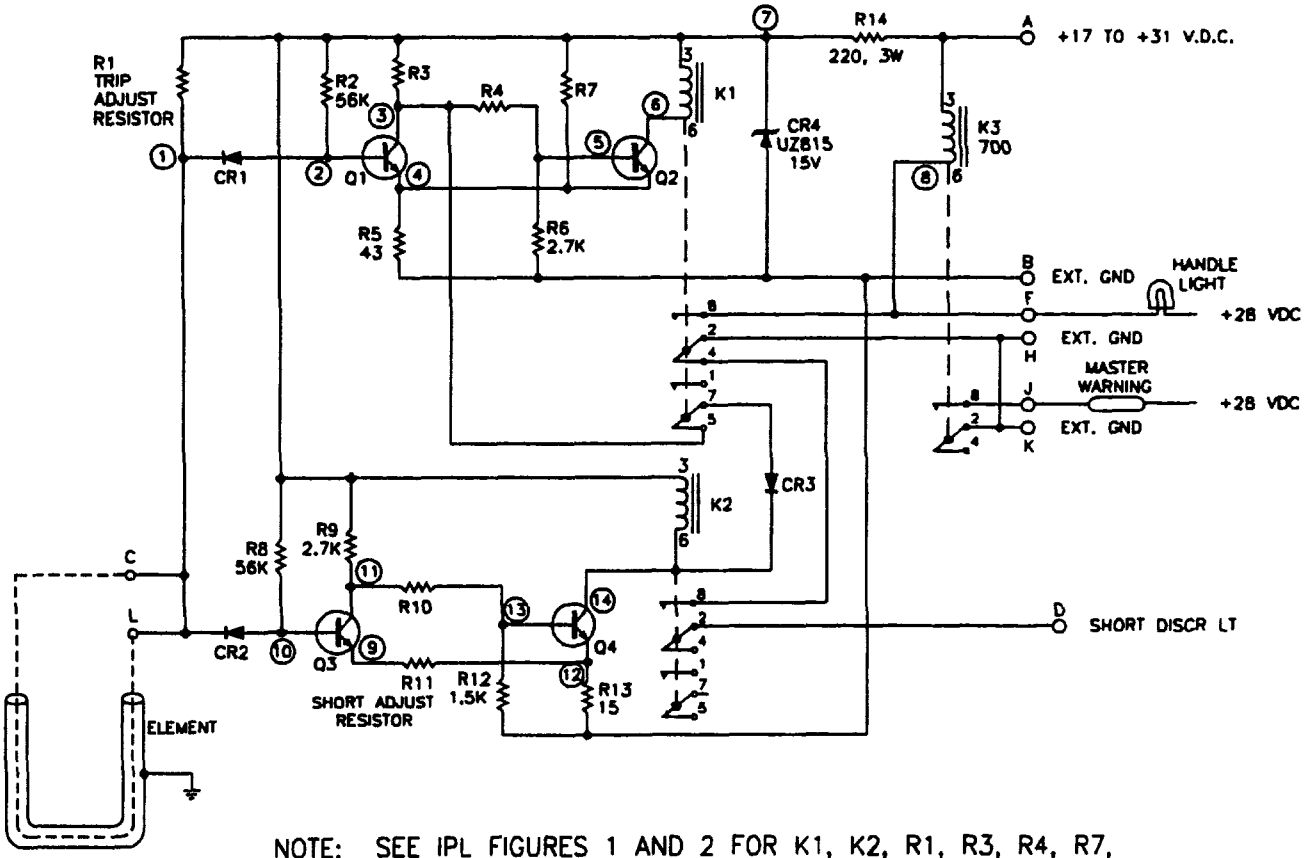
SPECIFIED ITEM/FUNCTION	DATA
Input Voltage Range	+17 to +31 VDC
Standby Power	2.6 Watts Max.
Alarm Power	4.0 Watts Max. (does not include indicators)
Fire Trip Value	Value given after basic part number in Ω; ± 5% at room temperature, ± 20% over ambient temperature operation range
Alarm Relay Contacts	2 Amps resistive
Ambient Temperature Range for Operation	-65°F to +160°F (-54°C to +71°C)
Electrical Connector	Cannon KH02-16-10PN-1
Electrical Interface Connector	Cannon K03-16-10SN
Control Unit Dimensions (approximate)	1.87 in. H x 3.08 in. W x 3.70 in. L (4.75 cm H x 7.82 cm W x 9.40 cm L)
Control Unit Weight	0.40 lb (0.18 kg) max.

B. Operation (See Figure 2)

(1) There are two circuits, that are almost the same, in the control unit. The two circuits operate from the same input signal. The circuits are the fire control circuit and the short discriminator circuit. The input circuit uses the external

sensing element and the fire trip-point adjustment resistor (R1) to make a voltage divider. The fire control circuit and the short discriminator circuit operate from the voltage that changes across the sensing element as its resistance changes.

(2) The fire control circuit contains transistors Q1, Q2, and the K1 relay coil. In the standby (usual) condition, the sensing element resistance is high which lets Q1 conduct (come on) which causes the voltage on the base of Q2 to be low. The low voltage on the base of Q2 keeps Q2 off which keeps K1 in the de-energized condition. The K1 alarm contacts in this condition are open. The other set of contacts are closed, which lets the short discriminator



NOTE: SEE IPL FIGURES 1 AND 2 FOR K1, K2, R1, R3, R4, R7, R10 AND R11 VALUES AND ALL COMPONENT TOLERANCES.

Control Unit Schematic Diagram
Figure 2

operate, if necessary. When the sensing element becomes hot, as in a fire, and the resistance of the element decreases to the fire trip-point value, diode CR1 begins to conduct (come on). This lowers the voltage on the base of Q1 and causes Q1 to not conduct (go off). With Q1 off, a high condition on the base of Q2 lets Q2 conduct (come on). When Q2 is on, it lets K1 energize and give the alarm signal through the closed alarm contacts. This lets the fire handle light come on, lets K3 energize, and gives the master fire warning. The other set of contacts open and stops the short discriminator operation. Diode CR3 does not let relay K2 energize when Q1 is on.

(3) The short discriminator circuit contains Q3 and Q4 and operates almost the same as the fire circuit except that when Q4 is on, it causes a heavy flow of current in the Q1 collector resistor, R3. This keeps Q2 off so that relay K1 cannot energize. When Q4 is on, it also keeps K2 energized which lets the short discriminator light come on through the K2 contacts. The short discriminator circuit is set to operate at approximately one half the resistance value of the fire trip circuit. If the sensing element resistance decreases from a shorted circuit and not from heat or a fire, the resistance decreases almost immediately. This causes the fire circuit and the short circuit to try to operate at the same time, since the resistance is below the two trip-point values. But, the small interval of time for the fire circuit relay to operate lets the short discriminator operate first. This stops the fire circuit operation, energizes relay K2, and lets the short discriminator light come on. If the shorted condition goes away, the short discriminator goes to the standby condition and lets the fire circuit operate again, if a fire condition occurs.

2. TESTING AND FAULT ISOLATION

A. General

(1) This section gives the procedures to do the tests and the data for troubleshooting that is necessary to find malfunctions in the control unit.

(2) You do the test with a test set that simulates operation of the control unit in an aircraft. An insulation resistance test is done after assembly to make sure the control unit wires and circuits do not have a shorted condition.

B. Test Equipment and Materials

(1) The test equipment and materials necessary to do the tests on the control unit are given in Table 2. You can use alternative equivalent items for those given in the table.

Table 2. Test Equipment and Materials

EQUIPMENT OR MATERIAL	RANGE	MANUFACTURER OR SOURCE
Power Supply, Regulated, Adjustable, Model LS30	+17-31 VDC, 1 amp min.	Electrostatics, Inc. (V34538)

Table 2. Test Equipment and Materials (Continued)

EQUIPMENT OR MATERIAL	RANGE	MANUFACTURER OR SOURCE
Helipot, 3400S-1-102 with CT-23 counting dial	0-1000Ω, ±3%	Bourns, Inc. (V32997)
Test Set, Functional	None	Make locally from Figure 3 and Table 3.
Multimeter, Fluke Model 77	100μ VDC to 1000 VDC, 20 KΩ/volt min., 0.1Ω to 20MΩ	Fluke (V89536)
Megohmmeter, Model L-12	10-1000VDC, 0.1-10KMΩ	Rosemount Analytical, Inc.(V30646)
Insulation-Resistance Test Cable		Make locally from Figure 4.
Resistance Substitution (Decade Box), Model 236a	0-1MΩ, ±1%	Phipps & Bird (V7T784)

C. Test Preparation

CAUTION: WHEN YOU TOUCH THE CONTROL UNIT OR COMPONENT BOARD ASSEMBLY, MAKE SURE YOU DO NOT APPLY A VOLTAGE HIGHER THAN THE MAXIMUM PERMITTED VOLTAGES TO DEVICES OR COMPONENTS IDENTIFIED AS ESD SENSITIVE. THESE DEVICES OR COMPONENTS ARE IDENTIFIED BY THE LETTERS (ESDS) THAT FOLLOW THE ITEM DATA IN THE ILLUSTRATED PARTS LIST NOMENCLATURE AREA.

(1) Make a test set from the schematic shown in Figure 3 and the parts given in Table 3.

(2) Make an insulation-resistance test cable as shown in Figure 4.

Table 3. Test Set Parts and Materials

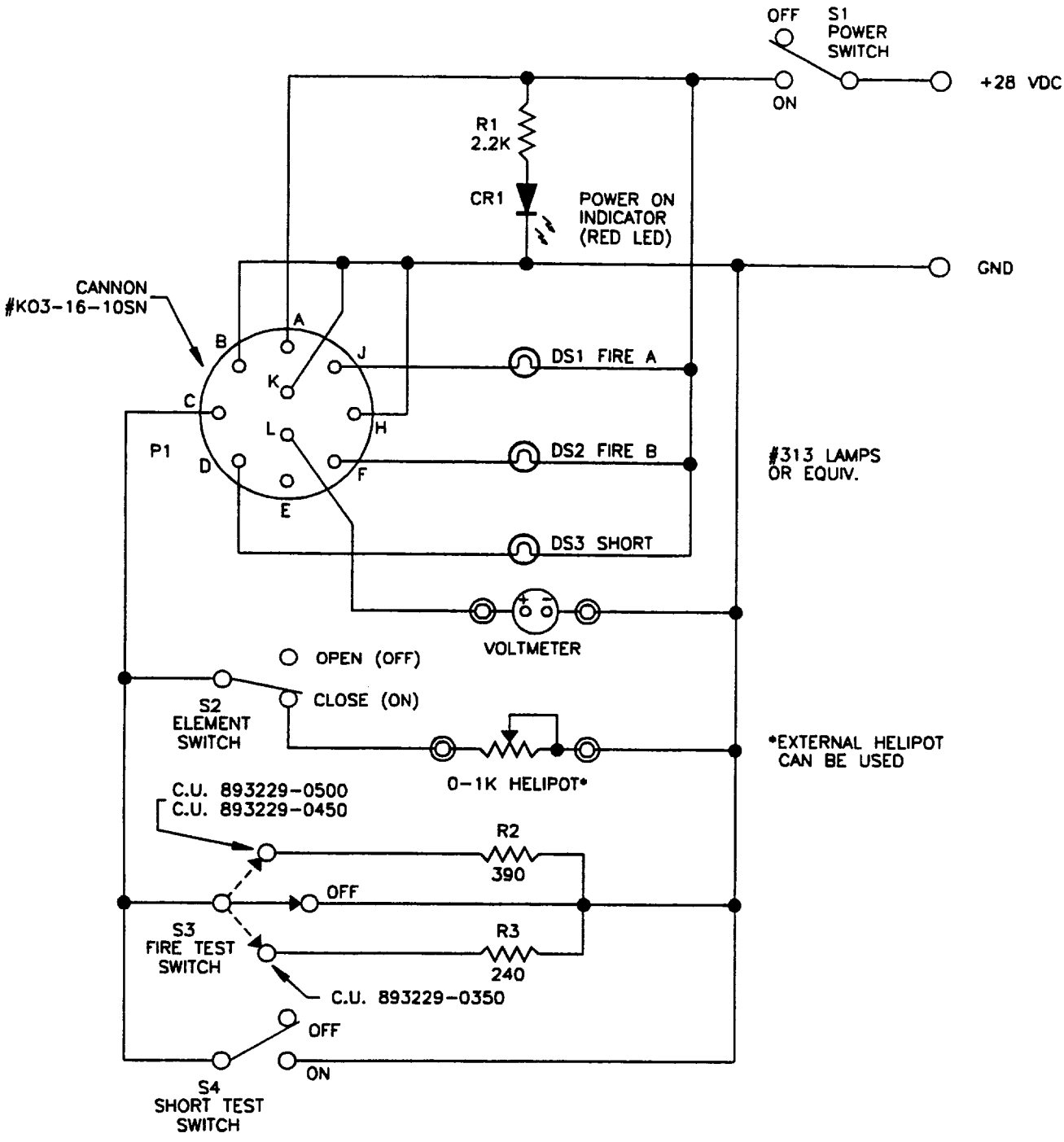
ITEM DESCRIPTION	SPECIFICATION/ PART NUMBER	QTY.	VENDOR'S VCODE
Banana Jack, Insulated Red (Helipot +) (Voltmeter +)	1509-102	3	V2R182
Banana Jack, Insulated, Black (28VDC-) (Helipot -) (Voltmeter -)	1509-103	3	V2R182
Switch, SPDT, On-None-On (S1, S2, S4)	7101SYZQE	3	V09353
LED, Red (Power On)	559-0102-007	1	V1EG71
Switch, SPDT, On-On-On (S3)	7211 SYZQE	1	V09353
Lens, Amber (Short Light)	135-1433-003	1	V1EG71

Table 3. Test Set Parts and Materials (Continued)

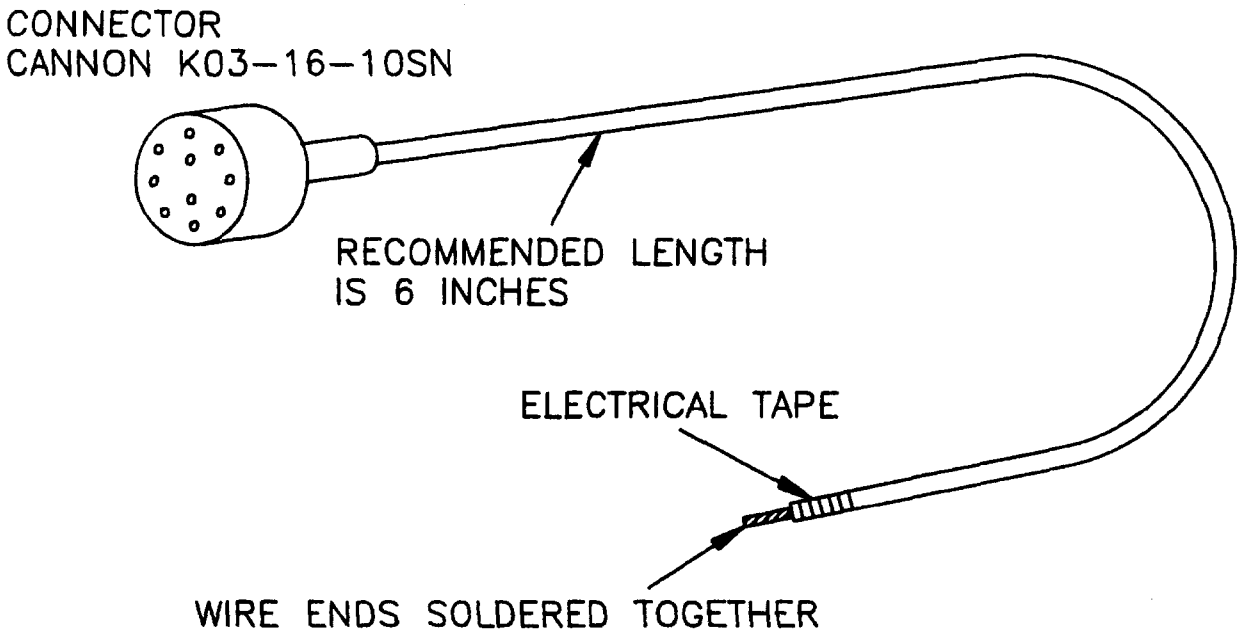
ITEM DESCRIPTION	SPECIFICATION/ PART NUMBER	QTY.	VENDOR'S VCODE
Lamp (Fire Lights and Short Light)	313	3	V1EG71
Lampholder (Fire Lights and Short Light)	081-0410-01-303	3	V1EG71
Lens, Red (Fire Lights)	135-1431-003	2	V1EG71
Resistor, 2.2 KΩ, ±2%,1/2 W (R1)	RLR20C2201GS	1	V81349
Resistor, 390Ω, ±2%,1/2 W (R2)	RLR20C3900GS	1	V81349
Resistor, 240Ω, ±2%,1/2 W (R3)	RLR20C2400GS	1	V81349
Wire, 18 AWG	MIL-W-16878, Type E	AR	V92194
Connector, Electrical	K03-16-10SN	1	V71468
Enclosure, Aluminum Chassis	SC12100	1	V71218
NOTE 1: The items and vendors given in the list are for you to refer to them. You can use equivalent parts and materials.			
NOTE 2: A list of vendors for the CAGE codes given is shown in Table 4.			

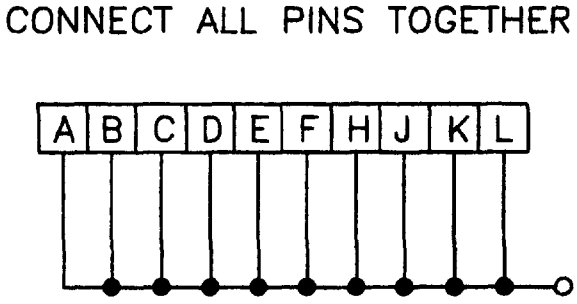
Table 4. Test Set Parts and Materials Vendors

CAGE CODE	NAME AND ADDRESS
V09353	C & K Components, Inc. 15 Riverdale Ave. Newton, MA 02158-1057
V1EG71	Dialight Corp. Roxboro Div. 265 Industrial Dr. Roxboro, NC 27573-6028
V2R182	H.H. Smith Co. 325 N. Illinois St. Indianapolis, IN 46204-1703
V71218	Bud Industries, Inc. 4605 E. 355th St. Willoughby, OH 44094-4629
V71468	ITT Industries, Inc. ITT Cannon Military/Aerospace 666 E. Dyer Rd. Santa Ana, CA 92702
V81349	Military Specifications promulgated by Military Departments/Agencies
V92194	Alpha Wire Corp. 711 Lidgerwood Ave. Elizabeth, NJ 07207



Functional Test Set Schematic
Figure 3





Insulation-Resistance Test Cable
Figure 4

D. Functional Test

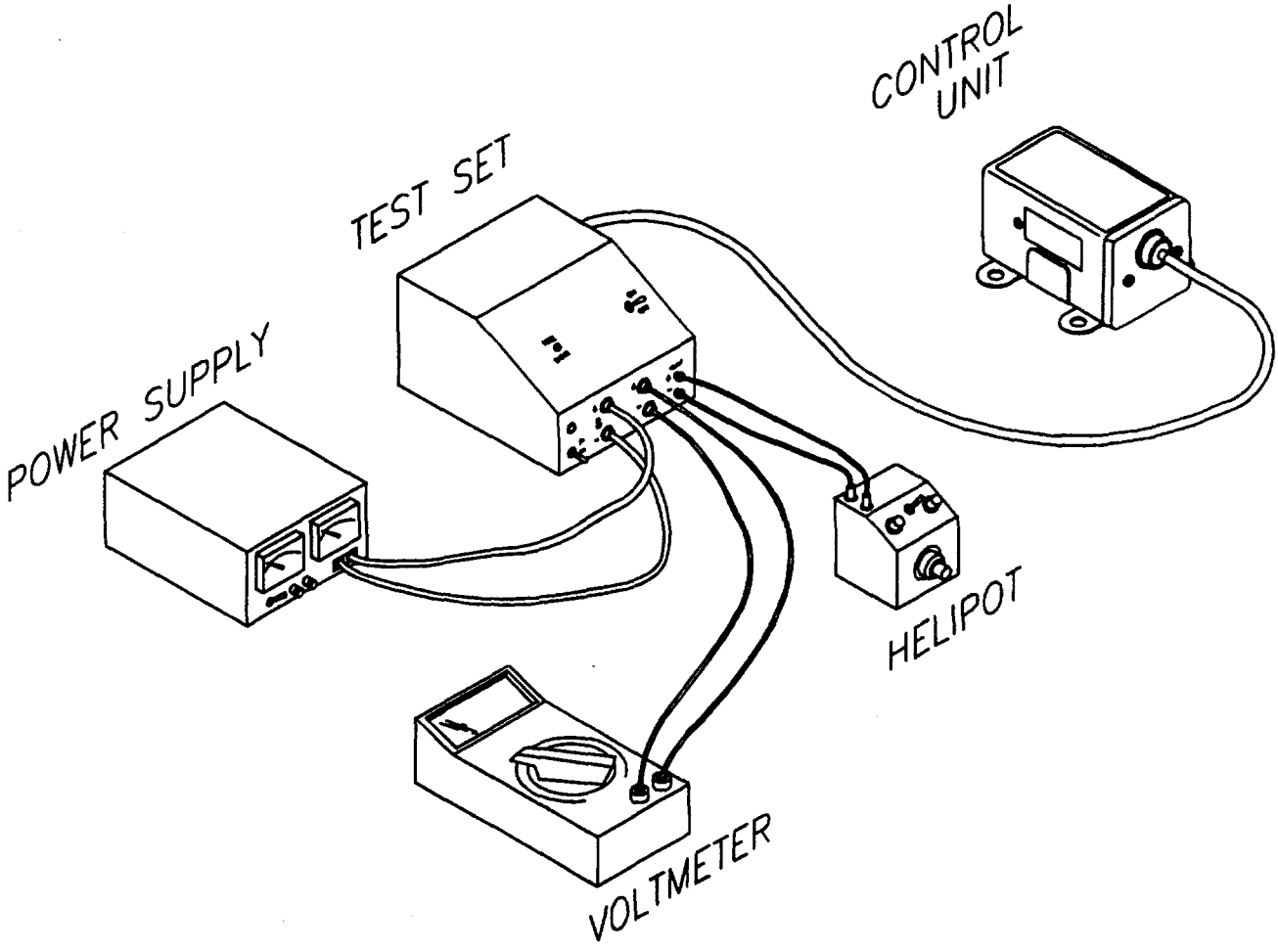
(1) You must do the functional test to make sure the control unit operates correctly.

(2) Connect the test equipment as shown in Test Setup No. 1 (Figure 5). Initially, set all ON/OFF switches to OFF. Adjust the helipot to maximum resistance.

(3) Before you apply power to the power supply, make sure that the power switch in the test set is in the OFF position.

(4) Apply 28VDC to the test set with the control unit connected.

(5) Do the functional test in Table 5 at ambient room temperature.



Test Setup No. 1
Figure 5

Table 5. Functional Test

Procedure		Specification	
Switch Pos.	Work Steps	Limits	Test Description
Test Setup No. 1	Do a test of the control unit.		Find if the control unit operates correctly with different conditions made with the test set.
On Test Set:			
S1-ON	Look at the test set power light.	ON	
	Adjust the helipot to maximum resistance.		
S2-ON	NOTE: You must turn the helipot slowly and stop when a light comes on or goes off to make sure of the precision of the helipot value.		
	Slowly decrease the helipot resistance value until the FIRE lights come on. Record the value of the helipot resistance where the lights came on.		This finds the fire trip-point value.
	Look at the control unit nameplate data and find the specified resistance value for the unit. The specified value is the 4 numbers (in ohms) that follow the part number.		
	Multiply the specified trip-point value by 0.05. Add and subtract this value from the specified trip-point value to find the upper and lower limit for the trip-point value. Record the trip-point limits.		
	Compare the helipot resistance where the FIRE lights came on to the trip-point limits.	Resistance must be in the limits.	
	Increase the helipot resistance until the FIRE lights go off. Record the helipot value.	Resistance must be less than 2 times the measured trip-point value.	This is the fire reset-point value.

Table 5. Functional Test (Continued)

Procedure		Specification	
Switch Pos.	Work Steps	Limits	Test Description
	Decrease the helipot resistance to 0.55 times the measured fire trip-point value.		
S2-OFF	Look at the FIRE lights.	OFF	
S2-ON	Look at the FIRE lights.	ON	
	Continue to decrease the helipot resistance while you intermittently open and close S2 until the SHORT light comes on. NOTE: The FIRE lights come on while the element switch S2 is on (closed) until the SHORT light comes on. Record the helipot value.	Resistance must be between 0.45 and 0.55 times the specified fire trip-point value.	This is the short discriminator trip-point value.
	Look at the FIRE lights.	OFF	NOTE: The FIRE lights and the SHORT light must not be on at the same time.
	Increase the helipot resistance until the SHORT light goes off. Record the helipot value.	Resistance must be less than 0.8 times the measured fire trip-point value.	This is the short discriminator reset point.
S2-OPEN S4-OFF S3-To the position for Unit Under Test	Look at the FIRE lights.	ON	This is the Fire Test function.
S3-OFF	Look at the FIRE lights.	OFF	
S4-ON	Look at the SHORT light.	ON	This is the Short Test function.
S4-OFF	Look at the SHORT light.	OFF	
Pwr Sup-Adjust to +17 VDC	Look at the voltmeter while you slowly adjust the power supply voltage from +17 to +31 VDC.	Voltmeter shows between +11 and +17.5 VDC and must not change more than 3 VDC.	This does a test of the control unit voltage regulation.
S1-OFF	End of test.		

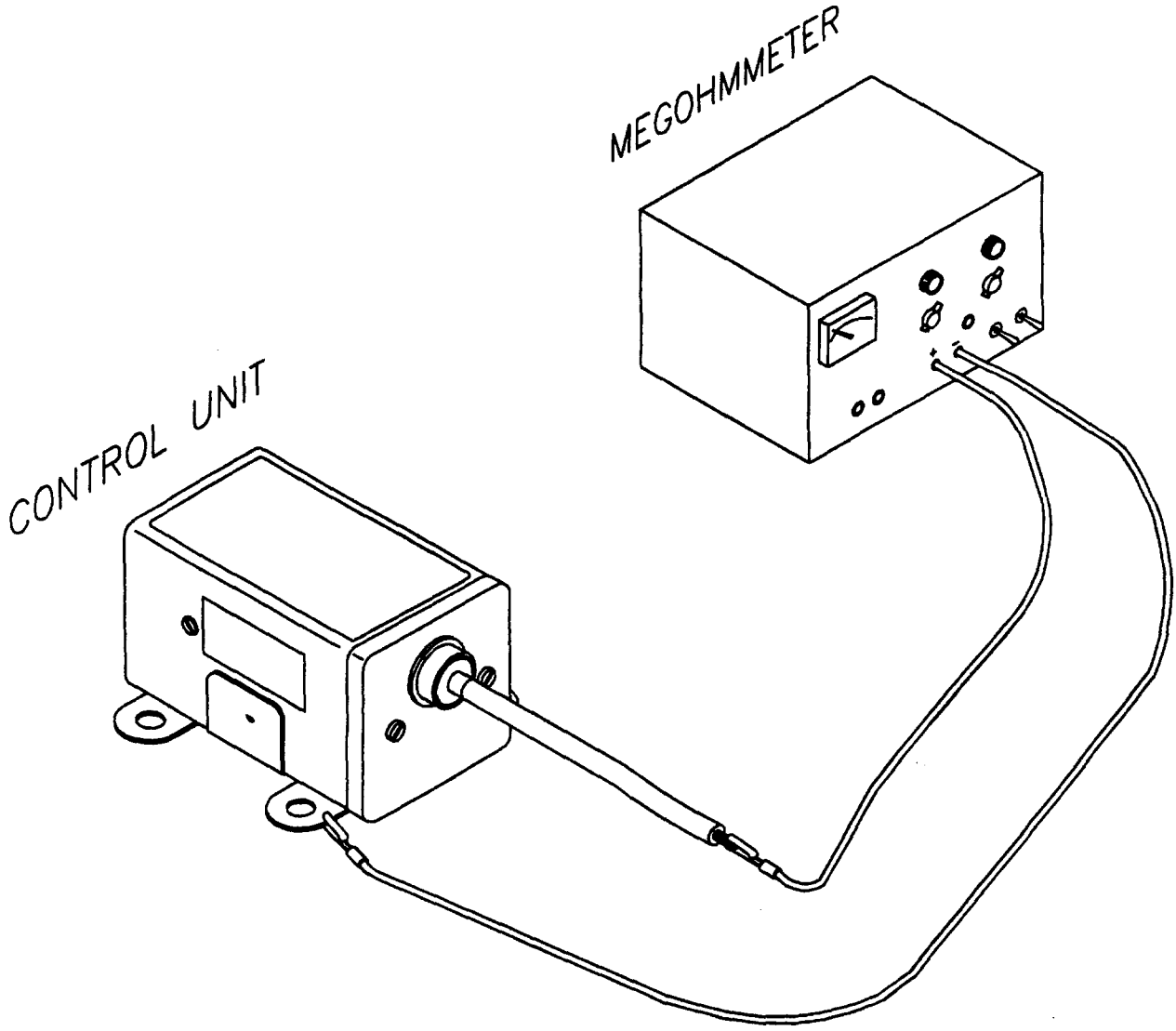
(6) Set all switches to OFF after the test.

(7) If the functional test fails, use the procedures in Fault Isolation to do troubleshooting of the control unit. After you repair the control unit, do the functional test again.

E. Insulation Resistance Test

(1) When you have done a repair of the control unit wires or when the control unit has been disassembled and assembled again, do the insulation resistance test.

(2) Set up the test equipment as shown in Test Setup No. 2 (Figure 6).



Test Setup No. 2
Figure 6

(3) Do the insulation resistance test in Table 6.

Table 6. Insulation Resistance Test

Procedure		Specification	
Switch Pos.	Work Steps	Limits	Test Description
Test Setup No. 2	Do an insulation resistance test of the control unit.		Find if the control unit circuitry and wiring has a shorted circuit.
	Connect the insulation-resistance test cable to the control unit.		
	Connect the megohmmeter positive lead to the insulation-resistance test cable and the negative lead to the control unit bracket.		
On Meg-ohmmeter:			
Voltage-500VDC	Look at the megohmmeter resistance value.	Resistance reads 100MΩ minimum.	This does a test of the control unit for shorted circuits.
	Disconnect the megohmmeter and the insulation-resistance test cable from the control unit.		
	End of Insulation Resistance Test.		

F. Fault Isolation

CAUTION: WHEN YOU TOUCH THE CONTROL UNIT OR COMPONENT BOARD ASSEMBLY , MAKE SURE YOU DO NOT APPLY A VOLTAGE HIGHER THAN THE MAXIMUM PERMITTED VOLTAGES TO DEVICES OR COMPONENTS IDENTIFIED AS ESD SENSITIVE. THESE DEVICES OR COMPONENTS ARE IDENTIFIED BY THE LETTERS (ESDS) THAT FOLLOW THE ITEM DATA IN THE ILLUSTRATED PARTS LIST NOMENCLATURE AREA.

(1) Refer to DISASSEMBLY and disassemble the control unit as much as necessary to do troubleshooting.

(2) You can do troubleshooting of malfunctions if you measure the voltage values given in Table 7. Use the control unit schematic diagram, Figure 2, and Illustrated Parts List (IPL) Figure 2 to find the test point locations. Use a digi-

tal multimeter to measure the voltages. If a voltage is incorrect, do a test of the components related to the test point that is unsatisfactory.

(3) Use the wiring diagram shown in Figure 7 and a multimeter to do troubleshooting of wires in the control unit.

(4) When you do troubleshooting and repair a malfunction in the control unit, do the functional test again before you assemble the unit.

(5) Trip-point adjustment is necessary if the trip-point is not correct.

NOTE: A change in the fire trip-point resistor can cause a change in the short discriminator trip-point value. A change in the short discriminator trip-point value can cause a change in the fire trip-point value. Make sure you do a check of each function when a change is made.

(a) Make a selection of a fire trip-point resistor (R1) as follows:

1 Remove resistor R1 (IPL Figure 2, 70) and connect a decade box across the connections where R1 was removed.

2 Adjust the test set helipot to the specified fire trip value.

3 Set the test set S2 to OFF.

4 Adjust the decade box to approximately 5KΩ.

5 Set S2 to ON and slowly increase the decade box resistance until the FIRE lights come on. Record the decade box resistance where the lights came on.

6 Make a selection of a resistor (IPL Figure 2, 70 thru 94) nearest to the value of the decade box resistance and install for R1.

7 Do the Functional Test.

8 It is recommended that you do the Hot and Cold Test.

(b) Make a selection of a short discriminator trip-point resistor (R11) as follows:

1 Remove resistor R11 (IPL Figure 2, 20) and connect a decade box across the connections where R11 was removed.

2 Adjust the test set helipot to a value that is 0.5 times the fire trip-point resistance.

3 Set S2 to OFF.

4 Adjust the decade box resistance to approximately 30Ω.

5 Set S2 to ON. The FIRE lights come on.

6 Set S2 intermittently to OFF and then ON, again and again, as you slowly increase the decade box resistance until the SHORT light comes on. Record the decade box resistance where the SHORT light came on.

7 Make a selection of a resistor (IPL Figure 2, 20 thru 34) nearest to the value of the decade box resistance and install for R11.

8 Do the Functional Test.

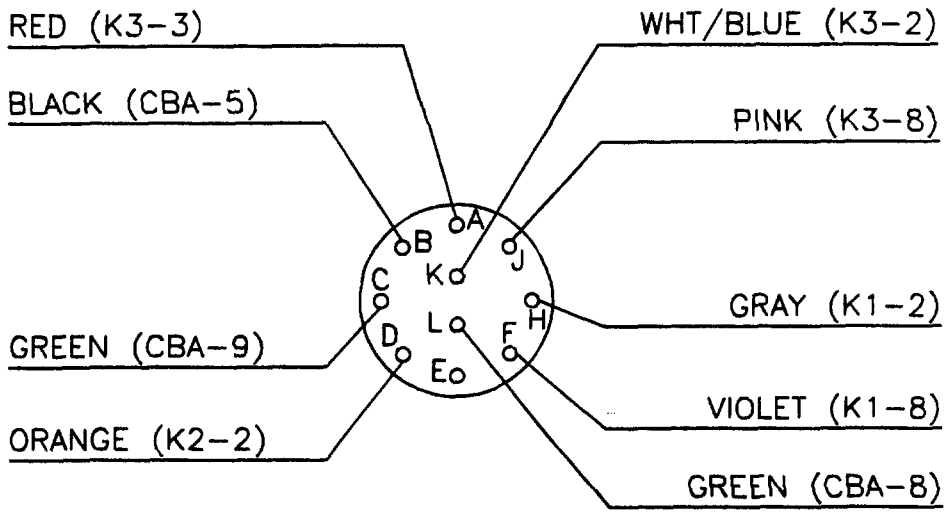
9 It is recommended that you do the Hot and Cold Test.

G. Hot and Cold Test

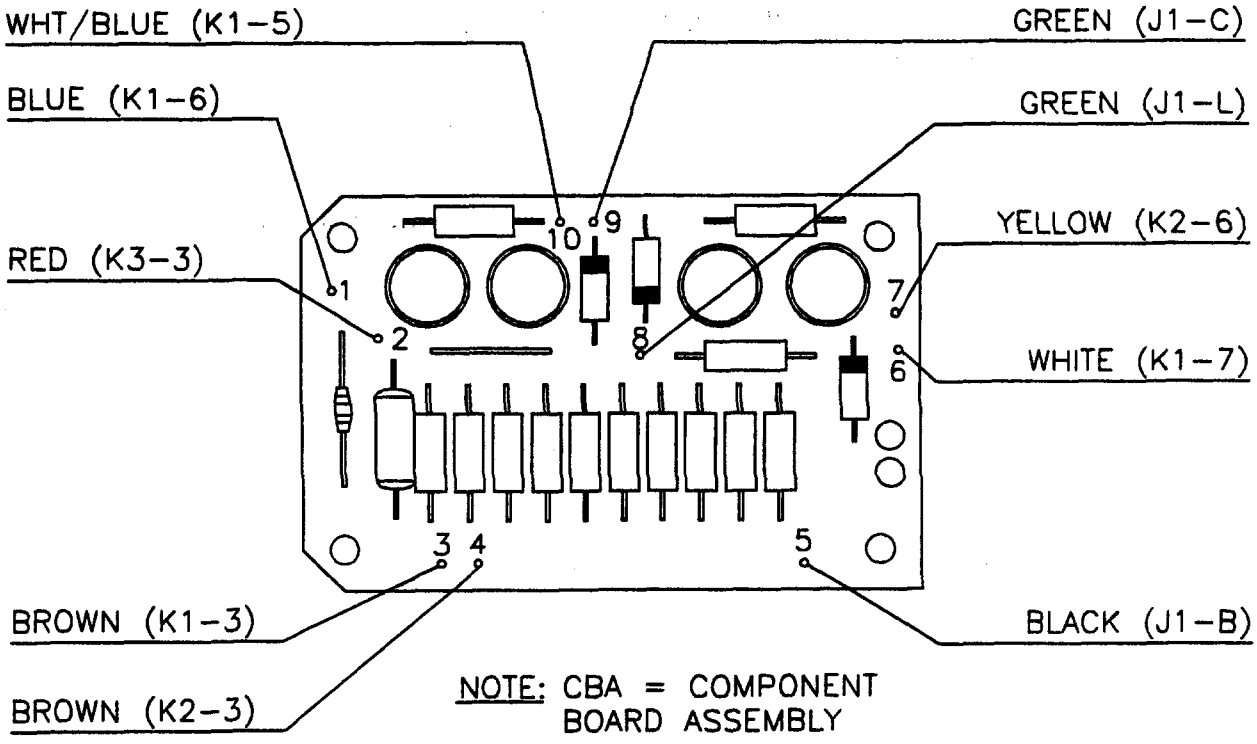
(1) It is recommended that you do a hot and cold test of the control unit when a trip-point resistor has been replaced or when intermittent malfunctions occur. Do these tests as follows:

(a) Put the control unit in a temperature chamber set from 155 to 160°F (68 to 71°C) for 1 hour. Then do the Functional Test. The fire trip value must be the measured value plus or minus 0.2 times the measured value recorded in the functional test. The short trip value must be between 0.40 and 0.60 times the specified fire trip value and the short reset value must be not less than 0.80 times the specified fire trip value.

(b) Put the control unit in a temperature chamber set from -60 to -65°F (-51 to -54°C) for 1 hour. Then do the Functional Test. The fire trip value and short trip and reset value must be in the limits given in step (a) above.



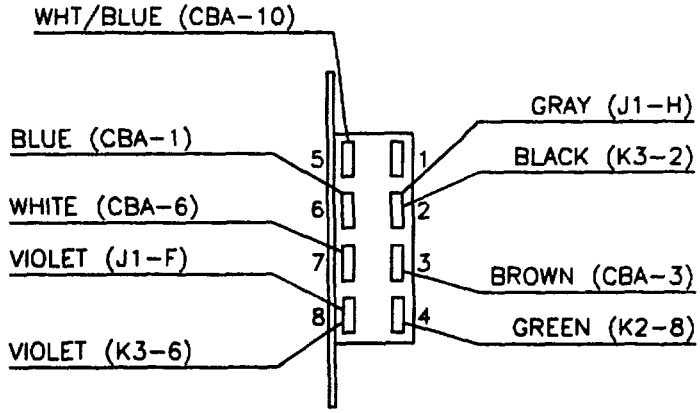
RECEPTACLE J1



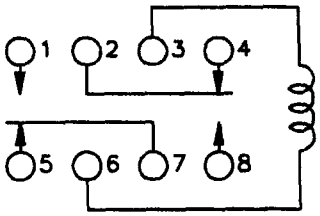
NOTE: CBA = COMPONENT BOARD ASSEMBLY

COMPONENT BOARD ASSEMBLY

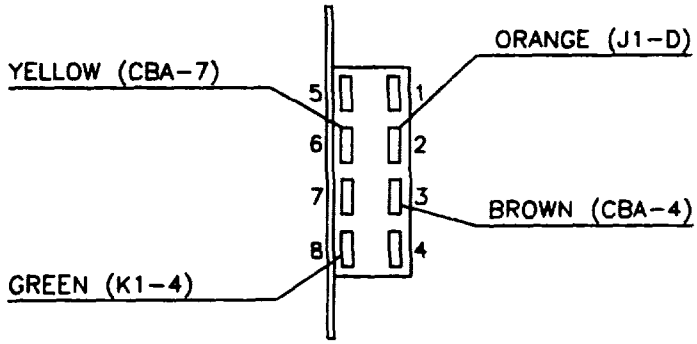
Control Unit Wiring Diagram (Sheet 1 of 2)
Figure 7



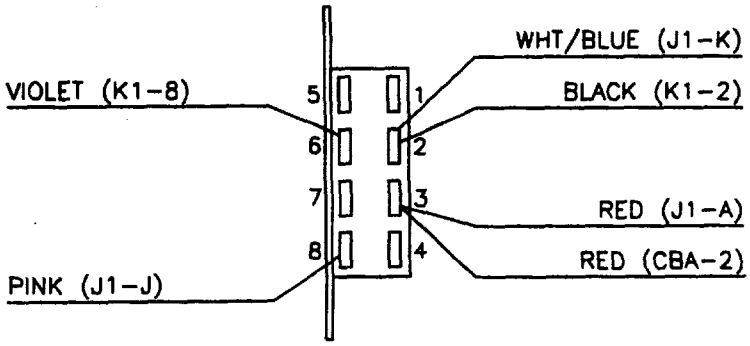
RELAY K1



RELAY SCHEMATIC



RELAY K2



RELAY K3

Control Unit Wiring Diagram (Sheet 2)
Figure 7

Table 7. Test Point Voltages and Conditions

INPUT VOLTAGE	HELIPOT VALUE	LIGHTS FIRE/SHORT	TEST POINTS						
			TP1	TP2	TP3	TP4	TP5	TP6	TP7
28 VDC	Infinite (Open)	OFF/OFF	11.6 to 17.4	0.89 to 1.41	0.86 to 1.34	0.4 to 0.6	0.136 to 0.144	11.6 to 17.4	11.6 to 17.4
28 VDC	Decreased to trip-point	ON/OFF	0.48 to 0.59	0.85 to 1.27	9.3 to 13.9	0.48 to 0.59	0.94 to 1.40	0.51 to 0.77	11.6 to 17.4
28 VDC	Decreased from trip-point to zero	ON/OFF	0	0.41 to 0.61	9.22 to 13.98	0.42 to 0.62	0.94 to 1.40	0.50 to 0.74	11.6 to 17.4
28 VDC	Shorted from maximum to zero	OFF/ON	0	0.41 to 0.61	0.84 to 1.26	0.2 to 0.3	0.17 to 0.25	11.6 to 17.4	11.6 to 17.4
INPUT VOLTAGE	HELIPOT VALUE	LIGHTS FIRE/SHORT	TEST POINTS						
			TP8	TP9	TP10	TP11	TP12	TP13	TP14
28 VDC	Infinite (Open)	OFF/OFF	22.4 to 28.0	0.28 to 0.42	0.82 to 1.22	0.4 to 0.6	0.09 to 0.13	0.08 to 0.12	11.6 to 17.4
28 VDC	Decreased to trip-point	ON/OFF	0	0.28 to 0.42	0.82 to 1.22	0.4 to 0.6	0.09 to 0.13	0.8 to 0.12	11.6 to 17.4
28 VDC	Decreased from trip-point to zero	ON/OFF	0	0.09 to 0.11	0.43 to 0.65	9.04 to 13.56	0.09 to 0.11	0.62 to 0.92	0.184 to 0.276
28 VDC	Shorted from maximum to zero	OFF/ON	22.4 to 28.0	0.044 to 0.216	0.43 to 0.65	9.04 to 13.56	0.152 to 0.228	0.70 to 1.04	0.288 to 0.432

NOTE: Values are in volts D.C. Measure from the test point to ground.

3. AUTOMATIC TEST REQUIREMENTS (ATLAS)

A. Not Applicable.

4. DISASSEMBLY

A. General

(1) This section gives the disassembly procedure for the control unit. Table 8 gives the necessary materials and equipment.

NOTE: Equivalent alternatives can be used for given items.

Table 8. Disassembly Materials and Equipment

MATERIAL AND EQUIPMENT	PART NO./ SPECIFICATION	SOURCE
Thinner, Cellulose Acetate	TT-T-266	Commercial
Air Source, Low Pressure, 30 psig (207 kPa) max.		Make Locally
Brush, Wire		Commercial
Soldering Iron, 250 watt, Broad Tip		Commercial
Soldering Iron, 40 watt, Fine Tip		Commercial
Torch, Propane		Commercial

NOTE: All equipment and materials are commercially available; thus specified vendors are not given.

CAUTION: WHEN YOU TOUCH THE CONTROL UNIT OR COMPONENT BOARD ASSEMBLY, MAKE SURE YOU DO NOT APPLY A VOLTAGE HIGHER THAN THE MAXIMUM PERMITTED VOLTAGES TO DEVICES OR COMPONENTS IDENTIFIED AS ESD SENSITIVE. THESE DEVICES OR COMPONENTS ARE IDENTIFIED BY THE LETTERS (ESDS) THAT FOLLOW THE ITEM DATA IN THE ILLUSTRATED PARTS LIST NOMENCLATURE AREA.

(2) Do a visual inspection of the external area of the control unit. Refer to CHECK, in Section 6.

(3) When the visual inspection is complete, do a functional test of the control unit as given in TESTING AND FAULT ISOLATION. The control unit is hermetically sealed with solder. Open the control unit only when necessary to do troubleshooting and repair. If the unit has a malfunction, refer to TESTING AND FAULT ISOLATION section to find the cause of the malfunction and make a decision for the level of disassembly necessary. Do a functional test after each repair or replacement to make sure the control unit operates correctly.

B. How to remove the seal and open the control unit (See IPL Figure 1).

NOTE: Disassemble only to the level necessary to make repairs.

(1) Remove the seal and open the control unit as follows:

(a) Record the data from the nameplate (IPL Figure 1, 20) on a tag.

(b) Remove the patent plate (25), ESD nameplate (30), and nameplate (20) from the case assembly (5).

WARNING: PAINT THINNER IS HIGHLY FLAMMABLE. DO NOT USE NEAR HEAT OR OPEN FLAME. USE IN AN AREA THAT HAS A GOOD AIRFLOW.

(c) Soak the control unit in thinner (Specification TT-T-266) to make the paint soft for removal.

(d) Use a wire brush to remove the paint and then flush with clean water.

WARNING: BE CAREFUL WHEN YOU USE COMPRESSED AIR OR GAS. ALWAYS POINT THE FLOW AWAY FROM PERSONS. COMPRESSED GAS AND MATERIAL MOVED BY THE GAS PRESSURE CAN CAUSE BAD INJURIES.

(e) Use compressed nitrogen or dry air at a maximum pressure of 15 psig (103 kPa) to dry the control unit.

(f) After paint removal is complete, temporarily attach the tag with data to the control unit.

(g) Put the control unit in a bench vise so that you can get to all the screws (40).

CAUTION: WHEN YOU REMOVE SOLDER FROM THE CASE ASSEMBLY AND THE COVER ASSEMBLY, ONLY APPLY AS MUCH HEAT AS NECESSARY TO PREVENT DAMAGE TO THE ELECTRICAL COMPONENTS. DO NOT APPLY TOO MUCH PRESSURE WITH THE VISE OR THE CASE CAN BEND AND CAUSE THE SIDES TO TOUCH THE CIRCUITS.

(h) Use a hand-held propane torch or a 250 watt soldering iron to melt the solder from the screw (40) heads. While the solder is melted, remove only the screws (40) from the case assembly (5).

(i) Melt the solder that seals the cover assembly (15) to the case assembly (5) with the torch or soldering iron.

(j) Loosen the cover assembly (15) from the case assembly (5).

NOTE: You can use a block made of phenolic to apply pressure between the case and cover to help loosen the assembly.

(k) Remove the chassis assembly (35) and cover assembly (15) from the case assembly (5).

(l) Cut off the sealed part of the exhaust tube (10) so that there is no flange.

(m)Melt the solder that seals the exhaust tube (10) to the case assembly (5).

(n) Remove and discard the exhaust tube (10).

C. Chassis Assembly Removal

(1) Remove the chassis assembly (35) as follows:

(a) Remove the two screws (40) that hold the cover assembly (15) to the chassis assembly (35). Melt the solder, if necessary.

CAUTION: IN THE PROCEDURE THAT FOLLOWS, THE CASE ASSEMBLY IS ATTACHED TO THE COVER ASSEMBLY BY ONLY THE WIRES. TO MAKE SURE THE WIRES DO NOT BREAK, DO NOT BEND OR TWIST THE WIRES CONNECTED TO THE ASSEMBLIES.

(b) Remove the four screws (115), lock washers (120), and flat washers (125) that attach the component board assembly (110) and insulator (105) to the chassis assembly(35).

(c) Remove the two screws (60), flat washers (65), lock washers (70), and nuts (75) that attach the relays (55) to the chassis assembly (35).

(d) Remove the two screws (85), flat washers (90), lock washers (95), and nuts (100) that attach the relay (80) to the chassis assembly (35).

(e) Remove unwanted solder from the cover assembly (15), refer to CLEANING.

NOTE: More disassembly is necessary only for replacement of parts or components found defective during visual inspection and/or from malfunctions found when you do a test or troubleshooting. Refer to CHECK and TESTING AND FAULT ISOLATION.

5. CLEANING

A. General

(1) This section gives the procedures and materials necessary to clean the control unit.

B. Materials

(1) The materials necessary to clean the control unit are given in Table 9. You can use alternative equivalents for the items given.

Table 9. Cleaning Materials

MATERIAL	PART NO./ SPECIFICATION	SOURCE
Brush, Acid	H-B-643	Commercial
Alcohol, Isopropyl		Commercial
Envi-Ro-Tech 1676		Tech Spray, Inc. P.O. Box 949 Amarillo, TX (V54700)
Nitrogen or Clean, Dry Air	BB-N-411	Commercial

C. Procedure

WARNING: CLEAN WITH SOLVENTS IN AN AREA THAT HAS A GOOD AIRFLOW. DO NOT CLEAN NEAR HEAT OR OPEN FLAME BECAUSE IT IS DANGEROUS.

CAUTION: WHEN YOU TOUCH THE CONTROL UNIT OR COMPONENT BOARD ASSEMBLY, MAKE SURE YOU DO NOT APPLY A VOLTAGE HIGHER THAN THE MAXIMUM PERMITTED VOLTAGES TO DEVICES OR COMPONENTS IDENTIFIED AS ESD SENSITIVE. THESE DEVICES OR COMPONENTS ARE IDENTIFIED BY THE LETTERS (ESDS) THAT FOLLOW THE ITEM DATA IN THE ILLUSTRATED PARTS LIST NOMENCLATURE AREA.

(1) Clean the connector, component board assembly , or internal parts of the control unit as follows:

(a) Use alcohol or Envi-Ro-Tech 1676 with an acid brush to clean the connector pins or components.

WARNING: BE CAREFUL WHEN YOU USE COMPRESSED AIR OR GAS. ALWAYS POINT THE FLOW AWAY FROM PERSONS. COMPRESSED GAS AND MATERIAL MOVED BY THE GAS PRESSURE CAN CAUSE BAD INJURIES.

(b) Use compressed nitrogen or dry air at a maximum pressure of 15 psig (103 kPa) to dry the connector, component board assembly, or other parts to remove unwanted materials.

(2) Remove all remaining unwanted solder.

(3) Use a soldering iron to melt and remove unwanted solder from the inside of the cover assembly (15) and the case assembly (5).

(4) When you have cleaned the control unit, put an ESD protection cap (CEC-16) on the connector.

6. CHECK

A. General

(1) This section gives the inspections necessary to find the condition of the control unit before and after disassembly, repairs, and assembly.

B. Inspection

CAUTION: WHEN YOU TOUCH THE CONTROL UNIT OR COMPONENT BOARD ASSEMBLY, MAKE SURE YOU DO NOT APPLY A VOLTAGE HIGHER THAN THE MAXIMUM PERMITTED VOLTAGES TO DEVICES OR COMPONENTS IDENTIFIED AS ESD SENSITIVE. THESE DEVICES OR COMPONENTS ARE IDENTIFIED BY THE LETTERS (ESDS) THAT FOLLOW THE ITEM DATA IN THE ILLUSTRATED PARTS LIST NOMENCLATURE AREA.

(1) External Inspection Before Disassembly and After Assembly

(a) Examine the connector on the cover assembly (15) for signs of damage such as bent or broken pins. If pins are lightly bent, make them straight with a pin that engages correctly with them. If pins are badly bent or broken, replace the cover assembly (15).

(b) Examine the case assembly (5) for bends, large dents and damage. Repair or replace as necessary.

(c) Make sure that all hardware is in position and tightened.

(2) Internal Inspection

(a) Examine all components for damage, and all solder connections for loose or cold solder joints. Repair or replace as necessary.

(b) Examine the wires for breaks, cracks in the insulation, burned areas or damaged sleeving. Repair or replace as necessary.

(c) Make sure that all unwanted solder has been removed. If not, remove as necessary.

7. REPAIR

A. General

(1) This section gives procedures to do repairs on the control unit.

(2) Materials and equipment that are necessary to make repairs on the control unit are given in Table 10. You can use alternative equivalents for the items given.

Table 10. Repair Materials and Equipment

MATERIALS AND EQUIPMENT	PART NO./ SPECIFICATION	SOURCE
Soldering Iron, Fine Tip, 40 watt		Commercial
Wire Stripper, Thermal		Commercial
Solder, SN60	QQ-S-571	Commercial
Tape, Lacing, Waxed Nylon	MIL-T-43435	Gudebrod, Inc. 33 W. Hawthorne Ave. Valley Stream, NY 11580 (V1B372)
Enamel, Red Glyptal	MIL-E-22118	Glyptal Inc. Chelsea, MA 02150-3344 (V65313)
Sleeving, Teflon	MIL-I-22129 or ASTM D 3295	Commercial
Wire, No. 22	MIL-W-16878, Type E	Commercial

B. Procedure

CAUTION: WHEN YOU TOUCH THE CONTROL UNIT OR COMPONENT BOARD ASSEMBLY, MAKE SURE YOU DO NOT APPLY A VOLTAGE HIGHER THAN THE MAXIMUM PERMITTED VOLTAGES TO DEVICES OR COMPONENTS IDENTIFIED AS ESD SENSITIVE. THESE DEVICES OR COMPONENTS ARE IDENTIFIED BY THE LETTERS (ESDS) THAT FOLLOW THE ITEM DATA IN THE ILLUSTRATED PARTS LIST NOMENCLATURE AREA.

(1) Cover Assembly

(a) The only repair you can do to the cover assembly is to make bent pins in the connector straight.

(b) Make bent pins straight with a pin that engages correctly with them.

(2) Wires

(a) Do a repair of wires that have been broken and moved from the soldered component board assembly (IPL Figure 1, 110), relays (55, 80), or cover assembly () electrical connector as follows:

1 Remove the solder and wire end from the printed-circuit-board eyelet (IPL Figure 2, 125) or electrical connector pin or relay (IPL Figure 1, 55, 80).

2 Remove approximately 0.125 in. (0.32 cm) of insulation from the end of the wire with a thermal wire stripper.

3 Tin the wire end with solder. Make sure a piece of AWG 14 teflon sleeving 0.375 in. (0.95 cm) long is installed on wires that connect to the connector and AWG 11 teflon sleeving 0.375 in. (0.95 cm) long is installed on wires that connect to the relays (55, 80).

4 Put the wire end into the eyelet or connector pin, or the relay terminal and solder. Move the sleeving over the connection, if applicable.

(b) If a broken wire becomes too short or if a wire is damaged, replace as follows:

1 Disconnect the wire. Carefully remove it.

2 Tie a new wire, with color the same as the removed wire, to the location where the wire was removed.

3 Use lacing tape and tie the new wire in as many locations as necessary.

4 Apply red enamel (Glyptal) to the lacing tape knots.

5 See Figure 7 for connection locations of wires. Make sure a piece of sleeving 0.375 in. (0.95 cm) long is installed on the wire to put over the soldered connection at the connector end or relay terminal. Solder the replacement wire in position.

6 Move the sleeving over the soldered connection, if applicable.

(c) Make sure the wires are held to the component board assembly (IPL Figure 1, 110) with lacing tape attached through the two holes in the printed-circuit-board.

(3) Component Board Assembly

(a) Use standard electronic shop repair procedures to replace components. Follow ESD precautions and procedures.

(b) When you must replace the K1 or K2 relay on units serial number 3617 and below, it is recommended that you complete SB 893229-26-374.

(c) When you must replace a transistor (Q1 thru Q4) or diode (CR1 thru CR3) on control units serial number 3617 and below, use the parts listed in IPL Figure 2 and replace them all as a group. A mixture of components does not operate correctly together. It is recommended that you complete Service Bulletin 893229-26-374.

(4) Chassis Assembly

(a) You can replace the standoffs (IPL Figure 1, 50) or self-clinching fasteners (45). You must push out a defective or damaged self-clinching fastener and push in a replacement.

8. ASSEMBLY

A. General

(1) This section gives the assembly procedures, the sequence of assembly, and a list of materials necessary to assemble components of the control unit. Always assemble components in specified sequence. Ignore assembly instructions for components that have not been disassembled or removed. See IPL Figure 1 for parts location.

B. Materials and Equipment

(1) Materials and equipment necessary for assembly are given in Table 11. You can use equivalent alternatives for the items given in the list.

Table 11. Assembly Materials and Equipment

DESCRIPTION	PART NO./ SPECIFICATION	SOURCE
Evacuation and Backfill Setup		Make locally from Figure 8.
Air Source, Low Pressure	30 psig (207 kPa)	Commercial
Wire Brush		Commercial
Propane Torch		Commercial
Soldering Iron	250 watt, Broad Tip	Commercial
Soldering Iron	40 watt, Fine Tip	Commercial
Solder, Resin Flux Core, Composition SN60	QQ-S-571	Commercial
Cap, Protection, ESD	CEC-16	Protective Closures Co., Inc. Buffalo, NY 1240 (V99017)
Primer, Paint, Zinc, Chromate	TT-P-1757	Commercial
Paint, Charcoal Gray, Wrinkle	Federal Std. 595, Color No. 26044	Randolph Products Co. Carlstadt, NJ (V77672)
Nitrogen	BB-N-411	Commercial
Helium		Commercial
Cleaner	Diversey 909	Commercial
Tape, Masking		Commercial
Trichloroethylene	O-T-6346	Commercial

C. Procedure

CAUTION: WHEN YOU TOUCH THE CONTROL UNIT OR COMPONENT BOARD ASSEMBLY, MAKE SURE YOU DO NOT APPLY A VOLTAGE HIGHER THAN THE MAXIMUM PERMITTED VOLTAGES TO DEVICES OR COMPONENTS IDENTIFIED AS ESD SENSITIVE. THESE DEVICES OR COMPONENTS ARE IDENTIFIED BY THE LETTERS (ESDS) THAT FOLLOW THE ITEM DATA IN THE ILLUSTRATED PARTS LIST NOMENCLATURE AREA.

CAUTION: IN THE OPERATION THAT FOLLOWS, THE COMPONENT BOARD ASSEMBLY IS ATTACHED TO THE COVER ASSEMBLY BY ONLY THE WIRING. TO MAKE SURE THE WIRES DO NOT BREAK, DO NOT BEND OR TWIST THE WIRES THAT CONNECT THE ASSEMBLIES.

(1) Assemble to Chassis

(a) Put the relays (IPL Figure 1, 55) on the chassis assembly(35) and attach with two screws (60), flat washers (65), lock washers (70), and nuts (75).

(b) Put the relay (80) on the chassis assembly (35) and attach with two screws (85), flat washers (90), lock washers (95), and nuts (100).

(c) Install the component board assembly (110) and insulator (105) to the chassis assembly (35) and attach with screws (115), lock washers (120), and flat washers (125).

(d) Position the cover assembly (15) to the chassis assembly (35) and attach with screws (40).

(e) Put the exhaust tube (10) into the rear of the case assembly (5) from the inside.

(f) Solder the exhaust tube (10) in position with a propane torch or a 250 watt soldering iron. Make sure the soldered joint is an air tight seal.

(g) Move the chassis assembly (35) with component board assembly (110) and cover assembly (15) into the case assembly (5) and attach with screws (40).

(h) Do a test of the control unit before you seal it with solder. Refer to TESTING AND FAULT ISOLATION.

(i) Use a propane torch or 250 watt soldering iron and solder the cover assembly (15) to the case assembly (5). Make sure the soldered joint has an airtight seal.

(j) Seal the screw (40) heads with melted solder.

(2) Control Unit Evacuation and Backfill

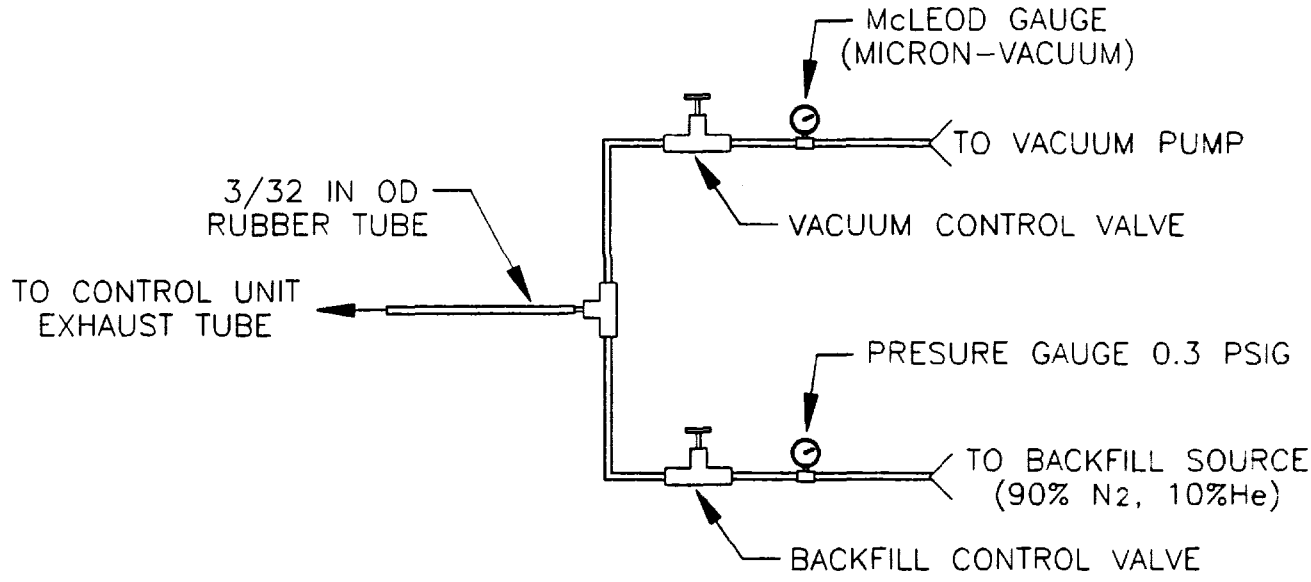
(a) Connect the exhaust tube (10) to the evacuation and backfill setup (Figure 8).

(b) Remove the air from the control unit at 70°F to 100°F (21°C to 38°C) to an absolute pressure of 1 micron maximum for no less than 15 minutes. Then, backfill the control unit to a pressure of 0.5 to 0.8 psi (3.45 to 5.5 kPa) above atmosphere with a mixture of 90% nitrogen and 10% helium by volume.

NOTE: Each gas must be dry with a maximum dew point of -65°F (-54°C). The two gases (nitrogen and helium) can come from different containers or from one container with the gases mixed.

(3) Control Unit Leak Test and Seal

(a) Use trichloroethylene, Federal Specification O-T-6346 or an equivalent, in a container for the leakage test.



Evacuation and Backfill Setup
Figure 8

(b) Let the air go out of the liquid for the test. Let it stand (approximately 30 minutes) at room temperature until all bubbles are gone or put the liquid for the test in an ultrasonic bath in a test chamber.

(c) Put the pressurized control unit fully into the liquid for test. There must be no signs of leakage.

(d) When you complete the test for leakage, while the control unit is pressurized, tightly compress the exhaust tube (IPL Figure 1, 10) closed to keep the control unit pressurized. Compress the exhaust tube 0.125 in. (0.32 cm) away from the rear of the case assembly (5) with vise grip pliers or an equivalent tool.

(e) Remove the control unit from the evacuation and backfill setup.

(f) Let the tool stay on the exhaust tube (10) and cut off the exhaust tube outside the tool.

(g) Use melted solder to seal the area of the exhaust tube (10) that you cut.

(h) Remove the tool from the exhaust tube (10).

(i) Do the test for leakage again. A visual sign of leakage shows that the seal is defective.

(j) If there is no leakage, remove and fully dry the control unit.

(4) Painting

(a) Clean the control unit with Diversey 909 cleaner or equivalent and flush with clean water.

(b) Dry the control unit fully.

(c) Apply masking tape to the connector and the bottom of the brackets that attach the control unit.

(d) Apply zinc chromate primer (TT-P-1757) to the control unit. Let the unit dry.

(e) Make the control unit warm from 75°F to 80°F (24°C to 27°C) and then paint with charcoal gray wrinkle paint, Federal Standard 595, Color No. 26044.

(f) Let the control unit air dry for 40 minutes.

(g) Make the control unit warm from 140°F to 150°F (60°C to 66°C) for approximately 90 minutes.

(h) Then, let the control unit air dry for 12 hours minimum before you touch it.

(i) Remove the masking tape.

(j) Put an ESD protection cap (CEC-16) on the control unit connector.

D. Final Assembly

(1) Nameplate, Patent Plate, ESD Nameplate

(a) Use a metal stamp and put the serial number and data on the nameplate (20).

(b) Remove the protection cover from the back of each nameplate (20, 25, 30) and push each nameplate tightly in position on the case assembly (5).

(c) Do a functional test and an insulation resistance test of the control unit. Refer to TESTING AND FAULT ISOLATION.

NOTE: You can do a functional test and an insulation resistance test before you apply primer or paint to the control unit.

(d) Put an ESD protection cap (CEC-16) on the control unit connector again after you do the tests.

E. Storage and Movement

(1) Protect the control unit with ESD protection materials.

(2) Put the control unit in an approved container.

(3) Keep the control unit in a cool, dry area that has no contamination.

(4) If you must move the control unit to another location, make sure it has sufficient protection to prevent damage.

9. FITS AND CLEARANCES

A. Not Applicable.

10. SPECIAL TOOLS, FIXTURES AND EQUIPMENT

A. General

(1) This section gives the special tools, fixtures, and equipment necessary to do maintenance on the control unit.

(2) Special tools, fixtures and equipment are given in Table 12. You can use alternative equivalents for the items given.

Table 12. Special Tools, Fixtures and Equipment

TOOL, FIXTURE, OR EQUIPMENT ITEM	PART NO.	SOURCE
Power Supply, Regulated, Adjustable, 0-50 VDC	Model LS30	Electrostatics, Inc. (V34538)
Helipot, 0-1000Ω	3400S-1-102 with CT-23 counting dial	Bourns Inc. (V32997)
Multimeter	Model 77	Fluke (V89536)
Megohmmeter	L-12	Rosemount Analytical Inc. (V30646)
Test Set, Functional		Make locally from Figure 3 and Table 3.
Test Cable, Insulation-Resistance		Make locally from Figure 4.
Soldering Iron, 40 watt, Fine Tip		Commercial
Soldering Iron, 250 watt, Broad Tip		Commercial
Propane Torch		Commercial
Evacuation and Backfill Setup		Make locally from Figure 8.
Air Source, Low Pressure		Commercial
Resistance Substitution (Decade Box)	Model 236a	Phipps & Bird (V7T784)

11. ILLUSTRATED PARTS LIST

A. Purpose

(1) This list of parts shows the location and identifies the parts used to make each assembly shown on the title page. These parts can be disassembled, repaired or replaced, and assembled again.

B. How To Read And Use The Illustrated Parts List (IPL)

(1) Assembly Order Indenture System

(a) The system used to write the parts list shows the relation of one part to a different part. For a given item, the number of spaces before the item shows the relation of the item to the next higher assembly (NHA) as follows:

1 2 3 4
Assembly
Attaching parts for assembly
***
. Detail parts for assembly
. Subassembly
. Attaching parts for subassembly
***
. . Detail parts for subassembly
. . Sub-subassembly
. . Attaching parts for sub-subassembly
***
. . . Detail parts for sub-subassembly

(2) Effectivity Code

(a) The EFF CODE area shows a letter (A, B, C, etc.) to refer to for each top assembly. The letter for the applicable top assembly is also shown in the EFF CODE area for each detail part and subassembly. No letter is shown for detail parts and subassemblies used on all top assemblies.

(3) Units Per Assembly

(a) The UNITS PER ASSY area shows the total number of units necessary for each assembly, for each subassembly, and for each sub-subassembly, as applicable. For large quantity items, the letters AR are for "as required". The letters RF show that the item is given to refer to.

(4) Parts Replacement Data

(a) The NOMENCLATURE area of the parts list gives the interchangeable relation between parts. The data and how it is written to show how the parts are interchangeable is as follows:

DATA	WRITTEN AS	SPECIFICATION
Optional	OPT	This part is optional to and interchangeable with other parts in the same item number variant group or other item number if written.
Superseded by	SUPSD BY	The part in the part number area of the parts list is replaced by and is not interchangeable with the item number written in the NOMENCLATURE area of the parts list.
Supersedes	SUPSDS	The part in the part number area of the parts list replaces and is not interchangeable with the item number that is written in the NOMENCLATURE area of the parts list.
Replaced by	REPLD BY	The part in the part number area of the parts list is replaced by and interchangeable with the item number that is written in the NOMENCLATURE area of the parts list.
Replaces	REPLS	The part in the part number area of the parts list replaces and is interchangeable with the item number that is written in the NOMENCLATURE area of the parts list.

(5) Service Bulletin Incorporation

(a) Assemblies, subassemblies and detail parts that can be changed, deleted, added or replaced by an issued service bulletin are written to show both pre- and post-service bulletin configuration. The data (PRE SB XXXX) in the NOMENCLATURE area of the parts list identifies the initial assemblies and parts and the data (POST SB XXXX) identifies assemblies and parts after the service bulletin has been completed.

(b) Subassemblies and detail parts used on assemblies that have the pre- or post- service bulletin identification do not have the same identification themselves if the use code(s) given to them clearly shows their pre- or post-service bulletin use.

(c) Top assemblies changed by a service bulletin and not given a new part number (no production equivalent of the modified assembly) are not identified with pre- or post-service bulletin data. But the subassemblies and detail parts effected by the service bulletin, when necessary, are identified with the pre- or post-service bulletin data.

(6) Items Not Illustrated

(a) A dash (-) before the item number in the FIG & ITEM NO. area of the parts list shows the item is not shown.

(7) Alpha Variant Item Numbers

(a) Alpha variants A-Z (does not include I and O) are given to item numbers used before when it is necessary to show:

1 Added items

2 Service bulletin modifications

3 Configuration differences

4 Optional parts

5 Product improvement part (not from a service bulletin)

(b) The exploded view does not show alpha variant item numbers when the appearance and location of the alpha variant item is the same as the basic item.

C. Electrostatic Discharge Sensitivity

(1) If the letters (ESDS) follow the item data in the NOMENCLATURE area of the parts list, the identified item can be damaged by electrostatic buildup and generation of electric fields.

D. Equipment Designator Index

(1) The equipment designator index is an alpha-numerical list of names or symbols assigned to identify each item of electrical and electronic equipment and gives a location for the part number and figure/item number. A hyphen between two names or symbols (example: A1-A5) shows one name or symbol that includes the names or symbols between the two.

E. Part Number Identification

(1) When the PART NO. area of the parts list shows a standard part number or another vendor's part number, the vendor code, which starts with the letter "V", is shown in parenthesis after the item data in the NOMENCLATURE area of the parts list. The Walter Kidde part number, in parenthesis, follows the vendor code. When you send an order for parts from Walter Kidde, use the Walter Kidde part number.

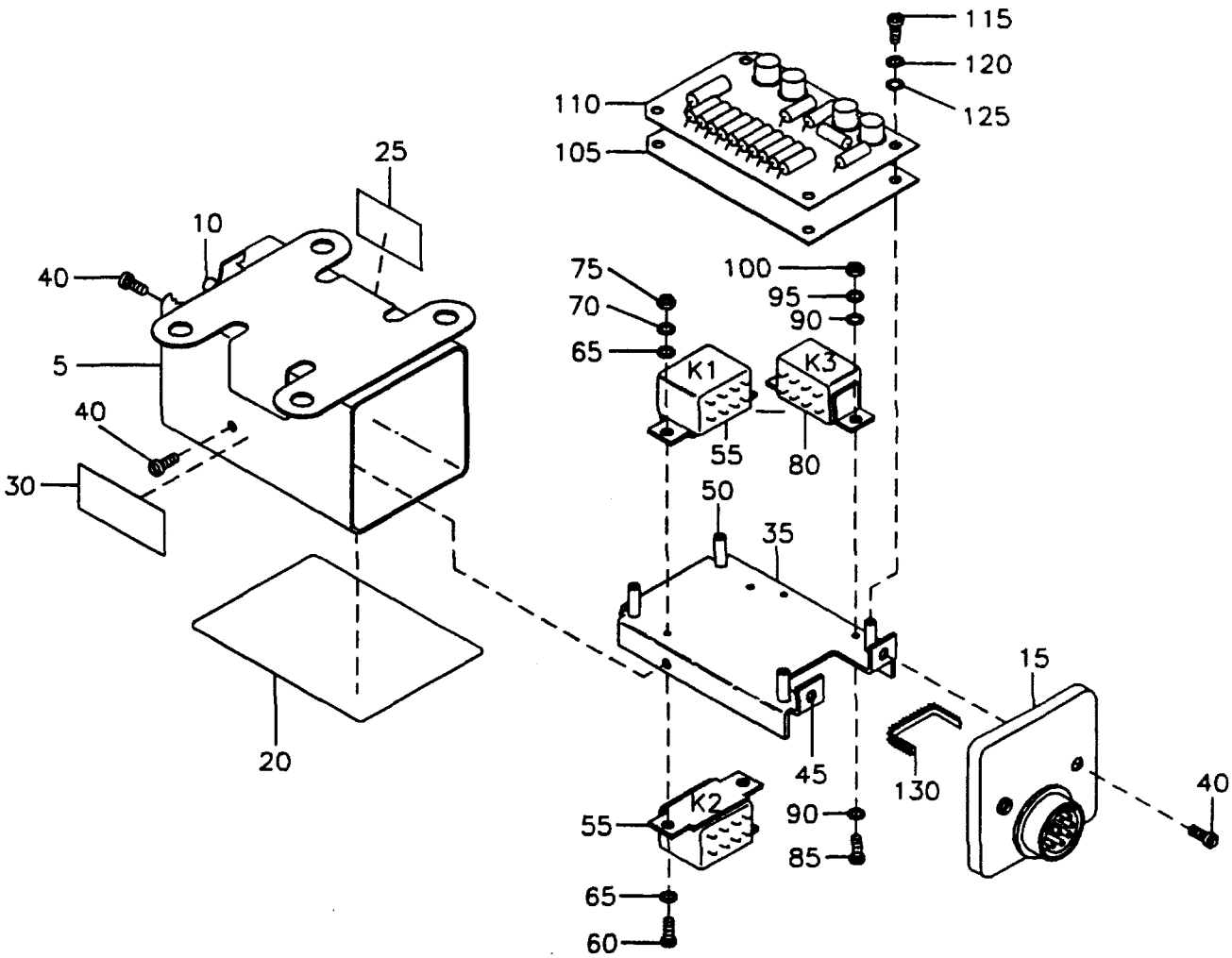
F. Vendors

CAGE	Manufacturer's Name and Address
V07047	The Ross Milton Co. 511 Second Street Pike Southampton, PA 18966-3804

CAGE	Manufacturer's Name and Address
V13141	Unitrode Transistor Products, Inc. Calabasas, CA 91302
V46384	Penn Engineering and Manufacturing Corporation Old Easton Rd P.O. Box 1000 Danboro, PA 18916
V58614	Communication Instruments, Inc. Hwy 74 East Fairview, NC 28730
V70318	Allmetal Screw Products 200 Executive Dr. Edgewood, NY 11717
V81349	Military Specifications promulgated by Military Departments/Agencies
V86577	Precision Metal Products Co. Peabody, MA
V96906	Military Standards

Equipment Designator Index

Equipment Designator	Figure Item	Equipment Designator	Figure Item	Equipment Designator	Figure Item
CR1-CR3	2-10		2-100A	R14	2-115
	2-10A		2-100B		
CR4	2-120	R6	2-60		
K1-K2	1-55		2-60A		
	1-55A	R7	2-110		
K3	1-80		2-110A		
Q1-Q4	2-40		2-110B		
	2-40A	R8	2-65		
	2-40B		2-65A		
R1	2-70	R9	2-60		
R2	2-65		2-60A		
	2-65A	R10	2-15		
R3	2-100		2-15A		
	2-100A		2-15B		
	2-100B	R11	2-20		
R4	2-5	R12	2-55		
	2-5A		2-55A		
	2-5B	R13	2-50		
R5	2-100		2-50A		



NOTE: THE WIRES ARE NOT SHOWN SO THAT ALL THE COMPONENTS CAN BE SEEN CLEARLY.

Control Unit, Fire Detecting System, Continuous Type DC with Short Discriminator Circuit
IPL Figure 1

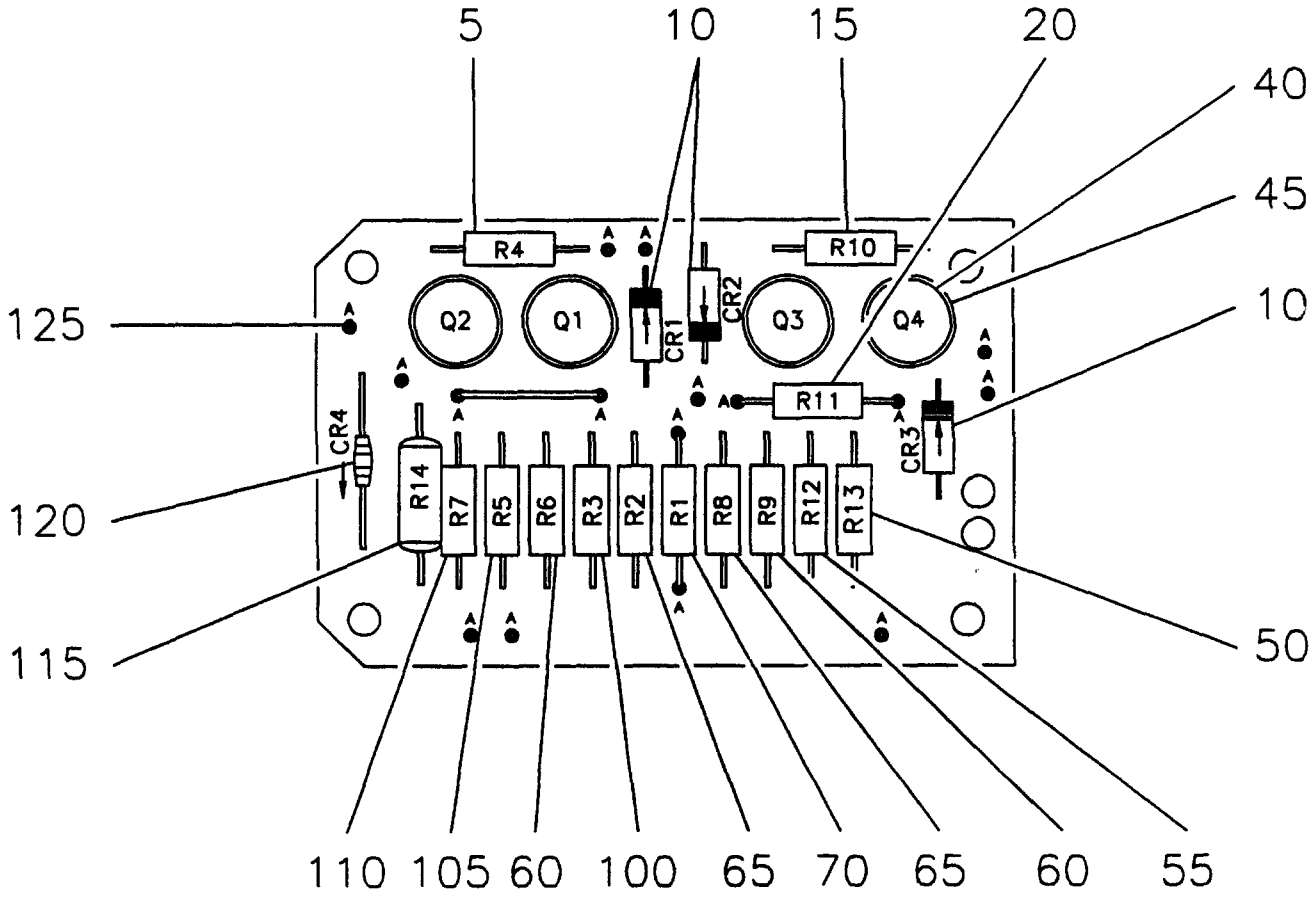
G. Parts List

FIG. & ITEM NO.	PART NO.	AIRLINE PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFF CODE	UNITS PER ASSY
1- 1	893229-0350		CONTROL UNIT, FIRE DETECTING SYSTEM, CONTINUOUS TYPE DC WITH SHORT DISCRIMINATOR CIRCUIT (ESDS) (PRE-SB 893229-26-374)	A	RF
1A	893229-0450		CONTROL UNIT, FIRE DETECTING SYSTEM, CONTINUOUS TYPE DC WITH SHORT DISCRIMINATOR CIRCUIT (ESDS) (PRE-SB 893229-26-374)	B	RF
1B	893229-0500		CONTROL UNIT, FIRE DETECTING SYSTEM, CONTINUOUS TYPE DC WITH SHORT DISCRIMINATOR CIRCUIT (ESDS) (PRE-SB 893229-26-374)	C	RF
1C	893229-0350-01		CONTROL UNIT, FIRE DETECTING SYSTEM, CONTINUOUS TYPE DC WITH SHORT DISCRIMINATOR CIRCUIT (ESDS) (POST-SB 893229-26-374)	D	RF
1D	893229-0450-01		CONTROL UNIT, FIRE DETECTING SYSTEM, CONTINUOUS TYPE DC WITH SHORT DISCRIMINATOR CIRCUIT (ESDS) (POST-SB 893229-26-374)	E	RF
1E	893229-0500-01		CONTROL UNIT, FIRE DETECTING SYSTEM, CONTINUOUS TYPE DC WITH SHORT DISCRIMINATOR CIRCUIT (ESDS) (POST-SB 893229-26-374)	F	RF
5	874800		. CASE ASSEMBLY		1
10	205808		. . EXHAUST TUBE		1
15	873652		. COVER ASSEMBLY		1
20	242256		. NAMEPLATE		1
25	250766		. PLATE, PATENT		1
30	324066		. NAMEPLATE, ESD		1
35	843323		. CHASSIS ASSEMBLY		1
			ATTACHING PARTS		
40	5269-0403		. SCREW, MACHINE, SLOTTED BINDING HD, STEEL, HOT-TIN DIP, #4-40 X 0.18 LG.		6
			***		
45	S440-1CI		. FASTENER, SELF-CLINCHING, #4-40 (V46384) (213528)		6
50	2520B1-2		. STAND-OFF, BRASS, CAD PLATED (V86577) (213591)		4
55	SF61104J01		. RELAY, DPDT, 2.5 KΩ COIL (K1, K2) (V58614) (246697)	A, B, C	2
55A	HMS11139S01		. RELAY, DPDT, 1.03 KΩ COIL (K1, K2) (V58614) (347088)	D, E, F	2
			ATTACHING PARTS		

-ITEM NOT ILLUSTRATED

FIG. & ITEM NO.	PART NO.	AIRLINE PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFF CODE	UNITS PER ASSY
1- 60	5269-0405		. SCREW, MACHINE, SLOTTED BINDING HD, HOT-TIN DIP, #4-40 X 0.30 LG.		2
65	MS15795-803		. WASHER, FLAT, #4 (V96906) (1159-9940)		4
70	MS35338-40		. WASHER, LOCK, STEEL, CAD PLATED, #4 (V96906) (1807-0400)		2
75	5335-0400		. NUT, HEX, STEEL, CAD PLATED, #4-40		2
			***		
80	HFW1112K04		. RELAY, DPDT, 700Ω (K3) (V58614) (273993)		1
			ATTACHING PARTS		
85	5269-0404		. SCREW, MACHINE, SLOTTED BINDING HD, HOT-TIN DIP, #4-40 X 0.24 LG.		2
90	MS15795-803		. WASHER, FLAT, #4 (V96906) (1159-9940)		2
95	MS35338-40		. WASHER, LOCK, STEEL, CAD PLATED, #4 (V96906) (1807-0400)		2
100	5335-0400		. NUT, HEX, STEEL, CAD PLATED , #4-40		2
			***		
105	213266		. INSULATOR, FIBERGLASS EPOXY		1
110	874736		. COMPONENT BOARD ASSEMBLY (ESDS) (SEE FIGURE 2 FOR DETAIL PARTS)		1
			ATTACHING PARTS		
115	5269-0204		. SCREW, MACHINE, SLOTTED BINDING HD, STEEL, HOT-TIN DIP#2-56 X 0.24 LG.		4
120	MS35338-39		. WASHER, LOCK, STEEL, CAD PLATED, #2 (V96906) (1807-0200)		4
125	NAS620C2		. WASHER, FLAT, #2 (V70318) (214847)		4
			. ***		
130	5608-0005		. GROMMET		1
-135	893293		. HARNESS, WIRING		1
	498		DELETED		

- ITEM NOT ILLUSTRATED



Component Board Assembly
IPL Figure 2

FIG. & ITEM NO.	PART NO.	AIRLINE PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFF CODE	UNITS PER ASSY
2- 1	874736		COMPONENT BOARD ASSEMBLY (ESDS) (SEE FIGURE 1 FOR NHA)		RF
5	5295-1035		. RESISTOR, FIXED COMPOSITION, 10KΩ, ±5%, 1/2W (R4) (SUPSD BY ITEM 5A)		1
5A	RLR20C1002 GS		. RESISTOR, METAL FILM, 10KΩ, ±2%, 1/2W, MIL-R-39017/2 (R4) (V81349) (6088-1035) (SUPSDS ITEM 5) (PRE SB 893229-26-374)		1
5B	RLR20C7501 GS		. RESISTOR, METAL FILM, 7.5KΩ, ±2%, 1/2W, MIL-R-39017/2 (R4) (V81349) (6088-7525) (POST SB 893229-26-374)		1
10	248961		. DIODE 1N457 (ESDS) (CR1, CR2, CR3) (PRE SB 893229-26-374)		3
10A	JANTX1N4148-1		. DIODE (ESDS), MIL-S-19500/116 (CR1, CR2, CR3) (POST SB 893229-26-374)		3
15	5295-7525		. RESISTOR, FIXED COMPOSITION, 7.5KΩ, ±5%, 1/2W (R10) (SUPSD BY ITEM 15A)		1
15A	RLR20C7501 GS		. RESISTOR, METAL FILM, 7.5KΩ, ±2%, 1/2W, MIL-R-39017/2 (R10) (V81349) (6088-7525) (SUPSDS ITEM 15) (PRE SB 893229-26-374)		1
15B	RLR20C8201 GS		. RESISTOR, METAL FILM, 8.2KΩ, ±2%, 1/2W, MIL-R-39017/2 (R10) (V81349) (6088-8225) (POST SB 893229-26-374)		1
20	RLR20C27R0 GS		. RESISTOR, METAL FILM, 27Ω, ±2%, 1/2W, MIL-R-39017/2 (R11) (V81349) (6088-2705) (POST SB 893229-26-374) (MAKE A SELECTION OF THIS OR FROM THE ITEMS THAT FOLLOW)		1
-21	RLR20C30R0 GS		. RESISTOR, METAL FILM, 30Ω, ±2%, 1/2W (V81349) (6088-3005)		AR
-22	RLR20C33R0 GS		. RESISTOR, METAL FILM, 33Ω, ±2%, 1/2W (V81349) (6088-3305)		AR
-23	RLR20C36R0 GS		. RESISTOR, METAL FILM, 36Ω, ±2%, 1/2W (V81349) (6088-3605)		AR
-24	RLR20C39R0 GS		. RESISTOR, METAL FILM, 39Ω, ±2%, 1/2W (V81349) (6088-3905)		AR
-25	5295-4305		. RESISTOR, SHORT DISCRIMINATOR (SUPSD BY ITEM 25A)		AR
-25A	RLR20C43R0 GS		. RESISTOR, METAL FILM, 43Ω, ±2%, 1/2W (V81349) (6088-4305) (SUPSDS ITEM 25)		AR
-26	RLR20C47R0 GS		. RESISTOR, METAL FILM, 47Ω, ±2%, 1/2W (V81349) (6088-4705)		AR

-ITEM NOT ILLUSTRATED

FIG. & ITEM NO.	PART NO.	AIRLINE PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFF CODE	UNITS PER ASSY
2- -27	RLR20C51R0 GS		. RESISTOR, METAL FILM, 51Ω, ±2%, 1/2W (V81349) (6088-)		AR
-28	RLR20C56R0 GS		. RESISTOR, METAL FILM, 56Ω, ±2%, 1/2W (V81349) (6088-5605)		AR
-29	RLR20C62R0 GS		. RESISTOR, METAL FILM, 62Ω, ±2%, 1/2W (V81349) (6088-6205)		AR
-30	RLR20C68R0 GS		. RESISTOR, METAL FILM, 68Ω, ±2%, 1/2W (V81349) (6088-6805)		AR
-31	RLR20C75R0 GS		. RESISTOR, METAL FILM, 75Ω, ±2%, 1/2W (V81349) (6088-7505)		AR
-32	RLR20C82R0 GS		. RESISTOR, METAL FILM, 82Ω, ±2%, 1/2W (V81349) (6088-8205)		AR
-33	RLR20C910 GS		. RESISTOR, METAL FILM, 91Ω, ±2%, 1/2W (V81349) (6088-9105)		AR
-34	RLR20C1000 GS		. RESISTOR, METAL FILM, 100Ω, ±2%, 1/2W (V81349) (6088-1015)		AR
40	248963		. TRANSISTOR, 2N697 (ESDS) (Q1 THRU Q4) (REPLD BY ITEM 40A)		4
40A	275569		. TRANSISTOR, 2N1613 (ESDS) (Q1 THRU Q4) (REPLS ITEM 40) (PRE SB 893229-26-374)		4
40B	JANTX2N3019		. TRANSISTOR (ESDS) (Q1 THRU Q4) (V81349) (283182) (POST SB 893229-26-374)		4
45	10035		. INSULATOR, TRANSISTOR, NYLON (V07047) (247227) (REPLD BY ITEM 45A)		4
45A	M38527-02-020N		. MOUNTING PAD, ELECTRICAL-ELECTRONIC COMPONENT, MIL-M-38527 (V81349) (263223) (REPLS ITEM 45)		4
50	5295-1505		. RESISTOR, FIXED COMPOSITION, 15Ω, ±5%, 1/2W (R13) (SUPSD BY ITEM 50A)		1
50A	RLR20C15R0 GS		. RESISTOR, METAL FILM, 15Ω, 1/2W, ±2%, MIL-R-39017/2 (R13) (V81349) (6088-1505) (SUPSDS ITEM 50)		1
55	5295-1525		. RESISTOR, FIXED COMPOSITION, 1.5KΩ, ±2%, 1/2W, MIL-R-39017/2 (R12) (SUPSD BY ITEM 55A)		1
55A	RLR20C1501 GS		. RESISTOR, METAL FILM, 1.5KΩ, 1/2W, ±2%, MIL-R-39017/2 (R12) (V81349) (6088-1525) (SUPSDS ITEM 55)		1
60	5295-2725		. RESISTOR, FIXED COMPOSITION, 2.7KΩ, ±5%, 1/2W (R6, R9) (SUPSD BY ITEM 60A)		2

-ITEM NOT ILLUSTRATED

FIG. & ITEM NO.	PART NO.	AIRLINE PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFF CODE	UNITS PER ASSY
2- 60A	RLR20C2701 GS		. RESISTOR, METAL FILM, 2.7KΩ, 1/2W, ±2%, MIL-R-39017/2 (R6, R9) (V81349) (6088-2725) (SUPSDS ITEM 60)		2
65	5295-5635		. RESISTOR, FIXED COMPOSITION, 56KΩ, ±5%, 1/2W (R2, R8) (SUPSD BY ITEM 65A)		2
65A	RLR20C5602 GS		. RESISTOR, METAL FILM, 56KΩ, 1/2W, ±2%, MIL-R-39017/2 (R2, R8) (V81349) (6088-5635) (SUPSDS ITEM 65)		2
70	RLR20C5101 GS		. RESISTOR, METAL FILM, 5.1KΩ, ±2%, 1/W2, MIL-R-39017/2 (R1) (V81349) (6088-5125) (POST SB 893229-26-374) MAKE A SELECTION FROM THIS OR FROM THE ITEMS THAT FOLLOW)		1
-71	RLR20C5601 GS		. RESISTOR, METAL FILM, 5.6KΩ, ±2%, 1/2W (V81349) (6088-5625)		AR
-72	RLR20C6201 GS		. RESISTOR, METAL FILM, 6.2Ω, ±2%, 1/2W (V81349) (6088-6225)		AR
-73	RLR20C6801 GS		. RESISTOR, METAL FILM, 6.8Ω, ±2%, 1/2W (V81349) (6088-25)		AR
-74	RLR20C7501 GS		. RESISTOR, METAL FILM, 7.5KΩ, ±2%, 1/2W (V81349) (6088-7525)		AR
-75	RLR20C8201 GS		. RESISTOR, METAL FILM, 8.2KΩ, ±2%, 1/2W (V81349) (6088-25)		AR
-76	RLR20C9101 GS		. RESISTOR, METAL FILM, 9.1KΩ, ±2%, 1/2W (V81349) (6088-9125)		AR
-77	5295-1035		. RESISTOR, FIXED COMPOSITION, 10KΩ, ±5% 1/2W (SUPSD BY ITEM 77A)		AR
-77A	RLR20C1002 GS		. RESISTOR, METAL FILM, 10KΩ, ±2%, 1/2W (V81349) (6088-1035) (SUPSDS ITEM 77)		AR
-78	5295-1135		. RESISTOR, FIXED COMPOSITION, 11KΩ, ±5% 1/2W (SUPSD BY ITEM 78A)		AR
-78A	RLR20C1102 GS		. RESISTOR, METAL FILM, 11KΩ, ±2%, 1/2W (V81349) (6088-1135) (SUPSDS ITEM 78)		AR
-79	5295-1235		. RESISTOR, FIXED COMPOSITION, 12KΩ, ±5% 1/2W (SUPSD BY ITEM 79A)		AR
-79A	RLR20C1202 GS		. RESISTOR, METAL FILM, 12KΩ, ±2%, 1/2W (V81349) (6088-1235) (SUPSDS ITEM 79)		AR
-80	5295-1335		. RESISTOR, FIXED COMPOSITION, 13KΩ, ±5% 1/2W (SUPSD BY ITEM 80A)		AR

-ITEM NOT ILLUSTRATED

FIG. & ITEM NO.	PART NO.	AIRLINE PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFF CODE	UNITS PER ASSY
2- -80A	RLR20C1302 GS		. RESISTOR, METAL FILM, 13KΩ, ±2%, 1/2W (V81349) (6088-1335) (SUPSDS ITEM 80)		AR
-81	5295-1535		. RESISTOR, FIXED COMPOSITION, 15KΩ, ±5% 1/2W (SUPSD BY ITEM 81A)		AR
-81A	RLR20C1502 GS		. RESISTOR, METAL FILM, 15KΩ, ±2%, 1/2W (V81349) (6088-1535) (SUPSDS ITEM 81)		AR
-82	5295-1635		. RESISTOR, FIXED COMPOSITION, 16KΩ, ±5%, 1/2W (SUPSD BY ITEM 82A)		AR
-82A	RLR20C1602 GS		. RESISTOR, METAL FILM, 16KΩ, ±2%, 1/2W (V81349) (6088-1635) (SUPSDS ITEM 82)		AR
-83	5295-1835		. RESISTOR, FIXED COMPOSITION, 18KΩ, ±5%, 1/2W (SUPSD BY ITEM 83A)		AR
-83A	RLR20C1802 GS		. RESISTOR, METAL FILM, 18KΩ, ±2%, 1/2W (V81349) (6088-1835) (SUPSDS ITEM 83)		AR
-84	5295-2035		. RESISTOR, FIXED COMPOSITION, 20KΩ, ±5%, 1/2W (SUPSD BY ITEM 84A)		AR
-84A	RLR20C2002 GS		. RESISTOR, METAL FILM, 20KΩ, ±2%, 1/2W (V81349) (6088-2035) (SUPSDS ITEM 84)		AR
-85	RLR20C2202 GS		. RESISTOR, METAL FILM, 22KΩ, ±2%, 1/2W (V81349) (6088-2235)		AR
-86	RLR20C2402 GS		. RESISTOR, METAL FILM, 24KΩ, ±2%, 1/2W (V81349) (6088-25)		AR
-87	RLR20C2702 GS		. RESISTOR, METAL FILM, 27KΩ, ±2%, 1/2W (V81349) (6088-2735)		AR
-88	RLR20C3002 GS		. RESISTOR, METAL FILM, 30KΩ, ±2%, 1/2W (V81349) (6088-3035)		AR
-89	RLR20C3302 GS		. RESISTOR, METAL FILM, 33KΩ, ±2%, 1/2W (V81349) (6088-3335)		AR
-90	RLR20C3602 GS		. RESISTOR, METAL FILM, 36KΩ, ±2%, 1/2W (V81349) (6088-3635)		AR
-91	RLR20C3902 GS		. RESISTOR, METAL FILM, 39KΩ, ±2%, 1/2W (V81349) (6088-3935)		AR
-92	RLR20C4302 GS		. RESISTOR, METAL FILM, 43KΩ, ±2%, 1/2W (V81349) (6088-4335)		AR
-93	RLR20C4702 GS		. RESISTOR, METAL FILM, 47KΩ, ±2%, 1/2W (V81349) (6088-4735)		AR
-94	RLR20C5102 GS		. RESISTOR, METAL FILM, 51KΩ, ±2%, 1/2W (V81349) (6088-5135)		AR

-ITEM NOT ILLUSTRATED

FIG. & ITEM NO.	PART NO.	AIRLINE PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFF CODE	UNITS PER ASSY
2- 100	5295-2725		. RESISTOR, FIXED COMPOSITION, 2.7KΩ, ±5%, 1/2W (R3) (SUPSD BY ITEM 100A)		1
100A	RLR20C2701 GS		. RESISTOR, METAL FILM, 2.7KΩ, ±2%, 1/2W MIL-R-39017/2 (R3) (V81349) (6088-2725) (SUPSDS ITEM 100) (PRE SB 893229-26-374)		1
100B	RWR81S1691 GS		. RESISTOR, FIXED, WIRE-WOUND, 1.69KΩ, ±1%, 1W, MIL-R-39017/2 (R3) (V81349) (7013-1691) (POST SB 893229-26-374)		1
105	5295-4305		. RESISTOR, FIXED COMPOSITION, 43KΩ, ±5%, 1/2W (R5) (SUPSD BY ITEM 105A)		1
105A	RLR20C43R02 GS		. RESISTOR, METAL FILM, 43KΩ, ±2%, 1/2W, MIL-R-39017/2 (R5) (V81349) (6088-4305) (SUPSDS ITEM 105)		1
110	5295-2425		. RESISTOR, FIXED COMPOSITION, 2.4KΩ, ±5%, 1/2W (R7) (SUPSD BY ITEM 110A)		1
110A	RLR20C43R02 GS		. RESISTOR, METAL FILM, 2.4KΩ, ±2%, 1/2W, MIL-R-39017/2 (R7) (V81349) (6088-2425) (SUPSDS ITEM110) (PRE SB 893229-26-374)		1
110B	RLR20C1801 GS		. RESISTOR, METAL FILM, 1.8KΩ, ±2%, 1/2W, MIL-R-39017/2 (R7) (V81349) (6088-1825) (POST SB 893229-26-374)		1
115	RW69V221		. RESISTOR, WIRE-WOUND, 220Ω, ±5%, 3W, MIL-R-26/4 (R14) (V81349) (5576-2215)		1
120	UZ815		. DIODE, ZENER (ESDS), 15V (CR4) (V13141) (248962)		1
125	211542		. EYELET, BRASS WITH HOT MOLTEN TIN FINISH		16
	249269		DELETED		
	5994-1402		DELETED		

- ITEM NOT ILLUSTRATED

WALTER KIDDE Aerospace
ABBREVIATED COMPONENT MAINTENANCE MANUAL (ACM)
POWER DEVICE CARTRIDGES

TO: HOLDERS OF FIRE EXTINGUISHER CARTRIDGE AND ACTUATOR SERVICE MANUAL

REVISION 6 DATED MAY 15/96

HIGHLIGHTS

This is a complete revision to the manual dated Apr 30/91. The purpose of the revision was to add data and schematics for additional part numbers and rewrite the text in Simplified English as an Abbreviated Component Maintenance Manual (ACM) in accordance with ATA100 requirements. Discard any earlier editions of this manual when you receive this revision.

WALTER KIDDE Aerospace
Division of KIDDE Technologies, Inc.
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Wilson, North Carolina 27896-9643 U.S.A.

POWER DEVICE

CARTRIDGES

ABBREVIATED COMPONENT

MAINTENANCE MANUAL

SAFETY SUMMARY

Power device cartridges are explosive devices used to operate safety equipment installed in aircraft are considered Safety of Flight equipment and must operate correctly the first time. Malfunction or failure of the power device cartridge to fire can cause material loss, damage to equipment and the possible injury or death to persons.

Power device cartridges are carefully designed by the maker. The maker does a test to make sure they operate as designed. You must correctly maintain the power device cartridge to make sure it operates correctly.

The following safety precautions are general in nature and are not applicable to any specific procedure. The precautions are recommended safety procedures that must be obeyed by maintenance persons each time they touch, move or keep power device cartridges.

KEEP AWAY FROM LIVE CIRCUITS

Electrically operated power device cartridges must be kept away from stray electrical currents, and must be correctly shunted. Under certain conditions, dangerous currents can stay in circuits after the power source has been disconnected. Make sure that you disconnect the power source and grounded the circuit before you touch it.

DO NOT SERVICE OR ADJUST ALONE

A person must never enter an enclosure alone, without an assistant, to maintain an item of equipment that has a power device cartridge. Make sure assistance is immediately available.

RESUSCITATION

Persons who do work with or near fire extinguishing equipment must know the methods of artificial respiration.

SUPERVISORY RESPONSIBILITY

Familiarity with work can cause carelessness. Therefore, a person who supervises or does work where it is necessary to touch and maintain power device cartridges must do the following:

Make sure that all applicable safety regulations and instructions are obeyed.

Carefully supervise the activities of all maintenance persons.

Inform all persons it is necessary that they use precaution when they do their work.

TOUCH, KEEP AND MOVE

To avoid injuries, prevent accidents and damage to equipment, make sure explosive devices are touched, kept or moved as specified by governmental regulations for Class "C"

explosives. You must also follow the maker's recommended safety guidelines and obey all warnings and cautions.

INSPECTION

Power device cartridges must be examined when you get them to make sure that the container, or its contents, are not damaged. You must do a check for the following:

Make sure the power device cartridge containers are correctly identified.

Make sure the sealed containers have not been opened.

NOTE: If a container is found open, the power device cartridge must be examined for corrosion, dents, cracks and other damage that can make it dangerous or not reliable.

IDENTIFICATION AND MOVEMENT

Power device cartridges removed from a device for examination must be identified for installation again in the same device from which it was removed.

Power device cartridges without identification, or with identification that you cannot read, must not be installed in a device. It must be made unserviceable as specified in Section 9.

Power device cartridges must be touched as little as possible and only when correctly shunted.

Do not drop or deform power device cartridges. Damaged or deformed power device cartridges must be made unserviceable as specified in Section 9.

No changes, modifications, or repairs are approved for power device cartridges.

INTERCHANGABILITY

Power device cartridges are designed for use in specific devices and though many power device cartridges have the same dimensions and look the same, they must not be installed in other devices.

DEFINITIONS

The following definitions apply to terms used in this publication.

Actuator. A mechanical device that changes chemical energy into mechanical motion.

All Fire. Minimum stimulus which must be applied to a device for it to correctly function.

Ambient. Local meteorological conditions such as temperature, humidity and pressure.

Bridgewire. A relatively fine resistance wire built into an ignition element attached to the electrical leads of an electro-explosive device.

Electro-Explosive Device (EED). Any power device cartridge, squib, igniter, etc., which is started electrically.

Hermetic Seal. A seal that keeps out to air and fluids. Hermetically sealed devices are generally welded or solder sealed rather than sealed with epoxy resin, etc.

No-Fire Current. Maximum current which can be applied to a bridgewire circuit without igniting the prime material.

One-Amp/One-Watt Device. An electro-explosive device (EED) which will not fire or change when one ampere and/or one watt is passed through the bridgewire circuit (usually for a five minute period).

Recommended Firing Current. The current which must be applied to a bridgewire circuit to operate of the device in a specified time.

Recommended Test Current. The maximum current that can be applied to a bridgewire circuit for a period of time without a change to the prime material.

Shunt. A shielding device used to protect an electro explosive device (EED) from accidental electrical ignition. A shunt device is a correctly sized threaded or press fit protection cap, which is assembled over the component's electrical contact(s). Two types are usually used:

1. A faraday shield is a conductive cap, usually threaded, which is put over the electro explosive device's ignition lead contacts.

2. A shunt plug made of conductive material, usually a press fit device, which completes a grounding circuit between contact pins and prevents any accidental flow of current through the EED's bridgewire circuit.

Squib. A small size pyrotechnic or explosive device. Specifically, a small explosive device similar in appearance to a detonator, but loaded with low explosive, so that its output is primarily heat (flash). Usually electrically started and used to initiate action of pyrotechnic devices and rocket igniters.

Total Life. The power device cartridge is a "lifed item" and Walter Kidde defines its useful life as "Total Life". Total Life starts on the day the cartridge is made and you must replace it at a specific time. Refer to Table 1, Specified Data for Total Life of a specific power device cartridge. Total life cannot be extended and includes any mix of time the power device cartridge is kept "on the shelf" **and/or** installed in a fire extinguisher.

Non-hermetic power device cartridges have the lowest Total Life. The Total Life can be decreased if it is kept for a long time at ambient temperatures in excess of 100°F (38°C). See Figure 3 for Temperature Exposure Limits graph.

NOTE: The graph is given to help you calculate the life limits of a non-hermetic power device cartridge that is exposed to high temperatures.

POWER DEVICE CARTRIDGES

Every possible example in which a power device cartridge is exposed to high temperatures cannot be discussed in this manual. Maintenance management must make decisions about the removal and replacement of power device cartridges that have been exposed to high temperatures. Maintenance management persons must carefully monitor the operating environment of the power device cartridges.

The following WARNINGS can be repeated throughout the manual.

WARNING: BEFORE YOU INSTALL OR REMOVE A POWER DEVICE CARTRIDGE MAKE SURE ALL ELECTRICAL CIRCUITS IN THE ACTUATING SYSTEM ARE OPEN.

WARNING: MAKE SURE YOU INSTALL A SHUNT DEVICE ON THE POWER DEVICE CARTRIDGE BEFORE YOU TOUCH IT. IF YOU TOUCH A POWER DEVICE CARTRIDGE THAT DOES NOT HAVE A SHUNT INSTALLED, IT CAN CAUSE BAD INJURIES TO YOU. DO NOT USE FOIL TO SHUNT THE PINS!

WARNING: DO NOT INSTALL A POWER DEVICE CARTRIDGE IN A VALVE BODY OR DISCHARGE HEAD UNTIL THE VALVE BODY, OR DISCHARGE HEAD IS ASSEMBLED TO THE CONTAINER. WHEN YOU INSTALL THE POWER DEVICE CARTRIDGE, THE CONTAINER MUST BE INSTALLED IN THE AIRCRAFT, OR AN APPLICABLE ANTI-RECOIL DEVICE MUST BE INSTALLED ON THE VALVE BODY OR DISCHARGE HEAD OUTLET.

1. DESCRIPTION AND OPERATION

A. Description

Cartridges, squibs or actuators are called power device cartridges in the pages that follow. Power device cartridges are explosive devices that are used to start a fire extinguisher. There are two general groups of power device cartridges; slug and shock wave devices.

The slug device (Figure 1A) fires a slug to break the closure (disc). Slug devices have a non-hermetic design and high temperatures can decrease their life. Slug type devices are usually used with non-hermetic fire extinguishers that have segmented closures (discs).

The shock wave device (Figure 1B) makes a shock wave to break the closure (disc). Shock wave type devices have a hermetic design and high temperatures do not decrease their life. Shock wave devices are used with hermetic fire extinguishers that have formed metal closures (discs).

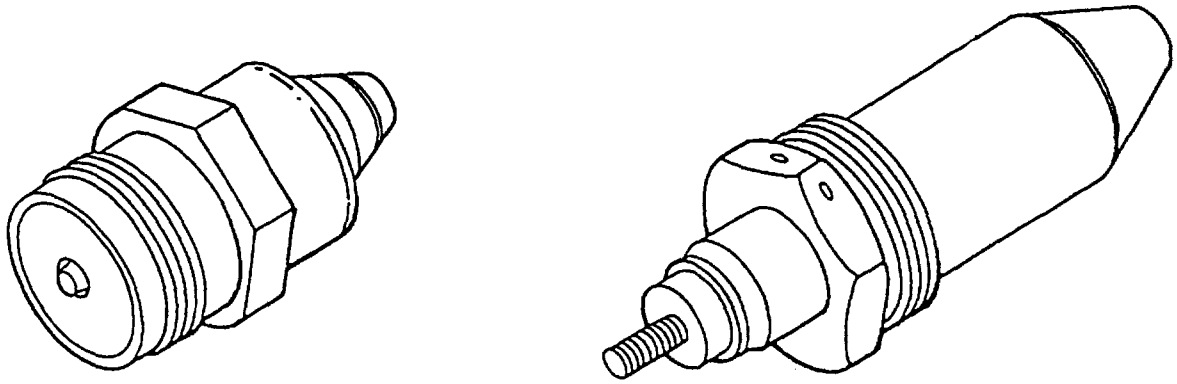
NOTE: Some non-hermetic fire extinguishers have formed metal discs.

B. Operation

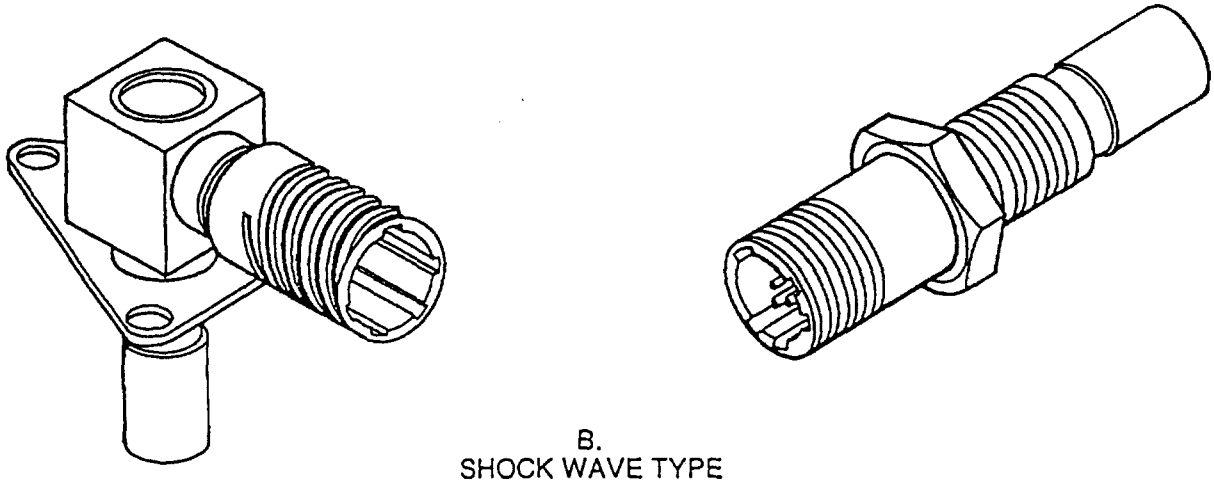
1. When the fire extinguisher circuit operates, an electric current goes through the power device cartridge makes the bridgewire hot and ignites the powder contained in the device. The ignition of the powder gives the energy to fire a slug through the frangible disc in the container, or to break the disc with the shock wave made by the explosion. This lets the extinguishing agent flow from the fire extinguisher, see Figure 2.

C. Refer to Table 1, Specified Data for the applicable data for a specified power device cartridge.

POWER DEVICE CARTRIDGES

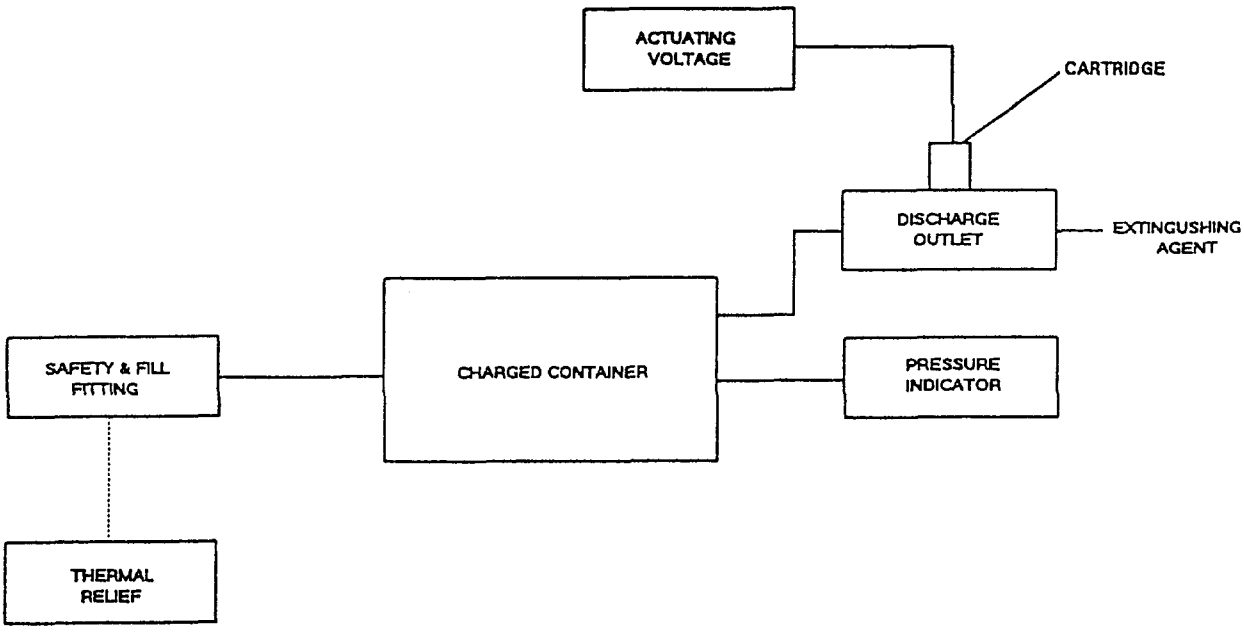


A.
SLUG TYPE



B.
SHOCK WAVE TYPE

Power Device Cartridges (Typical)
Figure 1



System Block Diagram (Typical)
Figure 2

POWER DEVICE CARTRIDGES

Table 1. Specified Data

Part No.	No Fire Each Bridgewire Circuit	Bridgewire Resistance, Ω	Mates w/Electrical Receptacle Connector	Minimum Recommended Firing Current Each Bridgewire Circuit	Elec. Schem (Fig)	Total Life (Yrs.)	Operating Temp. (°F)	Installation Torque (in. lbs)	Shunt/ Protection Cap Part No.
252066	1 amp, 1 watt	1.0 to 1.2	Bendix Pygmy PC06E-8-4S	5 amps min.	26	6	-65 to +160		
262299	1 amp, 1 watt, 5 min.	1.0 ± 0.1	MS2466R8T3SN	5 amps for 50 MS	8	10	-100 to +320	80-100	263193
262299-1	1 amp, 1 watt, 5 min.	1.0 ± 0.1	MS2466R8T3SN	5 amps for 50 MS	8	10	-100 to +320	80-100	263193
346070	1 amp, 1 watt, 5 min.	1.0 ± 0.1	MS27467(E or T)9F98SA	5 amps for 50 MS	6	10*	-100 to +320	90	324244
424030	1 amp, 1 watt, 5 min.	1.0 ± 0.1 (2.30 to 2.95 Assy Resistance)	D38999-26KA-98SN	5 amps	28	10	-65 to +200	80-100	324244
446032	1 amp, or 1 watt, 5 min.	1.0 ± 0.1	MS27467 (E or T) 9F98SA	5 amps for 50 MS	6	10*	-100 to +320	90	324244
446041	1 amp, 1 watt, 5 min.	1.0 ± 0.1	D38999-26KA-98SN	5 amps for 50 MS	6	10	-100 to +320	20-23 ft. lb	6971-0010
446046	1 amp, 1 watt, 5 min.	1.0 ± 0.1	Souriau 8526-6(N,W or H) 83ASN	5 amps for 50 MS	9	10	-100 to +320	80-100	6971-0008
446047	1 amp, 1 watt, 5 min.	1.0 ± 0.1	Souriau 8526-6(N,W or H) 83ASW	5 amps for 50 MS	9	10	-100 to +320	80-100	6971-0008
446090	1 amp, 1 watt, 5 min.	1.0 ± 0.1	MS24266R10T5S6 (BACC 45FS10-556)	5 amps for 50 MS	19	10	-100 to +320	90-100	324477
446090-1	1 amp, 1 watt, 5 min.	1.0 ± 0.1 (0.90 to 1.25 Assy Resistance)	BACC63BP12A3PNL	5 amps for 50 MS	7	10	-100 to +320	90-100	6971-0012
446138	1 amp, 1 watt, 5 min.	1.0 ± 0.1	D38999-26KA-98SN	5 amps for 50 MS	9	10	-100 to +320	80-100	6971-0010
446139	1 amp, 1 watt, 5 min.	1.0 ± 0.1	D38999-26KA-98SA	5 amps for 50 MS	9	10	-100 to +320	80-100	6971-0010
446158	1 amp, 1 watt, 5 min.	1.0 ± 0.1	Souriau 8533-4E08-03S8	5 amps for 50 MS	11	10	-100 to +320	80-100	263193
446161	1 amp, 1 watt, 5 min.	1.0 ± 0.1	M83723/95W8-3N or M83723/86R8-3N	5 amps for 50 MS	9	10	-100 to +320	80-100	263193
446189	1 amp, 1 watt, 5 min.	1.0 ± 0.1	MS24266R10B5S9	5 amps for 50 MS	30	10	-100 to +320	80-100	6971-0008
446201	1 amp, 1 watt, 5 min.	1.0 ± 0.1	Souriau 8533-4ES10-05S8	5 amps for 50 MS	20	10	-100 to +320	80-100	324477
446203	1 amp, 1 watt, 5 min.	1.0 ± 0.1	ASNE0441KE10-05SNA, Souriau 8533-4ES10-05SNL	5 amps for 50 MS	20	10	-100 to +320	80-100	324477
446282	1 amp, 1 watt, 5 min.	1.0 ± 0.1	JN1003FG0898SD	5 amps for 50 MS	12	10	-100 to +320	80-100	324089
446283	1 amp, 1 watt, 5 min.	1.0 ± 0.1	JN1003FG0898SA	5 amps for 50 MS	12	10	-100 to +320	80-100	324089
446290	1 amp, 1 watt, 5 min.	1.0 ± 0.1	MS27467-9-98SD	5 amps for 50 MS	9	10	-100 to +320	80-100	324244
446307	1 amp, 1 watt, 5 min.	1.0 ± 0.1	MS27467-9-98SA	5 amps for 50 MS	9	10	-100 to +320	80-100	324244
446384	1 amp, 1 watt, 5 min.	1.0 ± 0.1	MS83723/77W1020N	5 amps for 50 MS	31	10	-100 to +320	80-100	325054-1
446479	1 amp, 1 watt, 5 min.	1.0 ± 0.1	Harness Wired	5 amps for 4 MS	27	10	-100 to +320	80-100	-
446518-1	1 amp, 1 watt, 5 min.	1.0 ± 0.1	M83623/86S1005N	5 amps for 5 MS	36	10	-100 TO +320	80-100	324477
472001	2 amps max.	.04 to .09	Souriau 8525-16R-8-B-3A-SN	8 amps for 200 MS	13	6*	-65 to +160	150-200	324089
472001-01	1 amp, 1 watt, 5 min.	1.0 ± 0.1	Souriau 8525-16R-8-B-3A-SN	5 amps for 50 MS	13	10	-65 to +160	150-200	324089
841155	2 amps max.	.04 to .09	Contact Stud	8 amps for 200 MS	25	6*	-65 to +160	150-200	5104-5700
841155-1	1 amp, 1 watt 5 min.	1.0 ± 0.1	Contact Stud	5 amps for 50 MS	32	10	-65 to +160	150-200	5104-5700
872194-01	1 amp max.	.08 to .18	MS3106K-12S-3S	4 amps for 200 MS	16	6*	-65 to +160	150-200	5596-0012
872627	2 amps max.	.04 to .09	Terminal Lug	8 amps for 200 MS	23	6*	-65 to +160	150-200	244361
872627-01	1 amp, 1 watt, 5 min.	1.0 ± 0.1	Terminal Lug	5 amps for 50 MS	23	10	-65 to +160	150-200	244361
872627-02	1 amp, 1 watt, 5 min.	1.0 ± 0.1	Terminal Lug	5 amps for 50 MS	24	10	-65 to +160	150-200	244361
873364	2 amps max.	.04 to .09	Terminal Lug	8 amps for 200 MS	23	6*	-65 to +160	150-200	244361

*See Figure 3.
**@ 160°F (71°C)
†Service life in L-1011 aircraft is 5 years.

Table 1. Specified Data (Continued)

Part No.	No Fire Each Bridgewire Circuit	Bridgewire Resistance, Ω	Mates w/Electrical Receptacle Connector	Minimum Recommended Firing Current Each Bridgewire Circuit	Elec. Schem (Fig)	Total Life (Yrs.)	Operating Temp. (°F)	Installation Torque (in. lbs)	Shunt/ Protection Cap Part No.
873364-1	1 amp, 1 watt, 5 min.	1.0 ± 0.1	Terminal Lug	5 amps for 50 MS	24	10	-65 to +160	150-200	244361
873571	1 amp max.	.08 to .18	MS3106-10SL-4S	4 amps for 200 MS	16	6*	-65 to +160	150-200	5596-0010
873571-01	1 amp, 1 watt, 5 min.	1.0 ± 0.1	MS3106-10SL-4S	5 amps for 50 MS	16	10	-65 to +160	150-200	325344
874000	2 amps max.	.04 to .09	MS3106-10S-2S	8 amps for 200 MS	22	6*	-65 to +160	150-200	5596-0010
874000-01	1 amp, 1 watt, 5 min.	1.0 ± 0.1	MS3106-10S-2S	5 amps for 50 MS	33	10	-65 to +160	150-200	5596-0010
874103	2 amps max.	.04 to .09	MS3106K-12S-3S	8 amps for 200 MS	14	6*	-65 to +160	150-200	5596-0012
874310	2 amps max.	.04 to .09	Contact Stud	8 amps for 200 MS	25	4*	-65 to +160	150-200	5104-5700
876296	2 amps max.	.04 to .09	MS3106-10SL-4S	8 amps for 200 MS	16	6*	-65 to +160	150-200	5596-0010
876296-2	1 amp, 1 watt, 5 min.	1.0 ± 0.1	MS3106-10SL-4S	5 amps for 50 MS	15	10	-100 to +320	150-200	5596-0010
876299-02	2 amps max.	.08 to .18	Pyle-National FPK-1214-7S, MS24266G14T7SN, or MS83723-91R1407N	4 amps for 200 MS	18	6*†	-100 to +320	150-200	324088
876299-3	1 amp, 1 watt, 5 min.	1.0 ± 0.1	Pyle-National FPK-1214-7S, MS24266G14T7SN, or MS83723-91R1407N	5 amps for 50 MS	18	10	-100 to +320	150-200	324088
876561	2 amps max.	.04 to .09	Terminal Lug	8 amps for 200 MS	23	4*	-65 to +160	150-200	244361
876561-1	1 amp, 1 watt, 5 min.	1.0 ± 0.1	Terminal Lug	5 amps for 50 MS	24	10	-100 to +320	150-200	244361
876561-2	1 amp, 1 watt, 5 min.	1.0 ± 0.1	Terminal Lug	5 amps for 50 MS	24	10	-100 to +320	150-200	244361
877279	2 amp max.	.04 to .09	MS3106K-12S-3S	8 amps for 200 MS	14	6*	-65 to +160	150-200	5596-0012
877597	1 amp max.	.04 to .09	MS24266G14T7SN or Pyle-National FPK-1214-7S	4 amps for 200 MS	18	6*	-65 to +160	150-200	324088
877597-1	1 amp, 1 watt, 5 min.	1.0 ± 0.1	MS83723-91R1407N	5 amps for 50 MS	18	10	-100 to +320	150-200	324088
877723	2 amps max.	.04 to .09	MS3106-10SL-4S	8 amps for 200 MS	14	6*	-65 to +160	150-200	5596-0010
877744-01	1 amp max.	.08 to .18	Pyle-National FPK-1214-7S or MS24266G14T7SN	4 amps for 200 MS	18	6*	-100 to +320	150-200	324088
877744-2	1 amp, 1 watt, 5 min.	1.0 ± 0.1	Pyle-National FPK-1214-7S or MS24266G14T7SN	5 amps for 50 MS	18	10	-100 to +320	150-200	324088
877744-03	1 amp, 1 watt, 5 min.	1.0 ± 0.1	Pyle-National FPK-1214-7S or MS24266G14T7SN	5 amps for 50 MS	34	10	-100 to +320	150-200	324088
878269	2 amps max.	.04 to .09	Terminal Lug	8 amps for 200 MS	37	6*	-65 to +160	150-200	244361
878492	1 amp, 1 watt, 5 min.	1.0 ± 0.1	M83723/86W0803N	8 amps for 200 MS	8	10	-100 to +320	80-100	263193
878492-1	1 amp, 1 watt, 5 min.	1.0 ± 0.1	M83723/86W0803N	5 amps for 50 MS	8	10	-100 to +320	80-100	263193
878493	1 amp, 1 watt, 5 min.	1.0 ± 0.1	M83723/86W08036	8 amps for 200 MS	8	10	-100 to +320	80-100	263193
878493-1	1 amp, 1 watt, 5 min.	1.0 ± 0.1	M83723/86W08036	5 amps for 50 MS	8	10	-100 to +320	80-100	263193
878562	1 amp, 1 watt, 5 min.	1.0 ± 0.1	MS24266R14T7SN	5 amps for 50 MS	18	10	-100 to +320	80-100	324088
878562-1	1 amp, 1 watt, 5 min.	1.0 ± 0.1	MS24266R14T7SN	5 amps for 50 MS	18	10	-100 to +320	80-100	324088
878563	1 amp, 1 watt, 5 min.	1.0 ± 0.1	MS24266R14T7S7	5 amps for 50 MS	18	10	-100 to +320	80-100	324088
878563-1	1 amp, 1 watt, 5 min.	1.0 ± 0.1	MS24266R14T7S7	5 amps for 50 MS	18	10	-100 to +320	80-100	324088
893613	2 amps max.	.04 to .09	Terminal Lug	8 amps for 200 MS	23	4*	-65 to +160	80-100	244361
894846	2 amps max.	.04 to .09	Terminal Lug	8 amps for 200 MS	23	4*	-65 to +160	150-200	244361
894846-1	1 amp, 1 watt, 5 min.	1.0 ± 0.1	Terminal Lug	5 amps for 50 MS	24	10	-65 to +160	150-200	244361
895188	2 amps max.	.04 to .09	Contact Stud	8 amps for 200 MS	25	6*	-65 to +160	150-200	5104-5700
895188-1	1 amp, 1 watt, 5 min.	1.0 ± 0.1	Contact Stud	5 amps for 50 MS	32	10	-100 to +320	150-200	5104-5700

*See Figure 3.
**@ 160°F (71°C)
†Service life in L-1011 aircraft is 5 years.

Table 1. Specified Data (Continued)

Part No.	No Fire Each Bridgewire Circuit	Bridgewire Resistance, Ω	Mates w/Electrical Receptacle Connector	Minimum Recommended Firing Current Each Bridgewire Circuit	Elec. Schem (Fig)	Total Life (Yrs.)	Operating Temp. (°F)	Installation Torque (in. lbs)	Shunt/ Protection Cap Part No.
895189	1 amp max.	.08 to .18	MS3106K-12S-3S	4 amps for 200 MS	16	6*	-65 to +160	150-200	5596-0012
895408	2 amps max.	.04 to .09	Terminal Lug	8 amps for 200 MS	23	6*	-65 to +160	150-200	244361
895408-1	1 amp, 1 watt, 5 min.	1.0 ± 0.1	Terminal Lug	5 amps for 50 MS	24	10	-65 to +160	150-200	244361
895409	2 amps max.	.04 to .09	Terminal Lug	8 amps for 200 MS	23	6*	-65 to +160	150-200	256329
895409-1	1 amp, 1 watt, 5 min.	1.0 ± 0.1	Terminal Lug	5 amps for 50 MS	24	10	-65 to +160	150-200	244361
897776	2 amps max.	.08 to .18	MS3476L8-33S	8 amps for 200 MS	13	6*	-65 to +160	150-200	324089
897776-01	1 amp, 1 watt, 5 min.	1.0 ± 0.1	MS3476L8-33S	5 amps for 50 MS	13	10	-65 to +160	150-200	324089
897899	2 amps max.	.04 to .09	Terminal Lug	8 amps for 200 MS	23	6*	-65 to +160	150-200	244361
897899-1	1 amp, 1 watt, 5 min.	1.0 ± 0.1	Terminal Lug	5 amps for 50 MS	24	10	-65 to +160	150-200	244361
898558	2 amps max.	.08 to .18	MS3106R10SL-3S	8 amps for 200 MS	13	6*	-65 to +160	150-200	5596-0010
898558-01	1 amp, 1 watt, 5 min.	1.0 ± 0.1	MS3106R10SL-3S	5 amps for 50 MS	13	10	-65 to +160	150-200	325344
898760	1 amp max.	.08 to .18	Terminal Lug	4 amps for 200 MS	24	6*	-65 to +160	150-200	244361
898997	2 amps max.	.04 to .09	Terminal Lug	8 amps for 200 MS	23	6*	-65 to +160	150-200	244361
899855	2 amps max.	.04 to .09	Terminal Lug	8 amps for 200 MS	23	4*	-65 to +160	150-200	244361
899855-1	1 amp, 1 watt, 5 min.	1.0 ± 0.1	Terminal Lug	5 amps for 50 MS	23	10	-65 to +160	150-200	244361
A800545-1	0.5 amp	.58 to .61	#8 Terminal	1.5 amps min.	37	3**	-65 to +160		Gnd to Body
A800545-2	0.5 amp	.58 to .61	#10 Terminal	1.5 amps min.	37	3**	-65 to +160		Gnd to Body
A805300-2	1 amp, 1 watt, 5 min.	1.0 ± 0.1	MS24266R10T5S	3 amps for 200 MS	21	5	-65 to +200		Wrap in alum. foil
A805300-12	1 amp, 1 watt, 5 min.	1.0 ± 0.1	MS3106-10SL-4S	2 amps	16	10	-65 to +250	150-200	325344
A805300-41	1 amp, 1 watt, 5 min.	1.0 ± 0.1	Bendix PC06-8-2S	3.5 amps	17	10	-65 to +320	90-100	324101
A805300-43	0.25 amp	2.0 ± 0.2	MS24266R12B3S7	3 amps	29	10	-65 to +205	90-100	346023
A805300-44	0.25 amp	2.0 ± 0.2	MS24266R12B3SN	3 amps	29	10	-65 to +205	90-100	346023
A805300-45	0.25 amp	2.0 ± 0.2	MS24266R12B3SN	1.5 amps	29	10	-65 to +200		346023
A805300-46	0.25 amp	2.0 ± 0.2	MS24266R12B3S7	1.5 amps	29	10	-65 to +200		346023

*See Figure 3.
**@ 160°F (71°C)
†Service life in L-1011 aircraft is 5 years.

2. TESTING AND FAULT ISOLATION

A. Electrical Tests

1. Tests for resistance and "No-Fire" are done on the power device cartridges when they are made. Walter Kidde does not recommend regular tests of the bridgewire resistance.

2. Table 2 gives the test equipment necessary.

CAUTION: YOU MUST USE ELECTRICALLY EQUIVALENT ITEMS.

Table 2. Test Equipment

NOMENCLATURE	PART NUMBER/ SPECIFICATION	SOURCE
Multimeter	Fluke 75	Fluke Corp. (V89536)

WARNING: MAKE SURE YOU INSTALL A SHUNT DEVICE ON THE POWER DEVICE CARTRIDGE BEFORE YOU TOUCH IT. IF YOU TOUCH A POWER DEVICE CARTRIDGE THAT DOES NOT HAVE A SHUNT INSTALLED, IT CAN CAUSE BAD INJURIES TO YOU. DO NOT USE FOIL TO SHUNT THE PINS!

WARNING: MAKE SURE THE POWER DEVICE CARTRIDGE IS INSTALLED IN AN APPLICABLE TEST FIXTURE. MAKE SURE THE TEST AREA IS CORRECTLY BARRICADED TO PREVENT INJURY TO PERSONS. PERSONS MUST STAY AWAY FROM THE TEST FIXTURE DURING THE TEST.

WARNING: WHEN YOU DO A TEST OF A POWER DEVICE CARTRIDGE, USE A MULTIMETER THAT ELECTRICALLY LIMITS THE TEST CURRENT TO 0.040 AMPS MAXIMUM WITH THE SELECTOR SWITCH IN ALL POSITIONS. TOO MUCH AMPERAGE WILL FIRE THE CARTRIDGE AND CAUSE BAD INJURIES OR DEATH.

NOTE: When you do a test of the power device cartridge, do a test of each bridgewire circuit separately to the ground pin.

3. Install the power device cartridge in an applicable safety test fixture.

4. Connect a Fluke 75 multimeter, or the electrical equivalent, to applicable pins and check the circuit. Refer to Table 1, Specified Data for the applicable bridgewire resistance value and the applicable electrical schematic.

3. AUTOMATIC TEST REQUIREMENTS (ATLAS)

A. Not Applicable.

4. DISASSEMBLY/REMOVAL

A. Disassembly of the power device cartridge is not necessary.

B. Removal of a Used Power Device Cartridge from a Discharge Head

It can be necessary to use special procedures to remove a used power device cartridge from a discharge head. When the power device cartridge device fires, the design of the power device cartridge can make the part of the cartridge that is inside the discharge head body become larger and it is not possible to remove the power device cartridge from the discharge head with the usual procedure.

1. Loosen the power device cartridge to give sufficient clearance for a hacksaw blade.

CAUTION: WHEN YOU USE THE HACKSAW, USE PRECAUTION NOT TO DAMAGE THE SURFACE OF THE DISCHARGE HEAD.

2. Fully cut through the body of the power device cartridge at the point it comes out of the discharge head body.

3. Remove all unwanted material from the part of the power device cartridge that remains in the discharge head.

4. Turn the discharge head so you can see the part of the power device cartridge that is inside the discharge head.

5. Use pliers or a similar tool to hold the part of the power device cartridge inside the discharge head. Turn the power device cartridge counterclockwise until it comes out of the discharge head.

5. CLEANING

A. Not Applicable.

6. CHECK

A. General

1. Inspections are limited to visual checks only and electrical tests are limited to bridgewire continuity tests only. Do all inspections and electrical checks before you install the power device cartridge in the component. You must do electrical tests in an applicable safety fixture or safety chamber (proof booth).

B. Inspection

POWER DEVICE CARTRIDGES

WARNING: MAKE SURE YOU INSTALL A SHUNT DEVICE ON THE POWER DEVICE CARTRIDGE BEFORE YOU TOUCH IT. IF YOU TOUCH A POWER DEVICE CARTRIDGE THAT DOES NOT HAVE A SHUNT INSTALLED, IT CAN CAUSE BAD INJURIES TO YOU. DO NOT USE FOIL TO SHUNT THE PINS!

NOTE: Walter Kidde recommends that you keep the power device cartridge in the hermetic sealed envelope until you install it. If you do a test on a power device cartridge that is not installed, you must vacuum seal the envelope again, or install the power device cartridge immediately.

1. Examine the power device cartridge as follows:

   (a) Visually examine the case for cracks, dents, or distortions. Make damaged power device cartridges unserviceable as specified in Section 9.

   (b) Examine threaded surfaces for distortion or damage. Make power device cartridges with damaged or distorted threads unserviceable as specified in Section 9.

   (c) Examine crimped areas on the power device cartridge and make sure crimped parts do not move. Make power device cartridges with loose parts unserviceable as specified in Section 9.

   (d) The examples below give you the necessary data to find the date made the power device cartridge was made:

   The date the power device cartridge was made is etched, metal stamped or electroplated on the power device cartridge barrel or flats. Examples of typical power device cartridge date marks are given below.

   Some power device cartridges used in commercial applications can be marked as follows:

   61423 - 446283 A = shows the maker's CAGE code and part number. The letter "A" gives the revision of the drawing used to make the power device cartridge
   12/91 = shows the Month/Year the power device cartridge was made
   05350 = shows the Lot Number, 1st two digits, and Serial Number, last three digits. These are written on the hex flats.

   Some power device cartridges used in commercial applications can be marked as follows:

   61423 - 446283 F = gives the maker's CAGE code and part number. The letter "F" gives the revision of the drawing used to make the power device cartridge

1-89 2/89 = gives the Lot Number and Month/Year the power device cartridge was made. These are written on the hex flats.

Power device cartridges used in military applications are marked as follows:

61423 424030 = gives the maker's CAGE code and Part Number
WKD 91A001-001 = gives an abbreviation for the maker's company name "WKD = Walter Kidde", the year the cartridge was made "91", the month is shown by a letter "A", the Lot Interfix Number (001) and the Lot Number (001).

NOTE: Months are identified a letter; "A" for January, "B" for February, etc.

The power device cartridge has a limited life and must be removed from service in a specified period of time. Refer to Table 1, Specified Data for total life.

(e) Examine the solder contact for damage. Make power device cartridges with damaged solder contacts unserviceable as specified in Section 9.

(f) Examine terminal connector pins for deformed, damaged, or loose pins. Make power device cartridges with damaged, deformed or loose pins unserviceable as specified in Section 9.

7. REPAIR

A. Not Applicable.

8. ASSEMBLY

A. There are no assembly procedures applicable to power device cartridges.

B. Installation

WARNING: **DO NOT INSTALL A POWER DEVICE CARTRIDGE IN A VALVE BODY OR DISCHARGE HEAD UNTIL THE VALVE BODY OR DISCHARGE HEAD IS ASSEMBLED TO THE CONTAINER.THE CONTAINER MUST BE INSTALLED IN THE AIRCRAFT, OR AN APPLICABLE ANTI-RECOIL DEVICE MUST BE INSTALLED ON THE VALVE BODY OR DISCHARGE HEAD OUTLET.**

WARNING: **MAKE SURE YOU INSTALL A SHUNT DEVICE ON THE POWER DEVICE CARTRIDGE BEFORE YOU TOUCH IT. *IF YOU TOUCH A POWER DEVICE CARTRIDGE THAT* DOES NOT HAVE A SHUNT INSTALLED, IT CAN CAUSE BAD INJURIES TO YOU. DO NOT USE FOIL TO SHUNT THE PINS!**

WARNING: **BEFORE YOU INSTALL OR REMOVE A POWER DEVICE CARTRIDGE, MAKE SURE ALL ELECTRICAL CIRCUITS *IN THE ACTUATING SYSTEM ARE OPEN.***

1. Install power device cartridges as specified in the applicable aircraft maintenance manual.
2. Refer to Table 1, Specified Data for the applicable torque value.
3. You must not use force when you install a power device cartridge.

C. Keep, Move, and Touch Instructions

1. Keep Instructions

WARNING: **MAKE SURE YOU INSTALL A SHUNT DEVICE ON THE POWER DEVICE CARTRIDGE BEFORE YOU TOUCH IT. *IF YOU TOUCH A POWER DEVICE CARTRIDGE THAT* DOES NOT HAVE A SHUNT INSTALLED, IT CAN CAUSE BAD INJURIES TO YOU. DO NOT USE FOIL TO SHUNT THE PINS!**

(a) Use a shunt device to prevent accidental discharge of the power device cartridge because of stray static electrical charges that can occur.

(b) Keep the power device cartridges in their sealed envelopes or containers.

(c) Keep the power device cartridges at temperatures below 100°F (38°C). Temperatures less than 70°F (21°C) are recommended.

(d) Keep the power device cartridges in a dry location.

(e) Keep the power device cartridges away from possible fire hazards.

(f) Keep the power device cartridges as specified in local regulations for Class "C" explosives. Keep them in an area specified for explosives.

2. Touch Instructions

WARNING: MAKE SURE YOU INSTALL A SHUNT DEVICE ON THE POWER DEVICE CARTRIDGE BEFORE YOU TOUCH IT. IF YOU TOUCH A POWER DEVICE CARTRIDGE THAT DOES NOT HAVE A SHUNT INSTALLED, IT CAN CAUSE BAD INJURIES TO YOU. DO NOT USE FOIL TO SHUNT THE PINS!

(a) Power device cartridges are dangerous because they are explosive devices. Usually, you can touch a power device cartridge and it is not dangerous if you use care to prevent exposure to shock, high temperatures and stray electrical charges.

(b) You must not drop, or throw the power device cartridges.

(c) Touch the power device cartridges under usual, ambient temperatures, temperatures less than 70°F (21°C) are recommended. Do not touch power device cartridges that have been in very high temperatures.

3. Movement Instructions

WARNING: MAKE SURE YOU INSTALL A SHUNT DEVICE ON THE POWER DEVICE CARTRIDGE BEFORE YOU TOUCH IT. IF YOU TOUCH A POWER DEVICE CARTRIDGE THAT DOES NOT HAVE A SHUNT INSTALLED, IT CAN CAUSE BAD INJURIES TO YOU. DO NOT USE FOIL TO SHUNT THE PINS!

(a) If a shunt device is not installed on the power device cartridge, you must install a shunt device on it before you move it.

(b) Identify and move the power device cartridges as specified in Table 3, Identification and Movement Regulations.

(c) Keep the power device cartridges away from shock, high temperatures, and electrical charges.

(d) Do not drop, throw, or incorrectly touch the power device cartridges.

(e) Touch the power device cartridges in usual ambient temperatures; temperatures less than 70°F (21°C) are recommended.

Table 3. Identification and Movement Regulations

SHIPPING METHOD	APPLICABLE REGULATION(S)	
	U.S. DOMESTIC	INTERNATIONAL
Air	International Air Transport Association (IATA) Dangerous Goods Regulations	International Air Transport Association (IATA) Dangerous Goods Regulations and International Civil Aviation Organiza-tion (ICAO) Doc 9284-AN/905
Land	DOT 49 CFR 173, Subpart C	International Air Transport Association (IATA) Dangerous Goods Regulations and International Civil Aviation Organization (ICAO) Doc 9284-AN/905
Ocean	International Maritime Organization (IMO)	International Maritime Organization (IMO)

D. Calculation of Total Life for Non-Hermetic Power-Device-Cartridges

NOTE: The graph and calculation are not applicable to power device cartridges with a 10 year total life.

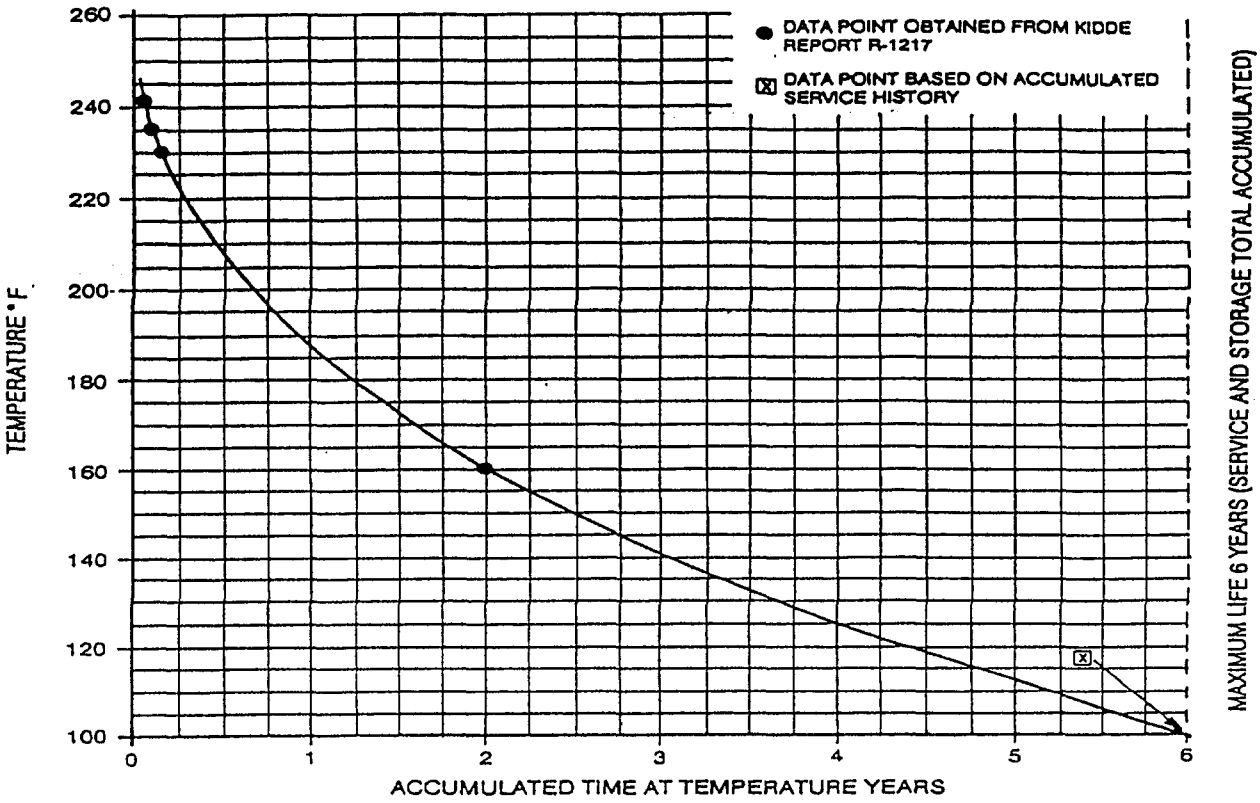
1. Non-hermetic power-device-cartridges are not sealed. If they stay for a long time in an area that has a high temperature, the total life can decrease and you must calculate the total life for the applicable temperature and operating hours. A high temperature is more than 100°F (38°C). Hermetic power-device-cartridges are sealed devices and high temperatures do not decrease their life.

2. If a non-hermetic power device cartridge operates at ambient temperatures less than 100°F (38°C), the total life of the power device cartridge life is 6 years, unless a shorter life is given in Table 1. Specified Data.

3. Figure 3 is a graph that has the data necessary to calculate the total life of a non-hermetic power device cartridge if the ambient temperature is more than 100°F (38°C). The vertical axis shows temperatures, in °F, and the horizontal axis shows the collected (accumulated) time at temperature years. The temperature curve on the graph shows the total life, in years, for power-device cartridges at given temperatures. To do a correct calculation of total life, you must also know the operating hours each year for the power device cartridge.

NOTE: Maintenance persons must make an estimate of the maximum ambient temperature and the operating hours for a specific power device cartridge.

4. If the collected time for a power device cartridge at the ambient temperature is more than 100°F (38°C), you must do the calculation to find the total life for the power device cartridge. The result is the calculated service life, in years.



Temperature Exposure Limits for Power Device Cartridges
Figure 3

When you know the calculated service life, you must compare it to the total life specified in Table 1, Specified Data. Two examples to calculate the life for power device cartridges are given below.

(a) Maintenance persons made an estimate that aircraft "A" has a maximum ambient temperature of 140°F (60°C) collected at a rate of 3,000 operating hours a year. Calculate the total life as follows:

1 *Find 140°F on the vertical axis of the graph.*

2 Read across the graph until the line for 140°F goes through the temperature curve.

3 Read the time in years shown on the horizontal axis of the graph below the point where the line for 140°F goes through the temperature curve.

4 *At 140°F (60°C), the graph shows that the collected life of the power* device cartridge is 3 years. Write this number.

5 Multiply the number of days in a year (365) by the number of hours in a day (24); then multiply the result by the number of years you wrote in step 4. The result shown below is the total operating hours.

365 x 24 x 1.27 = 11,125 total operating hours

6 Divide the total operating hours you got in step 5 by the number of hours the power device cartridge operates each year (3000). The result is the calculated service life, in years. Do the calculation as follows:

$$\frac{26280}{3000} = 8.76$$

7 This example shows that the calculated service life for this power device cartridge is 8.76 years. Compare the calculated total life to the total life specified in Table 1. If the calculated life is **more** than the total life specified in Table 1, you must use the total life given in the table; therefore, for this example, the maximum total life of this power device cartridge is 6 years.

(b) Maintenance persons made an estimate that aircraft "B" has a maximum ambient temperature 180°F (82°C) collected at a rate of 3,000 operating hours a year. Calculate the service life as follows:

1 Find 180°F on the vertical axis of the graph.

2 Read across the graph until the line for 180°F goes through the temperature curve.

3 Read the time in years shown on the horizontal axis of the graph below the point where the line for 180°F goes through th temperature curve.

4 At 180°F (82°C), the graph shows that the collected life life of the power device cartridge is 1.27 years. Write this number.

5 Multiply the number of days in a year (365) by the number of hours in a day (24); then multiply the result by the number of years you wrote in step 4. The result shown below is the total operating hours.

365 x 24 x 1.27 = 11,125 total operating hours

6 Divide the total operating hours you got in step 5 by the number of hours the power device cartridge operates each year (3000). The result is the calculated service life, in years. Do the calculation as follows:

$$\frac{11125}{3000} = 3.71$$

7 This example shows that the calculated service life for this power device cartridge is 3.71 years. Compare the calculated total life to the total life specified in Table 1. If the calculated life is less than the total life specified in Table 1, you must use the total life you calculated; therefore, for this example, the maximum total life of this power device cartridge is 3.71 years.

NOTE: The maximum life includes the time you keep the power device cartridge "on the shelf".

9. DISCARD

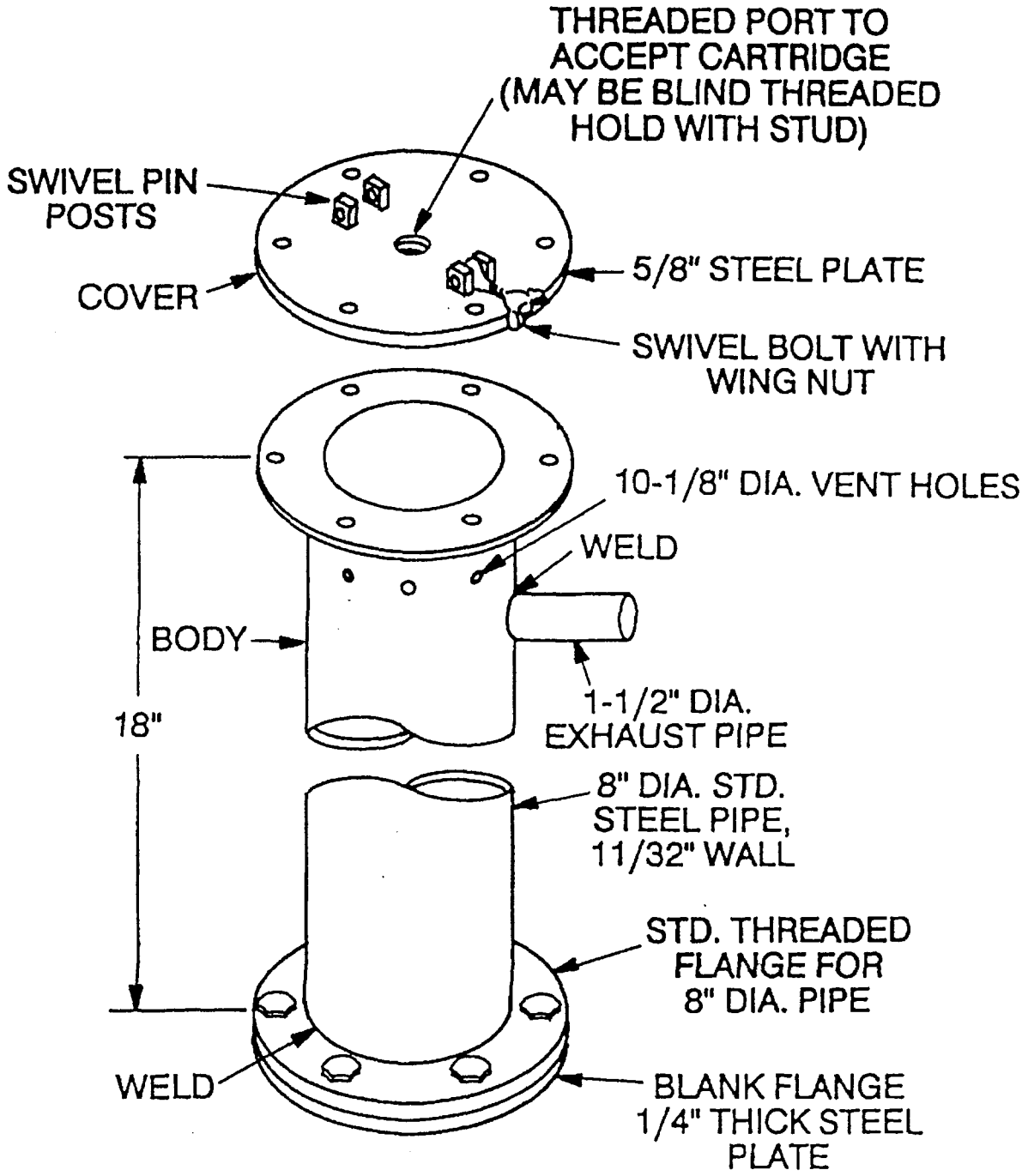
Make defective or old power device cartridges unserviceable before you discard them. If you discard a power device cartridge incorrectly, it can cause hazards to persons and the environment. Walter Kidde recommends that you use a disposal fixture to make the power device cartridge unserviceable.

A. Make the fixture as follows:

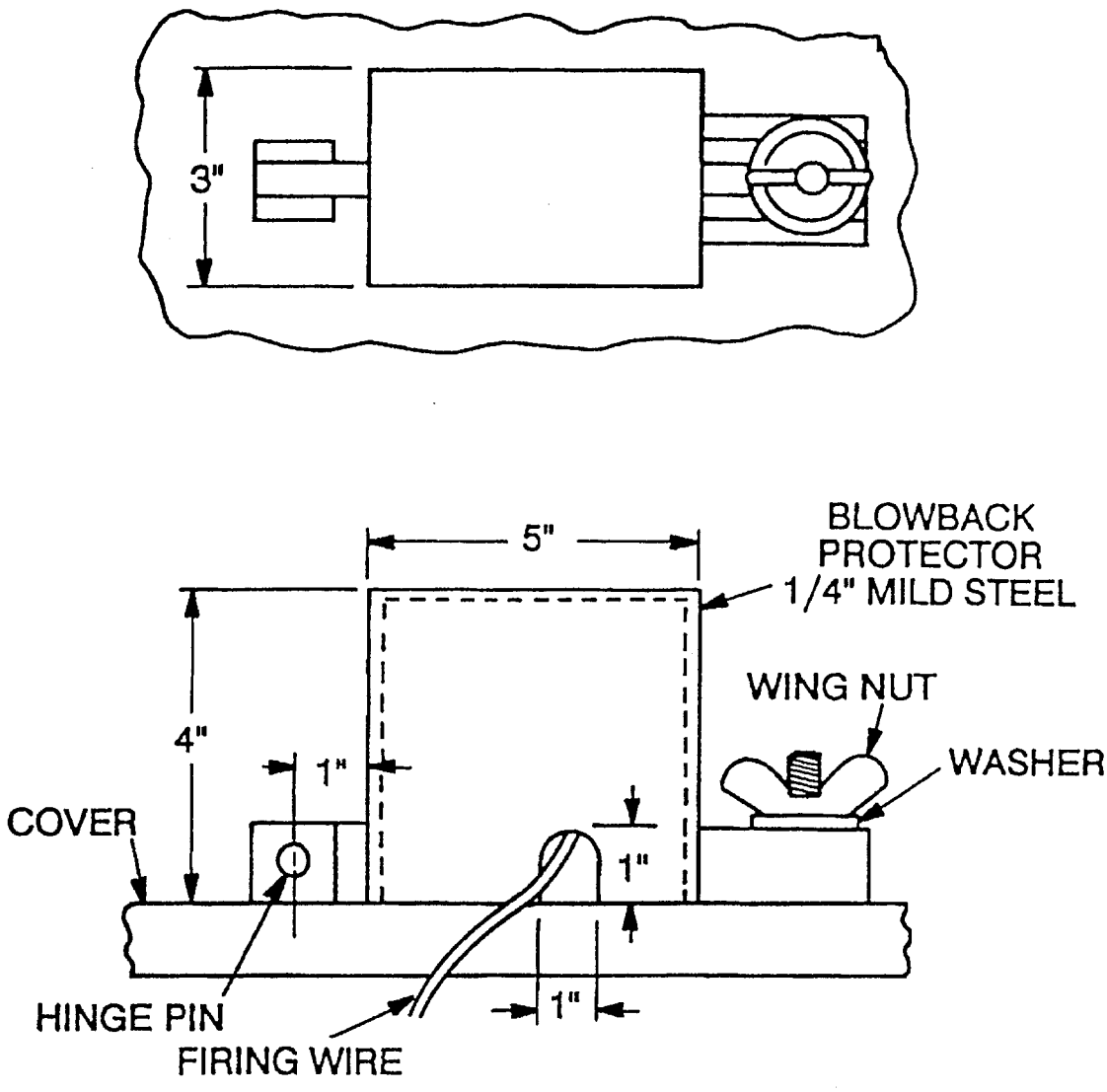
1. Use the dimensions and materials shown in Figure 4 to make the fixture.
2. Connect a blower (Transvector air flow amplifier) or equivalent to the exhaust pipe.
3. Make the outlet of the blower open to the air.
4. Connect the vacuum line to the exhaust pipe on the fixture.

B. Preparation

1. Loosen and remove the screws, nuts, and washers that hold the cover on the fixture.
2. Remove the cover from the fixture.
3. Fill the fixture with approximately six inches (15 cm) of moist sand. The moist sand will keep the amount of dust caused when you operate the fixture to a minimum.
4. Loosen and remove the wing nut on the blowback protector.
5. Open the blowback protector.



Cartridge Disposal Fixture
Figure 4 (Sheet 1 of 2)



Cartridge Disposal Fixture
Figure 4 (Sheet 2)

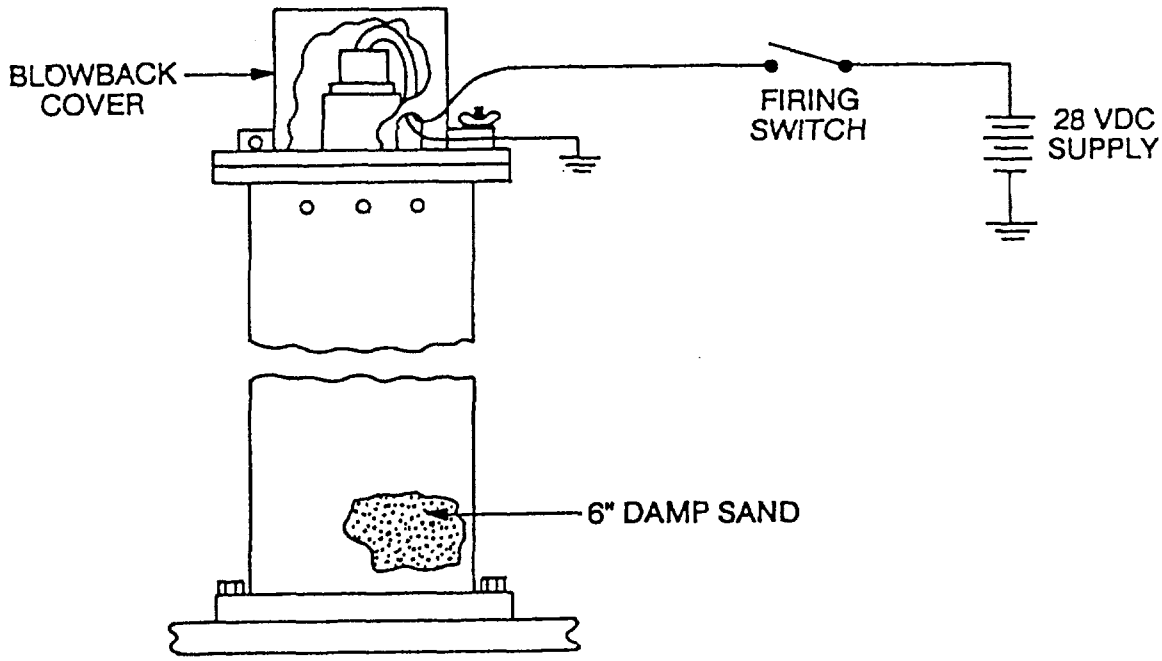
WARNING: **MAKE SURE YOU INSTALL A SHUNT DEVICE ON THE POWER DEVICE CARTRIDGE BEFORE YOU TOUCH IT. IF YOU TOUCH A POWER DEVICE CARTRIDGE THAT DOES NOT HAVE A SHUNT INSTALLED, IT CAN CAUSE BAD INJURIES TO YOU. DO NOT USE FOIL TO SHUNT THE PINS!**

6. Install the power device cartridge in the cover.

WARNING: **MAKE SURE THE FIRING CIRCUIT SWITCH IS OPEN (OFF) BEFORE YOU CONNECT THE POWER DEVICE CARTRIDGE TO THE FIRING CIRCUIT.**

7. With the firing circuit switch in the open (Off) position, remove the shunt plug.

8. Connect the power device cartridge to the firing circuit (Figure 5).



Firing Circuit Hookup
Figure 5

9. Close the blowback protector and install the wing nut.

10. Install the cover on the fixture body and install the screws, nuts, and washers to hold the cover on the fixture.

WARNING: VAPORS CAN CAUSE INJURY TO PERSONS. MAKE SURE ALL GASES ARE SUFFICIENTLY BLED TO THE AIR.

WARNING: THE EXPLOSIVE DEVICE GIVES OUT SUBSTANTIAL ENERGY WHEN IT OPERATES. MAKE SURE THE FIXTURE IS INSTALLED BEHIND AN APPLICABLE BARRICADE AND ALL PERSONS STAY AWAY FROM THE FIXTURE.

WARNING: PERSONS WHO DISCARD THE EXPLOSIVE DEVICES MUST KNOW THE SAFETY PROCEDURES FOR THE MOVEMENT OF EXPLOSIVE DEVICES.

C. Procedure

1. Start the vacuum system.

2. Close the firing switch. You can hear the power device cartridge operate. A power device that does not operate is defective. Incinerate any defective power device cartridges as specified in Paragraph D.

3. Open the firing circuit switch.

WARNING: IF THE POWER DEVICE CARTRIDGE DOES NOT OPERATE, IT IS DANGEROUS AND YOU MUST INSTALL A SHUNT BEFORE YOU REMOVE IT OR MOVE IT.

CAUTION: THE FIXTURE CAN KEEP THE HEAT MADE BY THE EXPLOSION. MAKE SURE YOU WEAR CORRECT HAND PROTECTION WHEN YOU TOUCH THE FIXTURE.

4. Remove the power device cartridge from the fixture.

5. Loosen the wing nut and open the blowback protector.

6. Disconnect the electrical connector.

WARNING: IF THE POWER DEVICE CARTRIDGE DID NOT OPERATE, IT IS DANGEROUS AND YOU MUST INSTALL A SHUNT BEFORE YOU REMOVE IT OR MOVE IT.

7. If the power device cartridge did not operate, install a shunt cap you before you remove it from the fixture.

8. Incinerate the power device cartridge as specified in paragraph D.

9. If power device cartridge operated, remove the it from the fixture and discard as scrap metal.

   NOTE: Regular removal of unwanted material from the sand in the fixture is necessary.

D. Incineration

1. Incinerate any power device cartridge that fails to fire electrically in an enclosed device that will prevent injury to persons.

2. The minimum temperature necessary to incinerate the power device cartridge is 700°F (371°C). Heat the power device cartridge for a minimum of one (1) minute, or until you hear the power device cartridge fire.

3. Incinerate the power device as follows:

WARNING: MAKE SURE YOU INSTALL A SHUNT DEVICE ON THE POWER DEVICE CARTRIDGE BEFORE YOU TOUCH IT. IF YOU TOUCH A POWER DEVICE CARTRIDGE THAT DOES NOT HAVE A SHUNT INSTALLED, IT CAN CAUSE BAD INJURIES TO YOU. DO NOT USE FOIL TO SHUNT THE PINS!

(a) Put the power device cartridge, with the shunt installed, in the incinerator.

(b) Ignite the incinerator and take shelter behind a protective barrier until power device cartridge fires.

(c) Shutdown the incinerator and let it become cool.

CAUTION: THE FIXTURE AND CASING KEEP HEAT MADE BY THE INCINERATION AND EXPLOSION. WEAR CORRECT HAND PROTECTION WHEN YOU TOUCH THE CASING.

(d) Remove and discard the casing.

10. FITS AND CLEARANCES

A. Not Applicable.

11. SPECIAL TOOLS, FIXTURES AND EQUIPMENT

Table 4. Special Tools, Fixtures and Equipment

NOMENCLATURE	PART NUMBER/ SPECIFICATION	SOURCE/CAGE CODE
Digital Multimeter	Fluke 75	Fluke Corp./89536
Disposal Fixture		User made from Figures 4 and 5
Transvector	Model 902, 912, or 952	Vortec Corp./51313

12. ILLUSTRATED PARTS LIST

A. Not Applicable.

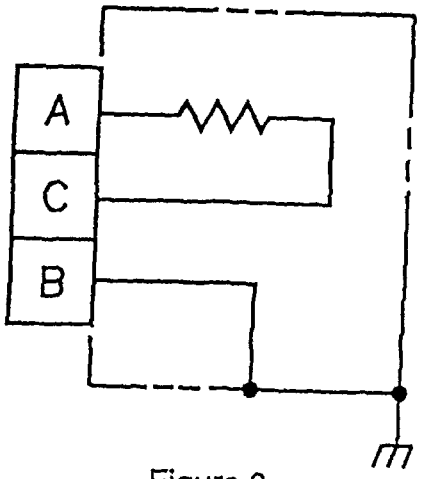


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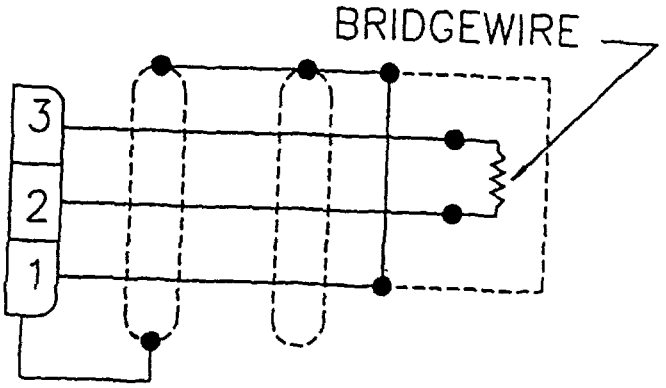


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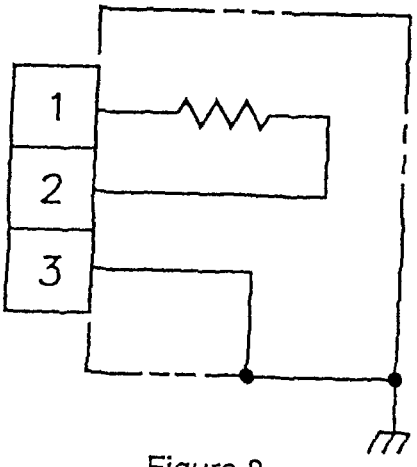


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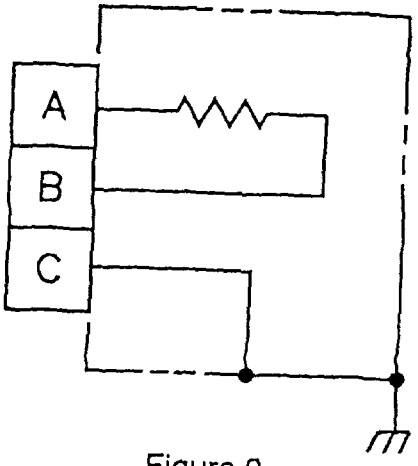


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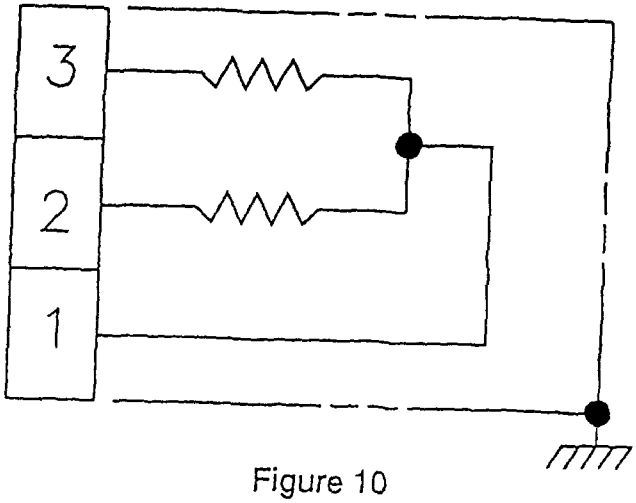


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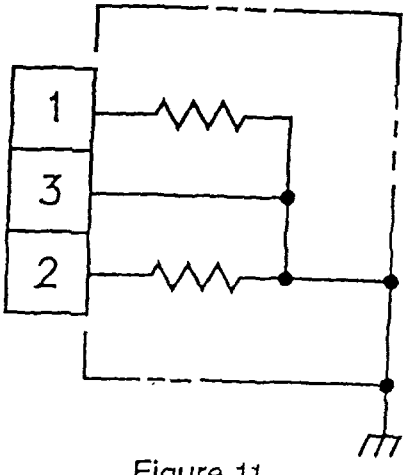


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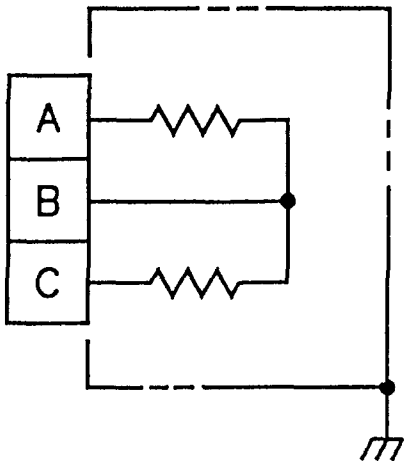


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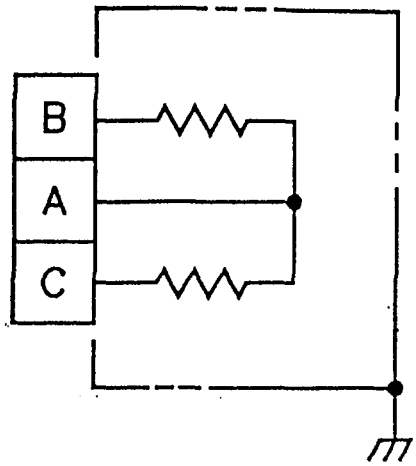


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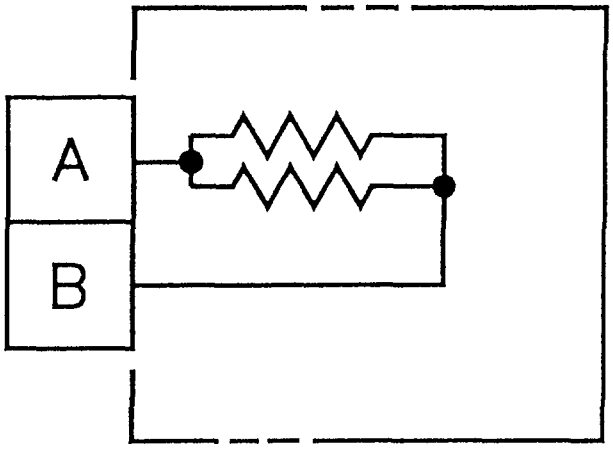


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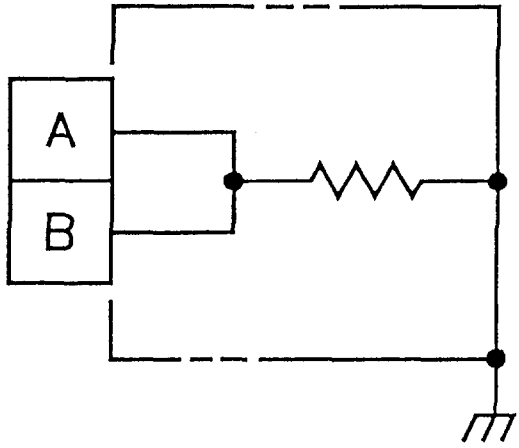


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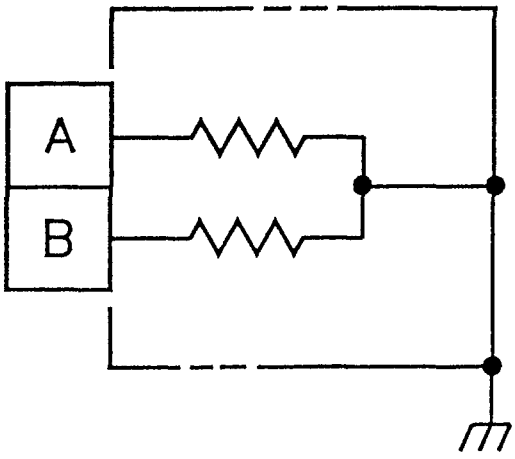


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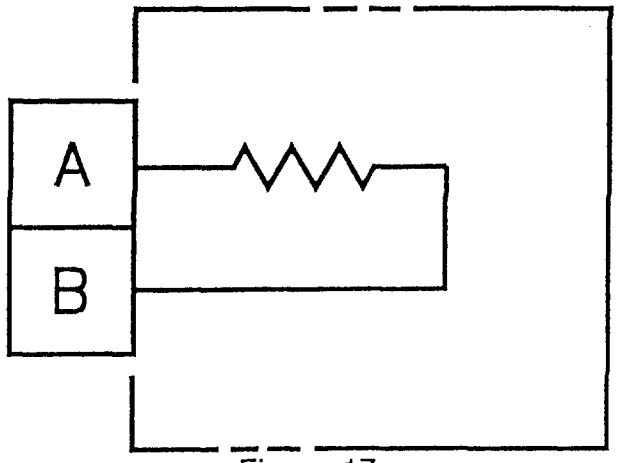


Figure 17

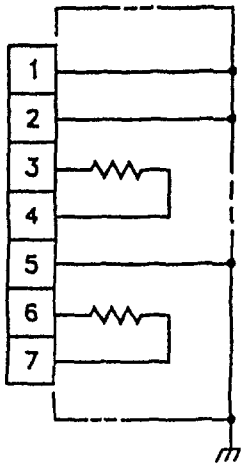


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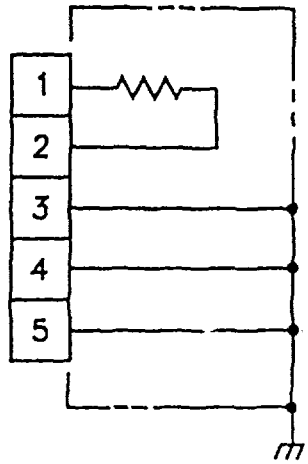


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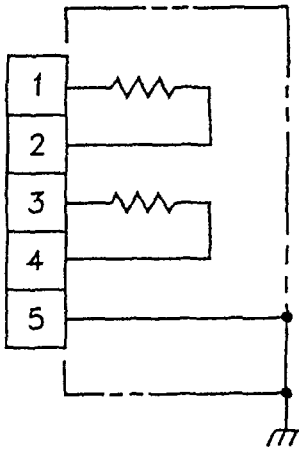


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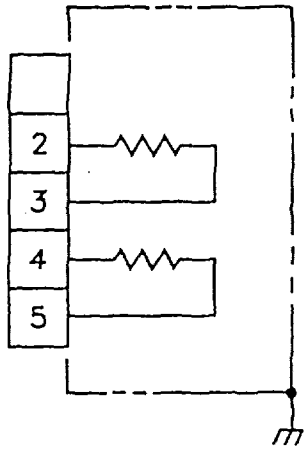


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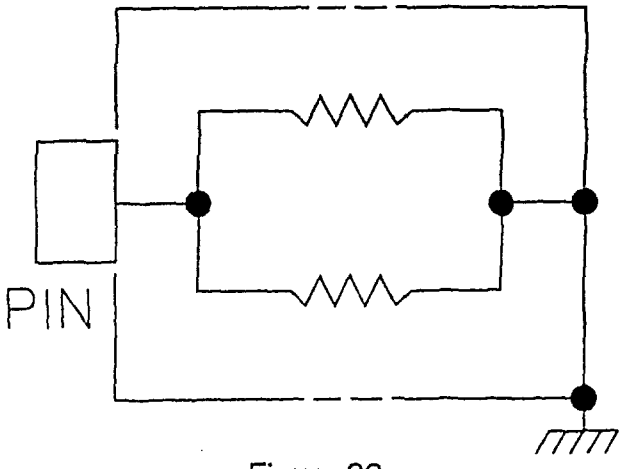


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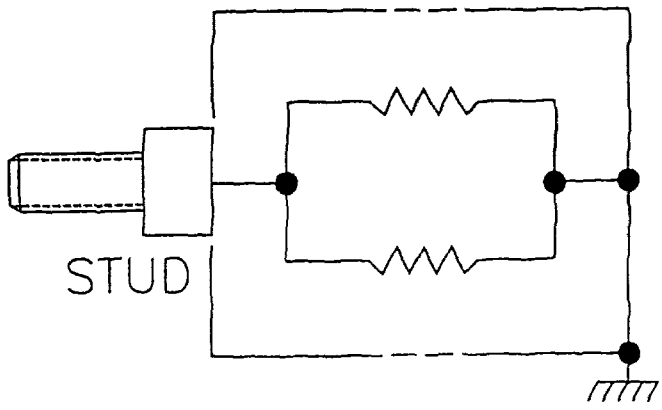


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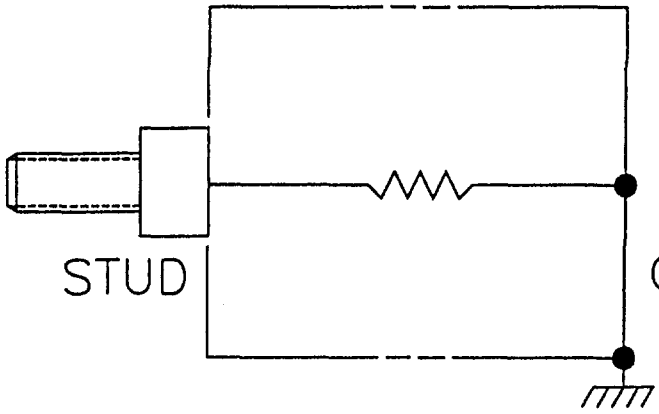


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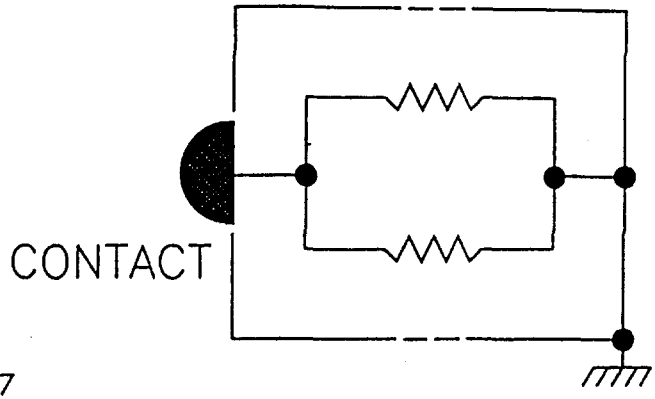


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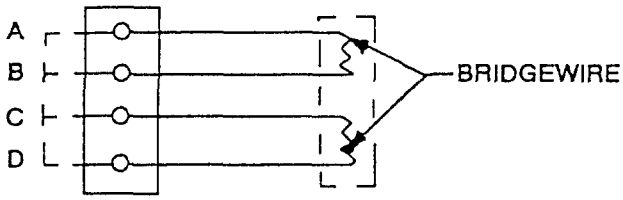


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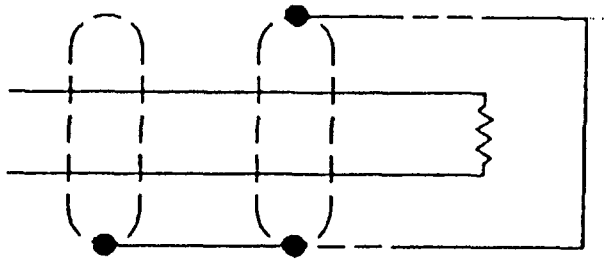


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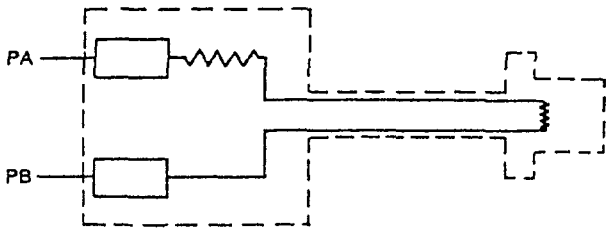


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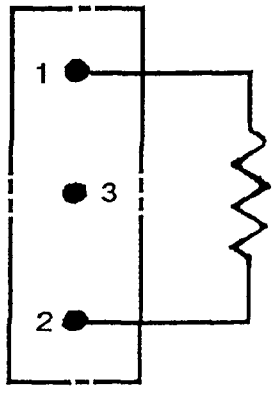


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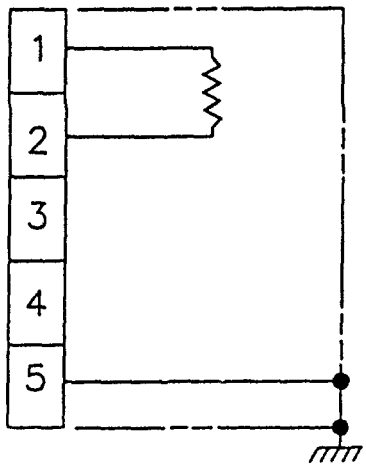


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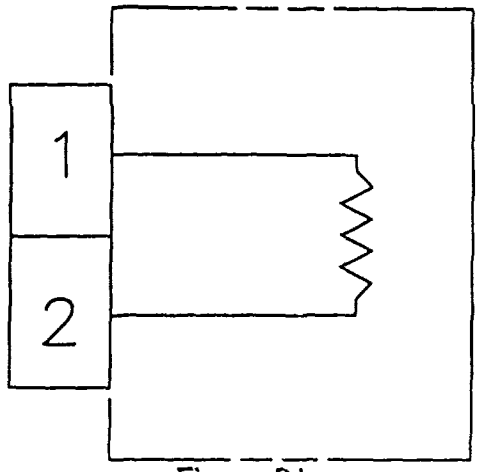


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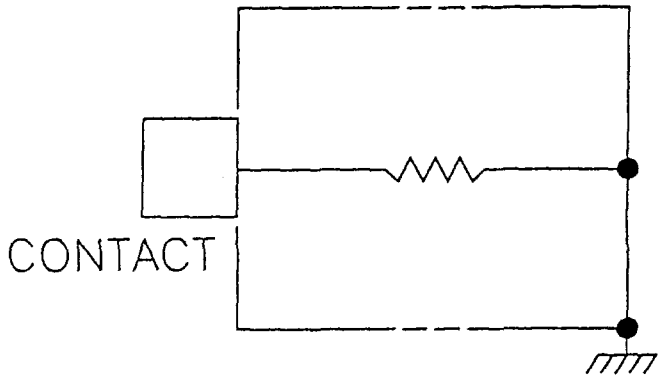


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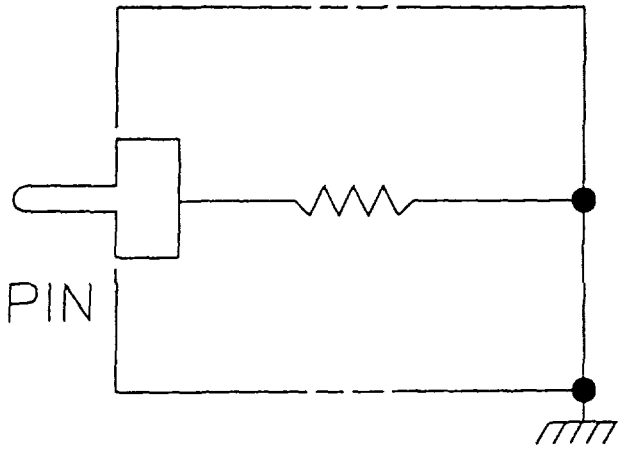


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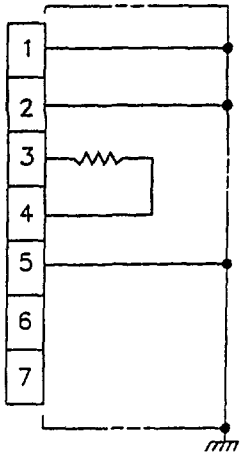


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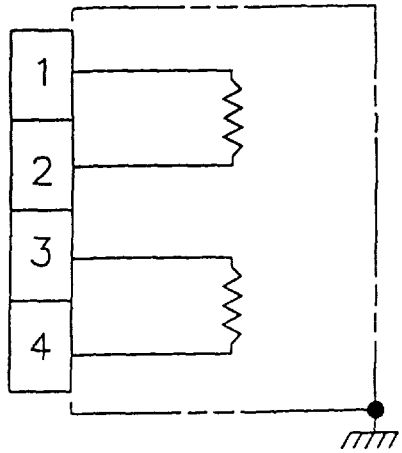


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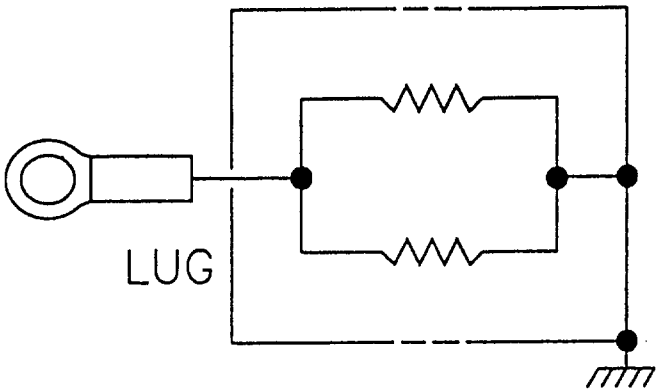


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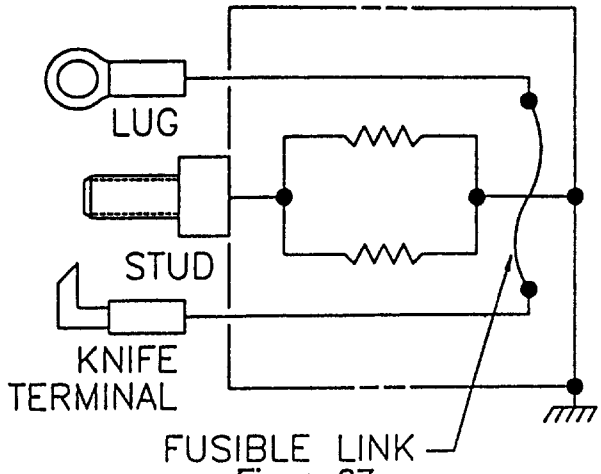


Figure 37

CHAPTER

27

FLIGHT CONTROLS

TABLE OF CONTENTS

MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B./T.R.
Eldec	Secondary Calibration Kit	1–899–15–CP	DOC NO. 750222		SIL 27–02
	Solid State Proximity Switch PC	8–060–02, –07 & –10	27–09–01	Jun 30/1991	
Plessey	Electro–Mechanical Linear Actuator	L10–20		Jul 20/1977	
DHC	Flap/Elevator Interconnect Ball Screw Jack	C6CF1080	27–36–11	Dec 14/1981	
	Geared Tab Gearing Mechanism	C6CF1174 & C6CF1174–3	27–26–11	Dec 17/2001	
	Screw Jack Assy	C6CT1010	27–09–01	Dec 1/1986	
	Trim Control	C6CF1053	27–23–11	Jul 1/1970	
	Wing Flap Actuator	C6HF1020	27–50–11	Dec 21/1979	
Syncro Devices	Flap Selector Valve	SKA104	27–50–1	Apr 1/1981	
Weston	Aileron Trim Indicator (Microammeter)	253607 (C6SC1038–1)	DOC NO. F–3543	1968	

NOTE: Please see the TEMPORARY REVISION that revises this page

BOMBARDIER – Temporary Revision

PSM NO. 1–6–6A AIRCRAFT DHC–6 Twin Otter SERIES ALL

PUBLICATION COMPONENT MAINTENANCE MANUAL TEMPORARY REVISION NO. 27–1

Insert in 27 – CONTENTS, facing page 1

CHAPTER 27 – FLIGHT CONTROLS

REASON FOR ISSUE:

This Temporary Revision adds TR 27–2 and TR 27–3 to Table of Contents.

ACTION:

Ignore existing page 1 and substitute revised page as shown on this Temporary Revision.

TABLE OF CONTENTS

MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B/T.R.
Eldec	Secondary Calibration Kit	1–899–15–CP	DOC NO. 750222		SIL 27–02
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	Geared Tab Gearing Mechanism	C6CF1174 & C6CF11 74–3	27–26–11	Dec 17/2001	TR 27–2 dated TBD
	Screw Jack Assy	C6CT1010	27–09–01	Dec 1/1986	
	Trim Control	C6CF1053	27–23–11	Jul 1/1970	
	Wing Flap Actuator	C6HF1020	27–50–11	Dec 21/1979	
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RECORDING INSTRUCTIONS:

Record this Temporary Revision No. and the relevant information in the appropriate columns of the TEMPORARY REVISION INDEX provided at the front of the manual.

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ELDEC Corporation
® Lynnwood, Washington

SOLID STATE PROXIMITY SWITCH PC ASSEMBLY

PART NO. 8-060-02
8-060-07
8-060-10

OVERHAUL MANUAL

WITH

ILLUSTRATED PARTS LIST

DOCUMENT NO. 700606

ELDEC Corporation
Lynnwood, Washington

OVERHAUL MANUAL WITH IPL
PART NUMBER 8-060

LIST OF EFFECTIVE PAGES

PAGE	DATE
Title Page	Jun 30/91
List of Effective Pages	Jun 30/91
Record of Revisions	Jun 30/91
Record of Temporary Revisions	Mar 30/75
Service Bulletin List	Mar 30/75
Policy Statement	Mar 30/75
Table of Contents	Mar 30/75
1	Mar 30/75
2	Mar 30/75
3	Nov 18/82
4	Blank
101	Mar 30/75
102	Blank
201	Mar 30/75
202	Blank
301	Mar 30/75
302	Blank
401	Nov 30/76
402	Nov 30/76
501	Apr 15/86
502	Aug 15/82
503	Apr 15/86
504	Apr 15/86
601	Mar 30/75
602	Blank
701	Apr 15/86
702	Aug 15/82
801	Nov 30/76
802	Aug 15/82
803	Nov 30/76
804	Jun 30/91
805	Jun 30/91
806	Blank
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1104	Jun 30/91
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1109	Jun 30/91
1110	Jun 30/91
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1112	Blank
1113	Jun 30/91
1114	Blank

ELDEC Corporation
Lynnwood, Washington

OVERHAUL MANUAL WITH IPL
PART NUMBER 8-060

RECORD OF REVISIONS

REV NO.	ISSUE DATE	INSERT DATE	BY	REV NO.	ISSUE DATE	INSERT DATE	BY	REV NO.	ISSUE DATE	INSERT DATE	BY
1	2-1-73	1-23-73	ELD								
2	3-30-75	3-30-75	ELD								
3	11-30-76	6-30-80	ELD								
4	8-15-82										
5	11-18-82										
6	4-15-86										
7	8-1-90										
8	9-15-90										
9	6-30-91	8/21/02	ATP								

Record of Temporary Revisions

TEMPORARY REV. NO.	PAGE NUMBER	ISSUE DATE	BY	DATE REMOVED	BY

PART NUMBER 8-060

SERVICE BULLETIN LIST

Service Bulletin Number	Revision Number	Date Bulletin Incorporated into Manual

POLICY STATEMENT

1. This manual has been prepared to the requirements of ATA Specification 100.

2. The Overhaul Instructions contained in this manual provide descriptive information, specific procedures, and data pertaining to work done on the units identified on the title page. These instructions pertain to the units after they have been removed from the airplane. The manual has been prepared for the experienced shop mechanic who normally performs shop work and not for the aircraft service mechanic who normally works on units while installed in the aircraft.

3. These instructions are not intended to cover all details and variations in equipment nor is it possible to cover every situation which may arise during overhaul. For further specific information or in case a particular problem cannot be solved using these instructions, contact the Product Support Manager, ELDEC Corp., Lynnwood, Washington, 98036.

ELDEC CORPORATION
LYNNWOOD, WASHINGTON

OVERHAUL MANUAL WITH IPL

PART NUMBER 8-060

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Cleaning	201
Check	301
Repair	401
Assembly	501
Fits and Clearances	601
Testing	701
Trouble Shooting	801
Storage Instructions	901
Special Tools, Fixtures and Equipment	1001
Illustrated Parts List	1101

DESCRIPTION AND OPERATION

1. Description

A. The ELDEC Proximity Switch PC Assembly, Part No. 8-060, is an all solid-state switch which works together with an ELDEC Proximity Sensor to detect the presence or absence of metal structure. ELDEC switches operate either normally open or normally closed (selected by jumpers at the switch card connector). Switch outputs can be connected in parallel for a logic OR function. Up to 6 switches may be connected in series for a logic AND function.

B. IPL Figure 1 illustrates this element of the basic system. The sensor (located remotely) appears as an inductance to the switch card. The switch card senses a change of inductance, caused by the proximity of a metal target. The switch card then completes (or, in the case of a normally closed switch, interrupts) the circuit to an external load. Table 1 lists specific test actuation distances and sensors that are applicable to switch card configurations.

C. For a given card and sensor system (8-060 used with a 1-899-15 sensor) any 8-060-02, -07, or -10 will operate with any -15 sensor. A particular pair (8-060 and 1-899-15) has a specific actuation point, but the actuation point of any pair will fall within the test limits specified in Table 1. Differential travel distances are given in Table 1. Differential travel is defined as the distance moved by the actuator away from the actuation point which results in deactuation.

D. The proximity switch is designed so that open or shorted sensor leads inhibit switch actuation, regardless of target position. Loss of power causes the switch output to fail, resulting in an open circuit to the load.

E. Power input 28 Vdc per MIL-STD-704A, Category C. Maximum power input at 28 Vdc: 1.8 watts, actuated; 1.4 watts deactuated.

NOTE: Part No. 8-060-02, -07, and -10 are the same except for different values of R26, R15, and R19. Refer to IPL Figure 1 and the schematic diagram.

2. Operation

A schematic diagram of the 8-060-02 proximity switch, divided into sections, is shown in Figure 802. Refer to the schematic diagram in conjunction with the following discussion.

A. Voltage Regulator. The voltage regulator provides stable voltage, free of large transient variations, to the remaining switch circuitry. Diodes CR1 and CR2 provide regulator input protection. CR1 protects against reverse voltage connection, and Zener CR2 provides high-voltage transient protection. CR3 and CR4 provide base voltages for emitter follower Q1, the series pass transistor. Q1 output voltage is approximately 18 volts, measured across C1. Diode CR4 also provides the common mode voltage required by the operational amplifiers. The combination of L1 and C1 prevents large current spikes from the oscillator circuit being impressed on the DC line.

B. Power Oscillator (1100 Hz). Sensor excitation is provided by a power oscillator including A1, Q3, Q4, T2 and associated components. Amplifier A1 is connected as an astable multivibrator and drives emitter followers Q3 and Q4. The emitters of Q3 and Q4 show an 1100 Hz square wave swinging between ground and the regulated voltage. Capacitor C4 provides dc isolation. Transformer T2 steps the voltage up to the level required for bridge excitation.

C. Bridge Circuit. The internal portion of the bridge circuit includes resistive arm R8, R9, R10, and capacitive arm R7, C3. The other two arms of the bridge (one inductive and one resistive) are located remotely in the sensor. The red and blue sensor leads are also connected to the primary side of transformer T1. Any bridge circuit unbalance is reflected as a change in voltage between the red and blue leads.

D. Synchronous Demodulator. T1 acts as a balanced input to the synchronous demodulator. The balanced input greatly increases common-mode rejection of unwanted signals on the sensor lines. The demodulator (Q5, C7, and R13) samples bridge unbalance every half cycle of sensor excitation. The drive signal for the demodulator is provided by C5 and R12. The bridge output signal charges capacitor C7 every half cycle. C7 is charged and discharged randomly by any non-synchronous noise. CR9 provides reverse voltage protection for C7. The voltage level developed across C7 is applied to the comparator circuit. Demodulator transistor Q5 is a junction FET acting as a switch.

E. Comparator. Amplifier A2 acts as a high-gain feedback amplifier with its bias point set by biasing resistors R17 and R18 and feedback resistor R19. Exceeding the threshold voltage causes the amplifier output (Pin 6) to change state. The comparator output is in the low state when the sensor target is at infinity and in the high state when the sensor is actuated. The comparator is isolated from switch driver Q6 by diode CR7. R21 and R22 are biasing components for switch driver transistor Q6.

F. Failsafe Circuit. The failsafe circuit consists of A3, CR5, CR6, and associated components. The failsafe circuit senses the peak voltage developed across T1 when demodulator switch Q5 is closed. The voltage across C6 is compared by amplifier A3 against a reference voltage determined by resistor R15 and R16. When the bridge is operating normally, the output of A3 (Pin 6) is near ground potential. In the event of a failure resulting in a high voltage across C6, the R15- R16 reference voltage is exceeded, causing the output of A3 (Pin 6) to change from ground potential to the reference voltage potential. A3 output (Pin 6) is applied through diode CR6 into the output stage of comparator amplifier A2 (Pin 5), biasing A2 to the low state. A2 output clamps to ground, simulating a deactuated sensor.

G. Output Switch. The output switch Q7, R24, C10, and CR8 is externally jumpered for normally open or normally closed operation. When the connector is wired for normally open operation, emitter current of Q6 provides base drive for Q7.

In the normally closed condition, Q7 is driven through R23. Zener diode CR8 across Q7 protects against transients. Capacitor C10 provides EMI suppression.

Weight	2.5 ounces
Power Requirements	28V dc, 1.8W
Temperature Range	-40°C to 85°C
Switch Range	0.500 ampere
Test Actuation Point for ELDEC AT10-1 Target and Center-Point Sensor	0.290 to 0.315 inch for 8-060-02 0.132 to 0.158 inch for 8-060-07 0.285 to 0.315 inch for 8-060-10
Differential Travel	0.005 to 0.025 inch for 8-060-02 0.005 to 0.020 inch for 8-060-07 0.004 to 0.010 inch for 8-060-10
Card Interchangeability	2-899-111 for 8-060-02 2-899-113 for 8-060-07 2-899-111-3 for 8-060-10
Recommended Sensor/Fixture for calibration/testing	1-899-15-CP-02 with AT10-1 target. Calibration Test Stand P/N 3-455-35

Leading Particulars
Table 1

DISASSEMBLY

The switch card is to be disassembled only to the extent necessary to remove defective components. Component identification is shown in IPL Figure 1. Refer to ILLUSTRATED PARTS LIST for part values.

CLEANING

1. General

This section contains instructions for cleaning the Proximity Switch Card after disassembly or repair. No special tools are required. Equivalent substitutes for cleaning agents may be used.

MATERIAL	USED ON
Stoddard Solvent (Commercial)	Electrical Components

2. Components and Assemblies

Clean printed circuit board with vacuum cleaner (preferred method) or low-pressure compressed air (optional method). Use a small-size soft nonmetallic bristle brush to dislodge foreign particles from the crevices and surfaces. Dip brush in Stoddard commercial solvent and wash parts as necessary to remove oily film. Dry circuit board with low-pressure compressed air.

WARNING: VENTILATE WORK AREAS THOROUGHLY WHEN SOLVENT IS USED. AVOID CONTACTING SOLVENT WITH BARE SKIN. OBSERVE ALL SAFETY AND FIRE PRECAUTIONS.

INSPECTION/CHECK

1. Check for evidence of physical damage due to mishandling.

2. Visually examine circuit board for broken components, defective solder joints and broken circuit traces.

3. Visually inspect connector for security of mounting and for bent, broken or corroded connector pins.

   NOTE: On some switch cards, resistor R8 of a certain type has shown a higher failure rate than expected. During maintenance, the resistor should be examined and replaced with the type given in the IPL, item 29. Details of the change are given in Service Information Letter 27-01, ELDEC Document No. 740222.

REPAIR

1. General

Replace components indicated to be faulty by inspection and functional test. For part locations and descriptions refer to IPL Figure 1 and accompanying parts list. Refer to DISASSEMBLY and ASSEMBLY.

2. Required Material

A. Trichlorethane -1, 1, 1 (Methylchloroform), O-T-620

B. Deionized/Distilled Water (1 Megohm or better purity)

C. Isopropyl Alcohol, TT-I-735

D. Solder, QQ-S-571D, Core Flux (WRAP-2 or WRAP-3)

E. Coating, Humiseal 1A20 (V99109)

3. Required Equipment

A. Nylon Brush

B. Soldering Iron, 40 watt

C. Dry, Low-Pressure Air (40 to 80 psi)

D. Hot-Air Dryer (190 to 220°F)

4. Procedure

CAUTION: LIMIT SOLDER OPERATIONS TO LESS THAN 5 SECONDS. LONGER SOLDERING PERIODS WILL DAMAGE PRINTED WIRING BOARD.

A. Unsolder and remove defective component(s). If necessary, use soldering iron to burn coating away from component.

WARNING: METHYLCHLOROFORM AND ALCOHOL ARE TOXIC. WEAR GOGGLES AND GLOVES AND USE GOOD VENTILATION. AVOID CONTACT WITH SKIN AND CLOTHING AND AVOID BREATHING VAPOR.

B. Clean repair area and solder surfaces using a nylon brush and methylchloroform, followed by spray rinse with fresh, virgin grade methylchloroform. Flush debris clear of board using deionized or distilled water followed by spray rinsing with alcohol.

C. Install and solder replacement component(s).

D. Repeat step B.

E. Dry board using low-pressure air followed by forced-air drying at 190 to 200 degrees F for 2 to 3 minutes using a hot air dryer.

F. Allow board to cool to room temperature and then apply protective coating. Nominal thickness shall be 1 to 3 mils on flat surfaces.

G. Air cure protective coating for 2 hrs at room temperature.

NOTE: Protective coating is fully cured after approximately 24 hours. Curing, however, requires a condition of at least 30% relative humidity.

H. Proceed with TESTING.

ASSEMBLY

1. General

Reassemble the switch card after repair. Refer to IPL Figure 1 and accompanying parts list for part locations and descriptions. Calibrate the switch card using the following procedure prior to TESTING.

2. Calibration

A. Equipment Required

(1) Calibration Test Stand. A special fixture, PN 3-455-16 (ref. Figure 501) is required to calibrate 8-060-02, -07, and -10 switch cards after repair. The fixture must be constructed so that the sensor is mounted on a non-metallic surface with sensing face of the sensor a minimum of 0.75 inch from any non-magnetic metal (aluminum) and a minimum of 2 inches from any magnetic material other than the target. The movable target must be parallel to the sensing face and cover 100 percent of sensing face. Target must be able to move from zero gap to a minimum of 1.0 inch from sensing face.

(2) Center Point Sensor Kit, Part No. 1-899-15-CP-01. Calibrating the switch card with a 1-899-15 sensor selected at random potentially broadens the actuation tolerance by a factor of two because of tolerance build-up. Therefore, it is recommended that the 1-899-15-CP-02 sensor with accompanying AT10-1 Target be used or the switch card be returned to the manufacturer for calibration.

NOTE: Target, Part No. AT10-1 included with 1-899-15-CP-01 Kit.

(3) Decade Resistor, General Radio Type 1434-N or equivalent.

B. Refer to Figure 502 for test setup.

C. Selection of R9 and R10.

(1) Make the equipment connections shown in Figure 502.

(2) Adjust calibration test stand target position until contact is made with target and sensor face. Set calibration test stand dial scale to zero.

(3) Remove R9 and R10 from switch card. Connect the decade resistor across the R9 terminals (connector pins A and C). See Figure 502.

(4) Turn on power supply and set its output to 28(± 1)V dc.

(5) Move target to the nominal gap (0.300 inch for the 8-060-02 and -10, or 0.145 inch for the 8-060-07).

(6) Adjust decade resistor to 100 ohms or greater. Indicator lamp loads should be off. Carefully decrease the decade resistor until the lamps illuminate.

(7) Select a standard resistor value (see ILLUSTRATED PARTS LIST for type) that is equal to or slightly greater than the decade resistor setting.

(8) Temporarily install the resistor in the R9 position. Adjust the decade box to 10K.

(9) Move target away from sensor beyond deactuation point.

(10) Slowly move target toward sensor until lamps illuminate.

(11) Measure distance of target from sensor face. If gap is greater than the nominal distance (0.300 inch for the 8-060-02 and -10, or 0.145 inch for the 8-060-07) use the next higher value of resistor for R9, and proceed to step (12). If the gap is nominal, select a 10K resistor and proceed to step (15). If the gap is less than nominal, proceed to step (12).

(12) Increase the target gap until the lamps turn off. Move the target to the nominal gap. Lamps should be off.

(13) Adjust the decade resistor for actuation at the nominal actuation point (0.300 inch for 8-060-02 and -10, or 0.145 inch for the -07).

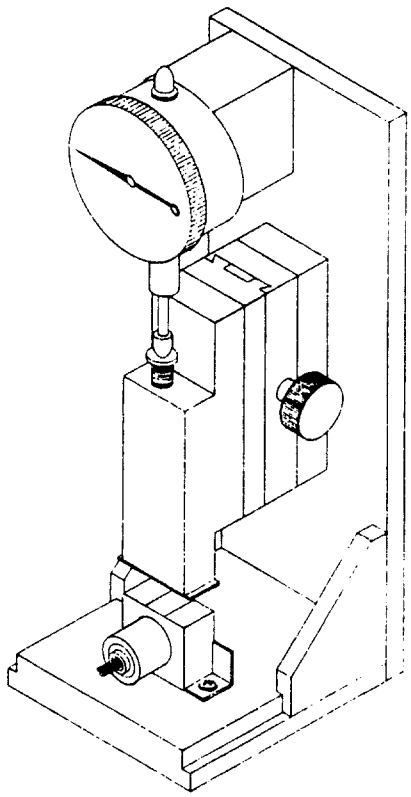
(14) Select a resistor that is closest to the decade box value. (See ILLUSTRATED PARTS LIST for type).

(15) Disconnect decade box and temporarily install selected resistor in parallel with R9.

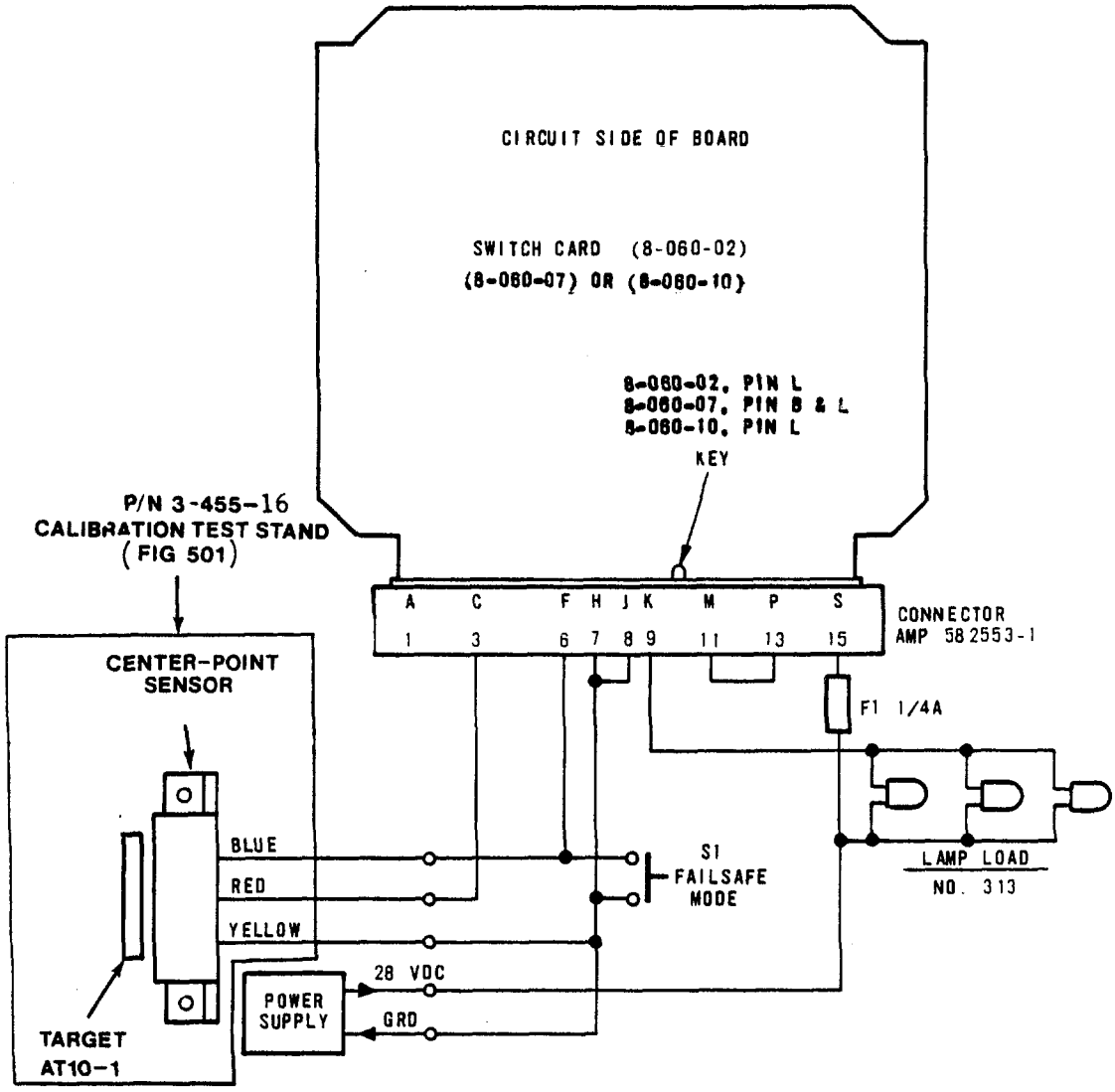
NOTE: If the actuation point is not within ±0.003 of nominal, select another resistor for R10. When the calibration is within ±0.003, install both R9 and R10 into the card. When the above steps have been performed, calibration is complete.

(16) After calibration, retest as described in TESTING.

(17) Apply conformal coating to calibration resistors and solder areas. (Ref. REPAIR.)



Part No. 3-455-16
Calibration Test Stand
Figure 501



NOTE: This Figure illustrates the requirements for testing and calibration.

Switch Card Test Set-Up
Figure 502

FITS AND CLEARANCES

No special fits and clearances are required.

TESTING

1. Test Equipment

   A. Test Set-up per Figure 502, Switch Card Test Set-up, or equivalent.

   B. Calibration Test Stand, P/N 3-455-16 (ref. Fig. 501).

   C. Center-Point Sensor Kit P/N 1-899-15-CP-01.

   D. Oscilloscope, Tektronix 531 or equivalent.

2. Test Procedure

   A. Install center-point sensor and target in calibration test stand. Adjust calibration test stand target position until contact is made with target and sensor face. Set calibration test stand dial scale to zero. Move target away from sensor to maximum distance.

   B. Make the equipment connections shown in Figure 502. Set power supply output to 28(±1)V dc.

   C. Verify waveform frequency at pin F (blue sensor lead) is 1100(±65)Hz. See TROUBLE SHOOTING, 3.0 for alignment.

   D. Slowly move calibration test stand target toward sensor until indicator light just turns on. Target position shall be as follows:

8-060-02	0.290 to 0.315 inch
8-060-07	0.132 to 0.158 inch
8-060-10	0.285 to 0.315 inch

   NOTE: See ASSEMBLY 2.0 for gap calibration.

   E. Record calibration test stand target position.

   F. Slowly move calibration test stand target away from sensor until indicator light just turns off. Target position shall be greater than that recorded in step C as follows:

8-060-02	0.005 to 0.025 inches
8-060-07	0.005 to 0.020 inches
8-060-10	0.004 to 0.010 inches

   G. Repeat steps C thru E with power supply set to 21.05V dc and 30V dc.

   H. Set power supply output to 28(±1)V dc.

   I. Repeat step D.

J. Close FAIL SAFE MODE switch, observing indicator light turns off. See TROUBLE SHOOTING, 2.0 for alignment.

K. Open FAIL SAFE MODE switch. Indicator light shall turn on.

L. Adjust calibration test stand target flush against sensor (zero gap). Indicator light shall be on.

M. Move calibration test stand target away from sensor, turn off power supply, and disconnect equipment. Testing is complete.

TROUBLESHOOTING

1. General

The following troubleshooting chart (Figure 801) and a schematic diagram (Figure 802) are provided to assist in isolating and correcting switch card malfunctions. Refer to IPL Figure 1 for location of parts.

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
1. Indicator lamp fails to light when test gage is in ON position.	A. Defective comparator (does not switch)	A. Check A2 and associated components. Replace defective parts.
	B. R17 open.	B. Replace R17
	C. T1 primary open.	C. Replace T1.
	D. Defective Synch demodulator	D. Check Q5 and associated components. Replace defective parts.
	E. Defective output switch.	E. Check Q7 and associated components. Replace defective parts.
	F. Defective Failsafe circuit.	F. Check A3 and associated components. Perform R16 Selection Procedure, 2.A. thru 2.G.
2. Indicator lamp fails to go out or lights when test gage is placed in OFF position.	A. Defective voltage regulator	A. Check Q1, CR2, CR3, CR4, and associated components. Replace defective parts.
	B. Defective output switch.	B. Check Q7, CR8 and associated components. Replace defective parts.
3. Correct waveform not present at Blue sensor lead terminal (Pin F)	A. Defective oscillator.	A1. Check A1 and associated components. Replace defective parts. A2. Check Q3, Q4, and associated components. Replace defective parts.
	B. Defective voltage regulator.	B. Check Q1 and associated components. Replace defective parts.
	C. Incorrect frequency.	C. Perform R5 Selection Procedure, para. 3.

Troubleshooting Chart
Figure 801 (Sheet 1 of 2)

MALFUNCTION	PROBABLE CAUSE	CORRECTIVE ACTION
4. Indicator lamp lights when Failsafe push-button is pressed.	A. Defective Failsafe circuit.	A1. Check A3, CR5, CR6, and associated components. A2. Perform R16 Selection Procedure 2.A. thru 2.G.
5. Indicator lamp fails to light when Target AT10-1, or piece of Carpenter Hi Mu 80 Steel) is placed against sensitive face.	A. See Malfunction No. 1.	A. See Malfunction No. 1.

Troubleshooting Chart
Figure 801 (Sheet 2 of 2)

2. R16 Selection Procedure

If the switch card fails the fail-safe test, a different value of R16 may be required. Proceed as follows:

A. Install the switch card in a temperature test chamber so that the card may be operated as in the Switch Card Test Setup, Figure 502.

NOTE: Use of heat guns is not recommended.

B. Apply power to test chamber and allow temperature to stabilize at 85°C (185°C).

C. Open the red lead to the sensor. Indicator lamp shall be off. A momentary flash of light is acceptable.

D. If the switch card fails step 2.C., increase the value of R16 to the next higher value.

E. Adjust the temperature of the test chamber to -40°C

F. Place the A10-1 Target against the sensitive face of the sensor (zero gap condition). The indicator lamp shall be illuminated.

G. If the switch card fails step 2.F, decrease the value of R16 to the next lower value.

H. Upon completion of R16 selection procedure, perform procedure given in TESTING.

3. R5 Selection Procedure

A. Make the equipment connections shown in Figure 502. Set power supply output to 28(±1) Vdc.

B. Verify frequency of waveform at pin F (blue sensor lead) is 1100(±65)Hz. If not, select value of resistor R5 as follows:

(1) Turn off dc power supply.

(2) Remove resistor R5.

(3) Connect decade resistance box set to 11.5K ohms as R5.

(4) Turn on dc power supply and set its output to 28(±1) Vdc.

(5) Adjust decade resistance box setting to obtain 1100(±30)Hz signal at pin F.

(6) Record decade resistance box setting. Resistance value shall be 9.75K to 12.7K ohms.

(7) Turn off dc power supply and disconnect decade resistance box.

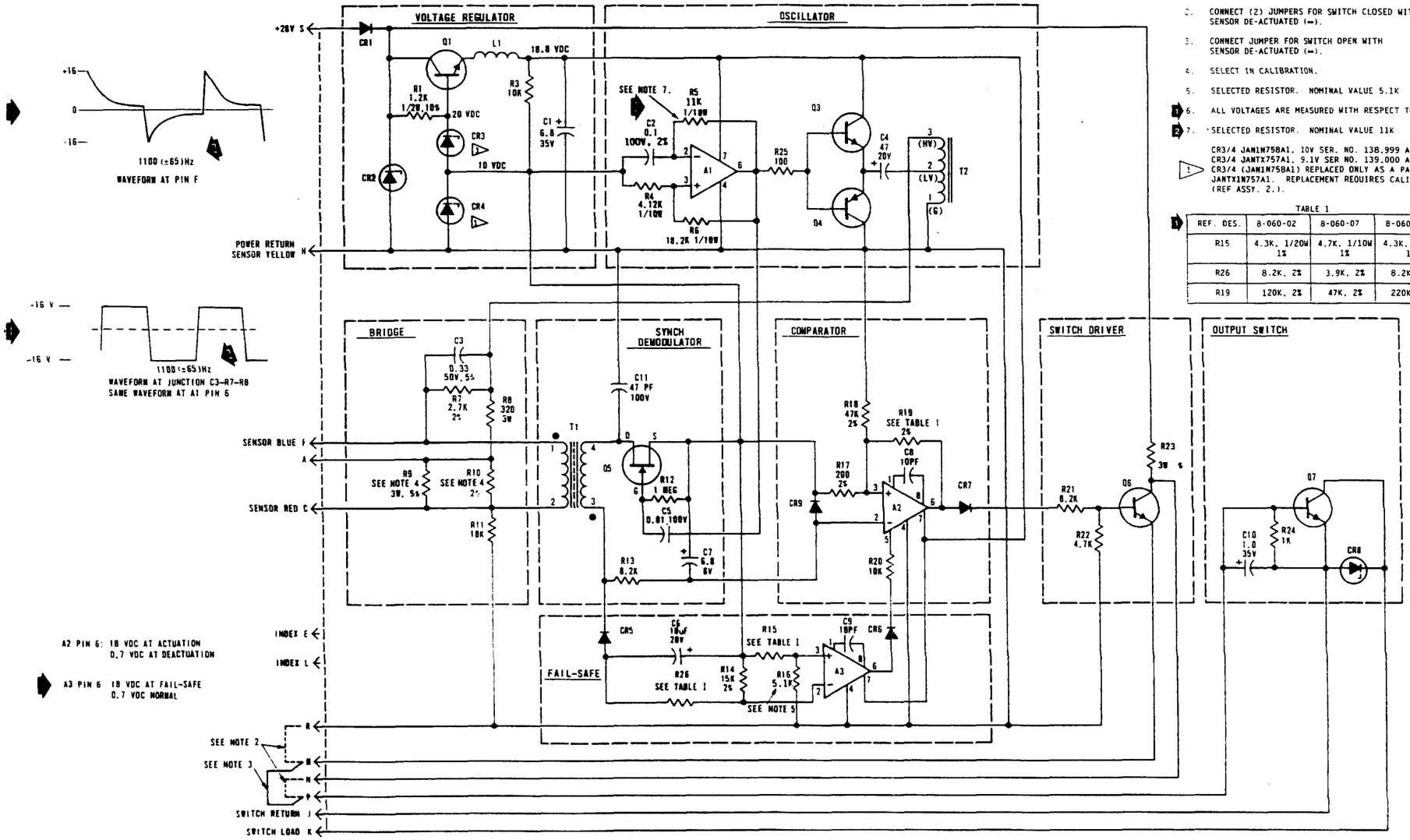
(8) Install a RN55C----F resistor having a value as near as possible to that recorded in step (6) as R5.

(9) Repeat step A and B.

C. Perform procedure given in TESTING.

REVISION CODE	REVISION DESCRIPTION	SERIAL NO. EFFECTIVITY
1	Revised values C1, C6, R16, R19 and Table I. Revised figure title. Added voltages and waveforms. Added Notes 5 and 6.	
2	Revised value of R5. Added tolerances to waveforms. Added Note 7.	
None	Revised values of C2, R9, R15, and R23. Revised tolerances in Note 1. Revised values in Notes 5 and 7.	
None	Added flagnote 1 for CR3 and CR4.	
None	Clarified flagnote 1.	

Solid State Proximity Switch PC Assembly
Schematic Diagram
Figure 802 (Sheet 1 of 2)



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTOR VALUES ARE IN OHMS, 1/4 WATT, ± 5%.
   K=1000.
   ALL CAPACITORS ARE IN MICROFARADS ± 10%.
2. CONNECT (2) JUMPERS FOR SWITCH CLOSED WITH SENSOR DE-ACTUATED (⟷).
3. CONNECT JUMPER FOR SWITCH OPEN WITH SENSOR DE-ACTUATED (⟷).
4. SELECT IN CALIBRATION.
5. SELECTED RESISTOR. NOMINAL VALUE 5.1K
6. ALL VOLTAGES ARE MEASURED WITH RESPECT TO PIN H.
7. SELECTED RESISTOR. NOMINAL VALUE 11K

CR3/4 JAN1N758A1, 10V SER. NO. 138,999 AND BELOW.
CR3/4 JANTX757A1, 9.1V SER NO. 139,000 AND ON.
CR3/4 (JAN1N758A1) REPLACED ONLY AS A PAIR BY JANTX1N757A1. REPLACEMENT REQUIRES CALIBRATION (REF ASSY. 2.).

TABLE 1

REF. DES.	8-060-02	8-060-07	8-060-10
R15	4.3K, 1/20W 1%	4.7K, 1/10W 1%	4.3K, 1/20W 1%
R26	8.2K, 2%	3.9K, 2%	8.2K, 2%
R19	120K, 2%	47K, 2%	220K, 5%

Solid State Proximity Switch PC Assembly
Schematic Diagram
Figure 802 (Sheet 2)

STORAGE INSTRUCTIONS

Package the Proximity Switch Card in a polyethylene bag. Seal in a commercial carton and store in a dry place. Recommended storage temperature 0^{o} to 50^{o}C.

SPECIAL TOOLS, FIXTURES AND EQUIPMENT

Special tools, fixtures and equipment required for overhaul of the 8-060 Switch Card are listed below.

A. Calibration Test Stand, Part No. 3-455-16 (Figure 501).

B. Center-Point Sensor Kit, Part No. 1-899-15-CP-01. Kit includes:

(1) Center Point Sensor, Part No. 1-899-15-CP-02.
(2) Target, Part No. AT10-1.
(3) Actuation Gap data sheet.
(4) Packing material and container.

C. Environmental Test Chamber (-40°C to 85°C) capable of operating switch card as shown in Figure 502.

ILLUSTRATED PARTS LIST

1. Introduction

A. The Illustrated Parts List provides a breakdown of the equipment covered by this manual. All parts are listed in order of disassembly, showing relationships of higher and lower assemblies, and are identified by corresponding item numbers on the equipment illustration.

B. All parts are assigned an item number. Parts listed but not illustrated are identified by a hyphen (-) preceding the item number.

C. For identification of detail parts and assemblies, the nomenclature employs the indenture system. Each assembly is listed with its detail parts listed in the next indenture below and to the right. Conversely, the next higher assembly of any detail part may be determined by its location in the indenture above and to the left.

D. Attaching parts immediately follow the part or assembly which they attach, and have the same indenture. They are introduced by the words, ATTACHING PARTS, and their conclusion is indicated by the symbol ***.

E. The letters appearing in the Effect Code column denote the configuration in which the applicable part is used. Where no letter appears, the part is used in all configurations.

The configuration of the unit can be determined by checking the part number and serial number on the identification label. Applicability of components to units and units to part numbers is indicated by the following codes:

EFFECT CODE	CONFIGURATION
A	8-060-02, SN 138,999 and below
B	8-060-07, SN 138,999 and below
C	8-060-10, SN 138,999 and below
D	8-060-02, SN 139,000 and above
E	8-060-07, SN 139,000 and above
F	8-060-10, SN 138,999 and above

F. Unless otherwise indicated by a vendor's code number in parentheses following the part name in the parts list, all parts are either commercial standard, military standard, or ELDEC (V08748) parts.

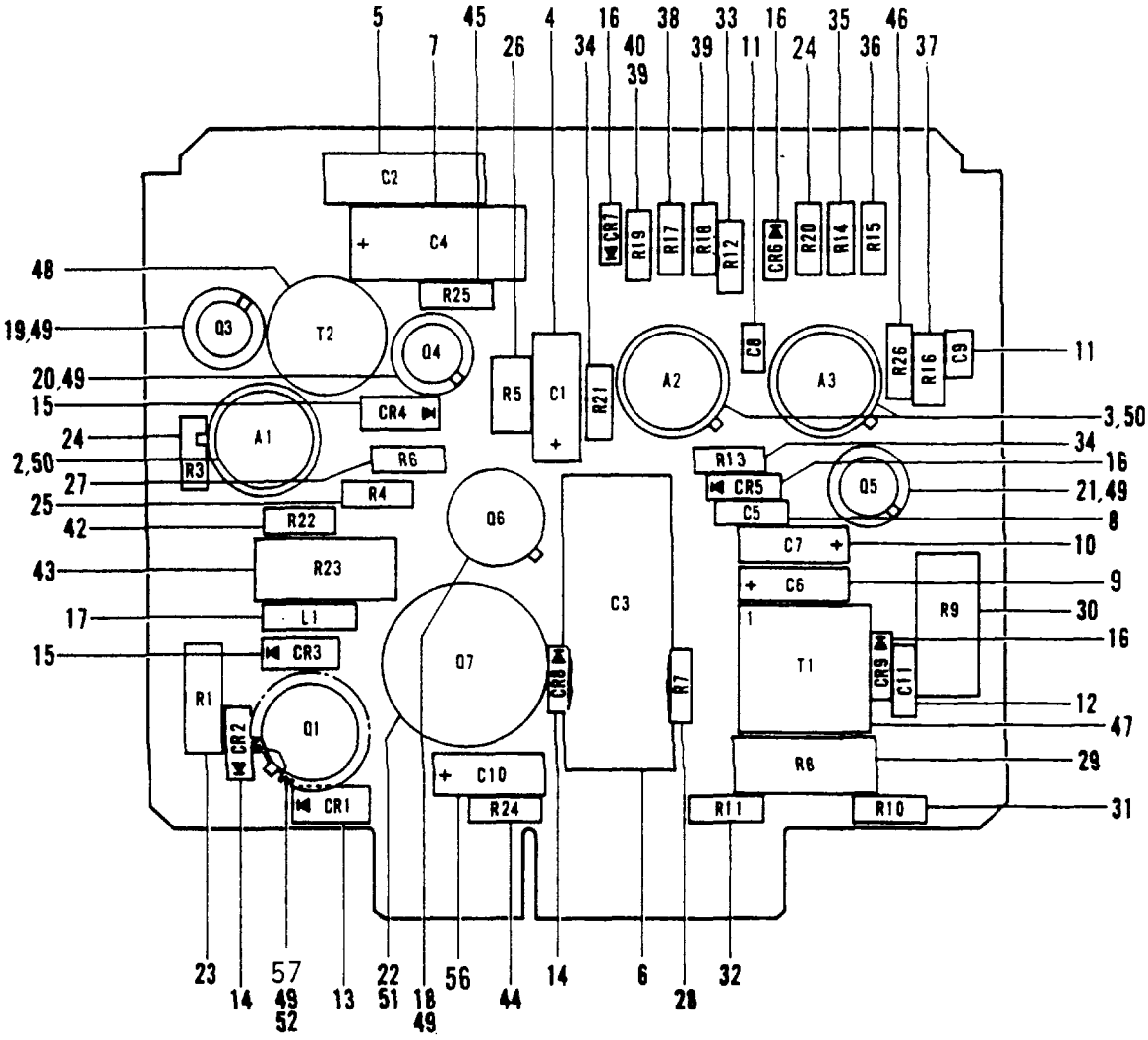
VENDOR CODE	NAME/ADDRESS
V04713	MOTOROLA INC. Semiconductor Products 5005 E. Mc Dowell Rd. Phoenix, AZ 85008-4229
V07047	THE ROSS MILTON CO. 511 Second Street Pike Southampton, PA 18966
V07256	SILICON TRANSISTOR CORP Katrina Rd. Chelmsford, MA 01824
V13103	THERMALLOY Dallas, TX

2. Numeric Index

The numeric index includes a complete listing of all parts in the Illustrated Parts List arranged in alphanumeric order.-

3. Equipment Designation Index

The equipment designation index contains the reference designations for the components shown on the schematic diagram. The designations are arranged in alphanumerical order.



Solid State Proximity Switch
PC Assembly
Figure 1

ILLUSTRATED PARTS LIST

FIG	ITEM	PART NUMBER	NOMENCLATURE 12345	EFFECT CODE	QTY PER ASSY	
1-	1	8-060-02	SOLID STATE PROXIMITY SWITCH PC ASSY	A	RF	
	1A	8-060-07	SOLID STATE PROXIMITY SWITCH PC ASSY	B	RF	
	1B	8-060-10	SOLID STATE PROXIMITY SWITCH PC ASSY	C	RF	
	1C	8-060-02	SOLID STATE PROXIMITY SWITCH PC ASSY	D	RF	
	1D	8-060-07	SOLID STATE PROXIMITY SWITCH PC ASSY	E	RF	
	1E	8-060-10	SOLID STATE PROXIMITY SWITCH PC ASSY	F	RF	
	2	AR7-01	.MICROCIRCUIT, LINEAR (V08748)		1	
	3	AR3-01	.MICROCIRCUIT, LINEAR (V08748)		2	
	4	M3900301-2304	.CAPACITOR, 6.8µF, 10%, 35V		1	
	4A	M3900301-6108	OPTIONAL,		1	
	4B	M3900301-2065	OPTIONAL, 20%		1	
	5	CA35-01	.CAPACITOR, 0.1µF, 2%, 100V (V08748)		1	
	5A	C15-6-0	OPTIONAL, 5% (V08748)		1	
	5B	CA122-02	OPTIONAL, (V08748)		1	
	6	CA34-02	.CAPACITOR, 0.33µF, 5%, 50V (V08748)		1	
	7	CA33-01	.CAPACITOR, 47µF, 20%, 20V (V08748)		1	
	8	M3901405-2061	.CAPACITOR, 0.01µF, 10%, 100V		1	
	8A	CK13BX103K	OPTIONAL		1	
	9	M3900301-2286	.CAPACITOR, 10µF, 10%, 20V		1	
	9A	M3900301-6078	OPTIONAL		1	
	10	M3900301-2242	.CAPACITOR, 6.8µF, 10%, 6V		1	
	10A	M3900301-6004	OPTIONAL		1	
	11	M3901405-2001	.CAPACITOR, 10pF, 10%, 100V		2	
	11A	CK12BX100K	OPTIONAL		2	
	12	M3901405-2013	.CAPACITOR, 47pF, 10%, 100V		1	
	12A	CK12BX470K	OPTIONAL		1	
	13	JAN1N649-1	.DIODE, ZENER		1	
	13A	JAN1N649	OPTIONAL		1	
	14	JAN1N983B1	.DIODE, ZENER		2	
	14A	JAN1N983B	OPTIONAL		2	
	14B	CR6-5-7J	OPTIONAL		2	
	15	JAN1N758A1	.DIODE, ZENER (REPLACED BY ITEM 15A)	ABC	2	R
	15A	JANTX1N757A1	.DIODE, ZENER (REPLACES ITEM 15 CR3/4 REF. FIG. 802, FLAGNOTE 1)		2	R R
	16	JANTX1N4148-1	.DIODE		4	
	16A	JANTX1N4148	OPTIONAL		4	
	17	MS90538-12	.INDUCTOR		1	
	18	Q11-2-0	.TRANSISTOR (V08748)		1	
	18A	2N2405	OPTIONAL (V04713)		1	

ILLUSTRATED PARTS LIST

FIG	ITEM	PART NUMBER	NOMENCLATURE 12345	EFFECT CODE	QTY PER ASSY	
1-	19	JAN2N2222A	.TRANSISTOR		1	
	19A	JAN2N2222	OPTIONAL		1	
	20	JAN2N2907A	.TRANSISTOR		1	
	20A	JAN2N2907	OPTIONAL		1	
	21	2N4858	.TRANSISTOR (V04713) (ELDEC SPEC TR138-01)		1	
	21A	JAN2N4858	OPTIONAL		1	
	22	STC7293	.TRANSISTOR (V07256) (ELDEC SPEC TR21-3)		1	
	23	RCR20G122JS	.RESISTOR, 1.2KΩ, 5%, 0.5W		1	
	24	RCR07G103JS	.RESISTOR, 10KΩ, 5%, 0.25W		2	
	25	RNC55H4121FS	.RESISTOR, 4.12KΩ, 1%, 0.1W		1	
	25A	RNC55H4121F	OPTIONAL		1	
	26	RNC55H1102FS	.RESISTOR, 11KΩ, 1%, 0.1W (SELECTED VALUE, RANGE 9.75-12.7KΩ)		1	
	27	RNC55H1822FS	.RESISTOR, 18.2KΩ, 1%, 0.1W		1	
	27A	RNC55H1822F	OPTIONAL		1	
	28	RLR07C2701GS	.RESISTOR, 2.7KΩ, 2%, 0.25W		1	
	28A	RLR07C2701GR	OPTIONAL		1	
	28B	RLR07C2701G	OPTIONAL		1	
	29	RE20-13	.RESISTOR, 320Ω, 5%, 3W (V08748)		1	R
	29A	T2A	.RESISTOR, 320Ω, 5%, 3W (V01686) (ELDEC SPEC RE53-04)		1	R R
	29B	R3-13-0	.RESISTOR, 320Ω, 5%, 3W (V08748)		1	R
	30	RWR79U22R6F	.RESISTOR, 22.6Ω, 1%, 3W (SELECTED VALUE, RANGE: 10-51.1Ω)	ACDF	1	
	30A	RWR89S22R6FR	OPTIONAL	ACDF	1	
	30B	RWR79U1000F	.RESISTOR, 100Ω, 1%, 3W (SELECTED VALUE, RANGE: 51-205Ω)	BE	1 R	
	30C	RWR89S1000FR	OPTIONAL	BE	1	
	31	RLR07C5100GS	.RESISTOR, 510Ω, 2%, 0.25W (SELECTED VALUE, RANGE: 200Ω-1KΩ)	AD	1	
	31A	RLR07C5100GR	OPTIONAL	AD	1	
	31B	RLR07S511G	OPTIONAL	AD	1	
	31C	RLR07C5101GS	.RESISTOR, 5.1KΩ, 2%, 0.25W (SELECTED VALUE, RANGE: 200Ω-10KΩ)	BCEF	1	
	31D	RLR07C5101GR	OPTIONAL	BCEF	1	
	31E	RLR07S512G	OPTIONAL	BCEF	1	
	32	RCR07G183JS	.RESISTOR, 18KΩ, 5%, 0.25W		1	
	33	RCR07G105JS	.RESISTOR, 1.0MΩ, 5%, 0.25W		1	
	34	RCR07G822JS	.RESISTOR, 8.2KΩ, 5%, 0.25W		2	

ILLUSTRATED PARTS LIST

FIG	ITEM	PART NUMBER	NOMENCLATURE 12345	EFFECT CODE	QTY PER ASSY	
1-	35	RLR07C1502GS	.RESISTOR, 15KΩ, 2%, 0.25W		1	
	35A	RLR07C1502GR	OPTIONAL		1	
	35B	RLR07S153G	OPTIONAL		1	R
	36	R4-1-0	.RESISTOR, 4.3KΩ, 1%, 0.05W (V08748)	ACDF	1	R
	36A	RE53-05	OPTIONAL	ACDF	1	R
	36B	R4-2-0	.RESISTOR, 4.7KΩ, 1%, 0.05W (V08748)	BE	1	R
	36C	RE13-4700B	OPTIONAL	BE	1	R
	37	RLR07C5101GS	.RESISTOR, 5.1KΩ, 2%, 0.25W		1	R
			(SELECTED VALUE, RANGE 3.3-6.8KΩ)			R
	38	RLR07C2000GS	.RESISTOR, 200Ω, 2%, 0.25W		1	R
	38A	RLR07C2000GR	OPTIONAL		1	R
	38B	RLR07S201G	OPTIONAL		1	R
	39	RLR07C4702GS	.RESISTOR, 47KΩ, 2%, 0.25W		1	R
	39A	RLR07C4702GR	OPTIONAL		1	R
	39B	RLR07S473G	OPTIONAL		1	R
	40	RLR07C1203GS	.RESISTOR, 120KΩ, 2%, 0.25W	AD	1	R
	40A	RLR07C1203GR	OPTIONAL	AD	1	R
	40B	RLR07S124G	OPTIONAL	AD	1	R
	40C	RLR07C4702GS	.RESISTOR, 47KΩ, 2%, 0.25W	BE	1	R
	40D	RLR07C4702GR	OPTIONAL	BE	1	R
	40E	RLR07C473G	OPTIONAL	BE	1	R
	40F	RCR07G224JS	.RESISTOR, 220KΩ, 5%, 0.25W	CF	1	R
	42	RCR07G472JS	.RESISTOR, 4.7KΩ, 5%, 0.25W		1	
	43	RWR79U2001FS	.RESISTOR, 2.0KΩ, 1%, 3W		1	
	44	RCR07G102JS	.RESISTOR, 1.0KΩ, 5%, 0.25W		1	
	45	RCR07G101JS	.RESISTOR, 100Ω, 5%, 0.25W		1	
	46	RLR07C8201GS	.RESISTOR, 8.2KΩ, 2%, 0.25W	AD	1	R
	46A	RLR07C8201GR	OPTIONAL	AD	1	R
	46B	RLR07C3901GS	.RESISTOR, 3.9KΩ, 2%, 0.25W	BCEF	1	R
	46C	RLR07C3901GR	OPTIONAL	BCEF	1	R
	47	5-464-01	.TRANSFORMER (V08748)		1	
	48	5-461-03	.TRANSFORMER (V08748)		1	
	49	10044DAP	.PAD, SEMICONDUCTOR MOUNTING (V07047) (ELDEC SPEC TP1-1)		5	
	50	10277DAP	.PAD, SEMICONDUCTOR MOUNTING (V07047) (ELDEC SPEC TP3-1)		3	
	51	10104DAP	.PAD, SEMICONDUCTOR MOUNTING (V07047) (ELDEC SPEC TP4-1)		1	

ILLUSTRATED PARTS LIST

FIG	ITEM	PART NUMBER	NOMENCLATURE 12345	EFFECT CODE	QTY PER ASSY	
1-	52	2257R	.HEATSINK (V13103)		1	R
			(ELDEC SPEC HE17-01)			R
	56	M3900301-2356	.CAPACITOR, 1.0µF, 10%, 50V		1	R
	56A	M3900301-6194	OPTIONAL, 35V		1	R
	56B	M3900301-2836	OPTIONAL, 35V		1	R
	56C	CS13BF105K	OPTIONAL, 35V		1	R
	57	TR33-01	.TRANSISTOR (V08748)		1	R

OVERHAUL MANUAL WITH IPL
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PART NUMBER	AIRLINE PART NUMBER	FIGURE-ITEM	QUANTITY
AR3-01		1- 3	2
AR7-01		1- 2	1
C15-6-0		1- 5A	1
CA122-02		1- 5B	1
CA33-01		1- 7	1
CA34-02		1- 6	1
CA35-01		1- 5	1
CK12BX100K		1- 11A	2
CK12BX470K		1- 12A	1
CK13BX103K		1- 8A	1
CR6-5-7J		1- 14B	2
CS13BF105K		1- 56C	1
JAN1N649		1- 13A	1
JAN1N649-1		1- 13	1
JAN1N758A1		1- 15	2 R
JAN1N983B		1- 14A	2
JAN1N983B1		1- 14	2
JAN2N2222		1- 19A	1
JAN2N2222A		1- 19	1
JAN2N2907		1- 20A	1
JAN2N2907A		1- 20	1
JAN2N4858		1- 21A	1
JANTX1N4148		1- 16A	4
JANTX1N4148-1		1- 16	4
JANTX1N757A1		1- 15A	2
M3900301-2065		1- 4B	1
M3900301-2242		1- 10	1
M3900301-2286		1- 9	1
M3900301-2304		1- 4	1
M3900301-2356		1- 56	1
M3900301-2836		1- 56B	1
M3900301-6004		1- 10A	1
M3900301-6078		1- 9A	1
M3900301-6108		1- 4A	1
M3900301-6194		1- 56A	1
M3901405-2001		1- 11	2
M3901405-2013		1- 12	1
M3901405-2061		1- 8	1
MS90538-12		1- 17	1
Q11-2-0		1- 18	1

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PART NUMBER	AIRLINE PART NUMBER	FIGURE-ITEM	QUANTITY	
R3-13-0		1- 29B	1	R
R4-1-0		1- 36	1	
R4-2-0		1- 36B	1	
RCR07G101JS		1- 45	1	
RCR07G102JS		1- 44	1	
RCR07G103JS		1- 24	2	
RCR07G105JS		1- 33	1	
RCR07G183JS		1- 32	1	
RCR07G224JS		1- 40F	1	
RCR07G472JS		1- 42	1	
RCR20G122JS		1- 23	1	
RE13-4700B		1- 36C	1	
RE20-13		1- 29	1	
RE53-05		1- 36A	1	
RLR07C1203GR		1- 40A	1	
RLR07C1203GS		1- 40	1	
RLR07C1502GRS		1- 35A	1	
RLR07C1502GS		1- 35	1	
RLR07C2000GR		1- 38A	1	
RLR07C2000GS		1- 38	1	
RLR07C2701G		1- 28B	1	
RLR07C2701GR		1- 28A	1	
RLR07C2701GS		1- 28	1	
RLR07C3901GR		1- 46C	1	
RLR07C3901GS		1- 46B	1	
RLR07C4702GR		1- 39A	1	
RLR07C4702GR		1- 40D	1	
RLR07C4702GS		1- 39	1	
RLR07C4702GS		1- 40C	1	
RLR07C473G		1- 40E	1	
RLR07C5100GR		1- 31A	1	
RLR07C5100GS		1- 31	1	
RLR07C5101GR		1- 31D	1	
RLR07C5101GS		1- 31C	1	
RLR07C5101GS		1- 37	1	
RLR07C8201GR		1- 46A	1	
RLR07C8201GS		1- 46	1	
RLR07S124G		1- 40B	1	
RLR07S153G		1- 35B	1	
RLR07S201G		1- 38B	1	

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PART NUMBER	AIRLINE PART NUMBER	FIGURE-ITEM	QUANTITY	
RLR07S473G		1- 39B	1	
RLR07S511G		1- 31B	1	
RLR07S512G		1- 31E	1	
RNC55H1102FS		1- 26	1	
RNC55H1822F		1- 27A	1	
RNC55H1822FS		1- 27	1	
RNC55H4121F		1- 25A	1	
RNC55H4121FS		1- 25	1	
RWR79U1000F		1- 30B	1	
RWR79U2001FS		1- 43	1	
RWR79U22R6F		1- 30	1	
RWR89S1000FR		1- 30C	1	
RWR89S22R6FR		1- 30A	1	
STC7293		1- 22	1	
T2A		1- 29A	1	R
TR33-01		1- 57	1	
10044DAP		1- 49	5	
10104DAP		1- 51	1	
10277DAP		1- 50	3	
2257R		1- 52	1	
2N2405		1- 18A	1	
2N4858		1- 21	1	
5-461-03		1- 48	1	
5-464-01		1- 47	1	
8-060-02		1- 1	RF	
8-060-02		1- 1C	RF	
8-060-07		1- 1A	RF	
8-060-07		1- 1D	RF	
8-060-10		1- 1B	RF	
8-060-10		1- 1E	RF	

EQUIPMENT DESIGNATION INDEX

EQUIPMENT DESIGNATOR	FIG. ITEM	EQUIPMENT DESIGNATOR	FIG. ITEM	EQUIPMENT DESIGNATOR	FIG. ITEM
A 1	1- 2	CR7	1-16	R10	1-31E
A 2	1- 3	CR7	1-16A	R11	1-32
A 3	1- 3	CR8	1-14	R12	1-33
C 1	1- 4	CR8	1-14A	R13	1-34
C 1	1- 4A	CR8	1-14B	R14	1-35
C 1	1- 4B	CR9	1-16	R14	1-35A
C 2	1- 5	CR9	1-16A	R14	1-35B
C 2	1- 5A	L 1	1-17	R15	1-36
C 2	1- 5B	Q 1	1-57	R15	1-36A
C 3	1- 6	Q 3	1-19	R15	1-36B
C 4	1- 7	Q 3	1-19A	R15	1-36C
C 5	1- 8	Q 4	1-20	R16	1-37
C 5	1- 8A	Q 4	1-20A	R17	1-38
C 6	1- 9	Q 5	1-21	R17	1-38A
C 6	1- 9A	Q 5	1-21A	R17	1-38B
C 7	1-10	Q 6	1-18	R18	1-39
C 7	1-10A	Q 6	1-18A	R18	1-39A
C 8	1-11	Q 7	1-22	R18	1-39B
C 8	1-11A	R 1	1-23	R19	1-40
C 9	1-11	R 3	1-24	R19	1-40A
C 9	1-11A	R 4	1-25	R19	1-40B
C10	1-56	R 4	1-25A	R19	1-40C
C10	1-56A	R 5	1-26	R19	1-40D
C10	1-56B	R 6	1-27	R19	1-40E
C10	1-56C	R 6	1-27A	R20	1-24
C11	1-12	R 7	1-28	R21	1-34
C11	1-12A	R 7	1-28A	R22	1-42
CR1	1-13	R 7	1-28B	R23	1-43
CR1	1-13A	R 8	1-29	R24	1-44
CR2	1-14	R 8	1-29A	R25	1-45
CR2	1-14A	R 8	1-29B	R26	1-46 R
CR2	1-14B	R 9	1-30	R26	1-46A
CR3	1-15	R 9	1-30A	R26	1-46B
CR3	1-15A	R 9	1-30B	R26	1-46C
CR4	1-15	R 9	1-30C	T 1	1-47
CR4	1-15A	R10	1-31	T 2	1-48
CR5	1-16	R10	1-31A		
CR5	1-16A	R10	1-31B		
CR6	1-16	R10	1-31C		
CR6	1-16A	R10	1-31D		

ELDEC CORPORATION
LYNNWOOD, WASHINGTON

SERVICE INFORMATION

SECONDARY CALIBRATION STANDARD KIT
ELDEC PART NO. 1-899-15-CP
SERVICE INFORMATION LETTER NO. 27-02, ELDEC DOCUMENT NO. 750222

1. General

This Service Information Letter serves to clarify the identification of the Secondary Calibration Standard Kit referenced in ELDEC overhaul manuals 24-09-01, dated April 1, 1969, Document Number 660630 and 27-09-01, dated February 1, 1973, Document Number 700606. It also notifies customers of ELDEC's requirements for returning center-point sensors for annual recertification.

2. Description

There has been some confusion involving part numbers on ELDEC's Secondary Standard Calibration Kit, 1-899-15-CP. The part number of the entire kit is 1-899-15-CP-01. This kit includes a center-point sensor, 1-899-15-CP-02; a target AT10-1; a data sheet; and various packing materials, all contained in a plastic box.

Some customers have ordered by the number from the sensor, 1-899-15-CP-02, believing they were ordering the entire kit. The center-point sensor is not sold as a separate item, since the close calibration of this item is done with a particular target, and that sensor must be used with that particular target for the calibration data to be valid.

3. Corrective Action

Customers desiring a center-point sensor should order the entire kit, 1-899-15-CP-01. Orders for 1-899-15-CP-02 will be filled with the entire kit. Similarly, when returning center-point sensors for annual recertification, the entire kit must be returned. If partial kits are received for recertification, a charge must be made for the missing parts, in addition to the normal recertification charge.

4. Further Information

For further information please contact ELDEC Product Support Office:

Product Support Manager
ELDEC Corporation
P.O. Box 100
Lynnwood, WA 98036 USA

Phone No. Area Code 206-743-1313
TELEX 32-8959, TWX 91-449-2855

PLESSEY

PLESSEY DYNAMICS DIVISION, PLESSEY INDUSTRIES, INC.
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OVERHAUL INSTRUCTIONS WITH ILLUSTRATED PARTS BREAKDOWN

ELECTRO-MECHANICAL

LINEAR ACTUATOR

MODEL

L10-20

Revised July 20/77

PLESSEY DYNAMICS DIVISION, PLESSEY INDUSTRIES, INC.
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MODEL L10-20 ELECTRO-MECHANICAL LINEAR ACTUATOR

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MODEL L10-20 ELECTRO-MECHANICAL LINEAR ACTUATOR

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MODEL L10-20 ELECTRO-MECHANICAL LINEAR ACTUATOR

1. DESCRIPTION AND OPERATION.

A. General. This handbook contains descriptive data, overhaul instructions and test procedures for Linear Actuator Model L10-20. The linear actuator is manufactured by Airborne Accessories Corporation, Hillside, New Jersey.

B. The Model L10-20 Electro-Mechanical Linear Actuator converts electrical energy into mechanically controlled linear motion of an output shaft. The actuator is used on the DeHavilland DHC-6 Aircraft, designated as an Aileron Trim Actuator.

C. The actuator incorporates a permanent magnetic motor operated by 26 V DC driving through 3 stages of gear reduction to a 1/4-28 drive screw. The motor has sufficient magnetic cogging effect (detent effect) so that it effectively acts as both a holding and overtravel brake without resorting to the usual friction braking devices. Internal limit switches limit output shaft movement.

D. Table of Leading Particulars

Operating Voltage	18 to 30 volts dc
Operating Temperature	-65°F (-54°C) to +160°F (+71°C)
Operating Duty Cycle	1 minute on, 9 minutes off
Maximum Operating Load	50 pounds (opposing or aiding)
Normal Operating Load	20 pounds (opposing)
Maximum Static Load	100 pounds
Maximum Operating Load Current	0.50 amperes
Maximum Normal Load Current	0.25 amperes
Altitude Range	Sea level to 50,000 feet
Weight	7 ounces

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2. DISASSEMBLY

ACTUATOR ASSEMBLY. Disassemble the actuator assembly as follows: (Ref. 27-10-12, Fig. 1.) Note that attaching parts are listed following the parts that they attach. Record thickness of shims removed during disassembly to facilitate reassembly. (Ref. 27-10-11 for special tools and fixtures.) Unsolder all leadwires from components during disassembly.

(1) Cut and remove lockwire from all drilled-head screws.

(2) Remove nut (2) and rubber "O" ring (3).

(3) Remove cover (1) with attached parts.

(4) Do not remove identification plate (8) , identification trademark plate (9) from cover (1) unless they are illegible or otherwise damaged and require replacement.

(5) Do not remove screw (6) washers (4 and 5) and nut (7) from cover (1).

(6) Using a suitable pin punch, remove pin (10) from nut tube (56).

(7) Remove jack end fitting (11) and shims (12) from nut tube (56).

(8) Remove clip retainer (13) from guide housing (63) by removing screws (14). Remove shims (15).

(9) Remove switch actuator block (17) with attached parts from guide housing (63). Do not remove set screws (16) from switch actuator block (17) unless they are damaged and require replacement.

(10) Remove switches (18) from guide housing (63) by removing nuts (19), screws (20) switch actuators (21 and 22), clip retainer (23), terminals (24) and filter coil assembly (25). Remove capacitors (62).

(11) Remove insulation sleeving from external leadwires of actuator assembly and using SPECIAL WRENCH AT3794, remove screw (26), shim (27) and grommet (28) from flanged cover (29).

(12) Remove flanged cover (29) from main housing (31) by removing screws (30).

(13) Remove main housing (31) with attached roller needle bearing (33) by removing screws (32). Do not remove roller needle bearing (33) unless damaged.

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2. DISASSEMBLY (continued)

(14) Remove spur gear (38) with attached parts from intermediate housing (46) and remove shims (34) and ball bearings (37).

(15) Remove spur gear (36) with attached parts from intermediate housing (46) and remove shims (34) and ball bearing (35).

(16) Remove motor assembly (39) from intermediate housing (46) by removing screws (40) and clamps (41).

(17) Using a suitable pin punch, remove pin (42) from nut (43) and remove nut (43), shims (44) and spur gear (45).

(18) Remove intermediate housing (46).

(19) Remove screw and nut assembly (59), with attached parts, from guide housing (63) and disassemble as follows:

(a) Remove keys (47 and 48), shim (49) ball bearing (50), shims (51), ball bearing (50), shims (52 and 51) from positive dog stop (53).

(b) Remove positive dog stop (53) from screw and nut assembly (59).

(c) Remove key (58), nut tube (56) and shim (57) from screw and nut assembly (59).

CAUTION: Use extreme care in removing key (58) to prevent damage to nut tube (56) or acme nut, portion of screw and nut assembly (59).

(d) Remove nut (54) and positive dog stop (55) from acme screw portion of screw and nut assembly (59).

NOTE: Acme nut and acme screw portions of screw and nut assembly (59) must be maintained as a matched set.

(20) Remove bushing (60) and seal washer (61) from guide housing (63).

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3. CLEANING

Actuator Assembly (Ref. 27-10-12 Fig. 1.)

(1) Clean all electrical parts and non-metallic parts using a stiff non-wire brush. Blow the loose foreign particles from the parts using dry, filtered, low pressure, compressed air. Wipe the parts with a clean, dry, lint-free cloth.

CAUTION: DO NOT USE A CLEANING SOLVENT OF ANY KIND TO CLEAN ANY ELECTRICAL PARTS OR NON-METALLIC PARTS.

(2) Clean all other parts using an ultrasonic cleaner or vapor liquid degreaser with spray attachments. Use a cleaning solvent which conforms to Federal Specification O-T-634, Type II.

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4. INSPECTION/CHECK

Actuator Assembly (Ref. 27-10-12, Fig. 1.)

(1) Visually examine all parts for damage or corrosion.

(2) Inspect all gear teeth for tooth deformation, stress cracks and scored teeth.

(3) Inspect all tapped holes and threaded parts for stripped or crossed threads.

(4) Inspect all leadwires for cracked insulation and test for continuity with an ohmmeter.

(5) Check inductance of filter coil assembly (25) using Impedence Bridge #1650-A. Inductance when measured between red and red/wht leadwires and green and green/wht leadwires shall be 60 uh to 70 uh.

(6) Inspect switches (18) for damaged cases and malfunction. Check electrical operation with an ohmmeter.

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5. REPAIR AND REPLACEMENT

(1) Replace all defective parts that do not meet the inspection criteria of 27-10-4.

(2) It is recommended that all ball bearings be replaced at each overhaul.

(3) Do not attempt to repair individual parts.

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6. ASSEMBLY

NOTE: Test motor assembly (38) (Ref. 27-10-8 Para. B.) before assembling the actuator.

Actuator Assembly. (Ref. 27-10-12, Fig. 1.) Assemble the actuator as follows: Initially install the same thickness of shims as removed and recorded during disassembly, unless otherwise specified. Refer to list of bulk materials and Ref. 27-10-11 for special and standard tools and fixtures.

(1) General

(a) Coat all gears and working parts lightly with grease conforming to Military Specification MIL-G-23827, unless otherwise specified.

(b) Coat screw and nut assembly (59) lightly with a mixture of Molykote Powder Type Z conforming to Military Specification. MIL-M-7866 and Aero-Lubriplate mixed half and half by volume.

(c) Apply anti-seize compound conforming to Military Specification MIL-T-5544 to all aluminum screw parts and to all steel screws that anchor into aluminum, unless otherwise specified.

(d) Make all electrical solder connections per Military Specification MIL-S-6872 using solder conforming to Federal Specification QQ-S-571.

(e) Lockwire all drilled head screws with wire conforming to Military Standard MS20995 using practices conforming with Military Standard MS33540.

(2) Assemble screw and nut assembly as follows:

(a) Install positive stop (55) onto screw and nut assembly (59) and adjust for maximum stop face engagement with acme nut portion of screw and nut assembly (59).

(b) Install self locking nut (54) and secure.

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6. ASSEMBLY (continued)

(c) Install shim (57) and nut tube (56) onto screw and nut assembly (59) and tighten hand tight. Thickness of shim (57) required shall result in alignment of nut tube slot with screw and nut assembly slot.

NOTE: When shimming requirement has been obtained, remove acme nut portio of screw and nut assembly (59) from nut tube (56) and lightly coat threads using adhesive GLYPTAL #ZV903 and reassembly.

(d) Install key (58) and secure using adhesive CEMENT #910.

WARNING: USE EXTREME CAUTION IN USING ADHESIVE CEMENT #910. REFER TO MANUFACTURES INSTRUCTIONS.

(e) Install shim (51), ball bearing (50), shim (51), ball bearing (50) and shim (49) onto positive stop (53).

(f) Install positive stop (53) with attached parts onto screw and nut assembly (59) and adjust for maximum stop face engagement with acme nut portion of screw and nut assembly (59).

(g) Install key (48).

(3) Install screw and nut assembly (59) with attached parts into guide housing (63) engaging guide housing slot with nut tange and install intermediate housing (46

(4) Install spur gear (45), keys (47), shims (44) and nut (43) onto screw and nut assembly (59). Add or remove shims (44) as necessary to align nut slot with hole in acme screw portion of screw and nut assembly (59).

(5) Using a suitable arbor press or pin punch install spring pin (42).

(6) Using a suitable magnetically mounted dial indicator, measure the end play of screw and nut assembly (59). Add shims (52) as necessary to remove all end play Air gap between intermediate housing (46) and guide housing (63) shall not exceed 0.002 in. maximum (Ref. Fig. 1).

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MODEL L10-20 ELECTRO-MECHANICAL LINEAR ACTUATOR

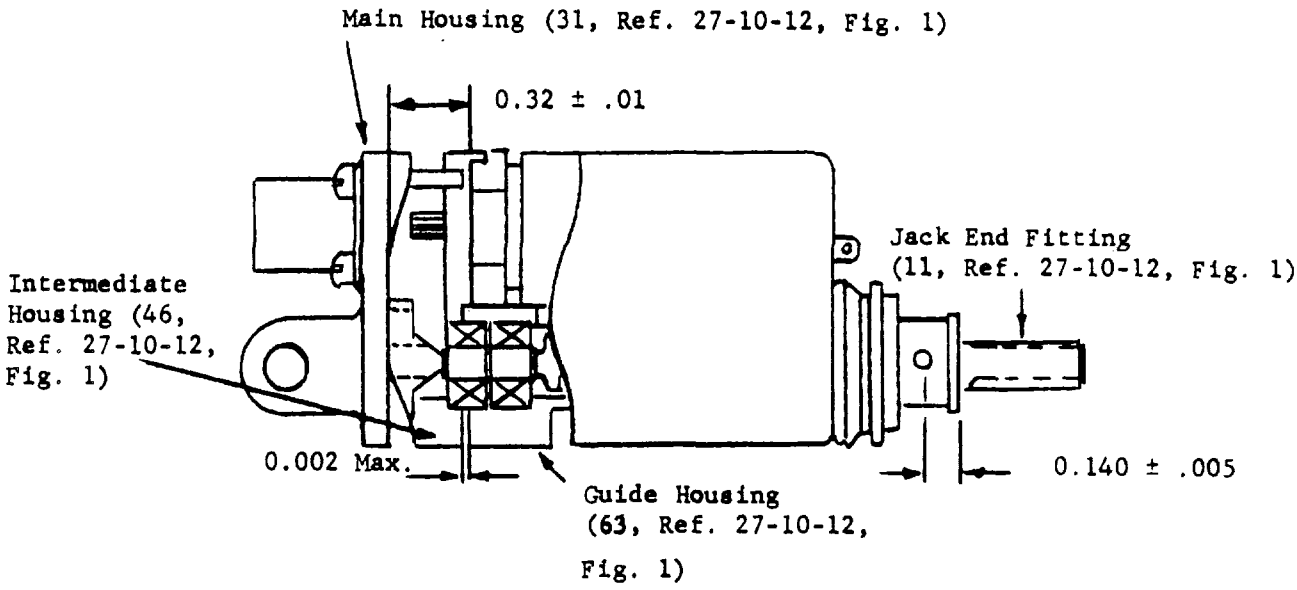


Figure 1. Air Gap and Pinning Diagram

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6. ASSEMBLY (continued)

(7) Install ball bearings (35 and 37) into applicable bores of intermediate housing (46) and main housing (31).

(8) Install motor assembly (39) onto intermediate housing (46) using clamps (41) and screws (40).

NOTE: Motor leadwires must face downward towards guide housing (63) before securing motor.

(9) Install spur gear (36) into intermediate housing (46) ensuring that spur gear (36) is fully seated and engaged with motor assembly pinion.

(10) Install spur gear (38) into intermediate housing (46) ensuring that spur gear (38) is fully seated and engaged with spur gear (36) and spur gear (45).

(11) Install ball bearings (35 and 37) on spur gear (36 and 38).

(12) If roller needle bearing (33) was removed from main housing (31) re-install, using suitable arbor press. Using a suitable depth micrometer, dimension from roller needle bearing face to main housing face shall be 0.31 to 0.33 maximum. (Ref. Fig. 1).

(13) Install shims (34) into applicable bores of main housing (31). Add or remove shims (34) as necessary to obtain 0.002 to 0.004 in end play of spur gears (36 and 38).

(14) Install main housing (31) with attached parts onto intermediate housing (46) and secure using screws (32).

NOTE: Ensure ball bearings (35 and 37) are fully seated in main housing (31).

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6. ASSEMBLY (continued)

(15) Coat seal washer (61) lightly with Beacon grease #325 and install into main housing (63).

(16) Install resilient bushing (60) into main housing (63) and temporary install nut (2).

(17) Install switches (18), switch actuators (21 and 22), capacitors (62), clip retainer (23), filter coil assembly (25) and terminals (24) onto guide housing (63) using screws (20) and nuts (19).

NOTE: Lightly coat both sides of switch actuators (21 and 22) using adhesive GLYPTAL #1276.

NOTE: Wrap capacitors (62) effeciently using mylar tape 0.62 or 0.50 in. wide to insure clamping with clamp (23).

(18) Secure nuts (19) using adhesive GLYPTAL #ZV903.

(19) Install switch actuator block (17) onto guide housing (63) engaging nut tang, portion of screw and nut assembly (59).

(20) Install set screws (16) into switch actuator block (17) sufficiently to make contact with switch actuators (21 and 22).

(21) Install shims (15) as necessary to obtain 0.001 to 0.003 in. clearance between clip retainer (13) and switch actuator block (17) Ref. Fig. 2). Install clip retainer (13) using screws (14).

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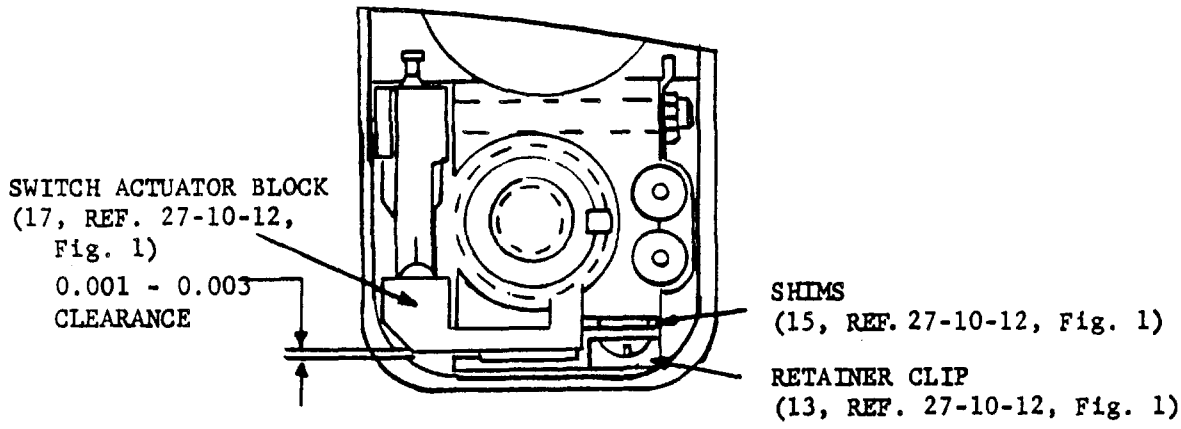


Figure 2 Shimming Diagram

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6. ASSEMBLY (continued)

(22) Secure screws (14) using adhesive GLYPTAL #ZV903.

(23) Install insulation, electrical paper 0.010 thk. X 0.50 in. w X 1.12 in. lg. (type "F") per Military Specification MIL-I-695 to motor assembly (39) to insulate switches (18). Secure insulation, electrical paper using adhesive GLYPTAL #1276.

(24) Install jack end fitting (11) and shims (12) into nut tube (56). Add or remove shims (12) as necessary to obtain 4.25 in. ± .03 dimension from center of hole in main housing (31) to end of jack end fitting (11).
NOTE: Unit in full mechanical retract position at this time.

(25) Ref. Fig. 3 for wiring connections.

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MODEL L10-20 ELECTRO-MECHANICAL LINEAR ACTUATOR

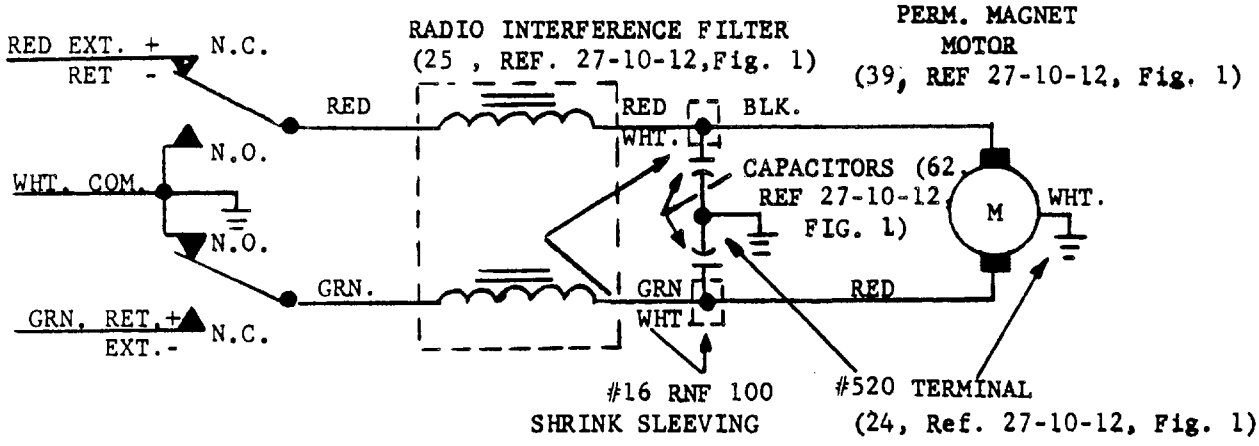


Figure 3 Wiring Diagram

MODEL L10-20 ELECTRO-MECHANICAL LINEAR ACTUATOR

6. ASSEMBLY (continued)

NOTE: After wiring has been completed, route external leadwires, green, white and red thru exit hole in main housing (31). At approximately 0.250 in. from face of main housing (31), single knot each leadwire.

(26) Install flanged cover (29) onto main housing (31) using screws (30).

(27) Install grommet (28), shim (27) and screw (26).

NOTE: Secure grommet using adhesive GLYPTAL #ZV903. SPECIAL WRENCH AT3794 to tighten screw (26).

(28) Install insulation sleeving #9 10.00 in. lg. per Military Specification MIL-I-7444 over external leadwires.

(29) Upon satisfactory completion of test procedures (Ref. 27-10-8 Para. A.), lockwire motor screws (40) with wire conforming to Military Standard MS20095 using practices conforming to Military Standard MS33540.

NOTE: Lockwire to route over roller needle bearing (33).

(30) Remove nut (2) temporary installed and apply SEALER #EC-1126 0.125 in. diameter to inside surface to main housing (31).

(31) If identification plates (8 and 9) were removed, secure new identification plates to cover (1).

(32) Install screw (6), washers (4 and 5) and nut (7) to cover (1) and secure using sealent per Military Specification MIL-S-22473 GRADE A.

NOTE: It may be necessary to install only one washer under head of screw (6) to provide clearance between filter coil assembly (25) and screw (6).

(33) Install cover (1) with attached parts, "O" ring (3) and nut (2) onto guide housing (63) and remove excess Sealer #EC-1126.

NOTE: Tighten nut (2) hand tight only.

(34) Using DRILLING AND PINNING FIXTURE AT3796, drill a 0.625 $^{+.0015}_{-.0000}$ inch diameter hole thru nut tube (56) and jack end fitting (11). Press in and centrally locate pin (10). Stake to secure. (Ref. Fig. 1).

(35) Lockwire all remaining screws and nuts with wire conforming to Military Standard MS20005 using practices conforming to Military Standard MS33540.

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6. ASSEMBLY (continued)

List of Bulk Material

MATERIAL	VENDOR	SPECIFICATION
Adhesive (GLYPTAL #ZV903)	General Electric Co. Chemical and Metallurgical Division Pittsfield, Mass.	
Adhesive #910	Tennessee Eastman Co. Kings Port, Tenn. Division of Eastman Kodak Co.	
Adhesive (GLYPTAL #1276)	General Electric Co. Chemical and Metallurgical Division Pittsfield, Mass.	
Compound (Anti-seize)	Black Bear Co. Inc. Long Island City, N.Y.	MIL-T-5544
Grease (Beacon #325)	Humble Oil and Refining Co. Chestnut Hill, Mass.	
Grease (Aero-Lubriplate)	Fiske Brothers Refining Co. Newark, N.J.	
Insulation (Electrical Paper)	Rummel Fiber Co. Newark, N.J.	MIL-I-695

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6. ASSEMBLY.

List of Bulk Material (continued)

MATERIAL	VENDOR	SPECIFICATION
Insulation Sleeving (#24 Vinylflex 4000)	Bently Harris Mfg. Co. Conshohocken, Penn.	
Insulation Sleeving (#9)		MIL-I-7444
Lockwire	Riverside Alloy Metal Div. Wire Works Prospect Park, Penn.	MS20995
Powder, Molykote (Type Z)	Alpha Molykote Corp. Stamford, Conn.	MIL-M-7866
Sealent (Grade "A" and Grade "B")	American Sealants Co. Hartford 6, Conn.	MIL-S-22473
Solvent, Cleaning	Ethyl Corporation New York, N.Y.	O-T-634
Sealer, #EC1126	Minnesota Minning Mfg. St. Paul, Minn.	
Solder (60% Tin - 40% Lead)	Kester Solder Co. Chicago, Ill.	QQ-S-571
Tubing, Heat Shrinkable #16 RNF-100	Rayclad Tubes Inc. Redwood City, Cal.	

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6. ASSEMBLY

List of Bulk Material (continued)

MATERIAL	VENDOR	SPECIFICATION
Tape, Mylar	Minnesota Minning Mfg. Co. St. Paul, Minn.	
Wire, Electrical (E22 extr. teflon grn, wht and red) (E24 extr. teflon blk)	Belden Mfg. Co. Clinton, Mass	MIL-W-16878

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7. FITS AND CLEARANCES.

Actuator Assembly (Ref. 27-10-12 Fig. 1.)

PARTS	METHOD	FIT/CLEARANCE
Nut Tube (56) and screw and nut assembly (59).	Use shim (57) as required.	Obtain alignment of slot of nut tube (56) with slot of acme screw, portion of screw and nut assembly (59).
Nut (43) and screw and nut assembly (59).	Use shims (44) as required.	Obtain alignment of slot of nut (43) with hole in acme screw portion of screw and nut assembly (59).
Intermediate housing (46), guide housing (63) and screw and nut assembly (59).	Use shims (52) as required.	Eliminate all end play of screw and nut assembly (59) and to obtain 0 to 0.002 in. max. air gap between guide housing (63) and intermediate housing (46).
Roller needle bearing (33).	Press in roller needle bearing as required.	Obtain 0.31 to 0.33 in. dimension from face of main housing (31).
Spur gears (36 and 38) and main housing (31).	Use shims (34) as required.	Obtain 0.002 to 0.004 in. end play of spur gears (36 and 38).
Clip retainer (13) and switch actuator block (17).	Use shims (15) as required.	Obtain 0.001 to 0.003 in. clearance between clip retainer (13) and switch actuator block (17).
Jack end fitting (11) And Nut Tube (56).	Use shim (12) as required	Obtain 4.25 ± .03 in. dimension from center of hole in main housing (31) to extreme end of jack end fitting (11).

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8. TESTING.

A. Actuator Assembly. (Ref. 27-10-12, Fig. 1) Ref. 27-10-11 for Special Tools, Fixtures and Test Equipment.

(1) General.

(a) Mount the actuator assembly in Load Test Fixture AT1390 using Pins AT1390-1 and Bushings AT1390-6. Use applicable adapter when mounting actuator assembly (Ref. 27-10-12 (**)).

(b) Mount the Dial Indicating Attachment AT3138 to Load Test Fixture AT1390.

(c) Use DC Test Panel AT3256 to provide necessary control of electrical power to operate the actuator assembly and to check current draw during operational tests.

NOTE: All operational tests are made at 26 volts dc.

(2) End Play: Using Push-Pull Scale #767, apply a 5 pound reversing axial load to the load support arm of Load Test Fixture AT1390. End play when measured under the applied load shall not exceed 0.005 inches.

(3) Mechanical Stops: Operate into each stop two times at no load speed. Damage or jamming must not occur at either stop. Check stop locations.

(4) Electrical Limits:

(a) Adjust Extend set screw (16) as required to obtain electrical extend stroke limit. (Ref. Fig. 1).

(b) Adjust Retact set screw (16) as required to obtain electrical retract stroke limit (Ref. Fig. 1).

NOTE: After final limit setting has been obtained, apply sealent per Military Specification MIL-S-22473 GRADE B. to the exposed threads of set screws (16).

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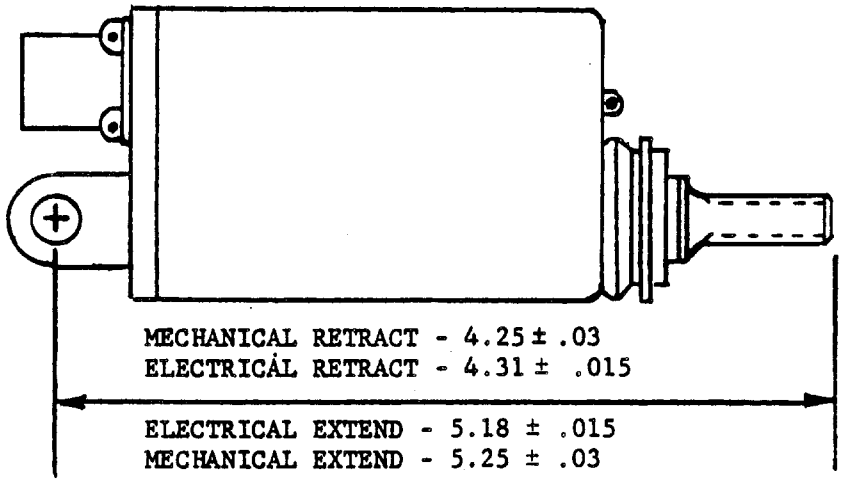


FIGURE 1 . STROKE SETTING DIAGRAM

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8. TESTING (continued)

(5) Maximum Load:

(a) Apply a 50 pound opposing load and operate actuator thru one complete cycle. Current shall not exceed 0.5 amperes.

(b) Apply a 50 pound aiding load and operate actuator thru one complete cycle. Current shall not exceed 0.5 amperes.

(6) Normal Load: Apply a 20 pound opposing load and operate actuator thru one complete cycle. Time shall be 7.43 to 13.81 seconds for a 0.87 in. stroke. Current must not exceed 0.25 amperes

B. Motor Assembly (Ref. 27-10-12 Fig. 1) Ref. 27-10-11 for Special Tools, Fixtures and Test Equipment.

(1) General

(a) Mount the motor assembly in the Bischoff-Sub-Fractional Dynamometer #10-B and mount Load Test Pulley AT3792 onto motor pinion.

(b) Use DC TEST PANEL AT3256 to provide necessary control of electrical power to operate the motor assembly and to check current draw during operational tests.

NOTE: All operational tests are performed at room temperature.

(2) Maximum Load: With 18 volts dc applied, the motor assembly shall operate against a 0.4 oz. in. load.

(3) Maximum Current: With 26 volts dc applied, the motor assembly shall operate against a 0.4 oz. in. load and the current draw shall not exceed 0.50 ampere.

(4) Rated Load: With 26 volts d.c. applied, the motor assembly shall operate against a 0.15 oz. in. load and the current draw shall not exceed 0.25 maximum ampere.

(5) Load Speed: With 26 volts dc applied and using STROBOTAC #1531-A, measure the motor assembly output shaft speed. Speed shall be 8,000 to 10,400 RPM with a 0.15 oz. in. rated load applied.

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MODEL L10-20 ELECTRO-MECHANICAL LINEAR ACTUATOR

9. TROUBLE SHOOTING

Actuator Assembly (Ref. 27-10-12, Fig. 1)

TROUBLE	PROBABLE CAUSE	REMEDY
INOPERATIVE, NO CURRENT	Open circuit	(Ref. 27-10-8, Fig. 1) Check continuity with an ohmmeter. Correct or replace motor assy. (39, Ref. 27-10-12, Fig. 1).
	Defective Limit Switches	Replace switches (18, Ref. 27-10-12, Fig. 1).
LOW SPEED HIGH CURRENT	Insufficient end play.	Disassemble and correct. (Ref. 27-10-6 steps (6) and (13)).
	Mechanical Binding	Disassemble, locate and correc
NOISY OPERATION	Excessive end play, improper shimming.	Disassemble and correct. (Ref. 27-10-6 steps (6) and (13)).
INOPERATIVE, EXCESSIVE CURRENT	Short Circuit	Remove motor assy, (39) and replace (Ref. 27-10-12, Fig. 1)
ERRATIC OPERATION OF LIMIT SWITCHES	Improper shimming	Disassemble and correct (Ref. 27-10-6 step (21)).

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10. STORAGE INSTRUCTIONS

No special storage instructions apply to the actuator assembly except that it be kept clean and away from excessive temperate ranges and high humidity.

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MODEL L10-20 ELECTRO-MECHANICAL LINEAR ACTUATOR

1. SPECIAL TOOLS, FIXTURES AND TEST EQUIPMENT

TOOL NUMBER	NOMENCLATURE	APPLICATION
AT1390 to include AT1390-1 Pin (2-Req'd) AT1390-6 Bushing (4-Req'd)	FIXTURE, Load Test	Used with Dial Indicating Attachment AT3138 and DC Test Panel AT3256 to check load, end play, mechanical stops and electrical limits of actuator assembly. Actuator shall use fitting assy. (Ref. 27-10-12(**) for tests.
AT3138	ATTACHMENT, Dial Indicating	Used with Load Test Fixture AT1390 and DC Test Panel AT3256 to check and measure load, end play and electrical limit requirements of actuator assembly.
AT3256	PANEL, Test, DC	Used to provide necessary control of electrical power to operate the actuator and/or motor assembly and to check current draw during operational testing.
AT3794	WRENCH, Special	Used to tighten nut (26) (Ref. 27-10-12, Fig. 1).
AT3796	FIXTURE, Drilling and Pinning	Used to support actuator assembly when drilling hole thru nut tube (56) and jack end fitting (11) (Ref. 27-10-12, Fig. 1). Also used to Press in groove pin (10). & stake (Ref. 27-10-12, Fig. 1).

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11. SPECIAL TOOLS, FIXTURES AND TEST EQUIPMENT (continued)

THE FOLLOWING STANDARD EQUIPMENT IS REQUIRED AND MAY BE PURCHASED FROM VENDORS OTHER THAN AIRBORNE ACCESSORIES CORPORATION.

TOOL NUMBER	NOMENCLATURE	APPLICATION
#500 Rayclad Tubes Inc. Redwood City, Calif.	THERMOGUN	Used to shrink fit heat shrinkable tubing over applicable leadwires on actuator assembly.
#767 John Chatillon and Sons, Inc. New York, N.Y.	SCALE, Push-Pull	Used with Load Test Fixture AT1390 to apply necessary load when checking end play requirement of actuator assembly.
#1650-A	BRIDGE, Impedence	Used to measure inductance of filter coil assembly (25, Ref. 27-10-12 Fig. 1).

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12. ILLUSTRATED PARTS LIST

A. Numerical Parts List (Ref. Fig 1).

Part Number	Figure and Index Number	Qty Per Article	Part Number	Figure and Index Number	Qty Per Article
AN340-2	1-7	5	2011411-4B4	1-16	2
	1-19		2011708	1-20	4
AN500A2-3	1-30	4	2030113	1-43	1
AN500A2-6	1-40	2	2030123	1-2	1
AN960-2	1-4	1	3010723	1-60	1
AN960-2L	1-5	1	3060109	1-28	1
E382M1	1-51	2	3090145	1-34	2
E878	1-52	1	3090154	1-15	3
E1024-4	1-27	1	3090176	1-57	1
E4955	1-12	1	3090301	1-44	1
E9090	1-61	1	3090301-4	1-49	1
E9500A2-2	1-6	1	4133105-2A3A	1-35	4
				1-37	
KR33H505	1-62	2			
L10-20	1-	Ref	4150811-1	1-17	1
MS9021-017	1-3	1			
MS9048-003	1-42	1	4370171-1	1-41	2
MS21042-04	1-54	1	4380210	1-23	1
MS24547-1	1-18	2	4380212	1-13	1
MS35223-2	1-14	3	4401303	1-25	1
520	1-24	2	4563023	1-1	1
7R4S1511CJ	1-50	1PR	4560215	1-29	1
1090967	1-45	1	4710532	1-11	1
1091837	1-36	1			
1091838	1-38	1	4990388-1	1-63	1
2010134-1	1-32	4	5051336	1-46	1
2010139	1-26	1			

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Hillside, New Jersey

MODEL L10-20 ELECTRO-MECHANICAL LINEAR ACTUATOR

12. ILLUSTRATED PARTS LIST.

A. Numerical Parts List (continued)

PART NUMBER	FIGURE AND INDEX NUMBER	QTY. PER ARTICLE	
5051420-1	I-31	1	
5170503	1-58	1	
5170520-2	1-47	1	
5170520-25	1-48	3	
5300305-1	1-39	1	
5412100C0437B	1-10	1	
5412046	1-33	1	
* 5470308	1-59	1	
5670312	1-55	1	
5670314	1-53	1	
5730256-1	1-21	1	(R)
5730256-2	1-22	1	(R)
5850669	1-56	1	
6021504	1-8	1	
6022101	1-9	1	

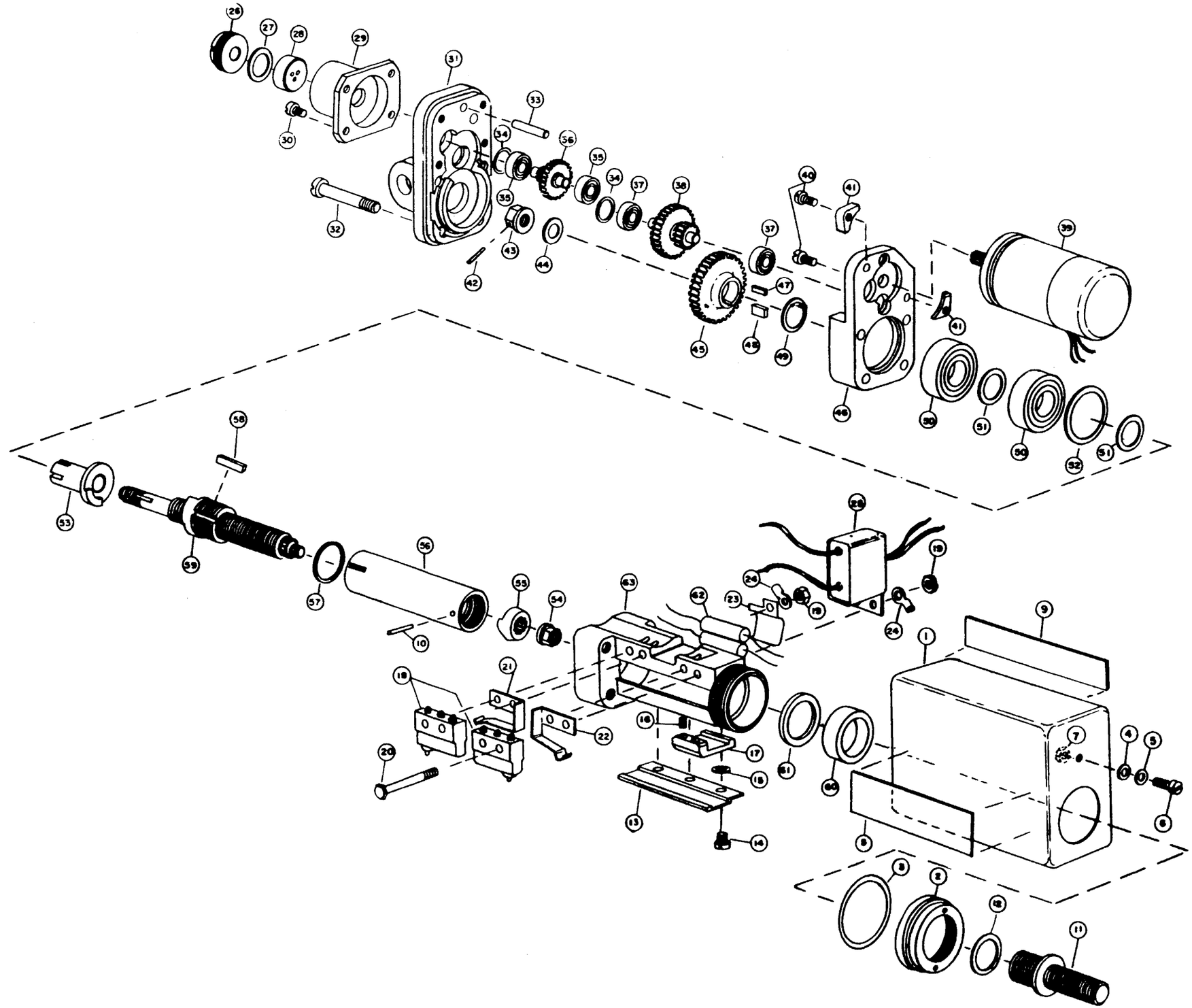


FIGURE 1. ELECTRO-MECHANICAL LINEAR ACTUATOR ASSEMBLY, EXPLODED VIEW

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12. ILLUSTRATED PARTS LIST

B. Group Assembly Parts List

Actuator Assembly (Ref. Fig. 1)

FIGURE AND INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	USAGE CODE	UNITS PER ASSY
1-	L10-20	ACTUATOR ASSEMBLY, LINEAR		Ref
-1	4563023	. COVER		1
-2	2030123	. NUT		1
-3	MS9021-017	. "O" RING		1
-4	AN960-2	. WASHER, FLAT		1
-5	AN960-2L	. WASHER, FLAT		1
-6	E9500A2-2	. SCREW, MACHINE		1
-7	AN340-2	. NUT, HEX		1
-8	6021504	. PLATE, IDENTIFICATION		1
-9	6022101	. PLATE, IDENTIFICATION		1
-10	5412100C0437B	. PIN, GROOVED		1
-11	4710532	. FITTING, JACK END		1
-12	E4955	. SHIM SET		1
-13	4380212	. CLIP, RETAINER		1
		ATTACHING PARTS		
-14	MS35223-2	. SCREW, MACHINE		3
		* * *		
-15	3090154	. SHIM SET		3
-16	2011411-4B4	. SCREW, SET		2
-17	4150811-1	. BLOCK, SWITCH ACTUATOR		1
-18	MS24547-1	. SWITCH, SENSITIVE		2
		ATTACHING PARTS		
-19	AN340-2	. NUT		4
-20	2011708	. SCREW, MACHINE		4
		* * *		

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12. ILLUSTRATED PARTS LIST.

B. Group Assembly Parts List

Actuator Assembly (continued)

FIGURE AND INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	USAGE CODE	UNITS PER ASSY	
-21	5730256-1	. SWITCH ACTUATOR		1	(R)
-22	5730256-2	. SWITCH ACTUATOR		1	(R)
-23	4380210	. CLIP RETAINER		1	
-24	520	. TERMINAL LUG V77147		2	
-25	4401303	. FILTER COIL ASSEMBLY		1	
-26	2010139	. SCREW		1	
-27	E1024-4	. SHIM		1	
-28	3060109	. GROMMET		1	
-29	4560215	. COVER, FLANGED		1	
		ATTACHING PARTS			
-30	AN500A2-3	. SCREW, MACHINE		4	
		* * *			
-31	5051420-1	. HOUSING, MAIN		1	
		ATTACHING PARTS			
-32	2010134-1	. SCREW, MACHINE		4	
		* * *			
-33	5412046	. ROLLER BRG, NEEDLE		1	
-34	3090145	. SHIM SET		2	
-35	4133105-2A3A	. BEARING, BALL		2	
-36	1091837	. GEAR, SPUR		1	
-37	4133105-2A3A	. BEARING, BALL		2	

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12. ILLUSTRATED PARTS LIST

B. Group Assembly Parts List

Actuator Assembly (continued)

FIGURE AND INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	USAGE CODE	UNITS PER ASSY
-38	1091838	. GEAR, SPUR		1
-39	5300305-1	. MOTOR ASSY, DC		1
		ATTACHING PARTS		
-40	AN500A2-6	. SCREW, MACHINE		2
-41	4370171-1	. CLAMP		2
		* * *		
-42	MS9048-003	. PIN, SPRING		1
-43	2030113	. NUT		1
-44	3090301	. SHIM SET		1
-45	1090967	. GEAR, SPUR, KEYED		1
-46	5051336	. HOUSING INTERMEDIATE		1
-47	5170520-2	. KEY, RECTANGULAR		3
-48	5170520-25	. KEY, RECTANGULAR		1
-49	3090301-4	. SHIM		1
-50	7R4S1511CJ	. BEARING, BALL V43334		1PR
-51	E382M1	. SHIM SET		2
-52	E878	. SHIM SET		1
-53	5670314	. STOP, Positive		1
-54	MS21042-04	. NUT, SELF LOCKING		1
-55	5670312	. STOP, POSITIVE		1
-56	5850669	. NUT TUBE		1
-57	3090176	. SHIM, LAMINATED		1
-58	5170503	. KEY, SQUARE		1
-59	*5470308	. SCREW AND NUT ASSEMBLY		1
-60	3010723	. BUSHING, RESILIENT		1

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12. ILLUSTRATED PARTS LIST

B. Group Assembly Parts List

Actuator Assembly (continued)

FIGURE AND INDEX NO.	NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	USAGE CODE	UNITS PER ASSY
-61	E9090	. WASHER, SEAL		1
-62	KR33H505	. CAPACITOR V05397		2
-63	4990388-1	. HOUSING, GUIDE		1
**	4720327	. FITTING ASSEMBLY (NOT ILLUSTRATED)		1

* Indicates matched components. Parts are procured only as a complete assembly.

** To be used for test purposes only.

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12. ILLUSTRATED PARTS LIST.

C. Vendor Code Numbers. If a part is purchased from a vendor other than Airborne Accessories Corporation, the vendor's name and address are identified by a code given in the description column. Vendor code numbers used in the group assembly parts list, together with the name and address of each vendor are given below.

CODE	NAME AND ADDRESS
V05397	Union Carbide, Kemet Dept. Cleveland, Ohio
V43334	New Departure, Division of General Motors Corp. Bristol, Conn.
V77147	Patton Mac Guyer Co. Providence, R.I.

De Havilland Canada

DHC-6 TWIN OTTER

OVERHAUL MANUAL

FLAP/ELEVATOR INTERCONNECT BALL SCREW JACK

PART NO. C6CF1080

THE DE HAVILLAND AIRCRAFT OF CANADA LIMITED
DOWNSVIEW ONTARIO

Mar 31/69

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3	Cleaning	1
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8	Testing	5
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De Havilland Canada

DHC-6 TWIN OTTER
OVERHAUL MANUAL
C6CF1080

RECORD OF REVISIONS

Retain this record in the front of the manual. On receipt of revisions, insert revised pages in the manual and enter the revision number, revision date, insertion date, and initials of person incorporating the revision, in the appropriate block on the revision record.

Rev. No.	Rev. Date	Insertion Date	By
1	MAR 20/74	JULY 29/74	TS.
2	DEC. 14/81	MAR. 16/83	DHC.

Rev. No.	Rev. Date	Insertion Date	By

LIST OF EFFECTIVE PAGES

Reference	Page	Date
Title	1	Mar 31/69
Effective Pages	*1	Dec 14/81
Record of Revisions	1	Mar 31/69
Introduction	1	Mar 31/69
Contents	1	Mar 31/69
27-36-11	1	Mar 31/69
27-36-11	2	Mar 31/69
27-36-11	3	Mar 20/74
27-36-11	4	Mar 20/74
27-36-11	5	Mar 20/74
27-36-11	6	Mar 31/69
27-36-11	*7	Dec 14/81

The asterisk (*) indicates pages revised, added or deleted by current revision.

INTRODUCTION

This manual contains instructions for the overhaul of the De Havilland Flap/Elevator Interconnect Ball Screw Jack Part No. C6CF1080.

BOMBARDIER – Temporary Revision

PSM NO. 1–6–6A AIRCRAFT DHC–6 Twin Otter SERIES ALL

PUBLICATION COMPONENT MAINTENANCE MANUAL TEMPORARY REVISION NO. 27–3

Insert in 27–36–11, before page 1

FLAP/ELEVATOR INTERCONNECT BALL SCREW JACK

PART NO. C6CF1080

REASON FOR ISSUE:

This Temporary Revision introduces Part no. C6CF1080–3 according to Modification 6/1866.

ACTION:

1. Ignore existing page 1 and substitute new page 2 of 6 as shown on this Temporary Revision.
2. Ignore existing page 4 and substitute new page 3 of 6 as shown on this Temporary Revision. Insert page 3 of 6 facing existing page 4.
3. Ignore existing page 6 and substitute new page 5 of 6 as shown on this Temporary Revision. Insert page 5 of 6 facing existing page 6.
4. Page 7, ignore existing table List of Parts in paragraph B. and substitute new table as shown on page 6 of 6 on this Temporary Revision.

– Continued overleaf –

RECORDING INSTRUCTIONS:

Record this Temporary Revision No. and the relevant information in the appropriate columns of the TEMPORARY REVISION INDEX provided at the front of the manual.

FLAP/ELEVATOR INTERCONNECT BALL SCREW JACK

PART NO. C6CF1080

1. Description and Operation (Figure 1)

   The flap/elevator interconnect ball screw jack converts flap system linear motion into rotary motion. The ball screw jack consists of a ball screw assembly, a spindle, an end plate and boss, or an end support assembly. The ball screw assembly consists of a threaded shaft which engages ballbearings enclosed in a tube integral with a ball cage. The ball cage is keyed into the spindle and integral cable drum; both rotate on a bearing mounted on the end plate support bracket. Linear movement of the ball screw assembly causes the spindle to rotate together with the integral cable drum.

2. Disassembly

   A. Disassemble Flap/Elevator Interconnect Ball Screw Jack (Figure 2)

      (1) Cut lockwire and remove headless bolts (1) and spring pin (2) from spindle (22).

      (2) Remove nut (3) and withdraw ball screw assembly (4) from spindle.

      (3) Tape ends of ball screw assembly screw, to prevent ball cage and balls from rotating off screw.

      (4) Remove cotter pin (5), nut (6), washer (7) from end of ball screw assembly.

      (5) Remove end fitting (8) from ball screw assembly, by removing bolt (9).

      (6) Remove end plate retaining nut, cotter pin (10), nut (11) and washer(s) (12).

      (7) Remove end plate (13) and boss (14), or end support assembly (15).

      (8) Remove cable guard pins retaining nuts (16), washers (17) and guard pins (18) from end plate, or end support assembly.

      (9) Remove bearing retaining ring (19), bearing (20) and bolt (21) from spindle (22).

3. Cleaning

   A. General

      (1) Clean components, except bearing (20), (Figure 2), by washing or spraying with a dry–cleaning solvent.

      (2) Dry with compressed, filtered, dry air or a lint–free cloth.

4. Inspection /Check

   A. General

      (1) Inspect metal components using the fluorescent penetrant method, or an approved dye penetrant method.

FLAP/ELEVATOR INTERCONNECT BALL SCREW JACK

PART NO. C6CF1080

1. Description and Operation (Figure 1)

The flap/elevator interconnect ball screw jack converts flap system linear motion into rotary motion. The ball screw jack consists of a ball screw assembly, a spindle, an end plate and boss, or an end support assembly. The ball screw assembly consists of a threaded shaft which engages ball bearings enclosed in a tube integral with a ball cage. The ball cage is keyed into the spindle and integral cable drum; both rotate on a bearing mounted on the end plate support bracket. Linear movement of the ball screw assembly causes the spindle to rotate together with the integral cable drum.

2. Disassembly

A. Disassemble Flap/Elevator Interconnect Ball Screw Jack (Figure 2)

(1) Cut lockwire and remove headless bolts (1) and spring pin (2) from spindle (22).

(2) Remove nut (3) and withdraw ball screw assembly (4) from spindle.

(3) Tape ends of ball screw assembly screw, to prevent ball cage and balls from rotating off screw.

(4) Remove cotter pin (5), nut (6), washer (7) from end of ball screw assembly.

(5) Remove end fitting (8) from ball screw assembly, by removing bolt (9).

(6) Remove end plate retaining nut, cotter pin (10), nut (11) and washers (12).

(7) Remove end plate (13) and boss (14), or end support assembly (15).

(8) Remove cable guard pins retaining nuts (16), washers (17) and guard pins (18) from end plate, or end support assembly.

(9) Remove bearing retaining ring (19), bearing (20) and bolt (21) with washers (12) from spindle (22).

3. Cleaning

A. General

(1) Clean components, except bearing (20), (Figure 2), by washing or spraying with a dry-cleaning solvent.

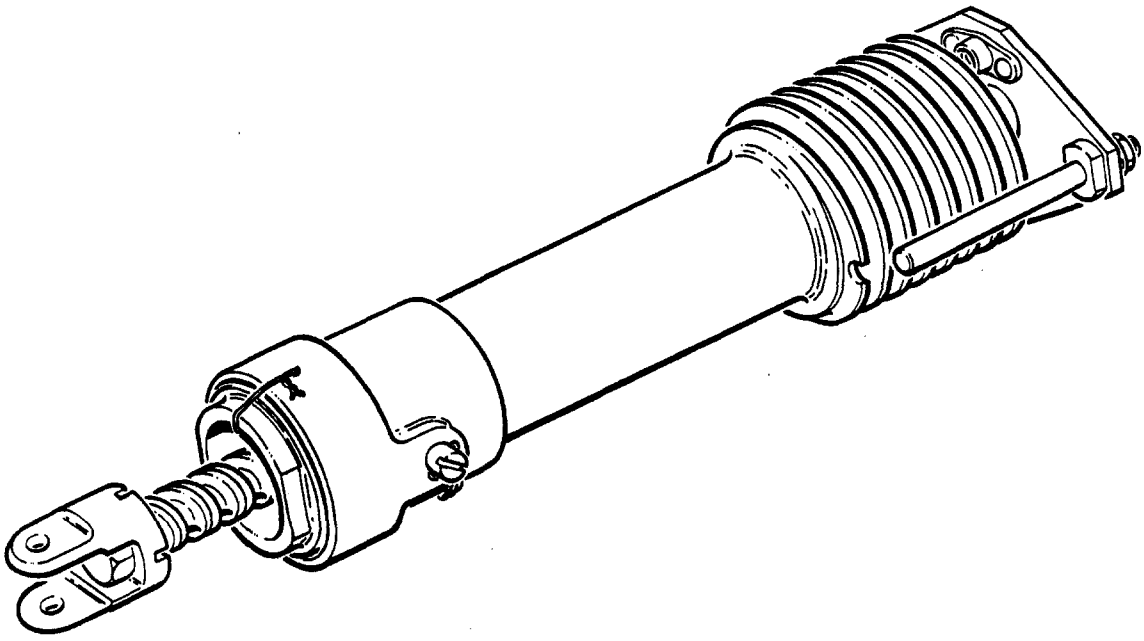
(2) Dry with compressed, filtered, dry air or a lint-free cloth.

4. Inspection/Check

A. General

(1) Inspect metal components using the fluorescent penetrant method, or an approved dye penetrant method.

NOTE: Please see the TEMPORARY REVISION that revises this page



Flap/Elevator Interconnect Ball Screw Jack

Figure 1

(2) Inspect all parts visually for signs of fatigue and cracks, and for damage such as galls, scores, scratches, excessive wear, and corrosion.

(3) Inspect all threads for damage and deformity.

(4) Refer to Table 1 for original tolerances and service limits. Repair or replace parts worn in excess of service limits as prescribed in Table 1. Replace all defective parts not listed in table.

Table 1

Original Tolerances and Service Limits

FIGURE 2 ITEM NO.	NAME	DISCREPANCY LOCATION	ORIGINAL DIMENSION (INCHES)	SERVICE LIMITS (INCHES)	DISPOSITION
8	End Fitting	Keyway Attachment holes	0.090 - 0.095 0.1897 - 0.1903	0.097 0.1913	Replace Replace
22	Spindle	Bearing housing	0.8998 - 0.9006	0.9007	Replace
4	Ball screw assembly	Key	0.087 - 0.085	0.083	Replace
20	Bearing	OD ID	0.9014 - 0.9009 0.2495 - 0.2500	0.9008 0.2510	Replace Replace

(5) Cycle ball nut of ball screw assembly (4) along screw shaft from end to end and check for smooth operation.

5. Repair

A. General

(1) Replace all defective parts.

(2) Replace cadmium-plated parts which have had coating damaged or removed, or replate the part.

(3) When anodized parts have had protective surface treatment removed, apply a protective coating of Alodine solution No. 1200 to affected area(s) or reanodize the part.

(4) Replace standard parts such as cotter pins, washers, and lockwire.

Insert facing page 4

6. Assembly

List of Materials

Material	Specification
Corrosion Preventative Compound	MIL–C–16173 Grade 2
Grease	MIL–G–23827
Grease	Aeroshell 7
Loctite Grade H Sealant	MIL–S–22473
Corrosion Resistant Lockwire 0.032	MS20995C32

A. Assemble Flap/Elevator Interconnect Ball Screw Jack (Figure 2)

(1) Apply corrosion preventive compound MIL–C–16173 Grade 2 to bolt (21) and insert bolt through bearing (20).

(2) Apply grease MIL–G–23827 through holes in outer race of bearing (20) and install bearing in spindle (22).

(3) Install bearing retaining ring (19).

(4) Install cable guard pins (18), washers (17) and retaining nuts (16) to end plate (13), or end support assembly (15).

(5) Install boss (14) and end plate (13), or end support assembly (15), to bolt (21).

(6) Install washer(s) (12), nut (11) and cotter pin (10).

(7) Assemble end fitting (8) to bolt (9).

(8) Insert bolt (9) through ball screw assembly (4), engaging ball screw key in one of the two slots in end fitting. Lightly lubricate ball screw assembly with Aeroshell 7 grease or equivalent.

(9) Install washer (7) and nut (6). Remove tape from ends of ball screw assembly.

NOTE: The installation of a one washer (7) and nut (6) (AN310–3), is a requirement of modification 6/1168, which should be followed if the modification has not been incorporated.

NOTE: When ball screw assembly (4) is installed in spindle (22), the dimension between the bolt hole in the end fitting (8) to the outside face of cable drum of spindle (22) should be 7. 28 to 7.40 inches, with cable slots of drum in line with bolt hole in end fitting.

(10) Carry out trial installation of ball screw assembly to insure conditions detailed in NOTE are met. If not, engage other slot in end fitting with ball screw key.

(11) Tighten nut (6) and install cotter pin (5).

(12) Apply Loctite Grade H to ball screw assembly (4) mating face and install in spindle (22). Line up holes in ball screw nut with headless bolt (1) holes in spindle.

(13) Install headless bolts (1).

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. Assembly

List of Materials

Material	Specification
Corrosion Preventative Compound	MIL-C-16173 Grade 2
Grease	MIL-G-23827
Loctite Grade H Sealant	MIL-S-22473
Corrosion Resistant Lockwire 0.032	MS20995C32

A. Assemble Flap/Elevator Interconnect Ball Screw Jack (Figure 2)

(1) Apply corrosion preventive compound MIL-C-16173 Grade 2 to bolt (21) and install two washers (12) under head, insert bolt through bearing (20).

(2) Apply grease MIL-G-23827 through holes in outer race of bearing (20) and install bearing in spindle (22).

(3) Install bearing retaining ring (19).

(4) Install cable guard pins (18), washers (17) and retaining nuts (16) to end plate (13), or end support assembly (15).

(5) Install boss (14) and end plate (13), or end support assembly (15), to bolt (12).

(6) Install two washers (12), nut (11) and cotter pin (10).

(7) Assemble end fitting (8) to bolt (9).

(8) Insert bolt (9) through ball screw assembly (4), engaging ball screw key in one of the two slots in end fitting. Lightly lubricate ball screw assembly with oil MIL-L-7870A.

(9) Install washer (7) and nut (6). Remove tape from ends of ball screw assembly.

NOTE: The installation of a one washer (7) and nut (6) (AN310-3), is a requirement of modification 6/1168, which should be followed if the modification has not been incorporated.

NOTE: When ball screw assembly (4) is installed in spindle (22), the dimension between the bolt hole in the end fitting (8) to the outside face of cable drum of spindle (22) should be 7.28 to 7.40 inches, with cable slots of drum in line with bolt hole in end fitting.

(10) Carry out trial installation of ball screw assembly to insure conditions detailed in NOTE are met. If not, engage other slot in end fitting with ball screw key.

(11) Tighten nut (6) and install cotter pin (5).

(12) Apply Loctite Grade H to ball screw assembly (4) mating face and install in spindle (22). Line up holes in ball screw nut with headless bolt (1) holes in spindle.

(13) Install headless bolts (1).

NOTE: Please see the TEMPORARY REVISION that revises this page

(14) Install nut (3) and tighten.

(15) Using hole in spindle as guide, drill 0.65 - 0.62 inch diameter hole through nut. (Not required if hole in nut lines up with hole in spindle.)

(16) Insert spring pin (2) into hole and lockwire nut (3) to spindle (22).

(17) Lockwire headless bolts (1).

(18) Operate assembly through full range and check for free and smooth movement.

7. Fits and Clearances

Refer to Table 1.

8. Testing

Not Applicable.

9. Trouble Shooting

Not Applicable.

10. Storage Instructions

A. Preparation

(1) Completely wrap component in water vapor resistant barrier material.

(2) Affix label to package, giving following information:

(a) Part and serial numbers.

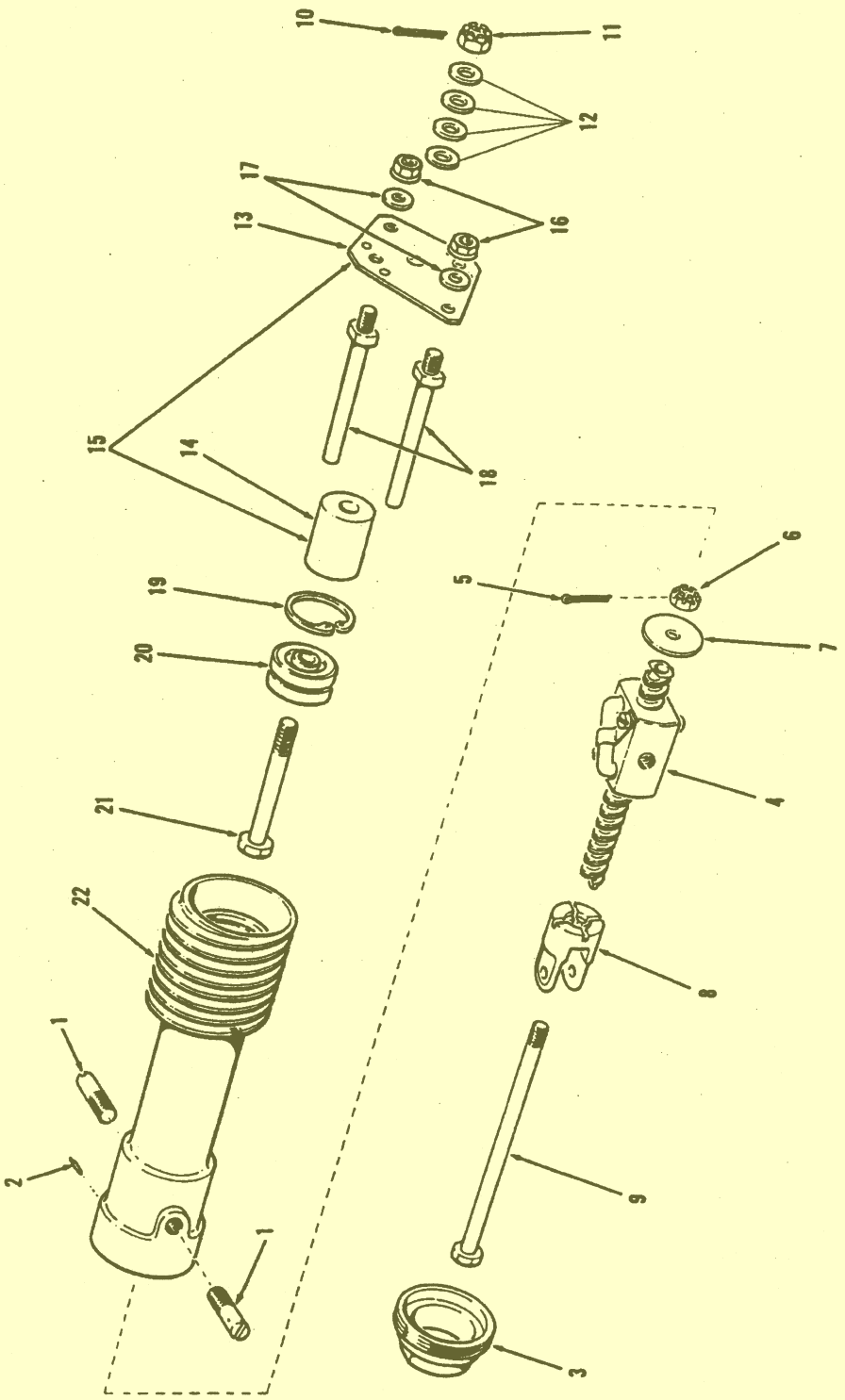
(b) Date of overhaul.

(c) Inspection.

11. Special Tools

No special tools are required.

Insert facing page 6

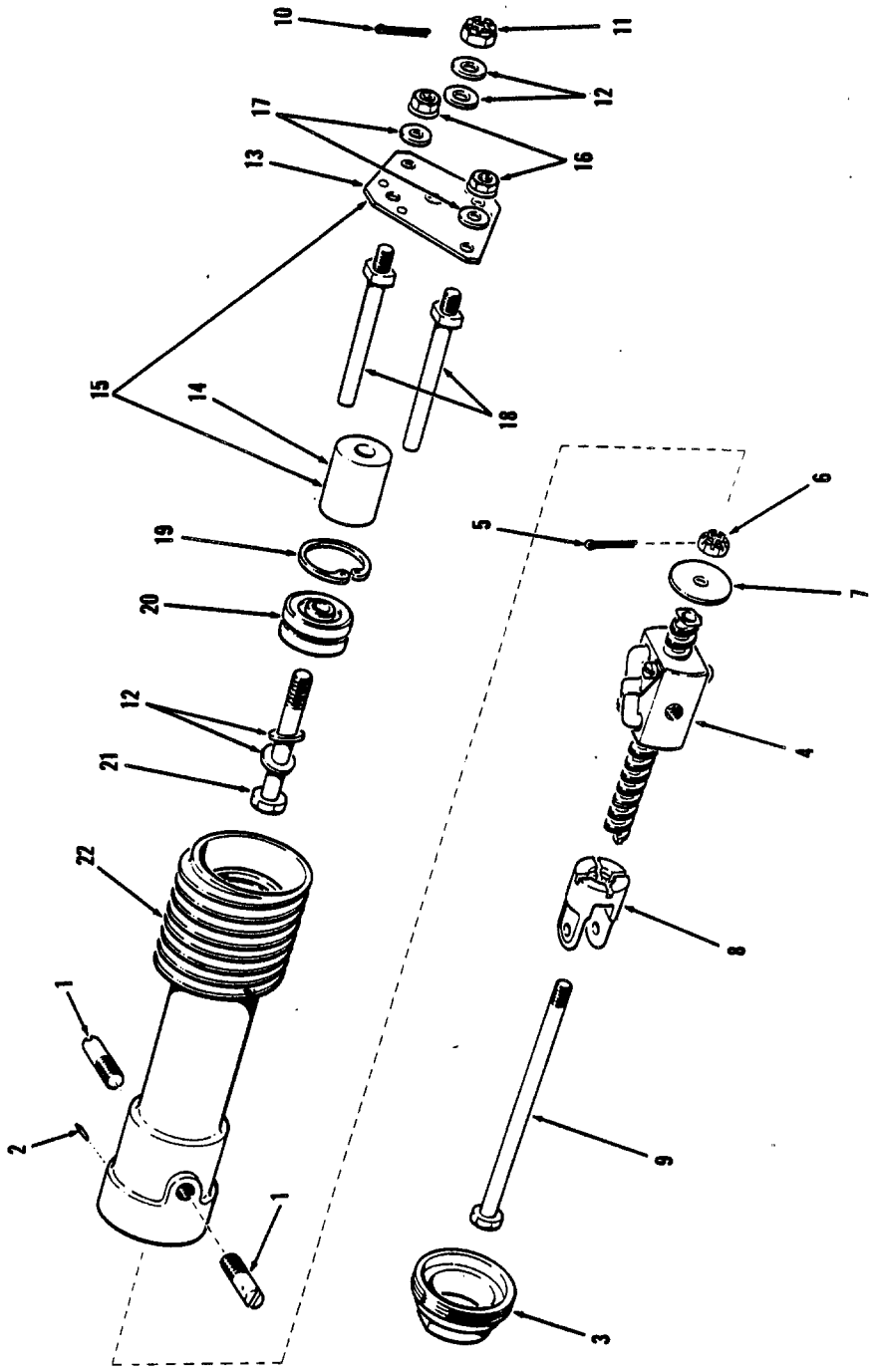


Exploded View – Flap Elevator Interconnect Ball Screw Jack C6CF1080
Figure 2

B. List of Parts

FIGURE & INDEX NO.	PART NUMBER	NOMENCLATURE	USAGE CODE	UNITS PER ASSEMBLY
		1 2 3 4 5 6 7		
2–	C6CF1080–1	Flap Elevator Interconnect Ball (Pre Mod 6/1866)		–
	C6CF1080–3	Flap Elevator Interconnect Ball (Post Mod 6/1866)		–
1	C6CFM1116–27	. Headless Bolt		2
2	MS16562–4	. Spring Pin		1
3	C6CFM1115–27	. Nut		1
4	C6CS1021–1	. Ball Screw Assembly		1
5	MS24665–134	. Cotter Pin		1
6	AN310–3	. Nut		1
7	AN970–3	. Washer		1
8	C6CFM1118–27	. End Fitting		1
9	AN3–50	. Bolt		1
10	MS24665–134	. Cotter Pin (Pre Mod 6/1866)		1
–10A	MS24665–153	. Cotter Pin (Post Mod 6/1866)		1
11	MS17826–4	. Nut (Pre Mod 6/1866)		1
–11A	MS14144L4	. Nut (Post Mod 6/1866)		1
12	AN960PD416L	. Washer (Pre Mod 6/1866)		4
–12A	AN960D416	. Washer (Post Mod 6/1866)		1
13	C6CF1196–1	. End Plate		1
14	C6CFM1168–27	. Boss		1
15	C6CFM1119–1	. End Support Assembly*		1
16	MS21042–3	. Nut		2
17	AN960PD10L	. Washer		2
18	C6CFM1120–27	. Guard Pin		2
19	RRN–90	. Retaining Ring (04994)		1
20	BR–4	. Bearing (77896)		1
–20	DAS4–14A	. Bearing (08156) (Alternative)		1
21	AN174–20	. Bolt (Pre Mod 6/1866)		1
–21A	NAS1304–27D	. Bolt (Post Mod 6/1866)		1
22	C6CFM1079–27	. Spindle		1

* Fitted on earlier screw jacks in place of items 13 and 14.



Exploded View - Flap/Elevator Interconnect Ball Screw Jack C6CF1080

Figure 2

NOTE: Please see the TEMPORARY REVISION that revises this page

12. Illustrated Parts List

A. Vendor Parts

VENDOR CODE	NAME AND ADDRESS
04994	Thomson Products St. Catherines Ontario Canada
08156	Rexnord Canada 1181 Sheppard Ave., East Willowdale Ontario Canada
77896	Shafner Bearing Downers Grove Illinois USA

B. List of Parts

FIGURE & INDEX NO.	PART NUMBER	NOMENCLATURE	USAGE CODE	UNITS PER ASSEMBLY
		1 2 3 4 5 6 7		
2-	C6CF1080-1	Flap/Elevator Interconnect Ball Screw Jack		-
1	C6CFM1116-27	· Headless Bolt		2
2	MS16562-4	· Spring Pin		1
3	C6CFM1115-27	· Nut		1
4	C6SC1021-1	· Ball Screw Assembly		1
5	MS24665-134	· Cotter Pin		1
6	AN310-3	· Nut		1
7	AN970-3	· Washer		1
8	C6CFM1118-27	· End Fitting		1
9	AN3-50	· Bolt		1
10	MS24665-134	· Cotter Pin		1
11	MS17826-4	· Nut		1
12	AN960PD4-161	· Washer		4
13	C6CF1196-1	· End Plate		1
14	C6CFM1168-27	· Boss		1
15	C6CFM1119-1	· End Support Assembly*		1
16	MS21042-3	· Nut		2
17	AN960PD10L	· Washer		2
18	C6CFM1120-27	· Guard Pin		2
19	RRN-90	· Retaining Ring (04994)		1
20	BR-4	· Bearing (77896)		1
-20	DAS4-14A	· Bearing (08156) (Alternative)		1
21	AN174-20	· Bolt		1
22	C6CFM1079-27	· Spindle		1

* Fitted on earlier screw jacks in place of items 13 and 14.

NOTE: Please see the TEMPORARY REVISION that revises this page

De Havilland Canada

DHC-6 TWIN OTTER

OVERHAUL MANUAL

GEARED TAB GEARING MECHANISM ASSEMBLY

PART NO. C6CF1174-1 AND C6CF1174-3

THE DE HAVILLAND AIRCRAFT OF CANADA LIMITED
DOWNSVIEW ONTARIO

May 1/69

BOMBARDIER
AEROSPACE
de Havilland Inc.
123 Garratt Boulevard
Downsview, Ontario
Canada
M3K 1Y5

To: Distribution

Date: December 17, 2001

Subject: Revision 2 to the Twin Otter Component Maintenance Manual, PSM 1-6-6A, Bombardier Aerospace/de Havilland Inc., Geared Tab Gearing Mechanism Assembly CMM, Part Number C6CF1147, ATA 27-26-11 dated December 17, 2001

This Revision is to PSM 1-6-6A, De Havilland Canada Component Maintenance Manual, Geared Tab Gearing Mechanism Assembly CMM, ATA 27-26-11, Revision No. 1 dated January 21, 1977.

An asterisk next to the specific page number in the List of Effective Pages and in the left hand margin of the revised pages indicates the new material added by this Revision.

Incorporate this Revision as follows:

1. Insert Technical Publications Manual Change Request (MCR) form following Volume one, frontispiece page.
2. Remove and destroy the following pages; List of Effective Pages, Record of Revisions, page 7 and 8 and insert the following revised pages; List of Effective Pages, Record of Revisions, & page 7 and 8 in their place.
3. Insert the new and revised documents as follows. Refer to the Revision Highlights section of this transmittal letter to identify the Component Maintenance Manual into which this document is to be inserted.
4. Record the incorporation of the Revision in the Record of Revision pages in the front of the CMM for Bombardier Aerospace/de Havilland Inc., Geared Tab Gearing Mechanism Assembly CMM, Part Number C6CF1147, ATA 27-26-11.

Revision Highlights:

This Revision 2 to the Twin Otter Component Maintenance Manual PSM 1-6-6A, Bombardier Aerospace/de Havilland Inc., Geared Tab Gearing Mechanism Assembly CMM, Part Number C6CF1147, ATA 27-26-11 dated December 17, 2001 substitutes locally approved solvents for 1-1-1 Trichlorethylene, incorporates revised Assembly procedures and expanded IPC numbering allocation within the text of the Assembly procedures section.

NOTE: We recommend that this letter of transmittal be retained for record purposes and inserted in the front of the manual.

R. Lesica

Robert Lesica

for/ Ms. Martine Hallé
Manager
Technical Publications
Customer Support Department

MH/BS/rl

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RECORD OF REVISIONS

Retain this record in the front of the manual. On receipt of revisions, insert revised pages in the manual and enter the revision number, revision date, insertion date, and initials of person incorporating the revision, in the appropriate block on the revision record.

Rev No.	Revision Date	Insertion Date	By
1	Jan 21/77	Apr 8/77	DHC
2	Dec 17/01		

Rev No.	Revision Date	Insertion Date	By

Rev No.	Revision Date	Insertion Date	By

Rev No.	Revision Date	Insertion Date	By

RECORD OF REVISIONS

De Havilland Canada

DHC-6 TWIN OTTER

OVERHAUL MANUAL

C6CF1174

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Record of Revisions	*1	Dec 17/2001
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27–26–11	*8	Dec 17/2001
27–26–11	9	Jan 21/1977
27–26–11	10	Jan 21/1977
27–26–11	11	Jan 21/1977

The asterisk (*) indicates pages revised, added or deleted by current revision.

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LIST OF EFFECTIVE PAGES

27–26–11

INTRODUCTION

This manual contains instructions for the overhaul of the De Havilland Geared Tab Gearing Mechanism Assembly Part No. C6CF1174-1 and C6CF1174-3.

GEARED TAB GEARING MECHANISM ASSEMBLY

PART NO. C6CF1174-1 AND C6CF1174-3

1. Description and Operation (Figure 1)

   A. Description

      The geared tab gearing mechanism assembly consists of a mounting plate, support assembly, gear quadrant and pinion, gearing lever assembly, and operating lever assembly. Top and bottom covers are provided to protect the gearing mechanism.

   B. Operation

      Movement of the control surface is transmitted by the operating lever, through the gearing mechanism, to change the ratio of movement of the tab to control surface as it moves the tab in the opposite direction to the control surface.

2. Disassembly

   A. Disassemble Geared Tab Gearing Mechanism Assembly (Figure 2)

      (1) Cut and remove lockwire from two screws securing top cover and remove two screws (1), two washers (2) and top cover (3).

      (2) Remove cotter pin (4), nut (5), washer (6), and operating lever (7) from bolt (14).

      (3) Remove two nuts (8), two washers (9), two screws (10), and remove bottom cover (11) complete with felt ring (12) and felt strip (13).

      (4) Withdraw bolt (14) and remove gear quadrant (15) with bushing (16), and shim washer (17).

      (5) Remove cotter pin (18), nut (19), washer (20), then remove pinion (21), key (22), and shim washer (23) from lever assembly (25).

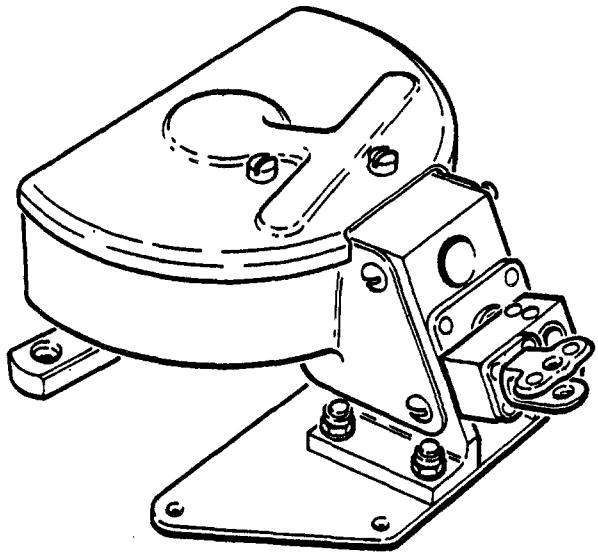
      (6) Withdraw lever assembly (25) from support assembly (42) and remove countersunk washer (24) from shaft of lever assembly.

      (7) Remove cotter pin (29), nut (30), washer (31), and withdraw bolt forked end (32) from lever assembly (25).

         NOTE: Removal of rivets (26), plate (27), and bearing (28) from lever assembly is only necessary on replacement of bearing (Ref paragraph 5).

      (8) Remove four nuts (33), four washers (34), four screws (35), and remove mounting plate (36) from support assembly (42).

         NOTE: Removal of ring (37), bearing (38), rivets (39), plate (40), and bearing (41) from support assembly (42) is only necessary on replacement of bearings (Ref paragraph 5).



Geared Tab Gearing Mechanism Assembly

Figure 1

3. Cleaning

A. General

(1) Do not immerse sealed bearings ((28), (38) and (41), Figure 2) in solvent. Clean lever assembly and support assembly with bearings installed using a cloth moistened with solvent.

(2) Clean remaining parts by washing or spraying with a dry-cleaning solvent. Dry with moisture-free compressed air or a lint-free cloth.

4. Inspection/Check

A. General

(1) Inspect all threads for damage and deformity.

(2) Inspect all parts visually for signs of fatigue and cracks, and for damage such as galls, scores, scratches, excessive wear and corrosion.

(3) Refer to Table 1 for original tolerances and service limits. Replace parts worn in excess of service limits. Replace all defective parts not listed in table.

Table 1

Original Tolerances and Service Limits

FIGURE 2 ITEM NO.	NAME	DISCREPANCY LOCATION	ORIGINAL DIMENSION (INCHES)	SERVICE LIMITS (INCHES)	DISPOSITION
7	Operating Lever	Bolt Hole Bolt Hole	0.3120 - 0.3130 0.2495 - 0.2505	0.3140 0.2515	Replace Replace
15	Gear Quadrant	Bushing Housing	0.4375 - 0.4385	0.4390	Replace
16	Bushing	I.D.	0.3120 - 0.3125	0.3130	Replace
21	Pinion	Shaft Hole Key Slot	0.3120 - 0.3125 0.0948 - 0.0958	0.3130 0.0963	Replace Replace
22	Key	Width	0.0948 - 0.0938	0.0933	Replace
25	Lever Assembly	Shaft O.D. Key Slot Bearing Housing	0.3117 - 0.3112 0.0938 - 0.0948 0.6245 - 0.6250	0.3107 0.0953 0.6255	Replace Replace Replace
28	Bearing	I.D.	0.2495 - 0.2500	0.2505	Replace
32	Bolt Forked End	O.D. Bolt Holes	0.2492 - 0.2487 0.2495 - 0.2505	0.2482 0.2515	Replace Replace
38 & 41	Bearing	I.D.	0.3120 - 0.3125	0.3130	Replace
42	Support Assembly	Bearing Housing	0.8745 - 0.8750	0.8755	Replace

BOMBARDIER – Temporary Revision

PSM NO. 1–6–6A AIRCRAFT DHC–6 Twin Otter SERIES ALL

PUBLICATION COMPONENT MAINTENANCE MANUAL TEMPORARY REVISION NO. 27–2

Insert in 27–26–11, facing page 4

GEARED TAB GEARING MECHANISM ASSEMBLY

PART NO. C6CF1174–1 AND C6CF1174–3

REASON FOR ISSUE:

This Temporary Revision adds information for locktite MIL–S–22473.

ACTION:

Ignore existing List of Materials on page 4, paragraph 5. and substitute new List of Materials as shown on this Temporary Revision.

5. Repair

List of Materials

MATERIAL	SPECIFICATION OR MANUFACTURER
Alodine 1200S	MIL–C–5541
Loctite Grade H Sealant	MIL–S–22473
Grease	MIL–G–3278
Lockwire, Corrosion Resistant	MS20995C32
Bostik 1142	B.B. Chemical Co., Montreal, P.Q.

RECORDING INSTRUCTIONS:

Record this Temporary Revision No. and the relevant information in the appropriate columns of the TEMPORARY REVISION INDEX provided at the front of the manual.

B. Detail Parts (Figure 2)

(1) Inspect teeth of gear quadrant (15) and pinion (21) for correct meshing, excessive wear, and distortion.

(2) If damaged, replace felt ring (12) and felt strip (13) on bottom cover (11) (Ref paragraph 5).

(3) If bushing (16), bearings (28), (38) or (41) are damaged or worn in excess of service limits, replace as detailed in paragraph 5.

5. Repair

List of Materials

MATERIAL	SPECIFICATION OR MANUFACTURER
Alodine 1200S	MIL-C-5541
Loctite	MIL-S-22473
Grease	MIL-G-3278
Lockwire, Corrosion Resistant	MS20995C32
Bostik 1142	B.B. Chemical Co., Montreal, P.Q.

A. General

(1) Replace all defective parts.

(2) Replace all standard parts such as cotter pins, washers and nuts.

(3) Replate cadmium-plated parts which have had coating damaged or removed, or replace the part.

(4) When anodized parts have had protective surface treatment removed, apply a protective coating of Alodine solution No. 1200S to affected area(s), or reanodize the part.

B. Detail Parts (Figure 2)

(1) If damaged, replace felt ring (12) and felt strip (13) on bottom cover (11) as follows:

(a) Remove felt ring, felt strip, and adhesive from bottom cover using toluol or methyl ethyl ketone.

WARNING: ADEQUATE VENTILATION MUST BE PROVIDED AND THE USE OF PROTECTIVE CLOTHING STRICTLY ADHERED TO AT ALL TIMES DUE TO THE TOXIC NATURE OF THE SOLVENTS.

(b) Cut felt ring (1/16-inch thick) to 1.88 inch outer diameter. Cut internal diameter of 1.25 inch to suit gear quadrant.

(c) Cut felt strip (1/16-inch thick) 1.25 inch long x 0.50 inch wide.

NOTE: Please see the TEMPORARY REVISION that revises this page

(d) Clean bond area of bottom cover using a napthol spirits soaked cloth, and wipe dry with a clean cloth before solvent evaporates.

(e) Apply two or more coats of Bostik 1142 to felt ring and felt strip until sufficient adhesive remains on contact surface. Apply a thin even coat of Bostik 1142 to contact surface of bottom cover.

(f) Allow adhesive to dry so that when lightly touched it adheres but does not transfer to finger.

(g) Join parts together and press down firmly with the fingers to insure intimate contact throughout.

(h) Allow 2 to 4 hours for bond to dry.

(2) If damaged, or worn in excess of limits specified in Table 1, replace bushing (16) in gear quadrant (15) as follows:

(a) Remove bushing and adhesive from gear quadrant using toluol or methyl ethyl ketone.

WARNING: ADEQUATE VENTILATION MUST BE PROVIDED AND THE USE OF PROTECTIVE CLOTHING STRICTLY ADHERED TO AT ALL TIMES DUE TO THE TOXIC NATURE OF THE SOLVENTS.

(b) Insure housing for bushing in gear quadrant is within the limits specified in Table 1.

(c) Clean contact surfaces of gear quadrant and new bushing using a napthol spirits soaked cloth, and wipe dry with a clean cloth before solvent evaporates.

(d) Apply an even coat of Bostik 1142 to contact surfaces of bushing, and gear quadrant, and join parts together immediately. Press bushing firmly into gear quadrant.

(e) Allow 2 to 4 hours for bond to dry. Carefully remove excess adhesive using toluol or methyl ethyl ketone.

(3) If damaged, or worn in excess of limits specified in Table 1, replace bearing (28) in lever assembly as follows:

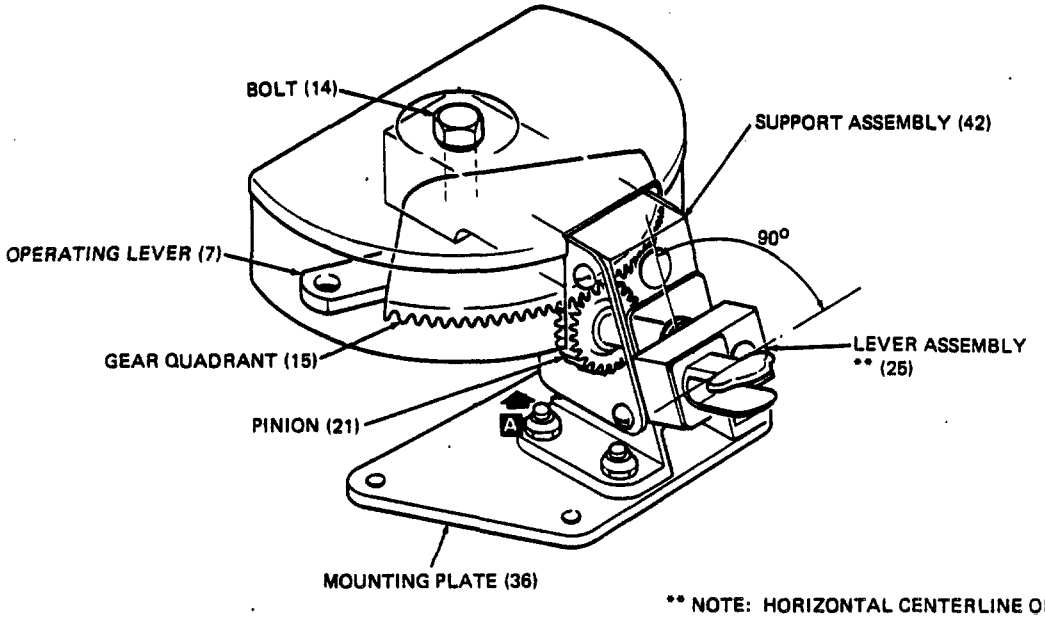
(a) Remove four rivets (26) and remove plate (27) from lever assembly.

(b) Remove defective bearing using a suitable arbor press or similar tool.

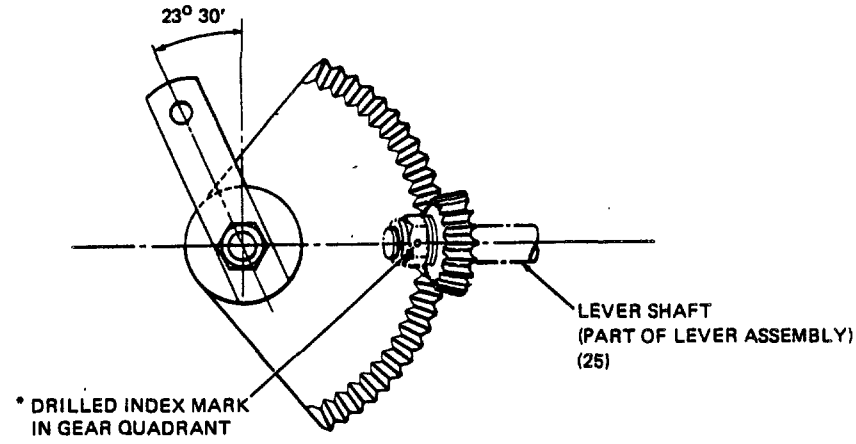
(c) Insure housing for bearing is within the limits specified in Table 1.

(d) Install bearing (28) in housing on lever assembly; position plate (27) on lever assembly and squeeze install four rivets (26) to secure plate over bearing.

(4) If damaged, or worn in excess of limits specified in Table 1, replace bearings (38) and (41) in support assembly (42) as follows:



** NOTE: HORIZONTAL CENTERLINE OF LEVER ASSEMBLY POSITIONED AT AN ANGLE OF 90 DEGREES TO VERTICAL CENTERLINE OF SUPPORT ASSEMBLY.



'NOTE: DRILLED INDEX MARK MUST BE ALIGNED WITH LEVER SHAFT CENTER LINE,WITH PINION ENGAGING QUADRANT GEAR.

VIEW ON ARROW 'A'

Gear Quadrant Alignment

Figure 1A

(a) To remove bearing (38), first remove ring (37) from support assembly.

(b) To remove bearing (41), first remove rivets (39) and plate (40) from support assembly.

(c) Remove defective bearing using a suitable arbor press or similar tool. Remove hardened Loctite on housing by gently scraping with a hard fibre scraper.

(d) Insure housing for bearing is within the limits specified in Table 1.

(e) Clean the housing thoroughly with locally approved solvent and insure that solvent does not enter the sealed bearing and contaminate the lubricant.

WARNING: ADEQUATE VENTILATION MUST BE PROVIDED AND THE USE OF PROTECTIVE CLOTHING STRICTLY ADHERED TO AT ALL TIMES DUE TO THE TOXIC NATURE OF THE SOLVENTS.

(f) Apply an even coating of Locquic activator, Grade C to contact surfaces of housing and bearing. Allow the activator to dry for 5 minutes minimum.

(g) Apply a film of Loctite to contact surfaces of housing and bearing. Assemble bearing in housing. Carefully remove excess Loctite.

(h) Install ring (37) to secure bearing (38) in support assembly.

(i) Position plate (40) on support assembly and squeeze install four rivets (39) to secure plate over bearing (41).

(j) Allow the assembly to cure for a minimum of two hours before further installation.

6. Assembly

A. Assemble Geared Tab Gearing Mechanism Assembly (Figure 2)

(1) Position mounting plate (36) on support assembly (42), and secure with four screws (35), four washers (34) and four nuts (33).

(2) Position bolt forked end (32) in lever assembly (25), and secure with washer (31), nut (30) and cotter pin (29).

(3) Position countersunk washer (24) on shaft of lever assembly (25). Insure countersink faces shoulder on shaft. Position lever assembly (25) in support assembly (42).

(4) Install shim washer (23), key (22), and pinion (21) on shaft of lever assembly (25) and secure with washer (20) and nut (19). Leave cotter pin (18) until completion of backlash check.

(5) Install gear quadrant (15) in support assembly (42) and insure correct alignment of bearing mechanism using the following procedure (Refer to Figure 1. A.):

(a) Position and maintain lever assembly (25) with its horizontal centerline at 90 degrees to vertical centerline of support assembly (42).

(b) Position shim washer (17) and gear quadrant (15) in support assembly (42). Mesh gear quadrant (15) with pinion (21) on lever assembly (25), with index mark in undersurface of quadrant in line with center of shaft lever assembly (25), insuring that lever assembly (25) is correctly positioned (Refer to step (a)). Insert bolt (14).

(c) Install operating lever (7), washer (6) and nut (5) onto bolt (14). Do not safety with cotter pin (18) at this step. Check that operating lever (25) is displaced approximately 23.5 degrees from transverse centerline of bolt (14) and away from support assembly (42), with lever assembly (25) positioned as in step (a). This insures correct mid-travel position of gearing mechanism.

(d) Maintaining the position of gearing mechanism set in step (c) mark an index line on top surface of gear quadrant (15) in line with one edge of the support assembly (42).

(6) Check backlash between gear quadrant (15) and pinion (21) is not more than 0.002 inch maximum. If required adjust thickness of shim washers (17) and (23) to achieve this condition.

NOTE: **If shims are adjusted, insure that gear quadrant (15) and pinion (21) are remeshed and aligned correctly as described in step (5).**

(7) Remove nut (5), washer (6), operating lever (7), gear quadrant (15) and shim washer (17) from bolt (14).

(8) Install cotter pin (18) to nut (19) securing pinon (21).

(9) Hand lubricate gear quadrant (15) and pinion teeth (21) lightly with grease MIL–G–3278.

(10) Lift bolt (14) to a position where it does not protrude below bottom of bearing (38) in support assembly (42).

(11) Install shim washer (17), gear quadrant (15), and bottom cover (11) together into support assembly (42) with index line on top of gear quadrant (15) in line with the same edge of support assembly (42) as used in step (5) (d). Ensure that the shaft lever assembly (25) is correctly positioned (Refer to step (a)).

(12) Release bolt (14) and insert through shim washer (17) and bushing (16), gear quadrant (15) and bottom cover (11).

(13) Secure bottom cover (11) with two screws (10), two washers (9) and two nuts (8).

(14) Install operating lever (7) on bolt (14) and secure with washer (6), nut (5) and cotter pin (4).

NOTE: **Check that operating lever (7) is displaced approximately 23.5 degrees from transverse centerline of bolt (14) and away from support assembly (42), with lever washer (7) assembly positioned as in step (a). This ensures correct mid–travel position of gearing mechanism.**

(15) Install top cover (3), and secure with two washers (2), and two screws (1). Lockwire two screws (1) using MS20995C32 lockwire.

7. Fits and Clearances

See Table 1.

8. Testing

Not Applicable.

9. Trouble Shooting

Not Applicable.

10. Storage Instruction

A. Preparation

(1) Tie operating lever to bolt forked end to prevent free movement of gear quadrant and pinion assemblies.

(2) Wrap the unit in water vapor resistant barrier material.

(3) Affix label giving following information:

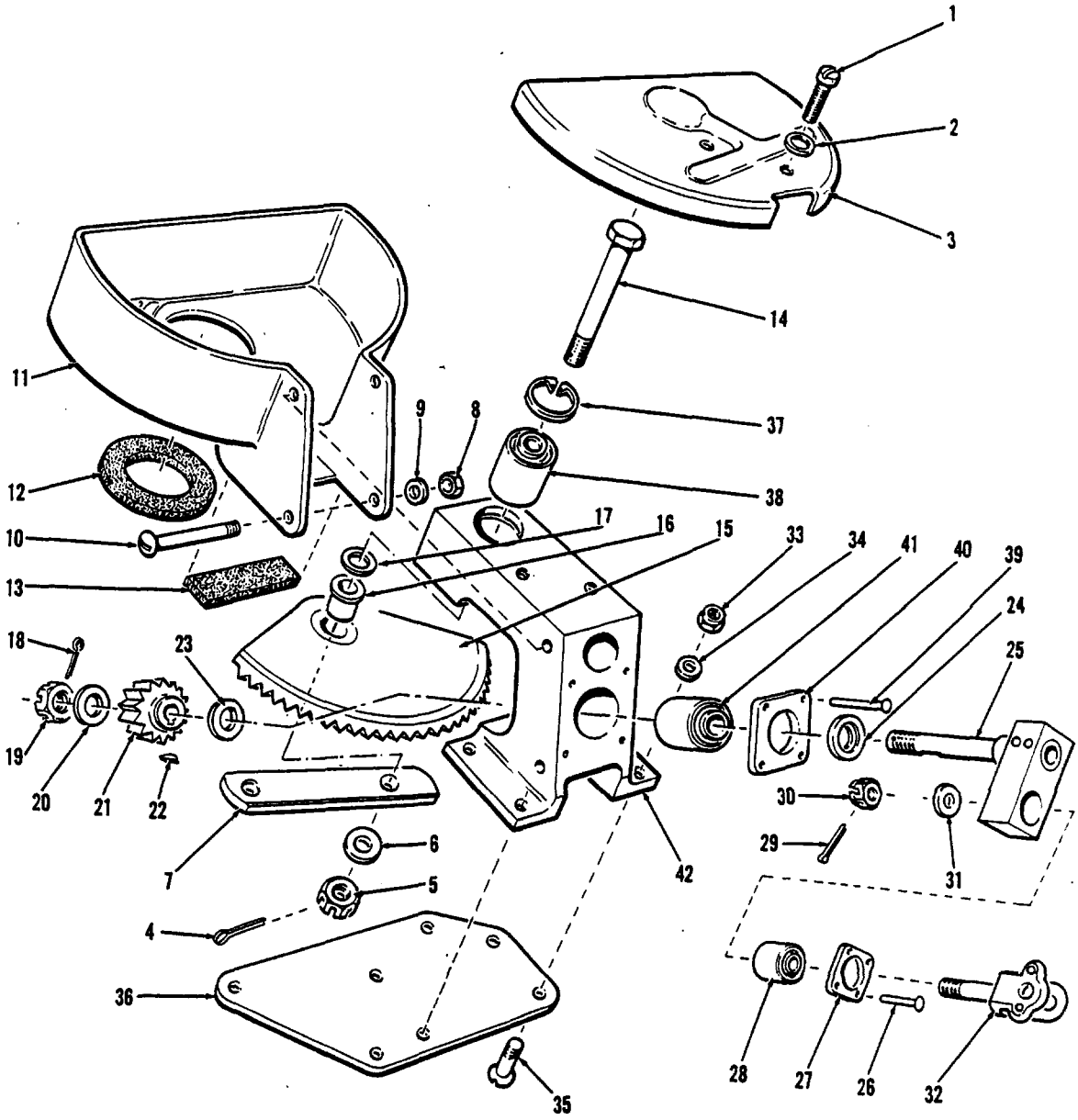
(a) Part and serial numbers.

(b) Date of overhaul.

(c) Inspection.

11. Special Tools

No special tools are required.



Exploded View - Geared Tab Gearing Mechanism Assembly

Figure 2

12. Illustrated Parts List

A. Vendor Parts

VENDOR CODE	NAME AND ADDRESS
21335	Fafnir Bearing Co., New Britain, Conn. U.S.A.

B. List of Parts

FIGURE & INDEX NO.	PART NUMBER	NOMENCLATURE	USAGE CODE	UNITS PER ASSEMBLY
		1 2 3 4 5 6 7		
2-	C6CF1174-1	Geared Tab Gearing Mechanism	A	-
	C6CF1174-3	Geared Tab Gearing Mechanism	B	-
1	AN503-8-6	.Screw	AB	2
2	AN960PD-8L	.Washer	AB	2
3	C6CF1183-29	.Cover - Top	AB	1
4	MS24665-134	.Pin - Cotter	AB	1
5	MS17825-5	.Nut	AB	1
6	AN960PD-516L	.Washer	AB	1
7	C6CFM1254-27	.Lever - Operating	A	1
7	C6CFM1409-27	.Lever - Operating	B	1
8	MS21042-06	.Nut	AB	2
9	AN960PD-6L	.Washer	AB	2
10	AN515-6-26	.Screw	AB	2
11	C6CF1184-13	.Cover - Bottom	A	1
11	C6CF1184-15	.Cover - Bottom	B	1
12	C6CF1184-29	..Ring - Felt	AB	1
13	C6CF1184-31	..Strip - Felt	AB	1
14	AN175-21	.Bolt	AB	1
15	C6CFM1177-1	.Quadrant - Gear	AB	1
16	C6CFM1178-27	..Bushing	AB	1
17	C6CF1174-27	.Washer - Shim	AB	1
18	MS24665-134	.Pin - Cotter	AB	1
19	MS17825-5	.Nut	AB	1
20	AN960PD-516L	.Washer	AB	1
21	C6CFM1176-27	.Pinion	AB	1
22	MS35756-2	.Key - Woodruff	AB	1
23	C6CFM1174-27	.Washer - Shim	AB	1
24	MS20002-C5	.Washer - Countersunk	AB	1
25	C6CFM1252-1	.Lever - Assembly	A	1
25	C6CFM1408-3	.Lever - Assembly	B	1
26	MS20426AD3	..Rivet	AB	4
27	C6CFM1169-27	..Plate	AB	1
28	DW4K2	..Bearing - (21335)	AB	1
29	MS24665-134	.Pin - Cotter	AB	1
30	MS17825-4	.Nut	AB	1
31	AN960PD-416	.Washer	AB	1
32	C6CFM1181-1	.Bolt - Forked End	AB	1
33	MS21042-3	.Nut	AB	4

FIGURE & INDEX NO.	PART NUMBER	NOMENCLATURE	USAGE CODE	UNITS PER ASSEMBLY
		1 2 3 4 5 6 7		
2-				
34	AN960PD-10L	.Washer	AB	4
35	AN509-10-11	.Screw	AB	4
36	C6CFM1255-27	.Plate - Mounting	A	1
36	C6CFM1410-27	.Plate - Mounting	B	1
42	C6CFM1175-1	.Support - Assembly	AB	1
37	NAS669-87	..Ring	AB	1
38	DW5	..Bearing - (21335)	AB	1
39	MS20426AD4	..Rivet	AB	4
40	C6CFM1185	..Plate	AB	1
41	DW5	..Bearing (21335)	AB	1

De Havilland Canada

DHC-6 TWIN OTTER

OVERHAUL MANUAL

SCREW JACK ASSEMBLY

PART NO. C6CT1010

THE DE HAVILLAND AIRCRAFT OF CANADA LIMITED
DOWNSVIEW ONTARIO

Mar 31/69

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27-09-01	*5	Dec 1/86
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The asterisk (*) indicates pages revised, added or deleted by current revision.

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Date: 1 December, 1986

To: Holders of PSM 1-6-6A-DHC6 Twin Otter Component Maintenance Manual

BOEING

Subject: Revision No. 4 dated Dec 1/86 to De Havilland CMM 27-09-01 for Screw Jack P.N. C6CT1010

This revision contains minor changes to the original dimensions and service limits for the cover and bearing. All pages are included in this revision. Incorporate this revision by destroying the existing manual, 27-09-01 and substituting this revised manual.

for/J. Kirkham,
Manager,
Technical Publications,
Customer Support Department.

INTRODUCTION

This manual contains instructions for the overhaul of the De Havilland Screw Jack Assembly Part No. C6CT1010.

SCREW JACK ASSEMBLY PART NO. C6CT1010-1 and -3

1. Description and Operation (Figure 1)

Screw jack assembly C6CT1010 converts rotary input motion into linear output motion, and is used in the operation of aircraft trim control systems. The screw jack consists of a cable drum drive assembly, a screw drive with a rod end, a plate for mounting, and a cover.

2. Disassembly

A. Disassemble Screw Jack (Figure 3)

(1) Remove roll pin (1) (rivet on earlier assemblies), and unscrew rod end (2) from screw drive (6).

(2) Remove loosely attached cable guard (3) and cover (4). Remove bearing (5) from cable drum drive (11).

(3) Unscrew screw drive (6) from cable drum drive (11).

(4) Remove retainer (7), unscrew nut (8) and remove bearing (9) and plate (10) from cable drum drive (11).

3. Cleaning

A. General

(1) Do not immerse sealed bearings (5 and 9 , Figure 3) in solvent. Wipe clean, externally only, with a cloth moistened with solvent.

(2) Clean components by washing or spraying with a dry-cleaning solvent. Dry with moisture-free compressed air or a lint-free cloth.

4. Inspection/Check

A. General

(1) Carry out a magnetic particle inspection of all magnetic metal components, where practicable.

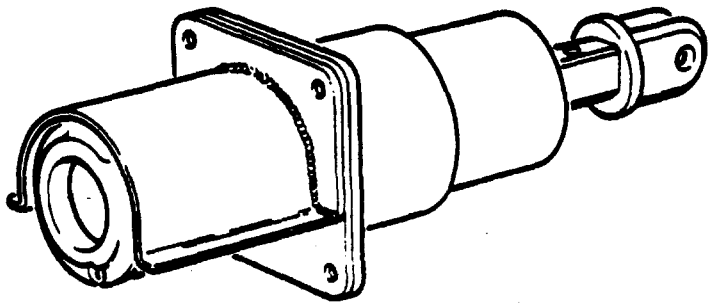
(2) Inspect non-magnetic metal components using the fluorescent penetrant method, or an approved dye penetrant method.

(3) Inspect all parts visually for signs of fatigue and cracks, and for damage such as galls, scores, scratches, excessive wear, and corrosion.

(4) Inspect all threads for damage and deformity.

(5) Refer to Table 1 for original tolerances and service limits. Repair or replace parts worn in excess of service limits specified in Table 1. Replace all defective parts not listed in table.

(6) Install (dry) screw drive into cable drum drive (6 and 11, Figure 3); check that end float between screw and drive is 0.002 to 0.005 inch. Disassemble parts.



Screw Jack Assembly

Figure 1

Table 1

Original Tolerances and Service Limits

FIGURE 3 ITEM NO.	NAME	DISCREPANCY LOCATION	ORIGINAL DIMENSION (INCHES)	SERVICE LIMIT (INCHES)	DISPOSITION
2	Rod End	Control Rod Attachment Hole	0.2500 - 0.2505	0.251	Replace
4	Cover	ID Bearing Surface	1.500 - 1.501	1.502	Replace
		ID Bearing Surface	1.750 - 1.751	1.752	Replace
		Square Shaft Hole	0.640 - 0.645	0.650	Replace
5	Bearing	OD	1.5000 - 1.4990	1.4980	Replace
		ID	1.0618 - 1.0632	1.0639	Replace
6	Screw Drive	Square Shaft	0.600 - 0.597	0.594	Replace
9	Bearing	OD	1.7500 - 1.7490	1.7480	Replace
		ID	1.3118 - 1.3132	1.3139	Replace
11	Cable Drum Drive	OD Bearing Surface	1.3118 - 1.3108	1.3101	Replace
		OD Bearing Surface	1.0618 - 1.0608	1.0601	Replace

5. Repair

A. General

(1) Replace all defective parts.

(2) Replace cadmium-plated parts which have had coating damaged or removed, or replate the part.

(3) When anodized parts have had protective surface treatment removed, apply protective coating of Alodine solution No. 1200S to affected area(s), or reanodize the part.

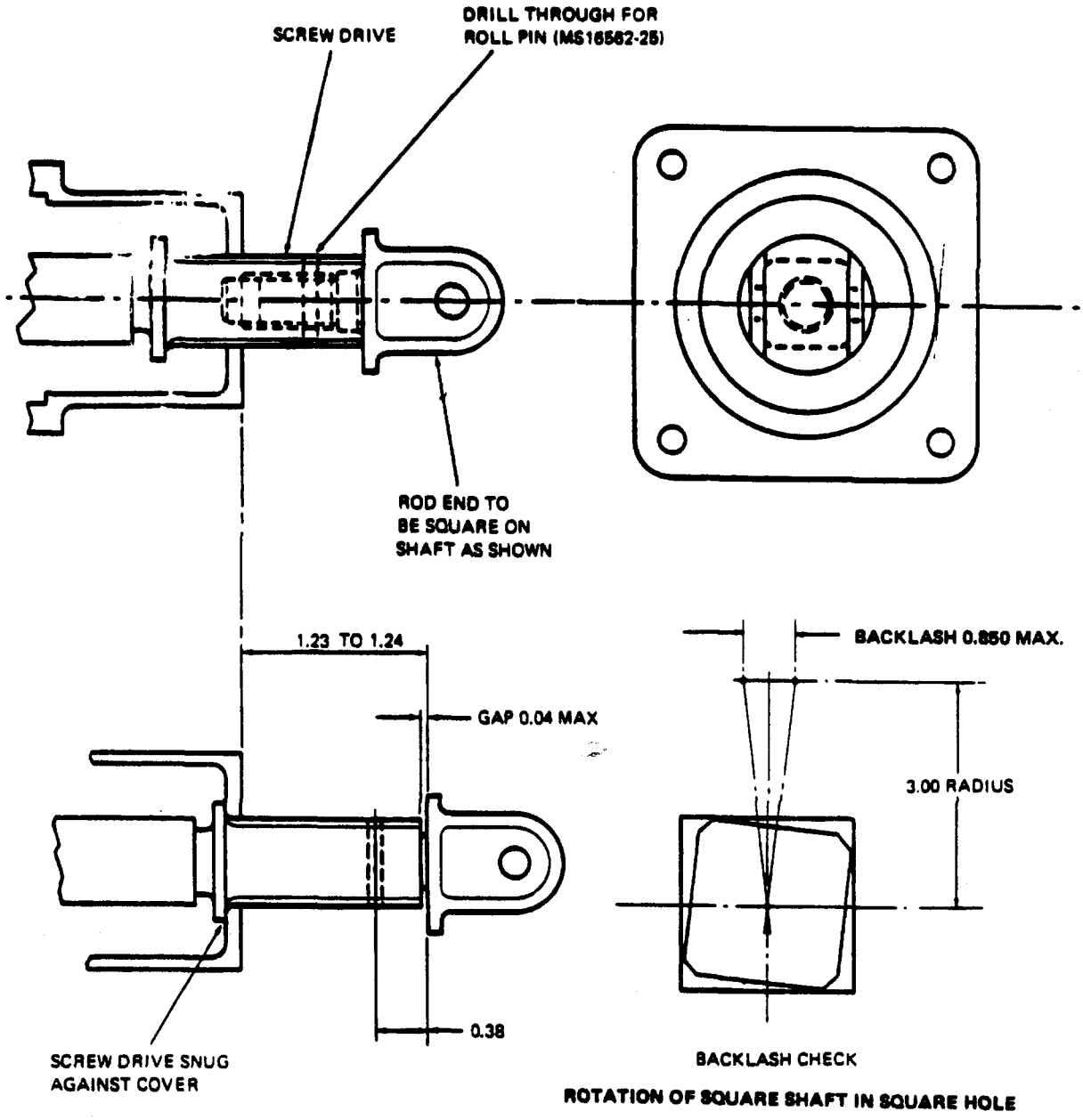
6. Assembly

List of Materials

Material	Specification
Grease	MIL-G-21164
Loctite Grade AA Sealant	MIL-S-22473

A. Assemble Screw Jack (Figure 3)

(1) Position plate (10) and bearing (9) on cable drum drive (11). Install nut (8) on cable drum drive and tighten to secure bearing (9). Lock nut (8) to cable drum drive with retainer (7).



ALL DIMENSIONS IN INCHES

Assembly of Rod to Screw Drive and Backlash Check

Figure 2

NOTE: If new cable drum drive (11) is a replacement, drill one No. 51 (0.067-inch diameter) hole through cable drum drive from nut (8) to accommodate retainer (7). Remove swarf.

(2) Thread screw drive (6) into cable drum drive (11). Install bearing (5) and cover (4).

(3) Temporarily install (dry) cable guard (3) and secure cable guard plate (10) and cover (4), together with four bolts AN3-5A and nuts MS21042-3.

(4) Check that end float between screw drive (6) and cover (4) does not exceed 0.008 inch.

(5) See Figure 2 and check that backlash between square shaft and square hole in cover does not exceed 0.850 inch measured at a radius of three inches.

(6) Disassemble parts installed in steps (2) and (3).

(7) Apply grease MIL-G-21164 to threads of screw drive (6) and thread screw drive into cable drum drive. Install bearing (5) and cover (4).

(8) Temporarily install cable guard (3) and secure cable guard plate (10) and cover (4), together with wire.

NOTE: Items are secured with bolts and washers when screw jack assembly is installed in aircraft.

(9) Thread rod end (2) into screw drive (6) and install roll pin (1) coated with Loctite Grade AA Sealant. See Figure 2 when installing a new rod end or screw drive.

7. Fits and Clearances

See Table 1.

8. Testing

Not Applicable.

9. Trouble Shooting

Not Applicable.

10. Storage Instructions

A. Preparation

(1) Completely wrap component in water vapor resistant barrier material.

(2) Affix label to package, giving following information.

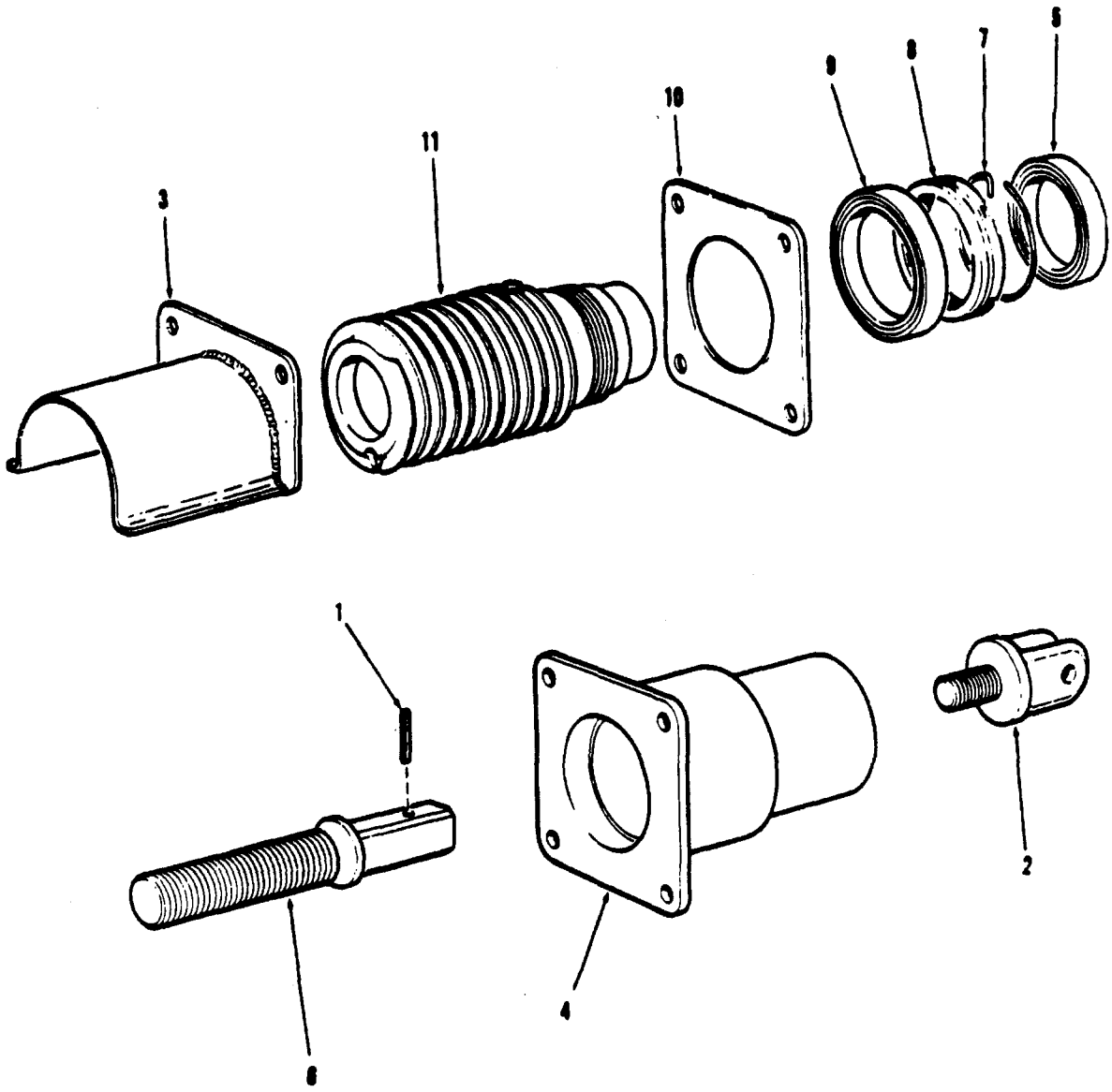
(a) Part and serial numbers.

(b) Date of overhaul.

(c) Inspection.

11. Special Tools

No special tools are required.



Exploded View - Screw Jack Assembly

Figure 3

12. Illustrated Parts List

A. Vendor Part

VENDOR CODE	NAME AND ADDRESS
21335	Fafnir Bearing Co., New Britain, Connecticut, U.S.A.
40920	Miniture Bearing Div., MPB Corp., Optical Ave., Precision Park, Keene, N.H., U.S.A.

B. List of Parts

FIGURE AND INDEX NO.	PART NUMBER	NOMENCLATURE	USAGE ON CODE	UNITS PER ASSEMBLY
		1 2 3 4 5 6 7		
3	C6CT1010-1	Screw Jack Assembly	A	
	C6CT1010-3	Screw Jack Assembly	B	
-1	MS20426AD-3	· Rivet (replaced by Roll Pin MS16562-25)	A,B	1
1	MS16562-25	· Roll Pin (replaces Rivet MS20426AD-3)	A,B	1
2	C4CM1956-11	· End - Rod	A,B	1
3	C4C1957-1	· Guard - Cable	A,B	1
4	C4M1953-13	· Cover	A,B	1
5	B541DD	· Bearing (21335)	A	1
5	C1724 B1E-5	· Bearing (40920)	B	1
6	C6CT1010-27	· Drive - Screw (replaced by C6CTM1028-27)	A,B	1
6	C6CTM1028-27	· Drive - Screw (replaces C6CT1010-27)	A,B	1
7	AN996-22	· Retainer	A,B	1
8	C4CM1954-11	· Nut	A,B	1
9	B542DD	· Bearing (21335)	A	1
■ 9	TWF21-28-U-5115	· Bearing (40920)	B	1
10	C4C1950-11	· Plate	A,B	1
11	C4CM1952-11	· Drive - Cable Drum	A,B	1

NOTE: - preceding index number indicates item not illustrated.

De Havilland Canada

DHC-6 TWIN OTTER

OVERHAUL MANUAL

TRIM CONTROL ASSEMBLY

PART NO. C6CF1053

THE DE HAVILLAND AIRCRAFT OF CANADA LIMITED
DOWNSVIEW ONTARIO

JUL 1/70

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INTRODUCTION

This manual contains instructions for the overhaul of the de Havilland Trim Control Assembly Part Numbers C6CF1053-1, C6CF1053-3 and C6CF1053-5.

TRIM CONTROL ASSEMBLY PART NO. C6CF1053

1. Description and Operation

A. Description (Figure 1)

The twin control assembly consists of two side plates which support individual handwheel installations, cable drums, cables, and operating lever and pointer assemblies, for rudder and elevator trim control.

B. Operation

Rotation of each handwheel winds one cable on and one cable off the respective cable drum, depending on direction of rotation. A plate with a spiral recess revolves with the cable drum, and operates a lever which moves a connected pointer through a distance relative to the amount of handwheel movement. When the assembly is installed in the aircraft, the cables operate screwjacks installed in the rudder and elevator trim control systems.

2. Disassembly

A. Disassemble Trim Control Assembly C6CF1053-1 (Figure 5)

(1) Withdraw rollpin (1) and remove handwheel (2) from shaft assembly (3) or (7).

(2) Remove four screws (11), and four screws (12), washers (13) and nuts (14) securing rudder trim control assembly to side plate assemblies (15) and (23).

(3) Remove rudder trim control assembly from side plate assemblies (15) and (23).

(4) Remove bearing assembly (33) complete with bearing (35) and housing (34), from shaft assembly (3) or (7).

NOTE: Removal of bearing (35) from housing (34) of bearing assembly (33) is only necessary on replacement of bearing.

(5) Remove pointer (36) complete with bush (37), washer (38), lever (39) and hinge plate assembly (40) from shaft assembly (3) or (7).

(6) Separate hinge plate (41) from lever (39) by removing cotter pin (43), nut (44) and two washers (45) and (46). Lift pointer (36) off lever (39).

(7) Withdraw bush (37) from pointer (36) and remove washer (38).

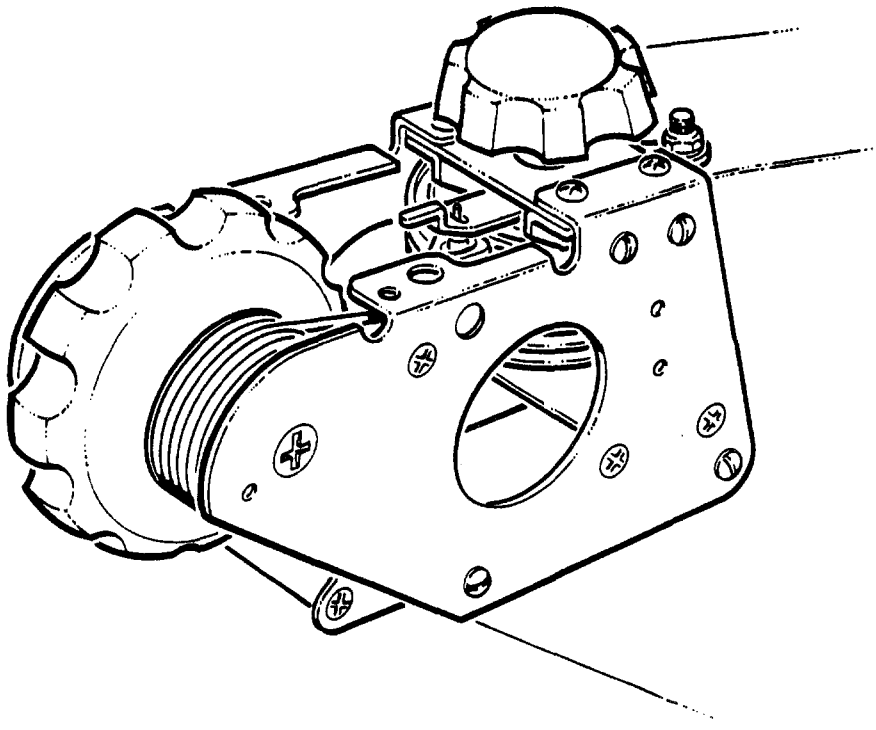
(8) Remove washer (47) and spiral plate (48) from shaft assembly (3) or (7).

(9) Remove cotter pin (49), nut (50) and washer (51), and withdraw channel assembly (52) from shaft assembly (3) or (7).

NOTE: Removal of bearing (53) from channel assembly (52) is only necessary on replacement of bearing.

(10) Remove cable drum (54) from shaft assembly (3) or (7).

NOTE: Removal of disc (55) from cable drum (54), or key sleeve (5) from shaft (4) of shaft assembly (3), is only necessary on replacement of these parts.



Trim Control Assembly

Figure 1

(11) Remove cables (56) and (57) from cable drum (54).

NOTE: Identify cables to assist assembly.

(12) Remove cotter pin (58), nut (59) and washer (60) securing lever (61) to hinge bracket (17) of side plate assembly (15).

(13) Remove rollpin (62) securing screw (63) in threaded boss (19) of side plate assembly (15).

(14) Loosen screw (63) from threaded boss (19) of side plate assembly (15). Do not withdraw screw at this stage. Support trim control assembly on outer face of side plate assembly (23) and remove side plate assembly (15).

(15) Remove washer (64), pointer (65), bush (66), lever (61), washer (67), spiral plate (68), handwheel (69) with cable drum (71), washer (72), and spacer (73) from screw (63). Remove washer (74) from lever (61).

NOTE: Removal of cable drum (71) or bush (70) from handwheel (69) is only necessary on replacement of these parts.

(16) Remove cables (75) and (76) from cable drum (71).

NOTE: Identify cables to assist assembly.

(17) Remove screw (63) from side plate assembly (23).

NOTE: Disassembly of parts from side plate assemblies (15) and (23) is only necessary on replacement of parts.

B. Disassemble Trim Control Assembly C6CF1053-3 and -5 (Figure 6)

(1) Withdraw rollpin (1) and remove rudder trim handwheel (2) from shaft assembly (3) or (7).

(2) Remove four screws (11), and four screws (12), washers (13) and nuts (14) securing rudder trim control assembly to side plate assemblies (15) and (23).

(3) Remove rudder trim control assembly from side plate assemblies (15) and (23).

(4) Remove bearing assembly (33), complete with bearing (35) and housing (34) from shaft assembly (3) and (7).

NOTE: Removal of bearing (35) from housing (34), of bearing assembly (33) is only necessary on replacement of bearing.

(5) Remove pointer (36) complete with spacer (37), washer (38), lever (39) and hinge plate (41) from shaft assembly (3) or (7).

(6) On C6CF1053-3

Separate pointer (36) from spacer (37), washer (38), lever (39) and hinge plate (41) as follows:

(a) Remove cotter pin (43), nut (44) and washer (45) which secures lever (39) to hinge plate (41). Remove hinge plate (41) and washer (46) from lever (39).

(b) Lift pointer (36) from lever (39).

(c) Remove spacer (37) and washer (38) from pointer (36).

(d) Remove washer (38) from spacer (37).

(7) On C6CF1053-5

Separate pointer (36) from spacer (37), washer (38), lever (39) and hinge plate (41), as follows:

(a) Remove cotter pin (43), nut (44) and washer (45) which secures lever (39) to hinge plate (41). Remove hinge plate (41) and washer (46) from lever (39).

(b) Remove nut (47), two washers (48) and bolt (49) which secures pointer (36) to lever (39). Remove pointer (36) from lever (39).

(c) Remove spacer (37) and washer (38) from pointer (36).

(d) Remove washer (38) from spacer (37).

(8) Remove washer (50) and spiral plate (51) from shaft assembly (3) or (7).

(9) Remove cotter pin (52), nut (53) and washer (54) and withdraw bracket (56), complete with bearing (57), and spacer (58), from shaft assembly (3) or (7).

NOTE: Removal of bearing (57) from bracket (56) is only necessary on replacement of bearing.

(10) Remove spacer (58) from bearing (57).

(11) Remove cable drum (59) from shaft assembly (3) or (7).

NOTE: Removal of disc (60) from cable drum (59), or key sleeve (9) from shaft (8) of shaft assembly (7), is only necessary on replacement of these parts.

(12) Remove cables (61) and (62) from cable drum (59).

NOTE: Identify cables to assist assembly.

(13) Remove cotter pin (63), nut (64) and washer (65) which secure lever (66) to hinge bracket (17) of side plate assembly (15).

(14) Remove rollpin (67) which secures screw (68) in threaded boss (19) of side plate assembly (15).

(15) Loosen screw (68) from threaded boss (19) (do not withdraw), support trim control assembly on outer face of side plate assembly (23), and remove side plate assembly (15).

(16) Remove washer (69) from lever (66).

(17) Remove washer (70), pointer (71), bush (72), lever (66), washer (73), spiral plate (74), washers (75) and (76), handwheel assembly (77) with cable drum (80), and washer (81), from screw (68).

NOTE: Removal of cable drum (80) from handwheel (78) is only necessary on replacement of these parts.

NOTE: Do not remove bushes (79) from handwheel (78). If bushes are defective, replace handwheel assembly (77).

(18) On C6CF1053-5

Remove washer (70), pointer (71), bush (72), lever (66), washer (73), spiral plate (74), washers (75) and (76), handwheel assembly (77) with cable drum (80), and washer (81), from screw (68). Separate lever (66) from pointer (71) by removing nut (82), bolt (83), and two washers (84).

NOTE: Removal of cable drum (80) from handwheel (78) is only necessary on replacement of these parts.

NOTE: Do not remove bushes (79) from handwheel (78). If bushes are defective, replace handwheel assembly (77).

(19) Remove cables (85) and (86) from cable drum (80).

(20) Remove screw (68) from side plate assembly (23).

NOTE: Disassembly of side plate assemblies (15) and (23) is only necessary on replacement of parts.

3. Cleaning

Table 1

Cleaning Materials and Compounds

MATERIAL	SPECIFICATION OR MANUFACTURER
Solvent	P-D-680

A. General

(1) Do not immerse sealed bearing (35) (Figure 6) in solvent. Clean with a clean cloth moistened in solvent.

(2) Clean remaining components by washing or spraying with solvent. Dry using moisture free compressed air or lint free cloth.

WARNING: USE SOLVENT IN A WELL VENTILATED AREA. AVOID SKIN CONTACT AND KEEP AWAY FROM FIRE.

4. Inspection/Check

A. General

(1) Inspect all parts for obvious wear, damage and corrosion.

(2) Inspect threaded parts for damaged, stripped or crossed threads.

(3) Inspect anodized surfaces for scratches and abrasions.

(4) Check that bearings (35) and (53) (Figure 5) can be moved with fingers through a 10° misalignment angle, and bearing (35) (Figure 6) through an 8° misalignment angle, and that all rotate with no binding or roughness.

(5) Refer to Table 2 for original tolerances and service limits. Replace parts worn in excess of service limits. Replace all defective parts not listed in table.

(6) Inspect trim cables for wear, kinks, flattening, fraying, corrosion and security of terminals.

NOTE: Excessive surface shine denotes wear.

(7) Inspect nylon stop on spiral plate (48) and (68) (Figure 5), for security.

Table 2

Original Tolerance and Service Limits

FIGURE 5 ITEM NO.	NAME	DISCREPANCY LOCATION	ORIGINAL DIMENSION (INCHES)	SERVICE LIMITS (INCHES)	DISPOSITION
34 & 52	Channel and Housing	Bearing Housing	0.8135 - 0.8128	0.8140	Replace
35 & 53	Bearing	ID	0.3745 - 0.3750	0.3770	Replace
36 & 65	Pointer	Pivot Hole	0.503 - 0.505	0.507	Replace
		Slot Width	0.100 - 0.102	0.104	Replace
37	Bush	ID	0.3750 - 0.3765	0.3785	Replace
		OD	0.5013 - 0.5006	0.4990	Replace
48 & 68	Spiral Plate	Stepped Hole	0.376 - 0.377	0.379	Replace
66	Bush	ID	0.3750 - 0.3765	0.3775	Replace
69	Handwheel	Bush Housing	0.5607 - 0.5619	0.5619	Replace
70	Bush	ID	0.3745 - 0.3755	0.3775	Replace

Table 3

Original Tolerance and Service Limits

FIGURE 6 ITEM NO.	NAME	DISCREPANCY LOCATION	ORIGINAL DIMENSION (INCHES)	SERVICE LIMITS (INCHES)	DISPOSITION
34	Housing	ID	0.8753 - 0.8760	0.8765	Replace
35	Bearing	ID	0.3745 - 0.3750	0.3770	Replace
36	Pointer	Pivot Hole	0.503 - 0.505	0.507	Replace
37	Spacer	ID	0.374 - 0.381	0.383	Replace
51 & 74	Spiral Plate	Stepped Hole	0.376 - 0.377	0.379	Replace
57	Bearing	ID	0.502 - 0.504	0.506	Replace
72	Bush	ID	0.3750 - 0.3765	0.3785	Replace

5. Repair

Table 4

Repair Materials and Compounds

MATERIAL	SPECIFICATION OR MANUFACTURER
Alodine Solution 1200S	MIL-C-5541 (Amchem Products)
Bostik 1142	B. B. Chemical Co., Montreal, P.Q.
Loctite Grade A. A.	MIL-S-22473
Trichlorethylene	MIL-T-7003

A. General

(1) Replace all defective parts.

(2) Replace all standard parts such as cotter pins, rollpins, washers and nuts.

(3) Touch up alumimum alloy surfaces with Alodine 1200S in accordance with manufacturer's instructions.

B. Detail Parts C6CF1053-1 (Figure 5)

(1) If loose, secure nylon stop on special plate (48) and (68) using Bostik 1142. Nylon stop is positioned in perimeter recess with stop face at an angle of 90° to slot in opposite face of spiral plate.

(2) If damaged or worn in excess of limits specified in Table 2, replace bush (70) in handwheel (69) as follows:

(a) Remove defective bush from handwheel using a suitable arbor press or extractor.

(b) Insure that housing for bush is within limits specified in Table 2.

(c) Clean faying surfaces of housing and bush using trichlorethylene. Dry with a lint-free cloth before solvent evaporates.

WARNING: USE SOLVENT IN A WELL VENTILATED AREA. AVOID SKIN CONTACT AND KEEP AWAY FROM FIRE.

NOTE: Avoid handling faying surfaces of housing and bush. The use of clean cotton gloves is recommended.

(d) Coat faying surfaces of housing and bush with Locquic N activator. Allow to air dry for 5 minutes.

(e) Apply even coat of Loctite Grade A. A. sealant to faying surfaces of housing and bush, and install bush in housing.

NOTE: If bush is a loose fit in housing, support until Loctite cure is effected.

(f) Immediately after installation of bush remove excess Loctite using a cloth moistened with trichlorethylene.

(g) Heat cure assembly for 30 minutes at a temperature of 120 - 150°F, using an air circulating oven or a heat lamp.

CAUTION: DO NOT SUBJECT ASSEMBLY TO UNNECESSARY MECHANICAL STRAIN UNTIL A FURTHER TWO HOURS HAVE ELAPSED.

(3) If damaged, or worn in excess of limits specified in Table 2, replace bearing (35) in housing (34), and bearing (53) in channel assembly (52), as follows:

(a) Remove defective bearing using a suitable arbor press or extractor. Remove hardened Loctite from housing by gently scraping with a hard fibre scraper.

(b) Insure housing is within the limits specified in Table 2.

(c) Clean faying surfaces of housing and bearing using trichlorethylene. Dry using a lint-free cloth before solvent evaporates.

WARNING: USE SOLVENT IN A WELL VENTILATED AREA. AVOID SKIN CONTACT AND KEEP AWAY FROM FIRE.

NOTE: Avoid handling faying surfaces of housing and bearing. The use of clean cotton gloves is recommended.

(d) Proceed as in step (2), (d) through (g).

(4) Replace cables if wear, flattened portions, fraying, kinks, corrosion or loose terminals exist.

(5) If replaced, cable drum (71), must be concentric to within 0.010-inch with center shaft of handwheel (69), and cable terminal barrel housings must align with slot in handwheel. Secure using rivets MS20470AD4.

(6) If replaced, disc (55) must be installed in cable drum (54) with slot aligned with cable terminal barrel housings. Secure using rivets MS20470AD4.

C. Detail Parts C6CF1053-3 and -5 (Figure 6)

(1) If damaged or worn in excess of limits specified in Table 3, replace bearing (35) in housing (34), as follows:

(a) Remove defective bearing using a suitable arbor press or extractor. Remove hardened Loctite from housing by gently scraping with a hard fibre scraper.

(b) Insure housing is within the limits specified in Table 3.

(c) Clean faying surfaces of housing and bearing using trichlorethylene. Dry with a lint-free cloth before solvent evaporates.

CAUTION: INSURE SOLVENT DOES NOT ENTER THE BEARING AND CONTAMINATE THE LUBRICANT.

WARNING: *USE SOLVENT IN A WELL VENTILATED AREA. AVOID* SKIN CONTACT AND KEEP AWAY FROM FLAME.

NOTE: Avoid handling faying surfaces of housing and bearing. The use of clean cotton gloves is recommended.

(d) Proceed as in paragraph 5. B. (2), steps (d) through (g).

(2) Replace cables if wear, flattened portions, fraying, kinks, corrosion or loose terminals exist.

(3) If replaced, cable drum (80) must be concentric to within 0.010-inch with center shaft of handwheel, and cable terminal barrel housings must align with slot in handwheel. Secure using six rivets MS20470AD4.

(4) If replaced, disc (60) must be installed in cable drum (59) with slot aligned with cable terminal barrel housings. Secure using six rivets MS20470AD4.

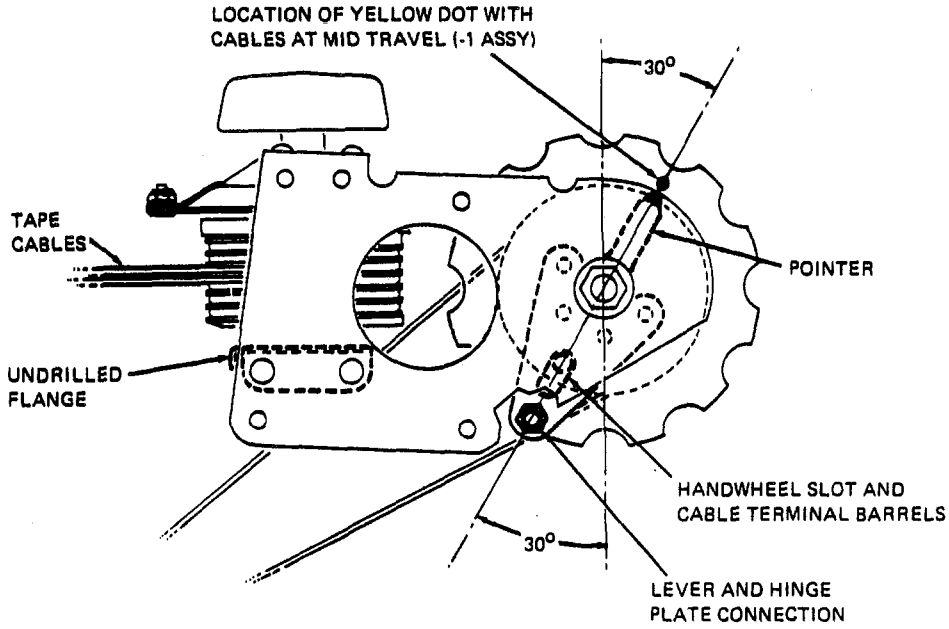
(5) If replaced, rollpins (6) of shaft assembly (3) are secured using Loctite Grade A. A. Refer to paragraph 5. B. (2), steps (c) through (g) for Loctite application.

(6) If defective, bushes (79) must not be replaced. Replace handwheel assembly (77).

6. Assembly

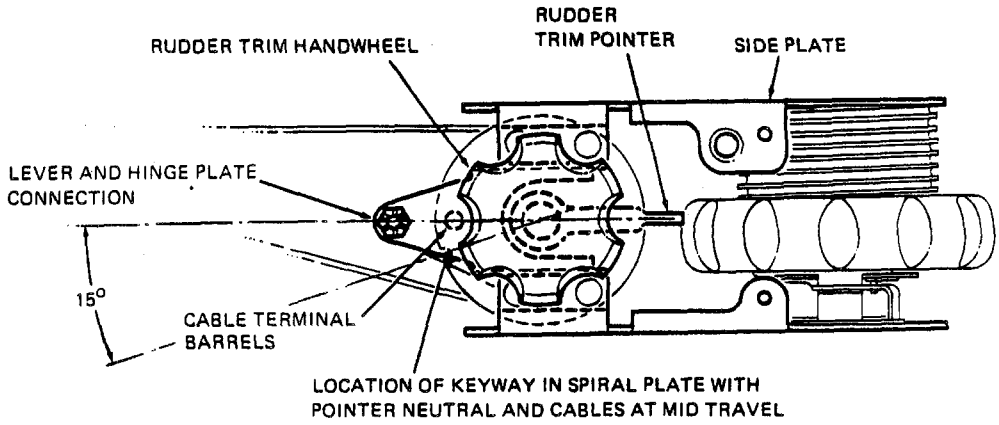
A. Assemble Trim Control Assembly C6CF1053-1 (Figures 2, 3 and 5)

(1) Install elevator trim cables (75) and (76) on cable drum (71) by inserting terminal barrels in appropriate housings in cable drum. Wrap each cable a



C6CF1053-1 and -3 Elevator Trim Handwheel - Neutral Position

Figure 2



C6CF1053-1, -3 and -5 Rudder Trim Pointer - Neutral Position

Figure 3

minimum of two and one half turns in opposite directions around the cable drum until all cable drum recesses are occupied. Adjust cables until both leave the cable drum from opposite sides, at points approximately 90° from, and in the same direction as, the cable terminal barrels and handwheel slot. Tape cables together adjacent to cable drum to prevent unwrapping (Refer to Figure 2.)

NOTE: Cables (75) and (76) are not interchangeable.

(2) Install screw (63) in side plate assembly (23). Tape flush head to outboard face of side plate to assist in preventing withdrawal during assembly procedure.

(3) Install spacer (73) and washer (72) on screw (63).

(4) Install cable drum (71) with handwheel (69) on screw (63), with cable drum adjacent to side plate assembly (23).

NOTE: Position handwheel (69) with yellow dot 30° forward from top dead center. Route cables (75) and (76) under guard sleeves (25) and (26) aft towards lightening hole in side plate assembly (23). (Refer to Figure 2.)

(5) Install spiral plate (68) on screw (63) with slot engaged with key in shaft of handwheel (69), and nylon stop adjacent to cable barrel terminal in cable drum (71).

(6) Install washer (67) on screw (63).

(7) Install bush (66) in pointer (65), and assemble pointer (65) and lever (61) by inserting outer plain pin of lever in slot of pointer.

(8) Install pointer (65) and bush (66) on screw (63) and engage center plain pin of lever (61) in spiral recess of spiral plate (68).

NOTE: Position pointer (65) at an angle of 30° forward of top dead center and aligned with yellow dot on handwheel (69) (Refer to Figure 2.)

(9) Install washer (74) on threaded pin of lever (61), and washer (64) on screw (63).

(10) Install side plate assembly (15) with threaded boss (19) engaged with screw (63). Insure that threaded pin of lever (61) is aligned with lug hole of hinge bracket (17), and handwheel slot and cable terminal barrels are located 30° aft of bottom dead center. (Refer to Figure 2.)

(11) Turn screw (63) into threaded boss (19) until 0.010 to 0.020-inch end float exists between inner face of threaded boss (19) and outer face of washer (64), and threaded pin of lever (61) is inserted into lug hole of hinge bracket (17).

(12) Lock screw (63) to threaded boss (19) using rollpin (62).

(13) Secure lever (61) to hinge bracket (17), using one washer (60), nut (59) and cotter pin (58). Insure that lever has easy hinge action but remains parallel to spiral plate (68).

(14) Install rudder trim cables (56) and (57) on cable drum (54) by inserting terminal barrels of cables in appropriate housings in cable drum. Wrap each cable a

minimum of two and one half turns in opposite directions around cable drum until all cable recesses are occupied. Adjust cables until both leave the cable drum from opposite sides at points 90° from, and in the same direction as, the cable terminal barrels. Tape cables together adjacent to cable drum to prevent unwrapping. (Refer to Figure 3.)

NOTE: Cables (56) and (57) are not interchangeable.

(15) Insert threaded end of shaft assembly (3) or (7) through cable drum (54) until key of shaft assembly key sleeve (5), or rollpin (10), as applicable, engages in slot of cable drum disc (55).

(16) Install channel assembly (52) on shaft assembly (3) or (7). Secure in position using washer (51), nut (50), and cotter pin (49).

(17) Install spiral plate (48) on shaft assembly (3) or (7) with slot of spiral plate engaged with key of shaft assembly (3) or rollpin (10), as applicable.

(18) Install washer (38) on bush (37). Insert bush (37) into pivot hole of pointer (36) until washer (38) rests on blade of pointer.

(19) Install washer (46) on threaded pin of lever (39). Assemble hinge plate (41), lever (39) and pointer (36) by inserting outer plain pin of lever in pointer slot, and threaded pin in lug hole of hinge plate assembly. Secure lever to hinge plate using washer (45) and nut (44).

NOTE: Do not install cotter pin (43) at this stage.

(20) Install washer (47) on shaft assembly (3) or (7).

(21) Install pointer (36) on shaft assembly (3) or (7) and engage center pin of lever (39) in spiral recess of spiral plate (48). Position hinge plate assembly (40) to allow shaft assembly (3) or (7) to project through cutout in hinge plate (41).

NOTE: Position pointer (36) diametrically opposite cable terminal barrels in cable drum (54). (Refer to Figure 3.)

(22) Tighten nut (44) on threaded pin of lever (39) until lever has easy hinge action but remains parallel to spiral plate (48). Lock nut (44) using cotter pin (43).

(23) Install bearing assembly (33) on shaft assembly (3)or (7) with bearing (35) resting on flange of bush (37).

(24) Install rudder trim tab control subassembly (less handwheel (2) and rollpin (1)) between side plate assemblies (15) and (23), with bearing assembly housing (34) under top rear flanges of side plate assemblies. Place pointer in neutral position.

NOTE: Pointer neutral position is centrally between side plate assemblies and facing elevator trim tab handwheel, with rudder cables positioned as in step (14). (Refer to Figure 3.)

(25) If alternative spiral plate (48) is installed, insure that keyway in perimeter is 15° off center, (Figure 3). Insure that undrilled flange of channel assembly (52) faces away from elevator trim tab cables. (Refer to Figure 2.)

(26) Secure rudder trim tab control assembly to upper flanges of side plate assemblies (15) and (23) using four screws (11) into anchor nuts on hinge plate (41) and four screws (12), washers (13) and nuts (14) through side plates (15) and (23) and channel assembly (52).

(27) Install handwheel (2) on shaft assembly (3) or (7). Secure using rollpin (1).

B. Assemble Trim Tab Control Assembly C6CF1053-3 and -5 (Figures 2, 3, 4 and 6)

(1) Insert terminal barrels of elevator trim cables (85) and (86) in appropriate housings of cable drum (80).

(2) On C6CF1053-3

Wrap each cable a minimum of two and one half turns in opposite direction around cable drum (80) until all cable drum recesses are occupied. Tape cables together at cable drum to prevent unwrapping.

(3) On C6CF1053-5

Wrap cable (85) three turns, and cable (86) a minimum of two turns, in opposite direction around cable drum (80), until all cable drum recesses are occupied. Tape cables together at cable drum to prevent unwrapping.

NOTE: Cables (85) and (86) are not interchangeable.

(4) Install screw (68) in side plate assembly (23). Tape screw flush head to outboard face of side plate assembly (23) to prevent withdrawal during assembly procedure.

(5) Install washer (81) on screw (68).

(6) Install handwheel assembly (77) and cable drum (80) on screw (68), with cable drum adjacent to side plate assembly (23). Route cables (85) and (86) under guard sleeves (26) and (25), and aft towards lightening hole in side plate (23).

(7) On C6CF1053-3

Turn handwheel assembly (77) until handwheel slot and cable terminal barrels are 30° aft of bottom dead center. (Refer to Figure 2.)

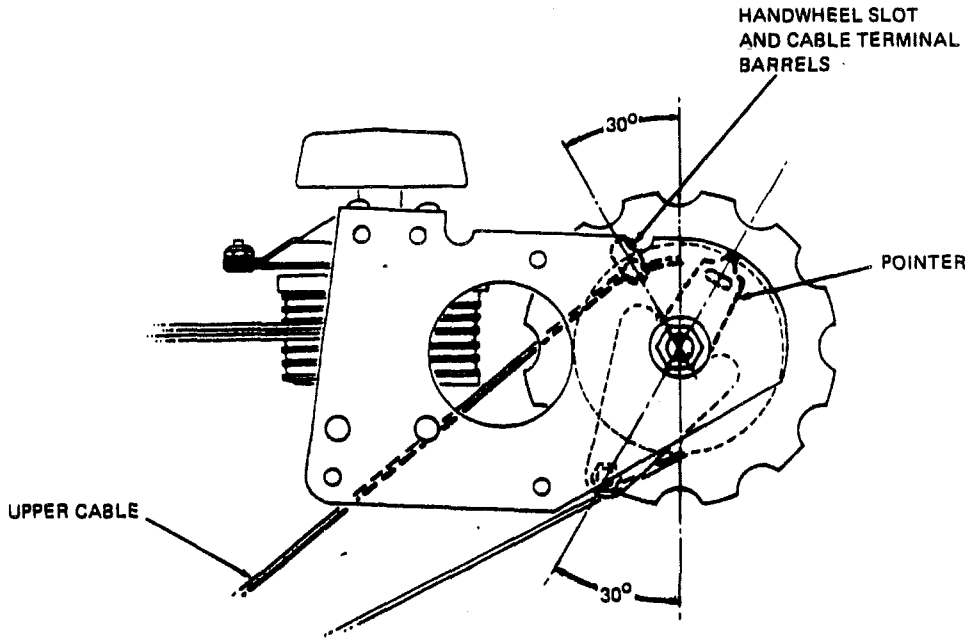
(8) On C6CF1053-5

Turn handwheel assembly (77) until handwheel slot and cable terminal barrels are 30° aft of top dead center. Insure cable (85) retains three turns around cable drum (80). (Refer to Figure 4.)

(9) Install washers (76) and (75) on screw (68).

(10) Install spiral plate (74) on screw (68) with spiral recesses facing out. Align cutout in perimeter of spiral plate with key on perimeter of handwheel open face. Press spiral plate into handwheel until spiral plate butts washer (75), and outer faces of spiral plate and handwheel are flush.

NOTE: Washers (76) and (75) may be added or discarded to obtain this condition.



C6CF1053-5 Elevator Handwheel - Neutral Position
Figure 4

(11) Install washer (73) on screw (68).

(12) Install bush (72) in pointer (71).

(13) On C6CF1053-3

(a) Assemble lever (66) and pointer (71) by inserting outer plain pin of lever (66) in slot of pointer.

(b) Install pointer (71) on screw (68) and insert center pin of lever (66) in spiral recess of spiral plate (74).

(14) On C6CF1053-5

(a) Assemble lever (66) and pointer (71) by aligning slots, and secure using bolt (83), one washer (84) on both sides of pointer, and nut (82).

(b) Install pointer (71) on screw (68) and insert center pin of lever (66) in spiral recess of spiral plate (74).

(15) Adjust lever center pin position in spiral plate until pointer (71) is 30° forward of top dead center.

(16) Install washer (70) on screw (68), and washer (69) on threaded pin of lever (66).

(17) Install side plate (15) with threaded boss (19) engaged with screw (68). Insure that threaded pin of lever (66) is aligned with lug hole of hinge bracket (17).

(18) Turn screw (68) into threaded boss (19) until 0.010 to 0.020-inch end float exists between inner face of threaded boss (19) and outer face of washer (70), and threaded pin of lever (66) is inserted into lug hole of hinge bracket (17). Secure screw (68) using cotter pin (67) through screw and threaded boss (19).

(19) Secure lever (66) to hinge plate (17) using washer (65), nut (64) and cotter pin (63). Insure lever (66) has easy hinge action but remains parallel to spiral plate (73).

(20) Install rudder trim cables (61) and (62) on cable drum (59) by inserting terminal barrels of cables in appropriate housings in cable drum. Wrap each cable a minimum of two and one half turns in opposite direction around cable drum until all cable reel recesses are occupied. Adjust cables until both leave cable drum at points 90° from, and in the same direction as, the cable terminal barrels. (Refer to Figure 3.) Tape cables together at cable drum to prevent unwrapping.

NOTE: Cables (61) and (62) are not interchangeable.

(21) Insert threaded end of shaft assembly (3) or (7) through cable drum (59) until rollpin (6) or key sleeve (9), as applicable, of shaft assembly engages in slot of cable drum disc (60).

(22) Install spacer (58) in bearing (57) of bracket assembly (55).

(23) Install bracket assembly (55) on shaft assembly (3) or (7) with bearing adjacent to cable drum (59). Secure using washer (54), nut (53) and cotter pin (52).

(24) Install spiral plate (51) on shaft assembly (3) or (7) until slot engages with rollpin (6) or key sleeve (9), as applicable.

(25) Install washer (38) over long end of spacer (37). Insert spacer into pivot hole of pointer (36) until washer (38) butts blade of pointer.

(26) On C6CF1053-3

Install washer (46) on threaded pin of lever (39). Assemble hinge plate (41), lever (39) and pointer (36) with outer plain pin of lever inserted in pointer slot, and threaded pin inserted in lug hole of hinge plate assembly. Secure lever to hinge plate assembly using washer (45) and nut (44).

NOTE: Do not install cotter pin (43) at this stage.

(27) On C6CF1053-5

Install washer (46) on threaded pin of lever (39). Assemble hinge plate (41), lever (39) and pointer (36), with threaded pin of lever inserted in hinge plate lug hole, and slots of lever and pointer aligned. Secure lever to pointer through slots of lever and pointer using bolt (49), one washer (48) on both sides of pointer, and nut (47). Secure lever to hinge plate using washer (45) and nut (44).

NOTE: Do not install cotter pin (43) at this stage.

(28) Install washer (50) on shaft assembly (3) or (7). Install pointer (36), with bush (37) and washer (38), on shaft assembly (3) or (7), and insert center pin of

lever (39) in spiral recess of spiral plate (51). Position hinge plate (41) to allow shaft assembly to project through hinge plate cutout.

NOTE: Position pointer diametrically opposite cable terminal barrels in cable drum (59). (Refer to Figure 3.)

(29) Tighten nut (44) on threaded pin of lever (39) until lever has easy hinge action but remains parallel to spiral plate (51). Lock using cotter pin (43).

(30) Install bearing assembly (33) on shaft assembly (3) or (7) with bearing (35) resting on short end of bush (37).

(31) Install rudder trim tab control subassembly (less handwheel (2) and rollpin (1)) between side plate assemblies (15) and (23), with bearing assembly housing (34) under top rear flange of side plate assemblies. Place pointer in neutral position.

NOTE: Pointer neutral position is centrally between side plate assemblies and facing elevator trim tab handwheel, with rudder cables positioned as in step (21). (Refer to Figure 3.)

(32) If alternative spiral plate (51) is installed, insure that keyway in perimeter is 15° off center (Figure 3.) Insure that undrilled flange of bracket (56) faces away from elevator trim tab cables. (Refer to Figure 4.)

(33) Secure rudder trim tab control subassembly to side plate assemblies (15) and (23) using four screws (11) through top rear flange of side plates, and four screws (12), washers (13) and nuts (14) through side plates and bracket (56).

(34) Install handwheel (2) on shaft assembly (3) or (7). Secure using rollpin (1).

7. Fits and Clearances

Refer to Tables 2 and 3.

8. Testing

A. Rudder Trim Control C6CF1053-1, -3 and -5

(1) Hold cables in tension and remove tape.

(2) Set rudder trim control handwheel in neutral position i. e. pointer centrally between side plates and facing elevator trim control handwheel, and cables evenly distributed about cable drum. (Refer to Figure 3.)

(3) Turn handwheel through full movement in both directions from neutral. Handwheel must turn a minimum of two full revolutions in both directions.

(4) Retape cables together to prevent unwrapping from cable drum.

B. Elevator Trim Control C6CF1053-1, -3 and -5

(1) Hold cables in tension and remove tape.

(2) On C6CF1053-1 and -3 (Refer to Figure 2)
Set elevator trim control handwheel in neutral position, i. e. pointer 30° forward

of top dead center, cable terminals and handwheel slot 30° aft of bottom dead center, and cables evenly distributed about cable drum.

(3) On C6CF1053-5 (Refer to Figure 4)

Set elevator trim control handwheel in neutral position, i. e. pointer 30° forward of top dead center, cable terminals and handwheel slot 30° aft of top dead center, and upper cable wrapped three turns around the cable drum.

(4) Turn handwheel through full movement in both directions from neutral. Handwheel must turn a minimum of two full revolutions in both directions.

(5) Retape cables together to prevent unwrapping from cable drum.

9. Trouble Shooting

A. If rudder or elevator trim control units fail to meet the requirements of the functional test procedure, refer to Table 5 to determine possible cause and correction of the malfunction.

Table 5

Trouble Shooting Information

TROUBLE	POSSIBLE CAUSE	CORRECTION
1. Handwheel does not turn a minimum of two revolutions in both directions from neutral.	Cables not correctly distributed around cable drum.	Redistribute cables as detailed in paragraph 6.

10. Storage Instructions

Table 6

Storage Materials and Compounds

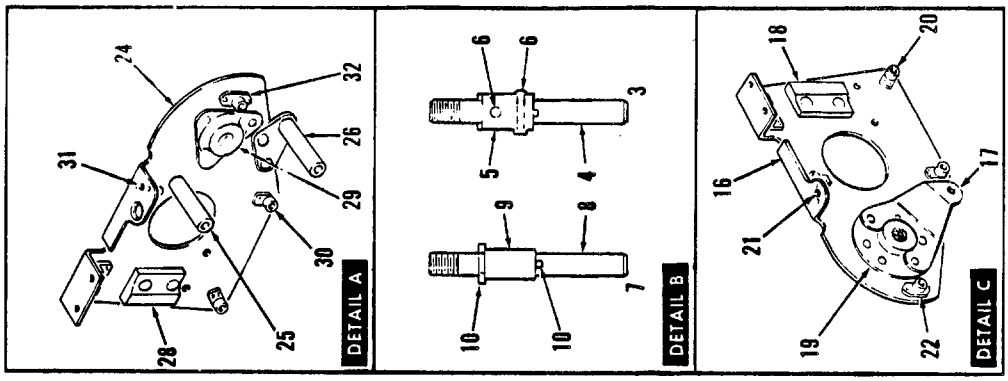
MATERIAL	SPECIFICATION OR MANUFACTURER
Barrier Material	MIL-B-121
Desiccant	MIL-D-3464

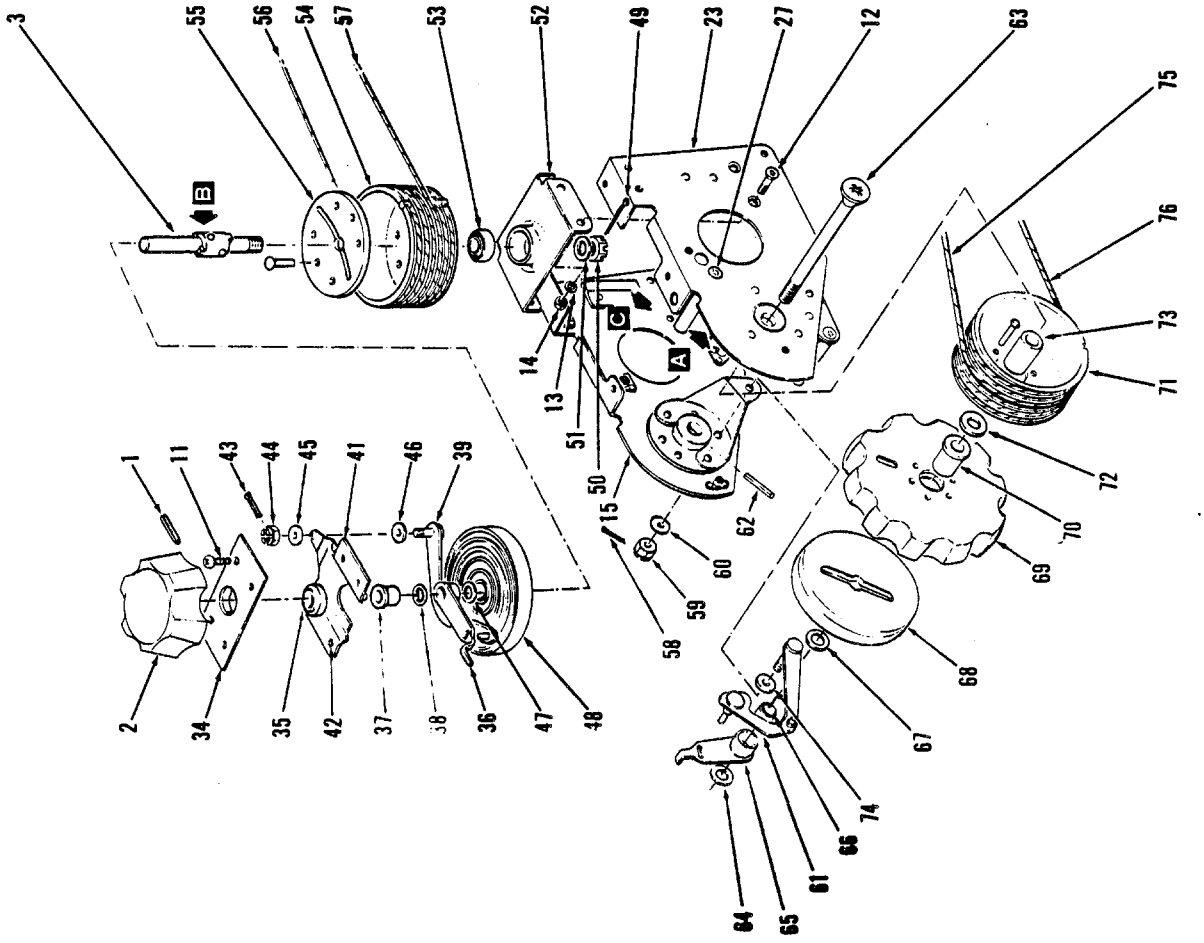
A. Preparation

(1) Loop rudder and elevator trim cables and tape to facilitate stowage.

(2) Wrap rudder and elevator trim control assembly in water vapor resistant barrier material, including a desiccant.

(3) Affix label giving following information:
(a) Identification
(b) Date of Overhaul
(c) Inspection





Exploded View - Trim Control Assembly C6CF1053-1

Figure 5

11. Special Tools

No special tools are required.

12. Illustrated Parts List

A. Vendor Parts

VENDOR CODE	NAME AND ADDRESS
08479	Garlock of Canada Ltd., Toronto, Ontario, Canada.
21335	Fafnir Bearing Co., Division of Textion Inc., New Britain, Connecticut, U. S. A.

B. Usage Codes

CODE	USED ON
A	C6CF1053-1
B	C6CF1053-3
C	C6CF1053-5

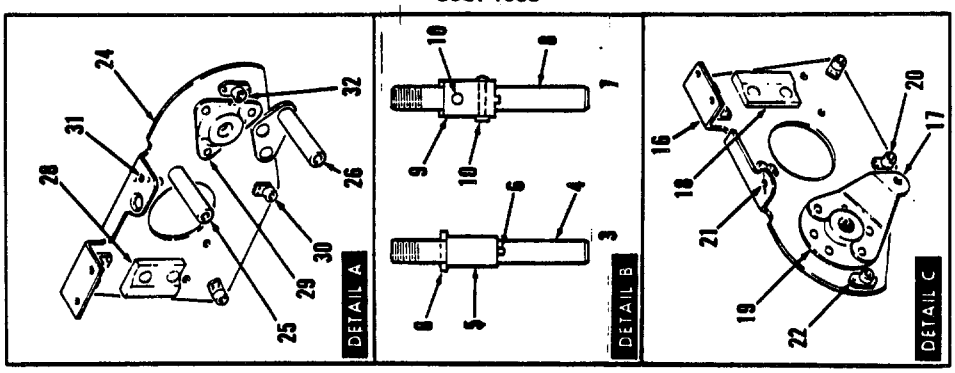
C. List of Parts - Trim Control Assembly C6CF1053-1

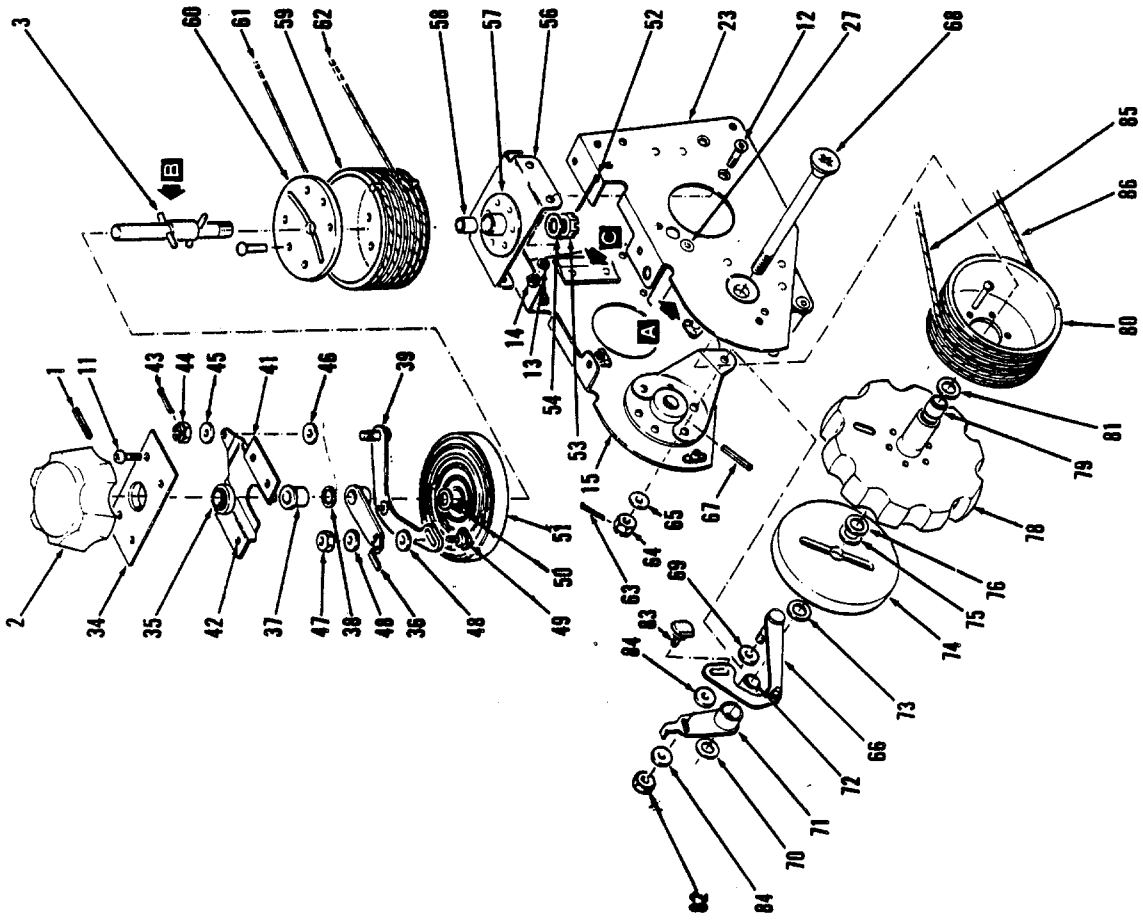
FIGURE & INDEX NO.	PART NUMBER	NOMENCLATURE 1234567	USAGE ON CODE	UNITS PER ASSEMBLY
5-	C6CF1053-1	. Trim Control Assembly	A	1
1	MS16562-34	.. Pin - Roll	A	1
2	C6CFM1243-27	.. Handwheel - Rudder Trim	A	1
3	C6CFM1069-1	.. Shaft Assembly	A	1
4	C6CFM1069-27	... Shaft	A	1
5	C6CFM1069-29	... Sleeve - Key	A	1
6	MS20470AD3	... Rivet	A	2
7	C6CFM1069-3	.. Shaft Assembly	A	1
8	C6CFM1069-27	... Shaft	A	1
9	NAS43DD6-64	... Spacer	A	1
10	MS16562-18	... Pin - Roll	A	2
11	NAS526-832R8	.. Screw	A	4
12	AN509-8R6	.. Screw	A	4
13	AN960PD8L	.. Washer	A	4
14	MS21042-08	.. Nut	A	4
15	C6CF1055-1	.. Plate Assembly	A	1
16	C6CF1055-27	... Plate	A	1
17	C6CF1063-29	... Bracket - Hinge	A	1
18	C6CFM1111-27	... Guard Piece - Cable	A	1

FIGURE & INDEX NO.	PART NUMBER	NOMENCLATURE 1234567	USAGE ON CODE	UNITS PER ASSEMBLY
5-				
19	C 6CFM1112-27	... Boss - Threaded	A	1
20	NAS1067A3	... Nut - Plate	A	5
21	NAS1068A06	... Nut - Plate	A	1
22	NAS1068A3	... Nut - Plate	A	1
23	C6CF1055-3	.. Plate Assembly - Side	A	1
24	C6CF1055-29	... Plate	A	1
25	C6CF1062-3	... Guard - Sleeve	A	1
26	C6CF1062-5	... Guard - Sleeve	A	1
27	AN509-8R19	... Screw	A	1
28	C6CFM1111-27	... Guard - Piece	A	1
29	C6CFM1113-27	... Boss - Countersunk	A	1
30	NAS1067A3	... Nut - Plate	A	5
31	NAS1068A06	... Nut - Plate	A	1
32	NAS1068A3	... Nut - Plate	A	1
-33	C6CFM1107-1	.. Bearing Assembly	A	1
34	C6CFM1107-27	... Housing	A	1
35	DSC2-6	... Bearing	A	1
36	C6CF1056-1	.. Pointer - Rudder Trim	A	1
37	NAS77-6-44	.. Bush	A	1
38	C6CF1053-27	.. Washer	A	1
39	C6CF1054-1	.. Lever - Rudder Trim	A	1
-40	C6CF1063-1	.. Hinge Plate Assembly	A	1
41	C6CF1063-27	... Plate	A	1
42	NAS696A08	... Nut - Plate	A	4
43	MS24665-74	.. Pin - Cotter	A	1
44	MS17826-3	.. Nut	A	1
45	NAS1515M3L	.. Washer	A	1
46	NAS1515M3L	.. Washer	A	1
47	C6CF1053-27	.. Washer	A	1
48	C6CFM1057-1	.. Plate - Spiral	A	1
-48	C6CFM1057-31	.. Plate - Spiral (Alternative)	A	1
49	MS24665-283	.. Pin - Cotter	A	1
50	MS17826-6	.. Nut	A	1
51	AN960PD616L	.. Washer	A	1
52	C6CFM1106-1	.. Channel Assembly	A	1
53	DSC2-6	... Bearing	A	1
54	C6CFM1058-27	.. Drum - Cable	A	1
55	C6CFM1061-27	.. Disc	A	1
56	C6CF1064-3	.. Cable Assembly - Rudder Trim	A	1
56	C6CF1064-1	.. Cable Assembly - Rudder Trim (Early alternative)	A	1
57	C6CF1065-3	.. Cable Assembly - Rudder Trim	A	1
57	C6CF1065-1	.. Cable Assembly - Rudder Trim (Early alternative)	A	1
58	MS24665-74	.. Pin - Cotter	A	1
59	MS17826-3	.. Nut	A	1
60	NAS1515M3L	.. Washer	A	1
61	C6CF1054-1	.. Lever	A	1
62	MS16562-34	.. Pin - Roll	A	1
63	AN509-616R48	.. Screw	A	1

FIGURE & INDEX NO.	PART NUMBER	NOMENCLATURE 1234567	USAGE ON CODE	UNITS PER ASSEMBLY
5-				
64	NAS1515M6L	.. Washer	A	1
65	C6CF1056-3	.. Pointer - Elevator Trim	A	1
66	NAS75-6-012	.. Bush	A	1
67	NAS1515M6L	.. Washer	A	1
68	C6CFM1057-1	.. Plate - Spiral	A	1
-68	C6CFM1057-31	.. Plate - Spiral (Alternative)	A	1
69	C6CFM1060-27	.. Handwheel	A	1
70	DSC10-6-11	.. Bush	A	1
71	C6CFM1058-27	.. Drum - Cable	A	1
72	NAS1515M6	.. Washer	A	1
73	NAS43DD6-64	.. Spacer	A	1
74	NAS1515M3L	.. Washer	A	1
75	C6CF1066-3	.. Cable Assembly - Elevator Trim	A	1
75	C6CF1066-1	.. Cable Assembly - Elevator Trim (Early alternative)	A	1
76	C6CF1067-3	.. Cable Assembly - Elevator Trim	A	1
76	C6CF1067-1	.. Cable Assembly - Elevator Trim (Early alternative)	A	1

NOTE: - preceding index number indicates item not illustrated.





Exploded View - Trim Control Assembly C6CF1053-3 and -5

Figure 6

D. List of Parts - Trim Control Assembly C6CF1053-3 and -5

FIGURE & INDEX NO.	PART NUMBER	NOMENCLATURE 1234567	USAGE ON CODE	UNITS PER ASSEMBLY
6-	C6CF1053-3	. Trim Control Assembly	B	1
6-	C6CF1053-5	. Trim Control Assembly	C	1
1	MS16562-34	.. Pin - Roll	BC	1
2	C6CFM1243-27	.. Handwheel - Rudder Trim	BC	1
3	C6CFM1069-3	.. Shaft Assembly	BC	1
4	C6CFM1069-27	... Shaft	BC	1
5	NAS43DD6-64	... Spacer	BC	1
6	MS16562-18	... Pin - Roll	BC	2
7	C6CFM1069-1	.. Shaft Assembly (Alternative)	BC	1
8	C6CFM1069-27	... Shaft	BC	1
9	C6CFM1069-29	... Sleeve - Key	BC	1
10	MS20470AD3	... Rivet	BC	2
11	AN526-832R8	.. Screw	BC	4
12	AN509-8R6	.. Screw	BC	4
13	AN960PD8L	.. Washer	BC	4
14	MS21042-08	.. Nut	BC	4
15	C6CF1055-1	.. Plate Assembly - Side	BC	1
16	C6CF1055-27	... Plate	BC	1
17	C6CF1063-29	... Bracket - Hinge	BC	1
18	C6CFM1111-27	... Guard Piece - Cable	BC	1
19	C6CFM1112-27	... Boss - Threaded	BC	1
20	NAS1067A3	... Nut - Plate	BC	5
21	NAS1068A06	... Nut - Plate	BC	1
22	NAS1068A3	... Nut - Plate	BC	1
23	C6CF1055-3	.. Plate Assembly - Side	BC	1
24	C6CF1055-29	... Plate	BC	1
25	C6CF1062-3	... Guard - Sleeve	BC	1
26	C6CF1062-5	... Guard - Sleeve	BC	1
27	AN509-8R19	... Screw	BC	1
28	C6CFM1111-27	... Guard Piece - Cable	BC	1
29	C6CFM1113-27	... Boss - Countersunk	BC	1
30	NAS1067A3	... Nut - Plate	BC	5
31	NAS1068A06	... Nut - Plate	BC	1
32	NAS1068A3	... Nut - Plate	BC	1
-33	C6CFM1285-1	.. Bearing Assembly	BC	1
34	C6CFM1285-27	... Housing	BC	1
35	KS6A	... Bearing (21335)	BC	1
-36	C6CF1056-1	.. Pointer	B	1
36	C6CF1418-1	.. Pointer	C	1
37	C6CFM1286-27	.. Spacer	BC	1
38	C6CF1053-27	.. Washer	BC	1
-39	C6CF1054-3	.. Lever	B	1
39	C6CF1419-1	.. Lever	C	1
-40	C6CF1063-1	.. Hinge Plate Assembly	BC	1
41	C6CF1063-27	... Plate - Hinge	BC	1
42	NAS696A08	... Nut - Plate	BC	4
43	MS24665-74	.. Pin - Cotter	BC	1
44	MS17826-3	.. Nut	BC	1
45	NAS1515M3L	.. Washer	BC	1
46	NAS1515M3L	.. Washer	BC	1

FIGURE & INDEX NO.	PART NUMBER	NOMENCLATURE 1234567	USAGE ON CODE	UNITS PER ASSEMBLY
6-				
47	MS21044N06	.. Nut	C	1
48	AN960-6	.. Washer	C	2
49	C6CFM1420-27	.. Bolt - Adjustable Pointer	C	1
50	C6CF1053-27	.. Washer	BC	1
51	C6CFM1057-37	.. Plate - Spiral	BC	1
-51	C6CFM1057-1	.. Plate - Spiral (Alternative)	B	1
52	MS24665-283	.. Pin - Cotter	BC	1
53	MS17826-6	.. Nut	BC	1
54	AN960PD616L	.. Washer	BC	1
-55	C6CF1282-1	.. Bracket Assembly	BC	1
56	C6CF1282-27	... Bracket	BC	1
57	C6CFM1283-27	... Bearing	BC	1
58	C6CF1053-29	.. Spacer	BC	1
59	C6CFM1058-27	.. Drum - Cable	BC	1
60	C6CFM1061-27	.. Disc	BC	1
61	C6CF1064-3	.. Cable Assembly - Rudder Trim	BC	1
-62	C6CF1065-3	.. Cable Assembly - Rudder Trim	B	1
62	C6CF1065-5	.. Cable Assembly - Rudder Trim	C	1
63	MS24665-74	.. Pin - Cotter	BC	1
64	MS17826-3	.. Nut	BC	1
65	NAS1515M3L	.. Washer	BC	1
-66	C6CF1054-3	.. Lever	B	1
66	C6CF1419-1	.. Lever	C	1
67	MS16562-34	.. Pin - Roll	BC	1
68	AN509-616R48	.. Screw	BC	1
69	NAS1515M3L	.. Washer	BC	1
70	NAS1515M6L	.. Washer	BC	1
-71	C6CF1056-3	.. Pointer - Elevator Trim	B	1
71	C6CF1418-3	.. Pointer - Elevator Trim	C	1
72	NAS75-6-012	.. Bush	BC	1
73	NAS1515M6L	.. Washer	BC	1
74	C6CFM1057-31	.. Plate - Spiral	BC	1
75	AN960PD616	.. Washer	BC	A/R
76	AN960PD616L	.. Washer	BC	A/R
-77	C6CFM1284-1	.. Handwheel Assembly	BC	1
78	C6CFM1284-27	... Handwheel	BC	1
79	06DU06	... Bush (08479)	BC	1
80	C6CFM1058-27	.. Drum - Cable	BC	1
81	NAS1515M6	.. Washer	BC	1
82	MS21044-N06	.. Nut	C	1
83	C6CFM1420-27	.. Bolt - Adjustable Pointer	C	1
84	AN960-6	.. Washer	C	2
85	C6CF1066-3	.. Cable Assembly - Elevator Trim	BC	1
86	C6CF1067-1	.. Cable Assembly - Elevator Trim	C	1
-86	C6CF1067-3	.. Cable Assembly - Elevator Trim	B	1

NOTE: - preceding index number indicates item not illustrated.

De Havilland Canada

DHC-6 TWIN OTTER

OVERHAUL MANUAL

WING FLAP ACTUATOR

PART NO. C6HF1020

THE DE HAVILLAND AIRCRAFT OF CANADA LIMITED
DOWNSVIEW ONTARIO

FEB 2/70

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RECORD OF REVISIONS

Retain this record in the front of the manual. On receipt of revisions, insert revised pages in the manual and enter the revision number, revision date, insertion date, and initials of person incorporating the revision, in the appropriate block on the revision record.

Rev. No.	Rev. Date	Insertion Date	By
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27-50-11	*7	Dec 21/79
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The asterisk (*) indicates pages revised, added or deleted by current revision.

INTRODUCTION

This manual contains instructions for the overhaul of the De Havilland Wing Flap Actuator Assembly Part No. C6HF1020.

WING FLAP ACTUATOR

PART NO. C6HF1020-1, -3 and -5

1. Description and Operation

A. Description (Figure 1)

The wing flap actuator consists of a cylinder containing a sliding piston. The cylinder has two ports with restrictors installed which are not interchangeable; each port is used for inlet hydraulic pressure and return, as selected. The outer end of the piston rod is threaded internally to allow installation of the end fitting, which connects the piston to the flap operating mechanism. Provision is made on the cylinder end cap for the attachment of a rotary selector valve.

B. Operation

The piston is cycled in the cylinder by the application of hydraulic oil under pressure to the appropriate port through the rotary selector valve. The amount of piston travel is controlled by a follow-up system within the selector valve.

C. Data

Hydraulic Fluid	MIL-H-5606
Operating Pressure	1500 PSI
Proof Pressure	2300 PSI
Stroke	3.4 inches

2. Disassembly

A. Disassemble Wing Flap Actuator (Figure 2)

CAUTION: ADEQUATE PRECAUTIONS MUST BE TAKEN TO PREVENT DAMAGE TO HIGHLY POLISHED SURFACES.

(1) Remove four bolts, washers and rotary selector valve from cylinder end cap. Remove elbows from cylinder hydraulic ports, if fitted. For overhaul data of rotary selector valve refer to Chapter 27-50-1, FLAP SELECTOR VALVE SKA104.

(2) Remove bolts (2), washers (3) and remove end cap (1) from cylinder (7).

(3) Remove O-ring (4) from end cap (1).

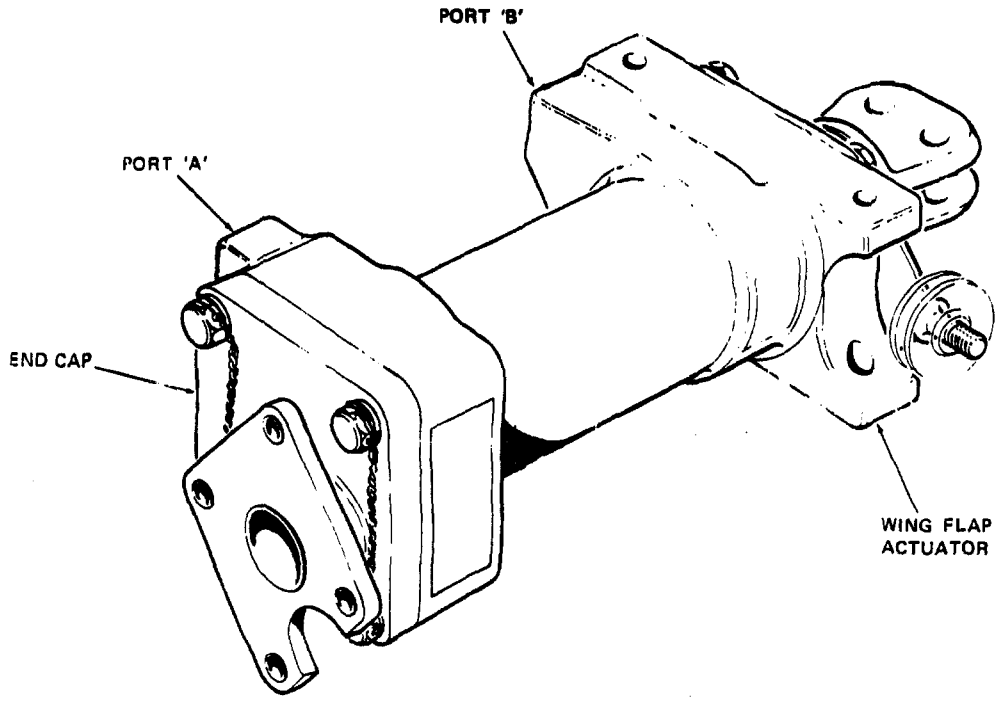
(4) Remove lockring(16) and unscrew end fitting (15) from piston rod (8).

(5) Withdraw piston rod (8) from cylinder (7).

(6) Remove O-ring (6) or seal set (6A) from piston rod (8).

(7) Remove bolts (11), washers (12), and remove retaining plate (10) from cylinder (7).

(8) Remove scraper ring (14) and O-ring (13A) or seal set (13) from cylinder (7).



Wing Flap Actuator

Figure 1

NOTE: No further disassembly is necessary unless jet assembly restrictors (5) and (9) are found to be damaged or obstructed (refer to Inspection/Check), in which case, remove using special tool No. 187-1.

Jet assembly restrictors (5) and (9) are not interchangeable. If removed identify each to assist in assembly of actuator.

3. Cleaning

A. General

(1) Clean components by washing or spraying with a dry-cleaning solvent.

WARNING: USE SOLVENT IN A WELL VENTILATED AREA. AVOID SKIN CONTACT. KEEP AWAY FROM FLAME.

(2) Reverse flush through jet assembly restrictors (5) and (9) in both directions to clean screens, using dry-cleaning solvent.

(3) Dry using moisture-free compressed air or lint-free cloth.

4. Inspection/Check

A. General

(1) Carry out a magnetic particle inspection of all magnetic metal components, where practicable.

(2) Inspect non-magnetic components using the fluorescent penetrant method, or an approved dye penetrant method.

(3) Inspect all parts visually for signs of fatigue and cracks, and for damage such as galls, scores, scratches, excessive wear and corrosion.

(4) Inspect all threads for damage and deformity.

(5) Check label (18) and name plate (17) for security and legibility.

(6) Refer to Table 1 for original tolerances and service limits. Check internal and external diameters of items listed for wear, concentricity and taper.

B. Restrictors

(1) Inspect restrictors (5) and (9) for damage.

(2) Inspect restrictors for obstruction and screens for cleanliness.

Table 1

Original Tolerances and Service Limits

FIGURE 2 ITEM NO.	NAME	DISCREPANCY LOCATION	ORIGINAL DIMENSIONS (INCHES)	SERVICE LIMIT (INCHES)	DISPOSITION
1	End cap	O. D.	2. 117 - 2. 115	2. 114	Replace
		O. D. (Groove)	1. 875 - 1. 873	1. 872	Replace
7	Cylinder	I. D. (Piston head bore)	2. 120 - 2. 122	2. 123	Replace
		I. D.	1. 751 - 1. 753	1. 754	Replace
15	End fitting	Attachment Holes	0. 3765 - 0. 3775	0. 3785	Replace
		Attachment Lug Gap	0. 573 - 0. 576	0. 578	Replace
8	Piston rod	O. D.	1. 748 - 1. 746	1. 745	Chrome plate to original dimension (surface finish 16) or replace.
		O. D. (Piston head)	2. 117 - 2. 115	2. 114	Chrome plate to original dimension (surface finish 32) or replace.

5. Repair

List of Materials

MATERIAL	SPECIFICATION OR MANUFACTURER
Alodine Solution 1200S	MIL-C-5541 (Amchem Products)
Soft Film Compound	MIL-C-16173 Grade 2 (Shell CG929)

A. General

(1) Repair or replace parts worn in excess of service limits (see Table 1).

NOTE: Where indicated in Table 1, parts may be repaired by hard chrome plating the affected surface, then grinding and honing the surface to the original dimension shown in the table. Where originally chrome plated, strip the original plating before repair.

(2) Replace all defective parts not listed in Table 1.

(3) Replace cadmium plated parts which have had coating damaged or removed.

(4) Where anodized parts have had protective surface treatment removed, apply a coating of Alodine Solution 1200S to affected area, or reanodize part.

(5) Replace tee-section seal sets (6A) and (13), if fitted.

(6) Replace all standard parts, such as O-rings, washers and lockwire.

(7) If protective compound on inner surface of piston rod (8) has deteriorated or has been removed, refinish with Soft Film Compound MIL-C-16173 Grade 2.

6. Assembly

List of Materials

MATERIAL	SPECIFICATION OR MANUFACTURER
Hydraulic Oil	MIL-H-5606
Corrosion Resistant Lockwire	MS20995C32

CAUTION: ADEQUATE PRECAUTIONS MUST BE TAKEN DURING HANDLING OF HIGHLY POLISHED SURFACES TO PREVENT DAMAGE, OR CONTAMINATION, BY BODY MOISTURES OR OTHER AGENTS WHICH MAY INITIATE CORROSION AFTER LUBRICANT IS APPLIED.

A. Assemble Wing Flap Actuator (Figure 2)

(1) Install jet assembly restrictors (5) and (9) in cylinder (7), if removed, using special tool No. 187-1.

CAUTION: JET ASSEMBLY RESTRICTORS (5) AND (9) MUST NOT BE INTERCHANGED. ITEM (9) HAS 0.030-INCH DIAMETER ORIFICE AND ITEM (5) HAS A 0.050-INCH ORIFICE.

(2) Lubricate O-ring (13A) or seal set (13) and scraper ring (14) with clean hydraulic oil MIL-H-5606 and install in cylinder (7).

CAUTION: ENSURE RADIUS ON EACH BACK-UP RING IS MATED WITH RADIUS AT ROOT OF T-SECTION SEALING RING OF SEAL SET.

NOTE: On actuator Part No. 6HF1020-1 (13A) is a standard O-ring and may be replaced by a seal set 327FR160 A-T (13). This is required by modification 6/1205 which, if incorporated, updates the actuator to Part No. 6HF1020-3. The identifying label must be marked accordingly.

(3) Position retaining plate (10) on cylinder (7) with pulley spigot diagonally opposite ports on actuator. Install washers (12) and bolts (11).

(4) On actuators Part No. C6HF1020-1 and C6HF1020-3, lubricate O-ring (6) with clean hydraulic fluid MIL-H-5606 and install in groove in piston rod (8). On actuator Part No. C6HF1020-5, install seal set (6A) in groove in piston rod (8), this is a requirement of modification 6/1650. When this modification is embodied, the actuator is up-dated to C6HF1020-5 and the identifying label must be marked accordingly.

CAUTION: ENSURE RADIUS ON EACH BACK-UP RING IS MATED WITH RADIUS AT ROOT OF T-SECTION SEALING RING OF SEAL SET.

(5) Coat internal surface of cylinder (7) with clean hydraulic fluid MIL-H-5606 and insert piston rod (8) with assembled seals into cylinder (7).

(6) Lubricate O-ring (4) with clean hydraulic oil MIL-H-5606 and install on end cap (1).

(7) Position end cap (1) in cylinder (7) with flange cutout in line with spigot (10), and install washers (3) and bolts (2).

(8) Screw end fitting (15) into piston rod (8) and install lockring (16). If new end fitting is used, drill a 0.086-inch diameter hole (No. 44 drill) in end fitting through hole in piston rod (8) to a depth of 0.35-inch. If a new piston is used with existing end fitting (15), and the locking holes on the piston rod and end fitting do not align, a new hole may be drilled in the end fitting through the pre-drilled hole in the piston rod, providing a distance of 0.1-inch is maintained between edges of the new and existing lockring holes in the end fitting.

(9) Lockwire bolts (2) and (11) using MS20995C32.

(10) If actuator is required for immediate service, position rotary selector valve on cylinder endcap (1) with pulley aligned with pulley spigot of retaining plate (10). Install four washers and bolts, and lockwire using MS20995C32. Install elbows in cylinder hydraulic ports, if removed.

7. Fits and Clearances

Refer to Table 1.

8. Testing

NOTE: Use only clean oil conforming to specification MIL-H-5606.

A. Pressure Test (Figure 1)

(1) Using a suitable test rig and, with port A open and piston rod retracted, apply 2300 psi hydraulic pressure for three minutes; there must be no external leakage or leakage from open port A. With port B open and piston rod fully extended, repeat test applying pressure at port A. There must be no leakage from open port B or cylinder. Release hydraulic pressure and check cylinder for permanent deformation.

(2) Using a suitable cycling rig, and with piston rod unrestrained, operate the piston rod in the cylinder for at least two cycles, raising pressure to 1500 psi at end of each stroke. Piston must move smoothly in both directions.

9. Trouble Shooting

Not applicable.

10. Storage Instructions

List of Materials

MATERIAL	SPECIFICATION OR MANUFACTURER
Hydraulic Oil	MIL-H-5606
Preservative Oil	MIL-H-6083
Barrier Material	MIL-B-121

A. Preparation

(1) Retract piston rod fully.

(2) Fill both ends of actuator with clean oil MIL-H-5606 or MIL-H-6083. Fit cap plugs to cylinder ports.

(3) Wrap unit in water vapor resistant barrier material.

(4) Affix label giving following information:

(a) Part and serial numbers.

(b) Date of overhaul.

(c) Type and specification of oil in actuator.

(d) Inspection.

11. Special Tools

Table 2

PART NO.	MANUFACTURER
187-1 Suitable Test Rig	The Lee Company, Westbrook, Conn., U.S.A.

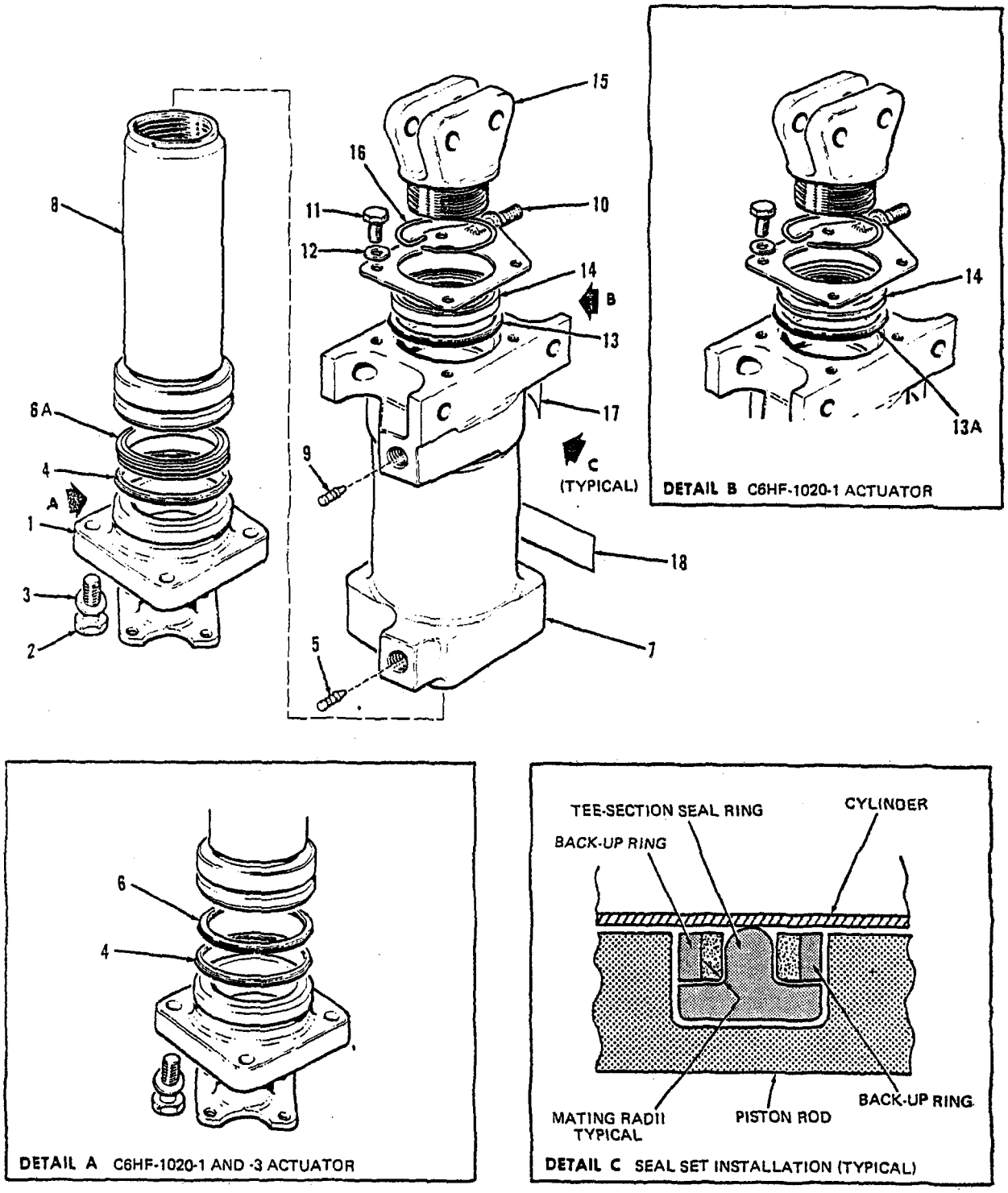
12. Illustrated Parts List

A. For explanation of vendor codes used in the illustrated parts list, refer to Table 3.

Table 3

Vendor Codes

VENDOR CODE	NAME AND ADDRESS
92555	The Lee Company, Westbrook, Conn., U.S.A.
72902	Greene Tweed and Company, North Wales, Pennsylvania, U.S.A.
05694	Equi-Flex Products Division of Master Pneumatic-Detroit Inc., Utica, Michigan, U.S.A.



Exploded View - Wing Flap Actuator

Figure 2

B. For explanation of usage codes used in illustrated parts list, refer to Table 4.

Table 4

Usage Codes

CODE	USED ON
A	Wing Flap Actuator C6HF1020-1
B	Wing Flap Actuator C6HF1020-3
C	Wing Flap Actuator C6HF1020-5

C. List of Parts

FIGURE AND INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
2	C6HF1020-1	Actuator Assembly - Flap		A	-
	C6HF1020-3	Actuator Assembly - Flap		B	-
	C6HF1020-5	Actuator Assembly - Flap		C	-
1	C6HFM1022-27	. Cap - End		A,B,C	1
2	AN4H7A	. Bolt		A,B,C	4
3	AN960-416L	. Washer		A,B,C	4
4	AN6230-3	. Gasket - O-ring		A,B,C	1
5	187-0-05000-0808	. Jet Assembly - Restrictor	(92555)	A,B,C	1
6	AN6227-30	. Packing - O-ring		A&B	1
6A	7327MR-160-T	. Seal - Set	(72902)	C	1
7	C6HFM1021-1	. Cylinder Assembly		A,B,C	1
8	C6HFM1023-27	. Rod - Piston		A,B,C	1
9	187-0-03000-0808	. Jet Assembly - Restrictor	(92555)	A,B,C	1
10	C6HF1025-1	. Plate - Retaining		A,B,C	1
11	AN3H4A	. Bolt		A,B,C	4
12	AN960-10L	. Washer		A,B,C	4
13	327FR160A-T	. Seal - Set	(72902)	B&C	1
13A	AN6277-30	. Packing - O-ring		A	1
14	419000A	. Ring - Scraper	(05694)	A,B,C	1
15	C6HFM1024-27	. Fitting - End		A,B,C	1
16	AN996-26	. Ring - Lock		A,B,C	1
17	CSP241-3	. Plate - Name		A,B,C	1
18	CSP174-3	. Label		A,B,C	1

SYNCRO DEVICES INCORPORATED

OVERHAUL INSTRUCTIONS

FLAP SELECTOR VALVE SKA104-1, SKA104-3 and SKA104-3A

1. DESCRIPTION AND DATA

A. DESCRIPTION
(Refer to Fig. 1)

The selector is a four way poppet type valve operated by a two lobe center camshaft to which is attached, at one end, an epicyclic gear mechanism. Input signals cause rotation of a gearwheel which transmits this motion, with a reduction ratio of 2, through a planetary gear system to the camshaft. The flap actuator output causes a signal of magnitude equal to the input, but of opposite sense, to cancel the input signal so that the valve is returned to its neutral position.

B. DATA

Operating Fluid - MIL-H-5606.
Operating Pressure - 1500 psi.
Operating Temperature - 65°F to 160°F.
Flow - 1.2 G.P.M.
Max Operating Torque - 15 pound-inches.

2. DISASSEMBLY

A. PROCEDURE
(Refer to Fig. 2)

(1) Cut and remove lockwire from plugs (1), (9), (17) and (25).

CAUTION: BECAUSE OF THE CRITICAL FACTORY SET ADJUSTMENT OF THE POPPET TO CAMSHAFT RELATIONSHIP, FOLLOW EACH STEP AS LISTED WHEN CARRYING OUT A COMPLETE OVERHAUL OF THE VALVE. IF ALL HARDWARE IS NOT REPLACED IN THE SAME CAVITIES OF THE VALVE BODY, THE UNIT WILL NOT FUNCTION AS REQUIRED.

NOTE: Observe the correct orientation of camshaft with respect to valve body. (In neutral position, the indexing notch of camshaft is at "6 o'clock position" when viewed from the input end, with the valve ports pointing towards the right). The camshaft must be reassembled in this position.

(2) Unscrew plug (1) and remove valve spring (2).

(3) Using special pliers (see figure 4), remove poppet and seat assembly (3) by inserting prongs of tool into holes in seat face until tool lip engages bottom face of seat. Apply a firm pressure on tool, slightly twist tool back and forth while pulling straight out, and remove assembly from cavity.

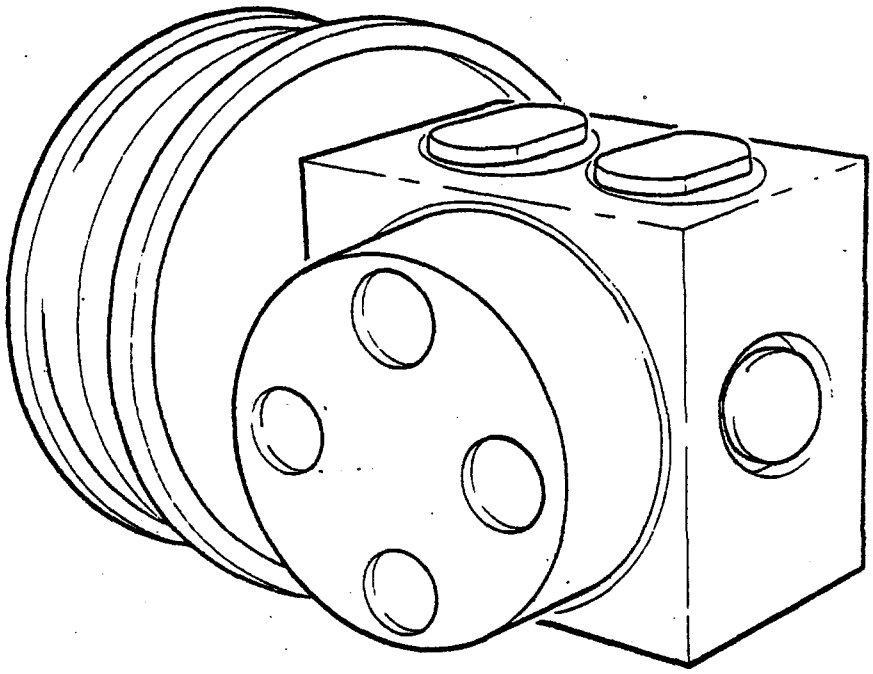


Figure 1. Selector Valve SKA 104

CAUTION: DO NOT REMOVE POPPET FOR PURPOSE OF REMOVING SEAT ASSEMBLY THROUGH CENTER HOLE.

(4) Remove O-ring (4) from top face and O-ring (5) from bottom face of seat assembly. Pull poppet (6) out of seat with a straight motion, and remove O-ring (7) from poppet.

CAUTION: DO NOT USE ANY FORM OF PLIERS TO REMOVE POPPET FROM SEAT.

(5) Remove shim (8) from body cavity. Ensure all parts are noted relative to body cavity.

(6) Remove plug (9), valve spring (10), poppet and seat assembly (11), O-ring (12), O-ring (13), poppet (14), O-ring (15) and shim (16) as detailed in steps (2) through (5).

(7) Remove plug (17), valve spring (18), poppet and seat assembly (19), O-ring (20), O-ring (21), poppet (22), O-ring (23) and shim (24) as detailed in steps (2) through (5).

(8) Remove plug (25), valve spring (26), poppet and seat assembly (27), O-ring (28), O-ring (29), poppet (30), O-ring (31) and shim (32) as detailed in steps (2) through (5).

(9) Remove circlip (33) from end of camshaft remote from gearing, and remove washer (34).

(10) Carefully withdraw camshaft assembly (35) complete with gearing from valve body (36) with light pressure and a twisting motion.

CAUTION: IF CAMSHAFT IS REMOVED IN A ROUGH MANNER, LINEAR SCRATCHES WILL CAUSE SHAFT LEAKAGE.

(11) Remove three O-rings (37) and on -3 and -3A assemblies, remove three back-up rings (38) from camshaft. Disassembly of gear assembly (under pulleys) is not necessary unless binding is evident. Check for binding by holding one pulley and rotating the other in turn. Both pulleys should roll freely.

(12) If binding is evident due to contamination, remove circlip (33) and washer (34) from pulley end of camshaft. Cut lockwire, remove screws (39), pulleys (40), gear (41) and gear (42). Remove four screws (43) and remove spider assembly (44) from camshaft.

3. CLEANING

A. PROCEDURE

(1) Clean all parts from one valve cavity at a time to ensure no chance of mixing shims and poppet and seat assemblies.

(2) Clean all parts using a dry cleaning solvent. Dry with lint-free dry cloth.

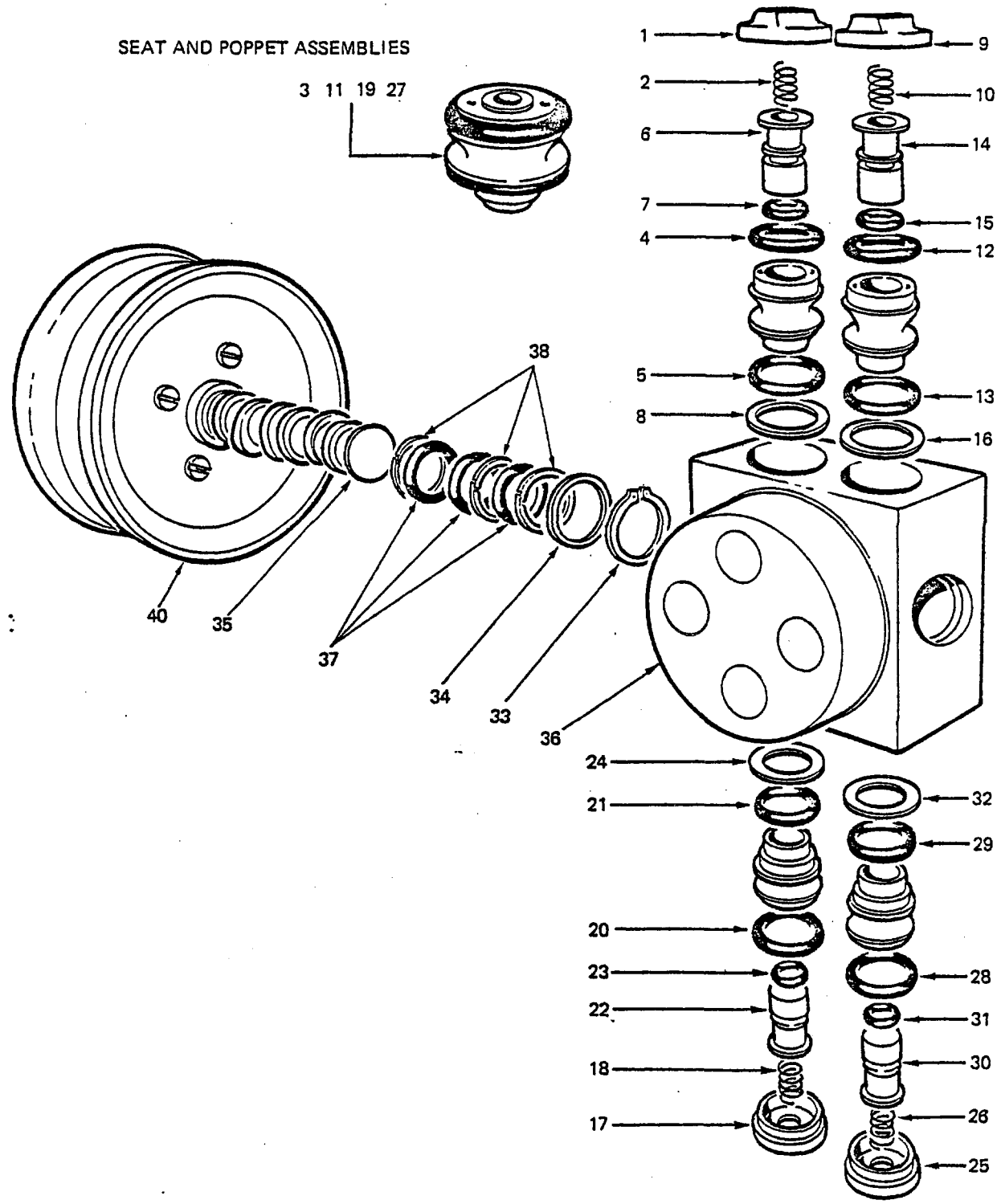


Figure 2. Selector Valve Assembly (Sheet 1)

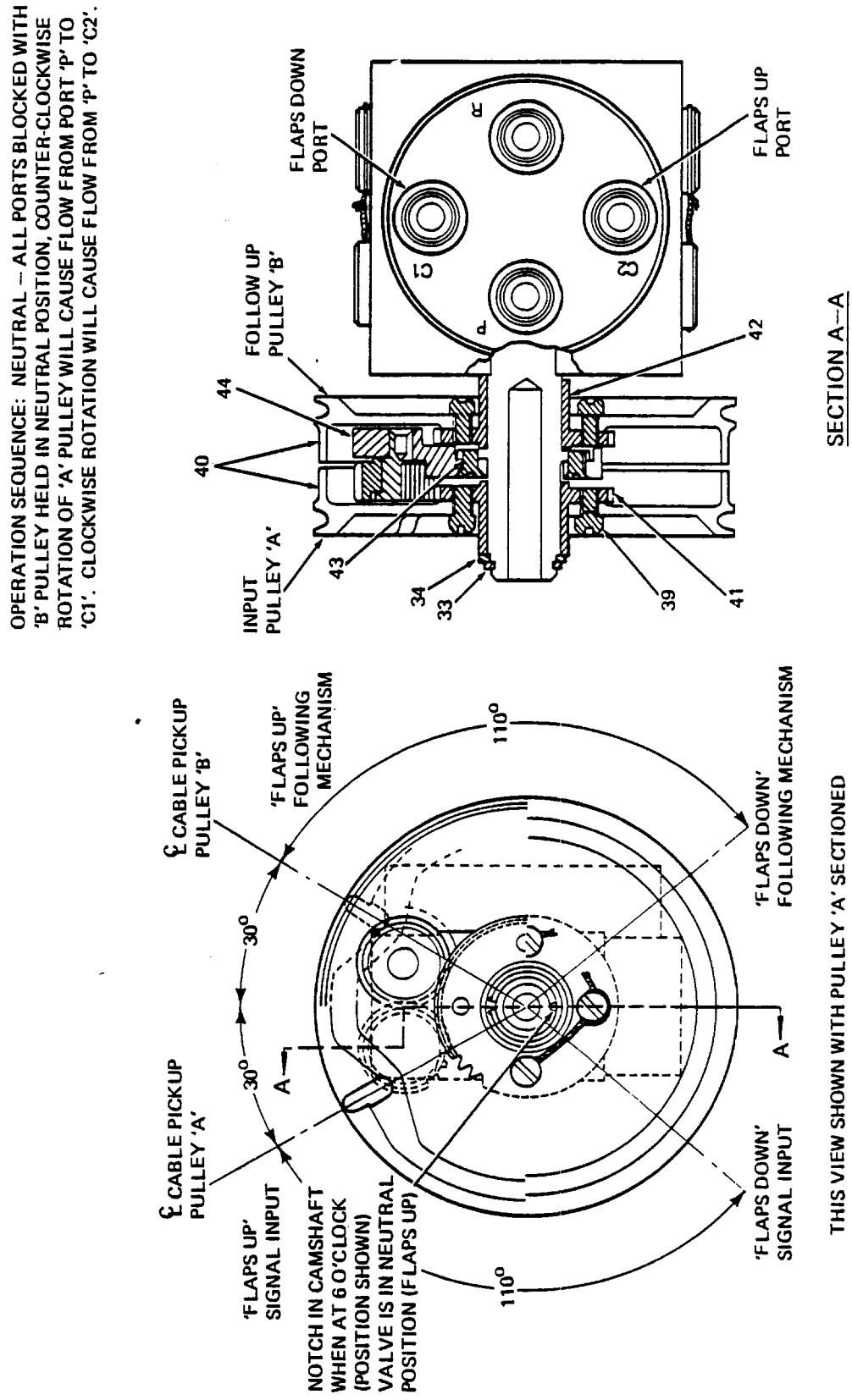


Figure 2. Selector Valve Assembly (Sheet 2)

4. INSPECTION

A. PROCEDURE

(1) Valve body should be free of scratch marks relative to the three O-ring areas. Minor radial scratch marks or burnishing of bore from camshaft bearing (6 places) is acceptable. Bore diameter should be between 0.562 and 0.565 inch. If bore is badly scored or outside allowable limits, it will be necessary to replace entire unit.

(2) Camshaft bearing journals should be free of scratch marks.

NOTE: Burnishing of black oxide is not cause for rejection. Diameter of journals should be between 0.561 and 0.5657 inch. If camshaft shows definite scratches, or bearing journals are beyond allowable limits, the selector valve should be replaced.

NOTE: Wear on cam lobes will be evident at and adjacent to corners, and is not cause for rejection as it only affects dead band. (Refer to TESTING.)

(3) Check gear assembly for freedom of movement. Hold one pulley and rotate the other. Both should roll freely without evidence of binding.

(4) Inspect large hole in seat (poppet and seat assemblies) for nicks. If evident, internal leakage of valve will occur, and selector valve should be replaced. If in doubt, reassemble unit and test for internal leakage. (Refer to TESTING.)

5. REPAIR

A. Not applicable

6. ASSEMBLY

A. PROCEDURE

(1) During assembly, lubricate all O-rings with petroleum jelly. If not available, lubricate using hydraulic fluid listed in 7. TESTING. Refer to Figure 2, position spider assembly (44) on camshaft (35) and install four screws (43). Position gear (42), gear (41), pulleys (40) and install screws (39). Install washer (34) and circlip (33) at pulley end of camshaft (35).

(2) Install three new O-rings (37), and on -3 and -3A assemblies install three back-up rings (38) on camshaft. Ensure back-up rings are installed opposite pressure side of O-ring. Wet bore of valve body (36) with test fluid (refer to paragraph 7) and assemble camshaft assembly into bore of valve body taking care not to pinch O-rings as they enter and continue through bore.

(3) Install washer (34) and circlip (33) to lock camshaft to valve body. Rotate camshaft notch to correct position. (Refer to paragraph 2.A. (1).)

(4) Install shim (32) to its relative cavity in valve body.

(5) Install new O-ring (31) to poppet (30) of poppet and seat assembly (27) and reinstall poppet in seat.

(6) Install new O-ring (29) to bottom face of poppet and seat assembly. Reinstall poppet and seat assembly (27) to its relative cavity in valve body taking care not to cut O-ring as it passes flow holes. Ensure that seat is at bottom of cavity.

(7) Install new O-ring (28) on top face of poppet and seat assembly. Push O-ring into position firmly.

CAUTION: DO NOT USE SHARP TOOLS OF ANY KIND TO POSITION O-RING.

(8) Install spring (26) and plug (25) to cavity.

(9) Install shim (24), O-ring (23), poppet (22), O-ring (21), poppet and seat assembly (19), O-ring (20), valve spring (18) and plug (17) to its relative cavity in valve body in a similar manner as detailed in steps (4) through (8).

(10) Install shim (16), O-ring (15), poppet (14), O-ring (13) poppet and seat assembly (11), O-ring (12), valve spring (10) and plug (9) to its relative cavity in valve body in a similar manner as detailed in steps (4) through (8).

(11) Install shim (8), O-ring (7), poppet (6), O-ring (5), poppet and seat assembly (3), O-ring (4), valve spring (2) and plug (1) to its relative cavity in valve body in a similar manner as detailed in steps (4) through (8).

(12) Using a torque wrench, tighten plugs (1), (9), (17) and (25) to 20-25 pounds-feet. Wirelock plugs with lockwire MS20995NC32.

7. TESTING

A. PROCEDURE

(1) Use hydraulic fluid to US specification MIL-H-5606A, "Esso Univas J43". "Shell Aeroshell Fluid 4".

(2) Connect selector valve as shown in Fig. 3.

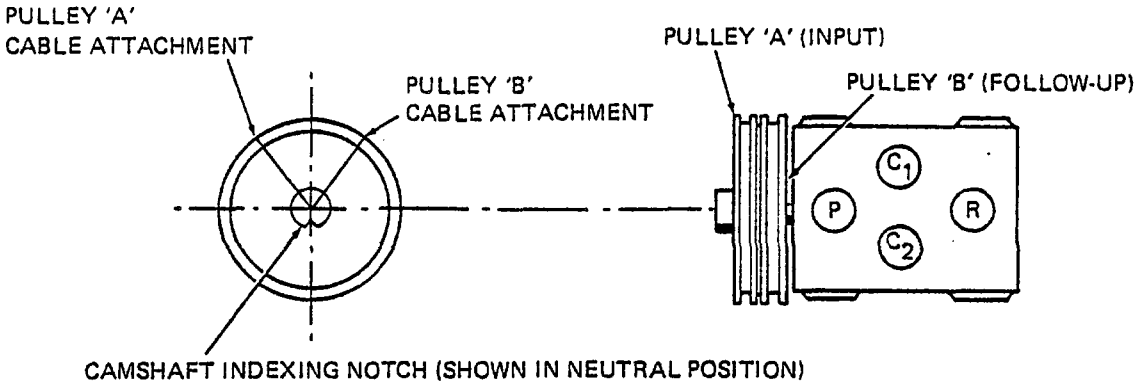
(3) Refer to Fig. 3 and carry out sequence of tests as detailed in Table 1.

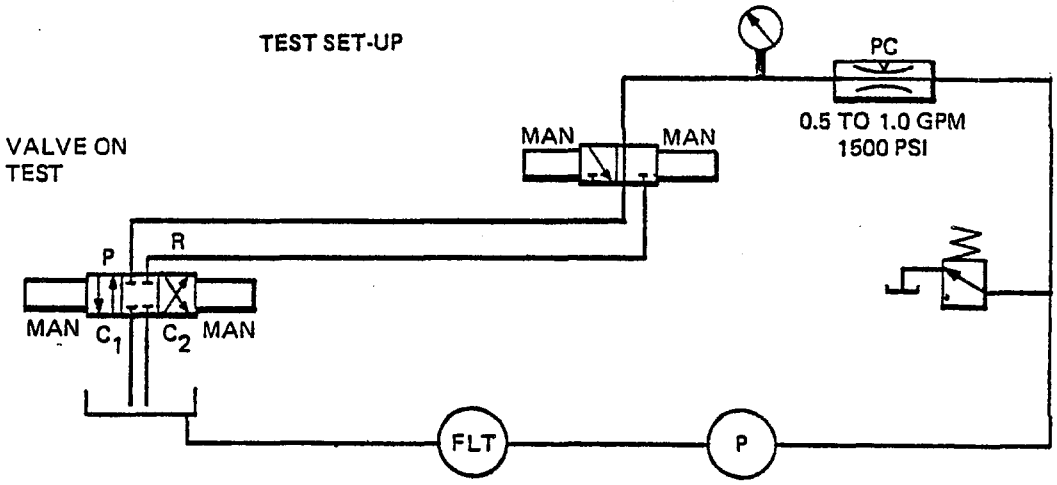
TABLE 1

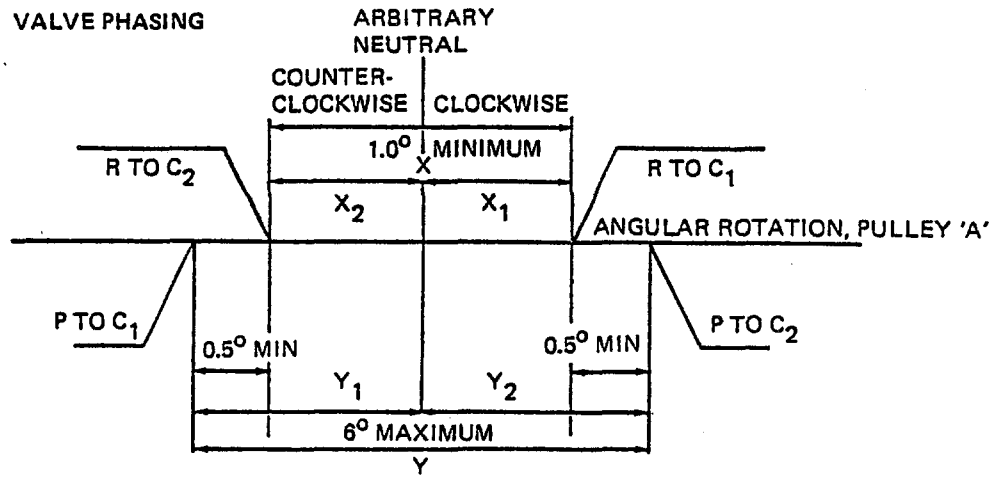
TEST REQUIREMENTS

Test No.	To Test	Apply Pressure at Port	Cap Ports	Initial Applied Pressure PSI	Pulley Position	Requirements and Observations
1.	Proof Pressure	P	R	2250 (Static)	Rotate A & B together	Ports C1 and C2 joined by shorting line. Apply pressure for 2 min-

VALVE PORT ORIENTATION







NOTE: THIS FIGURE SHALL BE $\left(\frac{Y-X}{2}\right)^{\circ} \pm .5^{\circ}$ EXAMPLE: $Y = 6^{\circ}$, $X = 1^{\circ}$, $\left(\frac{6-1}{2}\right)^{\circ} \pm .5^{\circ}$, $2.5^{\circ} \pm .5^{\circ}$

Figure 3. Rotary Control Valve Test Set-Up

Test No.	To Test	Apply Pressure at Port	Cap Ports	Initial Applied Pressure PSI	Pulley Position	Requirements and Observations
						utes, release and re-apply. There shall be no external leakage, permanent set or deformation.
2.	Low Pressure, External Leakage	P	None	10 (Static)	Neutral	As for Test 1, no external leakage.
3.(a)	Internal Leakage	P for a settling period of 9 min.	None	1500 at 0.5 to 1.0 gpm.	Neutral	Leakage rate from Port C1, C2 or R after settling period not to exceed 1 drop per minute Retest at 500 psi. No leakage from Ports C1 C2 or R (see Note 2).
(b)	Internal Leakage	R for a settling period of 9 min.	None	1500 at 0.5 to 1.0 gpm	Neutral	Leakage rate from Port C1, C2 or P after settling period not to exceed 1 drop per minute Retest at 50 psi. No leakage from Ports C1, C2 or P (see note 2).
4.(a)	Valve Phasing	R (Rigged as in Fig. 3)	None	1500 at 0.5 to 1.0 gpm	Pulley B locked, rotate A clockwise from arbitrary neutral.	Note angular displacement of Pulley A from arbitrary neutral until oil commences to flow from Port C1 (Angle X1 Without disturbing Pulley A setting, continue to test 4 (b).
(b)		P			Pulley B locked, rotate A clockwise from position determined at 4 (a).	Continue turning Pulley A until oil commences to flow from Port C2. Note total angular displacement of Pulley A (Angle Y2). Return Pulley to original neutral position.
(c)		R			Pulley B locked, rotate A counterclockwise from arbitrary neutral.	Note angular displacement of Pulley A from arbitrary neutral until oil commences to flow from Port C2 (Angle X2 Without disturbing Pulley A position continue to test 4 (d).

Test No.	To Test	Apply Pressure at Port	Cap Ports	Initial Applied Pressure PSI	Pulley Position	Requirements and Observations
(d)	Valve Phasing	P	None	1500 at 0.5 to 1.0 gpm.	Pulley B locked, rotate A counter-clockwise from arbitrary neutral	Continue turning Pulley A until oil commences to flow from Port C1. Note total angular displacement of Pulley A (Angle Y1). The sum of Angles X1 + X2 and Y1 + Y2 shall lie within the bands shown by Fig. 3.

NOTES: (1) "Neutral" position defined as Camshaft Notch at 6 o'clock position.
(2) "No Leakage" defined as 1 drop in 3 minutes. Tests 3 (a) and 3 (b) only.
(3) "Commences to Flow" defined as the first steady oil stream.

8. TROUBLE SHOOTING

Trouble	Probable Cause	Correction
Internal Leakage	Nicks or scratches on seat of poppet and seat assembly or cut O-ring.	Remove poppet and seat assemblies (paragraph 2A steps (1) through (8)). Clean and inspect seat. Reassemble (paragraph 6A steps (4) through (8)) and test. (Refer to Table 1, test 3 (a) and (b)).
Camshaft external leakage.	Scratches on camshaft or cut O-rings.	Remove plugs and valve springs. Reinstall plugs and hand tighten only. NOTE: It is not necessary to remove poppet and seat assemblies Holding both pulleys, rotate camshaft 360° to lift poppets. Remove camshaft assembly (paragraph 2A steps (9) through (11)). Examine valve body bore and camshaft for accessive scratches and loose pieces of O-rings. Clean and reassemble camshaft (paragraph 6A steps (1) through (3)). Remove plugs. Reinstall springs and plugs. Tighten plugs 20-25 pounds-feet. Carry out tests 1 and 2 of Table 1.

Plug external leakage.	Cut 0-ring on top face of poppet and seat assembly.	Remove leaking plug and valve spring. Note condition of 0-ring on top face of seat, then remove 0-ring. Ensure seat is bottomed and area free of contamaination or loose pieces of 0-ring. Lubricate and install new 0-ring. Push 0-ring into position firmly. CAUTION: DO NOT USE SHARP TOOLS OF ANY KIND TO POSITION 0-RING ON SEAT. Replace valve spring and plug. Tighten plug to 20-25 pounds-feet and wirelock. Test valve for external leakage (Refer to Table 1, tests 1 and 2).

9. STORAGE INSTRUCTIONS

A. Cap all ports, and enclose selector valve in polythene bag.

10. SPECIAL TOOLS

A. Pliers - (Local manufacture see figure 4.)

11. ILLUSTRATED PARTS LIST

A. General

Part variations between flap selector valve models are indicated by letter symbols placed under "Usage on Code" column of the Detailed Parts List. "Usage on Code" letter symbols are applicable as follows:

USAGE ON CODE	PART LIST NUMBER
A	SKA 104-1 (Serial Nos. 1 thru 126)
B	SKA 104-3 (Serial Nos. 1 thru 605)
C	SKA 104-3A (Serial Nos. 606 and sub)

B. Detailed Parts List

Fig. and Index No.	Part No.	Nomenclature 1234567	Usage On Code	Units p Assy.
2	SKA 104-1	Valve, Flap Selector	A	
2	SKA 104-3	Valve, Flap Selector	B	
2	SKA 104-3A	Valve, Flap Selector	C	
-1	SKD1010-1	Plug	ABC	1
-2	SKD1011-1	Spring	ABC	1
-3	SKS1017-1	Poppet and Seat Assy	ABC	1
-4	AN6227B14	0-ring	ABC	1

B. Detailed Parts List (Cont'd)

Fig. and Index No.	Part No.	Nomenclature 1234567	Usage on Code	Units per Assy.
2 -5	AN6227B14	O-ring	ABC	1
-6	-	Poppet (Matched Set with Seat of Item 3)	-	-
-7	AN6227B5	O-ring	ABC	1
-8	SKD1012-1	Shim, Laminated	ABC	1
-9	SKD1010-1	Plug	ABC	1
-10	SKD1011-1	Spring	ABC	1
-11	SKS1017-1	Poppet and Seat Assy	ABC	1
-12	AN6227B14	O-ring	ABC	1
-13	AN6227B14	O-ring	ABC	1
-14	-	Poppet (Matched Set with Seat of Item 11)	-	-
-15	AN6227B5	O-ring	ABC	1
-16	SKD1012-1	Shim, Laminated	ABC	1
-17	SKD1010-1	Plug	ABC	1
-18	SKD1011-	Spring	ABC	1
-19	SKS1017-1	Poppet and Seat Assy	ABC	1
-20	AN6227B14	O-ring	ABC	1
-21	AN6227B14	O-ring	ABC	1
-22	-	Poppet (Matched Set with Seat of Item 19)	-	-
-23	AN6227B5	O-ring	ABC	1
-24	SKD1012-1	Shim, Laminated	ABC	1
-25	SKD1010-1	Plug	ABC	1
-26	SKD1011-1	Spring	ABC	1
-27	SKS1017-1	Poppet and Seat Assy	ABC	1
-28	AN6227B5	O-ring	ABC	1
-29	AN6227B5	O-ring	ABC	1
-30	-	Poppet (Matched Set with Seat of Item 27)	-	-
-31	AN6227B5	O-ring	ABC	1
-32	SKD1012-1	Shim, Laminated	ABC	1
-33	NAS670-50	Circlip	ABC	2
-34	SKD1008-1	Washer	ABC	2
-35	SKD1014-1	Camshaft	A	1
	SKD1440-1	Camshaft	B C	1
-36	SKD1013-2	Body, Valve	A	1
	SFD1439-1	Body, Valve	B C	1
-37	AN6227B8	O-ring	ABC	3
-38	MS28774-110	Ring, Back-up	BC	3
-39	AN501A8-4	Screw	ABC	8
-40	SKD1036-1	Pulley	ABC	2
-41	SKD1059-1	Gear	ABC	1
-42	SKD1059-1	Gear	A	1
	SKD1059-3	Gear	BC	1
-43	AN505C3-4	Screw	ABC	4
-44	SKS1015-3	Spider Assy	AB	1
	SKS1015-3A	Spider Assy	C	1

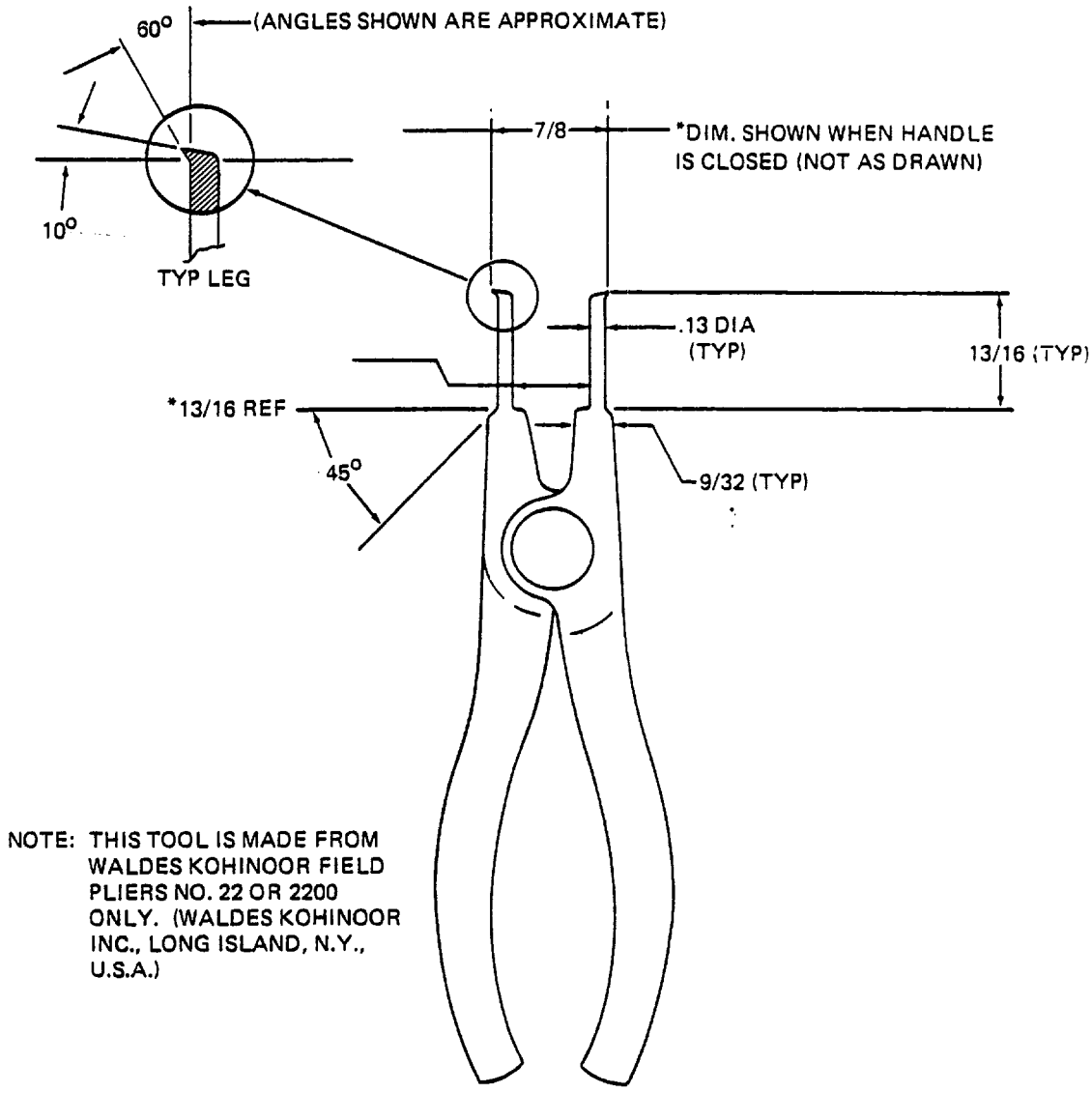


Figure 4. Special Pliers

OPERATION AND MAINTENANCE INSTRUCTIONS

with

PARTS LIST

for

WESTON®

MODEL 1511 DC MICROAMMETER

Part Number 253607

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GENERAL

This manual contains operating, maintenance, testing and calibration instructions with replacement parts list for the Weston Model 1511 DC Microammeter, part number 253607, manufactured by Weston Instruments Division, Weston Instruments, Inc., Newark, N. J.

This microammeter is a sealed, ruggedized, permanent magnet, moving coil type instrument designed for use in the vicinity of shock or vibration. It is provided with a special slotted bezel to allow for external edge lighting.

The meter is calibrated and tested as a microammeter but indicates aileron trim information.

TABLE OF SPECIFICATIONS

Range	500/0/500 Microamperes DC
Scale	LW DN (left) / 0 (center) / RW DN (right) Caption: Ail Trim
Resistance . . .	37.5K ± 235 ohms between pins A & B, and between pins B & C.
Accuracy	±3% of full scale
Case	1.5 inch dia. steel barrel with rubber shock mountings.

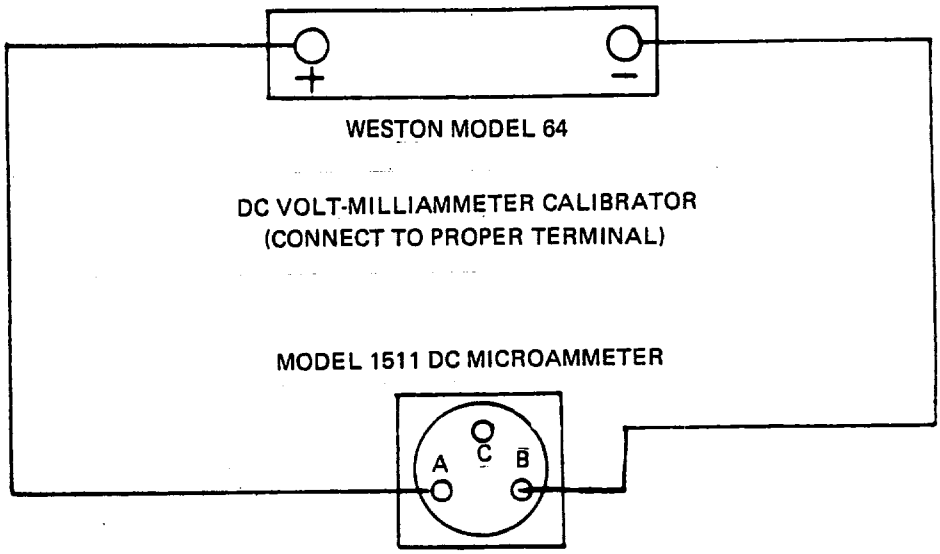
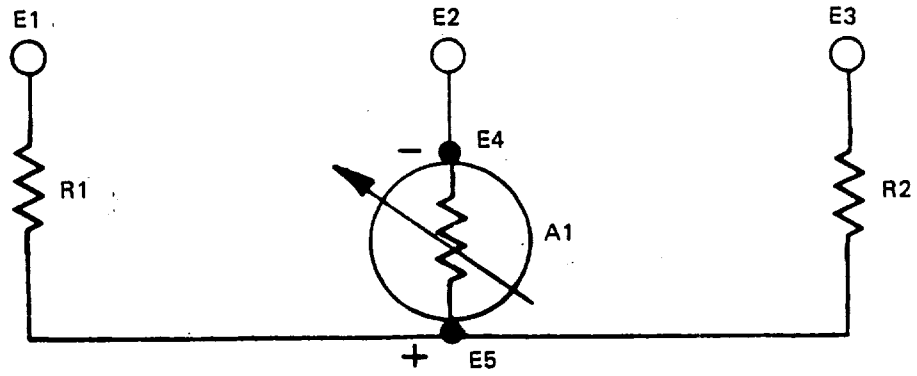


Figure 1. Calibration Circuit.



A1 = Moving Element Assembly (36.8 ohms ± 20%)
E1 = Back Connection Terminal (Pin A)
E2 = Back Connection Terminal (Pin B)
E3 = Back Connection Terminal (Pin C)
E4 = Bracket Bottom Solder Abutment
E5 = Bracket Top Solder Abutment
R1, R2 = Resistor, wire wound, 37.5K ± 1/2%, 0.1 watt

Figure 2. Internal Wiring Diagram.

OPERATING AND INSTALLATION INSTRUCTIONS

a. Mount the instrument on a vertical panel prepared in accordance with the drilling plan. (See Figure 3.) The panel material may be steel or a nonmagnetic material since the case provides magnetic shielding.

b. Connect the circuit lead wires to the back connection terminals, observing proper polarity.

MAINTENANCE INSTRUCTIONS

a. It is recommended that the instrument be tested for proper performance at twelve month intervals. It should always meet the requirements as stated in the Test Procedure and Calibration Check.

b. No lubrication is required of this instrument.

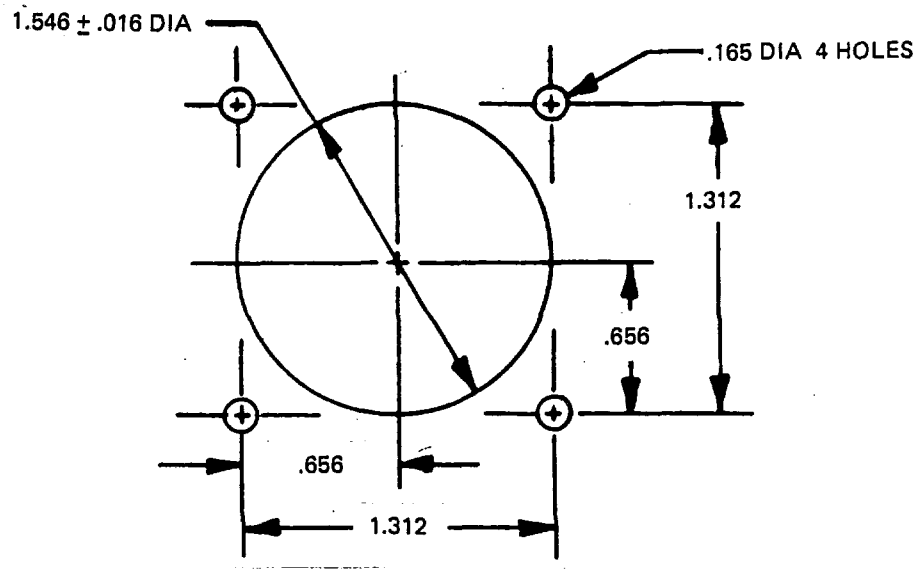


Figure 3. Panel Drilling Plan.

CALIBRATION CHECK

a. Connect the instrument in the circuit as shown in Figure 1.

b. Apply end scale current and note pointer deflection. The pointer must deflect to the RW end scale mark. (Tolerance is ± 3% of full scale.

c. Reverse polarity and note pointer deflection. The pointer must deflect to the LW end scale mark (within tolerance).

d. Repeat steps b and c with positive lead to terminal B, negative to A.

e. If the indications are not within the accuracy limits refer to the following trouble shooting chart and test procedures to determine the probable cause of calibration error.

TEST PROCEDURES

If the instrument does not meet the requirements of each of the following tests it is considered defective and should be repaired. Tests should be conducted at ambient room temperature 25°C (77°F). The instrument must be baked and resealed if opened. The instrument should be tapped lightly when test readings are taken.

Balance Test

a. With the instrument in its normal operating position, scale vertical and upright, pivot axis horizontal, the pointer shall rest at the center of the zero mark on the scale.

b. Tilt the instrument from this position 60 degrees to the left, to the right, and forward or backward. The pointer shall not deviate more than one-half the pointer tip width from its original position when checked in any of the aforementioned positions. If it does it will be necessary to rebalance the moving element assembly.

Dielectric Test

a. Gradually apply 1500 Volts RMS, sinusoidal 60 cycles, for five seconds between the three back connection terminals, connected together, and the case. Gradually reduce the voltage at the end of the five second test.

b. If breakdown occurs check the instrument internally for loose metal particles.

Watertightness

a. Immerse the instrument in water and apply a vacuum equivalent to an absolute pressure of two inches of mercury for two minutes. There shall be no stream of bubbles from the instrument. Bubbles from the water or clustered around the instrument may be ignored.

b. After releasing the vacuum and removing the instrument from the water there shall be no evidence of water within the case.

c. If moisture is found within the case replace the gasket and reseal.

Resistance

The resistance, as measured across the back connection terminals, must be as stated in the Table of Specifications.

ADJUSTMENT PROCEDURES

Final Jewel Adjustment

a. Make the final jewel adjustment under open circuit conditions. Alternately adjust the top and bottom jewel screws until the distance from the core to the top and bottom of the moving coil is equal.

TROUBLE SHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
FRICTION	Damaged pivots or jewel screws. Foreign particle in air gap. Fuzz on moving coil. Moving coil touching core. Distorted spring. Jewel screws too tight.	Replace pivots or jewel screws. Remove particle. Remove fuzz. Readjust jewel screws for proper moving coil clearance. Replace moving coil if it is bent or distorted. Realign spring with fine tweezers or replace it entirely. Readjust jewel screws.
NO INDICATION	Open moving coil. Poor solder connection.	Replace moving coil. Resolder connection.
VARIABLE READING	Poor connections. Friction. Loose balance weight. Distorted spring in moving element.	Tighten or resolder connections. See FRICTION section above. Replace balance weight and rebalance. Realign spring with fine tweezers or replace it entirely.
INDICATES	Friction. Loose connections. Spring test too high. Shorted turns on moving coil or incorrect moving coil. Incorrect resistance. Insufficient magnet strength.	See FRICTION above. Tighten or resolder connections. Replace springs. Replace moving coil. Replace or adjust resistor. Recharge and treat magnet.
INDICATES HIGH	Spring test too low. Incorrect moving coil. Excessive magnet strength. Incorrect reistance.	Replace springs. Replace moving coil. Treat magnet. Replace resistor.
CALIBRATION ERROR IN EXCESS	Moving element poorly balanced. Distorted spring.	Rebalance moving element. Realign spring with fine tweezers or replace it entirely.

b. Deflect the pointer from its original rest position and let the pointer oscillate. Tighten the top jewel screw slowly until a slight damping is detected. Back off from this point one-eight to one-quarter of a turn.

c. Apply red butyl methacrylate cement, Weston SND 23317-001, to the top and bottom jewel screws.

Magnet Charging

a. If the mechanism assembly was disassembled the magnet must be recharged on a suitable magnet charger having a capacity of at least 33,000 ampere turns DC.

b. After charging, the pointer must deflect in a clockwise direction with positive polarity applied to the bracket top insulated solder abutment.

c. If the pointer deflects to the opposite direction, reverse the charge on the magnet.

Balancing Moving Element

Before attempting to balance the moving element make sure that the pointer is straight and swings parallel to and between 0.05 and 0.10 inch from the scale plate. The moving element must be well balanced about the axis of rotation in order that the calibration will check in the normal operating position as well as when tilted. Adjustable balance weights are provided on the pointer arms for balancing purposes. The general procedure for balancing the instrument moving element is as follows:

a. Hold the instrument so that the scale palate is in horizontal position and adjust the pointer to 0 by means of the bracket top abutment.

b. Turn the instrument so that the scale is in a vertical position and the pointer is parallel to the floor.

c. Adjust the tail weight, in or out, until the pointer rest at the 0 mark and is parallel to the floor.

d. Rotate the instrument until the pointer is perpendicular to the floor.

e. Adjust the side arm weights until the pointer rests at the 0 mark and is perpendicular to the floor.

f. Repeat steps b thru e until proper balance is achieved. (See Balance Test.)

CALIBRATION PROCEDURE

a. Prior to instrument calibration check the resistance across the back connection terminals. The resistance must be within the tolerance as stated in the Table of Specifications.

b. Connect the instrument to the standard calibrator as shown in Figure 1.

c. Apply end scale current. If the pointer does not go beyond the end scale mark the spring test is too high, the moving coil has an insufficient number of turns, or the magnet is not fully charged.

d. Position the instrument between the jaws of an energized demagnetizing coil. Increase the voltage to the demagnetizing coil slowly until the pointer rests at the end scale mark with end scale current applied to the instrument.

e. Exercise care not to over-treat as the magnet will then have to be recharged.

f. Reverse the polarity and check pointer deflection in the other direction.

INSTRUMENT SEALING

a. The instrument window, flange, gasket, and bezel must be clean before sealing. Never use alchols, petroleums, or similar solvent on the window.

b. Dampen a soft cotton pad with Weston anti-static solution Statnul® and apply to the inside and outside surfaces of the window. Allow a slight haze to form by air drying. Polish with a soft clean cotton pad until haze is just visible.

c. Insert a dirt free metal spacer (such as a paper clip) between case flange and window for ventilation during next step.

d. Bake instrument in an oven, free of dirt and lint, for 2 hours at 145° - 165°F.

e. Upon removal from oven, remove metal spacer and immediately press window tightly against case flange with palm of hand to provide temporary seal while completing following steps.

f. Place the instrument with the bezel and window face down on a flat soft surface and align the holes on the bezel with the holes of the case flange.

g. Tighten all four case to bezel screws lightly initally to hold bezel in place, then proceed to tighten screws at a torque of 5 to 6 in. lbs. When tightening screws, tighten screws directly opposite one previously tightened.

h. When sealed, the instrument must pass the aforementioned watertightness test.

MODEL 1511

REPLACEMENT PARTS LIST

ITEM NO.	PART NUMBER	DESCRIPTION	QTY PER ASSY
1	253607	Instrument Assembly, Model 1511, 500/0/500 Microamperes DC	-
2	133340-172	Screw (Case to bezel)	4
3	257025-302	Bezel	1
4	148207-001	Gasket (Bezel to window)	1
5	148188-001	Window	1
6	148187-001	Gasket (Window to Case)	1
7	148213-001	Cushion Pointer Stop, left	1
8	148212-001	Cushion Pointer Stop, right	1
9	154430-024	Screw (Mounting Stops)	2
10	257247-901	Scale Plate, Dial	1
11	148196-001	Screw, Special (Mounting Magnet Retainer)	1
12	148195-001	Locking Terminal (Scale Mounting)	1
13	148197-001	Stud (Mounting Magnet)	2
14	ND37005-024	Lock Washer (Mounting Magnet)	2
15	125027-024	Washer (Mounting Magnet)	1
16	ND37880-033	Terminal, Solder Lug	1
17	148198-001	Retainer (Magnet Mounting)	1
18	No Number	Resistor, WW, 37.5K $\pm$ 1/2%, 0.1W Precision Resistor Corp., Hillside, N.J., Type SX093	2
19	148201-001	Retaining Stud (Mounting Back Connection Terminals)	2
20	148199-001	Back Connection Terminal (E1 & E3)	2
21	257753-901	Case Assembly (Includes E2)	1
22	152648-001	Screw (Mounting Magnet to Bracket)	2
23	148190-045	Magnet	1
24	249202-901#	Jewel and Screw Assembly	2
25	264940-901	Moving Element Assembly (A1)	1
26	22960-001 ≠	Nut	2
27	141988-901 ≠	Paired Springs	1 Pr.
28	150889-145 ≠	Pointer	1

NOTES: ≠ = Parts are part of Moving Element
= Parts are part of Bracket Assembly

ITEM NO.	PART NUMBER	DESCRIPTION		QTY PER ASSY
29	107381-001 ≠	Weight, Spiral, 4 turns	Select 2	AR
29	107382-001 ≠	Weight, Spiral, 6 turns	for pointer	AR
29	106356-001 ≠	Weight, Spiral, 8 turns	side arm	
30	81041-001 ≠	Weight, Spiral, 12 turns	Select 1 for	AR
30	106355-001 ≠	Weight, Spiral, 20 turns	pointer tail	AR
31	170928-234 ≠	Pivot		2
32	168995-001	Moving Coil		1
33	148210-001 #	Screw (Mounting Core)		1
34	ND20520-024 #	Nut (Mounting Core)		1
35	148214-045 #	Core		1
36	159070-901	Bracket Assembly		1

ACCESSORIES

172588-901	External Scale Plate	1
187205-915	Instrument Mounting Hardware Package	1

NOTES: ≠ = Parts are part of Moving Element
= Parts are part of Bracket Assembly

CHAPTER

28

FUEL

– Temporary Revision

PSM NO.: 1–6–6A **AIRCRAFT:** DHC-6 **SERIES:** ALL

PUBLICATION: COMPONENT MAINTENANCE MANUAL **TEMPORARY REVISION NO.:** 28–1

Insert in Chapter 28 – CONTENTS, before page 1

CHAPTER 28 – FUEL

REASON FOR ISSUE:

This Temporary Revision adds Section 28–10–1, Tank Filler Cap Assembly Part Number 38040–1 to the Table of Contents and updates part numbers for the Uniroyal Bladder Type Fuel & Oil Cells.

ACTION:

In Chapter 28, ignore existing Table of Contents and replace with revised Table of Contents, as shown on page 2 of this Temporary Revision.

— Continued overleaf —

RECORDING INSTRUCTIONS:

Record this Temporary Revision No. and the relevant information in the appropriate columns of the TEMPORARY REVISION INDEX provided at the front of the manual.

MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B./T.R.
Shaw Aero	Tank Filler Cap Assy	38040–1	28–10–1	July 29/04	
Adel	Fuel Booster Pump	71383–3 & –3A	28–20–6	Mar 1/1969	
Aero–Correy	Fuel Filter	52–2889–002	28–20–01	Feb 24/1969	SB 28–20–01–A dated Dec 3/1969
Airborne	Fuel Pump	Model 1D2–17		Oct 1/1980	
Aircraft Appliance	Check Valve	700 246		Sep 28/1967	
Crane (Hydro–Aire)	Fuel Booster Pump	60–611	28–20–0	Feb 15/1971	
	Fuel Booster Pump	160–011 & –065	28–20–28	Apr 1/1986	
	Fuel Booster Canister Pump	72266–3 & 72390–2	28–20–24	Feb 21/1986	
	Fuel Booster Pump	72368–1	28–20–22	Jan 21/1983	
	Fuel Booster Pump	71383–2	28–20–29	Feb 27/1986	
Custom Components	Gage Pressure Switch	8G361–1 (DHC7SC0020–5)	28–40–04	Oct 10/1969	
ITT General Controls	Motor Operate Gate Valve	AV16B1864B	28–1–1		All in same manual.
	Actuator Assembly Valve	106788B107	28–1–2		
	DC Motor	106785B100	28–1–3	Dec 15/1964	
	Motor Operated Gate Valve	AV16B1762B	28–1–4		
Lear Siegler	Booster Pump	RR12830A		May 1/1973	
Parker Aircraft	Level Control Valve	1321–536250		May 15/1968	
	Swing Check Valve	2650157		May 15/1968	
Simmonds	Tank Unit	391087 & 391088	28–40–001	Mar 1968	
	Liquid Quantity Indicator	391088–002 through –006	28–41–04	Jul 29/1988	
	Liquid Quantity Indicator	393000–01703 & 39300–01704		Jul 1969	
	Fuel Quantity Indicator	393004–060 through 393004–132		May 1986	
Uniroyal	Bladder Type Fuel & Oil Cells	C6SC1051–3 C6SC1052–3 C6SC1053–3 C6SC1054–3 C6SC1055–3 C6SC1056–3 C6SC1057–3 C6SC1058–3 C6SC1058–5		Nov 23/1967	

NOTE: Please see the TEMPORARY REVISION that revises this page.

BOMBARDIER
AEROSPACE

de Havilland Inc.
DHC–6 TWIN OTTER
COMPONENT MAINTENANCE MANUAL
CHAPTER 28 – FUEL
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MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B./T.R.
Adel	Fuel Booster Pump	71383–3 & –3A	28–20–6	Mar 1/1969	
Aero–Correy	Fuel Filter	52–2889–002	28–20–01	Feb 24/1969	SB 28–20–01–A dated Dec 3/1969
Airborne	Fuel Pump	Model 1D2–17		Oct 1/1980	
Aircraft Appliance	*Check Valve*	*700 246*		*Sep 28/1967*	
DELETED					
Crane (Hydro–Aire)	Fuel Booster Pump	60–611	28–20–0	Feb 15/1971	
	Fuel Booster Pump	160–011 & –065	28–20–28	Apr 1/1986	
	Fuel Booster Canister Pump	72266–3 & 72390–2	28–20–24	Feb 21/1986	
	Fuel Booster Pump	72368–1	28–20–22	Jan 21/1983	
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	Fuel Quantity Indicator	393004–060 through 393004–132		May 6/1986	
Uniroyal	Bladder Type Fuel & Oil Cells	C6SC1051 through 1058		Nov 23/1967	

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COMPONENT MAINTENANCE MANUAL WITH ILLUSTRATED PARTS LIST

TANK FILLER CAP ASSEMBLY

PART NUMBER 38040-1

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COMPONENT MAINTENANCE MANUAL

OVERHAUL MANUAL FOR PART NUMBER 38040-1
TANK FILLER CAP ASSEMBLY

HOLDERS OF ANTISIPHON ADAPTER ASSEMBLY PART NUMBER 38040-1 COMPONENT MAINTENANCE MANUAL 28-10-1 DATED 29 Jul 04.

REVISION 1 DATED 29 July 2004

HIGHLIGHTS

Pages that have been revised are listed below together with the highlights of the revision. Please Remove and insert the affected pages listed and enter insertion date and initials next to the Revision 1 issue date on the Record of Revisions page. On each affected page, an upper case "R" appears adjacent to the line(s) changed. An upper case "R" in the lower left-hand corner of an affected page indicates that the information on that page was relocated but remains unchanged.

PAGE NO.	DESCRIPTION OF CHANGE(S)
T-1	Added page
RR-1	Added page, Added Rev 1
RTR-1	Added page
SBL-1	Added page
LEP-1	Added page
TOC-1	Added page
INT-1	Added page
All Pages	Renumbered
Page 9	Item 1 is: 39120-1 Was: 37143-29

COMPONENT MAINTENANCE MANUAL

OVERHAUL MANUAL FOR PART NUMBER 38040-1
TANK FILLER CAP ASSEMBLY

RECORD OF REVISIONS

Retain this record in front of manual. Upon receipt of revision, insert revised pages in the manual and enter revision number, issue date, date inserted, and initials.

REVISION NUMBER	ISSUE DATE	DATE INSERTED	BY
Basic	07 Aug 68		
1	29 Jul 04	JAN 24, 2020	ATP/RLL

COMPONENT MAINTENANCE MANUAL

OVERHAUL MANUAL FOR PART NUMBER 38040-1
TANK FILLER CAP ASSEMBLY

RECORD OF TEMPORARY REVISIONS

Retain this record in front of manual. Upon receipt of revision, insert revised pages in the manual and enter revision number, issue date, date inserted, and initials.

TEMPORARY REV. NO.	PAGE NO.	ISSUE DATE	BY	DATE REMOVED	BY

COMPONENT MAINTENANCE MANUAL

OVERHAUL MANUAL FOR PART NUMBER 38040-1
TANK FILLER CAP ASSEMBLY

THE FOLLOWING SERVICE BULLETINS HAVE BEEN INCORPORATED INTO THIS MANUAL.

SERVICE BULLETIN LIST

SERVICE BULLETIN NO.	DATE INCORPORATED

COMPONENT MAINTENANCE MANUAL

OVERHAUL MANUAL FOR PART NUMBER 38040-1
TANK FILLER CAP ASSEMBLY

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Record of Temporary Revisions	RTR-1	29 Jul 04
Service Bulletin List	SBL-1	29 Jul 04
List of Effective Pages	LEP-1	29 Jul 04
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COMPONENT MAINTENANCE MANUAL

OVERHAUL MANUAL FOR PART NUMBER 38040-1
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COMPONENT MAINTENANCE MANUAL

OVERHAUL MANUAL FOR PART NUMBER 38040-1
TANK FILLER CAP ASSEMBLY

INTRODUCTION

This manual provides component level maintenance instructions with an illustrated parts breakdown for the Tank Filler Assembly, Part Number 38040-1. The assembly is manufactured by Shaw Aero Devices, Inc., 3580 Shaw Blvd., Naples, FL 34117, Telephone (239) 304-1000, Fax (239) 304-1088.

The instructions in this manual provide the information necessary to perform maintenance functions ranging from simple test and replacement to complete shop type repair.

This manual begins with a general description of the function and principals of operation of the unit. This is followed by instructions for the proper disassembly, cleaning, checking, repair, assembly and storage of the unit.

Refer to the Table of Contents for the page location of applicable topics.

This manual will be revised as necessary to reflect current or updated information.

COMPONENT MAINTENANCE MANUAL

OVERHAUL MANUAL FOR PART NUMBER 38040-1
TANK FILLER CAP ASSEMBLY

1. Description

   A. The unit shown in Figure 1 is a tank filler closure. It is designed to mate and seal a 3 inch diameter adapter opening.

2. Operation

   A. Before the Cap is inserted into the Adapter the Handle must be in the vertical or raised position and rotated counter-clockwise to its stops. The Cap is then inserted into the Adapter and the Handle rotated clock-wise to its stops at which point the Cap will be closed but not locked. A downward rotation of the Handle at this point will lock the Cap and the unit is now in its operation configuration.

OVERHAUL MANUAL FOR PART NUMBER 38040-1
TANK FILLER CAP ASSEMBLY

1. Dismantling

A. Dismantle Cap from Adapter

1. Lift Handle

Caution Because Pressure May Exist In The Tank Lift Handle But Do Not Turn. Make Certain Seal Between Cap And Adapter Is Broken Before Turning Handle.

2. Turn Handle counter-clockwise to its stops and lift Cap away from Adapter.

3. Unhook Chain from Cap.

B. Dismantle Cap

1. Remove Nut using 7/16 wrench and remove Washer. -

2. Slide off Cone and Spring.

3. Full Handle, Handle Pin and Cone Pin sub-assembly out of engagement with Base.

4. Remove Handle Pin thereby separating Handle from Cone Pin.

5. Remove Bearing Plate.

6. Remove 0 rings from Base and Cone Pin.

1. Cleaning

A-. No special procedures need be observed during cleaning except normal care in handling to preclude denting, chipping and/or distorting the parts.

2. Inspection

A. Inspect 0 rings and 0 ring seal surfaces. 0 rings and sealing surfaces should be smooth and free of nicks and/or cracks.

B. Handle Pin must be straight within .010 F.I.R. measured at its midpoint in relation to its end diameter centers.

C. Seal seat on Adapter must be smooth.

3. Repair

A. Because of the unit size and nature repair is generally not recommended. Defective parts should be replaced.

1. Assembly

A. Install 0 ring on Cone Pin using Parker-0-Lube or equivalent lubrication.

B. Assemble Handle to Cone Pin with Handle Pin.

Note: Head on Handle Pin must be to the left when Handle is in the position to read "Shaw".

C. Slide Bearing Plate over threaded end of Cone Pin and over 0 ring.

D. Insert Cone Pin Assembly thru hole in Base. Align the notch in the Bearing Plate with the projecting boss in the Handle recess of the Base and fold Handle down in the recess.

E. Turn Base Assembly over, slide Spring over projecting Cone Pin onto stepped boss on Base and place Cone in position over Cone Pin and against Spring.

F. Align rectangular hole in Cone with flats or. Cone Pin and the opening in the Cone flange with the narrow boss on the Base. Hold Cone down against Spring and in firm contact with Cone Pin. Slide washer over end of Cone Pin and install Nut with 35 pound inches of torque.

G. Install 0 ring in Base using Parker-0-Lube or equivalent lubrication.

1. Testing

A. Equipment

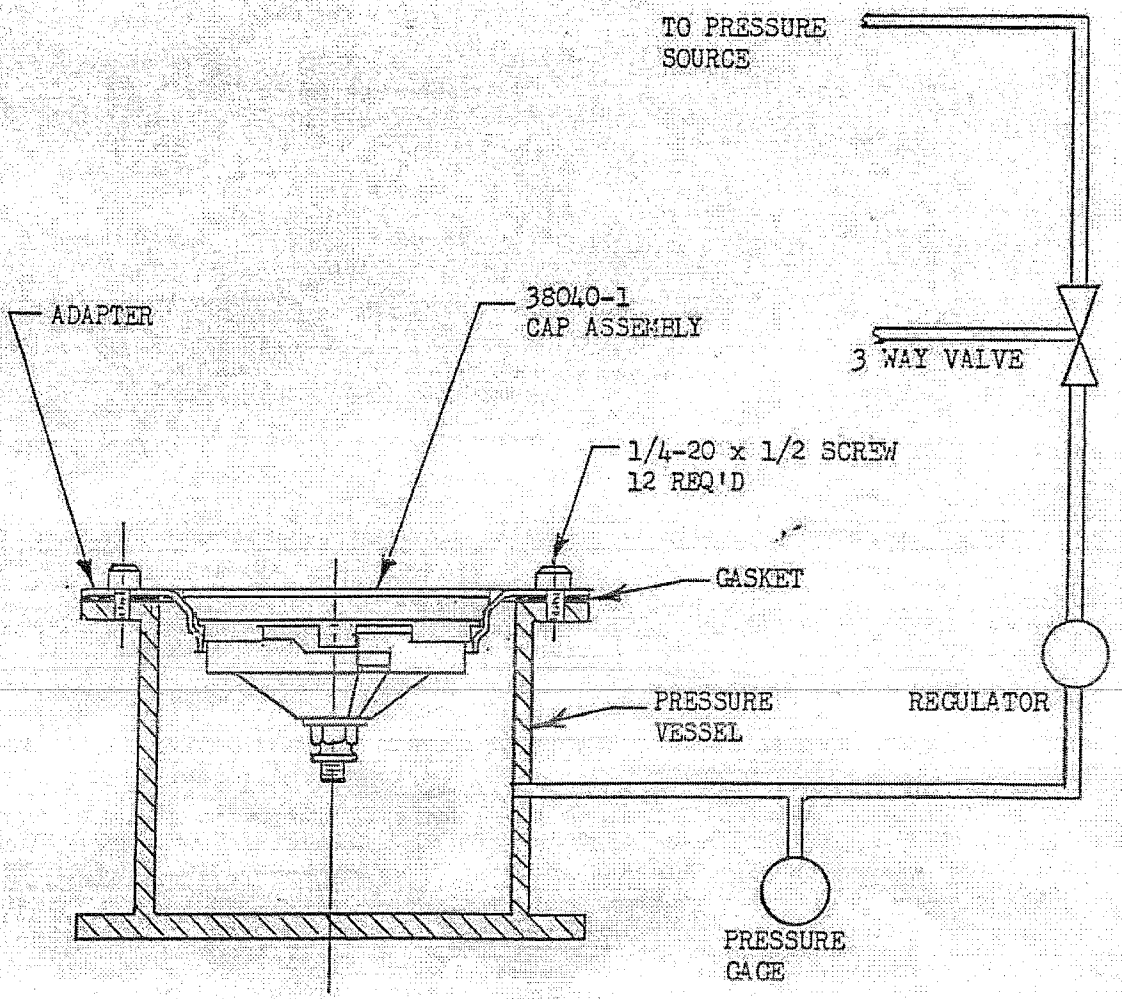
1. 25 psi pressure source
2. Pressure gage (0-60 psi preferred)
3. Three-way valve (Off-On-Exhaust)
4. Pressure Regulator
5. Pressure vessel or tank, approximately 1 quart capacity
6. Gasket
7. Test fluid - Stoddard solvent or TT-S-735, Type I
8. Filler Cap adapter

B. Set up

1. Test Set Up Page 6

C. Test Specifications

1. Pressurize to 25 psi holding pressure for 1 minute. There shall be no leakage as indicated by fluid seepage.


TO PRESSURE SOURCE
ADAPTER
38040-1 CAP ASSEMBLY
3 WAY VALVE
1/4-20 x 1/2 SCREW 12 REQ'D
GASKET
PRESSURE VESSEL
REGULATOR
PRESSURE GAGE

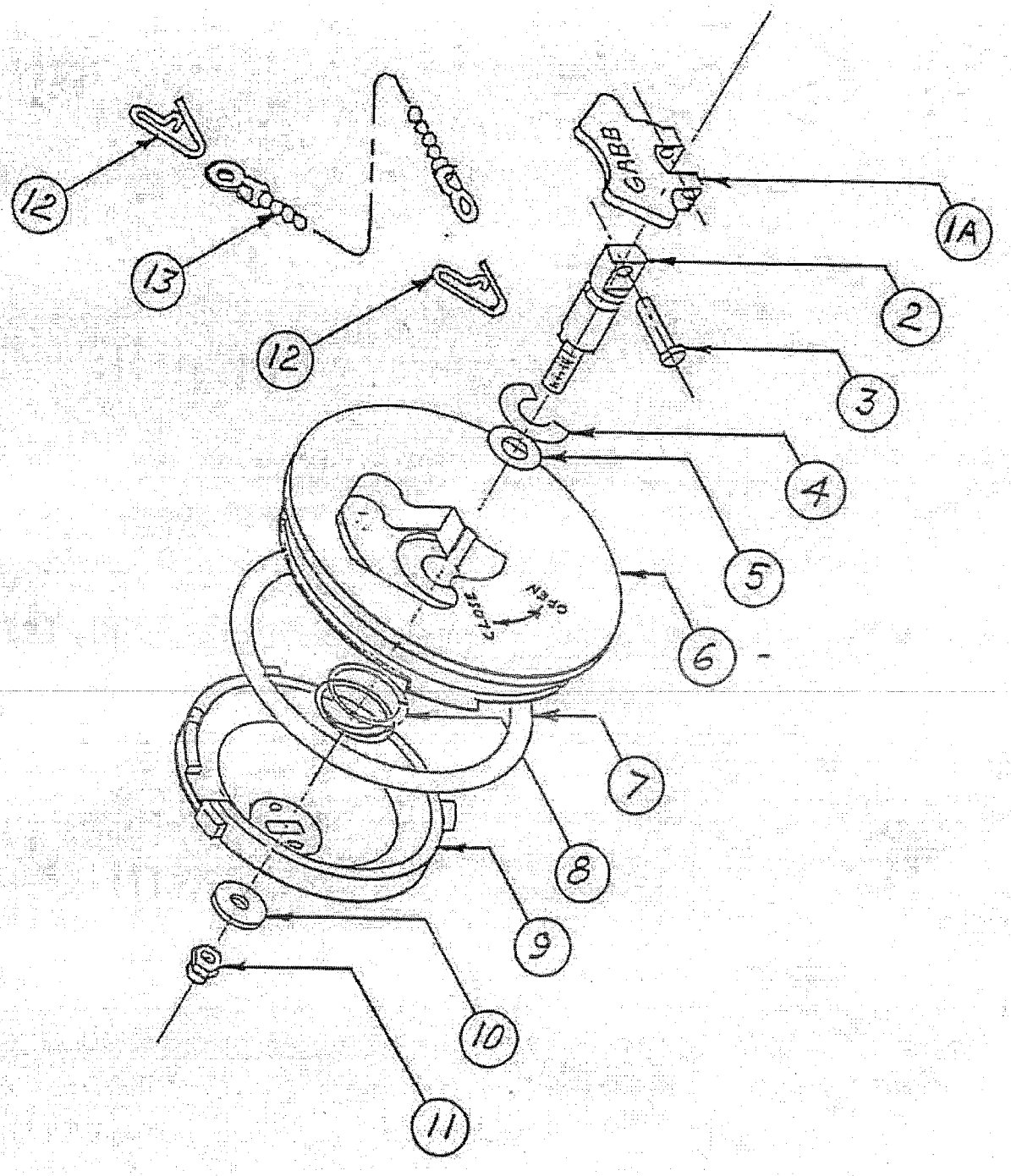
TEST SET - UP

1. Storage

A. Cap unit should not be stored mounted to an Adapter.

B. Cap unit should not be stored near heat or welding equipment or in direct sunlight.

C. Age control of seals per ANA 438.



38040-1 Tank Filler Cap
Fig. 1

OVERHAUL MANUAL FOR PART NUMBER 38040-1
TANK FILLER CAP ASSEMBLY

FIG. ITEM	PART NUMBER	AIRLINE PART NO. 1234567	NOMENCLATURE	EFF CODE	UNITS PER ASSY
1	38040-1		CAP ASSEMBLY-TANK FILLER		1
1-1A	39120-4		HANDLE (SUPSDS ITEM 1)		1
1	37143-29		HANDLE (SUPSD BY ITEM 1A)		1
2	37140		PIN - CONE		1
3	37329		PIN- HANDLE		1
4	37248		BEARING PLATE		1
5	37603-012		O RING (MS29513-012)		1
6	37399-2		BASE		1
7	37603-336		O RING (MS29513-336)		1
8	37141		SPRING		1
9	37942		CONE		1
10	3507		WASHER		1
11	MS20365-428C		NUT		1
12	MS29523-1		HOOK		2
13	3519-12		BEAD CHAIN		1

OVERHAUL MANUAL

FUEL BOOSTER PUMP

PART NO. 71383-3
71383-3A

ADEL
DIVISION
DE LAVAL TURBINE

BURBANK, CALIFORNIA

15 SEPT 1967
REV 1 MARCH 1969

LIST OF EFFECTIVE PAGES:

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 18, CONSISTING OF THE FOLLOWING:

Page	Issue
Title	1 March 1969
A	1 March 1969
i	1 March 1969
ii (blank)	1 March 1969
1 thru 13	1 March 1969
14 (blank)	1 March 1969

ADEL DIVISION
OVERHAUL MANUAL
FUEL BOOSTER PUMPS, P/N 71383-3,-3A

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1. DESCRIPTION AND OPERATION.

A. Description.

Adel Fuel Booster Pumps, Part Number 71383-3 and 71383-3A, are power-driven, screw-type pumps, designed for small aircraft and helicopter installations. The pumps are used to transfer fuel from the fuel system reservoir into feed lines at a specified design flow and pressure while submerged in the reservoir. The two units are identical except the 71383-3A contains a secondary seal (45, figure 4) between the slinger (43) and bearing (46).

B. Operation.

Each unit has a self-contained source of power which is an electrically-driven, explosion-proof motor whose main components are a field coil and an armature. The field coil provides the flux which causes the armature to rotate when an electrical current is made to flow through the system. Rotation of the armature turns the screw-type impeller enclosed in the pump chamber, thus creating the pump action. The pump is also equipped with a radio noise filter. Leading particulars are listed in Table I.

TABLE I. LEADING PARTICULARS

Pump Mounting Position	Motor upward; major axis vertical
System Fluid	Fuel per MIL-J-5624 (JP-4)
Rated Flow	450 PPH at 22 psig (min)
Power Input	8.0 amps at 28 vdc
Motor Duty Cycles	Continuous
Zero Flow	33.6 psig (max)
Pump Discharge Port	per AND10053 for 1/2 ANPT
Drain Ports (2)	per AND10053 for 1/4 ANPT
Weight Dry	4.2 lb (max) est

2. DISASSEMBLY. (See figure 4.)

Disassemble in order of index numbers assigned to figure 4, noting the following:

A. Remove lockwire after noting method of lockwiring for duplication during reassembly.

CAUTION: MAKE CERTAIN ALL PARTS ARE PROTECTED DURING DISASSEMBLY. PLACE ALL REMOVED PARTS IN ADEQUATE, CLEAN CONTAINERS, KEEPING PUMP PARTS (1 THROUGH 26) AND MOTOR PARTS (27 THROUGH 59) IN SEPARATE CONTAINERS.

WARNING: PREVENT FUEL SPILLAGE. DO NOT ALLOW ANY AMOUNT OF FUEL TO REMAIN IN PUMP CHAMBERS AND PASSAGES.

B. Following removal of pump parts (1 through 26), proceed with disassembly of motor. Parts (42 through 51) are to be removed together, after removal of screws (41), and then separated.

CAUTION: BEFORE REMOVING SCREWS (31) WHICH CONNECT LEADS OF COIL ASSEMBLY, BRUSHES (49) AND FILTER (34) TO PLATE ASSEMBLY (50), IDENTIFY POSITIVE LEAD COIL ASSEMBLY WITH A DAB OF BLACK INDIA INK. THE POSITIVE LEAD OF COIL ASSEMBLY IS CONNECTED WITH BLACK LEAD WIRE OF FILTER (34).

C. Do not remove nameplate (2) unless necessary for replacement.

D. Inspect check valve assembly (10 through 13) as outlined in paragraph 4B. Disassemble only if inspection requirements are not met.

E. Drill out plug (58) if it is scorched or damaged.

3. CLEANING. (See figure 4.)

A. Wash all non-electrical parts, except bearings, with an approved mineral oil base cleaning solvent. Dry with moisture-free, filtered compressed air at 20 psig, or use a dry, lint-free cloth. Make certain that flame arrester plug (58) is not clogged.

WARNING: USE SOLVENT IN A WELL-VENTILATED AREA. AVOID PROLONGED BREATHING OF FUMES. KEEP SOLVENT AWAY FROM FLAME.

B. Remove all surface dirt and grease, and clean electrical parts with a lint-free cloth slightly moistened with cleaning solvent.

C. Blow out all bores, internal passages, orifices and ports with filtered, compressed air at 20 psig.

D. Place all cleaned parts in adequate, clean, dust-tight containers.

4. INSPECTION/CHECK. (See figure 4.)

A. Under strong light and preferably under magnification, visually inspect all metallic parts, as applicable, for breaks, cracks, nicks, scratches, scoring, stripped or crossed threads, corrosion, distortion, worn plating, pitting, gouging, or other obvious defects.

B. Inspect check valve assembly (10 through 13) to make sure it is not distorted, that flapper (12) is seated by spring (11) tension, and that valve opens and closes smoothly, without binding. Check security of installation of flapper (12) components.

C. Check throat (15) for a minimum outside diameter (not at mounting section) of 1.8085 inch. Inspect bore of throat for nicks or scratches which would indicate distortion of pump components and/or improperly installed impeller (21), or presence of foriegn matter in impeller vanes.

D. Inspect impeller (21) for broken, cracked or bent blades.

E. Inspect seals (23, 24) for condition of contact area by running finger nail across sealing surface and examining under magnification. There shall be no evidence of galling or roughness.

F. Check alignment of spring (22) by rolling spring across a clean, smooth, flat surface; spring shall not wobble. Test spring for stacking or fatigue by measuring free length and compressed length of spring. Free length shall be 0.96 inch. Under a load of 2 ±0.1 pounds, compressed length shall be 0.280 inch.

NOTE: Flapper spring (11) and brush spring (48), if removed from their respective assemblies, must be replaced.

G. Check coil assembly (35 through 38) for security of installation and condition of lead terminals. Inspect laminations for nicks or scratches which would indicate a distorted pump assembly or worn bearings (39, 46) causing armature assembly (51) to rub against coil assembly. Check condition of insulation on coil leads. Measure coil resistance at 70°F; it should be between 23.9 and 26.5 ohms.

H. Inspect armature assembly (51) for smooth and shiny commutator surfaces and insulators between commutator bars recessed approximately 0.025 inch. Inspect shaft for evidence of excessive heat around bearing areas. Check commutator with a growler for open windings.

I. Inspect body (59) for warped mounting flange. Check body bore for evidence of incorrectly installed impeller (21) as indicated by nicks and/or heavy scratches. Use Zyglo or die-check inspection methods to check structural condition of body.

5. REPAIR. (See figure 4.)

A. Replace any part which fails to meet inspection requirements and is obviously damaged beyond allowable repairs specified below.

B. At each overhaul replace all packings, tablock washers (33), motor brushes (49) and bearings (39, 46). Replace removed springs (11, 48).

C. Replace coil assembly (35 through 38) and/or armature assembly (51) if electrical requirements specified for these parts are not met.

CAUTION: DO NOT ATTEMPT TO REMOVE LIGHT SCRATCHES OR OTHER MINOR IMPERFECTIONS FROM COMMUTATOR BARS OR COIL LAMINATIONS BY POLISHING OR ANY OTHER METHOD TO PREVENT ALTERATION OF THE DESIGN GAP BETWEEN COIL AND ARMATURE. IF COIL ASSEMBLY OR ARMATURE ASSEMBLY (51) IS OBVIOUSLY DAMAGED AS INDICATED BY HEAVY SCRATCHES, DISTORTION OF COMMUTATOR BARS OR COIL ASSEMBLY LAMINATIONS, REPLACE THE PART.

D. Non-critical internal surfaces of body (59) and external surfaces may be polished with aluminum abrasive cloth provided that not more than 0.002 inch of material is removed from polished area.

E. Replace entire pump assembly if there is evidence of distortion.

6. ASSEMBLY. (See figure 4.)

Reassemble in reverse order of index numbers assigned to figure 4, noting the following:

A. Install washer (55) on filter (34) wire lead, then insert lead through grommet (56) and washer (57)(for -3 only). Slide grommet down on wire lead until washer is held between grommet and lead shielding. Carefully insert lead into passage in body (59) and pull lead out of upper face of body (59). Pull lead through until grommet and washer are seated in body passage, then install retaining ring (54).

B. Solder terminals (53) to each wire using SN50W or SN60W solder per Specification QQ-5-571.

C. Assemble parts (42 through 51) and carefully position armature assembly (51) on body (59). Insert lead through opening in plate assembly (50), then secure installation with screws (41) which attach brush holder plate assembly (50) to body.

D. Press spring washer (40) into recessed bottom of cover (29) internal boss.

E. Install field coil assembly (35 through 38) in cover (29) and secure with tablock washers (33) and bolts (32). Tighten bolts well and bend tablock washer tabs against flat of bolt heads. Install insulator (30).

F. Connect leads of coil assembly (35 through 38), each wire of filter (34) lead, and leads of brush assembly (49) to brush holder plate assembly (50) with screws (31).

CAUTION: CONNECT WHITE WIRE OF LEAD AND NON-MARKED LEAD OF COIL ASSEMBLY TO NEGATIVE (GROUNDED) SIDE OF BRUSH HOLDER PLATE ASSEMBLY (50). CONNECT BLACK WIRE OF LEAD AND BLACK-MARKED LEAD OF COIL ASSEMBLY TO POSITIVE (INSULATED) SIDE OF BRUSH HOLDER PLATE ASSEMBLY (50).

G. Perform motor tests as outlined in paragraph 8B before continuing reassembly procedure.

H. Turn pump motor upside down and install packing (25) on seal (24), and install seal on armature assembly shaft.

I. Install packing (26) on armature assembly shaft.

J. Carefully install shaft rotating seal (23) on armature assembly shaft.

K. Install spring (22) and shaft key (20) on armature assembly shaft. Install impeller (21) and secure on shaft with locknut (19).

NOTE: Rotate impeller and shaft by hand to check for binding. Impeller must rotate freely without binding.

L. Required clearance between the installed impeller (21) and throat (15) (refer to figure 1) is 0.006 to 0.010 inch. Peel off or add laminations to shim (16) as required. Install correct shim thickness on throat matching installation holes in shim and throat. Install packings (18) in throat grooves and secure throat and filter (34) to body with screws (14).

M. Reassemble check valve (10 through 13), if disassembled. Install screen (8) and secure with cotter pin (7). Refer to figure 2 for cotter pin installation details.

N. Ascertain that flapper (12) operates freely, without binding. Load required to unseat flapper shall not exceed 0.0072 pound. Install check valve assembly in pump body and secure with screw (9).

NOTE: Install check valve assembly with hinge-pin side upward.

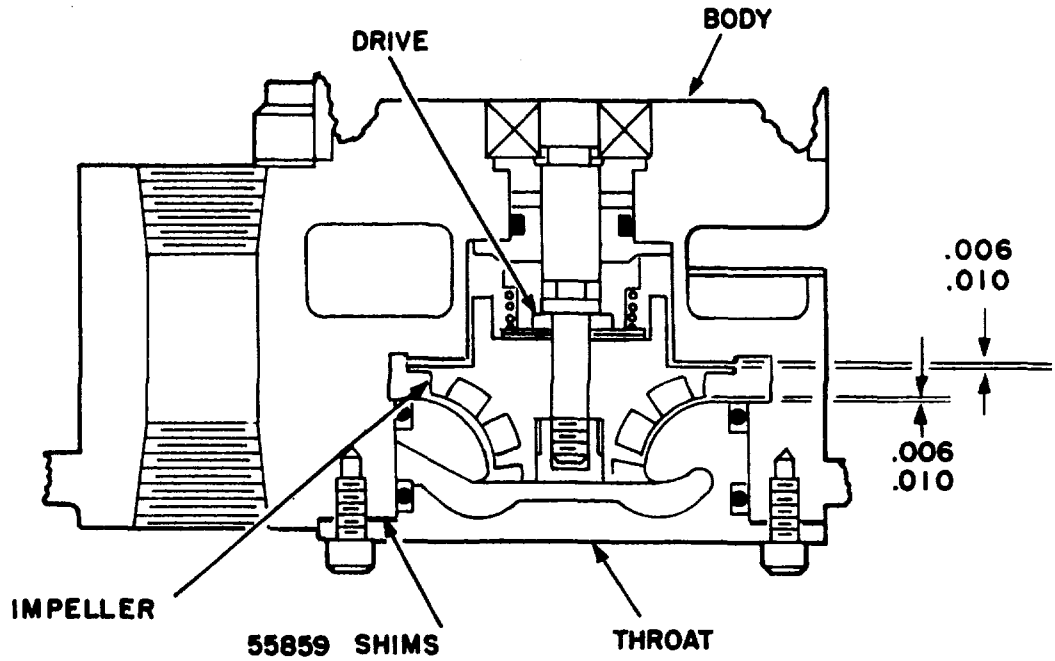


Figure 1. Shim Installation

O. Install screen (6) and secure with one screw (5), washers (4) and screws (3). Lockwire screws (3, 9)
P. as noted during disassembly.

Secure nameplate (2) to bottom of
Q. pump with screws (1).

Test reassembled unit as directed in paragraph 8C(1) and calibrate as instructed in paragraph 8C(2).

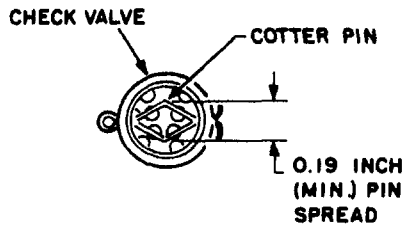


Figure 2.
Cotter Pin Installation

7. FITS AND CLEARANCES.

Not applicable. Refer to Section 6 for assembly clearances.

8. TESTING. (See figures 3 and 4.)

A. Setup and Equipment.

(1) A fluid reservoir capable of pressurization and equipped with an AN4130-7 fitting must be available for mounting and submersion of pump. (See figure 3.)

(2) As test fluid, use aviation gasoline, Specification MIL-G-5572, or solvent, Specification P-S-661, Type I.

B. Motor Assembly Tests.

(1) Dielectric Strength Test.

(a) Lift negative brush off commutator to unground motor.

(b) Apply 600 volts (rms), 60 cps, between positive (black) wire terminal and motor assembly cover or body for one second. There shall be no flashover or any evidence of damage.

(2) Brush Run-In Test.

(a) Replace negative brush in brush holder plate assembly making certain that it contacts the commutator.

(b) Connect motor to a direct-current power source.

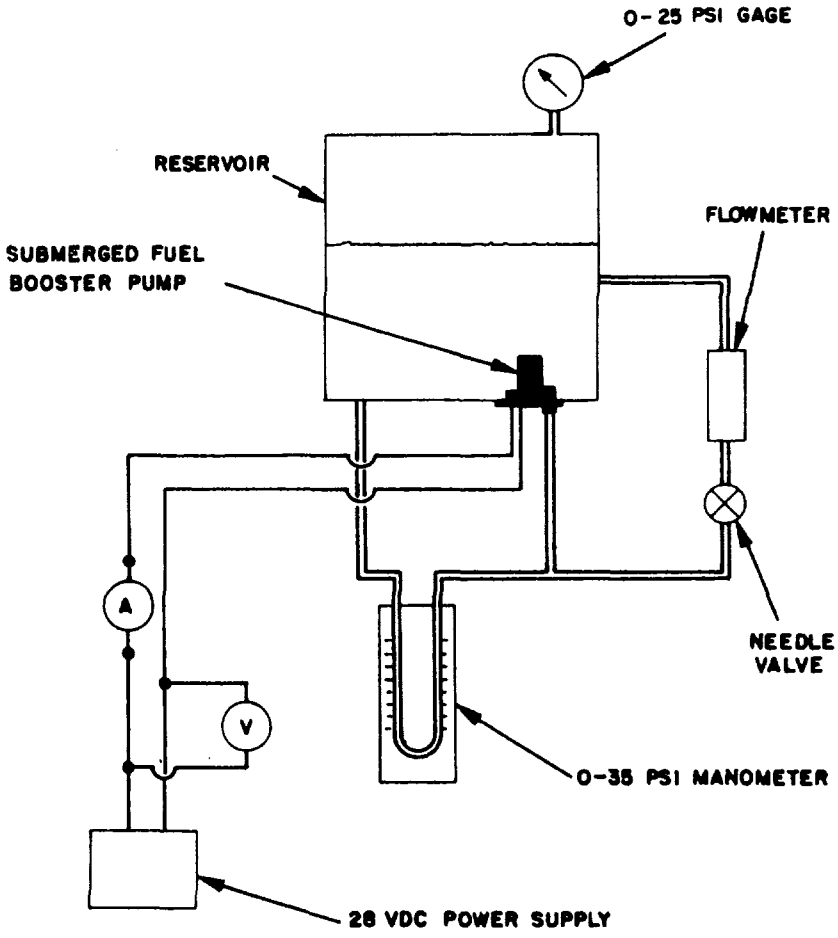


Figure 3. Test Setup

(c) Operate motor, unloaded, for 30 minutes at 27 vdc. Seat brushes on commutator with a cam stick, if necessary. Check for armature balance. Motor must operate smoothly, and direction of rotation (as viewed from shaft end) shall be clockwise. With a Frahm Tachometer, measure no-load speed; it shall not exceed 13, 200 rpm at 27 volts.

(d) Adjust power supply to deliver the voltage required to reduce the no-load speed to 10,300 rpm and allow motor to run until 100 percent brush contact in the direction of rotation is obtained. Total contact area between each brush and commutator shall be approximately 90 percent.

C. Fuel Booster Pump Tests.

NOTE: During the following tests, check for seal leakage at seal drain port. There shall be none. Should leakage occur, disassemble pump to the extent required to replace rotating seal (24, figure 4.) and stationary seal (25).

(1) External Leakage Test.

(a) Mount pump in suitable reservoir and connect the hydraulic test setup as illustrated in figure 3. Fill reservoir with enough test fluid for complete submergence of the pump.

(b) Apply 15 psig air pressure to reservoir for five minutes and check for leakage at flange casting, seal drain port, motor vent, or any other external (exposed) surfaces of pump. There shall be none.

CAUTION: IF SHAFT LEAKAGE OCCURS, THE DRAIN PORT MUST BE THOROUGHLY DRAINED BEFORE THE ATTITUDE OF THE PUMP IS CHANGED FROM THE DRAIN-PORT-DOWN POSITION TO PREVENT FUEL (OR SOLVENT) FROM COMING INTO DIRECT CONTACT WITH MOTOR BEARING.

(c) Relieve air pressure from reservoir.

(2) Calibration.

(a) With pump submerged in reservoir fluid, connect lead to a 28 vdc power supply, as shown in figure 3.

(b) Slowly apply voltage to pump motor to a maximun of 28 volts and observe current drain. Current drain shall not exceed 8.0 amperes. Allow pump to run for a maximum of 20 minutes. Adjust needle valve to allow zero and maximum (1.25 gpm) flow and calibrate pump as that the performance requirements listed in Table II are met without interference or switching pump on and off.

CAUTION: IF CURRENT DRAIN FLUCTUATES NOTICEABLY, SHUT OFF MOTOR SINCE IT MAY INDICATE MOTOR OVERHEATING. KEEP RESERVOIR FLUID COOL BY FANNING OR ANY OTHER CONVENIENT METHOD.

TABLE II. CALIBRATION PARAMETERS

TEST FLUID	GPM	PSI	AMPS
P-S-661 Type I	0	33.6 (max)	8.0 (max)
	1.15	22.0 (max)	8.0 (max)

9. TROUBLESHOOTING. (See figure 4.)

Refer to Table III for troubleshooting information.

TABLE III. TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Motor overheats	Insufficient clearance between impeller (21) and throat (15)	Refer to paragraph 6L for proper shimming.
Excessive current drain	Damaged bearing(s) (39, 46)	Replace damaged bearing(s).
Insufficient motor rpm	Coil assembly (35 through 38) and armature (51) binding or damaged.	Remove any foreign matter between coil and armature. Replace if damaged.
Pump delivery above or below desired values	Improper shimming	Refer to paragraph 6L and correct clearance.
	Damaged impeller (21) and/or throat (15)	Replace damaged part(s).
Erractic operation	Damaged electrical ports	Replace all electrical ports.
Pump fails to deliver any flow	Incorrect brush wiring (incorrect pump rotation)	Refer to paragraph 6F and correct wiring.
Fluid leakage through seal drain	Damaged seal(s) (23, 24)	Replace seals.
Leakage at throat	Damaged packing (18)	Replace packing.
	Damaged throat	Replace throat.

10. STORAGE INSTRUCTIONS.

A. Following satisfactory testing, lockwire screws as noted before disassembly.

B. Flush pump with preservative oil and plug all ports.

C. Store unit in accordance with local directives.

D. Storage time is limited to 12 months.

11. SPECIAL TOOLS, FIXTURES AND EQUIPMENT.

No special tools are required for overhaul of this pump. Refer to Section 8 and figure 3 for test equipment required.

12. ILLUSTRATED PARTS LIST.

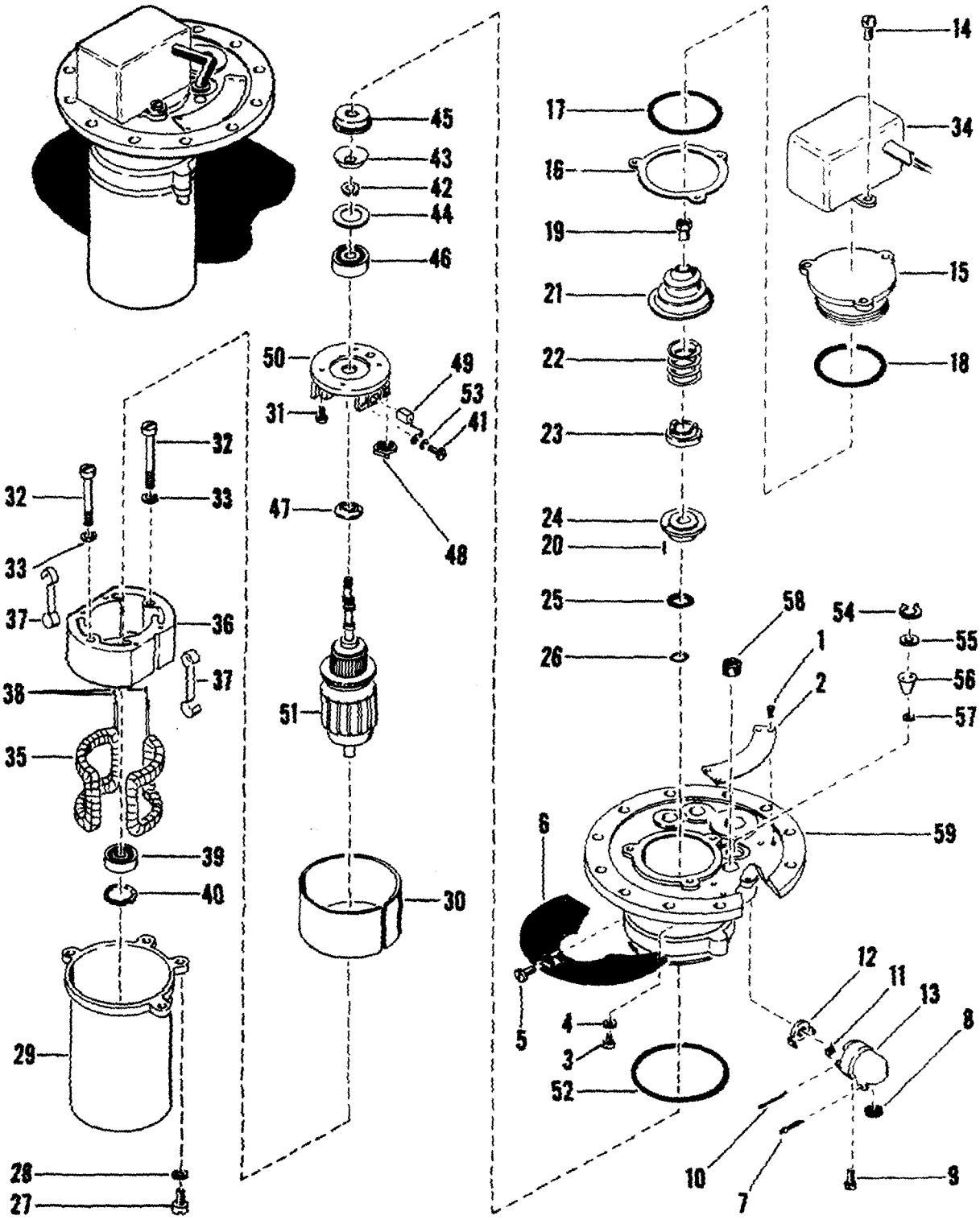


Figure 4. Fuel Booster Pumps, Part No. 71383-3,-3A

FIG. & INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
4-	71383-3	PUMP ASSY, Fuel Booster	REF	A
4-	71383-3A	PUMP ASSY, Fuel Booster	REF	B
-1	AN535-0-2	. SCREW, Drive	4	
-2	50945-38	. NAMEPLATE	1	A
	50945-44	. NAMEPLATE	1	B
-3	AN500A6-4	. SCREW, Machine	2	
-4	AN960D6	. WASHER, Flat	2	
-5	LL525-832-4M	. SCREW (Long Lok Corp., Santa Monica, Calif.). . .	1	
-6	59301	. SCREEN, Pump	1	
-7	MS24665-154	. PIN, Cotter	1	
-8	52257	. SCREEN, Pump check valve	1	
-9	AN500A6-6	. SCREW, Machine	1	
	52258	. VALVE ASSY, Check	1	
-10	25482	. . PIN, Hinge	1	
-11	23849	. . SPRING, Flapper	1	
-12	23357	. . FLAPPER, Valve	1	
-13	52256	. . BODY, Check valve	1	
-14	AN500A8-7	. SCREW, Machine	3	
-15	56878	. THROAT, Pump	1	
-16	55859	. SHIM, Laminated (Alternate 80802).	AR	
-17	MS29513-30	. PACKING, Preformed	1	
-18	MS29513-130	. PACKING, Preformed	1	
-19	54758	. LOCKNUT, Motor shaft	1	
-20	54752	. KEY, Shaft	1	
-21	55225	. IMPELLER, Pump	1	
-22	83547	. SPRING, Rotating seal	1	
-23	52750	. SEAL, Shaft rotating	1	
-24	81939	. SEAL, Stationary	1	
-25	MS29513-16	. PACKING, Preformed	1	
-26	MS29513-8	. PACKING, Preformed	1	
	83582	. MOTOR ASSY, Pump	1	A
	84706	. MOTOR ASSY, Pump	1	B
-27	AN500A8-8	. . SCREW, Machine	4	A
	MS35265-45	. . SCREW, Machine	4	B
-28	AN960D8L	. . WASHER, Flat	4	
-29	54669	. . COVER, Motor	1	
-30	55899-1	. . INSULATOR, Cover	1	
-31	LL500-4-6M	. . SCREW (Long Lok Corp., Santa Monica, Calif.) .	2	
-32	50965-1	. . BOLT, Field coil mounting . .	2	
-33	50966	. . WASHER, Tablock	2	
-34	81897	. . FILTER, Radio noise	1	
	54671	. . COIL ASSY, Field	1	
-35	54673	. . . COIL, Field	1	
-36	54672	. . . LAMINATION ASSY, Coil . .	1	
-37	59338	. . . STRAP	2	

FIG. & INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
4-38	43350-13	. . . TERMINAL, Coil lead . . .	2	
-39	40456-85	. . BEARING, Ball	1	
-40	43415-14	. . WASHER, Spring	1	
-41	LL500-4-4M	. . SCREW (Long Lok Corp., Santa Monica, Calif. .	4	
-42	43250-21	. . RING, Retaining	1	
-43	83848	. . SLINGER, Motor shaft	1	
	84698	. . SLINGER, Motor shaft	1	
-44	82116	. . WASHER, Shim	1	A
-45	84693	. . SEAL, Secondary	1	B
-46	40456-84	. . BEARING, Ball	1	
-47	83450	. . COVER, Bearing	1	
-48	54686	. . SPRING, Brush	2	
-49	59943	. . BRUSH ASSY, Motor	2	
-50	83744	. . PLATE ASSY, Brush holder . .	1	
-51	83556	. . ARMATURE ASSY	1	
-52	MS29513-141	. . PACKING, Preformed	1	
-53	43351-11	. . TERMINAL	2	
-54	MS16625-4050	. . RING, Interval retaining . .	1	
-55	43597-138	. . WASHER, Flat	1	
-56	84203	. . GROMMET	1	
-57	43597-132	. . WASHER, Flat	1	A
-58	83527	. . PLUG, Flame arrester	1	
-59	81999	. . BODY	1	

*Not procurable separately; order next higher assembly.

AERO-CORRY DIV. - - AERO-FLOW DYNAMICS, INC.
CORRY, PENNA. 16407 TEL. (814) 664-4602

SERVICE BULLETIN

PART NO. 52-2145-002

PART NO. 52-2889-002

Purpose:

For overhaul of P/N 52-2889-002, Fuel Filter, use Overhaul Instructions 28-20-01 dated 2/24/69. Differences in detail is shown on Page 2 of this Bulletin.

General Information:

P/N 52-2145-002 and 52-2889-002 serve the same function, the only difference being that P/N 52-2889-002 uses a disposable element somewhat larger than the cleanable element used in P/N 52-2145-002. To house the larger element for P/N 52-2889-002 it is necessary to use a larger can assembly and use an adapter ring to expand the overall diameter of the head assembly. Several additional "O" Rings are required at the various sealing points.

All procedures and tests described in Overhaul Instructions 28-20-01 are applicable to both models.

Parts Kit P/N 52-01127-2 is used to modify P/N 52-2145-002 to P/N 52-2889-002.

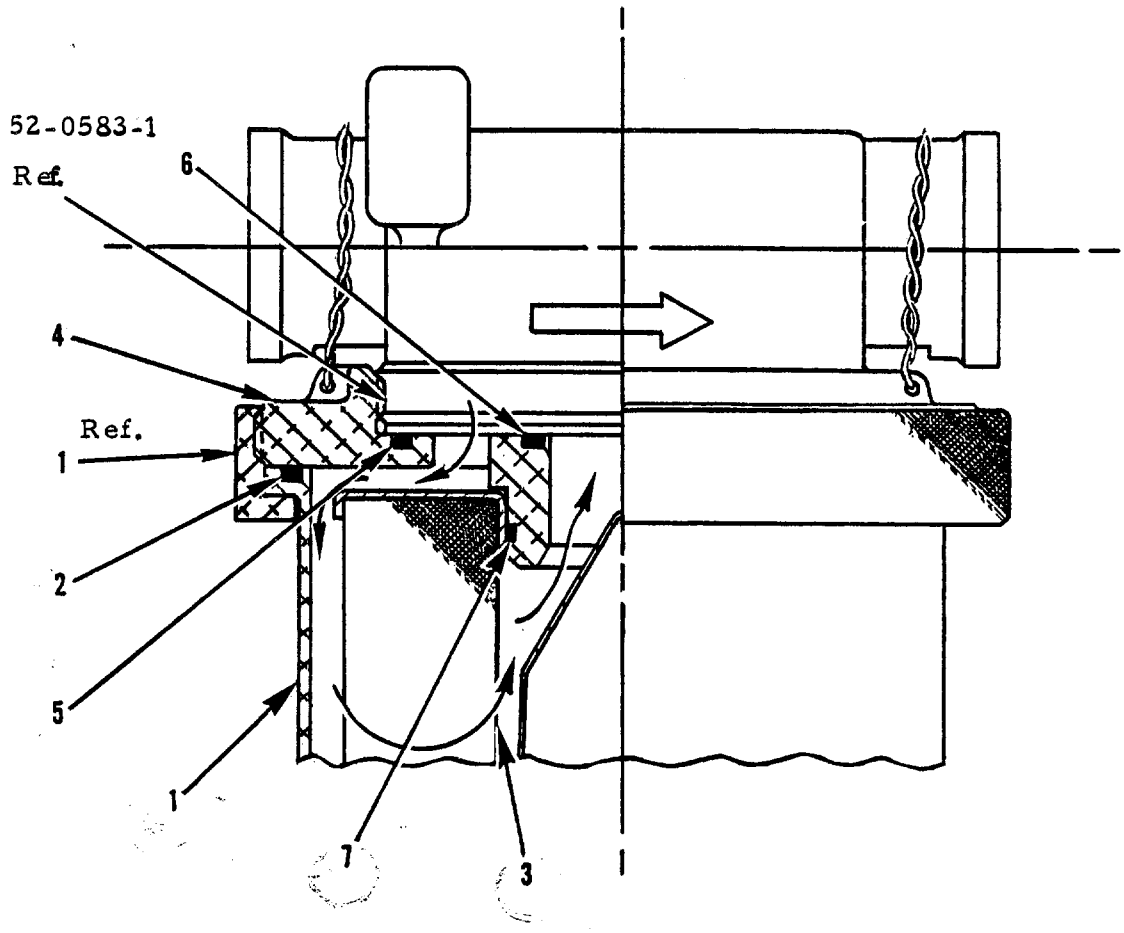


Figure 1

P/N 52-2145-002

Fig. & Index	P/N	Nomen	Qty
2-1	52-0508-1	Can Assembly	1
2-2	MS29513-140	Packing	1
2-3	52-0505-1	Seal Plate Assy	1
2-4	52-0618-1	Strainer	1

P/N 52-2889-002

Fig. & Index	P/N	Nomen	QTY
1-1	52-01106-17	Can Assy	1
1-2	MS29513-153	"O" Ring	1
1-3	52-01103-1	Element Dispos	1
1-4	52-01107-1	Adapter Ring	1
1-5	1011-10-2-36	"O" Ring *	1
1-6	MS29513-21	"O" Ring	1
1-7	MS29513-20	"O" Ring	1

* (Parker) Alternate N602-7-2-36

AERO-CORRY
CORRY, PENNSYLVANIA 16407

OVERHAUL
FUEL FILTER
PART NO. 52-2145-002

1. DESCRIPTION AND OPERATION

A. This fuel filter has a housing and valve assembly to which a can containing a 70-micron filter element is attached. The element is held against the housing by a spring loaded seal plate. The housing contains a spring loaded poppet that acts as a relief valve. The can has a drain port to remove dirt and water periodically.

B. Fuel entering at the housing inlet normally flows down in the can, around and through the filter element to the outlet of the housing. The relief valve, in a parallel circuit to the element, is mounted in a wall of the housing and opens only when the pressure drop across the element reaches 2.5 psi.

C. The housing is an aluminum alloy casting while the can is machined from aluminum alloy bar; the relief valve parts and seal plate are stainless steel; the filter element is a pleated stainless screen cemented between plates; packings and seal are fuel resistant synthetic rubber.

D. The filter is installed in the fuel system between the tank and the engine and is not accessible in flight.

E. Leading particulars of the filter are as follows:

(1)	Dimensions, inches:	Length	4.13
		Width	3.11
		Height	5.25
(2)	Ports: Inlet and outlet		7/8-14 internal thread for 5/8 in. OD tube fitting
	Drain		7/16-20 internal thread for 1/4 in. OD tube fitting
(3)	Mounting holes, tapped (screw thread inserts)		1/4-28 x 0.250 min depth
(4)	Filter opening size, microns		70
(5)	Performance, fluid		MIL-J-5624
	(calibrating)		MIL-F-7024
	rated flow		2.0 gpm
	pressure drop at rated flow		0.50 psi
	relief valve opens at pressure drop		1.50 psi
	relief valve pressure drop at rated flow		2.50 psi
	sump volume		3.3 cu in.
	operating pressure		60 psig
	temperature		-65° to +135°F
(6)	Weight, lb (approx)		1.0

2. DISASSEMBLY. (See figure 2.)

A. Cut lockwire, loosen can retainer (knurled) and remove filter can (1). Lift packing (2) from groove in can.

B. Do not remove nameplate or separate retainer from can unless damaged and replacement is required.

C. Lift strainer (3) from can then depress fingers of seal plate (4) to remove. Do not disassemble strainer or seal plate.

D. Remove 2 screws (6), withdraw access cap (5) and work packing (7) from groove in cap.

E. Hold stem (11) with a screw driver inserted through access hole of housing (12) and remove nut (8) from stem with open-end-wrench through bottom of housing. Withdraw spring (10) through larger passage at bottom of housing as other parts (8, 9, 11) are removed through access hole.

F. Hold stem in a suitable hand chuck (3/16 inch) to remove nut (8) and poppet (9).

CAUTION: HANDLE POPPET (9) WITH CARE TO AVOID DAMAGING VALVE FACE. SUCH DAMAGE WILL RESULT IN EXCESSIVE LEAKAGE THROUGH RELIEF VALVE.

3. CLEANING.

A. Clean all metal parts with solvent, Federal Specification P-D-680, Type II (Stoddard Solvent).

WARNING: USE SOLVENT IN A WELL-VENTILATED AREA AND AVOID PROLONGED BREATHING OF FUMES. KEEP SOLVENT AWAY FROM OPEN FLAME.

B. Use a stiff bristle brush dipped in solvent to remove stubborn residue.

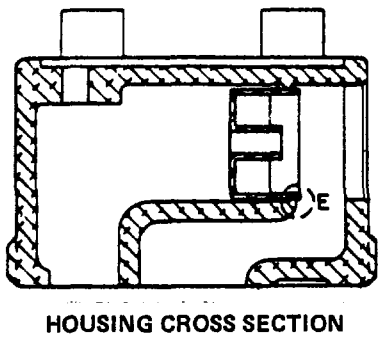
C. After all chips, grease, and dirt have been removed, dry components with clean, filtered, compressed air.

D. Flow solvent through strainer from central bore to outside (reverse of normal flow direction). Solvent for strainer flushing must be filtered to 10 microns and must not be re-used on other strainers unless filtered again.

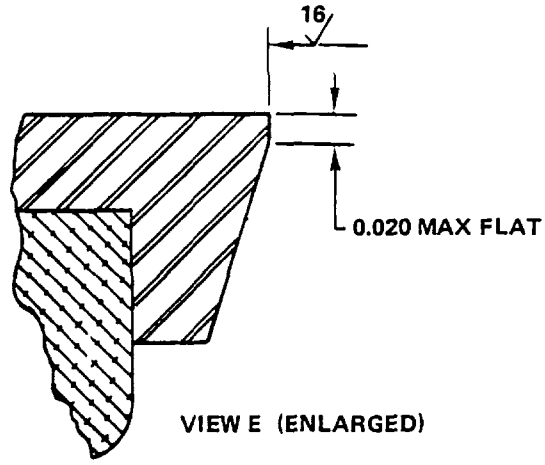
4. INSPECTION.

A. Inspect parts as follows:

Part Name and Index No. (See Figure 2)	Inspect For
All Parts	Cracks or distortion.
Threaded parts (1, 11, 12)	Stripped, crossed or otherwise damaged threads.
Can (1), access cap (5)	Inspect that O-ring groove is smooth and edges are free from burrs or nicks.
Strainer assembly (3)	Distortion or damage to screen; loose bonds; holes in fine-mesh, pleated screen; plugged area in excess of 3 square inches that cannot be removed by repeated cleaning.
Seal plate (4)	Inspect that seal has not deteriorated (not tacky) and that spring is securely attached.
Poppet (9)	Scratches or other damage to seating surface. Use 8X to 10X magnification.
Spring (10)	Cracks, deformation. Load at 0.800 in. from 11.0 to 13.5 oz.
Seating surface on housing (12) bushing	Scratches or other damage (must meet requirements given on figure 1). Use 8X to 10X magnification.



HOUSING CROSS SECTION



VIEW E (ENLARGED)

5. REPAIR AND REPLACEMENT.

A. Replace damaged parts unless simple minor repair will restore the part to serviceability without affecting sealing or operating action.

B. Remove and replace inserts in housing when necessary using standard tools and procedures.

C. Refinish bushing seat (installed in housing) by lapping to meet requirements shown on figure 1. Lap must pilot in bushing bore. To replace bushing, pull from casting, press in new bushing, and lap seat.

D. Replace strainer assemblies that do not meet inspection requirements. Do not attempt repair.

E. Replace packings and small hardware at each overhaul.

6. ASSEMBLY. (See figure 2.)

A. Hold stem (11) in chuck to attach poppet (9) with nut (8). Tighten nut securely.

B. As parts (8, 9, 11) are inserted through access hole of housing (12), insert spring (10) through larger passage in bottom of housing and slide over stem.

C. Restrain stem with screw driver through access hole to install second nut (8) approximately half way onto threaded end of stem.

D. Install new packing (7) in groove of access cap (5). Lubricate packing with petrolatum (Vaseline) then install cap in housing with 2 screws (6). Test housing and adjust relief valve if necessary, before completing assembly.

E. Depress fingers of seal plate (4) to install in can (1). Ends of fingers must hook below ring on inside of can with seal up.

F. Install packing (2) in groove of can and lubricate with petrolatum. Place strainer (3) on seal plate (either end down), engage housing assembly and securely tighten retainer.

G. After satisfactory completion of testing, attach lockwire between retainer and one adjacent port.

7. FITS AND CLEARANCES. Not applicable.

8. TESTING.

A. Use calibrating fluid, Military Specification MIL-F-7024A, Type II for all testing.

B. Clamp housing assembly (5 through 12, figure 2) to a metal plate using a suitable piece of sheet rubber for a gasket to seal across bottom of housing. Test (and adjust) as follows:

(1) Make a suitable connection and supply fluid to inlet port at a slowly increasing pressure. Check that valve cracks at a pressure between 1.3 and 1.7 psi (2.8 to 3.7 inches of mercury). Adjust valve if necessary by tightening or loosening nut (8) over spring (10).

(2) After adjustment supply fluid to inlet port at a flow rate of 2 gpm. Check that pressure drop through housing does not exceed 2.5 psi (5.1 inches of mercury). Allow for pressure drop of inlet and outlet fittings.

(3) Reduce fluid pressure to zero, then increase to 2.7 inches of mercury (1.32 psi) and check that leakage through the valve does not exceed 100 CC per minute after a three-minute waiting period.

(4) Increase pressure to 3.4 inches of mercury (1.67 psi) and check that flow exceeds 200 CC per minute.

(5) Recheck valve cracking pressure (paragraph (1) above).

C. Remove test plate and complete assembly (install parts 1 thru 4). Test complete filter as follows:

(1) Install gasket, MS29512-10, and plug, AN806-D10, in outlet port; gasket, MS29512-4, and plug, AN806-D4, in drain port.

(2) Completely fill filter with calibrating fluid. Apply pressure at inlet of 120 psig for not less than one minute. Observe that there is no leakage from any portion during the test period.

(3) Release all pressure and remove plug from outlet.

(4) Connect filter to a suitable flow system. Establish fluid flow through filter at 2 gpm and check that net pressure drop does not exceed 1 inch of mercury (0.49 psi).

D. After completion of all testing completely drain all fluid and install port closures.

9. TROUBLE SHOOTING.

A. If the filter fails to meet any test requirement, it must be disassembled, re-checked for defective parts or assembly procedures, reassembled and retested.

10. STORAGE INSTRUCTIONS.

A. Plug all ports to protect interior from dirt.

11. SPECIAL TOOLS, FIXTURES AND EQUIPMENT.

A. A steel plate, 3/8 inch thick by 3 inches square, with 1/16 inch rubber sheet cemented to one side, may be used for testing the housing assembly.

B. A test stand providing calibrating fluid at up to 2 gpm and 120 psig is required for testing the filter.

12. ILLUSTRATED PARTS LIST.

A. The parts list is arranged in the order of disassembly and each part is keyed to the illustration (figure 2) to provide accurate identification.

B. Symbols are employed in the Usage Code column to designate parts application to particular models. Where the application of a part applies to all models covered, the Usage Code column is blank.

C. Part numbers in this list are those of Aero-Flow Dynamics, Inc., Aero-Corry Division, unless a vendor's code number follows the part nomenclature. Standard numbers are prefixed as follows:

AN Army - Navy Standard
MS Military Standard

D. Part numbers of vendors are shown in the Part Number column whenever applicable. The vendor's code number is shown in parentheses following the description of the part. This code number is prefixed with a capital letter "V".

E. Vendor's codes used in this list are as follows:

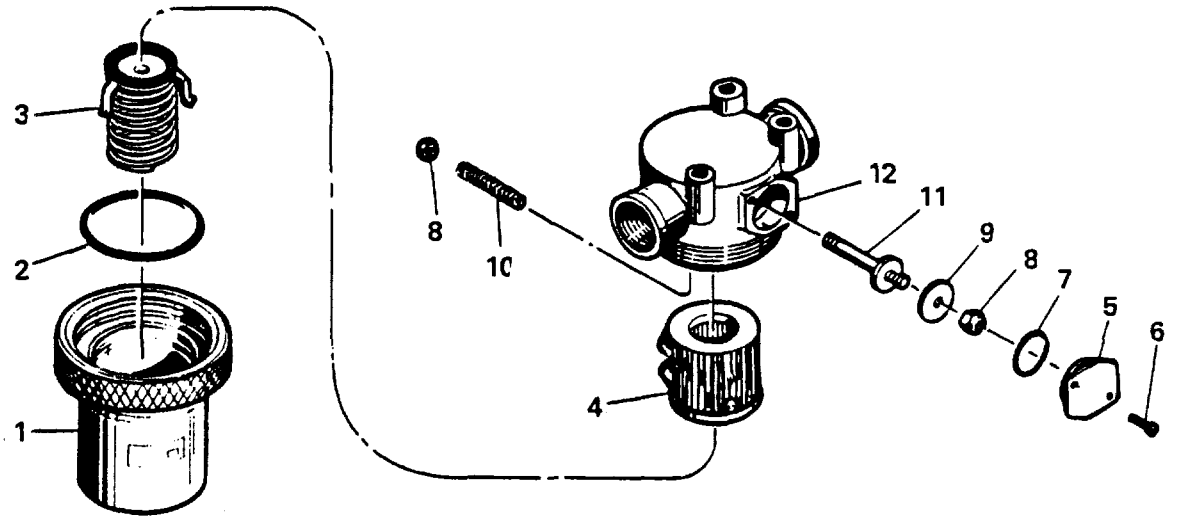
VENDOR CODES

V-02615	Nylok Co., The Division of United Shoe Machinery Corp 611 Industries Ave. Paramus, N.J. 07652
V-22893	Shell Chemical Co Willow Pass Road P.O. Box 831 Pittsburgh, Calif. 94565
V-72962	Elastic Stop Nut Corp of America 2330 Vauxhall Road Union, N.J. 07083
V-91767	Heli-Coil Corp Shelter Rock Lane Danbury, Conn. 06813

F. Symbols used, with the exception of vendor's code, symbols, are as follows: ---*--- Designates the end of each group of attaching parts.

G. Numerical Parts List Index.

(1) Due to the brevity of the Group Assembly Parts List, a numerical parts list index is not used.



Fuel Filter
Figure 2

H. Group Assembly Parts List.

Fig. & Index No.	Part Number	1 2 3 4 Nomenclature	Usage Code	Units Per Assy
2-	52-2145-002	Filter Assy - Fuel		1
-	52-0522-1	. Nameplate		1
1	52-0508-1	. Can Assy - Filter		1
	52-0499-1	. . Can - Filter		1
	52-0500-1	. . Retainer - Can		1
2	MS29513-140	. Packing		1
3	52-0618-2	. Seal Plate Assy		1
4	52-0505-1	. Strainer Assy - 70 micron		1
5	52-0509-1	. Cap - Access		1
		Attaching Part		
6	M33CR640-4E	. Screw - Machine, self-locking (V-02615)		2
		---*---		
7	MS29513-20	. Packing		1
-	52-0497-1	. Housing and Valve Assy		1

- ITEM NOT ILLUSTRATED

Fig. & Index No.	Part Number	1 2 3 4 Nomenclature	Usage Code	Units Per Assy
2 8	22NTM-82	. . Nut - Self-locking (V-72962)		2
9	52-0501-1	. . Poppet		1
10	52-0539-1	. . Spring		1
11	52-0495-1	. . Stem		1
12	52-0583-1	. . Housing Assy		1
-	52-0494-1	. . . Bushing		1
-	3591-4CN x 1/4	. . . Insert Thread (V-91767)		3
-	52-0498-1	. . . Housing		NP
-	901/B-1	Adhesive - Epon (V-22893)		AR
-	MS20995C32	Lockwire - CRES, 0.032 in. dia		AR

- ITEM NOT ILLUSTRATED

Airborne

Overhaul Instructions with Parts Catalog

SUBMERGED DUPLEX FUEL PUMP

Model 1D2-17

Parker General Aviation

Parker Hannifin Corporation
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Submerged Duplex Fuel Pump Model 1D2-17

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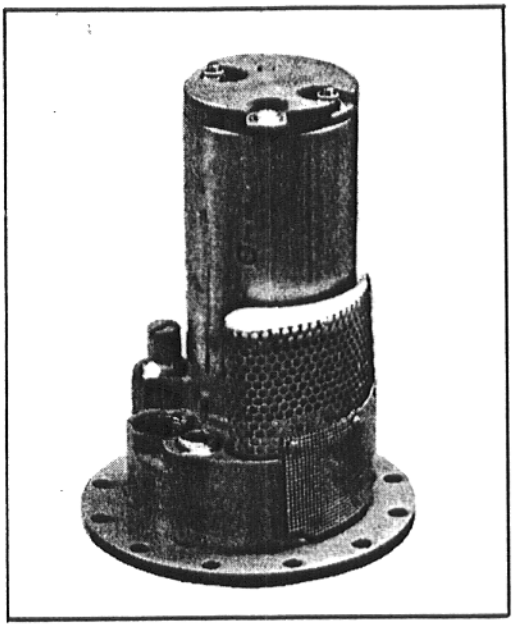


Figure 1. Model 1D2-17 Assembled.

Table 1. Leading Particulars

Model 1D2-17 (Illustrated)	
Capacity	22 PSI Min. at 450 P.P.H. 32 PSI Max. at 0 P.P.H.
Amperes	8.5 Max.
Volts	28 V.D.C.
Fuel	Jet A/JP-4

1. DESCRIPTION AND OPERATION

A. Introduction. This overhaul manual contains overhaul and testing instructions for Model 1D2-17 Submerged Duplex Fuel Pump.

B. Description. The Airborne submerged duplex pump is a new concept in high performance tank-mounted pumps. In this matched two-stage pump, the vapor separating ability of the centrifugal impeller and self-priming high pressure capabilities of the positive displacement vane section are combined to provide the advantages of both pumping element designs. The duplex pumps minimize fuel vaporization and help assure the delivery of "solid" high pressure fuel to the engines of the most demanding high performance aircraft.

(1) Wet DC motors are fuel-cooled and lubricated, eliminating the need for rotating seals and seal drain plumbing.

(2) Simple fuel-lubricated carbon sleeve bearings with virtually unlimited service life eliminate troublesome oil-lubricated ball and roller bearings.

(3) Commutators and brushes are fuel-cooled and lubricated, greatly improving brush life.

(4) Brushes are submerged in fuel, eliminating the excessive wear problems induced by high altitude operation of "dry" motor pumps.

(5) Permanent magnet motor keeps weight and current drain at a minimum.

C. Special tools are illustrated in Section 10, Figures 24 and 25. Detail dimensional drawings (Figures 26, 27 and 28) are provided to be used to fabricate tools not illustrated in Fugures 24 and 25.

2. DISASSEMBLY (see Figure 30)

A. Disassemble the unit only to the extent necessary for inspection, cleaning and repair. Detailed instructions are given in the following paragraphs.

B. Remove the one drive screw (2) holding strainer assembly (1) to pump housing (56).

NOTE: A small chisel sharpened on one side only will aid in this removal. (See Figure 2.)

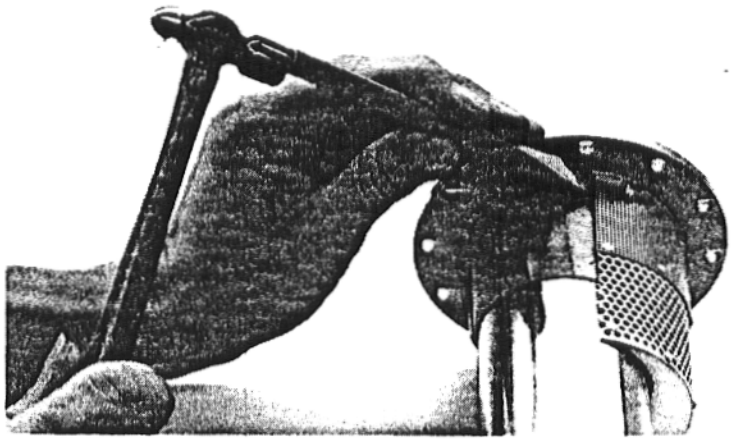


Figure 2

Very carefully break screen away from housing at flange surface. Remove screen and straighten any minor dents encountered during removal.

C. Remove two 3/8 hex nuts (3) and washers (4) and two round head screws (5) and washers (6) from motor cover, and lift cover (7) straight off so as to not damage cover bearing (not shown in Illustrated Parts Breakdown, Figure 29).

D. Remove two 5/16 hex nuts (10), two lockwashers (11), and phenolic cover (9) from upper brush holder assembly (8). Hold springs back and lift brushes (12) away from commutator on armature.

E. Remove upper brush holder (13), armature shims (14), and thrust washer (15). Lift field tube (16) from pump assembly. Locate the negative wire from the electrical terminal running up one of the studs (stud nearest the discharge port).

F. Unsolder the brush (12) and carefully cut black shrink tube holding the negative lead to the stud (43). Be careful not to cut the insulation on the wire. Locate the positive wire and remove the 5/16 hex nut (37) holding the wire to brush holder (33). See Figures 3 and 4.

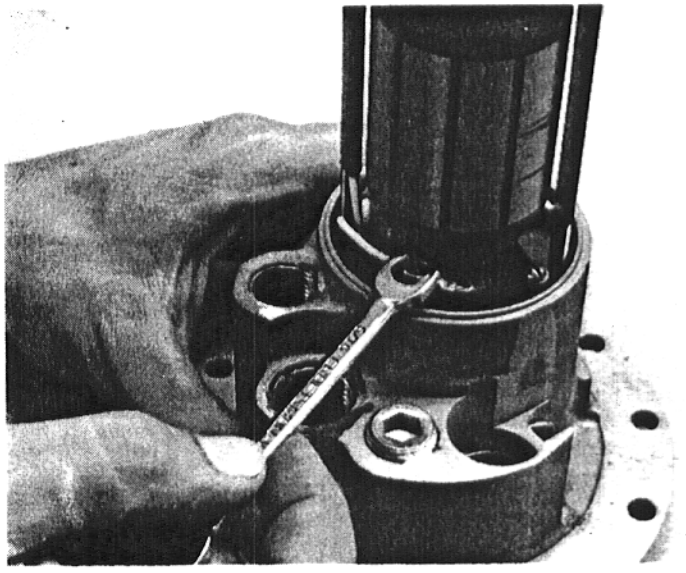


Figure 3

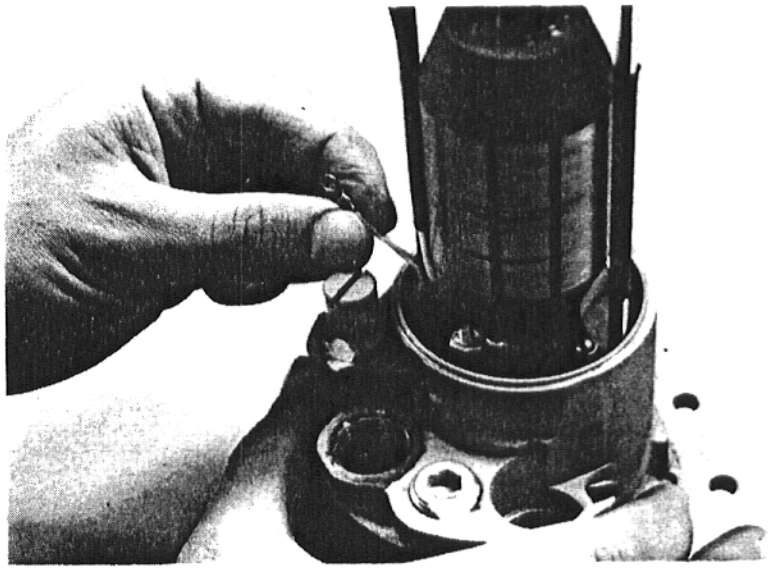


Figure 4

G. Unscrew nylon terminal assembly (17) using 9/16 box wrench. See Figure 19.
NOTE: Do not use an open end wrench, as damage to terminal will result. It may be helpful to turn wires while removing terminal to prevent wire from winding up and possible breaking.

H. Pry square wire retainer ring (19) from housing (54) with screwdriver or other suitable tool far enough to grasp with pliers (see Figures 5 and 6). Use pliers to complete removal of retainer.

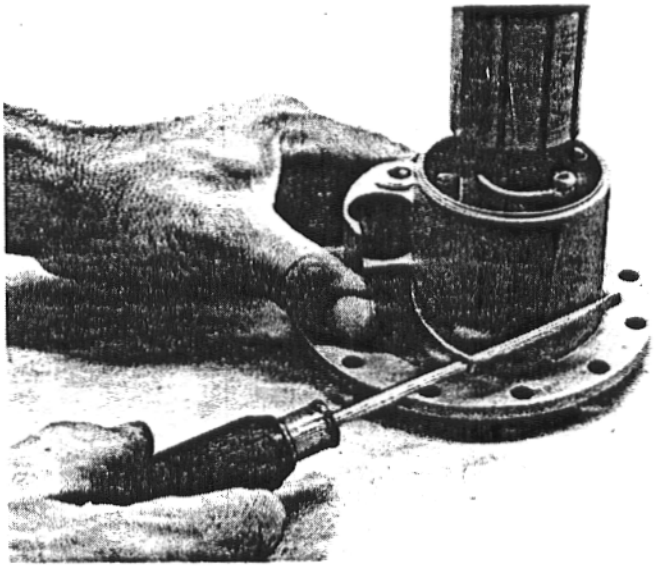


Figure 5

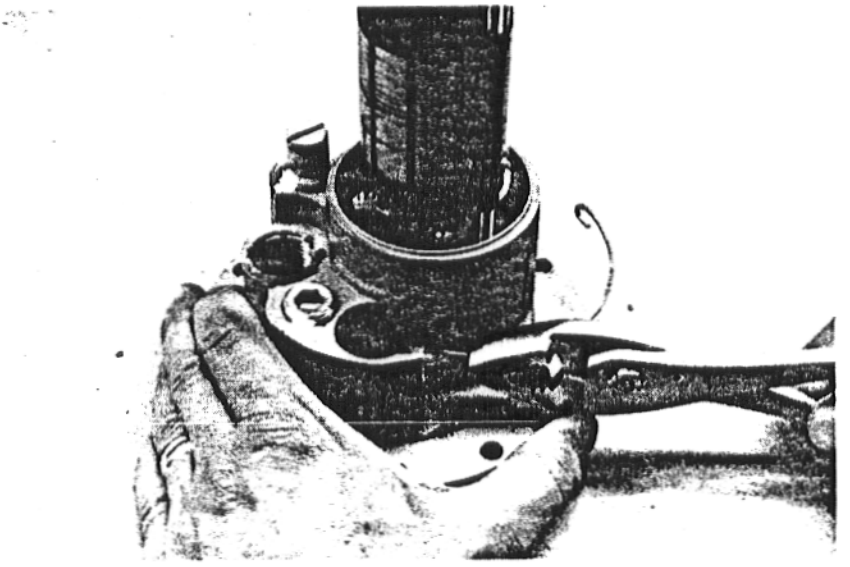


Figure 6

I. Grasp the armature and studs securely with one hand (see Figure 7) and without allowing armature to slip upward with respect to lower brush holder, tap downward on housing with rawhide or plastic mallet.

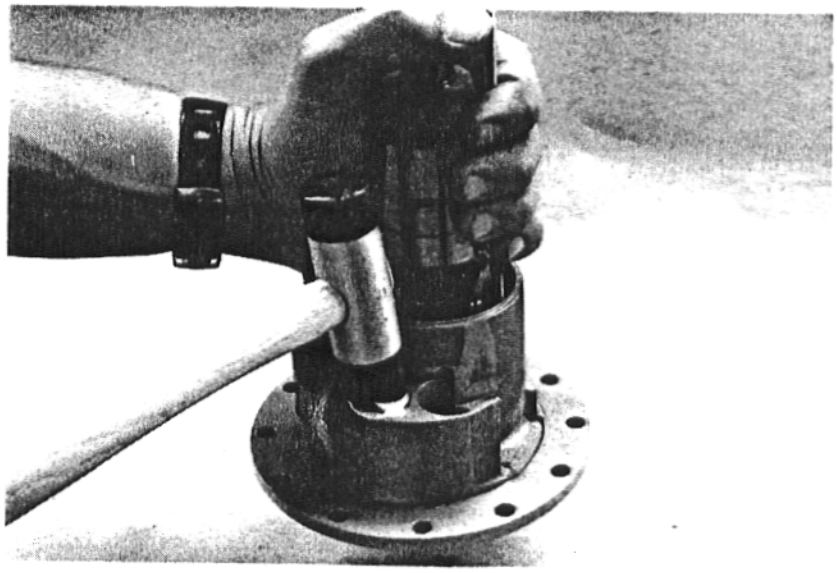


Figure 7

NOTE: Tap on heavy parts of housing, rather than on thin flange, where possible, to avoid any damage to gasket surface. This removal should be performed over a workbench area so as not to drop the housing or impeller.

Remove loose impeller and inlet seal (20) from housing. Discard carbon seal and O-ring (21) and (44).

J. Remove slotted head pipe plug (22) and carefully lift out poppet valve assembly (23). Check for damage and clean as necessary.

K. Keep armature down tight against brush holder while performing the following operations: Remove the woodruff key (25) and unscrew inlet retaining clamp (26). See Figure 16 and Figure 26. Lift off the bronze pressure plate (27). Remove the four vanes (28) and the rotor (29), then remove the square key (30) from the armature shaft.

L. Lift the brushes (36) and lock in outward position with brush springs. See Figure 8. Slide armature from pump. Do not lose thrust washer (31). Remove 5/16 nut holding remaining upper brush and remove the two round head screws (34) and washers (35) retaining the lower brush holder. Lift brush holder assembly (33) from liner housing (39).

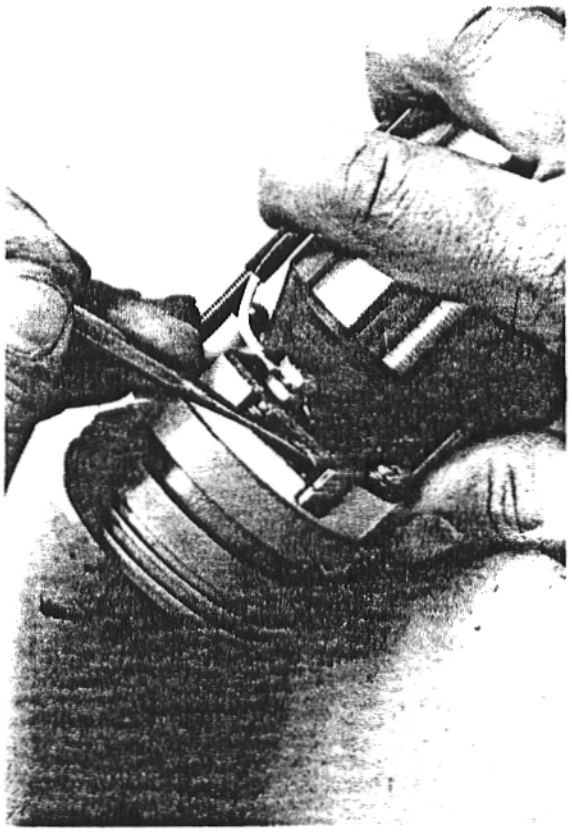


Figure 8

M. Press liner (38) from liner housing (39) and discard (see Figure 9).

3. CLEANING

A. General - Remove any loose accumulation of foreign matter from the disassembled parts with clean dry compressed air. Particular attention should be given to the passages in the pump housing and field tube assembly.

(1) Clean parts by immersing in clean solvent. Scrub with non-metallic brush if necessary. Dry with clean dry compressed air.

(2) Wipe parts with clean lintless cloth moistened in solvent. Give special attention to armature bearing journals, key slots, commutators, brush holders, rotor and threaded parts.

(3) Store cleaned parts in plastic bags or clean containers until reassembly.

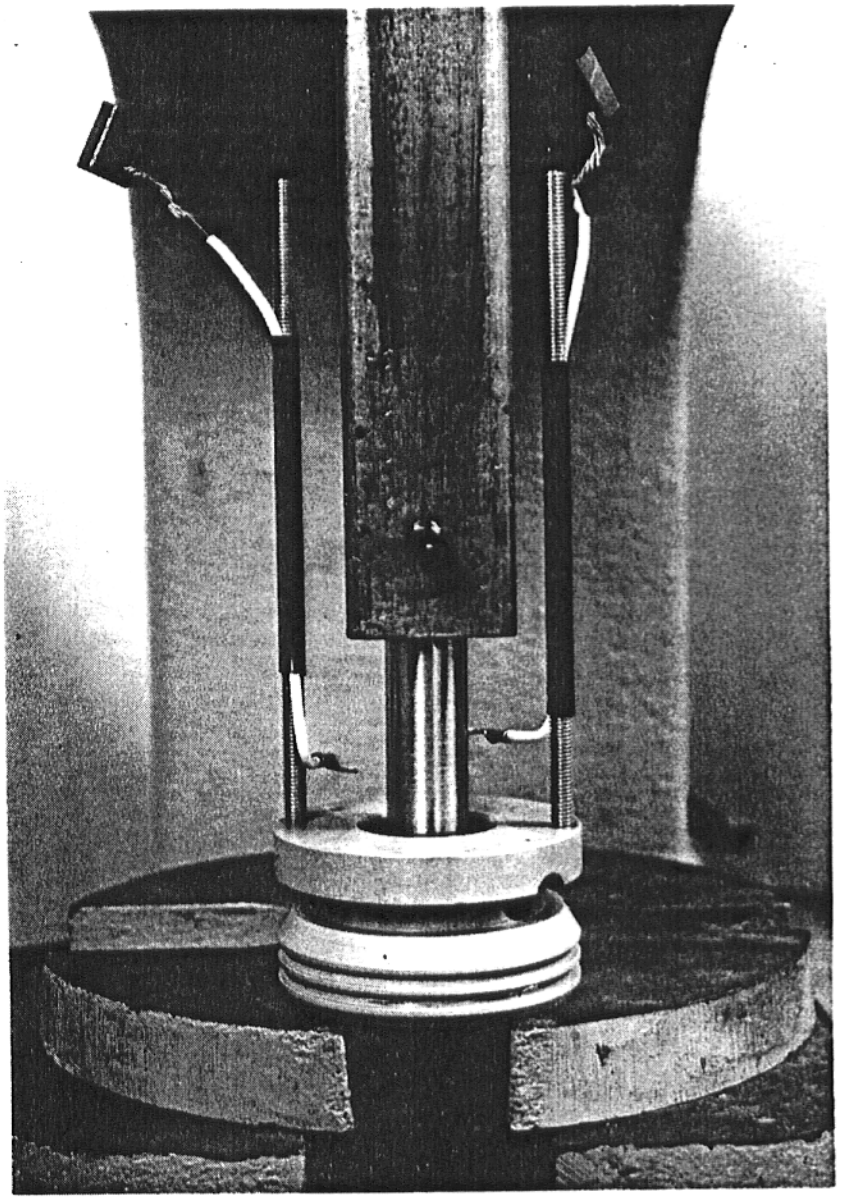


Figure 9

4. INSPECTION

A. General - Examine parts for obvious damage or wear; deep grooves, evidence of overheating such as swollen or expanded potting compound in armature. Damaged terminal loops are usually cause for rejection. The following table of inspection provides a guide for determining the serviceability of parts. See also individual paragraphs in Reassembly.

TABLE 2. INSPECTION

Part Name:	Type of Inspection:	Inspect For:	Disposition:
Liner	Visual	Scoring on face mating to thrust washer or bore (bare aluminum showing)	Replace.
Rotor	Visual	Nicks, scratches, scoring on both ends. (Scoring results from dry running.)	Wipe on true flat surface plate with 500 grit paper using Figure 8 movement.
Thrust Washers	Visual	Scoring	Replace.
Liner Housing Assembly	Visual	Nicks, burrs, distorted threads on housing on rods	Clean with fine tooth file or thread die on studs.
Housing	Visual	Thread distortion, nicks, burrs on gasket face. Inlet defuser for secure bonding. Vapor holes for foreign material.	Clean threads with thread tap, remove nicks and burrs with 500 grit paper. Clean vapor holes.
Brush Holder	Visual	Worn brushes. Dry running or overheating brush channels or warping.	Replace brushes. Replace holder.
O-rings	None		Replace all O-rings.
Lock Nuts	None		Replace all locknuts.
Internal Leads	Visual	Terminal damage	Replace.
Pressure Plate	Visual	Scoring (could lead to pump failure) (Results of dry running)	Resurface to tolerance in Table of Fits and Clearances.
Terminal Assembly	Visual		Replace as an assembly.
Impeller	Visual	Broken fin tips Scoring on bronze face.	Clean and lap to tolerance on Table of Fits and Clearances. Replace.
Cover Bearing	Visual	Wear on bearing face and bore	Press in new bearing. Ream to dimensions on Table of Fits and Clearances.

TABLE 2. INSPECTION (continued)

Part Name:	Type of Inspection:	Inspect For:	Disposition:
Cover Pilot Diameter	Visual	Check vapor holes for foreign material	Clean.
Inlet Seal	Visual	Seal face scoring	Replace.
Shims	Visual	Scoring	Replace.
Armature Assembly	Visual	Cracked potting (resulting from dry running).	Replace.
	Mechanical	Commutator diameters	Replace if below tolerance (Figure 3).
	Visual	Burned commutators	Grind to tolerance or replace.
	Mechanical	Shaft straightness	Straighten to tolerance or replace.
	Visual	Fretting in key slots	Replace (Figure 3).
Pipe Plug Relief Valve	Visual	Distorted threads	Replace.
Housing Volute	Visual	Residue of foreign material.	Clean.
	Visual	Pipe plug, terminal lead and discharge threads	Clean with tapping ream to remove burrs and loctite.

5. REPAIR AND REPLACEMENT

A. Check impeller for broken or nicked fins. Lap both ends of rotor to remove any burrs or high spots. Lubricate new liner (38) and liner housing (39) with Dow No. 107 or equivalent and press liner into proper position with discharge ports of both parts in alignment (see Figure 10, Figure 11 and Figure 28). Check for squareness and correct if necessary. Total tolerance is .001 inch out of parallel with liner housing.

B. Each part should be cleaned and inspected for excessive wear or damage (see Table 2. Inspection). Armature should be inspected for expanded or cracked

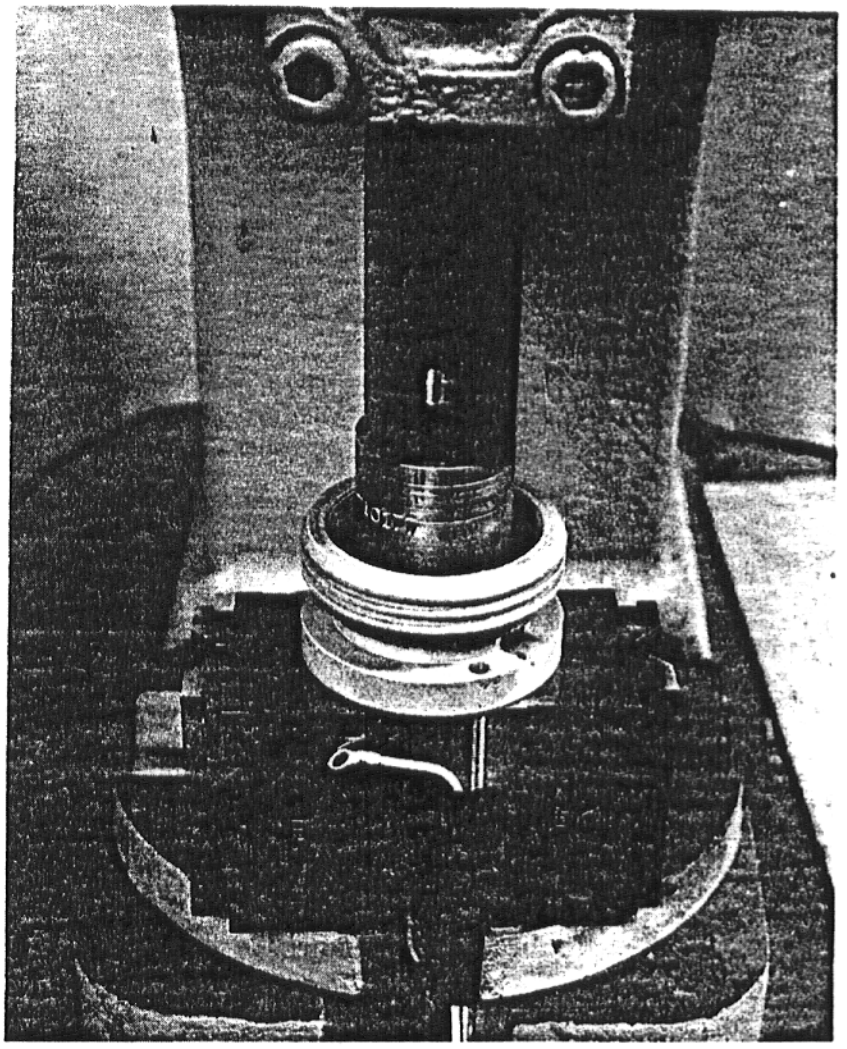


Figure 10

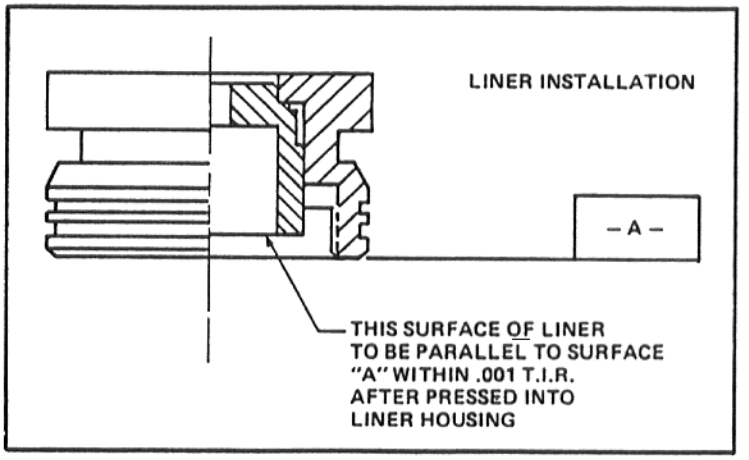


Figure 11

potting. Check armature to conditions shown on Figure 12. If within tolerances (see Table 3), grind on center, both commutators the minimum amount to just clean up completely. Minimum allowable diameter is .700 in. Deburr slots and polish afterward to prevent premature brush failure.

C. With a plug gage, check motor cover bearing (not illustrated in Parts Breakdown. Minimum diameter is .3135 and maximum diameter is .3145. If oversize, replace bearing and ream if necessary to specified tolerances (see Table 3). Lap impeller and pressure plate to restore flat surfaces if necessary. Any deep gouges, scratches or scoring is cause for replacement.

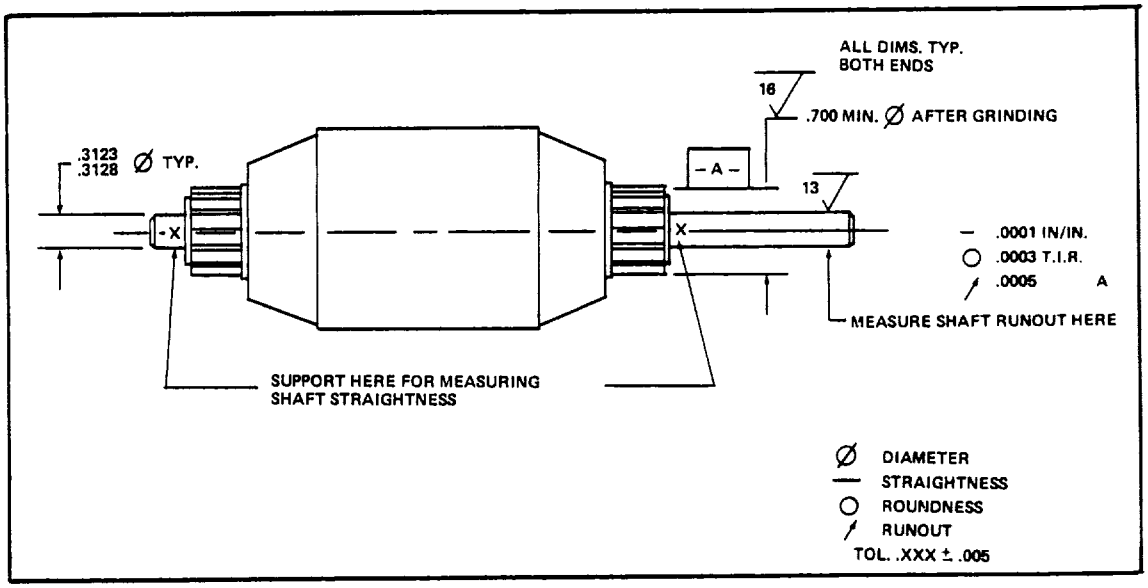


Figure 12

TABLE 3. PERMISSIBLE TOLERANCES

Part Area	Permissable Rework Dimension
Scored Impeller Bronze Face	Lap face flat and smooth.
Scored Pressure Plate Face	Lap face to flatness within 0.0005 T.I.R. Minimum thickness is 0.115 in.
Armature Assembly	Commutators diameter to .700 in. O.D. Deburr slots and edges. Clean out slots. Shaft straightness to .0008 in. T.I.R. runout as measured at long end when supported on parallel knife edges at journal areas.
Cover Bearing Bore	Bore diameter to .3135 .3145 in. I.D.

6. REASSEMBLY

A. Remove phenolic brush holder cover on brush holder assembly (33) and remove brushes (36). See Figure 13. Install new ring tongue terminals (42) on new brush leads and install brushes (36) in brush holder with springs holding them in the outward position.

NOTE: Watch for any frayed or loose strands of wire which may cause a short.

Replace cover and install brush holder assembly (33) onto liner housing (39) with two internal tooth lockwashers (35) and two round head screws (34) (see Figures 14 and 15). Use alignment tool (see Figure 27) to center brush holder assembly.

B. Place one thrust washer (31) over long shaft of armature (32) and install armature. Install square key (30), rotor (29) and vanes (28) with radius side toward bore of liner.

NOTE: End clearance of rotor and vanes must be .0008 minimum to .0022 inch maximum. Adjust as necessary. Vanes must have a clearance of .0015 / .0020 with respect to slots in rotor. Modify as necessary.

C. Position pressure plate (27) over roll pins and loosely install retaining clamp (26). Grasp liner housing (39) with one hand and with the armature up and as vertical as possible, tighten retaining clamp (26) against the pressure plate (27)



Figure 13

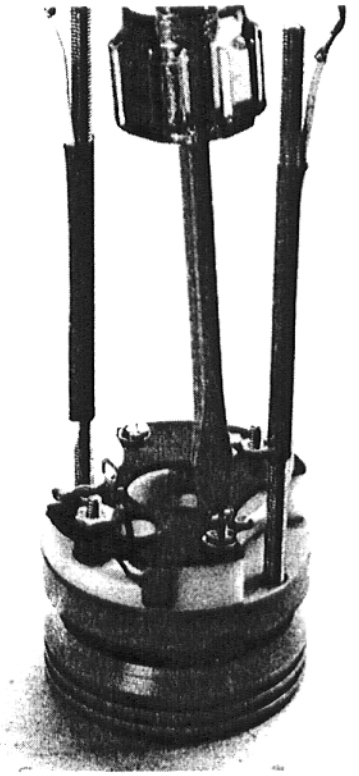


Figure 14

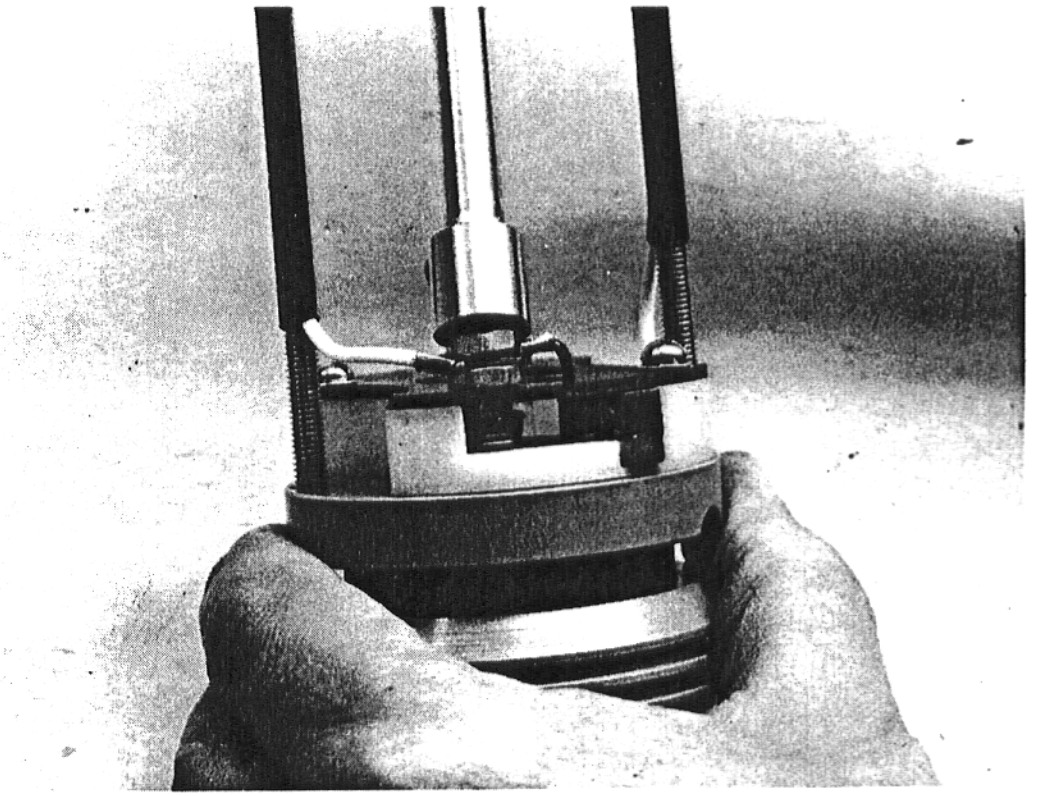


Figure 15

with tool (see Figure 16). This will prevent armature from influencing pressure plate in any one direction. Hold brush springs and carefully position brushes (36) against commutator.

D. Install woodruff key (25) and check impeller (24) for free sliding fit over shaft. Correct if necessary. Lubricate O-ring (21) and position on new seal (20). Carefully press seal and O-ring into housing. Lubricate O-ring (44) and install in top groove of liner housing (39) (see Figure 17). Also apply lubricant to bore of housing (54) to aid in assembly. Invert pumping section, impeller end up, and while holding armature UP against brush holder, lower main pump housing (54) over liner housing (39). Turn assembly right side up and slowly press down on top of brush holder assembly just far enough to allow insertion of wire retainer (19). See Figure 18. Also see Figure 6.



Figure 16

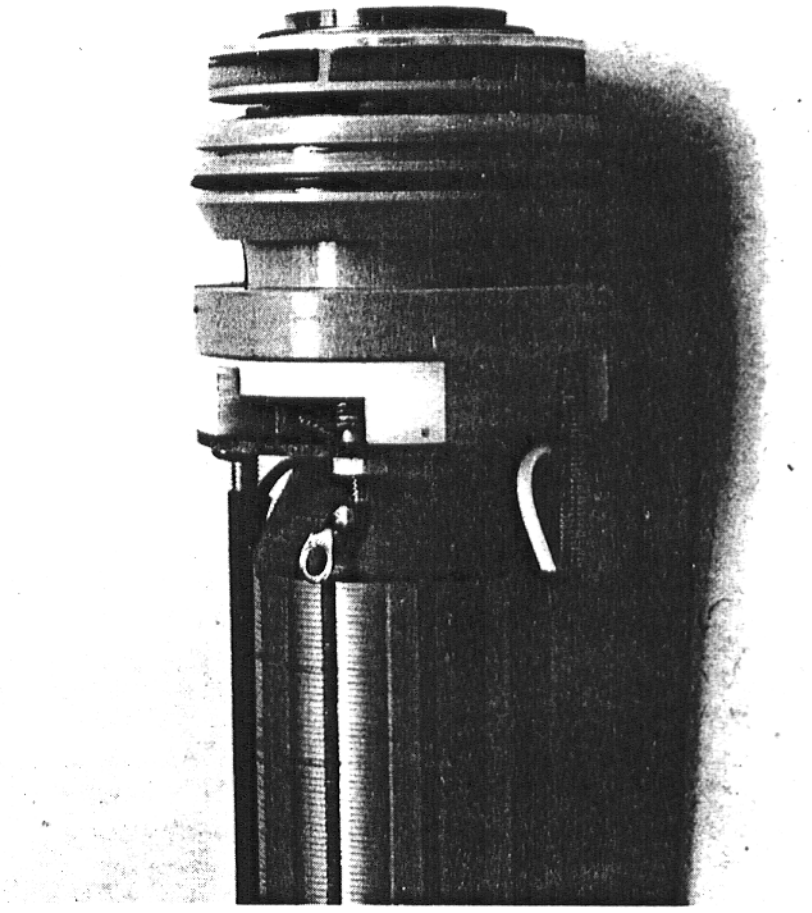


Figure 17

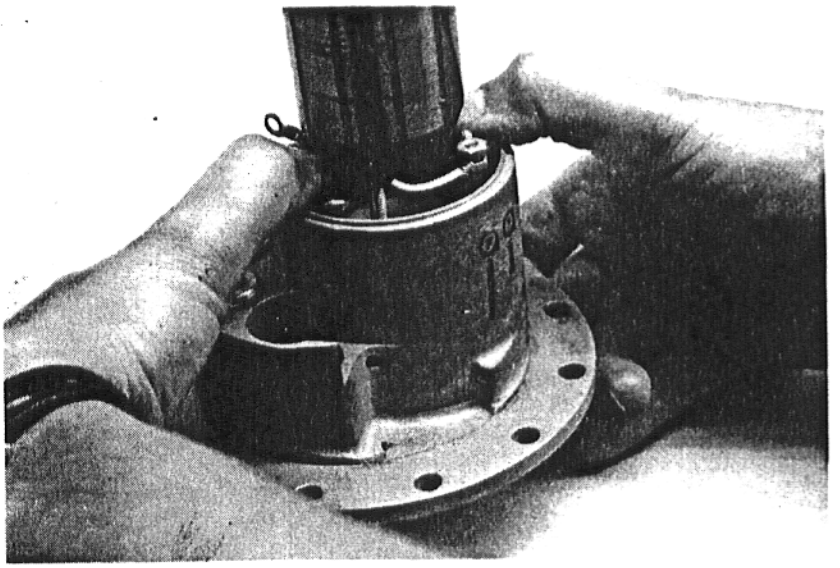


Figure 18

E. Position O-ring (18) over nylon terminal assembly (17) and start assembly into housing (see Figure 19). Apply loctite No. 601 to threads and O-ring prior to tightening terminal assembly.

NOTE: Make sure of alignment between housing and pumping cartridge before installation of terminal and wire assembly. It may be helpful to turn wires by hand near the armature to avoid winding up and possibly breaking. If new terminal assembly was used, install ring tongue terminal (42) on short positive wire from nylon terminal assembly.

F. Attach positive lead and one brush lead brush holder stud and retain with a No. 6 toploc nut (37) (see Figure 3). Route the long negative lead up the closest stud (42), slide a 2-1/2" piece of shrink tube (40) over stud and wire and shrink with heat gun to retain wire. Cut wire off flush with top of stud (42), strip insulation back 3/8" and tin. Trim brush (12) lead to 7/8" if required, tin, and solder to tinned lead (use a heat sink). Remove and replace remaining upper brush (12).

G. Attach lower negative brush lead and upper positive lead to stud on lower brush holder with a No. 6 toploc nut (32). Install the field tube with the North magnet (small white dot) over the positive brush on the lower brush holder assembly (see Figure 20). Install partially assembled upper brush holder (13). Hold springs back and install brushes (12) and wires in correct position to provide adequate movement. Relax spring pressure. Install phenolic cover (9), lockwashers (11), and two hex nuts (10). See Figure 21.

H. Place one thrust washer (15) and shims (14) as required to obtain .010 / .025 end clearance with cover installed. Rotate field tube (16) full CCW, viewing from motor end, and secure cover with two flat washers (4) and two locknuts (3) torqued to 30/35 in. lbs. Secure upper brush card with two flat washers (4) and two round head screws (5).

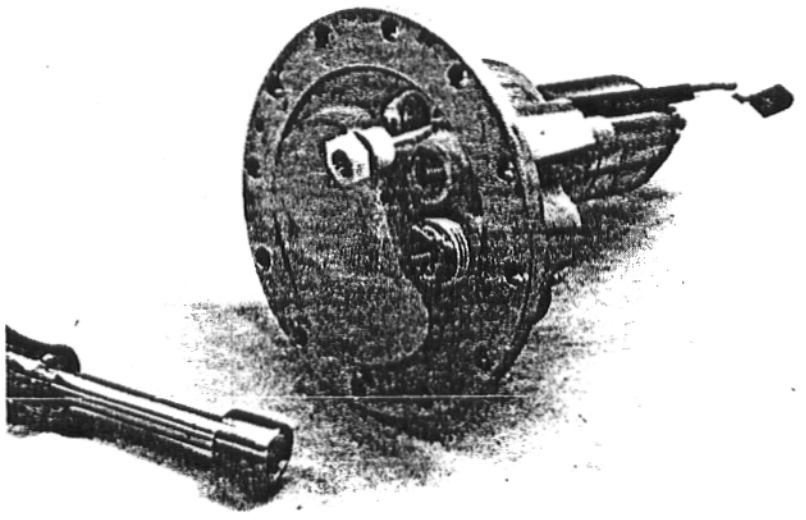


Figure 19

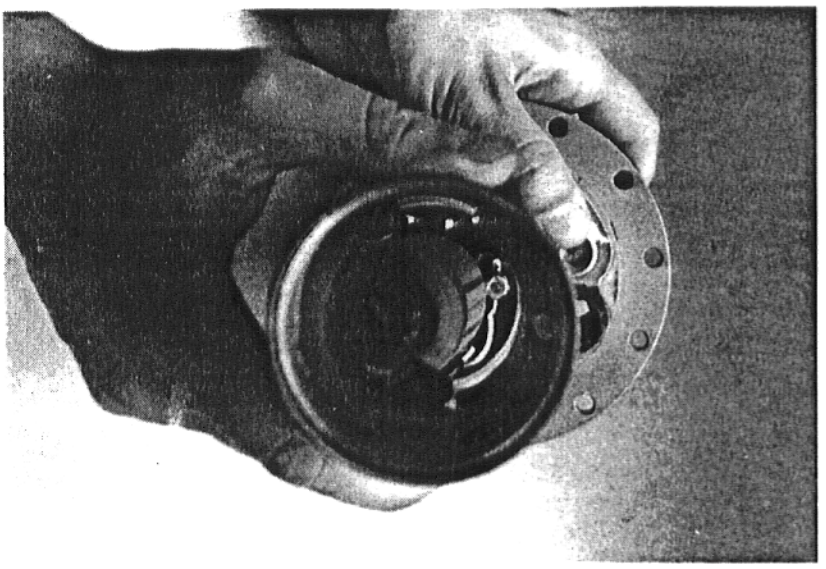


Figure 20

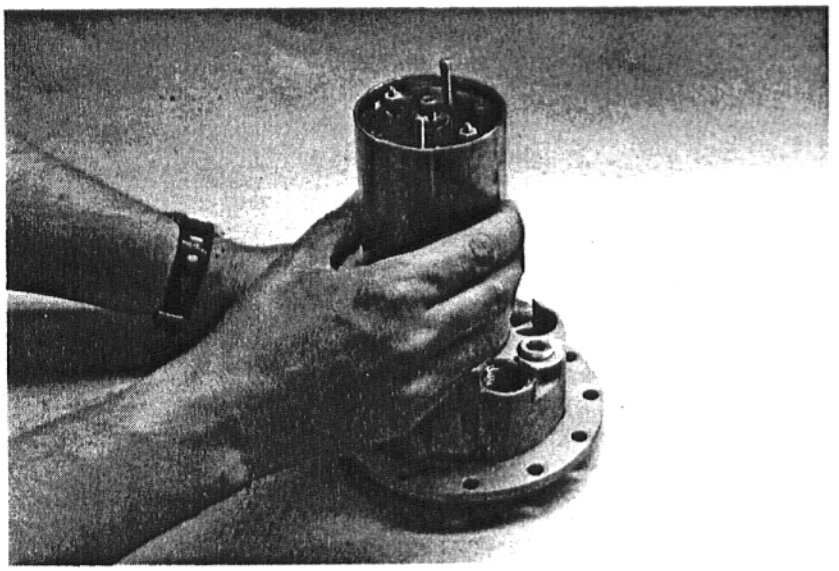


Figure 21

I. Install relief valve assembly in housing. See Figure 22. Apply an antiseize lubricant to threads of cover plug and install it into housing. Reinstall screen to housing with a drivescrew. Fill any void between screen and housing flange with 3M epoxy 2158.

7. TESTING

A. Hydrostatic Testing - The purpose of the hydrostatic test is to prove the integrity of the positive terminal seal, the lack of porosity in the housing, and the ability of the housing flange to seat and seal properly.

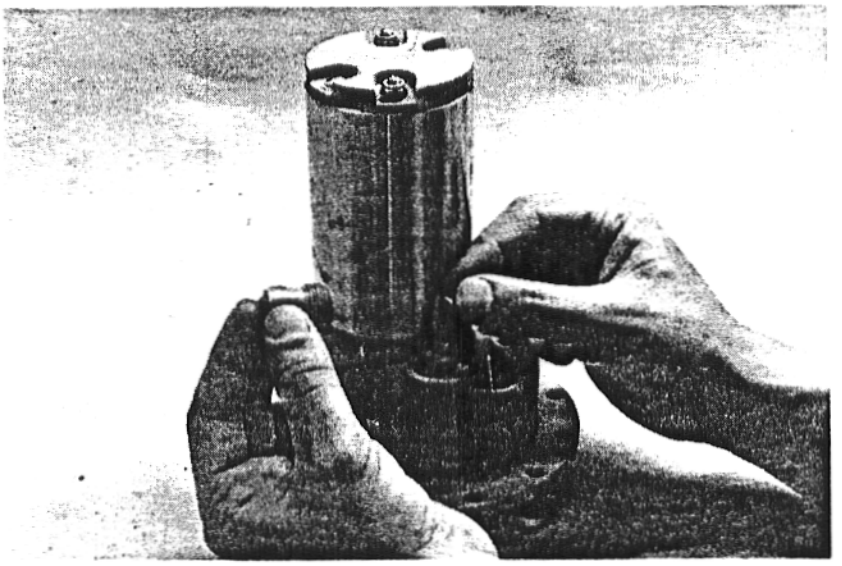


Figure 22

(1) The hydrostatic test setup consists of a tank suitable for mounting the unit and safely withstanding an internal air pressure of 60 PSIG. See Figure 23.

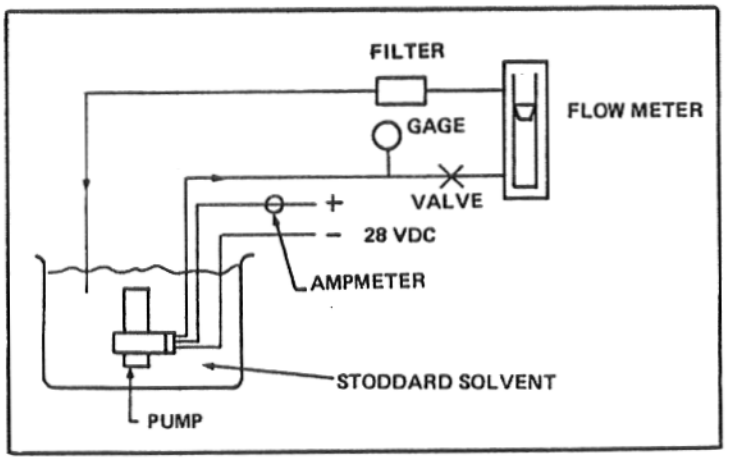


Figure 23

TEST PROCEDURE

1. Production test using Stoddard solvent or fuel specified on outline drawing. CAUTION: Do not run pump dry.
2. Performance: Measure pressure at flow and no flow conditions, and record along with highest current reading at specified voltage in the production test log. The test log must show test performance for each pump by serial number.

(2) Install seal drain plug. Mount unit in a suitable tank to which air pressure can be applied. Cover flange with water. Pressurize vessel. There shall be no leaks at 60 PSI. Leakage through the positive terminal, pores of the housing or around the edges of the flange shall be cause for rejection of the unit.

(a) Re-examine flange face for nicks or burrs and repair, should leak occur around edges.

(b) Re-install positive terminal, checking for cut or distorted O-ring and sufficient torquing of terminal plug, should leak occur here.

(c) Disassemble pump and rebuild with new housing should housing appear porous.

B. Functional Test - The purpose of the functional testing is to prove that the pump meets the performance characteristics for this model.

(1) The functional test setup consists of a vessel suitable for providing sufficient fluid to meet required flow. Instrumentation shall be capable of monitoring flow, discharge pressure, volts DC, current and fluid temperature. Figure 23 schematically illustrates the setup. All instruments must be accurate within plus or minus 2 percent of true reading.

(2) Open discharge valve. Apply voltage briefly to check for shorts or open circuit on ammeter. Apply 28 VDC. Set flow at 450 PPH. Recheck voltage and adjust to 28 VDC. Observe pressure and record. Shut off discharge valve and observe ammeter for increase or decrease in amperage. Record max amps. Read and record pressure at zero flow. Units successfully completing all tests shall be wiped clean of fluid and stored in a clean container with protective plugs in the drain and discharge ports.

Minimum pressure at 450 PPH is 22 PSI. Maximum pressure at 0 PPH is 32 PSI. Maximum current is 8.5 amps.

8. TROUBLESHOOTING

A. Units failing to meet any of the requirements shown in Table of Leading Particulars shall be rejected. Determine cause of failure, take necessary corrective action, and retest the pump. Table of Troubleshooting lists typical failures, their causes, and remedial action to be taken.

TABLE 4. TROUBLESHOOTING

Trouble	Probable Cause	Remedy
Loss of Flow and Pressure	Wedging vane in slot by foreign material	Disassemble, clean and reassemble.
	Worn pressure plate	Disassemble and lap. Replace.
	Relief valve hanging open by foreign material.	Remove valve, clean cavity.

TABLE 4. TROUBLESHOOTING (continued)

Trouble	Probable Cause	Remedy
Loss of Flow and Pressure	Relief valve seat damaged	Replace as assembly. Remove valve, inspect seat, replace if damaged.
	Relief valve improperly adjusted.	Remove and reset pressure.
	Broken impeller seal	Disassemble and replace.
	Broken O-Ring in liner housing	Disassemble and replace.
	Pump assembled without rotor key.	Disassemble and install.
	Vanes installed backwards.	Disassemble and reassemble with rounded edge outward.
	One or more vanes missing	Disassemble and reassemble correctly.
Failure to Operate	Brush hung-up	Disassemble and free up.
	Open circuit	Check for open circuit Check for poor solder connection.
	Short circuited to field tube or housing.	Examine leads. Check for foreign metallic fragments. Check for broken or chaffed insulation.
	Wedged vane	Disassemble. Examine for chips or foreign material. Clean if not chipped, or replace if damaged.
	Damaged armature. Wires cut during turning of armature commutators.	Replace armature
	Field tube on backwards, 180° out of polarity	Disassemble and correct polarity.
	Pump not connected electrically	Correct connections.
Noisy Pump	Broken vanes	Replace.
	Foreign material	Clean.
	Out-of-balance armature	Replace.
	Bent shaft	Straighten or replace.

9. STORAGE AND PRESERVATION

A. No special instructions are necessary for storage and preservation of these units except that after overhaul and test, the unit or units should be dry and protected against any dirt or foreign matter.

10. SPECIAL TOOLS

A. Special tools required to overhaul these units are shown in Figures 24 and 25. Detail dimensional drawings (Figures 26, 27, 28 and 29) are provided to be used to fabricate tools not illustrated in Figures 24 and 25.

(1) See Figure 24 for tools required.

(2) See Figures 25 and 26 for pliers ground to facilitate key installation and rotor removal.

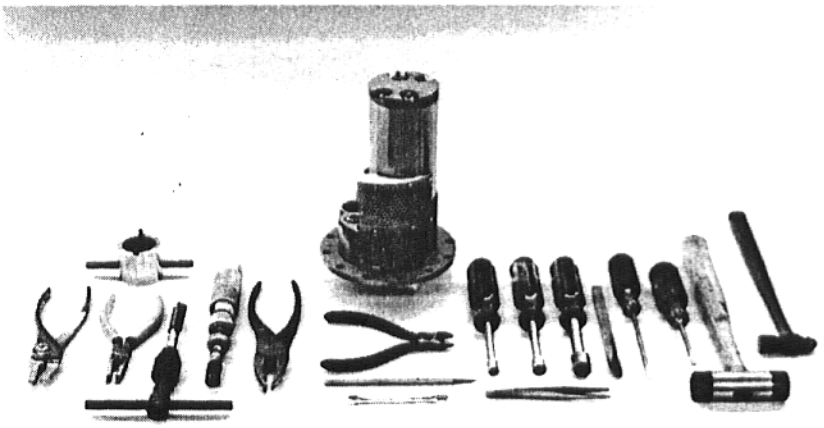


Figure 24

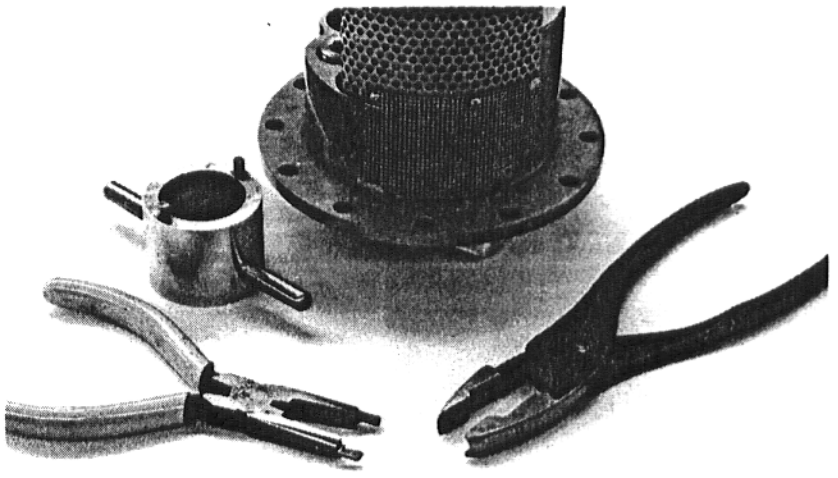


Figure 25

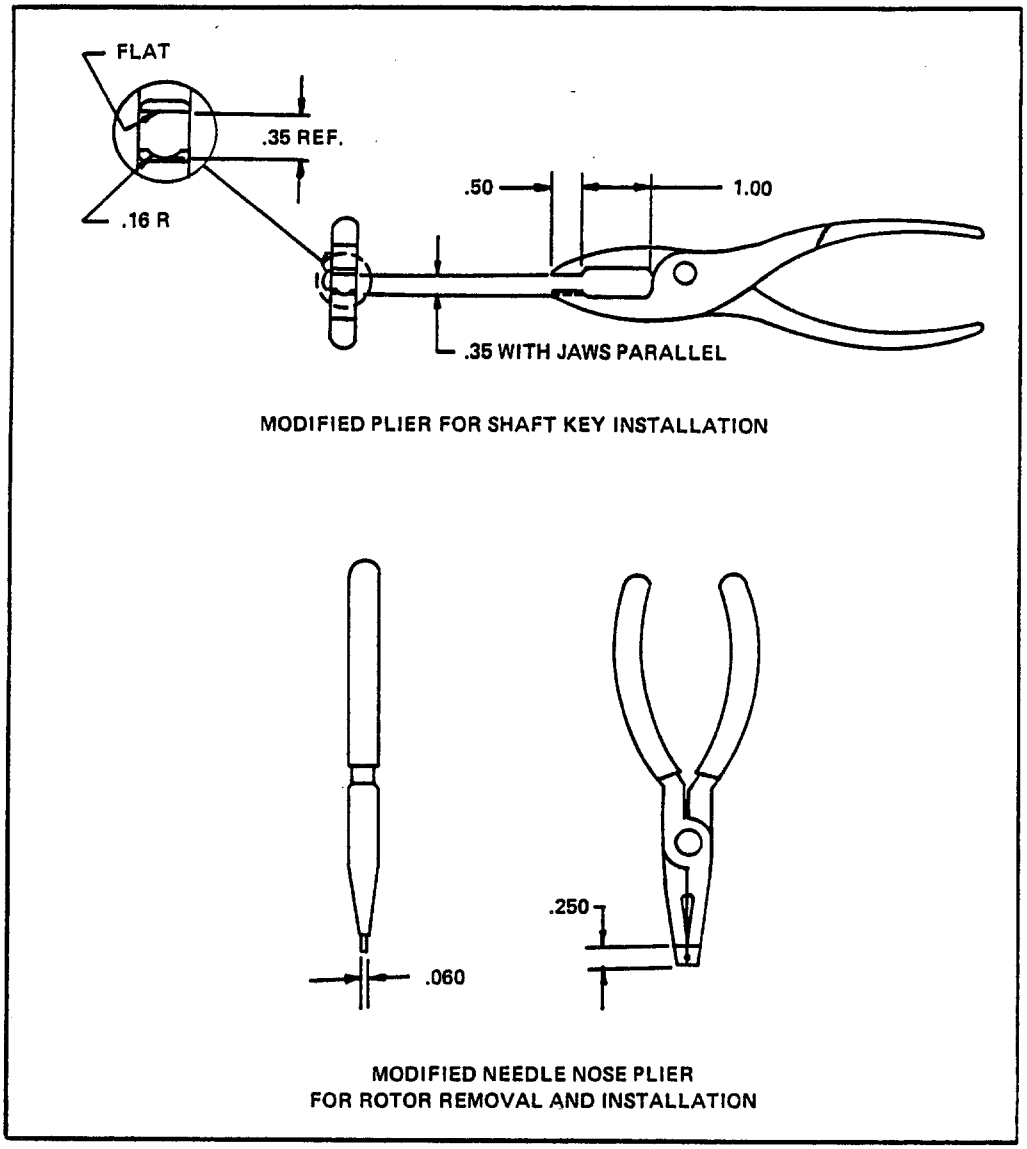

FLAT
.35 REF.
.16 R
.50
1.00
.35 WITH JAWS PARALLEL
MODIFIED PLIER FOR SHAFT KEY INSTALLATION
.060
.250
MODIFIED NEEDLE NOSE PLIER
FOR ROTOR REMOVAL AND INSTALLATION

Figure 26

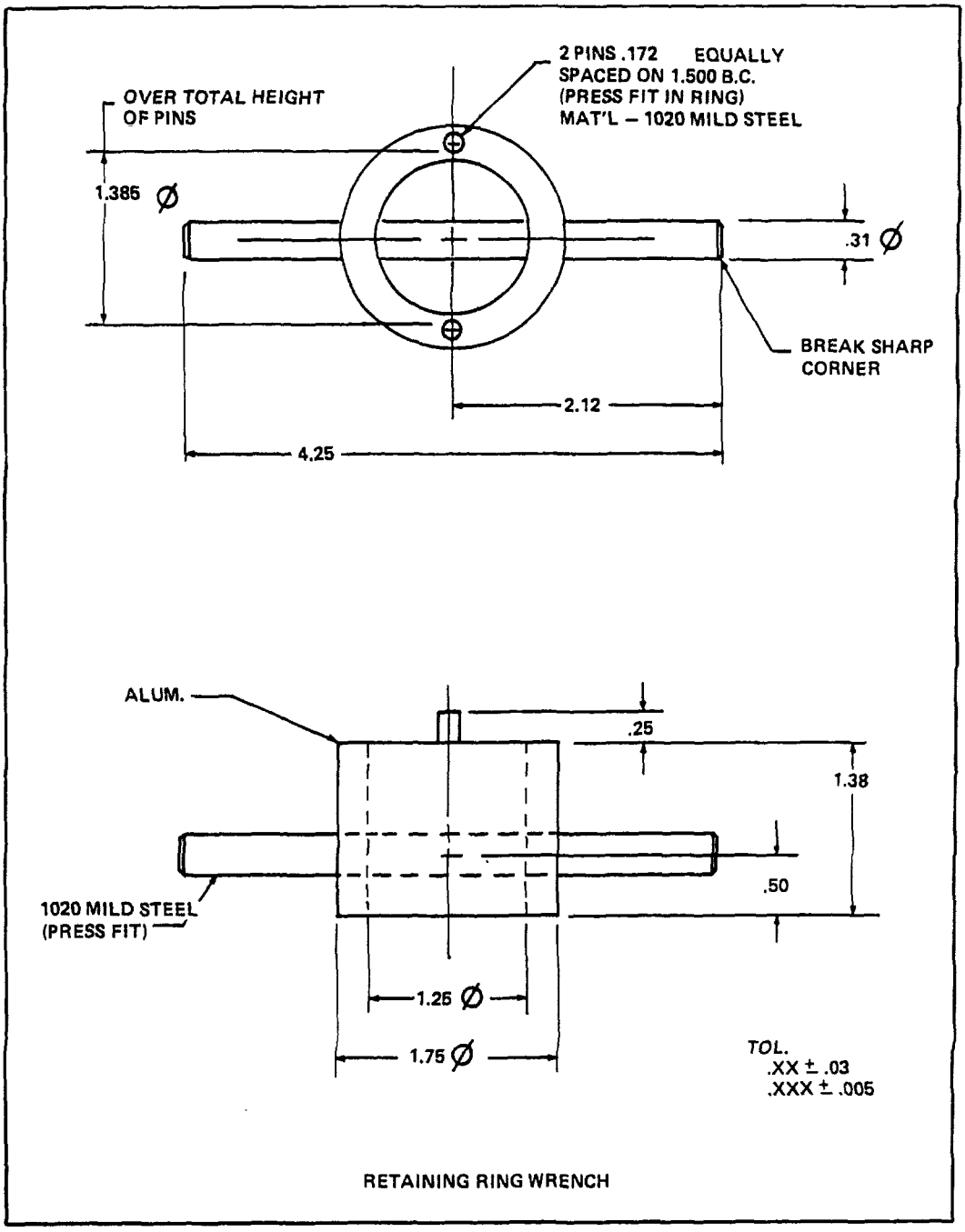

2 PINS .172 EQUALLY SPACED ON 1.500 B.C. (PRESS FIT IN RING) MAT'L – 1020 MILD STEEL
OVER TOTAL HEIGHT OF PINS
1.385 Ø
.31 Ø
BREAK SHARP CORNER
2.12
4.25
ALUM.
.25
1.38
.50
1020 MILD STEEL (PRESS FIT)
1.25 Ø
1.75 Ø
TOL.
.XX ± .03
.XXX ± .005
RETAINING RING WRENCH

Figure 27

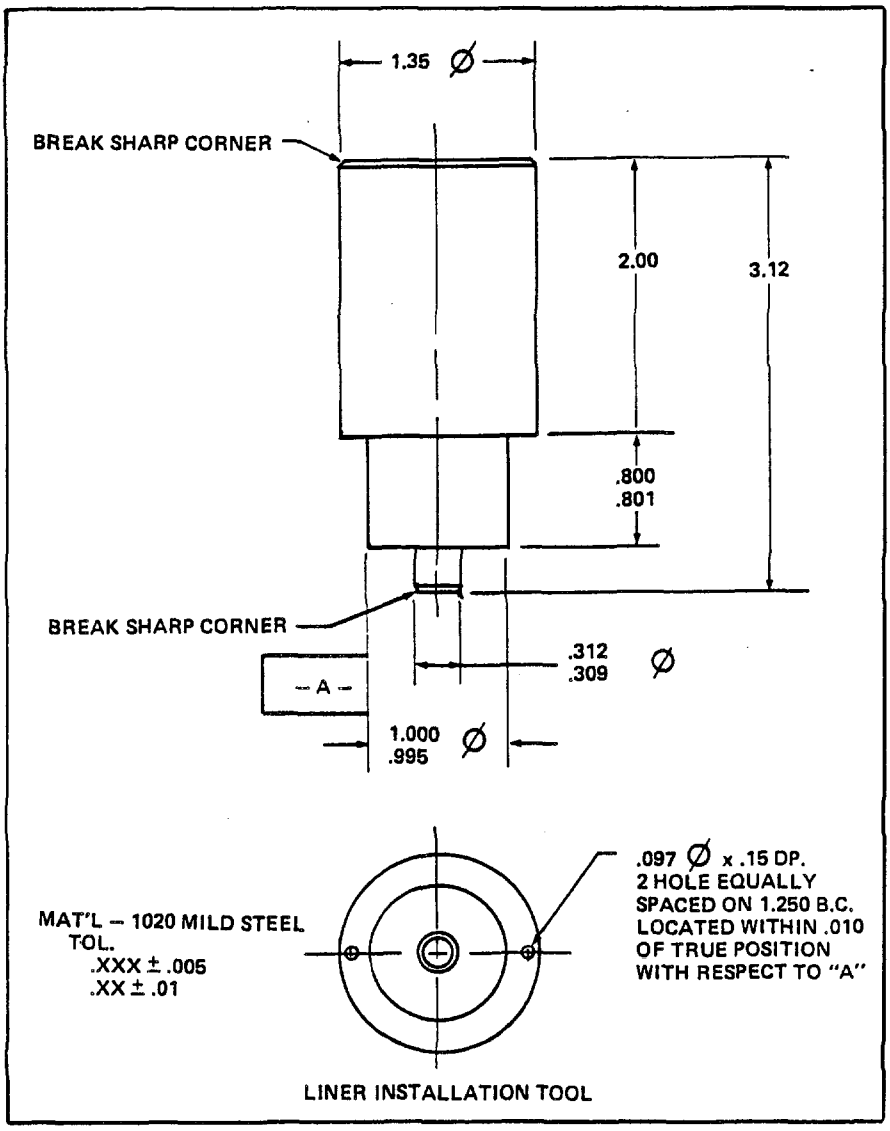

1.35 Ø
BREAK SHARP CORNER
2.00
3.12
.800
.801
BREAK SHARP CORNER
.312
.309 Ø
– A –
1.000
.995 Ø
MAT'L – 1020 MILD STEEL
TOL.
.XXX ± .005
.XX ± .01
.097 Ø x .15 DP.
2 HOLE EQUALLY
SPACED ON 1.250 B.C.
LOCATED WITHIN .010
OF TRUE POSITION
WITH RESPECT TO "A"
LINER INSTALLATION TOOL

Figure 28

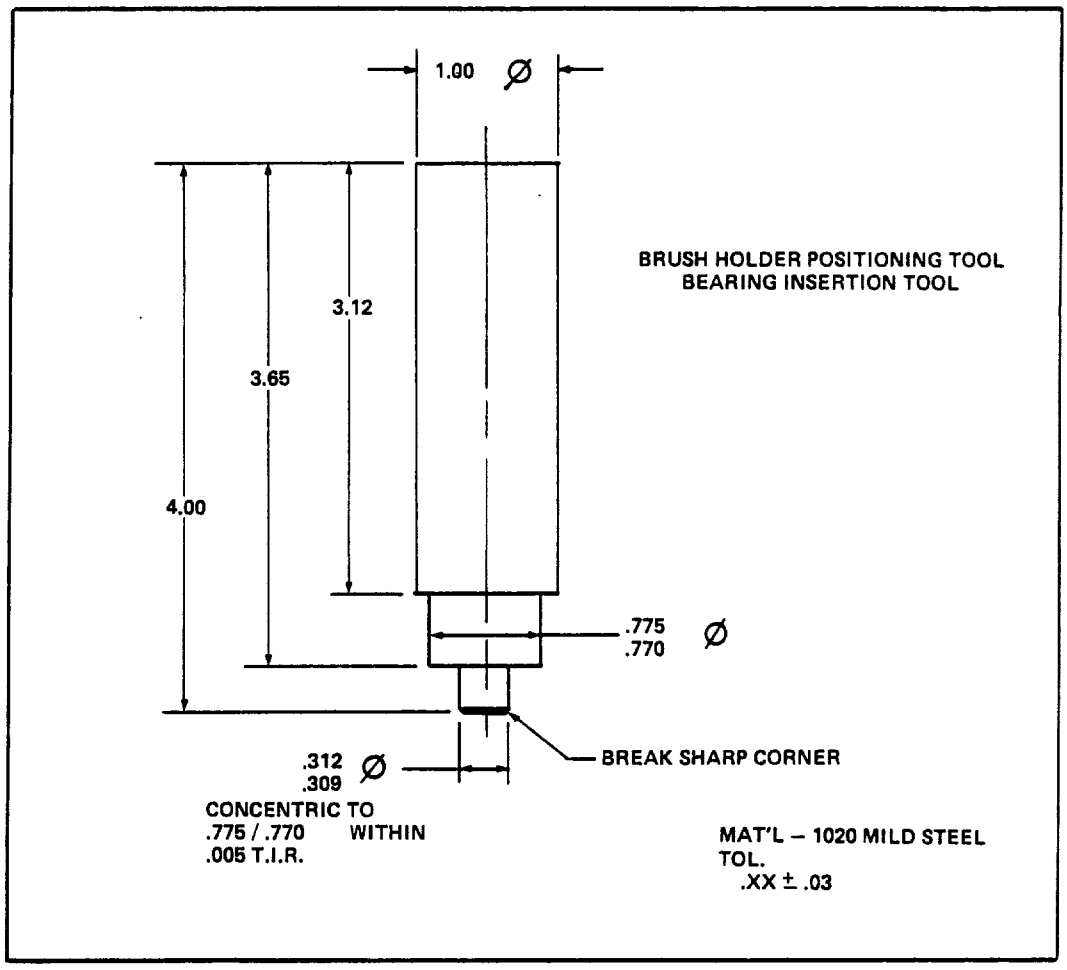


Figure 29

11. ILLUSTRATED PARTS LIST

A. General - This section contains listings of assemblies, sub-assemblies and detail parts arranged in disassembly sequence except that attaching parts are listed immediately after the parts they attach, under the heading of "ATTACHING PARTS."

B. Item Number - The item number indicates the identification of a part in the illustrations.

C. Part Number - This column contains numbers for identification of parts.

D. Description - Description of each item is indented by columns to indicate relationship to the next higher assembly.

E. Quantity Required - The numbers listed in the "Quantity Required" column indicate the quantity of parts used per assembly at the location shown and are not necessarily the total quantity used per pump. The letters "AR" indicate the part is used as required.

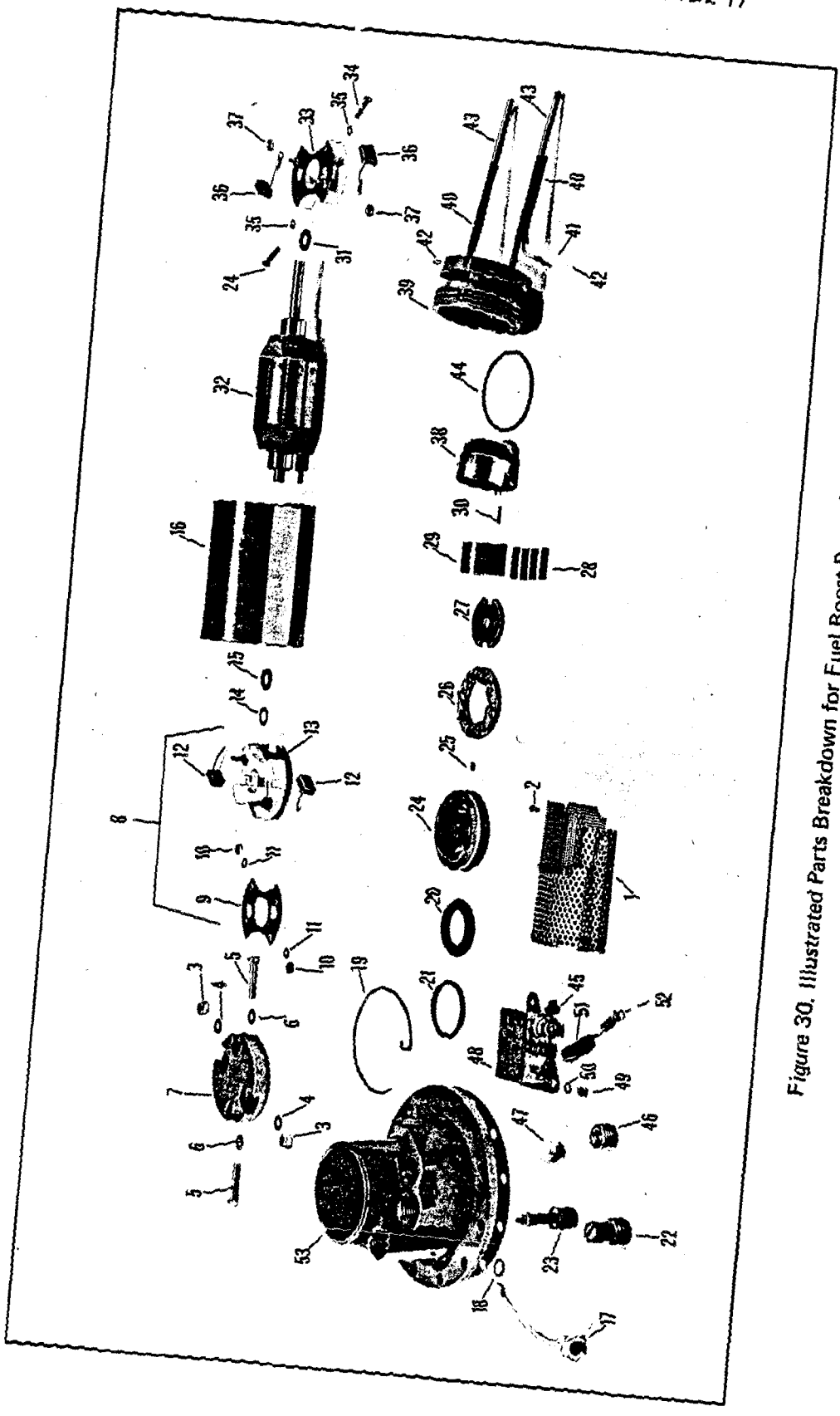


Figure 30. Illustrated Parts Breakdown for Fuel Boost Pump Model 1D2-17

PARTS LIST

ITEM NO.	PART NO.	PART DESCRIPTION	QTY. REQ'D.	USABLE ON CODE
	1D2-17	Duplex Fuel Pump Assembly		
1	D9-56-1	. Strainer Assembly	1	
		(Attaching Parts)		
2	No.2	. Drive Screw (1/4 inch long)	1	
		---*---		
3	104A10002-01	. ESNA Locknut	2	
4	No. 10	. Washer, Flat (.437 OD x .031)	2	
5	103A10002-09	. Screw, Round Head (1-1/8 inch long)	2	
6	No. 10	. Washer, Flat (.437 OD x .031)	2	
7	A3-18-1	. Cover Motor	1	
	C9-6-1	. Bearing, Cover (not illustrated)	1	
8	F4-11-4	. Brush Holder Assembly	1	
9	A3-87-2	. . Cover, Brush Holder	1	
		(Attaching Parts)		
10	104A10003-02	. . Nut, Toplock	3	
11	107A10004-05	. . Washer, Lock (internal tooth)	2	
		---*---		
12	F4-9-1	. . Brush	2	
13	F4-13-3	. . Brush Holder	1	
14	C5-2-14	. Shim (.005 inch thick)	AR	
	C5-2-15	. Shim (.009 inch thick)	AR	
	C5-2-16	. Shim (.015 inch thick)	AR	
15	C5-64-1	. Thrust Washer	1	
16	F3-17-4	. Field Tube and Magnet Assembly	1	
17	None	. Terminal Assembly (parts not sold separately)	1	
18	2-012	. O-Ring (.364 ID x .072)	1	
19	D1-65-1	. Retainer Wire	1	
20	C6-9-1	. Inlet Seal	1	
21	10ZA10001-14	. O-Ring (1.299 ID x .103W)	1	
22	B9-35-1	. Plug, Pipe (3/8 inch long)	1	
23	E6-17-3	. Poppet Valve Assembly	1	
24	B7-17-1	. Impeller Assembly	1	
25	C3-5-1	. Woodruff Key	1	
26	D2-14-1	. Clamp, Inlet Retaining	1	
27	B2-84-2	. Plate, Pressure	1	
28	A5-8-4	. Vane	4	
29	A6-8-5	. Rotor	1	
30	C3-4-4	. Key, Square	1	

PARTS LIST

ITEM NO.	PART NO.	PART DESCRIPTION	QTY. REQ'D.	USABLE ON CODE
31	C5-64-1	. Washer, Thrust	1	
32	F2-25-4	. Armature Assembly	1	
33	F4-11-2	. Brush Holder Assembly	1	
		(Attaching Parts)		
34	103A10001-07	. Screw, Round Head	2	
35	107A10004-05	. Washer, Lock (internal tooth)	2	
		---*---		
36	F4-9-1	. Brush	1	
		(Attaching Parts)		
37	104A10006-01	. Nut, Toplock	2	
		---*---		
38	A4-20-1	. Liner	1	
39	A1-158-1	. Liner Housing	1	
40	109A10001-05	. Shrink Tube (FIT-105-1/4)	AR	
41	No. 18	. Wire, Single Conductor	AR	
42	NIT-R-4105S	. Terminal, Ring Tongue	2	
43	C7-10-3	. Stud	2	
44	102A10001-11	. O-Ring (2.114 ID x .070W)	1	
45	10-32-UNC-2A	. Screw, Buttonhead (1/4 inch long NYLOC)	2	
46	3/8-18NPT	. Plug, Pipe	1	
47	D7-1-14	. Ball, Nylon (.56 inch dia.)	1	
48	F7-35-1	. Filter, Radio Noise	1	
		(Attaching Parts)		
49	103A10001-01	. Screw, Round Head	1	
50	107A10004-05	. Washer, Lock (internal tooth)	1	
		---*---		
51	109A10001-05	. Shrink Tube (FIT-105-1/4)	AR	
52	R1891S	. Terminal Ring Tongue (No. 10 stud)	1	
53	A1-148-6	. Housing	1	

M - 7016

OVERHAUL AND MAINTENANCE MANUAL

VALVE, CHECK 700 246

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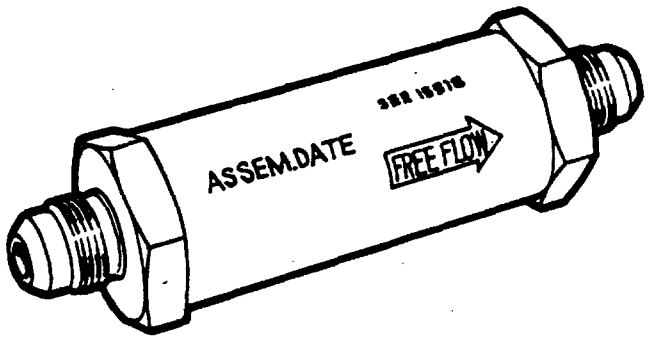
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OVERHAUL AND MAINTENANCE MANUAL

VALVE, CHECK 700 246



CONTENT: Overhaul, Maintenance and Testing.
Exploded view of 700 246 with Parts List.
Performance Data.

TORONTO – ONTARIO – CANADA

/

OVERHAUL, MAINTENANCE AND TESTING

of CHECK VALVE 700 246

28 September 1967

DISMANTLING: See Exploded View of 700 246

Unscrew valve and cap assembly, item 4, and with a suitable pair of pliers remove retaining ring, item 3. Remove the element, item 2, from the housing, item 1.

Check all sealing faces and threads for nicks, scratches, deformation or any other imperfections.

If the rubber seal in the valve, item 4, is damaged the complete valve and cap assembly should be replaced.

CLEANING:

Clean all the components ultrasonically or by soaking in clean varsol and scrubbing with a bristle brush, taking care not to damage the rubber seal. Rinse components with a final prefiltered petroleum naptha or varsol.

Dry components thoroughly using a clean filtered air blast.

ASSEMBLING:

Assemble element with housing ensuring retaining ring is fully inserted in the groove. (Ring gap shall be .179 minimum).

Assemble cap and valve assembly with aluminum gasket, item 5, into housing and tighten to 600 in. lbs. torque.

PROOF PRESSURE TESTING:

1. Connect outlet port of valve to an adequate source of hydrostatic pressure (hand pump). Fill the system with MIL-F-7024 Type II and use a test quality pressure gauge, the range of which is not greater than 500 PSI. The fluid shall be filtered to 10 micron.

2. Expell all air from the system.

3. Apply $\frac{1}{2}$ PSI pressure. Wipe the outside of the unit dry. Hold pressure for one minute. There shall be no leakage.

OVERHAUL, MAINTENANCE AND TESTING

of CHECK VALVE 700 246

4. Increase pressure to not less than 90 PSI and not more than 95 PSI. Hold for not less than two minutes. There shall be no leakage.

5. Release pressure. Check threaded joints for slackening tighten if necessary in accordance with relevant assembly procedure.

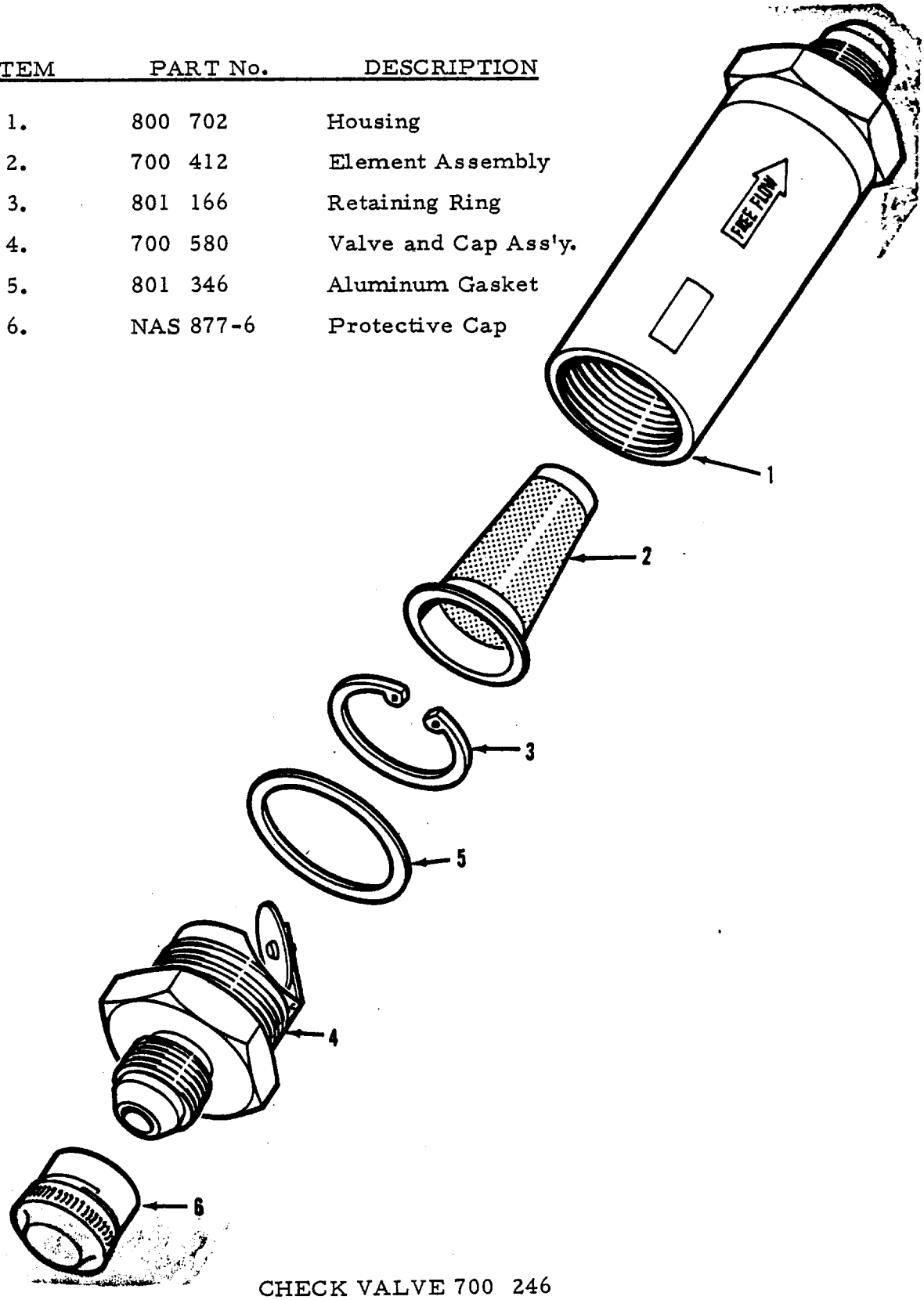
6. Repeat steps 3, 4 & 5 above.

7. The test shall be carried out at room temperature (65 - 85°F). Dry valve unit thoroughly in a clean oven at 160°F max. or with clean filtered air blast.

8. Store in a clean sealed polyethelene bag until used.

.....

ITEM	PART No.	DESCRIPTION
1.	800 702	Housing
2.	700 412	Element Assembly
3.	801 166	Retaining Ring
4.	700 580	Valve and Cap Ass'y.
5.	801 346	Aluminum Gasket
6.	NAS 877-6	Protective Cap



CHECK VALVE 700 246

REPORT NO. 8-162

OVERHAUL MANUAL

FUEL BOOSTER PUMP

PART NO.

60-611
60-611A

CRANE HYDRO-AIRE DIVISION

CRANE CO. • 3000 WINONA AVENUE • BURBANK, CALIFORNIA 91503

1 OCTOBER 1968
REV 15 FEBRUARY 1971

HYDRO-AIRE
OVERHAUL MANUAL

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HYDRO-AIRE

OVERHAUL MANUAL

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	102	Blank		802	Oct 1/68
	201	Oct 1/68		803	Oct 1/68
	202	Blank		804	Blank
	301	Oct 1/68		901	Oct 1/68
	302	Oct 1/68		1001	Blank
	401	Oct 1/68		1101	Oct 1/68
	402	Oct 1/68		1102	Oct 1/68
	501	Oct 1/68		1103	Oct 1/68
	502	Oct 1/68		1104	Feb 15/71
	503	Oct 1/68		1105	Feb 15/71
	504	Oct 1/68	28-20-0	1106	Feb 15/71
28-20-0	601	Oct 1/68			

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CRANE CO.

TO: HOLDERS OF ATA OVERHAUL MANUAL COVERING FUEL BOOSTER PUMP PART NOS. 60-611 AND 60-611A.

REVISION NO. 1, DATED 15 FEBRUARY 1971

HIGHLIGHTS

Pages which have been revised are outlined below, together with the highlights of the revision. Please delete affected pages and enter Revision No. 1 dated 15 February 1971.

Chapter/Section and Page Number	Description of Change
Title Page	Added current revision date.
List of Effective Pages	Added to identify changes.
28-20-0 Page 1104	Added item 33A.
28-20-0 Page 1105	Added item 33A.

Q. Description and Operation

A. Description

(1) The fuel booster pump, Part No. 60-611, is composed of a 28-volt DC motor, impeller and screen assemblies mounted on a flange assembly and is enclosed in an explosion-proof, cannister-type housing. The pump is a centrifugal fuel, continuous duty type, incorporating a thermal protector and radio interference filter.

B. Operation

(1) The pump is motor driven and is mounted on the fuel tank. The motor operates on 28 VDC with a maximum current drain of 4.0 amps. Pump rated flow is 1.155 gpm JP-4 aircraft fuel Motor rotation clockwise when viewed from shaft end.

Table 1. Leading Particulars

Use	Aircraft fuel system
Type	Centrifugal – motor-driven
Installation	Tank mounted
Operation	Continuous duty
Fluid	JP-4 fuel (MIL-T-5624)
Power Supply	28 VDC battery
Max. Current Drain	4.0 amperes
Thermal Protection	Non-resettable
Capacity	1.155 gpm
Weight	3.2 lbs.

1. Disassembly (see figure 6)

A. Disassemble in sequence of index numbers assigned to exploded view, observing the following:

NOTE: Prior to separation of flange assembly (15) and motor housing (6), disconnect wires from radio interference filter (4). Remove screws (5) and filter (4).

B. Remove motor housing (6) by removing screws (10) and washers (11).

C. Remove bearing (34), wick (35), and bearing retainer (36) from armature assembly (44) shaft. Remove O-Ring (8) from motor housing.

D. Pull slinger (40) from armature assembly (44) shaft.

E. Remove screws (50) washers (51), and disconnect brush wires from field assembly (54). Remove brush assembly (-45), and disassembly brush springs (47), and brushes (48), from plate (46). Discard brushes and springs. Unsolder and remove capacitors (49), from plate (46).

F. Remove spacer (52), and spacer assembly (56).

G. Remove thermal fuse (55), from field assembly (54).

H. Disassembly pump assembly (1) as follows:

(1) If necessary, remove nameplate (3) from flange assembly (15).

(2) Pry thrust bar (14), if necessary to remove, from flange assembly (15). Bar is cemented and pressed into flange assembly.

(3) Remove screen assembly (13), fron flange assembly (15). Separate inlet adaptor (16), from seal housing (32), by removing screws (1

NOTE: Adaptor (16) is cemented to housing (32).

(4) To remove impeller (20), pull pin (18). Remove O-Ring (19).

(5) Disassemble seal assembly by removing seal insert (23) and O-Ring (27) from seal holder (25). Remove spring (26).

(6) Remove seal shell (28) and plug (31) from seal housing (32). Remove and discard gasket (30).

(7) Remove bearing guide (39), bearing (43), wick (41), and bearing retainer (42) from armature (44) shaft.

NOTE: Bearing guide (39) is installed on Part No. 60-611A configuration only.

2. Cleaning (see figure 6)

WARNING: USE CLEANING SOLVENT IN A WELL-VENTILATED AREA. AVOID BREATHING FUMES. KEEP AWAY FROM FLAME.

A. Wash all non-electrical parts with dry-cleaning solvent (Federal Specification P-S-661) and thoroughly dry.

WARNING: USE METHYL-ETHYL-KETONE IN A WELL-VENTILATED AREA. AVOID BREATHING FUMES. KEEP AWAY FROM FLAME.

B. Remove cement and sealant from flange assembly (15), seal housing (32), inlet adaptor (16), thrust bar (14), nameplate (3), and screen assembly (13), with methyl-ethyl-ketone (Federal Specification TT-M-00261): then remove methyl-ethyl-ketone with dry-cleaning solvent (Federal Specification P-S-661).

C. Sonically clean seal assembly (-21) using an ultrasonic cleaner (Acoustica Associates, Inc., Los Angeles, California).

D. Wipe all electrical parts with a clean lint-free cloth. Use a soft bristle brush to clean hard-to-reach areas.

E. Carefully clean between commutator bars on armature assembly (44) with a copper wire brush.

3. Inspection/Check (see figure 6)

A. Visual Inspection

(1) Inspect all parts for damage. Check all threads for cross-threading and stripping.

(2) Examine machined surfaces for cracks, nicks, scratches, and corrosion.

(3) Thoroughly check bearing (34, 43). Bearings must not be rusted, discolored, fractured, or have obviously worn surfaces and must rotate smoothly without roughness or binding.

(4) Check armature assembly (44) shaft for chipping, scoring, and deep wear patterns. Dimensionally inspect in accordance with figure 1.

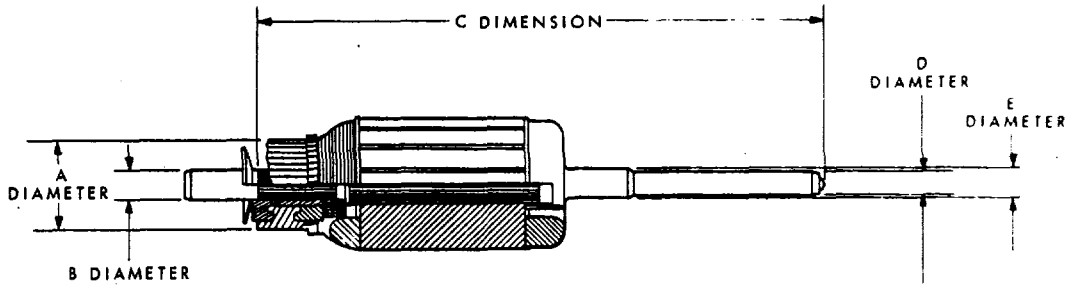
B. Mechanical Inspection

(1) Inspect spring (26) for cracks, breaks, and distortions. At compressed length of 0.245 inch, load must be 1.47 lb. maximum. When load is removed, spring must return to a free length of 1.111 inches (±0.010) with no permanent set or distortion.

(2) Check field assembly (54) for continuity.

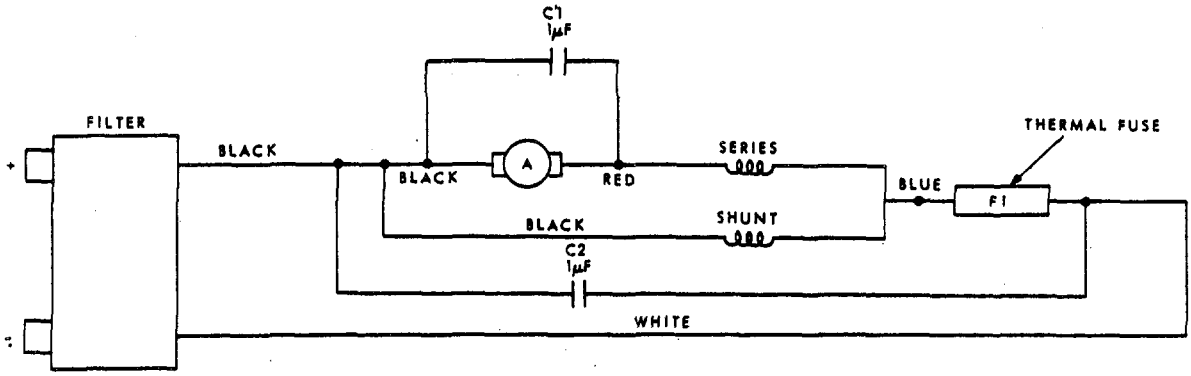
(3) Check resistance of field assembly (54, figure 6); resistance of one coil must be the same as the other within 10 percent of the higher value. (See figure 2 for wiring diagram.)

Dielectric test the motor applying 500 volts ac, rms, at 60 cps for one minute. Maximum leakage shall not exceed 0.003 ampere. There shall be no indication of insulation breakdown.



A	B	C	D	E
0.746 IN. (MIN)	0.2485 IN. (MIN)	4.664 IN. 4.684	0.1865 IN. (MIN)	0.2485 IN. (MIN)

Armature Dimensional Requirements
Figure 1



Wiring Diagram
Figure 2

(4) Check wiring insulation and sleeving for evidence of deterioration (brittleness) abrasion or other damage.

(5) Inspect filter (4) and field assembly (54) terminals for corrosion, looseness, breaks, and other damage.

4. Repairs (See figure 6)

A. Replace all parts that do not pass inspection/check and are damaged beyond simple repair.

B. Special materials required for repair are listed in Table 2.

C. Remove minor scratches, burrs, and corrosion from metal parts by light polishing with fine aluminum oxide or silicon carbide abrasive cloth (Federal Specification P-C-451).

D. Replace all packings at each overhaul.

E. If armature windings are shorted, check for solder deposits between commutator bars. Remove deposits and recheck windings. If still shorted, armature must be replaced. If circuit is open in armature windings, inspect for thrown solder. Resolder circuit where necessary using solder, specification QQ-S-571 and recheck circuit. If circuit is still open, replace the armature assembly.

F. If commutator eccentricity exceeds limits specified in figure 1, machine minimum amount of metal from commutator to bring commutator within limits. Use a diamond-bit tool and hand-feed lathe slowly at maximum spindle speed to machine commutator. Polish machined surface to a finish of approximately 16 micro-inches rms. If minimum B diameter (figure 1) cannot be maintained, replace armature assembly; slot in commutator bar indicates allowable minimum diameter. Undercut mica between commutator bars to a depth of 0.040 inch, using care to avoid removing material from bars.

G. If finish on outside diameter of armature laminations is defective, remove defects with abrasive paper (Federal Specification P-P-101,

Table 2. Special Materials for Repair

Material	Part No.	Vendor or Specification	Application
Anodic Coating	None	MIL-A-8625, Type II Class I	Para. 4H
Solder	SA5 WRAP2	QQ-S-571	Para. 4E
Varnish	6001	*11147	Para. 4G
Carbide Abrasive Cloth	None	P-C-451, Grit 600 to 800	Para. 4C
Abrasive Paper	None	P-P-101 600 Grit	Para. 4G

*Epoxylite Corp., South El Monte, California

No. 600 grit). Clean thoroughly, then bake at 2 hours at 235°F, 1.5 hours at 325°F. Apply one coat of varnish (See Table 2). Outside diameter must comply with dimensions shown in figure 1 after painting.

H. Touch up worn or rework anodized surfaces on aluminum parts by applying anodic coating in accordance with MIL-A-8625, Type II, Class I.

I. Replace pin (18) and springs (26, 47) at each overhaul.

5. Assembly (See figure 6)

A. General

Refer to Table 3 for special materials required for assembly procedures.

Table 3. Special Material for Assembly

Material	Part No.	Vendor or Specification	Application
Solder	Sn 60WRAP2	QQ-S-571	6B(2),(12),(13)
Lockwire	MS20995C32	MS20995	6B(16)
Adhesive	5403	*11147	6B(13)
Red Enamel	(GLYPTOL)	*24446	6B(2)
Sealant	94-002	*71984	6B(5)
Stud Lock	Grade A	*05972	6B(1)
Stabond	C-136	*83040 *05972	6B(7)
Primer	Grade N	MIL-S-22473	6B(1)
Methyl-Ethly-Ketone	MEK	TT-M-00261	6B(3)
Cement	R313	*97119	6B(4),(6),(11)
Oil		MIL-L-23699	6B(8),(14)
Grease	No. 33	*71984	6B

*VENDOR CODE	NAME AND ADDRESS
05972	American Sealants Co., Hartford, Connecticut
11147	Epoxylite Corp., South El Monte, California
24446	General Electric Co., Schenectady, New York
71984	Dow-Corning Corporation, Midland, Michigan
83040	American Latex Products Corp., Hawthorne, California
97119	Carl H. Biggs Co., Los Angeles, California

B. Pump and Motor Assembly (See figure 6)

NOTE: Apply light coating of grease to all packing and O-Rings prior to assembly.

(1) Coat mating surfaces of flange assembly (15) and screw (5) with primer (MIL-S-22473, Grade N) and allow to dry for two minutes; then coat screws (5) with stud lock and secure radio interference filter (4) on flange assembly. Tighten screws 5 to 10 inch-pounds torque.

(2) Solder black lead of motor to filter (4) positive terminal and white lead to negative terminal in accordance with MIL-S-6872. Coat terminals with red enamel.

(3) If nameplate (3) was removed, activate adhesive backing on new nameplate with methyl-ethyl-ketone and install on flange assembly (15).

(4) Coat mating surfaces of thrust bar (14) and flange assembly (15) with cement and press thrust bar into flange assembly.

(5) Install screen assembly (13) on flange assembly (15) and fill joints between assemblies with sealant. Joints must be water tight after sealant cures.

(6) Cement seal shell (28) in seal housing (32). Assemble seal insert (23) into seal holder (25). Install O-Ring (27) into holder and insert assembly into seal shell (28) with spring (26) installed.

(7) Apply a coating of Stabond to surfaces of flange assembly (15), seal housing (32), and gasket (30). Assemble parts while Stabond is still tacky. Cure at room temperature for 24 hours.

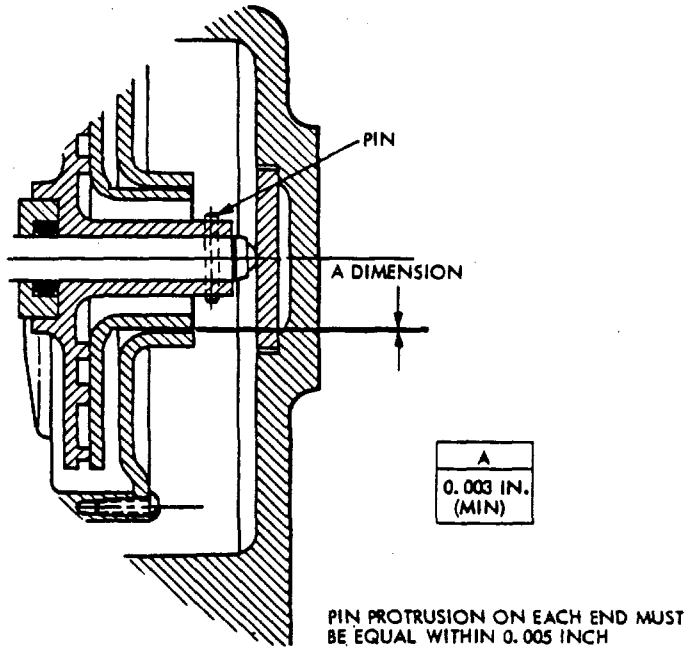
(8) Install bearing retainer (36), bearing wick (35) and bearing (34) on armature (44) shaft. Soak wick (35) with oil specification MIL-L-23699. The wick shall contain 2 to 3 grams of oil when installed.

(9) Install armature shaft (44) through seal assembly (-21) and seal housing (32). Insert plug (31) into housing (32).

(10) Install O-Ring (19) in impeller (20). Install impeller on armature (44) shaft and insert pin (18) through impeller and shaft. Amount of pin protrusion on each end shall be equal within 0.005 in.

(11) Apply cement to mating surfaces of inlet adaptor (16) and seal housing (32) and in two holes in seal housing. Install adaptor (16) so that clearance dimension complies with that specified in figure 3 when the armature (44) shaft is positioned in true running position.

NOTE: Secure inlet adaptor (16) to seal housing (32) with screws (17).



Inlet Adapter to Impeller Clearance
Figure 3

(12) Assemble spacers (52, 56) on field assembly (54). Solder thermal fuse (55) to field assembly wires.

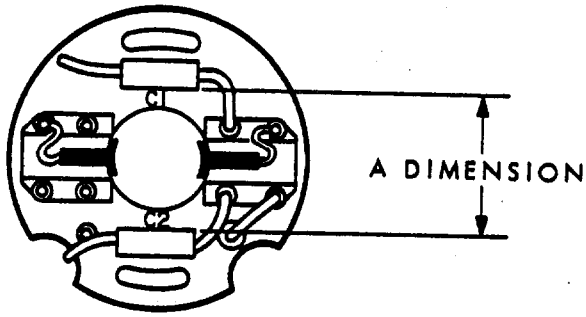
(13) Assemble brushes (48) and springs (47) on plate (46). Refer to figure 4 and solder the two capacitors (49) into the brush guide and brush assembly (-45). Coat slinger (40) and shaft (44) mating surfaces with adhesive and install slinger on armature shaft.

(14) Install the bearing retainer (42) bearing wick (41) and bearing (4 on armature shaft (44). Apply 2 to 3 grams oil specification MIL-L-23699 to the wick prior to installation.

NOTE: On Part No. 60-611A pump assemblies, a bearing guide (39) is installed prior to the retainer and wick.

(15) Secure bearing and brush assemblies through field assembly (54) an spacers to flange assembly (15) with screws (50) and washers (51).

(16) Insert O-Ring (8) in motor housing (6) and attach housing to flang assembly (15) with screws (10) and washers (11). Tighten screws



A
0.80 IN. 1.00

Capacitor Installation
Figure 4

4 to 6 inch-pounds torque. Safety wire screws with lockwire MS20995C32.

NOTE: On Part No. 60-611A pump assemblies, install flange (9) on housing (7) and secure to flange assembly (15) with screws (12). Tighten screws 4 to 6 inch-pounds torque. Safetywire screws with lockwire MS20995C32.

6. Fits and Clearance (See figure 6)

Table 4. Fits and Clearances

Impeller (20) to Inlet Adapter (16)	0.003 inch min.
Bearing (34, 43) to Armature Shaft (44)	0.0005 to 0.0020 in.

7. Testing

A. Test Conditions

(1) Test fuel shall be JP-4 in accordance with specification MIL-T-5624.

(2) Tests shall be conducted at ambient pressure and temperature.

(3) Motor brushes shall not be less than 90 percent seated prior to performance testing.

B. Test Fixtures and Equipment

Testing can be accomplished with the use of test fixtures and equipment listed in Table 5, as well as those normally available at overhaul facilities.

C. Partial Motor Assembly (see figure 6)

(1) Remove all grease, oil, or other corrosion resistant compounds from exterior of test unit.

(2) With motor installed in test fixture T-29363, perform dielectric test as follows:

(a) Disconnect one end of both capacitors (46).

(b) Apply 500 volts ac, rms, between motor winding and case for one minute. Increase and decrease voltage in steps of 100 volts per second. There shall be no evidence of flashover or breakdown. Maximum current leakage shall be 3 ma.

(3) With motor installed in test fixture T-29363, conduct the performance test as follows:

(a) Check that both capacitor leads are properly connected.

(b) Check that power switch of power supply is OFF.

(c) Connect the (black) motor lead to the positive terminal of th power supply.

(d) Connect the (white) motor lead to the negative terminal of th power supply.

(e) Set power switch on power supply to ON.

(f) Adjust voltage until voltmeter indicates 10.0 volts. Observe and record shaft rotation. Rotation shall be clockwise as viewed from shaft end.

Table 5. Test Fixtures and Equipment

Part No.	Description and Manufacturer	Application
Coml	Dynamometer, (0-10 oz-in.) ± 2% accuracy	Performance testing
Coml	Voltmeter (0 to 30 vdc (*16902)) ± 1/2% accuracy	Performance and continuity testing
Coml	Ammeter (0 to 5 amps) ± 1% accuracy	Performance testing
Coml	Power Supply (0 to 30 vdc) 5 amps minimum	Functional testing
Coml	Test Fixture - T-29363 or equivalent	Dielectric and performance test
Coml	RPM Counter (0 to 10,000 rpm) ± 2% accuracy	Performance testing
Coml	Test unit to Dynamotor adapter	Performance testing
Coml	Test fluid (JP-4 (MIL-T-5624))	Performance and leak testing
Coml	P Gauge (0 to 60 psig) ± 1% accuracy	Performance testing
Coml	Pressure Gauge (0 to 30 psig) ± 1% accuracy	Leakage testing
Coml	Vacuum Gauge (0 to 30 Hg) ± 1% accuracy	Leakage testing
Coml	Fuel Tank (30 gal. min. w/sight glass)	Performance and leak testing
Coml	Flowrater type Flowmeter (0 to 5 gpm) ± 1% accuracy	Performance testing
Coml	High Potential Tester (capable producing 500 VAC, rms, 60 cps	Insulation breakdown testing

*VENDOR CODE	NAME AND ADDRESS.
16902	Simpson Instruments, Inc., Escondido, California

(g) Increase power supply voltage until voltmeter indicates 28 ± 0.2 volts.

(h) Set dynamometer for 9.2 ± 2% inch torque. Reset voltage to 28.0 ± 0.2 volts.

Observe and record RPM and ammeter indication. RPM shall be greater than 8,800 RPM. Ammeter indication shall be 3.5 amps maximum.

D. Fuel Pump (See figure 6)

(1) Install the pump assembly in the test setup as shown in figure 5 and perform a break-in run as follows:

(a) With the double outlet port plugged, operate the pump for 15 minutes.

(b) Flow shall be from 1.18 to 1.50 gpm with 28 ± 0.2 VDC applied to the motor leads.

(2) With the pump operating as in paragraph D(1), perform external and shaft seal leakage test as follows:

(a) Apply 15 psig (+0.5, -0) air to the test tank for 5 minutes.

(b) There shall be no evidence of leakage or weeping from the flange (14).

(3) With the pump operating as in paragraph D(1), perform motor housing leakage test as follows:

(a) Apply 10 Hg (± 0.2) vacuum to test tank.

(b) Observe through the tank window for appearance of bubbles at flange (15).

(c) No air bubbles are permissible.

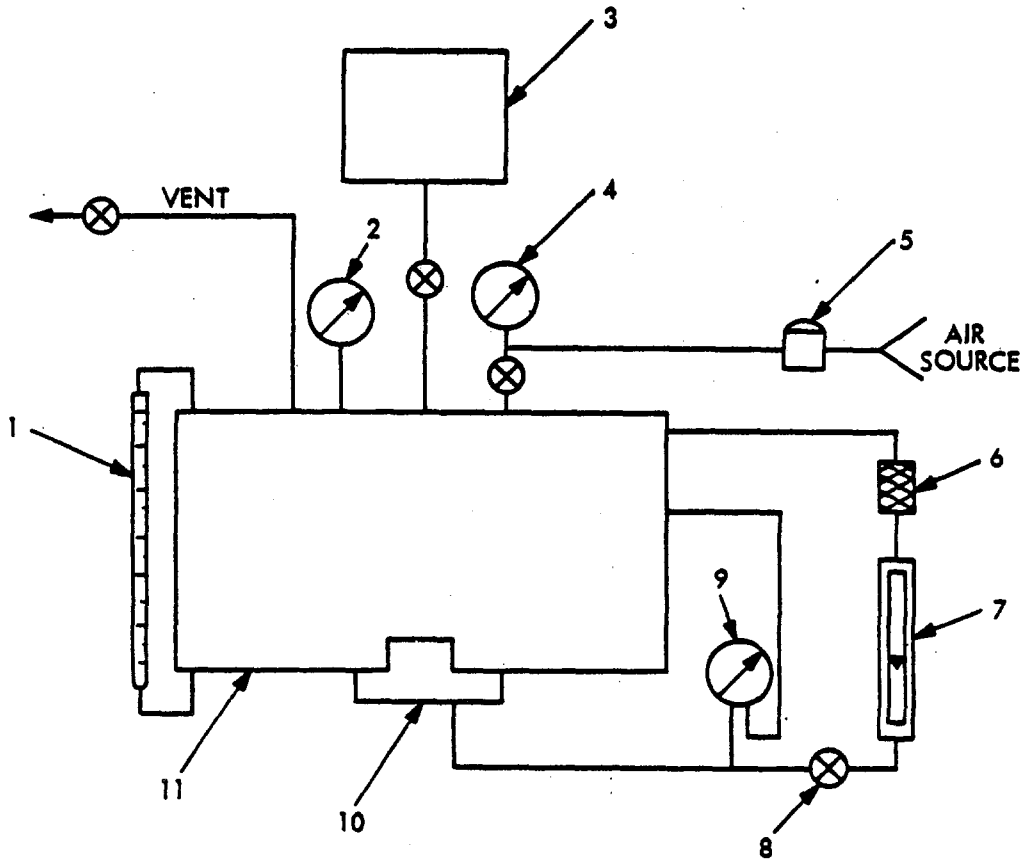
(4) No leakage of fuel from the seal drain port after break-in run and subsequent testing is permissible.

(5) Calibration Test

(a) Calibration is performed at ambient temperature and pressure.

(b) Pump performance shall be tested as follows.

(c) The pressures and flow rates are with 0.79 to 0.80 specific gravity JP-4 test fluid.



1. SIGHT GAGE
2. 30 IN. VAC. GAGE
3. VACUUM PUMP
4. 0 - 30 PSIG GAGE
5. PRESSURE REGULATOR
6. 10 MIC. NOM. 25 MIC. ABS. FILTER
7. 0 - 5 GPM FLOWRATER
8. FLOW CONTROL VALVE
9. 0 - 60 PSIG ΔP GAGE
10. 60-611 TEST UNIT
11. JP-4 TANK (WITH WINDOW)

Test Setup
Figure 5

(d) Fuel Flow GPM	Discharge Press. (PSID) Max.	Min.	Current Amps Max.
0	40	25	4.0
1.155	40	22	4.0

To account for varying fuel densities, the following procedure will be used in determining fuel flow rates and minimum discharge pressures at the rated flow of 450 PHR. To convert

from flow in pounds per hour (PHR) to flow in GPM, use the following values:

Fuel Sp. Gr.	GPM at 450 PHR	Discharge Press. (PSID) Min.	Max.
0.800	1.125	22.6	40
0.790	1.140	22.3	40
0.780	1.155	22.0	40
0.770	1.170	21.7	40
0.760	1.185	21.4	40
0.750	1.200	21.1	40

(6) Screen Sealant Bond Check (See figure 6)

(a) Wipe screen (13) and flange (15) dry.

(b) With pump positioned in installed attitude (motor vertical), fill the inside cavity with JP-4 fuel to the height of the screen bonding.

(c) No leakage of fuel through bonded joints after 5 minutes is permissible.

8. Trouble Shooting

Refer to Table 6 for trouble shooting information.

Table 6. Trouble Shooting Information

Trouble	Possible Cause	Isolation Procedure	Correction
Pump operates but does not pump fuel	Sheared impeller assembly pin	Check for shearing of impeller assembly pin	Replace impeller assembly pin
Pump operates at less than rated flow and pressure	Impeller assembly binding	Check impeller assembly for freedom of movement	Obtain correct assembly dimensions
	Pump clogged with foreign material	Check parts and impeller assembly for foreign material	Remove foreign material and clean parts
Pump operates but vibrates excessively	Armature assembly damaged	Remove armature assembly and dimensionally inspect	Repair or replace armature assembly
	Worn bearing assemblies	Check fit of rotor shaft in bearing assembly	If rotor shaft fits too loose in either bearing assembly, replace bearing assembly
	Bent or damaged impeller assembly	Check impeller assembly for damage or deformation	Replace defective impeller assembly
Motor fails to Operate	Power circuit open	Check power circuit	Repair power circuit.
	Brush connection defective	Check brush connection	Repair defective brush connection
	Thermal protector defective	Check thermal protector for continuity	Replace thermal protector
	Motor armature assembly open	Inspect motor armature assembly	Resolder commutator or replace armature assembly

Table 6. Trouble Shooting Information (cont)

Trouble	Possible Cause	Isolation Procedure	Correction
Motor runs at less than specified speed with no load	Brushes not fully seated	Check brushes and brush springs	Run in until approximately 80% contact is obtained
	Rough finish on commutator	Inspect armature assembly	Machine commutator
	Commutator bars or armature assembly winding shorted	Inspect armature assembly	Undercut commutator or replace motor armature assembly
	Bearing defective	Check bearings	Replace bearing
	Field assembly windings soiled	Check field assembly for continuity	Replace field assembly
	Defective capacitor	Check capacitor	Replace capacitor
Motor operates at excessive speed or runs too slow when rated load is applied	Field assembly coils loose	Check field assembly coils for looseness	Replace field assembly

9. Storage Instructions

Install a suitable protective cap on receptacle and plug inlet and outlet ports. Wrap fuel booster pump in grade A paper, Military Specification MIL-B-121, or equivalent. Place in padded carton. Seal carton and stamp pump assembly serial number, part number and overhaul date on carton.

10. Special Tools, Fixtures, and Equipment

Not applicable.

11. Illustrated Parts List

A. Introduction

(1) Purpose of parts list.

The illustrated parts list is intended for use in provisioning, storing and issuing the replaceable fuel booster pump assembly parts, and in identification of new and reclaimed parts.

(2) Use of parts list when part number is not known.

Look through the illustration and identify the part by appearance. Note the index number in the exploded view and check the corresponding index number in the accompanying parts list to find part number, the description, and quantity required for that application.

(3) Use of parts list when part number is known.

Turn to the numerical index, and locate the part number. Figure and index number on the illustration where the part appears are listed in the column to the right of the part number. Turn to the illustration and locate the index number. The corresponding index number in the accompanying parts list will give part number, description, assembly relationship, and quantity required for that particular application.

(4) Assemblies covered by parts list.

The illustrated parts list covers Fuel Booster Pump Part Number 60-611 and 60-611A.

(5) Assembly relationship.

Each assembly listed is followed immediately by a listing of its component parts, properly indented to show their relationship to the assembly. Parts are listed in general order of disassembly, with the exception of attaching parts. Attaching parts are captioned as such and follow immediately after the part they attach and are separated from other detail parts by a symbol "- - - * - - -", alternate parts are listed in parenthesis in the description column.

(6) Units per assembly.

Quantities specified in the "Units per Assy" column are the total number of each part required per assembly or subassembly and are not necessarily the total used per the complete equipment.

(7) Abbreviations.

Abbreviations used in the Illustrated Parts List are as follows:

AN	Army-Navy Standard
MS	Military Standard
NAS	National Aircraft Standard
NO	Number
P/N	Part Number
RF	Reference. Indicates those parts which have their requirements listed elsewhere in the parts list.

(8) Vendors' part.

Vendors' parts used in the Fuel Booster Pump assembly, and which are not altered by Hydro-Aire, are listed by the vendor's part number, vendor's description of the part, and vendor's code listed in parentheses following the description. Vendor's code symbols used in this publication are taken from Federal Supply Code of Manufacturers Cataloging Handbook H4-1 and consist of the applicable code symbol preceded by the letter "V". Following is a numerically arranged list of vendor codes used in this publication.

VENDOR's CODE	NAME AND ADDRESS
00287	CEM Co., Inc., Danielson, Connecticut
05972	American Sealants Co., Hartford, Connecticut
06255	Acoustica Associates, Inc., Los Angeles, California
11147	Epoxylite Corp., South El Monte, California
12406	ELPAC, Inc., Fullerton, California
16902	Simpson Instrument, Inc., Escondido, California
24446	General Electric Co., Schenectady, New York
27012	Micro Devices Corp., Dayton, Ohio
71984	Dow-Corning Corporation, Midland, Michigan

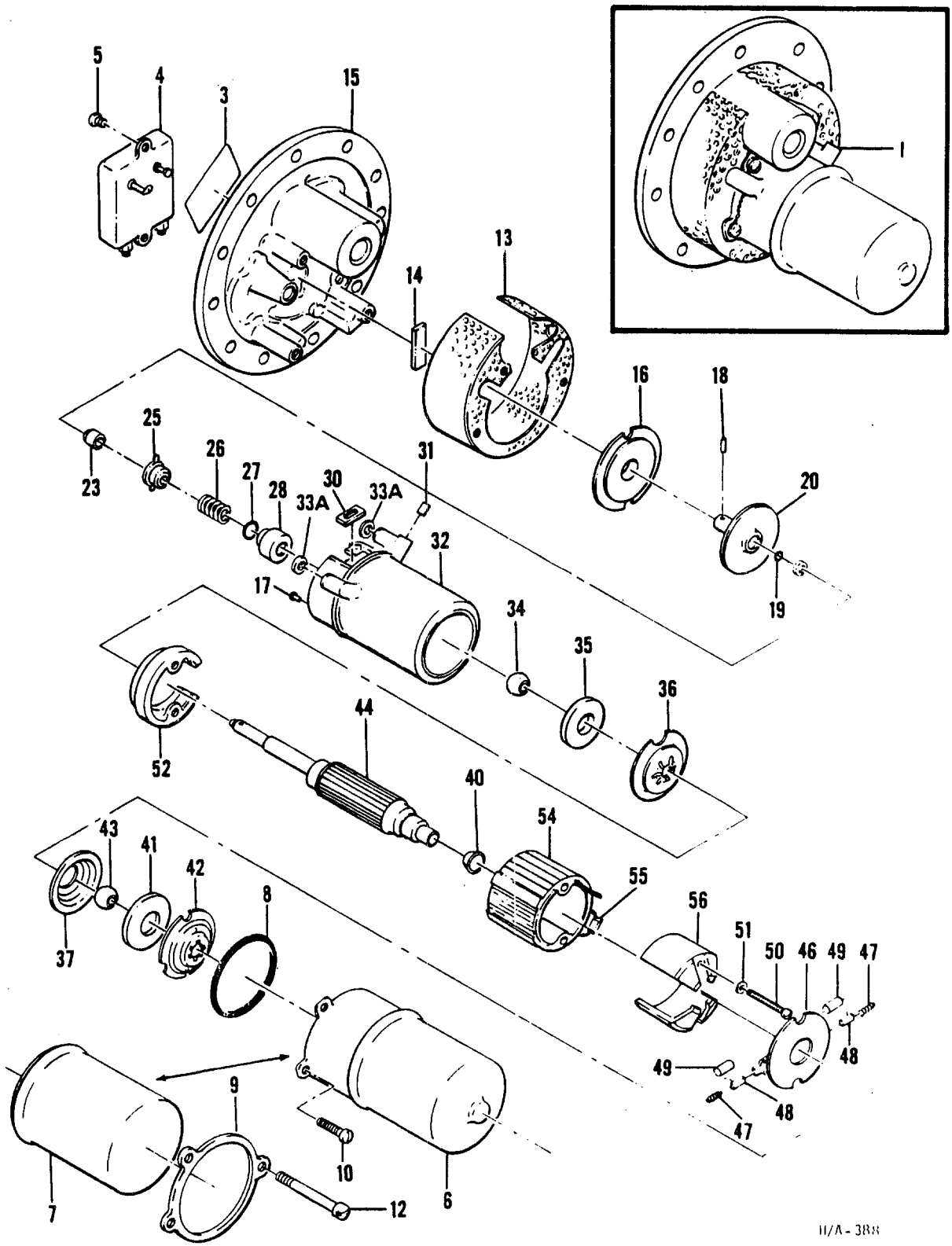
83040	American Latex Products Corp., Hawthorne, California
92555	The Lee Co., Westbrook, Connecticut
97119	Carl H. Biggs Co., Los Angeles, California

B. Illustrated Parts List

The illustrated parts list does not list or illustrate parts which lost their identity by being permanently welded to other pieces, or rivets, cotter pins (split pins) and items made from raw (bulk) stocks, such as cut to lengths of conduit, electric leadwire, locking wire, etc.

(1) Symbols used in the illustrated parts list.

- - - * - - -	Designates the end of each group of attaching parts.
-	A dash before an item number indicates a nonillustrated item.
*	Indicates items not procured separately; order next higher assembly.
A	Indicates items used on 60-611 Fuel Booster Pump only.
B	Indicates items used on 60-611A Fuel Booster Pump only.



Fuel Booster Pump Part No. 60-611 and 60-611A
Figure 6

FIG. & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6 1	60-611	PUMP - FUEL BOOSTER	1	A
-2	60-611A	PUMP - FUEL BOOSTER	1	B
3	60-61131	. NAMEPLATE	1	
4	60-61139	. FILTER - RADIO INTERFERENCE	1	
		ATTACHING PARTS		
5	MS24630-21	. SCREW, SELF TAPPING	2	
		---*---		
6	60-61113	. HOUSING - MOTOR	1	A
7	60-61168	. HOUSING - MOTOR	1	B
8	HS232-3-228	. O-RING	1	
9	60-61167	. FLANGE - HOUSING	1	B
		ATTACHING PARTS		
10	MS35265-49	. SCREW	3	A
11	NAS620ABL	. WASHER	3	A
12	MS35265-56	. SCREW	3	B
		---*---		
13	60-61129	. SCREEN ASSY	1	
14	60-61146	. BAR - THRUST	1	
15	60-61121	. FLANGE ASSY	1	
16	60-61150	. ADAPTOR - INLET	1	
		ATTACHING PARTS		
17	MS24630-3	. SCREW, SELF TAPPING	2	
18	062-0312-MDP	. PIN, SPIROL (V00287)	1	
19	HS232-3-008	. O-RING	1	
20	60-61155	. IMPELLER, MACHINED	1	
-21	60-61133	. SEAL ASSEMBLY	1	A
-22	60-61164	. SEAL ASSEMBLY	1	B
23	60-61135	. . INSERT - SEAL	1	A
-24	60-61163	. . INSERT - SEAL	1	B
25	60-61134	. . HOLDER - SEAL	1	
26	60-61136	. SPRING - SEAL	1	
27	HS232-3-011	. O-RING	1	
28	60-61132	. . SHELL - SEAL	1	A
-29	60-61165	. . SHELL - SEAL	1	B
30	60-61149	. GASKET	1	
31	156001	. . PLUG (V92555)	1	
32	60-61117	. HOUSING - SEAL, ASSEMBLY	1	A
-33	60-61166	. HOUSING - SEAL, ASSEMBLY	1	B
33A	60-61148	. PACKING	2	
34	60-61144	. BEARING	1	
35	60-61145	. WICK - BEARING	1	
36	60-61137	. RETAINER - BEARING	1	
-37	78-099	. MOTOR (SEE SOURCE CONT.	1	A
		DWG 60-61138)		
-38	78-099A	. MOTOR (SEE SOURCE CONT.	1	B
		DWG 60-61169)		
39	78-09964	. . GUIDE - BEARING	1	B
40	78-09913	. . . SLINGER	1	

FIG. & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
6 41	60-61145	. WICK - BEARING	1	
42	60-61137	. RETAINER - BEARING	1	
43	60-61144	. BEARING	1	
44	78-09912	. . ARMATURE ASSY	1	
-45	78-09952	. . BRUSH GUIDE & BRUSH ASSY	1	
46	78-09915	. . . PLATE - BRUSH	1	
47	78-09960	. . . SPRING - BRUSH	2	
48	78-09950	. . . BRUSH	2	
49	ZD1A104	. . . CAPACITOR (V12406)	2	
		ATTACHING PARTS		
50	AN15-C6-40	. . SCREW	2	A
51	AN960-C6	. . WASHER	6 max	A
52	78-09953	. . SPACER	2	A
-53	78-09965	. . SPACER	2	B
54	78-09918	. . FIELD ASSY	1	
55	1375	. . FUSE - THERMAL (MICRO DEVICES CORP., DAYTON, OHIO) (V27012)	1	
56	78-09954	. . SPACER ASSY	1	
-57	78-09963	. . GUIDE - BRUSH HOLDER	1	B

REPORT NO. 8-259

OVERHAUL MANUAL
WITH ILLUSTRATED PARTS LIST

FUEL BOOSTER PUMP

PART NO. 160-011
160-065

THIS COMPONENT IS USED ON DEHAVILLAND DHC-7 AIRCRAFT.

CRANE

HYDRO-AIRE DIVISION

CRANE CO. • 3000 WINONA AVENUE • P.O. BOX 7722 • BURBANK, CALIFORNIA 91510

28-20-28

MAY 15/79

REVISED APR 1/86

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RECORD OF REVISIONS

REV NO.	ISSUE DATE	DATE INSERTED	BY	REV NO.	ISSUE DATE	DATE INSERTED	BY
1	May 21/80						
2	Sep 10/82						
3	Apr 1/86						

Retain this record in the front of manual. On receipt of revisions, insert revised pages in the manual and enter revision number, date inserted and initials.

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SERVICE BULLETIN LIST

SERVICE BULLETIN NO.	DATE INCORPORATED	SERVICE BULLETIN NO.	DATE INCORPORATED

INTRODUCTION

1. GENERAL

This publication is issued to provide instructions to overhaul the Fuel Booster Pump Assembly, Part Numbers 160-011 and 160-065 manufactured by Hydro-Aire Division, Crane Co., Burbank, California 91510 USA.

The information in this manual is divided into sections in accordance with Air Transport Association Specification 100, to enable maintenance personnel to disassemble, clean, inspect, check, assemble, troubleshoot and test the pump. An illustrated parts list is provided to locate, identify and requisition parts.

To ensure that coverage contained in this publication will reflect changes in the pump overhaul concepts and procedures, revised information is provided to the customer through a letter of transmittal. The letter includes highlight pages which identify changed pages.

Warnings, Cautions and Notes are used to emphasize information throughout this publication. Warnings must be followed to avoid injury or death to persons. Cautions must be followed to avoid equipment damage and Notes call attention to work simplification, or additional information.

The following special terms and/or abbreviations are used in this publication.

%	Percent	PPH	Pounds Per Hour
°F	Degrees Fahrenheit	psi	Pounds Per Square Inch
ASSY	Assembly	psig	Pounds Per Square Inch Gage
EFFECT	Effectivity	REV	Revision
FIG.	Figure	RPM	Revolutions Per Minute
gpm	Gallons Per Minute	TP	Test Procedure
Hz	Hertz	UNC	Unified National Coarse
IPL	Illustrated Parts List	UNF	Unified National Fine
mA	Milliamperes	UNJC	Controlled Radius Root Screw Thread Coarse
N/A	Not Applicable	vac	Volts Alternating Current
No.	Number	vdc	Volts Direct Current

2. FACILITIES/EQUIPMENT REQUIREMENT

This component is critical to the certified performance of the aircraft. It is therefore equally critical that all maintenance, repair and/or overhaul activities relative to this unit be performed strictly in accordance with the provisions of this manual. Only those parts identified in the Illustrated Parts List of this manual are approved replacement parts.

All special tools and equipment must be calibrated within the intervals specified by the manufacturer, or at a maximum interval of six months. All calibration procedures and standards shall be traceable to the U.S. National Bureau of Standards, British Standards Institution or equivalent national standards.

Test fluids are to be maintained at contamination levels equivalent to those of new fluids.

All provisions of FAA Federal Air Regulations Part 43 "Maintenance, Preventive Maintenance, Rebuilding and Alterations"; Part 45 "Identification and Registration Markings"; Part 65 "Certification Airmen Other Than Flight Crew Members"; and Part 145 "Repair Stations" shall apply.

The overhaul shop work area designated for this component should be clean and environmentally controlled to prevent the accumulation of airborne dust particles or other contaminants that may interfere with the proper operation of the unit.

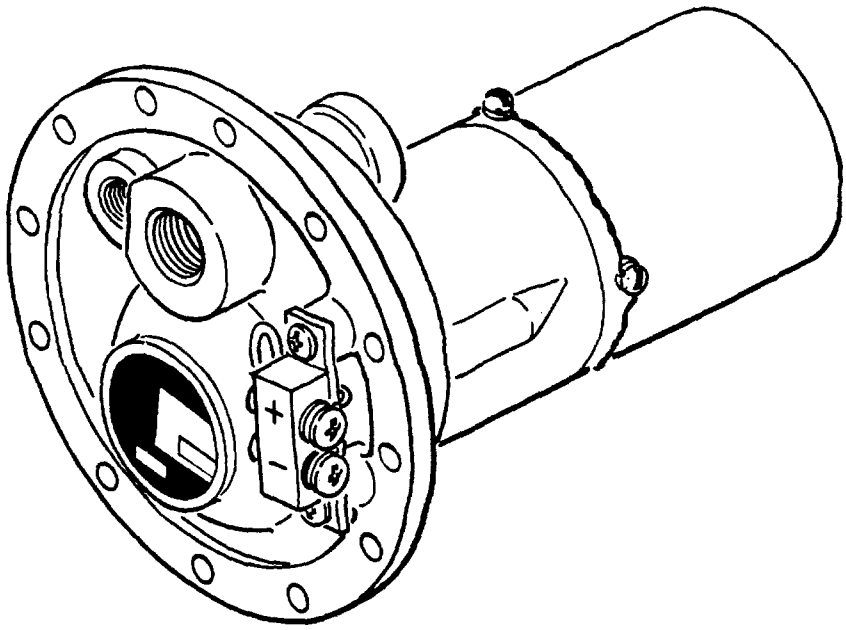
0. DESCRIPTION AND OPERATION

A. DESCRIPTION (See Figure 1)

The fuel booster pump is a bottom tank-mounted, gravity-fed, dc powered, ac motor-driven centrifugal pump suitable for operation with various grades of aviation fuel. The pump's major components consist of an ac motor, impeller and a dc-to-ac inverter assembly enclosed by aluminum housings. Leading particulars for the fuel booster pump are listed in Table 1.

B. OPERATION

The pump assembly contains a solid state inverter which converts 28 vdc input power into a three-phase 28 vac square wave output to supply the pump's ac induction motor with a maximum current usage of 7.5 amps. The pump's rated flow is 1.15 gpm at 22 psi using JP-4 aircraft fuel. It will boost fuel from remote fuel tanks to the aircraft engine-driven pump in a vapor-free condition. The pump employs wet-carbon bearings which serve as combination journal and thrust bearings. Pressurized fuel is routed internally for wet-carbon bearing lubrication and cooling of the ac motor and the inverter assembly.



Fuel Booster Pump - Assembled View
Figure 1

TABLE 1. LEADING PARTICULARS

Use	Aircraft Fuel System
Type	Solid state inverter supplying an ac induction motor
Operation	Continuous duty
Power Supply	7.5 amps max at 28 vdc 0.28 HP at 10,500 rpm
Nominal Rating	1.15 gpm at 22 psi
Weight	3.8 lb max with radio noise filter
Pressure at zero flow	35 psig max
Port Sizes:	
Inlet	Sump type with perforated screen
Discharge	1/2 inch per AND10053
Mounting	Bottom tank-mounted

1. DISASSEMBLY (See Figure 1101)

Do not disassemble pump more than necessary to effect repairs or replacement of defective parts.

A. Cut and discard all lockwire.

B. Disconnect leadwires at terminal block assembly (41).

C. Remove screws (4).

D. Remove flange (1) and screens (2, 3). Remove packing (5) from flange (1). Push lead wire assembly (35) from flange (1).

CAUTION: WHEN SEPARATING PUMP, TAKE CARE TO PREVENT ROTOR-SHAFT ASSEMBLY (20) FROM SCORING INSIDE OF STATOR ASSEMBLY (21).

E. Separate volute housing (6) from end bell assembly (17) and rotor-shaft assembly (20).

CAUTION: REMOVE IMPELLER (8) CAREFULLY TO AVOID DAMAGE.

F. Remove and discard nut (9) securing impeller (8) to rotor-shaft assembly (20). Remove impeller (8).

G. Remove spring pin (10) from rotor-shaft assembly (20).

H. Separate end bell assembly (17) from motor housing assembly (25).

I. Separate shims (11, 12, 13, 14), thrust washer (15), end bell assembly (17) and rotor-shaft assembly (20).

J. Remove thrust washer (24) and shims (14A, 14B, 14C) from rotor-shaft assembly (20). If necessary, remove spring pin (22).

K. Do not remove thrust bearing (18) from motor end bell (19), unless necessary for replacement.

NOTE: Thrust bearing (18), stator assembly (21) and bearing (26) are a shrink fit in motor end bell (19) and motor housing (27). Motor end bell and/or motor housing must be heated to 370 $\pm$15°F if stator assembly or bearings are to be replaced.

L. Remove screws (29) and cover (28).

M. Remove screws (32) and washers (33), or screws (32A) and spacers (33A), securing inverter assembly (30 or 30A) and radio noise filter (31) to motor housing assembly (25).

N. Disconnect radio noise filter (31) and stator assembly (21) leadwires from inverter assembly (30) leadwires by uncrimping end caps (-34).

O. Remove inverter assembly (30 or 30A).

NOTE: Inverter assembly is not field repairable. Replace as an assembly and return defective inverter to vendor.

P. Cut leadwires of radio noise filter (31) as close as possible to potting compound at leadwire assembly (35). Remove radio noise filter (31).

Q. Remove leadwire assembly (35) and conduit tube (36) from flange (1). Remove packing (37) from leadwire assembly (35).

R. Remove terminals (39, 40) from leadwire assembly (35).

S. Do not remove stator assembly (21) and bearing (26) from motor housing (27), unless necessary for replacement.

T. Remove spring pin (23) from stator assembly (21).

U. Remove screws (42), washers (43) and terminal block (41) from flange (1).

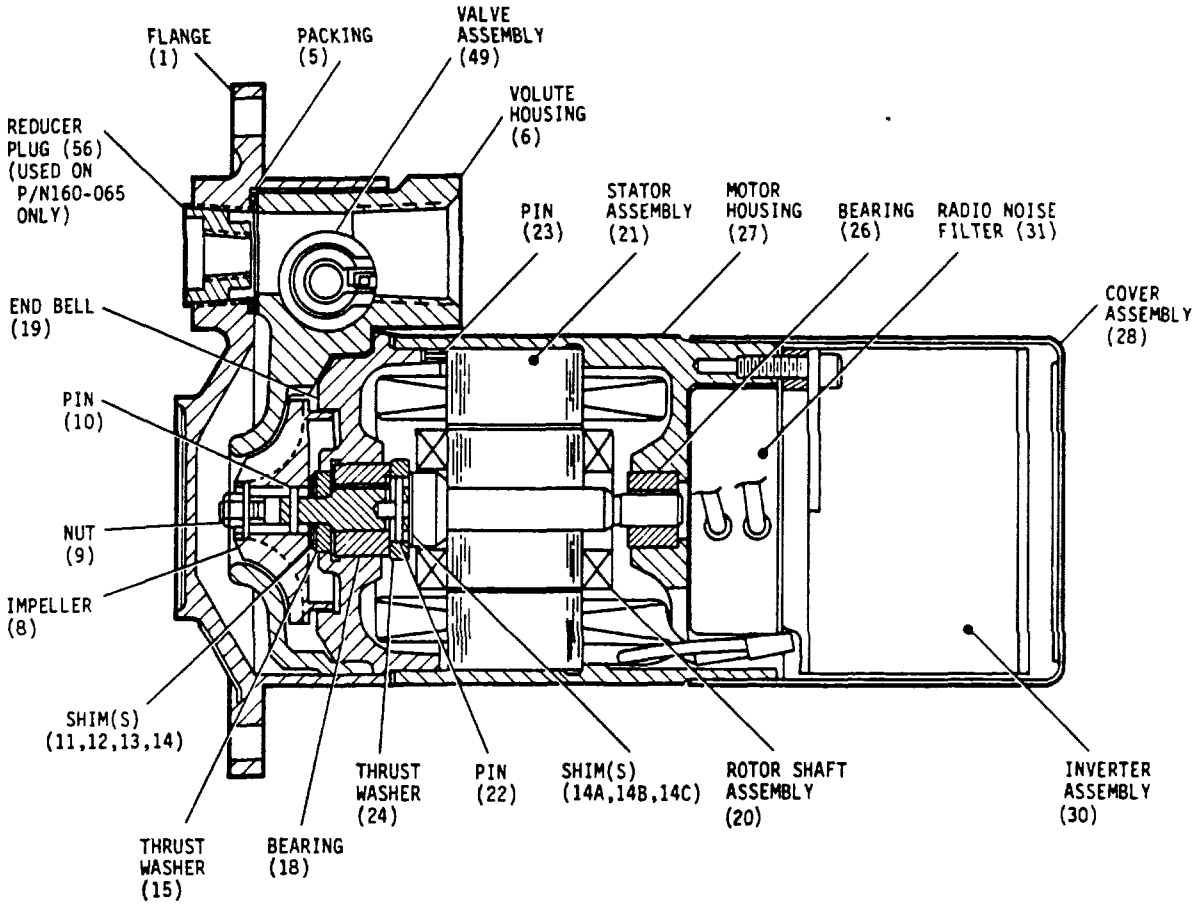
V. Remove pin (50) securing valve assembly (49) to volute housing (6).

W. Remove packing (55) from valve assembly (49).

X. Disassemble valve assembly (49) by removing pin (51), spring (52) and flapper assembly (53) from valve body (54).

Y. On 160-065 pumps, remove reducer plug (56).

-Index number not shown on Figure 1101.



NOTE: NUMBERS IN PARENTHESES ARE FIGURE 1101 INDEX NUMBERS.

Fuel Booster Pump - Cutaway View
Figure 101

2. CLEANING

The materials required for cleaning are listed in Table 201.

A. VAPOR DEGREASING PROCEDURES

This cleaning method is to be used prior to ultrasonic procedures when grease marks, metal chips, fingerprints, corrosion products, lubricants and other contaminants are evident at time of disassembly.

CAUTION: DO NOT CLEAN ELECTRICAL PARTS USING THIS PROCEDURE OR DAMAGE TO PARTS MAY OCCUR.

(1) Place parts to be cleaned in wire baskets or equivalent. Lower parts into solvent, within solvent container.

NOTE: Immerse parts in solvent and agitate for 30 seconds, or long enough to ensure cleanliness.

(2) Raise parts above solvent into the condensing zone and flush for 1 minute or more in vapors.

WARNING: WHEN USING COMPRESSED AIR, DIRECT AIRSTREAM AWAY FROM BODY AND OTHER PERSONNEL.

(3) Raise parts above cleaning container and allow to dry. Using clean filtered air (20 psi), apply pressurized air to parts to quicken drying.

NOTE: If use of compressed air is impractical, dry by wiping with a clean, lint-free cloth.

(4) Remove parts from basket with padded tongs, lint-free gloves, or equivalent.

(5) Check parts for cleanliness.

B. ULTRASONIC CLEANING PROCEDURES

(1) Place parts in wire racks or equivalent and submerge in cleaning solution within ultrasonic cleaning unit.

(2) Keep parts submerged between 5 to 10 minutes.

WARNING: WHEN USING COMPRESSED AIR, DIRECT AIRSTREAM AWAY FROM BODY AND OTHER PERSONNEL.

(3) Remove parts from ultrasonic cleaning unit and thoroughly dry, using clean, dry, compressed air at 20 psi.

NOTE: If the use of compressed air is impractical, dry by wiping with a clean, lint-free cloth.

(4) Check parts for cleanliness.

NOTE: If inspection/check is not to be performed immediately after cleaning, protect parts from damage or contamination. Place parts in a clean polyethylene container. Seal container and store in clean, dry area until inspection/check is to be performed.

C. Wipe electrical parts with a clean, lint-free cloth. Use a soft, bristle brush to clean hard-to-reach areas. Remove tarnish from pins of electrical connectors with a soft, rubber eraser.

TABLE 201. CLEANING MATERIALS

Material	Part Number	Specification
Solvents:		
Trichloroethylene	None	O-T-634B (Technical Grade)
Perchloroethylene (Tetrachloroethylene)	None	O-T-236B
Isopropyl Alcohol	None	Commercial

3. INSPECTION/CHECK

General inspection procedures are outlined in Paragraph A. Inspection procedures for the rotor-shaft assembly and inverter assembly are outlined in Paragraphs B and C.

A. GENERAL INSPECTION/CHECK

(1) Check all parts under strong light for cracks, nicks, distortion and other damage. Make sure all passages are clean and unobstructed, threads undamaged and sealing areas free from scratches, pits, nicks, excessive wear, corrosion and other damage.

NOTE: Excessive wear is defined as any obvious deformation or deterioration of parts which may render the pump inoperative. If doubt exists concerning condition of a part, replace part.

(2) Check plated areas for evidence of leakage, blisters, pits and other damage.

(3) Check threaded areas for stripped, crossed or otherwise damaged threads. Refer to Table 401.

B. ROTOR-SHAFT ASSEMBLY

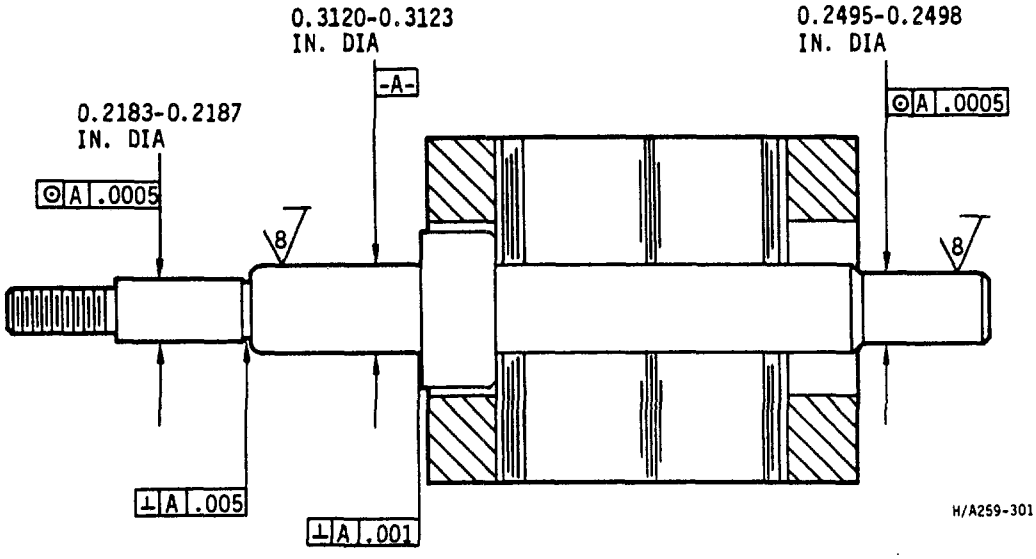
(1) Check bearing journals for deep wear pattern. Dimensionally check shaft as shown in Figure 501.

(2) Check shaft for damage and condition of rotor varnish coating.

NOTE: If shaft has rub marks of more than 0.010 inch in depth, replace rotor-shaft assembly.

(3) Check condition of varnish on lamination assembly. Check lamination assembly for deep scoring, nicks, pits or other damage.

NOTE: Varnish on lamination assembly may be repaired as outlined in Section 4, Repair.



Rotor-Shaft Assembly Dimensional Requirements
Figure 301

C. INVERTER ASSEMBLY P/N 52-485-183 (Ref TP 52-485-183, REV B)

Test inverter assembly for proper function, as follows:

CAUTION: INVERTER ASSEMBLY IS NOT FIELD REPAIRABLE AND NO ATTEMPT AT REPAIRS SHOULD BE MADE. RETURN DEFECTIVE UNIT TO VENDOR.

1.0 TEST EQUIPMENT AND REQUIREMENTS

1.1 Dual Trace Oscilloscope, Tektronix Model 561A (V80009).

1.2 Frequency Counter, HP Model 5223L (V28480).

1.3 DC Power Supply, Harrison Model 6289A, 28 VDC, 1.5A (V83572).

1.4 99-599 Inverter Tester (V81982).

1.5 All tests shall be performed in an ambient temperature of 72 ±12 degrees Fahrenheit.

1.6 DC Ammeter, Weston Model 901 (V65092).

1.7 DC Power Supply, NJE Model CR36-30 (V98380).

1.8 Motor Load, Hydro-Aire SE 1370 (V81982).

NOTE: Refer to Table 1101 for vendor name and address.

1.9 The preceding test equipment shall be used to perform the tests required by this procedure. Equivalent equipment may be substituted. Test equipment shall be tested and calibrated periodically and shall be current in regard to calibration.

2.0 PROCEDURE

2.1 Initial Test

2.1.1 Connect the DC supply to the DC supply terminals on the 99-599 tester. Set the tester power and load switches to OFF. Connect the inverter ground (white) lead wire to the white terminal and the inverter 28V pwr (orange) lead wire to the orange terminal. Connect the inverter phase wires to the 99-599 tester phase terminals (black to black, red to red and green to green). Set the power supply to ON and adjust to 28 ±0.1 volt. Set the 99-599 power switch to ON.

NOTE: All measurements shall be made with test equipment ground connected to the 99-599 ground (black) terminals.

2.1.2 Select the power supply meter to current. The meter shall indicate less than 0.5 amps.

2.2 Frequency Test

2.2.1 Connect the frequency counter to the black wire (black phase). Allow a minute for the converter to stabilize. The frequency counter shall indicate 183 ±3 Hz.

2.2.2 Set the power supply voltage to 16 ±0.1 volts. The frequency counter shall indicate 140 ±5 Hz.

2.3 Phasing and Magnitude

2.3.1 Set power supply voltage to 28 ±0.1V. Set the tester load switch to ON. Set the oscilloscope to chop mode. Connect channel 1 of the oscilloscope to the black phase and channel 2 to the red phase. Adjust the triggering to stabilize the waveform. The waveform shall resemble Figure 302, Pattern A, with a voltage minimum between +.5 and +1.5 volts and a maximum of 26 ±2 volts.

2.3.2 Connect channel 2 of the oscillscope to the green phase. Adjust the triggering to stabilize the waveform. The waveform shall resemble Figure 302, Pattern B, with a voltage minimum of between +.5 and +1.5 volts and a maximum of 26 ±2 volts.

2.4 Load Motor Test

2.4.1 Connect the NJE Model CR36-30 DC power supply to a 115 VAC source.

2.4.2 Set the AC and DC power switches to ON.

2.4.3 Connect a DVM set to DC volts to the power supply output terminals and set the output to 28.0 ±0.1 VDC.

2.4.4 Set the DC power switch to OFF. Connect the INVERTER to the motor load. See Figure 303 for the test setup.

CAUTION: DO NOT SET DC POWER SUPPLY SWITCH TO ON POSITION FOR MORE THAN 5.0 SECONDS. DAMAGE MIGHT OCCUR IN THE INVERTER DUE TO HEAT DISSIPATION ON THE INVERTER UNDER TEST.

2.4.5 Set the DC power supply DC power switch to ON for a maximum of 5.0 seconds only, then return the switch to OFF. The current meter shall indicate 7.5 amperes maximum after the unit has stabilized.

D. INVERTER ASSEMBLY P/N 52-527-183 (Ref TP 52-527-183, N/C)

Test inverter assembly for proper function, as follows:

CAUTION: INVERTER ASSEMBLY IS NOT FIELD REPAIRABLE AND NO ATTEMPT AT REPAIRS SHOULD BE MADE. RETURN DEFECTIVE UNIT TO VENDOR.

TEST EQUIPMENT

The following test equipment shall be used to perform the tests required by this procedure. Equivalent equipment may be substituted. Test equipment shall be tested and calibrated periodically and shall be current in regard to calibration.

Item	Manufacturer & Model No.
1. Dual Trace Oscilloscope	Tektronix Model 561A (V80009).
2. Frequency Counter	HP Model 5223L (V28480).
3. DC Power Supply, 28 VDC, 1.5A	Harrison Model 6289 (V83572).
4. Inverter Tester	Hydro-Aire 99-599 (V81982).
5. DC Ammeter	Weston Model 901 (V65092).
6. DC Power Supply	NJE Model CR36-30 (V98380).
7. Motor Load	Hydro-Aire T-62950 (V81982) (2 pole motor).

NOTE: Refer to Table 1101 for vendor name and address.

1.0 PROCEDURE

1.1 Initial Test

1.1.1 Connect the DC supply to the DC supply terminals on the 99-599 tester. Set the tester POWER and LOAD switches to OFF. Connect the inverter ground (white) lead wire to the white terminal and the inverter 28V Pwr (orange) lead wire to the orange terminal. Connect the inverter phase connections to the 99-599 tester phase terminals (black to black, red to red and green to green). Set the power supply to ON and adjust to 28.75 $\pm$0.1 volts. Set the 99-599 POWER switch to on.

NOTE: All measurements shall be made with test equipment ground connected to the 99-599 ground (black) terminals.

1.1.2 Select the POWER SUPPLY meter to CURRENT. The meter shall indicate less than 0.5 amps.

1.2 Frequency Test

1.2.1 Connect the frequency counter to the black phase. Allow a minute for the converter to stabilize. The frequency counter shall indicate 183 ±4 (179 - 187) Hz.

1.2.2 Set the power supply voltage to 14.0 +0.1 volts. The frequency counter shall indicate 140 ±8 (132 - 148) Hz.

1.3 Phasing and Magnitude

1.3.1 Set power supply voltage to 25.5 ±0.1 (25.4 - 25.6) volts. Set the tester LOAD switch to ON. Set the oscilloscope to chop mode. Connect channel 1 of the oscilloscope to the black phase and channel 2 to the red phase. Adjust the triggering to stabilize the waveform. The waveform shall resemble Figure 302, Pattern A, with a minimum of 0.5 ±1.0 (-0.5 - 1.5) volts and a maximum of 24 ±2 (22 - 26) volts.

1.3.2 Connect channel 2 of the oscilloscope to the green phase. Adjust the triggering to stabilize the waveform. The waveform shall resemble Figure 302, Pattern B, with a minimum of 0.5 ±1.0 (-0.5 - 1.5) volts and a maximum of 24 ±2 (22 - 26) volts.

1.4 Load Motor Test

1.4.1 Connect the NJE Model CR36-30 DC power supply to a 115 VAC source.

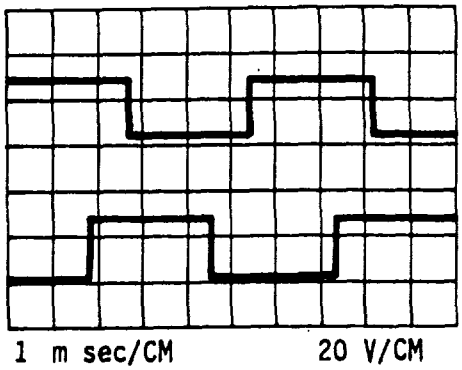
1.4.2 Set the AC and DC power switches to ON.

1.4.3 Connect a DVM set to DC volts to the power supply output terminals and set the output to 25.5 ±0.1 (25.4 - 25.6) volts.

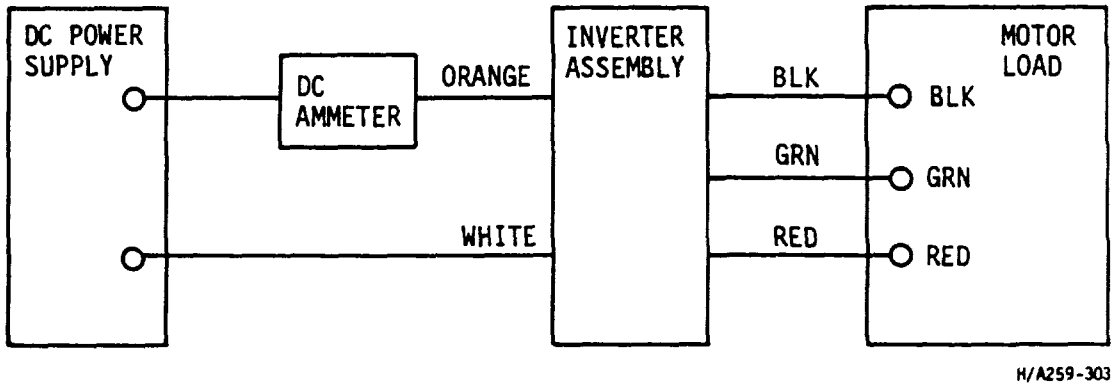
1.4.4 Set the DC POWER switch to OFF. Connect the inverter to the motor load. See Figure 304 for the test setup.

CAUTION: DO NOT SET DC POWER SUPPLY DC POWER SWITCH TO ON POSITION FOR MORE THAN 5.0 SECONDS. DAMAGE MIGHT OCCUR IN THE INVERTER DUE TO HEAT DISSIPATION ON THE INVERTER UNDER TEST.

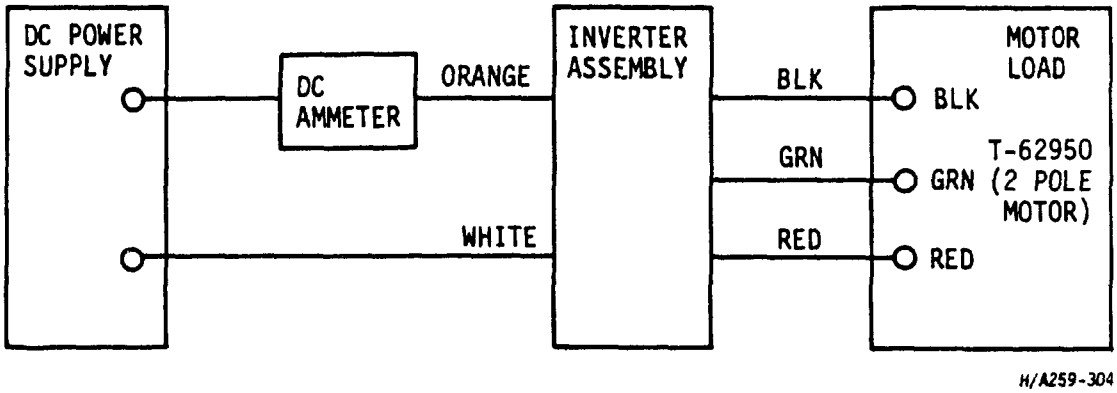
1.4.5 Set the DC power supply DC POWER switch to ON for a maximum of 5.0 seconds only, then return the switch to OFF. The current meter shall indicate 13.0 amperes maximum after the unit has stabilized.



Inverter Assembly Phasing and Magnitude Test Waveform
Figure 302



Inverter Assembly P/N 52-485-183 Motor Load Test Setup
Figure 303



Inverter Assembly P/N 52-527-183 Motor Load Test Setup
Figure 304

4. REPAIR

General repair procedures are outlined in Paragraph A. Repair procedures for the rotor-shaft assembly are outlined in Paragraph B. The materials required for repair are listed in Table 403. The vendor codes shown in this table, along with their names and addresses, are listed numerically in Table 1101.

A. GENERAL REPAIR

(1) Replace following parts at each overhaul.

All packings

Screws (4, 32 or 32A, 42)

Washers (33, 43)

Spacers (33A) (if applicable)

Nut (9)

(2) Polish out minor nicks and scratches on noncritical steel surfaces with abrasive cloth. Polish out minor nicks and scratches on aluminum parts with abrasive aluminum oxide cloth, provided that critical mating surfaces are not damaged.

NOTE: Do not make repairs on impeller. If surface is damaged, replace part.

NOTE: Ultrasonic clean repaired parts as described in Section 2, Cleaning.

(3) Use thread chaser or tap to repair stripped threads (2 threads maximum). Refer to Table 401.

TABLE 401. THREAD CHART

IPL Fig. and Item Number	Attachment Point Location	Tap and Die Size
1101 1	Screw (4, IPL 1101)	.190-32 UNF-2B (MIL-S-7742)
	Screw (42, IPL 1100)	.164-32 UNC-2B (MIL-S-7742)
	Reducer Plug (56, IPL 1101)	1/2 ANPT (MIL-P-7105)
1101 20	Nut (9, IPL 1101)	.1640-32 UNJC-3A (MIL-S-8879)
1101 56	Flange (1, IPL 1101)	1/8 ANPT (MIL-P-7105)

(4) Touch up worn or reworked anodized surfaces on aluminum parts by applying an alodine coating as follows:

(a) Remove soiled and oxide film by swabbing surface with acid solvent cleaner (1 volume Deoxidine 624 to 3 volumes water mixed at room temperature) allowing a 1 to 3 minute solution contact time. Keep entire rework surface wet.

(b) Rinse by swabbing with clean wipers or sponges soaked in water. Repeat at least twice, wringing out wipers or sponges after each rinse.

(c) Mix a solution of one and one-half parts alodine to one part water. Apply to area to be alodined liberally and evenly with a cotton swab, soft nylon brush or clean lint-free cloth.

WARNING: DO NOT ALLOW SPONGE, CLOTH, OR SWAB APPLICATORS USED TO APPLY ALODINE SOLUTION TO DRY OUT. WHEN DRY, EACH CONSTITUTES AN EXTREME FIRE HAZARD. RINSE THOROUGHLY IN WATER WHEN ALODINE APPLICATION IS COMPLETE.

NOTE: Do not alodine below 60°F.

(d) Swab off and rinse with cellulose sponge or clean, soft cloth saturated with clean water. Use blotting motion or very gentle swabbing to prevent damage to fresh alodine film. Wring out sponge or cloth and repeat rinsing at least twice, blotting any pools of water.

WARNING: WHEN USING COMPRESSED AIR, DIRECT AIRSTREAM AWAY FROM BODY AND OTHER PERSONNEL.

(e) Air dry thoroughly with plant air filtered to remove oil, water and solid particles, and not exceeding a temperature of 160°F.

NOTE: Do not touch new alodine surface until dry, as fresh alodine films are easily damaged. Refer to Table 402 for alodine drying times.

TABLE 402. ALODINE DRYING TIME

Ambient Temperature (°F)	105	100	95	90	85	80	75	70	65	60
Alodine Coating (minutes)	2	2.25	2.5	2.8	3.4	4.0	4.6	5.5	7	10

B. ROTOR-SHAFT ASSEMBLY (See Figure 301)

(1) Repair varnish on lamination assembly as follows:

(a) Remove old varnish by cleaning surface to be varnished with MEK (Methyl-ethyl-ketone) or acetone.

(b) Preheat rotor-shaft assembly at 350°F for 2 hours.

(c) Allow rotor-shaft assembly to cool to 200°F.

(d) Thin varnish 6001 with thinner 6001T to a suitable viscosity for spraying, then apply a light spray coat of varnish 6001.

(e) Place rotor-shaft assembly in a vertical position and bake at 250°F for 2 hours, then at 300°F for 3 hours.

TABLE 403. REPAIR MATERIALS

Material	Part Number	Vendor/ Specification
Acid-Solvent Cleaner	Deoxidine 624	V84063
Alodine Coating	Alodine 1000L (Liquid Concentrate)	V84063
Abrasive Aluminum Oxide Cloth	600 to 800 Grit	P-C-451
Abrasive Cloth	None	P-C-458
MEK (Methyl-Ethyl-Ketone)		TT-M-261
Thinner	6001T	V11147
Varnish	6001	V11147

Refer to Table 1101 for vendor name and address.

5. ASSEMBLY

Materials required for assembly are listed in Table 501. The vendor codes shown in this table, along with their names and addresses, are numerically listed in Table 1101.

A. Heat motor end bell (19) and motor housing (27) to 370 ±15°F.

CAUTION: MAKE SURE BEARINGS BOTTOM FIRMLY AGAINST SHOULDERS OF THEIR RESPECTIVE HOUSINGS. THRUST BEARING (18) MUST BE INSTALLED SO THAT THREE INTERRUPTED FACE GROOVES ARE FACING AWAY FROM SHOULDER OF MOTOR END BELL (19).

B. Apply a thin coat of R393 cement to OD of bearing (18, 26). Shrink fit thrust bearing (18) in motor end bell (19) and bearing (26) in motor housing (27).

CAUTION: MAKE SURE STATOR ASSEMBLY (21) SEATS FIRMLY AGAINST SHOULDER IN MOTOR HOUSING (27).

C. Shrink fit stator assembly (21) in motor housing (27) with leadwires toward ribbed end of housing and positioned approximately as shown in Figure 501.

D. Install spring pin (23) in stator assembly (21).

E. Lock motor housing assembly (25) and end bell assembly (17) together using two MS35207-264 screws, MS15795-742 washers and 0.190-32 nuts as shown in Figure 501.

WARNING: WHEN USING COMPRESSED AIR, DIRECT AIRSTREAM AWAY FROM BODY AND OTHER PERSONNEL.

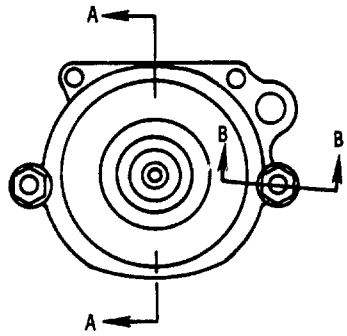
F. Line-ream bearings (18, 26) in line to dimensions shown in Figure 501. Blow out carbon dust with compressed air at 20 psi.

NOTE: Finish of bores shall be 32 microinches rms or better.

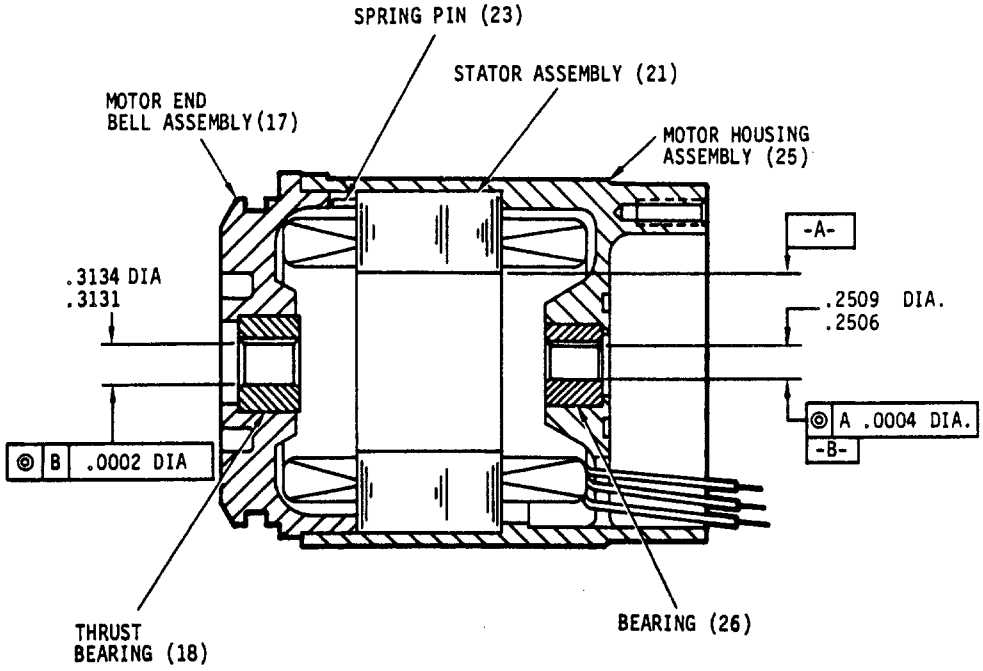
G. Remove screws, washers and nuts and separate motor housing assembly (25) and end bell assembly (17).

H. Assemble valve assembly (49) by connecting flapper assembly (53), spring (52) and pin (51) to valve body (54). Stake pin both sides of pin (51) to prevent pin from sliding.

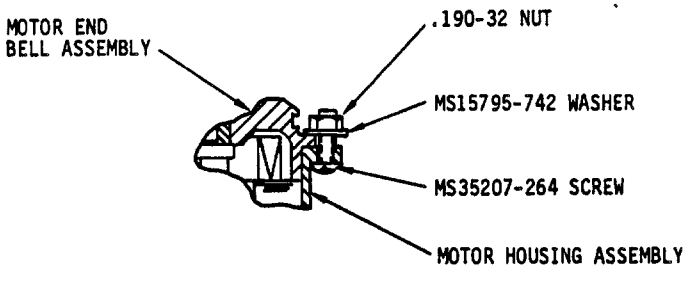
NOTE: Check for 0.005 inch minimum end play at hinge ears of flapper assembly (53), see Figure 502.



MOTOR HOUSING ASSEMBLY AND END BELL ASSEMBLY

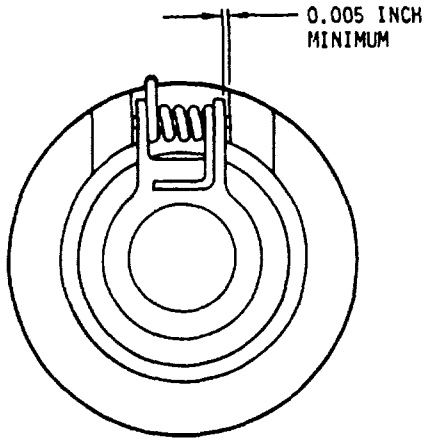


VIEW A-A



VIEW B-B

Bearing Machining Dimensions
Figure 501



H/A259-501

Valve Assembly Clearance Requirement
Figure 502

I. Install packing (55) on valve assembly (49). Install valve assembly (49) in volute housing (6) and secure with spring pin (50).

J. Thread shielded leadwires of radio noise filter (31) through motor housing assembly (25). Temporarily attach radio noise filter (31) to motor housing assembly (25) with screws (32 or 32A).

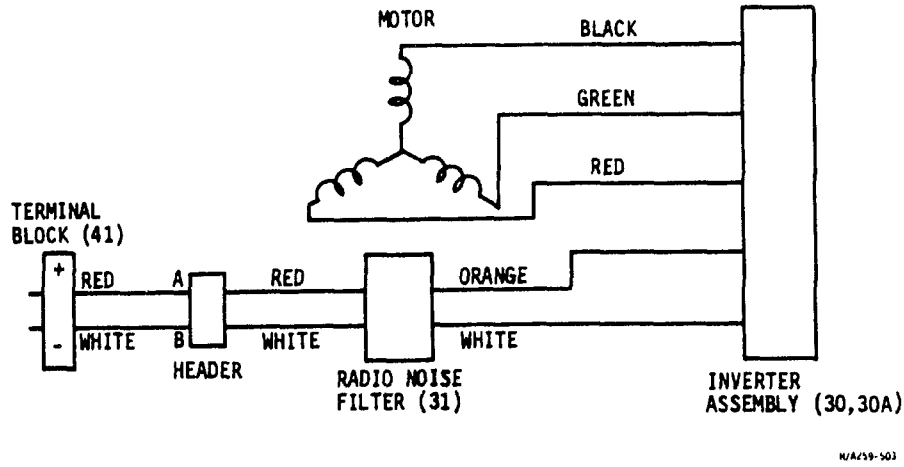
K. Trim leadwires of radio noise filter (31) to length required. Strip metal braid one inch from trimmed ends of leadwires. Etch tips.

L. Slide conduit tube (36) and T-61113 potting boot over radio noise filter (31) leadwires. Strip insulation 3/8 inch, tin wires and solder to header assembly of leadwire assembly (35) (red wire to pin A; white wire to pin B) per MIL-STD-454, requirement 5. (See Figure 503 for wiring diagram.)

M. Slide potting boot T-61113 on plug of leadwire assembly (35) and snap bead into packing groove. Encapsulate leadwire assembly (35) connection with 220 potting compound and 951 hardener per manufacturer's instructions. Cure for a minimum of 4 hours, then remove potting boot and discard.

N. Install required number of shims (14A thru 14C) on rotor-shaft assembly (20) to provide 0.0010 to 0.0020 inch end play.

O. Install spring pins (10, 22) and thrust washer (24) on shaft of rotor-shaft assembly (20).



Wiring Diagram
Figure 503

P. Obtain a 0.003 to 0.008 inch impeller clearance as follows.

(1) Install end bell assembly (17) over rotor-shaft assembly (20). Place thrust washer (15) and impeller (8) on rotor-shaft assembly (20). Secure with nut (9) and torque 7 to 10 inch-pounds.

(2) Install rotor-shaft/end bell assembly into a suitable holding fixture to hold thrust bearing (18) firmly against thrust washer (24).

(3) Set volute housing (6) over impeller (8) and end bell assembly (17).

(4) Using a depth micrometer, measure distance between top of volute housing (6) to top of impeller (8) as shown in Figure 504. Record as dimension A.

(5) Remove assembly from fixture and remove volute housing (6), nut (9) and impeller (8).

(6) Install 0.050 inch thickness of shims (11 thru 14) on rotor-shaft assembly (20).

(7) Reinstall impeller (8) and secure with nut (9). Torque nut 7 to 10 inch-pounds.

(8) Reinstall volute housing (6).

NOTE: There should be solid contact between impeller (8) and volute housing (6).

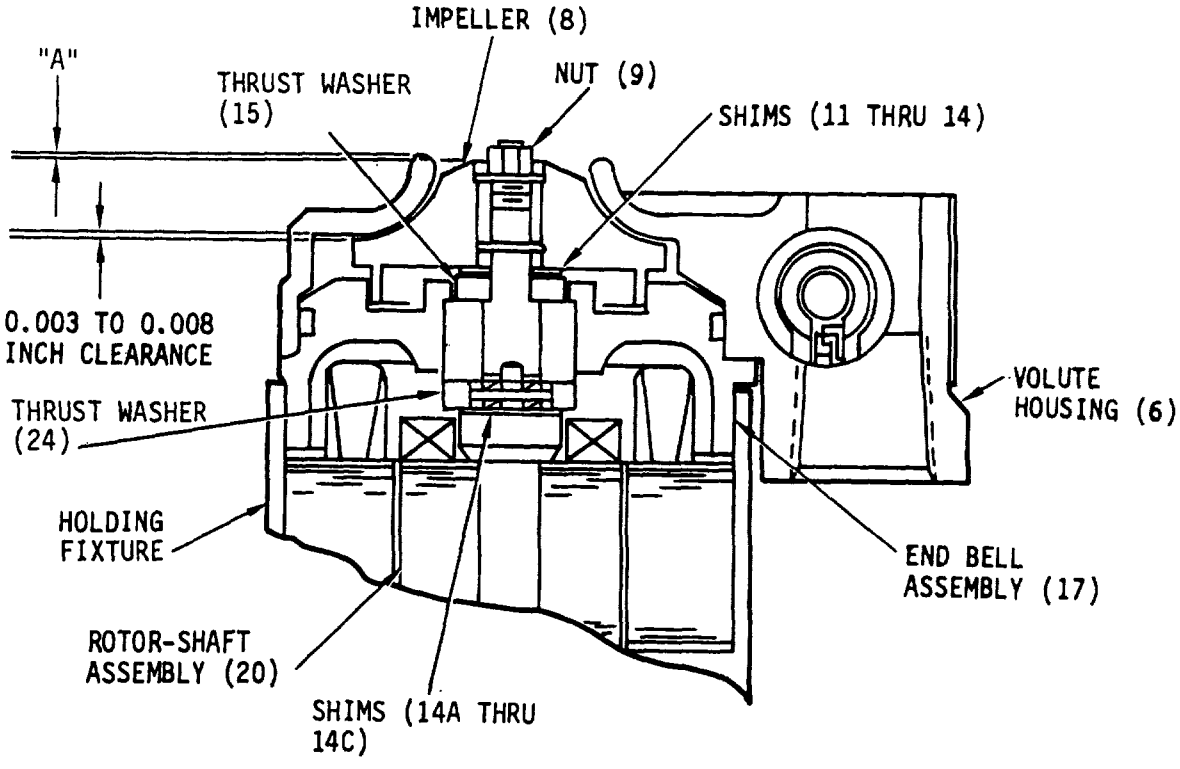
(9) Remeasure distance between top of volute housing (6) and top of impeller (8). Record as dimension B.

(10) Calculate required shim thickness. For example:

Dimension A (no shims installed)	0.206 inch
Dimension B (0.050 thickness shims installed)	-0.168 inch
	0.038 inch
Desired impeller clearance (0.003 to 0.008 inch)	-0.005 inch
Required shim thickness =	0.033 inch

(11) Remove volute housing (6), nut (9) and impeller (8).

(12) Install required number of shims (11 thru 14) on rotor-shaft assembly (20).



N/A259-504

Impeller Clearance Requirement
Figure 504

(13) Reinstall impeller (8) and secure with nut (9). Torque nut 7 to 10 inch-pounds.

(14) Reinstall volute housing (6) over end bell assembly (17). Turn assembly upside down and spin rotor-shaft assembly (20) to verify that impeller (8) rotates freely.

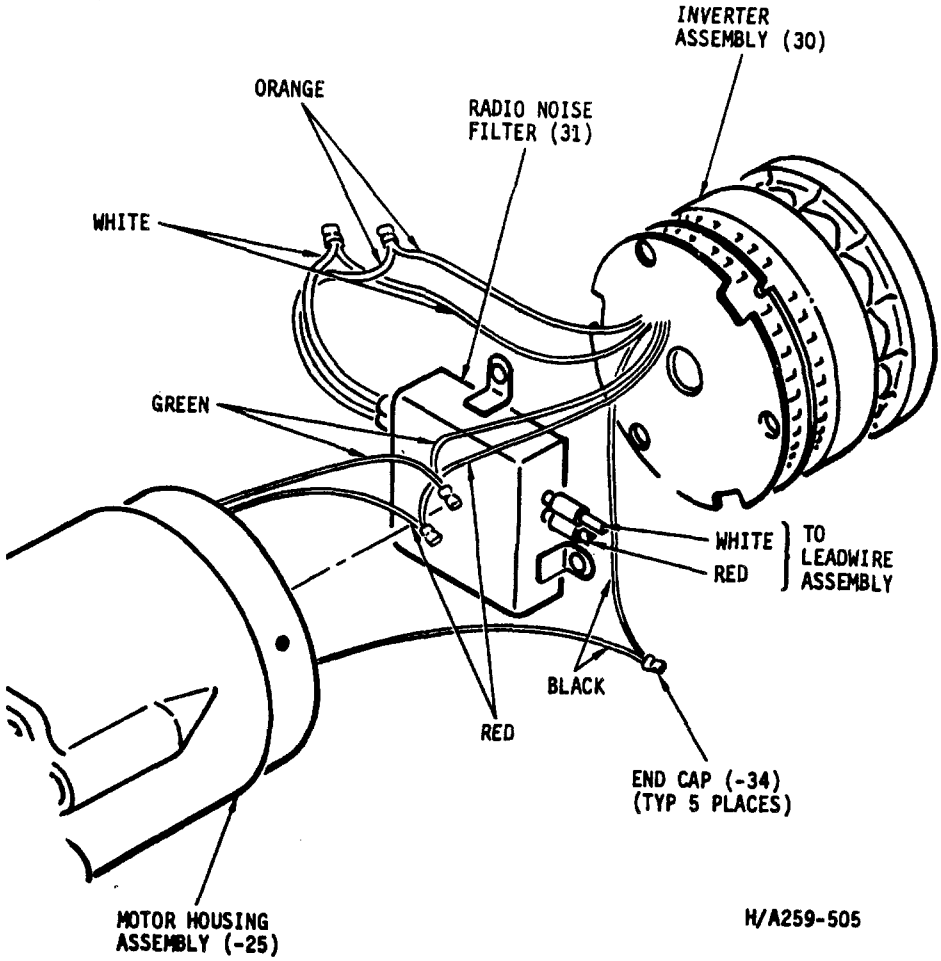
Q. Temporarily place assembly on flange (1).

R. Remove screws (32 or 32A) temporarily used to attach radio noise filter (31) to motor housing assembly (25). (Refer to Step J.)

S. Replace radio noise filter (31) on motor housing assembly (25).

T. Wire and secure inverter assembly (30) (52-485-183), radio noise filter (31) and stator assembly (23) as follows:

(1) Distribute and match leadwires according to colors as shown in Figure 505.



Inverter-Radio Noise Filter-Stator Wiring Connection for Inverter Assembly 52-485-183
Figure 505

(2) Trim leads to approximately 2 inches measured straight out from motor housing assembly (25).

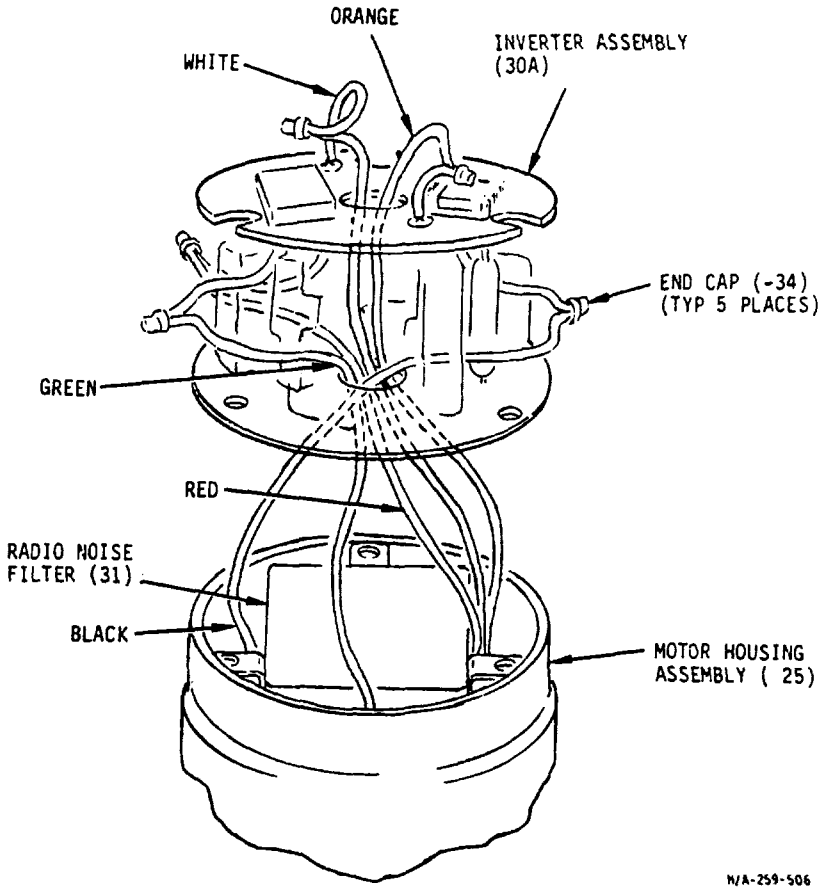
(3) Strip ends, twist together and crimp-fit end caps (-34) over each connection.

(4) Carefully twist, fold and tuck wires into cavities on underside of inverter assembly (30), taking care wires are not pinched when inverter is installed in position.

(5) Secure radio noise filter (31) and inverter (30) with screws (32) and washers (33). Torque screws (32) 7 to 10 inch-pounds.

U. Wire and secure inverter assembly (30A) (52-527-183), radio noise filter (31) and stator assembly (23) as follows:

(1) Distribute and match leadwires according to colors as shown in Figure 506.



Inverter-Radio Noise Filter-Stator Wiring Connection for
Inverter Assembly 52-527-183
Figure 506

(2) Trim leads to approximately 4 inches measured straight out from motor housing assembly (25).

(3) Strip ends, twist together and crimp-fit end caps (-34) over each connection.

(4) Carefully twist, fold and tuck wires into cavities of inverter assembly, taking care wires are not pinched when inverter is installed in position.

(5) Secure radio noise filter and inverter with screws (32A) and spacers (33A). Torque screws 7 to 10 inch-pounds.

V. Install cover (28) and secure with screws (29). Torque screws (29) 7 to 10 inch-pounds.

W. Lubricate and install packing (37) on leadwire assembly (35). Pull leadwires through passage toward filter end until potted end seats in conduit tube (36). Position conduit tube (36) in motor housing assembly (25).

X. Lubricate and install packing (5) on flange (1). Install screens (2, 3) on flange (1) and secure with screws (4). Torque screws (4) 18 to 22 inch-pounds.

Y. Trim leadwires of leadwire assembly (35) to 2 1/2 inch lengths. Crimp terminal (39) on white leadwire and terminal (40) on red leadwire.

Z. Install terminal block (41) on flange (1) and secure with screws (42) and washers (43). Torque screws (42) 7 to 10 inch-pounds.

AA. Connect terminal block (41) leadwires per wiring diagram, Figure 503. Bend terminals away from terminal block.

AB. If removed, bond identification plate (58) and thread tape decal (57) to flange (1) using 847 adhesive.

AC. After completion of testing, complete final assembly as follows:

(1) Safetywire and seal screws (4, 29, 42) with MS20995C20 lockwire per MS33540.

(2) Install sleeving S28A105-C over lockwire at terminal block (41) to prevent possibility of electrical short.

(3) Push leadwire assembly (35) inward and fill gap around flange (1) with PR1535 potting compound.

(4) On 160-065 fuel booster pump, apply R/C75 loctite on threads of reducer plug (56). Install reducer plug (56) in flange (1) and torque 90 to 100 inch-pounds.

(5) If alternate part number packings are installed, bond rubber curing date tag (59) to flange (1) using 847 adhesive.

TABLE 501. ASSEMBLY MATERIALS

Material	Part No.	Vendor/ Specification
Adhesive	847	V04963
Cement	R393	V05866
Hardener	951	V99384
Loctite	R/C75	V05972
Lockwire	MS20995C20	---
Potting Compound	PR1535	V83574
Potting Compound	220	V99384
Sleeving	S28A105-C	---
Solder	Sn63WRAP2	QQ-S-571
Tetra Etch	Etch	V07080

6. FITS AND CLEARANCES

Fits and clearances required for assembly of the fuel booster pump are a 0.003 to 0.008 inch clearance between the end bell assembly and impeller as shown in Figure 504, and a 0.0010 to 0.0020 inch rotor-shaft end play.

7. TESTING

A. TEST PROCEDURE (TP 160-011, Rev H)

1.0 TEST EQUIPMENT

The following test equipment shall be used to perform the tests required by this procedure. Equivalent test equipment may be substituted. Test equipment shall be tested and calibrated periodically and shall be current in regard to calibration.

Item	Manufacturer and Model No.
Voltmeter 0-30 VDC	Weston 931 (V65092)
Ammeter 0-10 amps DC	Weston 931 (V65092)
Pressure Gage 0-50 psig	Dresser 1801-T (V38056)
Flowmeter 0.7 - 5.7 gpm	Fisher & Porter 10A0735YP (V22375)
Reservoir 4 gal	Adel 622707 (V81833)
Pressure Regulator 0-100 psig	Union Carbide Purox GGA-540 (V21134)
Regulator Vent/Relief Open at 31 psig	---
Power Supply 0-30 volts at 8.5A and 30A peak in-rush	Sweinhart (V98965)
Tachometer 6,000 to 24,000 ±100 RPM	3215 Frahm (V87405)
Temperature Indicator 0-200°F	Dillon (V17879)

2.0 TEST CONDITIONS

Test fluid shall be P-D-680 (Type I) at a temperature of 80 ±10°F.

CAUTION: ENSURE THAT NO DUST, DIRT, OR FOREIGN MATERIALS ENTER PORTS OR CONNECTORS DURING TESTING.

3.0 EXTERNAL LEAKAGE TEST

3.1 Mount the pump per the schematic on Figure 701.

3.2 Apply fifteen (15) psi air pressure to the reservoir for 5 minutes and observe for any leakage.

3.3 There shall be no leakage from the pump tank drain, pump flange gasket, seal ring or any other external part.

4.0 CALIBRATION AT RATED VOLTAGE

4.1 Mount the pump per Figure 401, with a minimum fuel head of 10.0 inches.

4.2 Connect leads to DC power supply observing proper polarity (Figure 702).

4.3 Preset voltage source to 28.75 ±0.5 volts and throw power switch to pump ON. Observe that current remains at 7.5 amps or below in steady-state operation. Perform a warmup run for a minimum of 10 minutes at the rated flow of 450 PPH. After warmup, measure and record the pump differential pressure, and current for flow rates of zero flow and 450 PPH.

4.3.1 Requirement

The pump discharge pressure at 450 PPH shall be 22 psig minimum. The pump discharge pressure shall be 35 psig maximum at a flow rate of zero PPH. Current shall not exceed 7.5 amps during steady-state operation at any flow.

5.0 CALIBRATION AT REDUCED VOLTAGE AND VARIABLE FREQUENCY INVERTER CALIBRATION

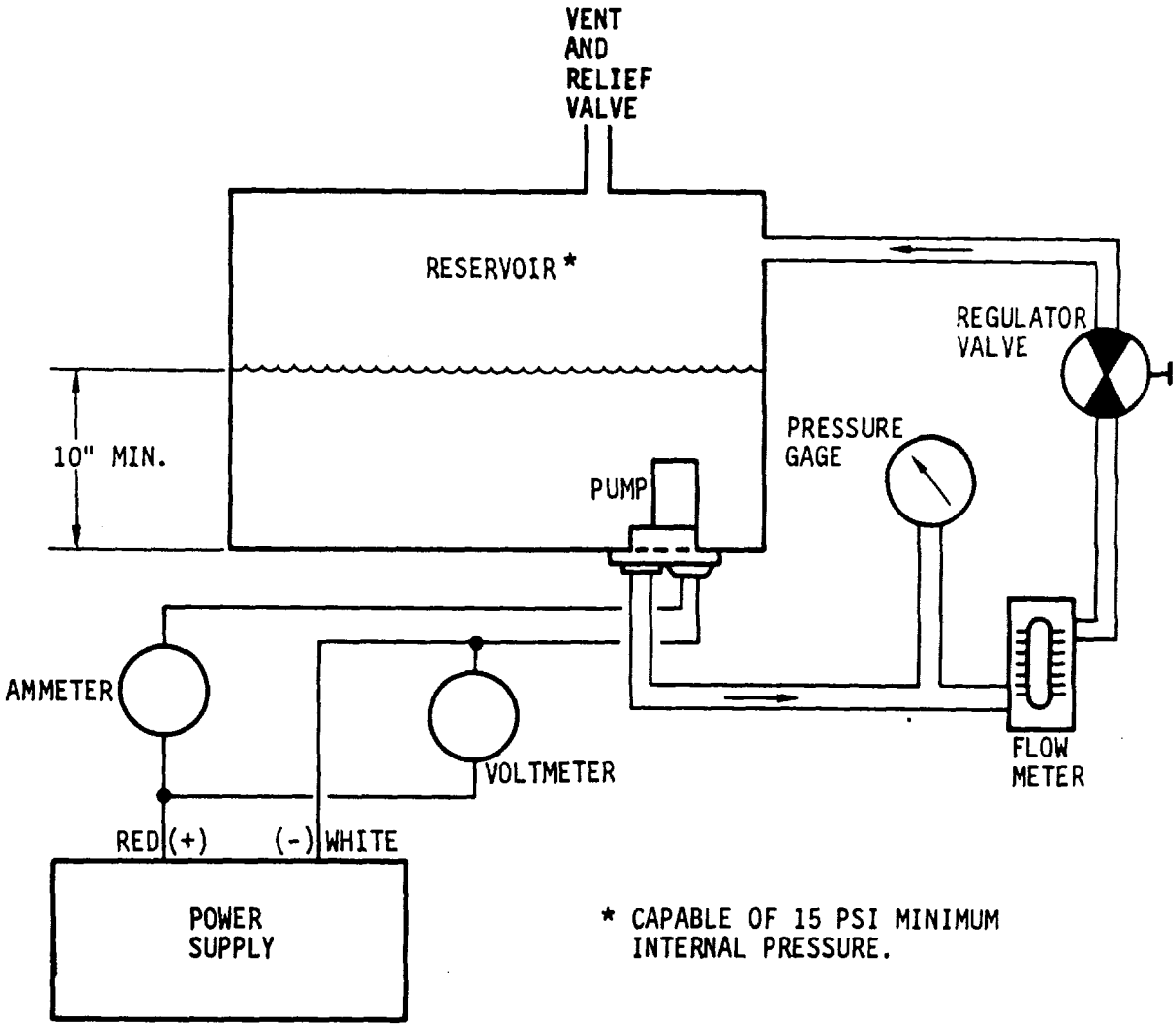
With the power supply set at 28.75 volts and with the power switch in the ON position, slowly decrease power supply voltage until either the current draw exceeds 8.0 amps (do not allow current draw to exceed 9.0 amps) or until the power supply reaches 16.0 volts.

5.1 If the current draw is greater than 8.0 amps, the pump does not contain a variable frequency inverter. Testing on this pump is complete.

5.2 If current draw is less than 8.0 amps, the pump contains a variable frequency inverter. Adjust pump flow rate to 390 PPH, at 16.0 ±0.5 volts.

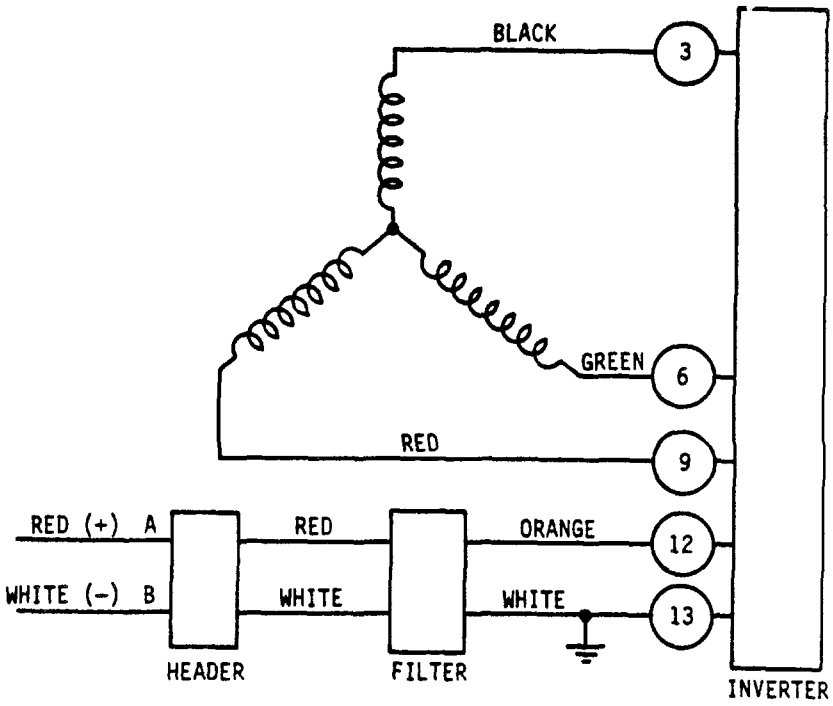
5.2.1 Requirement

The pump differential pressure at 390 PPH shall be 8 PSI minimum and the current shall not exceed 8.0 amps.



H/A159-701

Functional Test Setup
Figure 701



Wiring Diagram
Figure 702

8. TROUBLESHOOTING

The troubleshooting information for the fuel booster pump is contained in Table 801. Table 801 contains procedural steps, based on an obvious condition, and provides remedial steps necessary to effect a solution for the problem encountered.

TABLE 801. TROUBLESHOOTING INFORMATION

Trouble	Probable Cause	Corrective Action
Pump does not operate but consumes power	Nut securing impeller loose	Replace nut and torque to 7 to 10 inch-pounds.
	Frozen bearing in end bell assembly and/or motor housing assembly	Replace bearings. NOTE: Check rotor shaft for damage. Repair or replace as necessary.
	Impeller jammed or binding	Check for foreign matter at screens and/or between impeller and end bell assembly. Remove foreign material and clean parts.
Pump does not operate and consumes no power	Broken wires or excessive corrosion on soldered joints	Repair wiring and/or clean solder joints.
	Inverter assembly inoperative	Replace inverter.
Pump operates but vibrates excessively	Bent or damaged impeller	Replace impeller.
	Worn bearings in motor housing assembly and end bell assembly	Replace bearings. Check rotor shaft and stator. Repair or replace as necessary.
	Rotor shaft bent	Replace rotor shaft.

TABLE 801. TROUBLESHOOTING INFORMATION (Cont'd)

Trouble	Probable Cause	Corrective Action
Pump operates but does not pump fuel	Discharge plugged	Disassemble pump and clean.
	Missing impeller spring pin	Replace spring pin and retorque nut to 7 to 10 inch-pounds.
Pump operates at less than rated speed flow and pressure	Impeller rubbing, binding or bent	Check impeller for freedom of movement. Replace if necessary.
	Bearings binding	Replace bearings.
	Impeller to end bell assembly clearance is too great	Correct clearance.
	Pump clogged with foreign material	Remove foreign material and clean parts.
	Inverter defective	Replace inverter.
	Valve assembly installed incorrectly	Correct installation of valve.
Motor runs at less than 10,100 rpm	Rubbing internal parts	Disassemble unit and correct malfunction.
	Defective inverter	Replace inverter.
	High resistance at soldered or crimped leadwire connections	Correct defective connections.
Excessive current (higher than 7.5 amps at any condition)	Excessive thrust bearing drag	Run in unit at zero flow rate for 48 hours maximum.
	Inverter defective	Replace inverter.

9. STORAGE

For storage or shipment, the pump should be enclosed and sealed in a polyethylene bag and placed in a padded carton. A desiccant should be included in the polyethylene bag if storage area is not moisture free. The carton should be sealed and tag affixed stating Part No., Serial No., Date of Overhaul and Cure Date.

TABLE 901. STORAGE MATERIALS

Item	Manufacturer/ Specification
Polyethylene Bag	Noland Paper Co. Los Angeles, CA
Container	Noland Paper Co. Los Angeles, CA
Desiccant	MIL-D-3464
Cap Plug	Tubing Seal Cap Co. Azusa, CA

Equivalent substitutes may be used.

10. SPECIAL TOOLS, FIXTURES AND EQUIPMENT

Overhaul of the fuel booster pump assembly may be accomplished with the special tools, fixtures and equipment normally available at overhaul facilities as well as those listed in Table 1001. Equipment of equal or greater accuracy may be used.

TABLE 1001. SPECIAL TOOLS, FIXTURES AND EQUIPMENT

Part Number/ Manufacturer	Description	Application
Model D250 (V17274)	Ultrasonic Cleaner V81982	Clean parts ultrasonically.
10A0735YP (V22375)	Flowmeter 0.7 - 5.7 gpm 3% Full Scale	Measure fuel flow.
1801-T701 (V38056)	Pressure Gauges 0 to 50 psig; 1/2% Full Scale 0 to 5 psig; 1/2% Full Scale	Measure fuel discharge pressure.
901 (V65092)	Ammeter	Measure current for inverter assembly test.
931 (V65092)	Voltmeter 0 to 30 vdc, ±0.5%	Measure input dc voltage.
931 (V65092)	Ammeter 0 to 10 amps dc, ±0.5%	Measure current.
NJE Model CR36-30 (V98380)	Power Supply	Provide input power for inverter assem-
6289A (V83572)	DC Power Supply 28 vdc, 1.5 amps	Provide input power for inverter assembly test.

TABLE 1001. SPECIAL TOOLS, FIXTURES AND EQUIPMENT (Cont'd)

Part Number/ Manufacturer	Description	Application
(V98965)	Power Supply 0 to 30 volts at 3.5 amps and 30 amps peak in rush	Provide input power.
99-599 (V81982)	Inverter Tester	Test inverter assembly.
SE 1370 (V81982)	Motor Load	Test inverter assembly.
HP Model 5223L (V28480)	Frequency Counter	Test inverter assembly.
561A (V80009)	Dual Trace Oscilloscope	Test inverter assembly.
GGA-540 (V21134)	Pressure Regulator 0 to 100 psig	Regulate fuel flow.
62707 (V81833)	Reservoir 4 gal.	Fuel supply.
3215 (V87405)	Tachometer 6000 to 24000 ±100 rpm	Measure rotor speed (rpm).
(V17879)	Temperature Indicator 0 to 200°F	Indicate fuel temperature.
---	Vent and Relief Valve Open at 31 psig	Control reservoir pressure.
T62950 (V81982)	Motor Load	Test inverter assembly.
T61113 (V81982)	Potting Boot	To pot RNF leadwires.

Refer to Table 1101 for vendor name and address.

11. ILLUSTRATED PARTS LIST

A. PURPOSE

The Illustrated Parts List is intended to assist customer personnel in requisitioning, storing and issuing the replaceable components and in identifying new and reclaimed parts. It is not approved for any other purpose.

The Illustrated Parts List does not list or illustrate parts which lose their identity by being permanently welded or riveted to other pieces, items made from raw (bulk) stocks, such as cut to lengths of conduit, electric leadwire, lockwire, etc.

B. HOW TO USE THE PARTS LIST

The figure number on the parts list refers to the corresponding illustration.

The number in the FIG. ITEM column corresponds to the item number pointing to the part on the corresponding illustration.

A vendor's part is identified by the vendor's part number in the PART NUMBER column and the vendor's Federal Supply Code number following the part description in the NOMENCLATURE column.

Quantities specified in the UNITS PER ASSY column are the total number of each part required per assembly or subassembly and are not necessarily the total used per complete end item assembly.

RF in the UNITS PER ASSY column indicates the item is listed for reference purposes.

AR in the UNITS PER ASSY column indicates parts are used as required.

The EFFECT CODE column contains one or more code letters indicating the configuration to which an assembly or part applies. When no code letter appears in the column, the part is common to all units.

C. GENERAL SYSTEM OF ASSEMBLY ORDER

The indention system used in this illustrated parts list shows the relationship of one part to another. Each unit listed is followed immediately by a listing of its component parts. For a given item, the

indention code shows a system, installation or general heading starting in the extreme left position continuing on down into succeeding columns until the end detail is reached, as follows:

1234567

Installation Assembly (RF) Number
.Detail Parts for Installation
.Assembly
.Attaching Parts for Assembly
***
..Detail Parts for Assembly
..Subassembly
..Attaching Parts for Subassembly
***
...Detail Parts for Subassembly
...Sub-subassembly
...Attaching Parts for Sub-subassembly
***
....Detail Parts for Sub-subassembly

Parts are listed in general order of disassembly, with the exception of attaching parts. ATTACHING PARTS are captioned as such and follow immediately after the part they attach and are separated from other detail parts by the symbol ***.

D. NUMERICAL INDEX

The Numerical Index (refer to Table 1102) is a complete listing of all parts included in the illustrated parts list. These part numbers are cross-referenced to the applicable figure and item number in the parts list.

E. VENDORS' CODE

Vendor parts used, unaltered by Hydro-Aire, are listed by vendor part number, vendor description and vendor code. Vendors' code symbols used in this publication are taken from Federal Supply Code of Manufacturers Cataloging Handbook H4-1 and H4-2. Following is a numerically arranged list of vendor codes used in this publication.

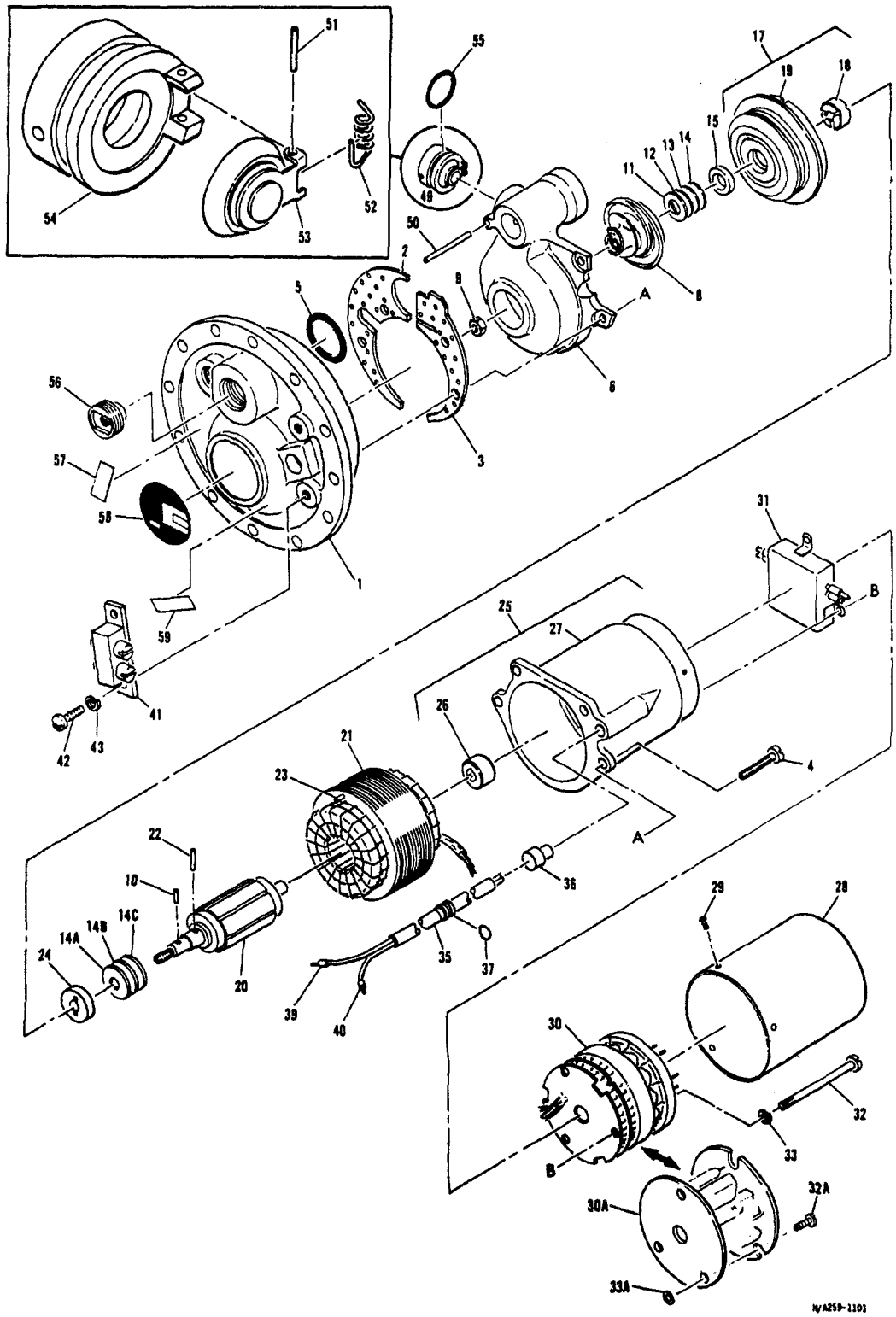
TABLE 1101. VENDOR CODE LIST

Vendor Code	Vendor Name and Address
V00779	AMP, Inc. Harrisburg, PA 17105
V04963	3M Mfg. Co. Adhesive Coatings and Sealer Div. St. Paul, MN 55101
V05866	Applied Plastics Co. Inc. El Segundo, CA 90245
V05972	Loctite Corp. Newington, CT 06111
V07080	Hughes R.S. Co. Inc. Mountain View, CA 94040
V11147	Epoxylite Corp. Anaheim, CA 92806
V17274	Delta Sonics Inc. Long Beach, CA 90806
V17879	Dillon Electric and Machine Co., Canton, OH 44705
V21134	All Tool Co. Union, NJ 07083
V22375	Fischer-Porter Co. Warminster, PA 18974
V28480	Hewlett-Packard Co. Palo Alto, CA 94304
V38056	Dresser Industries Inc. Stratford, CT 06497
V65092	Weston Instruments Inc. Newark, NJ 07114

TABLE 1101. VENDOR CODE LIST (Cont'd)

Vendor Code	Vendor Name and Address
V80009	Tektronix Inc. Beaverton, OR 97005
V81833	DeLaval Special Products Cleveland, OH
V81982	Hydro-Aire Division Crane Co. Burbank, CA 91510
V83572	Harrison Electronics Corp. Farmingdale, NY 11735
V83574	Product Research and Chemical Corp. Burbank, CA 91510
V84063	Amchem Products, Inc. Ambler, PA 19001
V87405	Fram Corp. Tulsa, OK 74150
V98380	NJE Corp. Subsidiary of Technology Development Corp. Dayton, NJ 08810
V98965	Sweinhart Electric Co. Inc. Los Angeles, CA 90023
V99384	Furane Plastics, Inc. W. Los Angeles, CA 90039

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Fuel Booster Pump - Exploded View
Figure 1101

FIG. ITEM	PART NUMBER	NOMENCLATURE 1234567	UNITS PER ASSY	EFFECT CODE
1101-	160-011	PUMP, FUEL BOOSTER	RF	A
	160-065	PUMP, FUEL BOOSTER	RF	B
1	60-98350	.FLANGE	1	
2	60-98360-11	.SCREEN, LEFT HALF	1	
3	60-98360-12	.SCREEN, RIGHT HALF	1	
		ATTACHING PARTS		
4	MS35276-266	.SCREW	4	
		***		
5	HS232-75-019	.PACKING	1	
	MS29513-019	.PACKING (ALTERNATE FOR HS232-75-019)	1	
6	60-98352	.VOLUTE HOUSING	1	
7	DELETED			
8	60-98358	.IMPELLER	1	
		ATTACHING PARTS		
9	MS21042-08	.NUT	1	
		***		
10	MS51923-132	.SPRING PIN	1	
11	S24B0-0500-0230	.SHIM	AR	
12	S24B2-0500-0230	.SHIM	AR	
13	S24B3-0500-0230	.SHIM	AR	
14	S24B6-0500-0230	.SHIM	AR	
14A	S24B1-0560-0329	.SHIM	AR	
14B	S24B3-0560-0329	.SHIM	AR	
14C	S24B5-0560-0329	.SHIM	AR	
15	60-98364	.THRUST WASHER	1	
-16	60-98340	.MOTOR ASSEMBLY	1	
17	60-98354	..END BELL ASSEMBLY	1	
18	60-98355	...THRUST BEARING	1	
19	60-98354-11	...MOTOR END BELL	1	
20	78-17112	..ROTOR-SHAFT ASSEMBLY	1	
21	78-17115	..STATOR ASSEMBLY	1	
22	MS171435	..SPRING PIN	1	
23	MS171434	..SPRING PIN	1	
24	55237-1	..THRUST WASHER	1	
25	60-98356	..MOTOR HOUSING ASSEMBLY	1	
26	60-98357	...BEARING	1	
27	60-98356-11	...MOTOR HOUSING	1	
28	60-98359	.COVER ASSEMBLY	1	
		ATTACHING PARTS		
29	MS35275-241	.SCREW	3	
		***		

-ITEM NOT SHOWN.

FIG. ITEM	PART NUMBER	NOMENCLATURE 1234567	UNITS PER ASSY	EFFECT CODE
1101-				
30	52-485-183	.INVERTER ASSEMBLY (SUPERSEDED BY ITEM 30A)	1	
30A	52-527-183	.INVERTER ASSEMBLY (SUPERSEDES ITEM 30)		
31	60-983502	.RADIO NOISE FILTER ASSEMBLY	1	
		ATTACHING PARTS		
32	MS35218-50	.SCREW (USED WITH ITEM 30)	3	
32A	MS21295-21	.SCREW (USED WITH ITEM 30A)	3	
33	MS35333-72	.WASHER (USED WITH ITEM 30)	3	
33A	52-52722-1	.SPACER (USED WITH ITEM 30A)	3	
		***		
-34	328308	.END CAP (V00779)	5	
35	60-98342-11	.LEADWIRE ASSEMBLY	1	
36	60-98362	.CONDUIT TUBE	1	
37	HS232-75-014	.PACKING	1	
	MS29513-014	.PACKING (ALTERNATE FOR HS232-75-014)	1	
38	DELETED			
39	323986	.TERMINAL, CLEAR (V00779)	1	
40	36151	.TERMINAL, RED (V00779)	1	
41	85198	.TERMINAL, BLOCK	1	
	85198-1	.TERMINAL, BLOCK (ALTERNATE FOR 85198)	1	
		ATTACHING PARTS		
42	MS35265-44	.SCREW	2	
43	AN960D8L	.WASHER	2	
		***		
-44	85197	..TERMINAL BLOCK	1	
	85197-1	..TERMINAL BLOCK (ALTERNATE FOR 85197)	1	
-45	MS51957-26	..SCREW	4	
	MS35233-26	..SCREW (ALTERNATE FOR MS51957-26)	4	
-46	AN960-C6	..WASHER	4	
-47	MS35333-37	..WASHER	4	
-48	85196	..INSERT	2	
49	60-98367	.VALVE ASSEMBLY	1	
		ATTACHING PARTS		
50	MS171442	.SPRING PIN	1	
		***		

-ITEM NOT SHOWN.

FIG. ITEM	PART NUMBER	NOMENCLATURE 1234567	UNITS PER ASSY	EFFECT CODE
1101-				
51	25482	..PIN	1	
52	160-20914	..SPRING	1	
53	23357	..FLAPPER ASSEMBLY	1	
54	60-98368	..VALVE BODY	1	
55	HS232-75-016	.PACKING	1	
	MS29513-016	.PACKING (ALTERNATE FOR HS232-75-016)	1	
56	160-06511	.REDUCER PLUG	1	B
57	60-98374	.THREAD TAPE DECAL	1	
58	60-98361	.IDENTIFICATION PLATE	1	
59	M9244-01	.RUBBER CURING DATE TAG	1	
-60	45116-1	.SEAL	2	

-ITEM NOT SHOWN.
REF DWG 160-011 (REV W) AND 160-065 (REV P)

TABLE 1102. NUMERICAL INDEX

Part Number	Fig. Item	Qty	Part Number	Fig. Item	Qty
AN960-C6	1101 -46	4	328308	1101 -34	5
AN960D8L	1101 43	2	323986	1101 39	1
HS232-75-014	1101 37	1	36151	1101 40	1
HS232-75-016	1101 55	1	45116-1	1101 -60	2
HS232-75-019	1101 5	1	52-485-183	1101 30	1
MS171434	1101 23	1	52-527-483	1101 30A	1
MS171435	1101 22	1	52-52722-1	1101 33A	3
MS171442	1101 50	1	55237-1	1101 24	1
MS21042-08	1101 9	1	60-98340	1101 -16	1
MS21295-21	1101 32A	3	60-98342-11	1101 35	1
MS29513-014	1101 37	1	60-98350	1101 1	1
MS29513-016	1101 55	1	60-983502	1101 31	1
MS29513-019	1101 5	1	60-98352	1101 6	1
MS35218-50	1101 32	3	60-98354	1101 17	1
MS352233-26	1101 45	4	60-98354-11	1101 19	1
MS35265-44	1101 42	2	60-98355	1101 18	1
MS35275-241	1101 29	3	60-98356	1101 25	1
MS35276-266	1101 4	4	60-98356-11	1101 27	1
MS35333-37	1101 -47	4	60-98357	1101 26	1
MS35333-72	1101 33	3	60-98358	1101 8	1
MS52923-132	1101 10	1	60-98359	1101 28	1
MS51957-26	1101 -45	4	60-98360-11	1101 2	1
M9244-01	1101 59	1	60-98360-12	1101 3	1
S24B0-0500-0230	1101 11	AR	60-98361	1101 58	1
S24B1-0560-0329	1101 14A	AR	60-98362	1101 36	1
S24B2-0500-0230	1101 12	AR	60-98364	1101 15	1
S24B3-0500-0230	1101 13	AR	60-98367	1101 47	1
S24B3-0560-0329	1101 14B	AR	60-98368	1101 54	1
S24B5-0560-0329	1101 14C	AR	60-98374	1101 57	1
S24B6-0500-0230	1101 14	AR	78-17112	1101 20	1
160-011	1101 RF		78-17115	1101 21	1
160-065	1101 RF		85196	1101 -48	2
160-06511	1101 56	1	85197	1101 -44	1
160-20914	1101 52	1	85197-1	1101 44	1
23357	1101 53	1	85198	1101 41	1
25482	1101 51	1	85198-1	1101 41	1

REPORT NO: 8-237

OVERHAUL MANUAL
WITH ILLUSTRATED PARTS LIST

FUEL BOOSTER CANISTER PUMP

PART NO. 72266-3
72390-2

THESE COMPONENTS ARE INSTALLED ON DEHAVILLAND DHC-6 AND BEECH AIRCRAFT.

THIS PUBLICATION REPLACES PREVIOUS ISSUE IN ITS ENTIRETY.

CRANE®

HYDRO-AIRE DIVISION

CRANE CO. • 3000 WINONA AVENUE • P.O. BOX 7722 • BURBANK, CALIFORNIA 91510

28-20-24

JUL 1/77

REVISED FEB 21/86

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RECORD OF REVISIONS

REV NO.	ISSUE DATE	DATE INSERTED	BY	REV NO.	ISSUE DATE	DATE INSERTED	BY
1	Feb 21/86						

Retain this record in the front of manual. On receipt of revisions, insert revised pages in the manual and enter revision number, date inserted and initials.

SERVICE BULLETIN LIST

SERVICE BULLETIN NO.	DATE INCORPORATED	SERVICE BULLETIN NO.	DATE INCORPORATED

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INTRODUCTION

This publication is issued to provide instructions to overhaul the Fuel Booster Canister Pumps, Part No's. 72266-3, 72390-2, manufactured by Hydro-Aire Division, Crane Co., Burbank, California 91510 USA.

The information in this manual is divided into sections in accordance with Air Transport Association Specification 100, to enable maintenance personnel to disassemble, clean, inspect/check, repair, assemble, troubleshoot and test the pumps. An illustrated parts list is provided to locate, identify and requisition parts.

To ensure that coverage contained in this handbook will reflect changes in the pump overhaul concepts and procedures, revised information is provided to the customer through a letter of transmittal. The letter includes highlight pages which identify changed pages.

Warnings, Cautions and Notes are used to emphasize information throughout this publication. Warnings must be followed to avoid injury or death to persons. Cautions must be followed to avoid equipment damage, and Notes call attention to work simplification, or additional information.

The following special terms and/or abbreviations are used in this publication.

°F	Degrees Fahrenheit	lb	pound
AMPS	Amperes	MAX	Maximum
ASSY	Assembly	MIN	Minimum
cc	Cubic Centimeter	pph	Pounds Per Hour
Dia	Diameter	psi	Pounds Per Square Inch
EFFECT	Effectivity	psig	Pounds Per Square Inch Gage
FIG	Figure	REV	Revision
FTP	Functional Test Procedure	rpm	Revolutions Per Minute
gpm	Gallons Per Minute	TP	Test Procedure
In	Inch	vdc	Volts Direct Current

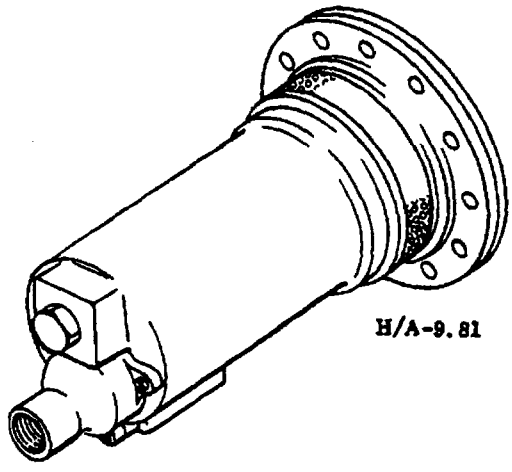
0. DESCRIPTION AND OPERATION

A. DESCRIPTION

Fuel Booster Canister Pumps, Part No's. 72266-3 and 72390-2 are rotary, power-driven pumps. The pumps are used to transfer fuel from fuel system reserviors into feed lines at specified design flow and pressure while submerged in the reservior.

The basic concept of the canister pump design is that of the cartridge or plug-in component which when applied to a submerged unit eliminates undesirable consequences of having to drain the aircraft fuel tank. The motor-pump cartridge is installed in a separate cylindrical shell, or housing, which is an integral part of the tank. This housing, or canister, is filled with an internal, rotary sleeve valve which, when rotated into closed position, seals the inside of the canister from the fuel tank. The motor-pump cartridge can then readily be withdrawn from canister without losing more than a few spoonfuls of fuel. The necessary sequence of operations is mechanically programmed by detailed design of the unit. Rotation of the sleeve valve to seal off canister from fuel tank, and removal of motor-pump assembly with simultaneous disconnecting of fluid and electrical fittings are controlled positively in this order for pump removal, and in the reverse order for reinstallation.

Positive cooling for the motor is furnished by primary fuel flow passing in the space between the outside of the motor housing and the inside of the canister. This port is equipped with a self-sealing disconnect valve which retains fuel in the discharge piping when motor-pump is removed.



Fuel Booster Canister Pump - Assembled View
Figure 1

B. OPERATION

Each pump has self-contained source of power which is an electrically driven, explosion-proof motor whose main components are a field coil and an armature. The field coil provides the flux which causes the armature to rotate when an electric current is made to flow through the system. Rotation of the armature turns the centrifugal type impeller enclosed in the pump chamber, thus creating the pump action. Physically, the two units differ in that Part No. 72266-3 incorporates a radio noise filter and a capacitor. Leading particulars are listed in Table 1.

TABLE 1. LEADING PARTICULARS

Pump Mounting Position	Motor upward; major axis vertical
System Fluid:	
72266-3	JP-4 Fuel per MIL-T-5624
72390-2	Jet "A" per ASTM Spec D1655-65T
Test Fluid	Stoddard Solvent per P-D-680, Type I
Rated Flow:	
72266-3	450 pph at 22 psig (min)
*72390-2	3 gpm at 19 psig (min)
Power Input:	
72266-3	8.0 amps at 28 volts dc
*72390-2	7.5 amps at 28.75 ±0.25 volts dc
Motor Duty Cycle	Continuous
Zero Flow:	
72266-3	33.6 psig (max)
72390-2	50 psig (max)
Dimensions:	
72266-3	5.25 in. dia x 11.49 in. high
72390-2	5.25 in. dia x 9.41 in. high
Weight	5.7 lb (max)

*Using test fluid.

1. DISASSEMBLY (See Figure 1101)

Prior to disassembly, perform the procedures in Section 7, Testing, to determine extent of disassembly required to repair or replace components.

Disassembly may be accomplished using tools and equipment normally available at maintenance facilities. Special tools, fixtures and equipment, if specified, are listed in Table 1001.

WARNING: AVOID SPILLING FUEL. DO NOT ALLOW ANY FUEL TO REMAIN IN PUMP CHAMBERS OR PASSAGES. KEEP PUMP AWAY FROM OPEN FLAME.

CAUTION: PLACE ALL PARTS IN CLEAN, COVERED CONTAINERS. KEEP PARTS (3 THROUGH 47) AND PARTS (50 THROUGH 90) SEPARATED.

NOTE: Note method of lockwiring for duplication during reassembly.

A. Remove screws (97) and locking plate assembly (-96 or -103). Do not remove nameplate.

B. On 72266-3 pump, remove two nuts (99) two screws (100) and block (98) from plate (102). Do not remove grommet (101) unless necessary for replacement.

C. Turn lever (5) counterclockwise with an 3/8 inch Allen wrench until it can be removed from canister pump. Remove and discard packing (6) from lever.

D. Pull pump assembly (-1 or -2) carefully out of canister (117) housing assembly. Remove and discard packings (3, 4) from pump assembly.

E. Remove two screws (7) and handle (8).

F. On 72266-3 pump, remove screw (9) and washer (11) and detach braid (13) with sleeving (15, 17, 18, 19, 20) and terminals (21, 22).

G. On 72390-2 pump, remove screw (-10) and washer (11) and detach braid (14) with flexible tubes (16, 23).

H. On 72266-3 pump, remove nut (24), union (25), packing (26), sleeve (27) and tubing (28).

I. Remove three screws (29) and pump body (30).

J. When removing shims (31, 32), record total thickness for use during reassembly.

K. To remove locknut (33), hold impeller (34) with wrench T47492 to prevent armature assembly (87) from turning. Then use screwdriver T56644, and unscrew locknut. After removal of locknut, pull impeller from armature shaft, then remove key (35). Upon removal of impeller (34) use care to prevent loss of key (35).

L. Remove screws (37) and bushing retainer (36).

WARNING: BUSHING RETAINER (36) IS LOADED BY SPRING (41) AND WILL BE FREE TO MOVE OUT OF END BELL WITHOUT EXTERNAL FORCE.

M. Remove bushing (38), adapter (39), drive (40), spring (41), rotating seal (42) and stationary seal (43).

N. Remove three slip tubes (46). Remove and discard packings (44, 45, 47).

CAUTION: LIFT MOTOR COVER (50) FROM END BELL (90) CAREFULLY BY TWISTING SLIGHTLY AND PULLING SIMULTANEOUSLY TO AVOID DAMAGE EITHER TO ELECTRICAL LEADS OR TO FIELD COIL ASSEMBLY (-56).

O. Remove four screws (51), then lift motor cover (50) away from end bell (90) far enough to gain access to two screws (64) which connect electrical leads to brush holder plate assembly (79, 80). Remove terminals (65 or 66).

P. Remove insulator (52) and packing (53). Discard packing.

NOTE: Remove field coil assembly (-56) only if replacement is necessary.

Q. Remove two screws (54) and two key washers (55) securing field coil assembly from motor cover assembly carefully to avoid damage to coil assembly. Do not disassemble coil assembly. If any part requires replacement, replace entire assembly.

R. Remove four screws (69, 71, 73) on 72266-3 pump or (67) on 72390-2 pump securing brush holder plate assembly (79 or 80) to end bell (90); then lift armature assembly (87) with slinger (78) and brush holder plate assembly attached from end bell.

S. On 72390-2 pump after removing screws (69, 71 and 73), remove noise filter (68), capacitor (70) and clamp (72).

CAUTION: DO NOT USE EXCESSIVE VICE CLAMPING PRESSURE ON ARMATURE AS DAMAGE TO ARMATURE LAMINATIONS OR WINDINGS MAY RESULT.

T. Hold armature assembly (87) in a vise with soft jaws as shown in Figure 101. Use two screwdrivers placed opposite each other and pry slinger (78) off of armature shaft. Then remove brush holder plate assembly (79 or 80).

U. Remove washers (85, 86) if used noting number to aid in reassembly. Remove and discard packing (84). Do not remove felt holder (81), spring (82) and felt rings, (83) unless replacement is required.

V. Do not remove springs (88) from brush plate holder assembly (79 or 80) when replacing brush assemblies (89). Remove brush by lifting spring and sliding brush out of holder.

W. Do not remove lead wires (74 or 75) unless necessary for replacement.

X. Do not remove nameplate (93 or -94) from canister (117) unless necessary for replacement.

Y. Remove screen (104), noting manner of lockwiring for duplication during reassembly. Remove screen only if damaged or if necessary for cleaning.

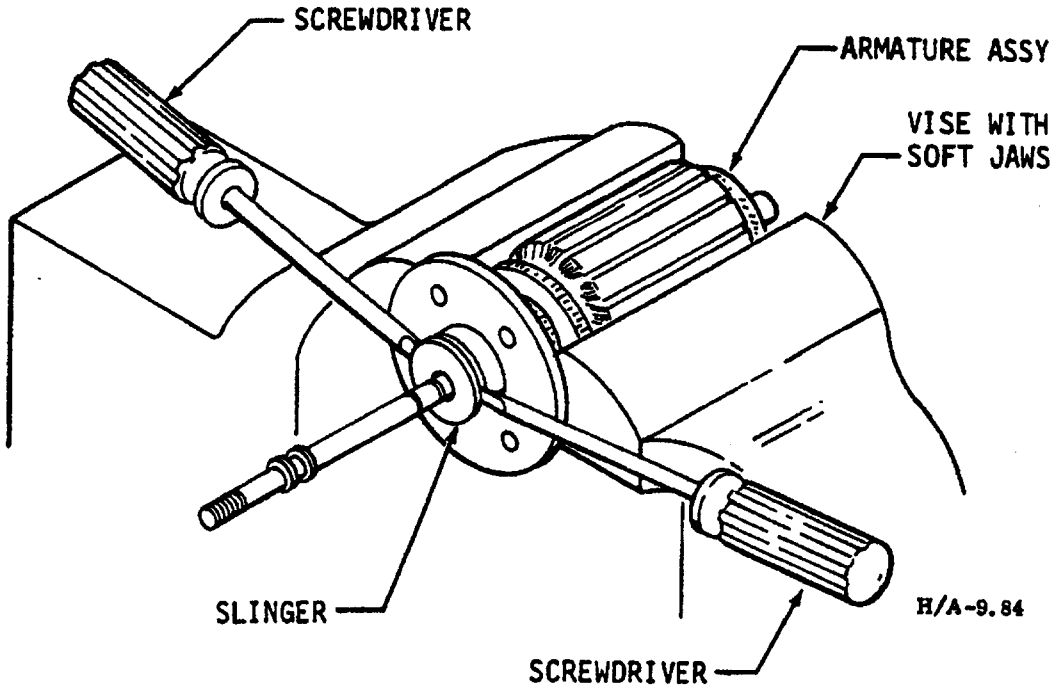
Z. Remove plug (105) and packing (106). Discard packing.

AA. Remove three screws (108) and washers (109) securing fitting (107).

AB. Remove two screws (111) and valve (110).

AC. Remove screw (112) and packing (113). Discard packing.

AD. Remove four screws (115), two segments (114) and sleeve (116). Use wrench T58525 to remove sleeve (116).



Slinger Removal
Figure 101

2. CLEANING

The materials required for cleaning are listed in Table 201.

A. ULTRASONIC CLEANING PROCEDURE

WARNING: USE SOLVENT IN A WELL-VENTILATED AREA. AVOID BREATHING FUMES. KEEP AWAY FROM OPEN FIRE OR FLAMES.

CAUTION: DO NOT CLEAN ELECTRICAL PARTS USING THIS PROCEDURE OR DAMAGE TO PARTS MAY OCCUR.

(1) Place parts in wire baskets, or equivalent, keeping parts separated from each other. Immerse parts in cleaning solution within ultrasonic cleaning unit and keep parts submerged between 5 to 10 minutes.

B. VAPOR DEGREASING PROCEDURE

(1) Raise parts above solvent into condensing zone of degreaser and flush for 1 minute or more in vapors.

WARNING: WHEN USING COMPRESSED AIR, DIRECT AIRSTREAM AWAY FROM BODY AND OTHER PERSONNEL.

(2) Raise parts above cleaning container and allow to dry. Use clean, dry, compressed air to quicken drying.

NOTE: If use of compressed air is impractical, dry by wiping with a clean, lint-free cloth.

(3) Remove parts from basket with padded tongs.

(4) Check parts for cleanliness.

TABLE 401. CLEANING MATERIALS

Item	Number	Manufacturer or Specification
Isopropyl Alcohol	None	TT-I-735A
Lint-free Cloth	None	Commercial
Padded Tongs	None	Commercial
Soft-bristled Brush	None	Commercial
Solvents: Trichloroethylene		O-T-634B (Technical Grade)
Perchloroethylene (Tetrachloroethylene)	None	O-T-236B

Equivalent substitutes may be used.

3. INSPECTION/CHECK

A. GENERAL

Check all parts under strong light for cracks, nicks, and other damage. Make sure all passages are clean and unobstructed, threads undamaged and sealing areas free from scratches, pits, nicks, excessive wear, corrosion and other damage.

NOTE: Excessive wear is defined as any obvious deformation or deterioration of parts which may render the pump inoperative. If doubt exists concerning the condition of a part, replace the part.

B. INDIVIDUAL PARTS CHECK

(1) Check pump body (30) bore for nicks and scratches that would indicate distortion of pump components, improperly installed impeller (34) or presence of foreign matter in impeller vanes.

(2) Check impeller (34) for broken, cracked or bent vanes.

(3) Check seals (42, 43) for condition of contact area by running fingernail across sealing surface. There should be no evidence of galling or roughness. If one seal is replaced, replace other seal also.

(4) Check alignment of spring (41) by rolling spring across a clean, smooth, flat surface. Spring shall not wobble. Test spring for stacking or fatigue by measuring free length and compressed length. Free length of spring shall be approximately 1.000-inch. Under a load of 1.806 to 2.006 pounds, compressed length shall be 0.282-inch.

NOTE: Brush springs (88), if removed, must be replaced.

(5) Check coil assembly (-56) for security of installation and condition of lead terminals. Inspect laminations for nicks and scratches which indicate a distorted pump assembly or worn bearing (62) causing armature assembly (87) to rub against coil assembly. Check condition of insulation on coil leads. Measure resistance of shunt coil between leads white and black. Resistance shall be 80 $\pm$4 ohms at 70°F. Measure resistance of series coil between leads green and black. Resistance shall be 0.209 $\pm$0.025 ohms at 70°F.

(6) Check armature assembly (87) for smooth and shiny commutator surfaces and insulators between commutator bars recessed approximately 0.025-inch. Check shaft for evidence of excessive heat around bearing area. Check armature with a growler for open windings.

(7) Check canister (117) for warped mounting flange.

(8) Check pump body (30) bore for evidence of incorrectly installed impeller (34) as indicated by nicks and/or heavy scratches. Use Zyglo or Diecheck inspection methods to check structural condition of body.

4. REPAIR

The repair procedure for the pumps are only those necessary to make simple repairs. The necessary repair materials are listed in Table 401.

A. Replace all parts that do not pass inspection/check and are damaged beyond simple repair.

B. Replace all packings and packing retainers, seals, insulators, sleeving and grommets.

C. Replace washers (55), brushes (89), bearing (62) and springs (88).

CAUTION: DO NOT ATTEMPT TO REMOVE LIGHT SCRATCHES OR OTHER MINOR IMPERFECTIONS FROM COMMUTATOR BARS OR COIL LAMINATIONS BY POLISHING OR ANY OTHER METHOD TO PREVENT ALTERATION OF THE DESIGN GAP BETWEEN COIL AND ARMATURE. IF COIL ASSEMBLY (-56) OR ARMATURE (87) IS OBVIOUSLY DAMAGED AS INDICATED BY HEAVY SCRATCHES, DISTORTION OR COMMUTATOR BARS OR COIL ASSEMBLY LAMINATIONS, REPLACE PART.

D. Replace coil assembly (-56) and/or armature (87) if electrical requirements specified for these parts are not met.

E. Noncritical internal surfaces of canister (117) and external surfaces may be polished with aluminum abrasive cloth provided that not more than 0.002 inch of material is removed from polished area.

CAUTION: DO NOT USE CROCUS ABRASIVE CLOTH P-C-458 ON ALUMINUM OR MAGNESIUM PARTS AS IT CONTAINS AN IRON OXIDE WHICH CAUSES RAPID CORROSION OF THESE METALS.

F. Polish out minor nicks and scratches on noncritical steel surfaces with crocus abrasive cloth P-C-458. Polish out minor nicks and scratches on aluminum parts with carbide abrasive cloth P-C-451, provided that critical mating surfaces are not damaged.

NOTE: After abrasive cloth has been used, ultrasonic clean as outlined in Section 2, Cleaning.

G. Use thread chaser or tap to repair stripped threads (2 threads maximum) at port and attachment points.

H. Touch up worn or reworked anodized surfaces on aluminum parts as follows:

(1) Remove soiled and oxide film by swabbing surface with acide solvent cleaner (1 volume Deoxidine 624 to 3 volumes water mixed at room temperature), allowing a 1 to 3 minute solution contact time. Keep entire rework surface wet.

(2) Rinse by swabbing with clean, soft, lint-free cloth soaked in water. Repeat at least twice, wringing out cloth after each rinse.

WARNING: ALL CLOTH APPLICATORS USED TO APPLY ALODINE SOLUTION SHALL NOT BE ALLOWED TO DRY OUT. WHEN DRY, EACH CONSTITUTES AN EXTREME FIRE HAZARD. RINSE THOROUGHLY IN WATER WHEN ALODINE APPLICATION IS COMPLETE.

(3) Apply alodine coating (3 volumes of alodine 1000L concentrate to 2 volumes of water) evenly and liberally with a clean, soft, lint-free cloth. Do not apply solution like paint, but thoroughly wet reworked surface to be alodines.

(4) Allow alodine coating to air dry as follows:

Ambient Temperature (°F)	100	90	80	70	60
Alodine Coating Contact (minutes)	2.25	2.8	4.0	5.5	10

NOTE: Do not touch new alodine surface until dry, as fresh alodine films are easily damaged.

(5) Swab off and rinse with cellulose sponge or clean, soft, lint-free cloth saturated with clean water. Use blotting motion or very gentle swabbing to prevent damage to fresh alodine film. Wring out sponge or cloth and repeat rinsing at least twice, blotting any pools of water.

TABLE 401. REPAIR MATERIALS

Item	Number	Manufacturer or Specification
Acid-Solvent Cleaner	Deoxidine 624	V84063
Alodine Coating	Alodine 1000L (Liquid Concentrate)	V84063
Abrasive Cloth, Aluminum Oxide	600 to 800 Grit	P-C-451
Abrasive Cloth	None	P-C-458

Equivalent substitutes may be used.
Refer to Table 1001 for vendor name and address.

5. ASSEMBLY (See Figure 1101)

Assembly may be accomplished using tools and equipment normally available at maintenance facilities. Special tools, fixtures and equipment, if specified, are listed in Table 1001.

CAUTION: ASSEMBLY SHOULD BE ACCOMPLISHED IN A WELL-LIGHTED, DUST-FREE AREA. ALL PARTS SHOULD BE THOROUGHLY CLEANED PRIOR TO ASSEMBLY.

NOTE : Coat bore of canister (117) (in teflon coated area) with fluorosilicone grease FS3451, before installing sleeve (116).

A. Install sleeve (116) in canister (117). Install segments (114) and secure with four screws (115). Segment gap to be located 45° counter clockwise from discharge port as viewed from flanged end of canister (117).

B. Install packing (113) and screw (112) in canister (117).

C. Install swing check valve (110) and secure with two screws (111).

D. Install fuel outlet fitting (107) and secure with three screws (108) and three washers (109). Apply permatex "Aviation Forms-A-Gasket No. 3" between fitting (107) and canister (117). Cure for 8 hours at room temperature.

E. Install packing (106) and plug (105) in canister (117).

F. If removed, install screen (104) and safetywire as noted during disassembly.

G. If nameplate (93 or -94) was removed from locking plate assembly (-96 or -103), install with screws (95).

H. Do not install locking plate assembly until pump assembly (3 through 90) has been assembled and inserted into canister assembly (-91 or -92).

I. Install bearing (62) on armature (87) shaft.

J. Lubricate packing (84) with fluorosilicone grease FS3451. Place packing (84) in groove of brush holder plate assembly (79 or 80). Install brush holder plate and slinger (78) on armature (87) shaft.

K. Install end bell (90) over brush holder plate assembly. On 72390-2 pump, use same number of washers (85, 86) noted during disassembly to maintain required dimension "L" of Figure 501. Fasten washers to underside of plate assembly with Eastman 910 adhesive, or equivalent.

L. Secure end bell (90) to brush holder plate as follows:

(1) On 72266-3 pump, secure end bell (90) to brush holder plate assembly (79) with screws (69, 71, 73) while installing flexible tubing (76, 77), noise filter (68), clamp (72), terminal (65) and capacitor (70). See Figures 502 and 503.

NOTE: Encapsulate capacitor (70) and leadwires (74, 75) using silastic sealant RTV732, after attaching them to brush holder plate assemblies.

(2) On 72390-2 pump, secure end bell (90) to brush holder plate assembly (80) with screws (67). Install leadwire (74, 75). See Figures 502 and 503.

NOTE: Solder leadwires and terminals per MIL-S-6872 using SN60 or SN40 per QQ-S-571.

M. Install two new brush assemblies (89) in brush holder plate assembly (79 or 80) with brush pigtail away from plate (79, 80). Perform dielectric test as outlined in Testing, Section 7.

N. Install spring washer (63) into internal boss of cover assembly (50). Use a small amount of heavy grease to retain spring washer during motor assembly.

O. Install packing (53) in groove of end bell (90). Lubricate packing with fluorosilicone grease FS3451 prior to installation.

CAUTION: INSTALL FIELD COIL ASSEMBLY (-56) AS SHOWN IN FIGURE 506 TO PREVENT MOTOR FROM TURNING IN WRONG DIRECTION.

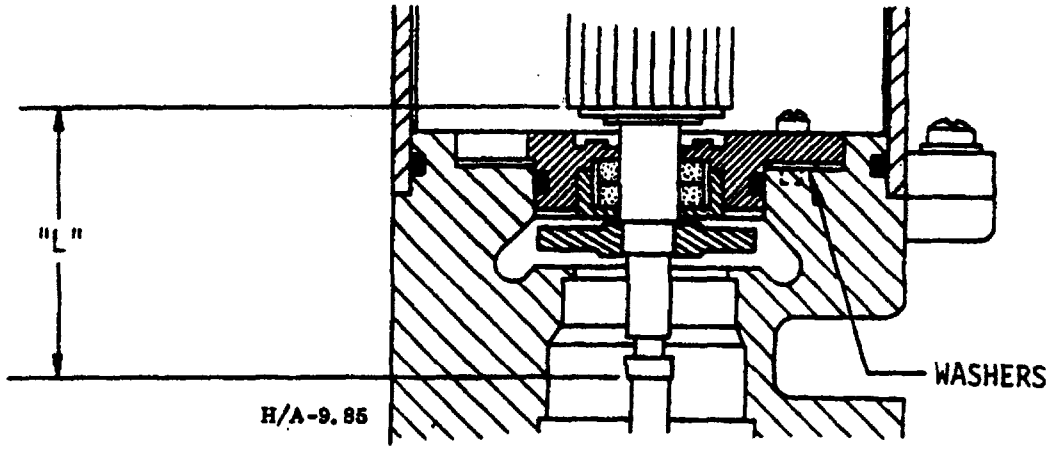
P. If field coil assembly (-56) was removed during disassembly, install coil assembly in cover assembly (50) as shown in Figure 506 and secure with key washers (55) and screws (54). Tighten screws and bend key washer tabs against flat of screw heads. Install insulator (52).

Q. Install leads of field coil assembly (-56) to brush holder plate assembly (79 or 80) with screws (67). See Figures 502 through 505.

R. Secure motor cover (50) to end bell (90) with screws (51). Alignment mark in end bell to be in line with index slot of cover.

S. Perform motor tests as outlined in Testing, Section 7 before continuing assembly procedure.

T. Turn pump motor (-48 or -49) upside down and install slip tubes (46) with packings (47).



Dimension "L" (inches)	No. of Washers Required (See Figure 1101) (85)	(86)	Stack Height (inch)
1.460 to 1.446	1	1	0.048
1.445 to 1.431	1	0	0.032
1.430 or less	0	1	0.016

NOTE: Fasten washers to underside of brush holder plate assembly using Eastman 910 adhesive.

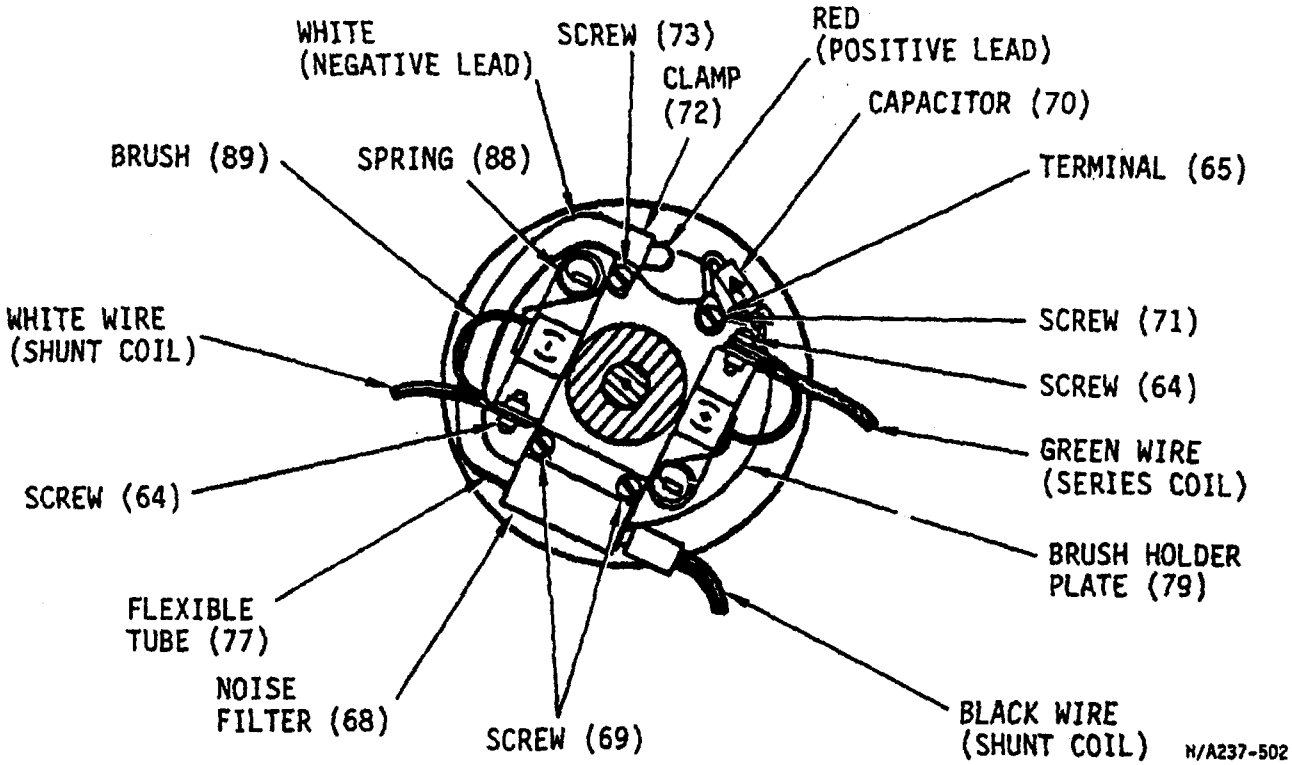
Impeller Dimension
Figure 501

U. Lubricate packing (44) with FS3451 silicone grease (Dow Corning), install on seal (43) and install seal on armature assembly (87) shaft being careful not to damage polished surface of seal.

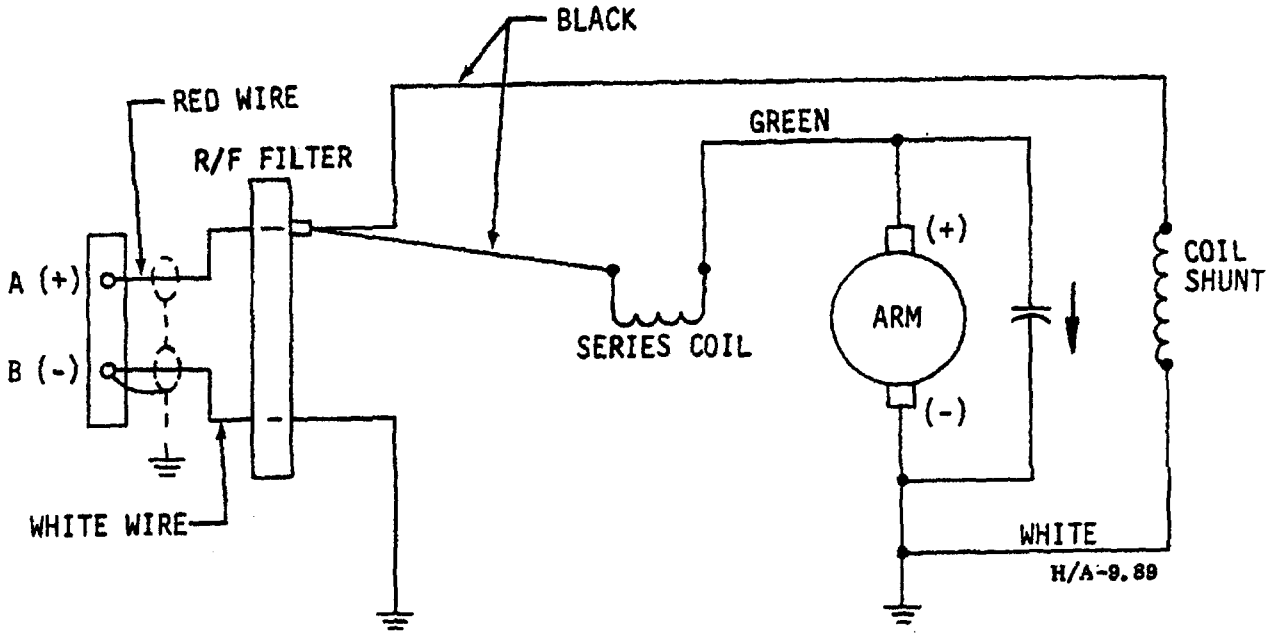
V. Install packing (45) on armature (87) shaft.

CAUTION: ENSURE THAT DRIVE (40) IS INSTALLED IN ACCORDANCE WITH FIGURE 507.

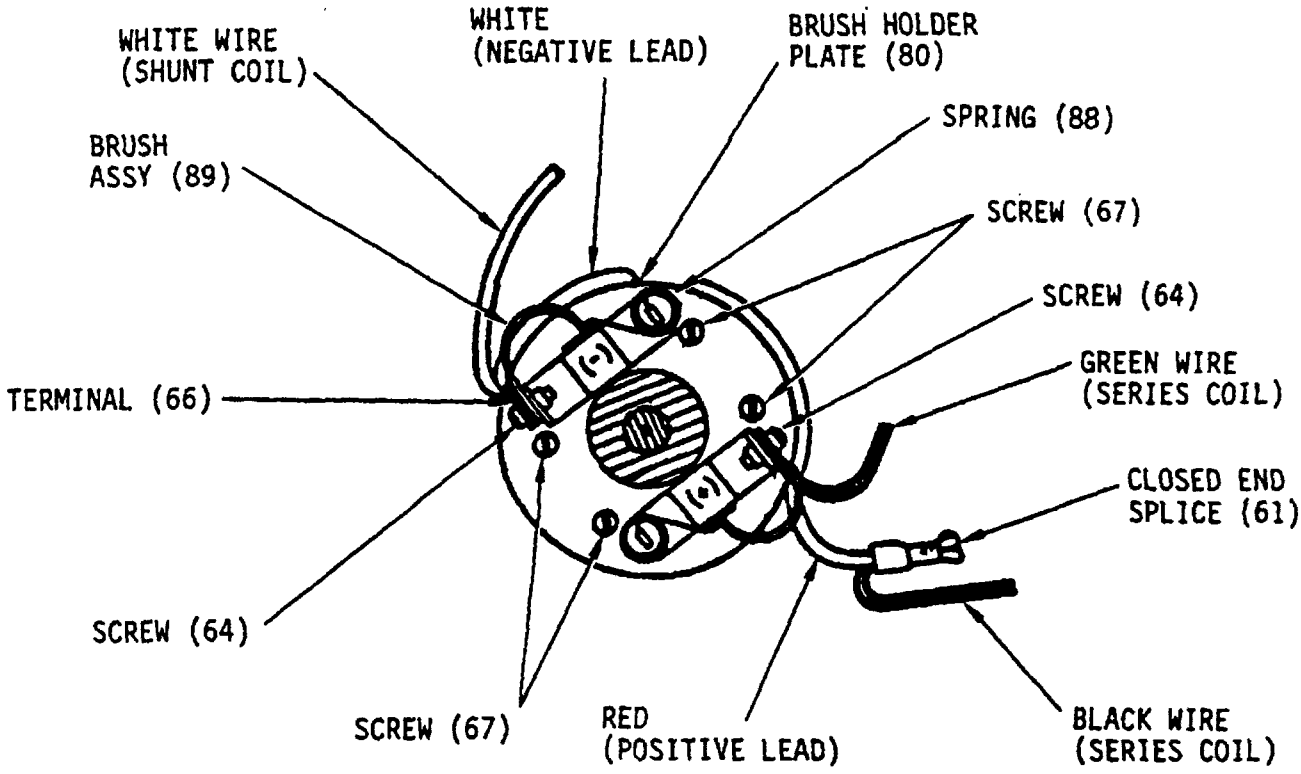
W. Carefully install rotating seal (42) and drive (40) on armature shaft.



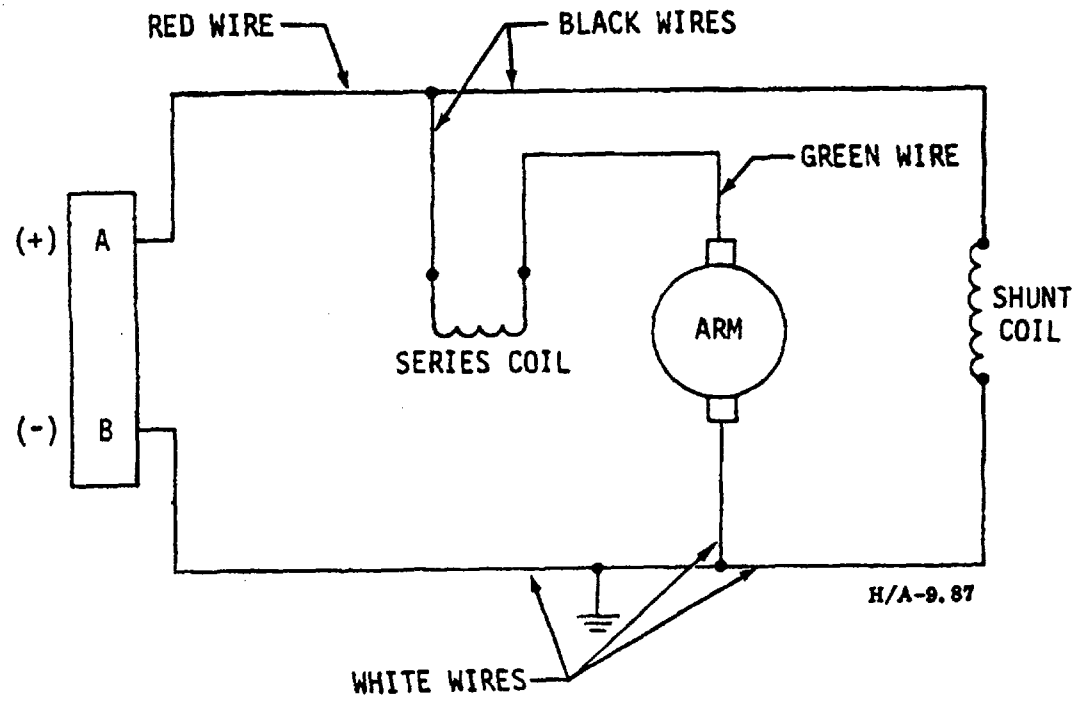
Electrical Assembly for 72266-3 Pump
Figure 502



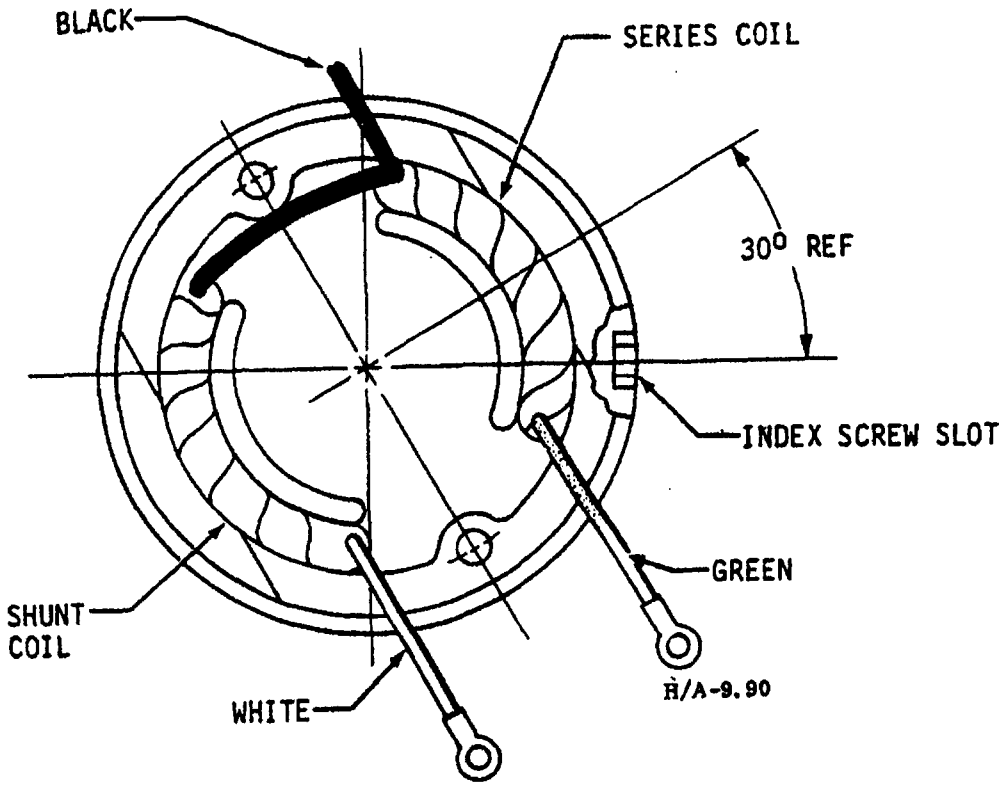
Wiring Diagram 72266-3 Pump
Figure 503



Electrical Assembly for 72390-2 Pump
Figure 504



Wiring Diagram for 72390-2 Pump
Figure 505



Field Coil Assembly Installation
Figure 506

X. Install spring (41), adapter (39), bushing (38) and bushing retainer (36). Secure with screws (37).

CAUTION: ENSURE THAT KEY (35) IS INSTALLED IN ACCORDANCE WITH FIGURE 507.

Y. Install key (35). Install impeller (34) using impeller wrench T47492. Secure with nut (33) using screwdriver T56644. Torque nut (33) to 5.50 ±0.50 inch-pounds.

NOTE: Rotate impeller and shaft by hand to check for binding. Impeller must rotate freely without binding.

Z. Shim to obtain required clearance 0.004 to 0.008-inch between impeller (34) and pump body (30). Proper clearance is obtained as follows (see Figure 508):

(1) Measure from face of body (30) to flat of throat in body and record as dimension "A".

(2) Measure from face of end bell (90) to point of top impeller vane and record as Dimension "B".

(3) Subtract dimension "A" from dimension "B". Result is total amount of shimming required to obtain metal to metal contact or zero clearance. Record this figure.

(4) To figure recorded in step (3), add clearance of 0.006 ±0.002-inch. Total will be amount of shimming required to establish proper clearance between impeller and throat.

(5) Install combination of shims (31, 32) as required to obtain clearance established in step (4).

AA. Secure body (30) with three screws (29).

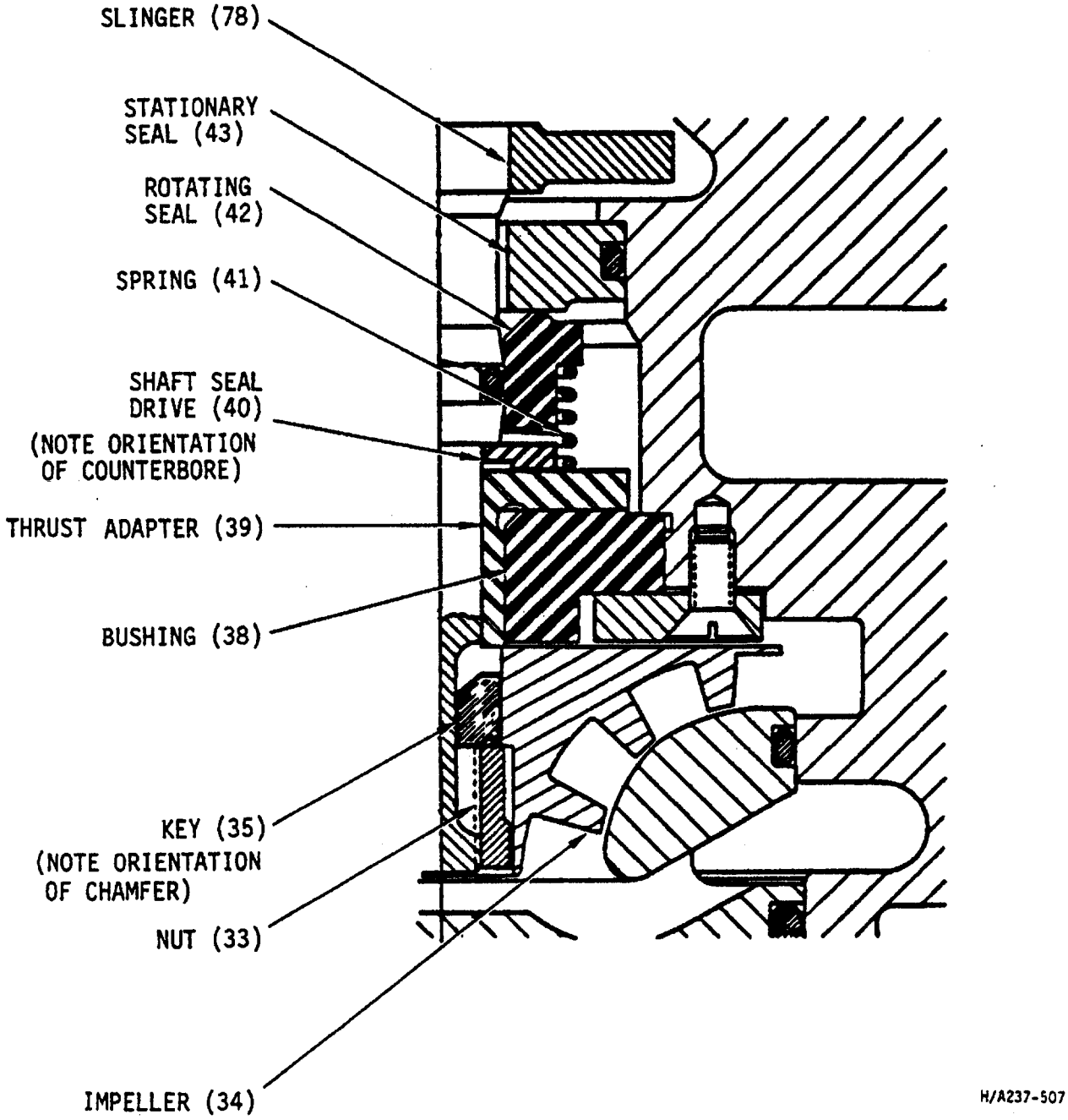
AB. On 72266-3 pump, install tubing (28), sleeve (27), packing (26), union (25) and nut (24).

AC. On 72266-3 pump, install terminals (21, 22), flexible tubes (17, 18, 19, 20) and braid (13) with washer (11) and screw (9). See Figure 509.

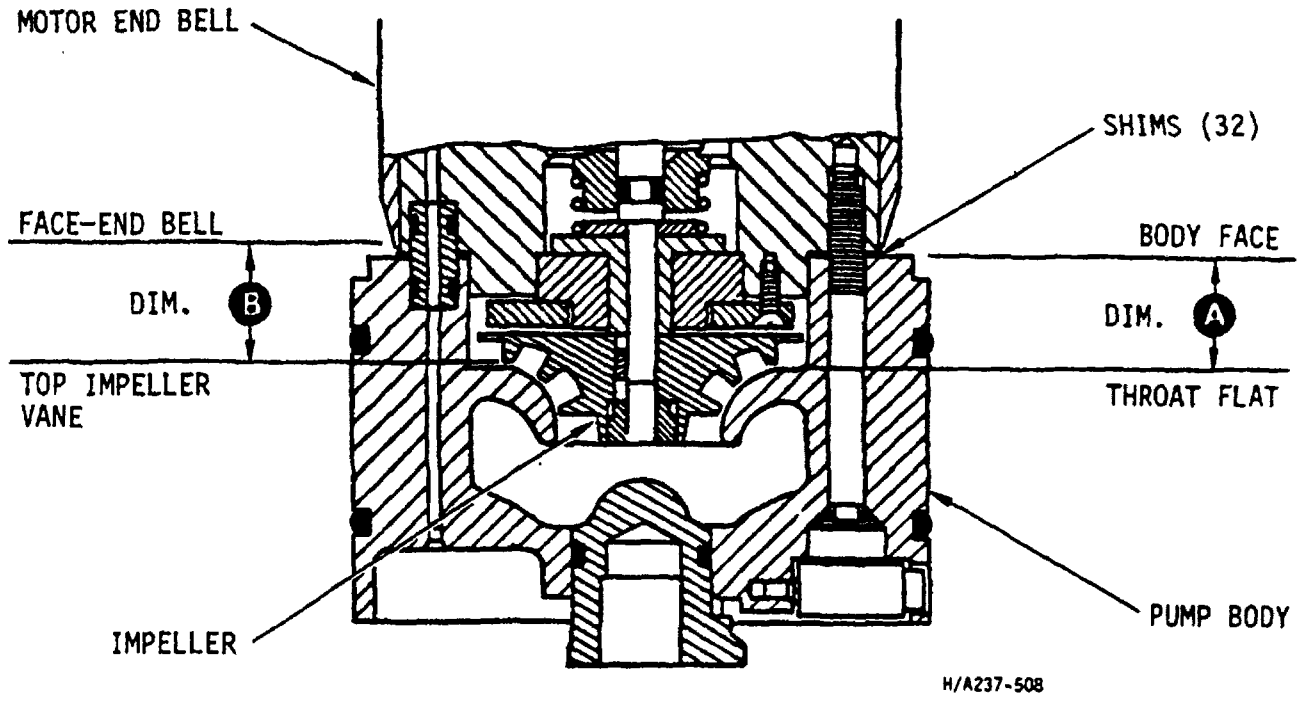
AD. On 72390-2 pump, install flexible tubes (16, 23) and braid (14) with washer (11) and screw (-10). See Figure 510.

AE. Install handle (8) with screws (7).

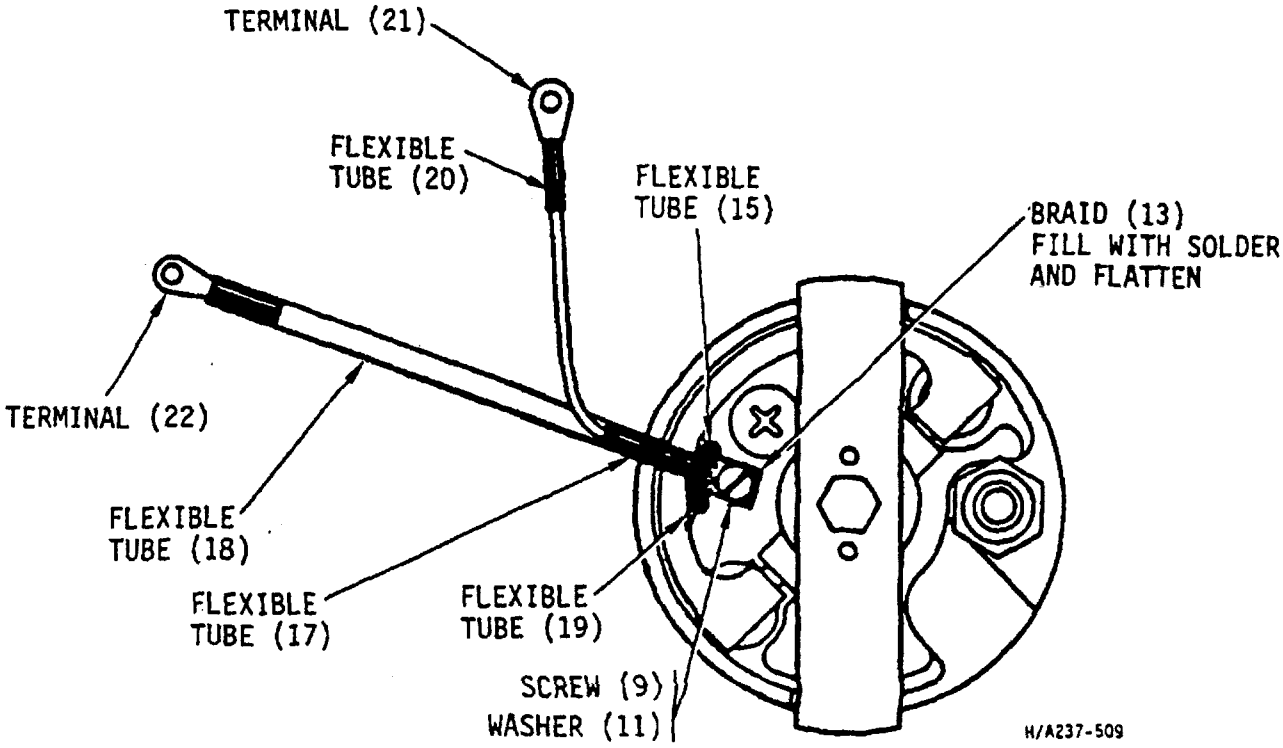
AF. Lubricate packings (3, 4) with fluorosilicone grease FS3451 and install on pump body (30).



Proper Installation of Drive and Key
Figure 507



Shim Installation
Figure 508



Wiring Assembly for 72266-3 Pump
Figure 509

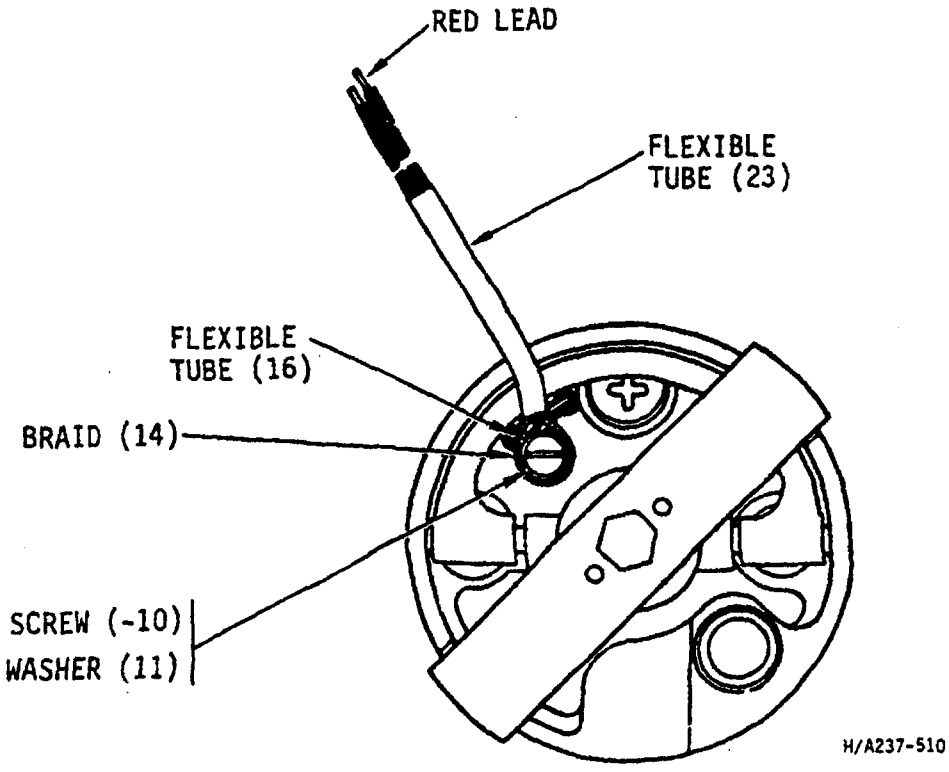
AG. Carefully insert pump and motor assembly (-1 or -2) into canister assembly (-91 or -92).

AH. Place packing (6) on lever (5). Insert lever into pump body (30). Turn lever clockwise with an 3/8 allen wrench until lever locks in place securing pump in canister.

AI. On 72266-3 pump, assemble block (98), two screws (100) and two nuts (90) on plate (102).

AJ. Install locking plate assembly (-96 or -103) with screws (97).

AK. Test completed assembly in accordance with Testing, Section 7.



Wiring Assembly for 72390-2 Pump
Figure 510

TABLE 501. ASSEMBLY MATERIALS

Item	Number	Manufacturer or Specification
Fluorosilicone Grease	FS3451	V71984
Permatex	Aviation Forms-A-Gasket No. 3	MIL-S-4580, Type III
Silastic Sealant	RTV732	V71984

Equivalent substitutes may be used.
Refer to Table 1101 for vendor name and address.

6. FITS AND CLEARANCES

Not applicable. See Assembly, Section 5, for clearances used during reassembly.

7. TESTING (TP 72266-3, REV C and FTP 72390-2, REV B)

1.0 TEST EQUIPMENT

The following test equipment shall be used to perform the required tests. Equivalent equipment may be substituted.

Description	Range and Accuracy
DC Power Supply	0-30 vdc
Ammeter	0-10 amps 1%
DC Voltmeter	0-30 vdc, 1/2%
Flowrater	0-4 gpm, 2%
Pressure Gauge	0-50 psig, 1%
Pressure Gauge	0-60 psig, 1%

2.0 TEST CONDITIONS

A fluid reservoir capable of pressurization to 15 psig minimum must be available for mounting and submersion of pump.

See Figure 701 for test setup. Test fluid shall be solvent, P-D-680, Type I, at a fluid temperature of 80° ±10°F.

All tests shall be conducted at an ambient temperature between 60°F and 90°F and ambient atmospheric pressure.

Voltage at motor terminals shall be as follows:

72266-3 Pump	28.0 ±0.25 volts dc.
72390-2 Pump	28.75 ±0.25 volts dc.

3.0 MOTOR TESTS

3.1 Assemble motor with run-in bearing support T57881 prior to break-in run test.

3.1.1 DIELECTRIC TEST

NOTE: Grounded motors must be ungrounded during this test. Disconnect leads from brush holder terminal and remove negative brush.

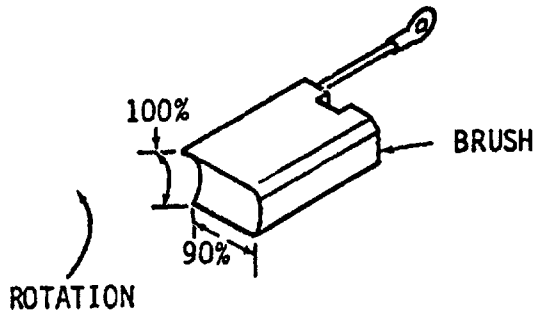
3.1.2 Apply 500 volts, 60 cycles ac between positive brush holder and end bell (90) for 15 seconds. No damage shall occur.

3.1.2 BREAK-IN RUN

CAUTION ELECTRIC CIRCUIT AND MOTOR FOR PUMP 72266-3 INCLUDE AN ELECTROLYTIC CAPACITOR. IF POLARITY OF POWER IS REVERSED EVEN FOR A FRACTION OF A SECOND, CAPACITOR WILL BURN OUT, AND UNIT WILL LOSE ITS RADIO NOISE FILTERING ABILITY. THERE IS NO EASY WAY TO DETERMINE WHETHER CAPACITOR IS FUNCTIONING OR BURNED OUT. HENCE, EXTREME CARE IS REQUIRED TO OBSERVE CORRECT POLARITY. RED LEAD IS (+); WHITE LEAD IS (-).

3.1.4 Run motor at no-load with voltage adjusted to give approximately 11,000 rpm until 100 percent brush contact in direction of rotation and approximately 90 percent of total area is obtained. See Figure 701.

3.1.5 Visually inspect brushes. Run-in time shall be 18 hours minimum.



Brush Run-in
Figure 701

4.0 CANISTER ASSEMBLY LEAKAGE TEST

4.1 Plug pressure pickup port with pressure outlet port open. Rotate sleeve valve to closed position.

CAUTION: A TEST TANK CAPABLE OF WITHSTANDING A MINIMUM OF 15 PSI INTERNAL PRESSURE IS REQUIRED.

4.2 Install canister in suitable tank with test fluid. Apply air pressure to tank and observe leakage through outlet check valve and sleeve valve. Pressure to be applied as follows:

Pressure	Time	Leakage Requirement
0.1 to 0.2 psig	5 min	0.01 cc/min (1 drop in 5 min)
2 psig	5 min	0.01 cc/min (1 drop in 5 min)
15 psig	5 min	0.01 cc/min (1 drop in 5 min)

5.0 PUMP CARTRIDGE TEST

5.1 Install pump cartridge inside canister assembly.

5.2 Install unit in test setup. See Figure 702.

5.3 OUTLET PORT LEAKAGE TEST

5.3.1 Test outlet port fitting for leakage at 60 psig. No leakage allowed.

5.4 WET RUNNING-IN.

CAUTION: OBSERVE POLARITY. POSTIVE, BLACK WIRE; NEGATIVE, WHITE WIRE.

5.4.1 Start fully submerged pump at 28 volts dc, then immediately reduce voltage until current drops to 7.5 amperes maximum.

5.4.2 Pump shall be run-in wet at rated flow for 18 hours minimum. During entire test, adjust voltage periodically to 28 volts dc, but at same time not exceeding 7.5 ampere limit.

5.5 SHAFT SEAL LEAKAGE TEST

5.5.1 This test shall be conducted simultaneously with running-in procedure for a minimum period of 18 hours.

5.5.2 Total leakage at seal drain port shall not exceed 2.25 cc for 18 hour period, or 3 cc for a 24 hour period.

5.6 CALIBRATION

5.6.1 Run pump a minimum of 15 minutes at rated voltage. Set flow rates indicated in Table 701 and record discharge pressure, amperes and fluid temperature.

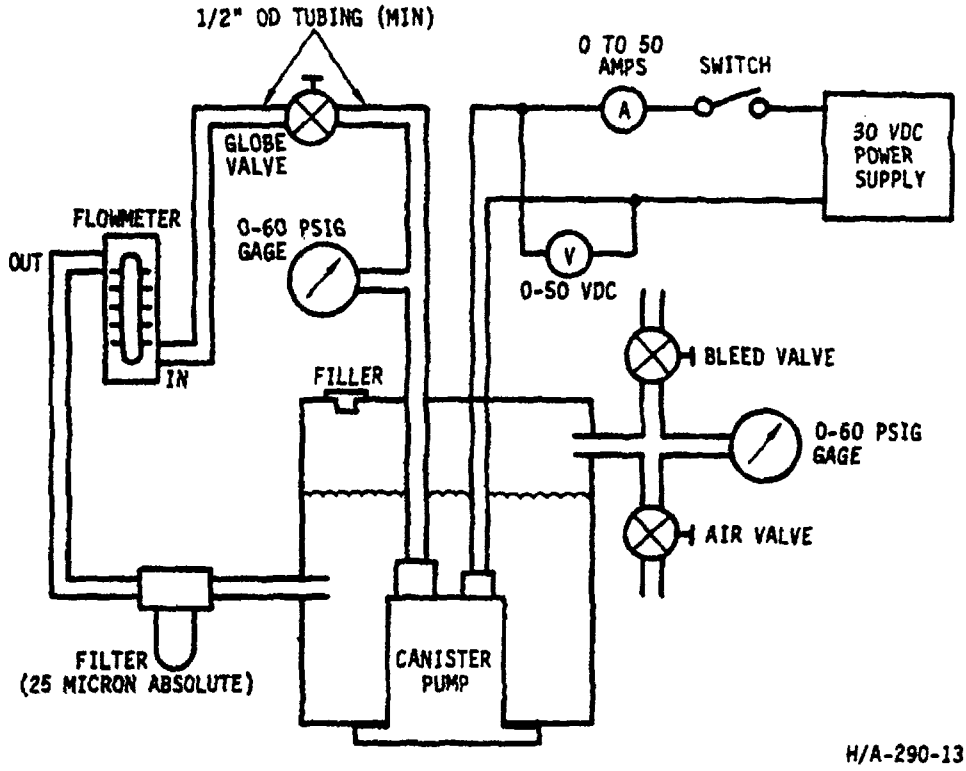
5.6.2 Pump performance shall be within limits shown in Table 701.

CAUTION: IF CURRENT DRAIN FLUCTUATES NOTICEABLY, SHUT OFF MOTOR SINCE CURRENT FLUCTUATIONS MAY INDICATE MOTOR OVERHEATING OR INCORRECT ASSEMBLY.

5.6.3 During calibration, observe for external leakage from pump body. None is permissible.

TABLE 701. PERFORMANCE PARAMETERS

Pump	Rated Voltage (vdc)	Flow (gpm)	Flow (pph)	Discharge Pressure (psig)	Current (amps)	Fluid Temp (°F)
72266-3	28.0	1.15	450	22 (min)	8 (max)	80 ±10
	28.0	0	0	33.6 (max)	8 (max)	80 ±10
72390-2	28.75	3.0	1170	19 (min)	7.5 (max)	80 ±10
	28.75	0	0	50 (max)	7.5 (max)	80 ±10



Test Setup
Figure 702

8. TROUBLESHOOTING

Troubleshooting information is contained in Table 801. This table is not all inclusive, however, it does contain the causes of malfunctions most likely to occur.

TABLE 801. TROUBLESHOOTING INFORMATION

Trouble	Probable Cause	Remedy
Motor overheats	Insufficient cooling	Convection cool externally.
	Damaged wiring	Continuity and visual check. Repair as required.
	Misalignment	Locate parts properly.
Excessive current drain	Damaged bearing (62)	Replace damaged bearing.
	Impeller (34) rubbing	Correct clearance.
Insufficient motor rpm	Coil assembly (-56) and armature (87) binding	Remove any foreign matter caught between coil and armature. Check parts for damage. Replace if damaged.
Pump delivery above or below desired values	Improper shimming	Correct impeller clearance.
	Damaged impeller (34) and/or body (30)	Replace damaged part or parts.
Erractic operation of pump	Damaged electrical parts	Replace all electrical parts.
Pump fails to deliver any flow	Incorrect brush wiring (incorrect pump rotation)	See Figures 502 through 505 for correct brush wiring.

TABLE 801. TROUBLESHOOTING (Cont'd)

Trouble	Probable Cause	Remedy
Fluid leaks through seal drain	Damaged seals (42, 43)	Replace seals.
Leakage at throat	Damaged packings (3, 4)	Replace packings.
	Damaged body (30)	Replace damaged body.

9. STORAGE INSTRUCTIONS

A. Flush pump with preservative oil and install plastic plugs in accordance with MIL-C-5501.

B. Encase pump in polyethylene bag, wrap in barrier material MIL-B-121 and place in a padded carton PPP-B-636 or equivalent.

C. Use desiccant MIL-D-4364 as required. Seal carton and stamp Part Number, Serial Number and Date of Overhaul on outside of carton.

10. SPECIAL TOOLS, FIXTURES AND EQUIPMENT

The test equipment required to test the pumps are listed under "Test Equipment" in Section 7, Testing. Maintenance can be accomplished with the use of special tools listed in Table 1001, as well as those normally available at maintenance faciliites. The tools may be obtained from the manufacturers indicated.

TABLE 1001. SPECIAL TOOLS

Part Number	Description and Manufacturer	Application
T56644	Screwdriver (V81982)	To remove and install locknut.
T47492	Impeller Wrench (V81982)	To hold impeller.
T57881	Bearing Support (V81982)	To assemble motor for run-in test.
T58525	Wrench (V81982)	To remove sleeve from canister.

11. ILLUSTRATED PARTS LIST

A. PURPOSE

The Illustrated Parts List is intended to assist customer personnel in requisitioning, storing and issuing the replaceable components and in identifying new and reclaimed parts. It is not approved for any other purpose.

The Illustrated Parts List does not list or illustrate parts which lose their identity by being permanently welded or riveted to other pieces, items made from raw (bulk) stocks, such as cut to lengths of conduit, electric leadwire, lockwire, etc.

B. HOW TO USE THE PARTS LIST

The figure number on the parts list refers to the corresponding illustration.

The number in the FIG. ITEM column corresponds to the item number pointing to the part on the corresponding illustration.

A vendor's part is identified by the vendor's part number in the PART NUMBER column and the vendor's Federal Supply Code number following the part description in the NOMENCLATURE column.

Quantities specified in the UNITS PER ASSY column are the total number of each part required per assembly or subassembly and are not necessarily the total used per complete end item assembly.

RF in the UNITS PER ASSY column indicates the item is listed for reference purposes.

AR in the UNITS PER ASSY column indicates parts are used as required.

The EFFECT CODE column contains one or more code letters indicating the configuration to which an assembly or part applies. When no code letter appears in the column, the part is common to all units.

C. GENERAL SYSTEM OF ASSEMBLY ORDER

The indention system used in this illustrated parts list shows the relationship of one part to another. Each unit listed is followed immediately by a listing of its component parts. For a given item, the

indention code shows a system, installation or general heading starting in the extreme left position continuing on down into succeeding columns until the end detail is reached, as follows:

1234567

Installation Assembly (RF) Number
.Detail Parts for Installation
.Assembly
.Attaching Parts for Assembly
***
..Detail Parts for Assembly
..Subassembly
..Attaching Parts for Subassembly
***
...Detail Parts for Subassembly
...Sub-subassembly
...Attaching Parts for Sub-subassembly
***
....Detail Parts for Sub-subassembly

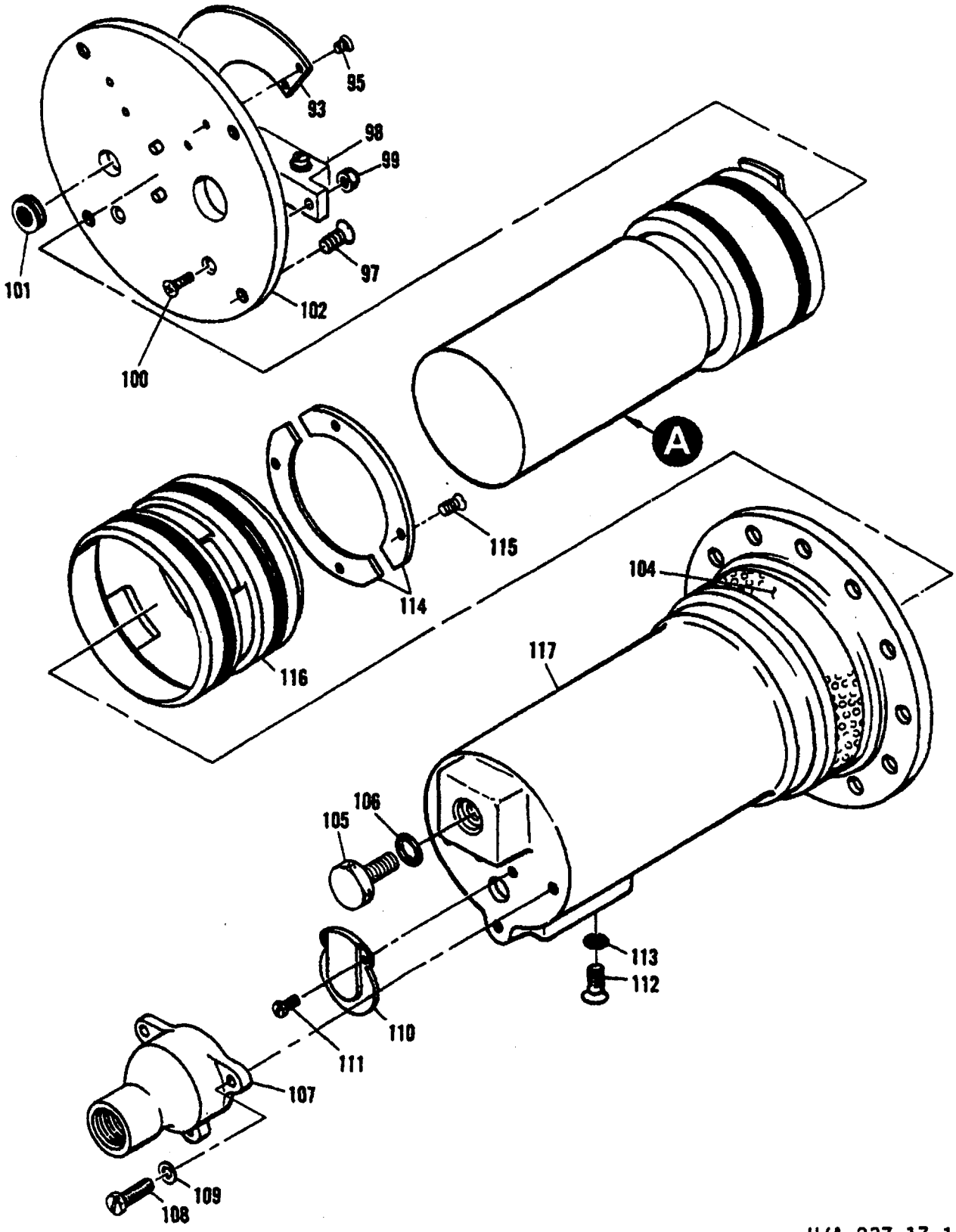
Parts are listed in general order of disassembly, with the exception of attaching parts. ATTACHING PARTS are captioned as such and follow immediately after the part they attach and are separated from other detail parts by the symbol ***.

D. VENDORS' CODE

Vendor parts used, unaltered by Hydro-Aire, are listed by vendor part number, vendor description and vendor code. Vendors' code symbols used in this publication are taken from Federal Supply Code of Manufacturers Cataloging Handbook H4-1 and H4-2. Following is a numerically arranged list of vendor codes used in this publication.

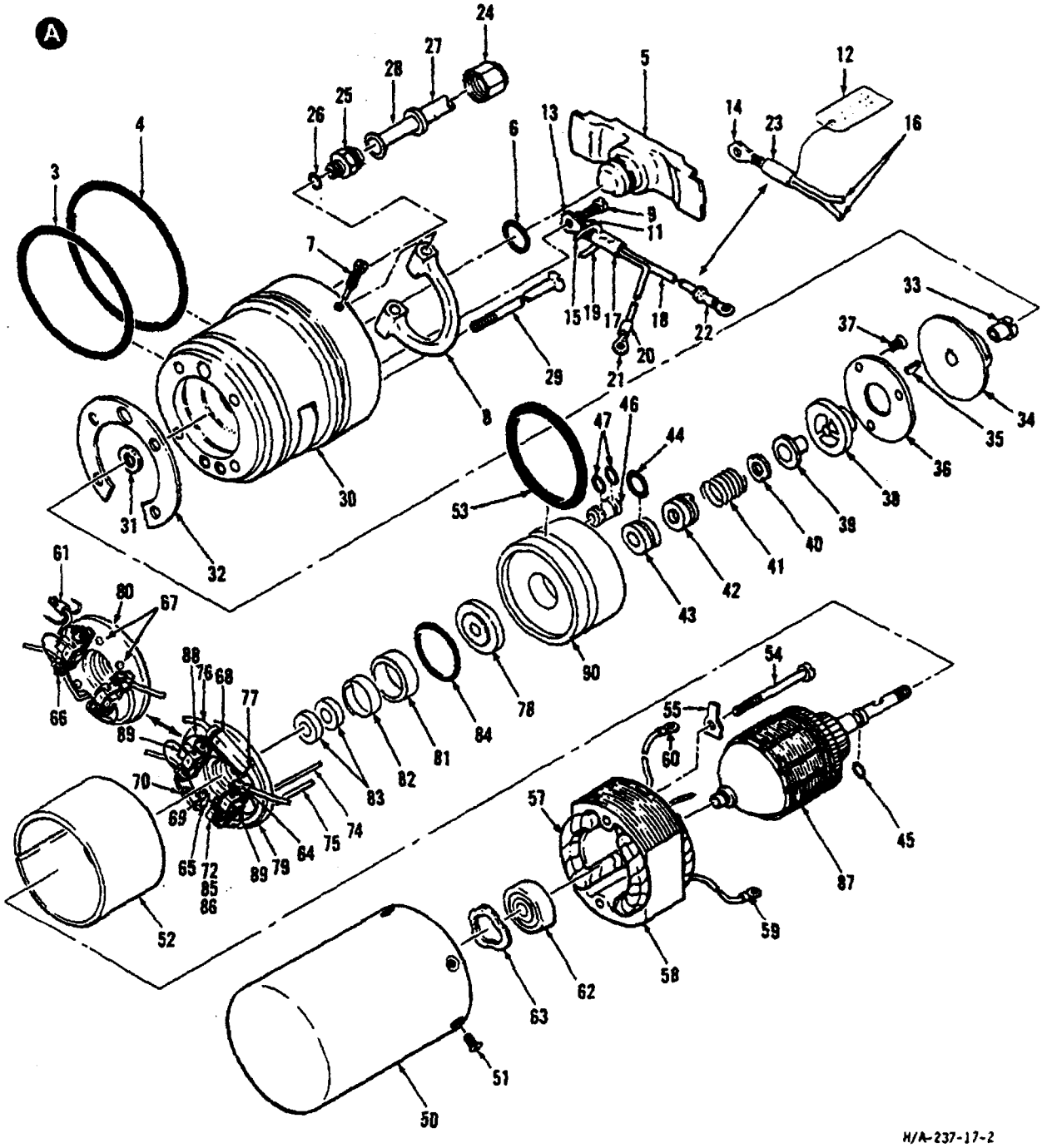
TABLE 1101. VENDOR CODE LIST

Vendor Code	Vendor Name and Address
V00779	Amp Incorporated Harrisburg, PA
V02310	Abscoa Industries, Inc. Inglewood, CA
V03038	Long Lok Corporation Santa Monica, CA
V06090	Raychem Corp. Menlo Park, CA
V21390	Litton Springfield, MO
V26045	Plough Inc. Memphis, TN
V59730	The Thomas and Betts Co. Elizabeth, NJ
V71884	Dow Corning Corp. Midland, MI
V81982	Hydro-Aire Division Crane Co. Burbank, CA
V84063	Amchem Products Inc. Ambler, PA



H/A-237-17-1

Fuel Booster Canister Pump - Exploded View (Sheet 1 of 2)
Figure 1101



Fuel Booster Canister Pump - Exploded View (Sheet 2 of 2)
Figure 1101

FIG. ITEM	PART NUMBER	NOMENCLATURE 1234567	UNITS PER ASSY	EFFECT CODE
1101	72266-3	PUMP, FUEL BOOSTER CANISTER	RF	A
	72390-2	PUMP, FUEL BOOSTER CANISTER	RF	B
-1	85816	.PUMP ASSEMBLY	1	A
-2	86060	.PUMP ASSEMBLY	1	B
3	HS232-91-148	..PACKING (V81982) (M25988/1-148 ALTERNATE)	1	
4	HS232-91-149	..PACKING (V81982) (M25988/1-149 ALTERNATE)	1	
5	86440	..LEVER, FUEL PUMP	1	
6	HS232-91-016	..PACKING (V81982) (M25988/1-016 ALTERNATE)	1	
7	85577	..SCREW, RETAINING HANDLE	2	
8	84667	..HANDLE, PUMP	1	
9	LL500-6-3	..SCREW (V03038)	1	A
-10	LL500-6-4	..SCREW (V03038)	1	B
11	AN960D6	..WASHER	1	
12	86200	..TAG, CAUTION	1	B
13	86257	..BRAID, SHIELD	1	A
14	86257-1	..BRAID, SHIELD	1	B
15	.093 ID RNF100	..SLEEVING, BLACK 4.25 LG (V06090)	1	A
16	44035-51	..TUBE, FLEXIBLE	2	B
17	.375 ID RNF100	..SLEEVING, BLACK .75 LG (V06090)	1	A
18	.250 ID RNF100	..SLEEVING, WHITE 3.00 LG (V06090)	1	A
19	.093 ID RNF100	..SLEEVING, BLACK 3.37 LG (V06090)	1	A
20	.125 ID RNF100	..SLEEVING, BLACK .50 LG (V06090)	1	A
21	A85	..TERMINAL (V59730)	1	A
22	MS20659-103	..TERMINAL	1	A
23	44035-65	..TUBE, FLEXIBLE	1	B
24	AN818-4D	..NUT, COUPLING	1	A
25	AN815-4D	..UNION	1	A
26	MS29512-04	..PACKING	1	A
27	MS20819-4D	..SLEEVE, FLARED TUBE	1	A
28	85815	..TUBING, 0.250 IN. DIA.	1	A
29	AB833F20LL	..SCREW (V02310)	3	
30	85660	..BODY	1	

-ITEM NOT SHOWN.

FIG. ITEM	PART NUMBER	NOMENCLATURE 1234567	UNITS PER ASSY	EFFECT CODE
1101				
31	50928-1	..SHIM, 0.002 IN. THICK (OPTIONAL WITH INDEX NO. 32)	AR	A
	50928-2	..SHIM, 0.006 IN. THICK (OPTIONAL WITH INDEX NO. (32)	AR	A
	50928-3	..SHIM, 0.009 IN. THICK (OPTIONAL WITH INDEX NO. (32)	AR	A
32	85667	..SHIM	AR	
33	MS21042-3	..NUT	1	A
-33A	54753	..NUT	1	B
34	84507-1	..IMPELLER	1	
35	84437	..KEY	1	
36	84495	..RETAINER, BUSHING	1	
		ATTACHING PARTS		
37	LL57G40S5	..SCREW (03038) ***	3	
38	84438	..BUSHING	1	
39	84439	..ADAPTOR	1	
40	52751	..DRIVE, SHAFT SEAL	1	
41	83547	..SPRING, HELICAL COMPRESSION	1	
42	52750	..SEAL, ROTATING	1	
43	84504	..SEAL, STATIONARY	1	
44	MS29513-019	..PACKING	1	
45	MS29513-008	..PACKING	1	
46	84659	..SLIP TUBE	3	
47	MS29513-007	..PACKING	6	
-48	86057	..MOTOR ASSEMBLY	1	A
-49	86059	..MOTOR ASSEMBLY	1	B
50	86056	...COVER ASSEMBLY	1	
		ATTACHING PARTS		
51	LL57G62S5	...SCREW (V03038) ***	4	
52	55899-3	...INSULATOR	1	
53	MS29513-141	...PACKING	1	
54	50965-1	...BOLT	2	
55	50966	...WASHER, KEY	2	
-56	85384	...FIELD COIL ASSEMBLY	1	
57	*86478	....COIL ASSEMBLY, D.C. MOTOR	1	
58	*54672	....CORE, LAMINATED STATOR	1	

-ITEM NOT SHOWN.
*NOT PROCURABLE SEPARATELY. ORDER NEXT HIGHER ASSEMBLY.

FIG. ITEM	PART NUMBER	NOMENCLATURE 1234567	UNITS PER ASSY	EFFECT CODE
1101				
59	31679	....TERMINAL, LUG (V00779)	1	
60	43351-14	....TERMINAL, LUG	1	
61	36964	...SPLICE, CLOSED END (V00779)	1	B
62	40456-85	...BEARING, BALL	1	
63	43515-14	...WASHER, SPRING	1	
64	LL500-4-4M	...SCREW (V03038)	2	
65	43351-11	...TERMINAL, LUG	2	A
66	43351-11	...TERMINAL, LUG	1	B
67	LL500-4-5M	...SCREW (V03038)	4	B
68	85236	...NOISE FILTER, R/F	1	A
		ATTACHING PARTS		
69	LL500-4-5M	...SCREW (V03038)	2	A
		***		
70	85124	...CAPACITOR, INSULATED	1	A
		ATTACHING PARTS		
71	LL500-4-5M	...SCREW (V03038)	1	A
		***		
72	85642	...CLAMP	1	A
		ATTACHING PARTS		
73	LL500-4-5M	...SCREW (V03038)	1	A
		***		
74	44059-209	...LEADWIRE (WHITE) (-)	1	B
75	44059-210	...LEADWIRE (RED) (+)	1	B
76	44035-45	...TUBE, FLEXIBLE	1	A
77	44035-55	...TUBE, FLEXIBLE	1	A
78	84494	...SLINGER	1	
79	85202	...PLATE ASSEMBLY, BRUSH HOLDER	1	A
80	84511	...PLATE ASSEMBLY, BRUSH HOLDER	1	B
81	84547	....HOLDER, FELT	1	
82	84884	....SPRING	1	
83	84573	....RING, FELT	2	
84	MS29513-020	...PACKING	1	
85	AN960D4	...WASHER	AR	B
86	AN960D4L	...WASHER	AR	B
87	84498	...ARMATURE ASSEMBLY	1	
88	54686	...SPRING, BRUSH	2	
89	59943	...BRUSH ASSEMBLY	2	
90	85661	...END BELL	1	
-91	85820	.CANIST[illegible] ASSEMBLY	1	A

-ITEM NOT SHOWN.

FIG. ITEM	PART NUMBER	NOMENCLATURE 1234567	UNITS PER ASSY	EFFECT CODE
1101				
-92	86049	.CANISTER ASSEMBLY	1	B
93	874-11	..NAMEPLATE	1	A
-94	874-12	..NAMEPLATE	1	B
		ATTACHING PARTS		
95	MS21318-7	..SCREW, DRIVE (V03038)	4	
		***		
-96	85781	...PLATE, TERMINAL BLOCK ASSEMBLY	1	A
		ATTACHING PARTS		
97	LL57G04P5	..SCREW (V03038) (NK50761024R5 ALTERNATE) (V21390)	4	
		***		
98	85198	..BLOCK, TERMINAL ASSEMBLY	1	A
		ATTACHING PARTS		
99	41967-42	..NUT	2	A
100	MS24693C28	..SCREW	2	A
		***		
101	85746	..GROMMET, RUBBER	1	
102	85776	..PLATE, LOCKING ASSEMBLY	1	A
-103	85668	..PLATE, LOCKING ASSEMBLY	1	B
104	84655	..SCREEN, INLET	1	
105	MS24391D4L	..PLUG	1	
106	MS29512-04	..PACKING	1	
107	86048	..FITTING, FUEL OUTLET	1	
		ATTACHING PARTS		
108	MS35265-45	..SCREW	3	
109	AN960C8	..WASHER	3	
		***		
110	86296	..VALVE, SWING CHECK	1	
		ATTACHING PARTS		
111	LL57N40S4	..SCREW (V03038)	2	
		***		
112	84285	..SCREW	1	
113	MS29513-007	..PACKING	1	
114	84654	..SEGMENT	2	
		ATTACHING PARTS		
115	LL57XA40J5	..SCREW (V03038)	4	
		***		

-ITEM NOT SHOWN.

FIG. ITEM	PART NUMBER	NOMENCLATURE 1234567	UNITS PER ASSY	EFFECT CODE
1101				
116	85757	..SLEEVE, VALVE ASSEMBLY	1	
117	86054	..CANISTER	1	

REF DWGS 72266-3, REV F; 72390-2, REV E
REF DWGS 85816, REV S; 86060, REV J
REF DWGS 86057, REV F; 86059, REV B
REF DWGS 85820, REV G; 86049, REV F

REPORT NO. 8-270

OVERHAUL MANUAL

WITH ILLUSTRATED PARTS LIST

FUEL BOOSTER PUMP

PART NO.

72368-1

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CRANE HYDRO-AIRE® DIVISION

CRANE CO. • 3000 WINONA AVENUE • P.O. BOX 7722 • BURBANK, CALIFORNIA 91510

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15 MARCH 1975

REVISED JAN 21/83

CRANE HYDRO-AIRE DIVISION

OVERHAUL MANUAL
72368-1

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ASSIGNED TO (JOB TITLE)								
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1	15 Aug 1977	H/A						
2	Jan 21/83							

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SERVICE BULLETIN LIST

SERVICE BULLETIN NO.	DATE INCORPORATED	SERVICE BULLETIN NO.	DATE INCORPORATED

OVERHAUL MANUAL
72368-1

INTRODUCTION

This publication is issued to provide instructions to overhaul the Fuel Booster Pump Assembly, Part No. 72368-1 manufactured by Hydro-Aire Division, Crane Co., Burbank, California.

The information in this manual is divided into sections in accordance with Air Transport Association Specification 100, to enable maintenance personnel to disassemble, clean, check, repair, assemble, troubleshoot and test the fuel booster pump. An illustrated parts list is provided to locate, identify and requisition parts.

To ensure that coverage contained in this handbook will reflect changes in the booster pump overhaul concepts and procedures, revised information is provided to the customer through a letter of transmittal. The letter includes highlight pages which identify changed pages.

Warnings, Cautions and Notes are used to emphasize information throughout this handbook. Warnings must be followed to avoid injury or death to persons. Cautions must be followed to avoid equipment damage, and Notes call attention to work simplification, or additional information.

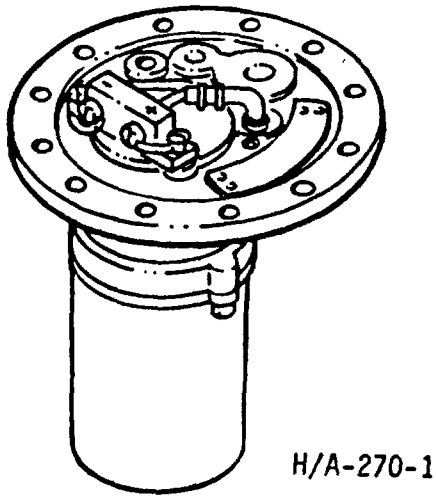
0.0 DESCRIPTION AND OPERATION.

A. DESCRIPTION. (See Figure 1.)

Hydro-Aire Fuel Booster Pump, Part No. 72368-1 is a rotary, power-driven screw type pump for use in small aircraft and helicopter installations. The self-contained source of power is an electrically-driven, explosion-proof motor whose main components are a field coil and an armature. The unit contains an internal radio noise filter per MIL-I-6181 and is of a wet carbon bearing design. Leading particulars are listed in Table 1.

B. PURPOSE AND LEADING PARTICULARS. (Refer to Table 1.)

The purpose of the fuel booster pump is to transfer fuel from the fuel system reservoir into feed lines at a specified design flow and pressure while submerged in the reservoir.



Fuel Booster Pump, Part No. 72368-1
Figure 1

C. OPERATION.

The field coil provides the flux which causes the armature to rotate when an electric current is made to flow through the system. Rotation of the armature turns the screw-type impeller enclosed in the pump chamber, thus creating the pump action.

TABLE 1. LEADING PARTICULARS

Pump Mounting Position	motor upward; major axis vertical
System Fluid	fuel Military Specification MIL-J-5624 (JP-4)
Rated Flow	450 pph at 22 psig (min)
Power Input	8.0 amps (max) at 28 vdc
Motor Duty Cycle	continuous
Zero Flow	33.6 psig (max)
Pump Discharge Port	per AND 10053 (MIL-P-7105) for 1/2 ANPT
Drain Ports (two)	per AND 10053 (MIL-P-7105) for 1/4 ANPT
Mounting Holes	12 holes 0.281 to 0.287 inch diameter equally spaced on 4.750 diameter bolt circle
Dimensions	2.64 in. dia to 5.25 in. dia x 6.62 in. high
Weight (dry)	4.0 pounds (max)

1.0 DISASSEMBLY.

A. See Figure 1101 and disassemble fuel pump noting the following:

WARNING: AVOID SPILLING FUEL. DO NOT ALLOW ANY FUEL TO REMAIN IN PUMP CHAMBERS OR PASSAGES. KEEP PUMP AWAY FROM OPEN FLAME.

CAUTION: PLACE ALL PARTS IN CLEAN COVERED CONTAINERS. KEEP PARTS (2 THROUGH 38) AND PARTS (40 THROUGH 81) SEPARATED.

(1) Remove lockwire. Note method of lockwiring for duplication during reassembly. (Item 2, Table 201)

(2) Do not remove nameplate (1) and screws (2) unless necessary for replacement.

(3) After removing valve assembly (10 through 13), inspect it as instructed in the CHECKING section, paragraph A, step (2). Disassemble only if replacement of a component is necessary.

(4) When removing shim (22), record thickness of laminations for use during reassembly after overhaul and modification.

(5) To remove slotted nut (25), carefully insert a hardwood stick between outer end of impeller (27) and pump body (81) to prevent armature assembly (71) from turning, then unscrew slotted nut. After removal of slotted nut, pull impeller from armature shaft, then remove shaft key (26).

(6) Remove three screws (29), retainer (28), bushing (31) and adapter (32).

CAUTION: REMOVE SEAL FROM ARMATURE ASSEMBLY SHAFT CAREFULLY TO AVOID DAMAGE TO LAP SEAL FACE.

(7) Remove seal (36) from armature assembly (71) as follows:

Prepare a soft wire lifter, horseshoe shaped, with flattened ends bent inward approximately 90 degrees. Insert wire lifter ends between seal (36) and pump body (81), then pull seal out of body bore.

CAUTION: LIFT MOTOR COVER ASSEMBLY FROM PUMP BODY CAREFULLY BY TWISTING SLIGHTLY AND PULLING SIMULTANEOUSLY TO AVOID DAMAGE TO ELECTRICAL LEADS AND TO FIELD COIL ASSEMBLY.

(8) Remove screws (41) and washers (42), then lift motor cover assembly (40) away from body (81) far enough to gain access to screws (44) which connect electrical leads to brush holder plate assembly (66). Identify electrical leads, positive and negative, and remove two screws (44). (See Figure 101 for wiring identification.)

(9) Remove screws (45) and key washers (46) securing field coil assembly (48 through 51) to motor cover assembly (40); then remove field coil assembly from motor carefully to avoid damage to coil assembly.

NOTE: Do not disassemble coil assembly. If any part requires replacement, replace entire assembly.

(10) Remove screws (56) securing brush holder plate assembly (66) to body (81) then lift armature assembly (71) with parts (34 through 38, 52, 54, 55, 59 through 70) attached from body (81). Discard packings (37, 38, 70).

NOTE: Some early Fuel Booster Pumps may contain washers under the brush holder plate assembly. If the pump does contain washers, the thickness must be noted during disassembly and either the same washers or washers of the same thickness must be used on reassembly to prevent armature from rubbing against the body.

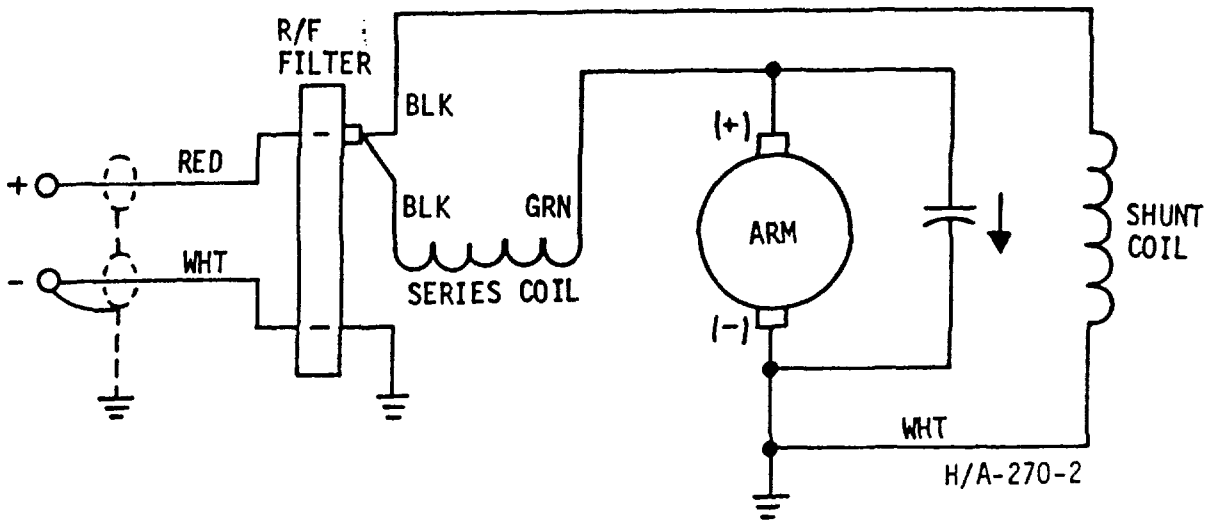
(11) Remove slinger (54) from armature assembly (71) shaft by holding armature in a vise with soft jaws as illustrated in Figure 102. Use two screwdrivers placed opposite each other between slinger (54) and plate assembly (66) and pry off from armature.

(12) Remove brush assemblies (65) by lifting springs (64), and sliding brushes out of holders.

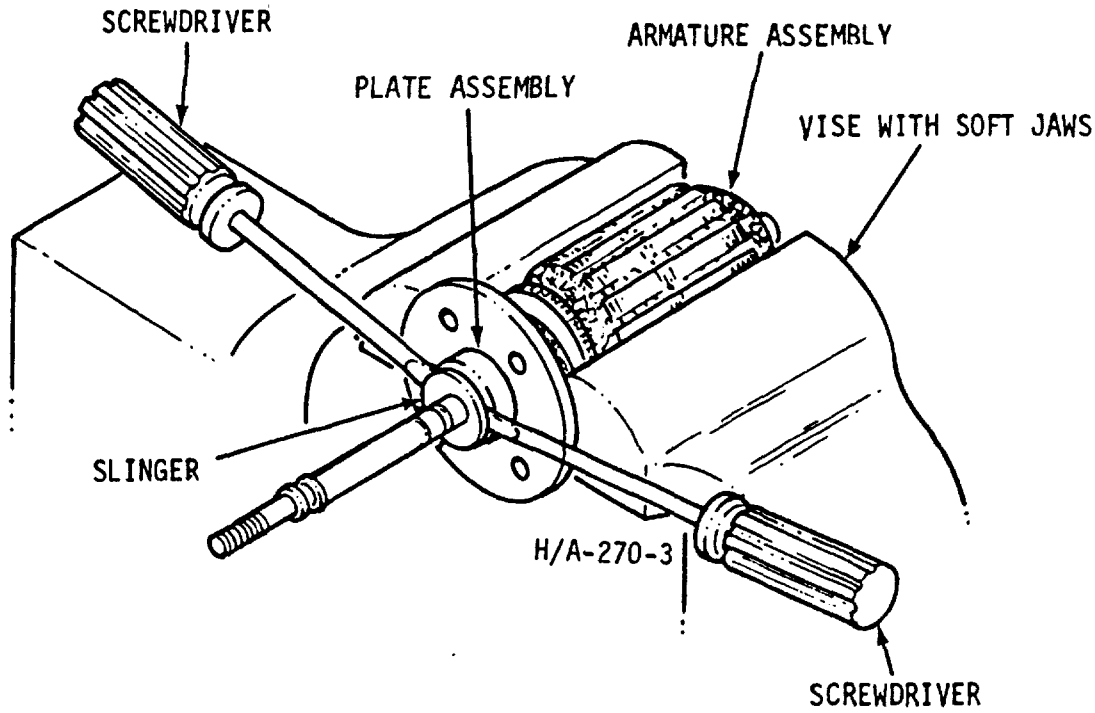
NOTE: Do not remove capacitor unless necessary for replacement. Do not remove springs from plate assembly when replacing brush assemblies. Do not remove flame arrester plug from body unless replacement is required. If plug is burned, clogged, or damaged, it may be removed by drilling out of body.

(13) Remove bearing (52) carefully to avoid damaging shaft threads.

NOTE: Use corrosion preventative oil (item 2, Table 201) and spray lubricate armature shaft of slinger and bearing several hours before disassembly.



Wiring Diagram
Figure 101



Slinger Removal
Figure 102

2.0 CLEANING.

A. Clean all nonelectrical parts, except bearings, with an approved mineral oil base cleaning solvent, (item 1, Table 201). Dry with moisture free, filtered, compressed air at 20 psig or use a clean, lint-free cloth. Make certain that flame arrester plug (80) is not clogged.

WARNING: SOLVENT, FEDERAL SPECIFICATION P-D-680 IS FLAMMABLE AND TOXIC. USE IN A WELL-VENTILATED AREA AWAY FROM FLAME AND HOT SURFACES. DO NOT DIRECT AIR PRESSURE AGAINST SOLVENT IN CONTACT WITH SKIN. BREATHING FUMES MAY CAUSE INJURY TO PERSONNEL.

B. Remove all surface dirt and grease, and clean electrical parts with a lint-free cloth slightly moistened with solvent.

WARNING: WHEN USING COMPRESSED AIR, DIRECT AIRSTREAM AWAY FROM BODY AND OTHER PERSONNEL.

C. Blow out bores, passages, orifices and ports with filtered compressed air at 20 psig.

D. Remove all paint from exterior surfaces using paint and varnish remover (item 3, Table 201).

E. Place all cleaned parts in clean, dust-tight containers.

TABLE 201. CLEANING MATERIALS

Item No.	Material	Type or Grade	Government Specification
1	Dry Cleaning Solvent		P-D-680
2	Corrosion Preventative Oil	WD 40	Not Known
3	Paint and Varnish Remover	999	Not Known

3.0 INSPECTION/CHECK.

A. The following visual check should be made under a strong light and preferably under magnification. (See Figure 1101.)

(1) Visually check all metallic parts, as applicable, for breaks, cracks, nicks, scratches, scoring, stripped or crossed threads, corrosion, distortion, worn plating, pitting, or other obvious damage.

(2) Verify condition of check valve assembly (10 through 13) to make sure that it is not distorted, that flapper (12) is seated by spring (11) tension, and that valve opens and closes smoothly without binding. Check security of installation of flapper (12) components.

(3) Check throat (21) for a minimum outside diameter (not a mounting section) of 1.810 ±0.001 inches. Check bore of throat for nicks or scratches which would indicate distortion of pump components and/or improperly installed impeller (27), or presence of foreign matter in impeller vanes.

(4) Check impeller (27) for broken, cracked or bent vanes.

(5) Check seals (35, 36) for condition of contact area by running fingernail across sealing surface and examining under magnification. There shall be no evidence of galling or roughness.

(6) Check alignment of spring (34) by rolling spring across a clean, smooth, flat surface; spring shall not wobble. Test spring for stacking, or fatigue by measuring free length and compressed length. Free length of spring shall be approximately 1.000 inch; under a load of 1.806 to 2.006 pounds, assembled length shall be 0.280 inch.

NOTE: Flapper spring (11) and brush spring (64) if removed, must be replaced.

(7) Check coil assembly (48 through 51) for security of installation and condition of lead terminals. Check laminations for nicks or scratches which would indicate a distorted pump assembly or worn bearing (52) causing armature assembly (71) to rub against coil assembly. Check condition of insulation on coil (leads). Measure coil resistance at 70°F. Resistance of shunt coil white lead to black lead shall be 80 ±4 ohms. Resistance of series coil black lead to green lead shall be 0.209 ±0.002 ohms.

(8) Check armature assembly (71) for smooth and shiny commutator surfaces and insulators between commutator bars recessed approximately 0.025 inch. Check shaft for evidence of excessive heat around bearing area. Check commutator with a growler for open windings.

(9) Check body (81) for warped mounting flange caused by unbalanced or excessive torque applied to installation bolts. Check body bore for evidence of incorrectly installed impeller (27) as indicated by nicks and/or heavy scratches.

4.0 REPAIR/REPLACEMENT.

A. Repair or replace disassembled parts of Fuel Booster Pump as follows:

(1) Noncritical internal surfaces of body (81) and external surfaces may be polished with aluminum abrasive cloth, (item 1, Table 401) provided that not more than 0.002 inch of material is removed from polished area.

WARNING: NON-METALLIC ITEMS THAT COME IN CONTACT WITH ALODINE BECOME HIGHLY FLAMMABLE. PLACE ALL RAGS, SWABS, PAPERS AND/OR BRUSHES USED IN APPLYING ALODINE IN CONTAINER MARKED OR DESIGNATED FIREPROOF FOR DISPOSAL.

(2) Alodine protected surfaces may be touched up using alodine (item 2, Table 401).

CAUTION: DO NOT ATTEMPT TO REMOVE LIGHT SCRATCHES OR OTHER MINOR IMPERFECTIONS FROM COMMUTATOR BARS OR COIL LAMINATIONS BY POLISHING OR ANY OTHER METHOD TO PREVENT ALTERATIONS OF THE DESIGN GAP BETWEEN COIL AND ARMATURE. IF COIL ASSEMBLY OR ARMATURE ASSEMBLY IS OBVIOUSLY DAMAGED AS INDICATED BY HEAVY SCRATCHES, DISTORTION OF COMMUTATOR BARS OR COIL ASSEMBLY LAMINATIONS, REPLACE THE PART.

(3) Replace coil assembly (48 through 51) and/or armature assembly (71) if electrical requirements specified for these parts are not met.

(4) Replace entire pump assembly if there is evidence of distorted assembly.

(5) Replace any part which fails to meet checking requirements and is obviously damaged beyond allowable repairs. Replace any part heavily scratched, pitted, corroded, obviously distorted, or cracked.

(6) At every overhaul replace all packings, key washers (46), motor brushes (65) and bearing (52). Replace removed springs (11, 64).

(7) Replace placarding or decals if damaged or illegible. Brush or spray trichloroethylene (item 6, Table 401) to activate adhesive backing.

TABLE 401. CONSUMABLE MATERIALS

Item No.	Material	Type or Grade	Government Specification
1	Abrasive Aluminum Oxide Cloth		P-C-451
2	Alodine		MIL-A-8625
3	Lockwire		MS20995C20
4	Solder SN50, SN60		QQ-S-571
5	Fluro Silicone Grease	FS1292	
6	Trichloroethylene		MIL-T-27602
7	Garnet Paper	240A	

(8) Remove corrosive carbon buildup or burrs from armature with finishing paper (item 7, Table 401).

(9) Install armature assembly (71) in standard lathe and using diamond tool resurface commutator removing not more than 0.003 inches of material. Diameter of commutator must not be less than 0.860 inches minimum after resurfacing. (If resurfacing does not clean the commutator, replace with new armature). After resurfacing, undercut commutator to remove all mica slivers, using 0.020 inch wide cutter, 0.025 inches deep.

(10) After repair, check armature on growler for continuity and shorts.

5.0 ASSEMBLY.

A. See Figures 501, 502, 503, 504 and 1101; assemble fuel pump noting the following:

NOTE: All parts must be kept thoroughly clean before and during assembly.

(1) Install one washer (78) over tubes (74, 71, 72). Slit grommet (79) and place over tubes. Slide grommet down on wire leads until washer is between grommet and lead shielding. Insert leads through second washer (78) into passage in body (81) and pull leads out of upper surface of body. Pull leads through until grommet and both washers are seated in body passage, then install retaining ring (77).

(2) Stake one terminal (73) to white wire lead (-) join shielding of white lead and red lead together and crimp terminal to both shieldings. Stake the other terminal (73) to red wire lead (+).

(3) Assemble parts (34 through 38, 54, 55, 59 through 70) and carefully position armature assembly (71) on body (81). Insert lead wires through opening in plate assembly (66) then secure installation with screws (56) which attach brush holder plate assembly (66) to body (81).

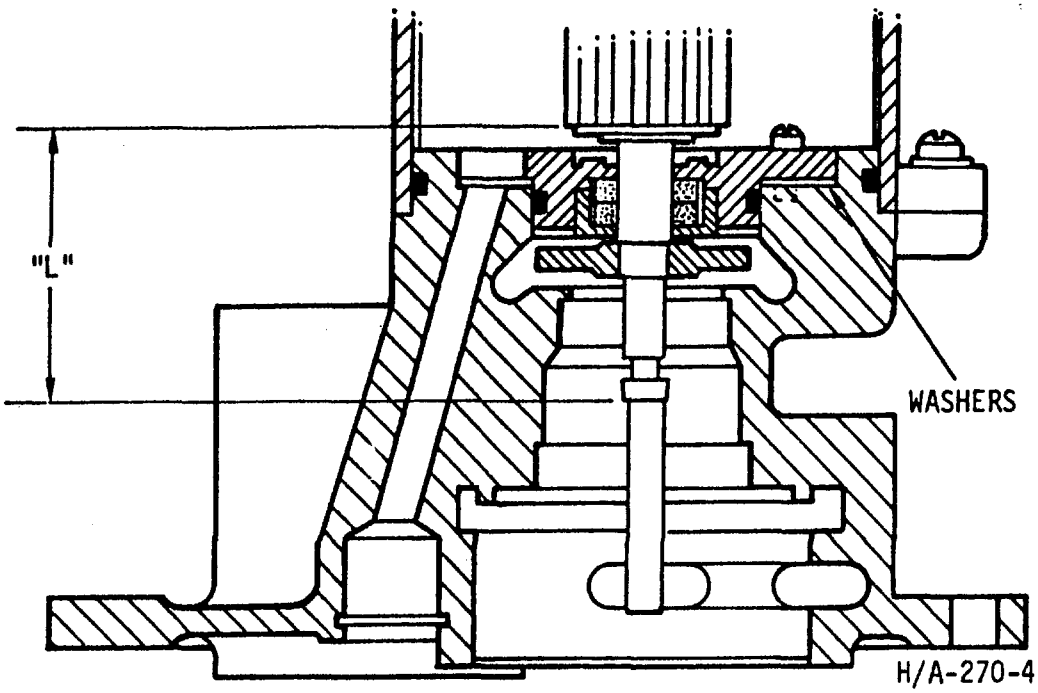
NOTE: If washers were noted under brush holder plate assembly during disassembly, install same washers or washers of the same thickness to maintain dimension "L" of Figure 501.

(4) Fasten washers to underside of plate assembly (66) using Eastman 910 adhesive or equivalent.

(5) Install spring washer (53) and bearing (52) in recessed bottom of cover assembly (40) internal boss.

(6) See Figure 502, install field coil assembly (48 through 51) in cover assembly (40) and secure with key washers (46) and screws (45). Tighten screws and bend key washer tabs against flat of bolt heads. Install insulator (43).

(7) Connect leads of coil assembly (48 through 51); each lead wire and leads of brush assembly (65) to brush holder plate assembly (66) with screws (44).



Dimension "L" (in.)	No. of Washers Required AN960D4	AN960D4L	Stack Height (in.)
1.645 to 1.631	1	1	0.048
1.630 to 1.616	1	0	0.392
1.615 or less	0	1	0.016

NOTE: Fasten washers to underside of brush holder plate assembly using Eastman 910 adhesive.

Assembly Dimensional Data
Figure 501

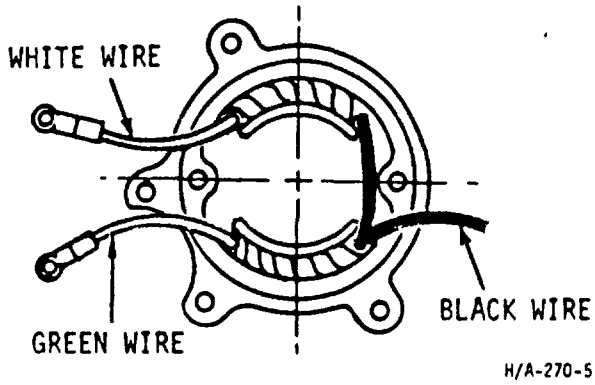
CAUTION: CONNECT WHITE WIRE OF LEAD AND WHITE LEAD OF COIL ASSEMBLY TO NEGATIVE (GROUNDED) SIDE OF BRUSH HOLDER PLATE ASSEMBLY. CONNECT WHITE/BLACK STRIPE TRACER WIRE OF LEAD AND GREEN LEAD OF COIL ASSEMBLY TO POSITIVE (INSULATED) SIDE OF BRUSH HOLDER PLATE ASSEMBLY.

(7) Perform the following motor tests before continuing reassembly procedures.

(a) Dielectric Strength.

(1) Lift negative brush off commutator to unground motor.

(2) Apply 600 volts (rms), 60 cps, between positive (black) wire terminal and motor assembly cover or body for one second. There shall be no flashover or any evidence of damage.



Field Coil Installation
Figure 502

(b) Brush Run-in Test.

CAUTION: THE ELECTRIC CIRCUIT AND THE MOTOR INCLUDE AN ELECTROLYTIC CAPACITOR. IF POLARITY OF POWER IS REVERSED EVEN FOR A FRACTION OF A SECOND, THE CAPACITOR WILL BURN OUT, AND THE UNIT WILL LOSE ITS RADIO NOISE FILTERING ABILITY. THERE IS NO EASY WAY TO DETERMINE WHETHER THE CAPACITOR IS FUNCTIONING OR BURNT OUT. EXTREME CARE IS REQUIRED TO OBSERVE CORRECT POLARITY.

RED WIRE: POSITIVE (+)

BLACK WIRE: NEGATIVE (-)

(1) Replace negative brush in brush holder plate assembly making certain it contacts the commutator.

(2) Connect motor to a direct-current power source.

(3) Operate motor, unloaded, for 30 minutes. Check for armature balance. Motor must operate smoothly and direction of rotation (as viewed from shaft end) shall be clockwise. No load speed shall not exceed 14,000 rpm at 28.75 volts d.c.

(4) Adjust power supply to deliver voltage required to reduce the no-load speed to 11,000 rpm and allow motor to run until 90 percent brush contact in the direction of rotation is obtained.

NOTE: Run-in time to be 24 hours minimum. Brush contact to be determined by sampling inspection.

(c) Load Test.

(1) Couple motor shaft to a dynamometer. With 28.75 d.c. applied, load motor to 12.0 ounce-inch torque.

(2) At 12.0 ounce-inch load, minimum shaft speed shall be 11,000 rpm and maximum current drain shall be 7.3 amperes.

NOTE: If insufficient motor speed is observed, refer to Trouble-shooting Chart, Table 801 for cause of trouble and remedy. Correct condition before proceeding with reassembly of pump (see Assembly paragraph A. 7).

(8) Turn pump motor upside down and install packing (37) on stationary seal (36), and install seal on armature assembly shaft.

(9) Install packing (38) on armature assembly shaft.

(10) Carefully install shaft rotating seal (35) and shaft seal drive (33) on armature assembly shaft. Place spring (34) over shaft on rotating seal; then install adaptor (32), bushing (31) and retainer (28). Secure retainer to body with screws (29).

(11) Install shaft key (26) on armature assembly shaft. Install impeller (27) and secure on shaft with locknut (25). Torque locknut to 5. 50 ±0. 50 inch-pounds.

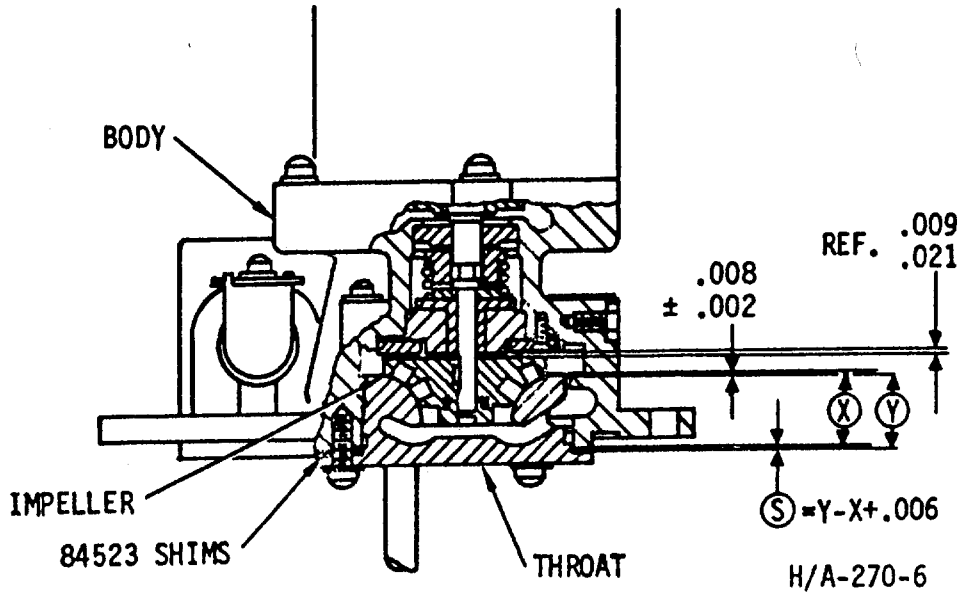
NOTE: Rotate impeller and shaft by hand to check for binding. Impeller must rotate freely.

(12) Determine end play of shaft of armature assembly (71) by pushing shaft down by hand until it bottoms and measuring depth of shaft end with depth gage. Pull shaft up by hand to extreme height and again measure depth of shaft end; the difference between the two measurements is the shaft end play. Record this figure.

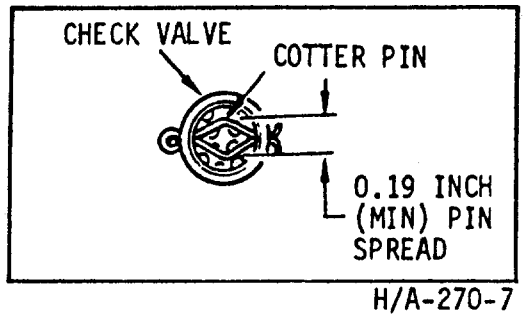
(13) To obtain required clearance between installed impeller (27) and throat (21), see Figure 503 and determine dimension "X" (distance from narrow spiral face of impeller blade at its extreme end to bottom face of pump body). Measure depth of throat (21), dimension "Y". See Figure 503 for applicable expression of shim (22) thickness "S" and add dimension obtained in step (12) to shim thickness.

(14) Peel off or add laminations to shim (28) as required and install correct shim thickness on throat, matching installation holes in shim and throat. Install packings (23, 24) in throat grooves.

(15) Reassemble check valve (8), if disassembled, install screen (7) and secure with cotter pin (6). See Figure 504 for cotter pin installation details.



Installation Details and Shimming
Figure 503



Cotter Pin Installation
Figure 504

(16) Check that flapper (12) operates freely, without binding. Load required to unseat flapper shall not exceed 0.0072 pound. Install check valve assembly (8) in pump body and secure with screw (9).

NOTE: Install check valve assembly (8) with hinge-pin side upward.

(17) Install screen (3) and secure with washers (5) and screws (4). Lockwire screws (4) as noted during disassembly.

(18) Secure nameplate (1) to bottom of pump with screws (2), if removed during disassembly.

(19) Test reassembled unit as directed in paragraph 7.0 and calibrate as instructed in paragraph 7.A.(6)(b).

6.0 FITS AND CLEARANCES.

A. This section is not applicable to this manual. See ASSEMBLY, Section 5.0, for assembly clearances.

7.0 TESTING.

A. Proceed with testing and calibration as follows:

(1) Test Equipment.

(a) A fluid reservoir capable of pressurization and equipped with an AN4130-7 fitting must be available for mounting and submersion of pump.

(b) See Figures 701 and 702 for test setup and related equipment.

(c) As test fluid, use solvent, Federal Specification P-D-680, Type I Stoddard solvent (formerly P-S-661). Fluid temperature +70° to +90°F (+21.1° to +32.2°C).

(d) Unless otherwise specified, all tests shall be conducted at ambient temperature between +60°F and +90°F (+15.6 to +32.2°C) and ambient atmospheric pressure.

(2) Pump Tests.

NOTE: During the following tests, check for seal leakage at seal drain port. There shall be none. Should leakage occur, disassemble pump to extent required to replace rotating seal (35, Figure 1101) and stationary seal (36).

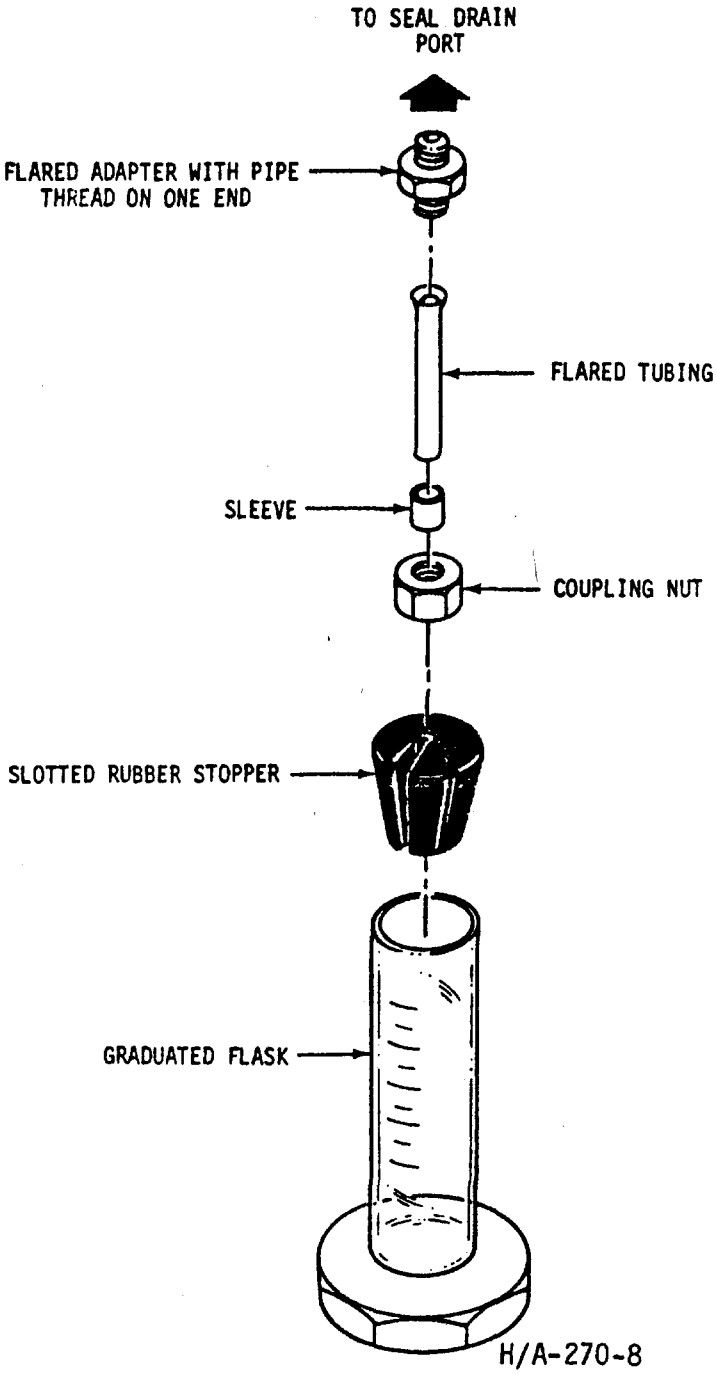
(3) Wet Running-In.

NOTE: Fluid temperature shall not exceed 100°F during this test.

(a) Start fully submerged pump at rated voltage then immediately reduce voltage until current drops to 8.0 amperes maximum.

(b) Pumps to be run-in wet for 18 hours minimum. During run-in adjust voltage periodically to rated voltage. Do not exceed the 8.0 maximum ampere limit.

NOTE: The wet running-in test is completed when with rated voltage applied, the current does not exceed 8.0 amperes.



Shaft Seal Leakage Setup
Figure 701

(4) Shaft Seal Leakage. (See Figure 701.)

(a) This test to be conducted simultaneously with the running-in procedure for a minimum of 18 hours.

(b) At end of this time check that the total leakage at seal drain port shall not exceed 2.25 cc or 3 cc per 24 hours.

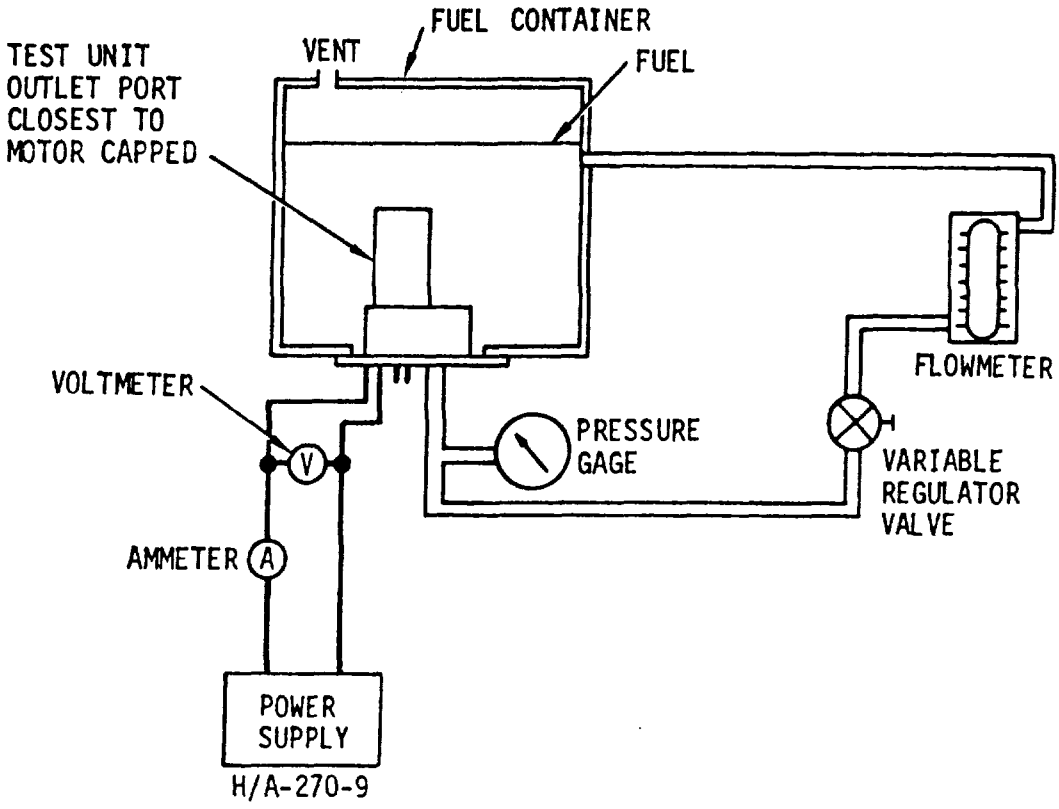
(5) External Leakage Test.

(a) Mount pump in suitable reservoir and connect the hydraulic test setup as illustrated in Figure 702. Fill reservoir with enough test fluid for complete submergence of fuel pump.

NOTE: Use dry cleaning (Stoddard) solvent, Federal Specification P-D-680, Type I, at +80°F ±10°F.

(b) Apply 15 psig air pressure to reservoir for five minutes and check for leakage at flange casting, seal drain port, motor vent, or any other external (exposed) surfaces of pump. There shall be no leakage allowable.

(c) Relieve air pressure from reservoir.



Test Setup
Figure 702

(6) Calibration.

CAUTION: IF CURRENT DRAIN FLUCTUATES NOTICEABLY, SHUT OFF MOTOR SINCE CURRENT FLUCTUATIONS MAY INDICATE MOTOR OVERHEATING. KEEP RESERVOIR FLUID COOL BY FANNING OR ANY OTHER CONVENIENT METHOD.

(a) With pump submerged in reservoir fluid, connect leads to a 28 vdc power supply as shown in Figure 702.

(b) Run pump for a minimum of 15 minutes at rated voltage. Record fluid, flow, pressure and amperes at two performance points. Adjust needle valve to allow zero and maximum (1.15 gpm) flow and calibrate pump so that the performance requirements listed in Table 701 are met without interruption or switching pump off and on.

TABLE 701. CALIBRATION PARAMETERS

Test Fluid	GPM	PSI	AMPS
P-D-680, Type I	0	33.6 Max	8.0 Max
P-D-680, Type I	1.15	22.0 Min	8.0 Max

NOTE: Pumps which exceed the maximum permissible amperes may be retested starting with paragraph A. (3) - Wet Running-In of Testing section.

8.0 TROUBLESHOOTING.

A. Trouble or test failure is normally traced by the nature of the malfunction.

(1) If fuel booster pump fails any any of the preceding tests, refer to Table 801, Troubleshooting Chart for probable cause and remedy.

(2) Replace parts as required and repeat all tests.

TABLE 801. TROUBLESHOOTING CHART

Trouble	Probable Cause	Remedy
Motor overheats Excessive current drain	Insufficient clearance between impeller (27) and body (81), and/or between impeller and throat (21)	Refer to Assembly paragraphs A. (13) and (14) for proper shimming; disassemble unit to extent required to check impeller clearances.
Insufficient motor rpm	Damaged bearing (52)	Replace damaged bearing.
	Coil assembly (47) and armature (71) binding, or damaged parts	Remove any foreign matter caught between coil and armature. Check these parts for damage; replace if damaged.
Pump delivery above or below desired values	Improper shimming	Refer to Assembly paragraphs (12 through 14) and correct impeller clearances.
	Damaged impeller (27) and/or throat (21)	Replace damaged part or parts.
Erratic operation of pump	Damaged electrical parts	Replace all electrical parts.
Pump fails to deliver any flow	Incorrect brush wiring (incorrect pump rotation)	See Figure 101 for correct brush wiring.
Fluid leakage through seal drain	Damaged seals (35, 36)	Replace seals.
Leakage at throat	Damaged packings (23, 24) Damaged throat (21)	Replace packings. Replace damaged throat.

9.0 STORAGE INSTRUCTIONS.

A. Prepare pump for storage or shipment as follows:

(1) Visually check pump for damage.

(2) Flush pump with preservative lubricating oil and install plastic plugs in accordance with MIL-C-5501.

(3) Encase pump in polyethylene bag, wrap in barrier material MIL-B-121 and place in a padded carton PPP-B-636 or equivalent.

(4) Use desiccant MIL-D-4364 as required, seal carton and stamp part number, serial number and date of overhaul on outside of carton.

10.0 SPECIAL TOOLS, FIXTURES AND EQUIPMENT.

A. No special tools, or fixtures are required. Refer to TESTING, section 7.0, and Figures 701 and 702 for test equipment required.

11.0 ILLUSTRATED PARTS LIST.

A. This section lists and illustrates parts for Fuel Booster Pump Assembly, Part No. 72368-1.

(1) Using the Parts Breakdown.

(a) This section is a breakdown of assemblies and detail parts of the unit. Index numbers on the exploded view illustration accompaying the parts breakdown indicate the order of disassembly of the unit for maintenance purposes. Component parts are indented to show relationship to the complete assembly.

(b) The Units Per Assy column of the parts breakdown indicates the quantity of each part required for the next higher assembly. The letters AR in this column indicate that the part is used as required. Letters
purposes.

(c) The Usable on Code column contains an alphabetical code which indicates applicability and interchangeability of parts. Where no code appears the part is applicable to all articles.

(d) Part numbers and description in the parts breakdown identify each part. The index numbers in the parts breakdown refer to the accompanying exploded view, and are used for locating a part after the part has been found in the illustration.

(e) Attaching parts are listed immediately beneath the item to be attached and preceding any detail part of the item. The caption "ATTACHING PARTS" is placed on the line immediately above the listing of attaching parts. The separation symbol "***" follows the listing of attaching parts in order to distinguish between attaching parts and subsequent listings of parts with the same indention or detail parts of the next indention to the right.

(2) Manufacturer's Codes.

(a) Manufacturer's code numbers are used in the parts breakdown to indicate original equipment procurement sources. These code numbers are placed in parenthesis following the part name in the Description column of the parts breakdown. No manufacturer's code following the part number indicates the part source is Hydro-Aire Division, Crane Co.

(b) Manufacturer's code numbers are in accordance with the Federal Supply Code for Manufacturers Cataloging Handbook H4-1 and H4-2. The codes, names and addresses of the manufacturers are listed numerically as follows:

Code	Manufacturer and Address
03038	Long-Lok Corporation Los Angeles, CA 90066
43334	New Departure, Hyatt Division General Motors Sandusky, OH 44870
81982	Hydro-Aire Division Crane Co. Burbank, CA 91504
83930	DeLaval Adel Fasteners Division Huntington, West Virginia 25704
88044	Aeronautical Standards Group Department of Navy and Air Force
96906	Military Standard Promulgated by Standardization Division Directorate of Logistic Services DSA

(3) Model.

(a) This parts list covers Hydro-Aire Fuel Booster Pump, Part No. 72368-1.

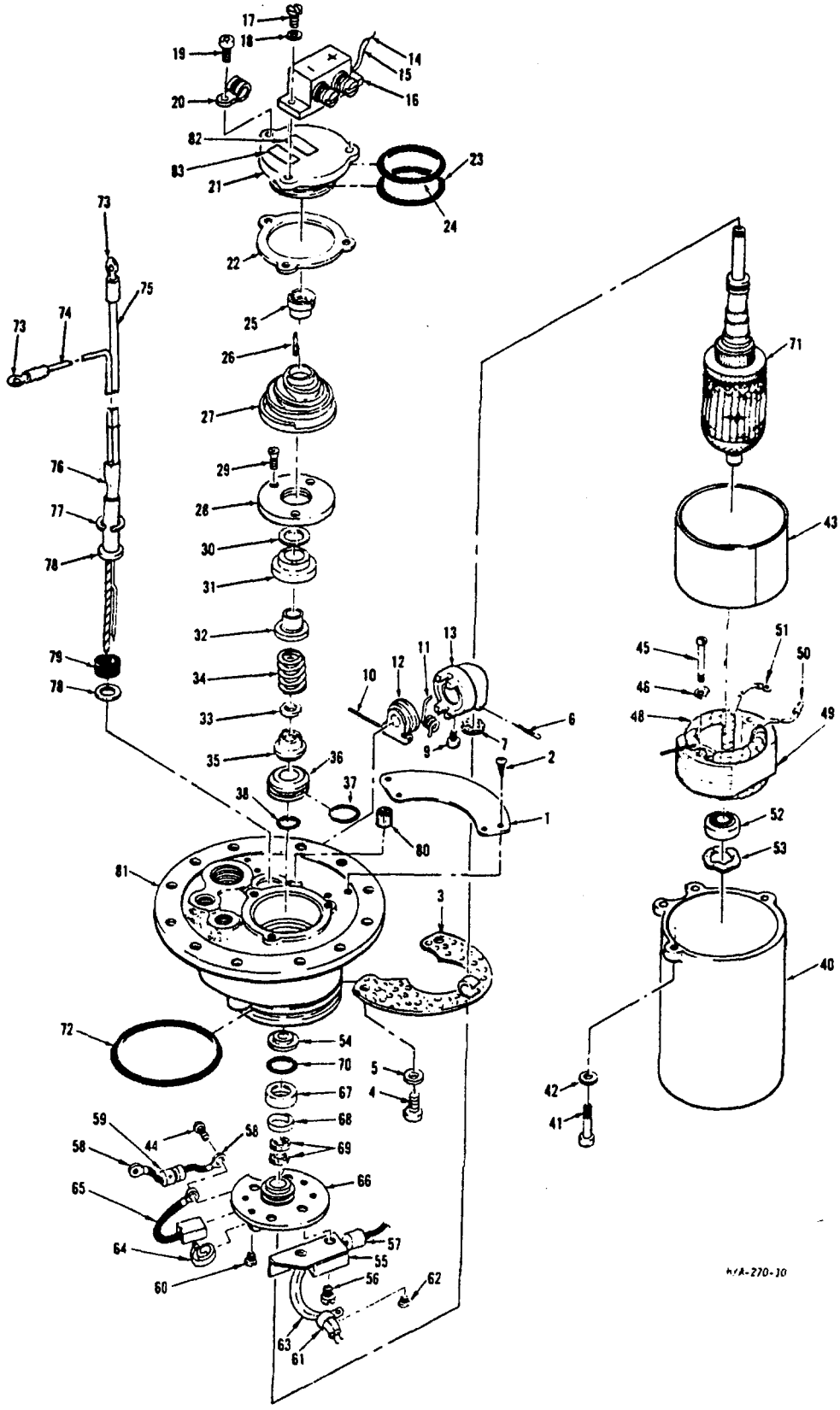
(4) General System of Assembly Order.

1 2 3 4 5 6 7

Installation
- Detail Parts for Installation
- Assembly
- Attaching Parts for Assembly
  - Detail Parts for Assembly
  - Subassembly
  - Attaching Parts for Subassembly
    - Detail Parts for Subassembly
    - Sub-Subassembly
    - Attaching Parts for Sub-Subassembly
      - Detail Parts for Sub-Subassembly

Parts are listed in general order of disassembly, with the exception of attaching parts. Attaching parts are captioned as such and follow immediately after the part they attach and are separated from the other detail parts by the symbol "***".

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Fuel Booster Pump, Part No. 72368-1, Exploded View
Figure 1101

FIG. & INDEX NO.	PART NO.	NOMENCLATURE 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
1101-	72368-1	PUMP ASSEMBLY, FUEL BOOSTER	RF	
1	874-9	. NAMEPLATE	1	
		ATTACHING PARTS		
2	MS21318-7	. SCREW, DRIVE (V96906)	4	
		***		
3	85659	. INLET SCREEN ASSEMBLY	1	
		ATTACHING PARTS		
4	MS35265-26	. SCREW (V96906)	2	
5	AN960D6	. WASHER, FLAT (V88044)	2	
		***		
6	MS24665-155	. PIN, COTTER (V96906)	1	
7	52257	. SCREEN	1	
-8	52258	. VALVE ASSEMBLY, FUEL PUMP	1	
		ATTACHING PARTS		
9	MS35265-28	. SCREW (96906)	1	
		***		
10	25482	. . PIN, HINGE	1	
11	23849	. . SPRING, FLAPPER	1	
12	23357	. . FLAPPER, VALVE	1	
13	52256	. . BODY, CHECK VALVE (84830 ALT)	1	
14	MS20995C20	. LOCKWIRE (V96906)	AR	
15	44035-60	. TUBE, FLEXIBLE	1	
16	85198	. BLOCK ASSEMBLY, TERMINAL	1	
		ATTACHING PARTS		
17	MS35265-46	. SCREW (V96906)	2	
18	AN960D8L	. WASHER, FLAT (V88044)	2	
		***		
19	MS21295-21	. SCREW (V96906)	1	
20	754SS-4-2-6	. CLIP, LINE SUPPORT (V83930)	1	
21	84508	. THROAT, PUMP	1	
22	84523	. SHIM, LAMINATED	AR	
23	MS29513-030	. PACKING, PREFORMED (V96906)	1	
24	MS29513-130	. PACKING, PREFORMED (V96906)	1	
25	54753	. NUT, SLOTTED	1	
26	84437	. KEY, SHAFT	1	
27	84507-1	. IMPELLER, PUMP	1	
28	84495	. RETAINER, BUSHING	1	
		ATTACHING PARTS		
29	LL57G40S4	. SCREW (V03038)	3	
		***		
30	50928-3	. SHIM (0.009 IN. THICK) OPTIONAL	AR	
31	84438	. BUSHING, CARBON	1	
32	84439	. ADAPTOR, THRUST	1	
33	52751	. DRIVE, SHAFT SEAL	1	
34	83547	. SPRING, HELICAL COMPRESSION	1	
35	52750	. SEAL, SHAFT ROTATING	1	
36	84504	. SEAL, STATIONARY	1	
37	MS29513-019	. PACKING, PREFORMED (V96906)	1	
38	MS29513-008	. PACKING, PREFORMED (V96906)	1	
-39	85200-1	. MOTOR ASSEMBLY, PUMP	1	
40	84701	. . COVER ASSEMBLY, MOTOR	1	A
	84873	. . COVER ASSEMBLY, MOTOR (ALTERNATE)	1	B
		ATTACHING PARTS		
41	MS35265-45	. . SCREW (V96906)	4	A
	MS35265-45	. . SCREW (V96906)		B

FIG. & INDEX NO.	PART NO.	NOMENCLATURE 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
1101-				
42	AN960D8L	. . WASHER, FLAT (V88044)	4	A
	AN960D8L	. . WASHER, FLAT (V88044)	3	B
		***		
43	55899-1	. . INSULATOR	1	
44	LL500-4-4M	. . SCREW (V03038)	2	
45	50965-1	. . SCREW, FIELD COIL MOUNTING	2	
46	50966	. . WASHER, KEY	2	
-47	85384	. . FIELD COIL ASSEMBLY	1	
48	*86478	. . . COIL ASSEMBLY, DC MOTOR	1	
49	*54672	. . . CORE, LAMINATE STATOR	1	
50	31679	. . . TERMINAL, LUG (V00779) (V81982 (DWG 43351-11)	1	
51	43351-14	. . . TERMINAL LUG	1	
52	Z99036LR3225CJ4	. . BEARING, BALL (V43334) (V81982 DWG 40456-85)	1	
53	43415-14	. . WASHER, SPRING	1	
54	84494	. . SLINGER, MOTOR SHAFT	1	
55	85236	. . NOISE FILTER, R/F	1	
		ATTACHING PARTS		
56	LL500-4-6M	. . SCREW (V03038)	4	
		***		
57	44035-45	. . TUBE, FLEXIBLE	1	
58	43351-11	. . TERMINAL, LUG	2	
59	85129	. . CAPACITOR, INSULATED	1	
		ATTACHING PARTS		
60	LL500-4-6M	. . SCREW (V03038)	RF	
		***		
61	85642	. . CLAMP, CABLE HOLDER	1	
		ATTACHING PARTS		
62	LL500-4-6M	. . SCREW (V03038)	RF	
		***		
63	44035-55	. . TUBE, FLEXIBLE	1	
64	54686	. . SPRING, BRUSH	2	
65	59943	. . BRUSH ASSEMBLY, MOTOR	2	
66	85202	. . PLATE ASSEMBLY, BRUSH HOLDER	1	
67	84547	. . . FELT HOLDER	1	
68	84884	. . . SPRING	1	
69	84573	. . . FELT RING	2	
70	MS29513-020	. . PACKING, PREFORMED (V96906)	1	
71	84498	. . ARMATURE ASSEMBLY	1	
72	MS28513-141	. . PACKING, PREFORMED (V96906)	1	
73	43350-14	. . TERMINAL, LUG	2	
74	RNF100	. . (+) SLEEVE (RED) 0.187 ID X 1.87 LG (V08795)	1	
75	RNF100	. . (-) SLEEVE (WHITE) 0.187 ID X 1.87 LG (V08795)	1	
76	44035-58	. . TUBE, FLEXIBLE	1	
77	MS16625-4050	. . RING, INTERNAL RETAINING	1	
78	43597-109	. . WASHER, FLAT	2	
79	84203	. . GROMMET	1	
80	24824	. . PLUG, FLAME ARRESTER	1	
81	84492-1	. . BODY, MOTOR PUMP	1	
82	911	. PLATE	1	
83	925	. PLATE, WARNING	1	

-Item not illustrated.
*Not procurable separately. Order next higher assembly.

REPORT NO: 8-319

OVERHAUL MANUAL
WITH ILLUSTRATED PARTS LIST

FUEL BOOSTER PUMP

PART NO. 71383-2

THIS COMPONENT INSTALLED ON DEHAVILLAND DHC-6 AIRCRAFT.

THIS REPORT REPLACES PREVIOUS ISSUE IN ITS ENTIRETY.

CRANE

HYDRO-AIRE DIVISION

CRANE CO. • 3000 WINONA AVENUE • P.O. BOX 7722 • BURBANK, CALIFORNIA 91510

28-20-29

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REVISED FEB 27/86

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RECORD OF REVISIONS

REV NO.	ISSUE DATE	DATE INSERTED	BY	REV NO.	ISSUE DATE	DATE INSERTED	BY
1	Feb 27/86						

Retain this record in the front of manual. On receipt of revisions, insert revised pages in the manual and enter revision number, date inserted and initials.

LIST OF EFFECTIVE PAGES

Section	Page	Date
Title	T-1	Feb 27/86
Notice		Feb 27/86
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Record of Revisions	RR-1	Feb 27/86
Service Bulletin List	SB-1	Feb 27/86
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	104	Blank
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Troubleshooting	801/	Feb 27/86
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Storage Instructions	901/	Feb 27/86
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SERVICE BULLETIN LIST

SERVICE BULLETIN NO.	DATE INCORPORATED	SERVICE BULLETIN NO.	DATE INCORPORATED

INTRODUCTION

This publication is issued to provide instructions to overhaul the Fuel Booster Pump Assembly Part No. 71383-2, manufactured by Hydro-Aire Division, Crane Co., Burbank, California 91510 U.S.A.

The information in this manual is divided into sections in accordance with Air Transport Association Specification 100, to enable maintenance personnel to disassemble, clean, inspect/check, repair, assemble, troubleshoot and test the pump. An illustrated parts list is provided to locate, identify and requisition parts.

To ensure that coverage contained in this handbook will reflect changes in the pump overhaul concepts and procedures, revised information is provided to the customer through a letter of transmittal. The letter includes highlight pages which identify changed pages.

Warnings, Cautions and Notes are used to emphasize information throughout this publication. Warnings must be followed to avoid injury or death to persons. Cautions must be followed to avoid equipment damage, and Notes call attention to work simplification, or additional information.

The following special terms and/or abbreviations are used in this publication.

°F	Degrees Fahrenheit	MAX	Maximum
ASSY	Assembly	pph	Pounds Per Hour
cc	Cubic Centimeter	psi	Pounds Per Square Inch
EFFECT	Effectivity	psig	Pounds Per Square Inch Gage
FIG	Figure	REV	Revision
FTP	Functional Test Procedure	rpm	Revolutions Per Minute
gpm	Gallons Per Minute	vdc	Volts Direct Current
MIN	Minimum		

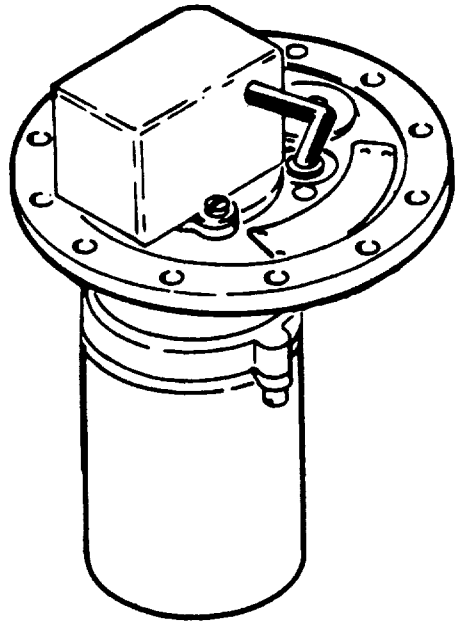
0. DESCRIPTION AND OPERATION

A. DESCRIPTION (See Figure 1)

Fuel Booster Pump, Part No. 71383-2 is a rotary, power-driven screw type pump. The self-contained source of power is an electrically driven, explosion-proof motor whose main components are a field coil and armature. The pump is also equipped with a radio noise filter.

B. PURPOSE AND LEADING PARTICULARS

The purpose of the fuel booster pump is to transfer fuel from the fuel system reservoir into feed lines at a specified design flow and pressure while submerged in the reservoir. Leading particulars are listed in Table 1.



Fuel Booster Pump - Assembled View
Figure 1

C. OPERATION

The field coil provides the flux which causes the armature to rotate when an electric current is made to flow through the system. Rotation of the armature turns the screw-type impeller enclosed in the pump chamber, thus creating the pump action.

TABLE 1. LEADING PARTICULARS

Pump Mounting Position	Motor upward; major axis vertical
System Fluid	Fuel per Spec MIL-J-5624 (JP-4)
Rated Flow	450 pph at 24 psig (min)
Power Input	8.0 amps (max) at 28 vdc
Motor Duty Cycle	Continuous
Zero Flow	33.6 psig (max)
Dimensions	2.64 inch diameter to 5.25 inch diameter x 7.0 inch high
Weight (dry)	4.2 pounds

1. DISASSEMBLY (See Figure 1101)

Prior to disassembly, perform the procedures in Section 7, Testing, to determine extent of disassembly required to repair or replace components.

Disassembly may be accomplished using tools and equipment normally available at maintenance facilities. Special tools, fixtures and equipment, if specified, are listed in Table 1001.

WARNING: AVOID SPILLING FUEL. DO NOT ALLOW ANY FUEL TO REMAIN IN PUMP CHAMBERS OR PASSAGES. KEEP PUMP AWAY FROM OPEN FLAME.

CAUTION: PLACE ALL PARTS IN CLEAN COVERED CONTAINERS. KEEP PARTS (1 THROUGH 29) AND PARTS (31 THROUGH 64) SEPARATED.

A. Do not remove nameplate (1) unless replacement is necessary.

B. After removing check valve assembly (11 through 14), disassemble only if replacement of a component is necessary.

C. When removing shim (17), record thickness of shim laminations for use during reassembly.

D. To remove locknut (20), hold impeller with wrench T47492 to prevent armature assembly (60) from turning. Then use screwdriver T5644, and unscrew locknut. After removal of locknut, pull impeller (22) from armature shaft, then remove key (18). Prevent loss of key by carefully removing impeller.

E. If shims (23) are removed from armature (60) shaft between impeller (22) and drive (25), record number and thickness of shims removed to facilitate reassembly.

CAUTION: REMOVE SEAL (28) FROM ARMATURE ASSEMBLY (60) SHAFT CAREFULLY TO AVOID DAMAGE TO LAP SEAL FACE.

F. Remove seal (28) from armature assembly (60) as follows:

(1) Prepare a soft wire lifter, horseshoe shaped, with flattened ends bent inward approximately 90 degrees.

(2) Insert wire lifter ends between seal (28) and pump body (64), then pull seal out of body bore.

CAUTION: LIFT MOTOR COVER ASSEMBLY (31) FROM PUMP BODY (64) CAREFULLY BY TWISTING SLIGHTLY AND PULLING SIMULTANEOUSLY TO AVOID DAMAGE TO ELECTRICAL LEADS AND TO FIELD COIL ASSEMBLY (45 THROUGH 48).

G. Remove four screws (32) and washers (33), then lift motor cover assembly (31) away from body (64) far enough to gain access to two screws (35) which connect electrical leads to brush holder plate assembly (59). Identify positive lead of field coil assembly (45 through 48) with a dab of paint or other means before disconnecting leads. The positive lead of the coil assembly is connected with the black lead wire of filter (38).

H. Remove two screws (36) and two key washers (37) securing field coil assembly (45 through 48) to motor cover assembly (31); then remove field coil assembly from motor carefully to avoid damage to coil assembly. Do not disassemble field coil assembly. If any part requires replacement, replace entire assembly.

NOTE: Remove field coil assembly (-44) only if replacement is necessary.

I. Remove four screws (51) securing brush holder plate assembly (59) to body (64) then lift armature assembly (60) with parts (52, 53, 55, 56, 57, 58, 59) attached from body (64) of pump. Discard screws (51).

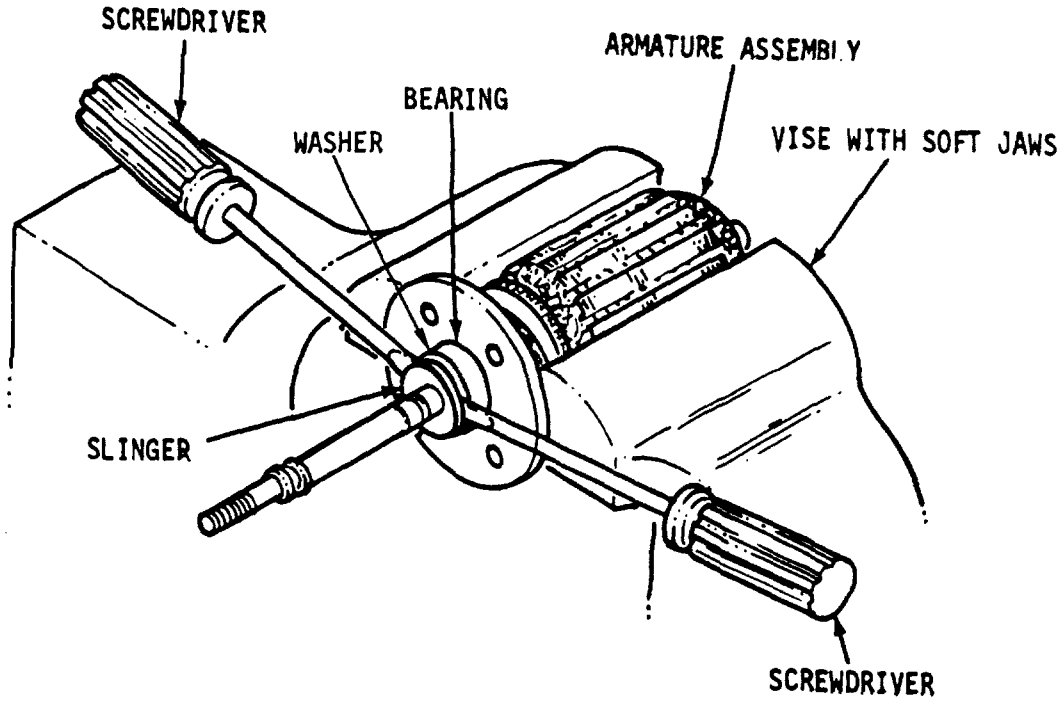
J. Remove slinger (53) from armature assembly (60) shaft by holding armature in a vise with soft jaws as shown in Figure 101. Use two screwdrivers placed opposite each other between slinger (53) and washer (54) and pry off from armature. Break swaged retaining ring (52) from armature shaft.

NOTE: Using corrosion preventative oil WD40, lubricate armature shaft at slingers and bearings several hours before disassembly.

K. Remove bearings (49, 55) carefully to avoid bending shaft or damaging shaft threads.

L. Do not remove springs (57) from brush holder plate assembly when replacing brushes (58). Remove brushes by lifting spring and sliding brush out of holder.

M. Do not remove flame arrester plug (63) from body (64) unless replacement is required. If plug is burned, clogged, or damaged in any way, it can be removed by drilling out of body.



Slinger Removal
Figure 101

2. CLEANING

The materials required for cleaning are listed in Table 201.

A. ULTRASONIC CLEANING PROCEDURE

WARNING: USE SOLVENT IN A WELL-VENTILATED AREA. AVOID BREATHING FUMES. KEEP AWAY FROM OPEN FIRE OR FLAMES.

CAUTION: DO NOT CLEAN ELECTRICAL PARTS USING THIS PROCEDURE OR DAMAGE TO PARTS MAY OCCUR.

(1) Place parts in wire baskets, or equivalent, keeping parts separated from each other. Immerse parts in cleaning solution within ultrasonic cleaning unit and keep parts submerged between 5 to 10 minutes.

B. VAPOR DEGREASING PROCEDURE

(1) Raise parts above solvent into condensing zone of degreaser and flush for 1 minute or more in vapors.

WARNING: WHEN USING COMPRESSED AIR, DIRECT AIRSTREAM AWAY FROM BODY AND OTHER PERSONNEL.

(2) Raise parts above cleaning container and allow to dry. Use clean, dry, compressed air to quicken drying.

NOTE: If use of compressed air is impractical, dry by wiping with a clean, lint-free cloth.

(3) Remove parts from basket with padded tongs.

(4) Check parts for cleanliness.

TABLE 201. CLEANING MATERIALS

Item	Number	Manufacturer or Specification
Isopropyl Alcohol	None	TT-I-735A
Lint-free Cloth	None	Commercial
Padded Tongs	None	Commercial
Soft-bristled Brush	None	Commercial
Solvent: Trichloroethylene		O-T-634B (Technical Grade)
Perchloroethylene (Tetrachloroethylene)	None	O-T-236B

Equivalent substitutes may be used.

3. INSPECTION/CHECK (See Figure 1101)

A. GENERAL.

Check all parts under strong light for cracks, nicks, and other damage. Make sure all passages are clean and unobstructed, threads undamaged and sealing areas free from scratches, pits, nicks, excessive wear, corrosion and other damage.

NOTE: Excessive wear is defined as any obvious deformation or deterioration of parts which may render the pump inoperative. If doubt exists concerning the condition of a part, replace the part.

B. INDIVIDUAL PARTS CHECK

(1) Verify condition of check valve assembly (11 through 14) to make sure that is not distorted, that flapper (13) is seated by spring (12) tension and that valve opens and closes smoothly without binding. Check security of installation of flapper (13) components.

(2) Check throat (15) for a minimum outside diameter (not a mounting section) of 1.809 inch. Check bore of throat for nicks or scratches which would indicate distortion of pump components and/or improperly installed impeller (22) or presence of foreign matter in impeller vanes.

(3) Check impeller (22) for broken, cracked or bent vanes.

(4) Check seals (26, 28) for condition of contact area by running fingernail across sealing surface and examining under magnification. There shall be no evidence of galling or roughness.

(5) Check alignment of spring (24) by rolling spring across a clean, smooth, flat surface. Spring shall not wobble. Test spring for stacking or fatigue by measuring free length and compressed length. Free length of spring shall be approximately 1,000 inch. Under a load of 1.806 to 2.006 pounds, compressed length shall be 0.280 inch.

NOTE: Flapper spring (12) and brush spring (57) if removed, must be replaced.

(6) Check field coil assembly (-44) for security of installation and condition of lead terminals. Check laminations for nicks or scratches which would indicate a distorted pump assembly or worn bearings (49, 55) causing armature assembly (60) to rub against coil assembly. Check condition of insulation on coil (leads). Measure coil resistance at 70°F; it shall be between 23.9 and 26.5 ohms.

(7) Check armature assembly (60) for smooth and shiny commutator surfaces and insulators between commutator bars recessed approximately 0.025 inch. Check shaft for evidence of excessive heat around bearing area. Check commutator with a growler for open windings.

(8) Check body (64) for warped mounting flange caused by unbalanced or excessive torque applied to installation bolts. Check body bore for evidence of incorrectly installed impeller (22) as indicated by nicks and/or heavy scratches.

4. REPAIR

The repair procedure for the pumps are only those necessary to make simple repairs. The necessary repair materials are listed in Table 401.

A. Replace all parts that do not pass inspection/check and are damaged beyond simple repair.

B. Replace all packings, key washers (37), motor brushes (58) and bearings (49, 55). Replace removed springs (12, 57).

CAUTION: DO NOT ATTEMPT TO REMOVE LIGHT SCRATCHES OR OTHER MINOR IMPERFECTIONS FROM COMMUTATOR BARS OR COIL LAMINATIONS BY POLISHING OR ANY OTHER METHOD TO PREVENT ALTERATIONS OF THE DESIGN GAP BETWEEN COIL AND ARMATURE. IF COIL ASSEMBLY (45 THROUGH 48) OR ARMATURE ASSEMBLY (60) IS OBVIOUSLY DAMAGED AS INDICATED BY HEAVY SCRATCHES, DISTORTION OF COMMUTATOR BARS OR COIL ASSEMBLY LAMINATIONS, REPLACE THE PART.

C. Replace coil assembly (-44) and/or armature assembly (60) if electrical requirements specified for these parts are not met.

D. Install armature assembly (60) in standard lathe and using diamond tool, resurface commutator removing not more than 0.003 inches of material. Diameter of commutator must not be less than 0.860 inches minimum after resurfacing. (If resurfacing does not clean up commutator, replace the new armature). After resurfacing, undercut commutator to remove all mica slivers, using 0.020 inch wide cutter, 0.025 inch deep.

E. After repair, check armature on growler for continuity and shorts.

CAUTION: DO NOT USE ABRASIVE CLOTH P-C-458 ON ALUMINUM OR MAGNESIUM PARTS AS IT CONTAINS AN IRON OXIDE WHICH CAUSES RAPID OXIDATION OF THESE METALS.

F. Polish out minor nicks and scratches on noncritical steel surfaces with abrasive cloth. Polish out minor nicks and scratches on aluminum parts with carbide abrasive cloth, provided that critical mating surfaces are not damaged.

NOTE: After abrasive cloth has been used, ultrasonic clean parts as outlined in Section 2, Cleaning.

G. Use thread chaser or tap to repair stripped threads (2 threads maximum) at port and attachment points.

H. Touch up worn or reworked anodized surfaces on aluminum parts as follows:

(1) Remove soiled and oxide film by swabbing surface with acid solvent cleaner (1 volume Deoxidine 624 to 3 volumes water mixed at room temperature), allowing a 1 to 3 minute solution contact time. Keep entire rework surface wet.

(2) Rinse by swabbing with clean wipers or sponges soaked in water. Repeat at least twice, wringing out wipers or sponges after each rinse.

WARNING: ALL CLOTH APPLICATORS USED OF ALODINE 1000L SOLUTION SHALL NOT BE ALLOWED TO DRY OUT. WHEN DRY, EACH CONSTITUTES AN EXTREME FIRE HAZARD. RINSE THOROUGHLY IN WATER WHEN ALODINE APPLICATION IS COMPLETE.

(3) Apply alodine coating (3 volumes of alodine 1000L concentrate to 2 volumes of water) evenly and liberally with a clean, soft, lint-free cloth. Do not apply solution like paint, but thoroughly wet reworked surface to be alodined.

(4) Allow alodine coating to air dry as follows:

Ambient Temperature (°F)	100	90	80	70	60
Alodine Coating Contact (minutes)	2.25	2.8	4.0	5.5	10

NOTE: Do not touch new alodine surface until dry, as fresh alodine films are easily damaged.

(5) Swab off and rinse with cellulose sponge or clean, soft cloth saturated with clean water. Use blotting motion or very gentle swabbing to prevent damage to fresh alodine film. Wring out sponge or cloth and repeat rinsing at least twice, blotting any pools of water.

TABLE 401. REPAIR MATERIALS

Item	Number	Manufacturer or Specification
Acid-Solvent Cleaner	Deoxidine 624	V84063
Alodine Coating	Alodine 1000L (Liquid Concentrate)	V84063
Abrasive Cloth, Aluminum Oxide	600 to 800 Grit	P-C-451
Abrasive Cloth	None	P-C-458

Equivalent substitutes may be used.
Refer to Table 1101 for vendor name and address.

5. ASSEMBLY (See Figure 1101)

Assembly may be accomplished using tools and equipment normally available at maintenance facilities. Special tools, fixtures and equipment, if specified, are listed in Table 1001.

CAUTION: ASSEMBLY SHOULD BE ACCOMPLISHED IN A WELL-LIGHTED, DUST-FREE AREA. ALL PARTS SHOULD BE THOROUGHLY CLEANED PRIOR TO ASSEMBLY.

A. Install washer (40) over lead shielding (43) on filter (38) wire lead. Insert lead through grommet (41) and washer (42). Slide grommet and washers down on wire lead until washer (42) is held between grommet and lead shielding. Carefully insert lead into passage in body (64) and pull lead out of upper face of body. Pull lead through until grommet and washers are seated in body passages, then install retaining ring (39).

B. Solder terminals (62) to each wire.

C. Assemble parts (52 through 60) and carefully position armature assembly (60) on body (64). Insert lead through opening in plate assembly (59), then secure with screws (51) which attach brush holder plate assembly (59) to body.

D. Install spring washer (50) and bearing (49) in recessed bottom of cover (31) internal boss.

CAUTION: CONNECT WHITE WIRE OF LEAD AND UNMARKED LEAD OF COIL ASSEMBLY TO NEGATIVE (GROUNDED) SIDE OF BRUSH HOLDER PLATE ASSEMBLY (59). CONNECT BLACK WIRE OF LEAD AND BLACK-MARKED LEAD OF COIL ASSEMBLY TO POSITIVE (INSULATED) SIDE OF BRUSH HOLDER PLATE ASSEMBLY (59).

E. Install field coil assembly (-44) in cover (31) and secure with key washers (37) and screws (36). Tighten screws and bend washer tab against flat of screw heads. Install insulator (34). See Figure 501.

F. Connect leads of field coil assembly (45 through 48), each wire of filter (38) lead, and leads of brush assemblies (58) to brush holder plate assembly (59) with screws (35).

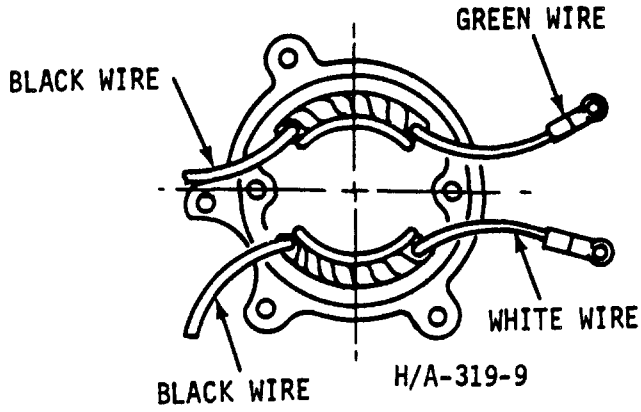
G. Perform following motor tests before continuing reassembly procedures.

(1) Dielectric Strength Test

NOTE: Grounded motors must be ungrounded during this test. Disconnect leads from brush holder terminal and remove negative brush.

(a) Apply 500 volts (rms), 60 Hz ac between positive brush holder and cover (31) or body (64) for 15 seconds.

(b) There shall be no flashover or any evidence of damage.



Field Coil Installation
Figure 501

(2) Brush Run-In

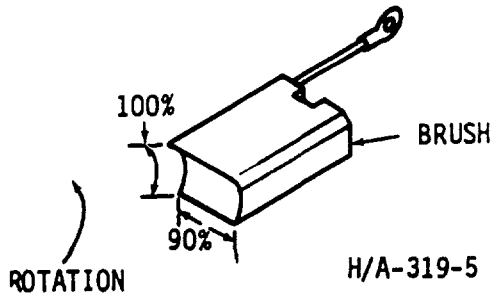
(a) Replace negative brush in brush holder plate assembly making certain it contacts commutator.

(b) Connect motor to a direct-current power source.

(c) Operate motor, unloaded, for 30 minutes. Check for armature balance. Motor must operate smoothly and direction of rotation (as viewed from shaft end) shall be clockwise. No-load speed shall not exceed 13,200 rpm at 27 volts dc.

(d) Adjust power supply to deliver voltage required to reduce no-load speed to 10,400 rpm and allow motor to run until 100 percent brush contact in direction of rotation is obtained with approximately 90 percent of total area in contact. See Figure 502.

NOTE: Run-in time to be 18 hours minimum. Brush contact to be determined by sampling inspection.



Brush Run-In
Figure 502

H. Turn pump motor upside down and install packing (29) on seal (28) and install seal on armature assembly shaft.

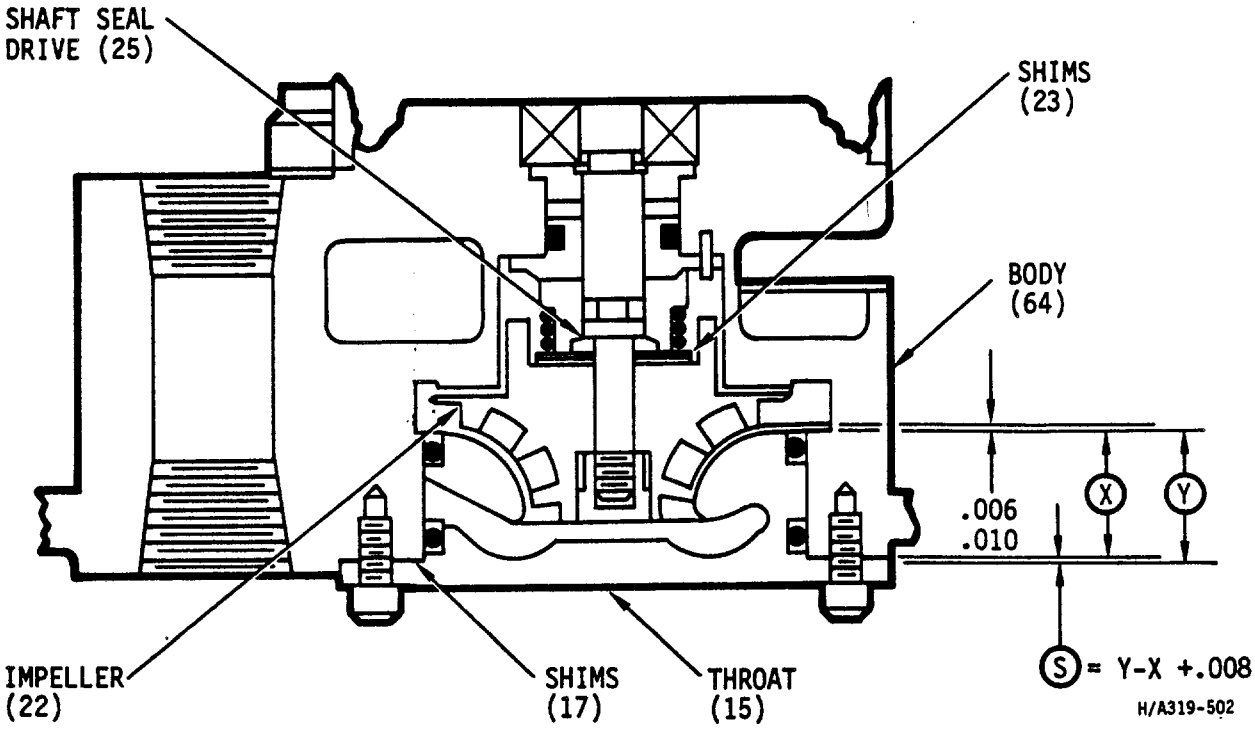
I. Install packing (27) on armature assembly shaft.

j. Carefully install shaft rotating seal (26) and shaft seal drive (25) on armature assembly shaft.

K. Install spring (24) and shaft key (21) on armature assembly shaft. Install impeller (22) and secure on shaft with locknut (20).

NOTE: Rotate impeller and shaft by hand to check for binding. Impeller must rotate freely.

L. To obtain required clearance between impeller (22) and throat (15), see Figure 503 and determine dimension X. With motor resting on bearing, measure distance from front vane surface of impeller to bottom face of pump body. Measure depth of throat (15) from inner flange to end of throat, dimension Y. See Figure 503 for applicable expression of shim (17) thickness S.



Shim Installation
Figure 503

M. Peel off or add laminations to shim (17) as required. Install correct shim thickness on throat matching installation holes in shim and throat. Install packings (19) in throat grooves and secure throat and filter (38) to body with screws (16).

N. If disassembled, reassemble check valve assembly (-9). Install screen (8) and secure with cotter pin (7). See Figure 504 for cotter pin installation details.

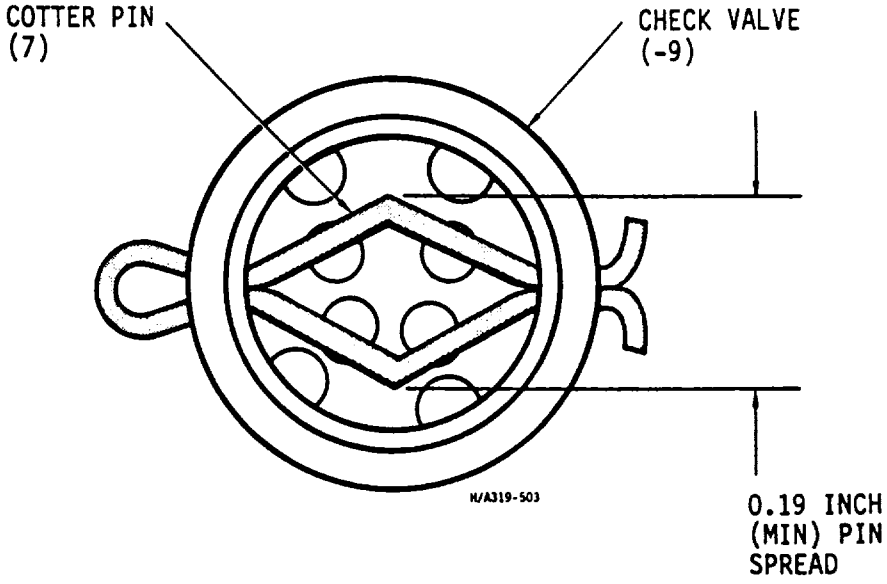
O. Check that flapper (13) operates freely without binding. Load required to unseat flapper shall not exceed 0.0072 pound. Install check valve assembly in pump body and secure with screw (10).

NOTE: Install check valve assembly with hinge-pin side upward.

P. Install screen (3) and secure with one screw (6), washers (5) and screws (4). Safetywire screws (4, 10) as noted during disassembly.

Q. Secure nameplate (1) to bottom of pump with screws (2).

R. Test completed assembly in accordance with Testing, Section 7.



Cotter Pin Installation
Figure 504

6. FITS AND CLEARANCES

A. This section is not applicable to this manual. See Assembly section for assembly clearances.

7. TESTING (FTP 71383-2, REV E)

1.0 TEST EQUIPMENT

The following test equipment shall be used to perform the required tests.

1.1 A fluid reservoir capable of 15 psi pressurization and equipped with an AN4130-7 fitting must be available for mounting and submersion of pump.

1.2 See Figures 701 and 702 for test setup and related equipment.

1.3 Test fluid shall be solvent, P-D-680, Type I, Stoddard solvent. Fluid temperature not to exceed 100°F.

NOTE: During following tests, check for seal leakage at seal drain port. There shall be none. Should leakage occur, disassemble pump to extent required to replace rotating seal (26) and stationary seal (28).

2.0 SHAFT SEAL LEAKAGE TEST (See Figure 701)

2.1 Start fully submerged pump at rated voltage then immediately reduce voltage until current drops to 7.5 amperes maximum.

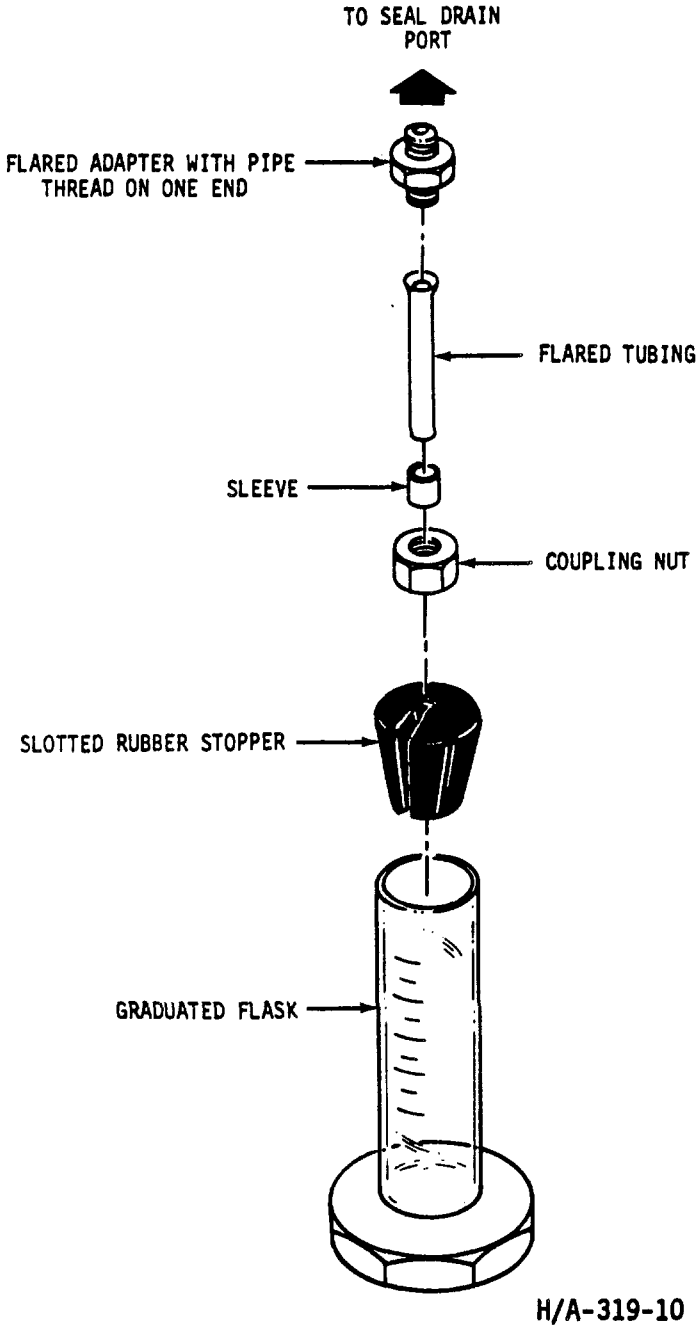
2.2 Pumps shall be run for 18 hours minimum. During this entire test, adjust voltage periodically to rated, but at same time not exceeding 7.5 maximum ampere limit.

2.3 At end of this time, total leakage at seal drain port shall not exceed 0.75 cc or 1 cc in 24 hours.

3.0 EXTERNAL LEAKAGE TEST

3.1 Mount pump in suitable reservoir and connect to test setup as shown in Figure 702. Fill reservoir with enough test fluid to completely submerge fuel pump.

NOTE: Use aviation gasoline, MIL-G-5572 or solvent, P-D-680, Type I at 100°F maximum.



Shaft Seal Leakage Setup
Figure 701

3.2 Apply 15 psi air pressure to rerservoir for 5 minutes and check for leakage at flange casting, seal drain port, motor vent or any other external (exposed) surfaces of pump. No leakage allowable.

CAUTION: IF SHAFT LEAKAGE OCCURS, DRAIN PORT MUST BE THOROUGHLY DRAINED BEFORE ATTITUDE OF PUMP IS CHANGED FROM DRAIN-PORT-DOWN POSITION TO PREVENT FUEL (OR SOLVENT) FROM COMING INTO DIRECT CONTACT WITH MOTOR BEARING.

3.3 Relieve air pressure from reservoir.

4.0 CALIBRATION

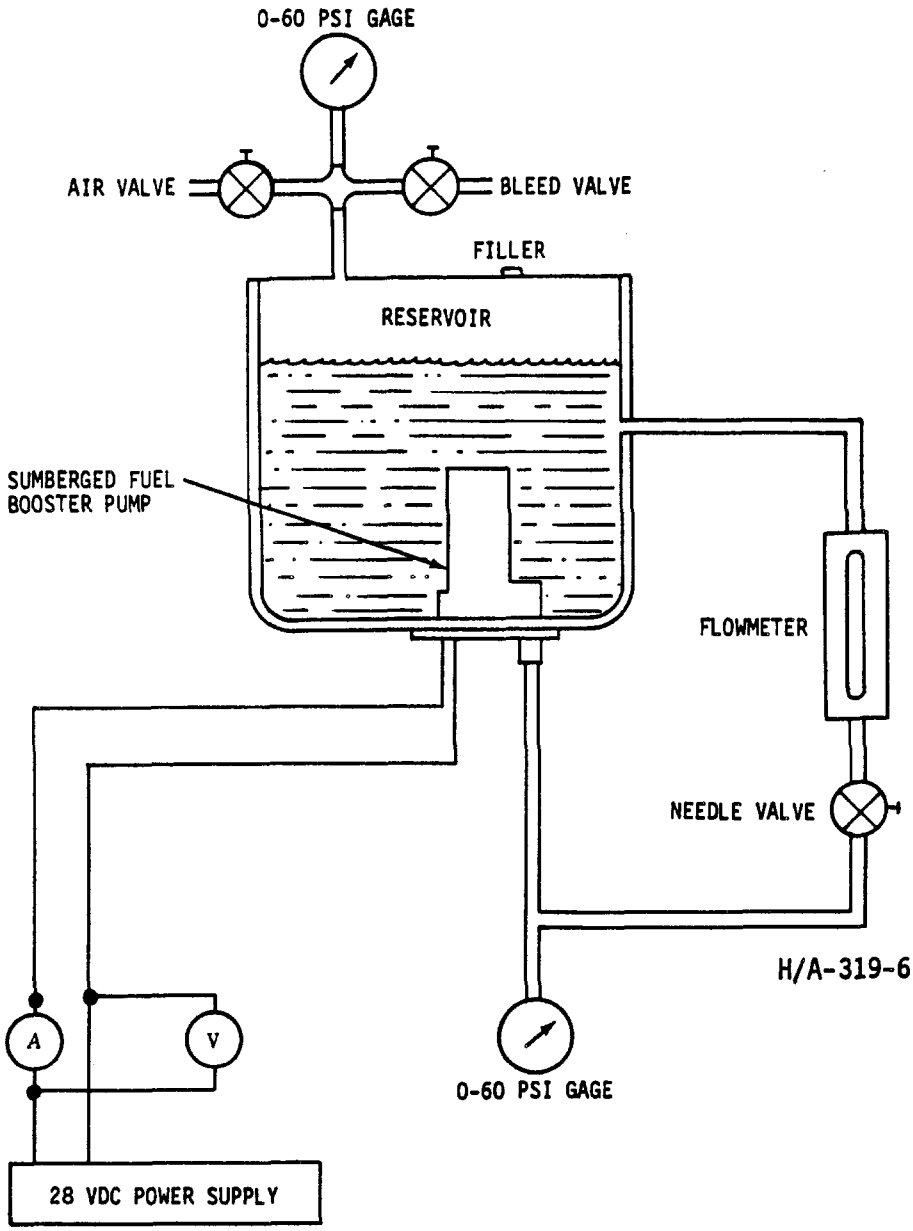
CAUTION: IF CURRENT DRAIN FLUCTUATES NOTICEABLY, SHUT OFF MOTOR SINCE CURRENT FLUCTUATIONS MAY INDICATE MOTOR OVERHEATING. KEEP RESERVOIR FLUID COOL BY FANNING OR ANY OTHER CONVENIENT METHOD.

4.1 With pump submerged in fluid, connect lead to a 28 vdc power supply as shown in Figure 702.

4.2 Slowly apply voltage to pump motor to a maximum of 28 volts and observe current drain. Current drain shall not exceed 8.0 amperes. Allow pump to run for a maximum of 20 minutes. Adjust needle valve to allow zero and maximum (1.15 gpm) flow and calibrate pump so that performance requirements listed in Table 701 are met without interruption or switching pump off and on.

TABLE 701. CALIBRATION PARAMETERS

Gpm	Psi	Amps
0	33.6 max	8.0 max
1.15	22.0 min	8.0 max



Test Setup
Figure 702

8. TROUBLESHOOTING

Troubleshooting information is contained in Table 801. This table is not all inclusive, however, it does contain the causes of malfunctions most likely to occur.

TABLE 801. TROUBLESHOOTING INFORMATION

Trouble	Probable Cause	Remedy
Motor overheats	Insufficient clearance between impeller (22) and throat (15)	Disassemble unit to extent required to check impeller clearance.
	Damaged bearings (49, 55)	Replace damaged bearings.
Insufficient motor rpm	Coil assembly (45) through (48) and armature (60) binding or damaged parts	Remove any foreign matter caught between coil and armature. Check parts for damage. Replace if damaged.
	Improper shimming	Correct impeller clearance.
Pump delivery above or below	Damaged impeller (22) and/or throat (15)	Replace damaged part or parts.
Erratic operation of pump	Damaged electrical parts	Replace all electrical parts.
Pump fails to deliver any flow	Incorrect brush wiring (incorrect pump rotation)	Correct brush wiring.
Fluid leakage through seal drain	Damaged seals (26, 28)	Replace seals.
Leakage at throat	Damaged packings (18, 19)	Replace packings.
	Damaged throat (15)	Replace damaged throat.

9. STORAGE INSTRUCTIONS

A. Flush pump with preservative oil and install plastic plugs in accordance with MIL-C-5501.

B. Encase pump in polyethylene bag, wrap in barrier material MIL-B-121 and place in a padded carton PPP-B-636 or equivalent.

C. Use desiccant MIL-D-4364 as required. Seal carton and stamp part number, serial number and date of overhaul on outside of carton.

10. SPECIAL TOOLS, FIXTURES AND EQUIPMENT

The test equipment required to test the pump is listed under "Test Equipment" in Section 7, Testing. Maintenance can be accomplished with the use of special tools listed in Table 1001, as well as those normally available at maintenance facilities. The tools may be obtained from the manufacturers indicated.

TABLE 1001. SPECIAL TOOLS, FIXTURES AND EQUIPMENT

Part Number	Description and Manufacturer	Application
T56644	Screwdriver (V81982)	Remove and install locknut.
T47492	Impeller Wrench (V81982)	Hold impeller.

11. ILLUSTRATED PARTS LIST

A. PURPOSE

The Illustrated Parts List is intended to assist customer personnel in requisitioning, storing and issuing the replaceable components and in identifying new and reclaimed parts. It is not approved for any other purpose.

The Illustrated Parts List does not list or illustrate parts which lose their identity by being permanently welded or riveted to other pieces, items made from raw (bulk) stocks, such as cut to lengths of conduit, electric leadwire, lockwire, etc.

B. HOW TO USE THE PARTS LIST

The figure number on the parts list refers to the corresponding illustration.

The number in the FIG. ITEM column corresponds to the item number pointing to the part on the corresponding illustration.

A vendor's part is identified by the vendor's part number in the PART NUMBER column and the vendor's Federal Supply Code number following the part description in the NOMENCLATURE column.

Quantities specified in the UNITS PER ASSY column are the total number of each part required per assembly or subassembly and are not necessarily the total used per complete end item assembly.

RF in the UNITS PER ASSY column indicates the item is listed for reference purposes.

AR in the UNITS PER ASSY column indicates parts are used as required.

The EFFECT CODE column contains one or more code letters indicating the configuration to which an assembly or part applies. When no code letter appears in the column, the part is common to all units.

C. GENERAL SYSTEM OF ASSEMBLY ORDER

The indention system used in this illustrated parts list shows the relationship of one part to another. Each unit listed is followed immediately by a listing of its component parts. For a given item, the

indention code shows a system, installation or general heading starting in the extreme left position continuing on down into succeeding columns until the end detail is reached, as follows:

1234567

Installation Assembly (RF) Number
.Detail Parts for Installation
.Assembly
.Attaching Parts for Assembly
***
..Detail Parts for Assembly
..Subassembly
..Attaching Parts for Subassembly
***
...Detail Parts for Subassembly
...Sub-subassembly
...Attaching Parts for Sub-subassembly
***
....Detail Parts for Sub-subassembly

Parts are listed in general order of disassembly, with the exception of attaching parts. ATTACHING PARTS are captioned as such and follow immediately after the part they attach and are separated from other detail parts by the symbol ***.

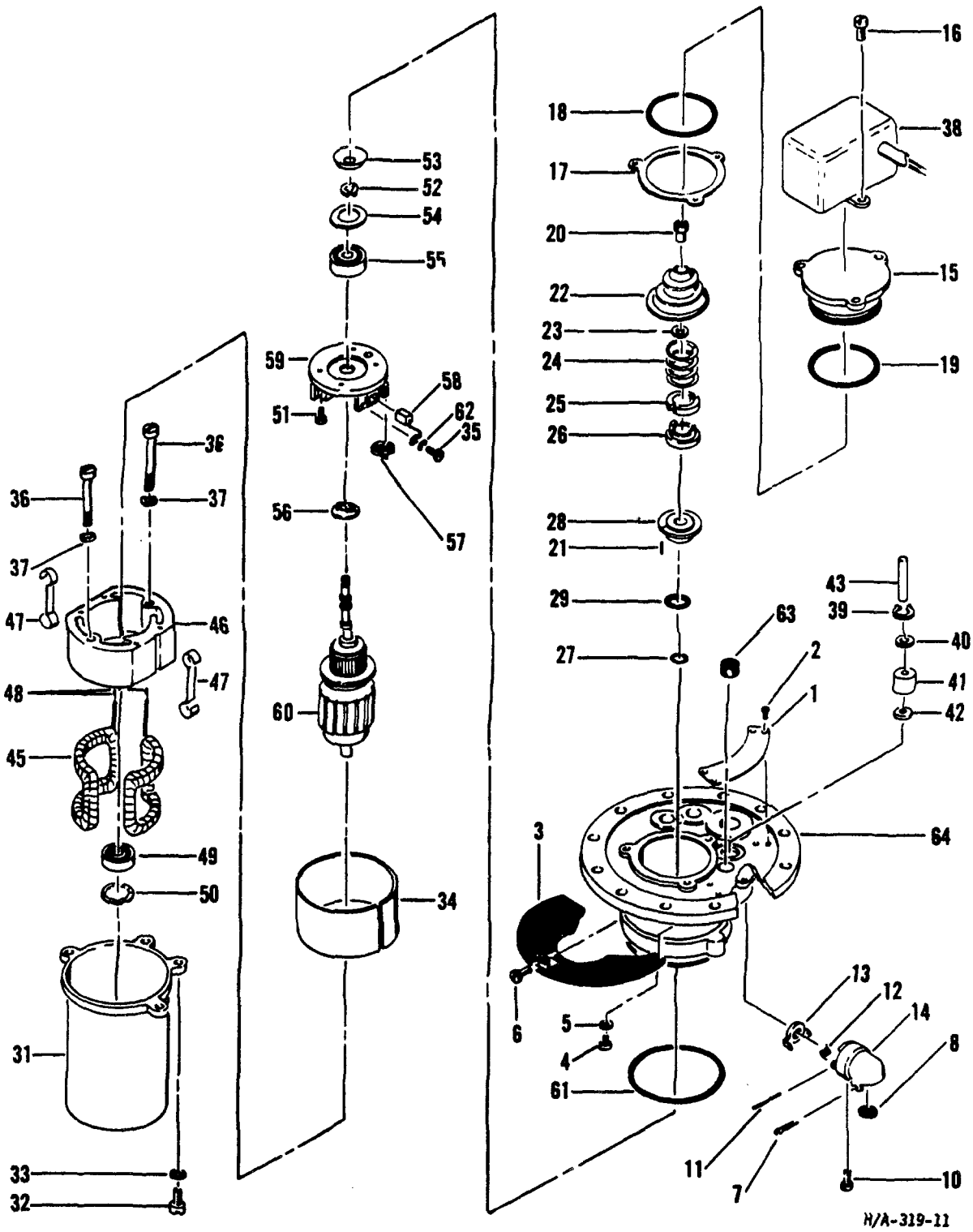
D. VENDORS' CODE

Vendor parts used, unaltered by Hydro-Aire, are listed by vendor part number, vendor description and vendor code. Vendors' code symbols used in this publication are taken from Federal Supply Code of Manufacturers Cataloging Handbook H4-1 and H4-2. Following is a numerically arranged list of vendor codes used in this publication.

TABLE 1101. VENDOR CODE LIST

Vendor Code	Vendor Name and Address
V03038	Long Lock Corporation Santa Monica, CA
V81982	Hydro-Aire Division Crane Co. Burbank, CA
V84063	Amchem Products Inc. Ambler, PA

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Fuel Booster Pump - Exploded View
Figure 1101

FIG. ITEM	PART NUMBER	NOMENCLATURE 1234567	UNITS PER ASSY	EFFECT CODE
1101-	71383-2	PUMP, FUEL BOOSTER	RF	
1	50945-37	.NAMEPLATE	1	
		ATTACHING PARTS		
2	AN535-0-2	.SCREW, DRIVE	4	
		***		
3	59301	.INLET SCREEN ASSEMBLY	1	
		ATTACHING PARTS		
4	MS35265-26	.SCREW	2	
5	AN960D6	.WASHER	2	
6	LL525-832-4M	.SCREW (V03038)	1	
		***		
7	MS24665-155	.PIN, COTTER	1	
8	52257	.SCREEN, PUMP CHECK VALVE	1	
-9	52258	.CHECK VALVE ASSEMBLY	1	
		ATTACHING PARTS		
10	MS35265-28	.SCREW	1	
		***		
11	25482	.PIN, HINGE	1	
12	23849	..SPRING, FLAPPER	1	
13	23357	..FLAPPER, VALVE	1	
14	52256	..BODY, CHECK VALVE (ALT 84830)	1	
15	56878	.THROAT	1	
		ATTACHING PARTS		
16	MS35265-44	.SCREW	3	
		***		
17	55859	.SHIM, LAMINATED (ALT 80802)	AR	
18	MS29513-030	.PACKING	1	
19	MS29513-130	.PACKING		
20	54753	.LOCKNUT, MOTOR SHAFT	1	
21	54752	.KEY, SHAFT	1	
22	55225	.IMPELLER, PUMP	1	
23	50928-1	.SHIM (0.002 IN. THICK)	AR	
	50928-2	.SHIM (0.006 IN. THICK)	AR	
	50928-3	.SHIM (0.009 IN. THICK)	AR	
24	83547	.SPRING, ROTATING SEAL	1	
25	52751	.DRIVE, SHAFT SEAL	1	
26	52750	.SEAL, SHAFT ROTATING	1	
27	MS29513-008	.PACKING	1	
28	81939	.SEAL, STATIONARY	1	

-ITEM NOT SHOWN.
REF DWG 71383-2 (REV F)

FIG. ITEM	PART NUMBER	NOMENCLATURE 1234567	UNITS PER ASSY	EFFECT CODE
1101-				
29	MS29513-016	.PACKING	4	
30	83582	.MOTOR ASSEMBLY, PUMP	1	
31	54669	..COVER	1	
		ATTACHING PARTS		
32	MS35265-45	..SCREW	4	
33	AN960D8L	..WASHER	4	
		***		
34	55899-1	..INSULATOR, COVER	1	
35	LL500-4-4M	..SCREW (V03038)	2	
36	50965-1	..SCREW, FIELD COIL MOUNTING	2	
37	50966910	..WASHER, KEY	2	
38	81897	..FILTER, RADIO NOISE	1	
39	MS16625-4050	...RING, INTERNAL RETAINING	1	
40	43597-138	...WASHER	1	
41	84203	...GROMMET	1	
42	43597-132	...WASHER	1	
43	44060-8	...SHIELDING, LEAD	1	
-44	54671	..FIELD COIL ASSEMBLY	1	
45	*54673	...COIL ASSEMBLY, D.C. MOTOR	1	
46	*54672	...COIL, LAMINATED STATOR	1	
47	*59338	...STRAP	2	
48	43350-13	...LUG, TERMINAL COIL LEAD	2	
49	40456-85	...BEARING, BALL	1	
50	43415-14	..WASHER, SPRING	1	
51	LL500-4-6M	..SCREW (V03038)	4	
52	43250-45	..RING, INTERNAL RETAINING	1	
53	83848	..SLINGER, MOTOR SHAFT	1	
54	82116	..WASHER, SHIM	1	
55	40456-85	..BEARING, BALL	1	
56	83450	..COVER, BEARING	1	
57	54686	..SPRING, BRUSH	2	
58	59943	..BRUSH ASSEMBLY, MOTOR	2	
59	83744	..PLATE ASSEMBLY, BRUSH HOLDER	1	
60	83556	..ARMATURE ASSEMBLY, MOTOR	1	
61	MS219513-141	..PACKING	1	
62	43351-11	..TERMINAL, LEADWIRE	2	
63	83527	..PLUG, FLAME ARRESTER	1	
64	81999	..BODY, MOTOR PUMP	1	

*NOT PROCURABLE SEPARATELY. ORDER NEXT HIGHER ASSEMBLY.
-ITEM NOT SHOWN.

CUSTOM COMPONENT SWITCHES, INC.
21111 PLUMMER ST. CHATSWORTH, CALIF.

GAGE PRESSURE SWITCH 8G361-1 OVERHAUL MANUAL

(DHC SC 70020-5)

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GAGE PRESSURE SWITCH 8G361-1 OVERHAUL MANUAL

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CUSTOM COMPONENT SWITCHES, INC.
21111 PLUMMER ST. CHATSWORTH, CALIF.

GAGE PRESSURE SWITCH 8G361-1 OVERHAUL MANUAL

1. DESCRIPTION AND OPERATION

Model 8G361-1 is a pressure actuated switch designed to sense gage pressure. Pressure is applied to a diaphragm. The resultant force created by the gage pressure is conveyed to a negative rate disc spring by a pressure plate. When the increasing gage pressure reaches a preset actuation point, the disc spring snaps over center allowing the pressure plate to actuate the electrical assembly. Upon decreasing gage pressure, at a preset value below the actuation point, the disc spring snaps back to its original position returning the pressure plate and electrical assembly to their original positions.

This model is used on commercial aircraft in the fuel boost pressure system for low fuel pressure warning.

TABLE I LEADING PARTICULARS

Service Media	JP4 and JP5 fuel
Actuation Points:	
Increasing Pressure	By 10 PSIG
Decreasing Pressure	At 2.5 ±0.5 PSIG
Proof Pressure	120 PSIG
Ambient Temperature	-65°F to +250°F -54°C to +121°C
Pressure Connection	Per MS33656E4 (mod.) 7/16-20 UNF-3A (thd.)
Electrical Data:	
Switching Element	SPDT
Current	5 amps resistive at 28 VDC
Receptacle	per MS33678-10SL-3P mates with MS3106-10SL-3S
Overall Dimensions:	
Height	2.50 inches max.
Width	0.68 inches hex.
Weight	1.5 ounces est.

2. DISASSEMBLY (See Figures 3 and 4)

A. Remove drive screws [13] from pressure capsule [4].

CAUTION: DO NOT MAR SURFACE OF PRESSURE CAPSULE [4].

B. Using a 66-4 tool, remove electrical assembly [12].

CAUTION: DO NOT ATTEMPT DISASSEMBLY OF ELECTRICAL ASSEMBLY [12]. ASSEMBLY IS SEALED WITH POTTING COMPOUND AND SHALL BE REPLACED AS A UNIT IF DEFECTIVE.

C. Remove O-ring [11] from electrical assembly [12].

NOTE: It is recommended that O-ring [11] be replaced at each overhaul.

D. Using blade end of 66-163 tool, remove helical spring [2] and adjustment shoe [3] from pressure capsule [4].

NOTE: Early models may have separate adjustment screw and helical spring. It is recommended that these parts be replaced by the current helical spring.

E. Apply a small amount of acetone to dissolve sealant which locks threads of stop [10] to disc spring register [9] and threads of disc spring register [9] to pressure capsule [4].

WARNING: AVOID SOLVENT CONTACT WITH SKIN AND AVOID BREATHING SOLVENT VAPORS. OBSERVE FIRE PRECAUTIONS.

F. Using a 66-48 tool, remove disc spring register [9] with stop [10] from pressure capsule [4].
G. Using 66-48 tool, remove stop [10] from disc spring register [9].
H. Remove register ring [8], disc spring [7], register ring [6] and pressure plate [5] from pressure capsule [4].

CAUTION: DO NOT ATTEMPT FURTHER DISASSEMBLY OF PRESSURE CAPSULE [4]. REPLACE AS A UNIT IF DEFECTIVE.

3. CLEANING

A. Clean all metal parts with dry cleaning solvent per Federal Specification P-D-680, Type 1, or equivalent; use a stiff bristle brush and/or a clean, lint-free cloth.

WARNING: AVOID SOLVENT CONTACT WITH SKIN AND AVOID BREATHING SOLVENT VAPORS. OBSERVE FIRE PRECAUTIONS.

B. Dry parts thoroughly with moisture free, compressed air or allow to air dry.

GAGF PRESSURE SWITCH 8G361-1 OVERHAUL MANUAL

4. INSPECTION/CHECK (See Figures 1 and 4)

A. Inspect all machined surfaces for cracks, nicks, burrs, corrosion, or any other condition which could cause a malfunction in service.
B. Inspect all threaded parts for crossed or stripped threads.
C. Check all plated parts for deterioration.
D. Check helical spring [2] for distortion, length, and rate.
(1) Free length should be .535/.565 inches.
(2) With spring deflected to solid height, reaction force should be approximately 1.2 pounds.
E. Refer to Figure 1 and using an ohmmeter or other suitable device, check circuitry of electrical assembly [12].
(1) With electrical assembly [12] in the deactuated position, there must be a closed circuit between receptacle pins A and B, and an open circuit between receptacle pins B and C.
(2) Apply slight pressure to actuating plunger at base of electrical assembly [12] until assembly actuates.

CAUTION: INTERNAL DAMAGE TO ELECTRICAL ASSEMBLY [12] CAN RESULT IF ACTUATING PLUNGER IS DEPRESSED TOO FAR.

(3) With electrical assembly [12] actuated, there must be a closed circuit between receptacle pins B and C, and an open circuit between receptacle pins A and B.
F. Test dielectric strength of electrical assembly [12].
(1) With the output limited to 18 milliamperes, apply 800 volts RMS 60 cycles between each receptacle pin and receptacle shell for a period of one minute.

CAUTION: THE OUTPUT CURRENT MUST BE LIMITED DURING THIS TEST AS A PRECAUTIONARY MEASURE TO PREVENT PERMANENT DAMAGE TO THE PART.

(2) There must be no arcing.
(3) Maximum permissible leakage is 2 milliamperes.

5. REPAIR (See Figure 4)

A. Stop [10] and disc spring register [9] contain nylon locking inserts. If required, these inserts should be removed and replaced with new nylon pellets of appropriate size.
B. Remove any minor nicks, corrosion, or burrs from aluminum parts with an aluminum oxide abrasive cloth per Federal Specification P-C-451.
C. Carefully deburr drive screw holes in pressure capsule [4].

D. Remove defects from stainless steel parts using crocus cloth per Federal Specification P-C-458, grade 600 or finer.
E. Repair minor thread damage by carefully chasing threads with an appropriate tap or die.
F. Replace any parts on which the plating has deteriorated.
G. Replace all parts that cannot be made serviceable by steps 5.A. thru 5.E.

6. ASSEMBLY (See Figures 1 thru 4)

A. Using a 66-48 tool, thread stop [10] into disc spring register [9] until bottom surfaces of each are approximately flush. Thread stop [10] 1/4 turn past flush.

NOTE: Stop [10] will protrude approximately .009 inch from disc spring side of disc spring register [9].

B. Install register ring [6] onto pressure plate [5]. Assemble register ring [8], disc spring [7], and pressure plate [5] with register ring [6] onto disc spring register [9] and stop [10].
C. With pressure capsule [4] inverted (pressure port up) and using outer portion of 66-48 tool, slowly thread disc spring register [9] with parts [5 thru 8] into pressure capsule [4] until disc spring register [9] bottoms out. Back out disc spring register [9] 1/4 turn (approximately .009 inch).
D. Mount the partially assembled unit in a test setup such as shown in Figure 2 and adjust disc spring [7] actuation.
(1) Slowly increase and decrease test pressure to obtain individual readings at which disc spring [7] actuates and deactuates.
(2) Using a 66-48 tool, adjust unit (see Table II) for decreasing pressure actuation of 6 to 8 PSIG with a 4 to 6 PSI dead band.

NOTE: The pressure difference between actuation and deactuation is the dead band.

TABLE II ADJUSTMENT PROCEDURES

PART	DIRECTION OF ROTATION	
	CLOCKWISE	COUNTERCLOCKWISE
Disc Spring Register [9]	Decreases actuation settings	Increases actuation settings
Stop [10]	Decr. dead band	Incr. dead band

(3) Fasten a .001 inch dial indicator to the pressure capsule [4] in such a manner that the movement of the pressure plate [5] will be indicated.

(4) Slowly increase and decrease test pressure to actuate and deactuate disc spring [7]. Check pressure plate [5] travel. If travel is not between .005 to .007 inch, adjust stop [10] to these values and recheck pressure settings per 6.D.(2). Use a 66-48 tool.

E. Using 66-163 tool, install helical spring [2] with adjustment shoe [3] into pressure port of pressure capsule [4].

NOTE: Use drill end of 66-163 tool to thread helical spring [2] into pressure capsule [4] and other end of tool to back out helical spring [2].

F. Adjust helical spring [2].

(1) With unit mounted in test setup, slowly increase and decrease test pressure to obtain individual readings at which disc spring [7] actuates and deactuates.

(2) If required, adjust helical spring [2] for decreasing pressure actuation of 1.0 to 2.0 PSIG with a 4 to 6 PSI dead band. To increase settings turn helical spring [2] counterclockwise; to decrease, turn clockwise.

G. Using a suitable torque locking material, (see Table III, Item 1), lock stop [10] to disc spring register [9] and disc spring register [9] to pressure capsule [4].

H. Install and synchronize electrical assembly [12].

(1) With partially assembled unit mounted in a test setup similar to Figure 2, slowly increase test pressure until disc spring [7] actuates and hold pressure.

(2) If electrical assembly [12] is not being replaced, it will be necessary to fill drive screw holes in the assembly with epoxy (see Table III, Item 3).

(3) Apply lubricant (see Table III, Item 2) to O-ring [11]. Install O-ring [11] around electrical assembly [12].

(4) Using a 66-4 tool, thread electrical assembly [12] into pressure capsule [4] until assembly actuates as noted by test lamp circuit A-B opening. Make a reference pencil mark on electrical assembly [12] and pressure capsule [4].

CAUTION: INTERNAL DAMAGE TO ELECTRICAL ASSEMBLY [12] MAY RESULT IF ASSEMBLY IS THREADED IN TOO FAR.

(5) Reduce test pressure to zero.

(6) Thread electrical assembly [12] into pressure capsule [4] until assembly actuates (circuit A-B opens). Back out electrical assembly [12] until assembly deactuates (circuit A-B closes). Make a pencil mark on pressure capsule [4] opposite mark on electrical assembly [12].
(7) Back out electrical assembly [12] until mark on assembly is halfway between marks on pressure capsule [4].

NOTE: Electrical assembly [12] has been synchronized and shall not be rotated again.

I. After unit has passed the testing of paragraph 8.A. thru 8.D., install drive screws [13].
(1) Drill new holes in electrical assembly [12] and/or pressure capsule [4]. Use a #51 drill (.067 inch) limited to 1/8 inch depth.

CAUTION: DO NOT ELONGATE EXISTING HOLES IN ELECTRICAL ASSEMBLY [12] AND/OR PRESSURE CAPSULE [4].

(2) Apply sealant (see Table III, Item 4) to drive screw holes in electrical assembly [12].
(3) Press drive screws [13] into electrical assembly [12].
(4) Cure sealant per manufacturer's instructions.
J. Test unit per paragraph 8.E.

TABLE III RECOMMENDED MATERIALS

ITEM	DESCRIPTION	MANUFACTURER
1	GLYPTAL 1201 Enamel	General Electric Company Schenectady, N.Y. (V08800)
2	INSULGREASE G624 Lubricant	General Electric Company Waterford, N.Y. (V01139)
3	STYCAST 2651 and CATALYST 9 Epoxy	Emerson and Cuming, Inc. Canton, Mass. (V04552)
4	PLASTIC GASKET Sealant	Loctite Corporation Newington, Conn. (V05972)

7. FITS AND CLEARANCES (Not Applicable)

GAGE PRESSURE SWITCH 8G361-1 OVERHAUL MANUAL

8. TESTING (See Figures 1, 2, and 4)

A. Mount the assembled unit in a test setup such as shown in Figure 2. The inlet manifold should be connected to a source of clean, dry, compressed air capable of delivering 120 PSIG.

B. Test unit for leakage by slowly applying 120 PSIG to pressure port. Shut off inlet valve and maintain a static pressure head for one minute. Reduce pressure to zero.

CAUTION: DO NOT EXCEED MAXIMUM INLET PRESSURE OF 120 PSIG.

C. Test unit operation.
(1) Slowly increase test pressure until circuit connected between receptacle pins B and C closes (A-B opens). Note the exact gage reading the instant this occurs.
(2) Slowly decrease test pressure until circuit connected between receptacle pins A and B closes (B-C opens).
(3) If required, adjust unit operation to conform with data given in Table IV by rotating helical spring [2] in small increments and repeating steps 8.C.(1) and 8.C.(2). To increase pressure settings, turn helical spring [2] counterclockwise; to decrease settings, turn clockwise.

TABLE IV UNIT OPERATING CHARACTERISTICS

TEST PRESSURE	PRESSURE PSIG	CIRCUIT	
		A-B	B-C
Increasing	By 10	Opens	Closes
Decreasing	At 2.5 ±.5	Closes	Opens

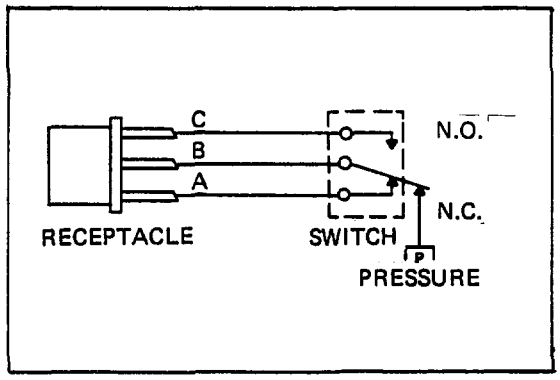


FIGURE 1 ELECTRICAL SCHEMATIC

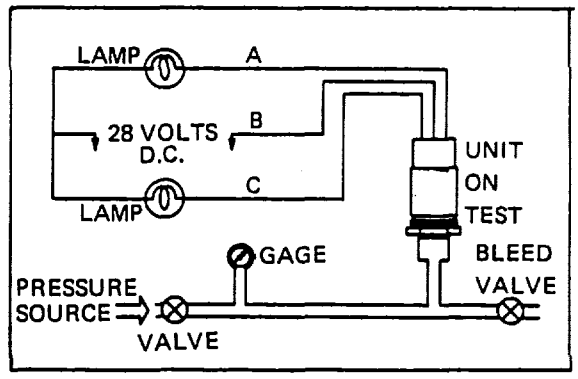


FIGURE 2 SUGGESTED TEST SETUP

D. Test dielectric strength.
(1) With the output limited to 18 milliamperes, apply 800 volts RMS 60 cycles between each receptacle pin and receptacle shell for a period of one minute.

CAUTION: THE OUTPUT CURRENT MUST BE LIMITED DURING THIS TEST AS A PRECAUTIONARY MEASURE TO PREVENT PERMANENT DAMAGE TO THE PART.

(2) There must be no arcing.
(3) Maximum permissible leakage is 2 milliamperes.

E. Test unit for leakage by slowly applying 2.5 PSIG to vent tube. Shut off inlet valve and maintain a static pressure head for one minute. Reduce pressure to zero.

CAUTION: DO NOT EXCEED MAXIMUM PRESSURE OF 2.5 PSIG.

9. TROUBLE SHOOTING (See Figure 4)

TABLE V

TROUBLE	PROBABLE CAUSE	REMEDY
Leakage	Defective pressure capsule [4]	Replace pressure capsule [4].
	Defective seal between elec. assy [12] and pressure capsule [4]	Reseal unit per paragraph 6.I.
Unit fails to operate or operate within pressure limits	Defective electrical assembly [12]	Check per paragraphs 4.E. and 4.F. Replace electrical assembly [12] if defective.
	Defective disc spring [7]	Replace disc spring [7].
	Incorrect synchronization of electrical assembly [12]	Resynchronize electrical assembly [12] per paragraph 6.H.
	Improper helical spring [2] setting	Readjust helical spring [2] per paragraph 8.C.
	Improper disc spring [7] setting	Adjust disc spring [7] per paragraph 6.D.

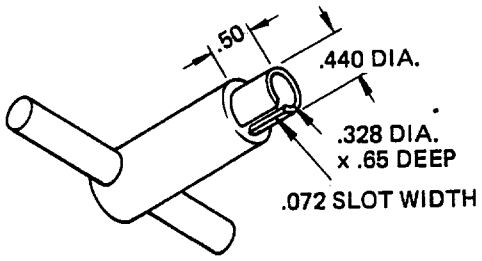
GAGE PRESSURE SWITCH 8G361-1 OVERHAUL MANUAL

10. STORAGE INSTRUCTIONS

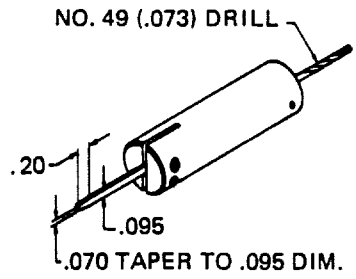
Cap pressure port and electrical receptacle with closures per MIL-C-5501. Place unit in a suitable plastic bag and/or corrugated cardboard container.

11. SPECIAL TOOLS (See Figure 3)

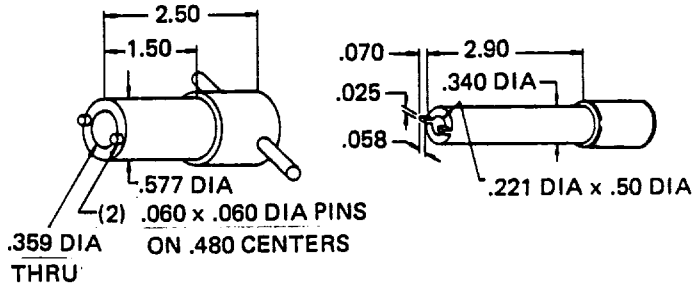
Tools similar to those shown in Figure 3 will aid in the assembly, disassembly, and adjustment of the unit. These tools may be made in the average machine shop, or they may be procured from Custom Aviation Supply under part numbers 66-4, 66-48, and 66-163.



66-4 ELECTRICAL ASSEMBLY TOOL



66-163 HELICAL SPRING INSTALLATION TOOL



66-48 STOP AND DISC SPRING REGISTER ADJUSTMENT TOOL

FIGURE 3 TOOLS

GAGE PRESSURE SWITCH 8G361-1 OVERHAUL MANUAL

12. ILLUSTRATED PARTS LIST (See Figure 4)

The illustrated parts list provides identification and spare parts ordering information. Order parts by part number and nomenclature.

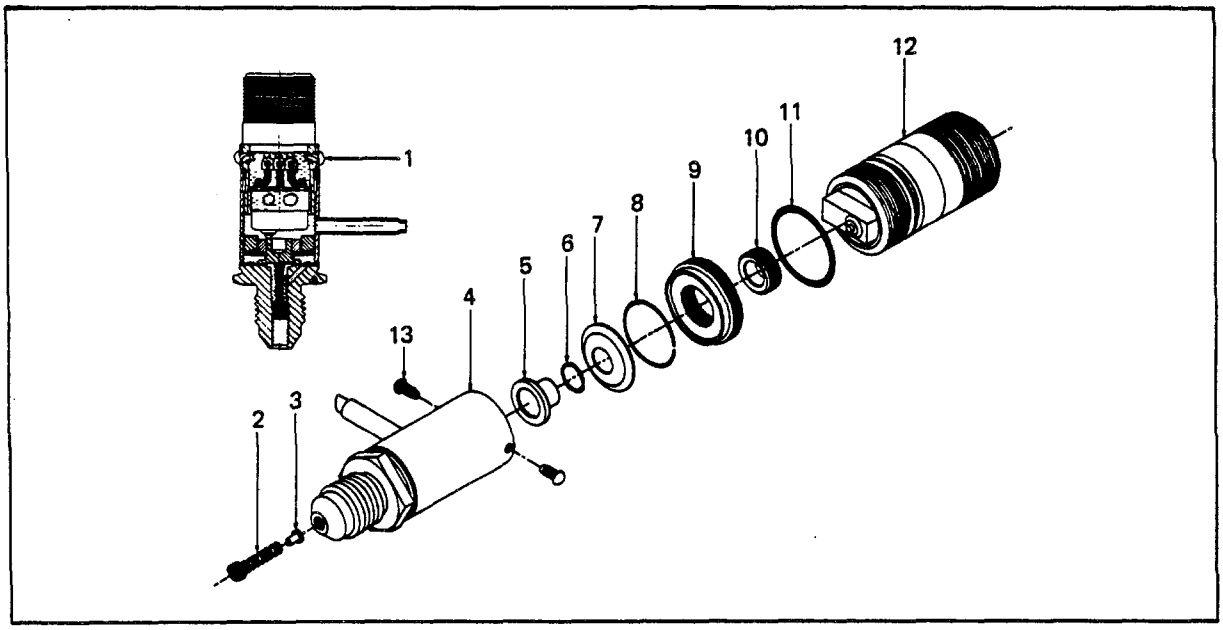


FIGURE 4 EXPLODED VIEW - GAGE PRESSURE SWITCH 8G361-1

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM TO	UNITS PER ASSY
4 1	8G361-1	SWITCH-GAGE PRESSURE		RF
2	1-69	. Spring-Helical		1
3	30-8	. Shoe-Adjustment		1
4	9-229	. Capsule-Pressure		1
5	32-100-3	. Plate-Pressure		1
6	54-29	. Ring-Register		1
7	2-86-13-361-1	. Spring-Disc		1
8	54-30	. Ring-Register		1
9	54-55-1	. Register-Disc Spring		1
10	23-20	. Stop		1
11	5-01	. Packing, O-ring Comp L449-6, V83259 CCS P/N 64-36-8		1
12	46-134-1	. Assembly-Electrical		1
13	AN535-0-2	. Screw-Drive CCS P/N 56-33		2

ITT GENERAL CONTROLS

OVERHAUL INSTRUCTIONS
WITH
PARTS BREAKDOWN

MOTOR OPERATED GATE VALVE

MODEL AV16B1864B

(These instructions also apply to Model AV16B1762B, when used with the difference data sheet at the back of the Manual.)

OVERHAUL MANUAL FOR MOTOR OPERATED GATE VALVE

1. Description and Operation

This overhaul manual covers Motor Operated Gate Valve AV16B1864B. The valve consists of three sub-assemblies: motor, actuator, and body assembly. The motor provides power through the gear train in the actuator to the slide in the body assembly. Movement of the slide allows or stops flow through the valve port.

A. Specification

Service MIL-H-5572, MIL-S-3136	Fuel Per MIL-I-5624 (JP-4)
Duty Rating	Intermittent
Operating Pressure	0 - 60 psig
Proof Pressure	188 psig
Ambient Temperature Range	-54°C (-65°F) to +71°C (+160°F)
Fluid Temperature Range	-54°C (-65°F) to +57°C (+135°F)
Rated Voltage	28 V dc (18 - 30 V dc)
Power Consumption	56 Watts
Weight	1.56 lb (approx)
Acceleration Factor	12 "G"
Operating Time at 28V dc and +21.1°C (+70°F)	0.5 sec (min) to 1.0 sec (m
Fluid Connection Size	MS33786-12
Electrical Connector	MS3102R14S5P

2. Disassembly (see Figure 3)

A. Disassemble in the same order as the key index number assigned to the exploded view illustration except as follows:

(1) Pull clip (4) from arm of needle bearing assembly (8).

(2) Do not disassemble needle bearing assembly (8). If defective, replace this unit as an assembly.

(3) Remove retainers (11) with an expanding drum mandrel of proper size

(4) Thermal reliefs 19 & 22 are staked; do not disassemble further.

(5) Refer to actuator section for disassembly of actuator.

3. Cleaning

A. Wash all metal parts except actuator in cleaning solvent, and dry with compressed air at 20 psig maximum, or a clean dry, lint-free cloth. Inaccessible places may be cleaned by using a soft nylon brush.

WARNING: IF MINERAL OIL SOLVENT IS UNAVAILABLE, AVOID BREATHING SOLVENT VAPORS AND SOLVENT CONTACT WITH SKIN. OBSERVE FIRE PRECAUTIONS. DO NOT DIRECT COMPRESSED AIR AGAINST SKIN.

4. Inspection

A. Inspect all parts for cracks, breaks, and signs of obvious damage or wear.

B. Check body (26) for cracks and slide groove for excessive wear and roughness. Slide groove must measure 0.103 ± .002 inch in width.

C. Check threaded surfaces for burrs, nicks, and evidence of cross-threading.

D. Check that rivet in needle bearing assembly (8) is tight and that driven head of rivet does not extend above surface of bearing valve arm.

E. Needle bearing assembly (8) shall turn freely without binding or sticking.

F. Check slide (9) for scoring and scratches that might allow leakage. Both sides shall be flat within 0.001 total indicator reading.

G. Spring (15) edges shall be flat and parallel within 0.020 total indicator reading. Concentricity and out-of-roundness of diameters must be within 0.020 total indicator reading.

H. Flange faces of body (26) shall be free of scratches or indentations.

5. Repair

A. Polish out minor scratches or marks in metal parts with crocus cloth and wash thoroughly to remove all traces of abrasive. Be certain that correct type crocus cloth is used for ferrous and non-ferrous parts.

B. Replace all packings each time valve is overhauled.

C. Thermal reliefs (19 & 22) have rubber type seat. If cure date limit is exceeded, replace entire assembly (19 & 22).

D. Replace all parts damaged, defective, or that fail inspection.

6. Lubrication

A. Lubricate slide contact surfaces of seal ring (13) and seal ring shell (13) and all "O" Ring packings with silicone grease MIL-L-15719 (DOW Corning 44) during assembly.

7. Assembly (see Figure 3)

A. Assemble parts 4 through 9 and move slide to closed position.

B. Push straight side of clip (4) through hole in arm assembly (8) that holds actuator (5) shaft.

C. Assemble parts 12 through 16 to each retainer (11) and push retainer into body (26). Retainer shall fit flush with body flange.

D. If heli-Coil inserts (17) are replaced, new inserts must be below body surface 3/4 to 1-1/2 turn.

E. Finish assembly of remaining parts and safetywire screws (6) and pins (1).

8. Testing

A. A test set-up as illustrated by Figure 1, or equivalent, is necessary for proper testing of this valve.

(1) Construct test plates per Specification MS33786-12. Drill mounting holes in test plates as necessary to fit valve body. Mount test plates uniformly over ports with even pressure around the flanges as shown in Figure 1. Connect air lines to fittings on plates.

(2) A light coat of silicone grease (DOW Corning 44) shall be applied to mating port flange seals before testing.

(3) Use mating connector for MS3102R14S5P electrical connector to apply 28 volts direct current.

(4) Use dry cleaning solvent, Commercial Standard 174-51-140-F, from regulated source to 188 psig for test medium. Ambient and fluid temperatures shall be between -15.6°C (+60°F) to -32.2°C (+90°F).

B. Continuity Test: Valve shall open when pin "A" is energized, and close when pin "B" is energized. When valve is open Pins "A" and "C" are connected. When valve is closed, Pins "B" and "D" are connected. Pin "E" is common.

C. Operate valve at zero pressure and check for binding or sticking.

CAUTION: KEEP HANDS CLEAR OF PORT OPENINGS WHEN OPERATING VALV

D. Submerge valve body in water, but do not immerse electrical connector.

(1) Apply internal fluid pressure (air may be used as an alternative for this test) to 188 psig to one port with other port blocked. Operate valve through 5 complete cycles. No external leakage allowed.

(2) Close slide (9) and apply pressures of 4 inches of fluid, 30 and 60 psig to one port with the other port open. Leakage from open port shall not exceed 0.5 cc after a two-minute waiting period. Repeat in opposite direction.

(3) The valve shall function properly at 60 psig pressure and shall not exceed the following time and electrical requirements at 27 $\pm$ 1 volts direct current

Amperes -- Starting: 5.0 maximum; -- running; 2.0 maximum; Operating time -- Opening or closing: 0.5 sec min; -- 1.0 sec max.

(4) Apply 60 psig pressure and operate valve at eighteen (18) volts direct current. Valve must operate in two (2) seconds or less.

(5) Cycle test valve 25 operations at 20 psig with 27 ± Volt dc.

(6) Interrupt current to valve at any partially closed position. When current is restored, valve must continue to the closed position.

E. Thermal Relief Test:

The procedure presented in this step should be followed to determine actual thermal relief valve operation. Operation of line thermal relief valve (22) and body thermal relief valve (19), when pressure is applied from the side opposite actuator of the valve, is difficult to detect since the line thermal relief valve relieves first.

NOTE: Body and line thermal relief valves may be tested either assembled in valve body or separately in an appropriate test fixture (Figure 2). If tested assembled in valve body, pressure seepage into body cavity is slow and body thermal relief valve operation in both directions (opening and closing) may require considerable time. Do not assume malfunction from operating time requirements only. For immediate operation, use test fixture as indicated in Figure 2 and reduce allowable leakage at test pressure to 5 bubbles air pressure per minute or 0.5cc fluid pressure per minute.

(1) Adjust old line thermal relief valve (22) to approximately 200 psig or solid and apply bright paint to external end to enable identification of these sub-assemblies as "test units" when assembled in valve.

CAUTION: TEST UNITS SHALL BE POSITIVELY IDENTIFIED. ATTACH TAG TO VALVE TO INDICATE THAT TEST UNIT THERMAL RELIEF VALVE ASSEMBLIES ARE INSTALLED.

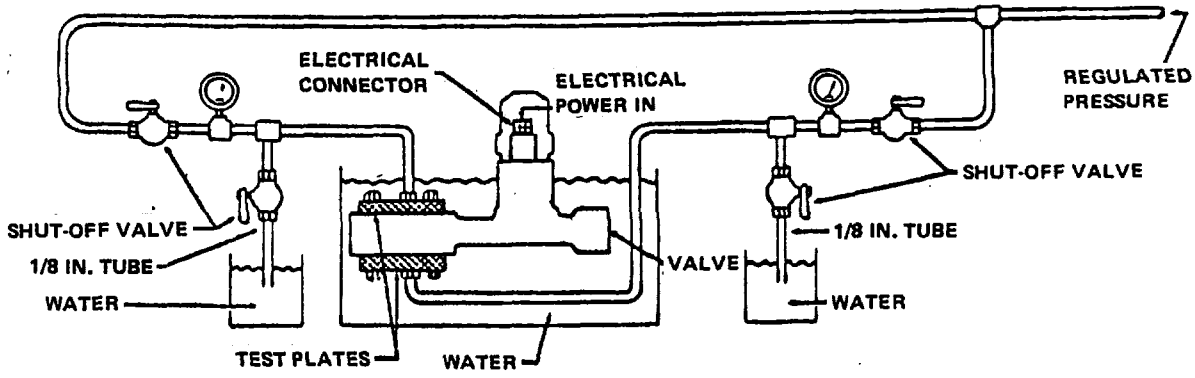
(2) Assemble test unit line thermal relief valve (22) to port on side of actuator and assemble new body thermal relief valve (19) to valve. Close slide (9) and apply test pressure of 60 psig to side opposite actuator of valve. Allowable leakage is 0.5cc per minute. Slowly increase pressure to 135 psig where flow is 1.0cc per minute minimum indicating opening. Slowly decrease pressure to 105 psig minimum for thermal relief valve to reseat; this will be indicated by a flow of 1.0cc per minute maximum. Further reduce pressure to 60 psig where leakage of 0.5cc per minute maximum is allowed. There shall be no external leakage.

(3) Replace "test unit" line thermal relief valve from port on side of actuator and assemble new line thermal relief valve (22) to valve. Close slide (9) and apply test pressure of 60 psig to side opposite actuator of valve. Allow

leakage is 0.5cc per minute. Slowly increase pressure to 100 psig where flow is 1.0cc per minute minimum. Slowly decrease pressure to 65 psig minimum for thermal relief valve to reseat; this will be indicated by a flow of 1.0cc per minute maximum. Reduce pressure to 60 psig, leakage shall not exceed 0.5cc per minute. There shall be no external leakage.

CAUTION: MAKE SURE THAT TEST UNIT IS REMOVED AND REPLACED WITH NEW THERMAL RELIEF VALVE ASSEMBLY (22) THAT HAS BEEN TESTED; OR SERIOUS DAMAGE COULD RESULT.

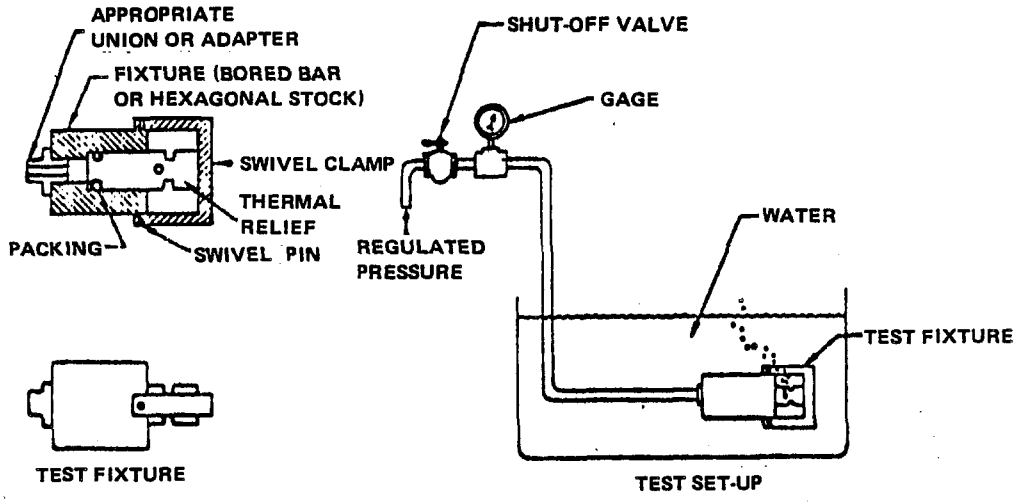
(4) Assemble new line thermal relief (22) to port on side opposite of actuator and apply pressure to valve on the actuator side. Thermal relief valve shall operate the same as in step 3.



Test Set-up
Figure 1

9. Trouble Shooting

A. Trouble	Possible Cause	Correction
Valve Inoperative.	Bad connector or switch, motor brushes worn.	Remove actuator and see "Actuator Overhaul".
Time of operation	Valve slide (9) drags.	Check slide for lubrication and point of drag.
	Actuator Assy. (5) drags.	Repair or replace actuator.
Retainer (11) leakage.	Packing (16).	Replace.
End cap (3) leakage.	Packing (2).	Replace.
Internal leakage.	Seal ring (13). Spring (15).	Lubricate or replace.
External leakage.	Cracked body (26).	Replace.
Thermal relief does not open or reseat properly.	Clogged thermal relief.	Increase pressure to thermal relief max. to clear, then recheck.
	Relief spring or seals in thermal relief (19 or 22) bad.	Replace thermal relief assy (19 or 22). Do not repair.



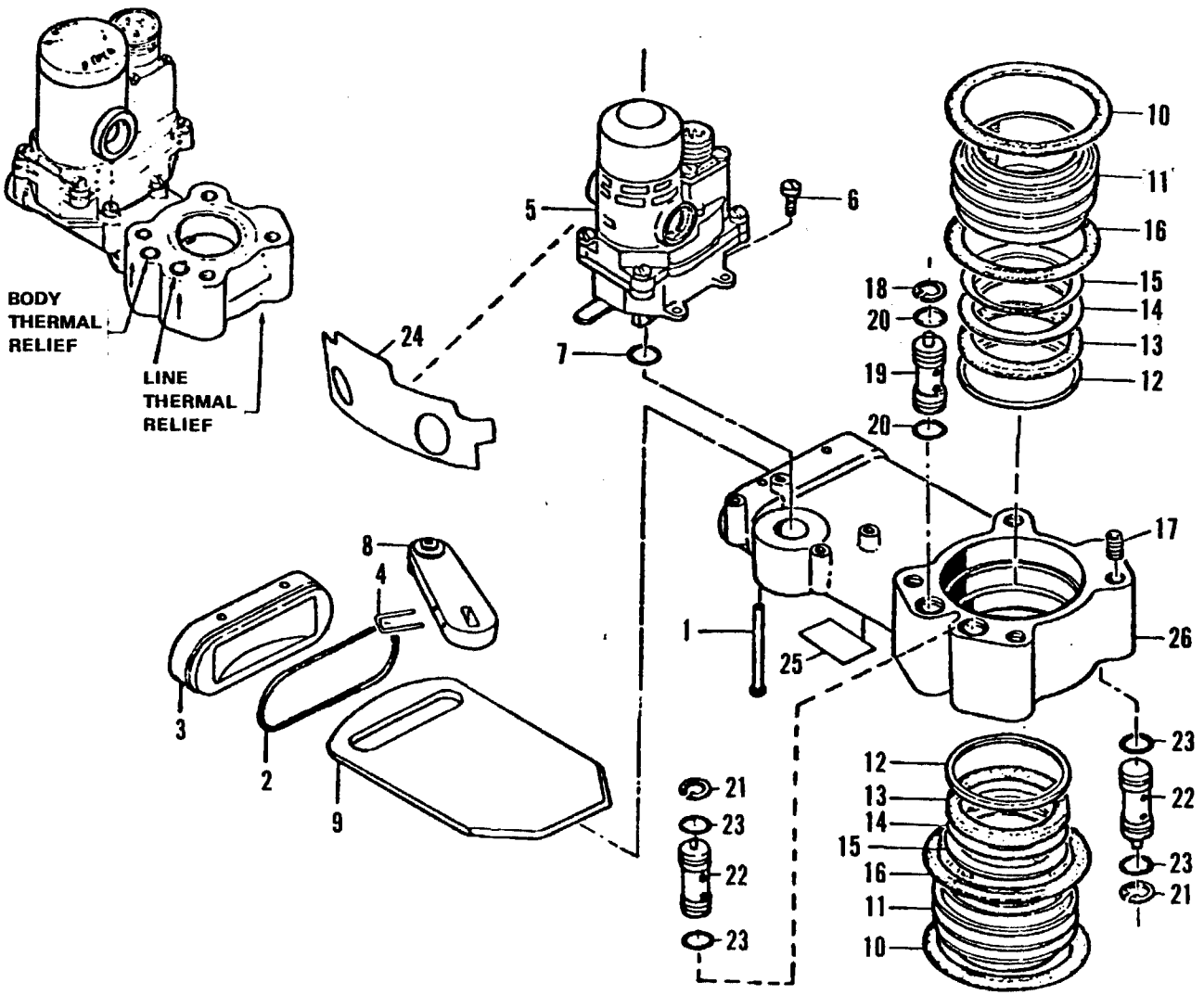
Thermal Relief Test Set-up
Figure 2

10. Storage Instructions

A. Store in a sealed heavy plastic bag or carton with desiccant enclosed.

11. Illustrated Parts List

Figure & Index No.	Part Number	1 2 3 4 5 6 7 Nomenclature	Usage Code	Units per Assy
3-	AV16B1864B	Valve Assembly-Motor Operated Gate		1
-1	15561D	. Pin		2
-2	MS29513-121	. Packing-Preformed "O" Ring		1
-3	15511BA	. Cap-End		1
-4	15549A	. Clip		1
-5	106788B107	. Actuator Assembly		1
		ATTACHING PARTS		
-6	4996 C	. Screw		4
		****		
-7	MS29513-11	. Packing-Preformed "O" Ring		1
-8	102855B	. Needle Bearing Assembly		1
-9	15508B	. Slide		1
-10	MS29513-212	. Packing-Preformed "O" Ring		2
-11	15510E	. Retainer		2
-12	15506B	. Shell-Seal Ring		2
-13	15507A	. Ring-Seal		2
-14	15504B	. Washer		2
-15	15505E	. Spring		2
-16	MS29513-121	. Packing-Preformed "O" Ring		4
-17	MS21208-F1-15	. Insert-Heli-Coil		8
-18	NAS669-37	. Ring-Snap		1
-19	102913M	. Thermal Relief Assembly (Body)		1
-20	MS29513-9	. Packing-Preformed "O" Ring		2
-21	NAS669-37	. Ring-Snap		2
-22	102913K	. Thermal Relief Assembly (Line)		2
-23	MS29513-9	. Packing-Preformed "O" Ring		4
-24	15562E	. Plate-Identification		1
-25	MS9244-01	. Decal-Rubber Cure		1
-26	15512EK3-06	. Body-Valve		1



Motor Operated Gate Valve, Part No. AV16B1864B
Figure 3

OVERHAUL MANUAL FOR ACTUATOR ASSEMBLY 106788B107

1. Specifications

Rated Voltage	28 V dc
Required Voltage	18 - 30 V dc
Operating Time (either direction)	0.50 to 1.00 sec
Electrical Connector	MS3102R14S5P
Ambient Temperature Range	-54°C (-65°F) to +71°C (+160°F)
Acceleration Factor	12 "G"
Weight	15 oz (approx)
Duty	Intermittent

2. Disassembly (see Figure 3)

A. Disassemble in the order of key index numbers assigned to exploded view illustration except as follows:

(1) Do not remove idler shaft (12) from housing (13). If shaft is worn or loose, replace both parts as an assembly.

(2) After disassembly of actuator housing (13), move indicator arm (33) to center position to assist removal of switch arm (21).

(3) Do not disassemble switch plate assembly (11), switch arm (21), spacer plate assembly (22) or gear housing assembly (35) further than indicated in exploded view. If damaged or worn, assemblies should be replaced in their entirety

(4) Refer to motor overhaul manual for motor (10) procedure.

3. Cleaning

A. Wash all metal parts in mineral oil base cleaning solvent and dry with compressed air or a clean, lint-free cloth.

CAUTION: DO NOT IMMERSE OR WASH MOTOR (10) OR SWITCH PLATE ASSEMBLY (7) IN CLEANING SOLVENT.

WARNING: IF MINERAL OIL BASE SOLVENT IS NOT AVAILABLE AND SUBSTITUTION IS NECESSARY, AVOID BREATHING SOLVENT VAPORS AN SOLVENT CONTACT WITH SKIN. OBSERVE FIRE PRECAUTIONS. D NOT DIRECT COMPRESSED AIR AGAINST THE SKIN.

4. Inspection

A. Under strong light and magnification, inspect all parts for cracks, breaks frayed wiring, or other signs of obvious damage or excessive wear. Also make the following detailed inspection:

(1) See Table to check gear tolerances. Maximum diametrical clearance mating surfaces of idler gear (14), idler shaft (12), input gear (17), pin (18), gears (24), planetary (25), gears (26) and planetary (27) to be 0.005 inch.

(2) Table of Gear Tolerances

Part and Index No.	Measure Across	Over Wires (in. dia.)	Dimensions (in.) Max.	Min
*Gear (14) 9785D	Teeth	0.027	0.7254	0.7218
9785M	Teeth	0.027	0.7225	0.7190
9785K	Teeth	0.027	0.7210	0.7175
9785V	Teeth	0.027	0.7179	0.7142
9785X	Teeth	0.027	0.7194	0.7158
	Splines	0.030	0.2757	0.2743
**Gears (17)	Teeth	0.027	0.7254	0.7218
	Splines	0.030	0.2757	0.2743
Gears (24,26)	Teeth	0.027	0.6277	0.6252
Planetary (25)	Splines	0.030	0.2775	0.2745
Planetary (25,27)	OD (3 bearing studs)	--	0.1860	0.1847
Gear Housing Assy (35) Ring Gear	--	0.0225	1.4008	± 0.001

*Dimension given for standard gear (14); undersize dimensions for select gears are given in parts list.

**Hole diameter for gear (17) is 0.094 to 0.095 inch.

(3) Check that idler shaft (12) is tight in housing (13), and for 0.0925 to 0.0935 inch diameter.

(4) Check spacer plate assembly (22) for damage to plate or seal ring.

(5) Place idler gear (14) and bushing (15) into position to mesh idler gear with motor shaft. Backlash shall be 0.001 to 0.005 inch maximum.

(6) Check spring (19), free length to be 0.475 inch; working height to be 0.358 inch + 0.000, -0.020 inch and load at working height 1.0 pound + 0.000, -0.250 pound.

(7) Inspect actuator housing (13) and gear housing (35) with fluorescent penetrant per MIL-I-6866A. Inspect planetaries (25,27) with magnaflux per MIL-I-6868.

(8) Bearing pin (23) head thickness shall be 0.015 to 0.017 inch.

(9) Inspect connector (4) for bent or broken pins and signs of arcing.

(10) Check microswitches on switch plate assembly (7) for operation. Place leads of an ohmmeter across terminals of each microswitch. Actuate switch buttons and check continuity. If condition indicates long usage and many operations, replace switch plate assembly (7).

5. Repair or Replacement

A. Minor scratches or grooves may be polished out of iron parts with crocus cloth and from aluminum parts by aluminum oxide abrasive cloth. Follow by a thorough cleaning to remove all traces of abrasive.

B. Replace all parts which are defective and cannot be repaired to meet the requirements of the inspections given in paragraph 4.

C. Replace packings (5, 11, and 31) at each overhaul.

D. If motor (10) or idler gear (14) is replaced, idler gear must be select fit between motor shaft and input gear (17) to establish backlash of 0.001 to 0.003 maximum. The idler gear is available in a standard pitch diameter, and in 0.003, 0.006, 0.008 and 0.010 inch undersized pitch diameters to provide the required fit.

E. Measure across top of contact ears of switch arm assembly (21) for a gap of approximately 1/4 inch equidistant from center line. Replace if out of tolerance.

F. If output planetary (27) or clutch ring (28) is replaced, clutch ring must be select fit to output planetary during reassembly in accordance with paragraph 7, step C.

G. Replace pin (29) at reassembly.

6. Lubrication

A. Lubricate teeth of all gears and bearing surfaces of planetaries (25,27) with a very light film of "Aero" Lubriplate grease (Fiske Bros Refining Co., Newark, New Jersey), available from ITT General Controls, Inc. under part No. 105185A.

CAUTION: EXCESSIVE GREASE ON GEARS MAY CAUSE CRITICALLY SLOW ACTUATION AT LOW TEMPERATURES.

B. Lubricate all packings and seals with a light film of "Aero" Lubriplate grease during assembly.

C. Apply a heavy coat of Lubriplate No. 630AA grease (Fiske Bros Refining Co.), available from ITT General Controls, Inc. under part No. 105185B, before installing clutch ring (28). Apply additional grease on both sides of clutch rings after installation.

D. Do not permit any grease around switch plate assembly (7), electrical con nector (4), motor (10) or in switch compartment.

7. Reassembly (see Figure 3)

A. Reassemble in the reverse order of disassembly, noting the following:

(1) Before assembly of components, check that actuator housing (13) and gear housing assembly (35) bear uniformly against seal assembly (22)

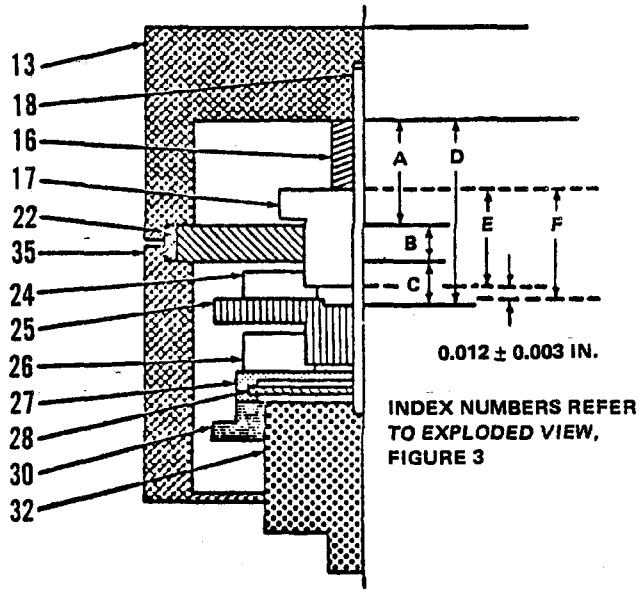
(2) Indicator arm (33) should turn freely without binding against either side of housing travel area. In the event of binding against lower ring, carefully pry away, using a non-metallic flat tool. Take care to prevent cracking or damage to finish.

B. Bend ends of pin (29) back and flat to secure in place after installing through arm (33) and output shaft (32). Check to see that pin ends do not scrape against housing (35).

C. Space between clutch ring (28) ears shall be 0.165 to 0.180 inch after reassembly. Select fit clutch ring to this requirement. The clutch ring is available in standard size and in several oversized and undersized dimensions varying in increments of 0.001 inch for correct fit.

D. Clearance between plate assembly (22) and upper bearing pins (23) shall be 0.005 to 0.015 to prevent binding of gear train against spacer plate assembly (22). If required clearance is not present, tap internal components lightly into housing to settle parts. If clearance is not obtained, replace parts as necessary to lower stack.

E. If actuator housing (13), gears (24,26), planetaries (25,27), stop ring (30), output shaft (32), plate assembly (22) or gear housing assembly (35) are replaced, spacer (16) shall be select fit as follows (see figure 1 for dimensioned cross-section):



Selection of Input Gear Spacer
Figure 1

(1) Measure and record dimension A, distance from actuator housing (13) lower land surface to bottom of pin (18) boss housing.

(2) Measure and record plate assembly (22) thickness, dimension B.

(3) With all components (parts 19 through 34) installed in gear housing (35), measure and record dimension C, distance from gear housing (35) upper land surface to bottom of depression in center of input planetary (25).

(4) Add dimensions A, B and C to obtain dimension D and record.

(5) Measure thickness of input gear (17), dimension E. Add 0.012 $\pm$ 0.003 inch to obtain dimension F and record.

(6) Subtract dimension F from dimension D. The difference is the required thickness of spacer (16). The spacer is available in a standard thickness and in several oversized and undersized thicknesses varying in increments of 0.001 inch for correct fit.

F. Install packing (11) under motor (10) and hold in place with one screw (8) through hole near idler shaft. Place large insulation sleeving over motor wires and solder wires to correct terminals on switch plate assembly (7). Use 50/50 solder, composition SN50; all wire joints must be secure and sound. (See Figure 2 for Wiring Diagram.)

G. Place safetywire, MS20995NC20 in holes in switch plate assembly (7) before installing in housing (13) with screws (6).

H. When assembling switch plate assembly (7), put red motor wire under switch plate assembly and under pin boss in actuator housing (13) to enable alignment of pin (18). Be sure insulator tabs located on outside edges of switch plate assembly (7) are positioned between wire solder connections to switch and ID of housing (13).

I. Locate connector (4) key adjacent to motor (10).

J. Hold actuator together by hand and test with operating voltage to verify that switch arm ears depress microswitches to stop motor at end of $92^{\circ} \pm 3^{\circ}$ rotation of output shaft (32). Assemble screws (1).

K. Invert actuator assembly until output end of shaft (32) is straight up. Tap unit lightly to settle parts. In this position, check operation for $92^{\circ} \pm 3^{\circ}$ rotation of output shaft (32), applying operating voltage. If actuator assembly overrides $92^{\circ} \pm 3^{\circ}$ rotation, replace stop ring (30).

L. Secure screws (1) with safety wire MS20995NC20, screws (2) with safetywire MS20995NC20, and screws (8) with safetywire MS20995NC20.

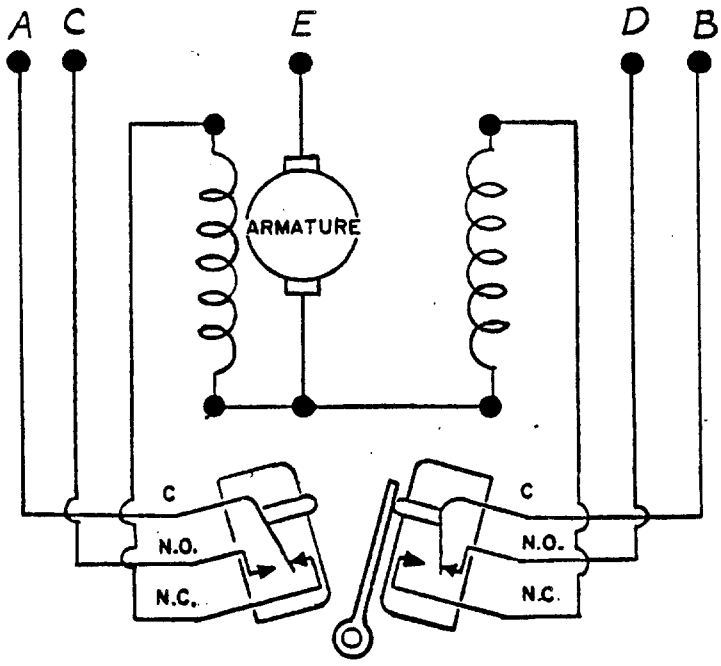
8. Test Procedure

A. Perform tests with actuator assembly mounted on AV16B Series motor operated gate valve body or equivalent. Be sure actuator assembly attachment holes line easily with gate valve body holes.

B. Use test body without packings, seals, retainers, or thermal reliefs.

C. Continuity Test: Check electrical continuity of circuits (see Figure 2). Indicator arm shall move to the open position when pin "A" is energized and to close position when pin "B" is energized. When in open position, pins "A" and "C" are connected. When in closed position, pins "B" and "D" are connected. Pin "E" is common.

D. Functional Test: Apply 27 ± 1 volt dc, cycle actuator assembly five times at no load. The actuator assembly shall operate freely with no evidence of binding or sticking. Starting amperes shall be 5.0 maximum and running amperes shall be 2.0 minimum. Operating time in either direction, opening or closing, shall be 0.50 minimum to 1.00 maximum seconds.



Wiring Diagram (Shown in Closed Position)
Figure 2

9. Trouble Shooting

Trouble	Possible Cause	Correction
Motor will not operate.	Broken wire or connection.	Replace or resolder wire.
	Faulty microswitch.	Replace switch plate assembly (7).
	Motor burned out.	Replace motor (10).
Operating time exceeds maximum.	Excessive drag of gear train.	Check fit of gears (14, 17, 24, 26) and clutch ring (28).
Motor does not shut off at end of travel.	Bent ears of switch arm assembly (21).	Replace switch arm assembly (21).
	Faulty microswitch.	Replace switch plate assembly (7).

10. Storage Instructions

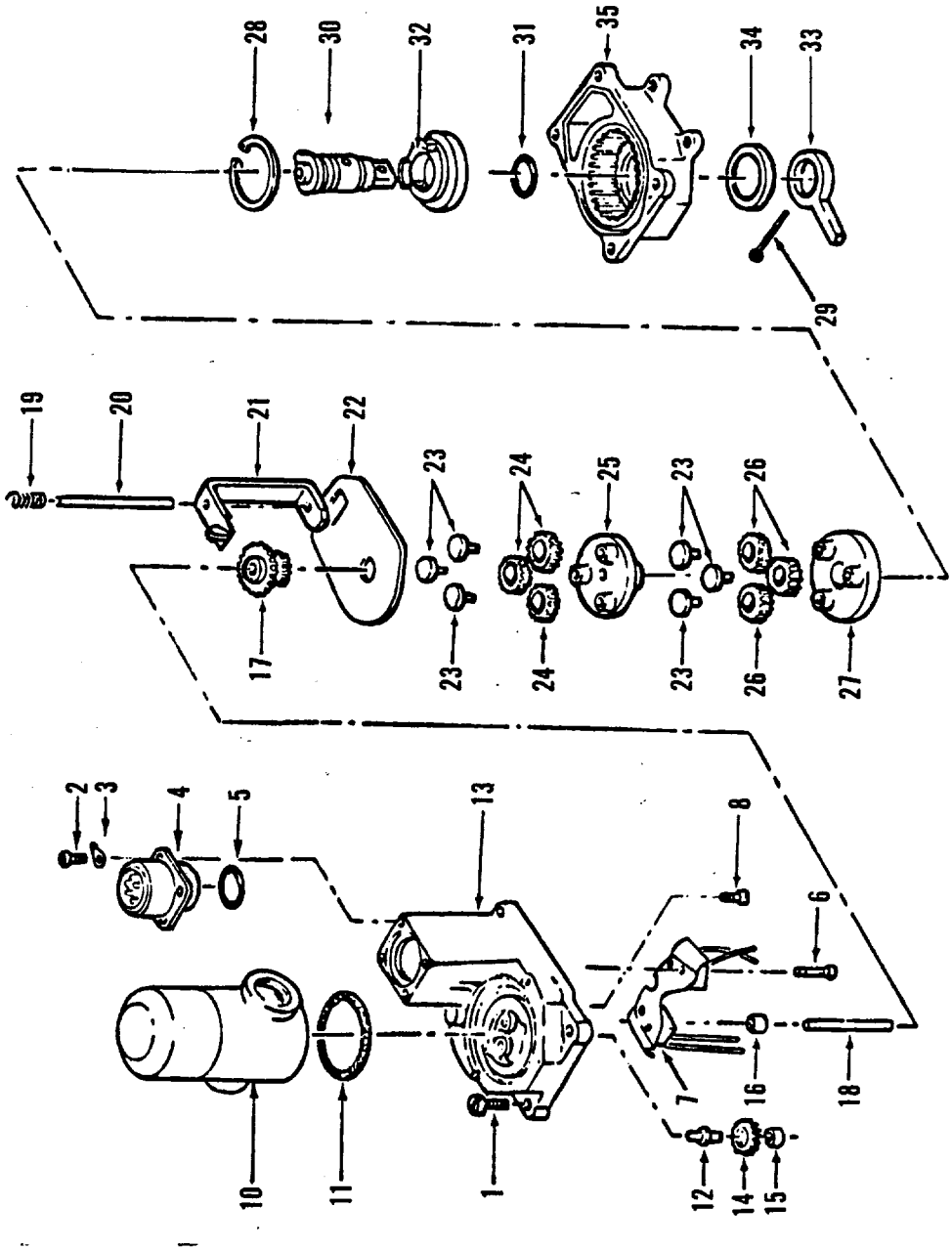
Store in a heavy plastic bag with desiccant enclosed.

11. Illustrated Parts List

Figure & Index No.	Part Number	1 2 3 4 5 6 7 Nomenclature	Uni per Ass
3-	106788B107	Actuator Assembly	1
-1	4996C	. Screw	4
	106786A120	. Housing Assembly - Actuator	1
-2	AN500A4-5	. . Screw	4
-3	16844A	. . Clip - Safetywire	1
-4	MS3102R14S5P	. . Connector - Electric	1
-5	MS29513-21	. . Packing	1
-6	AN500A2-7	. . Screw	2
-7	102663B	. . Plate Assembly - Switch	1
	W79D26X4.0X	. . Wire - Lead (Yellow)	1
	W79J26X4.0X	. . Wire - Lead (White)	1
-8	AN500A8-6	. . Screw	2
-9	Not Used		
-10	106785B100	. . Motor - Aircraft DC	1
-11	MS29513-26	. . Packing - Preformed "O" Ring	1

Figure & Index No.	Part Number	1 2 3 4 5 6 7 Nomenclature	Usage Code	Units per Assy
3-				
-12	*9784B	. . Shaft - Idler		1
-13	*9775MA	. . Housing - Actuator		1
-14	9785D	. . Gear - Idler (0.6875 pitch dia)		AR(1)
	9785M	. . Gear - Idler (0.003 in. undersized pitch dia)		AR(1)
	9785K	. . Gear - Idler (0.006 in. undersized pitch dia)		AR(1)
	9785V	. . Gear - Idler (0.010 in. undersized pitch dia)		AR(1)
	9785X	. . Gear - Idler (0.008 in. undersized pitch dia)		AR(1)
-15	15645A	. . Bushing - Oilite		1
-16	15716A	. . Spacer - Input gear (0.167 to 0.163 in. thick)		AR(1)
	15716B	. . Spacer - Input gear (0.177 to 0.174 in. thick)		AR(1)
	15716C	. . Spacer - Input gear (0.173 to 0.170 in. thick)		AR(1)
	15716D	. . Spacer - Input gear (0.169 to 0.165 in. thick)		AR(1)
	15716E	. . Spacer - Input gear (0.164 to 0.160 in. thick)		AR(1)
-17	9785C	. . Gear - Input		1
-18	15610A	. Pin - Centering		1
-19	5242B	. Spring - Spacer		1
-20	9792B	. Pin		1
-21	106611A	. Arm Assembly - Switch		1
-22	10365OA	. Plate Assembly - Spacer		1
-23	15543A	. Pin - Bearing		6
-24	6701C	. Gear		3
-25	9779C	. Planetary - Input		1
-26	6701D	. Gear		3
-27	15603A	. Planetary - Output		1
-28	16848BA	. Ring - Clutch (0.043 to 0.043 in. thick)		AR(1)
	16848BB	. Ring - Clutch (0.001 in. undersized)		AR(1)
	16848BC	. Ring - Clutch (0.001 in. oversized)		AR(1)
	16848BD	. Ring - Clutch (0.002 in. oversized)		AR(1)
	16848BE	. Ring - Clutch (0.003 in. oversized)		AR(1)
-29	15609A	. Pin - Lock		1
-30	9778B	. Shaft - Output		1
-31	MS29513-12	. Packing - Preformed "O" Ring		1
-32	15605D	. Ring - Stop		1
-33	15606A	. Arm - Indicator		1
-34	15607A	. Washer		AR(1)
-35	102655E	. Housing Assembly - Gear		1
	**6746-10-75BLK	. Sleeving - Insulator		5
	**6746-5-1.20BLK	. Sleeving - Insulator		1

* Cannot be ordered individually. Replace 9784B and 9775MA as an assembly.
** Indicates parts used for insulating or lubrication purposes only.



Actuator Assembly 106788B107
Figure 3

OVERHAUL MANUAL FOR DIRECT CURRENT MOTOR 106785B100

1. Specifications

Rated loads at +24°C (+75°F) ambient temperature:

Voltage	18	27	30
Torque (oz in.)	0.4	1.0	1.125
RPM (at torque)	14,000	18,000	20,000
Starting Current (amp) max.	5.0	7.0	8.0
Running Current (amp) max	2.0	2.6	2.9
Duty Cycle - Intermittent		3 min on, 17 min off	
Rotation		Reversible	
Weight		6.4 oz (max)	

2. Disassembly

A. Disassemble according to sequence of index numbers assigned to the exploded view, observing the following:

(1) Observe position of wire on brush (17) and method of bending end of brush terminal assembly (17) over brush guide (18).

(2) Do not remove field assembly (12) from brush plate (20). When removing field and brush holder plate assembly (12 thru 20), exercise care to prevent breaking the wire leads. If either part is damaged, tag wires to aid in reassembly.

3. Cleaning

A. Clean parts, using a cloth dampened with cleaning solvent, and wipe with a dry, lint-free cloth.

WARNING: USE SOLVENT IN A WELL VENTILATED AREA. AVOID PROLONGED INHALATION OF FUMES. KEEP AWAY FROM OPEN FLAMES.

4. Inspection

A. Inspect parts for excessive wear, cracks, scoring, evidence of corrosion, or other damage.

B. Check brush terminal assembly (17) for wear. Brush length must not be less than 0.112 inch. Minimum length of 0.112 inch is indicated by drilled hole, maximum length is 0.250 inch.

C. Check field assembly (12) for open windings. Apply 1000 volts AC (root mean square) 60 cycles between coil leads and core for one second; there must be no indication of insulation breakdown.

D. Check armature (23) for open or shorted windings. Check by applying 1000 volts AC (root mean square) 60 cycles per second between commutator and shaft for one second; there must be no indication of insulation breakdown. Bearing journals of shaft shall be concentric with each other within 0.001 inch total indicator reading.

CAUTION: TESTS "C" AND "D" SHALL NOT BE REPEATED EXCEPT WITH A MEGGER OR WITH 85% OF FIRST TEST VOLTAGE.

E. Armature assembly pinion diameter across 0.030 wire must be 0.1886 to 0.1926 inch. No broken or damaged teeth allowed.

5. Repair

A. Replace parts which are cracked, excessively worn, scored or corroded, or do not meet inspection requirements.

B. Remove mild corrosion and polish out minor nicks or scores in iron base parts with crocus cloth. Use aluminum oxide abrasive cloth for aluminum parts. Clean parts thoroughly after polishing.

C. Replace packings (3, 6) and bearings (21) at each overhaul.

D. If brush terminal assemblies (17) are replaced, resurface armature commutator with diamond tool. After machining, clean out bar with raking tool.

CAUTION: DO NOT UNDERCUT DEEPER. MINIMUM DIAMETER OF COMMUTATOR IS 0.509 INCH INDICATED BY WEAR GROOVE IN END.

E. Use insulating varnish, Specification MIL-V-1137, Type M, Grade CB, to touch up varnished surfaces of field assembly (12) and armature (23). OD laminations of field assembly must be varnish-free after touchup.

6. Lubrication

A. Apply a light film of grease (No. 44) (Dow Corning Corp., Midland, Mich.) to packing (6) before installing in motor housing cap assembly (5).

B. If bearings (21) are disassembled or replaced, they shall be packed 1/8 maximum with Texaco Unitemp 500 grease, using a nylon brush.

7. Assembly

A. Assemble washer (22) and press bearings (21) to armature (23). Check bearings for push fit to housing (26) and cap assembly (5).

NOTE: This is a precision matched assembly and no looseness is allowed.

B. Assemble stud (25) to housing assembly (26).

C. Line up field assembly (12) with studs (25) making sure black wire is near negative side indicated by mark near brush port on housing (26).

(1) Place line-up rods through stud holes of brush holder plate (20) and through spacers (11) and into stud holes of field assembly (12). Carefully assemble parts to studs (25).

NOTE: To assure that field assembly (12) is in place, look through brush port. End of field assembly (12) will show approximately 1/16 inch past edge of port.

(2) Turn nuts (10) onto studs (25) till snug. If nuts (10) are not properly set, edge of cap will not fit snugly against edge of housing (26).

(3) Place brush into brush holder plate (20) from side port. Be sure wire goes into side slot. Center spring (16) over round end of brush (17) and center round end of bracket (15) over spring. Insert screw (13) through lock washer (14), eye of brush terminal (17) and screw hole of bracket (15), and turn screw securely into brush holder plate (20). Bend terminal end of brush terminal assembly (17) flat over threads of screw (13).

(4) Brush load on commutator must be 50 to 60 grams accomplished by springs (16) that weigh 55 grams $\pm$ 5 percent at 0.400 inch working height. Replace springs (16) if not within tolerance.

D. Assemble armature (23) with bearings (21) and cap assembly (5), to housing assembly (26) with no spacer washers (7) installed. Measure distance from end of splined shaft on armature assembly (23) to lower land surface of cap assembly (5). The exposed shaft length shall be 0.397 to 0.382 inch (see Fig. 2).

E. Select spacer washers (7) available in increments of 0.003, 0.005 and 0.0 inch and place under bearing (21) in housing (26) or in cap (5) to establish correct shaft length.

F. Armature shaft must be concentric with end boss of cap assembly (5) within 0.005 inch total indicator reading.

G. Refer to Figure 2 for spring installation and Figure 3 for part identificatio to determine the proper loading on springs (8) as follows: With parts asser bled in paragraphs D. and E. remaining in housing (26), pull on armature (23) shaft to determine clearance between lower bearing (21) and cap (5).

H. Select spacer washers (7) to establish a clearance (end play) of 0.42 $\pm$ 0.0(inch for Belleville springs (8) and separating spacer washer (9). The clear ance will provide a resultant load of approximately six to eleven pounds aft springs (8) and separating spacer washer (9) are installed as illustrated in Figure 2.

CAUTION: SPRINGS (8), WHICH ARE SAUCER-SHAPED, SHALL BE ASSEMBLED BACK-TO-BACK, WITH INSIDE DIAMETER OF SPRINGS SEPARATED BY SPACER (9). THIS EXERTS FULL PRESSURE AGAINST OUTER BEARING RACE.

I. Assemble packing (6) to cap assembly (5) and secure with screws (4).

NOTE: Stake screws (4) in two places away from critical region of 0.17 inch from OD edges of end cap (5).

J. After assembly of motor, load required to move armature (23) shaft endwise may be checked. Load shall be between six to eleven pounds. If available, check spring load on fixture illustrated in Figure 4.

K. Wipe packings (3) dry and assemble. Add cap (2) and ring (1).

. Test Procedure

A. Conduct test at ambient temperatures of +24° to +32°C (+75° to +90°F).

B. If new brushes were installed, operate motor thirty minutes at no load, 16 volts DC or AC (60 cps), and reverse direction of rotation every five minutes. Lower temperature by fan or jet of air on motor housing.

C. Load Test: Check motor speed and current in both directions of rotation at voltage and torque loads below. Results may be ten percent under values specified. Maximum test operating time for each direction of rotation must not exceed eight seconds. Use dynamometer for load.

Volts	18	27	30
Torque (oz in.)	0.4	1.0	1.125
RPM (at torque)	14,000	18,000	20,000
Amp (starting((max.)	5.0	7.0	8.0
Amp (running) (max.)	2.0	2.6	2.9

D. Locked Rotor Test: Mount motor in test stand and hold shaft with fingers. Apply 26 ± volts DC and read locked rotor current; it shall not exceed 6.0 amps.

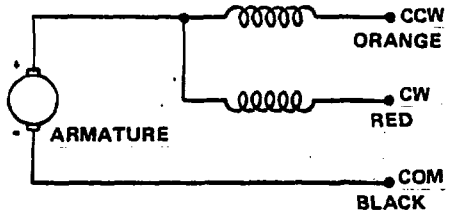
CAUTION: RELEASE SHAFT AT FIVE (5) SECONDS MAXIMUM.

. Trouble Shooting

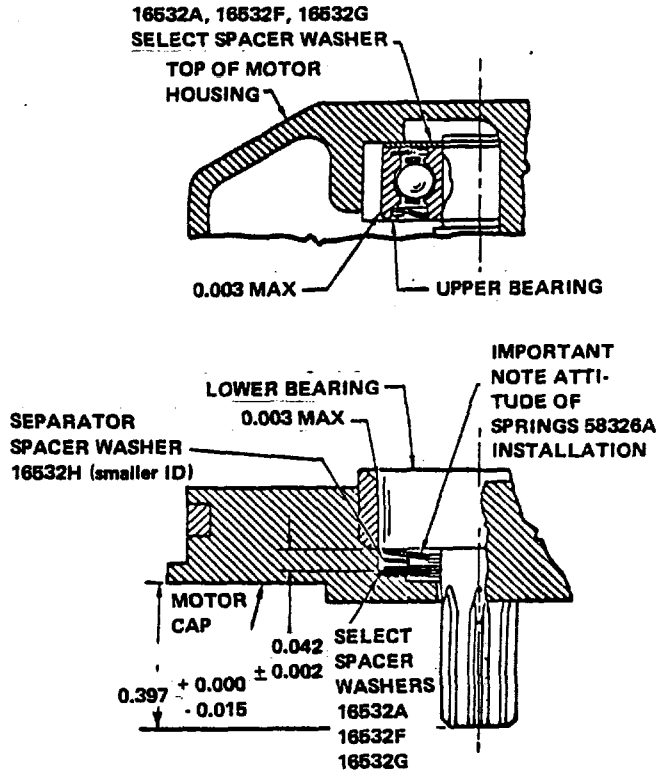
A. Possible Cause of Failure	Remedy
(1) Brushes binding in guide.	Free brushes.
(2) Wiring incorrect.	Check and correct wiring.
(3) Field or armature grounding bad.	Check and repair connection.

.0. Storage Instructions

Store in a sealed, heavy, plastic bag with desiccant enclosed.



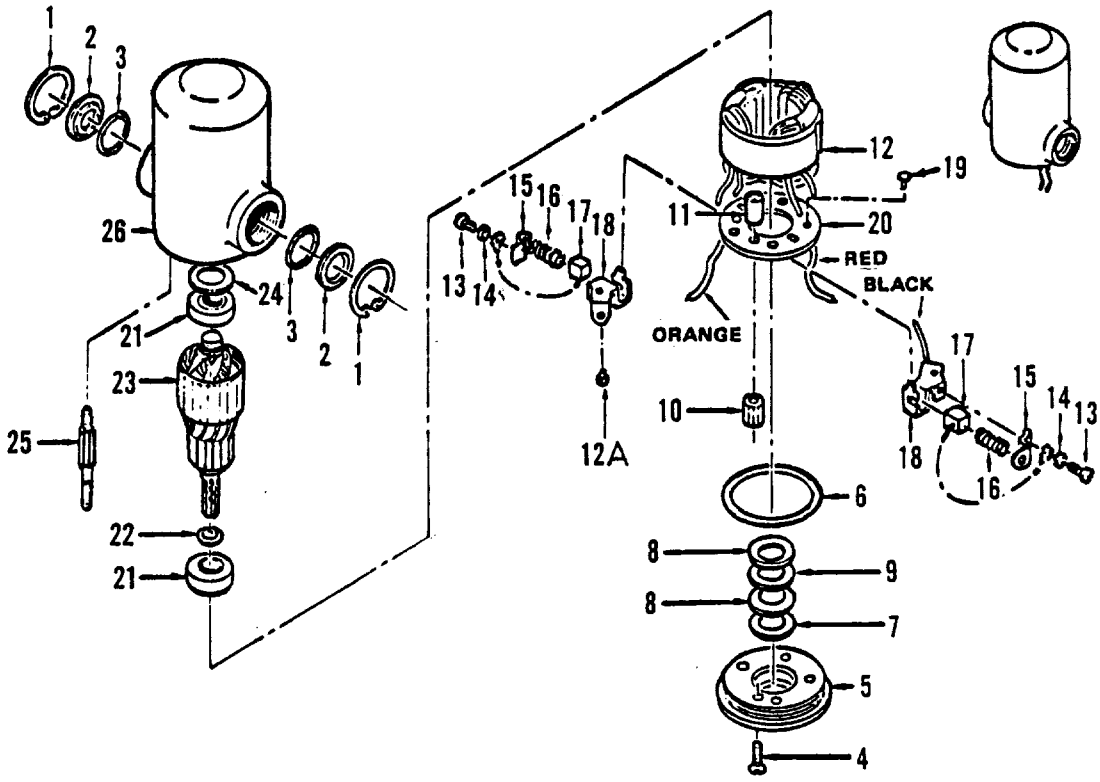
Wiring Diagram
Figure 1



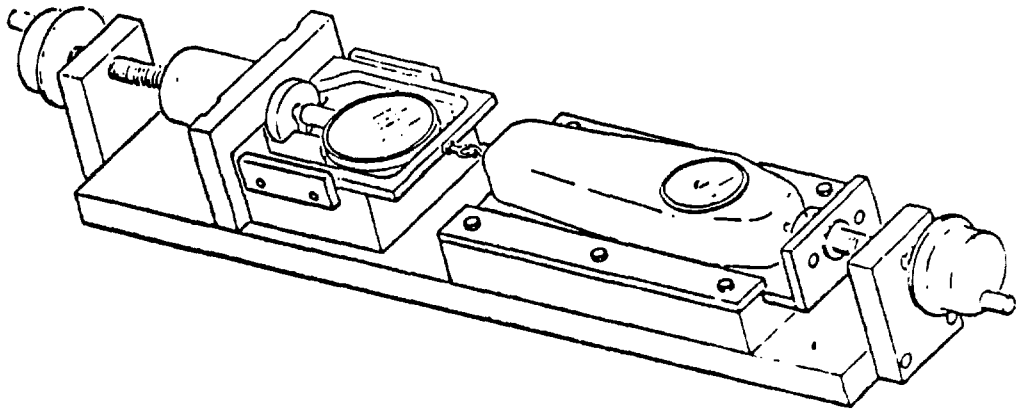
Spring Installation and Assembly
Figure 2

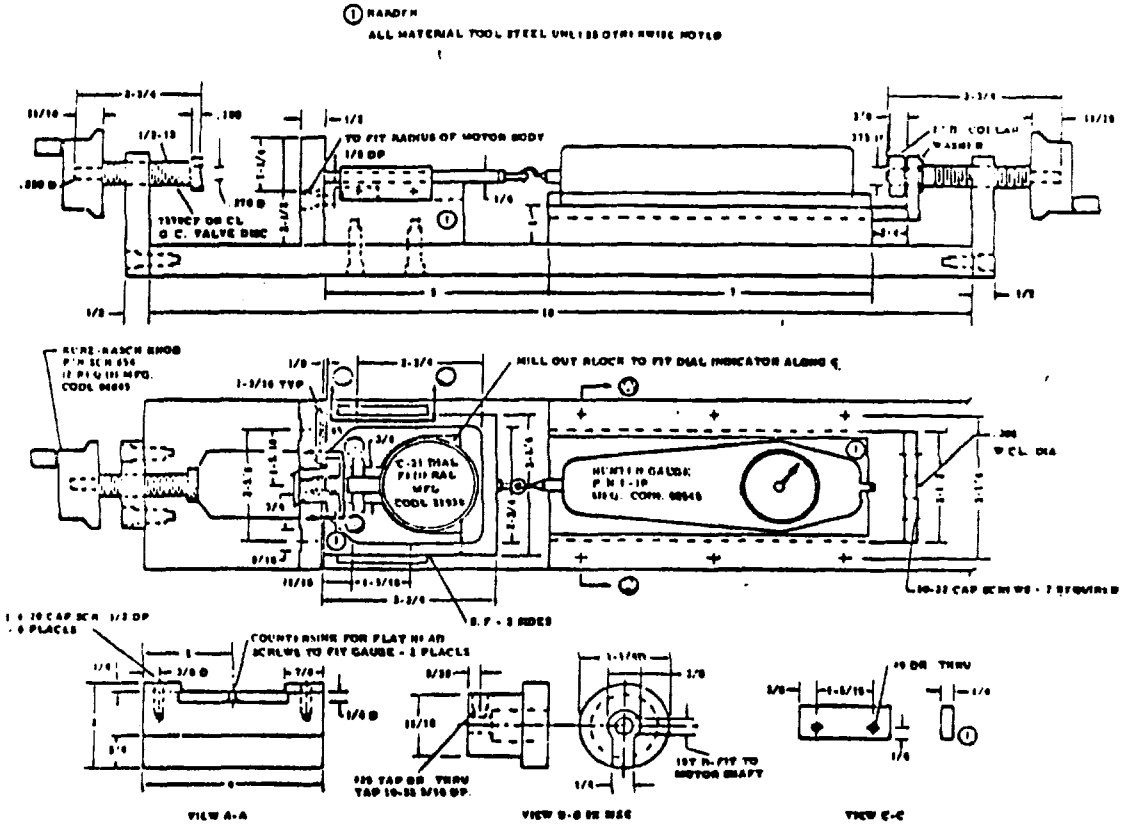
11. Illustrated Parts List

Figure & Index No.	Part Number	1 2 3 4 5 6 7 Nomenclature	Units per Assy
3-	106785B100	Motor - Direct Current	1
-1	NAS669-68	. Ring	2
-2	16542A	. Cap - Brush Port	2
-3	MS9021-015	. Packing	2
-4	AN505-4R6	. Screw	2
-5	103205N	. Cap Assembly - Motor Housing	1
-6	MS9021-027	. Packing	1
-7	16532A	. Washer, 0.005 in. thick	AR
	16532F	. Washer, 0.003 in. thick	AR
	16532G	. Washer, 0.010 in. thick	AR
-8	58326A	. Spring - Belleville	2
-9	16532H	. Washer	1
-10	16539B	. Nut	2
-11	15715A	. Spacer	2
	103202L	. Plate Assy - Field & Brush holder	1
-12	103201A	. . Field Assembly	1
	103204A	. . Brush Holder Plate Assembly	1
-13	AN500-2-3	. . . Screw	2
-14	AN935-2L	. . . Washer - Lock	2
-15	16536C	. . . Bracket - Brush spring	2
-16	16535A	. . . Spring - Brush	2
-17	103337A	. . . Terminal Assy - Brush	2
-18	16538A	. . . Guide - Brush	2
-19	2967-3-3	. . Eyelet	2
-19A	2967-3-4	. . Eyelet	2
-20	16537A	. . Plate - Brush holder	1
-21	77R3LR1DU2	. Bearing (ITT-GC #102549E)	2
	R3AZZ	. Bearing - Alternate (G. Muller Co.) (Dist. Oscar Eggen, 315 W. 9th, L.A.)	
-22	5528A	. Washer	1
-23	103198C	. Armature	1
-24	16532A	. Washer, 0.005 in. thick	AR
	16532F	. Washer, 0.003 in. thick	AR
	16532G	. Washer, 0.010 in. thick	AR
	103206A	. Housing Assembly - Motor	1
-25	16540B	. . Stud	2
-26	16380AA	. . Housing - Motor (non-procurable)	1



Direct Current Motor 106785B100
Figure 3





Spring Load Test Fixture
Figure 4

MODEL AV16B1762B

MOTOR OPERATED GATE VALVE

DIFFERENCE DATA SHEET

The basic difference between Model AV16B1762B and AV16B1864B is that Model AV16B1762B is fitted with an Actuator Assembly Type 106788B100 (the AV16B1864B is fitted with Type 106788B107). The limit switches of 106785B100 and not wired for position indication (the switches of 106788B107 are). The actuator type 106788B100 has a four-pin electrical connector MS3102R14S2P (the 106788B107 has a five-pin connector MS3102R14S5P). The AV16B1762B unit is "case-grounded" (the AV16B1864B is not). See Figure 1 for wiring of AV16B1762B.

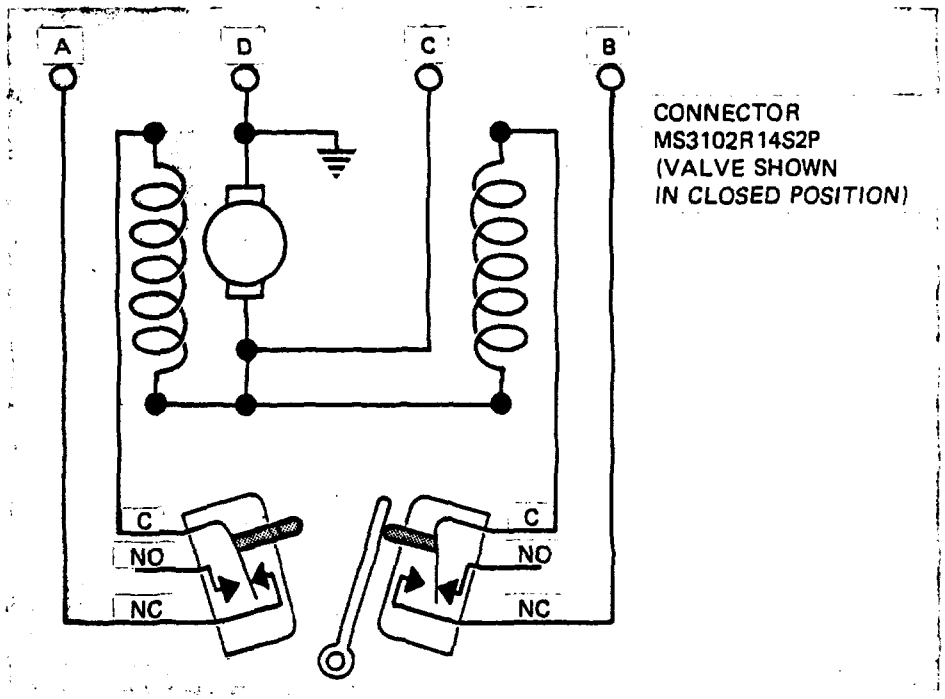


Figure 1. Wiring Diagram AV16B1762B

OVERHAUL MANUAL
with
PARTS LIST

CENTRIFUGAL FUEL BOOSTER PUMP

MODEL

RR12830A

NOTE: THIS PUBLICATION SUPERSEDES ALL PREVIOUS ISSUES USED ON DEHAVILLAND DHC-6 SERIES TWIN OTTER

LEAR SIEGLER, INC.

ROMEC DIVISION

241 SOUTH ABBE ROAD
ELYRIA, OHIO 44035
216-323-3211

May 1/73

LEAR SIEGLER INC.
ROMEC DIVISION

OVERHAUL MANUAL WITH ILLUSTRATED PARTS LIST
Model RR12830A Centrifugal Fuel Booster Pump

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Table 1. Leading Particulars and Main Features

Pump Rating	450 Pounds per hour at 22 PSI (40 PSIG maximum at zero flow)
Pumping Medium	Aircraft turbine fuel per MIL-T-5624 (JP-4)
Motor Rating	0.13 HP at 9300 RPM
. EMF	28 VDC
. Current Draw	7.25 AMPS maximum
Ambient Temperature Range	-65°F to + 165°F
Fuel Temperature Range	-65°F to + 135°F
Unit Weight	3.9 lb

1. DESCRIPTION AND OPERATION

Model RR12830A is a single element, electric motor driven, centrifugal pumping device designed to perform submerged booster pump duties in aircraft fuel systems. These pumps are manufactured by Lear Siegler, Inc., Romec Division, 241 South Abbe Road, Elyria, Ohio 44035.

A. Pumping Mechanism

A radial-type, centrifugal impeller turning within a voluted fuel passage provides the pumping action.

B. Drive Motor

The drive member is a permanent magnet type dc electric motor.

C. Main Features

Performance characteristics and other pertinent data are listed in table 1.

2. DISASSEMBLY

In the instructions that follow, references to parts and assemblies are followed by parenthetical numbers. These correspond with item numbers assigned to parts listed in the Illustrated Parts List, paragraph 12 and pictured in figure 6.

A. Filter Removal

Unsolder positive (black) brush lead, the shielding and shield cap from filter (2). Disconnect the negative (white lead) from filter terminal stud. Replace filter nut on stud after disconnecting lead. Cut off and discard terminal lug (5). Remove two screws and washers (3 and 4) to free filter (2).

B. Disassembly of Pumping Mechanism

Take out screws and washers (7, 8, 9, 11 and 12, figure 6). This frees pump housing mounting flange (15), inlet strainer (10) and cover spacer (18). Discard preformed packings (16, 17, 19 and 20). Do not remove insert (14) from housing flange (15) unless it requires replacement.

(1) Grasp impeller (21) and back off nut (22). Remove impeller (21), shim (23), key (24), shims (25) and seat seal (27) from motor drive shaft. Remove preformed packing (26) from groove in the ID of seal seat (27) and discard.

(2) Separate pump housing (31) from motor assembly. Discard preformed packing (30). Tap or press seal (29) from pump housing (31). Apply force against the encased side of seal (side toward motor end of pump housing with a wood or plastic dowel. Exercise care when handling seal to prevent chipping or cracking its carbon face.

C. Motor Disassembly

Take out two screws and packings with retainer (34 and 35) and slide off motor cover (33).

(1) Remove two screws and washers (37 and 38), lift brush springs and slide out two brushes (36).

NOTE: Threads of screws (40) are treated with a locking compound. If difficulty is experienced at removal, apply a heated soldering iron to screw head and allow screw to heat up. Effect removal while screw is hot.

(2) Take off two screws (40) and tap off endbell (39) with a plastic or fiber mallet. Disconnect ground by removing screw and washer (41 and 42). Discard rubber plug (44).

(3) Remove armature (47) from the magnetic ring (50). Press off bearings (45 and 46) using an arbor press. Retrieve shim washers (48). Discard rubber plug (49).

(4) Separate end cap (62) from magnetic ring (50) by tapping it off with a fiber mallet. Remove brush holders (55 and 60) only if their replacement is necessary. Brush springs (54 and 59) may be taken off and replaced by removing cotter pins (53 and 58).

(a) If brush holders require removal, a heated soldering iron may have to be applied to screws (52 and 57) to loosen sealant that is applied to threads.

WARNING: PERFORM HAND CLEANING OPERATIONS IN A VAPOR EXHAUSTING CLEANING CABINET OR IN A WELL VENTILATED AREA. AVOID INHALATION OF SOLVENT FUMES AND PROLONGED EXPOSURE OF SKIN TO CHEMICALS. OBSERVE LOCAL REGULATIONS REGARDING THE USE AND HANDLING OF COMBUSTIBLE MATERIALS.

3. CLEANING

Either vapor degreasing or hand cleaning with a petroleum based safety solvent (P-D-680 or similar) are acceptable cleaning methods.

A. Insulated Parts

Use filtered, dehumidified air (40 psi maximum) or a clean, lintless cloth to clean insulated motor parts. If necessary, moisten cloth in solvent (P-D-680) to remove hardened deposits. Immediately after solvent cleaning, blow off part with compressed air and oven dry at 140°F for one hour.

B. Protecting Cleaned Parts

Place cleaned parts in plastic bags or other dust-proof containers until ready for inspection or reassembly. Parts should be protected from impact with other parts or with cleaning and storage containers.

4. INSPECTION/CHECK

Subject all parts to a careful visual inspection after cleaning. Parts exhibiting cracks or fractures should be replaced immediately; welding is not a recommended repair action. Parts con-

tained in repair parts kit should be substituted for parts removed during overhaul, regardless of apparent condition of original part.

A. Aluminum Castings

The castings that make up the main structural members are most susceptible to damage by careless handling or improper maintenance methods. Surface injuries such as nicks, burrs or scratches can propagate fatigue cracks if stressed or cause mismatch of mating parts. Such damage should be blended or dressed out with a suitable abrasive. Careful attention should be given to preformed packing seats, and those areas that form interface with mating parts.

(1) Thread Damage

Damage to tapped threads in aluminum parts may be corrected by blending the entrance chamfer with crocus cloth or oil stone and chasing threads with a suitable tap. One piece, coil type screw thread inserts are replaceable.

(2) Pumping Element Inspection

Examine the impeller and pump housing for scoring, gouging or other evidence of impeller rub. These parts are also susceptable to erosion and cavitation damage which will give the part a dull, sand-blasted appearance. The lead edge of impeller fins is most likely to exhibit this type damage. Minor surface irregularities may be corrected by blending, or in the case of the pump housing, by machining. Since the clearances between impeller and housing greatly affect pump performance, no more than 0.002 inch of material should be removed in reconditioning parts.

B. Rotor Shaft Face Seal

Encased seal (29), figure 6, and seal seat (27) require smooth, flat contact surfaces to prevent fuel from entering the motor. Scoring or roughness to contact surfaces of either part, or chips or cracks to the encased seal carbon insert is cause for rejection, light carbon smear and other minor blemishes may be removed by hand lapping.

C. Armature Inspection

Examine overall condition of armature. Discard armature if commutator exhibits visably raised or lowered commutator bars, evidence of burning such as thrown solder, or deep grooving, scoring and other brush track mutilation. Bearing journals should be smooth and free from circumferential scoring or grooving, and contain no pitting that forms clusters or chains. Surface of commutators that exhibit normal wear may be refinished (see REPAIR). Minor surface irregularities may be removed from bearing journals by buffing. Armature dimensional and electrical inspection requirements are given in the following paragraphs:

(1) Armature Dimensional Inspection

Measure armature runout using vee-blocks and a dial indicator. Runout between bearing journals and between bearing journals and lamination stack shall not exceed 0.001 inch T.I.R. Commutator surface must run true with bearing journals within 0.0005 inch T.I.R. Bar-to-bar variation between any two adjacent commutator bars shall not exceed 0.0002 inch. Replace armature if shaft is bent.

(a) Measure bearing journal diameters. Commutator and drive end journals shall measure no less than 0.2361 and 0.3542 inch respectively.

(2) Armature Electrical Inspection

(a) Grounded Circuits

Test armature for grounds by checking continuity between shaft and each commutation bar. A completed circuit indicates a grounded coil. Inspection may be accomplished using an ohmmeter, test lamp or other low voltage continuity checker. Reject armature if a grounded circuit is indicated.

(b) Shorted or Open Circuits

NOTE: The method of checking out armature that is outlined here requires the use of a meter-indicating external growler. Available equipment and techniques may be used in lieu of procedure given here.

Place the armature on the laminated bed of the growler. Energize the growler. Apply the growler test probes to two adjacent commutator bars. Continue checking each set of bars, moving test probes toward the right. While checking, be sure that the left test probe contacts the bar that was previously occupied by the right probe. Tests are continued until the commutator circumference has been spanned. No meter reading indicates an open circuit. A reading above or below readings for other coils indicates a short circuited coil. Replace armature if fault is indicated.

D. Permanent Magnet Field Checkout

Check out of the field consists of a speed-torque test to determine if the permanent magnet has deteriorated. This is accomplished after motor is assembled, the brushes run-in and commutation is tuned. See paragraph 6.A. and 6.B.

5. REPAIR

Replace all parts condemned during inspection. Substitute parts contained in the repair parts kit for parts removed during disassembly regardless of apparent condition of original part. Where the serviceability of a part is questionable, it should be replaced rather than risk premature pump failure.

A. Restoration of Machined Aluminum Castings

Dress out nicks, burrs, gouges, etc. from machined surfaces of aluminum castings with a suitable abrasive. Flat surfaces that are warped or blemished are reworked with a large, flat mill file or on a surface plate covered with an abrasive sheet. Dress out damage to other areas with an oil stone, abrasive sheet or file as necessary to restore original contour or blend high metal. Preformed packing grooves are reworked circumferentially so as to prevent radial or spiral tool markings that could become a path for leakage.

(1) Thread Repair

Tapped holes may be restored by chasing threads with a suitable tap or die. Blend entrance chamfer to tapped holes to remove burrs or high metal using an oil stone or crocus cloth. Screw threads worn or reworked to an oversize condition where retention capacity is affected are unacceptable. Screw thread inserts are replaceable (see Bulletin 800 available from Helicoil Corp., Danbury, Connecticut, USA).

WARNING: CHEMICAL FILM MATERIALS ARE USUALLY STRONGLY OXIDIZING AND REPRESENT A POTENTIAL FIRE AND EXPLOSIVE HAZARD IN CONTACT WITH PAINT THINNERS. AVOID STORING OR MIXING SURFACE TREATMENT MATERIALS IN CONTAINERS PREVIOUSLY CONTAINING FLAMMABLE PRODUCTS.

(2) Alodine Touch-up of Aluminum Parts

Touch-up metal that has been exposed by reconditioning using the Alodine 1200 process. Alodine may either be sprayed or brushed on a part. Proceed as follows:

(a) Clean part with Deoxidien No. 600 (manufactured by Amchem Products, Inc., Ambler, Pa.).

(b) Keep part wet with Deoxidien for 1 to 5 minutes.

(c) Rinse part thoroughly with clear water.

(d) Brush or spray Alodine 1200 (Amchem Products, Inc., Ambler, Pa.) solution on surface of part and allow it to set from 3 to 5 minutes.

NOTE: Alodine No. 1200 coating is golden and irridescent when dry. The color of the coating however may vary with different aluminum alloys. The coating shall be adherent and free of dust.

(e) Remove excess Alodine with a wet cloth or sponge and rinse thoroughly in water. Allow coating to air dry.

B. Shaft Face Seal Restoration

Contact surfaces of shaft seal components (27 and 29, figure 6) should be lapped to obtain a smooth, polished, uniform finish.

(1) Resurface contact surface of seal seat (27) on a cast iron lap charged with a fine grit lapping compound. Select a lapping compound that will produce a 4 microinch finish. Avoid applying finger pressure to piece while lapping; to insure flatness, part should be lapped under its own weight. After resurfacing, thoroughly wash off all traces of all lapping compound. Avoid touching the polished surface with bare hands after lapping.

(2) Lap the carbon contact surface of encased seal (29) as in the previous paragraph except use an uncharged lapping plate wetted with naphtha. Encased seal contact surface requires a 4 microinch finish.

C. Armature Reconditioning

Resurface and true-up the armature commutator. Mount the armature in a lathe using a flexible collet in the head stock and a live bearing center in the tail stock. Chuck the collet on the bearing journal at the commutator end of the armature. Be sure that the journal is not damaged when chucking. Tighten the tail stock sufficiently to prevent end play. Bearing journals must be aligned and concentric within 0.0005 inch T.I.R.

(1) Rough Turn

Adjust a carbide tipped tool in the post on the commutator center line to 0.003 inch below to avoid chatter. Set machine for a commutator surface speed of 600 to 800 feet per minute. Adjust longitudinal tool feed to 0.004 to 0.006 inch per revolution. Take as many cuts as necessary to 'clean-up' the commutator. Depth of cut per pass must not exceed 0.005 inch. Provide a light flow of air over the armature to keep chips off the commutator.

(2) Commutator Slots

Undercut the mica insulators between the commutator bars to a depth of 0.020 inch using a 0.032 inch wide, 0.312 inch (maximum) diameter saw blade. Slots must be centered as close as possible on the interbar insulators. Slots should be as wide as the insulator, and run from the outboard edge of the commutator to the riser, but must not cut into the riser.

(3) Finish Turn

Finish turn the commutator with a diamond tipped tool having a 0.005 inch point radius (maximum). After undercutting, remount the armature on the lathe as instructed before. Adjust the tool on the commutator centerline to prevent grooving and drag-over. With the commutator surface of 600 to 800 feet per minute, and a tool feed of 0.0010 to 0.0015 inch per revolution, take light cuts across the commutator until it is 'cleaned-up' 100 percent. Depth of cut per pass shall not exceed 0.002 inch. After turning remove

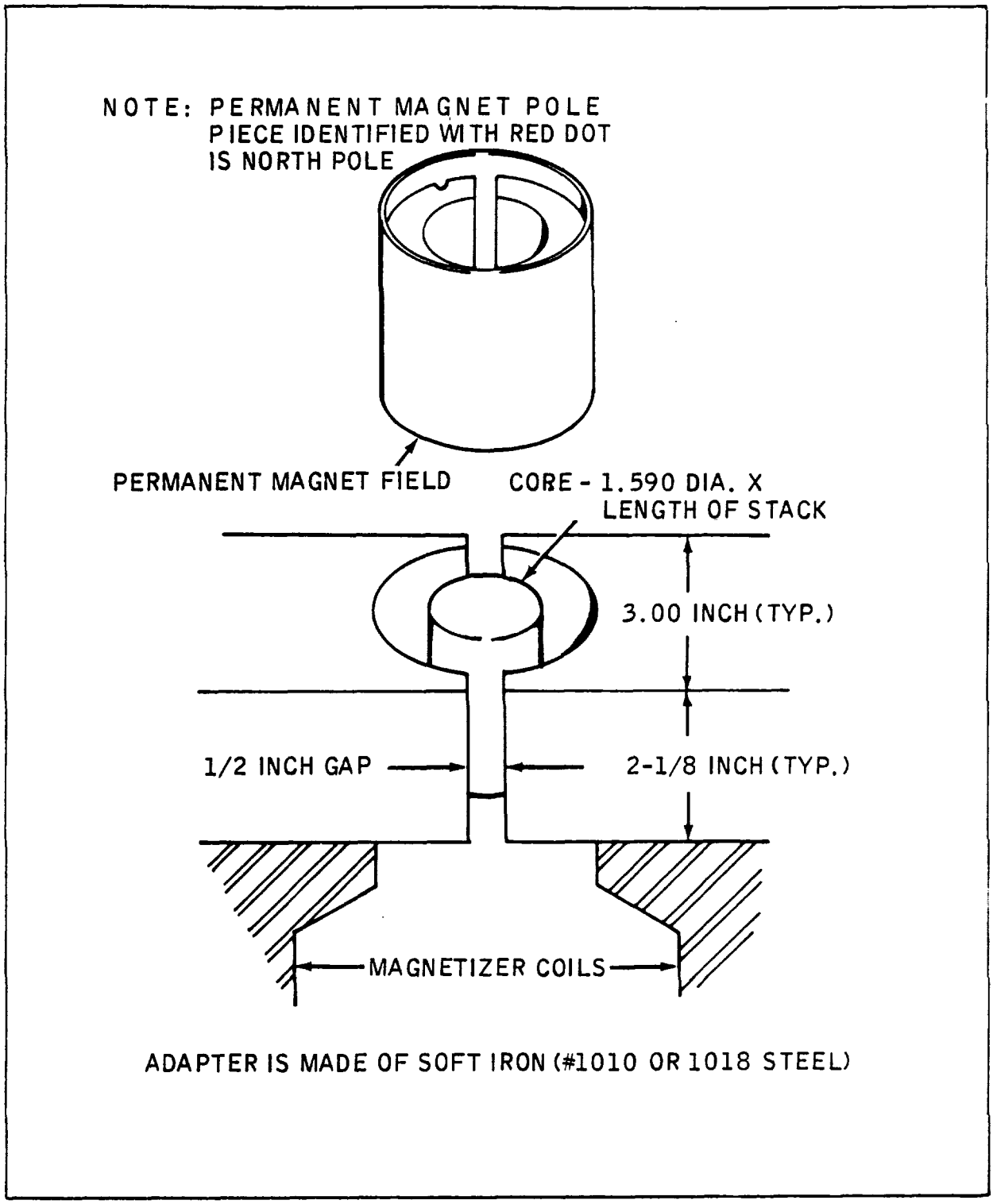


Figure 1. Remagnetizing Permanent Magnet Field

chips and mica dust with a clean, wax-free fiber brush.

NOTE: The minimum commutator diameter given in the following paragraph is the absolute minimum. As the commutator approaches this dimension, a judgement decision must be made as to whether the part should be continued in service. Consideration should be given to the amount of material removed in resurfacing, and the total operating time the unit has accumulated since last overhaul.

(4) Checkout

At completion of resurfacing operations dimensionally check the commutator. Commutator must be concentric with the bearing journals within 0.0005 inch T.I.R. Bar-to-bar variation between any two adjacent bars shall not exceed 0.0002 inch. Minimum commutator diameter is 0.900 inch. Commutator shall exhibit a surface finish of 8 to 32 microinches.

D. Field Remagnetization

The field magnet may be remagnetized using an electrocoil magnetizer. Fabricate an adaptor and set the field up for magnetization as shown in figure 1. Apply current until magnet field is saturated.

6. ASSEMBLY

Reassembly will generally follow the reverse of disassembly. Lubricate preformed packings with petroleum jelly as assembly progresses to reduce risk of damage to the packing, and ease installation.

A. Motor Assembly

(1) Brush Holder Assembly

Fit brush springs (54 and 59, figure 6) to brush holders (55 and 60) as shown in figure 2. Secure brush springs with cotter pins (53 and 58).

(2) Rear End Cap Assembly

Apply "Locquic Primer T" (manufactured by Loctite Corporation, Newington, Conn.) to threads of screws (52 and 57) and allow them to dry. Position brush holders (55 and 60) on end cap (62); make sure that

insulator (61) is positioned under the positive brush holder. Apply "Loctite Sealant Grade AA" (manufactured by Loctite Corp., Newington, Conn.) to threads of screws (52 and 57). Attach brush holders. Tighten screws to 6.5 to 7.0 inch pounds torque.

(3) Ball Bearing Assembly

Press ball bearings (45 and 46) onto journals of armature (47) using a suitable ram adaptor to transmit force from the arbor ram to the inner bearing races. Ram adaptor may be fabricated from a piece of tubing having a cross section approximately the same size as bearing inner race. It must be faced off square at both ends and deburred to prevent misalignment or contamination of bearings. Adaptor should be long enough to prevent the arbor ram from impacting armature shaft when bearing seats.

(4) Armature End Play Adjustment

Assemble end cap (62), armature with bearings (45 through 47), magnet ring (50) and endbell (39). Measure armature shaft end play using a dial indicator. Select fewest number of shims (48) required to limit end play to 0.004 to 0.007 inch.

(5) Final Motor Assembly

Separate components temporarily assembled in preceding paragraph. Install shims (48) and plugs (44 and 49), ground harness lug to the inside of endbell (39) using screw and washer (41 and 42) and reassemble motor.

NOTE: One end of magnet ring (50) is identified with a prick punch mark on its outside diameter. Marked end of magnet ring takes its position adjacent to end cap (62).

(a) Visually align (within 0.020 to 0.040 inch) the prick punch mark on magnet ring (50) with center line of one of the holes for screw (40) in end cap (62).

(b) Apply "Locquic Primer T" to threads of screws (40). After primer is dry, apply "Loctite Sealant Grade AA" to screw threads. Primer

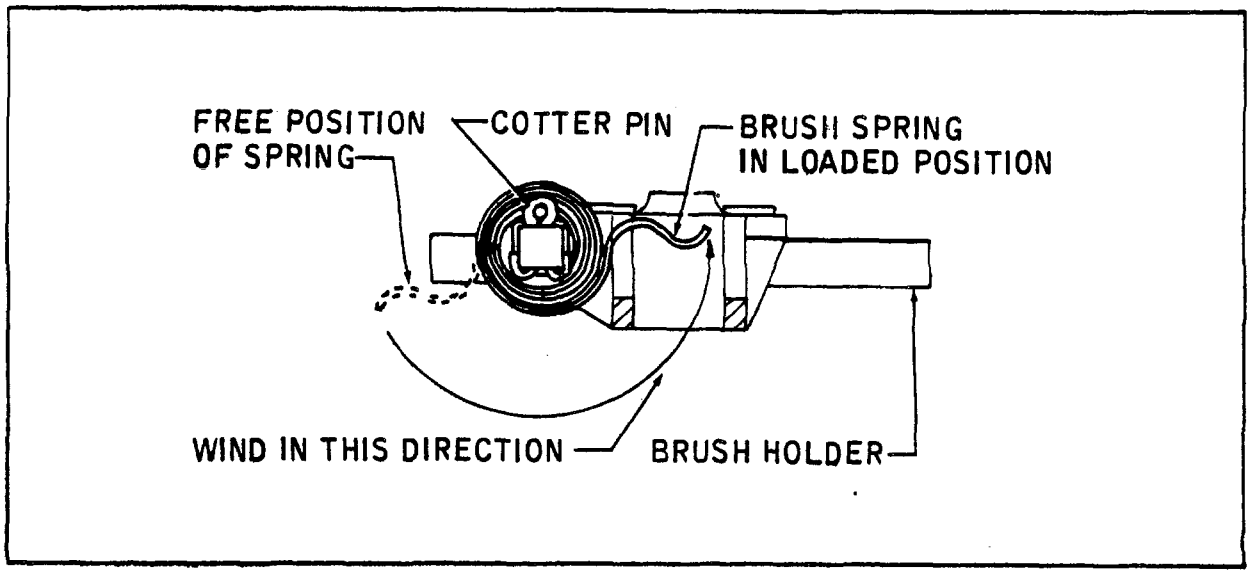


Figure 2. Brush Spring Installation

and sealant are products of Loctite Corp., Newington, Conn. Fit screws (40) through holes (in end cap) and thread them into holes in endbell (39). Tighten screws to 12 to 15 inch-pounds torque and allow sealant to cure for two hours at room temperature.

(c) Lift brush springs (54 and 59) and install brushes (36). Make electrical connections per figure 3 using screws and washers (37 and 38). Tighten screws to 8 to 11 inch-pounds torque.

B. Motor Checkout

Before assembling pump components, run-in brushes and check out motor.

(1) Brush Run-in

Apply 14 VDC to motor and check for clockwise rotation facing drive end of motor. Run-in brushes for 8 hours minimum at 14 VDC. Fan cool motor during brush run-in.

Table 2. Motor Performance Values

Voltage	Torque	Current AMP Max.	Speed RPM Min. - Max.
28 VDC	13.8 oz in.	8.0	9500 10,000

(2) Motor Checkout

Check out motor on a dynomometer. The method of mounting motor on dynomometer shall include a means of thermally isolating motor from any metal heat sinks (such as the use of a wooden mounting yoke, rubber or plastic shims, etc.). Prior to checkout, motor temperature shall be stabilized at ambient room temperature (60° - 90°F). The motor shall be run under rated load for one minute prior to taking meter readings. Readings shall be taken as close to conclusion of test run as practicable in order to obtain uniform frame temperatures. Required motor performances is given in table 2.

NOTE: Motor speed may be adjusted if necessary. Loosen screws (40) and rotate end cap (62) in direction of armature rotation to decrease speed.

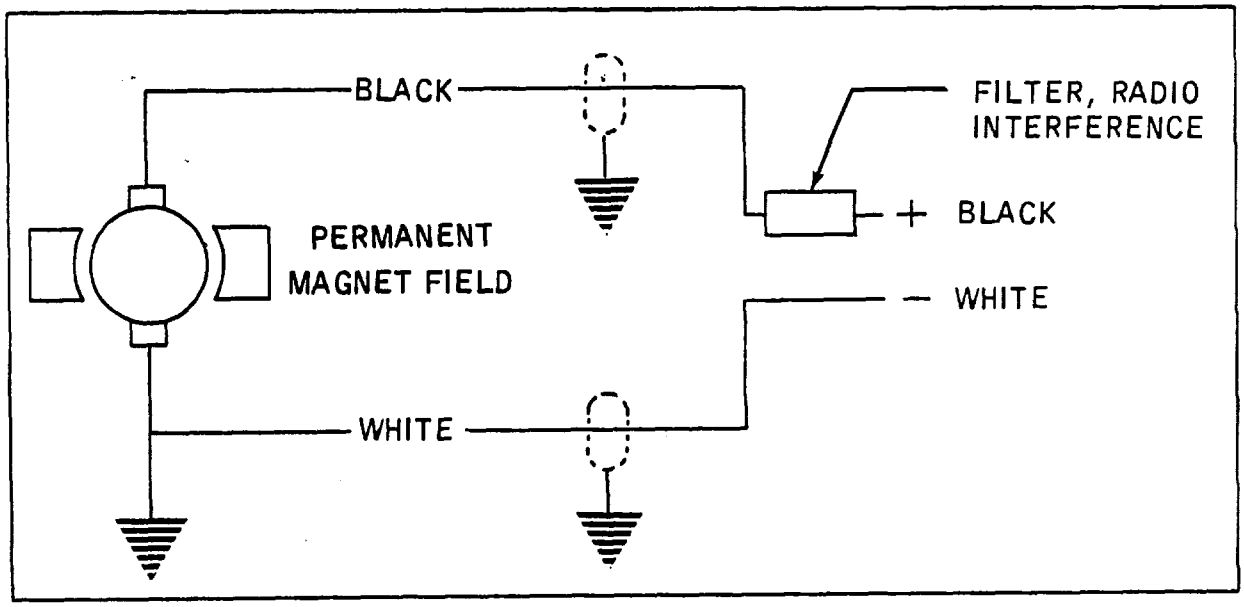


Figure 3. Schematic Motor Diagram

(3) After motor checkout, install preformed packing (43) on endbell (39). Slide motor cover (33) over the assembly. Treat screws (34) with Loctite primer and sealant as described in paragraph 6.A. (2). Secure motor cover with screws and packings with retainer (34 and 35). Tighten screws to 12 to 15 inch-pounds torque.

C. Pumping Element Assembly

Install preformed packing (28) in groove of seal (29). Press seal (29) into its cavity in pump housing (31). Seal is installed with its carbon face adjacent to impeller (21). Exercise care when installing seal to prevent damage to its carbon face.

(1) Impeller Installation

Fit motor assembly to pump housing. Assemble impeller (21) and associated parts (27, 24, 23 and 22) to motor shaft as shown in figure 4. With depth micrometers, measure impeller clearance from face of pump housing to impeller vanes. Select shims (25) required to limit clearance to 0.010 to 0.012 inch. Take off impeller, motor and associated parts, install shims (25) and preformed packings (26 and 30) then reassemble. Tighten impeller nut (22) to 12 - 15 inch pounds torque.

D. Final Assembly

Line up holes in motor mounting flange with those in pump housing (31), spacer cover (18) inlet strainer (10) and mounting flange housing (15). While stacking parts, thread wires through openings in castings and install preformed packings (19, 20, 16 and 17) around lead exit and seal drain.

(1) Apply "Locquic Grade N" cleaner to screws (7, 8 and 11), and to their receiving holes. Allow 10 minutes for cleaner to dry, then apply "Loctite Grade AV" sealant to screw threads. (Loctite and Locquic are products of Loctite Corporation, Newington, Conn.). Install screw and tighten screw (11) to 12 - 15 inch-pound, and screws (7 and 8) to 20 - 25 inch-pounds torque. Cure time for sealant is six hours at room temperature or ten minutes at 212°to 250°F.

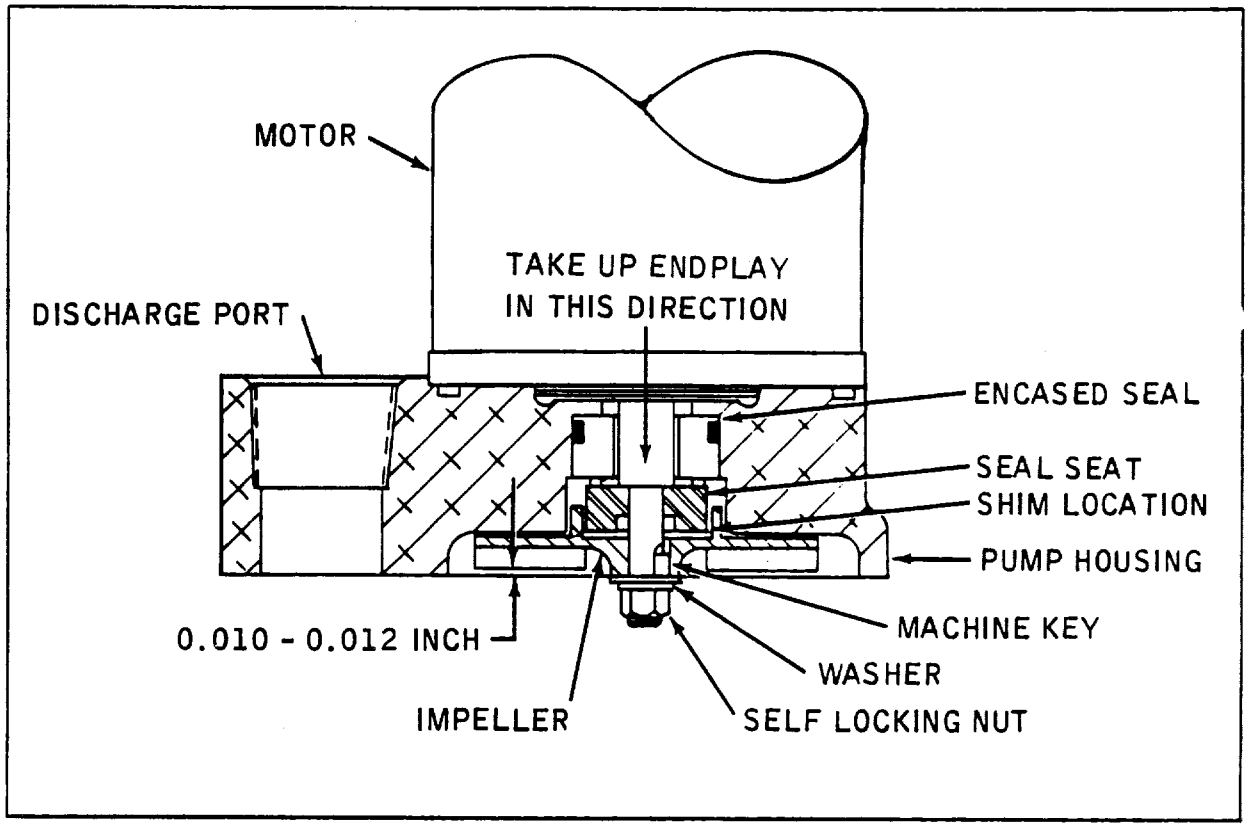


Figure 4. Impeller Shimming

(2) Filter Connections

Clean and apply sealant to screws (3) and their receiving holes as directed in preceeding paragraph. Attach filter (2) and tighten screws to 12 - 15 inch-pounds torque. Crimp terminal lug (5) over the negative brush lead so that it makes contact with both the conductor and the shielding. Attach negative lead to ground terminal stud on filter. Solder positive lead to filter motor terminal, the lead shielding to the shield cap, and the shield cap to the terminal cover. Use solder that conforms to Composition Sn 60 or Sn 63 of Federal Specification QQ-S-571.

7. FITS AND CLEARANCES

Critical dimensional data is listed under INSPECTION, paragraph 4.

8. TESTING

A. Test Conditions

(1) Pumping Medium

Fluid used for testing shall be solvent conforming to Military Specification MIL-F-7024A, Type II. Solvent must be clean and free of all foreign matter.

(2) Fluid Temperature

Temperature of test solvent shall be maintained at $80^{\circ} \pm 10^{\circ}F$ during break-in run and calibration.

(3) Fluid Quantity

Amount of fluid used for conducting tests shall be that amount required to produce a 10 inch head above pump mounting flange.

(4) Power Input

Operational tests shall be conducted with 27 volts DC applied to motor leads.

(5) Test Setup

Test installation shall consist of a tank suitable for mounting the pump and necessary instrumentation for monitoring flow (PPH) discharge pressure, voltage, current and fluid temperature. All instruments shall have an accuracy within $\pm$ 2% of true reading. Test setup is shown schematically in figure 5.

B. Break-In Run

Operate the pump at 460 to 560 PPH flow for 30 minutes.

(1) During break-in there shall be no fluid leakage through discharge port, seal drain port, tank drain port, castings, gaskets or around motor leads.

C. Performance Test

Operate unit and adjust flow control valve to flow rates given in the first column in table 3. Pump shall meet the pressure and current requirements given in the table for each flow setting.

(1) During performance test there shall be no fluid leakage through discharge port, seal drain port, tank drain port, castings, gaskets, or around motor leads.

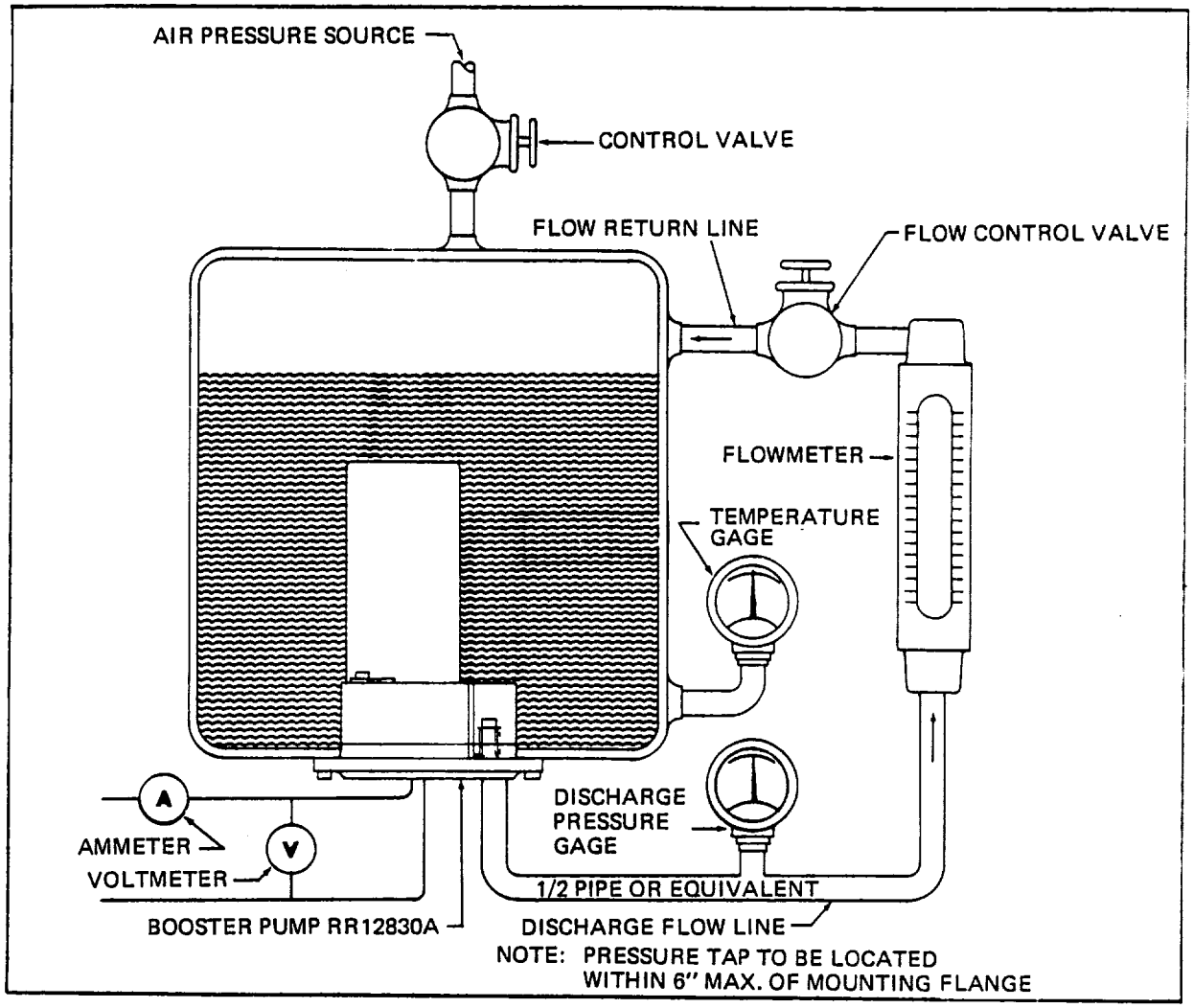


Figure 5. Schematic Test Setup

Table 3. Performance Test Values

Flow (PPH)	Discharge Pressure (PSI)	EMF (VDC)	Current (AMP)
0	40 maximum	27.0	8.0 maximum
450	22.0 minimum	27.0	8.0 maximum

D. External Leakage Test

De-energize pump, close off flow control valve and apply 15 PSI air pressure within the tank for a period of 10 minutes.

(1) During pressurization period there shall be no fluid leakage through discharge port, seal drain port, tank drain port, castings, gaskets or around motor leads.

9. TROUBLESHOOTING

Table 4 lists the most common faults, their probable causes and the corrective action to be taken to return the pump to a serviceable condition.

Table 4.

Troubleshooting (Sheet 1 of 4)

TROUBLE	PROBABLE CAUSE	REMEDY
1. Leakage		
a. From lead wires or seal drain.	Damaged shaft seal, damaged or missing preformed packings.	Disassemble and inspect packings and parts associated with shaft seal per paragraph 5.B. Repair or replace parts as necessary.
b. From castings or other areas.	Damaged packings; cracked castings, etc.	Replace faulty parts as necessary.

Table 4.

Troubleshooting (Sheet 2 of 4)

TROUBLE	PROBABLE CAUSE	REMEDY
2. Unit fails to start.		
a. No current voltage reading.	Open circuit in test setup.	Trace external circuit to power source. Reset breaker or replace fuse.
b. Low voltage reading.	Improper voltage.	Apply proper voltage.
c. high current	Excessive friction.	Remove the 3 flange holding screws (items 7 and 8) and pull away the flange and space cover and check impeller for fre dom of rotation. If this fails, disassemble unit and inspect for binding, mis-alignment or a bent armature shaft. Take corrective actic as necessary.
3. Unit stops running after a short time.	Failure of supply voltage, overload relay set too low.	Apply proper vo tage,replace fuses,orreset overload relay.

Table 4.

Troubleshooting (Sheet 3 of 4)

TROUBLE	PROBABLE CAUSE	REMEDY
4. Attempts to start, but overload relay trips out.	Weak motor field.	Replace or remagnetize field magnet ring.
	Overload relays set too low.	Reset relay.
5. Runs Slow	Line voltage low.	Apply proper voltage.
a. High or erratic current reading.	Poor commutation.	Confirm that brushes have been properly run-in (see paragraph 6.B. (1).) Check for: (1) sticking brushes; (2) proper spring action; (3) foreign matter on brushes or commutator; (4) high mica commutator insulation; (5) rough or eccentric commutator; (6) lead wires interfering with brush spring action; (7) damaged brush leads. Take necessary corrective action
	Electrical fault.	Check for open, grounded or short-circuited armature. Take necessary corrective action.

Table 4.

Troubleshooting (Sheet 4 of 4)

	TROUBLE	PROBABLE CAUSE	REMEDY
6.	Overheating/ noisy operation.	Same as 2.c.	
7.	Low system flow/pressure.		
	a. Electrical instrument readings normal.	Excessive impeller clearance.	Adjust clearance per paragraph 6.c. (1)
		Motor brushes insufficiently	Insure motor brushes are seated per paragraph 6.B. (1)
	b. High current reading.	Same as 5. a.	
	c. High current reading/noisy operaion.	Same as 2. c.	
8.	High pressure at zero flow.	Insufficient clearance between impeller and flange.	Adjust clearance per paragraph 6.c. (1)
		High motor speed	Reduce motor speed per paragraph 6.B. (1)

10. STORAGE INSTRUCTION

At completion of tests, drain test fluid from pump and plug the discharge and seal drain ports (not shown in parts list). Wipe outside of unit and package with a dehydrating agent in a clean, dust-free container. Packageing recommendations are contained in ATA Specification 300.

11. SPECIAL TOOL, FIXTURES AND EQUIPMENT

Only standard shop tools are required to accomplish overhaul.

2. ILLUSTRATED PARTS BREAKDOWN

A. Purpose

This parts list is intended for use in provisioning, requisitioning, storing and issuing replacement parts and units, and in identification of new and reclaimed parts. Each assembly breakdown is illustrated with exploded views prepared in disassembly relationship.

B. Arrangement

All the assemblies and parts are arranged in the order of disassembly with the exception of the Attaching Parts which follow immediately after the item to be attached. Sub-assemblies of parts are indented to indicate their relationship to the complete assembly. Associated with each parts list is an exploded view illustration. These illustrations serve to show the relative position of the various assemblies and parts and to identify fully all assemblies and parts. Where a sub-assembly requires an additional exploded view to show the breakdown of the detailed parts, a cross reference is provided to assist in locating the detailed parts of the sub-assemblies. The column used in the Parts List are as follows:

C. Figure and Index Number Column

The first index number identifies the figure number of the illustration. The second number is the item and locates the part on the illustration. Item numbers are assigned in the order of disassembly for each exploded view illustration.

D.

Romec's part numbers are prefixed by the letters RA, RB, RD, RG, RR and RS. All government standard parts will be listed without manufacturer's codes in the nomenclature column.

E. Nomenclature Column

This column lists the titles and modifiers of a part in accordance with manufacturer's drawing title, and other data characteristics where applicable. Government Standard Parts are described by a single identifying noun.

F. Indention

For proper identification of detailed assemblies and installations, the listings for each exploded view illustration have a column arrangement. Each assembly or installation (if broken down) is listed in the next column to the right; and conversely, the next higher assembly or installation of any part assembly may be determined by locating the first assembly or installation directly above in the first column to the left.

G. Attaching Parts

Attaching parts for any assembly or sub-assembly are listed in the same column immediately beneath the item to be attached and precede any detailed parts of that item. In general, attaching parts are listed only for those items that are frequently removed.

H. Units Per Assembly Column

Quantities listed in this column are, in the case of assemblies, the total quantity used per unit of equipment at the location indicated, while the sub-assembly and detailed parts indented under the assemblies only show the quantities used per one assembly. Therefore, the quantity specified is not necessarily the total quantity used per unit of equipment. Refer to the Numerical Index for the total quantities used per unit of equipment.

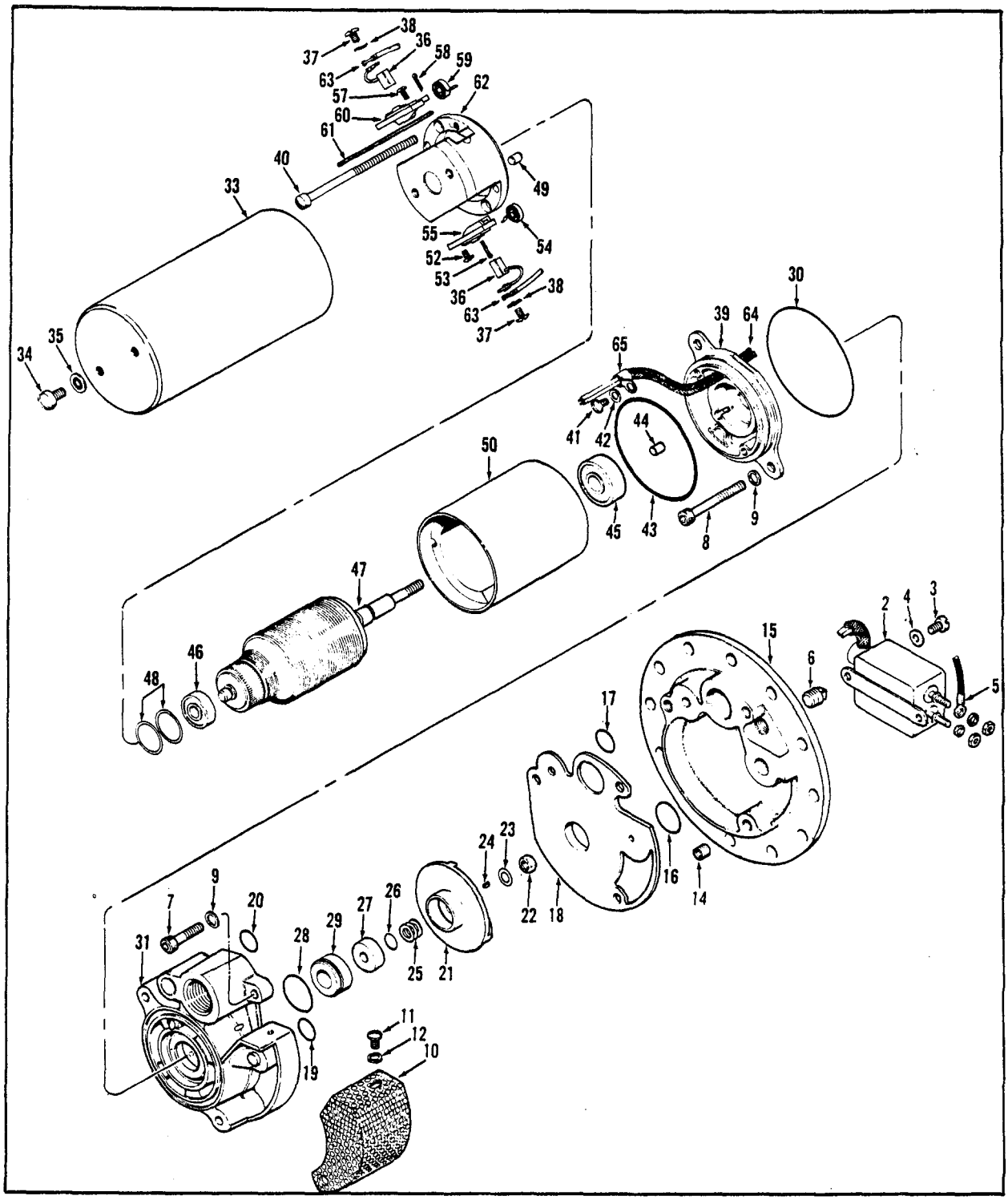


Figure 6. Centrifugal Fuel Booster Pump, Exploded View
Model RR12830A

Fig.& Index No.	Part Number	Description 1 2 3 4 5 6 7	Unit Per Assy	Usable On Code
6 - 1	RR12830A	PUMP, Centrifugal, fuel booster	REF	
2	RG12834-1	. FILTER, Radio interference	1	
		(ATTACHING PARTS)		
3	MS35265-41	. SCREW (KD)	2	
4	AN960-8	. WASHER (KD)	2	
		- - - * - - -		
5	MS20659-103	. TERMINAL, Lug (KD)	1	
6	MS20913-2D	. PLUG, Pipe (KD)	1	
7	NAS1351-3-14P	. SCREW (KD)	1	
8	NAS1351-3-28P	. SCREW (KD)	2	
9	AN960-10L	. WASHER (KD)	3	
10	RD12844	. STRAINER, Pump, inlet	1	
		(ATTACHING PARTS)		
11	MS35265-41	. SCREW (KD)	1	
12	AN960-8	. WASHER (KD)	1	
		- - - * - - -		
-13	RD12845	. HOUSING ASSY, Pump mounting flange	1	
14	MS21209F1-20	. . INSERT, Heli-coil	3	
15	RG12838	. . HOUSING, Pump mounting flange	1	
16	MS29513-015	. PACKING, Preformed (KD)	1	
17	MS29513-012	. PACKING, Preformed (KD)	1	
18	RG12836	. COVER, Spacer, pump housing	1	
19	MS29513-011	. PACKING, Preformed (KD)	1	
20	MS29513-012	. PACKING, Preformed (KD)	1	
21	RB12832	. IMPELLER, Pump	1	
		(ATTACHING PARTS)		
22	MS21042-3	. NUT, Self-locking (KD)	1	
23	RB12463-3	. SHIM (KD)	1	
		- - - * - - -		
24	RA12833	. KEY, Machine (KD)	1	
25	RA12463	. SHIM, 0.003 inch thick (KD)	AR	
	RA12463-1	. SHIM, 0.005 inch thick (KD)	AR	
	RA12463-2	. SHIM, 0.010 inch thick (KD)	AR	
	RA12463-3	. SHIM, 0.015 inch thick (KD)	AR	
26	MS29513-008	. PACKING, Preformed (KD)	1	
27	RD12906	. SEAT, Seal	1	
28	513CM-17	. PACKING, Preformed (KD)	1	
29	RD12841-1	. SEAL, Plain encased	1	
30	MS29513-034	. PACKING, Preformed (KD)	1	
31	RG12843	. HOUSING, Pump	1	
-32	RG21060	. MOTOR ASSEMBLY, 28 VDC	1	
33	RB56152	. . COVER, Motor	1	
		(ATTACHING PARTS)		

- Item Not Illustrated

Fig.& Index No.	Part Number	Description 1 2 3 4 5 6 7	Unit Per Assy	Usable On Code
6 34	MS35206-243	. . SCREW (KD)	2	
35	RD24065-2	. . PACKING WITH RETAINER (KD)	2	
		- - - * - - -		
36	RB56162	. . BRUSH, Electrical contact (KD)	2	
		(ATTACHING PARTS)		
37	MS35214-23	. . SCREW (KD)	2	
38	MS35338-41	. . WASHER (KD)	2	
		- - - * - - -		
39	RG56139	. . ENDBELL	1	
		(ATTACHING PARTS)		
40	MS35265-57	. . SCREW (KD)	2	
41	MS35214-23	. . SCREW (KD)	1	
42	MS35333-37	. . WASHER (KD)	1	
		- - - * - - -		
43	MS29513-139	. . PACKING, Preformed (KD)	1	
44	RB56144-2	. . PLUG, Rubber (KD)	1	
45	RB56167	. . BEARING, Ball (KD)	1	
46	RD56166	. . BEARING, Ball (KD)	1	
47	RG56175	. . ARMATURE	1	
48	RD56242	. . WASHER, Flat, shim (KD)	AR	
49	RB56144-1	. . PLUG, Rubber (KD)	1	
50	RD56176	. . MAGNET RING ASSY	1	
-51	RB56282-1	. . BRUSH HOLDER & BASE ASSY	1	
		(ATTACHING PARTS)		
52	MS35190-236	. . SCREW (KD)	2	
		- - - * - - -		
53	MS24665-65	. . . PIN, Cotter (KD)	1	
54	RB56148-1	. . . SPRING, Brush (KD)	1	
55	No Number	. . . BRUSH HOLDER & BASE SUB-ASSY	1	
-56	RB56282-2	. . BRUSH HOLDER & BASE ASSY	1	
		(ATTACHING PARTS)		
57	MS35190-236	. . SCREW (KD)	2	
		- - - * - - -		
58	MS24665-65	. . . PIN, Cotter	1	
59	RB56148-1	. . . SPRING, Brush	1	
60	No Number	. . . BRUSH HOLDER & BASE SUB-ASSY	1	
61	RB56165	. . INSULATOR	1	
62	RG56138	. . END CAP, Rear	1	
63	RB56187	. . TERMINAL	2	
64	RA56164	. . SLEEVE, Insulator	1	
65	RD56161-1	. . HARNESS ASSY, Elec lead	1	
-66	RB15259-4	. PLUG, Protective	2	
-67	RB15259-2	. PLUG, Protective	1	
-68	RA22764	PARTS KIT, Pump Overhaul	1	

-Item Not Illustrated

Parker Aircraft

OVERHAUL MANUAL

LEVEL CONTROL VALVE

Part No. 1321-536250

1. Description and Operation

The bottom level control valve is installed in an aircraft fuel tank and is used to shutoff the flow of fuel at a predetermined tank level during aircraft refueling operations. The valve contains a float assembly, which when raised by the fuel level, automatically closes a poppet and shuts off fuel flow.

Service Medium	Aviation Fuels per MIL-G-5572 and MIL-J-5624, Grades JP-4 and JP-5
Temperatures:	
Ambient	-65 to +160°F (-53.9 to +71.1°C)
Fluid	-65 to +135°F (-53.9 to +57.7°C)
Pressures:	
Operating	0 to 60 psig
Proof	125 psig
Leakage:	
Internal	31 cc per minute (maximum) at 0 to 50 psig
External	Zero from 0 to 125 psig
Weight	0.63 pounds

2. Disassembly

A. Disassemble according to sequence of index numbers assigned to the exploded-view illustration (figure 1).

B. Do not attempt to remove stud from body (18).

C. Do not disassemble poppet assembly (24). If damaged or defective replace in its entirety.

D. Note and record number of washers (10 and 11) removed to facilitate reassembly.

3. Cleaning

   A. Wash all parts in dry-cleaning solvent, Federal Specification P-D-680 and dry with a clean, lint-free cloth or moisture free compressed air at 10 psig. Place cleaned parts in a dust-proof container until ready for inspection.

      WARNING: USE SOLVENT IN A WELL-VENTILATED AREA. AVOID BREATHING FUMES. KEEP AWAY FROM OPEN FLAME.

4. Inspection

   A. Inspect all parts for cracks, breaks or other signs of excessive wear or damage. Ensure all ports are clean and unobstructed and that all threads are clean and undamaged.

   B. Roll spring (7) on a flat surface and check for distortion. Spring (7) must compress to 0.128 inches with a 1.50 to 2.00 pound load.

   C. Spring (21) must compress to 5/16 inch under a load of 5 to 7 ounces.

5. Repair

   A. Replace all parts that are damaged and cannot be repaired to meet inspection requirements.

   B. Polish out minor surface scratches and imperfections in other than microfinish surfaces, with crocus cloth, Federal Specification P-C-458 (ferrous materials only), or aluminum oxide abrasive cloth, Federal Specification P-C-451 (aluminum and aluminum alloy parts only).

   C. Touch up reworked areas with a chemical film, Military Specification MIL-C-5541 or equivalent.

6. Assembly

   A. Reassemble in reverse sequence of index numbers assigned to the exploded-view illustration, observing the following:

   B. Torque seat (14) into body (18) to 40 inch-pounds maximum.

   C. Do not safetywire screws (16) until completion of testing.

7. Fits and Clearances (not applicable)

8. Testing

Test with air and solvent, Specification P-D-680, from a 0 to 125 psig, 0 to 20 gpm source maintained at 26.6 ±5.6 °C (80 ± 10°F). Proceed with tests as follows:

A. Proof Pressure. With valve mounted upright in a suitable test fixture and submerged in test solvent, apply an increasing pressure to 125 psig. There must be no external leakage. Disregard leakage from seat and pilot. If air leakage is observed, invert valve and retest with solvent pressure at inlet port.

B. Leakage. Apply 60 psig solvent pressure to inlet, with valve in inverted position. Total internal leakage must not exceed 31 cc per minute.

C. Sensing Level. Mount valve in an upright position and establish solvent flow of one gpm at inlet port. Valve must shut off due to normal floatation of float. The sensing level must be 3-1/4 ±3/16 inch measured up from the mounting flange. Record the measurement.

D. Pressure Drop. Mount valve upright on a one-inch diameter calibrated pressure tap. Connect fluid source to inlet, and establish 20 gpm flow through valve. Net pressure drop must not exceed 2 psi.

E. If valve fails to meet requirements of any of these tests, disassemble, clean, and re-inspect components, replacing those found defective or suspected of malfunction. Then repeat entire test procedure.

F. After satisfactory completion of all tests flush valves with fuel, Specification MIL-J-5624, cap ports and secure float assembly down with a piece of cardboard. Store in a dust proof container.

9. Storage Instructions

A. At the conclusions of testing drain all excess fluid from unit.

B. Stamp valve with cure-date of parts in accordance with ANA Bulletin 438.

C. Cap port against entry of foreign matter.

10. Special Tools, Fixtures and Equipment (none required)

11. Illustrated Parts Breakdown.

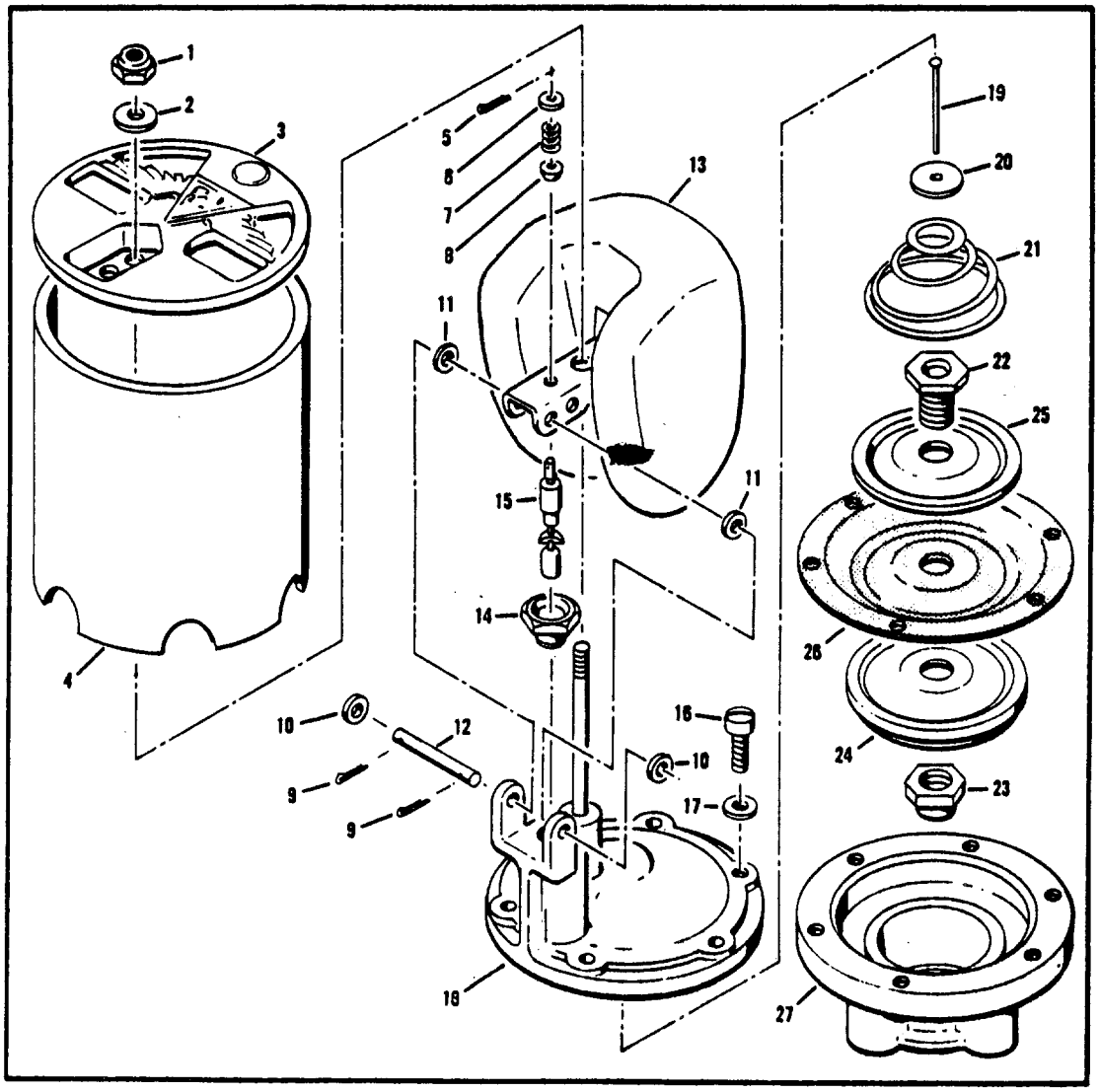


Figure 1. Level Control Valve, Part No. 1321-536250

Parker Aircraft

OVERHAUL MANUAL

LEVEL CONTROL VALVE

Part No. 1321-536250

Fig & Index No.	Part Number	Nomenclature 1 2 3 4 5 6 7	Qty Per Assy	Usable On Code
1-	1321-536250	VALVE, Bottom Fitting Control	1	
1	MS20364-1032C	. NUT	1	
2	AN960-10	. WASHER	1	
3	1423-536078	. RING	1	
4	1421-527767-1	. SHIELD	1	
5	AN381-1-6	. PIN	1	
6	1423-517684	. WASHER	1	
7	8730-527830	. SPRING	1	
8	1420-527901	. RETAINER	1	
9	AN381-1-6	. PIN	2	
10	8743-526934	. WASHER	AR	
11	7310-546009	. WASHER	AR	
12	1420-517373	. PIN, Hinge	1	
13	1421-527159	. FLOAT ASSEMBLY	1	
14	1420-517337	. SEAT	1	
15	1420-536209	. PILOT ASSEMBLY	1	
16	AN503-6-8	. SCREW	6	
17	8743-527368	. WASHER	6	
18	1421-536472	. BODY	1	
19	1420-527862	. PIN, Cleaning	1	
20	8743-527354	. RETAINER	1	
21	8730-527370	. SPRING	1	
	1421-546394	. DIAPHRAGM ASSEMBLY	1	
23	AN364-428C	. . NUT	1	
22	1421-517363	. . SCREW	1	
24	1421-526754	. . POPPET ASSEMBLY	1	
25	1421-526755	. . DISC, Backup	1	
26	1421-527360	. . DIAPHRAGM	2	
27	1421-536065	. ADAPTER	1	

Parker Aircraft

OVERHAUL MANUAL

SWING CHECK VALVE

Part No. 2650157

1. Description and Operation

This valve is of the swing check (flapper) type, spring-loaded to the closed position. The flapper uses a soft seat for sealing.

When pressure in excess of the cracking pressure is applied against the spring-loaded flapper, the flapper swings off its seat permitting flow through the valve in the direction of the "FREE FLOW" arrow which is stamped on the valve body. At pressures below the cracking pressure, or if pressure is applied in the opposite direction, the flapper closes, and the soft seat effectively closes the valve.

Operating Medium	Air and Fuel per MIL-G-5572 and MIL-F-5624
Temperature Range	-65° to +160°F(-53.9 to 71.1°F)
Pressures:	
Operating	50 psig
Proof	75 psig
Burst	125 psig
Cracking	8 inches H_2O max
Leakage	
External	None from zero to proof pressure
Internal	None above 3 inches H_2O (air) in checked flow direction with wet seat
Ports:	
Inlet	MS33677-1/2
Outlet	MS33656-10
Weight	0.17 pounds

2. Disassembly

Disassemble according to sequence of index numbers assigned to the exploded-view illustration (figure 2).

NOTE: Do not attempt to disassemble swing assembly (5). If damaged or defective, replace in its entirety.

3. Cleaning

Wash all parts, except swing assembly (5), in dry-cleaning solvent, Federal Specification P-D-680 or equivalent and dry parts thoroughly with a clean, lint-free cloth, or compressed air at 10 psig.

WARNING: USE DRY-CLEANING SOLVENT IN A WELL-VENTILATED AREA. AVOID BREATHING FUMES. KEEP AWAY FROM OPEN FLAME.

Clean swing assembly (5) with a cloth moistened with solvent.

4. Inspection

A. Anodized surfaces of body (1) and cap (6) should be clean and undamaged; ensure threads are clean and undamaged and there is no evidence of corrosion on interior surfaces.

B. Seating surface on cap (6) for swing assembly (5) must be smooth; no nicks or scratches which might prevent proper seating or cause damage to soft seat.

C. Outisde diameter of hinge pin (3) must not be worn below 0.0535 inch at any point; no visible distortion when rolled on a surface plate.

D. Spring (4) data:

(1) Must wind up to nominal working position (189^{o}) under a load of 0.00783 to 0.00957 inch-pounds.

(2) Must not bind on a 0.054 inch diameter pin when wound up 90^{o} beyond nominal working position; when released must exhibit no evidence of permanent set.

E. Swing Assembly (5) data:

(1) Soft seat must have no nicks or tears; cure date must be current.

(2) Inside diameter of holes in arm for hinge pin (3) must not be worn over 0.0565 inch diameter.

5. Repair

A. Replace all rubber components at each overhaul.

B. Polish out minor surface scratches and imperfections with crocus abrasive cloth, Federal Specification P-C-458 (ferrous material only), or aluminum oxide abrasive cloth, Federal Specification P-C-451 (aluminum and aluminum alloy parts only). Reclean all polished parts in accordance with paragraph 3.

C. Touch up reworked areas with a chemical film, Military Specification MIL-C-5541 or equivalent.

D. Replace any defective parts that cannot be repaired to meet inspection requirements.

6. Assembly

A. Reassemble in reverse sequence of index numbers assigned to the exploded view.

7. Fits and Clearances (not applicable)

8. Testing

A. Test Specifications:

(1) Test Medium: Air or solvent, Federal Specification P-D-680

(2) Temperature: +60 to 100°F (+15.6 to 37.8°C)

(3) Pressure Range: 0 to 75 psig

B. Test Procedures

(1) Visual

(a) With outlet port down, the torsion spring (4) must have sufficient force to return swing assembly to its seat after manually unseating.

(2) Internal Leakage

(a) Prior to performing the internal leakage test wet swing assembly (5) with solvent.

(b) With the valve in the vertical (upright position) connect outlet port to the air pressure source.

(c) Gradually apply air pressure to the outlet port and apply a small amount of solvent to the inlet port (enough to cover the swing assembly approximately

1/8 inch) and observe for leakage. Leakage can be observed as bubbles appearing in solvent. There shall be no internal leakage from 3 inches H_2O.

(d) Slowly increase pressure over a 30 second period (minimum) to 75 psig; observe for leakage during pressure increase. Time required to increase pressure from 3 inches H_2O to 20 psig shall not be less than 20 seconds. There shall be no internal leakage from 3 inches H_2O to 75 psig.

(3) Proof and External Leakage

(a) Connect valve as noted in paragraph (2)(b); submerge the valve in solvent and apply 75 psig air pressure.

(b) Observe for external leakage or distortion of part. There shall be no external leakage or permanent set shall result from test.

(4) Cracking Pressure

(a) Mount valve as shown in figure 1 (valve vertical and swing assembly on top).

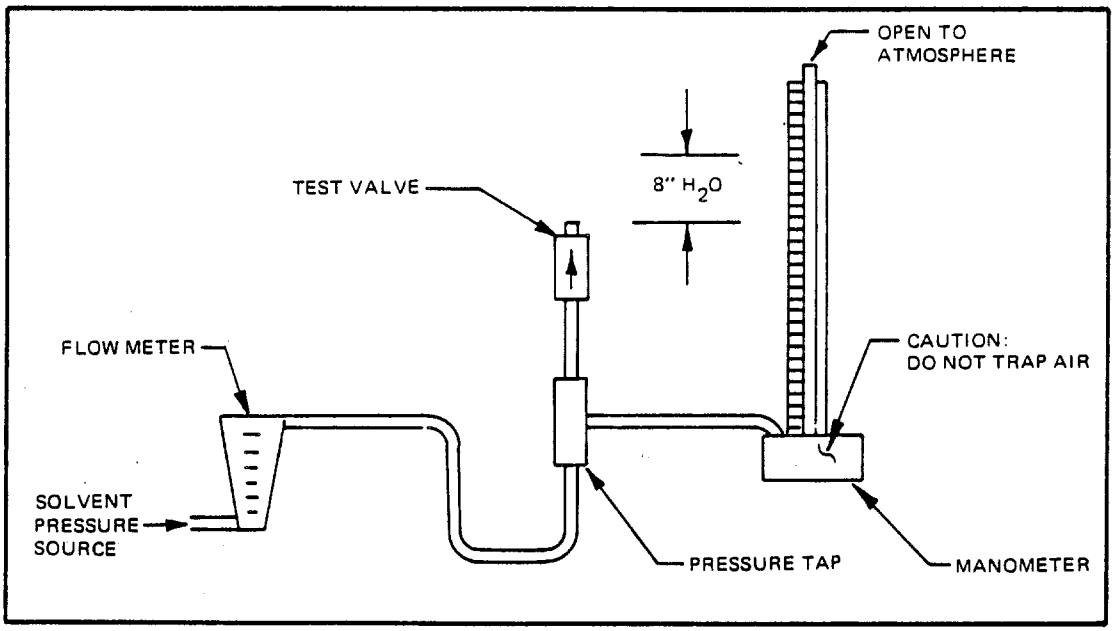


Figure 1. Cracking Pressure Test Setup

(b) Connect to solvent pressure source. Slowly apply pressure to the inlet port until a flow of 190 cc per minute is obtained from outlet port. Cracking pressure shall be 8 inches H_2O maximum with 190 cc per minute solvent.

(5) Test Results

(a) If valve fails to meet any requirement, repair or replace defective components and repeat all tests.

9. Storage Instructions

A. Upon completion of testing, drain all excess solvent from valve.

B. Cap ports against entry of foreign matter.

C. Stamp valve with cure-date of the installed rubber parts in accordance with ANA Bulletin 438.

10. Special Tools and Fixtures and Equipment (none required)

11. Illustrated Parts Breakdown

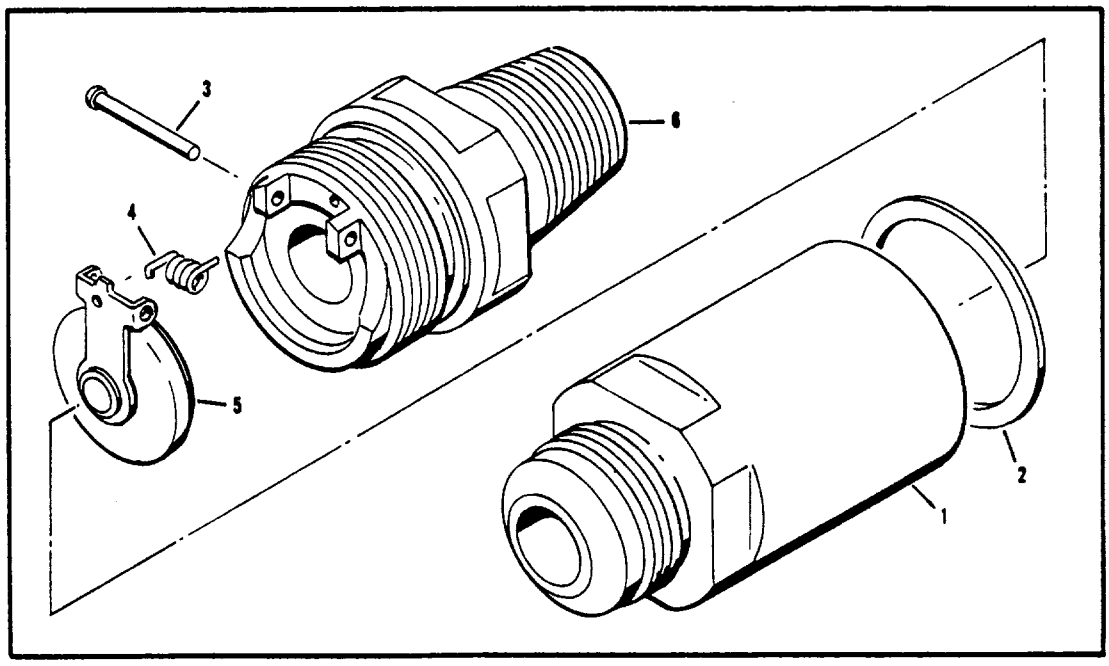


Figure 2. Swing Check Valve, Size 10, Part No. 2650157

Parker Aircraft

OVERHAUL MANUAL

SWING CHECK VALVE

Part No. 2650157

Fig. & Index No.	Part Number	Nomenclature 1 2 3 4 5 6 7	Qty Per Assy	Usable On Code
2-	2650157	VALVE, SWING CHECK, Size 10	1	
1	2651773	. BODY	1	
2	F61A1718-46	. GASKET	1	
3	1211-539000	. PIN, Hinge	1	
4	8730-517251	. SPRING, Torsion	1	
5	1211-517246	. SWING ASSEMBLY	1	
6	2651774	. CAP	1	

TANK UNIT.

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VERGENNES, VERMONT, U. S. A.

PART NOS. 391087 and 391088.

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SIMMONDS PRECISION PRODUCTS, INC.
LIQUID QUANTITY GAGING SYSTEM

DeHavilland DHC-6

OVERHAUL INSTRUCTIONS

FOR

LIQUID QUANTITY TRANSMITTER ASSEMBLY

PART NUMBERS

391087-03081
391087-03082
391087-03083
391087-03084
391087-03085

SIMMONDS PRECISION PRODUCTS, INC.
Panton Road
Vergennes, Vermont

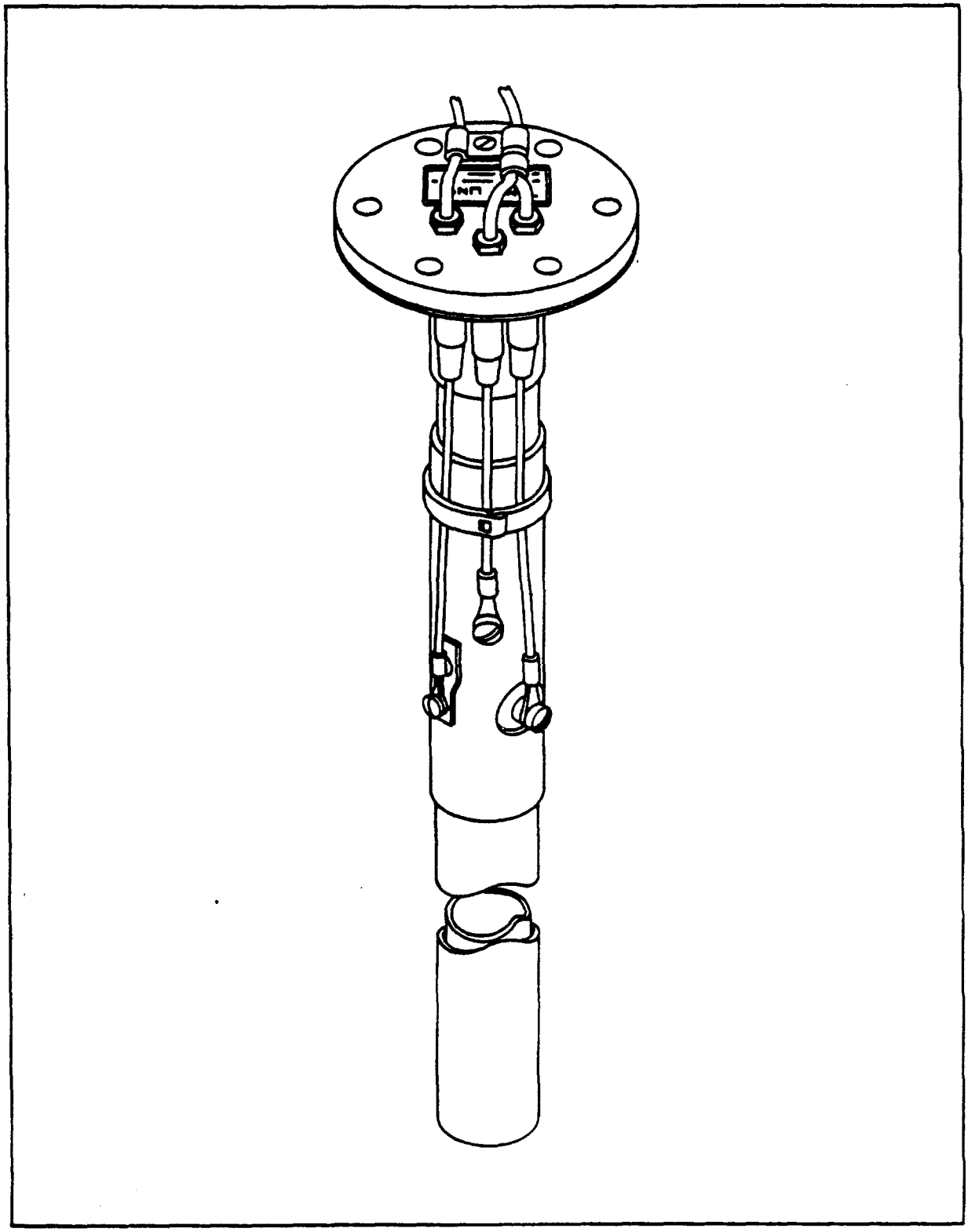
SIMMONDS AEROCESSORIES OF CANADA LIMITED
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Telephone 547-1283

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TANK UNIT



Liquid Quantity Transmitter Assembly,
Part Nos. 391087-03081, -03082, -03083, -03084, -03084, Assembled View
Figure 1

1. DESCRIPTION, OPERATION, AND DATA.

A. This handbook contains overhaul instructions, and test procedures for Liquid Quantity Transmitter Assemblies with part numbers listed in Table I.

B. The transmitter assembly (see Figure 1) is part of a capacitance gaging system. Such a system mea ures the mass of a liquid by making use of the liquid's dielectric properties. A transmitter assemb consisting of two tubular members separated by an air gap, is immersed in the fuel in such a way th as fuel level drops the dielectric between the members consists of a fuel-air mixture whose ratio is determined by fuel level. The capacitance of the transmitter assembly thus varies with the amount fuel in the tank.

C. Leading Particulars of the transmitter assemblies covered in this handbook are given in Table I.

TABLE I. LEADING PARTICULARS

Part No.	Length	Mounting	Capacitance (pf)	Weight (lbs)
391087-03081	14.50 ± 0.030	Flange	44.2	0.58
391087-03082	14.50 ± 0.030	Flange	37.7	0.58
391087-03083	14.50 ± 0.030	Flange	40.3	0.53
391087-03084	14.50 ± 0.030	Flange	43.9	0.53
391087-03085	14.02 ± 0.030	Flange	34.3	0.58

2. DISASSEMBLY.

Disassembly of the liquid quantity transmitter assemblies is not recommended.

3. CLEANING.

NOTE: See Table IV for special materials.

WARNING: USE METHYLETHYL KETONE IN A WELL VENTILATED AREA. AVOID CONTACT WITH SKIN AND OPEN FLAME.

A. Immerse transmitter components in methylethyl ketone.

B. Allow about 30 minutes for softening of deposits.

C. Agitate transmitter assembly in cleaning solvent to loosen and remove dirt and deposits. Scrub with a non-wire brush.

D. Remove transmitter assembly from cleaning solvent and rinse thoroughly in isopropanol.

E. Dry by means of clean, compressed air at a pressure no greater than 35 psi.

F. Carefully probe recesses with a small, soft, pointed instrument to make sure recesses are clean.

G. If traces of deposit or hole blockage is noted upon inspection, repeat cleaning procedure. Carefully clear blockage using a soft instrument while components are immersed in cleaning solvent.

4. INSPECTION/CHECK.

A. Examine transmitter assembly for dents, cracks, chips, or scoring which may effect electrical characteristics of the unit.

B. Check cable clamps for security of mounting.

C. Check leads for defective insulation and faulty connections.

5. REPAIR OR REPLACEMENT.

Replace preformed packing whenever assembly is replaced in installation. Repair is limited to replacement of the liquid quantity transmitter assembly.

6. ASSEMBLY.

Replace preformed packing, Part No. 398602.

7. TESTING.

A. CAPACITANCE TEST.

NOTE: Take into consideration the tolerance of the measuring equipment when making capacitance measurements.

Using the Automatic Capacitance Bridge, Simmonds Part No. 387011, or the bridge portion of the Field Calibration Unit, Simmonds Part No. 387991-003 (refer to paragraph 10), or equivalent, measure the capacitance between the coaxial and 400-cycle connections of each transmitter. The capacitance of each transmitter must be as shown in Table II.

TABLE II. CAPACITANCE VALUES

Part No.	Capacitance (pf)
391087-03081	44.2 ± 0.5
391087-03082	37.7 ± 0.5
391087-03083	40.3 ± 0.5
391087-03084	43.9 ± 0.5
391087-03085	34.3 ± 0.5

B. INSULATION RESISTANCE MEASUREMENT.

Using the Simmonds Three-Terminal Megohmmeter 388226,or equivalent, measure the insulation resistance between points shown in Table III. Resistance must be as shown.

TABLE III. INSULATION RESISTANCE VALUES

Part No.	Test Point (Megohms) Coaxial Terminal to Ground	Test Point (Megohms) 400-cycle Terminal to Ground	Test Point (Megohms) Coaxial Terminal to 400-cycle Terminal
391087-03081	4	4	1800
391087-03082	4	4	2000
391087-03083	4	4	2000
391087-03084	4	4	1800
391087-03085	4	4	2200

C. INSULATION BREAKDOWN TEST.

Using Insulation Breakdown Tester, Model P-2, or equivalent (refer to paragraph 10), apply 500 volts RMS, 60 cps between the test points indicated in Table III. There must be no insulation breakdown.

CAUTION: PERFORM THIS TEST ONLY ON A CLEAN, DRY TRANSMITTER ASSEMBLY. IT IS A DESTRUCTIVE TEST AND SHOULD BE PERFORMED ONLY ONCE OR TWICE DURING THE LIFE OF THE UNIT.

8. TROUBLE SHOOTING.

If the transmitter assembly fails to pass the tests specified in paragraph 7, check for improper electri connections and for tightness of parts. If these checks fail to provide test compliance, discard and replace unit.

9. STORAGE INSTRUCTIONS.

A. PACKAGING.

(1) It is recommended that the transmitter assembly be stored in the original container, if availal

(2) If the original container is not available, package the transmitter assembly as follows:

a. Completely wrap the transmitter assembly in water-resistant paper. Seal with waterproc tape.

b. Insert the wrapped equipment in a cardboard carton, being sure to adequately cushion the carton on all sides so that the equipment will be held securely in place. Seal the carton with tape.

c. Wrap the carton with water-resistant paper and seal with waterproof tape. Mark the cart "FRAGILE."

d. Affix a label containing the following information:

(i) Transmitter assembly part number.

(ii) Serial number.

(iii) Date of last overhaul.

(iv) Modification standard if applicable.

(v) Note and date of any other component change.

B. LIMITING PERIOD.

The storage period of the transmitter assembly is 18 months.

10. SPECIAL TOOLS, FIXTURES, AND EQUIPMENT.

Item	Description	*Part Number
1	Automatic Capacitance Bridge OR Field Calibration Unit	387011 Simmonds Precision Products, Inc. Tarrytown, New York, U.S.A. 387991-003 Simmonds Precision Products, Inc.
2	**Capacitance Standards Kit	387046 Simmonds Precision Products, Inc.
3	Voltage Breakdown Tester	Model P-2 Industrial Instruments, Inc. Cedar Grove, N.J., U.S.A.

* - Equivalent equipment may be used.
** - The Capacitance Standards Kit is recommended for use in checking accuracy of the capacitance measuring test equipment.

1. SCHEDULE OF OVERHAUL PERIODS.

Item	Manufacturer	Part No.	Period to Overhaul
Liquid quantity transmitter assembly	Simmonds Precision Products, Inc. Tarrytown, N. Y., U. S. A.	391087-03081 391087-03082 391087-03083 391087-03084 391087-03085	18 months elapsed time, or 12,000 flying hours, whichever occurs first.

TABLE IV. SPECIAL MATERIALS

Name	Manufacturer	Purpose
Methylethyl Ketone Federal Specification TT-M-261 (U. S. A.)		Clean components
Isopropanol Federal Specification TT-I-735A (U. S. A.)		Remove Methylethyl Ketone residue

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TA

SIMMONDS PRECISION PRODUCTS, INC.

OVERHAUL MANUAL

WITH ILLUSTRATED PARTS LIST

DHC-6

LIQUID QUANTITY TRANSMITTER

PART NUMBER

391088-002
391088-003
391088-004
391088-005
391088-006

SIMMONDS PRECISION
OVERHAUL MANUAL WITH IPL
PART NO. 391088-*

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SIMMONDS PRECISION
OVERHAUL MANUAL WITH IPL
PART NO. 391088-*

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A	7/29/88	8/21/02	ATP/MG				

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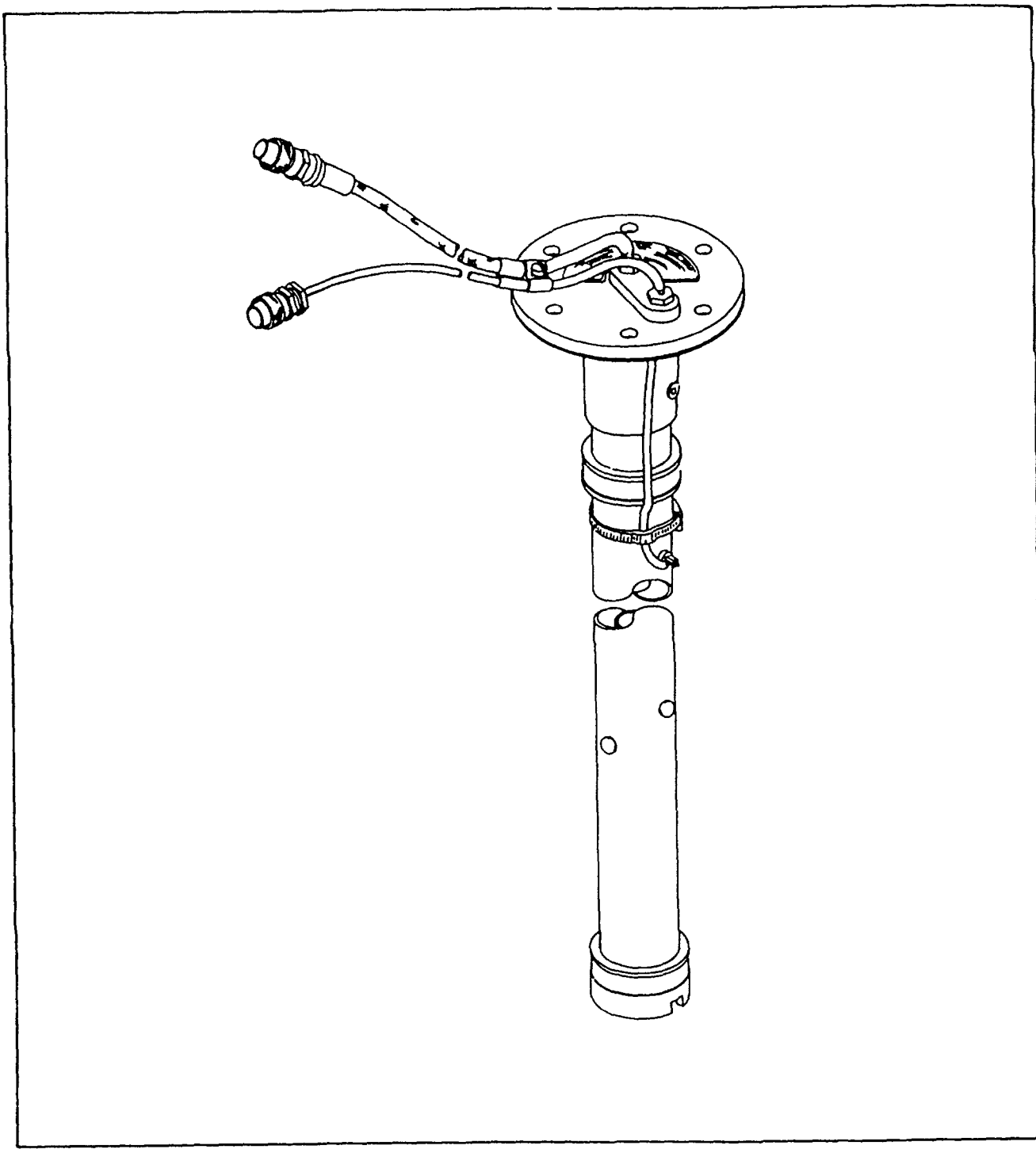
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Liquid Quantity Transmitter
Figure 1

DESCRIPTION AND OPERATION

1. Description (Ref Fig. 1)

   A. The liquid quantity transmitters, part number 391088-*, are components of the DeHavilland DHC-6 Fuel Quantity Gauging System (FQGS). The transmitter consists of two metal tubes, two lead assemblies with plug connectors, a flange and a scuff cap. The two tubes fit together, concentrically, one inside of the other. The inner (high impendance) tube is nickel electroform and the outer (low impedance) is anodized aluminum. Concentricity of the tubes is maintained by teflon insulating spacers distributed along the length of the transmitter. These spacers are retained in place on the outer tube by insulator rings and stainless steel spring clamps.

   B. The leading particulars of the liquid quantity transmitters covered in this manual are listed in Table 1.

2. Operation

   The liquid quantity transmitter is immersed in the fuel and acts as a variable capacitor whose capacitance varies only with a change in the dielectric value of the material between the tubular members. Since the liquid quantity transmitter is used to measure between tubular members will be either all fuel, partially fuel and air or all air, depending upon the amount of fuel in the tank. The capacitance is determined by the proportions of fuel and air. As a result of this condition, the capacitance will vary as the fuel level in the tank varies. The capacitance signal is transmitted to an indicator-amplifier-bridge which amplifies the signal and displays on a dial the quantity of fuel in the tank.

TABLE 1
LEADING PARTICULARS

Part Number	L Dim Inches	Capacitance Dry	Mounting
391088-002	14.5	43.1	Flange
391088-003	14.5	36.8	Flange
391088-004	14.5	39.4	Flange
391088-005	14.5	42.9	Flange
391088-006	14.0	33.4	Flange

DISASSEMBLY

1. **General**

   A. Test the liquid quantity transmitter as described in the testing section before disassembly, to help locate trouble. If the unit passes all tests satisfactorily, overhaul is not recommended.

   B. Do not disassemble the unit beyond the point necessary to repair or replace damaged or defective part. Refer to applicable IPL Fig. 1 thru 5 for individual transmitter.

2. **Transmitter** (Ref IPL Fig. 1 thru 5)

   A. Remove and discard gasket (2) and cable tie (3).

   B. Do not remove identification plate (4) unless replacement is necessary.

   C. Remove screw (6) lockwasher (7) and wire clamp (8).

   D. Unscrew retaining nut (9) and remove 400 cycle lead assembly (5) bushing (10) two clamps (11) two flat washers (12) and gasket (13).

   E. Loosen retaining nut part of shielded cable assembly (14) and remove shielded cable assembly.

   F. Cut ends from two cross pins (15) and remove.

   G. Remove two spacer clamps (16) and extract spacers (17 and 19).

   CAUTION: TO ASSURE REASSEMBLY, SEPARATE EACH SET OF SPACERS AND NOTE LOCATION OF EACH SET ON OUTER TUBE ASSEMBLY.

   H. Remove scuff cap (18) and split ring (20) and separate inner tube assembly (21) from outer tube assembly (22).

CLEANING

1. **Materials Required**

NOTE: Equivalent substitutes may be used for listed items.

MATERIAL	NUMBER
Oakite NST (Inhibited, non-silicated, non-etching alkaline detergent)	Fed. Spec. P-C-436b

2. **Equipment Required**

Steel Detergent Tank

Steel Clear-Water Rinse Tank

Toothbrush (or equivalent)

Circulating Air Oven

3. **Cleaning Procedure**

A. Fill suitably-sized detergent tank with hot (120° to 130°F) de-ionized water and Oakite NST (5 to 10% Oakite NST by volume).

B. Immerse tank unit(s) in detergent solution for 30 to 40 minutes. Agitate tank unit(s) in tank. Remove any residual deposits with toothbrush or similar stiff brush.

C. Fill suitably-sized clear-water rinse tank with unheated, de-ionized water.

D. Transfer tank unit(s) from detergent tank to clear-water rinse tank as quickly as possible to avoid the detergent solution from drying on the tank unit(s).

E. Tank units should remain in the rinse tank for at least five minutes to ensure complete removal of alkaline residue.

NOTE: Rinse tank water should be changed periodically.

F. Remove tank unit(s) and rinse thoroughly with running cold water.

G. Suspend cleaned tank unit(s) in circulating air oven and bake at 120° to 130°F for at least 2 hours.

H. As an alternate drying method, use clean, compressed air at a pressure no greater than 15 psig.

WARNING: DO NOT DIRECT COMPRESSED AIR AGAINST HUMAN BODY.

I. Carefully probe each flood hole, as well as all recesses, with a small, pointed instrument to make sure the holes are not plugged and all recesses are clean.

J. If traces of hole blockage or deposits are noted upon inspection, repeat cleaning procedure.

INSPECTION/CHECK

1. **General**

   When performance of inspection/check procedure indicates repair is required, see REPAIR. For part replacement see DISASSEMBLY and ASSEMBLY.

2. **Transmitter**

   A. Visually inspect identification plate for damage and legibility of markings.

   B. Visually inspect transmitter for deterioration, corrosion and fungus.

   C. Visually inspect components for cracks, dents, chips, scratches and scoring.

   D. Visually inspect cables for cracks, wear or defective solder joints.

REPAIR

1. **General**

This section contains repair procedure for the transmitter; for replacement of parts see DISASSEMBLY and ASSEMBLY.

2. **Materials**

MATERIAL	NUMBER	VENDOR
Trichloroethylene	Federal Specification O-T-634	- - -
Iridite	14-2	83574

3. **Flange Assembly and Pressure Plate Touchup** (Ref IPL Fig. 1)

A. Degrease the scratched area of the outer tube assembly with trichloroethylene.

B. Apply iridite 14-2 (2-4 oz/gal. concentration) with a brush or cotton swab for 30 seconds; swab must be wet at all times.

WARNING: IF IRIDITE IS SPILLED ON HANDS OR CLOTHING, RINSE WITH WATER IMMEDIATELY.

C. Rinse touchup area with demineralized water using a swab or brush. Dry with clean cheese-cloth or air.

ASSEMBLY

1. **General**

The procedure listed below (Ref IPL Fig. 1) has been chosen as being representative for all transmitters. Refer to applicable IPL Figures 1 thru 5 for individual transmitters.

2. **Material**

MATERIAL	NUMBER
Solder	Federal Specification QQ-S-571 Sn63WRMAP2
Alcohol, Isoprophyl	T-T1-735A No. 2
Adhesive	8400
Tubing Insulated	050029-004

3. **Transmitter** (Ref IPL Fig. 1)

A. Assemble inner tube assembly (21) into outer tube assembly (22).

B. Place split ring (20) onto outer tube assembly and insert three spacers (19) and secure with one spacer clamp (16).

C. Place scuff cap (18) onto outer tube assembly and insert three spacers (17) and secure with one spacer clamp (16).

D. Insert two cross pins (15) thru inner and outer tube assemblies. Do not flare cross pins at this time.

E. Insert terminal, part of shielded cable assembly (14) thru hole in flange of outer tube assembly (22) and seat it firmly into socket in end of inner tube assembly (21). Tighten retaining nut, part of shielded cable assembly into flange.

F. Slide a 2 1/2 inch length of insulated tubing over wire of 400 cycle lead assembly (5) and assemble lead assembly, retaining nut (9), bushing (10), two clamps (11) two washers (12) and gasket (13) to outer tube assembly (22). Tighten retaining nut.

G. Solder 400 cycle lead assembly to terminal on outer tube assembly.

H. Remove solder flux with isoprophyl alcohol and a stiff non-metallic brush.

I. Apply a drop of 8400 adhesive to end of 400 cycle lead to prevent wicking of fuel.

J. Attach wire clamp (8) with screw (6) and lockwasher (7).

K. Leak test per testing section.

L. If identification plate (4) was removed, stamp the information on a new plate, remove the protective backing and attach to flange.

M. Attach cable tie (3).

N. Reverse the tip in a 150 watt soldering iron and using the blunt, round end of tip flare the ends of cross pins (15).

O. Test per testing section.

FITS AND CLEARANCES

(Not Applicable)

TESTING

1. **Materials**

MATERIAL	NUMBER
Stoddard Solvent	ASTM D484-52

2. **Capacitance** (Ref Fig. 701)

A. Using capacitance bridge, (Simmonds Precision 387011), Field Calibration Unit PSD 40-1 or PSD 60-1, (or equivalent), measure the capacitance between the coax (Hi-Z) terminal and the 400 cycle (Lo-Z) terminal.

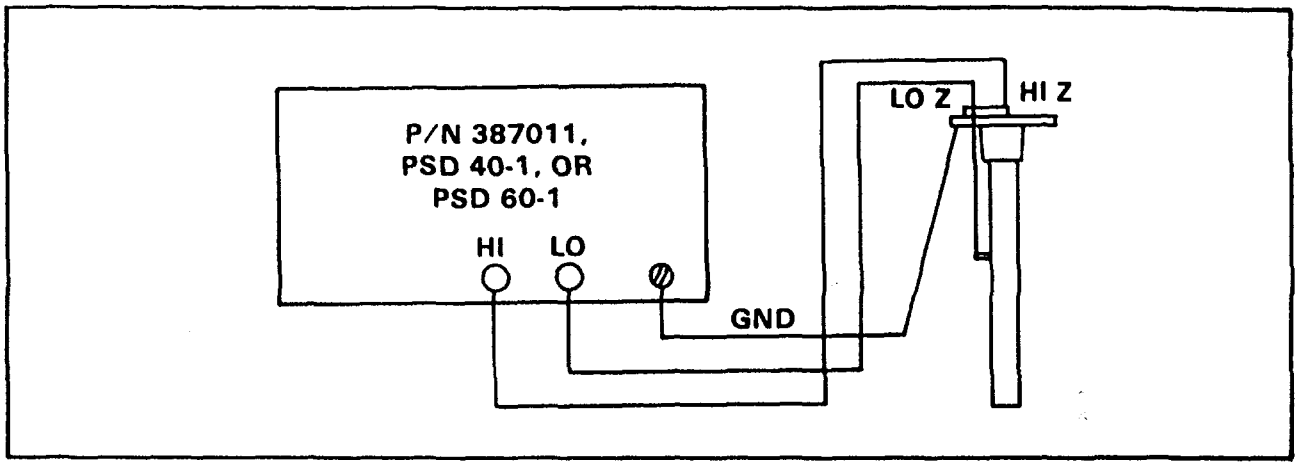
NOTE: Mounting flange must be grounded to test set.

B. The capacitance reading shall be as listed below:

TRANSMITTER	CAPACITANCE
391088-002	43.1 $\pm$ 0.5 pf
391088-003	36.8 $\pm$ 0.5 pf
391088-004	39.4 $\pm$ 0.5 pf
391088-005	42.9 $\pm$ 0.5 pf
391088-006	33.4 $\pm$ 0.5 pf

3. **Insulation Resistance**

A. Using megohmmeter (General Radio GR1862B or equivalent), turn the power switch to OFF. Place the Volts of Unknown switch to 500, and Multiplier switch to DISCHARGE.



Test Setup
Figure 701

B. Connect the Low probe to the ground (Flange) terminal and the High probe to the Hi-Z terminal. Turn the power switch to ON.

C. Turn the Multiplier switch to one (1) for 1 minute. The meter reading shall be greater than 2 (20 megohms).

D. Repeat steps A. thru C. with the test probes connected as directed below:

LOW PROBE	HIGH PROBE	METER READING
GND terminal	Lo-Z terminal	20 megohms
Hi-Z terminal	Lo-Z terminal	20 megohms

E. If above readings are below the acceptable limit (20 megohms) perform the following test with Simmonds Precision three-wire megohmmeter part number 388226.

(1) With megohmmeter Range switch in OFF position connect the probe as follows:

MEGOHMMETER	TRANSMITTER
Hz probe	Hi-Z terminal
Lz probe	Lo-Z terminal
G probe	Gnd terminal

(2) Place the Range switch to 1X position.

(3) With Mode switch on the megohmmeter positioned as directed, the meter readings shall be greater than indicated in the following table:

MODE SWITCH	METER READING
LZ - HZ	20 megohms
LZ - G	1 megohm
HZ - G	1 megohm

4. **Leak Test** (Ref Fig. 702)

A. Mount transmitter in leak test fixture Ref Figure 702 or equivalent.

B. Apply 15 psig air pressure to the leak test fixture.

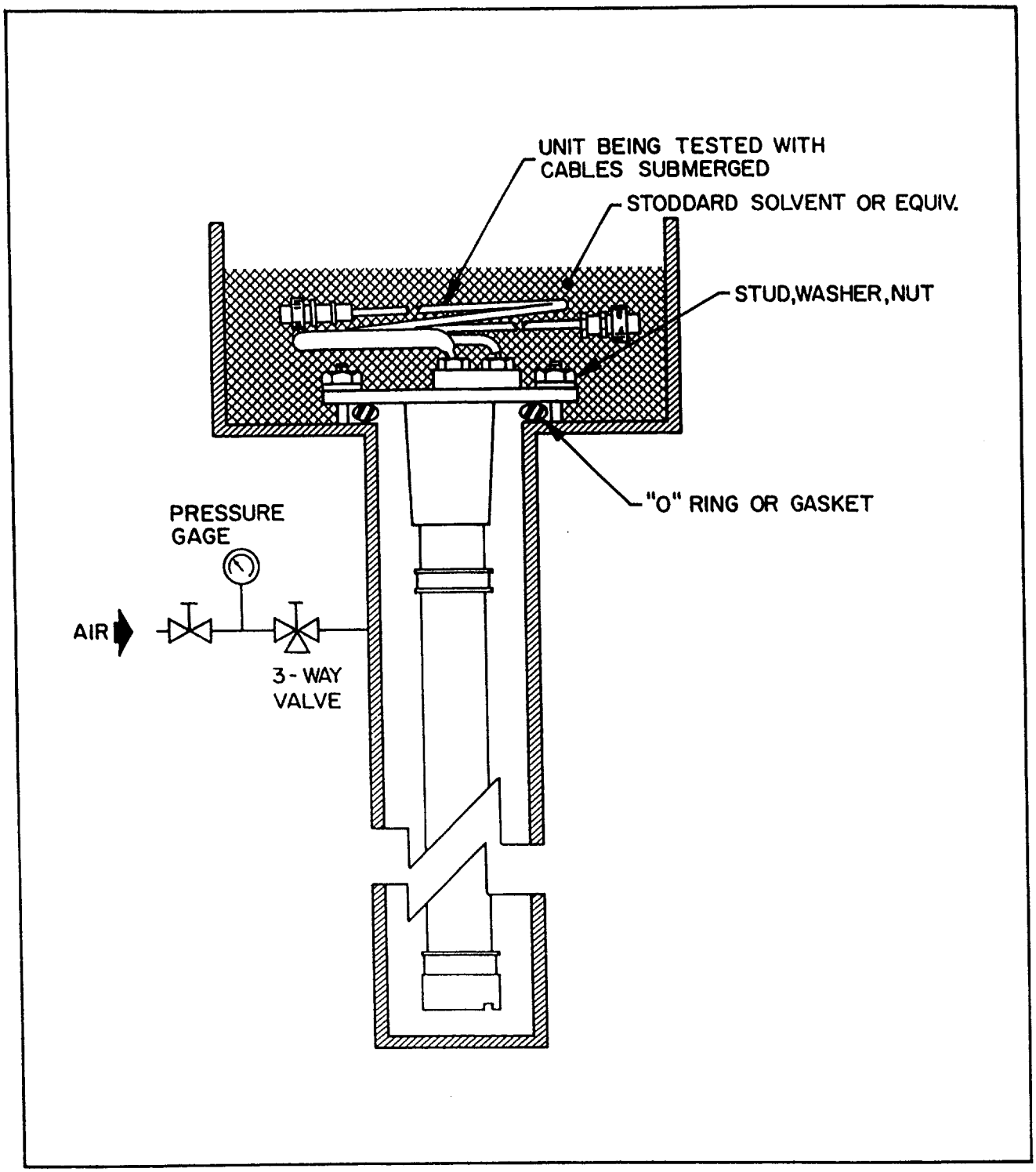
C. Flood the flange and cables of the transmitter with stoddard solvent.

D. No evidence of leaks shall appear for a minimum of 3 minutes.

E. Exhaust air from leak test fixture.

F. Drain stoddard solvent from leak test fixture.

G. Remove transmitter from leak test fixture and blow dry with clean dry compressed air 35 psig maximum.



Leak Test Fixture
Figure 702

TROUBLESHOOTING

If transmitter meets all of the testing requirements, see TESTING, overhaul is not recommended. If transmitter fails to meet testing requirements refer to the applicable steps in Table 801.

TABLE 801
TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	REMEDY
1. Transmitter fails capacitance test.	A. Dirty or contaminated transmitter.	A. Clean transmitter, see CLEANING.
	B. Defective transmitter.	B. Replace defective transmitter or components.
2. Transmitter fails insulation resistance test.	A. Dirty or contaminated transmitter.	A. Clean transmitter, see CLEANING.
	B. Defective cables, spacers, or hardware.	B. Isolate defective component - replace as required.
	C. Defective transmitter.	C. Replace defective transmitter or components.
3. Transmitter fails high potential test.	A. Dirty or contaminated transmitter.	A. Clean transmitter, see CLEANING.
	B. Defective Cables.	B. Replace cables.
	C. Defective transmitter.	C. Replace defective transmitter or components.

STORAGE INSTRUCTIONS

1. **General**

It is recommended that the transmitter be stored in the original container, if available, for a storage life of 18 months.

2. **Materials**

MATERIAL	COMMERCIAL SPECIFICATION
Polyethylene bag	L-378
Full pack package	PPP-B-636
Waterproof tape	PPP-T-76

3. **Signal Conditioner**

A. Place transmitter in polyethylene bag and seal bag.

B. Place bagged transmitter in suitable sized full pack package.

C. Seal package with waterproof tape.

D. Mark package FRAGILE.

E. Store in dry area.

SPECIAL TOOLS, FIXTURES, AND EQUIPMENT

1. All tests shall be conducted at an ambient temperature of 77 ± 18 degrees F, atmospheric pressure of 30 ± 2 inches of mercury, and relative humidity of 90 percent or less.

2. No special tools are required for overhaul of the transmitter. Test equipment is listed in Table 1001.

TABLE 1001
TEST EQUIPMENT

PART NUMBER	NOMENCLATURE
472090-007 or equivalent (Simmonds Precision, Instrument Division, Vergennes, Vermont)	Unit, Field Calibration
-- or --	
PSD 40-1 or PSD 60-1 (Simmonds Precision, Product Support Division, Ft. Lauderdale, FL)	Test Set, AC Field Calibration
GR1862B or equivalent (General Radio)	Megohmmeter

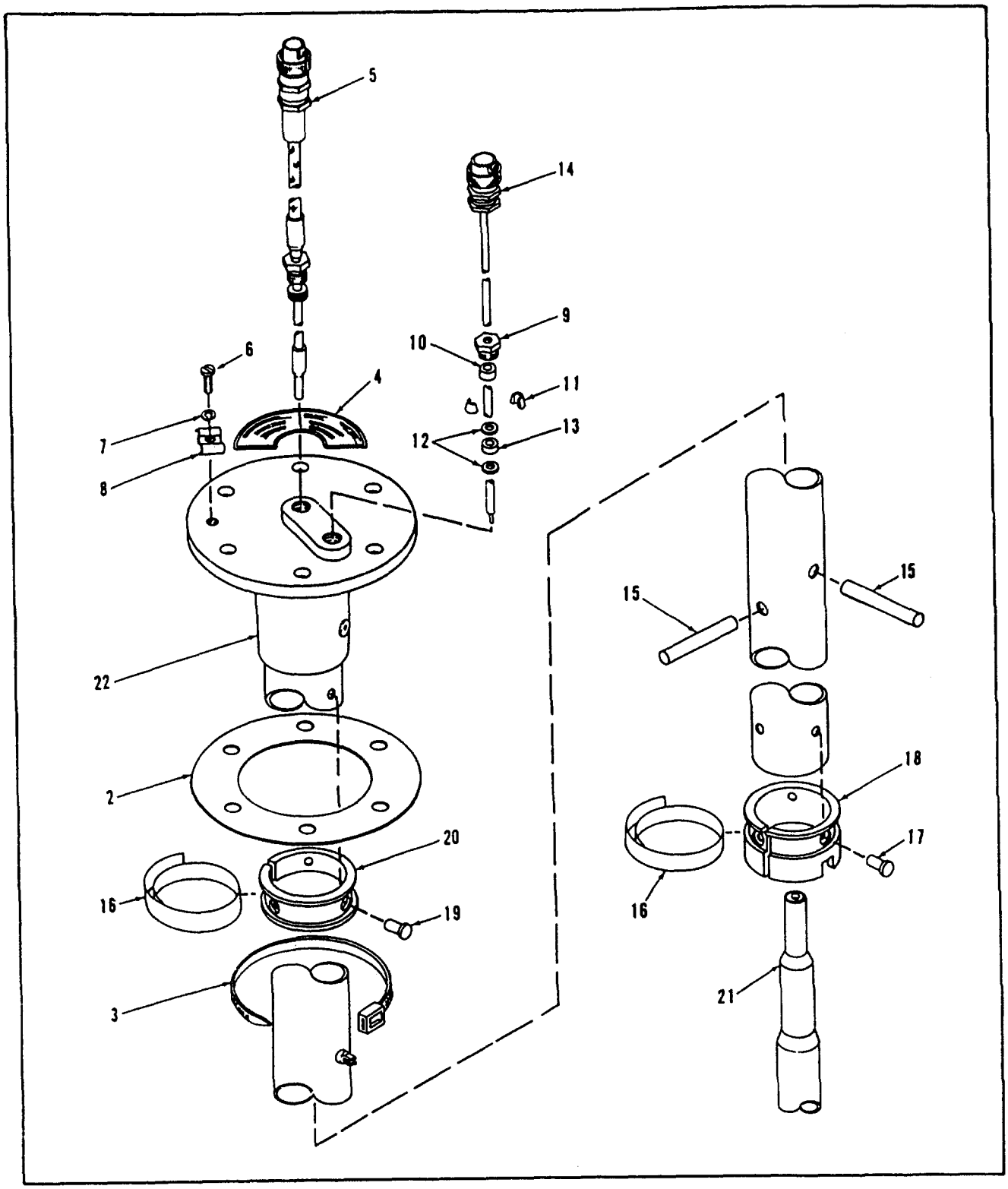
ILLUSTRATED PARTS LIST

Numerical Index of part number to figure.

Vendor Code List of manufacturers of materials or equipment.

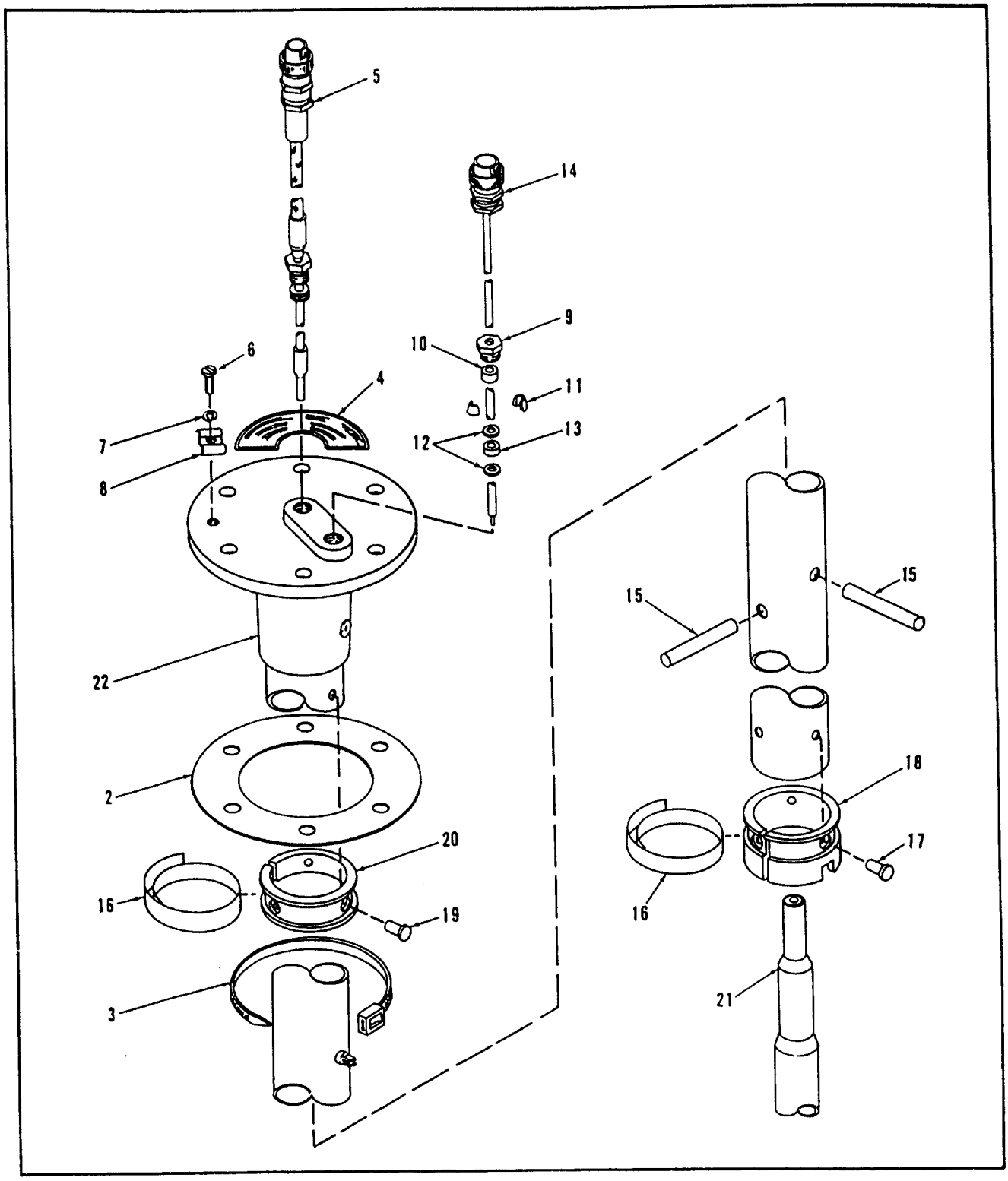
VENDOR CODE LIST

CODE	MANUFACTURER
95712	Dage Electric Co., Franklin, Indiana



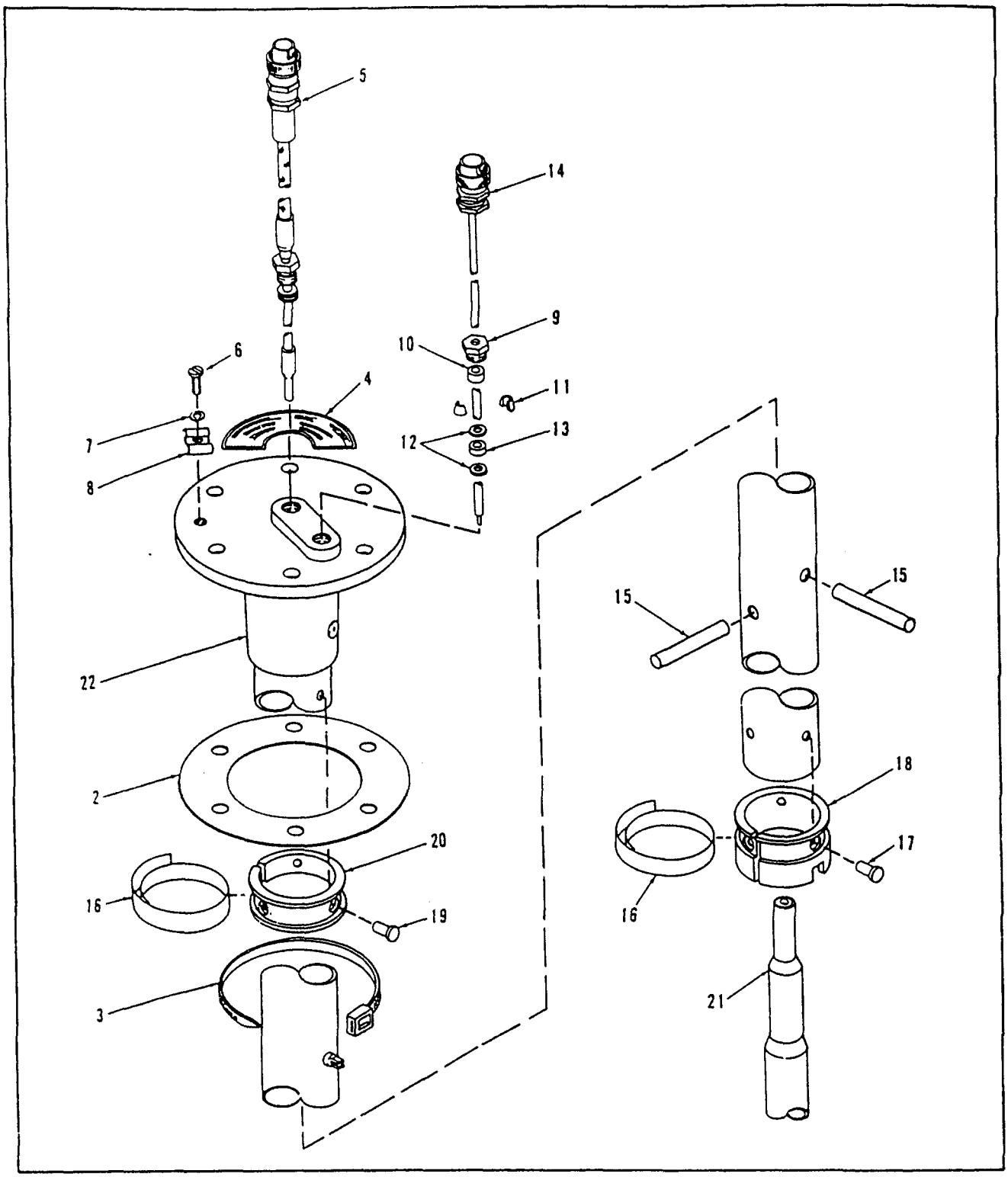
Liquid Quantity Transmitter
Figure 1

FIG. ITEM	PART NUMBER	1234567 NOMENCLATURE	UNITS PER ASSY	
1- 1	391088-002	TRANSMITTER, Liquid quantity	REF	
2	398602	.GASKET	1	
3	MS17821-1-9	.TIE, Cable (Supsd By Item 3A)	1	R
3A	MS3367-1-9	.TIE, Cable (Supsds Item 3)	1	R
4	465666	.PLATE, Identification	1	
5	465659-002	.LEAD ASSEMBLY, 400 cycle (ATTACHING PARTS)	1	
6	MS35275-241	.SCREW, Filh	1	R
7	MS35338-137	.LOCKWASHER	1	R
8	396626	.CLAMP, Wire	1	
		---*---		
9	A101-316-1	.NUT, Retaining (V95712) 048314	1	
10	A101-314-1	.BUSHING (V95712) 048313	1	
11	A101-671-1	.CLAMP (V95712) 032770 (Supsd By Item 11A)	2	R
11A	A101-705-4	.CLAMP (V95712) 032790 (Supsds Item 11)	2	R
12	465668	.WASHER, Flat	2	
13	A101-309-6	.GASKET (V95712) 048316-006	1	
14	465733-002	.SHIELDED CABLE ASSEMBLY	1	
15	465330	.PIN, Cross	2	
16	398402	.CLAMP, Spacer	2	
17	398401-186	.SPACER	3	
18	398615	.CAP, Scuff	1	
19	398401-270	.SPACER	3	
20	398616	.RING, Split	1	
21	465665-002	.INNER TUBE ASSEMBLY	1	
22	465667-001	.OUTER TUBE ASSEMBLY	1	



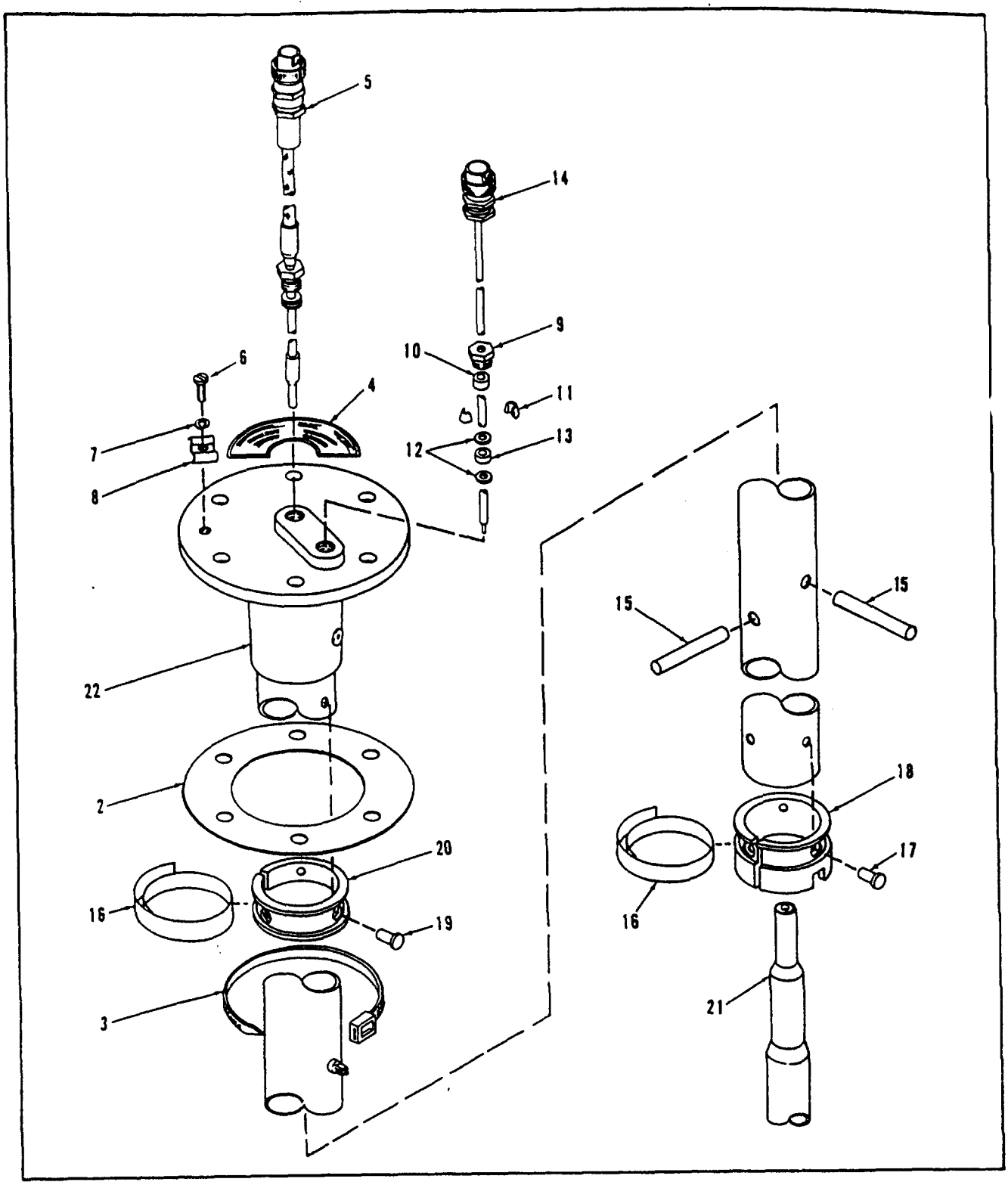
Liquid Quantity Transmitter
Figure 2

FIG. ITEM	PART NUMBER	1234567 NOMENCLATURE	UNITS PER ASSY	
2- 1	391088-003	TRANSMITTER, Liquid quantity	REF	
2	398602	.GASKET	1	
3	MS17821-1-9	.TIE, Cable (Supsd By Item 3A)	1	R
3A	MS3367-1-9	.TIE, Cable (Supsds Item 3)	1	R
4	465666	.PLATE, Identification	1	
5	465659-003	.LEAD ASSEMBLY, 400 cycle	1	
		(ATTACHING PARTS)		
6	MS35275-241	.SCREW, Filh	1	R
7	MS35338-137	.LOCKWASHER	1	R
8	396626	.CLAMP, Wire	1	
		---*---		
9	A101-316-1	.NUT, Retaining (V95712) 048314	1	
10	A101-314-1	.BUSHING (V95712) 048313	1	
11	A101-671-1	.CLAMP (V95712) 032770 (Supsd By Item 11A)	2	R
11A	A101-705-4	.CLAMP (V95712) 032790 (Supsds Item 11)	2	R
12	465668	.WASHER, Flat	2	
13	A101-309-6	.GASKET (V95712) 048316-006	1	
14	465733-003	.SHIELDED CABLE ASSEMBLY	1	
15	465330	.PIN, Cross	2	
16	398402	.CLAMP, Spacer	2	
17	398401-207	.SPACER	3	
18	398615	.CAP, Scuff	1	
19	398401-297	.SPACER	3	
20	398616	.RING, Split	1	
21	465665-003	.INNER TUBE ASSEMBLY	1	
22	465667-001	.OUTER TUBE ASSEMBLY	1	



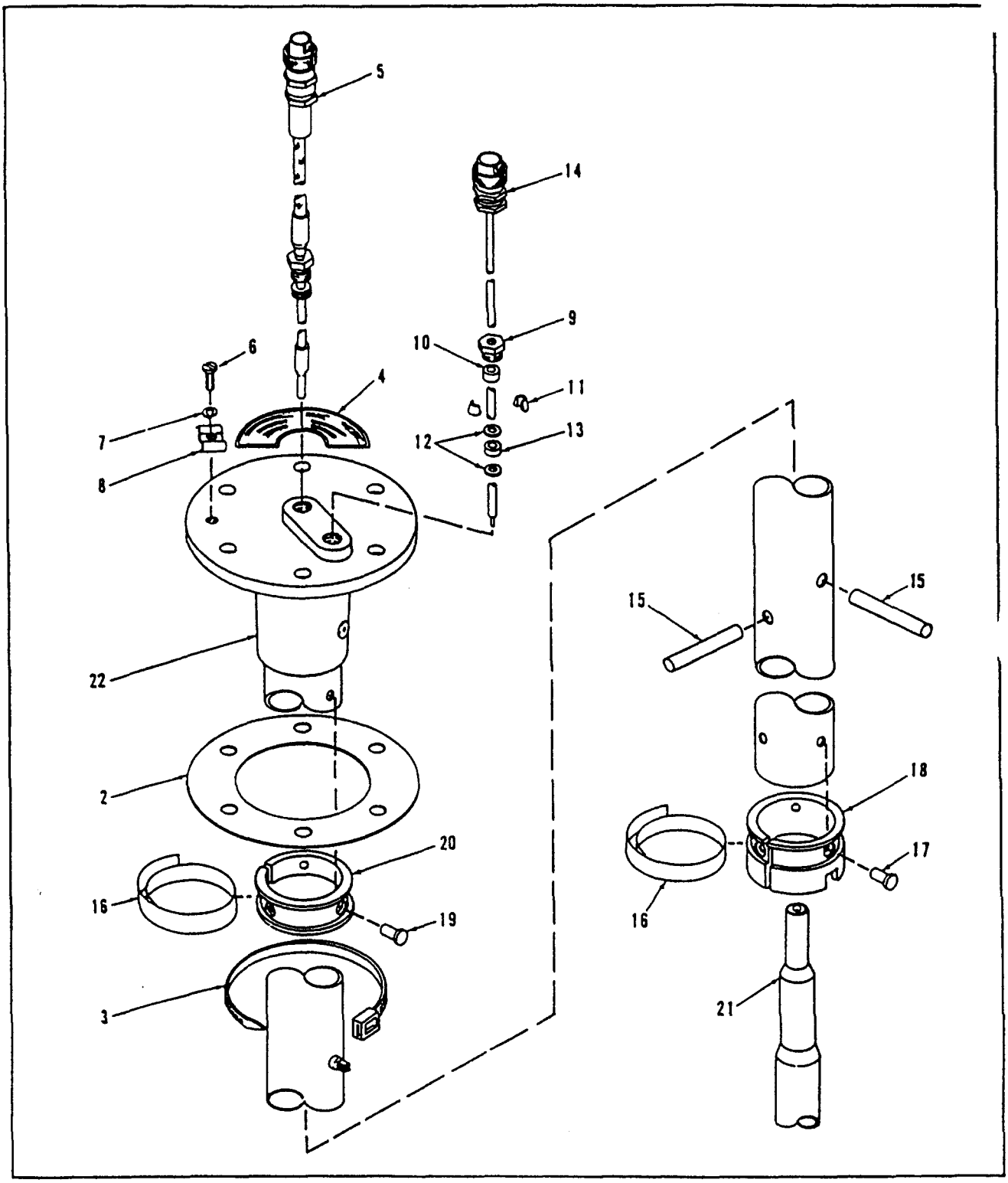
Liquid Quantity Transmitter
Figure 3

FIG. ITEM	PART NUMBER	1234567 NOMENCLATURE	UNITS PER ASSY	
3- 1	391088-004	TRANSMITTER, Liquid quantity	REF	
2	398602	.GASKET	1	
3	MS17821-1-9	.TIE, Cable (Supsd By Item 3A)	1	R
3A	MS3367-1-9	.TIE, Cable (Supsds Item 3)	1	R
4	465666	.PLATE, Identification	1	
5	465659-004	.LEAD ASSEMBLY, 400 cycle (ATTACHING PARTS)	1	
6	MS35275-241	.SCREW, Filh	1	R
7	MS35338-137	.LOCKWASHER	1	R
8	396626	.CLAMP, Wire	1	
		---*---		
9	A101-316-1	.NUT, Retaining (V95712) 048314	1	
10	A101-314-1	.BUSHING (V95712) 048313	1	
11	A101-671-1	.CLAMP (V95712) 032770 (Supsd By Item 11A)	2	R
11A	A101-705-4	.CLAMP (V95712) 032790 (Supsds Item 11)	2	R
12	465668	.WASHER, Flat	2	
13	*A101-309-6*	.GASKET (V95712) 048316-006	1	
14	465733-002	.SHIELDED CABLE ASSEMBLY	1	
15	465330	.PIN, Cross	2	
16	398402	.CLAMP, Spacer	2	
17	398401-198	.SPACER	3	
18	398615	.CAP, Scuff	1	
19	398401-286	.SPACER	3	
20	398616	.RING, Split	1	
21	465665-004	.INNER TUBE ASSEMBLY	1	
22	465667-001	.OUTER TUBE ASSEMBLY	1	



Liquid Quantity Transmitter
Figure 4

FIG. ITEM	PART NUMBER	1234567 NOMENCLATURE	UNITS PER ASSY	
4- 1	391088-005	TRANSMITTER, Liquid quantity	REF	
2	398602	.GASKET	1	
3	MS17821-1-9	.TIE, Cable (Supsd By Item 3A)	1	R
3A	MS3367-1-9	.TIE, Cable (Supsds Item 3)	1	R
4	465666	.PLATE, Identification	1	
5	465659-005	.LEAD ASSEMBLY, 400 cycle (ATTACHING PARTS)	1	
6	MS35275-241	.SCREW, Filh	1	R
7	MS35338-137	.LOCKWASHER	1	R
8	396626	.CLAMP, Wire	1	
		---*---		
9	A101-316-1	.NUT, Retaining (V95712) 048314	1	
10	A101-314-1	.BUSHING (V95712) 048313	1	
11	A101-671-1	.CLAMP (V95712) 032770 (Supsd By Item 11A)	2	R
11A	A101-705-4	.CLAMP (V95712) 032790 (Supsds Item 11)	2	R
12	465668	.WASHER, Flat	2	
13	A101-309-6	.GASKET (V95712) 048316-006	1	
14	465733-005	.SHIELDED CABLE ASSEMBLY	1	
15	465330	.PIN, Cross	2	
16	398402	.CLAMP, Spacer	2	
17	398401-184	.SPACER	3	
18	398615	.CAP, Scuff	1	
19	398401-272	.SPACER	3	
20	398616	.RING, Split	1	
21	465665-005	.INNER TUBE ASSEMBLY	1	
22	465667-001	.OUTER TUBE ASSEMBLY	1	



Liquid Quantity Transmitter
Figure 5

FIG. ITEM	PART NUMBER	1234567 NOMENCLATURE	UNITS PER ASSY	
5- 1	391088-006	TRANSMITTER, Liquid quantity	REF	
2	398602	.GASKET	1	
3	MS17821-1-9	.TIE, Cable (Supsd By Item 3A)	1	R
3A	MS3367-1-9	.TIE, Cable (Supsds Item 3)	1	R
4	465666	.PLATE, Identification	1	
5	465659-006	.LEAD ASSEMBLY, 400 cycle (ATTACHING PARTS)	1	
6	MS35275-241	.SCREW, Filh	1	R
7	MS35338-137	.LOCKWASHER	1	R
8	396626	.CLAMP, Wire	1	
		---*---		
9	A101-316-1	.NUT, Retaining (V95712) 048314	1	
10	A101-314-1	.BUSHING (V95712) 048313	1	
11	A101-671-1	.CLAMP (V95712) 032770 (Supsd By Item 11A)	2	R
11A	A101-705-4	.CLAMP (V95712) 032790 (Supsds Item 11)	2	R
12	465668	.WASHER, Flat	2	
13	A101-309-6	.GASKET (V95712) 048316-006	1	
14	465733-006	.SHIELDED CABLE ASSEMBLY	1	
15	465330	.PIN, Cross	2	
16	398402	.CLAMP, Spacer	2	
17	398401-217	.SPACER	3	
18	398615	.CAP, Scuff	1	
19	398401-308	.SPACER	3	
20	398616	.RING, Split	1	
21	465665-006	.INNER TUBE ASSEMBLY	1	
22	465667-002	.OUTER TUBE ASSEMBLY	1	

NUMERICAL INDEX

PART NUMBER	FIG.	ITEM	TOTAL REQD
A101-309-6	1	13	1
	2	13	
	3	13	
	4	13	
	5	13	
A101-314-1	1	10	1
	2	10	
	3	10	
	4	10	
	5	10	
A101-316-1	1	9	1
	2	9	
	3	9	
	4	9	
	5	9	
A101-671-1	1	11	2
	2	11	
	3	11	
	4	11	
	5	11	
A101-705-4	1	11A	2
	2	11A	
	3	11A	
	4	11A	
	5	11A	
MS17821-1-9	1	3	1
	2	3	
	3	3	
	4	3	
	5	3	
MS3367-1-9	1	3A	1
	2	3A	
	3	3A	
	4	3A	
	5	3A	
MS35275-241	1	6	1
	2	5	
	3	6	
	4	6	
	5	6	

PART NUMBER	FIG.	ITEM	TOTAL REQD
MS35338-137	1	7	1
	2	7	
	3	7	
	4	7	
	5	7	
391088-002	1	1	1
391088-003	2	1	1
391088-004	3	1	1
391088-005	4	1	1
391088-006	5	1	1
396626	1	8	1
	2	8	1
	3	8	1
	4	8	1
	5	8	1
398401-184	4	17	3
398401-186	1	17	3
398401-198	3	17	3
398401-207	2	17	3
398401-217	5	17	3
398401-270	1	19	3
398401-272	4	19	3
398401-286	3	19	3
398401-297	2	19	3
398401-308	5	19	3
398402	1	16	2
	2	16	
	3	16	
	4	16	
	5	16	
398602	1	2	1
	2	2	
	3	2	
	4	2	
	5	2	
398615	1	18	1
	2	18	
	3	18	
	4	18	
	5	18	

PART NUMBER	FIG.	ITEM	TOTAL REQD
398616	1	20	1
	2	20	
	3	20	
	4	20	
	5	20	
465330	1	15	2
	2	15	
	3	15	
	4	15	
	5	15	
465659-002	1	5	1
465659-003	2	5	1
465659-004	3	5	1
465659-005	4	5	1
465659-006	5	5	1
465665-002	1	21	1
465665-003	2	21	1
465665-004	3	21	1
465665-005	4	21	1
465665-006	5	21	1
465666	1	4	1
	2	4	
	3	4	
	4	4	
	5	4	
465667-001	1	22	1
	2	22	
	3	22	
	4	22	
465667-002	5	22	1
465668	1	12	2
	2	12	
	3	12	
	4	12	
	5	12	
465733-002	1	14	1
465733-003	2	14	1
465733-004	3	14	1
465733-005	4	14	1
465733-006	5	14	1

LIGHT OVERHAUL

Perform inspection/check steps in paragraph 2; see INSPECTION/CHECK.

Perform cleaning steps in paragraph 2; see CLEANING.

If flange assembly is scratched, perform the repair steps in paragraph 3; see REPAIR.

Perform applicable tests to qualify transmitter for continued service; see TESTING.

DeHAVILLAND DHC-6

OVERHAUL MANUAL

LIQUID QUANTITY INDICATOR ASSEMBLY

PART NOS.

393000-01703
393000-01704

PUBLISHED BY

SIMMONDS PRECISION PRODUCTS, INC. VERGENNES, VERMONT, U. S. A.

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SIMMONDS PRECISION PRODUCTS, INC.
DHC-6
OVERHAUL MANUAL

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Liquid 393000-01703

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LIQUID QUANTITY INDICATOR ASSEMBLY

Simmonds Part Nos. 393000-01703 and 393000-01704

1. DESCRIPTION AND OPERATION

A. DESCRIPTION.

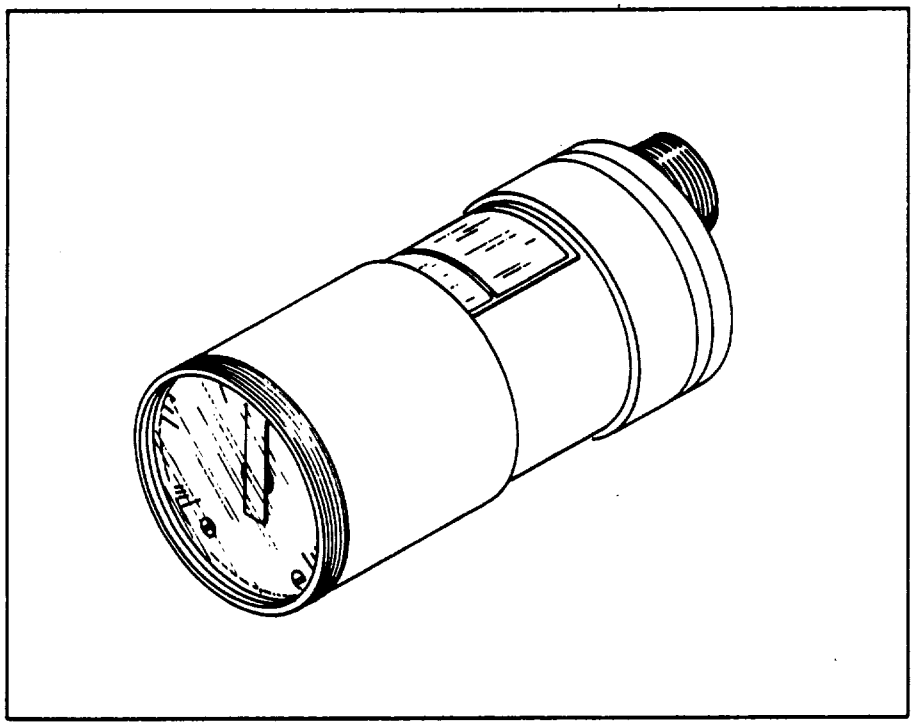
The Liquid Quantity Indicator Assembly, Part Nos. 393000-01703 and 393000-01704 (see Figure 1), is a pointer type, transistorized indicator-amplifier-bridge, enclosed in a metal cylindrical housing. The unit is one of the components of the capacitance fuel quantity gauging system.

B. OPERATION.

(1) Input power for the indicator assembly is 28 vdc at 0.22 ampere. An inverter assembly provides the necessary 115 vac for indicator operation.

(2) Fuel quantity is indicated utilizing an external capacitor type sensing element tank unit as the variable component of the indicator bridge circuit. This sensing element tank unit is located in the aircraft fuel tank. The bridge circuit output signal is cascade amplified in a four stage transistor amplifier. The amplified signal is fed to one winding of a two-phase eddy current motor. Signal voltage present at the control winding and excitation voltage present at the reference winding causes the motor to drive the indicator pointer to a reading relative to the quantity of fuel remaining in the tank.

(3) The indicator assembly power supply circuitry includes a dc to ac inverter assembly to supply the required ac operating voltages. Ac voltage is coupled from the inverter assembly to a transformer. Dc power for the transistor amplifiers is obtained directly from the input voltage.



Liquid Quantity Indicator Assembly, Part Nos. 393000-01703 and 393000-01704
Figure 1

C. LEADING PARTICULARS.

TABLE I. LEADING PARTICULARS.

	393000-01703	393000-01704
Overall Length	6.30 in.	6.30 in.
Diameter	2.00 in.	2.00 in.
Weight	1.10 lbs	1.10 lbs
Sealing	Hermetic	Hermetic
Function	FWD	AFT
External Adjustments	EMPTY	EMPTY
Mating Connector	MS3106-16S-1S	MS3106-16S-1S
Range	0-1375 lbs	0-1425 lbs
Mounting	Clamp	Clamp

2. DISASSEMBLY

A. GENERAL.

(1) Conduct tests as outlined in paragraph 7C to determine malfunction and required overhaul. If unit meets all the requirements of testing, overhaul is not recommended.

(2) Disassemble the unit in accordance with exploded and orthographic views, Figures 2 through 6. The numerical sequence of parts shown in these views follows the order of disassembly, except that attaching parts follow the parts they attach.

(3) Do not disassemble beyond the point necessary to make the required repair or replacement of parts.

(4) Unsolder and label wiring during disassembly.

B. DISASSEMBLE LIQUID QUANTITY INDICATOR ASSEMBLY. (See Figure 2.)

(1) Identification plate (1) is cemented around housing (7). Identification plate should only be removed if the housing is to be repaired or refinished or if the markings are illegible.

(2) If replacement is required, remove dial window (6) from between rim front (5) and housing (7) using an induction heater.

(3) Remove indicator subassembly (21) as follows:

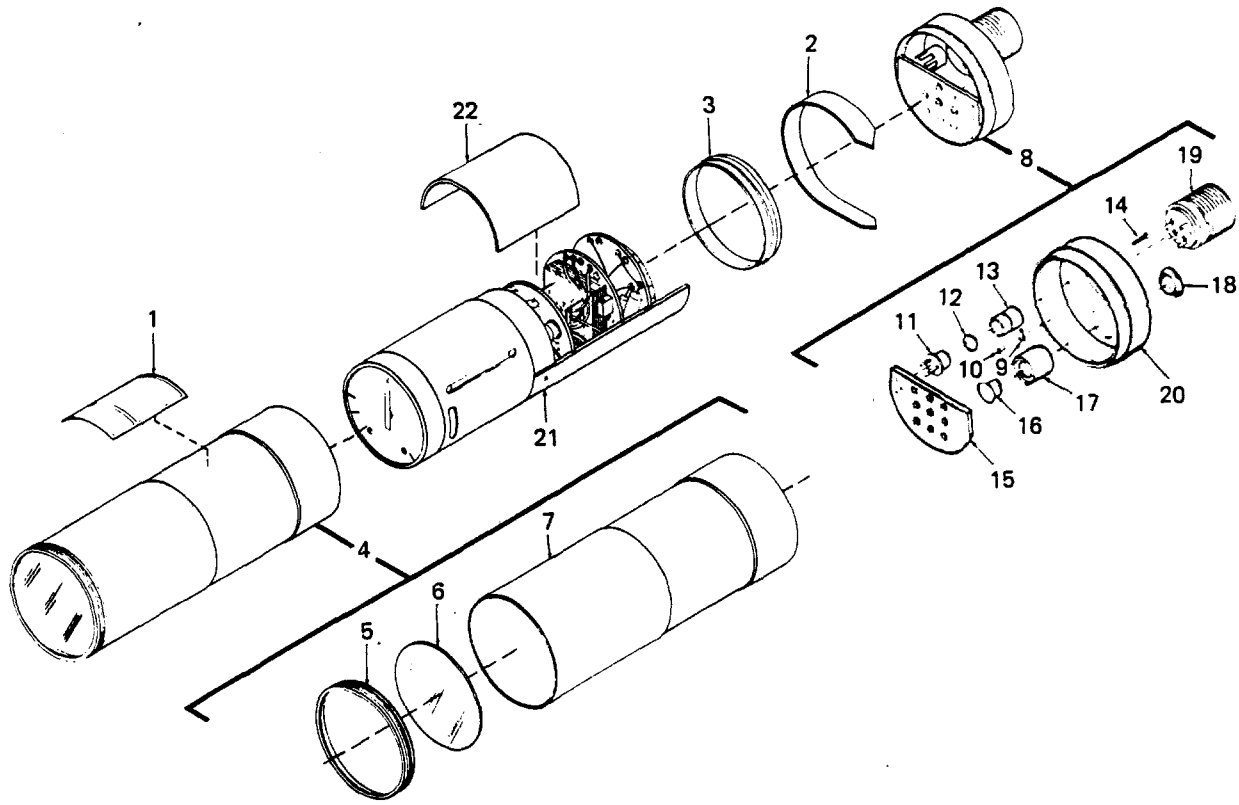
a. Using a pointed tool, locate end of solder sealing band (2). With a pair of pliers, strip off solder sealing band and discard. Remove lock ring (3).

CAUTION: DO NOT PULL ON END PLATE ASSEMBLY (8). IT IS WIRED TO INDICATOR SUBASSEMBLY. WIRES CONTAIN ONE-HALF INCH OF SLACK.

b. Carefully slip end plate assembly (8) from end of housing (7) and let it hang from slack wires. Remove indicator subassembly (21).

(4) If replacement is required, remove transistors (11), transistor insulators (12) and retainer (13) by removing screws (14).

CAUTION: USE ADEQUATE HEAT SINK PROTECTION WHEN UNSOLDERING TRANSISTORS.



1 Identification plate
2 Solder sealing band
3 Lock ring
4 Housing assembly
5 Front rim
6 Dial window
7 Housing
8 End plate assembly
9 Terminal lug
10 Metallic eyelet
11 Transistors, Q101, Q106
12 Transistor insulators
13 Retainers
14 Screws
15 Terminal board assembly
16 Variable resistor assembly, R103
17 Retainer
18 Cover retainer
19 Connector, J101
20 End plate
21 Indicator subassembly
22 Shell

Liquid Quantity Indicator Assembly, Part Nos. 393000-01703 and 393000-01704, Exploded View
Figure 2

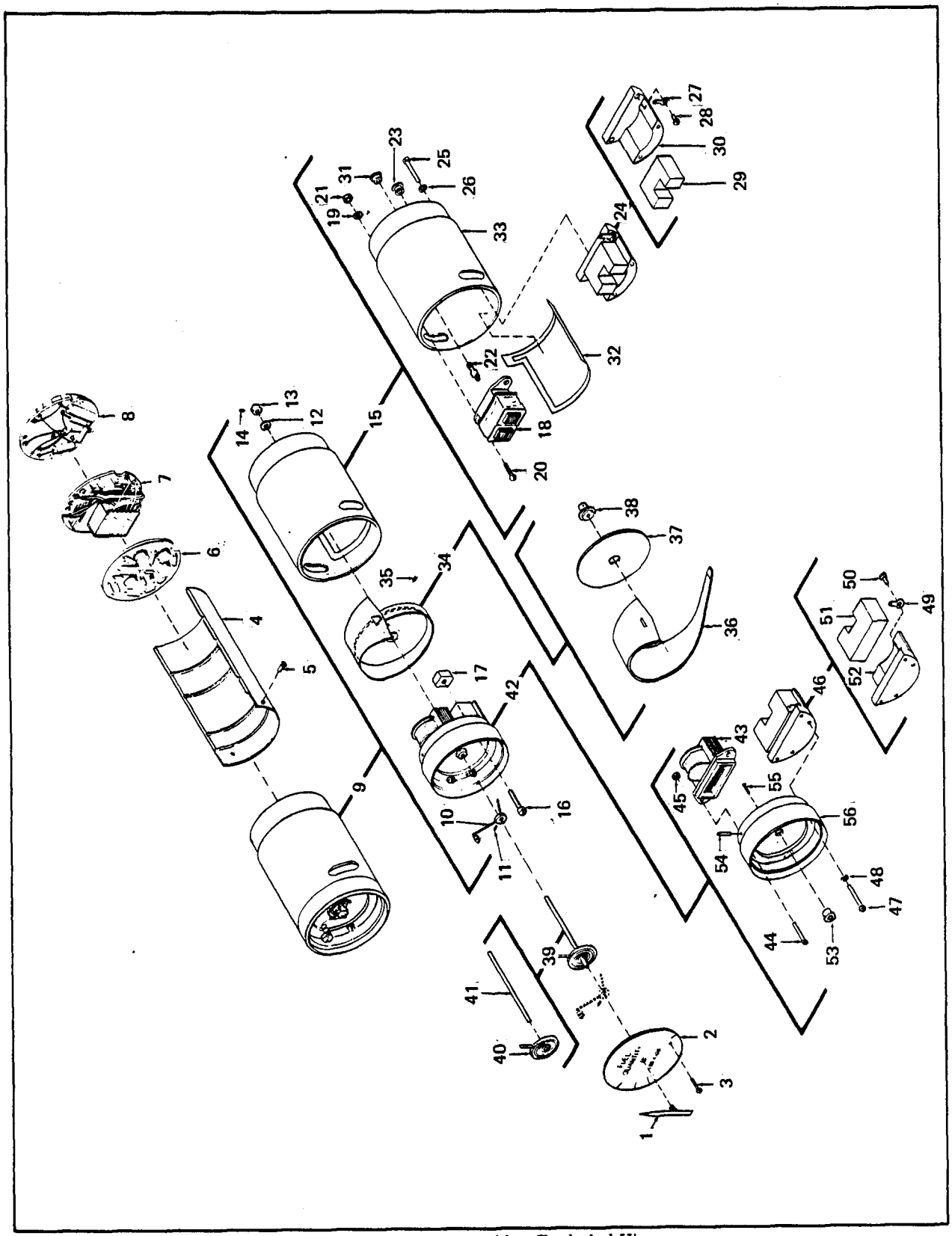
(5) Detach end plate assembly (8) by unsoldering attaching wires.

(6) Remove terminal board assembly (15), variable resistor assembly (16), retainer (17), cover retainer (18).

(7) If replacement is required, unsolder connector (19) from end plate (20) using an induction heater.

(8) Remove lug (9) from end plate by unsoldering eyelet (10).

(9) Remove shell (22).



Indicator Subassembly, Exploded View
Figure 3

LEGEND TO FIGURE 3

1 Pointer assembly
2 Scale dial
3 Screws
4 Circuit cradle
5 Metallic eyelets
6 Amplifier assembly
7 Bridge assembly
8 Inverter assembly
9 Capacitor (motor), C101
10 Stop assembly
11 Setscrew
12 Washer
13 Collar
14 Setscrew
15 Motor housing subassembly
16 Screws
17 Nuts
18 Motor coil assembly, L101
19 Terminal lug
20 Screws
21 Stop nuts
22 Feedthru
23 Rubber grommet
24 Capacitor plate No. 2
25 Screws
26 Lock washers
27 Terminal lug
28 Screw
29 Magnet
30 Magnet base
31 Bearing
32 Coaxial element
33 Motor housing
34 Rotor assembly
35 Setscrew
36 Ground cylinder
37 Rotor disk
38 Rotor hub
39 Shaft assembly
40 Hairspring
41 Shaft
42 Front housing assembly
43 Front motor coil, L102
44 Screw
45 Stop nut
46 Capacitor plate No. 1
47 Screw
48 Lock washers
49 Terminal lug
50 Screws
51 Magnet
52 Magnet base
53 Bearing
54 Spirol pin
55 Rivet
56 Front housing

C. DISASSEMBLE INDICATOR SUBASSEMBLY. (See Figure 3.)

(1) Using long-nose pliers or a similar tool, grip pointer assembly (1) at its hub on shaft (40) and remove.

(2) Remove screws (3) securing scale dial (2).

(3) Remove circuit cradle (4) from capacitor (motor) (9) by removing eyelets (5).

(4) Remove amplifier assembly (6), bridge assembly (7), and inverter assembly (8) from circuit cradle. See Figures 4, 5, and 6 for disassembly.

(5) Remove stop assembly (10) from shaft assembly (39) by removing setscrew (11). Unsolder hairspring (40).

(6) Detach motor housing subassembly (15) from front housing subassembly (42) by removing screws (16) and nuts (17). Loosen setscrew (14) and remove collar (13) and washer (12).

(7) Remove motor coil assembly (18) by removing screws (20) and stop nuts (21). Terminal lug (19) may also be removed. Remove feedthru (22) and rubber grommet (23).

(8) Remove capacitor plate No. 2 (24) by removing screws (25) and lock washers (26). Disassemble capacitor plate by removing screw (28) to release terminal lug (27). If required for replacement or repair, separate magnet (29) from magnet base (30) using a pointed instrument.

(9) Remove bearing (31) from motor housing (33). If required for replacement or repair, coaxial element (32) may also be removed.

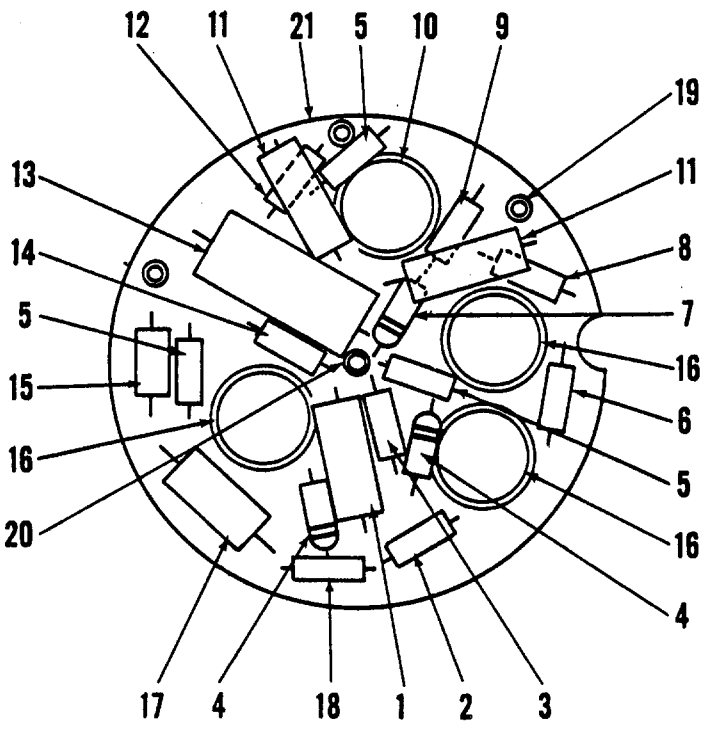
(10) Remove rotor assembly (34) from shaft assembly (39) by loosening setscrew (35). Remove ground cylinder (36). It is recommended that rotor disk (37) not be separated from rotor hub (38).

(11) Slide out shaft assembly (39) from bearing (53). If required for replacement or repair, remove hairspring (40) from shaft (41).

(12) On front housing subassembly (42), remove front motor coil (43) from front housing (56) by removing screws (44) and stop nuts (45).

(13) Remove capacitor plate No. 1 (46) by removing screws (47) and lock washers (48). Disassemble capacitor plate by removing screw (50) to release terminal lug (49). If required for replacement or repair, separate magnet (51) from magnet base (52) using a pointed instrument.

(14) Remove bearing (53), spirol pin (54), and rivet (55) from front housing (56).



1 Capacitor, C107
2 Resistor, R112
3 Resistor, R111
4 Diodes, CR101, CR102
5 Resistors, R108, R117, R118
6 Resistor, R115
7 Diode, CR103
8 Resistor, R116
9 Resistor, R121
10 Transistor, Q105
11 Capacitors, C109, C110
12 Resistor, R119
13 Capacitor, C105
14 Resistor, R110
15 Capacitor, C103
16 Transistors, Q102, Q103, Q104
17 Capacitor, C104
18 Resistor, R109
19 Metallic eyelet
20 Metallic eyelet
21 Amplifier board

Amplifier Assembly, Orthographic View
Figure 4

D. DISASSEMBLE AMPLIFIER ASSEMBLY. (See Figure 4.)

(1) Disassembly of amplifier assembly is not recommended unless replacement or repair is required.

(2) Remove components (1 through 18) from amplifier board (21), if required.

E. DISASSEMBLE INVERTER ASSEMBLY. (See Figure 5.)

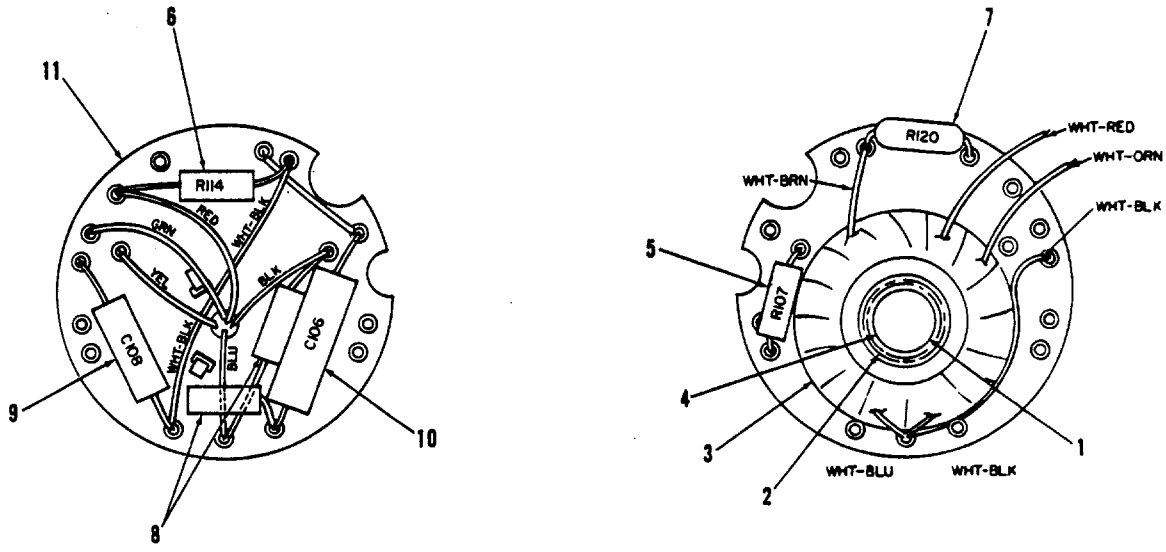
(1) Disassembly of bridge assembly is not recommended unless replacement or repair is required.

(2) Remove components (1 through 10) from chassis assembly (11), if required.

F. DISASSEMBLE BRIDGE ASSEMBLY. (See Figure 6).

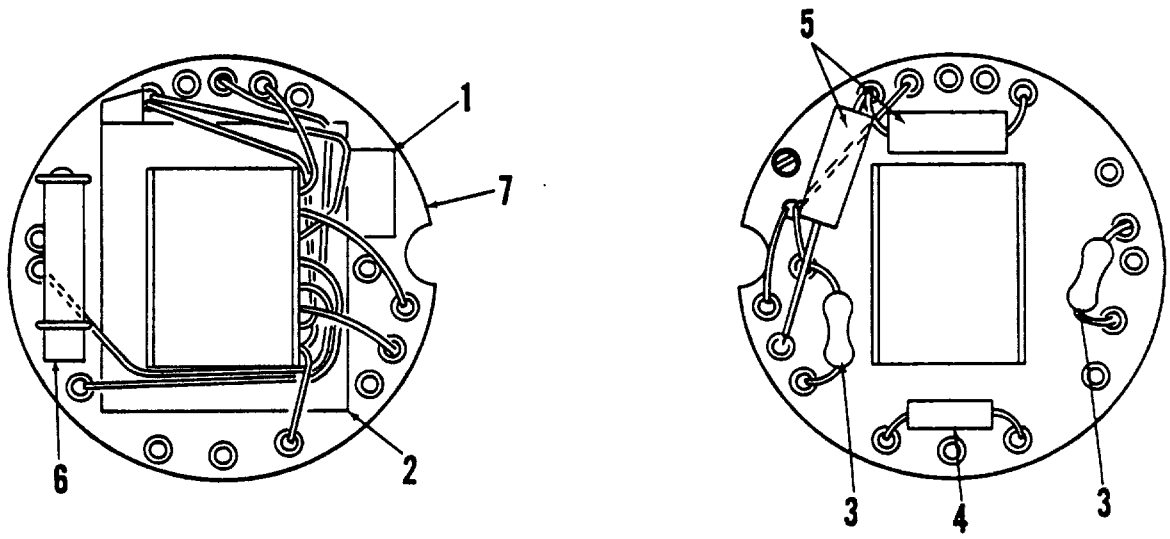
(1) Disassembly of inverter assembly is not recommended unless replacement or repair is required.

(2) Remove components (1 through 6) from chassis assembly (7), if required.



1 Transformer, T103
2 Transformer spacer
3 Transformer, T102
4 Mounting tube
5 Resistor, R107
6 Resistor, R114
7 Resistor, R120
8 Resistor, R106, R113
9 Capacitor, C108
10 Capacitor, C106
11 Chassis assembly

Inverter Assembly, Orthographic View
Figure 5



1 Variable resistor assembly, R101
2 Bridge transformer, T101
3 Resistor, R102, R104
4 Resistor, R105
5 Capacitor, C111, C112
6 Capacitor, C102
7 Chassis assembly

Bridge Assembly, Orthographic View
Figure 6

3. CLEANING

A. Remove excess solder from housing assembly (4, Figure 2) by heating with a soldering iron. Use wire brush to remove melted solder. Clean housing assembly with a solution of warm water and soap.

B. Clean dial window (6, Figure 2) with cotton swabs and a solution of mild water and soap.

C. Clean all non-electrical parts using a solvent such as trichloroethylene. Dip a stiff, non-wire brush into solvent and wash parts thoroughly. Do not dip parts in solvent.

D. Clean all electrical parts by blowing out dust and dirt with clean, dry, compressed air (approximately 5 psi). If necessary, use a clean, lint-free cloth moistened with trichloroethylene.

E. Dry all parts with clean, compressed air, and/or a clean, lint-free cloth.

F. Ultrasonic cleaning equipment may be used, if available.

4. INSPECTION/CHECK.

A. Inspect housing assembly (4, Figure 2) for dents, punctures or other structural damage. Surface where solder sealing band (2, Figure 2) fits should be smoothly and lightly tinned with no blobs of solder.

B. Examine dial window (6, Figure 2) for cracks and scratches.

C. Check scale dial (2, Figure 3) for legibility.

D. Examine connector (19, Figure 2) for loose, broken or missing pins.

E. Check rotor assembly (34, Figure 3) for freedom of movement. Inspect ground cylinder (36) for security of mounting to rotor, and for nicks.

F. Check hairspring (40) for proper operation.

G. Check amplifier board (21, Figure 4) for peeling of copper from backing and for breaks or shorts caused by solder blobs or excess flux.

H. Check wiring for evidence of damaged insulation.

I. Check for burned electronic components.

J. Check threads for damage.

5. REPAIR

A. GENERAL.

(1) Check components as described in paragraph 7B. Replace any components that fail to meet test requirements.

(2) Replace any threaded parts that show signs of stripped, worn or damaged threads.

(3) Replace any parts that fail to meet requirements of testing in paragraphs 7B and 7C.

(4) Use solder composed of 63% tin, 37% lead rosin core, unless otherwise specified.

B. HOUSING ASSEMBLY.

(1) Minor dents in housing assembly (4, Figure 2) may be straightened with a mallet and suitable blocks. If damage is severe, replace housing assembly.

(2) If dial window (6, Figure 2) is scratched, cracked or broken, replace it following procedures given in paragraph 6F, step (6).

(3) Remove excess solder in solder sealing band area by heating housing (4, Figure 2) with a 200-watt iron and using a wire brush to remove softened solder.

C. WIRING.

(1) Replace any damaged wiring. Refer to notes on wiring diagram Figure 12.

(2) Resolder any terminals that show evidence of poor soldering.

6. ASSEMBLY.

A. GENERAL.

(1) Assembly is essentially the reverse of disassembly. Follow the reverse order of key index numbers assigned to the exploded and orthographic views, Figures 2 through 6.

(2) As assembly proceeds, connect wiring as shown in Figures 11 and 12. When soldering wiring to eyelets and terminals connected to electrical components use proper heat sink precautions.

(3) Observe polarities when replacing capacitors and diodes.

(4) Use 63% tin, 37% lead rosin core solder for all connections, unless specified otherwise.

(5) See Table IV for Special Tools, Fixtures and Equipment.

(6) See Table V for Special Materials used in assembly.

B. ASSEMBLE INVERTER ASSEMBLY. (See Figure 5.)

If inverter assembly (8, Figure 3) was disassembled, assemble it by following the sequence of key index numbers of Figure 5.

C. ASSEMBLE BRIDGE ASSEMBLY. (See Figure 6.)

If bridge assembly (7, Figure 3) was disassembled, assemble it by following the sequence of key index numbers of Figure 6.

D. ASSEMBLE AMPLIFIER ASSEMBLY. (See Figure 4.)

If amplifier assembly (6, Figure 3) was disassembled, assemble it by following the sequence of key index numbers of Figure 4.

E. ASSEMBLE INDICATOR SUBASSEMBLY. (See Figure 3.)

(1) Replace rivet (55), spirol pin (54), and bearing (53) in front housing (56).

(2) If magnet (51) was separated from magnet base (52), cement the magnet to the base with No. 3199 Pacitite. Replace terminal lug (49), on capacitor plate No. 1 (46), with screw (50). Replace capacitor plate No. 1 with lock washers (48) and screws (47).

(3) Replace front motor coil (43) on front housing (56) using screws (44) and stop nuts (45).

(4) If hairspring (40) was removed from shaft (41), press hairspring onto shaft. Slide shaft assembly (39) into bearing (53).

(5) Replace ground cylinder (36). Place rotor assembly (34) onto shaft assembly (39) and tighten setscrew (35).

(6) If coaxial element (32) was removed, cement element to motor housing (33) using No. 3199 Pacitite. Replace bearing (31) in motor housing.

(7) If magnet (29) was separated from magnet base (30), cement magnet to base with No. 3199 Pacitite. Replace terminal lug (27) on capacitor plate No. 2 (24) with screw (25). Replace capacitor plate with lock washers (26) and screws (25).

(8) Replace motor coil assembly (18) and terminal lug (19) using screws (20) and stop nuts (21). Replace feedthru (22) and rubber grommet (23).

(9) Attach motor housing subassembly (15) to front housing subassembly (42) by replacing screws (16) and nuts (17). Place washer (12) and collar (13) on shaft assembly (39), and temporarily tighten setscrew (14).

(10) Place stop assembly (10) on shaft assembly (39) and temporarily tighten setscrew (11). Make certain that a clearance of 0.020 inch exists between rotor disk (37) and coils (18 and 43). If adjustment of clearance is necessary, loosen setscrews (11 and 14), adjust clearance and tighten setscrews. A shim of 0.020 inch thickness may be used to check clearance. Physically rotate rotor disk and check for 0.005 inch maximum wobble.

CAUTION: MAKE ABSOLUTELY CERTAIN THAT ROTOR DISK DOES NOT RUB AGAINST COILS WHEN TURNED IN EITHER DIRECTION.

(11) Perform motor test as described in paragraph 7B, step (6).

(12) Use special C-washer under hairspring (40). Solder end of hairspring to stop assembly (10). Carefully remove C-washer.

(13) Place inverter assembly (8), bridge assembly (7) and amplifier assembly (6) into grooves of circuit cradle (4).

(14) Wire amplifier assembly (6), bridge assembly (7) and inverter assembly (8) in accordance with Figures 11 and 12.

(15) Cement circuit cradle (4) to capacitor (motor) (9) with No. 3199 Pacitite. Replace eyelets (5).

(16) Replace dial scale (2) with screws (3).

(17) Press pointer assembly (1) onto shaft (41).

F. ASSEMBLE LIQUID QUANTITY INDICATOR ASSEMBLY. (See Figure 2.)

(1) Solder connector (19) to end plate (20) using a 63% tin, 37% lead solid wire solder, No. H200 soldering flux and a carbon filament heat lamp oven.

(2) Wash flux from assembly with water heated to 93°C (200°F). Dry assembly thoroughly.

(3) Place variable resistor assembly (16) in end plate (20). Insert retainer (17) and cover retainer (18).

(4) Attach retainers (13) to end plate (20) with screws (14). Cement transistor insulators (12) into transistor retainers using No. 8100 cement. Insert transistors (11) into retainers. Attach lug (9) to end plate with eyelet (10).

(5) Replace terminal board (15) and bring variable resistor assembly and transistor leads through terminal board eyelets.

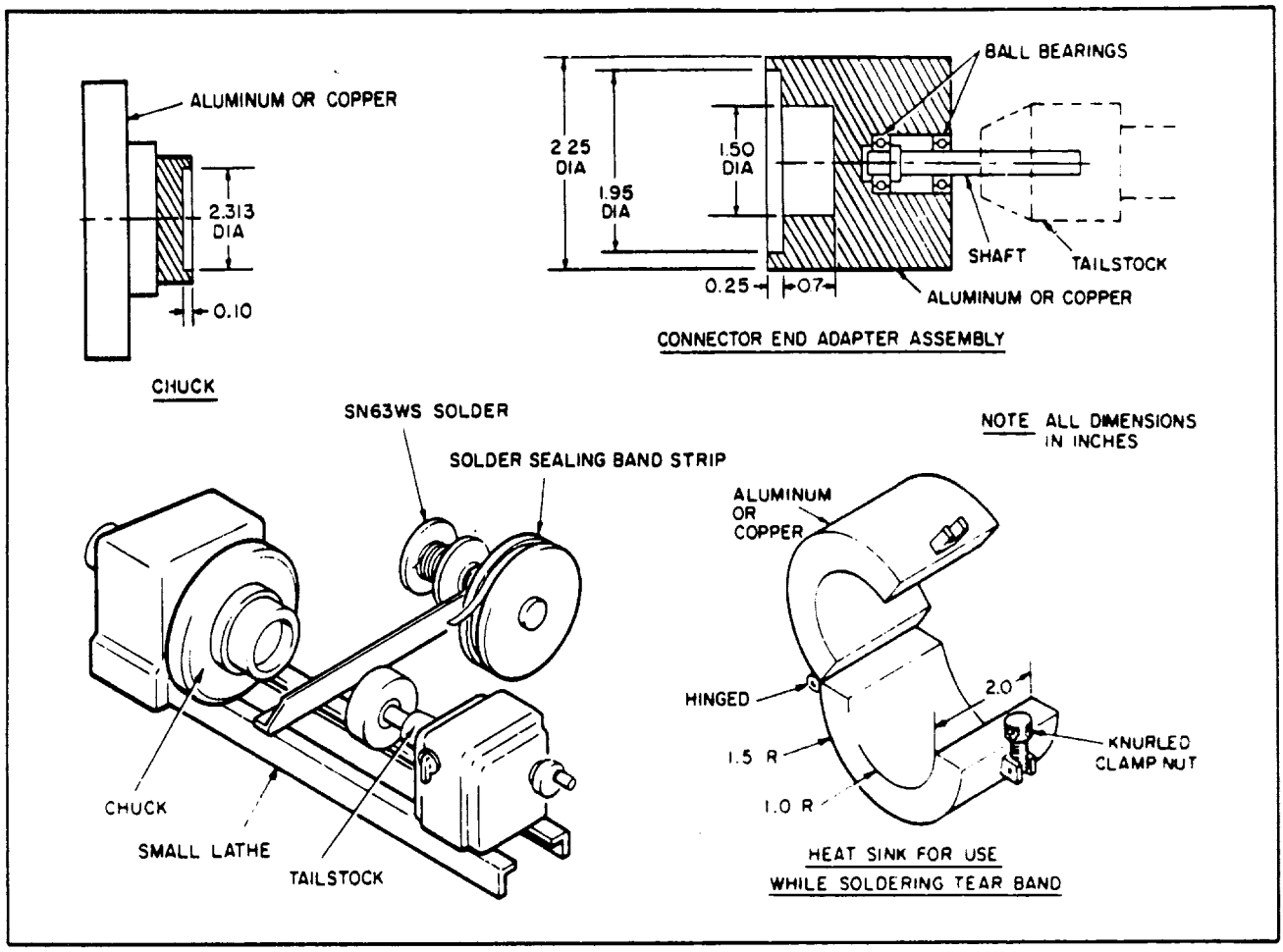
(6) If dial window (6) was removed, replace as described in steps a. through c.

a. Tin perimeter of rim front (5) using 63% tin, 37% lead, solid solder and No. H200 flux. Carefully insert in leading edge of housing (7). Tin inner perimeter of rim front (5). Install rim front around housing.

b. Insert housing assembly in an induction heater and apply heat until solder begins to flow. Apply more flux as required to enable solder to flow uniformly and produce a smooth surface between rim front and housing.

c. Wash in water heated to 93°C (200°F) to remove all traces of flux. Dry at 65.5°C (150°F) for one-half hour.

(7) Place both indicator subassembly and housing assembly in an oven heated to 65.5°C (150°F) for one-half hour.



Solder Sealing Band Fixture
Figure 7

(8) Perform test described in paragraph 7C before sealing indicator.

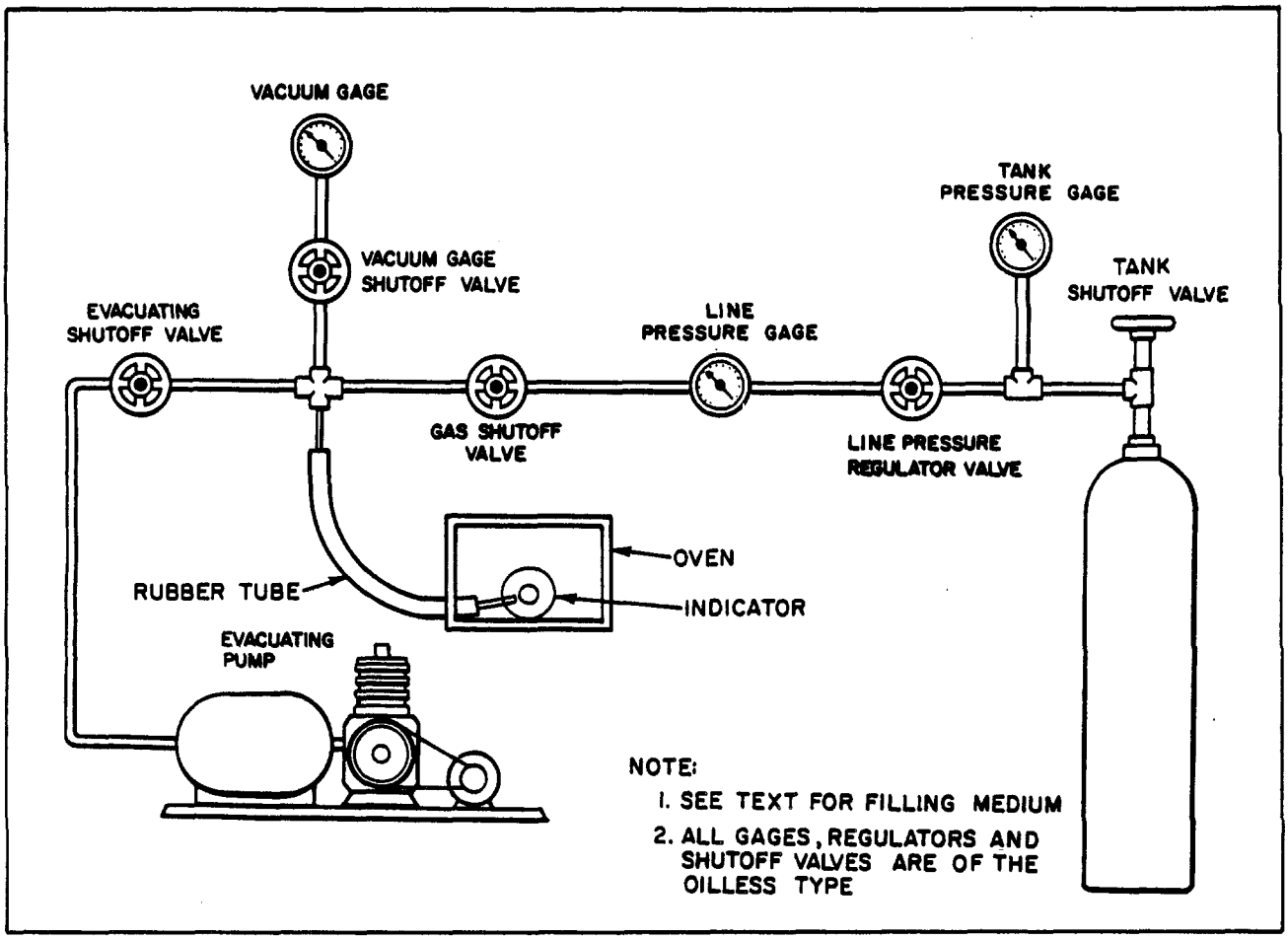
(9) Solder, solder sealing band (2) in place using a fixture such as shown in Figure 7. Mount indicator assembly between chuck and adapter. Fasten heat sink around housing assembly as close as possible to solder sealing band area to protect electrical components inside.

(10) Apply 63% tin, 37% lead wire solder to one surface of solder sealing band (2) covering approximately one inch at a time. Sweat solder sealing band (2) to housing assembly (4) and end plate assembly (8) with a 200-watt soldering iron. Flow solder on liberally, but not to excess. Observe that the outer surface of solder sealing band (2) becomes liquefied and the outer surface of solder sealing band (2) also becomes tinned.

(11) Cut off end of solder sealing band at 45-degree angle allowing overlap of approximately 3/4 inch and seal with solder. Remove from fixture.

(12) Connect indicator assembly to setup shown in Figure 8. Heat oven to 79°C ± 6° (175°F ± 10°).

(13) With GAS SHUTOFF VALVE closed, open VACUUM GAGE SHUTOFF VALVE and EVACUATING SHUTOFF VALVE. Pump out air in indicator assembly until VACUUM GAGE reads 29-inches of mercury. Close EVACUATING SHUTOFF VALVE and VACUUM GAGE SHUTOFF VALVE. Open PRESSURE REGULATOR VALVE until PRESSURE GAGE reads 15 psi. Open GAS SHUTOFF VALVE and fill indicator with 99/10 mixture of dry nitrogen and helium.



Evacuation and Filling Setup
Figure 8

(14) Evacuate and fill indicator assembly a second time. Remove copper tubing and allow pressure within indicator assembly to equalize with outside air pressure. Remove indicator assembly from oven. Use 63% tin, 37% lead solid wire solder to close hole in end plate. Hold soldering iron above hole to prevent fumes from entering indicator assembly.

(15) Test indicator assembly for leakage, using helium leak detector dual complemental bell jar. Test indicator assembly in a vacuum as described in leak detector manufacturer's instructions and in accordance with Specification MIL-G-26988.

(16) Permissible leak rate should not exceed 0.01 microns/cubic foot/hour.

(17) Mask dial window (6, Figure 2) and connector (19, Figure 2).

(18) Apply a primer spray coat of a 4 to 1 mixture of No. DS-C-2936 and CT9-1472 catalyst following manufacturer's instructions. A light even coat is desirable.

WARNING: DO NOT ALLOW CATALYST TO COME IN CONTACT WITH EYES AND SKIN.

Indicator assembly can be touched after 30 minutes air dry at room temperature. Air dry 24 hours at room temperature for complete cure. Spray a coating of No. XFO-1042 special flat black enamel (use No. 5811 thinner if necessary). Paint dries in 30 minutes at room temperature. Remove masking material.

(19) If identification plate was removed, replace with a new one containing proper information.

7. TESTING.

A. GENERAL.

(1) Paragraph 7B contains tests to be performed on individual components found defective during disassembly.

(2) Paragraph 7C contains tests performed on liquid quantity indicator assembly before disassembly or after assembly is complete.

B. TESTS DURING DISASSEMBLY.

(1) Using the ohmmeter section of multimeter, check resistors for proper values. Values may be found in Illustrated Parts List, paragraph 11, and in the legend of schematic diagram, Figure 11.

(2) Measure resistance of variable resistor assembly R101 between black and red leads. Resistance should be 200 ohms ± 10%. Measure resistance of variable resistor assembly R103 between black and red leads. Resistance should be 500 ohms ± 10%. Rotate shaft and check between red and white leads to see that resistance varies smoothly with no jumps.

(3) Check capacitors for shorts using ohmmeter section of multimeter. Check for an open circuited capacitor by placing ohmmeter leads directly across capacitor leads.

NOTE: Be careful not to handle metal portion of ohmmeter leads or erroneous reading will occur.

If the ohmmeter pointer fails to move, the capacitor is open and should be replaced.

(4) Check transistors using transistor tester.

(5) Check diodes for proper forward and reverse current using ammeter section of multimeter. Diodes may also be checked for proper forward and reverse resistance using the ohmmeter section of multimeter, provided the ohmmeter is set to the highest range to prevent diode burn-out.

(6) Motor test.

CAUTION: THIS TEST SHALL ONLY BE PERFORMED IMMEDIATELY AFTER COMPLETION OF PARAGRAPH 6E, step (10). THE GROUND CYLINDER (36, Figure 3) SHOULD NOT BE ASSEMBLED TO THE ROTOR ASSEMBLY (34) WHEN PERFORMING THIS TEST.

a. Connect capacitor (motor) to test circuit as shown in Figure 9.

b. Apply 22 v, 400 cps to line phase coil and 1 volt, $< 90°$, 400 cps to control phase coil. Rotor disk shall make one complete revolution.

c. Press torque arm on end of shaft (4 gram millimeters).

d. With 22 v, 400 cps applied to line phase coil and torque arm pointed downward, torque arm should make one revolution with a maximum of 7 volts, $<90°$, 400 cps applied to control phase coil.

e. Remove torque arm from end of shaft.

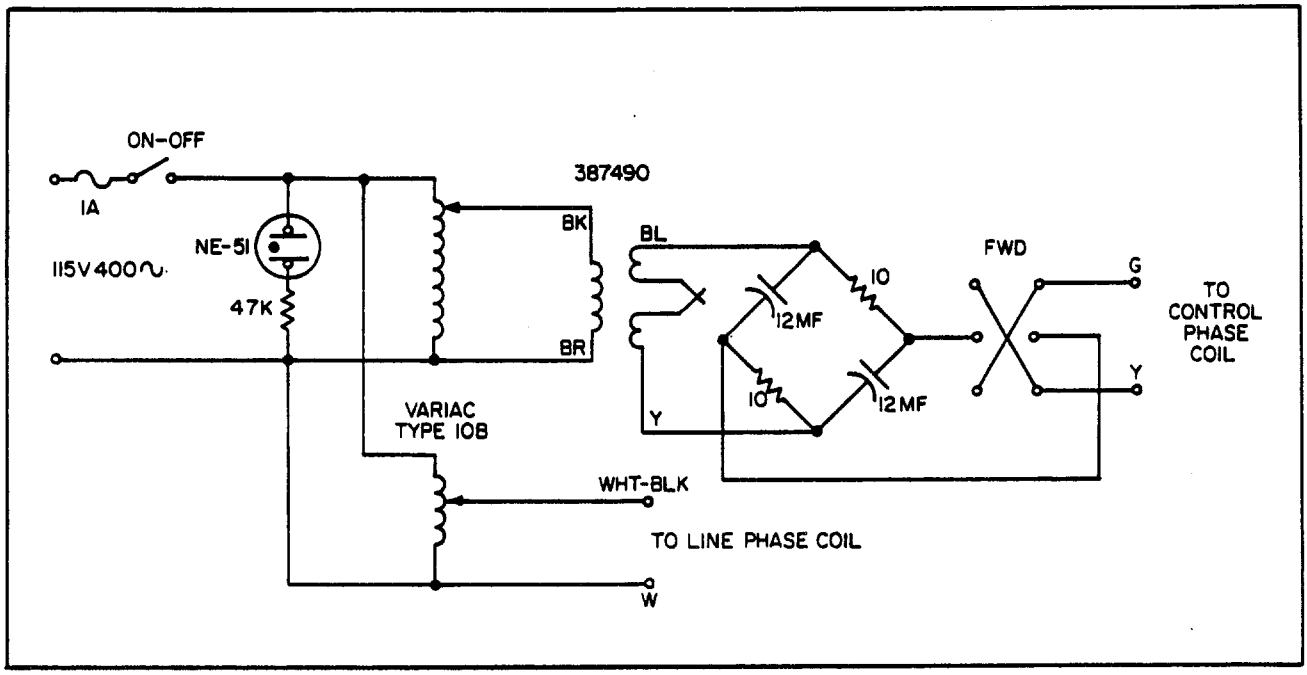
f. Apply 22 v, 400 cps to line phase coil. Apply 4 volts, $<90°$, 400 cps to control phase. Rotor RPM should not exceed 45 RPM.

(7) Indicator assembly Operational Test. (Housing off.)

a. Setup test circuit as shown in Figure 10.

b. Place milliammeter section of multimeter (0-500 ma) in 28 vdc line. Monitor dc input current. It should not exceed 250 ma with 24 vdc applied. Nominal input current is 140 ma at 24 vdc applied.

c. Vary calibration test set capacitance until pointer reads full with 28 vdc applied.



Motor Test Circuit
Figure 9

d. Lower variable power supply voltage to zero volts. Pointer should return to 0 graduation mark.

e. Slowly increase variable dc supply voltage to 18 volts. Pointer should return to full graduation within ± 5 percent.

f. Increase variable dc supply voltage to 30 vdc. Vary test set capacitance until pointer is at center of full graduation. Lower voltage to 20 vdc. Pointer movement should not exceed 2.5 percent.

g. If tolerances of steps e. and f. are not met, adjust inverter assembly for optimum performance as follows:

(i) Disconnect power and remove 8.2K resistor R114 from inverter assembly.

(ii) Replace with resistance decade. Set decade to 8.2K.

(iii) Reapply power and vary resistance decade through range of 3.9K to 18K. Determine which resistance value enables tolerances specified in steps e. and f. to be met.

(iv) Replace R114 with resistor of value obtained in (iii) above.

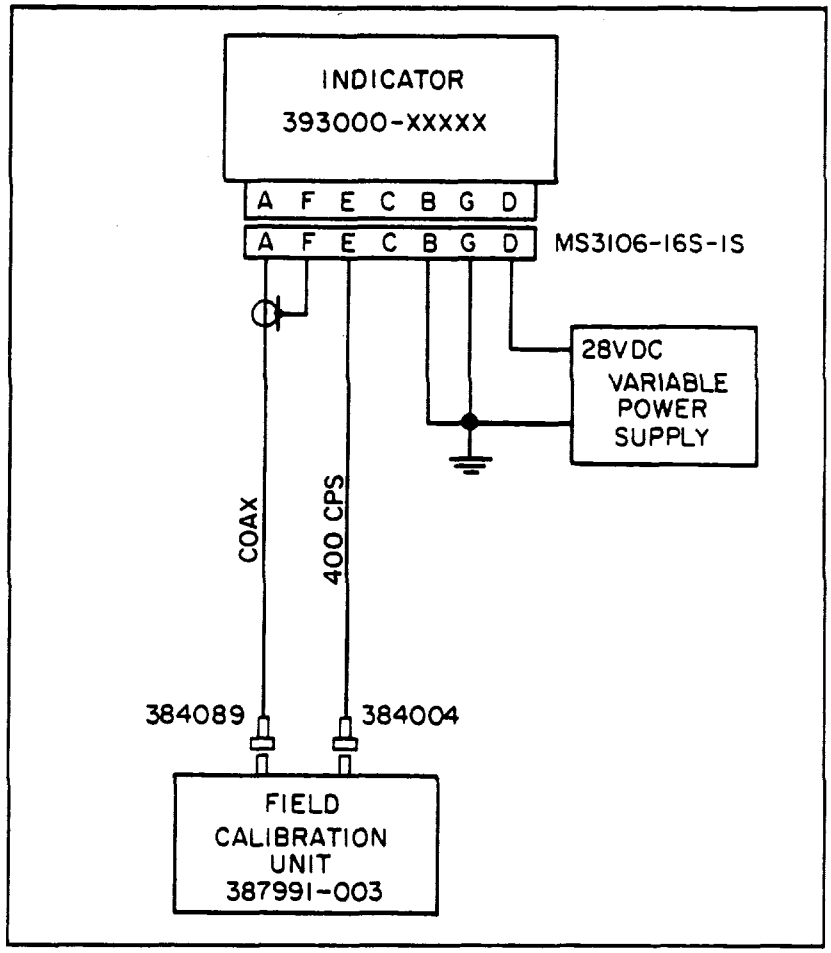
C. TESTING ASSEMBLED UNIT.

(1) Speed of Response Test.

a. Set up test circuit shown in Figure 10.

b. Set the decade section of Field Calibration Unit to empty reading shown in Table II. Adjust empty control (R103), if necessary for a zero reading. Remove power to indicator assembly.

c. Set decade section of Field Calibration Unit to full reading shown in Table II.



Indicator Assembly Test Circuit
Figure 10

d. Apply dc power to indicator assembly and observe time required for pointer to travel over scale. The time should be 2 seconds maximum.

e. Repeat test in a downscale direction. The same limits apply.

(2) Sensitivity Test.

a. Set decade section of the Field Calibration Unit to move pointer to any convenient mid-range reading. Record exact capacitance setting.

b. Decrease capacitance very slowly until indicator assembly pointer just moves. Required indicator assembly sensitivity should be 0.4 pf.

(3) Linearity and Calibration Check.

a. Set up test circuit shown in Figure 10.

b. Set decade section of the Field Calibration Unit to empty reading shown in Table II. Adjust empty control (R103), if necessary for a zero reading.

c. Set decade section of Field Calibration Unit to values shown in Table II. The capacitance settings on the Field Calibration Unit should be within tolerances given.

TABLE II. LINEARITY AND CALIBRATION

INDICATOR PART NO.	INDICATOR READING	CAPACITANCE (PF)	TOLERANCE (PF)
393000-01703	0	176.80	----
	200	207.64	1.35
	400	238.48	1.35
	600	269.32	1.35
	800	300.16	1.35
	1000	331.00	1.35
	1200	361.84	1.35
	1325	381.12	----
393000-01704	0	156.12	----
	200	181.39	1.35
	400	206.66	1.35
	600	231.93	1.35
	800	257.20	1.35
	1000	282.47	1.35
	1200	307.74	1.35
	1425	336.19	----

(4) Leakage Test.

a. Check for leakage using helium leak detector using the detector's bell jar and testing the indicator in a vacuum as described in manufacturer's instructions.

b. Leakage rate must not exceed 0.01 microns/cubic foot/hour.

8. TROUBLE SHOOTING

A. Test complete indicator assembly. (See paragraph 7C.) If indicator assembly meets all tests satisfactorily, overhaul is not recommended.

B. If the indicator assembly fails to meet linearity and calibration values shown in Table II, check for proper transformer (T101) voltages and dc voltages as shown in Table III. Refer to Figures 11 and 12.

C. If unit runs but cannot be adjusted for empty point, check adjustment control.

D. If unit does not operate at all, check for mechanical or electrical damage such as broken wires, defective solder joints and pinched wires.

TABLE III. TEST VOLTAGES

AC TEST VOLTAGES

INDICATOR PART NO.	TEST POINT									
	A	B	C	D	E	F	G	H	J	AA
393000-01703	75.0	26.0	0.0	7.5	5.0	0.0	1.1	8.3	500.0	115.0
393000-01704	75.0	26.0	0.0	9.2	6.0	0.0	1.8	9.6	500.0	115.0

DC TEST VOLTAGES

INDICATOR PART NO.	TEST POINT									
	K	L	M	N	P	Q	R	S	T	U
393000-01703 393000-01704	26.0	0.6	1.2	1.1	19.0	0.6	1.2	0.6	1.3	0.4-0.7

DC TEST VOLTAGES

INDICATOR PART NO.	TEST POINT							
	V	W	BB	CC	DD	Between EE and DD	Between FF and GG	HH
393000-01703 393000-01704	20.0	38.0	0.3	27.6	28.0	0.35	0.35	0.3

9. PACKAGING AND STORAGE INSTRUCTIONS.

A. It is recommended that liquid quantity indicator assembly be stored in original container, if available.

B. If original container is not available, package liquid quantity indicator assembly as follows:

(1) Completely wrap indicator assembly in water-resistant paper. Seal with waterproof tape.

(2) Insert wrapped indicator assembly in a cardboard carton, being sure to adequately cushion carton on all sides so that indicator will be held securely in place. Seal carton with tape.

(3) Wrap carton with water-resistant paper and seal with waterproof tape. Mark the carton "FRAGILE."

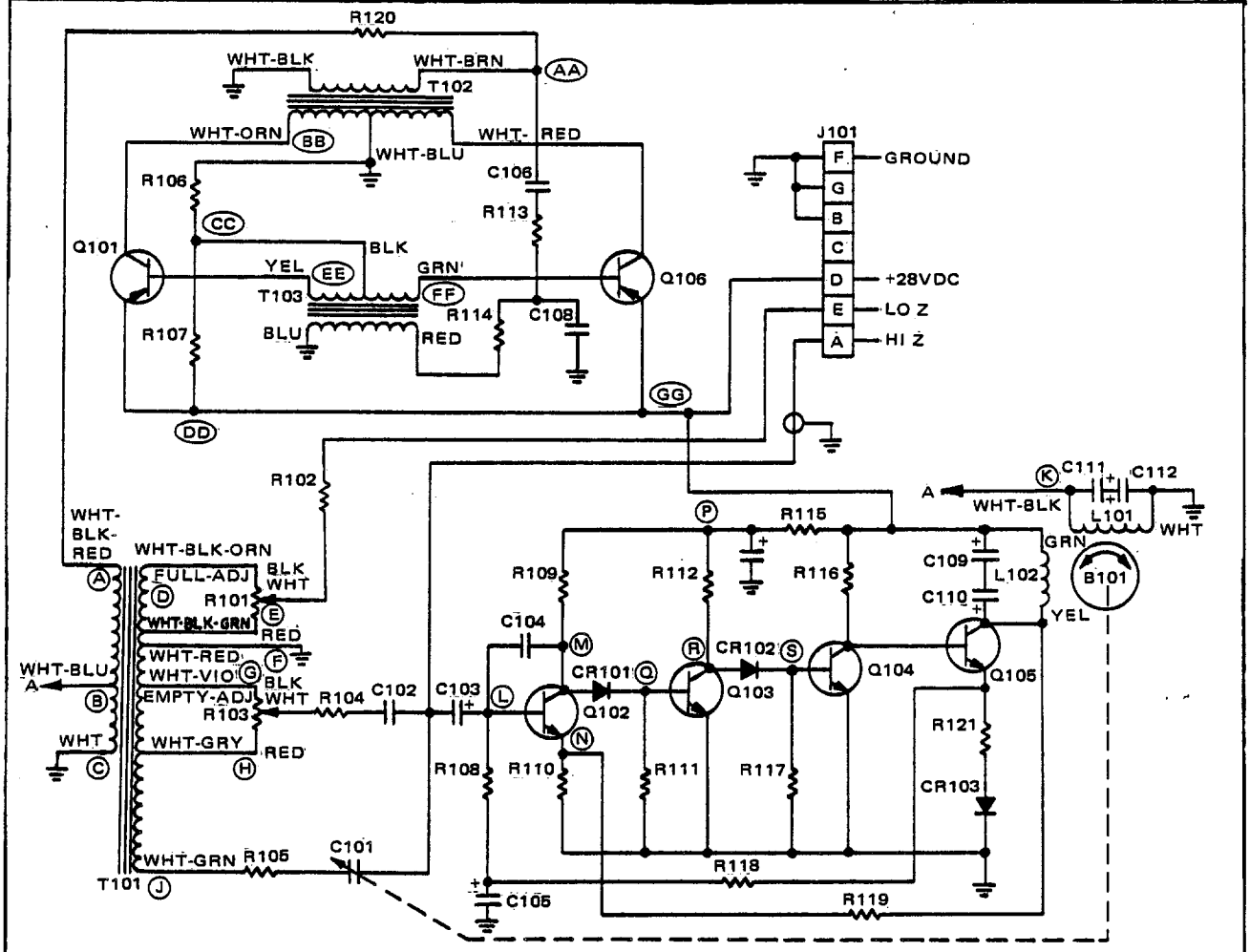
(4) Affix a label containing the following information:

a. Indicator part number.

b. Serial number.

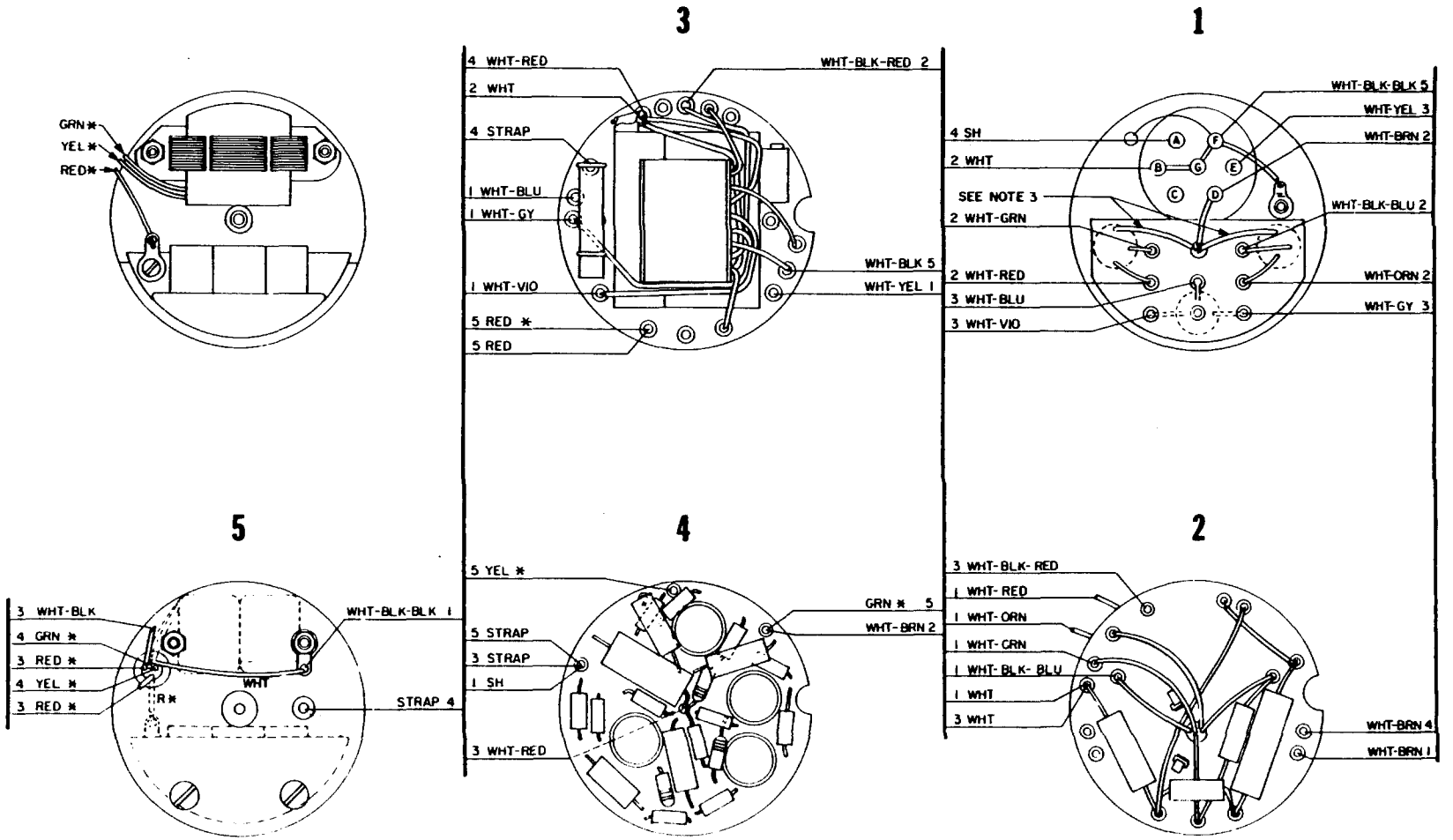
c. Date of last overhaul.

d. Note and date of any other component changes.



CR101 - Diode, 1N816
CR102 - Diode, 1N816
CR103 - Diode, S320G
C101 - Capacitor (Motor), 463192-001
C102 - Capacitor, 397615-00820
C103 - Capacitor, 6.8 uf ± 20%, 6 vdcw
C104 - Capacitor, 0.001 uf ± 25%, 200 vdcw
C105 - Capacitor, 180 uf ± 20%, 6 vdcw
C106 - Capacitor, 0.01 uf ± 25%, 200 vdcw
C107 - Capacitor, 15 uf ± 20%, 20 vdcw
C108 - Capacitor, 0.01 uf ± 25%, 200 vdcw
C109 - Capacitor, 2.2 uf ± 10%, 35 vdcw
C110 - Capacitor, 2.2 uf ± 10%, 35 vdcw
C111 - Capacitor, 1.8 uf ± 10%, 35 vdcw
C112 - Capacitor, 1.8 uf ± 10%, 35 vdcw
J101 - Connector, GS02-165-1P-001-A105
L101 - Motor coil assembly, 463124
L102 - Front motor coil, 463123
Q101 - Transistor, 2N1041
Q102 - Transistor, 462118
Q103 - Transistor, 462118
Q104 - Transistor, 462118
Q105 - Transistor, 2N1711
Q106 - Transistor, 2N1041
R101 - Variable resistor assembly, 200 ohms ± 10%, 1 w
R102 - Resistor, 100 ohms ± 5%, 0.125 w
R103 - Variable resistor assembly, 500 ohms ± 10%, 1 w
R104 - Resistor, 100 ohms ± 5%, 0.125 w
R105 - Resistor, 4.7K ± 20%, 0.5 w
R106 - Resistor, 2.2K ± 5%, 0.5 w
R107 - Resistor, 27 ohms ± 5%, 0.5 w
R108 - Resistor, 8.2K ± 10%, 0.25 w
R109 - Resistor, 56K ± 10%, 0.25 w
R110 - Resistor, 27 ohms ± 10%, 0.25 w
R111 - Resistor, 3.9K ± 10%, 0.25 w
R112 - Resistor, 33K ± 10%, 0.25 w
R113 - Resistor, 2.2K ± 5%, 0.5 w
R114 - Resistor, 8.2K ± 5%, 0.5 w
R115 - Resistor, 12K ± 10%, 0.25 w
R116 - Resistor, 15K ± 10%, 0.25 w
R117 - Resistor, 8.2K ± 10%, 0.25 w
R118 - Resistor, 8.2K ± 10%, 0.25 w
R120 - Resistor, 1.5K ± 5%, 3 w
R121 - Resistor, 39 ohms ± 10%, 0.25 w

Liquid Quantity Indicator Assembly, Part Nos. 393000-01703 and 393000-01704, Schematic Diagram
Figure 11



NOTES

1 ALL WIRES MARKED * TO BE TYPE "E" NO 30 AWG 7/38 TEFLON WRAPPED WIRE.

2 FOR HOOKUP WIRE USE TYPE "E" NO 28 AWG 7/36 TEFLON WRAPPED WIRE PER MIL-W-16878

3 SLEEVE LEADS WITH NO 14 THIN WALL TEFLON SLEEVING, BLACK

10. SPECIAL TOOLS, FIXTURES AND EQUIPMENT. The following special tools, fixtures and equipment (see Table IV) are required for performing the procedures described in this handbook.

TABLE IV. SPECIAL TOOLS, FIXTURES AND EQUIPMENT

Item	Description	*Part Number
1	Field Calibration Unit	387991-003 Simmonds Precision Products, Inc. Tarrytown, New York, U.S.A.
2	Induction Heater	T-25-1 Lepel High Frequencies Laboratories New York, New York, U.S.A.
3	Motor Test Unit	TE-175 Simmonds Precision Products, Inc.
4	Helium Leak Detector	MS-9ABC VEECO Instruments, Inc. Plainview, New York, U.S.A.
5	Variac, Variable Auto-transformer	V10B General Radio Co. West Concord, Massachusetts, U.S.A.
6	Variable DC Power Supply	865B Harrison Laboratories Berkeley Heights, New Jersey, U.S.A.
7	Transistor Checker	210 Owen Laboratories Pasadena, California, U.S.A.
8	Multimeter	260 Simpson Electric Co. Chicago, Illinois, U.S.A.
9	Solder Sealing Band Fixture	See Figure 7
10	Evacuation and Filling Setup	See Figure 8
11	Oven	Commercial
12	Carbon Filament Heat Lamp Oven	Commercial

*Equivalent part may be used.

TABLE V. SPECIAL MATERIALS

Item	Manufacturer	Purpose
Trichloroethylene, Specification MIL-O-T-634 (U.S.A.)		Cleaning rosin flux residue and mechanical parts.
Solder 63% tin, 37% lead solid wire, Specification QQ-S-571 (U.S.A.)	Kester Solder Co. Chicago, Illinois, U.S.A.	Solder housing and solder sealing band assembly.
Solder Flux No. H200	Fairmount Chemical Co. New York, New York, U.S.A.	Use with solid wire solder.
Solder 63% tin, 37% lead rosin core, Specification QQ-S-571 (U.S.A.)	Kester Solder Co.	Solder electrical components.
Wire, Type E, No. 28AWG, 7/36 Teflon insulated, Specification MIL-W-16878/4 (U.S.A.)		Point-to-point wire.
Wire, Type E, No. 30AWG, 7/38 Teflon insulated, Specification MIL-W-16878/4 (U.S.A.)		See wiring diagram, Figure 12 for use.
Insulation Tubing, No. 24, Black, thin-wall Teflon, Specification MIL-I-22129.		See wiring diagram, Figure 12 for use.
C-washer, 0.56 in. dia, 0.07 in. thick and 17/64 in. cutout		See Paragraph 6E, step (12).
Primer Paint No. DS-C-2936	Jamestown Finishes Inc. Jamestown, New York, U.S.A.	Prime housing assembly.
Catalyst No. CT9-1472	Jamestown Finishes Inc.	Use with primer paint.
Finishing Paint No. XFO-1042, Special Flat Black	Jamestown Finishes Inc.	Final painting.
Paint thinner No. 5811	Jamestown Finishes Inc.	Use with final paint.
Pacitite, No. 3199	Simmonds Precision Products, Inc. Tarrytown, New York, U.S.A.	Use with coaxial element (32, Figure 3) and circuit cradle (4, Figure 3).
Cement, No. 8100	Simmonds Precision Products, Inc.	Use with transistor insulators (12, Figure 2).
Helium	Commercial	Fill indicator assembly.
Nitrogen, Specification BB-N-411/A (U.S.A.)		Fill indicator assembly.

11. ILLUSTRATED PARTS LIST.

A. GROUP ASSEMBLY PARTS LIST.

Figure and Index No.	Part No.	1 2 3 4 5 6 7 NOMENCLATURE	Units per Assy	Usage Code
2-	393000-01703	INDICATOR ASSEMBLY, Liquid quantity	1	A
2-	393000-01704	INDICATOR ASSEMBLY, Liquid quantity	1	B
-1	397005	. PLATE, Identification	1	
-2	382978	. BAND, Solder sealing	1	
-3	463135	. RING, Lock	1	
-4	463137-001	. HOUSING ASSEMBLY	1	
-5	393165	. . RIM, Front	1	
-6	393166	. . WINDOW, Dial	1	
-7	463136-001	. . HOUSING	1	
-8	463141	. END PLATE ASSEMBLY	1	
-9	341	. . LUG, Terminal, 0.093 dia hole (V57771) ..... (ATTACHING PARTS)	1	
-10	A1701	. . EYELET, Metallic (V57771) ..... ---*---	1	
-11	2N1041	. . TRANSISTOR, Q101, Q106	2	R
-12	463389	. . INSULATOR, Transistor	2	
-13	TXB-032-037	. . RETAINER (V98978) ..... (ATTACHING PARTS)	2	
-14	AN507UB440-3	. . SCREW ..... ---*---	2	
-15	463197	. . TERMINAL BOARD ASSEMBLY	1	
-16	510-00-500	. . VARIABLE RESISTOR ASSEMBLY, 500 ohms ± 10%, 1 w, R103 (V94271)	1	
-17	463198	. . RETAINER	1	
-18	463199	. . RETAINER, Cover	1	
-19	GS02-165-1P-001-A105	. . CONNECTOR, Receptacle, electrical, J101 (V71468)	1	
-20	463140	. . PLATE, End	1	
-21	463446-01703	. INDICATOR SUBASSEMBLY (See Figure 3)	1	A
-21	463446-01704	. INDICATOR SUBASSEMBLY (See Figure 3)	1	B
-22	397010-2	. SHELL	1	

Figure and Index No.	Part No.	1 2 3 4 5 6 7 NOMENCLATURE	Units per Assy	Usage Code
3-	463446-01703	INDICATOR SUBASSEMBLY (See Figure 2, index No. 21)	REF	A
3-	463446-01704	INDICATOR SUBASSEMBLY (See Figure 2, index No. 21)	REF	B
-1	393172-2	. POINTER ASSEMBLY	1	
-2	393174-01703	. DIAL, Scale	1	A
-2	393174-01704	. DIAL, Scale	1	B
		(ATTACHING PARTS)		
-3	Coml	. SCREW, Fh, brs blk ox., No. 0-80 x 0.38 in.	2	
		---*---		
-4	463189	. CRADLE, Circuit	1	
		(ATTACHING PARTS)		
-5	A1675	. EYELET, Metallic (V57771)	2	
		---*---		
-6	397861	. AMPLIFIER ASSEMBLY (See Figure 4)	1	
-7	463447-01703	. BRIDGE ASSEMBLY (See Figure 6)	1	A
-7	463447-01704	. BRIDGE ASSEMBLY (See Figure 6)	1	B
-8	397386	. INVERTER ASSEMBLY (See Figure 5)	1	
-9	463192-001	. CAPACITOR (Motor), C101	1	
-10	463152	. . STOP ASSEMBLY	1	
		(ATTACHING PARTS)		
-11	Coml	. . SETSCREW, Hex hd, cup point, sst, No. 0-80 x 0.06 in.	2	
		---*---		
-12	397574	. . WASHER	1	
-13	463142	. . COLLAR	1	
		(ATTACHING PARTS)		
-14	Coml	. . SETSCREW, Socket hd, cup point, sst, No. 0-80 x 0.06 in.	1	
		---*---		
-15	463150	. . MOTOR HOUSING SUBASSEMBLY	1	
		(ATTACHING PARTS)		
-16	AN500C6-5	. . SCREW	2	
-17	463132	. . NUT	2	
		---*---		
-18	463124	. . . MOTOR COIL ASSEMBLY, L101	1	
-19	341	. . . LUG, Terminal, 0.093 dia hole (V79963)	1	
		(ATTACHING PARTS)		
-20	Coml	. . . SCREW, Fil h, sst, No. 2-56 x 0.25 in.	2	
-21	68-1660-26	. . . NUT, Stop (V72962)	2	
		---*---		
-22	FT-SM-1-TUR	. . . FEEDTHRU (V98291)	1	
-23	1150	. . . GROMMET, Rubber (V91265)	1	
-24	463119	. . . CAPACITOR PLATE, No. 2	1	
		(ATTACHING PARTS)		
-25	AN500C4-8	. . . SCREW	2	
-26	Coml	. . . WASHER, Lock, int tooth, No. 4	2	
		---*---		
-27	341	. . . . LUG, Terminal, 0.093 dia hole (V79963)	1	
		(ATTACHING PARTS)		
-28	Coml	. . . . SCREW, Bind. hd, self-tapping, stl, No. 2, Type Z x 0.12 in.	1	
		---*---		
-29	397395	. . . . MAGNET	1	
-30	463117-002	. . . . BASE, Magnet	1	
-31	463129	. . . BEARING	1	
-32	463131	. . . ELEMENT, Coaxial	1	
-33	463114	. . . HOUSING, Motor	1	
-34	463120	. . ROTOR ASSEMBLY	1	

Figure and Index No.	Part No.	1 2 3 4 5 6 7 NOMENCLATURE	Units per Assy	Usage Code
		(ATTACHING PARTS)		
3-35	Coml	. . SETSCREW, Hex, cup point, sst, No. 0-80 x 0.06 in.	1	
		---*---		
-36	393178	. . . CYLINDER, Ground	1	
-37	393188	. . . DISK, Rotor	1	
-38	393189	. . . HUB, Rotor	1	
-39	463126	. . SHAFT ASSEMBLY	1	
-40	393199	. . . HAIRSPRING	1	
-41	463125	. . . SHAFT	1	
-42	463151	. . FRONT HOUSING SUBASSEMBLY	1	
-43	463123	. . . FRONT MOTOR COIL, L102	1	
		(ATTACHING PARTS)		
-44	AN500C2-7	. . . SCREW	2	
-45	68-1660-26	. . . NUT, Stop (V72962)	2	
		---*---		
-46	463118	. . . CAPACITOR PLATE, No. 1	1	
		(ATTACHING PARTS)		
-47	AN500C4-8	. . . SCREW	2	
-48	Coml	. . . WASHER, Lock, int tooth, No. 4	2	
		---*---		
-49	341	. . . . LUG, Terminal, 0.093 dia hole (V79963)	1	
		(ATTACHING PARTS)		
-50	Coml	. . . . SCREW, Bind. hd, self-tapping, stl, No. 2, Type Z x 0.12 in.	1	
		---*---		
-51	397395	. . . . MAGNET	1	
-52	463117-001	. . . . BASE, Magnet	1	
-53	463129	. . . BEARING	1	
-54	062-0250MCP	. . . PIN, Spriol (V00287)	1	
-55	MS20427C2C4	. . . RIVET	1	
-56	463115	. . . HOUSING, Front	1	

Figure and Index No.	Part No.	1 2 3 4 5 6 7 NOMENCLATURE	Units per Assy	Usage Code
4-	397861	AMPLIFIER ASSEMBLY (See Figure 3, index No. 6)	REF	
-1	150D156X0020B2	. CAPACITOR, 15 uf ± 20%, 20 vdcw, C107 (V56289)	1	
-2	RC07GF333K	. RESISTOR, 33K ± 10%, 0.25 w, R112	1	
-3	RC07GF392K	. RESISTOR, 3.9K ± 10%, 0.25 w, R111	1	
-4	1N816	. SEMICONDUCTOR DEVICE, Diode, CR101, CR102	2	
-5	RC07GF822K	. RESISTOR, 8.2K ± 10%, 0.25 w, R108, R117, R118	3	
-6	RC07GF123K	. RESISTOR, 12K ± 10%, 0.25 w, R115	1	
-7	S320G	. SEMICONDUCTOR DEVICE, Diode, CR103 (V03877)	1	
-8	RC07GF153K	. RESISTOR, 15K ± 10%, 0.25 w, R116	1	
-9	RC07GF390K	. RESISTOR, 39 ohms ± 10%, 0.25 w, R121	1	
-10	2N1711	. TRANSISTOR, Q105	1	R
-11	150D225X9035B2	. CAPACITOR, 2.2 uf ± 10%, 35 vdcw, C109, C110	2	
-12	RC07GF105K	. RESISTOR, 1 mego ± 10%, 0.25 w, R119	1	
-13	150D187X0006R2	. CAPACITOR, 180 uf ± 20%, 6 vdcw, C105 (V56289)	1	
-14	RC07GF270K	. RESISTOR, 27 ohms ± 10%, 0.25 w, R110	1	
-15	150D685X0006A2	. CAPACITOR, 6.8 uf ± 20%, 6 vdcw, C103 (V56289)	1	
-16	462118	. TRANSISTOR, Q102, Q103, Q104	3	
-17	P123ZNG	. CAPACITOR, 0.001 uf ± 25%, 200 vdcw, C104 (V00656)	1	
-18	RC07GF563K	. RESISTOR, 56K ± 10%, 0.25 w, R109	1	
-19	*A1701	. EYELET, Metallic (V57771)	3	
-20	*A1029	. EYELET, Metallic (V57771)	1	
-21	397862	. BOARD, Amplifier	1	

* Order index numbers 19 and 20 attached to index number 21.

Figure and Index No.	Part No.	1 2 3 4 5 6 7 NOMENCLATURE	Units per Assy	Usage Code
5-	397386	INVERTER ASSEMBLY (See Figure 3, index No. 8)	REF	
-1	DO-T11	. TRANSFORMER, T103 (V80223)	1	
-2	397214	. SPACER, Transformer	1	
-3	397026	. TRANSFORMER, T102	1	
		(ATTACHING PARTS)		
-4	392307	. TUBE, Mounting	1	
		---*---		
-5	RC20GF270J	. . RESISTOR, 27 ohms ± 5%, 0.5 w, R107	1	
-6	RC20GF822J	. . RESISTOR, 8.2K ± 5%, 0.5 w, R114	1	
-7	242E1525	. . RESISTOR, 1.5K ± 5%, 3 w, R120 (V56289)	1	
-8	RC20GF222J	. . RESISTOR, 2.2K ± 5%, 0.5 w, R106, R113	2	
-9	P123ZNG	. . CAPACITOR, 0.01 uf ± 25%, 200 vdcw, C108 (V00656)	1	
-10	P123ZNG	. . CAPACITOR, 0.05 uf ± 20%, 200 vdcw, C106 (V00656)	1	
-11	397025	. . CHASSIS ASSEMBLY	1	

Figure and Index No.	Part No.	1 2 3 4 5 6 7 NOMENCLATURE	Units per Assy	Usage Code
6-	463447-01703	BRIDGE ASSEMBLY (See Figure 3, index No. 7)	REF	A
6-	463447-01704	BRIDGE ASSEMBLY (See Figure 3, index No. 7)	REF	B
-1	397925-2	. VARIABLE RESISTOR ASSEMBLY, 200 ohms ± 10%, 1 w, R101	1	
-2	463445-01703	. TRANSFORMER, Bridge, T101	1	A
-2	463445-01704	. TRANSFORMER, Bridge, T101	1	B
-3	CG1/8	. RESISTOR, 100 ohms ± 5%, 0.125 w, R102, R104 (V01295)	2	
-4	RC20GF472	. RESISTOR, 4.7K ± 20%, 0.5 w, R105	1	
-5	150D185X9035B2	. CAPACITOR, 1.8 uf ± 10, 35 vdcw, C111, C112 (V56289)	2	
-6	397615-00820	. CAPACITOR, 82 pf ± 1%, 500 vdcw, C102	1	
-7	463449	. CHASSIS ASSEMBLY	1	

CODE	VENDOR'S NAME AND ADDRESS
00287	CEM Co. Danielson, Connecticut
00656	Aerovox Corp. New Bedford, Massachusetts
01295	Texas Instruments, Inc., Components Division Dallas, Texas
03877	Transitron Electronic Corp. Wakefield, Massachusetts
56289	Sprague Electric Co. North Adams, Massachusetts
57771	Stimpson, Edwin B., Co. Inc. Brooklyn, New York
71468	Cannon Electric Co. Los Angeles, California
72962	Elastic Stop Nut Corp. of America Union, New Jersey
79963	Zierick Mfg. Corp. New Rochelle, New York
80223	United Transformer Co. New York, New York
91265	Goshen Rubber Co., Inc. Goshen, Indiana
94271	Daystrom Instrument Div., Daystrom, Inc. Archbald, Pennsylvania
98291	Sealectro Corp. Mamaroneck, New York
98978	Internation Electronic Research Corp. Burbank, California

B. NUMERICAL INDEX.

PART NUMBER	FIGURE AND INDEX NUMBER	QUANTITY PER ARTICLE	PART NUMBER	FIGURE AND INDEX NUMBER	QUANTITY PER ARTICLE	
AN500C2-7	3-44	2	2N1711	4-10	1	R
AN500C4-8	3-25	4	242E1525	5-5	1	
	3-49		341	2-9	4	
AN500C6-5	3-16	2		3-19		
AN507UB440-3	2-14	2		3-27		
A1029	4-20	1		3-47		
A1675	3-5	2	382978	2-2	1	
A1701	2-10	4	392307	5-4	1	
	4-19		393000-01703	2-	1	
CG1/8	6-3	2	393000-01704	2-	1	
DO-T11	5-2	1	393165	2-5	1	
FT-SM-1TUR	3-22	1	393166	2-6	1	
GS02-165-1P-001-A105	2-19	1	393172-2	3-1	1	
MS20427C2C4	3-55	1	393174-01703	3-2	1 (Code A)	
P123XNG	4-17	2	393174-01704	3-2	1 (Code B)	
	5-9		393178	3-36	1	
	5-10		393188	3-37	1	
RC07GF105K	4-12	1	393189	3-38	1	
RC07GF123K	4-6	1	393199	3-40	1	
RC07GF153K	4-8	1	397005	2-1	1	
RC07GF270K	4-14	1	397010-2	2-22	1	
RC07GF333K	4-2	1	397025	5-11	1	
RC07GF390K	4-9	1	397026	5-3	1	
RC07GF392K	4-3	1	397214	5-2	1	
RC07GF563K	4-18	1	397386	3-8	1	
RC07GF822K	4-5	3		5-		
RC07GF222J	5-8	2	397395	3-29	2	
RC07GF270J	5-4	1		3-51		
RC07GF472	6-4	1	397574	3-12	1	
RC07GF822J	5-6	1	397615-00820	6-6	1	
Screw, Fh, No. 0-80 x 0.38 in.	3-3	2	397861	3-6	1	
				4-		
Screw, Bind. hd, No. 2 Type Z x 0.12 in.	3-28	2	397862	4-21	1	
	3-50		397925-2	6-1	1	
Screw, Fil h, No. 2-56 x 0.25 in.	3-21	2	462118	4-16	3	
			463114	3-33	1	
Setscrew, Hex hd, No. 0-80 x 0.06 in.	3-11	1	463115	3-56	1	
			463117-001	3-51	1	
Setscrew, Hex. No. 0-80 x 0.06 in.	3-34	1	463117-002	3-30	1	
			463118	3-47	1	
Setscrew, Sch, No. 0-80 x 0.06 in.	3-14	1	463119	3-24	1	
			463120	3-34	1	
S320G	4-7	1	463123	3-43	1	
TXB-032-037	2-13	2	463124	3-18	1	
Washer, Lock. No. 4	3-26	3	463125	3-41	1	
	3-48		463126	3-39	1	
062-0250MCP	3-54	1	463129	3-31	2	
1N816	4-4	2		3-53		
1150	3-23	1	463132	3-17	2	
150D156X0020B2	4-1	1	463136-001	2-7	1	
150D185X9035B2	6-5	2	463137	2-3	1	
150D187X0006R2	4-13	1	463137-001	2-4	1	
150D225X9035B2	4-11	2	463140	2-20	1	
150D685X0006A2	4-15	1	463141	2-8	1	
2N1041	2-11	2	463142	3-13	1	R

PART NUMBER	FIGURE AND INDEX NUMBER	QUANTITY PER ARTICLE	PART NUMBER	INDEX NUMBER	QUANTITY PER ARTICLE
463150	3-15	1	463446-01703	3-	
463151	3-42	1	463446-01704	2-21	1 (Code B)
463152	3-10	1		3-	
453189	3-4	1	463447-01703	3-7	1 (Code A)
463192-001	3-9	1		6-	
463197	2-15	1	463447-01704	3-7	1 (Code B)
463198	2-17	1		6-	
463199	2-18	1	463449	6-7	1
463389	2-12	2	510-00-500	2-16	1
463445-01703	6-2	1 (Code A)	68-1660-26	3-22	4
463445-01704	6-2	1 (Code B)		3-45	
463446-01703	2-21	1 (Code A)			

REFERENCE DESIGNATION	FIGURE AND INDEX NUMBER	PART NUMBER	REFERENCE DESIGNATION	FIGURE AND INDEX NUMBER	PART NUMBER	
CR101	4-4	1N816	R102	6-3	CG1/8	
CR102	4-4	1N816	R103	2-16	510-00-500	
CR103	4-7	S320G	R104	6-3	CG1/8	
C101	3-9	463192-001	R105	6-4	RC20GF472	
C102	6-6	397615-00820	R106	5-8	RC20GF222J	
C103	4-15	150D685X0006A2	R107	5-5	RC20GF270J	
C104	4-17	P123ZNG	R108	4-5	RC07GF822K	
C105	4-13	150D187X0006R2	R109	4-18	RC07GF563K	
C106	5-10	P123ZNG	R110	4-14	RC07GF270K	
C107	4-1	150D156X0020B2	R111	4-3	RC07GF392K	
C108	5-9	P123ZNG	R112	4-2	RC07GF333K	
C109	4-11	150D225X9035B2	R113	5-8	RC20GF222J	
C110	4-11	150D225X9035B2	R114	5-6	RC20GF822J	
C111	6-5	150D185X9035B2	R115	4-6	RC07GF123K	
C112	6-5	150D185X9035B2	R116	4-8	RC07GF153K	
J101	2-19	GS02-165-1P-001-A105	R117	4-5	RC07GF822K	
			R118	4-5	RC07GF822K	
L101	3-18	463124	R119	4-12	RC07GF105K	
L102	3-44	463123	R120	5-7	242E1525	
Q101	2-11	2N1041	R121	4-9	RC07GF390K	R
Q102 thru Q104	4-16	462118	T101	6-2	463445-01703	
Q105	4-10	2N1711	T101	6-2	463445-01704	R
Q106	2-11	2N1041	T102	5-3	397026	R
R101	6-1	397925-2	T103	5-1	DO-T11	

PD 1208-3B

SIMMONDS PRECISION PRODUCTS, INC.
FUEL QUANTITY GAGE

OVERHAUL INSTRUCTIONS
for
FUEL QUANTITY INDICATOR

PART NUMBERS

393004-060	NSN 6680-21-860-3291
393004-061	NSN 6680-21-860-3292
393004-131	
393004-132	

DE HAVILLAND DHC-6

SIMMONDS PRECISION PRODUCTS, INC.
PANTON ROAD
VERGENNES, VT 05491

May 6, 1986

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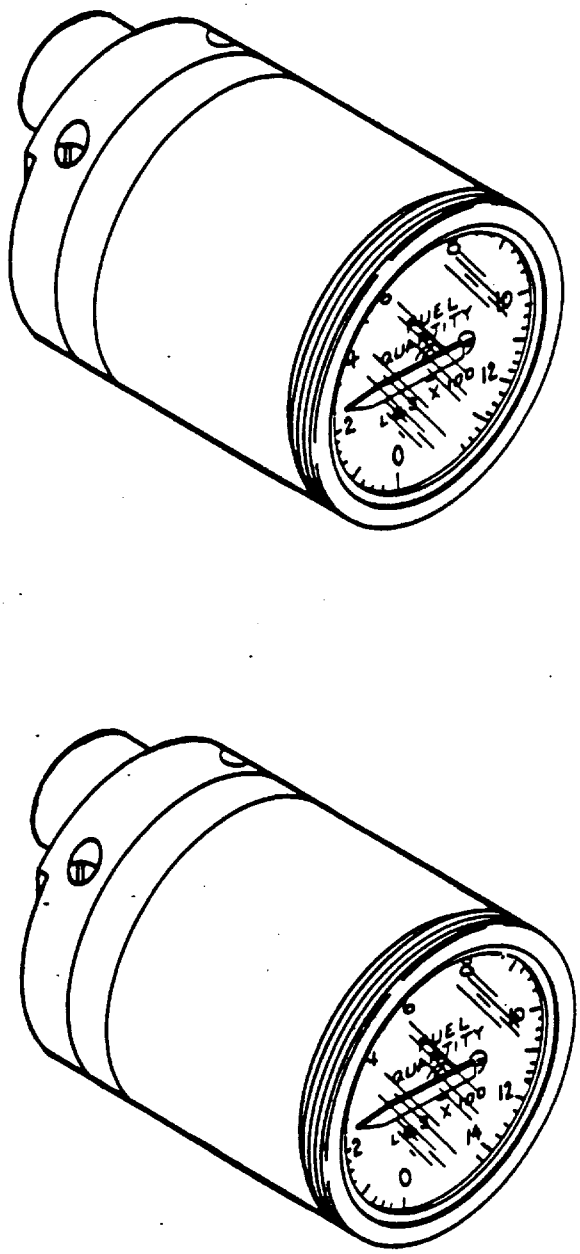


Figure 1. Fuel Quantity Indicator

0-1 DESCRIPTION AND OPERATION

A. GENERAL. The 393004- Fuel Quantity Indicators (Reference Figure 1) are a pointer type, transistorized indicator - amplifier - bridge enclosed in a hermetically sealed housing.

B. INTERNAL COMPONENTS.

1. The indicator is housed in a hermetically sealed, cylindrical case. Within the case is an amplifier-bridge assembly, which consists of a three-stage transistor amplifier, a bridge circuit, power supply circuitry, and an indicator motor which, through a gear box, drives the pointer and the rebalancing element of the bridge circuit.
2. At the rear of the indicator are the "FULL" and "EMPTY" adjustment controls.
3. The indicator motor is a two-phase motor with one winding in phase with the power source while the other winding is energized by the amplifier signal. Direction of rotation depends upon the phase relationship between the two windings.
4. The amplifier portion of the amplifier-bridge circuitry consists of a three-stage transistor amplifier which amplifies the signal received from the bridge circuit to drive the indicator motor. The bridge portion consists of a reference capacitance, a rebalancing potentiometer which restores the system to balance as it is driven by the motor, and the "FULL" and "EMPTY" adjustment controls.

5. The power supply circuitry includes a toroidal transformer which supplies voltage of correct phase and amplitude to the bridge circuit and two crystal diodes connected to taps on the transformer primary. These diodes are connected in a fullwave rectifier configuration and supply DC power to the amplifier.

C. LEADING PARTICULARS. Leading particulars for the indicators covered in this handbook are given in Table I.

TABLE I
LEADING PARTICULARS

PART NO.	OVERALL LENGTH	DIAMETER	WEIGHT	SEALING	DIAL	TANK
393004-060	2.94"	2.0"	0.60 Lbs (0.272 Kgs)	Hermetic	0-1375 Lbs	Forward
393004-061	2.94"	2.0"	0.60 Lbs (0.272 Kgs)	Hermetic	0-1425 Lbs	Aft
393004-131	2.94"	2.0"	0.60 Lbs (0.272 Kgs)	Hermetic	0-6.455 Kgs	Forward
393004-132	2.94"	2.0"	0.60 Lbs (0.272 Kgs)	Hermetic	0-6.455 Kgs	Aft

TABLE II
LIST OF VENDORS

CODE	VENDORS NAME AND ADDRESS
01121	Allen Bradley Co., 1201 South 2nd Street Milwaukee, Wisconsin
01295	Texas Instruments, Transistor Division Dallas, Texas
06641	Century Fasteners Corporation, 50-20 Ireland Street Elmhurst, New York
56289	Sprague Electric, Marshall Street North Adams, Massachusetts
70318	Allmetal Screw Products Co., Inc., 821 Steward Avenue Garden City, New York
77820	Bendix Corporation, The Electrical Component Division, Sherman Avenue, Sidney, New York

1-1 DISASSEMBLY

A. GENERAL.

1. Conduct tests as outlined in Section 7, to determine malfunction and required overhaul. If unit meets all requirements of testing, overhaul is not recommended.
2. Disassemble the unit according to the exploded and orthographic views (Reference Figures 2 through 6). The numerical sequence of the parts in these views follows the order of disassembly except that attaching parts follow the parts they attach. Do not disassemble the unit beyond the point necessary to make required repair or replacement of parts.

B. DISASSEMBLE INDICATOR (Reference Figure 2).

1. Remove two screws (2) securing identification plate (1). Remove identification plate.
2. Do not remove decal (3) unless required for replacement. Decal is cemented in place and will be damaged if removed.
3. Using a 200 watt soldering iron and heat sink protection (Reference Figure 8) unsolder end of tearband (4). Carefully remove tearband using a pair of pliers and a 200 watt soldering iron.
4. Slide case assembly (5) off indicator subassembly (9). If dial window requires replacement, insert case assembly (5) into an induction heater and unsolder glass (7) from case (6).
5. Remove spacer (8) from indicator subassembly (9).

C. DISASSEMBLY INDICATOR SUBASSEMBLY (Reference Figure 3).

1. Using two soft, pointed, instruments, carefully pry off pointer assembly (1).
2. Remove screws (3) securing dial (2). Remove dial.
3. Remove shaft screw (4).
4. Detach amplifier assembly (5) by removing mounting screws (6) and lockwashers (7). Reference Figure 4 for disassembly of amplifier.
5. Unscrew standoff (9) and remove motor indicator assembly (8).
6. Separate motor (10) from the gear box assembly (14) by removing screws (11), lockwashers (12), and motor clamps (13). If gearbox assembly (14) required disassembly, refer to Figure 5.
7. Remove transformer assembly (15) and spacer ring (16) from end plate assembly (17). Reference Figure 6 for breakdown of end plate assembly.

D. DISASSEMBLE AMPLIFIER ASSEMBLY (Reference Figure 4).

1. Unsolder and remove electrical components (1 through 23). Use proper heatsink protection to insure component safety. It is not recommended to disassemble terminal board (25).

E. DISASSEMBLE DRIVE ASSEMBLY (Reference Figure 5).

1. Remove retaining ring (2).

2. Lift out faceplate (3), cluster and wiper assembly (4), and potentiometer assembly (8). Separate wiper assembly (6), 320° cluster assembly (5), and dog pin (7) only if required for replacement.
3. Detach support plate (11) by removing screws (10).
4. Lift off rear plate (12).
5. Slide off spring shield (13) and remove clusters (14, 15, 16, and 17).
6. Separate the front plate (20) and housing (21) by removing three posts (18) and one key post (19).
7. Do not remove stop pin (22) from housing (21) unless required for replacement.

F. DISASSEMBLE END PLATE ASSEMBLY (Reference Figure 6).

1. Unscrew spade studs (1) from end plate (13).
2. Unsolder and remove resistor (2) and capacitor (3).
3. Remove screws (6), lockwashers (7 and 8), and flat lug (9).
4. Lift terminal strips (4) and trimmers (5) out of end plate (13).
5. Heat end plate (13) to approximately 460°F to remove receptacle (10).
6. Heat end plate (13) to approximately 597°F to remove evacuation tube (11) and bellows assembly (12).

2-1 CLEANING

A. GENERAL.

1. Clean all non-electrical parts using a solvent such as isopropyl alcohol. Dip a stiff, non-metalic brush into the solvent and wash parts thoroughly.
2. Clean electrical parts with a lint-free cloth moistened with isopropyl alcohol and blow dry with clean, dry, compressed air.
3. Mechanical parts such as clusters may be cleaned in an ultrosonic cleaner.
4. After cleaning clusters, lubricate cluster pivots with Dow Corning DC-560, (Dow Corning Corp., Midland, Michigan) or equivalent.
5. All cleaned parts should be stored in clean, labeled containers.
6. All excess solder on case assembly and end plate assembly should be removed by flowing excess solder with a 200 watt soldering iron and wiping clean with a damp rag.
7. Clean dial window with lens tissue and/or a mild dish detergent.

3-1 INSPECTION AND CHECK

A. GENERAL.

1. Visually inspect all parts and wiring for wear, corrosion, damage, and faulty insulation.
2. Inspect all clusters for tooth deformation, stress cracks, and scoring.
3. Inspect screws and other threaded parts for stripped, worn, or otherwise damaged threads.
4. Check all wiring for cold solder joints, cracked or damaged insulation, and/or loose connections.
5. Inspect all electrical components for proper values, signs of over-heating or other damage.
6. Inspect all rotating components for misalignment or wobble.

B. ELECTRICAL COMPONENTS.

1. Using a Simpson 260 (or equivalent) check all resistors for proper values as referenced in the legend of schematic diagram, Figure 13A or 13B.
2. Check all capacitors for shorts and proper values. Reference values found in illustrated parts list and the legend of the schematic diagram, Figure 13A or 13B.
3. Check all transistors on a standard transistor checker.
4. Check all diodes for proper forward and reverse currents.

C. FUEL QUANTITY INDICATOR (Reference Figure 2).

1. Check identification plate (1) for scratches or distorted lettering.
2. Check case assembly (5) for cracks or bad dents.
3. Check glass (7) for scratches or cracks.

D. INDICATOR SUBASSEMBLY (Reference Figure 3).

1. Check pointer (1) and dial (2) for scratched or chipped paint.
2. Inspect the motor (10) for signs of overheating, binding, and shaft wobble.
3. Connect the motor to a test circuit as shown in Figure 11. Mark the output pinion so that it will be visible under a Strobotac.
4. Close switch S1 and adjust Variac T1 until voltmeter M1 indicates 10 volts. The motor speed should be 2350 to 3500 rpm.
5. Adjust Variac T1 until voltmeter M1 indicates 20 volts. The motor speed must not be less than 4000 rpm.
6. Starting at zero, increase T1 until motor rotates. Motor shall rotate in either direction at not more than 1.5 volts.
7. Attach a 1/4" diameter pulley to the motor pinion shaft. Attach a 2" thread to the pulley and a 0.68 gram weight to the thread. Increase voltage until shaft rotates. The weight should rise to the pulley in both directions with no more than 2.0 volts applied.

8. Test gear box assembly (Index #1, Figure 5) by attaching the motor to the gear box with the proper hardware, reference Figure 3. Hold output gear of gear box assembly stationary and increase voltage of the test circuit to 2.0 volts. Release output gear. Gear box should turn freely. Repeat this operation several times in both directions.
9. Apply 500 volts, 60 cycles, to a white or yellow lead and a read or black lead for one minute. Connect all motor leads together and apply 500 volts, 60 cycles between the leads and the motor case for one minute.
10. The insulation resistance between the windings and between each winding and the motor case shall be greater than 500 megohms with 50 volt applied.
11. Check transformer assembly for damaged leads or insulation.

E. END PLATE ASSEMBLY (Reference Figure 6).

1. Trimmers (5) should measure 500 ohms ± 5% between red and black leads. Connect ohmmeter between white and red or black leads. As the trimmer adjustment is turned, the resistance should vary smoothly.
2. Check receptacle for bent or broken pin and damaged glass.

4-1 REPAIR AND REPLACEMENT

A. GENERAL.

1. Inspect and test all questionable components as described in Section 3. Replace any components or mechanical parts that fail to meet inspection and/or test requirements.
2. Replace any mechanical hardware that shows signs of worn or stripped threads.
3. Use solder composed of 60% tin and 40% lead for all soldering unless otherwise noted.

B. CASE ASSEMBLY (Reference Figure 2).

1. Minor dents in the case assembly (5) may be straightened out with a mallet and suitable block. If case is torn, punctured, or severely dented, it should be replaced.
2. If case window (7) is scratched, cracked, or broken, it should be replaced.

C. WIRING.

1. Replace any wiring having damaged conductor and/or insulation. Refer to notes on wiring diagram (Figure 12) for proper size and type of wire.
2. Resolder any solder joints that show evidence of damaged and/or poor soldering.

D. ROTATING COMPONENTS.

1. Replace motor (Index #10, Figure 3) if it fails to meet any of the Inspection and check requirements.
2. Repair of gear box subassembly (Index #9, Figure 5) is not recommended. Only in an emergency should individual components be replaced.
3. Tension of wiper assembly (6) against potentiometer assembly (7) should be 17 grams.

E. END PLATE ASSEMBLY (Reference Figure 6).

1. Replace receptacle (Index #10, Figure 6) and bellows assembly (12) reference Figure 6 and paragraph 5-1-B.

5-1 ASSEMBLY

A. GENERAL.

1. Assembly is essentially the reverse of disassembly. Follow the reverse order of index numbers assigned to the exploded and orthographic views, Figure 2 through 6.
2. As assembly proceeds, connect wiring as shown in Figure 12. When soldering wiring and electrical components, observe proper heat sink precautions. Reference Figure 3, 4, 6, and 12 for proper polarity and component layout.

B. ASSEMBLE END PLATE ASSEMBLY (Reference Figure 6).

1. Heat end plate (13) to approximately 597°F and solder bellows (12) and evacuation tube (11) in place with Sn5 solder and SPPI 2204 Solder Flux.
2. Preheat end plate (13) and receptacle (10) to approximately 460°F and solder in place with Sn40 solder and Kester 1544 flux or equivalent.
3. Clean end plate with tricloroethane.
4. Using an insulation resistance checker, measure the resistance from the pins of the receptacle to the end plate. Resistance shall be greater than 10,000 ohms.
5. Assemble trimmers R2 and R4 (5) and terminal strips (4) to end plate with screws (6), lockwashers (7 and 8) and lug (9).
6. Assemble Resistor R3 (2) and capacitor C1 (3) to end plate and wire per Figure 12.
7. Prewire receptacle per Figure 12.

8. Apply grade "E" Locktite or equivalent to the threaded portion of the spade studs (1) and assemble to end plate assembly. Make certain that the flat side of the spade stud faces the inside of the end plate.

C. ASSEMBLE INDICATOR DRIVE ASSEMBLY (Reference Figure 5).

1. Press stop pin (22) into housing (21) until large end of the stop pin is flush with the periphery of the housing.
2. Attach front plate (20) to housing (21) with three posts (18) and one key post (19).
3. Place clusters (14, 15, 16, and 17) into respective pivot holes in front plate (20).
4. Place spring shield (13) around clusters.
5. Place rear plate (12) on posts (18) and key post (19).
6. Attach support plate (11) with screws (10).
7. Place potentiometer assembly (8) into housing (21) and wire per Figure 12.
8. If wiper assembly (6), 320° cluster assembly (5), and dog pin (7) have been disassembled, assemble and realign per Figure 7.
9. Place cluster and wiper assembly (4) inside housing (21). Make certain that the wiper makes good contact with the coil.
10. Hold faceplate (3) in place with retaining ring (2).

D. ASSEMBLE AMPLIFIER ASSEMBLY (Reference Figure 4).

1. Place transipads (24) between terminal board (25) and transistors (23 and 24). Assemble transistors (23 and 24) to terminal board (25) using Sn60 solder and adequate heatsink protection.
2. Assemble components (1 through 21) to terminal board (25) and solder leads with Sn60 solder.

E. ASSEMBLE INDICATOR SUBASSEMBLY (Reference Figure 3).

1. Place ring spacer (16) into end plate assembly (17).
2. Place transformer (15) into end plate assembly (17).
3. Attach motor (10) to indicator gearbox assembly (14) with screws (11), lockwashers (12), and motor clamp (13).
4. Assemble indicator drive assembly (8) to the end plate assembly (16) with standoffs (9). Carefully route leads through the openings in support plate (Index #11, Figure 5).
5. Attach amplifier (5) to the two standoffs (9) with screws (6) and lockwashers (7). Carefully connect all wires to the amplifiers (5), referencing Figure 12.
6. Attach scale dial (2) to faceplate (Index #3, Figure 5) with screws (3).
7. Assemble shaft screw (4) to the cluster and wiper assembly (Index #4, Figure 5).
8. Press pointer assembly (1) to shaft screw (4). Pointer to be aligned during preseal test. Perform test per Paragraph 7-1.

F. ASSEMBLE FUEL QUANTITY INDICATOR (Reference Figure 2).

1. Slide spacer (8) onto indicator subassembly (9) until spacer (8) seats firmly against end plate assembly (Index #16, Figure 3).
2. If glass (7) requires replacement, preheat glass (7) and case (6) a minimum of 1/2 hour at 250° ± 10°F.
3. Make a solder ring, the approximate diameter of the glass, from Sn63 solder.
4. Coat the inside diameter of the front of case (6) with Kester Formula 1547 flux or equivalent.
5. Place glass and solder ring inside case and solder in place with an induction heater.
6. Clean entire case assembly (5) with trichloroethylene.
7. Paint a .300 stripe around the inside of the case directly adjacent to the glass with Jamestown XFO-1042 flat black or equivalent.
8. Assemble case assembly (5) to indicator subassembly (9).
9. Place indicator in tearbanding fixture (Reference Figure 8). Pretin the entire tearband area on both case and end plate with Sn63 solder using a 200 watt iron.
10. Make two 45° cuts on one end of the tearband (4) to form a point. Solder the pointed end of the tearband to the tearband area of the indicator. Wrap the tearband around the indicator and hold firmly in place. Slowly move the hot iron around the indicator. Feed enough solder to the tearband to form a

smooth, even fillet along both edges of the tearband. Allow for 3/4" overlap and cut the end at a 45° angle. Seal the end of the tearband with solder.

11. Make certain there are no wrinkles and/or cracks in the tearband. Care must be taken to avoid overheating the indicator.
12. Clean exterior of unit with acetone or equivalent.
13. Test unit per Section 7.

G. EVACUATING AND FILLING PROCEDURE (Reference Figure 9).

1. Connect a length of 1/16" inside diameter tubing to the fitting of the evacuation setup.
2. Connect the tubing to the evacuation tube.
3. Close the gas shutoff valve. Open the vacuum gage shutoff valve.
4. Open gas shutoff valve and fill the indicator assembly with 10 percent dry helium and 90 percent dry nitrogen until the pressure is approximately 15 psi.
5. Remove the rubber tubing from the evacuation tube allowing the extra gas to escape until the pressure inside the indicator and outside are equalized.

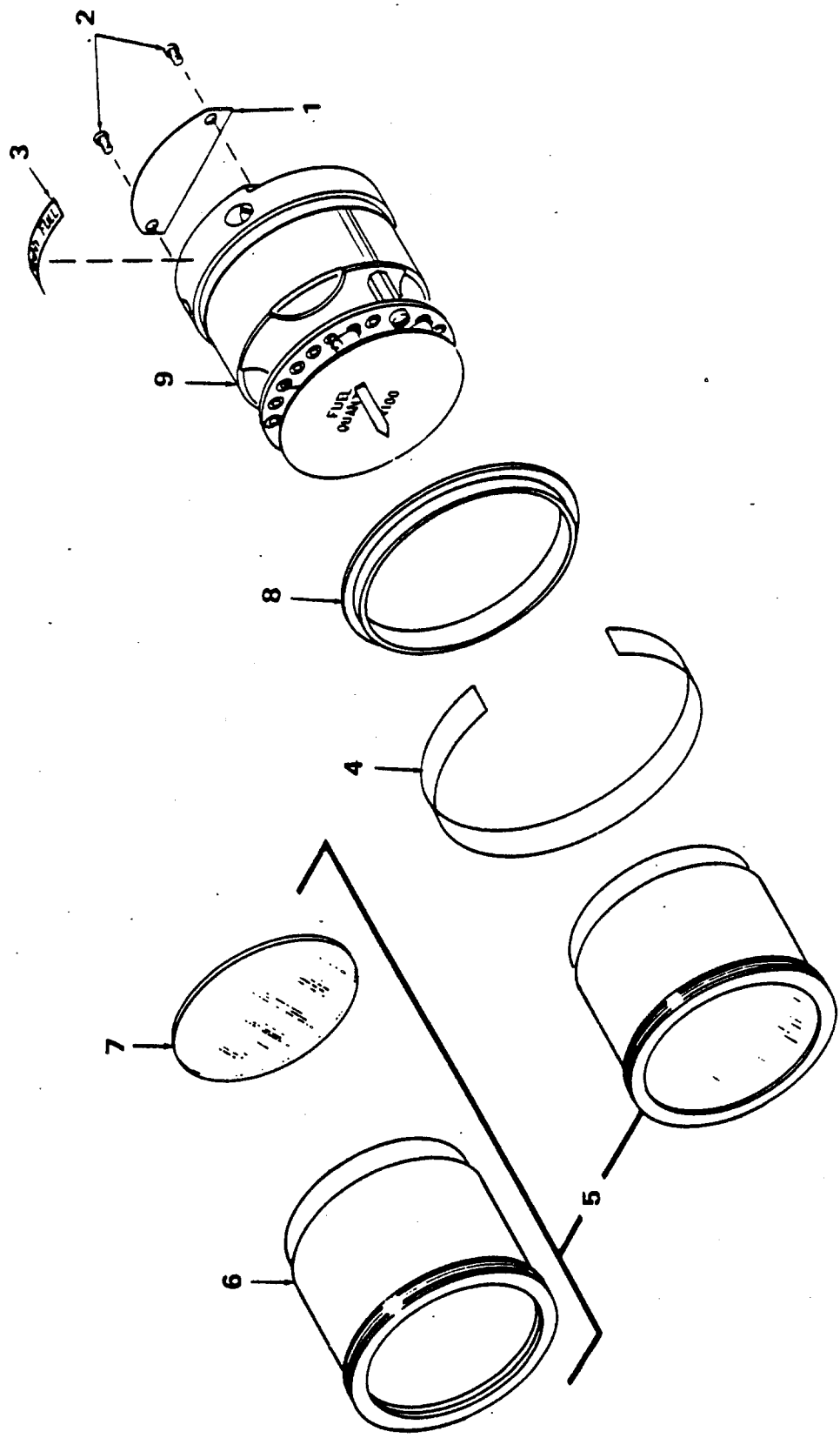


Figure 2. Fuel Quantity Indicator Assembly

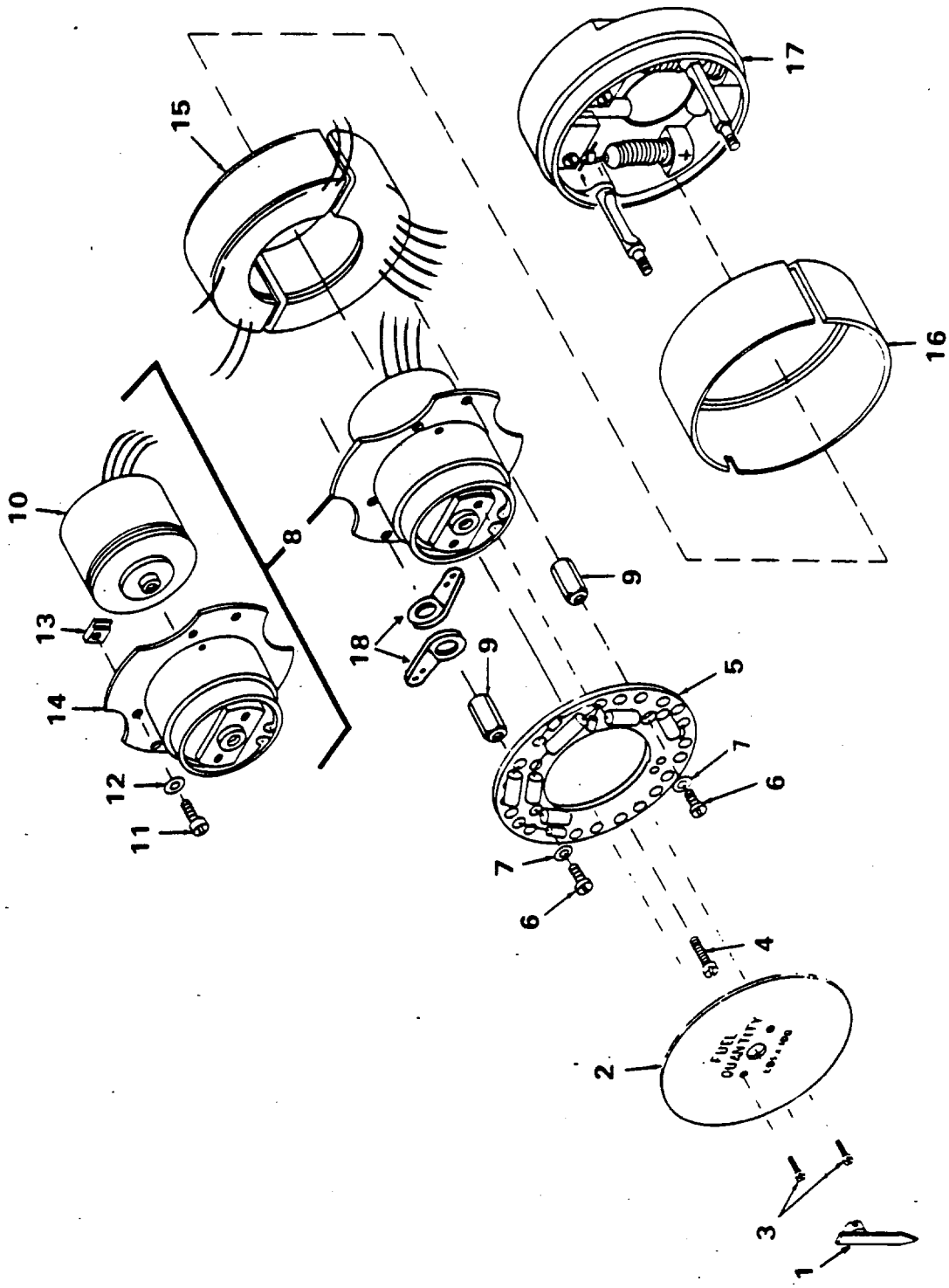


Figure 3. Indicator Subassembly

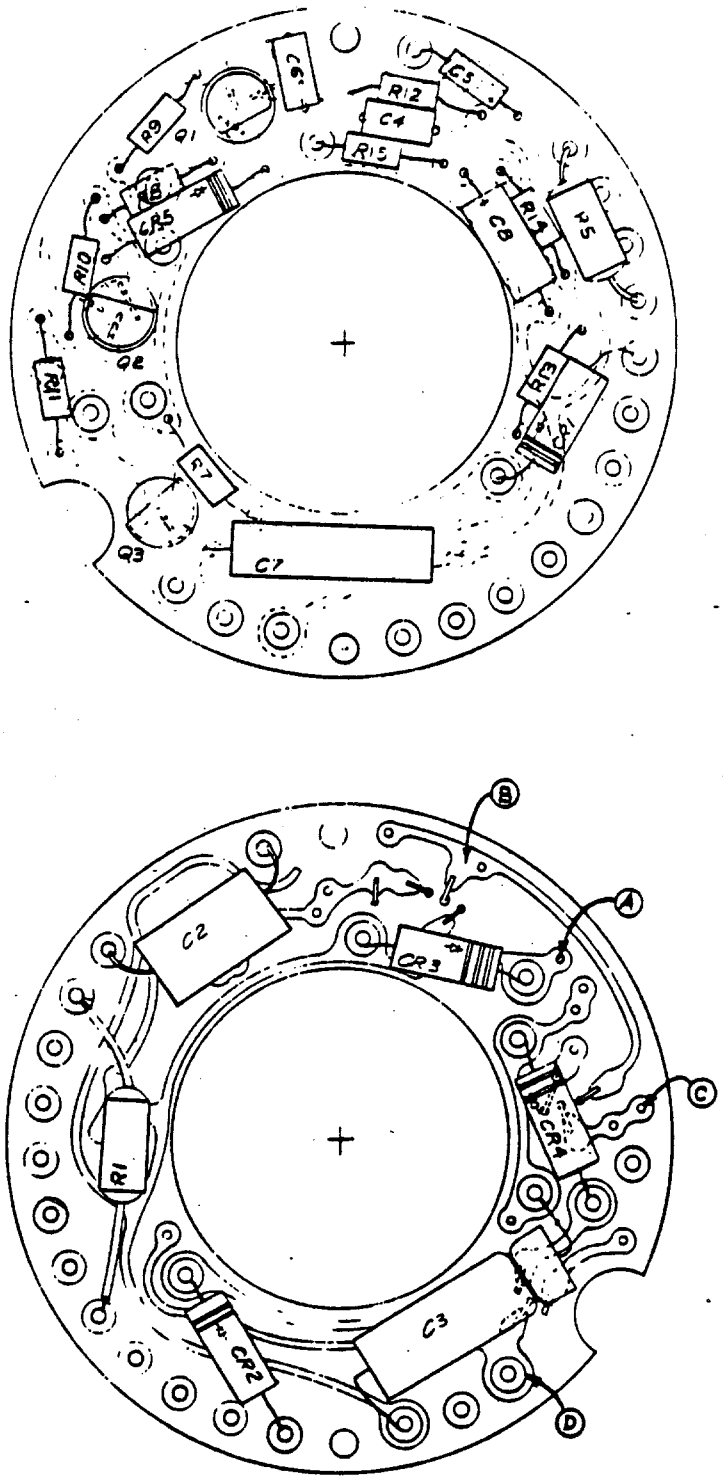


Figure 4. Amplifier Assembly, Part No. 463819-060

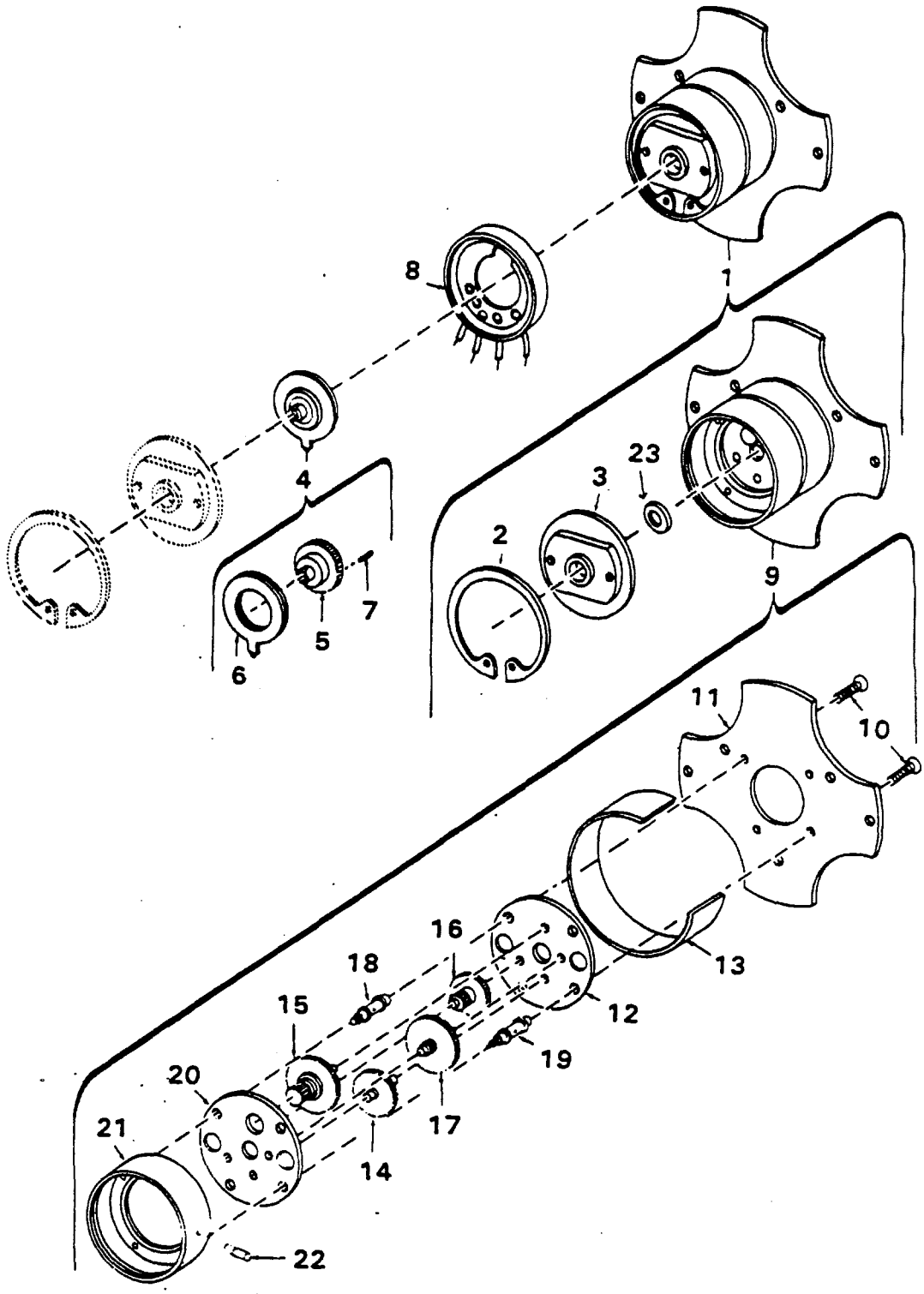


Figure 5. Indicator Drive Assembly

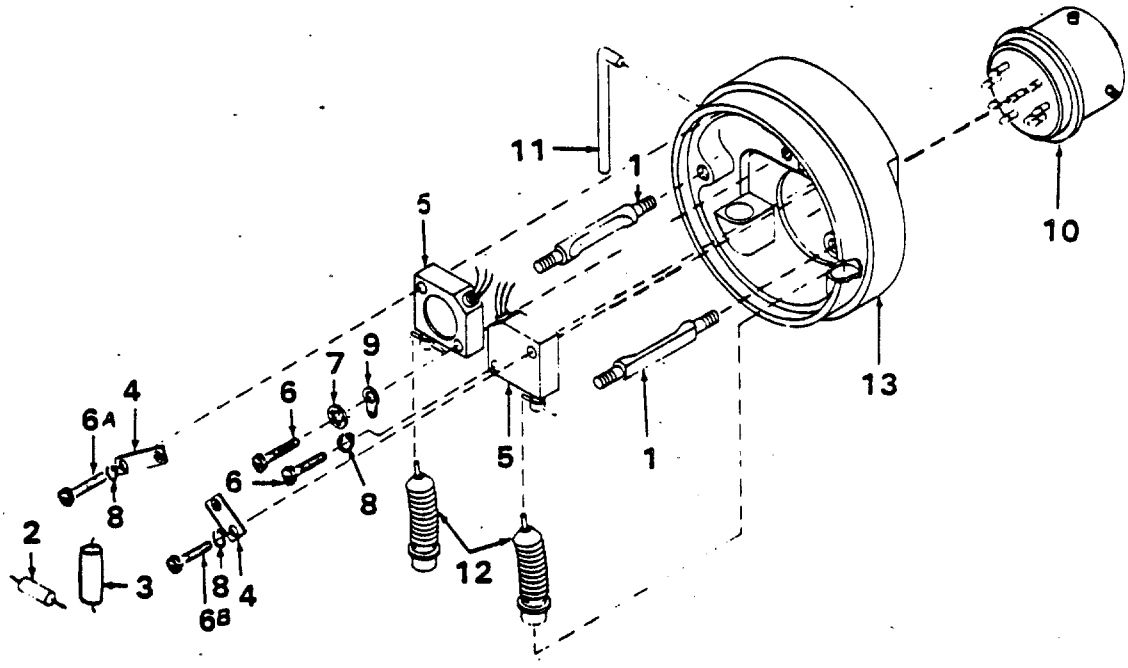


Figure 6. End Plate Assembly, Part No. 392138-060

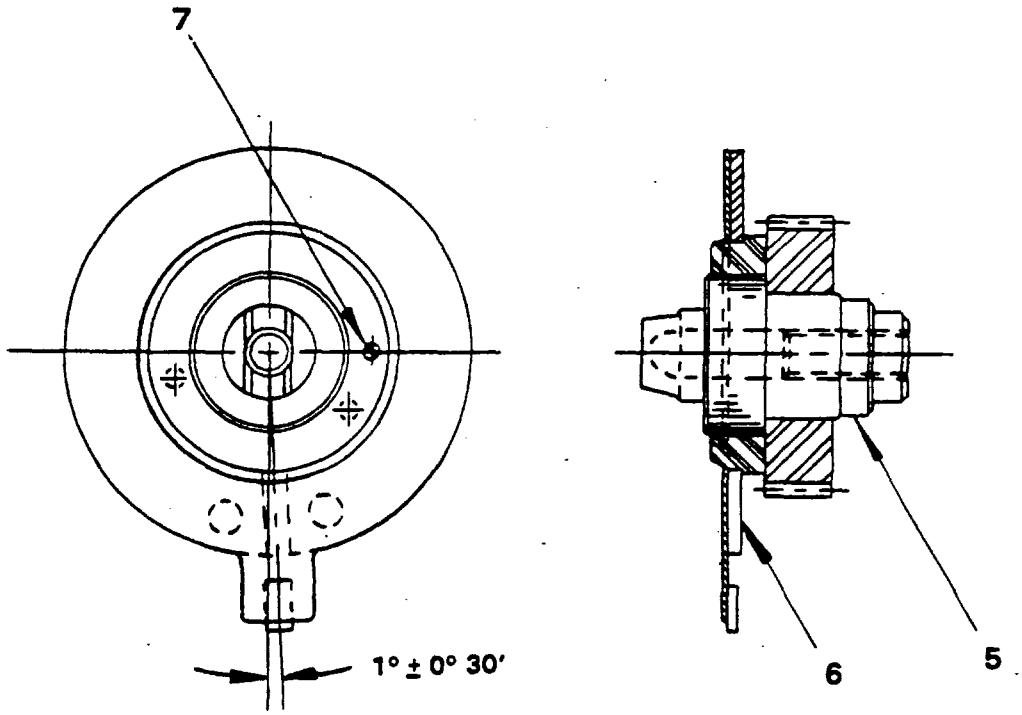


Figure 7. Wiper Alignment

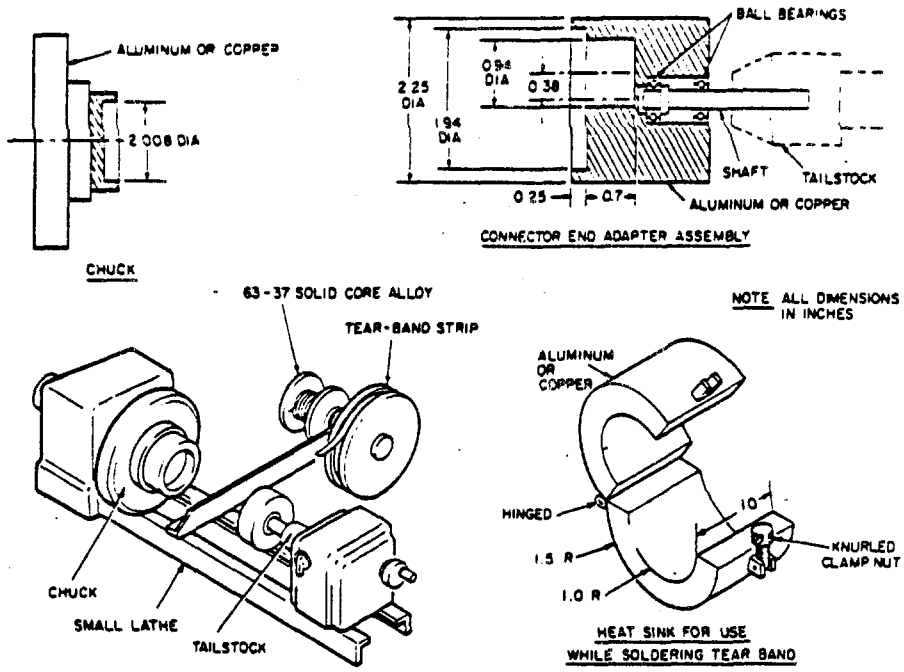


Figure 8. Typical Tearband Assembly Fixture

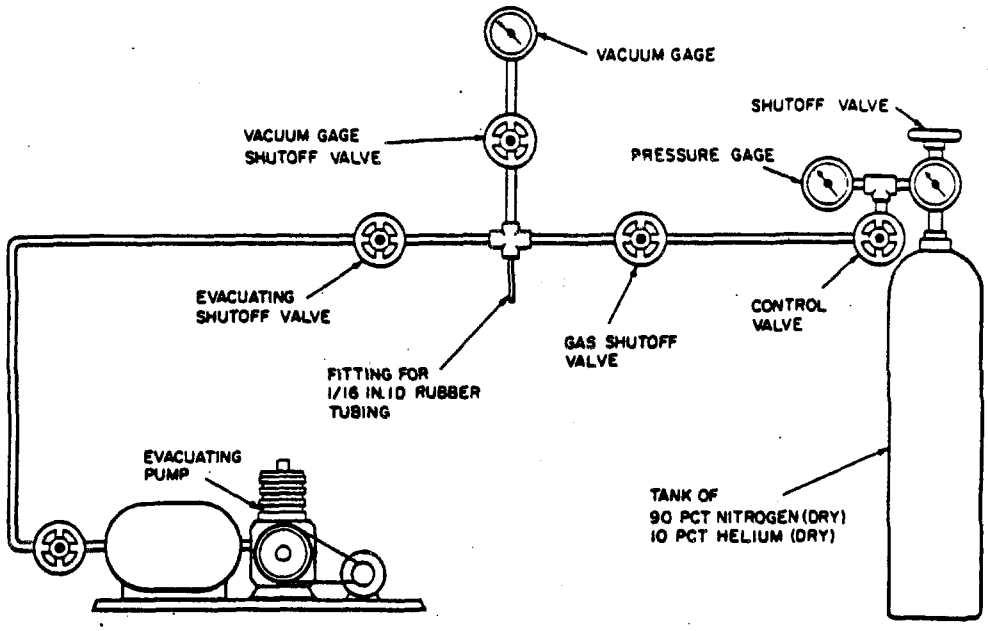


Figure 9. Typical Connections for Evacuation and Filling

6-1 FITS AND CLEARANCE

A. N/A

7-1 TESTING

A. GENERAL.

1. Testing of all basic components is covered in Section 3-1, Inspection and Check.

2. Preseal and final tests are both covered in Section 7, Testing.

B. FUNCTIONAL TEST.

1. Pointer Alignment.

   a. Connect the indicator assembly to the test circuit shown in Figure 11.

   b. Set decade section of the field calibration unit to the empty capacitance value given in Table III. Connect a voltmeter across the wiper of potentiometer R4 (Index No. 8, Figure 5) and ground pin B. Adjust the decade section capacitance until the voltmeter indicates a null.

   c. Using a soft, pointed instrument, adjust the pointer (Index No. 1, Figure 3) to indicate zero. (Adjustment possible only during preseal testing. Pointer alignment can only be verified during final test.)

2. Travel Time Test.

a. Open switch S1 and set the decade section of the field calibration unit to the full capacitance value given in Table III for the indicator under test. Close switch S1 and observe the time required for full scale deflection. The time must not exceed 30 seconds. Repeat the test in a downscale direction. The same limits apply.

TABLE III
FULL AND EMPTY CAPACITANCE

INDICATOR PART NO.	NOMINAL EMPTY AND FULL SCALE CAPACITANCE (UUF) EMPTY	FULL
393004-060	176.8	388.8
393004-061	156.12	336.19
393004-131	176.8	396.23
393004-132	156.12	335.94

3. Sensitivity Test.

a. Using the test setup of Figure 11, slowly increase the decade section of the field calibration unit to move the pointer upscale to any convenient mid-range readings. Record the exact capacitance setting.

b. Decrease the capacitance very slowly until the pointer moves. Proper indicator sensitivity is determined by the amount of capacitance change required to produce a pointer movement.

TABLE IV
CAPACITANCE VALUES FOR SENSITIVITY TEST

INDICATOR PART NO.	CAPACITANCE (UUF)
393004-060 and -131	.44 UUF
393004-061 and -132	.36 UUF

4. Linearity and Calibration.

a. Set the decade section of the field calibration unit to the zero capacitance value given in Table III for the particular indicator used. If necessary, adjust the "EMPTY" adjusting screw on the indicator so the pointer indicates zero.

b. Set the decade section to the full capacitance value given in Table III for the particular indicator used. If necessary, adjust the "FULL" adjusting screw on the indicator so that the indicator indicates full scale.

c. Set the decade section to move the pointer to each of the dial readings listed in Table V or Table VA for the particular indicator used. At each point, the capacitance must be within the tolerance listed. (Note: approach each point in an upscale direction.)

TABLE V
LINEARITY AND CALIBRATION VALUES

POINTER INDICATION	393004-060	393004-061
0	176.80	156.12
200	207.64 ± 1.35	181.39 ± 1.35
400	238.64 ± 1.35	206.66 ± 1.35
600	269.32 ± 1.35	231.93 ± 1.35
800	300.16 ± 1.35	257.20 ± 1.35
1000	331.00 ± 1.35	282.47 ± 1.35
1200	361.84 ± 1.35	307.74 ± 1.35
1375	388.8	N/A
1425	N/A	336.19

TABLE VA
LINEARITY AND CALIBRATION VALUES

POINTER INDICATION	393004-131	393004-132
0	176.80	156.12
1	210.80 ± 1.35	184.00 ± 1.35
2	244.80 ± 1.35	211.80 ± 1.35
3	278.80 ± 1.35	239.70 ± 1.35
4	312.80 ± 1.35	267.50 ± 1.35
5	346.80 ± 1.35	295.40 ± 1.35
6	380.80 ± 1.35	323.25 ± 1.35
6.455	396.23	335.94

C. SEALING.

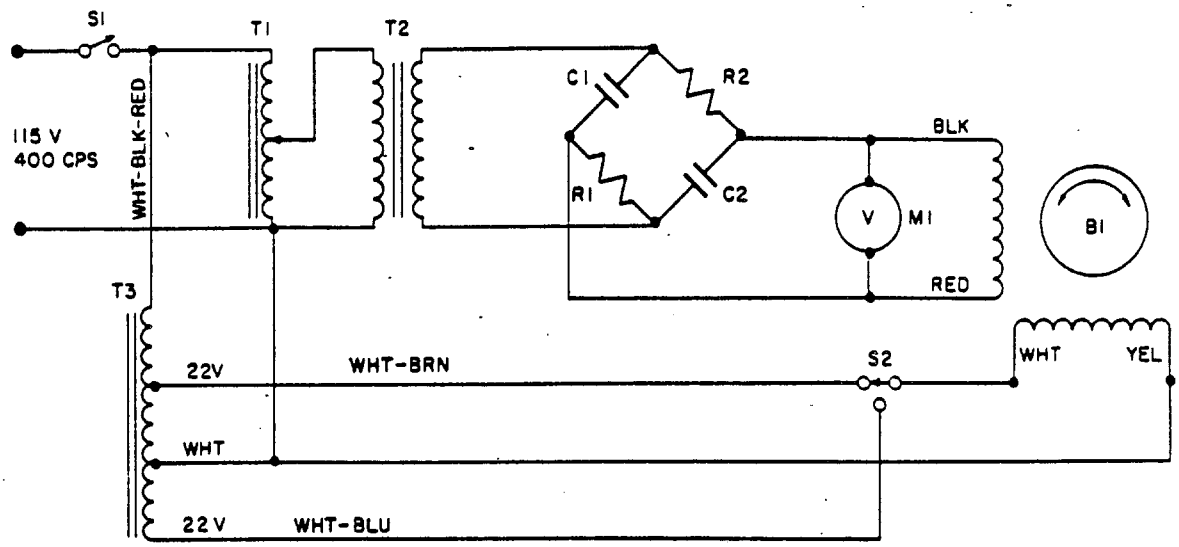
1. At this point in the test procedure, the indicator assembly should be sealed, evacuated, and backfilled as instructed in Paragraph 5-E.
2. When the indicator assembly has been completely sealed, proceed with tests of Paragraphs 7-D and 7-E.

D. LEAK TEST.

1. Check for leaks in the sealed indicator assembly using a helium leak dectector.
2. The leakage rate must not exceed 10^{-6} milliliters per second.

E. FINAL TEST.

1. Repeat testing described in Paragraph 7-B to insure that the sealing operation has not effected the calibration.



B1 - Motor Under Test (See text)
C1 - Capacitor. 12 UF. paper or plastic film Hi-quality 400 VDCW
C2 - Capacitor. 12 UF. paper or plastic film Hi-quality 400 VDCW
M1 - Voltmeter. 0-30 VAC. 1000 Ω V
R1 - Resistor. 40 Ω. 10 W. Wire-wound
R2 - Resistor. 40 Ω. 10 W. Wire-wound
S1 - Switch. SPST
S2 - Switch. SPDT
T1 - Transformer. Variable Auto (Variac W-10. or equivalent)
T2 - Transformer. Stepdown (3:1 Ratio. 115 V. 400 CPS primary)
T3 - Transformer. Auto (Primary of Transformer supplied in Indicator)

Figure 10. Motor-Test Circuit

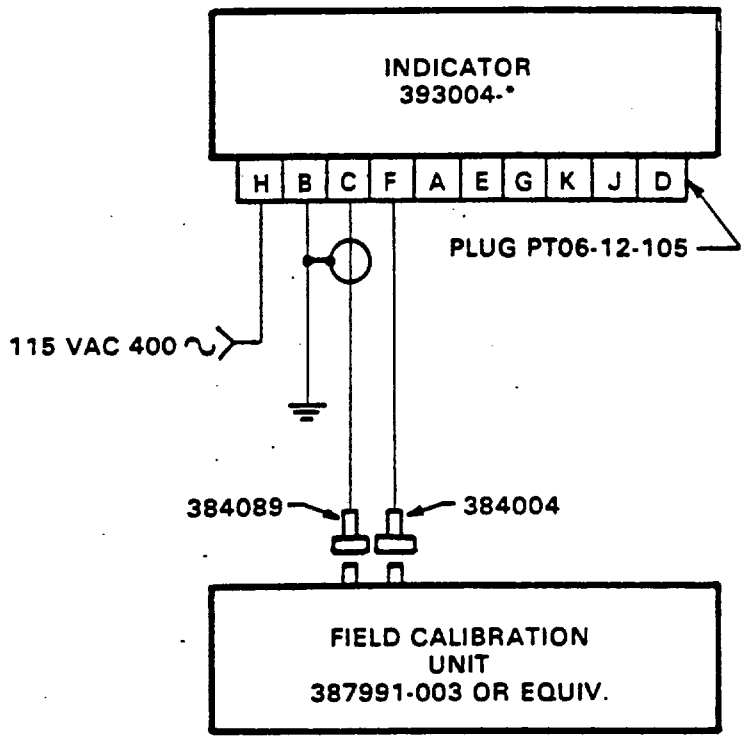


Figure 11. Circuit Arrangement for Testing Indicator, Part No. 393004-*

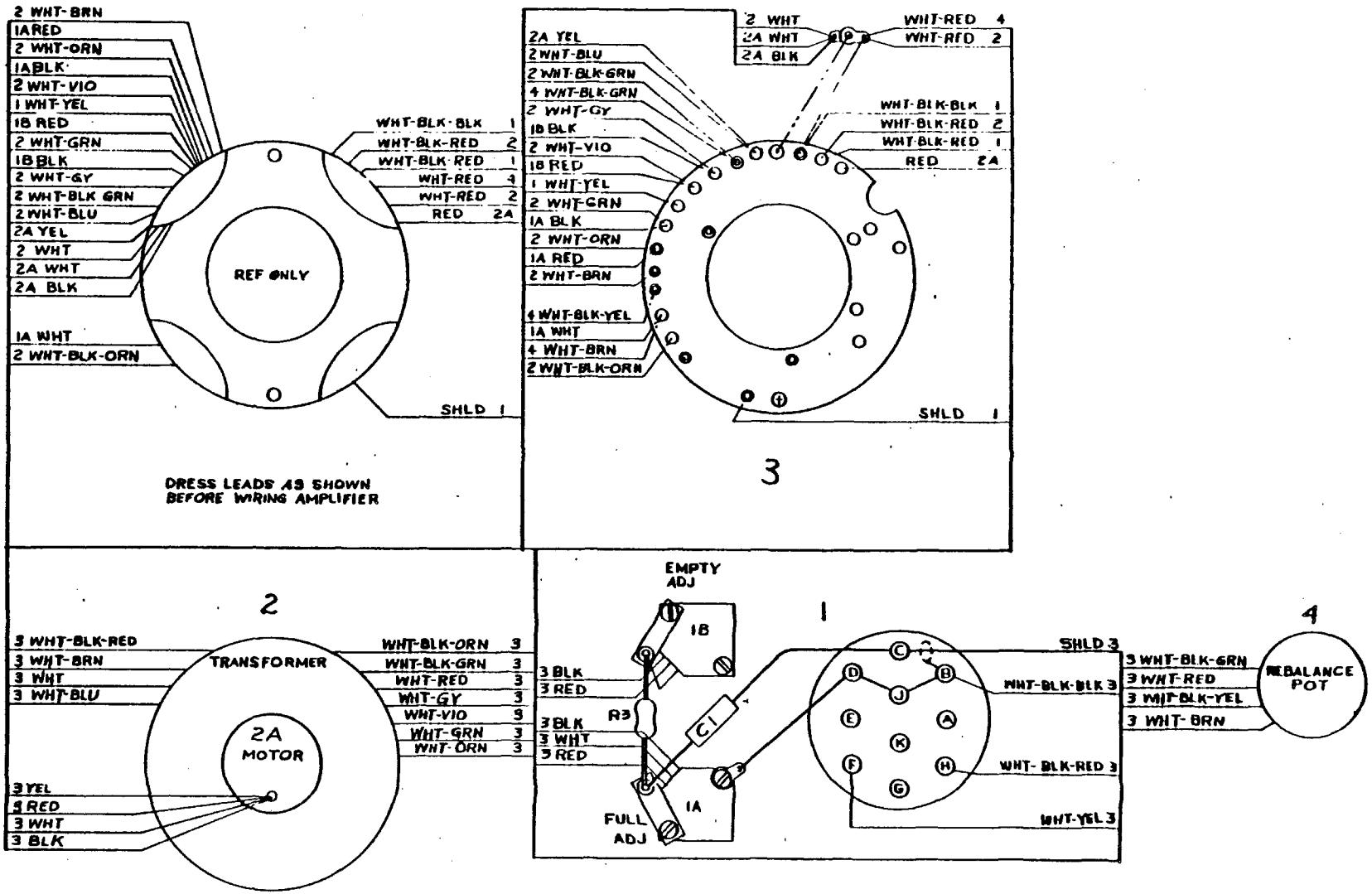
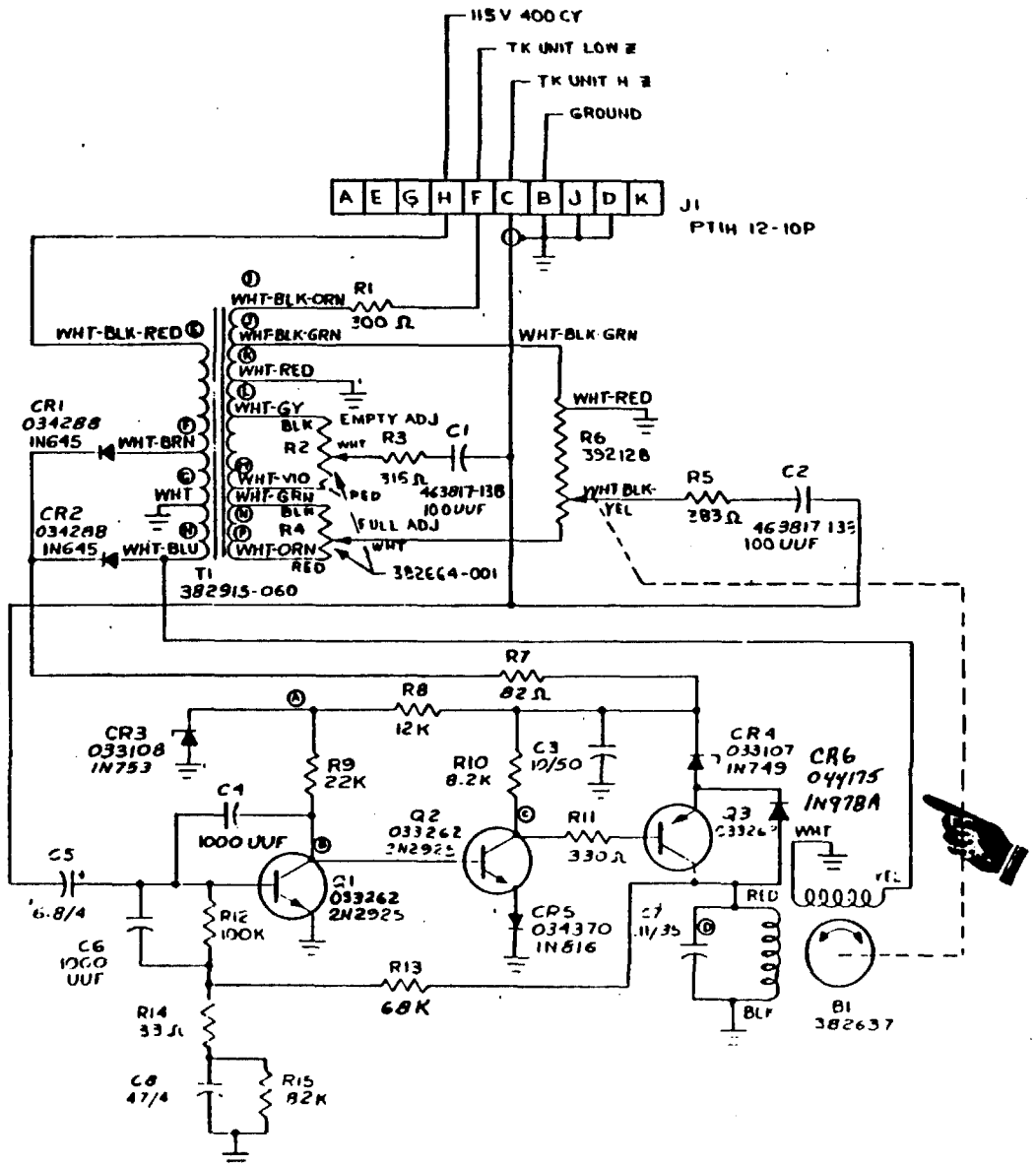
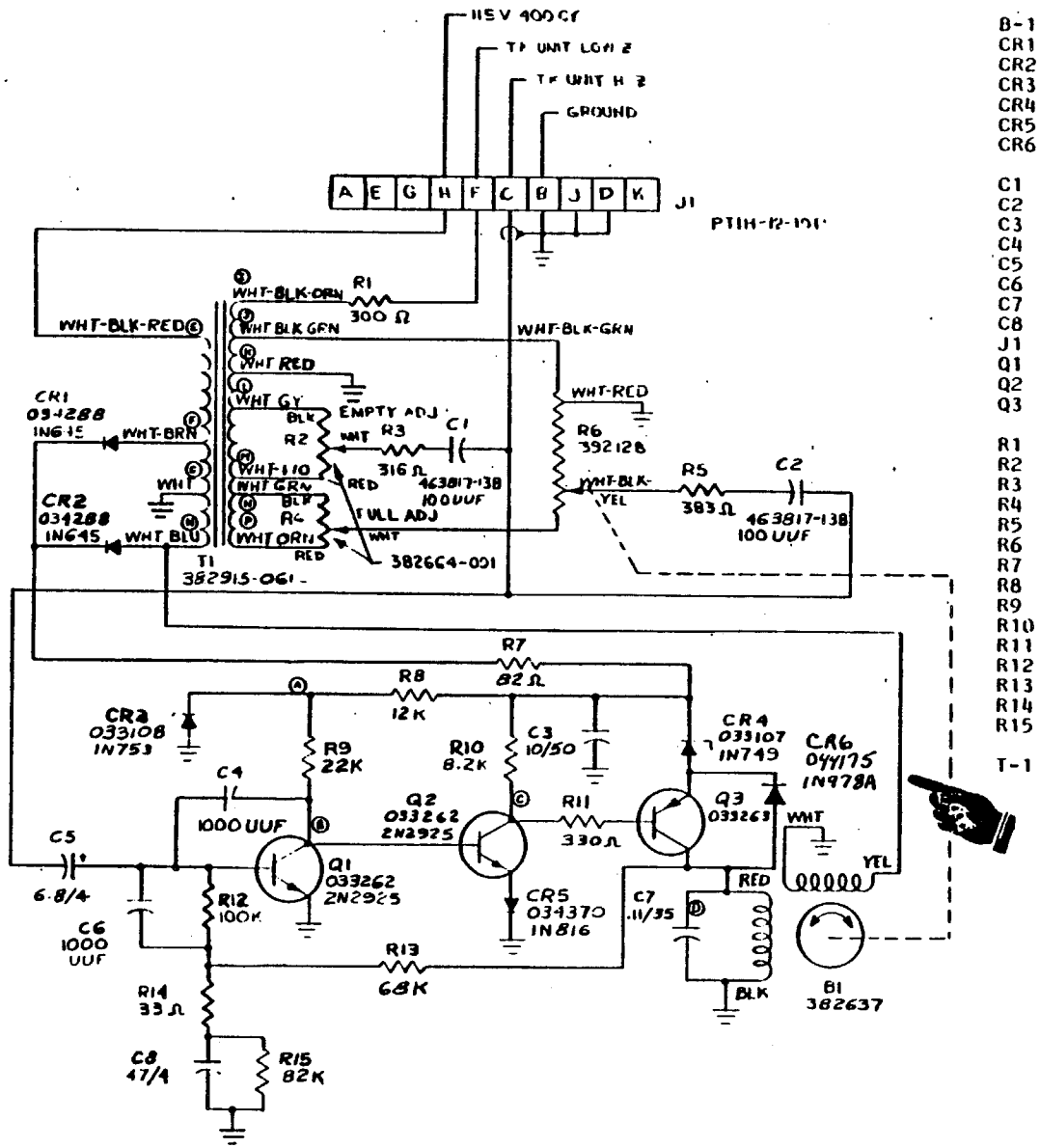


Figure 12. Wiring Diagram, Part Numbers 393004-060 and 393004-061



B-1	Motor 382637
CR1	Diode IN645
CR2	Diode IN645
CR3	Diode IN753
CR4	Diode IN749
CR5	Diode IN816
CR6	Diode IN978A
C1	Capacitor, 463817-138
C2	Capacitor, 463817-138
C3	Capacitor, 10 mf ± 5%, 50 wvdc
C4	Capacitor, VK20CW102K
C5	Capacitor, 618 mf ± 5%, 4 wvdc
C6	Capacitor, VK20CW102K
C7	Capacitor, .11 mf ± 10%, 35 wvdc
C8	Capacitor, 47 mf ± 10%, 50 wvdc
J1	PT1H-12-10P
Q1	Transistor 2N2925
Q2	Transistor 2N2925
Q3	Transistor 2N3702
R1	Resistor 242E3015
R2	Resistor 382664-001
R3	Resistor CG1/8 316 ohms ± 5%
R4	Resistor 382664-001
R5	Resistor CG1/8 383 ohms ± 5%
R6	Resistor 392128
R7	Resistor BB1/8 82 ohms
R8	Resistor BB1/8 12K
R9	Resistor BB1/8 22K
R10	Resistor BB1/8 8.3K
R11	Resistor BB1 8 330 ohms
R12	Resistor BB1/8 100K
R13	Resistor BB1/8 68K
R14	Resistor BB1/8 33 ohms
R15	Resistor BB1/8 82K
T-1	Transformer 382915-060

Figure 13A. Schematic Diagram, Part Numbers 393004-060 and 393004-131



B-1	Motor 382637
CR1	Diode IN645
CR2	Diode IN645
CR3	Diode IN753
CR4	Diode IN749
CR5	Diode IN816
CR6	Diode IN978A
C1	Capacitor, 463817-138
C2	Capacitor, 463817-138
C3	Capacitor, 10 mf ± 5%, 50 wvdc
C4	Capacitor, VK20CW102K
C5	Capacitor, 618 mf ± 5%, 4 wvdc
C6	Capacitor, VK20CW102K
C7	Capacitor, .11 mf ± 10%, 35 wvdc
C8	Capacitor, 47 mf ± 10%, 50 wvdc
J1	PTIH-12-10P
Q1	Transistor 2N2925
Q2	Transistor 2N2925
Q3	Transistor 2N3702
R1	Resistor 242E3015
R2	Resistor 382664-001
R3	Resistor CG1/8 316 ohms ± 5%
R4	Resistor 382664-001
R5	Resistor CG1/8 383 ohms ± 5%
R6	Resistor 392128
R7	Resistor BB1/8 82 ohms
R8	Resistor BB1/8 12k
R9	Resistor BB1/8 22k
R10	Resistor BB1/8 8.3k
R11	Resistor BB1 8 330 ohms
R12	Resistor BB1/8 100K
R13	Resistor BB1/8 68k
R14	Resistor BB1/8 33 ohms
R15	Resistor BB1/8 82k
T-1	Transformer 382915-061

Figure 13B. Schematic Diagram, Part Numbers 393004-061 and 393004-132

8-1 TROUBLESHOOTING

A. If the indicator assembly cannot be adjusted to "EMPTY" or "FULL", check resistors R2 and R4 respectively.

B. If the indicator assembly fails to meet linearity and calibration values of Tables III through VA, check resistor R6.

C. TEST POINT VOLTAGE MEASUREMENTS (Reference Figure 11).

1. Apply 115 volts, 400 cps to the appropriate pin of receptacle J1 as shown in Figure 11.

2. Using a Simpson 260 (or equivalent) voltmeter, measure the voltage (to ground) at test points labeled in schematic Figures 13A and 13B. Reference voltage readings in Table VI.

TABLE VI
AC AND DC VOLTAGE TEST POINTS

Test Point	DC				AC										
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	P
393004-060 and -131					115	22	0.0	22	18.2	2.0	0.0	28.9	35.4	38.4	47.1
393004-061 and -132					115	22	0.0	22	22.2	2.0	0.0	31.1	38.2	38.4	47.0
393004-060 and -131 and -061 and -132	6.3	1.2	2.0	1.2											

D. If test voltages (Table VI) are incorrect, check transformer T1. Incorrect AC voltages are an indication of a faulty transformer. Incorrect DC voltages are an indication of faulty amplifier components.

9-1 STORAGE AND PACKAGING

A. It is recommended to package the fuel quantity indicator in its original container.

B. If the original container is not available, package indicator as follows:

1. Completely wrap indicator in moisture-proof paper. Seal with moisture proof tape.
2. Insert wrapped indicator in a cardboard carton being sure to adequately cushion carton on all sides so indicator will be held securely in place. Seal carton with moisture-proof tape.
3. Wrap carton with moisture-proof paper and seal with moisture-proof tape. Mark the carton "FRAGILE".
4. Affix a label containing the following information:
   a. Indicator Part Number.
   b. Serial Number.
   c. Date of last overhaul.
   d. Note and date of any component change.

10-1 SPECIAL TOOLS, FIXTURES, AND EQUIPMENT

Part Number	Description	Application
387991-003 (or equivalent)	Field Calibration Unit	Supplies tank unit substitute capacitance.
Model P-2 (or equivalent)	Tester, Voltage Breakdown	Tests motor insulation.
T-25-1 (or equivalent)	Heater, Induction	Flowing Solder
63L-B (General Radio) (or equivalent)	"Strobotac" Stroboscopic Tachometer	Supplies variable speed control of motor.
210 (Ownens Laboratory) (or equivalent)	Checker, Transistor	Tests Transistors.
260 (Simpson Electric Co.) (or equivalent)	Volt-Ohmeter	General purpose, voltage and resistance readings.
Model 1862-B General Radio (or equivalent)	Megohmeter	Measures insulation resistance of Motor.
Model MS-9ABC (or equivalent)	Helium Leak Detector	For checking hermetic seal.
Model W-10 (or equivalent)	Variac	Motor Test Circuit

FIGURE ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	USABLE ON CODE	UNITS PER ASSY
2 -	393004-060	Indicator, Fuel Quantity	A	Ref
2 -	393004-061	Indicator, Fuel Quantity	B	Ref
2 -	393004-131	Indicator, Fuel Quantity	C	Ref
2 -	393004-132	Indicator, Fuel Quantity	D	Ref
- 1	382977	.Plate, Identification (Attaching Parts)		1
- 2	No. 2 TYPZ .12LG	.Screw, Bind. Hd. (V45722) (Simmonds Spec. Cont. Dwg. 030990) ---*---		2
- 3	382981	.Decal		1
- 4	382978	.Tearband		1
- 5	392162	.Case Assembly		1
- 6	382976-1	..Case		1
- 7	383324	..Glass		1
- 8	382701	.Spacer		1
- 9	392163-060	.Indicator Subassembly (Ref. Fig. 3)	A	1
- 9	392163-061	.Indicator Subassembly (Ref. Fig. 3)	B	1
- 9	392163-131	.Indicator Subassembly (Ref. Fig. 3)	C	1
- 9	392163-132	.Indicator Subassembly (Ref. Fig. 3)	D	1

FIGURE ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	USABLE ON CODE	UNITS PER ASSY
3 -	392163-060	Indicator Subassembly (Ref. Index 9, Fig. 2)	A	Ref
3 -	392163-061	Indicator Subassembly (Ref. Index 9, Fig. 2)	B	Ref
3 -	392163-131	Indicator Subassembly (Ref. Index 9, Fig. 2)	C	Ref
3 -	392163-132	Indicator Subassembly (Ref. Index 9, Fig. 2)	D	Ref
- 1	393650-001	.Pointer Assembly (Replaced by item 1A)		1
- 1A	393650-003	.Pointer Assembly (Replaces item 1)		1
- 2	382626-060	.Dial, Scale	A	1
- 2	382626-061	.Dial, Scale	B	1
- 2	382626-131	.Dial, Scale	C	1
- 2	382626-132	.Dial, Scale	D	1
		(Attaching Parts)		
- 3	1-64X.12LG	.Screw, Undercut, Brs. Blk. Oxide Simmonds Spec. Cont. Dwg. 035005		2
		---*---		
- 4	392161-001	.Screw, Shaft		1
- 5	463819-060	.Amplifier (Ref. Fig. 4)		1
		(Attaching Parts)		
- 6	035472-103	.Screw		2
- 7	MS35338-134	.Washer, Lk, Spg. Type Cres. No. 1		2
		---*---		
- 8	392164-001	.Indicator Drive Assembly (Ref. Fig. 5) (Replaced by item 8A)		1
- 8A	392164-003	.Indicator Drive Assembly (Ref. Fig. 5) (Replaces item 8)		1
		(Attaching Parts)		
- 9	463824	.Standoff		2
		---*---		
- 10	382637	Motor		1
		(Attaching Parts)		
- 11	035472-103	.Screw		3
- 12	No. 1	.Washer, Lock Sprg. Type Cres		3
- 13	397000	.Clamp, Motor		3
		---*---		
- 14	392100-001	.Gearbox Assy (Ref. Fig. 5) (Replaced by item 14A)		1
- 14A	392100-006	.Gearbox Assy (Ref. Fig. 5) (Replaces item 14)		1

FIGURE ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	USABLE ON CODE	UNITS PER ASSY
3 - 15 .	382915-060	.Transformer Assembly	A, C	1
- 15	382915-061	.Transformer Assembly	B, D	1
- 16	382980	.Spacer, Ring		1
- 17	392138-060	.End Plate Assembly (Ref. Fig. 6)		1
- 18	030768	.Lug, Flat		2

FIGURE ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	USABLE ON CODE	UNITS PER ASSY
4 -	463819-060	Amplifier Assembly (Ref. Index 5, Fig. 3)		Ref
- 1	242E3015	.Resistor, R1 (V56289) (Simmonds Spec. Cont. Dwg. 031755)		1
- 2	463817-138	.Capacitor C2		1
- 3	IN753	.Diode CR3 (Replaced by item 3A)		1
- 3A	IN753A	.Diode CR3 (Replaces item 3)		1
- 4	IN749	.Diode CR4		1
- 5	109D106X0050C2	.Capacitor C3 (V56289) (Replaced by item 5A)		1
- 5A	137D106X005002	.Capacitor C3 (V56289) (Replaces item 5)		1
- 6	IN645	.Diode CR6, (Replaced by item 6A)		1
- 6A	1N978A	.Diode, CR6, (Replaces item 6)		1
- 7	BB 1/8 68K	.Resistor R13 (V01121) (Replaced by item 7A)		1
- 7A	RCR05G683JS	.Resistor R13 (Replaces item 7)		1
- 8	CG 1/8 383Ω 5%	.Resistor R5 (V01295)		1
- 9	BB 1/8 33Ω	.Resistor R14 (V01121) (Replaced by item 9A)		1
- 9A	RCR05G560JS	.Resistor R14 (Replaces item 9)		1
- 10	162D476X0004CA2	.Capacitor C8 (V56289) (Simmonds Spec. Cont. Dwg. 036602-002)		1
- 11	162D684X0004AB2	.Capacitor C5 (V56289) (Replaced by item 11A)		1
- 11A	162D685X0004AB2	.Capacitor C5 (V56289) (Replaces item 11) (Simmonds Spec. Cont. Dwg. 036602-001)		1
- 12	BB 1/8 100K	.Resistor R12 (V01121) (Replaced by item 12A)		1
- 12A	RCR05G104JS	.Resistor R12 (Replaces item 12)		1
- 13	VK20CW102K	.Capacitor, C4, C6 (V95275)		2
- 14	BB 1/8 82K	.Resistor R15 (V01121) (Replaced by item 14A)		1
- 14A	RCR05G823JS	.Resistor R15 (Replaces item 14)		1
- 15	BB 1/8 22K	.Resistor R9 (V01121) (Replaced by item 15A)		1
- 15A	RCR05G223JS	.Resistor R9 (Replaces item 15)		1
- 16	BB 1/8 12K	.Resistor R8 (V01121) (Replaced by item 16A)		1
- 16A	RCR05G123JS	.Resistor R8 (Replaces item 16)		1
- 17	IN816	.Diode CR5		1

FIGURE ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	USABLE ON CODE	UNITS PER ASSY
4 - 18	BB 1/8 8.2K	.Resistor R10 (V01121) (Replaced by item 18A)		1
- 18A	RCR05G822JS	.Resistor R10 (Replaces item 18)		
- 19	BB 1/8 330Ω	.Resistor R11 (V01121) (Replaced by item 19A)		1
- 19A	RCR05G331JS	.Resistor R11 (Replaces item 19)		1
- 20	BB 1/8 82Ω	.Resistor R7 (V01121) (Replaced by item 20A)		1
- 20A	RCR05G820JS	.Resistor R7 (Replaces item 20)		1
- 21	151D114X9035W2	.Capacitor C7 (V56289) (Simmonds Spec. Cont. Dwg. 031587)		1
- 22	2N3702	.Transistor Q3 (Replaced by item 22A)		1
- 22A	033263	.Transistor Q3 (Simmonds Source Cont. Dwg.)		1
- 23	2N2925	.Transistor Q1, Q2 (Simmonds Spec. Cont. Dwg. 033262)		2
- 24	044150-001	.Transipad		26
- 25	463818	.Terminal Board (Replaced by item 25A)		1
- 25A	469164	.Terminal Board (Replaces item 25)		1
- 26	1N645	.Diode CR1, CR2		2

FIGURE ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	USABLE ON CODE	UNITS PER ASSY
5 -	392164-001	Indicator Drive Assembly (Ref. Index 8, Fig. 3) (Replaced by 5A)		Ref
5A-	392164-003	Indicator Drive Assembly (Ref. Index 8, Fig. 3) (Replaces item 5)		Ref
- 1	392100-001	.Gear Box Assembly (Replaced by item 1A)		1
- 1A	392100-006	.Gear Box Assembly (Replaces item 1)		1
- 2	393756	..Ring, Retaining		1
- 3	392394	..Faceplate (Replaced by item 3A)		1
- 3A	474340	..Faceplate (Replaces item 3)		1
- 4	392135	..Cluster and Wiper Assembly		1
- 5	392267	...Cluster Assembly, 320°		1
- 6	397064	...Wiper, Assembly		1
- 7	392435	...Pin, Dog		1
- 8	392128	..Potentiometer Assembly, R4 (Winding Res 4400 ohms ± 5%)		1
- 9	393510	.Gear Box Subassembly		1
- 10	0-80X.18Lg.	..Screw, Flat Hd SS		4
- 11	392104	..Plate, Support		1
- 12	392101	..Plate, Rear		1
- 13	469304	..Spring, Shield		1
- 14	392116	..Cluster, 2nd Stage		1
- 15	392110	..Cluster, 4th Stage		1
- 16	392119	..Cluster, 1st Stage		1
- 17	392113	..Cluster, 3rd Stage		1
- 18	392103	..Post, Support		3
- 19	392269	..Post, Key		1
- 20	392102	..Plate, Front		1
- 21	392106	..Housing		1
- 22	397565	..Pin, Stop		1
- 23	463944	..Spacer, Shaft		1

FIGURE ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	USABLE ON CODE	UNITS PER ASSY
6 -	392138-060	End Plate Assembly (Ref. Index 17, Fig. 3)		Ref
- 1	382982	.Stud, Space		2
- 2	CG 1/8	.Resistor, CG 1/8 316 Ω ± 5% (V01295) R3 (Simmonds Spec. Cont. Dwg. 031759-012)		1
- 3	463817-138	.Capacitor C1		1
- 4	392136	.Terminal Strip Assy		2
- 5	382664-001	.Trimmer R2, R4		2
		(Attaching Parts)		
- 6	048177-004	.Screw, Pan. Hd. (Replaced by items 6A and 6B)		4
- 6A	MS51957-4	.Screw, Pan. Hd (Replaces item 6)		2
- 6B	MS51957-5	.Screw, Pan Hd. (Replaces item 6)		2
- 7	AN936A2	.Washer, Lock Int Tooth (Replaced by item 7A)		1
- 7A	MS35333-35	.Washer, Lock Int Tooth (Replaces item 7)		1
- 8	MS35338-134	.Washer, Lock, Split		3
- 9	030768	.Lug, Flat		1
		---*---		
- 10	PT1H-12-10P	.Receptacle (V-77820)		1
- 11	382979	.Tube, Evacuation		1
- 12	392137	.Bellows Assembly		2
- 13	397030	.End Plate		1

HANDLING AND STORAGE PROCEDURE

BLADDER TYPE FUEL AND OIL CELLS

PART NO. C6SC1051 thru 1058

UNIROYAL (1966) Ltd.
GENERAL PRODUCTS DIVISION
KITCHENER, ONTARIO

Revised November 23, 1967

UNIROYAL (1966) LTD. was formerly Dominion Rubber Co. Ltd.

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STORAGE

UNIROYAL (1966) LTD.
Technical Field Service - Fuel Cell Department
Suggested Procedure for Bladder Type Fuel & Oil Cells

TITLE: HANDLING BLADDER TYPE FUEL CELLS

I. General:

A. The purpose of this procedure is to provide a method of handling bladder type fuel and oil cells, including storage, pre-installation inspection, installation, post-installation test for the entire system, removal of the cell in the event it is necessary, pressure test and minor repair.

B. The scope of this procedure should be such as to include all handling and minor repair of bladder type fuel and oil cells.

II. Detailed Requirements:

A. Storage, Inspection, and Handling of the bladder type cell prior to installation.

1. Cells should be stored only at room temperature and with no more than normal humidity. Cells should not be stored except in their original shipping container.
2. Cells should be removed from the shipping container only at time of installation.
3. Inspection of the cell and shipping container after the cell has been removed from the container should be made for any damage which may have occurred due to crating or removal from crate.
4. In transporting the cell from storage or inspection, it must not be picked up by the fittings and should be carried or transported on trucks. Under no circumstances should a cell be dragged, nor should cells be stacked except in their original shipping container.
5. Cells should be transported outside of installation area only in original shipping container.

6. Cells should not be handled with any sharp pointed tools and care should be exercised that the cell is not placed on any sharp edge or point while it is being transported.
7. Care should be taken to protect all projections, such as fittings, etc., of the cell during the handling or transportation.

B. Preparation of cell compartment for installation of bladder type cell.

1. Cell compartment must be thoroughly cleaned of all filings, trimmings, loose washers, bolts or nuts, etc.
2. All sharp edges of the cell compartment should be rounded off.
3. Cell compartments should be inspected just prior to the installation of the cell.
4. Tape over all sharp edges and rough rivets.

C. Installation.

1. Check to be sure cell is warm enough to be flexible.
2. All sharp tools such as screwdrivers, or files, should be prohibited for installation purposes.
3. As soon as the cell is in place in its compartment it should be developed out to its full size and hanger fittings connected. It should not remain in the folded or collapsed condition any longer than absolutely necessary.
4. After cell is developed out to its full size all connections should be made in accordance with instructions. Care should be exercised to check all fittings for proper alignment to avoid unnecessary strain.
5. The sealing or compression surfaces must be assembled when absolutely dry. (No sealing paste to be used.)
   NOTE: Item 6 for factory installation only.
6. When installation has advanced to the point where torque is

to be applied to bolts, nuts and studs, Company Inspection Representative should witness the application or check the torque controlled power tools to be used.

7. Torque shall be applied in the following manner if stop nuts are used.
   (a) The nut should be run on the bolt thread with the fingers until it reaches the locking area.
   (b) The torque wrench should then be applied and the bolt run through the lock.
   (c) A reading should be taken after the bolt has been run through the lock to determine the friction torque and this figure added to the final torque value of 35" lbs ∔ - 5" lbs. (See note X)
   (d) Nuts should be finally torqued to this combined torque value.

   NOTE: When using castellated nuts with cotter pins, turn nuts on with fingers and apply specified torque with torque wrench or torque controlled power tool.

   (X) These torque values are to be considered as recommended values unless otherwise specified on customers' assembly drawings.

8. There should be no repetition of torquing, after its first application under any circumstances, without first backing the nut off completely and procedure of II, C-7 again followed.
9. Special attention should be given to the following.
   (a) Bolt and stud lengths, to avoid "bottoming" on the inside of blind tapped holes or dome nuts.
   (b) Bolt lengths should be checked to avoid the riding of the nut on the shank or unthreaded area.

(c) Either of the above conditions results in an error which results in a loss of compression value on the sealing surface of the molded fittings.

(d) When fastening or unfastening the snap fasteners, great care should be exercised that a straight push or pull is not exerted, but that the fastener is tilted a little to one side before it is snapped or unsnapped.

(e) Internal rubber tubing protectors on hanger studs must be removed and should be saved for re-use on cells which may be removed from the airplane.

(f) Care should be taken to avoid damage to hangers and fittings during installation.

10. After final torque is applied, the cell should be inspected for final fit within its compartment, making certain that the cell is extended out to the structure and no corners are folded in.

11. The final inspection prior to closing the cell should be a close check to be sure the cell is free from foreign matter such as lint, dust, oil or other installation equipment. If cell is not thoroughly clean, it should be cleaned with a lint-free cloth soaked in water, alcohol, or kerosene. No other solvent shall be used.

D. Post Installation Pressure Check. Suggest use of UNIROYAL (1966) Limited Pressure Testing Procedure.

E. Removal of bladder type cell from its compartment.

1. If it is necessary for any reason to remove the cell from the cavity or to deform it inside the cavity, it is suggested that the cell be drained and then flushed, sprayed, or rubbed with light engine oil. The cell should not be removed or handled until 24 hours after the oil has been applied.

2. Upon removal, the following precautions are necessary:

(a) Disconnect all fittings, hangers, snap fasteners, etc.

(b) Collapse cell to as near the completely collapsed condition as is possible.

(c) Care should be exercised when actually removing the cell from its compartment so that the cell does not drag over any sharp edge or projection while it is being removed from the cavity.

III. General Procurement

A. Do not store bladder type cells under any circumstances near heat or in extremes of humidity.

B. Do not allow bladder type cells to remain longer than absolutely necessary in any strong light. When working inside cell do not allow hot light bulb to come in contact with liner. Fluorescent inspection lights are recommended for use with fuel cells.

C. When storing cells, store in such a manner that their shipping containers are placed level, and when necessary to stack more than one high, see that the containers are placed squarely on each other so as to preclude any danger of slipping and the sharp edge of one container perforating another.

D. Do not get inside cells with tools in pockets or with shoes on.

IV. References

A. Technical Order U.S.A.F. 03-10J-3, Fuel System - Required Torque on Self-Sealing Fuel Cell Fittings and Elimination of Sealing Paste.

B. Technical Order 03-10J-5 & 5A, Fuel System - Storage, Handling, and Packing of Fuel and Oil Cells.

C. Technical Order 03-10J-6 & 6A, Failures, Inspection and Disposition of Self-Sealing Fuel and Oil Cells.

D. Technical Order 6J14-1-3, Repair, Handling and Storage Instructions, Rubber and Nylon Fuel, Oil and Water Alcohol Cells.

E. R.C.A.F. references 05-1-3; and 05-1-2L.

UNIROYAL (1966) LTD.

PRESERVATION OF FUEL CELLS AFTER USE

When synthetic rubber fuel cells are placed in service, the gasoline has a tendency to extract the plasticizer from the inner liner of the cell. This extraction of plasticizer is not detrimental as long as gasoline remains in the fuel cells, in as much as the gasoline itself will act as a suitable plasticizer.

When the gasoline is drained from the fuel cell, the plasticizing effect of the gasoline is lost and the inner liner of the cell begins to dry out and subsequent cracking or checking will occur.

This cracking or checking may penetrate through the inner liner permitting gasoline to diffuse through walls of the cell after the cell has been re-fueled.

To prevent this failure, a thin coating of light engine oil should be applied to the inner liner of all serviceable fuel cells, which have contained gasoline, when it is evident that the cells will remain without fuel for more than ten days, whether installed in airplanes or in storage. The oil will act as a temporary plasticizer and will prevent the inner liner from drying out and cracking.

If it becomes necessary to return the cell to the contractor or the vendor for testing or repair, do not allow quantities of oil to be puddled in the cell as it will make handling and repair much more difficult. Cells should be re-packed as similar to the original factory pack as possible.

UNIROYAL (1966) LTD.

COMPRESSION METAL AND RUBBER MOLDED NIPPLE FITTINGS

COMPRESSION METAL FITTINGS:

Compression metal fittings have been developed by UNIROYAL (1966) LTD. for use with Mareng bladder type fuel cells. Replacement fittings are available by re-ordering by part number from UNIROYAL (1966) Limited.

The torque on the screws in the metal compression fittings should be 35" lbs +/- 5" lbs for 538N construction and 50" lbs +/- 5" lbs for 566R construction.

These torque values are to be considered as recommended values unless otherwise specified on customers' assembly drawings. This torque is sufficient to give positive fitting seal without damage to the fitting or cell material and will give permanent seal as long as the fitting is not disturbed.

Note: No sealing paste or gasket compound should be used with these fittings.

MOLDED NIPPLE FITTINGS:

The molded nipple fitting is a lightweight fitting developed for ease in installation in certain locations in the airplane. In order to get the best service from this type of fitting it is necessary to exercise certain precautions at the time of installation. The specific precautions other than the general care in handling are as follows:

1. The flow tube should be inserted into the fitting until the end is flush with the inside edge of the nipple.
2. The hose clamp should be clear of the end of the fitting by 1/4" where possible.
3. The hose clamp should always be located on the fabric reinforced area of the nipple.
4. The hose clamp should be tightened only finger tight. This tightening should be done at one time. No re-tightening should ever be done unless the hose clamp is loosened completely and allowed to set for 15 minutes before re-tightening.
5. No sealing paste or gasket compound should be used.

6. Apply thin film of Simonize Wax to metal flow tubes to facilitate installation and removal.

   Note: No other lubricants should be used on fittings of this type.

UNIROYAL (1966) LTD.

VARSOL LEAK TEST FOR BLADDER TYPE FUEL CELLS

1. Material and Equipment Required:

   A. Varsol.

   B. Controlled Air Pressure Line.

   C. Closure plates for cells - one with air line connector.

   D. Flexible coupling for air line.

2. Procedures:

   A. Plug fitting holes in cells.

   B. To access door apply plate with air line connector.

   C. Add Varsol to cell, 2 gallons for a small cell, 4 gallons for a large cell.

   D. Connect cell to air line.

   E. Inflate to 1/8 lb air pressure.

   F. Gently roll cell so that the whole of the inner surface becomes covered with liquid.

   G. Inspect cell for leaks (Leaks appear as a smear of oil).

   H. Cell should remain under pressure for 5 minutes.

   I. Inspect cell again for leaks and mark any found with wax crayon.

   J. Deflate cell, empty out Varsol and wipe the excess.

   K. Send cell for shipment or repair as appropriate.

REPAIR PROCEDURE FOR BLADDER TYPE FUEL CELLS
CONSTRUCTIONS US-566R & US-566RL
MANUFACTURED BY
UNIROYAL (1966) LTD.

WARNING

No repairs are to be made on the radius of a cell or in the fitting area of a cell. Cells with such damage are to be returned to the factory for repairs. No damaged areas such as cuts and tears larger than 1" are to be repaired in the field.

REFERENCE

USAF Technical Order No. 6J14-1-3.

REPAIRING THE CELL

A. Outside of Cell

1. Use a piece of synthetic rubber coated fabric UNIROYAL 5200 outside repair material, large enough to cover damage at least 2" from cut in any direction. Buff this material lightly and thoroughly with garnet paper and wash with Methyl Ethyl Ketone (UNIROYAL 3339 solution) to remove buffing dust.
2. Cement buffed side of patch with two coats of UNIROYAL 3200 repair cement. Allow each coat to dry 10 - 15 minutes.
3. Buff cell area to be patched lightly and thoroughly with garnet paper and wash with UNIROYAL 3339 solution to remove buffing dust.
4. Cement buffed area with two coats of UNIROYAL 3200 repair cement. Allow each coat to dry 10 - 15 minutes.
5. Freshen cemented area of patch and cemented area of cell with UNIROYAL 3339 solution.

6. While still tacky, apply edge of patch to edge of cemented area on the cell. With a roller or blunt instrument, roll or press the patch to the cemented area and roll or press it down a half-inch to an inch across at a time so as not to trap air between patch and cell. Lay 50 lbs shot bag over patch which is protected by a piece of Holland Cloth to prevent sticking. Weight should not be removed for 6 hours.
7. Seal coat edge of patch 1/2" with one coat of UNIROYAL 3200 repair cement and allow the cement to dry thoroughly.

B. Inside of Cell

1. After the damaged area has been patched on the outside of the cell and the repair allowed to stand a minimum of 6 hours, the cell is then ready to have the patch applied on the inside of the cell.
2. Lightly and thoroughly buff a piece of cured UNIROYAL 5200/5187 nylon sandwich material large enough to cover damage at least 2" from cut in any direction. Wash buffing dust off patch with Methyl Ethyl Ketone solution (UNIROYAL 3339).
3. Cement buffed side of patch with two coats of cement, UNIROYAL 3200 repair cement, and allow each coat to dry 10 - 15 minutes.
4. Buff cell area to be patched lightly and thoroughly with fine sandpaper (# "O" and then wash off buffing dust with Methyl Ethyl Ketone solution (UNIROYAL 3339).
5. Coat buffed area with two coats of cement, UNIROYAL 3200 repair cement, and allow each coat to dry 10 - 15 minutes.

6. Freshen cemented area of patch and cemented area of cell with Methyl Ethyl Ketone solution (UNIROYAL 3339).
7. While still tacky, apply edge of patch to edge of cemented area, centering patch over cut in cell. With a roller or blunt instrument, roll or press the patch to the cemented area on the cell. Hold part of patch off the cemented area and roll or press it down a half-inch to an inch across at a time so as not to trap air between patch and cell. Apply 50 lbs shot bag to repaired area and do not disturb for 6 hours.
8. Seal coat patch and 1/2" from edge of patch with two coats of UNIROYAL 3200 repair cement. Allow the first coat to dry one hour or more. Wipe patch and cemented area lightly with S.A.E. #10 oil, so that when the cell is in its original position the patch area will not stick to other areas of the cell.

C. Scuffed Fabric

1. Buff area surrounding scuffed fabric.
2. Wash buffing dust from area with UNIROYAL 3339 solution.
3. Apply two coats of UNIROYAL 3200 repair cement to the buffed area, allowing 10 minutes drying time between coats.

CHAPTER 29

HYDRAULIC POWER

TABLE OF CONTENTS

MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B./T.R.
Adel	Selector Valve	20907–1 & –2			S/B No. 174–104 dated Aug 5/1959
DHC	Reservoir Assembly Reservoir Assembly	C6HF1005 C6HF1057	26–10–16 29–10–15	Mar 31/1969 Mar 20/1974	TR 29–1 TR 29–2 dated Sep 17/1987
Gar Kenyon	Air Charging Valve	12057–1–3			
Adel Great Lakes	Hydraulic Pump Hydraulic Pump	Model 100–689–3 4100–689004 (Model 100–689–4)			 SB No. 689–4 dated Jun 15/1976
Parker Hannifin	Accumulator	1356–583314		Jun 15/1964	
Pneudraulics	Relief Valve	1000–4 (MS28893C4)		May 28/1957	
PTI Technologies was Purolator	Filter	50220		Jun 30/1993	
Teledyne Republic	Hand Pump	3–1158–18 (914)			

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Bulletin No. 174-104
18 August 1953
Rev. 5 Aug. 1959

ADEL DIVISION

GENERAL METALS CORPORATION

BURBANK, CALIFORNIA

OVERHAUL INSTRUCTIONS

WITH

PARTS BREAKDOWN

MANUALLY OPERATED FOUR-WAY HYDRAULIC SELECTOR VALVE (DISC TYPE) Part Nos 20907-1 and 20907-2

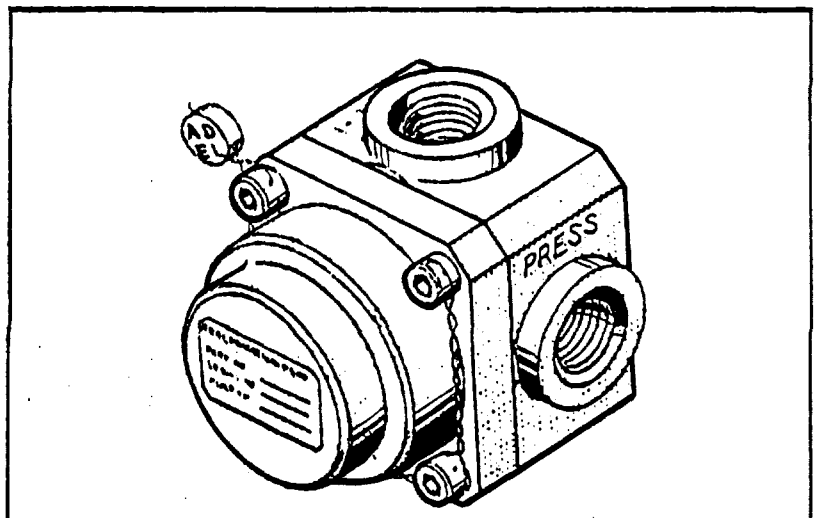


FIGURE 1

1. DESCRIPTION (see Figure 1).

   a. These valves are manually operated to direct the flow of hydraulic fluid under pressure to a double acting hydraulic mechanism, and to return the displaced fluid to the system or reservoir.

   b. Table of Leading Particulars:

System fluid	Hydraulic oil, Specification MIL-H-5606
Operating temperatures	-54°C to +77°C (-65°F to +170°F)
Max operating pressure	3000 psi
Shaft operating torque	17 in. lbs @ 1500 psi, 20 in. lbs @ 3000 psi

2. OPERATION (see Figure 2).

a. Valve shaft is directly connected with chambered valve disc. Rotation of disc controls fluid flow between ports in valve body. Mating surfaces of disc and body are ground optically flat. Internal stops limit travel to 45 degrees on either side of neutral center position.

3. DISASSEMBLY AND CLEANING

a. Disassemble valve in the order of the index numbers in Figure 3, using a clean, well-lighted working surface.

b. As parts are removed, they should be washed thoroughly in an approved solvent, dried with alint-free cloth, and placed in a clean, dust-tight container. Cleanliness is of utmost importance in servicing this valve.

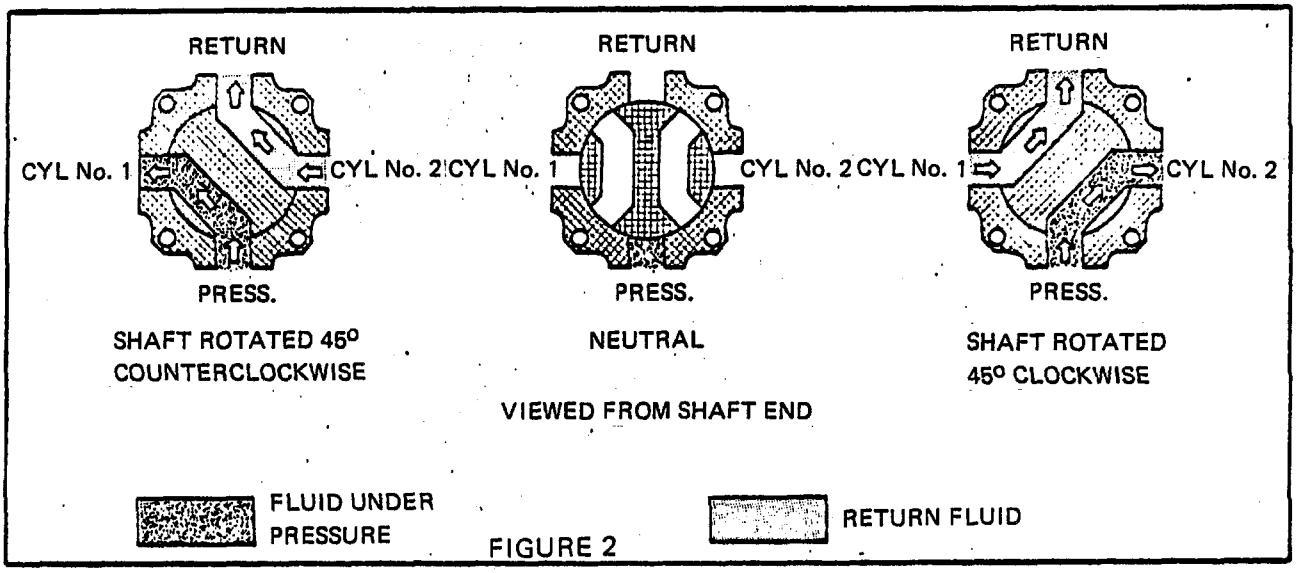


FIGURE 2

Optical flats on disc (17) and body (21) are critical surfaces. The slightest trace of foreign material lodging between these flats will cause valve to malfunction. As continued use tends to more perfectly mate these flats, disc (17) should always be replaced in the same valve body (21) from which it was removed.

c. If a vise is used to hold any part, be sure jaws are adequately padded.

4. INSPECTION, REPAIR AND REPLACEMENT

a. Inspect all parts for excessive wear or damage. Replace worn or damaged parts. Do not attempt repair of any part.

b. Inspect optical flats of disc (17) and body (21) under magnification, if possible. Damage to these surfaces will necessitate replacement of the entire valve.

c. Replace all "O" ring packings and back-up rings, regardless of condition.

5. LUBRICATION

a. System fluid provides adequate lubrication.

6. REASSEMBLY

a. Reassembly is the reverse of disassembly.

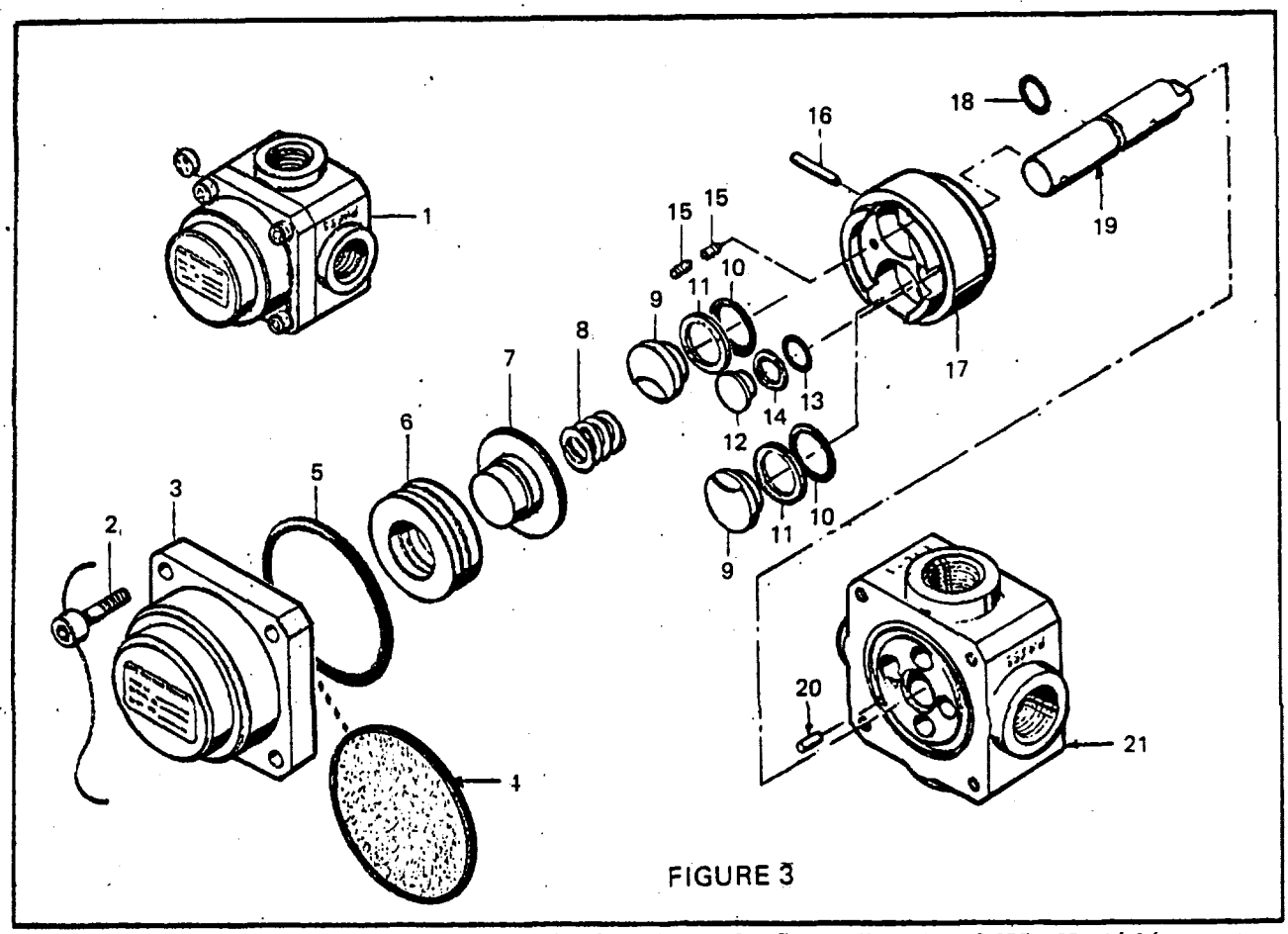


FIGURE 3

b. Moisten all parts with hydraulic oil, Specification MIL-H-5606, and assemble wet. Roll or rotate "O" ring packings to take out all twist.

c. Insert shims (4) as necessary to establish internal clearance of 0.003 to 0.006 inch.

Note

Flush valve thoroughly to remove air and wash out all foreign particles.

No external leakage allowed.

Check for external leakage at points 1 and 2

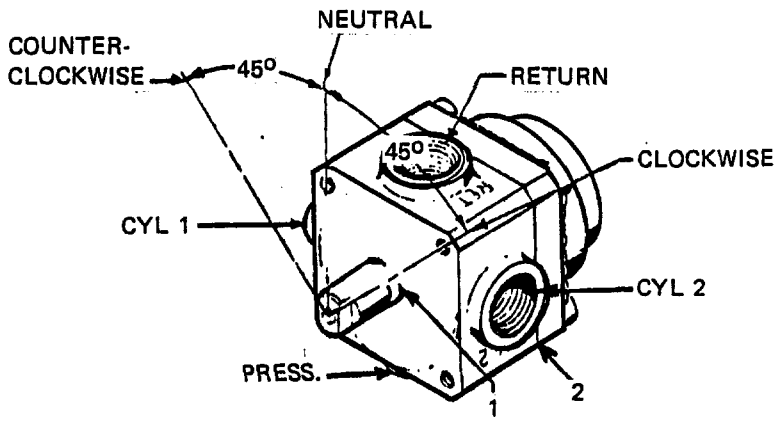


FIGURE 4

TEST PROCEDURES CHART

To Test	Apply Press. at	Plug	Valve Position	Test Press. (psi)	Max Internal Leakage	Remarks
Internal Leakage	Press.	Cyl 1 & Cyl 2	Neutral Counter-clockwise Clockwise	3000	1 drop per min.	Check for leakage at "Return" port in each handle position after waiting 2 min.
Handle Torque	Press.	Cyl 1 & Cyl 2	Counter-clockwise Clockwise	3000	-------	Max torque in either direction 20 in. lbs.
Internal Leakage	Cyl 1	Press. & Cyl 2	Counter-clockwise	3000	1 drop per min.	Check for leakage at "Return" port after waiting 2 min.
Internal Leakage	Cyl 2	Press. & Cyl 1	Clockwise	3000	1 drop per min.	Check for leakage at "Return" port after waiting 2 min.
External Leakage	Press.	Cyl 1 & Cyl 2	Neutral Counter-clockwise Clockwise	4500	-------	No external leakage allowed.
External Leakage	*Press. *Return	Cyl 1 & Cyl 2	Counter-clockwise Clockwise	4500 at press. port 1500 at return port	-------	No external leakage allowed.

*Test pressures as noted to be applied simultaneously for the test.
Note: Do not move handle when 4500 psi pressure is applied to valve for external leakage tests.

d. Before fully tightening screws (2), turn shaft several times to be sure bearing (6), retainer (7), spring (8) and plugs (9) are properly positioned.

7. TESTING (see Figure 4).

a. Tests must be conducted with filtered hydraulic preservative oil, Specification MIL-O-6083.

b. Valve must be thoroughly bled of air before applying test pressures.

c. Test pressures must be subject to accurate control up to 4500 psi.

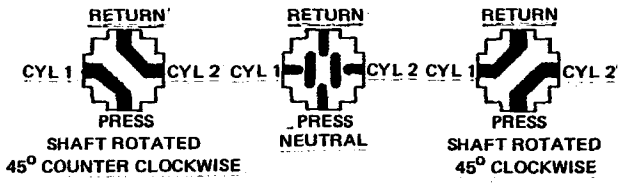
d. Conduct tests in sequence shown in Test Procedure Chart.

e. If valve is not to be installed immediately, all ports must be plugged after test to exclude foreign matter.

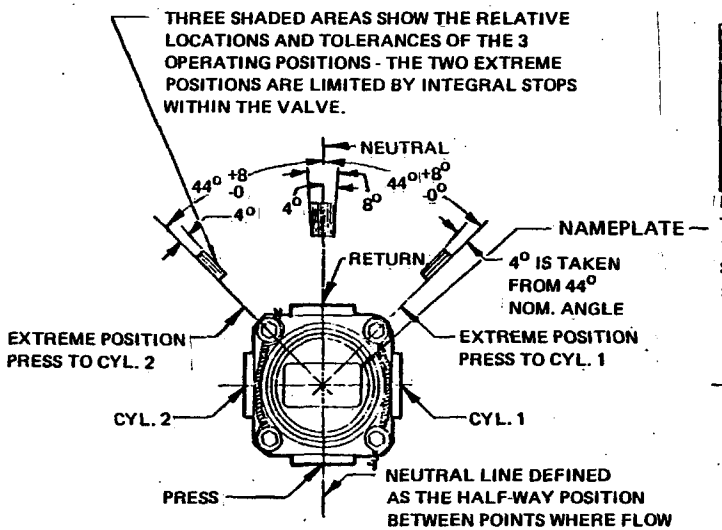
FIGURE & INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	UNITS PER ASSY
3 - 1	20907-1	VALVE ASSY - Four-way hyd selector 1/4 in. tube size	-
-	20907-2	VALVE ASSY - Four-way hyd selector 3/8 in. tube size	-
- 2	43101-29	. SCREW - Hex socket cap	4
- 3	20920	. COVER - Valve	1
- 4	#27288	. SHIM - Bearing	AR
- 5	AN6227-25	. PACKING - "O" ring hyd	1
- 6	DL15	. BEARING - Ball (Norma-Hoffman Corp) Adel P/N 40456-38	1
- 7	20982	. RETAINER - Spring.....	1
- 8	21028	. SPRING - Valve	1
- 9	20921	. PLUG - Valve	2
- 10	AN6227-8	. PACKING -"O" ring hyd	2
- 11	MS28774-016	. RING - Hyd back-up	2
- 12	20923	. PLUG - Valve	1
- 13	AN6227-5	. PACKING - "O" ring hyd	1
- 14	MS28774-012	. RING - Hyd back-up	1
- 15	AN565D6H2	. SCREW - Hex socket headless set ...	2
- 16	22929	. PIN - Dowel	1
- 17	*20922	. DISC - Valve	NP
- 18	AN6227-5	. PACKING - "O" ring hyd	1
- 19	20919	. SHAFT - Valve	1
- 20	21031	. PIN - Stop	1
- 21	21082	. BODY - Valve (used on 20907-1)	NP
	*20924	. BODY - Valve (used on 20907-2)	NP

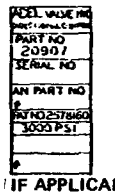
Used as required.
* Not procurable as a separate part.

PART NO.	TUBE SIZE	PORT SIZE PER AND 10030
20907-1	¼	7/16 - 20 NF - 3
20907-2	⅜	9/16 - 18 NF - 3

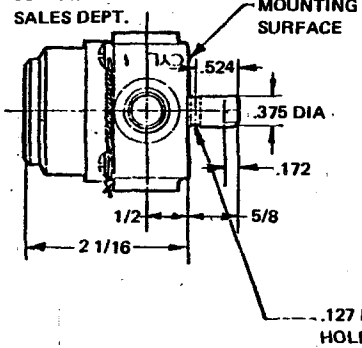


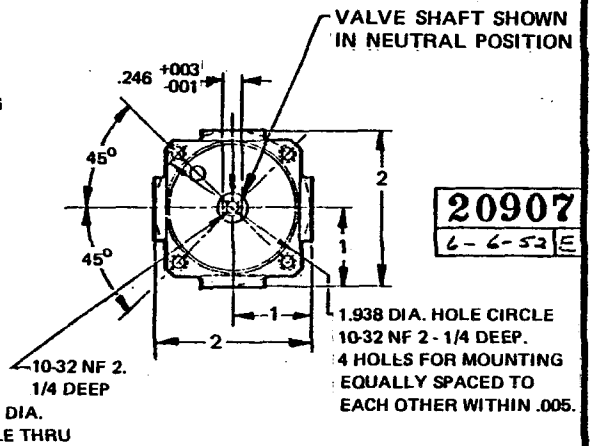
FLOW DIAGRAM — VIEWED FROM SHAFT END





IF APPLICABLE TO BE STAMPED WITH INFORMATION SUPPLIED BY SALES DEPT.





20907
6-6-52 E

NOTES

1. NO INTERFLOW WHEN CHANGING SHAFT POSITIONS.
2. TOTAL PRESSURE DROP:
   AT 2 G.P.M. FLOW 15 P.S.I. AT 3½ G.P.M 37 P.S.I. THRU 20907-2
   AT 1.2 G.P.M. FLOW 15 P.S.I., AT 2 G.P.M. 35 P.S.I. THRU 20907-1
3. SHAFT OPERATING TORQUE:
   AT 1500 P.S.I. 17 INCH LBS.
   AT 3000 P.S.I. 20 INCH LBS.
4. MAX. OPERATING PRESS. 3000 P.S.I.
5. NO EXTERNAL LEAKAGE OR DAMAGE AT 4500 P.S.I. PROOF OR AT 1500 P.S.I. BACK PRESSURE.
6. NO EXTERNAL LEAKAGE AND 1 DROP PER. MIN. INTERNAL LEAKAGE IN ANY OPERATING POSITION AT 3000 P.S.I. OPERATING PRESSURE.
7. PER AN-V-4 EXCEPT AS SHOWN.
8. VALVE PERFORMANCE CHARACTERISTICS NOTED AND QUALIFICATION BASED UPON FLUID PER MIL-H-5606. VALVE SUITABLE FOR USE WITH FLUID PER MIL-F-7083 (HYDROLUBE H-2) WITHIN THE LIMITATIONS OF THE FLUID.

TEST PER. H.T. 20907

ASSEMBLY DWG. N 20907 (REF.)

FULL

14-2

ADEL DIVISION, GENERAL METALS CORPORATION
10777 VANOWEN ST. BURBANK, CALIF.

VALVE - 4 WAY SELECTOR
¼ AND ⅜ TUBE SIZE

C

20907

De Havilland Canada

DHC-6 TWIN OTTER

OVERHAUL MANUAL

RESERVOIR ASSEMBLY

PART NO. C6HF1005

THE DE HAVILLAND AIRCRAFT OF CANADA LIMITED
DOWNSVIEW ONTARIO

Mar 31/69

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De Havilland Canada

DHC-6 TWIN OTTER
OVERHAUL MANUAL
C6HF1005

RECORD OF REVISIONS

Retain this record in the front of the manual. On receipt of revisions, insert revised pages in the manual and enter the revision number, revision date, insertion date, and initials of person incorporating the revision, in the appropriate block on the revision record.

Rev. No.	Rev. Date	Insertion Date	By

Rev. No.	Rev. Date	Insertion Date	By

LIST OF EFFECTIVE PAGES

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INTRODUCTION

This manual contains instructions for the overhaul of the De Havilland Reservoir Assembly Part No. C6HF1005.

RESERVOIR ASSEMBLY PART NO. C6HF1005

1. Description and Operation

The reservoir assembly (Figure 1) consists of a welded aluminum alloy body assembly with a filler neck, two suction outlets, a return inlet, a vent, and an adapter ring. A screen and cap are provided at the filler neck, and a view gage is attached to the adapter ring.

2. Disassembly

A. Disassemble Reservoir Assembly (Figure 3)

(1) Remove nut (1), washer (2), screw (3) and unscrew cap (4) with chain assembly (5) from filler neck. Remove O-ring (6) and screen assembly (7) from filler neck.

(2) Do not remove four screws (8) securing view gage assembly (9) to adapter ring except when a replacement view gage assembly is required.

(3) Remove union (10) and gasket (11) from handpump suction boss. Loosen nut (12) and remove elbow (13), O-ring (14) and gasket (15) from suction boss. Loosen nut (16) and remove elbow (17), O-ring (18) and gasket (19) from return boss.

(4) If damaged, remove label (20), label (21) and/or label (22) from body assembly (23).

3. Cleaning

A. General

(1) Clean components by washing or spraying with a dry-cleaning solvent.

(2) Dry with moisture-free compressed air or a lint-free cloth.

4. Inspection/Check

A. General

(1) Inspect nonmagnetic metal components using the fluorescent penetrant method, or an approved dye penetrant method. Concentrate inspection of body assembly at welded seams and joints.

(2) Inspect all threads for damage and deformity.

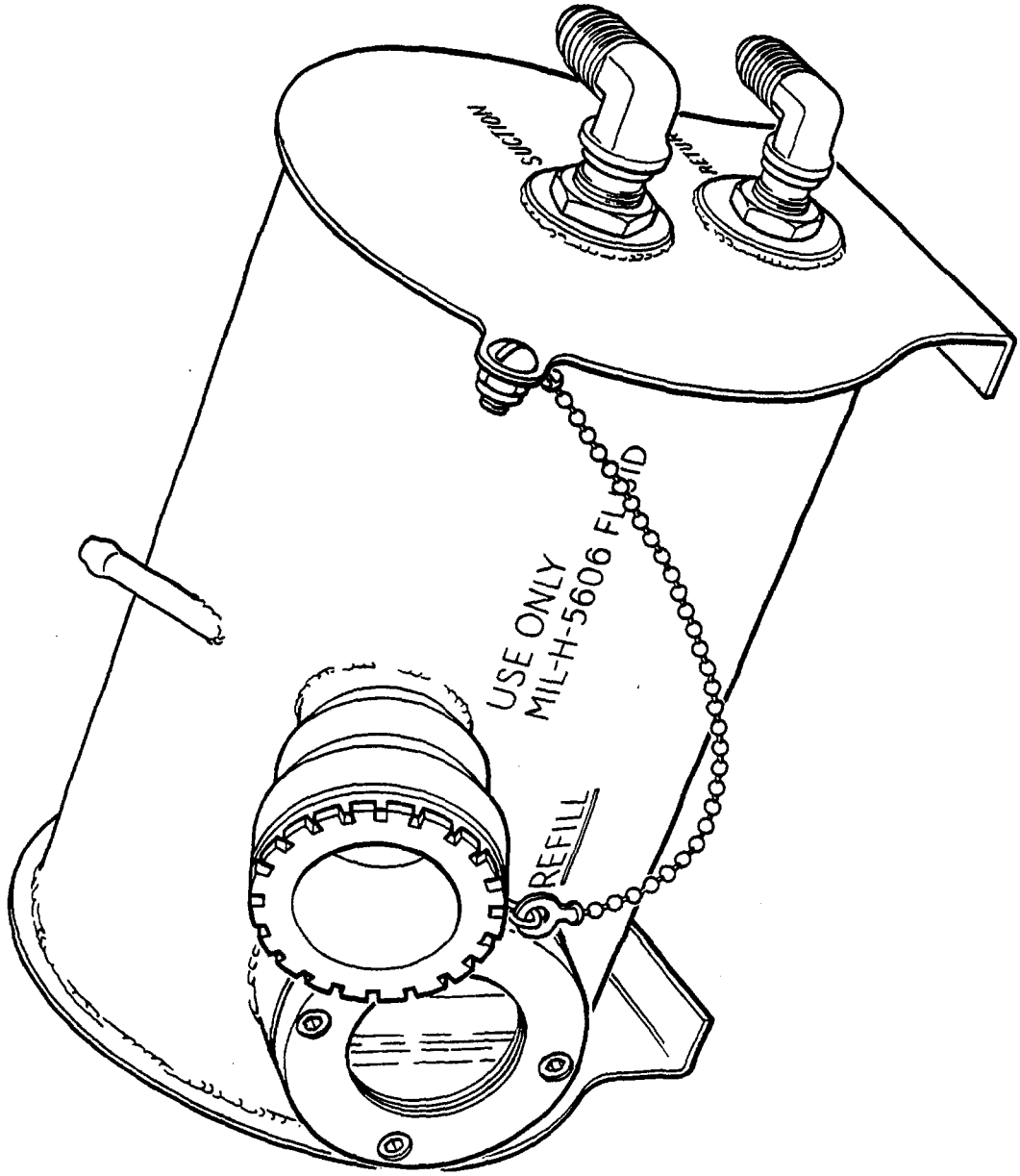
(3) Inspect all parts visually for damage such as galls, scores, scratches, excessive wear and corrosion.

(4) Inspect view gage assembly window for discoloration and evidence of leaks.

5. Repair (Figure 3)

A. General

(1) Replace all defective parts.



Reservoir Assembly C6HF1005

Figure 1

(2) When anodized parts have had protective surface treatment damaged or removed, apply a protective coating of Alodine solution No. 1200S to affected area(s), or reanodize the part.

(3) Replace O-rings (6), (14), (18), and gaskets (11), (15), and (19) at each overhaul.

6. Assembly

A. Assemble Reservoir Assembly (Figure 3)

(1) If removed during disassembly, install new label (22), label (21), and/or label (20) to body assembly (23). Refer to Figure 2 for position of labels and cut to suit.

(2) Install gasket (19), O-ring (18), elbow (17) into return boss and secure in position with nut (16). Install gasket (15), O-ring (14), elbow (13), into suction boss, and secure in position with nut (12). Install gasket (11) and union (10) into handpump suction boss.

(3) If removed during disassembly, install new view gage assembly (9). Apply sealant (Titeseal No. 3, Radiator Spec. Co.) to mating surfaces of adapter ring, gasket (part of view gage assembly), and view gage assembly. Position view gage assembly on adapter ring and secure using four screws (8).

(4) Position screen assembly (7), install O-ring (6), and secure cap (4) with chain assembly (5) to filler neck. Secure chain assembly (5) to body assembly (23) using screw (3), washer (2) and nut (1).

7. Fits and Clearances

Not Applicable

8. Testing

Insure cap is secure on filler neck. Cap handpump suction, suction, and return ports, and apply 6 to 10 psi air pressure at vent on body assembly. There should be no evidence of leakage or permanent deformation.

9. Trouble Shooting

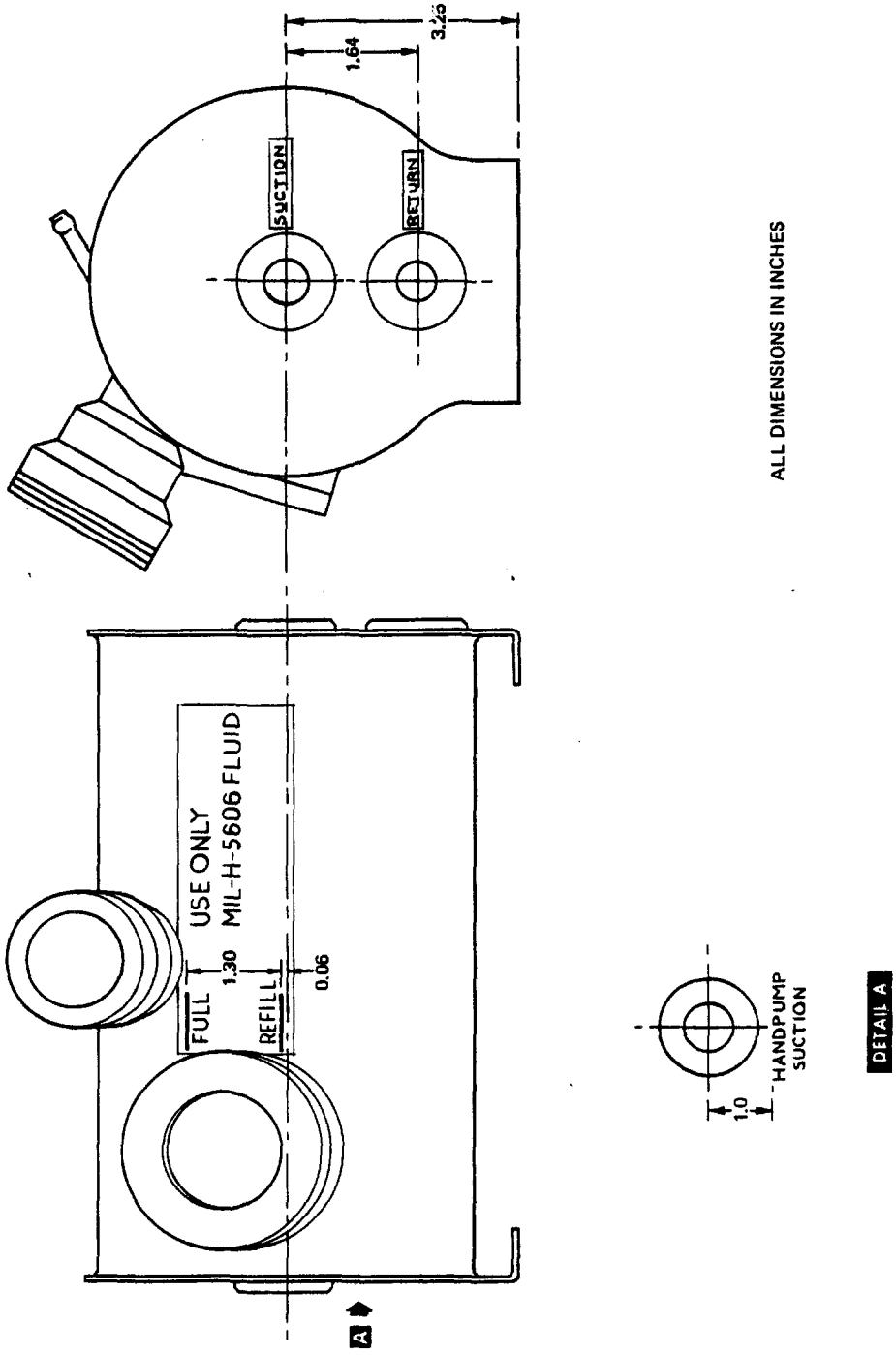
Not Applicable

10. Storage Instructions

A. Preparation

(1) Cap handpump suction, suction, and return ports. Insure cap on filler neck is secure. Seal vent on body assembly.

(2) Wrap reservoir assembly in water vapor resistant barrier material.



Body Assembly - Position of Labels

Figure 2

(3) Affix label giving following information:

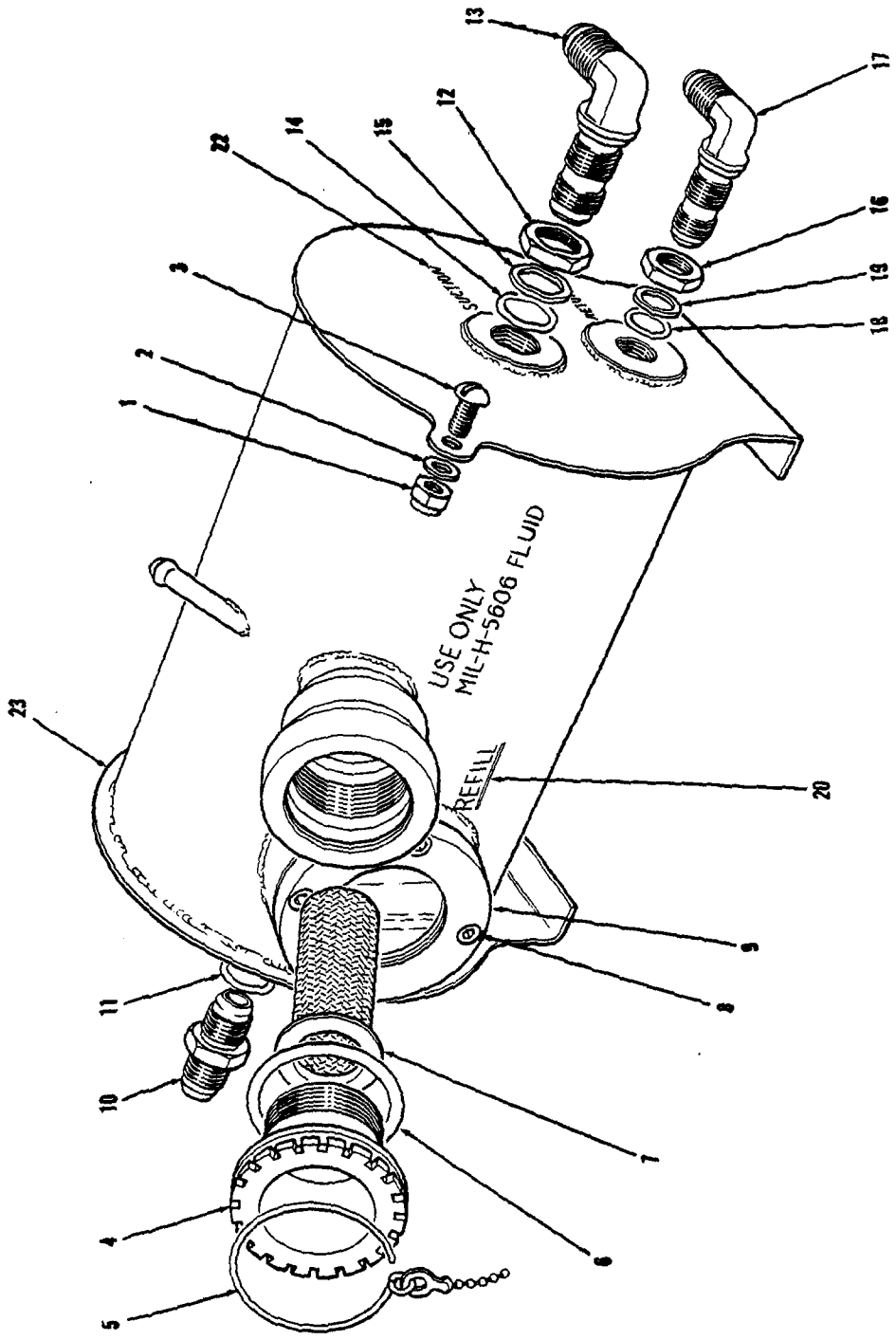
(a) Part and serial number.

(b) Date of overhaul.

(c) Inspection.

11. Special Tools

No special tools are required.



Exploded View - Reservoir C6HF1005

Figure 3

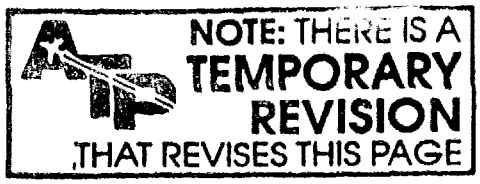
12. Illustrated Parts List

A. Vendor Parts

VENDOR CODE	NAME AND ADDRESS
24981	Gits Bros. Mfg. Co. Chicago, Illinois U.S.A.

B. List of Parts

FIGURE AND INDEX NO.	PART NUMBER	NOMENCLATURE	USAGE ON CODE	UNITS PER ASSEMBLY
		1 2 3 4 5 6 7		
3-	C6HF1005-1	Reservoir Assembly		-
1	NAS769-A3	.Nut		1
2	AN960D-10L	.Washer		1
3	AN526-1032-8	.Screw		1
4	C6HFM1012-27	.Cap		1
5	C6HF1017-1	.Chain Assembly		1
6	AN6227-29	.O-ring		1
7	C6HF1013-1	.Screen Assembly		1
8	MS16998-27	.Screw		4
9	CW-30-4312	.View Gage (24981)		1
10	AN815-6D	.Union		1
11	MS28779-6	.Gasket		1
12	AN6289-6D	.Nut		1
13	AN833-6D	.Elbow		1
14	MS28777-6	.O-ring		1
15	MS28778-6	.Gasket		1
16	AN6289-4D	.Nut		1
17	AN833-4D	.Elbow		1
18	MS28777-4	.O-ring		1
19	MS28778-4	.Gasket		1
20	C6HF1005-37	.Label		1
20	C6HF1005-43	.Label - Spanish		1
21	C6HF1005-39	.Label		1
21	C6HF1005-45	.Label - Spanish		1
22	C6HF1005-41	.Label		1
22	C6HF1005-47	.Label - Spanish		1
23	C6HF1005-11	.Body Assembly		1



DE HAVILLAND CANADA – TEMPORARY REVISION

PSM NO 1-6-6A AIRCRAFT DHC-6 TWIN OTTER SERIES ALL

PUBLICATION COMPONENT MAINTENANCE MANUAL TEMPORARY REVISION NO. 29-1

Insert in Chapter 29, CMM 29-10-16
De Havilland Reservoir P/N C6HF1005, facing page 7

REASON FOR ISSUE:

To correct part number of item 11 figure 3.

ACTION:

Delete part number MS 28779-6 for item 11 figure 3 and insert part number MS 28778-6.

RECORDING:

Record this Temporary Revision No. and the relevant information in the appropriate columns of the TEMPORARY REVISION INDEX provided at the front of the manual.

De Havilland Canada

DHC-6 TWIN OTTER

OVERHAUL MANUAL

RESERVOIR ASSEMBLY

PART NO. C6HF1057

THE DE HAVILLAND AIRCRAFT OF CANADA LIMITED
DOWNSVIEW ONTARIO

Mar 31/69

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De Havilland Canada

DHC-6 TWIN OTTER
OVERHAUL MANUAL
C6HF1057

RECORD OF REVISIONS

Retain this record in the front of the manual. On receipt of revisions, insert revised pages in the manual and enter the revision number, revision date, insertion date, and initials of person incorporating the revision, in the appropriate block on the revision record.

Rev. No.	Rev. Date	Insertion Date	By
1	MAR. 20/74	JULY 29/74	TS.

Rev. No.	Rev. Date	Insertion Date	By

LIST OF EFFECTIVE PAGES

Reference	Page	Date
Title	1	Mar 31/69
Effective Pages	*1	Mar 20/74
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29-10-15	4	Mar 31/69
29-10-15	5	Mar 31/69
29-10-15	*6	Mar 20/74

The asterisk (*) indicates pages revised, added or deleted by current revision.

INTRODUCTION

This manual contains instructions for the overhaul of De Havilland Reservoir Assembly Part No. C6HF1057.

RESERVOIR ASSEMBLY PART NO. C6HF1057

1. Description and Operation

The reservoir assembly (Figure 1) consists of a welded aluminum alloy body assembly with a filler neck, two suction outlets, a return inlet and a vent. A filter assembly and cap/dipstick assembly are provided at the filler neck.

2. Disassembly

A. Disassemble Reservoir Assembly (Figure 3)

(1) Cut and remove lockwire securing chain around filler neck, and remove cap/dipstick assembly (1). Remove filter assembly (2) from filler neck.

(2) Remove union (3) and gasket (4) from handpump suction boss. Loosen nut (5), and remove elbow (6), O-ring (7) and gasket (8) from suction boss. Loosen nut (9), and remove elbow (10), O-ring (11) and gasket (12) from return boss.

(3) If damaged, remove label (13), label (14), and/or label (15) from body assembly (16).

3. Cleaning

A. General

(1) Clean components by washing or spraying with a dry-cleaning solvent.

(2) Dry with moisture-free compressed air or a lint-free cloth.

4. Inspection/Check

A. General

(1) Inspect non-magnetic metal components using the fluorescent penetrant method, or an approved dye penetrant method. Concentrate inspection of body assembly at welded seams and joints.

(2) Inspect all threads for damage and deformity.

(3) Inspect all parts visually for damage such as galls, scores, scratches, excessive wear and corrosion.

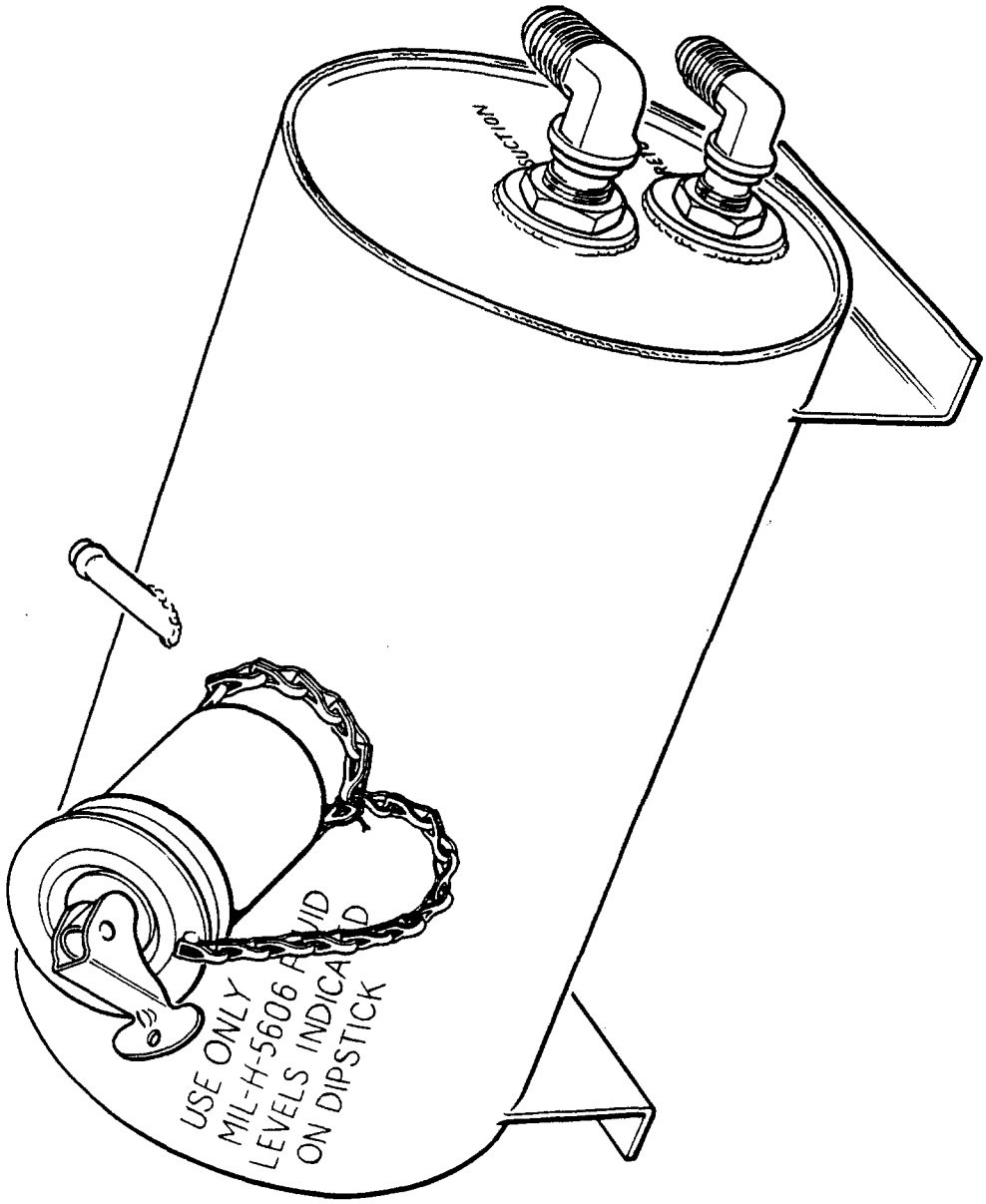
5. Repair

A. General (Figure 3)

(1) Replace all defective parts.

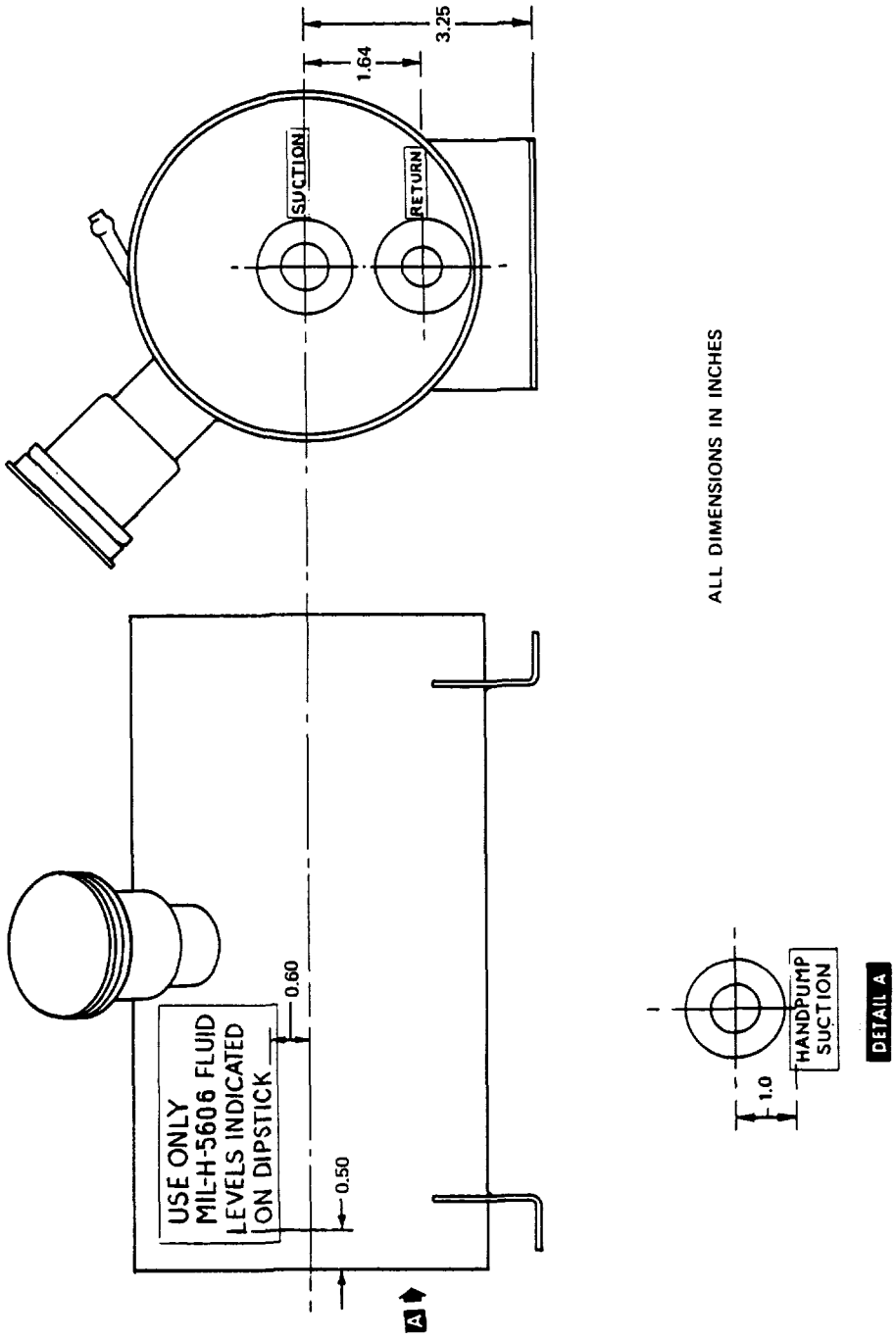
(2) When anodized parts have had protective surface treatment damaged or removed, apply a protective coating of Alodine solution No. 1200S to affected area(s), or reanodize the part.

(3) Replace O-rings (7), (11), and gaskets (4), (8) and (12) at each overhaul.



Hydraulic Reservoir Part No. C6HF1057

Figure 1



Body Assembly - Position of Labels

Figure 2

6. Assembly

A. Assemble Reservoir Assembly (Figure 3)

(1) If removed during disassembly, install new label (15), label (14) and/or label (13) to body assembly (16). Refer to Figure 2 for position of labels and cut to suit.

(2) Install gasket (12), O-ring (11), elbow (10) into return boss, and secure in position with nut (9). Install gasket (8), O-ring (7), elbow (6) into suction boss, and secure in position with nut (5). Install gasket (4) and union (3) into handpump suction boss.

(3) Position filter assembly (2) in filler neck, and secure cap/dipstick assembly (1). Secure chain of cap/dipstick assembly around filler neck using lockwire MS20995-C32.

7. Fits and Clearances

Not Applicable

8. Testing

Insure cap/dipstick assembly is secure on filler neck. Cap handpump suction, suction, and return ports, and apply 6 to 10 psi air pressure at vent on body assembly. There should be no evidence of leakage or permanent deformation.

9. Trouble Shooting

Not Applicable

10. Storage Instructions

A. Preparation

(1) Cap handpump suction, suction, and return ports. Insure cap/dipstick assembly on filler neck is secure. Seal vent on body assembly.

(2) Wrap reservoir assembly in water vapor resistant barrier material.

(3) Affix label giving following information:

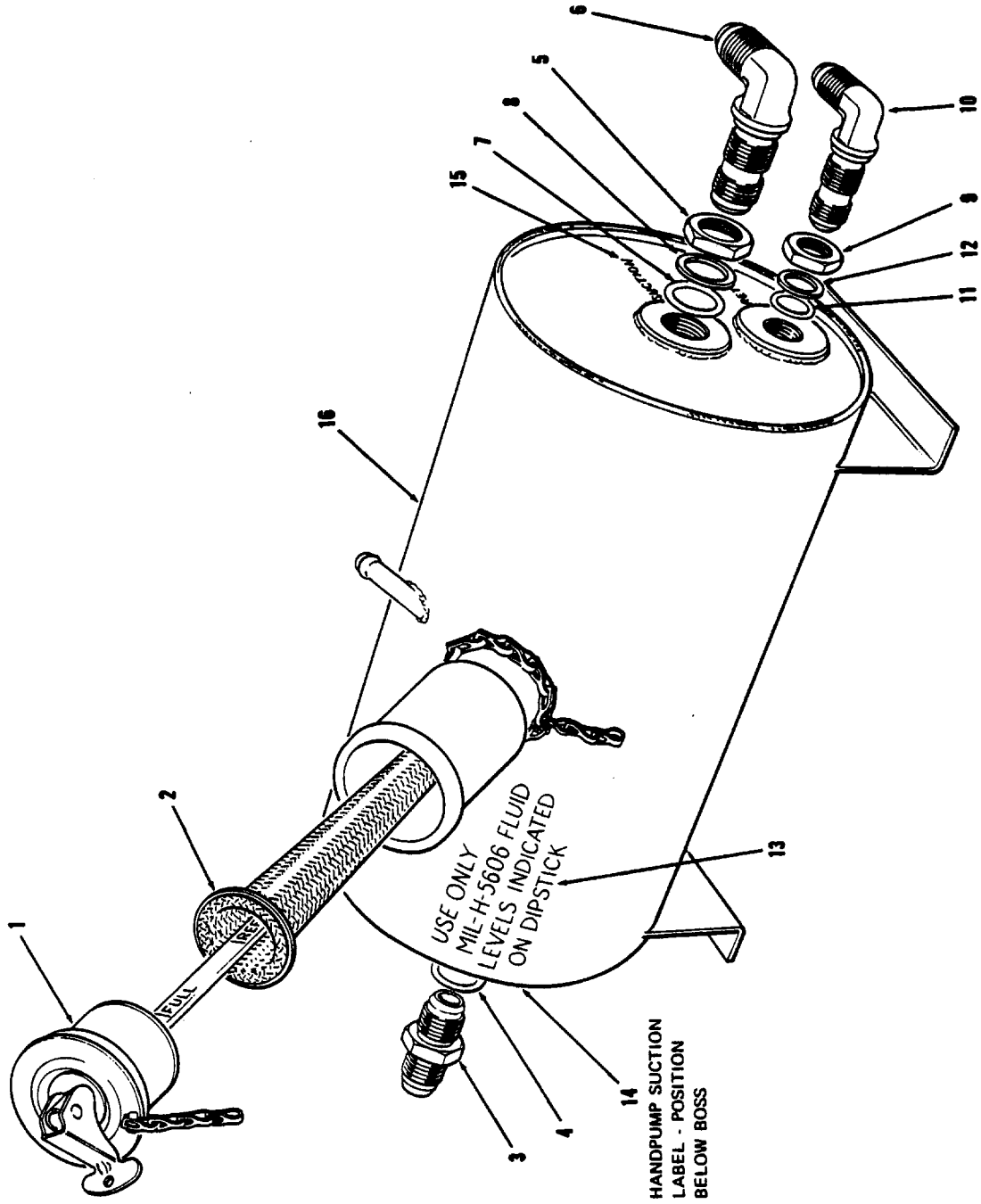
(a) Part and serial numbers.

(b) Date of overhaul.

(c) Inspection.

11. Special Tools

No special tools are required.



Exploded View - Reservoir C6HF1057

Figure 3

12. Illustrated Parts List

FIGURE AND INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	USAGE ON CODE	UNITS PER ASSEMBLY
3	C6HF1057-1	Reservoir Assembly		-
1	C6SC1080-1	. Cap/Dipstick Assembly (replaced by C6SC1100-1)		1
-1	C6SC1100-1	. Cap/Dipstick Assembly (replaces C6SC1080-1)		1
2	C6HF1061-1	. Filter Assembly		1
3	AN815-6D	. Union		1
4	MS28779-6	. Gasket		1
5	AN6289-6D	. Nut		1
6	AN833-6D	. Elbow		1
7	MS28777-6	. O-ring		1
8	MS28778-6	. Gasket		1
9	AN6289-4D	. Nut		1
10	AN833-4D	. Elbow		1
11	MS28777-4	. O-ring		1
12	MS28778-4	. Gasket		1
13	C6HF1057-43	. Label		1
-13	C6HF1057-45	. Label - Spanish		1
14	C6HF1057-35	. Label		1
-14	C6HF1057-47	. Label - Spanish		1
15	C6HF1057-37	. Label (Comprises Suction and Return)		1
-15	C6HF1057-49	. Label - Spanish		1
16	C6HF1057-11	. Body Assembly		1

NOTE: - preceding index number · indicates item not illustrated.

NOTE: Please see the TEMPORARY REVISION that revises this page.

DE HAVILLAND CANADA – TEMPORARY REVISION

PSM NO 1-6-6A AIRCRAFT DHC-6 TWIN OTTER SERIES ALL

PUBLICATION COMPONENT MAINTENANCE MANUAL TEMPORARY REVISION NO. 29-2

Insert in Chapter 29, CMM 29-10-15
De Havilland Reservoir P/N C6HF1057, facing page 6

REASON FOR ISSUE:

To correct part number of item 4 figure 3.

ACTION:

Delete part number MS 28779-6 for item 4 figure 3 and insert part number MS 28778-6.

RECORDING:

Record this Temporary Revision No. and the relevant information in the appropriate columns of the TEMPORARY REVISION INDEX provided at the front of the manual.

GAR-KENYON INSTRUMENTS, INC.

BREWSTER, N. Y.

MFC 26044

MANUAL OF INFORMATION
FOR
VALVE & GAUGE ASSEMBLIES

PART NUMBERS

12040
12056-1
12057-1-3
12149
12199

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6-1.	Disassembly Instructions	2
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6-3.	Assembly Instructions	5
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8.	Parts Lists	11-15
9.	Recommended Spare Parts Lists	16-20
10.	Assembly and Installation Drawing	Appendix A

1. GENERAL

1.1 Valve and gauge assembly 12199 is intended for checking and refilling air receivers in pneumatic systems. It has a range of 0-5000 psi.

1-2. Valve and gauge assemblies 12040-1, 12056-1, 12057-1 and 12149 are intended for checking and refilling air preload pressure in hydraulic accumulators.

1-3. Each of the above units consists of a cylindrical housing having a rectangular mounting base and containing a pressure gauge sub-assembly and a standard high pressure charging valve.

2. OPERATING INSTRUCTIONS

2-1. Assembly 12199 is a constant reading unit and will indicate receiver pressure continuously.

2-2. Assemblies 12056-1, 12057-1, 12149 and 12040 are constant reading units and will indicate accumulator air preload pressure or hydraulic system pressure, whichever is greater.

2-3. When charging or discharging air through the high pressure valve (AN6287-1), the AN813-1 must be removed and the 5/8 hex swivel nut loosened approximately two turns. Charging may then proceed by attaching a coupling to the threads exposed by removal of the cap. Discharging involves depressing the internal pin exposed by removal of the cap. Following charging the 5/8 hex swivel nut must be tightened and the cap replaced and tightened.

CAUTION: REPEAT THE 5/8 HEX SWIVEL NUT MUST BE LOOSENED BEFORE ATTEMPTING TO DISCHARGE OR CHARGE THROUGH THE GAUGE ASSEMBLY.

3. INSTALLATION INSTRUCTIONS

3-1. Securing of the assembly to the aircraft is accomplished by means of the four mounting holes in the base of the body. These receive #10 bolts.

3-2. The only plumbing connection required is for the AND 10050-4 boss on the side of the housing. It will receive any fitting having a port corresponding to AND 10056-4 Style E or AND 10057-4 Style E.

4. MAINTENANCE INSTRUCTIONS

4-1. Maintenance of any of the above units between regular overhauls should neither be required or attempted.

5. REMOVAL INSTRUCTIONS

5-1. Before attempting to disconnect the line to the AND 10050-4 port in the housing, all air pressure must be discharged. (See 2.3 and Caution Note, above.)

5-2. Remove the fitting from the AND 10050-4 port.

5-3. Remove the four #10 mounting bolts.

6. OVERHAUL INSTRUCTIONS

6-1. Disassembly instructions

6-1-1. Unscrew the knurled bezel ring from the top of the assembly by hand.

6-1-2. Lift the glass and its gasket from the top of the housing. Discard the gasket.

6-1-3. Place the palm of one hand over the top of the housing, grasping the sides of the housing with the fingers of the same hand. Invert the housing and with the other hand remove the two #8 fillister head screws, their lockwashers and plain washers from the bottom of the housing.

6-1-4. While still holding the housing as described in 6-1-3, above, gently shake the housing until the gauge mechanism falls into the palm of the hand covering the top of the housing.

CAUTION: HANDLE THE GAUGE MECHANISM GENTLY AT ALL TIMES.

6-1-5. Using a thin plastic or wooden rod, remove the MS28782-1 teflon backup ring and the AN6227-1 rubber "O" ring from the bore in the bottom of the inside of the housing. Extreme caution must be observed to avoid scratching the inside of this bore. Discard the "O" ring and backup ring.

6-1-6. Cut and remove the lockwire which secures the AN6287-1 valve to the housing.

6-1-7. Using a 3/4 wrench, remove the AN6287-1 charging valve from the housing.

6-1-8. Remove and discard the 47A1562 "O" ring from the groove in in the base of the AN6287-1 valve.

CAUTION: CARBON TETRACHLORIDE IS NOT TO BE USED IN CLEANING ANY PARTS OF THESE UNITS, OR THE ASSEMBLED UNITS.

6-2. Inspection and Disposition Instructions

6-2-1. Visually inspect the housing for the following and observe the parenthetical disposition instructions.

6-2-1-1. Torn or crossed threads (Discard the housing.)

6-2-1-2. Scratched "O" ring bore in bottom of housing base (Discard the housing.)

6-2-1-3. Scratched countersink or counterbore at entrance of AND 10050-4 boss (Polish to remove scratches.)

6-2-1-4. Anodized surface broken or scratched, other than as described in 6-2-1-1 or 6-2-1-2, above, (Touch up with alodine or iridite.)

6-2-2. Withdraw new AN6227-1 and 47A1562 "O" rings from stock. With the aid of a magnifier, inspect these rings for cuts, nicks, mold marks, feathers or other flaws. (Discard if any of these defects are present.)

6-2-3. Withdraw new MS28782-1 backup rings from stock. With the aid of a magnifier, inspect these rings for feathers, curlings or other flaws. (Discard if any of these defects are present.)

6-2-4. Visually examine the external surface of the small cylindrical protrusion at the bottom of the gauge assembly for sharp edges, nicks, and scratches. (Polish sharp edges, discard the assembly if the surface is scratched.)

6-2-5. Examine the bezel ring for torn or crossed threads and flaked or chipped chrome plating. (Discard if any of these defects are present.)

6-2-6. Examine the glass for chipped or cracked surfaces. (Discard if any of these defects are present.)

6-2-7. In addition to the above, all parts should be examined for foreign matter. Metallic parts may be cleaned by submersion in naptha or methyl-alcohol and air dried. Prior to immersing the gauge mechanism in the solvent, the small port hole in the bottom of the mechanism should be plugged. After immersion, the mechanism should be dried by static ex-

posure to air - do not expedite evaporation by blowing shop air through the mechanism.

6-3. Assembly

6-3-1. Apply a thin film of MIL-G-4343 silicone grease to the 47A1562 "O" ring and the threads of the AN6287-1 valve.

6-3-2. Insert the 47A1562 "O" ring in the groove of the AN6287-1 valve and install the valve firmly in the housing.

6-3-3. Lockwire the valve to the housing.

6-3-4. Apply a thin film of MIL-G-4343 silicone grease to the AN6227-1 "O" ring.

6-3-5. Insert the AN6227-1 "O" ring in the small bore in the bottom of the inside of the housing. Bottom the "O" ring in the bore, using a small plastic or wooden rod. Make certain that the "O" ring is not twisted or spiralled.

6-3-6. Insert the MS28782-1 back up ring in the bore on top of the "O" ring.

6-3-7. Apply a thin film of MIL-G-4343 silicone grease to the base of the gauge mechanism.

6-3-8. Gently insert the mechanism in the housing by applying pressure to the heads of the two small screws which hold the dial to the mechanism, gently center the mechanism in the housing until the protrusion on the base of the mechanism engages the backup ring and "O" ring in the base of the housing. Then apply further pressure to the two small screws to bring the base of the mechanism to rest against the housing. Do not apply pressure to any other part of the dial.

6-3-9. Place a lock washer and then a plain washer on each of the two #8 screws.

6-3-10. Holding the mechanism in place with the fingers of one hand, invert the housing. Rotate the mechanism in the housing until the two #8 threaded holes in the mechanism are aligned with the two #8 clearance holes in the bottom of the housing.

6-3-11. Insert and tighten the two #8 screws with their washers and lockwashers.

6-3-12. Place a new 10143 gasket on top of the housing.

6-3-13. Place the glass on top of the gasket and install and hand tighten the bezel ring.

7. PRODUCTION TEST AND ADJUSTMENT INSTRUCTIONS

CAUTION: FOR P/N 12199 NITROGEN OR AIR MUST BE USED AS THE TEST MEDIUM. OIL MUST NOT BE USED.

7-1. Remove the bezel ring, glass and gasket from the top of the assembly.

7-2. For P/N 12199 apply nitrogen or air pressure to the AND 10050-4 port. Pressure should be increased gradually and maintained at each of the check points noted on Table I for comparison with a standard gauge of known accuracy which is connected in parallel with the 12199 assembly. Readings at each check point must fall within the limits shown on Table I. Following the initial reading at each check point, the 12199 assembly should then be tapped gently and the error again determined. The accuracy limits of Table I must again be maintained.

7-3. When a highest check point pressure is reached, the gauge should be immersed in naptha, methyl alcohol or distilled water, and external leakage checked for a two minute period. If external leakage is noted, the assembly should be returned for Overhaul per 6, above, for replacement of "O" rings and examination of "O" ring sealing areas.

7-4. If no leakage is observed, pressure should be gradually reduced and readings checked per 7-2, above, at each of the check points. Accuracy limits shall again be per Table 1.

7-5. If the calibration test of 7-3 and 7-4 above, reveals any constant error (whether within tolerance or not) the pointer should be removed with a gauge pointer remover. Apply pressure of 2/5 of the range of the assembly as noted by the standard gauge, set the pointer at the exact correct pressure on the assembly and press it on the shaft.

7-6. If the calibration test of 7-2 and 7-4, above, reveals an unacceptable error which increases with increase in pressure, remove the pointer with a gauge pointer remover. Then remove the dial by removing the two small screws in the face of the dial. Loosen, but do not remove the adjustment screw which secures the link to the sector lever. Move the adjustment screw away from the center of the mechanism, thus lengthening the effective length of the lever. Tighten the adjustment screw, replace the dial and pointer and re-run the test.

7-7. If the calibration test of 7-2 and 7-4, above, reveals an unacceptable error which decreases with increased pressure follow the procedure of 7-6, above, with the exception that the adjustment screw should be moved toward the center of the mechanism, thus shortening the effective length of the lever.

7-8. After test, the moisture adhering to the unit as a result of the immersion during 7-3, above should be permitted to evaporate before the glass is replaced. This may be expedited by placing the assembly in a vacuum chamber, but not by blowing compressed air between the dial and the housing.

7-9. After drying, replace the gasket, glass and bezel, securing the bezel by hand.

7-10. The test and adjustment procedures for 12040, 12056-1, 12057-1 and 12149 are identical to those outlined above with the following exceptions:

7-10-1. Hydraulic oil pressure as supplied by a dead weight calibrator or hydraulic test stand may be used in lieu of air pressure for calibration tests (7-2 & 7-4, above). Air or nitrogen may be used if desired, however, (high pressure leakage (7-3, above) should be performed with nitrogen if oil is used for calibration.)

7-10-2. Test pressure check points and tolerances as shown on the following tables should apply.

12040	Table I
12056-1	Table II
12057-1-3	Table III
12149	Table IV

TABLE I

Test Pressure, PSI	Tolerance, PSI
0	+ 75
1,000	- 100
2,000	125
3,000	125
4,000	125
5,000	125

TABLE II

Test Pressure, PSI	Tolerance, PSI
0	+ 3
10	- 3
20	3
40	5
75	5
90	5
100	5
110	5
150	5
200	5

TABLE III

Test Pressure, PSI	Tolerance, PSI
0	+ 30
400	- 40
800	50
1200	50
1600	50
2000	50

TABLE IV

Test Pressure, PSI	Tolerance, PSI
0	+ 7
30	- 7
60	7
75	7
105	10
300	25
450	25
500	25
600	30
700	50
1000	50

NAME OF MANUFACTURER: GAR-KENYON INSTRUMENTS, INC.
ADDRESS: RT. 22, BREWSTER, N.Y. MFC-26044

NAME OF ASSEMBLY: GAUGE ASSEMBLY - HYDRAULIC SYSTEM
PART NO.: 12057-1

RECOMMENDED SPARE PARTS FOR:
COLUMN 5 - MAINTENANCE OF 100 UNITS BETWEEN OVERHAULS
COLUMN 6 - ONE AVERAGE OVERHAUL OF 100 UNITS
COLUMN 7 - TOTAL OF COLUMN 5 AND COLUMN 6

ITEM NUMBER (1)	PART NUMBER (2)	PART NAME (3)	QUANTITY PER ASSEMBLY (4)	QUANTITY FOR MAINTENANCE (5)	QUANTITY PER OVERHAUL (6)	TOTAL (7)
		SECTION 1				
1	12205	Gauge-Sub Assy	1	0	5	5
2	10144	Glass	1	0	10	10
3	10147	Bezel	1	0	10	10
4	10143	Gasket	1	0	100	100
5	12254	Dial	1	0	5	5
6	12197	Pointer	1	0	10	10
7	11291	Screw	2	0	10	10
		SECTION II				
		SECTION III				
1	AN935-8	Lockwasher	2	0	20	20
2	AN960-PD8L	Washer	2	0	20	20
3	AN6227-1	"O" Ring	1	0	100	100
4	AN6287-1	Valve	1	0	5	5
5	MS28782-1	Backup Ring	1	0	100	100
6	47A1562	"O" Ring	1	0	100	100

INSTRUCTION MANUAL WITH PARTS LIST

MODEL 100-689-3

ELECTRIC MOTOR DRIVEN HYDRAULIC PUMP

TABLE I LEADING PARTICULARS

TYPE	Electric Motor Driven Hydraulic
FLUID	Specification MIL-O-5606
CAPACITY	0.5 gpm at 1500 psi discharge pressure
VOLTAGE	27 Volts DC
AMPERAGE	33 amperes maximum
MOTOR RATING	0.7 H.P. at 26 volts DC. 6000 rpm
MOTOR MODEL	A9373M1 Delco Products Division, General Motors Corp., Dayton, Ohio
DUTY CYCLE	Continuous
OVERHAUL CYCLE	500 hours minimum at continuous duty rating
PUMP ROTATION	Counter-Clockwise facing drive end
MOTOR ROTATION	Clockwise facing drive end
AMBIENT TEMPERATURE RANGE	-65° F to +165° F
WEIGHT	7.9 pounds

1. SPECIAL TOOLS.
a. None.

2. DISASSEMBLY.
a. Disassemble in the same order as the key index numbers assigned to the exploded view illustration, Figure 1.
b. Disassembly of the electric motor is not covered in this Handbook. See applicable instructions for motor overhaul.

3. CLEANING.
a. Wash all parts except motor in dry cleaning solvent, Federal Specification P-S-661, and dry with filtered compressed air.

4. INSPECTION.
a. Inspect gears visually for worn or chipped teeth, journals for wear in excess of tolerances shown in Table II, and gear faces for taper.
b. Inspect bearing blocks for scored or worn rollers and gear seating faces. Check all rollers for free turning.
c. Inspect seal faces of retainer for scoring.
d. Inspect coupling and drive gear splines visually for wear. Replace parts if wear is excessive.
e. Inspect all threads for damage.
f. Measure body bore wear or scoring using a dial indicator.

5. REPAIR OR REPLACEMENT.
a. Replace all gaskets and "O" rings at each overhaul.
b. Replace seal seat at each overhaul.
c. Replace bearing block assemblies if rollers are scored, worn, or do not turn freely.

GREAT LAKES MANUFACTURING DIVISION
GENERAL METALS CORPORATION
4223 MONTICELLO BOULEVARD
CLEVELAND, OHIO 44121

d. Refinish bearing block faces within dimensions shown in Table II to clean up gear wear or scoring. Hold surface finish to ten micro-inches.
e. Refinish gear journals, if scored or worn, to dimension shown in Table II. Hold surface finish to six micro-inches.
f. Refinish gear faces, if scored or tapered, to dimension shown in Table II. Gear faces must be parallel within .001 inches total indicator reading and optically flat within six light bands.
g. Refinish seal face of retainer to remove all scoring or scratches. Face must be optically flat within two light bands. A surface finish of two micro-inches is desirable.

6. LUBRICATION.
a. No lubrication is required.

7. REASSEMBLY. (See Figure 1.)
a. Reassembly is the reverse of disassembly.
b. Assemble bearing block assemblies (25) with trapping grooves toward outlet side.
c. Position piston (19) in cover (16) with flat side toward outlet port.
d. After tightening seal retainer assembly (6), stake metal from flange (14) into retainer slots (two places to lock).

8. TEST PROCEDURE.
a. Seal drain port shall be open for all tests.

NOTE

Do not operate emergency pump more than 10 minutes under load.

b. Connect inlet port of pump to reservoir outlet. Connect outlet port to a flowmeter with a gage and shut off valve in the line. Connect motor to DC power source in test bench. Close valve in outlet line and pressurize reservoir to apply 2 psi at pump inlet. There shall be no external leakage and seal drain shall not exceed the rate of 1 drop in 12 minutes with the pump in a static condition.

TABLE II - PERMISSIBLE TOLERANCES

PART	NEW DIMENSION		PERMISSIBLE WORN DIMENSION	NEW CLEARANCE		WORN CLEARANCE
	max	min		max	min	max
Gear Journal	0.3751	0.3748	0.3743			
Gear Thickness	0.1000	0.0995	0.0990	Thickness of gears must be equal within 0.0002 inches.		
Gear Tooth Dia.	0.8120	0.8115	0.8110	0.0003	0.0013	0.0008
Body Bore	0.8128	0.8123	0.8135			
Bearing Block Thickness	0.460	0.455	0.450			

TABLE III - TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Seal Leak	Defective seat assembly	Replace.
	Defective seal face in retainer assembly.	Repair or Replace. See Paragraph 5g.
Low Capacity	Excessive gear clearance.	Replace gears or body as necessary to obtain clearance shown in Table II.
	Piston not seating properly on bearing block.	Position per Paragraph 7c.
	Low voltage	Check power supply.
	Gears not seating against bearing blocks	Check bearing blocks and gears. Sides must be flat and parallel.
	Defective "O" rings on bearing blocks.	Replace.

c. Open valve in outlet line. Energize pump motor and restrict outlet pressure to 1500 psi. Regulate pump inlet pressure to "0" psig. Allow pump and motor to operate in this condition for 3 minutes. During the last 1/2 minute of the 3 minutes run, observe flow and amperage drain. The flow shall be 0.5 gpm minimum and amperage drain shall not exceed 33 amps. Seal drain leakage shall not exceed an equivalent rate of 5 cc/hr. (5 drops in 3 minutes) while pump is operating.

d. Energize pump motor with 27 plus or minus .5 volts DC input and restrict "Outlet" pressure to 1500 psi. Pressurize reservoir to apply 26.7 psia at pump "Inlet". There shall be no external leakage and seal drain leakage shall not exceed the rate of 2 drops per minute.

e. Relieve pressure. Remove pump from test bench. Do not drain oil from pump. Cap ports and plug seal drain port.

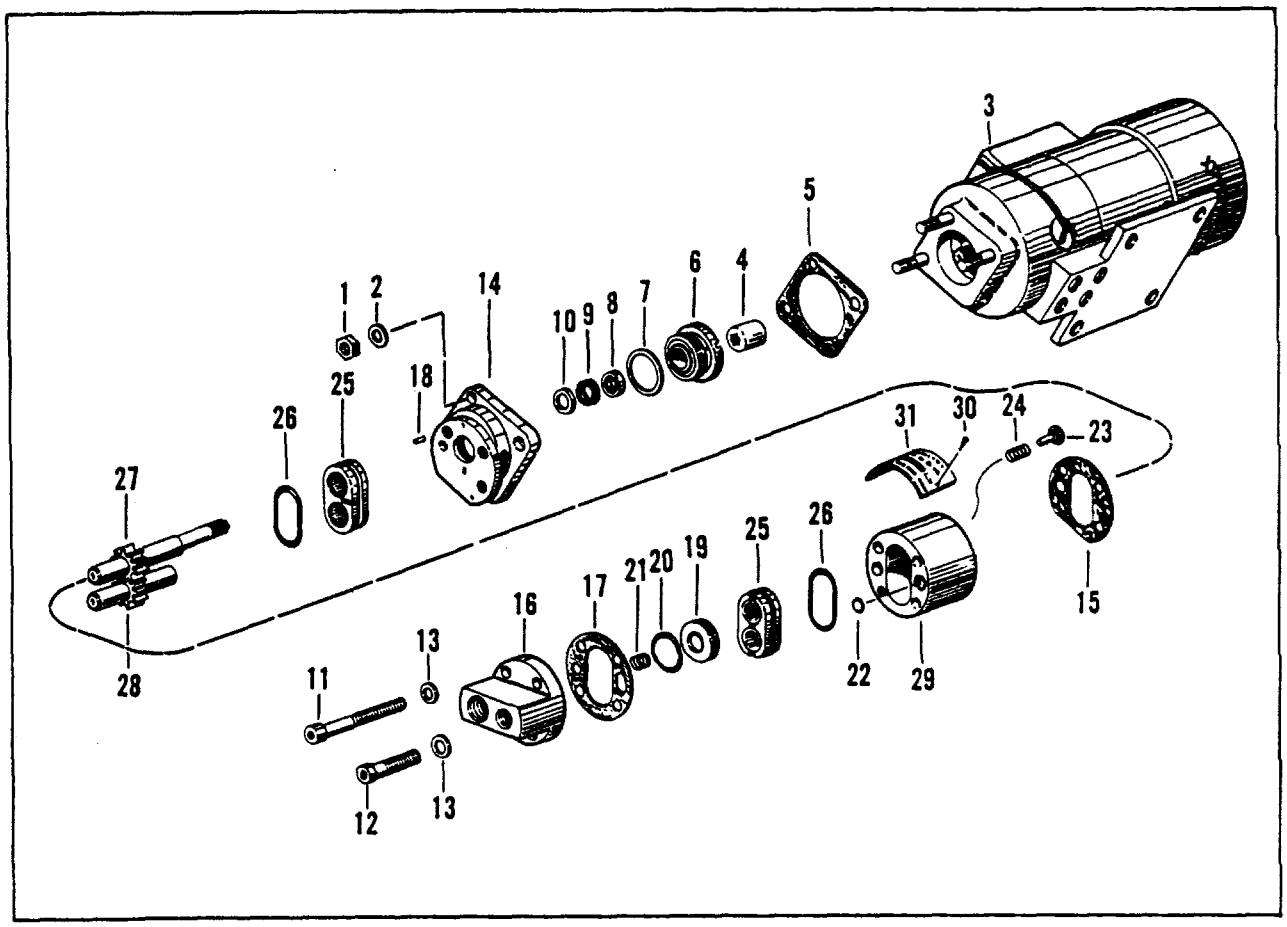


Figure 1. Exploded View 100-689-3 Pump Assembly

FIG. & INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY
1-	100-689-3	ELECTRIC MOTOR DRIVEN PUMP ASSY	1
1-1	AN364-428	. NUT	3
-2	AN960-416	. WASHER	3
-3	A9373M1	. MOTOR ASSY	1
		Delco Products (204-631-2)	
-4	204-453	. COUPLING	1
-5	204-427	. GASKET	1
	100-681-2	. PUMP ASSY	1
-6	204-455	. . SEAL ASSY	1
-7	204-424	. . GASKET	1
-8	204-265-2	. . SEAT-SEAL	1
-9	Q7	. . QUAD RING	1
-10	204-264-1	. . WASHER	1
-11	204-425-28	. . SCREW	3
-12	204-425-12	. . SCREW	1
-13	204-428	. . WASHER	4
-14	204-460	. . FLANGE	1

FIG. & INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY
1-15	204-577	. . GASKET	1
-16	204-462-1	. . COVER	1
-17	204-615	. . GASKET	1
-18	204-260	. . DOWEL	2
-19	204-463-1	. . PISTON	1
-20	AN6227-11	. . "O" RING	1
-21	204-259	. . SPRING	1
-22	AN6227-5	. . "O" RING	1
-23	204-272	. . VALVE ASSY	1
-24	204-273	. . SPRING	1
-25	204-457	. . BEARING BLOCK	2
-26	204-274	. . "O" RING	2
-27	204-459-2	. . GEAR, Drive	1
-28	204-458	. . GEAR, Driven	1
-29	204-461	. . BODY	1
-30	AN535-00-2	. . SCREW	2
-31	204-426	. . NAMEPLATE	1

DELCO PRODUCTS DIVISION

SERVICEABLE PARTS LIST

MODEL NO. A-9373M1, .7 HP, 26 Volts, DC, 6000 RPM, CW Drive End

Part No.	Description	No. Req.
5378290	Screw - Brush Retaining	4
1076424	Brush Assembly	4
5531549	Cover - Fan	1
5391564	Screw - Cover Retaining AN500-A8-4	4
5531550	Fan	1
5531551	Pin - Fan Locking	1
5359678	Nut - Fan Retaining AN364-1032	1
5531548	End Frame	1
5387272	Thru Bolt	2
5387275	Washer - Bearing Spacing	1
5373802	Spring Washer	1
5378727	Ball Bearing	2
5531542	Armature Assembly	1
3196626	Filter - Radio Noise	1
5516952	Screw - Filter Retaining (Drive End) AN500-A4-4	3
5531554	Screw - Filter Ret (Opp Drive End) AN500-A8-3	1
5389944	Terminal - Grounding	1
5531543	Frame and Coil Assembly	1
5531552	Plate - Filter Mounting	1
5531553	Base	1
5397983	Screw - Plate and Base Retaining	6
5531538	End Frame and Brush Holder Assembly	1
5317848	Name Plate	1
145365	Drive Screw - Name Plate Retaining AN535-0-2	4

MODEL 100-689-4
ELECTRIC MOTOR DRIVEN HYDRAULIC PUMP

The manufacturer of the hydraulic pump has changed the motor from a Delco to a Delaval unit 4100-689004. The hydraulic pump itself is unchanged. The new motor is identical and the parts completely interchangeable with those of the Delco. The following is a cross reference to these part numbers:

4217-544000 D. C. Motor Assembly

PART NO. CROSS REFERENCE

DELCO PART NO.	DELAVAL PART NO.	DESCRIPTION	UNITS PER ASSY.	SOURCE CODE
A9373	4217-544000	Motor Assembly, DC, Aircraft	1	81833
5378290	4907-000030	Nut Assembly	4	"
1076424	4907-000020	Brush Assembly	4	"
5531549	4907-000015	Cover, Motor (Attaching Part)	1	"
AN500A8-4	4907-000014	Screw, Machine	4	"
5531550	4907-000034	Fan, Motor (Attaching Part)	1	"
AN364-1032	4907-000024	Nut, Self-Locking	1	"
5531551	4907-000044	Pin	1	"
5531548	4907-000064	Frame, End (Attaching Part)	1	"
5387272	4907-000054	Screw	2	"
5387275	4907-000074	Spacer	1	"
5378802	4907-000025	Spring, Thrust	1	"
5378727	4907-000130	Bearing, Ball	2	"
5531542	4907-000050	Armature Assembly	1	"
3196626	4907-000090	Filter, Noise, Radio (Attaching Part)	1	"
AN500A8-3	4907-000204	Screw, Machine	1	"
AN500A4-4	4907-000104	Screw, Machine	3	"
5389944	4907-000045	Terminal, Locking	1	"
5531543	4907-000080	Frame and Coil Assembly	1	"
5531552	4907-000084	Plate, Mounting, Noise Filter	1	"
5531553	4907-000114	Base, Motor (Attaching Part)	1	"
5397983	4907-000094	Screw, Machine	6	"
5531538	4907-000060	Frame Assembly, End	1	"
No number	4217-569000	Nameplate	1	"

ADEL GREAT LAKES DIVISION
DE LAVAL TURBINE
4223 MONTICELLO BOULEVARD
CLEVELAND, OHIO 44121

INSTRUCTION MANUAL WITH PARTS LIST

MODEL 100-689-4

ELECTRIC MOTOR DRIVEN HYDRAULIC PUMP

TABLE I LEADING PARTICULARS

TYPE	Electric Motor Driven Hydraulic
FLUID	Specification MIL-O-5606
CAPACITY	0.5 gpm at 1500 psi discharge pressure
VOLTAGE	27 Volts DC
AMPERAGE	33 amperes maximum
MOTOR RATING	0.7 H.P. at 26 volts DC. 6000 rpm
MOTOR MODEL	A9373M1 Delco Products Division, General Motors Corp., Dayton, Ohio
DUTY CYCLE	Continuous
OVERHAUL CYCLE	500 hours minimum at continuous duty rating
PUMP ROTATION	Counter-Clockwise facing drive end
MOTOR ROTATION	Clockwise facing drive end
AMBIENT TEMPERATURE RANGE	-65° F to +165° F
WEIGHT	7.9 pounds

1. SPECIAL TOOLS.
a. None.

2. DISASSEMBLY.
a. Disassemble in the same order as the key index numbers assigned to the exploded view illustration, Figure 1.
b. Disassembly of the electric motor is not covered in this Handbook. See applicable instructions for motor overhaul.

3. CLEANING.
a. Wash all parts except motor in dry cleaning solvent, Federal Specification P-D-680, and dry with filtered compressed air.

4. INSPECTION.
a. Inspect gears visually for worn or chipped teeth, journals for wear in excess of tolerances shown in Table II, and gear faces for taper.
b. Inspect bearing blocks for scored or worn rollers and gear seating faces. Check all rollers for free turning.
c. Inspect seal faces of retainer for scoring.
d. Inspect coupling and drive gear splines visually for wear. Replace parts if wear is excessive.
e. Inspect all threads for damage.
f. Measure body bore wear or scoring using a dial indicator.

5. REPAIR OR REPLACEMENT.
a. Replace all gaskets and "O" rings at each overhaul.
b. Replace seal seat at each overhaul.
c. Replace bearing block assemblies if rollers are scored, worn, or do not turn freely.

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CLEVELAND, OHIO 44121

d. Refinish bearing block faces within dimensions shown in Table II to clean up gear wear or scoring. Hold surface finish to ten micro-inches.

e. Refinish gear journals, if scored or worn, to dimension shown in Table II. Hold surface finish to ten micro-inches.

f. Refinish gear faces, if scored or tapered, to dimension shown in Table II. Gear faces must be parallel within .001 inches total indicator reading and optically flat within six light bands.

g. Refinish seal face of retainer to remove all scoring or scratches. Face must be optically flat within two light bands. A surface finish of two micro-inches is desirable.

6. LUBRICATION.

a. No lubrication is required.

7. REASSEMBLY. (See Figure 1.)

a. Reassembly is the reverse of disassembly.

b. Assemble bearing block assemblies (26) with trapping grooves toward outlet side.

c. Position piston (20) in cover (17) with flat side toward outlet port.

d. After tightening seal retainer assembly screws (6), stake metal from flange (15) into screw slots to lock the screws. Stake each screw in two places.

8. TEST PROCEDURE.

a. Seal drain port shall be open for all tests.

b. Connect inlet port of pump to reservoir outlet. Connect outlet port to a flowmeter with a gage and shut off valve in the line. Connect motor to DC power source in test bench. Close valve in outlet line and pressurize reservoir to apply 2 psi at pump inlet. There shall be no external leakage and seal drain shall not exceed the rate of 1 drop in 12 minutes with the pump in a static condition.

TABLE II - PERMISSIBLE TOLERANCES

PART	NEW DIMENSION		PERMISSIBLE WORN DIMENSION	NEW CLEARANCE		WORN CLEARANCE
	max	min		max	min	max
Gear Journal	0.3751	0.3748	0.3743			
Gear Thickness	0.1000	0.0995	0.0990	Thickness of gears must be equal within 0.0002 inches.		
Gear Tooth Dia.	0.8120	0.8115	0.8110	0.0003	0.0013	0.0008
Body Bore	0.8128	0.8123	0.8135			
Bearing Block Thickness	0.460	0.455	0.450			

TABLE III - TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Seal Leak	Defective seat assembly	Replace.
	Defective seal face in retainer assembly.	Repair or Replace. See Paragraph 5g.
Low Capacity	Excessive gear clearance.	Replace gears or body as necessary to obtain clearance shown in Table II.
	Piston not seating properly on bearing block.	Position per Paragraph 7c.
	Low voltage	Check power supply.
	Gears not seating against bearing blocks	Check bearing blocks and gears. Sides must be flat and parallel.
	Defective "O" rings on bearing blocks.	Replace.

c. Open valve in outlet line. Energize pump motor and restrict outlet pressure to 1500 psi. Regulate pump inlet pressure to "0" psig. Allow pump and motor to operate in this condition for 3 minutes. During the last 1/2 minute of the 3 minutes run, observe flow and amperage drain. The flow shall be 0.5 gpm minimum and amperage drain shall not exceed 33 amps. Seal drain leakage shall not exceed an equivalent rate of 5 cc/hr. (5 drops in 3 minutes) while pump is operating.

d. Energize pump motor with 27 plus or minus .5 volts DC input and restrict "Outlet" pressure to 1500 psi. Pressurize reservoir to apply 26.7 psia at pump "Inlet". There shall be no external leakage and seal drain leakage shall not exceed the rate of 2 drops per minute.

e. Relieve pressure. Remove pump from test bench. Do not drain oil from pump. Cap ports and plug seal drain port.

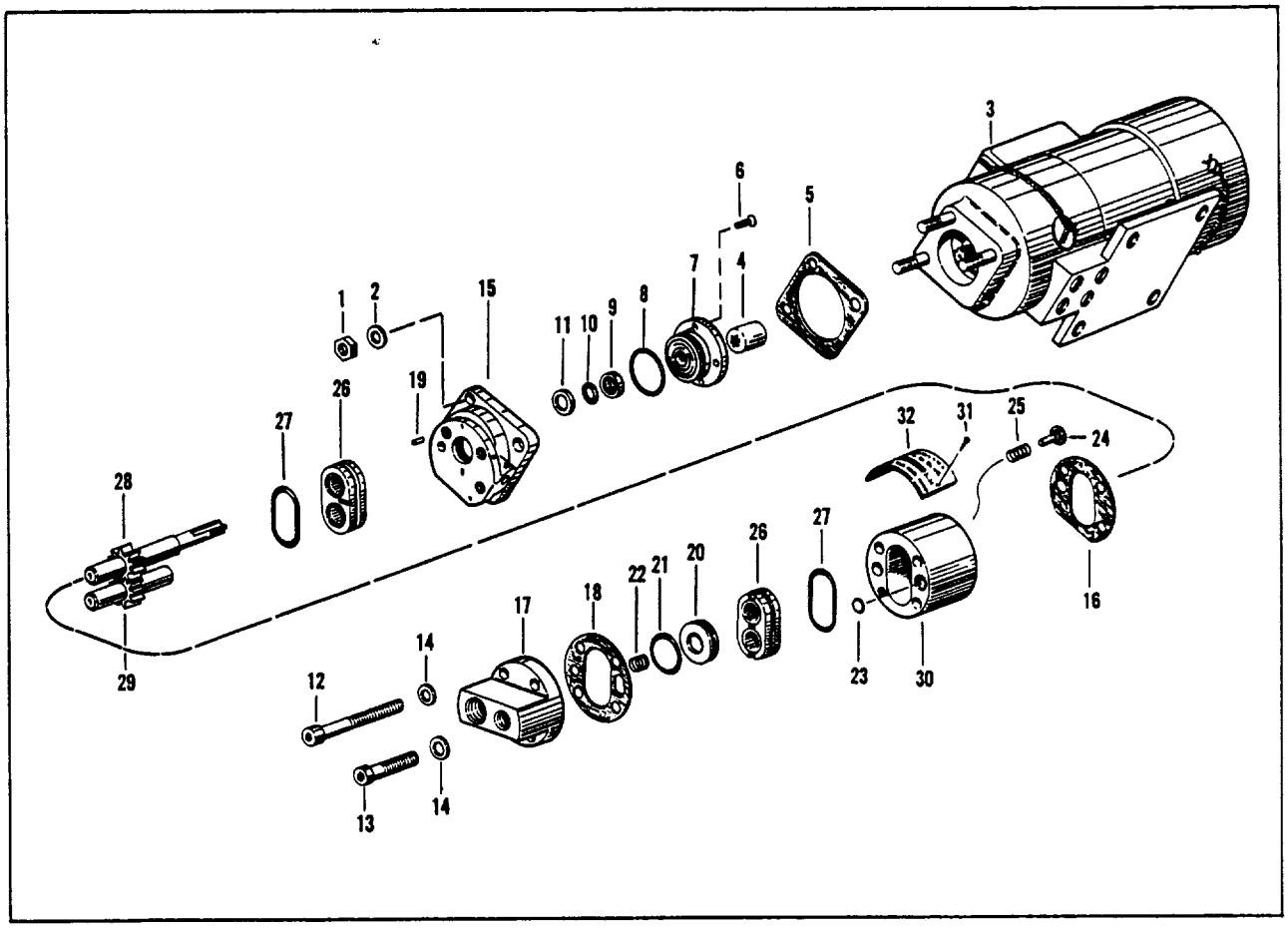


Figure 1. Exploded View 100-689-4 Pump Assembly

FIG. & INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY
1-	100-689-4	ELECTRIC MOTOR DRIVEN PUMP ASSY	1
1-1	AN364-428	. NUT	3
-2	AN960-416	. WASHER	3
-3	A9373M1	. MOTOR ASSY Delco Products (204-631-2)	1
-4	204-453	. COUPLING	1
-5	204-427	. GASKET	1
	100-681-8	. PUMP ASSY	1
-6	AN505C4-5	. . SCREW	4
-7	213-113	. . SEAL ASSY	1
-8	MS28775-021	. . "O" RING	1
-9	213-114	. . SEAT-SEAL	1
-10	MS28775-011	. . "O" RING	1
-11	213-115	. . WASHER	1
-12	204-425-28	. . SCREW	3
-13	204-425-12	. . SCREW	1
-14	204-428	. . WASHER	4
-15	204-460-1	. . FLANGE	1

FIG. & INDEX NO.		DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY
1-16	204-577	. . GASKET	1
-17	204-462-1	. . COVER	1
-18	204-615	. . GASKET	1
-19	204-260	. . DOWEL	2
-20	204-463-1	. . PISTON	1
-21	AN6227-11	. . "O" RING	1
-22	204-259	. . SPRING	1
-23	AN6227-5	. . "O" RING	1
-24	204-272	. . VALVE ASSY	1
-25	204-273	. . SPRING	1
-26	204-457	. . BEARING BLOCK	2
-27	204-274	. . "O" RING	2
-28	204-459-3	. . GEAR, Drive	1
-29	204-458	. . GEAR, Driven	1
-30	204-461	. . BODY	1
-31	AN535-00-2	. . SCREW	2
-32	213-117	. . NAMEPLATE	1

DELAVAL

DELAVAL
SPECIAL PRODUCTS
DIVISION

SERVICE BULLETIN

MODEL 100-689-4

ELECTRIC MOTOR DRIVEN HYDRAULIC PUMP

OVERHAUL IMPROVEMENT - REPLACEMENT PARTS

1. PLANNING INFORMATION:

A. EFFECTIVITY:

All: Delaval Part Number 100-689-4

B. Reason: Internal parts of pump assembly must be matched to pump body for proper performance. Spare parts are now procurable in matched sets only.

C. Description: This Bulletin provides data to buying and overhaul activities for proper parts to be used in repair of effected assemblies.

D. Approval: FAA Approval not applicable.

E. Manpower: This change may save up to 100% in overhaul time.

F. Materials: Parts identified below may be obtained from:
Delaval Special Products Division
Delaval Turbine Inc.
4223 Monticello Blvd.
Cleveland, Ohio 44121 U.S.A.

PART NUMBER	NOMENCLATURE
217-083	Gear Housing & Bearing Assembly

2. ACCOMPLISHMENT INFORMATION:

A. Parts are precision machined in matched sets to assure proper performance. During assembly operations,care must be exercised to assure that similar parts of prior manufacture do not become mixed.

B. Orientation of Bearings in Body must be maintained.

3. MATERIAL INFORMATION:

A. P/N 217-083 Assembly replaces separate items. P/N 204-461 Body; 204-260 Dowel; 204-457 Bearing Block (2).

4. ACTION

Insert this Service Bulletin in Chapter 29 of PSM 1-63-6 immediately before the Manual for Model 100-689-4 Electric Motor Driven Hydraulic Pump.

BULLETIN 1356813

Overhaul Instructions

WITH PARTS BREAKDOWN

ACCUMULATOR, HYDRAULIC

PART NUMBERS

1356-583314 ←

1356-583315

1356-583317

PUBLISHED BY

Service Department

PARKER-HANNIFIN CORPORATION

ACCESSORIES DIVISION

17325 Euclid Ave., Cleveland 12, Ohio

15 June 1964

	PART NUMBERS		
	1356-583314	1356-583315	1356-583317
Overall Dimensions:			
Length	12-1/2 IN.	20-3/8 IN.	20-3/8 IN.
Diameter	2-9/16 IN.	2-9/16 IN.	3-1/2 IN.
Rated Capacity, Gas Volume	25 CU IN.	50 CU IN.	100 CU IN.
Rated Pressure	3000 PSIG	3000 PSIG	3000 PSIG
Ports:			
Hydraulic	AND10050-8	AND10050-8	AND10050-8
Gas	AND10050-5	AND10050-5	AND10050-5
Weight (Empty)	2.8 LB MAX	3.8 LB MAX	7.5 LB MAX
Operating Temperature:			
Maximum	71.1°C (160°F)	71.1°C (160°F)	71.1°C (160°F)
Minimum	-53.8°C (-65°F)	-53.8°C (-65°F)	-53.8°C (-65°F)

Figure 1. Table of Leading Particulars

PART NO. USED WITH MODELS 1356-583314 AND 1356-583315	PART NO. USED WITH MODEL 1356-583317	NOMENCLATURE	APPLICATION
Y-106-1-16	Y-106-1-16	Wrench, End Cap Assembly	To adapt torque wrench for end caps.
X-106-1-7	X-106-1-8	Guide, Retainer	To aline retainers.
X-106-1-10	X-106-1-11	Tapered Sleeve	To install piston assembly.
W-106-1-13	W-106-1-13	Clamp Fixture, Bench	To hold accumulator during overhaul.
X-106-1-13-1	X-106-1-13-2	Blocks, Clamp Fixture	To hold accumulator during overhaul.

Figure 2. Table of Special Tools

1. SPECIAL TOOLS.

Special tools required for overhaul of these accumulators are listed in Figure 2, Table of Special Tools.

2. DISASSEMBLY.

Note

Before removing half mounting rings, note method of lock-wiring for reference during reassembly.

a. Remove lock wire that secures half mounting rings (1, Figure 6) to shell (13) and end caps (2 and 3); remove mounting rings.

b. Install accumulator in a suitable holding device equivalent to special tools, Bench Clamp Fixture, Part Number W-106-1-13, with Clamp Fixture Blocks, Part Number X-106-1-13-1 or X-106-1-13-2. (Refer to Figure 2.) Use End Cap Assembly Wrench, Part Number Y-106-1-16, during removal of end caps (2 and 3, Figure 6). Disassemble in the sequence of index numbers assigned to the exploded view illustration. If the identification band (12) is removed, it must be kept with the unit from which it was taken; it bears the serial number and part number.

CAUTION

The holding device should be such that it encases with nearly equal tightness the entire circumference of the accumulator shell. Uneven tightness such as vise jaws will distort the shell.

Note

Many repair parts for equipment covered in this publication are provided in the form of kits. See Parts Breakdown for details. Presence of a new part in the applicable kit eliminates the necessity of cleaning, inspecting, or reworking the equivalent used part removed from the assembly being repaired; therefore such instructions have been omitted from this manual. Activities shall replace all parts (regardless of condition) which are removed in the process of disassembly with all like parts furnished in the kit. If an installed part is not defective, it need not be removed solely for the purpose of replacement by a corresponding kitted part. Residue from kits and removed parts in this category shall be administratively condemned. The instructions which follow cover removed parts not supplied in kits and kitted parts (if any) which require cleaning, inspecting, or testing prior to installation.

3. CLEANING.

a. Clean all metal parts in cleaning solvent, Federal Specification P-S-661. Dry thoroughly after cleaning with filtered, compressed air.

4. INSPECTION.

a. Inspect ID of shell (13, Figure 6) and OD of piston (10) for scratches, burrs, or other damage affecting free sliding action of the piston in the shell. Inspect the shell, piston, retainers (4), and end caps (2 and 3) for cracks, deformation, or any other structural damage. Check threads for good condition.

b. Conduct non-destructive inspections outlined in Figure 3.

c. Proper fit of piston (10, Figure 6) in shell (13) is determined by test; there are no wear points to measure.

5. REPAIR OR REPLACEMENT.

a. Replace damaged parts unless minor repair will restore to serviceability. Do not attempt repair of the ID of the shell (13, Figure 6), as low spots can affect operation.

b. Replace backup rings (7), packings (6 and 8), and alining rings (9) at each overhaul regardless of condition.

PART IDENTIFICATION			TYPE OF NON-DESTRUCTIVE TEST	TEST PROCEDURE	ACCEPTABLE LIMITS
NAME	USED ON ACCUMULATOR PART NO.	PART NO.			
Hydraulic and Gas End Caps	1356-583314 and 1356-583315	1456-593843 and 1456-593844	Fluorescent Penetrant Inspection (per Military Specification MIL-I-6866)	Check for imperfections per Military Specification MIL-I-6866	Minor surface defects not detrimental to parts strength and serviceability
	1356-583317	1456-593846 and 1456-593845			
Shell	1356-583314	1456-537504	Magnetic Particle Inspection (per Military Specification MIL-I-6868)	Check for imperfections per Military Specification MIL-I-6868	Minor surface defects not detrimental to parts strength and serviceability
	1356-583315	1456-593837			
	1356-583317	1456-593839			

Figure 3. Table of Non-Destructive Inspection for Non-Kitted Parts

6. LUBRICATION.

a. Apply a light coating of hydraulic fluid (refer to the applicable test fluid as specified in paragraph 8) to ID of shell (13, Figure 6), to ring grooves of piston (10) and caps (2 and 3), to packings (6 and 8), and to threads of shell to facilitate assembly.

7. REASSEMBLY.

a. Reassembly is the reverse of disassembly except as noted below. Use Bench Clamp Fixture, Part Number W-106-1-13, with Clamp Fixture Blocks, Part Number X-106-1-13-1 or X-106-1-13-2, to hold the shell during reassembly. (Refer to Figure 2.) It is vital that all parts be completely clean. Check each part before installing it. Install new packing (6, Figure 6), with a backup ring (7) at each side of it, into center groove of piston (10). Install one alining ring (9) in each outer groove of piston (10).

CAUTION

Check the assembly of piston, packings, backup rings, and alining rings to assure that each is in its proper location as shown in Figure 4.

b. Carefully insert the assembled piston into the shell (13, Figure 6) using Tapered Sleeve, Part Number X-106-1-10 or X-106-1-11. (Refer to Figure 2.)

c. Install a Retainer Guide, Part Number X-106-1-7 or X-106-1-8, into each end cap to assure alinement during assembly of packings (6, Figure 6) and retainers (4). Tighten screws (5) so that retainers bottom against end caps while a 0.010-inch thick gage (or shim) is held between the retainer and the underside of the screw heads. Lock-wire screws using MS20995C20 wire and remove special tools and gages. If properly assembled, expansion of packings will keep retainers against screw heads, leaving a 0.010-inch gap (maximum) between retainers and end cap. If it is necessary to reposition screws for alining lock wire holes, tighten screws to obtain proper position.

d. Carefully screw the shell (13) into the end caps (2 and 3), making sure that the face of piston (10) is toward hydraulic end cap (2), until metal-to-metal contact at bottom is obtained. Hold the accumulator by the flats on one end cap and tighten the other to 1400 to 1500 pound-inches torque using Bench Clamp Fixture, Part Number W-106-1-13; Clamp Fixture Blocks, Part Number X-106-1-13-1

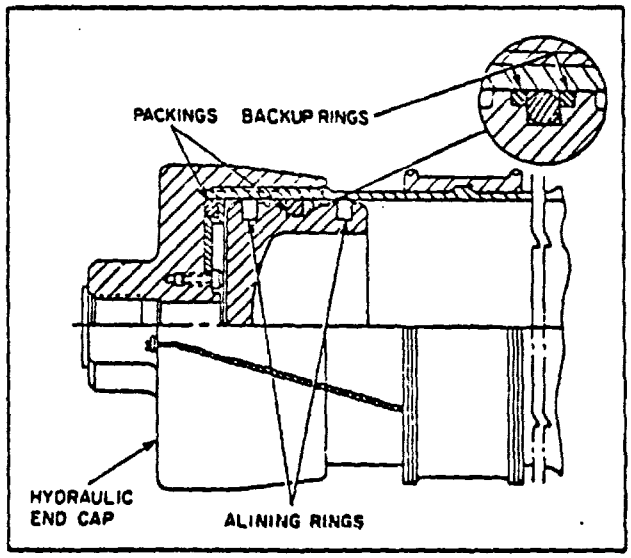


Figure 4. Sectional View of Hydraulic Accumulator

or X-106-1-13-2; and End Cap Assembly Wrench, Part Number Y-106-1-16. (Refer to Figure 2.)

c. Position the half mounting rings (1, Figure 6) over the circumferential ribs nearest the ends of the shell, with the ring inside slots straddling the small slots in the ribs. Lock-wire the half mounting rings to the shell as noted at disassembly. Use lock wire MS20995C32.

f. Check that identification band (12) is in place on the shell. If a new identification band is installed, transfer all identification data from old band.

8. TEST PROCEDURE.

WARNING

Nitrogen (or dry air) is under pressure during the following tests; exercise extreme caution when performing tests.

CAUTION

This accumulator is designed for use with hydraulic fluid, Military Specification MIL-H-5606, or preservative fluid, Military Specification MIL-H-6083. Tests should be performed using the fluid for the system in which the accumulator is to be installed, if known, to prevent contamination of the system. Tag the accumulator after test to identify the type fluid used for testing.

a. PREPARATION FOR TESTING. Provide a source of nitrogen (or dry air) capable of supplying pressures from 0 to 3000 PSIG. The nitrogen (or dry air) shall be continuously filtered through a 10-micron, or finer, filter.

b. Provide a source of hydraulic fluid capable of supplying controlled pressures from 0 to 6000 PSIG. The hydraulic fluid shall be continuously filtered through a 10-micron, or finer, filter.

Note

Use nitrogen (or dry air) and hydraulic fluid, Military Specification MIL-H-5606 or MIL-H-6083, to perform the tests described in the following paragraphs.

c. PISTON SEIZURE TEST. Determine the position of the piston (10, Figure 6) with respect to the end caps (2 and 3); connect the pressure source (nitrogen, dry air, or hydraulic fluid) to the end cap (2 or 3) nearest to the piston (10).

d. Slowly apply pressure, not in excess of 50 PSIG, to the accumulator until the piston (10) moves the entire length of the shell (13). There shall be no evidence of seizing or binding.

e. Connect the pressure source to the opposite end cap of the accumulator and repeat the procedure outlined in paragraph 8d, moving the piston (10) in the opposite direction.

f. Repeat the procedures outlined in paragraphs 8c through 8e. If more than 50 PSIG pressure is required to move the piston (10) during any part of the test, an improper fit or damage to surfaces is indicated.

g. After completion of test, connect pressure source to the end cap nearest the piston (10) and apply pressure to move the piston (10) to the approximate center of the shell (13).

Note

Do not actuate the piston (10) manually.

h. PROOF PRESSURE TEST. With the accumulator piston (10) positioned in the approximate center of the shell (13) (refer to paragraph 8g), fill the hydraulic end and gas end of the accumulator with hydraulic fluid. Plug one of the end cap ports and connect the other to the hydraulic fluid source with a pressure gage capable of indicating pressure from 0 to 6500 PSI.

WARNING

Be certain that all air is removed from the accumulator and connecting lines and that connections and plugs used are capable of withstanding 6250 PSIG pressure.

i. Apply 6000 to 6250 PSIG hydraulic pressure and hold for 5 minutes. There shall be no external leakage, evidence of damage, or deformation.

CAUTION

At the conclusion of the proof pressure test, hold the accumulator by the flats on one end cap while tightening the other to 1400 to 1500 pound-inches torque. Use Bench Clamp Fixture, Part Number W-106-1-13; Clamp Fixture Blocks, Part Number X-106-1-13-1 or X-106-1-13-2; and End Cap Assembly Wrench, Part Number Y-106-1-16. (Refer to Figure 2.)

j. *INTERNAL GAS LEAKAGE TEST. Connect a* nitrogen (or dry air) source to the accumulator at the gas end cap (3, Figure 6) and slowly apply pressure until the piston (10) bottoms lightly against the hydraulic end cap (2).

k. Connect the port of the hydraulic end cap (2) to a setup to measure leakage in an inverted glass graduate or a U-tube arrangement.

l. Apply 175 to 225 PSIG pressure to the gas end cap (3) port. Maintain pressure for 3 minutes

PART NUMBER	MAX LEAKAGE
1356-583314 and 1356-583315	0.1 milliliter free air
1356-583317	0.15 milliliter free air

Figure 5. Table of Internal Leakage Limits

and measure leakage. Leakage shall not exceed limits shown in Figure 5, Table of Internal Leakage Limits.

m. Increase the pressure to 1900 to 2100 PSIG. Maintain pressure for 3 minutes and measure leakage. Leakage shall not exceed limits shown in Figure 5, Table of Internal Leakage Limits.

n. EXTERNAL GAS LEAKAGE TEST. Connect nitrogen (or dry air) source to the accumulator hydraulic and gas ports.

o. Submerge the accumulator in water.

CAUTION

Exercise care to prevent water from entering and making contact with an internal surface of the accumulator by applying gas pressure prior to submersion and maintaining until after submersion.

p. Apply 175 to 225 PSIG pressure to the hydraulic and gas ports simultaneously. Maintain pressure for 5 minutes while observing water for evidence of leakage as indicated by air bubbles. There shall be no evidence of external leakage. Allow escape of trapped air before starting 5-minute test period.

q. Increase the pressure to 2900 to 3100 PSIG and maintain pressure for 5 minutes while again observing for evidence of leakage. There shall be no evidence of external leakage. Ignore the escape of trapped air during pressure rise.

r. TROUBLESHOOTING. Since there are no adjustments to be made, units that fail the tests outlined in paragraphs 8c through 8q must be rejected and returned to overhaul for diassembly, inspection, and replacement of defective parts. Then reassemble and retest.

s. STORAGE INSTRUCTIONS. After completion of testing, drain accumulator of excess hydraulic fluid; then install protective plugs in the hydraulic end cap (2) and gas end cap (3). Lock-wire the end caps to the shell using lock wire MS20995C32.

t. Tag the accumulator to identify the hydraulic fluid (Military Specification MIL-H-5606 or MIL-H-6083) with which it has been tested.

u. Mark assembly date on identification band (12) in accordance with ANA Bulletin 438. Use a permanent etching ink.

v. Wrap accumulator in waterproof paper prior to storing or shipping.

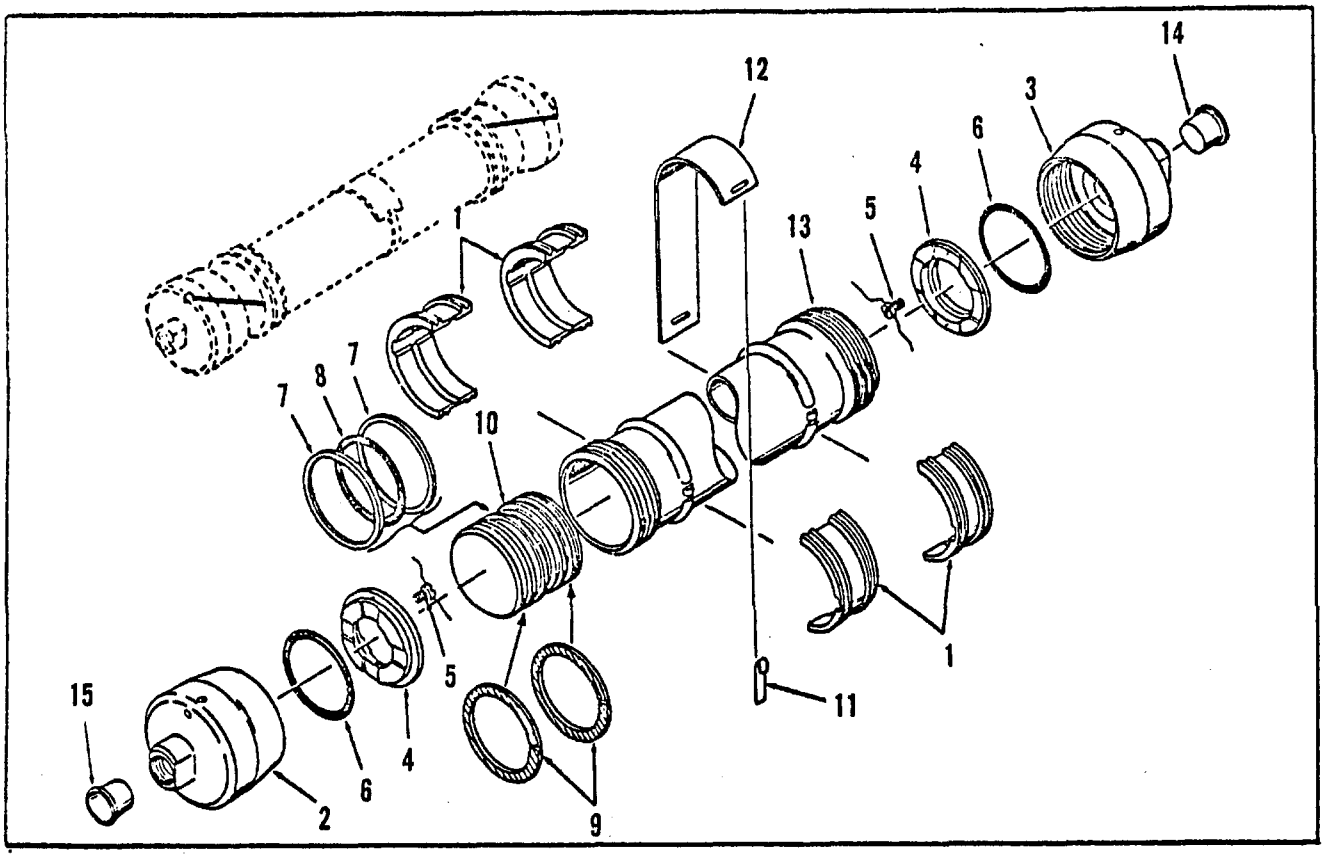


Figure 6. Exploded View of Hydraulic Accumulator

Note

This parts list reflects the use of repair kits intended to provide the user with most replacement parts usable at major overhaul and at minor repair. Certain replacement parts are stocked only in kits. Those procurable parts not in kits are stocked in their appropriate class. Standard parts and parts having multi-application, are stocked in their appropriate class, and may also be stocked in kits. Do not order kit parts from separate stock to serve the purpose of a kit.

FIG. & INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY.	USABLE ON CODE	SOURCE CODE
6-	1356-583314	ACCUMULATOR, Hydraulic	1	A	
	1356-583315	ACCUMULATOR, Hydraulic	1	B	
	1356-583317	ACCUMULATOR, Hydraulic	1	C	
-1	1456-573511	. RING, Mounting, half	4	AB	
	1456-593170	. RING, Mounting, half	4	C	
-2	1456-593843	. CAP, Hydraulic end	1	AB	
	1456-593846	. CAP, Hydraulic end	1	C	
-3	1456-593844	. CAP, Gas end	1	AB	
	1456-593845	. CAP, Gas end	1	C	
-4	1456-593852	. RETAINER	2	AB	
	1456-593853	. RETAINER	2	C	
		(ATTACHING PARTS)			
-5	AN500AC5-4	. SCREW	4	AB	
	AN500AC8-4	. SCREW	4	C	

FIG. & INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY.	USABLE ON CODE	SOURCE CODE
6-6	AN6230-1	. PACKING	2	AB	
	AN6227-35	. PACKING	2	C	
-7	1456-573507	. RING, Backup	2	AB	
	1456-573461	. RING, Backup	2	C	
-8	AN6227-28	. PACKING	1	AB	
	AN6227-35	. PACKING	1	C	
-9	1456-573506	. RING, Alining	2	AB	
	1456-573411	. RING, Alining	2	C	
-10	1456-573505	. PISTON	1	AB	
	1456-593168	. PISTON	1	C	
-11	1456-552196	. STRAP, Identification band	1	AB	
	1456-552197	. STRAP, Identification band	1	C	
-12	1456-552100	. BAND, Identification	1		
-13	1456-573504	. SHELL	1	A	
	1456-593837	. SHELL	1	B	
	1456-593839	. SHELL	1	C	
-14	COML	. PLUG, Protective (10-644-8-2)	1		
-15	COML	. PLUG, Protective (10-644-8-5)	1		
6-	1456-613140	. KIT, Repair parts, cure-dated items	1	AB	C
6-	1456-613141	. KIT, Repair parts, cure-dated items	1	C	C

Note

Parker-Hannifin assigned part numbers for commercial parts are listed parenthetically in the Description column.

9. SOURCE CODE DEFINITIONS.

Note

The source code definitions are extracted from AFLCM 65-3.

f. Code "C"--Cure-Dated Parts Kit. Code "C" is applied to kits containing parts that have a specific period of time (cure-date) to remain in storage without affecting their serviceability and are subject to deterioration due to aging or exposure. The cure-date for the kit is established on the shortest life item within the kit. C-Kit contains parts required for maintenance and overhaul and will be used in conjunction with Overhaul (Code "D") Repair Kits and/or Minor or Field (Code "F") Repair Kits, as applicable.

O V E R H A U L M A N U A L

SERVICE INSTRUCTIONS WITH

ILLUSTRATED PARTS BREAKDOWN

FOR

HYDRAULIC RELIEF VALVE

PNEUDRAULICS, INC.

PART NUMBER 1000-4

PREPARED BY THE ENGINEERING DEPARTMENT OF

PNEUDRAULICS, INC. MONTCLAIR, CALIFORNIA U.S.A.

INTRODUCTION: This report covers the service instructions for the PneuDraulics, Inc. Model 1000, 1100, and 1200 Series Main System Hydraulic Relief Valves in all tube sizes and pressure classes. A Spare Parts List for the specific model is included as Section 6.

SCOPE: The following information is presented in the various sections of this report.

Section 1: General Description of Function

Section 2: Cleanliness, Assembly, and Handling Safeguards

Section 3: Assembly and Disassembly Procedures

Section 4: Field Rework Procedures

Section 5: Functional Test Procedures

Section 6: Spare Parts List

SECTION I

GENERAL DESCRIPTION AND FUNCTION

1.0 INTENDED USE:

The PneuDraulics, Inc., Main System Relief Valves are designed to Military Specification MIL-V-8813 and are intended for use in either Type I (-65°F to +160°F) or Type II (-65°F to +275°F) Aircraft Hydraulic Systems to provide for relief of excessive hydraulic system pressures.

1.1 OPERATION:

Operation of the PneuDraulics, Inc., Main System Relief Valves is completely automatic. If the hydraulic pressure in the hydraulic system increases to the valve pressure setting, the valve will open at a predetermined and adjusted pressure level and pass flow; thus, preventing further increase in hydraulic system pressure within the limits defined by Military Specification MIL-V-8813 for each class valve. As the system pressure decreases, the valve will close or reseat at a predetermined point and maintain a pressure tight seal against leakage.

SECTION 2

CLEANLINESS, ASSEMBLY, AND HANDLING SAFEGUARDS

2.0 CLEANLINESS SAFEGUARDS:

It is necessary to maintain a normal degree of cleanliness when assembling and handling the PneuDraulics, Inc., Relief Valve, as is the case with all precision hydraulic devices. The safeguards listed below must be recognized and observed.

2.0.1 Assembly Area:

The assembly and disassembly area, which includes the work benches, should be segregated if possible from any area where drilling, filing, or grinding, etc., operations are performed in order to prevent assembly of contaminants into the valve.

2.0.2 Cleanliness Cautions:

2.0.2.1 Open ports on the valve, when not in use, should be plugged with metal port closures.

2.0.2.2 Do not assemble dirt into a valve. All parts should be dust and dirt free prior to assembly. Parts should be washed in solvent and thoroughly cleaned just prior to assembly. The solvent used for cleaning should be replaced periodically, dependent upon how dirty it becomes. All solvent and oil containers should be flushed out to remove metallic chips, lint, and other contamination which will collect.

2.0.2.3 Careful use of rags is important. Rags are to be used to "mop" up oil, debris, etc. If a rag is used to wipe out a bore or to wipe off a part, the rag must be absolutely clean, dry, and free of lint.

2.1 ASSEMBLY SAFEGUARDS:

2.1.1 General:

Precision hydraulic components are delicate pieces of equipment and must be treated as such.

2.1.2 Clamping:

Cylinders or any unit which has working parts, such as a piston, should never be clamped in a vise, except at obvious wrench pads which may be provided. Clamping in a vise is sufficient to cause binding of the working parts when assembling or disassembling, which will cause scoring or galling. Cylinders should always be held in a vise by use of special bored wooden blocks which fit the O.D. of the unit and distribute the vise pressure around the circumference.

2.1.3 Torqueing:

Caution must be exercised in excessive torqueing of threaded parts. Threaded parts should be well lubricated with clean hydraulic fluid prior to assembly.

2.1.4 Any highly polished surface, internal or external, is easily mutilated by dirt particles. All sliding surfaces of the valve, as well as "O" ring sealing surfaces, must be protected against mutilation, scratches, etc., and the assembly of dirt into the unit.

2.1.5 Never FORCE a valve together. All valves are engineered and manufactured to tolerances which allow easy assembly. If the valve does not assemble freely, then some part is not in its correct position for assembly. Disassemble and compare the part locations and positions with the assembly procedure and the assembly drawing.

2.2 HANDLING SAFEGUARDS:

2.2.1 General:

The critical functional parts of the relief valve which can be damaged due to improper handling are the seat, poppet, sleeve, and probe. The following cautions should be observed in the handling or storing of these parts.

2.2.2 Seat Handling:

The spherical lapped surface at the base of the cone on the seat is the sealing surface. This sealing surface is relatively well protected from damage due to its protected location. If this lapped surface becomes damaged, rough, scratched, or nicked, the valve will no longer function as it is intended. This surface must be thoroughly cleaned prior to assembly into the valve, as contamination will cause serious damage.

2.2.3 Poppet Handling:

The extreme corner on the small end of the poppet is the sealing surface. This surface must be protected at all times. If this surface becomes nicked, the valve will no longer function as it is intended. The small end of the poppet should always be protected with a clean plastic closure or, if this is not available, with a piece of tape.

2.2.4 Sleeve Handling:

The interior sliding surface of the sleeve must be thoroughly cleaned prior to assembly or valve operation will not be satisfactory. The sleeve should be handled with caution so that it does not become squeezed or egg-shaped.

2.2.5 Probe Handling:

The probe must be handled with extreme caution so that the small end does not become scratched or nicked. Also, the probe must be placed in a protected position so that it does not become bent or proper valve operation will be impaired.

SECTION 3

ASSEMBLY AND DISASSEMBLY PROCEDURE

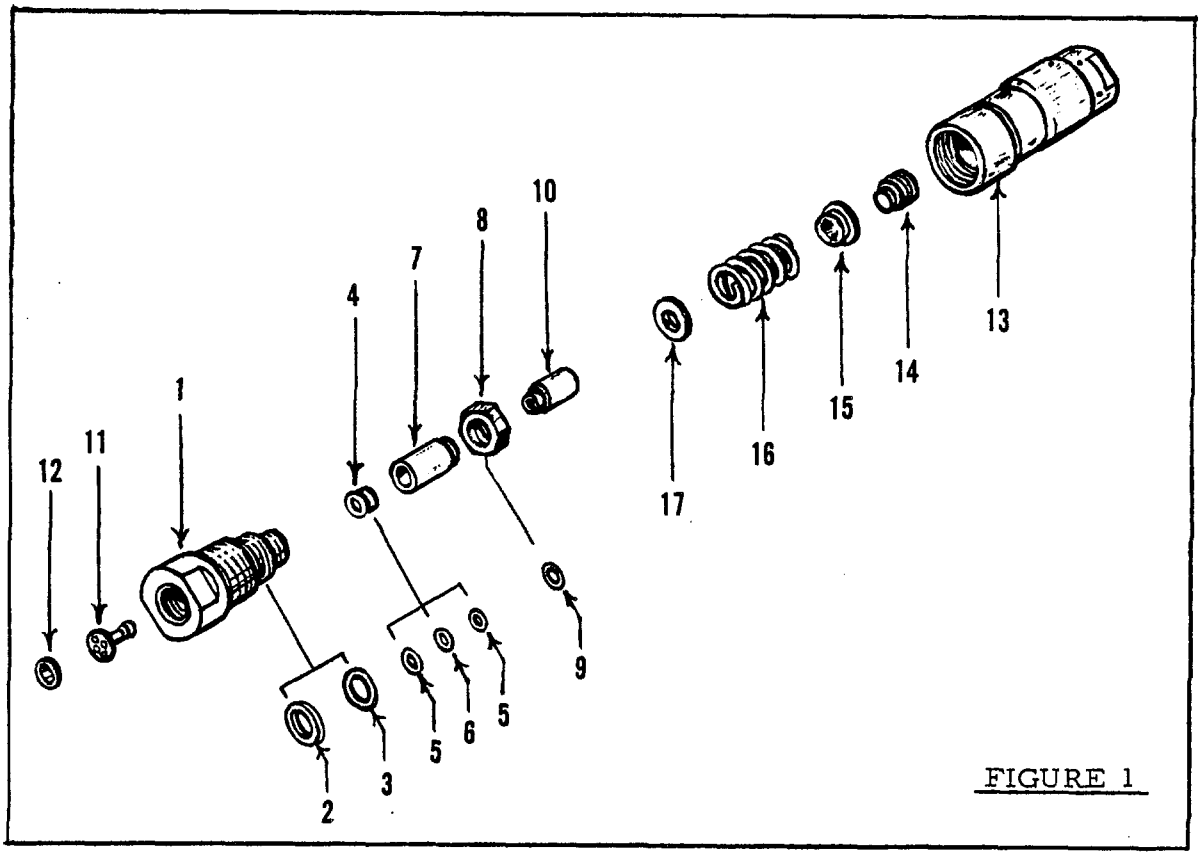


FIGURE 1

VALVE ASSEMBLY

- SUB-ASSEMBLY "A"
  - (1) END CAP SUB-ASSY
    - 1. END CAP
    - 2. BACKUP RING
    - 3. PACKING
  - (4) SEAT SUB-ASSY
    - 4. SEAT
    - 5. BACKUP RING (2)
    - 6. PACKING
  - 7. SLEEVE ASSY
  - 8. RETAINER NUT
  - 9. LOCK RING
  - 10. POPPET
  - 11. PROBE
  - 12. INLET NUT
- SUB-ASSEMBLY "B"
  - (13) BODY SUB-ASSEMBLY
    - 13. BODY
    - 14. SPRING ADJ SCREW
  - 15. SPRING ADAPTER
  - 16. SPRING
  - 17. SPRING GUIDE

3.0 INTRODUCTION:

This section explains the correct sequence of assembly and disassembly of the Model 1000, 1100, and 1200 Relief Valves. The exploded view (Figure 1), and the following instructions, should be referred to when any assembly or disassembly is undertaken. The safeguards of Section 2 of this document must be observed.

3.1 ASSEMBLY INSTRUCTIONS:

The following instructions indicate the correct method of assembly of the relief valve. Item numbers refer to those indicated in the exploded view (Figure 1). Clean all parts in solvent, and lubricate with clean hydraulic fluid prior to assembly. Refer to Section 6 for part number of any part which requires replacement.

3.1.1 To Complete Sub-Assembly "A":

3.1.1.1 Make End Cap Sub-Assembly (1) by assembling Backup 2 and Packing 3 to End Cap 1. The Packing to be toward the small end.

3.1.1.2 Make Seat Sub-Assembly (4) by assembling Backups 5 and Packing 6 to Seat 4. One (1) Backup to be to each end of Seat 4, with the Packing between.

3.1.1.3 Place End Cap Sub-Assembly (1) in a vise, clamping on the wrench flats provided. Clean Seat Sub-Assembly (4), lubricate with clean hydraulic fluid, and then with the lapped surface up, carefully place in the recessed internal bore of (1). After cleaning the Sleeve Assembly 7, place in the recessed internal bore, with the small lipped end up, and carefully push down. This will push the seat into the correct position within its bore. Next, assemble the Retainer Nut 8 to (1) by threading on. The Sleeve 7 lip will extend through the I.D. of 8. Be certain that the Nut 8 bottoms securely on shoulder of Sleeve 7.

3.1.1 To Complete Sub-Assembly "A": (Continued)

3.1.1.4 Remove the assembly created in the preceding paragraph 3.1.1.3 from the vise. Clean and assemble in solvent, and blow dry with clean air. Clean the Poppet 10, and dip in clean hydraulic fluid, then place in the bore of Sleeve 7 with the small end entering first. Hold in place with a finger over the end and, holding the assembly with the open port up, place the Probe 11 in the port, and carefully push down until it enters the Probe hole in the Poppet 10. Next, place the Inlet Nut 12 into the port and thread down into position. Exercise caution in tightening the Nut 12 so that misalignment of the Probe will not occur. When tightened securely, the Poppet 10 must be free to rotate 360° and must be free to move fore and aft without binding. Move the Poppet 10 in and out, and test for freedom. If any interference is observed, loosen Nut 12 and retighten. When freedom is achieved, Sub-Assembly "A" is complete.

3.1.2 To Complete Sub-Assembly "B":

3.1.2.1 Make Body Sub-Assembly (13) by threading the Adjustment Screw 14 into Body 13. The small end of Screw 14 must be toward the large open end of the Body 13. The Screw 14 is to be assembled from the large open end of Body 13 and backed into place with an Allen Wrench inserted through the port in the opposite end for Model 1000; either for Models 1100 and 1200.

3.1.2.2 Complete Sub-Assembly "B" by clamping body Sub-Assembly (13) in a vise on the wrench flats provided, with the large open end up. Then, carefully insert Spring Adapter 15. Make certain that the flat side of Adapter 15 is down and that 15 fits over the extension on Screw 14 and is flush.

3.1.2 To Complete Sub-Assembly "B": (Continued)

3.1.2.2 (Continued)

Next, drop Spring 16 into place, and ascertain that the I.D. of the Spring 16 fits over the extension diameter of Adapter 15 and is flush. Next, place Spring Guide 17 on the upper end of Spring 16. The spherical surface on Guide 17 must be up toward the open end of the body. Center Guide 17 as closely as possible to the centerline of the Body bore by eye. This completes Sub-Assembly "B". Leave it in the vise and complete final assembly as noted below.

3.1.3 To Complete Final Valve Assembly:

3.1.3.1 With Sub-Assembly "B" completed and clamped in the vise per paragraph 3.1.2 of this document, carefully invert Sub-Assembly "A" and insert into "B". Take care that the Poppet 10 does not drop out. Lubricate the threads with clean hydraulic fluid, and carefully thread "A" into "B" until it is flush on the shoulder. Take care that the backup ring does not cam out as the end cap is assembled into the body. If any resistance is observed, remove and inspect. When "A" has been securely threaded into "B", the valve final assembly is complete. Cap the ports with metal closures.

3.1.4 Functionally test and adjust the valve per the procedure outlined in Section 5 of this document.

3.2 DISASSEMBLY INSTRUCTIONS:

The following instructions indicate the correct method of disassembly of the relief valve. The item numbers refer to the exploded view (Figure 1). In general, disassembly is the reverse of assembly.

3.2.1 Remove Sub-Assembly "A":

3.2.1.1 Place the valve in a vise, and clamp on the wrench flats on the return port end. Remove the lockwire and lead seal from the End Cap. Loosen Sub-Assembly "A", unscrew from Body, and remove. If poppet 10 does not come out with "A", carefully remove it from the body and re-insert in bore in "A". This will afford protection to the poppet.

3.2.2 To Disassemble Sub-Assembly "B":

3.2.2.1 Remove Sub-Assembly "B" from the vise and invert onto the bench. Guide 17, Spring 16, and Adapter 15 will fall out. If Adapter 15 does not fall out, a few light taps on the bench will make it do so.

3.2.2.2 The Body 13 and Screw 14 may be separated if desired or required by screwing 14 into the bore of 13 from the outlet port, using an Allen Wrench.

3.2.3 To Disassemble Sub-Assembly "A":

3.2.3.1 Carefully remove Poppet 10 from the assembly, cover the sealing surface, and place the Poppet in a safe location.

3.2.3.2 The Sleeve Assembly 7 can be removed from the Assembly "A" without disturbing the alignment of the Probe by loosening and removing Nut 8 and then removing Sleeve 7.

3.2.3.3 To remove Seat 4, the Inlet Nut 12 and probe 11 must be removed. Place the Probe in a protected location in order to prevent damage. To remove Seat 4, insert a rod (0.28 dia.) through the Inlet Port on End Cap 1 and, with light pressure, push Seat 4 out of its bore. Place Seat in a protected location to prevent damage. Disassembly is now complete, except for removal of "O" rings and backups which is to be done in accordance with standard procedures.

SECTION 4

FIELD REWORK PROCEDURES

4.0 INTRODUCTION:

The manufacturer does not recommend field rework of any of the component parts of the relief valve. Replacement parts may be obtained from the Manufacturer either as details, or as sub-assemblies, as called out in the Spare Parts List, Section 6.

4.1 Replacement of parts in the valve is to be accomplished in accordance with the procedure of assembly and disassembly outlined in Section 3 of this document.

4.2 After part replacement and reassembly of the valve, the valve shall be tested in accordance with the procedures of Section 5 of this document.

SECTION 5

FUNCTIONAL TEST PROCEDURES

5.0 INTRODUCTION:

This section defines the test procedures which are to be applied to each relief valve after assembly per Section 3 of this document.

5.1 TEST CONDITIONS:

5.1.1 The test setup will be in accordance with Figure 2 below, or equivalent. The test fluid shall be MIL-H-5606 or MIL-H-6083, controlled between 80°F and 110°F during all tests. The test fluid shall be continuously filtered, using a standard AN rated 10 micron filter or equivalent.

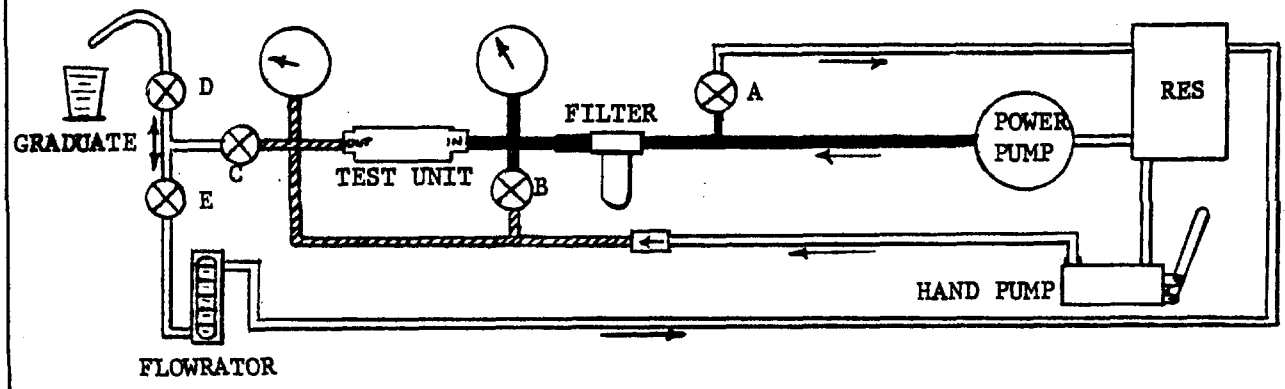


FIGURE 2

5.2 PRESSURE ADJUSTMENT PROCEDURE:

The test unit shall be adjusted to the desired rated flow pressure setting or lead seal pressure. If the valve does not have a lead seal pressure specified or required, it shall be adjusted to the maximum rated flow pressure setting of its class.

5.2.1 Connect the test unit into the circuit of Figure 2, but leave the outlet of the unit open to atmosphere. Open Valve A and close Valve B; then, start the power pump. Refer to Chart A, and determine the approximate cracking pressure which is required in order to obtain the specified rated flow pressure required for the test unit which is being adjusted.* By means of Valve A, increase the inlet pressure to the unit, and observe the flow out of the outlet. Adjust the unit through the outlet, using a standard Allen Wrench, until the approximate cracking pressure has been obtained.

CHART A

CRACK PRESSURE RANGES FOR VARIOUS VALVE CLASSES

Valve Class	Approximate Crack Pressure Range	Approximate Crack Pressure Difference From Rated Flow Differential Pressure
A	420 to 750	40 to 60 PSI
B	785 to 1290	65 to 80 PSI
C	1170 to 2100	120 to 160 PSI
D	1900 to 3500	200 to 300 PSI

* P/N 1000-4 is a Class "C" Valve.

5.2 PRESSURE ADJUSTMENT PROCEDURE: (Continued)

5.2.2 Connect the outlet of the unit into the circuit. Close Valve D, open Valves C and E. Increase the inlet pressure to the unit until flow is indicated on the flowrator. Manipulate Valves A and C until the unit is passing the rated flow through the flowrator with 200 ± 25 PSI back pressure. Record the actual inlet and outlet gage readings, and subtract the outlet gage reading from the inlet gage reading. This value is the rated flow differential pressure. Compare the value obtained with the desired pressure adjustment. Reduce the inlet pressure, open the unit outlet to atmosphere, and increase or decrease the crack pressure of the unit by the amount of error in actual versus desired pressure adjustment. Reconnect the unit outlet, and repeat the above procedure until the desired rated flow differential pressure has been obtained.

5.3 ACCEPTANCE TEST PROCEDURE:

The following acceptance test procedure shall be applied after the unit has been adjusted to the desired rated flow differential pressure setting per paragraph 5.2 of this document.

5.3.1 Pressure Setting Test and Reseat Test:

5.3.1.1 With the unit connected into the test circuit of Figure 2, open Valves A, C, and E; close Valves B and D; and start the power pump. Increase the inlet pressure and adjust the outlet pressure by manipulation of Valves A and C until the unit is passing rated flow through the flowrator at 200 ± 25 PSI back pressure. Record the inlet and outlet gage readings. Subtract the outlet gage reading from the inlet gage reading. This is the lead seal pressure.

5.3.1 Pressure Setting Test and Reseat Test: (Continued)

5.3.1.2 Determine the allowable reseat pressure for the unit under test by subtracting the value given in Chart B from the lead seal pressure.

CHART B

MAXIMUM PRESSURE DIFFERENTIAL BETWEEN FULL FLOW AND RESEAT

Valve Class	Maximum Pressure Spread Between Full Flow and Reseat Pressures
A	100 PSI
B	160 PSI
C	270 PSI
D	460 PSI

5.3.1.3 Reduce the inlet pressure to the reseat pressure determined in paragraph 5.5.1.2 above. Open Valve D, and close Valve E, and time. The unit shall reseat and the leakage shall not exceed the maximum values specified in Chart C for the tube size unit under test.

CHART C

MAXIMUM LEAKAGE AT MINIMUM RESEAT PRESSURE

Valve Tube Size	Maximum Leakage Allowable as Measured During 3rd Minute of a 3 Minute Waiting Period
-4	4.5 cc/minute
-6	4.5 cc/minute
-8	6.0 cc/minute

5.3 ACCEPTANCE TEST PROCEDURE: (Continued)

5.3.2 Decreasing and Increasing Pressure Leakage Test:

5.3.2.1 After checking the reseat pressure per paragraph 5.3.1.3 of this document, decrease the unit inlet pressure to 3/4 and 1/2 of the lead seal pressure. Leakage at these pressures shall not exceed the values given in Chart D for the tube size unit under test.

CHART D

MAXIMUM LEAKAGE AT PRESSURES BELOW RESEAT PRESSURE

Valve Tube Size	Maximum Leakage Allowable as Measured During 3rd Minute of a 3 Minute Waiting Period
-4	1.5 cc/minute
-6	1.5 cc/minute
-8	2.0 cc/minute

5.3.2.2 Gradually increase the inlet pressure to the unit to 3/4 of the lead seal pressure. Leakage shall not exceed the values given in Chart D.

5.3.2.3 Increase the inlet pressure gradually to the reseat pressure obtained in paragraph 5.3.1.3 of this document. Leakage shall not exceed the values given in Chart C for the tube size unit under test.

5.3 ACCEPTANCE TEST PROCEDURE: (Continued)

5.3.3 Proof Pressure Test:

5.3.3.1 With the unit connected into the circuit per Figure 2. Open Valves A, C, and E; close Valves B and D; start the power pump. Increase the inlet pressure to the unit by throttling Valve A until flow is noted at the flowrator. Manipulate Valve B and cycle the handpump until all traces of air have been purged from the system. Reduce the inlet pressure by opening Valve A; then, close Valve C, open Valve B, and shut down the power pump.

5.3.3.2 By means of the handpump, increase the pressure at the inlet and outlet of the unit to 4500 PSI at a rate not exceeding 25,000 PSI per minute, and hold the pressure for one (1) minute. There shall be no evidence of external leakage, failure, excessive distortion, or permanent set. Reduce the pressure by cracking Valve C, and then repeat the above procedure.

5.3.4 Reverse Flow Leakage:

5.3.4.1 At the conclusion of paragraph 5.3.3.2 above, reduce the pressure by cracking Valve C, and then close Valve B. Disconnect the line from the inlet port of the test unit. With Valve C closed, increase the pressure at the outlet port of the unit by means of the handpump until the rated flow has been reached. Leakage out of the unit inlet port shall not exceed the values indicated in Chart D for the tube size unit under test.

5.3.5 Final Adjustment Check:

5.3.5.1 At the conclusion of paragraph 5.3.4.1 above, bleed off pressure by opening Valve C, and reconnect the unit inlet line. Repeat paragraph 5.3.1 to determine that no deterioration has occurred due to application of proof pressure.

5.3 ACCEPTANCE TEST PROCEDURE: (Continued

5.3.6 Lockwire and Affix Lead Seal:

5.3.6.1 The acceptance test on the unit is now complete. Cap the ports on the unit, lockwire per the assembly drawing, and affix the lead seal, impressed with the lead seal pressure to which the unit has been adjusted.

5.3.7 Inspection Stamps, Cure, and Assembly Dates:

5.3.7.1 Affix rubber stamped Inspection Final, Function, and Pressure Test stamps to the unit. Be certain that the assembly date and rubber cure date rubber stamps have been applied.

SECTION 6

SPARE PARTS LIST

PART NUMBER 1000-4

FIG. & INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6	UNITS PER ASSY.
1-	1000-4	Valve, Hydraulic Relief	Ref.
1	10103	. End Cap	1
2	MS28774-113	. Backup Ring	2
3	MS28775-113	. Packing	1
4	12442	. Seat	1
5	MS28774-011	. Backup Ring	2
6	MS28775-011	. Packing	1
7	10501	. Sleeve Assy.	1
8	10431	. Retainer Nut	1
9	MS28775-014	. Lockring	1
10	12441	. Poppet	1
11	10444	. Probe	1
12	10432	. Inlet Nut	1
13	10200	. Body	1
14	10416	. Adj. Screw	1
15	10408	. Spring Adapter	1
16	10312	. Spring	1
17	10429	. Spring Guide	1
--	12705-04	. Nameplate	1
--	91000	. Drivescrew	4
--	AN 995-C32	. Lockwire	AR
--	COMMERCIAL	. Lead Seal	1

PTI Technologies Inc.

INSTALLATION, OPERATION, AND MAINTENANCE INSTRUCTIONS

PART NUMBER 50220

TO: HOLDERS OF INSTALLATION, OPERATION, AND MAINTENANCE INSTRUCTIONS FOR PART NUMBER 50220

REVISION NO. 3 DATED JUNE 30/93

HIGHLIGHTS

This is a complete revision of the Instructions, Revision 2 dated November 15/90. Pages that have revised material are listed below, together with highlights of the revision.

Page No.	Description of Change	Effectivity
All	Revised to indicate manufacturer's name and logo change: was Textron Filtration Systems/Subsidary of Textron Inc.	All
2	Added instructions for testing relief valve.	
3	Added instructions for proof testing filter assembly.	
5	Added Figure 1 for testing relief valve, and Figure 2 for proof test.	

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INSTALLATION, OPERATION, AND MAINTENANCE INSTRUCTIONS

PART NUMBER 50220

DESCRIPTION:

The PTI Technologes Inc. Type PR-401-3 hydraulic filter has an operating capacity of 1/2 gpm of hydraulic oil Specification MIL-H-5606 or Hydrolube (H-2) per specification MIL-F-7083 at 90° to 110°F with a maximum differential pressure of 6 psi.

The filter has an operating pressure of 3000 psi, a test pressure of 4500 psi minimum for two minutes, and a bursting pressure of 7500 psi minimum.

The element assembly filtering surface is approximately 14.6 square inches of chemically treated paper. The element paper is supported for the full length by a spring to further reinforce the convolutions. The estimated weight of the complete unit is 0.5 pounds.

There is a relief valve incorporated in the head assembly which is set to open at 50 ±5 psi differential pressure.

The inlet and outlet connections are located in the head below and at right angles to the two mounting holes. The thread sizes for these connections are 7/16-20 UNF-3 (female) threads per AND-10050-4. The diameter of each mounting hole is 0.2658 per AND-10387.

DISASSEMBLY:

To disassemble filter, proceed as follows:

a. Remove lockwire and clamp filter head assembly in a vise.
b. Using a 5/8-inch open-end wrench, unscrew case assembly from head assembly.

c. The element can easily be removed from center bushing in head assembly by gently rocking it back and forth. DO NOT rotate element, as this may damage convolutions.

CLEANING AND INSPECTION:

a. Clean head and case thoroughly and inspect parts for damage to threads or material. Any parts with damaged threads should be replaced.

b. Gaskets should be replaced at each overhaul.

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c. Element should be replaced at each overhaul. If replacement elements are not available, old element may be reused after special cleaning (to be done in emergencies only). Plug or mask open end of element to prevent the entry of dirt to the inside of the element convolutions. Clean element in a solution of 50 percent benzene and 50 percent lacquer thinner or 100 percent chloroform. As a substitute for benzene a 50 percent solution of toluene may be used with an equal portion of lacquer thinner. A soft brush or mild air blast may be used in conjunction with whichever solution is used.

CAUTION: DO NOT use a wire brush or scraper to clean element as this will damage the element convolutions beyond repair. Handle element cleaning operation with extreme care.

d. To inspect element, insert a small light in center of element convolutions to inspect for minute holes in element paper. Check both ends of element for damage.

REASSEMBLY:

Reassembly is the reverse of disassembly. When filter is completely reassembled and tested, replace safety wire. When installing filter, ensure inlet and outlet connections are in same direction as the arrow on the head assembly. There are no special tools required for the disassembly or reassembly of this filter.

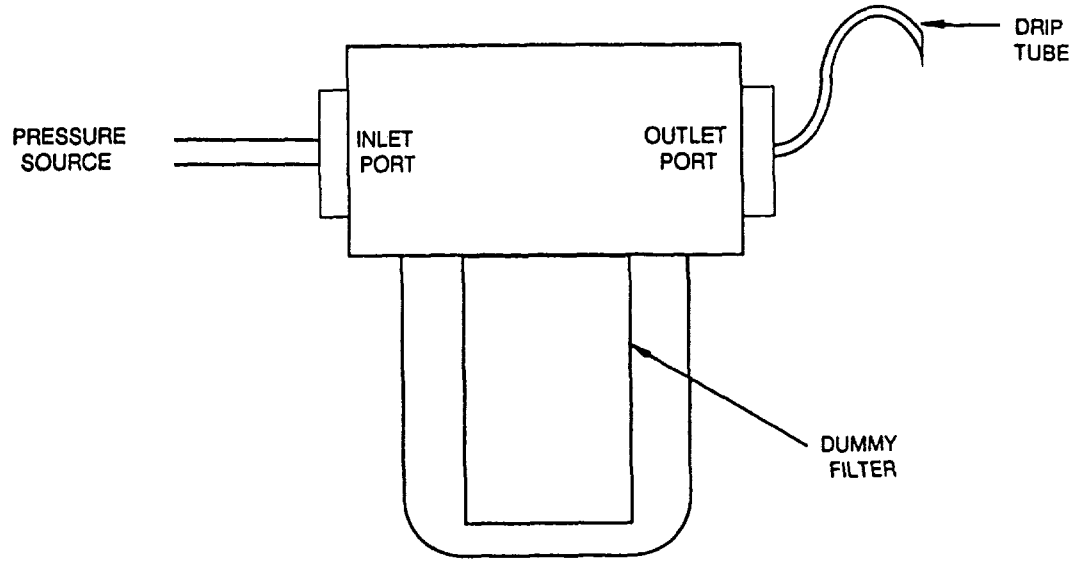
TEST:

To test relief valve, proceed as follows:

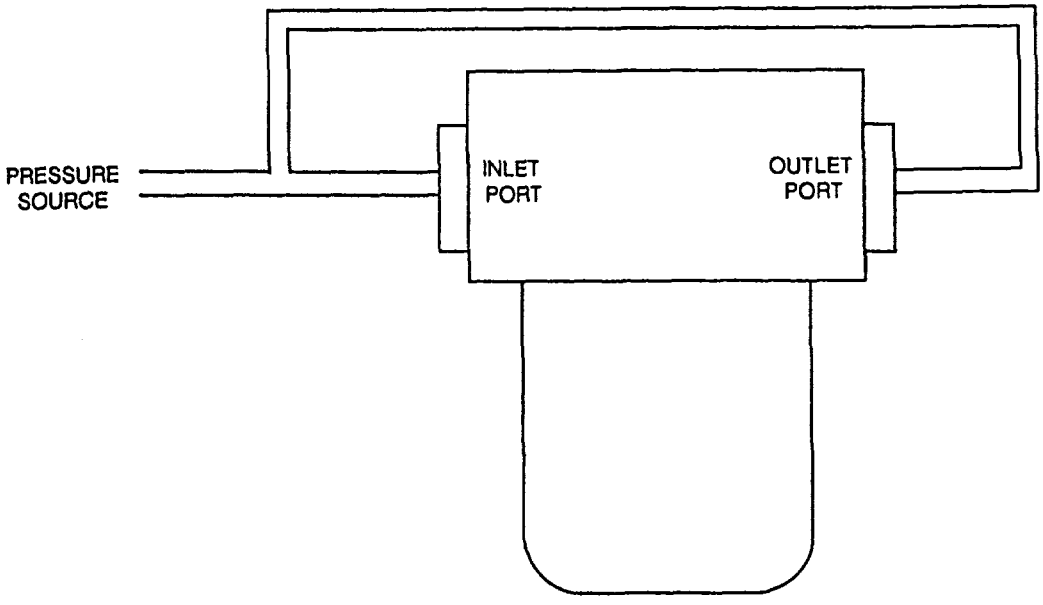
a. Disassemble filter and remove element.
b. Install dummy filter element in place of filter element and install case assembly.
c. Slowly apply hydraulic pressure to inlet port until fluid flows from the outlet port. the relief valve shall open at 50 ±5 psig (see figure 1).
d. Reduce pressure below 32 psig then raise to 40 psig. Leakage shall not exceed 2.0 cc per minute.
e. Raise inlet to 55 psig leakage shall exceed 4cc per minute.
f. Disassemble filter assembly. Remove dummy element and replace filter element. Reassemble filter assembly.

To test filter assembly for external leakage, proceed as follows:

a. Fill filter assembly with hydraulic fluid ensuring there is no trapped air.
b. Apply 4500 psig min. hydraulic pressure to both the inlet and outlet ports simeltaneously (see figure 2).
c. There shall be no set or external leakage allowed. (note hydraulic fluid less than one drop is considered to be zero.)
d. Install lockwire and two NAS 818-4 shipping plugs.



BYPASS VALVE LEAKAGE SCHEMATIC
FIGURE 1



PROOF PRESSURE SCHEMATIC
FIGURE 2

SPARE PARTS LIST

P/N 50220

PART NO.	PART NAME	NO. PER UNIT	NO. FOR MAINT	NO. FOR OVERHAUL	TOTAL
50224	Head Assembly	1	5	10	15
6655565	Element Assembly	1	50	100	150
38362	Case Assembly	1	5	10	15
62309-7	Case Gasket	1	50	100	150
62506-7	Back-Up Washer	1	50	100	150
15045	Safety Wire	1	50	100	150
50237	Name Plate	1	-	-	-
30743	Drive Screw	4	-	-	-

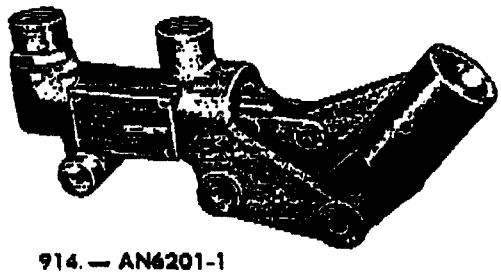
Bulletin No. 368

INSTALLATION OPERATION MAINTENANCE

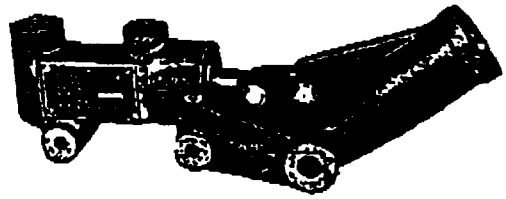
Service Instructions
for

TELEDYNE REPUBLIC

HYDRAULIC HAND PUMPS



914. — AN6201-1



915 — AN6248-2
916 — AN6248-3

WITH

ILLUSTRATED PARTS BREAKDOWN

TELEDYNE REPUBLIC
15655 Brookpark Road, Cleveland, Ohio 44142
216/267-2700 TELEX 980-637

Printed in U.S.A.

TELEDYNE REPUBLIC

Hand Pumps

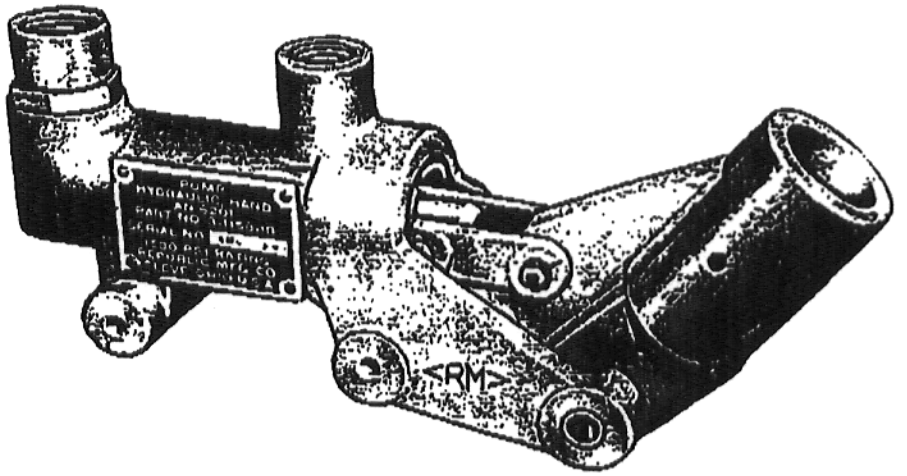


Fig. 1 914 — AN6201-1

ORIGINAL
As Received By
ATP

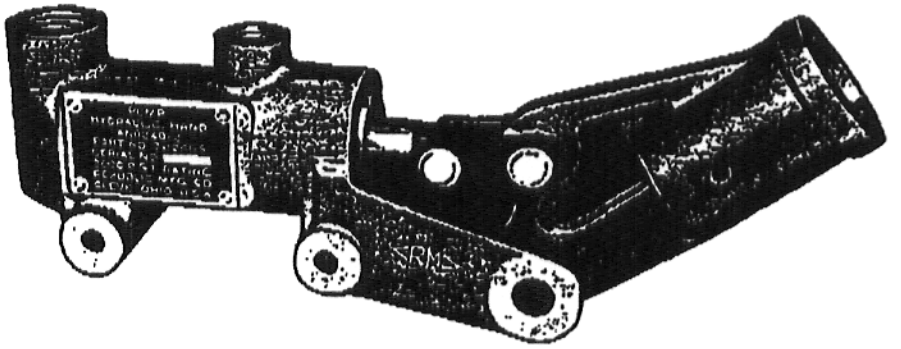


Fig. 2 915 — AN6248-2
916 —AN6248-3

INSTALLATION OPERATION MAINTENANCE

Service Instructions

for

TELEDYNE REPUBLIC HYDRAULIC HAND PUMPS

914 — AN6201-1 915 — AN6248-2

916 — AN6248-3

GENERAL

This Manual covers operation and maintenance instructions for Republic Hand Pumps 914, 915, AN6201-1, AN6428-2 and AN6248-3. These pumps are of the double-acting positive-displacement type.

Models 914 and AN6201 deliver 1.25 to 1.50 cu. in. per cycle (2 strokes) up to 1500 psi maximum, 915 and 916 AN6248-2 and AN6248-3 deliver .7 cu. in. minimum per cycle (2 strokes) up to 3000 psi.

Under AN6201-1, AN6248-2, and AN6248-3 ordering part numbers these pumps meet military specification MIL-P-5515, and are designed for use with hydraulic oil MIL-H-5606. Under Republic catalog numbers 914, 915, and 916, these pumps are standard for use with hydraulic oil MIL-H-5606, but the O-rings and seals may, on special order, be specified for use with fuels, and a wide variety of chemicals and liquids.

INSTALLATION

The Hand Pump, as received, is completely assembled and ready for installation. Visually inspect for possible shipping damage. Do not remove the port connectors until the pump is to be installed.

CAUTION

During installation do not permit any foreign matter to enter the ports.

Installation dimensions are shown in Figures 3 and 5. Ports are marked IN and OUT. Make plumbing connections by installing the ½ in. OD tube fittings and connecting lines to the IN or suction port, and the ⅜ in. (914/AN6201-1) or the ¼ in. (915/AN6248-2/916/AN6248-3) tube fittings to the OUT or discharge port, using a suitable gasket. Ports are SAE straight thread (AN10050 or MS33649) O-ring seal tube connections. Gaskets used should be dimensionally equivalent to AN6290-8, -6 and -4, respectively.

Make sure all connections are tight.

Continued on page 8

Installation Dimensions

914 — AN6201-1

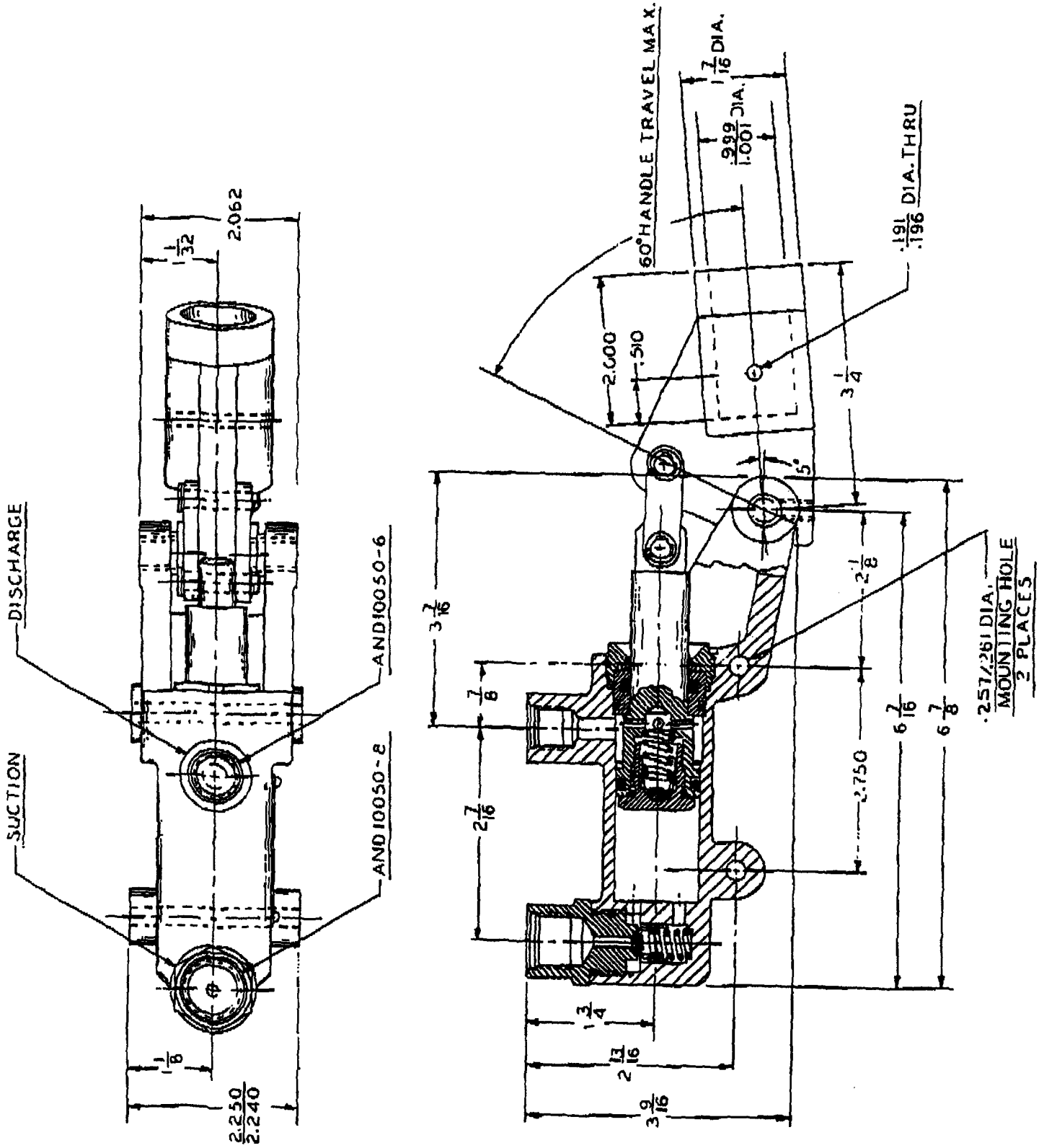


Fig. 3

Parts Breakdown

914-8D27 — AN6201-1

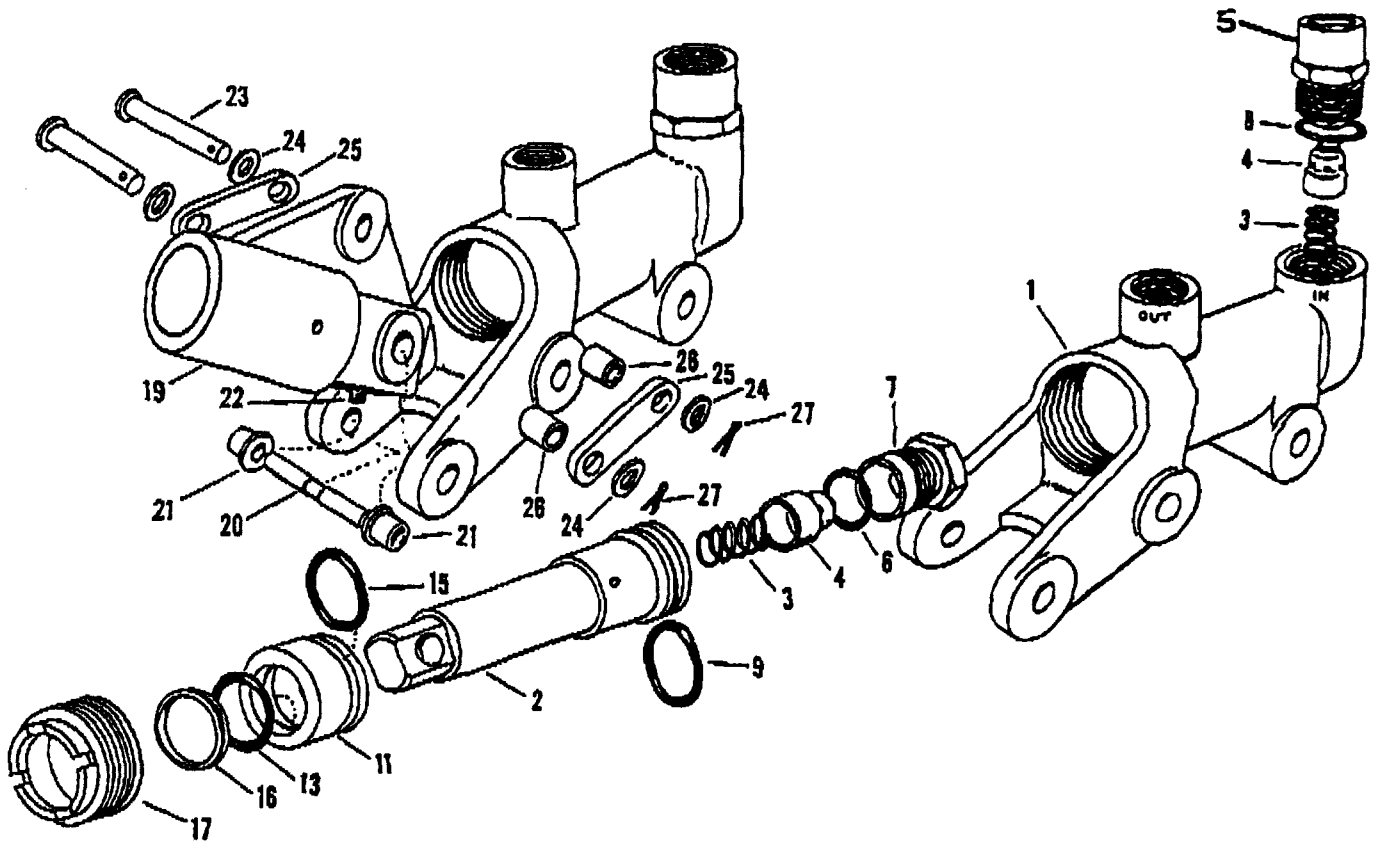


Fig. 4

Table 1 **RECOMMENDED REPLACEMENT PARTS**

ITEM	DESCRIPTION	PART NO.	MS EQUIV. NO.	QUANTITY
KIT	COMPLETE FIELD REPAIR KIT Contains the Following:	2-866-3	—	—
3	Spring	5-2755-2	—	2
4	Poppet Assembly	1-375-1-27	—	2
6	Piston Cap O-Ring	SP132-92	MS28775-16	1
8	Inlet Cap O-Ring	SP332-10	AN6290-10	1
9	Piston O-Ring	SP132-17	AN6227B-17	1
13	Inner Spacer O-Ring	SP132-16	AN6227B-16	1
15	Outer Spacer O-Ring	SP132-109	MS28775-121	1

Installation Dimensions

915 — AN6248-2 916-AN6248-3

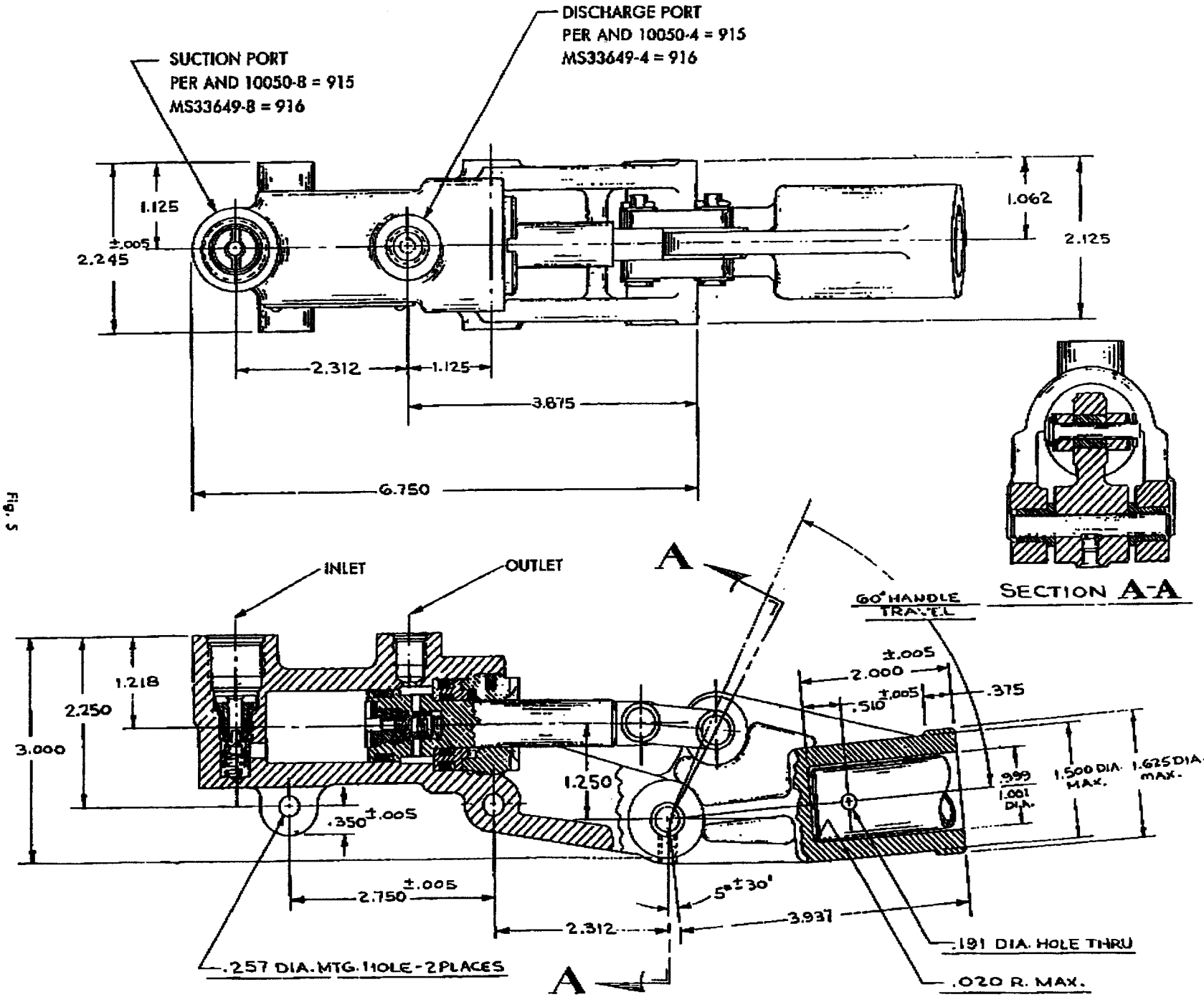


Fig. 5

Parts Breakdown

915-8D27 — AN6248-2
916-8D27-AN6248-3

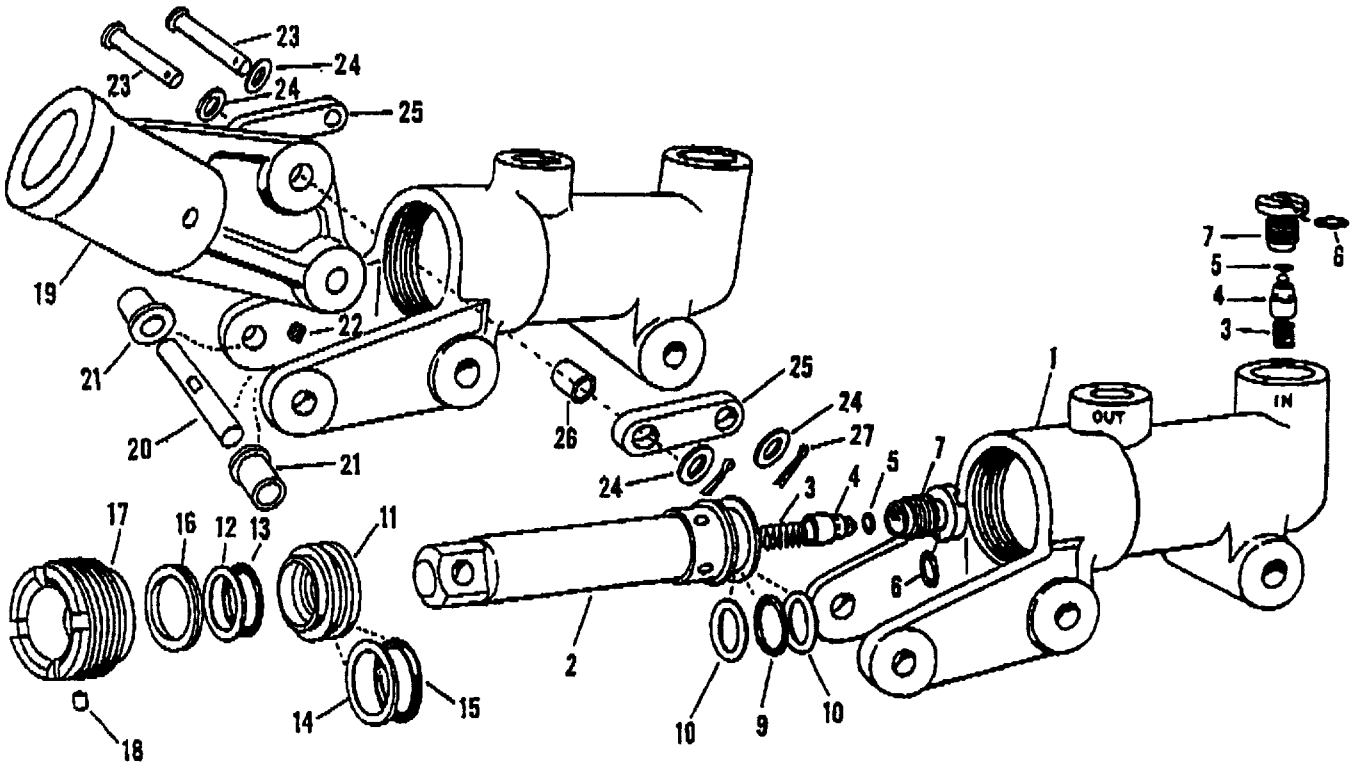


Fig. 6

Table 2 **RECOMMENDED REPLACEMENT PARTS**

ITEM	DESCRIPTION	PART NO.	MS EQUIV. NO.	QUANTITY
KIT	COMPLETE FIELD REPAIR KIT Contains the Following:	11-2266-4	—	—
3	Spring	11-661-1	—	2
5	Poppet O-Ring	SP132-1	MS28775-006	2
6	Valve Seat O-Ring	SP132-6	MS28775-011	2
9	Piston Head O-Ring	SP132-13	MS28775-115	1
10	Piston Head Back-Up Ring	SP201-13	MS28774-115	2
12	Piston Rod Back-Up Ring	SP201-12	MS28774-114	1
13	Piston Rod O-Ring	SP132-12	MS28775-114	1
14	Housing Back-Up Ring	SP201-108	MS28774-120	1
15	Housing O-Ring	SP132-108	MS28775-120	1

OPERATION

Liquid is forced through the pump by moving the handle between the two extreme positions.

When the pump handle is moved from the vertical to the horizontal position, as in piston stroke A (see schematic Fig. 7) chamber C1 draws fluid in through inlet or suction port check valve, while chamber C2 discharges fluid through outlet or discharge port. When the handle is returned to vertical position, as in piston stroke B, the volume of fluid in chamber C1 is transferred to chamber C2 through the piston check valve. Since chamber C2 holds half the volume of chamber C1, half the fluid in chamber C2 is discharged through the outlet port, and the other half is held for use in the following stroke A.

PRINCIPLE OF OPERATION

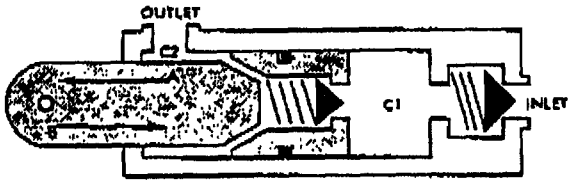


Fig. 7

MAINTENANCE

External leakage around the piston (2, Figs. 4 and 6), may often be stopped by further tightening of the gland (17).

If excessive force is required to actuate the pump, check the system pressure.

Should it become necessary to service the pump it can be completely disassembled and reassembled in the field.

Failure to build up pressure is probably caused by defective piston seals, or an inoperative check valve. Handle creep indicates leakage past the check valve. Most leakage is due to defective or incorrectly installed O-ring packings. Often foreign matter in the pump causes unsatisfactory service, which can be corrected by cleaning.

There is available a Field Repair Kit of replacement parts (Tables 1 and 2) which contains all the O-rings, back-up rings, springs, etc., necessary for complete overhaul of the standard pumps (for use with hydraulic oil MIL-H-5606). Figures 4 and 6.

DISASSEMBLY

All work should be done in as clean an area as is available. Figures 4 and 6 show the order of disassembly.

Remove handle. Place pump in a vise, bearing on the body at the ends of the mounting bosses.

To remove inlet valve, with a wrench (Fig. 4), or a wide screwdriver (Fig. 6), unscrew valve seat (7) from inlet port. Poppet (4) and spring (3) may then be removed.

Although the internal parts in each pump are identical, it is desirable that they be retained as parts of the same valve assembly. Therefore, if poppets are not to be renewed, identify poppets (4), seats (7) and O-rings, so they will be reassembled into the same valve bore from which they were removed.

To remove outlet valve, disconnect handle pivot (19) by releasing links (25) at the flat end of piston (2). Remove cotter pin (27), releasing washers (24) and spacer (26).

With a spanner wrench, unscrew the piston gland (17) and pull out the piston assembly. Remove scraper ring (16), O-rings, etc. Place piston (2) in a vise, gripped on the flats. With a wide screwdriver, unscrew valve seat (7) from valve in end of piston. Remove poppet (4) and spring (3). Remove O-rings and back-up rings.

Wash all parts in an approved oil base cleaning solvent (Fed. Spec. P-S-661). Dry with a clean, lint-free cloth, or use compressed air, if available.

WARNING

Use solvent in a well-ventilated area.
Avoid prolonged inhalation of fumes.
Keep away from open flames.

Check all parts for cracks, breaks and other obvious signs of damage and excessive wear. Springs must have no visible distortion when rolled on a surface plate. Examine all O-rings for cuts, tears, cracks and swelling. Imperfect rings should be replaced. To clean clogged passages, use a hardwood rod. Do not use metal.

After cleaning, if reassembly is not immediate, put a light film of preservative oil (Spec MIL-H-6083) on parts, and place in a dust-free container until ready for inspection and reassembly.

REASSEMBLY

It is wise to replace springs, O-rings and back-up rings at each overhaul, and Republic has kits of Recommended Replacement Parts available for this purpose. Tables 1 and 2.

Use extreme care during reassembly to prevent dirt particles from entering the pump that would score internal metal parts or sealing surfaces. Coat all rubber parts with a suitable lubricant before assembly. Handle O-rings with care, especially when passing them over threads or sharp edges. Twisting, small cuts or nicks may result in leakage after installation. Make sure O-rings and back-up rings are installed in the proper relationship to each other, and to pressure direction, as shown in the sectional views (Figs. 3 and 5).

Apply one or two drops of light oil to the three handle pivot pins (20, 23) as required.

PARTS BREAKDOWN
914-8D27 OR AN6201-1 OR 3-1158-18

ITEM NO.	DESCRIPTION	PART NO.	QUANTITY
1	BODY	3-1158-5	1
2	PISTON	3-1158-6	1
3	SPRING	5-2755-2	2
4	POPPET SUB-ASS'Y	1-375-1-27	2
5	CAP, INLET	3-1158-7	1
6	O-RING	SP132-92	1
7	CAP, PISTON	3-1158-10-1	1
8	O-RING	SP332-10	1
9	O-RING	SP132-17	1
11	SPACER	3-1158-8	1
13	O-RING	SP132-16	1
15	O-RING	SP132-109	1
16	SCRAPER	MS28776M2-6	1
17	SCREW	3-1158-11	1
19	PIVOT ARM	3-1958-15	1
20	PIN	3-1158-12	1
21	BUSHING	3-1158-13	2
22	SET SCREW	MS18063-14	1
23	PIN FLAT HEAD	MS20392-3C33	2
24	WASHER	AN960-416	4
25	LINK	3-1158-14	2
26	BUSHING	3-1158-15	2
27	COTTER PIN	MS24665-151	2

PARTS BREAKDOWN
915-8D27

ITEM NO.	DESCRIPTION	PART NO.	QUANTITY
1	BODY	8-1761-2	1
2	PISTON	8-1761-6	1
3	SPRING	11-661-1	2
4	POPPET	3-2860-17-1	2
5	O-RING	SP132-1	2
6	O-RING	SP132-6	2
7	SEAT	6-1583-2	2
9	O-RING	SP132-13	1
10	BACKUP RING	SP201-13	2
11	SEAL HOUSING	8-1761-4	1
12	BACKUP RING	SP201-12	1
13	O-RING	SP132-12	1
14	BACKUP RING	SP201-108	1
15	O-RING	SP132-108	1
16	SCRAPER	MS28776M2-3	1
17	SEAL RETAINER	8-1761-3	1
18	NYLON INSERT	8-1761-5	1
19	PIVOT ARM	8-1761-9	1
20	PIN	9-2763-1	1
21	BUSHING	3-1158-13	2
22	SET SCREW	MS18063-14	1
23	PIN FLAT HEAD	MS20392-3C33	2
24	WASHER	AN960-416L	4
25	LINK	8-1761-8	2
26	BUSHING	8-1761-11	1
27	COTTER PIN	MS24665-151	2

PARTS BREAKDOWN
916-8D27 OR AN6248-3 OR 10-1382-1

ITEM NO.	DESCRIPTION	PART NO.	QUANTITY
1	BODY	10-1382-2	1
2	PISTON	8-1761-6	1
3	SPRING	11-661-1	2
4	POPPET	3-2860-17-1	2
5	O-RING	SP132-1	2
6	O-RING	SP132-6	2
7	SEAT	6-1583-2	2
9	O-RING	SP132-13	1
10	BACKUP RING	SP201-13	2
11	SEAL HOUSING	8-1761-4	1
12	BACKUP RING	SP201-12	1
13	O-RING	SP132-12	1
14	BACKUP RING	SP201-108	1
15	O-RING	SP132-108	1
16	SCRAPER	MS28776M2-3	1
17	SEAL RETAINER	8-1761-3	1
18	NYLON INSERT	8-1761-5	1
19	PIVOT ARM	8-1761-9	1
20	PIN	9-2763-1	1
21	BUSHING	3-1158-13	2
22	SET SCREW	MS18063-14	1
23	PIN FLAT HEAD	MS20392-3C33	2
24	WASHER	AN960-416L	4
25	LINK	8-1761-8	2
26	BUSHING	8-1761-11	1
27	COTTER PIN	MS24665-151	2

PARTS BREAKDOWN
10-2285-1

ITEM NO.	DESCRIPTION	PART NO.	QUANTITY
1	BODY	10-2285-1	1
2	PISTON	8-1761-6	1
3	SPRING	11-661-1	2
4	POPPET	3-2860-17-1	2
5	O-RING	SP160-1	2
6	O-RING	SP60-6	2
7	SEAT	6-1583-2	2
9	O-RING	SP160-13	1
10	BACKUP RING	SP201-13	2
11	SEAL HOUSING	8-1761-4	1
12	BACKUP RING	SP201-12	1
13	O-RING	SP160-12	1
14	BACKUP RING	SP201-108	1
15	O-RING	SP160-108	1
16	SCRAPER	MS28776M2-3	1
17	SEAL RETAINER	8-1761-3	1
18	NYLON INSERT	8-1761-5	1
19	PIVOT ARM	OMIT	1
20	PIN	9-2763-1	1
21	BUSHING	3-1158-13	2
22	SET SCREW	OMIT	1
23	PIN FLAT HEAD	MS20392-3C33	2
24	WASHER	AN960-416L	4
25	LINK	8-1761-8	2
26	BUSHING	8-1761-11	1
27	COTTER PIN	MS24665-151	2

CHAPTER

30

ICE AND RAIN PROTECTION

de Havilland Inc.
DHC–6 TWIN OTTER
COMPONENT MAINTENANCE MANUAL
CHAPTER 30 –ICE AND RAIN PROTECTION
TABLE OF CONTENTS

MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B./T.R.
Alco	Electrical Windshield Wiper System (Mod S.O.O. 6157)	XW20101–DHC–6		May 15/1974	
Barber Colman	Windshield Temp. Controller	SYLZ 50157			
Marquette Metal a Cuttiss Wright Co.	Wiper Converter LH, RH	14–91355 & 14–91455	30–40–01	Dec 1/1973	
	Wiper Motor	14–97862–02		Jul 15/1964	
General Electric	Temperature Controller	3S2060DM109A1 & A2			
B.F. Goodrich Aerospace	Propeller Deicing System	Report 68–04–712C		Aug 15/1980	
	Install & Remove Deicers	Report 59–728K		Feb 1/1983	
	Brush Block Assemblies	Report 68–04–714–I		Feb 1/1983	S/B No. E79–59 dated 6/7/1979
B.F. Goodrich Aerospace was Bendix	Distributor Valve	1532–3–A			S/B No. 87, S/B No. 91 & S/B 97
	Ejector	19E26–1A			
	Sequential Timer	42E13–3A			
	Water Separator	44E06–2A			
B.F. Goodrich Aerospace / Rosemount	Windshield Wiper Motor Assembly	2311M95, 96 & 97	30–42–10	Oct 1/1993	
Lucas	Deicer Distributing Valve	1532–2A, –3A, –3B, –3C, –6A & –6C		Oct 1993	
	Deicer Distributing Valve	1532–8A, –8C, –10A & –10C		Oct 1990	
	Regulating & Relief Valve	38E96–2C through –6A		Jan 1995	
	Water Separator and Filter	44E15–1A through –2B		March 1992	

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O V E R H A U L M A N U A L

W I T H

P A R T S B R E A K D O W N

F O R

ELECTRIC WINDSHIELD WIPER SYSTEM

Part Number XW20101-DHC6

15 May 1974

Manufactured by

ALCO CONTROLS
St. Louis, Missouri

ALCO CONTROLS

XW20101-DHC6 OVERHAUL MANUAL

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ALCO CONTROLS

XW20101-DHC6 OVERHAUL MANUAL

Electric Windshield Wiper System for DHC6 Twin Otter

1. Description. This section contains a general description of the Alco Electric Windshield Wiper System XW20101-DHC6, manufactured by Alco Controls Division, Emerson Electric Co., St. Louis, Missouri, U.S.A. for the DHC6 Twin Otter aircraft.

   A. The system includes all necessary components to provide a clear area on the pilot and the co-pilot windshields.

   B. The wiper system consists of a Motor, two Converters, two Flexible Drive Assemblies, two Arm Assemblies, two Link Assemblies, two Wiper Blades.

   C. For clarity this manual discusses each component individually and includes sections covering the motor and the converter.

2. Operation. A CONTROL SWITCH (not an Alco part) is utilized to turn the wiper system on and off and select fast or slow blade speed. Slow motor speed is obtained by selecting a circuit with a resistor in series with the motor. A momentary park position on the control switch completes the circuit and causes the wiper to automatically return to the "stow" position. When the control switch knob is released, the switch returns to off position shutting down power to the wiper.

   A. The ELECTRIC MOTOR has an output shaft at each end and provides the power for operating both the pilot and the co-pilot wiper. It contains an automatic reset thermal protector to de-energize the motor in event of overload. Radio noise filters are contained in the base of the motor. The motor also contains a gear train driving a cam to operate the parking switch to automatically stow both wiper blades when the control switch is turned to "Park" position.

   B. FLEXIBLE DRIVE ASSEMBLIES are connected to the motor and to the converters to transmit the rotary output of the motor to each converter. These assemblies consist of a flexible drive shaft enclosed in a flexible casing. A threaded fitting on each end of the casing is the attaching means to the motor and the converters.

C. The CONVERTERS reduce the rotary speed input and convert the rotary motion to oscillating motion to drive the wiper arms. The motor contains a worm and gear train driving a linkage assembly to accomplish this purpose.

D. The ARM ASSEMBLIES, LINK ASSEMBLIES and WIPER BLADES are used to clear a suitable area on the windshield. The arm assembly is mounted on the converter shaft. The link assembly pivots on a stud adjacent to the converter pierce point. The arm assembly and the link assembly are secured to the wiper blade in a manner to drive the blade in a pantograph motion. See Figure A.

E. A resistor (not Alco-supplied) is in series with the wiper motor for slow speed operation.

LEADING PARTICULARS

Motor Operating Voltage	27 volts
Motor Speed	11,600 RPM (Approx.)
Converter Stroke Angle	90° ± 2°
Blade Speed (Fast)	160 Strokes per minute (Approximately)

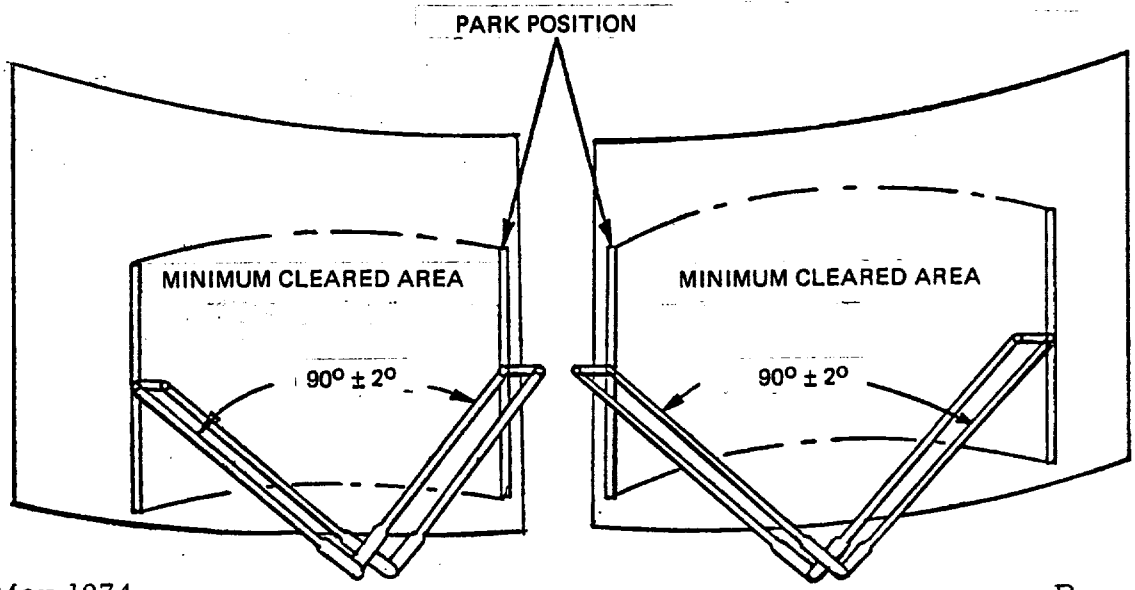


Figure A

3. System Disassembly. The relationship of the wiper components is shown in Figure 1 in the overhaul instructions which follow.

ELECTRIC MOTOR ASSEMBLY

1. Disassembly (See Figure 3 Parts Section)

   A. Disassemble in the general order shown by the index numbers on the motor illustration following.

   B. Remove brush and clip assembly (33).

   C. Soldered electrical leads may be disconnected as necessary. It is suggested that leads be marked for identification to facilitate reassembly.

   D. Remove shaft gear (12), bearings (21) and rotor assembly (22), as a unit and then disassemble if necessary.

2. Cleaning.

   A. Clean all metal parts with the exception of the rotor (22), brush and clip assembly (33) and barrel assembly (50) with cleaning solvent, Federal Specification P-S-661a.

   B. Dry with compressed air or clean lint-free cloth.

   C. Rotor assembly (22), particularly the commutator, should be cleaned with a dry brush. Commutator should be wiped clean to remove any film deposit.

3. Inspection.

   A. Visually inspect all parts for obvious defects or excessive wear. Particular attention should be given to gear and pinion teeth, gear posts and bores.

   B. Check bearings which should be free running. Bearing fits should be snug but not tight at room temperature.

   C. Check windings on rotor assembly (22) and stator windings of barrel assembly (50) for broken leads and frayed insulation.

D. Check commutator for excessive wear and inspect for smooth, clean surface.

E. Check brushes on brush and clip assemblies (33) and discard if worn excessively. Check brush holder assembly (35) spring pressure which should be adequate for positive contact.

F. Parking switch (18) may be checked by depressing and releasing the switch actuating plunger. A test lamp across the terminals will indicate whether or not the switch is operating satisfactorily. Check the switch for loose terminals. Check the cam assembly (6) for wear and replace if necessary.

4. Repair or Replacement.

A. Solder electrical connections and replace defective parts at re-assembly.

5. Lubrication.

A. MIL-G-3545 grease is to be used on all gear shafts and gear teeth. A light film is to be applied to the cam operating surface.

6. Reassembly.

A. Rewire motor in accordance with wiring schematic, Figure B. Use solder QQ-S-571, SN50 Type ARWP3 or commercial equivalent.

B. Assemble thermal protector (40) and snap ring (41) to barrel assembly (50), then solder leads to thermal protector.

C. Assemble all parts (31 through 39) and solder leads to terminals. Do not insert brushes into holders at this time. This assembly is the brush end bell assembly.

D. Assemble brush end bell assembly to the barrel assembly. When secured, fix all leads snugly against the barrel assembly. Leads to the connector (29) should be threaded through the opening in the barrel assembly before the electrical end bell assembly is placed into position.

E. Replace the bearings (21) and shaft gear (12) on the rotor assembly, if replacement is necessary. The shaft gear is to be pressed on to the drive shaft with the inside diameter chamfered end leading. Insert this assembly into the barrel assembly. Seat the bearing properly in the brush end bell assembly.

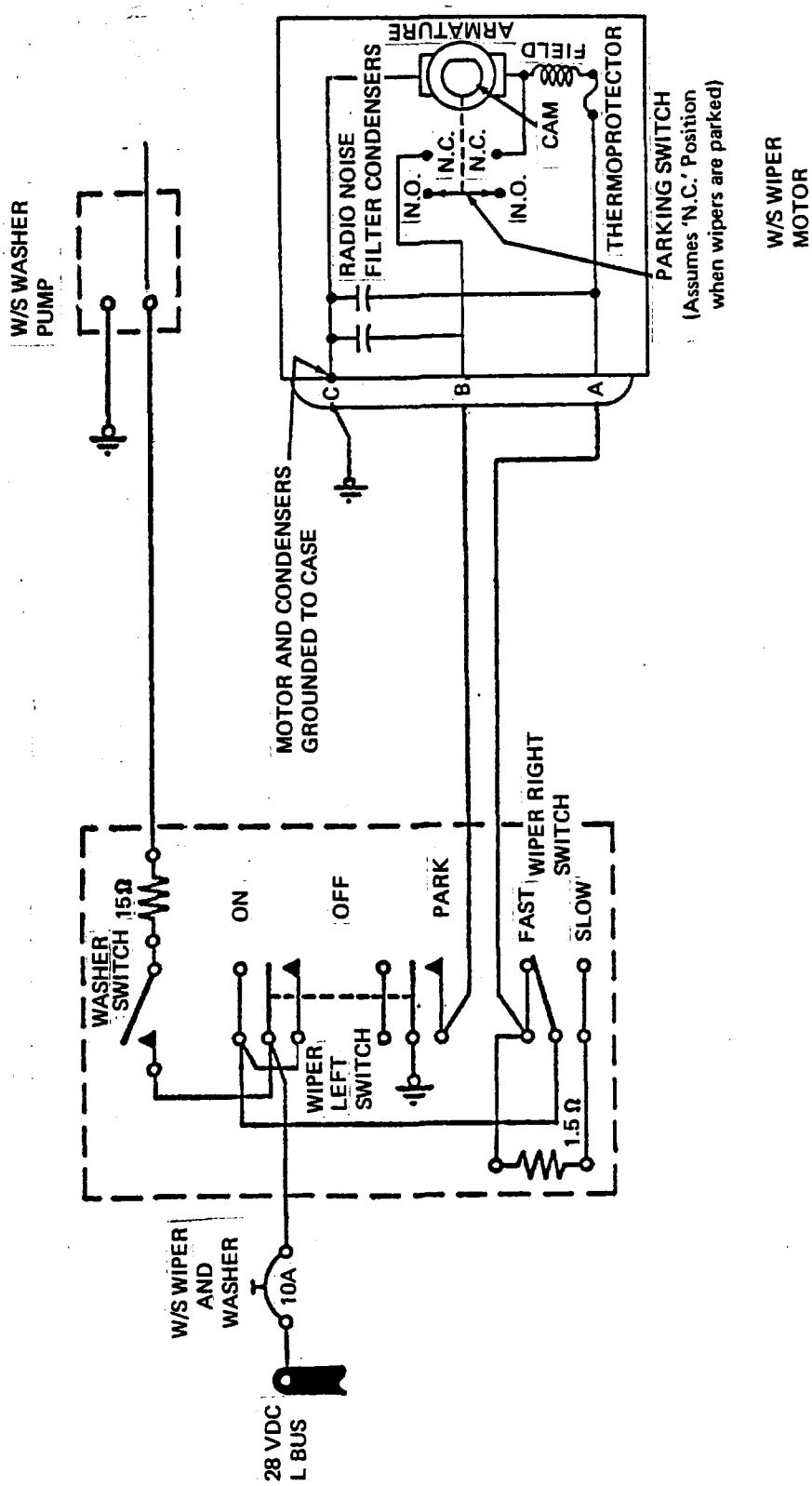

W/S WASHER PUMP
ARMATURE
FIELD
RADIO NOISE FILTER CONDENSERS
N.C.
N.C.
CAM
N.O.
N.O.
THERMOPROTECTOR
PARKING SWITCH
(Assumes 'N.C.' Position when wipers are parked)
W/S WIPER MOTOR
C
B
A
MOTOR AND CONDENSERS GROUNDED TO CASE
WASHER SWITCH
15Ω
ON
OFF
PARK
WIPER LEFT SWITCH
FAST
WIPER RIGHT SWITCH
SLOW
1.5Ω
W/S WIPER AND WASHER
10A
28 VDC L BUS

Figure B

F. Attach parking switch (18) to end bell and idler shaft assembly (19) with screws (16) and lockwashers (17). Thread leads to parking switch through end bell assembly, then assemble the electrical end bell assembly to the barrel assembly with bolts (13) and lockwashers (14). Dowel pins will locate the end bell assembly properly upon the barrel assembly.

G. Insert brushes into brush holders.

H. Complete assembly as shown on exploded view.

I. Conduct a performance test to determine satisfactory operation, then install closures on connector and shaft openings if unit is to be stored. Sealing tape may be used if closures are not available.

7. Test Procedure. Connect the motor as shown in the windshield wiper wiring diagram, Figure B, and perform the following operational tests. A trouble shooting chart follows the test procedure.

A. Turn the power on and turn the switch to LOW position. If new brushes have been installed, allow the motor to run for approximately six hours. It may be necessary to have air flowing across the resistor (utilize a fan) for cooling.

B. After brush run-in, inspect brushes to be sure they are moving properly in the brush holders and that at least 90% of the brush area is contacting the commutator.

C. Check for excessive running noise and vibration.

D. Lock the rotor in a stationary position and turn the switch to HIGH. Thermal protector must deenergize motor circuit in less than 30 seconds. Allow thermal protector to complete one on-off cycle.

E. With switch in "HIGH" position, check torque when the motor is operating at a speed of 10,000 rpm. It shall be no less than .6 in.-lb. Current shall not exceed 5.5 amperes.

F. Operation of the Parking Switch in the motor shall be checked in the following manner:

Operate the motor at 8 volts applied across the terminals "A" and "C". When speed stabilizes, connect a 6-volt automotive lamp across leads "B" and "C". The lamp shall light in regular pulsations.

TROUBLE	PROBABLE CAUSE	REMEDY
1. Motor fails to start.	a. Defective power supply.	Check power to motor and correct trouble where necessary.
	b. Defective thermoprotector.	Use an ohmmeter and check for continuity through the thermoprotector. Replace thermoprotector if circuit is open.
	c. Field or armature circuit.	Use an ohmmeter and check for open windings or shorted leads.
2. Motor runs noisy or vibrates excessively	a. Defective motor components.	Check rotor shaft for correct alignment, commutator and bearings for wear. Check for loose gears and chipped or broken gear teeth and for lubrication of gears. Replace any defective component.
3. Thermoprotector fails to de-energize motor.	a. Defective thermoprotector.	Replace thermoprotector.
4. Thermoprotector de-energizes motor but fails to complete cycle.	a. Defective thermoprotector.	Replace thermoprotector.
5. Excessive current consumption when motor operates under load and motor fails to reach minimum speed.	a. Arcing at brush and commutator due to bad brush contact or worn brushes.	Adjust brush tension for proper contact or replace brushes. Commutator dirty or glazed causing poor contact with brushes. Clean commutator.
	b. Field strength below normal.	Same reasons indicated above. Also check power supply for correct voltage.
	c. Shorted commutator segments or short in rotor windings.	Check with ohmmeter.
6. Motor fails to stop in "PARK" position.	a. Defective parking switch.	Check for closed circuit with control switch in "PARK" position. Replace switch if circuit is open.
	b. Defective cam assembly or any gear not secure to its pinion.	Check cam assembly to see if it is depressing the parking switch actuating plunger. Check for loose gears.

CONVERTER ASSEMBLY (See Figure 2, Parts Section)

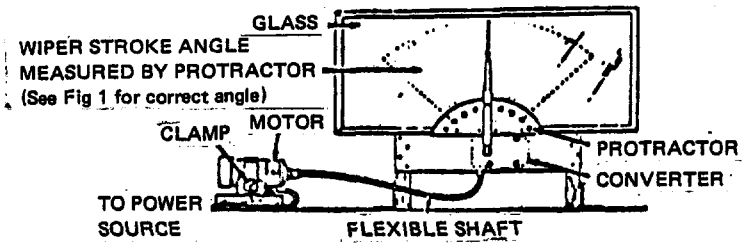


Figure C
Converter Test Diagram

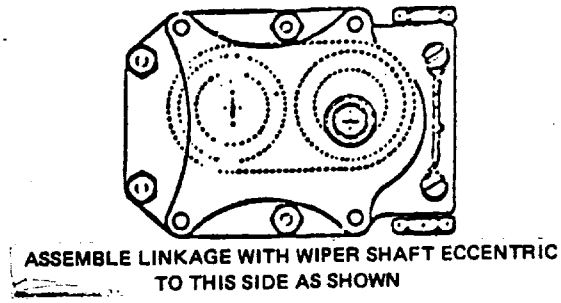


Figure D
Assembly Converter Linkage

1. Disassembly.

   A. Disassemble in the order shown by the index numbers in the exploded view, Parts Section. Scrap all locknuts.

   B. Cover plate (7), sleeve (8), "O" ring (9), and sleeve (10) may be removed from the housing as a unit. Sleeve (8) and "O" ring (9) are then removed from sleeve (10). Do not remove sleeve from cover plate unless it is to be replaced. The sleeve is staked in place and damage may result during removal.

   C. Remove any bearings that are not free running except in Item 13 (converter linkage assembly). This assembly must be replaced as a unit.

2. Cleaning.

   A. Wash all metal parts, except bearings, with cleaning solvent, Federal Specification P-S-661a or equivalent.

B. Dry with compressed air or clean lint-free cloth.

3. Inspection.

A. Inspect all parts for obvious defects or excessive wear.

B. Check condition of all parts of the converter linkage assembly. Examine serrations, gear teeth and shafts for wear or damage; examine the link for distortion; check the bearings for roughness.

4. Repair or Replacement.

A. Replace "O" ring.

B. Replace defective or worn parts in reassembly.

5. Lubrication. Fill housing with grease conforming to MIL-G-23827 on reassembly.

6. Reassembly.

A. Reassemble in the reverse order of disassembly.

B. Apply sealing compound to all mating surfaces of the housing assembly and cover plates during reassembly. Sealing compound should consist of a mixture of 8 parts EC801 to 1 part EC807 Accelerator, both manufactured by Minnesota Mining and Mfg. Co.

NOTE: Mix only enough compound for sealing one unit at a time.

C. Assemble the converter linkage assembly in the housing with wiper shaft eccentric to the side as shown in Figure D.

D. Stake screws securing idler cover plate (16) and nameplate (19). Stake nylon sleeve (8) to sleeve (10) after reassembly.

E. Lock wire screws (3) to each other.

F. Operate the unit and observe that the stroke is 90° ($\pm$ 2°) and that the wiper is operating smoothly. Install end caps if unit is to be stored. Sealing tape may be used if end caps are not available.

FLEXIBLE DRIVE ASSEMBLY (See Figure 4, Parts Section)

1. Disassembly. Disassembly is clear from observation of Figure 4.

2. Cleaning. Clean all parts with cleaning solvent, Federal Specification P-S-661a.

3. Inspection.

   A. Visually inspect all parts for obvious defects such as kinks, or unraveling of flexible casing and flexible shafting.

   B. Check flexible shaft to see if it is binding against the casing.

   C. Check flexible casing and ferrule connections. Discard if connection is loose.

   D. Discard flexible shaft if worn. Discard if the drive ends are not square.

   E. Inspect couplings for wear, discard if necessary.

4. Repair or Replacement. Replace worn or defective parts. If casing assembly must be replaced, it is recommended that the complete flexible drive assembly be replaced.

5. Lubrication. Lubricate flexible shaft with grease conforming to MIL-G-3545.

6. Reassembly. Install end caps to prevent loss of couplings, or seal ends with sealing tape.

OVERHAUL AND TEST INSTRUCTIONS

The foregoing covers overhaul and test instructions for the individual components comprising the wiper system. Individual units failing to meet the test conditions should be overhauled and retested.

Special tools or test equipment are not needed.

MAINTENANCE

There is no scheduled maintenance for the system as installed on the aircraft. The wiper blades should be replaced at the judgment of the flight officers. At time of blade replacement, the upper bushings in the arm and link should be examined. The blade studs must turn freely in these bushings. If not, replace the wiper arm or the link rod end. At this time the bushing in the hub end of the link should also be examined for wear. Replace the link if wear is excessive or if it does not pivot freely at the lower end.

The other units of the system should be removed during base overhaul of the aircraft, although "on-condition" removal is becoming a widely accepted practice on Alco wipers and may be a better practice for this aircraft.

Following are instructions for installing the arms, links and blades on the aircraft:

1. Prior to installation of the arm, blade and link, relieve the spring tension on the arm by placing a pin through the cross hole in the arm channel just above the hub.

2. Operate the wipers at slow speed and determine an approximate position on the serrated shafts for the wiper arms. Install the arm and tighten the allen head cross bolt in each arm hub.

3. Operate the wiper at slow speed. Turn the switch off allowing the arms to "coast" to a stop as closely as possible to the desired inboard end of the stroke. Several tries may be necessary to judge this "coast".

4. Adjust arm position, if necessary, as follows:

   A. Note that the adjustment sleeve in Arm Hub has 50 teeth inside (one every 7.2°); 51 outside (one every 7.06°). Difference, then is .14°. This .14° change of arm position corresponds to 1/16-inch change at the top of the arm.

B. Estimate the error of the position of the arm and multiply by 16. Example: Error 3/8-inch to right; 3/8 multiplied by 16 is 6.

C. Remove the arm and sleeve. Rotate the sleeve within the arm the calculated number of teeth, rotating in the same direction that the arm must be moved. In the example above, rotate six teeth counter-clockwise.

D. The arm should now locate on the shaft in the approximate desired position.

E. Tighten the allen head cross bolt in the arm hub.

F. Install the link assembly and the blade and remove the pin from the arm assembly, align the blade to contact the glass.

G. With the windshields wet, observe the pilot and the co-pilot wiper patterns. Adjust the arm position as outlined above or if the sweep of the arm is not satisfactory.

H. Adjust the link length if the pantograph pattern is not satisfactory.

5. Loosen the allen head cross bolt in the arm. Press the arm hub and the adjustment sleeve onto the converter shaft spline so that the bottom of the counter bore in the hub, the top of the adjustment sleeve and the top of the converter spline shaft are flush. Tighten the allen head cross bolt holding the arm in this position. Install the washer and the arm counter bore and install the safety bolt through the washer and screw it into the converter shaft.

6. Lock wire.

7. Adjust the arm pressure (wrench XW20509 is available) by turning the adjusting screw near the arm hub clockwise to decrease pressure or counterclockwise to increase pressure. Arm pressure should be 4.5 pounds measured by hooking a scale beneath the arm-blade attachment point. Pull the scale at a right angle to the glass. When the blade rubber begins to leave the glass, read the scale.

8. A retaining ring (Item 2 on the Parts List for the converter) must be in place on each converter. This prevents the adjusting sleeve and the arm from rubbing the converter sleeve. If these retaining rings are not in place, install new ones.

9. With the windshields kept wet, operate the wipers and observe that rain clearance is satisfactory both at high and low speeds.

10. Turn the control switch through the off position to the park position. If either wiper stops away from the park position, disconnect the flexible drive at the motor, manually rotate the drive until the wiper is in park position and reconnect. This must be done for both the pilot and the co-pilot wiper. (Manual rotation is easier if the arm is pulled away from the glass by inserting the cross pin as in Item 1 above.)

11. Lock wire in all required locations.

PARTS CATALOG

Replacement parts and complete systems for additional installations may be ordered by means of the replacement parts list and exploded view drawings of the complete system and component parts.

Each part is illustrated for easy identification and the accompanying parts list contains the part number, description and quantity required for replacement. The index number, preceding the part number, is keyed to the corresponding part in the illustration. Index numbers are assigned to parts in the general sequence of disassembly and also serve as a guide for removal and replacement. Figure 1 shows the relationship of the components and also shows a breakdown of the arm assembly and the link assembly. A breakdown of the converter, motor and flexdrive is shown in Figures 2, 3 and 4 respectively.

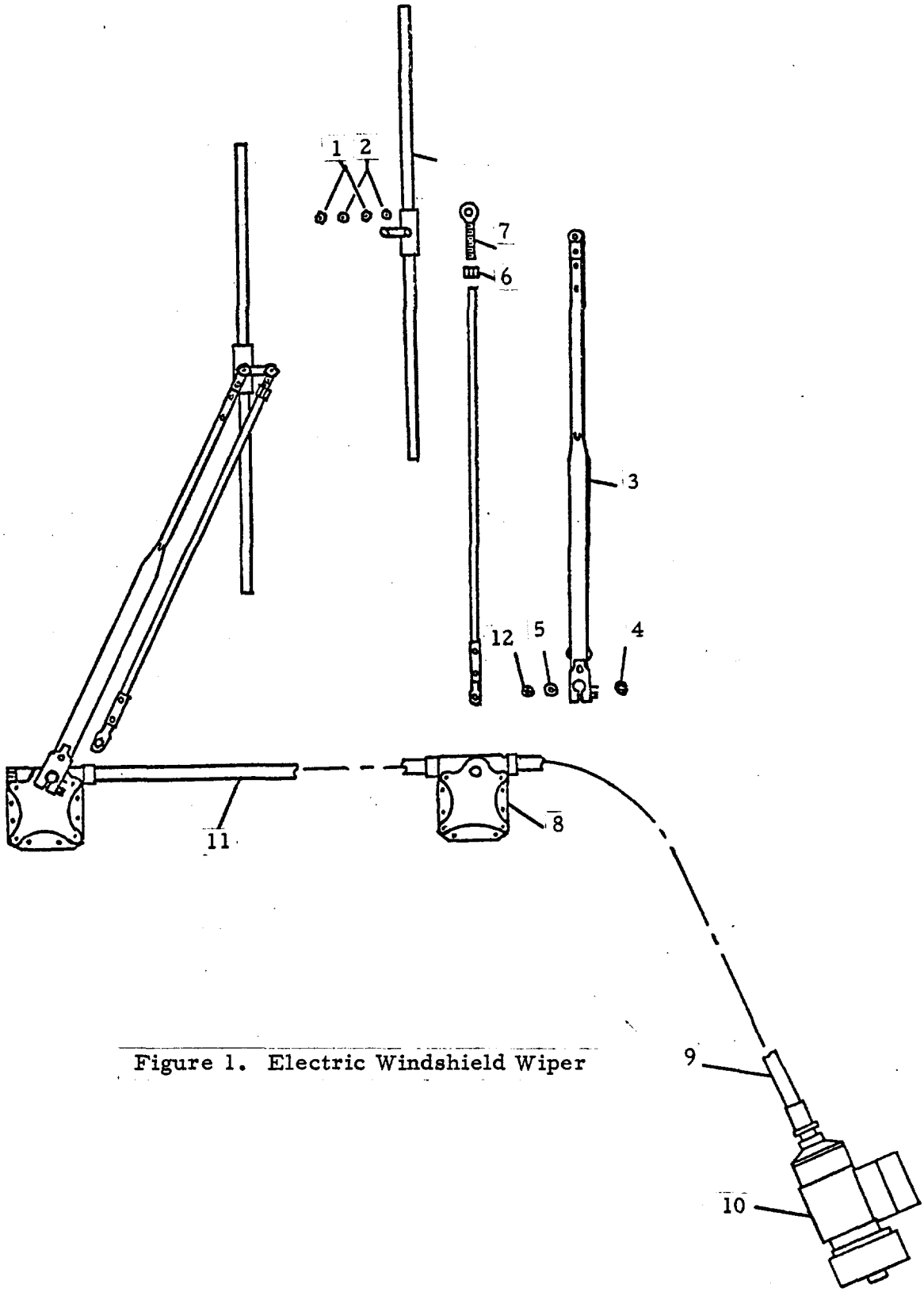


Figure 1. Electric Windshield Wiper

Fig & Index No.	Part Number	Description 1 2 3 4 5 6 7	Units Per Wiper System
1-	XW20101- DHC6	ELECTRIC WINDSHIELD WIPER ASSY	
	XW20197-H 90-12	Wiper Blade	2
-1	AN365B1032	Nut, Connector	2
-2	62072	Washer, Connector	2
	XW20500-2-1450-1	Arm Assembly	2
-3	XW20508-2-1450-1	Channel and Hub Assembly	1
-4	W20362-1	Sleeve, Adjustment	1
-5	6212A6A	Washer	1
	XW20375-145T	Link Assembly	2
-6	51380	Nut	1
-7	61701	Rod End	1
-8	XW21121-227-90	Converter Assembly	2
-9	XW20067-2075	Flexible Drive	1
-10	XW21160-2	Motor	1
-11	XW20067-2215	Flexible Drive	1
-12	AN73-4	Bolt (See Note)	

Note that the AN73-4 Bolt is supplied with the converter.

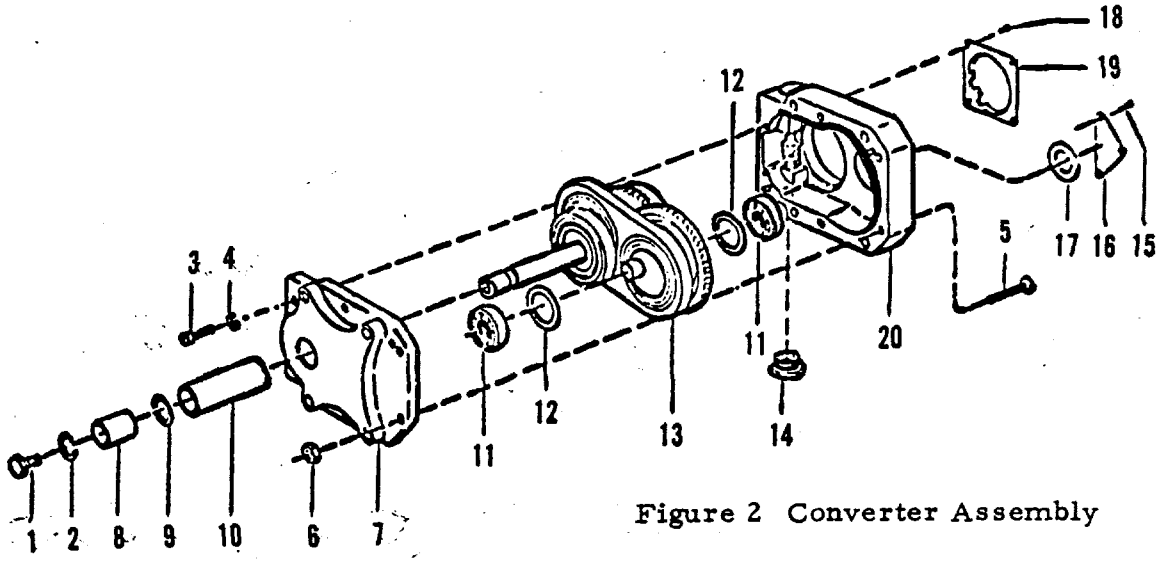


Figure 2 Converter Assembly

Fig. & Index No.	Part Number	Description 1 2 3 4 5 6 7	Units Per Wiper System
2- ..	XW21121-227-90	CONVERTER ASSEMBLY	
-1	AN73-4	Bolt	1
-2	PS1220-4	Retaining Ring	1
-3	AN500A8-6	Screw	2
-4	AN960-PD8	Washer	2
-5	AN509-8R16	Screw	4
-6	AN364D832A	Nut	4
-7	*W20286	Cover Plate	1
-8	W20150	Nylon Sleeve	1
-9	MS28775-012	"O" Ring	1
-10	W20367-227	Sleeve	1
-11	PS1219-8	Bearing	2
-12	W20166-9	Washer	2
-13	XW21127-227-90	Converter Linkage Assembly	1
-14	W20168	Worm End Cap	2
-15	AN507C440-3	Screw	3
-16	W20169	Idler Cover Plate	1
-17	W20166-8	Washer	1
-18	AN507C440-3	Screw	4
-19	W20170-5	Nameplate	1
-20	XW20368-2	Worm and Housing Assy.	1
	PS1255-4	Sealing Compound	A.R.
	AN995NC32	Lockwire	A.R.

*Not procurable as a separate item and is furnished only as a part of item 20, XW20368-2.

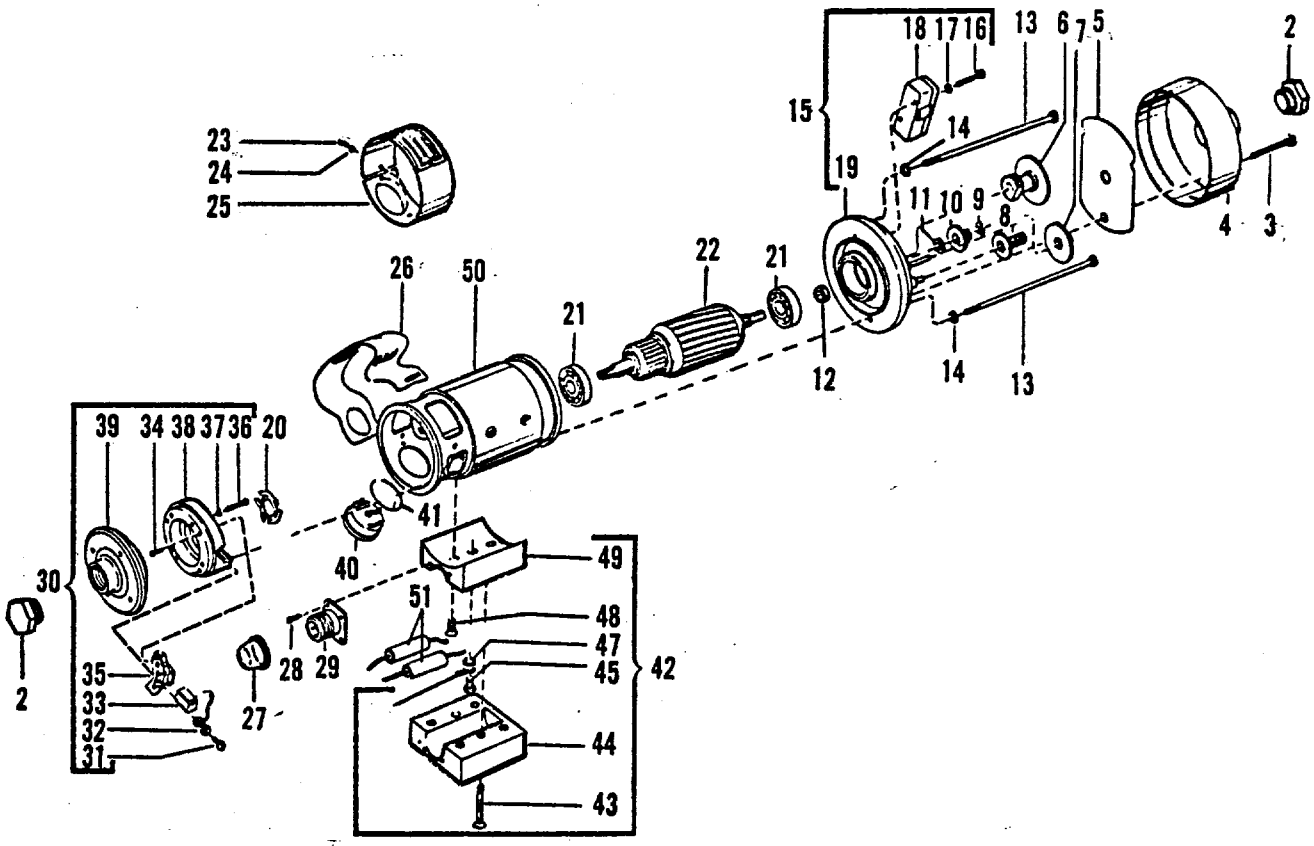


Figure 3 Electrical Motor Assembly

Fig. - Item	Part Number	Nomenclature 1 2 3 4 5 6 7	Effect From To	Units Per Assy
3-1	XW21160-2	ELECTRIC MOTOR ASSEMBLY		
-2	W20168	End Cap		2
-3	AN501A10-18	Screw		3
-4	XW20195-2	Gear Case Assembly		1
-5	W20388	Insulator		1
-6	XW20119	Cam Assembly		1
-7	XW20128-3	Idler Gear Assembly		1
-8	XW20128-5	Idler Gear Assembly		1
-9	W20048-12	Retaining Ring		1
-10	XW20128-4	Idler Gear Assembly		1
-11	W20166-2	Washer		1
-12	W20136	Drive Shaft Gear		1
-13	W17379	Tie Bolt		2
-14	AN935-6	Lockwasher		2
-15	XW21159	Electrical End Bell Assembly		1
-16	AN500-3-10	Screw		2
-17	AN935-3	Lockwasher		2
-18	PS1264-2	Parking Switch		1
-19	XW21158	End Bell and Idler Shaft Assembly		1
-20	PS1286-3	Spring Washer		1

Fig.-Item	Part Number	Nomenclature 1 2 3 4 5 6 7	Effect From To	Units Per Assy
3-21	PS1219-5	Ball Bearing		2
-22	XW17380-4	Rotor Assembly		1
-23	AN501-4-3	Screw		3
-24	AN935-4L	Lockwasher		3
-25	XW20442	Cover and Nameplate Assembly		1
-26	W17387	Brush Cover Insulation		1
-27	PS1163-7Y	Closure		1
-28	AN500A4-4	Screw		4
-29	AN/MS3102A-10SL-3P	Connector		1
-30	XW20441	Brush End Bell Assembly		1
-31	AN501-4-3	Screw		2
-32	AN935-4L	Lockwasher		2
-33	XW20020	Brush and Clip Assembly		2
-34	AN500B2-4	Screw		4
-35	XW17386	Brush Holder Assembly		2
-36	AN501-4-6	Screw		2
-37	AN935-4L	Lockwasher		2
-38	W17392	Brush Holder Ring		1
-39	XW20145-2	End Bell Assembly		1
-40	PS1239	Thermoprotector		1
-41	W2101	Snap Ring		1
-42	XW20142	Base Assembly		1
-43	AN507-832-14	Screw		2
-44	*W20144	Sub-Base		1
-45	AN515-8-5	Screw		1
-46	PS1247-5	Terminal		1
-47	PS198	Lockwasher		1
-48	AN507-832-R5	Screw		1
-49	*W20143	Base		1
-50	XW20175	Barrel Assembly		1
-51	PS1101-7	Condenser		2

*Sub-Base (Item No. 44) and Base (Item No. 49) are matched parts and must be replaced as an assembly. If either part is required, order Base Assembly (Item No. 42).

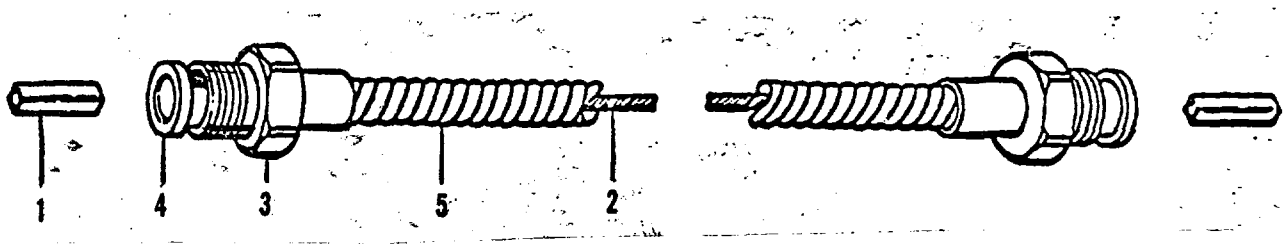


Figure 4 Flexible Drive Assembly

Fig. & Index No.	Part Number	Description 1 2 3 4 5 6 7	Units Per Assembly
4-	**XW20067-2215	FLEXIBLE DRIVE ASSY	
-1	W20075	Coupling	2
-2	**XW20066-2215	Flexible Shafting	1
	**XW20065-2215	Casing Assembly	1
-3	*W20074	Nut	2
-4	*W20071	Ferrule	2
-5	*W20070	Flexible Casing	1

*Item 3, 4 and 5 are not procurable as separate parts. When any of these parts are required, order Casing Assembly XW20065-2215.

**Two lengths of flexible drives are used on each aircraft--one as listed--the other XW20067-2075 for which the flexible shafting is XW20066-2075 and the casing assembly is XW20065-2075.

TECHNICAL MANUAL

BARBER-COLMAN COMPANY

PART SYLZ 50157

Scope: This manual contains technical information for testing and maintaining Barber-Colman Company's Part Number SYLZ 50157, Windshield Temperature Controller

References: Barber-Colman's SYLZ 50157 Installation Drawing

Barber-Colman Company's YL 1578 System Wiring Diagram

Barber-Colman Company
AIRCRAFT PRODUCTS
1300 Rock Street, Rockford, Illinois U.S.A. 61101 Phone: 815/968-6833 Teletype: 815/962-2420 Telex: 25-7413 Cable: BARCOL

REVISIONS

C.O. No.	Rev. Ltr.	Change	Date	Engineer	Signed

SYLZ 50157

1.0 Description and Operation

Barber-Colman part number SYLZ 50157 is a Temperature Controller designed to control the temperature of an electrically heated windshield. The Controller utilizes an electral signal from a sensor embedded in the windshield to give the proper output signal to a power contacter which in turn applies or removes voltage from the windshield.

Reference: Barber-Colman Drawing SYLZ 50157, Sheet 3 and YL 1578, Sheet 1.

2.0 Specifications

1. Type of Control --------- ON-OFF
2. Input Voltage ---------- 20-32 VDC
3. Maximum Output --------- 500 MA Max. Inductive @ 28 VDC
4. Control "off" Point ----- 104°F
5. Differential ----------- 5°F
6. Operating Temperature Range ----- -65°F to +165°F
7. Sensor------------------- AVK 1160 or equivalent
8. Sensor Operating Power --- Less than 50 Milli Watts
9. Transient Protection ----- +80V
10. Reverse Voltage Protection ------ NO
11. Inductive Load Protection ------ YES
12. Over Temperature Protection ------ NONE
13. Failed Sensor Protection -------- Open-Short Circuit

Specification (continued)

14. Over Temperature/Failed Sensor Warning Signal ---------- NONE
15. Warning Signal Output ---------- NONE
16. Construction ---------- Repairable Assembly
17. Size ---------- 3.687" Max. X 4.062" Max. X 2" Max.
18. Weight ---------- Approx. 8 oz.
19. Connector Type -------- Mates with MS3106-20-275

3.0 Inspection

Inspect visually for evidence of abuse such as: cracks, deformities, damaged threads etc., to determine suitability for reuse. If further inspection is indicated, remove cover by removing (4) attaching screws.

After disassembly inspect all wire and solder joints for loose connections or damaged insulation, or if there is evidence of over heating.

4.0 Functional Testing

4.1 Connect the control box to the test fixture as shown in Figure I. S1 closed, S2 open.

4.2 Set TR1 to 315 ohms, DS1 should be on. Increase TR1 until DS1 goes out. This should be 333 ±1.3 ohms. Decrease TR1 until DS1 just comes on. This should be 4 ± 1.7 ohms below where DS1 went out.

4.3 Continue decreasing TR1 to 180 ohms. DS1 should still be on. Increase TR1 to 315 ohms. Open S1, DS1 should go out. Close S1. DS1 should come on. Close S2. DS1 should go out. Open S2, DS1 should come on.

4.4 Satisfactory completion of this test indicates that this unit is electrically suitable for service.

5.0 Repair

The design of this Control Box limits repairs to removal of slight dents and metal deformities in metal parts such as the cover or the base plate. All other items should be repaired on a replacement basis.

5.1 Trouble shooting may be accomplished by a qualified electronic technician using standard tools, the test fisture in Figure I and by refering to Barber-Colman drawing YL 1578 and Figure II alternately. The unit may be returned to the factory for repair. Replace parts found defective during testing. See Figure II and Figure III for identification of electronic components.

6.0 Calibration Instructions

6.1 Connect the control box to the test fixture as shown in Figure I.

6.2 Set TR1 at 333 ohms, set calibration potentiometer R2 on printed circuit board full CW. DS1 should be on. Rotate R2 CCW until DS1 just goes out. Decrease TR1 until DS1 just comes on. Record this reading. Increase TR1 until DS1 just goes out. TR1 should read 333 ±1.3 ohms. Reading of where DS1 just came on should be 4 ± 1.7 ohms. below where DS1 just went out.

6.3 Decrease TR1 until DS1 comes on, continue decreasing TR1 to 180 ohms. DS1 should still be on. Increase TR1 to 315 ohms. Open S1, DS1 should go out. Close S1, DS1 should come on. Close S2, DS1 should go out. Open S2, DS1 should come on.

6.4 Satisfactory completion of this test indicates that this unit is electrically suitable for service.

7.0 Assembly

Reassemble all parts which were removed during disassembly. Before assembly of cover, calibrate and test Control Box as outlined in Para. 6.0.

8.0 Special Tools

Test fixture in accordance with Figure I.

FUNCTIONAL TEST FIXTURE SYLZ 50157

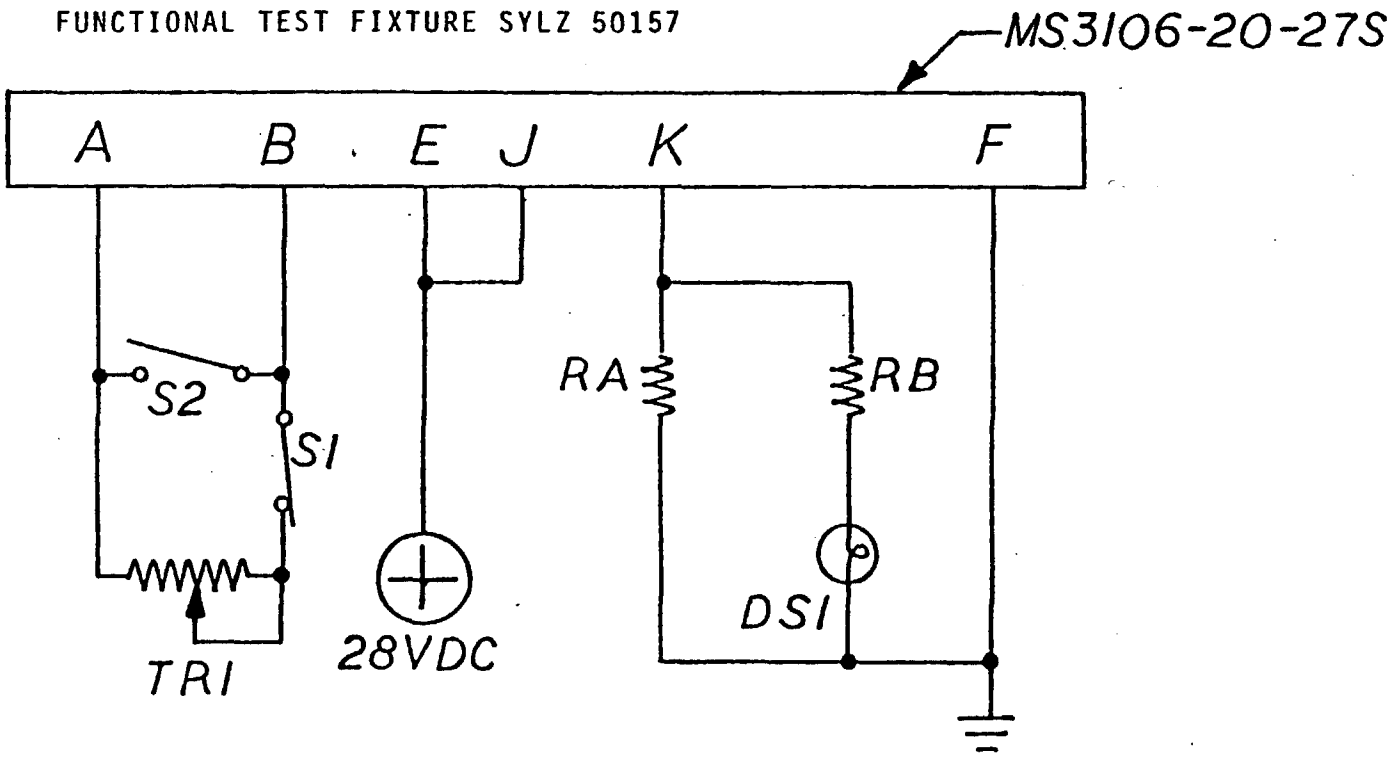
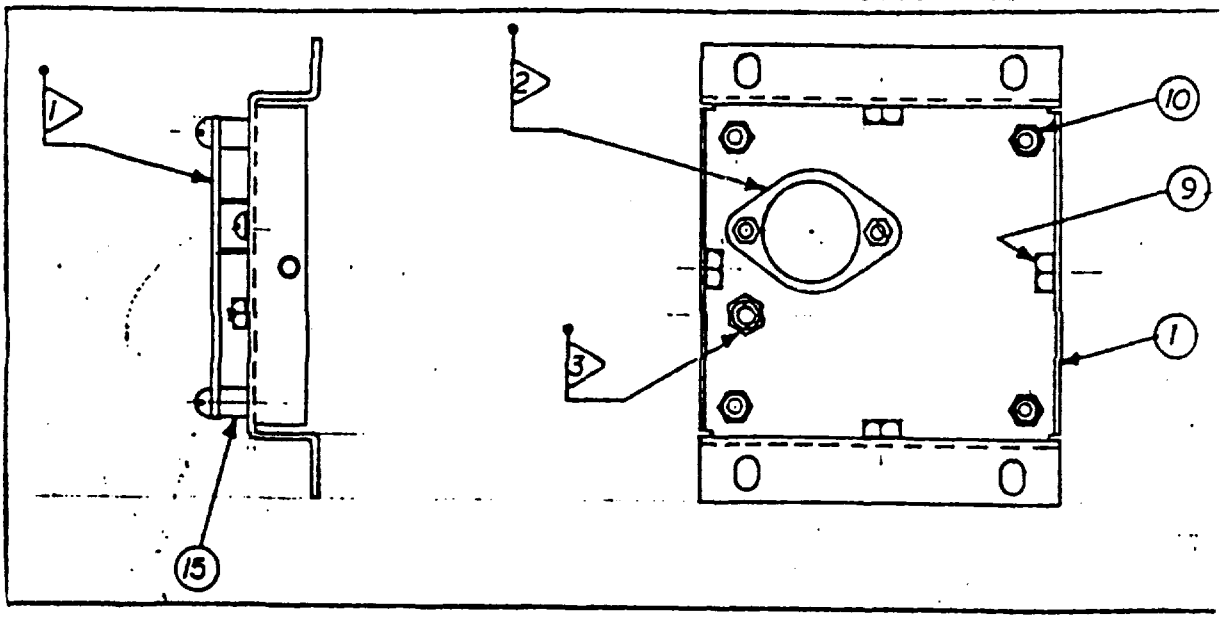


FIGURE I

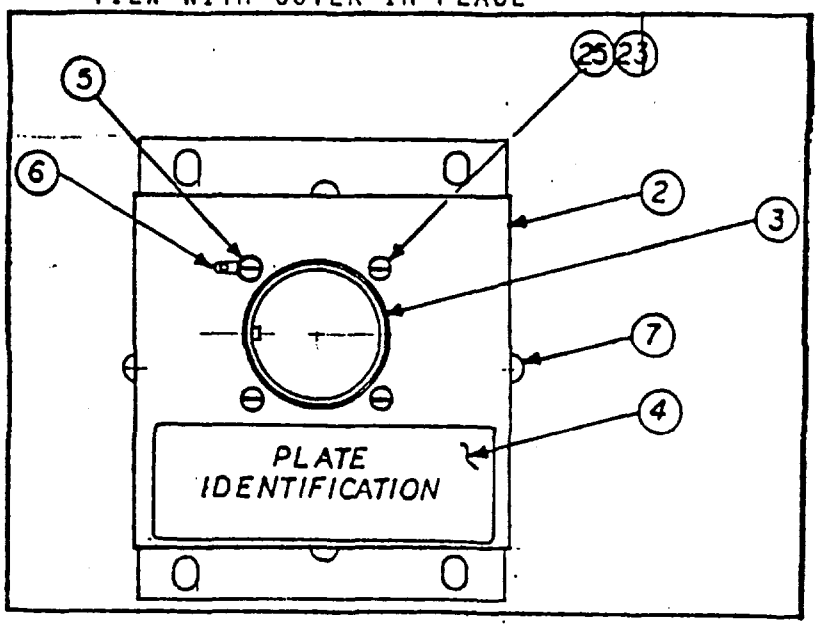
TR1	0-100 ohm Helipot in Series With 1000Ω Decade
RA	66 ohm 5% 12 W
RB	100 ohm 5% 1 W
DS1	#327 28V .04A Bulb

VIEW WITH COVER REMOVED

BOTTOM VIEW



VIEW WITH COVER IN PLACE



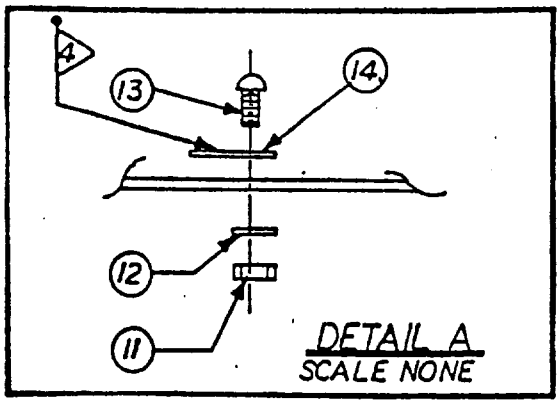
SEE FIGURE II B FOR ITEM LIST AND ASSEMBLY NOTES

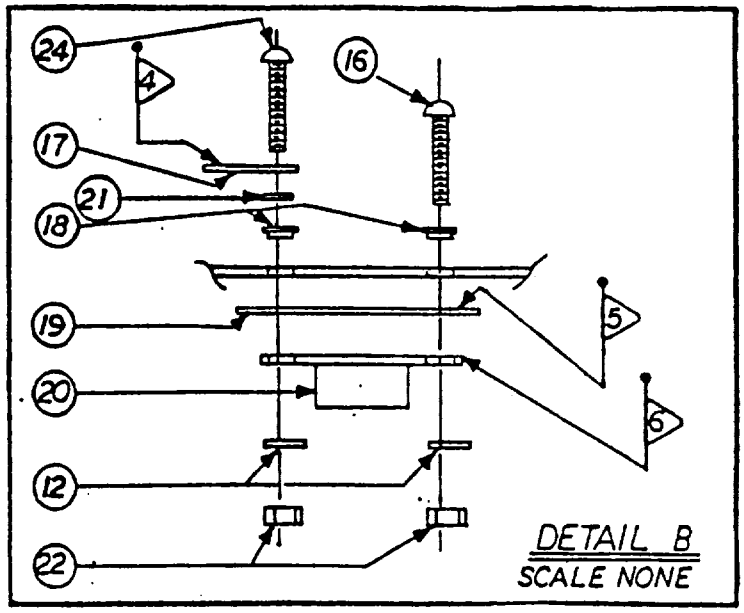
FIGURE II A

ITEM	B-C Part Number	Description	Qty
1	SYLZ 646	Chassis	1
2	SYLZ 647	Cover	1
3	CYLZ 1393	Connector	1
4	NYRZ 1-022-3	Plate Identification	1
5	BYRF 370	Screw 4-40 R.H. 3/8	1
6	AYLZ 43	Lug #4	1
7	BYRF 379	Screw 6-32 R.H. 3/8	4
8	BYRF 500-1	SCrew 6-32 R.H. 9/16	4
9	DYRF 153	Nut 6-32	4
10	DYRF 109	Nut 6-32	4
11	DYRF 257	Nut 6-32	1
12	CYRD 154	Lockwasher #6	3
13	AN515-6-5	Screw 6-32 R.H. 5/16 BYRF499	1
14	FYRE 16	Terminal Lug #6	1
15	AYRD 221	Spacer .250 Long	4
16	BYRF 322	Screw 6-32 R.H. 7/16	1
17	FYRE 16	Terminal Lug #6	1
18	JYRD 46	Shouldered Washer	2
19	EYZP 712	Mica Insulator (TO-3)	1
20	EYZP 676	Transistor (Q7)	1
21	CYRD 81	Flatwasher	1
22	DYRF 257	Nut 6-32	2
23	AYLZ 158	Nut 4-40	4
24	BYRF 897	Screw 6-32 B.H. 1/2	1
25	BYRF 356	Screw 4-40 R.H. 5/16	3

1. See Fig. III for Parts List and Assembly
2. See Detail "B" for Parts List and Assembly
3. See Detail "A" for Parts List and Assembly
4. Bend (FYRE 16) terminal lug away from (sYLZ 646) chassis so that there is electrical clearance between solder on lug and shassis.
5. Spread SYRZ 51 (Silicone Grease) evenly over noted surface before assembly.
6. Apply 600 VDC for one second between transistor case and chassis (Dielectric Test before making electrical connections.
7. After dielectric check, the exposed surfaces of the power transistor (EYZP 676) shall be coated with (DYRZ 146) Thermopoxy.

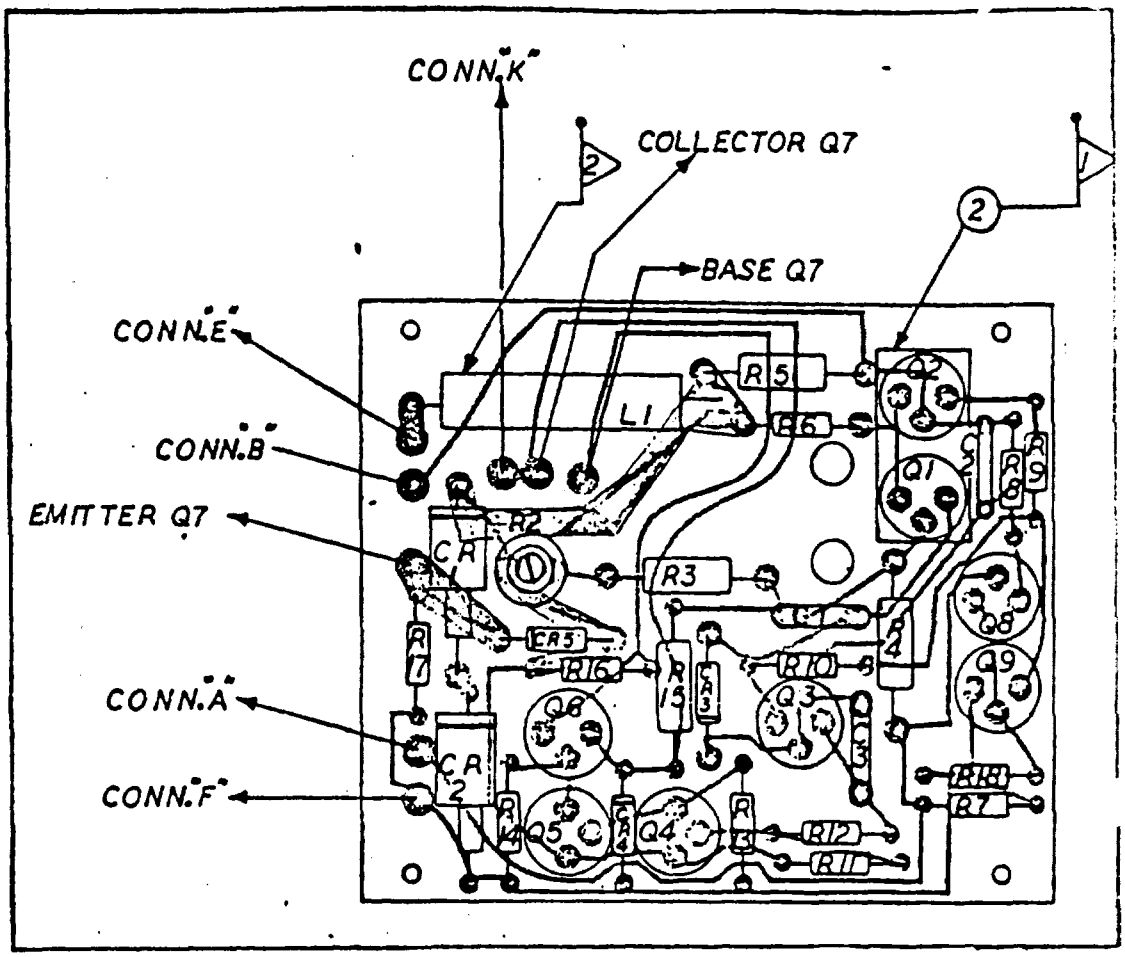
Figure II B





SEE FIGURE II B FOR ITEM LIST AND ASSEMBLY NOTES.

FIGURE II C



VIEW FROM COMPONENT SIDE

NOTES:

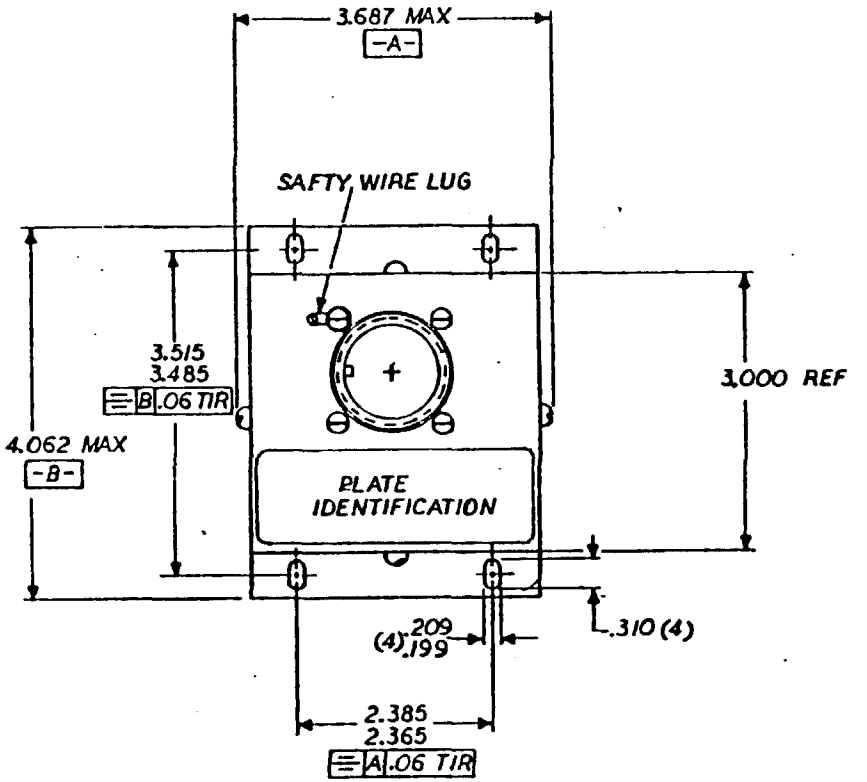
1. ITEM 2 IS SECURED TO ITEMS Q1 WITH EASTMAN 910 ADHESIVE
2. AFTER REPLACING ANY COMPNANT RECOAT THE AREA WITH THERMOPOXY (DYRZ 146)

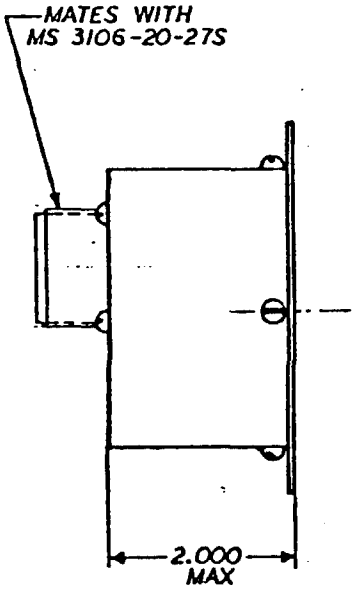
FIGURE III A

ITEM	BARBER-COLMAN PART NO.	DESCRIPTION
L1	CYZR 860	Choke RF
R2	BYZR 202-010	Potentiometer 50Ω
R3	CYZR 468-170	Resistor 1020Ω
R4	CYZR 468-034	" 330Ω
R5	CYZR 468-010	" 1KΩ
R6	CYZR 481-020	" 3.3KΩ
R7	CYZR 481-370	" 150Ω
R8	CYZR 481-380	" 5.6KΩ
R9	CYZR 481-030	" 1.2KΩ
R10	CYZR 481-030	" 1.2KΩ
R11	CYZR 481	" 1 KΩ
R12	CYZR 481-020	" 3.3KΩ
R13	CYZR 481-190	" 27KΩ
R14	CYZR 481-040	" 4.7KΩ
R15	CYZR 668-052	" 150KΩ
R16	CYZR 481-010	" 100KΩ
R17	CYZR 481-040	" 4.7KΩ
R18	CYZR 481-220	" 2.7KΩ
C1	CYZR 260	Capacitor .01UF
C2	CYZR 260	" .01UF
C3	CYZR 260	" .01UF
Q1,Q2	EYZP 441	Transistor, Matched Pair 2N404A
Q3	2N1893	Transistor (EYZP 671)
Q4	2N3638	" (EYZP 796)
Q5	2N3638	" (EYZP 796)
Q6	2N398A	" (EYZP 469)
Q8	2N404A	" (EYZP 414)
Q9	2N1711	" (EYZP 520)
CR1	IN3035B	Diode, Zener (EYZP 677)
CR2	IN3035B	" (EYZP 677)
CR3	IN4002	Diode (EYZP 467)
CR4	IN4002	" (EYZP 467)
CR5	IN4002	" (EYZP 467)

Figure III B

REVISIONS				
CO	LTR	DESCRIPTION	DATE	APPROVED
5890		RELEASE TO PRODUCTION	6-24-71	BAR

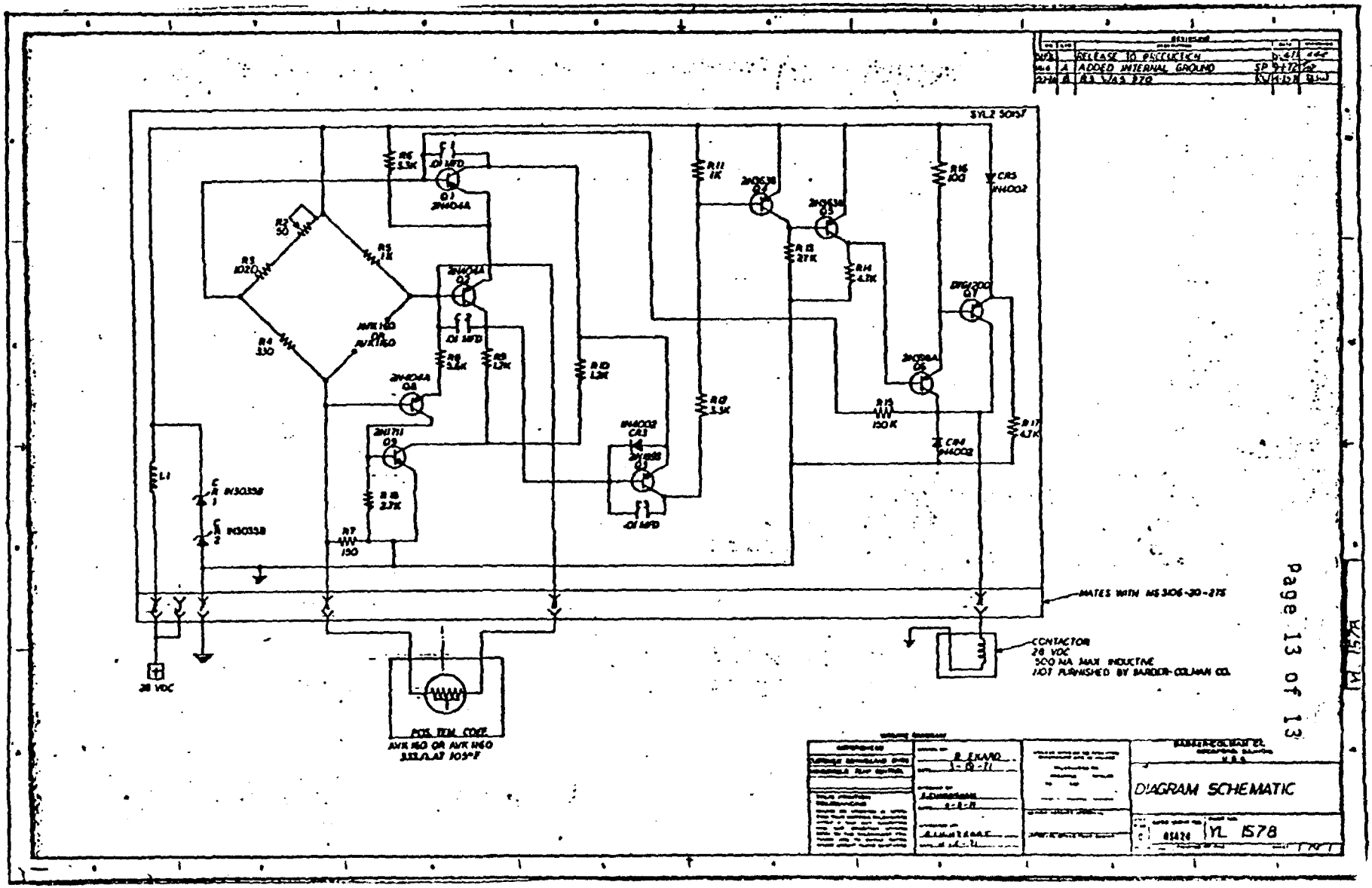




WIRING DIAGRAM

REFERENCES CUSTOMER: DEHAVILLAND DHC6 WINDSHIELD TEMP CONTROL YL 1578	DRAWN BY: R. EKARD DATE 3-19-71 CHECKED BY: E. CUNNINGHAM DATE 4-2-71 APPROVED BY: E. LIGHTFOOT DATE 4-5-71	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS ANGLES .XX .XXX ±.030 DESIGN ACTIVITY APPROVAL APPROVAL OTHER THAN DESIGN	BARBER-COLMAN COMPANY ROCKFORD, ILLINOIS U. S. A. NAME: BOX, CONTROL DWG SIZE C CODE IDENT NO. 05624 PART NO. SYLZ 50157 SCALE 1/1 FINISHED WT 0.5 LB SHEET 3 OF 3

TRUE POSITION TOLERANCING
WHERE NO MODIFIER IS SPECIFIED TRUE POSITION TOLERANCES APPLY @ MAX. MAT. CONDITION MAX. MAT. CONDITION APPLIES BOTH TO THE TOLERANCES FEATURES AND TO DATUM REFERENCES EXCEPT PLANE SURFACES


DIAGRAM SCHEMATIC
YL 1578
MATES WITH MS 3106-20-27S
CONTACTOR
28 VDC
500 MA MAX INDUCTIVE
NOT FURNISHED BY BARBER-COLMAN CO.
28 VDC
POS. TEM. COEF.
AVR 160 OR AVR 1160
RELAY 105°F
SYLZ 5057

OVERHAUL MANUAL
WITH
ILLUSTRATED PARTS LIST

WINDSHIELD WIPER CONVERTER

PART NUMBERS

14-91355 SERIES
14-91455 SERIES



MARQUETTE

THE MARQUETTE METAL PRODUCTS CO.
A WHOLLY OWNED SUBSIDIARY OF CURTISS-WRIGHT CORPORATION
1145 GALEWOOD DRIVE
CLEVELAND, OHIO 44110

MANUAL PN 14-41355-00

30-40-01
Dec 1/73

MARQUETTE METAL PRODUCTS CO.
OVERHAUL MANUAL WITH IPL
CONVERTER ASSEMBLY
14-91355 AND 14-91455 SERIES

TABLE OF CONTENTS

SUBJECT	PAGE
Description and Operation	1
Disassembly	101
Cleaning	201
Inspection/Check	301
Repair	401
Assembly	501
Fits and Clearances	601
Testing	701
Troubleshooting	801
Storage Instructions	901
Special Tools, Fixtures, and Equipment (Not Applicable)	
Illustrated Parts List	1101
Light Overhaul (Not Applicable)	

MARQUETTE METAL PRODUCTS CO.
OVERHAUL MANUAL WITH IPL
CONVERTER ASSEMBLY
14-91355 AND 14-91455 SERIES

RECORD OF REVISIONS

REV. NO.	ISSUE DATE	DATE INSERTED	BY	REV. NO.	ISSUE DATE	DATE INSERTED	BY	REV. NO.	ISSUE DATE	DATE INSERTED	BY

RETAIN THIS RECORD IN THE FRONT OF MANUAL OR CHAPTER.

ON RECEIPT OF REVISIONS, INSERT REVISED PAGES IN THE MANUAL, AND ENTER REVISION NUMBER, DATE INSERTED, AND INITIALS.

RECORD OF TEMPORARY REVISIONS

TEMPORARY REV NO	PAGE NUMBER	ISSUE DATE	BY	DATE REMOVED	BY

LIST OF EFFECTIVE PAGES

SUBJECT	PAGE	DATE
Title Page		Dec 1/73
Record of Revisions	1	Dec 1/73
Record of Temporary Revisions	1	Dec 1/73
List of Effective Pages	1	Dec 1/73
Service Bulletin List	1	Dec 1/73
Table of Contents	1	Dec 1/73
Description and Operation	1	Dec 1/73
	2	Dec 1/73
	3	Dec 1/73
	4	Blank
Disassembly	101	Dec 1/73
	102	Dec 1/73
	103	Dec 1/73
	104	Blank
Cleaning	201	Dec 1/73
	202	Blank
Inspection/ Check	301	Dec 1/73
	302	Dec 1/73
	303	Dec 1/73
	304	Dec 1/73
Repair	401	Dec 1/73
	402	Blank
Assembly	501	Dec 1/73
	502	Dec 1/73
	503	Dec 1/73
	504	Blank
Fits and Clearances	601	Dec 1/73
	602	Dec 1/73
	603	Dec 1/73
	604	Blank
Testing	701	Dec 1/73
	702	Dec 1/73
Trouble Shooting	801	Dec 1/73
	802	Blank
Storage Instructions	901	Dec 1/73
	902	Blank
Illustrated Parts List	1101	Dec 1/73
	1102	Dec 1/73
	1103	Dec 1/73
	1104	Dec 1/73
	1105	Dec 1/73
	1106	Blank
	1107	Dec 1/73
	1108	Dec 1/73
	1109	Dec 1/73
	1110	Dec 1/73
	1111	Dec 1/73
	1112	Dec 1/73
	1113	Dec 1/73
	1114	Blank

SERVICE BULLETIN LIST

SERVICE BULLETIN NUMBER	REVISION NUMBER	DATE OF ORIGINAL OR REVISED BULLETIN	DATE BULLETIN INCORPORATED INTO MANUAL
SB-1400.001		Apr 27/73	Dec 1/73
SB-1400.002		Jun 26/73	Dec 1/73
SB-1400.003		Jun 28/73	Dec 1/73
SB-1400.005		Apr 19/73	Dec 1/73
SB-1400.006		Apr 19/73	Dec 1/73
SB-1400.007		Jun 28/73	Dec 1/73
SB-1406.001		Jun 12/73	Dec 1/73

DESCRIPTION AND OPERATION

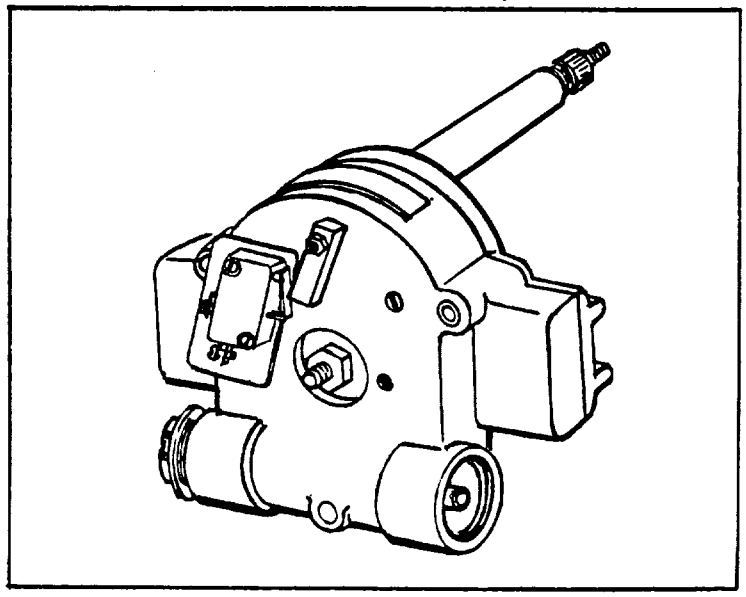
1. General

A. This manual contains the overhaul instructions for Windshield Wiper Converters Part Number Series 14-91355 and 14-91455, manufactured by Curtiss-Wright Corporation, Marquette Metal Products Co., Cleveland, Ohio. (See figure 1.)

2. Description

A. A complete Electric Windshield Wiper System consists of an electric motor, flexible drive shaft, converter assembly, drive arm, wiper blade, toggle switch, and a bottle of C-W 100 dust repellant static eliminator and cleaner. This electro-mechanical system is designed for installation on vehicle windshields to increase the range of visibility. Arrangement of the components comprising each system is accomplished in accordance with the detailed installation drawing for specific vehicle application.

B. The electric motor used in the windshield wiper system receives its power from the vehicle electric power system. Moving the toggle switch activates the electric motor of the wiper system. The toggle switch also features a park position for the wiper blade. Line protection is accomplished by using a 10 AMP customer supplied circuit breaker mounted in line with the power source and toggle switch.



Assembled View of Windshield Wiper Converter
Figure 1

3. Operation

A. Activate the windshield wiper system by placing the circuit breaker in the ON position. Start the wiper blade action by moving the toggle switch to the ON position. When operating on a wet surface the windshield wiper will perform at its maximum speed of approximately 250 strokes per minute.

CAUTION: THE WINDSHIELD WIPER BLADE SHALL NOT BE OPERATED ON A DRY SURFACE EXCEPT WHEN INCIDENTAL TO STARTING PRIOR TO ENTERING RAIN AND STOPPING AFTER RAIN.

CAUTION: FOR AIRCRAFT APPLICATIONS: DO NOT OPERATE WINDSHIELD WIPER SYSTEM WHEN INDICATED AIR SPEED EXCEEDS 150 MILES PER HOUR.

NOTE: During wiper operation an overload will cause the circuit breaker to automatically return to the OFF position. A thorough examination of the windshield wiper installation must be accomplished after the vehicle returns to its service base to ascertain the cause of the malfunction.

B. Stop the wiper blade action by moving the toggle switch to the OFF position. Park the wiper blade by moving the toggle switch to the PARK position; hold this position until the wiper blade is fully at rest in its parked position. Releasing the toggle switch will automatically return it to the OFF position.

C. Deactivate the windshield wiper system by placing the circuit breaker in the OFF position.

4. Remove Electric Windshield Wiper System From Vehicle

A. The Electric Windshield Wiper System is removed from the vehicle as subassemblies. Remove blade assembly and tie rod (if so equipped). Remove drive arm, flexible drive assemblies, converter, and motor.

5. Installation Instructions

A. Install a 10 AMP trip free circuit breaker, similar to type MS 25017, with the input side connected to the main bus bar. Use AN-18 cable size copper wire conforming to Specification, MIL-W-5086 (ASG), or equivalent. All wiring shall conform to CAM-18 and AIA Design Manual on aircraft electrical installations.

6. Adjustments

All adjustments are accomplished before the Electric Windshield Wiper System has been installed on a vehicle. Refer to ASSEMBLY.

A. Adjust length of drive arm.

(1) If drive arm is an adjustable length type, loosen lock on drive arm and adjust to desired length.

B. Adjust blade-to-arm angular relationship.

(1) Rotate the blade holder located on the outermost end of the drive arm to desired angular relationship.

CAUTION: DO NOT BEND OR TWIST THE DRIVE ARM OR WIPER BLADE.

C. Adjust blade-windshield load.

(1) If drive arm has an adjustable spring mechanism, turn adjustment screw to obtain 1-1/2 to 3 pounds blade load at all points within the wipe area. Where provided, an additional adjustment may be required by loosening or tightening the elastic stopnut that retains the "T" Bolt located in the mounting head adjacent to the shaft nut.

NOTE: Only the windshield wiper converter and motor are subject to overhaul. Refer to applicable manual for motor overhaul. If damaged, replace rubber insert of blade assembly. The metallic structure of the blade assembly, tie rods, drive arm, and flexible drive assemblies are not repairable and are to be replaced if damaged.

DISASSEMBLY

1. General

A. These procedures provide complete disassembly when required. Disassemble unit as necessary to accomplish repair using appropriate instructions detailed herein.

B. The parts listed in Table 101 must be discarded at each overhaul regardless of condition.

TABLE 101. PARTS REPLACED AT OVERHAUL

IPL FIG. 1, ITEM NO.	NOMENCLATURE
5	Screw
6	Washer
7	Switch Gasket
9	Screw
9	Nut
10	Washer
13	Screw
14	Retaining Ring
15	Retaining Ring
19	Seal
21	Packing
23	Gasket
27	Screw
28	Nut
29	Seal
34	Retaining Ring
35	Ball Bearing
38	Retaining Ring
39	Ball Bearing
40	Ball Bearing
43	Nut

2. Disassemble Windshield Wiper Converter Assembly (See IPL figure 1.)

A. Removal of Switch and Shutoff Cam.

(1) Remove two screws (5), washers (6), lift off switch (4) and switch gasket (7). For model 14-91355-34 remove actuator (3).

NOTE: Switch gasket (7) is not used on model 14-91355-34.

(2) Remove screw (9), washer (10) and lift off shutoff cam (8).

NOTE: Some models use self-locking nut (9) to secure shutoff cam (8).

B. Removal of Drive Arm Shaft And Cover Assembly.

(1) Separate drive arm shaft and cover assembly (-12) from housing and bearing assembly (37) by removing four screws (13). Lightly tap housing (-42), using a soft-faced hammer, at separation line and lift drive arm shaft and cover assembly (-12) off roll pins (-41). Remove gasket (23), rack spacer (24) and converter rack (25).

C. Disassemble Drive Arm Shaft And Cover Assembly.

(1) Remove retaining rings (14 and 15), slide off drive shaft gear (16) and pinion spacer (17). Remove drive arm shaft (18) from cover assembly (22). Remove seal (19) or packing (21).

CAUTION: DO NOT DISASSEMBLE COVER ASSEMBLY (22). EXCESSIVE DAMAGE OR WEAR TO THE COMPONENT PARTS OF COVER ASSEMBLY (22) WILL REQUIRE REPLACEMENT OF THE ASSEMBLY.

NOTE: Do not attempt to remove spacer (-20).

D. Removal of Drive Plate Assembly.

(1) Remove two screws (27) and pull drive plate assembly (26) off worm gear assembly (31) dowel pins.

E. Removal of Worm Gear Assembly.

(1) Secure pivot bolt (30) with a screwdriver and remove nut (28). Remove seal (29) from pivot bolt (30). Pull worm gear assembly (31), pivot bolt (30) and worm gear spacer (32) from housing and bearing assembly (37).

CAUTION: DO NOT REMOVE DOWEL PINS FROM WORM GEAR. ANY EXCESSIVE WEAR OR DAMAGE TO COMPONENTS WILL REQUIRE REPLACEMENT OF WORM GEAR ASSEMBLY (31).

F. Disassemble Housing And Bearing Assembly.

(1) Unscrew worm shaft cap (33) and remove retaining ring (34) from housing (-42).

(2) Push worm shaft (36) through longitudinal bore of housing (-42) and remove retaining ring (38).

(3) Remove ball bearing (35) from worm shaft (36).

(4) Remove ball bearing (39) and ball bearing (40) from housing (-42).

CAUTION: DO NOT REMOVE ROLL PINS (-41) FROM HOUSING (-42). EXCESSIVE DAMAGE OR WEAR TO COMPONENTS WILL REQUIRE REPLACEMENT OF THE ASSEMBLY.

CLEANING

1. Cleaning Materials Required

Refer to Table 201 for cleaning materials required.

TABLE 201. REQUIRED CLEANING MATERIALS

Brush, bristle, non-metallic	Commercially available
*Solvent	Fed. Spec. P-D-680
Cloth, clean, lint-free	Commercially available
*Detergent, aqueous anionic No. 815MX	Brulin & Co., Inc. 2920 Martindale Avenue Indianapolis, Ind. 46207
*Detergent, aqueous anionic No. 1300A	Diamond Chemical Co. 56 North Hill Avenue Pasadena, California 91106

NOTE: (a) Equivalent substitutes may be used for above items.

* (b) Alternate materials. Solvent P-D-680 is for use only in well ventilated work areas. Detergents No. 815MX and 1300A are for use in areas that are not well ventilated.

2. Cleaning Procedure

WARNING: SOLVENT P-D-680 IS TOXIC AND FLAMMABLE. AVOID PROLONGED CONTACT WITH SKIN AND KEEP AWAY FROM OPEN FLAME. USE ONLY IN A WELL VENTILATED AREA.

A. Cleaning of Parts

(1) Wash all metallic parts in cleaning solvent (or detergent) using a non-metallic brush to loosen caked dirt.

NOTE: When using either detergent 815MX or 1300A for an immersion bath solution, mix with four parts (by volume) of water. For general cleaning purposes detergent may be mixed with up to 20 parts of water.

(2) If detergent is used, rinse cleaned parts. Dry all parts using a lint-free clean cloth and/or compressed air at 20psig maximum.

WARNING: AVOID DIRECT CONTACT WITH SKIN WHEN USING COMPRESSED AIR.

(3) Do not immerse switch (4, IPL figure 1) in cleaning solution. Clean with a dry lint-free cloth.

INSPECTION/CHECK

1. General

   A. Visually inspect all components for thread damage.

   B. Visually inspect all parts for excessive scoring, cracks, breaks, corrosion, distortion, and other obvious signs of damage.

   C. Use a 10-power magnifying glass to inspect all aluminum castings for cracks. Use flourescent penetrate inspection in accordance with AMS 2645 to check suspected areas.

2. Inspection/Check

   A. Inspect individual parts as indicated in Table 301, Inspection Requirements.

   B. Check dimensional tolerances against requirements outlined in FITS AND CLEARANCES, Table 601, Wear Limits.

   C. Inspect all parts for cleanliness, cracks, deterioration and obvious signs of damage.

      NOTE: Where inspection for burrs, nicks and scratches is required, these are defined as material raised above the parent metal, which if not removed would prevent complete and proper mating of parts. Where nicks or scratches allow bare metal to show through a protective finish, note defect and assign part for rework during repair. Dents must not impair finish or the functional operation of any part of the assembly.

   D. Inspect all threaded parts for crossed or damaged threads. Reject part if thread damage exceeds 50 percent of one thread.

      NOTE: If damage to one thread is 50 percent or less, note defect and assign for rework during repair.

   E. Inspect switch (4, IPL figure 1) for cracks, damaged or corroded terminals or leads, and signs of overheating. Switch part number 1SE3 (14-01480-00) pretravel shall not exceed 0.050 inch; switch part number 2TMT-6-Y (14-01357-00) pretravel shall not exceed 0.047 inch. Switches must be replaced if not within these limits.

   F. Check worm gear assembly (31) runout.

      (1) Assemble worm gear assembly (31), worm gear spacer (32), pivot bolt (30) and nut (28) to housing (-42).

(2) Rotate worm gear assembly (31) and check runout with a dial indicator. Total indicator reading shall not exceed 0.003.

TABLE 301. INSPECTION REQUIREMENTS

PART NUMBER AND ITEM NUMBER (See IPL figure 1)	METHOD OF INSPECTION	CHECK	REQUIREMENTS
Nameplate (2)	Visual	Security & Legibility	Secure & Legible
Switch (4)	Ohmmeter	Resistance	If Resistance exceeds one Ohm, replace switch.
Drive Shaft Gear (16)	Visual	Uniformity of Contact	Contact uniformity must be 75 percent or greater of the working profile.
	Visual	Tooth Profile For Spalling	No visible damage.
	Visual	Tooth Erosion	Erosion shall not exceed 0.010 inch in depth.
Drive Arm Shaft (18)	Visual	Serration wear or damage	No visible damage.
	Visual	Journal for wear or bent shaft	No damage. Refer to Table 601, Wear Limits.
Cover Assembly (22)	Visual	Sleeve, bushing and pin security	No physical looseness.
	Visual	Cracks, signs of wear	No visible damage.
Converter Rack (25)	Visual	Uniformity of contact	Contact uniformity must be 75 percent or greater of the working profile.
	Visual	Tooth profile for spalling	No visible damage.

TABLE 301. INSPECTION REQUIREMENTS (CONTINUED)

PART NUMBER AND ITEM NUMBER (See IPL figure 1)	INSPECTION	CHECK	REQUIREMENTS
Converter Rack (25) (Continued)	Visual	Tooth erosion	Erosion shall not exceed 0.010 inch in depth.
	Visual	Drive slot for excessive wear, damage or scoring	No visible damage. Refer to Table 601, Wear Limits.
Drive Plate Assembly (26)	Visual	Dowel pin security	No physical looseness and no wear.
	Visual	Cracks, signs of wear	No visible damage.
Pivot Bolt (30)	Visual	Journal galling, scoring, discoloration or phonographic grooving	No visible damage.
Worm Gear Assembly (31)	Visual	Uniformity of contact	Contact uniformity must be 75 percent or greater of the working profile.
	Visual	Tooth profile for spalling	No visible damage.
	Visual	Tooth erosion	Erosion shall not exceed 0.010 inch in depth.
	Visual	Dowel pin security	No physical looseness
Worm Shaft Cap (33)	Visual	Cracks or chips or warpage	No visible damage.
Input Drive Worm Shaft (36)	Visual	Journals for discoloration, wear, scoring or bent shaft	No visible damage. Refer to Table 601, Wear Limits.
	Visual	Tooth profile for spalling	No visible damage.

TABLE 301. INSPECTION REQUIREMENTS (CONTINUED)

PART NUMBER AND ITEM NUMBER (See IPL figure 1)	INSPECTION	CHECK	REQUIREMENTS
Input Drive Worm Shaft (36) (Continued)	Visual	Tooth Erosion	Erosion shall not exceed 0.010 inch in depth.
	Magnetic Particle	Cracks, strains and fatigue	No visible damage.
Housing And Bearing Assembly (37)	Visual	Bearing bores for discoloration, wear or scoring	No visible damage.
	Visual	Retainer grooves for chips or cracks	No visible damage.
	Visual	Roll pin security	No physical looseness.

REPAIR

1. General

   A. Replace all parts which do not pass inspection, are damaged beyond simple repair, or show signs of excessive wear. Simple repair will be limited to polishing minor burrs, nicks, scoring, and scratches with number 400 grade abrasive cloth. For micro-finished surfaces, polish with number 600 grade crocus abrasive cloth.

   B. Clean all reworked parts in accordance with instructions detailed in CLEANING and re-inspect and check as detailed in INSPECTION/CHECK. Touch up all metal areas of anodized aluminum parts exposed during repair with alodine 1200 or equivalent.

   C. Do not repair parts listed in Table 101. These parts must be replaced at each overhaul regardless of condition.

ASSEMBLY

1. General

   A. These procedures provide for complete assembly of the windshield wiper converter when all parts were removed during DISASSEMBLY.

   B. Prior to assembly of the windshield wiper converter measure approximately 50 CC's of grease, Specification MIL-G-3278, mixed with 10 percent (by weight) of colloidal graphite and one percent (by weight) of molybdenum disulfide, Type C. Apply grease to components as specified throughout assembly and pack remaining quantity of grease in housing (-42) cavity.

      CAUTION: BE CERTAIN TO LEAVE AN AIR POCKET WHEN FILLING HOUSING (-42) CAVITY WITH GREASE.

2. Assemble Windshield Wiper Converter Assembly. (See IPL figure 1.)

   A. Assemble Housing And Bearing Assembly.

      (1) Lubricate and insert ball bearing (40) and ball bearing (39) into housing (-42).

      (2) Lubricate and install ball bearing (35) on worm shaft (36).

      (3) Position retaining ring (38) on worm shaft (36) and insert this assembly into housing (-42) through longitudinal bore.

      (4) Insert retaining ring (34) in housing (-42) and install worm shaft cap (33).

         NOTE: Do not tighten worm shaft cap (33). During installation of the Electric Windshield Wiper System on the vehicle, the worm shaft cap (33) can be located at either end of housing (-42).

   B. Install Worm Gear Assembly.

      (1) Apply lubricant on worm shaft (36) and worm gear assembly (31). Slide worm gear assembly (31) and worm gear spacer (32) on pivot bolt (30).

         NOTE: Chamfered edge of worm gear spacer (32) must face worm gear assembly (31).

      (2) Insert assembled worm gear assembly (31), worm gear spacer (32) and pivot bolt (30) into housing (-42).

(3) Slide seal (29) on pivot bolt (30) and secure with nut (28).

C. Install Drive Plate Assembly.

(1) Slide drive plate assembly (26) on worm gear assembly (31) dowel pins and secure with two screws (27). Lightly lubricate drive pin extending from drive plate assembly (26).

NOTE: Use crank and rotate worm shaft (36) until pin in drive plate assembly (26) is located in a vertical position closest to the worm shaft.

D. Assemble Drive Arm Shaft And Cover Assembly.

(1) Insert packing (21) or seal (19) into cover assembly (22).

(2) Carefully slide drive arm shaft (18) in cover assembly (22).

CAUTION: DO NOT NICK PACKING (21) OR SEAL (19).

(3) Install pinion spacer (17) and drive shaft gear (16) on drive arm shaft (18). Secure with retaining ring (15) and install retaining ring (14).

NOTE: Punch mark on drive shaft gear (16) must be visible after installation.

E. Install Drive Arm Shaft And Cover Assembly.

(1) Install gasket (23) on housing (-42). Apply lubricant to drive shaft gear (16), the teeth, vertical slot and guide pin slots of converter rack (25), and face of rack spacer (24).

(2) Place rack spacer (24) and converter rack (25) on the two guide pins of cover assembly (22).

(3) Line up converter rack (25) gear teeth and drive shaft gear (16) so the center tooth of the rack engages with the middle valley in the gear.

NOTE: Drive shaft gear (16) has a punch mark to indicate middle valley of gear section.

(4) Press the two assemblies together being certain the vertical slot in converter rack (25) is in line with the drive pin projecting from drive plate assembly (26). Secure with four screws (13).

CAUTION: DO NOT USE EXCESSIVE PRESSURE WHEN FITTING ASSEMBLIES TOGETHER. UNDUE PRESSURE DURING ASSEMBLY INDICATES MISALIGNED PARTS.

NOTE: Be certain gasket (23) remains in position during assembly.

F. Assembly Check.

(1) After converter is assembled check drive arm shaft (18) for rotational free play. It shall not exceed 5 degrees rotation. If limits are exceeded, disassemble and replace drive train.

G. Assemble Windshield Wiper Converter Assembly.

(1) Position shutoff cam (8) and attach washer (10) and screw (9).

NOTE: Some models use self locking nut (9) to secure shutoff cam (8).

NOTE: Do not tighten shutoff cam (8) attaching hardware.

(2) Position switch gasket (7) and install switch (4) with two screws (5). For model 14-91355-34 install actuator (3).

NOTE: Switch gasket (7) is not used on Model 14-91355-34.

NOTE: Refer to applicable vehicle installation drawing for positioning of switch (4). Proper positioning of switch determines left or right hand parking location.

(3) Insert converter crank, listed in Table 701, Test Equipment, into drive end of input drive worm shaft (36 IPL, figure 1). Turn crank until drive arm shaft (18) reaches its extreme rotation depending on left or right hand parking location determined in paragraph 2G(2).

(4) Slowly rotate shutoff cam (8) until contact is made with switch (4) indicated by an audible click. Hold shutoff cam (8) in this position and tighten attaching hardware.

FITS AND CLEARANCES

1. General

Table 601, Wear Limits, provides a list of permissible wear tolerances for specific components. Any component which does not meet the required limits of Table 601 must be repaired or replaced. Table 602, Torque Limits, indicates the torque requirements of the various attaching hardware.

TABLE 601. WEAR LIMITS

PART NAME AND INDEX NUMBER (See IPL figure 1)	WORN AREA	WORN DIMENSION
Drive Shaft Gear (16)	Gear Face (opposite center punch side)	Must be flat and square with center line of square bore and pitch line of gear teeth within 0.004 TIR, taken over entire gear.
	Square Bore	0.2510 inch maximum
	Gear Teeth (PN 14-01345-00)	Measurement from center line of square hole to top of 0.0864 inch DIA pins not to be less than 0.630 (0.005 inch wear)
	Gear Teeth (PN 14-01457-00)	Measurement from center line of square hole to top of 0.0864 inch DIA pins not to be less than 0.428 (0.004 inch wear)
	Gear Teeth	Chips on tooth surface shall not exceed 1/64 inch. Replace if more than a total of two chipped areas appear on one tooth
Pinion Spacer (17)	Faces	Faces must be parallel to each other within 0.003 TIR.
Drive Arm Shaft (18)	Concentricity	0.2360, 0.3120, 0.375 Diameters and 0.2515 square to be concentric to each other within 0.002 inch TIR.

TABLE 601. WEAR LIMITS (CONTINUED)

PART NAME AND INDEX NUMBER (See IPL figure 1)	WORN AREA	WORN DIMENSION
Drive Arm Shaft (18) (CONT)	Serrations	Serrations shall be straight and smooth. Replace shaft if damaged.
Rack Spacer (24)	Faces	Faces must be parallel to each other within 0.003 TIR
Converter Rack (25)	Faces	Faces must be parallel to each other and flat within 0.004 inch TIR
	Slot Width	0.258 inch maximum
	Gear Teeth	Chips on tooth surface shall not exceed 1/64 inch. Replace if more than a total of two chipped areas appear on one tooth.
	Gear Teeth (PN 14-01352-00)	Measurement from top of horizontal slot over two 0.0864 inch DIA pins not to be less than 0.729 (0.005 inch wear)
	Gear Teeth (PN 14-01456-00)	Measurement from top of horizontal slot over two 0.0864 inch DIA pins not to be less than 0.929 (0.005 inch wear)
Input Drive Worm Shaft (36)	Concentricity	TIR between 0.2502 DIA's and 0.1265 square shall not exceed 0.006. TIR between 0.2502 DIA's and 0.333 pitch diameter shall not exceed 0.002.
	Gear Teeth	Measurement over three 0.035 inch DIA pins not to be less than 0.3760 (0.003 inch wear)
Worm Gear Assembly (31)	Backlash	Backlash not to exceed 0.009 inch when parts are mounted on 1.208 inch center distance

TABLE 602. TORQUE LIMITS

PART NAME AND INDEX NUMBER (See IPL figure 1)	TORQUE LIMIT
Screw (5)	4 to 7 inch pounds
Screw (9)	55 to 75 inch pounds
Nut (9)	55 to 75 inch pounds
Screw (-11)	15 to 25 inch pounds
Screw (13)	55 to 75 inch pounds
Screw (27)	55 to 75 inch pounds
Nut (28)	60 to 100 inch pounds

TESTING

1. General

After overhaul, perform the tests described in the following paragraphs to determine if the Windshield Wiper Converter Assembly performs in accordance with the specific design requirements. If the equipment fails to pass the required tests, the test procedure should be stopped immediately, the cause of the failure determined and corrected as described in Table 801, Trouble Shooting.

TABLE 701. TEST EQUIPMENT

PART NUMBER	DESCRIPTION
14-19351-00	Converter Crank
14-01321-00 (or equivalent)	Electric Motor, 27 VDC
14-91365-19 (or equivalent)	Cable Assembly (with 1/8 inch square drive end) and (adapter for motor drive)
MS25017-10	Circuit Breaker, 10 AMP
MS35059-31	Toggle Switch, 3-Position
14-91380-00 (or equivalent)	Rheostat, 5 OHM, 25 Watt

2. Manual Test

A. Insert Converter Crank, listed in Table 701, Test Equipment, into drive end of input drive worm shaft (36, IPL figure 1). Turn Converter Crank clockwise and test for freedom of rotation of Windshield Wiper Converter Assembly components. If rotation is binding or restricting refer to Table 801, Trouble Shooting, and re-test.

3. Electro-Mechanical Test

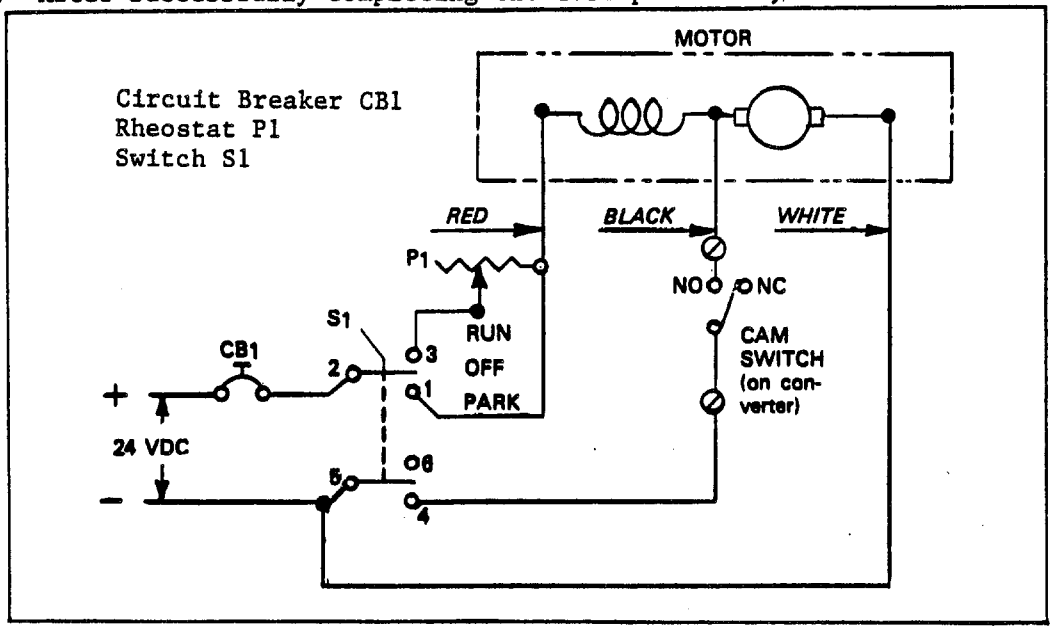
A. Connect Electric Motor, Circuit Breaker, Rheostat, and Toggle Switch listed in Table 701, Test Equipment, as shown in Figure 701, Wiring Diagram. Wire proper leads to switch (4, IPL figure 1) on Windshield Wiper Converter Assembly.

B. Insert Cable Assembly, listed in Table 701, Test Equipment, square end into drive end of input drive worm shaft (36, IPL figure 1). Attach opposite end into Electric Motor and operate Windshield Wiper Converter Assembly for 15 minutes. During this test, there shall be no indication of excessive heat generated from the converter. If any area of the converter feels hot, refer to Table 801, Trouble Shooting, and re-test.

C. After successfully completing the test described in Paragraph 3B, move Toggle Switch to the ON position for several cycles. Move Toggle Switch directly to the PARK position, hold for two seconds and release. The converter should stop in the park position. Repeat ON - PARK sequence several times to observe if proper shutoff cam (8, IPL figure 1) position has been attained. Refer to ASSEMBLY if readjustment is required.

CAUTION: DO NOT HOLD TOGGLE SWITCH IN PARK POSITION FOR MORE THAN TWO SECONDS.

D. After successfully completing the test procedure, stake four screws (13).



Wiring Diagram
Figure 701

TROUBLE SHOOTING

1. General

A list of troubles, probable causes and suggested remedies are listed in Table 801, Trouble Shooting. References are made to IPL, figure 1. After correcting the trouble re-test in accordance with instructions described in TESTING.

TABLE 801. TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Converter Fails To Stop In "PARK" Position	Defective parking switch.	Check for closed circuit with Toggle Switch in "PARK" position.
		Replace switch if circuit is open.
	Incorrect setting of shutoff cam.	Re-set cam shutoff by rotating cam. Refer to ASSEMBLY.
Converter Fails To Operate Or Operation Is Irregular	Flexible coupling not firmly engaged to Motor or converter shaft.	Disassemble and adjust to secure firm seating of flexible coupling.
	Defective flexible drive shaft.	Replace.
	Defective flexible coupling.	Replace.
	No power to Electric Motor.	Check Figure 701, Wiring Diagram.
	Electric Motor wiring not properly installed.	Check Figure 701, Wiring Diagram.
	Failure of Electric Motor.	Replace.
	Defective converter.	Turn square end of converter drive shaft, by hand or crank, continuously in one direction. If jamming or irregular operation, disassemble converter and replace defective parts.

STORAGE INSTRUCTIONS

1. General

   A. If unit is returned to service after a one year storage period it should be checked to assure correct operation.

2. Storage Procedure

   A. For short periods of storage, the unit can be placed in a dust proof plastic bag or container. If the unit is to be stored for long periods of time, it is recommended that it be repackaged in a moisture-proof container with a moisture-absorbing agent such as "Bagged ACTIVATED DESICCANT" per MIL-D-3464B.

1. Introduction

A. Purpose.

This catalog lists and describes the parts required for Windshield Wiper Converters Part Number Series 14-91355 and 14-91455, and is used in conjunction with the Overhaul Manual to serve as an aid to disassembly and reassembly.

B. Usage.

(1) The Detailed Parts List consists of the complete Windshield Wiper Converter listed in disassembly order.

(a) The first column lists the figure and index numbers for all items illustrated in the exploded view.

(b) The second and third columns list the part numbers and description of all assemblies, subassemblies and detailed parts.

(c) The fourth column shows the quantity required per assembly or subassembly.

(d) The fifth column provides for model variations as applicable.

(2) Part Numbering System.

All Marquette Metal Products Co. part numbers used for the equipment being covered are designated by five digit numbers prefixed and suffixed by a two digit number. Government standard parts are prefixed by the letters AN and MS. Purchased parts are listed by the manufacturer's part number. A Marquette Metal Products Co. part number has been assigned to all purchased items and is shown in parenthesis after the description of the part for reference purposes.

(3) Numerical Index.

(a) In the Numerical Index, all parts shown in the Detailed Parts List are arranged in alpha-numerical order. The arrangement sequence of each part begins at the extreme lefthand position and continues left to right, one column at a time, until complete numerical arrangement is determined.

(b) In the first position, the order of precedence is the letters A through Z, then the numerals 0 through 9.

(c) In the second and all suceeding positions, the order of precedence is as follows:

(1) Space (blank column)

(2) Diagonal (slant)

(3) Point (period)

(4) Dash (-)

(5) Letters A through Z

(6) Numerals 0 through 9

NOTE: Alphabetical O's shall be considered numerical zeros. Spaces, diagonals, points and dashes shall not appear in the extreme lefthand position of the part number. They may be used in the second and succeeding positions of the part number and shall take precedence over letters and numerals as indicated above.

(d) The columns used in the Numerical Index are as follows:

(1) PART NUMBER. Parts are listed by their respective part numbers only once, regardless of how many times they appear in the Detailed Parts List.

(2) FORMER PART NUMBER. This column indicates the former part number for each Marquette Metal Products Co. item.

(3) FIGURE AND ITEM NUMBER. For Government standard parts, the figure and item number is shown only for the first listing in the Numerical Index. For all other part numbers, each occurrence is shown.

(4) TOTAL QUANTITY. This column indicates the total quantity of parts for a complete unit of equipment. When a definite quantity cannot be shown, the letters "AR" are used to signify "As Required".

(4) Arrangement of Detailed Parts List.

(a) All assemblies and parts are arranged in the order of disassembly with the exception of attaching parts which follow immediately after the item to be attached.

(b) Subassemblies and parts are indented to indicate their relationship to the complete assembly. Associated with the list is an exploded view illustration. This illustration shows the relative positions of the various assemblies and parts and identifies all assemblies and parts.

(c) The quantities listed in the "Units Per Assy" column are, in the case of assemblies, the total quantity used per unit of equipment at the location indicated, while the component parts indented under the assemblies only show the quantity used per assembly. Therefore, the quantities specified are not necessarily the total used per unit of equipment.

(d) Part variations between models are indicated by letter symbols placed in the "Usable on Code" column of the Detailed Parts List. Where the parts are used on all units of equipment, the column is left blank.

USABLE ON CODE	PARTS LIST NUMBER
A	14-91355 Series (Up to SERNO 6999)
B	14-91355-34 (Up to SERNO 6999)
C	14-91355 Series (SERNO 7000 and Up)
D	14-91355-34 (SERNO 7000 and Up)
E	14-91455 Series (Up to SERNO 6999)
F	14-91455 Series (SERNO 7000 and Up)

NOTE: Part variations in the Usable on Code column with an "A", "B", or "E" code are for reference identification purposes only. If parts coded "A", "B" or "E" are not serviceable, they are to be discarded and replaced with like parts coded "C", "D" or "F".

(5) Converter Assembly Configuration List.

The configuration list relates the applicable component parts to the converter assembly (-) dash number. The component part numbers shown are for converter assembly serial numbers 7000 and UP only. Refer to Figure 1 for applicable index numbers.

(6) Vendor Codes.

Commercial suppliers are identified by a code in parenthesis immediately following the part description. Code symbols used are in accordance with the Federal Supply Code for Manufacturers, Cataloging Handbook H-4-1, except that each code symbol is preceded by the letter "V". Vendor codes are as follows:

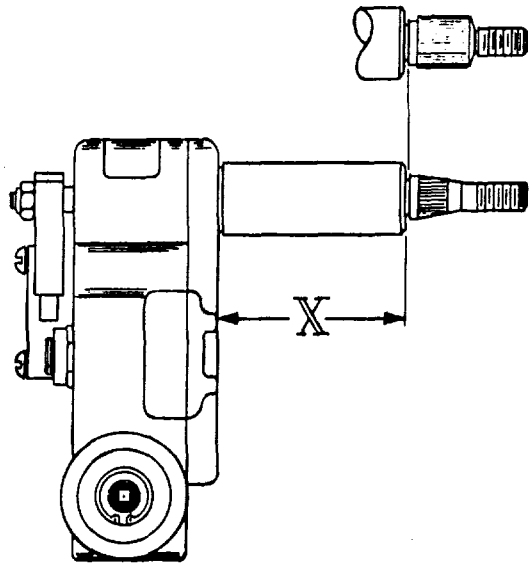
Code	Vendor's Name and Address
V79136	Waldes Kohinoor Inc. 47-16 Austel Place Long Island City, N.Y. 11101
V80207	Unimax Switch Corp. Ives Road Wallingford, Ct. 06492
V81965	Marlin-Rockwell, Div. of TRW Inc. Plainville Works Plainville, Ct. 06062
V86579	Precision Rubber Products Corp. 3110 Oakridge Drive Dayton, Ohio 45417
V88044	Aeronautical Standards Group Dept. of Navy and Air Force
V91929	Honeywell Inc., Micro Switch Division Chicago and Spring Streets Freeport, Illinois 61032
V96906	Military Standards Promulgated by Military Departments Under Authority of Defense Standardization Manual 4120 3M

2. Numerical Index

PART NUMBER	FORMER PART NUMBER	FIG. & ITEM	TOT REQD
AN515B2-10		1 5	2
AN936A4B		1 6	2
AN936A6		1 10	1
MS20364-1032		1 28	1
MS21044-N06		1 9	2
MS21083-N5		1 28	1
MS35214-17		1 5	2
N5000-62		1 34	2
		1 38	
R4Z		1 35	2
		1 39	
1SE3		1 4	1
110-3/16		1 29	1
110-5/16		1 29	1
14-01336-00	A2-01336	1 7	1
14-01338-*		1 -42	1
14-01341-00		See R4Z	
14-01342-00	B2-01342	1 36	1
14-01343-*	B2-01343	1 18	1
14-01344-00		See 36-Z	
14-01345-00	B2-01345	1 16	1
14-01346-00	A2-01346	1 17	1
14-01348-00	A2-01348	1 32	1
14-01348-01		1 32	1
14-01350-00	A2-01350	1 30	1
14-01350-01		1 30	1
14-01350-02		1 30	1
14-01352-00	B2-01352	1 25	1
14-01353-00	A2-01353	1 24	1
14-01354-00	A2-01354	1 23	1
14-01356-00		See 110-3/16	
14-01356-01		See 110-5/16	
14-01357-00		See 2TMT-6-Y	
14-01366-00	A2-01366	1 2	1
14-01369-00	A2-01369	1 33	1
14-01372-*	B2-01372	1 18	1
14-01454-*		1 -42	1

PART NUMBER	FORMER PART NUMBER	FIG. & ITEM	TOT REQD
14-01456-00	B2-01456	1 25	1
14-01457-00	B2-01457	1 16	1
14-01476-*		1 18	1
14-014-00		See 1SE3	
14-01481-00		1 3	1
14-05343-*		1 18	1
14-05476-*		1 18	1
14-19525-00		1 8	1
14-19525-01		1 8	1
14-19905-00		1 19	1
14-19942-00		1 -20	1
14-71339-*		1 22	1
14-71358-*	B2-71358-	1 37	1
14-71359-00	A2-71359	1 31	1
14-71360-*	B2-71360	1 -12	1
14-71361-*	A2-71361	1 26	1
14-71390-*		1 -12	1
14-71453-*	C2-71453	1 22	1
14-71460-*	B2-71460-	1 37	1
14-71461-*	B2-71461	1 -12	1
14-79815-00		1 31	1
14-79935-*		1 22	1
14-89941-*		1 -12	1
14-91355-*		1 -1	2
14-91355-34		1 -1	2
14-91455-*		1 -1	2
2TMT-6-Y		1 4	1
36-Z		1 40	1
5103-25		1 15	1
5555G-23		1 14	1
91-25869-00		1 -41	1
91-33060-00		1 9	1
91-33529-00		1 13	4
91-33530-00		1 27	2
91-33813-00		1 -11	1
91-34130-00		1 6	2
91-52057-00		See N5000-62	
91-52058-00		See 5555G-23	
91-52061-00		See 5103-25	
91-52526-00		1 21	1

CONVERTER ASSEMBLY CONFIGURATION LIST



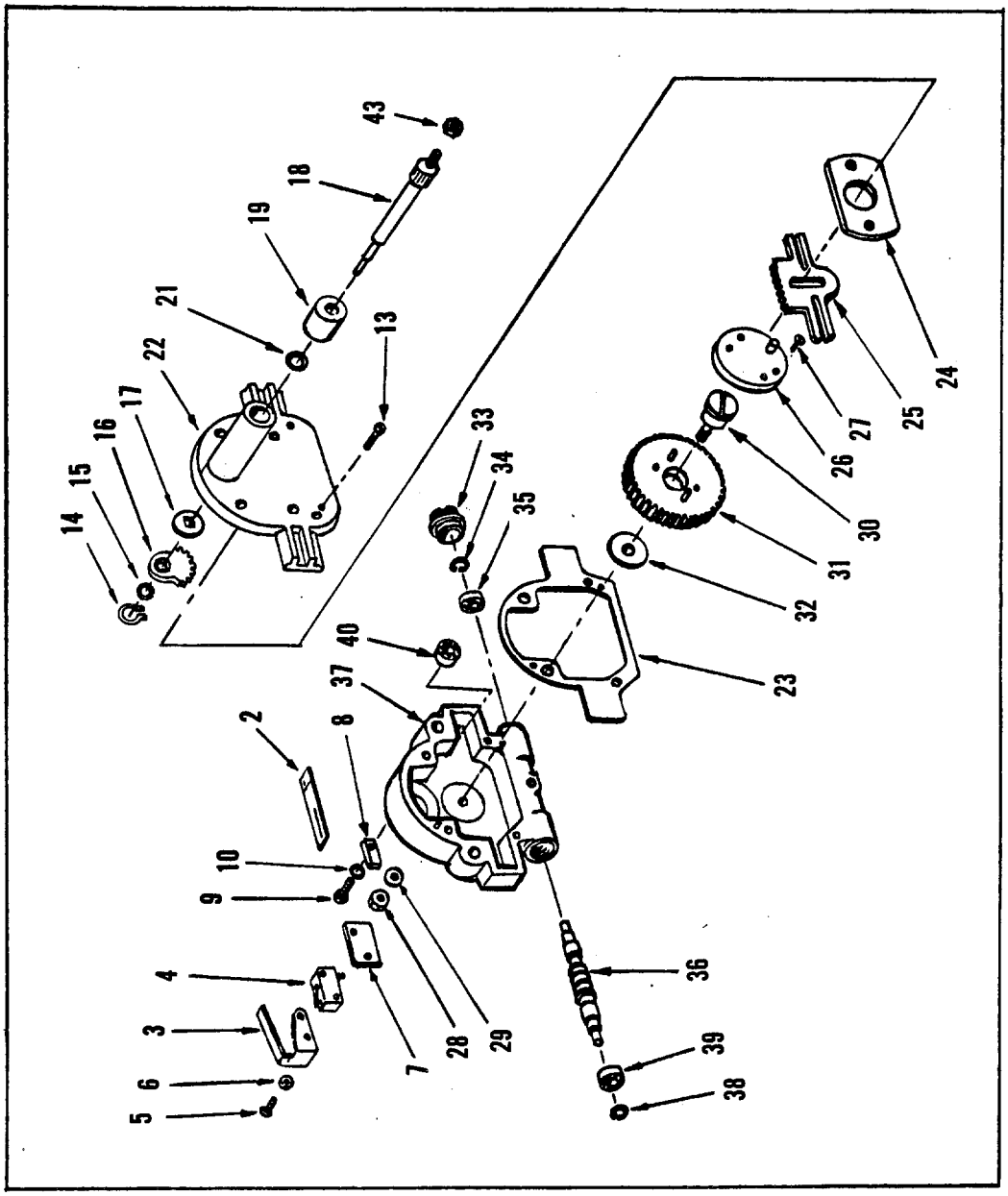
CONVERTER ASSY NUMBER	DRIVE ARM SHAFT (18)	COVER ASSY (22)	DRIVE PLATE ASSY (26)	"X" DIMENSION (INCHES)	WIPE ANGLE (DEG)	SWITCH (4)
14-91355-01	14-05343-01	14-79935-03	14-71361-01	1.656	75	YES
14-91355-02	14-05343-01	14-79935-03	14-71361-02	1.656	50	YES
14-91355-03	14-05343-01	14-79935-03	14-71361-03	1.656	66	YES
14-91355-04	14-05343-01	14-79935-03	14-71361-04	1.656	80	YES
14-91355-07	14-05476-07	14-79935-05	14-71361-07	2.500	33	YES
14-91355-12	14-05476-06	14-79935-01	14-71361-03	1.187	66	YES
14-91355-13	14-05476-13	14-79935-08	14-71361-02	3.313	50	YES
14-91355-15	14-05476-07	14-79935-05	14-71361-03	2.500	66	YES
14-91355-16	14-05476-07	14-79935-05	14-71361-01	2.500	75	YES
14-91355-18	14-05476-07	14-79935-05	14-71361-04	2.500	80	YES
14-91355-19	14-05476-07	14-79935-05	14-71361-10	2.500	60	YES
14-91355-21	14-05343-01	14-79935-03	14-71361-01	1.656	75	NO
14-91355-22	14-05343-01	14-79935-03	14-71361-02	1.656	50	NO
14-91355-23	14-05343-01	14-79935-03	14-71361-03	1.656	66	NO
14-91355-24	14-05343-01	14-79935-03	14-71361-04	1.656	80	NO
14-91355-26	14-05476-01	14-79935-10	14-71361-03	5.078	66	YES
14-91355-27	14-05476-02	14-79935-12	14-71361-09	7.078	45	YES
14-91355-28	14-05476-03	14-79935-09	14-71361-10	3.578	60	YES
14-91355-29	14-05476-04	14-79935-03	14-71361-11	1.656	25	YES
14-91355-30	14-05476-04	14-79935-03	14-71361-12	1.656	30	YES
14-91355-32	14-05476-06	14-79935-01	14-71361-03	1.187	66	NO
14-91355-33	14-05476-13	14-79935-08	14-71361-02	3.313	50	NO
14-91355-34	14-05476-12	14-79935-04	14-71361-11	2.250	25	YES
14-91355-35	14-05476-07	14-79935-05	14-71361-03	2.500	66	NO

CONVERTER ASSEMBLY CONFIGURATION LIST (CONTINUED)

CONVERTER ASSY NUMBER	DRIVE ARM SHAFT (18)	COVER ASSY (22)	DRIVE PLATE ASSY (26)	"X" DIMENSION (INCHES)	WIPE ANGLE (DEG)	SWITCH (4)
14-91355-36	14-05476-07	14-79935-05	14-71361-01	2.500	75	NO
14-91355-37	14-05343-04	14-79935-05	14-71361-04	2.500	80	YES
14-91355-39	14-05476-03	14-79935-03	14-71361-04	3.578	80	YES
14-91355-42	14-05343-01	14-79935-03	14-71361-14	1.656	40	YES
14-91355-44	14-05476-01	14-79935-10	14-71361-01	5.078	75	YES
14-91355-45	14-05476-01	14-79935-10	14-71361-14	5.078	40	YES
14-91355-46	14-05476-01	14-79935-10	14-71361-04	5.078	80	YES
14-91355-47	14-05476-01	14-79935-10	14-71361-09	5.078	45	YES
14-91355-49	14-05476-01	14-79935-10	14-71361-01	5.078	75	NO
14-91355-50	14-05476-06	14-79935-01	14-71361-03	1.187	66	YES
14-91355-51	14-05476-07	14-79935-05	14-71361-06	2.500	55	YES
14-91355-52	14-05476-07	14-79935-05	14-71361-06	2.500	55	NO
14-91355-53	14-05476-01	14-79935-10	14-71361-10	5.078	60	YES
14-91355-54	14-05476-08	14-79935-03	14-71361-03	3.000	66	YES
14-91355-55	14-05476-04	14-79935-05	14-71361-04	1.656	80	YES
14-91355-56	14-05343-01	14-79935-03	14-71361-14	1.656	40	NO
14-91355-57	14-05476-01	14-79935-10	14-71361-11	5.078	25	YES
14-91355-58	14-05476-04	14-79935-05	14-71361-04	1.656	80	NO
14-91355-59	14-05476-07	14-79935-05	14-71361-09	2.500	45	YES
14-91355-60	14-05476-07	14-79935-05	14-71361-09	2.500	45	NO
14-91355-61	14-05343-01	14-79935-03	14-71361-15	1.656	49	YES
14-91355-62	14-05343-01	14-79935-03	14-71361-15	1.656	49	NO
14-91355-63	14-05343-04	14-79935-05	14-71361-03	2.500	66	YES
14-91355-64	14-05476-04	14-79935-03	14-71361-03	1.656	66	YES
14-91355-65	14-05476-04	14-79935-03	14-71361-03	1.656	66	NO
14-91355-66	14-05476-08	14-79935-07	14-71361-15	3.000	49	YES
14-91355-67	14-05476-09	14-79935-13	14-71361-01	7.750	75	YES
14-91355-68	14-05476-09	14-79935-13	14-71361-01	7.750	75	NO
14-91355-69	14-05476-12	14-79935-04	14-71361-14	2.250	40	YES
14-91355-70	14-05476-12	14-79935-04	14-71361-14	2.250	40	NO
14-91355-72	14-05476-07	14-79935-05	14-71361-07	2.500	40	YES
14-91355-73	14-05476-04	14-79935-03	14-71361-10	1.656	60	YES
14-91355-74	14-05476-04	14-79935-03	14-71361-17	1.656	35	YES
14-91355-75	14-05476-04	14-79935-03	14-71361-01	1.656	75	YES
14-91355-76	14-05476-07	14-79935-05	14-71361-07	2.500	60	YES
14-91355-83	14-05476-01	14-79935-10	14-71361-18	5.078	20	YES
14-91355-85	14-05476-01	14-79935-10	14-71361-10	5.078	60	NO
14-91355-86	14-05476-07	14-79935-05	14-71361-07	2.500	60	NO
14-91355-87	14-05476-07	14-79935-05	14-71361-02	2.500	50	YES
14-91355-88	14-05476-04	14-79935-03	14-71361-09	1.656	45	YES
14-91355-89	14-05476-04	14-79935-03	14-71361-09	1.656	45	NO

CONVERTER ASSEMBLY CONFIGURATION LIST (CONTINUED)

CONVERTER ASSY NUMBER	DRIVE ARM SHAFT (18)	COVER ASSY (22)	DRIVE PLATE ASSY (26)	"X" DIMENSION (INCHES)	WIPE ANGLE (DEG)	SWITCH (4)
14-91455-01	14-05343-02	14-79935-06	14-71361-05	2.875	88	YES
14-91455-02	14-05343-02	14-79935-06	14-71361-05	2.875	88	NO
14-91455-05	14-05343-02	14-79935-06	14-71361-08	2.875	96	YES
14-91455-09	14-05343-02	14-79935-06	14-71361-14	2.875	60	YES
14-91455-10	14-05343-01	14-79935-03	14-71361-05	1.656	92	YES
14-91455-11	14-05343-01	14-79935-03	14-71361-05	1.656	92	NO
14-91455-12	14-05476-06	14-79935-01	14-71361-01	1.187	114	YES
14-91455-16	14-05476-01	14-79935-10	14-71361-08	5.078	96	YES
14-91455-17	14-05476-01	14-79935-10	14-71361-08	5.078	96	NO



Exploded View of Windshield Wiper Converter
Figure 1

FIG.	ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
1	-1	14-91355-*	CONVERTER ASSEMBLY, Wiper, ... Windshield (Up to SERNO 6999)	1	A
		14-91355-34	CONVERTER ASSEMBLY, Wiper, ... Windshield (Up to SERNO 6999)	1	B
		14-91355-*	CONVERTER ASSEMBLY, Wiper, ... Windshield (SERNO 7000 and Up)	1	C
		14-91355-34	CONVERTER ASSEMBLY, Wiper, ... Windshield (SERNO 7000 and Up)	1	D
		14-91455-*	CONVERTER ASSEMBLY, Wiper, ... Windshield (Up to SERNO 6999)	1	E
		14-91455-*	CONVERTER ASSEMBLY, Wiper, ... Windshield (SERNO 7000 and Up)	1	F
	2	14-01366-00	.NAMEPLATE	1	
	3	14-01481-00	.ACTUATOR	1	BD
	4	1SE3	.SWITCH (V91929)(14-01480-00)	1	BD
		2TMT-6-Y	.SWITCH (V80207)(14-01357-00) ..... (ATTACHING PARTS)	1	ACEF
	5	AN515B2-10	.SCREW (V88044)	2	BD
		MS35214-17	.SCREW (V96906)	2	ACEF
	6	91-34130-00	.WASHER, Internal Tooth Lock	2	BD
		AN936A4B	.WASHER, Internal Tooth Lock(V88044). -----*-----	2	ACEF
	7	14-01336-00	.GASKET, Switch	1	ACEF
	8	14-19525-00	.CAM, Shutoff	1	B
		14-19525-01	.CAM, Shutoff ..... (ATTACHING PARTS)	1	ACDEF
	9	91-33060-00	.SCREW, Cap, Socket Head	1	ABE
		MS21044-N06	.NUT, Self Locking(V96906)	1	CDF
	10	AN936A6	.WASHER(V88044) ..... -----*-----	1	ABE
	-11	91-33813-00	.SCREW, Button Head	AR	
	-12	14-71360-*	.DRIVE ARM SHAFT AND COVER ASSY	1	A
		14-71390-*	.DRIVE ARM SHAFT AND COVER ASSY	1	AB
		14-71461-*	.DRIVE ARM SHAFT AND COVER ASSY	1	E
		14-89941-*	.DRIVE ARM SHAFT AND COVER ASSY ..... (ATTACHING PARTS)	1	CDF
	13	91-33529-00	.SCREW, Flat Head ..... -----*-----	4	
	14	5555G-23	..RING, Retaining(V79136)(91-52058-00)	1	
	15	5103-25	..RING, Retaining(V79136)(91-52061-00)	1	
	16	14-01345-00	..GEAR, Drive Shaft	1	ABCD
		14-01457-00	..GEAR, Drive Shaft	1	EF
	17	14-01346-00	..SPACER, Pinion	1	

-Not Illustrated
*Denotes Series

FIG.	ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
1	18	14-01343-*	..SHAFT, Drive Arm ..... (Tapered Spline Mount)	1	AE
		14-01372-*	..SHAFT, Drive Arm ..... (Straight Spline Mount)	1	AE
		14-01476-*	..SHAFT, Drive Arm ..... (Straight Spline Mount)	1	ABE
		14-05343-*	..SHAFT, Drive Arm ..... (Tapered Spline Mount)	1	CF
		14-05476-*	..SHAFT, Drive Arm ..... (Straight Spline Mount)	1	CDF
	19	14-19905-00	..SEAL	1	ABE
	-20	14-19942-00	..SPACER	1	CDF
	21	91-52526-00	..PACKING	1	CDF
	22	14-71339-*	..COVER ASSEMBLY, Converter	1	AB
		14-71453-*	..COVER ASSEMBLY, Converter	1	E
		14-79935-*	..COVER ASSEMBLY, Converter	1	CDF
	23	14-01354-00	.GASKET	1	
	24	14-01353-00	.SPACER, Rack	1	
	25	14-01352-00	.RACK, Converter	1	ABCD
		14-01456-00	.RACK, Converter	1	EF
	26	14-71361-*	.DRIVE PLATE ASSEMBLY ..... (ATTACHING PARTS)	1	
	27	91-33530-00	.SCREW ..... -----*-----	2	
	28	MS20364-1032	.NUT, Self Locking(V96906)	1	ABE
		MS21083-N5	.NUT, Self Locking(V96906)	1	CDF
	29	110-3/16	.SEAL, Dyna(V86579)(14-01356-00) ...	1	ABE
		110-5/16	.SEAL, Dyna(V86579)(14-01356-01) ...	1	CDF
	30	14-01350-00	.BOLT, Pivot	1	ABE
		14-01350-01	.BOLT, Pivot	1	ABE
		14-01350-02	.BOLT, Pivot	1	CDF
	31	14-71359-00	.WORM GEAR ASSEMBLY	1	ABE
		14-79815-00	.WORM GEAR ASSEMBLY	1	CDF
	32	14-01348-00	.SPACER, Worm Gear	1	ABE
		14-01348-01	.SPACER, Worm Gear	1	CDF
	33	14-01369-00	.CAP, Worm Shaft	1	
	34	N5000-62	.RING, Retaining, Internal ..... (V79136)(91-52057-00)	1	
	35	R4Z	.BEARING, Ball(V81965)(14-01341-00).	1	
	36	14-01342-00	.SHAFT, Worm, Input Drive	1	
	37	14-71358-*	.HOUSING AND BEARING ASSEMBLY	1	ABCD
		14-71460-*	.HOUSING AND BEARING ASSEMBLY	1	EF
	38	N5000-62	..RING, Retaining, Internal ..... (V79136)(91-52057-00)	1	
	39	R4Z	..BEARING, Ball(V81965)(14-01341-00)	1	
	40	36-Z	..BEARING, Ball(V81965)(14-01344-00)	1	

-Not Illustrated
*Denotes Series

FIG. ITEM	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
1 -41	91-25869-00	..PIN, Roll	2	
-42	14-01338-*	..HOUSING	1	ABCD
	14-01454-*	..HOUSING	1	EF
43	MS21044-N06	.NUT, Self Locking(V96906)	1	

-Not Illustrated
*Denotes Series

MARQUETTE DIVISION
CURTISS-WRIGHT CORPORATION
1145 GALEWOOD DRIVE
CLEVELAND 10, OHIO

PART No. 14-97862-02

FUNCTIONAL TEST PROCEDURES

AND

OVERHAUL INSTRUCTIONS

FOR

ELECTRIC

WINDSHIELD WIPER

MOTORS

July 15, 1964

ELECTRIC MOTOR
FUNCTIONAL TEST INSTRUCTIONS

This manual contains test instructions for the electric motors used in Marquette Division, Curtiss-Wright Corporation wiper system installations. If there is an indication that a unit is not functioning properly, perform tests as indicated. If the unit fails to meet the test requirements, it should be overhauled and retested.

Disassembly and reassembly of the components may be readily determined from the exploded view illustration accompanying the overhaul instructions. Special instructions are given, wherever necessary, for parts requiring special attention. Disassembly of the unit will normally follow the same general order as the key index numbers assigned to the parts in the illustrations.

Test procedures are given first, and where applicable, a trouble shooting chart is provided for localizing the trouble within the unit. Immediately following the test procedures are the overhaul instructions. Motor performance curves are attached at the back of the manual. No special tools are needed for overhaul.

1. FUNCTIONAL TEST PROCEDURE

Connect the motor (refer to Fig. 1 for motor wiring diagram) as shown in the test connection diagram, Fig. 2, and perform the following operational tests. A trouble shooting chart follows the test procedure.

a. Turn the power on and turn switch to SLOW position. If new brushes have been installed, allow motor to run for approximately six hours.

CAUTION

On a long run, resistor box should be watched for overheating.

b. After run in, inspect brushes to make certain they are free to move in brush holders and at least 80% of brush area is making contact with commutator.

c. Check for excessive running noise and vibration while running at full speed with no load.

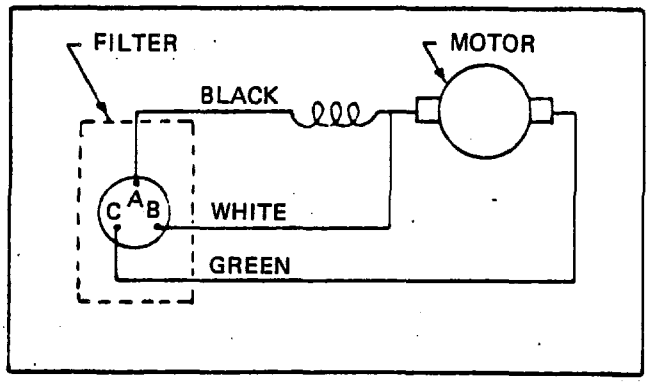
CAUTION

Do not run motor at full speed with no load longer than 30 seconds.

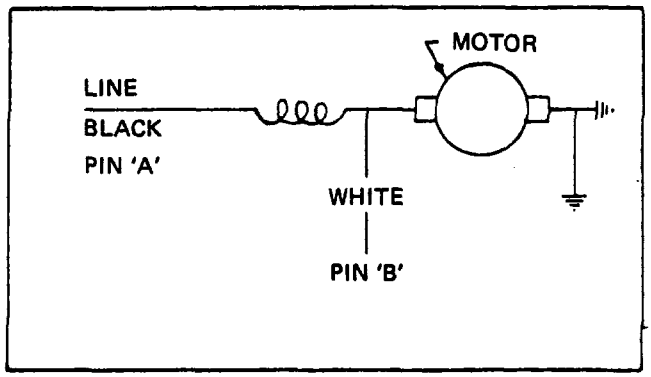
d. Lock the rotor in a stationary position and turn switch to FAST. Circuit breaker must de-energize motor circuit in less than 3 seconds.

e. Apply a load as specified in Table I to the motor and turn switch to FAST. A voltmeter reading taken across the motor input terminals should read as specified in Table I. With the motor hot, ammeter inserted in the line should read as specified in Table I, and motor speed should be RPM minimum as specified in Table I.

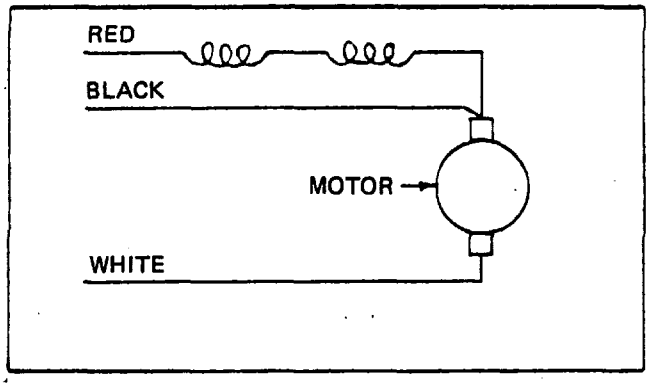
f. Turn control switch to PARK position and hold until motor stops. Coasting or creeping is permissible under this load condition.



Externally Grounded
Heavy Duty

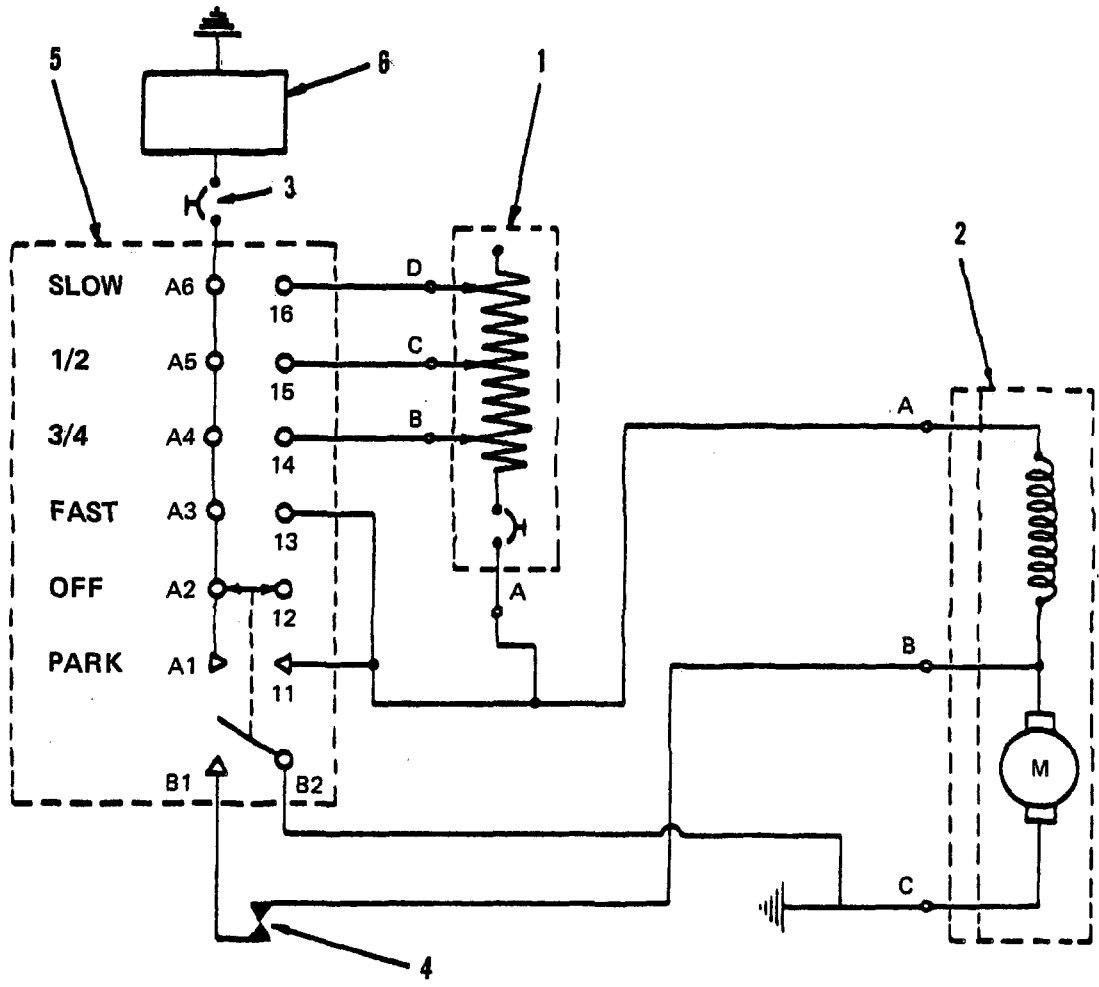


Internally Grounded
Heavy Duty



Externally Grounded
Light Plane Wiper

FIGURE 1



1. Resistor Assy
2. Electric Motor Assy
3. Circuit Breaker (15 amp)
4. Toggle Switch
5. Rotary Switch
6. Power Supply

FIGURE 2 MOTOR TEST CONNECTION DIAGRAM

TYPE	ASSEMBLY NO.	RATED H.P.	RATED R.P.M.	RATED TORQUE OZ.IN.	VOLT	FREQ.	FREE RUNNING	LOADED AMP.	STALL AMP.
HD	C2-91186-1	1/4	12,000	21.6	24	D.C.	5.0	13.5	90.0
HD	C2-97167	1/6	10,000	16.8	27	D.C.	3.0	8.0	44.0
HD	C2-97457	1/6	10,000	16.8	27	D.C.	3.0	8.0	44.0
HD	C2-97663	1/6	10,000	16.8	27	D.C.	3.0	8.0	44.0
HD	C2-97700	1/6	10,000	16.8	27	D.C.	3.0	8.0	44.0
HD	C2-98049	1/5	10,500	16.8	24	D.C.	1.4	10.0	85.0
HD	C2-98052	1/6	10,000	16.8	27	D.C.	3.0	8.0	44.0
HD	C2-98233	1/6	10,000	16.8	27	D.C.	3.0	8.0	44.0
HD	C2-98324	1/6	10,000	16.8	27	D.C.	3.0	8.0	44.0
HD	C2-98763	1/6	10,000	16.8	27	D.C.	3.0	8.0	44.0
HD	C2-98894	1/6	10,000	16.8	27	D.C.	3.0	8.0	44.0
HD	C2-99044	1/5	12.000	16.8	24	D.C.	1.5	11.0	99.0
	C2-91254-1	1/4	12,000	21.6	24	D.C.	5.0	13.5	90.0
HD	C2-97862	1/8	10,000	7.2	27	D.C.	1.0	5.5	27.0
HD	C2-98428))2 Speed	1/8	7,100		27	D.C.	3.0	8.0	23.0
HD	")Motor	1/6	10,000		27	D.C.	4.0	8.4	36.0
LPW	C2-91326	1/10	10,000	7.2	24	D.C.	0.8	4.0	11.6
LPW	C2-91327	1/12	10,000	7.4	24	D.C.	1.0	4.8	12.0
LPW	C2-91325	1/12	9,000	5.0	12	D.C.	3.6	8.0	24.0
LPW	C2-91329	1/10	8,000	5.0	115	AC-DC	0.66	1.8	30.5
LPW	C2-91328	1/12	10,000	5.0	115	AC-DC	0.5	0.65	23.5

TABLE I

HD Heavy Duty Overhaul Instructions Pages 9 thru 13

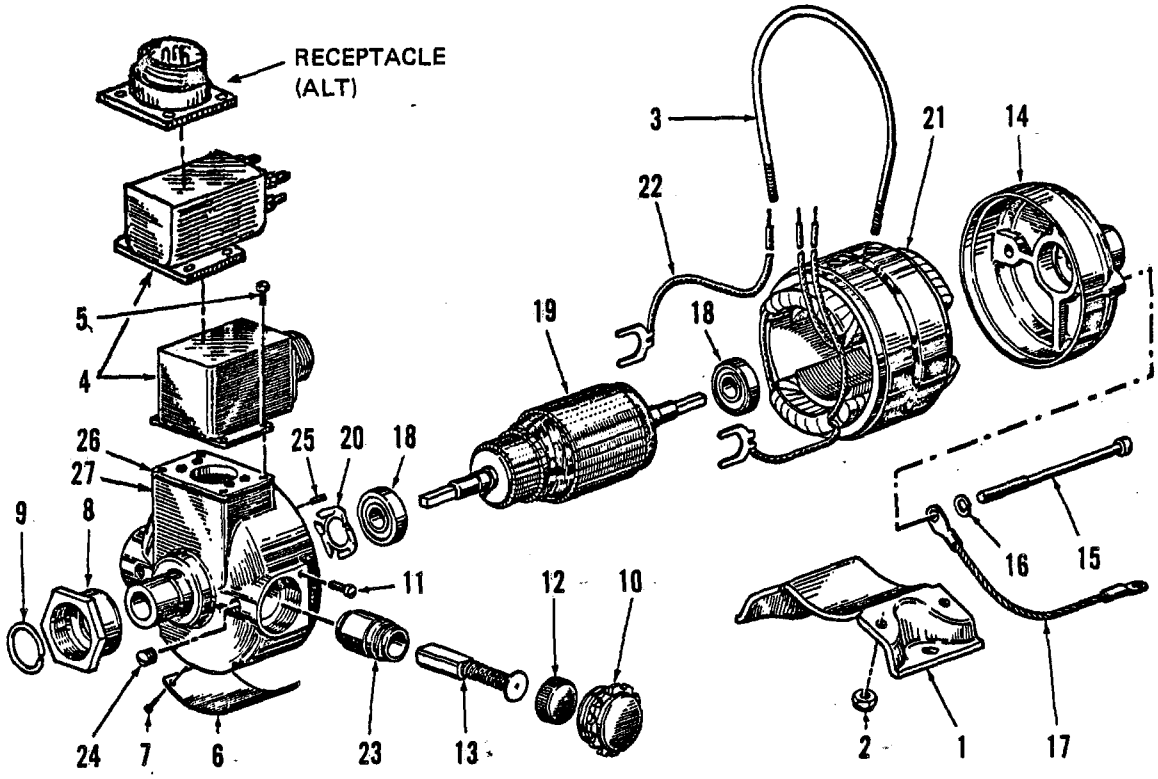
LPW Light Plane Wiper Overhaul Instructions Pages 15 thru 20

TABLE II TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
MOTOR FAILS TO START	a. Defective power supply.	Check power to motor and correct trouble where necessary.
	b. Defective circuit breaker.	Use an ohmmeter and check for continuity through the circuit breaker. Replace if circuit is open.
	c. Field or armature circuit.	Use an ohmmeter and check for open windings or shorted leads.
	d. Assembly too tight	Check for excessive loading on bearings and shaft. Check for misalignment of parts.
	e. Load excessive	Check for correct load.
	f. Improper electrical connection.	Check electric power supply to motor.
	g. Open external circuit.	Check electric power supply to motor.
	h. Faulty internal wiring.	Check field coils for continuity. Make sure brushes move freely in holders and make contact with the commutator. Check armature windings.
NOISY MOTOR	a. Defective motor components.	Check rotor shaft for correct alignment, commutator and bearings for wear. Replace any defective component.
	b. Insulation rubbing.	Check clearance of insulation.
	c. Armature not concentric.	Replace armature.
	d. Bearing faulty.	Replace damaged bearings.

TABLE II TROUBLE SHOOTING (continued)

TROUBLE	PROBABLE CAUSE	REMEDY
CIRCUIT BREAKER FAILS TO DE-ENERGIZE MOTOR	a. Defective circuit breaker.	Replace the circuit breaker.
EXCESSIVE CURRENT CONSUMPTION WHEN MOTOR OPERATES UNDER LOAD AND MOTOR FAILS TO REACH MINIMUM SPEED.	a. Arcing at brush and commutator due to bad brush contact or worn brushes.	Replace brushes. Commutator dirty or glazed causing poor contact with brushes. Clean commutator.
	b. Field strength below normal.	Same reasons indicated above. Also check power supply for correct voltage.
	c. Shorted commutator segments or short in rotor windings.	Check with ohmmeter.
	d. Rough commutator.	Resurface commutator.
	e. Mica insulation too high between commutator segments.	Undercut mica insulation.
	f. Open circuit in armature.	Replace armature.
MOTOR FAILS TO STOP IN "PARK" POSITION	a. Defective parking switch.	Check for closed circuit with control switch in "PARK" position. Replace switch if circuit is open.



1. Mounting Bracket
2. Self-locking Nut
3. "U" Bolt
4. Radio Noise Filter
5. Fillister Head Screw
6. Name Plate
7. Drive Screw
8. Nut
9. Snap Ring
10. Brush Holder Screw Assy
11. Fillister Head Screw
12. Brush Holder Screw
13. Brush and Spring Assy
14. Shaft End Bracket
15. Fillister Head Screw
16. Lock Washer
17. Bonding Jumper Assy
18. Ball Bearing
19. Armature Assy
20. Load Spring
21. Field Assy
22. Lead and Clip Assy
23. Brush Holder Assy
24. Setscrew
25. Pin
26. Adapter Plate
27. Bracket

FIGURE 3 EXPLODED VIEW OF HEAVY DUTY TYPE ELECTRIC MOTOR ASSEMBLY

2. DISASSEMBLY (HEAVY DUTY TYPE)

a. Disassembly is in accordance with the key index number assigned to the exploded view illustration except as noted (see Figure 3).

b. Remove the four nuts (2) and the two "U" bolts (3) freeing the motor mount (1) from the motor assembly.

c. Unscrew and remove the end cap, if the motor is used as a single end drive unit. The cap may be on either end.

d. Using a suitable tool, expand the snap ring (9) and withdraw the nuts (8).

e. If name plate (6) is damaged, remove it by taking out the four screws (7).

f. Remove four screws (5), lift up the receptacle or filter (4) and unsolder the lead wires to effect complete removal. Take out four screws to remove adapter plate if applicable.

g. Remove the two screws (11) and then back off the two brush holder screw assemblies (10). Unscrew the two brush holder screws (12) and lift out the two brush and spring assemblies (13).

NOTE

Mark the position of the brush and spring assembly when removing from the brush holder. This will facilitate reassembly in the proper position if the brush and spring assembly is still usable.

h. Remove the shunt (17) by removing screw (15) and washer (16). Remove the two screws (15) and washers (16). Separate the shaft end bracket (14) from the field assembly (21). Tap lightly around

the periphery of the end bracket with a rawhide mallet to aid in separation of the two parts.

NOTE

Inscribe alignment marks on both the shaft end bracket and field assembly to ensure correct positioning during reassembly.

i. Carefully withdraw the armature assembly (19) with the two ball bearings (18) from the commutator bracket assembly. Remove the bearings from the armature shaft, using a suitable bearing puller. Remove the load spring (20) from the commutator bracket assembly.

j. Withdraw the field assembly (21) from the commutator bracket assembly enough to disengage the lead wire clip from the slot in the brush holder assembly (23) and then lift free. Detach the lead and clip assembly (22) from the other brush holder assembly.

k. Take out the two screws (24) that secure the brush holder assemblies (23). Remove the two brush holder assemblies. Pull out pin (25) from the bracket (26) if damaged.

NOTE

Grounding stud is only used on internally grounded motors.

3. CLEANING

a. Wash all parts in cleaning solvent, Federal Specification P-S-661, except for shunt (17), receptacle or noise filter (4), brush holder screw assembly (10), brush and spring assembly (13), armature assembly (19) and field assembly (21). Dry parts immersed in solvent with dry compressed air.

b. Clean insulated wires and other electrical parts with a clean, lint-free cloth dampened with solvent.

CAUTION

Do not soak electrical parts in cleaning solvent.

4. INSPECTION

a. Inspect the armature shaft to ensure that it is not bent, worn or damaged. Check the shaft dimensions in accordance with Table III. If any of the shaft dimensions are not in accordance with Table III, replace them.

TABLE III ARMATURE SHAFT

INSPECT	DIMENSIONS (inches) Min.	Max.
Length of shaft	6.82812	6.85938
Ends across flats	0.147	0.150
End diagonal	0.194	0.196
Bearing surface diameter	0.3148	0.3151

b. Check commutator for roughness, pitting, scoring or excessive wear. If any of these conditions are apparent, resurface the commutator in accordance with paragraph 6. a.

c. Check brushes for excessive wear, signs of arcing or other damage that might result in motor malfunction. Also check the length of the brushes. When new, the brushes are 13/16 inch long. If the brushes have worn to less than 9/16 inch, they should be replaced. See paragraph 6. d. for brush replacement and run-in procedure.

d. Inspect the load spring for corrosion, distortion or permanent set. Measure the force required to compress the spring to 1/16 inch. This force should be between 3 and 7 pounds. If a greater or lesser force is required, replace the spring.

e. Inspect the brush springs for signs of distortion, permanent set or cracking. Check to ensure that the overall length is not greater than 1 5/32 inches or less than 1 3/32 inches.

f. Check ball bearings with a magnifying glass for balls that are pitted. Also for roughness or any other obvious defects.

g. Check all wiring insulation for soundness. Check for grease or other conditions which may cause failure. Inspect all wiring for conditions which may result in open or short circuits.

h. Inspect all threads for signs of damage. Check the screws for damaged heads.

5. TESTING

a. Using an ohmmeter, check the field winding resistance. Resistance at 24°C (75°F) should be 0.370 ohms. Test for grounded coils. Replace the field windings if the resistance is not 0.370 ohms.

b. Test the armature winding for resistance at 24°C (75°F). Resistance should be 0.105 ohms. Replace the armature if the resistance value is not as mentioned.

6. REPAIR OR REPLACEMENT

a. RESURFACING COMMUTATOR. Before resurfacing commutator, assure that the previous overhaul has not reduced the diameter to the minimum limits of 59/64 inch. Using a suitable tool, take the lightest possible cut until the proper clean-up is accomplished.

b. UNDERCUTTING THE MICA. After the commutator has been turned, undercut the mica insulation between the commutator bars to the width of the mica and a depth of 0.032 inch and approximately 1/2 inch long.

c. POLISHING COMMUTATOR. Smooth and polish the commutator by using a piece of heavy manila paper at a speed of approximately 700 surface feet per minute (1725 RPM).

CAUTION

Do not use sandpaper or emery cloth. Keep the commutator free of oil at all times. Thoroughly clean the commutator of all foreign particles with dry filtered compressed air at low pressure. Do not touch the commutator surface after the final finish is obtained. Finger prints will effect the performance of the electric motor assembly.

d. REPLACING BRUSHES. Replace brushes if they are less than 9/16 inch long. If the commutator has been resurfaced, new brushes installed or old brushes installed in the wrong brush holder, the brushes must be run-in until they are approximately 80 percent seated. To seat brushes, wrap a strip of No. 000 sandpaper around the commutator. Install the brushes so that they ride against the sandpaper, then rotate the commutator in the direction of rotation (counterclockwise when viewed from drive end) by hand until the brushes are properly seated).

CAUTION

After seating brushes, carefully clean the commutator of all carbon particles. In particular, clean out the undercut mica spaces between the commutator segments.

7. LUBRICATION

NOTE

The manufacturer of this equipment recommends that the two ball bearings be lubricated with Dow Corning medium grease DC-44.

8. REASSEMBLY

a. In general, reassembly is in the reverse order of disassembly with the exception of the following points. Reassemble the motor using the exploded view illustration (see Figure 3).

b. Reinstall the receptacle or filter (4) in the same position that it was prior to disassembly. After soldering the lead wires to the receptacle pins, slide protective sleeving over the connections. Refer to Figure 1 for schematic diagram of internal motor wiring.

NOTE

Paint around clip end of brush holder and adjacent parts of the casting with Westinghouse No. 672 red oil-proof enamel, as recommended by the manufacturer of this unit.

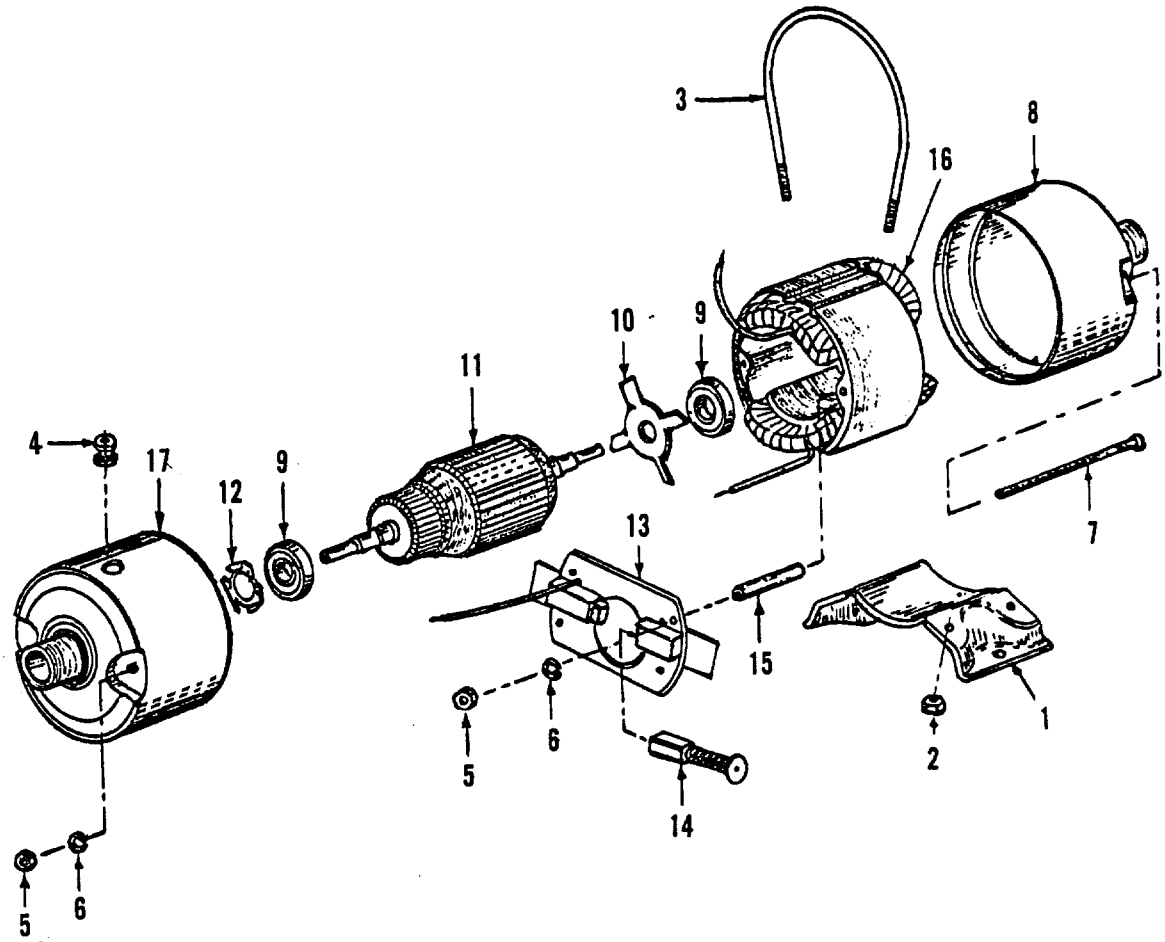
CAUTION

Do not allow paint to run into the clip slots on the brush holder assemblies.

c. Apply one coat of black air-dry paint on any area of the housing from which paint has been chipped.

NOTE

Be careful not to paint the collar portions of the housing adjacent to the ends of the shaft.



1. Mounting Bracket
2. Self Locking Nut
3. "U" Bolt
4. Grommet
5. Hex Nut
6. Lock Washer
7. Washer Head Screw
8. Shaft End Bracket
9. Ball Bearing
10. Fan
11. Armature Assy
12. Load Spring
13. Brush Box & Holder Assy
14. Brush & Spring Assy
15. Spacer
16. Field Assy
17. Comm End Bracket

FIGURE 4 EXPLODED VIEW OF ELECTRIC MOTOR ASSEMBLY

2. DISASSEMBLY (LIGHT PLANE TYPE)

a. Disassembly is in accordance with the key index number assigned to the exploded view illustration except as noted (see Figure 4).

b. Remove the four nuts (2) and the two "U" bolts (3) freeing the motor mount (1) from the motor assembly.

c. Remove the two outer nuts (5) and washers (6). Separate the commutator end bracket (17) from the assembly. Tap lightly around the periphery of the end bracket with a rawhide mallet if the parts do not separate freely. Feed the three lead wires through the grommet (4) to remove commutator end bracket completely. Remove load spring (12) from end bracket.

NOTE

Inscribe alignment marks on brush box and holder assembly, field assembly and shaft end bracket, to ensure correct positioning during re-assembly.

d. Remove the two inner nuts (5) and washers (6). Withdraw the two screws (7) from the brush box and holder assembly (13) from two spacers (15) and from field assembly (16) and shaft end bracket (8).

e. Separate the shaft end bracket (8) from the field assembly (16). Tap lightly around the periphery of the end bracket with a rawhide mallet to aid in the separation of the two parts.

f. Carefully withdraw the field assembly (16) with the brush box and holder assembly (13) and the armature assembly (11) with two ball bearings (9) and fan (10) from the end housing bracket (8).

g. Remove dust cover washer from front ball bearing (9) where applicable.

To remove armature assembly (11) with fan (10) and bearing (9) from the field assembly (16) push the two brushes (14) inside the brush boxes and withdraw the armature assembly from the brush holder assembly and field assembly.

NOTE

Brushes will spring out from the brush boxes after passing over the front bearing.

h. To remove the brush box and holder assembly (13) from the field assembly (16) unsolder the field leads from the holder and slip from the external lead wires.

i. Remove the bearings from the armature shaft, using a suitable bearing puller.

j. Remove the fan (10) from the armature shaft using a suitable gear, or bearing puller.

3. CLEANING

a. Wash all parts in cleaning solvent, Federal Specification P-S-661. except brush box and holder assembly (13), brush and spring assembly (14), armature assembly (11), and field assembly (16). Dry parts immersed in solvent with dry compressed air.

b. Clean insulated wires and other electrical parts with a clean, lint-free cloth dampened with solvent.

CAUTION

Do not soak electrical parts in cleaning solvent.

4. INSPECTION

a. Inspect the armature shaft to ensure that it is not bent, worn or damaged. Check the shaft dimensions in accordance with Table IV. If any of the shaft dimensions are not in accordance with Table IV, replace them.

TABLE IV ARMATURE SHAFT

INSPECT	DIMENSIONS (Inches) Min.	Max.
Length of Shaft (Single end drive)	4.796	4.828
(Double end drive)	5.580	5.595
Bearing Surface Diameter (over serrations)	.255	.257

b. Check commutator for roughness, pitting, scoring or excessive wear. If any of these conditions are apparent, resurface the commutator in accordance with paragraph 6. a.

c. Check brushes for excessive wear, signs of arcing or other damage that might result in motor malfunction. Also check the length of the brushes. When new, the brushes are 1/2 inch long. If the brushes have worn to less than 3/16 inch, they should be replaced. See paragraph 6. d. for brush replacement and run-in procedure.

d. Inspect the load spring for corrosion, distortion or permanent set. Measure the force required to compress the spring to 1/16 inch. This force should be between 3 and 7 pounds. If a greater or lesser force is required, replace the spring.

e. Inspect the brush springs for signs of distortion, permanent set or cracking. The brushes used in this motor are part of the field assembly, and the only way that replacement can be accomplished is by complete disassembly of the motor and partial destruction of the brush holder assembly.

f. Check ball bearings with a magnifying glass for balls that are pitted. Also for roughness or any other obvious defects.

g. Check all wiring insulation for soundness. Check for grease or other conditions which may cause failure. Inspect all wiring for conditions which may result in open or short circuits.

h. Inspect insulation strips attached to brush box and holder assembly.

i. Inspect threads for signs of damage. Check the screws for damaged heads.

5. TESTING

a. Using an ohmmeter, check the field resistance. Resistance at 24°C (75°F) should be 12V - .208 - 24V - .722 ohms. Test for grounded coils. Replace the field assembly if the resistance is not as mentioned.

b. Test the armature winding for resistance. Resistance at 24°C (75°F) should be 12V - .092 - 24V - .289 ohms. Replace the armature if the resistance value is not as mentioned.

6. REPAIR OR REPLACEMENT

a. Resurfacing Commutator

Before resurfacing commutator, assume that the previous overhaul has not reduced the diameter to the minimum limits of 11/16 inch. Using a suitable tool, take the lightest possible cut until the proper cleanup is accomplished.

b. Undercutting the Mica

After the commutator has been turned, undercut the mica insulation between the commutator bars to the width of the mica and a depth of 0.032 inch and approximately 11/32 inch long.

c. Polishing Commutator

Smooth the polish the commutator by using a piece of heavy manila paper at a speed of approximately 700 surface feet per minute (3600 RPM).

CAUTION

Do not use sandpaper or emery cloth. Keep the commutator free from oil at all times. Thoroughly clean the commutator of all foreign particles with dry filtered compressed air at low pressure. Do not touch the commutator surface after the final finish is obtained. Finger prints will effect the performance of the electric motor assembly.

d. Replacing Brushes

Replace brushes if they are less than 3/16 inch long. If the commutator has been resurfaced, new brushes installed or old brushes installed in the wrong brush box, the brushes must be run-in until they are approximately 80 percent seated. To seat brushes wrap a strip of No. 000 sandpaper around the commutator. Install the commutator in the direction of rotation (clockwise when viewed from commutator end) by hand until the brushes are properly seated.

CAUTION

After seating the brushes, carefully clean the commutator of all carbon particles. In particular, clean out the undercut mica spaces between the commutator segments.

7. LUBRICATION

NOTE

The manufacturer of this equipment recommends that the two ball bearings

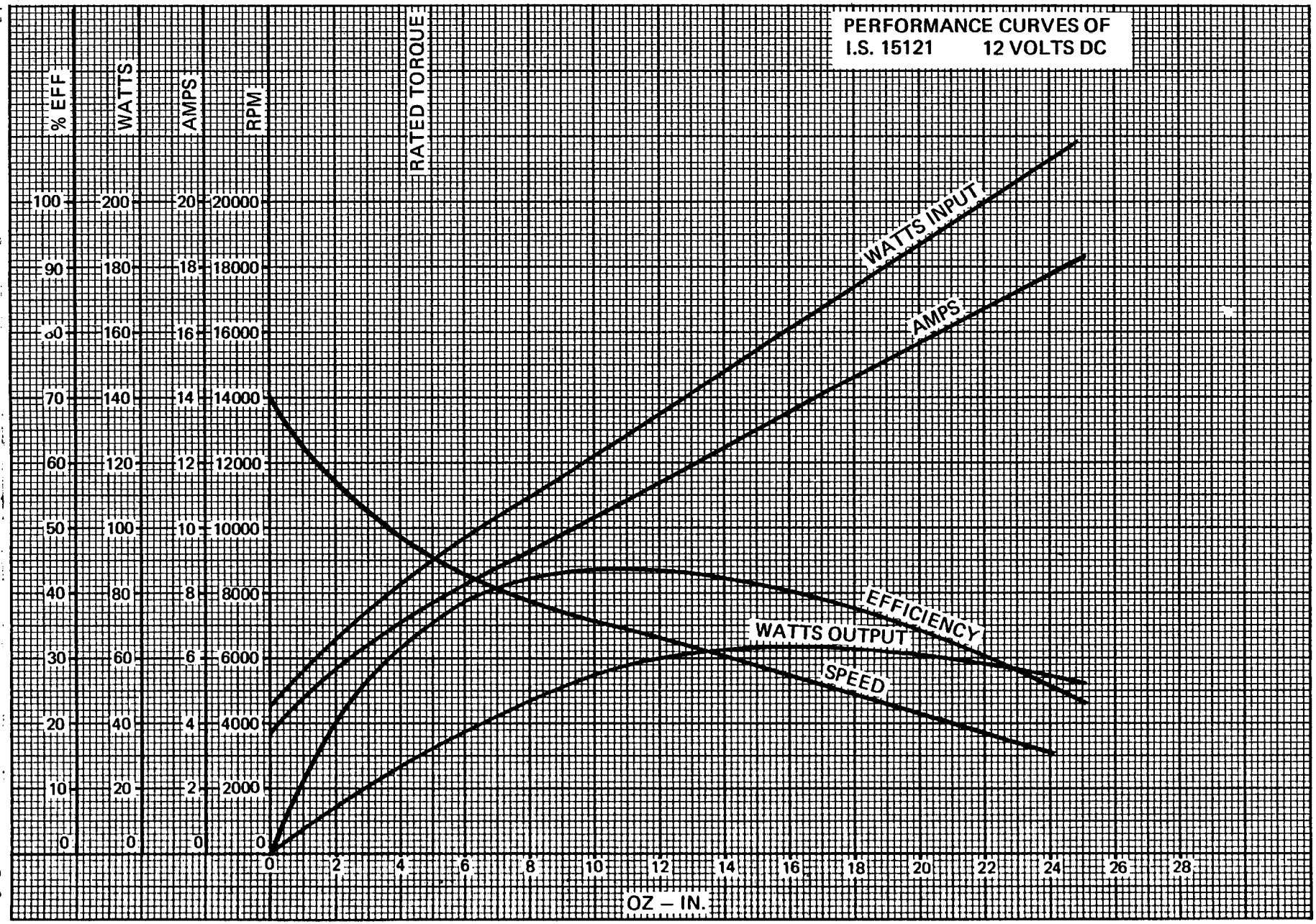
be lubricated with Dow Corning medium grease DC-44.

8. REASSEMBLY

a. In general, reassembly is in the reverse order of disassembly with the exception of the following points. Reassemble the motor using the exploded view illustration (see Figure 4) up to the point of installing the inner two lockwashers and two nuts.

b. Thread the three lead wires through the commutator end bracket and grommet, before slipping the commutator end bracket over the brush boxes making sure that the insulation strips are folded over the top of the brush boxes, now push the two brackets together and complete the assembly.

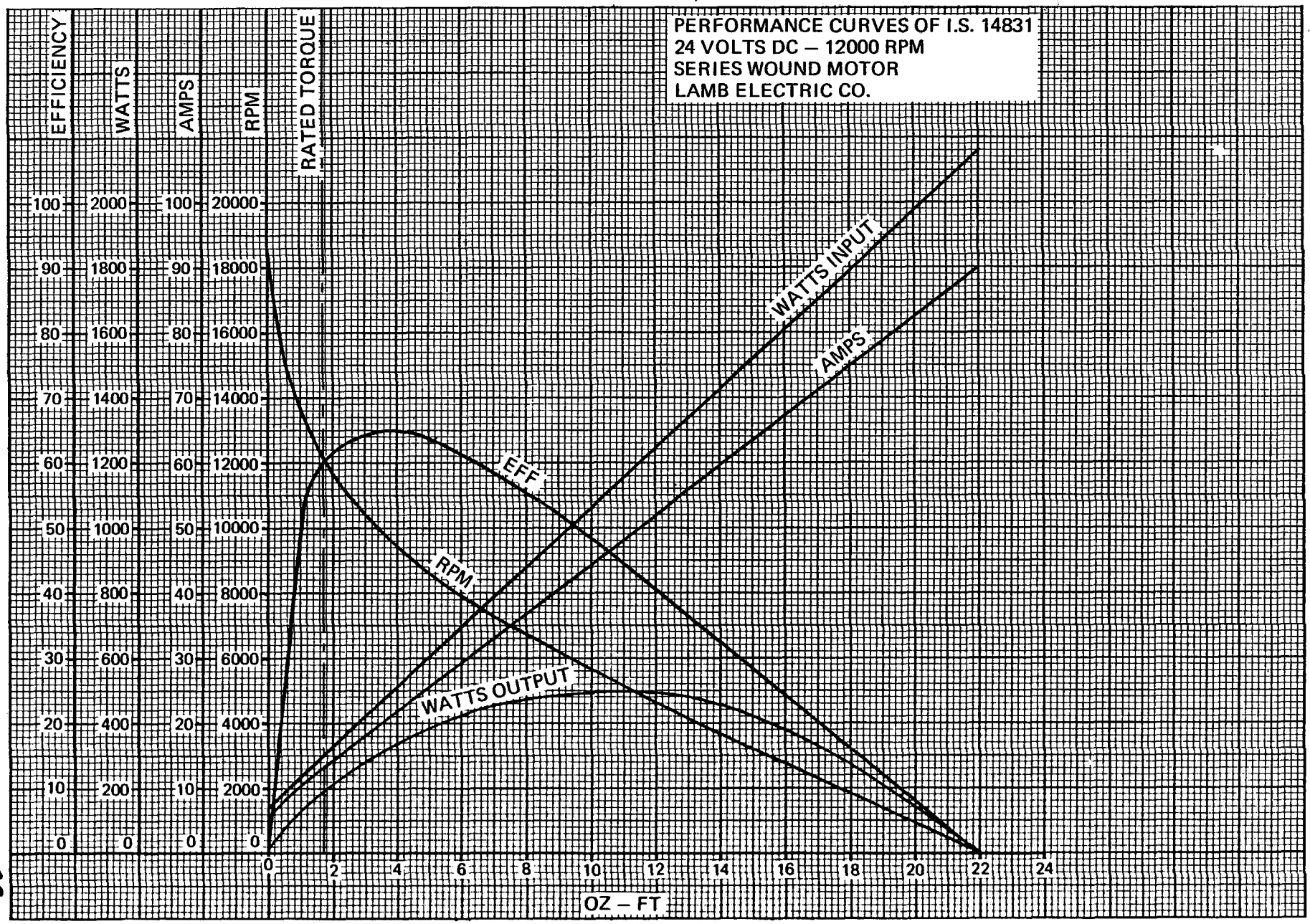
1/12 H.P. – SINGLE END C2-01325



I.S. 15121

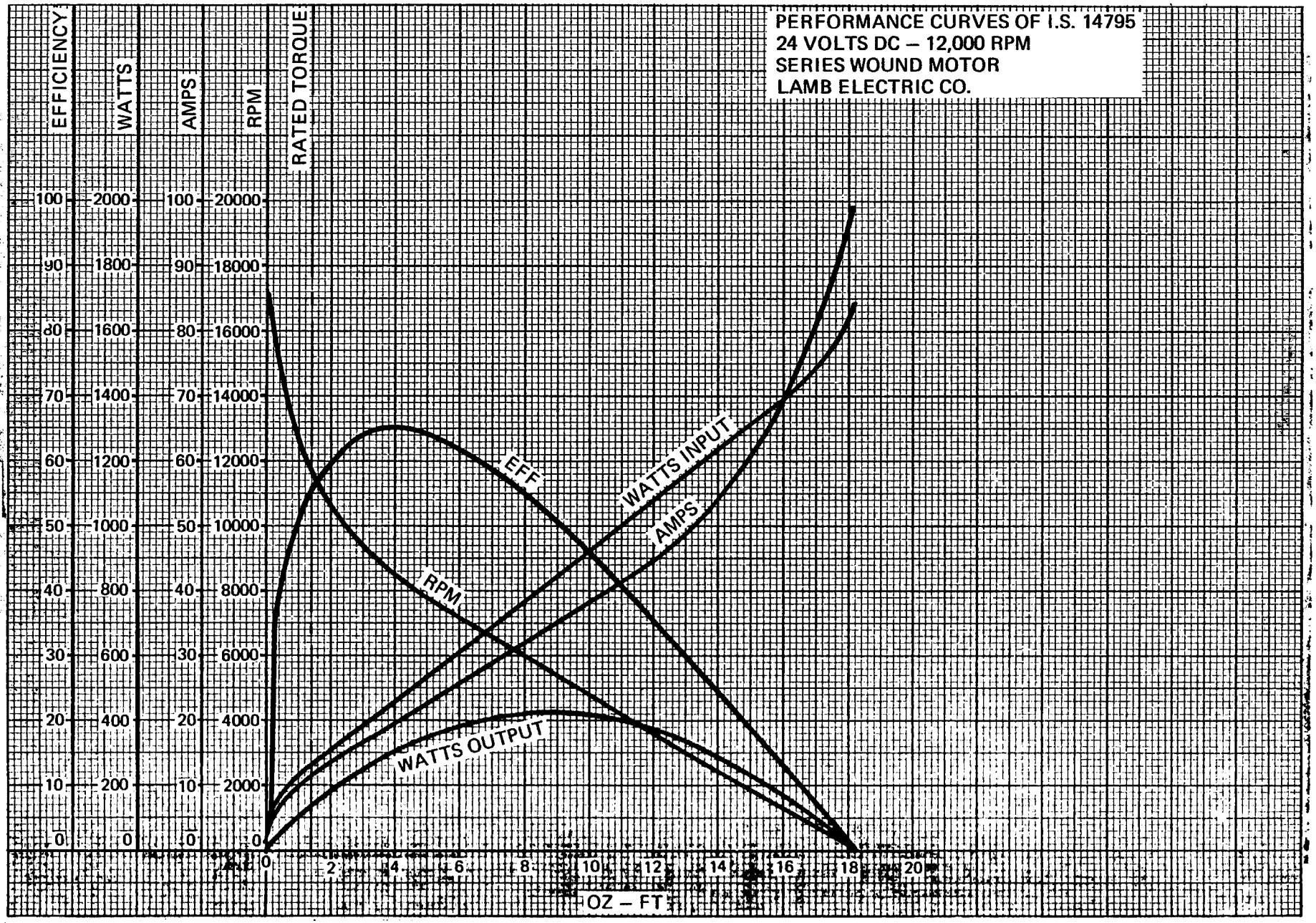
CURVE NO. 116

1/4 H.P. – C2-81134-1, C2-81253-1



CURVE NO. 151

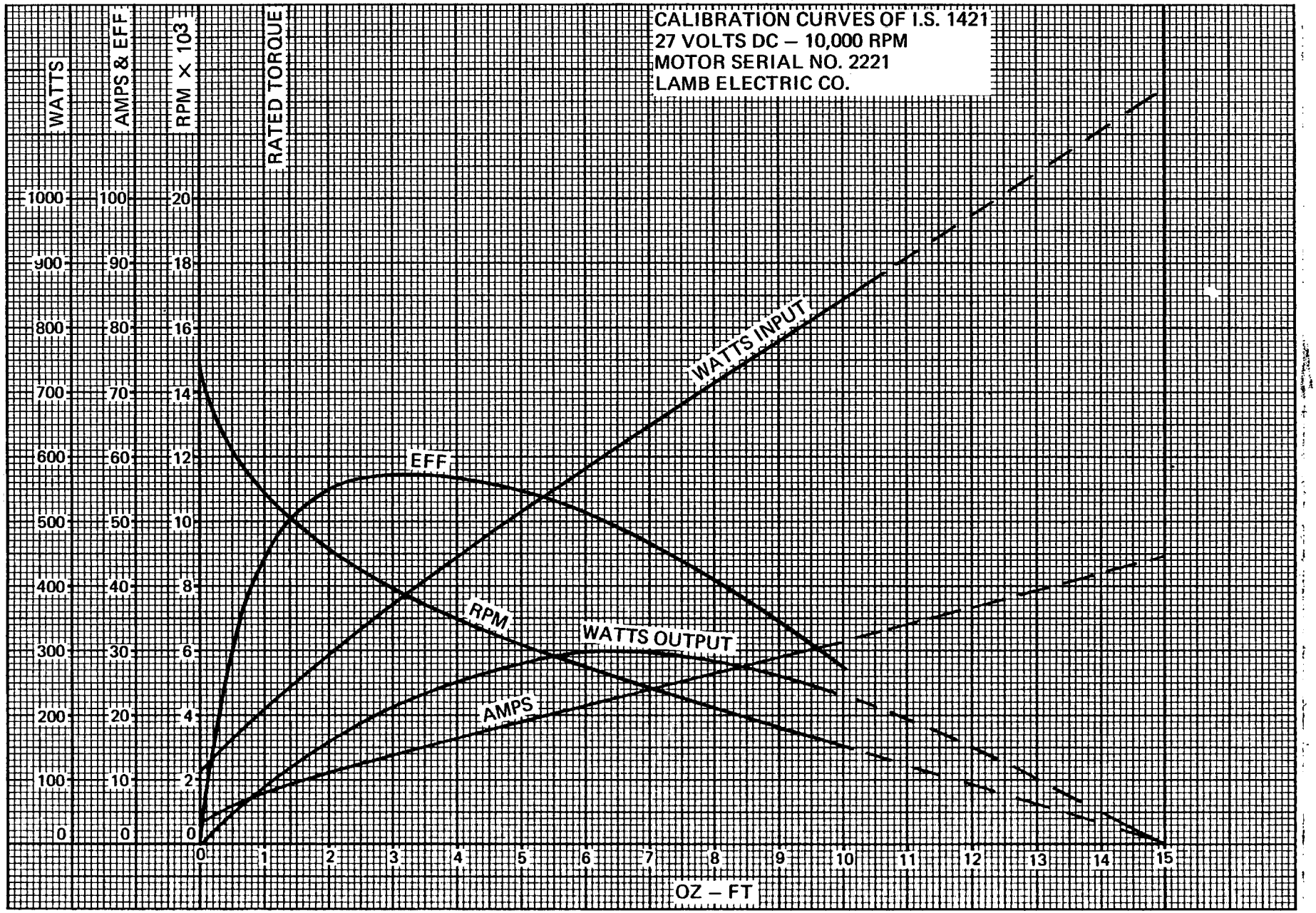
1/5 H.P. – C2-89049, C2-01168



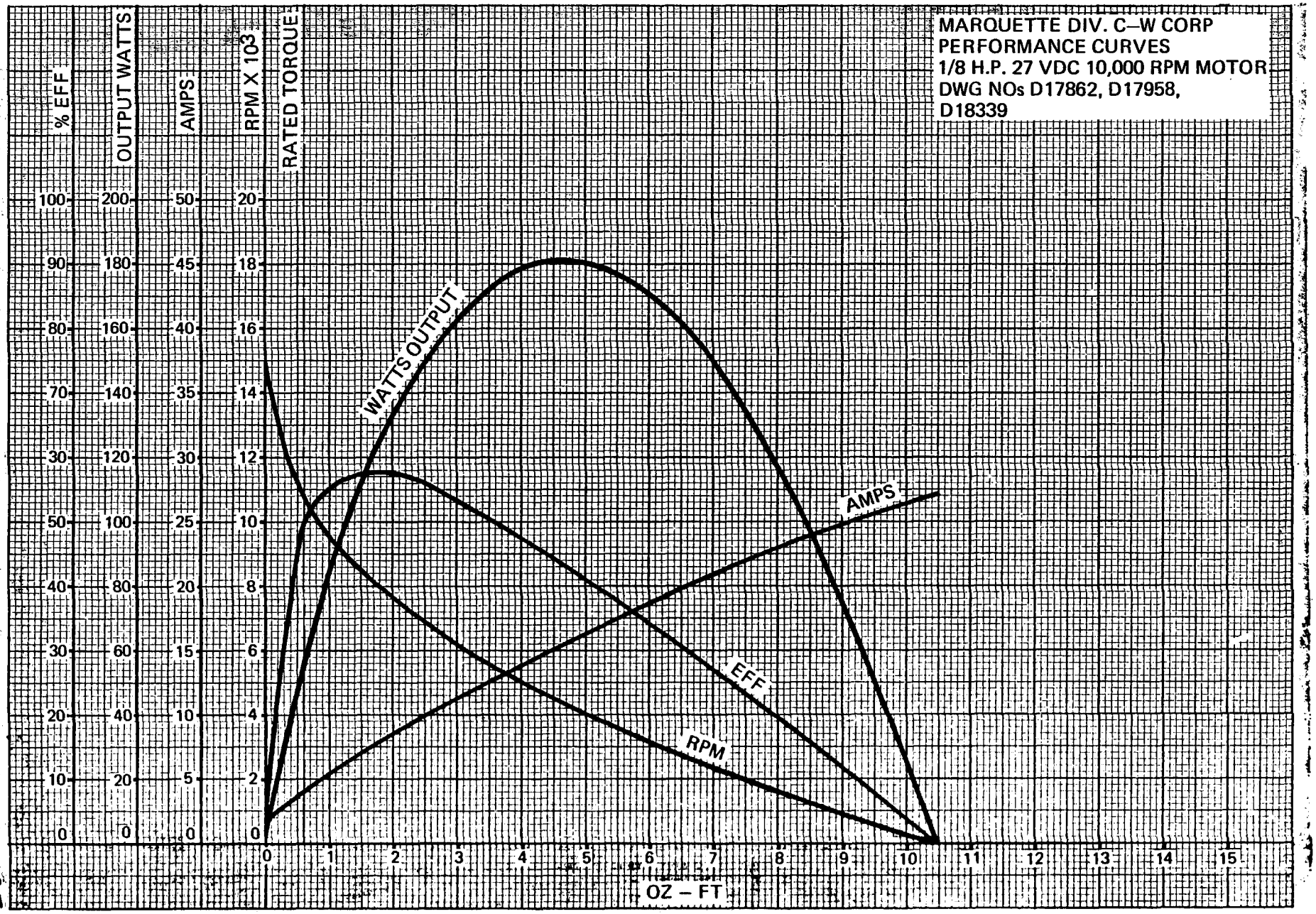
RATED 1.4 OZ-FT

CURVE NO. 40

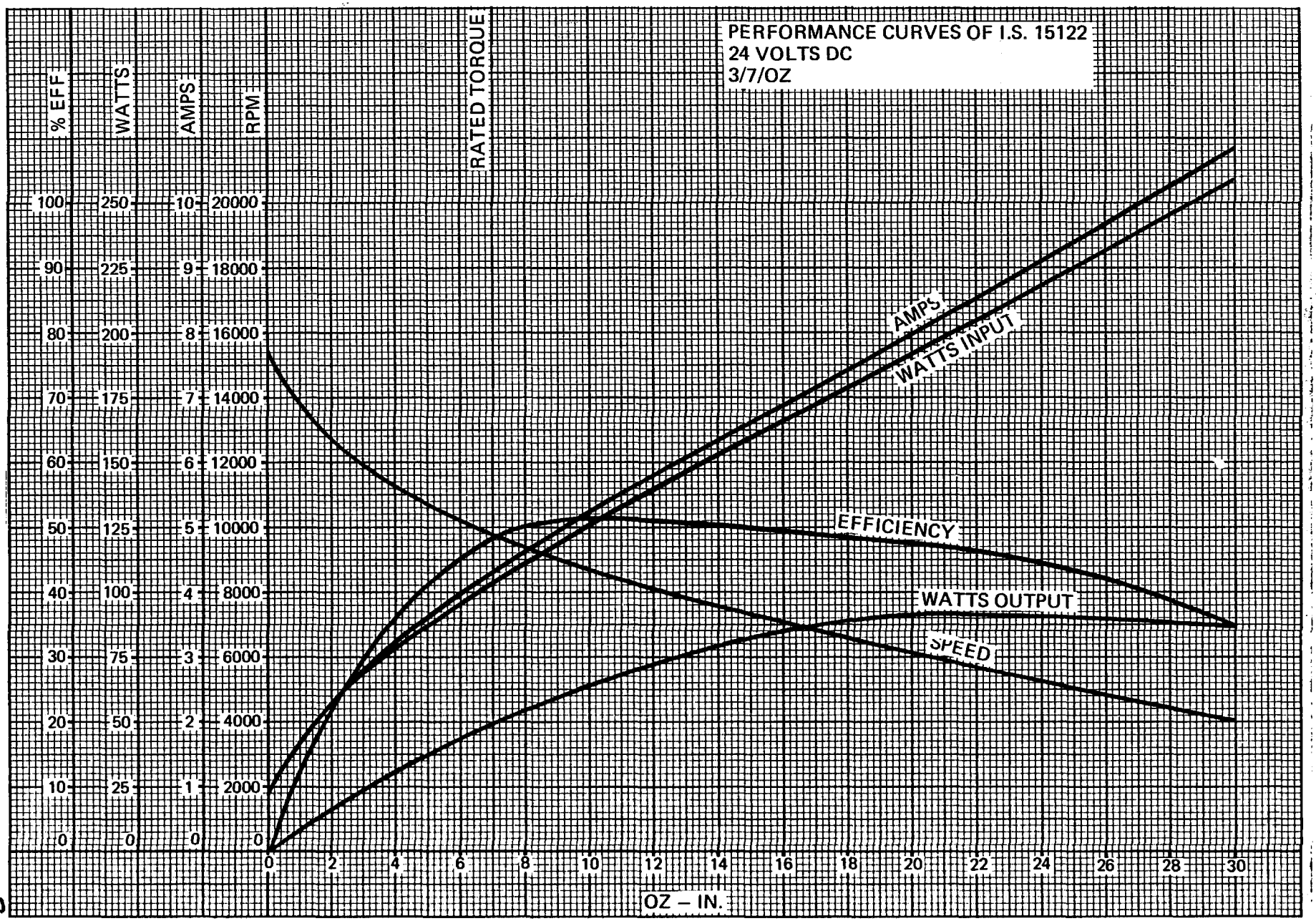
1/6 H.P. – C2-87193, C2-87461 & -1, C2-87702, C2-88323



RATED 1.4 OZ-FT

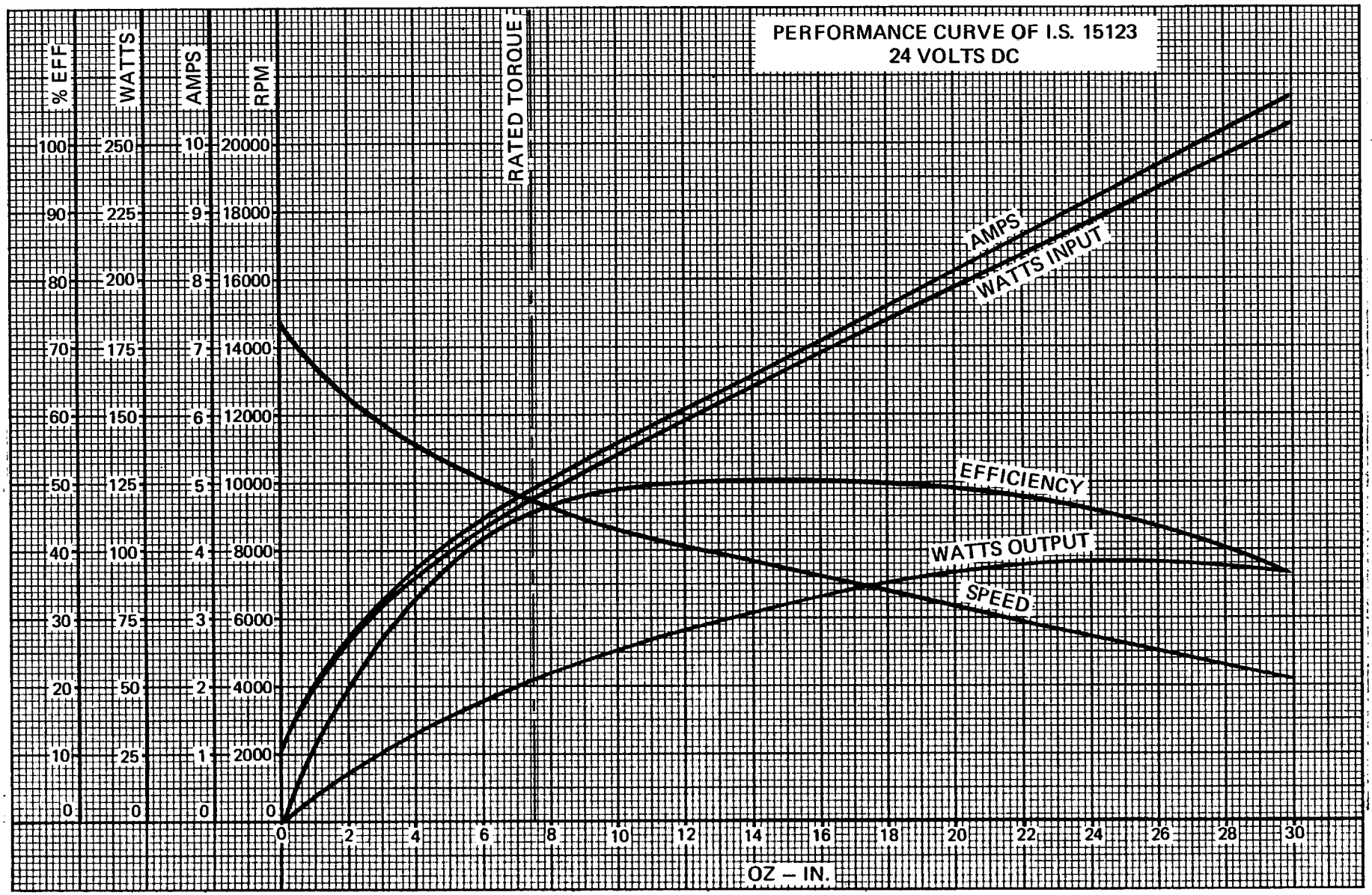

MARQUETTE DIV. C–W CORP
PERFORMANCE CURVES
1/8 H.P. 27 VDC 10,000 RPM MOTOR
DWG NOs D17862, D17958,
D18339
% EFF
OUTPUT WATTS
AMPS
RPM X 10³
RATED TORQUE
WATTS OUTPUT
AMPS
EFF
RPM
OZ – FT

1/10 H.P. – DOUBLE END C2-01326



I.S. 15122

1/12 H.P. – SINGLE END C2-01327



I.S. - 15123

PART BREAKDOWN
ELECTRIC MOTOR 1/6 H.P. 27 V.D.C.

MOTOR	14-97167-01&UP	14-97457-00	14-97663-00	14-97700-00	14-98052-00	14-98233-00	14-98324-01&UP	14-98763-00	14-98894-0
ASSY.	C2-97167	C2-97457	C2-97663	C 2-97700	C2-98052	C2-98233	C2-98324	C2-98763	C2-98894
CODE	A	B	C	D	E	F	G	H	I

INDEX NO.	PART NO.	NOMENCLATURE	UNITS PER ASSY.	CODE
	(C2-87193			
	(14-87193-00	Motor & Receptacle Assy.	1	A
	C2-87461	" " "	1	B,C,E
	C2-87702	" " "	1	D
	C2-88323	" Filter "	1	F,G,I
	C2-88788	" " "	1	H
1		Mounting Bracket		
2		Nut, Self Locking (AN 364-1032)		
3		"U" Bolt		
4	A2-19048	Radio Noise Filter	1	F,G,I
4	B2-18086	Radio Noise Filter	1	H
4	AN 3102-14S-9P	Receptacle	1	A,D
4	AN 3102-14S-7P	Receptacle	1	B,C,E
5	91-33298-00	Fill. Hd. Screw (20-7828)	8	A,B,C,D,E
5	91-33298-00	Fill. Hd. Screw (20-7828)	4	F,G,H,I
6	B2-17893	Name Plate	1	A,B,C,D,E,F,G,H,I
7	91-25805-00	Drive Screw (AN 535-0-3)	4	A,B,C,D,E,F,G,H,I
8	A2-16925	Nut	2	A,B,C,E,F,G,H,I
8	A2-16925	Nut	1	D
9	A2-16927	Snap Ring	2	A,B,C,E,F,G,H,I
10	14-89250-00	Brush Holder Screw Assy. (34023A)	2	A,B,C,D,E,F,G,H,I
11	14-19243-00	Fill. Hd. Screw (60-7835)	2	A,B,C,D,E,F,G,H,I
12	14-19244-00	Brush Holder Screw (10-7991)	2	A,B,C,D,E,F,G,H,I
13	14-89252-00	Brush & Spring Assy. (35130-A)	2	A,B,C,D,E,F,G,H,I
14	14-19241-00	Shaft End Bracket (0-6986)	1	A,B,C,E,F,G,H,I
14	A 17824	Shaft End Bracket (0-6986)	1	D
15	91-33299-00	Fill. Hd. Screw (50-7828)	2	A,B C,D,E,F,G,H,I
16	91-34018-00	Lock Washer (7817)	2	A,B,C,D,E,F,G,H,I
17	91-80001-00	Bonding Jumper Assy. (AN 749-2-6)	1	F,G,H,I
17	91-80013-00	" " " (AN 749-2-4)	1	A,D
18	14-19242-00	Ball Bearing (30-7616)	2	A,B,C,D,E,F,G,H,I
19	14-89248-00	Armature Assy. (32578-A)	1	A,B,C,D,E,F,G,H,I
20	14-19254-00	Load Spring (3503)	1	A,B,C,D,E,F,G,H,I

PAR BREAKDOWN
ELECTRIC MOTOR 1/6 H.P. 27 V.D.C.

MOTOR ASSY.	14-97167-01&Up C2-97167	14-97457-00 C2-97457	14-97663-00 C2-97663	14-97700-00 C2-97700	14-98052-00 C2-98052	14-98233-00 C2-98233	14-98324-01&Up C2-98324	14-98763-00 C2-98763	14-98894-0(C2-98894
CODE	A	B	C	D	E	F	G	H	I

INDEX NO.	PART NO.	NOMENCLATURE	UNITS PER ASSY.	CODE
21	14-89247-00	Field Assy. (27468-A)	1	A,B,C,D,E,F,G,H,I
22	14-89253-00	Lead & Clip Assy. (39162)	1	B,C,D,E,F,G,H,I
22	14-89306-00	Lead & Clip Assy. (39164)	1	A
23	14-89224-00	Brush Holder Assy. (33093-A)	1	A
23	14-89224-00	" " " "	2	B,C,D,E,F,G,H,I
23	14-89305-00	" " " (33225-A)	1	A
24	91-33741-00	Set Screw (7978)	2	A,B,C,D,E,F,G,H,I
25		Pin (8272)		
26	14-19237-00	Adapter Plate (20-4279)	1	A,B,C,D,E
27	14-89246-00	Bracket Comm. Assy. (22325-A)	1	B,C,D,E,F,G,H,I
27	14-89245-00	Bracket Comm. Assy. (22244-A)	1	A

PARTS BRE OWN
ELECTRIC MOTOR 1/4 H.P. 24 V.D.C.
1/5 H.P. 24 V.D.C.

MOTOR ASSY.	14-91186-01 C2-91186-1	14-91254-01 C2-91254-1	14-98049-01 & UP C2-98049-1	14-99044-01 & UP C2-99044-1 & UP
CODE	A	B	C	D

INDEX NO.	PART NO.	NOMENCLATURE	UNITS PER ASSY.	CODE
	C2-81134-1	Motor & Filter Assy.	1	A
	C2-81253-1	Motor & Filter Assy.	1	B
	C2-88216	Motor & Filter Assy.	1	C
	C2-89049	Motor & Filter Assy.	1	D
1		Mounting Bracket		
2		Nut, Self Locking (AN 364-832)		
3		"U" Bolt		
4	B2-18086-2	Radio Noise Filter	1	A
4	A2-19048	Radio Noise Filter	1	B,D
4	B-18086	Radio Noise Filter	1	C
5	91-33298-00	Fill. Hd. Screw (20-7828)	4	A,B,C,D
6	B2-17893	Name Plate	1	A,B,C,D
7	91-25805-00	Drive Screw (AN 535-0-3)	4	A,B,C,D
8	A2-16925	Nut	2	A,B,C D
9	A2-16927	Snap Ring	2	A,B,C,D
10	14-89250-00	Brush Holder Screw Assy. (34023A)	2	A,B,C,D
11	14-19243-00	Fill. Hd. Screw (60-7835)	2	A,B,C,D
12	14-19244-00	Brush Holder Screw (10-7991)	2	A,B,C,D
13	14-89252-00	Brush & Spring Assy. (35130-A)	2	A,B,C,D
14	14-19241-00	Shaft End Bracket (0-6986)	1	A,B,C,D
15	91-33299-00	Fill. Hd. Screw (50-7828)	2	A,B,C,D
16	91-34018-00	Lock Washer (7817)	2	A,B,C,D
17	91-80001-00	Bonding Jumper Assy. (AN 749-2-6)	1	A,B,C,D
18	14-19242-00	Ball Bearing (30-7616)	2	A,B,C,D
19	14-89248-00	Armature Assy. (32578A)	1	A,B,C,D
20	14-19254-00	Load Spring (3503)	1	A,B,C,D
21	14-89307-00	Field Assy. (27655)	1	A,B
21	14-89308-00	Field Assy. (IS 14746F)	1	C
21	14-89309-00	Field Assy. (IS 14795F)	1	D
22	14-89253-00	Lead & Clip Assy. (39162-A)	1	A,B,C,D

PARTS BREAKDOWN
ELECTRIC MOTOR 1/4 H.P. 24 V.D.C.
1/5 H.P. 24 V.D.C.

MOTOR	14-91186-01	14-91254-01	14-98049-01 & UP	14-99044-01 & UP
ASSY.	C2-91186-1	C2-91254-1	C2-98049-1	C2-99044-1 & UP
CODE				

INDEX NO.	PART NO.	NOMENCLATURE	UNITS PER ASSY.	CODE
23	14-89249-00	Brush Holder Assy. (33093A)	2	A,B,C,D
24	91-33741-00	Set Screw (7978)	2	A,B,C,D
25		Pin		
26		Adapter Plate		
27	14-89246-00	Bracket Comm. Assy. (22325A)	1	A,B,C,D

PART BREAKDOWN

ELECTRIC MOTOR 1/8 H.P. 27 V.D.C.

MOTOR	14-97862-01&UP	14-97958-01&UP	14-98339-00	14-98492-01&UP	14-98890-01&UP	14-99068-00
ASSY.	C2-97862	C2-97958	C2-98339	C2-98492	C2-98890	C2-99068
CODE	A	B	C	D	E	F

INDEX NO.	PART NO.	NOMENCLATURE	UNITS PER ASSY.	CODE
	C2-87864	Motor & Filter Assy.	1	A,E,F
	C2-87962	Motor & Filter Assy.	1	B
	C2-88338	Motor & Filter Assy.	1	C
	C2-88494	Motor & Filter Assy.	1	D
1		Mounting Bracket		
2		Nut, Self Locking		
3		"U"Bolt		
4	B2-18278	Radio Noise Filter	1	A,E,F
4	B2-18085	Radio Noise Filter	1	B
4	B2-18328	Radio Noise Filter	1	C
4	B2-18487	Radio Noise Filter	1	D
5	91-33298-00	Fill. Hd. Screw (20-7828)	4	A,B,C,D,E,F
6	B2-17893	Name Plate	1	A,B.C,D,E,F
7	91-25803-00	Drive Screw (AN 535-0-2)	4	A,B,C,D,E,F
8		Nut		
9		Snap Ring		
10	14-89251-00	Brush Holder Screw Assy. (34027A)	2	A,B,C,D,E,F
11	14-19243-00	Fill. Hd. Screw (60-7835)	2	A,B,C,D,E,F
12	14-19310-00	Brush Holder Screw (5735)	2	A,B,C,D,E,F
13	14-89311-00	Brush & Spring Assy. (35153A)	2	A,B,C,D,E,F
14	14-19312-00	Shaft End Bracket (22320A)	1	A,B,C,D,E,F
15	91-33300-00	Fill. Hd. Screw (50-7836)	2	A,B,C,D,E,F
16		Lock Washer		
17	91-80013-00	Bonding Jumper Assy. (39174A)	1	A,B,C,D,E,F
18	14-19313-00	Ball Bearing (20-7608)	1	A,B,C,D,E,F
18	14-19314-00	Ball Bearing (30-7623)	1	A,B,C,D,E,F
19	14-89315-00	Armature Assy. (32660A)	1	A,B,C,D,E,F
20		Load Spring		
21	14-89316-00	Field Assy. (27539A)	1	A,B,C,D,E,F
22	14-89306-00	Lead & Clip Assy. (39164-A)	1	B,C
23	14-89317-00	Brush Holder Assy. (33162-A)	2	A,B,C,D,E,F
24	91-33741-00	Set Screw (7978)	2	A,B,C,D,E,F
25		Pin		
26		Adapter Plate		
27	14-89318-00	Bracket Assy. Comm. End. (22318A)	1	A,B,C,D,E,F

PARTS BREAKDOW 2 SPEED
ELECTRIC MOTOR 1/8 H.P. 27 V.D.C.
1/6 H.P. 27 V.D.C.

MOTOR ASSY.	14-98428-01 & UP C2-98428	14-99148-00 C2-99148	14-95277-00 C2-95277
CODE	A	B	C

INDEX NO.	PART NO.	NOMENCLATURE	UNITS PER ASSY.	CODE
	C2-88427	Motor & Receptacle Assy.	1	A,B,C
1		Mounting (Bracket) Base		
2		Nut, Self Locking (AN 364-1032)		
3		"U" Bolt		
4	91-80025-00	Receptacle (2779)	1	A,B,C
5	91-33298-00	Fill Hd. Screw (20-7828)	4	A,B,C
6	B2-17893	Name Plate	1	A,B,C
7	91-25805-00	Drive Screw (AN 535-0-3)	4	A,B,C
8	A 16925	Nut	2	A,B,C
9	A 16927	Snap Ring	2	A,B,C
10	14-89250-00	Brush Holder Screw Assy. (34023A)	2	A,B,C
11	14-19243-00	Fill. Hd. Screw (60-7835)	2	A,B,C
12	14-19244-00	Brush Holder Screw (10-7991)	2	A,B,C
13	14-89252-00	Brush & Spring Assy. (35130A)	2	A,B,C
14	14-19319-00	Shaft End Bracket (10-6642)	1	A,B,C
15	91-33299-00	Fill. Hd. Screw (50-7828)	2	A,B,C
16	91-34018-00	Lock Washer (7817)	2	A,B,C
17		Bonding Jumper Assy.		
18	14-19242-00	Ball Bearing (30-7616)	2	A,B,C
19	14-89320-00	Armature Assembly (32693-A)	1	A,B,C
20	14-19254-00	Load Spring (3503)	1	A,B,C
21	14-89321-00	Field Assembly (27571-A)	1	A,B,C
22	14-89322-00	Lead & Clip Assy. (39077A)	1	A,B,C
23	14-89249-00	Brush Holder Assy. (33093A)	1	A,B,C
23	14-19240-00	Brush Holder Assy. (0-5517)	1	A,B,C
24	91-33741-00	Set Screw (7978)	2	A,B,C
25		Pin		
26		Adapter Plate		
27	14-89323-00	Bracket Comm. End. (22350A)	1	A,B,C

GEI-86820A

INSTRUCTIONS

"Regulations of the U. S. Department of Commerce prohibit the re-exportation of this technical data to Albania, Bulgaria, Communist China, the Communist controlled area of Vietnam, Cuba, Czechoslovakia, East Germany, Estonia, Hungary, Latvia, Lithuania, North Korea, Outer Mongolia, Poland, Rumania and the U.S.S.R."

TEMPERATURE CONTROLLER

3S2060DM109A1 AND A2

GENERAL ELECTRIC

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Fig. 2 Assembled View of 3S2060DM109A2 Temperature Controller.
Fig. 3 Outline Diagram of 3S2060DM109A1 Temperature Controller.
Fig. 4 Outline Diagram of 3S2060DM109A2 Temperature Controller.
Fig. 5 Interconnection Diagram for 3S2060DM109A1 and A2 Temperature Controller For DC Installation
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Fig. 7 Elementary Diagram of 3S2060DM109A1 and A2 Temperature Controller.
Fig. 8 Connection Diagram of the 3S2060DM109A1 Temperature Controller.
Fig. 9 Connection Diagram of the 3S2060DM109A2 Temperature Controller.

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation and maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

3S2060DM109A1 AND A2

TEMPERATURE CONTROLLER

INTRODUCTION

These instructions cover the Operation and Service for the 3S2060DM109A1 and A2 Temperature Controller shown in Fig. 1 and 2.

These controllers are used with a specially constructed windshield having a temperature sensitive resistance imbedded in the windshield as well as heating elements or a special conductive coating in the windshield which offers resistance to the flow of current, thereby heating up when supplied with power.

The controllers are "fail safe" for failures consisting of disconnecting or burning out of the temperature sensor, or loss of power to the controller. In these cases, the pilot relay will drop out, preventing the windshield from overheating.

The A2 differs from the A1 in that the housing is different and the A2 has the Zener Diode and resistor R12 mounted on the cover (heat sink) where the A1 has them mounted on the component assembly board. See outline and connection diagrams Figs. 3, 4, 8 and 9. The two models are electrically the same.

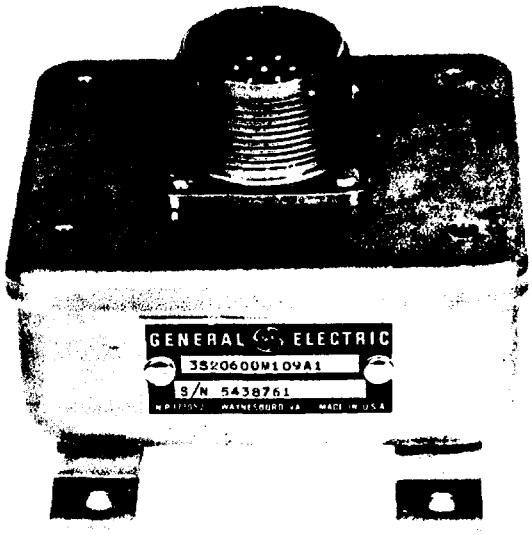


Fig. 1 Assembled View of 3S2060DM109A1 Temperature Controller (6025-349).

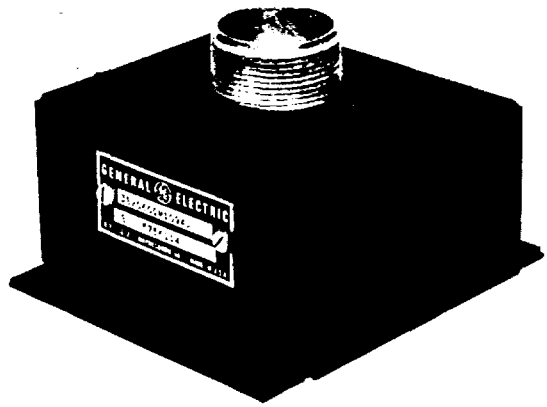


Fig. 2 Assembled View of 3S2060DM109A2 Temperature Controller (SCWP62-180).

LEADING PARTICULARS

Model 3S2060DM109A1

1. Weight ..... 0.80 pounds max.
2. Length ..... 3.70 inches
3. Width ..... 3.55 inches
4. Height ..... 2.85 inches
5. Power Dissipation ..... 7.5 watts
6. Input voltage ..... 22-29 volts, DC
7. Output ..... 0.5 amperes to coil of K1 whose contacts are rated 2 amperes at 115 volts, 400 CPS
8. Ambient Temperature ..... -65°F to +160°F (-55°C to +71°C)
9. Shock ..... 15g's

The A2 leading particulars are the same except the length is approximately 4 inches and the height is approximately 2.5 inches.

INSTALLATION

MOUNTING

The A1 controller has two brackets attached to the base with rivets. Each bracket has two 0.185 inch diameter mounting holes, four holes in all, to accommodate #8 bolts.

The A2 model has two mounting holes in a flange on either side of the cover. These flanges are formed with the cover.

These controllers may be mounted in any position, taking into consideration that:

1. Space must be allowed for making connections to AN connector MS3102A-20-27P.
2. Temperature adjustments are made through the front side of the drawn aluminum housing on the A1 model and through the top cover on the A2 model.
3. The temperature setting is made at the factory before the unit is shipped, so no readjustment should be required. The factory temperature setting is approximately 100°F (38°C). If adjustment is required, see "Adjustment Procedure".

CONNECTIONS

CAUTION

Due to the high sensitivity of this unit, excessive ripple on the DC input from a poorly filtered ground power supply may cause the controller to turn on and fail to turn off. The aircraft battery should always be used to help filter the DC bus.

Electrical connections to the temperature controller are made through connector AN3102A-20-27P on the controller.

Electrical connections to the power supply, sensor in the windshield, and the windshield power contactor should be made in accordance with the interconnection diagrams, Figs. 5 and 6.

CAUTION

When 100 volts, 400 CPS is used to power the heating elements in the windshield, make sure the AC connections are properly shielded and the shielding grounded to prevent interference with electrical instruments on the pilot's instrument panel.

Use proper wire size for connections as called out on interconnection diagrams, Figs. 5 and 6.

This controller weighs a maximum of 0.8 pounds and will not appreciably affect the weight and balance of the aircraft.

CAUTION

All wiring should be checked before the system is energized because any error in connection will damage the controller.

DESCRIPTION

GENERAL

The temperature controller is a transistorized amplifier which compares the resistance of a sensor imbedded in the windshield with a preselected resistance value. If the resistance of the sensor is less than the preselected value, (as in the case of a cold windshield), the pilot relay K1 picks up. The pilot relay controls a contactor (external to the controller) which in turn applies power to the windshield. As the windshield heats up, the resistance of the sensor increases until such time as it is slightly higher than the preset resistance value. The pilot relay then drops out and the contactor disconnects power to the windshield.

The controller has an adjusting potentiometer R14 which allows the selection of the desired operating temperature of the windshield. In order to prevent the contactor from cycling power on and off at rapid rates, especially in cold temperatures, the controller allows the windshield temperature to vary above and below the selected windshield temperature by 10°F (6°C). This means that if a temperature of 100°F (37°C) were selected, the vinyl layer of the windshield would vary from 90°F (32°C) to 110°F (43°C).

A narrower temperature band can be provided if required for a particular windshield installation. Although the controller will operate continuously over an ambient range of -65°F to +160°F (-55°C to +71°C), better control of the windshield temperature can be achieved by mounting the controller in an area of fairly constant temperature. This will minimize drift in nominal temperature of the windshield.

As soon as the heat control switch is placed in the ON position, the temperature controller senses the windshield temperature. If windshield temperature is not within 100 ± 10°F (38 ± 6°C), relay K1, whose contacts are in series with the power supply and the heating elements, will close. This supplies power to the heating element in the windshield, causing the windshield to heat up.

When the temperature of the windshield rises to the upper limit of 100 ± 10°F (38 ± 6°C), relay K1 will deenergize and power will be removed from the heating element.

ADJUSTMENT PROCEDURE

Temperature adjustments are made through the front side of the drawn aluminum housing on the A1 model and through the top cover on the A2 model. The units are set at the factory to regulate a windshield temperature of approximately 100°F (38°C).

If readjustment is required, one turn clockwise will increase the windshield temperature approximately 25°F (13°C).

To check the windshield temperature control point see "Temperature Operating Point Check" under "TEST PROCEDURE".

A resistance of approximately 333 ohms of the windshield sensor corresponds to a temperature of 100°F (38°C).

THEORY OF OPERATION

NOTE

Please refer to the elementary drawing, Fig. 7, when following the Theory of Operation.

GENERAL

The temperature controller is composed of the following parts:

1. Voltage Regulator
2. Difference Amplifier
3. Switch Amplifier
4. Output Switch

VOLTAGE REGULATOR CIRCUIT

The voltage regulator consists of an 18-volt zener diode and voltage dropping resistor R12. Input voltage in excess of 18 volts is dropped across the series voltage dropping resistor R12 maintaining a regulated 18 volts to circuit 2 of the controller.

DIFFERENCE AMPLIFIER

Transistors Q1 and Q2, their respective collector resistances R5 and R6 and their common emitter resistance R7 form a difference amplifier. The voltage divider formed by R1, R2, R14 and R4 is connected across the regulated 18 volts and supplies necessary bias voltages to the bases of transistors Q1 and Q2 through their respective resistors R16 and R8. Resistor R16 is the sensor resistor (temperature sensitive resistor) imbedded in the windshield.

The adjustable rheostat R14 is used to precisely set and determine the voltage difference between the R16 voltage to the base of transistor Q1 and the R8 voltage to the base of transistor Q2. Since R16 is supplied from a slightly higher potential than R8, the voltage to the base of Q1 is reduced to the level of Q2 base by the divider action of resistor R9 with R16. Diode CR5 is used for temperature compensation which is explained in the note at the end of this section.

Assume that the windshield is cold and therefore the resistance of sensor resistor R16 is low. This will increase the R16 current some of which will flow in the base of Q1 turning Q1 further on. The resulting increase in Q1 emitter current flowing through the common emitter resistor R7 will increase the voltage at Q2 emitter as well as that on Q1 emitter. This has the effect of back biasing Q2, turning it farther in the off direction. Turning Q2 further off allows R6 to supply more current to Q3 turning it on.

SWITCH AMPLIFIER-OUTPUT SWITCH

The switch amplifier consists of transistor Q3 and associated circuitry. The output switch consists of transistor Q4 and associated circuitry.

Like transistors Q1 and Q2, the bias voltage to the emitter of Q3 is supplied from the voltage divider circuit.

When Q3 is not conducting, there is no voltage drop across resistor R10 and the voltage on circuit point 15 is the same as the voltage on circuit point 2 which is slightly higher than the voltage at circuit point 13 due to the voltage drop across diodes CR2 and CR3 which is caused by the current thru them and resistor R15, which is directly across 18 volts. With voltage at circuit 15 higher than the voltage at circuit 13, the PNP transistor Q4 is biased off and is sufficiently high to prevent thermal runaway and eventual turn-on of Q4 with diode leakage current through the base and collector of Q4.

As Q3 starts to conduct, due to Q2 being turned off, the voltage at the base of Q4 decreases as the IR drop across R6 increases. This decreases the bias across the emitter (circuit point 13) and the base and Q4 would be biased on and start to conduct.

As Q4 starts to conduct, the collector potential would start to rise, which would allow current to flow from the collector to the base of Q3 through the regenerative path supplied by resistor R13. The increased base current in Q3 would in turn increase its collector current and therefore Q4 base current turning Q4 further on. This "snow-balling" effect causes Q4 to snap on.

When Q4 snaps on, its collector current flows through the relay operating coil of relay K1. The capacitor C3 across K1 prevents rapid changes in voltage across the coil and therefore minimizes relay chatter. The diode CR4 also minimizes relay chatter by providing a free wheeling path for the relay coil current during momentary interruptions of Q4 collector current.

As this is a very sensitive circuit operating at signal levels susceptible to AC pickup, the capacitor C1 was added to keep AC off the base of Q3 and capacitor C2 was added to keep AC off the base of Q4.

The normally opened contacts of relay K1 constitute the controllers output (pins J and K) supplying continuity to actuate a contactor to supply power to the windshield. This power can come from a battery, the aircraft AC system, or a special inverter such as General Electric's 3S2060DV105A1 or A2.

NOTE

The difference amplifier is uniquely balanced such that it usually requires no temperature compensation to maintain proper operation over the temperature range. Such is the case with this difference amplifier; however, as the temperature of Q3 increases, it requires more bias (lower voltage on its base) to prevent its collector current from increasing with no change in the sensor resistance (R16). To increase the bias on Q3, diode CR5 is connected from the base of Q1 through resistor R9 to ground. One of the characteristics of a diode is that as its temperature is increased, its forward voltage drop decreases. This decrease in voltage with increasing temperature decreases the voltage on the base of Q1 tending to turn Q1 off. The resulting decrease in Q1 collector current lowers the voltage drop across R7 and the voltage at the emitter of Q2 tending to turn Q2 further on. This increases the voltage drop across resistor R6 decreasing the voltage on the base of Q3 counteracting the increase in base voltage due to thermal conduction of Q3.

Component values are selected such that Q3 collector current and therefore the snapping point of the Q3-Q4 combination remains constant over the temperature range.

MAINTENANCE

GENERAL

This panel requires no periodic maintenance. Do not remove the cover of this panel except for maintenance or overhaul.

MALFUNCTION MAINTENANCE

If this panel should malfunction, the following procedure should be followed:

1. Remove cover from the equipment.
2. Inspect for loose screws, nuts, or components that might have become loose from vibration.
3. Tighten loose screws, nuts, and components.
4. Replace all malfunctioning or damaged components with approved replacement parts.
5. Replace all wiring and components that show signs of burning, wear, or deterioration.
6. Inspect for bent bracing, missing sleeving, and loose cord ties. Rework where necessary.
7. Thoroughly clean the equipment with gentle blasts of dry compressed air.
8. Modify equipment in accordance with any service bulletins that have been issued since the manufacture of the equipment or since it was last overhauled.
9. If the component causing the panel malfunction has not been discovered by this time, refer to the trouble shooting instructions as an aid in locating the trouble.
10. After complying with the above instructions, test and make adjustments to the equipment in accordance with the test procedure section that follows this section.

COMPONENT TESTING

Resistors and Capacitors - with all leads disconnected from one connection of the resistor or capacitor, measure its value with an impedance bridge. Compare the measured value with the value given in the parts list. If values do not agree, replace the component.

Transistors - test transistors with a Model 575 Transistor-Curve Tracer manufactured by Tektronix, Inc., Portland, Oregon or on equivalent equipment.

Zener Diode - Zener diode must maintain a voltage of less than 19 volts at circuit point 2.

TEST PROCEDURE

WARNING

This test procedure is written for the general guidance of competent and experienced electrical service personnel. It does not purport to include a complete statement of the safety precautions which should be observed in servicing this equipment nor does it attempt to cover all details or provide for every possible contingency to be met in connection with installation, operation or maintenance. The servicing of this equipment by inadequately trained or inexperienced personnel involves risks both to such personnel and the equipment for which its manufacturer cannot accept responsibility.

NOTE

The limits given for the following tests are room temperature values. The accuracy of the measuring instruments must be within the limits shown in the list of test equipment.

The limits given will insure meeting the specification limits under different environmental conditions.

TABLE I

TEST EQUIPMENT REQUIRED

EQUIPMENT	DESCRIPTION
Supply, shop	15-30 volts DC, accuracy ± 0.2 volts fused to 0.5 amperes. Supply must not drop more than 0.2 volts and 0-1.0 ampere with load.
Voltmeter, DC	0-50 volts ± 1.0%.
Ammeter, DC (averaging)	0-0.5 amperes ± 1%.
Resistance	Decade box 0-400 ohms in 0.1 ohm steps. 10 ma rating.
Multimeter	Shop meter.

TEST

With all power disconnected from the controller and using a shop multimeter, measure the pin to pin resistance on AN connector as shown below:

a. Pins J, K, I, C, L, N, H, D, M and G to all other pins - infinity.

b. Pin A to pin E 250 ohms ± 5%.

c. Pin A to pin F 250 ohms ± 5%.

ZENER DIODE TEST

1. Apply 28 volts DC (positive to pin E and ground to pin F) through a 0-0.5 ampere, DC meter.

2. Ammeter should indicate 175-250 ma if value of R12 is 47 ohms and 248-358 ma if R12 is 33 ohms.

3. Adjust input supply to 22 volts DC. Current through ammeter should be 47-123 ma if R12 is 47 ohms and 66-176 ma if R12 is 33 ohms.

4. Adjust input supply to 29 volts DC. Current should be 195-270 ma with a 47 ohm resistance. Current should be 279-388 ma with a 33 ohm resistance.

TEMPERATURE OPERATING POINT CHECK

1. Connect ohmmeter between pins J and K.

2. Apply 28 volts DC (positive to pin E and ground to pin F).

3. Connect the decade resistance box between pins A and B. Set resistance box at 330 ohms.

4. Adjust resistor R14 until relay K1 just picks up. (ohmmeter reads 0 ohms.)

5. Vary the decade resistance box to determine the dead band. The difference between the pickup and dropout resistance should be 7 + 2, -3 ohms.

6. Set decade resistance box to 300 ohms. Vary R14 to determine that relay K1 will pick up.

7. Set decade resistance box to 370 ohms. Vary resistor R14 to determine that relay K1 will pick up.

8. Reset resistor R14 for pickup with a decade resistance box setting of 330 ohms +5, -4 ohms.

9. Adjust the input voltage to 22 volts DC. Relay K1 pickup and dropout points should not differ by more than 1.6 ohms from the values obtained in paragraph 8.

10. Varying the decade resistance box to pick up and drop out relay K1 should result in no relay chattering or buzzing and the dead band should be within ± 0.5 ohm of the value measured in paragraph 5 above.

FAIL-SAFE TEST

1. Adjust the input voltage to 28 volts, and set decade resistance box to pick up relay K1.

2. Open decade resistance box circuit by removing connection from either pin A or pin B. Relay should immediately dropout. (Ohmmeter reads infinity.)

3. With decade resistance box set to one ohm greater than value required to pick up K1, momentarily apply a ground at pin A (jumper pin A to pin F). Relay K1 should drop out. Repeat with ground at pin B.

TROUBLE SHOOTING

If this panel malfunctions, it should be tested and adjusted in accordance with the test procedure in the previous section.

If panel cannot be adjusted, check for:

1. Approximately 18 volts at circuit 2. Must be less than 19 volts.

2. Approximately 9.1 volts at circuit 9.

3. Approximately 9.9 volts at circuit 17.

4. Approximately 11.9 volts at circuit 8.

5. Balanced voltage (5 - 7 volts) on bases of Q1 and Q2 when resistance of R16 is decreased calling for heat.

6. When resistance of R16 is high, no heat required, the voltage difference between circuit 2 and circuit 3 is approximately 1-1/2 volts biasing Q4 off.

RENEWAL PARTS

REPLACEMENT

The Specialty Control Department of the General Electric Co., Waynesboro, Va. exercises quality control inspection of its parts and will select the part from a vendor who is qualified at the time a

replacement part is ordered. This refers particularly to magnetic components such as relays, reactors, magnetic amplifiers and transformers which are considered critical parts.

CAUTION

Make certain replaced parts have passed through quality control inspection in accordance with specification drawing shown in part number column in the parts list.

ORDERING

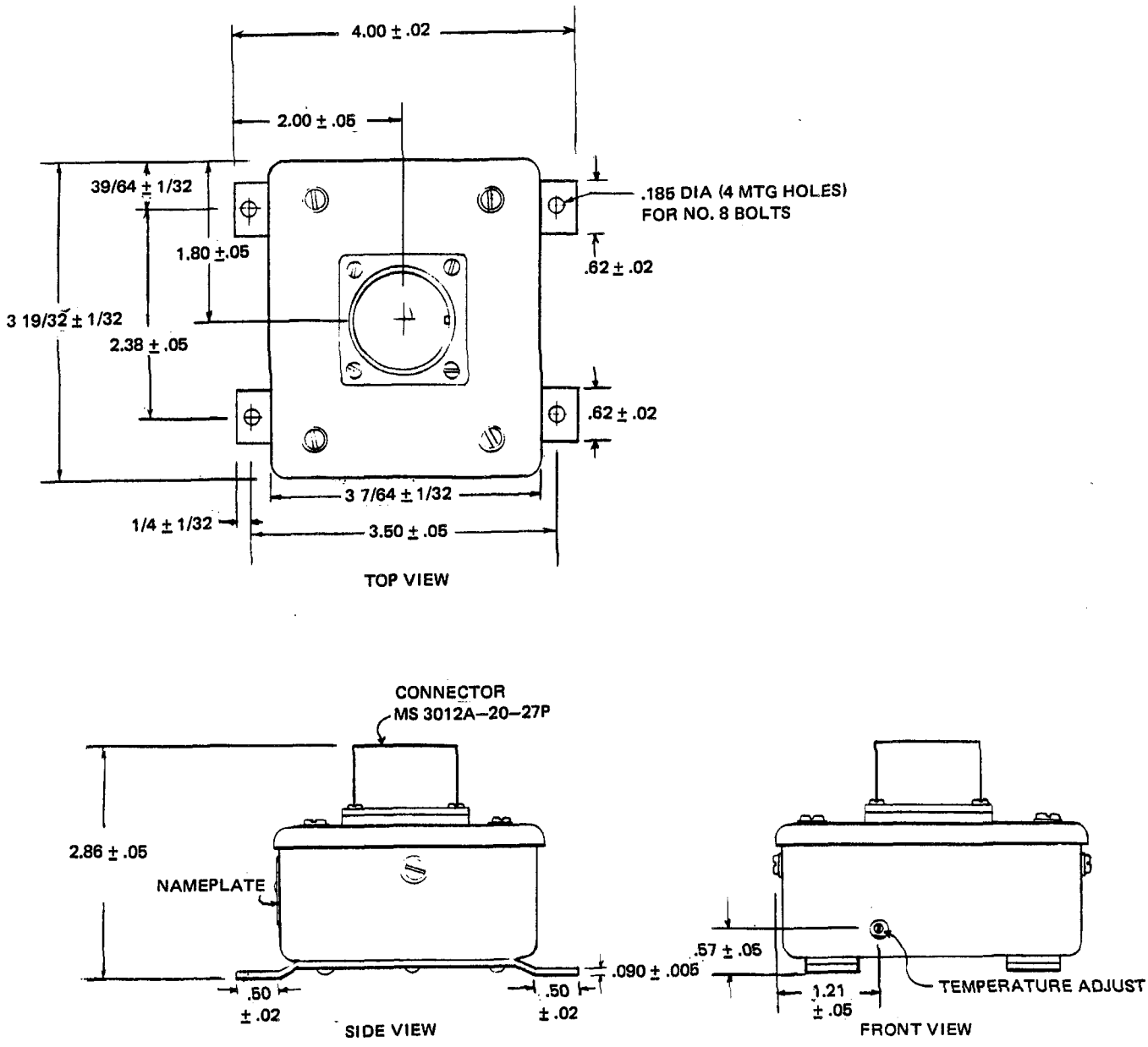
When ordering renewal parts, the following information should be given:

1. Catalog number of the part as stamped on the part itself, with complete description of the part, including its location.
2. Complete nameplate data appearing on the assembly of which the part is a component.
3. If possible, data on original order on which the equipment was first supplied, including all numerical references.

PRINCIPAL RENEWAL PARTS LIST
FOR: 3S2060DM109A1 AND A2

DIAGRAM SYMBOL	QTY. A1	QTY. A2	ORDER NO.	DESCRIPTION
R1	1	1	561A832ZE15	Resistor, 150 ohms ± 3%, 3 Watt
R2	1	1	561A832ZD50	Resistor, 50 ohms ± 3%, 3 Watt
R4	1	1	561A832ZE225	Resistor, 225 ohms ± 3%, 3 Watt
R5,R6	2	2	561A832ZF35	Resistor, 3.5K ± 3%, 3 Watt
R7	1	1	561A832ZF24 or YF24	Resistor 2.4K ± 3%, 3 Watt
R8	1	1	561A832ZE35 or YE35	Resistor, 350 ohms ± 3%, 3 Watt
R9,R10	2	2	561A832ZF47	Resistor, 4.7K ± 3%, 3 Watt
R11	1	1	561832ZF10	Resistor, 1K ± 3%, 3 Watt
R12		1	983B669ZD47	Resistor, 47 ohms ± 3%, 10 Watt
R12	1		561A835ZD33	Resistor, 33 ohms ± 3%, 7 Watt
R13	1	1	561A789H10	Resistor, 100K ± 1%, 1/2 Watt
R15	1	1	561A832ZF50	Resistor, 5K ± 3%, 3 Watt
R16	1	1	Customer's Windshield Sensor Resistor	
C1, C2	2	2	44B253155-001	Capacitor, 4.7 MFD, 35 WVDC ± 20%
C3	1	1	44B253155-002	Capacitor, 22 MFD, 35 WVDC ± 20%
R14	1	1	44B253154-001	Rheostat, 20 ohms ± 10%, .8 Watt
*CR1	1	1	44B253388-007	Zener Diode, 17 Volt, 10 Watt
CR2,3, 4,5,6	5	5	102B3461P1	Diode, 250 MA, 100 PIV
K1	1	1	3S2791G200E9A	Relay

*If CR1 is replaced, use 44B253388-007 and check R12 which should be 47 ohms (some units used 33 ohms).

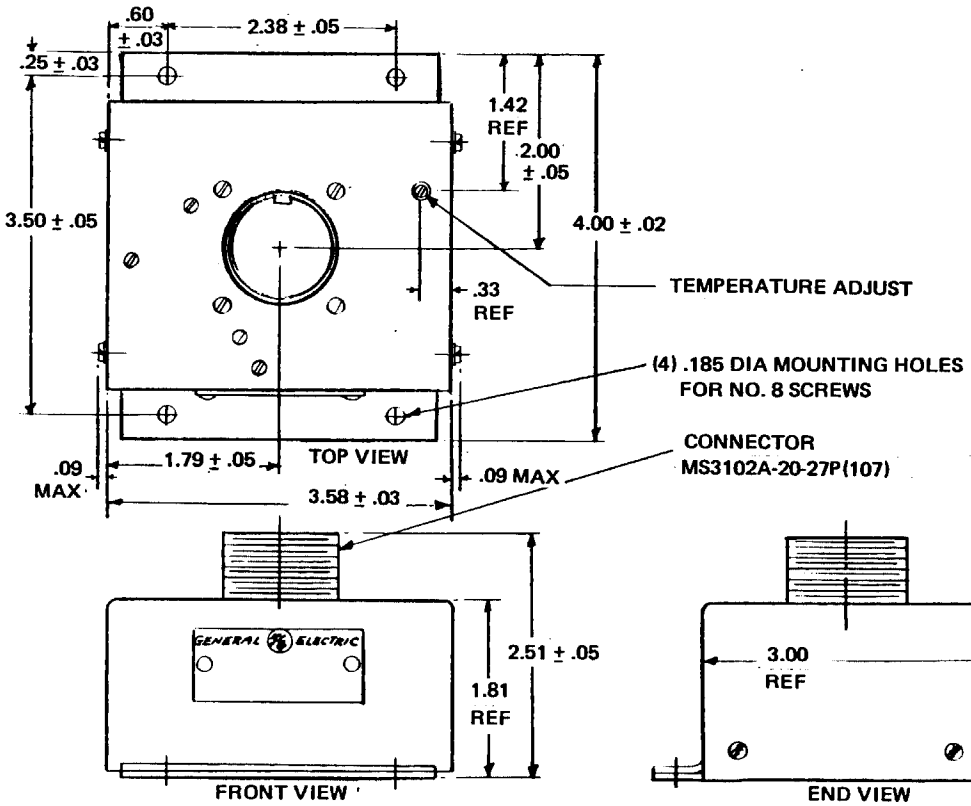


NOTES:

1. MAXIMUM WEIGHT 0. 80 LBS.
   NOMINAL WEIGHT 0. 71 LBS.
2. MAXIMUM POWER DISSIPATION 7. 5 WATTS

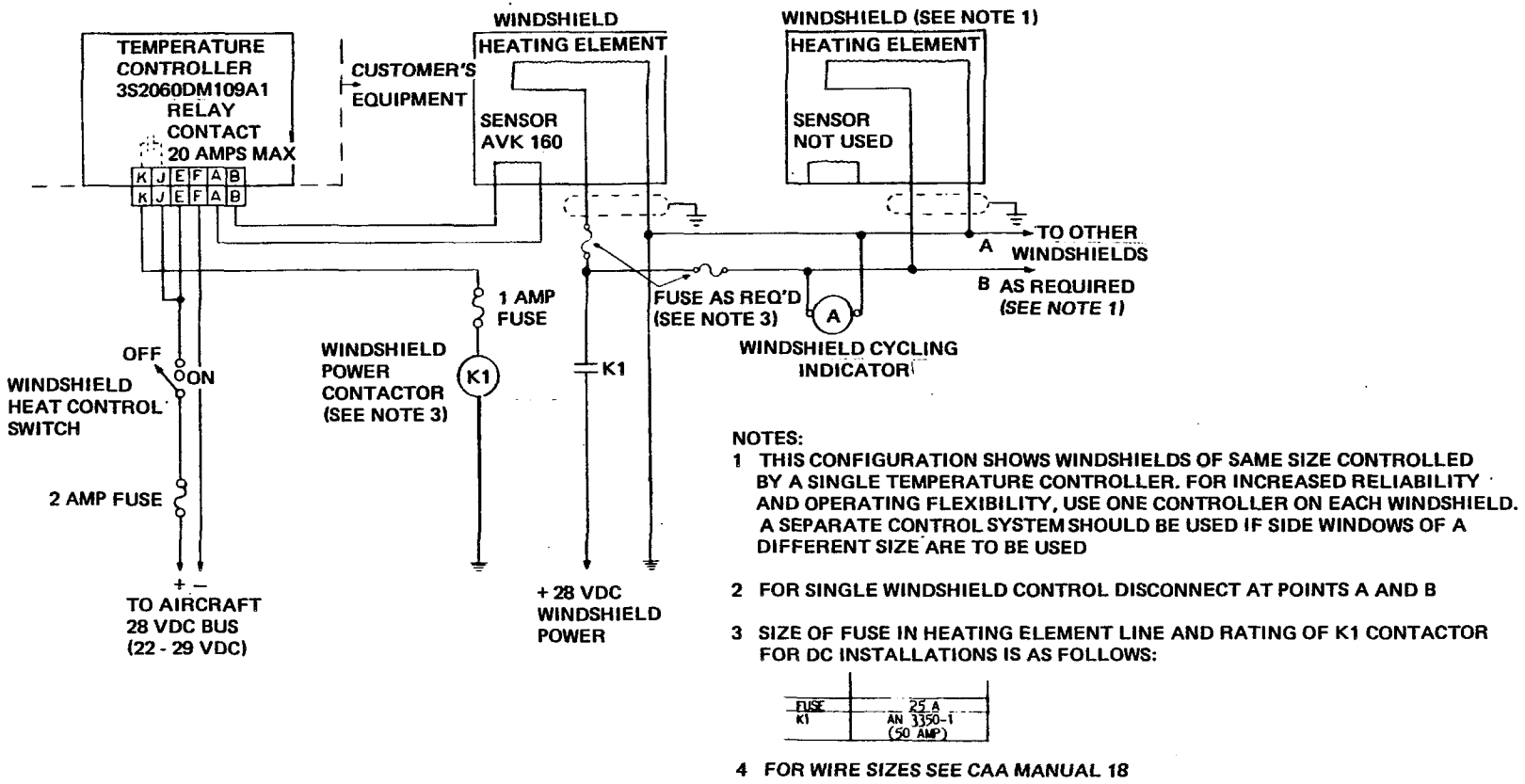
(001) FINISH: BLACK ENAMEL

Fig. 3 Outline Diagram of 3S2060DM109A1 Temperature Controller
(44C240738 - Rev. 2)



NOTES:
1 MAX WEIGHT 0.80 LB
2 NOMINAL WEIGHT 0.71 LB
2 MAX POWER DISSIPATION 7.5 WATTS
3 FINISH: BLACK ENAMEL

Fig. 4 Outline Diagram of 3S2060DM109A2 Temperature Controller (44B241042 - Rev. 0)



NOTES:

1 THIS CONFIGURATION SHOWS WINDSHIELDS OF SAME SIZE CONTROLLED BY A SINGLE TEMPERATURE CONTROLLER. FOR INCREASED RELIABILITY AND OPERATING FLEXIBILITY, USE ONE CONTROLLER ON EACH WINDSHIELD. A SEPARATE CONTROL SYSTEM SHOULD BE USED IF SIDE WINDOWS OF A DIFFERENT SIZE ARE TO BE USED

2 FOR SINGLE WINDSHIELD CONTROL DISCONNECT AT POINTS A AND B

3 SIZE OF FUSE IN HEATING ELEMENT LINE AND RATING OF K1 CONTACTOR FOR DC INSTALLATIONS IS AS FOLLOWS:

FUSE	25 A
K1	AN 3350-1 (50 AMP)

4 *FOR WIRE SIZES SEE CAA MANUAL 18*

Fig. 5 Interconnection Diagram for 3S2060DM109A1 and A2 Temperature Controller for DC Installations (44C240761 - Rev. C)

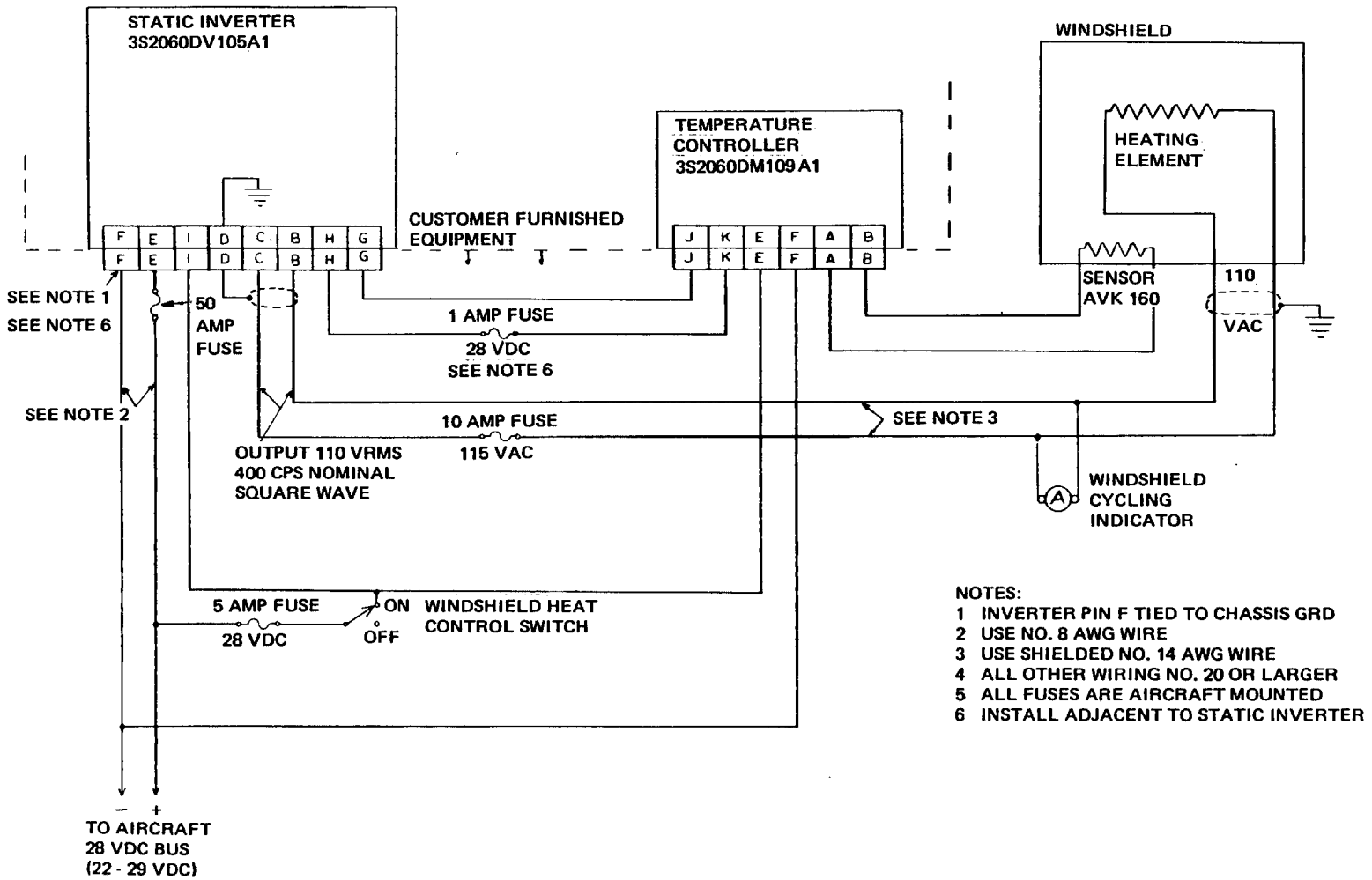


Fig. 6 Interconnection Diagram for 3S2060DM109A1 and A2 Temperature Controllers When Used With a 3S2060DV105A1 or A2 Static Inverter (44C240737 - Rev. 1)

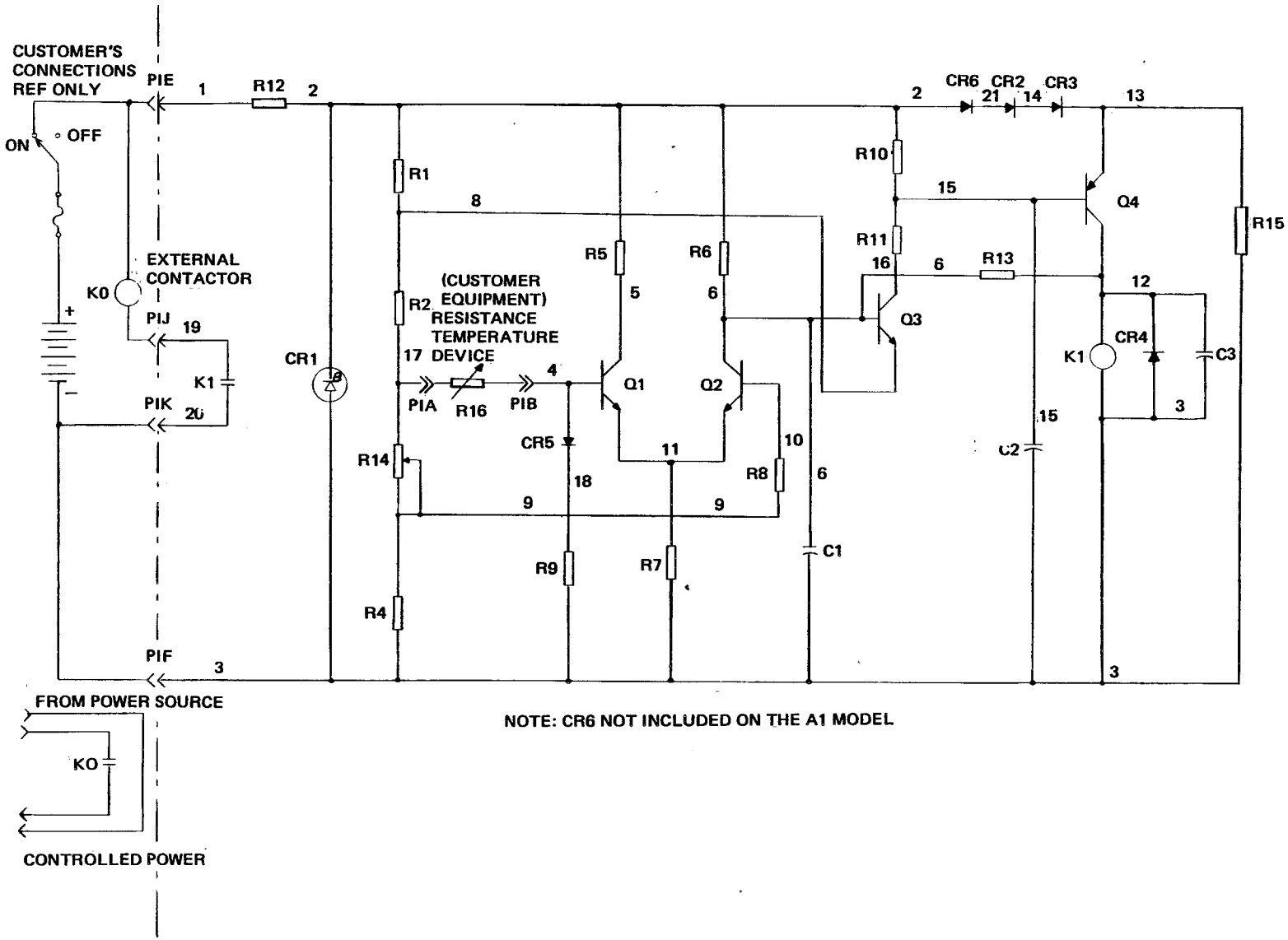
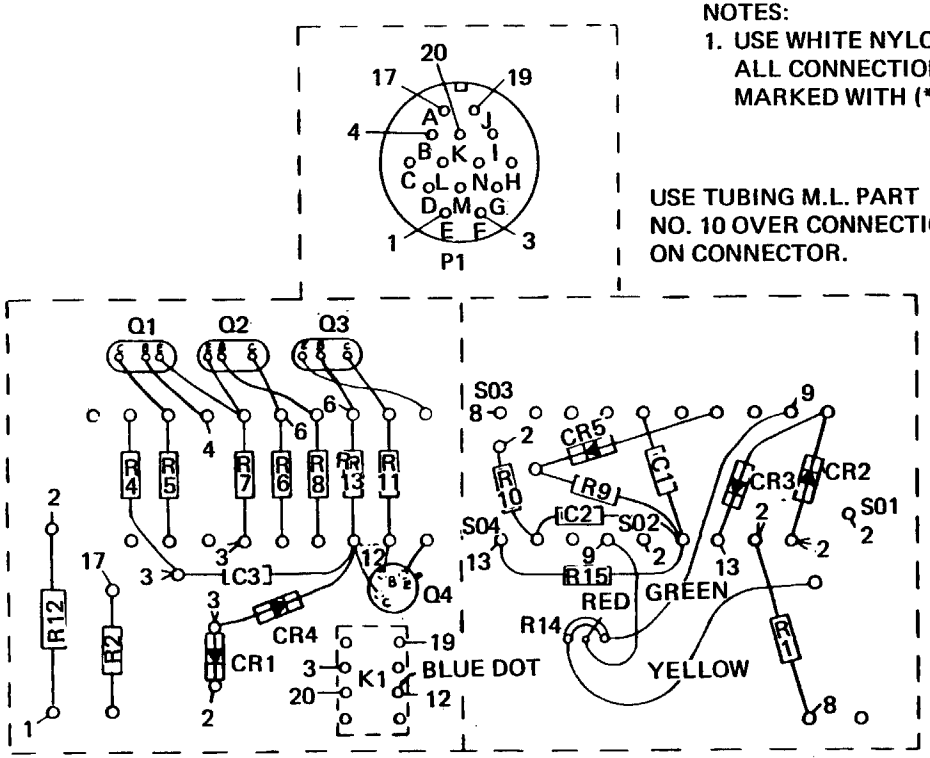


Fig. 7 Elementary Diagram of 3S2060DM109A1 and A2 Temperature Controller (44C240739 - Rev. A)

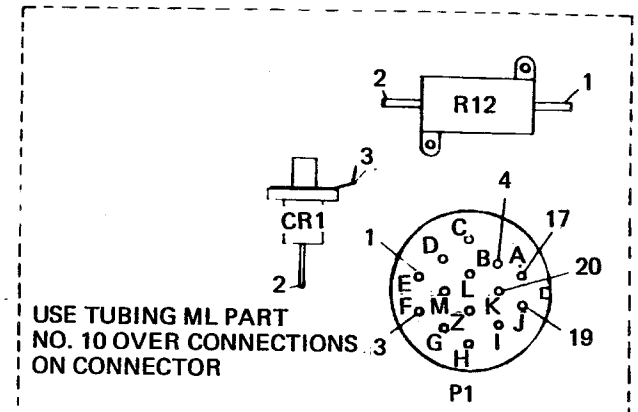
NOTES:
1. USE WHITE NYLON JACKETED AWG NO. 22 WIRE M9729494P131B. FOR ALL CONNECTIONS EXCEPT THOSE MARKED WITH (*). FOR CONNECTIONS MARKED WITH (*), USE BARE AWG NO. 22 WIRE.



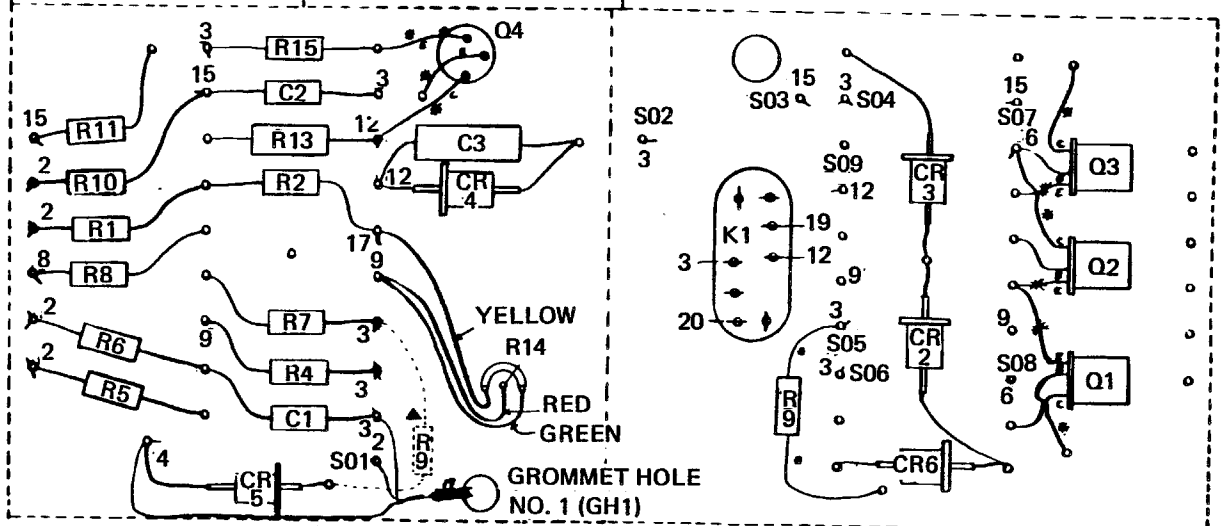
CIR NO	WIRE SIZE	SEQ OF CONNECTIONS
1	22	PIE, R12 (SEE NOTE 1)
3	AWG	PIF, CR1
4	↕	PIB, Q1
17		PIA, R2
19	22	PIJ, K1
20	AWG	PIK, K1

J NO.	CIR NO	WIRE SIZE	CONNECTIONS (SEE NOTE 1)
J1	2	22	R12, CR1
J2	2	AWG	S01, CR2 *
J3	2	↕	CR2, R1 *
J4	2		CR2, R10
J5	2		R1, S02 *
J6	3		CR1, C3
J7	3		C3, R7 *
J8	3		R7, K1
J9	6		R6, R13 *
J10	8		R1, S03
J11	12		R13, K1
J12	13	22	CR3, S04
J13	9	AWG	R4, R14

Fig. 8 Connection Diagram of the 3S2060DM109A1 Temperature Controller (44C240762 - Rev. 2)



NOTES:
1. USE WHITE NYLON JACKETED AWG NO. 22 WIRE M9729494P131B, FOR ALL CONNECTIONS EXCEPT THOSE MARKED WITH (*) FOR CONNECTIONS MARKED WITH (*) USE BARE AWG NO. 22 WIRE WITH TEFLON SLEEVING.
2. ON LEADS MARKED WITH (*), USE TEFLON SLEEVING.
3. ON CIRCUITS 4, 2 AND 3-2 GOING TO COMPONENT BOARD USE ITEM 19 TEFLON TUBING OVER LEADS.
4. LEADS FROM R14 TO BE CORD TIED TO TERMINALS.



CIR NO	WIRE SIZE	SEQUENCE OF CONNECTIONS
1	22	PIE - R12
3	AWG	PIF - CR1
3	↕	CR1 - thru GH1 - C1
4		P18 - " " - CR5
17		PIA - " " - R 2
19	↓	P1J - K1
20	22	P1K - K1
2	AWG	R12 thru GH1 - 501

J NO	CIR NO	WIRE SIZE	CONNECTIONS (SEE NOTE 1)
J1	2	22	R12, - CR1
J3	2	AWG	S01 - R5
J4	2	↕	R5 - R6 *
J5	2		R6 - R1 *
J6	2		R1 - R10 *
J7	15		R10 - R11 *
J8	9		R8 - R4 *
J9	3		R15 - C2 *
J10	3		R7 - R4 *
J11	3		R4 - C1 *
J12	12		R13 - CR4 *
J13	12		K1 - S09
J14	6		Q3 - S08
J15	3	↓	S02 - S04
J16	15	22	S09 - S07
J17	3	AWG	S04 - S08

J NO	CIR NO	WIRE SIZE	CONNECTIONS (SEE NOTE 1)
J18	3	22 AWG	K1-S06
J19	9	22 AWG	R4-R14

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Maintenance Manual

for electrothermal propeller de-icing systems



Report No. 68-04-712C August 15, 1980

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Section 1
Introduction

1-1. PURPOSE

This manual has been prepared to provide maintenance and repair procedures for BFGoodrich Electrothermal Propeller De-Icing Systems and components. All data are current as of the publication date of this manual; consult your BFGoodrich distributor for Service Bulletins or other supplemental data which may have been issued subsequently. Warranty claims and any problem not solved by reference to this manual should be referred to BFGoodrich Transportation Products Division, Akron, Ohio 44318.

1-2. APPLICABLE REGULATIONS

All work on the de-icing system must comply with FAA Advisory Circular 43 and superseding FAA releases. Where hardware or components have provisions for safety wiring, make sure that the safety wire is installed in accordance with C.A.R. Part 18 (Ref. C.A.R. 18.30-6(3)) and MS33540.

1-3. SUPPLEMENTAL PUBLICATIONS

Instructions for installation and removal of De-Icers are given in BFG Report No. 59-728. Instructions for the overhaul of brush block and modular brush assemblies are given in BFG Report No. 68-04-714.

NOTE

Some aircraft manufacturers modify the de-icing systems designed by BFGoodrich, making the instructions given in this manual either incomplete or not applicable. Information concerning maintenance of components not supplied by BFGoodrich and concerning operation of systems containing these additional (or substituted) components should be obtained from the aircraft manufacturer or modification station. No maintenance information is given for BFGoodrich components modified without specific written instructions from the BFGoodrich Company.

Section 2
Description

NOTE: DE-ICER OPERATION

It is recommended that propeller De-Icers be turned on when icing conditions are expected rather than after ice has already formed. This prevents inadvertent accumulation of excessively large amount of ice which, upon being shed during the first de-icing cycle, could damage the aircraft.

2-1. DESCRIPTION OF INSTALLATION

The propeller De-Icing System consists of the following components (see figure 2-1):

1. Electrically heated De-Icers bonded to each propeller blade.

2. Slip ring assemblies for power distribution to the propeller De-Icers.

3. Brush block assemblies* to transfer electric power to the rotating slip rings.

4. A timer to cycle electric power to the De-Icers in proper sequence.

5. An ammeter to indicate that the system is functioning correctly (optional in some systems).

6. An external shunt (some systems use ammeters with internal shunts).

7. A manually operated ON-OFF circuit breaker type switch (some aircraft have a separate circuit breaker and switch, and may use a relay as part of the control circuit also).

8. A wiring harness connecting electrical components.

9. An additional circuit breaker (required by some aircraft).

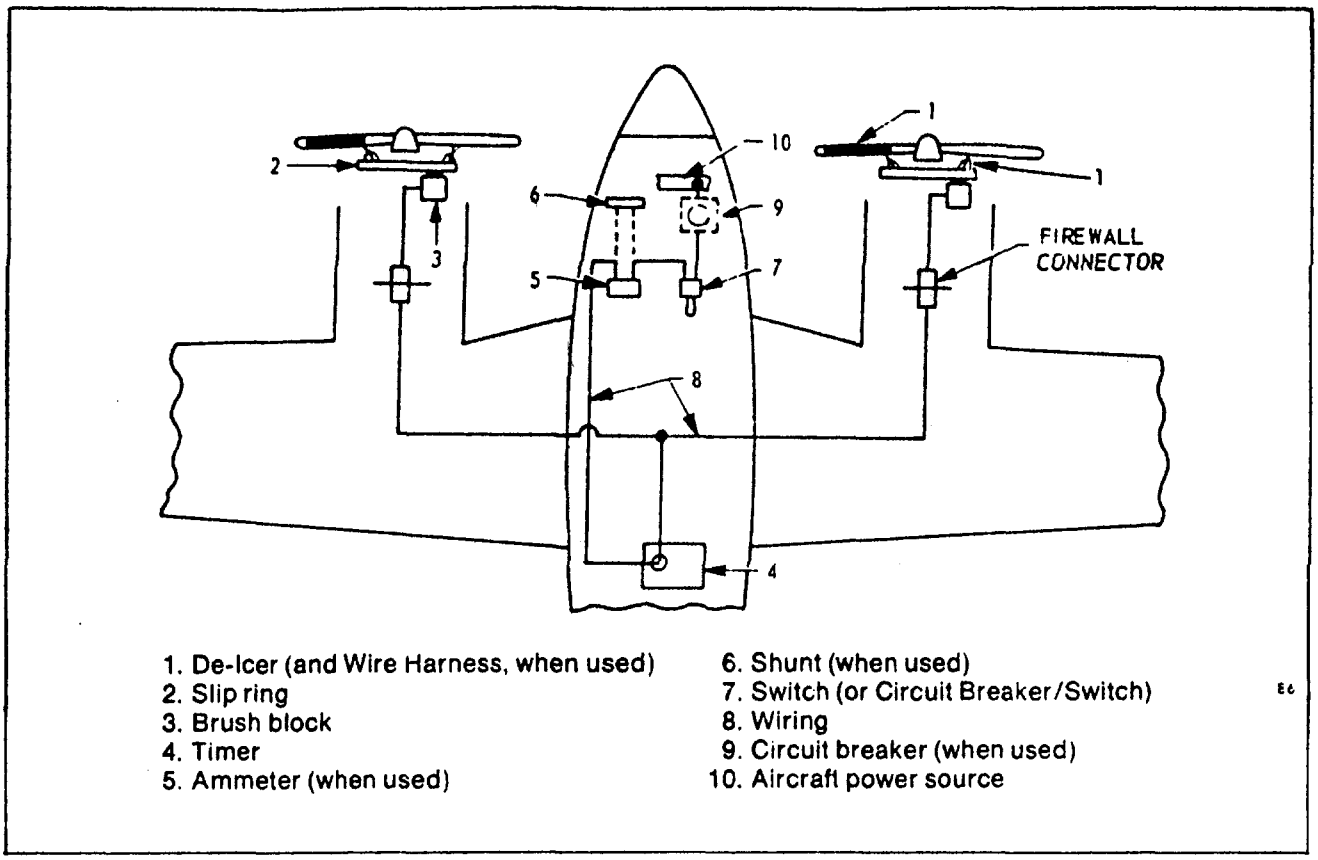
10. Aircraft power source.

2-2. PRINCIPLES OF OPERATION

The BFGoodrich De-Icing System applies heat to the surfaces of the propeller blades where ice normally would adhere. This heat, plus centrifugal force and the blast from the airstream, removes accumulated ice. (A minimum thickness or weight of ice must be formed before centrifugal force becomes a significant factor in propeller ice removal.)

To conserve electric power and effectively remove ice, power is provided to the De-Icers in timed intervals rather than continuously. (The time lapse between the heating cycles for any given De-Icer element will allow ice to accumulate slightly before removal.) Rotational balance of the propeller or propellers is maintained by heating either the entire De-Icer on each blade of a propeller or corresponding sections of the De-Icers on each blade. The following methods are used:

*Throughout this manual references to "brush block assemblies" may generally be assumed to apply also to "modular brush assemblies".



1. De-Icer (and Wire Harness, when used)
2. Slip ring
3. Brush block
4. Timer
5. Ammeter (when used)
6. Shunt (when used)
7. Switch (or Circuit Breaker/Switch)
8. Wiring
9. Circuit breaker (when used)
10. Aircraft power source

E6

Figure 2-1. Typical Twin Engine De-Icing System

1. DE-ICERS WITH DUAL HEATING ELEMENTS (See Figures 2-2 thru 2-5 for twin engine aircraft; see figures 2-6 and 2-7 for single engine aircraft.)

Each De-Icer has two separate electrothermal heating elements; an inboard and an outboard section. When the switch is turned on, the timer provides power through the brush block and slip ring to all outboard* elements on one propeller** for approximately 34*** seconds (Phase 1), reducing ice adhesion in these areas.

NOTE

The illustrations show two-bladed propellers. The procedure is the same if a third, fourth or fifth blade is added.

*Since the timer does not return to a "home" position when turned off, the heating cycle may begin at any of the four points mentioned but the sequence will be the same as indicated.

**Where systems have two timers operating independently, power is cycled to the propeller De-Icers on each engine separately: as in two separate single engine systems.

***Some aircraft have timers which switch the power every 20 seconds. See Table 4-1, notes, or aircraft manual for unusual system features.

Then the timer switches power to all inboard heating elements on the same propeller for 34 seconds (Phase 2). This outboard-inboard sequence is important since the loosened ice tends to move outward.

For single engine aircraft, this cycle is repeated. For twin engine aircraft, power is switched to the other propeller where the same procedure is followed: First all outboard elements are heated for 34 seconds (Phase 3) and then all inboard elements are heated for the same amount of time (Phase 4). As long as the control switch remains on, the cycle will repeat itself.

2. DE-ICERS WITH SINGLE HEATING ELEMENTS (See figures 2-8 and 2-9 for twin engine aircraft; see figures 2-10 and 2-11 for single engine aircraft.)

In this system, each De-Icer has one electrothermal heating element.

On twin engine aircraft, when the switch is turned on, the timer provides power through the brush block and slip ring to all heating elements on one propeller. Next, the timer switches power to all heating elements on the other propeller for the same length of time. As long as the power switch remains on, this cycle repeats itself.

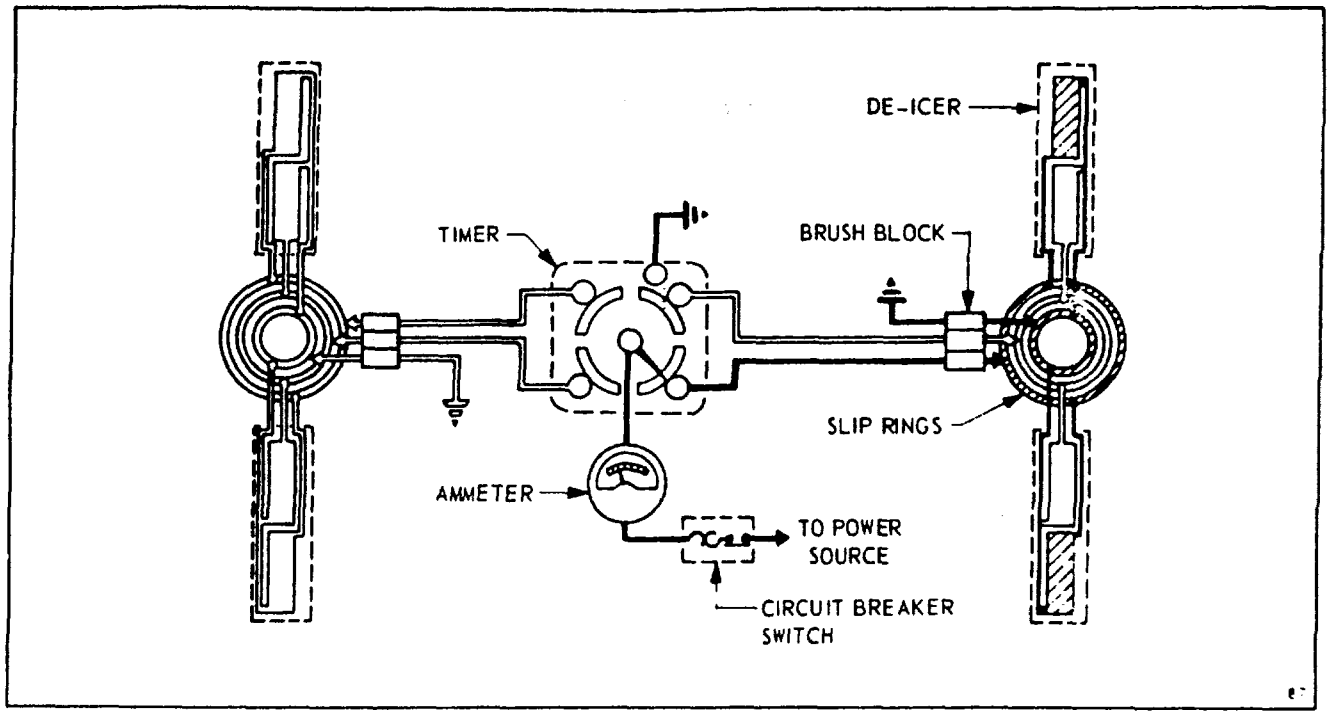


Figure 2-2. Dual Element, Twin Engine Cycle Sequence — Phase 1

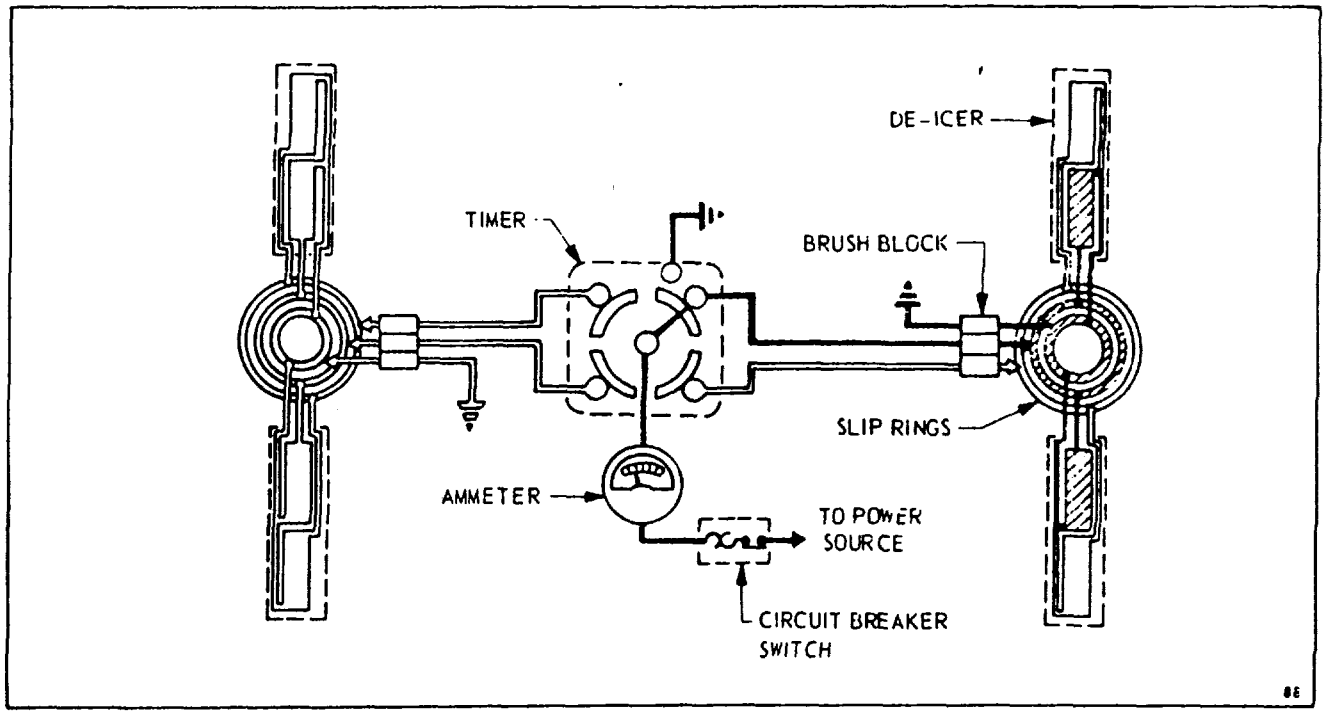


Figure 2-3. Dual Element, Twin Engine Cycle Sequence — Phase 2

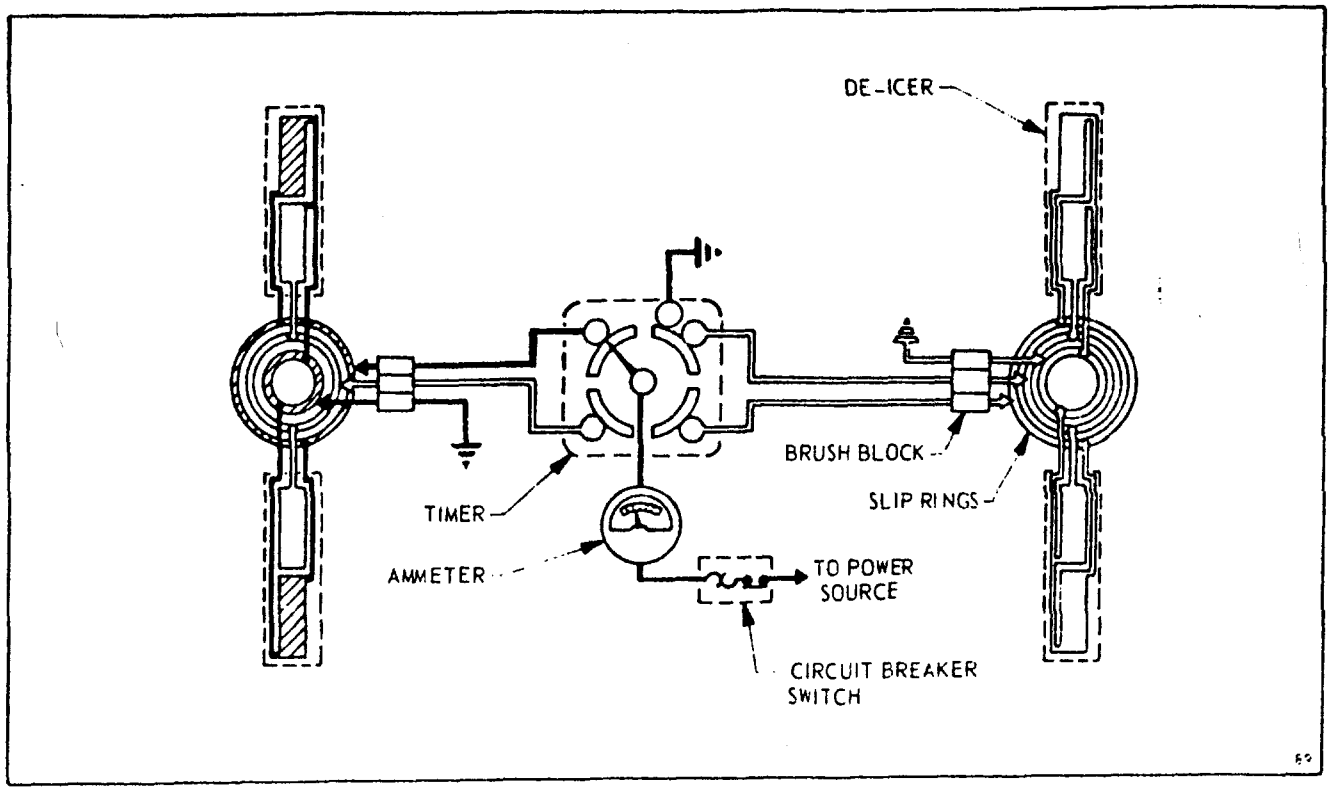


Figure 2-4. Dual Element, Twin Engine Cycle Sequence — Phase 3

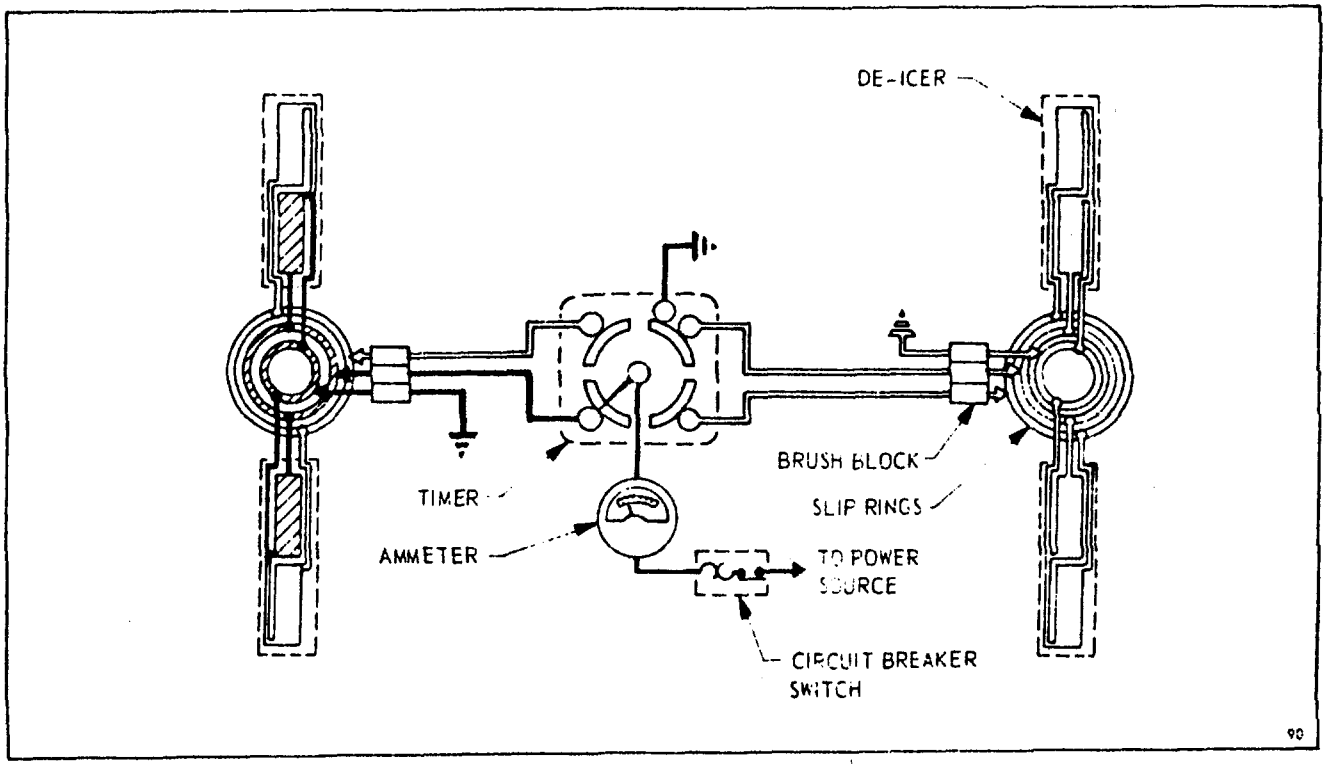


Figure 2-5. Dual Element, Twin Engine Cycle Sequence — Phase 4

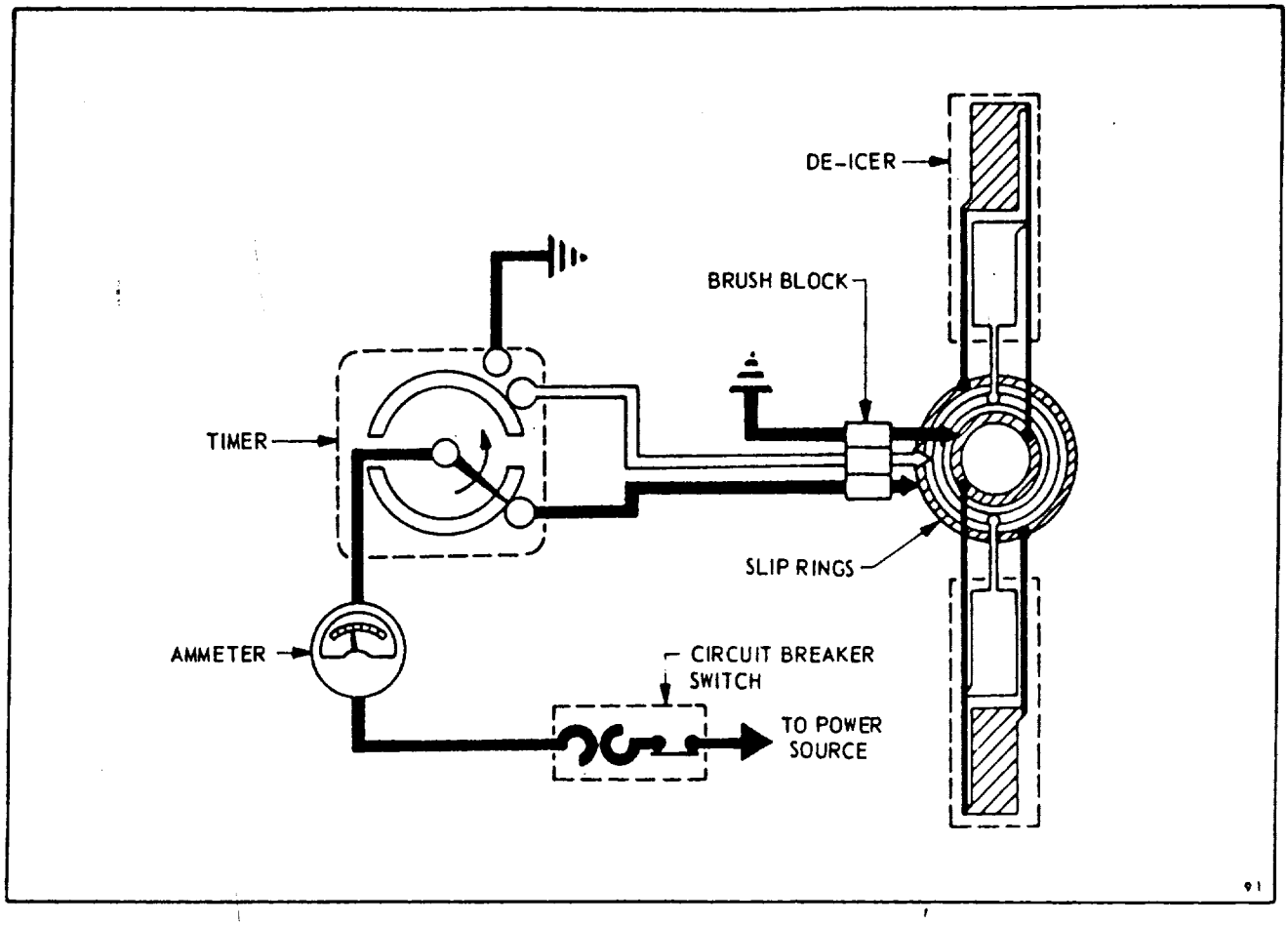


Figure 2-6. Dual Element, Single Engine Cycle Sequence — Phase 1

On single engine aircraft, when the switch is turned on, the timer provides power through the brush block and slip ring to all heating elements on the propeller. Next, the timer switches the power off for an equivalent length of time. This cycle is repeated as long as the switch remains on.

The single element systems are of two types. One type uses a wire element De-Icer energized by AC voltage. The other type uses a metal foil element De-Icer energized by DC voltage. The wire element De-Icer is energized for 34 seconds, whereas the metal foil element De-Icer is energized for 90 seconds.

2-3. DESCRIPTION OF COMPONENTS

De-Icers. The De-Icers contain special heater wires or metal foil protected by plies of fabric and rubber, compounded for oil, erosion, and abrasion resistance. One side of each De-Icer has a dull finish (fabric impressioned) to provide good adhesion when bonded to the propeller blade. The other side has a smooth, glossy finish. Dual element De-Icers have three electrical leads; one input for each heating element and a common ground. Single element De-Icers have only two leads (one input — one ground).

De-Icer Wire Harnesses. De-Icer wire harnesses are used with detachable lead strap De-Icers to connect the De-Icer leads to the slip ring leads. The De-Icer wire harnesses replace the integral De-Icer lead strap on specific De-Icers. (See Section 6.)

Slip Rings, Brushes and Brush Blocks or Modular Brush Assemblies. To conduct electric power to the rotating De-Icers, a brush block or modular brush assembly is mounted on the engine or other stationary member of the aircraft. Each brush assembly contains spring loaded brushes which contact the rotating slip rings. Depending on the specific aircraft, there are two general types of slip ring installations:

1. The slip ring is provided as part of a slip ring/starter ring gear assembly which replaces the original starter ring gear on the engine.

2. A slip ring assembly in a metal holder is attached to the aft side of the spinner bulkhead or to the engine crankshaft flange.

Timer. The electric timer distributes power to each of the De-Icer heating elements in a prescribed sequence. The timer will repeat this cycle as long as the control switch is on.

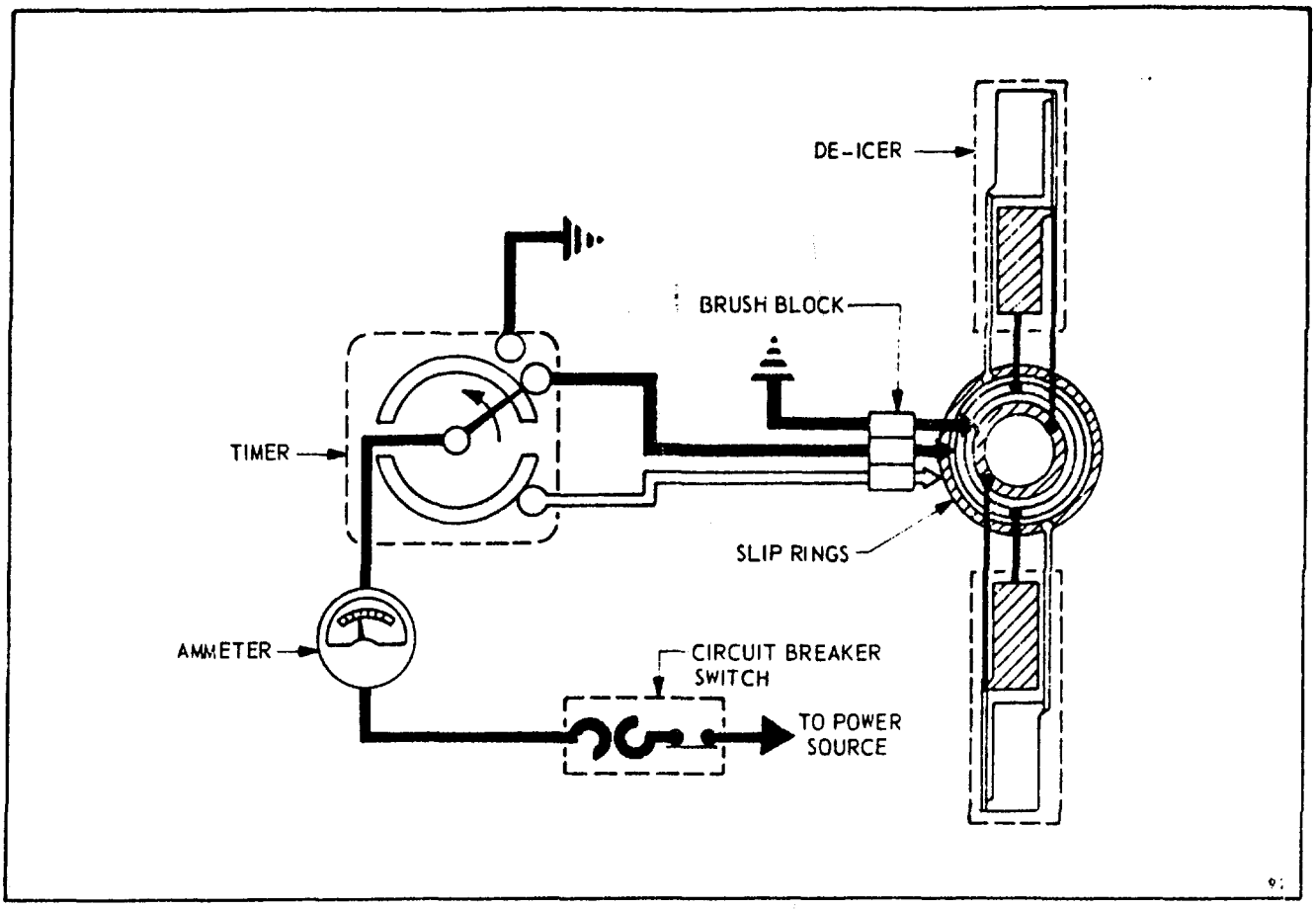


Figure 2-7. Dual Element, Single Engine Cycle Sequence — Phase 2

Ammeter. The ammeter (when used in the system) indicates current flow to the De-Icers. In the event of low aircraft battery voltage (possible in ground checks) the ammeter readings will be below the shaded area on the ammeter scale. Current flow is normal when the ammeter needle points to the shaded range of the scale. Depending on the system, the ammeter may be equipped with an internal or external shunt, and may be either DC or AC. Some ammeters have been adjusted internally to compensate for leadwire resistance for connection of external shunts.

Switch or Circuit Breaker/Switch. The switch may be a combined circuit breaker and switch unit, or it may be a common switch used with a separate circuit breaker. If the system current rises above the circuit breaker limit, it will open to cut power to the De-Icing system. The circuit breaker/switch can be reset by turning it OFF and then ON again. Consult Table 4-1 and the wiring schematics for type used.

Circuit Breaker. Certain aircraft use an additional or separate circuit breaker between the de-icing system and the aircraft power supply. If tripped, the circuit breaker must be reset manually, either in flight or on the ground, depending on the type of aircraft. Consult Table 4-1 and the wiring schematics for components of a specified system.

Other Components. Certain aircraft have additional components such as relays and overload sensing devices for controlling the de-icing system. Although shown in the schematic diagrams, these components may or may not be supplied by the BFGoodrich Company. Information concerning components not supplied by BFGoodrich may be obtained from the aircraft manufacturer or modification station.

CAUTION

Some aircraft manufacturers and modifiers deviate from the methods of installation and wiring propeller de-icing systems recommended by BFGoodrich. Table 4-1 provides BFGoodrich recommended wiring schematics. Where systems are known to have been altered, the wiring schematic must be obtained from the aircraft manufacturer or modifier.

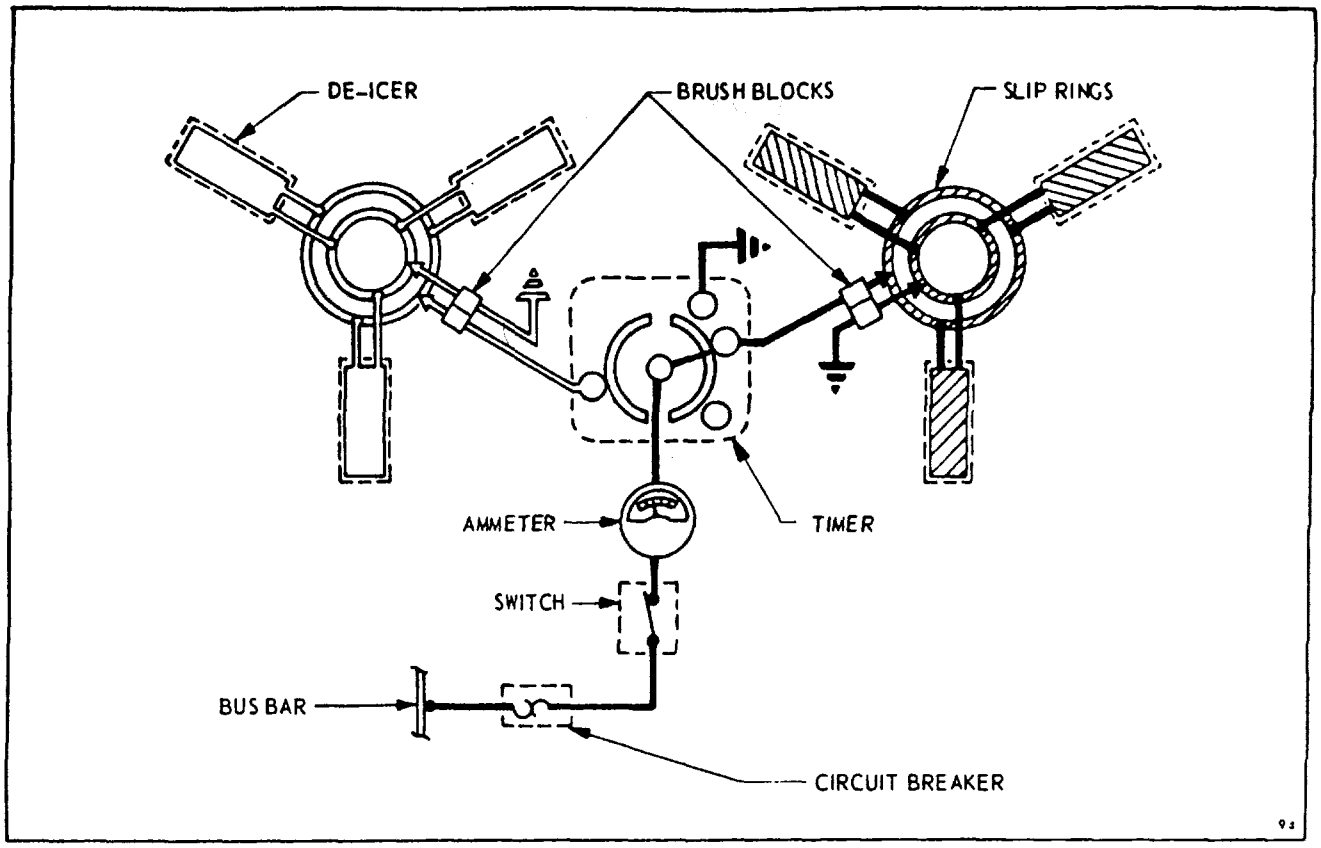


Figure 2-8. Single Element, Twin Engine Cycle Sequence — Phase 1

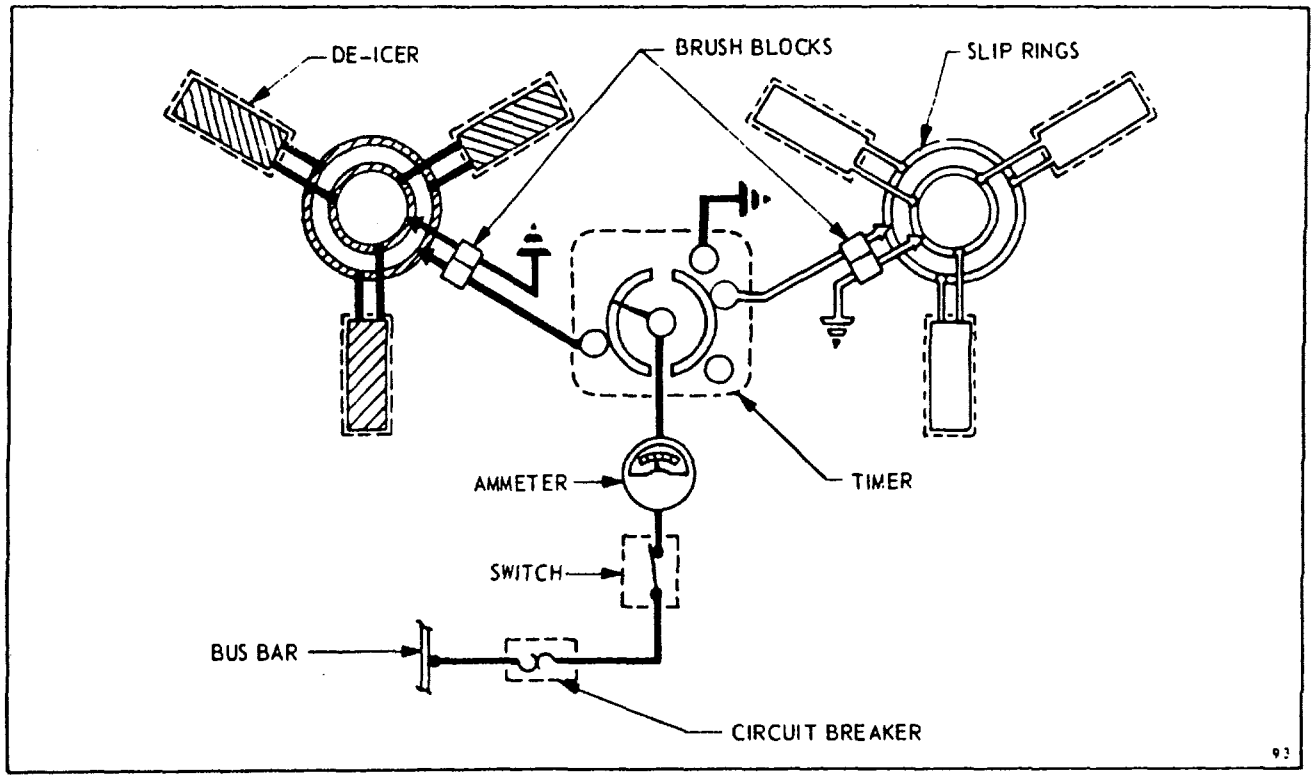


Figure 2-9. Single Element, Twin Engine Cycle Sequence — Phase 2

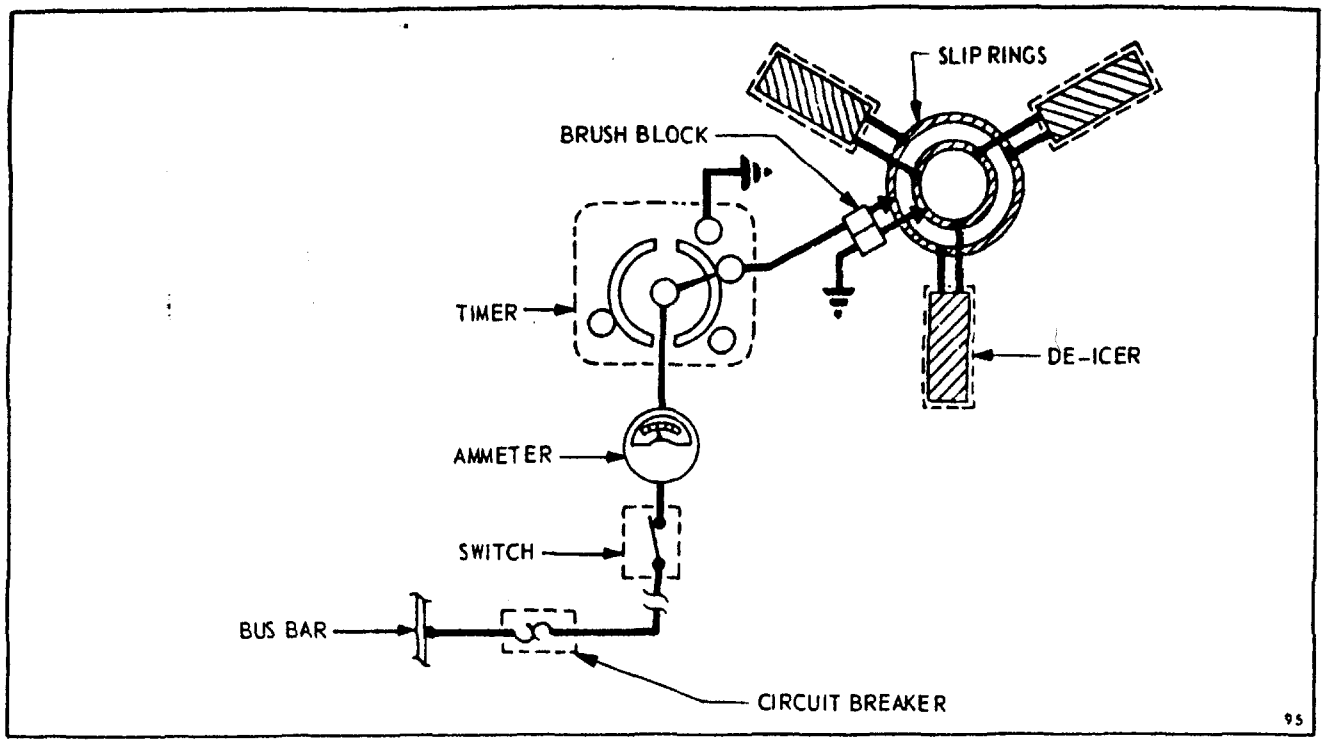


Figure 2-10. Single Element, Single Engine Cycle Sequence — Phase 1

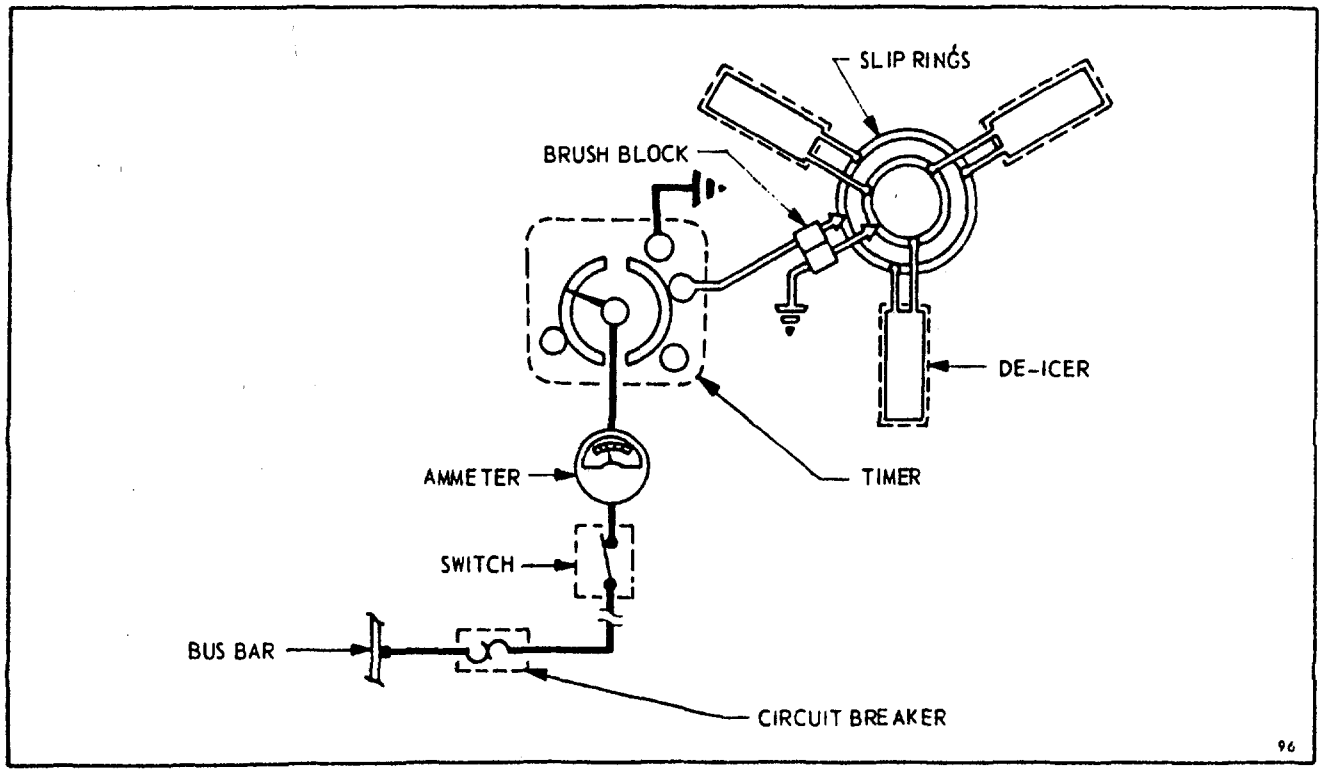


Figure 2-11. Single Element, Single Engine Cycle Sequence — Phase 2

Section 3
Required Inspections

(See, also, FAA Advisory Circular 43 and superseding FAA releases)

To preserve the battery when making ground checkouts, run a minimum number of cycles with the propeller in the static condition. Use of an auxiliary power supply (14 or 28 VDC, as applicable) is suggested. Functional ground checkouts of 115 VAC systems require use of an auxiliary power supply. If not available, make continuity check instead. In any case, the De-Icers should not be operated continuously for more than 5 minutes under high ambient temperature conditions (above 100°F) without allowing them to cool down.

3-1. 50 HOUR INSPECTION

Perform the following checks:

1. Remove spinner dome and open access doors as required to facilitate inspection of wiring.

NOTE

On turbine engines, check for fuel or oil leakage onto the brush blocks and slip rings. This will cause the brushes to wear excessively and to cut into the rings. Stop the leak! ***Clean and refurbish rings and brush block assemblies per maintenance instructions in Section 5-4 and Report No. 68-04-714 respectively.***

With assistant observing De-Icer ammeter* and with De-Icer switch ON, flex all accessible wiring — particularly the De-Icer lead straps, De-Icer wire harnesses, leads from slip ring assembly, and the fire wall electrical connectors, if any, and their wiring. Any movement of the ammeter needle other than the normal flicker from the timer cycling indicates a short or open that must be located and corrected. Check continuity of wiring affected while flexing and prodding the suspected area.

2. With De-Icer switch on, feel De-Icers on propellers for proper sequence of heater operation. The starting point is not important but sequence is vital and must be RIGHT OUTBOARD, RIGHT INBOARD, LEFT OUTBOARD, and LEFT INBOARD heaters, ***in that order.*** **(Single engine systems cycle outboard-inboard and repeat. Single element De-Icers cycle ON-OFF and repeat.) Temperature rise should be noticeable and each heater should warm while energized. Local hot spots indicate surface damage requiring replacement of De-Icer.

*For systems without ammeters, temporarily install an ammeter or amp-probe in the power input line to the timer. Determine proper operating range for system from Table 4-1. Ammeters installed in the propeller de-icing system circuit by some aircraft manufacturers can't be read with sufficient accuracy to provide the correct system amperage values. If ammeter readings are consistently in error, check accuracy per section 3-2.5.

**See appropriate wiring schematic and Table 3-1 for cycling of dual timer systems.

3. Reinstall all previously removed components.

4. Lock brakes and operate engine at near takeoff power. Turn De-Icer system switch ON and observe De-Icer ammeter for at least 2.2 minutes. Ammeter needle must rest within the shaded range on the ammeter. The ammeter may "flicker" when the timer switches. See 3-2.4. NOTE.

3-2. 100 HOUR INSPECTION

To facilitate inspection, insure that propellers are feathered when last shut down. Remove spinner dome and open access doors as necessary. Do not run up engine(s) with spinner dome(s) removed or failure of De-Icer lead straps or De-Icer wire harnesses will occur.

3-2.1. DE-ICERS

1. Closely check De-Icers for wrinkled, loose, or torn areas, particularly around the outboard end and where the strap passes under the lead strap clamp or restrainer. Look for abrasion or cuts, especially along the leading edge and the flat or thrust face.

2. Check that lead strap clamps, terminal clamps, tie straps or restrainers are secured and properly installed. (See figures 5-2 through 5-12, 6-3 through 6-9.) Look for cracks or other damage. Insure that screws are safety-wired.

3. Check that De-Icer lead straps or De-Icer wire harnesses are not placed in tension in the feathered position. If tension exists, insure that no slack has been left between the lead clip and terminal studs or between the lead strap clamp or restrainer and the De-Icer. If none, or if tension still exists after eliminating this slack, check De-Icer location dimension against Table 4-1, and De-Icer and clamp part numbers against parts list. If location exceeds given dimension, and part numbers are correct, then remove the De-Icer and recement it in the proper position. (See BFG report 59-728 for removal and recementing.) If part numbers are incorrect, replace with correct part. All De-Icers must be located the same distance from the hub for rotational balance.

On detachable leadstrap De-Icer installations, check that terminals and terminal studs are not shorting out to each other or the propeller hub. Inspect wire harness for evidence of chafing or shorting. If chafing is found, remove source, if possible, or contact BFGoodrich for corrective action directions. Insure that all clamps and tie straps are properly installed.

4. Insure that lead clips and terminal screw assemblies are tight and in good repair.

5. With De-Icer switch ON and assistant observing ammeter, flex lead straps or De-Icer wire harnesses of De-Icers which are operating and flex slip ring leads; any movement of the ammeter needle other than a normal flicker from the timer cycling indicates a short or open that must be located and corrected. Check continuity of wiring affected while flexing and prodding the suspected area.

6. Perform heat test as in 3-1.2.

3-2.2. SLIP RINGS

1. Visually and by feel, check slip rings for excessive wear, roughened surface, cracks, burned or discolored areas, and deposits of oil, grease and dirt.

2. Clean greasy or contaminated slip rings with CRC 2-26 solvent (from CRC Chemicals, Dresher, Pa.) or with Stoddard solvent. If Stoddard solvent is used, wipe off with a clean cloth dampened with MEK to avoid leaving a film.

3. If uneven wear is found or if wobble is noticed, set up dial indicator and check alignment of slip rings to propeller shaft. (See Section 4-5.)

4. Reface worn or damaged slip rings per Section 5-4.

3-2.3. BRUSH BLOCKS, MODULES AND BRUSHES (For Overhaul, Cleaning, Checkout and Installation Procedures, see Report 68-04-714)

1. Examine mounting brackets, blocks and modules for cracks, deformation, or other physical damage.

2. Check brushes for excessive wear, chipping or breakage.

3. Check brush block or module assembly for accumulation of grease or fuel and for accumulation of carbon on the block or module surface between the brushes. Clean the assembly using MEK and refurbish. Repair source of contaminant leakage.

4. Insure that each brush rides fully on its slip ring throughout 360° rotation. Report 68-04-714 shows the correct alignment; realign as necessary.

5. Check for proper clearance between brush block or module and slip rings and insure that assembly is cocked about 2° with respect to the rings. Loosen mounting screws and move assembly as necessary to comply. Changes in brush position may be made, if necessary, by varying the shim thickness (a laminated metal shim is provided in most instances.).

3-2.4. TIMER TEST

(Necessary in 100 hour inspection only if De-Icer heat test or reading outside normal current range indicates system malfunction.)

The correctness of the timer cycling sequence should be checked in the following manner: (Refer to system schematic; determine from Table 4-1 and appropriate figure for your aircraft.)

NOTE

For bench checkout of DC timers, use power supply with a range of 0-15 amp, 0-32 VDC, 0.75% or less ripple (e.g. Electro Products Labs Model NFB) and use 5 amp min. load on each output. See Table 3-1 for checkout of AC/DC timers.

1. Remove connector plug of wire harness from timer and jump power input socket or sockets of wire harness to timer input pin or pins (see wiring schematic for pin identification).

2. Jump timer ground pin to ground.

3. Turn on De-Icing System.

4. Check timer operation per Table 3-1 using a voltmeter.

NOTE

Some timers require a slight "warm-up" period before they will operate normally. Therefore, the first complete timing cycle may be somewhat longer than normal. This doesn't apply to the 3E1150-12, 3E1899-1, or the 3E1964-1, -2 and -3 timers with the manual step feature.

The 3E1899-1, 3E1964-1, -2 and -3 and 3E1150-7, -10 and -12 timers use electronic stepping circuits. Therefore, an ammeter "flicker" may not be observed when these timers are switching.

5. Check volts to ground in each case. If engines are not operating and auxiliary power is not used, voltage will be battery voltage and cycle time may be slightly longer than indicated.

6. Hold the voltmeter probe on the pin until the voltage drops to 0. Move the probe to the next pin in the sequence shown in the Table. Check voltages at each pin in sequence. When correctness of the cycling sequence is established, turn propeller de-icing switch off.

NOTE

Timers do not home to pin "C" when turned off. Timers of the 3E1150-2, -3, -12; 3E1899-1; 3E1964-1, -2 (S/N 1000 and up); 3E1964-3 and 3E1575 series will "step" power to the next pin in sequence each time they are turned OFF and then ON. Timers 3E1150-7 and -10, 3E1540, 3E1555 series and 3E1964-1, -2 (S/N 1000 and below) require the full cycle time before "stepping".

7. If timer operates correctly remove the jumper wires installed and replace the connector plug in the timer receptacle. If timer is faulty, see Repair Procedures, Section 5.

TABLE 3-1. TIMER OPERATION TEST

Timer P/N	Power Input Pin & Socket	Ground Pin	Output Sequence Time, Voltage	Total Repeat Cycle Time (minutes)
3E1150-2, -3, -10, -12	B(14 or 28 VDC)	A (14 VDC) G (28 VDC)	C, D, E, F -34 sec. each, (14 or 28 VDC)	2.2
3E1150-7	B (28 VDC)	G (28 VDC)	C, D, E, F - 34 sec. each, (28 VDC - 25 Amps, Max.)	2.2
3E1540-1	B (14 VDC)	A (14 VDC)	C, D - 34 sec. each, (14 VDC)	1.1
3E1555-1	B (28 VDC)	G (28 VDC)	C, D - 34 sec. each, (28 VDC)	1.1
3E1575-1	B (28 VDC)* A (115 VAC, 400 Hz)*	G (28 VDC)	C, D - 34 sec. each, (115 VAC, 400 Hz)	1.1
3E1899-1	B (14 or 28 VDC)	A (14 VDC) G (28 VDC)	C - 90 sec. (14 or 28 VDC)	1.5
3E1964-1	B (14 or 28 VDC)	A (14 VDC) G (28 VDC)	C, D - 34 sec. each (14 or 28 VDC)	1.1
3E1964-2	B (14 or 28 VDC)	A (14 VDC) G (28 VDC)	C, D - 20 sec. each (14 or 28 VDC)	.66
3E1964-3	B (14 or 28 VDC)	A (14 VDC) G (28 VDC)	D, F - 90 sec. each (14 or 28 VDC)	3.0
3E1968-1	B (14 VDC)	A (14 VDC)	C, D, E, F - 34 sec. each, (14 VDC - 25 Amps, Max.)	2.2

**The timing mechanism operates on 28 VDC power. It switches 115 VAC 400 Hz power to each of the output pins to operate the De-Icers. If an auxiliary power unit having 115 VAC, 400 Hz power is not available for this test, check the continuity from pins C and D to pin A instead. A closed circuit should be indicated in each, successively, for 34 seconds. For bench checkout, use power supply equivalent to that used for DC timer checkout. (See Note, Section 3-2.4.)*

3-2.5. AMMETER (If Permanent Part of De-Icer System)

At some convenient point between bus bar and ammeter, hook a good volt-ohmmeter with an ammeter scale or a standard ammeter into the circuit and, with the De-Icer switch ON, check the amperage being used by the De-Icer system. The reading of the standard ammeter should closely agree with the reading obtained from the De-Icer ammeter. Turn De-Icer switch OFF and remove volt-ohmmeter or standard ammeter from circuit. If ammeter readings were significantly different and rest of de-icing system checks out satisfactorily, see Ammeter Checkout, Section 4-7.

3-2.6. *CIRCUIT BREAKER AND SWITCH*

If testing required in 3-2.4 and 3-2.5 has been performed satisfactorily, de-icing system circuit breaker and switch are operable. If inoperable, see Repair Procedures, Section 5.

3-2.7. SYSTEM WIRING

With De-Icer system operating, have assistant observe ammeter while visually inspecting and physically flexing wiring from brush block to fire wall, timer, ammeter, switch, circuit breaker, and aircraft power supply. Any movement of the ammeter needle other than a flicker from the timer cycling indicates loose or broken wiring in the area under examination. In such case, check continuity through affected wiring while flexing and prodding area that gave initial indication of trouble.

3-2.8. OTHER

1. Visually and by feel, check all clamps, clips, mountings, electrical connections, and connectors for tightness and electrical soundness. Check for loose, broken or missing safety wire.

2. Replace all previously removed components.

3. Check for radio noise or radio compass interference — operate engine at near take-off power with radio gear ON while turning De-Icer switch ON and OFF. If noise or interference occurs with De-Icer switch ON and disappears when switch is OFF, see trouble-shooting chart, Section 4-3.9.

Section 4
Service Guide

4-1. INTRODUCTION

Whether in flight or during ground testing, the ammeter can be used to determine the general nature of most electrical problems. The Trouble Shooting Chart is based, primarily, on the use of the ammeter* and it is assumed that the user understands all normal operating modes of the system. (See Section 1). Read all of the "Trouble" entries to locate the one matching the conditions of the system being checked. The "Probable Cause" and "Remedy" entries pertinent to each trouble are arranged in the recommended checking sequence.

4-2. HELPFUL TIPS

1. Normal current is shown as a shaded range on the ammeter** for each propeller De-Icer system with engines running. The ammeter reading will be slightly lower when the system is operatec on battery voltage. An auxiliary power supply or engine operation is required when testing for AC voltage.

**If an ammeter is not normally included as a part of the propeller De-Icer system, install one at a convenient point between the bus bar and timer for this checkout.*

***See Table 4-1 for proper operating current range for your de-icing system. Current calculations are based upon nominal voltages of 14 or 28 VDC, or 115 VAC, depending on the system concerned.*

2. Use the "heat test" (Section 3-1.2) and "ammeter test" (Section 3-2.5) to determine which engine's De-Icers are not operating. Use appropriate wiring schematic (find from Table 4-1) to trace circuits.

3. Excess current reading on the ammeter always indicates a power lead is shorted to ground. Thus, when trouble of this nature is found, it is vital that the grounded power lead be located and corrected.

4. Ignore reference to ammeter as probable cause of trouble for systems without permanently installed ammeters.

5. A considerable number of timers have been returned for repair which proved, on test, to be fully operable. Before concluding that the timer is faulty, test it per Section 3-2.4.

6. For insulation resistance tests, use a "Megger" ("Meg" type insulation tester, James G. Biddle Company, Plymouth Meeting, Pa.) or other tester having a 500 VDC, 1000 megohm capacity.

7. Defective wiring in propeller mounted components may be indicated by normal current readings in ground checkouts (propellers not rotating) but low current with propellers rotating at cruise RPM.

4-3. TROUBLE SHOOTING CHART

Trouble	Probable Cause	Remedy
1. Ammeter snows 0 current all phases of the timer cycle.	a. No power from aircraft.	a. If no voltage into circuit breaker, locate and correct open.
	b. Tripped circuit breaker.	b. Locate and correct short before resetting circuit breaker.
	c. Circuit breaker or switch faulty.	c. If no voltage at circuit breaker output with voltage at input and circuit breaker does not reset, replace circuit breaker. If voltage is OK at output, check switch in same manner. If voltage is OK at switch output, go to Step d.
	d. Ammeter faulty.	d. Test ammeter per Section 4-7.
	e. Open ammeter to timer.	e. Disconnect harness at timer and check for appropriate voltage at harness Pin B (also check Pin A for AC voltage on 115 VAC system) to ground. If none, locate and correct open.

4-3. TROUBLESHOOTING CHART (Continued)

Trouble	Probable Cause	Remedy
1. Ammeter shows 0 current all phases of the timer cycle. (Continued)	f. Open timer to both brush blocks.	f. Disconnect wire harness at brush block and check voltage to ground from appropriate pins or leads. (See de-icing system wiring schematic for power and ground lead and pin identification. Find from Table 4-1). If low or no voltage, locate and correct open or high resistance in wire harness. Check continuity from appropriate pin or lead to ground; if high resistance is indicated, check ground wire for breakage and ground connections for correctness and tightness. Correct as required.
	g. Open in De-Icer, De-Icer wire harness or slip ring assembly *leads.*	g. Disconnect De-Icer leads and check resistance per Report *59-728. If not ok, replace faulty* De-Icer. If ok, check for (and fix) open in slip rings leads. See Section 5-4.5. Where detachable lead/strap De-Icers are used, check De-Icer wire harness leads for continuity. Ohmmeter needle must not flicker when leads are stretched or flexed. Replace as required.
2. Ammeter shows normal current part of cycle, zero current rest of cycle.	a. Open in wiring between timer and brush block assembly, one engine.	a. See 1.f. above.
	b. Open in De-Icer or slip ring assembly leads.	b. See 1.g. above.
	c. Timer faulty.	c. Test timer per Section 3-2.4.
3. Ammeter shows normal current part of cycle, low current rest of cycle.	a. Inner and outer De-Icer elements heating same phase (in series).	a. Locate and repair incorrect lead connections. See wiring schematic (Find from Table 4-1).
	b. Open circuit or high resistance in De-Icer or slip ring assembly leads.	b. See 1.g. above.
	c. High resistance in circuit with low current.	*c. Check contact of brushes to* slip rings per Report 68-04-714; correct as indicated: check wiring from timer to De-Icers for loose or corroded connections or partially broken wiring. Correct as required.

4-3. TROUBLESHOOTING CHART (Continued)

Trouble	Probable Cause	Remedy
4. Ammeter shows low current over entire cycle.	a. Aircraft voltage low under normal operating conditions.	a. Check voltage into switch.
	b. Ammeter, switch, or circuit breaker faulty.	b. Check voltage up to and out of ammeter, switch, and circuit breaker. Test ammeter per Section 4-7. If low output and input ok, replace defective component.
	c. High resistance up to timer.	c. Check for partially broken wire, or loose or corroded connection in wiring between aircraft supply and timer input. Correct as required.
	d. High contact resistance in timer.	d. Test timer per Section 3-2.4.
	e. One De-Icer element (or wiring connections to De-Icer) in each cycle out.	e. Perform a heat test on each De-Icer. Turn De-Icer switch ON, and after locating the De-Icer section being heated, follow the heating cycle as shown in Fig. 2-2 to 2-11 as applicable, feeling each section for heating in turn. Replace defective components.
5. Ammeter shows excess current over entire cycle.	a. Power lead shorted to ground.	a. Check power leads from ammeter to timer and then to De-Icers for evidence of damage or arcing. With de-icing system switch OFF and timer harness disconnected, check insulation resistance (use "Megger") to ground from timer harness Pin B (and Pin A on 115 VAC systems). Disconnect harness at brush block(s) and repeat check for applicable brush block harness Pins. (See wiring schematic - find from Table 4-1.) If ground is indicated, locate and correct it.
	b. Ammeter faulty.	b. Test ammeter per Section 4-7.
6. Ammeter shows normal current part of cycle, excess current rest of cycle.	a. Short to ground or short between adjacent circuits, timer to brush block.	a. Disconnect leads at brush block and timer. With "Megger", check insulation resistance from power leads to ground and between adjacent circuits. If ground or short is indicated, locate and correct.

4-3. TROUBLESHOOTING CHART (Continued)

Trouble	Probable Cause	Remedy
6. Ammeter shows normal current part of cycle, excess current rest of cycle. *(Continued)*	b. Short to ground or between adjacent circuits in brush block.	b. Electrically isolate brush block and test per Section 4-6.
	c. Short to propeller or short between two adjacent circuits - slip rings to De-Icers.	c. Isolate brush block. With "Megger", check insulation resistance from one ring of slip ring assembly to bare prop. Reading should be at least .5 megohms after one minute. If not ok, disconnect the slip ring leads one set at a time to trace short. If ok, disconnect slip ring leads and check insulation resistance between slip rings; reading should be at least .5 megohms after one minute. If not ok, clean assembly thoroughly as in 3-2.2 and retest. Replace as required.
	d. Timer faulty.	d. Test timer per Section 3-2.4.
7. Ammeter does not "flick" between cycles. (Timers with electronic stepping circuits may not "flick" noticeably. See 3-2.4 NOTE. To check for proper cycling, test per 3-1.2.)	a. Timer ground open: timer not cycling.	a. Disconnect harness at timer and check ground connection with ohmmeter from appropriate pin (See Table 3-1).
	b. Timer contacts welded together (caused by short in electrical system).	b. Test timer per Section 3-2.4. If timer is faulty, repair or replace it but insure that short causing original failure has been located and corrected.
8. Ammeter flicks between normal cycle periods (confirm by ground test per paragraph 3-2.7).	a. Loose connection between aircraft power supply and timer input.	a. Trace wiring from power source to timer input. Insure that good electrical contacts are made at each connection in the circuit.
	b. Loose or poor connection: timer to De-Icers.	b. If trouble occurs only part of the cycle, determine which De-Icers are affected and check for rough or dirty slip rings causing brush to skip. Also, check circuits for loose or poor connections. (If all De-Icers on one prop are affected, check ground circuit).
	c. Timer cycles erratically.	c. Test timer per Section 3-2.4 and 4-3.7.a. above.

4-3. TROUBLESHOOTING CHART (Continued)

Trouble	Probable Cause	Remedy
9. Radio noise or interference with De-Icers on.	a. Brushes arcing.	a. Check brush alignment per Report 68-04-714. Check for dirty or rough slip rings. If so, clean, machine or replace slip ring assembly. (See Section 5-4.) Check slip ring alignment per Section 4-5.
	b. Loose connection.	b. See 4-3.8.a and b.
	c. Switch or circuit breaker faulty.	c. Place jumper wire across switch or circuit breaker; if radio noise disappears replace switch or circuit breaker.
	d. Wiring too close to radio equipment or associated wiring.	d. Relocate De-Icer wiring at least 8" from radio equipment and wiring.
10. Cycling sequence not correct.	a. Crossed connections between timer and De-Icers.	a. Check system wiring against circuit diagram. (See Table 4-1 for correct circuit diagram.)
11. Rapid brush wear or frequent breakage.	a. Brush block out of alignment.	a. Check brush alignment per Report 68-04-714. Correct as required.
	b. Slip ring wobbles.	b. Check slip ring alignment with dial indicator per Section 4-5 and figure 4-1.
	c. Rough slip rings.	c. Refinish per Section 5-4.

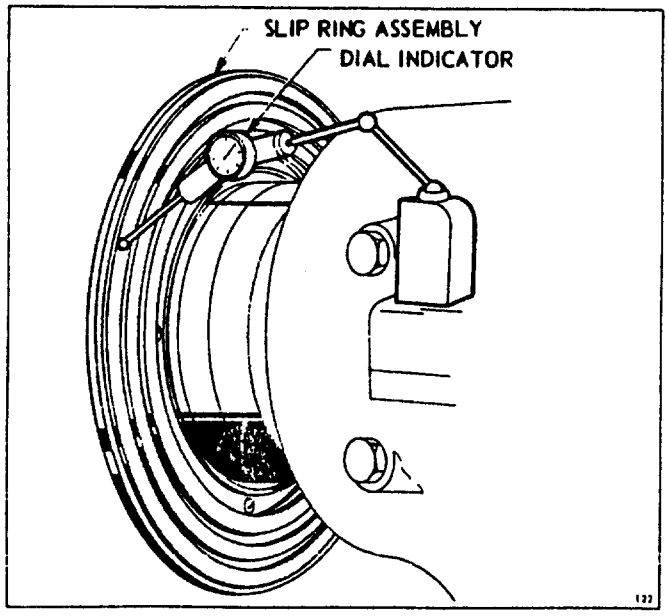


Figure 4-1. Slip Ring Run-Out Test

TABLE 4-1. AIRCRAFT AND SYSTEM IDENTIFICATION AND INFORMATION

(SEE TABLE 4-2. FOR BFG HOT PROP™ APPLICATIONS)

NOTE: ***Propeller de-icing system kit parts lists are available for most aircraft. To obtain one, specify the aircraft and BFG Kit No. from this table, Table 4-2 or Table 6-1, as applicable.***

Aircraft Make and Model No.	BFG Kit No.	De-Icer Strap Bond Area (Dimension Y-In) See Fig. 5.4 Only	De-Icer Location (Dimension X-In) See Figs. 5-2 - 5-12 and 6-3 - 6-8	Normal Current Range (Amps)	Wiring Schematic 4-2 Series/4-3 Series. Use both of Indicated Figures	Timer Ground Pin (A-14 VDC, G-28 VDC)	Notes
Aero Commander — See, also, Rockwell International							
Aero Commander 500	77-140		1/8	8-12	4-2.3/4-3.F	G	
Aero Commander 500A	77-160		1/4	8-12	3/D*	G	*2 blade—3 blade shown
Aero Commander 500A Conv.—See Coleman Enterprises							
Aero Commander 500B, U	77-180		1/2	14-18	3/D	G	
Aero Commander 500B, S, U	77-185-2 -3		1/2	14-18	3/D* 7/D**	G	*Early 185 Kit was factory version of 180 Kit **System may not have ammeter included
Aero Commander 500S, U	77-185-4, -5, -7+	1-3/8	2	14-18	7/D*	G	*System may not have ammeter included +Detachable leads
Aero Commander 560A, 560E, 680, 680E, 720	77-090 77-099* 77-320		1/8 1/8 1/8	14-18 14-18 14-18	3/G 3/A 3/A	G G G	*Conversion Kit 090 to 320 Kit
Aero Commander 560F, 680F, 680FL, 680FP, 680FLP	77-200 77-209* 77-420** 77-420A***		9/16 9/16 9/16 9/16	14-18 14-18 14-18 14-18	3/A 3/A 3/A 9/A	G G G G	*Conversion Kit—200 to 420 Kit **Field Kit ***Factory Kit
Aero Commander 560F, 680F, 680FP, 680FL, 680FLP Conv. See Mr. RPM							
Aero Commander 680T, 680V, 680W, 681	77-520		1-1/8	14-18	8/A	G	
Aero Commander 685	77-580 77-585+	1-5/8	2-1/8 2-1/8	14-18 14-18	8/A 1/A*	G G	+Detachable leads *Ammeter shown—no ammeter used
Aero Commander 690 690A	77-020 77-025+		3/4 3/4	14-18 14-18	7/A* 7/A**	G G	*Resistor shown—no resistor used +Detachable leads **Ammeter shown—no ammeter used
Ahrens AR404	65-220		3/8	14-18*	2/J*	G	3 Blade, 4 Eng. *Per Eng
Aero Star—See Ted Smith							
American Turbine—Westwind (Conv. of Beech 18)	77-560		1	14-18	1/A	G	
Aviocar—See CASA							
Banderrante EMB-110, -121—see Embraer EMB-110, -121							
Beagle B.206	77-015		5/8	14-18	6/A	G	
Beech D18C, D18S, E18S G18S, H18, C45G, C45H TC45G, TC45H	77-100		3/4	14-18	1/A	G	
Beech 18 Conv. See American Turbine, Westwind; Commuter Aircraft Corp.; Dee Howard; Volpar							
Beech N35, P35, S35 V35, V35A, V35B, 35-33, 35-A33, 35-B33, 35-C33, 35-C33A, E33, E33A, E33C, F33, F33A F33C, G33, 36, A36	77-640* 77-740**		13/16 3/16	20-24 30-34	1/L 1/K	A A	*McCauley 2-blade prop. **McCauley 3-blade prop.
Beech S35, V35, V35A 35-C33, 35-C33A, E33A	77-650		1/8	30-34	1/K	A	Hartzell 3-blade prop.
Beech E50, F50, G50, H50, J50, 65	77-129* 77-070		1/8 1/8	14-18 17-21	1/H 1/E	G G	*Conv. Kit 070 to 120 Kit Brush block gnd at mtg. bkt.
Beech E50, F50, G50, H50, J50, 65, 65-A80, 65-B80, 70	77-120		5/8** 1/8**	14-18	1/H	G	*Large Spinner **Small Spinner
Beech D55, D55A, 95-C55, 95-C55A	77-250		5/8	14-18	1/A	G	
Beech B55, E55	65-050* 65-055** 65-070*+ 65-075**+	1 1-1/4	1-3/4 1-15/16 1-3/4 1-15/16	8-12 14-18 8-12 14-18	1/B 1/A 1/B 4-2.1/4-3.A	G G G G	*2-blade prop. **3-blade prop. +Detachable leads

TABLE 4-1. AIRCRAFT AND SYSTEM IDENTIFICATION AND INFORMATION (continued)

Aircraft Make and Model No.	BFG Kit No.	De-Icer Strap Bond Area (Dimension Y-In) See Fig. 5.4 Only	De-Icer Location (Dimension X-In) See Figs. 5-2 - 5-12 and 6-3 - 6-8	Normal Current Range (Amps)	Wiring Schematic 4-2 Series/4-3 Series. Use both of Indicated Figures	Timer Ground Pin (A-14 VDC, G-28 VDC)	Notes
Beech 56TC, 60	77-040* 77-045*+ 77-260**	1-3/8 1-1/2	2 2 1-7/8	14-18 14-18 8-12	4-2.1/4-3.A 1/A 1/B	G G G	*3-blade prop. +Detachable leads **2-blade prop.
Beech 56TC with Allison Turbine Engine	77-860		1/8	14-18	1/A	G	
Beech 58	77-590*M 77-890**M 65-060*H 65-065**H 65-080*H+ 65-085**H+	 1 1 	7/8 7/16 1-3/4 1-3/4 1-3/4 1-3/4	8-12 14-18 8-12 14-18 8-12 14-18	1/B 1/A 1/B 1/A 1/B 1/A	G G G G G G	*2-blade prop. **3-blade prop. M-McCauley prop. H-Hartzell prop. +Detachable leads
Beech 58P	65-080*+ 65-085**+		1-3/4 1-3/4	8-12 14-18	1/B 1/A	G G	*Hartzell 2-blade prop. **Hartzell 3-blade prop. +Detachable leads
Beech 65-A85, 65-A88	77-290		1/4	14-18	1/A	G	
Beech 65-90 Series*	77-400		3/16	14-18	9/A	G	*NonReverse Pitch
Beech 65-90 Series*, 90 Series, 99 Series, 100 Series, 200	77-500 77-505 77-509** 65-100+		1 1 1 1	14-18 14-18 14-18 14-18	9/A 9/A 9/A 1/A	G G G G	*Reverse Pitch **Conversion Kit 400 to 500 Kit +Detachable leads
Beech C90, E90	65-145+	1	1-11/16	14-18	1/A	G	+Detachable leads.
Beech 95	77-050		1/8	8-12	1/F	G	Brush block gnd. at mtg. bkt.
Beech 95-55, 95-A55, 95-B55	77-230		5/8	14-18	1/A	G	
Beech A100	77-900+		1/2	17-21	S	G	+Detachable leads
Beech B100	65-125+		1	17-21	9/A*	G	*4-blade—3-blade shown Circuit breakers are used in lines C, D, E & F +Detachable leads
Beech 1079	77-780		1/4	5.5-7.5	R*	G	*Special—115 VAC System
Britten Norman BN-2 Series	77-810* 77-815**	 1-3/8	2-1/4 2-1/4	8-12 8-12	2/B 2/B	G G	*Lycoming O-540-E4B5 engine **Lycoming IO-540-K1B5 engine
Britten Norman BN-2A Mark III	77-880	1-1/2	2-1/4	8-24	2/B*&P	G	*3 engine, 2 blade; 2 timers operated through one DPST switch— one for front engs., one for back engine
Cardstedt CJ-600	77-840+		1	14-18	2/A	G	+Detachable leads
CASA (Construcciones Aeronauticas SA) C-212 Aviocar (with metal blades)	65-015* 65-105**+		1-1/4 1	14-18*** 17-21***	N**** N****	G G	*3-blade **4-blade ***Each engine ****On 3E1555-1 Timers pins E and F are not used. Other connections are as shown +Detachable leads
Cessna 210 Series	77-600 77-690 77-700 77-750 77-760 77-790		13/16 13/16 13/16 13/16 3/16 3/16	20-24 8-12 30-34 8-12 14-18 14-18	1/P 1/P 1/J 1/P* 1/J* 1/J	A G A G G G	2-blade, 14 VDC 2-blade, 28 VDC 3-blade, 14 VDC 2-blade, 28 VDC 3-blade, 28 VDC 3-blade, 28 VDC *No ammeter
Cessna 310, 310A to H	77-080		3/16	8-12	1/C	G	Field Kit, Hartzell prop. Brush block gnd. at mounting bracket
Cessna 310, 310A to I	77-280		3/16	8-12	5/C	G	Factory Kit, Hartzell or McCauley prop.
Cessna 310 Conv.—See Riley, Turbo—Propulsion							
Cessna E310J, 310J, K, L, N, T310P, T310Q, 340	77-480		5/8	8-12	9/B	G	2-blade prop.
Cessna 310 K, L, N	77-330		1-1/2	14-18	9/A	G	3-blade prop.
Cessna 320, 320A to C	77-370		5-8/M, 1/8H	8-12	4-2.5/4-3.D*	G	M-McCauley prop. H-Hartzell prop. *2-blade prop.—3-blade shown

TABLE 4-1. AIRCRAFT AND SYSTEM IDENTIFICATION AND INFORMATION (continued)

Aircraft Make and Model No.	BFG Kit No.	De-Icer Strap Bond Area (Dimension Y-In) See Fig. 5.4 Only	De-Icer Location (Dimension X-In) See Figs. 5-2 - 5-12 and 6-3 - 6-8	Normal Current Range (Amps)	Wiring Schematic 4-2 Series/4-3 Series. Use both of Indicated Figures	Timer Ground Pin (A-14 VDC, G-28 VDC)	Notes
Cessna 320D, E, F	77-350		1-1/2	8-12	4-2.9/4-3.B	G	Factory Kit, 2-blade prop
Cessna 320D, E, F, 340, 401 and 402 Series	77-570		5/8	14-18	9/A	G	Factory Kit, 3-blade prop.
Cessna 337 Series	77-390		3/4	8-12	2/L	G	
Cessna 411, 411A, 414, 421 Series	77-410		3/16H, 5/8M	14-18	9/A	G	H-Hartzell prop. M-McCauley prop.
Cessna 425	65-280		1-11/16	14-18	2/J*	G	Hartzell props. *Twin engine two timer system, one engine shown
Cessna 441	65-155		1-5/8	14-18	9/J*	G	Hartzell props. *Twin engine two timer system, one engine shown
Colemill Enterprises PA31 Series Conversion	65-225		2	17-21	6/X	G	
Coleman Enterprises Conv. of Aero Comm. 500A	77-510		5/8	14-18	3/A	G	Continental IO-520E engine, Hartzell props.
Commuter Aircraft Corporation Conv. of Beech 18	77-300		1/8	17-21	1/B	G	Hamilton standard props
Czech Turbolet 410	65-030+		1	14-18	1/A	G	3-blade +Detachable leads
Czech Turbolet 410L	65-110+		1/2	17-21*	N**	G	*Each engine **4-blade—3-blade shown +Detachable leads
Dee Howard Conv. of Beech 18 and Grumman Goose	77-960		1	14-18	1/A	G	Turboprop
DeHavilland DHC-6	77-490* 65-090*+		1 1	14-18 14-18	9/A 9/A	G G	*Factory Kit +Detachable leads
Embraer EMB-110	65-120+		3/8	26-30	2/A*	G	*5-blade—3 blade shown +Detachable leads
Embraer EMB-121	77-910+		1-11/16	14-18	1/A	G	+Detachable leads
Fairchild-Hiller Turbo Porter	77-680		1	14-18	1/J	G	AiResearch engines
Frakes Conv. of Nord 262	77-970+		5/16	26-30	*	G	+Detachable leads *5-blade special system—see aircraft manual
FUGI 300-12—See Rockwell 700							
GAF (Government Aircraft Factories—Australia) Nomad N-22	65-005+		1/16	14-18	6/A	G	+Detachable leads
Grumman Goose—See Dee Howard							
Handley Page HP137MK3M	77-440		1-11/16	5.5-7.5	U*	G	*Special—115 VAC System
Handley Page Conv.—See Riley							
Interceptor 400	77-610		1-11/16	14-18	1/J	G	
Israel Aircraft Industries Arava	65-035+		1	14-18	N*	G	*Connections are shown to E & F terminals of timer No connections to these pins are used +Detachable leads
Martin-Marietta Program 245	77-710	1-3/8	2	14-18	9/J	G	
Miller Conv. of Piper PA-30, PA-39	77-430	1-1/2	2-3/16	17-21	1/B	A	
Mitsubishi MU-2 Series	77-190 77-195+ 65-165+		1 1 1/2	14-18 14-18 17-21	1/A 1/A 9/A*	G G G	+Detachable leads *4-blade—3-blade shown
Mr. RPM Conv. A/C 560F, 680F, 680FP, 680FL, 680FLP	77-930		3/4	14-18	3/A	G	
North American Rockwell—See Aero Commander and Rockwell International							

TABLE 4-1. AIRCRAFT AND SYSTEM IDENTIFICATION AND INFORMATION (continued)

Aircraft Make and Model No.	BFG Kit No.	De-Icer Strap Bond Area (Dimension Y-In) See Fig. 5.4 Only	De-Icer Location (Dimension X-In) See Figs. 5-2 - 5-12 and 6-3 - 6-8	Normal Current Range (Amps)	Wiring Schematic 4-2 Series/4-3 Series. Use both of Indicated Figures	Timer Ground Pin (A-14 VDC, G-28 VDC)	Notes
Pacific Airmotive Conv. of Beech 18—See American Turbine							
Pacific Propeller Conv. of Pilatus Porter	77-630		1	14-18	1/K	G	
Partenavia P68	77-030	1-1/2	2-3/16	8-12	4-2.1/4-3.B	G	
Piaggio RP196-3	65-010+		3/4	29-33	4-2.2/4-3.A*	G	*4 eng.—2 eng. shown; wiring to additional engines is parallel to that shown—hook-ups are the same +Detachable leads
Pilatus PC-6	77-675+		1	14-18	1/J	G	+Detachable leads
Piper Aerostar—See Ted Smith							
Piper PA-23, PA-23-160	77-060		1/8	17-21	1/C	A	
Piper PA-23-250, PA-23-250 (6-place)	*77-110*		*1/8*	*17-21*	*1/C*	A	
Piper PA-23-250	77-150		1/2	30-34	1/A	A	Lycoming IO-540 engines 3-blade Hartzell props.
Piper PA-23-250, PA-E23-250, S/N 27-2505 and up	77-170* 77-870**	1 1	1-7/8 1-7/8	17-21 8-12	6***/B 6***/B	A G	*14 VDC only **28 VDC only ***Add jumper to existing instrument lights for lighted rocker switch
Piper PA-30	77-830	1-1/4	1-7/8	17-21	2/B	A	
Piper PA-30, PA-39 Conv.—See Miller							
Piper PA-31 Series, non-pressurized	77-240* 77-340** 77-349***	1 5/8 5/8	1-7/8 1-3/4 1-3/4	8-12 14-18 14-18	2/B 2/A 2/A	G G G	*2-blade **3-blade ***Conversion Kit, 240 to 340
Piper PA-31 Series, pressurized	77-940		2-5/16	14-18	6/A	G	
Piper PA-31-350, Air cond. and non-air cond.	77-845	1-1/4	1-3/4	14-18	2/A	G	
Piper PA-31T	65-040+		1	22-26*	T**	G	+Detachable leads *Each engine **Special system
Piper PA-32-260	77-660	1-1/4	1-3/4	20-24	1/C*	A	*Single engine—*2-engine shown*
Piper PA-34-200	77-220	1-1/8	1-5/8	17-21	6*/B	A	*Add jumper to existing instrument lights for lighted rocker switch
Piper PA-34-200T (with 2 blade Hartzell Prop)	65-115+		2	20-24	6*/B	A	*Add jumper to existing instrument lights for lighted rocker switch +Detachable leads
Piper PA-41P	77-875		1-7/8	8-12	6/B	G	
Piper Navy UO-1	77-310		1/8	8-12	1/C	G	
Polygrat PD-101	65-175+		3/8	26-30	2/A*	G	*5-blade—3-blade shown +Detachable leads
Potez 841	77-460		1	29-33	1/A*	G	*4-engine, 2-eng. shown
Riley Conv. of Cessna 310 Series A to G	77-380		1/2	14-18	1/A	G	
Riley Conv. of Handley Page Jetstream	65-095+		1	14-18*	N**	G	*Each engine **Pins E & F not connected on 3E1555-1 timer; connect as shown for 3E1150-3 use +Detachable leads
Riley 414-8	65-185		2	17-21	X	G	
Riley 421 Conv.	65-320		1	14-18	2/G	G	
Rockwell International—See, also, Aero Commander							
Rockwell International 700 (FUGI 300-12)	65-135+		2-3/16	14-18	2/A	G	+Detachable leads
Rockwell International 710	65-160+		1-3/4	14-18	2/A	G	+Detachable leads

TABLE 4-1. AIRCRAFT AND SYSTEM IDENTIFICATION AND INFORMATION (continued)

Aircraft Make and Model No.	BFG Kit No.	De-Icer Strap Bond Area (Dimension Y-In) See Fig. 5.4 Only	De-Icer Location (Dimension X-In) See Figs. 5-2 - 5-12 and 6-3 - 6-8	Normal Current Range (Amps)	Wiring Schematic 4-2 Series/4-3 Series. Use both of Indicated Figures	Timer Ground Pin (A-14 VDC, G-28 VDC)	Notes
Rockwell International 690C & 695	65-330		1-3/4	14-18	7/A	G	Dowty Rotol Props
RPM—See Mr. RPM							
Saunders ST-28	65-150+		1/2	17-21	4-3.S	G	+Detachable leads
Short Brothers (Shorts) SC7 Series 3	77-950* 77-955+ 77-980** 65-045***+		1-11/16 1-11/16 1 1	14-18 14-18 17-21 17-21	4-2.3/4-3.A 3/A 2/A** 2/A***	G G G G	3-blade **4-blade, std. rotating ***4-blade, counter rotating +Detachable leads
Short Brothers (Shorts) SD3-30	77-970+		5/16	26-30	V	G	+Detachable leads
SIAI Marchetti	77-850	1-1/2	2-3/16	8-12	5/B	G	
Swearingen Merlin II, IIA (SA26-T)	77-530* 77-540**		1 1	14-18 14-18	2/A 1/A	G G	*Non-Reverse Pitch **Reverse Pitch
Swearingen Merlin 11B (SA26-AT)	77-920		1-11/16	14-18	9/M	G	
Swearingen Merlin 11B, Merlin III, Merlin IV, Metro (SA26-AT, SA226-T, SA226-AT, SA226-TC)	65-020 65-025+		1-11/16 1-11/16	14-18 14-18	N* N*	G G	*Special system +Detachable leads
Swearingen Merlin III SA226-T(B)	65-210+*		1	17-21	3/Y	G	*4-blade +Detachable leads
Ted Smith Aerostar 600, 601, 601P	77-990 77-995+	1-3/8	2 2	14-18 14-18	6/A 6/A	G G	+Detachable leads
Ted Smith 800P	65-170	1-3/8	2	17-21	6/A	G	4-blade—3 blade shown
Turbo-Propulsion Conv. of Cessna 310	77-360	1-1/4	1-3/4	14-18	1/A	G	
Volpar Conv. of Beech 18	77-550+		1	14-18	4-2.1/4-3.A	G	Turbo prop. +Detachable leads

TABLE 4-2 AIRCRAFT AND SYSTEM IDENTIFICATION AND INFORMATION FOR BFG HOT PROP™ APPLICATIONS.

Aircraft Make and Model No.	BFG Kit No.	De-Icer Strap Bond Area (Dimension Y-In)	De-Icer Location (Dimension X-In)	Normal Current Range (Amps)	Wiring Schematic Use both of Indicated Figures	Timer Ground Pin (A-14 VDC, G-28 VDC)	Notes
Beech Bonanza V35, S35, 35-C33A	67-150** 67-270* 67-275** 67-140++	9/16 9/16 1/2 3/16	13/16 13/16 3/4 3/8	20-24 5-12 14-18 30-34	11/AA 11/AA 11/Z 11/Z	A G G A	+2 blade 14 VDC *2 blade 28 VDC **3 blade 28 VDC ++3 blade 14 VDC
Beech Baron E55, 58, 58P, 58TC	67-125		1-3/4	14-18	1/AD	G	3 blade Hartzell
Beech Baron E55 & B-55	67-215* 67-220+		1-3/4 1-15/16	8-12 14-18	1/AB 1/AD	G G	*2 blade +3 blade
Beech Baron E55 & 58	67-135		1-3/4	8-12	1/AB	G	2 blade (with air conditioning)
Beech 60	67-240		2	14-18	1/AD	G	
Beech C90, E90, C99, 200	67-280		1	14-18	1/AD	G	
Beech F90, A100	67-250		1/2	17-21	4.3AE	G	
Beech B100	67-265		1	17-21	9/AF	G	
Casa C212-10	67-110		*	24-28	4.3AC	G	*Hartzell composite blades follow blade contour
Cessna TR182	67-105	5/8	1	8-12	9/Z	G	
Cessna 210J, 210K, T210H, T210J, T210K	67-285	3/16	3/8	14-18	11/Z	G	3 blade McCauley
Mooney 231	67-310		1-1/2	8-12	2/P	A	
Mooney 201	67-155		1-3/4	8-12	2/P	A	
Piper PA34-200T	67-100* 67-195+		3/8 1-7/8	29-33	10/AD	A	*McCauley 3 blade +Hartzell 3 blade
Piper PA32-300T	67-120* 67-160**	3/4 —	1-1/2 1/2	8-12 14-18	10/P 10/W	A A	*2 blade **3 blade
Piper PA44-180	67-130* 67-145**		1-3/4 1-7/8	17-24 29-33	10/AB 10/AD	A A	*2 blade **3 blade

4-4. DE-ICER RESISTANCE CHECK

To determine incorrect resistance, short or open at the brush-to-slip ring contact, disconnect harness at the brush block and use an accurate low range ohmmeter or Wheatstone bridge to read resistance from each De-Icer circuit lead (Pins A, B or C of brush block. See Table 4-1 for correct wiring schematic) to brush block ground pin. The resistances should be as shown in Report 59-728. If not, disconnect De-Icer lead straps or De-Icer wire harnesses at the spinner bulkhead or starter ring gear and measure heater resistance individually. If first check is off limits but second check is ok, the trouble is probably in the brush-to-slip ring area; if the second check is off limits, the De-Icer or wire harness concerned is damaged and should be replaced.

4-5. SLIP RING RUN-OUT TEST

Severe arcing and brush wear often occur when there is a "wobble" in the starter ring gear or slip ring assembly. The wobble occurs because the slip rings do not run in a plane perpendicular to the center line of rotation of the propeller shaft. This condition, if allowed to exist, will cause rapid deterioration of the slip ring-brush contact surfaces and lead to the eventual failure of the de-icing system.

To alleviate this condition, insure that the slip rings deviate no more than ± .0025" for piston engines (± .004" for turbine engines) from a plane perpendicular to the center line of rotation of the propeller shaft.

PROCEDURE

1. Securely attach a dial indicator gauge, or equivalent, to the engine crankcase such that a reading of the slip ring wobble can be made. (See figure 4-1.)

2. Grasp the propeller blade and rotate it slowly, noting the deviation of the slip rings from a true plane as indicated on the gauge.

NOTE

Due to the loose fit of some propeller thrust bearings, a considerable error may be induced in the readings by pushing the propeller in or out. Care must be taken to exert a uniform push or pull on the propeller so as to hold this error to a minimum.

3. If the deviation measured is within ± .0025" (.005" total deviation) or ± .004" (.008" total deviation) as applicable, and does not exceed .002" in any 4" of slip ring travel, no further action is necessary.

4. If the total deviation exceeds .005" (.008") or .002" within any 4" of slip ring travel, note the amount and location of the deviation.

For starter ring gear mounted slip ring assemblies and slip ring assemblies mounting directly between prop shaft and engine flanges, remove assembly from engine, clean mounting surfaces, reinstall and recheck. If readings are still not within the limits given and refacing per Section 5-4 does not correct this problem, return the assembly to BFGoodrich. For all other types of slip ring assemblies, align per steps 5 through 8.

5. Vary the torque of the attachment bolts over the range of: 65-100 in-lbs. for 1/4-28 bolts, screws or hylock pins, 21-32 in-lbs. for 10-32 screws or bolts, or 100-150 in-lbs. for 5/16-24 bolts. Where belleville washers are used, vary the torque from 40-100 in-lbs.

Do not shim or vary torque of propeller attachment bolts!

6. If the deviation of the slip rings is still excessive, make small (up to .005" max.) washer-shaped shims and place them on the attachment bolts (limit one per bolt) between the slip ring assembly and its mounting surface. Again, vary the torque of the attachment bolts and repeat Step 2.

7. Adjust the shim height and vary the torque until the slip rings run true within the prescribed tolerance. If rings will not adjust within tolerance, check the flatness and structural integrity of the mounting surface. Correct as necessary. If mounting surface is satisfactory, remove slip ring assembly, clean per Section 3-2.2, place on a flat surface and recheck runout. Resurface per Section 5-4, as necessary, reinstall and realign.

8. After properly aligning the slip rings, check the brush block assembly for proper alignment with respect to the slip rings and adjust, if necessary. (See Report 68-04-714).

4-6. BRUSH BLOCK OR BRUSH MODULE RESISTANCE CHECK

To determine when open or short circuit or high resistance is present in brush block or brush module, use low range ohmmeter to measure resistance from face of brush to its receptacle pin. Probe contacting brush should have an area of 1/16 sq. in. min. If over 0.013 ohms, locate and repair cause of excessive resistance or replace brush or module. Check the insulation resistance between the three terminal studs or connector pins, also check from pins to connector housing; it should not be less than .5 megohms after one minute. If it is, check for a short between brush leads. Using instructions for brush replacement in Report 68-04-714, replace insulating tubing as required to correct short.

4-7. AMMETER CHECKOUT

To determine if the De-Icer ammeter is operable, check out as follows:

1. Determine whether ammeter is internally or externally shunted.

a. Examine lower right corner of ammeter face for notation of full scale (FS) deflection.

b. Internally shunted ammeters have the notation "FS = 30 Amps" or "FS = 40 Amps". (Ammeters for AC systems are internally shunted and have the notation FS = 10 Amps.)

c. Externally shunted ammeters have the notation "FS = 50 MV" (millivolts). Scale ranges are 0-30 or 0-50 amps. The external shunts have the notation "30 Amps = 50 MV" (use with 0-30 amp range ammeter) or "50 Amps = 50 MV" (use with 0-50 amp range ammeter). Insure that ammeter and shunt are correctly matched.

2. Check for good electrical connections at terminals of ammeter and shunt (if used). Power lead from bus bar must be connected to the + (Positive) terminal of an internally shunted ammeter. Where external shunt is used, the + terminal of the ammeter must be connected to the same shunt post as the power lead from the bus bar.

3. ELECTRICAL CHECK:

a. For internally shunted meters, connect an equivalent range, calibrated ammeter (accuracy ± 2% F.S. or better) in series with the meter. Turn de-icing system switch ON and check ammeter readings. They should be the same. If not, replace De-Icer ammeter.

b. To check shunt of externally shunted meters, disconnect the meter leads at the shunt and connect a volt-ohmmeter (or equivalent) with a millivolt scale in its place. Turn de-icing system switch ON and check millivolt reading. If De-Icer ammeter scale is 0-50, reading on millivoltmeter will fall within or close to the values for the shaded range (normal operating current range) on the De-Icer ammeter (see also, Table 4-1). If scale is 0-30, reading obtained will be 1⅔ (167%) times the shaded range. For example, if shaded range is 14-18 amps, reading should be about 23.3 to 30 millivolts.

To check meter, use alternative shunt of proper value and check for correct reading with de-icing system switch ON. Meter may be checked without shunt by using a good, adjustable 0-50 millivolt source. If readings from ammeter and shunt do not closely agree, replace defective component.

NOTE

3E1886 ammeter is adjusted to compensate for 0.2 ohm (total) shunt leadwires. When testing use equivalent resistance in series with meter.

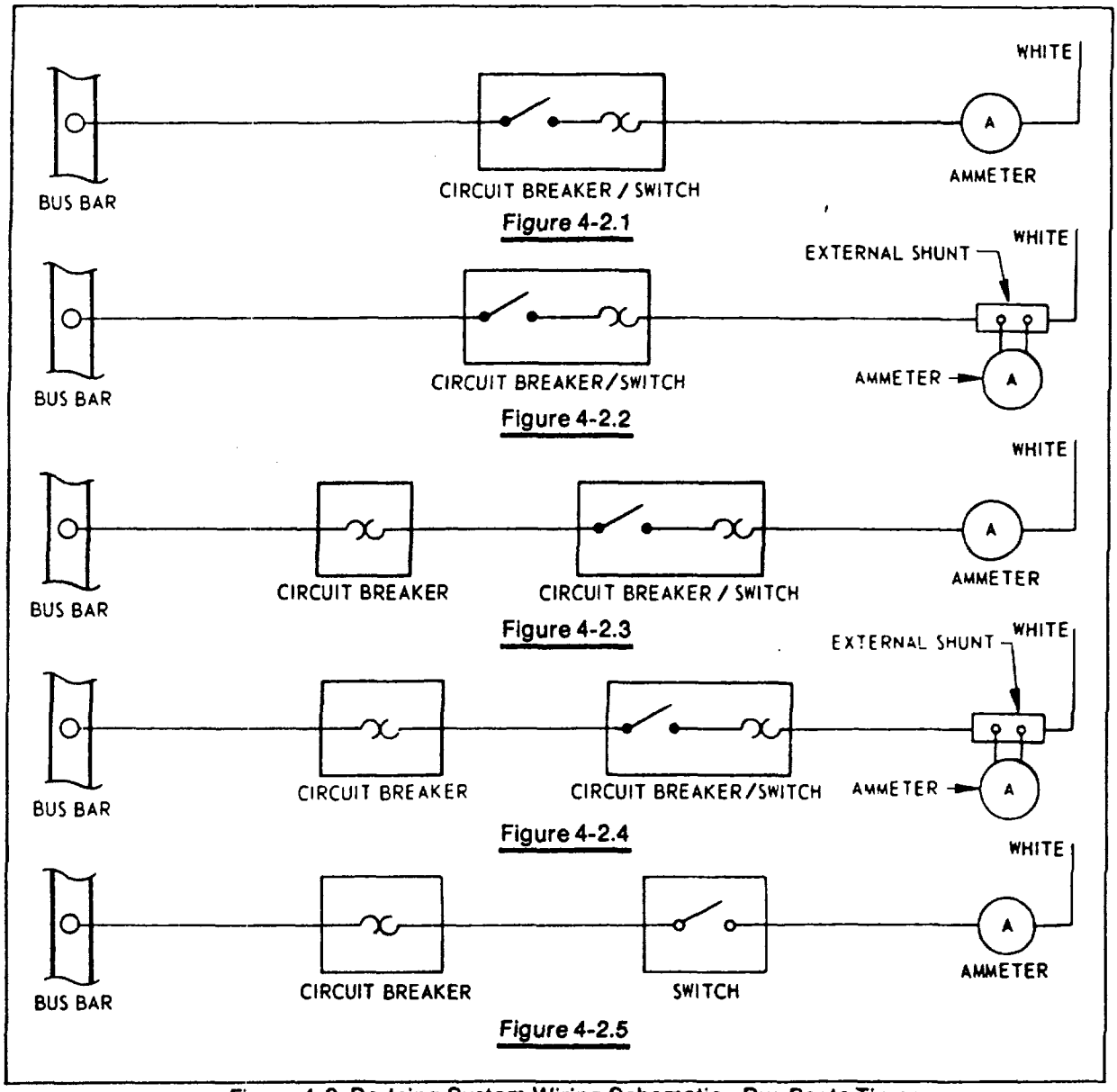


Figure 4-2. De-Icing System Wiring Schematic - Bus Bar to Timer

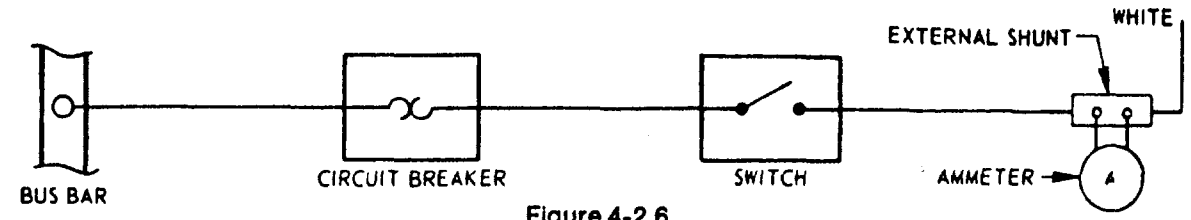


Figure 4-2.6

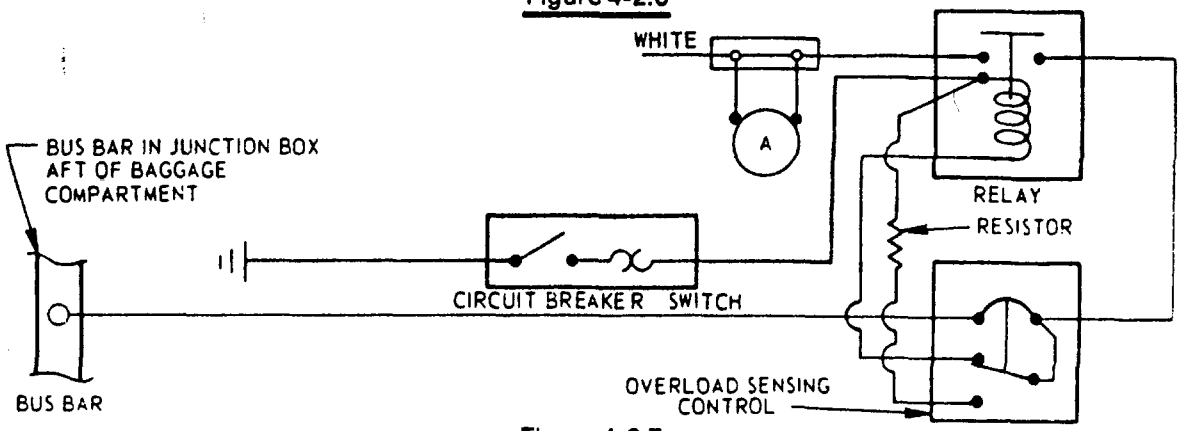


Figure 4-2.7

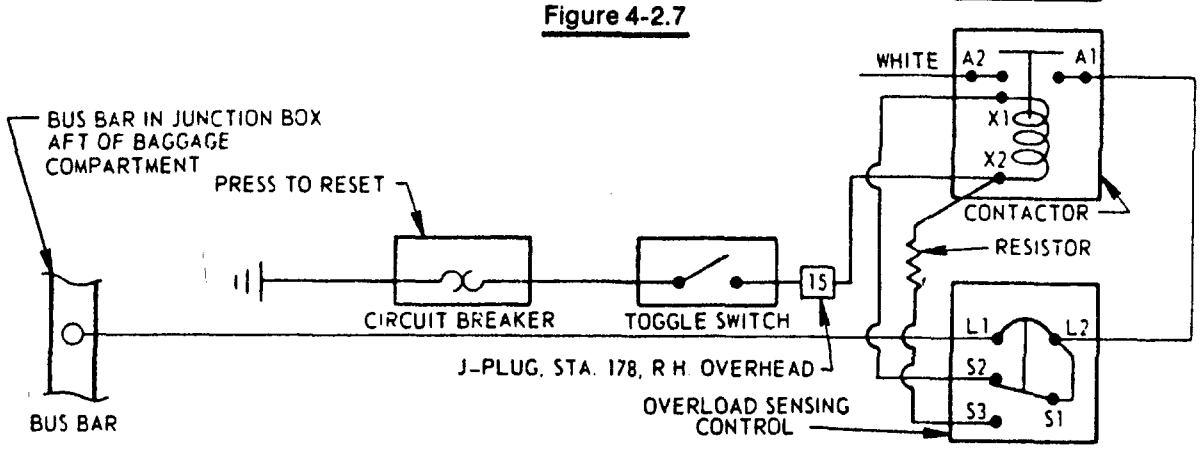


Figure 4-2.8

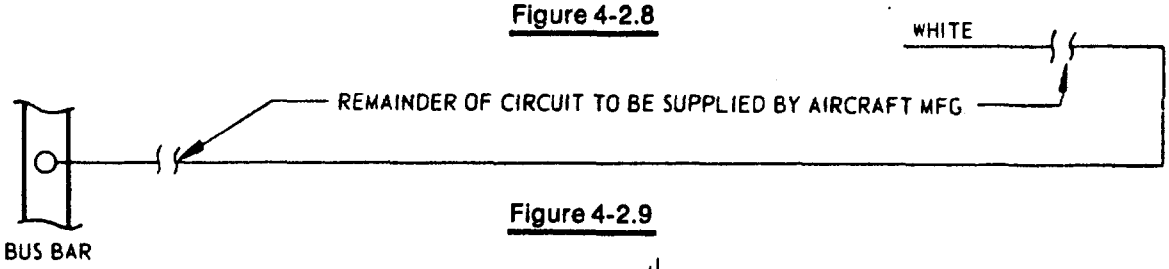


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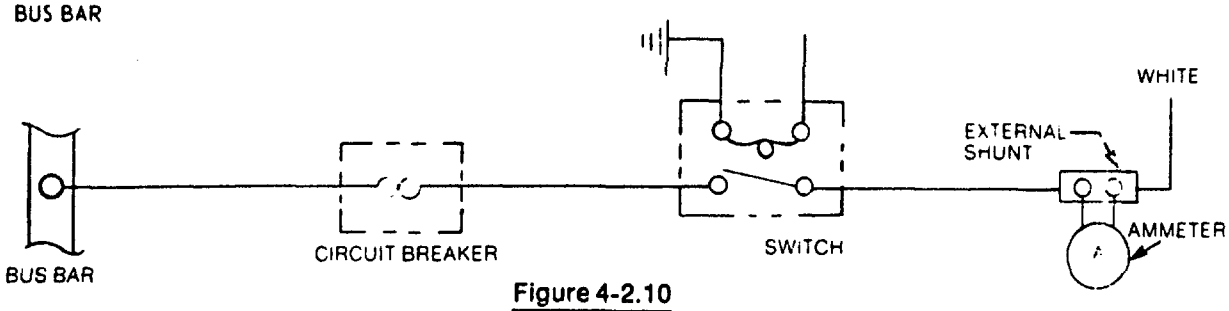


Figure 4-2.10

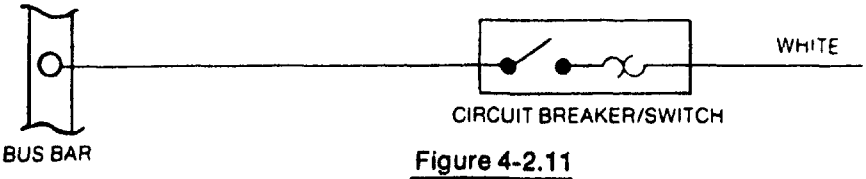


Figure 4-2.11

Figure 4-2. De-Icing System Wiring Schematic - Bus Bar to Timer (Continued)

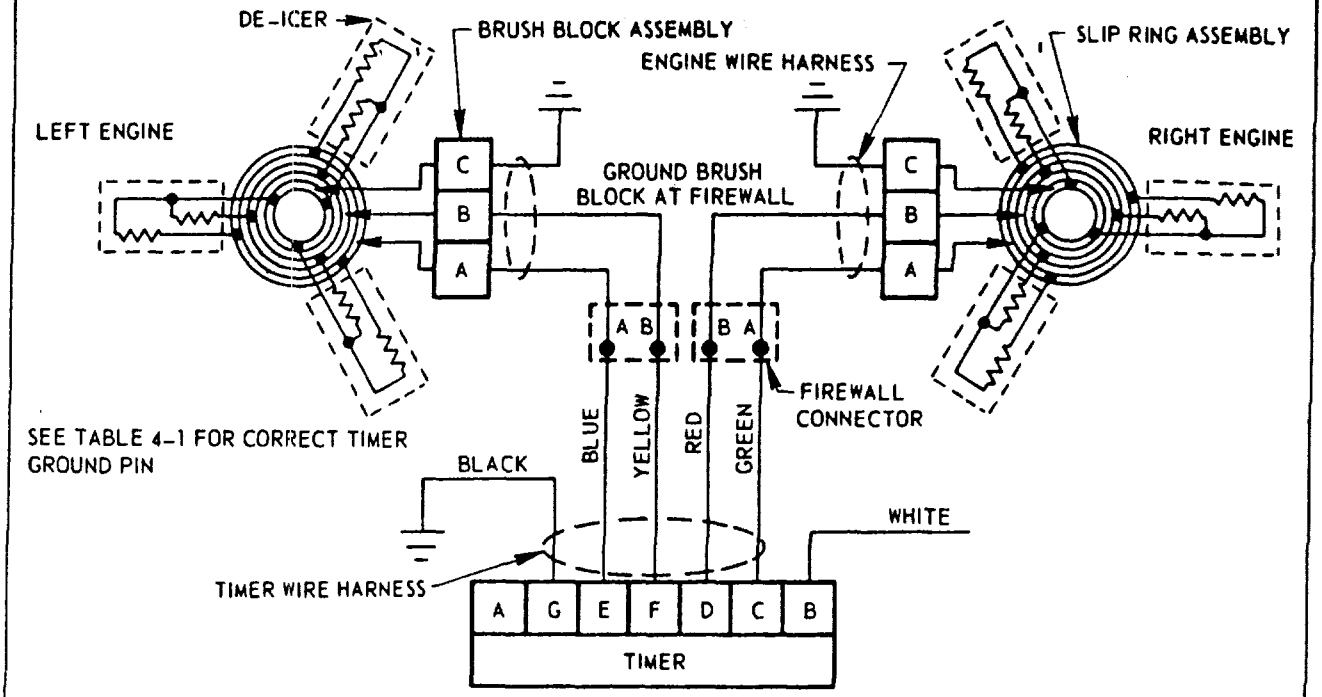


Figure 4-3.A

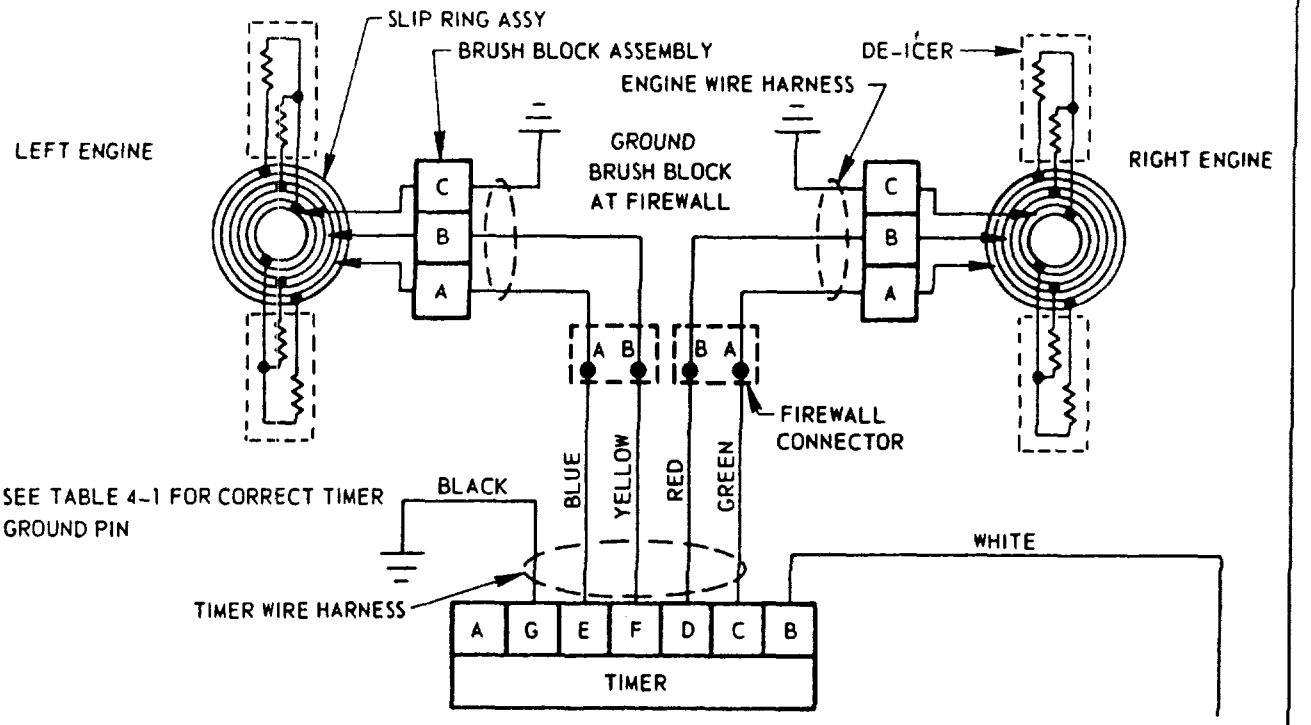


Figure 4-3.B

Figure 4-3. De-Icing System Wiring Schematic - Timer to De-Icers

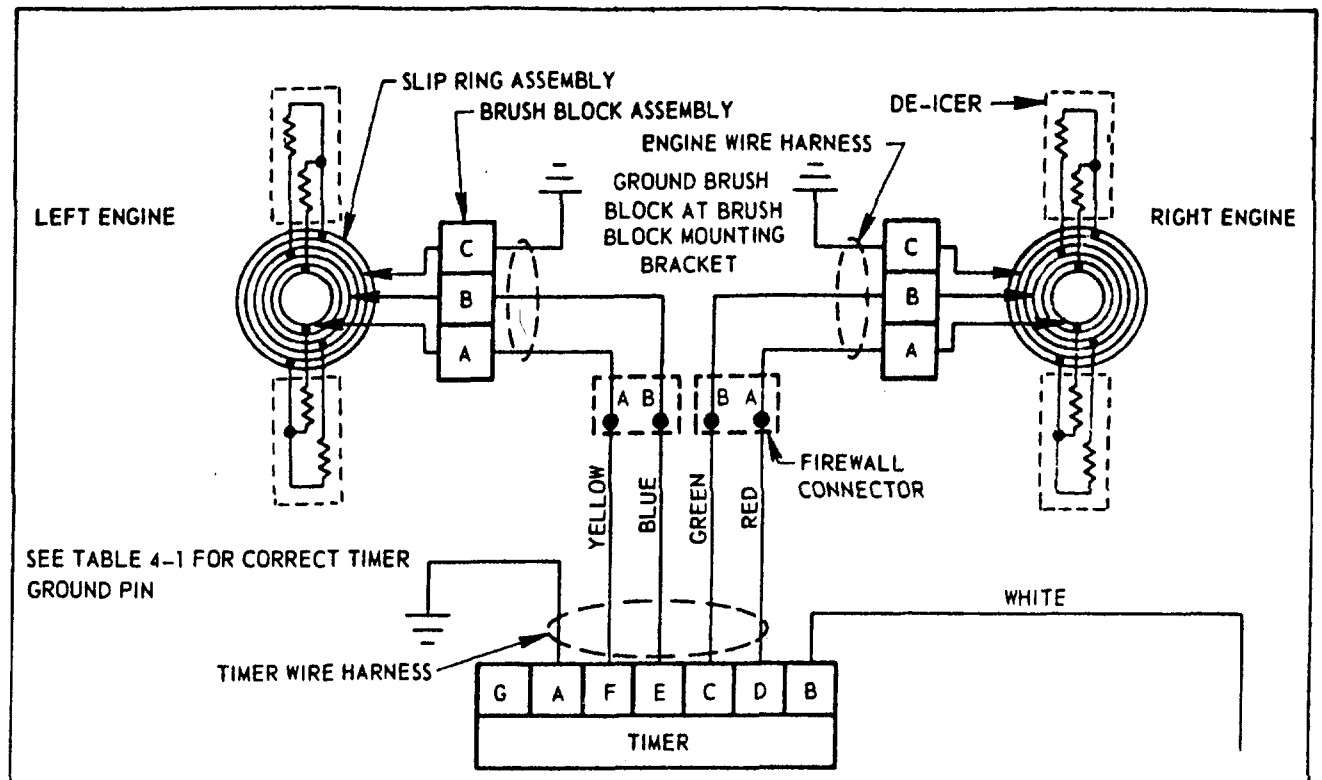


Figure 4-3.C

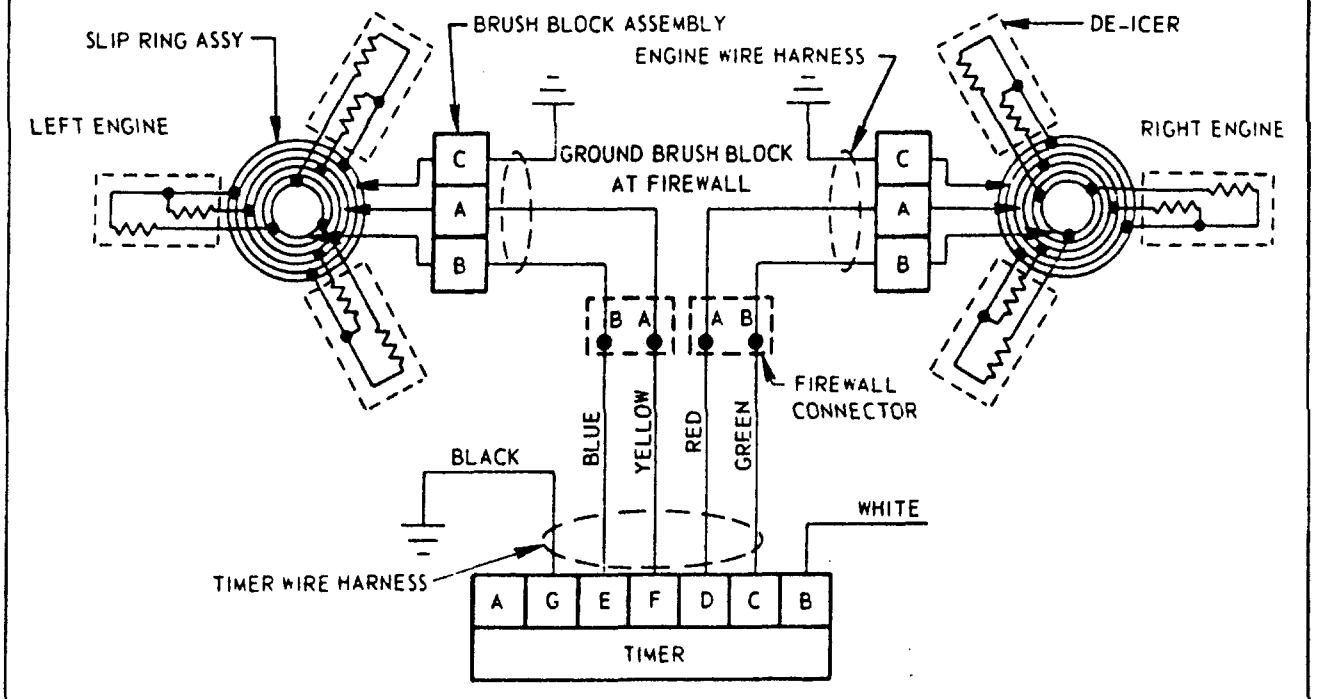


Figure 4-3.D

Figure 4-3. De-Icing System Wiring Schematic - Timer to De-Icers (Continued)

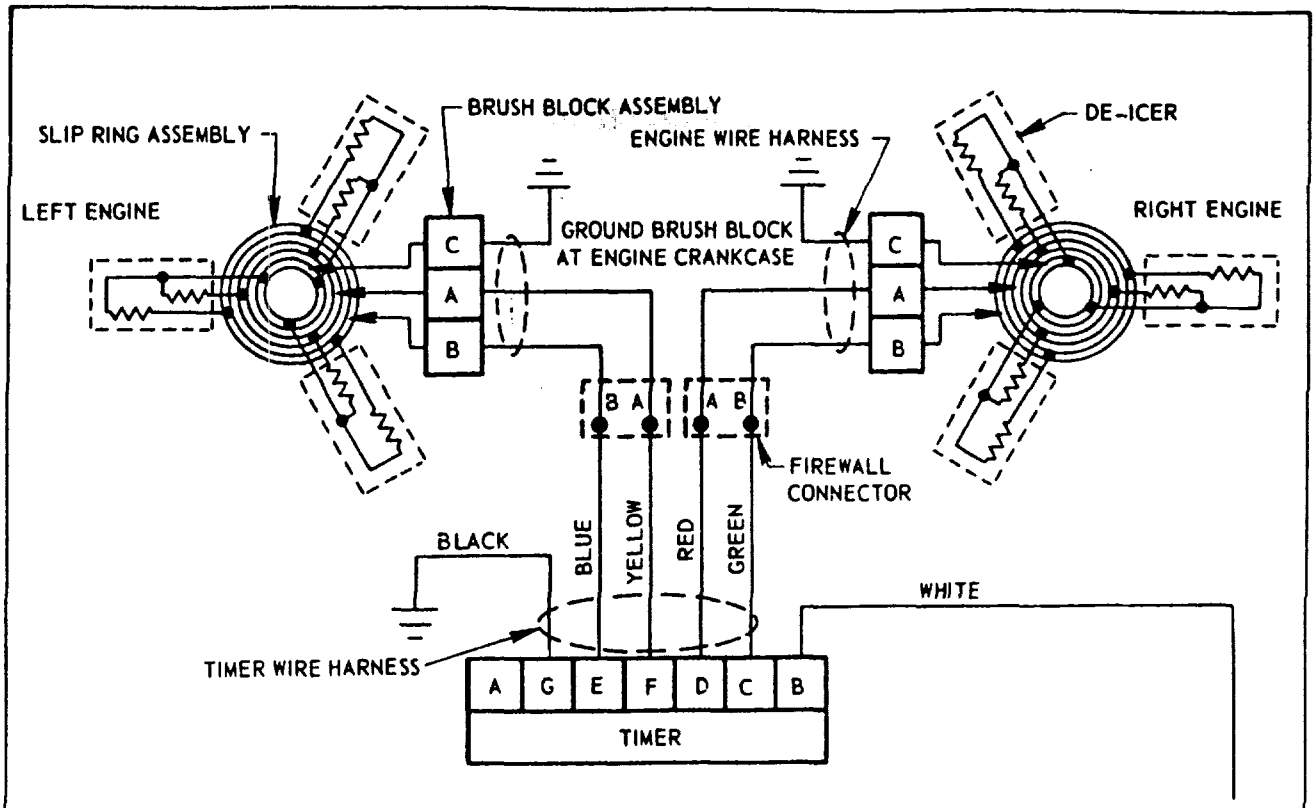


Figure 4-3.E

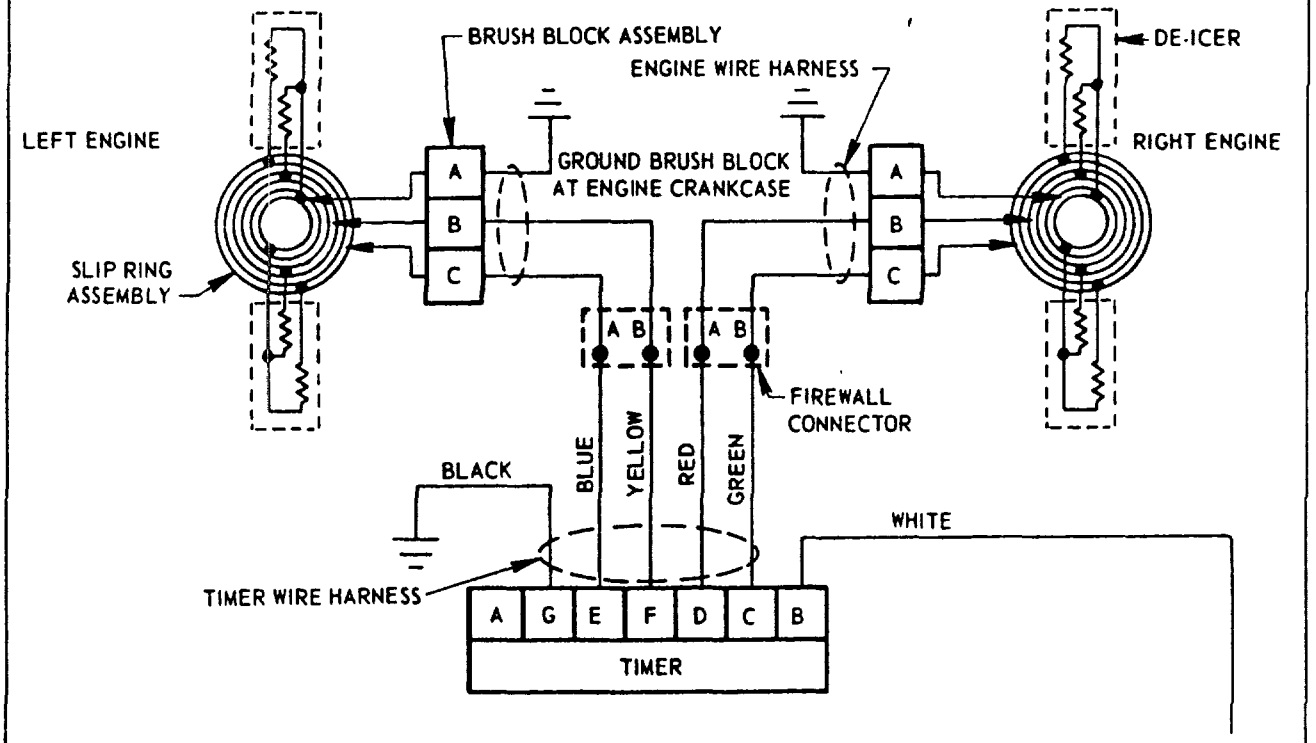


Figure 4-3.F

Figure 4-3. De-Icing System Wiring Schematic - Timer to De-Icers (Continued)

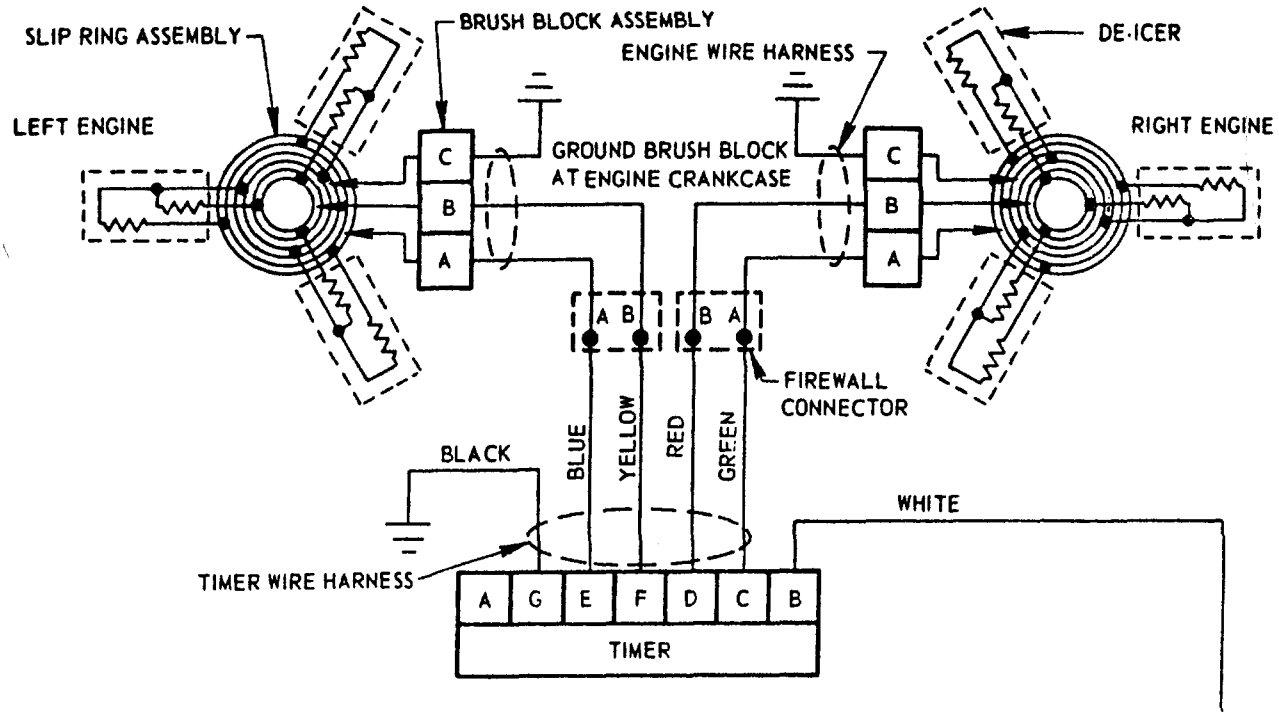


Figure 4-3.G

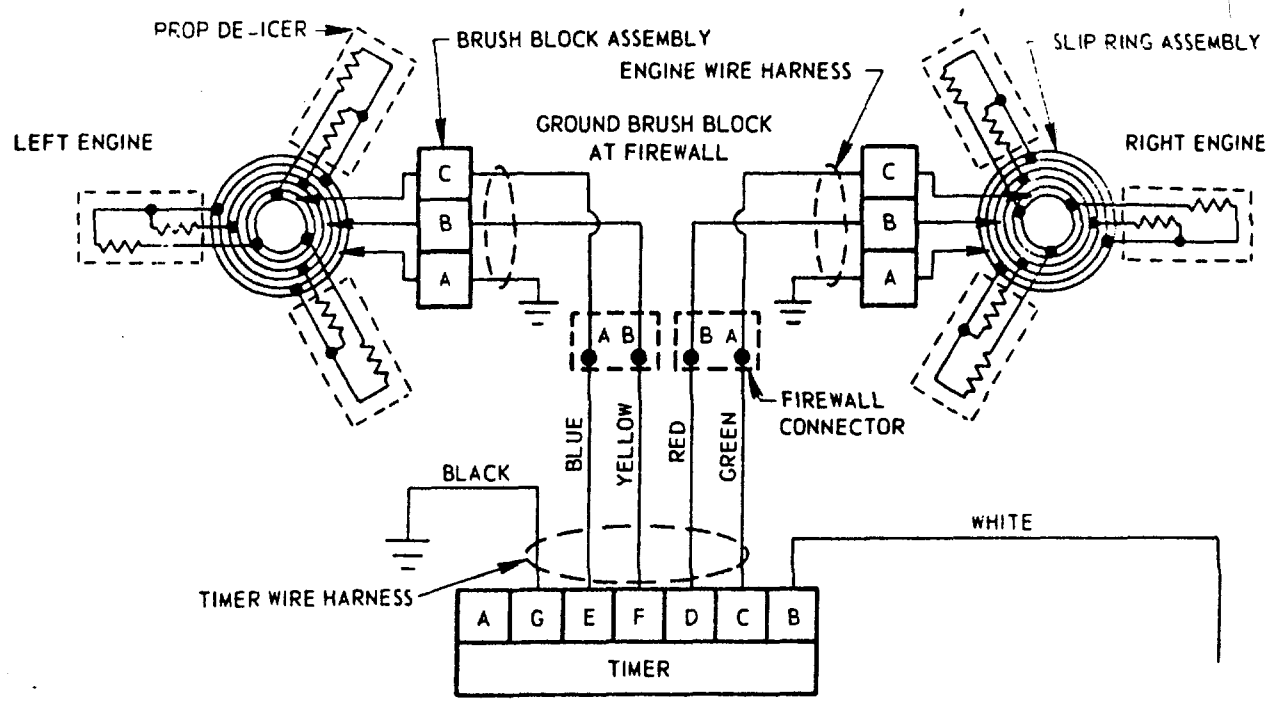


Figure 4-3.H

Figure 4-3. De-Icing System Wiring Schematic - Timer to De-Icers (Continued)

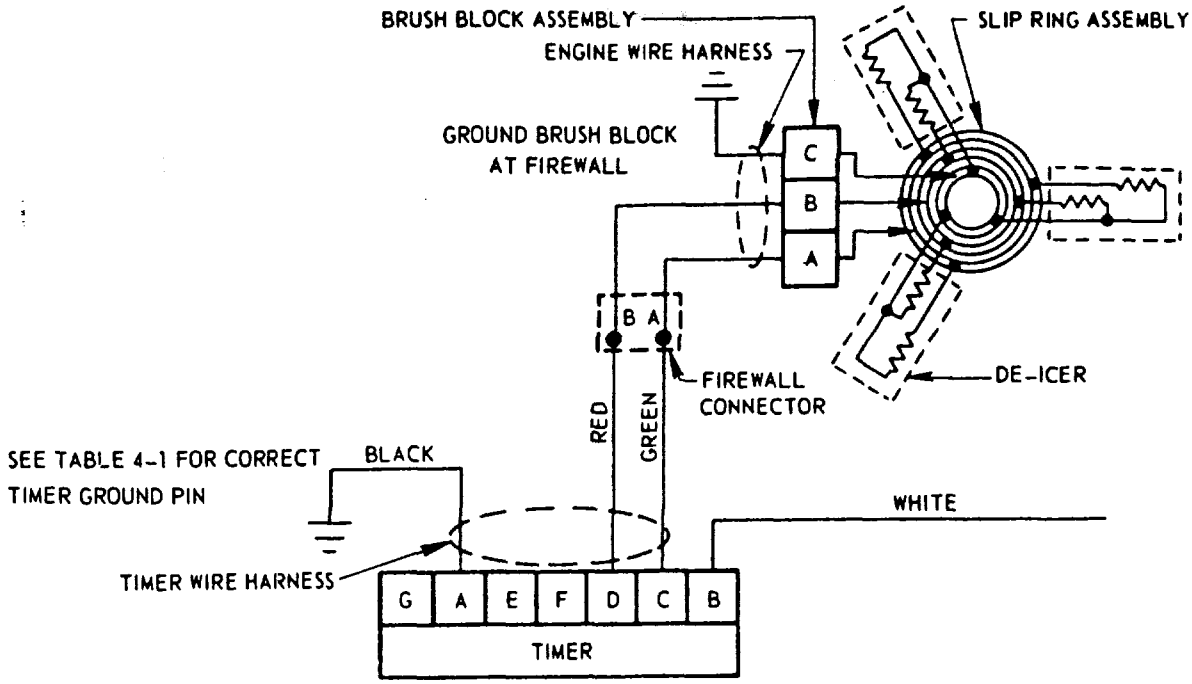


Figure 4-3.J

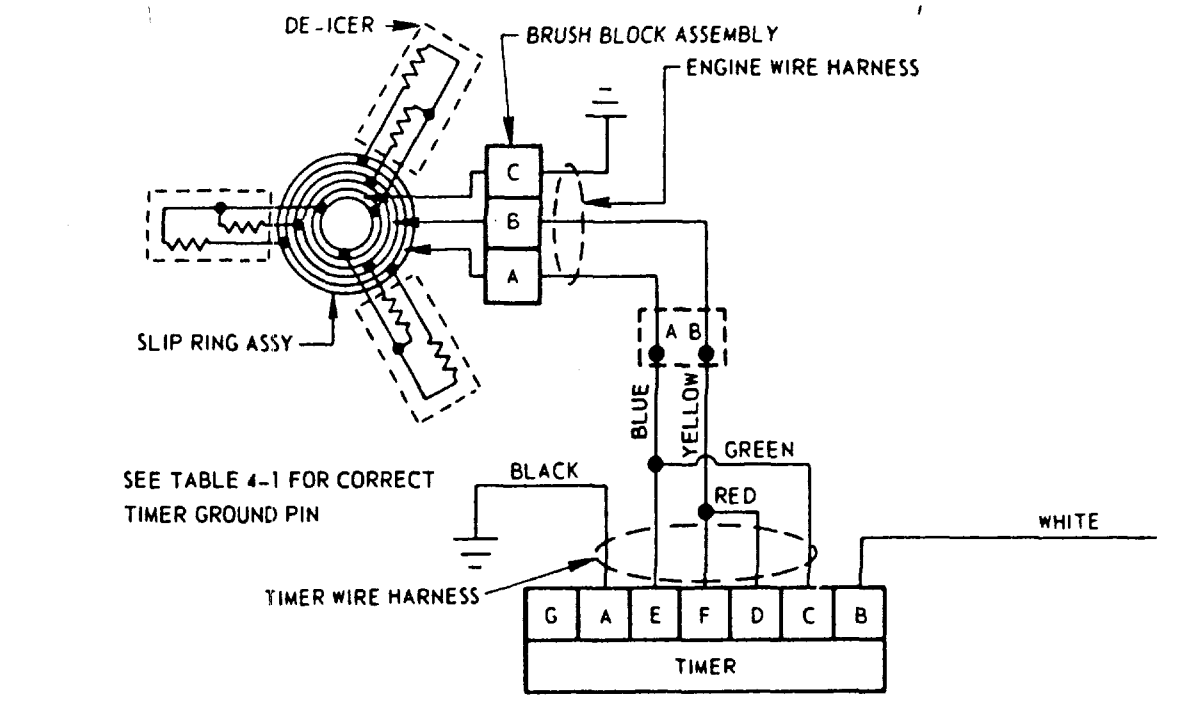


Figure 4-3.K

Figure 4-3. De-Icing System Wiring Schematic - Timer to De-Icers (Continued)

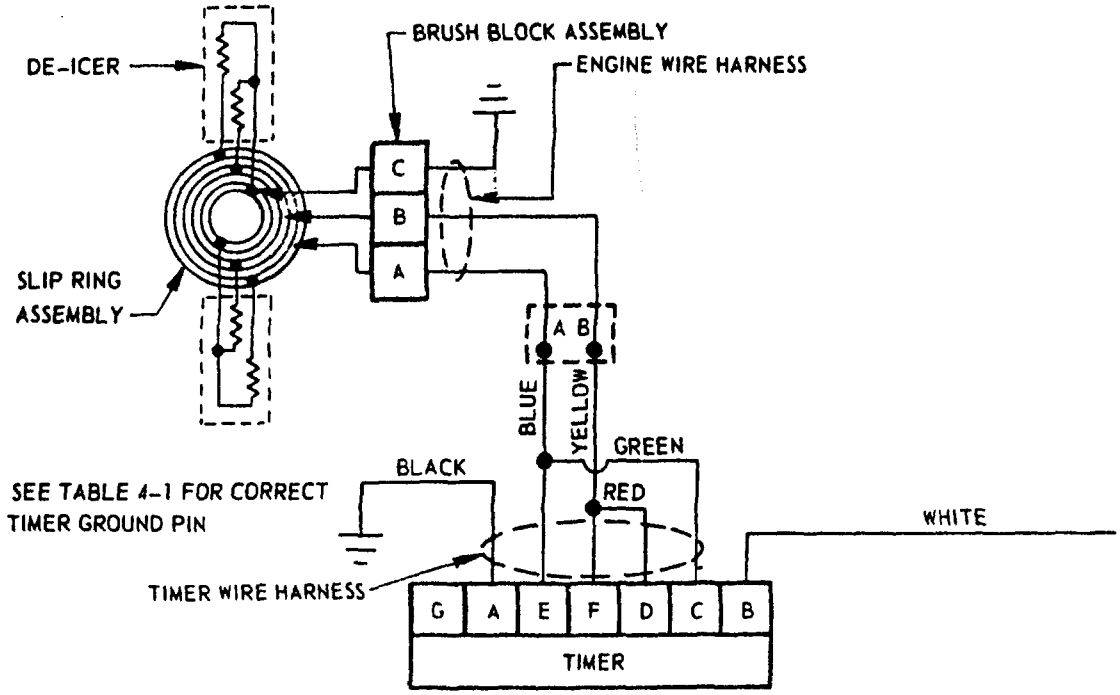


Figure 4-3.L

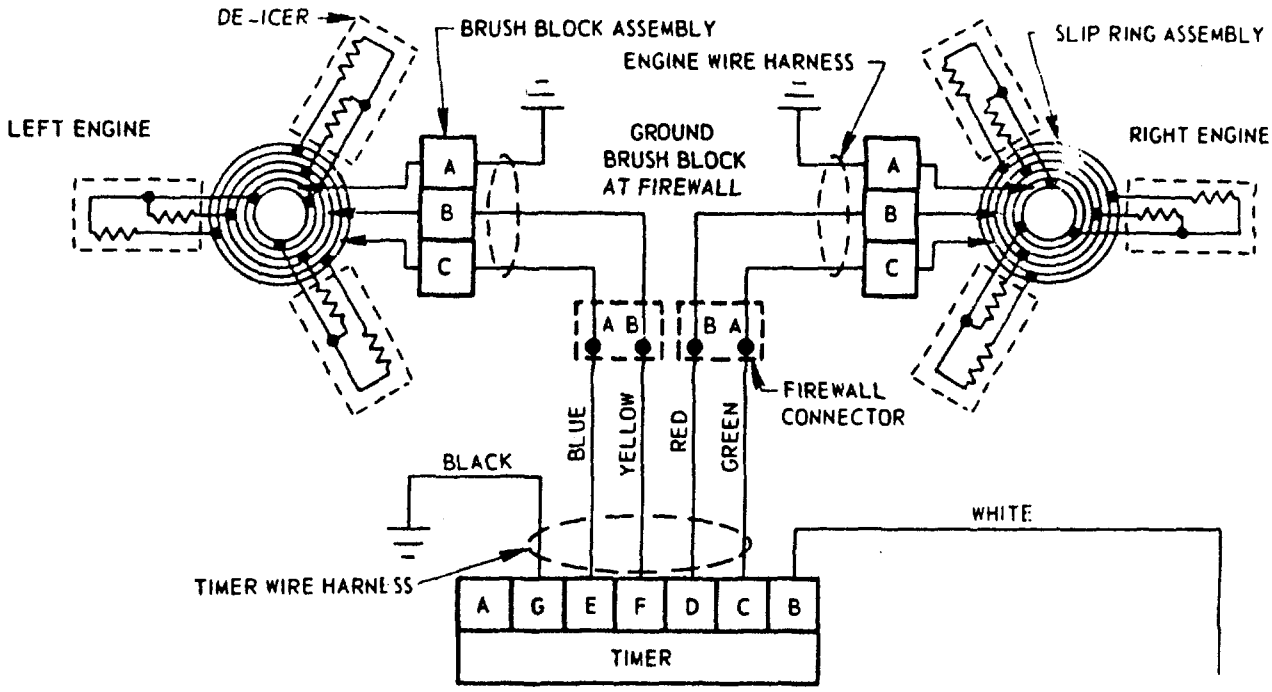


Figure 4-3.M

Figure 4-3. De-Icing System Wiring Schematic - Timer to De-Icers (Continued)

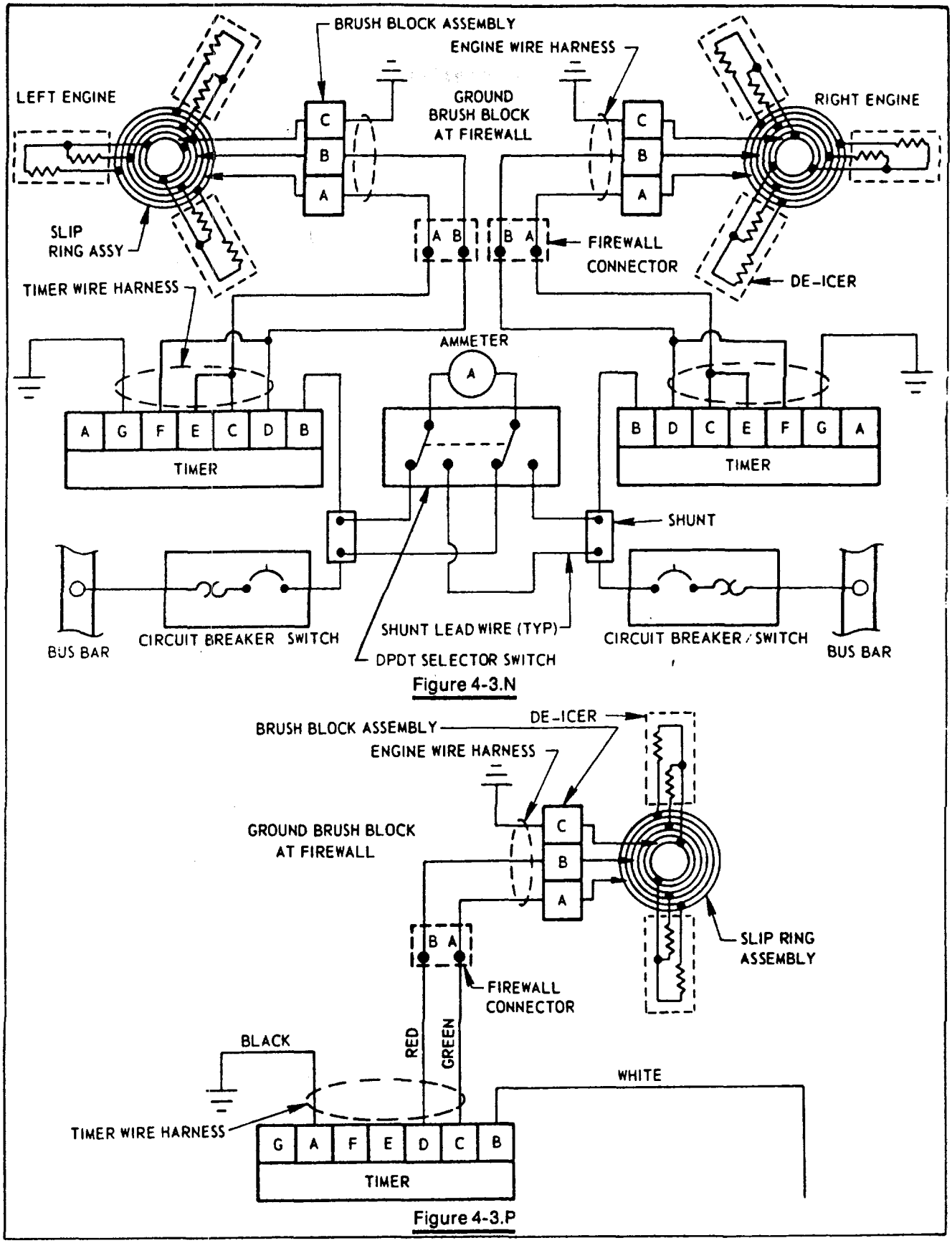


Figure 4-3. De-Icing System Wiring Schematic - Timer to De-Icers (Continued)

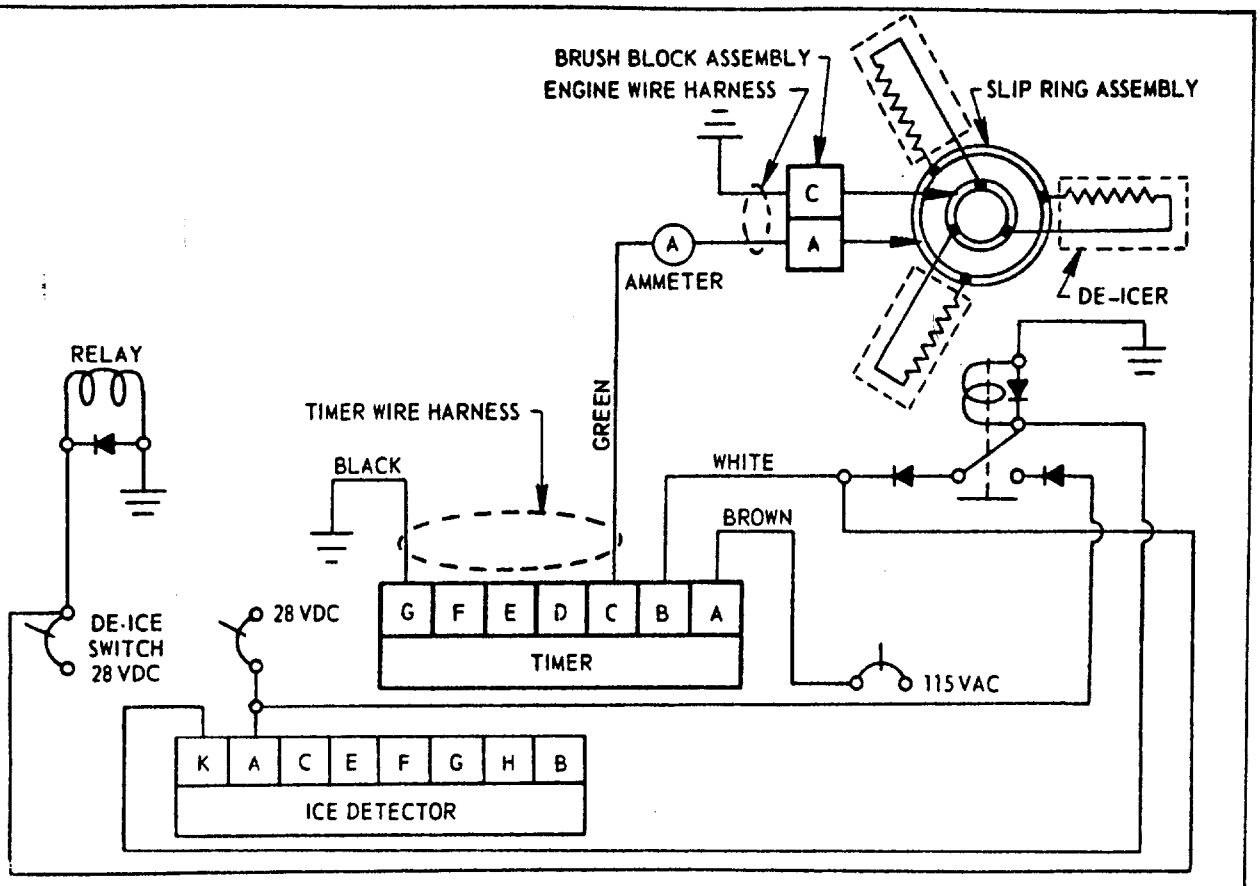


Figure 4-3.R

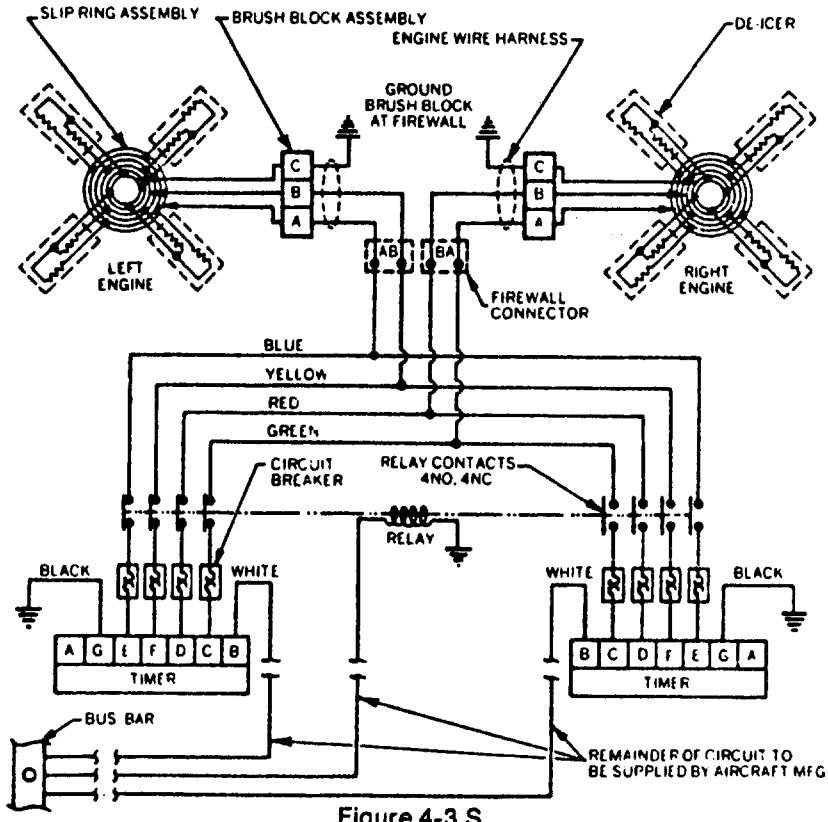


Figure 4-3.S

Figure 4-3. De-Icing System Wiring Schematic - Timer to De-Icers (Continued)

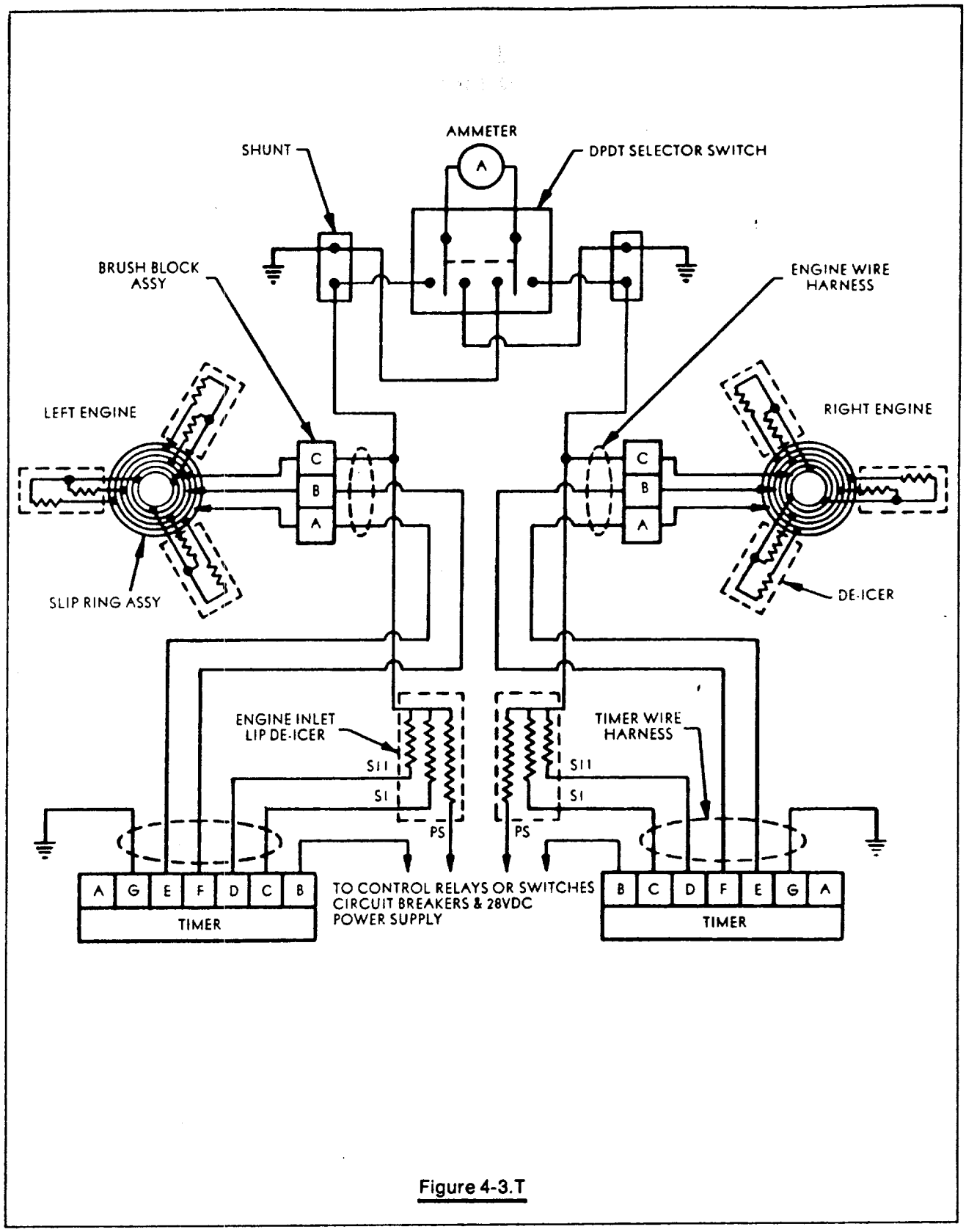


Figure 4-3.T

Figure 4-3. De-Icing System Wiring Schematic - Timer to De-Icers (Continued)

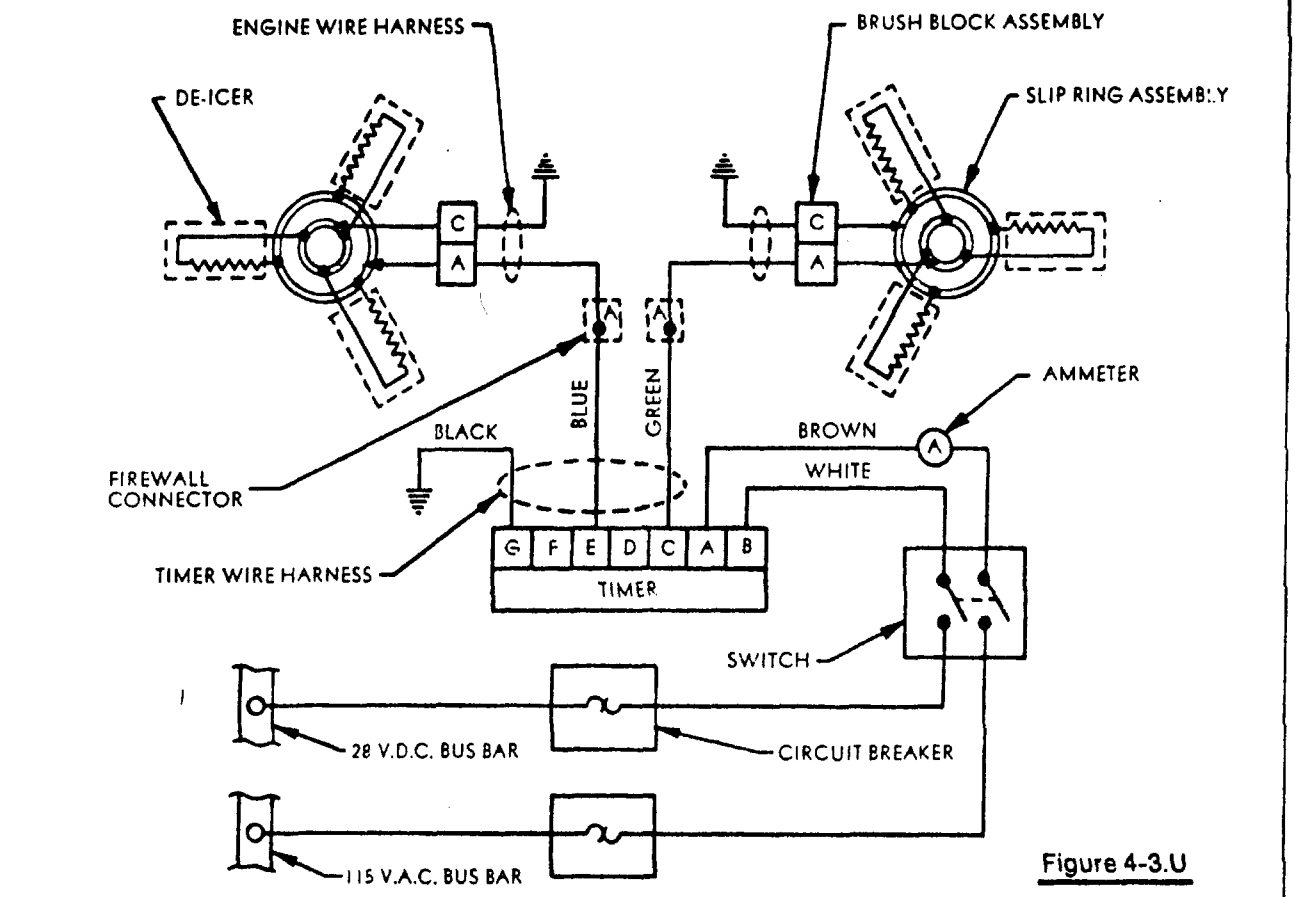


Figure 4-3.U

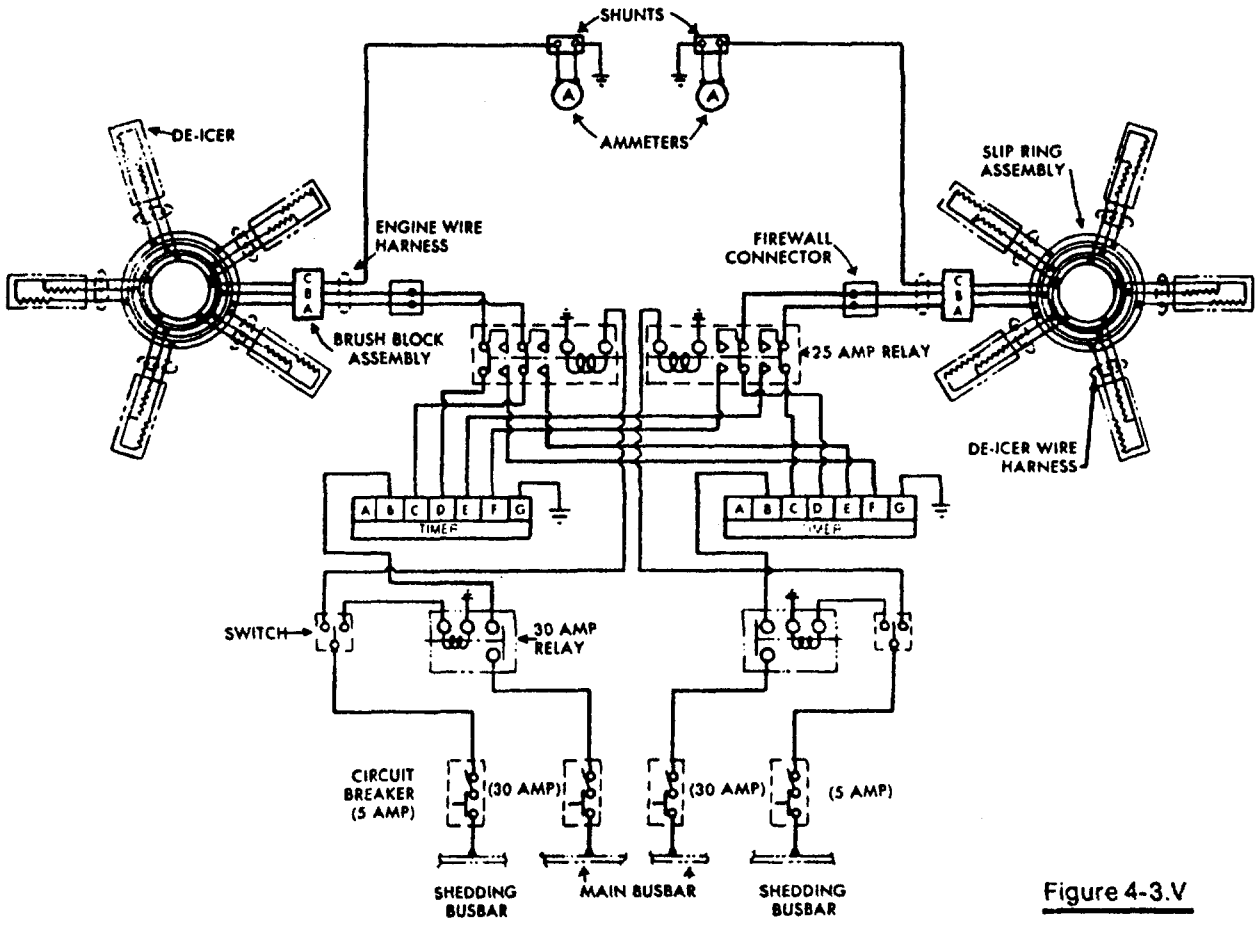


Figure 4-3.V

Figure 4-3. De-Icing System Wiring Schematic — Timer to De-Icers (continued)

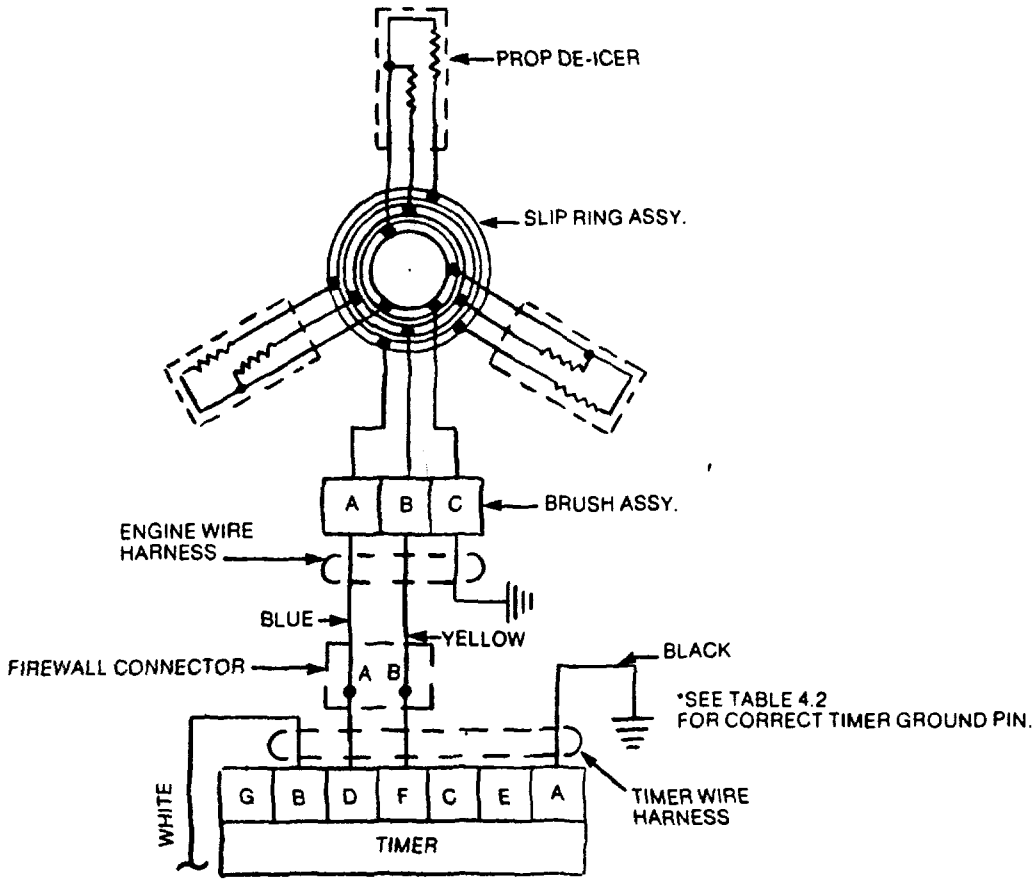


Figure 4-3.W

Figure 4-3. De-Icing System Wiring Schematic — Timer to De-Icer (continued)

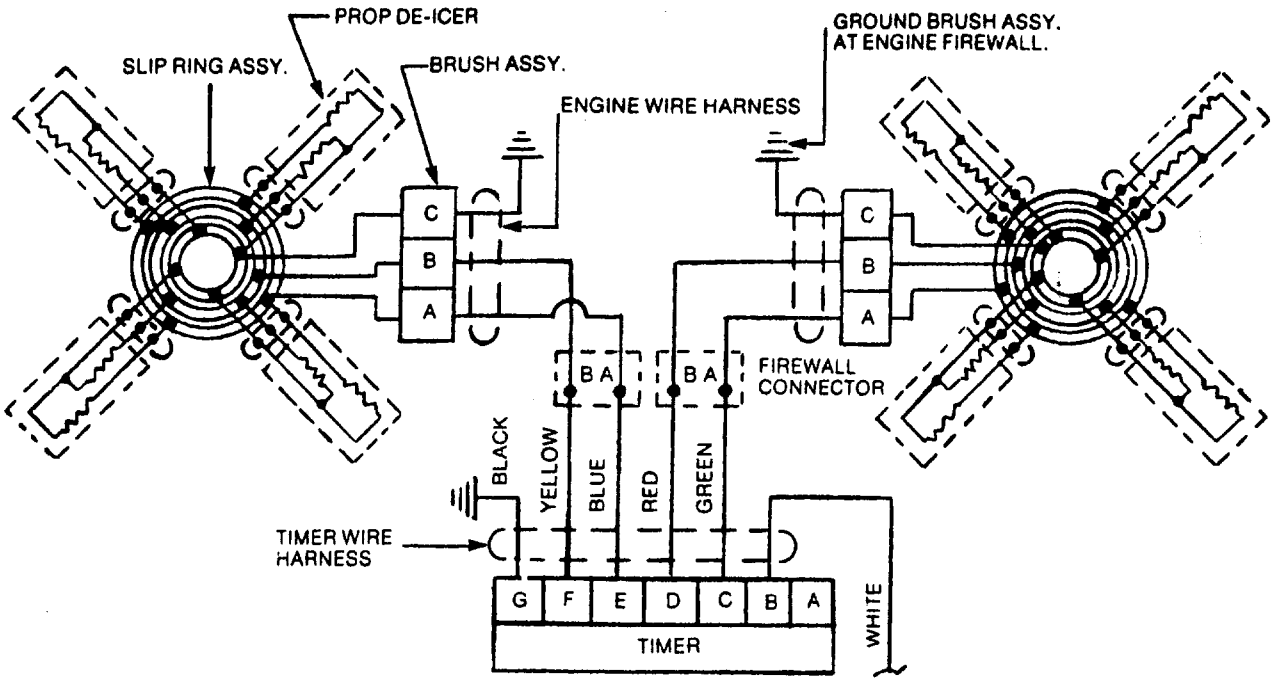


Figure 4-3.X

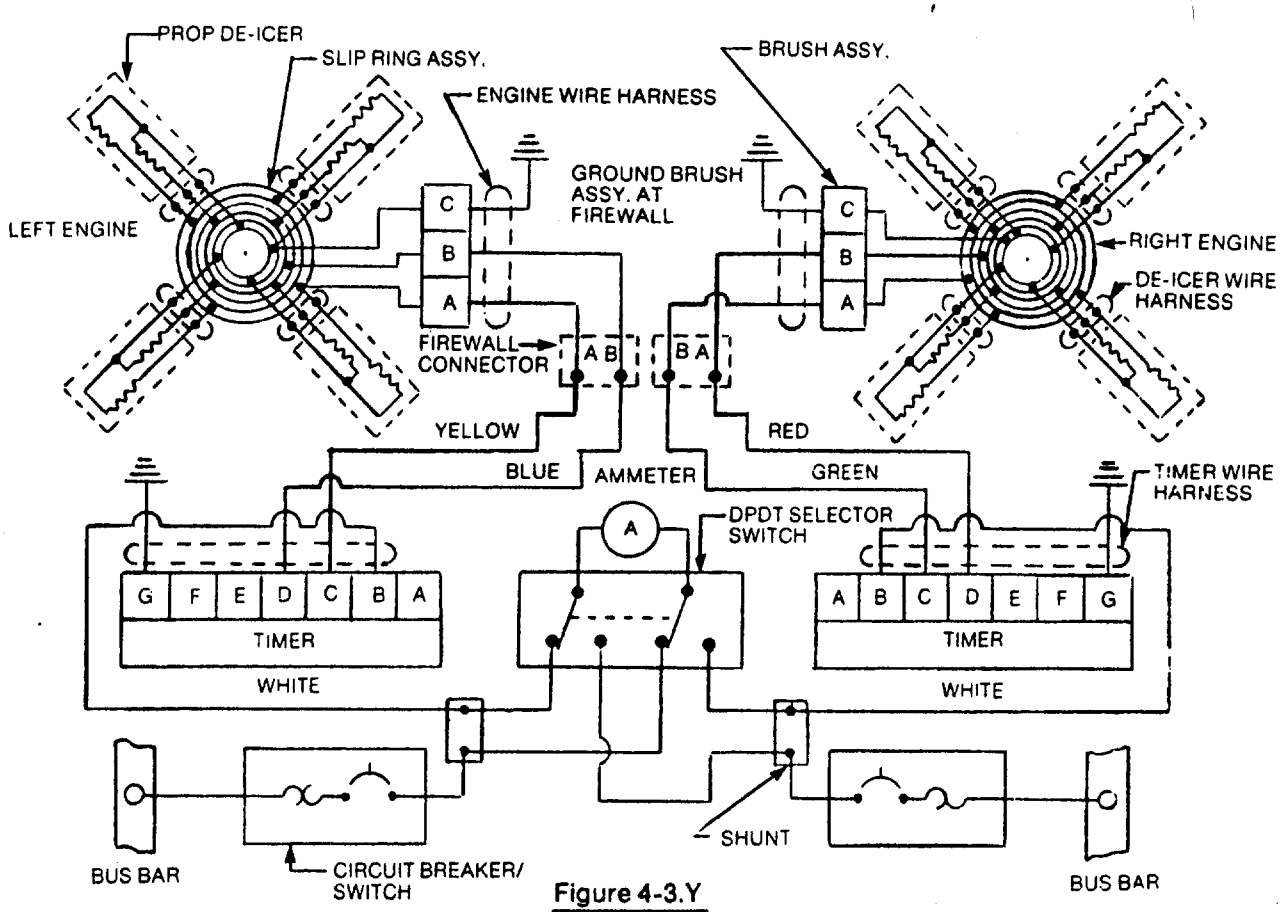


Figure 4-3.Y

Figure 4-3. De-Icing System Wiring Schematic — Timer to De-Icer (continued)

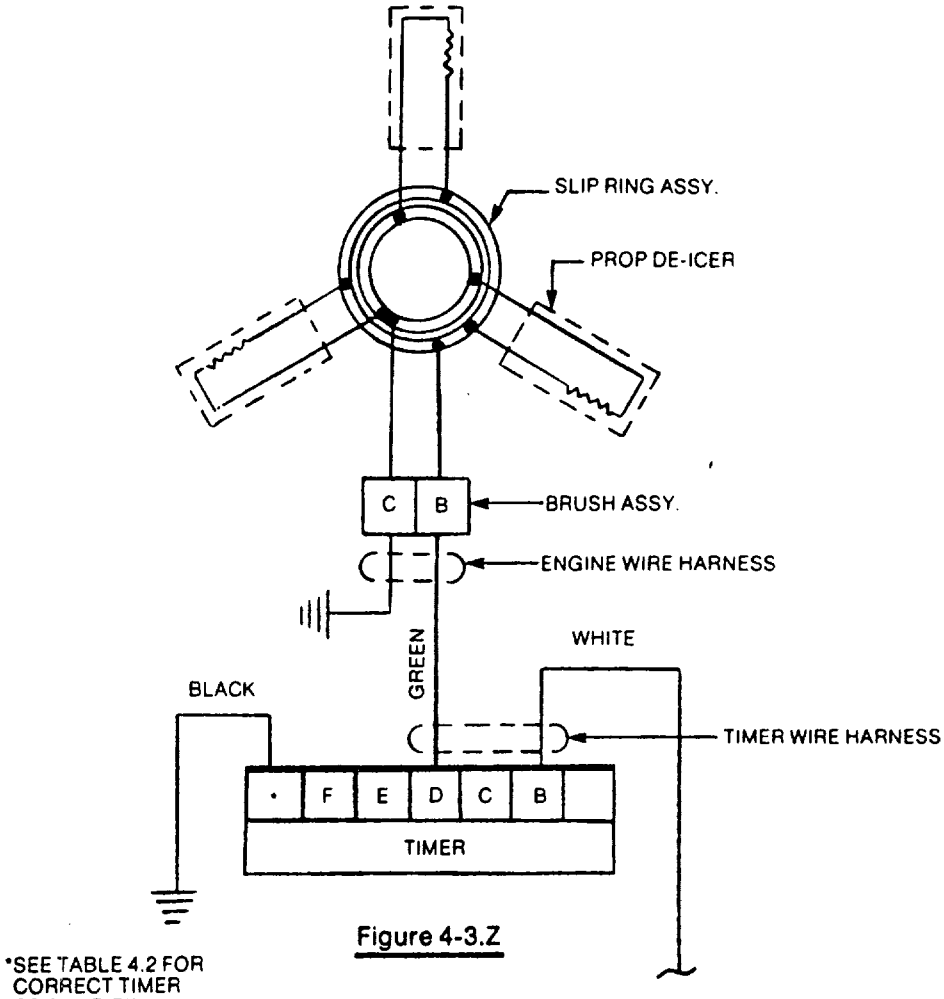


Figure 4-3.Z

*SEE TABLE 4.2 FOR CORRECT TIMER GROUND PIN

Figure 4-3. De-Icing System Wiring Schematic — Timer to De-Icer (continued)

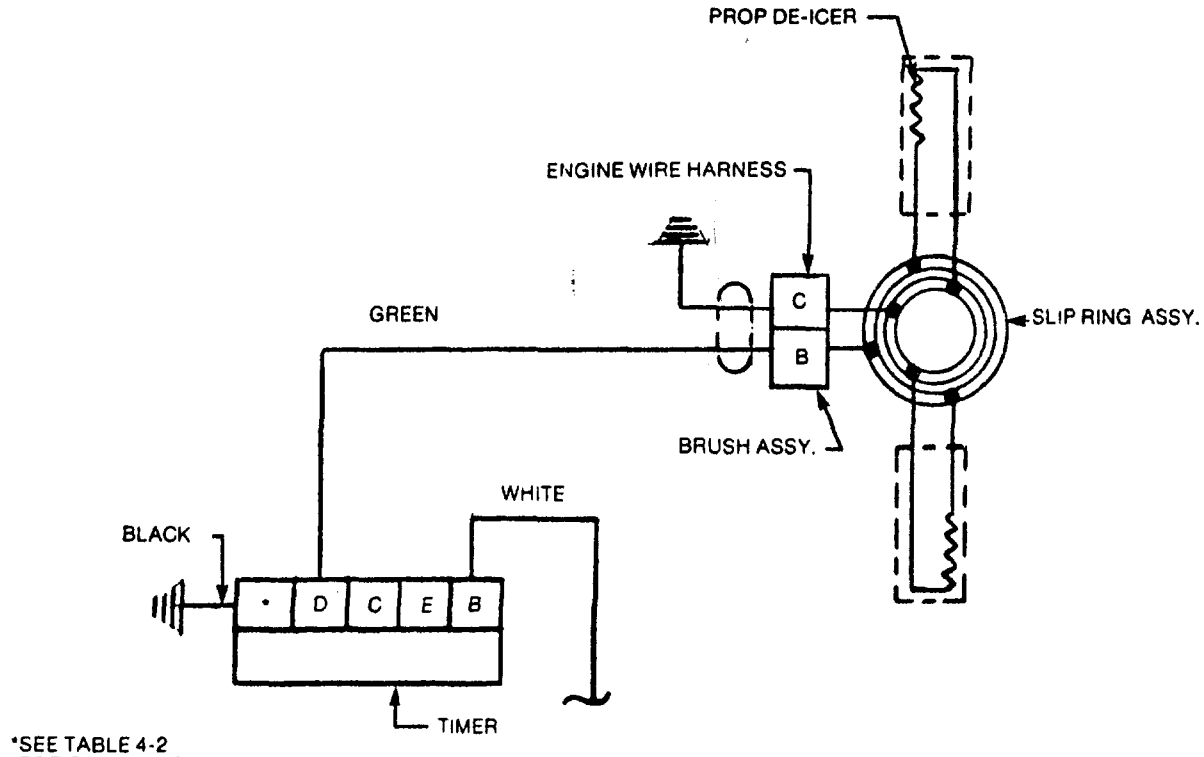


Figure 4-3.AA

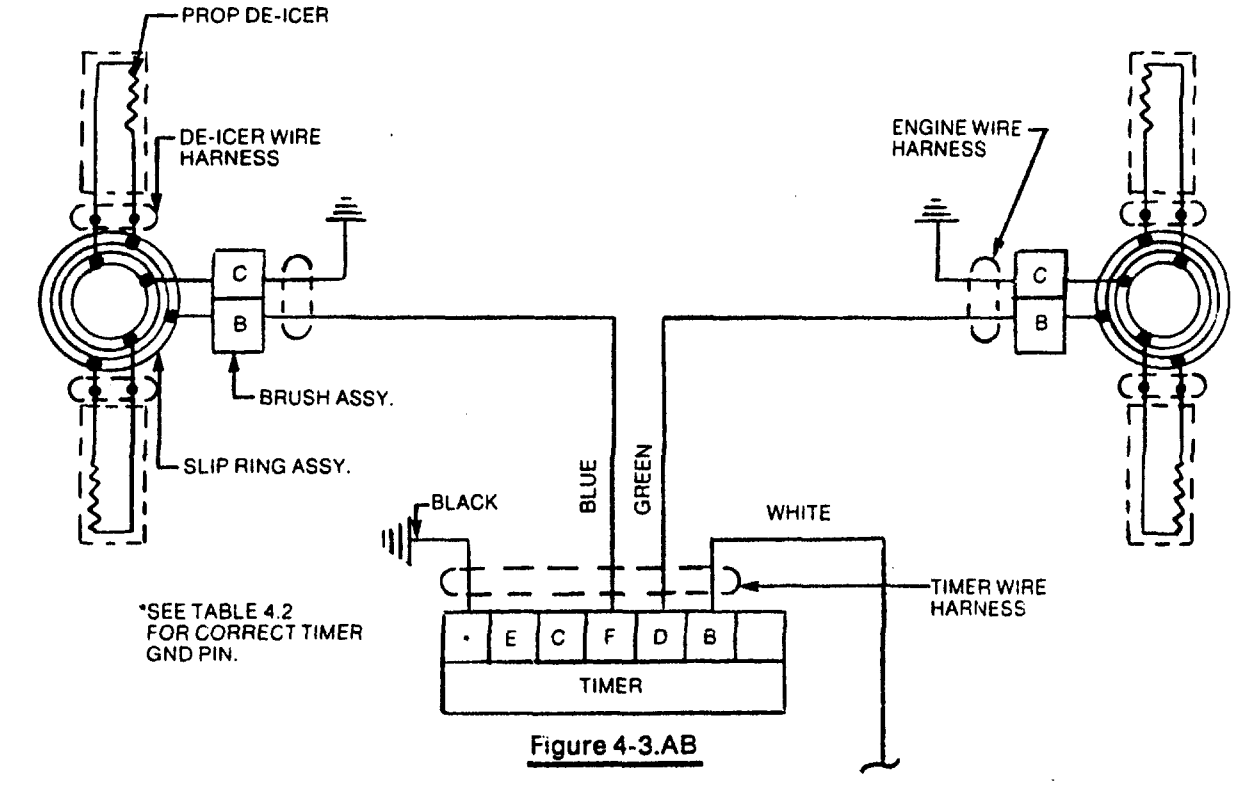


Figure 4-3.AB

Figure 4-3. De-Icing System Wiring Schematic — Timer to De-Icer (continued)

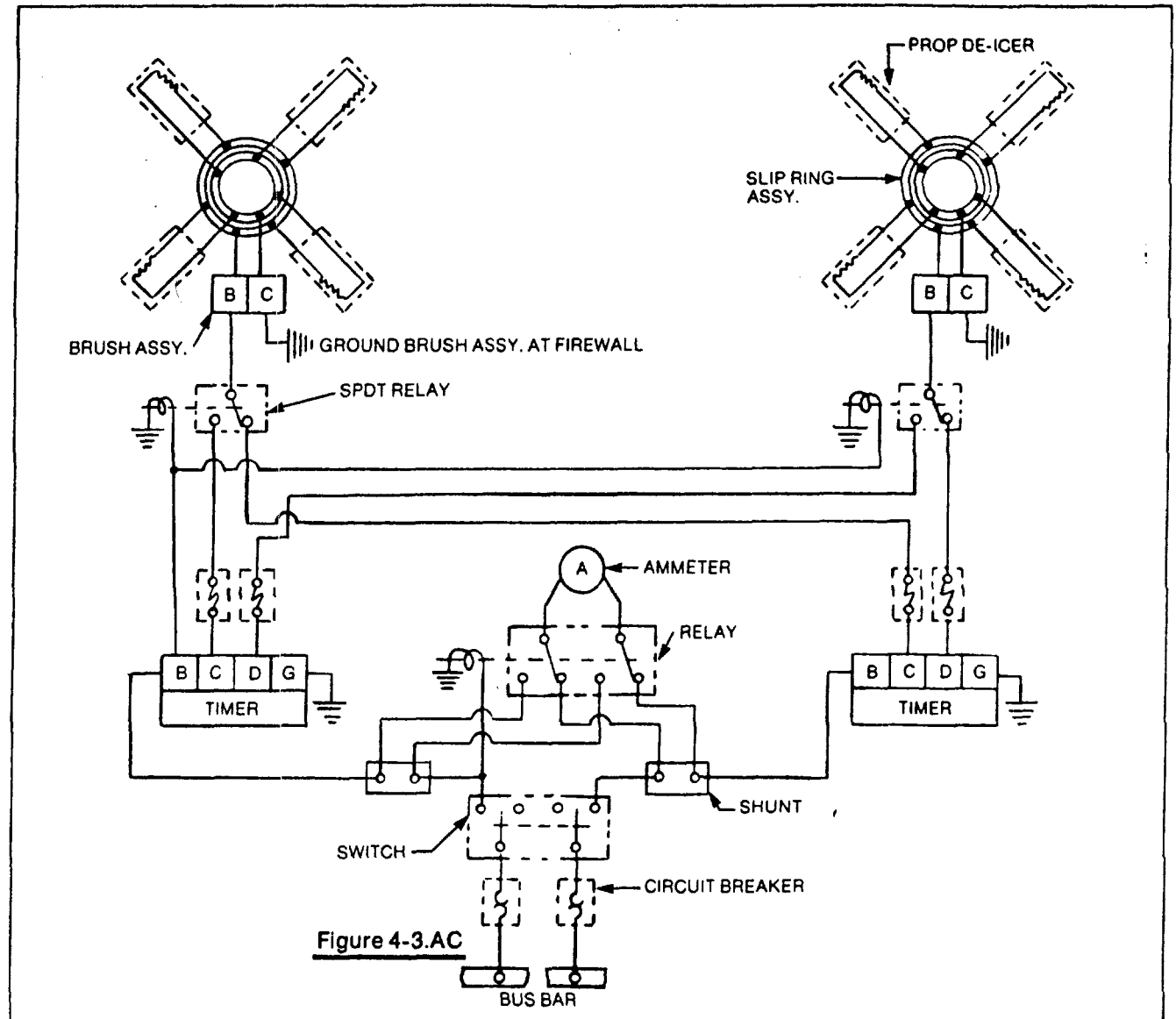


Figure 4-3.AC

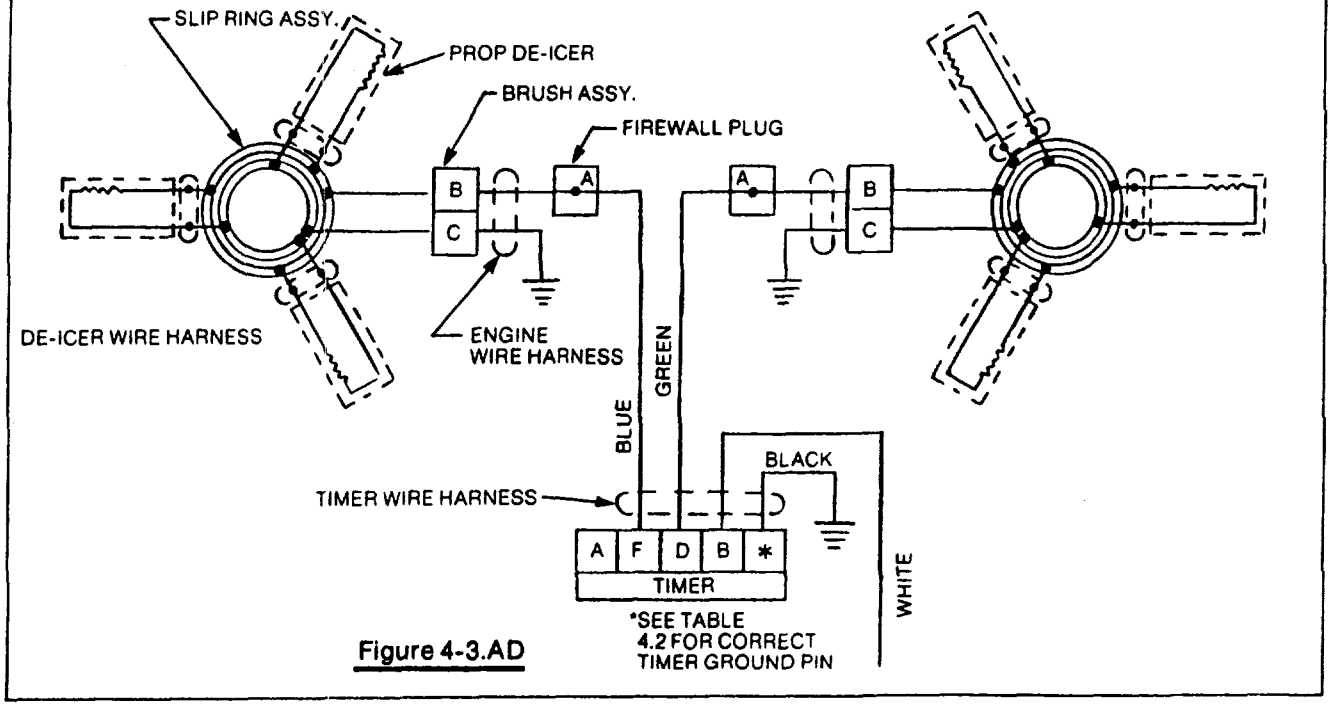


Figure 4-3.AD

Figure 4-3. De-Icing System Wiring Schematic — Timer to De-Icer (continued)

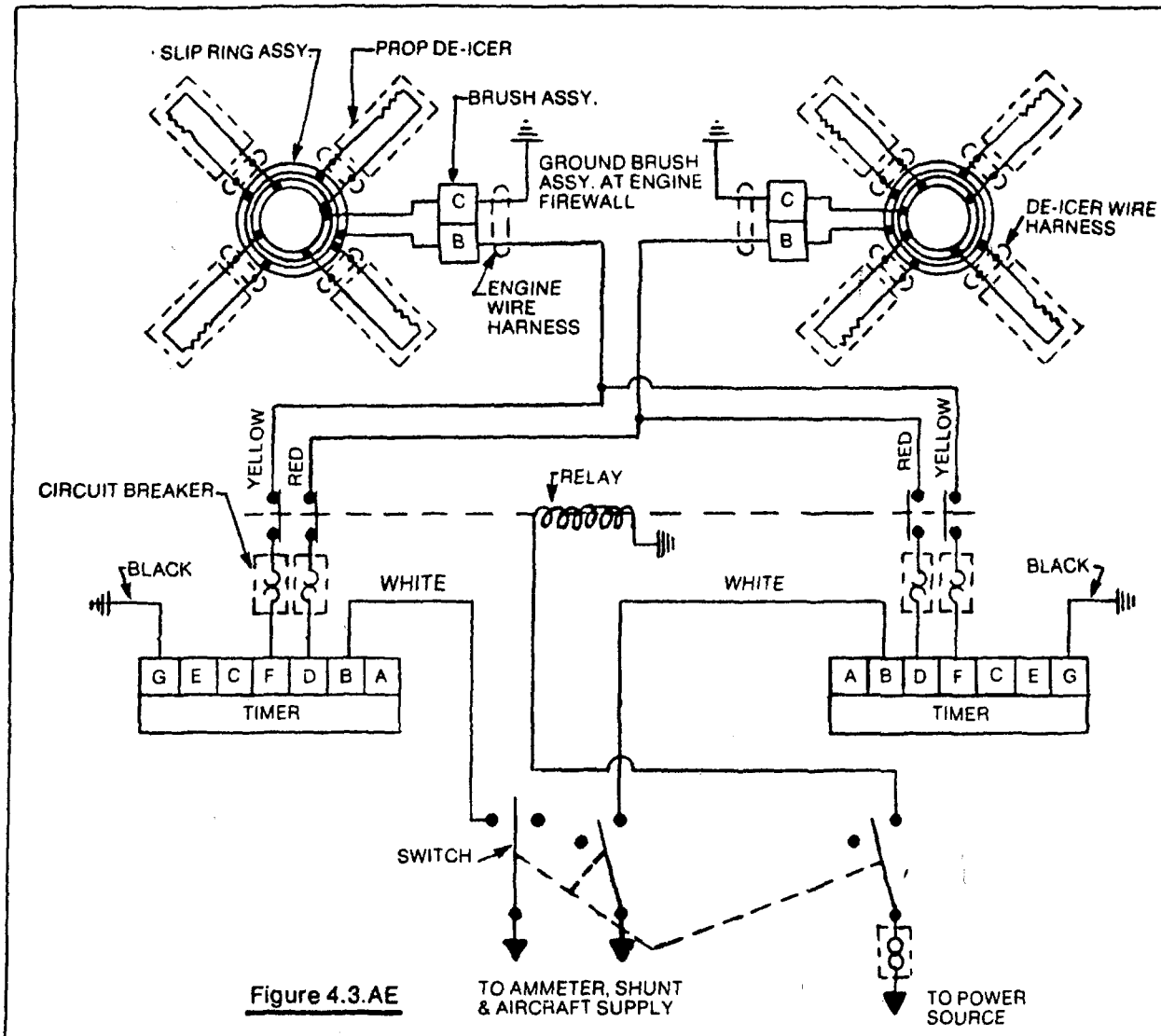


Figure 4.3.AE

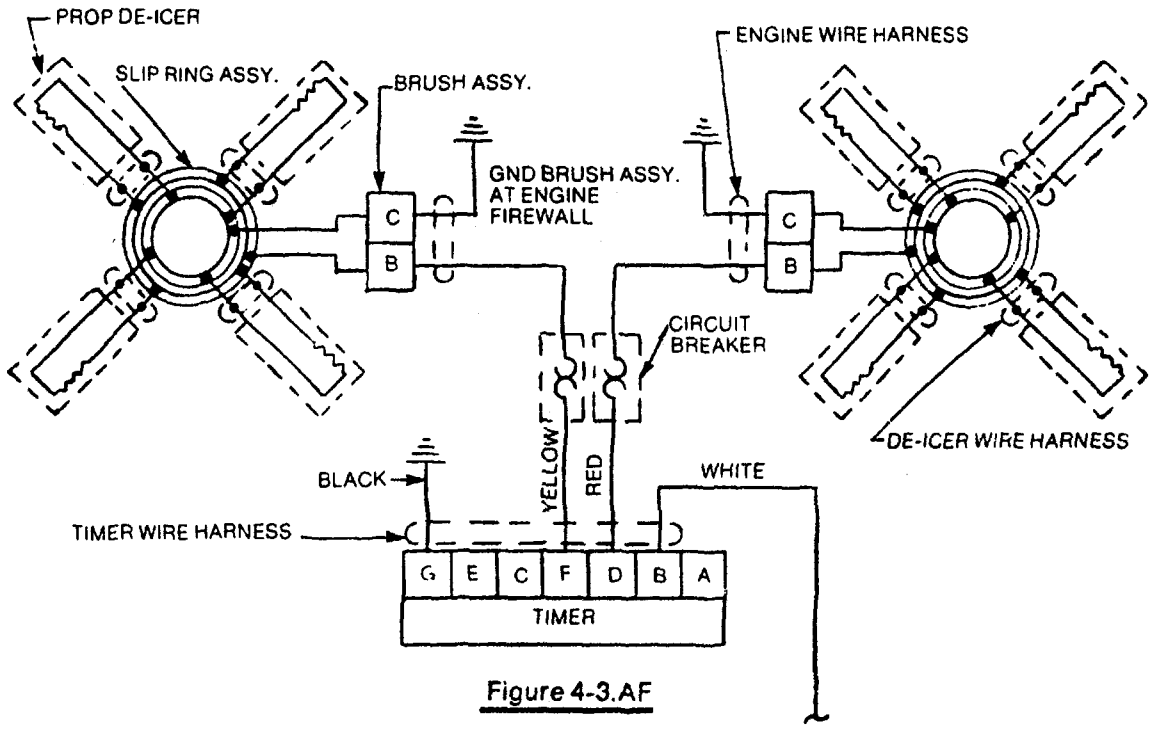


Figure 4-3.AF

Figure 4-3. De-Icing System Wiring Schematic — Timer to De-Icer (continued)

Section 5
Repair Procedures
5-1. INTRODUCTION

1. USE OF CORRECT PARTS

The type and number of De-Icers determine the system current drain. The ammeter (where BFG furnished), switch and circuit breaker are designed to operate at that current. Accordingly, only the De-Icers, ammeter, switch and circuit breaker specified for use on an aircraft may be used without affecting system operation. When replacing worn or defective parts, insure that the replacement instructions are followed explicitly. See BFGoodrich Parts List before ordering components. See Tables 4-1 and 4-2 for identification of Parts List for your aircraft.

2. ELECTRICAL

a. For soldering, use Kester "Resin Five" core solder, .062 strand, No. 66 or equivalent. Where flexibility of wire lead is vital, as in brush leads, slip ring leads, etc., guard against applying excess solder which would stiffen the wire or joint. This condition (called "wicking") must be held to ⅛" maximum on these leads.

b. In attaching terminals to wire, use crimping tool which crimps both sides of terminal to avoid loosening insulation. See that terminal is crimped to bare wire, not only on wire's insulation. If wires are too short to repair, replace with same gauge and quality.

c. Bent pins in receptacle may be straightened with long nose pliers, but insure that work hardening does not leave pin brittle and susceptible to breakage. If in doubt, replace the receptacle. Similarly, minor damage to receptacle threads may be repaired; major damage requires replacement. Check insulation resistance between pins to insure insulation has not been damaged. Resistance should be .5 megohm, minimum, after one minute.

d Chafed or worn harness areas indicate the need to redress the wiring. If not too badly damaged, chafed areas may be wrapped well with insulating tape and covered with vinyl tubing. If in doubt, replace the affected wire or harness with same gauge and quality.

3. MECHANICAL

Use safety wire at timer, wire harnesses, brush block assembly, slip ring assembly, lead clip of De-Icers, and wherever provisions are made for its use. Tighten mounting hardware and electrical connections firmly or according to torque values given. Avoid excess force which might strip threads.

5.2. SWITCH, CIRCUIT BREAKER, AMMETER, TIMER, HARNESS

The switch (and shunt), circuit breaker, ammeter, and timer* are not reparable, generally, in the field. If failure should occur, replace with identical parts as listed in the BFGoodrich Parts List. Use the same or equivalent hardware for mounting and making electrical connections as was used originally. Note that aircraft power supply lead ties to positive terminal of ammeter (where used); negative terminal connects to Pin B of connector plug at timer. If ammeter has external shunt, insure that proper connections are made between it and ammeter. If AC ammeter is used, make sure it is connected to correct power source.

*To repair 3E1150-3 timers, use Report 73-14-054; for 3E1150-7 timers use Report 75-23-009; for 3E1968-1 timers use Report 75-23-030.

Repair wire harness as noted in 5-1.2.d or replace with the same gauge and quality wire as originally used. Insure that insulation is equivalent or superior to original and that the same type of color coding shown in the wiring schematic is used.

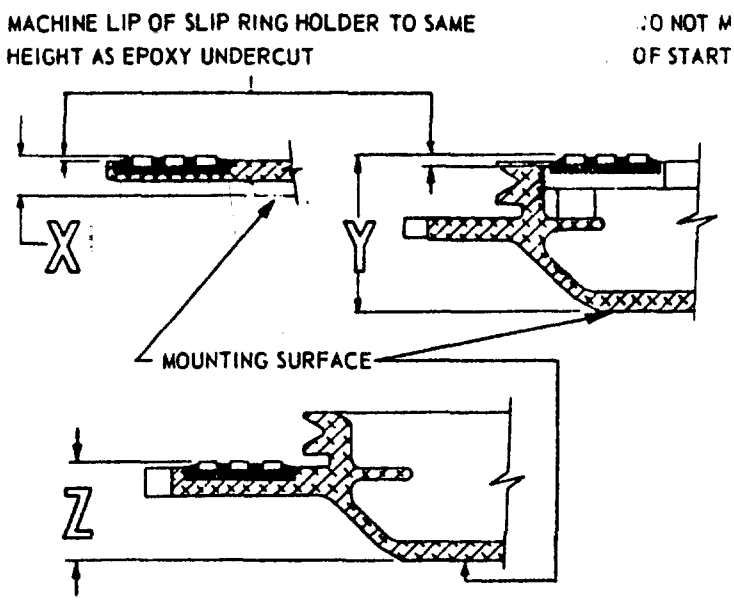
5-3. BRUSH BLOCK ASSEMBLY

See BFGoodrich Report No. 68-04-714.

5-4. SLIP RINGS (SEE, ALSO, 3-2.2)

1. MACHINING

If structurally sound, slip rings with roughened or damaged surfaces can be machined to restore to serviceability. See Figure 5-1 for machining instructions. See Table 5-1 for absolute minimum dimensions. Check assembly before machining to determine if sufficient ring remains to allow for machining. Do not use assemblies which are worn at or below the minimum dimensions.



PROCEDURE:

1. Thoroughly clean slip ring or starter ring gear assembly with MEK before beginning resurfacing.
2. Check flatness of slip ring or starter ring gear assembly mounting surface. It must be flat within .005" overall.
3. Locate assembly concentrically in lathe so that there is no more than .002" wobble or run-out over 360° rotation.
4. Take a light cut for a smooth finish (29-35 micro-inches). A tool with a 1/64 to 1/32"R edge is recommended. Cut no deeper than required to remove surface damage. Do not machine past dimension given in Table 5-1; dimension is measured from mounting surface.

   CAUTION: IN MACHINING, DO NOT ALLOW TEMPERATURE OF SLIP RINGS TO EXCEED 200°F.

5. Insure that contact surfaces of slip rings are parallel within 0.005" and flat within 0.005" overall — deviation not to exceed 0.002" over a 4" arc.
6. Undercut insulation between and around slip rings .020 to .030", as necessary. Slip ring holder outer edge must be undercut to same dimension as insulation. *Do not machine outer edge of slip ring holders containing synchrophasing targets and do not machine any portion of starter ring gears.*

   CAUTION: WHEN UNDERCUTTING INSULATION, WIDTH OF SLIP RINGS MUST NOT BE REDUCED MORE THAN .005".

7. Deburr slip ring edges.
8. To assure an accurate finish use emery paper.
9. *Check insulation resistance between slip rings and to metal holder with a* "megger" (see section 4-2.6). With 500 VDC applied, resistance must be at least .5 megohms after one minute.

Figure 5-1. Slip Ring Machining

TABLE 5-1. SLIP RING MINIMUM DIMENSIONS

CAUTION

Insure that correct part number is used when finding X, Y or Z dimension.

Slip Ring Assy. No.	X Min. Dim's.	Slip Ring Assy. No.	X Min. Dim's.	Starter Ring Gear/ Slip Ring Assy.	Min. Dim's. Y	Z
4E1287-1, -2	.453	4E2267	.295	4E1187		1.900
4E1295	.390	4E2276	.285	4E1212		1.900
4E1295-1	.390	4E2324	.295	4E1239		1.900
4E1295-2	.453	4E2350-1	.945	4E1365-1,-2,-3,-4,-6	2.875	
4E1352	.300	4E2363	.285	4E1637-2	1.920	
4E1353	.300	4E2366	.945	4E1673	2.960	
4E1424	.453	4E2371	.235	4E1677	2.875	
4E1448	.328	4E2373	.650	4E1686	2.960	
4E1454	.828	4E2375-1	.235	4E1943-1	2.825	
4E1474	.453	4E2377-1	.650	5E1421	2.960	
4E1489	.453	4E2406	.285	5E1450	2.875	
4E1494	.515	4E2422	.285	5E1455-1	3.015	
4E1508	.300	4E2440	.295	5E1482-1	2.875	
4E1518	.328	4E2442-1	.187	5E1526-1		1.820
4E1523	.328	4E2444	.187	5E1541-1	3.015	
4E1526	.475	4E2446	.295	5E1549-1	2.950	
						1.800
4E1526-4	.945	4E2448-1	.480	5E1551-1	2.950	
4E1555-1	.187			5E1559-1	2.620	
4E1555-2,-3	.187			5E1561-1	2.825	
4E1556	.328			5E1583-1		
4E1575	.421			5E1693		1.840
4E1578	.453			5E1749	2.980	
4E1598	.328			5E1819	2.625	
4E1614	.265			5E1820	2.825	
4E1614-3	.945			5E1834	2.900	
4E1621	.300			5E1837	2.960	
4E1635	.300			5E1840		1.800
4E1650	.328			5E1851-1,-2	2.930	
4E1676-1,-2,-3	.187			5E1857-1,-2,-3	2.930	
4E1681	.300			5E1892-1		1.820
4E1706	.300			5E1895-1		1.820
4E1708	.300			5E1901-1		1.800
4E1731-1	1.160			5E1919	2.960	
4E1748 2	.475			5E1922	2.825	
4E1803 1	1.160			5E1925-1	2.825	
4E1853-1	.390			5E1932-1	2.930	
4E1865-1	.475			5E1934	1.920	
4E1865-2	.945					
4E1874 1	.265					
4E1880-1	.300					
4E1882-1	.265					
4E1918-1	.235					
4E1923-1,-2,-3	.295					
4E1924-1,-2	.295					
4E1926-1	.235					
4E1933-1 thru -5	.480					
4E1933-6 thru -8	.945					
4E1948-1	.315					
4E1964-1	.480					
4E1964-2	.945					
4E1974	.410					
4E1988-1	.295					
4E2087	.650					
4E2115-1,-2,-3	.700					
4E2155	.650					

2. REPLACEMENT

Slip ring assemblies that are open electrically, cracked or damaged structurally, or which have damaged surfaces beyond the scope of minor repair, should be replaced with new assemblies and aligned per Section 4-5. Install slip rings and ring gears as removed. Where star washers are required in mounting slip ring assemblies, use new star washers. Insure that they are sandwiched between flat washers when used between slip ring assembly and its mounting surface. Insure that belleville washers, where used, are properly oriented. The larger diameter of the washer should be against tne slip ring assembly.

3. SLIP RING STUDS

Some slip ring assemblies use a stud brazed or welded to the slip ring for making the electrical connection. In any work around these studs, avoid side loads on the studs which might lead to breakage of the brazed joint and failure of the slip ring. Generally, broken studs cannot be repaired — the assembly must be replaced. However, parts may be returned to BFGoodrich for inspection and possible repair.

4. ECCENTRIC RUNNING

If brush block cannot be adjusted sufficiently to prevent brushes from riding partially off the edge of the slip rings at any point through 360° of rotation, the spinner bulkhead or slip ring mounting holes or the slip rings are non-concentric. The spinner bulkhead or slip ring must be replaced to permit proper mounting of the slip ring assembly — there is no adjustment for this condition.

5. SLIP RING LEAD WIRES

a. If slip ring lead wires are frayed or broken, they should be repaired or replaced with wire of equivalent length, gauge and quality per standard aircraft practices and Section 5-2.

b. If slip ring lead wire breaks inside the assembly itself, the wire cannot be replaced without probable damage to the assembly; replace the assembly.

c. If slip ring lead wire breaks at a stud, wire should be replaced in following manner:

1. Place assembly on good heat sink; temperature of assembly must not rise above 175°F in any area other than the stud itself.

2. Clean out hole in stud; remove broken wire.

3. Replace wire with equivalent length, gauge and quality, soldering per Section 5-2 and standard aircraft practices.

4. Install equivalent length of standard, thin wall, shrink tubing over stud and lead as was originally used.

5. When finished, check continuity with ohmmeter.

5-5. DE-ICER AND BALANCE WEIGHT INSTALLATION

1. DE-ICER REPLACEMENT

If tests show a De-Icer to have an open circuit, the wrong resistance, or visible damage, replace the De-Icer using removal and installation procedures in BFGoodrich Report 59-728.

2. BALANCE WEIGHT INSTALLATION

Before removing the old De-Icer and attachment hardware, carefully note and record the exact number, type, and location of all balance weights installed on the hub in the area where the De-Icer lead strap and lead strap clamp are located. Remove the weights and attaching parts and set them aside for reassembly after the De-Icers have been installed. Balance weights must be installed in their original position on the propeller hub or the propeller must be rebalanced as specified by the propeller manufacturer. However, balance weights may be installed above the lead strap clamp. See figure 5-8 for special Beech Model 58 installation. (Some clamps have tapped holes on top for installation of balance weights.)

NOTE

If balance weights are required over or under lead strap clamp use AN960 washers for shims. The number of washers needed depends upon the number of weights used. Clamp must be spaced away from hub so that portion of clamp passing over De-Icer lead strap is about .150" from hub. If washer is required below lead strap clamp, one side of AN960 washer may have to be trimmed to fit.

In some instances, installation of balance weights around or over lead strap clamp will require modification of the weights or replacement with new weights. Add additional modified balance weights to replace weight removed in modification of original weights. Observe propeller manufacturers' recommendations on maximum number of weights used.

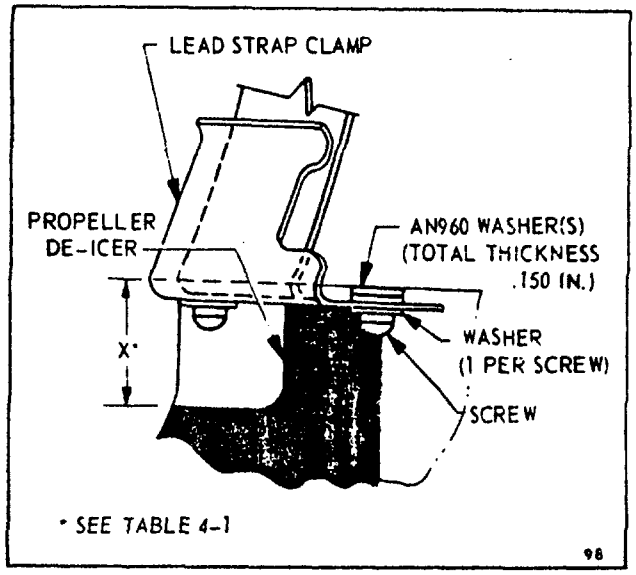
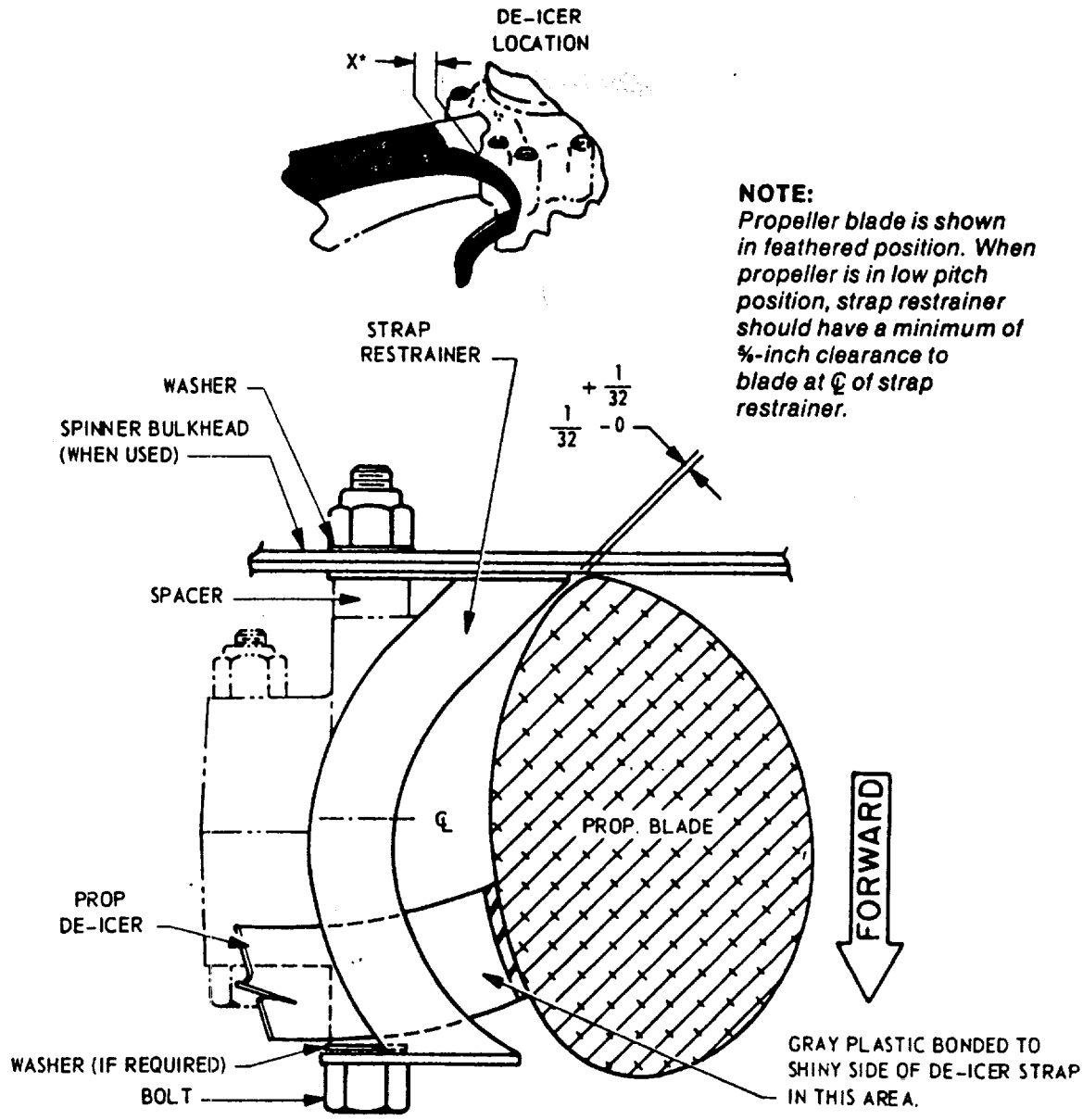


Figure 5-2. Lead Strap Clamp 2E1063-4



R.H. INSTALLATION SHOWN; L.H. OPPOSITE

NOTE:
Propeller blade is shown in feathered position. When propeller is in low pitch position, strap restrainer should have a minimum of 5/8-inch clearance to blade at ℄ of strap restrainer.

INSTALLATION

1. Insert spacer as shown against propeller hub.
2. Position strap restrainer leg against spacer.
3. Check for clearance between other leg of strap restrainer and propeller hub. If any, install washers for snug fit.
4. Install bolt. Do not use washer under bolt head.
5. Install washers as required (minimum one) to prevent nut from bottoming out on bolt.
6. Position strap restrainer to maintain clearance as shown.

NOTE:
Strap restrainers should be installed as shipped — in matched sets by color. Yellow parts are installed on normally rotating (R.H.) propellers. Blue parts are installed on counterrotating (L.H.) propellers.

99

Figure 5-3. Strap Restrainer

NOTE

On new installations, the screws provided for lead strap clamp installation are of sufficient length only for this installation. Where mounting location of balance weight and clamp correspond, new screws may be used. If so, select a screw which has minimum thread engagement per good aircraft practice but is not so long that it bottoms out in the hole (use AN502 or AN503 screws as required).

CAUTION

Insure that screw holding lead strap clamp and/or balance weights will not contact spinner dome in any pitch position.

5-6. LEAD STRAP CLAMP, RESTRAINER STRAP, STRAP RESTRAINER AND TIE STRAP INSTALLATION

A clamp or restrainer is required at the inboard end of the De-Icer to prevent loosening of the De-Icer bond when centrifugal force acts on the lead strap. Various common types of clamps and restrainers are illustrated in Figures 5-2 through 5-12. Attach lead strap clamp or restrainer as shown. Use only existing holes in the hub. Earlier versions of these clamps should be installed in the same manner as those shown.

CAUTION

When a clamp is used, it must not squeeze the lead strap so tightly as to cause damage or to place tension on the strap that could pull the De-Icer bond loose. Some clamps are spaced away from the hub with washers to about .150"; consult figures 5-2 through 5-12 for correct installation. Do not twist the lead straps over 180° during installation. They contain wires which could be broken by excessive twisting.

NOTE

Some old clamps may be modified to the current configuration as follows: 2E1063-1 becomes 2E1063-4 when the sponge is removed; 2E1087-1 and -2 become 2E1087-3 when the sponge is removed from the 2E1087-1 clamp and the clamps are ground off per Figure 5-9; 2E1200 and 2E1200-1 should be replaced with new 2E1200-4's; however, the old part is serviceable if neoprene tubing is in place as shown in Figure 5-10. Clamps 2E1200-2 and 2E1200-3 are OK as they are.

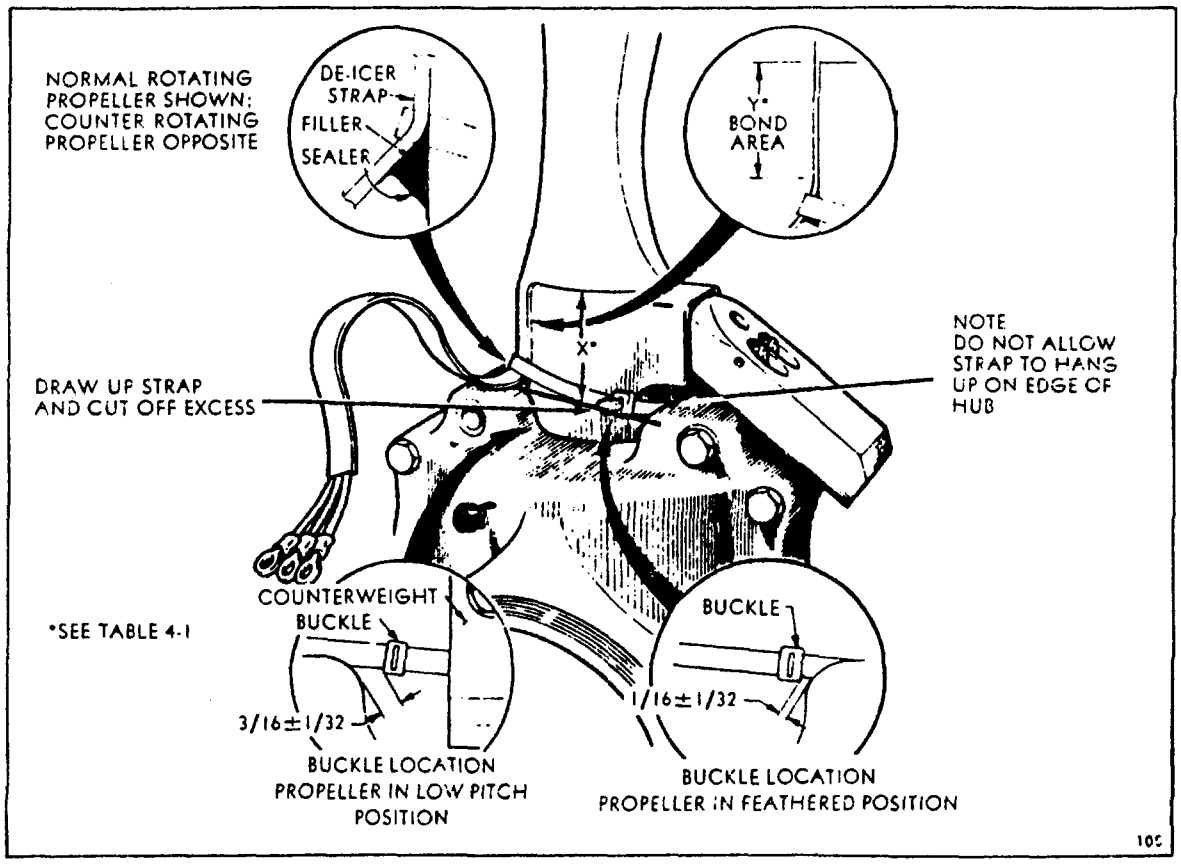


Figure 5-4. Installation of Nylon Tie Strap

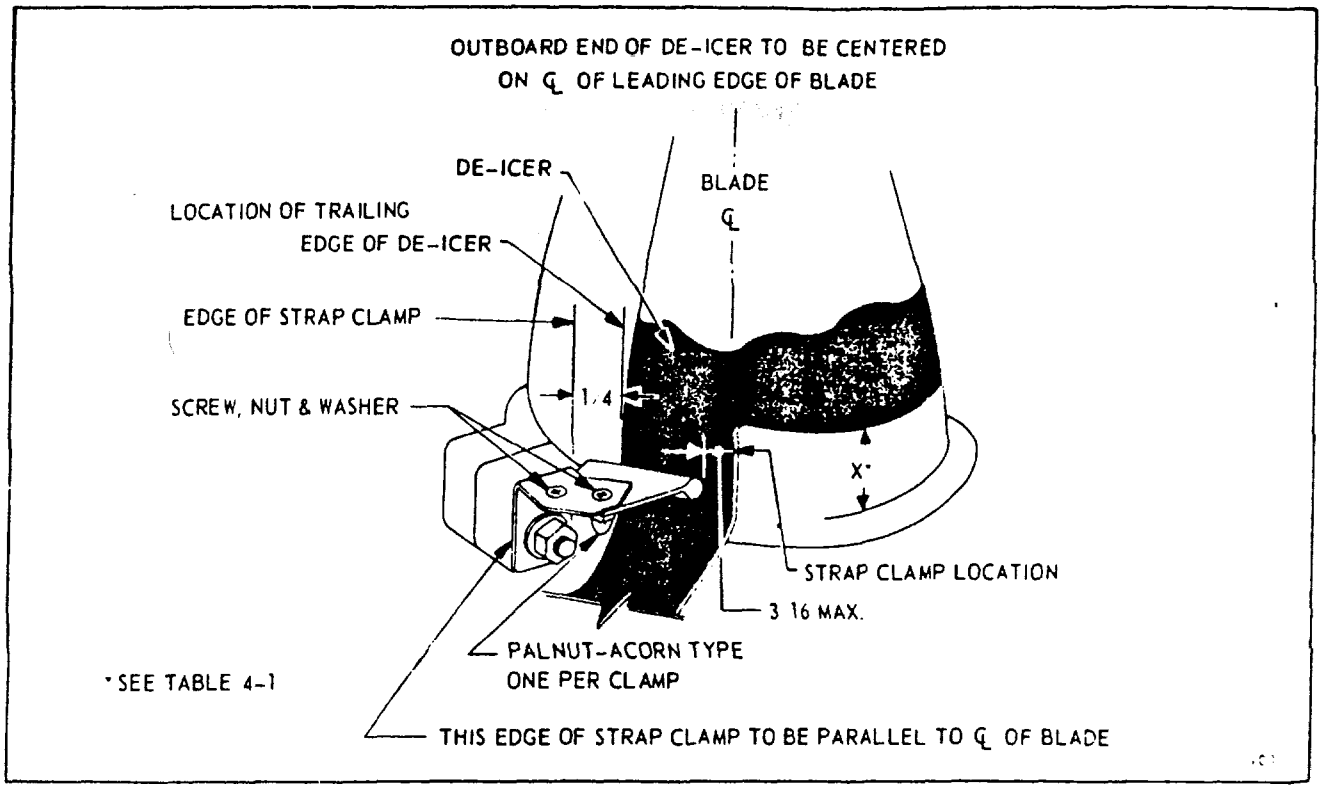


Figure 5-5. Lead Strap Clamp 2E1285-1, -2

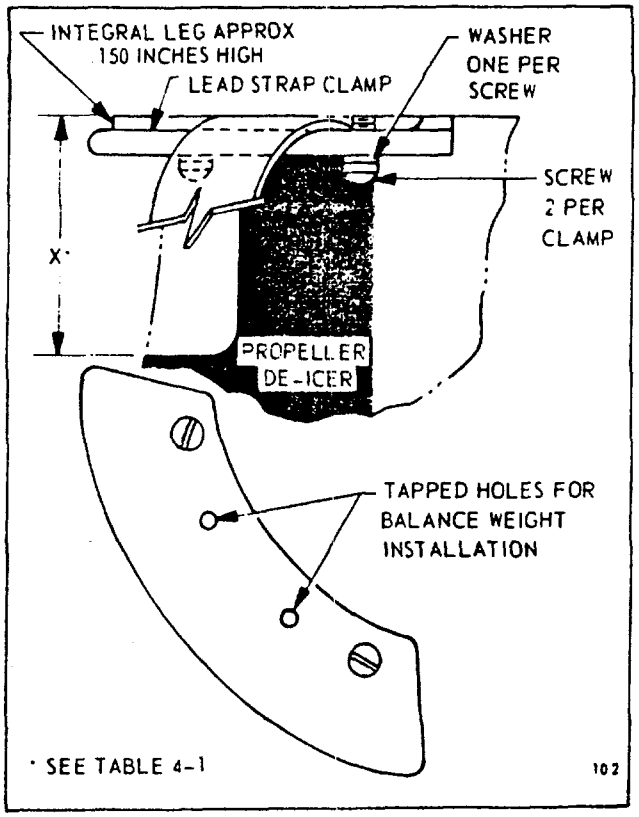


Figure 5-6. Lead Strap Clamp 2E1200-4

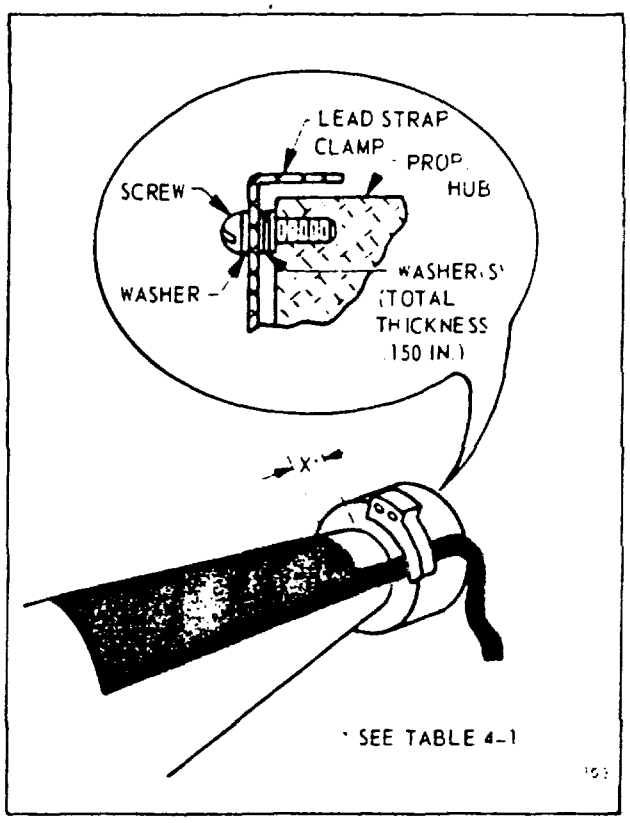
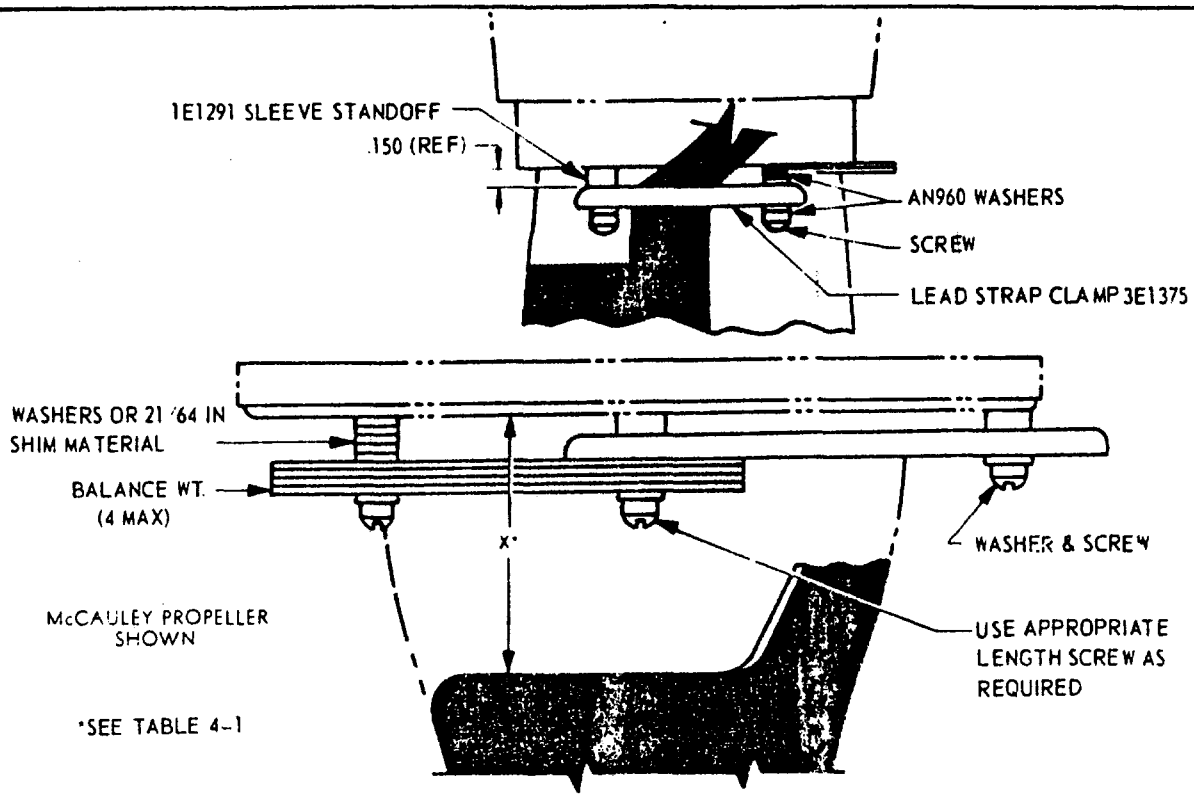


Figure 5-7. Lead Strap Clamp 2E1087-3



NOTE: *If two mounting holes of balance weight coincide with those of lead strap clamp,* modify balance weight to clamp configuration to avoid interference with De-Icer lead strap. Add modified balance weights to replace weight removed in modification.

On Beech Model 58, when balance weights coincide with both lead strap clamp mounting holes, mount weights under clamp. When weights coincide with one clamp mounting hole, install up to 4 weights under clamp and shim to .150" height. Where more than 4 weights are used, install them over the clamp.

Figure 5-8. Lead Strap Clamp 3E1375

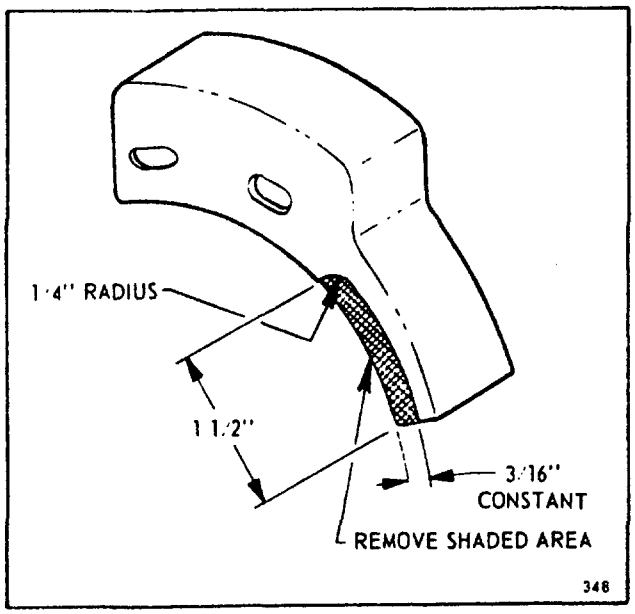


Figure 5-9. Modifying clamps 2E1087-1, -2 to the 2E1087-3 Clamp Configuration

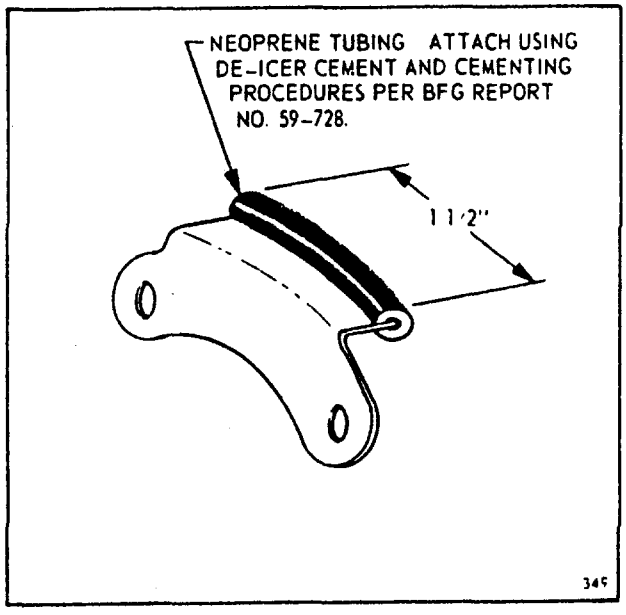


Figure 5-10. Lead Strap Clamps 2E1200 and 2E1200-1

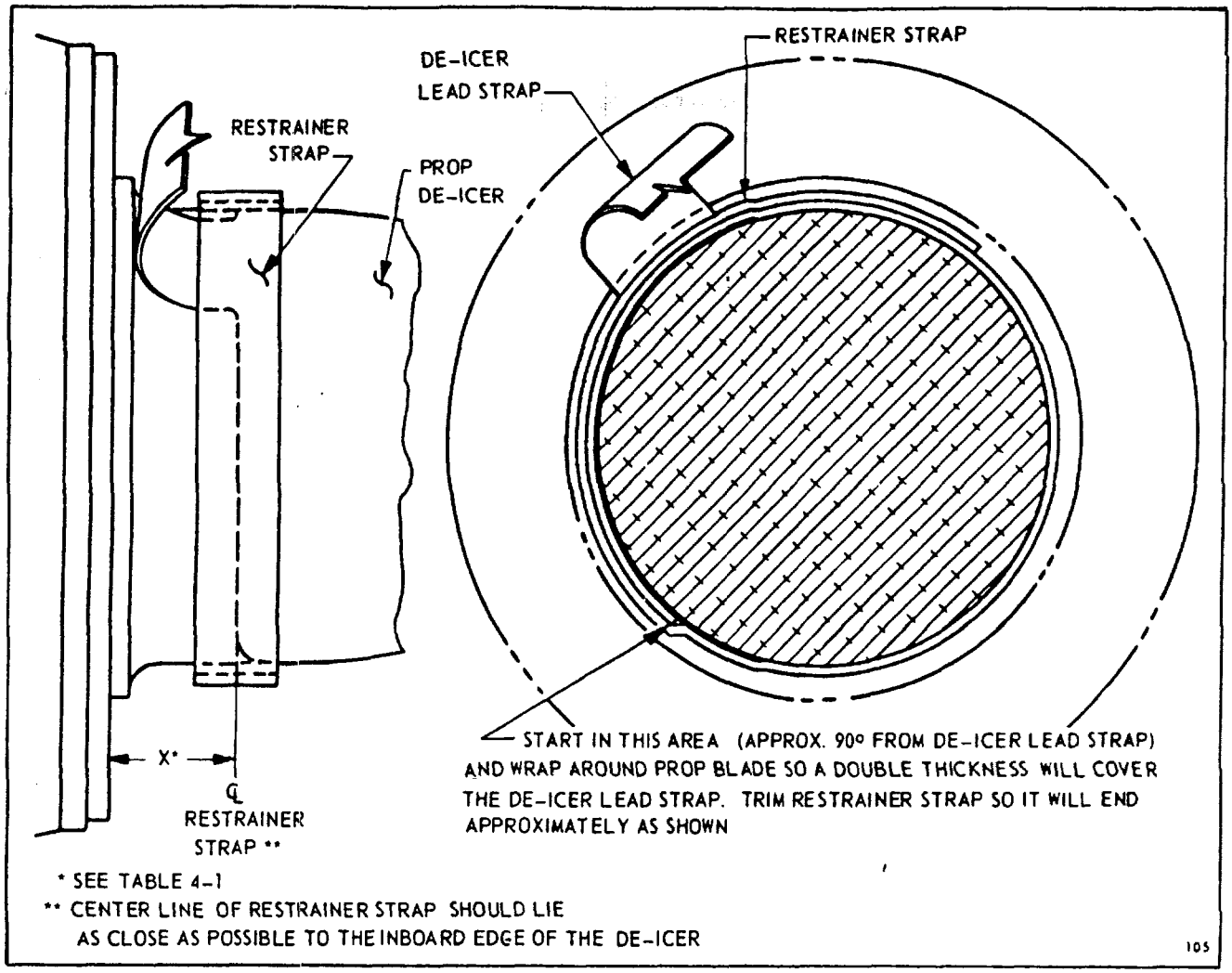


Figure 5-11. Rubber Restrainer Strap 2E1291 or 3E1470

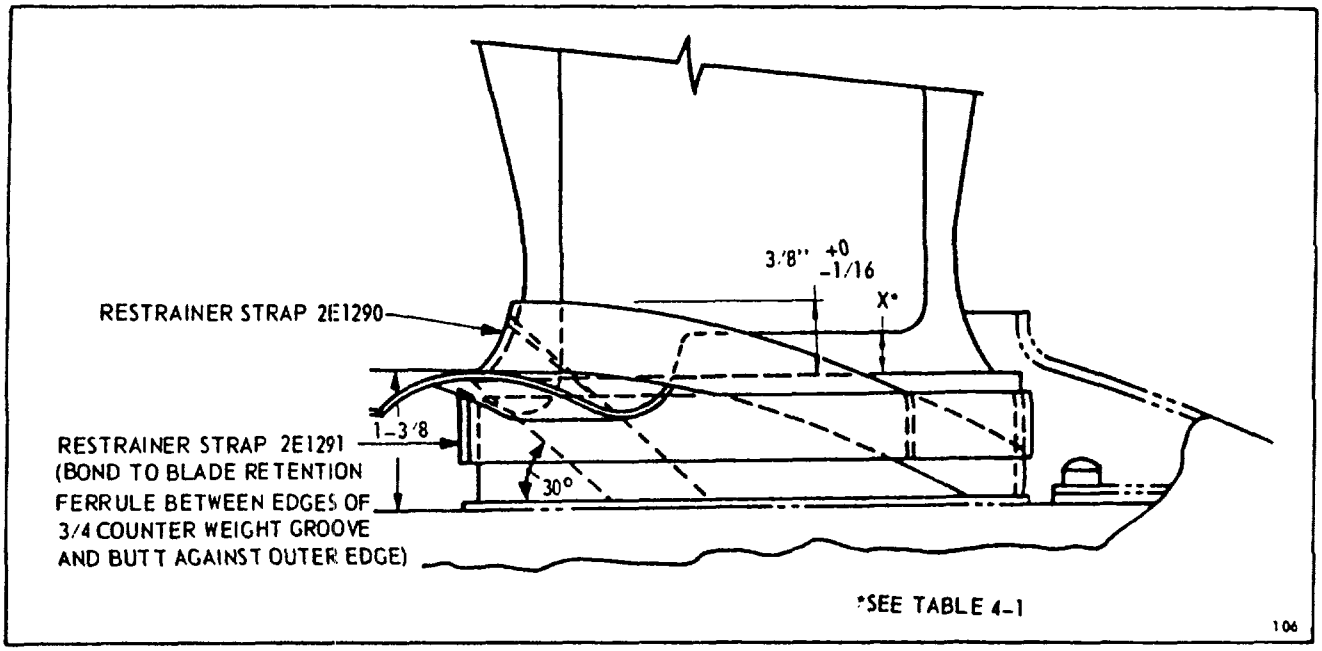


Figure 5-12. Rubber Restrainer Strap 2E1290, 2E1291

Section 6

Detachable Lead Strap De-Icers

6-1. INTRODUCTION

To increase the service life of propeller De-Icers, BFGoodrich isolated the most frequent area of failure — the strap — from the rest of the De-Icer. With this patented design, either the strap or the heating element portion can be replaced upon failure. Basically, conversion to this configuration requires the use of a wire harness to replace the De-Icer lead strap and a terminal clamp or terminal plug and attaching clamp to replace the existing lead strap clamp. In the case of Hartzell compact propellers, a new De-Icer is used, thus permitting discarding of the strap restrainer. See Tables 6-1, 6-2 and 6-3 for applicable aircraft, propellers, and modification kits.

6-2. MODIFICATION OF EXISTING DE-ICERS ON APPLICABLE HARTZELL PROPELLERS

Serviceable existing (installed) De-Icers may be modified to the new configuration per the following procedure:

1. Remove balance weights, if any, noting quantity and position and save for reinstallation.

2. Remove and discard existing lead strap clamps. Disconnect De-Icer leads at terminal strip or studs.

3. Measure De-Icer strap from hub as shown in Figure 6-1 and per Table 6-1 and cut off at appropriate point.

CAUTION

Insure measurements are made correctly or De-Icer will not perform satisfactorily.

4. Slit De-Icer lead strap BETWEEN the wires or braid down to the blade. DO NOT CUT WIRES OR BRAID!

5. Strip ends of wires or braid carefully by hand to dimension shown in Figure 6-1. DO NOT use mechanical wire stripper.

6. Assemble AMP terminal 32442 (or equivalent) to ends of lead wires using standard aircraft practices.

7. Apply BFGoodrich 82-076-1 and -2 sealer (or alternate per BFG Report 59-728F or subsequent) to strap where fabric has been exposed by cuts. Insure that there is insulation over all lead wires.

To permit correct installation of the De-Icer wire harness, it may be necessary to modify the lead clip assembly to permit installation of a clamp to hold the wire harness in place. See Figure 6-2 for lead clip modification and wire harness details.

Correct terminal clamp assembly is shown in Figures 6-3 and 6-4. Install terminal clamp on hub and reinstall balance weights in original position.

6-3. MODIFYING HARTZELL COMPACT PROPELLERS

To convert De-Icing systems on aircraft having Hartzell compact propellers, it is necessary to remove all existing De-Icers, install new De-Icers and modify the propeller counterweights. This work should be accomplished per the following procedure:

1. Remove existing De-Icers, strap restrainers and tie straps. Reinstall prop bolts per manufacturer's instructions.

2. Drill 9/32" diameter hole in counterweight and chamfer per Figure 6-5. File sharp corners as required and cover all modified areas with zinc chromate paint.

3. Install appropriate new De-Icers (See Table 6-1) per BFG Report 59-728F (or subsequent). Locate De-Icers out from hub the appropriate distance per Table 4-1 or 4-2.

4. Slide 5/16" I.D. transflex tubing over De-Icer leads.

5. Insert De-Icer wire harness leads through the counterweight.

6. Connect De-Icer and wire harness leads using window splice terminals (AMP 320559 or equivalent). Connect matching leads (GND-GND, etc.).

7. Form wires as shown in Figure 6-6 and install MS3367-1-9 tie strap in figure 8 configuration. Note position of tie strap buckle (see Figure 6-7 or 6-8). Tighten tie strap and slide tubing over coiled wires as shown.

8. Install MS3367-2-9 tie straps loosely around counterweight and wire harness 1/4" in from ends of tubing. Note position of tie strap buckles in Figures 6-7 or 6-8.

9. Install .263 I.D. transflex tubing over De-Icer wire harness up to counterweight then route under first tie strap. Tighten both tie straps.

10. Install terminals (AMP 32442 or equivalent) on wire harness per standard aircraft practice and connect to existing terminal studs. Insure that correct (OUTB'D-OUTB'D, INB'D-INB'D, GND-GND) connections are made.

11. Install existing clip bar (and cushion material, if applicable) over tubing and wire harness. Attach using spinner attachment hardware; torque per manufacturer's instructions.

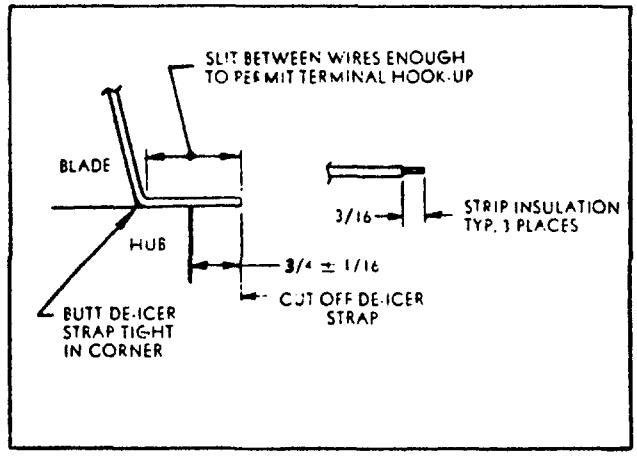


Figure 6-1. De-Icer Lead Strap Modification — Hartzell Propellers

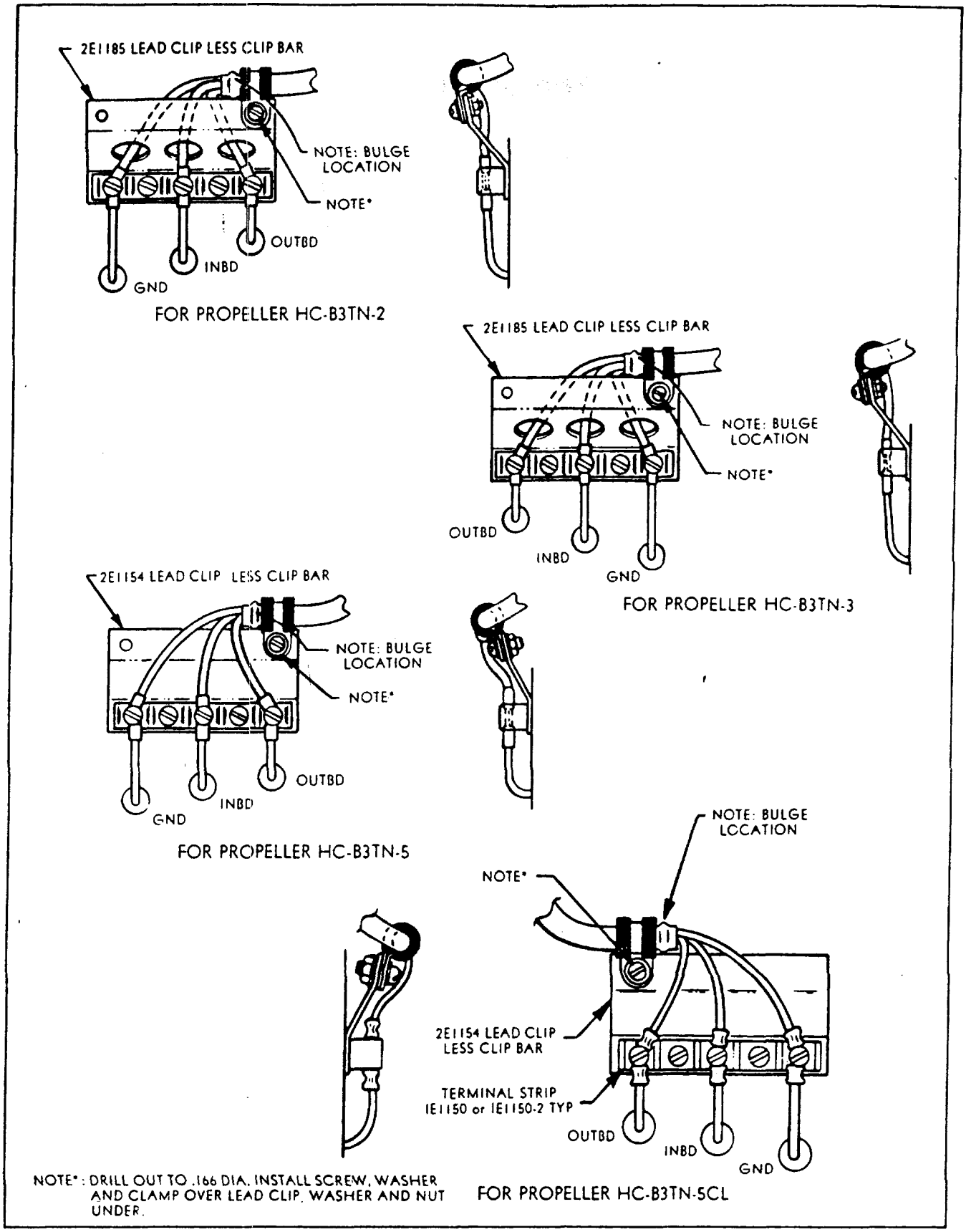


Figure 6-2. Lead Clip Assembly Modification — Hartzell Propellers

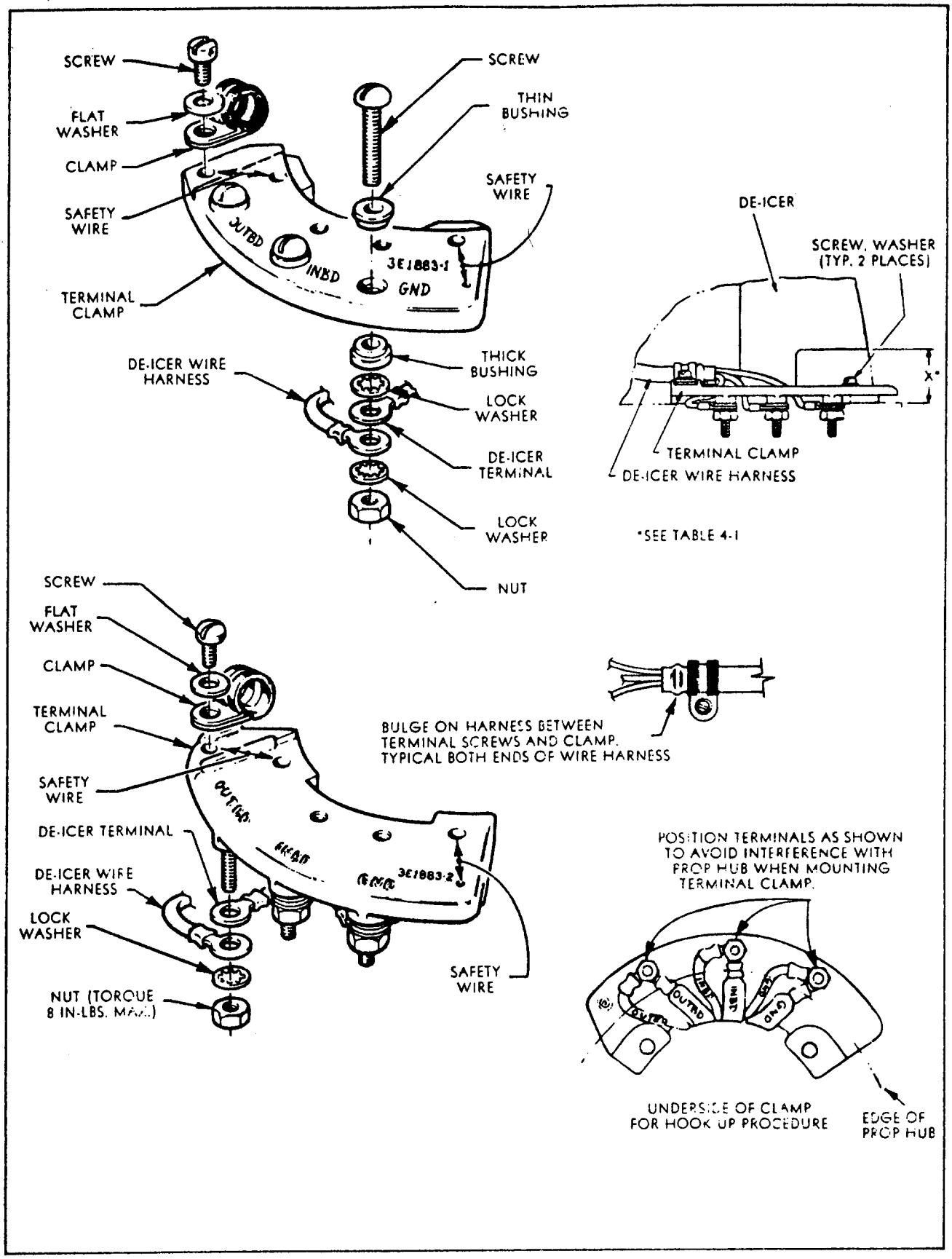


Figure 6-3. 3E1883-1 and -2 Terminal Clamp Assemblies

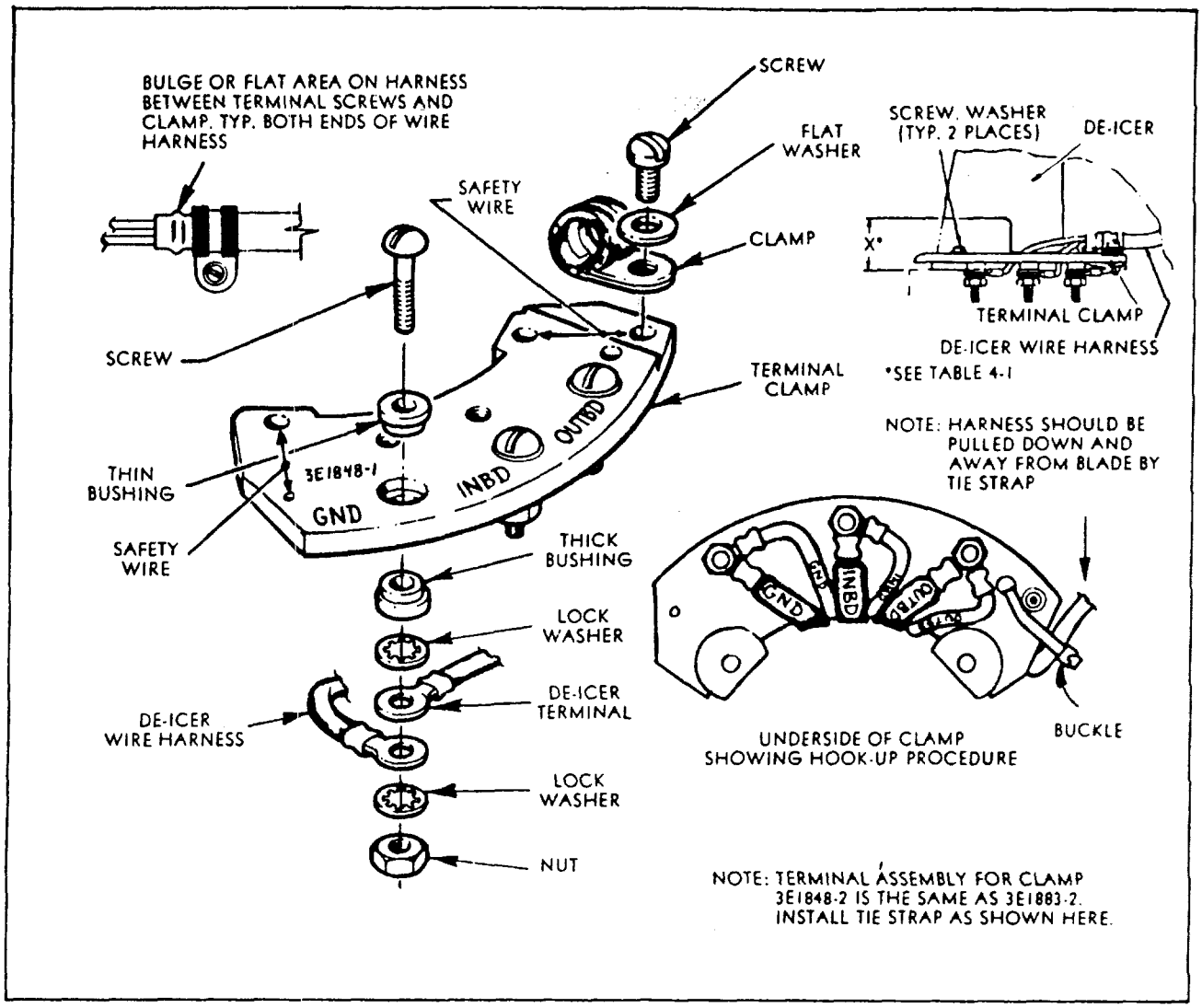


Figure 6-4. 3E1848-1 Terminal Clamp Assembly

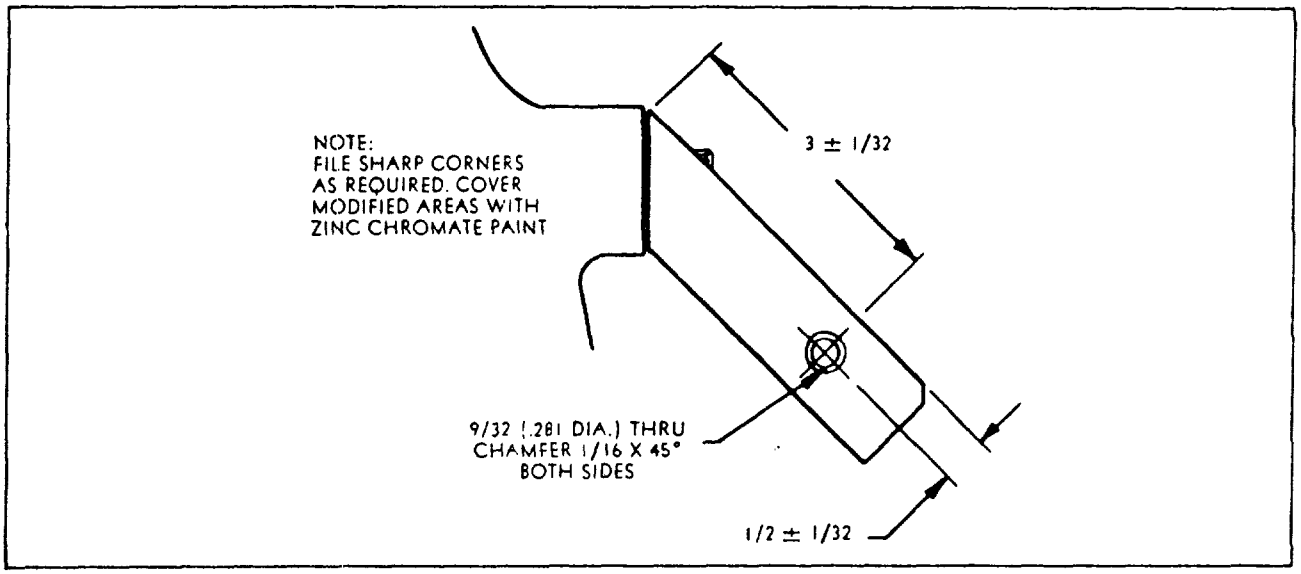


Figure 6-5. Counterweight Drilling Detail

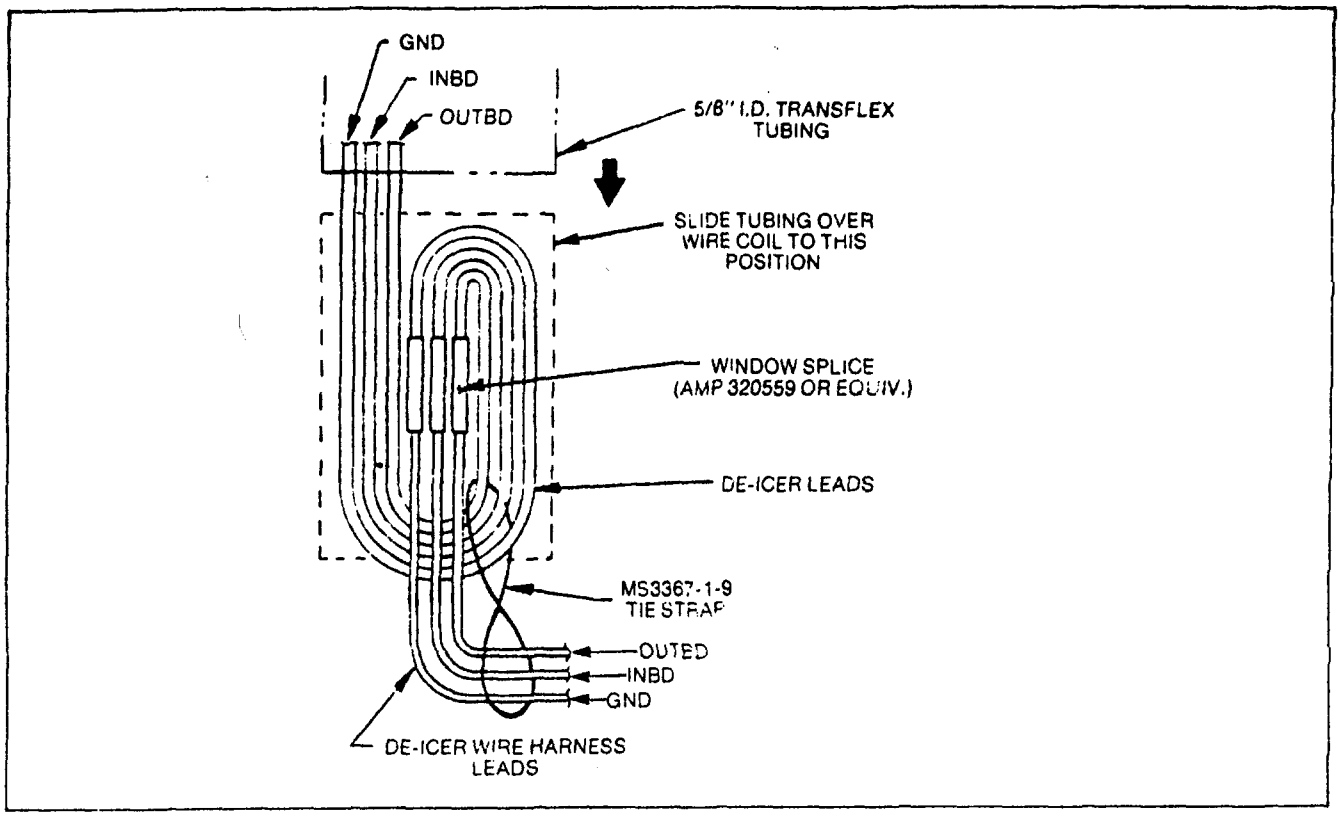


Figure 6-6. Wire Configuration Detail at Counterweight

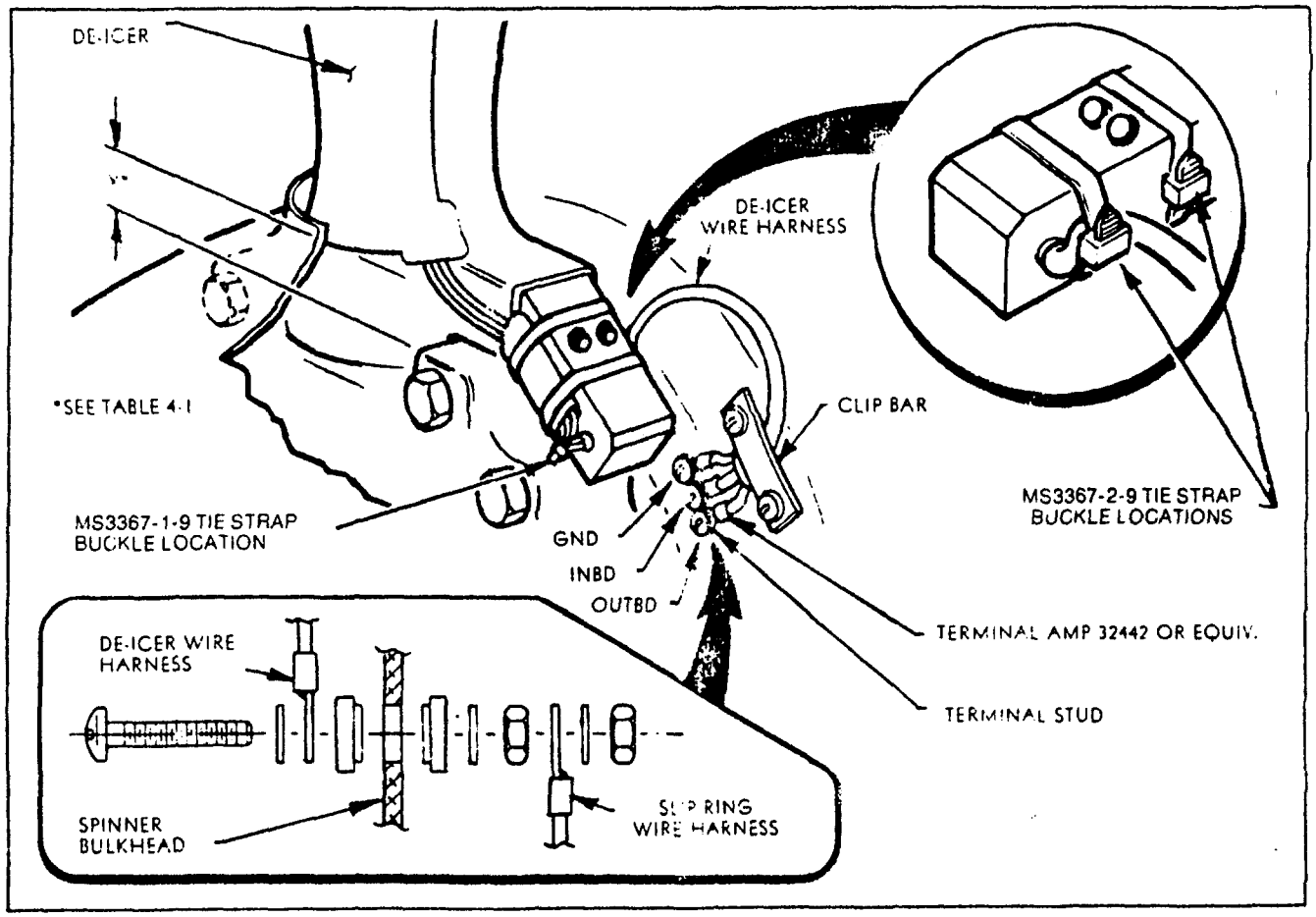


Figure 6-7. Assembly and Wiring Details at Spinner Bulkhead

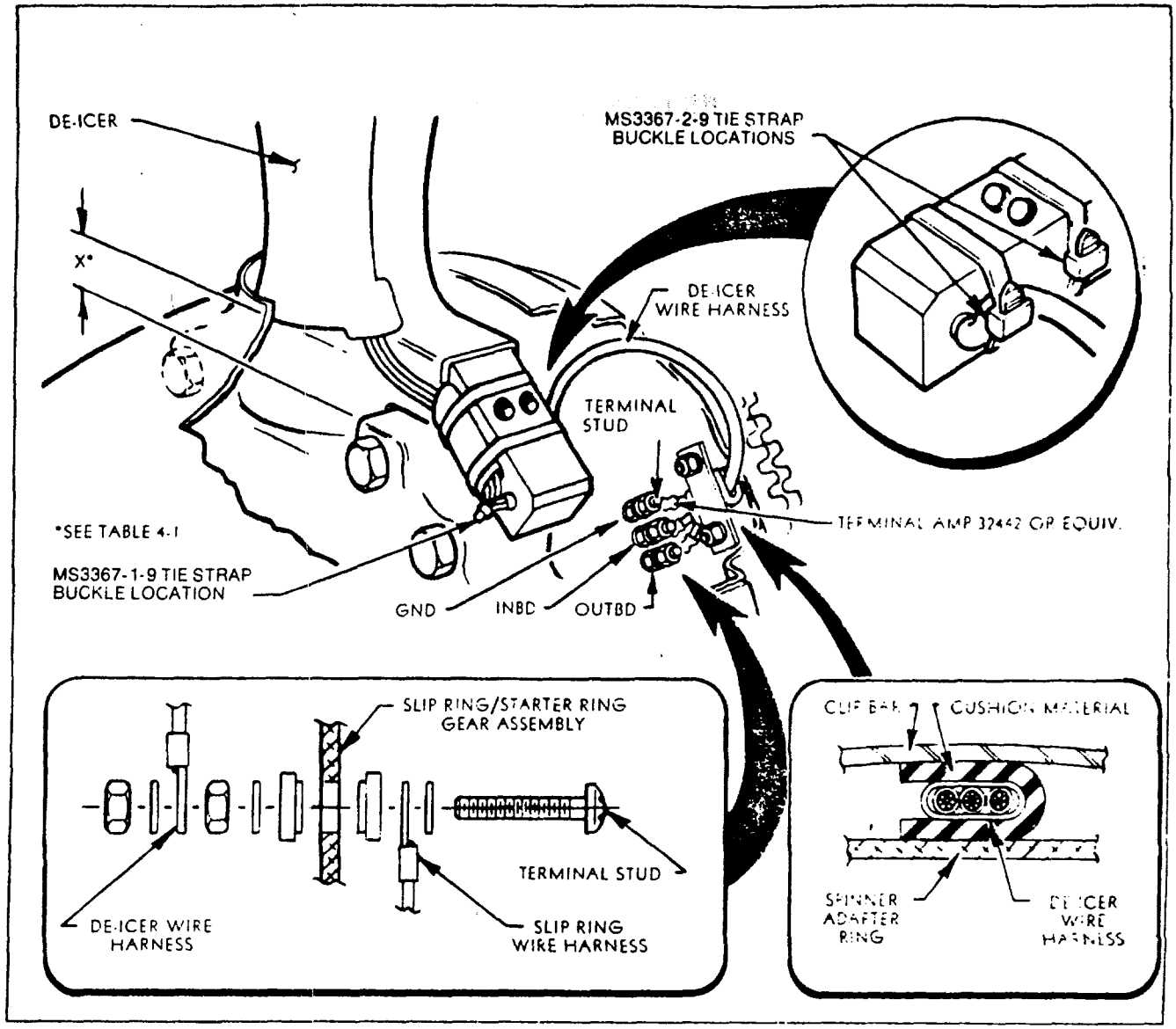


Figure 6-8. Assembly and Wiring Details at Starter Ring Gear

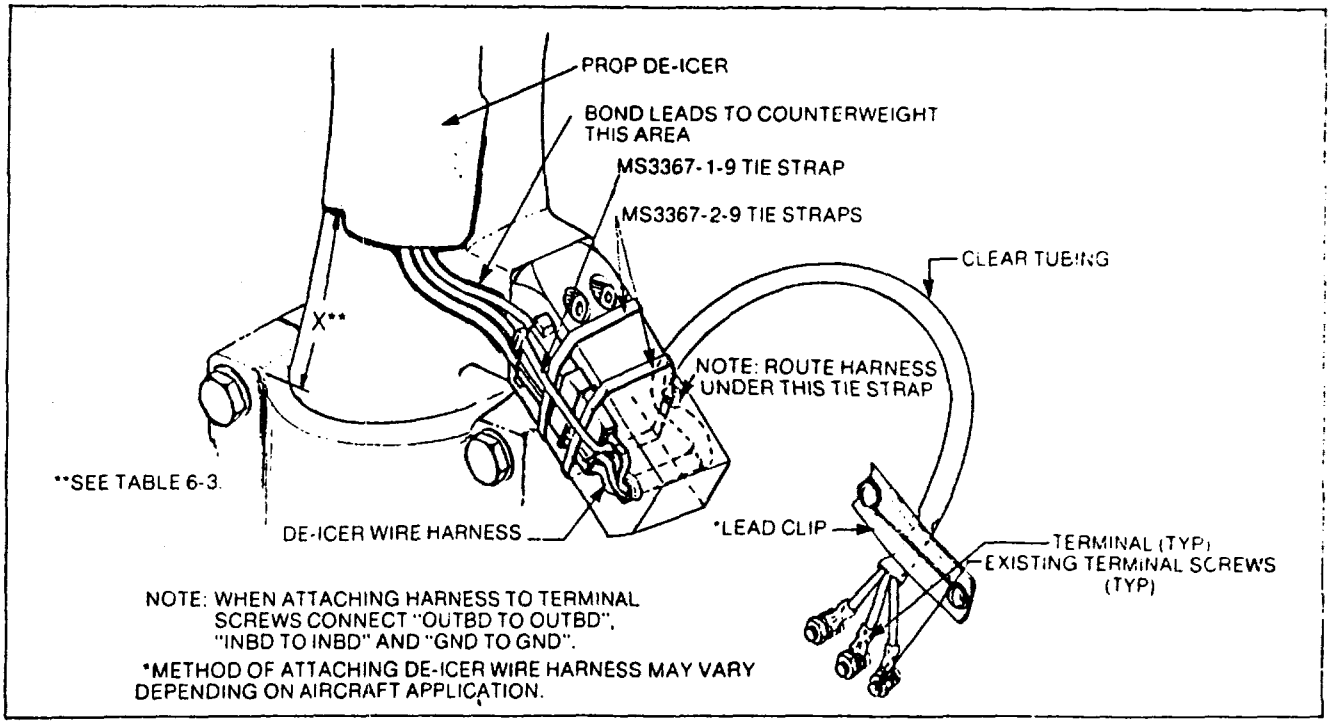


Figure 6-9. 4E1967-3 and -6 Wire Harness Installation

TABLE 6-1. AIRCRAFT AND DETACHABLE KIT IDENTIFICATION AND INFORMATION

CAUTION: *This table must be used in conjunction with Table 6-2. After locating Aircraft and Model No. and Kit No., check Table 6-2 for Kit-Propeller Model applicability.*

NOTE: *This table provides retrofit kit information and lists aircraft currently being reworked to this configuration. Aircraft having detachable leadstrap De-Icers installed as original equipment would not require a retrofit kit. Therefore, those aircraft are not listed here. Original equipment kits containing detachable leadstrap De-Icers are shown in Table 4-1 with a + next to the Kit No.*

Aircraft & Model No.	Modification Kit No.	Wire Harness P/N	Clamp P/N	New De-Icer P/N	Mod. De-Icer Strap Length meas. from edge of hub (See Fig. 6-1)	Component Quantity (Sets/Kit)
Aero Commander 500 S, U	77-189	4E1967-2		4E1601-7		3 ea.
Aero Commander 685	77-589	4E1967-1		4E1601-7		3 ea.
Aero Commander 690	77-023 77-024	4E1889-2 4E1889-2	3E1848-2* 3E1848-2*	4E1601-5	 3/4	3 ea. 3 ea.
American Turbine, Westwind Beech 18 Conv.	65-093 65-094	4E1889-2 4E1889-2	3E1883-2* 3E1883-2*	4E1188-5	 3/4	3 ea. 3 ea.
Beech B55, E55, 58, 58P	77-048	4E1967-2		4E1601-7		2 ea.
Beech B55, E55, 56TC, 58, 58P, 60	77-049	4E1967-1		4E1601-7		3 ea.
Beech 65-90 (Non Reverse Pitch) Series	65-093 65-094	4E1889-2 4E1889-2	3E1883-2* 3E1883-2*	4E1188-5	 3/4	3 ea. 3 ea.
Beech 65-90, 99, 100 (Reverse Pitch) Series	65-093 65-094	4E1889-2 4E1889-2	3E1883-2* 3E1883-2*	4E1188-5	 3/4	3 ea. 3 ea.
Czech Turbolet 410	65-093 65-094	4E1889-2 4E1889-2	3E1883-2* 3E1883-2*	4E1188-5	 3/4	3 ea. 3 ea.
Dee Howard Beech 18 Conversion	65-093 65-094	4E1889-2 4E1889-2	3E1883-2* 3E1883-2*	4E1188-5	 3/4	3 ea. 3 ea.
DeHavilland DHC-6	65-093 65-094	4E1889-2 4E1889-2	3E1883-2* 3E1883-2*	4E1188-5	 3/4	3 ea. 3 ea.
Fairchild Hiller Turbo Porter	65-093 65-094	4E1889-2 4E1889-2	3E1883-2* 3E1883-2*	4E1188-5	 3/4	3 ea. 3 ea.
Mitsubishi MU-2 Series	65-093 65-094	4E1889-2 4E1889-2	3E1883-2* 3E1883-2*	4E1188-5	 3/4	3 ea. 3 ea.
Pacific Propeller Conv. of Pilatus Porter	65-093 65-094	4E1889-2 4E1889-2	3E1883-2* 3E1883-2*	4E1188-5	 3/4	3 ea. 3 ea.
Potez 841	65-093 65-094	4E1889-2 4E1889-2	3E1883-2* 3E1883-2*	4E1188-5	 3/4	3 ea. 3 ea.
Short Brothers SC-7 Series 3	65-092 65-094	4E1889-2 4E1889-2	3E1883-2* 3E1883-2*	4E1188-6	 3/4	3 ea. 3 ea.
Swearingen Merlin IIA	65-093 65-094	4E1889-2 4E1889-2	3E1883-2* 3E1883-2*	4E1188-5	 3/4	3 ea. 3 ea.
Swearingen Merlin IIB, III, IV & Metro	65-092 65-094	4E1889-2 4E1889-2	3E1883-2* 3E1883-2*	4E1188-6	 3/4	3 ea. 3 ea.
Volpar Beech 18 Conv.	65-093 65-094	4E1889-2 4E1889-2	3E1883-2* 3E1883-2*	4E1188-5	 3/4	3 ea. 3 ea.

*or-1

TABLE 6-2. DETACHABLE KIT — PROPELLER MODEL APPLICABILITY

NOTE: *This table is intended for use with Table 6-1 to indicate the propeller models which are eligible for De-Icer conversion with the appropriate kit. To determine if your aircraft is eligible for conversion, locate Aircraft and Model No. and Kit No. in Table 6-1. Find the matching Kit No. in Table 6-2 to determine applicable propeller models.*

Modification No.	Applicable Propellers	Notes
65-092	Hartzell HC-B3TN-5 Series	
65-093	Hartzell HC-B3TN-2, -3, -5 Series	
65-094	Hartzell HC-B3TN-2, -3, -5 Series	
77-023	Hartzell HC-B3TN-5FL	
77-024	Hartzell HC-B3TN-5FL	
77-048	Hartzell HC-F3YR-2	
77-049	Hartzell HC-F3YR-2	
77-189	Hartzell HC-C3YR-2	Hartzell Compact Propeller
77-589	Hartzell HC-H3YN-2	

TABLE 6-3. MODIFICATION KIT — AIRCRAFT MODEL APPLICABILITY

NOTE: *This table provides retrofit kit information and lists aircraft currently approved to be reworked to the sealed connector plug, detachable wire harness as shown in Figure 6-9.*

Aircraft & Model No.	Modification Kit No.	Wire Harness P/N	De-Icer P/N	De-Icer Location Dimension "X"- In See Fig. 6-9	Qty. Per Kit (One Prop Assy)
Beech B55, E55 58, 58P, 58TC	65-380	4E1967-6	4E1601-10	1-3/4	2 ea.
Beech B55, E55 58, 58P, 58TC	65-385	4E1967-3	4E1601-10	1-3/4	3 ea.
Beech 60	65-385	4E1967-3	4E1601-10	2	3 ea.

Report No. 59-728K
February 1, 1983

BFGoodrich

INSTALLATION & REMOVAL PROCEDURES

ELECTRICALLY HEATED PROPELLER DE-ICERS

FOR

ALUMINUM PROPELLERS

GENERAL

The instructions herein apply to initial and replacement installations of BFGoodrich electrically heated propeller De-Icers. Follow instructions exactly to insure maximum adhesion of De-Icers to propeller blades. Hamilton Standard and Dowty Rotol propellers require different cements and procedures which are optional for other types of propellers. (See Section 12). READ ALL INSTRUCTIONS BEFORE BEGINNING WORK!

CAUTION: The condition of the propeller blades and the De-Icer installation must comply with applicable FAA regulations. Inspect prop blades before De-Icer installation. See Section 13.h.

MATERIALS REQUIRED

De-Icers (one for each propeller blade) are supplied in BFGoodrich propeller de-icing system kits. Replacement De-Icers may be ordered from The BFGoodrich Company by specifying the airplane make and model number or De-Icer part number. The following materials and tools are not supplied in the kit. They should be purchased from local suppliers.

Cement 1300L or EC1403 (Minnesota Mining & Manufacturing Company, St. Paul, Minn.); 1 pint is required for six blades.

Filler EC801, (3M Company); 3½ oz. kit for six blades.

Filler 750 (3M Company); 5 oz. is required for six blades.

Sealer 82-076-1, and -2 (BFGoodrich Engineered Products Group, Akron, Ohio); ½ pint is required for six blades.

Sealer F63B12, V66V29 (Sherwin Williams); ½ pint is required for six blades.

Sealer Kit A-2743 (TRW Hartzell Propeller, Piqua, Ohio); 1 qt. kit is provided.

Cleaning Solvent — MEK (Methyl Ethyl Ketone) or Acetone

Tackifying Solvent — Toluol or MEK (see note below)

Cleaning Cloth — any clean, lint-free cloth

1" paint brushes

2" rubber hand roller

¼" metal hand stitcher

Masking tape

NOTE: MEK may be used instead of Toluol to tackify cement, but it provides approximately 10 seconds working time for De-Icer applications, whereas Toluol provides approximately 40 seconds working time. To increase working time of MEK, add up to 5% by volume of cyclohexanone.

1. BLADE PREPARATION

NOTE: If propeller blades extend into the spinner (see Figure A), the inboard end of the De-Icer should be approximately ½" inside the point where the blade emerges from the spinner. If spinner does not cover blade shank, the inboard end of De-Icer should be within ⅛" of the edge of the hub. On non-reverse pitch propellers of Beech Models 65-90, 65-A90, 65-B90, De-Icer should be located 3/16" from hub. ALL DE-ICERS ON A SINGLE PROPELLER MUST BE LOCATED THE SAME DISTANCE FROM THE HUB FOR ROTATIONAL BALANCE.

a. Place center mark at hub end of blade in line with blade's leading edge. Determine location by sighting along leading edge. Starting at hub or at point out from hub indicated in preceding note (or in applicable installation manual) center the De-Icer on this center mark and fit De-Icer strap clamp or restrainer on the hub.* Compare its position with the position of the strap. Adjust position of the De-Icer, as necessary, to make the lead strap agree with the strap clamp unless more specific details are given in the applicable de-icing system installation manual. Hand fit edges, and hold De-Icer in this position while masking off an area approximately ½" from each side of the De-Icer and ½" from the outer end (See Figure B).

*Some BFG De-Icers have scribed centerlines at the inboard and outboard ends. These De-Icers are to be aligned so the scribe lines on the De-Icer align with the centerline of the leading edge.

b. Remove De-Icer. Clean masked off area thoroughly with MEK or Acetone. When rubber restrainer straps are used remove masking tape from the area that accepts the straps. Thoroughly clean around entire blade from hub out about 2". For final cleaning quickly wipe off solvent with a clean, dry, lint-free cloth to avoid leaving a film.

NOTE: Most Hartzell and McCauley propellers have a special protective coating not easily removed by solvents alone. De-Icers should be bonded directly over this protective coating. If bare metal is exposed on Hartzell blades refer to Hartzell's Blade Specification Manual 133 prior to De-Icer installation.

RECOMMENDED CEMENT DRYING TIMES

Propeller Type	Minimum Cement Drying Time*
McCauley or Dowty Rotol	12 hours
Hartzell-Standard blades	12 hours
Hartzell Compact-with long leadstrap De-Icer	24 hours
Hartzell Compact-with De-Icer lead attached to counterweight	12 hours

*Drying times before starting engines applicable to 3M 1300L cement (only). Allow an additional 12 hours cement curing time before energizing the De-Icers.

CAUTION: Cleanliness of metal and rubber parts cannot be over emphasized. Only very clean surfaces will assure maximum adhesion.

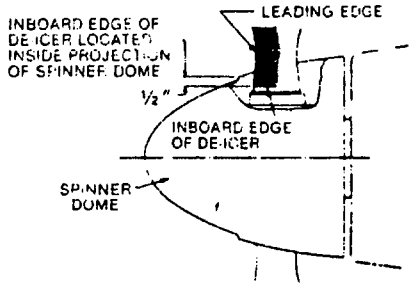


Fig. A — Locating De-Icer on Blade

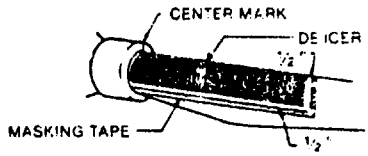


Fig. B — Masking Off De-Icer

2. CEMENT APPLICATION

a. With pencil or pen, mark a center line at the hub of the propeller blade and on the tape at the outboard edge of the masked area.

b. Moisten a clean cloth with MEK or acetone. Clean unglazed (back) surface of the De-Icer and strap. Change the cloth frequently to avoid contamination of the clean area.

c. THOROUGHLY MIX THE CEMENT.

NOTE: To prevent curling of De-Icer edges apply masking tape to the edges on the glazed side before applying cement to the unglazed side. Remove the tape before starting to install the De-Icer.

d. For best results, apply cement and make De-Icer installation at room temperature (65-75°F). Apply one even brush coat of cement to the unglazed back surface of the De-Icer. Apply cement to proper length of De-Icer lead strap so that strap will be cemented to blade up to hub. For propellers using metal strap restrainers, cement De-Icer strap to blade up to projection of centerline of strap restrainer (See Fig. H, View 3). Allow to air dry for a minimum of one hour at 50°F or above, when the relative humidity is less than 75%. If the humidity is 75-90%, allow additional drying time. Do not apply cement if relative humidity is higher than 90%, or if temperature is below

50°F. After cement is dry (not tacky), apply a second even brush coat of cement. Using a silver pencil or a ballpoint pen, mark a center line over the dry cement on the De-Icer before applying the second coat. Where scribe lines are embossed on the De-Icer breeze side, mark centerline on cemented side of De-Icer corresponding to these scribe lines.

NOTE: When cement is applied at temperatures below 65°F, the adhesive bond strength is diminished, regardless of the length of drying time.

e. Apply an even brush coat of cement on the cleaned surface of the propeller blade immediately after the second coat of cement has been applied to the De-Icer. Timing is important because the cement on both surfaces must reach the tacky stage at the same time.

3. DE-ICER INSTALLATION

NOTE: Tacky means slightly sticky to the touch — like adhesive or masking tape.

a. When cement coats are tacky dry on both blade and De-Icer surfaces, position De-Icer on the blade leading edge. Start at the hub end, using center lines as a guide. Make sure that the strap will fall in the previously-marked position. Working outward toward the tip, tack the De-Icer centerline to the leading edge of the propeller blade.

Use the tackifying solvent as necessary. If De-Icer is allowed to get off course, pull up with a quick motion and re-apply De-Icer. If cement is removed from either surface, completely remove De-Icer and re-apply cement as in 2d. Use tackifying solvent as necessary to reinstall De-Icer. When correctly positioned, roll firmly along the center line with a rubber roller (see Figure C).

b. Gradually tilt rubber roller (See Figure D). Carefully work De-Icer over either side of blade contour to avoid trapping air.

c. Roll outwardly from center lines to edges (See Figure E). BE ESPECIALLY CAREFUL TO WORK OUT EXCESS MATERIAL AT OUTBOARD EDGE OF DE-ICER BEFORE OTHER EDGES ARE COMPLETELY ROLLED DOWN. If excess material at edges tends to pucker, work out puckers smoothly and carefully with the fingers (See Figure F).

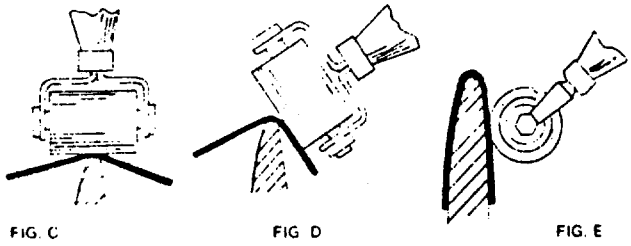


FIG. C FIG. D FIG. E

Fig. C, D, E — Rolling De-Icer onto Blade

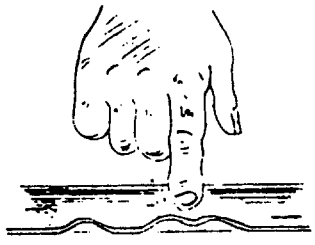


Fig. F — Example of Unacceptable Puckered Edge

d. Roll the tapered edges — especially inboard edge — of the De-Icer with metal stitcher. TO AVOID DAMAGE TO DE-ICER RESISTANCE WIRES OR ELEMENTS, DO NOT USE METAL STITCHER ON BODY OF DE-ICER (See Figure G).

4. APPLICATION OF FILLER AND SEALER

Application of the following sealer is required for **all propeller De-Icer installations.** Application of the following filler and sealer is required for **all De-Icers installed on propellers using Mil-G-23827 grease or equivalent.**

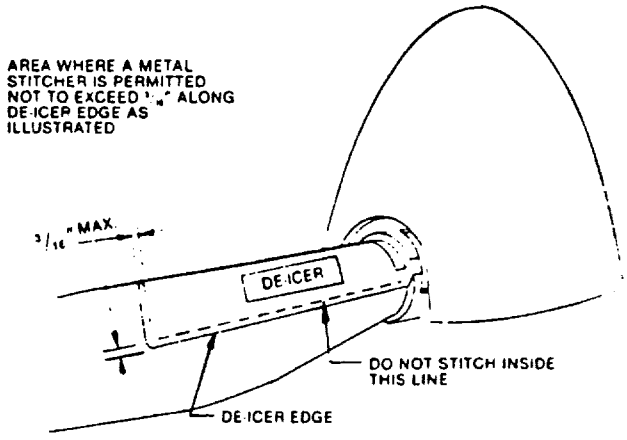


Fig. G — Area for Use of Metal Stitcher

a. MIXING OF MATERIALS — No mixing is required for 3M 750 filler.

CAUTION: 750 filler contains ketone and is extremely flammable.

Material	Manufacturer & No.	Mixing Proportions
Filler	3M EC651 2 Part Sealant	One part accelerator with 10 parts base
Sealer	BFG 82-076-1 & -2 or Sherwin Williams V66V29 & F63B12	Twelve parts -1 with one part -2* One part V66V29 with six parts F63B12

*Recommended ratio. If sealer dries too quickly, use less -2 with -1.

b. APPLICATION OF FILLER — Locate masking tape approximately 1/8" beyond cemented area around De-Icer to permit filler to contact non-cemented portion of blade. Apply one even coat of filler to area around the inboard end, strap, and sides of the De-Icer as shown in Figure H. Filler shall cover 1/8 inch of non-cemented portion of blade, cemented area, and about 1/8 inch of De-Icer as shown in Figure H, Section X-X. Make sure that a fillet of filler covers the area between the lead strap and the blade as shown. Immediately remove masking tape and allow filler to dry for six hours. (24 hours for 3M 750 filler).

NOTE: Filler is not required for short lead strap De-Icers; sealer only may be used.

c. APPLICATION OF SEALER — Apply masking tape about 1/8 inch beyond filler (or 1/4 inch beyond cemented area when no filler is used) to permit sealer to contact non-cemented portion of blade. Apply one even brush coat of either sealer listed to the area around the De-Icer as shown in Figure H. Sealer shall cover 1/8" of non-cemented portion of blade (or 1/4 inch of non-cemented portion of blade where no filler is used) filled area, cemented area, and approximately 1/4 inch of De-Icer as shown in Figure H, Section X-X and Y-Y. Make sure that sealer completely covers filled area (if any) between the lead strap and blade as shown. Immediately remove masking tape before sealer dries. Allow 12 hours cement curing time before starting engine; allow 24 hours cement curing time before operating the De-Icers. (Ref. 1.b. Note)

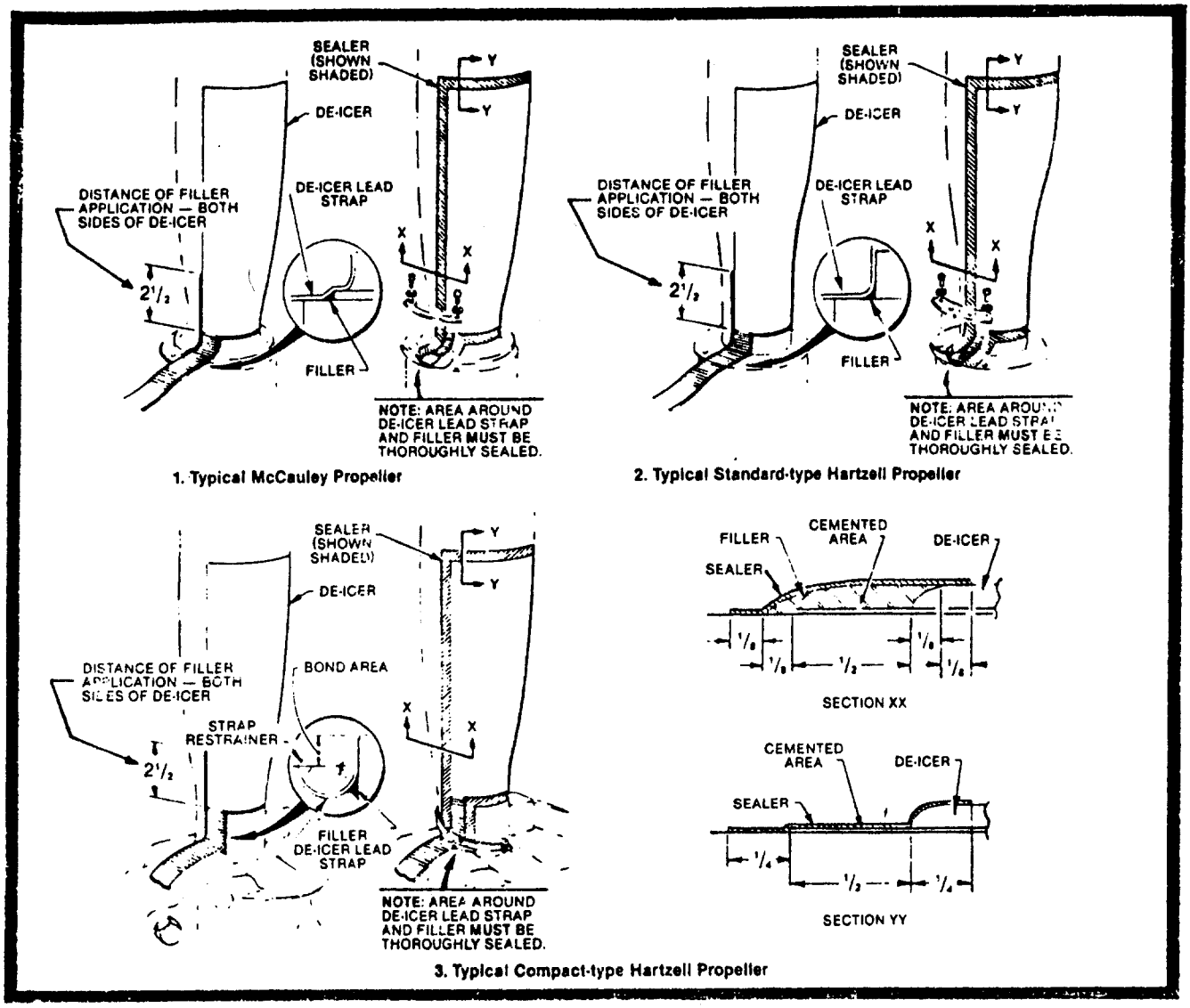


Fig. H — Filler and Sealer Application

5. MARKING HARTZELL PROPELLER BLADES

a. TRW Hartzell Propeller Company has established a method for identifying their propeller blades originally shipped with De-Icers installed. All such blades are marked with a letter "B" or "K" following the basic propeller model number in the blade model designation.

NOTE: The letter "B" represents blades with BFG conventional De-Icers; "K" represents blades with BFG Hot Prop™ De-Icers.

b. Blades which were shipped without De-Icers have a blank space in which the "B" or "K" must be added when the De-Icer is installed. Examples of the blade model designation are shown in Note 2 of the FAA Type Certificate Data Sheets applicable to propellers which are eligible for De-Icers. Examples are:

FAA Data Sheet	Example
P2EA	W 10252 B — 5½
P6EA	V 8433 B — 5½
P892	9349 B — 3
P907	10152 B — 5½
P913	8433 B — 5½

Note the position of the letter "B" in these examples.

c. After the De-Icers have been installed, check blade model designation marked on each blade of the Hartzell propeller.

d. On blades not previously marked, insert a letter "B" or "K" in the blank space following basic model or template number. Refer to the examples in preceding paragraph b, or in Note 2 of FAA Type Certificate Data Sheets.

e. Proceed as follows:

1. Clean off the protective lacquer over the proper space in the blade model designation.
2. Add a letter "B" or "K" in the space provided. Use opaque ink.
3. Apply a protective coating, such as an acrylic clear lacquer.

6. SECURING THE DE-ICER LEAD STRAP

a. Clamps, tie straps, strap restrainers, and restrainer straps are used to prevent loosening of the De-Icer when centrifugal loads are applied to the De-Icer strap. Clamps are used, where possible, to hold the lead strap securely against the hub. Alternately, tie straps, strap restrainers, and restrainer straps are used to limit the movement of the De-Icer strap.

b. For new installations, the proper clamps, restrainers, or straps are provided in the BFGoodrich propeller de-icing system kit. When De-Icers are being replaced, the old clamps or restrainers may be reinstalled. Use MEK or toluol to loosen adhesion of rubber restrainer straps if they are to be reused. Tie straps are not reusable and should be ordered with the De-Icers.

c. Install screws of proper length through clamp into the tapped holes in the propeller hub. Use only existing holes. That portion of the clamp under which the De-Icer

strap passes should be spaced away from hub about .150" with appropriate washers or spacers. Do not safety wire at this time.

d. Install strap restrainers, tie straps, or restrainer straps on the propeller blade or hub per the applicable BFGoodrich propeller De-Icer installation manual for new installations; for replacement installations, install in the same position previously used. Instructions for cementing the restrainer straps are given in Section 7.

7. RESTRAINER STRAP INSTALLATION

(See applicable de-icing system installation manual for other details of a specific installation.)

a. Clean and cement both sides of the restrainer strap. Use materials and procedures outlined for cementing De-Icer, as applicable.

b. When cement is dry, apply a second, even brush coat of cement to both sides of strap.

c. Immediately apply an even brush coat of cement to 2" cleaned area of blade next to hub and over any part of De-Icer and lead strap located in that area.

d. When the cement coats are tacky dry on the blade, De-Icer, and strap, position the strap on the blade and De-Icer as indicated in the applicable de-icing system manual. Roll firmly in place with rubber roller.

e. Apply one even brush coat of sealer (Section 4) over restrainer strap and cemented areas.

f. Allow 24 hours curing time before starting the engine.

8. INSTALLATION OF CLIPS AND TERMINALS

a. The De-Icer strap terminates in narrow leads to which terminals are attached. Attach these terminals to studs or screws on the starter ring gear, the terminal clamp, or the spinner bulkhead, depending upon the airplane being equipped. Secure the strap with a metal clip, as applicable. For Hartzell compact propellers with detachable lead De-Icers, connect the leads to the wire harness and secure to the counterweight.

Details of these types of installations are given in the applicable De-Icing System Installation or Maintenance Manual. For replacement installations, relocate the parts in the same positions from which they were removed.

CAUTION: The De-Icer lead strap must not be twisted more than one turn (180°) in lining up the respective leads.

CAUTION: Never use external tooth star washers (teeth on outer diameter) adjacent to the tongue of the terminals.

b. Be sure there is no slack in the leads between the terminals and the clip.

c. TEST EACH INSTALLED PROP DE-ICING SYSTEM TO INSURE THAT DE-ICERS ARE INSTALLED SO THE BLADES CAN BE MOVED THROUGHOUT THE ENTIRE BLADE PITCH RANGE WITHOUT PLACING THE STRAPS IN TENSION.

9. BALANCE WEIGHTS

a. Reinstall balance weights if previously removed. The original weights or their equivalents must be used. For replacement De-Icer installations, weights should be installed as removed. For new De-Icer installations, see the applicable de-icing system installation manual for details of weight installation. The clamp and weights or restrainer and weights should not contact any part of the propeller or spinner assembly under any condition.

b. Install safety wire on screws as required.

10. FINAL ELECTRICAL CHECK-OUT

a. Be sure terminals are tight, but do not over-torque.

b. Check electrical resistance between terminals or between the slip rings. Compare with the following table for minimum and maximum values in ohms between common ground and either of the other terminals when De-Icer terminals are attached to proper studs.

Part Number	1 De-Icer Ea. Element**		2 De-Icers* Parallel		3 De-Icers Parallel	
	Max.	Min.	Max.	Min.	Max.	Min.
4E1188	5.26	4.58	2.65	2.30	1.78	1.55
4E1214	1.15	0.95	0.58	0.47	0.39	0.32
4E1270	4.12	3.34	2.06	1.67	1.37	1.11
4E1525	3.03	2.63	1.51	1.32	1.01	0.88
4E1601	5.26	4.58	2.65	2.30	1.78	1.55
4E1746	57.40	50.00	28.70	25.00	19.10	16.70
4E1895	1.15	0.95	0.58	0.47	0.39	0.32
4E1956	5.26	4.58	2.65	2.30	1.78	1.55
4E2152	5.26	4.58	2.65	2.30	1.78	1.55
4E2200	4.90	4.74	2.45	2.37	1.64	1.56
4E2271	4.90	4.74	2.45	2.37	1.64	1.58
4E2292	1.12	1.04	0.56	0.52	0.38	0.35
4E2303	1.12	1.04	0.56	0.52	0.38	0.35
4E2336-10	4.24	4.00	2.12	2.00	1.42	1.34
4E2336-12	3.38	3.06	1.69	1.53	1.13	1.02
4E2560	3.60	3.26	1.80	1.63	1.20	1.09
4E2575	3.60	3.26	1.80	1.63	1.20	1.09
4E2595	4.10	3.80	2.05	1.90	1.37	1.27
4E2598	3.84	3.44	1.92	1.72	1.28	1.15

*Four De-Icers in parallel will have half the resistance of two
**Five De-Icers in parallel will have one-fifth the resistance of a single De-Icer element.

If propeller is installed on aircraft, propeller De-Icer circuits must be electrically isolated from the rest of the aircraft wiring when making the above resistance check. Use one of the following methods to isolate:

1. Remove the brush block or module assembly.
2. Retract brushes, and slip a sheet of paper between brushes and slip rings. Do not misalign or damage brushes when inserting the paper shim.
3. Disconnect wiring harness at brush block or module assembly, at a terminal strip, or at a firewall connector plug.

c. Check for intermittent open circuits by tensioning the De-Icer straps slightly while measuring resistance. Also, press lightly on the entire De-Icer heating surface and in the area adjacent to the clamp. Resistance must not fluctuate.

d. Reconnect any circuits that may have been disconnected, or remove paper shim if used. Installation of the electrical propeller De-Icers is now complete.

CAUTION: Observe the 12-hour cement curing time before starting engine. Also, observe the 24-hour curing time before operating the De-Icers. Handle the propeller carefully to prevent damage to the De-Icers. Recheck the position of the De-Icer straps so they are not pinched or snagged by nearby components.

11. ADDITION OF NEOPRENE TO SPINNER DOME FLANGE

(As required; consult applicable de-icing system installation manual.)

While the spinner domes are removed from the airplane, a neoprene strip should be bonded to the spinner dome flange to reduce abrasion in the lead strap area.

a. Thoroughly degrease this area, using MEK or acetone cleaning solvent and wipe clean with a clean, dry, lint-free cloth.

b. Lightly sand to remove all paint in the bond area. See Figure 1.

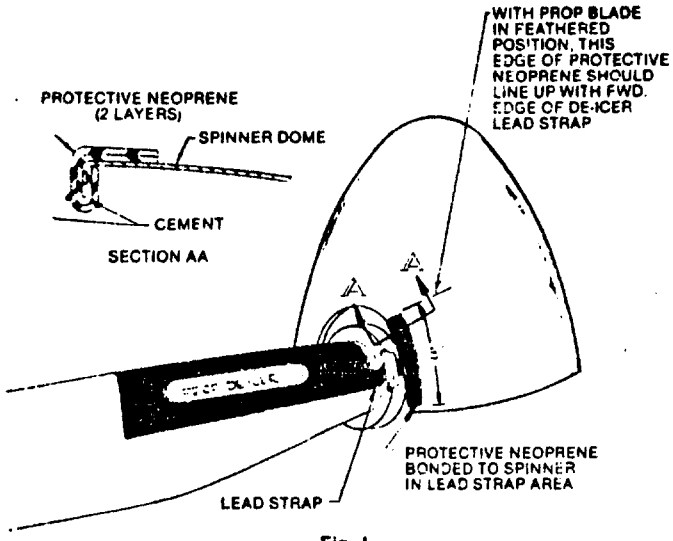


Fig. I
Positioning of Protective Neoprene on Spinner Dome

CAUTION: Cleanliness of bonding areas is vital. Only very clean surfaces will assure maximum adhesion.

c. Reclean with solvent as in paragraph (a) above.

d. Cut the .020 neoprene rubber into two strips each $^5/_8$" x 3".

e. Apply strips of masking tape to the exposed rubber sides of the neoprene to prevent curling during installation. Remove protective paper from neoprene and apply one even coat of 1300L cement to the surfaces and allow to air dry for one hour.

f. Apply one coat of 1300L cement to the spinner dome flange. Allow to air dry one hour so the surface is not tacky.

g. Apply a second coat of cement to one neoprene strip and allow to dry until tacky.

h. Tackify cement on the spinner dome with MEK or toluol, and press the twice-cemented neoprene into position. Extreme care must be used in applying the neoprene to insure a good bond, avoiding looseness or wrinkles. Remove masking tape.

i. After allowing proper drying time, lightly clean the exposed neoprene surface of the installed strip with MEK or acetone. For final cleaning, wipe off the solvent with a clean, dry, lint-free cloth to avoid leaving a film.

j. Apply one coat of 1300L cement to the neoprene rubber strip on the spinner dome flange. Allow to air dry about one hour so surface is not tacky.

k. Apply cement to both neoprene strips, and allow to dry until tacky.

l. Press the second neoprene strip into position. Extreme care must be used in applying the neoprene to insure a good bond, avoiding looseness or wrinkling. Remove masking tape.

m. After allowing proper drying time, lightly clean the exposed neoprene surface of the installed strip with a cloth dampened with MEK or acetone.

12. USE OF ALTERNATE CEMENT

A. HAMILTON STANDARD PROPELLERS

a. The cementing procedure which follows is an approved method for Hamilton Standard propellers, but is optional for other makes. In place of the 1300L or EC1403 cement, the following cements are used:

Cement EC776 (Minnesota Mining & Mfg. Co.); 1 pint is required for 18 blades.

Cement, Bostik 1024 (Part A)* (U.S.M. Chemical Company, Middleton, Mass.); 1 pint is required for 6 blades. Cement, Bostik 1024 (Part B)* Accelerator (U.S.M. Chemical Co.); 1 can is required for 6 blades.

Primer, Bostik 1007 (U.S.M. Chemical Company); 1 pint is required for 18 blades.

*Bostik 1088, parts A and B may be used in place of Bostik 1024; amounts are the same per propeller.

b. Prepare blade as described in Section 1. For best results, install De-Icer at normal room temperature.

c. Thoroughly mix EC776 cement, and brush apply one thin, uniform coat to cleaned metal surface within the masking tape. Allow to dry (at least 30 minutes) before going to next step.

d. Mix primer 1007 thoroughly and apply one even brush coat to the entire previously-coated area. Allow to dry at least 30 minutes.

e. Prepare the 1024 cement by mixing one part of 1024 accelerator (Part B) with 15 parts of 1024 cement (Part A). Prepare only enough for immediate use. The mixture will begin to gel in six to eight hours.

f. Moisten a clean cloth with MEK or acetone and clean the unglazed surface of the De-Icer, changing cloth frequently to avoid contamination.

CAUTION: Cleanliness of metal and rubber parts cannot be too highly stressed. Only very clean surfaces will assure maximum adhesion.

g. Apply two uniform brush coats of 1024 cement to the unglazed, clean, back surface of the De-Icer as in paragraph 2d.

h. Apply an even brush coat of 1024 cement to the primed surface of the propeller blade immediately after the second coat of cement has been applied to the De-Icer. Timing is important because the cement on both surfaces must reach the tacky stage at the same time.

i. When cement coats are tacky dry (usually 10 minutes in direct sunlight to 30 minutes under adverse drying conditions), proceed with installation as described in Section 3.

NOTE: Instead of Bostik primer 1007 and cement 1024, cement EC776 followed by cement 1300L may be used. Apply EC776 as in 12.A.c and 1300L as in 2c through e.

B. DOWTY ROTOL PROPELLERS

a. The cementing procedure which follows is an approved method for Dowty Rotol propellers but is optional for other makes. In place of the 1300L or EC1403 cement and aforementioned sealers, the following cements and sealant are used:

Cement-British Bostick 2402 (Bostik LTD, England)

Primer-British Bostick 9252 (Bostik LTD, England)

Sealer-Ault & Wiborg Base U-1-5-10
Catalyst U-1-4, Dowty Rotol Spec MAT 500

b. Prepare blade as discribed in Section 1. For best results, install De-Icer at room temperature.

c. Apply one coat of 9252 primer to blade and allow to dry for one hour.

d. Thoroughly mix 2402 cement and apply one coat to the De-Icer bonding surface and allow to dry for one hour.

e. Apply a second coat of cement to the De-Icer and immediately apply a coat of cement to the blade surface over the primer coat.

f. When cement coats are tacky dry (usually 10 minutes in direct sunlight to 30 minutes under adverse drying conditions), proceed with installation as described in Section 3.

g. Apply filler per section 4.b.

h. **APPLICATION OF SEALER**—Apply masking tape ¼" beyond De-Icer cement edge to permit sealer to contact base metal and apply one even coat of sealer all over the De-Icer. Prior to the application of sealer, lightly abrade surface of De-Icer with grade 320 silica carbide paper. The thickness of the sealer coat must not exceed .002". **Immediately** remove masking tape before sealer dries.

13. DE-ICER REMOVAL PROCEDURE

NOTE: Cushion the jaws of any pulling tool to prevent damage to the De-Icer, unless it is to be scrapped. If De-Icer has failed under warranty and is to be returned, use extreme care to prevent additional damage to the De-Icer during removal.

a. Remove propeller spinner.

b. Disconnect prop De-Icer terminals from studs on starter ring gear, terminal clamp, or spinner bulkhead (depending upon the airplane). Disconnect leads from wire harness at counterweight for Hartzell compact propellers.

c. Remove the clip which holds strap to starter ring gear or spinner bulkhead, as applicable.

d. Remove clamp or restrainer which holds strap to propeller hub. Note position for reinstallation purposes.

e. Use a liberal amount of MEK or toluol to soften adhesion line between De-Icer and propeller blade. Starting at one corner, loosen enough of the De-Icer to grasp in the jaws of a vise grip plier or similar tool. (See preceding note.) Apply a steady pull to remove De-Icer from the propeller surface slowly and carefully while continuing to use a liberal amount of MEK or toluol to soften adhesion line.

CAUTION: Do not allow solvents to leak into propeller hubs and cause damage to seals.

f. If condition of De-Icer after removal is not important, strip from blade without solvent. De-Icer may tear or come off in pieces.

g. Remove residual cement from blade. Use solvents mentioned above or Turco No. 3 (Turco Products, Inc., Wilmington, California, 1 pint per 6 De-Icers) as necessary.

h. Visually inspect used propeller blades for damage or deterioration prior to De-Icer installation. (Use of 10x magnifying glass is suggested.) Perform other inspection procedures and repair or replace blades per propeller manufacturers' recommendations.

BFGoodrich

REPORT NO. 68-04-714-I
February 1, 1983

OVERHAUL

BRUSH BLOCK ASSEMBLIES

AND MODULAR BRUSH ASSEMBLIES

FOR

ELECTROTHERMAL PROPELLER DE-ICING SYSTEMS

INTRODUCTION

Electrothermal propeller de-icing systems require one brush block assembly or one modular brush assembly per engine. Instructions relating to brush replacement in brush block assemblies are found in Section A of this report. Instructions concerning replacement of brush block assemblies with modular brush assemblies are given in Section B of this report. Replacement of individual brushes or brush modules is described in Section B also.

SECTION A

BRUSH BLOCK ASSEMBLY OVERHAUL

Most brush block assemblies contain a brush retainer assembly which, in turn, contains two or three brushes and springs. To determine if brushes should be replaced, consult the paragraph covering the specific brush block assembly for instructions telling how to measure brush wear. Dimensions are given indicating when brushes MUST be replaced. IF BRUSHES ARE PERMITTED TO WEAR BELOW THE MINIMUM ALLOWED, SYSTEM FAILURE AND SERIOUS SLIP RING DAMAGE MAY OCCUR.

Table 1 lists, in numerical order, all Brush Block Assemblies covered by this publication and may be used as an index to illustrations and pages for specific Brush Block Assemblies instructions. Table 1 also lists the part numbers of the brush block and brush retainer assemblies and their individual brushes and springs. These assemblies or their individual parts (including "B" barrels, braid, tubing, etc. as well as brushes and springs) can be purchased separately from BFGoodrich. However, it is recommended that brushes and their matching springs be purchased and installed in sets. Use only BFG leads and insulation tubing. They have been specifically selected for this application.

To provide a good electrical contact, brush block assemblies using 2E1132 brushes should have a five-hour minimum break-in before the system is operated. This applies to replacements and new installations. This does not prohibit ground checkout of the system with engines "OFF" as specified in the Installation Manual. No break-in time is required for other types of brushes.

TABLE I. ASSEMBLY AND REPAIR PARTS

Brush Block Assembly	Figure No.	Page No.	Brush Retainer Assembly	Brush	Spring
4E1213 4E1283	2	3	3E1176 3E1176	2E1081 2E1081	2E1076 2E1076
4E1294	6	6	None	3E1206-3 2E1132	1E1136
4E1311-1	5	5	3E1345	(2) 3E1206-1 (1) 3E1206-2	2E1108
4E1311-2	7	7	3E1483	(2) 3E1443-1 (1) 3E1443-2	1E1136
4E1311-3	7	7	3E1562	(2) 3E1443-1 (1) 3E1443-2	1E1136
4E1327	2	3	3E1176	2E1081	2E1076
4E1350-1 4E1350-2 4E1350-3	3	4	3E1294 3E1398 3E1450	3E1206-1 3E1206-1 3E1206-2	2E1207 2E1207 2E1207
4E1350-4 4E1350-5 4E1350-6	9	8	3E1536 3E1536 3E1538	3E1443-2 3E1443-2 (2) 3E1443-2 (1) 3E1443-1	2E1207 2E1207 2E1207
4E1387-1	5	5	3E1345	(2) 3E1206-1 (1) 3E1206-2	2E1108
4E1387-2	5	5	3E1416	(2) 3E1206-1 (1) 3E1206-2	2E1108
4E1387-3, -5	7	7	3E1483	(2) 3E1443-1 (1) 3E1443-2	1E1136
4E1387-4, -6	7	7	3E1562	(2) 3E1443-1 (1) 3E1443-2	1E1136
4E1560-2	5	5	3E1420	3E1206-3	2E1108
4E1639	7	7	3E1500	(2) 3E1443-1 (1) 3E1443-2	1E1136
4E1749-2	8	8	3E1573	(2) 3E1443-1	1E1136
4E1908-1	7	7	3E1789	3E1443-1	1E1136

1. GENERAL REPLACEMENT INSTRUCTIONS

The following instructions apply, in general, to all brush block assemblies covered in this publication. Additional instructions, where required, are given in the paragraphs treating the specific assembly. Read all general and specific instructions for your brush block before attempting to replace components.

NOTE: Follow established aircraft procedures when soldering, unsoldering, or safety-wiring. When soldering, avoid excessive "wicking" (solder flow) along the lead; wicking must not exceed 3/16 inch. To prevent corrosion use only non-corrosive flux; wipe or flush flux from brush leads and receptacle pins. Clean and degrease all brush block components before reassembling. Use cloth dampened with MEK (methyl-ethyl-ketone) for cleaning. DO NOT SOAK BRUSH BLOCK ASSEMBLY OR BRUSHES IN SOLVENT!

A. BRUSH RETAINER ASSEMBLY REPLACEMENT (See applicable figure and specific instructions)

1. Dismount brush block assembly from aircraft by removing attaching hardware.

2. Remove attaching hardware and separate brush retainer assembly from guide block. Note orientation of terminals with respect to assembly.

3. Discard old brush retainer assembly.

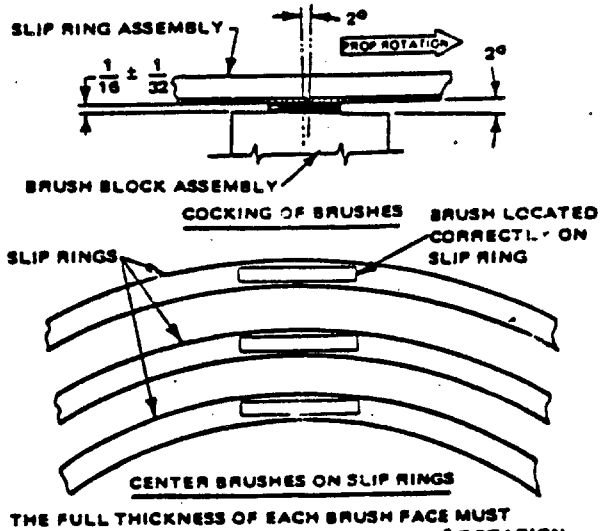


Figure 1. Brush Block Adjustment

4. Assemble new brush retainer assembly; determine correct orientation of brushes to receptacle (see applicable figure) and carefully insert brushes into brush guide block slots or slide guide block over brushes, as applicable. BRUSHES ARE EXTREMELY FRAGILE — AVOID ANY SIDE LOADING. Insure that springs are inserted in alignment slots or holes in retainer and guide blocks.

5. Replace attaching hardware removed in 1.A.2. Insure that new receptacle is oriented according to pin identification shown in applicable figure.

6. Install brush block assembly on aircraft with attaching hardware removed in 1.A.1. Check alignment per figure 1. Safety wire all bolts.

B. BRUSH REPLACEMENT (See applicable figure and specific instructions)

1. Dismount brush block assembly from aircraft by removing attaching hardware.

2. Matchmark receptacle flange and brush retainer block to permit reinstallation in the same position.

3. Remove attaching hardware and separate brush retainer assembly from brush guide block.

4. Unfasten receptacle from brush block and/or brush guide block.

5. Disconnect/unsolder brush leads from studs/receptacle pins.

6. Discard old brushes and springs.

7. Install insulating tubing over brush leads as shown.

8. Connect/solder brush leads to studs/receptacle pins; follow pin identification shown on exploded views.

9. Assemble brushes and springs to brush guide block.

10. Align matchmarks and refasten receptacle to brush retainer block and/or brush guide block.

11. Reassemble brush block assembly using components separated in 1.B.3. above.

12. Check freedom of movement of each brush; with finger at center of brush, press brush into guide block and allow spring to force brush back out slowly. DO NOT ALLOW BRUSH TO SNAP BACK!

13. Check resistance from each brush face to the respective stud/receptacle pin with low range ohmmeter. Resistance must not exceed 0.013 ohms. Probe contacting brush should have an area of 1/16 in² to provide an accurate measurement.

14. Check insulation resistance betwen brushes and from brushes to receptacle housing (when used), with 500VDC, 1000 megohm range "Megger" ("MEG" Type Insulation Tester, James G. Biddle Co., Plymouth Meeting, Pa. or equivalent). Resistance should not be less than 10 megohms for 1 minute.

15. Install assembly on aircraft with attaching hardware removed in 1.B.1. and check alignment per figure 1. Safety wire all bolts.

2. BRUSH BLOCK ASSEMBLIES 4E1213, 4E1283 and 4E1327 (See figure 2.)

A. Brushes should be replaced when "B" barrel is 1/8 inch from spring retainer plate; brushes MUST be replaced when "B" barrel is against spring retainer plate. Brushes should protrude from block 1/16 inch while measurement is made.

B. Follow instructions of paragraph 1.A. and as follows to replace the brush retainer assembly:

1. When removing the attaching hardware (1.A.2.) disconnect brush leads from terminal studs.

2. When assembling brush block (1.A.5.), connect new brush leads to terminal studs noting pin orientation shown in figure 2.

C. Follow instructions of paragraph 1.B. and as follows to replace the brushes:

1. Since a separate receptacle is not used, ignore 1.B.2., 1.B.4., and 1.B.10.

2. After disconnecting the brush leads (1.B.5.):

a. Compress springs so that rods protrude through rear of retainer block.

b. Unsolder "B" barrels and brush leads from brush rods; save barrels and leads for reuse unless new ones are provided.

c. Clean and tin end 1/4 inch of new brush rods; clean inside of "B" barrels and ends of brush leads.

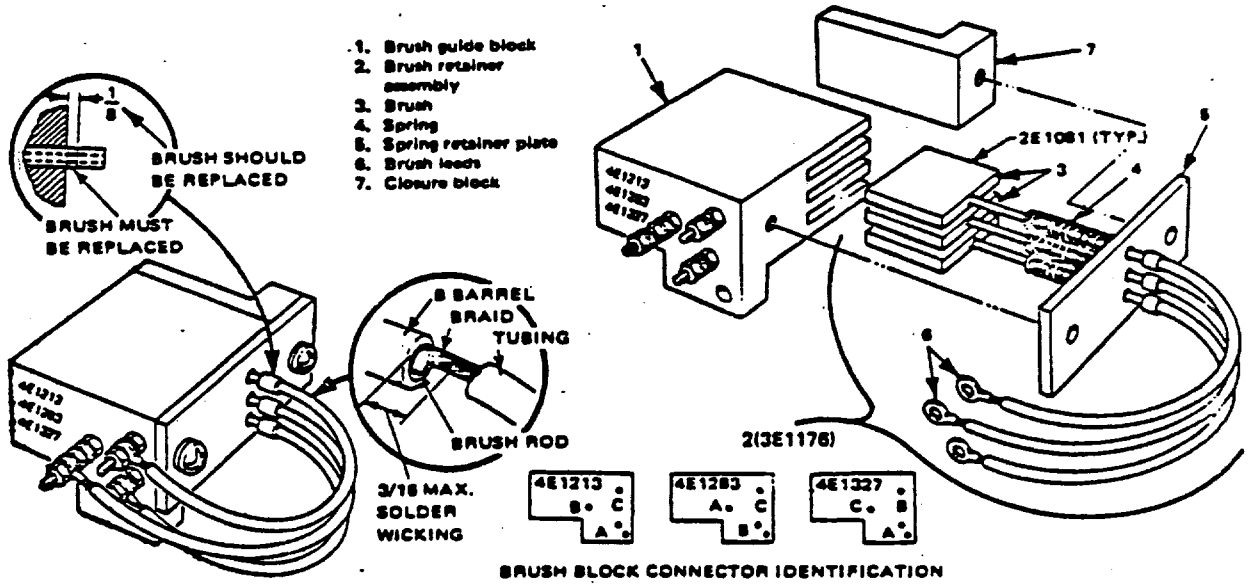


Figure 2. Brush Block Assemblies 4E1213, 4E1283 and 4E1327

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d. Place new springs over brush rods, insert rods in retainer plate so ends extend through, and hold brushes in position with rubber bands.

e. Install "B" barrels on brush rods so ends of barrels are flush and concentric with ends of rods.

f. Install tubing over brush leads, and insert brush leads between rods and barrels so that flat side of lead is parallel with longer retainer plate surface. Soft solder in place.

NOTE: Longest lead must be installed on center brush rod. Use care to limit wicking of solder on lead to a maximum of 3/16 inch. Do not leave solder on exterior of barrel.

g. Remove rubber bands.

3. BRUSH BLOCK ASSEMBLIES 4E1350-1, -2 and -3 (See figure 3.)

A. Brushes should be replaced when "B" barrel is 3/32 inch or less from the maximum wear position; brushes MUST be replaced when maximum wear position is reached. (See figure 3.) Brushes should protrude from block 1/16 inch while measurement is made.

B. Follow instructions of paragraph 1.A. to replace the brush retainer assembly.

C. Follow instructions of paragraph 1.B. and as follows to replace the brushes.

1. After disconnecting the brush leads (1.B.5.):

a. Compress springs so that rods protrude through rear of retainer block.

b. Unsolder "B" barrels from brush rods: save barrels for reuse.

c. Clean and tin 1/4 inch of end of new brush rods, clean inside of "B" barrels.

d. Place new springs over brush rods, insert rods in retainer block so ends extend through, and hold brushes in position with rubber bands.

e. Install "B" barrels on brush rods so ends of barrels are flush and concentric with ends of rods and soft solder in place. Do not leave solder on exterior of barrel.

f. Remove rubber bands.

2. After installing the insulating tubing (1.B.7.), run brush leads through slots in retainer block.

4. BRUSH BLOCK ASSEMBLIES 4E1311-1, 4E1387-1, -2 and 4E1580-2 (See figure 5.)

A. Measure brush wear as shown in Figure 4. X-dimension (inches) given indicates when brushes MUST be replaced.

B. Follow instructions of paragraph 1.A. and as follows to replace the brush retainer assembly:

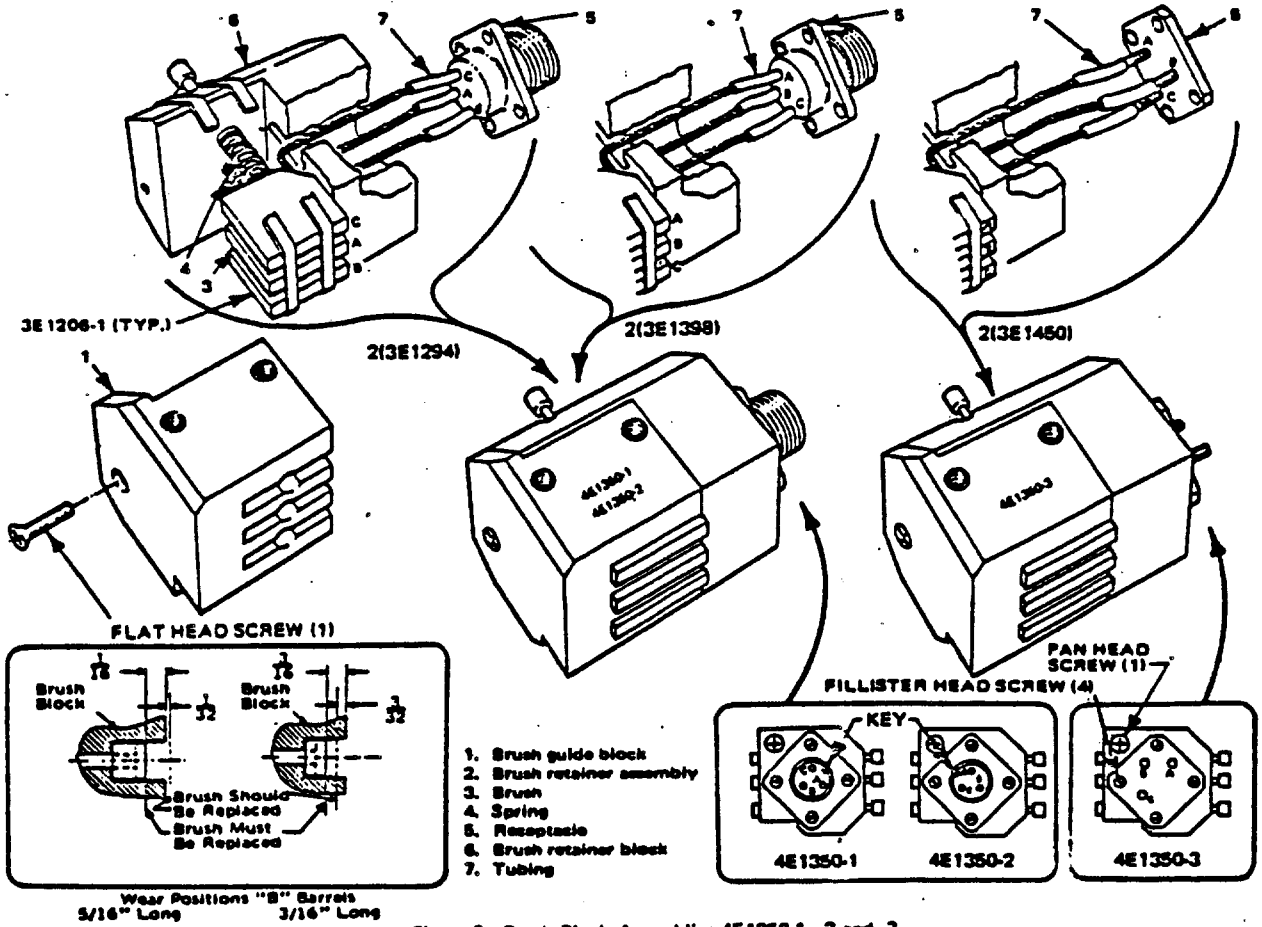


Figure 3. Brush Block Assemblies 4E1350-1, -2 and -3

1. When separating (1.A.2.) or reassembling (1.A.4.) brush retainer block, guide block, and brush retainer assembly, move the guide block laterally to disengage or re-engage dowel pins. (Disregard for assemblies without dowel pins.)

2. When reassembling (1.A.4.) the brush retainer assembly, align receptacle as shown in figure 5.

C. Follow instructions of paragraph 1.B. and as follows to replace the brushes:

1. When separating brush retainer block and guide block (1.B.3.), note instructions in 4.B.1. above.

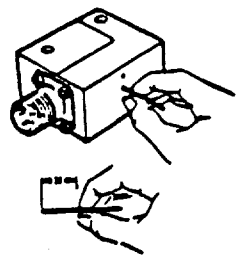
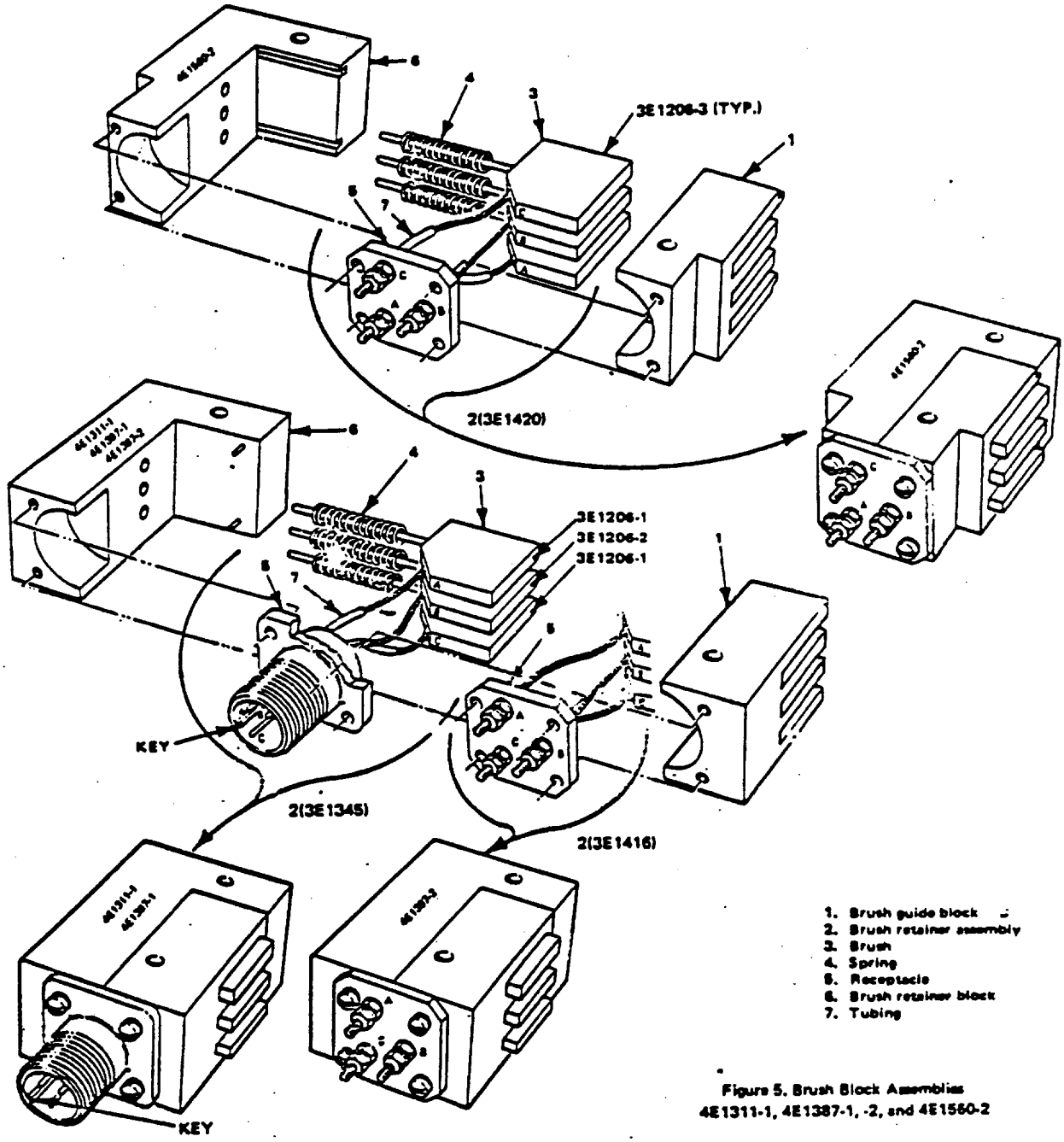


Figure 4. Measuring Brush Wear

Brush Block Assembly	X-Dimension (Inches) MUST Replace
4E1311-1, 4E1387-1-2	17/32
4E1311-2, -3, 4E1387-3, -4, -5, -6, 4E1749-2	1-9/16
4E1350-4, -5, -6	1-1/4
4E1560-2	15/32
4E1639 4E1908-1	1-3/8
Modular Brush Assemblies	
All modules having brushes with rods	23/64
All modules having brushes without rods	1-25/64

During measurement only 1/16 inch of brush should be allowed to protrude from brush block. This is the normal position of the brush when installed on the aircraft.



1. Brush guide block
2. Brush retainer assembly
3. Brush
4. Spring
5. Receptacle
6. Brush retainer block
7. Tubing

Figure 5. Brush Block Assemblies 4E1311-1, 4E1387-1, -2, and 4E1560-2

5. BRUSH BLOCK ASSEMBLY 4E1294 (See figure 6.)

A. Brushes should be replaced when end of "B" barrel is flush with brush guide block; brushes MUST be replaced when end of barrel is 3/32 inch within block counter bore. Brushes should protrude from block 1/16 inch while measurement is made.

NOTE: Either of two types of brushes, 2E1132 or 3E1206-3, may be used. The difference in "B" barrel installation for these brushes is shown in figure 6.

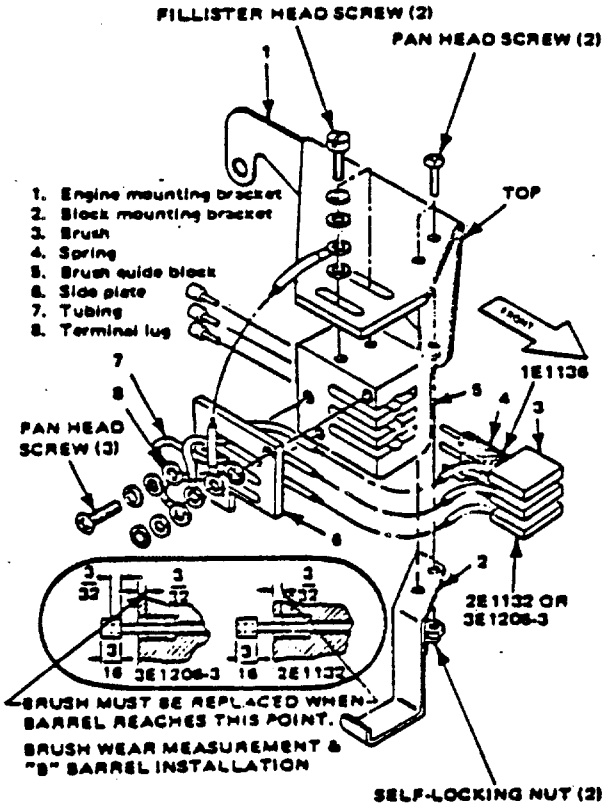


Figure 6. Brush Block Assembly 4E1294

B. A brush retainer assembly is not available as a replacement. The equivalent, as a "bolt-on" assembly, may be procured as "4E1294 WITHOUT MOUNTING BRACKET." Replaces as follows:

1. Dismount assembly from aircraft by removing attaching hardware.
2. Dismount guide block-side plate-brush assembly from mounting bracket by removing connecting screws and nuts.
3. Attach new assembly to mounting bracket with hardware removed in 5.B.2.
4. Install assembly on aircraft with attaching hardware removed in 5.B.1.
5. Check for proper alignment. (See figure 1.)

C. Replace brushes in the following manner.

1. Dismount and disassemble assembly as in 5.B.1. and 5.B.2.
2. Compress springs so that rods protrude through rear of guide block.
3. Unsolder and clean "B" barrels of brushes to be replaced.
4. Remove screws, washers, etc. and separate side plate from guide block.
5. Cut terminal lugs from leads of brushes to be replaced and discard brushes, springs, and lugs.
6. Clean and tin end 1/4 inch of new brush rods.
7. Place new springs over brush rods, insert rods in guide block so ends extend through, and hold brushes in position with rubber bands.
8. Install "B" barrels on brush rods so ends of barrels are concentric and flush with (or 3/32 inch over - see figure 6) ends of rods and soft solder in place. Do not leave solder on exterior of barrel.
9. Install tubing over brush leads and insert leads through the proper slots in the side plate.
10. Install crimp-on terminal lugs on brush leads and reassemble side plate with hardware removed in 5.C.4.
11. Remove rubber band and complete assembly and installation per 5.B.3., 4., and 5.

6. BRUSH BLOCK ASSEMBLIES 4E1311-2, -3, 4E1387-3, -4, -5, -6, 4E1639, 4E1908-1, (See figure 7) **and 4E1749-2** (See figure 8).

A. Measure brush wear as shown in Figure 4. X-dimension (inches) given indicates when brushes MUST be replaced.

B. Follow instructions of paragraph 1.A. and as follows to replace brush retainer assembly:

1. When separating (1.A.2.) or reassembling (1.A.4.) brush retainer block, guide block, and brush retainer assembly, move guide block laterally to disengage or re-engage dowel pins or grooves.
2. When reassembling (1.A.4.) brush retainer assembly, align receptacle as shown in figures 7 and 8.

C. Follow instructions of paragraph 1.B. and as follows to replace brushes:

1. When separating brush retainer block and brush guide block (1.B.3.), note instructions in 6.B.1. above.

7. BRUSH BLOCK ASSEMBLIES 4E1350-4, -5 and -6 (See figure 9).

A. Measure brush wear as shown in Figure 4. X-dimension (inches) given indicates when brushes MUST be replaced.

B. Follow instructions of paragraph 1.A. and the following paragraphs 1. and 2. to replace brush retainer assembly.

1. After separating (1.A.2.) brush retainer assembly from brush guide block, turn brushes sideways. Slip them through hole in brush retainer block to complete removal of brush retainer assembly.
2. To reassemble, turn brushes sideways. Slip them through hole in brush retainer block, and continue assembly per paragraph 1.A.4.

C. Follow instructions of paragraph 1.B. to replace brushes.

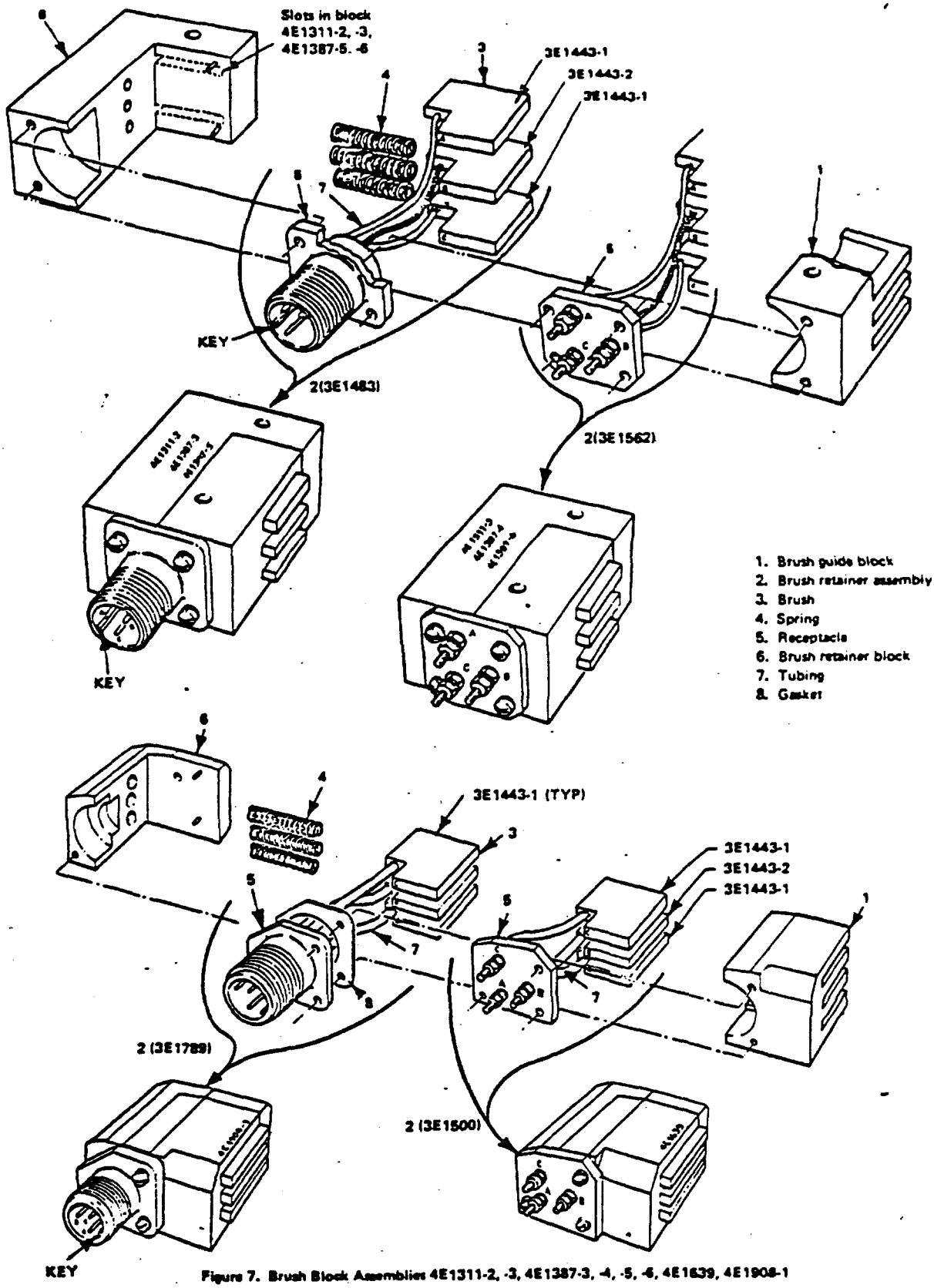


Figure 7. Brush Block Assemblies 4E1311-2, -3, 4E1387-3, -4, -5, -6, 4E1639, 4E1908-1

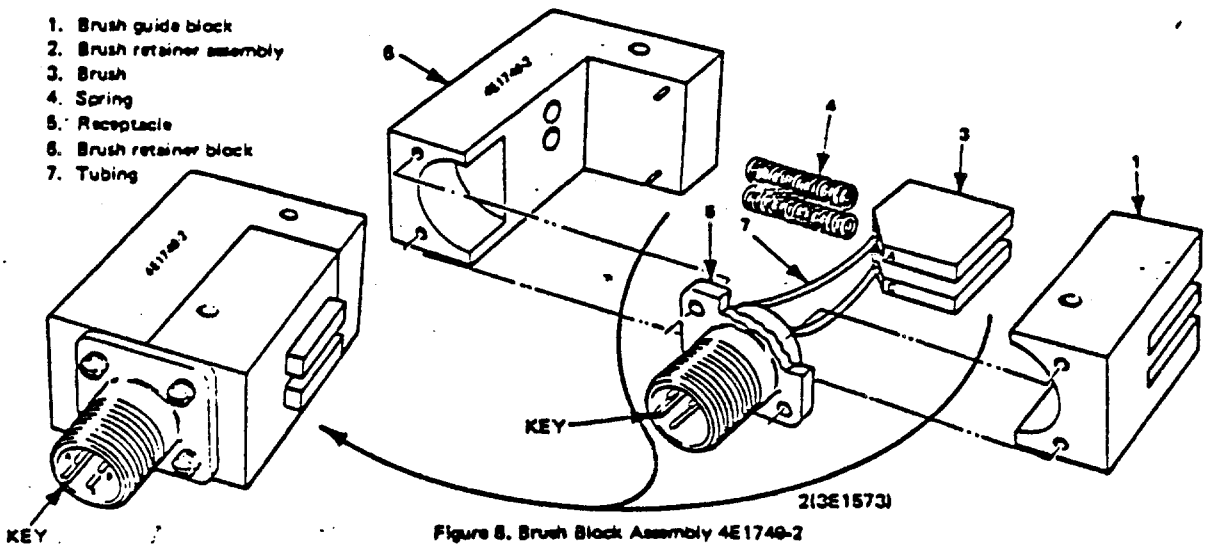


Figure 8. Brush Block Assembly 4E1749-2

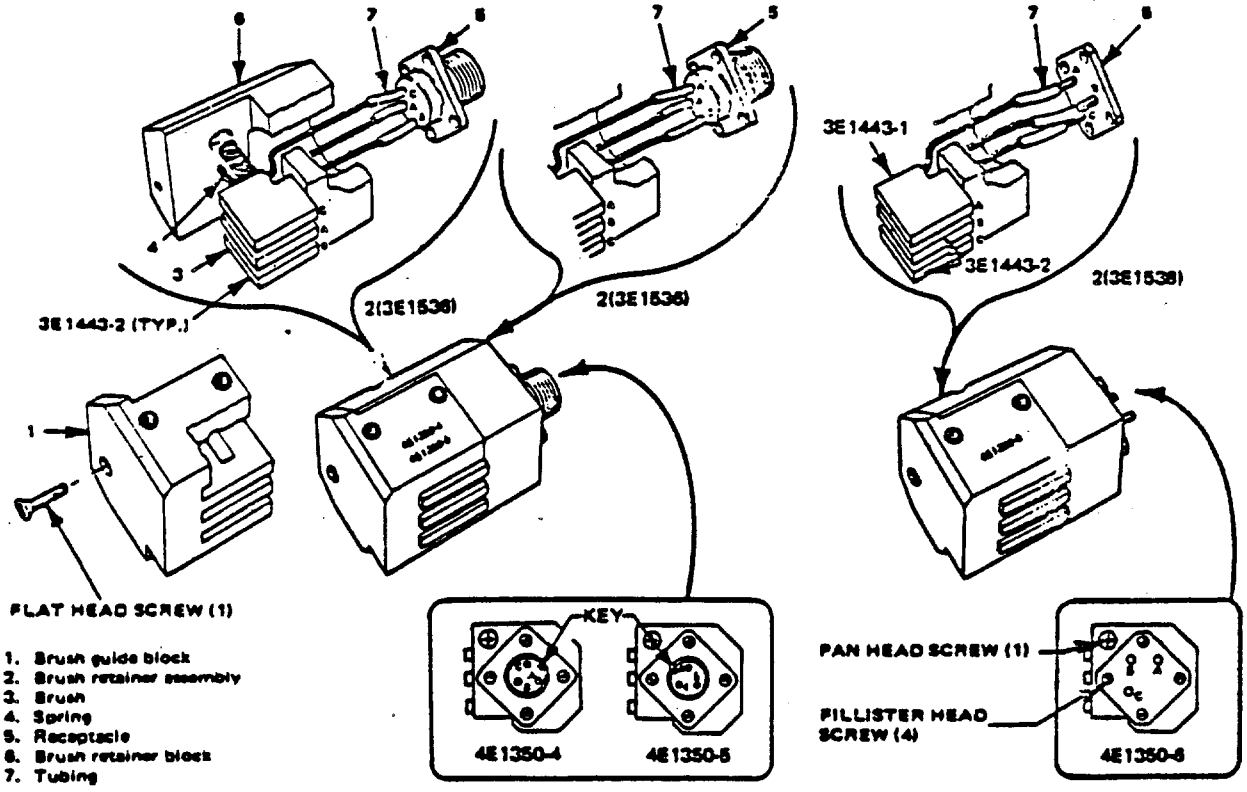


Figure 9. Brush Block Assemblies 4E1350-4, -5 and -6

SECTION B

MODULAR BRUSH ASSEMBLIES

Modular brush assemblies were developed to replace brush block assembly series 4E1311, 4E1350 and 4E1387 as shown in Table 2. Each modular brush assembly is made up of three modules. Each module consists of a plastic housing with an integral brush and spring. Variations of the basic module unit (3E2011) are shown in Figure 10. These modular units are stacked, with appropriate spacers, to produce the 3E2042-1 & -2, 3E2044-1, 3E2044-2, 3E2046-1, 3E2046-2 and 3E2046-3 assemblies. (See figures 11 to 13). Screws are used to hold the modules and spacers together.

All modular brush assemblies are designed for use with ring terminal connectors. Since some brush blocks and wire harnesses have used MS style connectors and receptacles, initial replacement kits are offered which contain the modular brush assembly, wire markers and ring terminals for 14/16 gauge wire and No. 6 studs. When any necessary wire harness modifications have been made, succeeding orders may be placed for single modules or modular assemblies (See Table 2.)

NOTE: When replacing brush blocks on Beech Turboprop (King Air Series) aircraft with modular brush assemblies, contact Beech for replacement details.

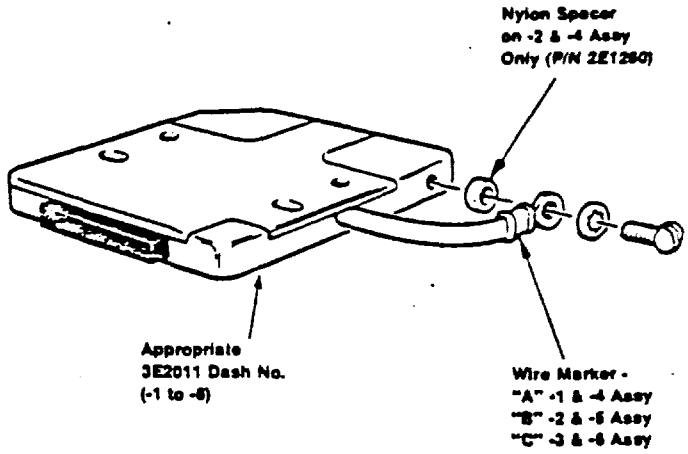


Figure 10. Brush Module Assy 3E2011

TABLE 2. REPLACEMENT MODULAR BRUSH ASSEMBLIES AND INITIAL REPLACEMENT KITS

Brush Block Assy.	Replacement Modular Brush Assembly	*Initial Replacement Kit
4E1311-1	3E2044-1	65-402
4E1311-2	3E2044-1	65-402
4E1311-3	3E2044-1 (Pratt & Whitney Engines)	65-402
4E1311-3	3E2044-2 (AiResearch Engines)	65-405
4E1350-1	3E3046-2	65-404
4E1350-2	3E2046-1	65-403
4E1350-3	3E2046-1	65-403
4E1350-4	3E2046-2	65-404
4E1350-5	**3E2046-3	65-406
4E1350-5	3E2046-1	65-403
4E1350-6	3E2046-1	65-403
4E1387-1	3E2042-1	65-401
4E1387-2	3E2042-1	65-401
4E1387-3	3E2042-1	65-401
4E1387-4	3E2042-1	65-401
4E1387-5	3E2042-1	65-401
4E1387-5	***3E2042-2	65-407
4E1387-6	3E2042-1	65-401

*Each initial replacement kit consists of one modular brush assy., three wire markers (A, B & C) and three AMP 32442 terminals for installation to 14 & 16 gauge leadwires from the engine wire harness.

**Beech Barons with continental engine TS10-520-L.

***Used in brush block and mounting bracket assy 4E1496-2 & -3 for Beech Barons 95-55, 95-A55 & 95-B55.

1. Brush Module Assembly 3E2011-1
2. Brush Module Assembly 3E2011-2
3. Brush Module Assembly 3E2011-3
4. Brush Module Assembly 3E2011-4
5. Brush Module Assembly 3E2011-5
6. Spacer 4E2218-3
7. Spacer 4E2218-4
8. Spacer 4E2218-5
9. Spacer 4E2218-6
10. Screw MS 24693-S35 (6-32 x 1-3/8)
11. Screw MS 24693-S34
12. Washer AN960C6
13. Lockwasher MS 35333-37
14. Nut MS 35649-262
15. Brush Module Assembly 3E2011-6
16. Screw MS 24693-S32
17. Brush 3E1443-5

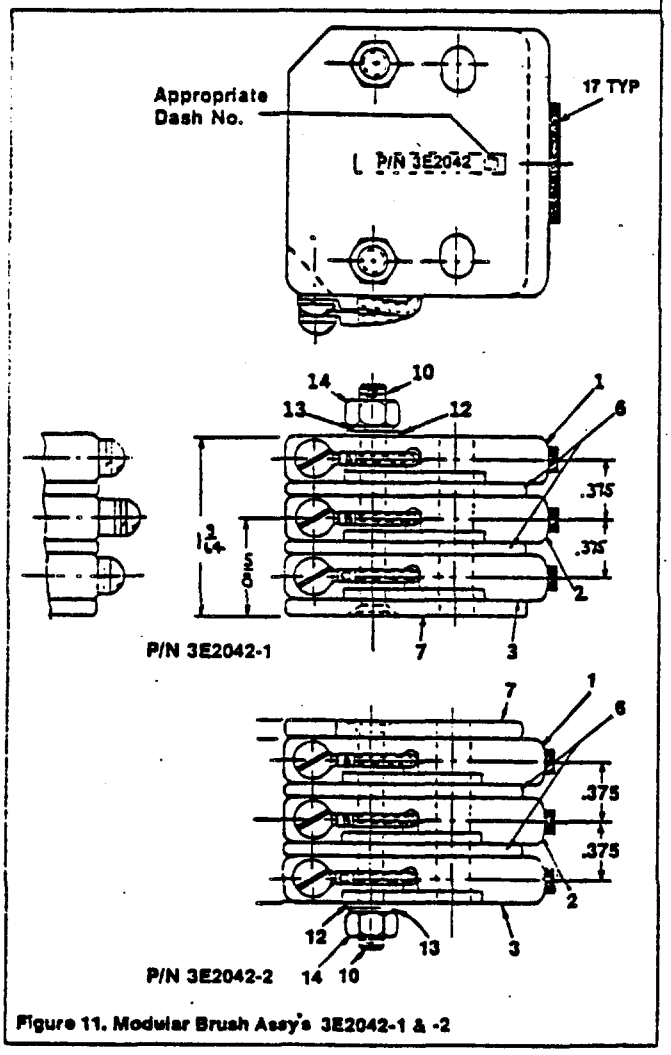


Figure 11. Modular Brush Assy's 3E2042-1 & -2

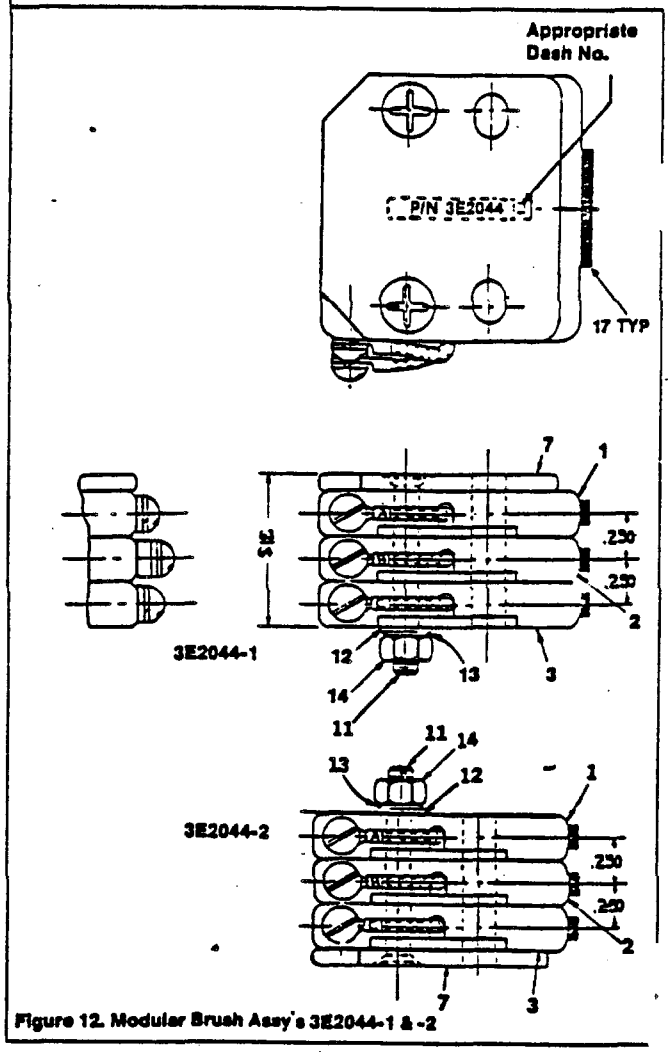


Figure 12. Modular Brush Assy's 3E2044-1 & -2

1. Brush Module Assembly 3E2011-1
2. Brush Module Assembly 3E2011-2
3. Brush Module Assembly 3E2011-3
4. Brush Module Assembly 3E2011-4
5. Brush Module Assembly 3E2011-5
6. Spacer 4E2218-3
7. Spacer 4E2218-4
8. Spacer 4E2218-5
9. Spacer 4E2218-6
10. Screw MS 24693-S35 (6-32 x 1-3/8)
11. Screw MS 24693-S34
12. Washer AN960C6
13. Lockwasher MS 35333-37
14. Nut MS 35649-262
15. Brush Module Assembly 3E2011-6
16. Screw MS 24693-S32
17. Brush 3E1443-5

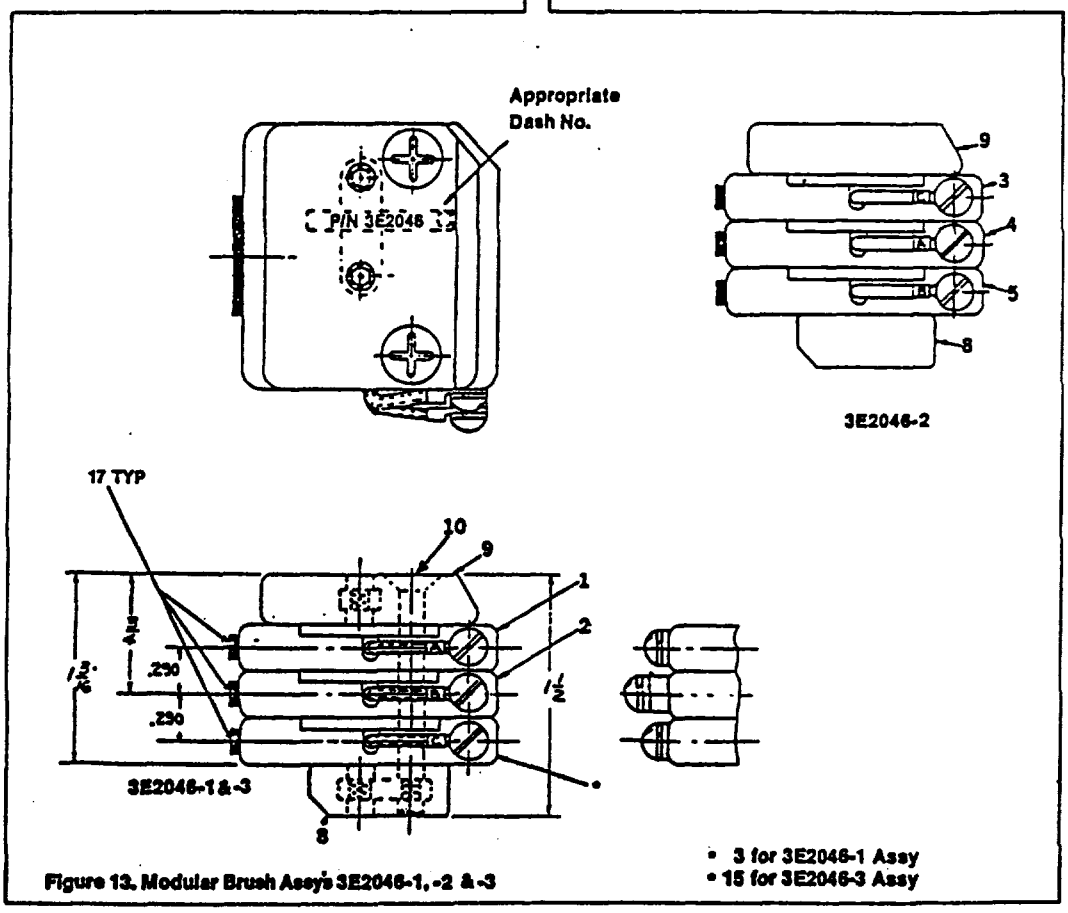


Figure 13. Modular Brush Assys 3E2046-1, -2 & -3

1. **Brush Block Replacement Instructions.** (Read all instructions pertaining to your assembly before attempting to replace components).

A. Replacing 4E1311-1 & -2, 4E1350-1, -2, -4 & -5 and 4E1387-1, -3 & -5 Brush Block Assemblies with Modular Brush Assemblies.

1. Remove the brush block assembly to be replaced from the mounting bracket and disconnect the MS connector and mating receptacle.

2. The pins of the mating receptacle are identified as "A", "B" and "C" on the surface of the rubber insert (looking at the face of the connector). Determine the identification of each leadwire going into that receptacle and wrap leadwires with appropriate wire markers.

3. Remove the cable clamp from the wire harness at the receptacle, disassemble the connector, and cut or desolder the wires. (Caution: Before cutting wires check wire lengths to make sure enough wire will be left to make electrical connection with the new assembly.) If sufficient wire is not available after desoldering, splice a suitable length of the same gauge aircraft wire (105°C min. insulation rating) to the harness with insulated butt splice connectors.

4. Cut off previously soldered portions of wire. Strip insulation from the wire 3/32 inch. Crimp the ring terminals provided to the wires. Make sure a good crimp has been obtained.

NOTE: The terminals provided are for wire gauges 16 and 14. If larger wires have been used, install an insulated ring terminal for that size wire and a number six stud.

5. Attach the modular brush assembly to the mounting bracket and align to the slip rings. Follow the instructions on page 2, figure 1, for aligning the brushes to the slip rings.

6. Connect the ring terminals on the wire harness to the terminals on the appropriate brush modules, that is "A" to "A", etc. Make sure the uninsulated portions of the ring terminals on adjacent modules are not touching. If there is interference between adjacent terminals, disassemble modular brush assembly and reassemble per section 2.B. and figure 14.

7. Make sure butt splice connectors and wires of the harness going to the modules do not interfere with any aircraft components.

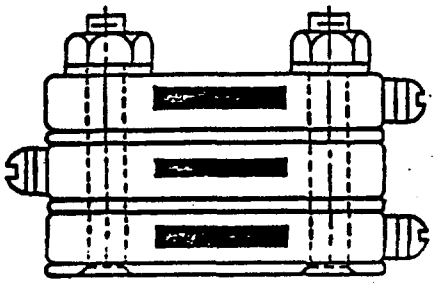


Figure 14. Alternate Module Stacking Arrangement

B. Replacing Brush Block Assemblies 4E1311-3; 4E1350-3 & -6; and 4E1387-2, -4 & -6 with Modular Brush Assemblies.

1. Remove the brush block assembly to be replaced from the mounting bracket but maintain the connection between the wiring harness and that assembly.

2. Each terminal on the surface of the receptacle is identified as "A", "B" and "C". Determine the identification of each leadwire going to this receptacle. Use wire markers to identify the wires or insulated portion of the terminals as "A", "B" and "C".

3. Disconnect the ring terminals of the harness from the receptacle.

4. Attach the modular brush assembly to the mounting bracket and align to the slip rings. Follow the instructions on page 2, figure 1, for aligning the brushes to the slip rings.

5. Connect the ring terminals on the wire harness to the terminals on the appropriate brush module, that is "A" to "A", etc. Make sure the uninsulated portions of the ring terminals of the adjacent modules are not touching. If there is interference between adjacent terminals, disassemble modular brush assembly and reassemble per Section 2.B. and figure 14.

6. Make sure the wires of the harness going to the modules do not interfere with any aircraft components.

2. BRUSH AND MODULE REPLACEMENT (See figures 11, 12, 13, 15, 16 and 17.)

A. Measure brush wear as shown in Figure 4. X-dimension (inches) given indicates when brushes MUST be replaced.

B. Replace Modules; Individual brush replacement is now offered however the entire module unit should be replaced when considerable wear of the housing is apparent.

1. Dismount modular brush assembly from aircraft by removing attaching hardware, and disconnect engine wire harness.

2. Remove assembly screws and separate modules and spacers.

3. The part number of each module is etched into the surface of the plastic housing; replace with the same part number module.

4. Restack modules and spacers as shown in figure 11, 12, 13, 15, 16 or 17. Check A/B/C, C/A/B, A/B, B/C or C/B stacking arrangement and location of spacers. If there is interference between adjacent ring terminals, reorient center module as shown in figure 14.

5. On 3E2042 series, 3E2044 series, 3E2062 series, 3E2071 series and 3E2092 series assemblies, make sure flat washer is positioned between star washer and housing. On 3E2046-1, 3E2046-2 and 3E2046-3 assemblies, use Loctite "C" (or equiv.) on the threads of the assembly screws. Make sure that assembly is square, then tighten screws.

6. Reconnect aircraft wire harness to applicable "A", "B", "C" terminals of modules. Insure that adjacent ring terminals are not touching.

7. Install assembly on aircraft with attaching hardware removed in 2.B.1.

8. Check assembly for proper alignment (see figure 1).

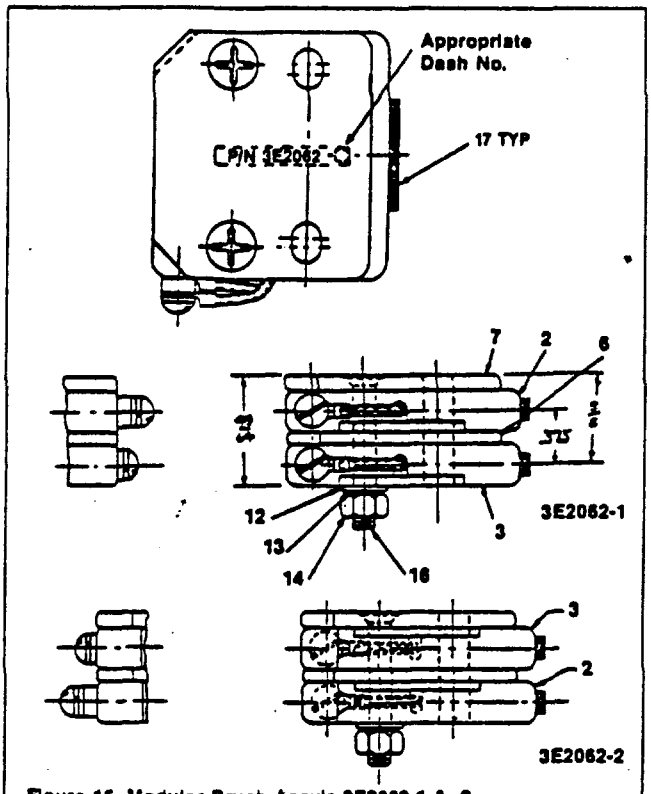


Figure 15. Modular Brush Assy's 3E2062-1 & -2

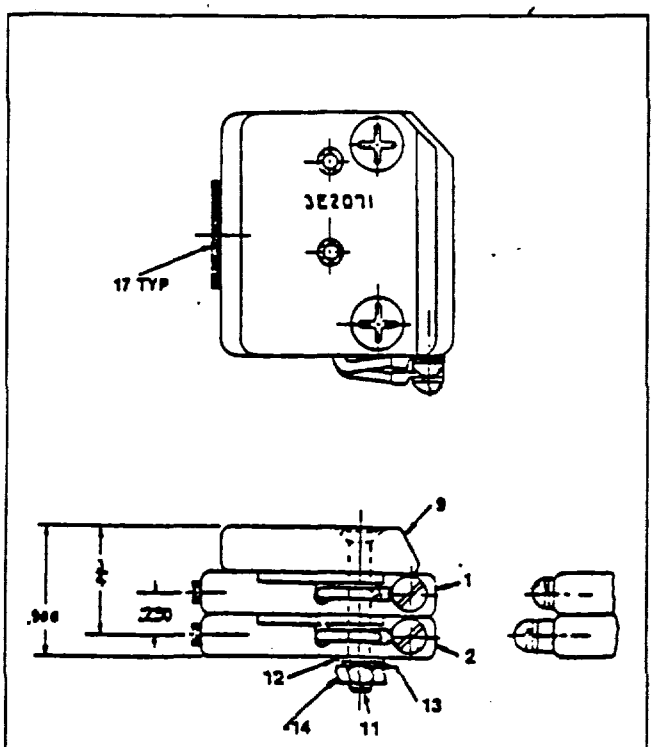


Figure 16. Modular Brush Assy 3E2071

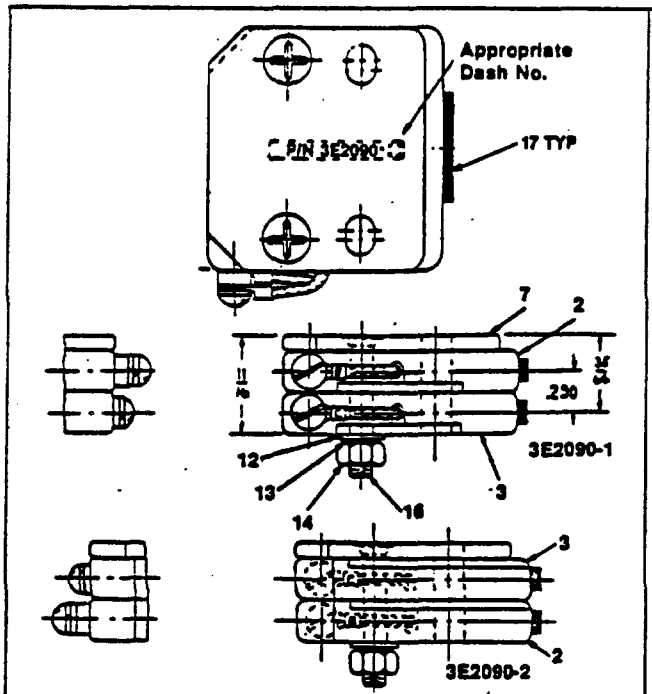


Figure 17. Modular Brush Assy's 3E2090-1 & -2

1. Brush Module Assembly 3E2011-1
2. Brush Module Assembly 3E2011-2
3. Brush Module Assembly 3E2011-3
4. Brush Module Assembly 3E2011-4
5. Brush Module Assembly 3E2011-5
6. Spacer 4E2218-3
7. Spacer 4E2218-4
8. Spacer 4E2218-5
9. Spacer 4E2218-6
10. Screw MS 24693-S35 (6-32 x 1-3/8)
11. Screw MS 24693-S34
12. Washer AN960C8
13. Lockwasher MS 35333-37
14. Nut MS 35649-262
15. Brush Module Assembly 3E2011-6
16. Screw MS 24693-S32
17. Brush 3E1443-5

WARNING

USE ONLY BFGOODRICH BRUSHES. DO NOT SEPARATE UNITS WHEN REPLACING BRUSHES. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN FAILURE OF THE DE-ICER UNIT.

NOTE: IF OIL IS PRESENT ON BRUSH UNIT, BRUSH AND RING SERVICE LIFE MAY BE REDUCED. CHECK ENGINE MANUFACTURERS RECOMMENDATIONS FOR FIXING OIL LEAKS.

C. **Replace Brushes;** If module unit housing is not worn or damaged the individual brush may be replaced as follows:

1. Remove old brush.

a. Remove #6-32 screw securing terminal to housing base. Note brush identification A, B, or C.

b. Remove terminal from brush lead and remove brush through brush opening of unit.

c. Inspect inside of module unit to assure no foreign material is present.

d. Clean outside around brush opening to remove any carbon deposits.

2. Prepare new brush. (See figure 18.)

a. Slide tubing over brush lead so end of tubing almost contacts the brush.

b. Form lead in an arc as shown.

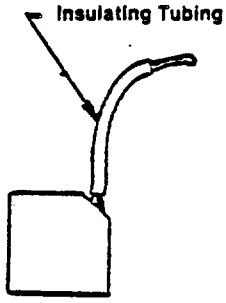


Figure 18. Preparing New Brush

3. Install brush in module. (See figure 19.)

a. Insert lead into brush opening and slide brush into base until lead protrudes through lead exit hole.

b. Compress brush and pull lead to obtain max. available length of lead, external of module base.

c. Secure brush in compressed state using rubber band (Ref. Step 4).

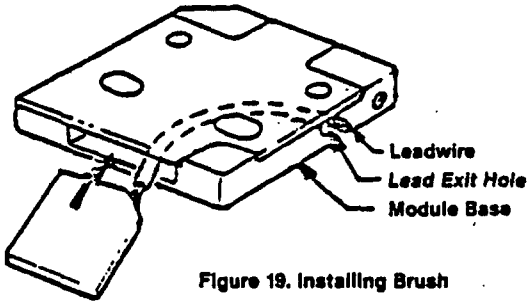


Figure 19. Installing Brush

4. Install terminal. (See figure 20.)

a. With brush compressed, slide tubing to within 3/16 inch of the end of the bare wire as shown.

b. Install ring terminal so the end of the insulating tubing is positioned inside the insulated jacket of the terminal so no bare wire is exposed.

c. Crimp terminal in place with recommended crimping die and tool.

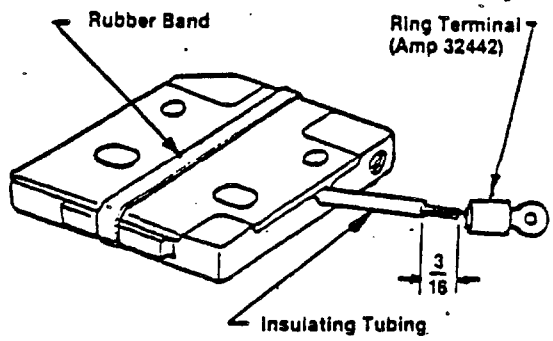


Figure 20. Installing Terminal

5. Attaching brush lead. (See figure 21.)

a. Replace screw and washer (and spacer if required) as shown.

b. Reidentify module unit A, B, or C as required with permanent ink or wire marker.

c. Remove rubber band and carefully pull brush until all slack in lead is incased in module.

d. Compress and release brush to assure it does not bind or hang-up inside module.

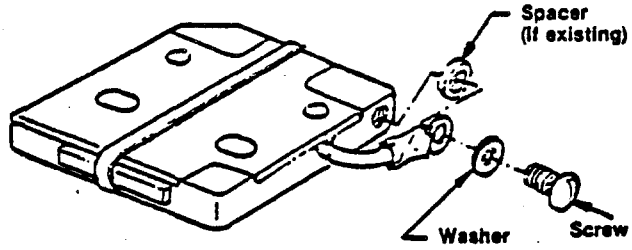


Figure 21. Attaching Brush Lead

NOTE:

FIGURES 18-21 SHOW THE REPLACEMENT OF A BRUSH IN AN INDIVIDUAL MODULE UNIT. IT IS NOT NECESSARY TO REMOVE THE INDIVIDUAL UNITS FROM THE MODULAR BRUSH ASSEMBLY FOR BRUSH REPLACEMENT WHEN THE ABOVE PROCEDURE IS FOLLOWED.

BFGoodrich
Engineered Products Group
AKRON, OHIO 44318

SERVICE BULLETIN

BFGoodrich

NO. - E79-59
ISSUED - 6-7-79

ENGINEERED SYSTEMS DIVISION

SUBJECT: Replacement of brushes on BFG modular brush and connector bracket assy 4E2360

APPLICABILITY: DeHavilland DHC-6 aircraft equipped with BFG electrical prop de-icing utilizing the subject brush assy.

REFERENCE DOCUMENT: BFG brush block overhaul manual report number 68-04-714H

NOTE: To determine if brushes need replaced refer to the above referenced document for "must replace" dimensions. (Fig. 4, Page 5)

DISCUSSION: The 4E2360 modular brush and connector bracket assy consists of a brush retainer assembly identified as P/N 3E2114-1 and a connector bracket P/N 3E2107, plus associated mounting hardware. The retainer assy is made up of three modular brush units soldered to an MS connector. When brush replacement becomes necessary, the entire brush retainer assy must be replaced. The associated mounting hardware and the 3E2107 bracket can be reused.

PROCEDURE: To replace the retainer assy remove the counter sunk screws securing the modular units to the bracket. Remove the screws securing the connector to the bracket. Before assembling the new retainer assy to the connector bracket note the A, B, C, pin identification of the connector plug with respect to the modular brush units. The "A" brush unit must be positioned against the connector bracket followed by the "B" & "C" units respectively (see Fig. I). The order of brush stacking must be maintained to insure correct electrical wiring when installed on the aircraft.

Install the connector to the bracket using the existing screws, washers and nuts. Carefully remove the cardboard cover protecting the brushes. (Caution should be taken as to not allow the brushes to spring forward when removing the cardboard cover since the brushes are under spring tension). With the brushes stacked in an ABC order install the modular units to the bracket using the counter sunk screws.

Order of installation for the washers and nuts should be: flat washer, star washer and nut. Before tightening these screws be sure the modular units are square to one another. Once squareness is obtained, tighten screws. Check for free brush movement.

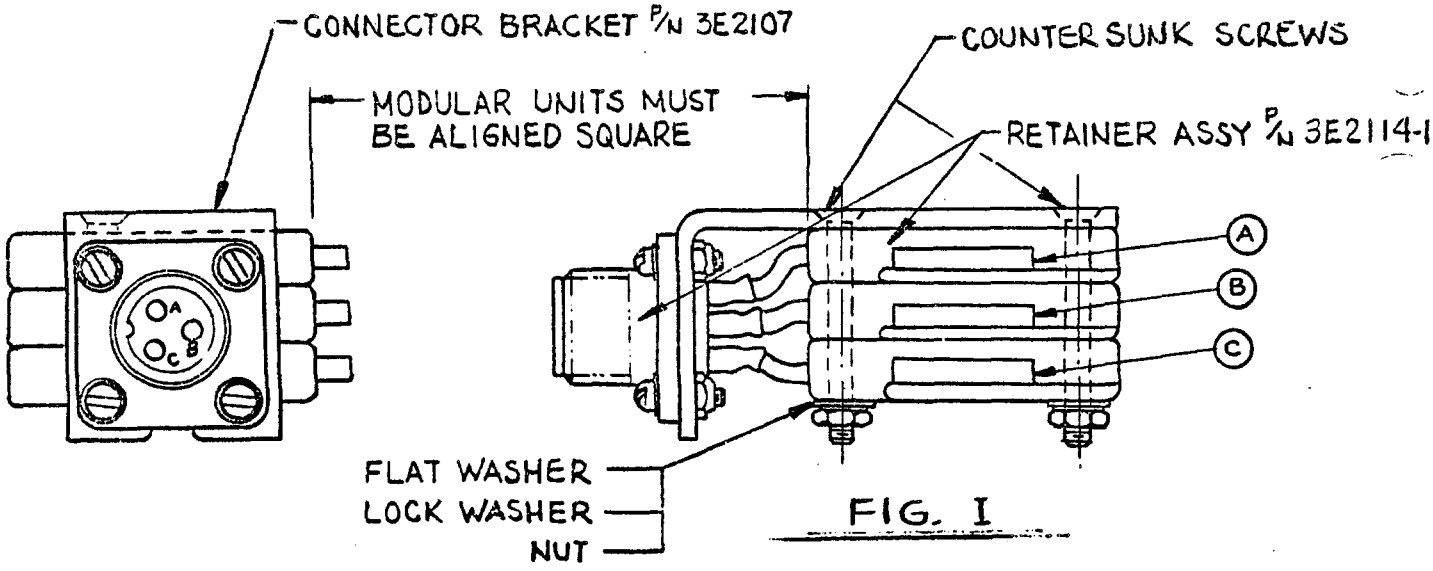


FIG. I

Service Bulletin No. 87

PUB. NO. 39U-4-678A The Bendix Corporation - Utica, New York

SUBJECT: Modification of 1532-3A Deicer Distributor Valve to the 1532-3B configuration.

EQUIPMENT AFFECTED: Bendix, Fluid Power Division, 1532-3A Series Deicer Distributor Valve

REASON FOR CHANGE: To increase valve service life.

ACCOMPLISHMENT: At customer's discretion during overhaul

PUBLICATION REFERENCE: Publication No. 38U-23-668A, Overhaul Instructions with Parts Breakdown.

PARTS REQUIRED:

Quantity	Part Number	Nomenclature
2	2484074	Valve Assembly, Poppet
2	2484073	Seal, Valve

PARTS REMOVED:

Quantity	Part Number	Nomenclature
2	101783	Valve Assembly, Poppet
2	648771	Seal, Valve

SPECIAL TOOLS REQUIRED: No special tools required.

PROCEDURE: Follow disassembly procedure listed in reference publication. Discard Valve Seal and Poppet Valve Assembly, parts removed and replace with parts required.

Reassemble in accordance with procedures in reference publication.

TEST PROCEDURE: Test in accordance with reference publication.

TYPE NUMBER CHANGE: After modification, the type number on the nameplate must be restamped as follows:

From	To
1532-3A	1532-3B

Bendix Fluid Power Division

Service Bulletin No. 91

PUB. NO. 39U-4-692A The Bendix Corporation - Utica, New York

SUBJECT: Modification of 1532-3A and 1532-3B Deicer Distribution Valves

EQUIPMENT AFFECTED:
1532-3A and 1532-3B Deicer Distribution Valves

REASON FOR BULLETIN:
To Incorporate Product Improvement Parts for Increased Service Life

ACCOMPLISHMENT: At Customer's discretion.

PUBLICATION REFERENCE:
Pub. No. 38U-23-668A

KIT AND PARTS REQUIRED:

Quantity	Part Number	Nomenclature
11	SK180	Service Kit Modification consisting of:
2	829489	Control Valve (modified)
2	101764	Plunger & Pin Assembly (modified)
2	834919	Valve Stem (modified)

PARTS REMOVED:

Quantity	Part Number	Nomenclature
2	829489	Control Valve
2	101764	Plunger & Pin Assembly
2	834919	Valve Stem

SPECIAL TOOLS REQUIRED:
None.

DISASSEMBLY: As per Reference Publication

EXPLANATION OF CHANGE:
To extend the life of the Distributor Valve by reducing the corrosive affects of water in the system, the parts in SK180 Kit have the following changes incorporated:

1. Control Valve - Sharp edges on lands which will assist in preventing corrosion build up in the valve land area.

Bendix Fluid Power Division

2.	Plunger & Pin Assembly -	Fused Tin Plate on plunger for added protection against corrosion.
3.	Valve Stem -	Teflon coat (stratified "S" Black) on O.D. of Shaft.

SPECIAL INSTRUCTIONS:

Inspect Valve Housing, P/N 834832, for corrosion (white residues). DO NOT reuse or attempt to clean housings which exhibit any corrosion since the protective coating has been removed in the area of corrosion. It is recommended these housings be replaced.

The rejected valve housings should be returned to Fluid Power Division, The Bendix Corporation, for special cleaning and rework. Due to the complexity of these procedures, the Fluid Power Division wishes to control the cleaning and rework to insure the valve housings are in a like new condition prior to reuse.

NOTE: It is strongly recommended that any valve housing exhibiting corrosion be replaced and the rejected housing be returned to Fluid Power Division.

REASSEMBLY: As per Reference Publication

TEST: As per Reference Publication

TYPE NUMBER CHANGE:

Not affected. However, the letter "M" shall be stamped two (2) spaces adjacent to the "U" in the Serial Number Block.

Service Bulletin No. 97

PUB. NO. 39U-4-704A The Bendix Corporation - Utica, New Yo

SUBJECT: Repair of Valve Housing, Part Numbers 834832, 2487289, 2487512 and 2487221.

EQUIPMENT AFFECTED:

Bendix Fluid Power Division 1532- Series and 38E63 Series Deicer Distributor Valves.

ACCOMPLISHMENT:

Whenever valve housing to control valve fits are more than .0016 per applicable Overhaul Manual

PUBLICATION REFERENCE:

Overhaul Instructions with Parts Breakdown Publication No. 38U-23-668A

Overhaul Instructions with Parts Breakdown Publication No. 38U-2-6911A

PARTS REQUIRED:

Quantity	Part Number	Nomenclature
2	2487527	Control Valves
2	2487888	Plugs

PARTS REMOVED:

Quantity	Part Number	Nomenclature
2	829489	Control Valves
2	834954	Plugs

SPECIAL TOOLS REQUIRED:

Standard Machine Shop Tools

PROCEDURE: Follow disassembly procedure listed in referenced publication.

REWORK:

1. Press out plugs, P/N 834954 and discard (Refer Figure 1).
2. Hone bushing bores to .1920/.1925 inch diameter as shown in Figure 1.
3. Counterbore housing to .4680/.4685 inch diameter, .175 to .180 inch deep. Brush alodine reworked surfaces.

Bendix Fluid Power Division

4. Pressure wash housing.

5. Press in new plugs flush, as noted. Plugs are identified by a .030 to .060 drill point as shown.

NOTE: Housings after rework will be identified by a .020 to .040 diameter drill point on top face of bushing as shown.

6. Reassemble with new valves, P/N 2487527, in accordance with the procedures in referenced publication.

NOTE: Valves, P/N 2487527, are identified by a .030 to .060 diameter drill point on .130/.120 diameter small end of valve

TEST PROCEDURE:

Test in accordance with referenced publication.

TYPE NUMBER CHANGE:

None

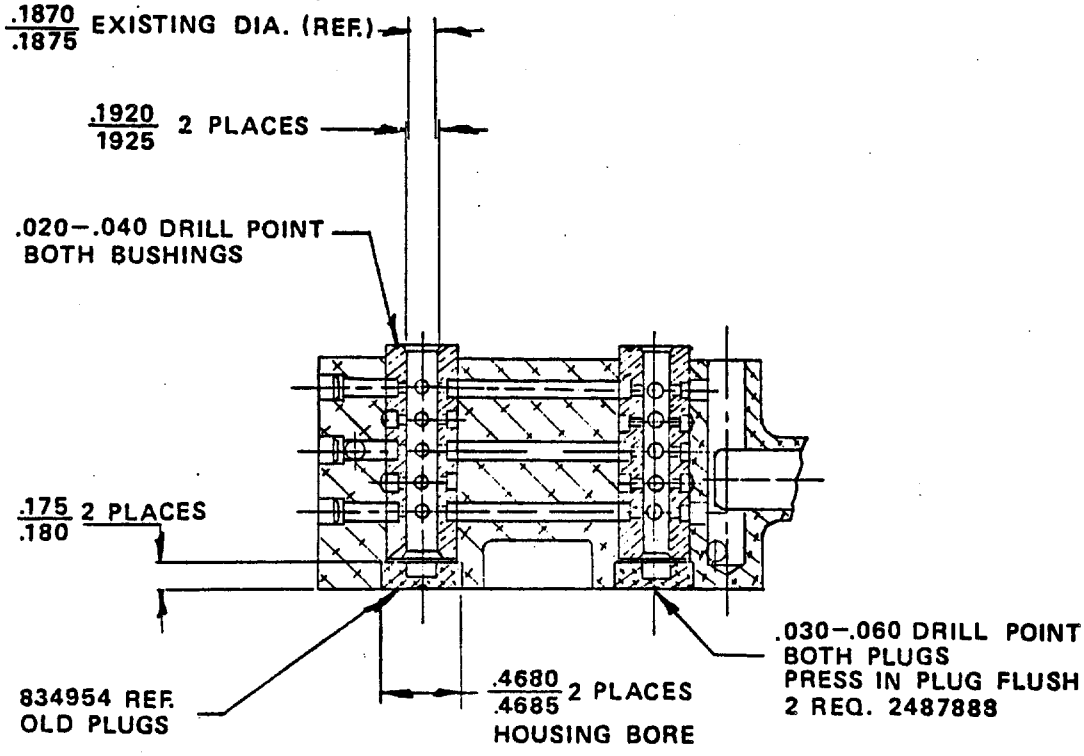


FIGURE 1

PUB. No. 38U-23-668A
Supersedes 38U-2-142

OVERHAUL INSTRUCTIONS with PARTS BREAKDOWN

DE-ICER DISTRIBUTING VALVE

TYPE NO. 1532-3-A

TABLE OF LEADING PARTICULARS

Overall Dimensions
- Height . . . . . 5-7/16 in.
- Length . . . . . 5-1/16 in.
- Width . . . . . 4-5/8 in.

Weight (approximate) . . . . . 2.25 lb

Mounting . . . . . 4 holes, 10-32 thd, 7/16 in. deep, 2 holes each side

Connections . . . . . Hose

Electrical Characteristics
- Receptacle . . . . . AN3102-14S-7P, 7/8-20 thd
- External Connection to Ground . . . . . Plug "C"
- Secondary Ground . . . . . Within unit
- Voltage . . . . . 28 volts dc
- Current Consumption . . . . . 1.45 to 1.75 amps at 28 volts dc
- Solenoid Coil Assembly Resistance . . . . . 17.5 ±5% ohms

Mechanical Characteristics (leakage)
- Solenoids Not Energized . . . . . 10 cubic feet per hour
- Solenoid "A" Energized (24 volts dc) . . . . . 20 cubic feet per hour
- Solenoid "B" Energized (24 volts dc) . . . . . 20 cubic feet per hour

Tolerances
- Control Valve Spring Preload Force . . . . . 5.5 to 6.5 oz at 1/2-inch length
- Diaphragm Springs Preload Force . . . . . 10.0 to 14.0 oz at 13/32-inch length
- Poppet Valve Springs Preload Force . . . . . 7.0 to 9.0 oz at 0.308-inch length

Part Nomenclature		New Dimensions (in.)		New Clearance	Permissible Worn Dimensions (in.)		Permissible Worn Clearance
		Min	Max		Min	Max	
Control Valve in Valve Bushing of Valve Housing	Control Valve OD	0.1865	0.1867	0.0003L to 0.0010L	0.1865	----	0.0010L
	Valve Bushing ID	0.1870	0.1875		----	0.1875	

Bendix Utica Division
Utica, New York

1. SPECIAL TOOLS. None.

2. DISASSEMBLY. (See figure 4.)
a. Disassemble in the same order as the key index numbers assigned to the exploded view illustration, except as noted below:
b. To remove diaphragm assembly (30), press down with thumb on each valve stem (33) and insert a 6-inch length of 5/64-inch drill rod in hole at bottom end of each valve stem. This will prevent turning of valve stems (33) while removing nuts (26). Remove nuts (31) in this same manner.

CAUTION

Hole in valve stems must not be burred or otherwise damaged.

c. Handle control valves (36) very carefully since they have a critical fit in valve bushings of valve housing (38).

3. CLEANING.
a. Clean all parts with cleaning solvent, Esso Varsol, and dry all parts thoroughly.

CAUTION

Do not use carbon tetrachloride since its use will result in corrosion of parts.

b. Wipe the solenoid coil assemblies thoroughly with a cloth moistened in cleaning solvent. Do not, however, soak the solenoid coil assemblies.
c. Make certain to remove thoroughly all oil from the various housings. See that all housing passages are free of obstructions.

4. INSPECTION.
a. All parts for cracks, breaks, excessive corrosion, and cleanliness.
b. All tapped or threaded parts for stripped and crossed threads.
c. All housings for loose or rough inserts, plugs, and bushings, and for satisfactory valve seats.
d. Solenoid windings and leads for burned, charred, cracked, or frayed insulation.
e. Solenoid coil assemblies for grounds, shorts, open circuits, and resistance. Refer to Table of Leading Particulars.
f. Receptacle for loose, bent, or broken contacts, and for cracked, chipped, or burned bakelite inserts.
g. Contact and lead assembly for broken strands in the lead, and for firm soldering of lead to contact.
h. Control valves for fit in valve bushings of valve housing. Refer to Table of Leading Particulars.
i. All springs for preload force. Refer to Table of Leading Particulars.
j. Valve seals for deeply grooved, fractured, hardened, or cracked seats.

5. REPAIR AND REPLACEMENT.
a. Replace all parts found to be damaged on inspection.
b. Replace all gaskets and the diaphragm at each overhaul.
c. Replace control valves if excessive clearance in valve bushings is due to worn valve surface. If excessive clearance is due to a worn valve bushing, replace the valve housing.

6. LUBRICATION. None.

7. REASSEMBLY. (See figure 4.)
a. Reassembly is the reverse of disassembly, except as noted below:
b. For proper electrical connections, see figure 1. Place the receptacle on the valve head with the "A" contact of the receptacle on the same side of the unit as the "A" boot port.

NOTE

Do not kink the leads while pushing the receptacle into the valve head.

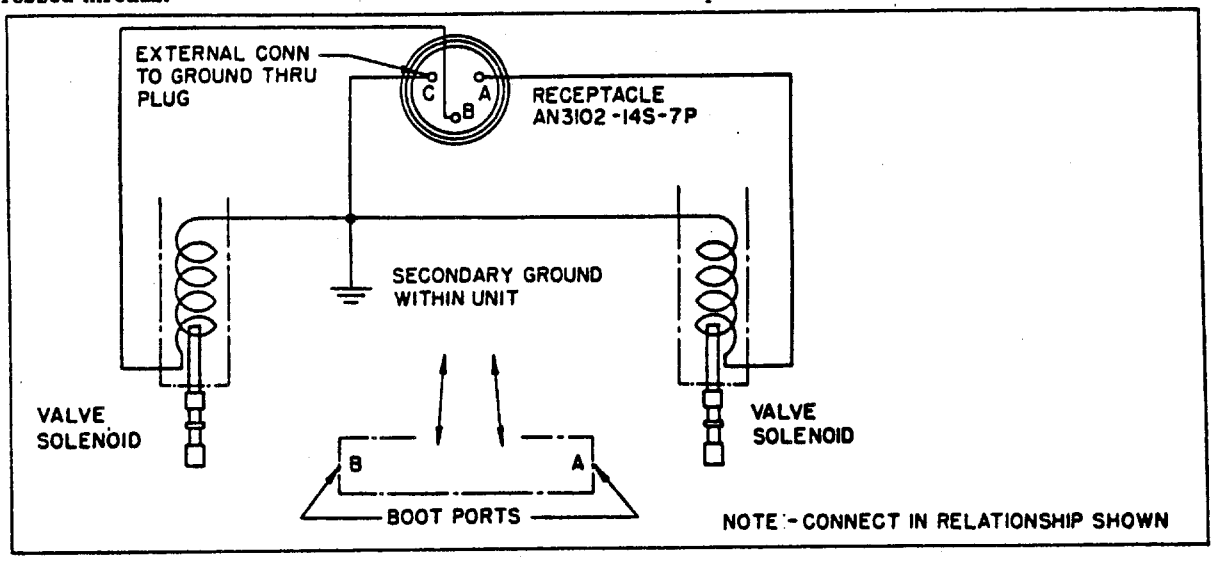


Figure 1. Internal Wiring Diagram - De-Icer Distributing Valve - Bendix Utica Type 1532-3-A

c. Make sure that the marked end of the control valves (36) are assembled next to the control valve springs (37).

d. Apply general purpose joint compound EC 524 manufactured by the Minnesota Manufacturing and Mining Co. around the valve stem pilot as shown in figure 2.

e. Insert a 6-inch length of 5/64-inch drill rod through the holes in the valve stems (33) to prevent turning of stems during assembly of nuts (31 and 26).

8. TEST PROCEDURE. (See figure 3.)

a. Set up complete valve as shown in test stand schematic drawing.

b. With solenoids not energized, set pressure at 16 inches mercury and vacuum at 5 inches suction. Gradually reduce pressure to 1 inch mercury and then restore to 16 inches mercury. Gradually reduce suction to 2 inches mercury and then restore to 4 inches mercury. Valves should remain closed throughout pressure and suction changes and leakage as indicated by flow meter in vacuum line must not exceed 10 cubic feet per hour.

c. Repeat procedure in subparagraph b. above with solenoid "A" energized (24 volts dc) and solenoid "B" not energized. Leakage must not exceed 20 cubic feet per hour.

d. Repeat procedure in subparagraph b. above with solenoid "A" de-energized and solenoid "B" energized (24 volts dc). Leakage must not exceed 20 cubic feet per hour.

e. With 16 inches mercury pressure and 6 inches mercury suction and both solenoids de-energized, the manometers connected to the "A" and "B" ports respectively should read the same value as the vacuum line manometer.

f. With 16 inches mercury pressure and 4 inches mercury suction, energize each solenoid separately several times with 20 volts dc. Valve action must be immediate and complete.

g. Apply 28 volts dc separately to each solenoid. Current consumption must be 1.45 to 1.75 amperes.

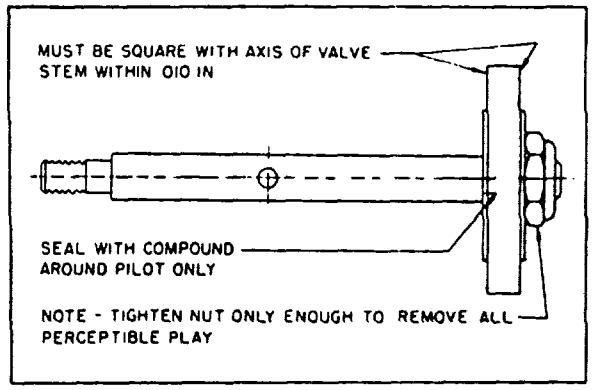
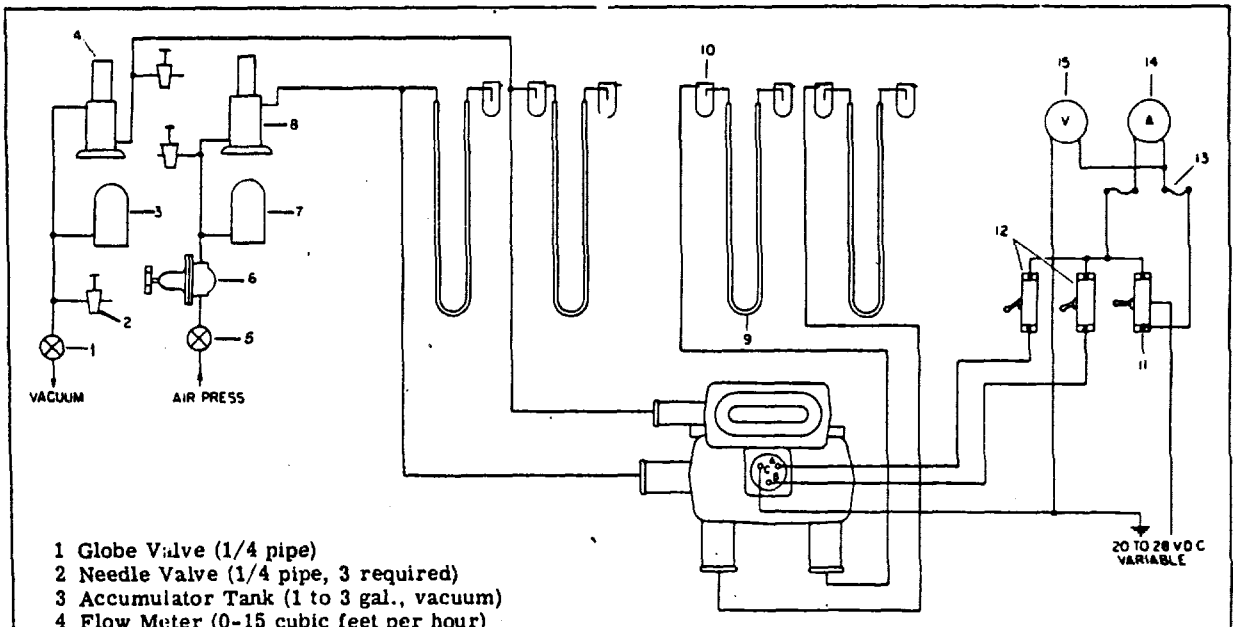


Figure 2. Assembly of Valve Seal Parts - De-Icer Distributing Valve - Bendix Utica Type 1532-3-A



1 Globe Valve (1/4 pipe)
2 Needle Valve (1/4 pipe, 3 required)
3 Accumulator Tank (1 to 3 gal., vacuum)
4 Flow Meter (0-15 cubic feet per hour)
5 Globe Valve (1/4 pipe)
6 Press. Reducing Valve (1/4 pipe, 0 to 15 psi)
7 Accumulator Tank (1 to 3 gal., pressure)
8 Flow Meter (0-40 cubic feet per hour)
9 Manometer (4 required, 20 to 60 in. Hg abs)
10 Mercury Trap (7 required)
11 SPDT Dead Center Position Toggle Switch
12 SPST Toggle Switch (2 required)
13 Fuse Panel Mount (2.5 amp)
14 Ammeter (0-3 amp, dc)
15 Voltmeter (0-30 v, dc)

Figure 3. Test Diagram - De-Icer Distributing Valve - Bendix Utica Type 1532-3-A

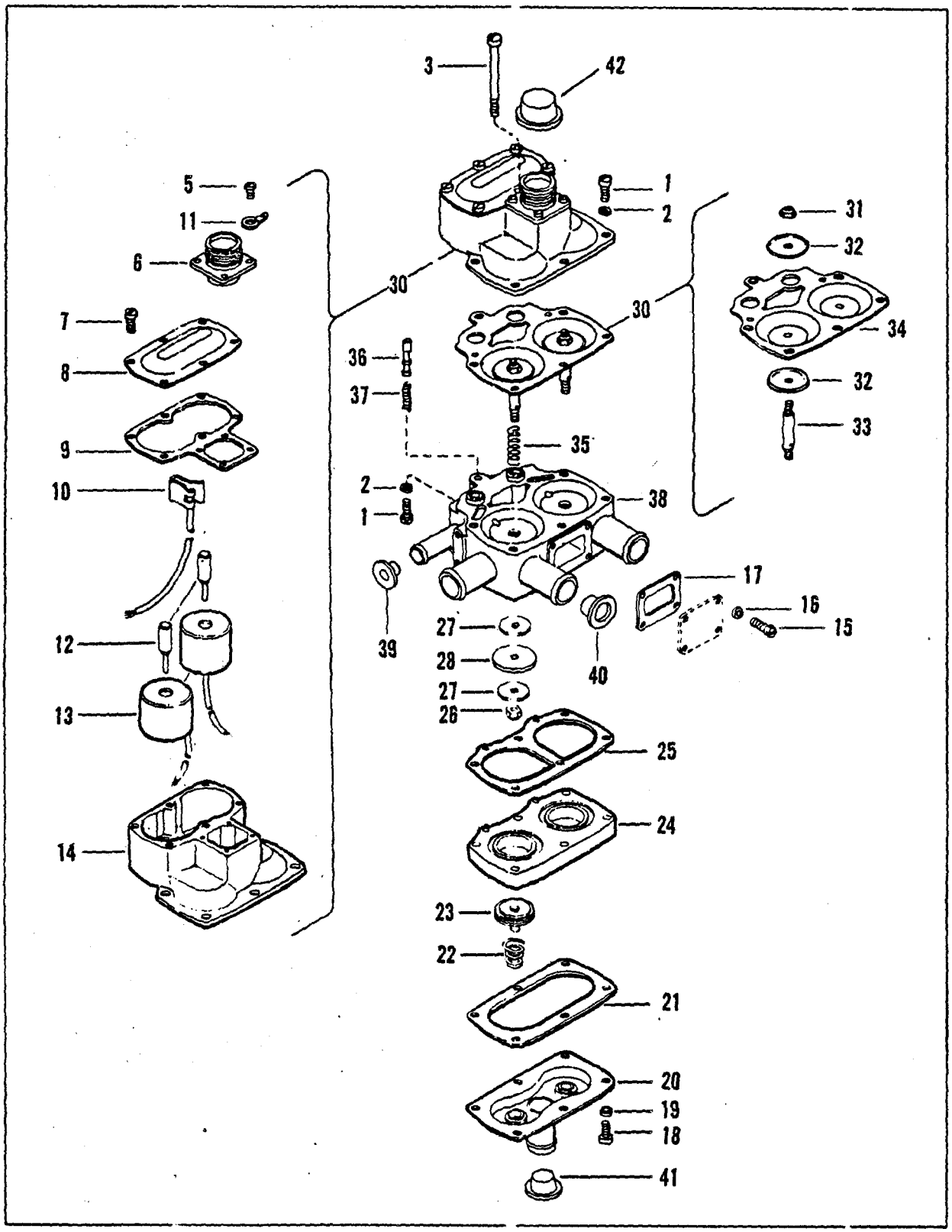


Figure 4. Exploded View - De-Icer Distributing Valve - Bendix Utica Type 1532-3-A

h. With both solenoids de-energized, apply 30 PSI regulated air pressure to pressure inlet port. Leakage as determined by flowmeter located in pressure supply line must not exceed 9 CFH (.15 CFM).

j. Apply 30 PSI regulated air pressure to pressure inlet port with "A" and "B" boot ports plugged. Energize solenoid "A". Leakage as determined by flowmeter located in pressure supply line must not exceed 22 CFH (.36 CFM).

k. Apply 30 PSI regulated air pressure to pressure inlet port with "A" and "B" boot ports plugged. Energize solenoid "B". Leakage as determined by flowmeter located in pressure supply line must not exceed 22 CFH (.36 CFM).

Figure & Index No.	Part Number	Nomenclature 1 2 3 4 5 6 7	Units Per Assy
4-	1532-3A	VALVE ASSEMBLY, De-icer distributing	1
-1	92612-7	. SCREW	6
-2	25103	. WASHER	6
-3	835875	. SCREW	1
-4	834853	. HEAD ASSEMBLY, Valve	1
-5	92630-4	. . SCREW	4
-6	AN3102E14.S7P	. . RECEPTACLE, Disconnect	1
-7	92634-5	. . SCREW	5
-8	830407	. . RETAINER, Solenoid	1
-9	830406	. . GASKET	1
-10	830413	. . CONTACT AND LEAD ASSEMBLY	1
-11	1337515	. . LUG	1
-12	101764	. . PLUNGER AND PIN ASSEMBLY	2
-13	648777	. . COIL ASSEMBLY, Solenoid	2
-14	836030	. . HEAD, Valve	1
-15	92630-4	. SCREW, Name plate	4
-16	61840	. WASHER, Name plate screw	4
-17	834916	. GASKET, Name plate	1
-18	92612-14	. SCREW	6
-19	25103	. WASHER	6
-20	869893	. COVER ASSEMBLY, Exhaust valve	1
-21	834961	. GASKET	1
-22	869890	. SPRING	2
-23	101783	. VALVE ASSEMBLY, Poppet	2
-24	869897	. HOUSING, Exhaust valve	1
-25	834958	. GASKET	1
-26	MS20364-632A	. NUT, Valve self-locking	2
-27	108054	. WASHER, Valve	4
-28	648771	. SEAL, Valve	2
-29	Deleted		
-30	834918	. DIAPHRAGM ASSEMBLY	1
-31	MS20364-632A	. . NUT, Diaphragm self-locking	2
-32	101778	. . WASHER, Diaphragm	4
-33	834919	. . STEM, Valve	2
-34	830281	. . DIAPHRAGM	1
-35	834915	. SPRING, Diaphragm	2
-36	829489	. VALVE, Control	2
-37	829488	. SPRING, Control Valve	2
-38	834832	. HOUSING, Valve	1
-39	1329968-13	PLUG, Shipping	1
-40	1329968-9	PLUG, Shipping	3
-41	1329968-10	PLUG, Shipping	1
-42	1329968-5	PLUG, Shipping	1

PUB. NO. 19U-2-631E

Bendix

Utica Division

OVERHAUL INSTRUCTIONS

AIR EJECTOR ASSEMBLY

TYPE NUMBERS

19E26-1A
19E31-1A
19E32-1A
19E36-2A

THE Bendix CORPORATION

UTICA DIVISION • UTICA 1, NEW YORK

OVERHAUL INSTRUCTIONS

AIR EJECTOR ASSEMBLY

TYPE NUMBERS

19E26-1A
19E31-1A
19E32-1A
19E36-2A

TABLE OF LEADING PARTICULARS

Model	19E26-1A	19E31-1A	19E32-1A	19E36-2A
Ports				
Inlet	AND10060 for 5/8" I. D. tubing	AND10050-6 for 3/8" O. D. tubing	AND10060-10 for 5/8" O. D. tubing	M. S. 33514E10 for 5/8" O. D. tubing
Suction	AND10060 for 5/8" I D tubing	AND10050-6 for 3/8" O. D. tubing	AND10060-10 for 5/8" O. D. tubing	M. S. 33514E12 for 3/4" O. D. tubing
Outlet	AND10060 for 5/8" I. D. tubing	AND10050-8 for 1/2" O. D. tubing	AND10060-12 for 3/4" O. D. tubing	AND10050-10 for 5/8" O. D. tubing
Overall Width	1. 0"	1 1/32"	1 3/32"	1 3/8"
Overall Length	5. 0"	4 1/50"	6 11/32"	5 9/16'
Overall Height	2 1/10"	1 31/64"	2 21/32"	3 17/64''
Weight	0. 13 lb.	0. 17 lb.	0. 15 lb.	0. 8 lb.

1. SPECIAL TOOLS. None.

2. DISASSEMBLY. None. The air ejector is a rolled and welded assembly whose component parts are not procurable or replaceable separately.

3. CLEANING. Use a soft-bristled brush and cleaning solvent, Federal Specification P-S-661, to clean unit internally and externally. Drain solvent thoroughly and dry with compressed air.

4. INSPECTION. Inspect unit for cracks, breaks, leakage, bent or distorted parts, or other damage.

5. REPAIR OR REPLACEMENT. Replace entire unit if damaged or unacceptable due to failure of test procedure (refer to paragraph 8).

6. LUBRICATION. None.

7. REASSEMBLY. None.

8. TEST PROCEDURE.

19E26-1A

a. Perform all tests under standard conditions with the test setup as shown in Figure 1. The temperature of the forcing air must be between 75°F (24°C) and 80°F (26.5°C).

b. Adjust the air pressure regulator valve to give a forcing pressure of 22 psig as indicated on the 0-100 psi gage No. 1. With the suction flow gate valve closed, the vacuum reading indicated on the manometer should be a minimum of 12.2 in. Hg and the forcing flow a maximum of 0.40 lb/min.

c. With a forcing pressure of 22 psig, adjust the suction flow gate valve to give a vacuum reading of 4.0 in. Hg on the manometer. The suction flowrator should indicate a minimum of 0.36 lb/min.

d. Repeat Step b with a forcing pressure of 18 psig. The vacuum reading should be a minimum of 10.0 in. Hg and the forcing flow a maximum of 0.35 lb. min.

e. Repeat Step c with a forcing pressure of 18 psig. The suction flowrator should indicate a minimum of 0.32 lb/min.

19E31-1A

a. Set up ejector in accordance with Figure 1.

b. Adjust air pressure regulator valve to give a forcing pressure of 40 psig. With vacuum flow gate valve closed, vacuum reading should be a minimum of 7.0 inches of Hg and the forcing flow a maximum of 0.25 lbs/min. with 70°F air.

c. With the same forcing pressure as in Step b, open the vacuum flow gate valve to give a vacuum reading of 3 inches of Hg. At this condition the vacuum flow should be a minimum of 0.16 lbs/min.

19E32-1A

a. Set up ejector in accordance with Figure 2.

b. Adjust air pressure regulator valve to give a forcing pressure of 18 psig. With vacuum flow gate valve closed, vacuum reading should be a minimum of 6.3 inches of Hg and the forcing flow a maximum of 0.85 lbs/min.

c. With the same forcing pressure as in Step b, open vacuum flow gate valve to give a vacuum reading of 4 inches of Hg. At this condition the vacuum flow should be a minimum of 0.57 lbs/min.

19E36-2A

a. Set up ejector in accordance with Figure 3.

b. Adjust the air pressure regulator valve to give a forcing pressure of 18 ± 1/2 psig at 70 ± 10°F. At sea level, with the vacuum flow gate valve closed, the forcing flow should be a maximum of 0.85 lbs/min. and the vacuum reading a minimum of 6.4 inches of Hg.

c. With the same forcing pressure as in Step b, open the vacuum flow gate valve to give a vacuum reading of 2.5 inches of Hg. The vacuum flow should be a minimum of 0.80 ± 0.05 lbs/min.

d. With the ejector discharge capped, the gate valve open and a forcing pressure of 3.5 psig, the check valve shall not leak more than 0.5 scfm.

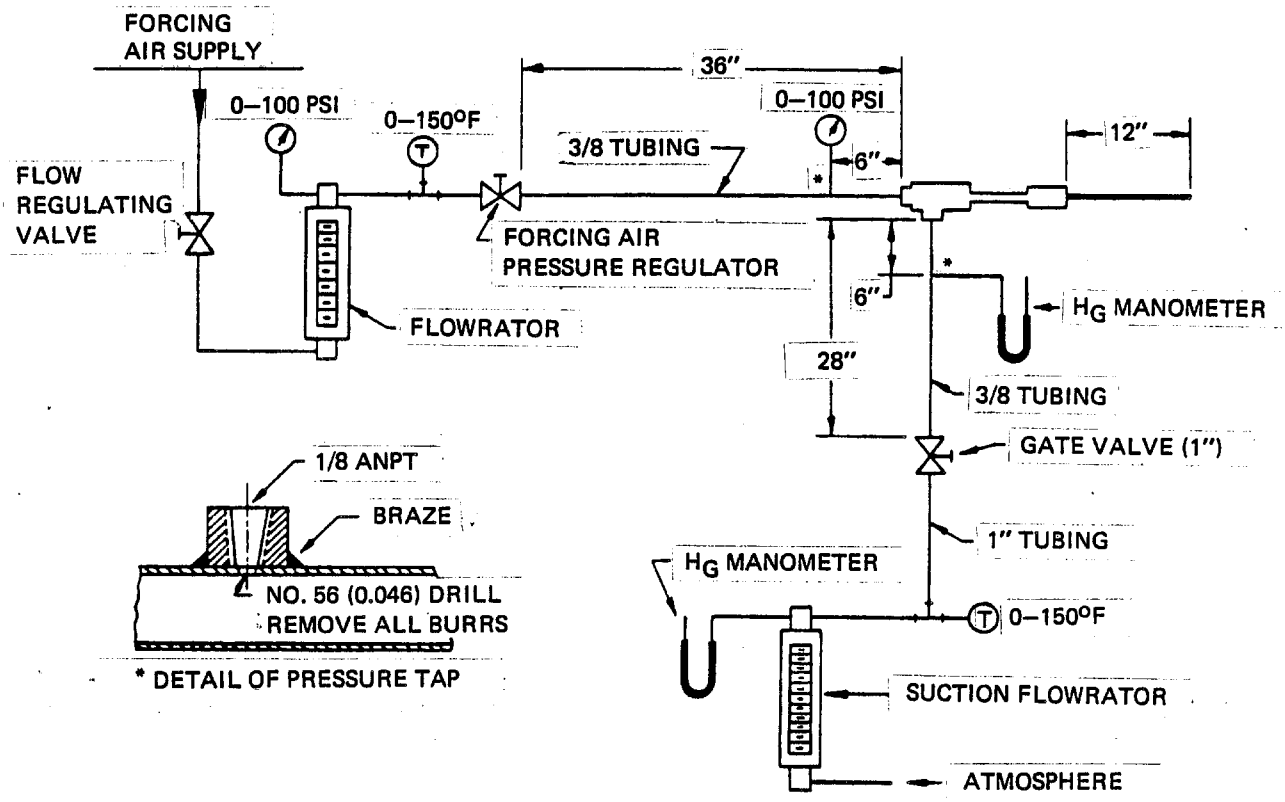


Fig. 1 - Test Set Up For 19E26-1A And 19E31-1A

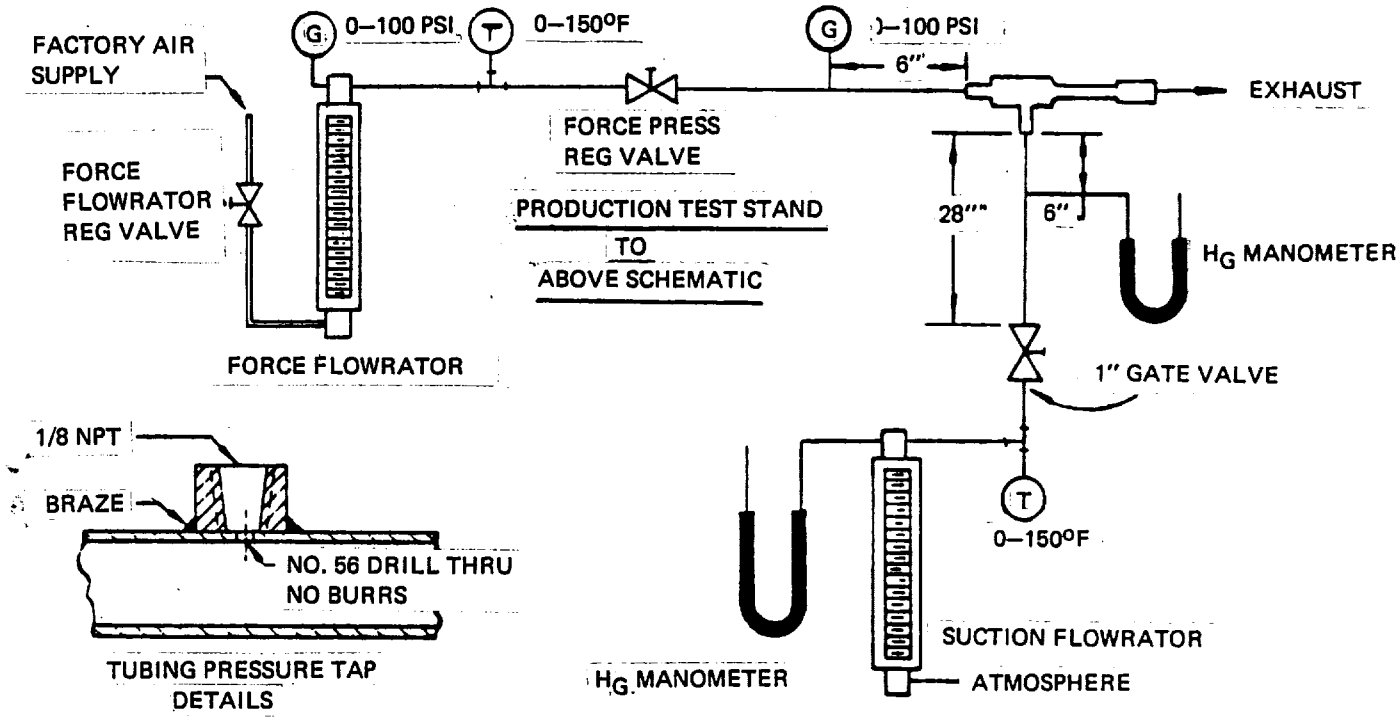


Fig. 2 - Test Set Up For 19E32-1A

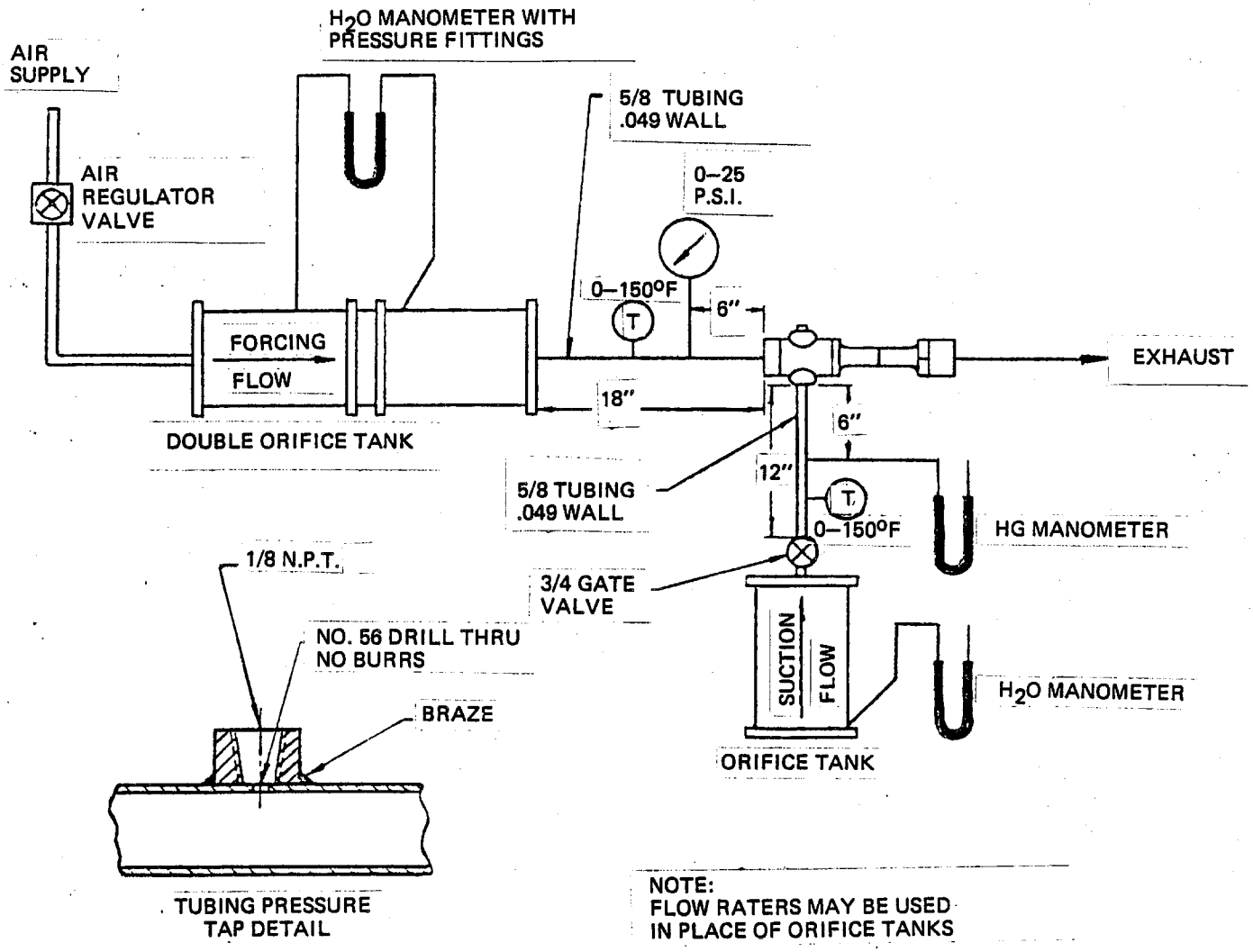


Fig. 3 - Test Set Up For 19E36-2A

Transistorized Sequential Timer

Overhaul Manual
with
Parts List

Part No.
42E13-3A

Pub. No. 42U-23-692C

Bendix Fluid Power Division

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TRANSISTORIZED SEQUENTIAL TIMER, PART NO. 42E13-3A

1. Description and Operation

This manual contains descriptive information, overhaul and test instructions, and an illustrated parts list for Transistorized Sequential Timer, Part No. 42E13-3A. This equipment is manufactured by The Bendix Corporation, Fluid Power Division, Utica, New York.

The transistorized sequential timer (Figure 1) is a component of the Model 26S deicing system used on the DeHavilland Twin-Otter.

The timer provides the energizing voltage to the solenoids in the system distributor valve for deicing specific aircraft boots at a predetermined rate. The timer cycles automatically at a "heavy" or "light" icing rate, as selected by a switch on the aircraft deicing system control panel in the cockpit.

In operation at either heavy or light ice conditions, the timer provides a five second "on" period for two boots and a three second "on" for the other two boots as a function of the rotary circuit selector connecting 28 volts to a connector pin during its cycling period. The total cycle time (including dwell time) is 60 seconds for heavy icing, and 180 seconds for light icing.

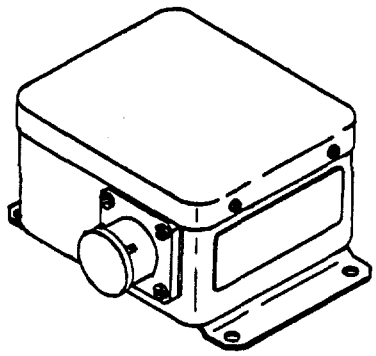


Figure 1

Transistorized Sequential Timer - Three-Quarter View

2. Disassembly (Ref. Figure 4)

A Since the transistorized sequential timer is an electronic assembly, complete disassembly (and subsequent overhaul and reassembly) is impractical and undesirable. Only parts which have been established by testing and inspection as being damaged should be removed.

B. If necessary to remove timer cover (1), remove screws (2). The cover is sealed with silicone rubber, and removal may be difficult.

NOTE: Complete component board (6) has been sealed and treated at the factory with a fungus-resistant varnish. If components on the component board are replaced, that area of the board where the component is replaced must be revarnished with the fungus-resistant varnish.

3. Cleaning

A. If the unit was disassembled, remove all traces of silicone rubber from the top of complete timer box (21, Figure 4), the inside of timer cover (1), and all screws that extend through the box, with acetone or other suitable solvent, and allow to air dry.

B. Clean all other components with clean, dry, compressed air. No further cleaning is required.

4. Inspection/Check

A. Inspect all parts for corrosion, wear, and damage.

B. Inspect all threaded parts for stripped, crossed, or otherwise damaged threads.

C. Inspect terminals and connector pins for damage.

D. Inspect wiring for burns, cracked or peeled insulation, loose connections, and cold solder joints.

5 Repair

If necessary to replace any wiring, see wiring diagram (Figure 2). Solder loose connections and new wiring with rosin core solder composed of 63 percent tin and 37 percent lead

6. Assembly (Ref. Figure 4)

A. Install rotary circuit selector (12) with screw (7), internal tooth lock washer (8), screw (13), and internal tooth lock washer (14), to rotary circuit selector bracket (15). Secure rotary circuit selector bracket to complete timer box (21) with screws (16) and internal lock washers (17)

B Secure complete component board (6) to complete timer box (21) with screw (9), ground terminal (11), and nut (10)

C Apply Locquic Grade N or Q primer or actuator (American Sealants Co., Hartford, Conn.) to the threaded shaft ends of rotary circuit selector (12) and the supplied nuts, and allow to dry thoroughly. When dry, apply one or two drops of Loctite Grade A (American Sealants Co.) to both threaded parts, and assemble through the top holes in rotary curcuit selector bracket (15).

NOTE: If a new rotary circuit selector (12) is used, remove the nuts and discard the supplied washers before installing.

D. Install receptacle connector (3) with mounting flange gasket (5), and secure with screws (4)

E. Make all electrical connections as shown in Figure 2

F Coat the top edge of complete timer box (21, Figure 4), the inside of timer cover (1), and the heads of all screws that extend through the box, with RTV 102 (General Electric Co., Pittsfield, Mass.) silicone rubber Make sure that the coating is thick enough to form a fillet between the

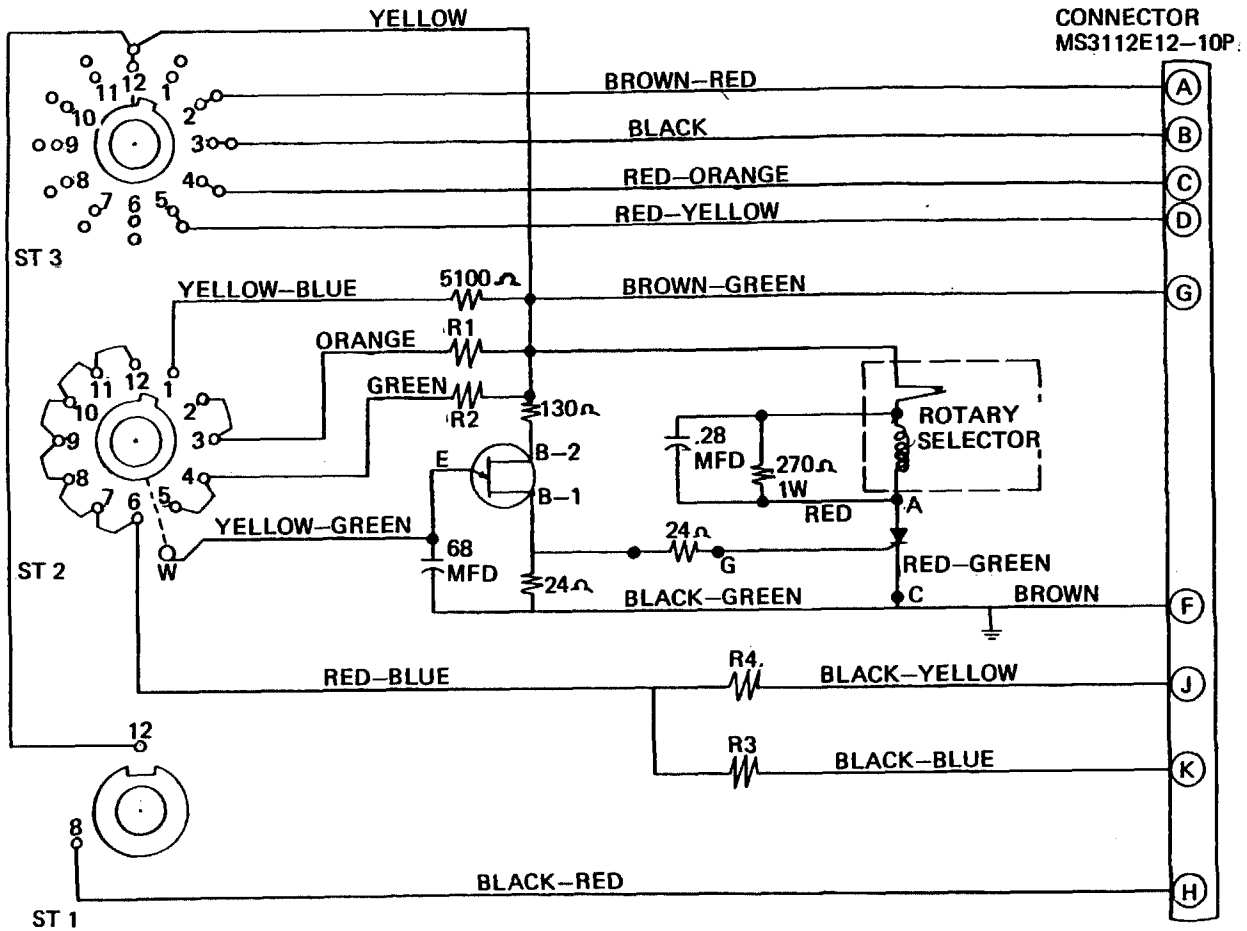


Figure 2

Note: All resistors shown above are .5 watt with a resistance tolerance of + 5%.

Select Resistor at Assembly		
R_1 - 5 ± .4	Sec. Per Step	
645024 - 6835A	68K	OHMS
" - 7535A	75K	"
" - 8235A	82K	"
" - 9135A	91K	"
" - 1045A	100K	"
" - 1145A	110K	"
" - 1245A	120K	"
" - 1345A	130K	"
" - 1545A	150K	"
R_2 - 3 ± .25	Sec. Per Step	
645024 - 4335A	43K	OHMS
" - 4735A	47K	"
" - 5135A	51K	"
" - 5635A	56K	"
" - 6235A	62K	"
" - 6835A	68K	"
" - 7535A	75K	"
" - 8235A	82K	"
" - 9135A	91K	"
R_3 - 6.3 ± 5	Sec. Per Step	
645024 - 9135A	91K	OHMS
" - 1045A	100K	"
" - 1145A	110K	"
" - 1245A	120K	"
" - 1345A	130K	"
" - 1545A	150K	"
" - 1645A	160K	"
" - 1845A	180K	"
" - 2045A	200K	"
R_4 - 23.4 ± 1.9	Sec. Per Step	
645024 - 3345A	330K	OHMS
" - 3645A	360K	"
" - 3945A	390K	"
" - 4345A	430K	"
" - 4745A	470K	"
" - 5145A	510K	"
" - 5645A	560K	"
" - 6245A	620K	"
" - 6845A	680K	"

cover and the outside of the box. Remove the excess material and allow to cure for two hours at room temperature before handling.

G. Install 4 lengths of 0.020 inch diameter stainless steel lock wire through the drilled heads of screws (2 and 4) (one length for two screws) in accordance with standard aircraft procedures, so that the wire tends to tighten the screws

7. Fits and Clearances

Not applicable.

8. Testing

A. General

(1) Perform all tests at a room temperature of approximately 78°F and at an atmospheric pressure of approximately 29.92 inches of mercury.

(2) If deicer timer test stand 53E42-1A is available, connect adapter cable U755 to the timer and follow the instructions provided with the test stand.

(3) If the deicer timer test stand is not available, connect the timer in a test setup as shown in Figure 3, using suitable test lamps.

B. Icing and Homing Operation

(1) Set the test switch (Figure 3) to the HEAVY ICE position. The timer must begin cycling as indicated by the alternate lighting of the test lamps, and continue cycling until the switch is set to OFF. The timer will continue cycling until the cycle is completed.

(2) Set the test switch to the LIGHT ICE position. The timer must begin cycling as indicated by the alternate lighting of the test lamps, and continue cycling until the switch is set to OFF. The timer will continue cycling until the cycle is completed.

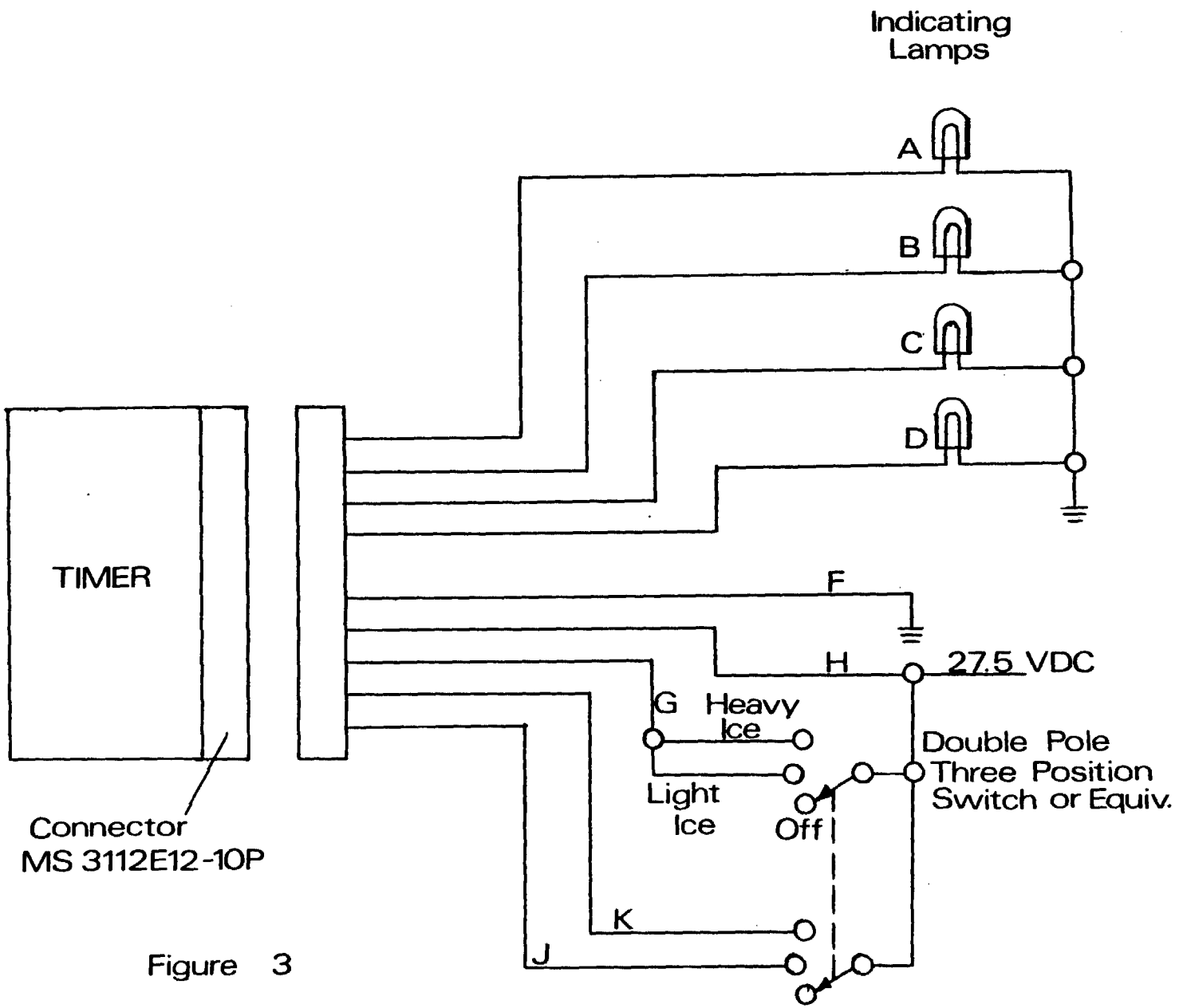

Indicating
Lamps
A
B
C
D
TIMER
F
H
27.5 VDC
G
Heavy
Ice
Light
Ice
Off
Double Pole
Three Position
Switch or Equiv.
Connector
MS 3112E12-10P
K
J

Figure 3

NOTE One complete cycle is the period of time between consecutive lightings of the same lamp This includes the dwell time, during which no lamp will be lit

C Time Intervals

(1) Connect a timer at each test lamp position in turn, so that each time interval may be timed

(2) Set the test switch to each position in order to time the intervals for each lamp The results must be as indicated in Table I

TIME INTERVAL TESTS
TABLE I

Connector Pin Energized	Time Interval (Seconds ± 10 Percent)	
	Heavy Ice Position	Light Ice Position
A	5	5
B	5	5
C	3	3
D	3	3
Dwell Time	44	164
Total Cycle Time	60	180

9 Troubleshooting

If the test values specified in Paragraph 8 cannot be obtained, refer to Table II for remedial procedures

TROUBLESHOOTING CHART
TABLE II

Test Failed	Probable Cause of Failure	Remedy
Paragraph 8 B	Wiring or connector damaged or improperly connected	Check wiring as per Figure 2 Correct or replace as necessary
	Rotary circuit selector damaged	Replace rotary circuit selector
Paragraph 8 C	Components damaged or improperly selected	Replace individual components as necessary. Test per paragraphs 8 A, B, C Revarnish areas where components were replaced

10. Storage Instructions

The transistorized sequential timer may be stored for 24 months (maximum time) provided the following conditions prevail. If these conditions are not observed, shelf life will be considerably shortened.

A. Storage area must be dry.

B. Units must not be subjected to extremely high temperature.

C. Units must be effectively protected from dust. Install cap and plug (20, Figure 4).

D. Units must be handled with care at all times

E. Units should be stored in shipping cartons if possible.

NOTE: Units that remain in storage (or inoperative) beyond the specified time limit must be inspected and tested prior to installation or use.

11. Special Equipment and Materials

The following equipment, or equivalent, is required to perform the overhaul procedures described in this manual.

A. Special

Special test equipment required is listed in Table III.

B. Standard

No standard test equipment is required.

C. Material

Grade 3 Salicyl Anilide - Fungicide

Procurable from: Maas Waldstein Company
2121 McCarter Highway
Newark, New Jersey 07104

SPECIAL TEST EQUIPMENT
TABLE III

Part No.	Nomenclature	Application
53E42-1A	Deicer Timer Test Stand	Used to test transistorized sequential timer.
U755	Adapter Cable (supplied with 53E42-1A)	Used to adapt timer to test stand.

12. Illustrated Parts List

A. Introduction

(1) Purpose: This parts list is intended for use in requisitioning, storing, and issuing the replaceable parts of Transistorized Sequential Timer, Part No. 42E13-3A.

(2) Usage Code Symbols: Since only one type is covered in this parts list, a usage code is not necessary.

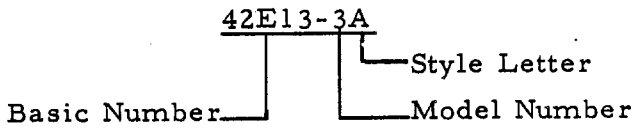
(3) Index Number Sequence: The sequence of the index numbers on the exploded view is the sequence of disassembly.

(4) How to Use this Parts List: When the part number is not known, locate the part on the exploded view and note its index number. Use this index number to locate the part number in the Group Assembly Parts List, Paragraph B.

(5) Bendix Part Numbering System: The part number consists of a basic number and a dash number. The dash number indicates variations of the basic part.

(6) Bendix Type Numbering System: The type numbering system indicates the essential characteristics of the unit.

Example:



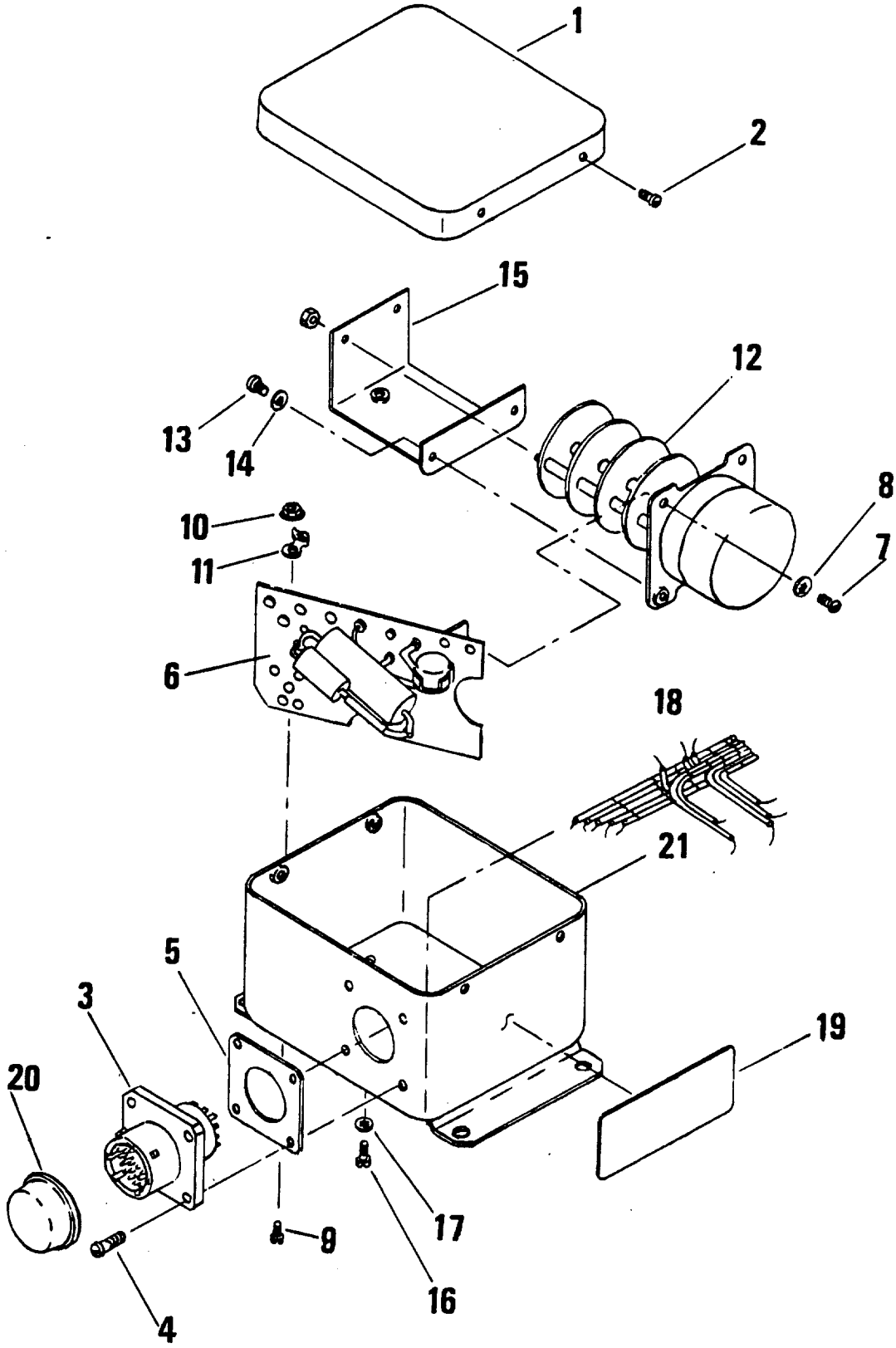


Figure 4

P. Group Assembly Parts List

FIG. & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY.
4-	42E13-3A	TIMER - Transistorized sequential	1
- 1	2481294	. COVER - Timer	1
		ATTACHING PARTS	
- 2	AN500AD4-3	. SCREW	4
		----*----	
- 3	MS3112E12-10P	. CONNECTOR - Receptacle	1
		ATTACHING PARTS	
- 4	AN500AD4-4	. SCREW	4
		----*----	
- 5	645248-12	. GASKET - Mounting flange	1
- 6	2481595	. BOARD - Complete component	1
		ATTACHING PARTS	
- 7	645227D3A	. SCREW - Fillister head, No. 4-40 by 3/16 in. lg.	1
- 8	AN936A4	. WASHER - Lock, internal tooth	1
- 9	MS51957-15	. SCREW	1
-10	MS21043-04	. NUT	1
		----*----	
-11	645059-2	. TERMINAL - Ground	1
-12	2481296	. SELECTOR - Rotary circuit	1
-13	645227D3A	. SCREW - Fillister head, No. 4-40 by 3/16 in. lg.	2
-14	AN936A4	. WASHER - Lock, internal tooth	2
		----*----	
-15	2481378	. BRACKET - Rotary circuit selector	1
		ATTACHING PARTS	
-16	MS51957-13	. SCREW	3
-17	AN936A4	. WASHER - Lock, internal tooth	3
-18	2481593	. CABLE - Complete timer	1
-19	2481422	. PLATE - Identification	1
-20	645247-15	. CAP AND PLUG - Plastic protector	1
-21	2481301	BOX - Complete timer	1

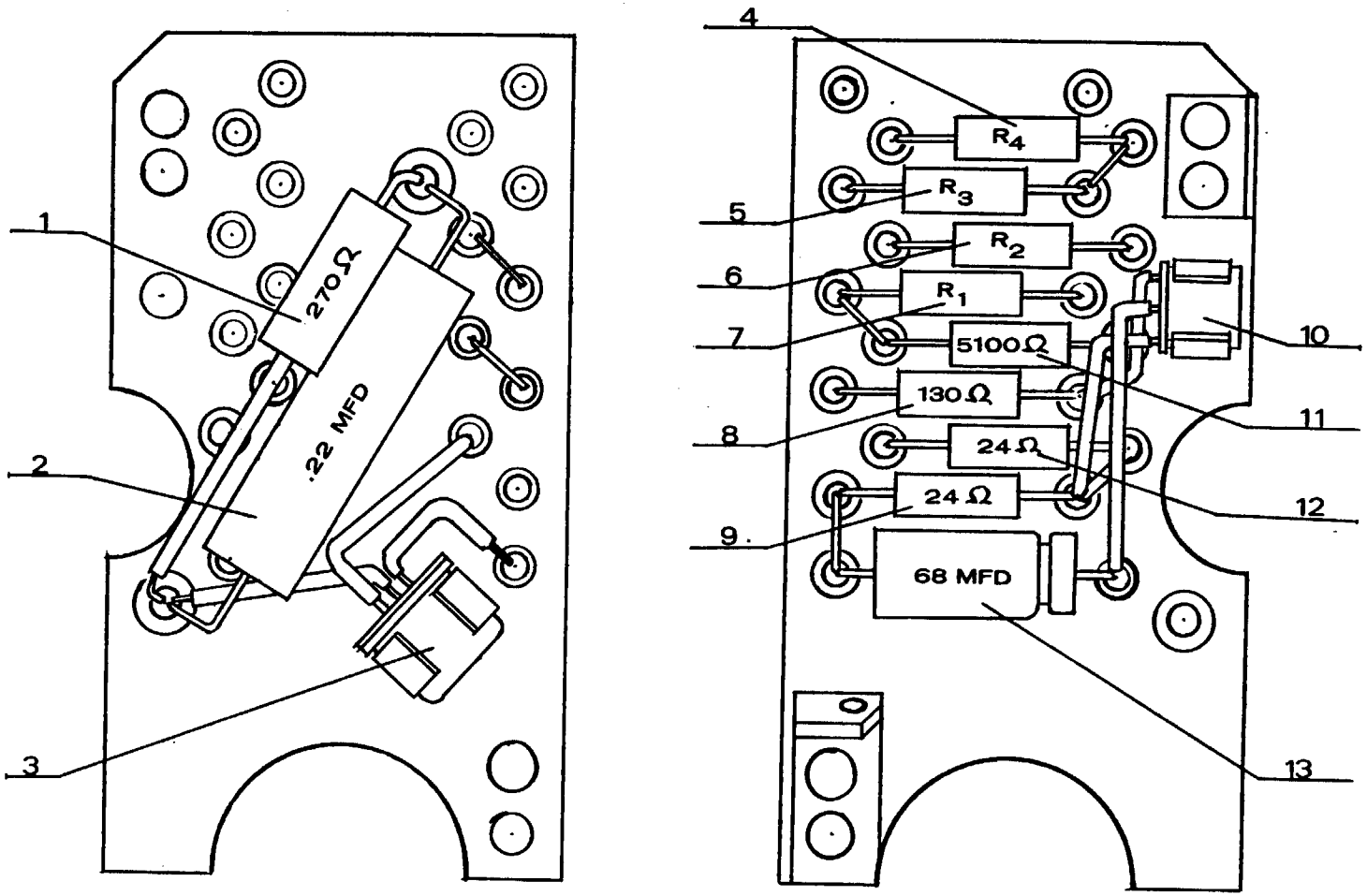

1
2
3
270Ω
.22 MFD
4
5
6
7
8
9
R4
R3
R2
R1
5100Ω
130Ω
24Ω
24Ω
68 MFD
10
11
12
13

Figure 5

C. Component Board Parts List

FIG. & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7		UNITS PER ASSY
5 -	2481595	BOARD, Complete component		1
- 1	645024-2715B	RESISTOR, 270 Ohms, 1 Watt resistance tolerance ±5%		1
- 2	640986	CAPACITOR, Switch -.22 MFD, 200V ±10%		1
- 3	2481373	RECTIFIER, Silicon Controlled - 50V, 8 Amp, 5 Watt		1
	645024-3345A	RESISTOR		
	645024-3645A	RESISTOR		
	645024-3945A	RESISTOR		Select
	645024-4345A	RESISTOR		one
- 4	645024-4745A	RESISTOR	R4	at
	645024-6245A	RESISTOR		assembly
	645024-6845A	RESISTOR		
	645024-5145A	RESISTOR		
	645024-5645A	RESISTOR		
	645024-9135A	RESISTOR		
	645024-1045A	RESISTOR		
	645024-1145A	RESISTOR		Select
	645024-1245A	RESISTOR		one
- 5	645024-1345A	RESISTOR	R3	at
	645024-1845A	RESISTOR		assembly
	645024-2045A	RESISTOR		
	645024-1545A	RESISTOR		
	645024-1645A	RESISTOR		
	645024-4335A	RESISTOR		
	645024-4735A	RESISTOR		
	645024-5135A	RESISTOR		Select
	645024-5635A	RESISTOR		one
- 6	645024-6235A	RESISTOR	R2	at
	645024-8235A	RESISTOR		assembly
	645024-9135A	RESISTOR		
	645024-6835A	RESISTOR		
	645024-7535A	RESISTOR		

FIG. & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY.
5 -	645024-6835A	. RESISTOR	
	645024-7535A	. RESISTOR	
	645024-8235A	. RESISTOR	Select
	645024-9135A	. RESISTOR	one
- 7	645024-1045A	. RESISTOR R1	at
	645024-1345A	. RESISTOR	assembly
	645024-1545A	. RESISTOR	
	645024-1145A	. RESISTOR	
	645024-1245A	. RESISTOR	
- 8	645024-1315A	. RESISTOR, 130 Ohms, ± 5 Watt, Resistance tolerance ±5%	1
- 9	645024-2405A	. RESISTOR, 24 Ohms, ± 5 Watt, Resistance tolerance ±5%	1
-10	649373	. TRANSISTOR, Silicon Unijunction	1
-11	645024-5115A	. RESISTOR, 5100 Ohms, ± 5 Watt, Resistance tolerance ±5%	1
-12	645024-2405A	. RESISTOR, 24 Ohms, ± 5 Watt, Resistance tolerance ±5%	1
-13	643635	. CAPACITOR, Tantalum, 68 MFD, 30 Volt DC	1

Pub. No. 44U-2-7512A

SERVICE AND OVERHAUL INSTRUCTIONS

WITH

ILLUSTRATED PARTS BREAKDOWN

WATER SEPARATOR AND FILTER

TYPE

44E06-1A
44E06-2A ←

TABLE OF LEADING PARTICULARS

	44E06-1	44E06-2
Normal Pressure	18 PSIG	18 PSIG
Maximum Pressure	40 PSIG	40 PSIG
Flow	20 SCFM	20 SCFM
Pressure Drop	4.5"	5.5"
Maximum Temperature	250°F (121.1°C)	250°F (121.1°C)
Filtration	2 Micron	.3 Micron

SERVICE INSTRUCTIONS

1. DISASSEMBLY

a

a) Disconnect drain line.

b) Backoff bolt (1 figure 1) separator housing (7) with associated parts (8 through 14), will follow as bolt is withdrawn.

c) Remove filter retaining cotter pin (14) from bolt (1).

d) Remove filter retainer (13) and filter element (12) from housing (7).

2. CLEANING

Thoroughly wash all parts with suitable cleaning solvent. Air dry all parts using filtered factory air.

3. INSPECTION

a) Inspect all parts for damage.

b) Inspect all threads for condition and cleanliness.

c) Inspect separator housing for damage and/or burrs.

d) Filter inspection

Inspect filter for a coating of dirt. Long filter life can be expected as most dirt will be entrapped in water droplets and drained over - board. Replace element if condition is questionable.

4. PART REPLACEMENT

a) Replace all damaged parts.

b) Replace filter element as required.

5. LUBRICATION

Lubricate all seals and "O" rings with FS-1265 lubricant obtainable from Dow Corning, Englewood Cliffs, New Jersey.

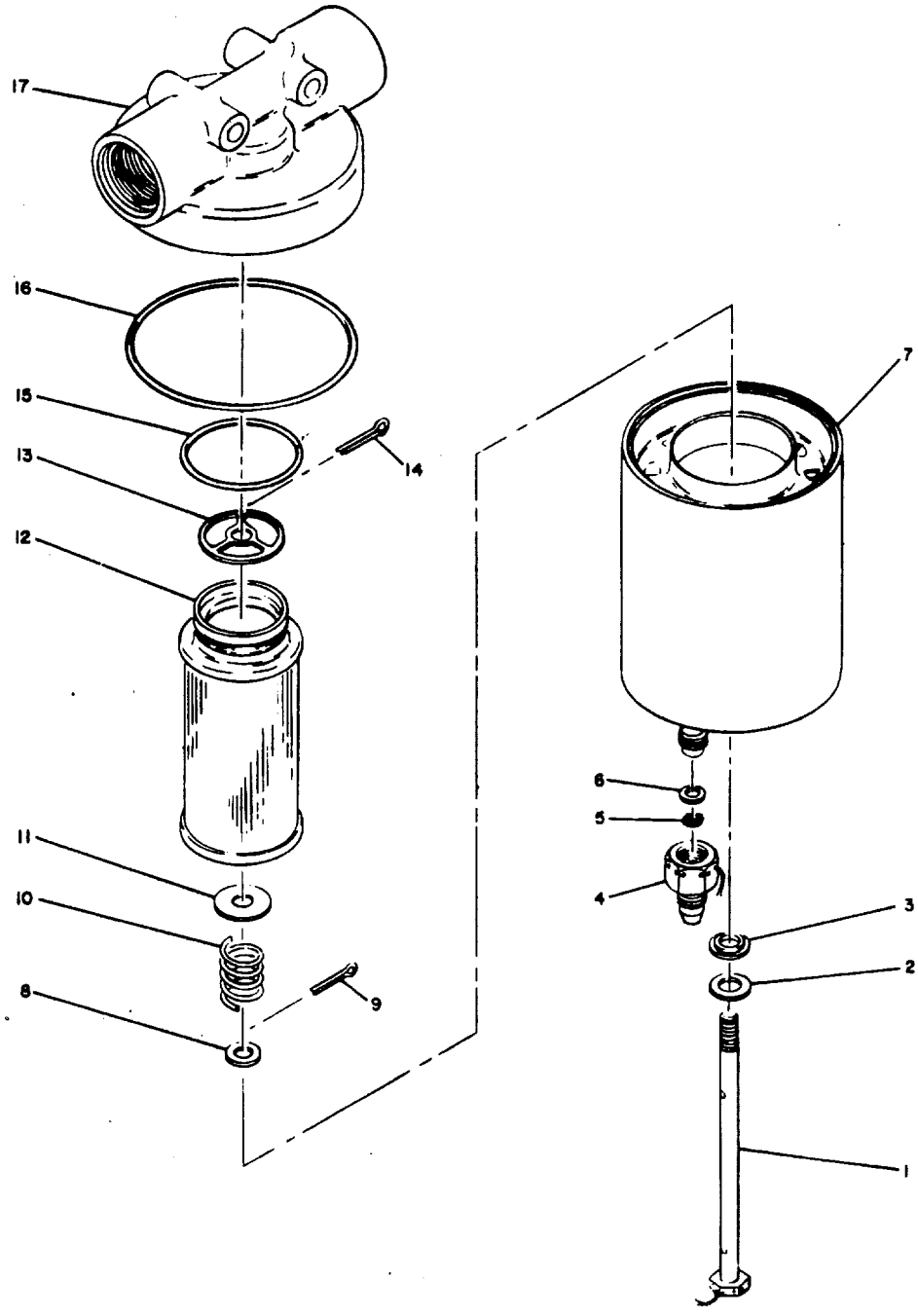


Figure 1 Water Separator and Filter - Exploded View

6. REASSEMBLY

Reassembly is the reverse of Disassembly.

CAUTION

Press the Separator Housing Assembly (7, figure 1) into the Separator Manifold (17). DO NOT FORCE THE BOWL INTO THE HOUSING BY TURNING IN THE RETAINING BOLT (1).

7. TEST PROCEDURE

None required other than a leak check after assembly.

8. OVERHAUL

Disassembly of the unit for Overhaul is the same as for Servicing the unit except the Separator Housing Assembly should be completely disassembled (1 through 9, figure 1). Follow the Service procedures replacing all "O" rings and seals and filter element.

ILLUSTRATED PARTS LIST

Figure 1 Item No.	Part Number	Description	44E06-1A	44E06-2A
1	2489711	Bolt, Housing Retaining	1	1
2	AN960C416L	Washer, Flat	1	1
3	NAS1523C4E	Packing, with Retainer	1	1
4	2487983	Nipple, Drain Fitting	1	1
5	99146	Screen, Drain	1	1
6	2488318	Washer, Drain	1	1
7	2487867	Housing Filter Element	1	1
8	AN960C416L	Washer, Flat	1	1
9	MS24665-86	Cotter, Pin	1	1
10	2487864	Spring, Filter Loading	1	1
11	2487863	Retainer, Spring	1	1
12	2488294	Filter, Comp * 2 Micron	1	-
12	2488889	Filter, Comp * .3 Micron	-	1
13	2487980	Retainer, Filter	1	1
14	MS24665-86	Cotter, Pin	1	1
15	645001RR222	Gasket, "O" Ring	1	1
16	645001RR236	Gasket, "O" Ring	1	1
17	2487872	Manifold, Separator	1	1

*NOTE: Filter comes complete with "O" Ring Seal

COMPONENT MAINTENANCE MANUAL

WITH

ILLUSTRATED PARTS LIST

WINDSHIELD WIPER

MOTOR ASSEMBLY

2311M95
2311M96
2311M97

Rosemount Aerospace Inc.
14300 Judicial Road
Burnsville, MN 55306 USA
Phone (612) 892-4297
Fax (612) 435-3512

BASIC ISSUE

OCTOBER 1/93

HIGHLIGHTS

This CMM supersedes all previous manuals and instruction sheets for the Rosemount Model 2311M95, 2311M96, and 2311M97 motor assemblies and for Model XW21160-G1 and Model XW21160-G2 motor assemblies produced by ALCO Controls Division of St. Louis, MO. Discard any instructions dated prior to October 1, 1993. Corresponding ALCO part numbers are referenced in the IPL section to facilitate the ordering of parts from Rosemount Aerospace Inc.

ROSEMOUNT AEROSPACE INC.
COMPONENT MAINTENANCE MANUAL
2311M95
2311M96
2311M97

RECORD OF REVISIONS

Retain this record in the front of the manual. On receipt of revisions, insert revised pages in the manual and enter revision number, date inserted and initials.

REVISION NUMBER	REVISION DATE	DATE FILED	BY
Orig. Rel.	Oct. 1/92	Aug 21/02	ATP/ MG

REVISION NUMBER	REVISION DATE	DATE FILED	BY

RECORD OF TEMPORARY REVISIONS

REV. NO.	ISSUE DATE	DATE INSERTED	REMOVAL DATE	INCORPORATOR'S INITIALS	REMOVER'S INITIALS

SERVICE BULLETIN LIST

SERVICE BULLETIN	ISSUE DATE	DATE INCORPORATED	BY

SERVICE BULLETIN	ISSUE DATE	DATE INCORPORATED	BY

LIST OF EFFECTIVE PAGES

SUBJECT	PAGE	DATE
Title Page	T-1	Oct. 1/93
	T-2	Blank
Record of Revisions	RR-1	Oct. 1/93
	RR-2	Blank
Record of Temporary Revisions	RTR-1	Oct. 1/93
	RTR-2	Blank
Service Bulletin List	SBL-1	Oct. 1/93
	SBL-2	Blank
List of Effective Pages	LEP-1	Oct. 1/93
	LEP-2	Oct. 1/93
Table of Contents	TC-1	Oct. 1/93
	TC-2	Blank
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	502	Blank
Repair	601	Oct. 1/93
	602	Blank
Assembly	701	Oct. 1/93
	702	Oct. 1/93
	703	Oct. 1/93
	704	Oct. 1/93

LIST OF EFFECTIVE PAGES

SUBJECT	PAGE	DATE
Fits and Clearances	801	Oct. 1/93
	802	Blank
Special Tools, Fixtures and Equipment	901	Oct. 1/93
	902	Oct. 1/93
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Illustrated Parts List	1001	Oct. 1/93
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Fits and Clearances	801
Special Tools, Fixtures and Equipment	901
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INTRODUCTION

This manual provides off-aircraft maintenance instructions for the Rosemount model 2311M95, 2311M96, and 2311M97 motor for aircraft windshield wiper systems. Aircraft windshield wiper systems using ALCO part numbers are cross referenced as follows:

		Configuration	
ALCO P/N	Rosemount P/N	Drive	Ground
XW-21160-2	02311-0095-0001	Double	Case
XW-21160-1	02311-0095-0002	Single	Case
XW-21160-G1	02311-0096-0001	Single	Bonding Jumper
XW-21160-G2	02311-0096-0002	Double	Bonding Jumper
XW-21160-M1	02311-0097-0001	Single	Bonding Jumper
XW-21160-M2	02311-0097-0002	Double	Bonding Jumper
XW-21160-M2B	02311-0097-0003	Double	Bonding Jumper

This manual contains maintenance procedures normally used by the shop mechanic/technician. For removal of the wiper system from the aircraft, comply with the instructions in the aircraft maintenance manual.

This manual is divided into separate sections:

1. Title Page
2. Record of Revisions
3. List of Effective Pages
4. Table of Contents
5. Introduction
6. Procedures and IPL

Refer to the Table of Contents for the page locations of applicable procedures and the Illustrated Parts List (IPL).

An explanation of the use of the IPL is provided in the introduction to that section.

This manual will be revised as necessary to reflect current information.

Verification

Testing and Troubleshooting	Verified 7/8/93
Disassembly	Verified 7/8/93
Assembly	Verified 7/8/93

LIST OF FIGURES

FIGURE		PAGE
1	Motor Assembly	1
2	Typical Windshield Wiper System Wiring Diagram	2
101	Motor Test Setup	102
701	Motor Wiring Diagram	702
702	Connector Wiring Diagram	702
901	Motor Bearing Removal Tool	901
902	Motor Bearing Pressing Fixture	902
(IPL) 1	Exploded View of Motor Assembly	1004

LIST OF TABLES

1	Leading Particulars	2
101	Motor Troubleshooting	103
301	Wiring Information	302
401	Cleaning Materials	401
701	Assembly Materials	703
801	Motor Assembly Table of Limits	801

DESCRIPTION AND OPERATION

1. DESCRIPTION

The motor assembly (Figure 1), in conjunction with the converter, wiper arm, and wiper blade, is used to clear the pilot's or co-pilot's windshield panels during inclement weather. The motor assembly provides the rotary power for operating the wiper system. An automatic reset thermoprotector, located on each motor, temporarily de-energizes the motor in the event of thermal or amperage overload (see Table 1) and radio noise (EMI) filters are contained in the base of the motor.

The pilot's and co-pilot's motor assemblies are mechanically identical.

2. OPERATION

The motor assembly may be operated at high or low speed, as selected by the wiper system controls located in the cockpit area. Low speed, if applicable, is accomplished through voltage reduction. A gear train, of identical ratio to the converter, is housed in the gear case of the motor. This gear train drives a cam assembly which actuates a parking switch (within the gear case) to automatically stow the wiper blade when the control switch is turned to the PARK position.

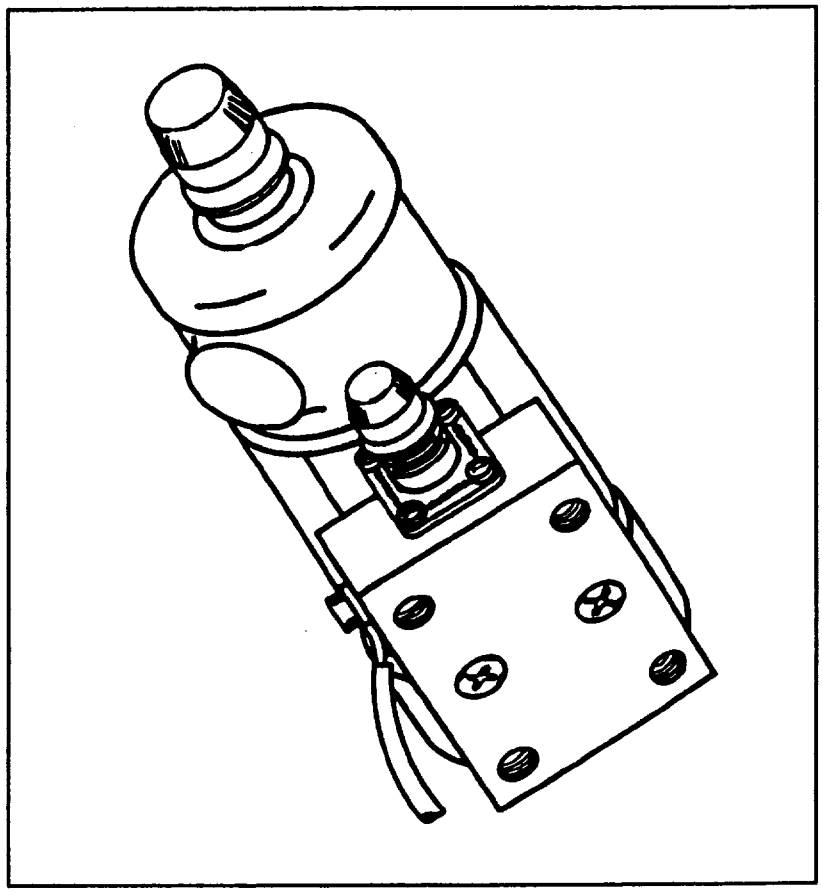


Figure 1. Motor Assembly

Table 1. Leading Particulars

Rated Voltage	28 VDC
Amperage	5.2 Amps
RPM	11,600
HP Rating	1/8 HP

Note: Rated values @ 10.9 in. oz. of torque

TESTING AND TROUBLESHOOTING

1. BENCH TESTING

A. Test Equipment

The following test equipment is needed to perform the test procedures:

- Rotor Lock Bar
- Dynamometer, Magtrol Model HD-400-6 (40 in-oz)
- Readout, Magtrol Model 4636
- Controller, Magtrol Model 4615C
- Power Supply (0-30 Volts, 40 Amps)
- Megohmmeter, Beckman Industrial Model L10A
- Dielectric Strength (Hypot) Meter, Associate Research Model 4450DT

NOTE: Equivalent substitutes may be used.

B. Motor Assembly Test Procedures

(1) Connect the motor assembly as shown in Figure 101.

(2) Apply 10 to 12 VDC across motor pins "A" and "C".

(3) Check for excessive running noise and vibration.

(4) Lock drive shaft of motor in a stationary position and apply 28 VDC across pins "A" and "C". Thermoprotector should de-energize motor circuit in approximately 30 seconds. Allow thermoprotector to complete one on-off cycle.

(5) With 28 VDC applied across pins "A" and "C" and motor operating at its rated torque of 10.9 inch-ounces, check speed and current draw of motor. Speed shall be no less than 10,500 rpm and current draw shall not exceed 6.2 Amperes.

C. Parking Switch Test Procedures

(1) Operate the motor at eight volts applied across motor pins "A" and "C".

(2) Allow motor speed to stabilize and connect a 6-volt lamp across motor pins "B" and "C". The lamp should light in regular pulsation if the parking switch is operating properly.

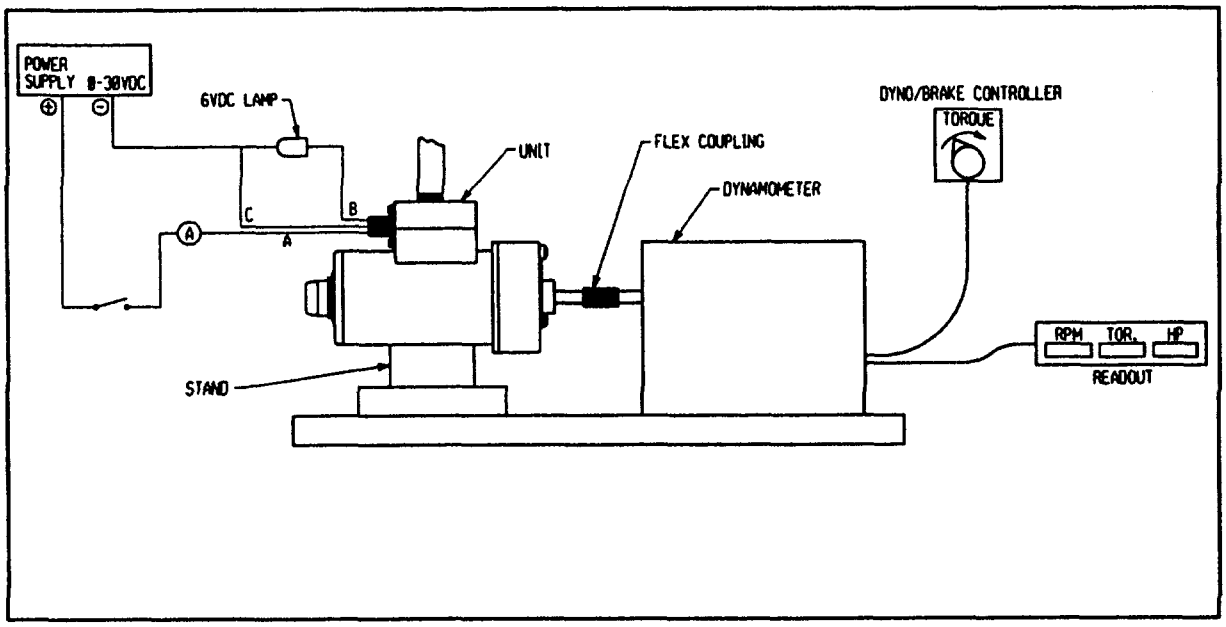
D. Insulation Resistance Breakdown Tests

CAUTION: THESE TESTS CAN ONLY BE PERFORMED IF THE EMI FILTER CAPACITORS HAVE BEEN REMOVED FROM THE ASSEMBLY. EMI FILTERS WILL BE DESTROYED IF AN INSULATION TEST IS PERFORMED WHILE THEY ARE ATTACHED.

(1) Ensure that no EMI filters are attached to motor and, using a dielectric strength meter, apply 1000 volts AC for 1 minute and check for ground faults between the motor lead wires and the motor barrel. Maximum leakage current is 2mA. Replace motor if ground fault is detected.

(2) Using a megohmeter, test the insulation resistance of the motor between the motor wires and barrel. The resistance should be >20 megohms.

Figure 101. Motor Test Set-up



2. TROUBLESHOOTING

If the motor assembly fails to operate properly, see Table 101 for troubleshooting instructions.

Table 101. Trouble Shooting Chart

PROBLEM	CAUSE	CORRECTION
Motor will not run		
- no current flow	1) Defective power supply or power supply not on.	1) Replace power supply or turn it on.
	2) Open circuit in motor. - open thermoprotector - open field coils - open winding in rotor	2) Check continuity between connector pins A and C and correct opens as necessary.
- current flow through motor	1) Defective or frozen bearings.	1) Replace bearings.
	2) Brushes frozen to commutator.	2) Replace brushes and resurface commutator.
	3) Foreign matter locking rotor.	3) Remove debris.
	4) Incorrect wiring.	4) Correct wiring.
Noisy operation/vibration		
	1) Defective, rough, or worn bearings.	1) Replace bearings.
	2) Defective or worn gears.	2) Check and replace as necessary.
	3) Rotor hitting pole piece or wires.	3) Replace barrel/correct wire placement.
	4) Rotor not balanced correctly/shaft bent (damage).	4) Replace rotor.
	5) Insufficient grease on gears and cam.	5) Apply grease to gears.
Thermoprotector will not cut power to motor		
- current flow through motor	1) Defective thermoprotector.	1) Remove from circuit and check continuity through thermoprotector. Replace as necessary.
- no current flow	1) See above (MOTOR WILL NOT RUN section).	1) See above.
Excessive current draw and/or low speed	1) Direct wiring shorts.	1) Locate and correct.
	2) Low field coil resistance.	2) Measure resistance w/ low resistance measuring ohmmeter. Resistance should be approximately 0.28 ohms.
	3) Dirty or glazed commutator.	3) Resurface commutator and replace brushes.
	4) Worn brushes.	4) Resurface commutator and replace brushes.
	5) Shorted commutator or rotor windings (indicated by a dark, discolored copper bar).	5) Check for burrs between comm bars and remove or replace rotor.
	6) Tight or defective bearings.	6) Replace bearings.
	7) Debris/wires impeding rotor rotation.	7) Remove debris or wires (replace wires if nicked).

Table 101. Trouble Shooting Chart (Continued)

PROBLEM	CAUSE	CORRECTION
Motor will not park or will not park consistently	1) Defective switch. 2) Damaged gear or cam. 3) Incorrect wiring.	1) Remove from circuit and check continuity through switch. Replace as necessary. 2) Replace damaged component. 3) Check for swapped "B" and "A" or "C" wires at connector and correct.

DISASSEMBLY

1. GENERAL

During the following procedures, refer to the item numbers assigned to IPL Figure 1. (Refer to testing and troubleshooting section before disassembling unit; disassemble only parts necessary to facilitate repair). See Testing and Troubleshooting to establish the condition of the unit to determine the extent of disassembly required. Remove only those parts necessary to accomplish the replacement.

2 SPECIAL TOOLS

The following special tools will be needed to perform the disassembly:

- Bearing Puller (Figure 901)

3. DISASSEMBLY PROCEDURES

During the following procedures, refer to item numbers assigned to IPL Figure 1. Refer to testing and troubleshooting section before disassembling unit; disassemble only parts necessary to facilitate repair.

NOTE: IPL Figure 1 presents an exploded view drawing of the motor assembly. The part numbers of all components and sub-assemblies are indicated on the Parts List which accompanies this illustration.

During disassembly procedures, be sure to mark all electrical wire leads that may have to be unsoldered, to ensure that they can be resoldered to their correct terminals during motor assembly.

A. Remove brush cover (220) and insulation (230) by removing lock wire and screws (240).

CAUTION: IF BRUSH COVER INSULATION (230) IS TORN OR OTHERWISE DAMAGED, IT SHOULD BE DISCARDED AND REPLACED.

B. Carefully remove brush and clip assemblies (320) from brush holder assemblies (300) by loosening screws (330).

C. Remove gear case (20, 20A) by removing lock wire and screws (100, 100A). Do not remove insulator (30) unless it is damaged or loose and needs replacement.

D. Remove retaining ring (70), slide cam assembly (40) off rotor shaft, and slide idler gears and washer (50, 60, 80 and 90) off of their posts.

E. Unsolder wire leads from parking switch (110). Remove parking switch by removing screws (120) and lock washers (130).

F. Remove end bell and idler shaft assembly (140) by removing tie bolts (150) and lock washers (160).

CAUTION: IF, FOR ANY REASON, BEARINGS MUST BE REMOVED, THEY SHOULD BE DISCARDED AND REPLACED.

NOTE: Do not disassemble gear or bearings from rotor unless damage of any component is evident (see Inspection/Check). These components are press-fitted and a suitable gear or bearing puller must be used for their removal.

G. Remove rotor assembly (200, 200A), with drive shaft gear (180), and ball bearings (190) as an assembly. Remove spring washer (210).

H. Working through holes in barrel assembly (245), unsolder wire leads from brush holder assembly (300) (See table 301 for wiring information).

J. Remove the brush holder end bell (250) from the barrel assembly (245).

K. Disassemble brush holder ring (270) and end bell assembly (260) by removing screws (280) and lock washers (290).

L. Remove brush holder assemblies (300) from brush holder ring (270) by removing four screws (310).

M. Unsolder wire leads from thermoprotector (340) and remove thermoprotector and snap ring (350).

N. Remove lock wire, four screws (490), two screws (370), and base (361).

P. Remove screw (400) by carefully lifting EMI filter capacitors (440, 440A) and connector (480) aside (as an assembly) to gain access to screw (400). Remove capacitors and connector. If necessary (see Inspection/Check), further disassembly is accomplished by unsoldering wire leads.

Q. Remove sub-base (362) from barrel assembly (245) by removing screw (380).

Table 301. Wiring Information

Model	18 Gauge Wire Color	From	To
-0095	Wht	Connector Pin A	Thermoprotector
	Wht	Connector Pin B	N/C SW (Terminal 1)
	Wht	Connector Pin C	Motor Brush (Near Thermoprotector)
	Wht	Motor Brush	N/C Sw (Terminal 2)
	Lug provides capacitor ground through base		
-0096	Wht	Connector Pin A	Thermoprotector
	Wht	Connector Pin B	N/C SW (Terminal 1)
	Wht	Connector Pin C	Motor Brush (Near Thermoprotector)
	Wht	Motor Brush	N/C Sw (Terminal 2)
-0097	Wht	Connector Pin A	N/O & N/C Sw (Pins 4 & 1)
	Wht	Connector Pin B	N/C SW (Terminal 1)
	Wht	Connector Pin C	Motor Brush (Near Thermoprotector)
	Wht	Motor Brush	N/C Sw (Terminal 2)
	Lug(ground)	Terminal 3	Tie Bolt

CLEANING

1. **MOTOR ASSEMBLY CLEANING** (Refer to IPL Figure 1).

   WARNING: CLEANING AGENTS ARE FLAMMABLE AND TOXIC. USE IN A WELL-VENTILATED AREA AWAY FROM FLAME AND HOT SURFACES. AVOID CONTACT WITH SKIN. DO NOT DIRECT AIR PRESSURE AGAINST SOLVENT IN CONTACT WITH SKIN. BREATHING FUMES MAY CAUSE INJURY.

   A. Wash all metal parts except the rotor assembly (200, 200A), brush and clip assemblies (320), and barrel assembly (245) with cleaning solvent. (Refer to Table 401 for cleaning materials.)

   B. Dry with compressed air or a clean, lint-free cloth.

   C. Rotor assembly (200, 200A), particularly the commutator, should be cleaned with a dry brush and compressed air. Commutator should be wiped clean to remove any film deposit.

Table 401. Cleaning Materials.

Cleaning solvent	Federal Specification P-S-661A
Cloth, lint-free	Commercially Available

NOTE: Equivalent substitutes may be used for above items.

INSPECTION/CHECK

1. INSPECTION

Minimum or maximum measurement limits which determine replacement requirements are provided in Fits and Clearances, Table 801. Perform a visual check of all parts. Pay particular attention to the condition of threads on all bolts and nuts. Check for nicks, burrs, dents and other deformities which may interfere with proper operation of the motor assembly. Visually examine all parts for obvious defects or excessive wear.

2. CHECK

A. Check brush holder ring (270) for cracks or chips and brush holder assemblies for deformities or damaged spring tensioners.

B. Check brushes for cracks, unusual wear pattern and contamination from grease or oil.

C. Check barrel assembly (245) for cracks and deformities, shorted or open field windings or evidence of overheating.

D. Check condition of rotor assembly (200, 200A) shaft and commutator segments, ball bearings (190) and brush holder assemblies (300).

E. Minimum or maximum measurement limits which determine replacement requirements are provided in Fits and Clearances, Table 801.

REPAIR

1. GENERAL

Extensive repair to any components is impractical due to the precise nature of the motor assembly. Repair is limited to replacement of parts determined defective during disassembly, inspection, and testing; resoldering loose wire connections; and reconditioning of motor rotor assembly commutator.

2. EQUIPMENT REQUIRED FOR REPAIR

- Commutator Resurfacer (vendor 30119, part 80-075)

3. RECONDITION MOTOR ROTOR ASSEMBLY COMMUTATOR

CAUTION: DO NOT USE ANY FORM OF EMERY PAPER OR CLOTH OR ANY FORM OF MATERIAL CONTAINING SILICON CARBIDE, ALUMINUM OXIDE, OR ANY OTHER CONDUCTIVE ABRASIVE ON THE COMMUTATOR.

NOTE: The following repair can be performed on the rotor assembly provided that no portion of the commutator diameter measures less than the minimum diameter limits listed in Table 801.

A. Remove glazed surface or recesses created by brushes by machining or refinishing with commutator resurfacer.

B. Wipe loose deposits from commutator using a dry bristle brush or lint-free cloth (See Table 401) and blow off with compressed air.

CAUTION: EXERCISE EXTREME CARE IN PERFORMING STEP C. DO NOT SCRATCH OR OTHERWISE MAR THE SURFACE OF THE COMMUTATOR.

C. Use a mica undercutter to clean out carbon deposits and other foreign particles from the commutator slots. Undercut .51 mm wide by 1.27 mm to 1.52 mm deep.

D. Wipe all dust and particles from the rotor assembly with a dry soft bristle brush or lint-free cloth.

NOTE: Following repair or replacement of parts, the motor should be retested in accordance with the testing and troubleshooting section.

ASSEMBLY

1. GENERAL

Refer to Table 701 for assembly materials.

2. SPECIAL TOOLS AND MATERIALS REQUIRED FOR ASSEMBLY

No special equipment is required to perform the assembly procedures.

3. PROCEDURES

During the following procedures, refer to item numbers assigned to IPL Figure 1. The part numbers of all components or sub-assemblies are indicated on the parts list which accompanies each illustration.

A. General Assembly

NOTE: Base (361) and sub-assembly (362) are matched parts. If either part has to be replaced, see Illustrated Parts List.

(1) Assemble sub-base (362) to barrel assembly (245) using screws (380) and lock washer (390).

(2) Install screw (400) in sub-base barrel assembly and stake screw in two places (180° apart).

(3) Install connector (480) on base using two screws (490).

(4) Assemble brush holder assemblies (300) to brush holder ring (270) using four screws (310) and apply Glyptol (item 7, Table 701) to heads of screws.

(5) Assemble brush holder ring (270) to end bell assembly (260) using two screws (280) and two lock washers (290).

(6) Align small locating pin, on end of barrel assembly (245), with mating hole in end bell assembly (260) and carefully push end bell assembly into barrel assembly until end bell is fully seated.

(7) Solder wire leads to brush holder assemblies (300) as shown in Motor Wiring Diagram Figure 701.

(8) Solder wire "A" and coil wire to Thermoprotector, insert this assembly into mating opening in barrel assembly (245).

(9) Arrange all electrical wiring snugly against inside of barrel assembly (245), allowing maximum clearance for rotor assembly (200, 200A).

(10) Assemble and solder capacitors and wires into sub-base assembly and connector as shown in figures 701 and 702.

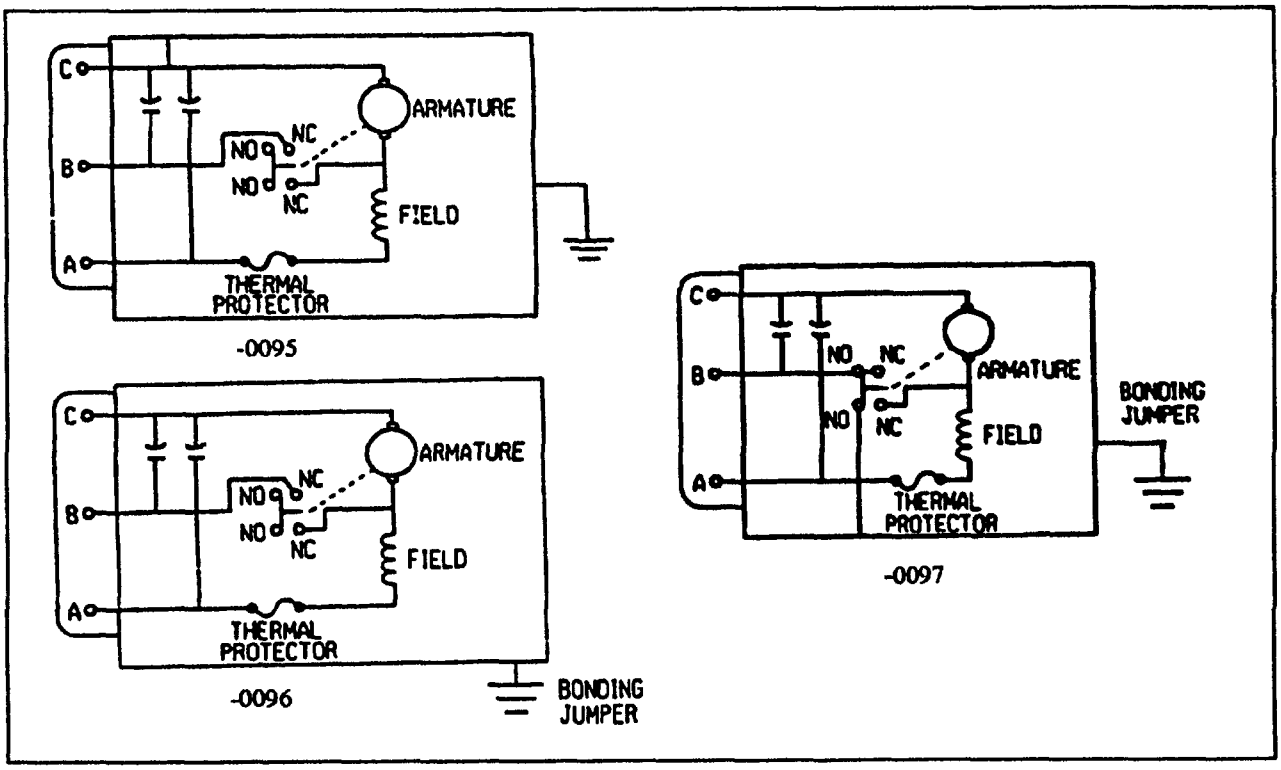


Figure 701. Motor Wiring Diagram

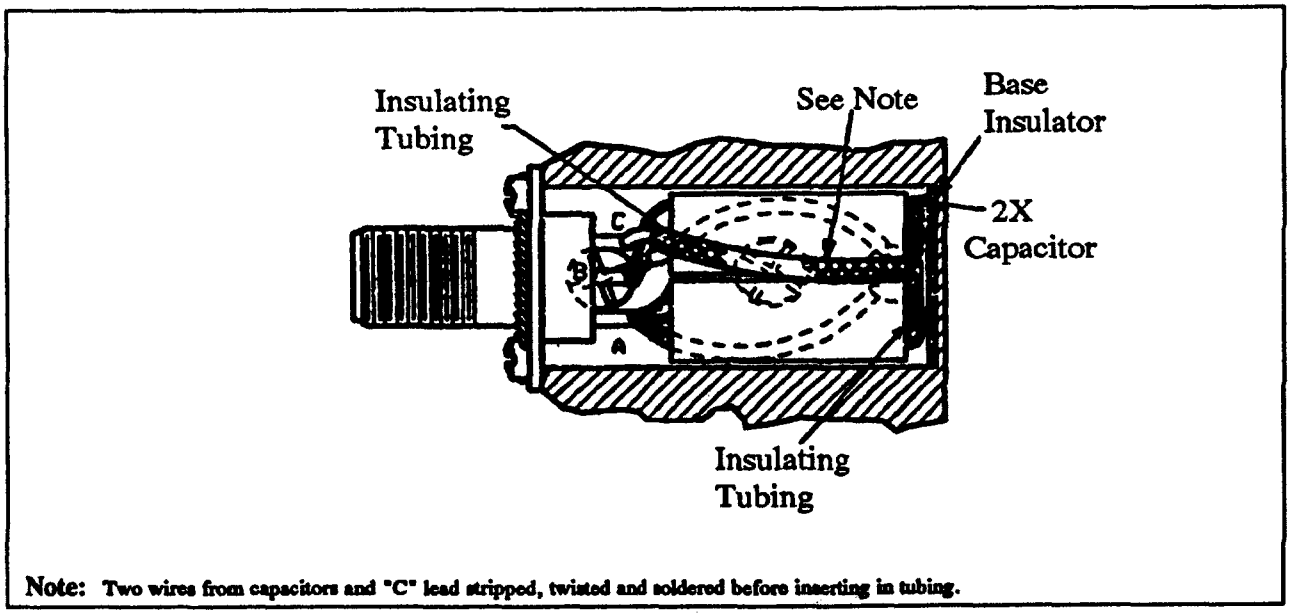


Figure 702. Connector Wiring Diagram

Table 701. Assembly Materials

ITEM	NOMENCLATURE	IDENTIFICATION	SOURCE
1	Solvent, Cleaning	Trichlorethane	34897
2	Solder, 60/40	QQ-S-571	70279
3	Paint, Flat Black	590-B-027	72225
4	Thinner, Lacquer	MIL-T-19544	72225
5	Glyptol	1201	59319
6	Wipe, Lint Free	05313	78112
7	Grease	MIL-G-81322D	54527
8	Sealant, Permatex	1372	62337
9	Tape, Protective	Masking	61139

(11) Insert paper insulator (430) between capacitors and back of the sub-base assembly, assemble base (361) using screws (370), stake screws into position(two places for each, 180° apart), and install two additional connector screws (490).

(12) If bearings (190) or drive shaft gear (180) were removed, press-fit bearings and drive shaft gear on rotor assembly (200, 200A) drive shaft using bearing installation tool (Figure 902).

(13) Position spring washer (210) (raised tangs facing rotor assembly) inside end bell assembly (250).

(14) Insert rotor assembly (200, 200A), with bearings and drive shaft gear, into barrel assembly (245) until its leading bearing is fully inserted into brush end bell assembly (250) and is seated on spring washer (210).

(15) Align small locating pin located on end of barrel assembly (245) with mating hole in back side of end bell idler shaft assembly (140), put electrical wiring (for parking switch) through holes in end bell and push end bell into barrel assembly (245).

(16) Secure idler shaft assembly (140) and brush end bell assembly (250) to barrel assembly using bolts (150) and lock washers (160).

(17) Assemble brush wire clip (320) on brush holder screw, tighten brush holder screw, lift the spring arm and install the brush clip (brush curvature must match curvature of rotor).

(18) Operate the motor at normal speed (27-30 VDC), holding the brushes tightly against commutator for about 15-20 seconds. Remove the brushes and check the brushes for chipping and minimum surface contact (shininess) of 90%.

(19) Run-in motor for approximately 1 hour at 10-12 VDC across pins "A" and "C".

(20) Assemble parking switch (110) to end bell idler shaft assembly (140) using screws (120) and lock washers (130).

(21) Solder wire leads, if applicable, to parking switch (110) as shown in Figure 701.

(22) Slide washer (90) over the idler shaft closest to the rotor.

(23) Lubricate idler shafts and rotor shaft with grease (item 7, Table 701), install idler gear (80) over first shaft, and install gear (60) over the second shaft.

(24) Install cam (40) on rotor shaft, lift cam slightly, and install gear (50).

(25) With all gears seated on the shafts and meshed properly with each other and rotor gear, install retaining ring (70) on first shaft.

(26) If insulator (30) was removed because of damage, install new insulator inside gear case assembly (20, 20A).

(27) Secure gear case (20, 20A) to idler shaft assembly (140) using bolts (100, 100A) and lockwire.

(28) Install brush cover insulation (230) on barrel assembly (245), working it carefully around thermoprotector (340), and install snap ring (350) around thermoprotector.

(29) Install brush cover (220) and secure using two screws (240) and lockwire.

3. PAINTING

A. Use masking tape (item 9, Table 701) to mask rotor shaft ends, electrical connector and nameplate if installed.

B. Using a clean, lint free cloth (see Table 401) wipe all unmasked surfaces with lacquer thinner.

C. Paint with flat black paint (item 3, Table 701) and allow to air dry.

4. STORAGE

Store in a dry dust-free area, preferably in original shipping container designed for shipment of spare assemblies. Shelf life is for indefinite period.

FITS AND CLEARANCES

1. General

Refer to the motor assembly table of limits (Table 801) to determine maximum and minimum inspection limits for fits and clearances.

Table 801. Motor Assembly Table of Limits

ITEM	INSPECTION	MAX.	MIN.	REMEDY
(Item numbers refer to IPL Figure 1 of Illustrated Parts List)				
Bearing Housing	Measure bearing housing.	0.8669"	0.8661"	Replace if housing measures more than indicated.
Shaft Diameter	Measure for minimum shaft diameter.	—	0.2754"	Replace if diameter measures less than indicated.
Bearings (190)	Bearings should be free running.	—	—	Replace if there is any doubt of condition.
Commutator	Make sure surfaces are smooth and clean (Rough commutator surface will cause excessive brush wear). Then, measure commutator diameter.	—	0.850"	Replace if diameter measures less than indicated.
Rotor and Stator	Check windings for broken leads and frayed insulation.	—	—	Repair if practical.
Brushes (320)	Measure brush length across back of brush.	—	5/32"	Replace both brushes if either brush is worn beyond dimension indicated.
Brush Springs (300)	Measure compression pressure of springs at new brush length.	0.650 lbs. at contact point	0.350	Replace if spring pressure is incorrect.

SPECIAL TOOLS, FIXTURES, AND EQUIPMENT

Table 901. Equipment List

Item	Description	Mfg.	Model	Range
1	Ammeter	Simpson	1227	0 - 5 Amps
2	Stopwatch	Minerva	140L	0 - 5 min.
3	Power Supply	Lambda	LPD422A-FM	0 to 40 VDC
4	Megohmmeter	Beckman	L10A	
5	Bearing Puller	Local		
6	Commutator Resurfacer	Ideal Industries Inc.	80-075	

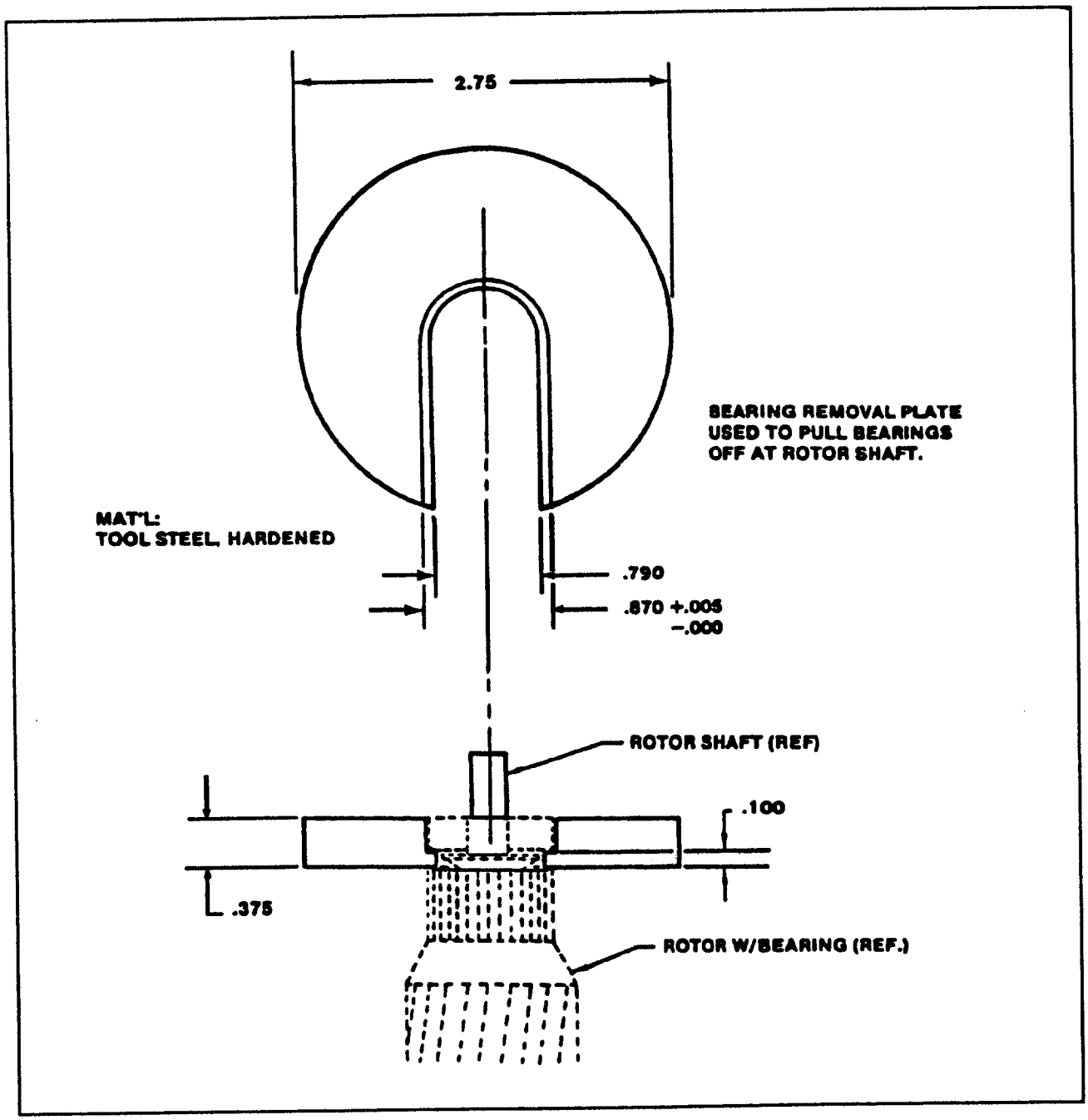


Figure 901. Motor Bearing Removal Tool

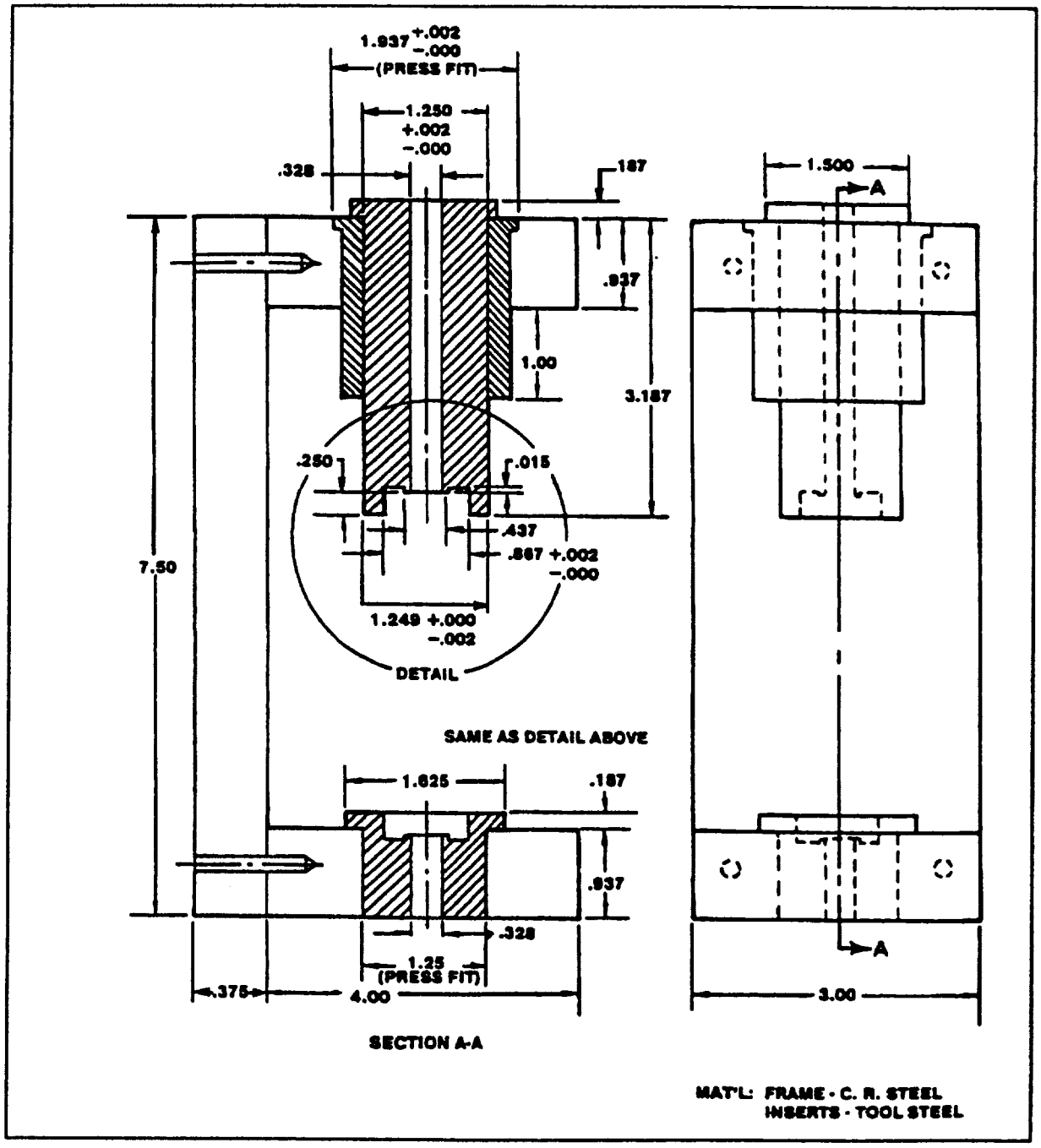


Figure 902. Motor Bearing Pressing Fixture

ILLUSTRATED PARTS LIST

1. INTRODUCTION

A. Purpose

Replacement parts and complete assemblies for additional installation may be ordered by means of the replacement parts list and exploded view drawings of the complete assembly and component parts.

B. How to Use

(1) Assembly Order Indenture System

The indenture system used in the parts list shows the relationship of one part to another. For a given item, the number of indentures depicts the relationship of the item to the associated next higher assembly as follows:

1 2 3
Assembly
• Detail Parts for Assembly
• Subassembly
• • Detail Parts for Subassembly
• • Subassembly

NOTE: The manufacture of aircraft wiper systems and components performed by ALCO Controls Division of St. Louis, MO (vendor code 70255) has been transferred to Rosemount Inc., Burnsville, MN. ALCO Controls Division part numbers are shown in parenthesis ( ) to cross reference existing units/parts when ordering replacement parts/units.

(2) Quantity Per Assembly

The UNITS PER ASSY column shows the total number of units required per assembly, per subassembly, etc., as applicable. The letters RF indicate the item is listed for reference purposes.

(3) Effectivity Code

The EFF CODE column designates which parts are contained in each of the various motor assembly models. All parts in a figure with the same effectivity code must be used together to ensure part compatibility.

(4) Vendor Numbers

V21452	Highland Electric P Los Angles, CA	V3U476	Honeywell Inc. Microswitch Division 1 Hickory Drive P.O. Box 460 Mars Hill, NC 28754
V21452	Highland Electric Los Angles, CA	V77535	Associated Spring 226 South Center Street Corry, PA 16407
V31335	Torrington Co. Fafnir Bearing Division 59 Field Street Torrington, CT 06790	V79963	Zierick Mfg. Co. Radio Cir. Mount Krisco, NY 10549
V34669	Alliance Plastics Inc 3123 Station Road Erie, PA 16510-3045	V82647	Texas Instruments Inc. Control Products Div. 34 Forest Street Attleboro, MA 02703-2454

C. Procurement

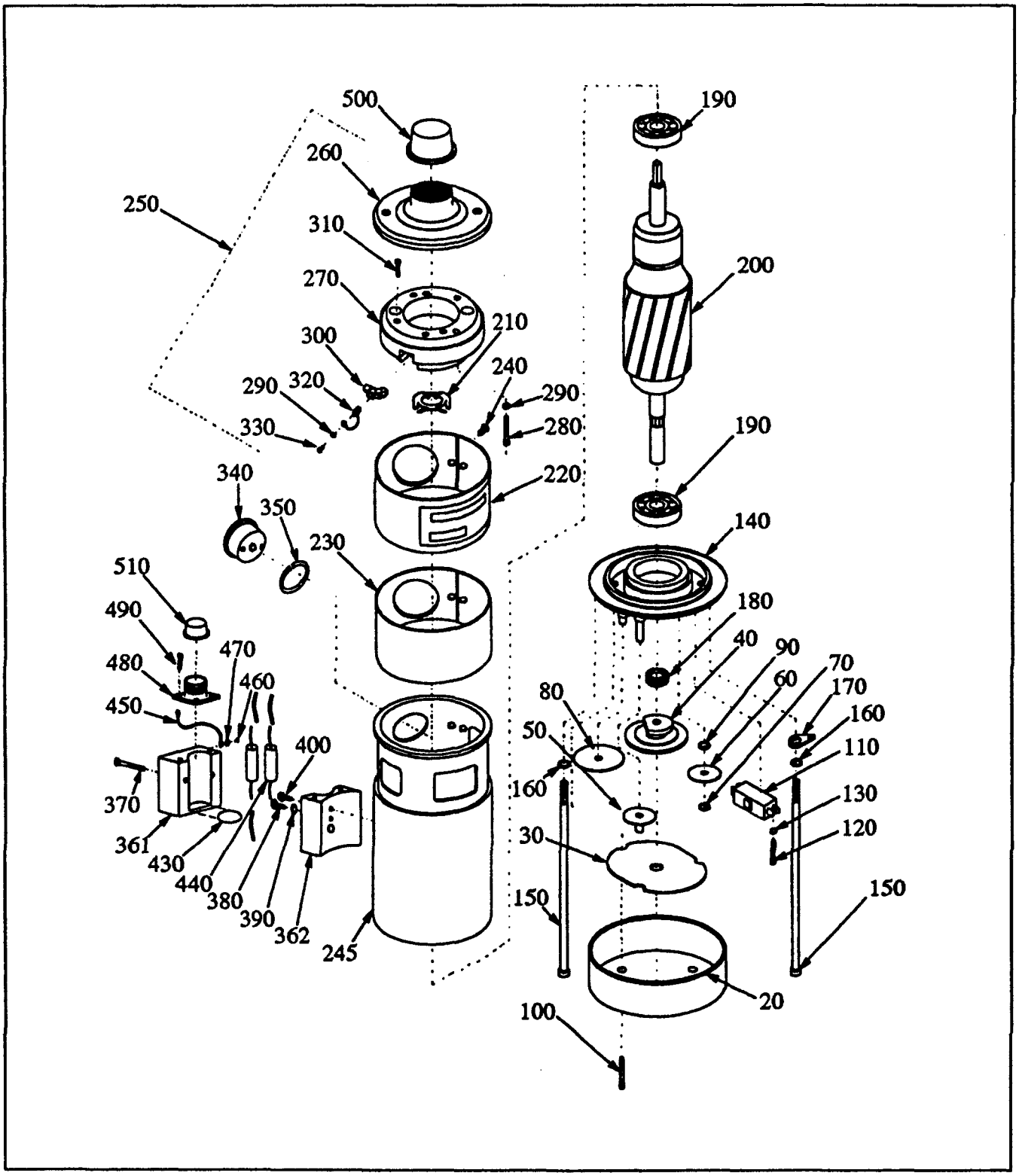
All parts, including vendor parts, can be procured from:

V59885	Rosemount Inc. Aerospace Division 14300 Judicial Road Burnsville, MN 55306-4898

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IPL Figure 1. Exploded View of Motor Assembly

FIG ITEM	PART NUMBER	AIRLINE PART NO.	NOMENCLATURE 1234567	EFF. CODE	UNITS PER ASSY
1-					
1	2311M95-1		MOTOR ASSEMBLY (V59885: 02311-0095-0001) (V70255: XW21160-2)	A	RF
-1A	2311M95-2		MOTOR ASSEMBLY (V59885: 02311-0095-0002) (V70255: XW21160-1)	B	RF
-1B	2311M96-1		MOTOR ASSEMBLY (V59885: 02311-0096-0001) (V70255: XW21160-G1)	C	RF
-1C	2311M96-2		MOTOR ASSEMBLY (V59885: 02311-0096-0002) (V70255: XW21160-G2)	D	RF
-1D	2311M97-1		MOTOR ASSEMBLY (V59885: 02311-0097-0001) (V70255: XW21160-M1)	E	RF
-1E	2311M97-2		MOTOR ASSEMBLY (V59885: 02311-0097-0002) (V70255: XW21160-M2)	F	RF
-1F	2311M97-3		MOTOR ASSEMBLY (V59885: 02311-0097-0003) (V70255: XW21160-M2B)	G	RF
20	02311-0038-0001		• GEAR CASE (V70255: W-20132)	A,D,F, G	1
-20A	02311-0057-0001		• GEAR CASE (V70255: W-20195-3)	B,C,E	1
30	02311-0063-0001		• INSULATOR SPSD by Item 30A (V70255: W-20388)		1
-30A	02311-0297-0001		• INSULATOR SPSDS Item 30		1
40	02311-0031-0001		• CAM ASSEMBLY (V70255: XW-20119)		1
50	02311-0035-0005		• IDLER GEAR ASSY (V70255: XW-20128-5)		1
60	02311-0035-0004		• IDLER GEAR ASSY (V70255: XW-20128-4)		1
70	02311-0027-0001		• RETAINING RING (V70255: W-20048-12)		1
80	02311-0035-0003		• IDLER GEAR ASSY (V70255: XW-20128-3)		1
90	C20885-0002		• WASHER .312OD, .125ID, .040THK (V70255: W-20166-2)		1
100	MS35266-67		• SCREW, FILH 190-32x1	A,D,F, G	3
-100A	AN501A10-18		• SCREW, FLHM 190-32x1.125	B,C,E	3

- Items not illustrated.

FIG ITEM	PART NUMBER	AIRLINE PART NO.	NOMENCLATURE 1234567	EFF. CODE	UNITS PER ASSY
1-					
110	1TB1-2		• SWITCH, PARKING (V3U476) (V59885: C20869-0002) (V70255: PS1264-2)		1
			ATTACHING PARTS		
120	AN500-3-10		• SCREW, FLHM 099-48X.625		2
130	AN936A3		• LOCK WASHER, NO.3 STEEL		2
			—*—		
140	02311-0094-0001		• END BELL AND IDLER SHAFT ASSEMBLY (V70255: XW21158-1)		1
			ATTACHING PARTS		
150	02311-0009-0001		• TIE BOLT (V70255: W17379)		2
160	AN936A3		• LOCK WASHER NO. 3, STEEL (V70255: AN935-6)		2
170	803-169		• TERMINAL (V79963) (V59885: C20944-0003) (V70255: AN935-6)	A,B,E F,G	1
			—*—		
180	02311-0039-0001		• GEAR, DRIVE SHAFT (V70255: W-20136)		1
190	P37KDD-FA-31155		• BALL BEARING (V21335) (V59885: C20862-0005) (V70255: PS1219-5)		2
200	02311-0010-0001		• ROTOR ASSEMBLY (V70255: XW17380-3)	A,C,E, G	1
-200A	02311-0010-0002		• ROTOR ASSEMBLY (V70255: XW17380-4)	B,D,F	1
210	FO846-006		• WASHER, SPRING (V77535) (V59885: C20880-0002) (V70255: PS1286-3)		1
220	02311-0002-0002		• BRUSH COVER (V70255: W17364-1)		1
230	02311-0212-0001		• INSULATION, BRUSH COVER (V70255: W17387)		1
			ATTACHING PARTS		
240	MS35266-11		• SCREW 4-48x.12		2
			—*—		
245	02311-0052-0001		• BARREL ASSEMBLY (V70255: XW20175)		1
250	02311-0080-0001		• BRUSH END BELL ASSEMBLY (V70255: XW20975-1)		1
260	02311-0047-0001		• • END BELL ASSEMBLY (V70255: XW20145-3)		1

- Items not illustrated.

FIG ITEM	PART NUMBER	AIRLINE PART NO.	NOMENCLATURE 1234567	EFF. CODE	UNITS PER ASSY
1-					
270	02311-0015-0001		• • BRUSH HOLDER RING (V70255: W17392-2)		1
			ATTACHING PARTS		
280	MS35266-15		• • SCREW 112-48 X 0.38		2
290	MS35338-40		• • LOCK WASHER .115 ID, .209 OD (V70255: C10293-0002-0001)		2
			—*—		
300	02311-0012-0001		• • BRUSH HOLDER ASSEMBLY (V70255: XW17386)		2
			ATTACHING PARTS		
310	AN500-2-4		• • SCREW 086-56, UNC-2A, 1/4		4
			—*—		
320	02311-0017-0001		• • BRUSH AND CLIP ASSEMBLY (V70255: XW20020)		2
			ATTACHING PARTS		
330	AN500-2-4		• • SCREW		4
			—*—		
340	MKA-7		• THERMOPROTECTOR (V82647) (V59885: C20867-0001) (V70255: PS1239)		1
350	02311-0001-0001		• SNAP RING (V70255: W2101)		1
			—*—		
-360	02311-0044-0001		• BASE ASSEMBLY SPSD BY ITEM 360A		1
-360A	02311-0285-0001		• BASE ASSEMBLY (V70255: XW20142) SPSDS ITEM 360		1
361	REF		• • BASE NONPROCURABLE ITEM - ORDER NHA		1
362	REF		• • SUB-BASE NONPROCURABLE ITEM - ORDER NHA		1
			ATTACHING PARTS		
370	MS24693-S53		• • SCREW 8-32 x 7/8		2
380	MS35206-242		• • SCREW 8-32 x .312		1
390	1208-00		• • LOCK WASHER (V78189) (V59885: C20843-0001) (V70255: PS198)	C,D,E, F,G	1
400	MS24693-S47		• • SCREW FTH, 8-32 x 5/26		1
			—*—		
430	02311-0064-0001		• INSULATOR (V70255: W20399)	C,D,E, FG	1

- Items not illustrated.

FIG ITEM	PART NUMBER	AIRLINE PART NO.	NOMENCLATURE 1234567	EFF. CODE	UNITS PER ASSY
1-					
440	17E3C5040		• CAPACITOR (V21452) (V59885: C20832-0504-3400) (V70255: PS1101-7)	A,B	2
-440A	17E1C5040		• CAPACITOR (V21452) (V59885: C20832-0504-1400) (V70255: PS1101-8)	C,D,E, F,G	2
450	MS25083-2AB4		• JUMPER, BONDING	C,E,F	1
-450A	MS25083-2AB8		• JUMPER, BONDING	D,G	1
			ATTACHING PARTS		
460	MS35265-26		• SCREW 6-32 x .25, CAST/CAD	C,D,E, F,G	1
470	MS35333-37		• WASHER, TOOTH .141ID, .295OD, .021 THK, CAST/CAD	C,D,E, F,G	1
			—*—		
480	MS3102A10SL-3P		• CONNECTOR		1
			ATTACHING PARTS		
490	MS35265-13		• SCREW 4-40 x 0.25		4
			—*—		
⊠500	E-5/8		• COVER (V34669) (V59885: C20962-0038) (V70255: PS1163-38)		1
⊠510	27		• COVER (V34669) (V59885: C20962-0012) (V70255: PS1163-129)		1
⊠510	27		• COVER (V34669) (V59885: C20962-0012) (V70255: PS1163-129)	A,B,F G	1

- Items not illustrated.
⊠ For shipping and storage use only.

Lucas Western

Power Transmission

Publication No. 1532U-23-865B
Revision I
October 1993

OVERHAUL MANUAL WITH ILLUSTRATED PARTS LIST

DEICER DISTRIBUTING VALVE

PART NO.
1532-2A
1532-3A
1532-3B
1532-3C
1532-6A
1532-6C

FOR REFERENCE ONLY
RECEIPT OF THIS MANUAL DOES NOT IMPLY AUTHORIZATION OR APPROVAL BY LUCAS WESTERN, INC. POWER TRANSMISSION FOR ANY REWORK OR OVERHAUL OF THE SUBJECT UNIT

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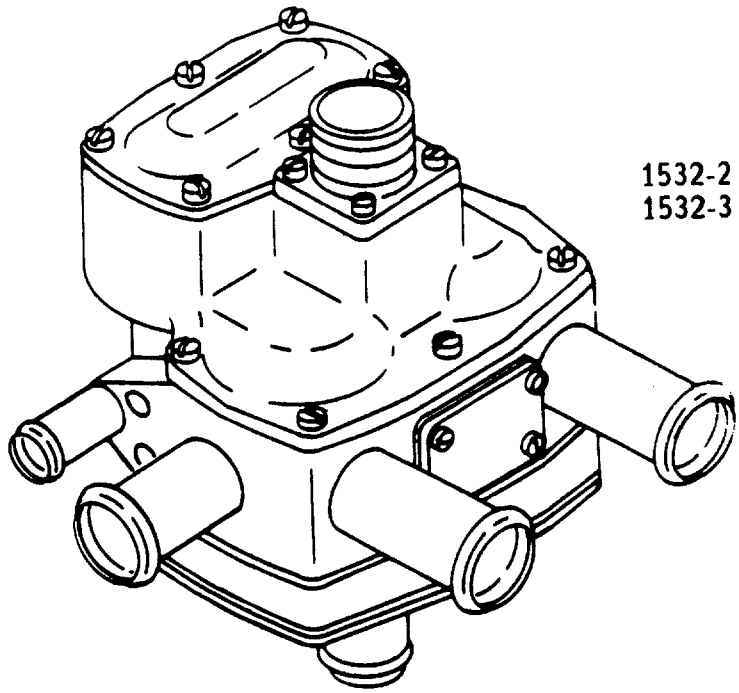
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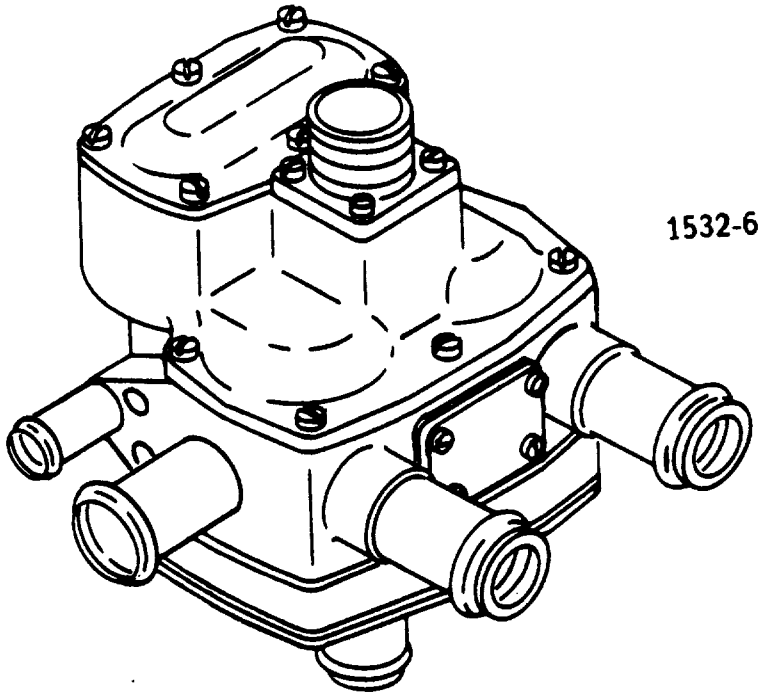


Figure 1. Deicer Distributing Valve

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1.0 DESCRIPTION AND OPERATION

This manual contains descriptive information, overhaul and test instructions, and an illustrated parts list for Deicer Distributing Valve, P/N's 1532-2A, 1532-3A, 1532-3B, 1532-3C, 1532-6A and 1532-6C manufactured by Lucas Western Inc., Power Transmission (LWIPT), Utica, New York 13503.

The deicer distributing valve (Figure 1) is a component of the aircraft deicer system.

The deicer distributing valve contains a pressure inlet port, a vacuum port, two ports (A and B) which connect to the associated deicer boots, and an exhaust port which is piped overboard to a low pressure area.

The pressure inlet port is integral with the aircraft manifold pressure line, thereby making pressure available at all times. Ports A and B are connected, through lines, to the deicer boots which provide the suction and pressure connections to operate the deicer boots. The exhaust port which is piped overboard to a low pressure area, serves to discharge the pressurized air in the deicer boots.

The deicer distributing valve normally has vacuum applied to it at all times. This suction within the deicer distributing valve holds down the deicer boots when the deicer system is not energized.

2.0 DISASSEMBLY

A. Remove tie wire, screws (6, Figure 7), and terminal lug (7), and carefully lift out receptacle connector (5). Unsolder wires.

B. Remove screws (9), solenoid retainer (8), and head gasket (10). Discard gasket (10).

C. Carefully pull wires from connector cavity down and through opening in valve head (14) for the solenoid and contact and lead assembly.

D. Remove tie wire. Remove screws (2 and 4), washers (3), and valve head assembly (1).

E. Remove plunger and pin assemblies (12) and solenoid coil assemblies (13) from valve head (14).

F. Carefully remove control valves (32) and control valve springs (33) from valve housing (38 or 39).

G. Remove tie wire. Remove screws (16), washers (17), and exhaust valve cover assembly (15).

H. Remove flapper valve cover gasket (18), poppet valve assemblies (20), and valve springs (19) from exhaust valve housing (21). Remove exhaust valve housing (21) and exhaust port housing gasket (22) from valve housing (38 or 39). Discard gaskets (18 and 22) and poppet valve assemblies (20).

I. To remove diaphragm assembly (26), remove self-locking nuts (27) on top side of diaphragm assembly (26).

J. Remove diaphragm washers (29), diaphragm (30), and diaphragm springs (31).

K. Invert valve housing (38 or 39) and remove self-locking nuts (23), valve washers (24), valve seals (25), and remaining valve washers (24) from valve stems (28). Record number of valve washers (24) removed. Remove valve stems (28) from valve housing (38 or 39). Discard valve seals (25), diaphragm (30), and self-locking nuts (23 and 27).

L. Remove tie wire, screws (35), washers (36), identification plate (34), and gasket (37). Discard gasket (37).

3.0 CLEANING

WARNING

USE CLEANING SOLVENT ONLY IN A WELL-VENTILATED AREA

Clean all arts, except solenoid coil assemblies (13, figure 7), with Esso Varsol (manufactured by the Humble Oil and Refining Co., Pelham, New York), or equivalent. Solenoid coil assemblies should be wiped with a clean cloth dampened with cleaning solvent. Dry parts using dry filtered air at a pressure of 25 to 30 psig.

4.0 INSPECTION/CHECK

A. Inspect and discard all parts that are cracked, broken, and have non-cleanable corrosion.

B. Inspect threaded parts for stripped and crossed threads.

C. Inspect valve housing (38 or 39, figure 7) for loose plugs. Check condition of valve seats.

D. Inspect leads of solenoid coil assemblies (13) for burned, charred, cracked, or frayed insulation.

E. Using ohmmeter, check resistance between lead and outer case of each solenoid coil assembly. The resistance should be 17.6 ohms ± 5%.

F. Inspect receptacle connector (5) for loose, bent, or broken pins, and for cracked, chipped, or burned inserts.

G. Inspect contact and lead assembly (11) for broken strands of wire and poor solder connection between lead and contact.

H. Inspect valve washers (24) for being grooved.

I. Check spring lengths and compression requirements as shown in Table 1.

J. Inspect control valves (32) for being scored and replace if scored.

5.0 REPAIR AND REPLACEMENT

A. Standard overhaul replacement parts kit for each model are as follows:

Unit	Kit
1532-2A	SK262
1532-3A	SK263
1532-3B	SK264
1532-3C	SK261
1532-6A	SK261
1532-6C	SK261

B. Replace any damaged parts in addition to the standard replacement parts as required.

C. Replace control valves (32, Figure 7) if excessive clearance in valve bushings is due to worn valve surface. If excessive clearance is due to worn valve bushings, replace valve housing (38 or 39). Permissible worn clearance is 0.0010 inch maximum.

6.0 ASSEMBLY

A. Apply EC1357 cement on both sides of diaphragm (30, figure 7) in small area around stem holes. (See Figure 2).

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TABLE 1. SPRING DATA

Spring	Compressed length	Compression load
Valve spring (19, Figure 7)	0.308 inch	14 to 16 ounces
Diaphragm spring (31, Figure 7)	0.406 inch	10 to 14 ounces
Control valve spring (33, Figure 7)	0.500 inch	5.5 to 6.5 ounces

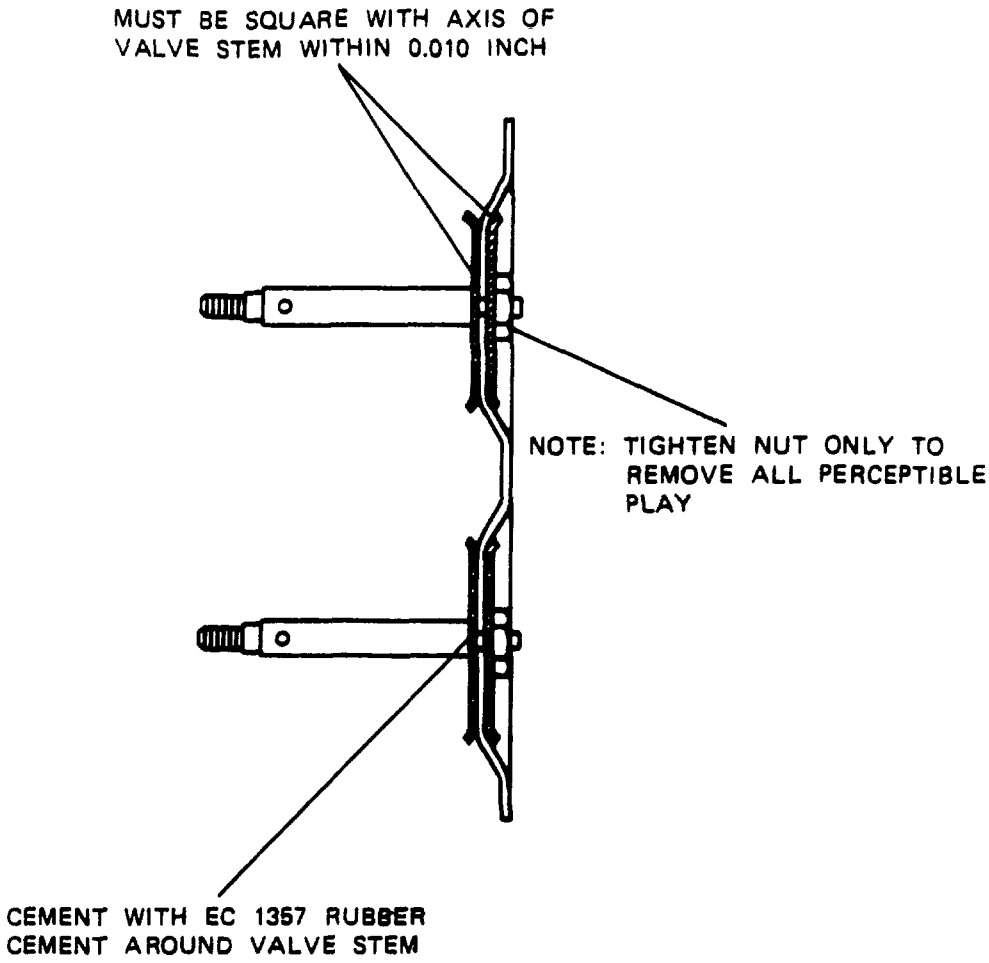


Figure 2. Diaphragm Assembly

B. Position diaphragm washers (29, figure 7) and valve stem (28) onto diaphragm (30) and loosely assemble new self-locking nuts (27). (See Figure 2).

C. Position diaphragm assembly (26, Figure 7) in fixture U6926, making sure it fits smoothly.

D. Assemble fixture cover U6925 in position on diaphragm assembly (26) and tighten with slave screws (2).

E. Locate a 1/16-inch drill rod 6 inches long into stem holes through fixtures tighten self-locking nuts (27).

NOTE:

DO NOT OVERTIGHTEN SELF-LOCKING NUTS TO AVOID CAUSING DISTORTION IN DIAPHRAGM.

F. Remove slave screws (2) and remove diaphragm assembly (26) from holding fixtures.

G. Install solenoid coil assemblies (13) and contact and lead assembly (11) into valve head (14). Carefully thread wires through opening in valve head (14) into cavity of receptacle connector (5). Place plunger and pin assemblies (12) into solenoid coil assemblies (13).

H. Place diaphragm springs (31) on protruding end of valve stems (28) and position diaphragm assembly (26) on valve housing (38 or 39).

NOTE:

WHEN ASSEMBLIED INTO VALVE HOUSING (38 OR 39), DIAPHRAGM ASSEMBLY (26) MUST OPERATE FREELY.

I. Install control valve springs (33) and control valves (32) in valve housing (38 or 39). Ensure small land ends of control valves (32) are assembled next to control valve springs (33).

J. Secure new head gasket (10) and solenoid retainer (8) using five screws (9). Torque screws (9) between 8 and 10 pound-inches.

K. Solder leads from solenoid coil assemblies (13) and contact and lead assembly (11) to receptacle connector (5) with Eclipsaloy No. 9, Grade 5 or 15 solder. (See Figure 3).

NOTE:

DO NOT KINK LEADS WHILE PUSHING RECEPTACLE CONNECTOR (5, FIGURE 7) INTO VALVE HEAD (14).

L. Secure receptacle connector (5) and terminal lug (7) to valve head (14) with screws (6). Torque screws (6) between 4 and 5 pound-inches. Install tie wire.

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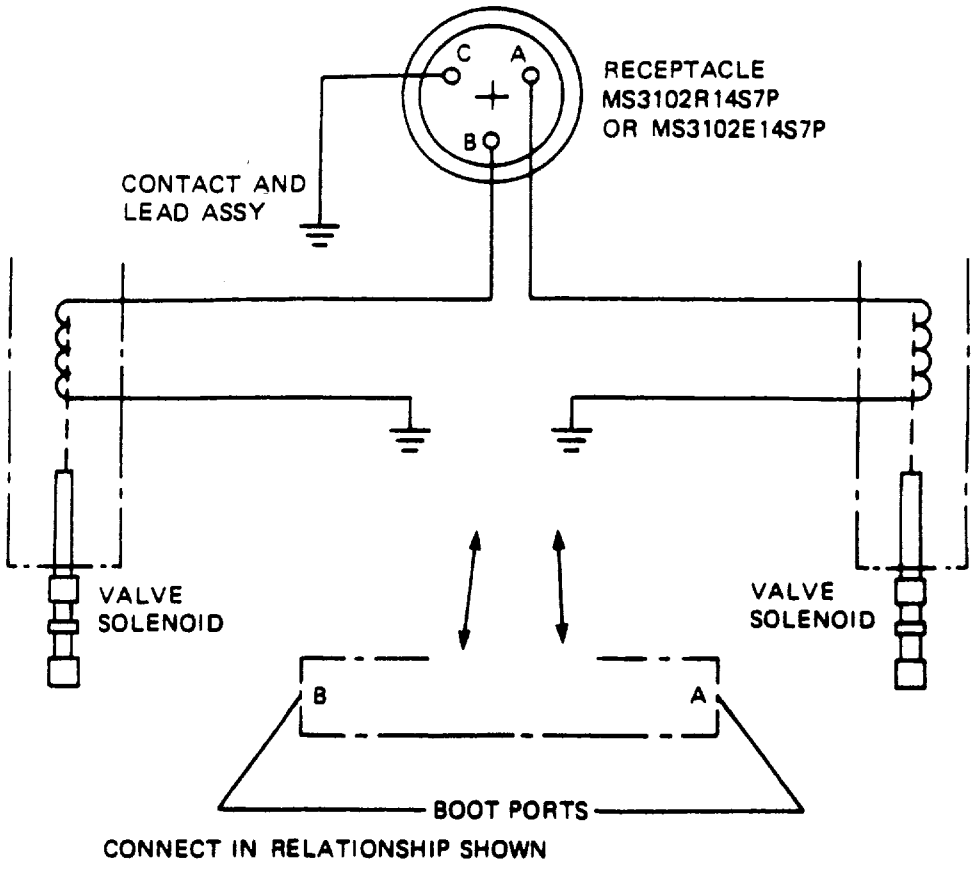


Figure 3. Wiring Diagram

M. Install valve washer (24), new valve seal (25), valve washer (24), and new self-locking nut (23) on each valve stem (28). Tighten self-locking nuts (23) to secure valve seals (25) onto seats of valve housing (38 or 39).

NOTE:

INSTALL SAME NUMBER OF INNER VALVE WASHERS (24) AS NOTED AT DISASSEMBLY.

N. Before continuing with assembly of the deicer distributing valve, it is necessary to adjust self-locking nuts (23) as follows:

1. Plug boot ports A and B.
2. Apply 2 psig air pressure to pressure port and energize each solenoid several times. (See Figure 4).
3. Adjust self-locking nuts (23, Figure 7) to obtain minimum air leakage past valves.

NOTE:

CARE MUST BE USED WHEN TIGHTENING NUTS SINCE OVERTIGHTENING OR UNDERTIGHTENING WILL CAUSE LEAKAGE PAST VALVES.

4. Re-energize both valves several more times and recheck leakage for proper sealing of valves with an air flowmeter for total leakage.
5. Leakage, as determined by flowmeter located in pressure supply line, represents total of internal as well as external leakage, and must not exceed 3 cubic feet per hour.
6. Repeat steps (2) through (5) with 8 psig air pressure applied.

O. Install new exhaust port housing gasket (22) and exhaust valve housing (21) on valve housing (38 or 39). Install new poppet valve assemblies (20) and valve springs (19) in exhaust valve cover assembly (15). Install flapper valve cover gasket (18) and exhaust valve cover assembly (15) on exhaust valve housing (21) and secure with washers (17) and screws (16). Torque screws (16) between 13 and 15 pound-inches. Install tie wire.

P. Secure valve head assembly (1) to valve housing (38 or 39) with screws (2), washers (3), and screw (4). Torque screws (2 and 4) between 13 and 15 pound-inches. Install tie wire.

Q. Secure name plate gasket (37) and identification plate (34) to valve housing (38 or 39) with washers (36) and screws (35). Torque screws (35) between 4 and 5 pound-inches. Install tie wire.

7.0 FITS AND CLEARANCES

Fit and clearance information appears in the applicable portion of paragraph 6.

8.0 TESTING

If performance test stand 53E19-35A is not available, test the deicer distributing valve as follows:

A. Operational Tests

1. Connect deicer distributing valve to test setup shown in Figure 5.

2. Apply vacuum to 4 inches of mercury to suction port, leaving pressure port open. Leakage rate, as indicated by the flowmeter, must not exceed 3 cubic feet per hours.

3. Connect pressure port and set pressure at 8 psig and vacuum at 6 inches of mercury.

4. Leakage, as indicated by flowmeter in vacuum line, must not exceed 5 cubic feet per hour. (Compound gages connected to A and B ports should read same as vacuum line manometer).

5. Repeat steps 3 and 4 with solenoid A energized with 20 Vdc and solenoid B deenergized. Leakage must not exceed 20 cubic feet per hour. (A port compound gage should read inlet pressure and B port compound gage should read vacuum inlet pressure).

6. Repeat step 5 (inflate condition) with solenoid A deenergized and solenoid B energized with 20 Vdc.

7. Readings on A and B port compound gages should be reversed from those in step 5.

8. Leakage must not exceed 20 cubic feet per hour.

9. With 8 psig pressure and 4 inches vacuum applied, energize each solenoid separately several times with 20 Vdc.

10. Valve action must be immediate and complete.

1 - FLOWMETER 0-15 CFH
2 - GLOBE VALVE - 1/4 PIPE
3 - PRESS. REDUCING VALVE - 1/4 PIPE 0 TO 15 PSIG
4 - ACCUMULATOR TANK - 1 TO 3 GAL. (PRESSURE)
5 - PRESSURE GAGE 0-30 PSI

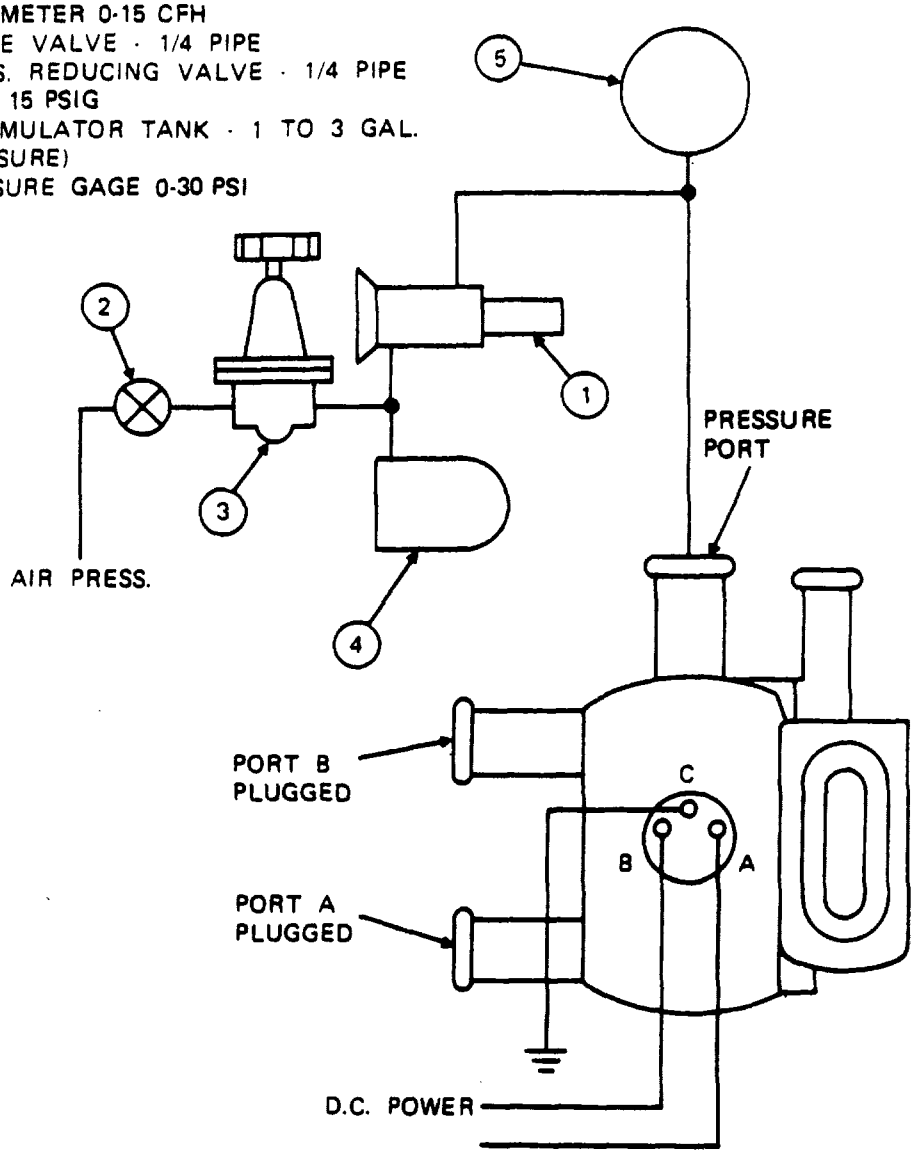


Figure 4. Test Setup

1 · GLOBE VALVE · 1/4 PIPE
2 · NEEDLE VALVE · 1/4 PIPE
3 · ACCUMULATOR TANK · 1 TO 3 GAL. (VACUUM)
4 · FLOWMETER 0-15 CFH
5 · GLOBE VALVE · 1/4 PIPE
6 · PRESS. REDUCING VALVE · 1/4 PIPE · 0 TO 15 PSI
7 · ACCUMULATOR TANK · 1 TO 3 GAL. (PRESSURE)
8 · FLOWMETER 0-40 CFH
9 · MANOMETER · 20 TO 60" HG. ABS.
10 · MERCURY TRAP
11 · PRESSURE GAGE 0-100 PSI
12 · SPDT DEAD CENTER POSITION TOGGLE SWITCH
13 · SPST TOGGLE SWITCH
14 · FUSE PANEL MOUNT · 2.5A
15 · AMMETER 0-3 ADC
16 · VOLTMETER 0-30 VDC
17 · COMPOUND GAGE 0-30 PSIG PRESS 0-30" HG.

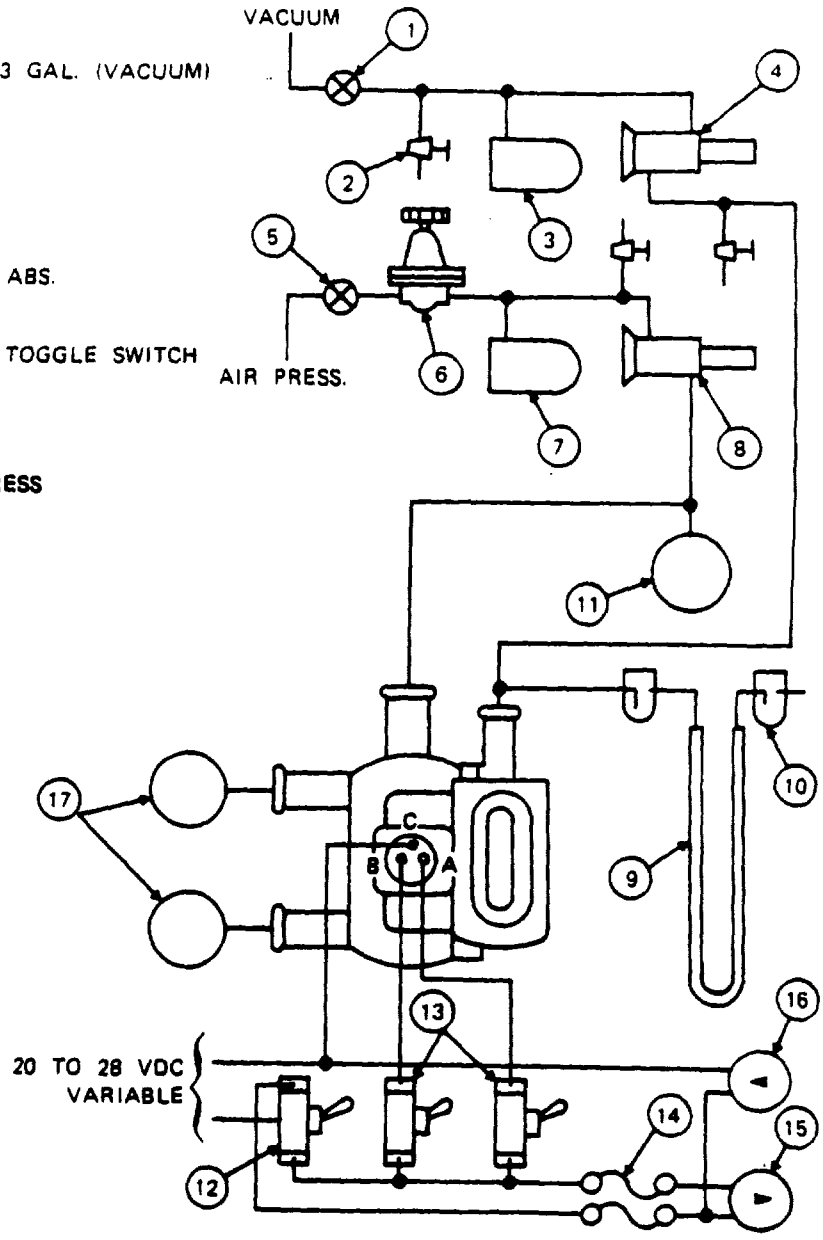


Figure 5. Test Setup

B. **Solenoid Current Consumption**

1. Energize each solenoid separately with 28 Vdc.
2. Current consumption should be between 1.45 and 1.75 amperes.

C. **Secondary Ground**

1. Using calibrated ohmmeter, check resistance from pin A to secondary ground lug on receptacle.
2. Repeat step 1 from pin B to secondary ground lug.
3. Resistance must not be more than 25 ohms.
4. Check resistance from pin C to secondary ground.
5. Resistance must not be more than 5 ohms.
6. Check rejected parts for cold solder joints or dirt at ground clip contact joints.

9.0 STORAGE INSTRUCTIONS

The deicer distributing valve may be stored for 60 months (maximum time) provided the following conditions prevail. If these conditions are not observed, shelf life will be considerably shortened.

A. Storage area must be dry.

B. Units must not be subjected to temperatures higher than 250°F.

C. Units must be effectively protected from dust.

D. Units must be handled with care at all times.

E. Units should be stored in shipping cartons if possible.

F. Units should be tested prior to installation.

NOTE:

UNITS THAT REMAIN IN STORAGE (OR INOPERATIVE) BEYOND THE SPECIFIED TIME LIMIT MUST BE INSPECTED AND TESTED PRIOR TO INSTALLATION OR USE.

10.0 SPECIAL TOOLS, FIGURES AND EQUIPMENT

The following equipment, or equivalent, is required to perform the overhaul procedures in this manual.

A. **Special**

Performance test stand 53E19-35A should be used, if available, to test the deicer distributing valve. Assembly fixture U6926 and fixture cover U6925 are used when assembling the valve. (See Figure 6).

B. **Standard**

Standard test equipment is listed in Table 2.

11.0 TROUBLESHOOTING

If the test values specified in Paragraph 8 cannot be obtained, refer to Figure 9 for item identification and Table 6 for remedial procedures.

TABLE 2 TROUBLESHOOTING

Test Failed	Probable Cause	Remedy
Paragraph 6N Excessive Leakage	Seal (25) loose or too tight	Readjust nut (23) to obtain minimum minimum leakage per Paragraph 6N, Step 5
	Defective seat on valve housing (38)	Inspect valve housing for chipped or uneven seats
	Quantity of shims (24) inadequate	Add or subtract shims as required to obtain minimum leakage: Paragraph 6N
	Defective nut (23) allowing for uneven seating of seal (25)	Inspect nut and seal for squareness. Replace nut if necessary.
	Internal valve housing leakage (38)	If the preceeding guides still allow leakage, internal housing leakage may exist. Replace housing
Paragraph 8A Step 2 Excessive Leakage	Defective diaphragm assembly (26)	Inspect diaphragm assembly for torn diaphragm (30) or leakage around valve stem (28) and washers (29). Replace if necessary

Test Failed	Probable Cause	Remedy
	Contamination of diaphragm assembly (26)	Inspect mating surfaces of diaphragm (30) and housing (38) for foreign matter. Insure clean surfaces of each
	Defective gasket (26)	Inspect condition of gasket. Replace if worn or cracked
	Defective sealing surface of valve poppet assembly (20)	Inspect condition of poppet assembly. Replace if seal is uneven
	Defective seat on exhaust valve housing (21)	Inspect condition of housing. Replace if chipped or uneven seats exist
	Defective control valve (32) and/or bushing	Inspect condition of control valves for burrs or scratches. Replace control valve if worn or scratched. Check clearance per Paragraph 5C.
	Spring (19) not seated properly on poppet valve assembly (20)	Cycle solenoids A and B several times to position spring. Insure that the large spring end rides on poppet valve assembly
	Loose screws (2), (4) (16)	Inspect for loose screws and tighten per Paragraph 6
	Loose hose connections	Inspect hose connections for leakage and tighten
	Head valve assembly (1) not installed properly	Inspect installation per Paragraph 6, Step P
Paragraph 8 Step 4 Excessive Leakage	Refer to Paragraph 8A, Step 2 - Troubleshooting	
Paragraph 8 Steps 5 & 6 Excessive Leakage	Refer to Paragraph 8A, Step 2 - Troubleshooting	
Boot Ports do not pressure	Control valve (32) stuck in control valve bushing	Inspect parts for contamination, burrs or scratches. Clean areas per Paragraph 3. Replace control valve if defective. Check clearance per Paragraph 5C. If bushing is defective, replace housing (38)

Test Failed	Probable Cause	Remedy
	Defective control spring (33)	Check spring requirements per Table 1. Replace if defective
	Control valve (32) installed incorrectly	Check control valve installation. Insure small land end of control valve rides on control valve spring
	Gasket (22) installed incorrectly	Check gasket installation. Insure that gasket is installed per Figure 7
	Movement of solenoid plunger (12) restricted	Inspect surrounding area of plunger for contamination. Clean area per Paragraph 3
	Defective solenoid coil assembly (13)	Check coil resistance. Replace solenoid if resistance does not meet Paragraph 4E
	Defective ground connection	Check continuity per Paragraph 8C, Steps 4 & 5
	Defective connector pins (5)	Inspect for bent or broken pins. Replace connector if defective
Paragraph 8A Step 9, 10 Excessive Leakage	Refer to Paragraph 8A, Steps 5 & 6 - Troubleshooting	
Paragraph 8B Step 2 Solenoid Current consumption not within specification	Defective solenoid coil assembly (17)	Check coil resistance. Replace solenoid if resistance does not meet Paragraph 4E criteria
	Defective ground connection	Check continuity per Paragraph 8C, Steps 4 & 5
	Defective solenoid wires	Check continuity per Paragraph 8C, Steps 1-3. Inspect condition of wires for frayed insulation
Paragraph 8C Steps 1-6 Resistance readings not within spec.	Defective solder connection	Check connections for cold solder joints, dirt, non-contact areas, and damaged wires

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12.0 ILLUSTRATED PARTS LIST

A. Introduction

1. Purpose

This parts list is intended for use in requisitioning, storing, and issuing replaceable parts of Deicer Distributing Valve, Part No's 1532-2A, 1532-3A, 1532-3B, 1532-3C, 1532-6A AND 1532-6C.

2. Usage Code Symbols

A = 1532-3A
B = 1532-3B
C = 1532-3C
D = 1532-6A
E = 1532-6C
F = 1532-2A

3. How To Use This Parts List

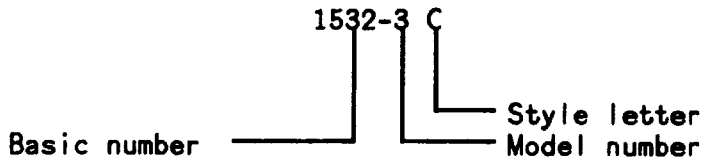
When the part number is not known, locate the part on the exploded view and note its index number. Use this index number to locate the part number in the Group Assembly Parts List, Paragraph B.

4. LWIPT Part Numbering System

The part number consists of a basic number and a dash number. The dash number indicates variations of the basic part.

5. LWIPT Type Numbering System

The type numbering system indicates the essential characteristics of the unit.

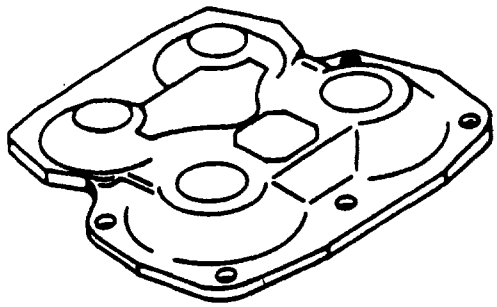


6. Vendor's Code

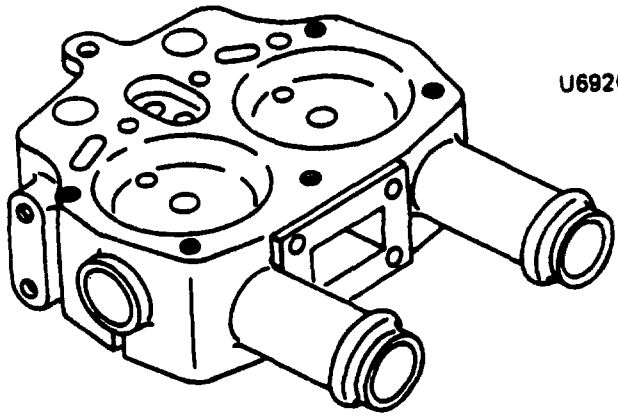
Parts obtainable from vendors other than LWIPT are listed (by the vendor's part number) in the part number column. The vendor's code number is listed in the description column preceded by the letter "V", and the LWIPT part number is listed for reference purposes following the vendor's code.

Vendor's Code	Name and Address
79963	Zierick Mfg. Corp. 83 Rockdale Avenue New Rochelle, NY 10802

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U6925



U6926

Figure 6. Special Tools

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Table 3.

Standard Test Equipment

Type or Model no.	Nomenclature	Application
C-2400, C-P	Mercury trap (8 req'd) Meriam Instrument Co., Cleveland, OH	Prevents mercury loss in manometers.
301	Ammeter Weston Instruments Division of Daystrom Inc., Newark, NJ	Used to measure solenoid coil current
301	Voltmeter Weston Instruments Division of Daystrom Inc., Newark, NJ	Used to measure variable DC power supply output
5300	Resistance bridge Leeds and Northrop Co., Philadelphia, PA	Used to measure solenoid coil resistance.
10AA25FF	Manometer (4 req'd) Meriam Instrument Co.	Provides load and indicates pressure.
10A2735	Flowmeter (2 req'd) Fischer and Porter Co., Warminster, PA	Used to measure pressure loss in vacuum and pressure lines.
------	Accumulator tank, 1 to 3 gallon capacity (2 req'd)	Used to eliminate pulsations in vacuum and pressure lines.
------	Fuse, 2.5-ampere (2 req'd)	Used to protect solenoid coils.
------	Globe Valve, 1/4 inch pipe (2 req'd)	Used to regulate air pressure and vacuum.
------	Needle valve, 1/4 inch pipe (3 req'd)	Used to regulate air pressure and vacuum.
------	Pressure reducing valve, 1/4 inch pipe, 0 to 15 psi	Used to regulate air pressure.
------	Pressure gage, 0 to 100 psi	Used to measure air pressure.
------	Toggle switch, spst	Used to switch ammeter in solenoid coil circuit.
------	Toggle switch, spst (2 req'd)	Used to energize solenoids A and B.

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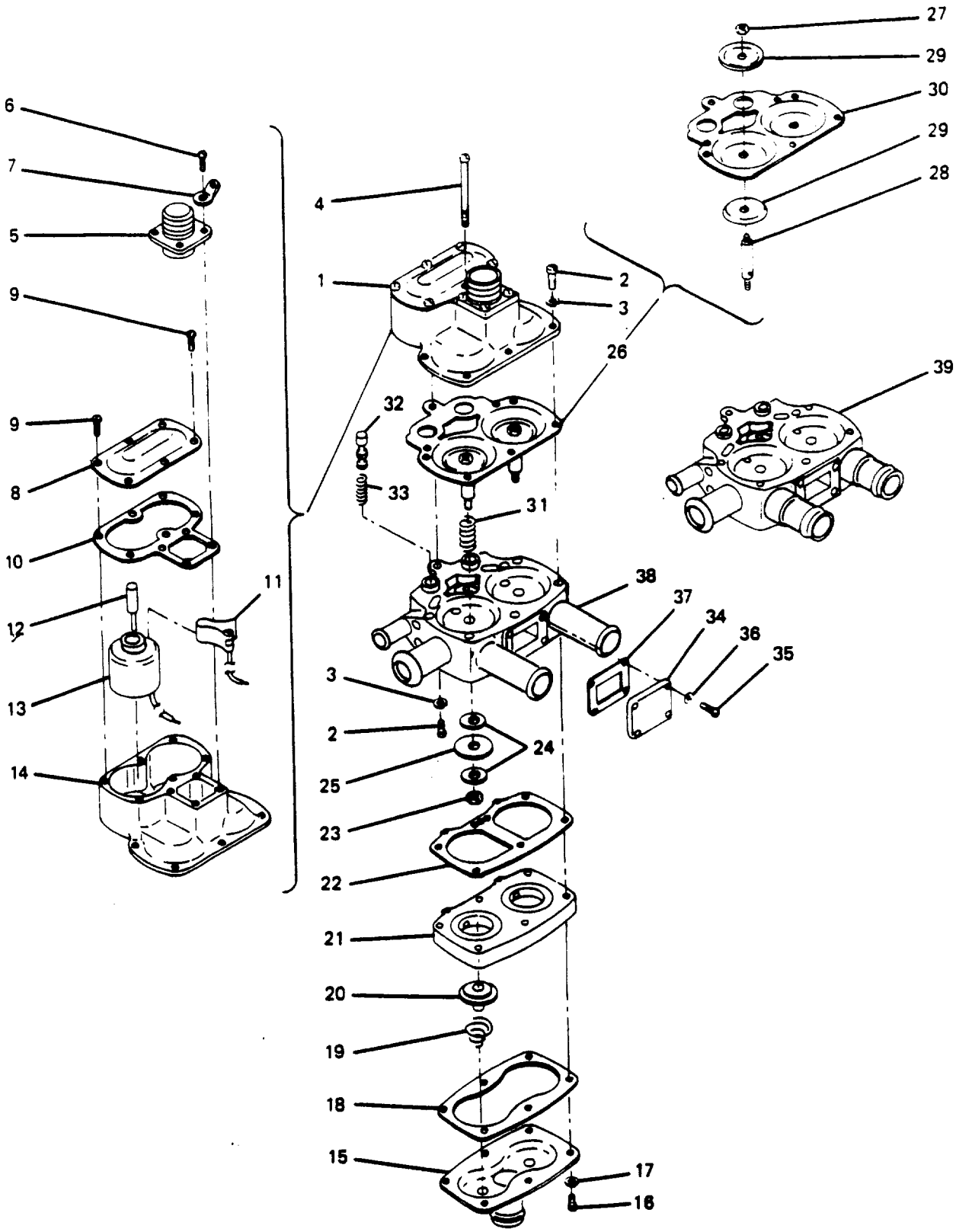


Figure 7. Deicer Distributing Valve - Exploded View

B. Group Assembly Parts List

Figure and Index no.	Part number	Description	Usage Code	Units Per Assy
7-	1532-3A 1532-3B 1532-3C	Deicer Distributing Valve	A B C	
7-	1532-6A	Deicer Distributing Valve	D	
7-	1532-6C 1532-2A	Deicer Distributing Valve Deicer Distributing Valve	E F	
-1	834853	Valve Head Assembly	A, B, C, D, E, F	1
-2	AN500A8-7	Screw	A, B, C, D, E,F	6
-3	25103	Washer	A, B, C, D, E, F	6
-4	835875	Screw	A, B, C, D, E, F	1
-5	MS3102R14S7P MS3102E14S7P	Connector, Receptacle Connector, Receptacle	A, B, C, E D, F	1 1
-6	AN500A4-4	Screw	A, B, C, D, E, F	4
-7	333	Lug, Terminal (V79963). (99551 P/N 1337515)	A, B, C, D, E, F	1
-8	830407	Retainer, Solenoid	A, B, C, D E, F	1
-9	AN500A6-5	Screw	A, B, C, D, E, F	5
-10	830406	Gasket, Head	A, B, C, D, E, F	1

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Figure and Index no.	Part number	Description	Usage Code	Units Per Assy
-11	830413	Contact & Lead Assembly	A, B, C, D, E, F	1
	2495417	Plunger & Pin Assembly	B, C, D, E, F	2
-12	101764	Plunger & Pin Assembly	A	2
-13	648777	Coil Assembly, Solenoid	A,B,D,F	2
	2489862	Coil Assembly, Solenoid	C,E	2
-14	836030	Head, Valve	A,B,C, D,E,F	1
	869809	Cover Assembly, Exhaust	D	1
-15	869893	Cover Assembly, Exhaust Valve	A,C,E	1
	644175	Cover Assembly, Exhaust Valve	B	1
	834971	Cover Assembly, Exhaust Valve	F	1
-16	AN500A8-14	Screw	A, B, C, D, E, F	6
-17	25103	Washer	A, B, C, D, E, F	6
-18	834961	Gasket, Flapper Valve Cover	A, B, C, D, E, F	1
-19	2495076	Spring, Valve	A,B,C, D,E	2
	835776	Spring, Valve	F	1
-20	2484074	Valve Assembly, Poppet	B,C,D,E	2
	101783	Valve Assembly, Poppet	A	2
	835540	Valve Assembly, Poppet	F	2

Figure and Index no.	Part number	Description	Usage Code	Units Per Assy
-21	869897	Housing, Exhaust Valve	A, B, C, D, E	1
	835539	Housing, Exhaust Valve	F	1
-22	834958	Gasket, Exhaust Port Housing	A, B, C, D, E, F	1
-23	MS21083-N06	Nut, Self-locking	A, B, C, D, E, F	2
-24	108054	Washer, Valve		4
-25	2484073	Seal, Valve	B,C,D,E	2
	648771	Seal, Valve	A,F	2
-26	834918	Diaphragm Assembly	A,B,F	1
	2496718	Diaphragm Assembly	C,D,E	1
-27	MS21083-N06	Nut, Self-locking	A, B, C, D, E, F	2
-28	834919	Stem, Valve	A, B, C, D, E, F	2
-29	101778	Washer, Diaphragm	A,B,F	4
	2496719	Washer, Diaphragm	C,D,E	4
-30	830281	Diaphragm	A,B,F	1
	2496720	Diaphragm	C,D,E	1
-31	834915	Spring, Diaphragm	A,B,C,D E,F	2
-32	829489	Valve, Control	A,B,C,D,E,F	2
-33	829488	Spring, Control Valve	A,B,C,D,E,F	2
-34	1381119	Plate, Identification	A,B,C,D,E,F	1

Figure and Index no.	Part number	Description	Usage Code	Units Per Assy
-35	AN500A4-4	Screw	A, B, C, D, E, F	4
-36	61840	Washer	A, B, C, D, E, F	4
-37	834916	Gasket, Nameplate	A, B, C, D, E, F	1
-38	2487289	Housing, Valve	C	1
	644873	Housing, Valve	D	1
-39	2487512	Housing, Valve	E	1
	834832	Housing, Valve	A,B	1
	834812	Housing, Valve	F	1

Lucas Aerospace

Lucas Aerospace Power Transmission Corporation

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OVERHAUL MANUAL WITH ILLUSTRATED PARTS LIST

DEICER DISTRIBUTING VALVE

PART NO.
1532-8A
1532-8C
1532-10A
1532-10C

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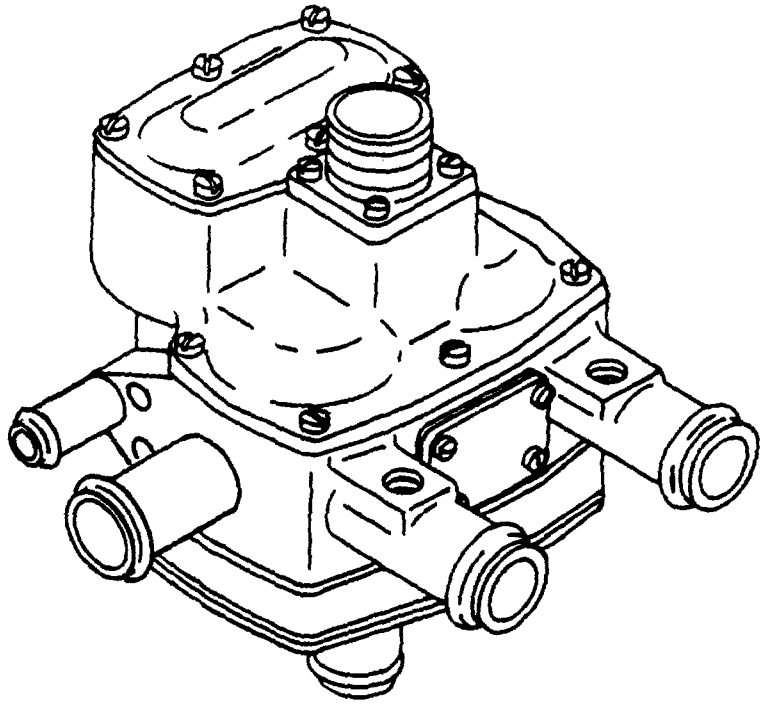
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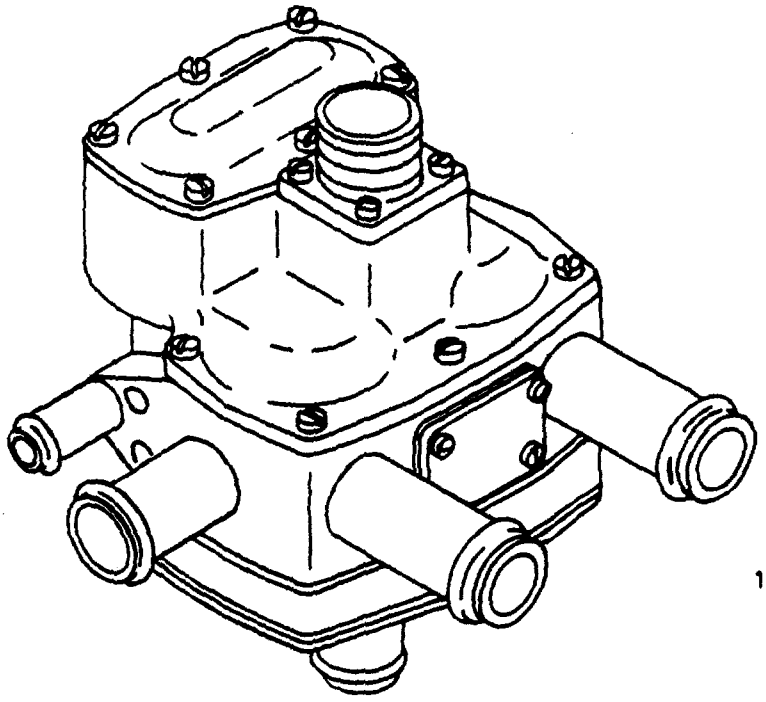
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1532-8



1532-10

Figure 1. Deicer Distributing Valve

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1.0 DESCRIPTION AND OPERATION

This manual contains descriptive information, overhaul and test instructions, and an illustrated parts list for Deicer Distributing Valve, P/N's 1532-8A, 1532-8C, 1532-10A and 1532-10C manufactured by Lucas Aerospace Power Transmission Corporation (LAPTC), Utica, New York 13503.

The deicer distributing valve (Figure 1) is a component of the aircraft deicer system.

The deicer distributing valve contains a pressure inlet port, a vacuum port, two ports (A and B) which connect to the associated deicer boots, and an exhaust port which is piped overboard to a low pressure area.

The pressure inlet port is integral with the aircraft manifold pressure line, thereby making pressure available at all times. Ports A and B are connected, through lines, to the deicer boots which provide the suction and pressure connections to operate the deicer boots. The exhaust port which is piped overboard to a low pressure area, serves to discharge the pressurized air in the deicer boots.

The deicer distributing valve normally has vacuum applied to it at all times. This suction within the deicer distributing valve holds down the deicer boots when the deicer system is not energized.

2.0 DISASSEMBLY

A. Remove screws (6, Figure 7), and terminal lug (7), and carefully lift out receptacle connector (5). Unsolder wires. Discard screws (6).

B. Remove screws (9), solenoid retainer (8), and head gasket (10)and grounding jumper (15). Discard gasket (10) and screws (9).

C. Carefully pull wires from connector cavity down and through opening in valve head (14) for the solenoid and contact and lead assembly.

D. Remove screws (2 and 4), washers (3), and valve head assembly (1). Discard screws (2) and (4).

E. Remove plunger and pin assemblies (12) and solenoid coil assemblies (13) from valve head (14).

F. Carefully remove control valves (33) and control valve springs (34) from valve housing (40 or 41).

G. Remove screws (17), washers (18), and exhaust valve cover assembly (16). Discard screws (17).

H. Remove flapper valve cover gasket (19), poppet valve assemblies (21), and valve springs (20) from exhaust valve housing (22). Remove exhaust valve housing (22) and exhaust port housing gasket (23) from valve housing (40 or 41). Discard gaskets (19 and 23) and poppet valve assemblies (21).

I. To remove diaphragm assembly (27), remove self-locking nuts (28) on top side of diaphragm assembly (27).

J. Remove diaphragm washers (30), diaphragm (31), and diaphragm springs (32).

K. Invert valve housing (40 or 41) and remove self-locking nuts (24), valve washers (25), valve seals (26), and remaining valve washers (25) from valve stems (29). Record number of valve washers (24) removed. Remove valve stems (29) from valve housing (40 or 41). Discard valve seals (26), diaphragm (31), and self-locking nuts (24 and 28).

L. Remove screws (36), washers (37), identification plate (35), and gasket (38). Discard gasket (38) and screws (36).

M. Remove pipe plugs (39) from housing (40) on model 1532-8A and 1532-8C.

3.0 CLEANING

WARNING

USE CLEANING SOLVENT ONLY IN A WELL-VENTILATED AREA

Clean all arts, except solenoid coil assemblies (13, figure 7), with Esso Varsol (manufactured by the Humble Oil and Refining Co., Pelham, New York), or equivalent. Solenoid coil assemblies should be wiped with a clean cloth dampened with cleaning solvent. Dry parts using dry filtered air at a pressure of 25 to 30 psig.

4.0 INSPECTION/CHECK

A. Inspect and discard all parts that are cracked, broken, and have non-cleanable corrosion.

B. Inspect threaded parts for stripped and crossed threads.

C. Inspect valve housing (40 or 41, figure 7) for loose inserts and plugs. Check condition of valve seats.

D. Inspect leads of solenoid coil assemblies (13) for burned, charred, cracked, or frayed insulation.

E. Using ohmmeter, check resistance between lead and outer case of each solenoid coil assembly. The resistance should be 17.6 ohms ± 5%.

F. Inspect receptacle connector (5) for loose, bent, or broken pins, and for cracked, chipped, or burned inserts.

G. Inspect contact and lead assembly (11) for broken strands of wire and poor solder connection between lead and contact.

H. Inspect valve washers (25) for being grooved.

I. Check spring lengths and compression requirements as shown in Table 1.

J. Inspect control valves (33) for being scored and replace if scored.

5.0 REPAIR AND REPLACEMENT

A. A standard overhaul replacement parts kit SK 271 is available from LAPTC for routine overhauls which covers all four models.

B. Replace any damaged parts in addition to the standard replacement parts as required.

C. Replace control valves (33, Figure 7) if excessive clearance in valve bushings is due to worn valve surface. If excessive clearance is due to worn valve bushings, replace valve housing (40 or 41). Permissible worn clearance is 0.0010 inch maximum.

6.0 ASSEMBLY

A. Apply EC1357 cement on both sides of diaphragm (31, figure 7) in small area around stem holes. (See Figure 2).

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TABLE 1. SPRING DATA

Spring	Compressed length	Compression load
Valve spring (20, Figure 7)	0.308 inch	14 to 16 ounces
Diaphragm spring (32, Figure 7)	0.406 inch	10 to 14 ounces
Control valve spring (34, Figure 7)	0.500 inch	5.5 to 6.5 ounces

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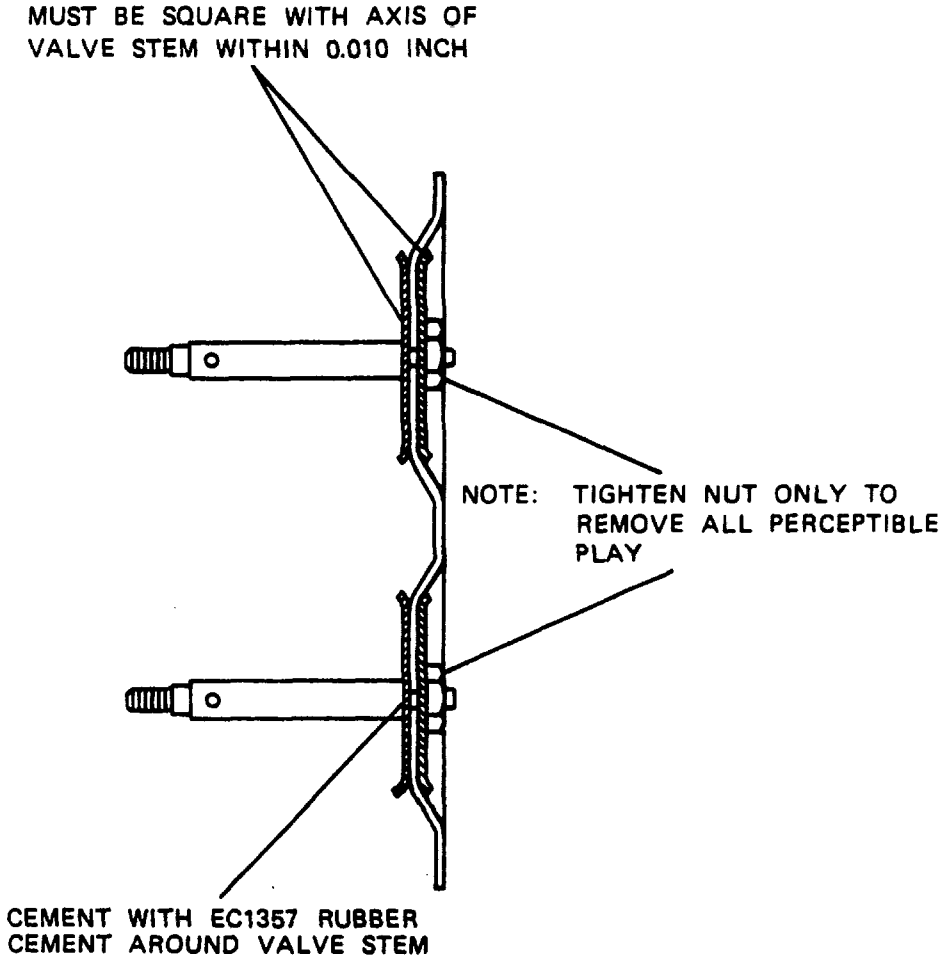


Figure 2. Diaphragm Assembly

B. Position diaphragm washers (30, figure 7) and valve stem (29) onto diaphragm (31) and loosely assemble new self-locking nuts (28). (See Figure 2).

C. Position diaphragm assembly (27, Figure 7) in fixture U6926, making sure it fits smoothly.

D. Assemble fixture cover U6925 in position on diaphragm assembly (27) and tighten with slave screws (2).

E. Locate a 1/16-inch drill rod 6 inches long into stem holes through fixtures tighten self-locking nuts (28).

NOTE:

DO NOT OVERTIGHTEN SELF-LOCKING NUTS TO AVOID CAUSING DISTORTION IN DIAPHRAGM.

F. Remove slave screws (2) and remove diaphragm assembly (27) from holding fixtures.

G. Install solenoid coil assemblies (13) and contact and lead assembly (11) into valve head (14). Carefully thread wires through opening in valve head (14) into cavity of receptacle connector (5). Place plunger and pin assemblies (12) into solenoid coil assemblies (13).

H. Place diaphragm springs (32) on protruding end of valve stems (29) and position diaphragm assembly (27) on valve housing (40 or 41).

NOTE:

WHEN ASSEMBLIED INTO VALVE HOUSING (40 OR 41), DIAPHRAGM ASSEMBLY (27) MUST OPERATE FREELY.

I. Install control valve springs (34) and control valves (33) in valve housing (40 or 41). Ensure small land ends of control valves (33) are assembled next to control valve springs (34).

J. Secure new head gasket (10) and solenoid retainer (8) and jumper assembly (15)using five screws (9). Torque screws (9) between 8 and 10 pound-inches.

K. Solder leads from solenoid coil assemblies (13) and contact and lead assembly (11) to receptacle connector (5) with Eclipsaloy No. 9, Grade 5 or 15 solder. (See Figure 3).

NOTE:

DO NOT KINK LEADS WHILE PUSHING RECEPTACLE CONNECTOR (5, FIGURE 7) INTO VALVE HEAD (14).

L. Secure receptacle connector (5) and terminal lug (7) to valve head (14) with screws (6). Torque screws (6) between 4 and 6 pound-inches.

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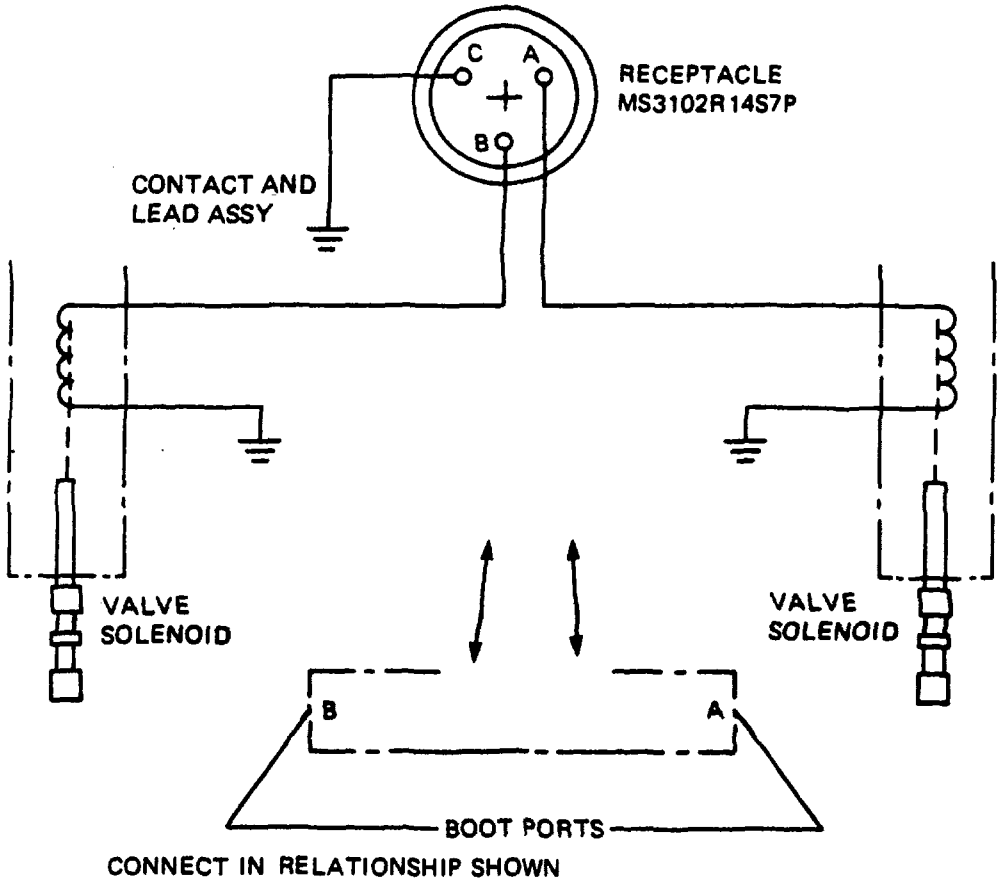


Figure 3. Wiring Diagram

M. Install valve washer (25), new valve seal (26), valve washer (25), and new self-locking nut (24) on each valve stem (29). Tighten self-locking nuts (24) to secure valve seals (26) onto seats of valve housing (40 or 41).

NOTE:

INSTALL SAME NUMBER OF INNER VALVE WASHERS (25) AS NOTED AT DISASSEMBLY.

N. Secure valve head assembly (1) to valve housing (40 or 41) with screws (2), washers (3), and screw (4). Torque screws (2 and 4) between 13 and 15 pound-inches.

O. Secure name plate gasket (38) and identification plate (35) to valve housing (40 or 41) with washers (37) and screws (36). Torque screws (36) between 4 and 6 pound-inches.

P. Apply loctite No. 592 pipe sealant with teflow to pipe plugs (40) for model numbers 1532-8A and 1532-8C and install in housing (39) torque to 10 to 12 inch pounds.

Q. Before continuing with assembly of the deicer distributing valve, it is necessary to adjust self-locking nuts (24) as follows:

1. Plug boot ports A and B.
2. Apply 2 psig air pressure to pressure port and energize each solenoid several times. (See Figure 4).
3. Adjust self-locking nuts (24, Figure 7) to obtain minimum air leakage past valves.

NOTE:

CARE MUST BE USED WHEN TIGHTENING NUTS SINCE OVERTIGHTENING OR UNDERTIGHTENING WILL CAUSE LEAKAGE PAST VALVES.

4. Re-energize both valves several more times and recheck leakage for proper sealing of valves with an air flowmeter for total leakage.

5. Leakage, as determined by flowmeter located in pressure supply line, represents total of internal as well as external leakage, and must not exceed 3 cubic feet per hour.

6. Repeat steps (2) through (5) with 8 psig air pressure applied.

R. Install new exhaust port housing gasket (23) and exhaust valve housing (22) on valve housing (40 or 41). Install new poppet valve assemblies (21) and valve springs (20) in exhaust valve cover assembly (16). Install flapper valve cover gasket (19) and exhaust valve cover assembly (16) on exhaust valve housing (22) and secure with washers (18) and screws (17). Torque screws (17) between 20 and 25 pound-inches.

7.0 FITS AND CLEARANCES

Fit and clearance information appears in the applicable portion of paragraph 6.

8.0 TESTING

If performance test stand 53E19-35A is not available, test the deicer distributing valve as follows:

A. Operational Tests

1. Connect deicer distributing valve to test setup shown in Figure 5.

2. Apply vacuum to 4 inches of mercury to suction port, leaving pressure port open. Leakage rate, as indicated by the flowmeter, must not exceed 3 cubic feet per hours.

3. Connect pressure port and set pressure at 8 psig and vacuum at 6 inches of mercury.

4. Leakage, as indicated by flowmeter in vacuum line, must not exceed 5 cubic feet per hour. (Compound gages connected to A and B ports should read same as vacuum line manometer).

5. Repeat steps 3 and 4 with solenoid A energized with 20 Vdc and solenoid B deenergized. Leakage must not exceed 20 cubic feet per hour. (A port compound gage should read inlet pressure and B port compound gage should read vacuum inlet pressure).

6. Repeat step 5 (inflate condition) with solenoid A deenergized and solenoid B energized with 20 Vdc.

7. Readings on A and B port compound gages should be reversed from those in step 5.

8. Leakage must not exceed 20 cubic feet per hour.

9. With 8 psig pressure and 4 inches vacuum applied, energize each solenoid separately several times with 20 Vdc.

10. Valve action must be immediate and complete.

1 - FLOWMETER 0-15 CFH
2 - GLOBE VALVE - 1/4 PIPE
3 - PRESS. REDUCING VALVE - 1/4 PIPE
0 TO 15 PSIG
4 - ACCUMULATOR TANK - 1 TO 3 GAL.
(PRESSURE)
5 - PRESSURE GAGE 0-30 PSIG

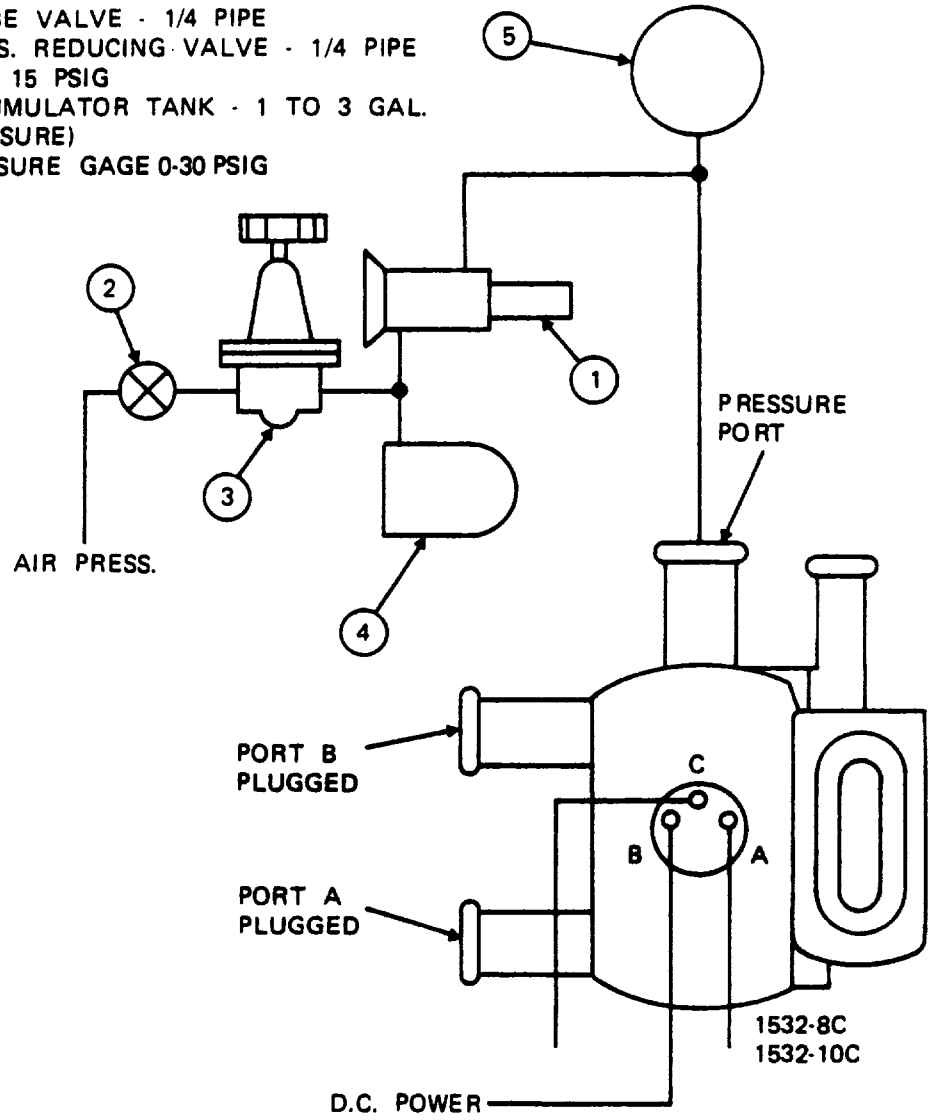


Figure 4. Test Setup

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1 - GLOBE VALVE - 1/4 PIPE
2 - NEEDLE VALVE - 1/4 PIPE
3 - ACCUMULATOR TANK - 1 TO 3 GAL. (VACUUM)
4 - FLOWMETER 0-15 CFH
5 - GLOBE VALVE - 1/4 PIPE
6 - PRESS. REDUCING VALVE 1/4 PIPE - 0 TO 15 PSI
7 - ACCUMULATOR TANK 1 TO 3 GAL. (PRESSURE)
8 - FLOWMETER 0-40 CFH
9 - MANOMETER - 20 TO 60" HG. ABS.
10 - MERCURY TRAP
11 - PRESSURE GAGE 0-100 PSI
12 - SPDT DEAD CENTER POSITION TOGGLE SWITCH
13 - SPST TOGGLE SWITCH
14 - FUSE PANEL MOUNT - 2.5A
15 - AMMETER 0-3 ADC
16 - VOLTMETER 0-30 VDC
17 - COMPOUND GAGE 0-30 PSIG PRESS 0-30" HG.

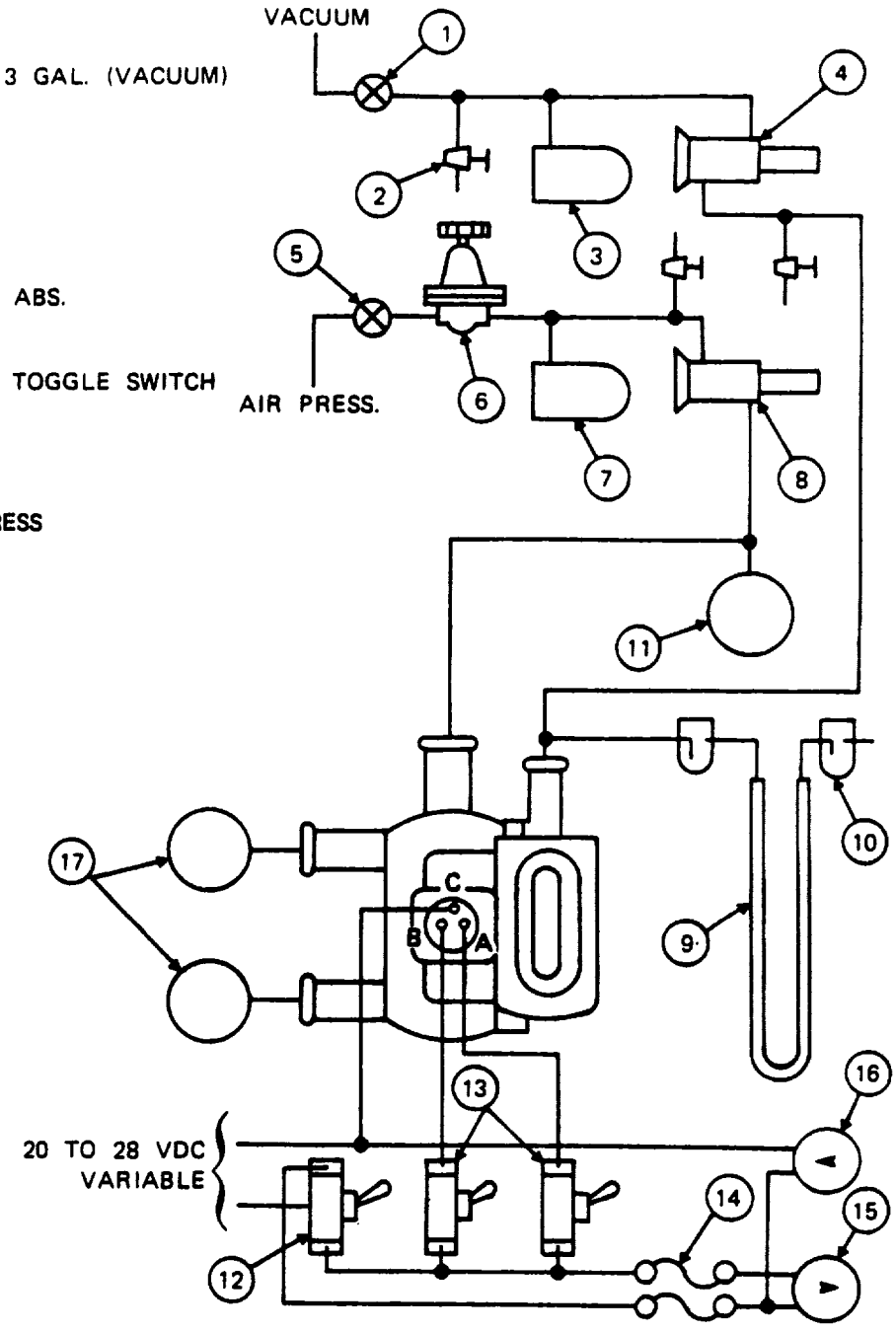


Figure 5. Test Setup

B. **Solenoid Current Consumption**

1. Energize each solenoid separately with 28 Vdc.
2. Current consumption should be between 1.45 and 1.75 amperes.

C. **Secondary Ground**

1. Using calibrated ohmmeter, check resistance from pin A to secondary ground lug on receptacle.
2. Repeat step 1 from pin B to secondary ground lug.
3. Resistance must not be more than 25 ohms.
4. Check resistance from pin C to secondary ground.
5. Resistance must not be more than 5 ohms.
6. Check rejected parts for cold solder joints or dirt at ground clip contact joints.

9.0 STORAGE INSTRUCTIONS

The deicer distributing valve may be stored for 60 months (maximum time) provided the following conditions prevail. If these conditions are not observed, shelf life will be considerably shortened.

A. Storage area must be dry.

B. Units must not be subjected to temperatures higher than 250°F.

C. Units must be effectively protected from dust.

D. Units must be handled with care at all times.

E. Units should be stored in shipping cartons if possible.

F. Units should be tested prior to installation.

NOTE:

UNITS THAT REMAIN IN STORAGE (OR INOPERATIVE) BEYOND THE SPECIFIED TIME LIMIT MUST BE INSPECTED AND TESTED PRIOR TO INSTALLATION OR USE.

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10.0 SPECIAL TOOLS, FIGURES AND EQUIPMENT

The following equipment, or equivalent, is required to perform the overhaul procedures in this manual.

A. **Special**

Performance test stand 53E19-35A should be used, if available, to test the deicer distributing valve. Assembly fixture U6926 and fixture cover U6925 are used when assembling the valve. (See Figure 6).

B. **Standard**

Standard test equipment is listed in Table 3.

11.0 TROUBLESHOOTING

If the test values specified in Paragraph 8 cannot be obtained, refer to Figure 9 for item identification and Table 6 for remedial procedures.

TABLE 2 TROUBLESHOOTING

Test Failed	Probable Cause	Remedy
Paragraph 6N Excessive Leakage	Seal (26) loose or too tight	Readjust nut (24) to obtain minimum minimum leakage per Paragraph 6N, Step 5
	Defective seat on valve housing (40 or 41)	Inspect valve housing for chipped or uneven seats
	Quantity of shims (25) inadequate	Add or subtract shims as required to obtain minimum leakage; Paragraph 6N
	Defective nut (24) allowing for uneven seating of seal (26)	Inspect nut and seal for squareness. Replace nut if necessary.
	Internal valve housing leakage (40 or 41)	If the preceeding guides still allow leakage, internal housing leakage may exist. Replace housing
Paragraph 8A Step 2 Excessive Leakage	Defective diaphragm assembly (27)	Inspect diaphragm assembly for torn diaphragm (31) or leakage around valve stem (29) and washers (30). Replace if necessary

Test Failed	Probable Cause	Remedy
	Contamination of diaphragm assembly (27)	Inspect mating surfaces of diaphragm (31) and housing (40 or 41) for foreign matter. Insure clean surfaces of each
	Defective gasket (27)	Inspect condition of gasket. Replace if worn or cracked
	Defective sealing surface of valve poppet assembly (21)	Inspect condition of poppet assembly. Replace if seal is uneven
	Defective seat on exhaust valve housing (22)	Inspect condition of housing. Replace if chipped or uneven seats exist
	Defective control valve (33) and/or bushing	Inspect condition of control valves for burrs or scratches. Replace control valve if worn or scratched. Check clearance per Paragraph 5C.
	Spring (20) not seated properly on poppet valve assembly (21)	Cycle solenoids A and B several times to position spring. Insure that the large spring end rides on poppet valve assembly
	Loose screws (2), (4) (17)	Inspect for loose screws and tighten per Paragraph 6
	Loose hose connections	Inspect hose connections for leakage and tighten
	Head valve assembly (1) not installed properly	Inspect installation per Paragraph 6, Step P
Paragraph 8 Step 4 Excessive Leakage	Refer to Paragraph 8A, Step 2 - Troubleshooting	
Paragraph 8 Steps 5 & 6 Excessive Leakage	Refer to Paragraph 8A, Step 2 - Troubleshooting	
Boot Ports do not pressure	Control valve (33) stuck in control valve bushing	Inspect parts for contamination, burrs or scratches. Clean areas per Paragraph 3. Replace control valve if defective. Check clearance per Paragraph 5C. If bushing is defective, replace housing (40 or 41).

Test Failed	Probable Cause	Remedy
	Defective control spring (34)	Check spring requirements per Table 1. Replace if defective
	Control valve (33) installed incorrectly	Check control valve installation. Insure small land end of control valve rides on control valve spring
	Gasket (23) installed incorrectly	Check gasket installation. Insure that gasket is installed per Figure 7
	Movement of solenoid plunger (12) restricted	Inspect surrounding area of plunger for contamination. Clean area per Paragraph 3
	Defective solenoid coil assembly (13)	Check coil resistance. Replace solenoid if resistance does not meet Paragraph 4E
	Defective ground connection	Check continuity per Paragraph 8C, Steps 4 & 5
	Defective connector pins (5)	Inspect for bent or broken pins. Replace connector if defective
Paragraph 8A Step 9, 10 Excessive Leakage	Refer to Paragraph 8A, Steps 5 & 6 - Troubleshooting	
Paragraph 8B Step 2 Solenoid Current consumption not within specification	Defective solenoid coil assembly (13)	Check coil resistance. Replace solenoid if resistance does not meet Paragraph 4E criteria
	Defective ground connection	Check continuity per Paragraph 8C, Steps 4 & 5
	Defective solenoid wires	Check continuity per Paragraph 8C, Steps 1-3. Inspect condition of wires for frayed insulation
Paragraph 8C Steps 1-6 Resistance readings not within spec.	Defective solder connection	Check connections for cold solder joints, dirt, non-contact areas, and damaged wires

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12.0 ILLUSTRATED PARTS LIST

A. Introduction

1. Purpose

This parts list is intended for use in requisitioning, storing, and issuing replaceable parts of Deicer Distributing Valve, Part No's 1532-8A, 1532-8C, 1532-10A and 1532-10C.

2. Usage Code Symbols

A = 1532-8A
B = 1532-8C
C = 1532-10A
D = 1532-10C

3. How To Use This Parts List

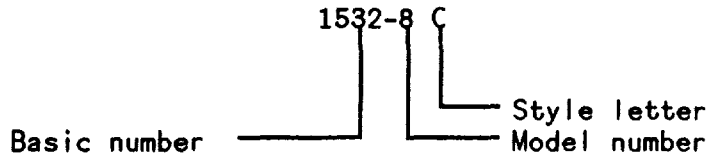
When the part number is not known, locate the part on the exploded view and note its index number. Use this index number to locate the part number in the Group Assembly Parts List, Paragraph B.

4. LAPTC Part Numbering System

The part number consists of a basic number and a dash number. The dash number indicates variations of the basic part.

5. LAPTC Type Numbering System

The type numbering system indicates the essential characteristics of the unit.

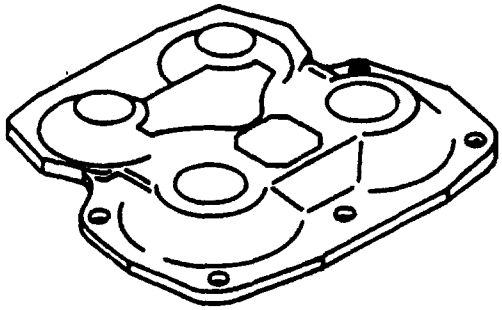


6. Vendor's Code

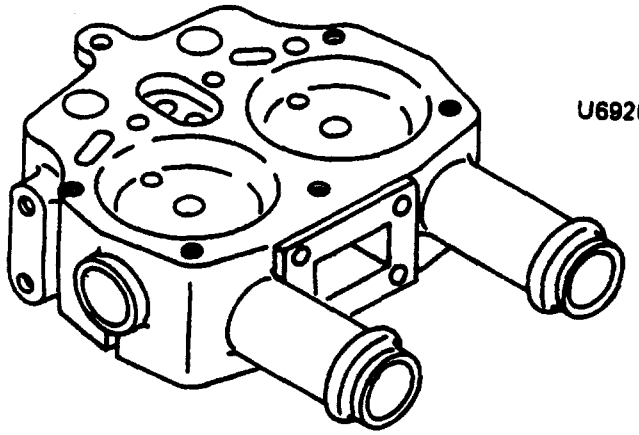
Parts obtainable from vendors other than LAPTC are listed (by the vendor's part number) in the part number column. The vendor's code number is listed in the description column preceded by the letter "V", and the LAPTC part number is listed for reference purposes following the vendor's code.

Vendor's Code	Name and Address
79963	Zierick Mfg. Corp. 83 Rockdale Avenue New Rochelle, NY 10802

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U6925



U6926

Figure 6. Special Tools

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Table 3.

Standard Test Equipment

Type or Model no.	Nomenclature	Application
C-2400, C-P	Mercury trap (8 req'd) Meriam Instrument Co., Cleveland, OH	Prevents mercury loss in manometers.
301	Ammeter Weston Instruments Division of Daystrom Inc., Newark, NJ	Used to measure solenoid coil current
301	Voltmeter Weston Instruments Division of Daystrom Inc., Newark, NJ	Used to measure variable DC power supply output
5300	Resistance bridge Leeds and Northrop Co., Philadelphia, PA	Used to measure solenoid coil resistance.
10AA25FF	Manometer (4 req'd) Meriam Instrument Co.	Provides load and indicates pressure.
10A2735	Flowmeter (2 req'd) Fischer and Porter Co., Warminster, PA	Used to measure pressure loss in vacuum and pressure lines.
------	Accumulator tank, 1 to 3 gallon capacity (2 req'd)	Used to eliminate pulsations in vacuum and pressure lines.
------	Fuse, 2.5-ampere (2 req'd)	Used to protect solenoid coils.
------	Globe Valve, 1/4 inch pipe (2 req'd)	Used to regulate air pressure and vacuum.
------	Needle valve, 1/4 inch pipe (3 req'd)	Used to regulate air pressure and vacuum.
------	Pressure reducing valve, 1/4 inch pipe, 0 to 15 psi	Used to regulate air pressure.
------	Pressure gage, 0 to 100 psi	Used to measure air pressure.
------	Toggle switch, spst	Used to switch ammeter in solenoid coil circuit.
------	Toggle switch, spst (2 req'd)	Used to energize solenoids A and B.

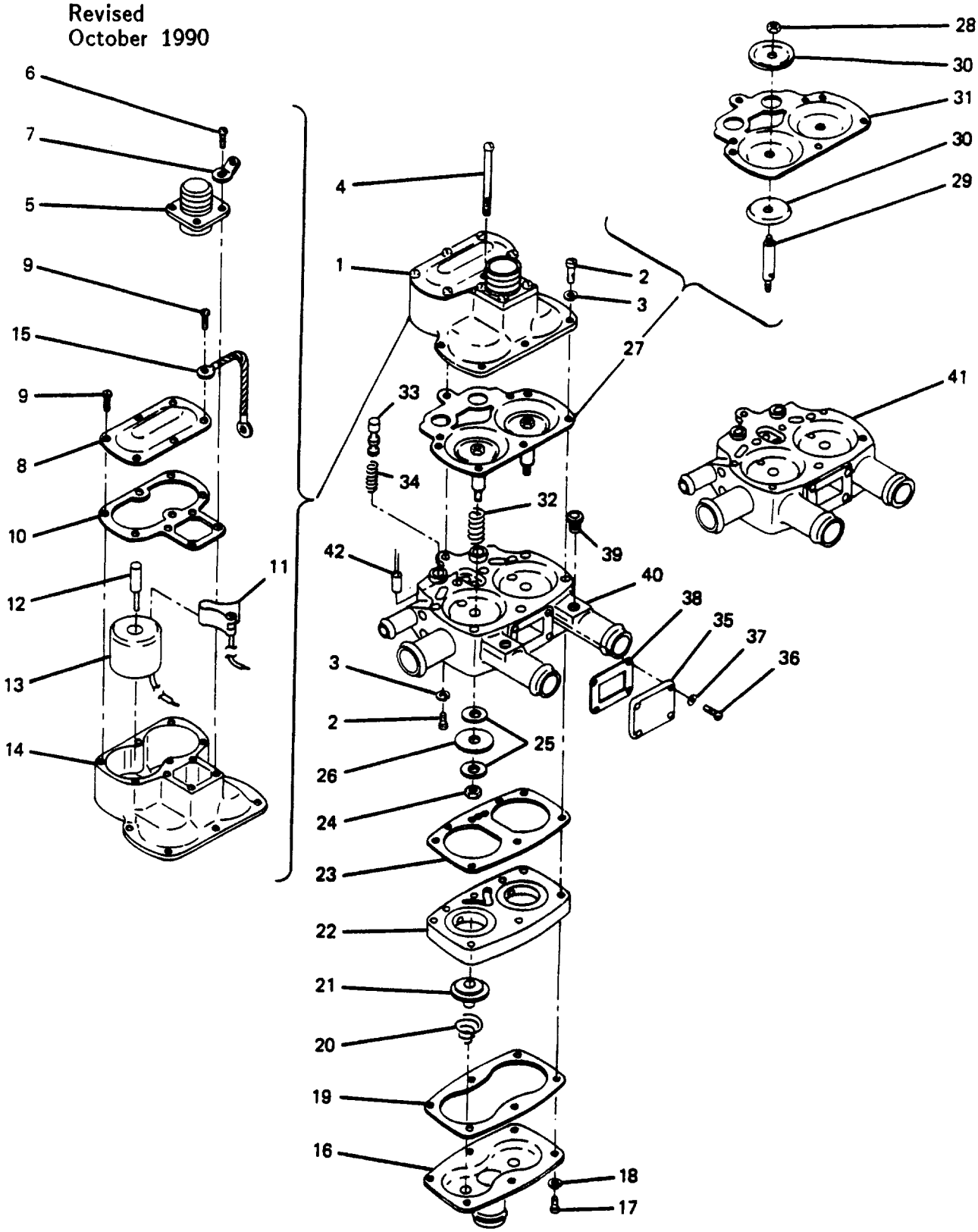


Figure 7. Deicer Distributing Valve - Exploded View

B. Group Assembly Parts List

Figure and Index no.	Part number	Description	Usage Code	Units Per Assy
7-	1532-8A 1532-8C 1532-10A	Deicer Distributing Valve	A B C	
7-	1532-10C	Deicer Distributing Valve	D	
-1	2494658	Valve Head Assembly	A, B, C, D	1
-2	645620ST8-7	Screw, Self Locking	A, B, C, D	6
-3	25103	Washer	A, B, C, D	6
-4	2494670	Screw, Self Locking	A, B, C, D	1
-5	MS3102R14S7P	Connector, Receptacle	A, B, C, D	1
-6	645620ST4-4	Screw, Self Locking	A, B, C, D	4
-7	333	Lug, Terminal (V79963), (99551 P/N 1337515)	A, B, C, D	1
-8	830407	Retainer, Solenoid	A, B, C, D	1
-9	645620ST6-5	Screw, Self Locking	A, B, C, D	5
-10	2496251	Gasket, Head	A, B, C, D	1
-11	830413	Contact & Lead Assembly	A, B, C, D	1
-12	2495417	Plunger & Pin Assembly	A, B, C, D	2
-13	2496706	Alternate Coil Assembly, Solenoid	B, D	2
	2489862	Coil Assembly, Solenoid	A, B, C, D	2
-14	2494163	Head, Valve	A, B, C, D	1
-15	2496668	Jumper Assembly Grounding	A, B, C, D	1

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Figure and Index no.	Part number	Description	Usage Code	Units Per Assy
-16	869893	Cover Assembly, Exhaust Valve	A, B, C, D	1
-17	645620ST8-14	Screw, Self Locking	A, B, C, D	6
-18	25103	Washer	A, B, C, D	6
-19	834961	Gasket, Flapper Valve	A, B, C, D	1
-20	2495076 2496732	Spring, Valve Alternate Spring, Valve	A, B, C, D B, D	2
-21	2484074	Valve Assembly, Poppet	A, B, C, D	2
-22	2494164	Housing, Exhaust Valve	A, B, C, D	1
-23	834958 2495294	Alternate Gasket, Exhaust Port Housing Gasket, Exhaust Port Housing	A, B, C, D, A, B, C, D	1 1
-24	MS21083-N06	Nut, Self-locking	A, B, C, D,	2
-25	108054	Washer, Valve	A, B, C, D	10
-26	2484073	Seal, Valve	A, B, C, D	2
-27	834918 2496718	Diaphragm Assembly Alternate Diaphragm Assembly	A, B, D, C B, D	1 1
-28	MS21083-N06	Nut, Self-locking	A, B, C, D	2
-29	834919	Stem, Valve	A, B, C, D	2
-30	101778 2496719	Washer, Diaphragm Alternate Washer, Diaphragm	A, B, C, D C, D	4 4
-31	830281 2496720	Diaphragm Alternate Diaphragm	A, B, C, D C, D	1 1

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Figure and Index no.	Part number	Description	Usage Code	Units Per Assy
-32	834915	Spring, Diaphragm	A, B, C, D	2
	2496721	Alternate Spring, Diaphragm	C, D	
-33	829489	Valve, Control	A, B, C, D	2
-34	829488	Spring, Control Valve	A, B, C, D	2
-35	2499812	Plate, Identification	C, D	1
	1381119	Plate, Identification	A, B	1
-36	645620ST4-4	Screw, self locking	A, B, C, D	4
-37	61840	Washer	A, B, C, D	4
	2496737	Alternate Washer	A, B, C, D	4
-38	834916	Gasket, Nameplate	A, B, C, D	1
-39	MS49005-2C	Plug, Pipe	A, B	2
-40	2494187	Housing, Valve	A	1
	2499445	Housing, Valve	B	1
-41	2496788	Housing, Valve	C	1
	2499446	Housing, Valve	D	1

Lucas Aerospace

Lucas Aerospace Power Transmission

Publication No. 38U-23-8511B
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January 1995

OVERHAUL MANUAL WITH ILLUSTRATED PARTS LIST

REGULATING & RELIEF VALVE

Type No.

38E96-2C
38E96-2D
38E96-2E
38E96-3A
38E96-4A
38E96-5A
38E96-6A

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DESCRIPTION

The Lucas Aerospace Power Transmission 38E96 Regulating and Relief Valve regulates high-pressure, engine compressor bleed air to a lower pressure that is used to operate various pneumatic aircraft accessories such as:

1) Pneumatic deicer systems
2) Ejector-operated vacuum systems.

In addition to the ability to regulate air, the valve has a built-in safety feature.

If the regulation section of the valve should fail, the safety feature takes over to regulate the system pressure 1.5 - 5.0 psi higher than maximum regulated pressure. This gives the valve a dual regulating feature and eliminates the need for installing separate safety valves in the system.

TABLE OF LEADING PARTICULARS

	38E96-2 A,B,C,D	38E96-2E	38E96-3	38E96-4	38E96-5	38E96-6
Regulated Pressure	18.0 ± 1.0 psig	18.0 ± 1.0 psig	18.0 ± 1.5 psig	18.0 ± 1.0 psig	21.5 ± 1.0 psig	20.0 ± 1.0 psig
Input Pressure	20 - 250 psig	20 - 250 psig	20 - 250 psig	20 - 250 psig	23 - 200 psig	23 - 200 psig
Rated Capacity	30 scfm @ 20 psig	30 scfm @ 20 psig	30 scfm @ 20 psig	32 scfm @ 20 psig	12.4 scfm @ 23 psig	12.4 scfm @ 23 psig
Air Temperature	-65°F to 550°F	-65°F to 550°F	-65°F to 550°F	-65°F to 550°F	-65°F to 550°F	-65°F to 550°F
Relief Valve Cracking Pressure	20.5 psig to 22.0 psig	23.0 psig to 26.0 psig	22.5 psig to 24.0 psig	20.5 psig to 22.0 psig	24.5 psig to 27.0 psig	23.0 psig to 26.0 psig
Weight	1.35 lbs.	1.35 lbs	1.35 lbs	1.35 lbs.	1.35 lbs.	1.35 lbs.

SPECIAL TOOLS AND TEST EQUIPMENT

Table 2 lists the special tools and equipment suggested for maintenance of the regulating and relief valve.

TABLE 2

SPECIAL TOOLS AND TEST EQUIPMENT

P/N	DESCRIPTION	APPLICATION
U-7958	Holding Fixture (Soft jaw vise may be used instead of holding fixture)	Used to hold housing (27) and (19) when assembling or disassembling items (14) thru (18).
U-7957	Assembly Fixture	Used to hold valve assembly when assembling or disassembling items (5) and (9) thru (13).
U-7957	Holding Fixture	Used to hold valve assembly when assembling or disassembling items (1) thru (4).
U-7960	Holding Fixture	Used to hold adjusting screw (7) while assembling nut (8).
U-7961	Guide (Bullet Nose)	Used to install sealing ring (20) on actuating rod (19).
53E19-35C	Performance Test Stand	Used for testing of Regulating and Relief Valve.

1. DISASSEMBLY

WARNING

DO NOT REMOVE ALL FOUR SCREWS FROM VALVE COVER (5) AS SPRINGS (10) AND (12) ARE UNDER COMPRESSION.

a) Remove two screws (1) and two washers (2) from regulator valve cover (3). Remove two screws (6) and two washers (2) from relief valve cover (5). Remove the two screws from each housing which will allow the valve assembly to be installed over the pins of the assembly fixture U7957 (or equivalent).

b) Install valve assembly in assembly fixture U7957 and clamp down. Remove the two remaining screws (6) and flat washer (2). Grasp relief valve cover (5) firmly, unclamp fixture and remove relief valve cover (5) slowly.

c) Remove items (7) through (13). Remove valve from assembly fixture and remove items (1) thru (4), (22) thru (25).

CAUTION

ASSEMBLY (9), (10) and (11) MAY BE WEDGED TOGETHER. HANDLING MAY PRODUCE SUDDEN MOVEMENT/RELEASE OF COMPONENTS.

d) Install valve housing assembly (27) on holding fixture U7958 or equivalent. Insure flat surfaces on head of actuating rod (19) line up with flat surfaces on holding fixture. Remove items (14) thru (18).

e) Remove valve housing (27) from holding fixture U7958 and remove rod (19). Remove sealing ring (20) from rod (19) and sealing ring (21) from valve housing (27).

2. CLEANING

Thoroughly wash all parts with a suitable cleaning solvent. Air dry all parts using clean, filtered, factory air.

3. INSPECTION

a) Inspect all parts for damage.

Note: If "O" rings are dried and brittle, expect to find wear on items 3, 19, 23 and 27 (in bore of regulating valve piston cavity).

b) Inspect all threads for condition and cleanliness.

c) Inspect valve housing (27) .161 - .163 inch diameter hole, Figure 2. If diameter exceeds .165 or is scored or out-of-round, repair per Paragraph 5.

d) Inspect actuating rod (19) for scoring or galling. Replace if either is evident.

e) Inspect cover (3) ID for scoring or galling. Replace if either is evident.

f) Inspect ID of housing (11) for wear from spring (12). Replace if wear is noted.

g) Inspect valve seat (15) and spring retainer (13) for wear or rounding on seating edge. Either condition is cause for replacement.

h) Inspect spring guide (9) and housing (11) for scoring or galling. Replace if either is evident.

i) Inspect for sharp edge of orifice. Replace if necessary. (See Figure 2).

4. PARTS REPLACEMENT

a) Standard overhaul replacement parts kit for each model are as follows:

UNIT	SERVICE KIT NUMBER
38E96-2C,2D,4A	SK276
38E96-3A	SK277
38E96-2E,5A,6A	SK278

b) In addition to standard replacement parts replace any worn or damaged parts as required.

5. REPAIR

Repair valve housing (27) as follows: (Refer to Figure 2.) Normal, standard machine shop tools are required.

a) Use a suitable fixture to support valve housing. Drill and tap one wall for .125 inch pipe thread plug.

b) Install plug MS20913-1D to depth shown, 0 - .030 inch. Use Loctite retaining compound RC620 on threads. Stake plug in place.

c) Machine plug head flush to .010 inch above surface "A".

d) Machine .161 - .163 inch must be held concentric with "A" within .001 inch. Do not exceed 32 micro finish.

WARNING

KEEP ALODINE 1200 AWAY FROM ACIDS. DO NOT LET ORGANIC MATERIALS, LIKE SAWDUST, RAGS, ETC., GET SATURATED WITH IT BECAUSE THEY CAN EASILY IGNITE WHEN DRY. IF IT GETS ON YOUR SKIN, WASH THOROUGHLY. IF IT GETS IN YOUR EYES, FLUSH WITH WATER FOR 15 MINUTES AND SEEK PROMPT MEDICAL ATTENTION.

f) Brush Alodine 1200 on remachined surfaces.

6. LUBRICATION

Lubricate all sealing rings and "O" rings with FS1265 lubricant or DC4 compound obtainable from Dow Corning, Englewood Cliffs, NJ.

7. REASSEMBLY (Refer to Figure 1)

a) Install "O" ring gasket (21) into housing (27). Using guide U7961, install sealing ring (20) onto rod (19). Install rod (19) into housing (27). Place housing assembly onto holding fixture U7958. Assemble items (15) through (18) over shaft (19). Insure item (18) is assembled chamfer side up.

Line up kidney slots of items (15) and (18), position a full kidney slot over the housing (27) opening. Place two screws (6) through assembly (15) - (18) into housing (27) to align diaphragm. Install nut (19) on shaft, make sure nut (14) is on seat valve (15), torque nut to 4.5 in-lbs above drag torque.

b) Assemble seal (4) onto cover (3). Install quad ring seal (24) onto piston (23). (Do not twist quad ring seal. Lubricate piston ID lightly.) Install gasket (25), piston (23), and spring (22) onto cover (3). Install cover assembly into valve housing (27). Install screws and washers (1) and (2), and torque screws (1) to 36 in-lbs.

c) Place valve over pins of assembly fixture U7957. Assemble items (9) through (13) onto valve housing (27).

d) Lube threads of screw (7) with Bostik never seize thread lube and assemble nut (8) using holding fixture U7960.

e) Install screw and nut assembly (7) and (8) into valve cover (5).

f) Place cover assembly (5), (7) and (8) over guide pins of fixture. Align guide (11) over seat (13), press down on cover to compress springs (10) and (12), and slide clamp of fixture over cover.

g) Install two screws (6) and two washers (2) through cover (5) into housing (27). Torque screws to 22 in-lbs.

h) Unclamp and remove assembly from fixture. Install the two remaining screws (6) with washers (2) through cover (5) into housing (27). Torque screws to 22 in-lbs.

8. TEST PROCEDURE 38E96

Install valve assembly in Test Stand 53E19-35C or test set up as shown by Figure 4.

a) Crack and Resetting Pressure Test

1) Gradually increase the pressure until leakage through the relief valve cap (5) reaches 5 scfh. At this point, the relief valve pressures should be as follows:

Relief Pressure PSIG	Style Number
20.5 to 22.0	2 A,B,C,D
22.5 to 24.0	3
20.5 to 22.0	4
24.5 to 17.0	5
23.0 to 26.0	6, 2E

Record this cracking pressure (refer to Figure 6 Data Sheet).

2) Increase relieving flow to above 12 scfh then decrease to the pressure per style number in the table below. The leakage flow allowed is 5 scfh maximum.

Relief Pressure PSIG	Style Number
19.5	2 A,B,C,D
21.5	3
19.5	4
23.5	5
22.5	6, 2E

Add shims item 11A, Figure 1, to maintain correct relief pressure levels (.090" maximum). Disassemble and correct part if unit fails this test.

b) Remove from leak fixture and increase pressure until relief valve is in full relief. Record this pressure.

c) Pressure Piston Test

If Test Stand 53E19-35C is not available, install valve in test set up as shown in Figure 3.

1) Set inlet pressure conditions to 85 psig min. and flow to 35 scfm. Reduce inlet pressure to 10 psig.

2) Slowly increase inlet pressure to 85 psig min. Observe that there is a sudden dip in regulated pressure or flow (pressure piston, item (23), Figure 1, has closed). Record the inlet pressure at which the regulated pressure dips momentarily.

3) Decrease the inlet pressure from 85 psig min. Observe that there is a sudden change in regulated pressure and flow (pressure piston has opened). Record the inlet pressure at which the regulated pressure raises momentarily.

4) The recorded inlet pressures of paragraphs c(2) and c(3) must be between 45 and 85 psig inlet pressure.

d) Calibration

The valve setting in paragraph 8(e) is for guidance only in making the initial setting. Readjustment may be necessary to meet the requirement of minimum flow of paragraphs e, f and g.

e) Setting

Adjust the power spring adjusting screw to maintain the regulating pressure per valve style shown in regulating pressure table. The inlet pressure is 85 psig min ± 1 psig (-2E 30 ± 1 psig) and flow 25 ± 1/2 scfm.

Regulating Pressure PSIG	Style Number
17.0 to 19.0	2 A,B,C,D,E
16.5 to 19.5	3
17.0 to 19.0	4
20.5 to 22.5	5
19.0 to 21.0	6

f) Test Acceptance Points

1) With inlet pressure of 85 psig min. ± 1 psig (-2E, 30 ± 1 psig) and flow of 25 ± 1/2 scfm, the regulated pressure should be within the limits of Table of paragraph e. Record the regulated pressure.

2) For the -2E Model only with 20 psig inlet pressure, record regulated pressure at flows of 5 and 20 scfm.

Proceed to paragraph g maintaining inlet pressure at 85 psig min.

g) Stability Test

1) Operate unit at 85 psig min. ± 1 psig inlet pressure and the following flows:

Style Number	Flow Scfm
2,3,4,5,6	25 ± 1/2

Record regulated pressure.

Perform following for all styles.

2) Introduce a rapid change in flow from 25 to 35 scfm (-2E only with 50 psig inlet pressure at flows of 5 to 20 scfm) and return to 25 scfm. Cycle three times. Valve must be stable with no chattering or relieving.

3) With inlet pressures of 30 ± 1 psig and flow of 30 ± 1/2 scfm, (-2E only 20 ± 1/2 scfm) the regulated pressure should be within the limits of paragraph 8e. Record the regulated pressure.

h) After setting the adjusting screw (7), torque nut (8) to 18 in-lbs above drag torque, apply Hysol epoxy 1C (white) on nut (8) and screw (7) and allow to cure.

i) Tie wire screws (6) no more than two screws each wrapping. Tie wire screws (1) in same manner. Use wire MS20995C20-6.

9. TROUBLESHOOTING

If the test values specified in paragraph 8 cannot be obtained, refer to Figure 1 for item identification and Table 3 for remedial procedures.

TABLE 3 TROUBLESHOOTING

Test Failed	Probable Cause	Remedy
Para 8.a) 1 cracking pressure too high	High Spring Tension	Remove Shim (11a). If no shim in unit, place valve in full relief and recheck. Replace spring (12)
Cracking pressure too low	Low spring tension	Add shim (11a). Check valve seat (15). Replace spring (12).
Para 8.a) 2 Cracking pressure good, valve leaks	Seating surfaces dirty, scratched	Inspect seating surfaces. Clean, polish or replace component
	Seating surface on seat valve (15) too wide	Replace seat valve.
	Nut (14) on actuating rod (19) not positioned correctly	Follow instructions in Para. 7
		Adding a shim (11a) may solve leak problem but may elevate cracking pressure beyond spec.
Para 8.b Valve fails to go into full relief		Adjust stand to read 1 lb over crack test pressure. Cover top of unit with hand to apply back pressure. Should put unit into relief. Check center hole in housing (27) for proper size or burrs, excess Everlube.

Test Failed	Probable Cause	Remedy
Para 8.c	Binding in lower portion of valve	Check cover (3), piston (23) and ring for wear or signs of binding/lack of lubrication. Repair/replace components
	Spring (22) too stiff	Replace spring (22)
	Actuation Rod (19) binding	Check for burr in housing (27) hole
Para 8.g Unstable valve chatter or shifting dip exaggerated	Check entire unit especially actuation rod (19)	
Air exhaust from vent under discharge port.	Damaged or missing "O" rings	Check "O" rings. Replace questionable items.

ILLUSTRATED PARTS LIST

Item No.	Part No	Description	2C	2D	2E	3A	4A	5A	6A
1	645010G5CV	Screw, Soc. Hd. Cap.	4	4	4	4	4	4	4
2	645074-16FW	Washer, Flat	8	8	8	8	8	8	8
3	2493670	Cover, Regulating Valve	1	1	1	1	1	1	1
4	645513B1	Seal, Quad Ring	1	1	1	1	1	1	1
5	2487795	Cover, Relief Valve Complete	1	1	1	1	1	1	1
6	645010G5CV	Screw, Soc. Hd. Cap.	4	4	4	4	4	4	4
7	2481040	Screw, Valve Spring Adj.	1	1	1	1	1	1	1
8	645167P624	Nut, Lock	1	1	1	1	1	1	1
9	2488176	Guide, Spring Regulating	1	1	1	1	1	1	1
10	2487793	Spring, Air Valve	1	1	1	1	1		
	2489479	Spring, Air Valve						1	1
11	2488177	Housing, Spring Air Valve	1	1	1	1	1	1	1
11a	1329922-4	Shim, Shaft	AR	AR	AR	AR	AR	AR	AR
	1329922-3	Shim, Shaft	AR	AR	AR	AR	AR	AR	AR
	1329922-2	Shim, Shaft	AR	AR	AR	AR	AR	AR	AR
	1329922-1	Shim, Shaft	AR	AR	AR	AR	AR	AR	AR
12	2487792	Spring, Air Valve Relief	1	1			1		
	2495833	Spring, Air Valve Relief				1			
	2489478	Spring, Air Valve Relief			1			1	1
13	2481053	Ret., Actuating Valve Spring	1	1	1	1	1	1	1
14	MS21043-06	Nut	1	1	1	1	1	1	1
15	2484154	Seat Valve	1	1	1	1	1	1	1
16	2481047	Plate Diaphragm	1	1	1	1	1	1	1
17	2481048	Diaphragm, Valve	1	1	1	1	1	1	1
18	2484153	Plate Diaphragm Retainer	1	1	1	1	1	1	1
19	2489085	Rod, Actuating	1	1	1	1	1	1	1
20	645001Q012	Ring, Sealing	1	1	1	1	1	1	1
21	645001KK018	Gasket "O" Ring	1	1	1	1	1	1	1
22	2487942	Spring, Regulating Valve	1	1	1	1	1	1	1
23	2493622	Piston, Regulating Valve	1	1	1	1	1	1	1

Item No.	Part No	Description	2C	2D	2E	3A	4A	5A	6A
24	645513B3	Seal, Quad Ring	1	1	1	1	1	1	1
25	2886226	Gasket, Cover (Preferred)	1	1	1	1	1	1	1
25	2484327	Gasket, Cover (Alternate)	1			1			1
25	2499787	Gasket, Cover (Alternate)		1	1		1	1	
26	2492778	Housing Valve				1			
	2498012	Housing Valve	1	1					
	2499788	Housing Valve			1		1	1	1
27	890335-51	Plug, Shipping	1	1	1	1			
	890335-56	Plug, Shipping	1	1	1		1	1	1
28	890335-58	Plug, Shipping				1			
29	2499797	Union, Flared Tube					1	1	
30	645001KK116	Gasket, "O" Ring					1	1	

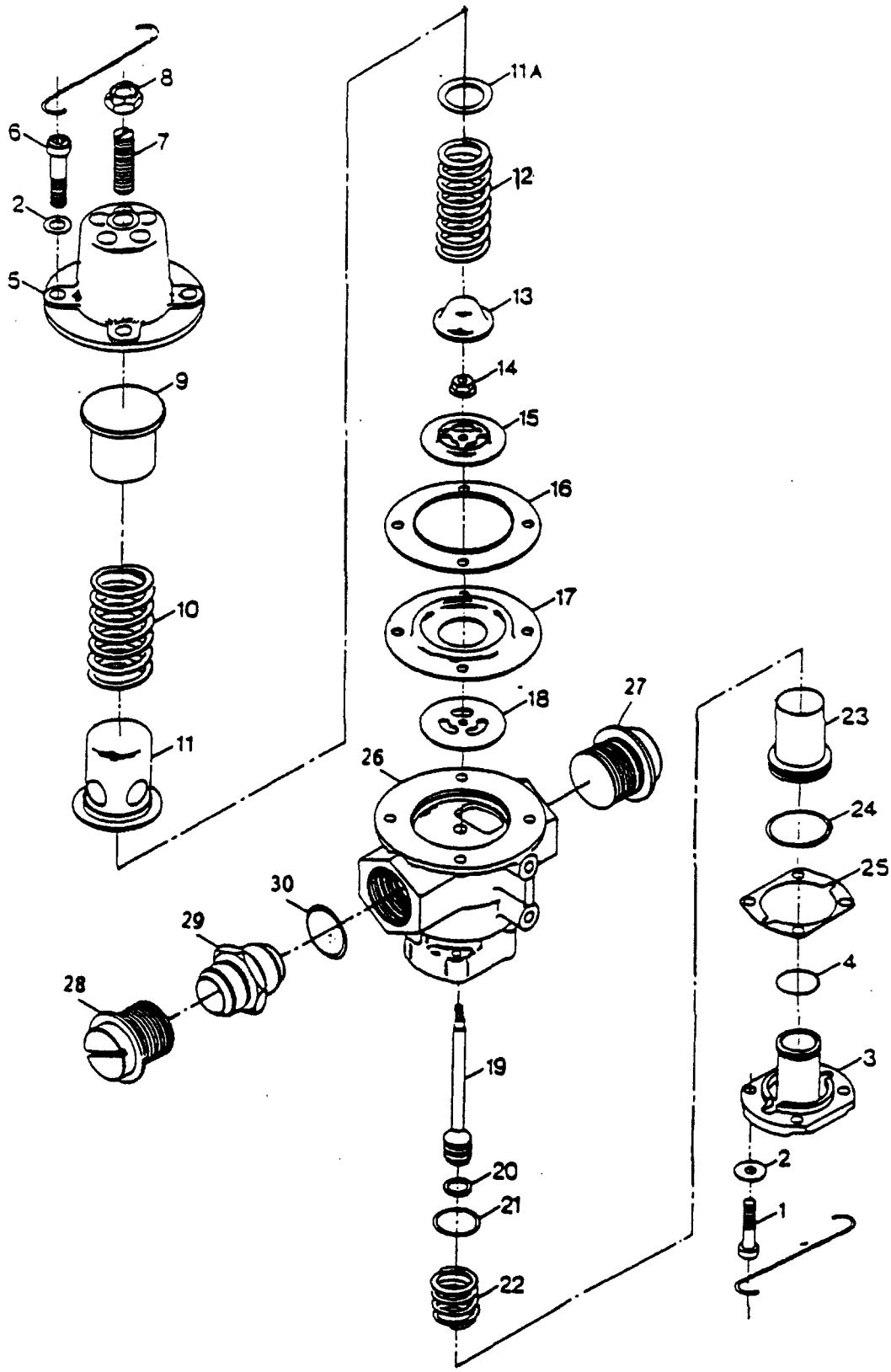


Figure 1 Regulating and Relief Valve - Exploded View

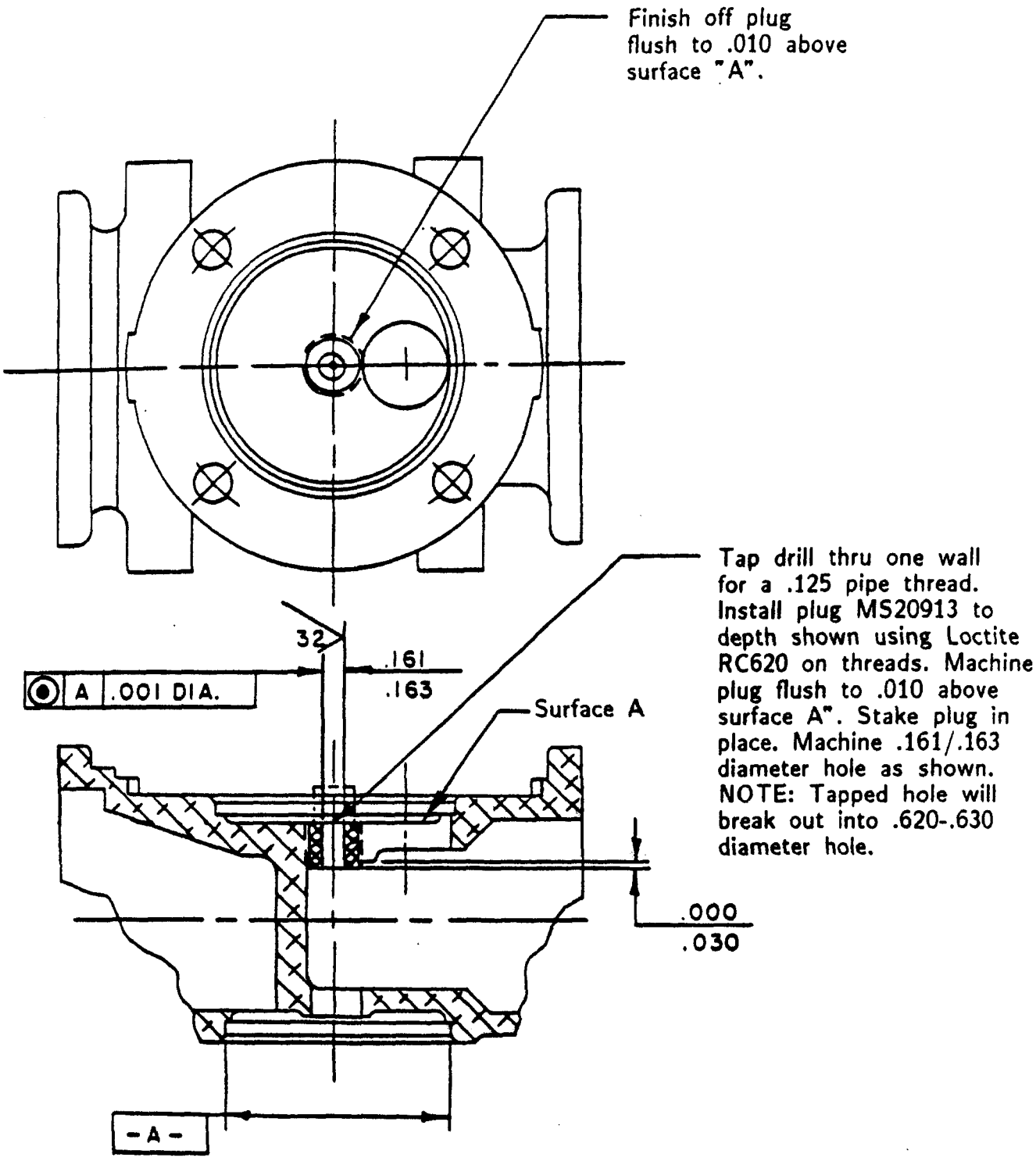


Figure 2 Valve Housing

Figure 3.

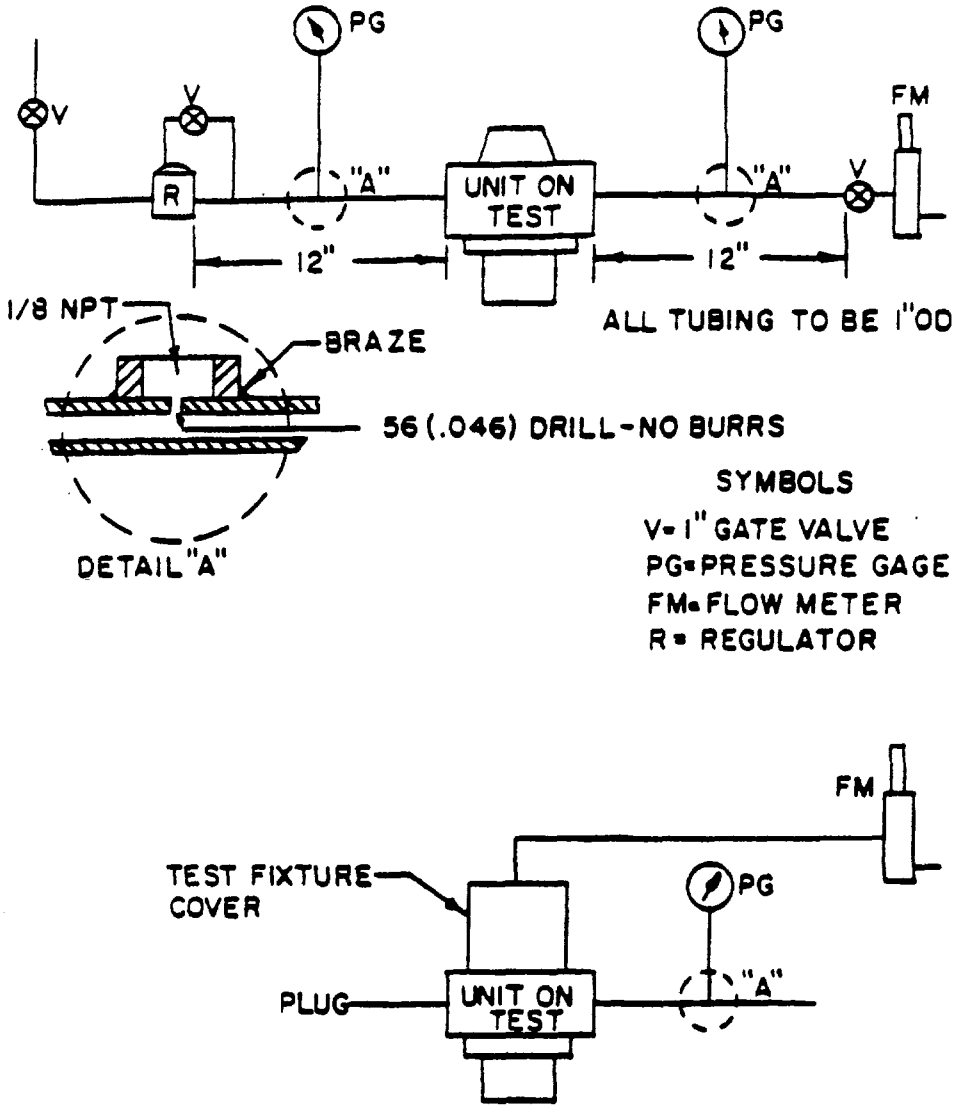


Figure 3

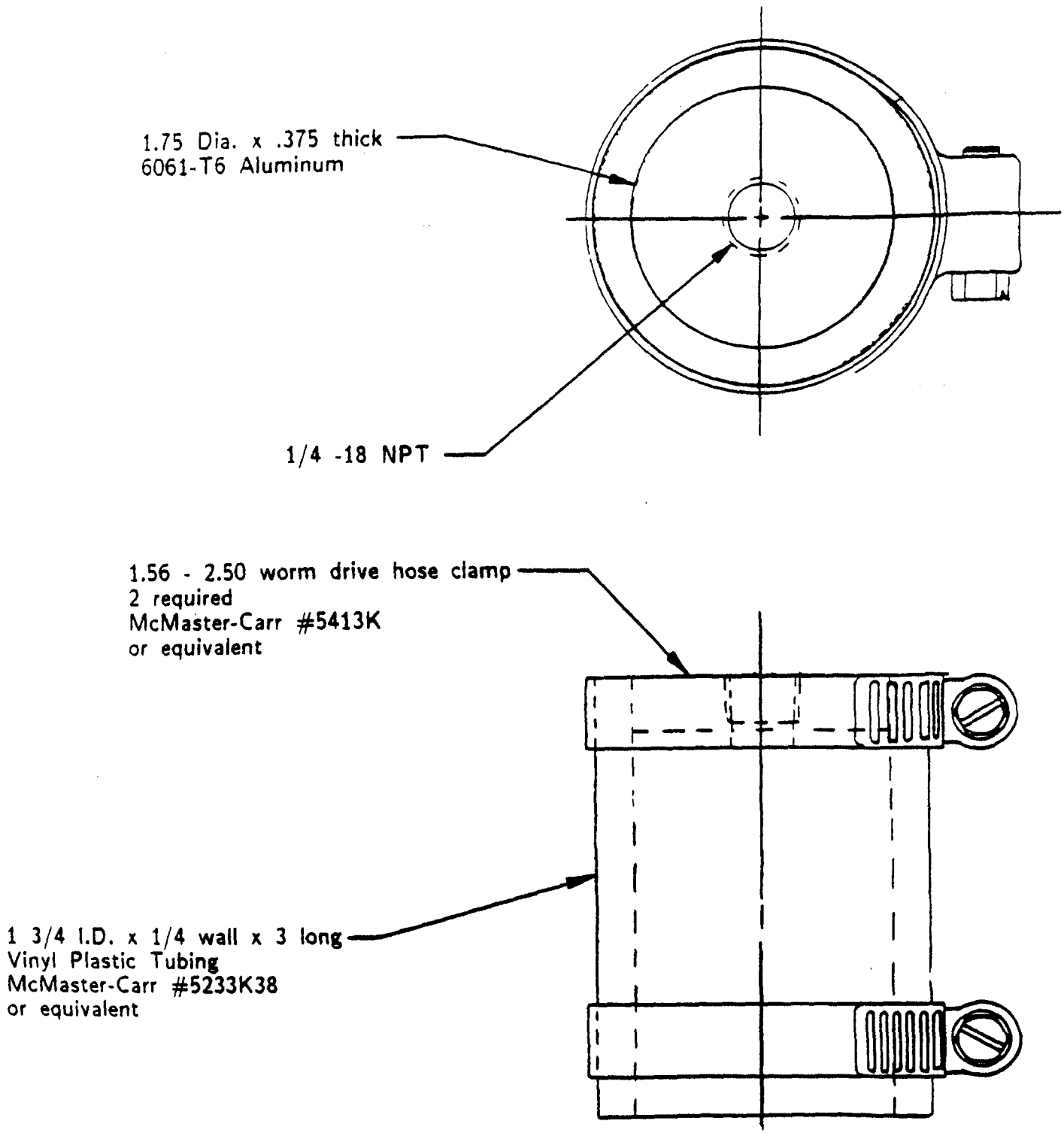


Figure 4 Test Fixture Cover U9408

39E96- ____ DATA SHEET

Assembly Date_____

Model Number_____

Serial Number_____

SECTION a	Cracking Pressure	_____	PSIG
SECTION b	Full Relief Pressure	_____	PSIG
SECTION c 2	Piston Closes @ Inlet Pressure	_____	PSIG
SECTION c 3	Piston Opens @ Inlet Pressure	_____	PSIG
SECTION e	Initial Pressure Setting	_____	PSIG
SECTION f 1	Regulated Pressure @ 85 PSIG Min. (-2E, 30 PSIG)	_____	PSIG
SECTION f 2 (-2E Only)	Regulated Pressure @ 5 SCFM	_____	PSIG
	Regulated Pressure @ 20 SCFM	_____	PSIG
SECTION g 1	Regulated Pressure	_____	PSIG
SECTION g 2	Valve is Stable with No Chattering or Relieving		
SECTION g 3	Regulated Pressure @ 30 PSIG	_____	PSIG

Figure 5

Lucas Aerospace

Lucas Aerospace Power Transmission Corporation

Pub. No. 44U-23-8511A
Revised
March 1992

OVERHAUL MANUAL WITH ILLUSTRATED PARTS LIST

WATER SEPARATOR AND FILTER

PART NUMBERS:

44E15-1A
44E15-1B
44E15-2A
44E15-2B

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1.0 DESCRIPTION

The 44E15 Water Separator and Filter Assembly removes water and contamination from the engine bleed system before it can collect and freeze in the bleed air components.

This separator provides a centrifugal component to the air, so that liquid water collects on the walls of the separator bowl. The collected water gravitates to the bottom of the bowl, where it is removed through a drain opening. There also is a bypass relief valve that will allow air flow through the separator in case the filter element becomes clogged.

TABLE OF LEADING PARTICULARS

Normal Pressure	18 Psig
Maximum Pressure	75 Psig
Flow	20 SCFM
Maximum Temperature	250° F
Filtration -1 models	0.3 Micron
Filtration -2 models	2.0 Micron

2.0 DISASSEMBLY

A. Back out housing retaining bolt (1, fig. 1) and remove housing (7) from manifold (10).

B. Remove O-ring (9) from manifold (10).

C. Remove cotter pin (19) and separate items 2, 3, 4, 5, 6, 7, 8 and 18.

D. Remove screws (17) and separate items 11 through 16.

3.0 CLEANING

Thoroughly wash all parts with suitable cleaning solvent. Air dry all parts using filtered air. The filter element (18) is not cleanable.

4.0 INSPECTION

A. Inspect all parts for damage.

B. Inspect all threads for condition and cleanliness.

C. Inspect separator housing and manifold for burrs.

5.0 PART REPLACEMENT

A. Standard overhaul replacement part kits for each model are as follows:

Unit No.	Kit No.
44E15-1A	SK 255
44E15-1B	SK 251
44E15-2A	SK 256
44E15-2B	SK 252

B. Replace any damaged parts in addition to the standard replacement kit as required.

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6.0 LUBRICATION

Lubricate all O-rings with DC-4 lubricant obtainable from Dow Corning, Midland, Michigan 48640 prior to assembly.

7.0 ASSEEMBLY

A. Assembly in reverse order of disassembly.

B. Torque bolt (1) to 9-11 inch pounds above running torque.

CAUTION

PRESS THE FILTER ELEMENT HOUSING ASSEMBLY (7) INTO THE SEPARATOR MANIFOLD (10). DO NOT FORCE THE ASSEMBLY INTO THE HOUSING BY TURNING IN THE RETAINING BOLT. (1).

8.0 TEST PROCEDURE

A. A unit leakage check is performed by plugging the drain fitting and discharge port of the unit with suitable fittings.

B. Connect the inlet port to a filtered source of air pressure.

C. Apply 125 PSIG air pressure to the inlet port and immerse the assembly in water. No leakage is permitted and no unit damage should be apparent.

CAUTION

TAKE ADEQUATE SAFETY PRECAUTIONS BEFORE APPLYING AIR PRESSURE.

E. Relieve air pressure, dry unit and install shipping caps.

9.0 STORAGE

The Water Separator may be stored for 60 months (maximum time) provided the following conditions prevail. If these conditions are not observed, shelf life will be considerably shortened.

A. Storage area must be dry.

B. Units must not be subjected to temperatures higher than 250° F.

C. Units must be effectively protected from dust.

D. Units should be stored in shipping cartons if possible

E. The unit should be tested per paragraph 7 prior to installation

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ILLUSTRATED PARTS LIST

Item No.	Part No.	Description	Quantity Per Assembly 1A	2A	1B	2B
	44E15-1A	Water Separator	1			
	44E15-1B	Water Separator			1	
	44E15-2A	Water Separator		1		
	44E15-2B	Water Separator				1
1	2487865	Bolt, Housing Retaining	1	1	1	1
2	AN960C416L	Washer, Flat	1	1	1	1
3	NAS1523C4E	Packing with Retainer	1	1	1	1
4	2487864	Spring, Seal Loading	1	1	1	1
5	2487863	Retainer, Spring	1	1	1	1
6	645001RR010	Gasket, O-Ring	1	1	1	1
7	2493231	Housing, Complete	1	1		
7	2883144	Housing, Complete			1	
7	2883145	Housing, Complete				1
8	2487980	Retainer, Filter	1	1	1	1
9	645001RR151	O-Ring	1	1	1	1
10	2497073	Manifold, Water Separator	1	1	1	1
11	2497089	Valve, Bypass Relief	1	1	1	1
11A	645001RR010	O-Ring	1	1	1	1
12	AN960C616LL	Washer, Flat	1	1	1	1
13	2497301	Spring, Relief Valve	1	1	1	1
14	645001RR026	O-Ring	1	1	1	1
15	2497075	Cover, Bypass Valve	1	1	1	1
16	NAS620C10L	Washer, Flat	2	2	2	2

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ILLUSTRATED PARTS LIST

Item No.	Part No.	Description	Quantity Per Assembly 1A	2A	1B	2B
17	645199-1	Screw, Fill. Hd.	2	2	2	2
18	2488889	Element, Filter Assembly	1			
18	2488294	Element, Filter Assembly		1		
18	2883136-1	Element, Filter Assembly			1	
18	2883136-2	Element, Filter Assembly				1
18A	645001RR215	O-Ring (Part of item 18)	1	1	1	1
19	MS24665-86	Pin, Cotter	1	1	1	1
20	1329968	Plug, Shipping	2	2	2	2

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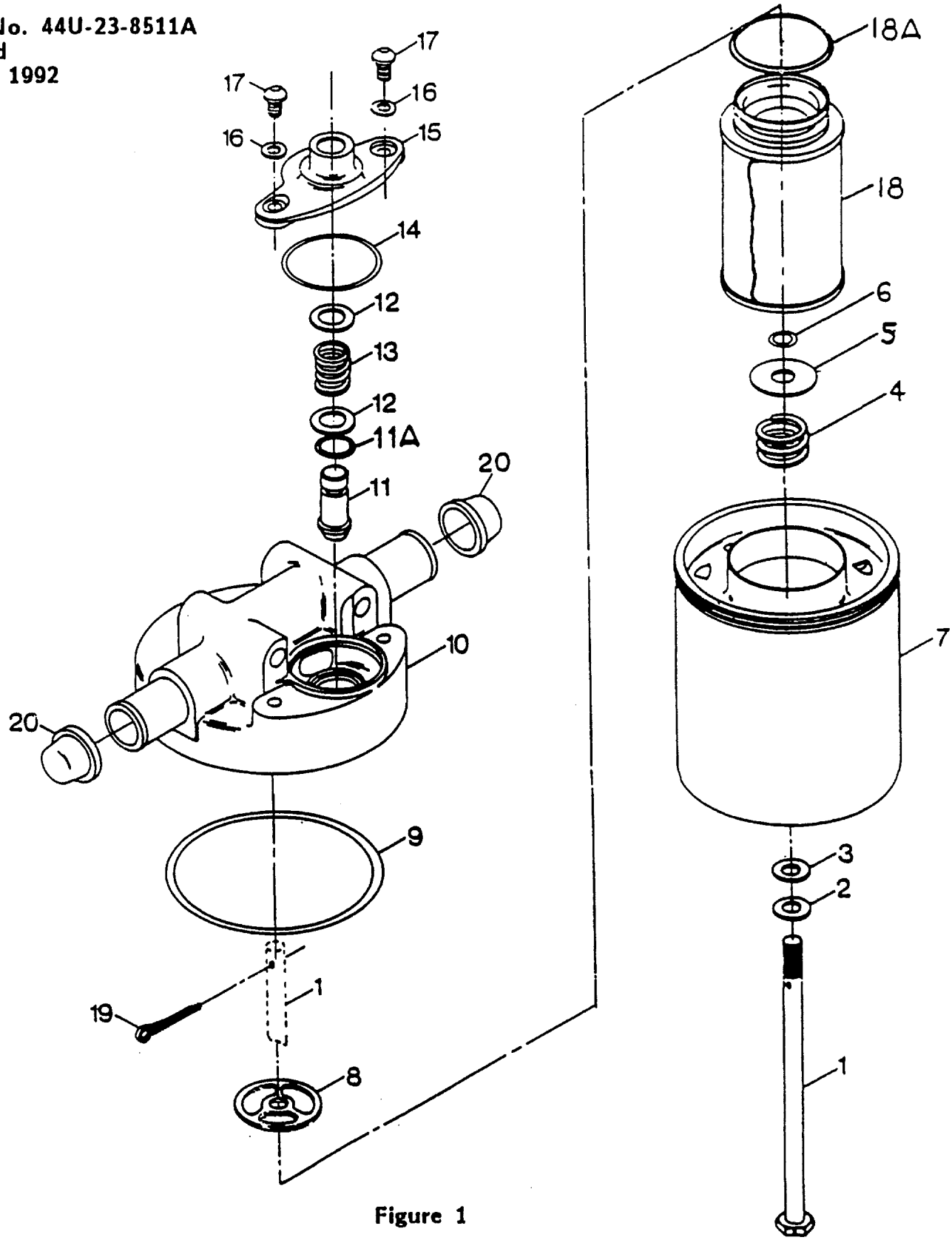


Figure 1

CHAPTER

31

INDICATING/ RECORDING SYSTEMS

MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B./T.R.
Wakmann	Aircraft Clock	Type A13A Model W-33-7540-4		Jan 31/1962	

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NAVWEPS 05-35A-27

TECHNICAL MANUAL

OVERHAUL INSTRUCTIONS WITH PARTS BREAKDOWN

AIRCRAFT CLOCK

TYPE A13A

WAKMANN MODEL W-33-7540-4

(WAKMANN)

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE AND THE CHIEF OF THE BUREAU OF AERONAUTICS

31 JANUARY 1962

TABLE OF LEADING PARTICULARS

Actuation	Manually set and manually wound
Indicator Hands	Hour, minute, second, minutes elapsed
Movement	17 jewel, 8 day
Overall Dimensions	2.375 inches square X 1.42 inches deep
Face Dimensions	1 7/8 inches diameter, 12 hour black face with fluorescent-luminescent hands and numerals
Weight	8.32 ounces
Rate	Variable, using the regulator lever

1. SPECIAL TOOLS. None.

2. DISASSEMBLY. (See figures 1 and 2.)

a. Disassemble in the same order as the key index numbers assigned to the exploded view illustrations. Disassemble only as far as necessary to replace defective parts.

3. CLEANING.

a. Cleaning should be accomplished by experienced and skilled watchmakers under shop conditions.

4. INSPECTION.

a. Check that winding and setting knob is properly secured and under spring tension.

b. Check clock regulator lever if clock is running too fast or too slow.

c. Check freedom of the minute and hour hands by pulling the winding and setting knob outward and rotating in both directions.

d. Check clock dial face for scratches and scoring.

e. Check clock case and plastic seal for evidence of scratches and scoring.

5. REPAIR AND REPLACEMENT.

Note

The following repair and replacement procedures may be performed by authorized field personnel. All practices not listed must be performed by skilled watchmakers under shop conditions.

a. To replace a damaged case or crystal, unscrew the lock ring (5, figure 1) and then remove crystal (6) and plastic seal (7). After unscrewing the back (15), remove the two small screws (20) from the case back. Tip case forward and the movement will drop out.

b. To replace a rear mounted clock installation, remove the two 6-32 bolts (43) from the front of the instrument panel. Remove the two Tinnerman nuts (42) from the instrument panel rear. See figure 3 for installation requirements of a rear mounted clock.

c. To replace a front mounted clock installation, remove the two 6-32 self-tapping screws (43, figure 1) from the front of the clock case. See figure 3 for installation requirements of a front mounted clock.

d. After repair or replacement, it may be necessary to regulate the clock. Remove clock from instrument panel. (Refer to step b. or c.) Remove the case back. (Refer to step a.) Move the regulator lever (5, figure 2) toward + or – as required.

Note

Regulator is graduated from + to –. If clock runs fast, move regulator toward –. If clock runs slow, move regulator toward +. One division on regulator dial will alter clock rate + one minute per day.

6. LUBRICATION.

a. Clock lubrication should be performed by skilled watchmakers under shop conditions. Use lubricating oil, Military Specification MIL-L-3918.

7. REASSEMBLY.

a. Reassembly is the reverse of disassembly.

8. TEST PROCEDURE.

a. Fully wind clock. Over a period of four days, determine the following factors. On the first day, determine the starting error. On the second day, run the minutes elapsed hand for six hours. On the third day, run the hour and minute hands for six hours. On the fourth day, run the minute and hour hands and minutes elapsed hand for six hours.

Note

Do not rewind the clock during or after the four day test period.

b. The average daily error rate should not exceed 30 seconds per day. The variation of any daily error rate from the average daily rate shall not exceed 15 seconds per day.

c. Allow clock to operate until it stops. The clock must run for a minimum of eight days (192 hours).

d. Check the rate during the eight days. The clock shall not gain or lose more than 15 seconds after eight days.

NOTE

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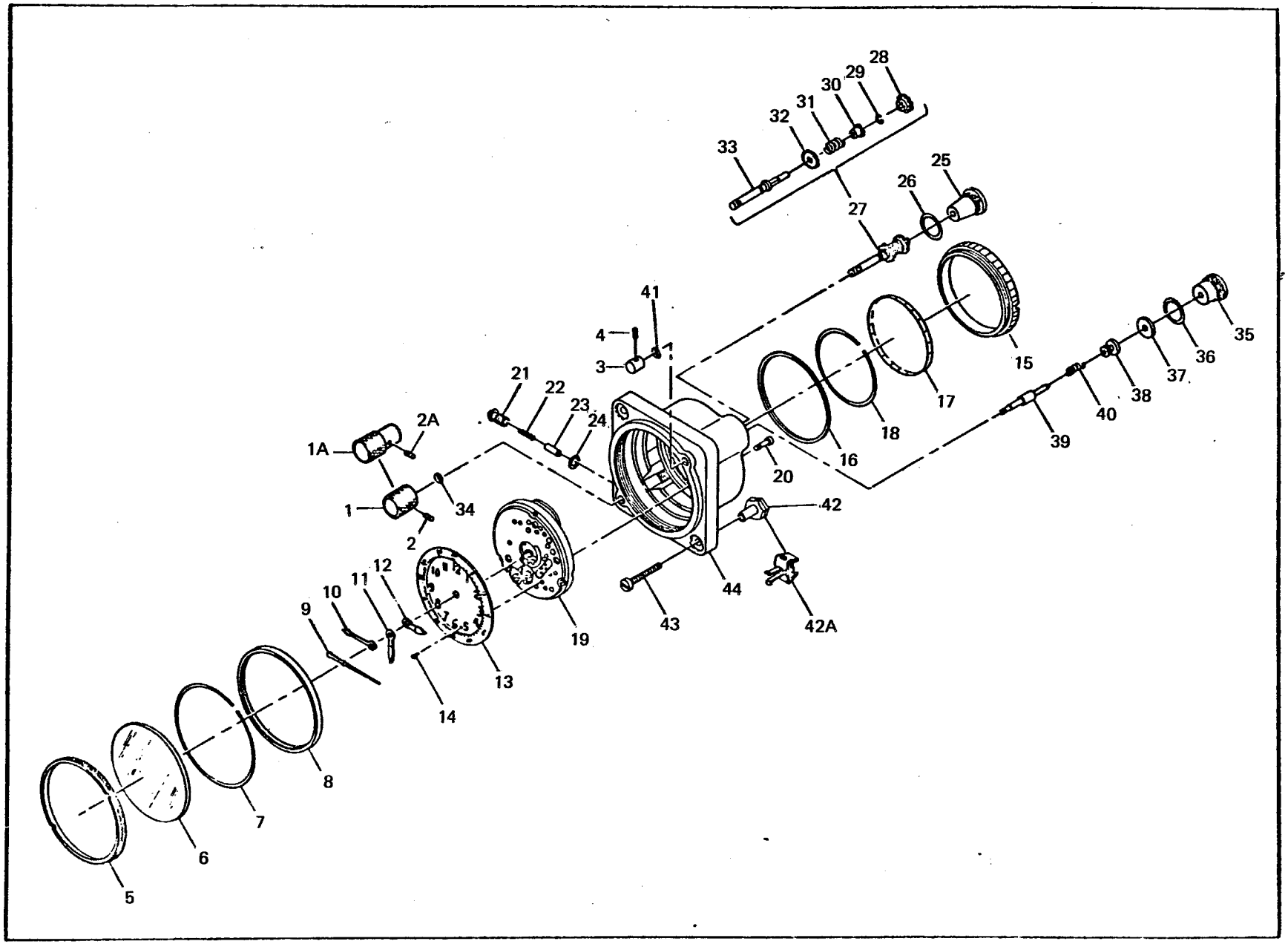
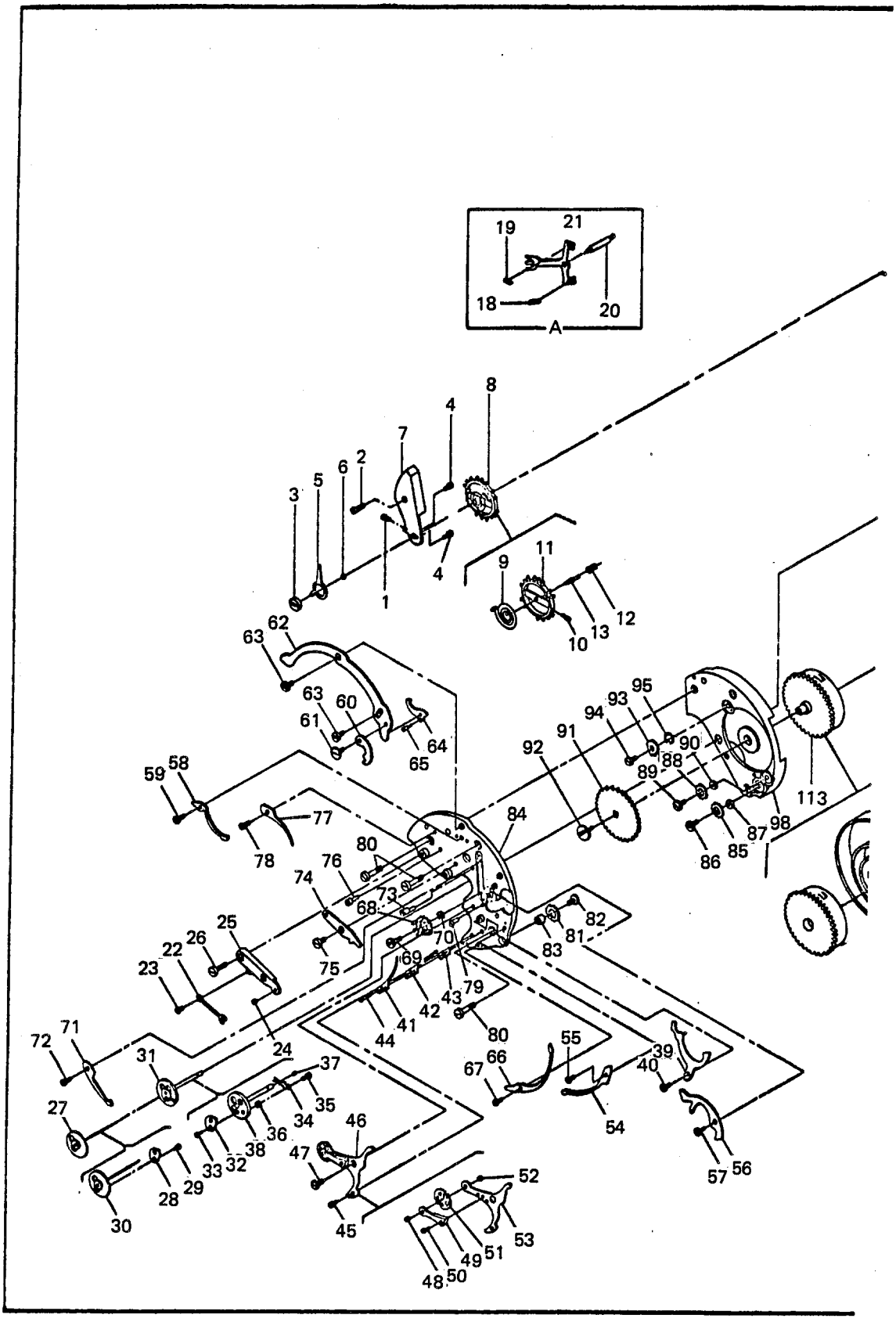


Figure 1. Aircraft Clock, Type A13A

AIRCRAFT CLOCK, CHRONOGRAPH, TYPE A-13A

Fig. & Index No.	Part No	DESCRIPTION 1 2 3 4 5 6 7	Units Per Assy	Source Code
1-		MODEL W-33-7540-4 AIRCRAFT CLOCK, CHRONOGRAPH, TYPE A-13-A	1	
-1.	4112	. KNOB, WINDING	1	
-1A	4113	. KNOB, WINDING LONG (Alternate for Part No. 4112)		
		(ATTACHING PARTS)		
-2	4164	. SCREW, WINDING KNOB	1	
-2A	4167	. SCREW, WINDING KNOB, LONG (Alternate for Part No. 4164)	1	
		*		
-3	4114	. KNOB, STOP	1	
		(ATTACHING PARTS)		
-4	4165	. SCREW, STOP KNOB	1	
		*		
-5	4108	. RING, CRYSTAL LOCK	1	
-6	4103	. CRYSTAL	1	
-7	4105	. SEAL, PLASTIC	1	
-8	4107	. RING, REFLECTOR	1	
-9	4093	. HAND, SWEEP SECOND	1	
-10	4095	. HAND, MINUTE RECORDER	1	
-11	4091	. HAND, MINUTE	1	
-12	4090	. HAND, HOUR	1	
-13	4101	. DIAL	1	
		(ATTACHING PARTS)		
-14	4163	. SCREW, DIAL	2	
		*		
-15	4099	. CASE, BACK	1	
-16	4110	. GASKET, BACK	1	
-17	17	. DEHUMIDIFIER PAPER	1	
-18	4122	. SPRING, LOCKING PAPER	1	
1-19	7540M	. MOVEMENT ASSEMBLY (See fig. 2 for breakdown)	1	
		(ATTACHING PARTS)		
-20	4166	. SCREW, CASE	2	
		*		
-21	4026	. CANNON, STEM HOLDER	1	
-22	4027	SPRING, CANNON STEM HOLDER	1	
-23	4025	. HOLDER, STEM	1	
-24	4028	. WASHER, STEM HOLDER	1	
-25	4118	. CUP, WINDING STEM	1	
-26	4121	. GASKET, CUP WINDING	1	
-27	27-7540	. STEM ASSEMBLY	1	
-28	4012	. . PINION, WINDING	1	
-29	4014	. . RING, STEM LOCKING	1	
-30	4013	. . WHEEL, CLUTCH	1	
-31	4015	. . SPRING, COIL CLUTCH WHEEL	1	
-32	4016	. . PINION, SETTING	1	
-33	4010	. . STEM, WINDING	1	
-34	4115	. SEAL, STEM	1	
-35	4119	. CUP, SHAFTSTOP	1	
-36	4121	. GASKET, CUP SHAFTSTOP	1	
-37	4086	. PUSH RING CHRONOGRAPH SLIDING	1	
-38	4085	. CANNON, STOPSHAFT	1	
-39	4082	. SHAFT, STOP	1	
-40	4084	. SPRING, STOPSHAFT	1	
-41	4115	. SEAL, SHAFT	1	
-42	4117	. NUT, CASE MOUNTING	2	
-42A	4117A	. NUT, TINNERMAN (Alternate for Part No. 4117)	2	
-43	4117B	. SCREW, MOUNTING	2	
-44	4097	. CASE	1	


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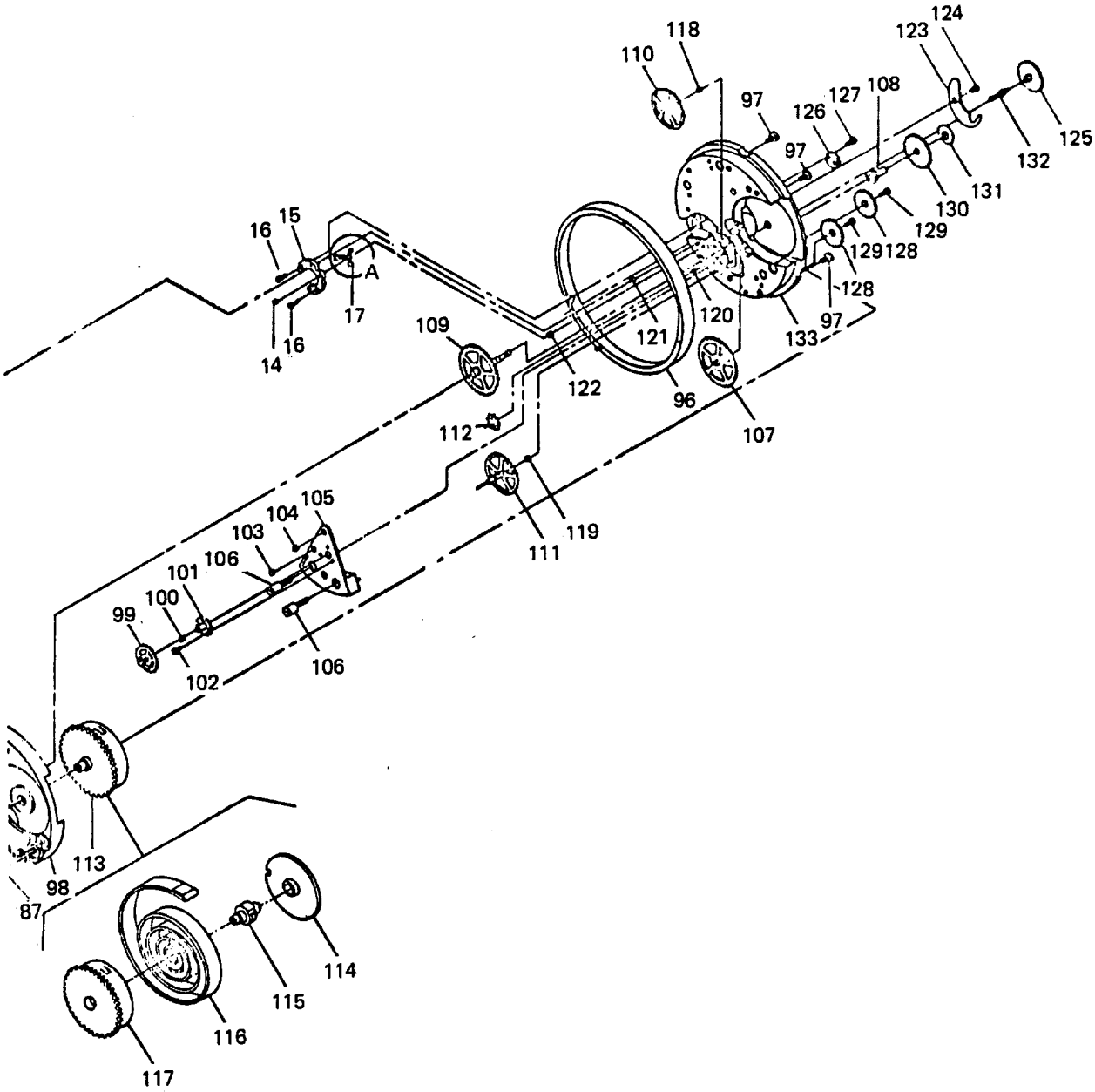


Figure 2. Movement Assembly

MOVEMENT ASSEMBLY

2-	7540M	MOVEMENT ASSEMBLY (See fig. 1-19 for next higher assy)	Ref
-1	4164	. SCREW, STUD	1
2-	NO NO.	. COCK BALANCE ASSEMBLY	1
		(ATTACHING PARTS)	
-2	4134	. SCREW, COCK BALANCE	1
		*	
-3	4053	. . JEWEL ASSEMBLY, UPPER CAP	
		(ATTACHING PARTS)	
-4	4145	. . SCREW, UPPER CAP, JEWEL	2
		*	
-5	4054	. . REGULATOR	1
-6	4171	. . JEWEL, BALANCE HOLE, UPPER	1
-7	4004	. . COCK, BALANCE	1
-8	4050	. BALANCE ASSEMBLY	1
-9	9722	. . HAIRSPRING	1
-10	9720-5	. . SCREW, BALANCE	16
-11	9720-A	. . BALANCE	1
-12	4049	. . ROLLER	1
-13	4051	. . STAFF	1
-14	4172	. JEWEL, PALLET, COCK	1
-15	4003	. COCK, PALLET	1
		(ATTACHING PARTS)	
-16	4133	. SCREW, PALLET, COCK	2
		*	
2-17	4048	. PALLET FORK ASSEMBLY	1
-18	185M	. . JEWEL, ENTRANCE	1
-19	195M	. . JEWEL, EXIT	1
-20	205M	. . PALLET, ARBOR	1
-21	215M	. . FORK	1
-22	4074	. SPRING, RUNNER TENSION	1
		(ATTACHING PARTS)	
-23	4159	. SCREW, RUNNER TENSION	1
		*	
-24	4175	. JEWEL, CHRONOGRAPH COCK	1
-25	4005	. COCK, CHRONOGRAPH	1
		(ATTACHING PARTS)	
-26	4135	. SCREW, CHRONOGRAPH COCK	2
		*	
-27	4079	. RUNNER ASSEMBLY	1
-28	4076	. . HEART, RUNNER	1
		(ATTACHING PARTS)	
-29	4161	. . SCREW, HEART RUNNER	1
		*	
-30	4079-A	. . RUNNER	1
-31	4080	. WHEEL ASSEMBLY, MINUTE RECORDER	1
-32	4077	. . HEART, MINUTE RECORDER	1

MOVEMENT ASSEMBLY (Cont)

Fig. & Index No.	Part No.	DESCRIPTION 1 2 3 4 5 6 7	Units Per Assy	Source Code
		(ATTACHING PARTS)		
2-33	4161	. . SCREW, HEART	1	
		*		
-34	4075	. . SPRING, FRICTION MINUTE RECORDER	1	
		(ATTACHING PARTS)		
-35		. . SCREW, FRICTION MINUTE RECORDER	1	
		*		
-36	4075A	. . SPACER SPRING, MINUTE RECORDER	1	
-37	4176	. . BUSHING, MINUTE RECORDER WHEEL	1	
-38	4080A	. . WHEEL, MINUTE RECORDER	1	
-39	4069	. BRAKE	1	
		(ATTACHING PARTS)		
-40	4142	. SCREW, BRAKE	1	
		*		
-41	4070	. SPRING, BRAKE	1	
-42	4068	. SPRING, OPERATING LEVER, UPPER	1	
-43	4073	. SPACER, OPERATING SPRING	1	
		(ATTACHING PARTS)		
-44	4158	. SCREW, SPRING BRAKE	1	
		*		
-45	4154	. STUD, ECCENTRIC, COUPLING CLUTCH	1	
-46	4063	. COUPLING CLUTCH ASSEMBLY	1	
		(ATTACHING PARTS)		
-47	4155	. SCREW, COUPLING CLUTCH	1	
		*		
-48	4174	. . JEWEL, COUPLING CLUTCH, COCK	1	
-49	4063A	. . COCK, COUPLING CLUTCH	1	
		(ATTACHING PARTS)		
-50	4153	. . SCREW, COUPLING CLUTCH, COCK	1	
		*		
-51	4078	. . WHEEL, COUPLING CLUTCH	1	
-52	4177	. . BUSHING, COUPLING CLUTCH, PLATE	1	
-53	4063C	. . PLATE, COUPLING CLUTCH	1	
-54	4064	. SPRING, COUPLING CLUTCH	1	
		(ATTACHING PARTS)		
-55	4162	. SCREW, SPRING, COUPLING CLUTCH	1	
		*		
-56	4065	. HAMMER	1	
		(ATTACHING PARTS)		
-57	4142	. SCREW, HAMMER	1	
		*		
-58	4066	. SPRING, HAMMER	1	
		(ATTACHING PARTS)		
-59	4149	. SCREW, SPRING, HAMMER	1	
		*		
2-60	4067	. CATCH, HAMMER	1	
		(ATTACHING PARTS)		
-61	4157	. SCREW, CATCH, HAMMER	1	
		*		
-62	4057	. LEVER, OPERATING	1	
		(ATTACHING PARTS)		
-63	4147	. SCREW, OPERATING LEVER	2	
		*		
-64	4058	. TONGUE, OPERATING LEVER	1	
		(ATTACHING PARTS)		
-65	4148	. SCREW, TONGUE	1	
		*		
-66	4059	. SPRING, OPERATING LEVER, LOWER	1	
		(ATTACHING PARTS)		
-67	4149	. SCREW, SPRING	1	
		*		
-68	4061	. WHEEL, PILLAR	1	
		(ATTACHING PARTS)		
-69	4152	. SCREW, WHEEL, PILLAR	1	
		*		
-70	4062	. RING, PILLAR	1	
-71	4060	. JUMPER WHEEL, PILLAR	1	
		(ATTACHING PARTS)		
-72	4151	. SCREW, JUMPER, PILLAR	1	
		*		
-73	4154	. STUD, ECCENTRIC HAMMER	1	
-74	4071	. BLOCKER, MINUTE RECORDER	1	
		(ATTACHING PARTS)		
-75	4155	. SCREW, BLOCKER, MINUTE RECORDER	1	
		*		
-76	4154	. STUD, ECCENTRIC MINUTE RECORDER BLOCKER	1	
-77	4072	. SPRING, BLOCKER	1	
		(ATTACHING PARTS)		
-78	4150	. SCREW, SPRING, BLOCKER	1	
		*		
-79	4156	. STUD, ECCENTRIC COUPLING CLUTCH	1	
2-	NO NO.	. PLATE ASSEMBLY, MECHANISM	1	
		(ATTACHING PARTS)		
-80	4131	. SCREW, PLATE MECHANISM	3	
		*		
-81	4018	. . WHEEL INTERMEDIATE WINDING	1	
		(ATTACHING PARTS)		
-82	4138	. . SCREW, INTERMEDIATE WINDING	1	
		*		

MOVEMENT ASSEMBLY (Cont)

Fig. & Index No.	Part No.	DESCRIPTION 1 2 3 4 5 6 7	Units Per Assy	Source Code
2-83	4019	. . BUSHING INTERMEDIATE WINDING, TAPPED	1	
-84	4006	. . PLATE, MECHANISM	1	
-85	4018	. WHEEL, INTERMEDIATE WINDING	1	
		(ATTACHING PARTS)		
-86	4139	. SCREW, INTERMEDIATE WINDING	1	
		*		
-87	4020	. RING, INTERMEDIATE WINDING	1	
-88	4018	. WHEEL, INTERMEDIATE WINDING	1	
		(ATTACHING PARTS)		
-89	4140	. SCREW, INTERMEDIATE WINDING	1	
		*		
-90	4020	. RING, INTERMEDIATE WINDING	1	
-91	4021	. WHEEL, RATCHET	1	
		(ATTACHING PARTS)		
-92	4141	. SCREW, WHEEL RATCHET	1	
		*		
-93	4022	. CLICK	1	
		(ATTACHING PARTS)		
-94	4142	. SCREW, CLICK	1	
		*		
-95	4023	. SPRING, CLICK	1	
-96	4007	. CIRCLE, MOVEMENT	1	
		(ATTACHING PARTS)		
-97	4130	. SCREW, CIRCLE MOVEMENT	3	
		*		
-98	4001	. BREACH, BARREL	1	
-99	4081	. WHEEL, DRIVING	1	
-100	4173	. JEWEL, WHEEL SEAT	1	
-101	4009	. SEAT, WHEEL, DRIVING	1	
		(ATTACHING PARTS)		
-102	4136	. SCREW, SEAT, WHEEL, DRIVING	3	
		*		
2-103	4172	. JEWEL, ESCAPE WHEEL	1	
-104	4174	. JEWEL, THIRD WHEEL	1	
-105	4002	. BREACH, TRAIN	1	
		(ATTACHING PARTS)		
-106	4132	. SCREW, TRAIN BREACH	2	
		*		
-107	4037	. WHEEL, INTERMEDIATE	1	
-108	4043	. PINION, CANNON	1	
-109	4038	. WHEEL, CENTER	1	
-110	4039	. WHEEL, THIRD	1	
-111	4040	. WHEEL, SECOND	1	
-112	4041	. WHEEL, ESCAPE	1	
-113	4035-113	. BARREL ASSEMBLY	1	
-114	4035A	. . COVER, BARREL	1	
-115	4036	. . ARBOR, BARREL	1	
-116	4045	. . MAINSPRING	1	
-117	4035	. . BARREL	1	
-118	4174	. JEWEL, THIRD WHEEL, LOWER	1	
-119	4173	. JEWEL, SECOND WHEEL, LOWER	1	
-120	4172	. JEWEL, ESCAPE WHEEL, LOWER	1	
-121	4171	. JEWEL, BALANCE, LOWER	1	
-122	4172	. JEWEL, PALLET, LOWER	1	
-123	4024	. COCK, MINUTE WHEEL	1	
		(ATTACHING PARTS)		
-124	4143	. SCREW, MINUTE WHEEL COCK	1	
		*		
-125	4042	. WHEEL, MINUTE	1	
-126	4052	. JEWEL ASSEMBLY, CAP, LOWER	1	
		(ATTACHING PARTS)		
-127	4144	. SCREW, CAP, JEWEL, LOWER	1	
		*		
-128	4017	. WHEELS, SETTING I, II	2	
		(ATTACHING PARTS)		
-129	4137	. SCREW, SETTING WHEEL	2	
		*		
-130	4044	. WHEEL, HOUR	1	
-131	4046	. WASHER, DIAL	1	
-132	4047	. PIN, MINUTE WHEEL	1	
-133	4000	. PLATE, MAIN	1	

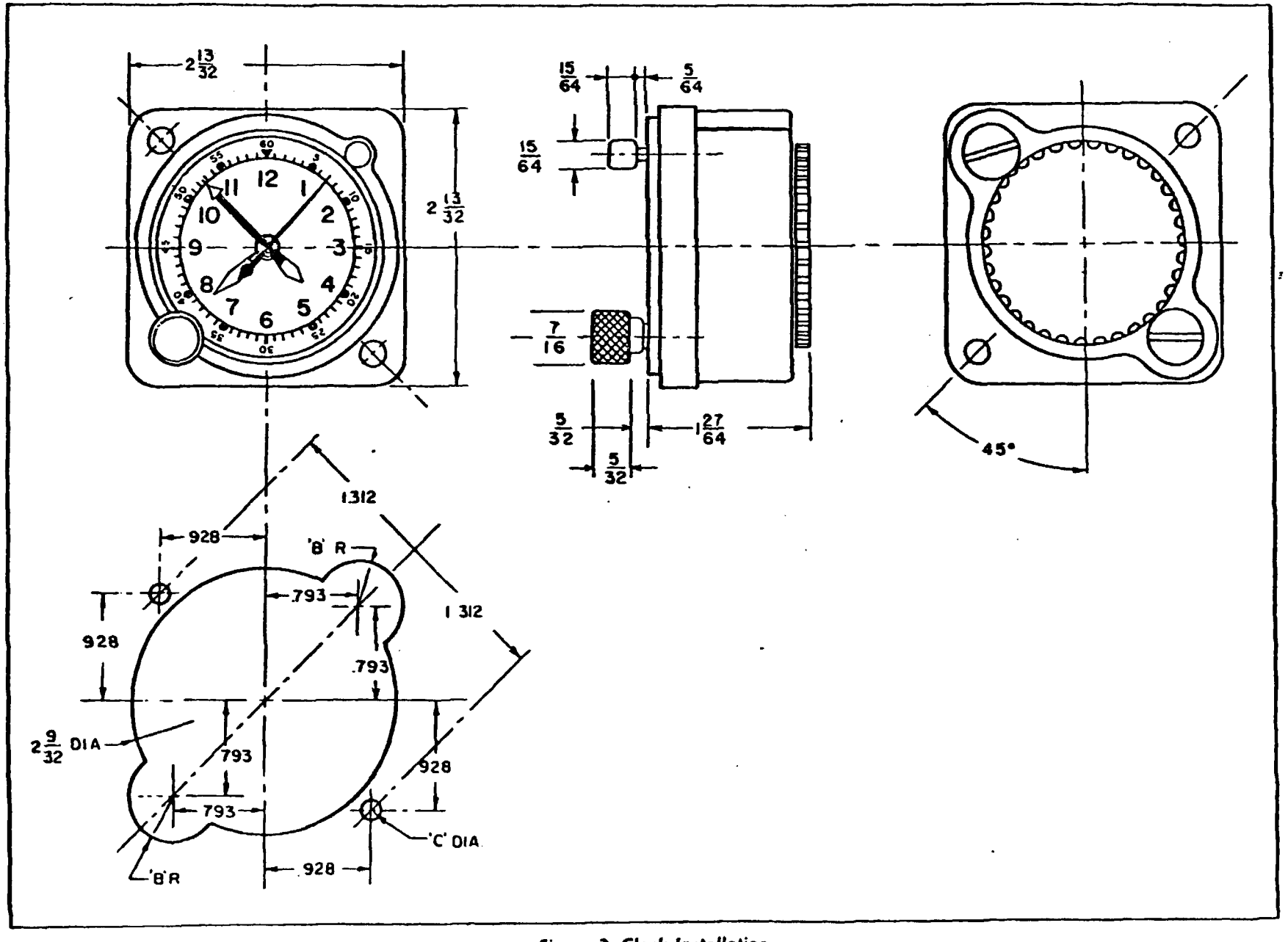


Figure 3. Clock Installation

CHAPTER

32

LANDING GEAR

VIKING – Temporary Revision

PSM NO.: 1–6–6A **AIRCRAFT:** DHC-6 **SERIES:** ALL

PUBLICATION: COMPONENT MAINTENANCE MANUAL **TEMPORARY REVISION NO.:** 32–21

Insert in Chapter 32 – CONTENTS, before page 1

CHAPTER 32 – LANDING GEAR

REASON FOR ISSUE:
This Temporary Revision supersedes TR 32-20 and replaces pages 1 & 2 of the Table of Contents.

ACTION:

In Chapter 32, remove existing TR 32-20 and replace with this Temporary Revision 32-21.

— Continued overleaf —

RECORDING INSTRUCTIONS:
Record this Temporary Revision No. and the relevant information in the appropriate columns of the TEMPORARY REVISION INDEX provided at the front of the manual.

MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B./T.R.
Aircraft Braking System Corp. (ABSC)					ABSC Service Letter GS-SL-46 dated Oct 10/1997 GS-SL-47 dated Feb 28/1998 GS-SL-48 dated Jun 15/1998 GS-SL-49 dated Oct 15/1998
was Goodyear	Wheel Assembly	5000444, -1 & -3	32-40-12	Sep 28/1990	ABSC TR no. 32-2 Dated Oct 20/1994
	Brake Assembly	50001571, -1 through -6	32-43-12	Jan 15/1990	ABSC Service Bulletin ARAVA-102-32-2, ARAVA-201-32-2 & ARAVA-202-32-2 dated Jun 7/1990 TR32-2 dated Dec 3/1992
was Goodyear	Main Wheel Assembly	9544382, -1 & -2	32-40-24	Oct 30/1998	ABSC TR 32-4 dated Dec 11/1992
was Goodyear	Brake Assembly	9550377, -1, -2 & -4	32-43-23	July 1/1990	ABSC TR 32-5 dated July 1/1993 TR 32-6 dated Mar 12/1999
DHC	Power Brake Valve Assembly	C6HF1036 & 1037	32-40-11	Dec 14 1981	
	DELETED				
	Nose Gear Leg Assembly	P/N 71-100 (Heroux)	32-20-11	Jul 27/2018	
	Nose Wheel Steering Actuator and Links Sub-assembly	P/N 71-190 (Heroux)	32-50-11	Sep 20/2012	
B.F. Goodrich Aerospace	Nose Landing Gear Wheel	3-1197		Feb 1/1974	
Parker Hannifin Corporation / Waterman Hydraulics	Hydraulic Fuse	G831-8-10A (DHC 7SC0110)	32-42-00	May 11/1992	PHC/WH S/BG831-32-1 dated Oct 17/1991 TR32-1 dated Jun 5/1992

MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B./T.R.
Aircraft Braking Systems Corp. (ABSC)					ABSC Service Letter GS–SL–46 dated Oct 10/1997 GS–SL–47 dated Feb 28/1998 GS–SL–48 dated Jun 15/1998 GS–SL–49 dated Oct 15/1998
was Goodyear	Wheel Assembly	5000444, –1 & –3	32–40–12	Sep 28/1990	ABSC TR No. 32–2 dated Oct 20/1994
	Brake Assembly	5001571, –1 through –6	32–43–12	Jan 15/1990	ABSC Service Bulletin ARAVA–102–32–2, ARAVA–201–32–2 & ARAVA–202–32–2 dated Jun 7/1990 TR 32–2 dated Dec 3/1992
was Goodyear	Main Wheel Assembly	9544382, –1 & –2	32–40–24	Oct 30/1988	ABSC TR 32–4 dated Dec 11/1992
was Goodyear	Brake Assembly	9550377, –1, –2 & –4	32–43–23	July 1/1990	ABSC TR 32–5 dated Jul 1/1993 TR 32–6 dated Mar 12/1999
DHC	Power Brake Valve Assembly	C6HF1036 & 1037	32–40–11	Dec 14/1981	
	Main Landing Gear Leg Assembly	C6U1103	32–10–11	Nov 8/1991	TR 32–8 dated Apr 24/1995 superseded by TR 32–13 dated Sep 3/1997 TR 32–9 dated Jan 12/1996 TR 32–10 dated Jan 12/1996 TR 32–14 dated Sep 3/1997

NOTE: Please see the TEMPORARY REVISION that revises this page

MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B./T.R.
DHC (Cont'd)	Nose Gear Leg Assembly	P/N 71–100 (Heroux)	32–20–11	Dec 14/1981	TR 32–4 dated Sep 17/1987 TR 32–5 dated Sep 17/1987 TR 32–6 dated Jun 25/1994 TR 32–11 dated Feb 5/1997 superseded by TR 32–12 dated Mar 12/1997 TR 32–15 dated Jun 5/1998
	Nosewheel Steering Actuator and Links Sub–Assembly	P/N 71–190 (Heroux)	32–50–11	Dec 21/1979	TR 32–7 dated Oct 14/1994
B.F. Goodrich Aerospace	Nose Landing Gear Wheel	3–1197		Feb 1/1974	
Parker Hannifin Corporation / Waterman Hydraulics	Hydraulic Fuse	G831–8–10A (DHC 7SC0110)	32–42–00	May 11/1992	PHC/WH S/BG831–32–1 dated Oct 17/1991 TR 32–1 dated Jun 5/1992

NOTE: Please see the TEMPORARY REVISION that revises this page

ABSC
AIRCRAFT BRAKING SYSTEMS CORPORATION

SERVICE LETTER

1204 Massillon Road
Akron, OH 44306–4186

Ph: (330) 796–4400
Fax: (330) 796–9805

SUBJECT: PAINT WHICH COMPLIES WITH EPA EMISSION STANDARDS

EFFECTIVITY: This General Service Letter is applicable to all Aircraft Braking Systems Corporation (ABSC) wheels and brakes in active service.

REFERENCE: All ABSC wheel and brake Component Maintenance Manuals and Overhaul Manuals for all wheel and brake assemblies (housings) on Commercial, General Utility and Military aircraft.

PROBLEM: High volatile organic compound (VOC) paints such as lacquer, enamel and polyurethane will not meet EPA emission standards for VOC's per liter (420 g/l) which become effective September 1998. A change to high solids (low VOC) paint is required to comply with future environmental regulations.

These regulations, which apply to ABSC, may not apply to the operator or overhauler because of differences in local requirements.

SOLUTION: Aircraft Braking Systems Corporation is converting its new production and overhauled products to environmentally compatible paint consisting of high solids polyurethane and primer. This conversion is planned to be completed by September 1998. Some product is already converted.

Although operators may choose from many other paint systems, the paint, described in this General Service Letter, is identified as providing good performance and processibility at reasonable cost.

1. **High Solids Polyurethane Topcoat per Specification MIL–C–85285:**

   A. *Recommended applications*: Use this paint when durability, appearance and cost similar to the former solvent based (high VOC) polyurethane is desired. This is a high performance paint and is relatively difficult to strip similar to the solvent based polyurethane paints.

   B. *Performance:* This high solids (low VOC) polyurethane has a service performance that is comparable to the former solvent based polyurethane, MIL–C–83286, with the possible exception of Skydrol compatibility. If a high level of Skydrol compatibility is desired, a MIL–C–85285 paint can be purchased that is qualified to the Douglas paint specification, DMS 2115, Composition C.

      Drying time is four (4) hours to touch compared to two (2) hours for solvent based polyurethane. This can be improved with an accelerator.

   C. *Supplier:* Suggested source for this paint:
      Courtaulds Aerospace Inc.
      Sealants, Adhesives and Coatings Division
      1608 Fourth Street
      Berkeley, CA 94710
      Ph: (510) 526–1525

      This suppler is listed in DMS QPL 2115.

   D. *Equipment:* A high volume, low pressure spray gun used with a pressure pot will provide a uniform high gloss coverage.

(RELEASED: 10/16/97)

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SERVICE INFORMATION LETTER (Continued)

For stripping, bead blasting with plastic media works well.

E. *Environmentally safe cleaning:* Use acetone to remove uncured paint from equipment.

A paint removal system called *Peel Away 5 or 7* can be used to remove cured paint:
Dumond Chemicals, Inc.
1501 Broadway
NY, NY 10036
Ph: (212) 869–6350

2. **High Solids Epoxy Polyamide Primer per Specification MIL–P–23377, Type I:**

A. *Recommended applications:* Use this primer with the high solids polyurethane paint of paragraph 1. above.

B. *Performance:* This primer is glossier than others but is very compatible with the topcoat. Masking tape does not adhere as well and may require roughing the surface if the tape is formed over a relatively sharp contour.

Drying time is longer than solvent primers. The application of heat will reduce cure time to one hour.

If maximum Skydrol resistance is required, this primer should be purchased to the Douglas specification, DMS 2104, Composition C.

C. *Supplier:* Suggested source for this primer:
Dexter Aerospace
Materials Division
1 East Water Street
Waukegan, IL 60085
Ph: (847) 623–4200

This supplier is listed in DMS QPL 2104.

D. *Equipment:* Same as for the topcoat. See Paragraph 1.D. above.

CORRECTIVE ACTION: At the next revision of each ABSC publication (Component Maintenance or Overhaul Manuals), the paint procedure will be reviewed and if appropriate, revised to include the paint in this General Service Letter.

RECOMMENDATION: The paint identified above is recommended for good performance and processing. Operators and overhaulers may choose other paint systems depending on their local clean air standards, paint availability and operating environment. Operators are reminded of the need to protect their wheels and brake housings from corrosion in order to maintain their warranty coverage.

ABSC
AIRCRAFT BRAKING SYSTEMS CORPORATION

SERVICE LETTER

1204 Massillon Road
Akron, OH 44306–4186

Ph: (330) 796–4400
Fax: (330) 796–9805

SUBJECT: RETURN MATERIAL AUTHORIZATION (RMA) PROCEDURE

1. EFFECTIVITY: This Service Letter is applicable to all customers of Aircraft Braking Systems Corporation.

2. REASON: The previous method for returning materials to ABSC did not provide adequate tracking of returns and did not lend itself to a timely returns process.

3. DESCRIPTION: A new Return Material Authorization (RMA) procedure has been developed to expedite material return and provide a method for tracking customer returns. This Service Letter describes the new procedure which will enhance ABSC's ability to process customer returns.

RETURN MATERIAL AUTHORIZATION (RMA) PROCEDURE

NOTE: All customers having a need to return materials to ABSC for any reason must contact their ABSC representative prior to returning the material to obtain Return Material Authorization (RMA).

Material received by ABSC without an RMA will be returned to the customer at their expense.

1. General:

   A. Customers of Aircraft Braking Systems Corporation will, on occasion, need to return materials to ABSC for:

      (1) Repair and/or overhaul work,

      (2) Engineering evaluation,

      (3) Quality analysis,

      (4) Inventory return, or

      (5) Shipping error

   B. The new RMA procedure provides a process for properly documenting the reason for the material return and assigns a unique tracking number to the returned material.

2. Advantages of the RMA Procedure:

   A. Customer returns will be handled more efficiently and timely.

   B. Quicker response to a customer's concerns.

   C. The same return process will be used for all types of material returns.

   D. The status of any return will be readily available by referencing the assigned RMA number.

(RELEASED: 3/11/98)

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3. The RMA Procedure:

A. When a customer has a need to return material to ABSC the following steps are taken:

(1) The customer contacts their usual ABSC representative.

(2) The ABSC representative collects all of the necessary information about the return from the customer.

NOTE: The information necessary to process returns is listed on the "Customer Request for Return Material Authorization" form attached to this Service Letter. This form may be completed by the customer and faxed to the ABSC representative to facilitate communications between ABSC and the customer.

A separate RMA will be issued for each type of return.

(3) An RMA number is assigned to the return.

(4) An RMA Fax with shipping instructions is sent to the customer. An example of the Authorization Fax is attached to this Service Letter.

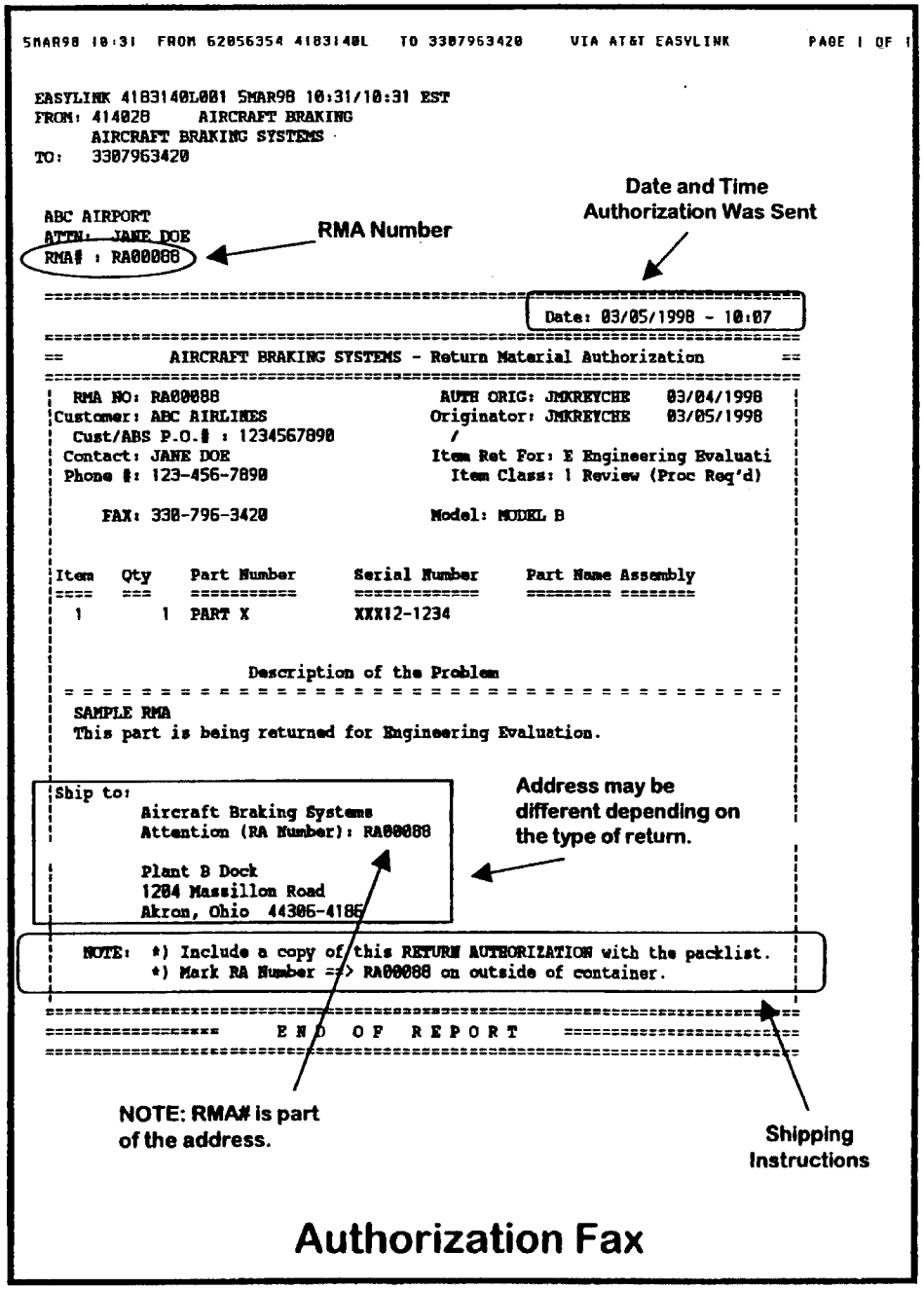
(5) The customer clearly marks the RMA number on the attention line of the address label on the container to be returned.

(6) The customer includes a copy of the RMA Fax with the packing list.

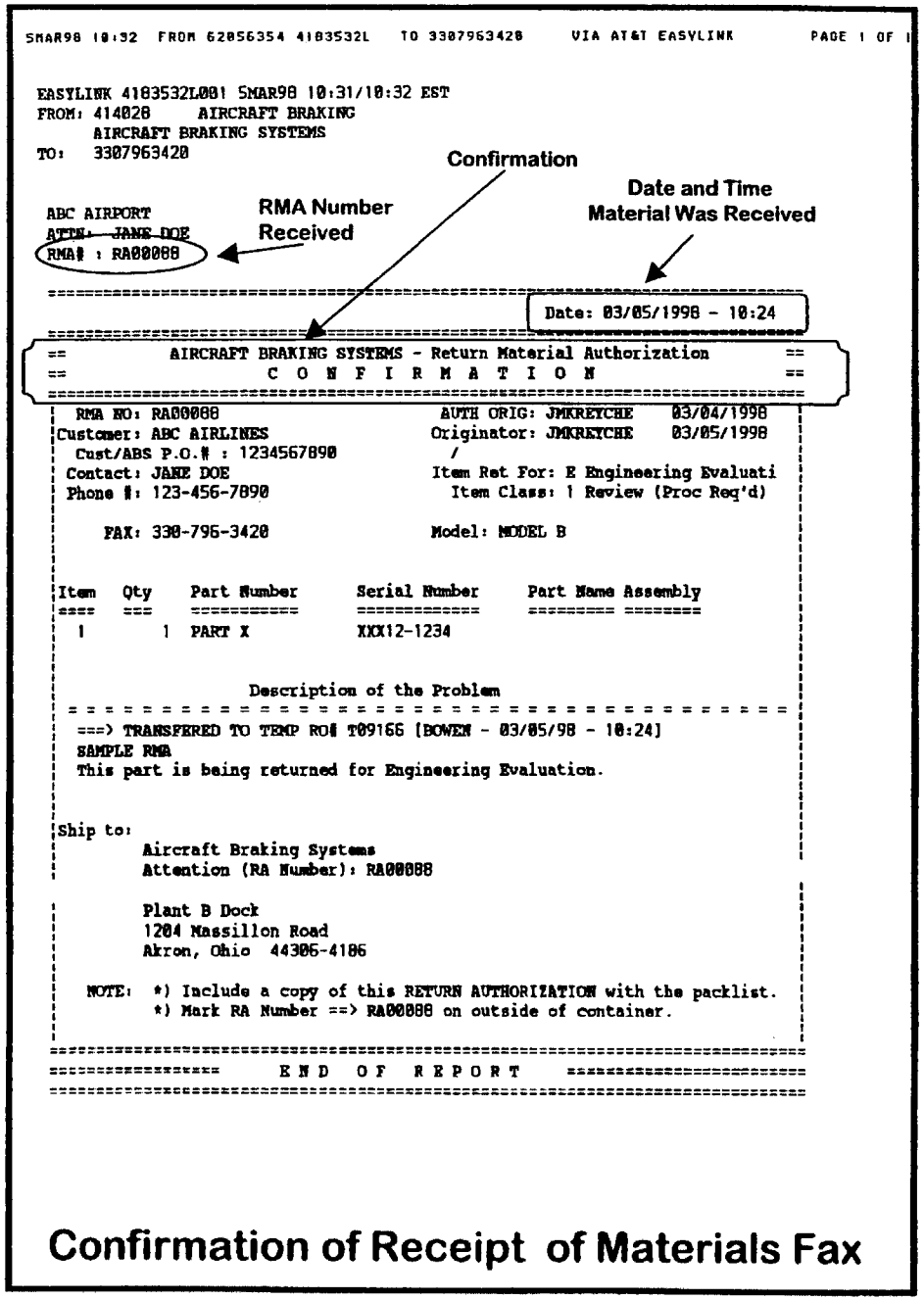
(7) The material is shipped by the customer to the address shown on the RMA Authorization.

NOTE: The RMA return address will be different for various return types. Each RMA type (refer to paragraph 1.A. of the Return Material Authorization Procedure) must be packaged separately.

(8) Upon receipt of the material at ABSC, a confirmation of receipt fax is sent to the customer, and the return is processed at ABSC. An example of the Confimation of Receipt of Materials Fax is attached to this Service Letter.



Authorization Fax



Confirmation of Receipt of Materials Fax

ABSC
AIRCRAFT BRAKING SYSTEMS CORPORATION

SERVICE LETTER

1204 Massillon Road
Akron, OH 44306–4186

Ph: (330) 796–4400
Fax: (330) 796–9805

SUBJECT: EXTENSION OF SHELF LIFE OF BUNA–N BASED BEARING SEALS AND GREASE RETAINER BAFFLES

1. EFFECTIVITY: This General Service Letter is applicable to all Aircraft Braking Systems Corporation (ABSC) bearing seals and grease retainer baffles. ABSC designs use Buna–N (nitrile) based elastomers. These are all packaged with labels identifying a 12 quarter (3 year) shelf life from cure date. This General Service Letter is applicable to all ABSC bearing seals and grease retainer baffles that have a 12 quarter (3 year) shelf life.

2. REASON: This General Service Letter is issued to relax the life restrictions on ABSC bearing seals and grease retainer baffles using Buna–N (nitrile) based elastomer.

   Perfectly good bearing seals manufactured with BUNA–N material are being scrapped because of a military age restriction (per MIL–STD–1523) for shelf life of 12 quarters (or 3 years) that took effect 01 February 1985. MIL–STD–1523A, issued 01 February 1984, extended the shelf life to 40 quarters (or 10 years) but was cancelled 30 January 1995. This was because of the realization that storage mode had a greater effect on elastomeric physical properties than age.

3. DESCRIPTION: Based on its use of chipboard box for resistance to ultraviolet light, and with the expectation that the box will be stored flat, at temperatures 5° to 35°C (41° to 95° F), and away from any room that generates ozone, ABSC extends the life of its BUNA–N bearing seals listed in SUBJECT given above to 40 quarters (or 10 years) from the cure date.

4. CORRECTIVE ACTION: For unused parts, the shelf life label may be altered as follows: The Expiration Date (E/D) identifier is to be lined out but remain legible. A new Expiration Date identification 40 quarters or 10 years after the Cure Date (C/D) identifier is to be added followed by "(GS–SL–48)". Example: WAS–"C/D 2Q97: E/D 2Q2000" becomes "C/D 2Q97: ~~E/D 2Q2000~~ E/D 2Q2007 (GS–SL–48)". The new characters need not immediately follow the original characters. They may be added near the original characters.

5. REFERENCES:

   A. SAE Aerospace Information Report AIR1364A, dated November, 1995.

   B. "Shelf Life of Elastomers", Electric Power Research Institute (EPRI–Q101–15s).

   C. Elements of British Standard BS 3F 68:1977 Re: Storage Practices.

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ABSC
AIRCRAFT BRAKING SYSTEMS CORPORATION

SERVICE LETTER

1204 Massillon Road
Akron, OH 44306–4186

Ph: (330) 796–4400
Fax: (330) 796–9805

SUBJECT: AIRCRAFT BRAKING SYSTEMS CORPORATION'S INTERNET WEB SITE: www.aircraftbraking.com

Aircraft Braking Systems Corporation (ABSC) is pleased to introduce ABSC's World Wide Web site to provide information and access for customers and users of ABSC equipment.



Welcome to the **ABSC Online** web site.

ABSC's web site provides access to online personnel, document indexes and current Service Bulletins leading toward **immediate response** to your product support requirements. In addition, we provide online registration for Technical Support training and for ABSC Airline Conferences. In the near future, we will be expanding our web site to provide direct access to more of the latest technical documents, a wide range of corporate information and additional ABSC departments.

ABSC wants to support your aircraft braking systems with the best response time and quality in the industry. We will continue to serve you better with the latest in communication technology. We're using the World Wide web to provide secured and interactive access to the people and information you want and need, when you need them.

The ABSC web site features the following major topics:

- **Customer Support**

  Identifies ABSC representatives who are the first line of contact for ABSC equipment users.

- **Technical Support**

  Supplies engineering information services directly by contacting the appropriate support engineer. Presents an organizational directory identifying program assignments with *e–mail* hot–links.

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- **Repair and Overhaul**

  Provides direct communication with ABSC Repair and Overhaul facilities in Akron, Ohio or Slough, England.

- **Distributors**

  Provides the list of worldwide distributors of ABSC authorized parts and supplies.

- **Training**

  Announces periodic general and specialized maintenance training seminars customized to meet operator's requirements. The ABSC video tape library of supporting information can be ordered Online.

- **Technical Publications**

  Contains a directory of all ABSC publications. New documents will be available for direct downloading from the site, while older documents are identified for reference only in the directory.

- **Corporate Information**

  Presents corporate and product information, press releases and promotional materials.

- **Employment Opportunities**

  Provides job requirements of open salary positions for engineering personnel and the aircraft programs they would support.

- **What's New?**

  Provides a summary of what is happening within ABSC and upcoming events for operators.

- **Upcoming Airline Conferences**

  Provides all the details of upcoming Airline Conferences and special events: **who, what, when, where and why and how!**

This is your service. Tell us what you want. Drop us a line to tell us what you like and what you don't like... about the website, about our service, or even about us. Go ahead and check us out...and be sure to tell us what you think. Thanks.

If you have comments or suggestions, *e–mail* ABSC at webmaster@aircraftbraking.com.

SERVICE BULLETIN

TO: HOLDERS OF SERVICE BULLETIN ARAVA–202–32–2 BRAKE ASSEMBLY IMPROVED LINING REPLACEMENT.

Attached to this transmittal letter is Revision No. 2 of Service Bulletin ARAVA–202–32–2 (basic issue dated Apr 23/87).

HIGHLIGHTS OF REVISION NO. 2 DATED 7 JUNE 1990

REVISION NO. 2 CONTAINS ALL PAGES OF THIS SERVICE BULLETIN. Pages which have been received are outlined below, together with the Highlights of the revision.

1. SUBJECT, Page 1 of 2:

   A. Changed applicability of conversion from Brake Assembly 5001571–2 to 5001571–5 to Brake Assemblies 5001571–2 and 5001572–5 to 5001571–7.

2. SECTION I, Page 1 of 2:

   A. Paragraph A. Updated effectivity to reflect latest manual revision and lining change.

   B. Paragraphs B. and C. Changed conversion instructions for asbestos and asbestos–free linings to new, improved asbestos–free linings.

   C. Paragraph F. Changed Reference to latest manual revision identification.

3. SECTION II, Page 1 of 2:

   A. Revised paragraphs A., B. and C. for new, improved asbestos–free lining conversion and re-identification instructions for Brake Assembly 5001571–7.

4. SECTION III, Page 2 of 2:

   A. Clarified parts required for conversion to Brake Assembly 5001571–7.

5. Replace Service Bulletin ARAVA–202–32–2, pages 1 and 2, Revision No. 1 dated April 21/89 with Service Bulletin ARAVA–102–32–2, ARAVA–201–32–2 and ARAVA–202–32–2, pages 1 and 2, Revision No. 2, revised Jun 7/90.

SERVICE BULLETIN

SUBJECT: LINING REPLACEMENT/REWORK BRAKE ASSEMBLIES 5001571–2 AND 5001571–5 TO 5001571–7

SECTION I – PLANNING INFORMATION

A. EFFECTIVITY: This Service Bulletin is applicable to Brake Assemblies 5001571–2 and 5001571–5.

B. REASON: This Service Bullletin is issued to replace asbestos and asbestos–free linings with new, improved asbestos–free linings and to advise operators of the availability of new, improved asbestos–free linings.

C. DESCRIPTION: This Service Bulletin provides instructions for replacing asbestos and asbestos–free linings with new improved asbestos–free linings and the reidentification of brake assemblies. The new, improved asbestos–free lining will be readily identified by white paint and part number stamped on the back side.

D. APPROVAL: Compliance with this Service Bulletin does not alter FAA TSO conformance.

E. WEIGHT AND BALANCE: None.

F. REFERENCE: AP–560 (32–43–12) Component Maintenance Manual with Illustrated Parts List (basic issue dated 1 June 1972) for Brake Assemblies 5001571–1, 5001571–2, 5001571–3, 5001571–4, 5001571–5 and 5001571–6.

SECTION II – ACCOMPLISHMENT INSTRUCTIONS

A. At the next brake overhaul or next lining replacement, replace Linings 5004562 or 5004562–1 with Linings 5010396.

(1) Operators are advised that old asbestos linings may be used until stock depletion. The new, improved asbestos–free linings are to be used as a set. They are not to be mixed with old linings in any one assembly.

B. Reidentify Brake Assembly 5001571–2 or 5001571–5 by grinding off "–2" or "–5" and metal stamping a "–7" after brake assembly number in 0.12 inch (3,05 mm) characters to read "5001571–7".

NOTE: Where necessary, the part should be suitably supported for stamping.

C. Metal stamp repair number 5R87–060–1 in 0.09 inch (2,3 mm) characters adjacent to the assembly number. Brakes which already have repair number 5R87–060 adjacent to assembly number should have a "–1" metal stamped in 0.09 inch (2,3 mm) characters following 5R87–060 to then read "5R87–060–1".

NOTE: Where necessary, the part should be suitably supported for stamping.

D. Re–treat and repaint any displaced metal in accordance with Referenced Component Maintenance Manual, REPAIR section.

SECTION III – MATERIAL INFORMATION

A. The following parts are required to rework Brake Assembly 5001571–2 to 5001571–7.

New Part Number	Units Per Assembly	Nomenclature	Old Part Number	Disposition
5010396	8	LINING, Brake	5004562	Discard

B. The following parts are required to rework Brake Assembly 5001571–5 to 50015071–7.

New Part Number	Units Per Assembly	Nomenclature	Old Part Number	Disposition
5010396	8	LINING, Brake	5004562–1	Discard

AIRCRAFT BRAKING SYSTEMS
Corporation

COMPONENT MAINTENANCE MANUAL with ILLUSTRATED PARTS LIST

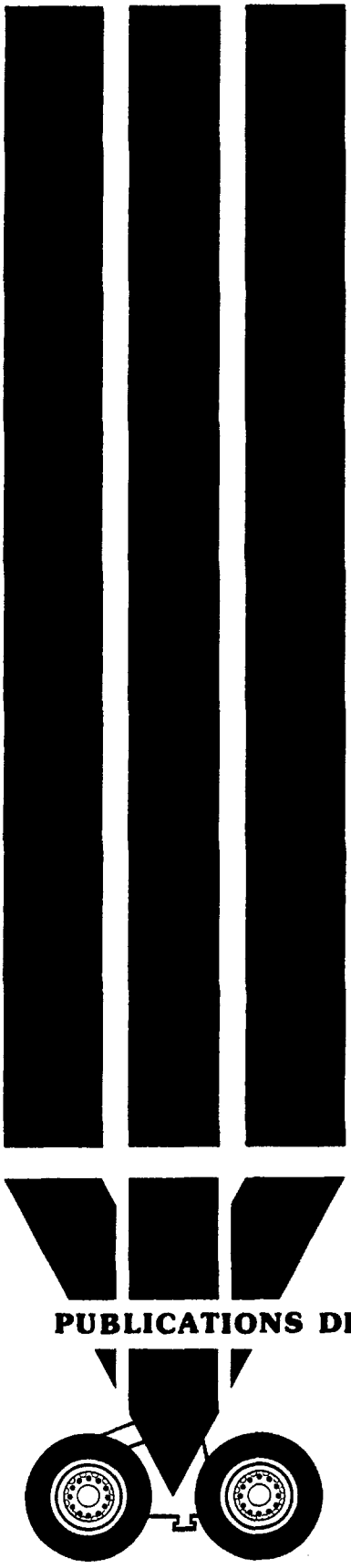
AP-559

MAIN WHEEL ASSEMBLY

Part No. 5000444

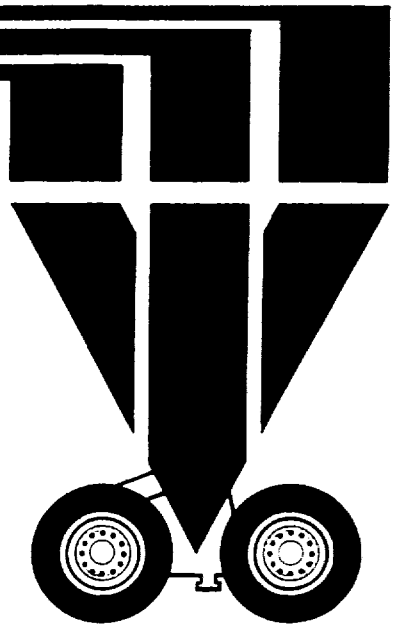
Part No. 5000444-1

Part No. 5000444-3



PUBLICATIONS DEPARTMENT

32-40-12



AP-559

COMPONENT MAINTENANCE MANUAL

WITH

ILLUSTRATED PARTS LIST

FOR

MAIN WHEEL ASSEMBLY 5000444

MAIN WHEEL ASSEMBLY 5000444-3

USED ON

DEHAVILLAND DHC-6,

AND

MAIN WHEEL ASSEMBLY 5000444-1

USED ON

IAI ARAVA-101 AND 202

BASIC ISSUE 1 MARCH 1972

AIRCRAFT BRAKING SYSTEMS
Corporation

PUBLICATIONS DEPARTMENT
AKRON, OHIO 44306-4186
CAGE CODE 0B9R9

32-40-12

Sep 28/90

COMPONENT MAINTENANCE MANUAL
MAIN WHEEL ASSEMBLY 5000444

TEMPORARY REVISION NO. 32–2

TO: HOLDERS OF AP-559 (32-40–12) COMPONENT MAINTENANCE MANUAL WITH ILLUSTRATED PARTS LIST FOR MAIN WHEEL ASSEMBLIES 5000444, 5000444–1 AND 5000444–3 USED ON DEHAVILLAND DHC–6 AIRCRAFT.

PURPOSE: This Temporary Revision is issued to clarify instructions for replacing disk drive ring.

FILING INSTRUCTIONS: Record applicable data on the RECORD OF TEMPORARY REVISIONS sheet in front of the manual. Insert page 1 facing the RECORD OF TEMPORARY REVISIONS.

Retain this Temporary Revision until normal revision service incorporates this information into the Component Maintenance Manual.

This Temporary Revision affects page 611 (32–40–12).

RECORD OF TEMPORARY REVISIONS

TEMPORARY REVISION NUMBER	PAGE NUMBER	ISSUE DATE	BY	DATE REMOVED	BY
32–2	1 and 2	Oct 20/94	ABSC		

(RELEASED: 10/20/94)

COMPONENT MAINTENANCE MANUAL
MAIN WHEEL ASSEMBLY 5000444

TO: HOLDERS OF AP-559 (32-40-12) COMPONENT MAINTENANCE MANUAL WITH ILLUSTRATED PARTS LIST FOR MAIN WHEEL ASSEMBLIES 5000444, 5000444-1 AND 5000444-3 USED ON DEHAVILLAND DHC-6 AND IAI ARAVA-101, 202 AIRCRAFT.

Attached to this transmittal letter is Revision No. 8 of AP-559 (basic issue dated 1 March 1972).

REVISION NO. 8 DATED 28 SEPTEMBER 1990

HIGHLIGHTS

Pages which have been added or revised are listed below, together with the Highlights of the revision. Please delete the affected pages and insert Revision No. 8 pages dated September 28, 1990. Enter Revision No. 8 dated Sep 28/90 and add insertion date on the Record of Revisions sheet.

The purpose of this Revision is to add information concerning repair bushings in Repairs No. 3 and No. 4 and add a second oversize tee bar plunger hole repair bushing in Repair No. 4.

Please retain all previous HIGHLIGHTS pages in this manual for future reference.

Chapter/Section and Page No.	Description of Change
Title Page	Added latest revision date.
List of Effective Pages, pages 1 and 2	Revised to reflect current revision.
Table of Contents, page 2	Revised to reflect current revision.
Introduction, pages 3 and 4	Revised to reflect current customer support offices.
32-40-12	
Repair No. 3 pages 601 and 602	Added reference to Repair Figure 601 in paragraph 2. and Repair Bushing 5006511 details to revised Repair Figure 601.
Repair No. 4 pages 601 and 602	Added new paragraph 1.C. concerning second oversize tee bar plunger hole repair, editorial changes in paragraph 2. and Repair Bushing 5007112 details to revised Repair Figure 601.
Repair No. 4 pages 603 and 604	Added new paragraph 3. concerning instructions on second oversize tee bar plunger hole repair and Repair Figure 602.
page 1004	Added (-) figure item 272 to IPL Parts List. Relocated text.
page 1005	Relocated text.

COMPONENT MAINTENANCE MANUAL
MAIN WHEEL ASSEMBLY 5000444

TO: HOLDERS OF AP-559 (32-40-12) COMPONENT MAINTENANCE MANUAL WITH ILLUSTRATED PARTS LIST FOR MAIN WHEEL ASSEMBLIES 5000444, 5000444-1 AND 50004344-3 USED ON DEHAVILLAND DHC-6 AND IAI ARAVA-101, 202 AIRCRAFT.

Attached to this transmittal letter is Revision No. 7 of AP-559 (basic issue dated 1 March 1972).

REVISION NO. 7 DATED 15 AUGUST 1989

HIGHLIGHTS

Pages which have been added or revised are listed below, together with the Highlights of the revision. Please delete the affected pages and insert Revision No. 7 pages dated August 15, 1989. Enter Revision No. 7 dated Aug 15/89 and add insertion date on the Record of Revisions sheet.

Please retain all previous HIGHLIGHTS pages in this manual for future reference.

Chapter/Section and Page No.	Description of Change
All Pages	This "pages only" revision changes company name and logo references from Loral Aircraft Braking Systems to Aircraft Braking Systems.
Cover	Changed cover to reflect company name, Aircraft Braking Systems.
Title Page	Changed title to reflect company name, Aircraft Braking Systems and added revision date.
List of Effective Pages, pages 1 and 2	Revised to reflect current revision.
Table of Contents, page 2	Added Repair No. 5.
Introduction, pages 1 thru 4	Revised to reflect current information and customer support offices.
32-40-12	
page 102	Revised paragraph 2.C. adding nuts for clarification.
page 302	Revised paragraph 2.F.(1)(a) and 2.F.(2).
pages 401 thru 405/406	Revised Cleaning Materials list and added paragraph 2.A.(1). Revised paint stripping procedures adding Method 1 and Figure 401. Relocated text.

Chapter/Section and Page No.	Description of Change
page 502	Added paragraph 3.C.
page 602	Added paragraph 3.B.
page 609	Added tool number 1-71409 to paragraph 5.B.(5).
page 612	Added paragraph 5.D.(6) for clarification and renumbered remaining paragraphs.
page 613	Clarified Figure 605, adding tool number 1-71409.
Repair No. 5 pages 601 and 602	Added Repair No. 5 - Repair of Fairing Retaining Screw Threads, Outboard Wheel Subassembly, including Repair Figures 601 and 602.
page 705	Editorial change.
page 707	Corrected 15 ounce-inches to 1.5 ounce-inches in paragraph 4.C.
page 1004	Added figure items 222 and 222A.

TO: HOLDERS OF AP-559 (32-40-12) OVERHAUL MANUAL WITH ILLUSTRATED PARTS LIST FOR MAIN WHEEL ASSEMBLIES 5000444, 5000444-1, 5000444-2, AND 5006586 USED ON DEHAVILLAND DHC-6, IAI ARAVA-101, 202, AND CASA C-212-200 AIRCRAFT.

Attached to this transmittal letter is Revision No. 6 of AP-559 (basic issue dated 1 March 1972).

REVISION NO. 6 DATED 15 SEPTEMBER 1988

REVISION NO. 6 CONTAINS ALL PAGES OF THE MANUAL. Pages which have been added or revised are outlined below, together with the Highlights of the revision.

Please retain all previous HIGHLIGHTS pages, inserting them in this manual for future reference.

HIGHLIGHTS

Chapter/Section and Page No.	Description of Change
All pages	This manual has been prepared with automated word processing equipment. Shifting of text may have occurred. Marking of the shifted text has been eliminated. Marking of text pages reflect only actual changes.
	This manual has been changed from Overhaul to Component Maintenance Manual. Sections have been relocated and pages renumbered accordingly. Changed the masthead to Component Maintenance Manual Loral Aircraft Braking Systems, and deleted 5006586 assembly. Added metric equivalents throughout text. The technical information has not changed unless specified in the following highlights.
	Deleted Main Wheel Assembly 5006586 and 5000444-2 throughout text. Wheel Assembly 5006586 is now in AP-678 (32-40-90).
Cover	Revised to latest format. Deleted Main Wheel Assemblies 5000444-2 and 5006586.
Title Page	Added Main Wheel Assembly 5000444-3 used on DHC-6 and deleted Main Wheel Assembly 5000444-2 and 5006586 used on CASA C-212-200.
Record of Revisions, page 1/2	Added Revision No. 5 and 6

Chapter/Section and Page No.	Description of Change
Service Bulletin List, page 1/2	Added Service Bulletin DH-32-3, ARAVA-101-32-1 and ARAVA-202-32-1. Deleted CASA 212-200-32-1 (date inserted Dec 31/81) and CASA 212-200-32-2.
List of Effective Pages, pages 1 and 2	Revised to reflect current revision.
Table of Contents pages 1 and 2	Expanded table to subjects in text for clarification.
Introduction pages 1 thru 4	Revised to latest format.
32-40-12	
page 1	Changed paragraph 1. to General. Renumbered paragraph 1. to 2. Description and Operation. Renumbered paragraph 1.B. to 2.A. Changed paragraph 1.D. to 2.C., adding clarification for steel disk drive ring. Changed paragraph 1.E. to 2.D. deleting paragraph 1.F. Changed paragraph 2. to 3. Paragraph 3.B., deleted "Do not use impact or power wrenches to remove or tighten any threaded part."
pages 2 thru 4	Changed Figure 1 to Sheet 1 of 3 and relocated Key to Figure. Added Figure 1 (Sheet 2 of 3) and (Sheet 3 of 3).
page 5	Revised Key to Figure 1 and Figure 1 (Sheet 1 of 2) to agree with IPL, adding zero to figure reference and as follows: Item 1 - Changed Not Used to RF. Items 10 & 20A - Added. Item 90 - Change wheel bolt to internal wrenching bolt. Item 100 - Was 11. Item 110 - Was 12. Item 120 - Was 13. Item 130 - Was 14. Item 140 - Was 15. Item 150 - Was 16. Item 160 - Was 17. Item 170 - Was 18, rubber grommet. Item 180 - Was 19.

Chapter/Section and Page No.	Description of Change
page 5 (continued)	Item 190 - Was 20, plain washer. Item 200 - Was 21. Item 210 - Was 22, tire change counter. Item 220 - Was 23. Item 230 - Was 11. Item 240A - Added. Item 255 - Added. Item 300A - Added. Changed paragraph 3. to 4. and clarified weights. Deleted paragraph 4. Metric Equivalents, adding dimensions to text.
page 6	Added paragraph 5., Wheel Differences.
page 101 thru 106	Added TESTING AND FAULT ISOLATION section. Added Hardness Test paragraph 5.
page 301 thru 303/304	Relocated data from pages 101 and 102. Adjusted figure item reference to agree with IPL changes.
page 301	Paragraph 1., added NOTE and CAUTION. Relocated existing WARNING and CAUTION to paragraph 2. Added paragraphs B., C. and D. Paragraph 2.A. changed Schrader No. 4722 to 4277 in error.
page 302	Added WARNING for paragraph E. Clarified WARNING for paragraph F. and deleted CAUTION "Do not use impact or power wrenches."
pages 302 and 303/304	Added paragraph F.(1) and (2) and CAUTION. Changed paragraph F. to F.(3) and added NOTE. Clarified paragraphs G. and H. Added paragraph J. and changed I. to K. and clarified. Added paragraph L.
page 401 thru 403/404	Relocated data from page 201 thru 204.
page 401	Added 1,1,1 Trichloroethane, brushes, and grease to Cleaning Materials paragraph 1., and CAUTION to paragraph 2.
page 402	Added NOTE to paragraph 2.B. and 2.C. Paragraph 3., changed to Paint Removal Procedures. Added NOTE for paragraph 3.A.

Chapter/Section and Page No.	Description of Change
pages 501 thru 506	Relocated data from page 301 thru 304. Clarified figure item references to agree with IPL changes.
page 501	Changed title of paragraph 1. to Check Materials from Approved Penetrant Inspection Materials. Added paragraphs 2.B. and 2.C.
page 502	Changed and relocated paragraphs 3.E.(1) and 3.F.(1) to 3., Wheel Subassembly and clarified.
page 503	Changed and relocated paragraphs 3.E.(5), 3.F.(3) and 3.D. to paragraph 4. Changed paragraph 3.E.(2) and 3.E.(4) to paragraph 5. adding steel drive ring (300A). Changed Figure 301 to 501. Changed paragraph 3.B. to paragraph 9. and added NOTE.
page 504	Changed paragraph 3.E.(3) to paragraph 6. Changed paragraph 3.F.(2) to paragraph 7. and clarified. Changed paragraph 3.A. to paragraph 8. adding Figure 502 reference.
page 505	Added Figure 502.
page 506	Combined paragraphs 3.G. and 3.H. to paragraph 10. Added self-locking nut 180 and minimum torque value. Added paragraphs 11. and 12.
page 601 thru 617/618	Relocated data from pages 401 thru 414 and clarified figure item references to agree with IPL changes.
page 601	Revised Repair Materials, clarified chemical film solutions. Added Loctite RC/620, MIBK, and Aeroprite paint.
page 602	Changed wheel halves to wheel subassembly. Deleted existing NOTE on corrosion and added NOTE to paragraph 3.A.
page 603	Changed Figure 401 to 601.
pages 602 and 604	Relocated and clarified paragraphs 3.A. thru 3.H. Added Key to Figure 601. Added General to Key.
pages 605 and 606	Added paragraphs 4.B. and renumbered 4.B. to 4.C. Added paragraph 4.C.(1) and renumbered sub-paragraphs (1) thru (6) to (2) thru (7). Clarified step (7) and added Figure 602. Changed 0.0015 to 0.002 maximum clearance.

Chapter/Section and Page No.	Description of Change
page 607	Relocated paragraph 5., Repairing Worn Bearing Bores to Repair No. 1 and Repair No. 2. Changed paragraph 6. to 5. Changed figure reference 403 to 603.
page 608	Changed Figure 403 to 603.
pages 609 thru 612	Added paragraph 5.C. and 5.D. adding steel drive ring data.
page 611	Added Figure 604.
pages 612 thru 617/618	Changed paragraph 7. to 6. Re-Treating and Repainting adding Aeroprite Method 1 and Figure 605, and Figure 606. Relocated paragraph 8. Drive Flange Rivet Hole Repair to Repair No. 3. Relocated paragraph 9. Drive Flange Tee Bar Plunger Hole Repair to Repair No. 4. Deleted paragraph 10., Wheel Assembly 5000444-2 Reidentification to Wheel Assembly 5006586.
Repair No. 1 pages 601 and 602	Added. Relocated text and format.
Repair No. 2 pages 601 and 602	Added. Relocated text and format.
Repair No. 3 pages 601 and 602	Added. Relocated text and format.
Repair No. 4 pages 601 and 602	Added. Relocated text and format.
pages 701 thru 709/710	Relocated data from pages 501 thru 506 and clarified figure item references to agree with IPL changes. Clarified data by subject.
page 701	Added paragraph 2.B., 2.C. and 2.D.
pages 702 and 703	Added paragraph 3.B. Renumbered paragraph 3.B. to 3.C. Changed paragraph C.(1) to paragraph D.
page 703	Changed paragraph C. to E. and clarified.
pages 704 and 705	Changed paragraph D. to F. and clarified. Added paragraph G., relocated data adding WARNING and CAUTION. Deleted CAUTION "Do not use impact or power wrenches."

Chapter/Section and Page No.	Description of Change
pages 705 and 706	Changed paragraph F. to H. and clarified. Changed *paragraph G. to I. and H. to J. Combined paragraphs* I., J., and K. to paragraph K. adding CAUTIONS.
pages 707 and 708	Added paragraph 3.L. Added paragraph 4., Wheel Balancing, and Figure 701.
page 709/710	Relocated Storage Instructions from page 901/902.
page 801/802	*Relocated data from 601 and 602 deleting metric* equivalent Figures 604, 605 and 607. Changed Figure 601 to 801, 602 to 802, and 603 to 803. Added bolt 255, self-locking nut 180 and disk drive ring 300A.
page 901/902	Added Special Tools section.
page 1001 thru 1006	Relocated data from page 1101 thru 1106.
page 1001	Revised Introduction to latest format.
page 1002	Revised IPL Figure 1 adding Main Wheel Assembly 5000444-3 and deleted P/Ns 5000444-2 and 5006586. Changed figure item references to agree with revised parts list.
pages 1003 thru 1005	Revised parts list as follows: Item 1.B. - Deleted. Item 1.C. - Added. Deleted Main Wheel Assembly 5006586. Item 10 - Added. Item 20 - Was 2. Added effect code AC. Item 20A - Was 2A. Item 20B - Was 2B, deleted. Item 30 - Was 3. Added (Order class 2 or 4 only). Item 40 - Was 4. Item 40 - Was 5. Item 60 - Was 6. Added (Order class 2 or 4 only). Item 70 - Was 7. Item 80 - Was 8. Item 90 - Was 9. Item 100 - Was 11. Item 110 - Was 12. Item 120 - Was 13. Item 130 - Was 14. Item 140 - Was 15.

Chapter/Section and Page No.	Description of Change
pages 1003 thru 1005	Item 150 - Was 16. Item 160 - Was 17. Item 170 - Was 18. Changed grommet to preformed packing. Item 180 - Was 19, P/N MS20364-1032. Item 190 - Was 20. Item 200 - Was 21. Item 210 - Was 22. Item 220 - Was 23. added (Order class 2 or 4 only). Item 221 - Was 23A. Item 230 - Was 10 (not in disassembly order). Item 240 - Was 24. Added effect code AB. Item 240A - Added. Item 250 - Was 25. Added effect code AB. Item 255 - Added. Item 260 - Was 26. Item 270 - Was 27. Item 271 - Was 27A. Added effect code AB. Item 280 - Was 28. Item 281 - Was 28A. Item 290 - Was 29. Added effect code AB. Item 300 - Was 30. Added effect code AB. Item 300A - Added. Item 310 - Was 31. Item 311 - Was 31A. Item 320 thru 350B - Added.
page 1006	Added vendor code 56878.

LORAL
Aircraft Braking Systems

OVERHAUL MANUAL WITH IPL
MAIN WHEEL ASSEMBLIES
5000444 AND 5006586

TO: HOLDERS OF AP-559 (32-40-12) OVERHAUL MANUAL WITH ILLUSTRATED PARTS LIST FOR MAIN WHEEL ASSEMBLIES 5000444, 5000444-1, 5000444-2, AND 5006586 USED ON DEHAVILLAND DHC-6, IAI ARAVA-101, 202, AND CASA C-212-200 AIRCRAFT.

Attached to this transmittal letter is Revision No. 5 of AP-559 (basic issue dated 1 March 1972).

REVISION NO. 5 DATED 16 APRIL 1984

HIGHLIGHTS

Pages which have been added or revised are listed below, together with the Highlights of the revision. Please delete the affected pages and insert Revision No. 5 pages dated April 16, 1984. Enter Revision No. 5 dated April 16, 1984 and add insertion date on the Record of Revisions sheet.

Please retain all previous HIGHLIGHTS pages in this manual for future reference.

Chapter/Section and Page No.	Description of Change
Service Bulletin List, page 1/2	Added Service Bulletins Casa 212-200-32-2, DH-32-1, and DH-32-2.
List of Effective Pages, page 1/2	Revised to reflect current revision.
Introduction, pages 1 thru 5/6	Revised Introduction to add manual verification and updated the field office address list.
32-40-12	
page 301	Added NOTE and added supplier addresses to paragraph 1. Numbered paragraph 2.A. Deleted NOTE from paragraph 2. Relocated text.
page 302	Deleted Figure 301. Added last sentence to paragraphs E.(2) and E.(3). Renumbered Figure 302 reference to 301 in paragraph E.(4) NOTE. Relocated text.
page 303/304	Renumbered Figure 302 to 301. Relocated text.
page 408	Added paragraph 6.A.(5).
page 411	Clarified paragraph 8. Drive Flange Rivet Hole Repair by adding steps 8.A.(2), (3), (4), (5), and (7). Renumbered step (4) to (6). Added new paragraph 9. Drive Flange Tee Bar Plunger Hole Repair. Relocated text.

Chapter/Section and Page No.	Description of Change
page 412	Clarified detail for bushing installation in Figure 404 and changed title to "Drive Flange Rivet Hole Repair". Relocated text.
page 413/414	Added page for revised Figure 405. Renumbered paragraph 9. to 10.
pages 1103 and 1104	Revised Parts List as follows: Item 23A - Added figure item to repair parts. Item 27A - Added. Item 31A - Added figure item to repair parts. Relocated text.
page 1105/1106	Added page for relocated text.

LORAL
Aircraft Braking Systems

OVERHAUL MANUAL WITH IPL
MAIN WHEEL ASSEMBLY 5000444 AND 5006586

TO: HOLDERS OF AP-559 (32-40-12) OVERHAUL MANUAL WITH ILLUSTRATED PARTS LIST FOR MAIN WHEEL ASSEMBLIES 5000444, 5000444-1, 5000444-2, AND 5006586 USED ON DEHAVILLAND DHC-6, IAI ARAVA-101, 202, AND CASA C-212-200 AIRCRAFT.

Attached to this transmittal letter is Revision No. 4 of AP-559 (basic issue dated 1 March 1972).

REVISION NO. 4 DATED 31 DECEMBER 1981

REVISION NO. 4 CONTAINS ALL PAGES OF THE MANUAL. Pages which have been added or revised are outlined below, together with the Highlights of the revision.

Please retain all previous HIGHLIGHTS pages, inserting them in this manual for future reference.

HIGHLIGHTS

Chapter/Section and Page No.	Description of Change
Rev. 3 Highlights Page	Corrected nomenclature in first paragraph which incorporated Temporary Revision No. 1, page 2.
All pages	Added 5006586 to Masthead.
Record of Revisions, page 1/2	Added Revision No. 4.
Record of Temporary Revisions, page 1/2	Added incorporation date of Temporary Revision 32-1.
Service Bulletin List, page 1/2	Added Service Bulletin Casa 212-200-32-1.
List of Effective Pages, page 1/2	Corrected Masthead which incorporates TR32-1. Revised effective page dates to agree with current revision.
Table of Contents, page 1/2	Corrected issue date which incorporated Temporary Revision 32-1, page 4.
Introduction, pages 1-4	Corrected ATA No. on page 1, which incorporated Temporary Revision 32-1, page 5. Also updated pages 1-4.

Chapter/Section and Page No.	Description of Change
32-40-12	
page 1	Revised paragraphs 1A and 1F to include 5006585 assembly.
page 2	Added 5006586 assembly to Figure 1.
page 201	Changed Specification MIL-C-25107A to MIL-C-19853, Type II, in 1. Cleaning Materials.
page 202	Changed specification MIL-C-25107A to MIL-C-19853, Type II, in paragraph 3C.
page 301	Added figure item reference 2A and 2B to paragraph 3A.
page 411	Added paragraph 8 - Drive Flange Rivet Hole Repair. Added Figure 404.
page 412	Added Figure 405. Added paragraph 9 Assembly Re-identification 5000444-2 to 5006585.
page 505	Clarified paragraph K.
page 1102	Added figure item reference 2A and 2B and Main Wheel Assembly 5006586 to Figure 1.
page 1103	Added figure item 1C and effect Code D. Added figure item 28A.

LORAL
Aircraft Braking Systems

OVERHAUL MANUAL WITH IPL
MAIN WHEEL ASSEMBLY 5000444

TO: HOLDERS OF XAP-559 (32-40-12) OVERHAUL MANUAL WITH ILLUSTRATED PARTS LIST FOR MAIN WHEEL ASSEMBLIES 5000444, USED ON DEHAVILL AND DHC-6, MAIN WHEEL ASSEMBLY 5000444-1 USED ON IAI ARAVA-101 AND 102, AND MAIN WHEEL ASSEMBLY 5000444-2 USED ON CASA C.212 AIRCRAFT.

Attached to this transmittal letter is Revision No. 3 of XAP-559 (basic issue dated 1 March 1972).

REVISION NO. 3 DATED 15 JUN 1979

REVISION NO. 3 CONTAINS ALL PAGES OF THE MANUAL. Pages which have been revised are outlined below, together with the Highlights of the revision.

Please remove and retain all previous Highlights pages in the manual for future reference.

No revision bars were used. All sections of the manual were revised to the latest format of ATA-100 and Goodyear technical information.

Manual number was changed from XAP-559 to AP-559.

TO: HOLDERS OF XAP-559 OVERHAUL MANUAL WITH ILLUSTRATED PARTS LIST FOR MAIN WHEEL ASSEMBLIES 5000444 AND 5000444-1 (32-40-12) USED ON DEHAVILLAND DHC-6.

Attached to this transmittal letter is Revision No. 2 of XAP-559 (basic issue dated 1 March 1972).

REVISION NO. 2 DATED 15 FEBRUARY 1978

REVSION NO. 2 CONTAINS ALL PAGES OF THE MANUAL. Pages which have been revised are outlined below, together with the Highlights of the revision. Retain Highlights pages in manual for future reference.

HIGHLIGHTS

Chapter/Section/Page No.	Description of Change
Cover	Revised to the latest format and added P/N 5000444-2.
Title Page	Clarified aircraft references. Added P/N 5000444-2 and revision date.
All pages	Revised masthead from Aviation Products to Goodyear Aerospace.
List of Effective Pages, page 1/2	Revised to reflect current revision.
Record of Revision, page 1/2	Revised to reflect current revision.
Introduction, pages 1 thru 4	Added Goodyear field offices and included "TSO NOTICE" from the Table of Contents.
Table of Contents, page 1/2	Removed Chapter/Section number and TSO Notice.
32-40-12, page 2	Added 5000444-2 to figure title.
32-40-12, page 3/4	Added paragraph 5. - Wheel Differences.

Chapter/Section/Page No.	Description of Change
32-40-12, page 201	In paragraph 1.C., changed the word inspect to check.
32-40-12, page 301	Changed title from Inspection/Check to Check.
32-40-12, pages 301, 302, 303/304	Revised section changing the word "inspect" to "check".
32-40-12, page 401	In paragraphs 1. and 2., replaced "retired from service" with "replaced".
32-40-12, page 501	In paragraphs 2.C.(2) and 2.C.(3), changed "alcohol" to "isopropyl alcohol".
32-40-12, page 502	In paragraph 2.D.(1), changed "alcohol" to "isopropyl alcohol".
32-40-12, page 901	Revised to latest Storage Instructions.
32-40-12, page 1101	Revised to latest format. Moved Vendor Codes to page 1104.
32-40-12, page 1102	Added Wheel Assembly 5000444-2 to Figure 1 title.
32-40-12, page 1103	Added Effect Codes to Wheel Assembly 5000444-2 and associated parts.
32-40-12, page 1104	Relocated Vendor Codes from page 1101.

LORAL
Aircraft Braking Systems

OVERHAUL MANUAL WITH IPL
MAIN WHEEL ASSEMBLY 5000444

TO: HOLDERS OF XAP-559 OVERHAUL MANUAL WITH ILLUSTRATED PARTS LIST FOR MAIN WHEEL ASSEMBLY, PART NO. 5000444-1.

Attached to this transmittal letter is Revision No. 1 of XAP-559 (basic issue dated 1 March 1972).

REVISION NO. 1 DATED 15 APRIL 1973

REVSION NO. 1 CONTAINS ALL PAGES OF THE MANUAL. Pages which have been revised are outlined below, together with the Highlights of the revision. Retain Highlights pages in manual for future reference.

HIGHLIGHTS

Chapter/Section/Page No.	Description of Change
All pages	Deleted (-1) in masthead with no revision date change.
Cover	Deleted aircraft reference and added P/N 5000444.
Title	Deleted aircraft reference, added P/N 5000444 and revision date.
List of Effective Pages	Revised to reflect current revision.
Record of Revision	Revised to reflect current revision.
Table of Contents	Revised Introduction Chapter/Section number.
Introduction	Revised to reflect current changes.
32-40-12, page 1	Deleted Part Number 5000444-1.
32-40-12, page 2	Added 5000444 to figure title.
32-40-12, page 101	Changed tire deflator number.
32-40-12, page 302	Revised approved penetrant in figure 302.
32-40-12, page 1101	Added "See T&R Standards for approved manufacturer".
32-40-12, page 1102	Added 5000444 to Figure 1 title.
32-40-12, page 1103	Added 5000444 wheel assembly to IPL.

COMPONENT MAINTENANCE MANUAL
MAIN WHEEL ASSEMBLY 5000444

RECORD OF REVISIONS

REV NO.	ISSUE DATE	DATE INSERTED	BY
1	Apr 15/73	Apr 15/73	GTR
2	Feb 15/78	Feb 15/78	GAC
3	Jun 15/79	Jun 15/79	GAC
4	Dec 31/81	Dec 31/81	GAC
5	Apr 16/84	Sep 15/88	LABS
6	Sep 15/88	Sep 15/88	LABS
7	Aug 15/89	Aug 21/02	ATP/MG

REV NO.	ISSUE DATE	DATE INSERTED	BY

RECORD OF TEMPORARY REVISIONS

TEMPORARY REVISION NUMBER	PAGE NUMBER	ISSUE DATE	BY	DATE REMOVED	BY
32-1	1 thru 6	02/21/80	GAC	12/31/81	GAC

SERVICE BULLETIN LIST

SERVICE BULLETIN NUMBER	REV NO.	DATE INSERTED
ARAVA 101-32-1		No Effect
ARAVA 202-32-1		No Effect
ARAVA 202-32-2		No Effect

SERVICE BULLETIN NUMBER	REV NO.	DATE INSERTED
DH-32-1		No Effect
DH-32-2		No Effect
DH-32-3		No Effect
DHC6-32-4		No Effect

LIST OF EFFECTIVE PAGES

SUBJECT	PAGE	DATE
Title		Sep 28/90
Record of Revisions	1	Sep 15/88
	2	Blank
Record of Temporary Revisions	1	Sep 15/88
	2	Blank
Service Bulletin List	1	Sep 15/88
	2	Blank
List of Effective Pages	1	Sep 28/90
	2	Sep 28/90
Table of Contents	1	Sep 15/88
	2	Sep 28/90
Introduction	1	Aug 15/89
	2	Aug 15/89
	3	Sep 28/90
	4	Sep 28/90
Description and Operation	1	Sep 15/88
	2	Sep 15/88
	3	Sep 15/88
	4	Sep 15/88
	5	Sep 15/88
	6	Sep 15/88
Testing and Fault Isolation	101	Sep 15/88
	102	Aug 15/89
	103	Sep 15/88
	104	Sep 15/88
	105	Sep 15/88
	106	Sep 15/88
Disassembly	301	Sep 15/88
	302	Aug 15/89
	303	Sep 15/88
	304	Blank
Cleaning	401	Aug 15/89
	402	Aug 15/89
	403	Aug 15/89
	404	Aug 15/89
	405	Aug 15/89
	406	Blank
Check	501	Sep 15/88
	502	Aug 15/89
	503	Sep 15/88
	504	Sep 15/88
	505	Sep 15/88
	506	Sep 15/88
Repair	601	Sep 15/88
	602	Aug 15/89
	603	Sep 15/88
	604	Sep 15/88
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COMPONENT MAINTENANCE MANUAL
MAIN WHEEL ASSEMBLY 5000444

INTRODUCTION

This manual is published in accordance with Air Transport Association Specification No. 100 for the guidance of personnel responsible for the overhaul and/or maintenance of the assembly(ies) covered in this publication. The procedures described in this manual may be altered if better and/or more economical equivalent methods can be employed by the individual facilities. However, the alternate procedures must not lessen the performance or efficiency of operation of the assembly, and all torque and specific limits or values contained herein must be strictly observed.

All dimensions and other values are expressed in U.S. units followed, where applicable, by the appropriate SI (International System) metric units in parentheses. All illustration dimensions are in inches with millimeter conversions in parentheses unless otherwise specified. Dimensions of standard tools or parts such as drills, taps, bolts, nuts, etc. where there are no equivalent metric tools or parts for the application, appear in U.S. units. Illustrations are for reference only and are not drawn to scale. Attempt is made to illustrate relationship to adjoining parts in proper proportion.

The following precautions apply to all procedures in this manual:

NOTICE

Any alteration to or substitution of any part contained in any wheel and/or brake affecting those assemblies could result in unit malfunction, or other adverse effects.

If alteration to or substitution of any part contained in any Aircraft Braking Systems' wheel and/or brake affecting those assemblies is necessary, obtain prior written Aircraft Braking Systems' authorization and instruction before performing such alteration or substitution.

AIRCRAFT BRAKING SYSTEMS ASSUMES NO LIABILITY WHATSOEVER, WHETHER CONTRACTURAL, WARRANTY, TORT OR OTHERWISE, FOR ANY UNAUTHORIZED SUBSTITUTION OF OR ALTERATION TO ANY PART CONTAINED IN ANY WHEEL AND/OR BRAKE OR FOR ANY ALTERATION NOT PERFORMED IN ACCORDANCE WITH AIRCRAFT BRAKING SYSTEMS APPROVED PROCEDURES.

While Aircraft Braking Systems represents the information contained in this manual was current at the time of publication of this issue, and verified by comparison to engineering documentation, the user is cautioned that he must inquire of the nearest authorized distributor or dealer of Aircraft Braking Systems' wheels and brakes as to whether a more recent publication is in existence before proceeding with overhaul or maintenance operations. If you cannot locate a dealer or distributor, make your inquiry directly to our Customer Support Department, Aircraft Braking Systems, 1204 Massillon Road, Akron, Ohio 44306-4186.

Users outside the United States and Canada should contact the nearest Aircraft Braking Systems International Field office as listed in this manual or the closest Aircraft Braking Systems' distributor.

The aircraft maintenance manual shall take precedence for the component's interface connections with the functional features as used in the aircraft. This manual may also describe functional features that may or may not be used when installed as a component of a system in the aircraft.

TSO NOTICE

This assembly for commercial transport usage carries a "TSO" marking which identifies it as having been fully laboratory tested and qualified to the applicable Federal Aviation Administration (FAA) regulations. As a commercial transport category assembly, it is also tested and qualified to the specification requirements of the applicable airframe manufacturer and, finally, is certified on the applicable aircraft.

After final certification, any substitution of or alteration to any part and/or any change of process or material is not permitted without complete requalification of this assembly and resubmittal of the test data to the FAA for approval.

The FAA regulations subject Aircraft Braking Systems, the airframe manufacturer and the operator to constant surveillance to assure that proper Quality Assurance material and processing controls are maintained in order to provide replacement parts that are the same quality as the parts originally certified in this assembly.

SAFETY SUMMARY

Adhere to all manufacturer's Warnings and Cautions for all materials specified in this manual. Wear protective clothing (gloves, apron, etc.) approved for the materials and tools being used.

ON-CONDITION MAINTENANCE

Individual operators shall determine the frequency of maintenance. Since each operator has a different set of operating conditions, overhaul frequency will vary. Aircraft Braking Systems recommends that on-condition maintenance be performed.

World Airlines Technical Operations Glossary (WATOG) defines on-condition maintenance as follows:

A primary maintenance process having repetitive inspections or tests to determine the condition of units, systems or portions of structure with regard to continued serviceability (corrective action is taken when required by item condition).

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DESCRIPTION AND OPERATION

1. General (Ref. Fig. 1)

   A. The main wheel assembly is designed for use with 11.00-12 tube-type or tubeless tires. The wheel subassembly is manufactured from forged aluminum alloy.

2. Description and Operation

   A. The main wheel is the divided type to facilitate tire installation and removal. The inboard and outboard subassemblies are held together by bolts, washers and self-locking nuts. When tubeless tires are mounted, a preformed packing is installed on the outboard wheel subassembly to provide an air seal at the juncture of the two wheel subassemblies. A separate valve subassembly is installed in the outboard wheel subassembly to inflate and deflate the tubeless tire. When tube-type types are installed, neither the preformed packing nor the valve subassembly is installed.

   B. The wheel rotates on two tapered roller bearings. The bearing cups are shrink-fitted into the hubs of each wheel subassembly. The bearings are protected against dirt and moisture contamination and loss of lubricant by a steel-reinforced rubber bearing seal installed on each wheel subassembly. The outboard bearing cone and seal are held in place by the axle nut. The inboard bearing cone and seal are held in place by a wire retaining ring.

   C. The disk drive ring is shrink-fitted into the flange of the inboard wheel subassembly, and is secured to the wheel flange. The disk drive ring engages the brake disk when the wheel and brake are installed on the aircraft. Three steel disk springs are secured to the wheel flange and disk drive ring. The springs secure three tee bar plungers, which align the brake disk in the drive ring and eliminate noise.

      (1) For Main Wheel Assembly 5000444 and 5000444-1, an aluminum alloy disk drive ring is secured with rivets and washers.

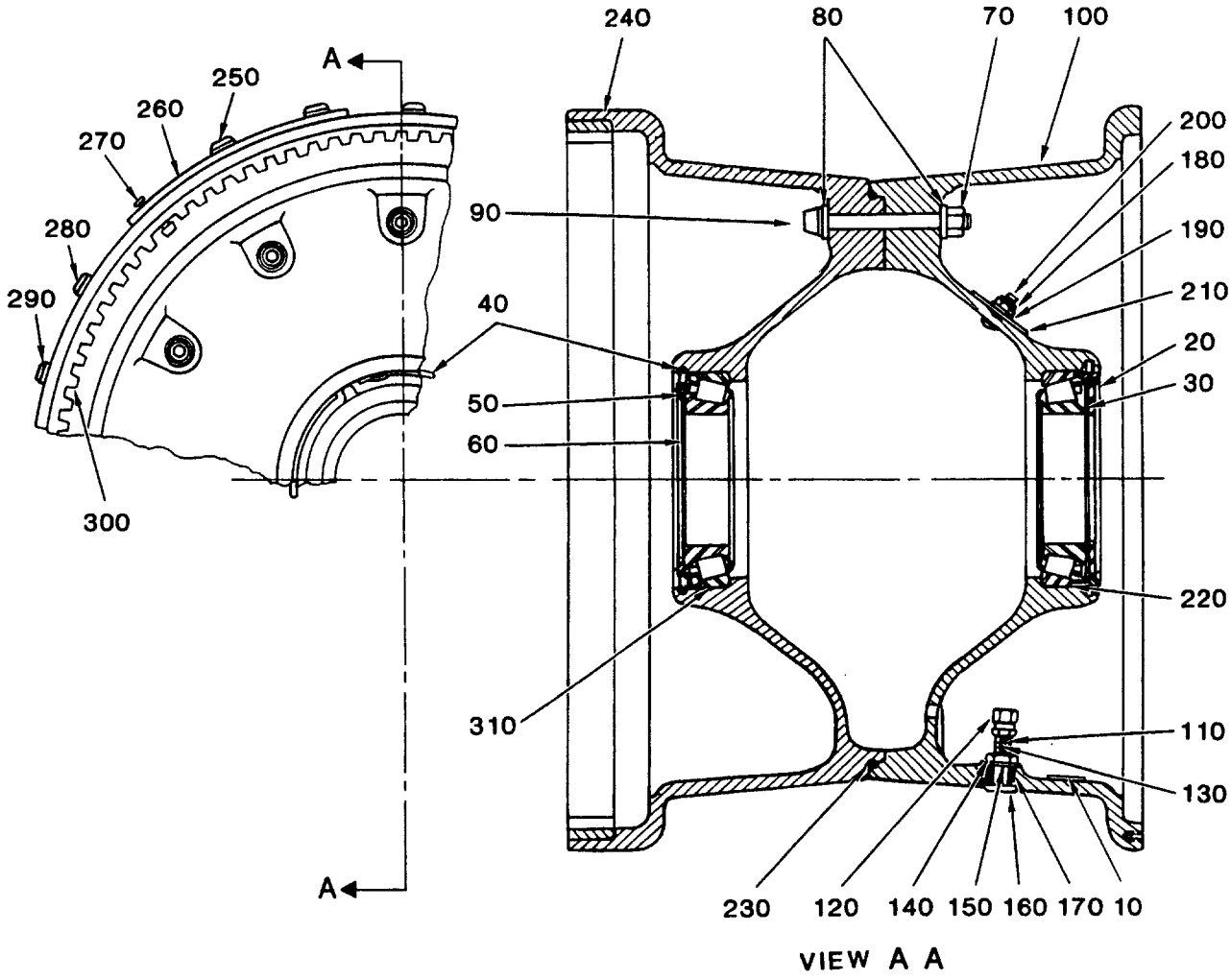
      (2) For Main Wheel Assembly 5000444-3, a steel disk drive ring is secured with hex head bolts and washers.

   D. Each wheel subassembly is individually balanced at the time of manufacture. This permits one wheel subassembly to be assembled in any position relative to the other subassembly and allows interchanging of wheel subassembly without rebalancing the assembly.

3. Handling Procedures

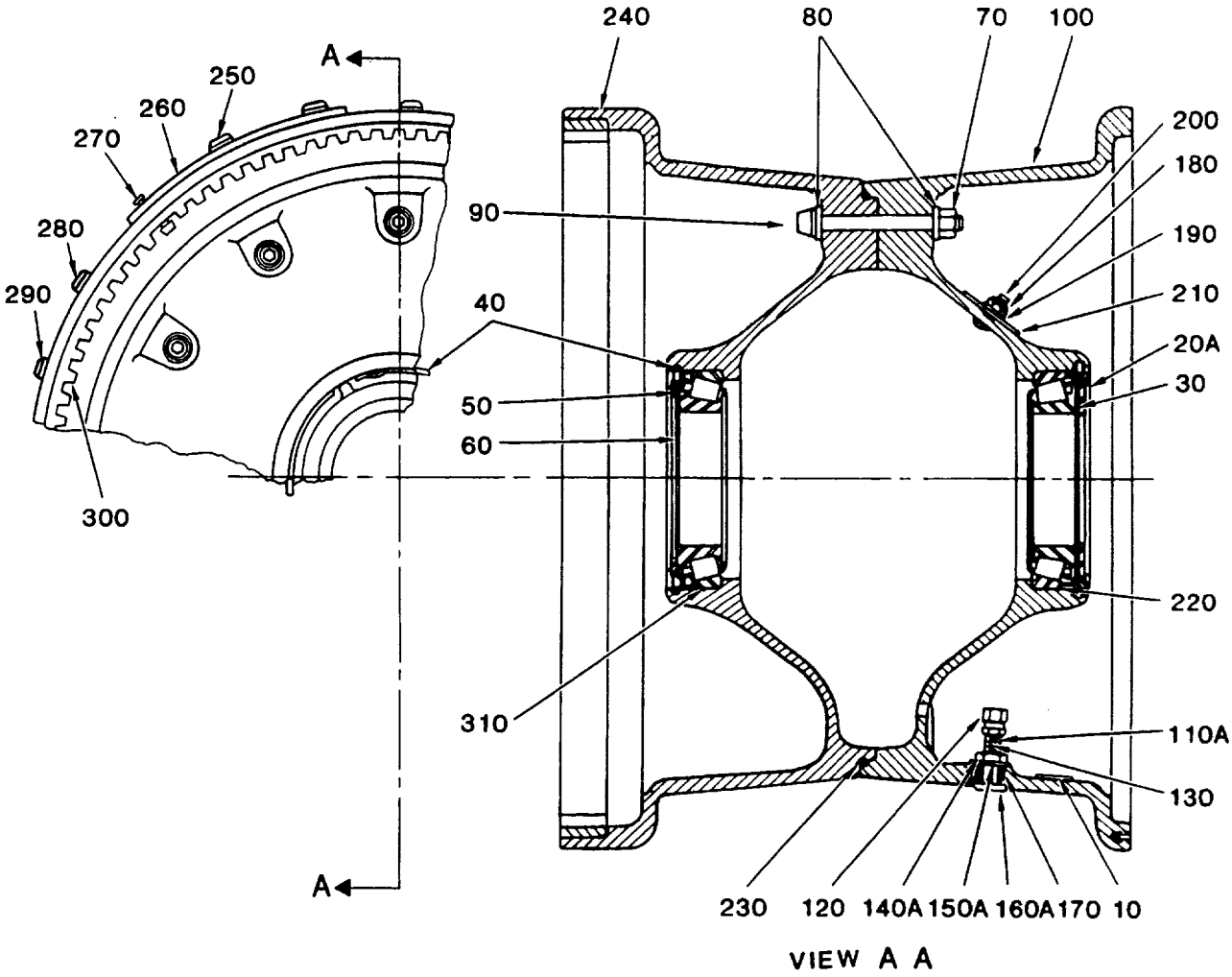
   A. Careful handling of the wheel components will assure long service life and trouble-free operation.

   B. Strictly observe the deflation and inflation procedures and the torque values specified in this manual. Do not overtighten any bolt or nut.



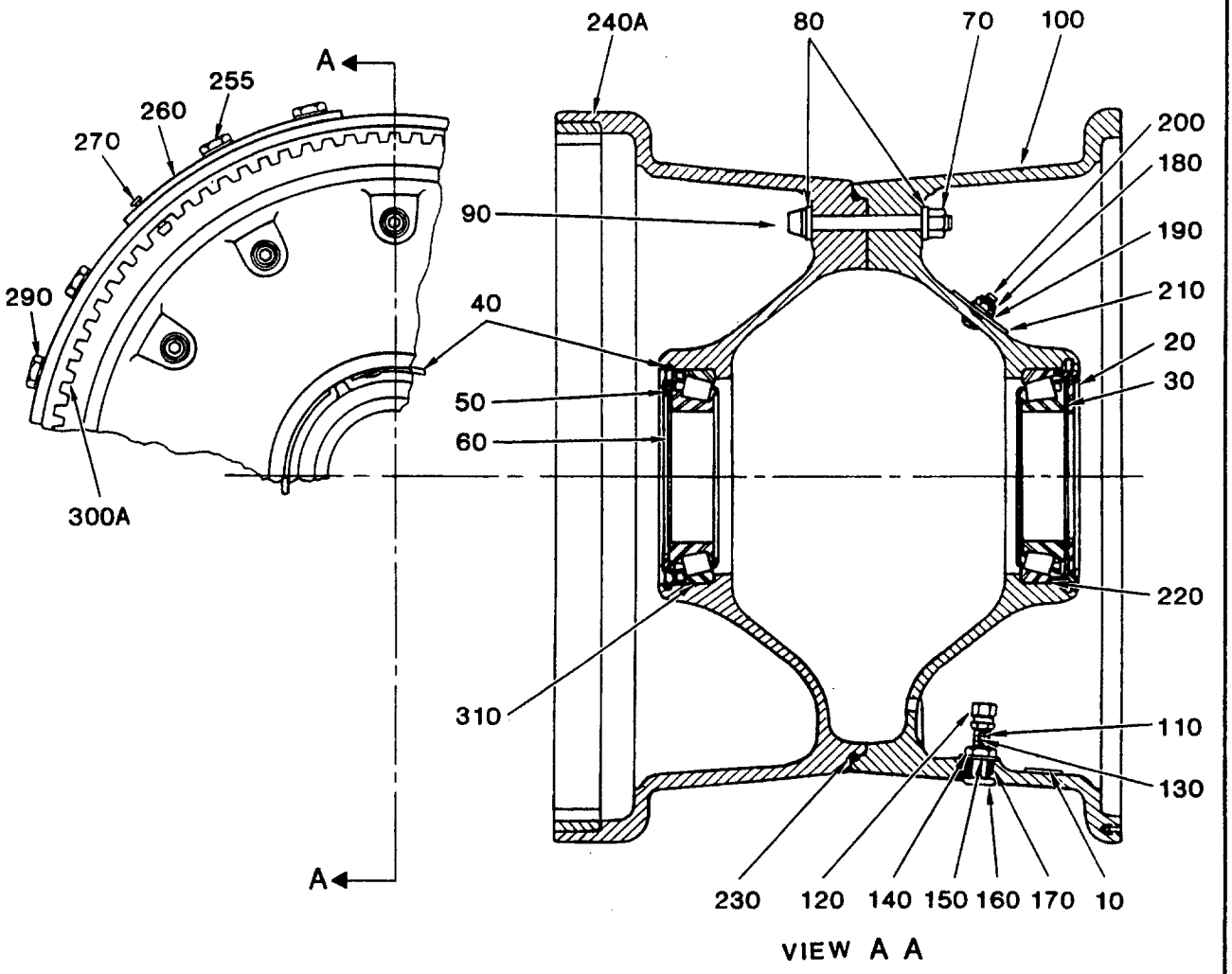
ASSEMBLY 5000444

Main Wheel Assembly
Figure 1 (Sheet 1 of 3)



ASSEMBLY 5000444-1

Main Wheel Assembly
Figure 1 (Sheet 2 of 3)



ASSEMBLY 5000444-3

Main Wheel Assembly
Figure 1 (Sheet 3 of 3)

Key to Figure 1

-1.	RF	160.	Valve Stem
10.	Instruction Data Plate	160A.	Valve Stem
20.	Outboard Bearing Seal	170.	Preformed Packing
20A.	Outboard Bearing Seal	180.	Self-Locking Nut
30.	Outboard Bearing Cone	190.	Plain Washer
40.	Retaining Ring	200.	Screw
50.	Inboard Bearing Seal	210.	Tire/Time Change Counter
60.	Inboard Bearing Cone	220.	Bearing Cup
70.	Self-Locking Nut	230.	Preformed Packing
80.	Double Recessed Washer	240.	Inboard Wheel Subassembly
90.	Internal Wrenching Bolt	240A.	Inboard Wheel Subassembly
100.	Outboard Wheel Subassembly	250.	Rivet
110.	Valve Subassembly	255.	Hex Head Bolt
110A.	Valve Subassembly	260.	Disk Spring
120.	Valve Cap	270.	Tee Bar Plunger
130.	Valve Core	280.	Rivet
140.	Hex Nut	290.	Plain Washer
140A.	Hex Nut	300.	Disk Drive Ring
150.	Washer	300A.	Disk Drive Ring
150A.	Spacer	310.	Bearing Cup

- Item not illustrated.

C. Handle the wheel bearing cones with extreme care. Dropping or mishandling the cones during maintenance may cause bearing failures. Do not drive bearing cones onto the aircraft axle. Never overtighten the axle nut.

D. The wheel should be properly maintained to protect the paint and surface finishes, as exposed surfaces are susceptible to corrosion. Nicks, scratches and other damage caused by improper handling of the wheel during maintenance invite corrosion, which if unattended will eventually lead to fatigue cracks and premature removal from service.

4. Leading Particulars

Wheel Size and Type	11.00-12, Tube or Tubeless
Weight (Approximate) 5000444	28.3 pounds (12,8 kg)
5000444-1	28.7 pounds (13,0 kg)
5000444-3	32.6 pounds (14,8 kg)
Material	Forged Aluminum Alloy
Wheel Bolt Nut Torque	150 pound-inches (16,9 N-m) (Lubtork)
Lubrication:	
Wheel Preformed Packing	Grease, Specification MIL-G-81322
Bearings	Grease, Specification MIL-G-81322
Bearing Seal Lips	Grease, Specification MIL-G-81322

5. Wheel Differences

A. Main Wheel Assembly 5000444 differs from Main Wheel Assembly 5000444-1 only in the outboard bearing seal and inflation valve.

B. Main Wheel Assembly 5000444 differs from Wheel Assembly 5000444-3 only in the inboard wheel subassembly.

(1) The 5000444-3 Wheel Assembly has a steel disk drive ring, secured with hex head bolts and washers.

TESTING AND FAULT ISOLATION

1. Test Equipment and Materials

NOTE: Equivalent substitutes may be used for items listed below.

Tire Pressure Gage - Capable of measuring up to 225 psi (15,51 bars). Scale may be greater than 1 psi (0,068 bars) increments but scale should be readable to 1 psi.	Commercially available
Inflation Cage	Commercially available
Tire Deflator Schrader 4277 or equivalent	Schrader Automotive, Incorporated Division of Arvin Industries 566 Mainstream Drive P.O. Box 675 Nashville, TN 37202-0675
Grease Specification MIL-G-81322	Commercially available
Antiseize Compound Specification MIL-T-5544	W J Ruscoe & Company 483 Kenmore Boulevard Akron, OH 44301
Soap Solution 30 percent soap solution	Commercially available
Soft Bristle Brush	Commercially available
Cellulose Sponge	Commercially available

2. General

WARNING: TO PREVENT POSSIBLE INJURY TO PERSONNEL, EXERCISE ALL SAFETY PRECAUTIONS BEFORE CONDUCTING TESTS.

A. The purpose of this test section is to provide guidance of maintenance personnel responsible for overhaul and/or maintenance as follows:

(1) To determine the extent of disassembly required.

(2) To provide operational test (leak test) after maintenance action to verify proper wheel/tire assembly.

B. Serviceability of aircraft wheels subjected to rolling with a flat or disintegrated tire and damage to overloaded mating wheel, where applicable, should be checked in accordance with CHECK section.

C. Check for missing or broken wheel bolts and nuts.

(1) If a single bolt or nut is broken or missing, replace it and the two (one on each side) adjacent bolts and nuts in accordance with DISASSEMBLY.

(a) If a bolt or nut is cracked, replace cracked bolt or nut only.

(2) Magnetic-particle check (or equivalent) all other bolts after thorough cleaning in accordance with CLEANING and CHECK.

(3) If more than one bolt is broken or missing, all bolts are nonserviceable.

3. Test Setup

A. None required.

4. Operational Test and Fault Isolation Procedures (Ref. IPL Fig. 1)

WARNING: TO PREVENT POSSIBLE INJURY TO PERSONNEL, EXERCISE ALL SAFETY PRECAUTIONS BEFORE CONDUCTING TESTS.

NOTE: Steps A. and B. should be performed to determine the exact condition or malfunction of the main wheel assembly. All variations from the established leakage rates should be noted for future reference during testing.

A. Perform the following to determine the extent of disassembly required.

CAUTION: BEARING SEALS AND CONES MAY BE LOOSE. CARE SHOULD BE TAKEN TO PREVENT DROPPING AND DAMAGING THESE PARTS.

(1) Remove bearing seals and bearing cones in accordance with DISASSEMBLY.

(2) Clean bearing cups (220 and 310) in accordance with CLEANING and check roller contacting surface of cups for damage in accordance with CHECK.

(3) Clean bearing cones (30 and 60) in accordance with CLEANING and check roller surfaces in accordance with CHECK.

(4) Check bearing seals (20 or 20A and 50) in accordance with CHECK.

(5) Cover hub openings of wheel assembly to prevent contamination of bearing lubricant.

(6) Check tightness of disk drive ring (300 or 300A). If disk drive ring is loose, replace in accordance with REPAIR.

(7) Check disk drive ring (300 or 300A) gear teeth for wear in accordance with CHECK.

B. Operational Test (Leak Test)

WARNING: TIRE AND/OR WHEEL FAILURE MAY OCCUR CAUSING INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT IF TIRE IS OVER-INFLATED FROM ANY HIGH PRESSURE SOURCE. TIRE AND WHEEL ASSEMBLY MUST BE SERVICED WITH INFLATION EQUIPMENT WHICH HAS BEEN SPECIFICALLY DESIGNED FOR THIS OPERATION.

(1) Place wheel/tire assembly in an inflation cage and inflate to recommended operating pressure.

NOTE: Verify and check operating pressure before handling wheel/tire assembly. Reference Aircraft Tire Manual and Data Book for specific tire data and checks.

(2) Coat juncture around inflation valve subassembly (110 or 110A) and tire beads with soap solution. Check carefully for air leaks in the form of soap bubbles.

NOTE: If air leaks are present, proceed to step (5).

(3) If no leaks occur, remove all traces of soap solution from wheel/tire assembly with water and a cellulose sponge or soft bristle brush. Dry wheel thoroughly with clean, compressed air.

(4) Check pressure after 24 hours.

(a) If reduction in pressure exceeds five percent of inflation pressure, completely deflate tire. Disassemble and check wheel preformed packing (230) and seal groove for damage. Replace wheel preformed packing (230), or if seal groove is damaged, repair and re-treat in accordance with REPAIR. Assemble in accordance with ASSEMBLY AND STORAGE and retest wheel/tire assembly.

(b) If reduction of pressure is less than five percent, reduce tire pressure to recommended storage pressure and remove wheel/tire assembly from inflation cage.

(5) If air leaks are present, proceed with the following steps:

(a) Completely deflate tire and remove assembly from inflation cage and remove all traces of soap solution from wheel/tire assembly with water and a cellulose sponge or soft bristle brush. Dry wheel assembly thoroughly with clean, compressed air.

(b) If leakage occurred around valve subassembly (110 or 110A), check torque on leaking part. Torque hex nut (140 or 140A). Retest the wheel/tire assembly.

(c) If leakage occurred around valve subassembly (110 or 110A) and persists after torque check, remove valve subassembly per DISASSEMBLY. Check interface surfaces and replace preformed packing (170). Reassemble in accordance with ASSEMBLY AND STORAGE and retest.

(d) If leakage occurred around tire bead seat, remove tire from wheel per DISASSEMBLY, check wheel bead seat and tire bead for damage. If tire bead is cut or defective, install a new tire. If wheel bead seat is scratched, nicked, or pitted, repair in accordance with REPAIR. Retreat and repaint areas per REPAIR. Reassemble tire in accordance with ASSEMBLY AND STORAGE and retest the wheel/tire assembly.

5. Hardness Test (Heat Damage Test)

A. Components of the wheel assembly that are suspected of having heat damage shall be checked for hardness as follows:

(1) Remove tire from wheel in accordance with DISASSEMBLY.

(2) Visually check wheel assembly for discoloration, scorched paint, or other evidence of overheated condition.

B. Hardness Test as follows:

(1) Rockwell or Brinell Test

(a) Perform a hardness test on the wheel at three places, 120° apart, as shown in Figure 101. Remove paint from surfaces to be checked and obtain hardness readings on three areas. Check hardness readings in accordance with Figure 102.

NOTE: Do not make tests over balance weight mounting holes.

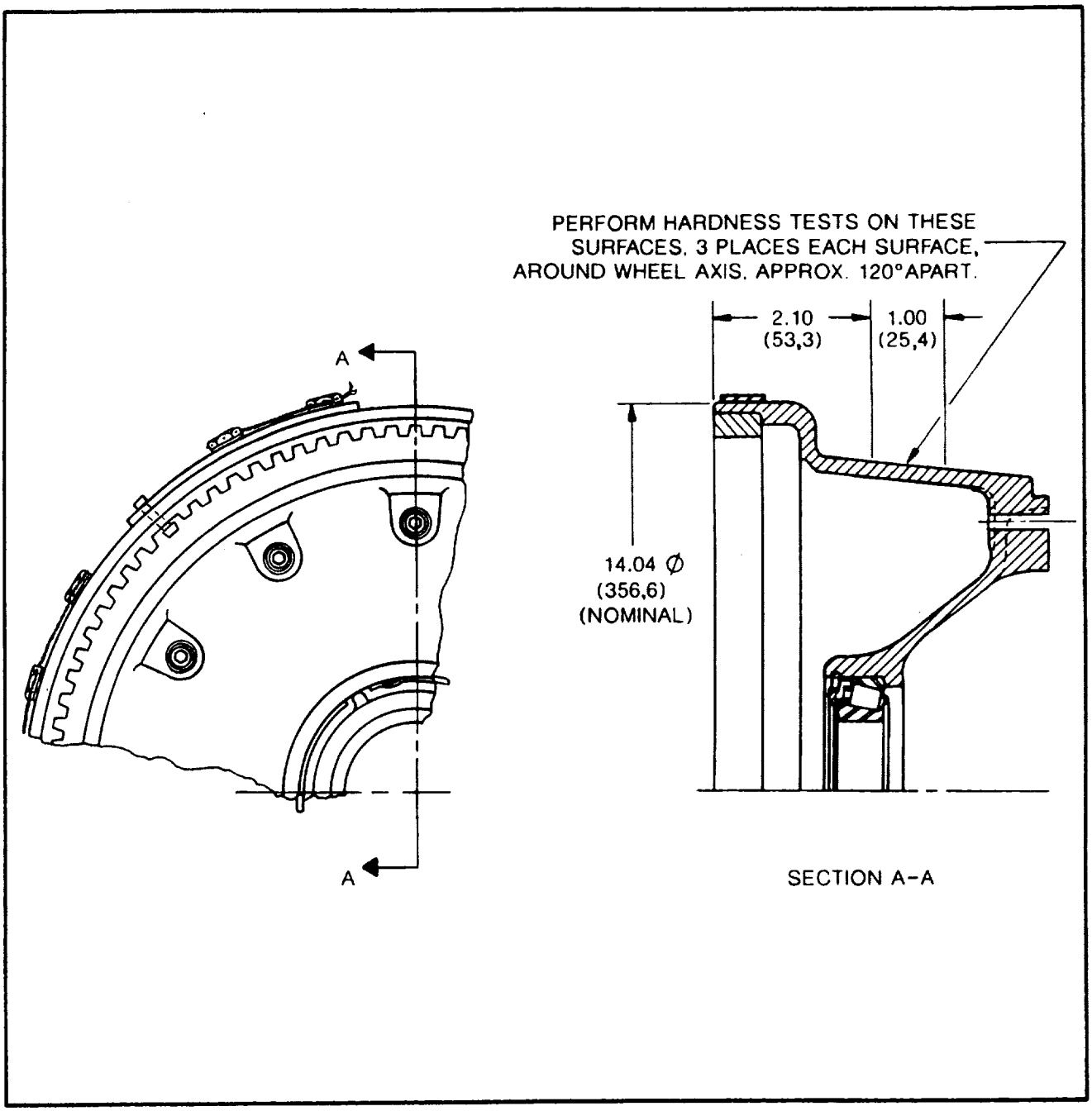
(b) If a reading of less than B71 (112 BHN) and greater than B63 (99 BHN) is obtained, perform a second test in tubewell area. The wheel subassembly shall be impression-stamped with the hardness value and letters "OV" (overheated). This stamping should be placed on the outside of any of the fusible plug bosses for future reference, and the wheel may be continued in service. If an average value of less than B63 is obtained, or if values obtained vary more than the specified range permitted in Figure 102, replace the wheel subassembly.

NOTE: A second hardness test reading is recommended if there is any question as to the accuracy due to an inconsistant reading or excessive point spread. The second check shall be performed in close proximity to the first hardness test reading.

(c) The Brinell test may be substituted, using data in Figure 102, if Rockwell test cannot be performed.

(d) The outboard wheel subassembly should be checked in the same manner if the inboard wheel subassembly has been excessively overheated.

(e) Refinish wheel areas where paint has been removed in accordance with REPAIR.



Heat Damage Test - Inboard Wheel Subassembly
Figure 101

Item	Brinell Test	Rockwell Test B Scale
Ball Diameter	10 mm	1/16 inch
Test Load	500 kg	100 kg
Number of Readings Equally Spaced	3	3
Acceptable Minimum Average Hardness	99 BHN	B63
Maximum Total Range of Three Readings	4 points*	2 points*

NOTE: Test area must be free of paint.

* Applicable to marginal hardness wheel only. Marginal hardness wheels are wheels with ANY ONE hardness reading of less than B64 (101 BHN).

Hardness Test Readings
Figure 102

DISASSEMBLY

1. General (Ref. IPL Fig. 1)

NOTE: See TESTING AND FAULT ISOLATION for operational test and fault isolation procedures to establish condition of unit and determine extent of disassembly required.

A. Disassemble the main wheel assembly in accordance with the following instructions and Disassembly Procedures.

CAUTION: BEARING SEALS AND BEARING CONES WILL BE RELEASED WHEN WHEEL ASSEMBLY IS REMOVED FROM AIRCRAFT AXLE. CARE SHOULD BE TAKEN TO PREVENT DROPPING AND DAMAGING THESE PARTS.

B. Any wheel subjected to rolling with a flat or disintegrated tire and the corresponding overloaded mating wheel where applicable, shall be subjected to checking or replacement as detailed in General Check Procedures (See CHECK).

C. The use of power wrenches for wheel disassembly is governed by the following:

(1) Do not use power wrenches for disassembly of any threaded parts made of nonferrous material or parts (aluminum, brass, etc) threaded into nonferrous tapped holes.

(2) The use of power wrenches for disassembly of any ferrous parts or parts threaded directly into ferrous tapped holes, such as wheel fasteners, is acceptable.

D. It is recommended new preformed packings be installed at each overhaul. If necessary to reuse preformed packing, mark installation position of packing with respect to wheel subassembly so the packing may be reinstalled in the original position. Carefully place packing on a clean, flat surface to avoid damage or stretching.

2. Disassembly Procedures

WARNING: DO NOT ATTEMPT TO DISASSEMBLE WHEEL UNTIL TIRE HAS BEEN COMPLETELY DEFLATED, OTHERWISE, SERIOUS INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT CAN RESULT.

CAUTION: DISASSEMBLE THE WHEEL ON A TIRE CHANGER OR A CLEAN, FLAT SURFACE, BEING CAREFUL NOT TO NICK, SCRATCH OR DAMAGE THE WHEEL SUBASSEMBLIES.

A. Remove valve cap (120) and apply a tire deflator (Schrader 4277 or equivalent) to release tire pressure completely.

WARNING: DO NOT ATTEMPT TO REMOVE VALVE CORE UNTIL TIRE HAS BEEN COMPLETELY DEFLATED. VALVE CORES WILL BE EJECTED AT HIGH VELOCITY IF UNSCREWED BEFORE AIR PRESSURE HAS BEEN RELEASED.

B. Remove valve core (130) from valve stem (160 or 160A).

CAUTION: HANDLE BEARING CONES WITH EXTREME CARE. MANY AIRCRAFT BEARING FAILURES OCCUR AS A RESULT OF MISHANDLING DURING SERVICING.

C. Remove outboard bearing seal (20 or 20A) and outboard bearing cone (30).

D. Remove retaining ring (40), inboard bearing seal (50) and inboard bearing cone (60).

WARNING: NEVER BREAK TIRE BEADS LOOSE UNTIL TIRE HAS BEEN COMPLETELY DEFLATED, OTHERWISE, EXPLOSIVE SEPARATION OF WHEEL COMPONENTS WILL RESULT.

CAUTION: DO NOT PRY BETWEEN WHEEL FLANGE AND TIRE BEADS AS THIS COULD DAMAGE THE WHEEL AND TIRE.

E. Break tire beads free of both wheel flanges by applying pressure in even increments around entire sidewall as close to tire beads as possible.

WARNING: NEVER ATTEMPT TO REMOVE WHEEL BOLTS OR NUTS UNTIL TIRE HAS BEEN COMPLETELY DEFLATED, OTHERWISE, EXPLOSIVE SEPARATION OF WHEEL COMPONENTS WILL RESULT.

F. Remove wheel fasteners as follows:

(1) Check for missing or broken wheel bolts or nuts. If a single broken or missing bolt or nut is found, replace it and the two (one on either side) adjacent bolts and nuts.

NOTE: Magnetic-particle check (or equivalent) all other bolts after thorough cleaning in accordance with CLEANING and CHECK.

(a) If a bolt or nut is cracked, replace cracked bolt or nut only.

(2) If more than one bolt is broken or missing, all bolts are nonserviceable.

CAUTION: IF ANY WHEEL BOLT OR NUT IS ACCIDENTALLY TIGHTENED, INSTEAD OF LOOSENED, TO MORE THAN 120 PERCENT OF RECOMMENDED FINAL TORQUE VALUE, REPLACE BOTH NUT AND BOLT.

(3) Remove self-locking nuts (70), double-recessed washers (80) and internal wrenching bolts (90) to release wheel subassemblies (100 and 240 or 240A).

NOTE: The use of power wrenches for disassembly of fasteners can reduce the service life of bolts and nuts.

G. Separate the wheel subassemblies and remove tubeless tire or tire and tube.

H. Carefully remove wheel preformed packing (230) from inboard wheel subassembly (240 or 240A), if tubeless tire was installed.

NOTE: It is recommended that new preformed packings be installed at each overhaul. If necessary to reuse preformed packing (230), mark installation position on wheel so it may be reinstalled in the original position. Carefully place packing on a flat, clean surface to avoid damage or stretching.

I. If installed, remove valve subassembly (110 or 110A) from outboard wheel subassembly (100) by removing hex nut (140 or 140A), washer (150) or spacer (150A), valve stem (160 or 160A) and preformed packing (170).

NOTE: It is not necessary to remove the valve subassembly at each tire change. It is recommended the valve subassembly be removed for inspection at each overhaul and whenever it is necessary to remove the bearing cup.

J. Remove self-locking nut (180), plain washer (190), and screw (200) releasing tire/time change counter (210).

K. The bearing cups (220 and 310), disk springs (260), tee bar plungers (270) and disk drive ring (300 or 300A) should not be removed unless replacement is necessary, if paint is to be stripped, or if a thorough check of wheel subassemblies is required. Instructions for removal and installation of these parts are given in REPAIR.

L. Instruction plate (10) should not be removed unless damaged or if paint is to be stripped or thorough check of wheel subassembly is required.

CLEANING

1. Cleaning Materials

NOTE: Equivalent substitutes may be used for items listed below.

Dry-Cleaning Solution Type I, Stoddard Solvent Type II, 140°F Solvent Specification P-D-680	Commercially available
Methyl Isobutyl Ketone (MIBK) Specification TT-M-268	Commercially available
Isopropyl Alcohol Specification TT-I-735	Commercially available
Vapor Degrease Solution 1,1,1-Trichloroethane Specification MIL-T-81533	Commercially available
Polyplus Plastic Media Screen Size 20/40 (Primary)	Inventive Machine Corporation (I.M.C.) P.O. Box 369 Bolivar, OH 44612
Plastic Reclaimable Abrasive Machine (PRAM)	See SPECIAL TOOLS, FIXTURES AND EQUIPMENT section
Plastic Media (Dry Stripping Abrasive)	U.S. Technology Corporation A Subsidiary of U.S. Plastic and Chemical Corporation 328 Kennedy Drive Putnam, CT 06260
Paint Removing Solvent (Alternate) Specification MIL-C-19853, Type II	Turco Products Division of Purex Corporation 24600 South Main Street Carson, CA 90749
Soft Wire Brush	Commercially available
Soft Bristle Brush	Commercially available
Grease Specification MIL-G-81322	Commercially available

2. Cleaning Procedures (Ref. IPL Fig. 1)

WARNING: CLEANING SOLVENTS ARE TOXIC AND VOLATILE. USE ONLY IN WELL-VENTILATED AREAS. AVOID PHYSICAL CONTACT WITH SOLVENT AND DO NOT INHALE VAPORS.

CAUTION: A THOROUGH CLEANING OR IMMERSION OF WHEELS MAY CAUSE ENTRAPMENT OF SOLVENT IN PASSAGE HOLES. ENSURE REMOVAL OF INFLATION VALVE PRIOR TO CLEANING.

CAUTION: CLEAN BEARING CONES CAREFULLY IN A SEPARATE CONTAINER OF CLEAN SOLVENT TO AVOID CONTAMINATION.

A. Clean all metal parts with dry-cleaning solution conforming to Specification P-D-680. Use a soft bristle brush to remove hardened grease, dust and dirt. Vapor degrease the wheel bolts and remove any scale with a soft, wire brush.

(1) If drive ring has been removed and carbon remover has not removed all of the sealant, use MIBK with light rubbing with a clean cloth.

CAUTION: DO NOT SPIN BEARING CONES WITH COMPRESSED AIR.

B. Dry all metal parts thoroughly after cleaning, using filtered and dried compressed air.

NOTE: Ensure foreign materials and solvents have been removed from all cavities, threaded holes, pockets and other areas where entrapment might occur.

C. Check in accordance with CHECK section and repack bearing cones and coat bearing cups with grease, Specification MIL-G-81322, immediately after drying.

NOTE: New bearing cones and bearing cups packaged in preservative need not be degreased prior to use as the preservative is compatible with the recommended grease.

Lubrication of bearings by mechanical or other pressure methods is recommended because it is more efficient, reduces the possibility of contamination, and assures a more even distribution of grease within the bearing.

D. Clean all rubber and nonmetallic parts in isopropyl alcohol, Specification TT-I-735 and dry with a clean, soft cloth.

3. Paint Removal Procedures

A. Strip wheel subassembly as follows - Method I (Dry Stripping)

WARNING: THE DRY STRIPPING PROCESS IS OPERATOR-SENSITIVE AND ONLY AN EXPERIENCED, TRAINED OPERATOR SHOULD BE PERMITTED TO PERFORM THE PAINT REMOVAL OPERATION IN ACCORDANCE WITH EQUIPMENT MANUFACTURER'S RECOMMENDATIONS.

NOTE: This procedure covers general information on the dry stripping process of pneumatic blast removal of paint utilizing ground plastic particles. The procedure provides suggested control parameters to safely and effectively remove paint from component parts using the dry stripping process.

Paint should be stripped from parts before inspecting by Zyglo, dye pentrant or eddy-current methods; otherwise, inaccurate readings will result.

(1) Completely disassemble the part to be stripped. Remove all parts from wheel subassemblies, including valve, instruction and data plates and balance weights.

NOTE: Bearing cups need not be removed during dry paint stripping.

(2) Clean part to be stripped in accordance with CLEANING section.

(3) Plug or seal off openings, threaded holes, bearing cups and inserts as required.

(4) Remove paint using the dry stripping procedure in accordance with Figure 401 and as follows:

(a) The media (dry stripping abrasives) is effective only when used with the appropriate equipment. Depending on operator requirements, check with these (or other suitable) manufacturers for advice and application information concerning their particular equipment.

(b) Refer to Cleaning Materials for recommended dry stripping abrasives and equipment.

CAUTION: FLUSH MEDIA FROM CAVITIES, THREADED HOLES, POCKETS AND OTHER AREAS WHERE ENTRAPMENT MIGHT OCCUR.

(5) Remove part and rinse thoroughly with water heated to a temperature of 160° to 180°F (71° to 82°C).

(6) Dry part thoroughly with filtered and dried compressed air. Apply grease, Specification MIL-G-81322, to bearing cups if installed.

NOTE: After paint stripping, the part must be re-treated and repainted in accordance with instruction in REPAIR.

NOZZLE TYPE/SIZE	NOZZLE PRESSURE	NOZZLE DISTANCE	MEDIA TYPE	ANGLE OF APPROACH
1 BMLV-8 1/2 inch (12,7 mm) 4	45 - 55 PSI (3,10-3,79 bars) 3	36 - 48 inch (914-1219 mm)	POLYPLUS 20/40	45 - 75°
2 VENTURI 5/16 inch (7,94 mm) 4	UNDER 30 PSI (2,07 bars) 3	6 - 8 inch (152,4-203,2 mm)	POLYPLUS 20/40	45 - 75°

PHYSICAL REQUIREMENTS OF MEDIA

	POLYEXTRA	POLYPLUS
HARDNESS (MOH SCALE)	3.0 ± .25	3.5 ± .25
SPECIFIC GRAVITY (GMS/CC)	1.15 ± 10%	1.50 ± 10%

NOTES:

1. STAND-OFF, OPEN BLASTING.
2. CLOSED-CYCLE BLASTING (PERFORMED IN PRESSURE BLAST EQUIPMENT CHAMBER).
3. PRESSURE READINGS MUST BE TAKEN AT THE NOZZLE RATHER THAN ESTIMATED FROM REGULATOR GAGE READINGS. RECHECK PRESSURE EVERY FOUR HOURS AND EACH TIME PRESSURE IS CHANGED AT REGULATOR.
4. PROCESS VARIABLES INCLUDE PRESSURE, DISTANCE FROM NOZZLE TO WORK PIECE, ANGLE OF ATTACK AND NOZZLE SIZE. PARAMETERS SELECTED WILL VARY WITH PAINT COATING AGE, TYPE AND NUMBER OF COATINGS, BUT THE FOLLOWING PARAMETERS HAVE SUCCESSFULLY REMOVED VARIOUS COATING TYPES WITH NO EFFECT ON SUBSTRATE.
5. RECOMMENDED PLASTIC MEDIA TYPE AND SIZE IS POLYPLUS 20/40. POLYEXTRA 12/20 OR 20/30 PRODUCES A SMOOTHER FINISH BUT PAINT REMOVAL RATE IS LOWER. TYPE III PLASTIC MEDIA TYPE IS NOT TO BE USED ON THE SUBJECT AIRCRAFT COMPONENTS.

Recommended Dry Stripping Variables
Figure 401

B. Strip wheel subassembly as follows - Method II (Wet Stripping)

WARNING: PAINT REMOVAL SOLVENTS ARE CAUSTIC, TOXIC AND VOLATILE. USE ONLY IN WELL-VENTILATED AREAS IN ACCORDANCE WITH MANUFACTURER'S DIRECTIONS. OBSERVE ALL SAFETY PRECAUTIONS. AVOID PHYSICAL CONTACT WITH SOLUTION AND DO NOT INHALE VAPORS.

NOTE: Paint should be stripped from wheel subassemblies before inspecting by Zyglo, dye penetrant or eddy-current methods; otherwise, inaccurate readings will result.

(1) Completely disassemble the part to be stripped to prevent solvent from being entrapped between mating surfaces. Remove all parts from wheel subassemblies, including valve, bearing cup, disk drive ring and balance weights.

NOTE: Bearing cups need not be removed during paint stripping if a suitable mask (or other method) is used to assure contamination does not occur behind the bearing cup by stripping fluids.

(2) Clean the part to be stripped in accordance with Cleaning Procedures.

(3) Plug and seal off threaded holes and threaded inserts.

CAUTION: PARTS MUST BE COMPLETELY IMMERSED IN SOLVENT. CONTACT WITH WATER BLANKET DURING IMMERSION WILL CAUSE SEVERE CORROSION OF THE PART.

(4) Immerse part in a paint removing solvent conforming to Specification MIL-C-19853 for a period of 30 minutes to two hours. Immersion time depends on condition of paint. Carefully follow the manufacturer's instructions for the particular solvent being used.

CAUTION: FLUSH SOLVENT FROM CAVITIES, THREADED HOLES, POCKETS AND OTHER AREAS WHERE ENTRAPMENT MIGHT OCCUR.

(5) Remove part from solvent and rinse thoroughly with water heated to a temperature of 160° to 180°F (71° to 82°C).

(6) Dry part thoroughly with filtered and dried compressed air. Apply grease, Specification MIL-G-81322, to bearing cups if installed.

NOTE: After paint stripping, the part must be re-treated and repainted in accordance with REPAIR.

CHECK

1. Check Materials

NOTE: Equivalent substitutes may be used for items listed below.

Type	Penetrant	Developer	Supplier
Fluorescent	Zyglo ZL-16	Zyglo ZP-13 (wet) optional	Magnaflux Corporation 7310 West Lawrence Street Chicago, IL 60656
	Penetrex ZL-2A with emulsifier ZE-4	Penetrex ZP-4 (dry) or ZP-13 (wet) optional	
Red Dye	Spot Check	Spot Check	
	Dy-Chek	Dy-Chek	Turco Products Division of Purex Corporation P.O. Box 6200 Carson, CA 90749
	Met-L-Chek	Met-L-Chek	Met-L-Chek 1639 Euclid Street Santa Monica, CA 90404

2. General (Ref. IPL Fig. 1)

A. Check all components of the main wheel assembly for cracks, nicks, corrosion, and other damage. Replace any cracked, severely corroded, or badly damaged parts.

B. Perform the specific checks listed, referring to REPAIR for the appropriate repair procedures.

C. Serviceability of aircraft wheels subjected to rolling with a flat or disintegrated tire and damage to overloaded mating wheel, where applicable, should be checked as follows:

(1) Wheel Rolled with a Flat Tire

(a) Check carefully for deformation in the flange area and for tire brinelling and/or chafing damage on the flange outside diameter. Check wheel for an out-of-round condition by measuring the diameter of the flange at three places, equally spaced, around the outside diameter. The difference between the largest and smallest diameter readings shall not exceed 0.030 inch (0,76 mm). Replace any wheel with damage or deformation in excess of limits.

(2) Wheel Rolled with Disintegrated Tire

(a) Any wheel where the flanges have made direct contact with the runway due to rolling or sliding should be replaced. The high stress levels imposed on the wheel flange and bead seat area will invariably render the wheel nonserviceable even with minimal damage.

(3) Mating Wheel

(a) In the event of a wheel rolled with a flat or disintegrated tire on any aircraft fitted with dual, tandem or dual tandem wheels, the corresponding mating overloaded wheel must also be considered. The mating wheel should be removed from service if the distance rolled was sufficient to cause any damage to the overloaded tire. Rolling in the overloaded condition will impose additional stress on the bolts and nuts fastening the wheel subassemblies and may require early replacement. In all cases of overloaded rolling, the bolts and nuts should be replaced or checked for fatique damage at each tire change.

3. Wheel Subassembly (100 and 240 or 240A)

A. Check wheel subassembly for cracks and structural damage. Pay particular attention to the bead seat, bolt boss, valve hole, drive ring interface and tubewell radius. Check the underside of the tubewell area paying particular attention to the area from the tire bead seat radius to the end of the toe of the tire. Replace cracked wheel subassembly.

NOTE: Strip paint from wheel subassembly and check wheel bead seat, using ultrasonic or eddy-current methods. Check all other areas of the wheel subassembly by Zyglo or dye penetrant methods. Replace cracked wheel subassembly.

B. Check wheel subassembly for corrosion, nicks, scratches, tool marks, and other damage. Remove any corrosion and surface damage up to the limits given in REPAIR. Wheel subassembly damaged beyond these limits should be replaced.

C. Check the threaded steel inserts in the outboard wheel subassembly hub flange for damage. If stripped or damaged, replace insert according to instructions in REPAIR.

CAUTION: HANDLE BEARING CONES WITH EXTREME CARE. MANY AIRCRAFT BEARING FAILURES OCCUR AS A RESULT OF MISHANDLING DURING SERVICING.

4. *Bearing Cup (220 and 310) and Bearing Cone (30 and 60)*

A. Wipe bearing cups free of grease and visually check roller contacting surface of cups for looseness, scratches, pitting, brinelling, spalling, heat discoloration, rust, corrosion, and excessive wear. Replace bearing cups having any defects in accordance with instructions in REPAIR.

B. Check bearing cones (30 and 60) and roller surfaces for nicks, scratches, rust, corrosion, spalling, flat spots, pitting, roller end scoring, heat discoloration, and wear. Check bearing cage rib faces for scoring and bearing cage for nicks, dents, distortion, and wear in the roller pockets. Replace bearing cones having any defects.

5. Disk Drive Ring (300 or 300A)

A. Check disk drive ring (300), rivets (280), and plain washers (290) for tightness. If rivets are loose or rivet holes are enlarged, see REPAIR.

B. Check disk drive ring (300A), hex head bolts (255) and plain washers (290) for tightness. If bolts are loose or threads are stripped see REPAIR.

C. Check disk drive ring gear teeth for wear. Replace ring if three or more teeth are worn to a thickness of 0.125 inch (3,17 mm) or less at a point 0.078 inch (1,98 mm) from top of tooth.

NOTE: Check worn condition of gear teeth with the disk drive ring wear template shown in Figure 501.

6. Disk Spring (260) and Tee Bar Plunger (270)

A. Check disk springs (260) and tee bar plungers (270) for security, wear or damage. If tee bar plunger is loose due to enlarged or damaged holes see REPAIR.

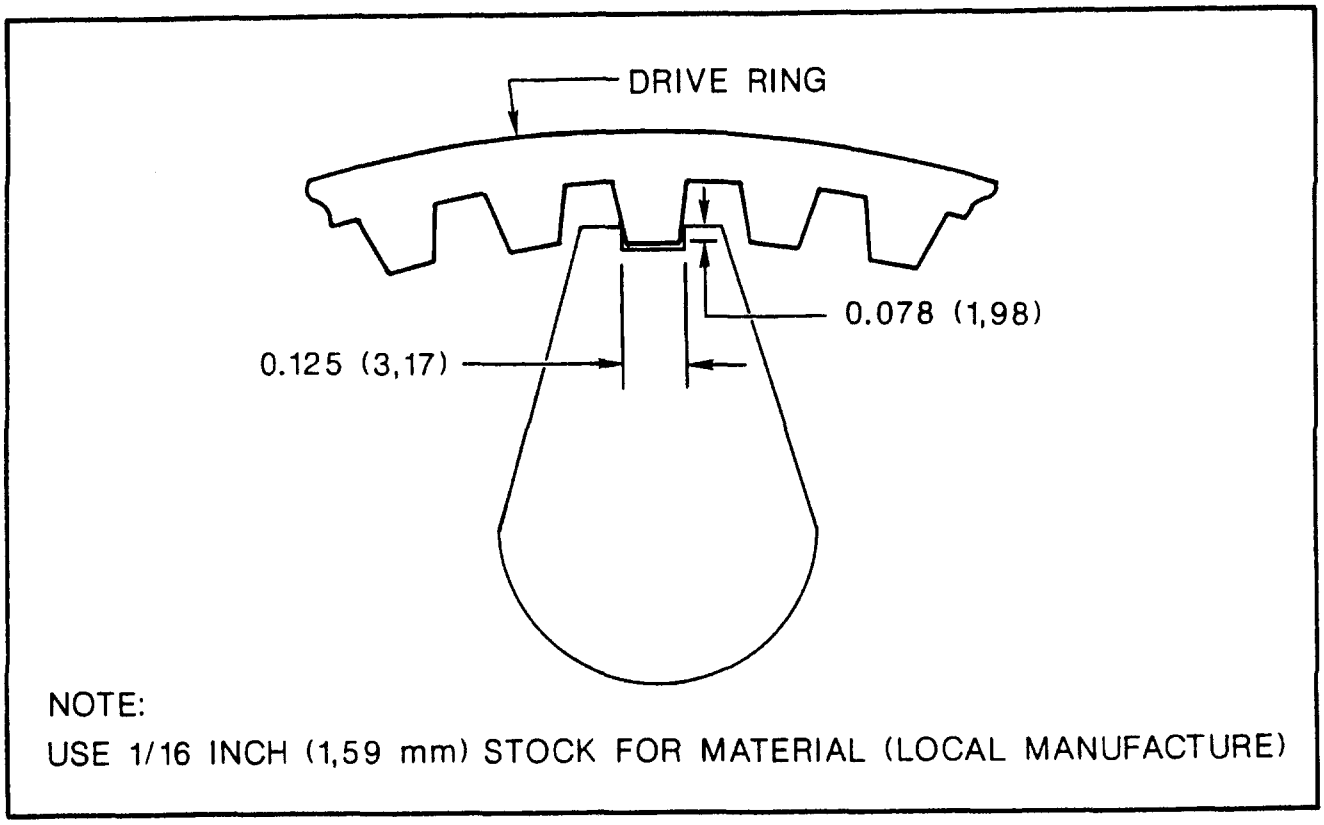
7. Valve Subassembly (110 or 110A)

A. Check valve stem (160 or 160A) and hex nuts (140 or 140A) for stripped or crossed threads and other damage. Replace valve stem if bent or damaged.

B. Replace valve cap (120) or valve core (130) if these parts are unserviceable.

8. Bearing Seal (20 or 20A and 50)

A. Check bearing seals for cuts, nicks, distortion, and other damage. Check for permanent set or distortion of seal lips, security of the rubber-to-metal bond and for damage and distortion to the metal base. Replace defective seals.



Disk Drive Ring Wear Template
Figure 501

B. Check bearing seals for wear as follows:

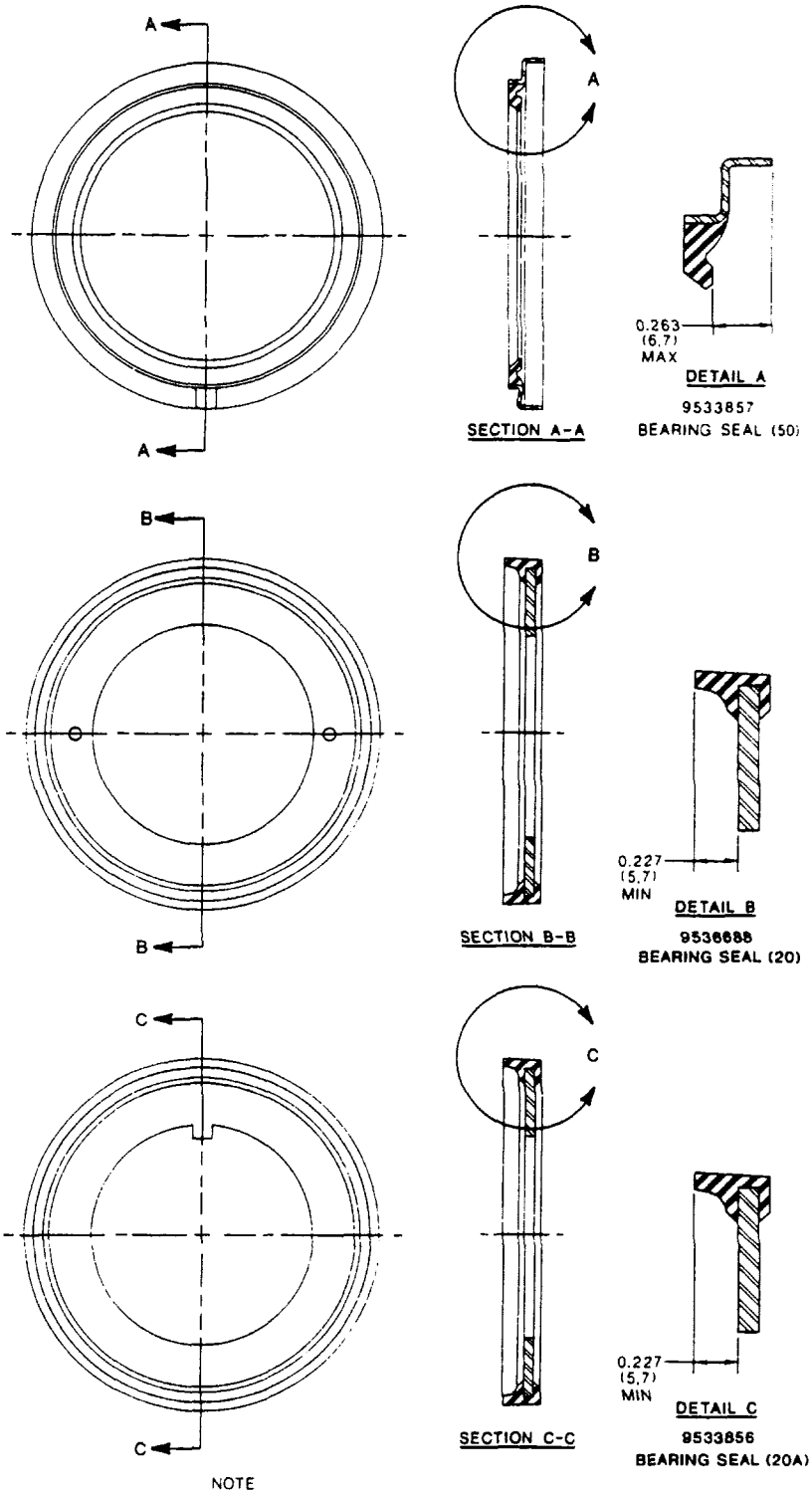
(1) Check seals for wear by measuring the lip-to-face distance as shown in Figure 502. Replace seals not meeting dimension given.

(2) Check bearing seal for grooves or damage. Replace seals if damaged.

9. Preformed Packing (170 and 230)

A. It is recommended new preformed packings be installed at each overhaul. If necessary to reuse these parts, check for cuts, permanent set, and other damage. Replace packings that are cut or damaged, or that have a permanent set.

NOTE: Cuts on packings often indicate the presence of burrs or other damage on adjoining wheel parts. Check adjoining parts and remove burrs or other damage that may cause packing damage to reccur, see REPAIR.



NOTE
SHORE "A" HARDNESS READING OF 60 TO 80 REQUIRED

Bearing Seal Wear Limit
Figure 502

10. Self-Locking Nut (70 and 180) and Internal Wrenching Bolt (90)

A. Check self-locking nuts for worn, stripped, and crossed threads. Replace if damaged. Nuts should be replaced after 10 applications. If unable to determine the number of applications, degrease the nut and bolt and check the torque required to turn nut on a nonlubricated bolt past the nut's locking section. Replace any self-locking nut requiring less than the minimum torque value as follows:

(1) Replace self-locking nut (70) when minimum torque value is less than 15 pound-inches (1,69 N-m).

(2) Replace self-locking nut (180) when minimum torque value is less than 2 pound-inches (0,23 N-m).

B. Degrease and magnetic-particle check all bolts for cracks, paying particular attention to radius under the bolt head and to the threads adjacent to the bolt shank. Replace any cracked bolts and those having stripped, crossed, or damaged threads. No reworking of the bolts is permissible.

11. Tire/Time Change Counter (210)

A. Check tire/time change counters for damage. Replace if illegible or damaged.

12. Retaining Ring (40)

A. Check retaining ring for deformation, corrosion and damage. Replace if damaged.

13. Instruction Data Plate (10)

A. Check instruction plate for looseness and legibility. Replace if loose or illegible.

REPAIR

1. Repair Materials

NOTE: Equivalent substitutes may be used for items listed below.

Aluminum Oxide Cloth (320 to 360 grit, wet-or-dry)	Commercially available
Grease Specification MIL-G-81322	Commercially available
Chemical Film Solutions Specification MIL-C-5541	
Alodine 1200	Amchem Products, Incorporated 300 Brookside Avenue Ambler, PA 19002
Turco 4178	Turco Products Division of Purex Corporation 24600 South Main Street Carson, CA 90749
Iridite 14-2	Allied-Kelite Products Division Richardson Chemical Company 2400 East Devon Avenue Des Plaines, IL 60016
Loctite RC/620	Loctite Company 705 North Mountain Road Newington, CT 06111
3M776 Adhesive Sealant	Minnesota Mining & Manufacturing Company Adhesive Coating and Sealer Division 3M Center St. Paul, MN
Aluminum Lacquer Specification TT-L-32	Commercially available
Zinc Chromate Primer Specification TT-P-1757	Commercially available
Methyl Isobutyl Ketone (MIBK) Specification TT-M-268	Commercially available
Aluminum Topcoat/Primer Combination (FA-10242) Aeroprite	Contact your local distributor of aviation products and supplies.
Aeroprite Reducer TH-89	Contact your local distributor of aviation products and supplies.

2. General (Ref. IPL Fig. 1)

A. Repairs to the main wheel are limited to the replacement of parts and repairs specified in this section. No attempt should be made to repair cracked, severely corroded or badly damaged parts. Components that cannot be repaired within the limits defined in this section should be replaced.

3. Repair of Wheel Subassembly (100 and 240 or 240A)

CAUTION: REMOVAL OF CORROSION AND SURFACE DAMAGE WILL PREVENT STRESS CONCENTRATIONS AND PREMATURE WHEEL FAILURE. HOWEVER, ANY REMOVAL OF MATERIAL WILL SHORTEN THE ROLL LIFE OF THE WHEEL. THEREFORE, IT IS RECOMMENDED THAT REMOVAL OF MATERIAL BY BLENDING BE LIMITED TO THE MINIMUM REQUIRED FOR REMOVING CORROSION OR SURFACE DAMAGE.

A. Remove all corrosion and surface damage from wheel subassemblies according to limits defined in Figure 601. Wheel subassemblies corroded or damaged beyond these limits should be replaced. Imperfections should be blended out. Use fine, aluminum oxide cloth for polishing. Unless otherwise specified, surface finish of repaired surfaces should not exceed a roughness of 150 microinches RHR. All reworked surfaces shall be cleaned thoroughly, then re-treated and repainted in accordance with Re-Treating and Repainting.

NOTE: All scratches, nicks, tool marks and other surface damage should be blended out to a minimum 1/4 inch (6,35 mm) radius and then highly polished. Use fine aluminum oxide cloth for polishing. This will prevent stress concentrations and premature wheel failure. In repairing wheels, any removal of material will shorten the roll life of the wheel; therefore, it is recommended material removed by blending be kept to a minimum.

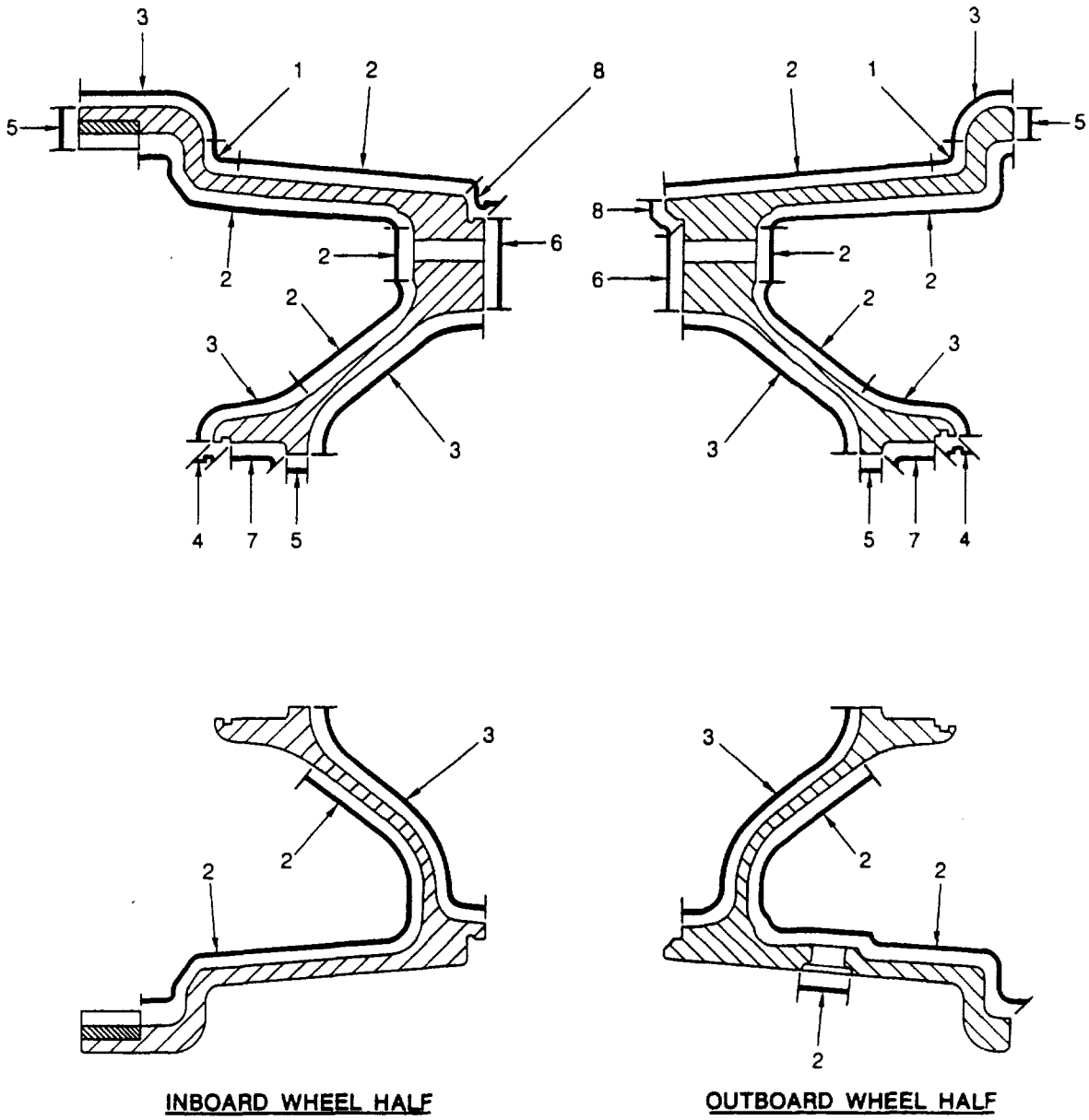
B. If threaded holes or inserts are damaged in the outboard wheel subassembly, replace inserts or repair in accordance with Repair No. 5 - Repair of Fairing Retaining Screw Threads, Outboard Wheel Subassembly.

4. Replacing Bearing Cup (220 and 310)

A. Remove bearing cups from wheel subassemblies as follows:

CAUTION: DO NOT OVERHEAT WHEEL SUBASSEMBLY OR PROLONG THE HEATING PERIOD. OVERHEATING WILL ADVERSELY AFFECT THE WHEEL'S SERVICE LIFE. REMOVE VALVE SUBASSEMBLY (IF INSTALLED) BEFORE HEATING WHEEL SUBASSEMBLY.

(1) Heat wheel subassembly in an oven not exceeding 250°F (121°C) for 30 minutes.



NOTE:
NUMBERS INDICATE REPAIR AREAS (SEE KEY TO FIGURE)

Wheel Subassembly Repair Limits
Figure 601

Key to Figure 601

General:	Internal and external tubewell, hub and web repairs shall not be located directly opposite surfaces previously blended. When damaged depth is less than 0.015 inch (0,38 mm) deep, all blended type repairs shall be blended with a depth to width ratio of 1 to 100 in surface width. Where not possible, use as generous a width to depth ratio as practical with the area being repaired. Repairs are limited in each marked area to the following limits:
Area 1:	Blend out and polish imperfections up to 0.010 inch (0,25 mm) deep and 0.050 inch (1,27 mm) long. Maintain surface finish of 20 microinches RHR.
Area 2:	Blend out and polish imperfections up to 0.015 inch (0,38 mm) deep and 1.00 inch (25,4 mm) long. Blemish area must not exceed 1.00 square inch (6,45 sq cm). Do not blend opposite surfaces. Remove corrosion, nicks and other imperfections from valve hole.
Area 3:	Blend out and polish nicks and other imperfections up to 0.031 inch (0,787 mm) deep and 1.00 inch (25,4 mm) long. Do not blend opposite surfaces.
Area 4:	Blend out and polish nicks and other imperfections as long as retention and seating of bearing seal is not impaired.
Area 5:	Blend out and polish nicks and other imperfections up to 0.060 inch (1,52 mm) deep and 1.00 inch (25,4 mm) long.
Area 6:	Blend out and polish imperfections up to 0.010 inch (0,25 mm) deep and 1.00 inch (25,4 mm) long. Reworked area must not exceed 0.50 square inch (3,225 sq cm). Radius sharp bolt hole edges up to 0.03 inch (0,78 mm).
Area 7:	Blend out and polish imperfections as long as bearing cup retention is not impaired. Maintain surface finish of 100 microinches RHR.
Area 8:	Blend out and polish imperfections as long as sealing qualities are not impaired. Maintain surface of 63 microinches RHR.

CAUTION: WHEN REMOVING CUP, EXERCISE EXTREME CARE TO AVOID RAISING BURRS IN THE BEARING BORE. ALWAYS SUPPORT THE WHEEL SUBASSEMBLY ON THE HUB, NOT ON THE FLANGE.

(2) Remove wheel subassembly from heat source and immediately remove cup from bearing bore by tapping it out evenly with a fiber or phenolic punch.

(3) Carefully remove primer residue and any foreign matter from bearing bore. Make sure that bearing bore and shoulder are clean and free of burrs.

B. Allow wheel subassembly to cool to room temperature and check maximum bearing bore dimension.

(1) If the bore surface is damaged, refer to Repair No. 1 - Inboard Wheel Bearing Cup Bore Repair or Repair No. 2 - Outboard Wheel Bearing Cup Bore Repair.

(2) Check the wheel subassemblies for maximum bore dimension. The maximum dimension to be an average of three readings taken 120 degrees apart.

(a) Maximum diameter of the outboard wheel subassembly (100) hub bore shall not exceed 4.1187 inches (104,6 mm).

(b) Maximum diameter of the inboard wheel subassembly (240 or 240A) hub bore shall not exceed 4.1187 inches (104,6 mm).

(3) If maximum dimension is exceeded, repair in accordance with Repair No. 1 - Inboard Wheel Bearing Cup Bore Repair or Repair No. 2 - Outboard Wheel Bearing Cup Bore Repair.

C. Install bearing cups as follows:

(1) Make sure bearing bore and shoulder in wheel hub are clean and free from burrs or any other imperfections which might prevent proper seating of bearing cup.

(2) Chill new bearing cup with dry ice.

CAUTION: DO NOT OVERHEAT WHEEL SUBASSEMBLY OR PROLONG THE HEATING PERIOD. OVERHEATING WILL ADVERSELY AFFECT THE WHEEL'S SERVICE LIFE.

(3) Heat wheel subassembly in an oven not exceeding 250°F (121°C) for 30 minutes.

(4) Remove wheel subassembly from heat source and remove bearing cup from dry ice. Dry hub bore and cup thoroughly.

(5) Coat wheel contact surfaces of bearing cup with zinc chromate primer or paste, Specification TT-P-1757 and immediately install cup into bearing bore while primer or paste is still wet.

NOTE: When installing Bushing Cup Subassembly 5R4-140, align slot in bushing with hole in wheel subassembly.

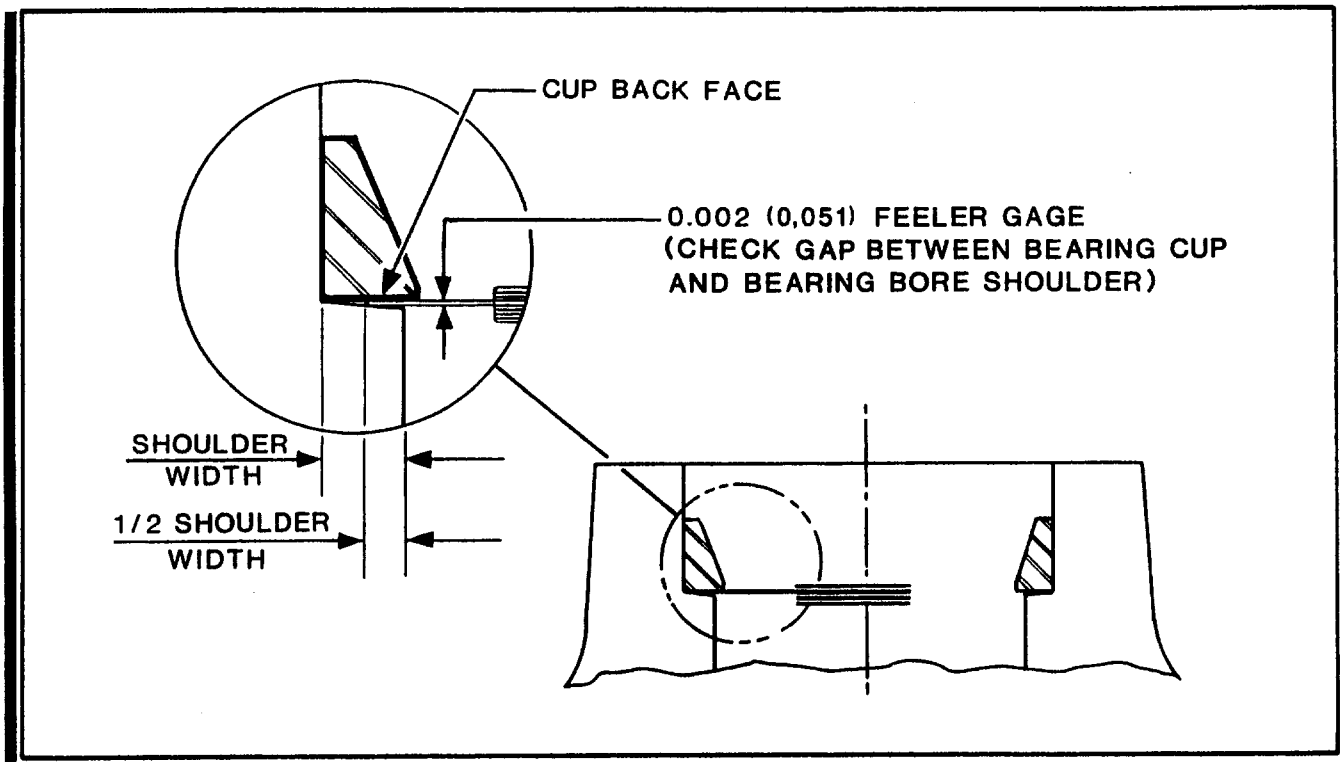
CAUTION: WHEN INSTALLING THE BEARING CUP, SUPPORT THE WHEEL SUBASSEMBLY ON THE HUB, NOT ON THE FLANGE.

(6) Using a fiber or phenolic punch, tap cup into bore and up tightly against shoulder. Avoid cocking the cup during installation.

(7) Cup seating should be checked after the wheel hub has cooled enough to hold the cup. To ensure the cup is adequately seated, check for any clearance (gap) between the cup back face and the shoulder (register) in the wheel hub with a 0.002 inch (0,05 mm) feeler gage. A 0.002 inch (0,05 mm) maximum clearance between cup and shoulder is permissible, provided the feeler gage cannot be inserted more than one-half the width of the shoulder at any location around back face of cup as shown in Figure 602.

NOTE: Above limits do not apply to areas of wheel hub shoulder cleaned up in accordance with Repair of Wheel Subassemblies.

(8) Allow wheel to cool to room temperature. Apply a light coat of grease, Specification MIL-G-81322, to bearing cup to prevent corrosion.



Typical Bearing Cup Register Check
Figure 602

5. Replacing Disk Drive Ring (300 or 300A)

CAUTION: WHEN HEATING WHEEL SUBASSEMBLY FOR DRIVE RING REMOVAL AND INSTALLATION, ENSURE THAT CUP SEATING HAS NOT BEEN IMPAIRED.

NOTE: Remove disk drive ring only if it requires replacement or if a thorough check of the wheel subassembly is necessary. If removed for checking, mark the location of the disk drive ring to ensure reassembly in the original position.

A. Remove disk drive ring (300) from inboard wheel subassembly (240) as follows:

(1) Cover bearing cup with cardboard or fiber disk to prevent contamination or damage.

CAUTION: WHEN REMOVING RIVETS, BE CAREFUL NOT TO ENLARGE RIVET HOLES IN WHEEL FLANGE.

(2) Remove the two rivets (250) holding each disk spring (260) to the wheel flange; then disengage disk spring from the tee bar plunger (270) and remove plunger from inside of wheel.

(3) Remove rivets (280) and plain washers (290).

CAUTION: DO NOT OVERHEAT WHEEL SUBASSEMBLY OR PROLONG THE HEATING PERIOD. OVERHEATING WILL ADVERSELY AFFECT THE WHEEL'S SERVICE LIFE.

(4) Heat wheel subassembly in an oven not exceeding 250°F (121°C) for 30 minutes. Tap disk drive ring carefully out of wheel subassembly with a fiber or phenolic drift pin.

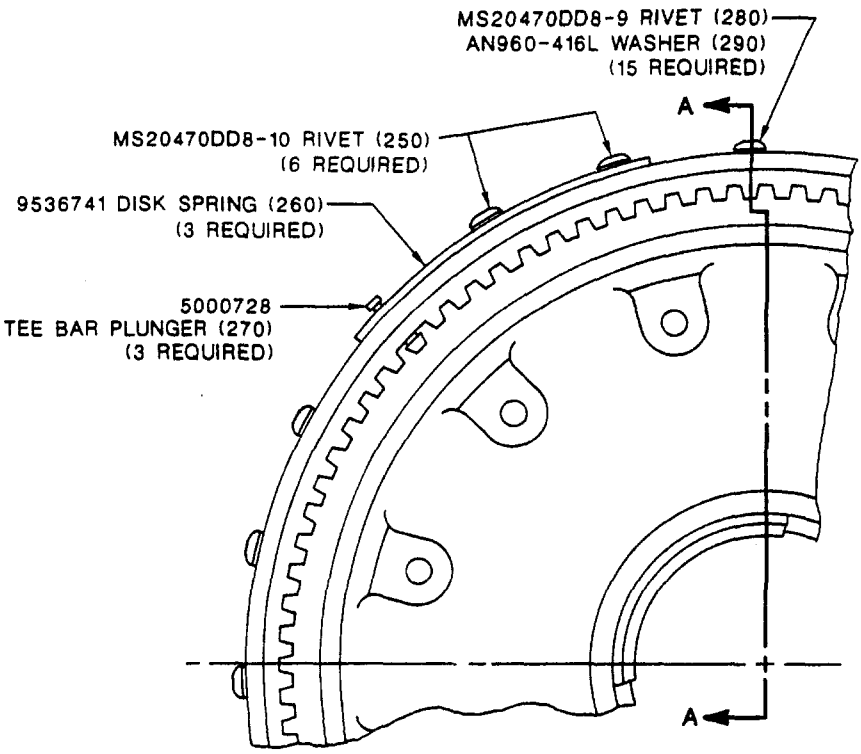
(5) Check wheel subassembly rivet holes for enlarged or elongated holes or if rivets were found loose prior to removal of disk drive ring. Repair rivet holes on inboard wheel flange in accordance with Repair No. 3 - Drive Flange Rivet Hole Repair or Repair No. 4 - Drive Flange Tee Bar Plunger Hole Repair.

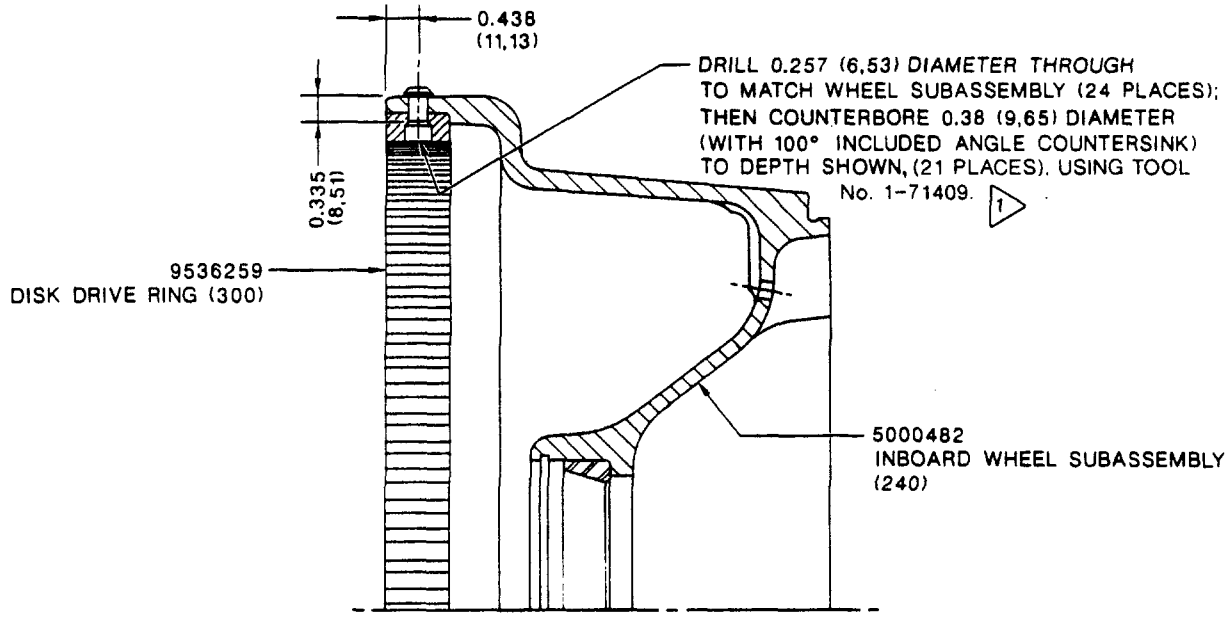
B. Install aluminum disk drive ring (300) in inboard wheel subassembly (240) as follows (Ref. Fig. 603):

CAUTION: DO NOT OVERHEAT WHEEL SUBASSEMBLY OR PROLONG THE HEATING PERIOD. OVERHEATING WILL ADVERSELY AFFECT THE WHEEL'S SERVICE LIFE.

(1) Heat inboard wheel subassembly (240) in an oven not exceeding 250°F (121°C) for 30 minutes.

(2) Remove wheel subassembly from heat source.





SECTION A-A

NOTE:

1 NO COUNTERBORE REQUIRED AT TEE BAR HOLES.

Installing Disk Drive Ring 9536259
Figure 603

CAUTION: THE CENTERLINES OF THE DRIVE GEAR TEETH MUST BE ALIGNED WITHIN 0.008 INCH (0,203 MM) OF THE CENTERLINE OF THE EXISTING HOLES IN THE WHEEL FLANGE. THE THREE PLACES ON THE DISK DRIVE RING WITHOUT A GEAR TOOTH MUST BE ALIGNED WITH THE PROPER HOLES IN THE WHEEL FLANGE TO PERMIT INSTALLATION OF TEE BAR PLUNGERS. MAKE SURE THE DISK DRIVE RING IS PROPERLY ALIGNED AND COMPLETELY SEATED IN THE WHEEL SUBASSEMBLY.

(3) Paint contacting surfaces of wheel and disk drive ring with zinc chromate paste or primer, Specification TT-P-1757 and install disk drive ring immediately into wheel flange while zinc chromate paste or primer is still wet.

NOTE: Disk drive ring should be assembled while ring is at a temperature of 75°F (24°C) and wheel subassembly is at 250°F (121°C). Reducing temperature of disk drive ring will increase clearance and ease of assembly.

(4) Use drill bushing to locate center of holes and using rivet holes in wheel subassembly as a guide, drill size (F) 0.257 inch (6,53 mm) holes through disk drive ring to match (24 places).

(5) Counterbore holes in disk drive ring (21 places) as shown in Figure 603 using tool number 1-71409.

NOTE: 21 holes equally spaced on basis of 24 spaces. Counterbore not required at location of tee bar.

(6) Apply two coats of zinc chromate primer, Specification TT-P-1757 to rivet holes.

NOTE: The aluminum disk drive ring does not require sealant coating.

(7) Rivet disk drive ring to wheel flange with 15 rivets (280) and plain washers (290).

NOTE: Do not install these rivets in holes reserved for installing disk springs.

(8) Insert three tee bar plungers (270) in place as shown in Figure 603.

(9) Slide the disk springs (260) into position with the slots holding the tee bar plungers in place. Then install six rivets (250) to secure the disk springs and tee bar plunger.

C. Remove disk drive ring (300A) from inboard wheel subassembly (240A) as follows:

(1) Cover bearing cup with cardboard or fiber disk to prevent contamination or damage.

(2) Cut lockwire and remove the two hex head bolts (255) holding each disk spring (260) to the wheel flange; then disengage disk spring from the tee bar plunger (270) and remove plunger from inside of wheel.

(3) Cut lockwire and remove remaining hex head bolts (255) and plain washers (290).

CAUTION: DO NOT OVERHEAT WHEEL SUBASSEMBLY OR PROLONG THE HEATING PERIOD. OVERHEATING WILL ADVERSELY AFFECT THE WHEEL'S SERVICE LIFE.

(4) Heat wheel subassembly in an oven not exceeding 250°F (121°C) for 30 minutes. Tap disk drive ring carefully out of wheel subassembly with a fiber or phenolic drift pin.

(5) If applicable, remove adhesive sealant from wheel subassembly and disk drive ring using methyl isobutyl ketone (MIBK), Specification TT-M-268.

NOTE: When disk drive ring has been removed, check wheel subassembly for cracks at radius behind the drive ring seat. Replace any wheel subassembly cracked in this area. Check threaded holes in wheel flange for damage or cracks.

D. Install steel disk drive ring (300A) in inboard wheel subassembly (240A) as follows (Ref. Figs. 604 and 605):

(1) Coat contacting surfaces of inboard wheel subassembly (240A) for disk drive ring (300A) with Adhesive Sealant 3M776 (Ref. Fig. 604).

WARNING: SEALANT SOLUTIONS ARE TOXIC AND VOLATILE. USE IN WELL VENTILATED AREA IN ABSENCE OF OPEN FLAME OR ELECTRICAL SPARKS. DO NOT INHALE VAPORS OR ALLOW SOLUTION TO CONTACT SKIN OR CLOTHING.

(a) Allow 24 hours drying time before assembly of disk drive ring into wheel.

(b) Excess material will not harm adjacent areas and may be removed from equipment with methyl isobutyl ketone (MIBK), Specification TT-M-268 and light rubbing with a clean cloth.

CAUTION: DO NOT OVERHEAT WHEEL SUBASSEMBLY OR PROLONG THE HEATING PERIOD. OVERHEATING WILL ADVERSELY AFFECT THE WHEEL'S SERVICE LIFE.

(2) Heat inboard wheel subassembly (240A) in an oven not exceeding 250°F (121°C) for 30 minutes.

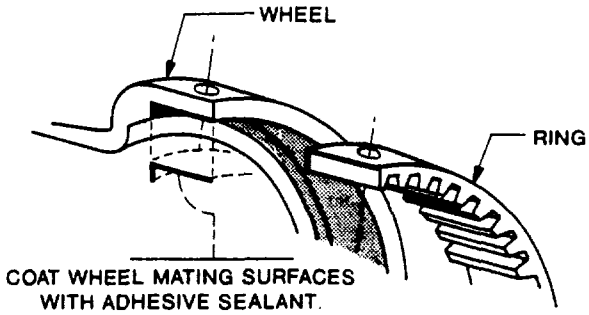
(3) Remove wheel subassembly from heat source.

TEMPORARY REVISION NO. 32–2

FILING INSTRUCTIONS: Insert facing page 611

DESCRIPTION: Clarified text—from "between" to "over"— in paragraph 5.D.(4) concerning replacing disk drive ring.

(1) Install disk drive ring, chamfered or radius end first, into heated wheel subassembly. If using the original ring, tap with a fiber drift pin to align the ring in its original position. Align a new ring so that the screw holes in the wheel flange are centered directly over the teeth of the disk drive ring. Disk drive ring must not protrude beyond the face of wheel subassembly.



NOTES:
1. 3M776 ADHESIVE SEALANT SHALL BE APPLIED TO A THICKNESS OF 0.0005 TO 0.003 (0.013 TO 0.076) BY NATURAL BRISTLE BRUSH TO A CLEAN, DRY, GREASE FREE SURFACE
2. IF MULTIPLE COATS ARE REQUIRED TO GET EVEN THICKNESS, ALLOW TEN MINUTES DRYING TIME BETWEEN COATS.
3. MATERIAL MAY BE REMOVED FROM EQUIPMENT WITH METHYL ISOBUTYL KETONE, (MIBK) AND LIGHT RUBBING WITH A CLEAN CLOTH.
4. ALLOW 24 HOURS DRYING TIME BEFORE ASSEMBLY OF RING INTO WHEEL.
5. NEW MATERIAL MAY BE THINNED BY ADDITION OF MIBK TO OBTAIN WORKABLE CONSISTENCY.

Application of Adhesive Sealant
Figure 604

CAUTION: THE CENTERLINES OF THE DRIVE GEAR TEETH MUST BE ALIGNED WITHIN 0.008 INCH (0,203 MM) OF THE CENTERLINE OF THE EXISTING HOLES IN THE WHEEL FLANGE. THE THREE PLACES ON THE DISK DRIVE RING WITHOUT A GEAR TOOTH MUST BE ALIGNED WITH THE PROPER HOLES IN THE WHEEL FLANGE TO PERMIT INSTALLATION OF TEE BAR PLUNGERS. MAKE SURE THE DISK DRIVE RING IS PROPERLY ALIGNED AND COMPLETELY SEATED IN THE WHEEL SUBASSEMBLY.

NOTE: Disk drive ring should be assembled while ring is at a temperature of 75°F (24°C) and wheel subassembly is at 250°F (121°C). Reducing temperature of disk drive ring will increase clearance and ease of assembly.

(4) Install disk drive ring, chamfered or radius end first, into heated wheel subassembly. If using the original ring, tap with a fiber drift pin to align the ring in its original position. Align a new ring so that the screw holes in the wheel flange are centered directly between the teeth of the disk drive ring. Disk drive ring must not protrude beyond face of wheel subassembly.

NOTE: Please see the TEMPORARY REVISION that revises this page.

(5) Being careful not to damage the existing threads, use the bolt holes in the wheel flange as guides, install temporary drill guide and drill and tap holes through disk drive ring to match (24 places) as shown in Figure 605.

(6) Counterbore holes in disk drive ring (21 places) as shown in Figure 605 using tool number 1-71409.

NOTE: 21 holes equally spaced on basis of 24 spaces. Counterbore not required at location of tee bar.

(7) Install drive ring bolts (255) and plain washers (290) as follows (Ref. Fig. 605):

(a) Bolt disk drive ring (300A) to wheel flange with 15 bolts (25) and plain washers (290). Tighten bolts (255) to a torque value of 50 to 70 pound-inches (5,6 to 7,9 N-m).

NOTE: Do not install bolts in holes reserved for installing disk springs.

(8) Insert three tee bar plungers (270) in place as shown in Figure 605.

(9) Slide the disk springs (260) into position with the slots holding the tee bar plungers in place. Then install six bolts (255) to secure the disk springs and tee bar plunger (270). Tighten bolts (255) to a torque value of 50 to 70 pound-inches (5,6 to 7,9 N-m).

NOTE: Do not install washers under bolts for disk springs.

(10) Safetywire bolt heads (255) in pairs with Lockwire MS20995C32 and safetywire three bolts adjacent to tee bar (3 places) with Lockwire MS20995C32 (Ref. Fig. 605).

6. Re-Treating and Repainting

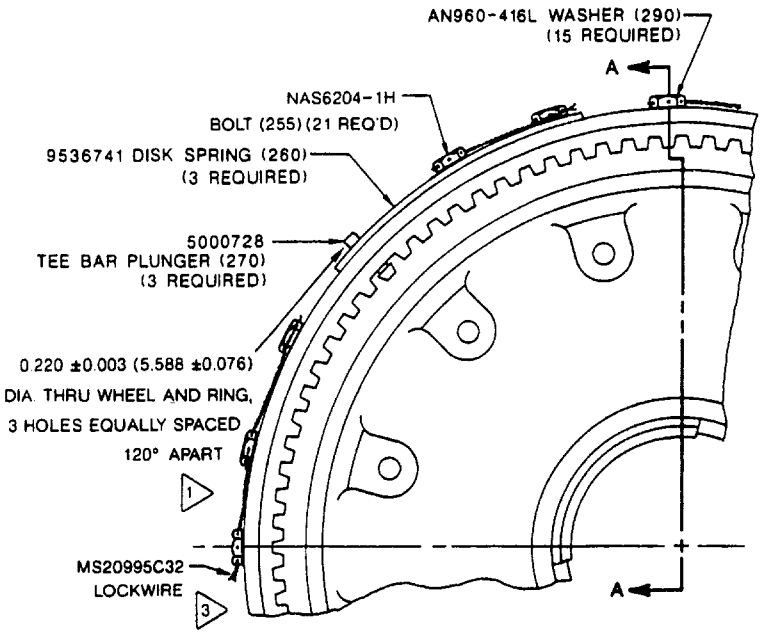
A. Repaired areas of the wheel subassemblies and those having the paint and treated finish removed should be re-treated as follows and repainted in accordance with the following procedures:

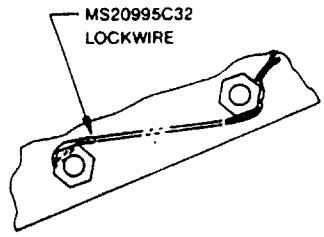
B. Re-Treating

WARNING: CLEANING SOLVENTS ARE TOXIC AND VOLATILE. USE ONLY IN WELL-VENTILATED AREAS. AVOID PHYSICAL CONTACT WITH SOLVENT AND DO NOT INHALE VAPORS.

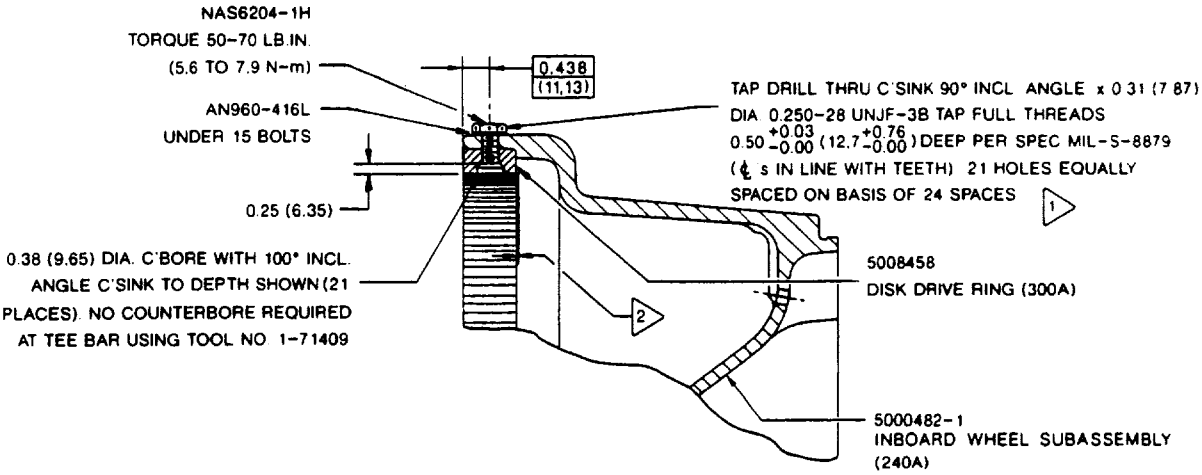
(1) Thoroughly clean surface to be re-treated and repainted. Clean with hot water or methyl isobutyl ketone, Specification TT-M-268, and dry thoroughly with compressed air.

(2) Re-treat all exposed surfaces of wheel subassemblies with chemical film solution conforming to Specification MIL-C-5541 in accordance with the manufacturer's instructions. Refer to Repair Materials for recommended solution.





VIEW SHOWING TYPICAL SAFETY WIRING



SECTION A-A

NOTES:

1. USE 0.125 (3.18) DIA. LOCATOR HOLE IN DRIVE RING FOR DRILLING AND TAPPING HOLES. USE DRILL BUSHING TO LOCATE CENTER OF HOLE.
2. 0.005 (0.127) MAXIMUM GAP ALLOWABLE FOR 1/4 OF SEAT CIRCUMFERENCE
3. THESE 3 BOLTS (3 PLACES) TO BE LOCKWIRED TOGETHER ON THIS SIDE OF TEE BAR

Installing Disk Drive Ring 5008458
Figure 605

C. Touchup painting should be performed as follows:

(1) The part or area requiring touchup painting must be thoroughly clean and free of all contaminants.

(2) Prepare area to be painted (scratches, nicks, chipped paint, etc) by sanding lightly to feather out all edges of adjacent finish, using 320 to 360 grit, wet-or-dry, aluminum oxide cloth. Wet sanding is preferred. Avoid removing more primer than is absolutely necessary from damaged area.

WARNING: CLEANING SOLVENTS ARE TOXIC AND VOLATILE. USE ONLY IN WELL-VENTILATED AREAS. AVOID PHYSICAL CONTACT WITH SOLVENT AND DO NOT INHALE VAPORS.

(3) Wipe repaired surface with a cloth moistened with methyl isobutyl ketone, Specification TT-M-268, and wipe surface dry with a clean cloth.

CAUTION: IF BARE METAL IS EXPOSED BY SANDING, IT MUST BE RE-TREATED BEFORE APPLYING PRIMER.

(4) Starting with the last intact paint layer, reapply paint coats in accordance with repainting wheel assembly.

NOTE: The gloss must be removed in the area to be touched up with an abrasive material, the defective area smoothed and edges feathered. The area must then be cleaned removing all loose and foreign material.

D. Repaint wheel assembly as follows - Method I (Primary) (Ref. Fig. 606).

WARNING: CLEANING SOLVENTS ARE TOXIC AND VOLATILE. USE ONLY IN WELL-VENTILATED AREAS. AVOID PHYSICAL CONTACT WITH SOLVENT AND DO NOT INHALE VAPORS.

(1) Thoroughly clean all surfaces to be treated and/or painted. Wheel subassembly should be washed with methyl isobutyl ketone, Specification TT-M-268.

(2) Treat all exposed metal surfaces of wheel subassemblies with chemical film solution conforming to Specification MIL-C-5541, in accordance with manufacturer's instructions.

CAUTION: DO NOT PAINT ROLLER CONTACTING SURFACES OF BEARING CUPS. PAINT ON THESE SURFACES WILL CONTRIBUTE OR RESULT IN LOSS OF BEARING PRELOAD.

(3) Mask bearing cups (220 and 310) and threaded holes to avoid getting paint on these surfaces.

(4) Mix the aluminum topcoat/primer combination until a viscosity of approximately 25 seconds in a No. 2 Zahn cup is obtained.

NOTE: Aluminum topcoat/primer combination should be at the proper viscosity. If required, thinning can be accomplished using Aeroprite Reducer TH-89.

CAUTION: APPLY ONLY ONE MIST COAT OF TOPCOAT/PRIMER COMBINATION TO REGISTER SURFACES, MATING SURFACES, AND BOLT BOSSES. EXCESSIVE PAINT ON THESE SURFACES MAY CONTRIBUTE OR RESULT IN LOSS OF BOLT PRELOAD.

(5) Apply two coats of aluminum topcoat/primer combination in accordance with Figure 606.

(a) Spray one full wet cross coat to a dry film thickness of approximately 0.0004 to 0.0006 inch (0,010 to 0,015 mm).

(b) Air dry for a minimum of 45 minutes before applying a second coat.

(c) Spray a second full cross coat to a dry film thickness of approximately 0.0004 to 0.0006 inch (0,010 to 0,015 mm).

NOTE: Due to abrasion in the tire bead contacting surfaces, it is recommended that tire bead contacting surfaces have a minimum of 0.0015 inch (0,038 mm) thickness of paint.

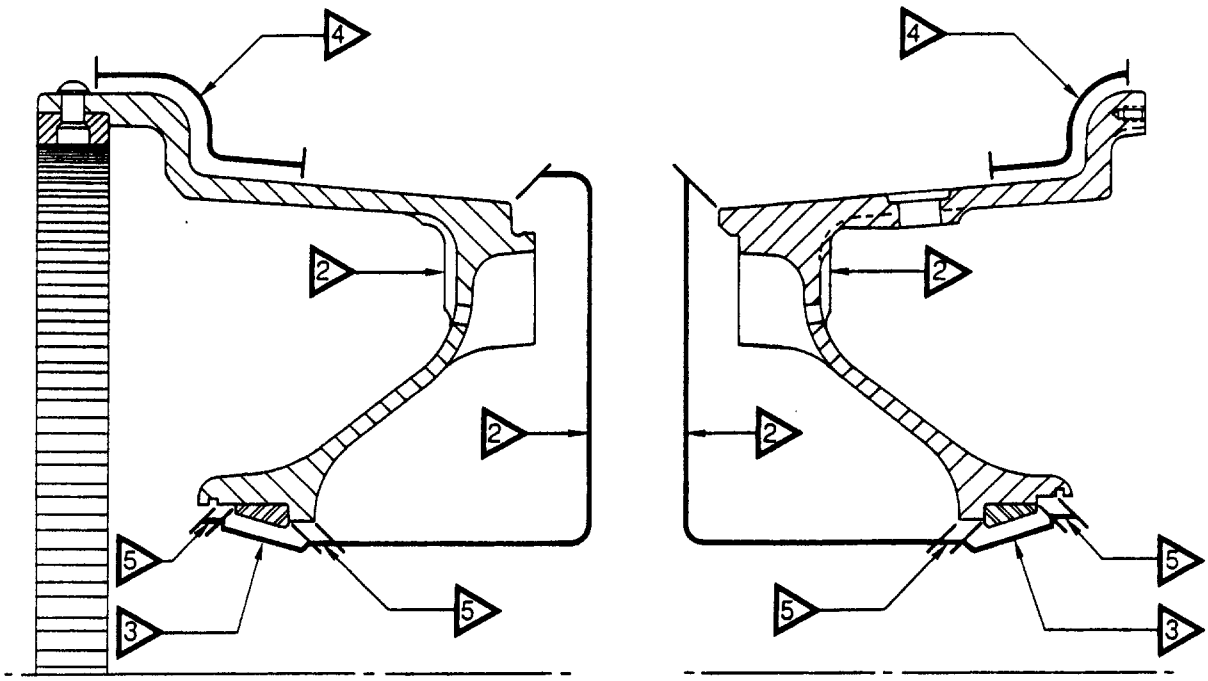
(d) Air dry 45 minutes before handling. Paint will reach full cure in 72 hours.

E. Repaint wheel assembly as follows - Method II (Alternate) (Ref. Fig. 606):

WARNING: CLEANING SOLVENTS ARE TOXIC AND VOLATILE. USE ONLY IN WELL-VENTILATED AREAS. AVOID PHYSICAL CONTACT WITH SOLVENT AND DO NOT INHALE VAPORS.

(1) Thoroughly clean all surfaces to be treated and/or painted. Wheel subassembly should be washed with methyl isobutyl ketone, Specification TT-M-268.

(2) Treat all exposed metal surfaces of wheel subassemblies with chemical film solution conforming to Specification MIL-C-5541, in accordance with manufacturer's instructions.



NOTES:

1 METHOD I - APPLY TWO COATS OF ALUMINUM TOPCOAT/PRIMER COMBINATION. METHOD II - TWO COATS OF ZINC CHROMATE PRIMER AND TWO COATS OF ALUMINUM LAQUER EXCEPT AS SHOWN.

2 METHOD I - ONE COAT OF TOPCOAT/PRIMER ONLY ON THESE SURFACES. METHOD II - ONE MIST COAT OF PRIMER ONLY ON THESE SURFACES.

3 THESE SURFACES TO BE COATED WITH BEARING GREASE. PAINT OR PRIMER NOT PERMITTED.

4 TIRE BEAD CONTACTING SURFACES MUST BE PAINTED THOROUGHLY.

5 THESE SURFACES TO BE COATED WITH BEARING GREASE. OVERSPRAY PERMITTED.

Wheel Painting Diagram
Figure 606

CAUTION: DO NOT PAINT ROLLER CONTACTING SURFACES OF BEARING CUPS. PAINT ON THESE SURFACES MAY CONTRIBUTE OR RESULT IN LOSS OF BEARING PRELOAD.

(3) Mask bearing cups (220 and 310) and threaded holes to avoid getting paint on these surfaces.

CAUTION: APPLY ONLY ONE MIST COAT OF ZINC CHROMATE PRIMER TO REGISTER SURFACES, MATING SURFACES AND BOLT BOSSES. EXCESSIVE PRIMER ON THESE SURFACES MAY CONTRIBUTE OR RESULT IN LOSS OF BOLT PRELOAD.

(4) Paint exposed metal surfaces in accordance with Figure 606 and as follows:

(5) Apply one coat of zinc chromate primer, Specification TT-P-1757, in accordance with Figure 606.

NOTE: Do not exceed the recommended thickness for the applied topcoats. If the humidity should drop below 20 percent, primer application should be stopped until steps are taken to raise the percent humidity.

(a) Apply one coat of primer to obtain a dry film thickness of 0.0003 to 0.0004 inch (0,00762 to 0,0102 mm).

(b) Allow the primer surface to dry a minimum of two hours and a maximum of 12 hours before topcoating with aluminum lacquer, Specification TT-L-32.

(6) Apply one coat of aluminum lacquer, Specification TT-L-32, in accordance with Figure 606.

(a) Spray one full wet cross coat to a dry film thickness of approximately 0.0004 to 0.0006 inch (0,0102 to 0,0152 mm) over the primer coating.

(b) Air dry 45 minutes before handling. Paint will reach full cure in 24 hours.

REPAIR NO. 1 - INBOARD WHEEL BEARING CUP BORE REPAIR

1. General (Ref. IPL Fig. 1)

   A. This repair is used for the repair of damaged bearing cup bores in Inboard Wheel Subassembly 5000482 (240) and 5000482-1 (240A).

   B. This repair provides for machining the bearing cup bore for installation of Bushing Cup Subassembly 5R4-139.

   C. Disassemble as required in accordance with DISASSEMBLY.

2. Repair of Worn Inboard Wheel Bearing Cup Bores

   A. Should a bearing cup be loose in its bore, repair as follows:

      (1) Remove loose bearing cup from wheel subassembly as described in Replacing Bearing Cups.

   B. Bushing-Cup Repair

      (1) Machine hub bore of wheel subassembly oversized as follows:

         NOTE: One oversize machining operation is available to correct the worn inboard bearing bore.

         (a) Machine hub of wheel subassembly to the dimensions shown in Repair, Figure 601. If bore does not cleanup, replace wheel subassembly.

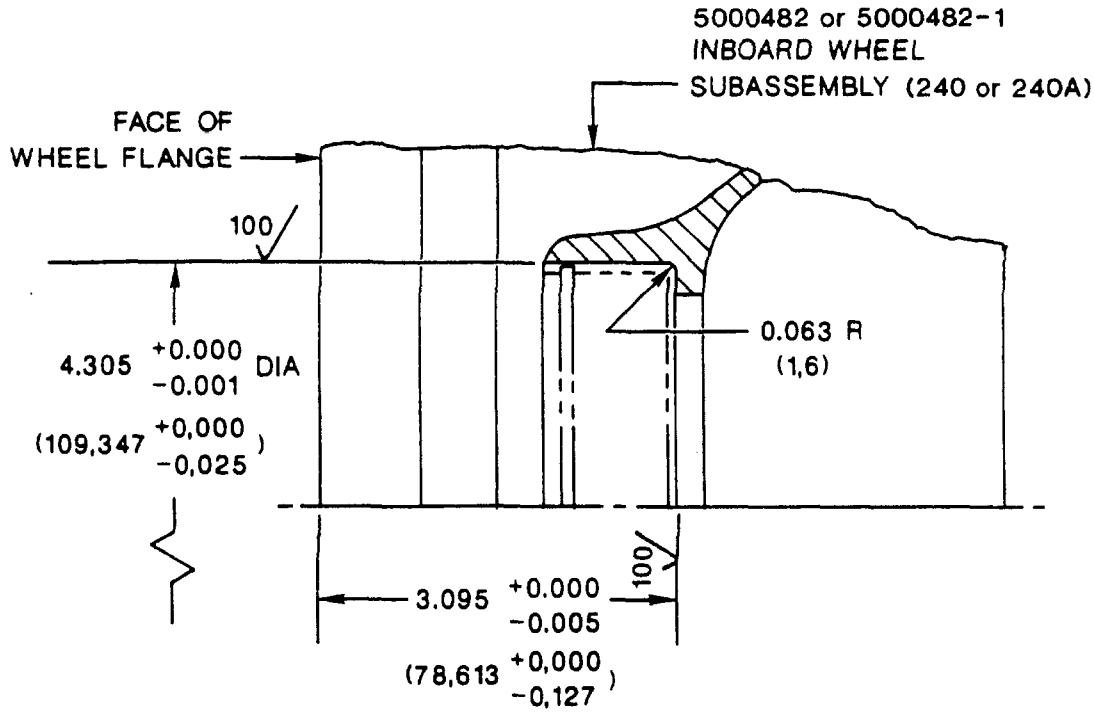
      (2) Thoroughly clean and then treat newly machined surfaces with chemical film solution, Specification MIL-C-5541.

      (3) Install the proper repair bushing cup subassembly (311) as described in Replacing Bearing Cups.

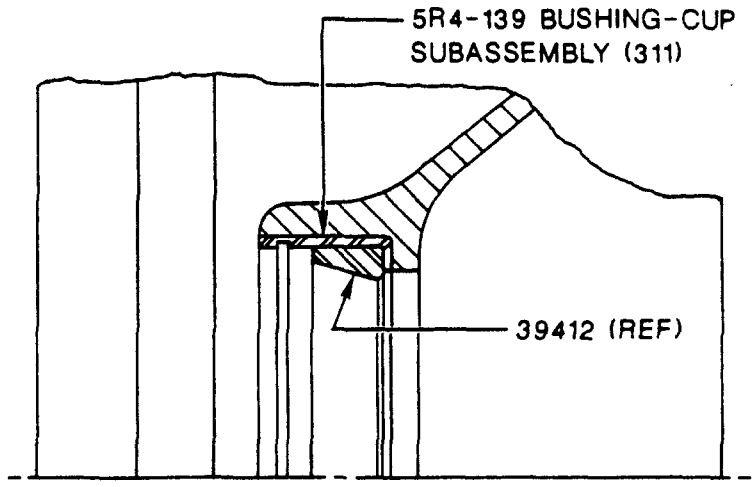
         (a) The inboard wheel subassembly requires the 5R4-139 bushing cup subassembly (311).

      (4) Metal stamp "5R4-139" in 0.19 inch (4,8 mm) characters after Wheel Assembly 5000444 or 5000444-1 or 5000444-3.

      (5) Re-treat and repaint any displaced metal in accordance with Re-Treating and Repainting.



MACHINING DETAIL FOR INBOARD BEARING BORE



INSTALLATION DETAIL

REPAIR NO. 2 - OUTBOARD WHEEL BEARING CUP BORE REPAIR

1. General (Ref. IPL Fig. 1)

   A. This repair is used for the repair of damaged bearing cup bores in Outboard Wheel Subassemblies 5000484 (100).

   B. This repair provides for machining the bearing cup bore for installation of a Bushing Cup Subassembly 5R4-140.

   C. Disassemble as required in accordance with DISASSEMBLY.

2. Repair of Worn Outboard Wheel Bearing Cup Bores

   A. Should a bearing cup be loose in its bore, repair as follows:

      (1) Remove loose bearing cup from wheel subassembly as described in Replacing Bearing Cups.

   B. Bushing Cup Repair

      (1) Machine hub bore of wheel subassembly oversized as follows:

         NOTE: One oversize machining operation is available to correct the worn outboard bearing bore.

         (a) Machine hub of wheel subassembly to the dimensions shown in Repair Figure 601. If bore does not cleanup, replace wheel subassembly.

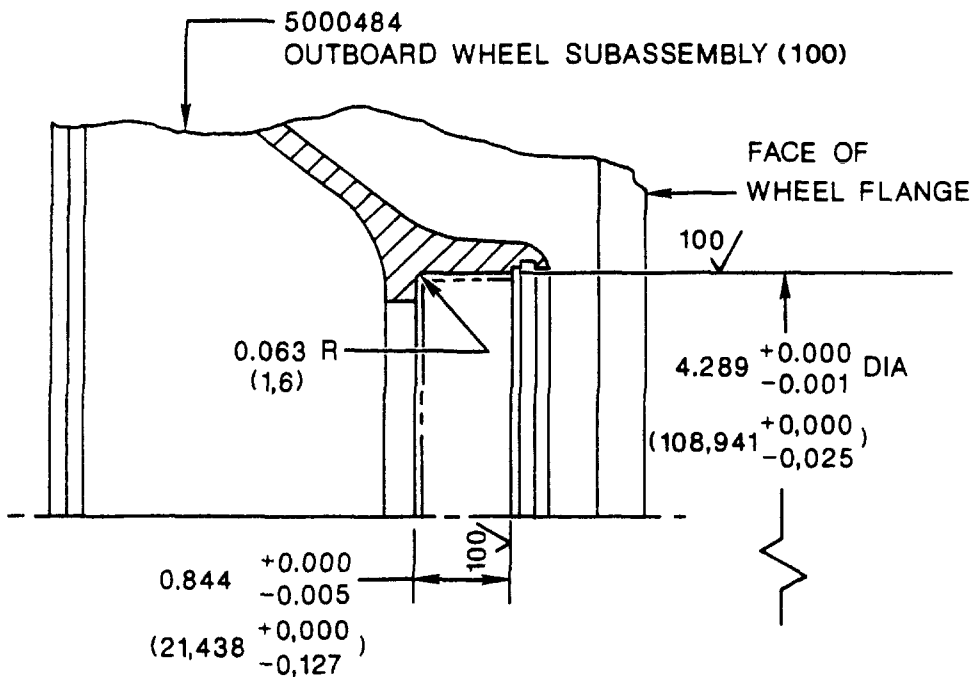
      (2) Thoroughly clean and then treat newly machined surfaces with chemical film solution, Specification MIL-C-5541.

      (3) Install the proper repair bushing cup subassembly (221) as described in Replacing Bearing Cups.

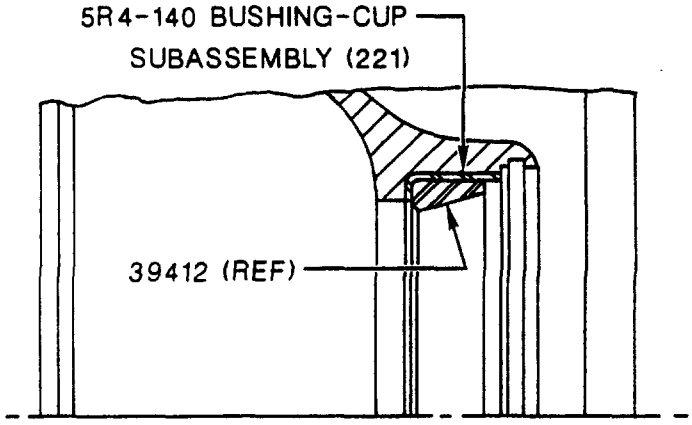
         (a) The outboard wheel subassembly requires the 5R4-140 bushing cup subassembly (221).

      (4) Metal stamp "5R4-140" in 0.19 inch (4,8 mm) characters after Wheel Assembly 5000444 or 5000444-1 or 5000444-3.

      (5) Re-treat and repaint any displaced metal in accordance with Re-Treating and Repainting.



MACHINING DETAIL - OUTBOARD BEARING BORE



INSTALLATION DETAIL - OUTBOARD WHEEL SUBASSEMBLY

NOTE:
WHEN INSTALLING BUSHING-CUP SUBASSEMBLY 5R4-140, ALIGN SLOT IN BUSHING WITH HOLE IN WHEEL SUBASSEMBLY.

Outboard Wheel Bearing Cup Bore Repair
Figure 601

REPAIR NO. 3 - DRIVE FLANGE RIVET HOLE REPAIR

1. General (Ref. IPL Fig. 1)

   A. This repair is used for the repair of damaged drive flange rivet holes on Inboard Wheel Subassembly 5000482 (240).

   B. This repair provides for machining the rivet hole oversize and installation of Rivet Bushing 5006511 (281).

   C. Disassemble as required in accordance with DISASSEMBLY and Replacing Disk Drive Ring in REPAIR.

2. Repair of Drive Flange Rivet Holes

   A. If drive ring rivets were found loose prior to drive ring removal from inboard wheel subassembly, repair enlarged or damaged rivet holes in flange of inboard wheel subassembly as follows:

      (1) Machine damaged rivet holes in accordance with Repair Figure 601.

      (2) Treat newly machined surfaces of wheel subassembly with chemical film solution conforming to Specification MIL-C-5541.

      (3) Chill rivet bushing (281) with dry ice or freeze to aid installation (Ref. Repair Figure 601).

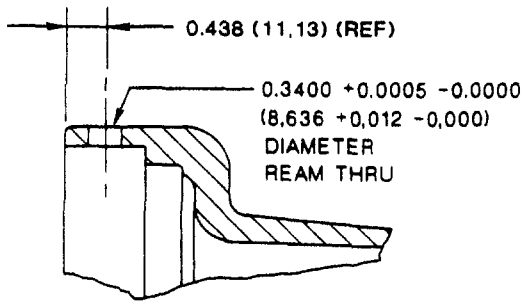
      (4) Install chilled rivet bushing (281) in accordance with Repair Figure 601.

      (5) Metal stamp "R" in 0.12 inch (3,05 mm) characters adjacent to each repaired rivet hole.

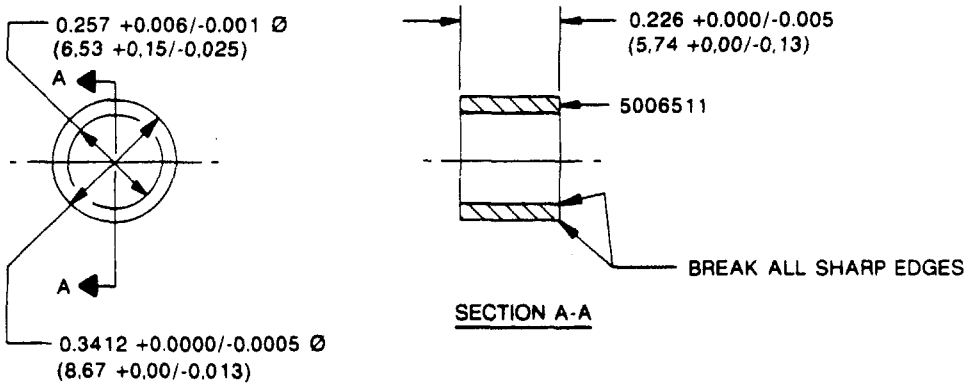
      (6) Metal stamp "5R81-033" adjacent to Inboard Wheel Subassembly 5000482 number in 0.12 inch (3,05 mm) characters no deeper than 0.015 inch (0,381 mm).

      (7) Re-treat and repaint any displaced metal in accordance with Re-Treating and Repainting.

      (8) Install disk drive ring in accordance with Replacing Disk Drive Ring.



MACHINING

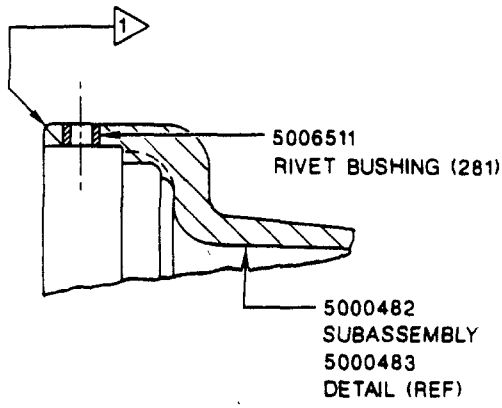


SECTION A-A

NOTES:

1. 150 ALL OVER.
2. ANODIC TREAT TO SPEC MIL-C-5541.
3. MATERIAL IS ALUMINUM ALLOY 6061-T6.

REPAIR BUSHING 5006511



INSTALLATION

NOTES:

1. METAL STAMP "R" IN 0.12 (3,05) CHARACTERS ADJACENT TO EACH RIVET HOLE REPAIR

REPAIR NO. 4 - DRIVE FLANGE TEE BAR PLUNGER HOLE REPAIR

1. General (Ref. IPL Fig. 1)

   A. This repair is used for the repair of damaged tee bar plunger hole on the Inboard Wheel Subassembly 5000482 (240).

   B. The first repair provides for machining the tee bar plunger hole oversized and installation of Flange Bushing 5007112 (271).

   C. The second repair provides for machining the tee bar plunger hole oversized and installation of Flange Bushing 5011243 (272).

   D. Disassemble as required in accordance with DISASSEMBLY.

      NOTE: Do not remove disk drive ring for this repair.

2. Repair of Drive Flange Tee Bar Plunger Hole (First Oversize)

   A. If tee bar plunger is found excessively loose or plunger hole is damaged or enlarged in the inboard wheel subassembly and disk drive ring replacement is not required, repair plunger holes as follows:

      (1) Remove tee bar plunger in accordance with Replacing Disk Drive Ring.

          NOTE: Do not remove disk drive ring for this repair.

      (2) Machine damaged plunger hole in accordance with Repair Figure 601.

      (3) Treat newly machined surfaces of wheel subassembly and disk drive ring with chemical film solution conforming to Specification MIL-C-5541.

      (4) Chill flange bushing (271) with dry ice or freeze to aid installation (Ref. Repair Figure 601).

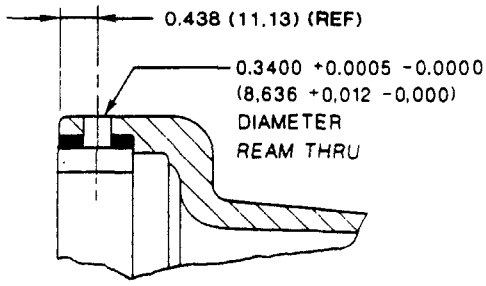
      (5) Coat chilled flange bushing and plunger hole with Loctite RC/620 and install flange bushing (271) in accordance with Repair Figure 601.

      (6) Metal stamp "R" in 0.12 inch (3,05 mm) characters adjacent to each repaired tee bar plunger hole.

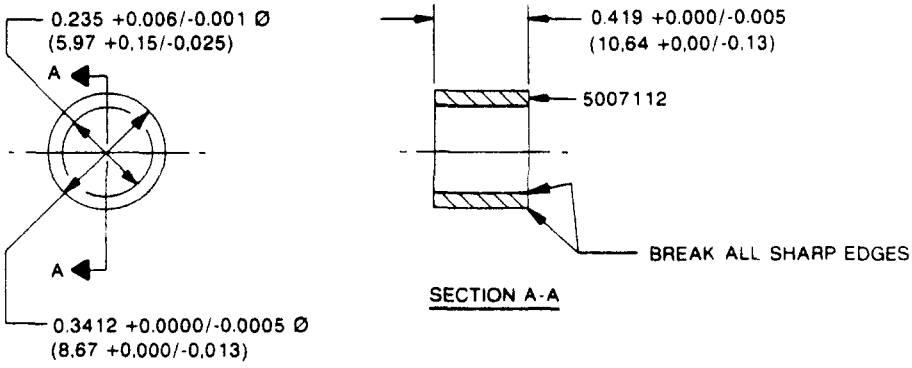
      (7) Metal stamp "5R83-008" adjacent to Inboard Wheel Subassembly 5000482 number in 0.12 inch (3,05 mm) characters.

      (8) Re-treat and repaint any displaced metal in accordance with Re-Treating and Repainting.

      (9) Replace tee bar plunger and spring disk in accordance with Replacing Disk Drive Ring.



MACHINING

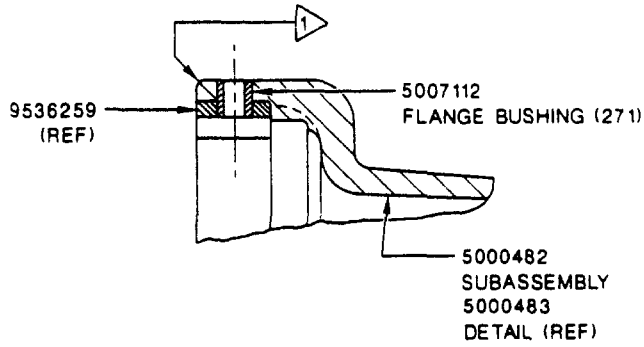


SECTION A-A

NOTES:

1. 150 ALL OVER.
2. ANODIC TREAT TO SPEC MIL-C-5541.
3. MATERIAL IS ALUMINUM ALLOY 6061-T6.

REPAIR BUSHING 5007112



INSTALLATION

NOTES:

1 METAL STAMP "R" IN 0.12 (3,05) CHARACTERS ADJACENT TO EACH T-BAR GUIDE HOLE REPAIR

Tee Bar Plunger Hole Repair
Figure 601

3. Repair of Drive Flange Tee Bar Plunger Hole (Second Oversize)

A. If tee bar plunger is found excessively loose or plunger hole is damaged or enlarged in the inboard wheel subassembly and disk drive ring replacement is not required, repair plunger holes as follows:

(1) Remove tee bar plunger in accordance with Replacing Disk Drive Ring.

NOTE: Do not remove disk drive ring for this repair.

(2) Remove Flange Bushing 5007112 (271) if installed.

(3) Machine damaged plunger hole in accordance with Repair Figure 602.

(4) Treat newly machined surfaces of wheel subassembly and disk drive ring with chemical film solution conforming to Specification MIL-C-5541.

(5) Chill flange bushing (272) with dry ice or freeze to aid installation (Ref. Repair Figure 602).

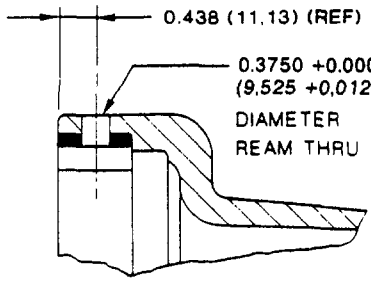
(6) Coat chilled flange bushing and plunger hole with Loctite RC/620 and install flange bushing (272) in accordance with Repair Figure 602.

(7) Metal stamp "R" in 0.12 inch (3,05 mm) characters adjacent to each repaired tee bar plunger hole.

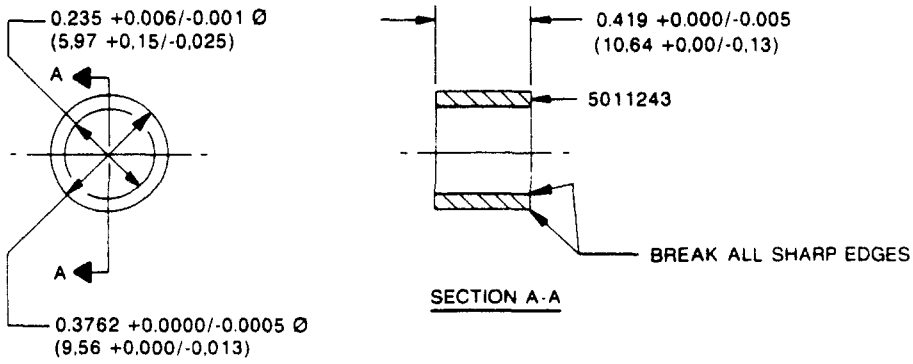
(8) Metal stamp "-1" or "5R83-008-1" adjacent to Inboard Wheel Subassembly 5000482 number in 0.12 inch (3,05 mm) characters to read "5R83-008-1".

(9) Re-treat and repaint any displaced metal in accordance with Re-Treating and Repainting.

(10) Replace tee bar plunger and spring disk in accordance with Replacing Disk Drive Ring.



MACHINING

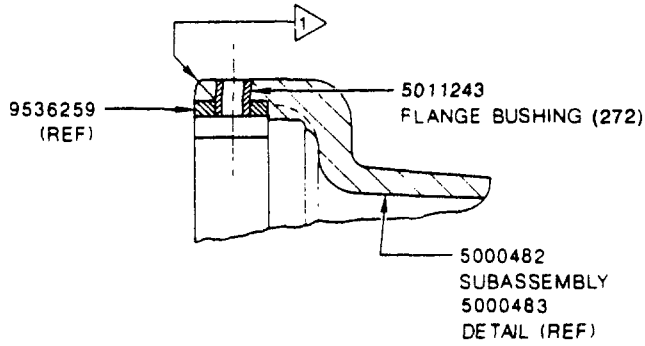


SECTION A-A

NOTES:

1. 150 ALL OVER.
2. ANODIC TREAT TO SPEC MIL-C-5541
3. MATERIAL IS ALUMINUM ALLOY 6061-T6

REPAIR BUSHING 5011243



INSTALLATION

NOTES:

1. METAL STAMP "R" IN 0.12 (3,05) CHARACTERS ADJACENT TO EACH T-BAR GUIDE HOLE REPAIR

REPAIR NO. 5 - REPAIR OF FAIRING RETAINING SCREW THREADS, OUTBOARD WHEEL SUBASSEMBLY

1. General (Ref. IPL Fig. 1)

   A. This repair is used for the repair of stripped or damaged fairing retaining screw holes on Outboard Wheel Subassembly 5000484.

   B. This repair provides for machining the fairing retaining screw holes for installation of Heli-Coil inserts.

   C. If the fairing retaining screw hole contains stripped or damaged threads, repair using Heli-Coil inserts. If the fairing retaining screw hole has been repaired with Heli-Coil inserts and contains stripped or damaged threads, replace outboard wheel subassembly.

2. Repair of Fairing Retaining Screw Threads (Heli-Coil Inserts)

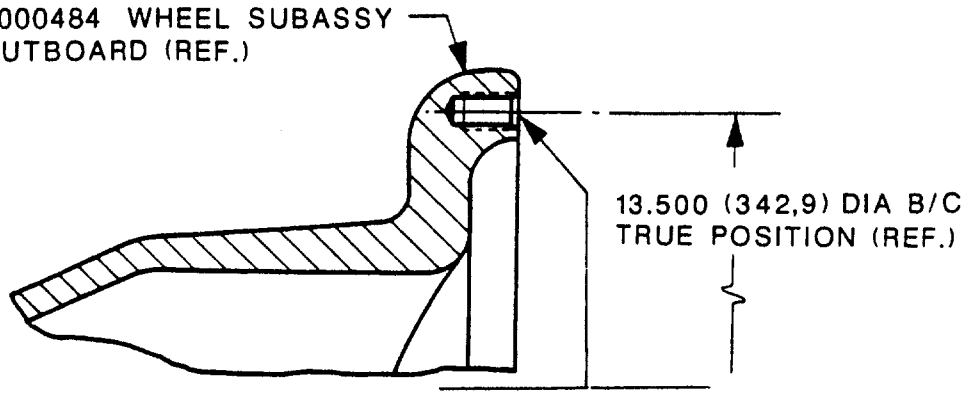
   A. The following repair consists of remachining the fairing retaining screw holes and installing Heli-Coil inserts when the fairing retaining threads are stripped or damaged (Ref. Repair Fig. 601).

   B. Machine fairing retaining screw hole oversize to dimension in Repair Figure 601.

      (1) Re-treat all exposed aluminum surfaces with chemical film solution, Specification MIL-C-5541, in accordance with manufacturer's instructions. Refer to Repair Materials for recommended solution.

   C. Install Heli-Coil inserts in accordance with Repair Figure 602.

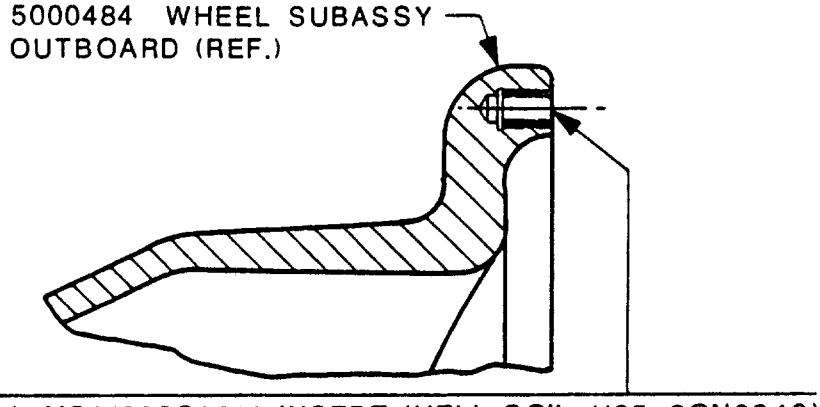
   D. Metal stamp "5R3-353" adjacent to subassembly number in 0.12 inch (3,05 mm) characters.



TAP DRILL 0.174/0.180 DIA. 0.418 DEEP. C'SK 120°INCL ANGLE TO 0.200/0.230 DIA. HELI-COIL FINISHING TAP 2CPA (0.280 MIN. DEEP) FOR 8-32UNC-2B MS21208C0815 INSERT (HELI-COIL 1185-2CN0246). REWORKED HOLES 5 PLACES EQUALLY SPACED WITHIN 0.005 (0,127) OF TRUE POSITION.

NOTE: METAL STAMP "5R3-353" ADJACENT TO SUBASSY NO. IN 0.12 (3,05) CHARACTERS.

Stripped Fairing Thread Machining
Figure 601



INSTALL MS21208C0815 INSERT (HELI-COIL 1185-2CN0246), 3/4 TO 1 1/2 PITCH BELOW SURFACE.

NOTE: REMOVE TANG. USE ZINC CHROMATE PRIMER, SPECIFICATION TT-P-1757, WHEN INSTALLING INSERTS.

Heli-Coil Insert Installation
Figure 602

ASSEMBLY AND STORAGE

1. Assembly Materials

NOTE: Equivalent substitutes may be used for items listed below.

Isopropyl Alcohol Specification TT-I-735	Commercially available
Grease Specification MIL-G-81322	Commercially available
Antiseize Compound Specification MIL-T-5544	Commercially available

2. General (Ref. IPL Fig. 1)

A. Assemble the main wheel in accordance with the following instructions.

CAUTION: ASSEMBLE WHEEL ON A CLEAN, FLAT SURFACE, BEING CAREFUL NOT TO NICK, SCRATCH OR SCUFF PAINT OR PROTECTIVE FINISH FROM WHEEL SUBASSEMBLIES. ENSURE PROPER PARTS ARE USED FOR EACH WHEEL ASSEMBLY.

B. It is recommended new preformed packings be installed at each reassembly.

C. Install instruction plate (10) and balance weights if removed at disassembly. Instructions for attaching balance weights are given in Wheel Balancing.

D. The use of power wrenches for wheel assembly is governed by the following:

(1) Do not use power wrenches for assembly of any threaded parts made of nonferrous material or parts threaded directly into nonferrous tapped holes.

(2) When power wrenches, other than automatic wrenching systems are used to assemble bolts and nuts, fastener tightness shall not exceed 50 percent of final torque value. Tightening to final torque value shall be accomplished using manual torque wrenches.

(3) Automatic wrenching systems which provide a preload or torque accuracy of ± 4 percent or better may be used to tighten bolts and nuts to final torque value.

3. Assembly Procedures

A. If removed at disassembly, install bearing cups (220 and 310), disk spring (260), tee bar plunger (270), and disk drive ring (300 or 300A) in accordance with procedures in REPAIR.

B. Install instruction plate (10) on outboard wheel subassembly (100) as follows:

(1) Area in which plate is to be installed must be clean. Use a clean cloth dampened with isopropyl alcohol, Specification TT-I-735.

(2) Remove paper backing from adhesive surface being careful not to touch the adhesive.

(3) Apply plate to proper location, press firmly with roller (minimum 5 pounds (2,268 kg) pressure applied to roller) to ensure proper contact to both surfaces. Be sure that edges of plate are rolled down firmly.

(4) A set-up or curing time of approximately 48 hours is required to permanently set the adhesive, and plate should not be disturbed during this time.

C. Position tire/time change counter (210) on outboard wheel subassembly (100) and secure counter in place with screw (200), plain washer (190), and self-locking nut (180).

D. Install valve subassembly (110 or 110A) as follows:

NOTE: If tube-type tire is installed, do not install valve subassembly.

(1) For Main Wheel Assembly 5000444 and 5000444-3 install valve subassembly (110) onto outboard wheel subassembly (100) as follows:

(a) Install preformed packing (170) on valve stem (160) and seat tightly against stem base.

(b) Clean area of outboard wheel subassembly (100) around valve hole thoroughly with a clean cloth. Insert valve stem through valve hole with valve stem towards outside of wheel and preformed packing in valve hole.

(c) Place washer (150) over valve stem and onto preformed packing (170). Install hex nut (140) on valve stem and tighten until preformed packing is firmly compressed and valve hole is sealed.

(2) For Main Wheel Assembly 5000444-1 install valve subassembly (110A) onto outboard wheel subassembly (100) as follows:

(a) Install preformed packing (170) on valve stem (160A) and seat tightly against stem base.

(b) Clean area of outboard wheel subassembly (100) around valve hole thoroughly with a clean cloth. Insert valve stem through valve hole with valve stem towards outside of wheel and preformed packing in valve hole.

(c) Place spacer (150A) over valve stem and onto preformed packing (170). Install hex nut (140A) on valve stem and tighten until preformed packing is firmly compressed and valve hole is sealed.

E. Install "tubeless" tire as follows:

(1) Check tire for word "Tubeless" on sidewall.

(2) Visually check tire with emphasis on bead area for shipping or handling damage.

(3) Make certain tire is free of foreign material and that bead areas are clean.

WARNING: CLEANING SOLVENTS ARE TOXIC AND VOLATILE. USE ONLY IN WELL-VENTILATED AREAS. AVOID PHYSICAL CONTACT WITH SOLVENT AND DO NOT INHALE VAPORS.

(4) Clean tire beads, wheel flange bead seats and wheel register surfaces with a cloth dampened with isopropyl alcohol, Specification TT-I-735.

(5) Place inboard wheel subassembly (240 or 240A) on clean, flat surface with flange down.

CAUTION: EQUALIZE THE PACKING AROUND THE PACKING GROOVE BE CAREFUL PACKING IS NOT STRETCHED, TWISTED, PINCHED OR UNSEATED. REUSED PACKINGS SHOULD BE INSTALLED AS CLOSE AS POSSIBLE TO THEIR ORIGINAL POSITION.

(6) Lubricate preformed packing (230) with light coat of grease, Specification MIL-G-81322, and install into groove on the inboard wheel subassembly (240 or 240A).

(7) Position tire on inboard wheel subassembly (240 or 240A) with red balance dot on tire sidewall up.

(8) Place outboard wheel subassembly (100) in tire with valve subassembly at red dot on the tire and align bolt holes with those in inboard wheel subassembly. Seat wheel subassemblies together.

(9) Make sure preformed packing (230) is not unseated.

F. Install tube-type tire as follows:

(1) Visually check tire with emphasis on bead area for shipping or handling damage.

(2) Make certain tire is free of foreign material and that bead areas are clean.

WARNING: CLEANING SOLVENTS ARE TOXIC AND VOLATILE. USE ONLY IN WELL-VENTILATED AREAS. AVOID PHYSICAL CONTACT WITH SOLVENT AND DO NOT INHALE VAPORS.

(3) Clean tire beads, wheel flange bead seats and wheel register surfaces with a cloth dampened with isopropyl alcohol, Specification TT-I-735.

(4) Place outboard wheel subassembly (100) on a clean, flat surface.

NOTE: Valve subassembly (110 or 110A) and preformed packing (230) are not used when tube-type tire is installed on the wheel.

(5) Inflate inner tube just enough to round it out. Position tube in tire. Align yellow stripe on base with tube with branded red dot on tire sidewall.

(6) Place tire on outboard wheel subassembly (100) and position valve stem through valve hole.

CAUTION: MAKE CERTAIN THE INNER TUBE IS NOT PINCHED BETWEEN WHEEL SUBASSEMBLIES BEFORE WHEEL BOLTS ARE INSTALLED.

(7) Install inboard wheel subassembly (240 or 240A) in tire so that bolt holes align with those in outboard wheel subassembly and seat wheel subassemblies together.

G. Install wheel fasteners as follows:

(1) Lubricate internal wrenching bolt (90) threads and bearing surfaces of the bolt head, self-locking nuts (70) and double-recessed washers (80) with antiseize compound, Specification MIL-T-5544, before each assembly.

NOTE: Use antiseize compound as received. Do not dilute.

CAUTION: INSTALL BOLT HEADS ON INBOARD SIDE OF WHEEL. THERE MUST BE A COUNTERSUNK WASHER UNDER EACH BOLT HEAD AND UNDER EACH NUT.

(2) Place a double-recessed washer (80) on internal wrenching bolt (90) and install through the inboard and outboard wheel subassemblies. Secure with double-recessed washer (80) and self-locking nut (70).

CAUTION: IF ANY BOLT OR NUT IS ACCIDENTALLY TIGHTENED TO MORE THAN 120 PERCENT OF RECOMMENDED FINAL TORQUE VALUE, REPLACE NUT AND BOLT.

IF POWER WRENCHES ARE USED, ANY FASTENERS TIGHTENED TO MORE THAN 50 PERCENT, BUT LESS THAN 120 PERCENT, OF FINAL TORQUE VALUE SHALL BE DISASSEMBLED AND RELUBRICATED WITH ANTISEIZE COMPOUND, SPECIFICATION MIL-T-5544 BEFORE REASSEMBLY.

(3) Install bolts, washers and nuts in four positions, 90 degrees apart and draw up evenly until wheel subassemblies seat; then install remaining bolts, washers and nuts.

NOTE: When tube-type tire is installed, make certain that inner tube is not pinched between wheel subassemblies.

(4) Tighten nuts in a criss-cross pattern in increments of approximately 50 pound-inches (5,6 N-m) to a final Lubtork value of 150 pound-inches (16,9 N-m).

(a) When power wrenches, other than automatic wrenching systems are used to assemble bolts and nuts, fastener tightness shall not exceed 50 percent of final torque value. Tightening to final torque value shall be accomplished using manual torque wrenches.

(b) Automatic wrenching systems which provide a preload or torque accuracy of ± 4 percent or better may be used to tighten bolts and nuts to final torque value.

NOTE: The use of high speed power wrenches for installation of fasteners can reduce the service life of bolts and nuts.

WARNING: PLACE WHEEL/TIRE IN AN INFLATION CAGE FOR INITIAL INFLATION. DO NOT INFLATE TIRE IN EXCESS OF FULL OPERATING PRESSURE TO SEAT THE BEADS. REDUCE TIRE PRESSURE TO RECOMMENDED STORAGE PRESSURE UNTIL WHEEL/TIRE ASSEMBLY IS READY FOR TESTING. TIRE AND/OR WHEEL FAILURE MAY OCCUR, CAUSING INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT IF THE TIRE IS OVERINFLATED FROM ANY HIGH PRESSURE SOURCE. TIRE AND WHEEL ASSEMBLIES MUST BE SERVICED WITH INFLATION EQUIPMENT WHICH HAS BEEN SPECIFICALLY DESIGNED FOR THIS OPERATION.

H. Install valve core (130) in valve stem. Place wheel/tire assembly in inflation cage and inflate tire just enough to seat beads.

I. Inflate tube-type tires to one-half of recommended operating pressure after beads are seated and then deflate tire completely. Inflate tire again to recommended storage pressure.

NOTE: This procedure permits the tube to equalize within the tire, preventing thinned and stretched sections in the base of the tube and reduces air leakage.

J. Deflate tire to storage pressure. Install valve cap (120) on valve and remove wheel from inflation cage.

K. Install bearings completing the assembly as follows:

CAUTION: HANDLE BEARING CONES WITH EXTREME CARE. MANY AIRCRAFT BEARING FAILURES RESULT FROM MISHANDLING DURING MAINTENANCE.

USE CLASS 2 OR 4 BEARINGS ONLY. DO NOT SUBSTITUTE ANOTHER CLASS BEARING FOR CLASS 2 OR 4.

(1) Pack bearing cones (30 and 60) and coat bearing cups (220 and 310) and lips of bearing seals (20 and 50) with grease, Specification MIL-G-81322.

NOTE: Lubrication of bearings by mechanical or other pressure methods is recommended because it is more efficient, reduces the possibility of contamination and assures a more even distribution of grease within the bearing.

(2) Install bearing cone (60) into hub of inboard wheel subassembly. Align bearing seal (50) with hub and install seal into hub. Secure seal with retaining ring (40).

NOTE: Install retaining ring so that ends of ring are positioned on each side of antirotation lug on bearing seal (Ref. Fig. 1).

(3) Cover hub opening of inboard wheel subassembly (240 or 240A) to protect bearings from dirt and moisture until wheel assembly is installed on aircraft.

(4) Install outboard bearing cone (30) into hub of outboard wheel subassembly (100).

(5) Align outboard bearing seal (20) with wheel hub and install outboard bearing seal (20) into hub of outboard wheel subassembly (100).

(6) Cover hub opening of outboard wheel subassembly to protect bearings from dirt and moisture until wheel assembly is installed on aircraft.

L. Test wheel/tire assembly as required in accordance with TESTING AND FAULT ISOLATION.

M. *Install axle nut as follows:*

NOTE: Data given for information only.

(1) Make sure axle and nut threads are clean and free of burrs.

(2) Apply bearing grease, Specification MIL-G-81322, to all threads and load-bearing surfaces of axle, washer and nut.

(3) Tighten axle nut to 200 pound-inches (22,6 N-m) while manually rotating wheel. Back-off nut to zero pound-inches but with all parts still in contact.

(4) Retighten nut to 100 pound-inches (11,3 N-m) while manually rotating wheel.

(5) If not at a locking position, advance nut to the nearest locking position, not to exceed 30 degrees, and secure.

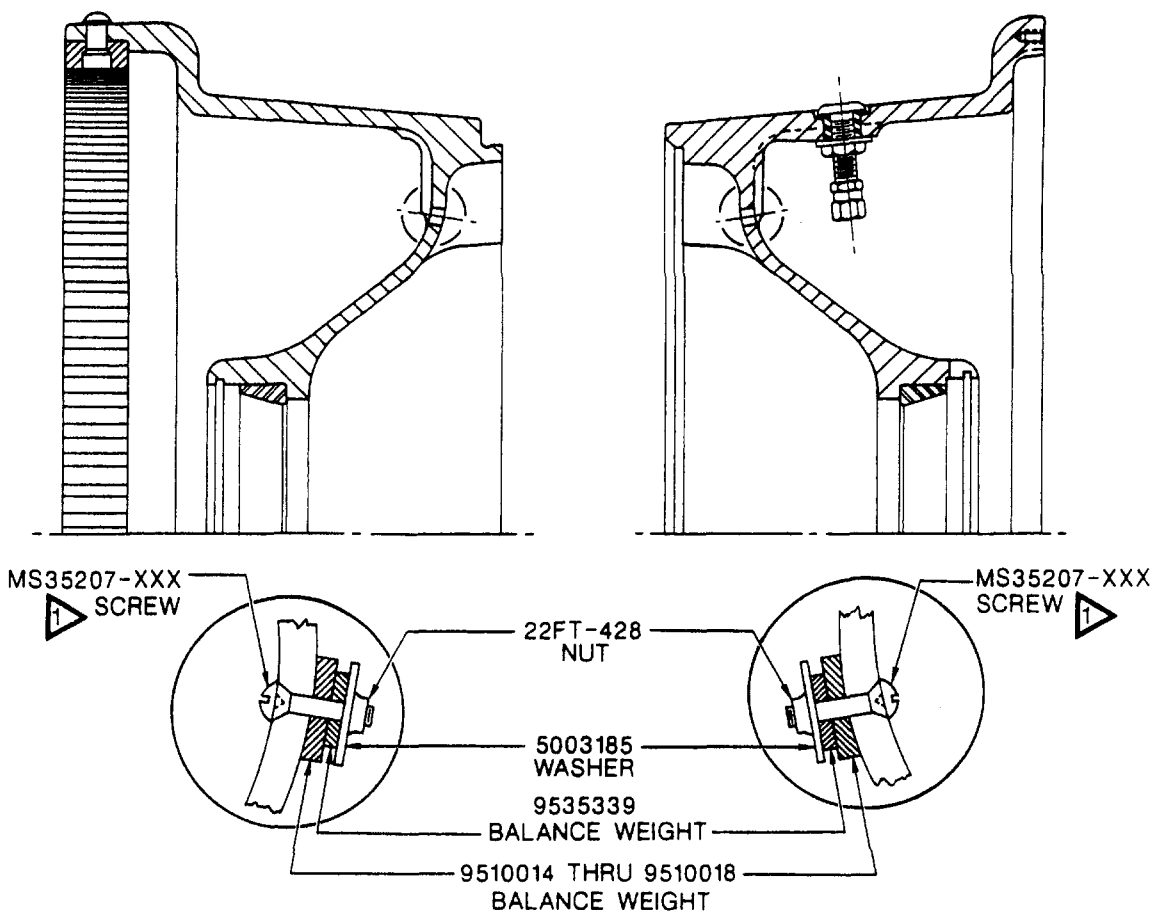
4. Wheel Balancing

A. Any permanent balance weights removed at disassembly should be reinstalled. The weight values of the permanent balance weights are stamped adjacent and to the right of the hole to which the weights are bolted. See Figure 701 for installation details.

B. Should the wheel require static or dynamic balancing after tire mounting, additional weights may be added to bring the assembly into balance. Secure weights to wheel using the holes provided. Attach weights with a screw of the required length for the number of weights used. Installed weights should not protrude beyond the register edge. See Figure 701 for installation details.

C. If rebalancing of individual wheel subassemblies has been accomplished after wheel repair, then new permanent balance weight values followed by letter "B" should be restamped on flange face adjacent to weights. Obliterate any obsolete values. Balance wheel subassembly to within 1.5 ounce-inches (108 g-cm).

D. Balance weights are available for balancing the wheel/tire assembly. The required weight is obtained by using multiples of the balance weights. Total weight added to the inboard wheel subassembly must not exceed 3.0 ounces (85,05 g). Total weight added to the outboard wheel subassembly must not exceed 3.0 ounces (85,05 g). The installed weights must not extend beyond the register edge of the wheel. The weights are bolted to the wheel web of the wheel subassemblies as shown in Figure 701.



BALANCE WEIGHT P/N	WEIGHT	SCREW LENGTH
9535339	3/4 OZ (21,3 g)	MS35207-280
9510014	1 OZ (28,3 g)	MS35207-280
9510015	1 1/2 OZ (42,5 g)	MS35207-280
9510016	2 OZ (56,7 g)	MS35207-281
9510017	2 1/2 OZ (70,9 g)	MS35207-281
9510018	3 OZ (85,1 g)	MS35207-282

NOTES:

1. INSTALL MS35207 "DASH" WITH PROPER SCREW AS SHOWN IN TABLE, SCREW LENGTH TO ALLOW MINIMUM OF ONE THREAD TO PROTRUDE FROM NUT.
2. USE EXISTING DRILLED HOLE IN WHEEL SUBASSEMBLY AND WEIGHT AS STAMPED NEAR HOLE.
3. COAT SURFACE CONTACT AREAS OF WHEEL AND BALANCE WEIGHT WITH ONE COAT OF ZINC CHROMATE PRIMER.
4. BALANCE WEIGHTS MUST NOT EXTEND BEYOND WHEEL REGISTER EDGE.

Balance Weight Installation
Figure 701

5. Storage Instructions

A. Wheels Stored with Tires Installed

(1) The length of time that a wheel assembly can be stored is governed by the storage life of its rubber components. The usable life may be shortened by exposure to sunlight, ozone concentration, extreme temperatures and contamination by fluids and foreign particles.

(2) The wheel/tire assembly should be stored in a clean, cool, dry storeroom out of direct sunlight. The desirable storeroom temperature range is 32° to 75°F (0° to 24°C). If this temperature range cannot be maintained, temperatures as high as 100°F (38°C) or even 125°F (52°C) can be tolerated for short periods with only minor degradation.

(3) The recommended storage pressure for tires is 40 psi (2,7 bars).

B. Wheels Stored without Tires Installed

(1) The wheel assembly is stored without the wheel preformed packing installed between the two subassemblies. The packaged preformed packing is normally taped to the wheel for initial shipment and should be stored in this manner.

(2) Wheels stored without rubber components have an indefinite storage life.

FITS AND CLEARANCES

Item No. (Ref. IPL Fig. 1)	Nomenclature	Torque Value
70	Self-Locking Nut	150 pound-inches (16,9 N-m) Lubtork*
255	Hex Head Bolt (Steel Drive Ring)	50 to 70 pound-inches (5,6 to 7,9 N-m)
*Lubtork: At each installation, lubricate bolt threads and bearing surfaces of nuts, bolt heads and washers with antiseize compound conforming to Specification MIL-T-5544. Use compound full strength; do not dilute.		

Torque Value
Figure 801

Item No. (Ref. IPL Fig. 1)	Nomenclature	Locking Value
70	Self-Locking Nut	15 pound-inches (1,69 N-m) minimum torque required to assure self-locking capability.
180	Self-Locking Nut	2 pound-inches (0,23 N-m) minimum torque required to assure self-locking capability.

Minimum Locking Value
Figure 802

Item No. (Ref. IPL Fig. 1)	Nomenclature	Wear Limit
300 or 300A	Disk Drive Ring	Replace disk drive ring if three or more teeth are worn to a thickness of 0.125 inch (3,17 mm) or less at a point 0.078 inch (1,98 mm) from the top of the tooth.

Wear Limits
Figure 803

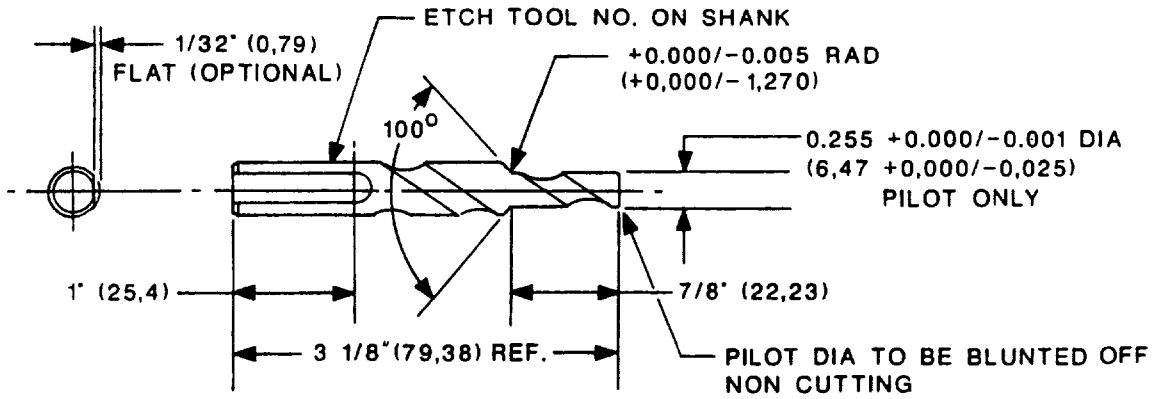
SPECIAL TOOLS, FIXTURES, AND EQUIPMENT

NOTE: Equivalent substitutes may be used for items listed below.

Figure No.	Tool No.	Description	Application
901	1-71409	Countersink Tool	Used to countersink rivet holes in aluminum drive ring.

NOTE: Special tools may be purchased from:

Air Treads
5075 Pine Tree Street
Forest Park, GA 30050



NOTES:

1. ALTER A 3/8 DIA SCREW MACHINE LENGTH STRAIGHT SHANK DRILL -NATIONAL LIST 240 (OR EQUIV.)
2. 3/8 DIA AND 0.255 DIA TO BE CONCENTRIC WITHIN 0.001 T.I.R.

ILLUSTRATED PARTS LIST

1. Introduction

A. General

(1) The Illustrated Parts List (IPL) section illustrates and lists the procurable parts of the assembly(ies) in this publication.

B. Parts List

(1) The illustration is an exploded view of assembly(ies) covered by the parts list.

(2) Components in the parts list are listed in order of disassembly.

(3) The Figure and Item column provides the cross reference between the parts list and the associated IPL Figure 1.

(4) The Part Number column gives the part number of the item, which is stamped on the part when practical. This number should be used when ordering parts.

(5) The Airline Stock Number column is provided for the convenience of the operator to enter individual part numbers.

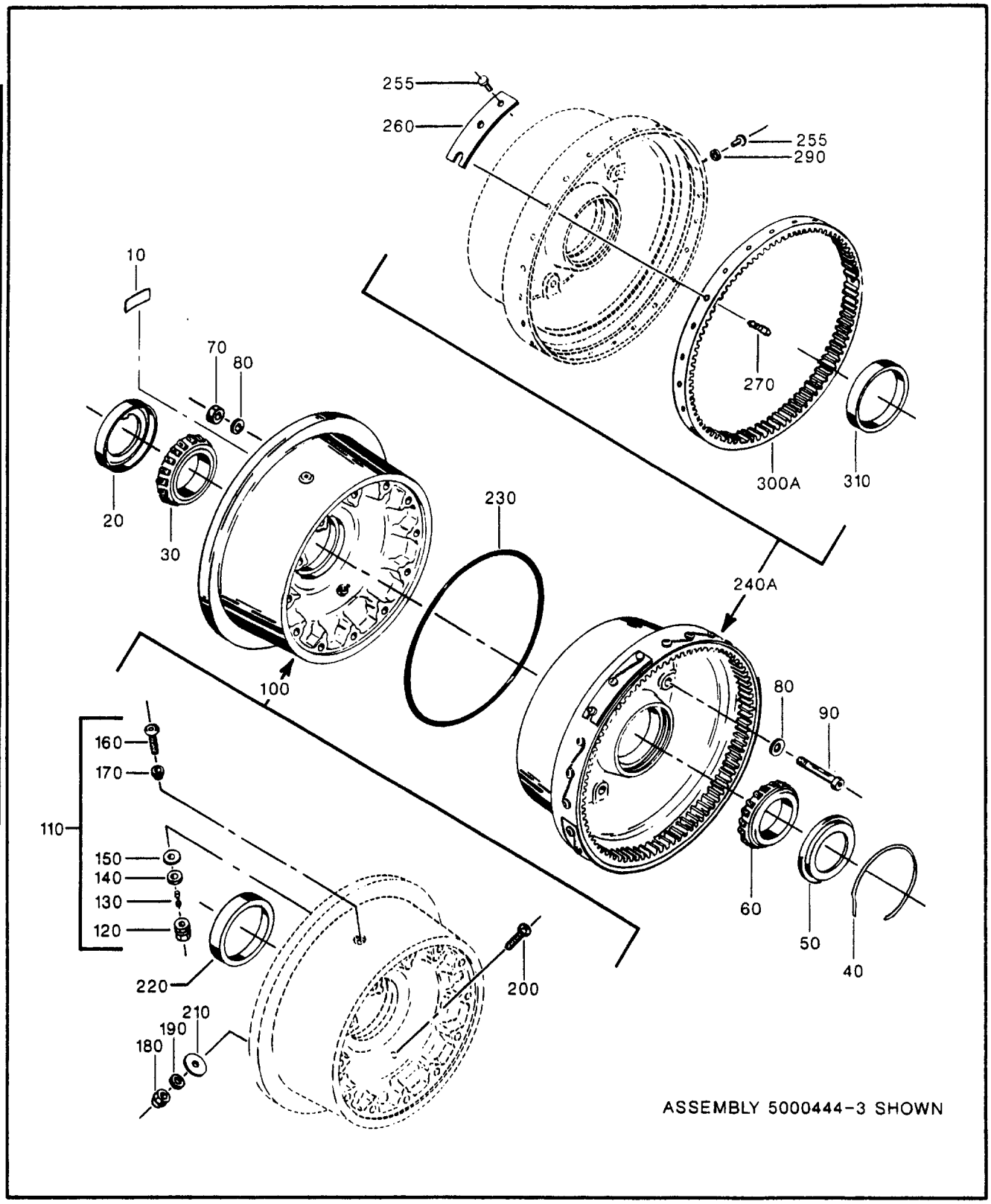
(6) The Nomenclature column gives the basic noun name of each part, together with any descriptive or dimensional information and specifications required to identify the part listed. Parts are indented under the numbered sub-column heading showing the relationship of the parts to their subassemblies and to the assembly. When an alternate part or repair part exists for the recommended part, it is indicated in parentheses following the part nomenclature. A federal supply code number is given for all vendor-supplied items.

(7) The Effect Code column shall establish parts relationship with units or assemblies which are essentially the same but have minor variations. These units or assemblies are the lead items. These units or assemblies shall be assigned reference letters such as A, B, C, D, etc. Parts which are not common to all configurations, but are associated with one or more of the coded lead items, shall carry the letter or letters assigned to the lead item with which it is associated. If a part is common to all lead items, the Effect Code column shall be blank.

(8) The Units Per Assembly column gives the number of parts required for each assembly or subassembly.

C. Federal Supply Codes for Manufacturers

(1) A list of vendor/manufacturer names and addresses is provided following the parts list.



Main Wheel Assemblies 5000444, 5000444-1 and 5000444-3
IPL Figure 1

2. Parts List

FIGURE ITEM	PART NUMBER	AIRLINE STOCK NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT CODE	UNITS PER ASSY	
1 -1	5000444		WHEEL ASSEMBLY, Main . .	A	RF	
-1A	5000444-1		WHEEL ASSEMBLY, Main . .	B	RF	
-1B	5000444-2		DELETED			R
-1C	5000444-3		WHEEL ASSEMBLY, Main	C	RF	R
10	5002742		. PLATE, Data, Instruction .		1	R
20	9536688		. SEAL, Bearing Outboard . .	AC	1	R
-20A	9533856		. SEAL, Bearing, Outboard. .	B	1	R
20	5004387		DELETED			R
30	39250		. CONE, Bearing, Outboard (V60038) (Order Class 2 or 4 only)		1	R
40	9526147		. RING, Retaining		1	R
50	9533857		. SEAL, Bearing, Inboard . .		1	R
60	39250		. CONE, Bearing, Inboard (V60038) (Order Class 2 or 4 only)		1	R
70	GYN165		. NUT, Self-Locking		12	R
80	GWA182-5		. WASHER, Double Recessed.		24	R
90	GY165MS36		. BOLT, Internal Wrenching .		12	R
100	5000484		. WHEEL SUBASSEMBLY, Outboard		1	R
110	TR721-05		. . VALVE SUBASSEMBLY (V79934)	AC	1	R
-110A	TR764-03		. . VALVE SUBASSEMBLY (V79934)	B	1	R
120	VC5		. . . CAP, Valve (V79934) .		1	R
130	C4		. . . CORE, Valve (V79934) .		1	R
140	HN2		. . . NUT, Hex (V79934) (For item 110) . . .	AC	1	R
-140A	HN5		. . . NUT, Hex (V79934) (For item 110A). . .	B	1	R
150	W1		. . . WASHER (V79934) (For item 110) . . .	AC	1	R
-150A	S4		. . . SPACER (V79934) (For item 110A). . .	B	1	R
160	TR721-04		. . . STEM, Valve (V79934) (For item 110) . . .	AC	1	R
160A	TR764-02		. . . STEM, Valve (V79934) (For item 110A). . .	B	1	R
170	RG8		. . . PACKING, Preformed (V79934)		1	R
180	MS21083N3		. . NUT, Self-Locking . . .		1	R
190	AN960D10L		. . WASHER, Plain.		1	R

- Item not illustrated.

FIGURE ITEM	PART NUMBER	AIRLINE STOCK NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT CODE	UNITS PER ASSY	
1-200	MS35207-263		. . SCREW		1	
210	59A64135-6		. . COUNTER, Tire/Time Change (V98747) . . .		1	
220	39412		. . CUP, Bearing (V60038) (Order Class 2 or 4 only)		1	
-221	5R4-140*		. . BUSHING CUP SUBASSEMBLY (Repair only) .		AR	
-222	MS21208C815		. . INSERT (Repair only) . .		AR	
-222A	1185-2CN0246		. . INSERT (Repair only) (Alternate for item 222)		AR	
230	9534716		. PACKING, Preformed . . .		1	
-240	5000482		. WHEEL SUBASSEMBLY, Inboard	AB	1	
-240A	5000482-1		. WHEEL SUBASSEMBLY, Inboard	C	1	
-250	MS20470DD8-10		. . RIVET.	AB	6	
255	NAS6204-1H		. . BOLT, Hex Head	C	21	
260	9536741		. . SPRING, Disk		3	
270	5000728		. . PLUNGER, Tee Bar . . .		3	
-271	5007112*		. . BUSHING, Flange (Repair only)	AB	AR	
-272	5011243*		. . BUSHING, Flange (Repair only)	AB	AR	R
-280	MS20470DD8-9		. . RIVET.	AB	15	
-281	5006511*		. . BUSHING, Rivet (Repair only)	AB	AR	
290	AN960-416L		. . WASHER, Plain.	AB	15	
-	AN960-416L		. . WASHER, Plain.	C	21	
-300	9536259		. . RING, Disk Drive (Aluminum)	AB	1	
300A	5008458		. . RING, Disk Drive (Steel) .	C	1	
310	39412		. . CUP, Bearing (V60038) (Order Class 2 or 4 only)		1	
-311	5R4-139*		. . BUSHING CUP SUBASSEMBLY (Repair only)		AR	
-320	22FT428*		. NUT, Self-Locking (V56878)		AR	
-330	5003185*		. WASHER, Flat		AR	
-340	9535339*		. WEIGHT, Balance 3/4 oz (21 g)		AR	

- Item not illustrated.
* Not furnished - order separately.

FIGURE ITEM	PART NUMBER	AIRLINE STOCK NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT CODE	UNITS PER ASSY
-340A	9510014*		. WEIGHT, Balance 1 oz (28 g)		AR
-340B	9510015*		. WEIGHT, Balance 1.5 oz (43 g)		AR
-340C	9510016*		. WEIGHT, Balance 2 oz (57 g)		AR
-340D	9510017*		. WEIGHT, Balance 2.5 oz (71 g)		AR
-340E	9510018*		. WEIGHT, Balance 3 oz (85 g)		AR
-350	MS35207-280*		. SCREW		AR
-350A	MS35207-281*		. SCREW		AR
-350B	MS35207-282*		. SCREW		AR

- Item not illustrated.
* Not furnished - order separately.

3. Federal Supply Codes for Manufacturers

Code No.	Name and Address
56878	SPS Technologies, Incorporated Aerospace and Industrial Products Division Highland Avenue Jenkintown, PA 19046
60038	The Timken Company 1835 Dueber Avenue Southwest Canton, OH 44706
79934	The Tire & Rim Association, Incorporated Akron, OH 44313 See T&R Standard. *Possible sources for valve and valve parts.
98747	Hill Air Force Base Air Material Area Ogden, UT
*17875	Eaton Corporation Route 501 South Roxboro, NC 27573
*27783	Schrader Automotive, Incorporated Division of Arvin Industries 566 Mainstream Drive P.O. Box 675 Nashville, TN 37202-0675

AIRCRAFT BRAKING SYSTEMS
Corporation

COMPONENT MAINTENANCE MANUAL with ILLUSTRATED PARTS LIST

AP-560

BRAKE ASSEMBLY

Part No. 5001571

Part No. 5001571-1

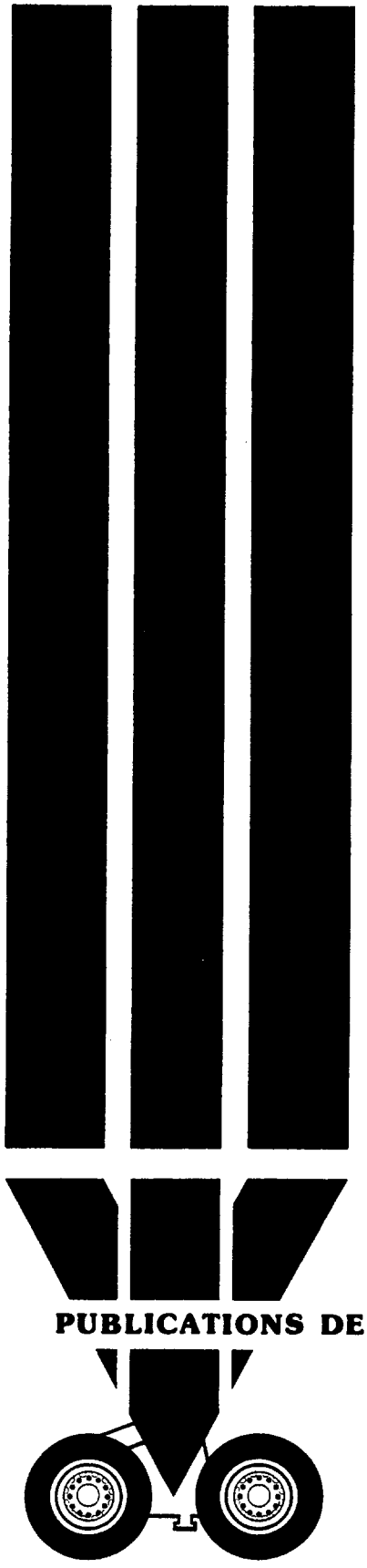
Part No. 5001571-2

Part No. 5001571-3

Part No. 5001571-4

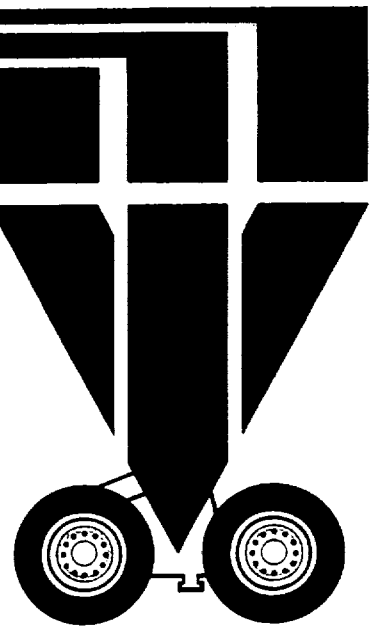
Part No. 5001571-5

Part No. 5001571-6



PUBLICATIONS DEPARTMENT

32-43-12



AP-560

COMPONENT MAINTENANCE MANUAL

WITH

ILLUSTRATED PARTS LIST

FOR

BRAKE ASSEMBLY

PART NO. 5001571 and 5001571-1

PART NO. 5001571-3 and 5001571-4

PART NO. 5001571-6

USED ON

IAI ARAVA 101, 101B, 102, 201 AND

DEHAVILLAND DHC-6

AND

BRAKE ASSEMBLY

PART NO. 5001571-2 AND 5001571-5

USED ON

IAI ARAVA 102, 201 and 202 AIRCRAFT

BASIC ISSUE JUNE 1 1972

AIRCRAFT BRAKING SYSTEMS
Corporation

PUBLICATIONS DEPARTMENT
AKRON, OHIO 44306-4186
CAGE CODE OB9R9

32-43-12 Jan 15/90

COMPONENT MAINTENANCE MANUAL
BRAKE ASSEMBLY 5001571

TEMPORARY REVISION NO. 32–2

TO: HOLDERS OF AP-560 (32-43–12) COMPONENT MAINTENANCE MANUAL WITH ILLUSTRATED PARTS LIST FOR BRAKE ASSEMBLIES 5001571, 5001571–1, 5001571–2, 5001571–3, 5001571–4, 5001571–5 AND 5001571–6 USED ON ARAVA 101, 101B, 102, 201 AND 202 AND DEHAVILLAND DHC–6 AIRCRAFT.

PURPOSE: This Temporary Revision is issued to add rework repair limit for brake housing.

FILING INSTRUCTIONS: Record applicable data on the RECORD OF TEMPORARY REVISIONS sheet in front of the manual. Insert page 1 facing the RECORD OF TEMPORARY REVISIONS.

Retain this Temporary Revision until normal revision service incorporates this information into the Component Maintenance Manual.

This Temporary Revision affects page 603 (32–43–12).

RECORD OF TEMPORARY REVISIONS

TEMPORARY REVISION NUMBER	PAGE NUMBER	ISSUE DATE	BY	DATE REMOVED	BY
32–2	1 and 2	Dec 3/92	ABSC		

(RELEASED: 12/4/92)

COMPONENT MAINTENANCE MANUAL
BRAKE ASSEMBLY 5001571

TO: HOLDERS OF XAP-560 (32-43-12) OVERHAUL MANUAL WITH ILLUSTRATED PARTS LIST FOR BRAKE ASSEMBLY 5001571 USED ON ARAVA 101, 201 AND 202 AIRCRAFT.

Attached to this transmittal letter is Revision No. 4 of XAP-560 (basic issue dated 1 June 1972).

REVISION NO. 4 DATED 15 JANUARY 1990

HIGHLIGHTS

REVISION NO. 4 CONTAINS ALL PAGES OF THE MANUAL. Pages which have been added or revised are outlined below, together with the Highlights of the revision.

Please retain all previous HIGHLIGHTS pages inserting them into this manual for future reference.

Chapter/Section and Page No.	Description of Change
All pages	This manual has been prepared with automated word processing equipment. Shifting of text may have occured. Marking of the shifted text has been eliminated. Marking of text pages reflect only actual changes. This manual has been changed from an Overhaul to a Component Maintenance Manual. Sections have been relocated and pages renumbered accordingly. The technical information has not changed unless specified in the following highlights. Added metric units to all dimensions. Changed IPL figure item references to agree with revised parts list, and numbered by increments of 10. Clarified nomenclature in text to agree with parts list.
Cover	Changed from XAP-560 to AP-560 Component Maintenance Manual and added Brake Assemblies 5001571-3, 5001571-4, 5001571-5 and 5001571-6.
Title Page	Changed to Component Maintenance Manual, added part numbers 5001571-3, 5001571-4, 5001571-5 and 5001571-6 and revision date. Clarified aircraft references incorporating Temporary Revision No. 31-1.
Record of Revisions, page 1/2	Added Revision No. 4 and date.
Record of Temporary Revisions, page 1/2	Added Temporary Revision 32-1.

Chapter/Section and Page No.	Description of Change
Service Bulletin List, page 1/2	Added Service Bulletins ARAVA-101-32-1, ARAVA-101B-32-1, ARAVA-102-32-1, ARAVA-201-32-1, ARAVA-202-32-1, ARAVA-101-32-2, ARAVA-101B-32-2, ARAVA-102-32-2, ARAVA-102-32-3, ARAVA-201-32-2, ARAVA-201-32-3, ARAVA-202-32-2.
List of Effective Pages, pages 1/2	Revised to reflect added, revised and/or deleted pages. Changed sections to ATA 100 format.
Table of Contents, pages 1 and 2	Expanded table for clarification.
Introduction, pages 1 thru 4 32-43-12	Added new Introduction with updated field office address list.
page 1	Revised paragraph 1. to add paragraphs 1.A. through 1.E.
page 2	Revised Figure 1 title and added Brake Assemblies 5001571, 5001571-3, 5001571-4, 5001571-5 and 5001571-6. Revised figure item numbering to agree with revised IPL.
page 3	Revised Key to Figure 1 to agree with renumbered IPL. Added new paragraph 3. Handling Procedures.
page 4	Revised paragraph 4. Leading Particulars and added Brake Assemblies 5001571, 5001571-3, 5001571-4, 5001571-5 and 5001571-6. Revised and expanded paragraph 5. Brake Differences.
page 5/6	Added new paragraph 6., Brake Modification. Renumbered previous paragraph 3. to 7. Brake Lining Wear Check. Revised Figure 2 to add Brake Assemblies 5001571, 5001571-3, 5001571-4 and 5001571-6 to existing Brake Assembly 5001571-1. Added Brake Assembly 5001571-5 to existing Brake Assembly 5001571-2.
page 101	Combined information from previous TESTING AND TROUBLESHOOTING section, revised and incorporated into new TESTING AND FAULT ISOLATION section. Revised entire section.
pages 102 and 103/104	Added Figure 101. Renumbered Figure 801 to 102 and revised.

Chapter/Section and Page No.	Description of Change
pages 301 and 302	Revised and relocated entire DISASSEMBLY section. Revised previous DISASSEMBLY section to expand paragraph 1. General, and revise paragraph 2. Disassembly Procedures.
pages 401 thru 405/406	Revised, relocated and renumbered entire CLEANING section. Deleted paragraph 2. General, from previous CLEANING section, and renumbered paragraph 3. to paragraph 2. Cleaning Procedures. Renumbered previous paragraph 4. to 3. and revised to add Method I Dry-Stripping. Previous Wet Stripping is now Method II. Revised paragraph 1, Cleaning Materials to add Dry Stripping materials.
pages 501 and 502	Revised, relocated and renumbered entire CHECK section. Revised paragraph 1. title to Check Materials. Revised paragraph 2. General to add new paragraphs 2.A. and 2.B. Deleted paragraph 3. Check Procedures. Added new paragraph 3. Brake Disk. Added new paragraph 4. Brake Lining, new paragraph 5. Self-Adjusting Pin Nut and new paragraph 6. Self-Adjusting Pin Grip and Steel Washer.
page 503	Added new paragraphs 7. Preformed Packing, and 8. Retaining Ring and Spring Guide. Added new paragraph 9. Brake Release Spring, paragraph 10. Flat Head Pin and paragraph 11. Piston. Added new paragraph 12. Protective Plug and Inlet Adapter and paragraph 13. Bleeder Valve and Bleeder Valve Adapter.
page 504	Added paragraphs 14. Brake Housing, 15. Bolts and Self-Locking Nuts, 16. Disk Guide Lining and 17. Disk Guide Bracket.
pages 601 thru 610	Revised, relocated and renumbered entire REPAIR section.
page 601	Revised and expanded paragraph 1., Repair Materials.
page 602	Revised paragraph 3. and renumbered. Revised previous paragraph 4. title to Repair of Worn Lining Recesses.
page 603	Renumbered previous Figure 401 to Figure 601 and revised title.
page 604	Incorporated information in previous paragraphs 3.A. thru 3.J. into Key to Figure 601.

Chapter/Section and Page No.	Description of Change
page 605	Numbered previous Lining Recess Figure to Figure 602 Lining Recess Edge Repair Limits. Revised paragraph 5. title to Repair of Flat Head Pin.
page 606	Renumbered previous Figure 402 to 603, Lining Recess Repair.
pages 607 thru 611	Added new paragraph 6. Replacing Disk Guide Lining. Relocated previous paragraph 6. Piston Release Springs to CHECK section. Relocated previous paragraphs 7. and 8. to CHECK section. Renumbered previous paragraph 9. to paragraph 7., Re-Treating and Repainting. Added Method I (Primary) for aluminum topcoat/primer combination. Existing method now Method II (Alternate).
pages 611 and 612	Added new paragraph 8. Modification of Brake Assembly 5001571, 5001571-1, 5001571-3 and 5001571-4 to Brake Assembly 5001571-6. Added paragraph 9., Modification of Brake Assembly 5001571-2 to Brake Assembly 5001571-5, incorporating referenced Service Bulletins.
pages 701 thru 705	Revised ASSEMBLY section to ASSEMBLY AND STORAGE section and relocated. Revised paragraph 1., Assembly and Storage Materials to add Pliobond 5001, hydraulic preservative fluid, Specification MIL-H-6083, Rust Veto 4214, and Naptha or Lead-Free Gasoline. Also added antiseize compound (Lubtork), Specification MIL-T-83483 as prime and changed antiseize compound, Specification MIL-T-5544 to alternate. Revised paragraph 2. to add new paragraphs 2.A. and 2.B. Revised paragraph 3. Assembly Procedures to expand and clarify.
page 702	Added new paragraph 3.B. to install bleeder. Added paragraph 3.C. to install inlet and 3.D. to assemble piston units.
page 703	Added new paragraph 3.E. to install piston units. Added new Figure 701 Preformed Packing Installation.
page 704	Added new paragraph 3.F. to install brake fasteners. Added new paragraph 3.G. to install brake linings.
pages 705 and 706	Added new paragraph 4. Installation of Disk Guide Bracket Subassembly. Added new paragraph 5. Storage Instructions, incorporating information from previous Storage Instructions section.

Chapter/Section and Page No.	Description of Change
page 801	Renumbered previous Figure 601 to 801 Spring Values. Revised figure item numbers to agree with revised parts list. Renumbered previous Figure 602 to 802 Wear Tolerances. Revised figure item numbers to agree with revised parts list.
page 802	Renumbered previous Figure 603 to 803, Torque Values. Revised figure item numbers to agree with revised parts list. Deleted previous Figure 604 Conversion Table Inches/Millimeters and added metrics throughout text.
page 901/902	Added SPECIAL TOOLS, FIXTURES AND EQUIPMENT section.
page 1001	Relocated previous Illustrated Parts List section and revised. Revised paragraph 1. Introduction.
page 1002	Revised IPL Figure 1 to add Brake Assemblies 5001571-3, 5001571-4, 5001571-5 and 5001571-6. Added IPL to precede Figure 1 title and renumbered items in Figure 1 to agree with revised parts list. Added "5001571-6 Shown" to field of illustration.
page 1003	Revised parts list as follows: Item 1-1 - Added new item 1 Brake Assembly 5001571, (Order -3) and effect code A. Item 1A - Renumbered previous item 1-1 to 1A for Brake Assembly 5001571-1 (Order -4) and effect code B. Item 1B - Renumbered previous Figure item 1-1A to 1-1B for Brake Assembly 5001571-2 (Order -5) and effect code C. Item 1C - Added Brake Assembly 5001571-3 (Order -6) and effect code D. Item 1D - Added Brake Assembly 5001571-4 (Order -6) and effect code E. Item 1E - Added Brake Assembly 5001571-5 and effect code F. Item 1F - Added Brake Assembly 5001571-6 and effect code G. Item 10 - Renumbered previous item 2 to 10 for Brake Disk 5001585. Added effect codes BDEG. Item 10A - Renumbered previous item 2A to -10A for Brake Disk 5004272. Added effect codes CF. Item 20 - Renumbered previous item 8 to 20 for Brake Lining 9523331. Added effect code B and *- Not procurable, use until stock depletion. Item 20A - Renumbered previous item 8A to -20A for Brake Lining 5004562. Added *- Not procurable, use until stock depletion. Added effect code C.

Chapter/Section and Page No.	Description of Change
page 1003 (Continued)	Revised parts list as follows: Item 20B - Added new Brake Lining 9523331-1* and effect codes DE. This lining is not procurable, use until stock depletion. Item 20C - Added new Brake Lining 5004562-1 and effect code F. Item 20D - Added new Brake Lining 5008993, and effect code G. Item 30 -Renumbered previous item 7 to 30 for Self-locking Nut 22FH-624. Item 40 - Renumbered previous item 5 to 40 for Plain Washer MS2002-6. Item 50 - Renumbered previous item 4 to 50 for Internal Wrenching Bolt MS20006-61. Item 60 - Renumbered previous item 6 to 60 for Countersunk Washer MS20002C6. Item 70 - Renumbered previous item 30 to 70 for Brake Backing Plate 5001581. Item 70A - Added Brake Backing Plate 5010119. Item 80 - Renumbered previous item 9 to 80 for Self-adjusting Pin Nut 9510894. Item 90 - Renumbered previous item 10 to 90 for Self-adjusting Pin Grip 9510895. Item 100 - Renumbered previous item 11 to 100 for Flat Washer 9523046. Nomenclature was self-adjusting pin washer. Item 110 - Renumbered previous item 12 to 110 and changed nomenclature to Preformed Packing AN6227-5. Added effect codes ABC. Item 110A - Added new Preformed Packing MS28775-010, and added effect codes DEFG. Item 120 - Renumbered previous item 13 to 120 for Backup Ring MS28774-327. Item 130 - Renumbered previous item 14 to 130 and changed nomenclature to Preformed Packing AN6227-30. Added effect codes ABC. Item 130A - Added new preformed packing MS28775-327, and added effect codes DEFG. Item 140 - Renumbered previous item 15 to 140 for Spring Retaining Ring MS16625-3137. Item 150 - Renumbered previous item 16 to 150 for Spring Guide 9524307. Item 160 - Renumbered previous item 17 to 160 for Brake Release Spring 9524304. Item 170 - Renumbered previous item 18 to 170 for Brake Release Spring 9524305.

Chapter/Section and Page No.	Description of Change
page 1003 (Continued)	Revised parts list as follows: Item 180 - Renumbered previous item 19 to 180 and revised nomenclature to Flat Head Pin 9524306. Item 190 - Renumbered previous item 20 to 190 for Piston 5000904. Item 200 - Renumbered previous item 21 to 200 and revised nomenclature to Protective Plug 1604-73. Changed vendor code to (V79555). Item 210 - Renumbered previous item 22 to 210 and revised nomenclature to Preformed Packing MS28778-4. Item 220 - Renumbered previous item 23 to 220 and changed nomenclature to Inlet Adapter 9536102. Item 230 - Renumbered previous item 24 to 230 and changed nomenclature to Preformed Packing MS28778-8. Item 240 - Renumbered previous item 25 to 240 for Bleeder Screw MS35207-260. And added effect codes ABC. Item 240A - Added new item 240A MS35207-259 for bleeder screw. Added effect codes DEF. Item 250 - Renumbered previous item 26 to 250 for Bleeder Washer 511846-4. Item 260 - Renumbered previous item 27 to 260 for Bleeder Valve AN6204-1.
page 1004	Item 270 - Renumbered previous item 28 to 270 for Bleeder Valve. Adapter 9511157. Item 280 - Renumbered previous item 29 to 280 and changed nomenclature to Preformed Packing MS28778-8. Item 290 - Renumbered previous item 3 to 290 for Brake Housing 5001582. Item -300 - Added new Disk Guide Bracket Subassembly 5001607**. Added effect codes ADG. Item -310 - Added new Disk Guide Bracket 5000220. Added effect codes ADG. Item -320 - Added new Disk Guide Lining 5001608. Added effect codes ADG. Item -330 - Added new Tubular Rivet GY16B-12. Added effect codes ADG.
page 1005/1006	Changed vendor code number from 65301 to 79555. Added vendor code 56878.

COMPONENT MAINTENANCE MANUAL
BRAKE ASSEMBLY 5001571

RECORD OF REVISIONS

REV NO.	ISSUE DATE	DATE INSERTED	BY
1	Apr 15/73	Apr 15/73	GTR
2	Oct 15/76	Jun 15/78	GAC
3	Jun 15/78	Jun 15/78	GAC
4	Jan 15/90	Jan 15/90	ABS

REV NO.	ISSUE DATE	DATE INSERTED	BY

COMPONENT MAINTENANCE MANUAL
BRAKE ASSEMBLY 5001571

RECORD OF TEMPORARY REVISIONS

TEMPORARY REVISION NUMBER	PAGE NUMBER	ISSUE DATE	BY	DATE REMOVED	BY
32-1	1 and 2	Feb 15/84	GAC	Jan 15/90	ABS

COMPONENT MAINTENANCE MANUAL
BRAKE ASSEMBLY 5001571

SERVICE BULLETIN LIST

SERVICE BULLETIN NUMBER	REV NO.	DATE INSERTED
ARAVA-101-32-1	1	Jan 15/90
ARAVA-101B-32-1	1	Jan 15/90
ARAVA-102-32-1	1	Jan 15/90
ARAVA-201-32-1	1	Jan 15/90
ARAVA 202-32-1	1	Jan 15/90
ARAVA-101-32-2		Jan 15/90
ARAVA-101B-32-2		Jan 15/90
ARAVA-102-32-2		Jan 15/90
ARAVA-102-32-3		Jan 15/90
ARAVA-201-32-2		Jan 15/90
ARAVA-201-32-3		Jan 15/90
ARAVA-202-32-2		Jan 15/90

SERVICE BULLETIN NUMBER	REV NO.	DATE INSERTED

COMPONENT MAINTENANCE MANUAL
BRAKE ASSEMBLY 5001571

LIST OF EFFECTIVE PAGES

SUBJECT	PAGE	DATE
Title		Jan 15/90
Record of Revisions	1	Jan 15/90
	2	Blank
Record of Temporary Revisions	1	Jan 15/90
	2	Blank
Service Bulletin List	1	Jan 15/90
	2	Blank
List of Effective Pages	1	Jan 15/90
	2	Blank
Table of Contents	1	Jan 15/90
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	3	Jan 15/90
	4	Jan 15/90
Description and Operation	1	Jan 15/90
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	3	Jan 15/90
	4	Jan 15/90
	5	Jan 15/90
	6	Blank
Testing and Fault Isolation	101	Jan 15/90
	102	Jan 15/90
	103	Jan 15/90
	104	Blank
Disassembly	301	Jan 15/90
	302	Jan 15/90
Cleaning	401	Jan 15/90
	402	Jan 15/90
	403	Jan 15/90
	404	Jan 15/90
	405	Jan 15/90
	406	Blank
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	502	Jan 15/90
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Repair	601	Jan 15/90
	602	Jan 15/90
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	706	Jan 15/90
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	802	Jan 15/90
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	902	Blank
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	1006	Blank

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INTRODUCTION

This manual is published in accordance with Air Transport Association Specification No. 100 for the guidance of personnel responsible for the overhaul and/or maintenance of the assembly(ies) covered in this publication. The procedures described in this manual may be altered if better and/or more economical equivalent methods can be employed by the individual facilities. However, the alternate procedures must not lessen the performance or efficiency of operation of the assembly, and all torque and specific limits or values contained herein must be strictly observed.

All dimensions and other values are expressed in U.S. units followed, where applicable, by the appropriate SI (International System) metric units in parentheses. All illustration dimensions are in inches with millimeter conversions in parentheses unless otherwise specified. Dimensions of standard tools or parts such as drills, taps, bolts, nuts, etc. where there are no equivalent metric tools or parts for the application, appear in U.S. units. Illustrations are for reference only and are not drawn to scale. Attempt is made to illustrate relationship to adjoining parts in proper proportion.

The following precautions apply to all procedures in this manual:

NOTICE

Any alteration to or substitution of any part contained in any wheel and/or brake affecting those assemblies could result in unit malfunction, or other adverse effects.

If alteration to or substitution of any part contained in any Aircraft Braking Systems' wheel and/or brake affecting those assemblies is necessary, obtain prior written Aircraft Braking Systems' authorization and instruction before performing such alteration or substitution.

AIRCRAFT BRAKING SYSTEMS ASSUMES NO LIABILITY WHATSOEVER, WHETHER CONTRACTURAL, WARRANTY, TORT OR OTHERWISE, FOR ANY UNAUTHORIZED SUBSTITUTION OF OR ALTERATION TO ANY PART CONTAINED IN ANY WHEEL AND/OR BRAKE OR FOR ANY ALTERATION NOT PERFORMED IN ACCORDANCE WITH AIRCRAFT BRAKING SYSTEMS APPROVED PROCEDURES.

While Aircraft Braking Systems represents the information contained in this manual was current at the time of publication of this issue, and verified by comparison to engineering documentation, the user is cautioned that he must inquire of the nearest authorized distributor or dealer of Aircraft Braking Systems' wheels and brakes as to whether a more recent publication is in existence before proceeding with overhaul or maintenance operations. If you cannot locate a dealer or distributor, make your inquiry directly to our Customer Support Department, Aircraft Braking Systems, 1204 Massillon Road, Akron, Ohio 44306-4186.

Users outside the United States and Canada should contact the nearest Aircraft Braking Systems International Field office as listed in this manual or the closest Aircraft Braking Systems' distributor.

The aircraft maintenance manual shall take precedence for the component's interface connections with the functional features as used in the aircraft. This manual may also describe functional features that may or may not be used when installed as a component of a system in the aircraft.

TSO NOTICE

This assembly for commercial transport usage carries a "TSO" marking which identifies it as having been fully laboratory tested and qualified to the applicable Federal Aviation Administration (FAA) regulations. As a commercial transport category assembly, it is also tested and qualified to the specification requirements of the applicable airframe manufacturer and, finally, is certified on the applicable aircraft.

After final certification, any substitution of or alteration to any part and/or any change of process or material is not permitted without complete requalification of this assembly and resubmittal of the test data to the FAA for approval.

The FAA regulations subject Aircraft Braking Systems, the airframe manufacturer and the operator to constant surveillance to assure that proper Quality Assurance material and processing controls are maintained in order to provide replacement parts that are the same quality as the parts originally certified in this assembly.

SAFETY SUMMARY

Adhere to all manufacturer's Warnings and Cautions for all materials specified in this manual. Wear protective clothing (gloves, apron, etc.) approved for the materials and tools being used.

ON-CONDITION MAINTENANCE

Individual operators shall determine the frequency of maintenance. Since each operator has a different set of operating conditions, overhaul frequency will vary. Aircraft Braking Systems recommends that on-condition maintenance be performed.

World Airlines Technical Operations Glossary (WATOG) defines on-condition maintenance as follows:

A primary maintenance process having repetitive inspections or tests to determine the condition of units, systems or portions of structure with regard to continued serviceability (corrective action is taken when required by item condition).

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DESCRIPTION AND OPERATION

1. Description (Ref. Fig. 1)

A. The single disk brake assembly is used on the main landing gear of the aircraft. The brake disk contains gear teeth at its perimeter for mating with a wheel assembly containing a gear tooth drive ring. Two interchangeable inlet ports are provided on the brake housing. Only one port is used as an inlet (depending on installation position on landing gear), and the other is used as a bleeder port.

B. The brake assembly contains four pistons. Incorporated in each of the four pistons is an automatic adjustment mechanism which controls the clearance between disk and linings when the brake is in the off position, ensuring constant clearance during the life of the linings.

C. The brake pistons are sealed by means of preformed packings compounded for the type of brake fluid used in the brake system.

D. The brake housing is secured to axle torque flange by five bolts.

E. At operator's option, on Brake Assemblies 5001571, 5001571-3 and 5001571-6, an outer disk guide subassembly is available, but is not furnished unless ordered separately.

2. Operation

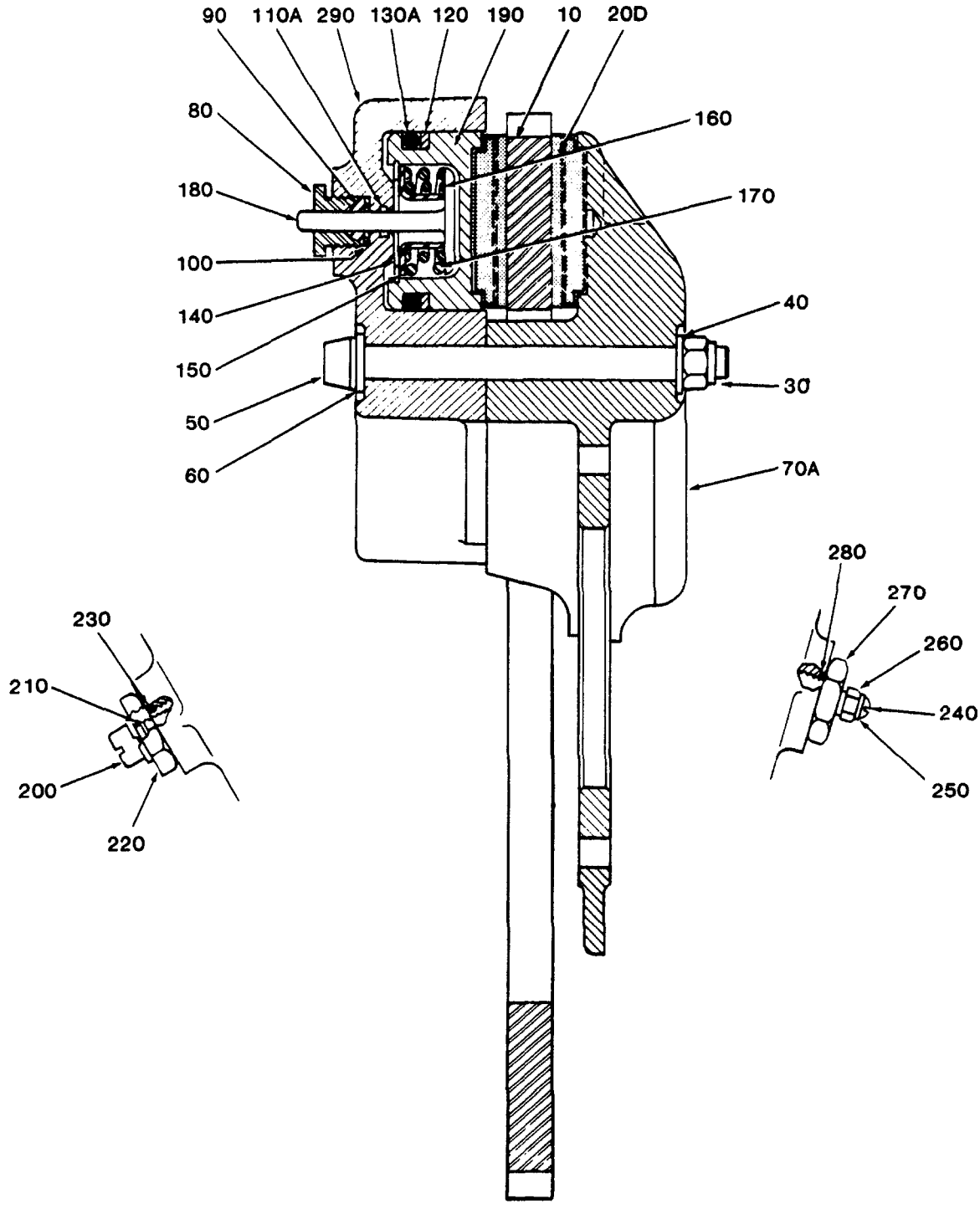
A. Single disk brakes operate on the principle of two opposed sections of brake lining separated by an annular disk, which is engaged to rotate with the aircraft wheel. To provide braking action, the linings are pressed against the disk by hydraulic pressure applied against the brake piston.

B. The brake linings are contained in recesses in the piston and backing plate section of the brake housing. A throat or groove is provided in the housing for the annular disk to pass through as the wheel rotates.

C. The disk floats on the wheel internal drive ring. This floating action compensates for the movement of the disk when braking pressure is applied. Only the piston side brake lining moves toward the disk, while the backing plate lining remains stationary. As the piston lining presses it, the disk moves until it contacts the backing plate lining. The disk then receives equal clamping action on both sides as pressure is increased. Optional disk guides may be installed on Brake Assemblies 5001571, 5001571-3 and 5001571-6 to minimize sideway movement and cocking of the brake disk.

D. The single disk brake is used with a wheel having an aluminum gear tooth drive ring riveted to the drive flange. When rotation of the disk is restrained by the brake unit, the torque forces are transmitted to the wheel through the drive ring.

E. Each brake contains an automatic adjustment mechanism which maintains a constant disk-to-lining clearance throughout the life of the lining, thereby ensuring a drag-free brake.



Brake Assemblies 5001571, 5001571-1, 5001571-2, 5001571-3,
5001571-4, 5001571-5 and 5001571-6
Figure 1

Key to Figure 1

-1.	RF	140.	Spring Retaining Ring
10.	Brake Disk	150.	Spring Guide
-10A.	Brake Disk	160.	Brake Release Spring
20.	Brake Lining	170.	Brake Release Spring
-20A.	Brake Lining	180.	Flat Head Pin
20B.	Brake Lining	190.	Piston
20C.	Brake Lining	200.	Protective Plug
20D.	Brake Lining	210.	Preformed Packing
30.	Self-Locking Nut	220.	Inlet Adapter
40.	Plain Washer	230.	Preformed Packing
50.	Internal Wrenching Bolt	240.	Bleeder Screw
60.	Countersunk Washer	240A.	Bleeder Screw
70.	Brake Backing Plate	250.	Bleeder Washer
-70A.	Brake Backing Plate	260.	Bleeder Valve
80.	Self-adjusting Pin Nut	270.	Bleeder Valve Adapter
90.	Self-adjusting Pin Grip	280.	Preformed Packing
100.	Flat Washer	290.	Brake Housing
110.	Preformed Packing	-300.	Disk Guide Bracket Subassembly
120.	Backup Ring	-310.	Disk Guide Bracket
130.	Preformed Packing	-320.	Disk Guide Lining
		-330.	Tubular Rivet

- Item not illustrated.

3. Handling Procedures

A. Careful handling of the brake components will assure a long service life and trouble-free operation.

B. Strictly observe torque and Lubtork values specified in this manual. Do not overtighten any bolt, nut or fitting.

C. Handle the brake parts with extreme care. Many failures can be traced to dropping or mishandling the parts during maintenance.

D. The brake should be properly maintained to protect the paint and surface finishes, as exposed surfaces are susceptible to corrosion. Nicks, scratches, and other damage caused by improper handling of the brake during maintenance invite corrosion, which if unattended will eventually lead to fatigue cracks and premature removal from service.

4. Leading Particulars

Weight (approximate)
for 5001571, 5001571-3 . . . . . 21.2 pounds (9,6 kg)
Weight (approximate)
for 5001571-1, 5001571-4 . . . . . 22.3 pounds (10,1 kg)
Weight (approximate)
for 5001571-2, 5001571-5 . . . . . 23.8 pounds (10,8 kg)
Weight (approximate)
for 5001571-6 . . . . . 25.1 pounds (11,4 kg)
Hydraulic Fluid . . . . . Specification MIL-H-5606

Operating Pressure
Brake Assembly 5001571,-1,-3, -4, -5 and -6 . . . . . 700 psi (48,3 bars)
Brake Assembly 5001571-2 . . . . . 900 psi (62,1 bars)

Back Pressure . . . . . 40 psi (2,8 bars)

Operating Clearance . . . . . 0.028 inch (0,71 mm) (minimum)
. . . . . 0.50 inch (1,27 mm) (maximum)
Material:
Brake Housing . . . . . Cast Magnesium Alloy
Brake Backing Plate . . . . . Cast Magnesium Alloy
Pistons . . . . . Cast Magnesium Alloy

Brake Disk Material . . . . . Forged Steel

5. Brake Differences

A. Brake Assemblies 5001571 and 5001571-1 differ only in the disk guide bracket subassembly. Brake Assembly 5001571 uses a disk guide bracket subassembly.

B. Brake Assemblies 5001571-1 and 5001571-2 differ only in the brake disk and linings. Brake Assemblies 5001571-1 and 5001571-2 are superceded by Brake Assemblies 5001571-4 and 5001571-5 respectively.

C. Brake Assemblies 5001571-3 and 5001571-4 are identical except that a disk guide bracket subassembly is available to be installed on Brake Assemblies 5001571-3 and 5001571-6. Disk guide bracket subassembly is optional and not furnished with the brake. Brake Assemblies 5001571-3 and 5001571-4 are superceded by Brake Assembly 5001571-6.

D. Brake Assemblies 5001571-5 and 5001571-6 differ only in the brake disk and linings.

6. Brake Modification

A. Modification is provided in REPAIR to convert Brake Assemblies 5001571, 5001571-1, 5001571-3 and 5001571-4 to Brake Assembly 5001571-6.

7. Brake Lining Wear Check

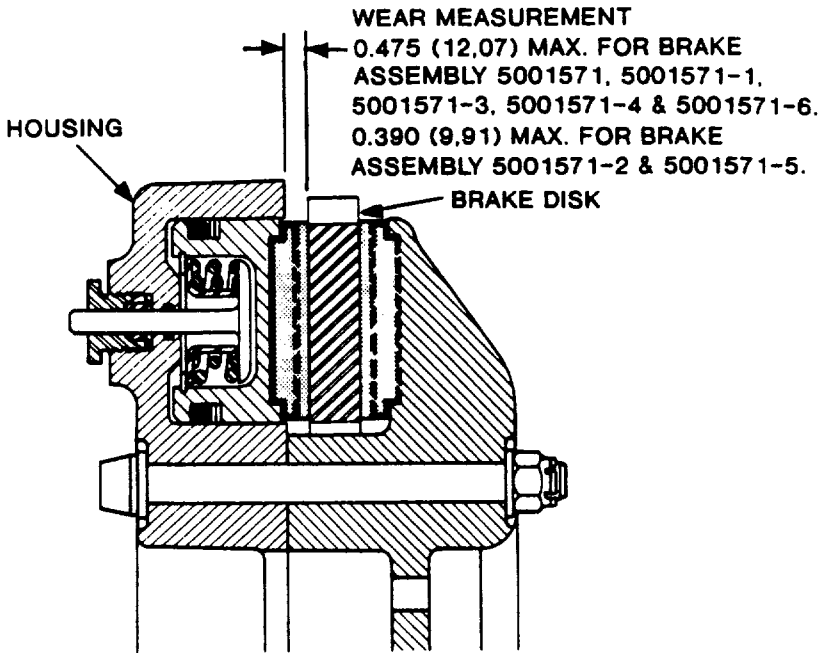
A. Check brake linings while the brake is on the aircraft as follows:

(1) Apply brakes and hold.

B. Measure the distance from the flat of the brake housing (parallel to the disk) to the surface of the brake disk as shown in Figure 2, at bleeder or inlet port.

CAUTION: NEVER MIX NEW AND USED BRAKE LININGS. IF NECESSARY TO REUSE WORN LININGS, REINSTALL THEM IN THEIR ORIGINAL POSITION.

C. When this dimension reaches 0.475 inch (12,07 mm) or more, for Brake Assemblies 5001571, 5001571-1, 5001571-3, 5001571-4 and 5001571-6, and 0.390 inch (9,91 mm) or more for Brake Assemblies 5001571-2 and 5001571-5, the brake linings should be replaced.



Brake Wear Measurement
Figure 2

TESTING AND FAULT ISOLATION

1. Test Equipment and Materials

NOTE: Equivalent substitutes may be used for items listed.

Hydraulic Test Stand Supplies 0 to 3,000 psi (206,84 bars) pressure gaged to read output pressure to 5 psi (0,345 bars) increments	Commercially available
Hydraulic Fluid (Red Oil) Specification MIL-H-5606	Commercially available

2. Test Setup

A. None required.

3. Operational Test and Fault Isolation Procedures

CAUTION: HYDRAULIC TEST STAND MUST CONTAIN RED OIL TO SPECIFICATION MIL-H-5606.

A. Connect brake assembly to a hydraulic test stand capable of applying 700 psi (48,3 bars) hydraulic pressure to brake.

(1) Use brake disk (10 or 10A) or a spacer of equal thickness between brake linings (20B, 20C or 20D)

B. Place brake in upright position with disk (10 or 10A) in place between linings.

(1) Apply pressure and bleed brake.

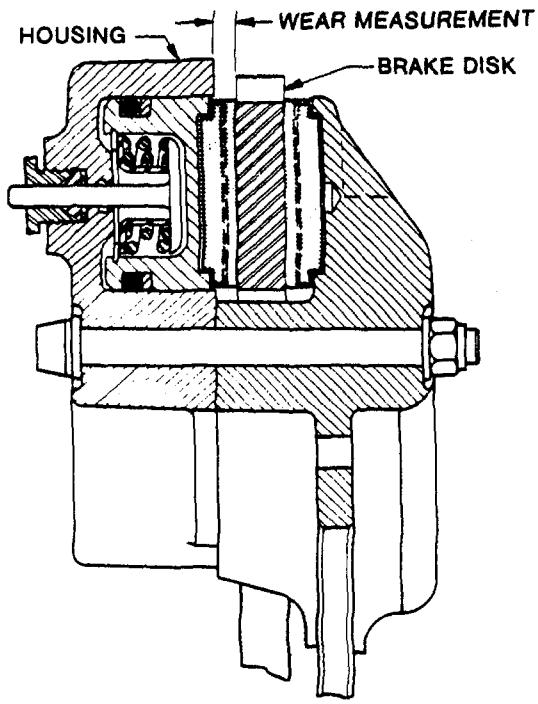
(2) Apply 5 psi (0,345 bars) hydraulic pressure at inlet for five minutes. There shall be no measurable leakage.

(3) Apply 700 psi (48,3 bars) hydraulic pressure at inlet for five minutes. There shall be no measurable leakage.

C. Apply and hold pressure for brake lining wear check.

(1) Measure the distance from the flat of the brake housing (parallel to disk) to the surface of the brake disk at inlet or bleeder port as shown in Figure 101.

(2) When this dimension reaches 0.475 inch (12,07 mm) or more, for Brake Assemblies 5001571, 5001571-1, 5001571-3, 500571-4 and 5001571-6, and 0.390 inch (9,91 mm) or more for Brake Assemblies 5001571-2 and 5001571-5, the brake linings should be replaced.



Brake Wear Measurement
Figure 101

D. *Adjusting pin slippage test.*

(1) Remove disk (10 or 10A) or spacer from brake assembly.

(2) Fully retract pistons and apply 50 psi (3,45 bars) hydraulic pressure.

(3) After the piston has advanced the amount permitted by the built-in clearance, hold this pressure for 15 seconds. If the required hydraulic pressure is held and there is no further movement of the piston, the pin grip *holding force is satisfactory.*

NOTE: If pin slippage occurs, the brake shall be rejected and the pin and grip combination replaced.

(4) Reinstall disk (10 or 10A) or spacer in brake assembly between linings.

E. Apply 700 psi (48,3 bars) pressure and then release brake checking for proper brake release. Repeat three times. The disk (10 or 10A) should be free to rotate when the brake pressure is released. The hydraulic back pressure should not be greater than 40 psi (2,76 bars).

F. Apply 700 psi (48,3 bars) pressure and release pressure to 40 psi (2,76 bars); then check brake clearance. The brake clearance measured between the lining (20B, 20C or 20D) and disk (10 or 10A) should be 0.028 to 0.050 inch (0,71 to 1,27 mm). The hydraulic back pressure should not be greater than 40 psi (2,76 bars).

4. Fault Isolation Procedures

A. Fault isolate in accordance with Figure 102.

Trouble	Probable Cause	Correction
Hydraulic fluid leaking from brake	Defective hydraulic connection	Tighten connection or replace fitting.
	Defective preformed packing	Replace preformed packing.
	Piston worn or damaged	Replace piston and/or housing.
Brake not engaging correctly	Air in brake	Bleed brake.
	Brake lining worn out	Overhaul brake.
	Obstruction in hydraulic line or fluid passage	Remove obstruction.
	Pistons sticking	Replace piston preformed packings.
	Pistons damaged	Replace pistons.
	Disk gear defective and disk not moving freely in wheel when brake pressure is released	Replace disk.
Brake not releasing correctly	Obstruction in hydraulic line or fluid passage	Remove obstruction.
	Piston sticking	Replace piston preformed packings.
	Pistons damaged	Replace pistons.
	Disk not releasing when brake pressure is released	Replace pin grip and torque pin nut to manual specification.

DISASSEMBLY

1. General (Ref. IPL Fig. 1)

   NOTE: See TESTING AND FAULT ISOLATION for operational and test and fault isolation procedures to establish condition of unit and determine extent of disassembly required.

   A. Prior to dismounting and disassembling brake, check lining for wear in accordance with the DESCRIPTION AND OPERATION section.

   B. Disassemble the brake assembly in accordance with the following instructions.

2. Disassembly Procedures

   A. Position brake assembly on a clean work surface.

   B. Remove brake disk (10 or 10A) from brake.

   C. Remove brake linings (20B, 20C or 20D).

      (1) If it is necessary to reuse linings, the linings should be replaced in the same position.

   D. Remove self-locking nuts (30), washers (40 and 60) and internal wrenching bolts (50), releasing brake backing plate (70 or 70A).

   E. Cut and remove lockwire from self-adjusting pin nuts (80) and remove nuts.

   F. Remove self-adjusting pin grips (90), flat washers (100) and preformed packings (110 or 110A) from each cylinder head on the brake housing (290).

   G. Remove pistons (190) from brake housing (290).

   H. Remove backup ring (120) and preformed packing (130 or 130A) from each piston (190).

   I. Remove flat head pin (180) from each piston (190) as follows:

      (1) Place piston in arbor press. Compress spring guide (150) and hold.

      (2) Remove spring retaining ring (140) with Truarc (or equivalent) pliers.

      (3) Carefully release arbor press and remove spring guide (150), brake release springs (160 and 170) and flat head pin (180) from piston.

   J. Remove protective plug (200), if installed, and preformed packing (210).

K. Remove inlet adapter (220) and preformed packing (230) from brake housing (290).

L. Complete the disassembly by removing bleeder screw (240 or 240A), bleeder washer (250), bleeder valve (260), bleeder valve adapter (270) and preformed packing (280) from brake housing (290).

CLEANING

1. Cleaning Materials

NOTE: Equivalent substitutes may be used for items listed.

Dry-Cleaning Solution Specification P-D-680 Type I, Stoddard Solvent Type II, 140°F Solvent	Commercially available
Isopropyl Alcohol Specification TT-I-735	Commercially available
Soft Lint-free Cloth	Commercially available
Soft Bristle Brush	Commercially available
Polyplus Plastic Media Screen Size 20/40 (Primary)	Inventive Machine Corporation (I.M.C.) P.O. Box 369 Bolivar, OH 44612
Plastic Reclaimable Abrasive Machine (PRAM)	See SPECIAL TOOLS, FIXTURES AND EQUIPMENT section.
Plastic Media (Dry Stripping Abrasive)	U.S. Technology Corporation A Subsidiary of U.S. Plastic and Chemical Corporation 328 Kennedy Drive Putnam, CT 06260
Paint Removing Solvent (Alternate) Specification MIL-C-19853	Turco Products Division of Purex Corporation 24600 South Main Street P.O. Box 6200 Carson, CA 90749

2. Cleaning Procedures (Ref. IPL Fig. 1)

WARNING: CLEANING SOLVENTS ARE TOXIC AND VOLATILE. USE ONLY IN WELL-VENTILATED AREAS. AVOID PHYSICAL CONTACT WITH SOLVENT AND DO NOT INHALE VAPORS.

CAUTION: A THOROUGH CLEANING OR IMMERSION OF BRAKES MAY CAUSE ENTRAPMENT OF SOLVENT IN PASSAGE HOLES.

A. Clean all metal parts with dry-cleaning solvent, Specification P-D-680. Use a soft bristle brush when necessary.

B. Dry all metal parts thoroughly after cleaning, using filtered and dried compressed air.

NOTE: Ensure foreign materials have been removed from all cavities, threaded holes, pockets and other areas where entrapment might occur.

C. Clean all preformed packings with isopropyl alcohol, Specification TT-I-735. Dry with a clean, soft cloth.

NOTE: It is recommended new preformed packings be installed at each brake overhaul.

D. Brake disks (10 or 10A) may be cleaned with the aid of compressed air and a soft wire or bristle brush.

E. Clean brake linings (20B, 20C or 20D) by brushing with a soft bristle brush.

3. Paint Removal Procedures

A. Strip brake housing as follows - Method I (Dry Stripping).

WARNING: THE DRY STRIPPING PROCESS IS OPERATOR-SENSITIVE AND ONLY AN EXPERIENCED, TRAINED OPERATOR SHOULD BE PERMITTED TO PERFORM THE PAINT REMOVAL OPERATION IN ACCORDANCE WITH EQUIPMENT MANUFACTURER'S RECOMMENDATIONS.

NOTE: This procedure covers general information of dry stripping process of pneumatic blast removal of paint utilizing ground plastic particles. The procedure provides suggested control parameters to safely and effectively remove paint from aircraft component parts using the dry stripping process.

Paint must be stripped from parts before inspecting by Zyglo, dye penetrant or eddy-current methods; otherwise, inaccurate readings will result.

(1) Completely disassemble the part to be stripped. Remove all parts from brake housing in accordance with DISASSEMBLY.

(2) Clean the part to be stripped per Cleaning Procedures.

(3) Plug and seal off any threaded holes and piston cavities as required.

(4) Remove paint using the dry stripping procedure in accordance with Figure 401 as follows:

(a) The media dry stripping abrasive is effective only when used with the appropriate equipment. Depending on operator requirements, it is advised that the operator check with these (or other suitable) *manufacturers for advice and application information concerning their* particular equipment.

(b) Refer to Cleaning Materials for recommended dry stripping abrasive and equipment.

CAUTION: FLUSH MEDIA FROM CAVITIES, THREADED HOLES, POCKETS AND OTHER AREAS WHERE ENTRAPMENT MIGHT OCCUR.

(5) Remove part from solvent and rinse thoroughly, two times, with water heated to a temperature of 160° to 180°F (71° to 82°C).

(6) Dry the part thoroughly with filtered and dried compressed air.

NOTE: After paint stripping, the parts must be re-treated and repainted in accordance with instructions in REPAIR.

B. Strip brake housing as follows - Method II (Wet Stripping).

WARNING: PAINT REMOVAL SOLVENTS ARE TOXIC AND VOLATILE. USE ONLY IN WELL-VENTILATED AREAS. AVOID PHYSICAL CONTACT WITH SOLVENT AND DO NOT INHALE VAPORS.

NOTE: Paint must be stripped from brake assembly before inspecting by Zyglo, dye penetant or eddy-current methods; otherwise, inaccurate readings will result.

(1) Completely disassemble the part to be cleaned to prevent solvent from being entrapped between mating surfaces. Remove all parts from brake housing in accordance with DISASSEMBLY.

(2) Clean the part to be stripped in accordance with Cleaning Procedures.

CAUTION: PARTS MUST BE COMPLETELY IMMERSED IN SOLVENT. CONTACT WITH WATER BLANKET DURING IMMERSION WILL CAUSE SEVERE CORROSION OF THE PART.

(3) Immerse part in paint removing solvent, Specification MIL-C-19853, for a period of 30 minutes to two hours. Immersion time depends upon condition of paint. Carefully follow the manufacturer's instructions for the particular solvent being used.

NOZZLE TYPE/SIZE	NOZZLE PRESSURE	NOZZLE DISTANCE	MEDIA TYPE	ANGLE OF APPROACH
1 BMLV-8 1/2 inch 4 (12,7 mm)	45 - 55 PSI (3,10-3,79 bars) 3	36 - 48 inch (914-1219 mm)	POLYPLUS 20/40	45 - 75°
2 VENTURI 5/16 inch 4 (7,94 mm)	UNDER 30 PSI (2,07 bars) 3	6 - 8 inch (152,4-203,2 mm)	POLYPLUS 20/40	45 - 75°

PHYSICAL REQUIREMENTS OF MEDIA

	POLYEXTRA	POLYPLUS
HARDNESS (MOH SCALE)	3.0 ± .25	3.5 ± .25
SPECIFIC GRAVITY (GMS/CC)	1.15 ± 10%	1.50 ± 10%

NOTES:

1. STAND-OFF, OPEN BLASTING.
2. CLOSED-CYCLE BLASTING (PERFORMED IN PRESSURE BLAST EQUIPMENT CHAMBER).
3. PRESSURE READINGS MUST BE TAKEN AT THE NOZZLE RATHER THAN ESTIMATED FROM REGULATOR GAGE READINGS. RECHECK PRESSURE EVERY FOUR HOURS AND EACH TIME PRESSURE IS CHANGED AT REGULATOR.
4. PROCESS VARIABLES INCLUDE PRESSURE, DISTANCE FROM NOZZLE TO WORK PIECE, ANGLE OF ATTACK AND NOZZLE SIZE. PARAMETERS SELECTED WILL VARY WITH PAINT COATING AGE, TYPE AND NUMBER OF COATINGS, BUT THE FOLLOWING PARAMETERS HAVE SUCCESSFULLY REMOVED VARIOUS COATING TYPES WITH NO EFFECT ON SUBSTRATE.
5. RECOMMENDED PLASTIC MEDIA TYPE AND SIZE IS POLYPLUS 20/40. POLYEXTRA 12/20 OR 20/30 PRODUCES A SMOOTHER FINISH BUT PAINT REMOVAL RATE IS LOWER. TYPE III PLASTIC MEDIA TYPE IS NOT TO BE USED ON THE SUBJECT AIRCRAFT COMPONENTS.

Recommended Dry Stripping Variables
Figure 401

CAUTION: FLUSH SOLVENT FROM CAVITIES, THREADED HOLES, POCKETS AND OTHER AREAS WHERE ENTRAPMENT MIGHT OCCUR.

(4) Remove part from solvent and rinse thoroughly in water heated to a temperature of 160° to 180°F (71° to 82°C).

(5) Dry the part thoroughly with filtered and dried compressed air.

NOTE: After paint stripping, the part must be re-treated and repainted in accordance with instructions in REPAIR.

CHECK

1. Check Materials

NOTE: Equivalent substitutes may be used for items listed.

Type	Penetrant	Developer	Supplier
Fluorescent	Zyglo ZL-16	Zyglo ZP-13 (wet) optional	Magnaflux Corporation 7330 West Lawrence Street Chicago, IL 60656
	Penetrex ZL-2A with emulsifier ZE-4	Penetrex ZP-4 (dry) or ZP-13 optional	
Red Dye	Spot Check	Spot Check	
	Dy-Chek	Dy-Chek	Turco Products Division of Purex Corporation P.O. Box 6200 24600 South Main Street Carson, CA 90749
	Met-L-Chek	Met-L-Chek	Met-L-Chek 1639 Euclid Street Santa Monica, CA 90404

2. General (Ref. IPL Fig. 1)

A. Check all components of the brake assembly for wear, cracks, corrosion, structural damage, distortion and thread damage. Replace all parts that show evidence of cracks, excessive wear, severe corrosion and structural and thread damage. Repair minor scratches and corrosion.

B. Perform the specific checks listed referring to REPAIR for appropriate repair procedures.

3. Brake Disk (10 or 10A)

A. Check brake disk (10 or 10A) as follows.

(1) Measure thickness of disk.

(a) Brake disks (10) that are worn to a thickness of 0.490 inch (12,45 mm) or less must be replaced.

(b) Brake disks (10A) that are worn to a thickness of 0.586 inch (14,88 mm) or less must be replaced.

(2) Check disk for warpage. Disks that have warped or dished to the extent they cause brake drag can be surface ground and reused if they exceed the minimum thickness of 0.490 inch (12,45 mm) for disk (10) and 0.586 inch (14,88 mm) for disk (10A) after grinding.

NOTE: It is recommended the disk be reversed in the brake housing at each tire change to minimize dishing.

(3) Measure outside diameter of disks. Replace disks which have shrunk to an outside diameter of 13.025 inches (330,83 mm) or less.

(4) Check disk for heat checks. Disks containing heat checks of less than 1.25 inches (31,75 mm) in length that do not extend to within 0.25 inch (6,35 mm) of the inside or outside diameter edge can be continued in service. Check disks with such heat checks at time of each lining change.

4. Brake Lining (20B, 20C or 20D)

CAUTION: NEVER MIX NEW AND USED BRAKE LININGS. IF NECESSARY TO REUSE WORN LININGS, INSTALL THEM IN THEIR ORIGINAL POSITION.

A. Measure thickness of brake linings at center of lining.

(1) Replace linings (20B or 20D) if worn to a thickness of 0.220 inch (5,58 mm) or less. On anvil side, if one lining requires replacement, always replace all four linings.

(2) Replace linings (20C) if worn to a thickness of 0.200 inch (5,08 mm) or less. On anvil side, if one lining requires replacement always replace all four linings.

B. Replace linings when the lining cup is found to be deformed and out of round.

NOTE: The lining cup is designed to wear away with lining.

5. Self-Adjusting Pin Nut (80)

A. Check self-adjusting pin nut for stripped threads or other damage and distortion. Replace damaged parts.

6. Self-Adjusting Pin Grip (90) and Steel Washer (100)

A. Check for damage and distortion. Replace any unserviceable parts.

7. Preformed Packing (110A, 130A, 210, 230, 250 and 280)

   A. Check preformed packings for distortion and wear. It is recommended all gaskets and packings be replaced at each overhaul.

8. Retaining Ring (140) and Spring Guide (150)

   A. Check retaining ring and spring guide for structural damage, corrosion and distortion. Replace any damaged parts.

9. Brake Release Spring (160 and 170)

   A. Check brake release springs as follows:

      (1) Measure force required to compress springs.

      (2) Replace brake release spring (160) when compression force is less than 60 pounds (267 N) at a height of 0.538 inch (13,66 mm).

      (3) Replace brake release spring (170) when compression force is less than 115 pounds (512 N) at a height of 0.538 inch (13,66 mm).

10. Flat Head Pin (180)

   A. Check flat head pins (180) for nicks, rough spots, distortion or damage which might injure preformed packing. Depressions of 0.003 inch (0,076 mm) deep and 0.060 inch (1,52 mm) in length or less are acceptable. However, raised metal from such nicks should be removed by polishing. If grip holding surfaces of pins are tapered or reduced in diameter more than 0.0005 inch (0,013 mm) in the operating length, the pins should be replaced.

   B. If grip holding surfaces of pins are reduced in diameter in the operating length to 0.245 inch (6,22 mm) or less, the pins should be replaced.

11. Piston (190)

   A. Check contacting surfaces of pistons for wear or scratches which might injure preformed packing and cause leaks. Measure piston diameter at three different places. If piston is worn to a diameter of 2.112 inches (53,64 mm) or less, replace piston.

12. Protective Plug (200) and Inlet Adapter (220)

   A. Check protective plug and inlet adapter for stripped threads or other damage. Replace if damaged.

13. Bleeder Valve (260) and Bleeder Valve Adapter (270)

   A. Check bleeder valve and valve adapter for stripped threads or other damage. Replace damaged parts.

14. Brake Housing (290)

A. Check brake housing for cracks using a dye-penetrant method. Replace housing if cracked.

NOTE: Pay particular attention to housing throat section.

B. Visually check housing for corrosion and scratches. Blend out minor corrosion and scratches. See REPAIR.

C. Check cylinder wall for damage to threads and packing seat. See REPAIR.

D. Check lining recesses in the anvil section of the brake housing for wear and damage. See REPAIR.

15. Bolts (50) and Self-Locking Nuts (30)

A. Check all bolts and nuts for stripped threads. Replace all bolts and nuts that have stripped or damaged threads.

B. Magnetic-particle check bolts (50) for cracks, particularly under head and in threads adjacent to shank. Replace all cracked bolts.

C. Measure torque required to turn self-locking nuts on bolts to check self-locking feature.

(1) Replace self-locking nuts when torque value is less than 9.5 pound-inches (1,1 N-m).

16. Disk Guide Lining (320)

A. Check disk guide linings for wear if installed. Replace disk guide lining when thickness reaches 0.140 inch (3,56 mm) or less.

17. Disk Guide Bracket (310)

A. Check disk guide bracket for distortion or damage. Replace damaged parts.

REPAIR

1. Repair Materials

NOTE: Equivalent substitutes may be used for items listed.

Surface Treat Solution Specification MIL-M-3171, Type VI	Commercially available
Methyl Isobutyl Ketone (MIBK) Specification TT-M-268	Commercially available
Zinc Chromate Primer Specification TT-P-1757	Commercially available
Aluminum Lacquer Specification TT-L-32	Commercially available
Aluminum Topcoat/Primer Combination (FA-10242) Aeroprite	Contact your local distributor of aviation products and supplies.
Aeroprite Reducer TH-89	Contact your local distributor of aviation products and supplies.
Aluminum Oxide Cloth (320 to 420 grit, wet or dry)	Commercially available
Wash Primer Specification MIL-C-8514	Commercially available
Butyl Alcohol Thinner Specification TT-B-846	Commercially available
Ethyl Alcohol Thinner Specification O-E-760, Type III	Commercially available

2. General (Ref. IPL Fig. 1)

A. Repair of the brake assembly is limited to the replacement of worn or damaged parts and to the specific repairs listed in this section. Replace all cracked parts. No attempt should be made to repair cracked, severely corroded or badly damaged parts. Components that cannot be repaired within the limits defined in this section should be replaced.

3. Repair of Brake Housing (290) and Brake Backing Plate (70 or 70A)

CAUTION: REMOVAL OF CORROSION AND SURFACE DAMAGE WILL PREVENT STRESS CONCENTRATIONS. HOWEVER, ANY REMOVAL OF MATERIAL WILL SHORTEN THE LIFE OF THE BRAKE HOUSING. THEREFORE, IT IS RECOMMENDED THAT MATERIAL REMOVED BY BLENDING BE LIMITED TO THE MINIMUM REQUIRED FOR REMOVING CORROSION OR SURFACE DAMAGE.

A. Remove corrosion, scratches, nicks and abrasions with aluminum oxide cloth. Remove all corrosion and surface damage on the brake housing according to limits defined in Figure 601. Blend out any damage that might become a source of corrosion or stress cracks. Remove any corrosion from threads with a soft wire brush.

NOTE: Since removal of metal in Areas 1, 2, and 6 can shorten the ultimate life of the part, it is recommended that removal in these areas be kept to a minimum.

B. Thoroughly clean surface. Treat and repaint reworked areas of housing in accordance with Re-Treating and Repainting.

C. If piston cavity is worn or damage exists beyond the 2.136 inch (54,25 mm) inside diameter, replace brake housing.

D. If lining recess is worn or damage exceeds limits as shown in Figure 602, repair lining recesses as follows.

4. Repair of Worn Lining Recesses

A. If damage on one side of lining recess is beyond the limits of 0.062 inch (1,57 mm) deep and 0.145 inch (3,7 mm) wide, rework as follows:

B. Fabricate ring from No. 1117 Steel Bar, Federal Specification QQ-S-633, as shown in Figure 603. Cadmium plate (Federal Specification QQ-P-416, Type II, Class 3) to 0.0002 inch (0,0051 mm) maximum to 0.0003 inch (0,0076).

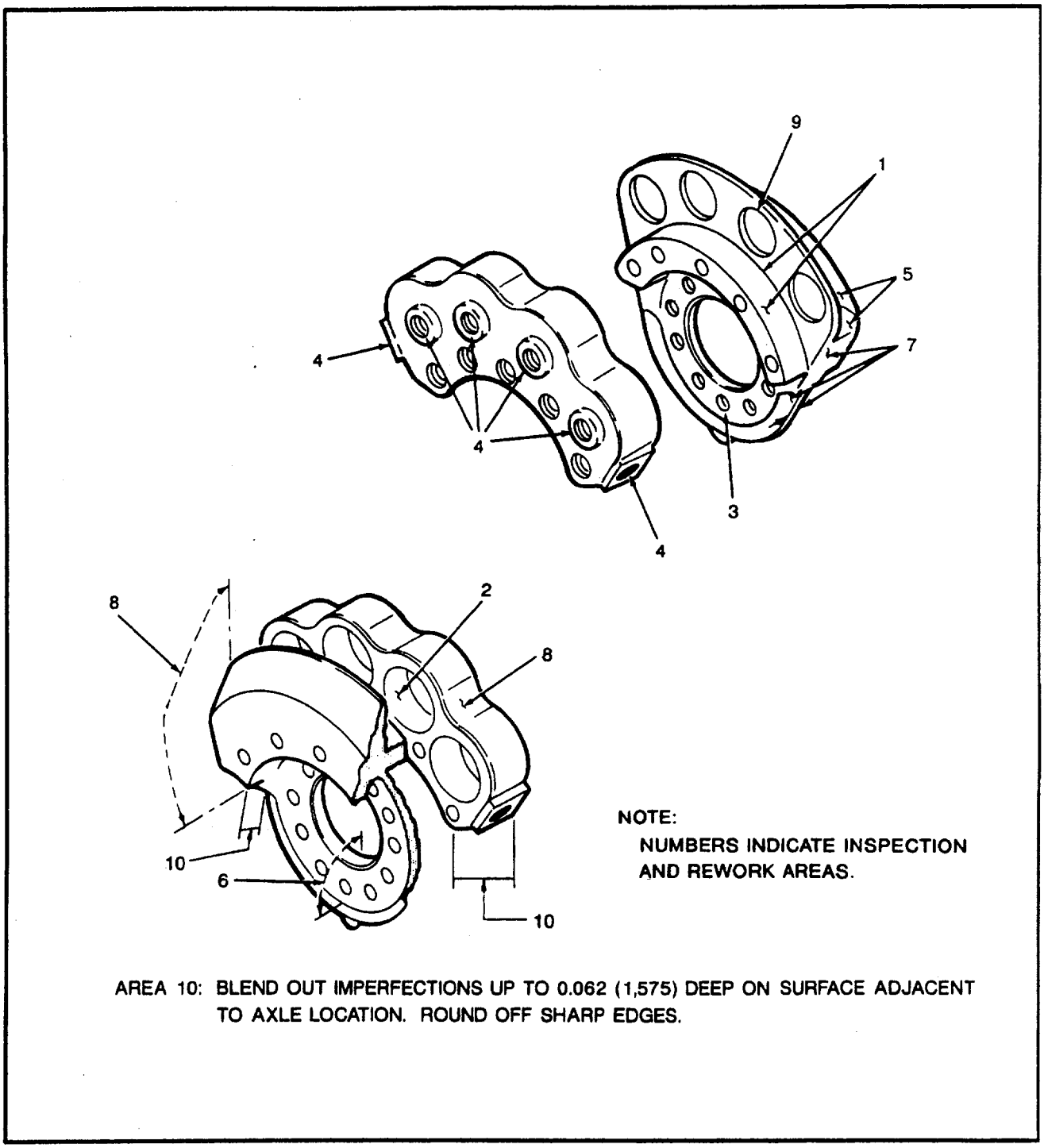
CAUTION: MAINTAIN ORIGINAL CENTER POINT OF LINING RECESS.

B. Machine lining recess diameter to 2.047 +0.000, -0.001 inch (52,00 + 0,000, -0.025 mm) as shown in Figure 603.

TEMPORARY REVISION NO. 32–2

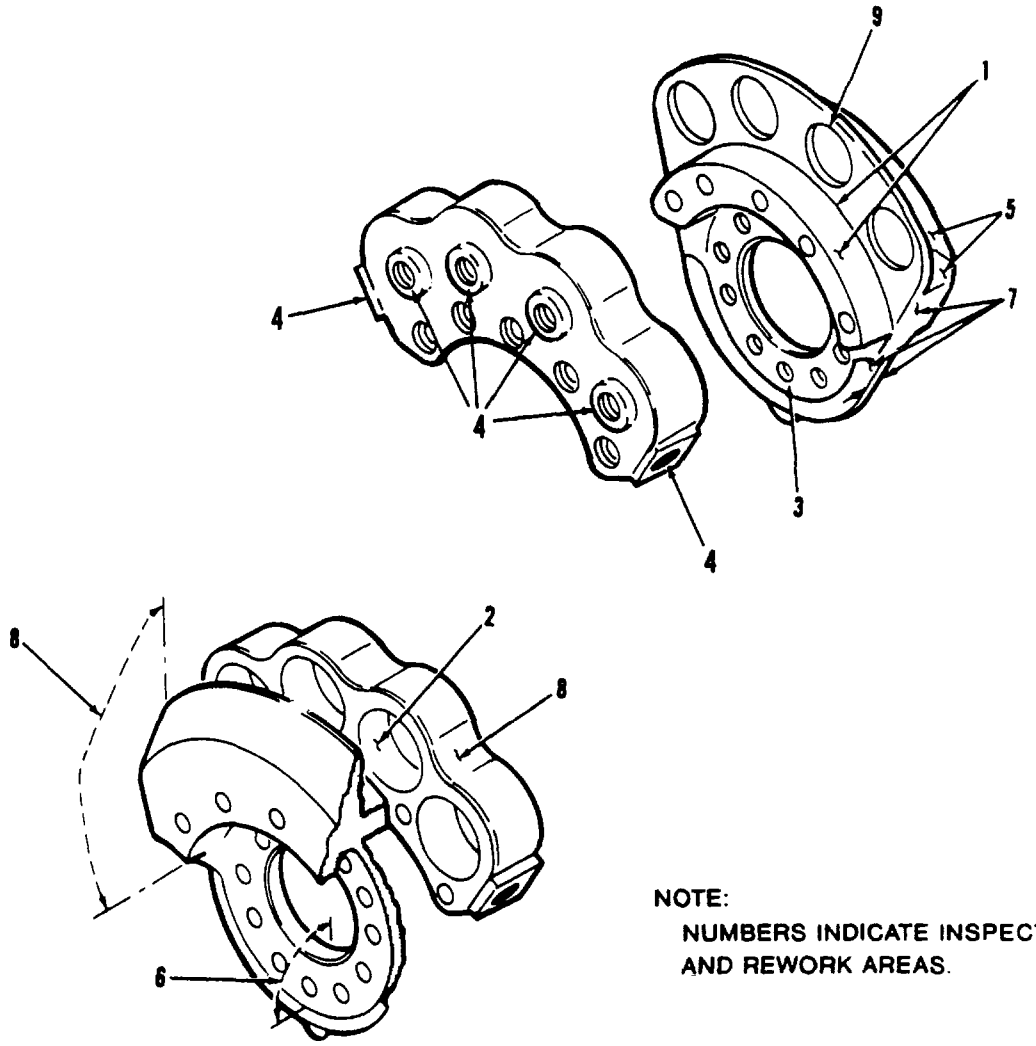
FILING INSTRUCTIONS: Insert facing page 603 (32–43–12).

DESCRIPTION: Added "Area 10" brake housing repair limits in Figure 601.



AREA 10: BLEND OUT IMPERFECTIONS UP TO 0.062 (1,575) DEEP ON SURFACE ADJACENT TO AXLE LOCATION. ROUND OFF SHARP EDGES.

Rework Areas for Brake Housing
Figure 601



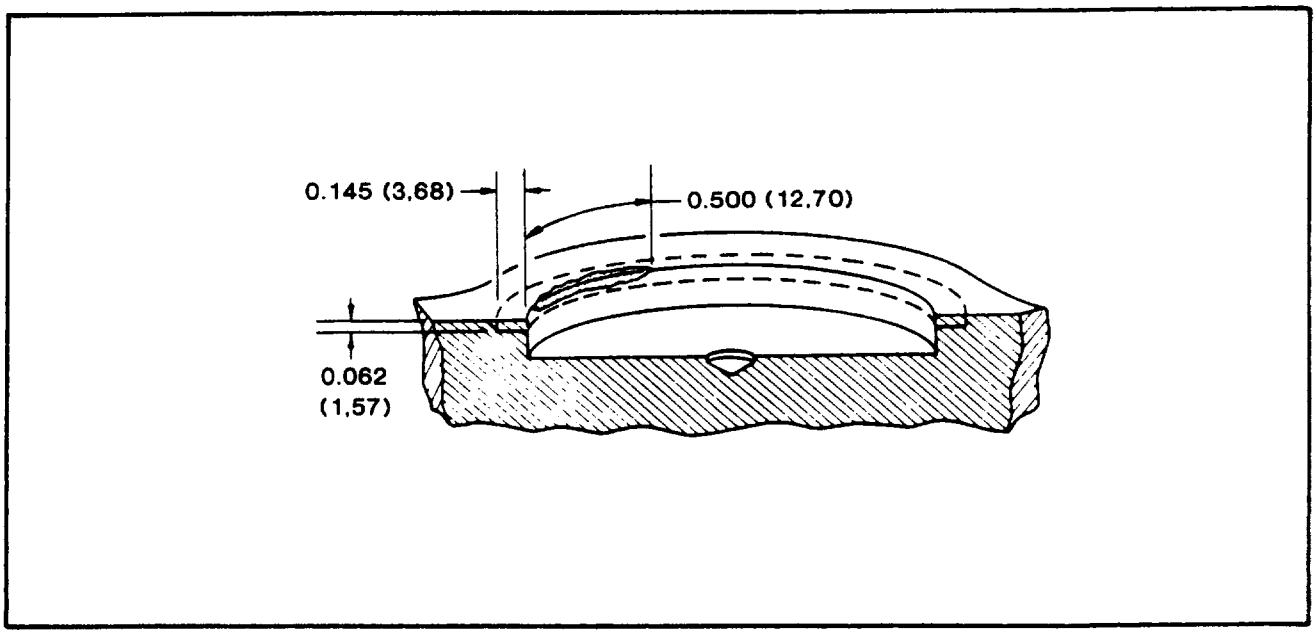
NOTE:
NUMBERS INDICATE INSPECTION AND REWORK AREAS.

Rework Areas for Brake Housing
Figure 601

NOTE: Please see the TEMPORARY REVISION that revises this page.

Key to Figure 601

General:	Repairs are limited in each marked area to the following limits. The material removed by blending is limited to the minimum required for removing corrosion or surface damage. Except where restricted by length or locale when damage depth is less than 0.015 inch (0,381 mm) deep, all blend type repairs should be blended with a depth to width ratio of 1 to 100 in surface width. Where not possible, use as generous a width to depth ratio as practical with the area being repaired.
Area 1:	Carefully check by Zyglo, dye-penetrant or other methods suitable for use with cast magnesium. Replace cracked housings. Grooves or scratches to 0.010 inch (0,254 mm) maximum deep in throat area of brake should be blended and polished out with 340 grit, aluminum oxide cloth.
Area 2:	Polish out minor scratches and/or pits with 360 grit, aluminum oxide cloth. Do not polish beyond 2.136 inches (54,25 mm) inside diameter at any location in the piston cavity.
Area 3:	Rework holes as required to 0.015 inch (0,381 mm) maximum oversize. Do not exceed 0.345 inch (8,767 mm) diameter. Round off sharp edges.
Area 4:	Clean and remove housing and replace if threads are stripped or badly damaged.
Area 5:	Blend out and polish imperfections up to 0.03 inch (0,762 mm) deep.
Area 6:	Blend out imperfections up to 0.03 inch (0,762 mm) deep. In area covered by mounting bolt washers, blend out nicks or scratches up to 0.010 inch (0,254 mm) deep.
Area 7:	Blend out and polish imperfections up to 0.03 inch (0,762 mm) deep. Do not blend opposite surfaces.
Area 8:	Blend out imperfections up to 0.03 inch (0,762 mm) deep, other than in the bolt hole area, 0.010 inch (0,25 mm) allowable in the bolt hole area.
Area 9:	Blend out imperfections up to 0.062 inch (1,575 mm) deep, 0.145 inch (3,687 mm) wide and 0.500 inch (12,700 mm) long on edge of lining recess as shown in Figure 602. One repair to above limits is permissible per recess. Refer to Repair of Worn Lining Recesses paragraph 4. for rework of lining recess damaged beyond above limits.



Lining Recess Edge Repair Limits
Figure 602

C. Treat machined surfaces of housing with surface treat solution, Specification MIL-M-3171, Type VI.

D. Heat housing in an oven to 225°F (106°C).

E. Apply one coat of zinc chromate primer, Specification TT-P-1757, to reworked area of housing.

F. Insert ring, fabricated in paragraph A., chamfered edge first, into reworked recess of heated housing as shown in Figure 603.

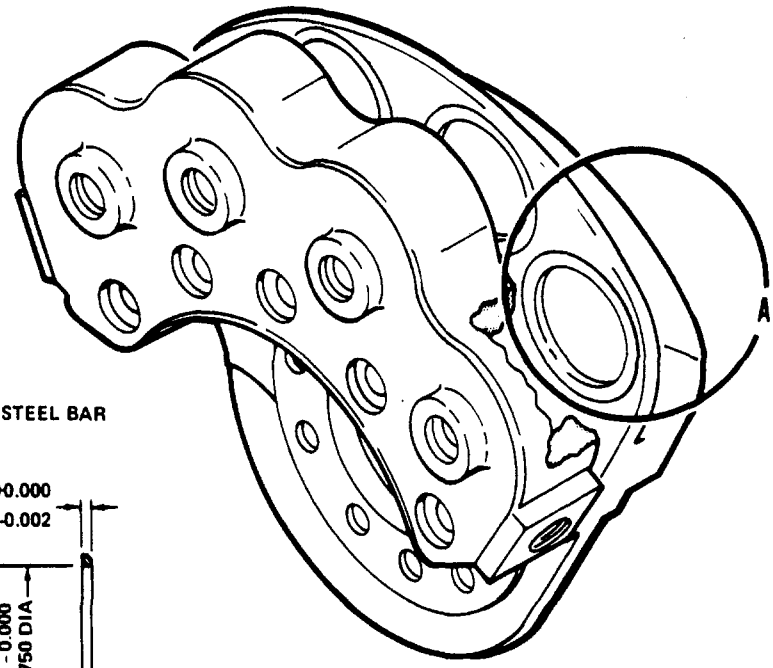
5. Repair of Flat Head Pin (180)

A. Repair damaged flat head pins as follows:

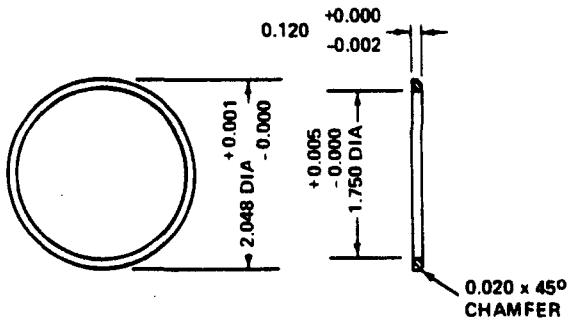
(1) Flat head pins with small nicks or imperfections on the seal contacting surfaces of 0.003 inch (0,076 mm) or less in depth and 0.060 inch (1,52 mm) in length are acceptable; however, raised metal from nicks should be removed by polishing with 400 grit, aluminum oxide cloth.

(2) If grip holding surfaces of pins are tapered more than 0.0005 inch (0,013 mm), the pins should be replaced.

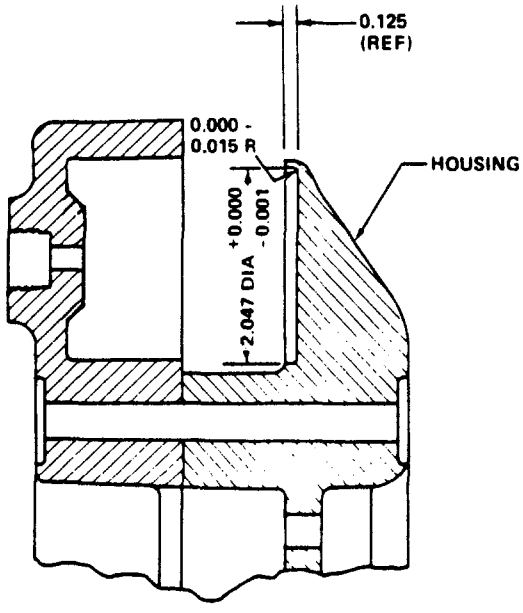
(3) Measure diameter of pins at grip holding surface. If diameter is less than 0.245 inch (6,22 mm), replace pins.



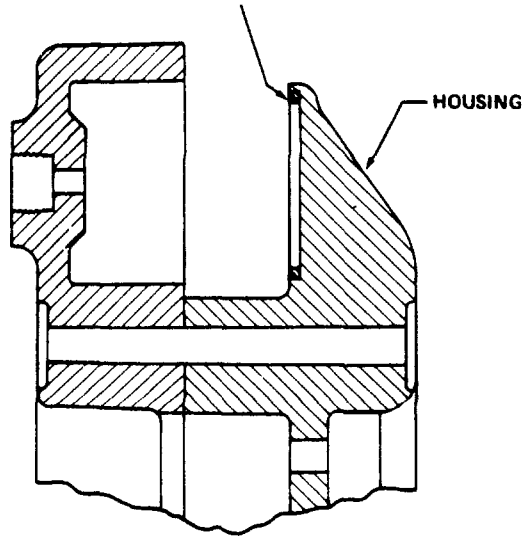
(1) FABRICATE A RING FROM 1117 STEEL BAR SPECIFICATION QQ-S-633.



(2) MACHINE HOUSING



(3) HEAT HOUSING TO 225° F AND INSERT RING IN PLACE WITH CHAMFERED EDGE INSIDE. TOUCH UP REWORKED AREAS OF HOUSING WITH ONE COAT ZINC CHROMATE PRIMER.



DETAIL A

Lining Recess Repair
Figure 603

6. Replacing Disk Guide Lining

A. Using a 5/32 (0.156) inch drill, drill out shop head of rivet (330)

B. Remove rivet from disk guide bracket (310) being careful to avoid enlarging the rivet hole.

C. Insert new rivet (330) through lining (320) and disk guide bracket (310) and form shop head of rivet against disk guide.

D. Shop head of rivet must have an outside diameter of 80 percent (minimum) of the outside diameter of the manufactured head. Disk guide lining is to be tight under finger pressure.

7. Re-Treating and Repainting

A. Repaired areas of brake housing and brake backing plate and those having paint and treated finish removed, should be re-treated and repainted in accordance with following procedures:

B. Re-Treating

WARNING: CLEANING SOLVENTS ARE TOXIC AND VOLATILE. USE ONLY IN WELL-VENTILATED AREAS. AVOID PHYSICAL CONTACT WITH SOLVENT AND DO NOT INHALE VAPORS.

(1) Thoroughly clean surface to be re-treated and repainted. Clean with hot water or methyl isobutyl ketone, Specification TT-M-268, and dry thoroughly with compressed air.

(2) Re-treat all exposed magnesium surfaces with surface treat solution conforming to Specification MIL-M-3171 in accordance with the manufacturer's instructions. Refer to Repair Materials for recommended solution.

C. Repair and touchup painting should be performed as follows.

(1) The part or area requiring touchup painting must be thoroughly clean and free of all contaminants.

(2) Prepare area to be painted (scratches, nicks, chipped paint, etc) by sanding lightly to feather out all edges of adjacent finish, using 320 to 360 grit, wet-or-dry aluminum oxide cloth. Wet sanding is preferred. Avoid removing more primer than absolutely necessary from damaged area.

WARNING: CLEANING SOLVENTS ARE TOXIC AND VOLATILE. USE ONLY IN WELL-VENTILATED AREAS. AVOID PHYSICAL CONTACT WITH SOLVENT AND DO NOT INHALE VAPORS.

(3) Wipe repaired surface with a cloth moistened with methyl isobutyl ketone, Specification TT-M-268, and wipe surface dry with clean cheesecloth.

WARNING: CLEANING SOLVENTS ARE TOXIC AND VOLATILE. USE ONLY IN WELL-VENTILATED AREAS. AVOID PHYSICAL CONTACT WITH SOLVENT AND DO NOT INHALE VAPORS.

(3) Wipe repaired surface with a cloth moistened with methyl isobutyl ketone, Specification TT-M-268, and wipe surface dry with clean cheesecloth.

CAUTION: IF BARE METAL IS EXPOSED BY SANDING, IT MUST BE RE-TREATED BEFORE APPLYING WASH PRIMER.

(4) Starting with the last intact paint layer, reapply paint coats in accordance with repainting.

NOTE: The gloss must be removed in the area to be touched up with an abrasive material, the defective area smoothed and edges feathered. The area must then be cleaned removing all loose and foreign material.

D. Repaint brake housing and brake backing plate as follows.

WARNING: CLEANING SOLVENTS ARE TOXIC AND VOLATILE. USE ONLY IN WELL-VENTILATED AREAS. AVOID PHYSICAL CONTACT WITH SOLVENT AND DO NOT INHALE VAPORS.

(1) Thoroughly clean all surfaces to be treated and/or painted. Housing subassembly should be vapor degreased or washed with methyl isobutyl ketone, Specification TT-M-268.

(2) Treat all exposed metal surfaces of wheel subassemblies with surface treat solution conforming to Specification MIL-M-3171, in accordance with manufacturer's instructions. Refer to Repair Materials for recommended solution.

CAUTION: DO NOT PAINT INTERIOR OF PISTON CAVITIES, INLET OR BLEEDER OPENINGS.

(3) Mask all threaded holes and hydraulic cavities to avoid getting paint on these surfaces.

E. Repaint reworked and treated areas with one coat of wash primer as follows.

(1) Wash primer is supplied in two separate containers; one contains the base primer, the other the acid component. Both must be thoroughly mixed before use.

(2) Mix wash primer, Specification MIL-C-8514 as follows.

(a) The resin component should be well stirred to redisperse any settled pigment. Then add the acid component slowly to the resin while stirring; never add in reverse order. One volume of acid component is always used with four volumes of the resin. Add the water to the alcohol (ethyl), do not reverse this admix procedure. Mix and stir well. Add only enough of the water alcohol mix to the resin mix to reduce the specific gravity to a range of 0.885 to 0.915.

NOTE: If either of the admix procedures are reversed, scrap the material and start over.

(b) Formula to be used when humidity is below 90 percent:

16 ounces (453,6 grams) resin component
4 ounces (113,4 grams) acid component
12 ounces (340,2 grams) ethyl alcohol, Specification O-E-760, Type III
1/2 ounce (14,18 grams) distilled water

Batch life under four hours

(c) Formula to be used when humidity is above 90 percent:

16 ounces (453,6 grams) resin component
4 ounces (113,4 grams) acid component
9 ounces (255,15 grams) ethyl alcohol, Specification O-E-760, Type III
3 ounces (85,05 grams) butyl alcohol, Specification TT-B-846
1/2 ounce (14,18 grams) distilled water

Batch life under two hours

Specific gravity range 0.885 to 0.915.

(3) Application

NOTE: All surfaces should have received anodic or chemical treatment. All surfaces must be clean of all contaminantes by degreasing and/or solvent washing prior to applying the wash primer.

(a) Apply a single wet coat of wash primer to a dry film thickness of approximately 0.0002 to 0.0003 inch (0,005 to 0,007 mm). Do not attempt to obtain a full hiding coat. If such a coating is produced, it should be immediately removed with alcohol and replaced with a properly applied coating.

(b) Air dry one hour minimum to four hours maximum. Subsequent topcoats should be applied as soon as practical after the minimum drying time but no later than four hours after the application of the wash primer. If subsequent primer coats are not applied within the specified time, the parts should be stripped and recoated with wash primer.

F. Method I (Primary) - Repaint brake housing and brake backing plate with two coats of aluminum topcoat/primer combination as follows.

(1) Surface Preparation

(a) Parts must be clean and have received the surface treatment required and one coat of wash primer before the application of paint.

(2) Mixing

(a) Mix the aluminum topcoat/primer combination until a viscosity of approximately 25 seconds in a No. 2 Zahn cup is obtained.

NOTE: Aluminum topcoat/primer combination should be at the proper viscosity. If required, thinning can be accomplished using Aeroprite Reducer TH-89.

(3) Application

(a) Spray one full wet cross coat to a dry film thickness of approximately 0.0004 to 0.0006 inch (0,010 to 0,015 mm).

(b) Air dry for a minimum of 45 minutes before applying a second coat.

(c) Spray a second full cross coat to a dry film thickness of approximately 0.0004 to 0.0006 inch (0,010 to 0,015 mm).

(d) Air dry 45 minutes before handling. Paint will reach full cure in 72 hours.

G. Method II (Alternate) - Repaint brake housing and brake backing plate with two coats of zinc chromate primer, Specification TT-P-1757, and two coats of aluminum lacquer, Specification TT-L-32, as follows.

(1) Surface Preparation

(a) Parts must be clean and have received the surface treatment required and one coat of wash primer before the application of paint.

(2) Apply two coats of zinc chromate primer, Specification TT-P-1757.

NOTE: Do not exceed the recommended thickness for the applied topcoats. If the humidity should drop below 20 percent, primer application should be stopped until steps are taken to raise the percent humidity.

(a) Apply one coat of primer to obtain a dry film thickness of 0.0003 to 0.0004 inch (0,00762 to 0,0102 mm).

(b) After a minimum flash off period of five minutes, apply second coat of primer to obtain a total dry film thickness of 0.0006 to 0.0008 inch (0,015 to 0,020 mm).

(c) Allow the primed surface to dry a minimum of two hours and a maximum of 12 hours before topcoating with aluminum lacquer, Specification TT-L-32.

(3) Apply two coats of aluminum lacquer, Specification TT-L-32.

(a) Spray one full wet cross coat to a dry film thickness of approximately 0.0004 to 0.0006 inch (0,010 to 0,015 mm) over the primer coating.

(b) After a minimum flash off period of five minutes, apply second coat of aluminum lacquer to obtain a total thickness of 0.0008 to 0.0012 inch (0,020 to 0,030 mm).

(c) Air dry 45 minutes before handling. Paint will reach full cure in 24 hours.

8. Modification of Brake Assembly 5001571, 5001571-1, 5001571-3 and 5001571-4 to Brake Assembly 5001571-6

A. At operator's option, Asbestos-Free Linings 9523331-1 may be replaced with improved Asbestos-Free Linings 5008993 as follows:

(1) At the next brake overhaul or next lining replacement, replace Linings 9523331-1 with improved Asbestos-Free Linings 5008993.

(a) Operators are advised that old asbestos-free linings may be used until stock depletion. The improved asbestos-free linings are to be used as a set, they are not to be mixed with the old linings in any one assembly.

(2) Reidentify Brake Assemblies as follows:

(a) *Reidentify Brake Assemblies 5001571 or 5001571-1 by grinding off the* "-1" and metal stamping a "-6" after brake assembly number in 0.12 inch (3,05 mm) characters to read "5001571-6".

NOTE: Where necessary, the part should be suitably supported for stamping.

(b) Reidentify Brake Assemblies 5001571-3 or 5001571-4 by grinding off "-3" or "-4" and metal stamping a "-6" after brake assembly number in 0.12 inch (3,05 mm) characters to read "5001571-6".

NOTE: Where necessary, the part should be suitably supported for stamping.

(3) Re-treat and repaint any displaced metal in accordance with Re-Treating and Repainting.

(4) After installing the improved Asbestos-Free Linings 5008993 the disk surface should be checked for toughness or material buildup. The disk should be resurfaced to remove the lining transferred material or install a new disk to mate with new linings.

9. Modification of Brake Assembly 5001571-2 to Brake Assembly 5001571-5

A. At operator's option, Asbestos Linings 5004562 may be replaced with Asbestos-Free Linings 5004562-1.

NOTE: Asbestos linings are no longer manufactured. The new asbestos-free linings will be readily identified by their white color.

(1) At the next brake overhaul or next lining replacement, replace Linings 5004562 with Asbestos-Free Linings 5004562-1.

(a) Operators are advised that old asbestos linings may be used until stock depletion. The new asbestos-free linings are to be used as a set, they are not to be mixed with the old linings in any one assembly.

(2) Reidentify Brake Assembly 5001571-2 by grinding off "2 and by metal stamping a "-5" after brake assembly number in 0.12 inch (3,05 mm) characters to read "5001571-5."

NOTE: Where necessary, the part should be suitably supported for stamping.

(3) Metal stamp repair number "5R87-060" in 0.09 inch (2,3 mm) characters adjacent to the assembly number.

NOTE: Where necessary, the part should be suitable supported for stamping.

(4) Re-treat and repaint any displaced metal in accordance with Re-Treating and Repainting.

(5) After installing the improved Asbestos-Free Linings 5004562-1, the disk surface should be checked for roughness or material build up. The disk should be resurfaced to remove the lining transferred material or install a new disk to mate with linings.

ASSEMBLY AND STORAGE

1. Assembly and Storage Materials

NOTE: Equivalent substitutes may be used for items listed.

Pliobond 5001	W. J. Ruscoe and Company 483 Kenmore Boulevard Akron, OH 44301
Lockwire (MS20995C32)	Commerically available
Hydraulic Preservative Fluid Specification MIL-H-6083	Commercially available
Hydraulic Fluid (Red Oil) Specification MIL-H-5606	Commercially available
Antiseize Compound (Lubtork) Specification MIL-T-83483 (Prime)	Armite Laboratories 1845 Randolph Avenue Los Angeles, CA 90001
Antiseize Compound Specification MIL-T-5544 (Alternate)	Armite Laboratories 1845 Randolph Avenue Los Angeles, CA 90001
Rust Veto 4214	E. F. Houghton and Company Madison and Van Buren Street Valley Forge, PA 19482
Naphtha or Lead-Free Gasoline	Commercially available

2. General (Ref. IPL Fig. 1)

A. It is recommended that new preformed packings be installed at each overhaul.

B. It is recommended that brake linings be replaced at time of overhaul.

NOTE: Brake linings must be similar and not intermixed with alternate brake linings. Alternate brake linings must be replaced as a set.

3. Assembly Procedures (Ref. IPL Fig. 1)

A. Assemble the brake assembly in accordance with the following procedures.

CAUTION: ASSEMBLE THE BRAKE ON A CLEAN, FLAT SURFACE BEING CAREFUL NOT TO NICK, SCRATCH OR SCUFF THE PAINT OR PROTECTIVE FINISH. ENSURE PROPER PARTS ARE USED FOR EACH BRAKE ASSEMBLY.

B. Install bleeder as follows:

(1) Lubricate preformed packing (280) with a light coat of hydraulic preservative fluid, Specification MIL-H-6083.

(2) Place lubricated preformed packing (280) on bleeder valve adapter (270) then install in brake housing (290) bleeder port.

(3) Tighten bleeder valve adapter (270) to a torque value of 30 pound-feet (41 N-m).

(4) Install bleeder valve (260) into bleeder valve adapter (270) and tighten to a torque value of 120 pound-inches (13,6 N-m).

(5) Place bleeder washer (250) on bleeder screw (240 or 240A) and install in bleeder valve (260).

C. Install inlet as follows:

(1) Lubricate preformed packing (230) with a light coat of hydraulic preservative fluid, Specification MIL-H-6083.

(2) Place lubricated preformed packing (230) on inlet adapter (220) and install in brake housing (290) inlet port.

(3) Tighten inlet adapter to a torque value of 30 pound-feet (41 N-m).

(4) Lubricate preformed packing (210) with a light coat of hydraulic preservative fluid, Specification MIL-H-6083.

(5) Place lubricated preformed packing (210) on protective plug (200) and install in inlet adapter.

D. Assemble each of the piston units as follows:

NOTE: If letter "R" has been stamped after brake assembly number on housing, assembly has been reworked for oversize piston.

(1) Place the head of flat head pin (180) into piston (190).

(2) Place brake release spring (170) over pin into piston.

(3) Place brake release spring (160) over flat head pin (180) and inside brake release spring (170).

(4) Place spring guide (150) over flat head pin (180) and on the inside brake release spring (160).

(5) With piston opening up, place retaining ring (140) on top of piston over opening.

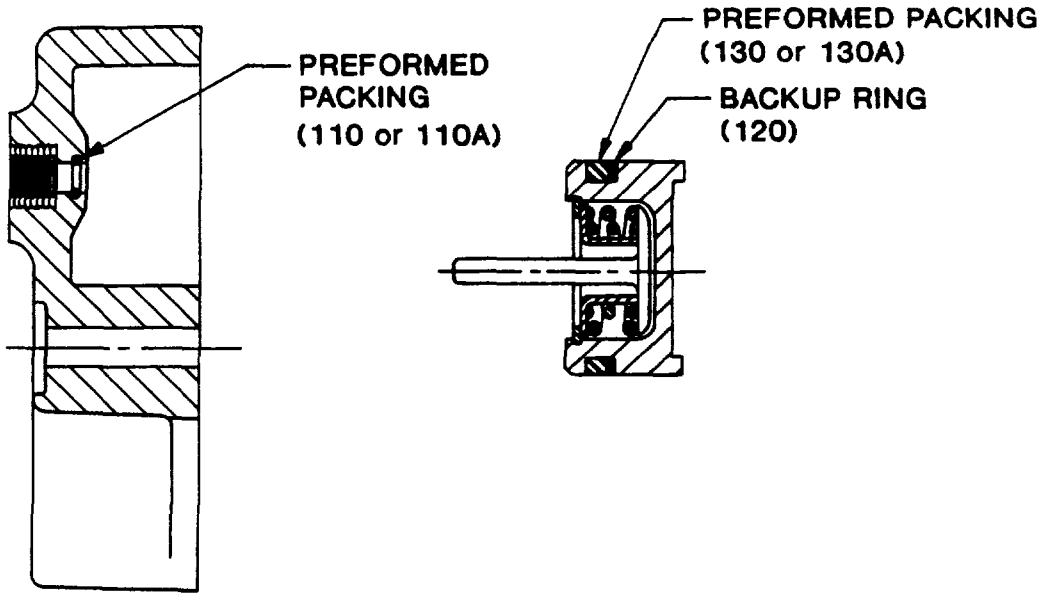
(6) Place tool (tubing used in disassembly) over flat head pin (180), inside retaining ring (140) and against spring guide (150).

(7) Place piston unit into arbor press and apply force to tool (tubing), against spring guide (150), compressing the springs just enough to enable the installation of retaining ring (140) into groove of piston. Release arbor press slowly and ensure retaining ring is seated. Remove piston unit from arbor press.

E. Install piston units as follows:

(1) Lubricate preformed packings (130 or 130A) and preformed packing (110 or 110A) with hydraulic preservative fluid, Specification MIL-H-6083.

(2) Install lubricated preformed packing (130 or 130A) and backup ring (120) in seal groove of piston (190) (Ref Fig. 701).



Preformed Packing Installation
Figure 701

(3) Install lubricated preformed packing (110 or 110A) in brake housing (290) (Ref. Fig. 701).

(4) Lubricate contacting surfaces of pistons and piston cavity with light coat of hydraulic preservative fluid, Specification MIL-H-6083.

(5) Install lubricated piston unit with preformed packing (130 or 130A) and backup ring (120) in brake housing.

(6) Install flat washer (100) on flat head pin (180).

(7) Dip self-adjusting pin grip (90) into clean hydraulic brake fluid, Specification MIL-H-5606 and install on flat head pin (180), large end first.

(8) Install self-adjusting pin nut (80) over flat head pins (180) and screw into brake housing (290) but do not tighten.

(9) Push pistons (190) completely back against brake housing (290) and tighten self-adjusting pin nuts (80) to a torque value of 25 pound-feet (34 N-m) and back off several times to seat parts and final torque.

(10) Lockwire self-adjusting pin nuts (80) in series, using Lockwire MS20995C32 (Ref. Fig. 1).

F. Install brake fasteners as follows:

(1) Lubricate bolt threads and bearing surfaces of bolts (50), countersunk washers (60), plain washer (40) and self-locking nut (30) with antiseize compound, Specification MIL-T-83483.

(2) Assemble backing plate (70 or 70A) on brake housing (290) and install internal wrenching bolts (50) and countersunk washer (60) through brake housing side. Secure with plain washer (40) and self-locking nut (30).

(3) Tighten bolts (50) to a Lubtork value of 20 pound-feet (27,1 N-m).

G. Install brake linings as follows:

(1) Apply Pliobond 5001 cement to back of brake linings. Use naphtha or lead-free gasoline to remove cement that may accidentally drip on lining wear surface.

(2) For Brake Assemblies 5001571-3 and 5001571-4, install brake lining (20B) in piston and anvil recesses of brake housing.

(3) For Brake Assembly 5001571-5, install brake lining (20C) in piston and anvil recesses of brake housing.

(4) For Brake Assembly 5001571-6, install brake lining (20D) in piston and anvil recesses of brake housing.

H. Install brake disk (10 or 10A) into position between brake linings.

NOTE: Brake disk (10) P/N 5001585 is used on Brake Assemblies 5001571-, -1, -3, -4 and -6, Brake Disk (10A) P/N 5004272 is used on Brake Assemblies 5001571-2 and 5001571-5.

I. Test brake assembly in accordance with applicable TESTING AND FAULT ISOLATION instructions.

4. Installation of Disk Guide Bracket Subassembly (300)

NOTE: Disk guides are installed at operator's option on Brake Assemblies 5001571, 5001571-3 and 5001571-6 after installation of brake assembly on aircraft.

A. Install disk guides as follows:

(1) Install disk guide bracket subassembly using brake mounting bolts in the two adjacent bolt holes in bottom of brake housing. Install disk guide with lining toward brake disk (10) (Ref. Fig. 1).

5. Storage Instructions

A. The brake assembly should be stored as follows:

CAUTION: BRAKES EQUIPPED WITH QUICK-DISCONNECT FITTINGS SHOULD HAVE THE FITTINGS PROTECTED DURING SHELF STORAGE BY SUITABLE CAPS OR OTHER MEANS.

(1) The brake assembly should be stored in moisture-barrier material and a sealed corrugated cardboard container, or equivalent.

(2) The brake assembly should be stored in a clean, dry storeroom. The desirable storeroom temperature range is from 50° to 70°F (10° to 21°C). If this temperature range cannot be maintained, temperatures as high as 125°F (+52°C) and as low as -20°F (-29°C) can be tolerated for short periods. Total time above 100°F (38°C) should not exceed three months.

(3) When brake disk is stored separated, insert cardboard between brake linings to hold them in position.

B. Housing, backing plate and disk:

(1) Housings and disks that are to be stored for an indefinite period should be treated as follows:

(a) Vapor degrease metal parts to remove all oil and residue.

WARNING: RUST INHIBITORS ARE HIGHLY FLAMMABLE AND MUST BE USED ONLY IN AN OPEN OR WELL-VENTILATED AREA. EXERCISE EXTREME CARE.

(b) Immerse parts in Houghton's Rust Veto 4214 or equivalent. Use in the "as-received" condition without dilution. Allow parts to drip and air dry for five minutes. Clean compressed air may be used to speed drying.

(c) Wrap parts in moisture-barrier material and package in a cardboard container.

(d) Prior to placing parts back into service, degrease in a vapor degreaser.

FITS AND CLEARANCES

Item No. (Ref. IPL Fig. 1)	Compressed Length	Minimum Load
160	0.538 inch (13,66 mm)	60 pounds (267 N)
170	0.538 inch (13,66 mm)	115 pounds (512 N)

Spring Values
Figure 801

Item No. (Ref. IPL Fig. 1)	Nomenclature	Replacement Dimension
10	Brake Disk Thickness (minimum) Outside diameter (minimum)	 0.490 inch (12,45 mm) 13,025 inches (330,83 mm)
10A	Brake Disk Thickness (minimum) Outside diameter (minimum)	 0.586 inch (14,88 mm) 13,025 inches (330,82 mm)
20C or 20D	Brake Lining (Thickness)	0.220 inch (5,6 mm) 0.200 inch (5,1 mm)
180	Flat Head Pin (Diameter at grip holding surface)	0.245 inch (6,22 mm)
190	Piston (Diameter)	2.112 inches (53,64 mm)
320	Disk Guide Linings (Thickness)	0.140 inch (3,56 mm)

Wear Tolerances
Figure 802

Item No. (Ref. IPL Fig. 1)	Nomenclature	Torque Value
30	Self-Locking Nuts	25 pound-feet (34 N-m)
80	Self-Adjusting Pin Nuts	25 pound-feet (34 N-m)
220	Inlet Adapter	30 pound-feet (41 N-m)
260	Bleeder Valve	120 pound-inches (13,6 N-m)
270	Bleeder Valve Adapter	30 pound-feet (41 N-m)

Torque Values
Figure 803

SPECIAL TOOLS, FIXTURES AND EQUIPMENT

The following special tools will facilitate the disassembly and reassembly of the brake.

NOTE: The following type of equipment is recommended for paint removal using the dry-stripping procedure.

Model - PRAM31
Pauli and Griffin
907 Cotting Lane
Vocaville, CA 95688

ILLUSTRATED PARTS LIST

1. Introduction

A. General

(1) The Illustrated Parts List (IPL) section illustrates and lists the procurable parts of the assembly(ies) in this publication.

B. Parts List

(1) The illustration is an exploded view of assembly(ies) covered by the parts list.

(2) Components in the parts list are listed in order of disassembly.

(3) The Figure and Item column provides the cross reference between the parts list and the associated IPL Figure(s).

(4) The Part Number column gives the part number of the item, which is stamped on the part when practical. This number should be used when ordering parts.

(5) The Airline Stock Number column is provided for the convenience of the operator to enter individual part numbers.

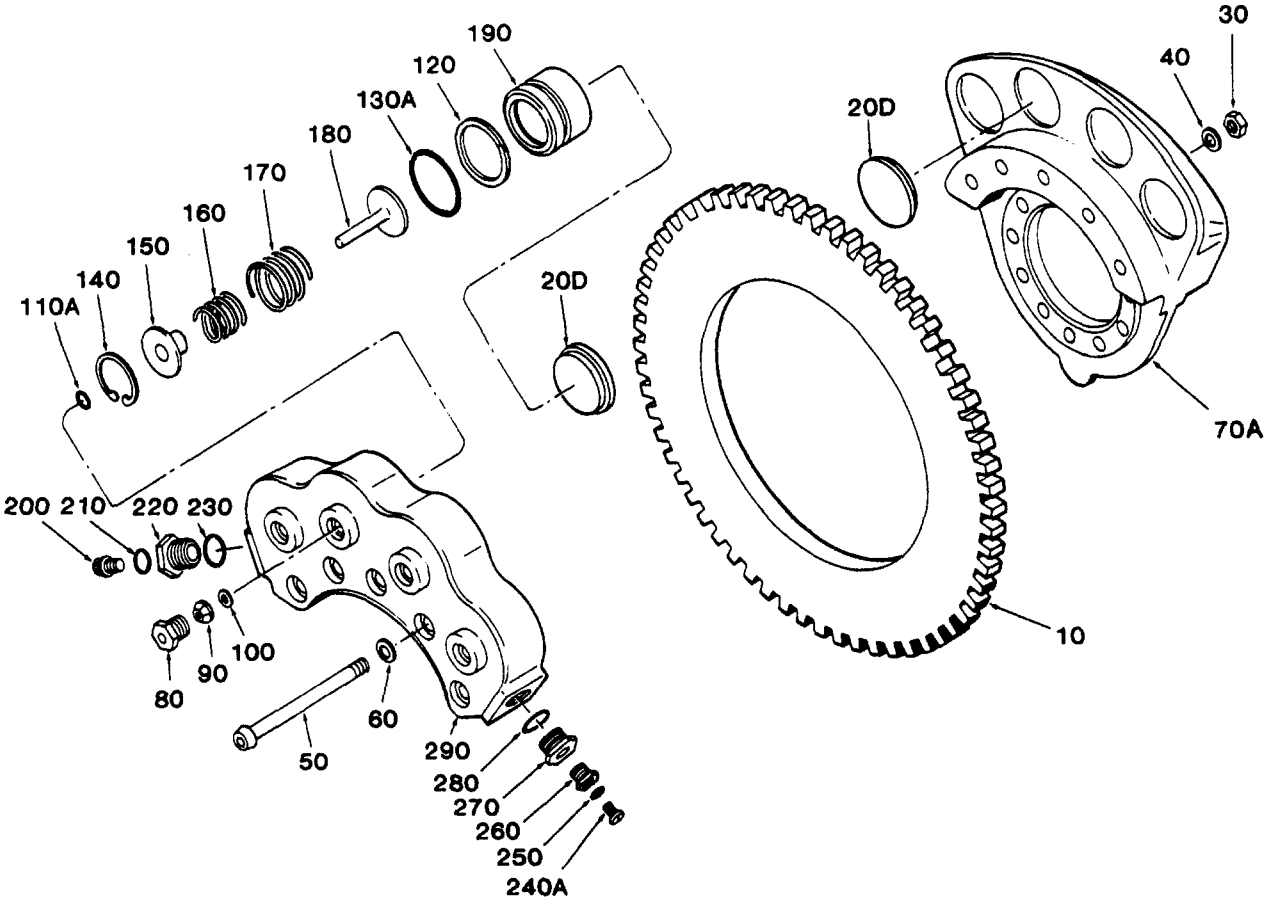
(6) The Nomenclature column gives the basic noun name of each part, together with any descriptive or dimensional information and specifications required to identify part listed. Parts are indented under the numbered sub-column heading showing the relationship of the parts to their subassemblies and to the assembly. When an alternate part or repair part exists for the recommended part, it is indicated in parentheses following the part nomenclature. A federal supply code number is given for all vendor-supplied items.

(7) The Effect Code column shall establish parts relationship with units or assemblies which are essentially the same but have minor variations. These units or assemblies are the lead items. These units or assemblies shall be assigned reference letters such as A, B, C, D, etc. Parts which are not common to all configurations, but are associated with one or more of the coded lead items, shall carry the letter or letters assigned to the lead item with which it is associated. If a part is common to all lead items, the Effect Code column shall be blank.

(8) The Units Per Assembly column gives the number of parts required for each assembly or subassembly.

C. Federal Supply Codes for Manufacturers

(1) A list of vendor/manufacturer names and addresses is provided following the parts list.



5001571-6 SHOWN

2. Parts List

FIGURE ITEM	PART NUMBER	AIRLINE STOCK NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT CODE	UNITS PER ASSY	
1-1	5001571*		BRAKE ASSEMBLY (Order -3)	A	RF	R
-1A	5001571-1*		BRAKE ASSEMBLY (Order -4)	B	RF	R
-1B	5001571-2*		BRAKE ASSEMBLY (Order -5)	C	RF	R
-1C	5001571-3*		BRAKE ASSEMBLY (Order -6)	D	RF	R
-1D	5001571-4*		BRAKE ASSEMBLY (Order -6)	E	RF	R
-1E	5001571-5		BRAKE ASSEMBLY	F	RF	R
-1F	5001571-6		BRAKE ASSEMBLY	G	RF	R
10	5001585		. DISK, Brake.	ABDEG	1	R
-10A	5004272		. DISK, Brake.	CF	1	R
-20	9523331*		. LINING, Brake.	AB	8	R
-20A	5004562*		. LINING, Brake.	C	8	R
-20B	9523331-1*		. LINING, Brake.	DE	8	R
-20C	5004562-1		. LINING, Brake.	F	8	R
20D	5008993		. LINING, Brake.	G	8	R
30	22FH-624		. NUT, Self-Locking (V56878)		5	R
40	MS20002-6		. WASHER, Plain.		5	R
50	MS20006-61		. BOLT, Internal Wrenching.		5	R
60	MS20002C6		. WASHER, Countersunk. .		5	R
-70	5001581		. PLATE, Backing, Brake.	ABCDE F	1	R
70A	5010119		. PLATE, Backing, Brake. .	G		R
80	9510894		. NUT, Self-adjusting pin. .		4	R
90	9510895		. GRIP, Self-adjusting pin. .		4	R
100	9523046		. WASHER, Flat.		4	R
-110	AN6227-5		. PACKING, Preformed . .	ABC	4	R
110A	MS28775-010		. PACKING, Preformed . .	DEFG	4	R
120	MS28774-327		. RING, Backup.		4	R
-130	AN6227-30		. PACKING, Preformed . .	ABC	4	R
130A	MS28775-327		. PACKING, Preformed . .	DEFG	4	R
140	MS16625-3137		. RING, Spring Retaining. .		4	R
150	9524307		. GUIDE, Spring.		4	R
160	9524304		. SPRING, Brake Release. .		4	R
170	9524305		. SPRING, Brake Release. .		4	R
180	9524306		. PIN, Flat Head		4	R
190	5000904		. PISTON.		4	R
200	1604-73		. PLUG, Protective (V79555).		1	R
210	MS28778-4		. PACKING, Preformed . .		1	R
220	9536102		. ADAPTER, Inlet.		1	R
230	MS28778-8		. PACKING, Preformed . .		1	R
-240	MS35207-260		. SCREW, Bleeder.	ABC	1	R
240A	MS35207-259		. SCREW, Bleeder.	DEFG	1	R
250	511846-4		. WASHER, Bleeder. . . .		1	R
260	AN6204-1		. VALVE, Bleeder.		1	R

\- Item not illustrated.
* Not procurable - use until stock depletion
** Not furnished - order separately

FIGURE ITEM	PART NUMBER	AIRLINE STOCK NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT CODE	UNITS PER ASSY	
270	9511157		. ADAPTER, Bleeder Valve.		1	R
280	MS28778-8		. PACKING, Preformed . .		1	R
290	5001582		. HOUSING, Brake.			R
-300	5001607**		. BRACKET SUBASSEMBLY DISK GUIDE.	ADG	AR	R
-310	5000220		. . BRACKET, Disk Guide.	ADG	1	R
-320	5001608		. . LINING, Disk Guide . .	ADG	1	R
-330	GY16B-12		. . RIVET, Tubular. . . .	ADG	1	R

- Item not illustrated.
* Not furnished, order separately.
** Not procurable, use until stock depletion.

3. Federal Supply Codes for Manufacturers

Code No.	Name and Addresses
56878	SPS Technologies, Incorporated Aerospace and Industrial Products Division Highland Avenue Jenkintown, PA 19046
79555	Pennwalt Corporation S.S. White Division Three Parkway Philadelphia, PA 19102-1321

AIRCRAFT BRAKING SYSTEMS
Corporation

COMPONENT MAINTENANCE MANUAL with ILLUSTRATED PARTS LIST

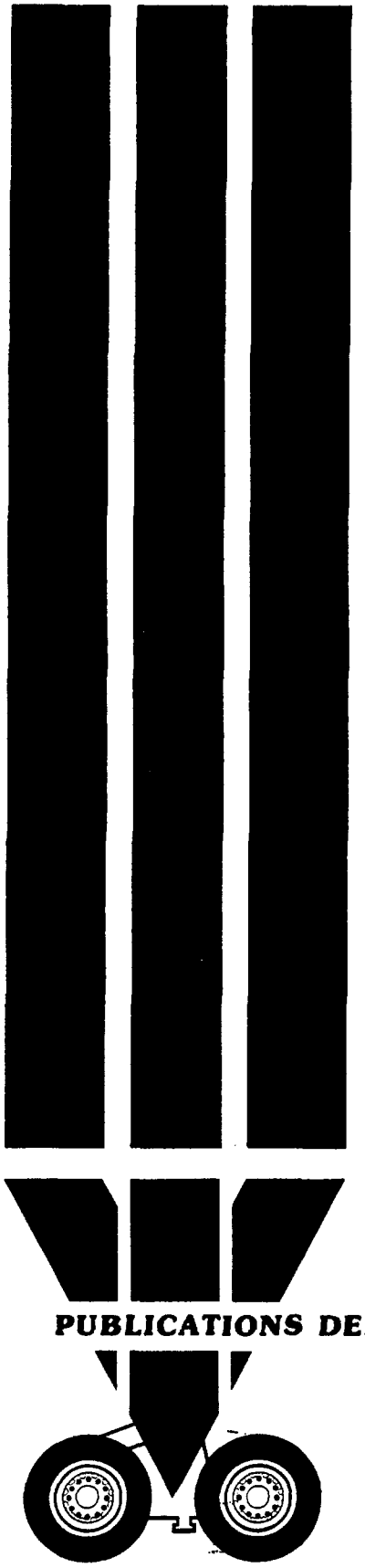
AP-309

MAIN WHEEL ASSEMBLY

Part No. 9544382

Part No. 9544382-1

Part No. 9544382-2

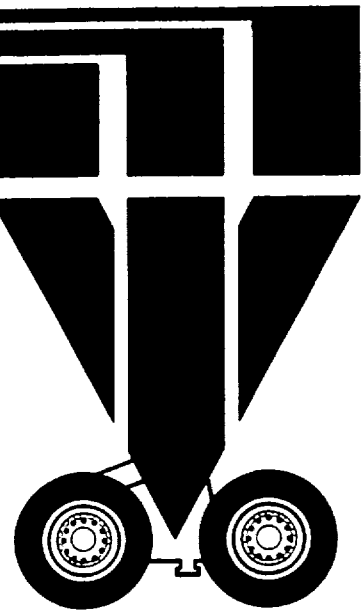


PUBLICATIONS DEPARTMENT

32-40-24

LORAL

Aircraft Braking Systems



AP-309

COMPONENT MAINTENANCE MANUAL

WITH

ILLUSTRATED PARTS LIST

MAIN WHEEL ASSEMBLY

PART NO. 9544382

PART NO. 9544382-1

PART NO. 9544382-2

USED ON

DEHAVILLAND DH C-6 TWIN OTTER

AIRCRAFT

BASIC ISSUE 15 JANUARY 1969

PUBLICATIONS DEPARTMENT
AKRON, OHIO 44315-0001
CAGE CODE OB9R9

COMPONENT MAINTENANCE MANUAL
MAIN WHEEL ASSEMBLY 9544382

TEMPORARY REVISION NO. 32–4

TO: HOLDERS OF AP–309 (32–40–24) COMPONENT MAINTENANCE MANUAL WITH ILLUSTRATED PARTS LIST FOR MAIN WHEEL ASSEMBLIES 9544382 AND 9544382–1 USED ON THE DE HAVILLAND TWIN OTTER AIRCRAFT.

PURPOSE: This Temporary Revision is issued to correct a part number in the Illustrated Parts List.

FILING INSTRUCTIONS: Record applicable data on the RECORD OF TEMPORARY REVISIONS sheet in front of the manual. Insert page 1 facing the RECORD OF TEMPORARY REVISIONS.

Retain this Temporary Revision until normal revision service incorporates this information into the Component Maintenance Manual.

This Temporary Revision affects page 1004 (32–40–24).

RECORD OF TEMPORARY REVISIONS

TEMPORARY REVISION NUMBER	PAGE NUMBER	ISSUE DATE	BY	DATE REMOVED	BY
32–4	1 and 2	Dec 11/92	ABSC		

(RELEASED: 12/10/92)

TO: HOLDERS OF AP-309 (32-40-24) COMPONENT MAINTENANCE MANUAL WITH ILLUSTRATED PARTS LIST FOR MAIN WHEEL ASSEMBLIES 9544382 AND 9544382-1 USED ON THE DE HAVILLAND TWIN OTTER AIRCRAFT.

Attached to this transmittal letter is Revision No. 6 of AP-309 (basic issue dated 15 January 1969).

REVISION NO. 6 DATED 30 OCTOBER 1988

HIGHLIGHTS

REVISION NO. 6 CONTAINS ALL PAGES OF THE MANUAL. Pages which have been added or revised are outlined below, together with the Highlights of the revision.

Please retain all previous HIGHLIGHTS pages inserting them into this manual for future reference.

Chapter/Section and Page No.	Description of Change
All pages	Changed masthead from Goodyear to Loral Aircraft Braking Systems. Multiplied all figure item numbers by 10. Added metrics.
Cover	Revised to latest format and added Wheel Assembly 9544382-2.
Title Page	Revised to latest format and added Wheel Assembly 9544382-2.
Record of Revisions, page 1/2	Added Revision No. 6.
Service Bulletin List, page 1/2	Added Service Bulletins considered.
List of Effective Pages, pages 1 and 2	Revised to reflect current revision.
Table of Contents, pages 1 thru 3/4	Revised to reflect current revision.
Introduction, pages 1 thru 4	Revised to reflect current revision and field office addresses. Deleted pages 5/6.

Chapter/Section and Page No.	Description of Change
32-40-24	
page 1	Deleted Goodyear and part numbers from paragraph 1., General. Revised paragraph 2.C. and added paragraph 2.D.
pages 2 and 3	Changed Figure 1 to Sheet 1 of 2 and added Sheet 2 for Wheel Assembly 9544382-2. Multiplied all figure items by 10. Changed figure item 9A to 95 and added item 165 (Sheet 1). Relocated text.
page 4	Revised Key to Figure 1, multiplying all figure items by 10. Added item 1 as "Not Used", deleted item 1A, changed item 9A to 95, added items 165, 170B, 215 and 230A. Distinguished items 230 and 230A as aluminum and steel disk drive rings respectively. Added new paragraph 5.B. Relocated text.
page 101	Revised paragraph 1., Test Equipment and Materials.
page 102	Relocated text.
page 103	Deleted reference to Goodyear in paragraph 4.B.(1) NOTE. Changed figure item 9A to 95 in paragraph 4.B.(2). Relocated text.
pages 104 thru 106	Relocated text.
page 302	Added figure item s 120A and 140A to paragraph 2.H. Added figure item 230A to paragraph 2.I.
page 401	Deleted vapor degrease solution, Specification MIL-T-81533, 1,1,1-Trichloroethane from paragraph 1., Cleaning Materials and paragraph 3. B., Paint Removal Procedure. Added materials equipment and instructions for primary Paint Removal using dry-stripping method and making solvent method an alternate.
page 502	Revised paragraph 2.C.(1)(a).
page 503	Added figure item 170B to paragraph 3. Revised paragraph 4.B. Relocated text.
page 504	Added figure item 230A in title and new paragraph 5.B. Renumbered previous paragraph 5.B. to 5.C.

Chapter/Section and Page No.	Description of Change
pages 504 thru 506	Added new paragraph 6. and renumbered paragraphs 6. thru 10. to 7. thru 11. Relocated text.
page 505	Corrected Figure 503.
page 506	Added new paragraph 12.
pages 601 and 602	Revised and added information to paragraph 1., Repair Materials. Relocated text.
page 602	Added figure item 170B to paragraph 3. Relocated text.
page 603	Added Wheel Subassembly 9544383-2 to Figure 601.
pages 607 and 608	Added figure item 170B. Revised and added omitted text to paragraph 4. Relocated text.
pages 608 thru 616	Added Figure 603. Completely revised paragraph 5., *Replacing Disk Drive Ring, by adding instructions for* replacing steel disk drive ring (230A). Added Figures 605, 606 and 607. Renumbered Figure 604 and 605 references to 608 and 609. Relocated text.
pages 617 and 618	Changed Figures 607 and 605 to Figures 608 and 609. Added pages for relocated text.
pages 619 thru 621	Added pages for renumbered figure references and relocated text.
pages 621 thru 623/624	Added pages for new paragraph 7. Rework of Wheel Assemblies 9544382 and 9544382 -1 to Wheel Assembly 9544382-2 and new Figure 610.
Repair No. 1 page 601	Added figure item 170B to paragraph 1.A.
page 701	Added new paragraphs 2.B. thru 2.D. Relocated text.
page 702 thru 707	Revised paragraphing throughout the section. Deleted paragraph titles 3. thru 7. Relocated text.
pages 702, 703	Changed title of paragraph 3. from Assembly Inboard Wheel Subassembly to Assembly Procedures. Relocated assembly of *bearing cups and disk drive ring to REPAIR section.* Deleted Figure 701. Added assembly of overinflation instruction plate (165) and valve subassembly as paragraphs B. and C. Changed paragraph 5. to paragraph 3.D., paragraph 6. to paragraph 3.E. and subparagraphs. Added figure item 170B to paragraphs 3.D.(9) and 3.E.(7). Changed paragraph 7. to paragraph 3.F. and renumbered subparagraph (1). Relocated text.

Chapter/Section and Page No.	Description of Change
page 704	Renumbered paragraph 3.F. text. Changed CAUTION to WARNING and added NOTE for paragraph 3.G. Relocated text.
pages 705, 706	Combined steps (1) thru (5) under new paragraph 3.J. Added NOTE to step (1) and steps (3) and (5). Added new paragraph 3.K. Renumbered previous paragraph 8. to 4. Wheel Balancing and paragraph 9. to 5. Storage Instructions. Renumbered Figure 702 and references to Figure 701. Renumbered Figure 703 references to 702.
page 707	Renumbered Figure 703 to Figure 702. Relocated text.
page 708	Relocated text.
page 801/802	Added figure item 215 to Figure 801 and figure item 230A to Figure 802.
page 901/902	Changed application for Tool No. 1-71409 to use with aluminum disk drive ring only. Deleted Goodyear reference in NOTE.
page 1001	Revised paragraph 1., IPL Introduction to latest format.
page 1002	Revised IPL Figure 1 adding part number 9544382-2 to title. Changed figure item references to agree with Parts List.
pages 1003 thru 1005	Revised paragraph 2., Parts List as follows: Multipled all figure items by 10. Items 1 and 1A - Added with "Order 1 or 2". Item 1B - Added with Effect Code. Items 10 and 10A - Was 1 and 1A. Item 20 - Was 2. Item 30 - Was 3. Item 40 - Was 4. Item 50 - Was 5. Item 60 - Was 6. Item 60A - Added as replacement for Effect Code B only. Item 70 - Was 7. Item 80 - Was 8. Item 90 - Was 9. Item 95 - Was 9A. Item 95A - Was 9B. Item 100 - Was 10.

Chapter/Section and Page No.	Description of Change
pages 1003 thru 1005 (continued)	Item 110 - Was 11. Item 120 - Was 12. Item 120A - Was 12A. Item 130 - Was 13. Item 140 - Was 14. Item 140A - Was 14A. Item 150 - Was 15. Item 160 - Was 16. Item 160A - Was 16A. Item 165 - Added. Item 170 - Was 17. Item 170A - Was 17A. Item 170B - Added with Effect Code. Item 180 - Added Effect Code AB. Item 190 - Was 19. Item 200 - Was 20. Item 200A - Was 20A. Added Effect C. Item 201 - Was 20B. Item 210 - Was 21. Added Effect Code AB. Item 211 - Was 21A. Item 215 - Added with Effect Code C. Item 220 - Was 22. Item 220A - Added with Effect Code C. Item 230 - Was 23 and illustrated. Added Effect Code AB. Item 230A - Added with Effect Code C. Item 240 - Was 24. Item 241 - Was 24A. Items 201, 211, 241, 250, 260, 270 thru 270E, 280 thru 280B - Added asterisk (*) for items not furnished; order separately. Relocated text.
page 1006	Updated vendor names and addresses in pararaph 3. Relocated text.

TO: HOLDERS OF AP-309 (32-40-24) OVERHAUL MANUAL WITH ILLUSTRATED PARTS LIST FOR MAIN WHEEL ASSEMBLIES 9544382 and 9544382-1 USED ON THE DE HAVILLAND TWIN OTTER AIRCRAFT.

Attached to this transmittal letter is Revision No. 5 of AP-309 (basic issue dated 15 January 1969).

REVISION NO. 5 DATED 30 JULY 1985

HIGHLIGHTS

REVISION NO. 5 CONTAINS ALL PAGES OF THE MANUAL. Pages which have been added or revised are outlined below, together with the Highlights of the revision.

Please retain all previous HIGHLIGHTS pages inserting them into this manual for future reference.

Chapter/Section and Page No.	Description of Change
All pages	This manual has been prepared with automated word processing equipment. Shifting of text may have occurred. Marking of the shifted text has been eliminated. Marking of text pages reflect only actual changes. Changed the format of Overhaul Manual to Component Maintenance Manual, renumbering and relocating sections in compliance with ATA-100. Changed the masthead to Component Maintenance Manual. Changed O-ring to preformed packing and wheel half to wheel subassembly throughout the text.
Cover	Revised to reflect current revision.
Title Page	Revised to reflect current revision.
Record of Revisions, page 1/2	Added Revision No. 5.
List of Effective Pages pages 1 and 2	Revised to reflect current revision.
Table of Contents, pages 1 and 2	Revised to latest format. Expanded table for clarification. Added TESTING AND FAULT ISOLATION section, combined ASSEMBLY and STORAGE into one section, added SPECIAL TOOLS, FIXTURES, AND EQUIPMENT section.
Introduction, pages 1 thru 5/6	Revised to reflect current revision and field office addresses.

Chapter/Section and Page No.	Description of Change
32-40-24	
page 1	Relocated last sentence of paragraph 1.A. to Wheel Differences. Deleted titles to paragraphs 2.A., B., and C. Changed disk drive ring to internal drive ring in paragraph 2.C.
page 2	Added new Figure 1. Relocated text.
page 3/4	Added new paragraph 5. for Wheel Differences. Added figure item 9.A. in Key to Figure 1. Changed disk drive ring to internal drive ring, figure item 23.
pages 101 thru 106	Added new TESTING AND FAULT ISOLATION Section.
pages 301 and 302	Revised and relocated DISASSEMBLY section from page 101 to 301. Revised paragraph 1. Deleted previous paragraphs 1.(1), (2), and (3).
page 401	Relocated CLEANING section from page 201 to 401. Renumbered and revised entire section. Added Specification MIL-T-81533 and soft wire brush to Cleaning Materials, paragraph 1.
page 402	Added (Ref. IPL Fig. 1) to paragraph 2. title and added CAUTION. Added new paragraph 2.A. Renumbered paragraphs 2.C. to 2.B. and 2.D. NOTE to 2.B. Added new NOTES for paragraphs B. and C. and paragraph 2.D.
page 403/404	Revised paragraph 3., Paint Removal Procedures. Deleted reference to carbon throughout paragraph 3. Added page for revised paragraph 3. text. Relocated text.
page 501	Relocated CHECK section from page 301 to 501. Renumbered and revised entire section. Added new paragraphs 2.B. and 2.C. Relocated NOTE to follow new paragraph 2.C. and changed Figure 301 reference to Figure 501. Deleted paragraph 3. Examination.
pages 502 and 503	Renumbered Figure 301 to 501 and renumbered figure references 401 and 402 to 601 and 602. Deleted paragraphs 3.B. thru 3.E. Added new subparagraphs 2.C.(1) thru (3).
page 503	Added new paragraph 3., Wheel Subassembly.

Chapter/Section and Page No.	Description of Change
pages 503 and 504	Added new paragraphs 4. thru 7. for checking main wheel components. Relocated Figure 302 and renumbered to Figure 502.
pages 505 and 506	Added new Figure 503, Bearing Seal Wear Limits. Added new paragraphs 8. thru 10. for checking main wheel components.
page 601	Relocated REPAIR section from page 401 to 601. Revised and renumbered entire section. Expanded Repair Materials List, paragraph 1.
page 602	Relocated paragraph 2. General. Changed paragraph 3. title to Repair of Wheel Subassemblies, and revised text. Relocated previous paragraph 4. text into new paragraph 3. Relocated paragraph 5. text into new paragraph 4., Replacing Defective Tapered Roller Bearing Cups.
page 603	Relocated and renumbered Figure 401 to Figure 601. Revised title to Repair Areas for Inboard Wheel Subassemblies 9544393 and 9544383-1.
page 604	Revised and relocated repair areas, as Key to Figure 601, for Inboard Wheel Subassembly.
page 605	Relocated and renumbered Figure 402 to Figure 602. Revised title to Repair Areas for Outboard Wheel Subassembly 9543052.
page 606	Revised and relocated repair areas, as Key to Figure 602, for Outboard Wheel Subassembly.
page 607	Added expanded text for new paragraph 4. Replacing Defective Bearing Cups.
pages 607, 608, and 610	Added new paragraph 5., Replacing Internal Drive Ring.
page 609	Added new Figure 603, Installing Internal Drive Ring.
pages 610 thru 615/616	Renumbered paragraph 7. to paragraph 6., Re-Treating and Repainting.
page 611	Added new Figure 604, Painting Diagram (Method I).
page 612	Added new Figure 605, Painting Diagram (Method II).
pages 613 thru 615/616	Added new text for Re-Treating and Repainting paragraph 6.

Chapter/Section and Page No.	Description of Change
REPAIR NO. 1	
pages 601 thru 603/604	Relocated previous paragraph 5. to REPAIR NO. 1. Expanded text.
page 602	Relocated and renumbered Figure 403 to 601.
REPAIR NO. 2	
pages 601 thru 604	Relocated previous paragraph 6. to REPAIR NO. 2. Expanded text.
page 602	Relocated and renumbered Figures 404 and 406 to 601 and 602.
page 603	Added new Figure 603, New Fairing Mounting Hole Rework (Metal Set-A4).
REPAIR NO. 3	
pages 601 and 602	Relocated previous paragraph 8. to REPAIR NO. 3. Added new Figures 601, Drive Flange Rivet Hole Repair and Figure 602, Drive Flange Rivet Hole Repair Bushing 5006511.
REPAIR NO. 4	
pages 601 and 602	Added text for Drive Flange Tee Bar Plunger Hole Repair.
page 701	Relocated section from pages 501 and 901. Changed title of section to ASSEMBLY AND STORAGE.
page 703	Relocated and renumbered Figure 501 to Figure 701.
page 706	Relocated and renumbered Figure 502 to Figure 702. Relocated text.
page 707	Added paragraph 8., Wheel Balancing. Relocated paragraph 9. Storage Instructions, from previous STORAGE section.
page 708	Added Figure 703 Balance Weight Installation for inboard and outboard wheel subassemblies.
page 709/710	Relocated Storage Instructions, paragraph 9.
page 801/802	Relocated FITS AND CLEARANCES section from page 601 to 801. Renumbered Figures 601 and 602 to Figures 801 and 802 respectively. Changed Disk Drive Ring to Internal Drive Ring in Figure 802.

Chapter/Section and Page No.	Description of Change
page 901	Added SPECIAL TOOLS, FIXTURES, AND EQUIPMENT section.
page 1001	Added latest Illustrated Parts List Introduction.
page 1002	Identified figure item 6 in Figure 1.
page 1003	Revised Parts List as follows: Item 1 - Added (order-1) and effect code A to Main Wheel Assembly 9544382. Added effect code B to Main Wheel Assembly 9544382-1. Item 2 - Added tapered roller bearing and (Class 2 or 4 only) to nomenclature. Item 8 - Corrected part number to AN6230-49 and changed nomenclature to preformed packing. Item 9A - Added figure item number for valve subassembly TR757-03. Added vendor code 79934. Item 9B - Added figure item number for valve subassembly. Added vendor code 79934. Item 12A - Added part. Item 14A - Added part. Item 16 - Added tapered roller to nomenclature. Item 16A - Added figure item number for bushing-cup subassembly. Item 17 - Added effect code A. Deleted (for 9544382). Item 17A - Added effect code B. Deleted (for 9544382-1). Item 20 - Added effect code A. Item 20A - Added effect code B. Deleted (for 9544382-1). Item 20B - Added figure item -20B, Flange Bushing 5007112 for repair only. Item 21A - Corrected to not illustrated. Item 23 - Changed Disk Drive Ring to Internal Drive Ring. Item 24 - Added tapered roller bearing and (Class 2 or 4 only) to nomenclature. Item 24A - Added for bushing-cup subassembly, part number 5R3-4-167. Item 25 - Added nut for balancing. Item 26 - Added washer for balancing. Item 27, A thru E - Added balance weights. Item 28, A and B - Added screws for balance weights.
page 1005/1006	Updated vendor addresses in paragraph 3.

TO: HOLDERS OF AP-309 (32-40-24) OVERHAUL MANUAL WITH ILLUSTRATED PARTS LIST FOR MAIN WHEEL ASSEMBLIES 9544382 and 9544382-1 USED ON THE DE HAVILLAND TWIN OTTER AIRCRAFT.

Attached to this transmittal letter is Revision No. 4 of AP-309 (basic issue dated 15 January 1969).

REVISION NO. 4 DATED 16 AUGUST 1982

HIGHLIGHTS

Pages which have been added or revised are listed below together with the Highlights of the revisions. Please delete the affected pages and insert Revision No. 4 pages dated August 16, 1982. Enter Revision No. 4 dated August 16, 1982 and insertion date on the Record of Revisions sheet.

Please retain all previous HIGHLIGHTS pages inserting them into this manual for future reference.

Chapter/Section and Page No.	Description of Change
Title Page	Revised to reflect current revision.
List of Effective Pages, page 1/2	Revised to reflect current revision.
32-40-24	
page 2	Corrected antiseize compound Specification MIL-G-81322 to MIL-T-5544.
page 601	Corrected 90 lb-ft to 90 lb-in in Figure 601.

LORAL
Aircraft Braking Systems

OVERHAUL MANUAL WITH IPL
MAIN WHEEL ASSEMBLY 9544382

TO: HOLDERS OF AP-309 (32-40-24) OVERHAUL MANUAL WITH ILLUSTRATED PARTS LIST FOR MAIN WHEEL ASSEMBLIES 9544382 and 9544382-1 USED ON THE DE HAVILLAND TWIN OTTER AIRCRAFT.

Attached to this transmittal letter is Revision No. 3 of AP-309 (basic issue dated 15 January 1969).

REVISION NO. 3 DATED 1 APRIL 1982

HIGHLIGHTS

REVISION NO. 3 CONTAINS ALL PAGES OF THE MANUAL. Pages which have been added or revised are outlined below, together with the Highlights of the revision.

Please retain all previous HIGHLIGHTS pages inserting them into this manual for future reference.

Chapter/Section and Page No.	Description of Change
All pages	This manual has been prepared with automated word processing equipment. Shifting of text may have occurred. Marking of the shifted text has been eliminated. Marking of text pages reflect only actual changes. Changed masthead to Goodyear Aerospace.
Cover	Revised to reflect current revision.
Title Page	Revised to reflect current revision.
Record of Revision, page 1/2	Added Revision No. 3.
Record of Temporary Revisions, page 1/2	Added Temporary Revisions 32-1, 32-2, and 32-3.
List of Effective Pages, page 1/2	Revised to reflect current revision.
Table of Contents pages 1 and 2	Expanded table for clarification and added Introduction.
Introduction, pages 1 thru 4	Revised to reflect current revision and field office addresses.

Chapter/Section and Page No.	Description of Change
32-40-24	
page 1	Relocated text. Added Operation to paragraph 2. title. Added paragraph 3. Handling Procedures.
page 2	Relocated text. Changed paragraph 3. to 4. Added wheel size, material, and lubricant information to paragraph 4. Added 1A Alternate Outboard Bearing Seal, incorporating TR32-1, to Key to Figure 1.
page 3/4	Added figure item 1A to Figure 1., incorporating TR32-1.
page 101	Relocated text. Changed Schrader 4722 to 4277 in paragraph 2.A. Added paragraph 2.B. and renumbered paragraphs B. thru E. to C. thru F. Added or 1A to paragraph 2.B. NOTE., incorporating TR32-1.
page 102	Relocated text. Renumbered paragraphs F., G. and H. to G., H. and I.
page 201	Added paragraph 1. Cleaning Materials. Changed paragraph 1. title and number to paragraph 2. Cleaning Procedures and renumbered subparagraphs. Relocated text.
page 202	Relocated text. Added or 1.A. to paragraph 2.E., incorporating TR 32-1. Changed paragraph 2. to 3. Paint and/or Carbon Removal Procedures. Added paint removal instructions to paragraph 3. and renumbered subparagraphs. Changed Specification MIL-C-25107 to MIL-C-19853, Type II in paragraph 3.B.
page 301	Deleted Figure 302 information is now incorporated in paragraph 1. - Check Materials. Changed paragraph 1. to 2. and 2. to 3. Added or 1.A. to paragraph 3.A., incorporating TR32-1. Relocated text.
page 302	Relocated text.
page 303	Relocated text. Renumbered figure references and Figure 303 to 302.
page 304	Relocated text.

Chapter/Section and Page No.	Description of Change
page 401	Added paragraph 1. - Repair Materials. Renumbered paragraphs 1. and 2. to 2. and 3. and subparagraphs. Revised paragraph 2. Added CAUTION to paragraph 3. Relocated text.
page 402	Relocated text. Renumbered paragraph 3. subparagraphs.
page 403	Renumbered paragraph 3. to 4. and subparagraphs. Relocated text.
page 404	Renumbered paragraphs 4. and 5. to 5. and 6. and subparagraphs. Deleted Dow 1. and added Type VI in paragraph 5.A.(3). Relocated text.
page 406	Changed Specification MIL-P-8585 to TT-P-1757 in Figure 405 NOTE.
page 407	Renumbered paragraph 6. to 7. Deleted Dow 1 and added Type VI in paragraph 7.A. Changed Specification MIL-P-8585 to TT-P-1757 in paragraphs 7.B. and 7.C. Added paragraph 8. Drive Flange Rivet Hole Repair. Relocated text.
page 408	Added page for new Figures 406 and 407.
page 501	Added paragraph 1. - Assembly Materials. Renumbered paragraphs 1. and 2. to 2. and 3. and subparagraphs. Changed Specification MIL-P-8585 to TT-P-1757 in paragraph 3.A.(1)(b). Relocated text.
page 502	Relocated text. Renumbered paragraph A subparagraphs. Added included angle -21 places to paragraph 3.A.(2)(d). Changed paragraph C. to B.
page 503	Relocated text. Added 21 places for counterboring, Counterbore tool: 5T1-71409, and No counterbore this location, 3 places to Figure 501, incorporating TR 32-3.
page 504	Renumbered paragraph D. and E. to C. and D. Renumbered paragraphs 3. and 4. to 4. and 5. Renumbered paragraph 4. subparagraphs. Changed Specification MIL-P-8585 to TT-P-1757 in paragraph 4.A.(1)(b). Relocated text.
page 505	Renumbered paragraphs 5. and 6. to 6. and 7. Relocated text.
page 506	Relocated text. Added or 1.A. to paragraph 7.E.

Chapter/Section and Page No.	Description of Change
page 507/508	Relocated text.
page 601/602	Added Figures 601 and 602 using deleted paragraphs 1 and 2 information.
page 901/902	Revised STORAGE INSTRUCTIONS to reflect the latest information.
page 1101	Revised IPL Introduction to reflect the latest information. Relocated text.
page 1102	Added figure item no. 1A to IPL Figure 1.
pages 1103 and 1104	Renumbered paragraph 3. to 2. Parts List. Relocated text. Revised Parts List, incorporating TR 32-1, as follows: Added figure item no. 1A, Alternate Outboard Bearing Seal 9533856. Changed figure item no 6, Washer COML3954771 to MS20002-6. Added (for 9544382) to figure item no 17. Added (for 9544382-1) to figure item no. 17A. Added figure item no. 21A, Rivet Bushing 5006511.
page 1105/1106	Renumbered paragraph 2. to 3. and revised vendor addresses. Added page for relocated text.

LORAL
Aircraft Braking Systems

OVERHAUL MANUAL WITH IPL
WHEEL ASSEMBLY PART NO. 9544382

TO: HOLDERS OF AP-309 - OVERHAUL MANUAL AND ILLUSTRATED PARTS LIST - MAIN WHEEL ASSEMBLY 9544382 AND BRAKE ASSEMBLY 9550377 FOR DE HAVILLAND TWIN OTTER AIRCRAFT.

Attached to this transmittal letter is Revision No. 2 of AP-309 (basic issue dated 15 January 1969).

REVISION NO. 2 DATED 1 NOVEMBER 1973

REVISION NO. 2 CONTAINS ALL PAGES OF THE MANUAL. Pages which have been revised are outlined below, together with the Highlights of the revision. Retain Highlights pages in manual for future reference.

HIGHLIGHTS

Chapter/Section/Page	Description of Change
Cover	Changed to new format and deleted Brake Assembly 9550377. Added 9544382-1 Wheel Assembly.
Title	Changed revision date.
List of Effective Pages	Revised to reflect current revision.
Record of Revisions	Added Revision 2.
Service Bulletin List	Revised to indicate service bulletins considered.
Introduction, pages 1 thru 4	Revised to reflect current changes.
Contents	Revised to reflect current changes.
All pages	Changed masthead and "disc" to "disk."
32-40-24, page 1	Added 9544382-1 Wheel Assembly and reference to Figure 1. Relocated text.
32-40-24, page 2	Added page for Key to Figure 1 and relocation of text.

OVERHAUL MANUAL WITH IPL
WHEEL ASSEMBLY PART NO. 9544382

Chapter/Section/Page	Description of Change
32-40-24, page 3/4	Added page for Figure 1.
32-40-24, page 101	Added reference to IPL Fig. 1, WARNING and revised CAUTION to paragraph 1. Revised paragraph 2A. Relocated text.
32-40-24, page 102	Relocated text. Changed item numbers in paragraph H.
32-40-24, page 103/104	Deleted.
32-40-24, page 201	Changed to IPL Fig. 1 reference in paragraph 1. Changed grease specification in paragraph 1B. Changed denatured to isopropyl alcohol in paragraph 1 C & D. Relocated text.
32-40-24, page 202	Changed grease specification in paragraph 2C. Relocated text.
32-40-24, page 301	Relocated text. Changed Inspection/Check to Check. Changed Inspect to check in all paragraphs. Changed reference to IPL Fig. 1 in paragraphs 1 & 2. Added item number to paragraph E.
32-40-24, page 302	Revised Fig. 302. Relocated text.
32-40-24, page 303	Relocated text.
32-40-24, page 401	Relocated text. Added 9544383-1 Wheel Subassembly to Figure 401.
32-40-24, pages 402 & 403	Relocated text.
32-40-24, page 404	Relocated text and added paragraph 5.
32-40-24, page 405	Revised Figure 403.
32-40-24, page 406	Added page for Figures 404 & 405.

Chapter/Section/Page	Description of Change
32-40-24, pages 407/408	Added page for relocation of text. Paragraph 6 was 5.
32-40-24, page 501	Added reference to IPL Fig. 1 in paragraph 2. Relocated text.
32-40-24, page 503	Relocated text. Added item number and NOTE to paragraph 2C. Added paragraph 2E.
32-40-24, page 504	Relocated text. Added reference to IPL Fig. 1 to paragraphs 3 & 4. Changed denatured to isopropyl alcohol in paragraph 4A.
32-40-24, page 505	Relocated text. Changed grease specification in paragraph 4G. Added item number to paragraph 4I & 5G. Changed IPL Fig. 1 reference number in paragraphs 5 & 6. Changed denatured to isopropyl alcohol in paragraph 5A.
32-40-24, page 506	Relocated text. Changed grease specification and revised CAUTION in paragraph 6C.
32-40-24, page 507	Relocated text. Revised Figure 502 title.
32-40-24, page 601/602	Changed reference to IPL Fig. 1.
32-40-24, page 901/902	Revised Storage Instructions.
32-40-24, page 1101	Revised Illustrated Parts List.
32-40-24, page 1102	Changed Figure 1101 to 1 and revised picture.
32-40-24, page 1103/1104	Revised Parts List.

LORAL
Aircraft Braking Systems

COMPONENT MAINTNANCE MANUAL
MAIN WHEEL ASSEMBLY 9544382

RECORD OF REVISIONS

REV NO.	ISSUE DATE	DATE INSERTED	BY
1	May 1/73	Nov 1/73	GTR
2	Nov 1/73	Nov 1/73	GTR
3	Apr 1/82	Apr 1/82	GAC
4	Aug 16/82	Oct 10/85	GAC
5	Jul 30/85	Jul 30/85	GAC
6	Oct 30/88	Oct 30/88	LABS

REV NO.	ISSUE DATE	DATE INSERTED	BY

COMPONENT MAINTENANCE MANUAL
MAIN WHEEL ASSEMBLY 9544382

RECORD OF TEMPORARY REVISIONS

TEMPORARY REVISION NUMBER	PAGE NUMBER	ISSUE DATE	BY	DATE REMOVED	BY
32-1	1 thru 9	Aug 27/76	GAC	Apr 1/82	GAC
32-2	1 and 2	May 22/80	GAC	Apr 1/82	GAC
32-3	1 and 2	Jul 29/80	GAC	Apr 1/82	GAC

SERVICE BULLETIN LIST

SERVICE BULLETIN NUMBER	REV NO.	DATE INSERTED
DH-32-1		Nov 1/73
DH-32-2		No Effect
DH-32-3		No Effect
DH-32-4		No Effect

SERVICE BULLETIN NUMBER	REV NO.	DATE INSERTED

To Be Corrected at next manual revision

LIST OF EFFECTIVE PAGES

SUBJECT	PAGE	DATE
Title		Oct 30/88
Record of Revisions	1	Oct 30/88
	2	Blank
Record of Temporary Revisions	1	Oct 30/88
	2	Blank
Service Bulletin List	1	Oct 30/88
	2	Blank
List of Effective Pages	1	Oct 30/88
	2	Oct 30/88
Table of Contents	1	Oct 30/88
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	4	Blank
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Repair No. 1	601	Oct 30/88
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624 Blank

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Assembly and Storage	701	Oct 30/88
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	707	Oct 30/88
	708	Oct 30/88
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	802	Blank
Special Tools, Fixtures, and Equipment	901	Oct 30/88
	902	Blank
Illustrated Parts List	1001	Oct 30/88
	1002	Oct 30/88
	1003	Oct 30/88
	1004	Oct 30/88
	1005	Oct 30/88
	1006	Oct 30/88

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INTRODUCTION

This manual is published in accordance with Air Transport Association Specification No. 100 for the guidance of personnel responsible for the overhaul and/or maintenance of the assembly(ies) covered in this publication. The procedures described in this manual may be altered if better and/or more economical equivalent methods can be employed by the individual facilities. However, the alternate procedures must not lessen the performance or efficiency of operation of the assembly, and all torque and specific limits or values contained herein must be strictly observed.

All dimensions and other values are expressed in U.S. units followed, where applicable, by the appropriate SI (International System) metric units in parentheses. All illustration dimensions are in inches with millimeter conversions in parentheses unless otherwise specified. Dimensions of standard tools or parts such as drills, taps, bolts, nuts, etc. where there are no equivalent metric tools or parts for the application, appear in U.S. units. Illustrations are for reference only and are not drawn to scale. Attempt is made to illustrate relationship to adjoining parts in proper proportion.

The following precautions apply to all procedures in this manual:

NOTICE

Any alteration to or substitution of any part contained in any wheel and/or brake affecting those assemblies could result in unit malfunction, or other adverse effects.

If alteration to or substitution of any part contained in any Loral Aircraft Braking Systems wheel and/or brake affecting those assemblies is necessary, obtain prior written Loral Aircraft Braking Systems authorization and instruction before performing such alteration or substitution.

LORAL AIRCRAFT BRAKING SYSTEMS ASSUMES NO LIABILITY WHATSOEVER, WHETHER CONTRACTURAL, WARRANTY, TORT OR OTHERWISE, FOR ANY UNAUTHORIZED SUBSTITUTION OF OR ALTERATION TO ANY PART CONTAINED IN ANY WHEEL AND/OR BRAKE OR FOR ANY ALTERATION NOT PERFORMED IN ACCORDANCE WITH LORAL AIRCRAFT BRAKING SYSTEMS APPROVED PROCEDURES.

While Loral Aircraft Braking Systems represents the information contained in this manual was current at the time of publication of this issue, and verified by comparison to engineering documentation, the user is cautioned that he must inquire of the nearest authorized distributor or dealer of Loral Aircraft Braking Systems wheels and brakes as to whether a more recent publication is in existence before proceeding with overhaul or maintenance operations. If you cannot locate a dealer or distributor, make your inquiry directly to our Customer Support Department, Loral Aircraft Braking Systems, 1204 Massillon Road, Akron, Ohio 443306-4186.

Users outside the United States and Canada should contact the nearest Loral Aircraft Braking Systems International Field office as listed in this manual or the closest Loral Aircraft Braking Systems distributor.

The aircraft maintenance manual shall take precedence for the component's interface connections with the functional features as used in the aircraft. This manual may also describe functional features that may or may not be used when installed as a component of a system in the aircraft.

TSO NOTICE

This assembly for commercial transport usage carries a "TSO" marking which identifies it as hav'ng been fully laboratory tested and qualified to the applicable Federal Aviation Administration (FAA) regulations. As a commercial transport category assembly, it is also tested and qualified to the specification requirements of the applicable airframe manufacturer and, finally, is certified on the applicable aircraft.

After final certification, any substitution of or alteration to any part and/or any change of process or material is not permitted without complete requalification of this assembly and resubmittal of the test data to the FAA for approval.

The FAA regulations subject Loral Aircraft Braking Systems the airframe manufacturer and the operator to constant surveillance to assure that proper Quality Assurance material and processing controls are maintained in order to provide replacement parts that are the same quality as the parts originally certified in this assembly.

SAFETY SUMMARY

Adhere to all manufacturer's Warnings and Cautions for all materials specified in this manual. Wear protective clothing (gloves, apron, etc.) approved for the materials and tools being used.

DATA RIGHTS

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DESCRIPTION AND OPERATION

1. General

A. The main wheel assemblies are 11.00 x 12 wheels designed for tube or tubeless Type III tires. The wheels are manufactured from magnesium alloy castings.

2. Description and Operation (Ref. Fig. 1)

A. The wheel is the divided type to facilitate tire installation and removal. The two wheel subassemblies (inboard and outboard) are held together with 12 bolts and self-locking nuts, with a washer under each bolt head and nut. A preformed packing mounted on the outboard subassembly, provides the air seal at the juncture of the two wheel subassemblies. A special valve assembly is installed in the outboard wheel subassembly to inflate and deflate the tubeless tire. With tube-type tires, neither the preformed packing nor valve assembly are used.

B. When the assembly is installed on the aircraft, the tapered cone and roller bearings, on which the wheel rotates, seat inside the bearing cups. The bearing cups are shrink-fitted into the hubs of each wheel subassembly. The bearings are protected against the loss of grease or entrance of foreign material by rubber-lipped bearing seals. The outboard bearing and seal are held in position by the axle nut, and the inboard bearing seal is held in position by a retaining ring.

C. An aluminum alloy or steel internal drive ring is shrink-fitted into the inboard wheel subassembly and is secured with rivets or bolts and washers. It engages the brake disk when the wheel and brake are installed on the aircraft. Three steel disk springs and three tee bar plungers are secured to the flange of the inboard wheel subassembly to align the disk in the wheel and eliminate noise.

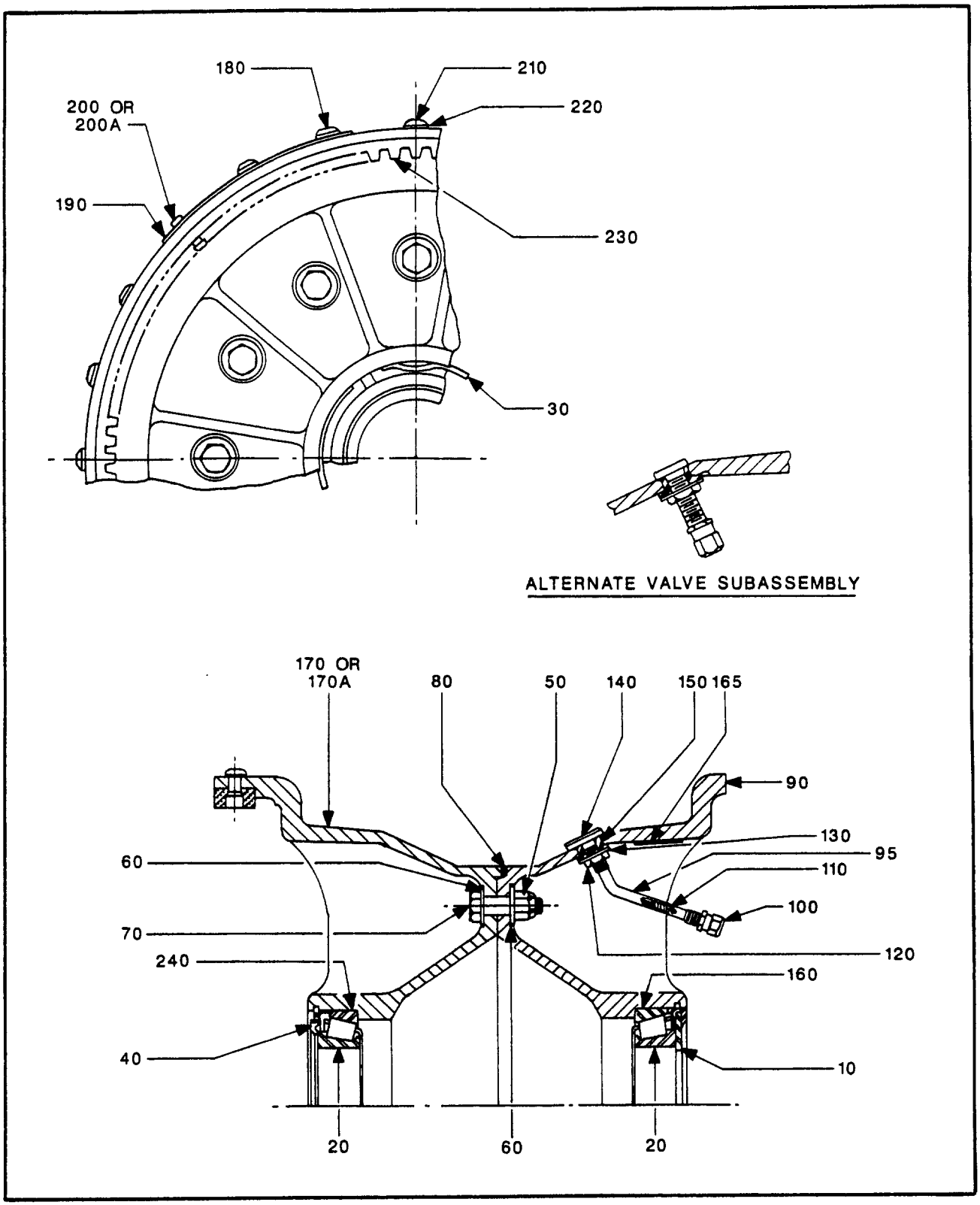
D. Each wheel subassembly is balanced individually at the time of manufacture. This permits one wheel subassembly to be assembled in any position in relation to the other wheel subassembly and allows interchanging of wheel subassemblies without rebalancing the assembly.

3. Handling Procedures

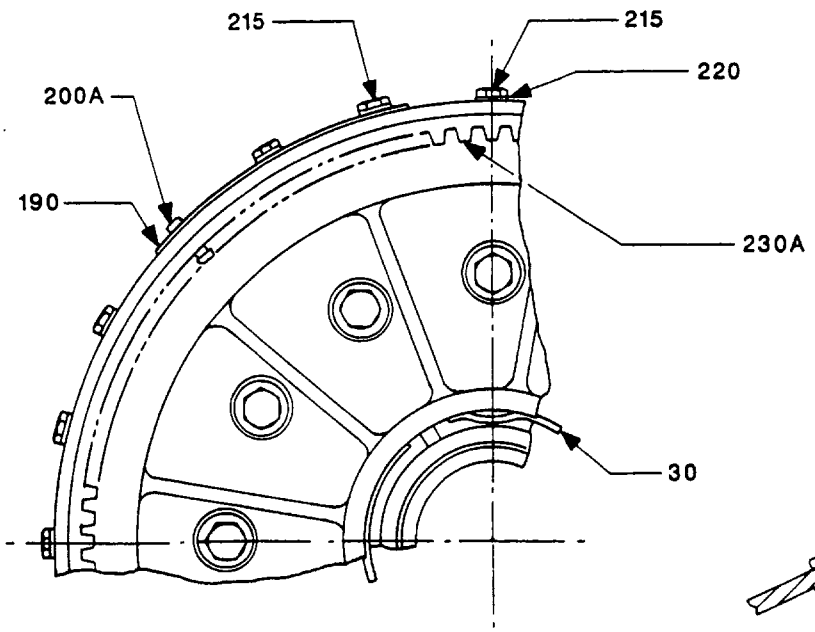
A. Careful handling of the wheel components will assure a long service life and trouble-free operation.

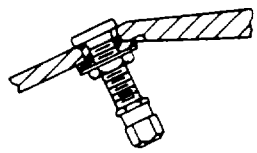
B. Strictly observe the inflation and deflation procedures and the torque values specified in this manual. Do not overtighten any bolt or nut. Do not use impact or power wrenches to remove or tighten any threaded parts.

C. Handle the wheel bearing cones with extreme care. Dropping or mishandling the cones during maintenance or overhaul may cause bearing failures. Do not drive bearing cones onto aircraft axle. Never overtighten the axle nut.

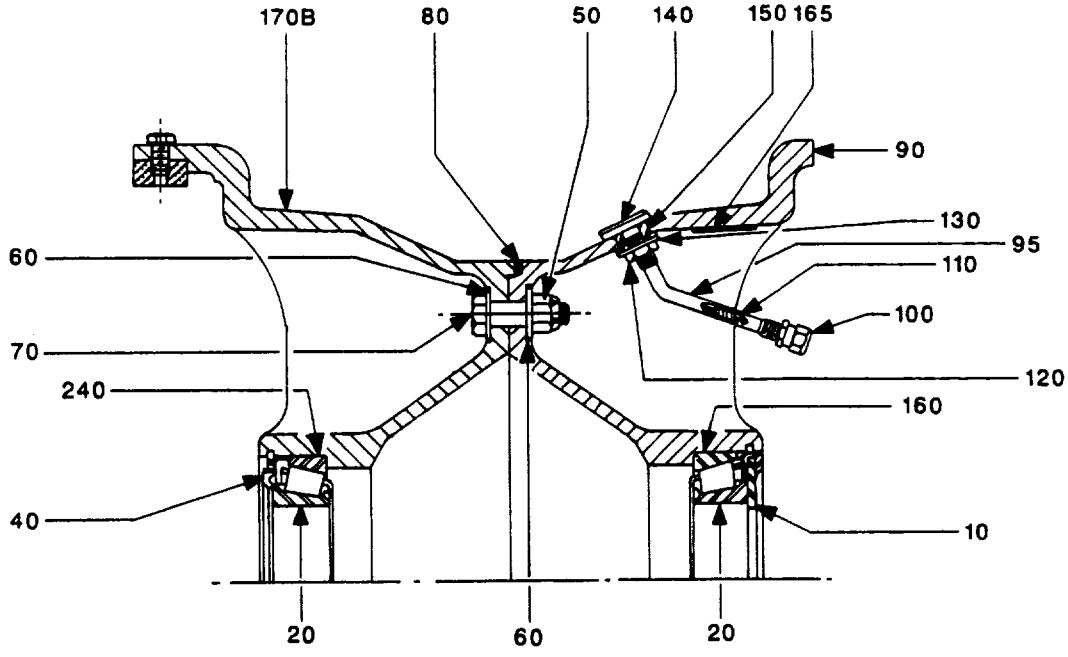


Main Wheel Assemblies 9544382 and 9544382-1
Figure 1 (Sheet 1 of 2)





ALTERNATE VALVE SUBASSEMBLY



Main Wheel Assemblies 9544382-2
Figure 1 (Sheet 2 of 2)

Key to Figure 1

-1.	Not Used	140.	Valve Stem
10.	Outboard Bearing Seal	150.	Rubber Grommet
20.	Tapered Roller Bearing Cone and Rollers	160.	Tapered Roller Bearing Cup
30.	Wire Retaining Ring	165.	Instruction Plate
40.	Inboard Bearing Seal	170.	Inboard Wheel Subassembly
50.	Self-Locking Nut	170A.	Inboard Wheel Subassembly
60.	Washer	170B.	Inboard Wheel Subassembly
70.	Bolt	180.	Rivet
80.	Preformed Packing	190.	Disk Spring
90.	Outboard Wheel Subassembly	200.	Tee Bar Plunger
95.	Valve Subassembly	200A.	Tee Bar Plunger
100.	Valve Cap	210.	Rivet
110.	Valve Core	215.	Bolt
120.	Hex Nut	220.	Washer
130.	Ring Washer	230.	Internal Drive Ring (Aluminum)
		230A.	Internal Drive Ring (Steel)
		240.	Tapered Roller Bearing Cup

- Item not illustrated.

D. Handle and maintain the wheel subassemblies properly to protect the paint and surface finishes. Exposed magnesium is susceptible to corrosion. Nicks, scratches, and other damage caused by improper handling of the wheel subassemblies invite corrosion, which if unattended will lead eventually to fatigue cracks and premature removal from service.

4. Leading Particulars

Wheel (Tire) Size and Type . . . . . 11.00 x 12 (Type III), tube or tubeless
Material . . . . . Magnesium Alloy
Wheel Bolt Nut Torque. . . . . 90 pound-inches (10,2 N-m) Lubtork*
Bearing and Packing Lubricant . . . . Bearing Grease, Specification MIL-G-81322

*Lubtork- At each installation, lubricate bolt threads and bearing surfaces of bolt heads, washers, and nuts with antiseize compound conforming to Specification MIL-T-5544.

5. Wheel Differences

A. Main Wheel Assembly 9544382-1 is identical to Main Wheel Assembly 9544382 except for the tee bar plunger.

B. Main Wheel Assembly 9544382-2 with a steel disk drive ring differs from Main Wheel Assembly 9544382-1 with an aluminum disk drive ring. Also, bolts instead of rivets are used on Main Wheel Assembly 9544382-2.

TESTING AND FAULT ISOLATION

1. Test Equipment and Materials

NOTE: Equivalent substitutes may be used for items listed below.

Tire Pressure Gage - Capable of measuring up to 225 psi (15,51 bars). Scale may be greater than 1 psi (0,068 bars) increments but scale should be readable to 1 psi.	Commercially available
Inflation Cage	Commercially available
Tire Deflator Schrader No. 4277	Schrader Automotive, Incorporated Division of Arvin Industries 566 Mainstream Drive P.O. Box 675 Nashville, TN 37202-0675
Grease Specification MIL-G-81322	Commercially available
Antiseize Compound Specification MIL-T-5544 (or)	W J Ruscoe and Company 483 Kenmore Boulevard Akron, OH 44301
Antiseize Compound Specification MIL-T-83483	Commercially available
Soap Solution 30 percent soap solution	Commercially available
Soft Bristle Brush	Commercially available
Cellulose Sponge	Commercially available
Hardness Tester Rockwell (B Scale preferred), Model 4YSPL or 3QR-146	Page-Wilson Corporation 929 Connecticut Avenue P.O. Box 9021 Bridgeport, CT 06602
Hardness Tester King Portable Brinell	King Tester Corporation Philadelphia, PA

2. General

WARNING: TO PREVENT POSSIBLE INJURY TO PERSONNEL, EXERCISE ALL SAFETY PRECAUTIONS BEFORE CONDUCTING TESTS.

A. The purpose of this test section is to provide guidance of maintenance personnel responsible for overhaul and/or maintenance as follows:

(1) To determine the extent of disassembly required.

(2) To provide operational test (leak test) after maintenance action to verify proper wheel/tire assembly.

B. Serviceability of aircraft wheels subjected to rolling with a flat or disintegrated tire and damage to overloaded mating wheel, where applicable, should be checked in accordance with CHECK.

C. Check for missing or broken wheel bolts.

(1) If a single bolt is broken or missing, replace bolt and two adjacent bolts (one on either side). If a bolt is cracked, replaced cracked bolt only, in accordance with DISASSEMBLY.

(2) Magnetic particle check (or equivalent) all other bolts after thorough cleaning in accordance with CLEANING and CHECK.

(3) If more than one bolt is broken, all bolts are nonserviceable.

3. Test Setup

A. None required.

4. Operational Test and Fault Isolation Procedures (Ref. IPL Fig. 1)

WARNING: TO PREVENT POSSIBLE INJURY TO PERSONNEL, EXERCISE ALL SAFETY PRECAUTIONS BEFORE CONDUCTING TESTS.

NOTE: Steps A. and B. should be performed to determine the exact condition or malfunction of the main wheel assembly. All variations from the established leakage rates should be noted for future reference during testing.

A. Perform the following to determine the extent of disassembly required.

CAUTION: BEARING SEALS AND CONES MAY BE LOOSE. CARE SHOULD BE TAKEN TO PREVENT DROPPING AND DAMAGING THESE PARTS.

(1) Remove bearing seals and bearing cones in accordance with DISASSEMBLY.

(2) Clean tapered roller bearing cups (160 and 240) accordance with CLEANING, and check roller contacting surface of cups for damage in accordance with CHECK.

(3) Clean tapered roller bearing cones and rollers (20) in accordance with CLEANING and check roller surfaces in accordance with CHECK.

(4) Check bearing seals (10 or 10A and 40) in accordance with CHECK.

(5) Cover hub openings of wheel subassemblies to prevent contamination of bearing lubricant.

(6) Check interal drive ring gear teeth for damage in accordance with CHECK.

(7) Perform Hardness Test in accordance with this section if wheel paint is scorched or any other visible evidence of heat damage is apparent.

B. Operational Test (Leak Test)

WARNING: TIRE AND/OR WHEEL FAILURE MAY OCCUR CAUSING INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT IF TIRE IS OVER-INFLATED FROM ANY HIGH PRESSURE SOURCE. TIRE AND WHEEL ASSEMBLIES MUST BE SERVICED WITH INFLATION EQUIPMENT WHICH HAS BEEN SPECIFICALLY DESIGNED FOR THIS OPERATION.

(1) Place wheel/tire assembly in an inflation cage and inflate to recommended operating pressure.

NOTE: Verify and check operating pressure before handling wheel/tire assembly. Reference Aircraft Tire Manual and Data Book for specific tire data and checks.

(2) Coat juncture around valve subassembly (95) and tire beads with soap solution. Check carefully for air leaks in the form of soap bubbles.

NOTE: If air leaks are present proceed to step (5).

(3) If no leaks occur, remove all traces of soap solution from wheel/tire assembly with water and a cellulose sponge or soft bristle brush. Dry wheel thoroughly with clean, compressed air.

(4) Check pressure after 24 hours.

(a) If reduction in pressure exceeds five percent of inflation pressure, completely deflate tire. Disassemble and check preformed packing (80) and seal groove for damage. Replace wheel preformed packing (80), or if seal groove is damaged, repair and re-treat in accordance with REPAIR. Assemble in accordance with ASSEMBLY and retest wheel/tire assembly.

(b) If reduction of pressure is less than five percent, reduce tire pressure to recommended storage pressure and remove wheel/tire assembly from inflation cage.

(5) If air leaks are present, proceed with the following steps.

(a) Completely deflate tire and remove assembly from inflation cage and remove all traces of soap solution from wheel/tire assembly with water and a cellulose sponge or soft bristle brush. Dry wheel thoroughly with clean, compressed air.

(6) If leakage occurs around valve subassembly, check torque on leaking part. Torque valve stem (140) until seated. Retest the wheel/tire assembly.

(a) If leakage occurs around valve subassembly and persists after torque check, remove valve subassembly per DISASSEMBLY, check interface surfaces and replace rubber grommet (150). Reinstall valve in accordance with ASSEMBLY and retest.

(b) If leakage occurs around tire bead seat, remove tire from wheel per DISASSEMBLY, check wheel bead seat and tire bead for damage. If tire bead is cut or defective, install a new tire. If wheel bead seat is scratched, nicked, or pitted, repair in accordance with REPAIR. Retreat and repaint areas per REPAIR. Reinstall tire in accordance with ASSEMBLY, and retest the wheel/tire assembly.

5. Hardness Test (Heat Damage Test)

A. Components of the wheel assembly that are suspected of having heat damage shall be checked for hardness.

(1) Remove tire from wheel in accordance with DISASSEMBLY.

(2) Visually check wheel for discoloration, scorched paint, or other evidence of overheated condition.

(3) If any indication of an overheated condition exists, check wheel subassembly as follows:

(a) Check wheel subassembly for an out-of-round condition in accordance with CHECK.

(b) If diametral check is acceptable, perform hardness test on the inboard wheel subassembly.

B. Brinell Test

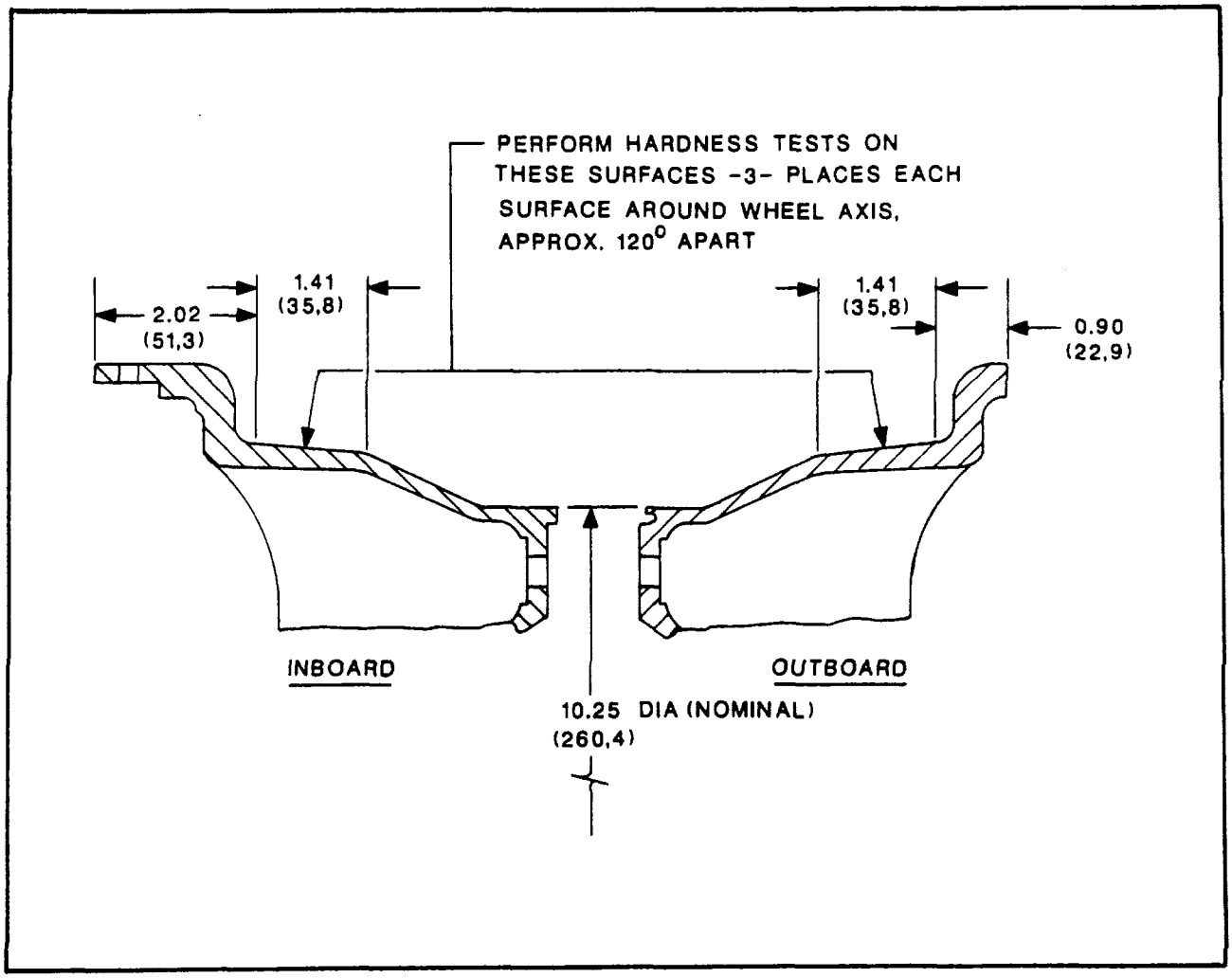
(1) Perform a hardness test on the wheel at three places, 120 degrees apart, as shown in Figure 101. Remove paint from surfaces to be checked and obtain hardness readings on three areas. Check hardness readings in accordance with Figure 102.

(2) If a reading of less than 54 BHN and greater than 52 BHN is obtained, perform a second test in tubewell area. The wheel subassembly shall be impression-stamped with the hardness value and letters "OV" (overheated). If an average value of less than B52 is obtained, or if values obtained vary more than the specified range permitted in Figure 102, replace the wheel subassembly.

NOTE: A second hardness test reading is recommended if there is any question as to the accuracy due to an inconsistent reading or excessive point spread. The second check shall be performed in close proximity to the first hardness test reading.

(3) The outboard wheel subassembly should be checked in the same manner if the inboard wheel subassembly has been excessively overheated.

(4) Refinish wheel areas where paint has been removed in accordance with REPAIR.



Heat Damage Test
Figure 101

Item	Brinell Test
Ball Diameter	10 mm
Test Load	500 kg
Number of Readings Equally Spaced	3
Acceptable Minimum Average Hardness	52 BHN
Maximum Total Range of Three Readings	2 points*

* Applicable to marginal hardness wheel only. Marginal hardness wheels are wheels with ANY ONE hardness reading of less than BHN54.

Hardness Test Readings
Figure 102

DISASSEMBLY

1. General (Ref. IPL Fig. 1)

WARNING: DO NOT ATTEMPT TO DISASSEMBLE WHEEL UNTIL TIRE HAS BEEN COMPLETELY DEFLATED; OTHERWISE, SERIOUS INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT CAN RESULT.

A. Disassemble the main wheel assembly in accordance with the following instructions.

2. Disassembly Procedures

CAUTION: DISASSEMBLE WHEEL ON A TIRE CHANGER OR A CLEAN, FLAT SURFACE, BEING CAREFUL NOT TO NICK, SCRATCH, OR OTHERWISE DAMAGE WHEEL SUBASSEMBLIES OR FLANGES.

A. Remove valve cap (100) and apply tire deflator (Schrader No. 4277 or equivalent) to completely deflate tire.

WARNING: *DO NOT ATTEMPT TO REMOVE VALVE CORE UNTIL TIRE HAS* BEEN COMPLETELY DEFLATED. VALVE CORES WILL BE EJECTED AT HIGH VELOCITY IF UNSCREWED BEFORE AIR PRESSURE HAS BEEN RELEASED.

B. Remove valve core (110).

NOTE: Outboard bearing seal (10 or 10A) and outboard tapered roller bearing cone and rollers (20) are removed when the wheel assembly is removed from the aircraft axle.

C. Remove wire retaining ring (30), inboard bearing seal (40), and inboard tapered roller bearing cone and rollers (20).

CAUTION: DO NOT PRY BETWEEN FLANGE AND BEAD WITH SHARP TOOLS OR WHEEL AND TIRE MAY BE DAMAGED, DESTROYING THEIR SEALING AND STRUCTURAL PROPERTIES.

D. Break tire beads away from both wheel flanges by applying pressure in even *increments around entire sidewall as close to tire beads as possible.*

CAUTION: DO NOT USE IMPACT OR POWER WRENCHES TO REMOVE WHEEL NUTS AND BOLTS.

E. Remove self-locking nuts (50), washers (60), and bolts (70).

F. Separate the wheel subassemblies and remove tire or tire and tube.

G. Remove preformed packing (80) if installed.

NOTE: It is recommended that a new preformed packing be installed at each overhaul. If packing must be reused, mark position of packing with respect to wheel subassembly so packing can be reinstalled in the same position. Carefully remove packing and place on a clean, flat surface. Do not hang or stretch packing.

H. If necessary, remove valve subassembly from outboard wheel subassembly (90) by removing hex nut (120 or 120A), ring washer (130), valve stem (140 or 140A) and rubber grommet (150).

NOTE: It is unnecessary to remove the valve stem and fusible plug at each tire change. It is recommended these parts be removed for checking at each overhaul and whenever it is necessary to remove the bearing cups or strip the paint from wheel.

I. Tapered roller bearing cups (160 and 240), disk spring (190), tee bar plungers (200 and 200A) and internal drive ring (230 or 230A) should not be removed from wheel subassemblies unless replacement is necessary. Refer to REPAIR for replacement procedures.

CLEANING

1. Cleaning Materials

NOTE: Equivalent substitutes may be used for items listed below.

Dry-Cleaning Solution Type I, Stoddard Solvent Type II, 140°F Solvent Specification P-D-680	Commercially available
Methyl Isobutyl Ketone (MIBK) Specification TT-M-268	Commercially available
Isopropyl Alcohol Specification TT-I-735	Commercially available
Polyplus Plastic Media Screen Size 20/40 (Primary)	Inventive Machine Corporation (I.M.C) P.O. Box 369 Bolivar, OH 44612
Plastic Reclaimable Abrasive Machine (PRAM)	See SPECIAL TOOLS, FIXTURES, AND EQUIPMENT section
Plastic Media (Dry Stripping Abrasive)	U.S. Technology Corporation A Subsidiary of U.S. Plastic and Chemical Corporation 328 Kennedy Drive Putnam, CT 06260
Paint Removing Solvent (Alternate) Specification MIL-C-19853, Type II	Turco Products Division of Purex Corporation 24600 South Main Street Carson, CA 90749
Soft Bristle Brush	Commercially available
Soft Wire Brush	Commercially available
Grease Specification MIL-G-81322	Commercially available

2. Cleaning Procedures (Ref. IPL Fig. 1)

WARNING: CLEANING SOLVENTS ARE TOXIC AND VOLATILE. USE ONLY IN WELL-VENTILATED AREAS. AVOID PHYSICAL CONTACT WITH SOLVENT AND DO NOT INHALE VAPORS.

CAUTION: CLEAN BEARING CONES CAREFULLY IN A SEPARATE CONTAINER OF CLEAN SOLVENT.

A. Clean all metal parts by immersing in dry-cleaning solution conforming to Specification P-D-680. Use a soft bristle brush to remove hardened grease, dust, and dirt. Deposits and scale on bolts (70) may be removed with a soft wire brush. If drive ring has been removed and carbon remover has not removed all of the sealant, use MIBK with light rubbing with a clean cloth.

CAUTION: DO NOT SPIN BEARING CONES WITH COMPRESSED AIR.

B. Dry all metal parts thoroughly after cleaning, using filtered and dried compressed air.

NOTE: Ensure foreign materials and solvents have been removed from all cavities, threaded holes, packets and other areas where entrapment might occur.

C. Check in accordance with CHECK section and repack bearing cones and coat bearing cups with grease, Specification MIL-G-81322, immediately after drying.

NOTE: New bearing cones and bearing cups packaged in preservative need not be degreased prior to use as the preservative is compatible with the recommended grease.

Lubrication of bearings by mechanical or other pressure methods is recommended because it is more efficient, reduces the possibility of contamination and assures a more even distribution of grease within the bearing.

D. Clean all rubber and nonmetallic parts in isopropyl alcohol, Specification TT-I-735 and dry with a clean, soft cloth.

3. Paint Removal Procedures

A. Strip wheel subassembly as follows - Method I (Dry Stripping)

WARNING: THE DRY STRIPPING PROCESS IS OPERATOR-SENSITIVE AND ONLY AN EXPERIENCED, TRAINED OPERATOR SHOULD BE PERMITTED TO PERFORM THE PAINT REMOVAL OPERATION IN ACCORDANCE WITH EQUIPMENT MANUFACTURER'S RECOMMENDATIONS.

NOTE: This procedure covers general information on dry stripping process of pneumatic blast removal of paint utilizing ground plastic particles. The procedure provides suggested control parameters to safely and effectively remove paint from aircraft component parts using the dry stripping process.

Paint must be stripped from parts before inspecting by Zyglo, dye penetrant or eddy-current methods; otherwise, inaccurate readings will result.

(1) Completely disassemble the part to be stripped. Remove all parts from wheel subassemblies, including valve, instruction and data plates, and balance weights.

NOTE: Bearing cups need not be removed during dry paint stripping.

(2) Clean part to be stripped in accordance with CLEANING section.

(3) Plug or seal off openings, threaded holes, bearing cups, and inserts as required.

(4) Remove paint using the dry stripping procedure in accordance with Figure 401 and as follows:

(a) The media (dry stripping abrasives) is effective only when used with the appropriate equipment. Depending on operator requirements, check with these (or other suitable) manufacturers for advice and application information concerning their particular equipment.

(b) Refer to Cleaning Materials for recommended dry stripping abrasives and equipment.

CAUTION: FLUSH MEDIA FROM CAVITIES, THREADED HOLES, POCKETS, AND OTHER AREAS WHERE ENTRAPMENT MIGHT OCCUR.

(5) Remove part and rinse thoroughly with water heated to a temperature of 160° to 180°F (71° to 82°C).

(6) Dry part thoroughly with filtered and dried compressed air. Apply grease, Specification MIL-G-81322, to bearing cups if installed.

NOTE: After paint stripping, the part must be re-treated and repainted in accordance with instructions in REPAIR.

NOZZLE TYPE/SIZE	NOZZLE PRESSURE	NOZZLE DISTANCE	MEDIA TYPE	ANGLE OF APPROACH
BMLV-8 1/2" 1 4	45 - 55 PSI 3	36 - 48"	POLYPLUS 20/40	45 - 75°
VENTURI 5/16" 2 4	UNDER 30 PSI 3	6 - 8"	POLYPLUS 20/40	45 - 75°

PHYSICAL REQUIREMENTS OF MEDIA

	POLYEXTRA	POLYPLUS
HARDNESS (MOH SCALE)	3.0 ± .25	3.5 ± .25
SPECIFIC GRAVITY (GMS/CC)	1.15 ± 10%	1.50 ± 10%

NOTES:

1. STAND-OFF, OPEN BLASTING.

2. CLOSED-CYCLE BLASTING (PERFORMED IN PRESSURE BLAST EQUIPMENT CHAMBER).

3. PRESSURE READINGS MUST BE TAKEN AT THE NOZZLE RATHER THAN ESTIMATED FROM REGULATOR GAUGE READINGS. RECHECK PRESSURE EVERY FOUR HOURS AND EACH TIME PRESSURE IS CHANGED AT REGULATOR.

4. PROCESS VARIABLES INCLUDE PRESSURE, DISTANCE FROM NOZZLE TO WORK PIECE, ANGLE OF ATTACK AND NOZZLE SIZE. PARAMETERS SELECTED WILL VARY WITH PAINT COATING AGE, TYPE AND NUMBER OF COATINGS BUT THE FOLLOWING PARAMETERS HAVE SUCCESSFULLY REMOVED VARIOUS COATING TYPES WITH NO EFFECT ON SUBSTRATE.

5. RECOMMENDED PLASTIC MEDIA TYPE AND SIZE IS POLYPLUS 20/40. POLYEXTRA 12/20 OR 20/30 PRODUCES A SMOOTHER FINISH BUT PAINT REMOVAL RATE IS LOWER. TYPE III PLASTIC MEDIA TYPE IS NOT TO BE USED ON THE SUBJECT AIRCRAFT COMPONENTS.

Recommended Dry Stripping Variables
Figure 401

B. Strip wheel subassembly as follows - Method II (Wet Stripping)

WARNING: PAINT REMOVAL SOLVENTS ARE CAUSTIC, TOXIC AND VOLATILE. USE ONLY IN WELL-VENTILATED AREAS IN ACCORDANCE WITH MANUFACTURER'S DIRECTIONS. OBSERVE ALL SAFETY PRECAUTIONS. AVOID PHYSICAL CONTACT WITH SOLUTION AND DO NOT INHALE VAPORS.

NOTE: Paint must be stripped from wheel subassemblies before inspecting by Zyglo, dye penetrant or eddy-current methods; otherwise, inaccurate readings will result.

(1) Completely disassemble the part to be stripped to prevent solvent from being entrapped between mating surfaces. Remove all parts from wheel subassemblies, including valve, bearing cup, disk drive ring and balance weights.

NOTE: Bearing cups need not be removed during paint stripping if a suitable mask (or other method) is used to assure contamination does not occur (behind the bearing cup) by stripping fluids.

(2) Clean the part to be stripped in accordance with Cleaning Procedures.

(3) Plug and seal off threaded holes and threaded inserts.

CAUTION: PARTS MUST BE COMPLETED IMMERSED IN SOLVENT. CONTACT WITH WATER BLANKET DURING IMMERSION WILL CAUSE SEVERE CORROSION OF THE PART.

(4) Immerse part in a paint removing solvent conforming to Specification MIL-C-19853 for a period of 30 minutes to two hours. Immersion time depends upon condition of paint. Carefully follow the manufacturer's instructions for the particular solvent being used.

CAUTION: FLUSH SOLVENT FROM CAVITIES, THREADED HOLES, POCKETS, AND OTHER AREAS WHERE ENTRAPMENT MIGHT OCCUR.

(5) Remove part from solvent and rinse thoroughly with water heated to a temperature of 160° to 180°F (71° to 82°C).

(6) Dry part thoroughly with filtered and dried compressed air. Apply grease Specification MIL-G-81322 to bearing cups if installed.

NOTE: After paint stripping, the part must be re-treated and repainted in accordance with REPAIR.

CHECK

1. Check Materials

NOTE: Equivalent substitutes may be used for items listed below.

Type	Penetrant	Developer	Supplier
Fluorescent	Zyglo ZL-16	Zyglo ZP-13 (wet) optional	Magnaflux Corporation 7310 West Lawrence Street Chicago, IL 60656
	Penetrex ZL-2A with emulsifier ZE-4	Penetrex ZP-4 (dry) or ZP-13 optional	
Red Dye	Spot Check	Spot Check	
	Dy-Chek	Dy-Chek	Turco Products Division of Purex Corporation P.O. Box 6200 Carson, CA 90749
	Met-L-Chek	Met-L-Chek	Met-L-Chek 1639 Euclid Street Santa Monica, CA 90404

2. General (Ref. IPL Fig. 1)

A. Check all components of the main wheel assembly for cracks, nicks, corrosion and other damage. Replace any cracked, severely corroded or badly damaged parts.

B. Perform the specific checks listed, referring to REPAIR for the appropriate repair procedures.

C. Serviceability of aircraft wheels subjected to rolling with a flat or disintegrated tire and damage to overloaded mating wheel, where applicable, should be checked as follows:

NOTE: Examinations listed in Figure 501 are recommended to be conducted during the life of the wheel. They are to be performed in addition to examinations conducted during wheel overhaul.

Method	Areas	Time
Using magnifying glass, visually check for cracks.	Area 1, Figure 601 Area 1, Figure 602	At each tire change.
Using Zyglo or dye-penetrant methods, check for cracks (Ref. Fig. 502).	Area 1, Figure 601 Area 1, Figure 602	At first tire change after 1,500 landings.
	Area 1, Figure 601 Area 1, Figure 602	At first tire change after 2,500 landings.
	Area 1, Figure 601 Area 1, Figure 602	At first tire change after 3,000 landings.
	Area 1, Figure 601 Area 1, Figure 602	At first tire change and each subsequent tire change after 3,250 landings.

Recommended Wheel Examinations
Figure 501

(1) Wheel Rolled with a Flat Tire

(a) Check carefully for deformation in the flange area and for tire brinelling and/or chafing damage on the flange outside diameter. Check wheel for an out-of-round condition by measuring the diameter of the flange at three places, equally spaced, around the outside diameter. The difference between the largest and smallest diameter readings shall not exceed 0.030 inch (0,76 mm); maximum bolt hole of 0.407 inch (10,3 mm) diameter (elongated). Replace any wheel with damage or deformation in excess of limits.

(2) Wheel Rolled with Disintegrated Tire

(a) Any wheel where the flanges have made direct contact with the runway due to rolling or sliding should be replaced. The high stress levels imposed on the wheel flange and bead seat area will invariably render the wheel nonserviceable even with minimal damage.

(3) Mating Wheel

(a) In the event of a wheel rolled with a flat or disintegrated tire on any aircraft fitted with dual, tandem, or dual tandem wheels, the corresponding mating wheel must also be considered. The mating wheel should be removed from service if the distance rolled was sufficient to cause any damage to the overloaded tire. Rolling in the overloaded

condition will impose additional stress on the bolts and nuts fastening the wheel subassemblies and may require early replacement. In all cases of overloaded rolling, the bolts and nuts should be replaced or checked for fatique damage at each tire change. The overpressurization relief device, where fitted, or the replaceable diaphragm, as applicable, should be replaced in all cases.

3. Wheel Subassembly (90, 170, 170A or 170B)

A. Check wheel subassemblies for cracks and structural damage. Pay particular attention to the bead seat, bolt boss, valve hole, and tubewell radius.

NOTE: Check wheel bead seats, using ultrasonic or eddy-current methods. Check all other areas of the wheel subassemblies by Zyglo or dye penetrant methods. Replace all cracked wheel castings.

B. Check wheel subassemblies for corrosion, nicks, scratches, tool marks, and other damage. Remove any corrosion and surface damage up to the limits given in REPAIR. Wheel subassemblies damaged beyond these limits should be replaced.

C. Check disk springs (190) and tee bar plungers (200 or 200A) in the inboard wheel subassembly for security, wear, or damage.

D. Check the valve hole threads in the outboard wheel subassembly (90) for damage and tightness in wheel. Check valve section of wheel for damage or corrosion. Re-treat and repaint in accordance with REPAIR section.

E. Check the threaded steel inserts in the outboard wheel subassembly hub flange for damage. If stripped or damaged, replace insert according to instructions in REPAIR.

CAUTION: HANDLE BEARING CONES WITH EXTREME CARE. MANY AIRCRAFT BEARING FAILURES OCCUR AS A RESULT OF MISHANDLING DURING SERVICING.

4. Tapered Roller Bearing Cups (160 and 240) and Tapered Roller Bearing Cones and Rollers (20)

A. Wipe bearing cups free of grease and visually check roller contacting surface of cups for looseness, scratches, pitting, brinelling, spalling, heat discoloration, rust, corrosion, and excessive wear. Replace bearing cups having any defects in accordance with instructions in REPAIR.

B. Check tapered roller bearing cones (20) and roller surfaces for nicks, scratches, rust, corrosion, spalling, flat spots, pitting, heat discoloration, and wear. Check bearing cage rib surfaces for scoring and bearing cage for nicks, dents, distortion, roller end scoring and wear in the roller pockets. Replace bearing cones having any defects.

5. Internal Drive Ring (230 or 230A)

A. Check drive ring (230), rivets (210), and washers (220) for tightness. If rivets are loose or rivet holes are enlarged, see REPAIR.

B. Check disk drive ring (230A), non-locking bolts (215) and plain washers (220) for tightness. If bolts are loose or threads are stripped, see REPAIR.

C. Check drive ring gear teeth for wear or damage. Replace ring if three or more teeth are worn to a thickness of 0.125 inch (3,18 mm) less at a point 0.078 inch (1,98 mm) from top of tooth.

NOTE: Check worn condition of gear teeth with the drive ring wear template shown in Figure 502.

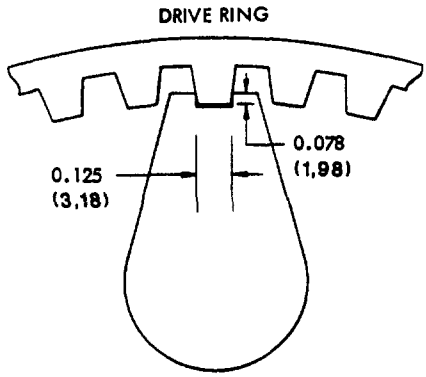
6. Disk Spring (190) and Tee Bar Plunger (200 or 200A)

A. Check disk spring and tee bar plungers for security, wear or damage. If tee bar plunger is loose due to enlarged or damaged holes, see REPAIR.

7. Valve Subassembly (95)

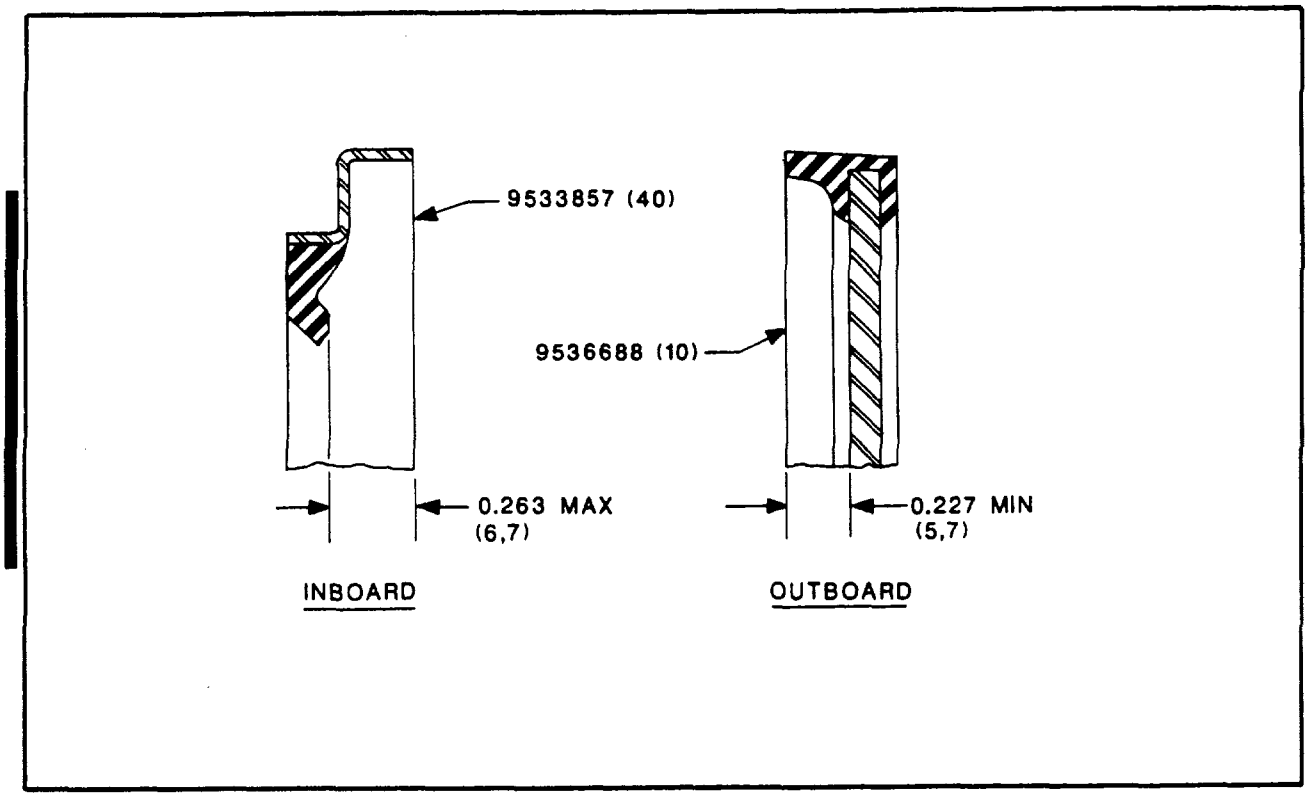
A. Check valve stem (140) for stripped or crossed threads and other damage. Replace valve stem if bent or damaged.

B. Replace valve cap (100) or valve core (110) if these parts are unserviceable.



NOTE: USE 1/16-INCH STOCK FOR MATERIAL
(LOCAL MANUFACTURE)

Internal Drive Ring Wear Template
Figure 502



Bearing Seal Wear Limits
Figure 503

8. Bearing Seal (10, 10A or 40)

A. Check bearing seal for wear. Measure from the metal face to the seal lip as shown in Figure 503. If this dimension measures less than 0.227 inch (5,7 mm) for outboard bearing seal, and more than 0.263 inch (6,7 mm) for inboard bearing seal at any point, or if rubbing surface is distorted, cut or grooved, or does not meet a Shore "A" hardness reading of 60 minimum or 80 maximum, the seal should be replaced.

B. Check bearing seal for grooves or damage. Replace seal if damaged.

9. Preformed Packing (80)

A. It is recommended new preformed packings be installed at each overhaul. If necessary to reuse these parts, check for cuts, permanent set, and other damage. Replace packings that are cut or damaged, or that have a permanent set.

NOTE: Cuts on packings often indicate the presence of burrs or other damage on the adjoining wheel parts. Check adjoining parts and remove burrs or other damage that may cause seal damage to reoccur see REPAIR.

10. Self-Locking Nut (50) and Bolt (70)

A. Check self-locking nuts for worn, stripped, and crossed threads. Replace if damaged. Nuts should be replaced after 15 applications. If unable to determine the number of applications, degrease the nut and bolt and check the torque required to turn nut on a nonlubricated bolt past the nut's locking section. Replace any nut requiring less than the minimum torque value as follows:

(1) Replace self-locking nut (50) when minimum torque value is less than 9.5 pound-inches (1,07 N-m).

B. Degrease and magnetic-particle check all bolts for cracks, paying particular attention to radius under the bolt head and to the threads adjacent to the bolt shank. Replace any cracked bolts and those having stripped, crossed, or damaged threads. No reworking of the bolts is permissible.

11. Wire Retaining Ring (30)

A. Check retaining ring for deformation, corrosion and damage. Replace if damaged.

12. Instruction Plate (165)

A. Check instruction plate for legibility and looseness. Replace if loose or illegible.

REPAIR

1. Repair Materials

NOTE: Equivalent substitutes may be used for items listed below.

Surface Treat Solution Specification MIL-M-3171, Type I and VI	Commercially available
Zinc Chromate Primer Specification TT-P-1757	Commercially available
Aluminum Lacquer Specification TT-L-32	Commercially available
Methyl Isobutyl Ketone (MIBK) Specification TT-M-265	Commercially available
Wash Primer Specification MIL-C-8514	Commercially available
Grease Specification MIL-G-81322	Commercially available
Antiseize Compound (Lubtork) Specification MIL-T-5544	W.J. Ruscoe & Company 483 Kenmore Boulevard Akron, Ohio 44301
Aluminum Oxide Cloth (Wet-or-dry, 320 to 400 grit)	Commercially available
Aluminum Topcoat/Primer Combination (FA 10242) Aeroprite	Contact your local distributor of aviation products and supplies.
Aeroprite Reducer TH-89	Contact your local distributor of aviation products and supplies.
Metal Set-A4	Smooth-On, Incorporated 1000 Valley Road Gillette, NJ 07933
Loctite RC/620	Loctite Company 705 North Mountain Road Newington, CT 06111
3M776 Adhesive Sealant	Minnesota Mining and Manufacturing Company Adhesive Coating and Sealer Division 3M Center St. Paul, MN

Dry Film Lubricant Sandstrom 26A	Sandstrom Products, Company 224 Main Street Port Byron, IL 61275
Solid Film Lubricant Lubribond A or B	E.M. Corporation P.O. Box 2200 Highway 52 Northwest West LaFayette, IN 47906
Lockwire MS20995C32 (160 in.)	Commercially available

2. General (Ref. IPL Fig. 1)

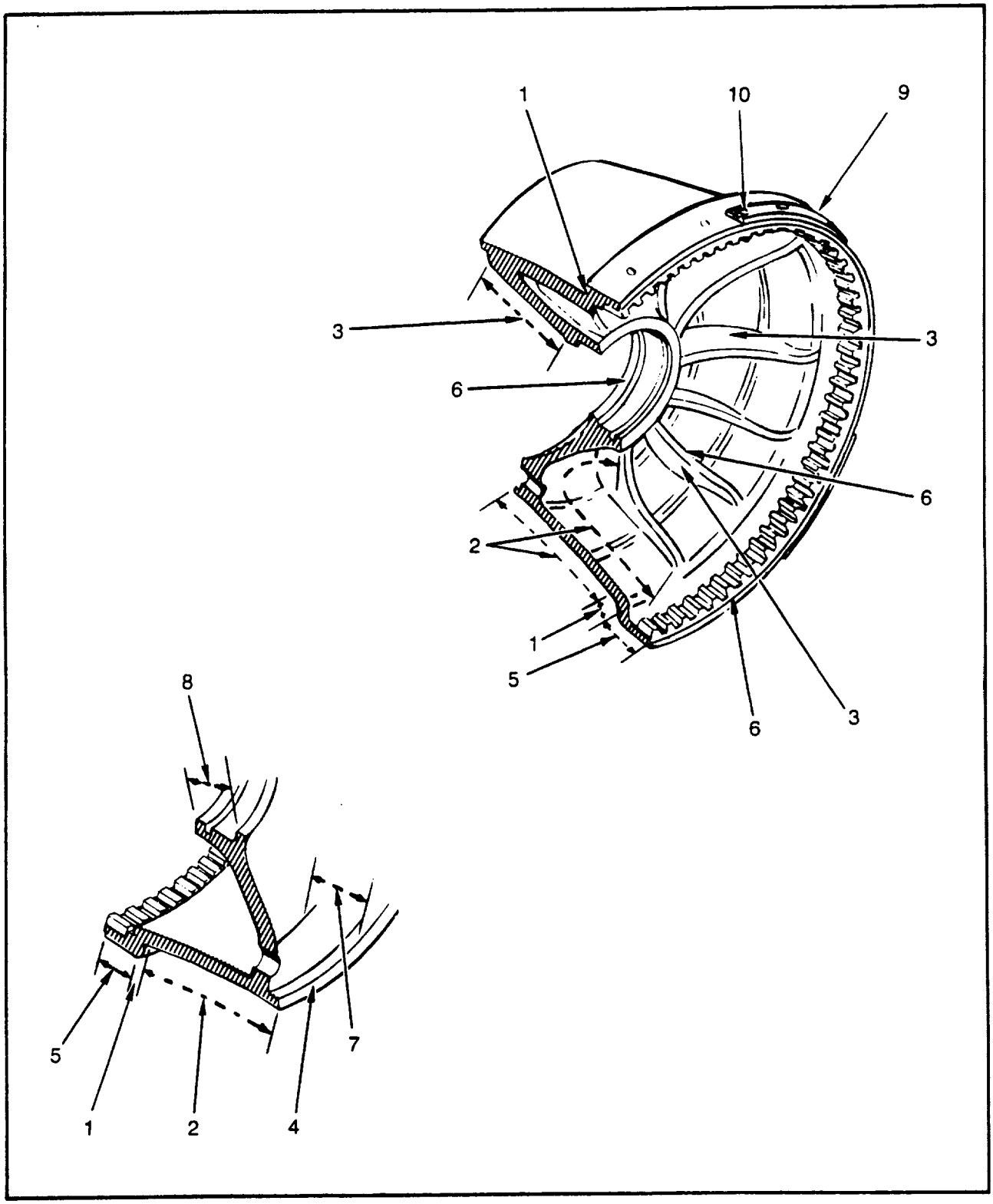
A. Repairs to the main wheel are limited to the replacement of parts and to the repairs specified in this section. No attempt should be made to repair cracked, severely corroded or badly damaged parts. Components that cannot be repaired within the limits defined in this section should be replaced.

CAUTION: REMOVAL OF CORROSION AND SURFACE DAMAGE WILL REDUCE STRESS CONCENTRATIONS AND PREMATURE WHEEL FAILURE. HOWEVER, ANY REMOVAL OF MATERIAL WILL SHORTEN THE ROLL LIFE OF THE WHEEL; THEREFORE, IT IS RECOMMENDED THAT REMOVAL OF MATERIAL BY BLENDING BE LIMITED TO THE MINIMUM REQUIRED FOR REMOVING CORROSION OR SURFACE DAMAGE.

3. Repair of Wheel Subassemblies (90, 170, 170A or 170B)

CAUTION: REMOVAL OF CORROSION AND SURFACE DAMAGE WILL PREVENT STRESS CONCENTRATIONS AND PREMATURE WHEEL FAILURE, ANY REMOVAL OF MATERIAL WILL SHORTEN THE ROLL LIFE OF THE WHEEL; THEREFORE, IT IS RECOMMENDED THAT MATERIAL REMOVED BY BLENDING BE LIMITED TO THE MINIMUM REQUIRED FOR REMOVING CORROSION OR SURFACE DAMAGE. BLENDED SURFACES SHOULD NOT BE OPPOSITE EACH OTHER.

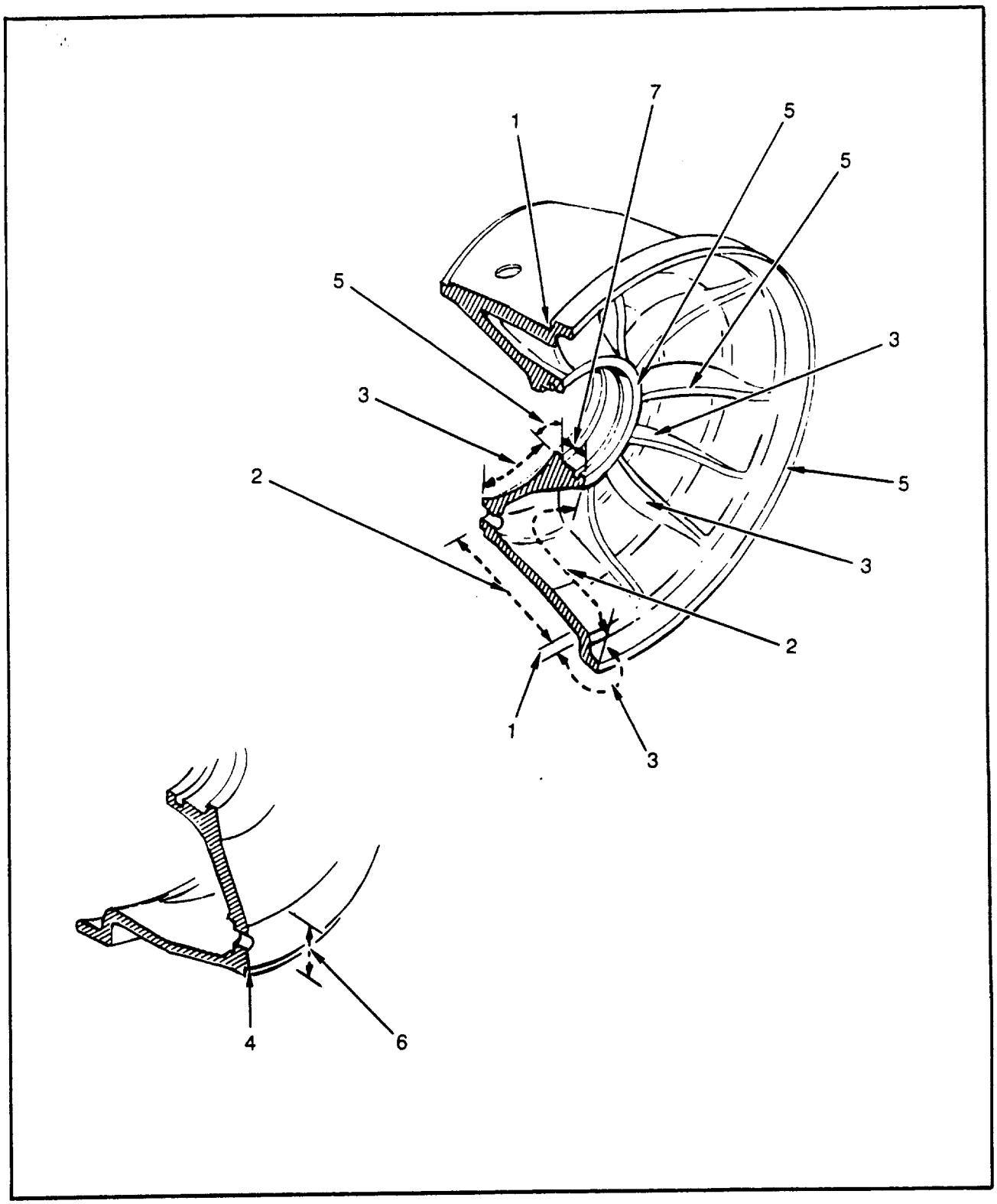
A. Remove all corrosion and surface damage from wheel subassembly castings according to limits specified in Figure 601 and 602. Any wheel subassemblies that are corroded or damaged beyond these limits should be replaced. Imperfections should be blended out to a minimum of one quarter inch (6,35 mm) radius and then polished. Use fine, wet-or-dry, aluminum oxide cloth (320 to 400 grit) for polishing. Unless otherwise specified, surface finish of repaired surfaces should not exceed a roughness of 150 microinches RHR except in Area 1 (tire bead radius), where the surface should not exceed a roughness of 32 RHR. All reworked surfaces shall be cleaned thoroughly, then re-treated and repainted in accordance with Re-Treating and Repainting.



Repair Areas for Inboard
Wheel Subassemblies 9544383, 9544383-1 and 9544383-2
Figure 601

Key to Figure 601

General:	Repairs are limited in each marked area to the following limits. The material removed by blending is limited to the minimum required for removing corrosion or surface damage. Except where restricted by length or locale, when damage depth is less than 0.015 inch (0,38 mm) deep, all blend type repairs shall be blended with a depth to width ratio of 1 to 100. Where not possible, use as generous a width to depth ratio as practical with the area being repaired.
Area 1:	Remove tool marks or other damage up to 0.015 inch (0,38 mm) deep by polishing to remove imperfections.
Area 2:	Blend out and polish imperfections up to 0.015 inch (0,38 mm) deep.
Area 3:	Blend out and polish nicks and imperfections up to 0.031 inch (0,78 mm) deep and one-inch (25,4 mm) long. Each blemish area must not exceed one inch (25,4 mm) square. Do not blend opposite areas in any section.
Area 4:	Blend out and polish imperfections to 0.010 inch (0,25 mm) maximum depth. Sealing quality must be maintained.
Area 5:	Blend out imperfections or circumferential grooves up to 0.031 inch (0,78 mm) deep. Rework area must not exceed one inch square (25,4 mm sq).
Area 6:	Blend out nicks and imperfections up to 0.06 inch (1,5 mm) deep and one inch (25,4 mm) long.
Area 7:	Blend out and polish imperfections up to 0.015 inch (0,38 mm) deep. Rework area must not exceed 0.5 inch square (12,7 mm sq).
Area 8:	Blend out minor imperfections. Cup retention characteristics must be maintained (refer to paragraph 4).
Area 9:	Replace disk spring if worn or damaged.
Area 10:	Replace tee bar plunger if worn or damaged. Repair damaged tee bar plunger holes in accordance with REPAIR NO. 4.



Repair Areas for Outboard
Wheel Subassembly 9543052
Figure 602

Key to Figure 602

General:	Repairs are limited in each marked area to the following limits. The material removed by blending is limited to the minimum required for removing corrosion or surface damage. Except where restricted by length or locale, when damage depth is less than 0.015 inch (0,38 mm) deep, all blend type repairs shall be blended with a depth to width ratio of 1 to 100. Where not possible, use as generous a width to depth ratio as practical with the area being repaired.
Area 1:	Remove tool marks or other damage up to 0.015 inch (0,38 mm) deep by polishing to remove imperfections.
Area 2:	Blend out and polish imperfections up to 0.015 inch (0,38 mm) deep.
Area 3:	Blend out and polish nicks 0.03 inch (0,7 mm) deep and one-inch (25,4 mm) long. Each blemish area must not exceed one inch square (25,4 mm sq). Do not blend opposite areas in any section.
Area 4:	Blend out and polish imperfections to 0.010 inch (0,25 mm) maximum depth. Sealing quality must be maintained.
Area 5:	Blend out imperfections up to 0.06 inch (1,5 mm) deep and one inch (25,4 mm) long.
Area 6:	Blend out and polish imperfections up to 0.015 inch (0,38 mm) deep. Blemish area must not exceed 0.60 inch square (12,7 mm sq).
Area 7:	Blend out minor imperfections. Cup retention characteristics must be maintained.

4. Replacing Defective Tapered Roller Bearing Cups (160 and 240)

A. Remove defective bearing cups from wheel subassemblies as follows:

CAUTION: DO NOT OVERHEAT WHEEL SUBASSEMBLY OR PROLONG THE HEATING PERIOD. OVERHEATING WILL AVERSELY AFFECT THE SERVICE LIFE OF THE WHEEL. REMOVE VALVE SUBASSEMBLY (IF INSTALLED) BEFORE HEATING WHEEL SUBASSEMBLY.

(1) Heat wheel subassembly in an oven not exceeding 250°F (121°C) for 30 minutes.

CAUTION: WHEN REMOVING CUP, EXERCISE EXTREME CARE TO AVOID RAISING BURRS IN THE BEARING BORE. ALWAYS SUPPORT THE WHEEL SUBASSEMBLY ON THE HUB, NOT ON THE FLANGE.

(2) Remove wheel subassembly from heat source and immediately remove cup from bearing bore by tapping it out evenly with a fiber or phenolic punch.

(3) Carefully remove primer residue and any foreign matter from bearing bore. Make sure that bearing bore and shoulder are clean and free of burrs.

B. Allow wheel subassembly to cool to room temperature and check maximum bearing bore dimension.

(1) If the bore surface is damaged, refer to Repair No. 1 - Repair of Main Wheel Bearing Cup Bores.

(2) Check the wheel subassemblies for maximum bore dimension. The maximum dimension to be an average of three readings taken 120 degrees apart.

(a) Maximum diameter of the outboard wheel subassembly (90) hub bore shall not exceed 4.1187 inches (104,6 mm).

(b) Maximum diameter of the inboard wheel subassembly (170, 170A or 170B) hub bore shall not exceed 4.1187 inches (104,6 mm).

(3) If maximum dimension is exceeded, repair in accordance with Repair No. 1 - Repair of Main Wheel Bearing Cup Bores.

C. Install bearing cups as follows:

(1) Make sure bearing bore and shoulder in wheel hub are clean and free from burrs or any other imperfections which might prevent proper seating of bearing cup.

(2) Chill new bearing cup with dry ice.

CAUTION: DO NOT OVERHEAT WHEEL SUBASSEMBLY OR PROLONG THE HEATING PERIOD. OVERHEATING WILL ADVERSELY AFFECT THE WHEEL'S SERVICE LIFE.

(3) Heat wheel subassembly in an oven not exceeding 250°F (121°C) for 30 minutes.

(4) Remove wheel subassembly from heat source and remove bearing cup from dry ice. Dry hub bore and cup thoroughly.

(5) Coat wheel contact surfaces of bearing cup with zinc chromate primer or paste, Specification TT-P-1757 and immediately install cup into bearing bore while primer or paste is still wet.

CAUTION: WHEN INSTALLING THE BEARING CUP, SUPPORT THE WHEEL SUBASSEMBLY ON THE HUB, NOT ON THE FLANGE.

(6) Using a fiber or phenolic punch, tap cup into bore and up tightly against shoulder. Avoid cocking the cup during installation.

(7) Cup seating should be checked after the wheel hub has cooled enough to hold the cup. To ensure the cup is adequately seated, check for any clearance (gap) between the cup back face and the shoulder (register) in the wheel hub with a 0.002 inch (0,05 mm) feeler gage. A 0.002 inch (0,05 mm) maximum clearance between cup and shoulder is permissible, provided the feeler gage cannot be inserted more than one-half the width of the shoulder at any location around back face of cup as shown in Figure 603.

NOTE: Above limits do not apply to areas of wheel hub shoulder cleaned up in accordance with Repair of Wheel Subassemblies.

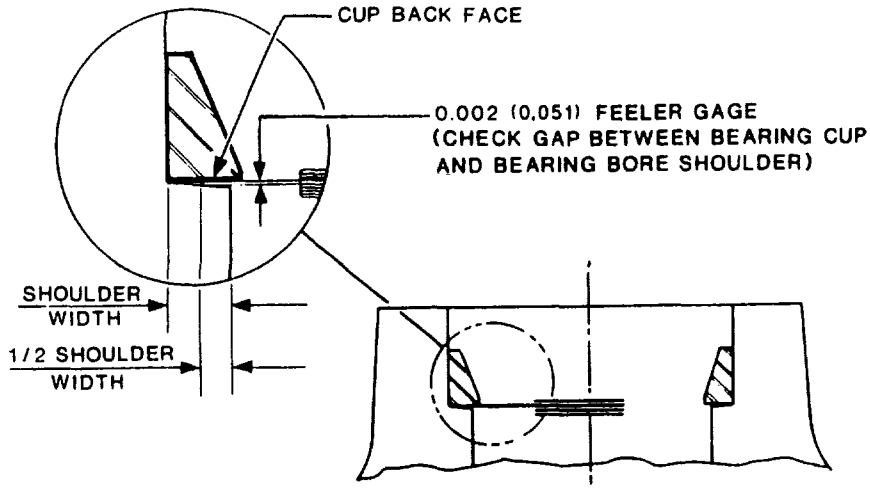
(8) Allow wheel to cool to room temperature. Apply a light coat of grease, Specification MIL-G-81322, to bearing cup to prevent corrosion.

5. Replacing Disk Drive Ring (230 or 230A)

CAUTION: WHEN HEATING WHEEL SUBASSEMBLY FOR DRIVE RING REMOVAL AND INSTALLATION, ENSURE THAT CUP SEATING HAS NOT BEEN IMPAIRED.

NOTE: Remove disk drive ring only if it requires replacement or if a thorough check of the wheel subassembly is necessary. If removed for checking, mark the location of the disk drive ring to ensure reassembly in the original position.

A. Remove aluminum disk drive ring (230) from inboard wheel subassembly (170 or 170A) as follows:



Typical Bearing Cup Register Check
Figure 603

(1) Cover bearing cup with cardboard or fiber disk to prevent contamination or damage.

CAUTION: WHEN REMOVING RIVETS, BE CAREFUL NOT TO ENLARGE RIVET HOLES IN WHEEL FLANGE.

(2) Remove the two rivets (180) holding each disk spring (190) to the wheel flange; then disengage disk spring from the tee bar plunger (200 or 200A) and remove plunger from inside of wheel.

(3) Remove rivets (210) and plain washers (220).

CAUTION: DO NOT OVERHEAT WHEEL SUBASSEMBLY OR PROLONG THE HEATING PERIOD. OVERHEATING WILL ADVERSELY AFFECT THE WHEEL'S SERVICE LIFE.

(4) Heat wheel subassembly in an oven not exceeding 250°F (121°C) for 30 minutes. Tap disk drive ring carefully out of wheel subassembly with a fiber or phenolic drift pin.

(5) Check wheel subassembly rivet holes for enlarged or elongated holes or if rivets were found loose prior to removal of disk drive ring. Repair rivet holes on inboard wheel flange in accordance with Repair No. 3 - Drive Flange Rivet Hole Repair or Repair No. 4 - Drive Flange Tee Bar Plunger Hole Repair.

B. Install aluminum disk drive ring (230) in inboard wheel subassembly (170 or 170A) as follows (Ref. Fig. 604):

CAUTION: DO NOT OVERHEAT WHEEL SUBASSEMBLY OR PROLONG THE HEATING PERIOD. OVERHEATING WILL ADVERSELY AFFECT THE WHEEL'S SERVICE LIFE.

(1) Heat inboard wheel subassembly (170 or 170A) in an oven not exceeding 250°F (121°C) for 30 minutes.

(2) Remove wheel subassembly from heat source.

CAUTION: THE CENTERLINES OF THE DRIVE GEAR TEETH MUST BE ALIGNED WITHIN 0.008 INCH (0,203 MM) OF THE CENTERLINE OF THE EXISTING HOLES IN THE WHEEL FLANGE. THE THREE PLACES ON THE DISK DRIVE RING WITHOUT A GEAR TOOTH MUST BE ALIGNED WITH THE PROPER HOLES IN THE WHEEL FLANGE TO PERMIT INSTALLATION OF TEE BAR PLUNGERS. MAKE SURE THE DISK DRIVE RING IS PROPERLY ALIGNED AND COMPLETELY SEATED IN THE WHEEL SUBASSEMBLY.

(3) Paint contacting surfaces of wheel and disk drive ring with zinc chromate paste or primer, Specification TT-P-1757 and install disk drive ring immediately into wheel flange while zinc chromate paste or primer is still wet.

NOTE: Disk drive ring should be assembled while ring is at a temperature of 75°F (24°C) and wheel subassembly is at 250°F (121°C). Reducing temperature of disk drive ring will increase clearance and ease of assembly.

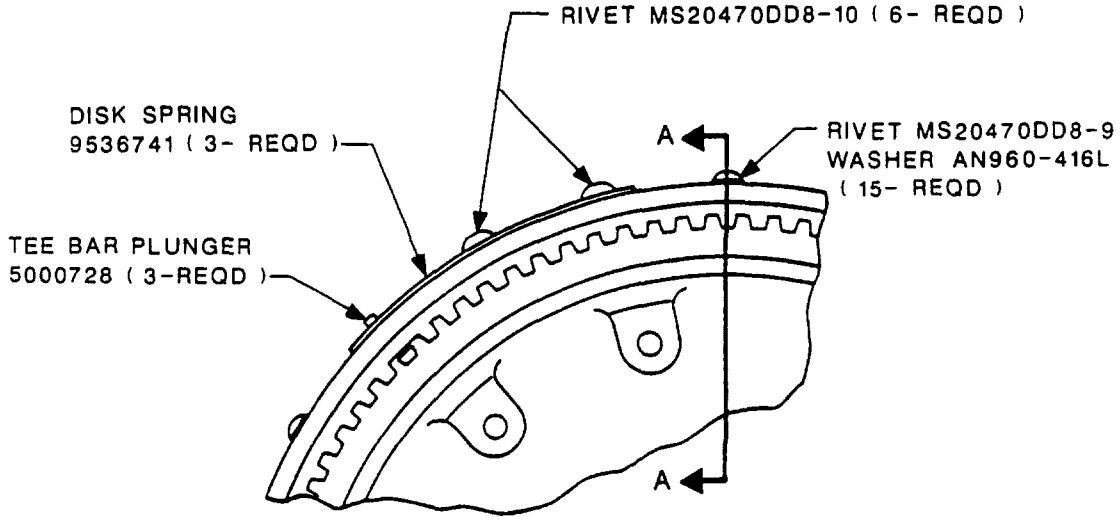
(4) Use drill bushing to locate center of holes and using rivet holes in wheel subassembly as a guide, drill size (F) 0.257 inch (6,53 mm) holes through disk drive ring to match (24 places).

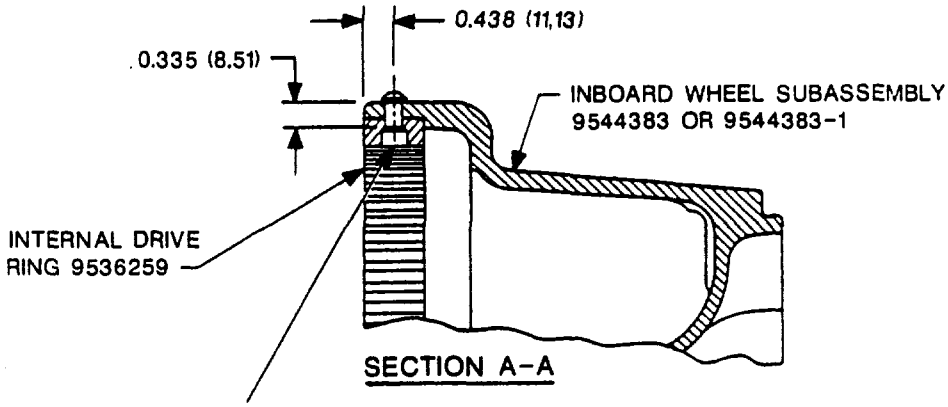
(5) Counterbore holes in disk drive ring (21 places) as shown in Figure 604.

NOTE: 21 holes equally spaced on basis of 24 spaces. Counterbore not required at location of tee bar.

(6) Apply two coats of zinc chromate primer, Specification TT-P-1757 to rivet holes.

NOTE: The aluminum disk drive ring does not required sealant cooling.





DRILL 0.257 (6,53) DIAMETER THROUGH TO MATCH WHEEL SUBASSEMBLY (24-PLACES); THEN COUNTERBORE 0.38 (9,7) DIAMETER WITH 100° INCLUDED ANGLE AT 21 PLACES. COUNTERSINK TO DEPTH SHOWN, USING TOOL NO. 1-71409. NO COUNTERBORE AT TEE BAR HOLES.

Installing Aluminum Internal Drive Ring 9536259
Figure 604

(7) Rivet disk drive ring to wheel flange with 15 rivets (210) and plain washers (220).

NOTE: Do not install these rivets in holes reserved for installing disk springs.

Rivets MS20470DD8-9 and MS20470DD8-10 are known as "ice box" rivets and are usually kept in a freezer until ready for use, since the aluminum alloy of rivet work hardens at room temperature. It is recommended that rivets used at room temperature be set (squeezed) with a compression type riveter. If only impact forming can be performed, the rivet must be annealed and kept in a freezer until ready for use.

(8) Insert three tee bar plungers (200A) in place as shown in Figure 604.

(9) Slide the disk springs (190) into position with the slots holding the tee bar plungers in place. Then install six rivets (180) to secure the disk springs and tee bar plunger.

C. Remove steel disk drive ring (230A) from inboard wheel subassembly (170B) as follows:

(1) Cover bearing cup with cardboard or fiber disk to prevent contamination or damage.

(2) Cut lockwire and remove the two hex head non-locking bolts (215) holding each disk spring (190) to the wheel flange; then disengage disk spring from the tee bar plunger (200 or 200A) and remove plunger from inside of wheel.

(3) Cut lockwire and remove remaining hex head non-locking bolts (215) and plain washers (220).

CAUTION: DO NOT OVERHEAT WHEEL SUBASSEMBLY OR PROLONG THE HEATING PERIOD. OVERHEATING WILL ADVERSELY AFFECT THE WHEEL'S SERVICE LIFE.

(4) Heat wheel subassembly in an oven not exceeding 250°F (121°C) for 30 minutes. Tap disk drive ring carefully out of wheel subassembly with a fiber or phenolic drift pin.

(5) If applicable, remove adhesive sealant from wheel subassembly and disk drive ring using methyl isobutyl ketone (MIBK), Specification TT-M-268.

NOTE: When disk drive ring has been removed, check wheel subassembly for cracks at radius behind the drive ring seat. Replace any wheel subassembly cracked in this area. Check threaded holes in wheel flange for damage or cracks.

D. Install steel disk drive ring (230A) in inboard wheel subassembly (170B) as follows (Ref. Figs. 605 and 606):

(1) Coat contacting surfaces of inboard wheel subassembly (170B) for disk drive ring (230A) with Adhesive Sealant 3M776 (Ref. Fig. 605).

WARNING: SEALANT SOLUTIONS ARE TOXIC AND VOLATILE. USE IN WELL VENTILATED AREA IN ABSENCE OF OPEN FLAME OR ELECTRICAL SPARKS. DO NOT INHALE VAPORS OR ALLOW SOLUTION TO CONTACT SKIN OR CLOTHING.

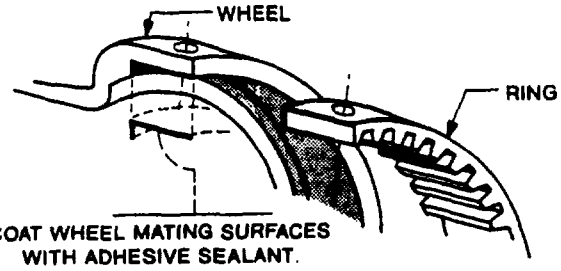
(a) Allow 24 hours drying time before assembly of disk drive ring into wheel.

(b) Excess material will not harm adjacent areas and may be removed from equipment with methyl isobutyl ketone (MIBK), Specification TT-M-268 and light rubbing with a clean cloth.

CAUTION: DO NOT OVERHEAT WHEEL SUBASSEMBLY OR PROLONG THE HEATING PERIOD. OVERHEATING WILL ADVERSELY AFFECT THE WHEEL'S SERVICE LIFE.

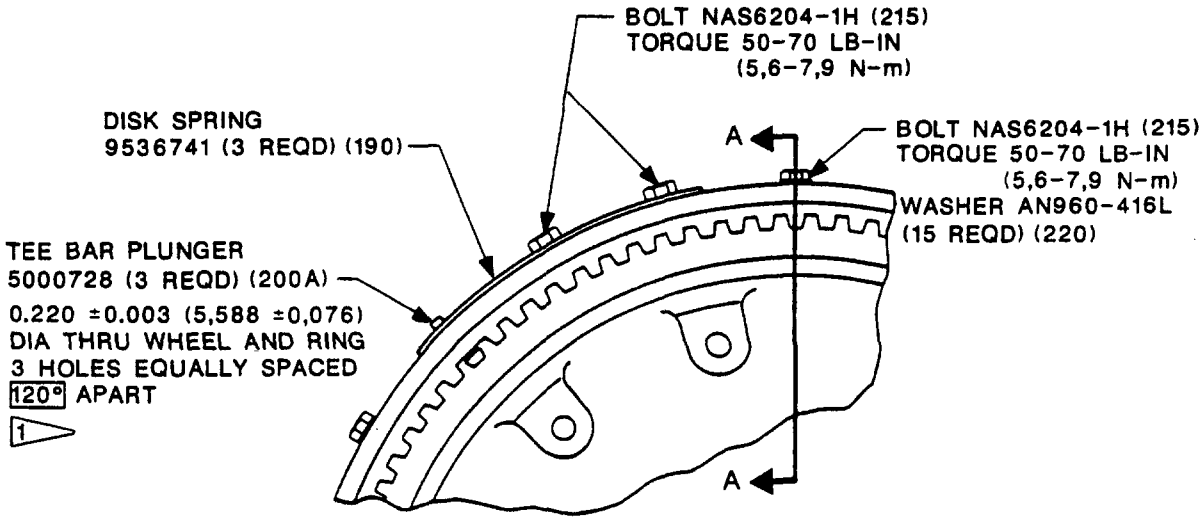
(2) Heat inboard wheel subassembly (170B) in an oven not exceeding 250°F (121°C) for 30 minutes.

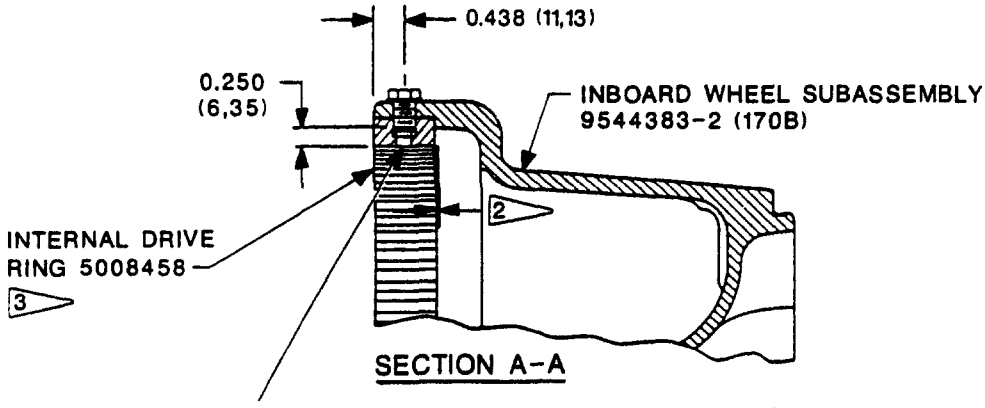
(3) Remove wheel subassembly from heat source.



NOTES:
1. 3M776 ADHESIVE SEALANT SHALL BE APPLIED TO A THICKNESS OF 0.0005 TO 0.003 (0.013 TO 0.076) BY NATURAL BRISTLE BRUSH TO A CLEAN, DRY, GREASE FREE SURFACE.
2. IF MULTIPLE COATS ARE REQUIRED TO GET EVEN THICKNESS, ALLOW TEN MINUTES DRYING TIME BETWEEN COATS.
3. MATERIAL MAY BE REMOVED FROM EQUIPMENT WITH METHYL ISOBUTYL KETONE, (MIBK) AND LIGHT RUBBING WITH A CLEAN CLOTH.
4. ALLOW 24 HOURS DRYING TIME BEFORE ASSEMBLY OF RING INTO WHEEL.
5. NEW MATERIAL MAY BE THINNED BY ADDITION OF MIBK TO OBTAIN WORKABLE CONSISTENCY.

Application of Adhesive Sealant
Figure 605





TAP DRILL THRU COUNTERSINK 90° INCLUDED ANGLE X 0.31 (7,87) DIA
0.250-28 UNJF-3B TAP FULL THREADS 0.515 ±0.015 (13,1 ±0,38) DEEP PER SPEC MIL-S-8879.
CENTERLINES IN LINE WITH TEETH, 21 HOLES EQUALLY SPACED ON BASIS OF 24 SPACES.
THEN COUNTERBORE 0.38 (9,7) DIAMETER WITH 100° INCLUDED ANGLE. COUNTERSINK TO
DEPTH SHOWN USING TOOL NO. 1-71409 1

1 USE 0.125 (3,18) DIA LOCATOR HOLE IN DRIVE RING FOR DRILLING AND TAPPING HOLES. USE DRILL BUSHING TO LOCATE CENTER OF HOLE

2 0.005 (0,127) MAX GAP ALLOWABLE FOR 1/4 OF SEAT CIRCUMFERENCE

3 RANDOM RADIAL POSITIONING OF DRIVE RING PERMISSIBLE

Installing Steel Internal Drive Ring 5008458
Figure 606

CAUTION: THE CENTERLINES OF THE DRIVE GEAR TEETH MUST BE ALIGNED WITHIN 0.008 INCH (0,203 MM) OF THE CENTERLINE OF THE EXISTING HOLES IN THE WHEEL FLANGE. THE THREE PLACES ON THE DISK DRIVE RING WITHOUT A GEAR TOOTH MUST BE ALIGNED WITH THE PROPER HOLES IN THE WHEEL FLANGE TO PERMIT INSTALLATION OF TEE BAR PLUNGERS. MAKE SURE THE DISK DRIVE RING IS PROPERLY ALIGNED AND COMPLETELY SEATED IN THE WHEEL SUBASSEMBLY.

(4) Install disk drive ring, chamfered or radius end first, into heated wheel subassembly. If using the original ring, tap with a fiber drift pin to align the ring in its original position. Align a new ring so that the screw holes in the wheel flange are centered directly between the teeth of the disk drive ring. Disk drive ring must not protrude beyond face of wheel subassembly.

NOTE: Disk drive ring should be assembled while ring is at a temperature of 75°F (24°C) and wheel subassembly is at 250°F (121°C). Reducing temperature of disk drive ring will increase clearance and ease of assembly.

(5) Being careful not to damage the existing threads, use the bolt holes in the wheel flange as guides, install temporary drill guide and drill and tap holes through disk drive ring to match (24 places) as shown in Figure 606.

(6) Install drive ring non-locking bolts (215) and plain washers (220) as follows (Ref. Fig. 606):

(a) Bolt disk drive ring (230A) to wheel flange with 15 bolts (215) and plain washers (220). Tighten bolts (215) to a torque value of 50 to 70 pound-inches (5,6 to 7,9 N-m).

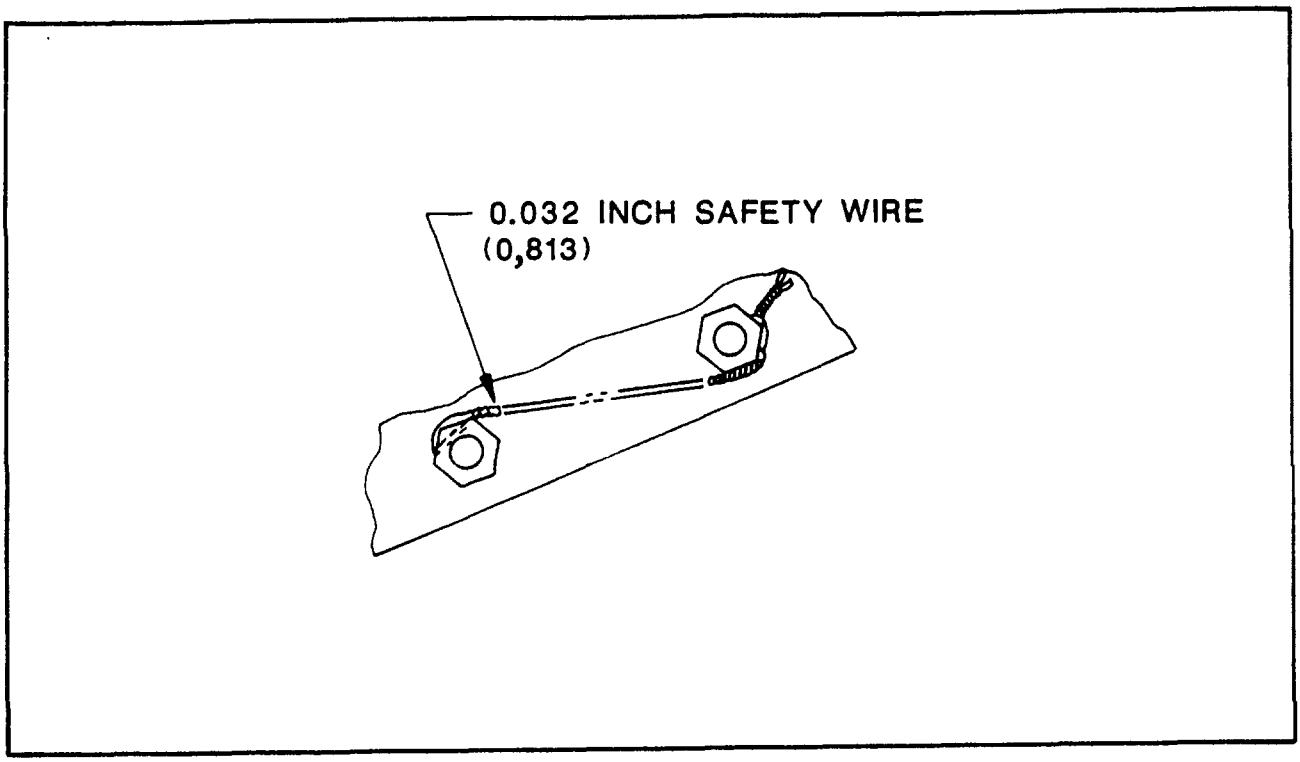
NOTE: Do not install bolts in holes reserved for installing disk springs.

(7) Insert three tee bar plungers (200A) in place as shown in Figure 606.

(8) Slide the disk springs (190) into position with the slots holding the tee bar plungers in place. Then install six bolts (215) to secure the disk springs and tee bar plunger (200A). Tighten bolts (215) to a torque value of 50 to 70 pound-inches (5,6 to 7,9 N-m).

NOTE: If the disk springs (190) and tee bar plungers (200A) are not used, install six bolts (215) with washers (220A) and tighten to a value of 50-70 pound-inches (5,6 to 7,9 N-m).

(9) Safetywire non-locking bolt heads (215) in pairs with Lockwire MS20995C32 and safetywire three bolts adjacent to tee bar (3 places) with Lockwire MS20995C32 (Ref. Fig. 607).



Safetywire Drive Ring Screws
Figure 607

6. Re-Treating and Repainting (Ref. Figs. 608 and 609)

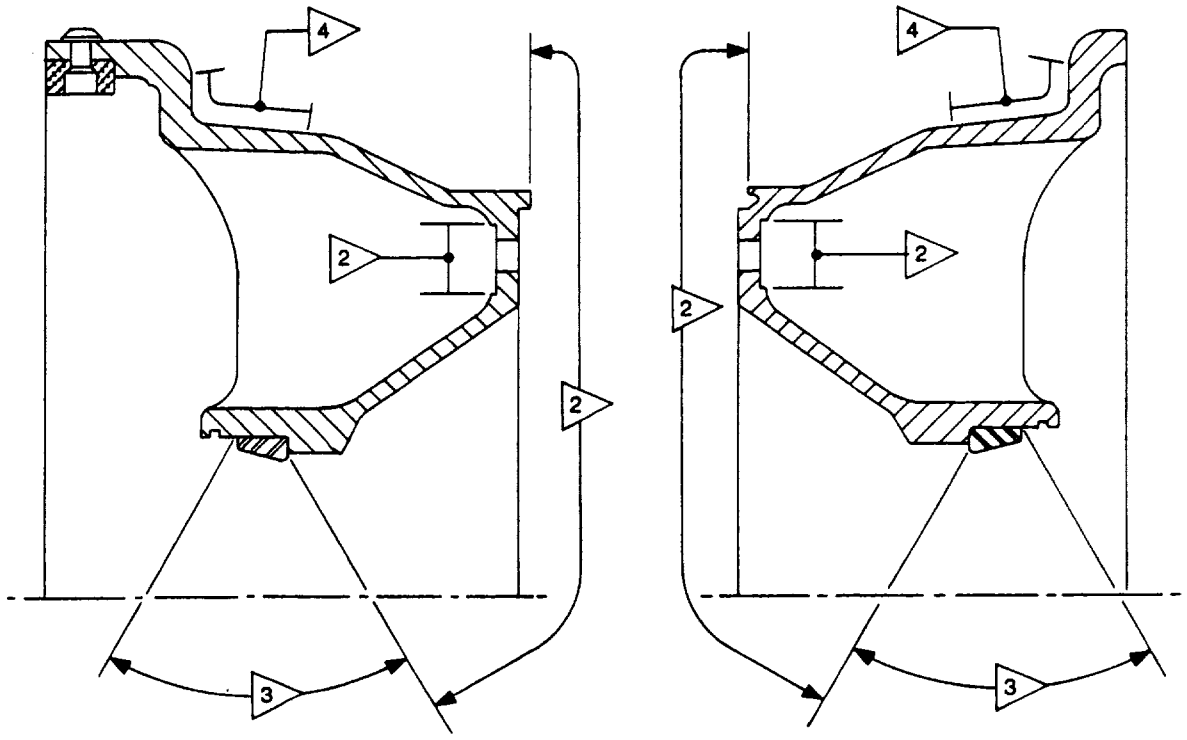
A. Repaired areas of the wheel subassemblies and those having the paint and treated finish removed, should be re-treated as follows:

WARNING: CLEANING SOLVENTS ARE TOXIC AND VOLATILE. USE ONLY IN WELL-VENTILATED AREAS. AVOID PHYSICAL CONTACT WITH SOLVENT AND DO NOT INHALE VAPORS.

(1) Thoroughly clean surface to be re-treated and repainted. Clean with hot water or methyl isobutyl ketone, Specification TT-M-268, and dry thoroughly with compressed air.

(2) Re-treat all exposed surfaces of wheel subassemblies with surface treat solution, Specification MIL-M-3171, Type VI, in accordance with the manufacturer's instructions. Refer to Repair Materials for recommended solution.

NOTE: Specification MIL-M-3171, Type VI is a dilute chomic acid brush-on solution.



NOTES:

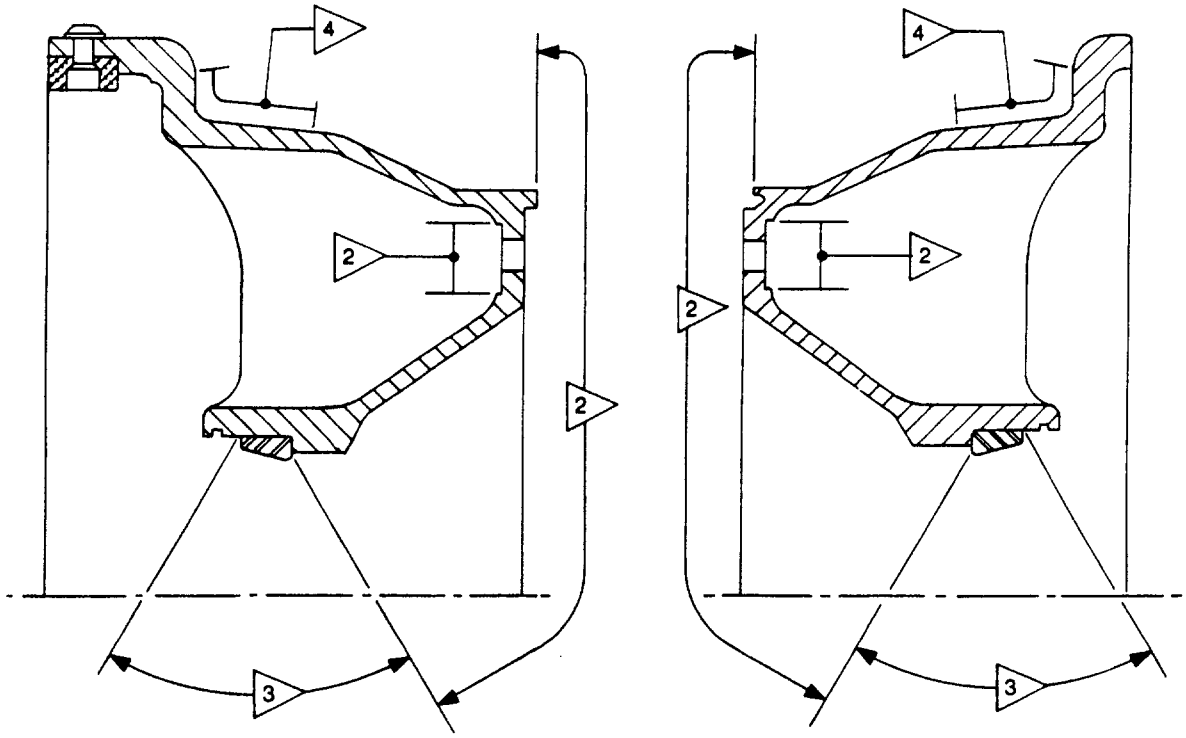
1. APPLY TWO COATS OF ALUMINUM TOP/COAT PRIMER COMBINATION EXCEPT AS NOTED.

2. ONE MIST COAT OF TOP/COAT PRIMER COMBINATION ONLY ON THESE SURFACES.

3. NO PAINT OR PRIMER ON THESE SURFACES, COAT WITH BEARING GREASE.

4. TIRE BEAD CONTACTING SURFACES MUST BE PAINTED THOROUGHLY.

Painting Diagram (Method I)
Figure 608



NOTES:

1. APPLY TWO COATS OF ZINC CHROMATE PRIMER, SPECIFICATION TT-P-1757 AND TWO COATS OF ALUMINUM LACQUER SPECIFICATION TT-L-32 TO ALL EXPOSED AREAS EXCEPT AS NOTED.

2. ONE MIST COAT OF PRIMER ONLY ON THESE SURFACES.

3. NO PAINT OR PRIMER ON THESE SURFACES. COAT WITH BEARING GREASE.

4. TIRE BEAD CONTACTING SURFACES MUST BE PAINTED THOROUGHLY.

Painting Diagram (Method II)
Figure 609

B. Touchup painting should be performed as follows:

(1) The part or area requiring touchup painting must be thoroughly clean and free of all contaminants.

(2) Prepare area to be painted (scratches, nicks, chipped paint, etc) by sanding lightly to feather out all edges of adjacent finish, using 320 to 400 grit, wet-or-dry, aluminum oxide cloth. Wet sanding is preferred. Avoid removing more primer than is absolutely necessary from damaged area.

WARNING: CLEANING SOLVENTS ARE TOXIC AND VOLATILE. USE ONLY IN WELL-VENTILATED AREAS. AVOID PHYSICAL CONTACT WITH SOLVENT AND DO NOT INHALE VAPORS.

(3) Wash the area to be touched up with methyl isobutyl ketone, Specification TT-M-268, and allow to air dry until no solvent odors are detectible.

CAUTION: IF BARE METAL IS EXPOSED BY SANDING, IT MUST BE RE-TREATED BY APPLYING WASH PRIMER.

(4) Starting with the last intact paint layer, reapply paint coats in accordance with repainting wheel assembly.

C. Repaint main wheel assembly as follows - Method I (Primary) (Ref. Fig. 608)

WARNING: CLEANING SOLVENTS ARE TOXIC AND VOLATILE. USE ONLY IN WELL-VENTILATED AREAS. AVOID PHYSICAL CONTACT WITH SOLVENT AND DO NOT INHALE VAPORS.

(1) Thoroughly clean all surfaces to be treated and/or painted. Wheel subassembly should be vapor degreased or washed with methyl isobutyl ketone, Specification TT-M-268.

(2) Treat all exposed metal surfaces of wheel subassemblies with chemical film solution conforming to Specification MIL-M-3171, in accordance with manufacturer's instructions.

CAUTION: DO NOT PAINT ROLLER CONTACTING SURFACES OF BEARING CUPS. PAINT ON THESE SURFACES WILL CONTRIBUTE OR RESULT IN LOSS OF BEARING PRELOAD.

(3) Mask bearing cups and threaded holes to avoid getting paint on these surfaces.

CAUTION: APPLY ONLY ONE COAT OF WASH PRIMER AND ONLY ONE MIST COAT OF TOPCOAT/PRIMER TO REGISTER SURFACES AND BOLT BOSSES. EXCESSIVE PRIMER ON THESE SURFACES MAY CONTRIBUTE TO WHEEL FAILURE.

(4) Apply one even wet coat of wash primer, Specification MIL-C-8514. The dry film thickness shall be 0.0002 to 0.0004 inch (0,0051 to 0,0102 mm). This film shall be allowed to air dry a minimum of one hour and a maximum of four hours before coating.

(5) Paint exposed metal surfaces in accordance with Figure 608 and as follows:

(a) Apply two coats of aluminum topcoat/primer combination in accordance with Figure 608.

(b) Spray one full wet cross coat to a dry film thickness of approximately 0.0005 inch (0,0127 mm). Air dry 45 minutes minimum before applying next coat. Spray another full cross coat to a dry film thickness of approximately 0.0004 inch (0,0102 mm) to 0.0006 inch (0,0152 mm).

NOTE: Due to abrasion in the tire bead contacting surfaces, it is recommended that tire bead contacting surfaces have a minimum of 0.0015 inch (0,038 mm) thickness of paint.

(c) Air dry 45 minutes before handling. Paint will reach full cure in 72 hours.

D. Repaint main wheel assembly as follows - Method II (Alternate) (Ref. Fig. 609)

WARNING: CLEANING SOLVENTS ARE TOXIC AND VOLATILE. USE ONLY IN WELL-VENTILATED AREAS. AVOID PHYSICAL CONTACT WITH SOLVENT AND DO NOT INHALE VAPORS.

(1) Thoroughly clean all surfaces to be treated and/or painted. Main wheel subassembly should be vapor degreased or washed with methyl isobutyl ketone, Specification TT-M-268.

(2) Treat all exposed metal surfaces of wheel subassemblies with surface treat solution, Specification MIL-M-3171, Type VI, in accordance with manufacturer's instructions.

CAUTION: DO NOT PAINT ROLLER CONTACTING SURFACES OF BEARING CUPS. PAINT ON THESE SURFACES WILL CONTRIBUTE OR RESULT IN LOSS OF BEARING PRELOAD.

(3) Mask bearing cups and threaded holes to avoid getting paint on these surfaces.

CAUTION: APPLY ONLY ONE COAT OF WASH PRIMER AND ONLY ONE MIST COAT OF ZINC CHROMATE PRIMER TO REGISTER SURFACES AND BOLT BOSSES. EXCESSIVE PRIMER ON THESE SURFACES MAY CONTRIBUTE OR RESULT IN LOSS OF BOLT PRELOAD.

(4) Apply one even wet coat of wash primer, Specification MIL-C-8514. The dry film thickness shall be 0.0002 to 0.0004 inch (0,0051 to 0,0102 mm). This film shall be allowed to air dry a minimum of one hour and a maximum of four hours before recoating.

(5) Paint exposed metal surfaces in accordance with Figure 609 and as follows:

(a) Apply two coats of zinc chromate primer, Specification TT-P-1757 in accordance with Figure 609.

NOTE: Do not exceed the recommended thickness for the applied topcoats. If the humidity should drop below 20 percent, primer application should be stopped until steps are taken to raise the percent humidity.

(b) Apply one coat of primer to obtain a dry film thickness of 0.0003 to 0.0004 inch (0,00762 to 0,0102 mm).

(c) After a minimum flash off period of five minutes, apply second coat of primer to obtain a total dry film thickness of 0.0006 to 0.0008 inch (0,015 to 0,020 mm).

(d) Allow the primed surface to dry a minimum of two hours and a maximum of 12 hours before topcoating with aluminum lacquer, Specification TT-L-32.

(6) Apply two coats of aluminum lacquer, Specification TT-L-32 in accordance with Figure 609.

(a) Spray one full wet cross coat to a dry film thickness of approximately 0.0004 to 0.0006 inch (0,0102 to 0,0152 mm) over the primer coating.

(b) After a minimum flash off period of five minutes, apply second coat of aluminum lacquer to obtain a total thickness of 0.0008 to 0.0012 inch (0,020 to 0,030 mm).

(c) Air dry 45 minutes before handling. Paint will reach full cure in 24 hours.

7. Rework of Wheel Assemblies 9544382 and 9544382-1 to Wheel Assembly 9544382-2.

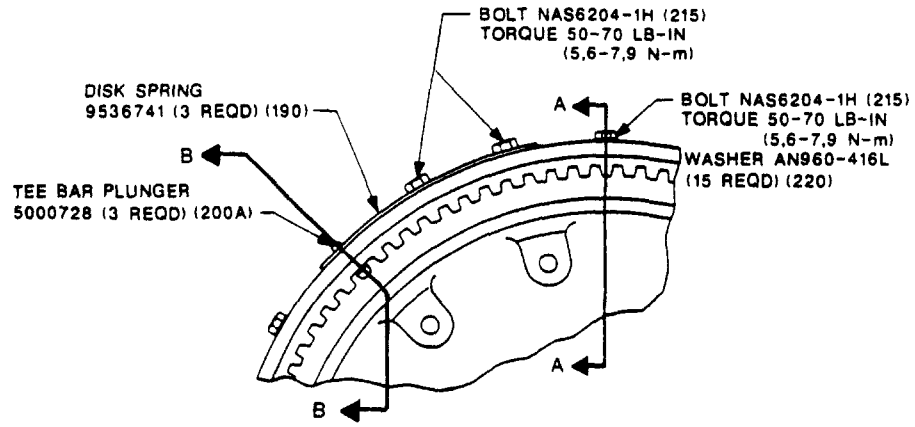
A. Remove aluminum drive ring (230) in accordance with Replacing Disk Drive Ring.

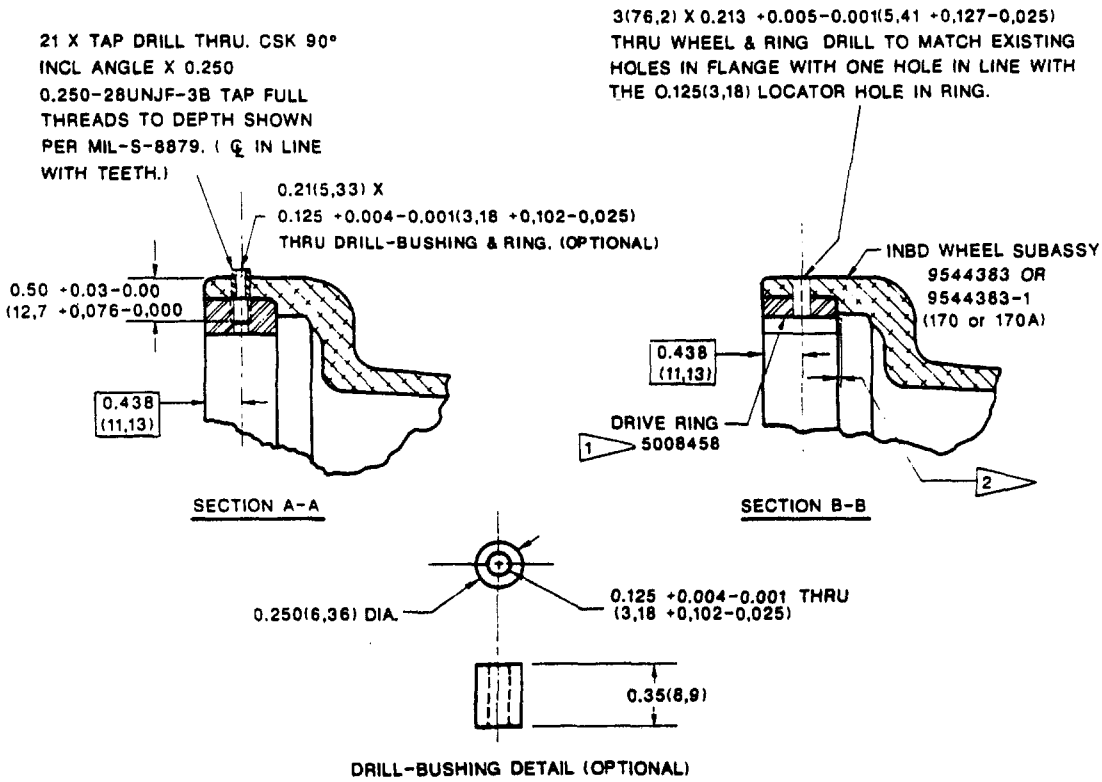
B. *Machine wheel subassembly flange in accordance with Figure 610 and as follows:*

(1) Install drive ring so that centerline of the 0.125 inch (3,18 mm) diameter location hole in the drive ring is on the centerline of one of the tee-bar holes in the wheel. The threaded holes are to be in line with gear teeth.

(2) Install drill-bushings into existing rivet holes in wheel flange as an optional tool for locating centers of rivet holes for pilot drilling into steel drive ring.

(a) Remove bushings, complete tap drill and threads per Figure 610.





MATERIAL: STEEL 1010-1020
ASTM A-108 OR EQUIV

NOTES:

1. INSTALL DRIVE RING SO THAT CENTERLINE OF THE 0.125(3,18) DIA. LOCATOR HOLE IN THE DRIVE RING IS ON THE CENTERLINE OF ONE OF THE T-BAR HOLES IN THE WHEEL. THE THREADED HOLES ARE IN LINE WITH GEAR TOOTH.
2. 0.005(0,127) MAX GAP ALLOWABLE FOR 1/4 OF SEAT CIRCUMFERENCE.

Rework of Wheel Assemblies 9544382 and 9544382-1 to 9544382-2
Figure 610

C. Treat newly machined surfaces of wheel with zinc chromate paste or primer and treat adjacent areas of wheel with surface treat solution, Specification MIL-M-3171, Type I.

D. Coat newly machined surfaces of drive ring with Sandstrom 26A dry film lubricant.

E. Install steel drive ring (230A) in accordance with Replacing Disk Drive Ring.

NOTE: Disk drive ring should be assembled while ring is at a temperature of 75°F (24°C) and wheel subassembly is at 250°F (121°C). Reducing temperature of disk drive ring will increase clearance and ease of assembly.

F. Metal stamp "5R87-053" next to wheel subassembly number in 0.09 inch (2,29 mm) characters.

REPAIR NO. 1 - REPAIR OF MAIN WHEEL BEARING BORES

1. General (Ref. IPL Fig. 1)

   A. This repair is used for the repair of worn bearing bores in the inboard and outboard wheel subassemblies (90, 170, 170A or 170B).

   B. This repair provides for machining the bearing cup bore and installation of Cup Bushing 5R3-4-167 or 5R3-4-113.

   C. Disassemble as required in accordance with DISASSEMBLY.

2. Repair of Main Wheel Bearing Bores

   A. Remove loose bearing cup by following the procedures in Replacing Defective Bearing Cup.

   B. Machine bearing bore of wheel subassembly oversized to the dimensions shown in Figure 601. If bore does not cleanup at oversized dimensions, replace wheel subassembly.

   C. Thoroughly clean and then treat newly machined surfaces with surface treat solution, Specification MIL-M-3171, Type I. Apply solution in accordance with manufactuer's instructions.

   D. Install the proper repair bushing cup subassembly in the bearing bore as follows:

      NOTE: For bearing bore repairs, use Bushing Cup Subassembly 5R3-4-167 for inboard and 5R3-4-113 for outboard wheel half subassembly. Metal stamp repaired wheel half with the applicable 5R3-4 number (in 0.09 inch, (2,3 mm) characters) in area adjacent to wheel subassembly number.

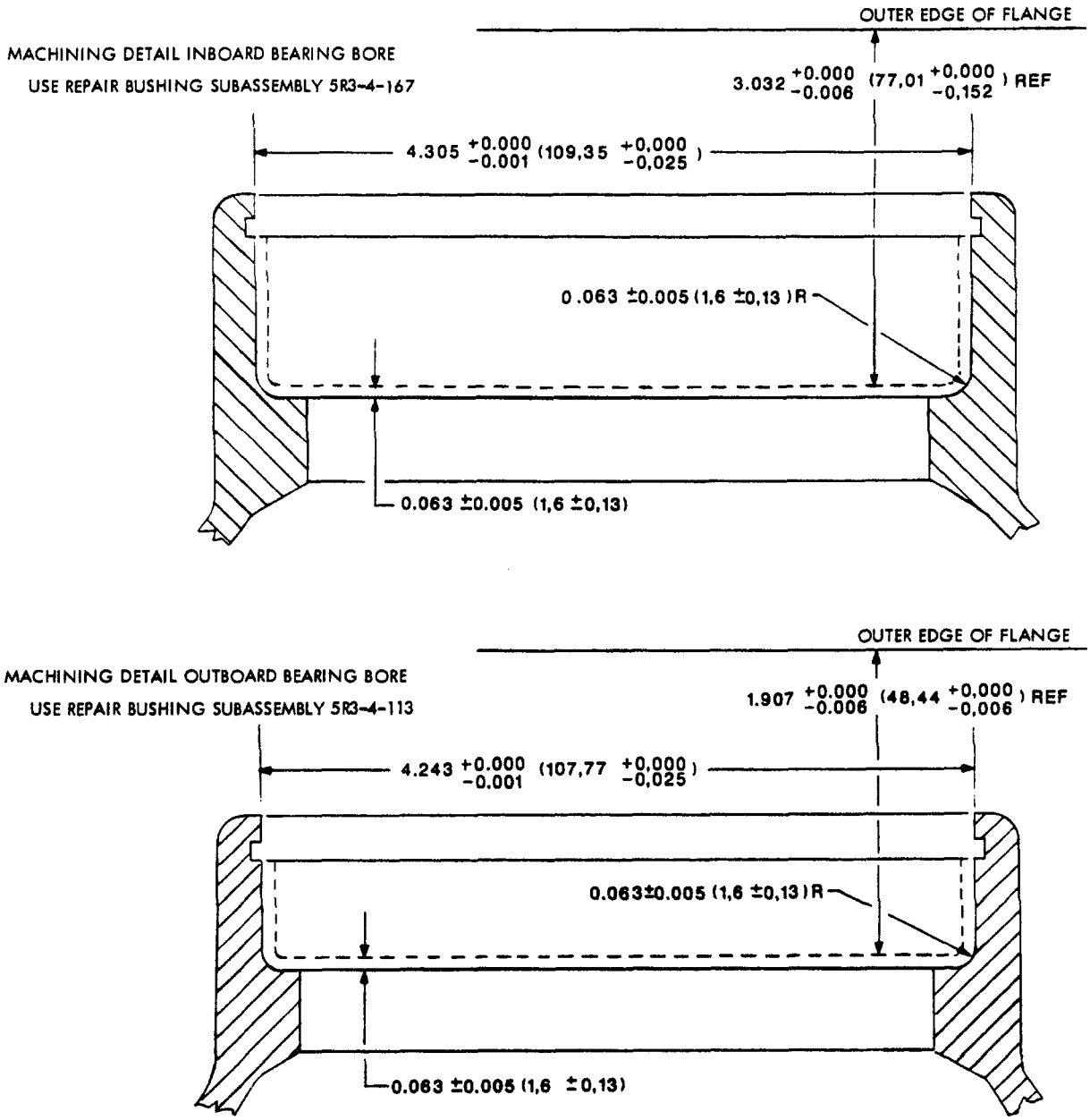
      CAUTION: DO NOT OVERHEAT WHEEL HALF OR PROLONG THE HEATING PERIOD. OVERHEATING WILL ADVERSELY AFFECT THE SERVICE LIFE OF THE WHEEL.

      (1) Heat wheel half in an oven not exceeding 250°F (121°C) for 30 minutes.

      (2) Chill bushing cup subassembly on dry ice.

      (3) Remove wheel half from heat source and remove bearing cup from dry ice. Dry cup thoroughly.

      (4) Coat wheel contact surfaces of bearing cup with zinc chromate primer or paste, Specification TT-P-1757, and immediately install cup into bearing bore while primer or paste is still wet.



Wheel Bearing Bore Repair
Figure 601

CAUTION: WHEN INSTALLING THE BEARING CUP, SUPPORT THE WHEEL HALF ON THE HUB, NOT ON THE FLANGE.

(5) Using a fiber or phenolic punch, tap cup into bore and up tightly against shoulder. Avoid cocking the cup during installation.

(6) Make sure cup is seated on bore shoulder. A 0.0015 inch (0,04 mm) maximum clearance between cup and shoulder is permissible, provided that it does not extend more than one quarter of the cup's periphery.

(7) Allow wheel subassembly to cool to room temperature.

(8) Apply a light coat of grease, Specification MIL-G-81322, to bearing cup to prevent corrosion.

REPAIR NO. 2 - REPAIR OF FAIRING RETAINING SCREW THREADS, OUTBOARD WHEEL SUBASSEMBLY (METHOD I)

1. General (Ref. IPL Fig. 1)

   A. This repair is used for the repair of stripped or damaged fairing retaining screw holes on Outboard Wheel Subassembly 9543052.

   B. This repair provides for machining the fairing retaining screw holes for installation of Heli-Coil inserts for the first repair and filling existing (old) screw holes with Metal Set-A4 and tap drilling new holes for the second repair.

2. Repair of Fairing Retaining Screw Threads

   A. If the fairing retaining screw hole contains stripped or damaged threads, repair using Heli-Coil inserts (Ref. paragraph 3. First Repair (Heli-Coil Inserts)). If the fairing retaining screw hole has been repaired with Heli-Coil Inserts and contains stripped or damaged threads, repair by filling existing (old) screw holes with Metal Set-A4 and tap drilling new holes (Ref. paragraph 4., Second Repair (Metal Set-A4 Repair).

3. First Repair (Heli-Coil Inserts)

   A. The following repair consists of remachining the fairing retaining screw holes and installing Heli-Coil inserts when the fairing retaining threads are stripped or damaged (Ref. Fig. 601).

   B. Machine fairing retaining screw hole oversize to dimension in Figure 601.

   C. Install Heli-Coil inserts in accordance with Figure 602.

   D. Metal stamp 5R3-353 adjacent to subassembly number in 0.12 inch (3,05 mm) characters.

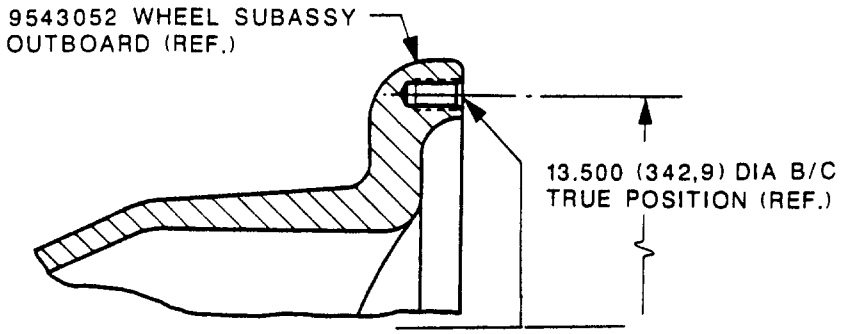
4. Second Repair (Metal Set-A4 Repair)

   A. In addition to the described Heli-Coil rework, a second repair scheme is provided. The repair consists of remachining damaged fairing retaining screw holes and filling with Metal Set-A4 and tap drilling new holes (Ref. Fig. 603).

   B. Fairing mounting holes must be clean and dry prior to applying Metal Set-A4.

   C. Apply Metal Set-A4 with a putty knife, trowel, or brush to fill the existing (old) screw holes.

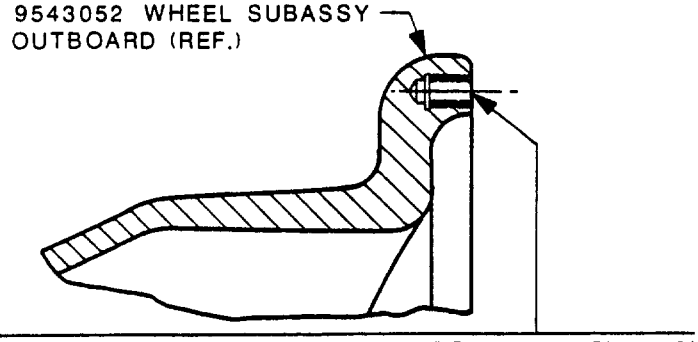
   D. Quickly level the top of the recess with a putty knife; the metal structure will solidify automatically.



TAP DRILL 0.174/0.180 DIA. 0.418 DEEP. C'SK 120°INCL ANGLE TO 0.200/0.230 DIA. HELI-COIL FINISHING TAP 2CPA (0.280 MIN. DEEP) FOR 8-32UNC-2B MS21208C0815 INSERT (HELI-COIL 1185-2CN0246).
REWORKED HOLES 5 PLACES EQUALLY SPACED WITHIN 0.005 OF TRUE POSITION.

NOTE: METAL STAMP 5R3-353 ADJACENT TO SUBASSY NO. IN 0.12 (3,05) CHARACTERS.

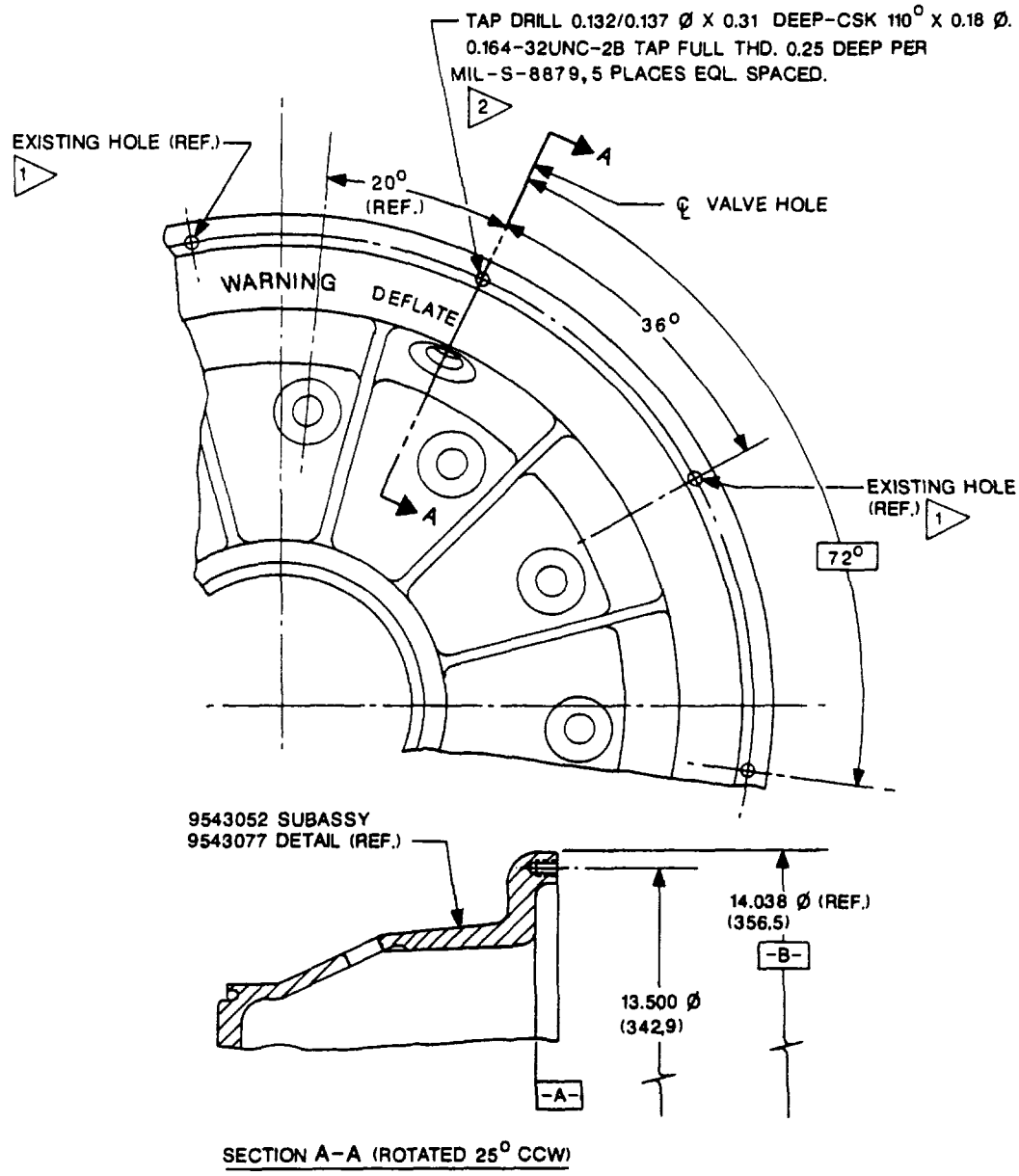
Stripped Fairing Thread Machining
Figure 601



INSTALL MS21208C0815 INSERT (HELI-COIL 1185-2CN0246), 3/4 TO 1 1/2 PITCH BELOW SURFACE.

NOTE: REMOVE TANG. USE ZINC CHROMATE PRIMER, SPECIFICATION TT-P-1757, WHEN INSTALLING INSERTS.

Heli-Coil Insert Installation
Figure 602



SECTION A-A (ROTATED 25° CCW)

NOTES:

1. FILL FIVE EXISTING (OLD) SCREW HOLES WITH 'METALSET-A4'.
2. APPROPRIATE SIZE SCREW HOLES MUST BE INSTALLED IN ASSOCIATED WHEEL FAIRING TO MATCH THESE NEW TAPPED HOLES. MODIFIED FAIRING TO BE INSTALLED SUCH THAT THE AIR CHUCK CLEARANCE HOLE IS ALIGNED WITH FILL VALVE.

E. Setting takes place in approximately 90 minutes at room temperature for a thickness up to 0.250 inch (6,35 mm). Metal Set-A4 will cure full strength in 24 hours; heating to 167°F (75°C) will greatly accelerate the reaction.

F. Tap drill new holes to 0.132 - 0.137 x 0.31 deep. Countersink 110° x 0.18° diameter, using 0.164-32 UNC-2B Tap Drill, full thread, 0.25 deep per Specification MIL-S-8879, in five places equally spaced.

G. Metal stamp the letter "R" adjacent to each tapped hole, and "5R83-044" adjacent to subassembly number in 0.09 inch (2,3 mm) characters.

H. Dichromate treat all newly machined surfaces per Specification MIL-M-3171, Type III.

REPAIR NO. 3 - DRIVE FLANGE RIVET HOLE REPAIR

1. General (Ref. IPL Fig. 1)

   A. This repair is used for the repair of enlarged or damaged rivet holes in flange of inboard wheel subassembly.

   B. This repair provides for machining damaged rivet holes and installation of Rivet Bushing 5006511.

2. Drive Flange Rivet Hole Repair

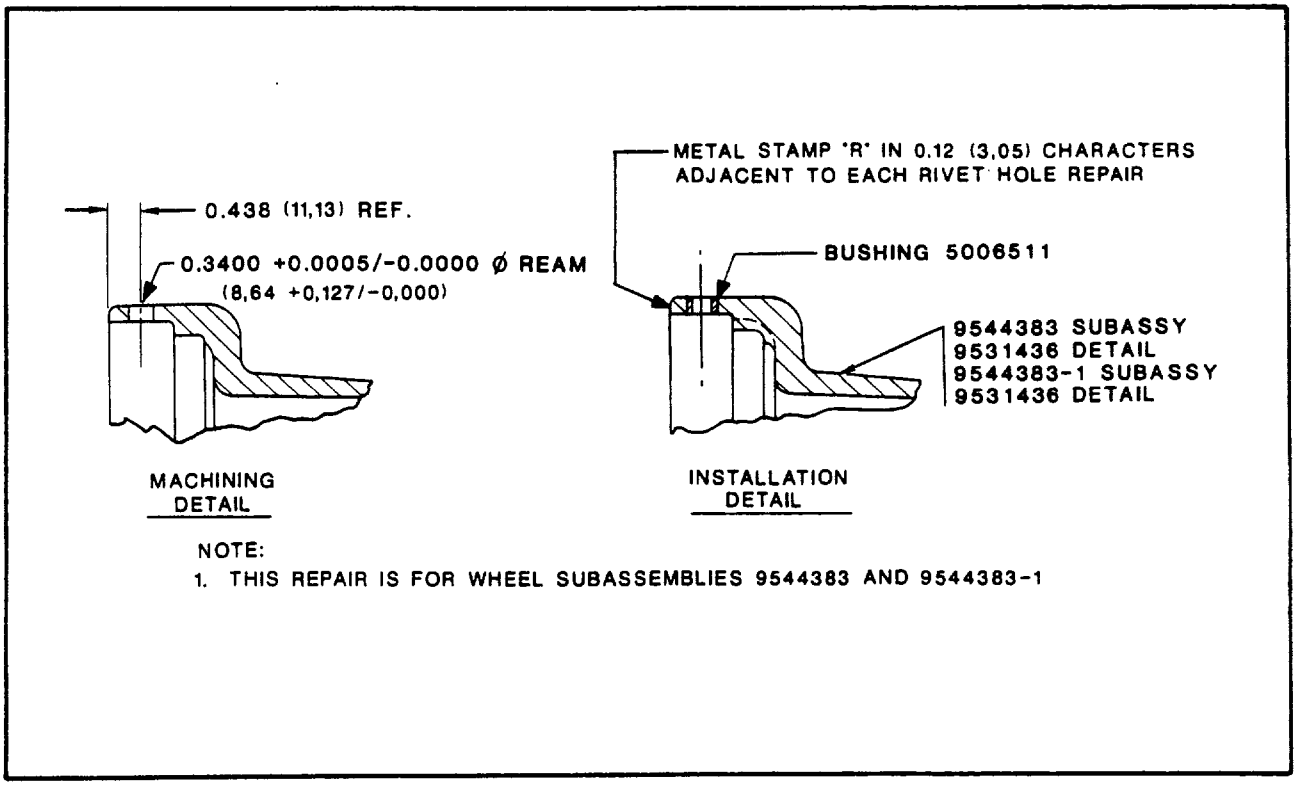
   A. If drive ring rivets were found loose, prior to drive ring removal from inboard wheel subassembly, repair enlarged or damaged rivet holes in flange of inboard wheel subassembly as follows:

      (1) Machine damaged rivet holes in accordance with Figure 601.

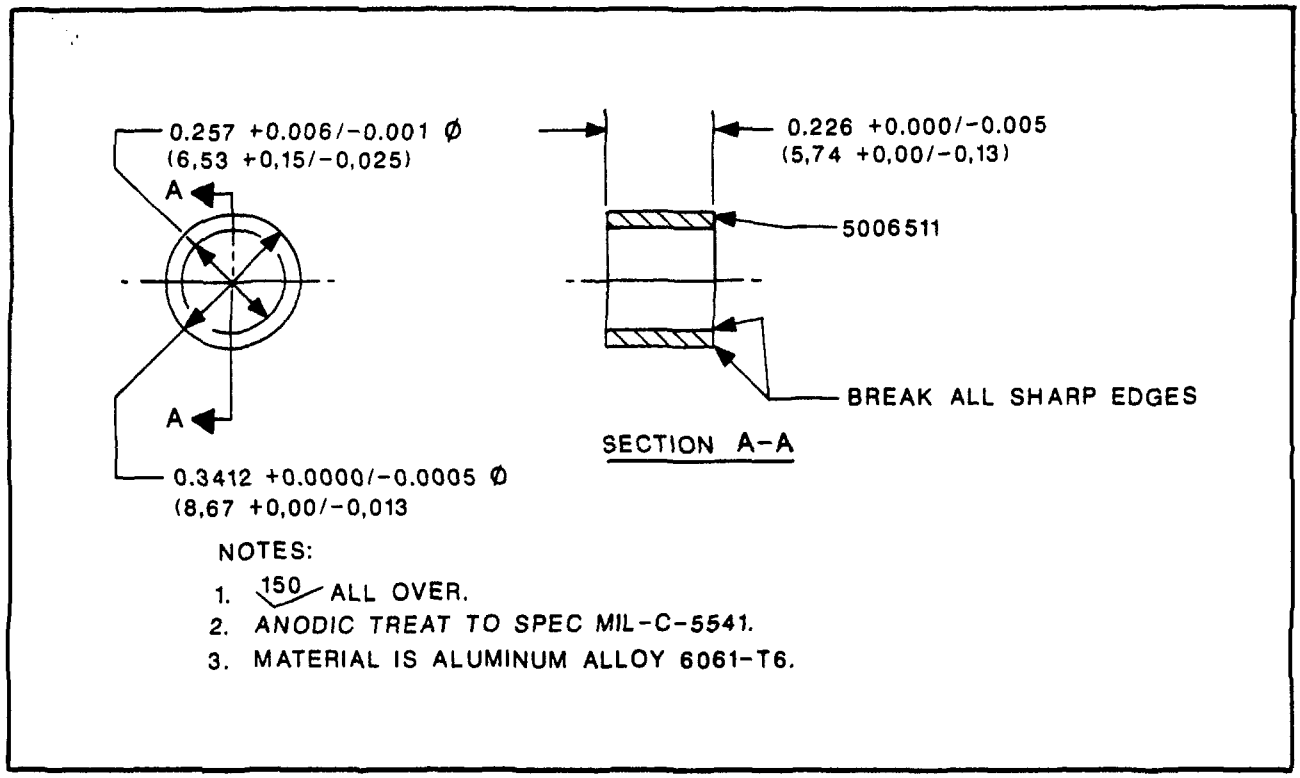
      (2) Treat newly machined surfaces of wheel subassembly with surface treat solution, Specification MIL-M-3171, Type VI.

      (3) Chill Rivet Bushing 5006511, with dry ice or freeze to aid installation.

      (4) Install chilled Rivet Bushing 5006511 in accordance with Figures 601 and 602.



Drive Flange Rivet Hole Repair
Figure 601



Drive Flange Rivet Hole Repair Bushing 5006511
Figure 602

(5) Metal stamp "R" in 0.12 inch (3,05 mm) characters adjacent to each repaired rivet hole.

(6) Metal stamp 5R81-033 adjacent to subassembly number in 0.12 inch (3,05 mm) characters no deeper than 0.015 inch (0,38 mm).

(7) Install internal drive ring in accordance with Replacing Internal Drive Ring.

REPAIR NO. 4 - DRIVE FLANGE TEE BAR PLUNGER HOLE REPAIR

1. General (Ref. IPL Fig. 1)

   A. This repair is used for the repair of enlarged or damaged plunger holes in the inboard wheel subassembly.

   B. This repair provides for machining damaged plunger holes and installation of Flange Bushing 5007112.

2. Drive Flange Tee Bar Plunger Hole Repair

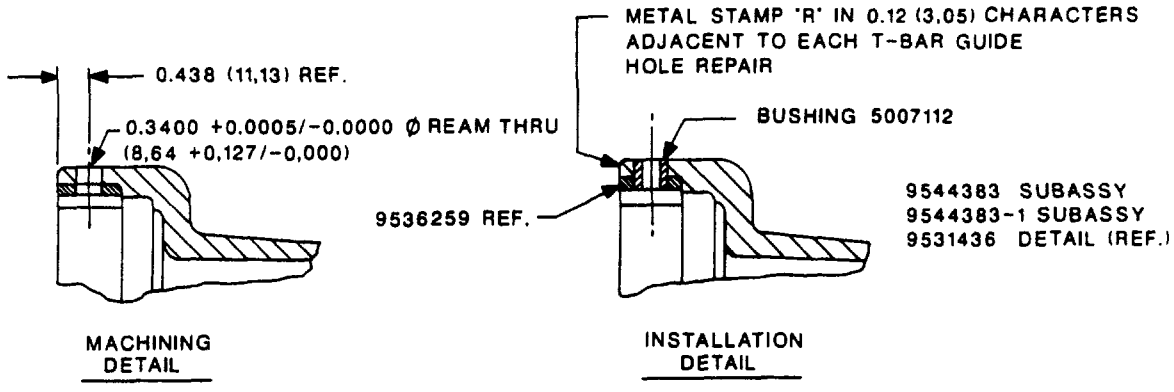
   A. If tee bar plunger is found excessively loose or plunger hole is damaged or enlarged in the inboard wheel subassembly, and internal drive ring replacement is not required, repair plunger holes as follows:

      (1) Remove tee bar plunger in accordance with Replacing Internal Drive Ring.

      NOTE: Do not remove drive ring for this repair.

      (2) Machine damaged plunger hole in accordance with Figure 601.

      (3) Treat newly machined surfaces of wheel subassembly and internal drive ring with surface treat solution, Specification MIL-M-3171, Type VI.



NOTES:

1. THIS DRAWING IS FOR REPAIR WHEEL SUBASSEMBLY 5000482.
2. CHILL BUSHING P/N 5007112 PRIOR TO INSTALLATION, COAT WITH LOCTITE RC/620 AND INSTALL INTO WHEEL SUBASSEMBLY.

Tee Bar Hole Repair
Figure 601

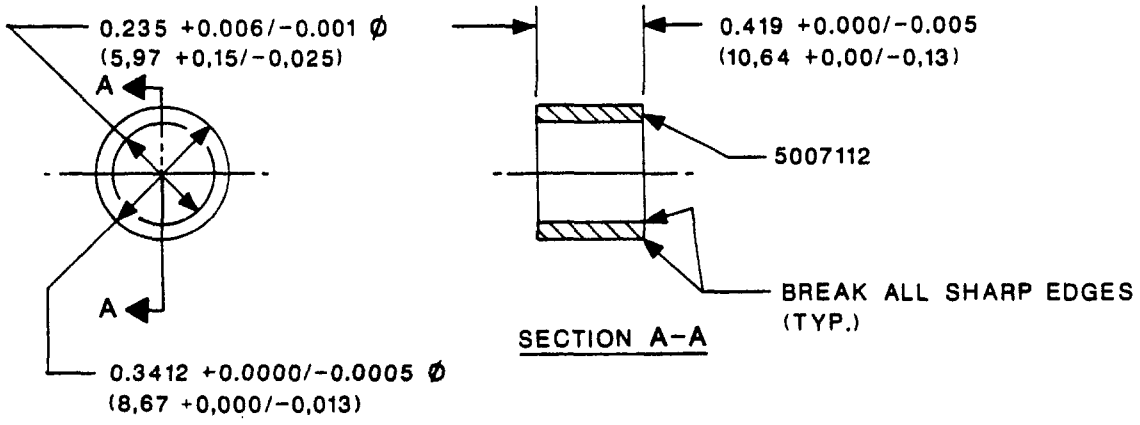
(4) Chill Flange Bushing 5007112 with dry ice or freeze to aid installation.

(5) Coat chilled flange bushing and plunger hole with Loctite RC/620 and install flange bushing in accordance with Figures 601 and 602.

(6) Metal stamp "R" in 0.12 inch (3,05 mm) characters adjacent to each repaired tee bar hole.

(7) Metal stamp 5R83-008 adjacent to subassembly number in 0.12 inch (3,05 mm) characters.

(8) Replace tee bar plunger and spring disk in accordance with Replacing Internal Drive Ring.



NOTES:
1. 150 ALL OVER.
2. ANODIC TREAT TO SPEC. MIL-C-5541.
3. MATERIAL IS ALUMINUM ALLOY 6061-T6.

Tee Bar Hole Repair Bushing 5007112
Figure 602

ASSEMBLY AND STORAGE

1. Assembly Materials

NOTE: Equivalent substitutes may be used for items listed below.

Isopropyl Alcohol Specification TT-I-735	Commercially available
Grease Specification MIL-G-81322	Commercially available
Antiseize Compound Specification MIL-T-5544	Commercially available

2. General (Ref. IPL Fig. 1)

A. Assemble the main wheel in accordance with the following instructions.

CAUTION: ASSEMBLE WHEEL ON A CLEAN, FLAT SURFACE, BEING CAREFUL NOT TO NICK, SCRATCH OR SCUFF PAINT OR PROTECTIVE FINISH FROM WHEEL SUBASSEMBLIES. ENSURE PROPER PARTS ARE USED FOR EACH WHEEL ASSEMBLY.

B. It is recommended new preformed packings be installed at each reassembly.

WARNING: TIRE OVERINFLATION MAY RESULT IN EXPLOSIVE FAILURE.

C. Install balance weights if removed at disassembly. Instructions for attaching balance weights are given in Wheel Balancing paragraph of this section.

D. The use of power wrenches for wheel assembly is governed by the following:

(1) Do not use power wrenches for assembly of any threaded parts made of nonferrous material or parts threaded directly into nonferrous tapped holes.

(2) When power wrenches, other than automatic wrenching systems are used to assemble bolts and nuts, fastener tightness shall not exceed 50 percent of final torque value. Tightening to final torque value shall be accomplished using manual torque wrenches.

(3) Automatic wrenching systems which provide a preload or torque accuracy of ± 4 percent or better may be used to tighten bolts and nuts to final torque value.

3. Assembly Procedures (Ref. IPL Fig. 1)

A. If removed at disassembly, install outboard and inboard bearing cups (160 and 240), and disk spring (190), tee bar plunger (200 or 200A), and disk drive ring (230 or 230A) on inboard wheel subassembly in accordance with procedures in REPAIR.

B. Install instruction plate (165) on outboard wheel subassembly (90) as follows:

(1) Area in which plate is to be installed must be clean. Use a clean cloth dampened with isopropyl alcohol, Specification TT-I-735.

(2) Remove paper backing from adhesive surface being careful not to touch the adhesive.

(3) Apply plate to proper location, press firmly with roller (minimum 5 pounds (2,268 kg) pressure applied to roller) to ensure proper contact to both surfaces. Be sure that edges of plate are rolled down firmly.

(4) A set-up or curing time of approximately 48 hours is required to permanently set the adhesive, and plate should not be disturbed during this time.

C. Install valve subassembly (95 or 95A) on outboard wheel subassembly (90) as follows:

NOTE: If tube-type tire is installed, do not install valve subassembly.

(1) Install rubber grommet (150) on valve stem (140 or 140A) and seat tightly against stem base.

(2) Clean area of outboard wheel subassembly (90) around valve hole thoroughly with a clean cloth. Insert valve stem through valve hole with valve stem towards outside of wheel and preformed packing in valve hole.

(3) Place washer (130) over valve stem and onto rubber grommet (150). Install hex nut (120 or 120A) on valve stem and tighten until preformed packing is firmly compressed and valve hole is sealed.

D. Install "tubeless" tire as follows:

(1) To remove any foreign matter, wipe wheel flange bead seats and wheel register areas with a cloth dampened with isopropyl alcohol, Specification TT-I-735.

(2) Check tire for word "Tubeless" on sidewall.

(3) Make certain that tire is free of foreign material and that bead areas are clean.

(4) Check tire, with emphasis on the bead area, for shipping or handling damage.

(5) Check tubeless valve installation in wheel for proper sealing and security.

(6) Place outboard wheel subassembly (90) on a flat surface.

CAUTION: EQUALIZE THE PACKING AROUND THE PACKING GROOVE. BE CAREFUL PACKING IS NOT STRETCHED, TWISTED, PINCHED OR UNSEATED. REUSED PACKINGS SHOULD BE INSTALLED AS CLOSE AS POSSIBLE TO THEIR ORIGINAL POSITION.

(7) Lubricate preformed packing (80) with a light coat of grease, Specification MIL-G-81322, and install on wheel subassembly.

(8) Place tire on the outboard wheel subassembly with red balance dot aligned with valve subassembly.

(9) Position on the inboard wheel subassembly (170, 170A or 170B) in tire and align the bolt holes with those in the outboard subassembly, being careful not to disturb the preformed packing.

E. Install tube-type tire as follows:

(1) Clean wheel flange bead seats and register areas with a clean cloth dampened with isopropyl alcohol, Specification TT-I-735.

(2) Make certain tire is free of foreign material and bead areas are clean.

(3) Check tire, with emphasis on bead area, for shipping or handling damage.

(4) Place outboard wheel subassembly (90) on a flat surface.

(5) Inflate inner tube just enough to round it out and position tube in tire. Align yellow stripe on base of tube with red dot on sidewall of tire.

(6) Place tire on outboard wheel subassembly (90) and position the valve stem through the valve hole in the wheel subassembly.

(7) Position the inboard wheel subassembly (170, 170A or 170B) in the tire so the bolt holes align with those in the outboard subassembly.

F. Install wheel fasteners as follows:

(1) Lubricate threads of bolts (70), bearing surfaces of bolt heads, self-locking nuts (50) and washers (60) with antiseize compound, Specification MIL-T-5544.

CAUTION: INSTALL BOLT HEAD ON INBOARD SIDE OF WHEEL. THERE MUST BE A WASHER UNDER EACH BOLT HEAD AND EACH NUT.

(2) Install a washer (60) on each bolt (70). Compress wheel subassemblies and install four bolts (70), 90 degrees apart. Install a second washer (60) on bolt (70) and secure with self-locking nuts (50).

CAUTION: DO NOT USE IMPACT OR POWER WRENCHES TO TIGHTEN WHEEL BOLTS AND NUTS.

(3) Draw nuts up evenly until wheel subassemblies seat. Install remaining bolts, washers, and self-locking nuts.

(4) Tighten self-locking nuts equally in increments of 30 pound-inches (3,4 N-m) until a Lubtork value of 90 pound-inches (10,2 N-m) is obtained.

NOTE: Tighten nuts in a criss-cross pattern to obtain a more even torque value.

WARNING: PLACE WHEEL/TIRE IN AN INFLATION CAGE FOR INITIAL INFLATION. DO NOT INFLATE TIRE IN EXCESS OF FULL OPERATING PRESSURE TO SEAT THE BEADS. REDUCE TIRE PRESSURE TO RECOMMENDED STORAGE PRESSURE UNTIL WHEEL/TIRE ASSEMBLY IS READY FOR TESTING. TIRE AND/OR WHEEL FAILURE MAY OCCUR, CAUSING INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT IF THE TIRE IS OVERINFLATED FROM ANY HIGH PRESSURE SOURCE. TIRE AND WHEEL ASSEMBLIES MUST BE SERVICED WITH INFLATION EQUIPMENT WHICH HAS BEEN SPECIFICALLY DESIGNED FOR THIS OPERATION.

G. Install valve core (110) in valve stem. Place wheel/tire assembly in inflation cage and inflate tire just enough to seat beads.

NOTE: It is recommended that only nitrogen be used for tire inflation to preclude possible condensation buildup with air inflation; nitrogen will not sustain combustion and will reduce degradation of inner liner material due to oxidation.

H. Inflate tube-type tires to one-half of recommended operating pressure after beads are seated and then deflate tire completely. Inflate tire again to recommended storage pressure.

NOTE: This procedure permits the tube to equalize within the tire, preventing thinned and stretched sections in the base of the tube and reduces air leakage.

I. Deflate tire to storage pressure. Install valve cap (110) on valve, and remove wheel from inflation cage.

J. Install bearings completing the assembly as follows:

CAUTION: HANDLE BEARING CONES WITH EXTREME CARE. MANY AIRCRAFT BEARING FAILURES RESULT FROM MISHANDLING DURING MAINTENANCE.

USE CLASS 2 OR 4 BEARINGS ONLY. DO NOT SUBSTITUTE ANOTHER CLASS BEARING FOR CLASS 2 OR 4.

(1) Pack tapered roller bearing cones and rollers (20) and coat bearing surface of cup and lips of bearing seals with a grease, Specification MIL-G-81322.

NOTE: Lubrication of bearings by mechanical or other pressure methods is recommended because it is more efficient, reduces the possibility of contamination and assures a more even distribution of grease within the bearing.

CAUTION: RETAINING RING MUST BE INSTALLED WITH RESPECT TO ANTI-ROTATION LUG OF SEAL FOR THE INBOARD WHEEL SUBASSEMBLY ONLY, AS SHOWN IN FIGURE 701.

(2) Install tapered roller cone and rollers (20) and inboard bearing seal (40) in inboard wheel subassembly, and secure with wire retaining ring (30).

(3) Cover hub opening of inboard wheel subassembly (170, 170A or 170B) to protect bearings from dirt and moisture until wheel assembly is installed on aircraft.

(4) Install tapered roller bearing cone and rollers (20) and outboard bearing seal (10 or 10A), in outboard wheel subassembly.

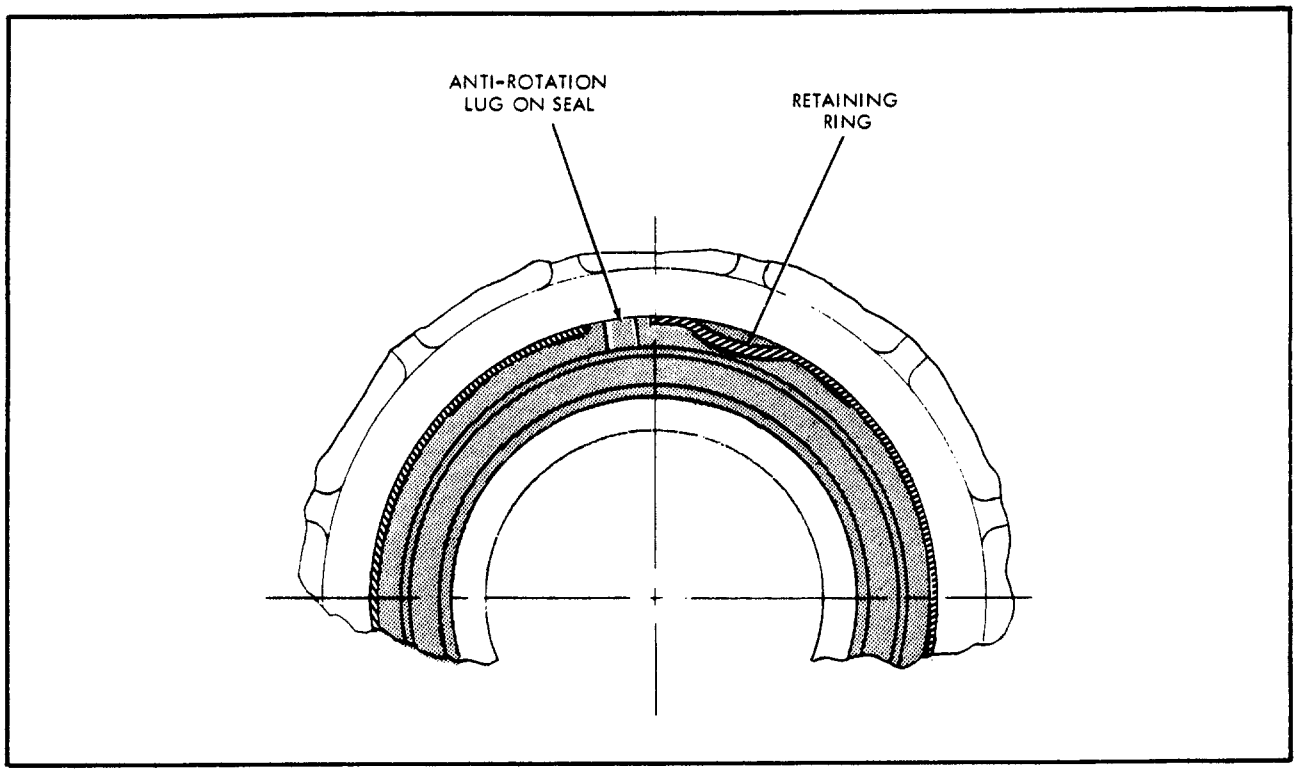
(5) Cover hub opening of outboard wheel subassembly (90) to protect bearings from dirt and moisture until wheel assembly is installed on aircraft.

K. Test wheel/tire assembly as required in accordance with TESTING AND FAULT ISOLATION.

4. Wheel Balancing

A. Any permanent balance weights removed at disassembly should be reinstalled. Weight values of permanent balance weights are stamped adjacent to the hole to which the weights are bolted. See Figure 702 for installation details.

(1) If rebalancing of individual wheel subassemblies is required after wheel repair, then new permanent balance weight values followed by letter "B" should be restamped on face adjacent to weights.



Installing Retaining Ring (Inboard Wheel Only)
Figure 701

(2) Obliterate any obsolete values.

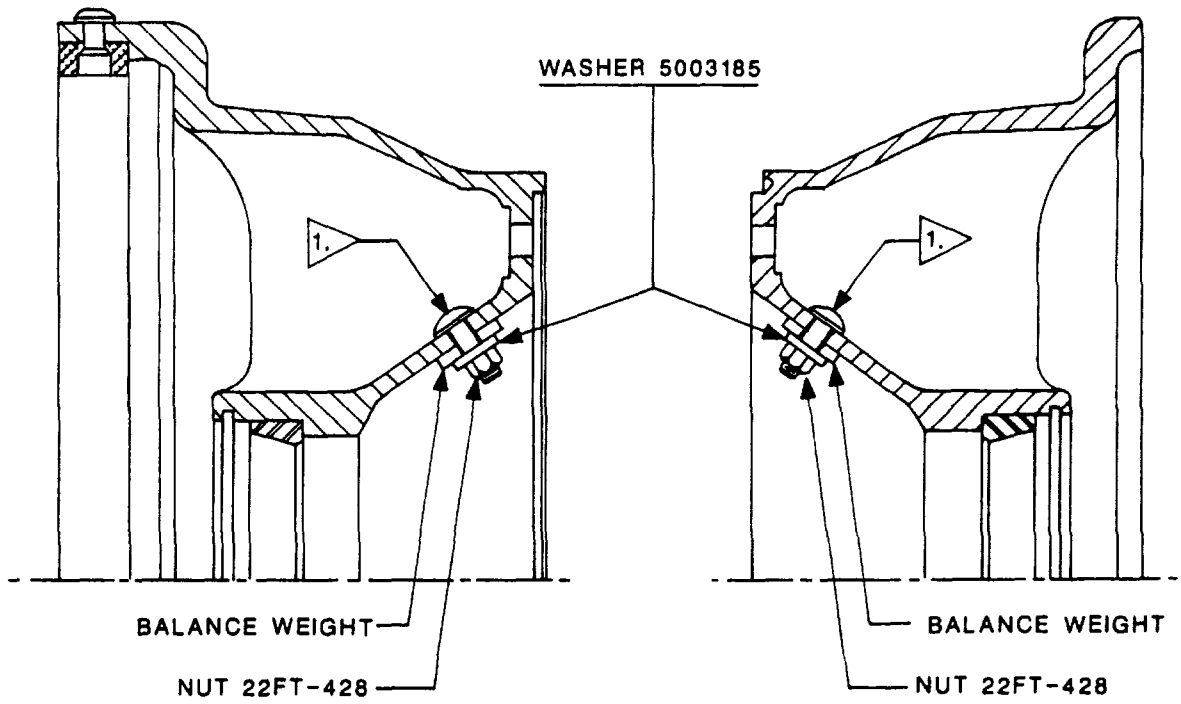
(3) Balance wheel subassembly to within 1.5 ounce-inches (108 g-cm).

B. Balance Weights are available for balancing the wheel/tire assembly. The required weight is obtained by using multiples of the balance weights. Total weight added to the inboard wheel subassembly must not exceed 3.0 ounces (85,05 g) total weight added to the outboard wheel subassembly must not exceed 3.0 ounces (85,05 g). The installed weights must not extend beyond the face of the wheel. The weights are bolted to the reinforcing flange of the wheel subassemblies as shown in Figure 702.

5. Storage Instructions

A. Wheels Stored with Tires Installed

(1) The length of time that a wheel assembly can be stored is governed by the storage life of its rubber components. The usable life may be shortened by exposure to sunlight, ozone concentration, extreme temperatures, and contamination by fluids and foreign particles.



BALANCE WEIGHT P/N	WEIGHT	SCREW LENGTH
9535339	3/4 OZ (21,3 g)	MS35207-280
9510014	1 OZ (28,3 g)	MS35207-280
9510015	1 1/2 OZ (42,5 g)	MS35207-280
9510016	2 OZ (56,7 g)	MS35207-281
9510017	2 1/2 OZ (70,9 g)	MS35207-281
9510018	3 OZ (85,1 g	MS35207-282

NOTES:

1. INSTALL MS35207 "DASH" WITH PROPER SCREW AS SHOWN IN TABLE.
2. USE EXISTING DRILLED HOLE IN WHEEL SUBASSEMBLY AND WEIGHT AS STAMPED NEAR HOLE.
3. BALANCE WEIGHTS MUST NOT EXTEND BEYOND WHEEL REGISTER EDGE.
4. TOTAL BALANCE WEIGHT ADDED FOR INBOARD WHEEL SUBASSEMBLY SHALL NOT EXCEED 3.0 OZ (85,05 g).

Balance Weight Installation
Figure 702

(2) The wheel/tire assembly should be stored in a clean, cool, dry storeroom out of direct sunlight. The desirable storeroom temperature range is 32° to 75°F (0° to 24°C). If this temperature range cannot be maintained, temperatures as high as 100°F (38°C) or even 125° (52°C) can be tolerated for short periods with only minor degradation.

(3) The recommended storage pressure for tires is 40 psi (27,6 N/cm^2).

B. Wheel Stored without Tires Installed

(1) The wheel assembly is stored without the wheel preformed packing installed between the two subassemblies. The packaged preformed packing is normally taped to the wheel for initial shipment and should be stored in this manner.

(2) Wheels stored without rubber components have an indefinite storage life.

FITS AND CLEARANCES

Item No. (Ref. IPL Fig. 1)	Nomenclature	Torque Value
50	Self-Locking Nuts	90 pound-inches (Lubtork*) (10,2 N-m)
215	Non-Locking Bolt (Steel Drive Ring)	50 to 70 pound-inches (5,6 to 7,9 N-m)
*Lubtork - At each installation, lubricate bolt threads and bearing surfaces of nuts, bolt heads, and washers with antiseize compound conforming to Specification MIL-T-5544 (W J Ruscoe & Company, 483 Kenmore Boulevard, Akron, Ohio 44301). Use full strength; do not dilute.		

Torque Value Table
Figure 801

Item No. (Ref. IPL Fig. 1)	Nomenclature	Replacement Dimension
230 or 230A	Internal Drive Ring Thickness (three or more teeth)	0.125 inch (3,18 mm) (minimum) measured 0.078 inch (1,98 mm) from top of tooth.

Internal Drive Ring Wear
Figure 802

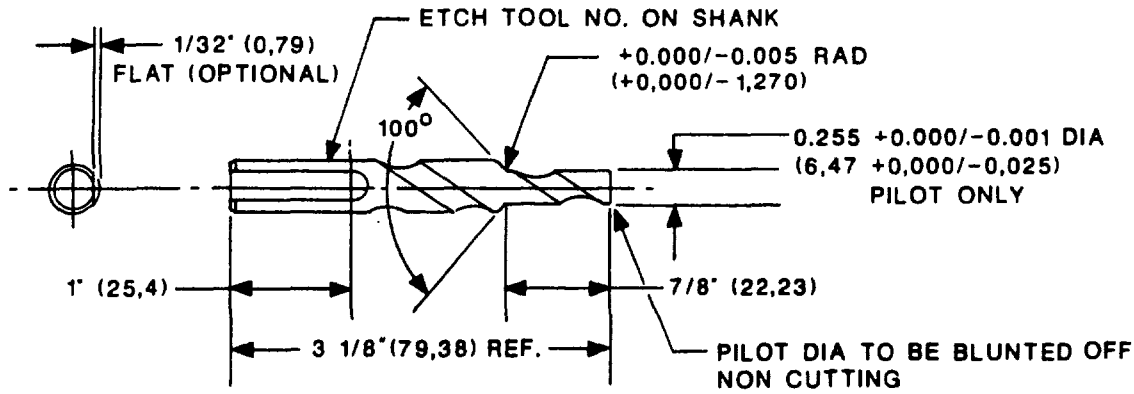
SPECIAL TOOLS, FIXTURES, AND EQUIPMENT

NOTE: Equivalent substitutes may be used for items listed below.

Figure No.	Tool No.	Description	Application
901	1-71409	Countersink Tool	Used to countersink holes in aluminum disk drive ring (230A)

NOTE: All special tools may be purchased from:

Air Treads
5075 Pine Tree Street
Forest Park, GA 30050



NOTES:

1. ALTER A 3/8 DIA SCREW MACHINE LENGTH STRAIGHT SHANK DRILL -NATIONAL LIST 240 (OR EQUIV.)
2. 3/8 DIA AND 0.255 DIA TO BE CONCENTRIC WITHIN 0.001 T.I.R.

Countersink Tool 1-71409
Figure 901

ILLUSTRATED PARTS LIST

1. Introduction

A. General

(1) The Illustrated Parts List (IPL) section illustrates and lists the procurable parts of the assembly(ies) in this publication.

B. Parts List

(1) IPL Figure 1 is an exploded view of assembly(ies) covered by the parts list.

(2) Components in the parts list are listed in order of disassembly.

(3) The Figure and Item column provides the cross reference between the parts list and the associated IPL Figure 1.

(4) The Part Number column gives the part number of the item, which is stamped on the part when practical. This number should be used when ordering parts.

(5) The Airline Stock Number column is provided for the convenience of the operator to enter individual part numbers.

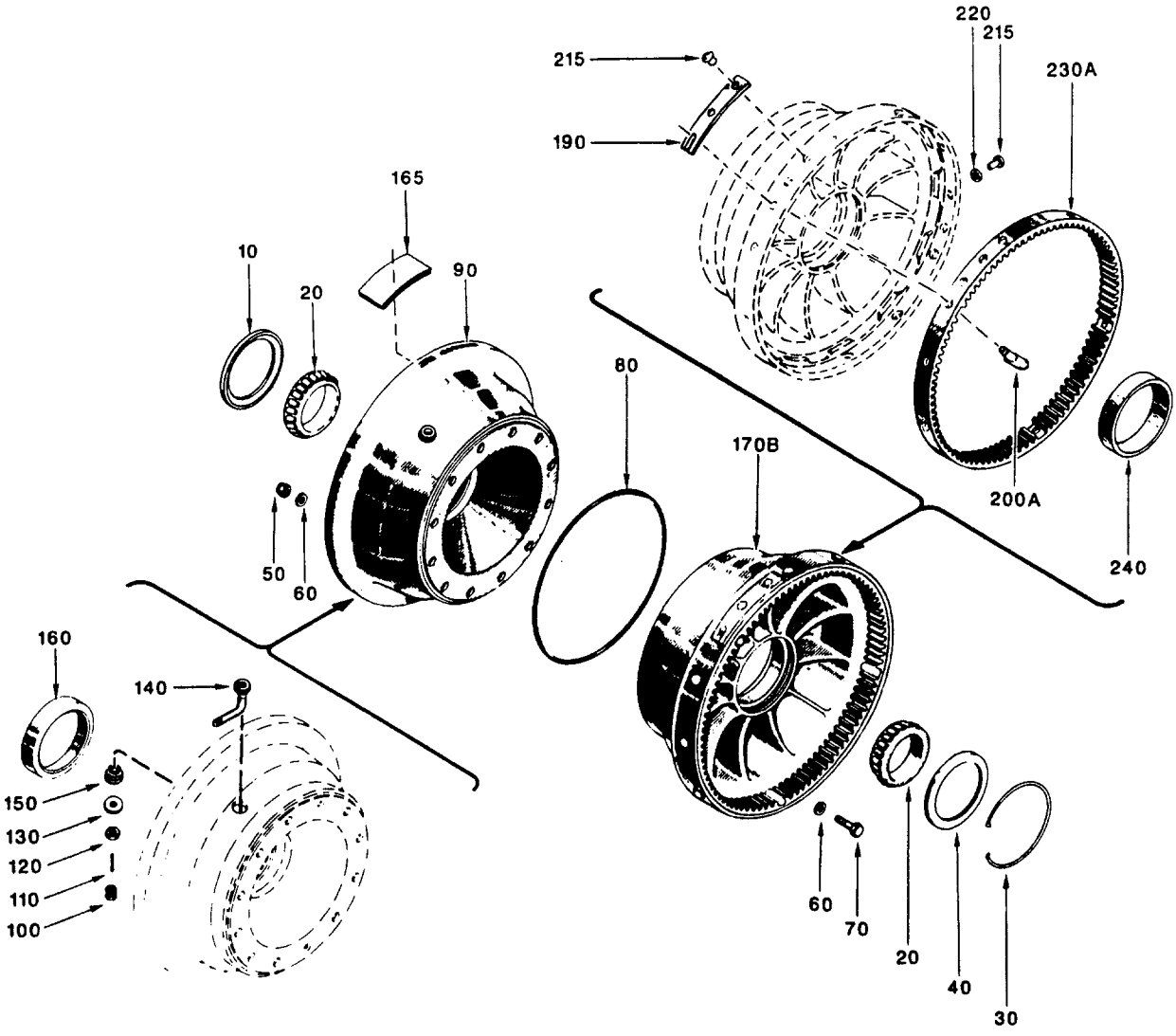
(6) The Nomenclature column gives the basic noun name of each part, together with any descriptive or dimensional information and specifications required to identify the part listed. Parts are indented under the numbered sub-column heading showing the relationship of the parts to their subassemblies and to the assembly. When an alternate part or repair part exists for the recommended part, it is indicated in parentheses following the part nomenclature. A federal supply code number is given for all vendor-supplied items.

(7) The Effect Code column shall establish parts relationship with units or assemblies which are essentially the same but have minor variations. These units or assemblies are the lead items. These units or assemblies shall be assigned reference letters such as A, B, C, D, etc. Parts which are not common to all configurations, but are associated with one or more of the coded lead items, shall carry the letter or letters assigned to the lead item with which it is associated. If a part is common to all lead items, the Effect Code column shall be blank.

(8) The Units Per Assembly column gives the number of parts required for each assembly or subassembly.

C. Federal Supply Codes for Manufacturers

(1) A list of vendor/manufacturers names and addresses is provided following the parts list.



WHEEL ASSEMBLY 9544382-2 SHOWN

2. Parts List

FIGURE ITEM	PART NUMBER	AIRLINE STOCK NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT CODE	UNITS PER ASSY	
1- 1	9544382		WHEEL ASSEMBLY, Main (Order -1 or -2)	A	RF	R
1A	9544382-1		WHEEL ASSEMBLY, Main	B	RF	R
1B	9544382-2		WHEEL ASSEMBLY, Main	C	RF	R
10	9536688		. SEAL, Bearing, (Outboard)		1	R
-10A	9533856		. SEAL, Bearing, (Outboard) (Alternate for fig. item 10)		1	R
20	39250		. CONE AND ROLLERS, Tapered Roller Bearing (Class 2 or 4 only)		2	R
30	9526147		. RING, Wire, retaining		1	R
40	9533857		. SEAL, Bearing, Inboard		1	R
50	22FH-624		. NUT, Self-locking (V56878)		12	R
60	MS20002-6		. WASHER		24	R
-60A	MS27183-14		. WASHER	B	24	R
70	9520218		. BOLT		12	R
80	AN6230-49		. PACKING, Preformed		1	R
90	9543052		. WHEEL SUBASSEMBLY, Outboard		1	R
-95	TR757-03		. . VALVE SUBASSEMBLY (V79934)		1	R
-95A	TR721-03		. . VALVE SUBASSEMBLY (V79934) (Short stem)		1	R
100	VC5		. . . CAP, Valve (MS20813-1) (V79934)		1	R
110	C-4		. . . CORE, Valve (V79934)		1	R
120	HN-5		. . . NUT, Hex (V79934)		1	R
-120A	HN-2		. NUT, Hex (Used with fig. item 95A) (V79934)		1	R
130	W-1		. . . WASHER, Ring (79934)		1	R
140	TR757-02		. . . STEM, Valve (Order TR757-03) (V79934)		1	R
-140A	TR721		. STEM, Valve (Order (TR721-03) (Used with fig. item 95A) (V79934)		1	R
150	RG-27		. . . GROMMET, Rubber (V79934)		1	R
160	39412		. . CUP, Tapered Roller Bearing (V60038)		1	R

- Item not illustrated.

TEMPORARY REVISION NO. 32–4

FILING INSTRUCTIONS: Insert facing page 1004 (32–40–24).

DESCRIPTION: Corrected part number 9544883–2 to 9544383–2 for figure item 170B.

FIGURE ITEM	PART NUMBER	AIRLINE STOCK NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT CODE	UNITS PER ASSY	
–160A	5R3–4–113		BUSHING–CUP SUB–ASSEMBLY, (Repair only) (Outboard)		AR	
165	5002742		. PLATE, Instruction		1	
–170	9544383		. WHEEL SUBASSEMBLY, Inboard	A	1	
–170A	9544383–1		. WHEEL SUBASSEMBLY, Inboard	B	1	
170B	9544383–2		. WHEEL SUBASSEMBLY, Inboard	C	1	R
–180	MS20470DD8		. . RIVET	AB	6	
190	9536741		. . SPRING, Disk		3	

– Item not illustrated.

FIGURE ITEM	PART NUMBER	AIRLINE STOCK NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT CODE	UNITS PER ASSY	
-160A	5R3-4-113		BUSHING-CUP SUB-ASSEMBLY, (Repair only) (Outboard)		AR	R
165	5002742		. PLATE, Instruction . . .		1	R
-170	9544383		. WHEEL SUBASSEMBLY, Inboard	A	1	R
-170A	9544383-1		. WHEEL SUBASSEMBLY, Inboard	B		R
170B	9544883-2		. WHEEL SUBASSEMBLY, Inboard	C	1	R
-180	MS20470DD8-10		. . RIVET	AB	6	R
190	9536741		. . SPRING, Disk		3	R
-200	9536742		. . PLUNGER, Tee bar . .	A	3	R
200A	5000728		. . PLUNGER, Tee bar . .	BC	3	R
-201	5007112*		. BUSHING, Flange (Repair only)		AR	R
-210	MS20470DD8-9		. . RIVET	AB	15	R
-211	5006511*		. BUSHING, Rivet (Repair only)		AR	R
215	NAS6204-1H		. . BOLT, Non-locking . .	C	21	R
220	AN960-416L		. . WASHER		15	R
-220A	AN960-416L		. . WASHER, (Optional part with fig. item 215 when fig. items 190 and 200A are not used)	C	6	R
-230	9536259		. . RING, Internal disk drive (Aluminum)	AB	1	R
230A	5008458		. . RING, Internal disk drive (Steel)	C	1	R
240	39412		. . CUP, Tapered Roller Bearing (V60038) (Order class 2 or 4 only)		1	R
-241	5R3-4-167*		BUSHING CUP SUB-ASSEMBLY, Repair (Inboard)		AR	R
-250	22FT-428*		. NUT (V56878)		AR	R
-260	5003185*		. WASHER		AR	R
-270	9535339*		. BALANCE WEIGHT, 0.75 ounce (21 g)		AR	R
-270A	9510014*		. WEIGHT, Balance, 1 ounce (28 g)		AR	R

- Item not illustrated.
* Item not furnished; order separately.

NOTE: Please see the TEMPORARY REVISION that revises this page.

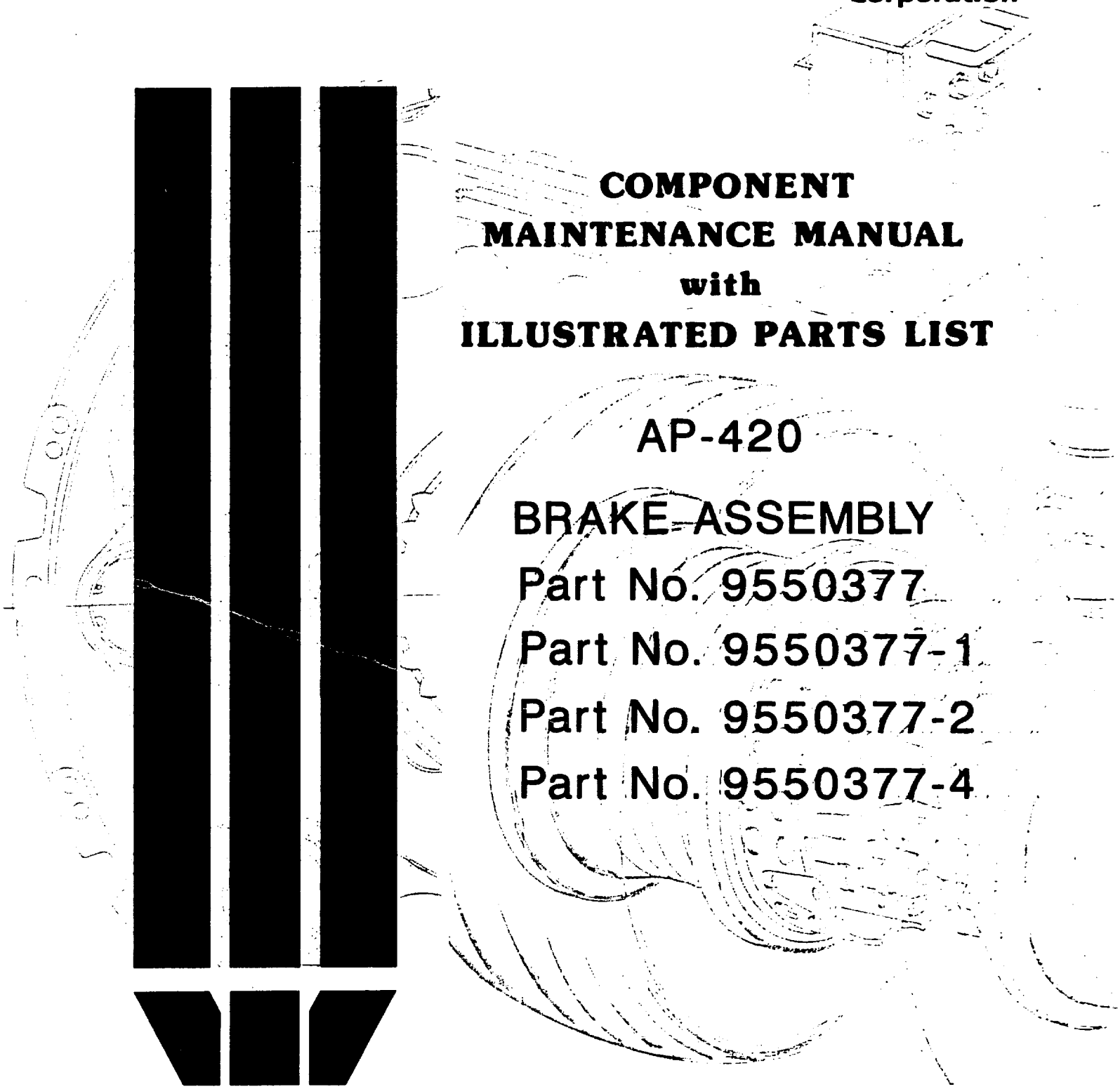
FIGURE ITEM	PART NUMBER	AIRLINE STOCK NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT CODE	UNITS PER ASSY	
-270B	9510015*		. WEIGHT, Balance, 1.5 ounce (43 g)		AR	R
-270C	9510016*		. WEIGHT, Balance, 2 ounces (57 g)		AR	R
-270D	9510017*		. WEIGHT, Balance, 2.5 ounces (71 g)		AR	R
-270E	9510018*		. WEIGHT, Balance, 3 ounces (85 g)		AR	R
-280	MS35207-280*		. SCREW		AR	R
-280A	MS35207-281*		. SCREW		AR	R
-280B	MS35207-282*		. SCREW		AR	R

- Item not illustrated.
* Item not furnished; order separately.

3. Federal Supply Codes for Manufacturers

Code No.	Name and Addresses
56878	SPS Technologies, Incorporated Aerospace and Industrial Products Division Highland Avenue Jenkintown, PA 19046
60038	The Timken Company 1835 Dueber Avenue, Southwest Canton, OH 44706
79934	The Tire and Rim Association, Incorporated Akron, OH 44313 See T&R Standard for approved manufacturers *Possible sources for valve and valve parts.
*17875	Eaton Corporation Route 501 South Roxboro, NC 27573
*27783	Schrader Automotive Incorporated Division of Arvin Industries 566 Mainstream Drive P.O. Box 675 Nashville, TN 37202-0675

AIRCRAFT BRAKING SYSTEMS
Corporation



COMPONENT MAINTENANCE MANUAL with ILLUSTRATED PARTS LIST

AP-420

BRAKE ASSEMBLY

Part No. 9550377

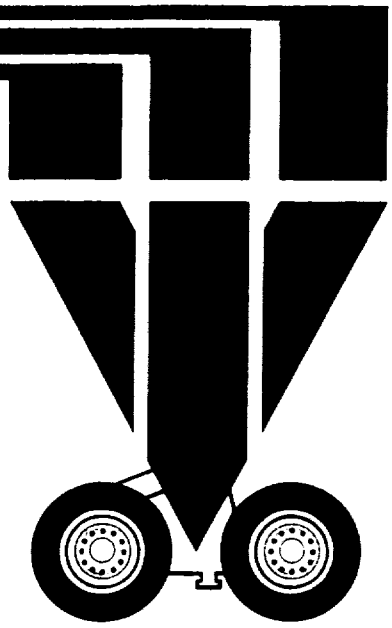
Part No. 9550377-1

Part No. 9550377-2

Part No. 9550377-4

PUBLICATIONS DEPARTMENT

32-43-23



AP-420

COMPONENT MAINTENANCE MANUAL

WITH

ILLUSTRATED PARTS LIST

FOR

BRAKE ASSEMBLY PART NO. 9550377,

9550377-1, 9550377-2 AND 9550377-4

USED ON

DE HAVILLAND TWIN OTTER AIRCRAFT

BASIC ISSUE 1 NOVEMBER 1973

AIRCRAFT BRAKING SYSTEMS
Corporation

PUBLICATIONS DEPARTMENT
AKRON, OHIO 44306-4186
CAGE CODE 0B9R9

COMPONENT MAINTENANCE MANUAL
BRAKE ASSEMBLY

TEMPORARY REVISION NO. 32–6

TO: HOLDERS OF AP-420 (32-43–23) COMPONENT MAINTENANCE MANUAL WITH ILLUSTRATED PARTS LIST FOR BRAKE ASSEMBLIES 9550377, 9550377–1, 9550377–2 AND 9550377–4 USED ON DE HAVILLAND TWIN OTTER AIRCRAFT.

PURPOSE: This Temporary Revision corrects part ordering information and adds Brake Linings 5008993–1 and 5009124 as alternates for Brake Lining 5008993 to Illustrated Parts List. This Temporary Revision is also issued to correct the List of Effective Pages and to remove the Disk Guide Bracket Assembly 5008294. In addition, this Temporary Revision changes the item nomenclature in the List of Effective Pages to make clear the difference between the aluminum parts and the magnesium parts. This Temporary Revision replaces Temporary Revision No. 32–5, which can be removed.

FILING INSTRUCTIONS: Record applicable data on the RECORD OF TEMPORARY REVISIONS sheet in front of the manual. Insert page 1 facing the RECORD OF TEMPORARY REVISIONS.

Retain this Temporary Revision until normal revision service incorporates this information into the Component Maintenance Manual.

This Temporary Revision affects the List of Effective Pages, page 2 and pages 2, 3, 1002, 1003 and 1004 (32–43–23).

RECORD OF TEMPORARY REVISIONS

TEMPORARY REVISION NUMBER	PAGE NUMBER	ISSUE DATE	BY	DATE REMOVED	BY
32–4	1 thru 6	Mar 12/92	ABSC	Jul 1/93	ABSC
32–5	1 thru 7	Jul 1/93	ABSC	Mar 12/99	ABSC
32–6	1 thru 7	Mar 12/99	ABSC		

(RELEASED: 3/24/99)

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COMPONENT MAINTENANCE MANUAL
BRAKE ASSEMBLY 9550377

TO: HOLDERS OF AP-420 (32-43-23) COMPONENT MAINTENANCE MANUAL WITH ILLUSTRATED PARTS LIST FOR BRAKE ASSEMBLY 9550377, 9550377-1 AND 9550377-4 USED ON DEHAVILLAND TWIN OTTER AIRCRAFT.

Attached to this transmittal letter is Revision No. 4 of AP-420 (basic issue dated 1 November 1973).

REVISION NO. 4 DATED 1 JULY 1990

HIGHLIGHTS

Pages which have been added or revised are listed below together with the Highlights of the revision. Please delete the affected pages and insert Revision No. 4 pages dated July 1, 1990. Enter Revision No. 4 dated Jul 1/90 and insertion date on the Records of Revisions sheet.

Chapter/Section and Page No.	Description of Change
Reason	Revision No. 4 adds Brake Assembly 9550377-2 as a production unit. Item numbers have been revised and added throughout the manual to reflect the detail parts of the new brake assembly.
Cover	Added Brake Assembly 9550377-2.
Title Page	Added Brake Assembly 9550377-2 and Revision No. 4 date.
Service Bulletin List, page 1/2	Added Service Bulletins DHC-6-32-5 and DHC-6-32-6.
List of Effective Pages, pages 1 and 2	Revised to reflect added, revised and/or deleted pages.
Table of Contents pages 1 thru 3/4	Revised to reflect current revision. Added paragraph 9 and Repair No. 7 under REPAIR.
32-43-23 page 3	Revised figure item numbers in Key to Figure 1.
page 4	Added Brake Assembly 9550377-2 weight and material to paragraph 4. Added paragraph 5.C. describing Brake Assembly 9550377-2 differences. Relocated text.
page 5/6	Relocated text.

Chapter/Section and Page No.	Description of Change
pages 101 and 103/104	Added figure items 20C and 20D to paragraphs 3.A.(1) and 3.F.
pages 301 and 302	Added figure items 20D, 60A, 150B and 250A to paragraphs 2.C, 2.E, 2.I. and 2.L.
pages 502 and 503	Added figure items 20D, 150B, 150C and 250A to paragraphs 4., 4.A, 12., 12.A and 15.
page 504	Added paragraph 15.E. concerning check of lining retainer and rivet.
page 602	Revised paragraph 3.H., specifying magnesium housing and revised Repair No. 6 title. Added step 3.I referencing Repair No. 7 for piston lining retainer.
pages 606, 607, 608 and 609	Revised re-treating and repainting instructions to include procedures for both aluminum and magnesium parts in paragraphs 6.B, 6.C.(3), 6.D.(2), (3), (4), 6.E and 6.F(1). Relocated text.
page 610 and 611	Relocated text.
page 612	Added paragraph 9, instructions for replacing lining retainer and rivet. Relocated text.
Repair No. 1 page 601	Added figure items 250A, 150B and 150C to paragraphs 1.A, B., C.(1), C.(2) and C.(3)(a).
page 602	Added instructions for treating machined surfaces of aluminum housing. Added instructions to use aluminum Pistons 5009128 with aluminum brake Housing 5009126 in paragraphs 2.A(3) and 2.C.
Repair Nos. 2 and 3 page 601	Added figure item 250A to paragraph 1.A.
Repair No. 3 page 602	Deleted housing part number from Repair Figure 601.
Repair No. 6 page 601	Added part number to Repair No. 6 title.
Repair No. 7 pages 601 and 602	Added Repair No. 7 - Repair of Piston Lining Retainer.

Chapter/Section and Page No.	Description of Change
pages 702, 703 and 704	Added figure items 250A, 150B, 150C and 60A to paragraphs 3.B.(2), 3.C.(2), 3.D.(1), 3.E, 3.F.(3), (5), (6), (10) and (11). Changed figure items 263 and 264 to 255 and 256 in paragraphs 3.E, 3.E NOTE, 3E(1) and (2). Changed figure items 262 and 261 to 254 and 253 in paragraph 3.G. NOTE.
page 705	Revised paragraph 3.G.(1) adding Brake Assemblies 9550377, -1 and -4. Added paragraph 3.H.(3) for installing brake linings in Brake Assembly 9550377-2.
page 801	Added figure items 20D, 150B and 150C to Figure 802.
page 802	Added figure item 60A to Figure 803.
pages 1003 and 1004	Changed Brake Assembly 9550377-2 to production part incorporating SB DHC-6-32-6. Added the following parts as detail parts of Brake Assembly 9550377-2 and revised parts list as follows. Item 1B - Added effect code C. Item 20C - Changed effect code to C. Item 20D - Added Brake Lining 5009124 Item 60A - Added Cylinder Head 5009127 Item 70 - Added effect code C. Item 70A - Changed effect code to D. Item 80 - Added effect code C. Item 80A - Changed effect code to D. Item 90 - Added effect code C. Item 90A - Changed effect code to D. Item 150 - Added effect codes ABD. Item 150A - Added effect Codes ABD. Item 150B - Added Piston 5009128 Item 150C - Added oversize repair Piston 5009408. Item 200A - Added effect codes CD. Item 250 - Added effect codes ABD. Item 250A - Added Brake Housing 5009126 Item 251 - Added Repair Rivet MS20426AD-510. Item 252 - Added Repair Lining Retainer 9521519. Item 253 - Added Repair Retaining Ring 9521958. Item 254 - Was item 261. Item 255 - Was item 262. Item 256 - Was item 263. Item 257 - Was item 264.

COMPONENT MAINTENANCE MANUAL
BRAKE ASSEMBLY 9550377

TO: HOLDERS OF AP-420 (32-43-23) COMPONENT MAINTENANCE MANUAL WITH ILLUSTRATED PARTS LIST FOR BRAKE ASSEMBLY 9550377 AND 9550377-1 USED ON DEHAVILLAND TWIN OTTER AIRCRAFT.

Attached to this transmittal letter is Revision No. 3 of AP-420 (basic issue dated 1 November 1973).

REVISION NO. 3 DATED 31 MAY 1989

HIGHLIGHTS

REVISION NO. 3 CONTAINS ALL PAGES OF THE MANUAL. Pages which have been added or revised are outlined below, together with the Highlights of the revision.

Please retain all previous HIGHLIGHTS pages inserting them into this manual for future reference.

Chapter/Section and Page No.	Description of Change
All pages	The purpose of this revision is to add the conversion of Brake Assembly 9550377-1 to 9550377-4 by adding new improved asbestos-free linings. Added Repair Nos. 4 thru 6. Corrected Manual to show correct brake wear measurement location. Changes masthead logo to Aircraft Braking Systems. Added Brake Assembly 9550377-4 to manual and parts peculiar to brake assembly.
Cover	Added Brake Assembly 9550377-4 and latest format for Aircraft Braking Systems.
Title Page	Added Brake Assembly 9550377-1 and 9550377-4 and latest format for Aircraft Braking Systems.
Record of Revisions, page 1/2	Added Revision No. 3 and date.
Service Bulletin List, page 1/2	Added Service Bulletin DHC6-32-4.
List of Effective Pages, page 1/2	Added title to precede Record of Revisions. Added Repair Nos. 4 thru 6. Revised to reflect added, revised, and/or deleted pages.
Table of Contents, pages 1 thru 3/4	Added paragraph 8. to REPAIR for Modification of Brake Assembly 9550377-1 to 9550377-4. Added Repair Nos. 4 thru 6.
Introduction, pages 1 thru 4	Added latest Introduction and field office office address list.

Chapter/Section and Page No.	Description of Change
32-43-23	
Technical changes are as follows:	
pages 2, 3, 1002 1003 and 1004	Added Brake Assembly 9550377-4 and component parts to Figure 1, Key to Figure 1, IPL Figure 1 and illustrated parts list.
page 4	Added new paragraph 5.B. for brake differences between Brake Assemblies 9550377-1 and 9550377-4. Added paragraph 6.B. for Modification of Brake Assembly 9550377-1 to 9550377-4. Relocated Test.
page 102	Revised Figure 101, Brake Wear Measurement to show correct wear measurement location.
page 401 thru 405/406 and 901,902	Revised paragraph 3., Paint Removal Procedures to add Dry Stripping as (Method I) and changed Wet Stripping to (Method II). Added new Figure 401, Recommended Dry Stripping Variables. Added Dry-Stripping Materials to paragraph 1. Cleaning Materials and added equipment to SPECIAL TOOLS, FIXTURES AND EQUIPMENT section.
page 503	Added Oversize Piston 9522145 (150A) and Replacement Dimension of 2.161 inches (54,89 mm).
page 604	Revised Repair Areas 6 thru 9 to add "Maximum blending of reworked area limited to 0.50 square inch".
page 611/612	Added new paragraph 8., Modification and/or Rework of Brake Assembly 9550377-1 to Brake Assembly 9550377-4, incorporating Service Bulletin DHC6-32-4.
Repair No. 2 page 602	Revised Repair Figure 601, Lining Recess Repair to clarify.
Repair No. 4 pages 601 thru 603/604	Added Repair No. 4 - Repair of Brake Housing for Anvil Lining Retention Repair.
Repair No. 5 pages 601 and 602	Added Repair No. 5 - Repair of Brake Housing for Machining Wiper Ring Groove.
Repair No. 6 pages 601 and 602	Added Repair No. 6 - Rework of Brake Housing for Removal of Excess Casting Material, which incorporates Service Letter DHC-6-SL-4.

Chapter/Section and Page No.		Description of Change
page 703		Added new paragraph 3.E. for wiper ring installation on reworked brake housings stamped "5R86-067".
page 704		Added NOTE to new paragraph 3.G. to reference "5R85-015" repair, and installation of countersunk head screw and self-locking nut.
page 705		Added NOTE to paragraph 4. to insure that bushings are installed on housings with reworked mounting bolt holes.
page 1002		Renumbered items 20B to 20C, 70 to 70A, 80 to 80A and 90 to 90A in IPL Figure 1.
page 1003	Item no.	Revised parts list as follows:
	1	Changes (Order-1) to (Order-4)
	1A	Added (Order-4) to Brake Assembly.
	1B	Added P/N 9550377-2, NONPRODUCTION.
	1C	Added P/N 9550377-3, NONPRODUCTION.
	1D	Added P/N 9550377-4 for Brake Assembly and added effect code C.
	-20B	Added not illustrated symbol "_" to item number and added "**" to follow P/N for not procurable.
	20C	Added P/N 5008993 for brake lining. Added effect code C.
	70	Added (Alternate for item 70A) to nomenclature. Added effect codes AB.
	70A	Added P/N MS28775-228, Preformed Packing. Added effect code C.
	80	Added (Alternate for item 80A) to nomenclature. Added effect codes AB.
	80A	Added P/N MS28775-010, Preformed Packing. Added effect code C.
	90	Added (Alternate for item 90A) to nomenclature. Added effect codes AB.
	90A	Added P/N MS28775-327, Preformed Packing. Added effect code C.
page 1004	-261	Added P/N FN12L-82, Self-Locking Nut (Repair Only).
	-262	Added P/N MS24694-S9, Machine Screw (Repair Only).
	-263	Added P/N 5009211, Wiper Ring (Repair Only).
	-264	Added P/N 5009213, Wiper Ring (Oversize) (Repair Only).
	270	Changes P/N from GYR6B10 to GY16B-10* to correct.

Editorial changes are as follows:

page 5/6	Relocated text.
page 301	Editorial changes.
page 502	In paragraph 4., title and 4.A., changed brake lining (20, 20A or 20B) to brake lining (20C). Added preformed packings 70A, 80A and 90A to paragraph 8. title.
page 601	Revised vendor for Aeroprite Reducer TH-89.
page 602	Added paragraphs 3.F., 3.G. and 3.H. to reference Repair No. 4, Repair No. 5 and Repair No. 6 respectively. Relocated text.
pages 605 and 606	Relocated text.
Repair No. 1 pages 601 and 602	Editorial changes.
Repair No. 2 page 601	Added paragraph 2.B.(a) for retreating and repainting metal stamped areas. Editorial changes.
Repair No. 3 page 601	Editorial changes.
page 602	Deleted note in Assembly view of Repair Figure 601, discussed in text.
pages 703 thru 706	Editorial changes. Relocated text.
pages 801 and 802	Changes items 20, 20A or 20B to 20B or 20C and added item 150A, Piston to Figure 802. Editorial changes.
page 1001	Revised IPL Introduction to latest.
page 1002	Deleted Brake Assemblies 9550377 and 9550377-1 from IPL Figure 1 title. Added 9550377-4 SHOWN to field of illustration.
page 1005/1006	Relocated text.

COMPONENT MAINTENANCE MANUAL
BRAKE ASSEMBLY 9550377

TO: HOLDERS OF AP-420 (32-43-23) OVERHAUL MANUAL WITH ILLUSTRATED PARTS LIST FOR BRAKE ASSEMBLY 9550377 USED ON DEHAVILLAND TWIN OTTER AIRCRAFT.

Attached to this transmittal letter is Revision No. 2 of AP-420 (basic issue dated 1 November 1973).

REVISION NO. 2 DATED 15 SEPTEMBER 1986

HIGHLIGHTS

REVISION NO. 2 CONTAINS ALL PAGES OF THE MANUAL. Pages which have been added or revised are outlined below, together with the Highlights of the revision.

Please retain all previous HIGHLIGHTS pages inserting them into this manual for future reference.

Chapter/Section and Page No.	Description of Change
All pages	This manual has been prepared with automated word processing equipment. Shifting of text may have occured. Marking of the shifted text has been eliminated. Marking of text pages reflect only actual changes. This manual has been changed from an Overhaul to a Component Maintenance Manual. Sections have been relocated and pages renumbered accordingly. The technical information has not changed unless specified in the following highlights. Added metric units to all dimensions. Changed IPL figure item references adding "zero" to existing references. Clarified nomenclature in text to agree with parts list.
Cover	Changed to Component Maintenance Manual and added Brake Assembly 9550377-1.
Revision Highlights page 1	Corrected ATA number from 32-40-20 to 32-43-23.
Title Page	Changed to Component Maintenance Manual, added part number 9550377-1 and revision date.
Record of Revisions, page 1/2	Added Revision No. 2.
Record of Temporary Revisions, page 1/2	Added Temporary Revisions 32-1, 32-2 and 32-3.

Chapter/Section and Page No.	Description of Change
Service Bulletin List, page 1/2	Added Service Bulletin 32-3.
List of Effective Pages, pages 1 and 2	Revised to reflect added, revised, and/or deleted pages.
Table of Contents, pages 1 and 2	Expanded table for clarification.
Introduction, pages 1 thru 5/6	Revised to provide certification, the latest information and field office addresses.
32-43-23	
page 1	Clarified paragraph 1.A. and added paragraphs 1.B., 1.C., 1.D., and 1.E. Relocated text.
page 2	Revised Figure 1 from exploded view to cross sectional view, added figure items 260 and 300, added lockwire requirements and suggested disk wear measurements. Changed Figure 1 title to Brake Assemblies 9550377 and 9550377-1. Relocated text.
page 3	Revised Key to Figure 1 to agree with Illustrated Parts List, by adding "zero" to existing references and revising nomenclature. Added figure items 20A, 20B, 150A, 200A, 290 thru 330 and not illustrated symbol (-) and NOTE. Added paragraph 3. Handing Procedures. Relocated text.
page 4	Renumbered paragraph 3. to 4. Leading Particulars and clarified Material. Added new paragraphs 5. Brake Differences and 6. Brake Modification. Added new paragraph 7. Brake Lining Wear Check on Aircraft, which incorporates TR32-2 data previously located in CHECK. Relocated text.
pages 101 thru 103/104	Renumbered, relocated and revised entire section.
page 101	Incorporated data from previous TESTING and TROUBLE SHOOTING sections into new TESTING AND FAULT ISOLATION section. Added paragraph 1. Test Equipment and Materials, paragraph 2. Test Setup and paragraph 3. Operational Test and Fault Isolation Procedures.
page 102	Added Figure 101 and paragraph 3. text.
page 103/104	Added paragraph 3. text, paragraph 4. Fault Isolation and Figure 102.

Chapter/Section and Page No.	Description of Change
pages 301 and 302	Renumbered, relocated and revised entire section.
page 301	Added (Ref. IPL Fig. 1) to paragraph 1. title. Added NOTE and paragraph 1.A. Changed paragraph 1.A. to 1.B. Deleted paragraph 2.B. and renumbered remaining paragraphs C. thru K. to B. thru J., clarifying nomenclature to agree with parts list. Added paragraphs J.(1) and (2).
page 302	Renumbered paragraphs L. and M. to J. (3) and (4). Added paragraph K. and renumbered paragraph N. to L. and O. to M.
pages 401 and 402	Renumbered, relocated and revised entire section.
page 401	Added paragraph 1. Cleaning Materials. Changed paragraph 2. title to Cleaning Procedures and added WARNING, CAUTION, and NOTE.
page 402	Added paragraphs 2.C., 2.D. and 2.E. Added paragraph 3. Paint Removal Procedures.
pages 501 thru 504	Renumbered, relocated and revised entire section. Deleted paragraph 3. Brake Lining Check on Aircraft - relocated data to Description and Operation section.
page 501	Added paragraph 1. Check Materials from deleted Figure 301 information. Renumbered paragraph 1. to 2. General and added paragraphs 2.A. and 2.B. Renumbered paragraph 2. to 3. Brake Disk and renumbered subparagraphs.
page 502	Renumbered paragraph 2. subparagraphs. Added paragraph 4. Brake Lining. Added paragraphs 5. thru 9.
page 503	Added paragraph 10. from information in previous paragraph 1.F. Changed minimum force of 105 to 115 pounds and 55 to 60 pounds. Added paragraph 11. from information in previous paragraph 1.E. Added paragraph 12. from information in previous paragraph 1.D. Added paragraphs 13. and 14. Added paragraph 15. from information in previous paragraphs 1.B., 1.C., and 1.H.
page 504	Added paragraph 15. text. Added paragraph 16. from information in previous paragraph 4. Changed lining thickness from 0.175 to 0.205 inch, incorporating TR32-2. Added paragraph 17.

Chapter/Section and Page No.	Description of Change
pages 601 thru 610	Renumbered, relocated and revised entire section.
page 601	Added paragraph 1. Repair Materials.
page 602	Added paragraph 2. General. Added paragraph 3. Repair of Brake Housing. Revised paragraph 4. by renumbering subparagraphs.
page 603	Renumbered Figure 401 to 601, and revised by changing rework areas 1, 6, 8, 9, and 11 and added Detail A.
page 604	Added Key to Figure 601 from information in previous paragraphs 1.A. thru 1.J.
page 605	Renumbered Figure 402 to 602. Renumbered paragraph 4. subparagraphs. Added paragraph 5. from information in previous paragraphs 9. and 12. and incorporated TR32-2. Added paragraph 6. Re-Treating and Repainting.
page 606	Renumbered Figure 407 to 603. Added paragraph 6. text.
pages 607 thru 609	Added paragraph 6. text.
page 610	Added paragraph 6. text. Added paragraph 7., incorporating SB32-3.
Repair No. 1 pages 601 and 602	Added from relocated data in previous paragraph 3.
Repair No. 2 pages 601 and 602	Added from relocated data in previous paragraph 8. and renumbered Figure 404 to 601.
Repair No. 3 pages 601 and 602	Added from relocated data in previous paragraph 11. and renumbered Figure 406 to 601.
pages 701 thru 705/706	Renumbered, relocated and revised entire section. Changed section title to ASSEMBLY AND STORAGE.
page 701	Added paragraph 1. Assembly and Storage Materials and changed MIL-G-81322 grease to hydraulic preservative fluid MIL-H-6083. Added paragraph 2. General. Added paragraph 3. Assembly Procedures.

Chapter/Section and Page No.	Description of Change
page 702	Added paragraph 3.B., replacing previous paragraphs 3., 15., 16. and 17., incorporating TR32-2. Added paragraph 3.C., replacing previous paragraphs 3, and 14., incorporating TR32-2. Added paragraph 3.D., replacing previous paragraph 2. and clarifying.
page 703	Added paragraph 3.D. text. Added paragraph 3.E., replacing previous paragraphs 3. thru 13. Added Figure 701.
page 704	Added paragraph 3.E. text. Added paragraph 3.F., incorporating TR32-1. Renumbered paragraph 18. to 3.G. Added paragraph 3.H. Added paragraph 4., replacing paragraphs 19. thru 21.
page 705/706	Clarified paragraph 5. Storage Instructions.
pages 801 and 802	Renumbered, relocated and revised entire section. Renumbered Figures 601 thru 603 to 801 thru 803.
page 801	Changed item no. 120 minimum load from 55 to 60 pounds and item no 130 minimum load from 105 to 115 pounds in Figure 801. Revised Figure 802 as follows: item no. 10. - Added outside diameter or 13,025 inch; item no. 280 - added item no. 320 reference and changed dimension 0.175 to 0.205 inch; Added item nos. 20, 20A, 20B and 140.
page 802	Revised Figure 803 by adding item nos. 180, 220 and 230, incorporating TR32-3.
page 901/902	Renumbered, relocated and revised entire section.
pages 1001 thru 1004	Renumbered, relocated and revised entire section.
page 1001	Revised IPL Introduction.
page 1002	Revised Figure 1 adding "zero" to existing figure item numbers. Added part number 9550377-1 to Figure 1. title. Added figure items 300, 310, 320 and 330. Changed figure items 200 to 200A and 20 to 20B. Corrected figure item 260 to 290 and added bracket for figure item 260 subassembly.

Chapter/Section and Page No.	Description of Change
page 1003	Revised Parts List as follows: Renumbered paragraph 3. to 2., Parts List. Added "zero" after existing item numbers. Item 1 - Added **, Order -1 and effect code A. Item 1A - Added. Item 20 - Added ** and effect code A. Item 20A - Added ** and effect code A. Item 20B - Added. Item 40 - Added "self". Item 50 - Changed "adjusting pin" to "steel". Item 70 - Changed O-ring packing to O-ring gasket. Item 90 - Deleted piston. Item 100 - Deleted spring. Item 120 - Changed return to release. Item 130 - Changed return to release. Item 150A - Added "only". Item 160 - Changed V65301 to V79555 and shipping to protective. Item 170 - Changed O-ring to preformed. Item 180 - Changed inlet bushing to screw thread insert. Item 190 - Changed O-ring to preformed. Item 200 - Added effect code A. Item 200A - Added. Item 240 - Changed O-ring to preformed. Item 260 - Clarified nomenclature. Item 270 - Changed GY16B12 to GYR6B10. Item 300 - Deleted lockwire MS20995C32. Added Bracket Subassembly, Disk Guide, part number 5008294. Item 310 - Added. Item 320 - Added. Item 330 - Added.
page 1004	Renumbered paragraph 2. to 3. Federal Supply Codes for Manufacturers. Deleted Code No. 65301 and added Code No. 79555.

OVERHAUL MANUAL WITH IPL
PART NO. 9550377

TO: Holders of AP-309, Overhaul Manual and Illustrated Parts List, Main Wheel Assembly 9544382 and Brake Assembly 9550377 for DeHavilland Twin Otter Aircraft, dated 15 January 1969 (revised 1 May 1970).

Attached to this transmittal letter is AP-420, Overhaul Manual with Illustrated Parts List, Brake Assembly 9550377 for DeHavilland Twin Otter Aircraft, dated 1 November 1973. This manual replaces the brake overhaul section (32-40-2) of AP-309 dated 15 January 1969 (revised 1 May 1970), which should be removed and destroyed.

Service Bulletins issued for AP-309, applicable to Brake Assembly 9550377, have been incorporated into AP-420, dated 1 November 1973, and are listed in the AP-420 Service Bulletin List.

Following are brief highlights of the changes which took place in updating the Brake Assembly 9550377 from AP-309 to AP-420:

a. Changed Cover and Title pages to new format.

b. Changed Masthead and "disc" to "disk".

c. Added Leading Particulars.

d. Changed rubber parts cleaning solution.

e. Revised Checking procedures and added approved penetrant materials.

f. Revised Repair procedures.

g. Revised Storage Instructions and Illustrated Parts List.

COMPONENT MAINTENANCE MANUAL
BRAKE ASSEMBLY 9550377

RECORD OF REVISIONS

REV NO.	ISSUE DATE	DATE INSERTED	BY
1	Jul 15/76	Sep 15/86	GAC
2	Sep 15/86	Sep 15/86	GAC
3	May 31/89	May 31/89	ABS

REV NO.	ISSUE DATE	DATE INSERTED	BY

COMPONENT MAINTENANCE MANUAL
BRAKE ASSEMBLY 9550377

RECORD OF TEMPORARY REVISIONS

TEMPORARY REVISION NUMBER	PAGE NUMBER	ISSUE DATE	BY	DATE REMOVED	BY
32-1	1 and 2	May 18/77	GAC	Sep 15/86	GAC
32-2	1 thru 3	May 21/80	GAC	Sep 15/86	GAC
32-3	1 thru 3	Sep 13/83	GAC	Sep 15/86	GAC

COMPONENT MAINTENANCE MANUAL
BRAKE ASSEMBLY 9550377

SERVICE BULLETIN LIST

SERVICE BULLETIN NUMBER	REV NO.	DATE INSERTED
DHC-6-32-1		No Effect
DHC-6-32-2		Nov 1/73
DHC-6-32-3		Sep 15/86
DHC-6-32-4		May 31/89
DHC-6-32-5		Nov 17/89
DHC-6-32-6		Jul 1/90

SERVICE BULLETIN NUMBER	REV NO.	DATE INSERTED

COMPONENT MAINTENANCE MANUAL
BRAKE ASSEMBLY 9550377

LIST OF EFFECTIVE PAGES

SUBJECT	PAGE	DATE
Title		Jul 1/90
Record of Revisions	1	May 31/89
	2	Blank
Record of Temporary Revisions	1	Sep 15/86
	2	Blank
Service Bulletin List	1	Jul 1/90
	2	Blank
List of Effective Pages	1	Jul 1/90
	2	Jul 1/90
Table of Contents	1	Jul 1/90
	2	Jul 1/90
	3	Jul 1/90
	4	Blank
Introduction	1	May 31/89
	2	May 31/89
	3	May 31/89
	4	May 31/89
Description and Operation	1	Sep 15/86
	2	May 31/89
	3	Jul 1/90
	4	Jul 1/90
	5	Jul 1/90
	6	Blank
Testing and Fault Isolation	101	Jul 1/90
	102	May 31/89
	103	Jul 1/90
	104	Blank
Disassembly	301	Jul 1/90
	302	Jul 1/90
Cleaning	401	May 31/89
	402	May 31/89
	403	May 31/89
	404	May 31/89
	405	May 31/89
	406	Blank
Check	501	Sep 15/86
	502	Jul 1/90
	503	Jul 1/90
	504	Jul 1/90
Repair	601	May 31/89
	602	Jul 1/90
	603	Sep 15/86
	604	May 31/89
	605	May 31/89
	606	Jul 1/90
	607	Jul 1/90
	608	Jul 1/90
	609	Jul 1/90
	610	Jul 1/90
	611	Jul 1/90
	612	Jul 1/90
Repair No. 1	601	Jul 1/90
	602	Jul 1/90
Repair No. 2	601	Jul 1/90
	602	May 31/89
Repair No. 3	601	Jul 1/90
	602	Jul 1/90
Repair No. 4	601	May 31/89
	602	May 31/89
	603	May 31/89
	604	Blank
Repair No. 5	601	May 31/89
	602	May 31/89
Repair No. 6	601	Jul 1/90
	602	May 31/89

TEMPORARY REVISION NO. 32–6

FILING INSTRUCTIONS: Insert facing the List of Effective Pages, page 2 (32–43–23).

DESCRIPTION: Changed the date for page 902 to "Blank". This Temporary Revision replaces Temporary Revision No. 32–5, which can be removed.

LIST OF EFFECTIVE PAGES (CONTINUED)

SUBJECT	PAGE	DATE
Repair No. 7	601	Jul 1/90
	602	Jul 1/90
Assembly and Storage	701	Sep 15/86
	702	Jul 1/90
	703	Jul 1/90
	704	Jul 1/90
	705	Jul 1/90
	706	May 31/89
Fits and Clearances	801	Jul 1/90
	802	Jul 1/90
Special Tools, Fixtures and Equipment	901	May 31/89
	902	Blank
Illustrated Parts List	1001	May 31/89
	1002	May 31/89
	1003	Jul 1/90
	1004	Jul 1/90
	1005	May 31/89
	1006	Blank

TEMPORARY REVISION NO. 32–5

FILING INSTRUCTIONS: Insert facing the List of Effective Pages, page 2 (32–43–23).

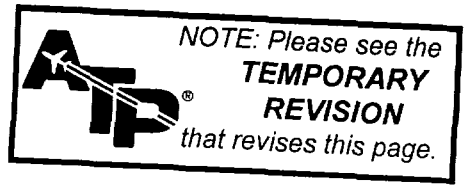
DESCRIPTION: Changed the date for page 902 to "Blank".

LIST OF EFFECTIVE PAGES (CONTINUED)

SUBJECT	PAGE	DATE
Repair No. 7	601	Jul 1/90
	602	Jul 1/90
Assembly and Storage	701	Sep 15/86
	702	Jul 1/90
	703	Jul 1/90
	704	Jul 1/90
	705	Jul 1/90
	706	May 31/89
Fits and Clearances	801	Jul 1/90
	802	Jul 1/90
Special Tools, Fixtures and Equipment	901	May 31/89
	902	Blank
Illustrated Parts List	1001	May 31/89
	1002	May 31/89
	1003	Jul 1/90
	1004	Jul 1/90
	1005	May 31/89
	1006	Blank

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	705	Jul 1/90
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Illustrated Parts List	1001	May 31/89
	1002	May 31/89
	1003	Jul 1/90
	1004	Jul 1/90
	1005	May 31/89
	1006	Blank



COMPONENT MAINTENANCE MANUAL
BRAKE ASSEMBLY 9550377

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COMPONENT MAINTENANCE MANUAL
BRAKE ASSEMBLY 9550377

INTRODUCTION

This manual is published in accordance with Air Transport Association Specification No. 100 for the guidance of personnel responsible for the overhaul and/or maintenance of the assembly(ies) covered in this publication. The procedures described in this manual may be altered if better and/or more economical equivalent methods can be employed by the individual facilities. However, the alternate procedures must not lessen the performance or efficiency of operation of the assembly, and all torque and specific limits or values contained herein must be strictly observed.

All dimensions and other values are expressed in U.S. units followed, where applicable, by the appropriate SI (International System) metric units in parentheses. All illustration dimensions are in inches with millimeter conversions in parentheses unless otherwise specified. Dimensions of standard tools or parts such as drills, taps, bolts, nuts, etc. where there are no equivalent metric tools or parts for the application, appear in U.S. units. Illustrations are for reference only and are not drawn to scale. Attempt is made to illustrate relationship to adjoining parts in proper proportion.

The following precautions apply to all procedures in this manual:

NOTICE

Any alteration to or substitution of any part contained in any wheel and/or brake affecting those assemblies could result in unit malfunction, or other adverse effects.

If alteration to or substitution of any part contained in any Aircraft Braking Systems' wheel and/or brake affecting those assemblies is necessary, obtain prior written Aircraft Braking Systems' authorization and instruction before performing such alteration or substitution.

AIRCRAFT BRAKING SYSTEMS ASSUMES NO LIABILITY WHATSOEVER, WHETHER CONTRACTURAL, WARRANTY, TORT OR OTHERWISE, FOR ANY UNAUTHORIZED SUBSTITUTION OF OR ALTERATION TO ANY PART CONTAINED IN ANY WHEEL AND/OR BRAKE OR FOR ANY ALTERATION NOT PERFORMED IN ACCORDANCE WITH AIRCRAFT BRAKING SYSTEMS APPROVED PROCEDURES.

While Aircraft Braking Systems represents the information contained in this manual was current at the time of publication of this issue, and verified by comparison to engineering documentation, the user is cautioned that he must inquire of the nearest authorized distributor or dealer of Aircraft Braking Systems' wheels and brakes as to whether a more recent publication is in existence before proceeding with overhaul or maintenance operations. If you cannot locate a dealer or distributor, make your inquiry directly to our Customer Support Department, Aircraft Braking Systems, 1204 Massillon Road, Akron, Ohio 44306-4186.

Users outside the United States and Canada should contact the nearest Aircraft Braking Systems International Field office as listed in this manual or the closest Aircraft Braking Systems' distributor.

The aircraft maintenance manual shall take precedence for the component's interface connections with the functional features as used in the aircraft. This manual may also describe functional features that may or may not be used when installed as a component of a system in the aircraft.

TSO NOTICE

This assembly for commercial transport usage carries a "TSO" marking which identifies it as having been fully laboratory tested and qualified to the applicable Federal Aviation Administration (FAA) regulations. As a commercial transport category assembly, it is also tested and qualified to the specification requirements of the applicable airframe manufacturer and, finally, is certified on the applicable aircraft.

After final certification, any substitution of or alteration to any part and/or any change of process or material is not permitted without complete requalification of this assembly and resubmittal of the test data to the FAA for approval.

The FAA regulations subject Aircraft Braking Systems, the airframe manufacturer and the operator to constant surveillance to assure that proper Quality Assurance material and processing controls are maintained in order to provide replacement parts that are the same quality as the parts originally certified in this assembly.

SAFETY SUMMARY

Adhere to all manufacturer's Warnings and Cautions for all materials specified in this manual. Wear protective clothing (gloves, apron, etc.) approved for the materials and tools being used.

ON-CONDITION MAINTENANCE

Individual operators shall determine the frequency of maintenance. Since each operator has a different set of operating conditions, overhaul frequency will vary. Aircraft Braking Systems recommends that on-condition maintenance be performed.

World Airlines Technical Operations Glossary (WATOG) defines on-condition maintenance as follows:

A primary maintenance process having repetitive inspections or tests to determine the condition of units, systems or portions of structure with regard to continued serviceability (corrective action is taken when required by item condition).

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DESCRIPTION AND OPERATION

1. Description (Ref. Fig. 1)

A. The single disk brake assembly is used on the main landing gear of the aircraft. The brake disk contains gear teeth at its perimeter for mating with a wheel assembly containing a gear tooth drive ring. Two interchangeable inlet ports are provided on the brake housing. Only one port is used as an inlet (depending on installation position on landing gear), and the other is used as a bleeder port.

B. The brake assembly contains three pistons. Incorporated in each of the three pistons is an automatic adjustment mechanism which controls the clearance between disk and linings when the brake is in the off position, ensuring constant clearance during the life of the linings.

C. The brake pistons are sealed by means of preformed packings compounded for the type of brake fluid used in the brake system.

D. The brake housing is secured to axle torque flange by 12 bolts.

E. At operator's option, an inner and outer disk guide subassembly is provided, but is not furnished unless ordered separately.

2. Operation

A. Single disk brakes operate on the principle of two opposed sections of brake lining separated by an annular disk, which is engaged to rotate with the aircraft wheel. To provide braking action, the linings are pressed against the disk by hydraulic pressure applied against the brake piston.

B. The brake linings are contained in recesses in the piston and anvil section of the brake housing. A throat or groove is provided in the housing for the annular disk to pass through as the wheel rotates.

C. The disk floats on the wheel internal drive ring. This floating action compensates for the movement of the disk when braking pressure is applied. Only the piston side brake lining moves toward the disk, while the anvil side lining remains stationary. As the piston lining presses it, the disk moves until it contacts the anvil lining. The disk then receives equal clamping action on both sides as pressure is increased. Optional disk guides may be installed to minimize sideways movement and cocking of the brake disk.

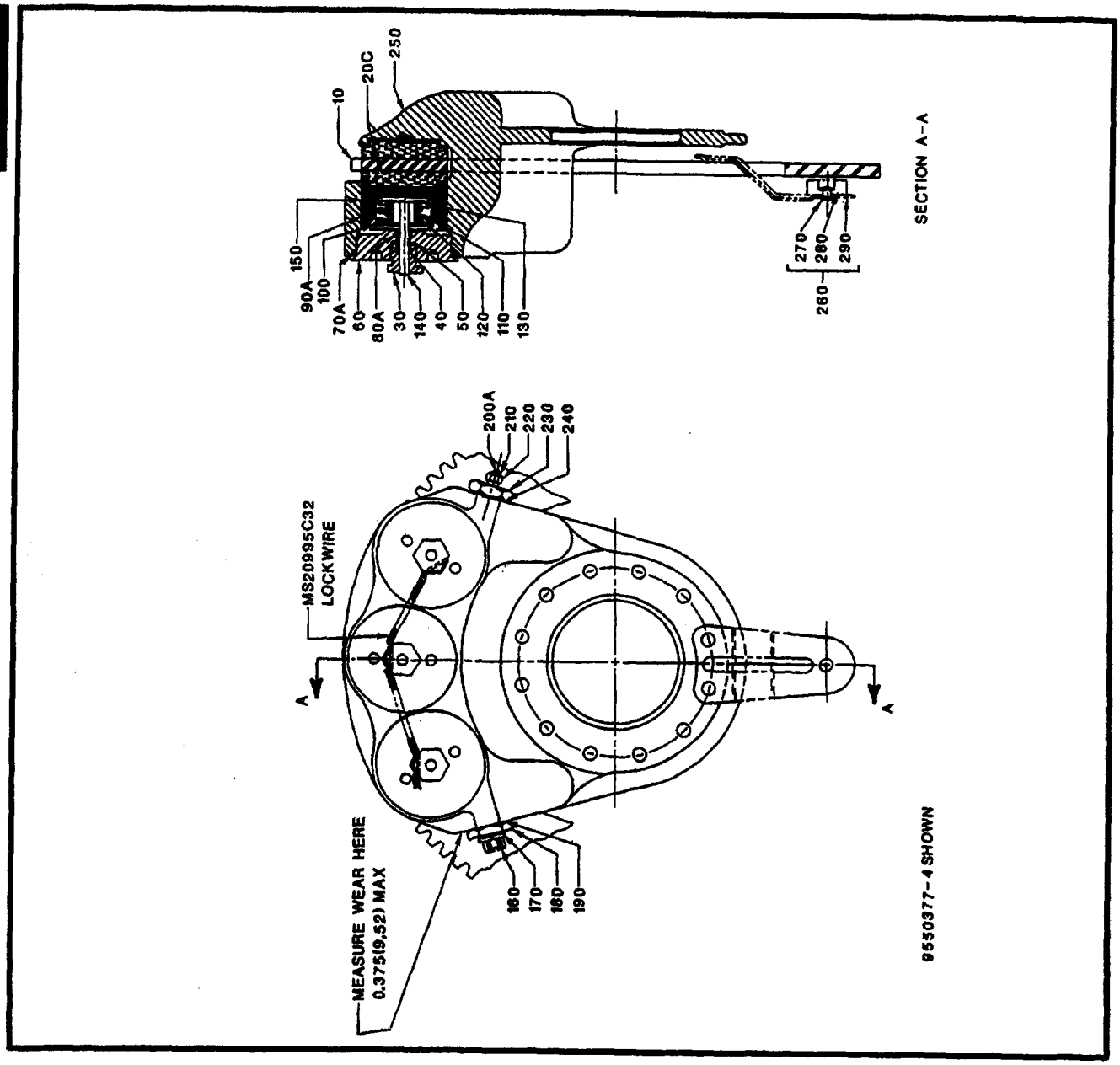
D. The single disk brake is used with a wheel having an aluminum gear tooth drive ring riveted to the drive flange. When rotation of the disk is restrained by the brake unit, the torque forces are transmitted to the wheel through the drive ring.

E. Each brake contains an automatic adjustment mechanism which maintains a constant disk-to-lining clearance throughout the life of the lining, thereby ensuring a drag-free brake.

TEMPORARY REVISION NO. 32–6

FILING INSTRUCTIONS: Insert facing page 2 (32–43–23).

DESCRIPTION: Removed items 300, 310, 320 and 330 from Figure 1. This Temporary Revision replaces Temporary Revision No. 32–5, which can be removed.

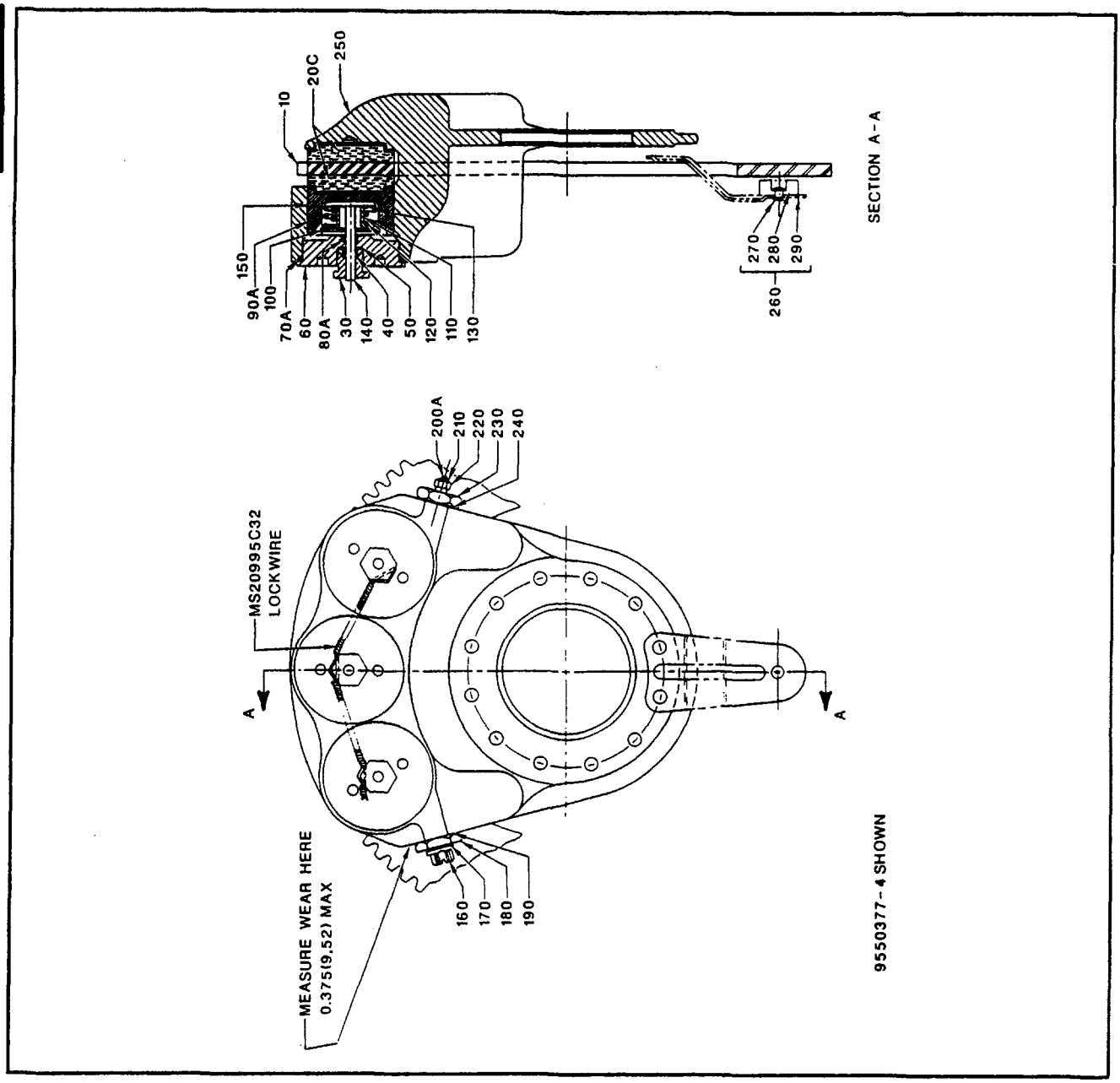


Brake Assembly
Figure 1

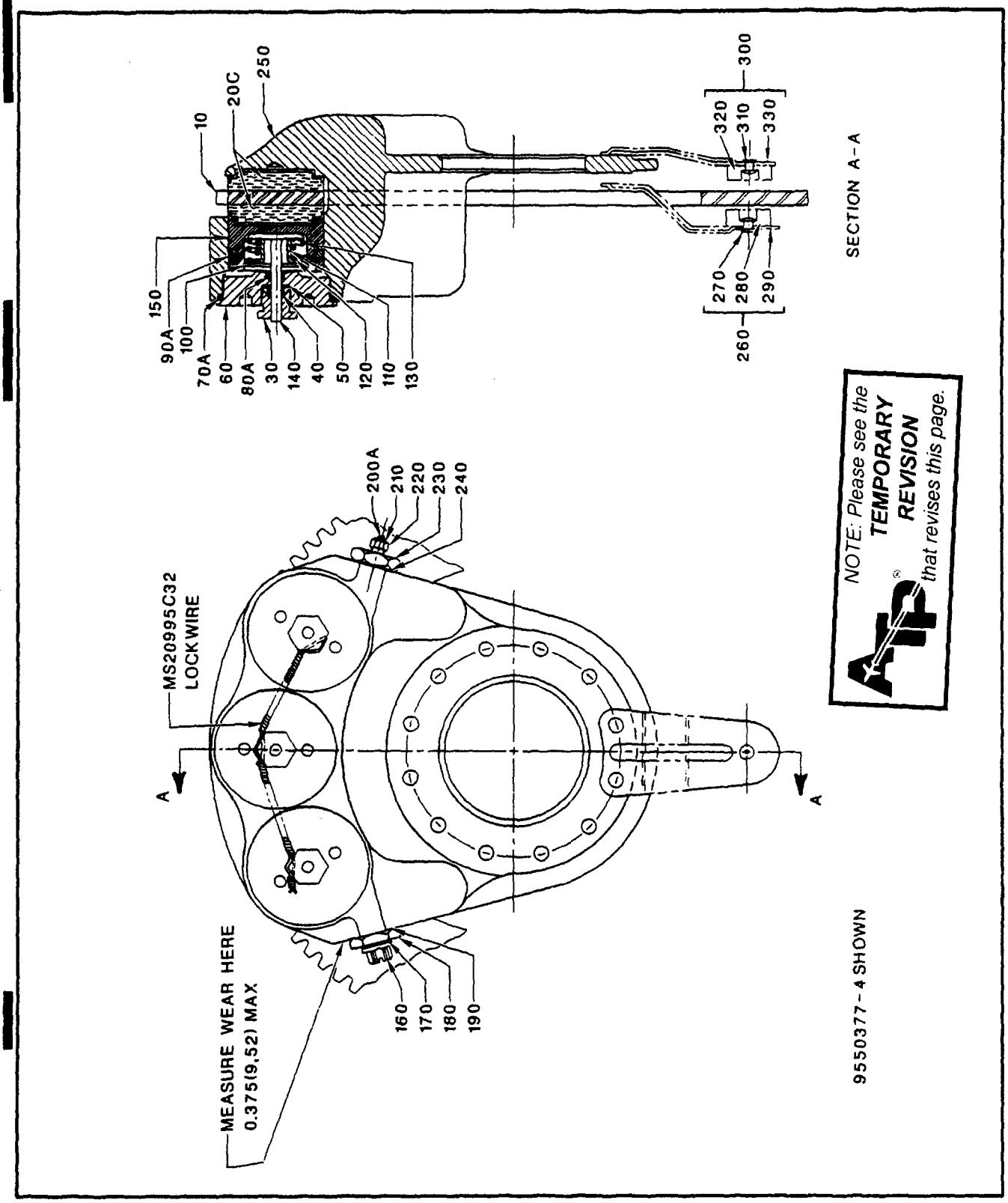
TEMPORARY REVISION NO. 32–5

FILING INSTRUCTIONS: Insert facing page 2 (32–43–23).

DESCRIPTION: Removed items 300, 310, 320 and 330 from Figure 1. This Temporary Revision replaces Temporary Revision No. 32–4, which can be removed.



Brake Assembly
Figure 1



Brake Assembly
Figure 1

TEMPORARY REVISION NO. 32–6

FILING INSTRUCTIONS: Insert facing page 3 (32–43–23).

DESCRIPTION: Added brake lining item 20E. Changed items 300 through 330 to "DELETED". This Temporary Revision replaces Temporary Revision No. 32–5, which can be removed.

Key to Figure 1

–20E.Brake Lining (Alternate)

–300.	DELETED
–310.	DELETED
–320.	DELETED
–330.	DELETED

– Item not illustrated.

TEMPORARY REVISION NO. 32–5

FILING INSTRUCTIONS: Insert facing page 3 (32–43–23).

DESCRIPTION: Added brake lining item 20E. Changed items 300 through 330 to "DELETED". This Temporary Revision replaces Temporary Revision No. 32–4, which can be removed.

Key to Figure 1

–20E.Brake Lining (Alternate)

–300.	DELETED
–310.	DELETED
–320.	DELETED
–330.	DELETED

– Item not illustrated.

Key to Figure 1

-1.	RF	140.	Self-Adjusting Pin
10.	Brake Disk	150.	Piston
-20.	Brake Lining	-150A.	Piston (Repair only)
-20A.	Brake Lining (Alternate)	-150B.	Piston
-20B.	Brake Lining	160.	Protective Plug
20C.	Brake Lining	170.	Preformed Packing
-20D.	Brake Lining	180.	Screw Thread Insert
30.	Self-Adjusting Pin Nut	190.	Preformed Packing
40.	Self-Adjusting Pin Grip	-200.	Bleeder Screw
50.	Steel Washer	200A.	Bleeder Screw
60.	Cylinder Head	210.	Bleeder Washer
-60A.	Cylinder Head	220.	Bleeder Valve
-70.	O-Ring Gasket	230.	Bleeder Valve Adapter
70A.	Preformed Packing	240.	Preformed Packing
-80.	O-Ring Packing	250.	Brake Housing
80A.	Preformed Packing	250A.	Brake Housing
-90.	O-Ring Packing	260.	Disk Guide Bracket Subassembly
90A.	Preformed Packing	270.	Tubular Rivet
100.	Retaining Ring	280.	Disk Guide Lining
110.	Spring Guide	290.	Disk Guide Bracket
120.	Brake Release Spring	300.	Disk Guide Bracket Subassembly
130.	Brake Release Spring	310.	Tubular Rivet
		320.	Disk Guide Lining
		330.	Disk Guide Bracket

- Item not illustrated.

3. Handling Procedures

A. Careful handling of the brake components will assure a long service life and trouble-free operation.

B. Strictly observe torque and Lubtork values specified in this manual. Do not overtighten any bolt, nut or fittting.

C. Handle the brake parts with extreme care. Many failures can be traced to dropping or mishandling the parts during maintenance.

D. The brake should be properly maintained to protect the paint and surface finishes, as exposed surfaces are susceptible to corrosion. Nicks, scratches, and other damage caused by improper handling of the brake during maintenance invite corrosion, which if unattended will lead eventually to fatigue cracks and premature removal from service.

NOTE: Please see the TEMPORARY REVISION that revises this page.

4. Leading Particulars

Weight (approximate)	16.4 pounds (7,44 kg)
(Brake Assembly 9550377-2)	19.1 pounds (8,66 kg)
Brake	Single disk
Hydraulic Fluid	Specification MIL-H-5606
Functional and Clearance Test Pressure	770 psi (53,1 bars)
Operating Clearance at 40 psi (2,76 bars)	
Back Pressure	0.028 inch minimum (0,71 mm)
	0.050 inch maximum (1,27 mm)
Material:	
Brake Housing	Cast Magnesium Alloy
Pistons	Magnesium Alloy
Cylinder Head	Magnesium Alloy
(Brake Assembly 9550377-2)	
Brake Housing	Aluminum Alloy
Pistons	Aluminum Alloy
Cylinder Heads	Aluminum Alloy

5. Brake Differences

A. Brake Assemblies 9550377 and 9550377-1 differ only in the brake linings. Brake Assembly 9550377-1 uses asbestos-free linings.

B. Brake Assemblies 9550377-1 and 9550377-4 differ only in the brake linings and seals. Brake Assembly 9550377-4 uses new, improved asbestos-free linings and "MS" packings.

C. Brake Assembly 9550377-2 differs from 9550377, 9550377-1 and 9550377-4 in that it uses an aluminum brake housing, pistons and cylinder heads rather than magnesium. Brake Assembly 9550377-2 also incorporates a positive brake lining retention feature consisting of buttons machined on the pistons and buttons riveted to the anvil. The asbestos-free brake linings have fastener sockets that mate with the buttons to hold the liners in place.

6. Brake Modification

A. Brake Assembly 9550377

(1) Modification is provided in REPAIR at operator's option to convert Brake Assembly 9550377 to 9550377-1.

(2) This modification provides instructions for replacing asbestos linings with asbestos-free linings and reidentification of brake assemblies.

B. Brake Assembly 9550377-1

(1) Modification is provided in REPIAR, at operator's option, to convert Brake Assembly 9550377-1 to 9550377-4.

(2) This modification provides instructions for replacing asbestos-free linings with new, improved asbestos-free linings and reidentification of brake assemblies.

7. Brake Lining Wear Check on Aircraft

A. Check brake linings while the brake is on the aircraft as follows:

(1) Apply brakes and hold.

B. Measure the distance from the flat of the brake housing (parallel to the disk) to the surface of the brake disk (Ref. Fig. 1), at bleeder or inlet port.

CAUTION: NEVER MIX NEW AND USED BRAKE LININGS. IF NECESSARY TO REUSE WORN LININGS, REINSTALL THEM IN THEIR ORIGINAL POSITION.

LINING SHOULD NOT BE WORN BEYOND THE SPECIFIED 0.375 DIMENSION, OR A BREAKING UP OF LINING COULD OCCUR AND AN EVENTUAL BRAKE LINING LOSS COULD RESULT. REPLACE LINING WHEN THE LINING CUP IS FOUND TO BE DEFORMED AND OUT OF ROUND. ALSO CHECK, AND REPAIR IF NECESSARY, LINING RECESSES IN ACCORDANCE WITH REPAIR.

C. When this dimension reaches 0.375 inch (9,52 mm) or more, the brake linings should be replaced.

TESTING AND FAULT ISOLATION

1. Test Equipment and Materials

NOTE: Equivalent substitutes may be used for items listed.

Hydraulic Test Stand Supplies 0 to 3,000 psi (206,84 bars) pressure gaged to read output pressure to 5 psi (0,345 bars) increments	Commercially available
Hydraulic Fluid (Red Oil) Specification MIL-H-5606	Commercially available

2. Test Setup

A. None required.

3. Operational Test and Fault Isolation Procedures

CAUTION: HYDRAULIC TEST STAND MUST CONTAIN RED OIL TO SPECIFICATION MIL-H-5606.

A. Connect brake assembly to a hydraulic test stand capable of applying 770 psi (53,1 bars) hydraulic pressure to brake.

(1) Use brake disk (10) or a spacer of equal thickness between brake linings (20C or 20D).

B. Place brake in upright position with disk (10) in place between linings.

(1) Apply pressure and bleed brake.

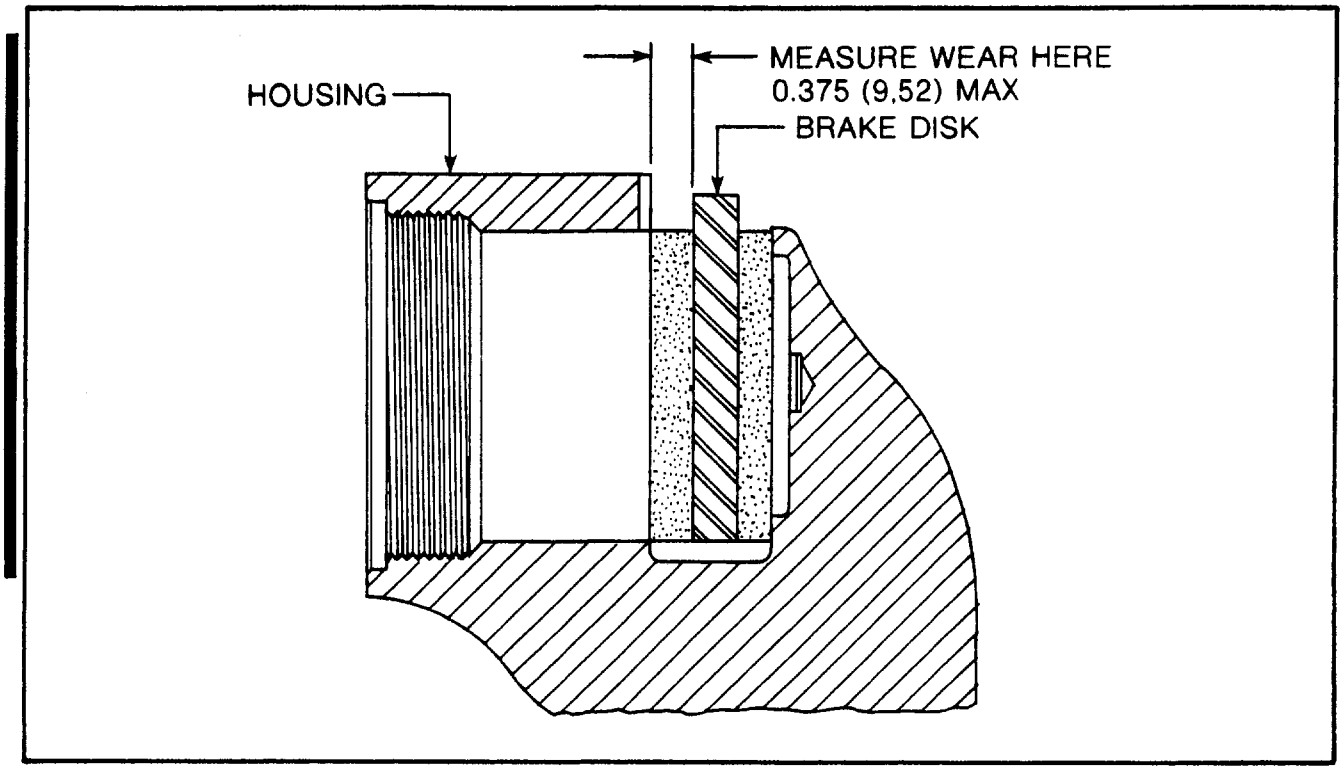
(2) Apply 5 psi (0,345 bars) hydraulic pressure at inlet for five minutes. There shall be no measurable leakage.

(3) Apply 770 psi (53,1 bars) hydraulic pressure at inlet for five minutes. There shall be no measurable leakage.

C. Apply and hold pressure for brake lining wear check.

(1) Measure the distance from the flat of the brake housing (parallel to disk) to the surface of the brake disk at inlet or bleeder port as shown in Figure 101.

(2) When this dimension reaches 0.375 inch (9,52 mm) or more, the brake linings should be replaced.



Brake Wear Measurement
Figure 101

D. Adjusting pin slippage test.

(1) Remove disk (10) or spacer from brake assembly.

(2) Fully retract pistons and apply 80 psi (5,52 bars) hydraulic pressure.

(3) After the piston has advanced the amount permitted by the built-in clearance, hold this pressure for 15 seconds. If the required hydraulic pressure is held and there is no further movement of the piston, the pin grip holding force is satisfactory.

NOTE: If pin slippage occurs, the brake shall be rejected and the pin and grip combination replaced.

(4) Reinstall disk (10) or spacer in brake assembly between linings.

E. Apply 770 psi (53,1 bars) pressure and then release brake checking for proper brake release. Repeat three times. The disk (10) should be free to rotate when the brake pressure is released. The hyraulic back pressure should not be greater than 40 psi (2,76 bars).

F. Apply 770 psi (53,1 bars) pressure and release pressure to 40 psi (2,76 bars); then check brake clearance. The brake clearance measured between the lining (20, 20A, 20B, 20C or 20D) and disk (10) should be 0.028 to 0.050 inch (0,71 to 1,27 mm). The hydraulic back pressure should not be greater than 40 psi (2,76 bars).

4. Fault Isolation

A. Fault isolate in accordance with Figure 102.

Trouble	Probable Cause	Correction
Hydraulic fluid leaking from brake	Defective hydraulic connection	Tighten connection or replace fitting.
	Defective preformed packing	Replace preformed packing.
	Piston or cylinder head worn or damaged	Replace piston and/or housing.
Brake not engaging correctly	Air in brake	Bleed brake.
	Brake lining worn out	Overhaul brake.
	Obstruction in hydraulic line or fluid passage	Remove obstruction.
	Pistons sticking	Replace piston O-ring packings.
	Pistons damaged	Replace pistons.
	Cylinder head damaged	Replace cylinder head or brake housing.
	Disk gear defective and disk not moving freely in wheel when brake pressure is released	Replace disk.
Brake not releasing correctly	Obstruction in hydraulic line or fluid passage	Remove obstruction.
	Piston sticking	Replace piston preformed packings.
	Pistons damaged	Replace pistons.
	Cylinder head damaged	Replace cylinder head or brake housing.

Fault Isolation Chart
Figure 102

DISASSEMBLY

1. General (Ref. IPL Fig. 1)

NOTE: See TESTING AND FAULT ISOLATION for operational and test and fault isolation procedures to establish condition of unit and determine extent of disassembly required.

A. Prior to dismounting and disassembling brake, check lining for wear in accordance with the DESCRIPTION AND OPERATION section.

B. Disassemble the brake assembly in accordance with the following instructions.

2. Disassembly Procedures

A. Position brake assembly on a clean work surface.

B. Remove brake disk (10) from brake.

C. Remove brake linings (20B, 20C or 20D).

(1) If it is necessary to reuse linings, the linings should be replaced in the same position.

D. Cut and remove lockwire from self-adjusting pin nuts (30). Remove self-adjusting pin nuts (30).

E. Using a spanner wrench or Cylinder Head Wrench Adapter 43193, remove cylinder heads (60 or 60A).

F. Remove self-adjusting pin grips (40) and steel washers (50).

G. Remove hydraulic preformed packing (70A) and hydraulic preformed packings (80A) from groove in cylinder heads.

H. Remove piston units from brake housing (250).

I. Remove hydraulic preformed packings (90A) from pistons (150 or 150B).

J. Place piston units in arbor press and remove self-adjusting return mechanism as follows:

(1) Fabricate a tool from steel tubing to clear self-adjusting pin (140) and to clear the inside diameter of retaining ring (100).

(2) Place tool over self-adjusting pin (140) and against spring guide (110). Apply pressure to tool with an arbor press until spring force is removed from the retaining ring (100) and hold.

(3) Remove retaining rings (100) with Tru-Arc (or equivalent) pliers.

(4) Carefully release arbor press and remove spring guides (110), brake release springs (120 and 130), and self-adjusting pins (140) from pistons (150).

K. Remove shipping plug (160), if installed, and preformed packing (170).

L. Remove screw thread insert (180) and preformed packing (190) from brake housing (250 or 250A).

M. Complete the disassembly by removing bleeder screw (200), bleeder washer (210), bleeder valve (220), bleeder valve adapter (230) and preformed packing (240).

CLEANING

1. Cleaning Materials

NOTE: Equivalent substitutes may be used for items listed below.

Dry-Cleaning Solution Specification P-D-680 Type I, Stoddard Solvent Type II, 140°F Solvent	Commercially available
Isopropyl Alcohol Specification TT-I-735	Commercially available
Soft Lint-free Cloth	Commercially available
Soft Bristle Brush	Commercially available
Polyplus Plastic Media Screen Size 20/40 (Primary)	Inventive Machine Corporation (I.M.C.) P.O. Box 369 Bolivar, OH 44612
Plastic Reclaimable Abrasive Machine (PRAM)	See SPECIAL TOOLS, FIXTURES AND EQUIPMENT section.
Plastic Media (Dry Stripping Abrasive)	U.S. Technology Corporation A Subsidiary of U.S. Plastic and Chemical Corporation 328 Kennedy Drive Putnam, CT 06260
Paint Removing Solvent (Alternate) Specification MIL-C-19853	Turco Products Division of Purex Corporation 24600 South Main Street P.O. Box 6200 Carson, CA 90749

2. Cleaning Procedures (Ref. IPL Fig. 1)

WARNING: CLEANING SOLVENTS ARE TOXIC AND VOLATILE. USE ONLY IN WELL-VENTILATED AREAS. AVOID PHYSICAL CONTACT WITH SOLVENT AND DO NOT INHALE VAPORS.

CAUTION: A THOROUGH CLEANING OR IMMERSION OF BRAKES MAY CAUSE ENTRAPMENT OF SOLVENT IN PASSAGE HOLES.

A. Clean all metal parts with dry-cleaning solvent, Specification P-D-680. Use a soft bristle brush when necessary.

B. Dry all metal parts thoroughly after cleaning, using filtered and dried compressed air.

NOTE: Ensure foreign materials have been removed from all cavities, threaded holes, pockets and other areas where entrapment might occur.

C. Clean all preformed and O-ring packings or gaskets with isopropyl alcohol, Specification TT-I-735. Dry with a clean, soft cloth.

NOTE: It is recommended new preformed and O-ring packings or gaskets be installed at each brake overhaul.

D. Brake disks (10) may be cleaned with the aid of compressed air and a soft wire or bristle brush.

E. Clean brake linings (20B or 20C) by brushing with a soft bristle brush.

3. Paint Removal Procedures

A. Strip brake housing as follows - Method 1 (Dry Stripping):

WARNING: THE DRY STRIPPING PROCESS IS OPERATOR-SENSITIVE AND ONLY AN EXPERIENCED, TRAINED OPERATOR SHOULD BE PERMITTED TO PERFORM THE PAINT REMOVAL OPERATION IN ACCORDANCE WITH EQUIPMENT MANUFACTURER'S RECOMMENDATIONS.

NOTE: This procedure covers general information of dry stripping process of pneumatic blast removal of paint utrilizing ground plastic particles. The procedure provides suggested control parameters to safely and effectively remove paint from aircraft component parts using the dry stripping process.

Paint must be stripped from parts before inspecting by Zyglo, dye penetrant or eddy-current methods; otherwise, inaccurate readings will result.

(1) Completely disassemble the part to be stripped. Remove all parts from brake housing in accordance with DISASSEMBLY.

(2) Clean the part to be stripped per Cleaning Procedures.

(3) Plug and seal off any threaded holes and piston cavities as required.

(4) Remove paint using the dry stripping procedure in accordance with Figure 401 as follows:

(a) The media dry stripping abrasive is effective only when used with the appropriate equipment. Depending on operator requirements, it is advised that the operator check with these (or other suitable) manufacturers for advice and application information concerning their particular equipment.

(b) Refer to Cleaning Materials for recommended dry stripping abrasive and equipment.

CAUTION: FLUSH MEDIA FROM CAVITIES, THREADED HOLES, POCKETS AND OTHER AREAS WHERE ENTRAPMENT MIGHT OCCUR.

(5) Remove part from solvent and rinse thoroughly, two times, with water heated to a temperature of 160° to 180°F (71° to 82°C).

(6) Dry the part thoroughly with filtered and dried compressed air.

NOTE: After paint stripping, the parts must be re-treated and repainted in accordance with instructions in REPAIR.

B. Strip brake housing as follows - Method II (Wet Stripping):

WARNING: PAINT REMOVAL SOLVENTS ARE TOXIC AND VOLATILE. USE ONLY IN WELL-VENTILATED AREAS. AVOID PHYSICAL CONTACT WITH SOLVENT AND DO NOT INHALE VAPORS.

NOTE: Paint must be stripped from brake assembly before inspecting by Zyglo, dye penetant or eddy-current methods; otherwise, inaccurate readings will result.

(1) Completely disassemble the part to be cleaned to prevent solvent from being entrapped between mating surfaces. Remove all parts from brake housing in accordance with DISASSEMBLY.

(2) Clean the part to be stripped in accordance with Cleaning Procedures.

CAUTION: PARTS MUST BE COMPLETELY IMMERSED IN SOLVENT. CONTACT WITH WATER BLANKET DURING IMMERSION WILL CAUSE SEVERE CORROSION OF THE PART.

(3) Immerse part in paint removing solvent, Specification MIL-C-19853, for a period of 30 minutes to two hours. Immersion time depends upon condition of paint. Carefully follow the manufacturer's instructions for the particular solvent being used.

NOZZLE TYPE/SIZE	NOZZLE PRESSURE	NOZZLE DISTANCE	MEDIA TYPE	ANGLE OF APPROACH
1, 4 BMLV-8 1/2 inch (12,7 mm)	45 - 55 PSI (3,10-3,79 bars) 3	36 - 48 inch (914-1219 mm)	POLYPLUS 20/40	45 - 75°
2, 4 VENTURI 5/16 inch (7,94 mm)	UNDER 30 PSI (2,07 bars) 3	6 - 8 inch (152,4-203,2 mm)	POLYPLUS 20/40	45 - 75°

PHYSICAL REQUIREMENTS OF MEDIA

	POLYEXTRA	POLYPLUS
HARDNESS (MOH SCALE)	3.0 ± .25	3.5 ± .25
SPECIFIC GRAVITY (GMS/CC)	1.15 ± 10%	1.50 ± 10%

NOTES:

1. STAND-OFF, OPEN BLASTING.
2. CLOSED-CYCLE BLASTING (PERFORMED IN PRESSURE BLAST EQUIPMENT CHAMBER).
3. PRESSURE READINGS MUST BE TAKEN AT THE NOZZLE RATHER THAN ESTIMATED FROM REGULATOR GAGE READINGS. RECHECK PRESSURE EVERY FOUR HOURS AND EACH TIME PRESSURE IS CHANGED AT REGULATOR.
4. PROCESS VARIABLES INCLUDE PRESSURE, DISTANCE FROM NOZZLE TO WORK PIECE, ANGLE OF ATTACK AND NOZZLE SIZE. PARAMETERS SELECTED WILL VARY WITH PAINT COATING AGE, TYPE AND NUMBER OF COATINGS, BUT THE FOLLOWING PARAMETERS HAVE SUCCESSFULLY REMOVED VARIOUS COATING TYPES WITH NO EFFECT ON SUBSTRATE.
5. RECOMMENDED PLASTIC MEDIA TYPE AND SIZE IS POLYPLUS 20/40. POLYEXTRA 12/20 OR 20/30 PRODUCES A SMOOTHER FINISH BUT PAINT REMOVAL RATE IS LOWER. TYPE III PLASTIC MEDIA TYPE IS NOT TO BE USED ON THE SUBJECT AIRCRAFT COMPONENTS.

Recommended Dry Stripping Variables
Figure 401

CAUTION: FLUSH SOLVENT FROM CAVITIES, THREADED HOLES, POCKETS AND OTHER AREAS WHERE ENTRAPMENT MIGHT OCCUR.

(4) Remove part from solvent and rinse thoroughly in water heated to a temperature of 160° to 180°F (71° to 82°C).

(5) Dry the part thoroughly with filtered and dried compressed air.

NOTE: After paint stripping, the part must be re-treated and repainted in accordance with instructions in REPAIR.

CHECK

1. Check Materials

NOTE: Equivalent substitutes may be used for items listed below.

Type	Penetrant	Developer	Supplier
Fluorescent	Zyglo ZL-16	Zyglo ZP-13 (wet) optional	Magnaflux Corporation 7310 West Lawrence Street Chicago, IL 60656
	Penetrex ZL-2A with emulsifier ZE-4	Penetrex ZP-4 (dry) or ZP-13 optional	
Red Dye	Spot Check	Spot Check	
	Dy-Chek	Dy-Chek	Turco Products Division of Purex Corporation P.O. Box 6200 Carson, CA 90749
	Met-L-Chek	Met-L-Chek	Met-L-Chek 1639 Euclid Street Santa Monica, CA 90404

2. General (Ref. IPL Fig. 1)

A. Check all components of the brake assembly for wear, cracks, corrosion, structural damage, distortion and thread damage. Replace all parts that show evidence of cracks, excessive wear, severe corrosion, and structural and thread damage. Repair minor scratches and corrosion.

B. Perform the specific checks listed referring to REPAIR for appropriate repair procedures.

3. Brake Disk (10)

A. Check brake disk (10) as follows:

(1) Measure thickness of disk. Disks that have worn to a thickness of 0.360 inch (9,14 mm) or less must be replaced.

(2) Check disk for warpage. Disks that have warped or dished to the extent they cause brake drag can be surface ground and reused if they exceed the minimum thickness of 0.360 inch (9,14 mm) after grinding.

NOTE: It is recommended the disk be reversed in the brake housing at each tire change to minimize dishing.

(3) Replace disks which have shrunk to an outside diameter of 13.025 inches (330,83 mm).

(4) Disks containing heat checks of less than 1.25 inches (31,75 mm) in length that do not extend to within 0.25 inch (6,35 mm) of the inside or outside diameter edge can be continued in service. Check disks with such heat checks at time of each lining change.

4. Brake Lining (20C or 20D)

CAUTION: NEVER MIX NEW AND USED BRAKE LININGS. IF NECESSARY TO REUSE WORN LININGS, INSTALL THEM IN THEIR ORIGINAL POSITION.

A. Measure thickness of brake linings (20C or 20D) at center of lining. Replace linings if worn to a thickness of 0.195 inch (4,95 mm) or less. Always replace both piston and anvil linings.

B. Replace linings when the lining cup is found to be deformed and out of round.

NOTE: The lining cup is designed to wear away with lining.

5. Self-Adjusting Pin Nut (30)

A. Check self-adjusting pin nut (30) for stripped threads or other damage and distortion. Replace defective parts.

6. Self-Adjusting Pin Grip (40) and Steel Washer (50)

A. Check for damage and distortion. Replace any defective parts.

7. Cylinder Head (60)

A. Check cylinder heads for stripped threads or other damage. Replace if damaged.

8. O-Ring Gasket (70), O-Ring Packing (80, 90) and Preformed Packing (70A, 80A, 90A, 170, 190 and 240)

A. Check O-ring gasket, O-ring packing and preformed packings for distortion and wear. It is recommended all gaskets and packings be replaced at each overhaul.

9. Retaining Ring (100) and Spring Guide (110)

A. Check retaining ring and spring guide for structural damage, corrosion and distortion. Replace any defective parts.

10. Brake Release Spring (120 and 130)

A. Check brake release springs as follows:

(1) Measure force required to compress springs.

(2) Replace brake release spring (120) when compression force is less than 60 pounds (267 N) at a height of 0.538 inch (13,66 mm).

(3) Replace brake release spring (130) when compression force is less than 115 pounds (512 N) at a height of 0.538 inch (13,66 mm).

11. Self-Adjusting Pin (140)

A. Check self-adjusting pins (140) for nicks, rough spots, distortion or damage which might injure O-ring packing. Depressions of 0.003 inch (0,076 mm) or less are acceptable. However, raised metal from such nicks should be removed by polishing. If grip holding surfaces of pins are tapered or reduced in diameter, more than 0.0005 inch (0,013 mm) in the operating length, the pins should be replaced.

B. If grip holding surfaces of pins are reduced in diameter in the operating length to 0.245 inch (6,22 mm) or less, the pins should be replaced.

12. Piston (150, 150A, 150B or 150C)

A. Check contacting surfaces of pistons (150, 150A, 150B or 150C) for wear or scratches which might injure preformed packing and cause leaks. Measure piston diameter at three different places. If piston (150 or150B) is worn to a diameter of 2.112 inches (53,64 mm) or less, replace piston. If piston (150A or 150C) is worn to a diameter of 2.161 inches (54,89 mm) or less, replace piston.

13. Protective Plug (160) and Threaded Insert (180)

A. Check protective plug and threaded insert for stripped threads or other damage. Replace if damaged.

14. Bleeder Valve (220) and Bleeder Valve Adapter (230)

A. Check bleeder valve and valve adapter for stripped threads or other damage. Replace defective parts.

15. Brake Housing (250 or 250A)

A. Check brake housing for cracks using a dye-penetrant method. Replace housing if cracked.

NOTE: Pay particular attention to housing throat section.

B. Visually check housing for corrosion and scratches. Blend out minor corrosion and scratches. See REPAIR.

C. Check cylinder wall for damage to threads and packing seat. See REPAIR.

D. Check lining recesses in the anvil section of the brake housing for wear and damage. See REPAIR.

E. Check lining retainer (252) and rivet (251) for security of attachment and damage. See REPAIR.

16. Disk Guide Lining (280 and 320)

A. Check disk guide linings for wear. Replace disk guide lining (280 and 320) when thickness reaches 0.205 inch (5,21 mm) or less. New linings 0.375 inch (9,53 mm) thick should be ground down to 0.325 +0.002, -0.003 inch (8,25 +0.051, -0,076 mm) thick as shown in REPAIR.

17. Disk Guide Bracket (290 and 330)

A. Check disk guide bracket for distortion or damage. Replace damaged parts.

REPAIR

1. Repair Materials

NOTE: Equivalent substitutes may be used for items listed below.

Surface Treat Solution Specification MIL-M-3171, Type VI	Commercially available
Methyl Isobutyl Ketone (MIBK) Specification TT-M-268	Commercially available
Zinc Chromate Primer Specification TT-P-1757	Commercially available
Aluminum Lacquer Specification TT-L-32	Commercially available
Aluminum Topcoat/Primer Combination (FA-10242) Aeroprite	Contact your local distributor of aviation products and supplies.
Aeroprite Reducer TH-89	Contract your local distributor of aviation products and supplies.
Aluminum Oxide Cloth (340 to 400 grit, wet or dry)	Commercially available
Steel Bar No. 1117 Specification QQ-S-633	Commercially available
Cadmium Plating Specification QQ-P-416, Type II, Class 3	Commercially available
Wash Primer Specification MIL-C-8514	Commercially available
Butyl Alcohol Thinner Specification TT-B-846	Commercially available
Ethyl Alcohol Thinner Specification O-E-760, Type III	Commercially available

2. General (Ref. IPL Fig. 1)

A. Repair of the brake assembly is limited to the replacement of worn or damaged parts and to the specific repairs listed in this section. Replace all cracked parts. No attempt should be made to repair cracked, severely corroded or badly damaged parts. Components that cannot be repaired within the limits defined in this section should be replaced.

3. Repair of Brake Housing (250)

CAUTION: REMOVAL OF CORROSION AND SURFACE DAMAGE WILL PREVENT STRESS CONCENTRATIONS. HOWEVER, ANY REMOVAL OF MATERIAL WILL SHORTEN THE LIFE OF THE BRAKE HOUSING. THEREFORE, IT IS RECOMMENDED THAT MATERIAL REMOVED BY BLENDING BE LIMITED TO THE MINIMUM REQUIRED FOR REMOVING CORROSION OR SURFACE DAMAGE.

A. Remove corrosion, scratches, nicks and abrasions with aluminum oxide cloth. Remove all corrosion and surface damage on the brake housing according to limits defined in Figure 601. Blend out any damage that might become a source of corrosion or stress cracks. Remove any corrosion from threads with a soft wire brush.

NOTE: Since removal of metal in areas 1, 2, 3 and 7 can shorten the ultimate life of the part, it is recommended that removal in these areas be kept to a minimum.

B. Thoroughly clean surface. Treat and repaint reworked areas of housing in accordance with Re-Treating and Repainting.

C. If piston cavity is worn or damage exists beyond the 2.136 inch (54,25 mm) inside diameter, repair piston cavity in accordance with Repair No. 1 - Repair of Piston Cavity for Oversize Piston.

D. If lining recess is worn or damage exceeds limits as shown in Figure 602, repair lining recess in accordance with Repair No. 2 - Repair of Lining Recesses.

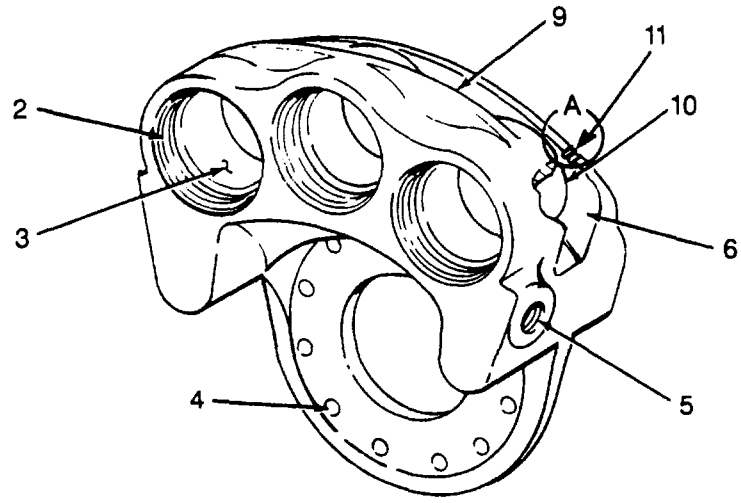
E. If mounting bolt holes have conical surface cracks, material distortion or other damage, repair in accordance with Repair No. 3 - Repair of Mounting Bolt Holes.

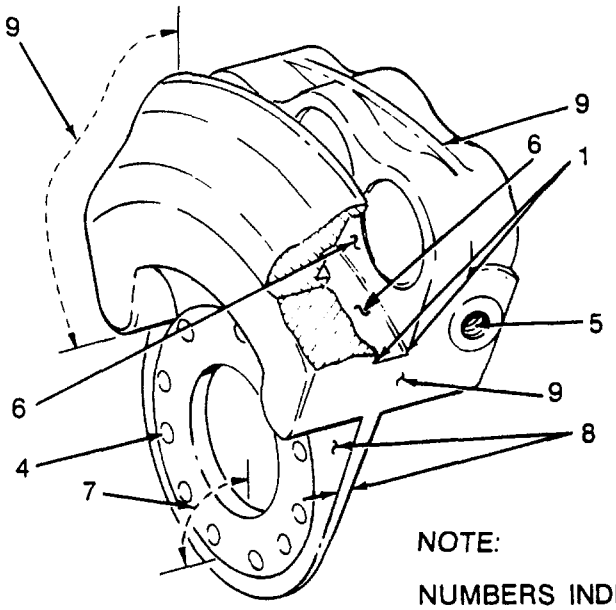
F. If linings are loose on the anvil side of brake housing, repair in accordance with Repair No. 4 - Repair of Brake Housing for Anvil Lining Retention Repair.

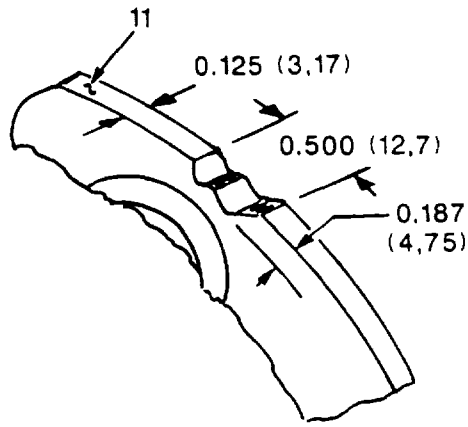
G. At operator's option, the piston cavity may be machined to accept a wiper ring. Repair in accordance with Repair No. 5 - Repair of Brake Housing for Machining Wiper Ring Groove.

H. To eliminate interference between brake disk and magnesium housing during disk installation and removal while brake is on aircraft, repair in accordance with Rework No. 6 - Rework of Brake Housing 9550376 for Removal of Excess Material.

I. If lining retainer on aluminum Pistons 5009128 or 5009408 is damaged, repair in accordance with Repair No. 7 - Repair of Piston Lining Retainer.







DETAIL A

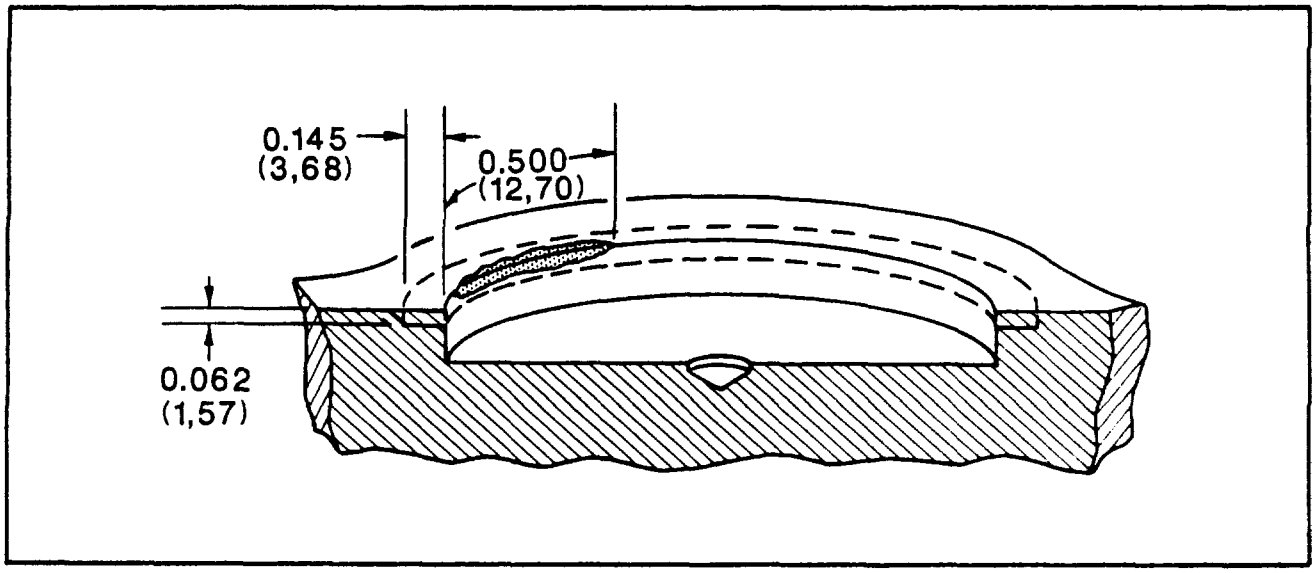
NOTE:

NUMBERS INDICATE INSPECTION AND REWORK AREAS.

Rework Areas for Brake Housing
Figure 601

Key to Figure 601

General:	Repairs are limited in each marked area to the following limits. The material removed by blending is limited to the minimum required for removing corrosion or surface damage. Except where restricted by length or locale when damage depth is less than 0.015 inch (0,381 mm) deep, all blend type repairs should be blended with a depth to width ratio of 1 to 100 in surface width. Where not possible, use as generous a width to depth ratio as practical with the area being repaired.
Area 1:	Carefully check by Zyglo, dye-penetrant or other methods suitable for use with cast magnesium. Replace cracked housings. Grooves or scratches to 0.010 inch (0,254 mm) maximum deep in throat area of brake should be blended and polished out with 340 grit, aluminum oxide cloth.
Area 2:	Check cylinder head cavity threads for damage. If threads are worn or badly damaged, remove brake housing from service.
Area 3:	Polish out minor scratches and/or pits with 360 grit, aluminum oxide cloth. Do not polish beyond 2.136 inches (54,25 mm) inside diameter at any location in the piston cavity.
Area 4:	Rework holes as required to 0.015 inch (0,381 mm) maximum oversize. Do not exceed 0.345 inch (8,767 mm) diameter. Round off sharp edges.
Area 5:	Clean and remove housing and replace if threads are stripped or badly damaged.
Area 6:	Blend out and polish imperfections up to 0.03 inch (0,762 mm) deep. Maximum blending of reworked area limited to 0.50 square inch (12,70 sq. mm).
Area 7:	Blend out imperfections up to 0.03 inch (0,762 mm) deep. In area covered by mounting bolt washers, blend out nicks or scratches up to 0.010 inch (0,254 mm) deep. Maximum blending of reworked area limited to 0.50 square inch (12,70 sq. mm).
Area 8:	Blend out and polish imperfections up to 0.03 inch (0,762 mm) deep. Do not blend opposite surfaces. Maximum blending of reworked area limited to 0.50 square inch (12,70 mm).
Area 9:	Blend out imperfections up to 0.03 inch (0,762 mm) deep. Maximum blending of reworked area limited to 0.50 square inch (12,70 sq. mm).
Area 10:	Blend out imperfections up to 0.062 inch (1,575 mm) deep, 0.145 inch (3,687 mm) wide and 0.500 inch (12,700 mm) long on edge of lining recess as shown in Figure 602. One repair to above limits is permissible per recess.
Area 11:	Blend to remove all sharp edges if damage occurs to the outer radius of the housing anvil. The repair of this damaged or chipped area is limited to a maximum area 0.50 inch (12,70 mm) long by 0.187 inch (4,648 mm) wide by 0.125 inch (3,175 mm) deep (recess bore depth). Replace brake housing if damage has occurred beyond this limit. When lining recess repair is made, the damaged or chipped area at the anvil outer edge may be blended to the insert ring.



Lining Recess Edge Repair Limits
Figure 602

4. Repair of Self-Adjusting Pin (140)

   A. Repair damaged self-adjusting pins as follows:

      (1) Self-adjusting pins with small nicks or imperfections on the seal contacting surfaces of 0.003 inch (0,076 mm) or less in depth are acceptable; however, raised metal from such nicks should be removed by polishing with 400 grit, aluminum oxide cloth.

      (2) If grip holding surfaces of pins are tapered more than 0.0005 inch (0,013 mm), the pins should be replaced.

      (3) Measure diameter of pins at grip holding surface. If diameter is less than 0.245 inch (6,22 mm), replace pins.

5. Replacing Disk Guide Lining

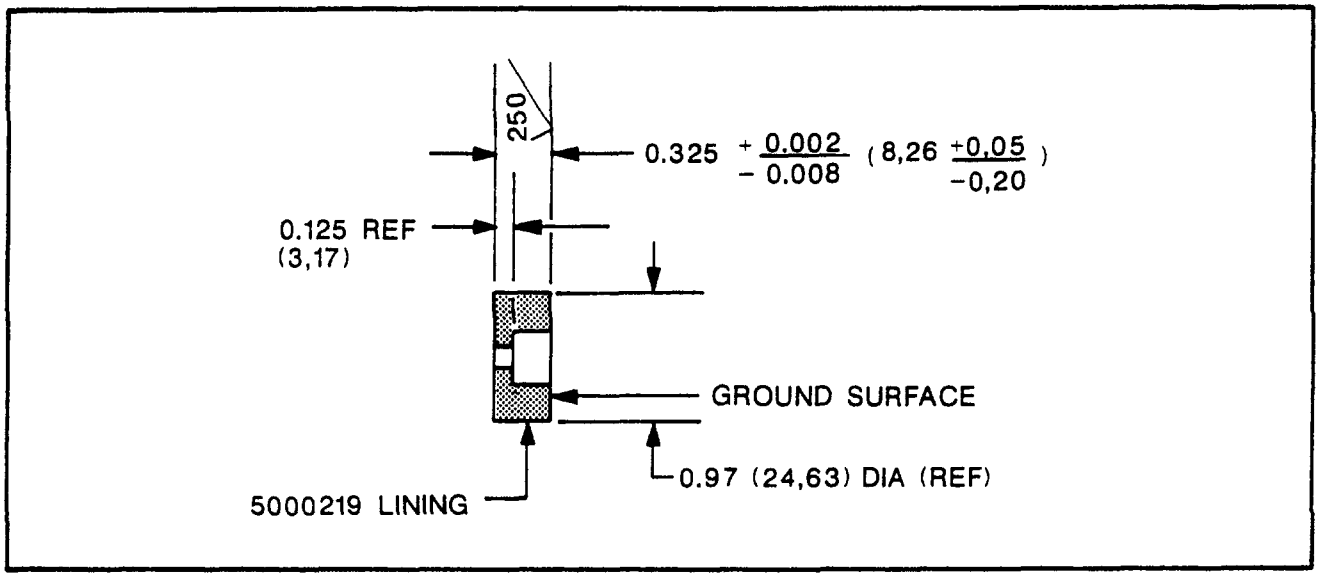
   A. Using a 5/32 (0.156) inch drill, drill out shop head of rivet (270 and 310).

   B. Remove rivet from disk guide bracket (290 and 330) being careful to avoid enlarging the rivet hole.

   C. Grind new disk guide linings (270 or 320) if they are 0.375 inch (9,58 mm) thick to 0.325, +0.002, - 0.008 inch (8,26 + 0,051, -0,203 mm) thick as shown in Figure 603.

   D. Insert new rivet (270 or 310) through lining (280 or 320) and disk guide bracket (320) and form shop head of rivet against disk guide.

   E. Shop head of rivet must have an outside diameter of 80 percent (minimum) of the outside diameter of the manufactured head. Disk guide lining is to be tight under finger pressure.



Disk Guide Lining Rework
Figure 603

6. Re-Treating and Repainting

A. Repaired areas of brake housing and those having paint and treated finish removed, should be re-treated and repainted in accordance with following procedures:

B. Re-Treating

WARNING: CLEANING SOLVENTS ARE TOXIC AND VOLATILE. USE ONLY IN WELL-VENTILATED AREAS. AVOID PHYSICAL CONTACT WITH SOLVENT AND DO NOT INHALE VAPORS.

(1) Thoroughly clean surface to be re-treated and repainted. Clean with hot water or methyl isobutyl ketone, Specification TT-M-268, and dry thoroughly with compressed air.

(2) Re-treat all exposed magnesium surfaces with surface treat solution conforming to Specification MIL-M-3171 in accordance with the manufacturer's instructions. Refer to Repair Materials for recommended solution.

(3) Re-treat all exposed aluminum surfaces with chemical film solution, Specification MIL-C-5541, in accordance with the manufacturer's instructions. Refer to Repair Materials for recommended solution.

C. Repair and touchup painting should be performed as follows:

(1) The part or area requiring touchup painting must be thoroughly clean and free of all contaminants.

(2) Prepare area to be painted (scratches, nicks, chipped paint, etc) by sanding lightly to feather out all edges of adjacent finish, using 320 to 360 grit, wet-or-dry aluminum oxide cloth. Wet sanding is preferred. Avoid removing more primer than absolutely necessary from damaged area.

WARNING: CLEANING SOLVENTS ARE TOXIC AND VOLATILE. USE ONLY IN WELL-VENTILATED AREAS. AVOID PHYSICAL CONTACT WITH SOLVENT AND DO NOT INHALE VAPORS.

(3) Wipe repaired surface with a cloth moistened with methyl isobutyl ketone, Specification TT-M-268, and wipe surface dry with clean cheesecloth. If chemical film solution has been removed, re-treat as required.

CAUTION: IF BARE METAL IS EXPOSED BY SANDING, IT MUST BE RE-TREATED BEFORE APPLYING WASH PRIMER.

(4) Starting with the last intact paint layer, reapply paint coats in accordance with repainting.

NOTE: *The gloss must be removed in the area to be touched up with an* abrasive material, the defective area smoothed and edges feathered. The area must then be cleaned removing all loose and foreign material.

D. Repaint brake housing as follows:

WARNING: CLEANING SOLVENTS ARE TOXIC AND VOLATILE. USE ONLY IN WELL-VENTILATED AREAS. AVOID PHYSICAL CONTACT WITH SOLVENT AND DO NOT INHALE VAPORS.

(1) *Thoroughly clean all surfaces to be treated and/or painted.* Housing subassembly should be vapor degreased or washed with methyl isobutyl ketone, Specification TT-M-268.

(2) Treat all magnesium surfaces of brake subassemblies with chemical film solution conforming to Specification MIL-M-3171, in accordance with manufacturer's instructions. Refer to Repair Materials for recommended solution.

(3) Re-treat all exposed aluminum surfaces with chemical film solution, Specification MIL-C-5541, in accordance with the manufacturer's instructions. Refer to Repair Materials for recommended solution.

CAUTION: DO NOT PAINT INTERIOR OF PISTON CAVITIES, INLET OR BLEEDER OPENINGS.

(4) Mask all threaded holes and hydraulic cavities to avoid getting paint on these surfaces.

E. For magnesium parts only, repaint reworked and treated areas with one coat of wash primer as follows:

(1) Wash primer is supplied in two separate containers; one contains the base primer, the other the acid component. Both must be thoroughly mixed before use.

(2) Mix wash primer, Specification MIL-C-8514 as follows:

(a) The resin component should be well stirred to redisperse any settled pigment. Then add the acid component slowly to the resin while stirring; never add in reverse order. One volume of acid component is always used with four volumes of the resin. Add the water to the alcohol (ethyl), do not reverse this admix procedure. Mix and stir well. Add only enough of the water alcohol mix to the resin mix to reduce the specific gravity to a range of 0.885 to 0.915.

NOTE: If either of the admix procedures are reversed, scrap the material and start over.

(b) Formula to be used when humidity is below 90 percent:

16 ounces (453,6 grams) resin component
4 ounces (113,4 grams) acid component
12 ounces (340,2 grams) ethyl alcohol, Specification O-E-760, Type III
1/2 ounce (14,18 grams) distilled water

Batch life under four hours

(c) Formula to be used when humidity is above 90 percent:

16 ounces (453,6 grams) resin component
4 ounces (113,4 grams) acid component
9 ounces (255,15 grams) ethyl alcohol, Specification O-E-760, Type III
3 ounces (85,05 grams) butyl alcohol, Specification TT-B-846
1/2 ounce (14,18 grams) distilled water

Batch life under two hours

Specific gravity range 0.885 to 0.915.

(3) Application

NOTE: All surfaces should have received anodic or chemical treatment. All surfaces must be clean of all contaminantes by degreasing and/or solvent washing prior to applying the wash primer.

(a) Apply a single wet coat of wash primer to a dry film thickness of approximately 0.0002 to 0.0003 inch (0,005 to 0,007 mm). Do not attempt to obtain a full hiding coat. If such a coating is produced, it should be immediately removed with alcohol and replaced with a properly applied coating.

(b) Air dry one hour minimum to four hours maximum. Subsequent topcoats should be applied as soon as practical after the minimum drying time but no later than four hours after the application of the wash primer. If subsequent primer coats are not applied within the specified time, the parts should be stripped and recoated with wash primer.

F. *Method I (Primary) - Repaint brake housing with two coats of aluminum* topcoat/primer combination as follows:

(1) Surface Preparation

(a) Parts must be clean and have received the surface treatment required. Magnesium parts must have one coat of wash primer before the application of paint.

(2) Mixing

(a) Mix the aluminum topcoat/primer combination until a viscosity of approximately 25 seconds in a No. 2 Zahn cup is obtained.

NOTE: Aluminum topcoat/primer combination should be at the proper viscosity. If required, thinning can be accomplished using *Aeroprite Reducer TH-89.*

(3) Application

(a) Spray one full wet cross coat to a dry film thickness of approximately 0.0004 to 0.0006 inch (0,010 to 0,015 mm).

(b) Air dry for a minimum of 45 minutes before applying a second coat.

(c) Spray a second full cross coat to a dry film thickness of approximately 0.0004 to 0.0006 inch (0,010 to 0,015 mm).

(d) Air dry 45 minutes before handling. Paint will reach full cure in 72 hours.

G. Method II (Alternate) - Repaint brake housing with two coats of zinc chromate primer and two coats of aluminum lacquer as follows:

(1) Surface Preparation

(a) Parts must be clean and have received the surface treatment required and one coat of wash primer before the application of paint.

(2) Apply two coats of zinc chromate primer, Specification TT-P-1757.

NOTE: Do not exceed the recommended thickness for the applied topcoats. If the humidity should drop below 20 percent, primer application should be stopped until steps are taken to raise the percent humidity.

(a) Apply one coat of primer to obtain a dry film thickness of 0.0003 to 0.0004 inch (0,00762 to 0,0102 mm).

(b) After a minimum flash off period of five minutes, apply second coat of primer to obtain a total dry film thickness of 0.0006 to 0.0008 inch (0,015 to 0,020 mm).

(c) Allow the primed surface to dry a minimum of two hours and a maximum of 12 hours before topcoating with aluminum lacquer, Specification TT-L-32.

(3) Apply two coats of aluminum lacquer, Specification TT-L-32.

(a) Spray one full wet cross coat to a dry film thickness of approximately 0.0004 to 0.0006 inch (0,010 to 0,015 mm) over the primer coating.

(b) After a minimum flash off period of five minutes, apply second coat of aluminum lacquer to obtain a total thickness of 0.0008 to 0.0012 inch (0,020 to 0,030 mm).

(c) Air dry 45 minutes before handling. Paint will reach full cure in 24 hours.

7. Modification and/or Rework Brake Assembly 9550377 to Brake Assembly 9550377-1

A. At operator's option, Asbestos Linings 9523331 or Alternate Asbestos Linings 9534896 may be replaced with Asbestos-Free Linings 9523331-1 as follows:

NOTE: Asbestos linings are no longer manufactured. The new asbestos-free linings will be readily identified by their white color.

(1) At the next brake overhaul or next lining replacement, replace Linings 9523331 or 9534896 with Asbestos-free Linings 9523331-1.

(a) Operators are advised that old asbestos linings may be used until stock depletion. The new asbestos-free linings are to be used as a set, they are not to be mixed with the old linings in any one assembly.

(2) Reidentify Brake Assembly 9550377, by metal stamping a "-1" after brake assembly number in 0.12 inch (3,05 mm) characters to read 9550377-1.

NOTE: Where necessary, the part should be suitably supported for stamping.

(3) Metal stamp repair number "5R85-078" in 0.09 inch (2,3 mm) characters adjacent to the assembly number.

NOTE: Where necessary, the part should be suitably supported for stamping.

(4) Re-treat and repaint any displaced metal in accordance with Re-Treating and Repainting.

8. Modification and/or Rework of Brake Assembly 9550377-1 to Brake Assembly 9550377-4

A. At operator's option, Asbetos-Free Linings 9523331-1 may be replaced with new, improved Asbestos-Free Linings 5008993 as follows:

NOTE: The new, improved asbestos-free linings will be readily identified by white paint and part number on the back side.

(1) At the next brake overhaul or next lining replacement, replace Linings 9523331-1 with new, improved Asbestos-free Linings 5008993.

(a) Operators are advised that Linings 9523331-1 may be used until stock depletion. The new, improved asbestos-free linings are to be used as a set, they are not to be mixed with the old linings in any one assembly.

(2) Reidentify Brake Assembly 9550377-1, by metal stamping a "-4" after brake assembly number in 0.12 inch (3,05 mm) characters to read 9550377-4.

NOTE: Where necessary, the part should be suitably supported for stamping.

(3) Metal stamp repair number "5R87-064 " in 0.09 inch (2,3 mm) characters adjacent to the assembly number.

NOTE: Where necessary, the part should be suitably supported for stamping.

(4) Re-treat and repaint any displaced metal in accordance with Re-Treating and Repainting.

9. Replacing Lining Retainer (252) or Rivet (251)

A. Use a 1/8 (0.125) inch drill to drill out rivet (251), being careful to avoid damaging housing.

B. Remove remainder of rivet (251) and lining retainer (252).

C. Install new lining retainer (252) and secure with rivet (251).

REPAIR NO. 1 - REPAIR OF PISTON CAVITY

1. General (Ref. IPL Fig. 1)

   A. This repair is used for the repair of worn or damaged piston cavities in brake housing (250 and 250A).

   B. This repair provides for machining of piston cavity for oversize pistons (150A and 150C).

   C. Use the following procedure to determine when rework is required.

      (1) Remove pistons (150 or 150B) from brake housing and remove preformed packings (90A) from pistons.

      (2) Place the pistons (150 or 150B) in the piston cavity and check the clearance between pistons and piston cavity walls with a narrow feeler gage. Check clearance at several positions around the pistons. If clearance does not exceed 0.010 inch (0,254 mm), continue unit in service.

      (3) If the clearance is more than 0.010 inch (0,254 mm), remove pistons and proceed as follows:

         (a) Measure diameter of each piston (150 or 150B) at three different places and if worn to a diameter of 2.112 inches (53,64 mm), replace the piston.

         (b) Measure inside diameter of cylinder cavity. If worn to 2.136 inches (54,24 mm) or greater, machine cylinder bore to oversize dimensions in accordance with Piston Cavity Repair.

            NOTE: If cylinder wall diameter has not reached the dimension necessary for rework, it may be possible to obtain a measurement of less than 0.010 inch (0,254 mm) between piston and piston cavity by installing a new piston. By using selective fits, additional service life can often be obtained from the brake housing before rework is required.

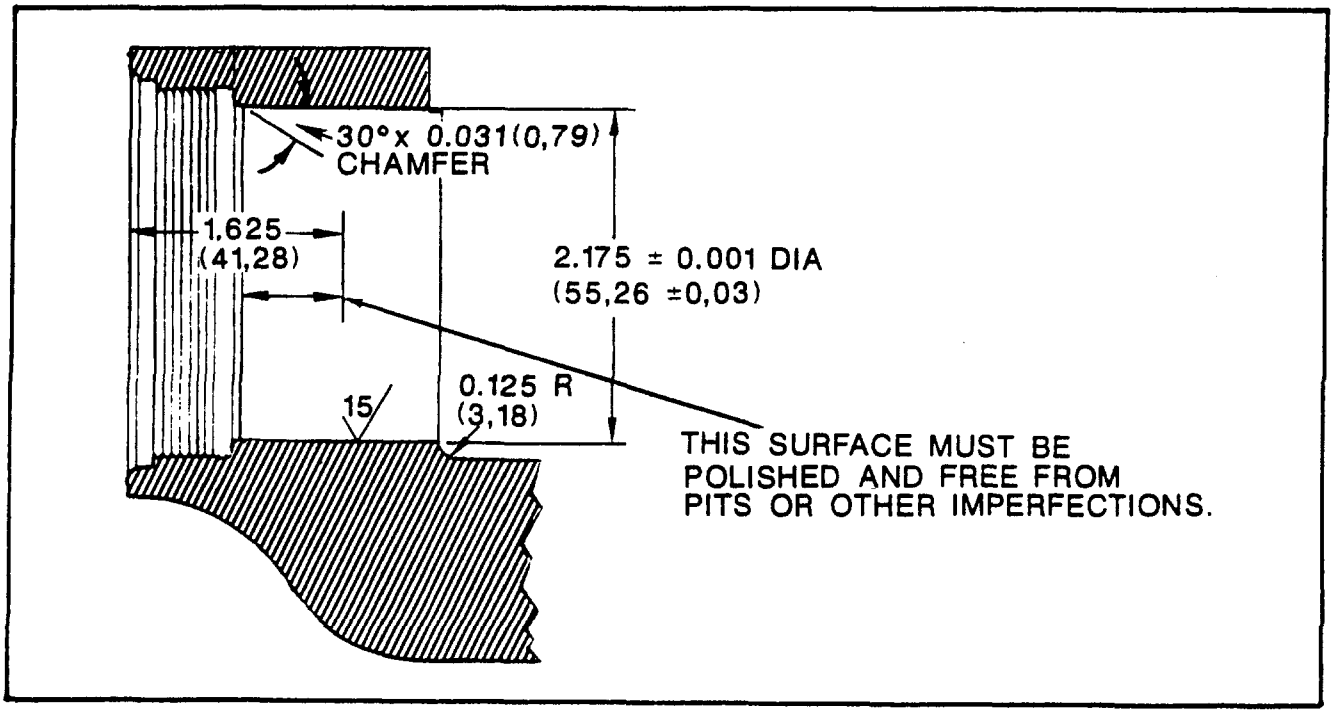
2. Piston Cavity Repair (Ref. Repair Fig. 601)

   A. If machining of piston bore is required, proceed as follows:

      (1) Machine cylinder bore to 2.175 ± 0.001 inches (55,26 ± 0,03 mm) diameter.

         NOTE: Concentricity with the cylinder head thread diameter must be maintained.

      (2) Working surface of the piston cavity must be polished free of pits or other imperfections. The recommended surface finish is 15 RHR.



Piston Cavity Rework for Oversize Piston
Figure 601

(3) Treat machined surface of brake housing 9550376 (250) with surface treat solution, Specification MIL-M-3171, Type VI. Treat machined surface of Brake Housing 5009126 (250A) with chemical conversion coating, Specification MIL-C-5541, Alodine 1200.

B. Metal stamp the letter "R" after the brake assembly number on the housing in 0.12 inch (3,05 mm) characters to show the assembly has been reworked for oversize pistons.

C. Use oversize Pistons 9522145 (150A) and standard Preformed Packings MS28775-327 (90A) with reworked Brake Housings 9550376 (250). Use oversize Pistons 5009128 (150B) and standard Preformed Packings MS28775-327 (90A) with reworked Brake Housings 5009126 (250A).

REPAIR NO. 2 - REPAIR OF LINING RECESS

1. General (Ref. IPL Fig. 1)

   A. This repair is used for the repair of worn or damaged lining recesses in brake housing (250 or 250A).

   B. This repair provides for machining of lining recess and installing a locally fabricated ring.

2. Lining Recess Repair (Ref. Repair Fig. 601)

   A. If damage on one side of lining recess is beyond the limits of 0.062 inch (1,57 mm) deep and 0.145 inch (3,68 mm) wide, rework as follows:

      (1) Fabricate a ring from No. 1117 steel bar (Specification QQ-S-633) as shown in Repair Figure 601. Cadmium plate (Specification QQ-P-416, Type II, Class 3) to 0.0002 inch (0,0051 mm) to maximum 0.0003 inch (0,0076 mm).

      CAUTION: MAINTAIN ORIGINAL CENTER POINT OF LINING RECESS.

      (2) Machine lining recess diameter to 2.047 +0.000,-0.001 inches (51,99 +0,000, -0,025 mm) as shown in Repair Figure 601.

      (3) Treat machined surfaces of housing (250) with surface treat solution, Specification MIL-M-3171, Type VI.

      (4) Heat brake housing in an oven to 275°F (135°C).

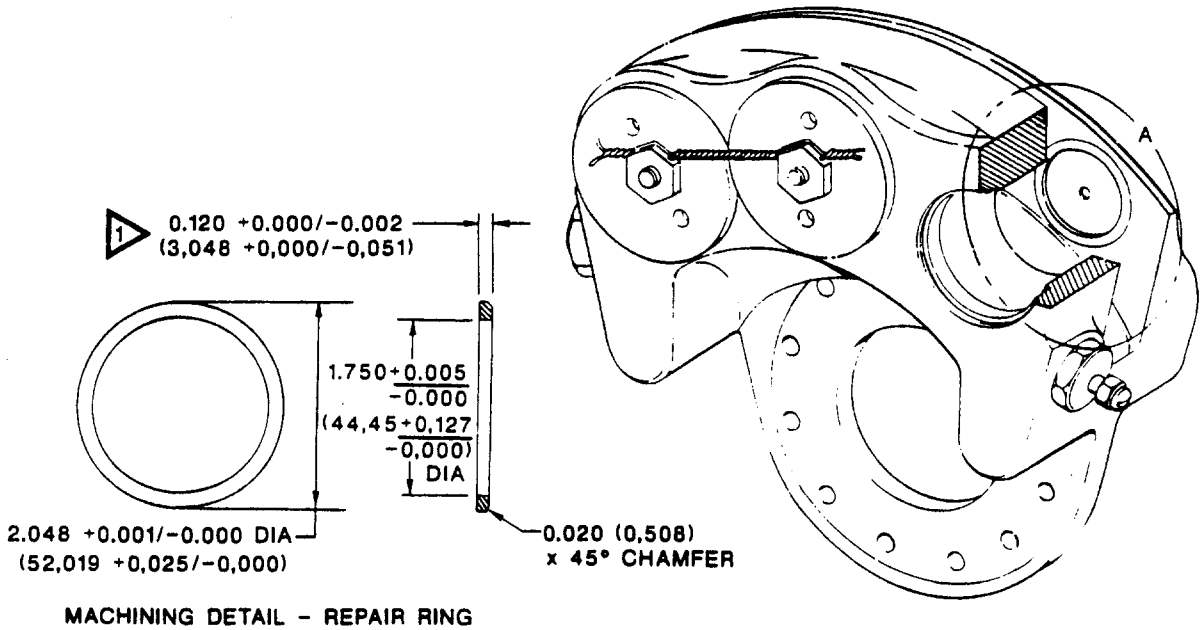
      (5) Apply one coat of zinc chromate primer, Specification TT-P-1757, to reworked area of housing.

      (6) Insert ring fabricated in step (1), chamfered edge first, into reworked recess of heated housing as shown in Repair Figure 601.

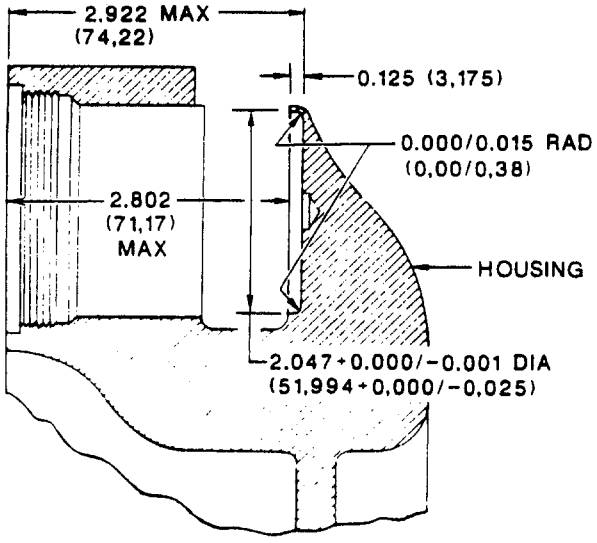
      NOTE: Blend any metal that extends over the edge of the housing to the original housing contour after repair of lining recess.

   B. Metal stamp repair number "5R3-167" on surface shown on Repair Figure 601 in 0.12 inch (3,05 mm) characters.

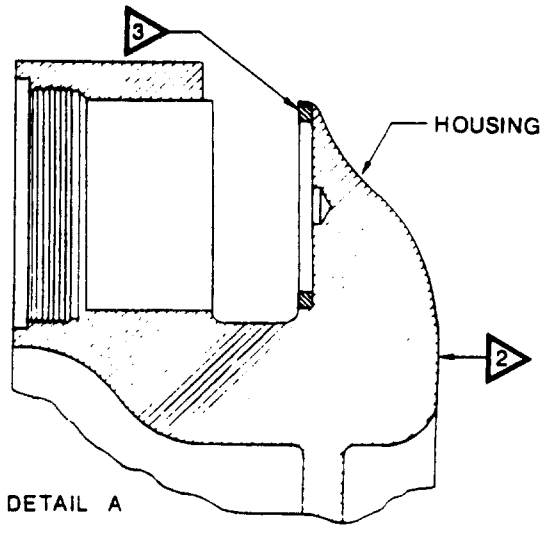
      (a) Re-Treat and repaint metal stamped areas of brake housing in accordance with Re-Treating and Repainting.



MACHINING DETAIL - REPAIR RING



MACHINING DETAIL - HOUSING



INSTALLATION DETAIL

NOTES:

1. MATERIAL - 1117 STEEL BAR, SPECIFICATION QQ-S-633, CADMIUM PLATE PER QQ-P-416, TYPE II, CLASS 3 - THICKNESS OF 0.0002-0.0003 (0,0051-0,0076).
2. METAL STAMP "5R3-167" ON SURFACE SHOWN IN 0.12 (3,05) CHARACTERS.
3. INSERT RING WITH CHAMFERED EDGE INSIDE.

Lining Recess Repair
Figure 601

REPAIR NO. 3 - REPAIR OF MOUNTING BOLT HOLE

1. General (Ref. IPL Fig. 1)

   A. This repair is used for the repair of worn or damaged mounting bolt holes on brake housings (250 and 250A).

   B. This repair provides for machining of mounting bolt holes and installation of locally manufactured bushing.

2. Mounting Bolt Hole Repair (Ref. Repair Fig. 601)

   A. Housing mounting bolt holes which have conical surface cracks, show material distortion or other damage, may be repaired as follows:

      (1) Machine bushing from Steel Rod F.A.O., Type SAE 1113 or equivalent, Specification QQ-S-633, as shown in Repair Figure 601. Cadmium plate (Specification QQ-P-416, Type III, Class 3) to 0.0002 inch (0,0051 mm) to maximum 0.0003 inch (0,0076 mm).

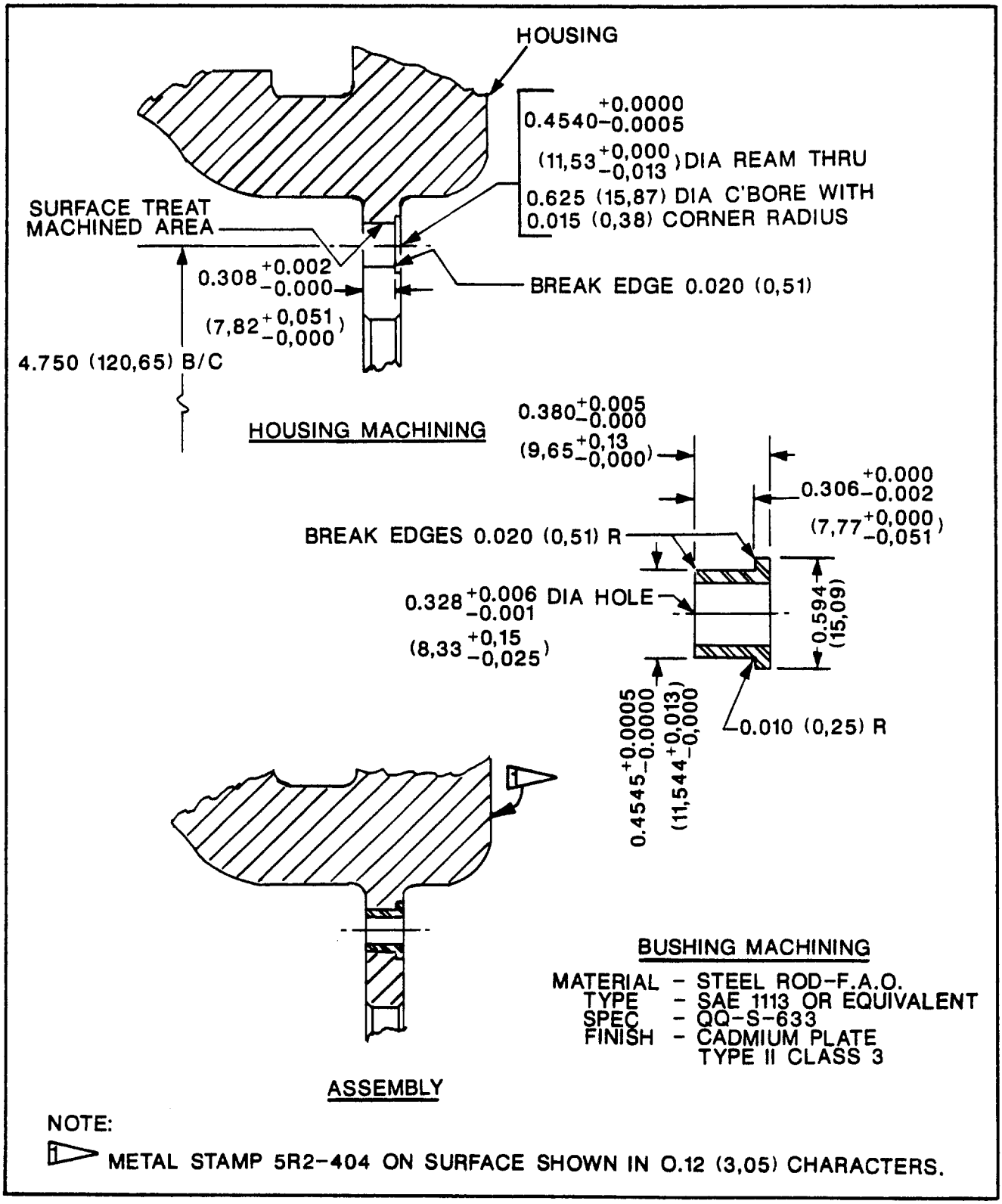
      (2) Machine mounting bolt holes as shown in Repair Figure 601.

      (3) Treat machined surfaces of housing.

      (4) Heat brake housing in an oven to 250°F (121°C) and cool machined bushing.

      (5) Shrink fit bushing into torque flange of brake housing.

   B. Metal stamp repair number "5R2-404" on surface shown on Repair Figure 601 in 0.12 inch (3,05 mm) characters.



Mounting Bolt Hole Repair
Figure 601

REPAIR NO. 4 - REPAIR OF BRAKE HOUSING FOR ANVIL LINING RETENTION REPAIR

1. General (Ref. IPL Fig. 1)

   A. This repair is for the rework of Brake Assemblies 9550377, 9550377-1 and 9550377-4.

   B. This repair provides for the machining of the anvil side of brake housing, and brake lining to accept a fastener to improve brake lining retention.

2. Repair of Brake Housing Anvil and Lining (Ref. Repair Fig. 601)

   A. Disassemble brake assembly completely in accordance with DISASSEMBLY.

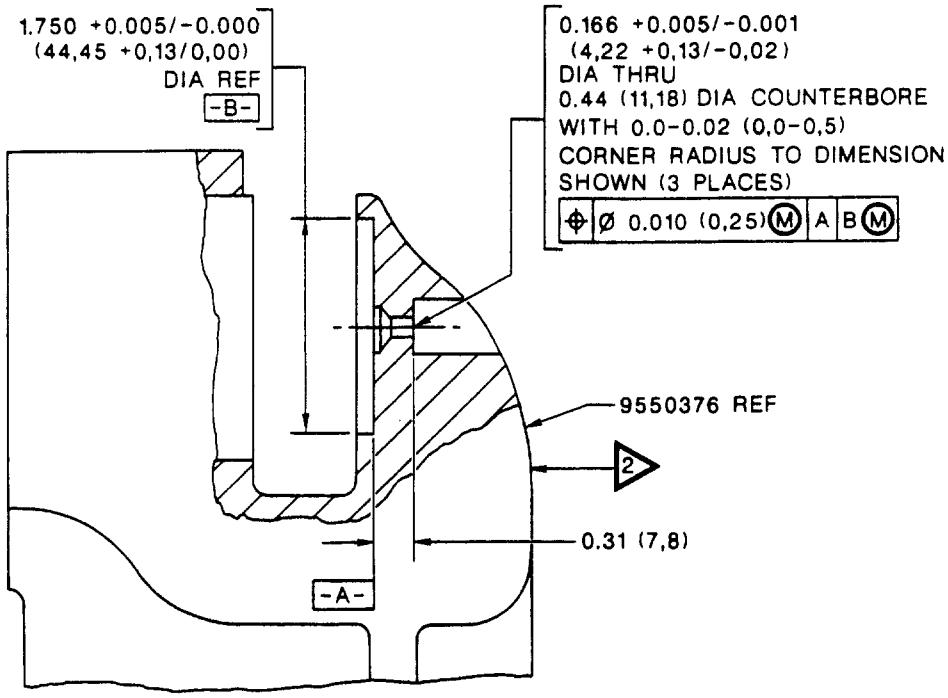
   B. Machine brake housing and brake linings in accordance with Repair Figure 601 and as follows:

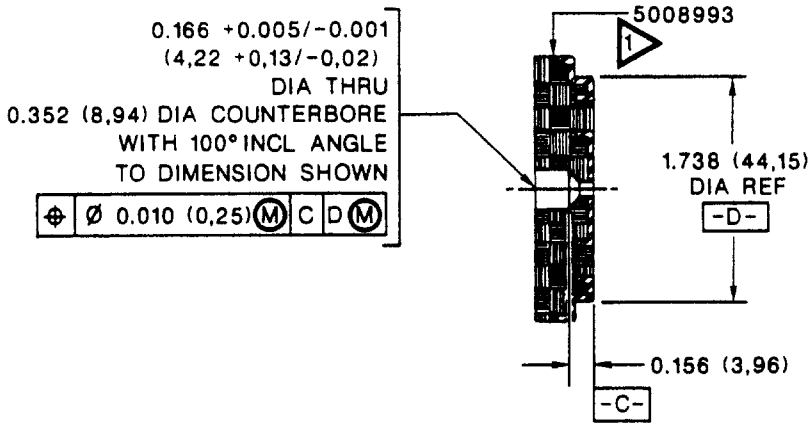
      (1) Machine anvil side of brake housing to dimension shown in Repair Figure 601.

      (2) Machine anvil lining only to dimension shown in Repair Figure 601.

      (3) Metal stamp "5R85-015" in 0.12 inch (3,05 mm) characters on surface shown in Repair Figure 601.

      (4) Ink stamp "R" in 0.12 inch (3,05 mm) characters adjacent to brake lining part number.



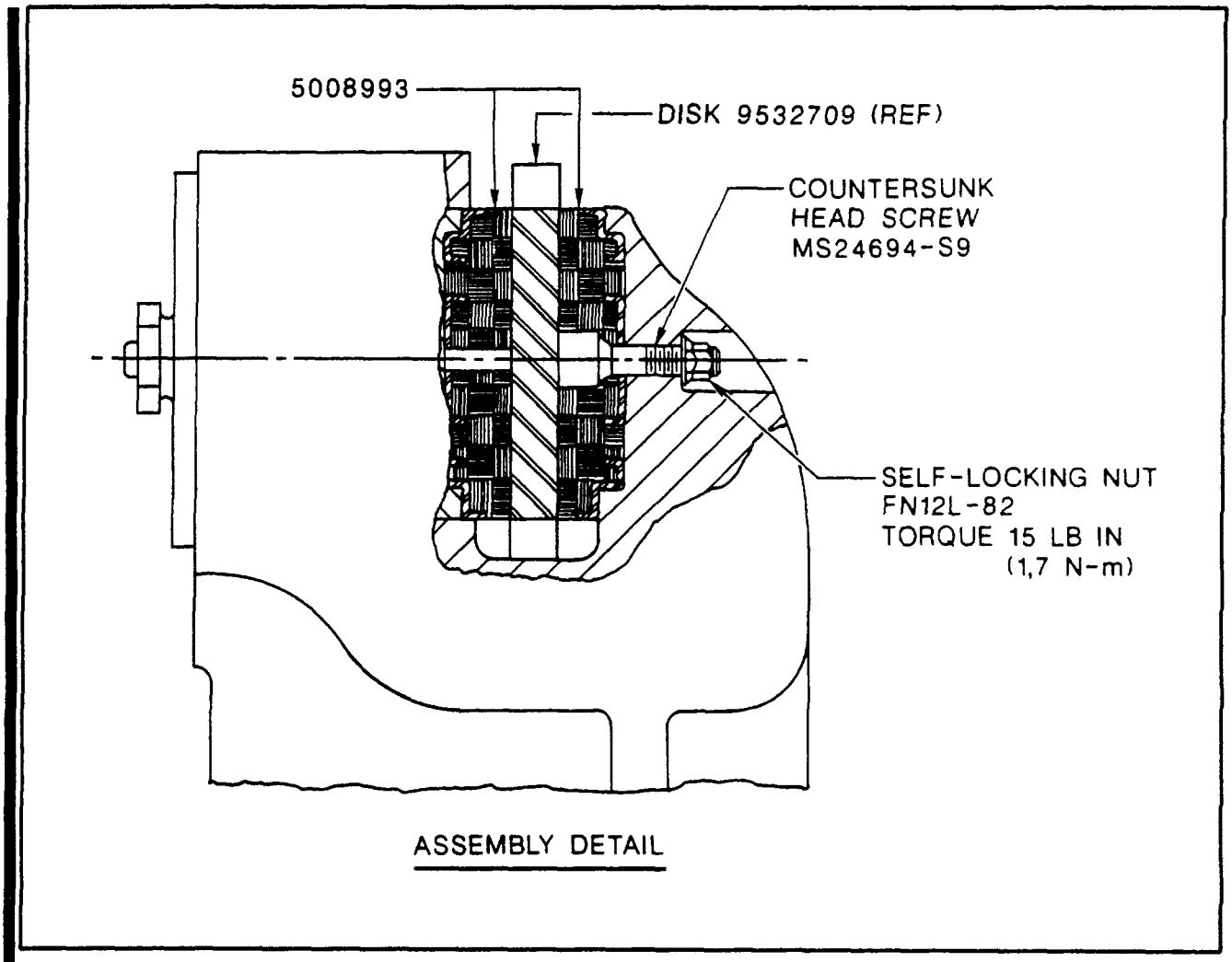


MACHINING DETAIL
FOR BRAKE HOUSING AND LINING

NOTE:

1. REWORK REQUIRED FOR ANVIL LINING ONLY.
2. METAL STAMP "5R85-015" ON SURFACE SHOWN IN 0.12 (3,05) CHARACTERS.

Anvil Lining Retention Repair
Figure 601 (Sheet 1 of 2)



Anvil Lining Retention Repair
Figure 601 (Sheet 2 of 2)

REPAIR NO. 5 - REPAIR OF BRAKE HOUSING FOR MACHINING WIPER RING GROOVE

1. General (Ref. IPL Fig. 1)

   A. This repair is for Brake Housing 9550376 (250).

   B. This repair provides instructions for machining a groove in the piston cavity to facilitate the installation of a wiper ring which will prevent foreign material from entering the piston cavity.

2. Brake Housing Piston Cavity Rework

   A. Rework piston cavities in Brake Housing 9550376 (250) as follows:

      NOTE: Reworked piston cavities require the installation of a wiper ring at assembly.

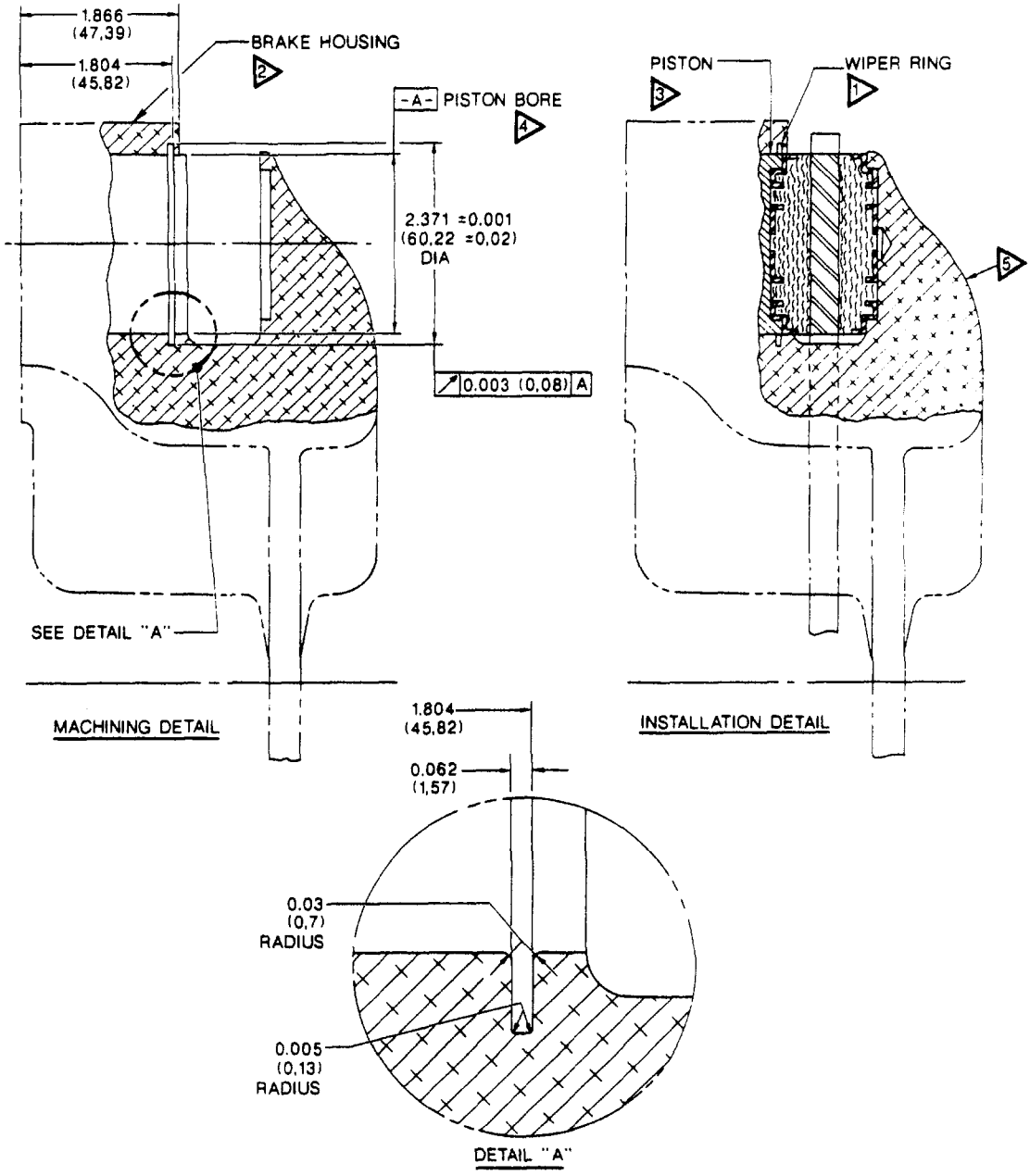
      (1) Machine a 2.371 ±0.001 (60,22 mm) diameter groove in each piston cavity and radius as shown in Repair Figure 601.

      (2) Metal stamp "5R86-067" in a 0.12 inch (3,05 mm) characters on surface shown in Repair Figure 601.

      (3) Treat all newly machined surfaces of Brake Housing 9550376 (250) with surface treat solution, Specification MIL-M-3171.

   B. Install appropriate wiper ring for piston bore machined, in accordance with ASSEMBLY AND STORAGE.

      NOTE: Piston cavity for Brake Housing 9550376 requires Wiper Ring 5009211. Piston Cavities bored oversize for Brake Housing 9550376 require Wiper Ring 5009213.



WIPER RING 1	BRAKE HOUSING 2	PISTON 3	PISTON BORE 4
5009211	9550376 (MAG)	511921	2.126 (54,00) DIA
5009213	9550376 (MAG)	9522145 (OVERSIZE)	2.175 (55,25) DIA

NOTE:

5 METAL STAMP "5R86-067" ON SURFACE SHOWN IN 0.12 (3,05) CHARACTERS.

Piston Cavity Rework for Machining Wiper Ring Groove
Figure 601

COMPONENT MAINTENANCE MATERIAL
BRAKE ASSEMBLY 9550377

REPAIR NO. 6 - REWORK OF BRAKE HOUSING 9550376 FOR REMOVAL OF EXCESS CASTING MATERIAL

1. General (Ref. IPL Fig. 1)

   A. This repair is for Brake Housing 9550376 (250).

   B. This repair provides instructions for grinding off excess material parallel to piston cavity at two (2) places to ease brake disk installation and removal.

2. Rework of Brake Housing (Ref. Repair Fig. 601)

   NOTE: It is recommended this rework and/or repair be accomplished at the next maintenace action at operator's option.

   A. Rework brake housing to remove excess brake housing material as follows (Ref. Repair Fig. 601):

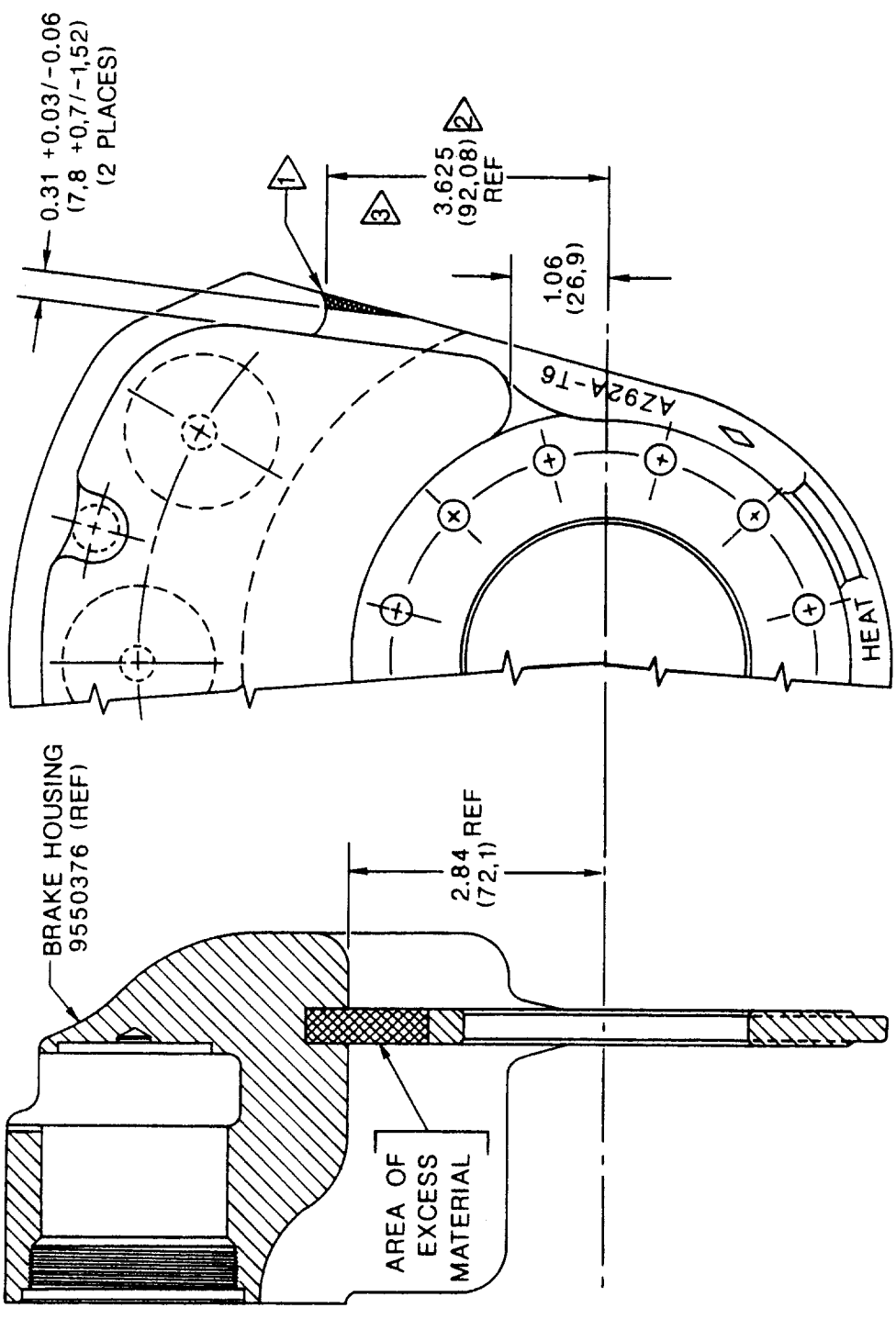
      NOTE: This rework can be performed on aircraft if required.

      (1) Scribe a line parallel to piston housing at a distance of 0.31 + 0.03/-0.06 inch (7,8 + 0,7/-1,52 mm).

      (2) Grind off excess brake housing material on outside lower anvil area of housing as shown in Repair Figure 601 (2 places).

      (3) Metal stamp repair number "5R88-001" in 0.12 inch (3,05 mm) characters in area of removed material after rework.

      (4) Re-treat and repaint reworked area in accordance with Re-Treating and Repainting.



Brake Housing Rework
Figure 601

REPAIR NO. 7 - REPAIR OF PISTON LINING RETAINER

1. General (Ref. IPL Fig. 1)

   A. This repair is for Pistons 5009128 and 5009408 (150B and 150C).

   B. This repair provides instructions for machining off a damaged lining retainer and for machining a hole to install a new lining retainer.

2. Repair of Piston Lining Retainer (Ref. Repair Fig. 601)

   A. Repair damaged piston lining retainer in accordance with Repair Figure 601 and the following instructions.

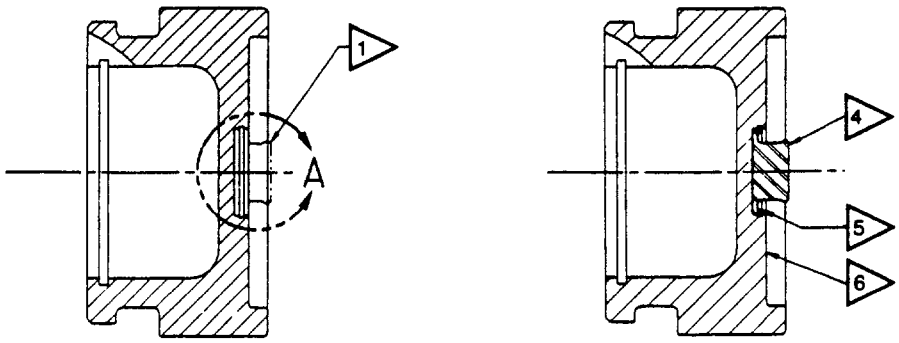
      (1) Machine off damaged button.

      (2) Machine retaining ring and lining retainer recess according to Repair Figure 601.

      (3) Treat newly machined surface with Alodine 1200 chemical conversion coating, Specification MIL-C-5541.

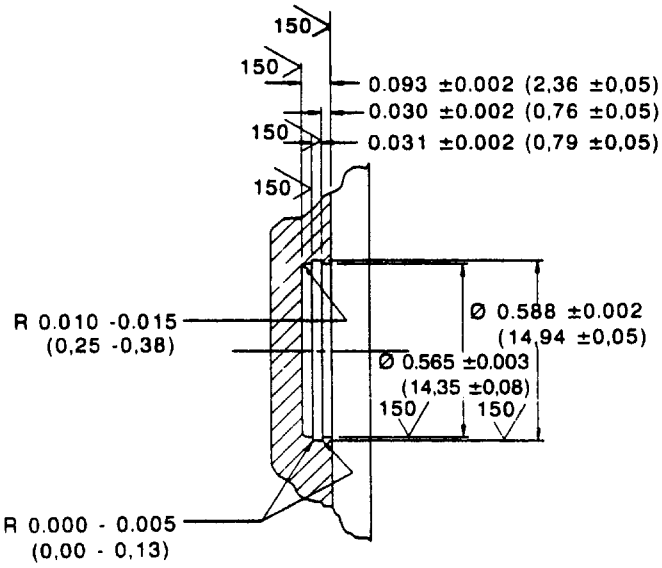
      (4) Install new Lining Retainer 5009129 and new Retaining Ring 9521958.

   B. Metal stamp repair number "5R87-30" in 0.09 inch (2,29 mm) characters on surface shown in Repair Figure 601.



MACHINING DETAIL

INSTALLATION DETAIL



DETAIL A

1. MACHINE OFF DAMAGED BUTTON.
2. MACHINE HOLE FOR LINING RETAINER AND RETAINING RING ACCORDING TO DETAIL A.
3. TREAT NEWLY MACHINED SURFACES WITH ALODINE 1200 CHEMICAL CONVERSION COATING, SPECIFICATION MIL-C-5541.
4. LINING RETAINER 5009129.
5. RETAINING RING 9521958.
6. METAL STAMP "5R87-30" IN 0.09 (2,29) CHARACTERS ADJACENT TO PART NUMBER. REMOVE DISPLACED METAL TO MAINTAIN FLAT SURFACES.

Repair of Piston Lining Retainer
Figure 601

ASSEMBLY AND STORAGE

1. Assembly and Storage Materials

NOTE: Equivalent substitutes may be used for items listed below.

Pliobond 5001	W. J. Ruscoe and Company 483 Kenmore Boulevard Akron, OH 44301
Lockwire (MS20995C32)	Commerically available
Hydraulic Preservative Fluid Specification MIL-H-6083	Commercially available
Hydraulic Fluid (Red Oil) Specification MIL-H-5606 (Alternate for Hydraulic Preservative Fluid)	Commercially available
Rust Veto 4214	E. F. Houghton and Company Madison and VanBuren Street Valley Forge, PA 19482
Naphtha or Lead-Free Gasoline	Commercially available
Zinc Chromate Primer Specification TT-P-1757	Commercially available

2. General (Ref. IPL Fig. 1)

A. It is recommended that new preformed packings be installed at each overhaul.

B. It is recommended that brake linings be replaced at time of overhaul.

NOTE: Brake linings must be similar and not intermixed with alternate brake linings. Alternate brake linings must be replaced as a set.

3. Assembly Procedures (Ref. IPL Fig. 1)

A. Assemble the brake assembly in accordance with the following procedures:

CAUTION: ASSEMBLE THE BRAKE ON A CLEAN, FLAT SURFACE BEING CAREFUL NOT TO NICK, SCRATCH OR SCUFF THE PAINT OR PROTECTIVE FINISH. ENSURE PROPER PARTS ARE USED FOR EACH BRAKE ASSEMBLY.

B. Install bleeder as follows:

(1) Lubricate preformed packing (240) with a light coat of hydraulic preservative fluid, Specification MIL-H-6083.

(2) Place lubricated preformed packing (240) on bleeder valve adapter (230); then install in brake housing (250 or 250A) bleeder port.

(3) Tighten bleeder valve adapter (230) to a torque value of 30 pound-feet (41 N-m).

(4) Install bleeder valve (220) into bleeder valve adapter (230) and tighten to a torque value of 120 pound-inches (13,6 N-m).

(5) Place bleeder washer (210) on bleeder screw (200) and install in bleeder valve (220).

C. Install inlet as follows:

(1) Lubricate preformed packing (190) with a light coat of hydraulic preservative fluid, Specification MIL-H-6083.

(2) Place lubricated preformed packing (190) on screw threaded insert (180) and install in brake housing (250 or 250A) inlet port.

(3) Tighten screw thread insert (180) to a torque value of 30 pound-feet (41 N-m).

(4) Lubricate preformed packing (170) with a light coat of hydraulic preservative fluid, Specification MIL-H-6083.

(5) Place lubricated preformed packing (170) on protective plug (160) and install in screw thread insert (180).

D. Assemble each of the piston units as follows:

NOTE: If letter "R" has been stamped after brake assembly number on housing, assembly has been reworked for oversize piston.

(1) Place the head of self-adjusting pin (140) into piston (150, 150A, 150B or 150C).

(2) Place brake release spring (130) over pin into piston.

(3) Place brake release spring (120) over self-adjusting pin (140) and inside brake release spring (130).

(4) Place spring guide (110) over self-adjusting pin (140) and on the inside brake release spring (120).

(5) With piston opening up, place retaining ring (100) on top of piston over opening.

(6) Place tool (tubing used in disassembly) over self-adjusting pin (140), inside retaining ring (100) and against spring guide (110).

(7) Place piston unit into arbor press and apply force to tool (tubing), against spring guide (110), compressing the springs just enough to enable the installation of retaining ring (100) into groove of piston. Release arbor press slowly and ensure retaining ring is seated. Remove piston unit from arbor press.

E. Install wiper ring (255 or 256) in brake housing as follows:

NOTE: If "5R86-067" has been stamped on brake housing, piston cavity has been reworked for a wiper ring. Install Wiper Ring 5009211 (255) or wiper ring (256) (oversize) (Ref. Repair No. 5 - Repair of Brake Housing for Machining Wiper Ring Groove.)

(1) Lubricate wiper ring (255 or 256) with hydraulic preservative fluid, Specification MIL-H-6083.

(2) Install lubricated wiper ring (255 or 256) in groove of piston cavity.

F. Install piston units and cylinder head as follows:

(1) Lubricate preformed packings (80A and 90A) and preformed packing (70A) with hydraulic preservative fluid, Specification MIL-H-6083.

(2) Install lubricated preformed packing (90A) in seal groove of piston (150) (Ref. Fig. 701).

(3) Install lubricated preformed packing (80A) and preformed packing (70A) in cylinder head (60 or 60A) (Ref. Fig. 701).

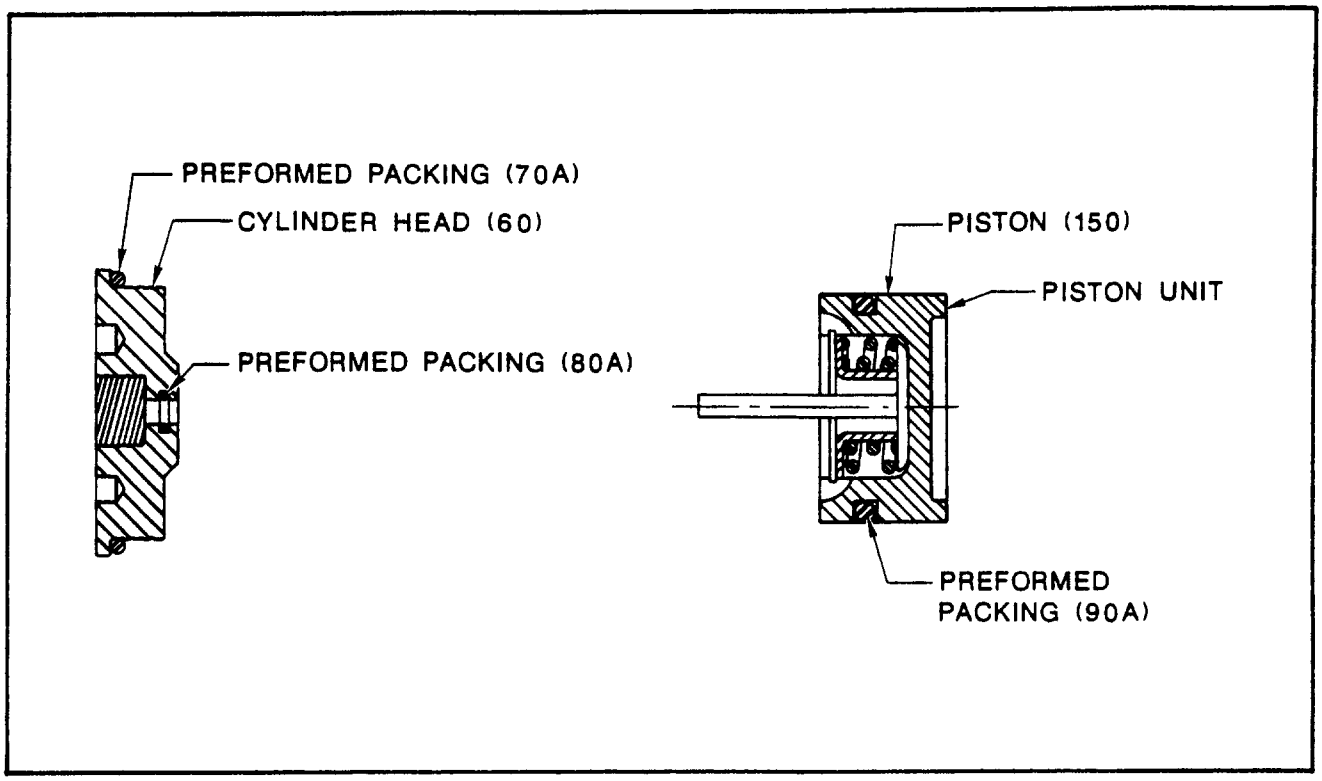
(4) Lubricate contacting surfaces of pistons and piston cavity with light coat of hydraulic preservative fluid, Specification MIL-H-6083.

(5) Install lubricated piston unit with preformed packing (90A) on brake housing (250 or 250A).

(6) Install cylinder head (60 or 60A) with packings (70A and 80A) over self-adjusting pin (140) and thread into position in brake housing (250 or 250A).

(7) Using a spanner wrench on cylinder head wrench adapter, tighten cylinder head to a torque value of 75 pound-feet (102 N-m).

(8) Install steel washer (50) on self-adjusting pin (140).



Preformed Packing Installation
Figure 701

(9) Dip self-adjusting pin grip (40) into clean hydraulic brake fluid, Specification MIL-H-5606 and install on self-adjusting pin (140), large end first.

(10) Install self-adjusting pin nut (30) over self-adjusting pins (140) and screw into cylinder head (60 or 60A) but do not tighten.

(11) Push pistons (150, 150A, 150B or 150C) completely back against cylinder head (140) and tighten self-adjusting pin nuts (30) to a torque value of 25 pound-feet (34 N-m) and back off several times to seat parts and final torque.

(12) Lockwire self-adjusting pin nuts (30) in series, using Lockwire MS20995C32 (Ref. Fig. 1).

G. Install brake linings as follows:

NOTE: If "5R85-015" has been stamped on brake housing, anvil section has been reworked to accept a fastner to improve brake lining retention. Install reworked lining, countersunk head screw (254), and self-locking nut (253). Torque self-locking nut to 15 pound-inches (1,7 N-m). (Ref. Repair No. 4 - Repair of Brake Housing for Anvil Lining Rention Repair.)

(1) For Brake Assemblies 9550377, 9550377-1 and 9550377-4, apply Pliobond 5001 cement to back of brake linings. Use naphtha or lead-free gasoline to remove cement that may accidentally drip on lining wear surface.

(2) For Brake Assembly 9550377-4, install brake lining (20C) in piston and anvil recesses of brake housing.

(3) For Brake Assembly 9550377-2, install brake linings (20D) in piston and anvil recesses of brake housing so that lining retaining cups mate with the lining retainers.

H. Install brake disk (10) into position between brake linings.

I. Test brake assembly in accordance with applicable TESTING AND FAULT ISOLATION instructions.

4. Installation of Disk Guide Bracket Subassembly (260 and 300)

NOTE: Disk guides are installed at operator's option after installation of brake assembly on aircraft.

A. Install disk guide bracket subassembly as follows:

(1) Install disk guide bracket subassembly (260 and 300) using brake mounting bolts in the two adjacent bolt holes in bottom of brake housing. Install disk guide with lining toward brake disk (10) (Ref. Fig. 1).

NOTE: If "5R2-404" has been stamped on brake housing, mounting bolt holes have been reworked oversize. Ensure that locally manufactured bushing is installed (Ref. Repair No. 3 - Repair of Mounting Bolt Hole).

5. Storage Instructions

A. The brake assembly should be stored as follows:

CAUTION: BRAKES EQUIPPED WITH QUICK-DISCONNECT FITTINGS SHOULD HAVE THE FITTINGS PROTECTED DURING SHELF STORAGE BY SUITABLE CAPS OR OTHER MEANS.

(1) The brake assembly should be stored in moisture-barrier material and a sealed corrugated cardboard container, or equivalent.

(2) The brake assembly should be stored in a clean, dry storeroom. The desirable storeroom temperature range is from 50° to 70°F (10° to 21°C). If this temperature range cannot be maintained, temperatures as high as 125°F (+52°C) and as low as -20°F (-29°C) can be tolerated for short periods. Total time above 100°F (38°C) should not exceed three months.

(3) When brake disk is stored separated, insert cardboard between brake linings to hold them in position.

B. Housing and disk:

(1) Housings and disks that are to be stored for an indefinite period should be treated as follows:

(a) Vapor degrease metal parts to remove all oil and residue.

WARNING: RUST INHIBITORS ARE HIGHLY FLAMMABLE AND MUST BE USED ONLY IN AN OPEN OR WELL-VENTILATED AREA. EXERCISE EXTREME CARE.

(b) Immerse parts in Houghton's Rust Veto 4214 or equivalent. Use in the "as-received" condition without dilution. Allow parts to drip and air dry for five minutes. Clean compressed air may be used to speed drying.

(c) Wrap parts in moisture-barrier material and package in a cardboard container.

(d) Prior to placing parts back into service, degrease in a vapor degreaser.

FITS AND CLEARANCES

Item No. (Ref. IPL Fig. 1)	Compressed Length	Minimum Load
120	0.538 inch (13,66 mm)	60 pounds (267 Newtons)
130	0.538 inch (13,66 mm)	115 pounds (512 Newtons)

Spring Values
Figure 801

Item No. (Ref. IPL Fig. 1)	Nomenclature	Replacement Dimension
10	Brake Disk Thickness (minimum) Outside diameter (minimum)	 0.360 inch (9,14 mm) 13,025 inches (330,83 mm)
20B, 20C or 20D	Brake Lining (Thickness)	 0.195 inch (4,95 mm)
140	Self-Adjusting Pin (Diameter at grip holding surface)	 0.245 inch (6,22 mm)
150 or 150B	Piston (Diameter)	 2.112 inches (53,64 mm)
150A or 150C	Piston (Diameter)	2.161 inches (54,89 mm)
280 or 320	Disk Guide Linings (Thickness)	0.205 inch (5,21 mm)

Wear Tolerances
Figure 802

Item No. (Ref. IPL Fig. 1)	Nomenclature	Torque Value
30	Self-Adjusting Pin Nuts	25 pound-feet (34 N-m)
60 or 60A	Cylinder Head	75 pound-feet (102 N-m)
180	Screw Thread Insert	30 pound-feet (41 N-m)
220	Bleeder Valve	120 pound-inches (13,6 N-m)
230	Bleeder Valve Adapter	30 pound-feet (41 N-m)

Torque Values
Figure 803

SPECIAL TOOLS, FIXTURES AND EQUIPMENT

NOTE: Equivalent substitutes may be used for items listed below.

Figure	Tool/Fixture No.	Description	Application
-	43193	Cylinder Head Wrench Adapter Cook Manufacturing Company 4585 Allen Road Stow, OH 44224	Used to remove and install cylinder head.

NOTE: The following type of equipment is used for paint removal using the dry-stripping procedure:

Plastic Reclaimable Abrasive Machine (PRAM)

Pauli and Griffin
907 Cotting Lane
Vocaville, CA 95688

ILLUSTRATED PARTS LIST

1. Introduction

A. General

(1) The Illustrated Parts List (IPL) section illustrates and lists the procurable parts of the assembly(ies) in this publication.

B. Parts List

(1) IPL Figure 1 is an exploded view of assembly(ies) covered by the parts list.

(2) Components in the parts list are listed in order of disassembly.

(3) The Figure and Item column provides the cross reference between the parts list and the associated IPL Figure 1.

(4) The Part Number column gives the part number of the item, which is stamped on the part when practical. This number should be used when ordering parts.

(5) The Airline Stock Number column is provided for the convenience of the operator to enter individual part numbers.

(6) The Nomenclature column gives the basic noun name of each part, together with any descriptive or dimensional information and specifications required to identify the part listed. Parts are indented under the numbered sub-column heading showing the relationship of the parts to their subassemblies and to the assembly. When an alternate part or repair part exists for the recommended part, it is indicated in parentheses following the part nomenclature. A federal supply code number is given for all vendor-supplied items.

(7) The Effect Code column shall establish parts relationship with units or assemblies which are essentially the same but have minor variations. These units or assemblies are the lead items. These units or assemblies shall be assigned reference letters such as A, B, C, D, etc. Parts which are not common to all configurations, but are associated with one or more of the coded lead items, shall carry the letter or letters assigned to the lead item with which it is associated. If a part is common to all lead items, the Effect Code column shall be blank.

(8) The Units Per Assembly column gives the number of parts required for each assembly or subassembly.

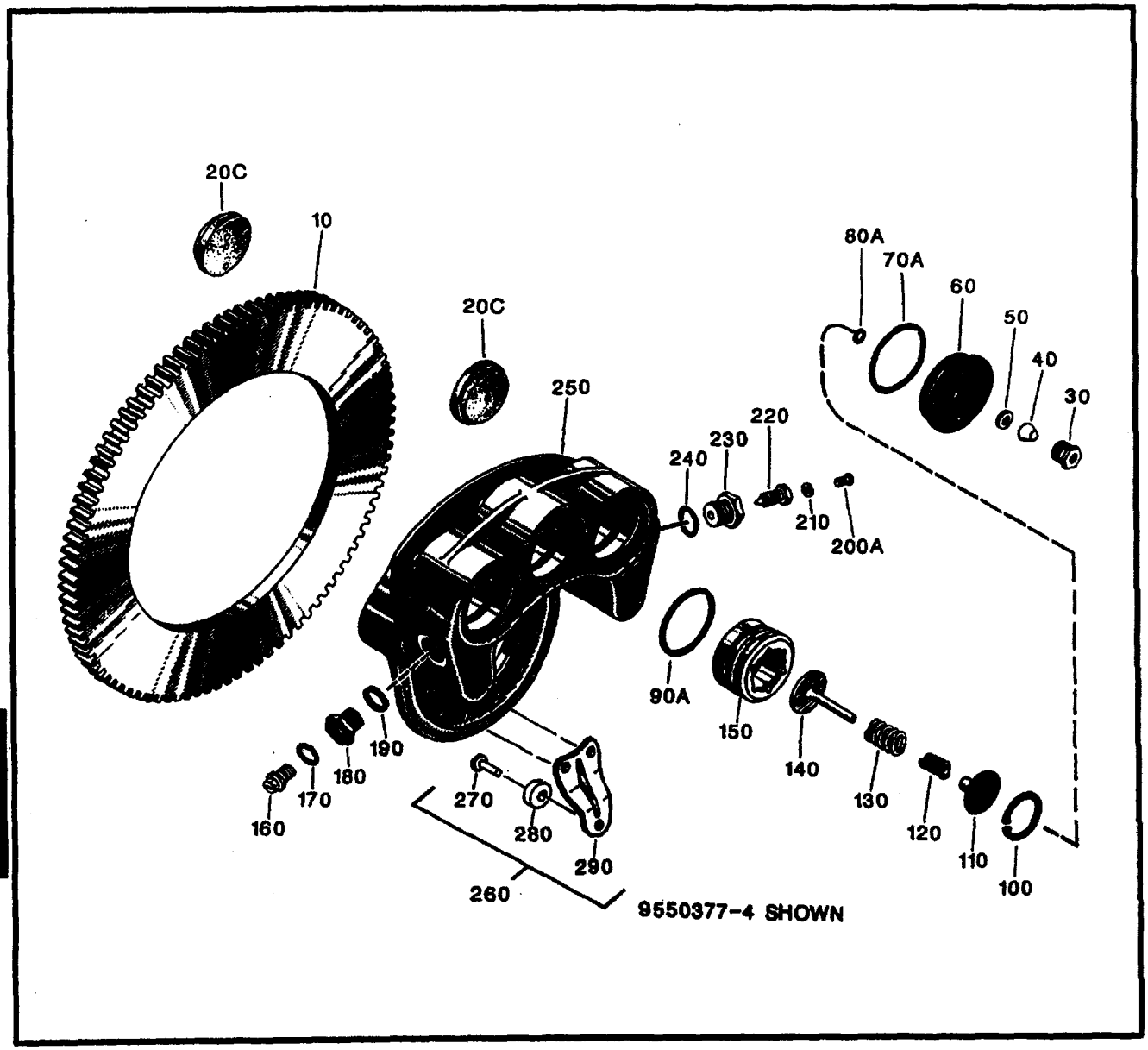
C. Federal Supply Codes for Manufacturers

(1) A list of vendor codes with names and addresses is provided.

TEMPORARY REVISION NO. 32–6

FILING INSTRUCTIONS: Insert facing page 1002 (32–43–23).

DESCRIPTION: Removed items 300, 310, 320 and 330 from IPL Figure 1. This Temporary Revision replaces Temporary Revision No. 32–5, which can be removed.

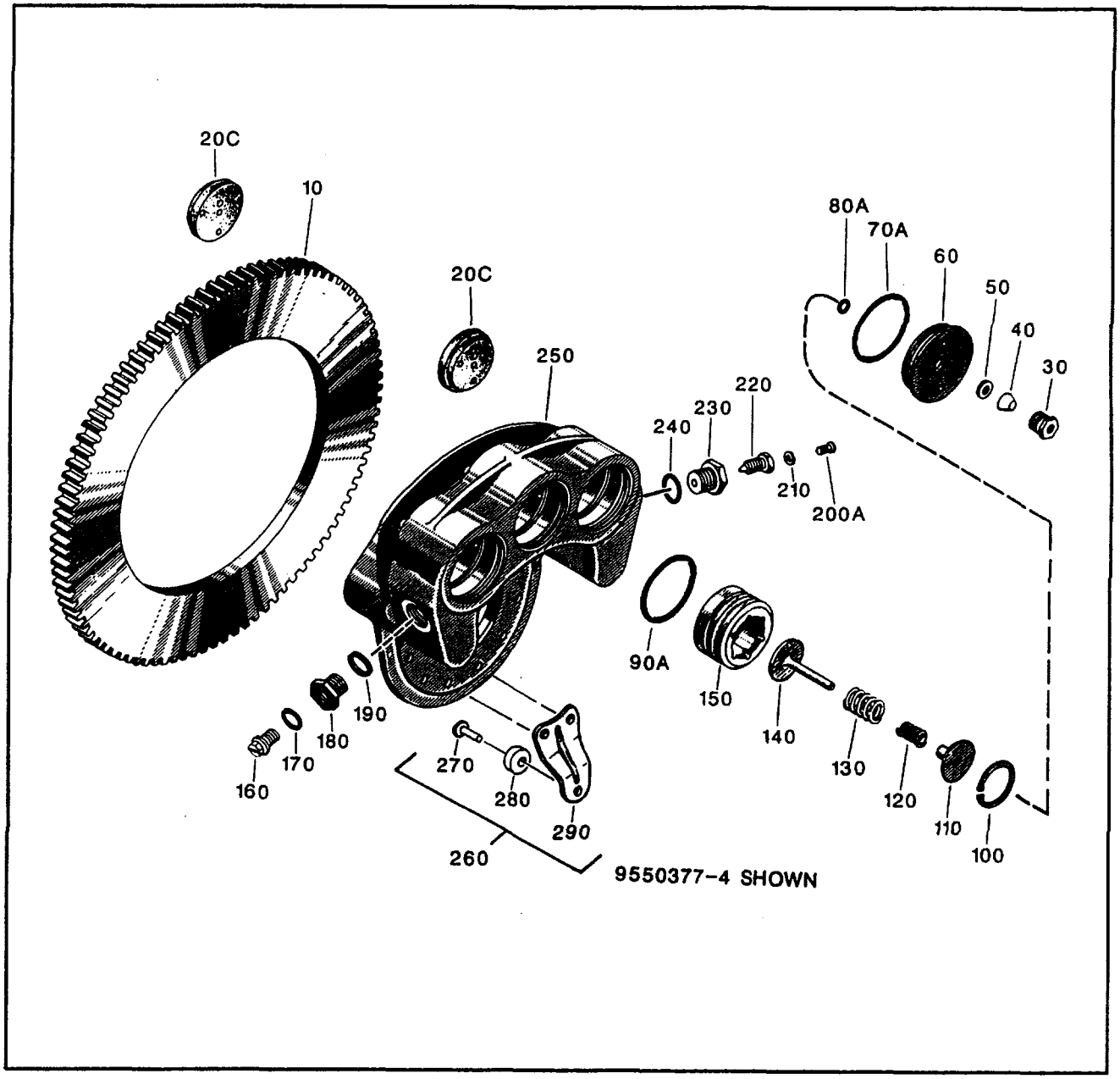


Brake Assembly
IPL Figure 1

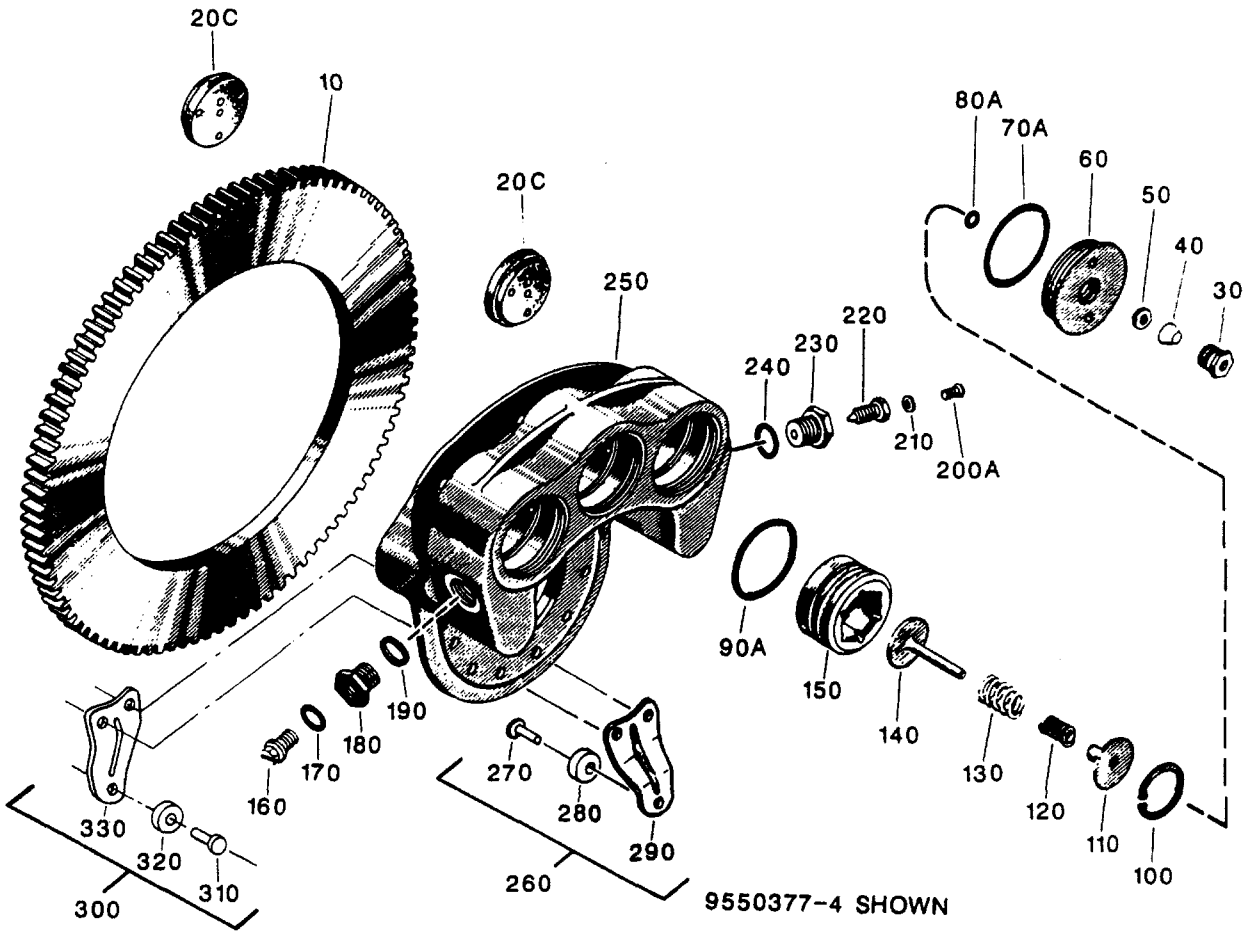
TEMPORARY REVISION NO. 32–5

FILING INSTRUCTIONS: Insert facing page 1002 (32–43–23).

DESCRIPTION: Removed items 300, 310, 320 and 330 from IPL Figure 1. This Temporary Revision replaces Temporary Revision No. 32–4, which can be removed.



Brake Assembly
IPL Figure 1


20C
10
20C
250
80A
70A
60
50
40
30
220
230
240
210
200A
90A
150
140
130
120
110
100
190
180
170
160
270
280
290
260
330
320
310
300
9550377-4 SHOWN

TEMPORARY REVISION NO. 32–6

FILING INSTRUCTIONS: Insert facing page 1003 (32–43–23).

DESCRIPTION: Corrected "Order –4" to "Order –2" for items 1 and 1A and added it to item 1D and added items 20D and 20E as alternates for item 20C. Also, changed item 1B, 20D, 150, 150A, 150B and 150C nomenclature to tell which items are aluminum and which items are magnesium.

1. Parts List

FIGURE ITEM	PART NUMBER	AIRLINE STOCK NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT CODE	UNITS PER ASSY	
1 –1	9550377**		BRAKE ASSEMBLY (Order –2)	A	RF	R
–1A	9550377–1		BRAKE ASSEMBLY (Order –2)	B	RF	R
–1B	9550377–2		BRAKE ASSEMBLY (Aluminum Housing with snap fasteners)	C	RF	R
–1C	9550377–3		NON PRODUCTION			
–1D	9550377–4		BRAKE ASSEMBLY (Order –2)	D	RF	R
–20C	5008993		. LINING, Brake	D	6	
–20D	5009124		. LINING, Brake (With snap fasteners) (Alternate for item 20C)	CD	6	R
–20E	5008993–1**		. LINING, Brake (Alternate for item 20C)	D	6	R
150	511921		. PISTON (Magnesium)	ABD	3	R
–150A	9522145		. PISTON (Oversize repair only) (Magnesium)	ABD	AR	R
–150B	5009128		. PISTON (Aluminum with snap fastener)	C	3	R
–150C	5009408		. PISTON (Oversize repair only) (Aluminum with snap fastener)	C	AR	R

– Item not illustrated.
* Not furnished, order separately.
** Not procurable, use until stock depletion.

TEMPORARY REVISION NO. 32–5

FILING INSTRUCTIONS: Insert facing page 1003 (32–43–23).

DESCRIPTION: Changed item 1B, 20D, 150, 150A, 150B and 150C nomenclature to tell which items are aluminum and which items are magnesium. Added item 20E as an alternate for item 20C. This Temporary Revision replaces Temporary Revision No. 32–4, which can be removed.

2. Parts List

FIGURE ITEM	PART NUMBER	AIRLINE STOCK NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT CODE	UNITS PER ASSY	
1 –1	9550377**		BRAKE ASSEMBLY (Order –4)	A	RF	
–1A	9550377–1		BRAKE ASSEMBLY (Order –4)	B	RF	
–1B	9550377–2		BRAKE ASSEMBLY (Aluminum Housing with snap fasteners)	C	RF	R
–20D	5009124		. LINING, Brake (With snap fasteners)	C	6	R
–20E	5008993–1		. LINING, Brake (Alternate for item 20C)	D	6	R
150	511921		. PISTON (Magnesium)	ABD	3	R
–150A	9522145		. PISTON (Oversize repair only) (Magnesium)	ABD	AR	R
–150B	5009128		. PISTON (Aluminum with snap fastener)	C	3	R
–150C	5009408		. PISTON (Oversize repair only) (Aluminum with snap fastener)	C	AR	R

– Item not illustrated.
* Not furnished, order separately.
** Not procurable, use until stock depletion.

2. Parts List

FIGURE ITEM	PART NUMBER	AIRLINE STOCK NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT CODE	UNITS PER ASSY	
1- 1	9550377**		BRAKE ASSEMBLY (Order -4)	A	RF	R
-1A	9550377-1		BRAKE ASSEMBLY (Order -4)	B	RF	R
-1B	9550377-2		BRAKE ASSEMBLY (Added per SB DHC-6-32-6)	C	RF	R
-1C	9550377-3		NONPRODUCTION			
1D	9550377-4		BRAKE ASSEMBLY	D	RF	R
10	9532709		.DISK, Brake		1	
-20	9523331**		.LINING, Brake	A	6	
-20A	9534896**		.LINING, Brake (Alternate for item 20)	A	6	
-20B	9523331-1**		.LINING, Brake	B	6	
20C	5008993		.LINING, Brake	D	6	R
-20D	5009124		.LINING, Brake	C	6	R
30	9510894		.NUT, Self-Adjusting Pin . .		3	
40	9510895		.GRIP, Self-Adjusting Pin . .		3	
50	511820-7		.WASHER, Steel		3	
60	9524338		.HEAD, Cylinder (May be used as alternate for item 60A on item 1B).	ABD	3	R
-60A	5009127		.HEAD, Cylinder	C	3	R
-70	AN6230-6		.GASKET, O-Ring (Alternate for item 70A).	ABC	3	R
70A	MS28775-228		.PACKING, Preformed . . .	D	3	R
-80	AN6227-5		.PACKING, O-Ring (Alternate for item 80A) . . .	ABC	3	R
80A	MS28775-010		.PACKING, Preformed . . .	D	3	R
-90	AN6227-30		.PACKING, O-Ring (Alternate for item 90A) . . .	ABC	3	R
90A	MS28775-327		.PACKING, Preformed . . .	D	3	R
100	MS16625-3137		.RING, Retaining		3	
110	9524307		.GUIDE, Spring		3	
120	9524304		.SPRING, Release		3	
130	9524305		.SPRING, Release		3	
140	9524306		.PIN, Self-Adjusting		3	
150	511921		.PISTON	ABD	3	R
-150A	9522145		.PISTON, (Oversize repair only)	ABD	AR	R
-150B	5009128		.PISTON	C	3	R
-150C	5009408		.PISTON, (Oversize repair only)	C	AR	R

- Item not illustrated.
* Not furnished, order separately.
** Not procurable, use until stock depletion.

TEMPORARY REVISION NO. 32–6

FILING INSTRUCTIONS: Insert facing page 1004 (32–43–23).

DESCRIPTION: Changed item 250 and 250A nomenclature to tell which items are aluminum and which items are magnesium. Changed items 300, 310, 320 and 330 to "DELETED". This Temporary Revision replaces Temporary Revision No. 32–5, which can be removed.

FIGURE ITEM	PART NUMBER	AIRLINE STOCK NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT CODE	UNITS PER ASSY	
250	9550376		. HOUSING, Brake (Magnesium)	ABD	1	R
–250A	5009126		. HOUSING, Brake (Aluminum)	C	1	R
–300	5008294 *		DELETED			R
–310	GYR6B10		DELETED			R
–320	5000219		DELETED			R
–330	5008293		DELETED			R

– Item not illustrated.
* Not furnished, order separately.
** Not procurable, use until stock depletion.

TEMPORARY REVISION NO. 32–5

FILING INSTRUCTIONS: Insert facing page 1004 (32–43–23).

DESCRIPTION: Changed item 250 and 250A nomenclature to tell which items are aluminum and which items are magnesium. Changed items 300, 310, 320 and 330 to "DELETED". This Temporary Revision replaces Temporary Revision No. 32–4, which can be removed.

FIGURE ITEM	PART NUMBER	AIRLINE STOCK NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT CODE	UNITS PER ASSY	
250	9550376		. HOUSING, Brake (Magnesium)	ABD	1	R
–250A	5009126		. HOUSING, Brake (Aluminum)	C	1	R
–300	5008294		DELETED			R
–310	GYR6B10		DELETED			R
–320	5000219		DELETED			R
–330	5008293		DELETED			R

– Item not illustrated.
* Not furnished, order separately.
** Not procurable, use until stock depletion.

NOTE: Please see the **TEMPORARY REVISION** that revises this page.

FIGURE ITEM	PART NUMBER	AIRLINE STOCK NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT CODE	UNITS PER ASSY	
1-160	1604-73		. PLUG, Protective (V79555) .		|	
170	MS28778-4		. PACKING, Preformed . . .		|	
180	512054		. INSERT, Screw Thread . . .		|	
190	MS28778-8		. PACKING, Preformed . . .		|	
-200	MS35207-260		. SCREW, Bleeder	A	|	
200A	MS35207-259		. SCREW, Bleeder	BCD	|	R
210	511846-4		. WASHER, Bleeder		|	
220	AN6204-1		. VALVE, Bleeder		|	
230	9511157		. ADAPTER, Bleeder Valve .		|	
240	MS28778-8		. PACKING, Preformed . . .		|	
250	9550376		. HOUSING, Brake	ABD	|	R
-250A	5009126		. HOUSING, Brake	C	|	R
-251	MS20426AD-510		.. RIVET, Solid (Repair Only)	C	AR	R
-252	9521519		.. RETAINER, Lining (Repair Only)	C	AR	R
-253	9521958		.. RING, Retaining (Repair Only)	C	AR	R
-254	FN12L-82		.. NUT, Self-Locking (Repair Only)		AR	R
-255	MS24694-S9		.. SCREW, Machine Countersunk Head (Repair Only)		AR	R
-256	5009211		.. RING, Wiper (Repair Only)		AR	R
-257	5009213		.. RING, Wiper (Oversize, Repair Only)		AR	R
260	5000221*		BRACKET SUBASSEMBLY, Disk Guide		|	
270	GY16B-10*		. RIVET, Tubular		|	
280	5000219*		. LINING, Disk Guide		|	
290	5000220*		. BRACKET, Disk Guide . . .		|	
300	5008294*		BRACKET SUBASSEMBLY, Disk Guide		|	
310	GYR6B10*		. RIVET, Tubular		|	
320	5000219*		. LINING, Disk Guide		|	
330	5008293*		. BRACKET, Disk Guide . . .		|	

\- Item not illustrated.
* Not furnished, order separately.
** Not procurable, use until stock depletion.

3. Federal Supply Codes for Manufacturers

Code No.	Name and Addresses
79555	Pennwalt Corporation S.S. White Division Three Parkway Philadelphia, PA 19102

De Havilland Canada

DHC-6 TWIN OTTER

OVERHAUL MANUAL

POWER BRAKE VALVE ASSEMBLY

PART NOS. C6HF1036 and C6HF1037

THE DE HAVILLAND AIRCRAFT OF CANADA LIMITED
DOWNSVIEW ONTARIO

Mar 31/69

De Havilland Canada

DHC-6 TWIN OTTER
OVERHAUL MANUAL
C6HF1036 and C6HF1037

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De Havilland Canada

DHC-6 TWIN OTTER
OVERHAUL MANUAL
C6HF1036 and C6HF1037

RECORD OF REVISIONS

Retain this record in the front of the manual. On receipt of revisions, insert revised pages in the manual and enter the revision number, revision date, insertion date, and initials of person incorporating the revision, in the appropriate block on the revision record.

Rev. No.	Rev. Date	Insertion Date	By
1	MAR 20/74	MAY 24/74	R.M.
2	OCT 25/74	NOV 29/74	R.M.
3	DEC. 14/81	MAR. 17/83	DHC

Rev. No.	Rev. Date	Insertion Date	By

LIST OF EFFECTIVE PAGES

Reference	Page	Date
Title	1	Mar 31/69
Effective Pages	*1	Dec 14/81
Record of Revisions	1	Mar 31/69
Introduction	1	Mar 31/69
Contents	1	Mar 31/69
32-40-11	1	Mar 31/69
32-40-11	2	Mar 31/69
32-40-11	3	Mar 31/69
32-40-11	4	Mar 31/69
32-40-11	*5	Dec 14/81
32-40-11	6	Oct 25/74
32-40-11	*7	Dec 14/81
32-40-11	*8	Dec 14/81
32-40-11	9	Mar 31/69
32-40-11	10	Mar 31/69

The asterisk (*) indicates pages revised, added or deleted by current revision.

De Havilland Canada

DHC-6 TWIN OTTER
OVERHAUL MANUAL
C6HF1036 and C6HF1037

INTRODUCTION

This manual contains instructions for the overhaul of the De Havilland Power Brake Control Assembly Part Nos. C6HF1036 and C6HF1037.

POWER BRAKE VALVE ASSEMBLY PART NO. C6HF1036 AND C6HF1037

1. Description and Operation

A. Description

The power brake valve assembly (Figure 1), consists of a cast aluminum body containing a lever-operated floating piston and a spring-loaded inlet/outlet poppet valve. The valve body has three ports; inlet pressure, brake pressure, and return.

B. Operation

Deflection of the splined lever is transmitted to the valve piston, and piston movement momentarily opens the pressure inlet valve to the brake pressure port. Pressure build-up in the brake pressure port is sensed by the valve piston, which yields a predetermined amount closing the inlet valve. Release of the splined lever allows the valve piston to withdraw under hydraulic pressure load and in so doing opens the brake pressure port to return, releasing any residual pressure.

C. Data

Hydraulic Fluid	MIL-H-5606
Operating Pressure	3000 psig
Proof Pressure	4000 psig
Brake Port Pressure	1000 + 50 psig - 0
Mounting Holes	0.256 to 0.261 inch diameter
Weight (nominal)	2.5 pounds

2. Disassembly

A. Disassemble Power Brake Valve (Figure 3)

(1) Remove two retainer rings (1), withdraw pin (2), and slide splined lever (7) complete with nut (3), washer (4), adjusting screw (5), and screw locking insert (6) from valve body (29), then remove rod (8).

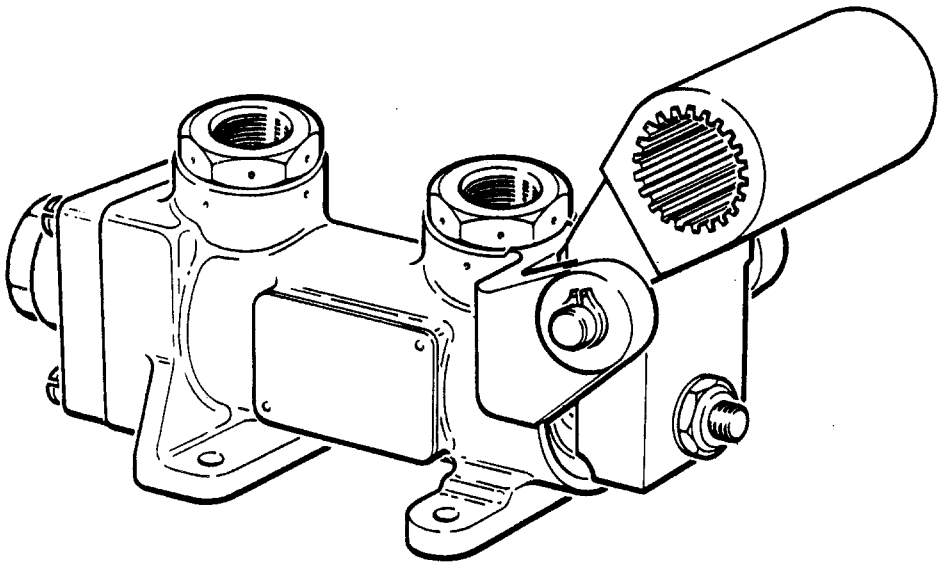
(2) Remove nut (3), washer (4), and unscrew adjusting screw (5) from splined lever (7). Remove screw locking insert (6) from splined lever.

(3) Remove bushing (9) and gasket (10) from end (12). Cut and remove lockwire from four screws (11), remove screws and separate end (12) from valve body (29).

(4) Pull spacer (13), packing (14), and stake assembly (15) from valve body (29).

(5) Disassemble stake assembly (15) as follows:

(a) Depress retainer (18), drill out pin (16), and slide poppet (17), retainer (18), and spring (19) in order from valve (20).



Power Brake Valve Assembly

Figure 1

(b) Remove valve (20) from seat (21).

(6) Pull spring (22) and piston (23) with two packings (24) from valve body (29). Remove packings (24) from grooves of piston (23).

(7) Remove bushing (25), gasket (26), bushing (27), and gasket (28) from ports on valve body (29).

3. Cleaning

A. General

(1) Clean component parts by washing or spraying with a dry-cleaning solvent.

(2) Dry with moisture-free compressed air or a lint-free cloth.

4. Inspection/Check

A. General

(1) *Inspect all threads for damage and deformity.*

(2) Under a strong light and preferably under magnification, inspect all parts for nicks, scores, scratches, or excessive wear that might cause improper operation of the valve.

(3) Refer to Table 1 for original tolerances and service limits. Replace parts worn in excess of service limits. Replace all defective parts not listed in table.

B. Detail Parts (Figure 3)

(1) Carry out a magnetic particle inspection of pin (2), rod (8), and seat (21).

(2) Check adjusting screw (5) head interior for excessive wear. Rod (8) should slide perfectly into head of adjusting screw.

(3) Carefully inspect seating surfaces of seat (21), valve (20), and poppet (17) for nicks, scoring, or sharp and smooth corners.

(4) Inspect piston (23) for distortion, nicks, cracks, or excessive wear and roughness at groove seating of packings (24). Seat must be round within 0.005 inch with sharp edges.

(5) Inspect valve body (29) for cracks, scoring, or pitted surfaces in area of packings, and other apparent defects. All passages must be free of restriction.

5. Repair

A. General

(1) Except for minor scratches that can be polished out with crocus cloth, Federal Specification P-C-458, repair of detail parts is not practical. Replace all parts which fail to meet inspection requirements.

B. Detail Parts (Figure 3)

(1) Install new packings (14) and (24), gaskets (10), (26) and (28), screw locking insert (6), and pin (16) at each overhaul of the power brake valve.

(2) Remove roughness of sealing areas in contact with packings using No. 600 emery paper. If a satisfactory finish cannot be obtained, replace the damaged part.

Table 1

Original Tolerances and Service Limits

FIGURE 3 ITEM NO.	NAME	DISCREPANCY LOCATION	ORIGINAL DIMENSION (INCHES)	SERVICE LIMIT (INCHES)	DISPOSITION
2	Pin	OD	0.3125 - 0.3115	0.311	Replace
7	Splined Lever	Pin Hole Diameter	0.3125 - 0.3134	0.3143	Replace
29	Valve Body	Pin Hole Diameter	0.313 - 0.315	0.317	Replace

6. Assembly

List of Materials

MATERIAL	SPECIFICATION
Oil	MIL-H-6083

A. Assemble Power Brake Valve (Figure 3)

(1) Install gasket (28), bushing (27), gasket (26) and bushing (25) to ports on valve body (29).

(2) On assembly, lubricate all internal metal parts using preservative oil MIL-H-6083. Install two packings (24) to grooves on piston (23), then position piston and spring (22) in valve body (29).

(3) Assemble stake assembly (15) as follows:

(a) Assemble poppet (17) to seat (21). Slide spring (19) and retainer (18) over end of poppet, and screw valve (20) onto end of poppet.

(b) Depress retainer (18) and install pin (16). Stake retainer in place in area next to ends of pin with two 0.06-inch diameter stakes from 0.010 to 0.020 inch deep.

(4) Position stake assembly (15) in valve body (29), making certain that spring (22) seats properly against shoulders of retainer (18).

(5) Insert packing (14) and spacer (13) in valve body (29). Position end (12) and secure using four screws (11). Do not lockwire screws until completion of test (see Testing). Install gasket (10) and bushing (9) on end (12).

(6) Install screw locking insert (6) in splined lever (7). Thread adjusting screw (5) into splined lever, and temporarily install washer (4) and nut (3). Do not secure washer and nut on adjusting screw. (See Testing).

(7) Position rod (8) and assembled splined lever (7) in valve body (29), and insert pin (2). Secure pin using two retainer rings (1).

7. Fits and Clearances

See Table 1.

8. Testing (Figure 2)

List of Materials

MATERIAL	SPECIFICATION
Red Lacquer	TT-L-32

A. General

(1) The hydraulic test rig must be capable of supplying and maintaining the pressures required by the test procedures in Table 2.

(2) Clean hydraulic fluid MIL-H-5606 or MIL-H-6083 must be used as the test medium (at room temperature).

CAUTION: DO NOT DRY CYCLE VALVE. CYCLING MAY OCCUR ONLY WHEN UNDER PRESSURE AND LUBRICATED WITH HYDRAULIC FLUID.

(3) Bleed all air from valve prior to testing.

B. Test Set-up

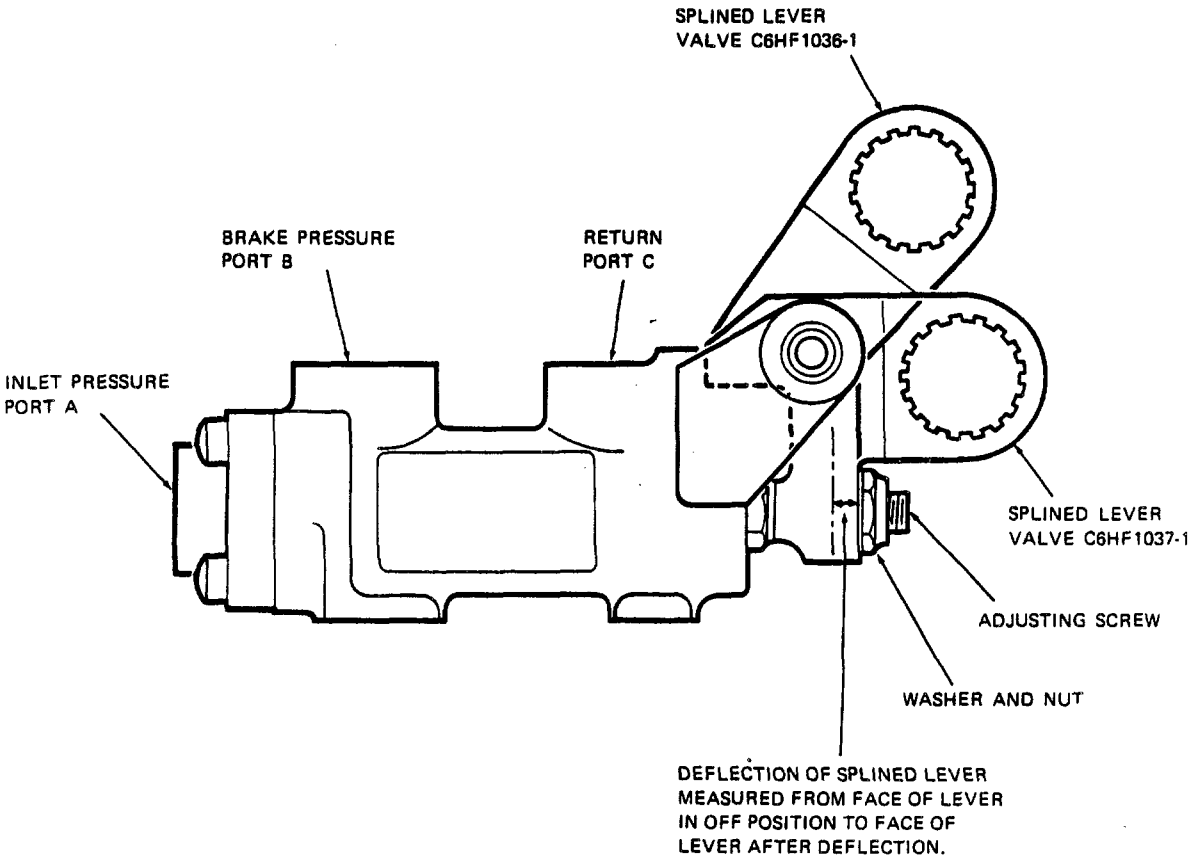
(1) Connect supply to inlet pressure port ("A"). Turn adjusting screw until fluid flows from brake pressure port ("B"). Regulate screw until flow stops. Turn an additional 1/2 to 3/4 turn, and lock adjusting screw with washer and nut.

(2) Witness-mark setting of adjusting screw with red lacquer TT-L-32.

C. Proof Pressure, Function and Leakage Tests

(1) Test power brake valve in the sequence designated in Table 2.

(2) On completion of testing, lockwire four screws securing end to valve body.



Testing - Power Brake Valve

Figure 2

Table 2

Test Requirements

TEST NO.	TEST PORT	PRESS. P.S.I.	PORT PLUGGED	TEST TIME	REMARKS
1	A	2250	None	2 Minutes	Lever in OFF position. There must be no leakage, permanent set or deformation.
2	A and C	1000	B	2 Minutes	Deflect splined lever 0.125 in. before applying pressure. There must be no external leakage or permanent set.
3	A	1000	B	5 Minutes	Splined lever in OFF position. Leakage at port C shall not exceed 20 drops in the last 4 minutes of 5 minute test.
4	Couple up a high pressure gage to port B. With 1000 psi at port A and splined lever initially relaxed, progressively deflect splined lever until pressure at port B increases to 800 psi. Hold at this pressure for 5 minutes; check that pressure at port B does not creep more than 10% of initial pressure and that leakage at port C does not exceed 20 drops in last 4 minutes of test. Release splined lever and note that pressure at port B immediately drops to zero.				

9. Trouble Shooting (Figure 3)

TROUBLE	PROBABLE DAUSE	CORRECTION
Internal leakage.	Incorrect setting of adjusting screw.	Refer to Testing, Set adjusting screw and test.
	Nicks or scores on seating surfaces of poppet (17) seat (21), or valve (20).	Remove stake assembly (15). Clean and inspect for excessive wear, nicks or scores. Replace suspect parts, reassemble and test.
External leakage at end (12).	Sealing of packing (14).	Remove packing, Inspect for roughness on valve body in area of packing. Install new packing, reassemble and test.

9. Trouble Shooting (Figure 3) (Cont'd)

TROUBLE	PROBABLE CAUSE	CORRECTION
External leakage at adjusting screw (5).	Sealing of packing (24) on piston (23).	Remove packing. Inspect groove on piston. Inspect for roughness on valve body in area of packing. Install new packing, reassemble and test.

10. Storage Instructions

A. Preparation

(1) Cap inlet pressure, brake pressure and return ports.

(2) Clean power brake valve with a clean dry cloth.

(3) Enclose unit in a polyethylene bag.

(4) Affix label, giving following information:

(a) Part and serial numbers.

(b) Date of overhaul.

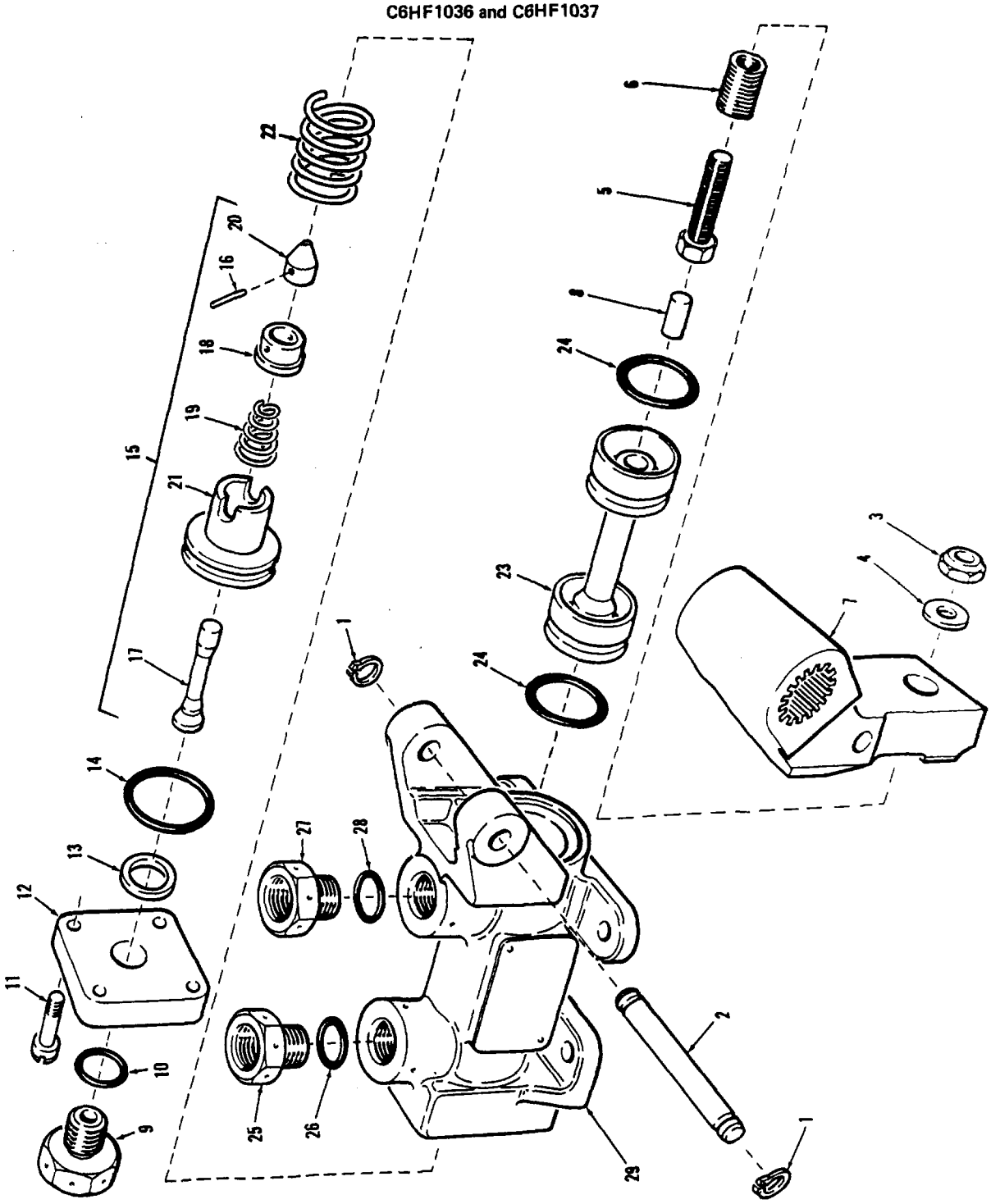
(c) Inspection.

11. Special Tools

Hydraulic test rig capable of supplying and maintaining pressure of 2250 psi.

High pressure gage 0 to 1500 psi.

Tool capable of progressively deflecting the splined lever.



Exploded View - Power Brake Valve

Figure 3

12. Illustrated Parts List

A. Vendor Parts

VENDOR'S CODE	NAME AND ADDRESS
77068	Bendix Pacific Division of Bendix Corp. North Hollywood, Calif. U.S.A.

B. List of Parts

FIGURE AND INDEX NO.	PART NUMBER	NOMENCLATURE	USAGE ON CODE	UNITS PER ASSEMBLY
		1234567		
3-	C6HF1036-1	Brake Valve Assembly, RH	A	-
	C6HF1037-1	Brake Valve Assembly, LH	B	-
1	NAS51-31	.Retainer Ring		2
2	401024	.Pin (77068)	A & B	1
3	AN365-524	.Nut		1
4	AN960-516	.Washer		1
5	1002807	.Adjusting Screw (77068)	A & B	1
6	MS21208-F5-15	.Screw Locking Insert		1
7	C6HFM1038-27	.Splined Lever	A	1
7	C6HFM1039-27	.Splined Lever	B	1
8	401352	.Rod (77068)	A & B	1
9	AN893-3D	.Bushing		1
10	MS28778-8	.Gasket		1
11	AN503-416-12	.Screw		4
12	411361	.End (77068)	A & B	1
13	1010564	.Spacer (77068)	A & B	1
14	AN6227-20	.Packing		1
15	1013380-1	.Stake Assembly (77068)	A & B	1
16	1013379	..Pin		1
17	1002941	..Poppet		1
18	1013378	..Retainer		1
19	401372	..Spring		1
20	1005264	..Valve		1
21	1009037	..Seat		1
22	1009036	.Spring (77068)	A & B	1
23	551554	.Piston (77068)	A & B	1
24	AN6227-16	.Packing		2
25	AN893-3D	.Bushing		1
26	MS28778-8	.Gasket		1
27	AN893-3D	.Bushing		1
28	MS28778-8	.Gasket		1
29	1005245	.Valve Body (77068)	A & B	1

MAIN LANDING GEAR

LEG ASSEMBLY

PART NO. C6U1103

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Record of Revisions					
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8	MAY 18, 2018	MAY 25, 2018	ATP/RLL

Revision No.	Revision Date	Insertion Date	By

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INTRODUCTION

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NOSE GEAR LEG ASSEMBLY

HEROUX PART NO. 71-100

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Rev. No.	Rev. Date	Insertion Date	By

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INTRODUCTION

This manual contains instructions for the overhaul of the Heroux Nose Gear Leg Assembly Part No. 71-100.

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NOSE GEAR LEG ASSEMBLY - HEROUX PART NOS. 71-100-1, -3, -5, -7, -9, -9B, -11, -11B, -15, -17, -19, -21, -23, -25, -27, -29, -31, -33 AND -35

DESCRIPTION AND OPERATION

1. General (Figure 1)

The nose gear leg assembly consists of a shock strut assembly, and a steering actuator and links sub-assembly.

The shock strut assembly is an oleo pneumatic type, and consists of an outer cylinder, piston assembly, steering collar, nose wheel fork, axle, and upper and lower torque arms. The oil and air is contained within the outer cylinder and the inner cylinder of the piston assembly. The piston assembly telescopes into the outer cylinder, which forms the main structure of the shock strut assembly and provides the mounting for the steering actuator. The links sub-assembly connects the steering actuator with the steering collar which transmits steering selection through the upper and lower torque arms to the nose wheel fork and axle. The nose wheel fork is secured to the lower end of the piston assembly. When subjected to loads, the compression and extension of the shock strut is dampened by restricting the flow of oil and air between the outer cylinder and the inner cylinder of the piston assembly. The oil and air charging valve is located at the top of the shock strut assembly.

The steering actuator and links sub-assembly is descibed in 32-50-11, NOSE WHEEL STEERING ACTUATOR AND LINKS SUB-ASSEMBLY.

2. Data

A. General

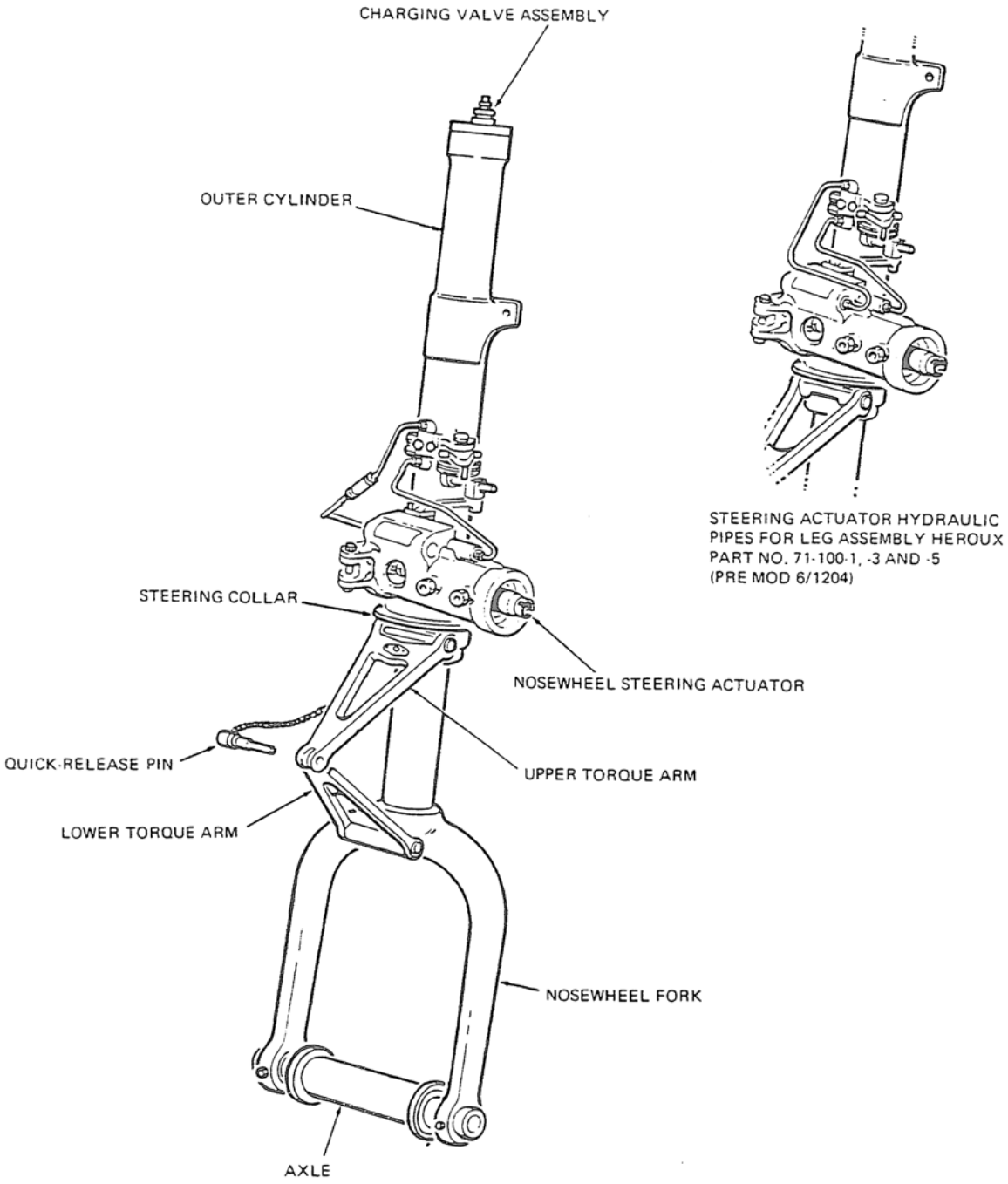
Oil Type - Hydraulic Fluid MIL-H-5606
Air Pressure - 91± 4 psi with shock strut fully extended.

Table 1
Nose Gear Leg Assembly Configuration

NOSE GEAR LEG ASSY PART NO.	SHOCK STRUT ASSY PART NO.	STEERING ACTUATOR & LINKS SUB-ASSY PART NO.	STEERING ACTUATOR ASSY PART NO.
71-100-1	71-300-1	71-190-1	71-200-1
71-100-3	71-300-3	71-190-3	71-200-3
71-100-5	71-300-5	71-190-3	71-200-3
71-100-7	71-300-7	71-190-7	71-200-7
71-100-9	71-300-7	71-190-9	71-200-9
71-100-9B	71-300-7	71-190-11B	71-200-11B
71-100-11	71-300-9	71-190-11B	71-200-11B
71-100-11B	71-300-11	71-190-11B	71-200-11B

Table 1 (Cont'd)
Nose Gear Leg Assembly Configuration

NOSE GEAR LEG ASSY PART NO.	SHOCK STRUT ASSY PART NO.	STEERING ACTUATOR & LINKS SUB-ASSY PART NO.	STEERING ACTUATOR ASSY PART NO.
71-100-15	71-300-15	71-190-11B	71-200-11B
71-100-17	71-300-17	71-190-11B	71-200-11B
71-100-19	71-300-19	71-190-11B	71-200-11B
71-100-21	71-300-21	71-190-11B	71-200-11B
71-100-23	71-300-23	71-190-11B	71-200-11B
71-100-25	71-300-25	71-190-11B	71-200-11B
71-100-27	71-300-25	71-190-13	71-200-13
71-100-29	71-300-27	71-190-13	71-200-13
71-100-31	71-300-29	71-190-13	71-200-13
71-100-33	71-300-31	71-190-15	71-200-15
71-100-35	71-300-33	71-190-15	71-200-15



Nose Gear Leg Assembly

Figure 1

B. Configuration

Refer to Table 1 for buildup of main components comprising the nose gear leg assembly.

C. Shimmy Damper Installation

Certain shock strut assemblies have a special shimmy damper installation at the steering collar. Tables 2 through 5A list the additional parts required, together with any superseded parts, for this installation, which will be embodied under the following circumstances:

(a) When wheel skis are installed (Mod S.O.O. 6001).

(b) When intermediate flotation gear (15.00 x 12.00 tires) is installed (Mod S.O.O. 6048).

(c) As a special order option (Mod S.O.O. 6149)

NOTE: Mod S.O.O. 6149 is up-dated by Mod 6/1321 to improve shimmy damping.
:

Table 2

Shimmy Damper Installation on Shock Strut Assemblies 71-300-1 and -3 (Pre Mod 6/1321)

PART NO. REQUIRED	NAME	PART NO. SUPERSEDED	REMARKS
C6US1032-29	Friction Disc	-	
71-054-1 (modified) to drawing C6Z1191)	Journal Bearing	71-054-1	
C6Z1191-11	Nut Assembly	71-160-1 71-018-1	71-018-1 (modified) is used in buildup of nut assembly.
71-060-5	Locking Key	71-165-1	
71-058-5	Locking Clip	MS35277-61	
MS35206-230	Screw	-	
MS21042-06	Nut	-	
AN960PD6	Washer	-	

Table 3

Shimmy Damper Installation on Shock Strut Assemblies 71-300-1 and -3 (Mod 6/1321)

PART NO. REQUIRED	NAME	PART NO. SUPERSEDED	REMARKS
C6US1032-29	Friction Disc	-	
71-054-1 (modified to drawing C6Z1191)	Journal Bearing	71-054-1	
C6US1044-27	Washer, shim	-	

Table 3 (Cont'd)

Shimmy Damper Installation on Shock Strut Assemblies 71-300-1 and -3 (Mod 6/1321)

PART NO. REQUIRED	NAME	PART NO. SUPERSEDED	REMARKS
C6US1045-27	Ring	-	
71-018-3 or -5 or -1 (modified)	Thrust Washer	71-018-1	

Table 4

Shimmy Damper Installation on Shock Strut Assemblies 71-300-5, -7, -9 and -11 (Pre Mod 6/1321)

PART NO. REQUIRED	NAME	PART NO. SUPERSEDED	REMARKS
C6US1032-29	Friction Disc	71-061-5 (2 off)	
C6US1000-11	Nut Assembly	71-160 and 71-018-5	(Superseded parts are included in buildup of nut assembly.

Table 5

Shimmy Damper Installation on Shock Strut Assemblies 71-300-5, -7, -9 and -11 (Mod 6/1321)

PART NO. REQUIRED	NAME	PART NO. SUPERSEDED	REMARKS
C6US1032-29	Friction Disc	71-061-5 (2 off)	
C6US1044-27	Washer, Shim	-	
C6US1045-27	Ring	-	

Table 5A

Shimmy Damper Installation on Shock Strut Assemblies 71-300-11 and -15

(Equivalent to Mod 6/1554)

PART NO. REQUIRED	NAME	PART NO. SUPERSEDED	REMARKS
71-323-1	Friction Disc	C6US1032-29	
71-325-1	Washer, Wear	C6US1044-27	
71-326-1	Thrust Washer	C6US1045-27	
71-327-1	Washer		
71-331-1	Bearing	71-59-5	

Modification 6/1554 introduces the shimmy damper installation as basic and it equivalent to S.O.O. 6149 and Mod 6/1321.

D. Interchangeability

It is permitted to interchange the main components comprising the nose gear leg assembly (refer to Table 1 for production standard configuration). For example, the steering actuator and links sub-assembly Part No. 71-190-9 can be fitted to shock strut assembly Part No. 71-300-1, 71-300-3 and 71-300-5. When interchanged, note that the overhaul instructions and any spare parts required are as detailed for the appropriate main component.

E. To Upgrade Shock Strut Assembly During Overhaul

For operators wishing to upgrade shock strut assemblies, Part No. 71-300-3, 71-300-5, 71-300-7 or 71-300-9 to the standard of Part No. 71-300-11 during overhaul. Tables 6, 7, 8 and 8A are provided to list new parts required and parts superseded. Tables 8B, 8C, 8D, 8E and 8F are provided to upgrade shock strut assemblies, Part No. 71-300-11, 71-300-15, 71-300-17, 71-300-19, 71-300-21 or 71-300-23 to the latest standard of Part No. 71-300-25.

If upgrading, use assembly procedures provided for shock strut assemblies Part No. 71-300-11 or Part No. 71-300-15 through 71-300-25, as applicable. It is not recommended that operators upgrade shock strut assembly Part No. 71-300-1 to a later standard.

Table 6

Upgrade Shock Strut Assembly, Part No. 71-300-7 to 71-300-11

PARTS REQUIRED		PARTS SUPERSEDED		REASON FOR CHANGE AND GENERAL INFORMATION
PART NO.	NAME	PART NO.	NAME	
Kit K71-509 (See Table 9) AN960PD416 MS17825-4 MS24665-138	Piston - Fork Joint Kit Washer Nut Cotter Pin	71-090-7 71-156-1 71-155-1 AN935-10	Dowel Pin Locknut Set-Screw Washer	) Improved locking of cylinder) to fork.
71-136-9 71-157-9 71-305-9 NAS156-1	Fork Bushing Bushing (2 off) Lubricator	71-136-7 71-157-7 06DU12 MS16556-801 DU06	Fork Bushing Bushing (2 off) Pin (2 off) Thrust Washer (2off)	) Improved fork assembly with) lubricator and revised bushing.) This represents Kit K71-511) less bushings 71-189-5.))
71-115-9 71-096-9	Support Tube Shoulder (Shrink fit in support tube)	71-115-1	Support Tube	) Design improvements.)))
7331FTE-987-T 7336MTE-987-T MS28776M2-27	Ring GT Ring GT Scraper	8-331-N-300-9 MS28775-331 8-336-N300-9 MS28775-336 527000A 71-144-1	Back-up Rings O-rings Back-up Rings O-ring Scraper Flapper	) Improved scraper and new) piston assembly introduced) 71-140-11 in lieu of 71-140-7)) (equivalent to DH Mod 6/1474).) New piston assembly deletes) flapper and introduces) floating piston rings. An) improved bumper (also) introduced by DH Mod 6/1378).

Table 6 (Cont'd)

Upgrade Shock Strut Assembly, Part No. 71-300-7 to 71-300-11

PARTS REQUIRED		PARTS SUPERSEDED		REASON FOR CHANGE AND GENERAL INFORMATION
PART NO.	NAME	PART NO.	NAME	
71-141-9 71-129-9	Piston Bumper	71-141-7 71-129-3	Piston Bumper	) Piston 71-141-7 and) 71-141-9 are completely) interchangeable.
71-163-9 71-107-9 NAS516-1	Torque Arm, Lower Bushing Lubricator	71-163-3 06DU08 71-167-1 MS35198-3	Torque Arm, Lower Bushing Thrust Washer Screw, Machine (4 off)	) New lower torque arm) assembly introduced) (71-171-9 in lieu of 71-171-3)) with lubricator and revised) bushing (includes Part of DH) Mod 6/1377).
Kit K71-504 (See Table 9)	Steering Collar Kit	71-177-7	Steering Collar Assembly	) Improved steering collar) assembly.

NOTE: On incorporation of the above parts, reidentify shock strut assembly accordingly.

Table 7

Upgrade Shock Strut Assembly, Part No. 71-300-5 to 71-300-11

PARTS REQUIRED		PARTS SUPERSEDED		REASON FOR CHANGE AND GENERAL INFORMATION
PART NO.	NAME	PART NO.	NAME	
71-081-7 MS28774-137	Cartridge Assembly Back-up Ring	71-120-1	Cartridge Assembly	) Design improvements.))
Kit K71-509 (See Table 9) AN960PD416 MS17825-4 MS24665-138	Piston - Fork Joint Kit Washer Nut Cotter Pin	AN122718 71-156-1 71-155-1 AN935-10	Dowel Pin Locknut Set-screw Washer	) Improved locking of) cylinder to fork.)))
71-136-9 71-157-9 71-305-9 NAS516-1	Fork Bushing Bushing (2 off) Lubricator	71-136-3 71-157-1 06DU12 MS16556-801 DU06	Fork Bushing Bushing (2 off) Pin (2 off) Thrust Washer (2 off)	) Improved fork assembly) with lubricator and revised) bushing.)))
71-1159-9 71-096-9	Support Tube Shoulder (shrink fit in support tube)	71-115-1	Support Tube	) Design improvements.)))

Table 7 (Cont'd)

Upgrade Shock Strut Assembly, Part No. 71-300-5 to 71-300-11

PARTS REQUIRED		PARTS SUPERSEDED		REASON FOR CHANGE AND GENERAL INFORMATION
PART NO.	NAME	PART NO.	NAME	
7331FTE-987-T	Ring GT	8-331-N300-9 MS28775-331	Back-up Rings O-ring	) Improved scraper and new) piston assembly introduced
7336MTE-987-T	Ring GT	8-336-N300-9 MS28775-336	Back-up Rings O-ring	) (71-140-11 in lieu of) 71-140-3)
MS28776MS-27	Scraper	527000A	Scraper	) (equivalent to DH Mod
		71-1441-1	Flapper	) 6/1474)) New piston assembly) deletes flapper and) introduces new floating) piston rings. An improved) bumper (also introduced by) (also introduced by) DH Mod 6/1378).
71-141-9 71-129-9	Piston Bumper	71-141-7 71-129-3	Piston Bumper	) Pistons 71-141-7 and) 71-141-9 are completely) interchangeable.
71-163-9	Torque Arm, Lower	71-163-3	Torque Arm, Lower	) New lower torque arm) assembly introduced
71-107-9 NAS516-1	Bushing Lubricator	06DU08 71-167-1	Bushing Thrust Washer (2 off)	) (71-171-9 in lieu of) 71-171-3) with lubricator) and revised bushing).
		MS35198-3	Screw, Machine (4 off)	))
Kit K71-504 (See Table 9)	Steering Collar Kit	71-177-5	Steering Collar Assembly	) Improved steering collar) assembly.

NOTE: On incorporation of the above parts, reidentify shock strut assembly accordingly.

Table 8

Upgrade Shock Strut Assembly, Part No. 71-300-3 to 71-300-11

PARTS REQUIRED		PARTS SUPERSEDED		REASON FOR CHANGE AND GENERAL INFORMATION
PART NO.	NAME	PART NO.	NAME	
71-081-7	Cartridge Assembly	71-120-1	Cartridge Assembly	) Design improvements.)
MS28774-137	Back-up Ring			)
Kit K71-509 (See Table 9)	Piston - Fork Joint Kit	AN122718	Dowel Pin	) Improved locking of) cylinder to fork.
		71-156-1	Locknut	)
AN960PD416	Washer	71-155-1	Set-screw	)
MS17825-4	Nut	AN935-10	Washer	)
MS24665-138	Cotter Pin			)

Table 8 (Cont'd)

Upgrade Shock Strut Assembly, Part No. 71-300-3 to 71-300-11

PARTS REQUIRED		PARTS SUPERSEDED		REASON FOR CHANGE AND GENERAL INFORMATION
PART NO.	NAME	PART NO.	NAME	
71-108-9	Fork Assembly	71-136-3 71-157-1 71-189-3 06DU12 MS16556-801 DU06	Fork Bushing Bushing, Axle Bushing Pin (2 off) Thrust Washer (2 off)	) Improved fork assembly) with lubricator and revised) bushing.))))
71-115-9 71-096-9	Support Tube Shoulder (shrink fit in support tube)	71-115-1	Support Tube	) Design improvements)))
7331FTE-987-T 7336MTE-987-T MS28776M2-27 71-141-9 71-129-9	Ring GT Ring GT Scraper Piston Bumper	8-331-N300-9 MS28775-331 8-336-N300-9 MS28775-336 527000A 71-1441-1 71-141-7 71-129-3	Back-up Rings O-ring Back-up Rings O-ring Scraper Flapper Piston Bumper	) Improved scraper and new) piston assembly introduced) (7-140-11 in lieu of) 71-140-3)) (equivalent to DH Mod) 6/1474).) New piston assembly) deletes flapper and introduces) new floating piston rings.) An improved bumper (also) introduced by DH Mod 6/1378).) Pistons 71-141-7 and) 71-141-9 are completely) interchangeable.
71-163-9 71-107-9 NAS516-1	Torque Arm, Lower Bushing Lubricator	71-163-3 06DU08 71-167-1 MS35198-3	Torque Arm, Lower Bushing Thrust Washer (2 off) Screw, Machine (4 off)	) New lower torque arm) assembly introduced) (71-171-9 in lieu of) 71-171-3) with lubricator) and revised bushings.))
71-059-5	Bearing			) To accommodate shimmy) damper installation.
Kit K71-503 (See Table 9) AN960-PD6 MS35206-230 MS21042-06	Cylinder Nut Kit Washer Screw, Machine Nut	71-160-1 71-018-1 71-165-1 MS35277-61	Cylinder Nut Thrust Washer Locking Key Screw, Machine	) Improved cylinder nut) locking.)))))

Table 8 (Cont'd)

Upgrade Shock Strut Assembly, Part No. 71-300-3 to 71-300-11

PARTS REQUIRED		PARTS SUPERSEDED		REASON FOR CHANGE AND GENERAL INFORMATION
PART NO.	NAME	PART NO.	NAME	
Kit K71-504 (See Table 9)	Steering Collar Kit	71-054-1 71-177-3	Bearing Steering Collar Assembly	) Improved steering collar) assembly.)
71-055-5	Journal Bearing	71-055-1	Bearing	) Improved wear) characteristics.

NOTE: On incorporation of the above parts, reidentify shock strut assembly accordingly.

Table 8A

Upgrade Shock Strut Assembly, Part No. 71-300-9 to 71-300-11

PARTS REQUIRED		PARTS SUPERSEDED		REASON FOR CHANGE AND GENERAL INFORMATION
PART NO.	NAME	PART NO.	NAME	
71-009-3	Floating Piston	71-099-9 71-098-9 71-097-9	Floating Piston Outer Bearing Inner Bearing	) New piston assembly) introduced (71-140-11 in) lieu of 71-140-9) with new
7331FTE-987-T	Ring GT	7331FT160A-T	Ring GT	) floating piston and GT) rings; flapper deleted.
7336MTE-987-T	Ring GT	7336MT160A-T	Ring GT	) Improved scraper introduced.) (This change is equivalent
MS28776M2-27	Scraper	527000A 71-144-1	Scraper Flapper	) to DH Mod 6/1474 and is) made to improve sealing) characteristics.)

NOTE: On incorporation of the above parts, reidentify shock strut assembly accordingly.

Table 8B

Upgrade Shock Strut Assembly, Part No. 71-300-11 to 71-300-25

PARTS REQUIRED		PARTS SUPERSEDED		REASON FOR CHANGE AND GENERAL INFORMATION
PART NO.	NAME	PART NO.	NAME	
71-111-15 71-317-1	Cylinder Sleeve	71-111-3 or 71-111-11	Outer Cylinder	) To prevent wear and reduce) fluid leakage.) NOTE) Thick sidewall cylinder) 71-111-11 only may be) bored to take sleeve) 71-317-1.)) Equivalent to DH Mod) 6/1537.

Table 8B (Cont'd)

Upgrade Shock Strut Assembly, Part No. 71-300-11 to -25

PARTS REQUIRED		PARTS SUPERSEDED		REASON FOR CHANGE AND GENERAL INFORMATION
PART NO.	NAME	PART NO.	NAME	
71-335-1 71-336-1 527000A	Journal Bearing Locknut Scraper	71-055-5 71-153-1 MS28776M2-27	Journal Bearing Sub-assembly Locknut Scraper	) To improve sealing at) lower support bearing and) increase service life.) Support bearing with greater) bearing area and improved) scraper rings introduced.) Equivalent to DH Mod 6/1566.
71-332-1 7336MTE987-4780 7331FTE987-4780 71-322-1 71-101-11	Piston Ring GT Ring GT Piston Nut Name and Instruction Plate	71-009-3 7336MTE-987-T 7331FTE-987-T 71-145-1 71-143-1 71-101-7 or 71-101-9	Piston Ring GT Ring Gt Nut, Shoulder Spacer, Flapper Name and Instruction Plate	) To reduce piston and cylinder) wear and increase service) life. Larger area floating) piston and improved sealing) rings. Charging instructions) updated.)Equivalent to DH Mod 6/1567.)))))
71-339-1 71-338-1 71-156-11 71-340-1 71-341-1 71-093-9 NAS679A4	Torque Link Assembly, Lower Torque Link, Lower Locknut Lockbolt Washer (Profile) Bushing Nut, Self-Locking	71-171-9 71-163-9 71-156-9 71-092-9 71-094-9 MS17825-4 MS24665-138	Torque Link Assembly, Lower Torque Link, Lower Locknut Lockbolt Bushing Nut Cotter Pin	) Improved lower torque link.) To aid in reduction of) shimmy. Equivalent to DH) Mod 6/1580.))) To facilitate locking of) shock strut for locknut.) Equivalent to DH Mod) 6/1618.))))
71-161-11 NAS561PF4-16 AN960C816L	Collar, Steering Pin, Spring Coiled Washer	71-161-9 MS9048-114	Collar, Steering Pin, Spring	) Improved steering collar.) To extend service life of) steering mechanism.) Equivalent to DH Mod) 6/1622.

NOTE: 1. Shimmy damper installation per Table 5A.

2. On incorporation of the above parts reidentify shock strut assembly accordingly.

Table 8C

Upgrade Shock Strut Assemblies Part No. 71-300-15 and -17 to -25

PARTS REQUIRED		PARTS SUPERSEDED		REASON FOR CHANGE AND GENERAL INFORMATION
PART NO.	NAME	PART NO.	NAME	
71-335-1	Journal Bearing	71-055-5	Journal Bearing Assembly	) To improve sealing at lower) support bearing and) increase service life.
71-336-1 527000A	Locknut Scraper	71-153-1 MS28786M2-27	Locknut Scraper	) Support bearing with greater) bearing area and improved) scraper ring introduced.) Equivalent to DH Mod 6/1566.
71-332-1 7336MTE987-4780 7331FTE987-4780	Piston Ring GT Ring GT	71-009-3 7336MTE-987T 7331FTE-987T	Piston Ring GT Ring GT	) To reduce piston and) cylinder wear, thus increasing) service life. Larger area) floating piston and improved) sealing rings. Charging
71-322-1	Piston Nut	71-145-1 71-143-1	Nut, Shoulder Spacer, Flapper	) instructions updated.) Equivalent to DH Mod 6/1567.)
71-101-11	Name and Instruction Plate	71-101-9	Name and Instruction Plate	)))
71-339-1	Torque Link Assembly, Lower	71-171-9	Torque Link Assembly, Lower	) Improved lower torque link.) To aid in reduction of) shimmy. Equivalent to DH
71-338-1	Torque Link Lower	71-163-9	Torque Link Lower	) Mod 6/1580.))
71-156-11 71-340-1 71-341-1 71-093-9 NAS679A4	Locknut Lockbolt Washer (Profile) Bushing Nut, Self-locking	71-156-9 71-092-9 71-094-9 MS17825-4 MS24665-138	Locknut Lockbolt Bushing Nut Cotter Pin	)To facilitate locking of) shock strut fork locknut.) Equivalent to DH Mod) 6/1618.)))
71-161-11 NAS561PF4-16 AN960C816L	Collar, Steering Pin, Spring Coiled Washer	71-161-9	Collar, Steering	) Improved steering collar.) To extend service life of) steering mechanism.) Equivalent to DH Mod) 6/1622.

NOTE: 1. Shimmy damper installation per Table 5A. on 71-300-15 only.

2. On incorporation of the above parts, reidentify shock strut assembly accordingly.

Table 8D

Upgrade Shock Strut Assembly, Part No. 71-300-19 to -27

PARTS REQUIRED		PARTS SUPERSEDED		REASON FOR CHANGE AND GENERAL INFORMATION
PART NO.	NAME	PART NO.	NAME	
71-101-11	Name and Instruction Plate	71-101-9	Name and Instruction Plate	) Charging instructions) up-dated Part of DH) Mod 6/1567.
71-335-1 71-336-1 527000A	Journal Bearing Locknut Scraper	71-055-5 71-153-1 MS28776M2-27	Journal Bearing Assembly Locknut Scraper	) To improve sealing at lower) support beam and increase) service life. Support bearing) with greater bearing area) and improved scraper ring.) Equivalent to DH Mod 6/1566.
71-339-1 71-338-1	Torque Link Assembly, Lower Torque Link Lower	71-171-9 71-163-9	Torque Link Assembly, Lower Torque Link, Lower	) Improved lower torque link.) To aid in reduction of shimmy) Equivalent to DH Mod 6/1580.))
71-156-11 71-340-1 71-341-1 71-093-9 NAS679A4 AN960D416	Locknut Lockbolt Washer (Profile) Bushing Nut, Self-locking Washer	71-156-9 71-092-9 71-094-9 MS17825-4 MS24665-138	Locknut Lockbolt Washer Bushing Nut Cotter Pin	) To facilitate locking of) shock strut fork locknut.) Equivalent to DH Mod 6/1618.))))))
71-161-11 NAS561PF4-16 AN960C816L	Collar Steering Pin, Spring Coiled Washer	71-161-9 MS9048-114	Collar Steering Pin, Spring	) Improved steering collar.) To extend service life of) steering mechanism.) Equivalent to DH Mod 6/1622.)
71-322-3 MS35275-241 MS24665-24	Nut, Shoulder Screw, Locking Pin, Cotter	71-322-1 71-149-1	Nut, Shoulder Ring, Lock	) Improved shoulder nut) retension. Equivalent to) DH Mod 6/1763.

NOTE: On incorporation of the above parts, reidentify shock strut assembly accordingly.

Table 8E

Upgrade Shock Strut Assembly, Part No

PARTS REQUIRED		PARTS SUPERSEDED		REASON FOR CHANGE AND GENERAL INFORMATION
PART NO.	NAME	PART NO.	NAME	
71-101-11	Name and Instruction Plate	71-101-9	Name and Instruction Plate	) Charging instructions) updated. Part of DH) Mod 6/1567.
71-339-1 71-338-1	Torque Link Assembly, Lower Torque Link Lower	71-171-9 71-163-9	Torque Link Assembly, Lower Torque Link, Lower	) Improved lower torque link.) To aid in reducion of shimmy.) Equivalent to DH Mod 6/1580.))
71-156-11 71-340-1 71-341-1 71-093-9 NAS679A4 AN960D416	Locknut Lockbolt Washer (Profile) Bushing Nut, Self-locking Washer	71-156-9 71-092-9 71-094-9 MS17825-4 MS24665-138	Locknut Lockbolt Bushing Nut Cotter Pin	) To facilitate locking of shock) strut fork locknut. Equivalent) to DH Mod 6/1618.))))))
71-161-11 NAS561PF4-16 AN960C816L	Collar, Steering Pin, Spring Coiled Washer	71-16109 MS9048-114	Collar, Steering Pin, Spring	) Improved steering collar.) To extend service life of) steering mechanism.) Equivalent to DH Mod) 6/1622.
71-322-3 MS35275-241 MS24665-24	Nut, Shoulder Screw, Locking Pin, Cotter	71-322-1 71-149-1	Nut, Shoulder Ring, Lock	) Improved shoulder nut) retension. Equivalent to DH) Mod 6/1763.

NOTE: On incorporation of the above parts, reidentify shock strut assembly accordingly.

Table 8F

Upgrade Shock Strut Assembly, Part No. 71-300-23 to -27

PARTS REQUIRED		PARTS SUPERSEDED		REASON FOR CHANGE AND GENERAL INFORMATION
PART NO.	NAME	PART NO.	NAME	
71-101-11	Name and Instruction Plate	71-101-9	Name and Instruction Plate	)Charging instructions) updated. Part of DH) Mod 6/1567.
71-156-11 71-340-1 71-341-1 71-093-9 NAS679A4 AN960D416	Locknut Lockbolt Washer Bushing Nut, Self-locking Washer	71-156-9 71-092-9 71-094-9 MS17825-4 MS24665-138	Locknut Lockbolt Bushing Nut Cotter Pin	) To facilitate locking of shock) strut fork locknut.) Equivalent to DH Mod 6/1618.)))))
71-161-11 NAS561PF4-16 AN960C816L	Collar, Steering Pin, Spring Coiled Washer	71-16109 MS9048-114	Collar, Steering Pin, Spring	) Improved steering collar.) To extend service life of) steering mechanism.) Equivalent to DH Mod 6/1622.)
71-322-3 MS35275-241 MS24665-24	Nut, Shoulder Screw, Locking Pin, Cotter	71-322-1 71-149-1	Nut, Shoulder Ring, Lock	) Improved shoulder nut) retension. Equivalent to DH) Mod 6/1763.

NOTE: On incorporation of above parts, reidentify shock strut assembly accordingly.

Table 8G

Upgrade Shock Strut Assembly, Part No. 71-300-27 to -29

PARTS REQUIRED		PARTS SUPERSEDED		REASON FOR CHANGE AND GENERAL INFORMATION
PART NO.	NAME	PART NO.	NAME	
71-335-5	Lower Bearing	71-335-1	Lower Bearing	) Improves the Nose Landing) Gear lower bearing service life.

NOTE: On incorporation of above part, reidentify shock strut assembly accordingly.

F. Heroux Modification Kits

Table 9 provides details of Heroux Modification Kits for use with Tables 6, 7 or 8 when upgrading shock strut assemblies, or with the Illustrated Parts List.

Table 9

Heroux Modification Kits

KIT NO.	DESCRIPTION	KIT COMPONENT PARTS	
		PART NAME	PART NO.
K71-501	Ski axle and fork kit	Fork assembly Spacer Retaining nut Set-screw (2) Ski axle kit	71-108-9 71-132-3 71-137-3 71-204-3 K71-502
K71-502	Ski axle kit	Axle Towing spool (2)	71-135-3 71-139-3
K71-503	Cylinder nut kit	Thrust washer Block (2) Locking clip Locking key Cylinder nut	71-018-5 71-057-5 71-058-5 71-060-5 71-160-5
K71-509	Piston - fork joint kit (includes requirements of DH Mod 6/1379)	Lockbolt Bushing Bushing Shim Locknut Diaphragm Washer	71-092-9 71-093-9 71-094-9 71-095-9 71-156-9 71-199-9 71-309-9
K71-511	Fork assembly kit (includes requirements of DH Mod 6/1379) and part of DH Mod 6/1377)	Fork assembly Pin	71-108-9 71-090-7
K71-513	Collar bushing kit	Bushing Washer (2)	71-054-5 71-061-5

G. To upgrade steering actuator and links sub-assembly during overhaul, refer to 32-50-11, NOSE WHEEL STEERING ACTUATOR AND LINKS SUB-ASSEMBLY.

DISASSEMBLY

1. Procedures

A. Separate Shock Strut Assembly and Steering Actuator and Links Sub-Assembly (Figure 101)

(1) Disconnect hydraulic return pipe at top swivel fitting (16), and hydraulic pressure pipe at bottom swivel fitting (15) on leg assembly.

(2) Remove cotter pin (11) and nut (12) securing actuator lever assembly (8) to stud (10) on steering collar (9).

(3) Support steering actuator (6), and remove cotter pin (3), nut (14) and washer (13) from bolt (5) attaching actuator to shock strut assembly. Turn leg to obtain clearance from steering collar and upper torque arm (7), and withdraw bolt (5). Turn leg assembly fully to right, disengage pivot (2) and slider (1) from steering lever (4), and lift actuator clear of stud on steering collar. (For further breakdown of steering actuator and link sub-assembly, refer to 32-50-11 NOSE WHEEL STEERING ACTUATOR AND LINKS SUB-ASSEMBLY).

(4) Temporarily install nut (12) to stud (10), and bolt (5), washer (13) and nut (14) to lugs on leg assembly. When DH Mod 6/1622 is embodied, ensure that washer (17) is located on stud (10) adjacent to steering collar (9).

B. Disassemble Nose Gear Shock Strut, Part No. 71-300-1 and 71-300-3 (Figure 1101)

WARNING: DO NOT ATTEMPT TO DISASSEMBLE SHOCK STRUT OR REMOVE AIR CHARGING VALVE BEFORE RELEASING ALL AIR PRESSURE THROUGH AIR CHARGING VALVE. FAILURE TO DO SO COULD RESULT IN SERIOUS INJURY OR POSSIBLE LOSS OF LIFE.

(1) Remove air charging valve cap (2). Unscrew nut of air charging valve (1) counterclockwise (approximately one turn) to slowly release air pressure.

WARNING: DO NOT ATTEMPT TO FURTHER LOOSEN OR BACK OFF 3/4 INCH HEXAGON STEM ASSEMBLY BEFORE ENSURING THAT ALL AIR PRESSURE IS RELEASED FROM THE SHOCK STRUT ASSEMBLY.

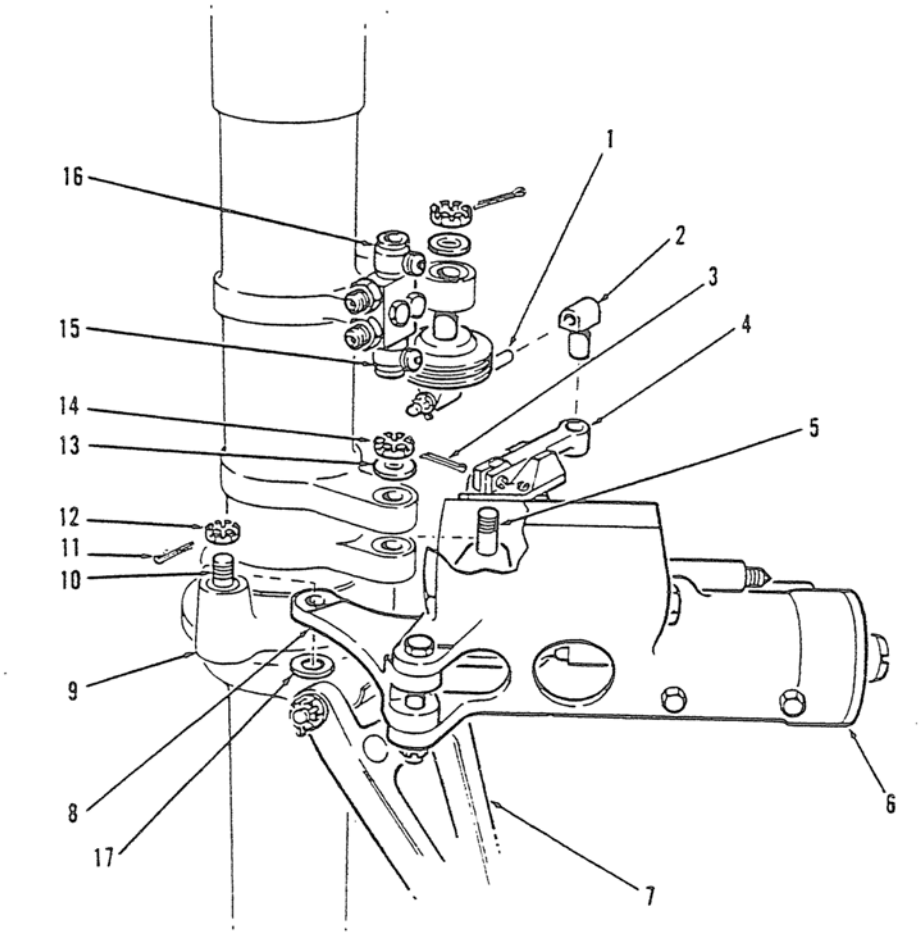
(2) Remove air charging valve (1).

(3) Remove set-screw (3) securing end cap sub-assembly to outer cylinder. Unscrew and remove end cap sub-assembly from outer cylinder. Turn shock strut upside down and drain off hydraulic fluid.

NOTE: Strain fluid through a suitable fine mesh strainer. Pay particular attention to any foreign matter removed from the fluid (refer to INSPECTION/CHECK) and reject fluid for further use in nose gear shock strut.

(4) Remove O-ring (4) from end cap sub-assembly.

(5) Cut lockwire and remove machine screw (6) securing nut (7) of end cap sub-assembly. Unscrew nut (7) using special tool T-188, and remove end cap (8) from support tube (9). Remove O-ring (10) from upper end of support tube.



1. SLIDER
2. PIVOT
3. COTTER PIN
4. STEERING LEVER
5. BOLT
6. STEERING ACTUATOR
7. UPPER TORQUE ARM
8. ACTUATOR LEVER ASSEMBLY
9. STEERING COLLAR
10. STUD
11. COTTER PIN
12. NUT
13. WASHER
14. NUT
15. BOTTOM SWIVEL FITTING
16. TOP SWIVEL FITTING
17. WASHER (MOD 6/1622)

Steering Actuator Mounting on Nose Gear Shock Strut

Figure 101

(6) At lower end of support tube, remove pellet (11) covering set-screw (12), loosen set-screw and remove guide bearing (13), damping plate (14) and place orifice (15) from support tube.

NOTE: Do not remove slipper ring (17) unless it is defective. A split ring is fitted under slipper ring only where guide bearing has a corresponding groove.

(7) Disengage upper and lower torque arms by removing quick-release pin (18). Remove chain (19) securing quick-release pin to upper torque arm.

(8) Push piston assembly into outer cylinder, and remove lockring (21) from shoulder nut (22) at top of piston assembly. Remove shoulder nut using special tool T-190, and withdraw piston assembly with fork from outer cylinder, dislodging flapper (23), flapper spacer (24), floating piston (25) and rubber bumper (26) of piston assembly. Remove shoulder (27) from piston tube (28). Remove two back-up rings (29), O-ring (30), two back-up rings (31) and O-ring (32) from floating piston (25).

(9) Cut lockwire, and remove set-screw (33) and washer (34) from locknut (35) securing fork to piston tube. Unscrew locknut (35) using special tool T-187, remove cartridge assembly and withdraw piston tube from fork.

(10) Remove O-ring (36) from cartridge assembly. Cut lockwire, and remove plug (38) and packing (39) from cylinder (40) of cartridge assembly.

(11) Remove dowel (42) and withdraw bushing (43) from fork (41).

(12) Remove cotter pin (44), nut (45), washer (46) and bolt (47), and remove lower torque arm assembly from fork. Remove four screws (49), two thrust washers (50), two dust rings (51) and bushing (52) from lower torque arm (53). Remove two pins (54), two thrust washers (55), two dust rings (56) and two bushings (57) from fork.

(13) On shock strut assembly Part No. 71-300-1 only: remove two nuts (58) and two bolts (60) attaching axle and two towing spools to fork, and withdraw two towing spools (61); remove cotter pin securing retaining nut (63) to adjustment spacer (64) and withdraw axle (67) from spacer (66), adjustment spacer, retaining nut and fork; remove two flanged bushings (68) from lugs on fork.

(14) On shock strut assembly Part No. 71-300-3 only: remove two nuts (58), two washers (59), and two bolts (60) attaching axle and two towing spools to fork, and withdraw two towing spools (61); cut lockwire and loosen setting screws (62) securing retaining nut (63) to adjustment spacer (64), and remove lockring (65) from spacer (66); withdraw axle (67) from spacer, adjustment spacer, retaining nut and fork. Remove four bushes (68) from lugs on fork.

(15) Remove set-screw (69) securing locknut (70) to lower end of outer cylinder, and remove locknut using special tool T-191. Remove washer (71), scraper (72), bearing retainer (73) and bearing (74) from outer cylinder.

(16) Cut lockwire and remove two machine screws (75) and two lockring nuts (76) from cylinder nut (77) securing steering collar assembly to outer cylinder. Remove cylinder nut (77), thrust washer (78), steering collar assembly complete with upper torque arm assembly, and journal bearing (79) from outer cylinder.

NOTE: Refer to DESCRIPTION AND OPERATION, Tables 2 and 3 for variations due to special shimmy damper installation.

(17) Remove screws (99) and cover (100) from steering collar assembly. Remove cotter pin (80), nut (81) and washer (82) from bolt (83) attaching upper torque arm assembly to steering collar. Hold upper torque arm to its uppermost position, and using a screwdriver, carefully pry off cam (84) from bolt (83). Withdraw bolt and remove spring (85) and upper torque arm assembly.

(18) Remove nuts (87), washers (88), screws (89), spring retainer (90), spring (91) and latch pin (92) from upper torque arm (93).

NOTE: Do not remove two bushings (94) from upper torque arm unless they are defective and have to be replaced (refer to FITS AND CLEARANCES).

(19) Remove two pins (95), two thrust washers (96) and two dust rings (97) from steering collar assembly.

(20) Remove spring pin (101), and stud (102) with locknut (104) from steering collar (107).

NOTE: Do not remove bushing (105) or two bushings (106) from steering collar (107) unless they are defective and have to be replaced (refer to FITS AND CLEARANCES).

Cotter pin (103) securing locknut (104) to stud (102) is removed on separation of steering actuator and shock strut assemblies.

(21) Cut lockwire and remove two bolts (108) attaching swivel fitting assembly to outer cylinder. Remove two unions (110) and two packings (111) fro swivel fitting assembly. Remove spring pin (112), collar (113), swivel (114), two back-up rings (115) and two O-rings (116) from each end of swivel bolt (117).

(22) Remove cotter pin (118), nut (119), washer (120), washer (121) and withdraw pulley shaft (122) from outer cylinder. Remove cotter pin (123), nut (124) and washer (125) from slider (126), and remove slider with pivot (127) and bushing (128) from pulley shaft.

(23) Remove set-screw (129) securing cable guard assembly, loosen two nuts (131) from two screws (132), and remove both halves of cable guard (133) with guard pins (134) from outer cylinder.

(24) Remove two pins (135), two thrust washers (136) and bushing (137) from outer cylinder.

(25) Remove nut (139), washer (140), two washers (141) and bolt (142), and remove two pins (143), two bushings (144) and spacer (145) from outer cylinder (146).

NOTE: Cotter pin (138) securing nut (139) to bolt 9142) is removed on separation of steering actuator and shock strut assembly.

C. Disassemble Nose Gear Shock Strut Part No. 71-300-5 and -7 (Figure 1102)

<u>WARNING</u>: DO NOT ATTEMPT TO DISASSEMBLE SHOCK STRUT OR REMOVE AIR CHARGING VALVE BEFORE RELEASING ALL AIR PRESSURE THROUGH AIR CHARGING VALVE. FAILURE TO DO SO COULD RESULT IN SERIOUS INJURY OR POSSIBLE LOSS OF LIFE.

(1) Release air pressure, remove air charging valve, disassemble end cap sub-assembly and drain off hydraulic fluid as detailed in Paragraph 1.B., steps (1) through (6).

(2) Disengage upper and lower torque arms, disassemble piston assembly and remove cartridge assembly as detailed in Paragraph 1.B., steps (7) through (9).

(3) Disassemble cartridge assembly for shock strut assembly Part No. 71-300-5 only, as follows:

(a) Refer to Figure 1101, and remove O-ring (36) from cartridge assembly. Cut lockwire, and remove plug (38) and packing (39) from cylinder (40) of cartridge assembly.

(4) Disassemble cartridge assembly for shock strut assembly Part no. 71-300-7 only, as follows:

(a) Remove O-ring (36) and back-up ring (37) from cap plug (39) of cartridge assembly.

NOTE: Do not remove cap plug (39) from cylinder (41) of cartridge assembly unless it is defective and has to be replaced (refer to FITS AND CLEARANCES).

(5) Remove dowel (43) and withdraw bushing (44) from fork (42).

(6) Remove cotter pin (45), nut (46), washer (47) and bolt (48), and remove lower torque arm assembly from fork. Remove four screws (50), two thrust washers (51), two dust rings (52) and bushing (53) from lower torque arm (54). Remove two pins (55), two thrust washers (56), two dust rings (57) and two bushings (58) from fork.

(7) Remove two nuts (59), two washers (60), and two bolts (61) attaching axle and two towing spools to fork, and withdraw two towing spools (62); cut lockwire and loosen setting screws (63) securing retaining nut (64) to adjustment spacer (65), and remove lockring (66) from spacer (67); withdraw axle (68) from spacer, adjustment spacer, retaining nut and fork. Remove four bushes (69) from lugs on fork.

(8) Remove set-screw (70) securing locknut (71) to lower end of outer cylinder, and remove locknut using special tool T-191. Remove washer (72), scraper (73), bearing retainer (74) and bearing (75).

NOTE: Do not remove sleeve (76) of outer cylinder unless it is defective and has to be replaced (refer to FITS AND CLEARANCES).

(9) Remove nut (77), washer (78), screw (79), two blocks (80), locking clip (81) and locking key (82) at cylinder nut (83) securing steering collar assembly to outer cylinder. Remove cylinder nut (83), thrust washer (84), steering collar assembly complete with upper torque arm assembly, bushing (85) and two thrust washers (86) from outer cylinder.

NOTE: Refer to DESCRIPTION AND OPERATION, Tables 4 and 5 for variations due to special shimmy damper installation.

(10) Remove screws (106) and cover (107) from steering collar assembly. Remove cotter pin (87), nut (88) and washer (89) from bolt (90) attaching upper torque arm assembly to steering collar. Hold upper torque arm to its uppermost position, and using a screwdriver, carefully pry off cam (91) from bolt (90). Withdraw bolt and remove spring (92)and upper torque arm assembly.

(11) Remove nuts (94), washers (95), screws (96), spring retainer (97), spring (98) and latch pin (99) from upper torque arm (100).

NOTE: Do not remove two bushings (101) from upper torque arm unless they are defective and have to be replaced (refer to FITS AND CLEARANCES).

(12) Remove two pins (102), two thrust washers (103) and two dust rings (104) from steering collar assembly.

(13) Remove spring pin (108) and stud (109) with locknut (111) from steering collar assembly.

NOTE: Do not remove bushings (112), two bushings (113), bearing (114) from steering collar (115) unless they are defective and have to be replaced (refer to FITS AND CLEARANCES).

Cotter pin (110) securing locknut (111) to stud (109) is removed on separation of steering actuator and shock strut assemblies.

(14) Cut lockwire and remove two bolts (116) attaching swivel fitting assembly to outer cylinder. Remove two unions (118) and two packings (119) from swivel fitting assembly. Remove spring pin (120), collar (121), swivel (122), two back-up rings (123), and two O-rings (124) from each end of swivel bolt (125).

(15) Remove cotter pin (126), nut (127), washer (128), washer (129), and withdraw pulley shaft (130) from outer cylinder. Remove cotter pin (131), nut (132) and washer (133) from slider (134), and remove slider with pivot (135) and bushing (136) from pulley shaft.

(16) Remove set-screw (137) securing cable guard assembly, loosen two nuts (139) from two screws (140), and remove both halves of cable guard (141) with guard pins (142) from outer cylinder.

(17) Remove two pins (143), two thrust washers (144) and bushing (145) from outer cylinder.

(18) Remove nut (147), washer (148), two pins (151), two washers (149) and bolt (150), and remove two bushings (152) and spacer (153) from outer cylinder (154).

NOTE: Cotter pin (146) securing nut (147) to bolt (150) is removed on separation of steering actuator and shock strut assembly.

D. Disassemble Nose Gear Shock Strut Part No. 71-300-9 and 71-300-11 (Figure 1103)

WARNING: DO NOT ATTEMPT TO DISASSEMBLE SHOCK STRUT OR REMOVE AIR CHARGING VALVE BEFORE RELEASING ALL AIR PRESSURE THROUGH AIR CHARGING VALVE. FAILURE TO DO SO COULD RESULT IN SERIOUS INJURY OR POSSIBLE LOSS OF LIFE.

(1) Remove air charging valve cap (2). Unscrew nut of air charging valve (1) couter clockwise (approximately one turn) to slowly release air pressure.

WARNING: DO NOT ATTEMPT TO FURTHER LOOSEN OR BACK OFF 3/4 INCH HEXAGON STEM ASSEMBLY BEFORE ENSURING THAT ALL AIR PRESSURE IS RELEASED FROM THE SHOCK STRUT ASSEMBLY.

(2) Remove air charging valve (1).

(3) Remove set-screw (3) securing end cap sub-assembly to outer cylinder. Unscrew and remove end cap sub-assembly from outer cylinder. Turn shock strut upside down and drain off hydraulic fluid.

NOTE: Strain fluid through a suitable fine mesh strainer. Pay particular attention to any foreign matter removed from the fluid (refer to INSPECTION/CHECK) and reject fluid for further use in nose gear shock strut.

(4) Remove O-ring (4) from end cap sub-assembly.

(5) Cut lockwire and remove machine screw (6) securing nut (7) of end cap sub-assembly. Unscrew nut (7) using special tool T-188, and remove end cap (8) from support tube (9). Remove O-ring (11) from upper end of support tube.

NOTE: The shoulder in support tube (9) is a shrink fit and will not be removed.

(6) At lower end of support tube, remove pellet (12) covering set-screw (13), loosen set-screw and remove guide bearing (14), damping plate (15) and plate orifice (16) from support tube.

NOTE: Do not remove slipper ring (18) unless it is defective. A split ring is fitted under slipper ring only where guide bearing has a corresponding groove.

(7) Disengage upper and lower torque arms by removing quick-release pin (19). Remove chain (20) securing quick-release pin to upper torque arm.

(8) On shock strut assembly Part No. 71-300-9 only: push piston assembly into outer cylinder and remove lockring (22) from shoulder nut (23) at top of piston assembly. Remove shoulder nut using special tool T-190, and withdraw piston assembly with for from outer cylinder, dislodging flapper (24), flapper spacer (25), floating piston (28) and bumper (29) of piston assembly. Remove shoulder (30) from piston tube (31). Remove rings (32) and (33), and bearings (26) and (27) from floating piston (28).

NOTE: The two bearings (27) each consist of two halves. The halves are matched and must be retained as sets.

(9) On shock strut assembly Part No. 71-300-11 only: push piston assembly into outer cylinder, and remove lock ring (22) from shoulder nut (23) at top of piston assembly. Remove shoulder nut using special tool T-190, and withdraw piston assembly with fork from outer cylinder, dislodging flapper spacer (25), floating piston (28) and bumper (29) of piston assembly. Remove shoulder (30) from piston tube (31). Remove rings (32) and (33) from floating piston (28).

(10) Remove cotter pin (38), nut (39), washer (40) and lock bolt (41). Unscrew locknut (34) using special tool T-187, and remove nut with washer (35) and shim (36).

(11) Remove diaphragm (37) and cartridge assembly, and withdraw piston tube (31) from fork (55). Remove O-ring (42) and back-up ring (43) from cap plug (45) of cartridge assembly.

NOTE: Do not remove cap plug (45) from cylinder (46) of cartridge assembly unless it is defective and has to be replaced (refer to FITS AND CLEARANCES).

(12) Withdraw bushing (53) from fork (55). Remove lubricator (54) if defective.

NOTE: Remove bushings (48) and (49) only if defective (refer to FITS AND CLEARANCES).

(13) Remove cotter pin (56), nut (57), washer (58) and bolt (59), and remove lower torque arm assembly from fork. Remove bushings (61) and dust ring (62) from torque arm (64). Remove lubricator (63) if defective remove two dust rings (66) from fork (55).

NOTE: Do not remove bushings (50) from fork (55) unless they are defective and have to be replaced (refer to FITS AND CLEARANCES). If bushings are removed, there may be shims under the bushing flanges; these shims will have been installed during a previous repair (refer to REPAIR). Similarly shims may be installed under the flanges of bushings (61) if these bushings have been previously installed by Mod 6/1377. In both cases make carefully note of shim position for subsequent installation.

(14) Remove two nuts (67), two washers (68) and two bolts (69) attaching axle and two towing spools to fork, and withdraw two towing spools (70); cut lockwire and loosen setting screws (71) securing retaining nut (72) to adjustment spacer (73), and remove lockring (74) from spacer (75); withdraw axle (76) from spacer, adjustment spacer, retaining nut and fork. Remove four bushes (52) from lugs on fork.

(15) Remove set-screw (77) securing locknut (78) to lower end of outer cylinder, and remove locknut using special tool T-191. Remove washer (79), scraper (80), bearing retainer (81), and bearing (82).

NOTE: Do not remove sleeve (83) from outer cylinder unless it is defective and has to be replaced (refer to FITS AND CLEARANCES).

(16) Remove nut (84), washer (85), screw (86), two blocks (87), locking clip (88) and locking key (89) at cylinder nut (90) securing steering collar assembly to outer cylinder. Remove cylinder nut (90), thrust washer (91), steering collar assembly complete with upper torque arm assembly, bushing (92) and two thrust washers (93) from outer cylinder.

NOTE: Refer to DESCRIPTION AND OPERATION, Tables 4 and 5 from variations due to special shimmy damper installation.

(17) Remove screws (111) and cover (112) from steering collar assembly. Remove cotter pin (94), nut (95) and washer (96) from bolt (97) attaching upper torque arm assembly to steering collar. Hold upper torque arm to its uppermost position, and using a screwdriver, carefully pry off cam (98) from bolt (97). Withdraw bolt and remove spring (99) and upper torque arm assembly. Remove two dust rings (109) from steering collar assembly.

(18) Remove nuts (101), washers (102), screws (103), spring retainer (104), spring (105) and latch pin (106) from upper torque arm (107).

NOTE: Do not remove two bushings (108) from upper torque arm unless they are defective and have to be replaced (refer to FITS AND CLEARANCES).

(19) Remove spring pin (113) and stud (114) with locknut (116) from steering collar assembly.

NOTE: Do not remove bushing (117), two bushings (119), bearing (118) or lubricator (120) from steering collar (121) unless they are defective and have to be replaced (refer to FITS

AND CLEARANCES). If bushings (119) are removed, there may be shims under the bushing flanges. These shims were installed during a previous repair (refer to REPAIR), and shim positions should be recorded for subsequent re-installation.

Cotter pin (115) securing locknut (116) to stud (114) is removed on separation of steering actuator and shock strut assemblies.

(20) Cut lockwire and remove two bolts (122) attaching swivel fitting assembly to outer cylinder. Remove two unions (124) and two packings (125) from swivel fitting assembly. Remove spring pin (126), collar (127), swivel (128), two back-up rings (129), and two O-rings (130) from each end of swivel bolt (131).

(21) Remove cotter pin (132), nut (133), washer (134), washer (135), and withdraw pulley shaft (136) from outer cylinder. Remove cotter pin (137), nut (138) and washer (139) from slider (140), and remove slider with pivot (141) and bushing (142) from pulley shaft.

(22) Remove set-screw (143) securing cable guard assembly. Slacken two nuts (145) from screws (146) and remove both halves of cable guard (147) with guard pins (148) from outer cylinder.

(23) Remove two pins (149), two thrust washers (150) and bushing (151) from outer cylinder.

(24) Remove nut (153), washer (154), two pins (157), two washers (155) and bolt (156), and remove two bushings (158) and spacer (159) from outer cylinder (160).

NOTE: Cotter pin (152) securing nut (153) to bolt (156) is removed on separation of steering actuator and shock strut assembly.

E. Disassemble Nose Gear Shock Strut Part No. 71-300-15 through 71-300-33 (Figure 1104)

WARNING: DO NOT ATTEMPT TO DISASSEMBLE SHOCK STRUT OR REMOVE AIR CHARGING VALVE BEFORE RELEASING ALL AIR PRESSURE THROUGH AIR CHARGING VALVE. FAILURE TO DO SO COULD RESULT IN SERIOUS INJURY OR POSSIBLE LOSS OF LIFE.

(1) Remove air charging valve cap (2). Unscrew nut of air charging valve (1) counterclockwise (approximately one turn) to slowly release air pressure.

WARNING: DO NOT ATTEMPT TO FURTHER LOOSEN OR BACK OFF 3/4 INCH HEXAGON STEM ASSEMBLY BEFORE ENSURING THAT ALL AIR PRESSURE IS RELEASED FROM THE SHOCK STRUT ASSEMBLY.

(2) Remove air charging valve (1).

(3) Remove set-screw (3) securing end cap sub-assembly to outer cylinder. Unscrew and remove end cap sub-assembly from outer cylinder. Turn shock strut upside down and drain off hydraulic fluid.

NOTE: Strain fluid through a suitable fine mesh strainer. Pay particular attention to any foreign matter removed from the fluid (refer to INSPECTION/CHECK) and reject fluid for further use in nose gear shock strut.

(4) Remove O-ring (4) from end cap sub-assembly.

(5) Cut lockwire and remove machine screw (6) securing nut (7) of end cap sub-assembly. Unscrew nut (7) using special tool T-188, and remove end cap (8) from support tube (9). Remove O-ring (11) from upper end of support tube.

NOTE: The shoulder in support tube (9) is a shrink fit and is not removed.

(6) At lower end of support tube, remove pellet (12) covering set-screw (13), loosen set-screw and remove guide bearing (14), damping plate (15) and plate orifice (16) from support tube.

NOTE: Do not remove slipper ring (18) unless it is defective. A split ring is fitted under slipper ring only where guide bearing has a corresponding groove.

(7) Disengage upper and lower torque arms by removing quick-release pin (19). Remove chain (20) securing quick-release pin to upper torque arm.

(8) On shock strut assembly Part No. 71-300-15 and -17 only: Push piston rod and fork assembly into outer cylinder, and remove lockring (23) from shoulder nut (24) at top of piston assembly. Remove shoulder nut using special tool T-190, and withdraw piston assembly with fork from outer cylinder, dislodging flapper spacer (26), floating piston (27) and bumper (29) of piston assembly. Remove shoulder (30) from piston tube (31). Remove piston and bumper from outer cylinder and remove rings (32) and (34) from floating piston (27).

(9) On shock strut assemblies Part No. 71-300-19, -21, -23, and -25 only: Push piston rod and fork sub-assembly into outer cylinder and remove lockring (23) from shoulder nut (25). Remove shoulder nut using special tool T-190 and withdraw piston rod and fork sub-assembly from outer cylinder, dislodging floating piston (28) and bumper (29) of piston assembly. Remove shoulder (30) from piston tube (31). Remove piston and bumper from cylinder and remove rings (33) and (35) from piston.

(10) On shock strut assemblies Part No. 71-300-27, -29, -31 and -33 only: Push piston rod and fork sub-assembly into outer cylinder and remove cotter pin (23A) and locking screw (23B) from shoulder nut (25A). Remove shoulder nut using special tool T-190 and withdraw piston rod and fork sub-assembly from outer cylinder, dislodging floating piston (28) and bumper (29) of piston assembly. Remove shoulder (30) from piston tube (31). Remove piston and bumper from cylinder and remove rings (33) and (35) from piston.

(11) On shock strut assemblies Part No. 71-300-15 through -23 only: Remove cotter pin (40), nut (41), washer (42) and lockbolt (43). Unscrew locknut (36) using special tool T-187 and remove locknut with washer (37) and shim (38).

(12) On shock strut assemblies Part No. 71-300-25, -27, -29, -31 and -33 only: Gain access through hole in locknut (36A) and remove self-locking nuts (41A), washer (176) and profile washer (42A) securing lockbolts (43A). Remove lockbolts. Unscrew locknut (36A) using special tool T-187 and remove locknut with washer (37) and shim (38).

(13) Remove diaphragm (39) and cartridge assembly, and withdraw piston tube (31) from fork (56). Remove O-ring (44) and back-up ring (45) from cap plug (47) of cartridge assembly.

NOTE: Do not remove cap plug (47) from cylinder (48) of cartridge assembly unless it is defective and has to be replaced (refer to FITS AND CLEARANCES).

(14) Withdraw bushings (54) from fork (56). Remove lubricator (55) if defective.

NOTE: On shock strut assemblies Part No. 71-300-15 through -23 only: Remove bushing (49) and (50) only if defective (refer to FITS AND CLEARANCES). On shock strut assemblies Part No. 71-300-25, -27, -29, -31 and -33, bushings (49) and (50) are replaced by two bushings (49A).

(15) Remove cotter pin (57), nut (58), washer (59) and bolt (60), and remove lower torque arm assembly from fork. Remove bushings (61) and dust ring (62) from torque arm (65). Remove lubricator (64) if defective. Remove two dust rings (66) from fork (56).

NOTE: Do not remove bushings (52) from fork (56) unless they are defective and have to be replaced (refer to FITS AND CLEARANCES). If bushings are removed, there may be shims (172) under the bushing flanges; these shims were installed during a previous repair (refer to REPAIR). Similarly, shims may be installed under the flanges of bushings (61). In both cases, record shim positions for subsequent re-installation.

(16) Remove two nuts (67), two washers (68) and two bolts (69) attaching axle and two towing spools to fork, and withdraw two towing spools (70); cut lockwire and loosen setting screws (71) securing retaining nut (72) to adjustment spacer (73), and remove lockring (74) from spacer (75); withdraw axle (76) from spacer, adjustment spacer, retaining nut and fork. Remove four bushings (53) from lugs on fork.

(17) On shock strut assemblies Part No. 71-300-15, -17 and -19 only: Remove set-screw (77) securing locknut (79) to lower end of outer cylinder, and remove locknut using special tool T-191. Remove washer (80), scraper (82), bearing retainer (83), and bearing assembly (85). Remove sleeve from bearing assembly.

(18) On shock strut assemblies Part No. 71-300-21, -23, -25, -27, -29, -31 and -33 only: Remove set-screw (77), securing locknut (78) to lower end of outer cylinder, using special tool T-191. Remove scraper (81) and bearing (84).

(19) On shock strut assembly Part No. 71-300-15 only: Remove nut (86), washer (87), screw (88), two blocks (89), locking clip (90) and locking key (91) at cylinder nut (92), locating steering collar assembly on outer cylinder. Remove cylinder nut (92), thrust washer (93), steering collar assembly complete with upper torque arm assembly bushing (98) and two thrust washers (94) from outer cylinder.

NOTE: Refer to DESCRIPTION AND OPERATION, Table 5A for variations due to special shimmy damper installation on shock strut assembly Part No. 71-300-15 only.

(20) On shock strut assemblies Part No. 71-300-17, -19, -21, -23, -25, -27, -29, -31 and -33 only: Remove nut (86), washer (87), screw (88), two blocks (89), locking clip (90) and locking key (91) at cylinder nut (92), locating steering collar on outer cylinder. Remove cylinder nut (92), shim washer (96) thrust ring (95) and slide steering collar complete with bonded item thrust washer (130) and wear washer (129) and attached upper torque arm and bushing (98) from outer cylinder.

(21) Remove screws (117) and cover (118) from steering collar assembly. Remove cotter pin (99), nut (100) and washer (101) from bolt (102) attaching upper torque arm assembly to steering collar. Hold upper torque arm to its uppermost position, and using a screwdriver, carefully pry off cam (103) from bolt (102). Withdraw bolt and remove spring (104) and upper torque arm assembly. Remove two dust rings (114) from steering collar assembly.

(22) Remove nuts (106), washers (107), screws (108), spring retainer (109), spring (110) and latch pin (111) from upper torque arm (112).

NOTE: Do not remove two bushings (113) from upper torque arm unless they are defective and have to be replaced (refer to FITS AND CLEARANCES).

(23) On shock strut assemblies Part No. 71-300-15 through -23 only: Remove spring pin (119) and stud (120) with locknut (122) from steering collar assembly.

NOTE: 1. On shock strut assembly Part No. 71-300-15 only: Do not remove bushing (123), two bushings (126), bearing (124) or lubricator (127) from steering collar (128) unless they are unserviceable and have to be replaced (refer to FITS AND CLEARANCES). If bushings (126) are removed, there may be shims under the bushing flanges. These shims were installed during a previous repair (refer to REPAIR) and shim positions should be recorded for subsequent re-installation.

2. On shock strut assemblies Part No. 71-300-17, -19, -21, -23, -25, -27, -29, -31 and -33 only: Do not remove bushing (123), two bushings (126), bearing (125), lubricator (127) and bonded items, wear washer (129) and thrust washer (130) from steering collar (128) unless unserviceable (refer to FITS AND CLEARANCES). If bushings (126) are removed, there may be shims under bushings flanges. These shims were installed during previous repair (refer to REPAIR). Shim positions should be recorded for use in subsequent re-installation.

3. Cotter pin (121) securing locknut (122) to stud (120) was removed during separation of steering actuator and shock strut assembly.

(24) On shock strut assemblies Part No. 71-300-25, -27, -29, -31 and -33: Remove spring pin (119) and stud (120) with washer (123A) and locknut (122) from steering collar. Carry out requirements of NOTE following step (23), as applicable.

(25) Cut lockwire and remove two bolts (131) attaching swivel fitting assembly to outer cylinder. Remove two unions (133) and two packings (134) from swivel fitting assembly. Remove spring pin (135), collar (136), swivel (137), two back-up rings (138) and two O-rings (139) from each end of swivel bolt (140).

(26) Remove cotter pin (141), nut (142), washer (143), washer (144) and withdraw pulley shaft (145) from outer cylinder. Remove cotter pin (146), nut (147) and washer (148) from slider (140), and remove slider with pivot (150) and bushing (151) from pulley shaft.

(27) Remove two pins (158), two thrust washers (159) and bushing (160) from outer cylinder.

(28) Remove set-screw (152) securing cable guard assembly. Remove two nuts (154) from two screws (155) and remove both halves of cable guard (156) with guard pins (157) from outer cylinder.

(29) Remove nut (162), washer (163), two pins (166), two washers (164) and bolt (165), and remove two bushings (167) and spacer (168) from outer cylinder (170).

NOTE: Cotter pin (161) securing nut (162) to bolt (165) is removed on separation of steering actuator and shock strut assembly.

(30) Remove sleeve (171) from outer cylinder (170).

NOTE: Do not attempt to remove bonded item, friction disc (97) from outer cylinder unless it is unserviceable (refer to FITS AND CLEARANCES).

(31) Do not remove name and instruction label (173) on Modification plate (174).

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CLEANING

1. Procedures

   A. General

      (1) Clean components by washing or spraying with a dry cleaning solvent (refer to Table 201).

      WARNING: USE SOLVENT IN A WELL-VENTILATED AREA AND AVOID BREATHING FUMES. AVOID SKIN CONTACT AND KEEP AWAY FROM FLAME.

      (2) Dry with moisture-free compressed air or a lint-free cloth.

Table 201

Cleaning Materials and Compounds

MATERIAL	SPECIFICATION OR MANUFACTURER
Solvent	P-D-680

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INSPECTION/CHECK

1. Procedures

   A. General

      (1) Examine any foreign matter found on draining the hydraulic fluid from the shock strut assembly (refer to DISASSEMBLY). Pay particular attention to any metal particles, and determine the source during the inspection procedure.

      (2) Carry out a magnetic particle inspection of all magnetic metal components, where practicable.

      (3) Inspect non-magnetic metal components using the fluorescent penetrant method, or an approved dye penetrant method.

      (4) Inspect all parts visually for signs of fatigue and cracks, and for damage such as galls, scores, scratches, excessive wear and corrosion.

      (5) Inspect threaded parts for damaged, stripped or crossed threads.

      (6) Check all holes, internal and external diameters for wear, concentricity, and taper. Refer to FITS AND CLEARANCES, Table 601, for original tolerances and service limits. Repair or replace parts worn in excess of service limits.

      (7) Inspect dry film lubrication on lugs of upper and lower torque arms, torque arm repair bushings and wear plates for adhesion to parent metal, scuffing and scoring.

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REPAIR

1. Procedures

A. General

(1) Replace all defective parts not listed in FITS AND CLEARANCES, Table 601.

(2) When anodized parts have had protective treatment damaged or removed, apply a protective coating of Alodine solution 1200S (refer to Table 401) to the affected area(s) or reanodize the part.

(3) Replace standard parts such as cotter pins, spring pins, washers, nuts, bolts or screws, lockrings, packing or O-rings, back-up rings and springs at each overhaul.

(4) Where indicated in FITS AND CLEARANCES, Table 601, parts may be repaired by hard chrome plating or hard anodizing the affected surface, then grinding or honing the surface to the original dimension shown in the table. Where parts were originally chrome plated, strip the original plating before repair. Parts not previously plated should be ground to the minimum necessary to produce a smooth surface before plating the part.

(5) Dry film lubricant on lugs of upper and lower torque arms, or repair bushings (refer to paragraph C.) must be repaired or stripped and re-processed (refer to paragraph H.).

B. Replating Piston Tube

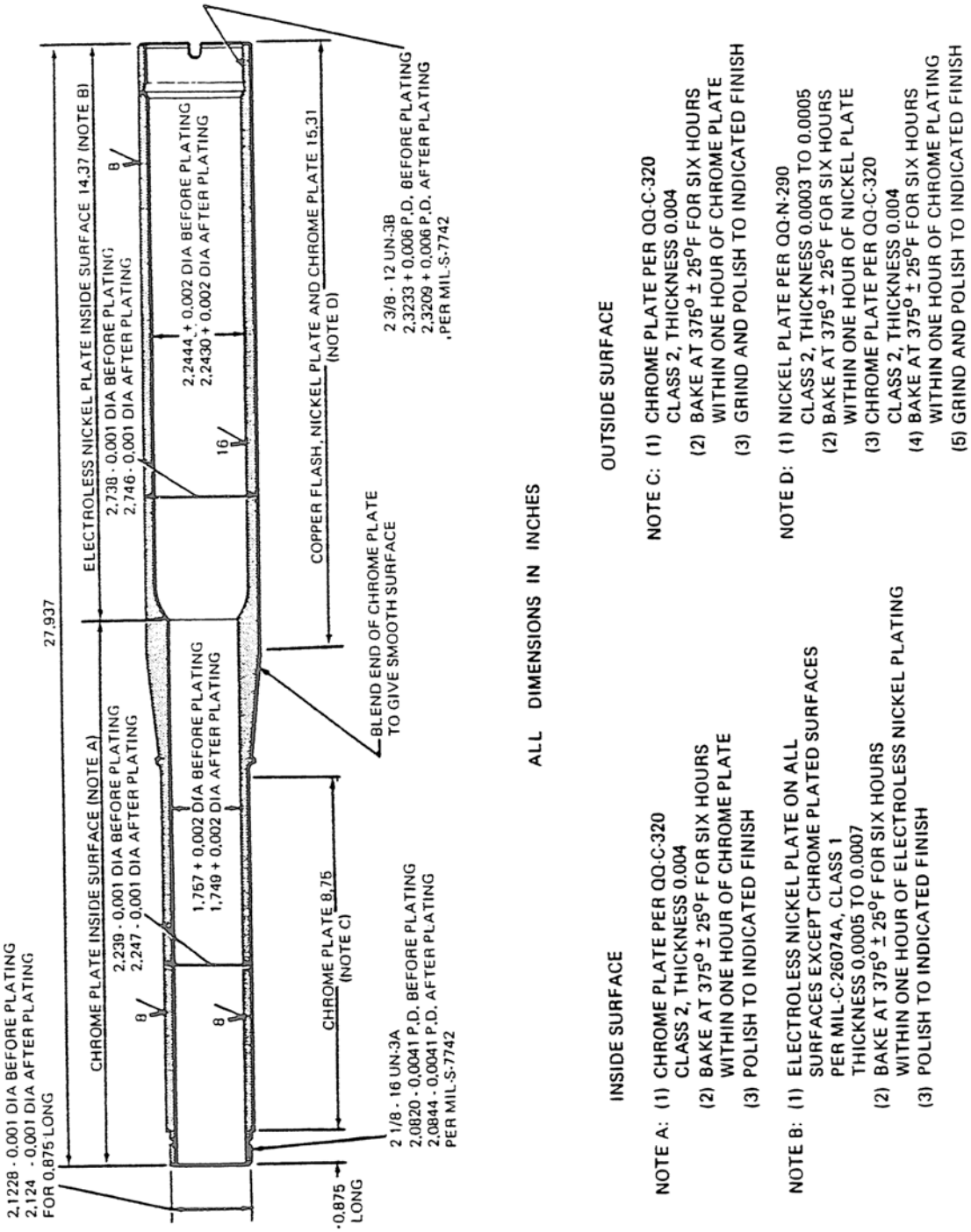
(1) When replating of piston tube (index No. (28), Figure 1101 or 1102, index No (31), Figures 1103 and 1104 is necessary, refer to Figure 401 for chrome plating and electroless nickel plating areas, and dimensions of inside and outside surfaces.

NOTE: When a piston tube fails to meet inspection requirements and cannot be replaced, piston tubes 71-141-7 and 71-141-9 are interchangeable, and can be fitted to shock strut assemblies Part No. 71-300-1 through -11 and 71-300-15 through -27.

Table 401

Repair Materials and Compounds

MATERIAL	SPECIFIFCATION OR MANUFACTURER
Protective Coating,	
Alodine 1200S	MIL-C-5541
Molykote 321	Dow Corning Silicones
Dry Film Lubricant	MIL-L-46010 or MIL-L-8937
Zinc Chromate Primer	MIL-P-8585
Methyl-ethyl-ketone (MEK)	MIL-M1399
Acetone	O-A-51
Trichlorethylene	MIL-T-7003
Scotch Weld Adhesive	EC-1751 (Minnesota Mining and Mfg Co.)
Scotch Brite Pad	Minnesota Mining and Mfg Co.



Plating of Piston Tube

Figure 401

C. Repair Upper and Lower Torque Arms with Worn Inner Faces

A torque arm (Part No. 71-102 or 71-163) or torque link (Part No. 71-338) with worn inner faces can be repaired as follows:

(1) Rework torque arm inner faces and holes to dimensions shown in Figures 402.

(2) Apply protective coating of Alodine solution 1200S (refer to Table 401) to bare metal surfaces.

(3) Machine two bushings to dimensions shown in Figure 402. Use 17-4PH Corrosion Resistant Steel, Condition H-1150.

(4) Coat bushings with zinc chromate primer (refer to Table 401) and press bushings into position with flanges against torque arm inner faces.

(5) Line ream bushing holes to 0.3750 + 0.0006 inch diameter.

(6) Apply dry film lubricant to outer face of bushings in areas of contact with bushings in shock strut boss (refer to Table 401).

D. Repair Upper and Lower Torque Arms with Damaged Anti-rotation Shoulders

A torque arm (Part No. 71-102 or 71-163) or torque link (Part No. 71-338) with damaged anti-rotation shoulders can be repaired as follows:

(1) Manufacture stop plate as shown in Figure 403.

(2) Machine off existing shoulder until thickness of torque arm lug is 0.510 - 0.005 inch. Refer to Figure 403. Apply protective coating of Alodine solution 1200S (refer to Table 401) to bare metal surfaces.

(3) Clamp stop plate to torque arm in location shown in Figure 403. Using stop plate as template, drill holes in torque arms using a No. 29 drill and tap 8-32UNC-3B.

(4) Coat contact face of stop plate with zinc chromate primer (refer to Table 401) and secure stop plate to torque arm with two MS24677-15 screws.

(5) Wirelock screws using MS20995C32 lockwire.

E. Repair Steering Collar Assembly or Fork Sub-assembly at Torque Arm Lugs

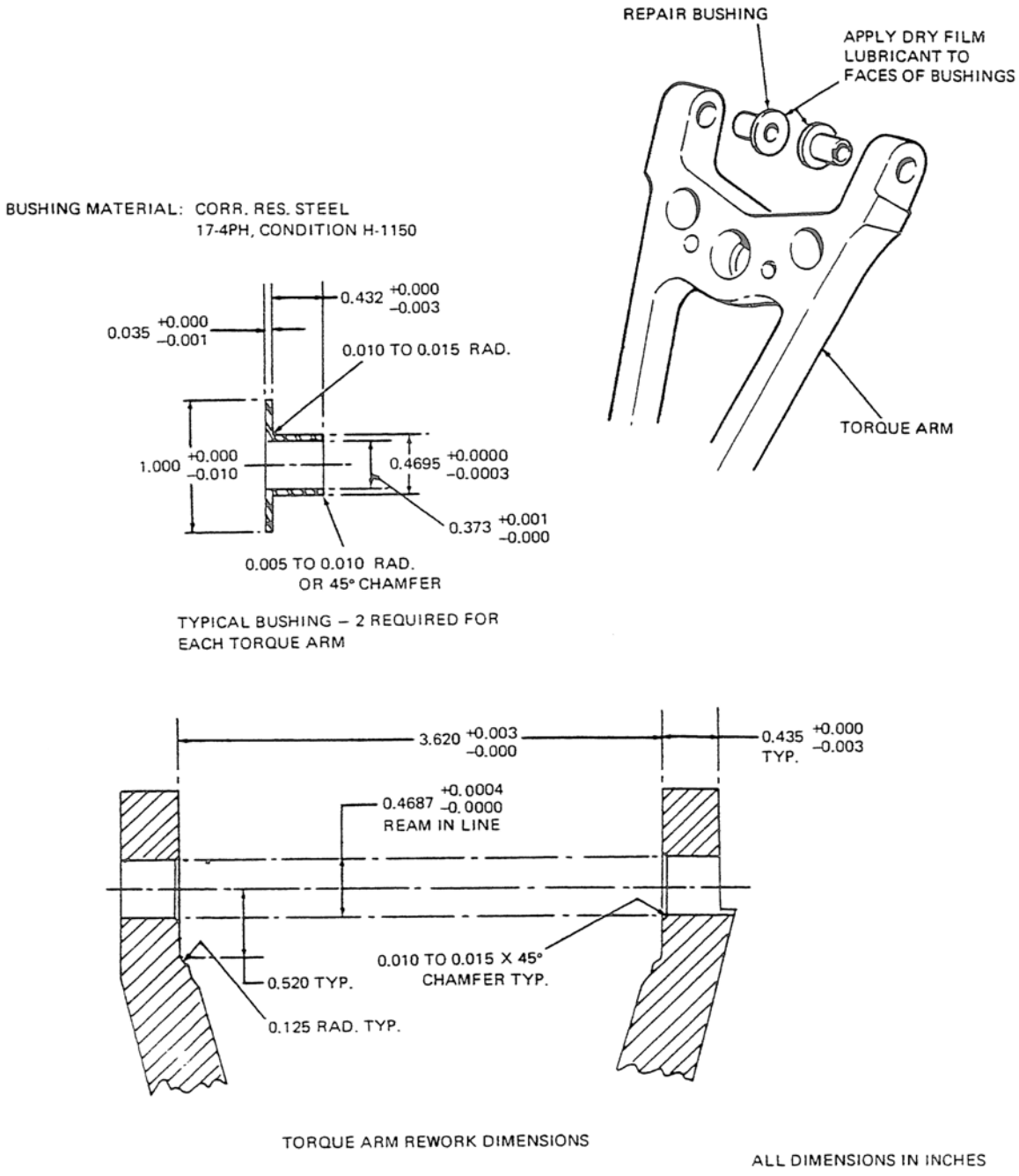
Wear at torque arm lugs of steering collar assembly (Part No. 71-177) or fork assembly (Part No. 71-108) may be required as follows:

(1) If still installed, remove flanged bushings (Part No. 71-305-9).

(2) Clean up spotface of torque arm lug to a maximum increase in depth of 0.030 inch. Note depth increases.

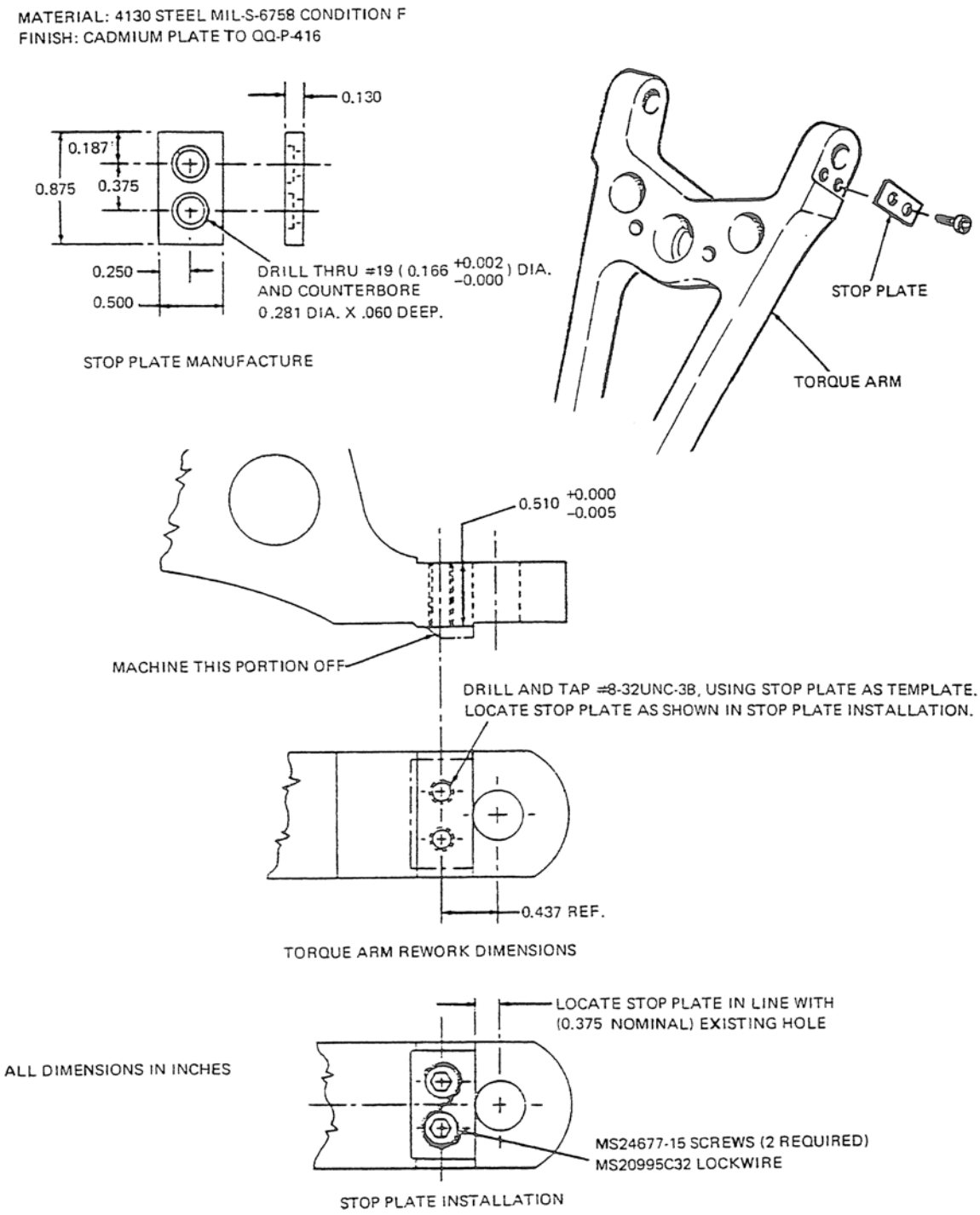
(3) Apply protective coating of Alodine solution 1200S (refer to Table 401) to bare metal surfaces.

(4) Record face-to-face dimension as shown in Figure 404 (dimension A).



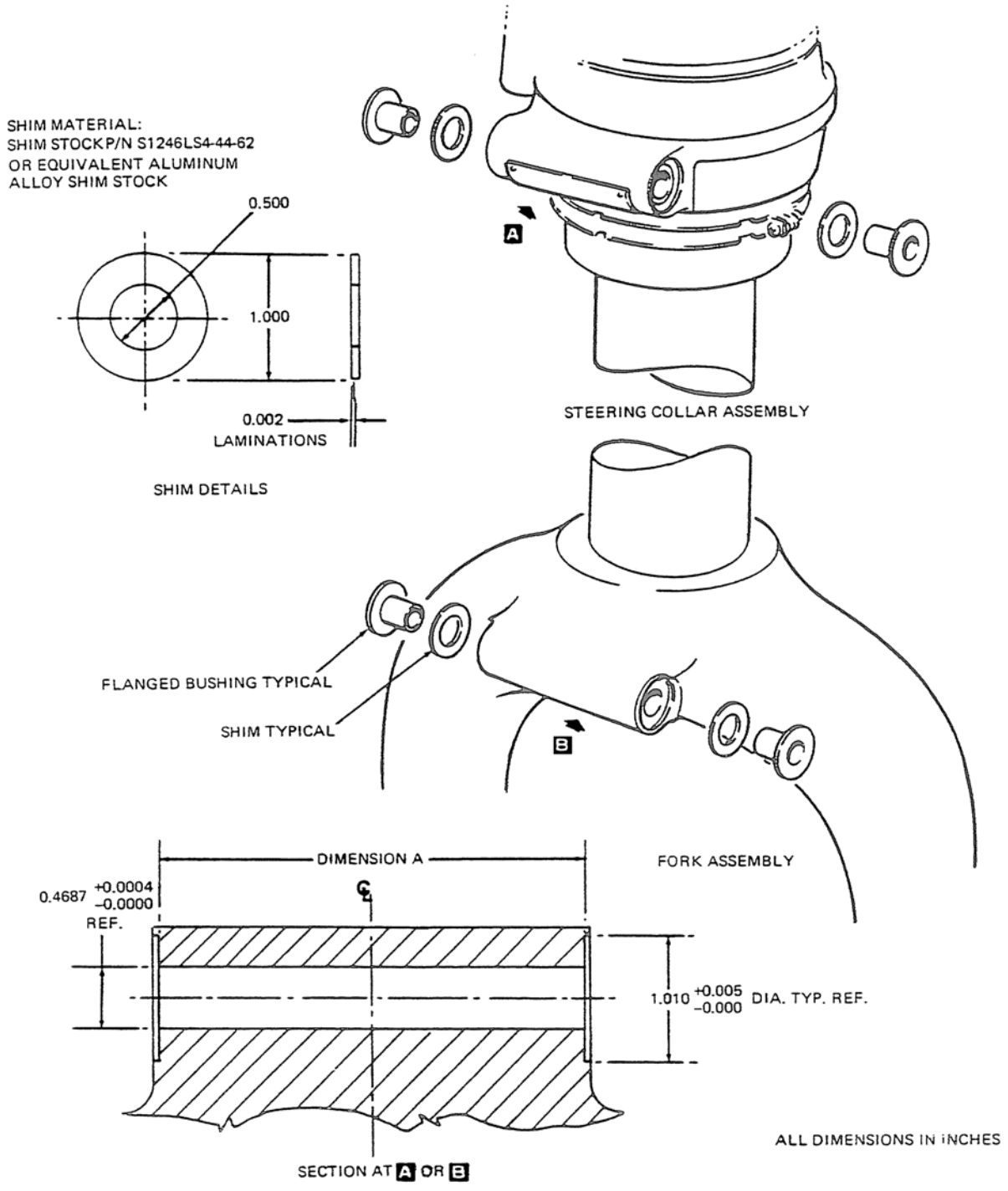
Repair to Torque Arms with Worn Inner Faces

Figure 402



Repair to Torque Arms with Damaged Anti-rotation Shoulders

Figure 403



Repair to Torque Arm Lugs on Steering Collar Assembly or Fork Sub-assembly

Figure 404

(5) Machine shims from shim stock Part No. S1246LS4-44-62 (or equivalent aluminum alloy shim stock) as shown in Figure 404.

(6) Determine shims required to give face-to-face dimension of 3.424 - 0.002 inches equally disposed about the centerline.

(7) Assemble shims against bushing (Part No. 71-305-9) flanges and install bushings.

F. Repair Upper Torque Arm Forked Lugs (Figure 405)

(1) Remove bushings (Part No. 71-164) if installed in torque arm.

(2) Spotface inside surfaces of lug 1.000 + 0.005 inch diameter to a width of 0.570 + 0.005 inch. New width must be equal about centerline of torque arm.

(3) Machine circular groove 0.030 inch deep with 0.030 radius around OD of spotface. Grind 0.060 inch radii (to relieve sharp edges left by spotfacing) to dimensions shown.

(4) Manufacture two wear plates from 302 stainless steel plate, 1/2 hard or better, to dimensions shown.

(5) Scuff sand spotfaced areas on torque arm and one side of each wear plate, using Scotch Brite pad or aluminum emery paper No. 300. Clean scuffed areas with methyl-ethyl-ketone or acetone.

(6) Observe safety precautions. Prepare and apply Scotch Weld Adhesive EC1751 B/A in accordance with the manufacturer's instructions to scuffed surfaces of torque arm and wear plates. Position wear plates on inner surfaces of lugs, mating adhesive surfaces and aligning hole in plate with corresponding hole in lug. Clamp plates in position and ensure that width between inside surfaces of installed wear plates is not less than 0.537 inch.

(7) Permit bonded areas to cure for 24 hours at room temperature (approximately 70ºF) before removing clamps.

NOTE: Scotch Weld is considered cured when surface of adhesive resists fingernail penetration.

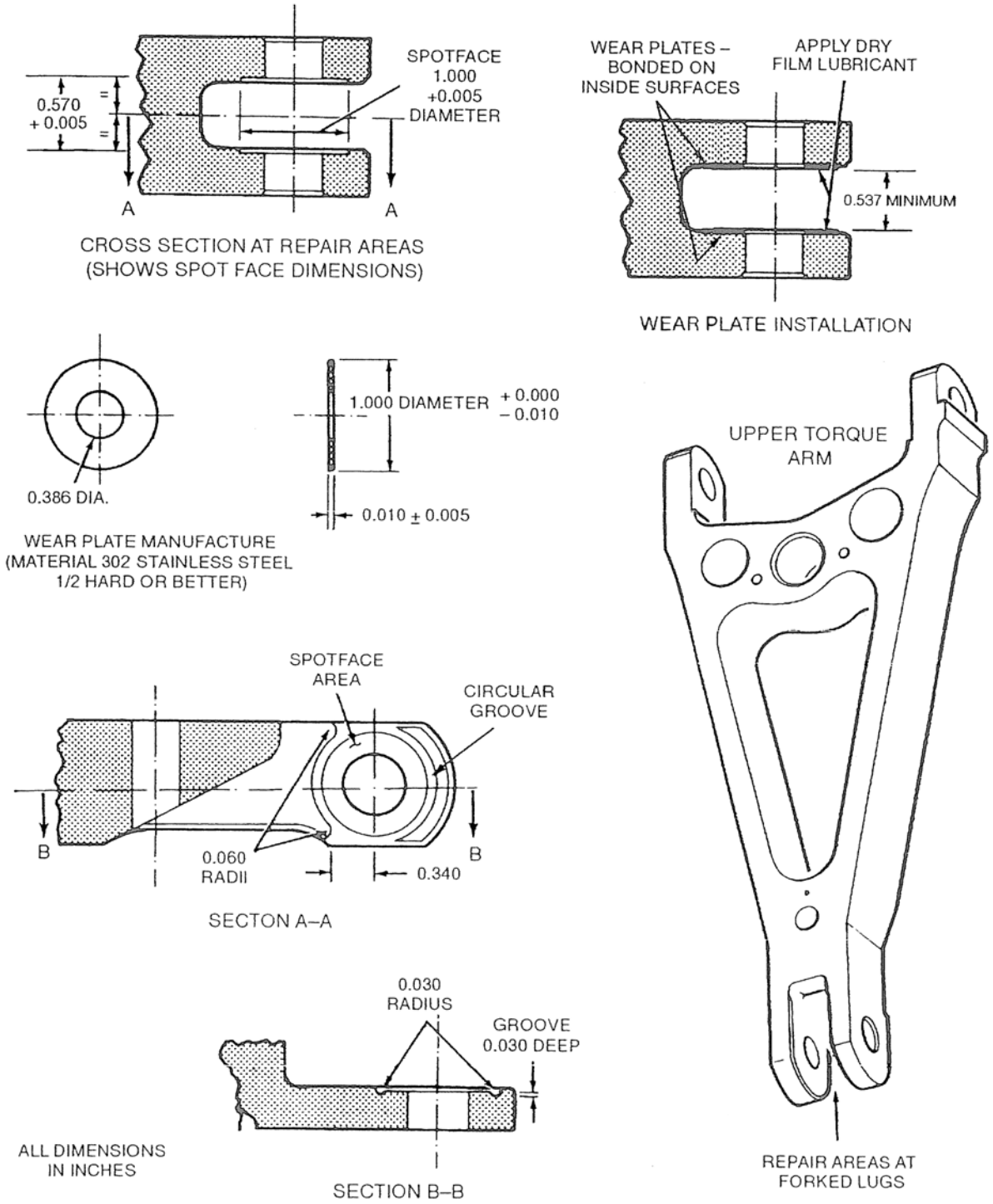
(8) Reinstall bushings on torque arm lugs (if removed) and ensure correct fit (refer to FITS AND CLEARANCES).

(9) Apply dry film lubricant to wear plates in areas of contact with bushings in lower torque arm.

(10) Assemble torque arm to shock strut. Use shims 71-311-9 as necessary to obtain correct fit at joint formed when connecting upper and lower torque arms (refer to ASSEMBLY).

G. Replace Shimmy Damper Bonded Parts (Shock Strut Assemblies 71-300-17 to 71-300-29)

Shock strut shimmy damper bonded parts, thrust washer (Part No. 71-018-5) and friction disc (Part No. 71-323-1), can be replaced as follows:



Repair to Upper Torque Arm with wear at Fork-end Lugs

Figure 405

(1) Remove thrust washer or friction disc (as required) by machining, taking care not to remove metal from steering collar when machining thrust washer, or outer cylinder when machining friction disc.

(2) Scuff and machined areas to remove any residual bonding material, using Scotch Brite pad or aluminum emery paper No. 300. Similarly, scuff sand one side of friction disc or backing side of thrust washer bearing material.

(3) Clean scuffed areas with methyl-ethyl-ketone or acetone.

(4) Observe any safety precautions, prepare and apply Scotch Weld adhesive EC1752 B/A in accordance with adhesive manufacturer's instructions to scuffed areas of parent component and part being bonded.

(5) Position items for bonding as follows:

(a) Position thrust washer concentrically on steering collar, mating adhesive side of washer with adhesive on collar and clamp securely.

OR

(b) Position friction disc on outer cylinder, mating adhesive side of disc with adhesive on cylinder and clamp securely.

(6) Leave clamps in position during curing period of 24 hours at room temperature (approximately 70ºF).

H. Repair Dry Film Lubricant (Molykote 106 or Electrofilm No. 1000)

CAUTION: MATERIALS AND SOLVENTS USED DURING REPAIR OR REPLACEMENT OF DRY FILM LUBRICANT ARE HIGHLY TOXIC AND ARE FLAMMABLE. WORK MUST TAKE PLACE IN A WELL VENTILATED AREA, FACE MASK SHOULD BE WORN AND FIRE PRECAUTIONS TAKEN.

Dry film lubricant (Molykote 106 or Electrofilm No. 1000) on lug faces of upper torque arm (Part No. 71-102), lower torque arm (Part No. 71-163 or 71-338, repair bushings (refer to paragraph C.), and repair plates (refer to paragraph F.), may be repaired as follows:

(1) Lightly scuffed or scored surfaces:

(a) Wash surface of dry film lubricant with methyl-ethyl-ketone or trichlor-ethylene. Ensure adhesion of lubricant to parent metal.

(b) Repair scuffed or scored areas by spraying or by hand application of Molykote 321. Prepare and apply Molykote in accordance with manufacturer's instructions. Apply sufficient new film to effect repair, final thickness not to exceed that of original coating (0.0002 to 0.0004 inch).

(c) Allow repair to air dry for five minutes at room temperature (approximately 70ºF).

NOTE: Molykote coating when dry, must be dull and gray-black in color, with smooth, even finish. Slight variations in color are acceptable. Glossy coatings or coating which appears brown, yellow or green must be replaced (refer to step (d)).

(d) Strip air-dried (cured) Molykote 321 coating by rubbing area with a lint-free cloth soaked in methyl-ethyl-ketone. Repeat steps (b) and (c).

(2) Detached or excessively damaged areas of dry film lubricant may be repaired by stripping original film of lubricant. The lubricant may be replaced to Specification MIL-L-46010, providing wear to the parent material is within limits (refer to FITS AND CLEARANCES).

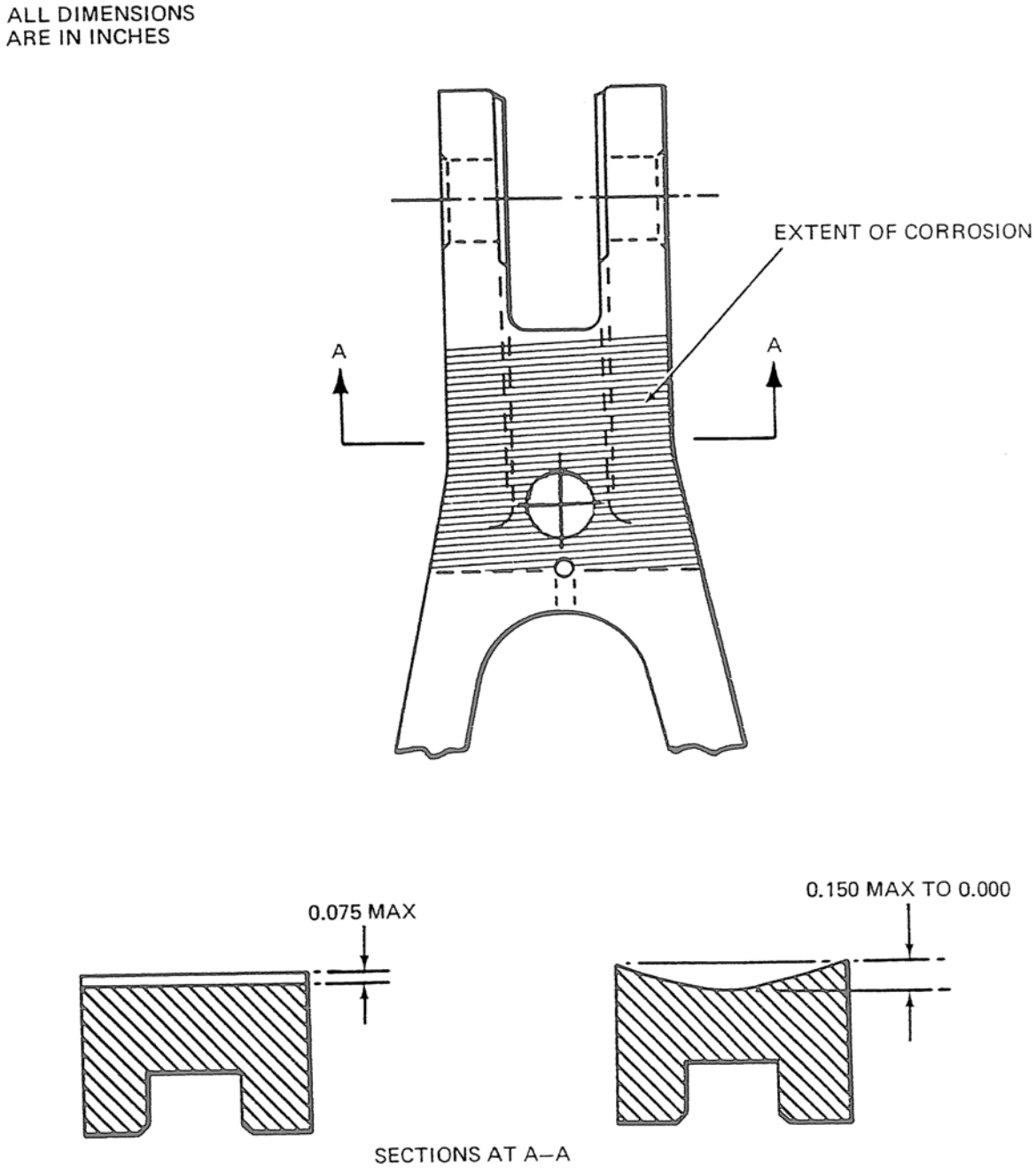
I. Repair of Upper Torque Arm to Remove Corrosion

Corrosion of upper torque arm may be repaired as follows:

(1) Clean up face of torque arm as shown in Figure 406, to a maximum depth of 0.075 inch over entire face, or, up to a maximum depth of 0.150 inch, tapered to 0.000 at edges of torque arm.

(2) Apply protective coating of Alodine solution 1200S (refer to Table 401), to bare metal surfaces.

(3) Paint repaired surfaces with epoxy zinc chromate primer (refer to Table 401).



Repair of Upper Torque Arm to Remove Corrosion

Figure 406

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ASSEMBLY

1. Procedures

A. Assemble Nose Gear Shock Strut, Part No. 71-300-1 and 71-300-3 (Figure 1101)

(1) Install two bushings (144), with spacer (145) between bushings, to outer cylinder. Secure two washers (141) with two pins (143). Temporarily attach bolt (142), washer (140) and nut (139).

(2) Position cable guard assembly and secure with set-screw (129). Tighten two nuts (131) on two screws (132) to secure both halves of cable guard (133) with guard pins (134) to outer cylinder.

(3) Position bushing (137), two thrust washers (136), and secure in outer cylinder with two pins (135). Assemble slider (126) with pivot (127) and bushing (128) to pulley shaft (122), and secure with washer (125) and nut (124). Torque nut (124) to 6 pounds-feet and install cotter pin (123). Position pulley shaft on outer cylinder, and secure with washer (121), washer (120), and nut (119). Finger tighten nut (119), then tighten to next slot and install cotter pin (118). Check pulley shaft for freedom of movement.

(4) Coat O-rings (116) with grease G. E. Versilube G300 and install two O-rings (116), two back-up rings (115), swivel (114), collar (113) and spring pin (112) at both ends of swivel bolt (117). Install two packings (111) and two unions (110) to swivel bolt. Position swivel fitting assembly on outer cylinder, ensuring that end with engraved marking RET is towards the top of outer cylinder, and secure with two bolts (108). Lockwire bolts (108) using MS20995-C20.

(5) If removed for replacement of defective parts, install two bushing (106) and bushing (105) to steering collar (107). Bushings must be a press fit in steering collar (refer to FITS AND CLEARANCES). Install stud (102) to steering collar and secure with spring pin (101). Temporarily thread locknut (104) to stud. Install two dust rings (97), two thrust washers (96) and two pins (95) to steering collar.

NOTE: If a new stud (102) o steering collar (107) is fitted, drill 0.125 to 0.129 inch diameter hole for spring pin (101) through steering collar and/or stud using hole in steering collar as pilot. Round off end of hole with 0.005 to 0.010 inch radius. Drill hole for cotter pin (103) through stud after assembly to steering collar: measure a dimension of 0.938 to 0.943 inch along stud from face of steering collar, and use a 3/32 inch diameter drill.

Table 501
Assembly Materials and Compounds

MATERIAL	SPECIFICATION OR MANUFACTURER
Grease	MIL-G-23827
Grease	G. E. Versilube G300
Grease, Silicone	MIL-H-8660 or equivalent
Grease	MIL-G-81322 or equivalent
Compound Type 1	MIL-C-16173
Emery Cloth No. 60	P-C-451
Lockwire, Corrosion Resistant	MS20995C20
Lockwire, Corrosion Resistant	MS20995C32

Table 501
Assembly Materials and Compounds

MATERIAL	SPECIFICATION OR MANUFACTURER
Machine Oil	3-GP-335a or MIL-L-7870A
Primer, Epoxy Chromate	B. B. Chemicals Co.

(6) If removed for replacement of defective parts, install two bushings (94) in upper torque arm (93). Bushings must be a press fit in upper torque arm (refer to FITS AND CLEARANCES). Lubricate latch pin (92) and spring (91) with grease MIL-G-23827. Position latch pin (92), spring (91) and spring retainer (90), and secure to upper torque arm with screws (89), washers (88) and nuts (87).

(7) Position upper torque arm assembly on steering collar assembly, and install bolt (83) with spring (85). Hold upper torque arm to its uppermost position, compress spring (85) to allow cam (84) to readily slide on over the flats of bolt (83). Secure bolt with washer (82) and nut (81). Finger tighten nut (81), then tighten to next slot and install cotter pin (80). Depress torque arm, then release. Check that torque arm returns upwards under spring tension. Position cover (100) on steering collar assembly and secure with screws (99).

(8) Position journal bearing (79) in steering collar, and assemble steering collar assembly with upper torque arm assembly on outer cylinder. Ensure thrust washer (78) is tight on shoulder and install cylinder nut (77). Tighten cylinder nut to 30 pounds-feet, then back off to next slot and check steering collar for freedom of movement. Lock cylinder nut with two locking nuts (76) and two machine screws (75). Torque machine screws (75) to 4 pounds-feet, and lockwire with MS20995C32.

NOTE: Refer to DESCRIPTION AND OPERATION, Table 2 and 3 for variations due to special shimmy damper installation.

(9) Install bearing (74) in bore of outer cylinder.

(10) On shock strut assembly, Part No. 71-300-1 only: Install two flanged bushings (68) to lugs on fork, with flange of each bushing on inner face of lug; coat inside of axle with Compound Type 1, MIL-C-16173 (Shell H927); install axle (67), spacer (66), adjustment spacer (64), retaining nut (63), two towing spools (61), and secure to fork with two bolts (60) and two nuts (58); thread retaining nut onto adjustment spacer, and temporarily install cotter pin (62).

(11) On shock strut assembly, Part No. 71-300-3 only: Install four bushings (68) to lugs on fork; coat inside of axle with Compound Type 1, MIL-C-16173 (Shell H927); install axle (67), spacer (66), adjustment spacer (64), retaining nut (63), two towing spools (61), and secure to fork with two bolts (60), two washers (59) and two nuts (58); install lockring (65) securing spacer (66) to axle; thread retaining nut onto adjustment spacer, and temporarily secure with setting screws (62).

(12) Install two bushings (57), two dust rings (56), two thrust washer (55) and two pins (54) to fork. Install bushing (52), two dust rings (51), two thrust washers (50) to lower torque arm (53), and secure with four screws (49). Position lower torque arm assembly on fork, and secure with bolt (47), washer (46) and nut (45). Finger tighten nut (45), then tighten to next slot and install cotter pin (44). Check lower torque arm for freedom of movement.

(13) Install bushing (43) and dowel (42) to fork (41). Retain dowel (42) by peening.

NOTE: Do not insert dowel (42) too far below surface of fork or fouling may occur when installing locknut (35).

(14) Coat packing (39) and O-ring (36) with grease, G. E. Versilube G300; install packing (39) and plug (38) to cylinder (40) of cartridge assembly. Tighten plug and lockwire using MS20995C32. Install O-ring (36) to cartridge assembly.

(15) Position piston tube (28) in fork and ensure that slot engages dowel (42). Install cartridge assembly within piston tube, lubricate contact surface of fork (for locknut (35)) with machine oil, and secure piston tube to fork with locknut (35), using special tool T-187. Torque locknut (35) to 400 pounds-feet and install washer (34) and set-screw (33). Torque set-screw (33) to 1 pound-feet, and lockwire using MS20995C32.

NOTE: If new fork is being installed, drill hole in fork (0.125 + 0.010 inch diameter and 0.20 inch deep) for set-screw (33), after torquing locknut (35).

(16) Lubricate scraper (72) with grease, Specification MIL-G-81322 or equivalent. Position locknut (70), washer (71), scraper (72) and bearing retainer (73) (correctly oriented for assembly into outer cylinder) on piston tube of piston tube and fork sub-assembly.

(17) Install shoulder (27) on piston tube (28). Coat internal surfaces of outer cylinder and bearing (74) with hydraulic fluid, Specification MIL-H-5606 and slide piston tube of piston tube and fork assembly through journal bearing (refer to step (9)) and into bore of outer cylinder.

(18) Slide bearing retainer (73), scraper (72), washer (71) into outer cylinder bore to contact journal bearing. Install locknut (70) and torque to approximately 2 pounds-feet, using special tool T-191, to align set-screw hole in outer cylinder with hole in locknut. Install set-screw (69), tighten to a snug fit, then file flat to contour of outer cylinder.

NOTE: If replacement locknut is installed, torque locknut at assembly to 2 pounds-feet. Drill through locknut 9/64 (0.140 + 0.005) inch diameter, using smaller diameter of set-screw hole in outer cylinder at pilot hole. Install set-screw (refer to step (18)).

(19) Position rubber bumper (26) on piston tube. Coat O-rings (32) and (30) with grease, G. E. Versilube G300, and install O-ring (32), two back-up rings (31), O-ring (30) and two back-up rings (29) to floating piston (25). Position floating piston (25), flapper spacer (24) and flapper (23) on piston tube, and install shoulder nut (22) using special tool T-190. Torque shoulder nut (22) to approximately 20 pounds-feet, to align slot in shoulder nut with existing hole in piston tube. Install lockring (21).

NOTE: If replacement piston tube is installed, torque shoulder nut (22) to 20 pounds-feet, then drill through piston tube 3/32 (0.093) inch diameter, using a slot in nut as pilot.

(20) Install chain (19) and quick-release pin (18) to upper torque arm assembly. Engage quick-release pin in upper and lower torque arms.

(21) If slipper ring (17) has been removed from guide bearing (13), a new slipper ring can be fitted after submerging in boiling water. Where guide bearing has a corresponding groove, install split ring before application of slipper ring. Position orifice plate (15), damping plate (14) and guide bearing (13) on lower end of support tube (9), and secure with set-screw (12). Press fit pellet (11) to cover set-screw, and smooth edge of pellet using No. 60 emery cloth.

(22) Coat O-rings (10) and (4) with grease, G. E. Versilube G300. Install O-ring (10) in groove at upper end of support tube (9). Position end cap (8) and secure with nut (7), using special tool T-188. Tighten nut to align threaded hole in end cap with hole in nut, then install machine screw (6). Install O-ring (4) in groove in end cap sub-assembly. Screw end cap sub-assembly into outer cylinder, using special tool T-188 engaged with nut (7) and torque to 20 pounds-feet. Install set-screw (3) and torque to 2 pounds-feet. Lockwire machine screw (6) to nut (7) using MS20995C32.

(23) Install air charging valve (1) and valve cap (2) to end cap sub-assembly except when shock strut assembly is to be immediately filled with hydraulic fluid (refer to TESTING).

B. Assemble Nose Gear Shock Strut, Part No. 71-300-5 and 71-300-7 (Figure 1102)

(1) Install two bushings (152), with spacer (153) between bushings, to outer cylinder (154). Secure two washers (149) with two pins (151). Temporarily attach bolt (150), washer (148) and nut (147).

(2) Position cable guard assembly and secure with set-screw (137). Tighten two nuts (139) on two screws (140) to secure both halves of cable guard (141) with guard pins (142) to outer cylinder.

(3) Position bushing (145), two thrust washers (144), and secure in outer cylinder with two pins (143). Assemble slider (134) with pivot (135) and bushing (136) to pulley shaft (130), and secure with washer (133) and nut (132). Torque nut (132) to 6 pounds-feet and install cotter pin (131). Position pulley shaft on outer cylinder and secure with washer (129), washer (128) and nut (127). Finger tighten nut (127), then tighten to next slot and install cotter pin (126). Check pulley shaft for freedom of movement.

(4) Coat O-rings (124) with grease, G. E. Versilube G300, and install two O-rings (124) two back-up rings (123), swivel (122), collar (121) and spring pin (120) at both ends of swivel bolt (125). Install two packings (119) and two unions (118) to swivel bolt. Position swivel fitting assembly on outer cylinder, ensuring that end with engraved marking RET is towards the top of outer cylinder, and secure with two bolts (116). Lockwire bolts (116) using MS20995C20.

(5) If removed for replacement of defective parts, install bearing (114), two bushings (113) and bushing (112) to steering collar (115). Bearing and bushings must be a press fit in steering collar (refer to FITS AND CLEARANCES). Install stud (109) to steering collar and secure with spring pin (108). Temporarily thread locknut (111) to stud. Install two dust rings (104), two thrust washer (103) and two pins (102) to steering collar.

NOTE: If a new stud (109) or steering collar (115) is fitted, drill 0.125 to 0.129 inch diameter hole for spring pin (108) through steering collar and/or stud using hole in steering collar as pilot. Round off ends of hole with 0.005 to 0.010 inch radius. Drill hole for cotter pin (110) through stud after assembly to steering collar; measure a dimension of 0.938 to 0.943 inch along stud from face of steering collar, and use a 3/32 inch diameter drill.

(6) If removed for replacement of defective parts, install two bushings (101) in upper torque arm (100). Bushings must be a press fit in upper torque arm (refer to FITS AND CLEARANCES). Lubricate latch pin (99) and spring (98) with grease MIL-G-23827. Position latch pin (99), spring (98) and spring retainer (97), and secure to upper torque arm with screws (96), washers (95) and nuts (94).

(7) Position upper torque arm assembly on steering collar assembly and install bolt (90) with spring (92). Hold upper torque arm to its uppermost position, compress spring (92) to allow cam (91) to readily slide on over the flats of bolt (90). Secure bolt with washer (89) and nut (88). Finger tighten nut (88), then tighten to next slot and install cotter pin (87). Depress upper torque arm, then release and check that arm returns upward by spring action. Position cover (107) on steering collar assembly and secure with screws (106).

(8) Position two thrust washers (86), bushing (85) and steering collar assembly, complete with upper torque arm assembly on outer cylinder. Ensure thrust washer (84) is tight on shoulder and install cylinder nut (83). Tighten cylinder nut to 30 pounds-feet, then back off to next slot and check steering collar for freedom of movement. Lock cylinder nut with locking key (82), locking clip (81), two blocks (80), screw (79), washer (78) and nut (77).

NOTE: Refer to DESCRIPTION AND OEPRATION, Tables 4 and 5 for variations due to special shimmy damper installation.

(9) Install journal bearing assembly consisting of bearing (75) and sleeve (76) in bore of outer cylinder (154).

(10) Install four bushings (69) to lugs on fork; coat inside of axle with Compound Type 1, MIL-C-16173 (Shell H927); install axle (68), spacer (67), adjustment spacer (65), retaining nut (64), two towing spools (62) and secure to fork with two bolts (61), two washers (60) and two nuts (59); install lockring (66) securing spacer (67) to axle; thread retaining nut onto adjustment spacer, and temporarily secure with setting screws (63).

(11) Install two bushings (58), two dust rings (57), two thrust washer (56) and two pins (55) to fork. Install bushing (53), two dust rings (52), two thrust washers (51) to lower torque arm (54), and secure with four screws (50). Position lower torque arm assembly on fork, and secure with bolt (48), washer (47) and nut (46). Finger tighten nut (46), then tighten to next slot and install cotter pin (45). Check lower torque arm for freedom of movement.

(12) Install bushing (44) and dowel (43) to fork (42). Retain dowel (43) by peening.

NOTE: Do not insert dowel (43) too far below surface of fork or fouling may occur when installing locknut (35).

(13) Assemble cartridge assembly for shock strut assembly Part No. 71-300-5 only, as detailed in Paragraph 1.A., step (14), and refer to Figure 1101.

(14) Assemble cartridge assembly for shock strut assembly Part No. 71-300-7 only, as follows:

(a) If removed for replacement of defective part, install cap plug (39) to cylinder (41). Cap plug must be a press fit in cylinder (refer to FITS AND CLEARANCES).

(b) Coat O-ring (36) with grease, G. E. Versilube G300, and install with back-up ring (37) to cap plug (39) of cartridge assembly.

(15) Position piston tube (28) in fork, and ensure that slot engages dowel (43). Install cartridge assembly within piston tube, lubricate contact surface of fork (for locknut (35)) with machine oil, and secure piston tube to fork with locknut (35) using special tool T-187. Torque locknut (35) to 400 pounds-feet, and install washer (34) and set-screw (33). Torque set-screw (33) to 1 pound-feet, and lockwire using MS20995C32.

NOTE: If new fork is being installed, drill hole in fork (0.125 + 0.010 inch diameter and 0.20 inch deep) for set-screw (33), after torquing locknut (35).

(16) Lubricate scraper (73) with grease, Specification MIL-G-81322 or equivalent. Position locknut (71), washer (72), scraper (73) and bearing retainer (74) (correctly oriented for assembly in outer cylinder) on piston ube of piston tube and fork sub-assembly.

(17) Install shoulder (27) on piston tube (28). Coat bores of outer cylinder and journal bearing assembly (refer to step (9)) with hydraulic fluid, Specification MIL-H-5606 and slide piston tube of piston tube and fork assembly through journal bearing and into bore of outer cylinder.

(18) Slide bearing retainer (74), scraper (73), and washer (72) into bore of outer cylinder to contact journal bearing. Install locknut (71) and torque to approximately 2 pounds-feet using special tool T-191, to align set-screw hole in outer cylinder with hole in locknut. Install set-screw (70), tighten to a snug fit and file flat to contour of outer cylinder.

NOTE: If replacement locknut is installed, torque locknut at assembly to 2 pounds-feet. Drill through locknut 9/64 (0.140 + 0.005) inch diameter, using smaller diameter of set-screw hole to outer cylinder as pilot hole. Install set-screw (refer to step (18)).

(19) Position rubber bumper (26) on piston tube. Coat O-rings (32) and (30) with grease G.E. Versilube G300, and install O-ring (32), two back-up rings (31), O-ring (30) and two back-up rings (29) to floating piston (25). Position floating piston (25) flapper spacer (24) and flapper 923) on piston tube, and install shoulder nut (22) using special tool T-190. Torque shoulder nut (22) to approximately 20 pounds-feet, to align slot in shoulder nut with existing hole in piston tube. Install locking (20).

NOTE: If replacement piston tube is installed, torque shoulder nut (22) to 20 pounds-feet and drill through piston tube 3/32 (0.093) inch diameter using slot in shoulder nut as pilot.

(20) Install chain (19) and quick-release pin (18) to upper torque arm assembly. Engage quick-release pin in upper and lower torque arms.

(21) If slipper ring (17) has been removed from guide bearing (13), a new slipper ring can be fitted after submerging in boiling water. Where guide bearing has a corresponding groove, install split ring before installation of slipper ring. Position orifice plate (15), damping plate (14) and guide bearing (13) on lower end of support tube (9), and secure with set-screw (12). Press fit pellet (11) to cover set-screw, and smooth edge of pellet using No. 60 emery cloth.

(22) Coat O-rings (10) and (4) with grease, G. E. Versilube G300. Install O-ring (10) in groove at upper end of support tube (9). Position end cap (8) on support tube and secure with nut (7), using special tool T-188. Tighten nut to align threaded hole in end cap with hole in nut. Install O-ring (4) in groove in end cap sub-assembly. Screw sub-assembly into outer cylinder, using special tool T-188 on nut (7) and torque to approximately 20 pounds-feet. Install set-screw (3) and torque to 2 pounds-feet. Lockwire machine screw (6) to nut (7) using MS20995C32.

(23) Install air charging valve (1) and valve cap (2) to end cap sub-assembly except when shock strut assembly is to be immediately filled with hydraulic fluid (refer to TESTING).

C. Assembly Nose Gear Shock Strut, Part No. 71-300-9 and 71-300-11 (Figure 1103)

(1) Install two bushings (158) with spacer (159) between bushings, to outer cylinder (160). Secure two washers (155) with two pins (157). Temporarily attach bolt (156) washer (154) and nut (153).

(2) Position cable guard assembly and secure with set-screw (143). Tighten two nuts (145) to secure both halves of cable guard (147) with guard pins (148) to outer cylinder.

(3) Position bushing (151), two thrust washers (150), and secure in outer cylinder with two pins (149). Assemble slider (140) with pivot (141) and bushing (142) to pulley shaft (136), and secure with washer (139) and nut (138). Torque nut (138) to 6 pounds-feet and install cotter pin (137). Position pulley shaft on outer cylinder, and secure with washer (135), washer (134) and nut (133). Finger tighten nut (133) then tighten to next slot and install cotter pin (132). Check pulley shaft for freedom of movement.

(4) Coat O-rings (130) with grease, G. E. Versilube G300, and install two O-rings, two back-up rings (129), swivel (128), collar (127) and spring pin (126) at both ends of swivel bolt (131). Install two packings (125) and two unions (124) to swivel bolt. Position swivel fitting assembly on outer cylinder, ensuring that end with engraved marking RET is towards the top of outer cylinder, and secure with two bolts (122). Lockwire bolts (122) using MS20995C20.

(5) If removed for replacement of defective parts, install bearing (118), two bushings (119), and bushing (117) and lubricator (120) to steering collar (121). Bearing and bushings must be a press fit in steering collar (refer to FITS AND CLEARANCES).

NOTE: If steering collar assembly has been repaired, shims may be required under flanges of bushings (119) (refer to DISASSEMBLY).

After installation, line ream bushings (119) to 0.375 + 0.005 inch diameter.

(6) Install stud (114) to steering collar and secure with spring (113). Temporarily thread locknut (116) to stud.

NOTE: If a new stud (114) or steering collar (121) is fitted, drill 0.125 to 0.129 inch diameter hole for spring pin (113) through steering collar and/or stud using hole in steering collar as pilot. Round off ends of hole with 0.005 to 0.010 inch radius. Drill hole for cotter pin (115) through stud after assembly to steering collar; measure a dimension of 0.098 to 0.943 inch along stud from face of steering collar, and use a 3/32 inch diameter drill.

(7) If removed for replacement of defective parts, install two bushings (108) in upper torque arm (107). Bushings must be a press fit in upper torque arm (refer to FITS AND CLEARANCES). Lubricate latch pin (106), spring (105) and spring retainer (104), and secure to upper torque arm with screws (103), washers (102) and nuts (101).

(8) Position two dust rings (109) at bushings (119) on steering collar assembly. Position upper torque arm assembly on steering collar assembly and install bolt (97) with spring (99). Hold upper torque arm to its uppermost position, compress spring (99) to allow cam (98) to readily slide on over the flats of bolt (97). Secure bolt with washer (96) and nut (95). Finger tighten nut (95), then tighten to next slot and install cotter pin (94). Depress upper torque arm, then release. Check that torque arm is returned upwards by spring action. Position cover (112) on steering collar assembly and secure with screws (111).

(9) Position two thrust washers (93), bushings (92) and steering collar assembly, complete with upper torque arm assembly on outer cylinder. Ensure thrust washer (91) is tight on shoulder and install cylinder nut (90). Tighten cylinder nut to 30 pounds-feet, then back off to next slot and check steering collar for freedom of movement. Lock cylinder nut with locking key (89), locking clip (88), two blocks (87), screw (86), washer (85) and nut (84).

NOTE: Refer to DESCRIPTION AND OPERATINON, Tables 4, 5 and 5A for variations due to special shimmy damper installation.

(10) Install journal bearing assembly, consisting of bearing (82) and sleeve (83) in bore of outer cylinder.

(11) Install four bushings (52) to lugs on fork; coat inside of axle with Compound Type 1, MIL-C-16173 (Shell H927); install axle (76), spacer (75), adjustment spacer (73), retaining nut (72), two towing spools (70), and secure to fork with two bots (69), two washers (68) and two nuts (67); install lockring (74) securing spacer (75) to axle; thread retaining nut onto adjustment spacer, and temporarily secure with setting screws (71).

(12) If removed for replacement of defective parts, install lubricator (54) and two bushings (50) to fork (55). Install two dust rings (66).

NOTE: If fork assembly (55) has been repaired, shims may be required under flanges of bushings (50) (refer to DISASSEMBLY).

After installation, line ream bushings (50) to 0.375 + 0.0005 inch diameter.

(13) Install two dust rings (62) and two bushings (61) to lower torque arm (64). If removed for replacement of defective part, install lubricator (63). Position lower torque arm assembly on fork, and secure with bolt (59), washer (58) and nut (57). Finger tighten nut (57), then tighten to next slot and install cotter pin (56). Check lower torque arm for freedom of movement.

NOTE: Bushings (61) installed as part of Mod 6/1377 may require shims (Part No. 71-311-9) under the flanges of the bushings (refer to DISASSEMBLY) to maintain 0.001 inch maximum interference fit to 0.002 inch maximum clearance at joint between upper and lower torque arms.

(14) Assemble cartridge assembly as follows:

(a) If removed for replacement of defective part, install cap plug (45) to cylinder (46). Cap plug must be a press fit in cylinder (refer to FITS AND CLEARANCES).

(b) Coat O-ring (42) with grease, G. E. Versilube G300, and install with back-up ring (43) to cap plug (45) of cartridge assembly.

(15) If removed for replacement of defective parts, coat bushings (48) and (49) with epoxy chromate primer and install to fork while primer is still wet. Install bushing (53) aligning holes in bushings (53), (48) and (49).

(16) Position piston tube (31) in fork, aligning slot with holes in bushings. Install cartridge assembly within piston tube and insert diaphragm (37). Lubricate surface of fork to be contacted by locknut (34) with machine oil and install shim (36), washer (35), and locknut (34) to piston tube (31).

NOTE: To maintain alignment between piston tube and bushings during following locknut tightening procedure, it is recommended that a headed pin, 0.25 inch dia and approximately 0.625 inch in length be inserted through bushing (49), bushing (53) and slot in piston tube (31).

(17) Using special tool T-187, torque locknut (34) to 400 pounds-feet. If the elongated hole in the locknut is visible through the bushing (48), increase torque until holes in locknut and bushing align.

NOTE: If hole in locknut is not visible through bushing (48) after initial torque loading, reduce thickness of shim (36) as necessary and repeat tightening procedure.

(18) Remove alignment pin (refer to step (16)) if fitted.

(19) Coat bores of bushing (48) an (49), lockbolt (41) and washer (40) with epoxy chromate primer and install in fork while primer is still wet. Lock nut (39) with cotter pin (38).

(20) Position locknut (78), washer (79), scraper (80) and bearing retainer (81) (correctly oriented for assembly in outer cylinder) on piston tube (31) of piston tube and fork sub-assembly.

NOTE: On shock strut assembly 71-300-9, lubricate scraper (80) with grease, Specification MIL-G-81322 or equivalent, prior to assembly.

(21) Install shoulder (30) to piston tube (31) of piston tube and fork assembly. Coat internal surfaces of outer cylinder and journal bearing previously installed (refer to step (10)), with hydraulic fluid MIL-H-5606 and slide piston tube of piston tube and fork assembly through journal bearing into bore of outer cylinder.

(22) Position bearing retainer (81), scraper (80) and washer (79) in bore of outer cylinder adjacent to journal bearing. Install locknut (78) and using special tool T-191, torque locknut to approximately 2 pounds-feet to align set-screw hole in outer cylinder with hole in locknut. Install set-screw (77), tighten to a snug fit and file flat to contour of outer cylinder.

NOTE: If replacement locknut is installed, torque locknut at assembly to 2 pounds-feet, then drill through locknut 9/64 (0.140 + 0.0005) inch diameter, using smaller diameter of set-screw hole in outer cylinder as pilot hole. Install set-screw (77) (refer to step 22)).

(23) On shock strut assembly Part No. 71-300-9 only: Install ring (32) and ring (33) in floating piston (28). Ensure that bearing halves (27) are a matched set, then position bearing halves in floating piston. Position floating piston sub-assembly, flapper spacer (25) and flapper (24) on piston tube. Install shoulder nut (23) using special tool T-190. Torque shoulder nut to approximately 20 pounds-feet to align slot in shoulder nut with existing hole in piston tube. Install lockring (22) through nut and piston tube.

(24) On shock strut assembly Part No. 71-300-11 only: Install ring (32) and ring (33) to floating piston (28). Position floating piston (28) and flapper spacer (25) on piston tube, and install shoulder nut (23) using special tool T-190. Torque shoulder nut (23) to approximately 20 pounds-feet to align slot in shoulder nut with existing hole in piston tube. Install lockring (22) through nut and piston tube.

NOTE: When installing rings (32) and (33), ensure the radii of back-up portions face radii of main ring.

If replacement piston tube is installed (refer to steps (23) and (24)), torque shoulder nut to 20 pounds-feet and drill through piston tube 3/32 (0.093) inch diameter, using a slot in shoulder nut as pilot.

(25) Install chain (20) and quick-release pin (19) to upper torque arm assembly. Engage quick-release pin in upper and lower torque arms. Shim bushings (61) with shims Part No. 71-311-9 if necessary to obtain a 0.001 inch interference fit to 0.002 inch maximum clearance at joint formed by upper and lower torque arm.

(26) If slipper ring (18) has been removed from guide bearing (14), a new slipper ring can be fitted after submerging in boiling water. Where guide bearing has a corresponding groove, install split ring before installation of slipper ring. Position orifice plate (16), damping plate (15) and guide bearing (14) on lower end of support tube (9) and secure with set-screw (13). Press fit pellet (12) to cover set-screw, and smooth edge of pellet using No. 60 emery cloth.

(27) Coat O-rings (11) and (4) with grease G. E. Versilube G300 and install O-ring (11) in groove at upper end of support tube (9). Position end cap (8) and secure with nut (7), using special tool T-188. Tighten nut (7) to align threaded hole in end cap with hole in nut and install machine screw (6). Install O-ring (4) in groove in end cap. Screw end cap sub-assembly to outer cylinder, and torque to approximately 20 pounds-feet, engaging special tool T-180 with nut (7). Install set-screw (3) and torque to 2 pounds-feet. Lockwire machine screw (6) to nut (7) using MS20995C32.

(28) Install air charging valve (1) and valve cap (2) to end cap sub-assembly except when shock strut assembly is to be immediately filled with hydraulic fluid (refer to TESTING).

(29) Lubricate upper and lower torque arms through lubricators (54), (63) and (120) using grease MIL-G-81322.

D. Assemble Nose Gear Shock Struts, Part No. 71-300-15, -17, -19, -21, -23, -25, -27, -29, -31 and -33 (Figure 1104)

CAUTION: FIT BETWEEN OUTER CYLINDER BORE AND CYLINDER SLEEVE IS CLOSE TOLERANCE. CARE SHOULD BE EXERCISED TO ENSURE 'IN-LINE' ASSEMBLY.

(1) Apply an even coating of silicone grease, Specification MIL-I-8660 or equivalent to outer surface of sleeve (171) and bore of cylinder (170) in area of contact with sleeve. Assemble sleeve into cylinder, using firm hand pressure. Remove excess silicone grease from cylinder bore and external surfaces with trichlorethylene.

(2) Install two bushings (167), with spacer (168) between bushings, to outer cylinder. Secure two washers (164) with two pins (166). Temporarily attach bolt (165), washer (163) and nut (162).

(3) Position cable guard assembly and secure with set-screw (152). Tighten two nuts (154) to secure both halves of cable guard (156) with guard pins (157) to outer cylinder.

(4) Position bushing (160), two thrust washers (159), and secure in outer cylinder with two pins (158). Assemble slider (149) with pivot (150) and bushing (151) to pulley shaft (145), and secure with washer (148) and nut (147). Torque nut (147) to 6 pounds-feet and install cotter pin (146). Position pulley shaft on outer cylinder, and secure with washer (144), washer (143) and nut (142). Finger tighten nut (142), then tighten to next slot and install cotter pin (141). Check pulley shaft for freedom of movement.

(5) Coat O-rings (139) with grease, G. E. Versilube G300, and install two O-rings, two back-up rings (138), swivel (137), collar (136) and spring pin (135) at both ends of swivel bolt (140). Install two packings (134) and two unions (133) to swivel bolt. Position swivel fitting assembly on outer cylinder, ensuring that end with engraved marking RET is towards the top of outer cylinder, and secure with two bolts (131). Lockwire bolts (131) using MS20995C20.

(6) On shock strut assembly Part No. 71-300-15 only: Install the following parts if removed for replacement of defective parts: bearing (124), two bushings (126), bushing (123) and two lubricators (127) to steering collar (128). Bearing and bushings must be press fit in steering collar (refer to FITS AND CLEARANCES).

(7) On shock strut assembly Part No. 71-300-17, -19, -21, -23, -25, -27, -29, -31 and -33 only: Install the following parts if removed for replacement of defective parts: bearing (125), two bushings (126), bushing (123) and two lubricators (127) to steering collar (128). Bearing and bushings must be press fit in steering collar (refer to FITS AND CLEARANCES).

NOTE: If a new stud (120) or steering collar (128) is fitted, drill 0.125 to 0.129 inch diameter hole for spring pin (119) through steering collar and/or stud using hole in steering collar as pilot. Round off ends of hole with 0.005 to 0.010 inch radius. Drill hole for cotter pin (121) through stud after assembly to steering collar; measure a dimension of 0.938 to 0.943 inch along stud fro face of steering collar, and use a 3/32 inch dia drill.

After installation, line bushings (126) to 0.375 + 0.0005 inch diameter.

(8) On shock strut assembly Part No. 71-300-15, -17, -19, -21 and -23 only: Install stud (120) to steering collar and secure with spring pin (119). Temporarily thread locknut (122) to stud.

NOTE: If a new stud (120) or steering collar (128) is fitted, drill 0.125 to 0.129 inch diameter hole for spring pin (119) through steering collar and/or stud using hole in steering collar as pilot. Round off ends of hole with 0.005 to 0.010 inch radius. Drill hole for cotter pin (121) through stud after assembly to steering collar; measure a dimension of 0.938 to 0.943 inch along stud fro face of steering collar, and use a 3/32 inch dia drill.

(9) On shock strut assemblies Part No. 71-300-25, -27, -29, -31 and -33 only: Install stud (120) to steering collar and secure with spring pin (119). Position washer (123A) on stud, then temporarily thread locknut (122) to stud. Observe requirements in NOTE following step (8).

(10) If removed for replacement of defective parts, install two bushings (113) in upper torque arms (112). Bushings must be a press fit in upper torque arm (refer to FITS AND CLEARANCES). Lubricate latch pin (111), spring (110) and spring retainer (109), and secure upper torque arm with screws (108), washers (107) and nuts (106).

(11) Position two dust rings (114) at bushings (126) on steering collar assembly. Position upper torque arm assembly on steering collar assembly and install bolt (102) with spring (104). Hold upper torque arm to its uppermost position, compress spring (104), to allow cam (103) to readily slide on over the flats of bolt (102). Secure bolt with washer (101) and nut (100). Finger tighten nut (100), then tighten to next slot and install cotter pin (99). Depress upper torque arm, then release. Check that arm returns upward due to spring action.

(12) On shock strut assembly No. 71-300-15 only: Position two thrust washers (94), bushing (98) and steering collar assembly, complete with upper torque arm assembly on outer cylinder. Ensure thrust washer (93) is tight on shoulder and install cylinder nut (92). Tighten cylinder nut to 30 pounds-feet, then back off to next slot and check steering collar for freedom of movement. Lock cylinder nut with locking key (91), locking clip (90), two blocks (89), screw (88), washer (87) and nut (86).

NOTE: Refer to DESCRIPTION AND OPERATION, Table 5A for variations due to special shimmy damper installation on shock strut assembly 71-300-15 only.

(13) On shock strut assemblies Part No. 71-300-17, -19, -21, -23, -25, -27, -29, -31 and -33 only: Ensure that mating surfaces of wear washer (129) (bonded to steering collar) and friction disc (97) (bonded to outer cylinder) are clean and dry, then position bushing (98) and steering assembly complete with upper torque arm on outer cylinder. Position thrust ring (95), and shim washer (96) on outer cylinder and install cylinder nut (92) finger tight. With spring balance attached to stud (120) (which is located three inches from center of shock strut), check that force required to rotate steering collar is less that 20 pounds. Adjust steering collar to provide shimmy damping as follows:

(a) Tighten cylinder nut (92) until force required to rotate steering collar, after 10 cycles, is 50 to 70 pounds at end of extended upper torque link.

(b) Note relative position of nut slot and cylinder keyway, back off nut and peel off one or two laminations of shim washer (96) as required to align nearest slot and keyway. Maximum misalignment: 10º equals 3 shim laminations of 0.002 inch.

(c) Tighten cylinder nut and lock with locking key (91), locking clip (90), two blocks (89), screw (88), washer (87) and nut (86).

(14) On shock strut assembly Part No. 71-300-15, -17 and -19 only: Install journal bearing sub-assembly (85) (consisting of bearing (85A) and sleeve (85B) in bore of outer cylinder.

(15) On shock strut assembly Part No. 71-300-21, -23, -25, -27, -29, -31 and -33 only: Install journal bearing (84) in bore of outer cylinder.

(16) Install four bushings (53) to lug on fork. Coat inside of axle (76) with Compound Type 1, MIL-C-16173 (Shell H927). Install axle, spacer (75), adjustment spacer (73), retaining nut (72), two towing spools (70) and secure to fork with two bolts (69), two washers (68) and two nuts (67); install lockring (74), securing spacer (75) to axle; thread retaining nut onto adjustment spacer, and temporarily secure with setting screws (71).

(17) If removed for replacement of defective parts, install lubricator (55) and two bushings (52) to fork (56). Install two dust rings (66).

NOTE: If fork assembly (56) has been repaired, shims may be required under flanges of bushings (52) (refer to DISASSEMBLY).

After installation, line ream bushings (52) to 0.375 + 0.0005 inch diameter.

(18) Install two dust rings (62) and two bushing (61) to lower torque arm (65). If removed for replacement of defective part, install lubricator (64). Position lower torque arm assembly on fork, and secure with bolt (60), washer (59) and nut (58). Finger tighten nut (58), then tighten to next slot and install cotter pin (57). Check lower torque arm for freedom of movement.

NOTE: Bushings (61) may require shims (172) under the flanges of the bushings (refer to step (35)).

(19) Assemble cartridge assembly as follows:

(a) If removed for replacement of defective part, install cap plug (47) to cylinder (48). Cap plug must be a press fit in cylinder (refer to FITS AND CLEARANCES).

(b) Coat O-ring (44) with grease, G. E. Versilube G300, and install with back-up ring (45) to cap plug (47) of cartridge assembly.

(20) On shock strut assembly Part No. 71-300-15, -17, -19, -21 and -23 only: (if removed for replacement of defective parts). Coat bushings (49) and (50) with epoxy chromate primer and install to fork while primer is still wet. Install bushing0 (54), aligning holes in bushings (54), (49) and (50).

(21) On shock strut assemblies Part No. 71-300-25, -27, -29, -31 and -33 only: (if removed for replacement of defective parts). Coat two bushings (49A) with epoxy chromate primer and install to fork while primer is still wet. Install bushing (54), aligning holes in bushings (54) and (49A).

(22) On shock strut assembly Part No. 71-300-15, -17, -19, -21 and -23 only: Position piston tube (31) in fork, aligning slot with holes in bushings. Install cartridge assembly within piston tube and insert diaphragm (39). Lubricate surface of fork to be contacted by locknut (36), with machine oil and install shim (38), washer (37) and locknut 936) to piston tube (31).

NOTE: To maintain alignment between piston tube and bushings during following locknut tightening procedure (step 23)), it is recommended that a headed pin, 0.25 inch dia and approximately 0.625 inch in length be inserted through bushing (50), bushing (54) and slot in piston tube (31).

(23) On shock strut assembly Part No. 71-300-15, -17, -19, -21 and -23 only: Use special tool T-187 to torque locknut (36) to 400 pounds-feet. If the elongated hole in the locknut is visible through the bushing (49), increase torque until holes in locknut and bushing align.

NOTE: If hole in locknut is not visible through bushing (49) after initial torque loading, reduce thickness of shim (38) as necessary and repeat tightening procedures.

(24) On shock strut assemblies 71-300-25, -27, -29, -31 and -33 only: Position piston tube (31) in fork, aligning slot with holes in bushings. Install cartridge assembly with piston tube and insert diaphragm (39). Lubricate surface of fork to be contacted by locknut (36A) with machine oil and install shim (38), washer (37) and locknut (36A) to piston tube (31).

NOTE: To maintain alignment between piston tube and bushings during following locknut tightening procedure, it is recommended that a headed pin, 0.25 inch dia and approximately 0.625 inch in length be inserted through one bushing (49A), bushing (54) and slot in piston tube (31).

(25) On shock strut assemblies 71-300-25, -27, -29, -31 and -33 only: Use special tool T-187 to torque locknut (36A) to 400 pounds-feet. Align two holes 180º apart in locknut with holes in bushing (54), bushing (49A) and slot in piston tube (31).

(26) On shock strut assembly Part No. 71-300-15, -17, -19, -21 and -23 only: Remove alignment pin if fitted (refer to step (22)). Coat bores of bushing (49) and (50), lockbolt (43) and washer (42) with epoxy chromate primer and install in fork while primer is still wet. Lock nut (41) with cotter pin (40).

(27) On shock strut assemblies 71-300-25, -27, -29, -31 and -33 only: Remove alignment pin if fitted (refer to step (24)), coat bores of bushings (49A), lockbolts (43A) and washer (42A) with epoxy chromate primer and install fork while primer is still wet, and install one lockbolt in each bushing (49A). Insert washers (42A), washers (176) and self-locking nuts (41A) through square hole in locknut (36A) to engage threads on lockbolts (43A). Tighten nuts (41A).

(28) On shock strut assembly Part No. 71-300-15, -17 and -19 only: Position locknut (79), washer (80), scraper (82), and bearing retainer (83) (correctly oriented for assembly into outer cylinder) over piston tube (31) of piston tube and fork sub-assembly.

(29) On shock strut assemblies 71-300-21, -23, -25, -27, -29, -31 and -33 only: Lubricate scraper (81) with grease, Specifications MIL-G-81322 or equivalent. Position locknut (78) and scraper (81) (correctly oriented for assembly in outer cylinder) over piston tube (31) of piston tube and fork sub-assembly.

(30) Coat internal surfaces of outer cylinder sleeve (171) and journal bearing (84) or (85), as applicable (refer to steps (14) and (15)), with hydraulic fluid MIL-H-5606.

(31) Install shoulder (30) to piston tube (31) of piston tube and fork sub-assembly. Slide piston tube of piston tube and fork sub-assembly through journal bearing into outer cylinder. Position bumper (29) on piston tube.

(32) Slide locknut (79) or (78), as applicable and items assembled over piston tube in step (28) or (29) upwards into cylinder bore to contact journal bearing. Install locknut using special tool T-191 and torque to approximately 2 pounds-feet to align set-screw hole in outer cylinder with hole in locknut. Install set-screw (77) to a snug fit and file it flat to contour of outer cylinder.

NOTE: If replacement locknut (78) or (79) is installed, torque locknut at assembly to 2 pounds-feet. Drill through locknut 9/64 (0.140 + 0.005) inch diameter, using smaller diameter of set-screw hole in outer cylinder as pilot hole. Install set-screw (refer to step (32)).

(33) On shock strut assembly Part No. 71-300-15 and -17 only: Install rings (32) and (34) in grooves in floating piston (27) (refer to NOTE following). Position piston and flapper spacer (26) on piston tube (31) and install shoulder nut (24), using special tool T-190. Torque shoulder nut to approximately 20 pounds-feet to align nearest slot in nut with existing hole in piston tube. Install lockring (23).

NOTE: When installing rings (32) and (34) or rings (33) and (35) (step 34) into floating piston, ensure that radii of back-up rings face radii at root of main T-ring.

(34) On shock strut assembly Part No. 71-300-19, -21, -23 and -25 only: Install rings (33) and (35) into grooves in floating piston (28) (refer to NOTE in step (33)). Position piston on piston tube (31). Assemble locking (23) on nut (25); check that it is correctly seated in groove and outer diameter of lockring does not exceed 2.550 inches. (Discard lockring that does not meet this requirement). Lift lockring tongue from 0.093 inch diameter hole and hole pre-positioned in 0.37 inch sot. Install nut, using special tool T-190. Torque nut to approximately 20 pounds-feet, to align nearest slot in nut with existing hole in piston tube. Seat lockring tongue in 0.093 inch diameter hole to secure nut. Check that lockring is seated correctly.

NOTE: If replacement piston tube (31) is installed, torque shoulder nut (24) (step (33)) or shoulder nut (25) (step (34)) to 20 pounds-feet and drill through piston tube 3/32 (0.093) inch diameter using slot in nut as pilot.

(35) On shock strut assembly 71-300-27, -29, -31 and -33 only: Install rings (33) and (35) into grooves in floating piston (28) (refer to NOTE in step (33)). Position piston on piston tube (31); install shoulder nut (25A) using special tool T-190 and torque to approximately 20 pounds-feet, and align locking holes. Install lockring screw (23B) and align hole in head of screw with groove in nut. Secure locking screw with cotter pin (23A).

CAUTION: COTTER PIN (23A) MUST NOT PROTRUDE FROM GROOVE.

NOTE: If replacement piston tube (31) is installed, torque shoulder nut (25A) to 20 pound-feet using special tool T-190. Using hole in nut, drill #29 (0.136 inch dia) hole through piston tube (31). Remove nut and tap hole in piston to #8-32 UNC-2B. Deburr parts.

(36) Install chain (20) and quick-release pin (19) to upper torque arm assembly. Engage quick-release pin in upper and lower torque arms. Shim bushings (61) with equal thickness of shim (172) to obtain 0.001 inch maximum interference fit to 0.002 inch maximum clearance at joint formed by the mating lugs of the upper and lower torque arms.

(37) If slipper ring (18) has been removed from guide bearing (14), a new slipper ring can be fitted after submerging in boiling water. Where guide bearing has a corresponding groove, install split ring before installation of slipper ring. Position orifice plate (16), damping plate (15) and guide bearing (14) on lower end of support tube (9), and secure with set-screw (13). Press fit pellet (12) to cover set-screw, and smooth edge of pellet using No. 60 emery cloth.

(38) Coat O-rings (11) and (4) with grease, G. E. Versilube G300 and install O-ring (11) in groove at upper end of support tube (9). Position end cap (8) and secure with nut (7), using special tool Y-188. Tighten nut (7) to align threaded hole in end cap with hole in nut and install machine screw (6). Install O-ring (4) in groove in end cap. Screw end cap sub-assembly into outer cylinder and torque to 20 pounds-feet, using special tool T-188, engaged on nut (7). Install set-screw (3) and torque to 2 pounds-feet. Lockwire machine screw (6) to nut (7) using wire MS20995C32.

(39) Install air charging valve (1) and valve cap (2) to end cap sub-assembly except when shock strut assembly is to be immediately filled with hydraulic fluid (refer to TESTING).

(40) Lubricate upper and lower torque arms through lubricators (55), (64) and (127) using grease MIL-G-81322.

E. Assemble Shock Strut Assembly and Steering Actuator and Links Sub-assembly (Figure 101)

(1) Remove temporarily attached nut (12) from stud (10) and nut (14), washer (13) and bolt (5) from lugs on outer cylinder of shock strut assembly.

NOTE: When DH Mod 6/1622 is embodied, ensure that washer (17) is located on stud (10) between steering collar (19) and actuator lever assembly (8).

(2) Position and support steering actuator (6) at leg assembly, locate actuator lever (8) on stud (10) of steering collar (9), and engage pivot (2) on slider (1) with steering lever (4). Align actuator with lugs on outer cylinder and insert bolt (5). Secure bolt with washer (13) and nut (14). Finger tighten nut (14), then tighten to next slot and install cotter pin (3). Use cotter pin Part No. MS24665-300.

(3) Install nut (12) to stud (10). Torque nut to 20 pounds-feet and install cotter pin (11). Use cotter pin Part No. MS24665-231.

(4) Remove lock key from jam nut on piston rod end. Loosen jam nut using special tool T-194.

(5) Turn leg assembly fully to right (clockwise). Turn piston to adjust rod end so that with piston firmly against internal stop, a minimum clearance of 0.010 inch and a maximum clearance of 0.020 inch is obtained between actuator lever (8) and outer cylinder of the shock strut. Tighten jam nut on piston rod end using special tool T-194. Install lock key, and lockwire using MS20995C20.

(6) Turn leg assembly fully to left (counterclockwise). Check that with piston firmly against internal stop (end cap on manifold), a minimum clearance of 0.010 inch and a maximum clearance of 0.020 inch is obtained between stud lug on steering collar and lugs on outer cylinder. If necessary, cut lockwire, remove lock key and nut from end cap, and adjust end cap using special tool T-186 to obtain clearance. Finger tighten nut on end cap, install lock key and lockwire using MS20995C20.

(7) Connect hydraulic return pipe to top swivel fitting, and hydraulic pressure pipe to bottom swivel fitting on shock strut assembly.

FITS AND CLEARANCES

1. Original Dimensions and Service Limits

   A. Refer to Table 601 for original dimensions, service limits, and disposition of parts failing to meet inspection requirements.

Table 601
Original Tolerances and Service Limits

FIG. NO. 1101	FIG. NO. 1102	FIG. NO. 1103	FIG. NO. 1104	NAME	DISCREPANCY LOCATION	ORIGINAL DIMENSIONS (INCHES)	SERVICE LIMIT (INCHES)	DISPOSITION
13	13	14	14	Guide bearing	OD	1.7460 - 1.7430	1.7410	Replace
28	28	31	31	Piston tube	OD	2.7460 - 2.7450	2.7430	) Repair (refer to
					OD	2.2470 - 2.2460	2.2440	) REPAIR)
					ID	2.2430 - 2.2450	2.2460	) or replace
					ID	1.7490 - 1.7510	1.7520	)
	39	45	47	Cap, plug	OD for cylinder fit	2.1018 - 2.1013	Must be press fit in cylinder	Replace
	41	46	48	Cylinder	ID cap location	2.1000 - 2.1007	Cap must be press fit	Replace
41				Fork	Piston tube bushing location.	2.8750 - 28.8757	2.8765	Hard anodize or replace
					Torque arm attachment bushing location.	0.4687 - 0.4691	0.4695	Replace
					Axle bushing location.	0.8120 - 1.8126	1.8132	Replace
- 41	42 - 42			Fork	Piston tube bushing location.	2.8750 - 2.8757	2.8764	Hard anodize or replace
					Torque arm attachment bushing location.	0.4687 - 0.4691	0.4695	Replace

Table 601 (Cont'd)
Original Tolerances and Service Limits

FIG. NO. 1101	FIG. NO. 1102	FIG. NO. 1103	FIG. NO. 1104	NAME	DISCREPANCY LOCATION	ORIGINAL DIMENSIONS (INCHES)	SERVICE LIMIT (INCHES)	DISPOSITION
-41	42 - 42			Fork (Cont'd)	Axle bushings locations.	1.7808 - 1.7814	1.7820	Hard anodize or replace
		55	56	Fork	Piston tube bushing location.	2.8750 - 2.8757	2.8764	Hard anodize or replace
					Axle bushing location.	1.7808 - 1.7814	1.7820	Hard anodize or replace
43	44			Bushing	OD	2.8754 - 2.8747	2.8740	Replace
					ID	2.7500 - 2.7510	2.7520	Replace
	- 44	53	54	Bushing	OD	2.8754 - 2.8747	2.8740	Replace
					ID	2.7460 - 2.7470	2.7480	Replace
47	48	59	60	Bolt	OD	0.3750 - 0.3747	0.3744	Chrome plate and grind to orig dim ($^{16}\surd$ finish) or replace
52	53			Bushing	ID	0.3750 - 0.3760	0.3770	Replace
		61	61	Bushing	ID	0.3740 - 0.3750	0.3760	Replace
		48	(49, (49A	Bushing	ID	0.2810 - 0.2820	0.2830	Replace
		49	50	Bushing	ID	0.2500 - 0.2510	0.2520	Replace
53	54	64	65	Lower torque arm (71-163)	Bushing location.	0.4687 - 0.4691	0.4695	Replace
					Bolt location.	0.3747 - 0.3756	0.3765	Replace
					Male lug - width.	0.5000 - 0.4950	0.4900	Replace
					Attachment lugs to steering collar - width between inner surfaces	3.5500 - 3.5550	3.5650	Repair by bushing
					- width across outer faces	4.5100 - 4.4900	4.4800	Replace

Table 601 (Cont'd)
Original Tolerances and Service Limits

FIG. NO. 1101	FIG. NO. 1102	FIG. NO. 1103	FIG. NO. 1104	NAME	DISCREPANCY LOCATION	ORIGINAL DIMENSIONS (INCHES)	SERVICE LIMIT (INCHES)	DISPOSITION
53	54	64	65	Lower torque arm (71-163) (Cont'd)	- width across lug (Typical 2 places)	0.4850 - 0.4650	0.4600	Replace
			- 65	Lower torque link (71-338)	Bushing location.	0.4687 - 0.4691	3.5650	Replace
					Bolt location.	0.3750 - 0.3756	4.4800	Replace
					Male lug - width. Attachment lugs to steering colalr	0.5050 - 0.5000	0.4600	Replace
					- width between inner surfaces	3.5500 - 3.5550	3.5650	Repair by bushing (refer to REPAIR)
					- width across outer surfaces	4.5100 - 4.4900	4.4800	Replace
					- width across lug (Typical 2 places)	0.4850 - 0.4650	0.4600	Replace
57	58			Bushing	ID	0.3750 - 0.3760	0.3770	Replace
		50	52	Bushing	ID	0.3750 + 0.0005 (after line ream)	0.3760	Replace
- 61				Towing spool	OD	1.3750 - 1.3740	1.3730	Replace
61	62	70	70	Towing spool	OD	1.2125 - 1.2115	1.2060	Replace
64	65	73	73	Adjustment spacer	ID	1.6260 - 1.6360	1.6310	Replace
- 66 66	67	75	75	Spacer	ID	1.6260 - 1.6360	1.6310	Replace
- 67 67	68	76	76	Axle	OD	1.6248 - 1.6243	1.6238	Chrome plate, grind and polish to orig dim. ($^{32}\surd$ finish) or replace

Table 601 (Cont'd)
Original Tolerances and Service Limits

FIG. NO. 1101	FIG. NO. 1102	FIG. NO. 1103	FIG. NO. 1104	NAME	DISCREPANCY LOCATION	ORIGINAL DIMENSIONS (INCHES)	SERVICE LIMIT (INCHES)	DISPOSITION
- 68				Bushing	OD ID	1.8137 - 1.8130 1.6260 - 1.6270	1.8123 1.6280	Replace Replace
68				Bushing	OD ID	1.7820 - 1.7815 1.6250 - 1.6260	1.7810 1.6270	Replace Replace
	69	52	52	Bushing	OD ID	1.7820 - 1.7815 1.6255 - 1.6270	1.7810 1.6280	Replace Replace
73	74	81	83	Bearing retainer	OD ID	3.1883 - 3.1863 2.7600 - 2.7620	3.1853 2.7630	Replace Replace
74				Bearing	Wall thickness (Measure in four places).	0.1255 - 0.1232	0.1202	Replace
			-84	Journal bearing	OD Smaller dia.	3.0000 - 2.9992	Must be press fit in outer cylinder	Replace
					ID	2.7485 - 2.7505	2.7515	Replace
	75	82	-85A	Bearing	Wall thickness (Measure in four places).	0.0928 - 0.0918	0.0908	Replace bearing sub-assembly 71-055
	76	83	-85B	Sleeve	ID	2.932 - 2.933	2.934	
79				Journal bearing	OD ID	3.8740 - 3.8710 3.7500 - 3.7510	3.8700 3.7520	Replace Replace
	85	92		Bushing	OD	3.8740 - 3.8730	3.8720	Chrome plate to orig dim. or replace
83	90	97		Bolt	OD Milled flats	0.3750 - 0.3747 0.3000 - 0.2950	0.3744 0.2940	Chrome plate to orig dim. or replace

Table 601 (Cont'd)
Original Tolerances and Service Limits

FIG. NO. 1101	FIG. NO. 1102	FIG. NO. 1103	FIG. NO. 1104	NAME	DISCREPANCY LOCATION	ORIGINAL DIMENSIONS (INCHES)	SERVICE LIMIT (INCHES)	DISPOSITION
84	91	98	103	Cam	Slot	0.3050 - 0.3100	0.3120	Replace
92	99	106	111	Latch Pin	OD	0.6230 - 0.6220	0.6210	Replace
					OD	0.4980 - 0.4970	0.4960	Replace
					Across flats	0.5000 - 0.4990	0.4800	Replace
93	100	107	112	Upper torque arm	ID Latch pin location	0.7810 - 0.7820	0.7830	Replace
					ID Latch pin location	0.6250 - 0.6260	0.6270	Replace
					Bushing location	0.4687 - 0.4691	Bushing must be press fit	Replace
					Bolt holes	0.3747 - 0.3756	0.3765	Replace
					Female lug fork - width between inner faces	0.5370 - 0.5420	0.5620	Install wear washers (refer to REPAIR)
					Attachment lugs to steering collar - width between inner faces	3.5500 - 3.5550	3.5600	Repair by bushing (refer to REPAIR)
					- width across outer faces	4.5100 - 4.4900	4.4800	Replace
					- width across lug (Typical 2 places)	4.850 - 0.4650	0.4600	Replace
94	101	108	113	Bushing	OD	0.4695 - 0.4692	Must be pr fit in upper torque arm	Replace
					ID	0.3755 - 0.3760	0.3765	Replace
102	109	114	120	Stud	OD	0.4991 - 0.4986	0.4981	Replace

Table 601 (Cont'd)
Original Tolerances and Service Limits

FIG. NO. 1101	FIG. NO. 1102	FIG. NO. 1103	FIG. NO. 1104	NAME	DISCREPANCY LOCATION	ORIGINAL DIMENSIONS (INCHES)	SERVICE LIMIT (INCHES)	DISPOSITION
105	112	117	123	Bushing	OD	0.7510 - 0.7507	Must be press fit in steering collar	Replace
					ID	0.4991 - 0.5001	0.5011	Replace
106	113			Bushing	ID	0.3750 - 0.3760	0.3770	Replace
		119	126	Bushing	ID	0.3750 + 0.0005 (after line ream)	0.3760	Replace
	114	118	124	Bearing	Wall thickness (Measure in four places).	0.0768 - 0.0738	0.0680	Replace
			125	Bearing	OD	4.0260 - 4.0270	Must be press fit in steering collar	Replace
					ID	3.8780 - 3.8790	3.8800	Replace
- 107				Steering collar	Stud bushing location	0.7500 - 0.7507	Bushing to be press fit	Replace
107					. Torque arm attachment	0.4687 - 0.4691	0.4695	Replace
					Journal bearing location	3.8750 - 3.8770	3.8780	Replace
	115	121	128	Steering collar	Stud bushing location.	0.7500 - 0.7507	Bushing to be press fit	Replace

Table 601 (Cont'd)
Original Tolerances and Service Limits

FIG. NO. 1101	FIG. NO. 1102	FIG. NO. 1103	FIG. NO. 1104	NAME	DISCREPANCY LOCATION	ORIGINAL DIMENSIONS (INCHES)	SERVICE LIMIT (INCHES)	DISPOSITION
	115	121	123	Steering collar (Cont'd)	Torque arm attachment bushing location.	0.4687 - 0.4691	0.4695	Replace
					Bearing location.	4.026 - 4.027	Bearing to be press fit	Replace or hard anodize
			- 116	Steering collar sub-assembly	Axial build dim.	2.6097 - 2.5695	2.5600	Replace thrust washer (71-18-5) (refer to REPAIR)
114	122	128	137	Swivel	ID	0.5420 - 0.5450	Not applic	No service limits given
117	125	131	140	Swivel bolt	OD (Typical 8 places).	0.4996 - 0.4993	Not applic	Serviceable providing there are no leaks after replacing O-rings and seals
					OD (Typical at both ends).	0.4390 - 0.4370	Not applic	
					OD (Typical 4 grooves).	0.3900 - 0.3880	Not applic	
					ID x 0.430 - 0.440 deep (Typical at both ends).	0.2480 - 0.2500	Not applic	
122	130	136	145	Pulley shaft	OD	0.5000 - 0.4996	0.4992	Replace
					ID Slider location	0.3125 - 0.3131	0.3137	Replace
126	134	140	149	Slider	OD	0.3125 - 0.3121	0.3117	Chrome plate to orig dim. or replace
127	135	141	150	Pivot	OD	0.3750 - 0.3740	0.3730	Replace
					ID	0.3747 - 0.3753	0.3759	Replace

Table 601 (Cont'd)
Original Tolerances and Service Limits

FIG. NO. 1101	FIG. NO. 1102	FIG. NO. 1103	FIG. NO. 1104	NAME	DISCREPANCY LOCATION	ORIGINAL DIMENSIONS (INCHES)	SERVICE LIMIT (INCHES)	DISPOSITION
128	136	142	151	Bushing	ID	0.3125 - 0.3135	0.3145	Replace
137	145	151	160	Bushing	ID	0.5000 - 0.5010	0.5020	Replace
142	150	156	165	Bolt	OD	0.5000 - 0.4997	0.4994	Chrome plate to orig dim. or replace
144	152	158	167	Bushing	ID	0.5000 - 0.5010	0.5020	Replace
145	153	159	168	Spacer	OD ID	0.5750 - 0.5700 0.5050 - 0.5100	Not applic Not applic	Replace Replace
-146 146	154	160		Outer cylinder (71-111-3)	OD at steering collar bearing location. ID upper end. At 16-inch deep	3.7524 - 3.7518 3.2450 - 3.2470	3.7512 3.2490 3.2550	Replace Replace Replace outer cylinder
146A	154A	160A		Outer cylinder (71-111-11)	ID Upper end. At 16-inch deep ID at piston tube bearing location. ID at pulley shaft bushing location ID at actuator attachment bushing location.	3.2450 - 3.2470 2.9985 - 2.9991 0.5934 - 0.5941 0.5934 - 0.5941	3.2490 3.2550 2.9997 0.5948 0.5948	Incorporate DH Mod 6/1537 on outer cylinder Replace Replace Replace
			170	Cylinder	OD at steering collar bearing location	3.7524 - 3.7518	3.7512	Replace

Table 601 (Cont'd)
Original Tolerances and Service Limits

FIG. NO. 1101	FIG. NO. 1102	FIG. NO. 1103	FIG. NO. 1104	NAME	DISCREPANCY LOCATION	ORIGINAL DIMENSIONS (INCHES)	SERVICE LIMIT (INCHES)	DISPOSITION
			170	Outer cylinder (Cont'd)	ID upper end of cylinder in area of contact with sleeve.	3.3800 - 3.3810	3.3820	Replace
					ID at piston tube journal bearing location (smaller dia).	2.9985 - 29991	2.9997	Replace
					ID at pulley shaft bushing location.	0.5934 - 0.5941	0.5948	Replace
					ID at actuator bushing location.	0.5934 - 0.5941	0.5948	Replace
					Axial thickness of bonded friction disc (item 97).	0.1100 - 0.1400	0.0850	Replace (refer to REPAIR)
			171	Sleeve	OD	3.3780 - 3.3770	Sleeve to be sliding fit in outer cylinder	Replace
					ID	3.2470 - 3.2450	3.2490	Replace

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TESTING

1. Procedures

   A. General

      The following tests must be carried out using hydraulic fluid MIL-H-5606.

      (1) Place assembly in a vertical position. Remove valve cap, and release air slowly.

      (2) Remove air charging valve and slowly compress the strut fully to expel oil (fork to contact cylinder).

         NOTE: If no oil is expelled, strut is almost empty. Add approximately 10 fluid ounces (300 cubic centimeters) of hydraulic fluid, while extending strut. Repeat step (2).

      (3) Extend strut fully permitting strut to suck air, then compress strut fully to expel additional oil.

      (4) Repeat step (3) five times and until no additional oil is discharged.

      (5) Add 25 fluid ounces (725 cubic centimeters) of oil while slowly extending strut.

      (6) Install pressure gauge, and with strut fully extended, inflate to 95 psi air pressure. There must be no pressure loss after 48 hours.

      (7) Ensure there is no sign of leakage at upper and lower ends of cylinder, or at joint of piston and fork.

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TROUBLESHOOTING

1. General

Refer to Table 801 for possible cause and correction of defects.

Table 801

Troubleshooting Information

TROUBLE	POSSIBLE CAUSE	CORRECTION
Hydraulic fluid leak at upper end of cylinder	Faulty O-rings at end cap assembly	Replace O-ring between end cap and cylinder and/or between end cap and support tube.
Hydraulic fluid leak at lower end of cylinder.	Faulty O-rings at floating piston on piston assembly.	Replace O-rings on floating piston.
Hydraulic fluid leak at locknut securing fork to piston tube	Faulty O-rings or packing at cartridge assembly plug.	Replace O-ring or packing on cartridge assembly plug.

NOTE: When correcting defects refer to the applicable DISASSEMBLY and REASSEMBLY procedures. After reassembly, test shock strut assembly as detailed in TESTING.

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STORAGE INSTRUCTIONS

1. Procedures

A. Preparation

(1) Release air pressure. Leave fluid in shock strut.

(2) Cap union connections on swivel fitting assembly.

(3) Secure steering actuator and steering collar assembly to shock strut assembly to prevent free movement of steering actuator. Wrap steering actuator, steering collar assembly, and actuator to outer cylinder mountings in water resistant vapor barrier material (refer to Table 901).

(4) Wrap exposed part of piston tube, and upper and lower torque arm mountings in water resistant vapor barrier material.

(5) Wrap axle, spacers, towing spools and axle mountings on fork lugs in water resistant vapor barrier material.

(6) Affix label giving following information:

(a) Part and serial number

(b) Date of Overhaul.

(c) Inspection.

Table 901

Storage Materials and Compounds

MATERIAL	SPECIFICATION OR MANUFACTURER
Barrier Material	MIL-B-121

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SPECIAL TOOLS

1. General

Refer to Table 1001 for special tools required for the overhaul procedure detailed in this manual..

Table 1001

Special Tools and Equipment

HEROUX PART NO.	DESCRIPTION
T-187	Adapter for fork locknut.
T-188	Wrench for nut on end cap sub-assembly.
T-190	Adapter for shoulder nut on piston assembly.
T-191	Wrench for cylinder locknut
	Suitable cycling test rig.

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ILLUSTRATED PARTS LIST

1. Vendor Codes

For explanation of vendor codes used in the Illustrated Parts List, refer to Table 1101.

Table 1101

Vendor Codes

CODE	NAME AND ADDRESS
02565	Hamler Corp. Mount Vernon, N.Y., U.S.A.
05694	Equi-Flex Products, Detroit, Michigan, U.S.A.
17194	Glacier Packing Co., Sanger, California, U.S.A.
36164	Heroux Machine Parts Ltd., Longueuil, P.Q., Canada
72902	Greene Tweed & Co., N. Wales, Pennsylvania, U.S.A.

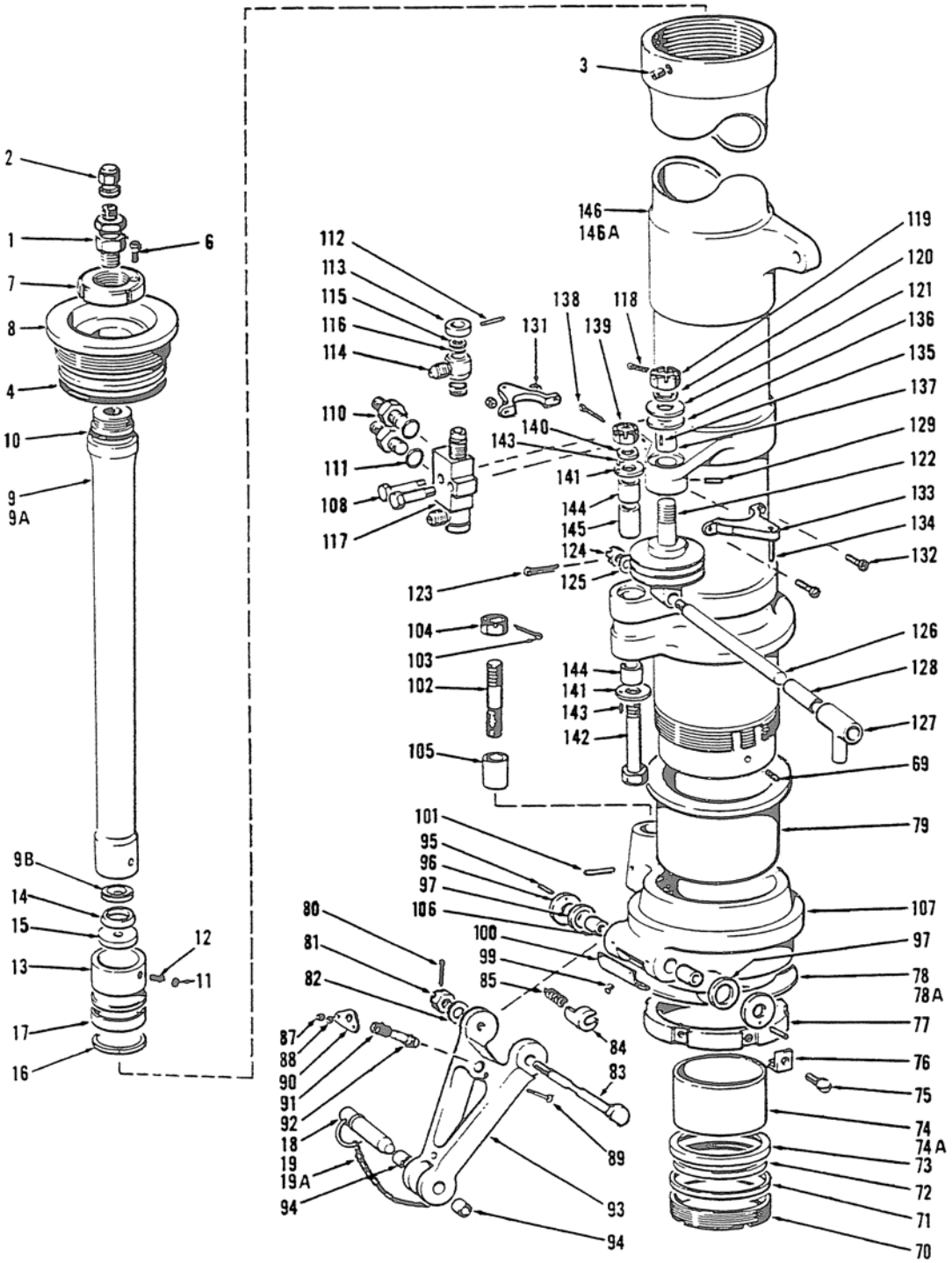
2. Usage Code

To determine the applicability of the usage code letters used in the following Illustrated Parts List, refer to Table 1102.

Table 1102

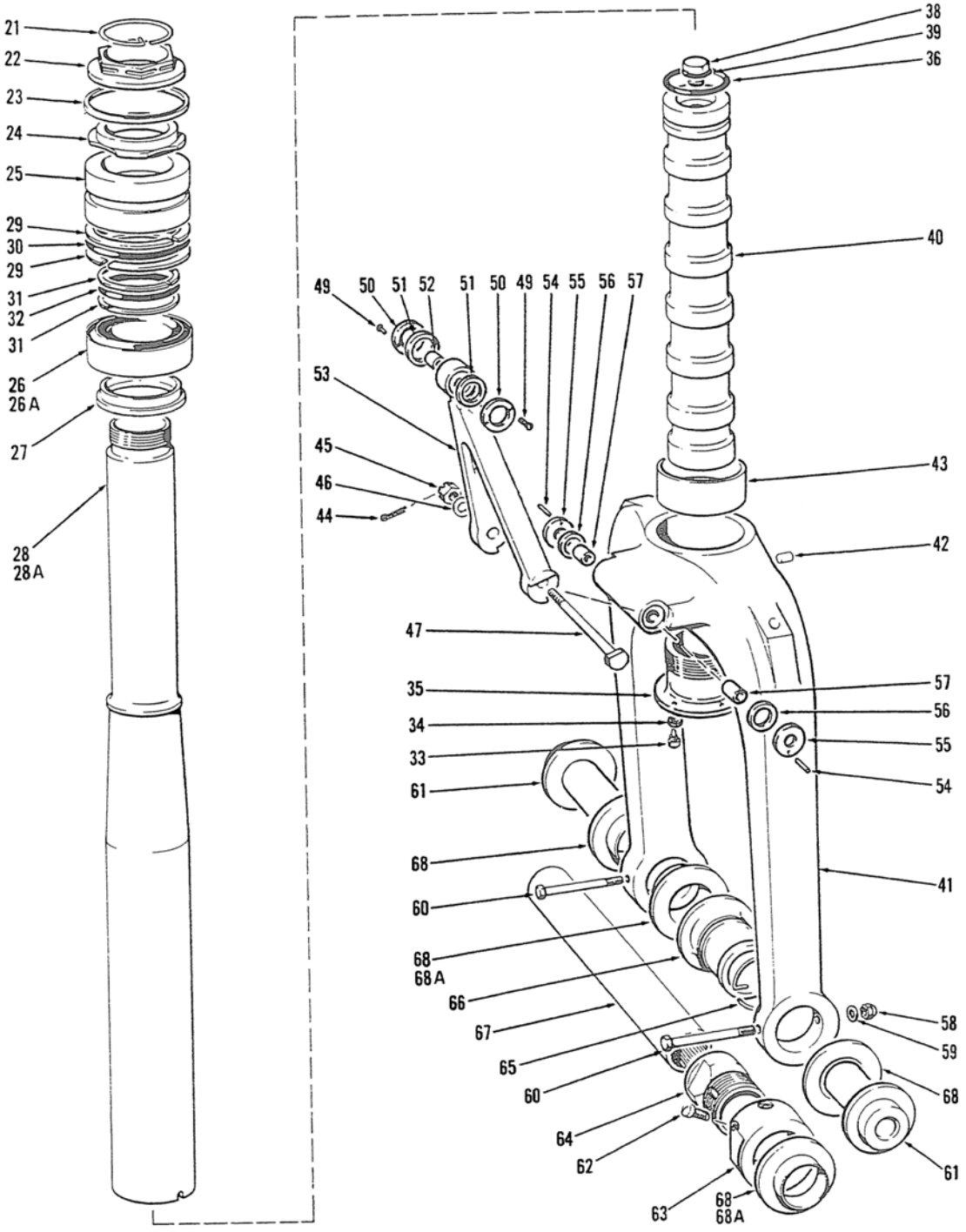
Usage Codes

CODE	USED ON	FIGURE NO.
A	Shock Strut Assembly Part No. 71-300-1	1101
B	Shock Strut Assembly Part No. 71-300-3	1101
C	Shock Strut Assembly Part No. 71-300-5	1102
D	Shock Strut Assembly Part No. 71-300-7	1102
E	Shock Strut Assembly Part No. 71-300-9	1103
F	Shock Strut Assembly Part No. 71-300-11	1103
G	Shock Strut Assembly Part No. 71-300-15	1104
H	Shock Strut Assembly Part No. 71-300-17	1104
I	Shock Strut Assembly Part No. 71-300-19	1104
J	Shock Strut Assembly Part No. 71-300-21	1104
K	Shock Strut Assembly Part No. 71-300-23	1104
L	Shock Strut Assembly Part No. 71-300-25	1104
M	Shock Strut Assembly Part No. 71-300-27	1104
N	Shock Strut Assembly Part No. 71-300-29	1104
P	Shock Strut Assembly Part No. 71-300-33	1104
Q	Shock Strut Assembly Part No. 71-300-31	1104



Exploded View - Shock Strut Assembly Part No. 71-300-1 and 71-300-3

Figure 1101 (Sheet 1 of 2)



Exploded View - Shock Strut Assembly Part No. 71-300-1 and 71-300-3

Figure 1101 (Sheet 2 of 2)

3. List of Parts, Shock Strut Assemblies 71-300-1 and 71-300-3 (Figure 1101)

FIGURE 1101 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
-	71-300-1	Shock Strut Assembly	(36164)	A	-
-	71-300-3	Shock Strut Assembly	(36164)	B	-
1	MS28889-1	.Valve, Air Charging		A, B	1
2	MS20813-1	..Cap, Air Charging Valve		A, B	1
3	MS18066-08	.Set-screw		A, B	1
4	MS28775-234	.O-ring		A, B	1
-5	71-110-1	.End Cap Sub-assembly	(36164)	A,B	1
-5A	71-110-9	.End Cap Sub-assembly (alternative to 71-110-1, See Figure 1103 for breakdown)	(36164)		1
6	AN501A10-5	..Screw, Machine, Fillister Head		A, B	1
7	71-116-1	..Nut	(36164)	A, B	1
8	71-114-1	..End Cap	(36164)	A, B	1
9	71-115-1	..Support Tube	(36164)	A, B	1
9A	71-115-9	..Support Tube (alternative to 71-115-1)	(36164)		1
9B	71-096-9	..Shoulder (used with 71-115-9)	(36164)		1
10	MS28775-121	..O-ring		A, B	1
11	71-113-1	..Pellet	(36164)	A, B	1
12	MS51976-34	..Set-screw		A, B	1
13	71-117-1	..Guide Bearing	(36164)	A, B	1
14	71-188-1	..Damping Plate	(36164)	A,B	1
15	71-118-1	..Plate Orifice	(36164)	A, B	1
16	71-150-1	..Split Ring	(36164)	A, B	1
17	71-130-1	..Slipper Ring	(36164)	A, B	1
18	MS17987-C614	.Pin, Quick release		A, B	1
19	S1192-2-3	.Chain		A, B	1
19A	71-315-3	.Chain (alternative to S1192-2-3)		A, B	1
-20	71-140-1	.Piston Assembly	(36164)	A	1
-20	71-140-3	.Piston Assembly	(36164)	B	1
-20A	71-140-11	.Piston Assembly (alternative to 71-140-1 or 71-140-3. See Figure 1103 for breakdown)	(36164)		1
21	71-149-1	..Lockring	(36164)	A, B	1
22	71-145-1	..Nut, Shoulder	(36164)	A, B	1

NOTE: – preceding index number indicates item not illustrated.

FIGURE 1101 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
23	71-144-1	..Flapper	(36164)	A, B	1
24	71-143-1	..Spacer, Flapper	(36164)	A, B	1
25 +	71-009-1	..Floating Piston	(36164)	A	1
25	71-009-3	..Floating Piston	(36164)	B	1
26	71-129-1	..Bumper	(36164)	A	1
26	71-129-3	..Bumper	(36164)	B	1
26A	71-129-9	..Bumper (alternative to 71-129-1 or 71-129-3)	(36164)		1
27	71-142-1	..Shoulder	(36164)	A, B	1
28	71-141-1	..Piston Tube (replaced by 71-141-9)	(36164)	A, B	1
28A	71-141-9	..Piston Tube (replaces by 71-141-1)	(36164)		1
29	8-336-N300-9	..Ring, Back-up	(36164)	A, B	2
30	MS28775-336	..O-ring		A, B	1
31	8-331-N300-9	..Ring, Back-up	(36164)	A, B	2
32	MS28775-331	..O-ring		A, B	1
33	71-155-1	.Set-screw	(36164)	A, B	1
34	AN935-10	.Washer		A, B	1
35	71-156-1	.Locknut	(36164)	A, B	1
36	MS28775-137	.O-ring		A, B	1
-37	71-120-1	.Cartridge Assembly (replaced by 71-081-7)	(36164)	A, B	1
-37A	71-081-7	.Cartridge Assembly (replaces 71-120-1, See Figure 1103 for breakdown)	(36164)		1
38	71-124-1	..Plug	(36164)	A, B	1
39	MS28775-014	..Packing		A, B	1
40	71-121-1	..Cylinder	(36164)	A, B	1
41 *	71-136-1	.Fork	(36164)	A	1
-41	71-136-3	.Fork (replaced by 71-108-9)	(36164)	B	1
-41A	71-108-9	.Fork Assembly (replaces by 71-136-3, See Figure 1103 for breakdown)	(36164)		1
42	AN122718	.Pin, Dowel		A, B	1

NOTE: – preceding index number indicates item not illustrated.
+ Not procurable as a spare. For future procurement order 71-009-3.
* Not procurable as a spare. For future procurement use Kit K71-511. See DESCRIPTION AND OPERATION, Table 9.

FIGURE 1101 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
43	71-157-1	.Bushing (replaced by 71-157-9)	(36164)	A, B	1
43	71-157-9	.Bushing (replaces 71-157-1)	(36164)	A,B	1
44	MS24665-300	.Pin, Cotter		A, B	1
45	AN320-C6	.Nut		A, B	1
46	AN960-C616L	.Washer		A, B	1
47	71-187-1	.Bolt	(36164)	A, B	1
-48	71-171-1	.Lower Torque Arm Assembly	(36164)	A	1
-48	71-171-3	.Lower Torque Arm Assembly	(36164)	B	1
-48A	71-171-9	.Lower Torque Arm Assembly (alternative to 71-171-1 or 71-171-3. See Figure 1103 for breakdown)	(36164)		1
49	MS35198-3	..Screw, Machine		A, B	4
49	AN502-2-R4	..Screw, Machine (alternative item)		A, B	4
50	71-167-1	..Thrust Washer	(36164)	A, B	2
51	71-168-1	..Dust Ring	(36164)	A, B	2
52	06-DU-08	..Bushing	(17194)	A, B	1
53	71-163-1	..Torque Arm, Lower	(36164)	A	1
53	71-163-3	..Torque Arm, Lower	(36164)	B	1
54	MS16556-801	.Pin, Straight, Headless		A, B	2
54	MS9047-002	.Pin, Spring (alternative item)		A, B	2
55	DU-06	.Thrust Washer	(17194)	A, B	2
56	71-166-1	.Dust Ring	(36164)	A, B	2
57	06-DU-12	.Bushing	(17194)	A, B	2
58	MS20364-428	.Nut		A, B	2
59	AN960-C416L	.Washer		B	2
60	AN4-31A	.Bolt		A, B	2
61	71-139-1	.Towing Spool	(36164)	A	2
61	71-139-3	.Towing Spool	(36164)	B	2
62	MS24665-428	.Pin, Cotter		A	1
62	71-204-3	.Screw, Setting	(36164)	B	2
63	71-137-1	.Nut, Retaining (replaced by 71-137-3)	(36164)	A	1
63	71-137-3	.Nut, Retaining	(36164)	B	1

NOTE: – preceding index number indicates item not illustrated.

FIGURE 1101 INDEX NO.		PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
64		71-133-1	.Spacer, Adjustment	(36164)	A, B	1
65		AN996-30	.Lockring		B	1
66		71-132-1	.Spacer (replaced by 71-132-3)	(36164)	A	1
66		71-132-3	.Spacer	(36164)	B	1
67		71-131-1	.Axle	(36164)	A	1
67		71-135-3	.Axle	(36164)	B	1
68		71-138-1	.Bushing, Flanged	(36164)	A	2
68		71-189-3	.Bushing, Axle (replaced by 71-189-5)	(36164)	B	4
68A		71-189-5	.Bushing, Axle (replaces 71-189-3)	(36164)		4
69		MS18066-08	.Set-screw		A, B	1
70		71-153-1	.Locknut	(36164)	A, B	1
71		71-152-1	.Washer	(36164)	A, B	1
72		527000A	.Scraper	(05694)	A, B	1
73		71-151-1	.Bearing Retainer	(36164)	A, B	1
74		71-055-1	.Bearing (replaced by 71-055-5)	(36164)	A, B	1
74A		71-055-5	.Bearing (replaces 71-055-1)	(36164)		1
75	*	MS35277-61	.Screw, Machine, Fillister Head		A, B	2
76	*	71-165-1	.Nut, Locking	(36164)	A, B	2
77	*	71-160-1	.Nut, Cylinder	(36164)	A, B	1
78	*	71-018-1	.Thrust Washer (replaced by 71-018-5)	(36164)	A, B	1
78A	*	71-018-5	.Thrust Washer (replaces 71-018-1)	(36164)		1
79	+*	71-054-1	.Journal Bearing	(36164)	A, B	1
80		MS24665-300	.Pin, Cotter		A, B	1
81		AN320-C6	.Nut		A, B	1
82		AN960-C616L	.Washer		A, B	1
83		71-173-1	.Bolt	(36164)	A, B	1
84		71-174-1	.Cam	(36164)	A, B	1
85		71-175-1	. Spring	(36164)	A, B	1

NOTE: – preceding index number indicates item not illustrated.
* For details of shimmy damper installation refer to DESCRIPTION AND OPERATION, Tables 2 and 3.
+ Not procurable as a spare. For furture procurement use Kit K71-513. See DESCRIPTION AND OPERATION, Table 9.

FIGURE 1101 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
-86	71-105-5	.Upper Torque Arm Assembly	(36164)	A, B	1
87	MS21042-L08	..Nut		A, B	2
88	AN960-PD8L	..Washer		A, B	2
89	AN509-8R-21	..Screw, Machine, Flat Head		A, B	2
90	71-104-5	..Retainer, Spring	(36164)	A, B	1
91	MS24585-497	..Spring		A, B	1
92	71-103-5	..Latch Pin	(36164)	A, B	1
93	71-102-5	..Torque Arm, Upper	(36164)	A, B	1
94	71-164-1	..Bushing	(36164)	A, B	2
95	MS16556-801	.Pin, Straight, Headless		A, B	2
95	MS9047-002	.Pin, Spring (alternative item)		A, B	2
96	DU-06	.Thrust Washer	(17194)	A, B	2
97	71-166-1	.Dust Ring	(36164)	A, B	2
-98	71-177-1	.Steering Collar Assembly	(36164)	A	1
-98	71-177-3	.Steering Collar Assembly	(36164)	B	1
99	AN520-4-4	..Screw, Machine, Round Head		A, B	6
100	71-148-1	..Cover	(36164)	A	1
100	71-176-3	..Cover	(36164)	B	1
101	MS9048-114	..Pin, Spring		A, B	1
102	71-276-1	..Stud	(36164)	A, B	1
103	MS24665-231	..Pin, Cotter		A, B	1
104	MS17825-8	..Locknut		A, B	1
105	71-169-1	..Bushing	(36164)	A, B	1
106	06-DU-12	..Bushing	(17194)	A, B	1
107	71-161-1	..Collar, Steering	(36164)	A	1
107	71-161-3	..Collar, Steering	(36164)	B	1
108	MS200074-04-11	.Bolt, Machine		A, B	2
-109	71-184-1	.Swivel Fitting Assembly	(36164)	A, B	1
110	AN815-4	..Union		A, B	2
111	MS28778-4	..Packing, Preformed		A, B	2
112	MS9048-071	..Pin, Spring		A, B	2
113	2107-1	..Collar	(36164)	A, B	2
114	71-183-1	..Swivel	(36164)	A, B	2
115	MS28774-012	..Ring, Back-up		A, B	4

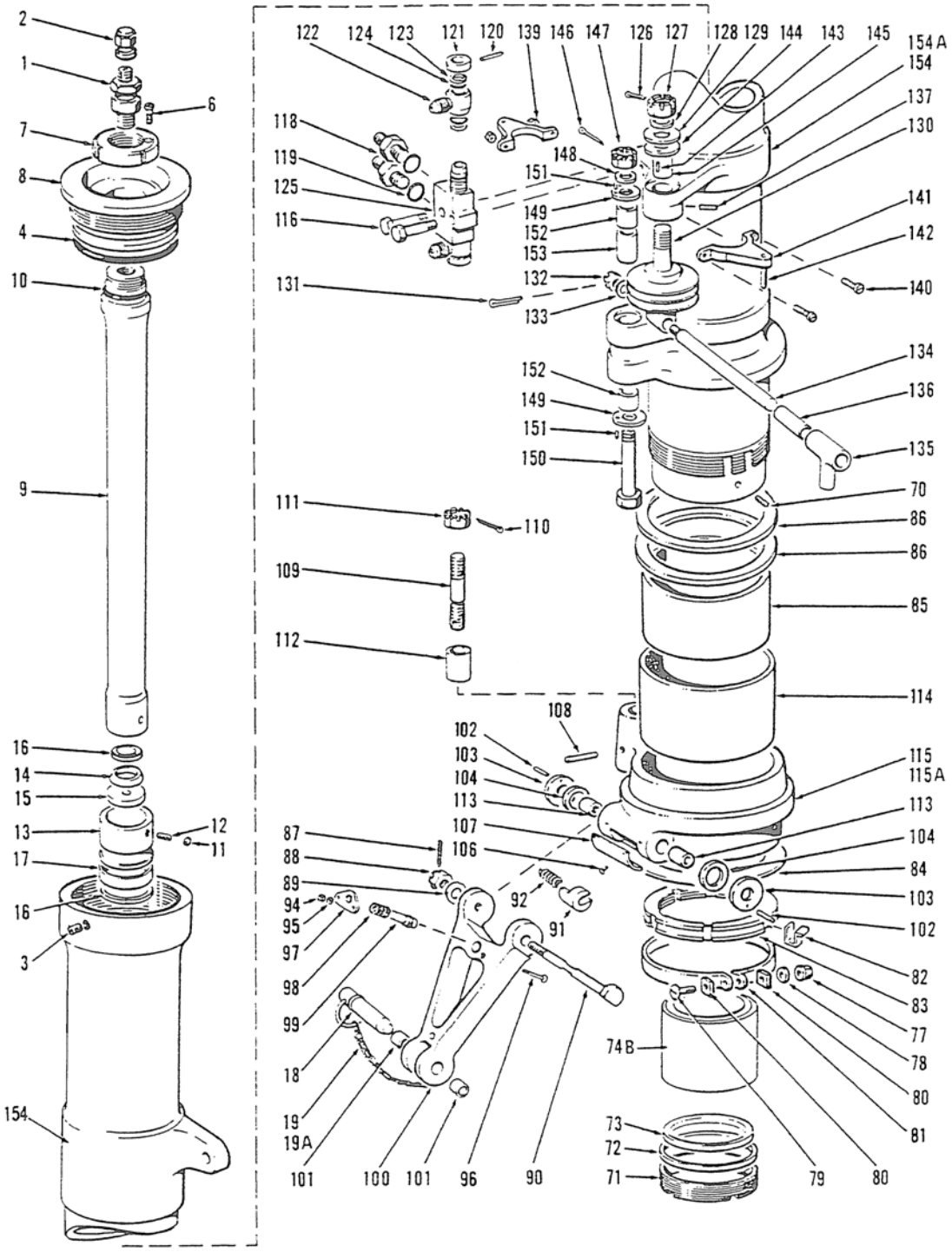
NOTE: – preceding index number indicates item not illustrated.

FIGURE 1101 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
116	MS28775-012	..O-ring		A, B	4
117	71-180-1	..Adapter, Swivel	(36164)	A, B	1
118	MS24665-285	.Pin, Cotter		A, B	1
119	AN320-D8	.Nut		A, B	1
120	MS35333-44	.Washer		A, B	1
121	71-197-1	.Washer	(36164)	A, B	1
122	71-191-1	.Pulley Shaft	(36164)	A, B	1
123	MS24665-138	.Pin, Cotter		A, B	1
124	AN320-C4	.Nut		A, B	1
125	AN960-C416L	.Washer		A, B	1
126	71-192-1	.Slider	(36164)	A, B	1
127	71-194-1	.Pivot	(36164)	A, B	1
128	05-DU-08	.Bushing	(17194)	A, B	1
129	MS18066-30	.Set-screw		A, B	1
-130	71-196-1	.Cable Guard Assembly	(36164)	A, B	1
131	MS21042L-3	..Nut		A, B	2
132	AN501-10-10	..Screw, Machine, Fillister Head		A, B	2
133	71-196-11	..Guard, Cable	(36164)	A, B	2
134	71-196-13	..Pin, Guard	(36164)	A, B	2
135	MS16556-817	.Pin, Straight, Headless		A, B	2
135	MS9047-066	.Pin, Spring (alternative item)		A, B	2
136	DU-08	.Thrust Washer	(17194)	A, B	2
137	08-DU-14	.Bushing	(17194)	A, B	1
138	MS24665-300	.Pin, Cotter		A, B	1
139	AN320-C8	.Nut		A, B	1
140	AN960C816L	.Washer		A, B	1
141	71-125-1	.Washer	(36164)	A, B	2
142	71-186-1	.Bolt	(36164)	A, B	1
143	MS16556-801	.Pin, Straight, Headless		A, B	2
143	MS9047-002	.Pin, Spring (alternative item)		A, B	2
144	08-DU-10	.Bushing	(17194)	A, B	2

NOTE: – preceding index number indicates item not illustrated.

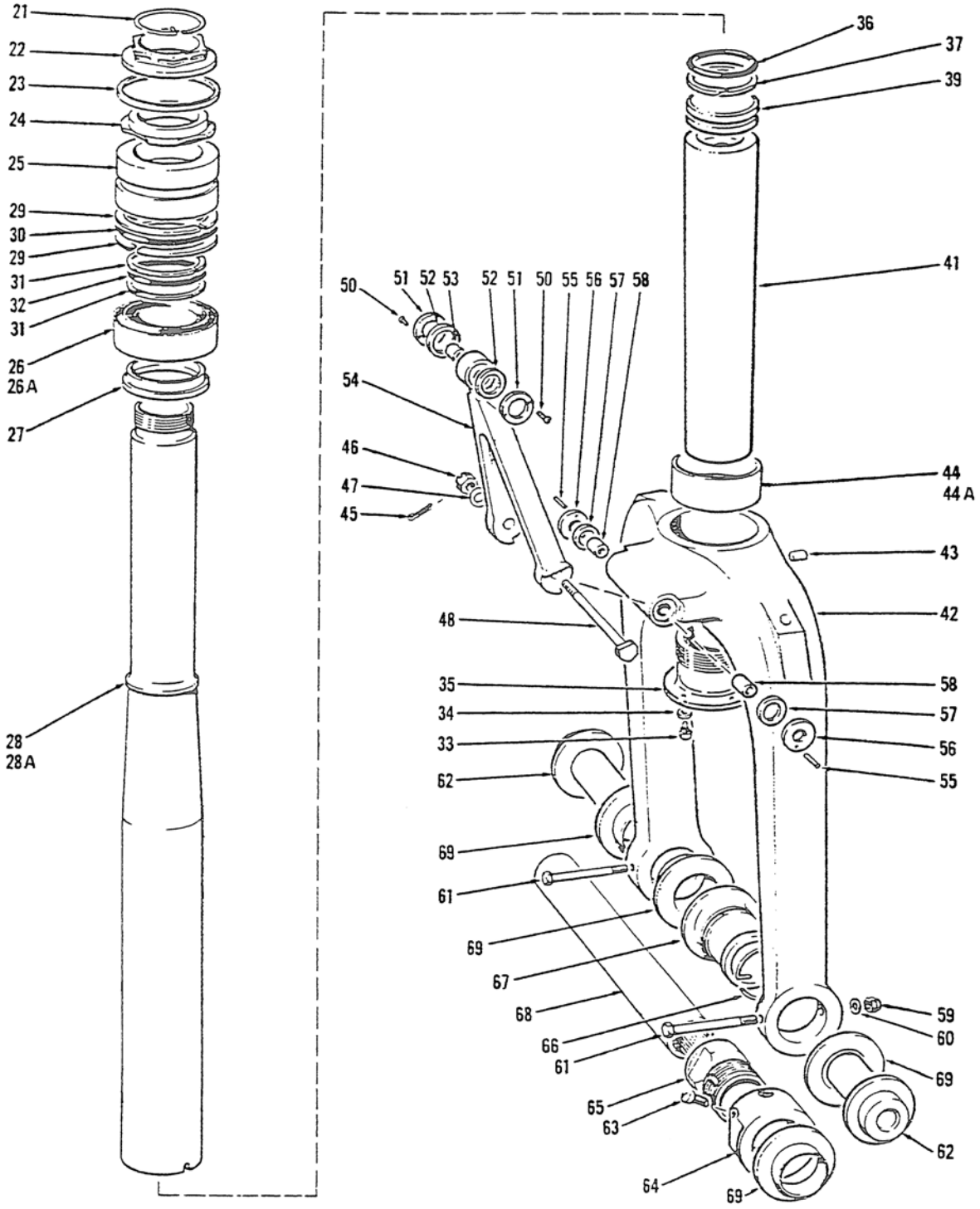
FIGURE 1101 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
145	71-172-1	.Spacer	(36164)	A, B	1
146	71-111-1	.Outer Cylinder (replaced by 71-111-3)	(36164)	A	1
146	71-111-3	.Outer Cylinder (replaced by 71-111-11)	(36164)	B	1
146A	71-111-11	.Outer Cylinder (replaces 71-111-3)	(36164)		1

NOTE: – preceding index number indicates item not illustrated.



Exploded View - Shock Strut Assembly Part No. 71-300-5 and 71-300-7

Figure 1102 (Sheet 1 of 2)



Exploded View - Shock Strut Assembly Part No. 71-300-5 and 71-300-7

Figure 1102 (Sheet 2 of 2)

4. List of Parts, Shock Strut Assemblies 71-300-5 and 71-300-7 (Figure 1102)

FIGURE 1102 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
-	71-300-5	Shock Strut Assembly	(36164)	C	-
-	71-300-7	Shock Strut Assembly	(36164)	D	-
1	MS28889-1	.Valve, Air Charging		C, D	1
2	MS20813-1	..Cap, Air Charging Valve		C, D	1
3	MS18066-08	.Set-screw		C, D	1
4	MS28875-234	.O-ring		C, D	1
-5	71-110-1	.End Cap Sub-assembly	(36164)	C, D	1
-5A	71-110-9	.End Cap Sub-assembly (alternative to 71-110-1. See Figure 1103 for breakdown)	(36164)		1
6	AN501A10-5	..Screw, Machine, Fillister Head		C, D	1
7	71-116-1	..Nut	(36164)	C, D	1
8	71-114-1	..End Cap	(36164)	C, D	1
9	71-115-1	..Support Tube	(36164)	C, D	1
10	MS28755-121	..O-ring		C, D	1
11	71-113-1	..Pellet	(36164)	C, D	1
12	MS51976-34	..Set-screw		C, D	1
13	71-117-1	..Guide Bearing	(36164)	C, D	1
14	71-188-1	..Damping Plate	(36164)	C, D	1
15	71-118-1	..Plate Orifice	(36164)	C, D	1
16	71-150-1	..Split Ring	(36164)	C, D	1
17	71-130-1	..Slipper Ring	(36164)	C, D	1
18	MS17987-C614	.Pin, Quick-release		C, D	1
19	S1192-2-3	.Chain		C, D	1
19A	71-315-3	.Chain (alternative to S1192-2-3)		C, D	1
-20	71-140-3	.Piston Assembly	(36164)	C	1
-20	71-140-7	.Piston Assembly	(36164)	D	1
-20A	71-140-11	.Piston Assembly (alternative to 71-140-3 or 71-140-7. See Figure 1103 for breakdown)	(36164)		1
21	71-149-1	..Lockring	(36164)	C, D	1
22	71-145-1	..Nut, Shoulder	(36164)	C, D	1
23	71-144-1	..Flapper	(36164)	C, D	1

NOTE: – preceding index number indicates item not illustrated.

FIGURE 1102 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
24	71-143-1	..Spacer, Flapper	(36164)	C, D	1
25	71-009-3	..Floating Piston	(36164)	C, D	1
26	71-129-3	..Bumper	(36164)	C, D	1
26A	71-129-9	..Bumper (alternative to 71-129-3)	(36164)		1
27	71-142-1	..Shoulder	(36164)	C, D	1
28	71-141-1	..Piston Tube) replaced by	(36164)	C, D	1
28	71-141-7	..Piston Tube) 71-141-9	(36164)	C, D	1
28A	71-141-9	..Piston Tube (replaces 71-141-1 or 71-141-7)	(36164)		
29	8-336-N300-9	..Ring, Back-up	(36164)	C, D	2
30	MS28775-336	..O-ring		C, D	1
31	8-331-N-300-9	..Ring, Back-up	(36164)	C, D	2
32	MS28775-331	..O-ring		C, D	1
33	71-155-1	.Set-screw	(36164)	C, D	1
34	AN8935-10	.Washer		C, D	1
35	71-156-1	.Locknut	(36164)	C, D	1
36	MS28775-137	.O-ring		C, D	1
37	MS28774-137	.Ring, Back-up		D	1
-38	71-120-1	.Cartridge Assembly (replaced by 71-081-7)	(36164)	C	1
-39	71-124-1	..Plug	(36164)	C	1
-40	MS28775-014	..Packing		C	1
-41	71-121-1	..Cylinder	(36164)	C	1
-38	71-081-7	.Cartridge Assembly (replaces by 71-120-1	(36164)	D	1
39	71-083-7	..Cap, Plug	(36164)	D	1
41	71-082-7	..Cylinder	(36164)	D	1
42	71-136-3	.Fork (replaced by 71-108-9)	(36164)	C	1
-42	71-136-7	.Fork (replaced by 71-108-9)	(36164)	D	1
-42A	71-108-9	.Fork (replaces 71-136-3 or 71-136-7. See Figure 1103 for breakdown)	(36164)		1
43	AN122718	.Pin, Dowel		C	1
43	71-090-7	.Pin	(36164)	D	1

NOTE: – preceding index number indicates item not illustrated.

FIGURE 1102 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
44	71-157-1	.Bushing (replaced by 71-157-9)	(36164)	C	1
44	71-157-7	.Bushing (replaced by 71-157-9)	(36164)	D	1
44A	71-157-9	.Bushing (replaces 71-157-1 or 71-157-7)	(36164)		1
45	MS24665-300	.Pin, Cotter		C, D	1
46	AN320-C6	.Nut		C, D	1
47	AN960-C616L	.Washer		C, D	1
48	71-187-1	.Bolt	(36164)	C, D	1
-49	71-171-3	.Lower Torque Arm Assembly	(36164)	C, D	1
-49A	71-171-9	.Lower Torque Arm Assembly (alternative to 71-171-3. See Figure 1103 for breakdown)	(36164)		1
50	MS35198-3	..Screw, Machine		C, D	4
50	AN505-2-R4	..Screw, Machine (alternative item)	(36164)	C, D	4
51	71-167-1	..Thrust Washer	(36164)	C, D	2
52	71-168-1	..Dust Ring	(36164)	C, D	2
53	06-DU-08	..Bushing	(17194)	C, D	1
54	71-163-3	..Torque Arm, Lower	(36164)	C, D	1
55	MS16556-801	.Pin, Straight, Headless		C, D	2
55	MS9047-002	.Pin, Spring (alternative item)		C, D	2
56	DU-06	.Thrust Washer	(17194)	C, D	2
57	71-166-1	.Dust Ring	(36164)	C, D	2
58	06-DU-12	.Bushing	(17194)	C, D	2
59	MS20364-428	.Nut		C, D	2
60	AN960-C416L	.Washer		C, D	2
61	AN4-31A	.Bolt		C, D	2
62	71-139-3	.Towing Spool	(36164)	C, D	2
63	71-204-3	.Screw, Setting	(36164)	C, D	2
64	71-137-3	.Nut, Retaining	(36164)	C, D	1
65	71-133-1	.Spacer, Adjustment	(36164)	C, D	1
66	AN996-30	.Lockring		C, D	1
67	71-132-3	.Spacer	(36164)	C, D	1
68	71-135-3	.Axle	(36164)	C, D	1
69	71-189-5	.Bushing	(36164)	C, D	4

NOTE: – preceding index number indicates item not illustrated.

FIGURE 1102 INDEX NO.		PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
70		MS18066-08	.Set-screw		C, D	1
71		71-153-1	.Locknut	(36164)	C, D	1
72		71-152-1	.Washer	(36164)	C, D	1
73		527000A	.Scraper	(05694)	C, D	1
-74		71-151-1	.Bearing Retainer	(36164)	C, D	1
74B		71-055-5	.Journal Bearing	(36164)	C, D	1
-75	+	71-086-5	..Bearing	(36164)	C, D	1
-76	+	71-085-5	..Sleeve	(36164)	C, D	1
77		MS21042-06	.Nut		C, D	1
78		AN960-PD6	.Washer		C, D	1
79		MS35206-230	.Screw, Machine, Pan Head		C, D	1
80		71-057-5	.Block	(36164)	C, D	1
81		71-058-5	.Locking Clip	(36164)	C, D	1
82		71-060-5	.Locking Key	(36164)	C, D	1
83	*	71-160-5	.Nut, Cylinder (replaced by 71-160-9)	(36164)	C, D	1
83	*	71-160-9	.Nut, Cylinder (replaces 71-160-5)	(36164)		1
84	*	71-018-5	.Thrust Washer	(36164)	C, D	1
85		71-062-5	.Bushing	(36164)	C, D	1
86	*	71-061-5	.Thrust Washer	(36164)	C, D	2
87		MS24665-300	.Pin Cotter		C, D	1
88		AN320-C6	.Nut		C, D	1
89		AN960-C616L	.Washer		C, D	1
90		71-173-1	.Bolt	(36164)	C, D	1
91		71-174-1	.Cam	(36164)	C, D	1
92		71-175-1	.Spring	(36164)	C, D	1
-93		71-105-5	.Upper Torque Arm Assembly	(36164)	C, D	1
94		MS21042-L08	..Nut		C, D	2
95		AN960-PD8L	..Washer		C, D	2
96		AN509-8R-21	..Screw, Machine, Flat Head		C, D	2
97		71-104-5	..Retainer, Spring	(36164)	C, D	1
98		MS24585-497	..Spring		C, D	1

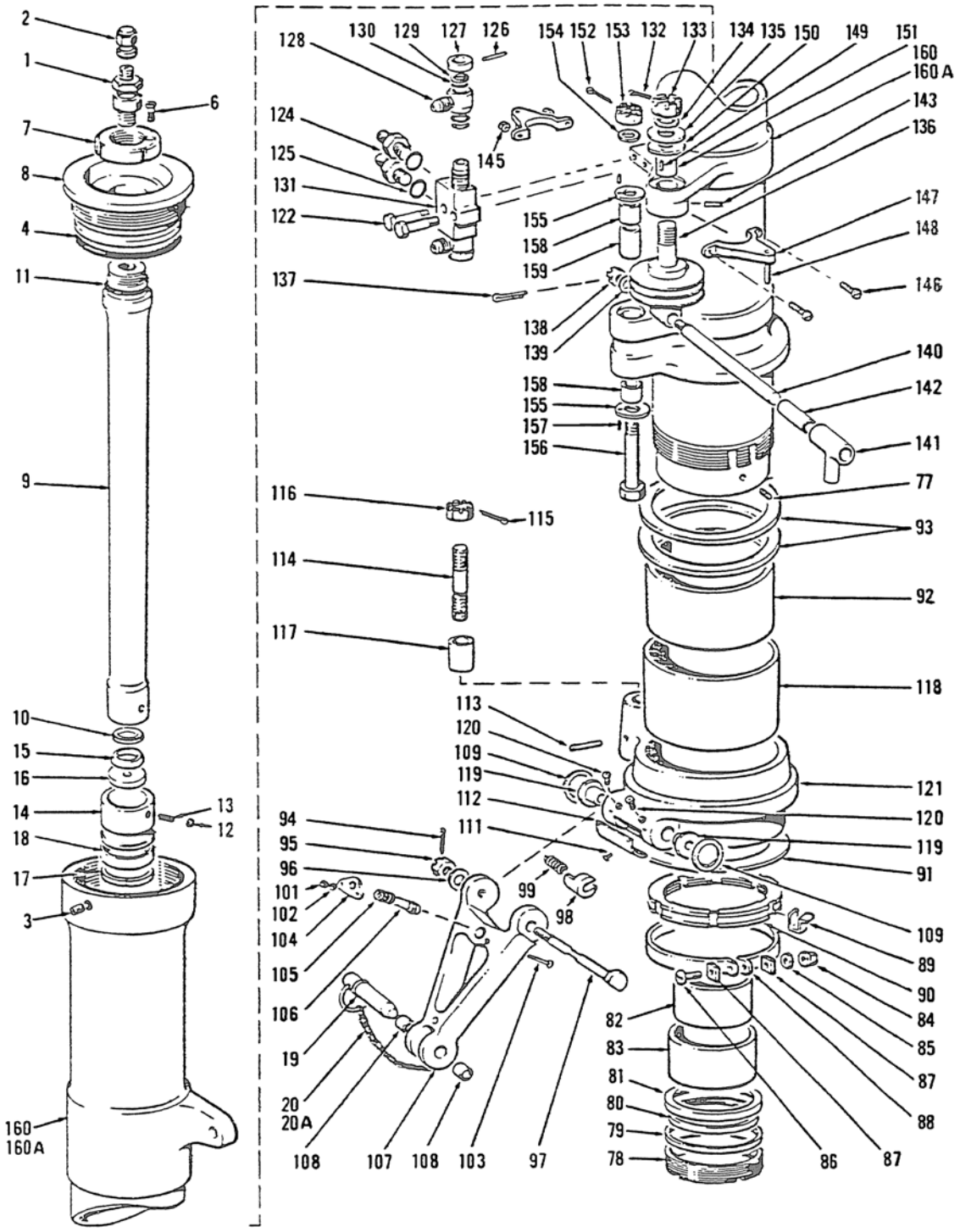
NOTE: – preceding index number indicates item not illustrated.
+ Not procurable as a spare. For future procurement order 71-055-5.
* For details of shimmy damper installation, refer to DESCRIPTION AND OPERATION, Tables 4 and 5.

FIGURE 1102 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
99	71-103-5	..Latch Pin	(36164)	C, D	1
100	71-102-5	..Torque Arm, Upper	(36164)	C, D	1
101	71-164-1	..Bushing	(36164)	C, D	1
102	MS16556-801	.Pin, Straight, Headless		C, D	2
102	MS9047-002	.Pin, Spring (alternative item)		C, D	2
103	DU-06	.Thrust Washer	(17194)	C, D	2
104	71-166-1	.Dust Ring	(36164)	C, D	2
-105	71-177-5	.Steering Collar Assembly	(36164)	C	1
-105	71-177-7	.Steering Collar Assembly	(36164)	D	1
-105A	71-177-9	.Steering Collar Assembly (alternative to 71-177-5 or 71-177-7. See Figure 1103 for breakdown)	(36164)		1
106	AN520-4-4	..Screw, Machine, Round Head		C, D	6
107	71-176-3	..Cover	(36164)	C, D	1
108	MS9048-114	..Pin, Spring		C, D	1
109	71-276-1	..Stud	(36164)	C, D	1
110	MS24665-231	..Pin, Cotter		C, D	1
111	MS17825-8	..Locknut		C, D	1
112	71-169-1	..Bushing	(36164)	C, D	1
113	06-DU-12	..Bushing	(17194)	C, D	2
114	71-059-5	..Bearing	(36164)	C, D	1
115	71-161-5	..Collar, Steering (replaced by 71-161-9	(36164)	C, D	1
115A	71-161-9	..Collar, Steering) (replaces 71-161-5			1
116	MS20074-04-11	.Bolt, Machine		C, D	2
-117	71-184-1	.Swivel Fitting Assembly	(36164)	C, D	1
118	AN815-4	..Union		C, D	2
119	MS28778-4	..Packing, Preformed		C, D	2
120	MS9048-071	..Pin, Spring		C, D	2
121	2107-1	..Collar	(36164)	C, D	2
122	71-183-1	..Swivel	(36164)	C, D	2
123	MS28774-012	..Ring, Back-up		C, D	4
124	MS28775-012	..O-ring		C, D	4
125	71-180-1	..Adapter, Swivel	(36164)	C, D	1
126	MS24665-285	.Pin, Cotter		C, D	1

NOTE: – preceding index number indicates item not illustrated.

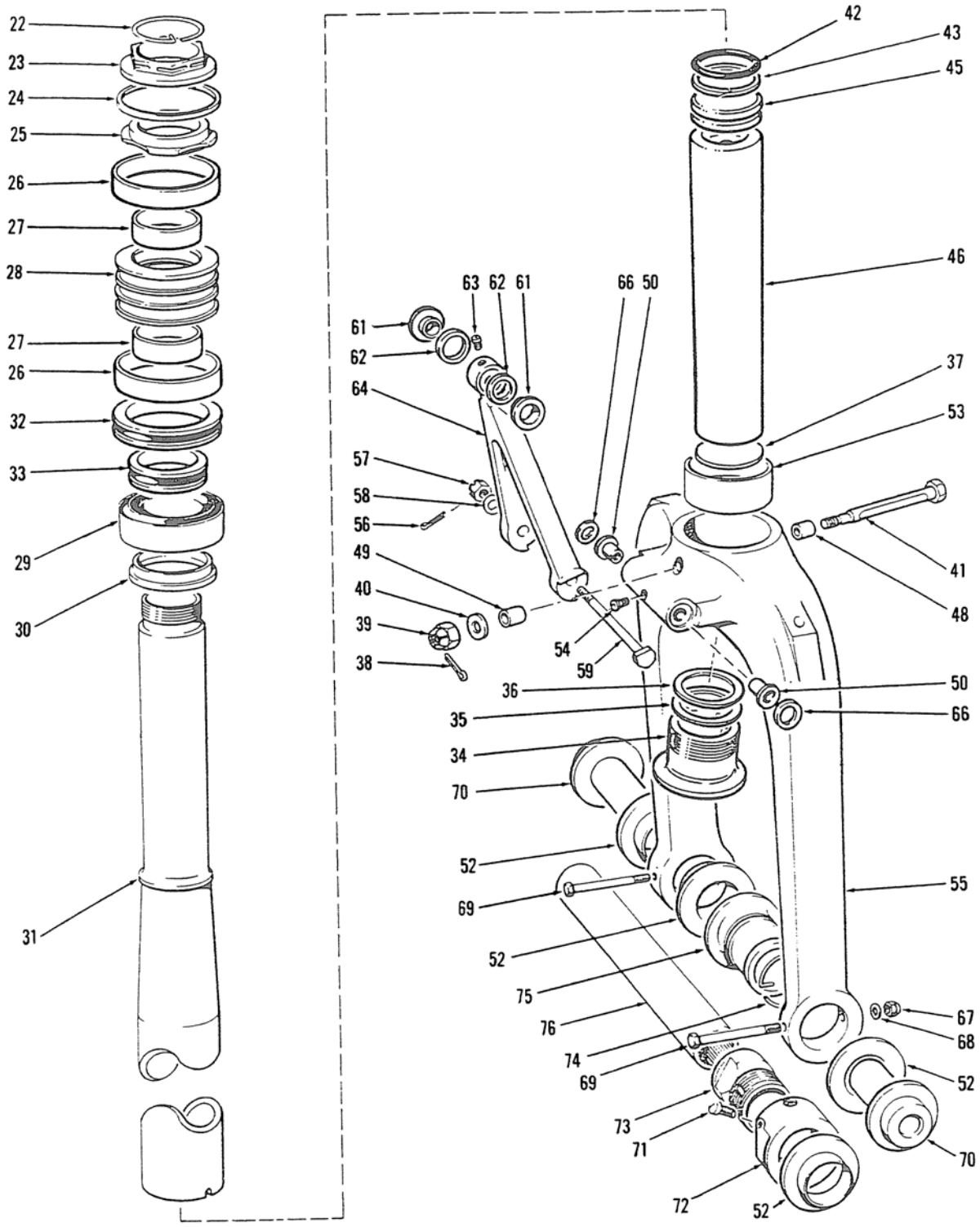
FIGURE 1102 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
127	AN320-D8	.Nut		C, D	1
128	MS35333-44	.Washer		C, D	1
129	71-197-1	.Washer	(36164)	C, D	1
130	71-191-1	.Pulley Shaft	(36164)	C, D	1
131	MS24665-138	.Pin, Cotter		C, D	1
132	AN320-C4	.Nut		C, D	1
133	AN960-C416L	.Washer		C, D	1
134	71-192-1	.Slider	(36164)	C, D	1
135	71-194-1	.Pivot	(36164)	C, D	1
136	05-DU-08	.Bushing	(17194)	C, D	1
137	MS18066-30	.Set-screw		C, D	1
-138	71-196-1	.Cable Guard Assembly	(36164)	C, D	1
139	MS21042L3	..Nut		C, D	2
140	AN501-10-10	..Screw, Machine, Fillister Head		C, D	2
141	71-196-11	..Guard, Cable	(36164)	C, D	2
142	71-196-13	..Pin, Guard	(36164)	C, D	2
143	MS16556-817	.Pin Straight, Headless		C, D	2
-143	MS9047-066	.Pin, Spring (alternative item)		C, D	2
144	DU-08	.Thrust Washer	(17194)	C, D	2
145	08-DU-14	.Bushing	(17194)	C, D	1
146	MS24665-300	.Pin, Cotter		C, D	1
147	AN320-C8	.Nut		C, D	1
148	AN960C816L	.Washer		C, D	1
149	71-125-1	.Washer	(36164)	C, D	2
150	71-186-1	.Bolt	(36164)	C, D	1
151	MS16556-801	.Pin, Straight, Headless		C, D	2
151	MS9047-002	.Pin, Spring (alternative item)		C, D	2
152	08-DU-10	.Bushing	(17194)	C, D	2
153	71-172-1	.Spacer	(36164)	C, D	1
154	71-111-3	.Outer Cylinder (replaced by 71-111-11)	(36164)	C, D	1
154A	71-111-11	.Outer Cylinder (replaces 71-111-3)	(36164)		1

NOTE: – preceding index number indicates item not illustrated.



Exploded View - Shock Strut Assembly Part No. 71-300-9 and 71-300-11

Figure 1103 (Sheet 1 of 2)



Exploded View - Shock Strut Assembly Part No. 71-300-9 and 71-300-11

Figure 1103 (Sheet 2 of 2)

5. List of Parts, Shock Strut Assemblies 71-300-9 and 71-300-11 (Figure 1103)

FIGURE 1103 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
-	71-300-9	Shock Strut Assembly	(36164)	E	-
-	71-300-11	Shock Strut Assembly	(36164)	F	-
1	MS28889-1	.Valve, Air Charging		E, F	1
2	MS20813-1	..Cap, Air Charging Valve		E, F	1
3	MS18066-08	.Set-screw		E, F	1
4	MS28875-234	.O-ring		E, F	1
-5	71-110-9	.End Cap Sub-assembly	(36164)	E, F	1
6	AN501A10-5	..Screw, Machine, Fillister Head		E, F	1
7	71-116-1	..Nut	(36164)	E, F	1
8	71-114-1	..End Cap	(36164)	E, F	1
9	71-115-9	..Support Tube	(36164)	E, F	1
10	71-096-9	..Shoulder	(36164)	E, F	1
11	MS28775-121	..O-ring		E, F	1
12	71-113-1	..Pellet	(36164)	E, F	1
13	MS51976-34	..Set-screw		E, F	1
14	71-117-1	..Guide Bearing	(36164)	E, F	1
15	71-188-1	..Damping Plate	(36164)	E, F	1
16	71-118-1	..Plate Orifice	(36164)	E, F	1
17	71-150-1	..Split Ring	(36164)	E, F	1
18	71-130-1	..Slipper Ring	(36164)	E, F	1
19	MS17987-C614	.Pin, Quick-release		E, F	1
20	S1192-2-3	.Chain		E, F	1
20A	71-315-3	.Chain (alternative to S1192-2-3)	(36164)		1
-21	71-140-9	.Piston Assembly	(36164)	E	1
-21	71-140-11	.Piston Assembly (alternative to 71-140-9)	(36164)	F	1
22	71-149-1	..Lockring	(36164)	E, F	1
23	71-145-1	..Nut, Shoulder	(36164)	E, F	1
24	71-144-1	..Flapper	(36164)	E	1
25	71-143-1	..Spacer, Flapper	(36164)	E, F	1
26	71-098-9	..Outer Bearing	(36164)	E	2
27	71-097-9	..Inner Bearing	(36164)	E	2
28	71-099-9	..Floating Piston	(36164)	E	1
28	71-009-3	..Floating Piston	(36164)	F	1

NOTE: – preceding index number indicates item not illustrated.

FIGURE 1103 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
29	71-129-9	..Bumper	(36164)	E, F	1
30	71-142-1	..Shoulder	(36164)	E, F	1
31	71-141-9	..Piston Tube	(36164)	E, F	1
32	7336MT160A-T	..Ring GT	(72902)	E	1
32	7336MTE-987-T	..Ring GT	(72902)	F	1
33	7331FT160A-T	..Ring GT	(72902)	E	1
33	7331FTE-987-T	..Ring GT	(72902)	F	1
34	71-156-9	.Locknut	(36164)	E, F	1
35	71-309-9	.Washer	(36164)	E, F	1
36	71-095-9	.Shim	(36164)	E, F	1
37	71-199-9	.Diaphragm	(36164)	E, F	1
38	MS24665-138	.Pin, Cotter		E, F	1
39	MS17825-4	.Nut		E, F	1
40	AN960PD416	.Washer		E, F	1
41	71-092-9	.Lockbolt	(36164)	E, F	1
42	MS28775-137	.O-ring		E, F	1
43	MS28774-137	.Ring, Back-up		E, F	1
-44	71-081-7	.Cartridge Assembly	(36164)	E, F	1
45	71-083-7	..Cap, Plug	(36164)	E, F	1
46	71-082-7	..Cylinder	(36164)	E, F	1
-47	71-108-9	.Fork Assembly	(36164)	E, F	1
48	71-093-9	..Bushing	(36164)	E, F	1
49	71-094-9	..Bushing	(36164)	E, F	1
50	71-305-9	..Bushing	(36164)	E, F	2
52	71-189-5	..Bushing	(36164)	E, F	4
53	71-157-9	..Bushing	(36164)	E, F	1
54	NAS516-1	..Lubricator		E, F	1
55	71-136-9	..Fork	(36164)	E, F	1
56	MS24665-300	.Pin, Cotter		E, F	1
57	AN320C6	.Nut		E, F	1
58	AN960-C616L	.Washer		E, F	1
59	71-187-1	.Bolt	(36164)	E, F	1
-60	71-171-9	.Lower Torque Arm Assembly	(36164)	E, F	1
61	71-107-9	..Bushing	(36164)	E	2
61	71-107-11	..Bushing	(36164)	F	2

NOTE: – preceding index number indicates item not illustrated.

FIGURE 1103 INDEX NO.		PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
62		71-168-1	..Dust Ring	(36164)	E, F	2
63		NAS516-1	..Lubricator		E, F	1
64		71-163-9	..Torque Arm, Lower	(36164)	E, F	1
66		71-166-1	.Dust Ring	(36164)	E, F	2
67		MS20364-428	.Nut		E, F	2
68		AN960-C416L	.Washer		E, F	2
69		AN4-31A	.Bolt		E, F	2
70		71-139-3	.Towing Spool	(36164)	E, F	2
71		71-204-3	.Screw, Setting	(36164)	E, F	2
72		71-137-3	.Nut, Retaining	(36164)	E, F	1
73		71-133-1	.Spacer, Adjustment	(36164)	E, F	1
74		AN996-30	.Lockring		E, F	1
75		71-132-3	.Spacer	(36164)	E, F	1
76		71-135-3	.Axle	(36164)	E, F	1
77		MS18066-08	.Set-screw		E, F	1
78		71-153-1	.Locknut	(36164)	E, F	1
79		71-152-1	.Washer	(36164)	E, F	1
80		527000A	.Scraper	(05694)	E	1
80		MS28776M2-27	.Scraper		F	1
81		71-151-1	.Bearing Retainer	(36164)	E, F	1
-81B		71-055-5	.Journal Bearing	(36164)	E, F	1
82	+	71-086-5	..Bearing	(36164)	E, F	1
83	+	71-085-5	..Sleeve	(36164)	E, F	1
84		MS21042-06	.Nut		E, F	1
85		AN960-PD6	.Washer		E, F	1
86		MS35206-230	.Screw, Machine, Pan Head		E, F	1
87		71-057-5	.Block	(36164)	E, F	1
88		71-058-5	.Locking Clip	(36164)	E, F	1
89		71-060-5	.Locking Key	(36164)	E, F	1
90	*	71-160-5	.Nut, Cylinder (replaced by 71-160-9)	(36164)	E, F	1
90	*	71-160-9	Nut, Cylinder (replaces 71-160-5)	(36164)		1
91	*	71-018-5	.Thrust Washer	(36164)	E, F	1

NOTE: – preceding index number indicates item not illustrated.
+ Not procurable as a spare. For future procurement order 71-055-5.
* For details of shimmy damper installation, refer to DESCRIPTION AND OPERATION. Table 4 and 5.

FIGURE 1103 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
92	71-062-5	.Bushing	(36164)	E, F	1
93 *	71-061-5	.Thrust Washer	(36164)	E, F	2
94	MS24665-300	.Pin, Cotter		E, F	1
95	AN320-C6	.Nut		E, F	1
96	AN960-C616L	.Washer		E, F	1
97	71-173-1	.Bolt	(36164)	E, F	1
98	71-174-1	.Cam	(36164)	E, F	1
99	71-175-1	.Spring	(36164)	E, F	1
-100	71-105-5	.Upper Torque Arm Assembly	(36164)	E, F	1
101	MS21042-L08	..Nut		E, F	2
102	AN960-PD8L	..Washer		E, F	2
103	AN509-8R-21	..Screw, Machine, Flat Head		E, F	2
104	71-104-5	..Retainer, Spring	(36164)	E, F	1
105	MS24585-497	..Spring	(36164)	E, F	1
106	71-103-5	..Latch Pin	(36164)	E, F	1
107	71-102-5	..Torque Arm, Upper	(36164)	E, F	1
108	71-164-1	..Bushing	(36164)	E, F	2
109	71-166-1	.Dust Ring	(36164)	E, F	2
-110	71-177-9	.Steering Collar Assembly	(36164)	E, F	1
111	AN520-4-4	..Screw, Machine, Round Head		E, F	6
112	71-176-3	..Cover	(36164)	E, F	1
113	MS9048-114	..Pin, Spring		E, F	1
114	71-276-1	..Stud	(36164)	E, F	1
115	MS24665-231	..Pin, Cotter		E, F	1
116	MS17825-8	..Stud	(36164)	E, F	1
117	71-169-1	..Bushing	(36164)	E, F	1
118	71-059-5	..Bearing	(36164)	E, F	1
119	71-305-9	..Bushing	(36164)	E, F	1
120	NAS516-1	..Lubricator	(36164)	E, F	1
121	71-161-9	..Collar, Steering	(36164)	E, F	1
122	MS20074-04-11	.Bolt, Machine		E, F	2
-123	71-184-1	.Swivel Fitting Assembly	(36164)	E, F	1
124	AN815-4	..Union		E, F	2
125	MS28778-4	..Packing, Preformed		E, F	2

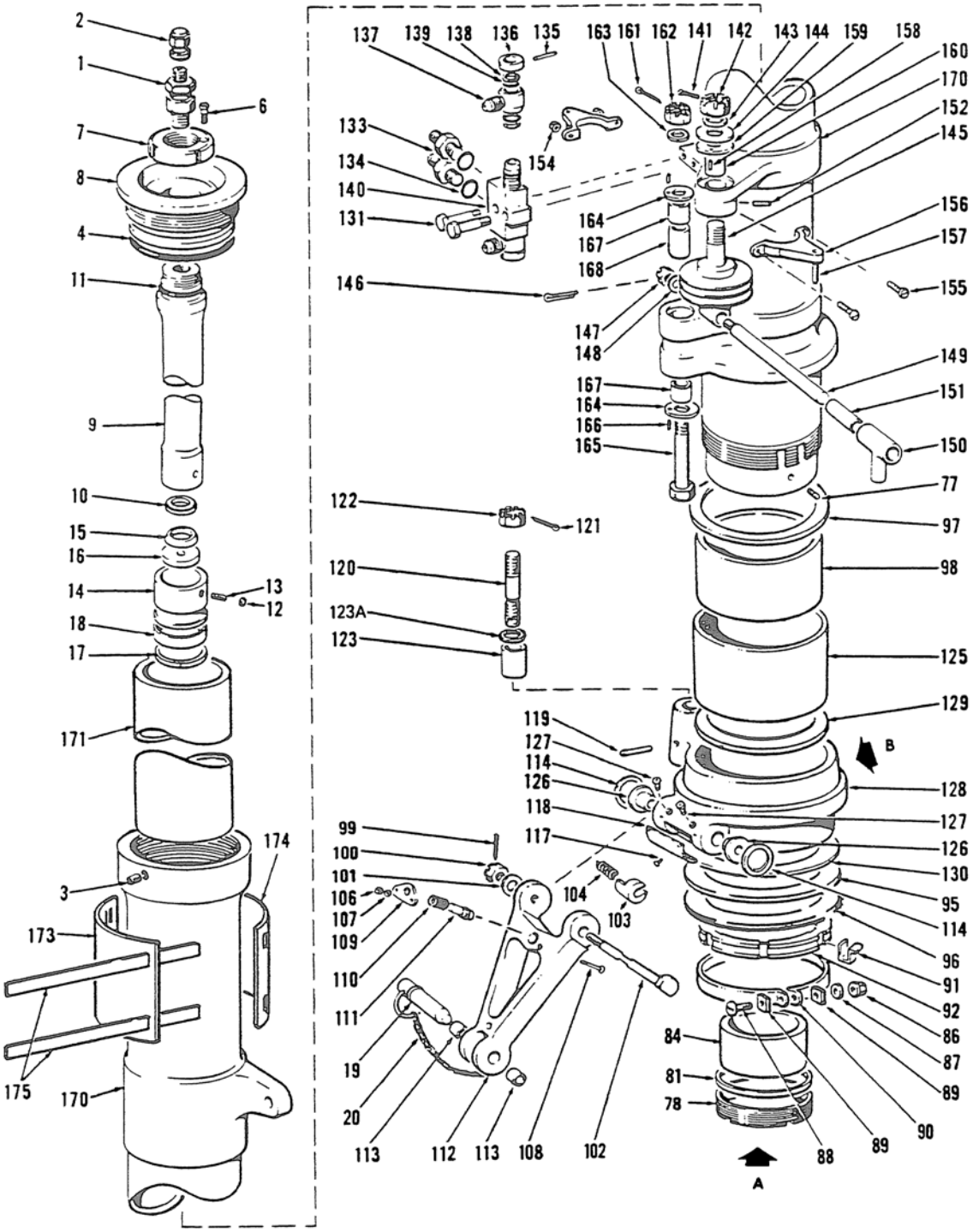
NOTE: – preceding index number indicates item not illustrated.
* For details of shimmy damper installation, refer to DESCRIPTION AND OPERATION. Table 4 and 5.

FIGURE 1103 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
126	MS9048-071	..Pin, Spring		E, F	2
127	2107-1	..Collar	(36164)	E, F	2
128	71-183-1	..Swivel	(36164)	E, F	2
129	MS28774-012	..Ring, Back-up		E, F	4
130	MS28775-012	..O-ring		E, F	4
131	71-180-1	..Adapter, Swivel	(36164)	E, F	1
132	MS24665-285	.Pin, Cotter		E, F	1
133	AN320-D8	.Nut		E, F	1
134	MS35333-44	.Washer		E, F	1
135	71-197-1	.Washer	(36164)	E, F	1
136	71-191-1	.Pulley Shaft	(36164)	E, F	1
137	MS24665-138	.Pin, Cotter		E, F	1
138	AN320-C4	.Nut		E, F	1
139	AN960-C416L	.Washer		E, F	1
140	71-192-1	.Slider	(36164)	E, F	1
141	71-194-1	.Pivot	(36164)	E, F	1
142	05-DU-08	.Bushing	(17194)	E, F	1
143	MS18066-30	.Set-screw		E, F	1
-144	71-191-1	.Cable Guard Assembly	(36164)	E, F	1
145	MS21042L3	..Nut		E, F	2
146	AN501-10-10	..Screw, Machine, Fillister Head		E, F	2
147	71-196-11	..Guard, Cable	(36164)	E, F	2
148	71-196-13	..Pin, Guard	(36164)	E, F	2
149	MS16556-817	.Pin, Straight, Headless		E, F	2
149	MS9047-066	.Pin, Spring (alternative item)		E, F	2
150	DU-08	.Thrust Washer	(17194)	E, F	2
151	08-DU-14	.Bushing	(17194)	E, F	1
152	MS24665-300	.Pin, Cotter		E, F	1
153	AN320-C8	.Nut		E, F	1
154	AN960-C816L	.Washer		E, F	1
155	71-125-1	.Washer	(36164)	E, F	1
156	71-186-1	.Bolt	(36164)	E, F	1
157	MS16556-801	.Pin, Straight, Headless		E, F	2

NOTE: – preceding index number indicates item not illustrated.

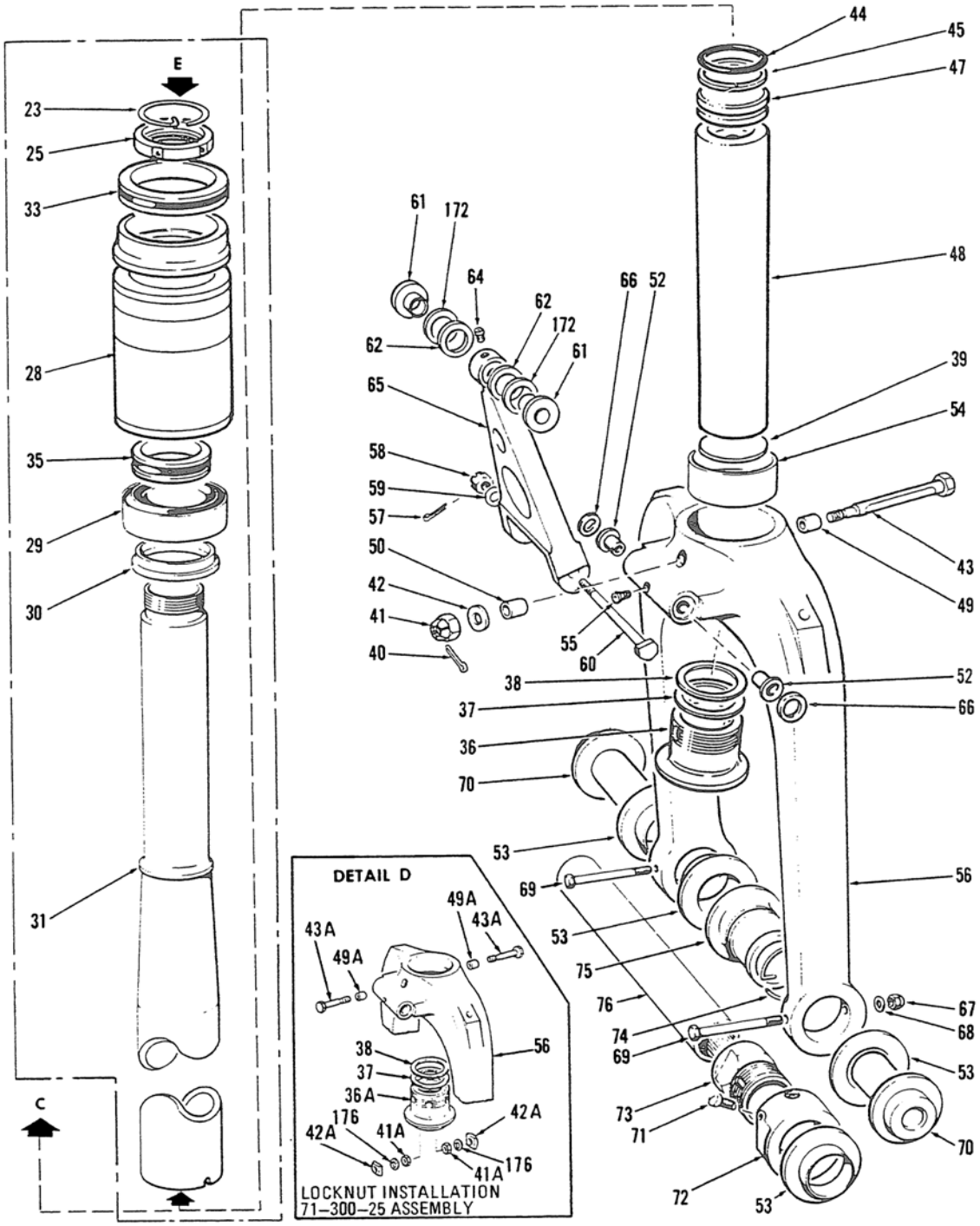
FIGURE 1103 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
157	MS9047-002	.Pin, Spring (alternative item)		E, F	2
158	08-DU-10	.Bushing	(17194)	E, F	2
159	71-172-1	.Spacer	(36164)	E, F	1
160	71-111-3	.Outer Cylinder (replaced by 71-111-11)	(36164)	E, F	1
160A	71-111-11	.Outer Cylinder (replaces 71-111-3)	(36164)		1

NOTE: – preceding index number indicates item not illustrated.



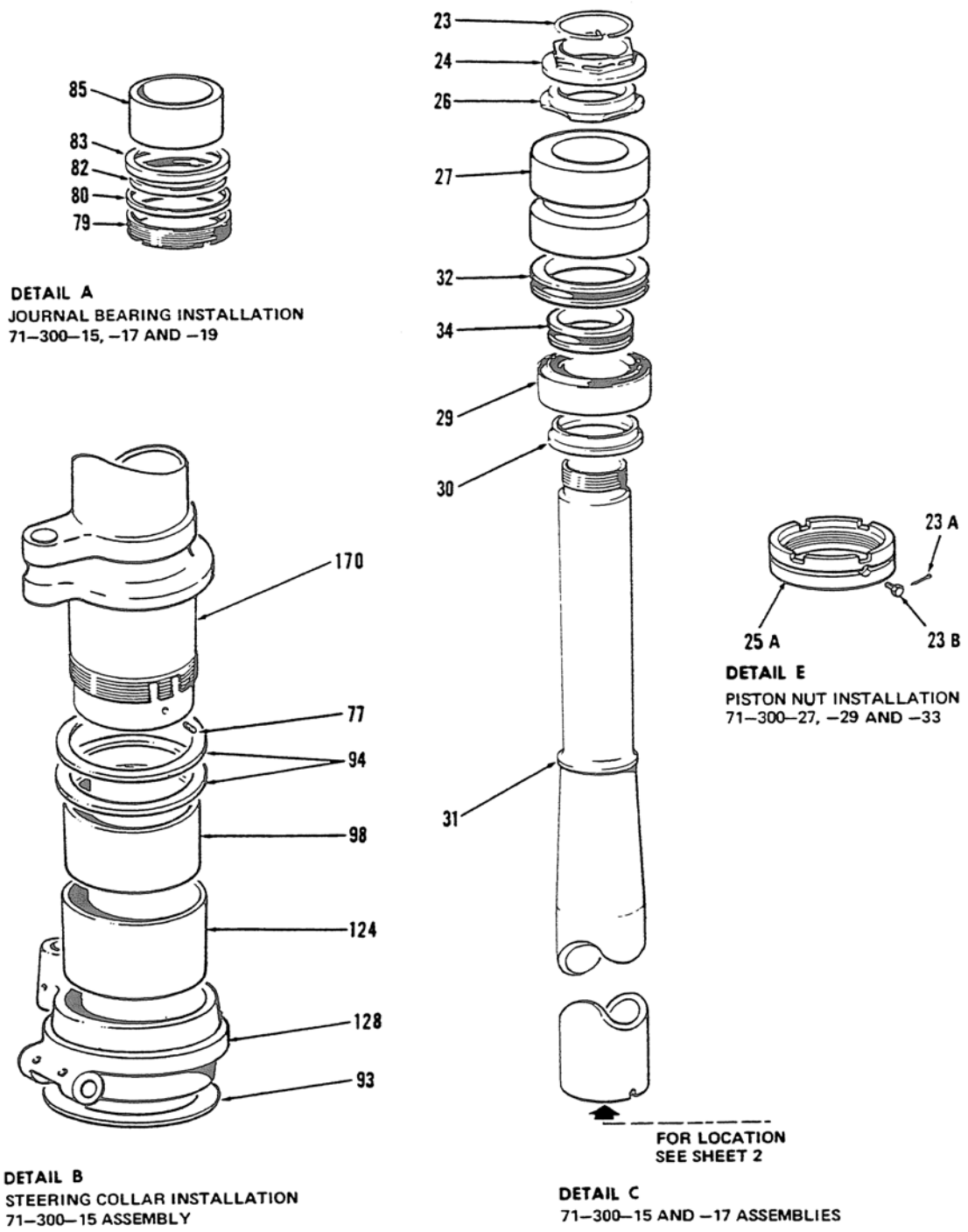
Exploded View – Shock Strut Assembly Part No. 71-300-15 through -33

Figure 1104 (Sheet 1 of 3)



Exploded View – Shock Strut Assembly Part No. 71-300-15 through -33

Figure 1104 (Sheet 2 of 3)



Exploded View – Shock Strut Assembly Part No. 71-300-15 through -33

Figure 1104 (Sheet 3 of 3)

6. List of Parts, Shock Strut Assembly 71-300-15, -17, -19, -21, -23, -25, -27, -29, -31 and -33 (Figure 1104)

FIGURE 1104 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
-	71-300-15	Shock Strut Assembly	(36164)	G	-
-	71-300-17	Shock Strut Assembly	(36164)	H	-
-	71-300-19	Shock Strut Assembly	(36164)	I	-
-	71-300-21	Shock Strut Assembly	(36164)	J	-
-	71-300-23	Shock Strut Assembly	(36164)	K	-
-	71-300-25	Shock Strut Assembly	(36164)	L	-
-	71-300-27	Shock Strut Assembly	(36164)	M	-
-	71-300-29	Shock Strut Assembly	(36164)	N	-
-	71-300-33	Shock Strut Assembly	(36164)	P	-
-	71-300-31	Shock Strut Assembly	(36164)	Q	-
1	MS28889-2	.Valve, Air Charging		G, H, I, J, K, L, M, N, P, Q	1
2	MS20813-1	..Cap Air Charging	(36164)	G, H, I, J, K, L, M, N, P, Q	1
3	MS18066-8	.Screw, Set		G, H, I, J, K, L, M, N, P, Q	1
4	MS28775-234	.O-ring		G, H, I, J, K, L, M, N, P, Q	1
-5	71-110-9	.End Cap Assembly	(36164)	G, H, I, J, K, L, M, N, P, Q	1
6	AN501A10-5	..Screw, Machine, Fillister Head		G, H, I, J, K, L, M, N, P, Q	1
7	71-116-1	..Nut	(36164)	G, H, I, J, K, L, M, N, P, Q	1
8	71-114-1	..End Cap	(36164)	G, H, I, J, K, L, M, N, P, Q	1
9	71-115-9	..Support Tube	(36164)	G, H, I, J, K, L, M, N, P, Q	1
10	71-096-9	..Shoulder	(36164)	G, H, I, J, K, L, M, N, P, Q	1
11	MS28775-121	..O-ring		G, H, I, J, K, L, M, N, P, Q	1
12	71-113-1	..Pellet	(36164)	G, H, I, J, K, L, M, N, P, Q	1
13	MS51976-34	..Set-screw		G, H, I, J, K, L, M, N, P, Q	1
14	71-117-1	..Guide Bearing	(36164)	G, H, I, J, K, L, M, N, P, Q	1
15	71-188-1	..Damping Plate	(36164)	G, H, I, J, K, L, M, N, P, Q	1
16	71-118-1	..Plate Orifice	(36164)	G, H, I, J, K, L, M, N, P, Q	1
17	71-150-1	..Split Ring	(36164)	G, H, I, J, K, L, M, N, P, Q	1
18	71-130-1	..Slipper Ring	(36164)	G, H, I, J, K, L, M, N, P, Q	1
19	MS17987-C614	.Pin, Quick-release		G, H, I, J, K, L, M, N, P, Q	1
20	71-315-3	.Chain Assembly	(36164)	G, H, I, J, K, L, M, N, P, Q	1
-21	71-140-11	.Piston Assembly	(36164)	M, N, P, Q	1
-22	71-140-19	.Piston Assembly	(36164)	I, J, K, L	1
-22A	71-140-21	.Piston Assembly	(36164)	M, N, P, Q	1
23	71-149-1	..Lockring	(36164)	G, H, I, J, K, L, M, N, P, Q	1

NOTE: – preceding index number indicates item not illustrated.

FIGURE 1104 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
23A	MS24665-24	..Cotter Pin	(36164)	M, N, P, Q	1
23B	MS35275-241	..Screw, Lockring	(36164)	M, N, P, Q	1
24	71-145-1	..Nut, Shoulder	(36164)	G, H	1
25	71-322-3	..Nut, Shoulder	(36164)	I, J, K, L, M, N, P, Q	1
26	71-143-1	..Spacer, Flapper	(36164)	G, H	1
27	71-009-3	..Floating Piston (Superseded by 71-332-1)		G, H, I, J, K, L, M, N, P, Q	1
28	71-332-1	..Floating Piston	(36164)	I, J, K, L, M, N, P, Q	1
29	71-129-9	..Bumper, Rubber	(36164)	G, H, I, J, K, L, M, N, P, Q	1
30	71-142-1	..Shoulder	(36164)	G, H, I, J, K, L, M, N, P, Q	1
31	71-141-9	..Piston Tube	(36164)	G, H, I, J, K, L, M, N, P, Q	1
32	7336MTE-987T	..Ring GT	(72902)	G, H	1
33	7336MTE-987-4780	..Ring FT	(72902)	I, J, K, L, M, N, P, Q	1
34	7331FTE-987T	..Ring GT	(72902)	G, H	1
35	7331FTE-987-4780	..Ring GT	(72902)	I, J, K, L, M, N, P, Q	1
36	71-156-9	.Locknut (superseded by 71-156-11)	(36164)	G, H, I, J, K	1
36A	71-156-11	.Locknut	(36164)	G, H, I, J, K, L, M, N, P, Q	1
37	71-309-9	.Washer	(36164)	G, H, I, J, K, L, M, N, P, Q	1
38	71-095-9	.Shim	(36164)	G, H, I, J, K, L, M, N, P, Q	1
39	71-199-9	.Diaphragm	(36164)	G, H, I, J, K, L, M, N, P, Q	1
40	MS24665-138	.Pin, Cotter		G, H, I, J, K, L, M, N, P, Q	1
41	MS17825-4	.Nut		G, H, I, J, K	1
41A	NAS679A4	.Nut, Self-locking		L, M, N, P, Q	2
42	AN960PD416	.Washer		G, H, I, J, K, L, M, N, P, Q	1
42A	71-341-1	.Washer, Profile	(36164)	L, M, N, P, Q	2
43	71-092-9	.Lockbolt	(36164)	G, H, I, J, K	1
43A	71-340-1	.Lockbolt	(36164)	L, M, N, P, Q	2
44	MS28775-137	.O-ring		G, H, I, J, K, L, M, N, P, Q	1
45	MS28774-137	.Ring, Back-up		G, H, I, J, K, L, M, N, P, Q	1
-46	71-081-7	.Cartridge Assembly	(36164)	G, H, I, J, K, L, M, N, P, Q	1
47	71-083-7	..Cap Plug	(36164)	G, H, I, J, K, L, M, N, P, Q	1
48	71-082-7	..Cylinder	(36164)	G, H, I, J, K, L, M, N, P, Q	1
49	71-093-9	.Bushing	(36164)	G, H, I, J, K, L, M, N, P, Q	1
49A	71-094-9	.Bushing (superseded by 71-093-9)		G, H, I, J, K, L, M, N, P, Q	1
50	71-093-9	.Bushing	(36164)	G, H, I, J, K	2

NOTE: – preceding index number indicates item not illustrated.

FIGURE 1104 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
-51	71-108-9	.Fork Assembly	(36164)	G, H, I, J, K, L, M, N, P, Q	1
52	71-305-9	..Bushing	(36164)	G, H, I, J, K, L, M, N, P, Q	2
53	71-189-5	..Bushing	(36164)	G, H, I, J, K, L, M, N, P, Q	4
54	71-157-9	..Bushing	(36164)	G, H, I, J, K, L, M, N, P, Q	1
55	NAS516-1	..Lubricator	(36164)	G, H, I, J, K, L, M, N, P, Q	1
56	71-136-9	..Fork	(36164)	G, H, I, J, K, L, M, N, P, Q	1
57	MS24665-300	.Pin, Cotter		G, H, I, J, K, L, M, N, P, Q	1
58	AN320C6	.Nut		G, H, I, J, K, L, M, N, P, Q	1
59	AN960-C616L	.Washer		G, H, I, J, K, L, M, N, P, Q	1
60	71-187-1	.Bolt	(36164)	G, H, I, J, K, L, M, N, P, Q	1
61	71-107-11	.Bushing	(36164)	G, H, I, J, K, L, M, N, P, Q	2
62	71-168-1	.Dust Ring	(36164)	G, H, I, J, K, L, M, N, P, Q	2
-63	71-171-9	.Torque Link Assembly Lower (superseded by 71-339-1)	(36164)	G, H, I, J	1
-63	71-339-1	.Torque Link Assembly Lower	(36164)	G, H, I, J, K, L, M, N, P, Q	1
64	NAS516-1	..Lubricator		G, H, I, J, K, L, M, N, P, Q	1
65	71-163-9	..Torque Link, Lower (superseded by 71-338-1)	(36164)	G, H, I, J	1
-65	71-338-1	..Torque Link, Lower	(36164)	G, H, I, J, K, L, M, N, P, Q	1
66	71-166-1	.Dust Ring	(36164)	G, H, I, J, K, L, M, N, P, Q	2
67	MS20364-428	.Nut		G, H, I, J, K, L, M, N, P, Q	2
68	AN960C416L	.Washer		G, H, I, J, K, L, M, N, P, Q	2
69	AN4-31A	.Bolt		G, H, I, J, K, L, M, N, P, Q	2
70	71-139-3	.Towing Spool	(36164)	G, H, I, J, K, L, M, N, P, Q	2
71	71-204-3	.Screw, Setting	(36164)	G, H, I, J, K, L, M, N, P, Q	2
72	71-137-3	.Nut, Retaining	(36164)	G, H, I, J, K, L, M, N, P, Q	1
73	71-133-1	.Spacer, Adjustment	(36164)	G, H, I, J, K, L, M, N, P, Q	1
74	AN996-30	.Lockring		G, H, I, J, K, L, M, N, P, Q	1
75	71-132-3	.Spacer	(36164)	G, H, I, J, K, L, M, N, P, Q	1
76	71-135-3	.Axle	(36164)	G, H, I, J, K, L, M, N, P, Q	1
77	MS18066-08	.Set-screw		G, H, I, J, K, L, M, N, P, Q	1
78	71-336-1	.Locknut	(36164)	J, K, L, M, N, P, Q	1
79	71-153-1	.Locknut	(36164)	G, H, I	1
80	71-152-1	.Washer	(36164)	G, H, I	1
81	527000A	.Scraper	(05694)	J, K, L, M, N, P, Q	1
82	MS28776M2-27	.Scraper		G, H, I	1

NOTE: – preceding index number indicates item not illustrated.

FIGURE 1104 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
83	71-151-1	.Bearing Retainer	(36164)	G, H, I	1
-84	71-335-1	.Journal Bearing (superseded by 71-055-5)		J, K, L, M, N, P, Q	1
-84	71-335-5	.Journal Bearing		J, K, L, M, N, P, Q	1
85	71-055-5	.Journal Bearing Sub-assembly	(36164)	G, H, I	1
-85A	*71-086-5	..Bearing	(36164)	G, H, I	1
-85B	*71-085-5	..Sleeve	(36164)	G, H, I	1
86	MS21042-06	.Nut		G, H, I, J, K, L, M, N, P, Q	1
87	AN960PD6	.Washer		G, H, I, J, K, L, M, N, P, Q	1
88	MS35206-230	.Screw, Machine Pan Head		G, H, I, J, K, L, M, N, P, Q	1
89	71-057-5	.Block	(36164)	G, H, I, J, K, L, M, N, P, Q	2
90	71-058-5	.Locking Clip	(36164)	G, H, I, J, K, L, M, N, P, Q	1
91	71-060-5	.Locking Key	(36164)	G, H, I, J, K, L, M, N, P, Q	1
92	71-160-9	.Nut, Cylinder	(36164)	G, H, I, J, K, L, M, N, P, Q	1
93	71-018-5	.Thrust Washer	(36164)	G	1
94	71-061-5	.Thrust Washer	(36164)	G	2
95	71-326-1	.Thrust Ring	(36164)	H, I, J, K, L, M, N, P, Q	1
96	71-327-1	.Shim Washer	(36164)	H, I, J, K, L, M, N	1
97	71-323-1	.Disc, Friction	(36164)	H, I, J, K, L, M, N, Q	1
-97A	71-323-1	.Disc, Friction	(36164)	P	2
98	71-062-5	.Bushing	(36164)	G, H, I, J, K, L, M, N, P, Q	1
99	MS24665-300	.Pin, Cotter		G, H, I, J, K, L, M, N, P, Q	1
100	AN320C6	.Nut		G, H, I, J, K, L, M, N, P, Q	1
101	AN960C616L	.Washer		G, H, I, J, K, L, M, N, P, Q	1
102	71-173-1	.Bolt	(36164)	G, H, I, J, K, L, M, N, P, Q	1
103	71-174-1	.Cam	(36164)	G, H, I, J, K, L, M, N, P, Q	1
104	71-175-1	.Spring	(36164)	G, H, I, J, K, L, M, N, P, Q	1
-105	71-105-5	.Upper Torque Arm Assembly	(36164)	G, H, I, J, K, L, M, N, P, Q	1
106	MS21042-L08	..Nut		G, H, I, J, K, L, M, N, P, Q	2
107	AN960PD8L	..Washer		G, H, I, J, K, L, M, N, P, Q	2
108	AN509-8R-21	..Screw, Machine Flat Head		G, H, I, J, K, L, M, N, P, Q	2
109	71-104-5	..Retainer, Spring	(36164)	G, H, I, J, K, L, M, N, P, Q	1
110	MS24585-497	..Spring		G, H, I, J, K, L, M, N, P, Q	1
111	71-103-5	..Latch Pin	(36164)	G, H, I, J, K, L, M, N, P, Q	1
112	71-102-5	..Torque Arm, Upper	(36164)	G, H, I, J, K, L, M, N, P, Q	1

NOTE: – preceding index number indicates item not illustrated.
* Not procurable as a spare. For future procurement, order Index No. 85

FIGURE 1104 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
113	71-164-1	..Bushing	(36164)	G, H, I, J, K, L, M, N, P, Q	2
114	71-166-1	.Dust Ring	(36164)	G, H, I, J, K, L, M, N, Q	2
114A	71-166-3	.Dust Ring	(36164)	P	2
-115	71-177-9	.Steering Collar Assembly (superseded by 71-177-17)	(36164)	G	1
-116	71-177-17	.Steering Collar Assembly	(36164)	G, H, I, J, K, L, M, N, Q	1
-116A	71-177-19	.Steering Collar Assembly	(36164)	P	1
117	AN520-4-4	..Screw, Machine Round Head		G, H, I, J, K, L, M, N, P, Q	6
118	71-176-3	..Cover	(36164)	G, H, I, J, K, L, M, N, P, Q	1
119	MS9048-114	..Pin, Spring (replaced by NAS516PF4-16)		G, H, I, J, K	1
119	NAS561PF4-16	..Pin, Spring (replaces MS9048-114)		L, M, N, P, Q	1
120	71-276-1	..Stud	(36164)	G, H, I, J, K, L, M, N, P, Q	1
121	MS24665-231	..Pin, Cotter		G, H, I, J, K, L, M, N, P, Q	1
122	MS17825-8	..Locknut		G, H, I, J, K, L, M, N, P, Q	1
123	71-169-1	..Bushing	(36164)	G, H, I, J, K, L, M, N, P, Q	1
123A	AN960C816L	..Washer		L, M, N, P, Q	1
124	71-059-5	..Bearing (superseded by 71-331-1)	(36164)	G	1
125	71-331-1	..Bearing	(36164)	G, H, I, J, K, L, M, N, P, Q	1
126	71-305-9	..Bushing	(36164)	G, H, I, J, K, L, M, N, P, Q	2
127	NAS516-1	..Lubricator		G, H, I, J, K, L, M, N, P, Q	2
128	71-161-9	..Collar, Steering (superseded by 71-161-11)		G, H, I, J, K	1
128	71-161-11	..Collar, Steering	(36164)	G, H, I, J, K, L, M, N, P, Q	1
129	71-325-1	..Washer, Wear	(36164)	H, I, J, K, L, M, N, P, Q	1
130	71-018-5	..Thrust Washer	(36164)	H, I, J, K, L, M, N, P, Q	1
131	MS20074-04-11	..Bolt, Machine		G, H, I, J, K, L, M, N, P, Q	2
-132	71-184-1	.Swivel Fitting Assembly	(36164)	G, H, I, J, K, L, M, N, P, Q	1
133	AN815-4	..Union, Flared Tube		G, H, I, J, K, L, M, N, P, Q	2
134	MS28778-4	..Packing, Preformed		G, H, I, J, K, L, M, N, P, Q	2
135	MS9048-071	..Pin, Spring		G, H, I, J, K, L, M, N, P, Q	2
136	2107-1	..Collar	(36164)	G, H, I, J, K, L, M, N, P, Q	2
137	71-183-1	..Swivel	(36164)	G, H, I, J, K, L, M, N, P, Q	2
138	MS28774-012	..Ring, Back-up		G, H, I, J, K, L, M, N, P, Q	4
139	MS28775-012	..O-ring		G, H, I, J, K, L, M, N, P, Q	4

NOTE: – preceding index number indicates item not illustrated.

FIGURE 1104 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
140	71-180-1	..Adapter, Swivel	(36164)	L, M, N, P, Q	1
141	MS24665-285	.Pin, Cotter		G, H, I, J, K, L, M, N, P, Q	1
142	AN320D8	.Nut		G, H, I, J, K, L, M, N, P, Q	1
143	MS35333-44	.Washer		G, H, I, J, K, L, M, N, P, Q	1
144	71-197-1	.Washer	(36164)	G, H, I, J, K, L, M, N, P, Q	1
145	71-191-1	.Pulley, Shaft	(36164)	G, H, I, J, K, L, M, N, P, Q	1
146	MS24665-138	.Pin, Cotter		G, H, I, J, K, L, M, N, P, Q	1
147	AN320C4	.Nut		G, H, I, J, K, L, M, N, P, Q	1
148	AN960C416L	.Washer		G, H, I, J, K, L, M, N, P, Q	1
149	71-192-1	.Slider	(36164)	G, H, I, J, K, L, M, N, P, Q	1
150	71-194-1	.Pivot	(36164)	G, H, I, J, K, L, M, N, P, Q	1
151	05-DU-08	.Bushing	(17194)	G, H, I, J, K, L, M, N, P, Q	1
152	MS18066-30	.Screw, Set		G, H, I, J, K, L, M, N, P, Q	1
-153	71-196-1	.Cable Guard Assembly	(36164)	G, H, I, J, K, L, M, N, P, Q	1
154	MS21042L-3	..Nut		G, H, I, J, K, L, M, N, P, Q	2
155	AN501-10-10	..Screw, Machine Fillister Head		G, H, I, J, K, L, M, N, P, Q	2
156	71-196-11	..Guard, Cable	(36164)	G, H, I, J, K, L, M, N, P, Q	2
157	71-196-13	..Pin, Guard	(36164)	G, H, I, J, K, L, M, N, P, Q	2
158	MS16556-817	.Pin, Straight, Headless		G, H, I, J, K, L, M, N, P, Q	2
158	MS9047-066	.Pin, Spring (alternative item)		G, H, I, J, K, L, M, N, P, Q	2
159	DU08	.Thrust Washer	(17194)	G, H, I, J, K, L, M, N, P, Q	2
160	08DU14	.Bushing	(17194)	G, H, I, J, K, L, M, N, P, Q	1
161	MS24665-300	.Pin, Cotter		G, H, I, J, K, L, M, N, P, Q	1
162	AN320C8	.Nut		G, H, I, J, K, L, M, N, P, Q	1
163	AN960C816L	.Washer		G, H, I, J, K, L, M, N, P, Q	1
164	71-125-1	.Washer, Special	(36164)	G, H, I, J, K, L, M, N, P, Q	2
165	71-186-1	.Bolt	(36164)	G, H, I, J, K, L, M, N, P, Q	2
166	MS16556-801	.Pin, Straight, Headless		G, H, I, J, K, L, M, N, P, Q	2
166	MS9047-002	.Pin, Spring (alternative item)		G, H, I, J, K, L, M, N, P, Q	2
167	08DU10	.Bushing	(17194)	G, H, I, J, K, L, M, N, P, Q	2
168	71-172-1	.Spacer	(36164)	G, H, I, J, K, L, M, N, P, Q	1
-169	71-330-1	.Cylinder Assembly	(36164)	G, H, I, J, K, L, M, N, P, Q	1
170	71-111-15	..Cylinder	(36164)	G, H, I, J, K, L, M, N, P, Q	1

NOTE: – preceding index number indicates item not illustrated.

FIGURE 1104 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
171	71-317-1	..Sleeve	(36164)	G, H, I, J, K, L, M, N, P, Q	1
172	71-311-9	.Shim	(36164)	G, H, I, J, K, L, M, N, P, Q	AR
173	71-101-9	.Plate, Name and Instruction (superseded by 71-101-11)	(36164)	G	1
173	71-101-11	.Plate, Name and Instruction	(36164)	G, H, I, J, K, L, M, N, P, Q	1
174	71-314-1	.Plate, Modification	(36164)	G, H, I, J, K, L, M, N, P, Q	1
175	C6MK1260-S1	.Strap, Steel, 1/2 inch width	(71867)	G, H, I, J, K, L, M, N	AR
176	AN960D416	.Washer		L, M, N, P, Q	2

NOTE: – preceding index number indicates item not illustrated.

NOSE WHEEL STEERING ACTUATOR AND LINKS SUB-ASSEMBLY

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RECORD OF REVISIONS

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Rev. No.	Rev. Date	Insertion Date	By
1	Oct 30/72	Mar. 12/73	DHC
2	Mar 20/74	April 22/74	RM.
3	MAY 20/77	JUN 21/77	M.B.
4	DEC 21/79	JAN 20/80	D.H.
-	9/20/2012	10/16/2012	ATP/RLL

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RECORD OF TEMPORARY REVISIONS

TEMP REV NO	DESCRIPTION	ISSUE DATE	ATP REV DATE	INSERT BY	DATE REMOVED	REV INCOR	REMOVE BY
32-7	32-50-11:1103	10/14/94	11/21/94	ATP/RD			

LIST OF EFFECTIVE PAGES

On a revised page the portion of the text and illustration affected by the latest technical revision is indicated by a black vertical line. Pages with a black vertical line against the date at the bottom of the page are the result of text shift from page to page or nontechnical corrections.

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Effective Pages	*1	Sep 20/12		*1103	Sep 20/12
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Record of Revisions	1	Nov 5/70		1106	Oct 30/72
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	702	Dec 21/79			
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De Havilland Canada

DHC-6 TWIN OTTER

OVERHAUL MANUAL
71-190

INTRODUCTION

This manual contains instructions for the overhaul of the Heroux Nosewheel Steering Actuator and Links Sub-assembly Part No. 71-190.

NOSEWHEEL STEERING ACTUATOR AND LINKS SUB-ASSEMBLY

HEROUX PART NO,. 71-190-1, -3, -7, -9, -11B, -13 AND -15

DESCRIPTION AND OPERATION

1. General (Figure 1)

The nosewheel steering actuator and links sub-assembly is part of the nose gear leg assembly, and is mounted on the shock strut assembly. Refer to 32-20-11, NOSE GEAR LEG ASSEMBLY for configuration, and separation of the nose wheel steering actuator and links sub-assembly from the shock strut assembly.

The links sub-assembly consists of a lever assembly, two links, and the attaching part to connect the lever assembly and links to the steering actuator assembly. The lever assembly is attached at two lugs, and connected by the two links to a piston and rod assembly on the steering actuator assembly. When installed, the lever assembly is also connected to a steering collar on the shock strut assembly.

The steering actuator assembly is hydraulically-operated, and consists of a manifold, a piston and rod assembly, an input swivel assembly, a filter, and control valve, check valve, relief valve, and shimmy damper sub-assemblies which are housed within the manifold. On assemblies Part No. 71-190-7, 71-190-11B, 71-190-13 and 71-190-15, a check valve is fitted externally to replace a check valve within the manifold.

When installed and connected into the aircraft nosewheel steering system, movement of the system steering wheel is transmitted by cables and pulleys to move the input swivel shaft from its neutral position. An input swivel, driven by the input shaft positions a control valve in the actuator to direct hydraulic pressure to the appropriate side of the piston and rod assembly opening the other side to return. The pressure acts on the piston to extend or retract the piston and rod assembly and the links connected operating lever. The operating lever turns the steering collar to move the nosewheel to the left or right, as selected. Internal stops formed by the actuator end cap and an undercut at the opposite end of the manifold bore limits piston travel between fully extended and fully retracted. Actuator piston speed is limited by mechanical stops on the input swivel assembly.

2. Data

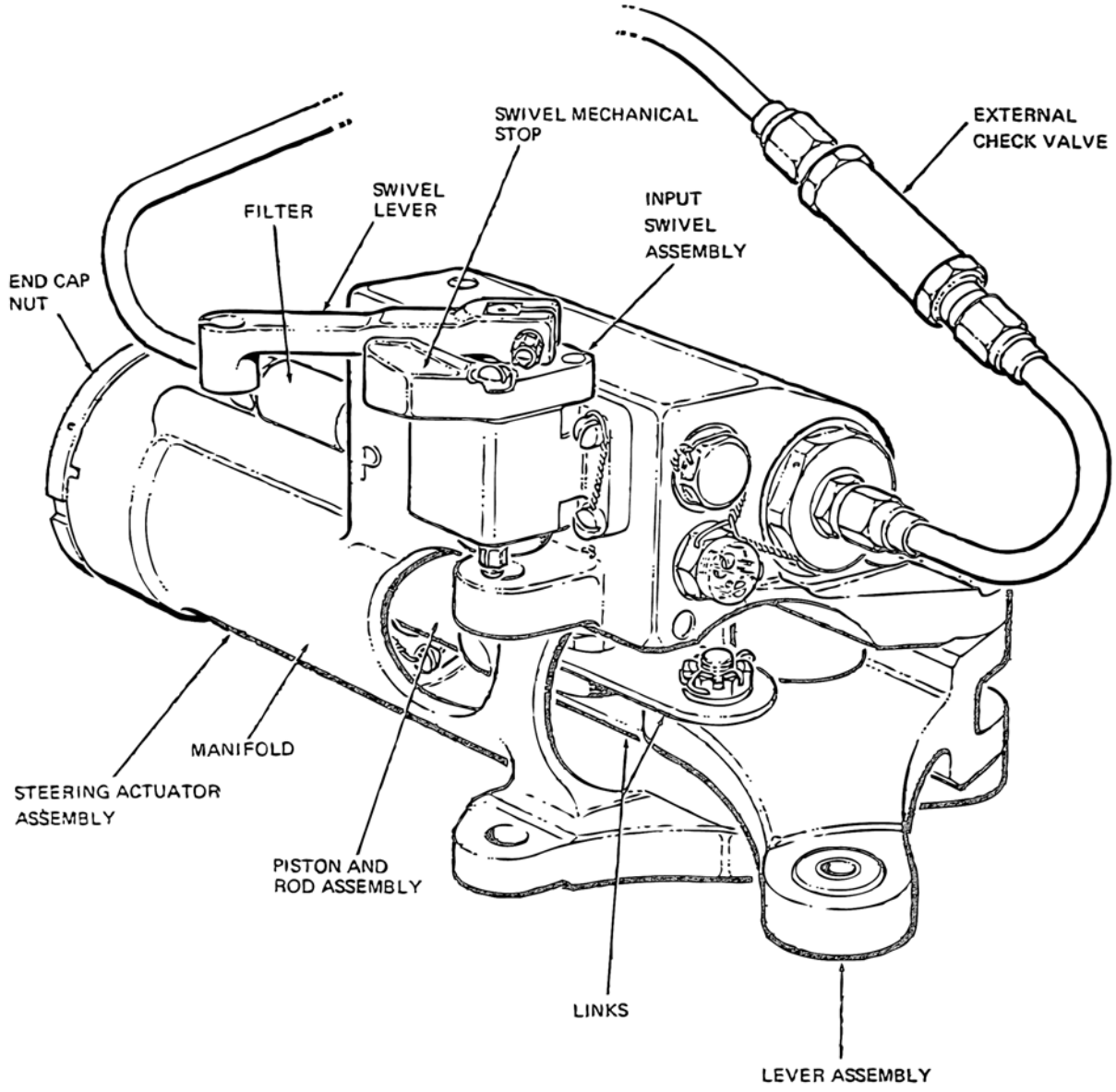
A. General

Hydraulic fluid	- MIL-H-5606
Operating Pressure	- 1500 psi
Proof Pressure	- 2250 psi
Flow Rate	- 1.0 to 1.3 Imp (1.2 to 1.6 US) gpm
Internal Relief	- 1.0 Imp (1.2 US) gpm at 1800 psi
Temperature Range	- 65°F to + 160°F

B. To Upgrade Steering Actuator and Links Sub-Assembly During Overhaul

By incorporating certain modifications during overhaul, the actuator and links sub-assembly may be upgraded to a later dash number standard. Refer to Tables 1 through 3A.

NOTE: If steering actuator and links sub-assembly are upgraded to the latest dash number during overhaul, they should be assembled to the appropriate assembly instructions for the later dash number using the required mod kits.



Steering Actuator and Links Sub-assembly

Figure 1

Table 1

Upgrade Part No. 71-190-9 to -11B Standard

MOD NO.	MOD KIT NO.	DESCRIPTION OF CHANGE
6/1380	C6MK1380	Improved shimmy damper with spring-loaded poppet valve, orifice plate with larger hole, modified restrictor and input swivel assembly installed in actuator.

Table 2

Upgrade Part No. 71-190-7 to -11B Standard

MOD NO.	MOD KIT NO.	DESCRIPTION OF CHANGE
*6/1240	C6MK1240	Improved check valve assembly installed in actuator.
6/1250	C6MK1250	Strengthened lever assembly and improved links.
6/1380	C6MK1380	Improved shimmy damper with spring-loaded poppet valve, orifice plate with larger hole, modified restrictor and input swivel assembly installed in actuator.
6/1386	C6MK1386	New end cap installed in actuator.

* Actuators Serial No. H344 and subsequent have this improvement embodied at manufacture.

Table 3

Upgrade Part No. 71-190-3 to -11B Standard

MOD NO.	MOD KIT NO.	DESCRIPTION OF CHANGE
6/1204	C6MK1204	External check valve introduced to replace check valve in actuator manifold.
6/1240	C6MK1240	Improved check valve assembly installed in actuator.
6/1250	C6MK1250	Strengthened lever assembly and improved links.
6/1380	C6MK1380	Improved shimmy damper with spring-loaded poppet valve, orifice plate with larger hole, modified restrictor and input swivel assembly installed in actuator.
6/1386	C6MK1386	New end cap installed in actuator.

NOTE: Upgrading an actuator and links assembly Part No. 71-190-1 to a higher dash number will not normally be done as this involves the changing of the manifold Part No. 71-201-1 to a manifold Part No. 71-201-3.

Table 3A

Upgrade Part No. 71-190-11B to -13

MOD NO.	MOD KIT NO.	DESCRIPTION OF CHANGE
6/1683	NO NUMBER (Refer to TAB or S/Bulletin)	Improved steering valve adjustment

C. Heroux Modification Kit

Table 4 lists the content of Heroux Modification Kit K71-506, for use with the Illustrated Parts List.

NOTE: The incorporation of De Havilland Modifications 6/1250 and 6/1386 satisfies the requirements of Mod Kit K71-506.

Table 4

Heroux Modification Kit

KIT PART NO.	KIT CONTENT		PARTS SUPERSEDED	
	DESCRIPTION	PART NO.	DESCRIPTION	PART NO.
K71-506	Link (2 off)	71-158-9	Link	71-158-1
	Lever assembly	71-170-9	Lever assembly	71-170-1
	Bolt	71-179-1	Bolt	71-178-1
	End cap	71-215-9	End cap	71-215-1
	Nut	AN320C8	Nut	AN320C7
	Washer (2 off)	AN960C816L	Washer	AN960C716L
	Washer (4 off)	NAS1515M12L		

DISASSEMBLY

1. Procedures

A. Separate Links Sub-assembly and Steering Actuator Assembly (Figure 1101)

(1) Remove cotter pin (1), nut (2), washer (3), and withdraw bolt (4) attaching links (21) to lever (16). On steering actuator and links sub-assemblies Part No. 71-190-9, 71-190-11B and 71-190-13 only, remove two washers (22) positioned between links and lever.

(2) Remove cotter pin (5), nut (6), washer (7), and withdraw bolt (8) attaching lever (16) to lugs on steering actuator assembly (23).

(3) Remove two pins (9), two thrust washers (10), two dust rings (11), and two bushings (12) from lever (16).

NOTE: Do not remove spherical bearing (14) or spherical bearing (15) from lever (16) unless they are defective and have to be replaced (refer to FITS AND CLEARANCES).

(4) Remove cotter pin (17), nut (18), washer (19), turn piston and rod assembly to obtain clearance, and withdraw bolt (20) attaching links (21) to piston rod end of steering actuator assembly (23). On steering actuator and links sub-assemblies Part No. 71-190-9, 71-190-11B and 71-190-13 only, remove two washers (22) positioned between links and piston rod end.

B. Disassemble Steering Actuator Assembly, Heroux Part No. 71-200-1 and -3 (Figure 1102)

NOTE: If Mod 6/1204 is embodied, the steering actuator assembly should be disassembled in accordance with Paragraph 1.C. and Figure 1103.

(1) Disconnect pressure tube assembly (1) from filter (2). Cut lockwire, and remove filter (using special tool T-189) and packing (3) from manifold. Disconnect return tube assembly (4) from union (5), and remove union and packing (6) from manifold.

(2) Cut lockwire, remove four screws (7) and withdraw input swivel assembly and O-ring (8) from manifold.

(3) Loosen nut (11) on screw (12), and remove lever (13) with bearing (9) from input swivel assembly. Remove two nuts (14), two screws (15), two dowels (16) and end cap (17) with shims (18). Remove O-ring (19) from end cap. Withdraw shaft (21) of input shaft assembly and remove input swivel lever (22) and bearing (23) from shaft. Remove O-ring (24), race (25), bearing (26), race (27), and bearing (28) from swivel housing (29).

(4) On steering actuator assembly Part No. 71-200-1 only, remove set screw at end cap (31).

(5) Cut lockwire, unscrew end cap (31), and remove pellet (32). Remove O-ring (33) from end cap. Withdraw spacer (34) and control valve assembly from bore of manifold. Remove spring pin (36), unscrew extension (37) from spool and sleeve assembly, and remove two spring seats (38) with spring (39), spacer (40) and

shims (44). Note number of shims to assist reassembly. Remove spool (42) from sleeve (43) using special tool T-197. Remove four O-rings (45) from sleeve.

NOTE: Extension (37), spring seats (38), spacer (40), spool (42) and sleeve (43) are a matched marked set, and cannot be replaced individually. Keep parts in a separate container when disassembled.

(6) On steering actuator assembly Part No. 71-200-1 only, remove set screw at end cap (47).

(7) Cut lockwire, unscrew end cap (47) complete with adjustment screw (53) and insert (54), and remove pellet (48) from end cap (47). Remove O-ring (49), two screws (50), and cap (51) from end cap. Unscrew adjustment screw (53) from end cap, and remove insert (54) and O-ring (55) from adjustment screw.

(8) Withdraw spring seat (56), spring (57) and relief valve assembly from bore of manifold. Remove casing (59) and poppet (60) from sleeve (61) of relief valve assembly. Remove two O-rings (62) from sleeve.

NOTE: Casing (59), poppet (60) and sleeve (61) are a matched marked set and cannot be replaced individually. Keep parts in a separate container when disassembled.

(9) Remove orifice plate (63) and shimmy damper assembly from bore of manifold. Remove poppet (65) from sleeve (66) of shimmy damper assembly. Remove two O-rings (67) from sleeve.

NOTE: Poppet (65) and sleeve (66) are a matched marked pair, and cannot be replaced individually. Keep parts in a separate container when disassembled.

(10) Remove restrictor (68), spring (69) and check valve assembly from bore of manifold.

NOTE: Check valve assembly Mod 6/1240 is interchangeable, and may be fitted as a replacement for check valve assembly Pre Mod 6/1240. The poppet, seat, and O-ring comprising the assembly are restricted to their respective assembly.

(11) Disassemble check valve by removing poppet (71) from seat (72), and O-ring (73) from poppet; remove O-ring (74) from seat.

NOTE: Poppet (71) and seat (72) are a matched marked pair, and cannot be replaced individually. Keep parts in a separate container when disassembled.

(12) On steering actuator assembly Part No. 71-200-1 only, remove set screw at end cap (76).

(13) Cut lockwire, unscrew end cap (76) and remove pellet (77) from end cap (76A). Remove O-ring (78) from end cap. If installed, remove plug (76C) and packing (76B).

(14) Remove piston (79) from bore of manifold, and remove O-ring (80) from piston. Remove check valve assembly, spring (86), seat (87) and spring (88) from bore of manifold.

NOTE: Check valve assembly Mod 6/1240 is interchangeable and may be fitted as a replacement for check valve assembly Pre Mod 6/1240. The poppet, seat, and O-ring comprising the assembly are restricted to their respective assembly.

(15) Disassemble check valve assembly by removing poppet (82) from seat (83), and O-ring (84) from poppet; remove O-ring (85) from seat.

NOTE: Poppet (82) and seat (83) are a matched marked pair, and cannot be replaced individually. Keep parts in a separate container when disassembled.

(16) Cut lockwire, remove lock key (89), unscrew jam nut (90) using special tool T-194, and unscrew rod end (91) from piston. Cut lockwire, remove lock key (92), nut (93), and using special tool T-186, unscrew end cap (94) from manifold. Remove O-ring (95) from end cap. Cut lockwire, remove four screws (96), and remove plate (97), scraper (98) and O-ring (99) from end cap.

(17) Withdraw piston (100) from manifold, and remove piston ring (101) from piston.

(18) Cut lockwire, remove four screws (102), and remove plate (103), scraper (104) and O-ring (105) from manifold.

(19) Cut lockwire, and remove two plugs (106) and two packings (107) from test ports on manifold (110).

NOTE: Do not remove three pin plugs (108) or three pin plugs (109) from manifold unless they are defective and have to be replaced.

C. Dissasemble Steering Actuator Assembly, Heroux Part No. 71-200-7, 71-200-9, 71-200-11B, 71-200-13, and 71-200-15 (Figure 1103).

(1) Disconnect pressure tube assembly (1) from filter (2). Cut lockwire, and remove filter (using special tool T-189) and packing (3) from manifold. Disconnect return tube assembly (4) from union on end cap (76), and remove valve (5) and return tube assembly (6).

(2) Continue disassembly as detailed in Paragraph 1.B. steps (2), (3), (5), (7) and (8). On steering actuator Part No. 71-200-11B only, remove screw (10C) and spacer (10B).

(3) Remove orifice plate (63) and shimmy damper assembly from bore of manifold. Remove poppet (65) from sleeve (66) of shimmy damper assembly; on steering actuators Part No. 71-200-11B and 71-200-13 only, remove spring (68) from poppet. remove two O-rings (69) from sleeve.

NOTE: Poppet (65) and sleeve (66) are a matched marked pair, and cannot be replaced individually. Keep parts in a separate container when disassembled.

(4) Remove restrictor (70), spring (71) and check valve assembly for bore of manifold.

NOTE: Check valve assembly Mod 6/1240 is interchangeable, and may be fitted as a replacement for check valve assembly Pre Mod 6/1240. The poppet, seat, and O-ring comprising the assembly are restricted to their respective assembly.

(5) Disassemble check valve by removing poppet (73) from seat (74), and O-ring (75) from poppet; remove O-ring (76) from seat.

NOTE: Poppet (73) and seat (74) are a matched marked pair, and cannot be replaced individually. Keep parts in a separate container when disassembled.

(6) Cut lockwire, unscrew end cap (78) and remove pellet (79), union (80) and packing (81). Remove O-ring (82) from end cap.

(7) Remove piston (83) and spring (85) from bore of manifold, and remove O-ring (84) from piston. Remove air filter assembly and packing (89) from manifold.

NOTE: Do not remove filter from plug (87) of air filter assembly, unless it is defective and has to be replaced.

(8) Cut lockwire, remove lock key (90), unscrew jam nut (91) using special tool T-194, and unscrew rod end (92) from piston. Cut lockwire, remove lock key (93), nut (94), and using special tool T-186, unscrew end cap (95) from manifold. Remove O-ring (96) from end cap. Cut lockwire, remove four screws (97), and remove plate (98), scrapper (99) and O-ring (100) from end cap.

(9) Withdraw piston (101) and spacer (112) fom manifold, and remove piston ring (102) from piston.

(10) Cut lockwire, remove four screws (103), and remove plate (104), scraper (105) and O-ring (106) from manifold.

(11) Cut lockwire, and remove two plugs (107) and two packings (108) from test ports on manifold (111).

NOTE: Do not remove three pin plugs (109) or three pin plugs (110) from manifold unless they are defective and have to be replaced.

CLEANING

1. Procedures

A. General

(1) Clean components by washing or spraying with a dry cleaning solvent (refer to Table 201). Matched marked sets must be cleaned separately, and replaced in container after cleaning.

WARNING: USE SOLVENT IN A WELL-VENTILATED AREA, AND AVOID BREATHING FUMES. AVOID SKIN CONTACT AND KEEP AWAY FROM FLAME.

(2) Dry with moisture-free compressed air or a lint-free cloth.

B. Hydraulic Filter (item (2), Figure 1102 or 1103)

It is recommended that the filter element (Part No. 700419, Aircraft Appliances and Equipment Ltd., Toronto, Ontario, Canada.) complete with O-rings (MS28778-6 and MS28775-010) be replaced during overhaul. If replacement items are not available, filter can be cleaned by any conventional method.

After cleaning, pressure drop is not to exceed 10 psi at 0.8 Imp (1 US) gpm, using MIL-H-5606 fluid at 100° F (38° C).

Table 201

Cleaning Materials and Compounds

MATERIAL	SPECIFICATION OR MANUFACTURER
Solvent	P-D-680

INSPECTION/CHECK

1. Procedures

A. General

(1) Carry out a magnetic particle inspection of all magnetic metal components, where practicable.

(2) Inspect non-magnetic metal components using the fluorescent penetrant method, or an approved dye penetrant method.

(3) Inspect all parts visually for signs of fatigue and cracks, and for damage such as galls, scores, scratches, excessive wear and corrosion.

(4) Inspect all threaded parts for damaged, stripped, or crossed threads.

(5) Check all holes, internal and external diameters for wear, concentricity and taper. Refer to FITS AND CLEARANCES (Tables 601 and 602) for original tolerances and service limits. Repair or replace parts worn in excess of service limits.

(6) Check springs conform to operating values given in Table 301.

Table 301

Spring Values

FIG. 1102 ITEM NO.	FIG. 1103 ITEM NO.	CONDITION	LENGTH (INCHES)	LOAD (POUNDS)	SERVICE LIMITS (POUNDS)
39	39	Free Length Installed Length	0.773 0.615	39 to 41	38
57	57	Free Length Installed Length	0.862 0.500	22.9 to 23.9	22
69	71	Free Length Installed Length	0.750 0.437	0.5 to 0.6	0.45
86 (on actuator 71-200-1)	-	Free Length Installed Length	0.500 0.480	1.0 to 1.2	0.80
86 (on actuator 71-200-3)	-	Free Length Installed Length	0.482 0.465	1.0 to 1.2	0.80
88	85	Free Length Installed Length	4.317 1.412	50.5 to 60.5	49
-	68	Free Length Installed Length	0.360 0.285	6.0	5.8

REPAIR

1. Procedures

A. General

(1) Refer to FITS AND CLEARANCES. Replace all defective parts not listed in Tables 601 or 602.

(2) Replace all pellets of end cap assemblies at each overhaul.

(3) Replace standard parts such as cotter pins, spring pins, washers, nuts, bolts or screws, lock keys, dowels, and packing or O-rings at each overhaul.

(4) When anodized parts have had protective treatment damaged or removed, apply a protective coating of Alodine solution 1200S (refer to Table 401) to the affected area(s) or reanodize the part.

(5) Replate cadmium-plated parts which have had plating damaged or removed.

(6) Where indicated in Tables 601 or 602, parts may be repaired by hard chrome plating or hard anodizing the affected surface, then grinding or honing the surface to the original dimension shown in the table. Where parts were originally chrome plated, strip the original plating before repair. Parts not previously plated should be ground to the minimum necessary to produce a smooth surface before plating the part.

(7) When any item of a matched marked set is found to be defective, the complete set must be replaced.

Table 401

Repair Materials and Compounds

MATERIAL	SPECIFICATION OR MANUFACTURER
Protective Coating, Alodine 1200S	MIL-C-5541

ASSEMBLY

1. Procedures

A. Assemble Steering Actuator Assembly, Heroux Part No. 71-200-1 and -3 (Figure 1102)

(1) If removed for replacement of defective parts, install pin plugs (108) or pin plugs (109) to manifold (110).

(2) Temporarily install two packings (107) and two plugs (106) to test ports on manifold. Do not tighten or lockwire plugs until completion of testing (refer to TESTING).

(3) Coat O-ring (105) with grease G.E. Versilube G300. Install O-ring (105), scraper (104), and secure plate (103) to manifold using four screws (102). Torque screws to 12 pound-inches, and lockwire using MS20995-C20.

(4) Install piston ring (101) to piston (100). Insert piston into manifold using special tool T-193.

(5) Coat O-rings (99) and (95) with grease G.E. Versilube G300. Install O-ring (99), scraper (98), and secure plate (97) to end cap (94) using four screws (96). Torque screws to 12 pound-inches and lockwire using MS20995-C20. Install O-rings (95) to end cap (94).

Table 501

Assembly Materials and Compounds

MATERIAL	SPECIFICATION OR MANUFACTURER
Grease	G.E. Versilube G300
Lockwire, Corrosion Resistant	MS20995-C20
Lockwire, Corrosion Resistant	MS20995-C32
Hydraulic Fluid	MIL-H-5606B
Hydraulic Fluid, Preservative	MIL-H-6083
Petroleum	VV-P-236

(6) Install end cap (94) and set piston travel as follows:

(a) Screw end cap (94) into manifold using special tool T-186.

(b) Push piston into manifold until it butts firmly against internal stop. Measure and record the dimension along the piston from plate (103) to end of piston.

NOTE: To facilitate measurement, a 5/8-18 UNF bolt may be threaded into the piston. Insure bolt is not turned during setting of piston travel and check dimension from plate (103) to head of bolt.

(c) Push piston to other end of manifold until it butts firmly against end cap (94). Adjust end cap (using special tool T-186) so that dimension along piston from plate (103) to end of piston (or head of bolt) is equal to the recorded dimension minus 2.30 inches.

(d) Finger-tighten nut (93) onto end cap (94) and install lock key (92). Do not lockwire lock key until completion of testing (refer to TESTING).

(7) Temporarily thread rod end (91) with jam nut (90) into piston and position lock key (89). Do not tighten jam nut or lockwire lock key until assembly of steering actuator and links sub-assembly to shock strut assembly (refer to 32-20-11, NOSE GEAR LEG ASSEMBLY).

(8) Coat all O-rings with grease G.E. Versilube G300 and assemble spring (88), seat (87), spring (86), check valve assembly, piston (79) and end cap assembly into bore of manifold as follows:

(a) Check valve assembly: Install O-ring (84) to poppet (82) and position poppet in seat (83); install O-ring (85) to seat (83).

(b) Position check valve assembly in piston (79) and install O-ring (80) to piston. Position spring (86) in poppet of check valve assembly, and engage seat (87) with piston (79). Position spring (88) between seat and piston, and insert assembled parts into bore of manifold.

(c) Press fit pellet (77) into end cap (76A) and install O-ring (78), plug (76C) with packing (76B) to end cap. Thread end cap assembly (75) into manifold and tighten to 15 pound-feet. Do not lockwire end cap until completion of testing (refer to TESTING).

(9) On steering actuator assembly Part No. 71-200-1 only, install set screw at end cap (76A). Torque set screw to 12 pound-inches.

(10) Coat all O-rings with grease G.E. Versilube G300, and assemble check valve assembly, spring (69), restrictor (68), shimmy damper assembly, orifice plate (63), relief valve assembly, spring (57), spring seat (56), adjustment screw assembly and end cap assembly into bore of manifold as follows:

(a) Check valve assembly: Install O-ring (73) to poppet (71) and position poppet in seat (72); install O-ring (74) to seat (72).

(b) Install two O-rings (67) to sleeve (66) of shimmy damper assembly, and position poppet (65) in sleeve.

(c) Install two O-rings (62) to sleeve (61) of relief valve assembly, and position poppet (60) and casing (59) in sleeve.

(d) Position spring (69) in poppet of check valve assembly and position restrictor (68) at spring. Position orifice plate (63) between shimmy damper assembly and relief valve assembly, and insert assembled parts into bore of manifold.

(e) Position spring (57) and seat (56) in casing (59) of relief valve assembly.

(f) Press fit insert (54) into adjustment screw (53) and install O-ring (55) to adjustment screw. Thread adjustment screw into end cap (47). Press fit pellet (48) into end cap and install O-ring (49) to end cap. Thread end cap complete

with adjustment screw assembly into manifold and tighten to 8 pound-feet. Position cap (51) at end cap assembly and temporarily secure with two screws (50). Do not tighten screws or lockwire end cap assembly until completion of testing (refer to TESTING).

(11) On steering actuator assembly Part No. 71-200-1 only, install set screw at end cap (47). Torque set screw to 12 pound-inches.

(12) Coat all O-rings with grease G.E. Versilube G300 and assemble control valve assembly, spacer (34) and end cap assembly into bore of manifold as follows:

(a) Install four O-rings (45) to sleeve (43), and position spool (42) in sleeve.

(b) Position number of shims (44) noted at disassembly, and spacer (40) at spool and sleeve assembly, position two spring seats (38) with spring (39) in spacer and thread extension (37) onto spool of spool and sleeve assembly. Adjust extension so that length of two seats (38) with spring (39) is equal to length of spacer (40). Install spring pin (36) to secure extension at slot in spool.

(c) Position spacer (34) over extension of control valve assembly and insert assembled parts into bore of manifold. Insure spacer and extension are positioned to accept spherical end of input swivel lever (22).

(d) Press fit pellet (32) into end cap (31), and install O-ring (33) to end cap. Thread end cap assembly into manifold and tighten to 10 pound-feet. Do not lockwire end cap assembly until completion of testing (refer to TESTING).

(13) On steering actuator assembly Part No. 71-200-1 only, install set screw at end cap (31). Torque set screw to 12 pound-inches.

(14) Use small amounts of hydraulic fluid MIL-H-5606B, preservative hydraulic fluid MIL-H-6083, or petroleum VV-P-236 to assist installation of O-rings and bearings, and assemble input swivel assembly as follows:

NOTE When new Torrington bearings are installed, ensure that preservative and/or lubrication is removed before assembly.

(a) Position bearing (28), race (27), bearing (26) and race (25) in swivel housing (29). Install O-ring (24) in swivel housing. Position input swivel lever (22) and insert shaft (21) to engage input swivel lever in swivel housing.

(b) Install O-ring (19) to end cap (17) and position bearing (23) and end cap on swivel housing. Secure end cap using two screws (15) and two nuts (14). Tighten screws evenly and determine shims (18) required between end cap and swivel housing as follows:

(i) Measure gaps between end cap and swivel housing at four places.

(ii) Add 0.002 to 0.039 inch to maximum measured gap to make measurement a multiple of 0.002 inch.

(iii) Peel laminations from shim (18) till residue equals measurement calculated in (ii) above.

(c) Remove nuts (14), screws (15) and end cap (17), position shims (18) and reassemble end cap to swivel housing, Tighten two nuts (14) and two screws (15) evenly. Install two dowels (16) at end cap.

(d) Position lever (13) with bearing (9) on shaft (21) and secure using screw (12) and nut (11).

(15) Install O-ring (8) to manifold. Position input swivel assembly in manifold, and insure that spherical end of input swivel lever (22) engages extension (37) of control valve assembly. Secure input swivel assembly to manifold using four screws (7). Torque screws to 12 pound-inches and lockwire using MS20995-C20.

(16) Install packing (6) and union (5) to manifold and connect return tube assembly (4) to union. Install packing (3) and filter (2) (using special tool T-189) to manifold. Lockwire filter using MS20995-C20. Connect pressure tube assembly (1) to filter.

(17) Test steering actuator assembly (refer to TESTING) before installing links sub-assembly (refer to Paragraph 1.C.).

B. Assemble Steering Actuator Assembly, Heroux Part No. 71-200-7, 71-200-9, 71-200-11B, 71-200-13 and 71-200-15 (Figure 1103).

(1) If removed for replacement of defective parts, install pin plugs (109) or pin plugs (110) to manifold (111).

(2) Temporarily install two packings (108) and two plugs (107) to test ports on manifold. Do not tighten or lockire plugs until completion of testing (refer to TESTING).

(3) Coat O-ring (106) with grease G.E. Versilube G300. Install O-ring (100), scraper (105), and secure plate (104) to manifold using four screws (103). Torque screws to 12 pound-inches and lockwire using MS20995-C20. Install O-ring (96) to end cap (95).

(4) Install piston ring (102) to piston (101). Install spacer (112) into manifold. Insert piston into manifold using special tool T-193.

(5) Coat O-rings (100) and (94) with grease G.E. Versilube G300. Install O-ring (100), scraper (99), and secure plate (98) to end cap (95) using four screws (97). Torque screws to 12 pound-inches and lockwire using MS20995-C20. Install O-ring (96) to end cap (95).

(6) Install end cap (95) and set piston travel as follows:

(a) Screw end cap (95) into manifold using special tool T-186.

(b) Push piston into manifold until it butts firmly against internal stop. Measure and record the dimension along piston from plate (104) to end of piston.

NOTE: To facilitate measurement, a 5/8-18 UNF bolt may be threaded into the piston. Ensure bolt is not turned during setting of piston travel and check dimension from plate (104) to head of bolt.

(c) Push piston to other end of manifold until it butts firmly against end cap (95). Adjust end cap (using special tool T-186) so that dimension along piston from plate (104) to end of piston (or head of bolt) is equal to the recorded dimension minus 2.30 inches.

(d) Fingertighten nut (94) onto end cap (95) and install lock key (93). Do not lockwire lock key until completion of test (refer to TESTING).

(7) Temporarily thread rod end (92) with jam nut (91) into piston and position lock key (90). Do not tighten jam nut or lockwire lock key until assembly of steering actuator and links sub-assembly to shock strut assembly (refer to 32-20-11, NOSE GEAR LEG ASSEMBLY).

(8) If removed for replacement of defective parts, install filter to plug (87) of air filter assembly. Install packing (89) and air filter assembly to manifold.

(9) Coat O-rings (84) and (82) with grease G.E. Versilube G300. Install O-ring (84) to piston (83). Press fit insert (79) into end cap (78) and install O-ring (82), packing (81) and union (80) to end cap. Position spring (85) and piston (83) in bore of manifold and thread end cap assembly into manifold. Tighten end cap assembly to 15 pound-feet. Do not lockwire until completion of testing (refer to TESTING).

(10) Coat all O-rings with grease G.E. Versilube G300, and assemble check valve assembly, spring (71), restrictor (70), shimmy damper assembly, orifice plate (63), relief valve assembly, spring (57), spring seat (56), adjustment screw assembly and end cap assembly into bore of manifold as follows:

(a) Check valve assembly: Install O-ring (75) to poppet (73) and position poppet in seat (74); install O-ring (76) to seat (74).

(b) Install two O-rings (69) to sleeve (66) of shimmy damper assembly, and position poppet (65) in sleeve. On steering actuaters Part No. 71-200-11B and 71-200-13 only, install spring (68) to poppet before positioning in sleeve.

(c) Install two O-rings (62) to sleeve (61) of relief valve assembly, and position poppet (60) and casing (59) in sleeve.

(d) Position spring (71) in poppet of check valve assembly and position restrictor (70) at spring. Position orifice plate (63) between shimmy damper assembly and relief valve assembly, and insert assembled parts into bore of manifold.

(e) Position spring (57) and seat (56) in casing (59) of relief valve assembly.

(f) Press fit insert (54) into adjustment screw (53) and install O-ring (55) to adjustment screw. Thread adjustment screw into end cap (47). Press fit pellet (48) into end cap and install O-ring (49) to end cap. Thread end cap complete with adjustment screw assembly into manifold and tighten to 8 pound-feet. Position cap (51) at end cap assembly and temporarily secure with two screws (50). Do not tighten screws or lockwire end cap assembly until completion of testing (refer to TESTING).

(11) Continue assembly of steering actuator as detailed in Paragraph 1.A. steps (12), (14) and (15). On steering actuator Part No. 71-200-11B, install spacer (10B) and secure with screw (10C). Do not lockwire spacer until completion of testing (refer to TESTING). On steering actuator, Part No. 71-200-13, slacken lock nut (10E) and back-off adjusting screws (10D) in end cap to facilitate assembly of lever (13). Refer to paragraph 1.A. step 14 (d).

(12) Connect return tube assembly (6), valve (5) and return tube assembly (4) to union (80) of end cap assembly. Install packing (3) and filter (2) (using special tool T-189) to manifold. Lockwire filter using MS20995-C20. Connect pressure tube assembly (1) to filter.

(13) Test steering actuator assembly (refer to TESTING) before installing links sub-assembly (refer to Paragraph 1.C.).

C. Assemble Links Sub-assembly to Steering Actuator Assembly (Figure 1101)

(1) Position two links (21) at piston rod end of steering actuator assembly and install bolt (20), washer (19), nut (18) and cotter pin (17).

NOTE: On steering actuator and links sub-assemblies Part No. 71-190-9, 71-190-11B and 71-190-13 only, position two washers (22) (one between each link and piston rod end) before installing bolt (20).

(2) If removed for replacement of defective parts, install spherical bearing (15) and/or spherical bearing (14) to lever (16). Stake over bearings.

(3) Install two bushings (12), two dust rings (11), two thrust washers (10) and two pins (9) to lever (16).

(4) Position lever assembly at lugs on steering actuator assembly and install bolt (8), washer (7), nut (6) and cotter pin (5).

(5) Position links (21) at lever (16) and install bolt (4), washer (3), nut (2) and cotter pin (1).

NOTE: On steering actuator and links sub-assemblies Part No. 71-190-9, 71-190-11B and 71-190-13 only, position two washers (22) (one between each link and piston rod end) before installing bolt.

FITS AND CLEARANCES

1. Original Dimensions and Service Limits

A. Steering Actuator and Links Sub-assembly (Figure 1101)

Refer to Table 601 for original dimensions and service limits of the links sub-assembly and disposition of parts failing to meet inspection requirements.

B. Steering Actuator Assembly (Figures 1102 and 1103)

Refer to Table 602 for original dimensions, service limits and disposition of parts failing to meet inspection requirements.

Table 601

Links Sub-assembly - Original Tolerances and Service Limits

FIG. 1101 INDEX NO.	NAME	DISCREPANCY LOCATION	ORIGINAL DIMENSION (INCHES)	SERVICE LIMITS (INCHES)	DISPOSITION
4	Bolt (for spherical bearing on lever 71-159-1)	O.D.	0.4370 - 0.4367	0.4364	Chrome plate to original dimension or replace
	Bolt (for spherical bearing on lever 71-159-9)	O.D.	0.4995 - 0.4992	0.4889	
8	Bolt	O.D.	0.3750 - 0.3747	0.3744	Chrome plate to original dimension or replace
12	Bushing	I.D.	0.3750 - 0.3760	0.3770	Replace
14	Spherical Bearing	I.D. O.D.	0.4995 - 0.5000 1.0000 - 0.9995	0.5005 0.9990	Replace Replace
15	Spherical Bearing (for lever 71-159-1)	I.D. O.D.	0.4370 - 0.4375 0.9375 - 0.9370	0.4380 0.9365	Replace Replace
	Spherical Bearing (for lever 71-159-9)	I.D. O.D.	0.4995 - 0.5000 1.0000 - 0.9995	0.5005 0.9990	Replace Replace
16	Lever	I.D. (location for bushings (12))	0.4687 - 0.4691 x 0.375 deep	0.4695	Replace

Table 601 (Cont'd)

Links Sub-assembly - Original Tolerances and Service Limits

FIG. 1101 INDEX NO.	NAME	DISCREPANCY LOCATION	ORIGINAL DIMENSION (INCHES)	SERVICE LIMITS (INCHES)	DISPOSITION
16		Spherical bearing (14) housing	0.9998 - 1.0003	1.0008	Replace
	Lever (71-159-1 only)	Spherical bearing (15) housing	0.9373 - 0.9378	0.9383	Replace
	Lever (71-159-9 only)	Spherical bearing (15) housing	0.9998 - 1.0003	1.0008	Replace
20	Bolt	O. D.	0.4995 - 0.4992	0.4889	Chrome plate to original dimension or replace
21	Link (71-158-1)	Bolt hole Bolt hole	0.4370 - 0.4375 0.4995 - 0.5000	0.4380 0.5005	Replace Replace
	Link (71-158-9)	Bolt holes (2 positions)	0.4995 - 0.5000	0.5005	Replace

Table 602

Steering Actuator Assembly - Original Tolerances and Service Limits

FIG. 1102 INDEX NO.	FIG. 1103 INDEX NO.	NAME	DISCREPANCY LOCATION	ORIGINAL DIMENSION (INCHES)	SERVICE LIMITS (INCHES)	DISPOSITION
9	9	Nyliner Bearing	I. D.	-	-	Replace on visible signs of wear or play
13	13	Lever	Bearing (9) location	0.4370 - 0.4380	0.4390	Replace
17	17	End Cap	Bearing (23) location	0.6825 - 0.6828	0.6831	Replace
			Shaft (21) location	0.5020 - 0.5040	0.5050	Replace

Table 602 (Cont'd)

Steering Actuator Assembly - Original Tolerances and Service Limits

FIG. 1102 INDEX NO.	FIG. 1103 INDEX NO.	NAME	DISCREPANCY LOCATION	ORIGINAL DIMENSION (INCHES)	SERVICE LIMITS (INCHES)	DISPOSITION
21	21	Shaft	O. D.	0.4950 - 0.4850	0.4800	Replace
			O. D.	0.3752 - 0.3750	0.3748	Replace
22	22	Lever	Spherical end diameter	0.3127 - 0.3125	0.3123	Replace on visible signs of wear or play
23	23	Bearing	-	-	-	Replace on visible signs of wear or play
27	27	Bearing	-	-	-	
28	28	Bearing	-	-	-	
29	29	Swivel Housing	Bearing (28) location	0.5575 - 0.5578	0.5581	Replace
			I. D. Housing	0.8810 - 0.8820	0.8830	Replace
			O. D. Manifold location	0.8620 - 0.8610	0.8600	Replace
37	37	Extension	Lever (22) Spherical end location	0.3125 - 0.3130	0.3135	Replace
38	38	Spring Seat	O. D.	0.4500 - 0.4400	-	Replace on visible signs of wear
			I. D.	0.2550 - 0.2600		
40	40	Spacer	O. D.	0.8600 - 0.8550	-	Replace on visible signs of wear
			I. D.	0.6850 - 0.6900	-	
42	42	Spool	O. D. Spool lands	0.3810 - 0.3805 (before lapping)	-	Refer to Note (1)
43	43	Sleeve	I. D.	0.3780 - 0.3785 (before lapping)	-	Refer to Note (1)
			O. D.	0.7370 - 0.7350	0.7340	Replace spool and sleeve assembly
59	59	Casing	O. D.	0.6970 - 0.6940	0.6920	Replace relief valve assembly
60	60	Poppet	O. D.	0.1945 - 0.1940 (before lapping)	-	Refer to Note (2)
61	61	Sleeve	O. D.	0.7990 - 0.7980	0.7970)	Replace relief valve assembly
			I. D. Casing (59) location	0.7000 - 0.7020	0.7030)	
			I. D. Poppet (60) location	0.1925 - 0.1930 (before lapping)	-	Refer to Note (2)

Table 602 (Cont'd)

Steering Actuator Assembly - Original Tolerances and Service Limits

FIG. 1102 INDEX NO.	FIG. 1103 INDEX NO.	NAME	DISCREPANCY LOCATION	ORIGINAL DIMENSION (INCHES)	SERVICE LIMITS (INCHES)	DISPOSITION
65	65	Poppet	O. D.	0.1945 - 0.1940 (before lapping)	-	) Refer to Note (3))
66	66	Sleeve	I. D. Poppet (65) location	0.1925 - 0.1930 (before lapping)	-	))
			O. D.	0.7990 - 0.7980	0.7970	Replace shimmy damper assembly
68	70	Restrictor	O. D.	0.7900 - 0.7800	-	Replace on visible signs of wear
			I. D.	0.6900 - 0.6950	-	
71	73	Poppet	O. D.	0.5060 - 0.5040 (before lapping)	-	) Refer to Note (4))
72	74	Seat	I. D.	0.5000 - 0.5004 (before lapping)	-	))
			O. D. Seat lands	0.7990 - 0.7980	0.7970	Replace check valve assembly
79	-	Piston	O. D. Piston lands	1.4890 - 1.4880	1.4870	Replace
			I. D. Seat (87) location	1.1750 - 1.1850	1.1870	Replace
			I. D. Seat (72) location	0.8000 - 0.8020	0.8030	Replace
-	83	Piston	O. D. Piston lands	1.4890 - 1.4880	1.4870	Replace
			I. D. Spring location	0.9100 - 0.9200	-	Replace on visible signs of wear
82	-	Poppet	O. D.	0.5060 - 0.5040 (before lapping)	-	) Refer to Note (4))
83	-	Seat	I. D.	0.5000 - 0.5004 (before lapping)	-	))
			O. D. Seat lands	0.7990 - 0.7980	0.7970	Replace check valve assembly
87	-	Seat	O. D. Seat lands	1.1300 - 1.1200	0.1150	Replace
			O. D. Spring	0.9200 - 0.9100	-	Replace on visible signs of wear
91	92	Rod End	I. D. Bolt location	0.4995 - 0.5000	0.5005	Replace

Table 602 (Cont'd)

Steering Actuator Assembly - Original Tolerances and Service Limits

FIG. 1102 INDEX NO.	FIG. 1103 INDEX NO.	NAME	DISCREPANCY LOCATION	ORIGINAL DIMENSION (INCHES)	SERVICE LIMITS (INCHES)	DISPOSITION
100	101	Piston	O.D. Piston lands	2.6210 - 2.6195	2.6180	Chrome plate external surfaces to original dimensions or replace
			O.D.	0.9980 - 0.9960	0.9950	
110	111	Manifold	I.D. Piston location	2.6240 - 2.6260	2.6270	Replace
			I.D. Piston shaft location	1.0000 - 1.0020	1.0030	Replace
			I.D. Piston (79) (Fig. 1102) or (83) (Fig. 1103) location	1.4910 - 1.4930	1.4940	Replace
			I.D. Spacer (40) location	0.8630 - 0.8650	0.8660	Replace
			I.D. Sleeve (43) location	0.7380 - 0.7400	0.7410	Replace
			I.D. Relief and shimmy damper valve location	0.8000 - 0.8020	0.8030	Replace
			I.D. Two holes in line at lugs	0.4996 - 0.5001	0.5005	Replace
			I.D. Two holes in line at lugs	0.3747 - 0.3756	0.3765	Replace

NOTES: (1) Spool lap fitted to sleeve. If diametrical clearance exceeds 0.00015 inch and assembly does not meet test requirements (refer to TESTING), replace spool and sleeve assembly.

(2) Poppet lap fitted to sleeve. If diametrical clearance exceeds 0.00015 inch and assembly does not meet test requirements (refer to TESTING), replace relief valve assembly (poppet, sleeve and casing).

(3) Poppet lap fitted to sleeve. If diametrical clearance exceeds 0.0004 inch and assembly does not meet test requirements (refer to TESTING), replace shimmy damper assembly.

(4) Poppet lap fitted to seat. If diametrical clearance exceeds 0.0007 inch and assembly does not meet test requirements (refer to TESTING), replace check valve assembly.

TESTING

1. Procedures (Figure 701)

A. Filling and Bleeding

(1) Remove test port plugs and connect test ports A and B together.

(2) Connect hydraulic test rig (fluid MIL-H-5606) supply line to pressure tube assembly and return line to the return tube assembly.

(3) Place actuator so that input swivel assembly is facing down.

(4) Apply pressure of 1500 psi, turn lever of input swivel assembly fully in one direction and hold for 10 seconds minimum. Turn lever fully in opposite direction and hold for 10 seconds minimum.

(5) Repeat step (4) a minimum of five times.

(6) Place actuator so that input swivel assembly is facing up, then repeat steps (4) and (5).

B. Cracking Pressure, Inlet Check Valve

(1) Connect hydraulic test rig supply line to pressure tube assembly. Remove test port plugs and leave test ports open.

(2) Turn lever of input swivel assembly fully in either direction and gradually increase supply pressure until a small steady flow is obtained at test port. Check that supply pressure is 20 to 30 psi for steering actuator assembly 71-200-1, or 15 to 30 psi for steering actuator assemblies 71-200-3, 71-200-7, 71-200-9, 71-200-11B and 71-200-13.

C. Reseat Pressure, Back Pressure Check Valve

(1) Open pressure tube assembly to atmosphere. Connect hydraulic test rig supply line to test port A.

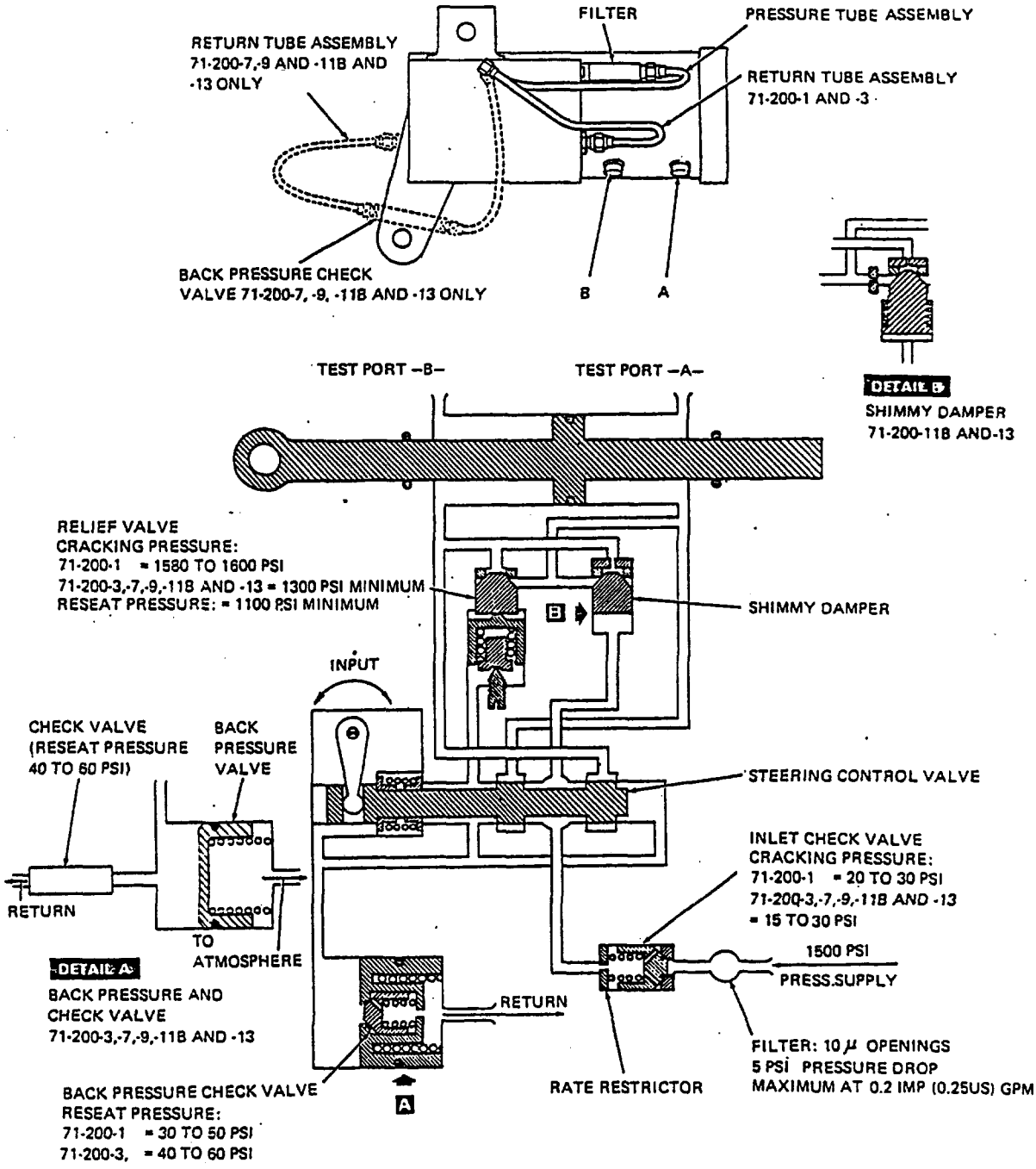
(2) Place actuator so that input swivel assembly is facing up.

(3) Turn lever of input swivel assembly fully counterclockwise (looking from above). Raise supply pressure until a steady flow is obtained at return tube assembly. Decrease supply pressure gradually until flow stops. Check supply pressure is 30 to 50 psi at reseat for steering actuator assembly 71-200-1 or 40 to 60 psi for steering actuator assemblies 71-200-3, 71-200-7, 71-200-9, 71-200-11B and 71-200-13.

(4) Maintain reseat pressure. After 3 minutes, external leakage must not exceed five drops per minute at each port.

D. Relief Valve and Shimmy Damper

(1) Place lever of input swivel assembly in neutral position (control valve centered). Connect hydraulic test rig supply line to pressure tube assembly and apply pressure of 1500 psi.



Test Ports and Schematic Hydraulic Diagram

Figure 701

(2) Connect test port A to a regulated supply line. Raise regulated pressure until flow is increased over leakage flow at test port B. Cracking pressure must be between 1580 to 1600 psi for steering actuator assembly 71-200-1, or must not be less than 1300 psi for steering actuator assemblies 71-200-3, 71-200-7, 71-200-9, 71-200-11B and 71-200-13. Adjust relief valve setting as follows:

(a) Refer to Figure 1102 or 1103.

(b) Remove two screws (50) and cap (51) from end cap (47).

(c) Turn adjuster screw (53) clockwise to increase relief valve cracking pressure or counterclockwise to decrease cracking pressure.

(d) Replace cap (51) on end cap (47) and secure with two screws (50).

(3) Lower regulated pressure at test port A gradually until flow at test port B is reduced to leakage flow. Reseat pressure must not be less than 1100 psi.

(4) Connect a flowmeter at test port B. Increase regulated pressure at test port A until 1.0 Imp (1.2 US) gpm flow is obtained at test port B. Check that pressure does not exceed 1800 psi.

(5) Connect regulated supply line to test port B and flowmeter to test port A. Repeat tests similar to steps (1) through (4), noting that adjustment of relief valve cracking pressure should not be required.

(6) Release pressure supply at pressure tube assembly and disconnect supply line. Leave pressure tube assembly open to atmosphere to permit bypass through shimmy damper orifice.

(7) Apply regulated pressure of 1000 psi at test port B. Flow at test port A must be 1.1 to 1.3 Imp (1.4 to 1.6 US) gpm.

E. Control Valve

(1) Connect test ports A and B together. Connect hydraulic test rig supply line to pressure tube assembly. Place lever of input swivel assembly in neutral (control valve centered).

(2) Apply pressure of 1500 psi. Leakage flow at return tube assembly must be 12 to 20cc per minute. If required, shims (item (44). Figure 1102 or 1103) may be added or removed to center control valve with lever within 0.005 inch.

(3) Torque required at lever of input swivel assembly to crack control valve must not exceed 65 pound-inches, and the flow must stop on reduction to 40 pound-inches.

(4) Disconnect test ports A and B and install packing and plug at each port.

(5) With supply pressure at 1500 psi, apply torque of 75 pound-inches to lever of input swivel assembly in both directions from neutral. Extension and retraction rate must be 7 $\pm$ 1 seconds for a complete stroke in each direction. On actuators Part No. 71-200-11B, or actuators with Mod 6/1380 embodied, limit retractor extension and retraction rate by cutting sides of spacer (item 10B Figure 1103) vertically, as required. See Figure 702. On actuators Part No. 71-200-13 slacken locknuts and adjust screws (items (10D) and (10E), Figure 1103) to limit actuator extension and retraction speeds. See Figure 702.

(6) Position piston at center of stroke. With control valve centered, piston creep rate must be less than 0.030 inch per minute.

F. Proof Pressure

(1) With plugs installed at test ports A and B and return tube assembly capped, apply a pressure of 2250 psi at pressure tube assembly at a rate of not more than 25,000 psi per minute (400 psi per second).

(2) Turn lever of input swivel assembly slowly clockwise and hold for 2 minutes.

(3) Turn lever of input swivel assembly slowly counterclockwise and hold for 2 minutes.

(4) There must be no leakage or permanent set.

NOTE: A slight wetting insufficient to form a drop is acceptable.

(5) Release pressure completely and then apply 40 psi at pressure tube assembly. There must be no leakage.

G. Lockwiring After Test (Figure 1102 or 1103)

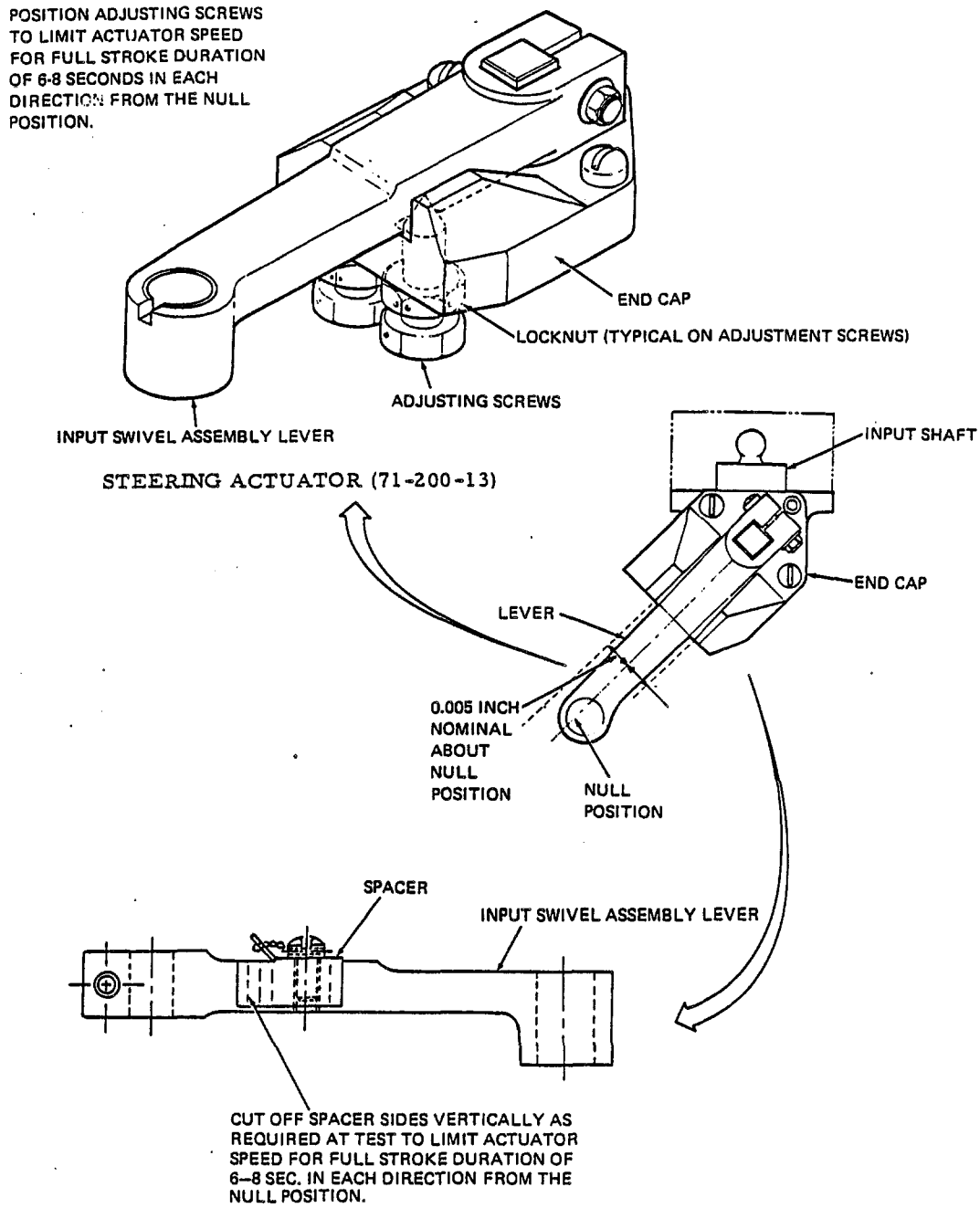
(1) Lockwire end cap (31), end cap (47) and end cap (item (76A), Figure 1102 or item (78), Figure 1103) using MS20995-C32.

(2) Lockwire lock key (item (92), Figure 1102 or item (93), Figure 1103) using MS20995-C20.

(3) Lockwire two plugs at test ports using MS20995-C20.

(4) On steering actuator 71-200-11B, lockwire spacer securing screw (item (10C), Figure 1103) to spacer, using MS20995-C20.

(5) On steering actuator 71-200-13, lockwire adjusting screw and locknut to end cap using MS20995-C32.



Input Swivel Assembly Lever Adjustment

Figure 702

TROUBLE SHOOTING

1. General

Refer to Table 801 for possible cause and correction of defects. For item numbers refer to Figure 1102 or Figure 1103.

Table 801

Trouble Shooting Information

TROUBLE	POSSIBLE CAUSE	CORRECTION
With lever (13) centered, piston creep exceeds 0.030 inch per minute	Control valve not centered with lever within 0.005 inch	Remove control valve assembly. Add or remove shims (44) to center control valve with lever to within 0.005 inch. Reassemble and test.
External leaks	Faulty O-ring or packing	Replace applicable O-ring or packing.
	NOTE: (1) Piston travel must be reset when end cap (item (94) Figure 1102, or item (95) Figure 1103) is removed for O-ring replacement. (2) Piston travel and rod end setting must be reset if piston is removed for replacement of O-ring (item (105) Figure 1102, or item (106) Figure 1103).	
Actuator extension or retraction does not meet requirements (6-8 seconds) for complete stroke.	Faulty O-rings on control valve sleeve (43)	Replace O-rings and test.
	Incorrect setting or poppet not seating at relief valve assembly	Remove and clean relief valve assembly. Reassemble, test and adjust relief valve setting.
	Input swivel assembly incorrectly adjusted.	Adjust spacer (item (10B), Figure 1103). Actuator Part No. 71-200-11B. Refer to TESTING. OR Adjust adjusting screws item (10D), Figure 1103 - Actuator Part No. 71-200-13. Refer to TESTING.

STORAGE INSTRUCTIONS

1. Procedures

A. General

(1) If steering actuator and links sub-assembly is mounted on the shock strut assembly, carry out storage instructions given in 32-20-11, NOSE GEAR LEG ASSEMBLY.

B. Preparation

(1) Fill steering actuator as far as possible with hydraulic fluid (refer to Table 901), and cap pressure and return tube assemblies.

(2) Secure links sub-assembly to steering actuator to prevent movement of piston assembly.

(3) Wrap steering actuator and links sub-assembly in water resistant vapor barrier material (refer to Table 901), or enclose in a plastic bag.

(4) Affix label giving following information:

(a) Part and serial number.

(b) Date of overhaul

(c) Inspection

Table 901

Storage Materials and Compounds

MATERIAL	SPECIFICATION OR MANUFACTURER
Barrier Material	MIL-B-121
Hydraulic Fluid	MIL-H-5606

SPECIAL TOOLS

1. General

Refer to Table 1001 for special tools required for the overhaul procedure detailed in this manual.

Table 1001

Special Tools and Equipment

HEROUX PART NO.	DESCRIPTION
T-186	Wrench for end cap
T-189	Adapter for filter
T-193	Guide for piston installation
T-194	Wrench assembly, piston rod end jam nut
T-197	Extractor, spool and sleeve assembly
-	Torque wrench to 100 pound-inches
-	Flowmeter to check flow rate 1.0 to 1.3 Imp (1.2 to 1.6 US) gpm
-	Hydraulic test rig, two pressure supplies 2250 psi, and flow rate 1.3 Imp (1.6 US) gpm

ILLUSTRATED PARTS LIST

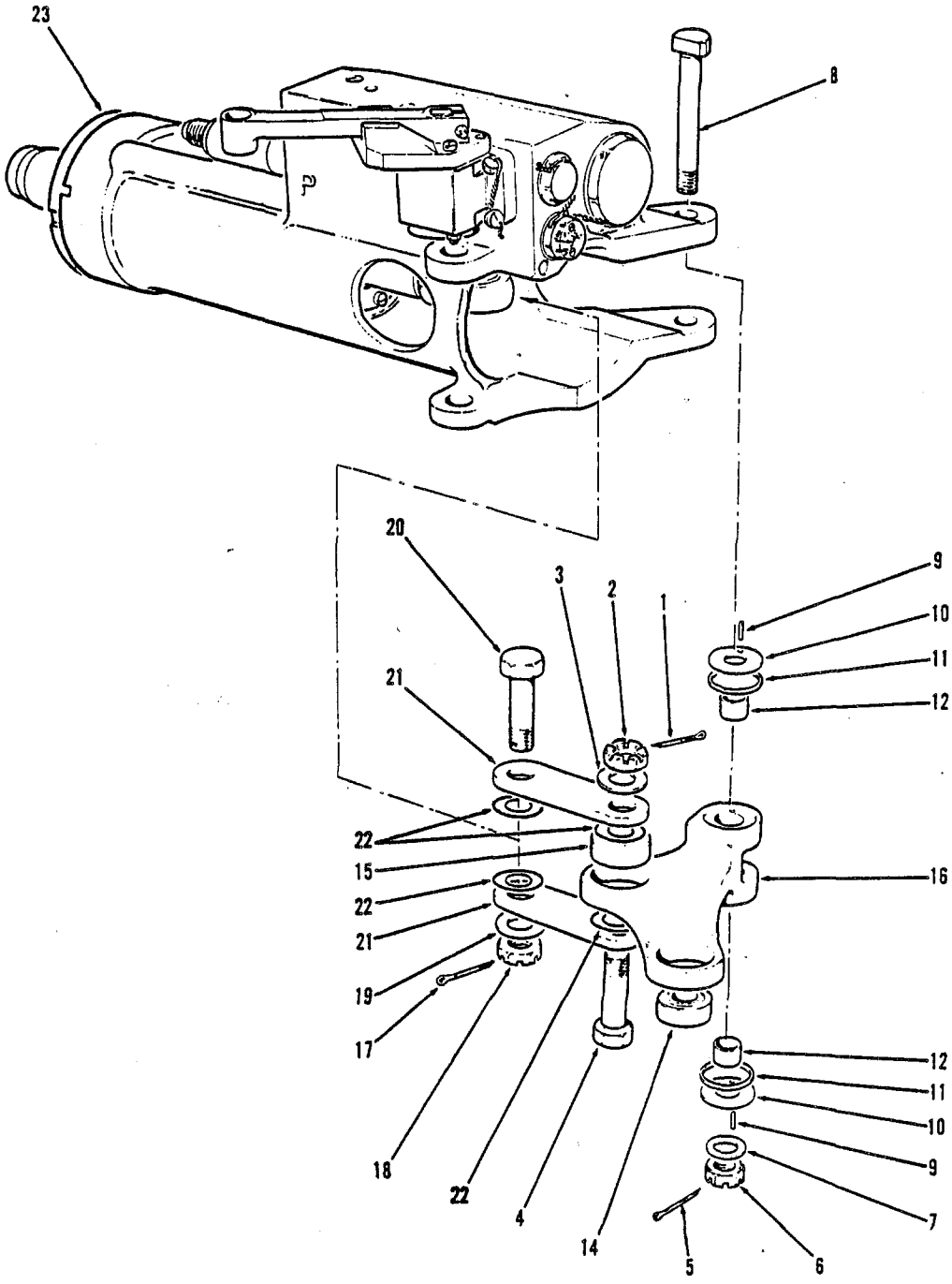
1. Vendor Codes

For explanation of vendor codes used in the Illustrated Parts List, refer to Table 1101.

Table 1101

Vendor Codes

CODE	NAME AND ADDRESS
05694	Equi-Flex Products, Detroit, Michigan, U.S.A.
15860	Astro Division of New Hampshire Ball Bearing Inc., El Segundo, California, U.S.A.
17194	Glacier Packing Co., Sanger, California, U.S.A.
35076	Aircraft Appliances and Equipment Ltd., 152 East Drive, Bramalea, Ontario, Canada.
36164	Heroux Machine Parts Ltd., Longueuil, P.Q., Canada.
36972	Tor Manufacturing Co. Ltd., 3289 Lenworth Drive, Cooksville, Ontario, Canada
80648	The Torrington Co., South Bend, Indiana, U.S.A.
86768	Republic Manufacturing Co., Cleveland, Ohio, U.S.A.
92555	The Lee Co., Westbrook, Connecticut, U.S.A.
96881	Thomson Industries Inc., 1029 Plandome Rd., Manhasset, N.Y., 11030, U.S.A.
97613	Kahr Bearing, Burbank, California, U.S.A.
97820	W.S. Shamban & Co., Culver City, California, U.S.A.



Exploded View - Steering Actuator and Links Sub-assembly

Figure 1101

2. List of Parts, Steering Actuator and Links Sub-assemblies 71–190–1, 71–190–3, 71–190–7, 7–190–9, 71–190–11B, 71–190–13 and 71–190–15.

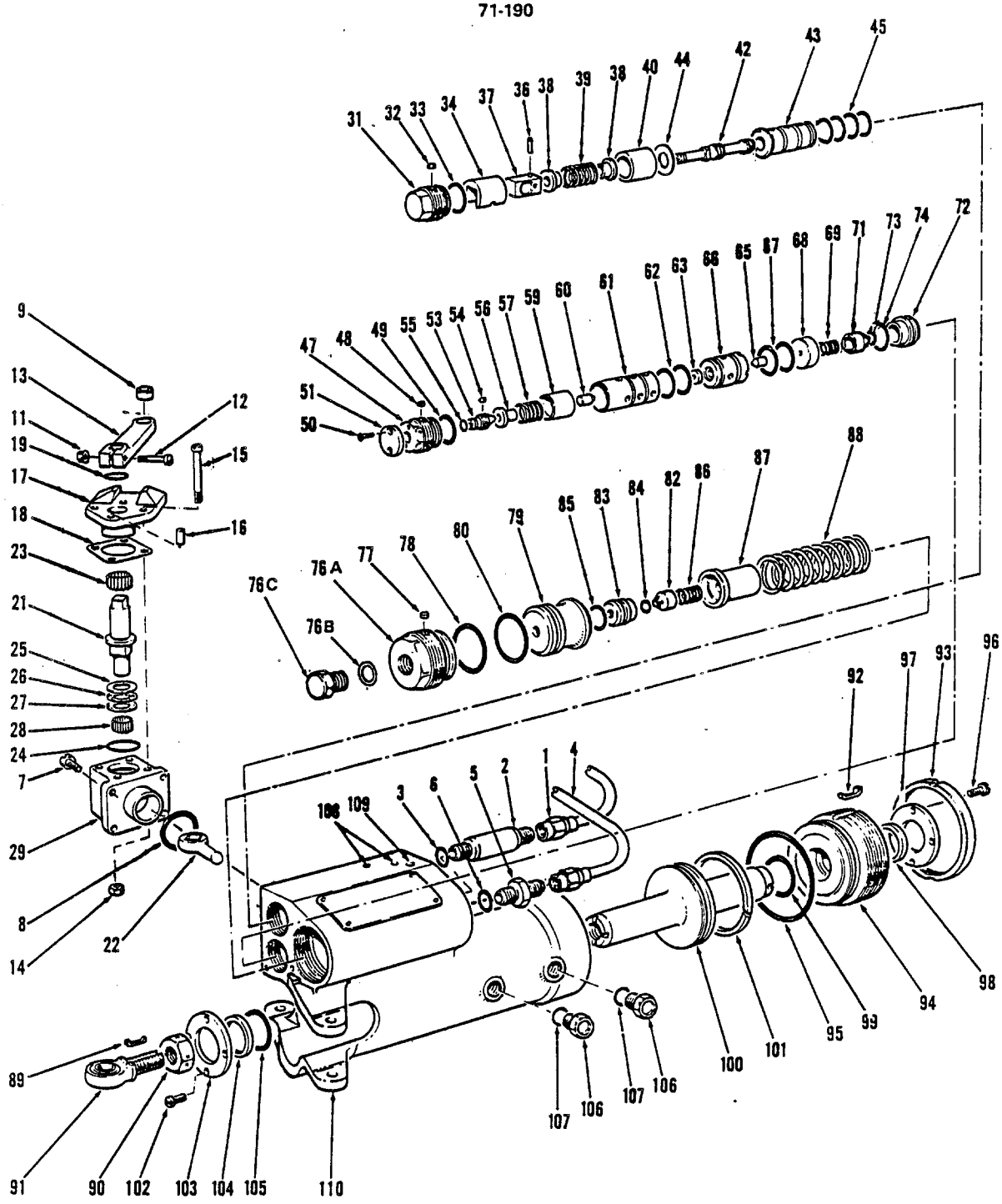
FIG. 1101 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
	71–190–1	Steering Actuator and Links Sub-assembly	(36164)	A	–
	71–190–3	Steering Actuator and Links Sub-assembly	(36164)	B	–
	71–190–7	Steering Actuator and Links Sub-assembly	(36164)	C	–
	71–190–9	Steering Actuator and Links Sub-assembly	(36164)	D	–
	71–190–11B	Steering Actuator and Links Sub-assembly	(36164)	E	–
	71–190–13	Steering Actuator and Links Sub-assembly	(36164)	F	–
	71–190–15	Steering Actuator and Links Sub-assembly	(36164)	G	–
1	MS24665–300	.Pin, Cotter		ABCDEFG	1
2	AN320–C7	.Nut		ABC	1
2	AN320–C8	.Nut		DEFG	1
3	AN960–C716L	.Washer		ABC	1
3	AN960–C816L	.Washer		DEFG	1
4	71–178–1	.Bolt	(36164)	ABC	1
4	71–179–1	.Bolt	(36164)	DEFG	1
5	MS24665–300	.Pin, Cotter		ABCDEFG	1
6	AN320–C6	.Nut		ABCDEFG	1
7	AN960–C616L	.Washer		ABCDEFG	1
8	71–146–1	.Bolt	(36164)	ABCDEFG	1
9	MS16556–801	.Pin		ABCDEFG	2
10	DU–06	.Thrust Washer	(17194)	ABCDEFG	2
11	71–166–1	.Dust Ring	(36164)	ABCDEFG	2
12	06–DU–06	.Bushing	(17194)	ABCDEFG	2
13	71–170–1	.Lever Assembly	(36164)	ABC	1
13	71–170–9	.Lever Assembly	(36164)	DEFG	1
14	KSBN8	..Spherical Bearing	(97613)	ABC	1

NOTE: – preceding item number indicates item not illustrated.
* Not procurable as a spare. For future procurement order Kit K71–506. See DESCRIPTION AND OPERATION, Table 4

FIG. 1101 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
	ASB8VDU	..Spherical Bearing (alternative item)	(15860)	ABC	1
	TN8SL	..Spherical Bearing (alternative item)	(36972)	ABC	1
14	TN8SLV	..Spherical Bearing	(36972)	DEFG	1
	ASB–8DU	..Spherical Bearing (alternative item)	(15860)	DEFG	1
15	KWB–7N	..Spherical Bearing	(97613)	ABC	1
	AW–7DU	..Spherical Bearing (alternative item)	(15860)	ABC	1
	TW7SL	..Spherical Bearing (alternative item)	(36972)	ABC	1
15	TW8SLV	..Spherical Bearing	(36972)	DEFG	1
	AW–8VDU	..Spherical Bearing (alternative item)	(15860)	DEFG	1
16 *	71–159–1	..Lever	(36164)	ABC	1
16	71–159–9	..Lever	(36164)	DEFG	1
17	MS24665–300	.Pin, Cotter		ABCDEFG	1
18	AN320–C8	.Nut		ABCDEFG	1
19	AN960–C816L	.Washer		ABCDEFG	1
20	71–179–1	.Bolt	(36164)	ABCDEFG	1
21	71–158–1	.Link	(36164)	ABC	2
21	71–158–9	.Link	(36164)	DEFG	2
22	NAS1515–M12L	.Washer		DEFG	4
23	71–200–1	.Steering Actuator Assembly	(36164)	A	1
23	71–200–3	.Steering Actuator Assembly	(36164)	B	1
23	71–200–7	.Steering Actuator Assembly	(36164)	C	1
23	71–200–9	.Steering Actuator Assembly	(36164)	D	1
23	71–200–11B	.Steering Actuator Assembly	(36164)	E	1
23	71–200–13	.Steering Actuator Assembly	(36164)	F	1
23	71–200–15	.Steering Actuator Assembly	(36164)	G	1
		For breakdown of steering actuator assembly see Figure 1102 or 1103, as applicable			

NOTE:

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Exploded View - Steering Actuator Part No. 71-200-1 and 71-200-3

Figure 1102

3. List of Parts, Steering Actuator Assemblies 71-200-1 and 71-200-3

FIGURE 1102 INDEX NO.	PART NUMBER	NOMENCLATURE 1234567		USAGE ON CODE	UNITS PER ASSY
-	71-200-1	Steering Actuator Assembly	(36164)	A	-
-	71-200-3	Steering Actuator Assembly	(36164)	B	-
1	71-181-1	. Tube Assembly, Pressure	(36164)	AB	1
2	71-277-1	. Filter (Replaced by 50-270-066-901)	(36164)	AB	1
2	50-270-066-901	. Filter (Replaces 71-277-1)	(35076)	AB	1
	50-270-041-901	.. Element, Replaceable	(35076)		1
3	MS28778-4	. Packing, Preformed		AB	1
4	71-182-1	. Tube Assembly, Return	(36164)	AB	1
5	AN815-4D	. Union		AB	1
6	MS28778-4	. Packing, Preformed		AB	1
7	AN501A10-7	. Screw, Machine, Fillister Head		AB	4
8	MS28775-019	. O-ring		AB	1
9	6L11-FK	. Bearing, Nyliner	(96881)	AB	1
-10	71-230-1	. Input Swivel Assembly	(36164)	AB	1
11	MS21042L-3	.. Nut		AB	1
12	AN501-10-12	.. Screw, Machine, Fillister Head		AB	1
13	71-193-1	.. Lever (Replaced by 71-193-11)	(36164)	AB	1
-13	71-193-11	.. Lever (Replaces 71-193-1)	(36164)		1
14	MS21042L-3	.. Nut			
15	AN501-10-32	.. Screw, Machine, Fillister Head		AB	2
16	AN122718	.. Dowel		AB	2
17	71-232-1	.. End Cap	(36164)	AB	1
18	71-235-1	.. Shim	(36164)	AB	AR
19	MS28775-112	.. O-ring		AB	1
-20	71-274-1	.. Input Shaft Assembly	(36164)	AB	1
21	* 71-233-1	... Shaft, Control Valve	(36164)	AB	1
22	* 71-234-1	... Lever, Input Swivel	(36164)	AB	1
23	GB-85	.. Bearing	(80648)	AB	1
24	MS28775-020	.. O-ring		AB	1
25	TRB-613	.. Race	(80648)	AB	1
26	NTA-613	.. Bearing	(80648)	AB	1
27	TRB-613	.. Race	(80648)	AB	1
28	GB-65	.. Bearing	(80648)	AB	1
29	71-231-1	.. Housing, Swivel	(36164)	AB	1
-30	71-220-1	. End Cap Assembly, Control Valve	(36164)	AB	1
31	71-224-1	.. End Cap	(36164)	AB	1

Note - preceding index number indicates item not illustrated
* Not procurable as a spare. For future procurement order assembly item -10

FIGURE 1102 INDEX NO.	PART NUMBER	NOMENCLATURE 1234567		USAGE ON CODE	UNITS PER ASSY
32	71-228-1	..Pellet	(36164)	AB	1
33	MS28775-018	.O-ring		AB	1
34	71-227-1	.Spacer	(36164)	AB	1
-35	71-229-1	.Control Valve Assembly	(36164)	AB	1
36	MS9047-006	..Pin, Spring		AB	1
37	71-225-1	..Extension	(36164)	AB	1
38	71-226-1	..Seat, Spring	(36164)	AB	2
39	71-223-1	..Spring	(36164)	AB	1
40	71-236-1	..Spacer	(36164)	AB	1
-41	71-237-1	..Spool and Sleeve Assembly	(36164)	AB	1
42	71-221-1	...Spool) Matched items	(36164)	AB	1
43	71-222-1	...Sleeve) Order assembly) item -41	(36164)	AB	1
44	71-275-1	.Shim	(36164)	AB	AR
45	MS28775-016	.O-ring		AB	4
-46	71-238-1	.End Cap Assembly	(36164)	AB	1
47	71-253-1	..End Cap	(36164)	AB	1
48	71-228-1	..Pellet	(36164)	AB	1
49	MS28775-017	.O-ring		AB	1
50	AN505-4-8	.Screw, Machine, Flat Head		AB	2
51	71-273-1	.Cap, Relief Valve	(36164)	AB	1
-52	71-252-1	.Adjustment Screw Assembly	(36164)	AB	1
53	71-252-11	..Adjustment Screw	(36164)	AB	1
54	71-228-1	..Pellet	(36164)	AB	1
55	MS28775-007	.O-ring		AB	1
56	71-251-1	.Seat, Spring	(36164)	AB	1
57	71-249-1	.Spring	(36164)	AB	1
-58	71-261-1	.Relief Valve Assembly	(36164)	AB	1
59	71-250-1	..Casing) Matched items	(36164)	AB	1
60	71-254-1	..Poppet) Order assembly) item -58	(36164)	AB	1
61	71-247-1	..Sleeve	(36164)	AB	1
62	MS28775-017	.O-ring		AB	2
63	71-248-1	.Orifice Plate	(36164)	AB	1
-64	71-260-1	.Shimmy Damper Assembly	(36164)	AB	1
65	71-254-1	..Poppet	(36164)	AB	1
66	71-246-1	..Sleeve	(36164)	AB	1
67	MS28775-017	.O-ring		AB	2
68	71-245-1	.Restrictor	(36164)	AB	1
69	71-243-1	.Spring	(36164)	AB	1
-70	71-240-1	.Check Valve Assembly (Replaced by 71-240-7)	(36164)	AB	1
71	71-242-1	..Poppet)Matched items	(36164)	AB	1
72	71-241-1	..Seat)			
73	MS28775-003	..O-ring		AB	1

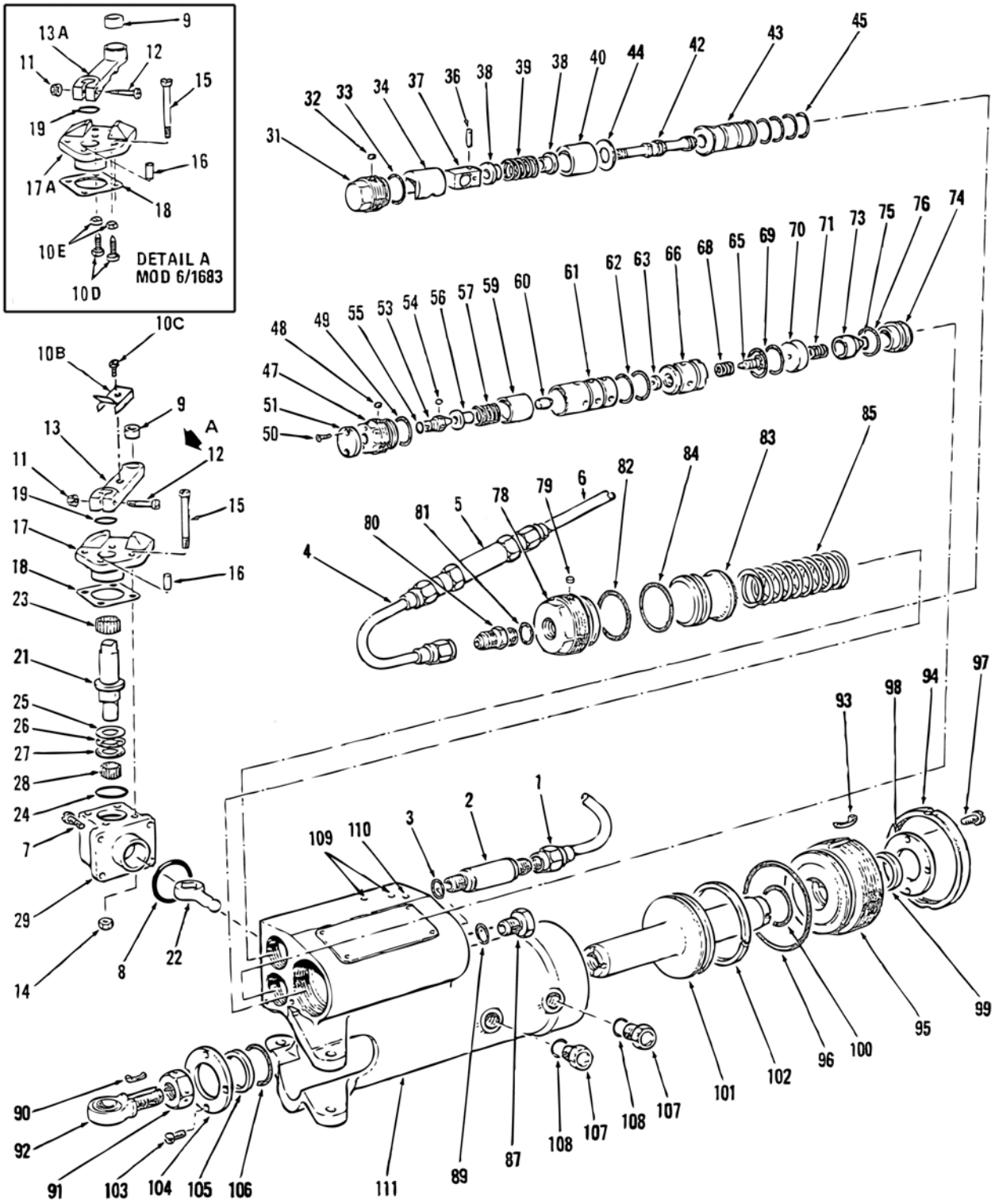
Note - preceding index number indicates item not illustrated

FIGURE 1102 INDEX NO.	PART NUMBER	NOMENCLATURE 1234567		USAGE ON CODE	UNITS PER ASSY
-70A	71-240-7	. Check Valve Assembly (Mod 6/1240)	(36164)	AB	1
-71A	71-242-7	.. Poppet) Matched items	(36164)	AB	1
72	71-241-1	.. Seat) Order assembly) item -70A	(36164)	AB	1
-73A	MS28775-005	.. O-ring		AB	1
74	MS28775-017	. O-ring		AB	1
-75	71-239-1	. End Cap Assembly	(36164)	AB	1
-76	* 71-255-1	.. End Cap	(36164)	AB	1
76A	71-255-7	.. End Cap	(36164)	AB	1
76B	MS28778-4	.. Packing, Preformed		AB	1
76C	AN814-4DL	.. Plug		AB	1
77	71-228-1	.. Pellet	(36164)	AB	1
78	MS28775-028	. O-ring		AB	1
79	71-257-1	. Piston	(36164)	AB	1
80	MS28775-218	. O-ring		AB	1
-81	71-240-1	. Check Valve Assembly (Replaced by 71-240-7)	(36164)	AB	1
82	71-242-1	.. Poppet) Matched items	(36164)	AB	1
83	71-241-1	.. Seat)	(36164)	AB	1
84	MS28775-003	.. O-ring		AB	1
-81A	71-240-7	. Check Valve Assembly (Mod 6/1240)	(36164)	AB	1
-82A	71-242-7	.. Poppet) Matched items	(36164)	AB	1
83	71-241-1	.. Seat) Order assembly) item 81A	(36164)	AB	1
-84A	MS28775-005	.. O-ring		AB	1
85	MS28775-017	. O-ring		AB	1
86	71-263-1	. Spring (Replaced by 71-263-5)	(36164)	A	1
86	71-263-5	. Spring	(36164)	B	1
87	71-258-1	. Seat	(36164)	AB	1
88	71-256-1	. Spring	(36164)	AB	1
89	NAS559-3	. Key, Lock		AB	1
90	71-217-1	. Jam Nut	(36164)	AB	1
91	AREM8-5W	. Rod End	(15860)	AB	1
	TQ8SL-2	. Rod End (Alternative item)	(36972)	AB	1
92	NAS559-3	. Key, Lock		AB	1
93	71-213-1	. Nut	(36164)	AB	1
94	71-215-1	. End Cap (Replaced by 71-215-9)	(36164)	AB	1
94	71-215-9	. End Cap (Replaces 71-215-1)	(36164)		1
95	MS28775-143	. O-ring		AB	1
96	AN500A8-6	. Screw, Machine, Fillister Head		AB	4

Note - preceding index number indicates item not illustrated
* Not procurable as a spare. For future procurement order items 76A, 76B, 76C.

FIGURE 1102 INDEX NO.	PART NUMBER	NOMENCLATURE 1234567		USAGE ON CODE	UNITS PER ASSY
97	71-212-1	.Plate	(36164)	AB	1
98	309000-A	.Scraper	(05694)	AB	1
99	MS28775-214	.O-ring		AB	1
100	71-216-1	.Piston	(36164)	AB	1
101	S11052-42P	.Ring, Piston	(97820)	AB	1
102	AN500A8-6	.Screw, Machine, Fillister Head		AB	4
103	71-212-1	.Plate	(36164)	AB	1
104	309000-A	.Scraper	(05694)	AB	1
105	MS28775-214	.O-ring		AB	1
106	AN814-2DL	.Plug		AB	2
107	MS28778-2	.Packing, Preformed		AB	2
108	187001	.Pin Plug	(92555)	AB	3
109	281001	.Pin Plug	(92555)	AB	3
110	71-201-1	.Manifold (Replaced by 71-201-3)	(36164)	A	1
110	71-201-3	.Manifold	(36164)	B	1
-111	MS18064-13	.Set-screw		A	3

Note - preceding index number indicates item not illustrated



Exploded View – Steering Actuator Part No. 71–200–7, 71–200–9, 71–200–11B, 71–200–13 and 71–200–15

Figure 1103

4. List of Parts, Steering Actuator Assembly 71–200–9, 71–200–11B, 71–200–13 and 71–200–15,

FIGURE 1103 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
–	71–200–7	Steering Actuator Assembly	(36164)	C	–
–	71–200–9	Steering Actuator Assembly	(36164)	D	–
–	71–200–11B	Steering Actuator Assembly	(36164)	E	–
–	71–200–13	Steering Actuator Assembly	(36164)	F	–
–	71–200–15	Steering Actuator Assembly	(36164)	G	–
1	71–181–1	.Tube Assembly, Pressure	(36164)	CDEFG	1
2	71–277–1	.Filter (Replaced by 50–270–066–901)	(36164)	CDEFG	1
2	50–270–066–901	.Filter (Replaces 71–277–1)	(35076)	CDEFG	1
	50–270–041–901	..Element, Replaceable	(35076)		1
3	MS28778–4	.Packing, Preformed		CDEFG	1
4	71–087–7	.Tube Assembly, Return	(36164)	CDEFG	1
5	1304C–1–50	.Valve	(86768)	CDEFG	1
6	71–088–7	.Tube Assembly, Return	(36164)	CDEFG	1
7	AN501A10–7	.Screw, Machine Fillister Head		CDEFG	4
8	MS28775–019	.O-ring		CDEFG	1
9	6L11–FK	.Bearing, Nyliner	(96881)	CDEFG	1
–10	71–230–1	.Input Swivel Assembly	(36164)	CD	1
–10	71–230–11	.Input Swivel Assembly	(36164)	E	1
–10	71–230–13	.Input Swivel Assembly	(36164)	FG	1
10B	71–310–11	..Spacer, Adjusting	(36164)	E	1
10C	MS35266–60	..Screw		E	1
10D	71–342–1	..Screw, Adjusting		FG	2
10E	NAS509–4	..Nut, Lock		FG	2
11	MS21042L–3	..Nut		CDEFG	1
12	AN501–10–12	..Screw, Machine, Fillister Head		CDEFG	1
13	71–193–1	..Lever (Replaced by 71-193-11)	(36164)	CD	1
13	71–193–11	..Lever	(36164)	E	1
13A	71–193–13	..Lever	(36164)	FG	1
14	MS21042L–3	..Nut	(36164)	CDEFG	2
15	AN501–10–32	..Screw, Machine, Fillister Head		CDEFG	2
16	AN122718	..Dowel		CDEFG	2
17	71–232–1	..End Cap	(36164)	CDE	AR
17A	71–232–3	..End Cap	(36164)	FG	1

NOTE: – preceding index number indicates item not illustrated.
* Not procurable as a spare. For future procurement order assembly item –10

FIGURE 1103 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
18	71–235–1	..Shim	(36164)	CDEFG	AR
19	MS28775–112	..O-ring		CDEFG	1
–20	71–274–1	..Input Shaft Assembly	(36164)	CDEFG	1
21	*71–233–1	...Shaft, Control Valve	(36164)	CDEFG	1
22	*71–234–1	...Lever, Input Swivel	(36164)	CDEFG	1
23	GB–85	..Bearing	(80648)	CDEFG	1
24	MS28775–020	..O-ring		CDEFG	1
25	TRB–613	..Race	(80648)	CDEFG	1
26	NTA–613	..Bearing	(80648)	CDEFG	1
27	TRB–613	..Race	(80648)	CDEFG	1
28	GB–65	..Bearing	(80648)	CDEFG	1
29	71–231–1	..Housing, Swivel	(36164)	CDEFG	1
–30	71–220–1	.End Cap Assembly	(36164)	CDEFG	1
31	71–224–1	..End Cap	(36164)	CDEFG	1
32	71–228–1	..Pellet	(36164)	CDEFG	1
33	MS28775–018	.O-ring		CDEFG	1
34	71–227–1	.Spacer	(36164)	CDEFG	1
–35	71–229–1	.Control Valve Assembly	(36164)	CDEFG	1
36	MS9047–006	..Pin, Spring		CDEFG	1
37	71–225–1	..Extension	(36164)	CDEFG	1
38	71–226–1	..Seat, Spring	(36164)	CDEFG	2
39	71–223–1	..Spring	(36164)	CDEFG	1
40	71–236–1	..Spacer	(36164)	CDEFG	1
–41	71–237–1	..Spool and Sleeve Assembly	(36164)	CDEFG	1
42	71–221–1	...Spool	(36164)	CDEFG	1
43	71–222–1	...Sleeve	(36164)	CDEFG	1
44	71–275–1	.Shim	(36164)	CDEFG	AR
45	MS28775–016	.O-ring		CDEFG	4
–46	71–238–1	.End Cap Assembly	(36164)	CDEFG	1
47	71–253–1	..End Cap	(36164)	CDEFG	1
48	71–228–1	..Pellet	(36164)	CDEFG	1
49	MS28775–017	.O-ring		CDEFG	1
50	AN505–4–8	.Screw, Machine, Flat Head		CDEFG	2
51	71–273–1	.Cap, Relief Valve	(36164)	CDEFG	1
–52	71–252–1	.Adjustment Screw Assembly	(36164)	CDEFG	1

NOTE: – preceding index number indicates item not illustrated.

FIGURE 1103 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
53	71–252–11	..Adjustment Screw	(36164)	CDEFG	1
54	71–228–1	..Pellet	(36164)	CDEFG	1
55	MS28775-007	.O-ring		CDEFG	1
56	71–251–1	.Seat, Spring	(36164)	CDEFG	1
57	71–249–1	.Spring	(36164)	CDEFG	1
–58	71–261–1	.Relief Valve Assembly	(36164)	CDEFG	1
59	71–250–1	..Casing	(36164)	CDEFG	1
60	71–254–1	..Poppet	(36164)	CDEFG	1
61	71–247–1	..Sleeve	(36164)	CDEFG	1
62	MS28775–017	.O-ring		CDEFG	2
63	71–248–1	.Orifice Plate	(36164)	CD	1
63	71–248–11	.Orifice Plate	(36164)	EFG	1
–64	71–260–1	.Shimmy Damper Assembly	(36164)	CD	1
–65	71–254–1	..Poppet	(36164)	CD	1
66	71–246–1	..Sleeve	(36164)	CD	1
–64	71–260–11A	.Shimmy Damper Assembly	(36164)	EFG	1
65	71–306–11	..Poppet	(36164)	EFG	1
66	71–246–11A	..Sleeve Assembly	(36164)	EFG	1
68	71–304–11	..Spring	(36164)	EFG	1
69	MS28775–017	.O-ring		CDEFG	2
70	71–245–1	.Restrictor	(36164)	CD	1
70	71–245–11	.Restrictor	(36164)	EFG	1
71	71–243–1	.Spring	(36164)	CDEFG	1
–72	71–240–1	.Check Valve Assembly (replaced by 71–240–7) (Pre Mod 6/1240)	(36164)	C	1
73	71–242–1	..Poppet) Matched	(36164)	C	1
74	71–241–1	..Seat) items	(36164)	C	1
75	MS28775–003	..O-ring		C	1
–72A	71–240–7	.Check Valve Assembly (Mod 6/1240) (replaces 71–240–1)	(36164)	C	1
–73A	71–242–7	..Poppet) Matched	(36164)	CDEFG	1
74	71–241–1	..Seat) Order assembly) item –72A	(36164)	CDEFG	1
–75A	MS28775–005	..O-ring		CDEFG	1
76	MS28775–017	.O-ring		CDEFG	1

NOTE: – preceding index number indicates item not illustrated.

FIGURE 1103 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
–77	71–239–7	.End Cap Assembly	(36164)	CDEFG	1
78	71–255–7	..End Cap	(36164)	CDEFG	1
79	71–228–1	..Pellet	(36164)	CDEFG	1
80	AN815–4D	.Union		CDEFG	1
81	MS28778–4	.Packing, Preformed		CDEFG	1
82	MS28775–028	O-ring		CDEFG	1
83	71–257–7	.Piston	(36164)	CDEFG	1
84	MS28775–218	.O-ring		CDEFG	1
85	71–256–1	.Spring	(36164)	CDEFG	1
–86	71–089–7	.Air Filter Assembly	(36164)	CDEFG	1
87	AN814–4D	..Plug (Modified)		CDEFG	1
–88	G365–4	..Filter		CDEFG	1
89	MS28778–4	.Packing, Preformed		CDEFG	1
90	NAS559–3	.Key, Lock		CDEFG	1
91	71–217–1	.Jam Nut	(36164)	CDEFG	1
92	AREM8–5W	.Rod End	(15860)	CDEFG	1
	TQ8SL–2	.Rod End (alternative item)		CDEFG	1
93	NAS559–3	.Key, Lock		CDEFG	1
94	71–213–1	..Nut	(36164)	CDEFG	1
95	71–215–1	.End Cap (replaced by 71–215–9)		C	1
95	71–215–9	.End Cap	(36164)	DEFG	1
96	MS28775–143	.O-ring		CDEFG	1
97	AN500A8–6	.Screw, Machine, Fillister Head		CDEFG	4
98	71–212–1	.Plate	(36164)	CDEFG	
99	309000–A	.Scraper	(05694)	CDEFG	
100	MS28775–214	.O-ring		CDEFG	
101	71–216–1	.Piston	(36164)	CDEFG	
102	S11052–42P	.Ring, Piston	(97820)	CDEFG	
103	AN500A8–6	.Screw, Machine, Fillister Head		CDEFG	
104	71–212–1	.Plate	(36164)	CDEFG	
105	309000–A	.Scraper		CDEFG	
106	MS28775–214	.O-ring		CDEFG	
107	AN814–2DL	.Plug		CDEFG	

NOTE: – preceding index number indicates item not illustrated

FIGURE 1103 INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7		USAGE ON CODE	UNITS PER ASSY
108	MS28778–2	.Packing, Preformed		CDEFG	
109	187001	.Pin Plug	(92555)	CDEFG	
110	281001	.Pin Plug	(92555)	CDEFG	
111	71–201–3	.Manifold	(36164)	CDEFG	
112	200–0059–101	.Spacer (Preferred)		G	
112A	200–0059–103	.Spacer (Alternate)		G	
112B	200–0059–105	.Spacer (Alternate)		G	

NOTE: – preceding index number indicates item not illustrated

B.F.Goodrich

MANUAL 266

INSTALLATION, MAINTENANCE, AND OVERHAUL
3-1197
Nose Landing Gear Wheel
(De Havilland DHC-6)

ISSUED: 12 January 1966
REVISED: 1 February 1974
JN2174

B.F.GOODRICH AEROSPACE & DEFENSE PRODUCTS
A Division of The B.F.Goodrich Company
Wheel and Brake Plant
Troy, Ohio

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B.F.Goodrich

REVISION HIGHLIGHTS!!

MANUAL 266

INSTALLATION, MAINTENANCE, AND OVERHAUL
3-1197
Nose Landing Gear Wheel
(De Havilland DHC-6)

REVISED: 1 February 1974

This manual has been completely revised to include the latest overhaul and rework procedures.

1. DESCRIPTION

1.1 The 3-1197 wheel is designed for use with 8.90 - 12.50, Type III, six-ply rated, low-pressure, tubeless tire, and has a maximum static rating of 1900 lb. The wheel consists of the following parts.

1.2 Inner (27) and outer (20) cast magnesium wheel halves are bolted together with bolts (11) and nuts (9). Washers (10, 12) are used beneath the nuts and bolt heads to prevent galling and stress concentration. A packing (13) mounted in the groove in the inner wheel half seals against air leaking from tubeless tires.

1.3 Bearing cups (19, 26) and cones (8) are installed in the hub area of both wheel halves. Balance weights (14, 22), to balance the wheel, are fastened with nuts (15, 23) and screws (16, 24) to the inner surfaces; and an instruction plate (17) is fastened to the outer wheel half (20). A tubeless valve (1 thru 6), installed in the outer wheel half, is used to inflate or deflate the tire.

2. ASSEMBLY

2.1 The wheel is shipped from the factory completely assembled. The bearings are packed with the proper grease and may be installed as received. To install the tire, proceed as follows.

2.2 Remove nuts (9), washers (10, 12), bolts (11), and separate the wheel halves (20, 27).

2.3 Remove packing (13) from its package and install on the inner wheel half (27). Mount tire on the inner wheel half.

2.4 Assemble the outer wheel half (20) onto the inner wheel half (27).

2.5 Install bolts (11), washers (10, 12), and nuts (9). Tighten the nuts to 240 to 260 lb inch torque, using the following procedure.

2.5.1 Apply a generous coat of thread compound, specification MIL-T-5544, to threads of bolts (11), faces of washers (10, 12), and bearing face of nuts (9). Tighten to 192 lb inch torque, four nuts, approximately diametrically opposite and at 90°.

2.5.2 Stagger-tighten the remaining nuts to 192 lb inch torque, then, using the same procedure, retighten all nuts to 240 to 260 lb inch torque.

NOTE: Do not use impact wrench when applying final torque. Use hand torque wrench only.

3. INSTALLATION

3.1 Check axle for burrs and thread damage. Hand file to remove damaged threads. Smear bearing grease on axle nut threads on axle.

3.2 Install wheel onto axle being careful not to damage the grease seals (7) located on each side of the wheel.

3.3 Install axle nut. While rotating wheel, torque axle nut to 30 ft-lbs to properly seat bearings. Loosen axle nut to zero torque, and while rotating wheel, retighten to 15 ft-lbs. Check for alignment of locking hole. If locking holes are not aligned, continue tightening to first locking hole and safety-lock axle nut.

3.4 Inflate tire.

4. MAINTENANCE (While equipment is on aircraft)

4.1 Inspect wheel half flanges for cracks and corrosion.

4.2 Check for loose bolts and nuts and retighten or replace.

NOTE: No repair or replacement is recommended while equipment is on the aircraft except the tightening or replacing of bolts and nuts.

4.3 At each tire change visually inspect wheel halves for evidence of corrosion (white powder on surface) noting especially the bead seat area (tire contact surface) and the tie-bolt hole areas. Corrosion areas which can be removed by sanding with emery cloth (240 grit) may be touched up with Dow No. 19 solution, followed by zinc chromate (MIL-P-8585) primer. Paint all bare magnesium.

NOTE: Bare magnesium is silver in color, the protective finishes put on the wheel at the factory is gold (Dow #7). If corrosion cannot be removed by sanding down to bare metal within the limits given in Figure 5-2, the wheel should not be continued in service.

4.4 To replace a valve core (2, Figure 6-1), use a standard extraction tool to unscrew the valve core. If the valve stem (5) is replaced, a new grommet (5) should be installed on the stem.

5. OVERHAUL

5.1 Dismounting.

5.1.1 Deflate tire. Remove valve core (2) from valve stem (6) to assure complete deflation. Remove outer seal (7) and bearing cone (8). Dismount wheel and tire assembly from axle as a unit. Remove inner seal (7) and bearing cone (8).

5.2 Disassembly.

WARNING: TIRE MUST BE DEFLATED BEFORE LOOSENING TIE BOLTS.

5.2.1 Break tire beads away from wheel flanges with a bead breaker or pneumatic tire dismounter.

CAUTION: DO NOT USE TIRE IRONS. THEY MAY DAMAGE THE WHEEL FLANGES OR TIRE BEADS AND PREVENT PROPER AIR RETENTION.

5.2.2 Remove nuts (9), washers (10, 12) and bolts (11) from the wheel.

5.2.3 Separate the wheel halves (20, 27) and remove tire and packing (13).

5.2.4 If packing (13) is to be reinstalled, place it on a clean sheet of paper for cleaning.

5.2.5 Balance weights (22) should only be removed if loose, or for zyglo inspection of the wheel half.

5.2.6 Bearing cups (19, 26) are shrunk fit into the wheel halves (20, 27) and should not be removed unless replacement is necessary. If a bearing cup is to be replaced, heat the wheel half to 149°C (300°F) maximum for 20 minutes before trying to remove the cup. Support the wheel hub while removing the cup, as in Figure 5-1.

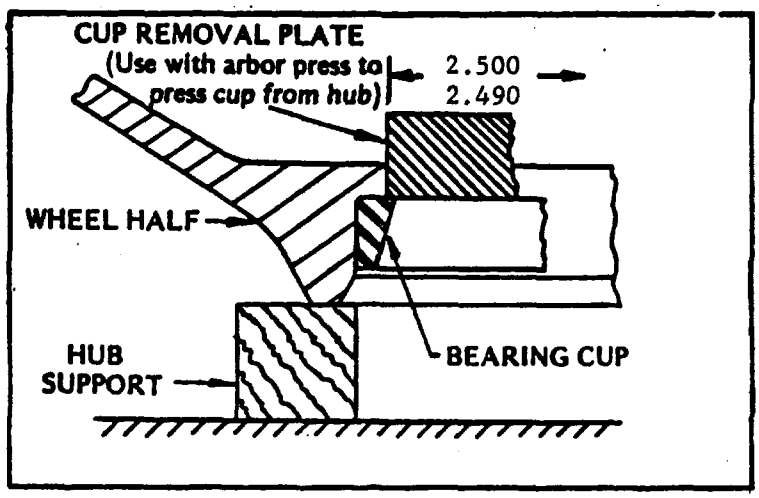


Figure 5-1. Supporting Wheel Hub

5.3 Cleaning.

5.3.1 Clean all metal parts in Stoddard solvent, or equivalent, and dry with compressed air.

5.3.2 Wipe bearing seals clean with dry cloth. Do not use cleaning solvents on rubber parts.

5.3.3 Wash bearing cones in uncontaminated cleaning solution, rotate the bearing cage by hand while submerged in the solution. Repack bearing with grease immediately after inspection to prevent corrosion and place in a clean, closed container.

CAUTION: DO NOT SPIN DRY BEARINGS OR HANDLE BEARINGS WITH BARE HANDS.

5.3.4 Remove paint from wheel halves using any of the methods that follow, taking care to avoid removing the surface treatment underneath the paint.

5.3.5 Remove paint from wheel halves by abrasive blasting using ground walnut hulls per MIL-G-5634, Types II or III. This method is recommended as it will not remove the surface treatment and does not require masking or removal of the bearing cup.

NOTE: Sand blasting may be used if adequately controlled to prevent damage to the surface.

5.3.6 Paint can be stripped from wheel halves using acetone, methylene chloride, or Formula No. 1006 (Allied Ketite Chemical Co., 2400 East Devon Avenue, Des Plaines, Illinois 60018). Commercial paint strippers not harmful to magnesium may be used.

WARNING: USE PAINT STRIPPERS IN A WELL VENTILATED AREA AND AVOID PROLONGED INHALATION OF FUMES.

CAUTION: REMOVE OR MASK BEARING CUP PRIOR TO PAINT STRIPPING THE WHEEL HALF.

5.4 Inspection.

NOTE: Inspect bolts (11) and wheel halves (20, 27), per 5.4.1 and 5.4.2, at each fifth tire change, and each third subsequent tire change, for a total of twenty tire changes; and on each tire change thereafter.

5.4.1 Magnaflux bolts (11) for cracks and breaks.

5.4.2 With dy-check or fluorescent penetrant, inspect wheel halves (20, 27) for cracks and breaks, noting in particular the bead seat, tubewell, and web junction areas.

5.4.3 Visually inspect all metal parts for pitting, corrosion, cracks, breaks, uneven wear, and other surface defects.

5.4.4 Inspect packing sealing surfaces for surface smoothness.

5.4.5 Inspect packings (13), grommets (5), and bearing grease seals (7) for pits, cuts, and other defects. Replace as necessary.

5.5 Repair and Replacement.

5.5.1 Wheel Half (20, 27) Repair and Surface Treatment.

5.5.2 Rework limits and the areas in which they are permitted are shown in Figure 5-2.

5.5.3 All allowable blending of damaged areas should be done over an area of from 1/2" to 1" around the damage. The blended surface should be smooth and free from any abrupt changes in contour. Blended area should be as smooth as is possible to obtain with a fine (240 grit) emery cloth.

5.5.4 Repair can be made to both sides of a section as long as the total removal limit of both sides is not exceeded.

5.5.5 Repairs can be made adjacent to each other as long as the blended areas do not touch or any one blended area does not exceed 3" in length.

5.5.6 Repair damaged O-ring, wheel half mating surfaces and torque key slots with Metalset A4 (Obtain from Smooth-On Incorporated, 1000 Valley Road, Gillette, New Jersey 07933) as follows:

5.5.7 Blend damaged area with a hand file to provide minimum patching surface 1/16 inch square. Maximum patching surface should not exceed width of the gasket groove 2" long, (O-ring seal) or 1/4 x 2" long (wheel half mating surface).

5.5.8 Remove all surface treatment, dirt, and other contaminants from the damaged area and thoroughly clean with thinner or alcohol.

5.5.9 Thoroughly blend equal amounts of Metalset "A" and "B", apply to damaged area, and let harden.

NOTE: Metalset hardens in a few hours at room temperature ($77^{o}F$). Heat to speed hardening. At $150^{o}F$, Metalset will harden in a few minutes. Use disposable equipment in mixing and applying Metalset to prevent permanent adherence to tools if not cleaned immediately after use.

5.5.10 After hardening, blend and smooth surfaces to original configuration with emery cloth.

5.5.11 If any Dow No. 7 surface treatment has been removed from the magnesium wheel halves, prepare the surface of the wheels for painting as follows.

5.5.12 Apply chromic acid etch solution (Dow #1) by brushing, dipping, spraying, or with a pad. The solution will complete its action in two minutes. Wash off with cold water.

Dow No. 1 Chromic Acid Etch Solution Formula

Chromic Acid: 1 lb.
Nitric Acid (1.4 sp. Gr.): 0.9 pint (426 CC): 1.3 lb.
Water: To make one gallon of solution.

5.5.13 Follow the chromic acid etch treatment with Dow No. 19 surface treatment using the same application procedure as above.

Dow No. 19 Solution Formula

Chromic Acid: 1-1/3 oz.
Calcium Sulfate: 1 oz.
Water: To make one gallon of solution

NOTE: Solutions described in 5.5.12 and 5.5.13 can be safely stored in containers made of glass, stainless steel, aluminum, vinyl or polyethurane rubber-lined tanks.

5.5.14 Paint prepared surfaces with two coats zinc chromate primer, specification MIL-P-8585 and one coat aluminum lacquer, specification MIL-L-7178.

NOTE: Use only one coat zinc chromate primer and no finish coat on packing groove and mating surfaces of the wheel halves.

5.5.15 Replace all parts damaged beyond repair.

5.5.16 Replace packings (13) at each overhaul.

5.5.17 To replace bearing cups (19, 26), proceed as follows:

5.5.18 Heat wheel halves (20, 27) to 149°C (300°F) maximum and cool cups to -18°C (0°F).

5.5.19 Support wheel hub and paint the ID of the hub with zinc chromate primer. Then press cup into wheel half.

NOTE: The wet zinc chromate primer lubricates the parts to be pressed together and acts as a protective against galvanic corrosion between the parts.

5.5.20 If corrosion is beyond limits or if cups have loosened, rework seal and bearing bore areas in accordance with Figures 5-3 and 5-4 or 5-5, plus the following.

5.5.20.1 Machine seal or bearing bore as shown in Figure 5-3, 5-4, or 5-5.

5.5.20.2 Spray with one coat zinc chromate primer in accordance with MIL-P-8585.

5.5.20.3 Heat the wheel to 135 to 149°C (275 to 300°F), cool the bushing to -18°C (0°F), and rapidly install the bushing in the wheel, using a hand arbor press. If bushing starts to bind during installation, remove it immediately.

NOTE: This procedure must be done rapidly as the bushing absorbs heat quickly and may expand in the bore of the wheel before being properly seated.

5.5.20.4 Rough- and finish-bore the bushing in the wheel as shown in Figure 5-3 or 5-4 and 5-5.

NOTE: After final machining the seal bushing, hardcoat the ID with Alumilite 226 in accordance with AMS 2468 or MIL-A-8625, Type III.

5.5.20.5 Spray seal and bearing bushings with one coat of zinc chromate primer MIL-P-8585, before installing bearing cup.

5.5.20.6 See that 0.002 inch feeler gage will not go between the end of the bushing and the bottom face of the bearing bore.

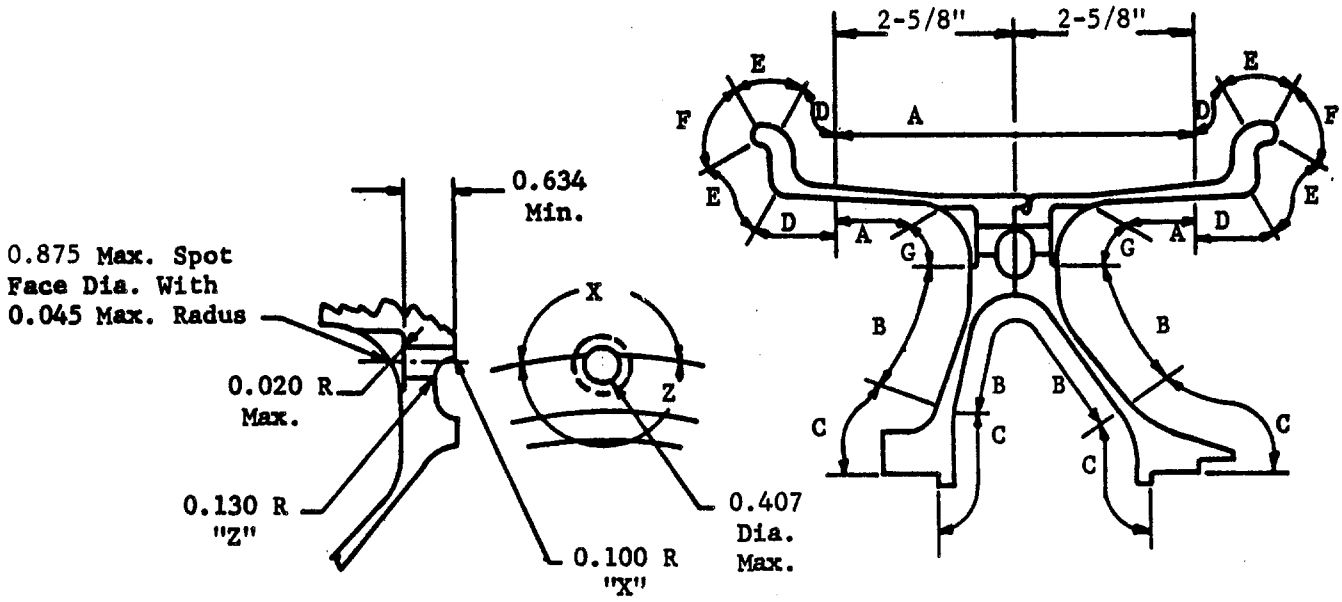
5.5.21 Replace packing at each overhaul.

5.6 Lubrication.

5.6.1 Bearings. Pack with Aeroshell #7 grease, specification MIL-G-23827A, into bearing cones and smear grease on ends of rollers. Do not overlubricate. Spread a thin coat of grease on the surface of the bearing cups.

CAUTION: IF GREASE IS CHANGED, TAKE CAREFUL NOTE OF MANUFACTURER'S REQUIREMENTS CONCERNING COMPATIBILITY WITH RECOMMENDED GREASE AND CLEANING REQUIRED BEFORE APPLICATION.

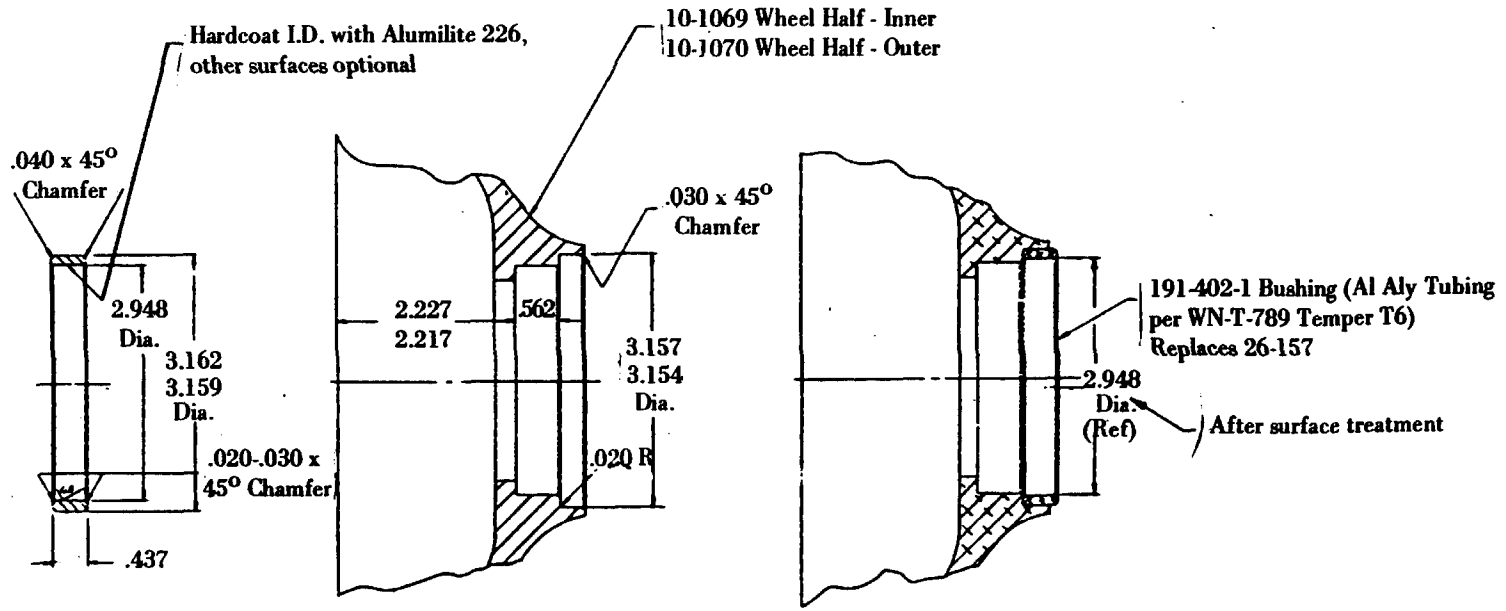
5.6.2 Bolts, Nuts, and Washers. Lubricate threads of bolts and nuts and face of the washers with thread compound, specification MIL-T-5544.



TIE-BOLT SECTION (TYP)

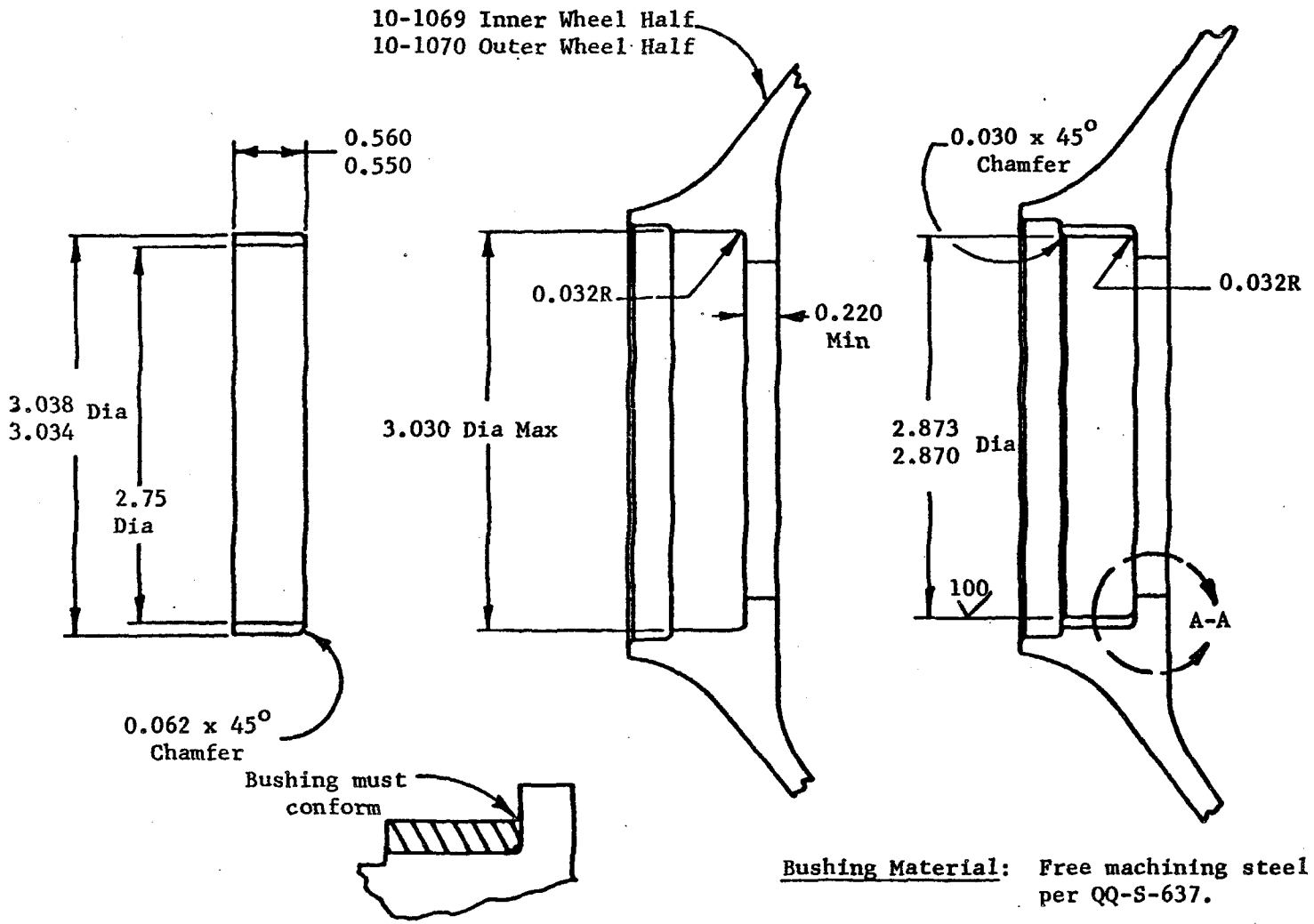
Area	Type Repair	Maximum Discrepancy Allow In Area	Removal Limit - Total Both Sides (Inches)
A	Blend	None After Blending	0.010 Below Original Surface
B	Blend	None After Blending	0.010 Below Original Surface
C	Blend	None After Blending	0.030 Below Original Surface
D	None	None	None
E	Blending	None After Blending	0.040 Below Original Surface
F	Blending	None After Blending	0.050 Below Original Surface (One Surface Only)
G	Respot Face Ream, Radius	None	See Detail

Figure 5-2. 3-1197 NLG Wheel Half Surface Repair Limits



NOTE: See paragraph 5.5.20 for installation procedure.

Figure 5-3. Seal Bore Rework



Bushing Material: Free machining steel per QQ-S-637.

NOTE: See paragraph 5.5.20 for installation procedure.

Figure 5-4. Bearing Bore Rework

Tolerance: xxx = ± 0.010
xx = ± 0.030

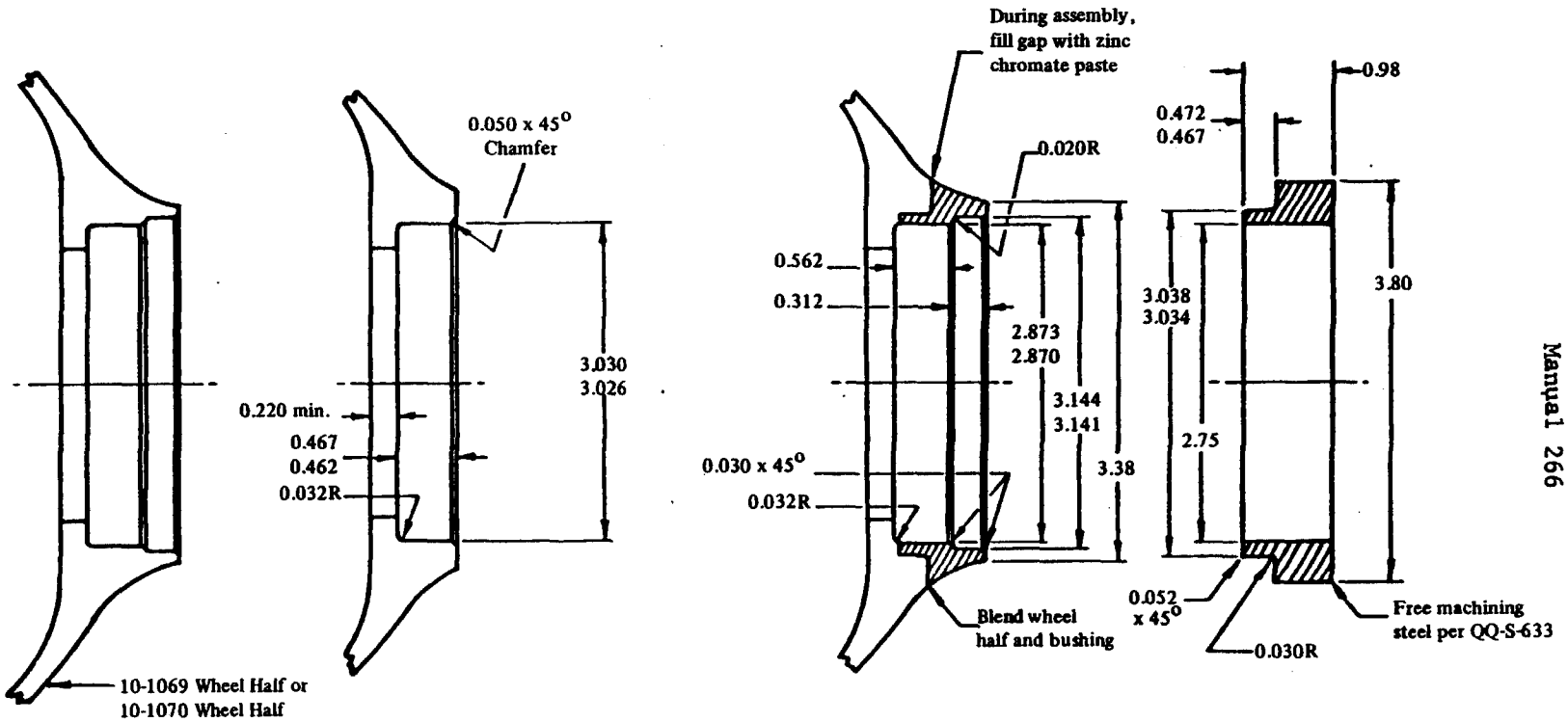


Figure 5-5. Alternate Bearing Bore Rework

5.7 Reassembly.

5.7.1 Reassemble in reverse sequence of the index numbers of Figure 6-1, noting the following.

5.7.2 Clean and lubricate bearings as instructed in Paragraphs 5.3.3 and 5.6.1.

5.7.3 If bearing cups (19, 26) have been removed, install cups as instructed in Paragraphs 5.5.18 and 5.5.19.

5.7.4 If balance weights (14, 22) have been removed, reinstall in their original location.

5.7.5 Apply a generous coat of thread compound, specification MIL-T-5544, to threads of bolts (11), faces of washers (10, 12), and bearing face of nuts (9). Tighten to 192 lb inch torque, four nuts, diametrically opposite and at 90°. Stagger-tighten remaining nuts to 192 lb inch torque. Then, using the same procedure, retighten all nuts to 240 to 260 lb inch torque.

NOTE: Do not use impact wrench when applying final torque. Use hand torque wrench only.

5.8 Testing.

5.8.1 After tire growth has stabilized, the wheel shall be required to hold the normal inflation pressure for 24 hours with not more than four per cent loss in pressure.

CAUTION: DO NOT INFLATE TIRE IN EXCESS OF 60 PSI.

6. ILLUSTRATED PARTS BREAKDOWN

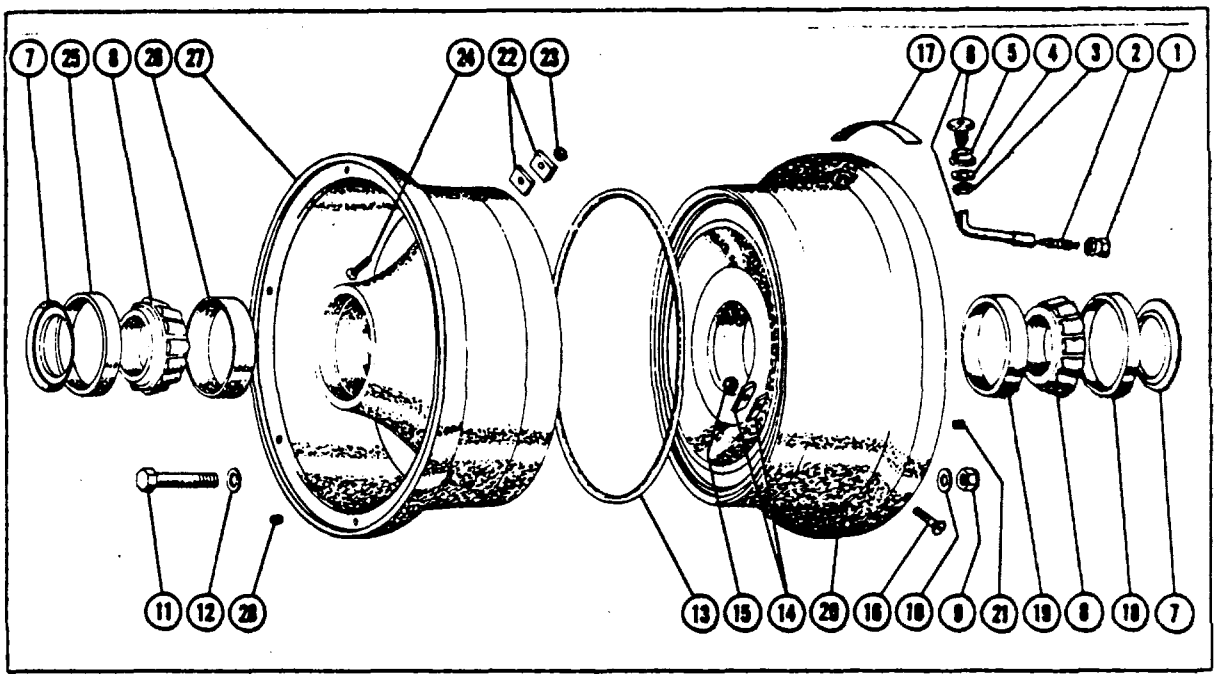


Figure 6-1. 3-1197 Landing Gear Wheel, Exploded View

Figure & Index No.	Part Number	Description 1 2 3 4 5 6 7	Units Per Assy.
6-1-	3-1197	WHEEL, LANDING GEAR, NOSE, 8.90-12.50, TYPE III	1
-	TR758-03	. VALVE ASSEMBLY, TUBELESS TIRE (79934) .	1
-1	TR-VC5	. . CAP, VALVE (79934)	1
-2	TR-C4	. . VALVE, INSIDE (79934)	1
-3	TR-HN2	. . NUT, HEX (79934)	1
-4	TR-S12	. . SPACER (79934)	1
-5	TR-RG40	. . GROMMET (79934)	1
-6	TR758-02	. . STEM, VALVE (79934)	1
-7	68-570	. SEAL	2
-8	18590	. CONE, BEARING (60038)	2
-9	AN363-624	. NUT (88044)	9
-10	AN960-616	. WASHER (88044)	18

Figure & Index No.	Part Number	Description 1 2 3 4 5 6 7	Units Per Assy.
6-1-11	AN6-17A	. BOLT (88044)	9
-12	AN960-616	. WASHER (88044)	REF
-13	68-503	. PACKING, PREFORMED	1
-	300-264	. WHEEL HALF ASSEMBLY, OUTER	1
-14	97-64	. . WEIGHT, WHEEL BALANCE, ½ OZ.	AR
	97-74	. . WEIGHT, WHEEL BALANCE, ½ OZ.	AR
		(ATTACHING PARTS)	
-15	MS20364-1032C	. . NUT (96906)	AR
-16	AN507-1032R14	. . SCREW (88044)	
		- - - - * - - - -	
-17	50-205	. . INSTRUCTION PLATE	1
-18	26-157	. . BUSHING	2
-19	18520	. . CUP, BEARING (60038)	2
-20	10-1070	. . WHEEL HALF, OUTER	
-21	1185-2CN0164	. . . HELI-COIL INSERT (91767)	12
-	300-265	. WHEEL HALF ASSEMBLY, INNER	1
-22	97-64	. . WEIGHT, WHEEL BALANCE, ½ OZ.	REF
	97-74	. . WEIGHT, WHEEL BALANCE, ½ OZ.	REF
		(ATTACHING PARTS)	
-23	MS20364-1032C	. . NUT (96906)	REF
-24	AN507-1032R14	. . SCREW (88044)	REF
		- - - - * - - - -	
-25	26-157	. . BUSHING	REF
-26	18520	. . CUP, BEARING (60038)	REF
-27	10-1069	. . WHEEL HALF, INNER	1
-28	1185-2CN0164	. . . HELI-COIL INSERT (91767)	REF

VENDOR CODES	
Code	Vendor Name and Address
60038	Timken Roller Bearing Co., Canton, Ohio
79934	Tire and Rim Assn. Inc., The, Akron, Ohio
88044	Aeronautical Standards Group, Dept. of Navy and Air Force
91767	Heli-Coil Corp., Danbury, Conn.
96906	Military Standard, Promulgated by Standardization Div Directorate of Logistic Services DSA

NOTE: Federal Manufacturer's Codes are taken from Federal Handbook H4-1.

WATERMAN HYDRAULICS
Parker Hannifin Corporation

COMPONENT MAINTENANCE MANUAL
G831-8-10A

Hydraulic Fuse

WATERMAN PART NO.
G831-8-10A

DE HAVILLAND PART NO.
7SC0110

COMPONENT MAINTENANCE MANUAL
WITH
ILLUSTRATED PARTS LIST

WATERMAN HYDRAULICS
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COMPONENT MAINTENANCE MANUAL
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HIGHLIGHTS

This is a complete republication of the compontent maintenance manual.

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8	May 11/92
9	May 11/92
10	May 11/92

WATERMAN HYDRAULICS
Parker Hannifin Corporation

COMPONENT MAINTENANCE MANUAL
G831-8-10A

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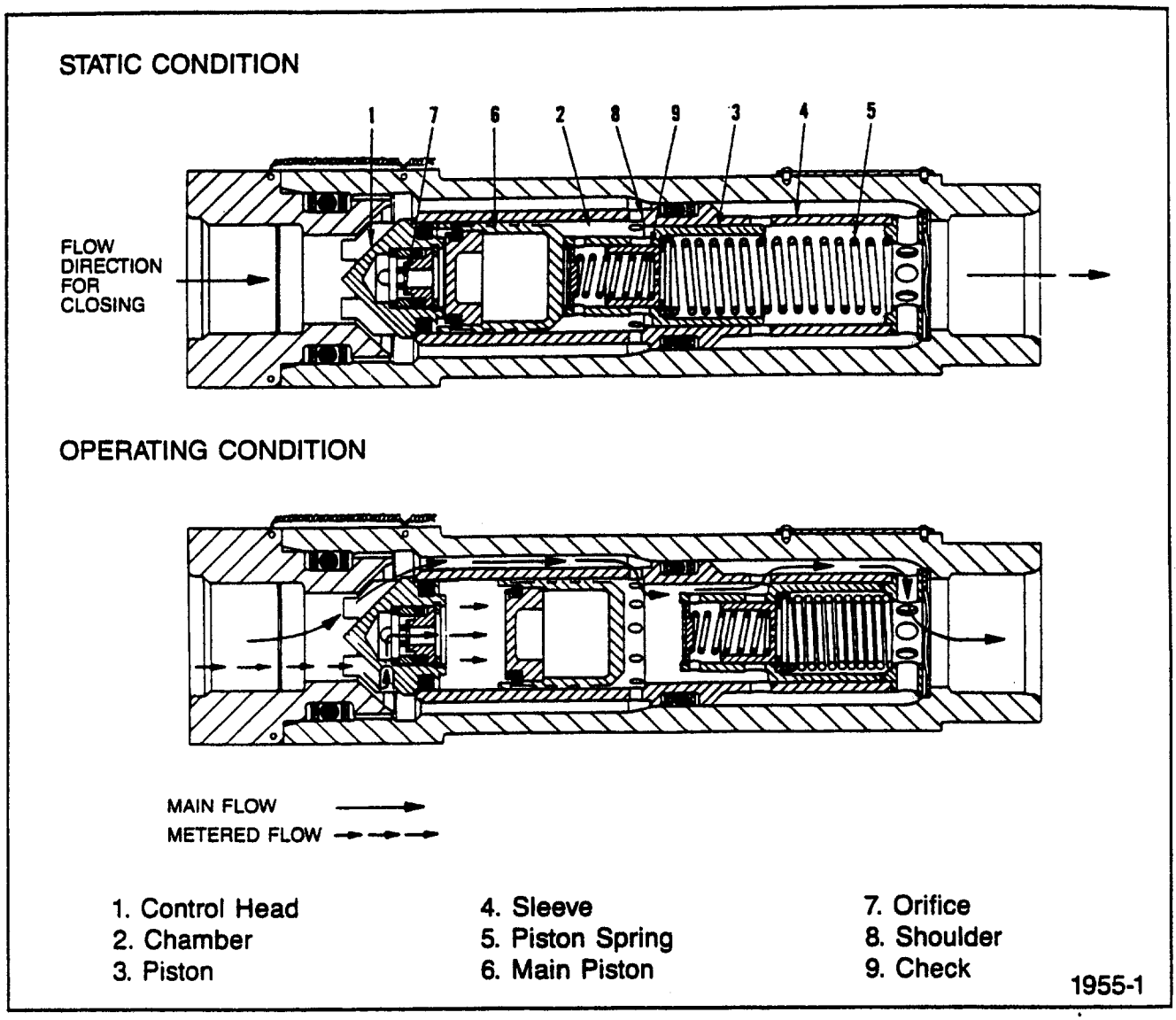
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1. Description and Operation

A. The hydraulic fuse is a device designed for installation in a hydraulic line to prevent excessive loss of hydraulic fluid in the event of a failure in the system downstream of the fuse. The hydraulic fuse is completely non-functional in normal operation, yet reacts automatically to shut off all flow when flow has reached the predetermined amount. The hydraulic fuse covered in this manual is of the self-resetting type. Leading particulars of the hydraulic fuse are presented in Table 1.

Waterman Part Number	G831-8-10A
Operating Pressure	3,000 psi
Proof Pressure	4,500 psi
Operating Fluid	Skydrol 500A
Operating Temperature	
Minimum	−65°F
Maximum	+160°F
Nominal Volumetric Capacity	10 cu. in.
Test Volumetric Capacity	
at Flow Rate of 2.4 gallons per minute	10.5 to 12.5 cu. in.
at Flow Rate of 1.2 gallons per minute	10.5 to 12.5 cu. in.
at Flow Rate of 0.25 gallons per minute	10.5 to 20.0 cu. in.
at Flow Rate of 0.5 gallons per minute	10.5 to 20.0 cu. in.
Connections	accommodating 1/2 in. tube
Dimensions	
Length	5-11/32 in.
Diameter	1-3/8 in.
Width Across Flats	1-1/8 in.
Weight (not to exceed)	9-1/2 oz.

Leading Particulars
Table 1



Principles of Hydraulic Fuse Operation
Figure 1

B. Fluid entering the hydraulic fuse is divided into two flow paths by the control head (1, figure 1). The main flow follows the path noted by the heavy arrows. The main flow entering chamber (2) forces piston (3) to the right, compressing piston spring (5). With piston (3) displaced, hydraulic fluid flows through ports in sleeve (4) to the downstream connection. Note that when piston (3) moves to the right, it is no longer in contact with main piston (6). Since the inlet holes into the inside of sleeve (4) are smaller than the outlet holes, a pressure drop occurs in chamber (2).

This pressure drop is proportional to the flow rate. The metered flow through orifice (7) forces main piston (6) to the right. The rate at which main piston (6) moves toward the right is proportional to the pressure in chamber (2), which (as stated above) is proportional to the flow rate through the fuse. During a normal flow cycle, main piston (6) does not travel its entire stroke, since the rated capacity of the fuse in cubic inches of fluid is larger than the capacity of the system or subsystem connected to the downstream side. In the event of a failure in the downstream system or subsystem, main piston (6) travels its entire stroke, contacting shoulder (8). This prevents further downstream flow. Once in this condition, the line will remain fused until upstream pressure is reduced to approximately 5 psi. Reduction of the upstream pressure allows piston spring (5) to return piston (3) and main piston (6) to their original positions. The fuse is thus prepared for another cycle.

C. In normal operation, the check (9) will permit a small quantity of fluid to flow downstream to preclude the possibility of the fuse closing at extremely low flow rates. During any reverse flow, the check will upset to permit free reverse flow. Under these conditions, the orifice (7) also acts as a check valve since it is displaced from its seat to permit free exit of fluid which has moved main piston (6) to the right.

2. Disassembly

A. With flats of body (60, Figure 3) held securely in a protected vise, remove lockwire (290), unscrew cap (10) and remove packing (20) from groove in cap (10).

B. Invert body (60) and tap outlet end with a wooden or fiber mallet until sleeve (280) can be grasped with the fingers. Gently withdraw sleeve with its associated internal parts and remove spring washer (70), spacer (80), and spring (90) from body (60) and sleeve (280).

NOTE: Do not remove nameplate (50) from body (60).

C. Remove piston (100) from sleeve (280); then remove retaining rings (110 and 150), plate (120), spring (130), check (140), and check stop (160) from piston (100).

D. Gently remove control sub-subassembly (110, 200 through 250) from end of sleeve (280); then, remove retaining ring (110), orifice seat (200), preformed packing (210), orifice (220), orifice retainer (230), and washer (240) from head (250). Remove preformed packing (260) from groove in head (250).

E. Carefully remove piston (270) from bore in sleeve (280) and remove preformed packing (170) from groove in sleeve (280).

3. Cleaning

A. Clean all metallic parts by immersing in solvent (Federal Specification P-S-661, or other similar approved solvent). Soaking of parts for several hours is recommended to remove accumulation of dirt and gum from ports and orifices. Use a soft brush or lint-free cloth to wash parts. Clean drilled ports with a fine bottle brush.

B. Dry parts with compressed air under moderate pressure. Direct compressed air into holes, ports, and orifices.

CAUTION: DO NOT INSERT METAL RODS OR WIRES INTO PORTS OR OTHER OPENINGS. THIS PROCEDURE COULD RESULT IN ENLARGEMENT OF THE PORTS OR OPENINGS, CAUSING UNSATISFACTORY OPERATION OR A CHANGE IN CALIBRATION.

4. Inspection/Check

A. Inspect all metallic parts for burrs, scratches, scores, nicks, dents, distortion, blemishes, or other surface defects affecting serviceability.

B. Check that check (140) slides freely in corresponding bore of piston (100) and that piston (100) slides freely in corresponding bore of sleeve (280).

C. Check that piston (270) slides freely in corresponding bore of sleeve (280).

NOTE: Since normal wear is insignificant, there are no wear limits established for parts. Surface defects caused by dirt or other foreign matter will be the most common type of defect. The ultimate determination of serviceability must be made on the basis of test results (paragraph 7).

5. Repair

A. No remachining, resurfacing, or other repair of parts is recommended. Parts found to be defective during disassembly and inspection must be replaced with serviceable parts.

B. Replace all preformed packings with new parts at each assembly regardless of the apparent serviceability of parts removed.

NOTE: Many parts are matched and are not therefore individually replaceable. These parts are designated by an asterisk (*) following the description in the parts list. Replacement must be made by replacing the entire assembly or subassembly in which the defective part is used.

6. Assembly

A. Install preformed packing (170, Figure 3) in groove on sleeve (280). Carefully insert piston (270) into corresponding bore of sleeve (28).

B. Place washer (240), orifice retainer (230), orifice (220) with counter-sunk side toward orifice seat (200), preformed packing (210), and orifice seat (200) into recess in head (250), and secure with retaining ring (110).

C. Place preformed packing (260) in groove on head (250) and install head in end of sleeve (280).

D. Place check stop (160) in piston (100) and secure with retaining ring (150).

E. Place check (140) in piston (100), followed by spring (130) and plate (120). Depress plate (120) to compress spring (130) and install retaining ring (110) in internal groove in piston (100).

F. Place body (60) open end up in a protected vise. Place spring washer (70), spacer (80), and spring (90) in body (60). Then insert piston (100) into sleeve (280) and insert sleeve (280) into body (60) so that spring (90) contacts retaining ring (150).

G. Install preformed packing (20) in groove of cap (10) and screw cap (10) into end of body (60). Tighten cap (10) securely.

H. Lockwire (290), cap (10) to body (60).

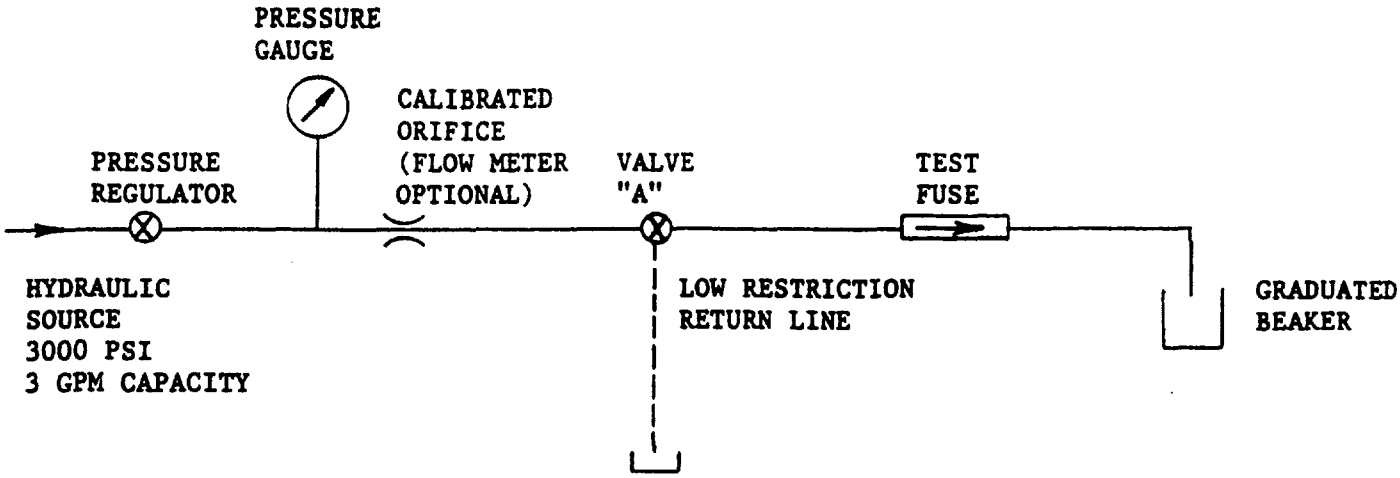
7. Testing

A. Install the assembled hydraulic fuse in a test setup as shown in figure 2, using fluid specified in Table 1. Assure that the system is filled with clean fluid. Purge all air from lines and valves by permitting rated flow to pass through the fuse, then reversing the flow. Repeat this cycle at least five times to insure complete elimination of air from the system.

B. Apply a fluid pressure of 4500 psig to the hydraulic fuse and maintain this pressure for five minutes. There must be no evidence of external leakage, and no failure, distortion, permanent set, or other damage due to the applied pressure. Reduce system pressure to zero.

TEMPORARY REVISION NO. 32-1

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Setup for Testing Hydraulic Fuse
Figure 2

To set flow:

1. Install orifice in test setup as shown.
2. Install return line in place of test fuse and graduated beaker.
3. Open valve "A" completely and apply required inlet pressure (see following paragraphs).

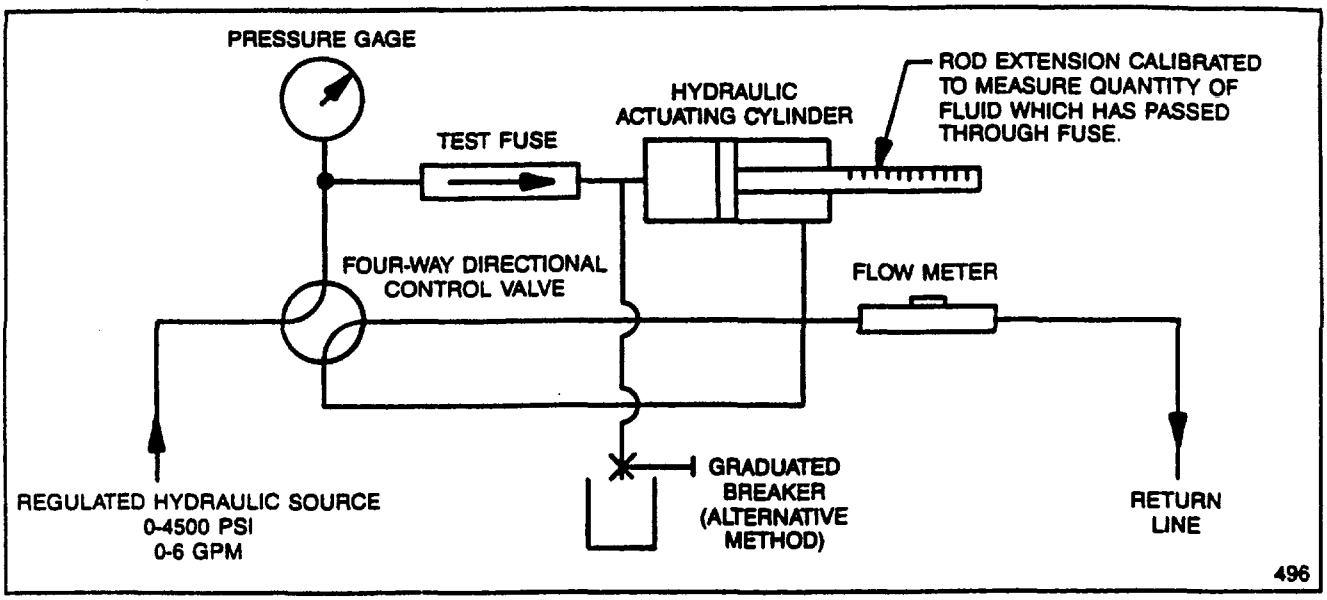
NOTE: If a 3 or 4 way valve is available, setup valve "A" to divert flow between test fuse and return line, otherwise, a ball valve is recommended.

To test fuse:

1. With proper flow established and test setup operating, close valve "A".
2. Replace return line with test fuse and graduated beaker.
3. Open valve "A" and measure volume of fluid required to close fuse.

C. Test volumetric capacity at flow rates of 1.2 and 2.4 gallons per minute using a calibrated orifice size of .0477 inches (suggested Lee part number JEHB1875425L) with inlet pressures of 750 and 2900 pounds per square inch respectively. At both flow rates, capacity must be within the range of 10.5 to 12.5 cubic inches (172 to 205 ml).

D. Test volumetric capacity at flow rates of .5 and .25 gallon per minute using a calibrated orifice size of .0218 inches (suggested Lee part number JETB1875190D) with inlet pressures of 2400 and 600 pound per square inch respectively. At both flow rates, capacity must be within the range of 10.5 to 20.0 cubic inches (172 to 328 ml).



Setup for Testing Hydraulic Fuse
Figure 2

C. Test volumetric capacity at a flow rate of 1.2 gallons per minute ±10 percent and at 2.4 gallons per minute ±10 percent. At both flow rates, capacity must be within the range of 10.5 to 12.5 cubic inches.

D. Test volumetric capacity at flow rates of 0.5 gallon per minute ±10 percent and 0.25 gallon per minute ±10 percent. At both flow rates, capacity must be within the range of 10.5 to 20.0 cubic inches.

E. With fuse closed, adjust upstream pressure to 40 psig ±10 percent. Disconnect line from downstream side of fuse and maintain upstream pressure for five minutes. During last three minutes of this interval, the leakage from the downstream port must not exceed 5 drops per minute.

F. Increase upstream pressure to 3000 psig ±10 percent. Maintain this pressure for five minutes. During last three minutes of this interval, leakage from downstream port must not exceed one drop per minute. Reduce pressure to zero.

NOTE: In steps E and F leakage will usually be much less than allowable maximum or much greater. High leakage is usually an indication of dirt or other foreign matter in the fuse. Disassemble, clean thoroughly, reassemble, and retest fuse.

G. Reconnect line to fuse downstream port. Apply upstream pressure and allow flow through fuse to continue until rated capacity is reached. Decrease upstream pressure to zero. Reapply upstream pressure after a slight delay and check that flow through fuse continues as evidence of resetting.

NOTE: Please see the ***TEMPORARY REVISION*** *that revises this page.*

TROUBLE	PROBABLE CAUSE	REMEDY
External leakage during pressure test.	Defective packing (20, figure 3) or improper installation of packing.	Remove cap (10) and packing (20).
	Crack or rupture in cap (10) or in body (60).	Replace cracked or ruptured part.
Volumetric capacity higher than specified maximum.	Obstruction of fluid flow through orifice (220).	Disassemble parts from head (250), clean parts and reassemble.
	Piston (270) does not slide freely in bore of sleeve (280).	Disassemble and determine cause of binding. Replace defective parts and reassemble.
	Piston (100) does not complete full stroke.	Remove piston (100) and check for binding between piston and bore of sleeve (280). Clean or replace binding parts and reassemble.
Volumetric capacity lower than specified minimum.	Improperly sized orifice (220).	Replace orifice (220).
	Leakage past packing (260) due to defective packing or improper installation.	Replace packing (260), being careful to install properly.
	Leakage past packing (210) due to defective packing or improper installation.	Replace packing (210), being careful to install properly.
Fuse fails to reset when upstream pressure is reduced.	Binding between check (140) and bore of piston (100).	Disassemble check (140) from piston (100), clean or replace defective parts and reassemble.

Trouble Shooting
Table 2

H. Disconnect hydraulic fuse from test setup.

8. Troubleshooting (See Table 2)

9. Storage Instructions

A. Partially fill hydraulic fuse with Skydrol 500A fluid after testing has been completed.

B. Install preformed packing (310, figure 3) and shipping plug (300) in each end of fuse.

10. Special Tools, Fixtures and Equipment

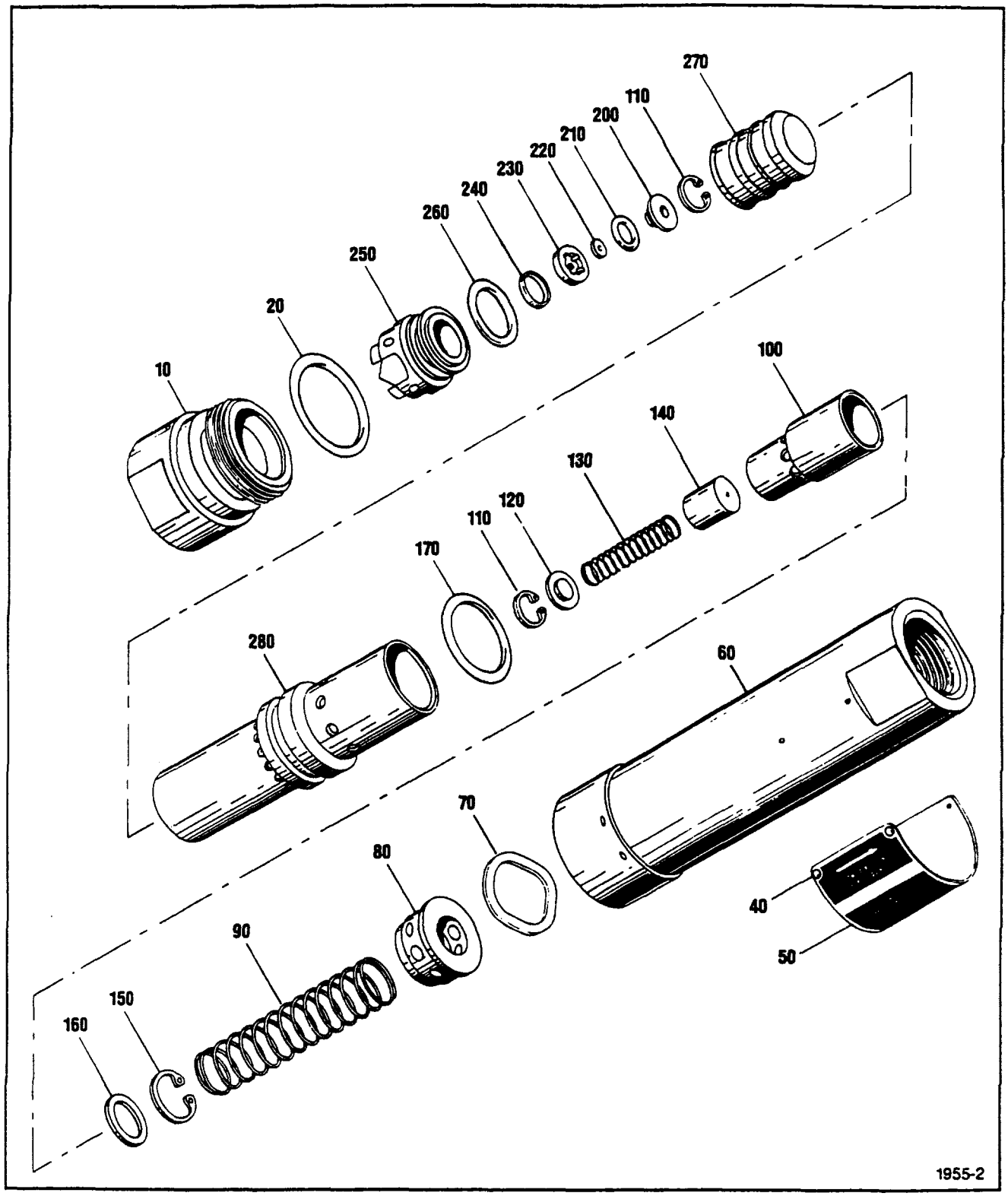
No special tools, fixtures, or test equipment are required to overhaul the hydraulic fuse as described in this manual.

11. Illustrated Parts List

A. Following is an illustrated parts list for the hydraulic fuse covered in this publication. Parts are listed in one possible order of disassembly.

B. The following code numbers are included in the parts list to identify manufacturers or vendors:

V82271 - Waterman Hydraulics, 6565 W. Howard, Niles, Illinois.



Hydraulic Fuse, Exploded View
Figure 3

FIG. & ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	UNITS PER ASSY.	USAGE CODE
3-	G831-8-10A	Fuse Hydraulic	1	
10	008322-00	. Cap	1	
20	NAS1611-211	. Packing, Preformed (V82271 P/N 114943-00)	1	
- 30	200447-00	. Body Subassembly	1	
40	MS21318-13	. . Screw, Drive (V82271 P/N 008336-00)*	4	
50	200446-00	. . Name Plate*	1	
60	008323-00	. . Body*	1	
70	008330-00	. Washer, Spring	1	
80	008313-00	. Spacer	1	
90	008334-00	. Spring	1	
100	008312-00	. Piston, Spring	1	
110	MS16625-37	. Ring, Retaining (V82271 P/N 114772-00)	2	
120	008331-00	. Plate	1	
130	008335-00	. Spring, Check	1	
140	008329-00	. Check	1	
150	MS16625-50	. Ring, Retaining (V82271 P/N 114773-00)	1	
160	008332-00	. Stop, Check	1	
170	NAS1611-116	. Packing, Preformed (V82271 P/N 114941)	1	
-180	200455-10	. Valve Subassembly	1	
-190	200456-10	. . Control Sub-subassembly*	1	
200	008341-00	. . . Seat, Orifice	1	
210	NAS1611-010	. . . Packing, Preformed (V82271 P/N 114931-00)	1	
220	008319-10	. . . Orifice	1	
230	008342-00	. . . Retainer, Orifice	1	
240	008337-00	. . . Washer	1	
250	008311-00	. . . Head	1	
260	NAS1611-112	. . . Packing, Preformed (V82271 P/N 114937-00)	1	
270		. . Piston	1	
280	008314-10	. . Sleeve	1	
-290	MS20995C20	. . Lockwire (V82271 P/N 115002-00)	AR	
-300	115109-00	Plug, Shipping	2	
-310	NAS1612-8	Packing, Preformed (V82271 P/N 115113-00)	2	

* Indicates non-procurable part: Procure next higher assembly.

SERVICE BULLETIN

HYDRAULIC FUSE CONVERSION

1 --- PLANNING INFORMATION

A --- EFFECTIVITY

This service bulletin is applicable to the following hydraulic fuse.

Waterman Part Number	BCDD Part Number	Aircraft Application
G831-8-10	7SC0110	Dash 7, Dash 8

Serial numbers affected. All.

B --- REASON

(1) To eliminate corrosion problems with piston assembly.
(2) Background. Fuses were reported to have been corroding and not shutting off after downstream failure. Piston was corroded and sticking.
(3) Action. To eliminate corrosion, piston and plug material were changed from magnesium to aluminum.

C --- DESCRIPTION

This service bulletin provides information required to convert hydraulic fuses from part number G831-8-10 to part number G831-8-10 A.

D --- APPROVAL

BCDD approval has been granted to G831-8-10 A.

E --- MANPOWER

No additional manpower is required to accomplish this conversion over that required for overhaul or repair.

F --- MATERIAL COST AND AVAILABILITY

New parts may be procured from Parker Hannifin Waterman Operation within 12 weeks after issue of service bulletin. Valves supplied on aircraft sold to operators by BCDD within the past two (2) years will be repaired under warranty at no cost to the operator. Valves supplied on aircraft sold prior to this period, conversion kits to complete the modification may be procured at a cost of $57.08, or the unit may be returned to the factory for conversion at a cost of $106.26. These costs are valid for an 18 month period after issuance of service bulletin.

G --- TOOLING

No special tooling required.

Parker Hannifin Corporation
Hydraulic Valve Division
6565 West Howard Street
Chicago, Illinois 60648-3387 USA
Phone (708) 647-0450
FAX (708) 647-1854

SERVICE BULLETIN

H --- WEIGHT AND BALANCE

Not applicable.

I --- OTHER PUBLICATIONS AFFECTED

None.

2 --- CONVERSION INSTRUCTIONS

A --- Remove safety wire and end cap.

B --- Discard o-ring on cap.

C --- Remove valve sub-assembly. Use care not to drop or damage the spring piston, see Fig. 1.

D --- Place spring piston into new valve S/A in relation shown in Fig. 1.

E --- Ensure wave washer is seated in counterbore in bottom of the body, below the spacer.

F --- Place spring in body, make sure spring is seated in the spacer, see Fig. 1.

G --- Replace sleeve seal and lubricate with BM3-11G. Place the valve S/A with the spring piston into the body with the spring going inside the spring piston. Press firmly on the valve S/A to insure valve S/A is seated properly.

H --- Replace o-ring on cap, lubricate with BM3-11G and screw cap in body, torque to 250 in-lbs.

I --- Function test.

J --- Safety wire cap to body.

K --- Metal stamp an "A" after the 10 in G831-8-10 on the nameplate to signify updated model.

Parker Hannifin Corporation
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FAX (708) 647-1864

SERVICE BULLETIN

3 --- MATERIAL INFORMATION

The following new parts are required to accomplish the modification:

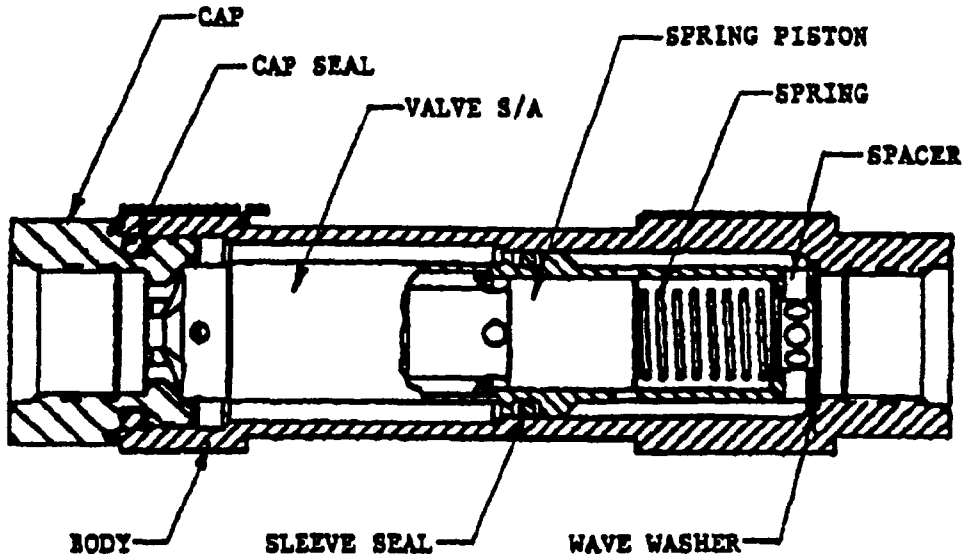
Old Part	Parts Being Replaced	Old	New	New Part	BCDD No.
G831-8-10	Piston Sub-assembly	700491-00	*702776-00	G831-8-10 A	7SC0110
	Valve Sub-Assembly	200455-10	712733-00		

* Not procurable separately. Order conversion kit no. 712734-00 contains [illegible] and sleeve seal no. 114941-00 (NAS1611-116).

Note: Nameplate must reflect new part number.

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SERVICE BULLETIN



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ASSEMBLY DIAGRAM
Figure 1

G831-32-1

October 17, 1991

CHAPTER 33

LIGHTS

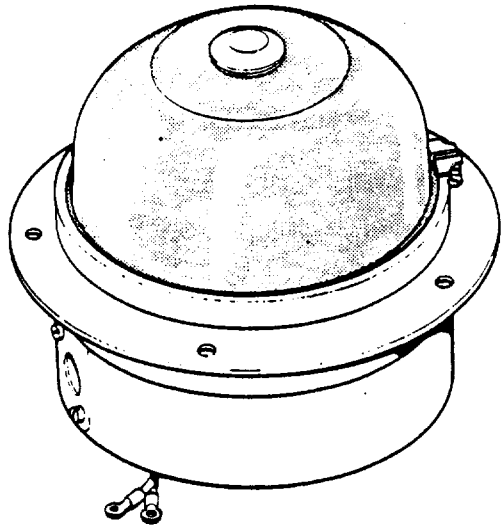
MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B./T.R.
Grimes	Aircraft Navigational Rotating Warning Light	G8400A36-24	33-40-21	Feb15/1975	
	Tandem Oscillating Light	Model No. 41905			
	Strobe Light Flasher	70-0075-1	MD70-1	Jul 1/1973	
	Strobe Repair Manual	60-1755		Mar/1974	
	Wing Position Aircraft Navigational Light	30-0863-3 & 4	33-40-74	Mar 15/1976	
Plessey	Emergency Light	614-1-03460	33-50-02	Jul 2/1970	

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GRIMES

OVERHAUL MANUAL
WITH
ILLUSTRATED PARTS LIST
AIRCRAFT NAVIGATIONAL
ROTATING WARNING LIGHT

G8400A12	G8400A10-24	G8400A22-24	G8400A41-24
G8400A24	G8400A11-24	G8400A23-24	G8400A43-24
G8400A3-12	G8400A12-12	G8400A24-24	G8400A45-12
G8400A3-24	G8400A13-24	G8400A31-24	G8400A47-24
G8400A8-12	G8400A14-24	G8400A36-24	G8400A49-24
G8400A8-24	G8400A15-24	G8400A37-24	
G8400A9-24	G8400A21-24	G8400A39-24	



GRIMES MANUFACTURING COMPANY

516 NORTH RUSSELL STREET, URBANA, OHIO 43078, U.S.A. • TELEPHONE: (513)-652-1431 • TELETYPE: (810)-467-2852 • TELEX: 206 438

LIGHTING EQUIPMENT FOR THE TRANSPORTATION INDUSTRY

33-40-21

REV 15/75

GRIMES MANUFACTURING COMPANY
OVERHAUL MANUAL WITH
ILLUSTRATED PARTS LIST
PART NO. G8400A

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1	4/1/73	4/1/73	GMC								
2	2/15/75	2/15/75	GMC								

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OVERHAUL MANUAL WITH
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SERVICE BULLETIN LIST

Service Bulletin Number	Revision Number	Date Bulletin Incorporated into Manual
B5-21043		Feb 15/75
B5-21044		Feb 15/75
B5-21206		Feb 15/75

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OVERHAUL MANUAL WITH
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PART NO. G8400A

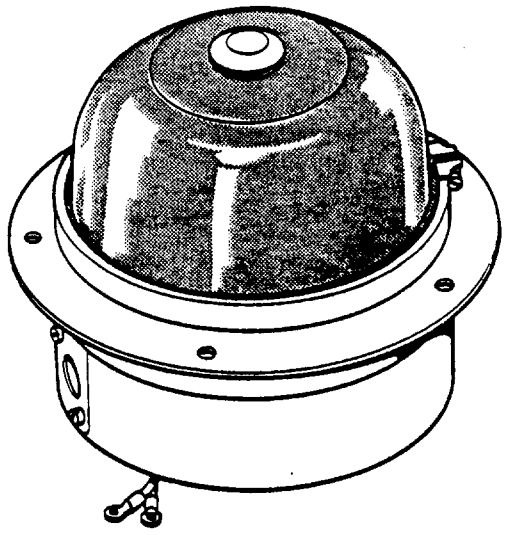
DESCRIPTION AND OPERATION

1. Description

A. The G8400A series Aircraft Navigational Rotating Warning Lights (Ref. Figure 1), are designed for installation in either the top or bottom of an aircraft fuselage, to provide adequate warning to approaching aircraft. The high intensity flashes of light are very effective, even under adverse weather conditions, for ascertaining aircraft location.

B. To simplify identification of the light assembly models described in this manual, an alphabetical designation has been assigned to each. The designators used as as follows:

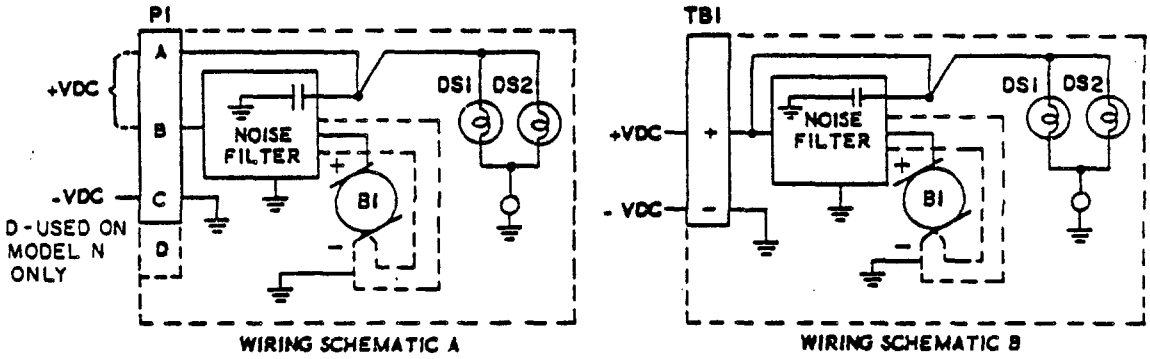
MODEL	CODE	MODEL	CODE	MODEL	CODE
G8400A12	A	G8400A12-12	K	G8400A36-24	U
G8400A24	B	G8400A13-24	L	G8400A37-24	V
G8400A3-12	C	G8400A14-24	M	G8400A39-24	W
G8400A3-24	D	G8400A15-24	N	G8400A41-24	X
G8400A8-12	E	G8400A21-24	P	G8400A43-24	Y
G8400A8-24	F	G8400A22-24	Q	G8400A45-12	Z
G8400A9-24	G	G8400A23-24	R	G8400A47-24	AA
G8400A10-24	H	G8400A24-24	S	G8400A49-24	AB
G8400A11-24	J	G8400A31-24	T		



Aircraft Navigational Rotating Warning Light
Figure 1

2. Operation

Two high intensity lamps are installed diametrically opposed on a turntable which revolves at a controlled speed, producing intermittent visible light. A red glass lens protects the mechanism and produces the approxed warning color. Electrical power is supplied from the aircraft electrical system (Ref. Figure 2). Wiring Schematic B applies to models C, D and R. Wiring Schematic A applies to all other models.



Electrical Schematic Diagram
Figure 2

3. Leading Particulars

Refer to Figure 3 for leading particulars.

Operating Voltages	
Models A,C,E,K,Z	13 VDC
Models B,D,F-J,L-Y,AA,AB,G,H,M,N,P,Q,R,S,T,U,V,W,X	28 VDC
Flashes per minute	85 ±5
Radio noise filter	In accordance with ATA specifications
Dimensions	
Mounting flange diameter:	
Models C,D,E,F,G,H,J,K,N,T,U,Y,Z,AB	5.00 ±0.015
Models Q,R,S,W,X,AA	5.25 ±0.015
Model V	4.75 ±0.015
Height:	
With bottom connector	4-15/16 in.
Without connector	4-3/8 in.
Weight	2 pounds (max).

Leading Particulars
Figure 3

DISASSEMBLY

1. Disassemble Light Assembly

   A. Remove lens retaining band assembly (Ref. 22, IPL Fig. 1).

   B. Pull lens and plug assembly (consisting of items 24 through 30) off the light assembly. Do not disassemble the lens and plug assembly unless drain plug replacement is required. If required, disassemble the lens and plug assemblies as follows:

      NOTE: The lens installed on model Q is not equipped with a drain plug.

      (1) Remove screw (25) and drain hole plug (24).

      (2) Separate lock washer (26), washers (27 and 28) and drain hole plug gasket (29) from lens (30).

   C. Remove incandescent lamps (32).

   D. Remove screws (36) and motor cover (34). Do not disassemble the motor cover unless repair is required. If necessary disassemble the motor cover as follows:

      (1) Remove screws (42), lock washers (43) and cover plate (41). Remove screws (50B), lock washers (50A) and cover plate (50). Remove grommet (39).

         NOTE: Light assemblies designated with the suffix "X" utilize an alternate design incorporating rivets (38) instead of screws to attach cover plate (37).

   E. Remove screws (46), lock washers (48) and connector assembly (44).

   F. Do not remove terminals (51) unless replacement is required.

   G. Remove screws (58) and pry mounting flange (52) from mechanism assembly (69) except for models A, B, L, M and P.

   H. Remove screws (66), lock washers (67), nuts (68) and baffle on models G, H, J, L and M only.

2. Disassemble Mechanism Assembly

   A. Remove lock nut (Ref. 9, IPL Fig. 2) and washer (10). Pull lamp gear assembly (8) off the base assembly post.

   B. Disassemble Lamp Gear Assembly (8) as follows:

      (1) Remove screws (12), lock washers (13), nuts (15), lock washers (14), insulators (16 and 17) and contact assembly (11).

(2) Remove screws (20), nuts (21), lock washers (22), flat washers (23), bushings (24), insulators (25) and lampholder and ferrule assemblies (18 and 19).

(3) Unsolder the brush lead and remove electrical brush (27) and brush spring (28).

(4) Do not remove rivets (31), plate (30) and bracket (29) from mounting bracket (26) unless part replacement is required.

(5) Remove roll pin (33), groove pin (34), bearings (37), spacers (35 and 36), hub (32) and gear (38).

C. Remove screw (40) and self-locking nut (41). Remove one screw and lock washer that secures the base of motor (45) to support bracket (39). Remove the support bracket.

D. Remove the remaining screw and lock washer and end plate from the base of motor (45). Remove screw (43), lock washer (44) and lug terminal (42) from inside of motor (45).

E. Remove screws (47), lock washers (48) and motor (45).

F. Remove setscrews (50) and worm (49) from motor shaft.

G. Remove screws (52), lock washers (53), nuts (54), radio noise filter (51) and noise filter spacer (55).

H. Remove screw (57), lock washers (58), nut (59) and terminal block (56) from models C, D and R.

I. Remove screws (60), lock washers (61) and nuts (62) from base (95).

J. Do not remove instruction plate (63) or identification plate (64) from base (95) unless replacement is required.

K. Disassemble Base Assembly as follows:

(1) Remove terminal (71), on models C, D and R only, contact (69) and insulator (70) from flange and shaft assembly (86).

(2) Remove setscrews (73) and worm wheel and hub assembly (72).

(3) Remove pinion shaft (83), bearings (84) and washer (85). Drill out rivets (82) and remove screw (76), lock washer (78), nut (80) and bearing retainer assembly (74).

(4) Drill out rivets (90) and remove support (89). Do not remove inserts (88) from support (89) unless replacement is required.

(5) Drill out rivets (87) and remove flange and shaft assembly (86).

(6) Remove drain tubes (91) and plate (92) from base (95).

(7) Do not remove clinch nuts (93) from base (95) unless replacement is required.

CLEANING

1. Clean electrical parts with a clean, lint-free cloth moistened with isopropyl alcohol, Federal Specification TT-I-735, or equivalent. Allow to air dry.

   WARNING: SOLVENT AND ACETONE FUMES ARE TOXIC. PROLONGED INHALATION OF THE FUMES MAY CAUSE ILLNESS.

2. Clean metal parts with dry cleaning solvent, Federal Specification P-D-680, or equivalent.

3. Clean lamps (Ref. 32, IPL Fig. 1) with acetone, Federal Specification O-A-51, or equivalent.

INSPECTION/CHECK

1. Inspect all gears for cracks, chips, broken teeth and excessive or uneven wear.

2. Observe condition of all electrical contact points, see that they are free of excess pitting or burning.

3. Check condition of all threaded parts for crossed or stripped threads.

4. Inspect the length and contact surface of electrical brush (Ref. 27, IPL Fig. 2). Replace if less than 0.437 inch or worn unevenly.

5. Inspect the radio noise filter (51) for damage to the case, shorts between circuits and shorts between circuits and case. If the case is damaged, replace the noise filter.

6. Check legibility of instruction plate (63) and identification plate (64).

7. Inspect lens (Ref. 30, IPL Fig. 1) for cracks, chips or discoloration.

8. Inspect insulator (Ref. 70, IPL Fig. 2) for evidence of deterioration.

9. The following preventive maintenance procedures shall be made every 1000 hours:

   A. Replace contact assembly (11).

   B. Replace bearings (37) on turntable.

   C. Replace bearings (84) on pinion shaft (83).

   D. Replace worm wheel and hub assembly (72).

   E. Replace contact (69) at top of flange and shaft assembly (86).

   F. Replace electrical brushes (27) and brush springs (28) if total brush length is less than 0.437 inch.

   G. Clean dust and dirt from the light assembly.

   H. Return motor (45) to factory for bearing and brush replacement.

   I. Polish the brush ring portion of flange and shaft assembly (86), or replace if badly pitted or burned.

   J. Inspect the light assembly for miscellaneous damage, such as broken gear teeth, defective wire leads, broken or distorted metal parts and deteriorated non-metallic parts. Replace defective parts.

K. Apply Dow Corning M77 molybdenum disulfide grease to turntable gear (38).

REPAIR

1. Replace all bearings removed in disassembly.

2. Replace defective contact assembly (Ref. 11, IPL Fig. 2) and contact (69). Adjust center contact pressure to 6-9 ounces using a Pelouze Scale, Model 2-T, or equivalent.

3. Replace all parts determined defective during INSPECTION/CHECK, TESTING and TROUBLE SHOOTING.

ASSEMBLY

1. Assemble Base Assembly

   A. If clinch nuts (Ref. 93, IPL Fig. 2) were removed, press replacement clinch nuts on base (95).

   B. Position plate (92) on base (95) and install drain tube (91).

   C. Install flange and shaft assembly (86) on base (95) and secure with rivets (87).

   D. If inserts (88) were removed, press replacement inserts on support (89). Install support (89) on base (95) and secure with rivets (90).

   E. Press bearing (84) into bearing retainer assembly (74). Position the bearing retainer assembly on base (95) and secure with rivets (82), screw (76), lock washer (78) and nut (80). Insert the drive end of pinion shaft (83) through the top bearing (84). Place washer (85) and worm wheel and hub assembly (72) on the other end of the pinion shaft and secure with setscrews (73). Ensure that the pinion shaft rotates freely with 0.004 to 0.005 inch end play.

   F. Install insulator (70) in flange and shaft assembly (86). Solder the electrical lead to contact (69) and press contact into insulator (70). Attach terminal (71), on models C, D and R, to the other end of the electrical lead.

2. Assemble Lamp Gear Assembly

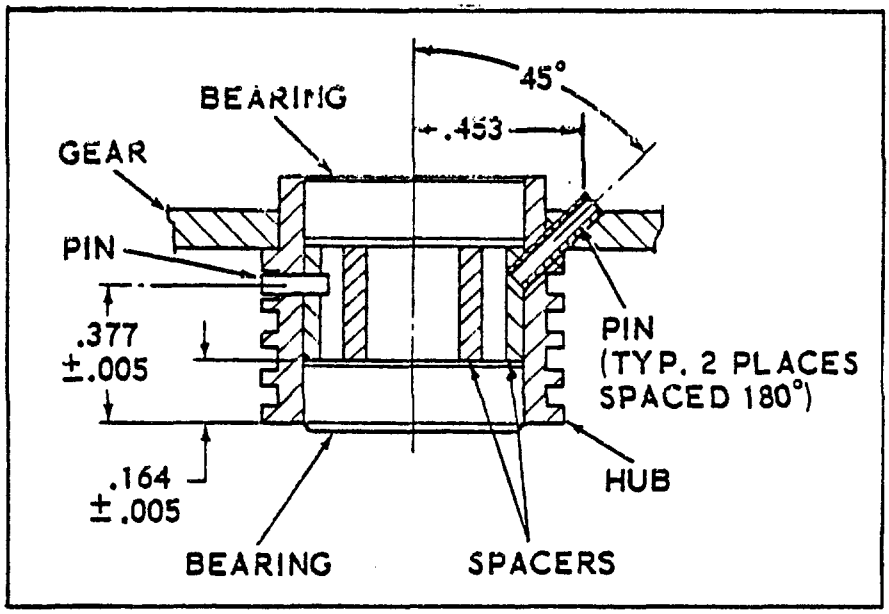
   A. Press spacer (Ref. 35, IPL Fig. 2) into hub (32) until centered. When properly centered the spacer will be located 0.164 $\pm$0.005 inch from the lower end of the hub. (Ref. Figure 501).

   B. Drill a 0.0625 inch diameter hole 0.377 inch from the largest diameter end of the hub. Insert new groove pin (Ref. 34, IPL Fig. 2) flush with the outside surface of the hub.

   C. Position hub (32) into gear (38). Drill two holes 0.062 inch diameter through the gear and hub as shown in Figure 501.

   D. Install new roll pins (Ref. 33, IPL Fig. 2) into both holes.

   E. Install spacer (36) and press new bearings (37) into both ends of hub (32). The inside diameter of the spacer must be aligned with the inside diameter of both bearings.



Hub Installation
Figure 501

F. Position lampholder and ferrule assemblies (18 and 19) with the inclines toward the center of gear (38). Place two insulators (25) between the lampholders and gear. Loosely install one screw (20), flat washer (23), bushing (24), lock washer (22) and nut (21) into the end of each lampholder toward the contact arm side of the gear.

G. If bracket (29) and plate (30) were removed, secure replacement bracket and plate to mounting bracket (26) with rivets (31).

H. Install brush spring (28) and electrical brush (27) into brush holder assembly (consisting of items 26, 29, 30 and 31). Solder electrical brush lead to the brush holder assembly.

I. Position the holes in mounting bracket (26) over the lampholder mounting holes, with electrical brush (27), towards the outside diameter of gear (38). Install the remaining insulators (25), screws (20), flat washers (23), bushings (24), lock washers (22) and nuts (21). Tighten four screws (20).

J. Insert contact assembly (11) through the gear opening. Position insulator (16) on the top side of the gear, position insulator (17) between the gear and contact assembly. Secure the contact assembly to the gear with screws (12), lock washers (13 and 14) and nuts (15). Adjust the center contact pressure to 6-9 ounces using Pelouze Scale, Model 2-T, or equivalent.

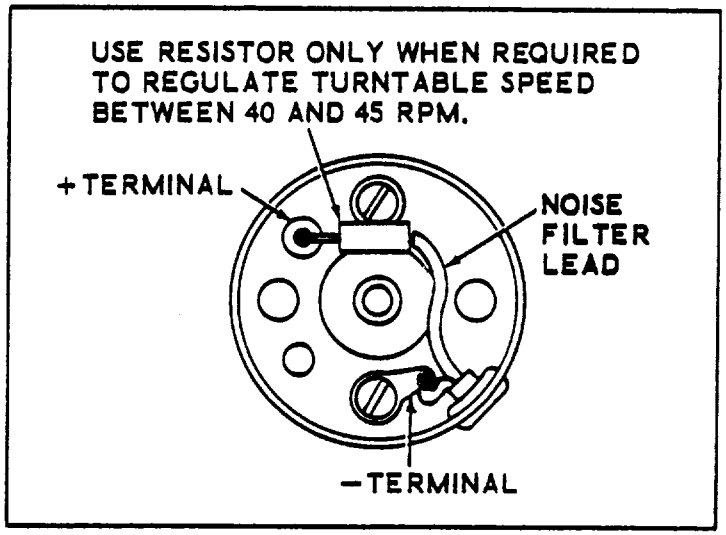
3. Assemble Mechanism Assembly

A. Attach terminal block (Ref. 56, IPL Fig. 2) to base (95) with screw (57), lock washers (58) and nut (59), models C, D and R only. Refer to Figure 2 for wiring instructions.

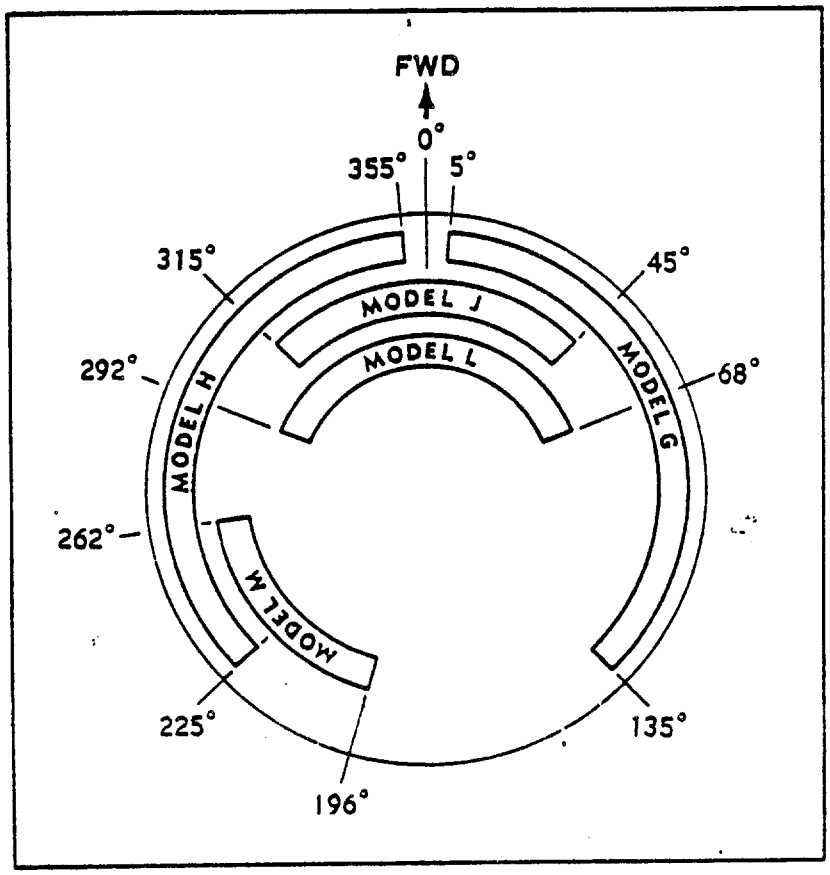
B. Position noise filter spacer (Ref. 55, IPL Fig. 2) against the bottom of base (95) with the square opening in the spacer toward the center of the base. Ensure that the spacer fits flush against the base. Attach radio noise filter (51) and the spacer to the base with screws (52), lock washers (53) and nuts (54). Place the terminal on electrical lead from connector pin c between one lock washer and the radio noise filter.

NOTE: Light models C, D and R do not have connector assemblies.

C. Remove the end plate from the base of motor (45). Refer to Figure 502 and connect lug terminal (Ref. 42, IPL Fig. 2) to the motor negative terminal with screw (43) and lock washer (44). Solder radio noise filter lead to the motor positive terminal.



Motor Wiring Diagram
Figure 502



Light Baffle Installation
Figure 503

D. Install the motor end plate and insulator with one screw and lock washer opposite the grommet. Attach support bracket (39) to motor (45) with the remaining screw and lock washer.

E. Insert the motor shaft through the support (89) and attach motor (45) with screws (47) and lock washers (48).

F. Attach support bracket (39) to base (95) with screw (40) and self-locking nut (41).

G. Place two washers (10) onto flange and shaft assembly (86). Slide gear assembly (consisting of items 11 through 38) onto the shaft. Place one washer (10) onto the gear assembly and secure the gear assembly with lock nut (9).

H. Slide worm (49) onto the motor shaft. Ensure that the worm is properly engaged with worm wheel and hub assembly (72). Tighten two setscrews (50).

I. Connect the wiring as shown in Figure 2 as applicable.

J. Install screws (Ref. 60, IPL Fig. 2), lock washers (61) and nuts (62) on base (95).

K. If instruction plate (63) and identification plate (64) were removed, affix new instruction plate and identification plate on base (95).

4. Assemble Light Assembly

A. Install baffle (Ref. 61, IPL Fig. 1) in the position as applicable and as shown in Figure 503. Attach with screws (Ref. 66, IPL Fig. 1), lock washers (67) and nuts (68), applies to models G, H, J, L and M only.

B. Slide mounting flange (52) onto mechanism assembly (69) and attach with screws (58).

C. Apply sealant EC801, manufactured by Minnesota Mining and Manufacturing Company, St. Paul, Minnesota, onto the outer surface of the base near the flange (models S, W, Y only).

NOTE: The flange is installed with the mounting ring in the downward position on models G, H, X. Models A, B, L, M and P are supplied without a flange.

D. Attach cover plate (37) to motor cover (40) with rivets (38), models C, D and R only. Install grommet (39).

E. Attach connector assembly (44) to motor cover (34) with screws (46) and lock washers (48). Refer to Figure 504 for connector position.

NOTE: Where connector location is indicated as either bottom or side, the light is normally supplied with connector in the bottom position. A suffix "S" is added to the light part number if these light assemblies are supplied with the connector in a side position.

MODEL	CONNECTOR POSITION
A	Bottom or Side
B	Bottom or Side
C	None
D	None
E	Bottom or Side
F	Bottom or Side
G	Bottom or Side
H	Bottom or Side
J	Side

MODEL	CONNECTOR POSITION
K	Side
L	Bottom or Side
M	Bottom or Side
N	Bottom or Side
P	Bottom
Q	Side
R	None
S	Bottom or Side
T	Bottom

MODEL	CONNECTOR POSITION
U	Bottom or Side
V	Bottom or Side
W	Bottom or Side
X	Bottom or Side
Y	Bottom
Z	Bottom or Side
AA	Bottom
AB	Bottom

Connector Position
Figure 504

F. Install cover plate (Ref. 41 or 50, IPL Fig. 1) to the remaining connector hole, with screws (42 or 50B) and lock washers (43 or 50A) as applicable.

G. If terminals (51) were removed during disassembly, crimp replacement terminals on Model R.

H. Install motor cover (34) with screws (36).

I. Cement lens gasket (31) on the mechanism assembly flange using EC-847 adhesive manufactured by Minnesota Mining and Manufacturing Company, St. Paul, Minn.

J. Install incandescent lamps (32).

K. If the drain hole plug (24) has been removed from lens (30), install as follows:

(1) Place drain hole plug gasket (29) onto drain hole plug (24). Insert the drain hole plug through the outer side of lens (30).

(2) Place washer (28) onto the drain hole plug shank. Place washer (27), bossed side away from lens (30) onto washer (28).

(3) Secure the parts with screw (25) and lock washer (26).

L. Position lens and plug assembly (consisting of items 24 through 30) on mechanism assembly (69) and secure with lens retaining band assembly (22).

TESTING

1. Test the rotating mechanism prior to installation into the base assembly.

2. With the lamps removed, connect the rotating mechanism as shown in Fig. 501 and observe the following:

   A. The gears shall engage and operate with no excessive noise.

   B. The lamp gear shall rotate at a rate of 45 ±5 RPM. A wire wound resistor, 18 ohm, 1-1/2 watt, can be added to the motor lead to control motor speed (Ref. Figure 502).

3. Install the lamps and operate the mechanism. The lamps shall illuminate with no evidence of dimming or flickering.

4. Install the mechanism into the base assembly. Test the light unit as described in paragraph 2.

TROUBLE SHOOTING

Refer to Figure 801 for trouble shooting procedures.

TROUBLE	CAUSE	ISOLATION PROCEDURE	REMEDY
Lamps (Ref. 32, IPL Fig. 1) fail to illuminate	No power	Check line fuses or circuit breaker. If tripped, check wiring in light and between light and fuse. Also check for defective center contact insulator (Ref. 70, IPL Fig. 2) causing shorted center contact.	Replace defective wiring or defective center contact insulator. Replace blown fuse or reset tripped circuit breaker.
	Defective lamps	Install lamps known to be operational.	Replace defective lamps.
	Worn electrical brushes (Ref. 27, IPL Fig. 2)	Remove the lens and plug assembly. Electrical brush must be visible through the inspection hole located in the side of the brushholder.	Replace worn brush.
	Defective radio noise filter (51)	Install a by-pass circuit around the noise filter.	Replace noise filter.
	Defective electrical leads	Install a by-pass circuit to check each lead.	Replace defective lead.
	Burned center contact (69)	By-pass both contacts with the motor (45) disconnected.	Replace contact.
Turntable does not rotate	Gear train inoperative	Check all gears for worn or broken teeth.	Replace defective gear.
		Gears loose on shaft.	Tighten setscrews.
	Motor worm misadjusted	Check for motor worm being too tight with worm wheel.	Loosen motor attaching screws and adjust for proper mesh of worm, then retighten screws.

Trouble Shooting
Figure 801 (Sheet 1 of 2)

TROUBLE	CAUSE	ISOLATION PROCEDURE	REMEDY
Turntable does not rotate (cont)	Motor (Ref. 45, IPL Fig. 2 does not operate	Bench check motor with external power source.	Replace defective motor.
	Defective radio noise filter (51)	Install a by-pass circuit around the radio noise filter to the motor.	Replace defective radio noise filter.

Trouble Shooting
Figure 801 (Sheet 2 of 2)

STORAGE INSTRUCTIONS

1. Wrap the Aircraft Navigational Rotating Warning Light with cushioning material, Military Specification MIL-C-81013.

2. Enclose the assembly and desiccant, Military Specification MIL-D-3464, in heat sealable film, Military Specification MIL-F-22191, and seal the film using a sealing iron, Military Specification MIL-S-43336.

3. Store the assembly in an area with a temperature range of 65°F to 120°F.

SPECIAL TOOLS, FITTINGS AND EQUIPMENT

Refer to Figure 1001 for special equipment.

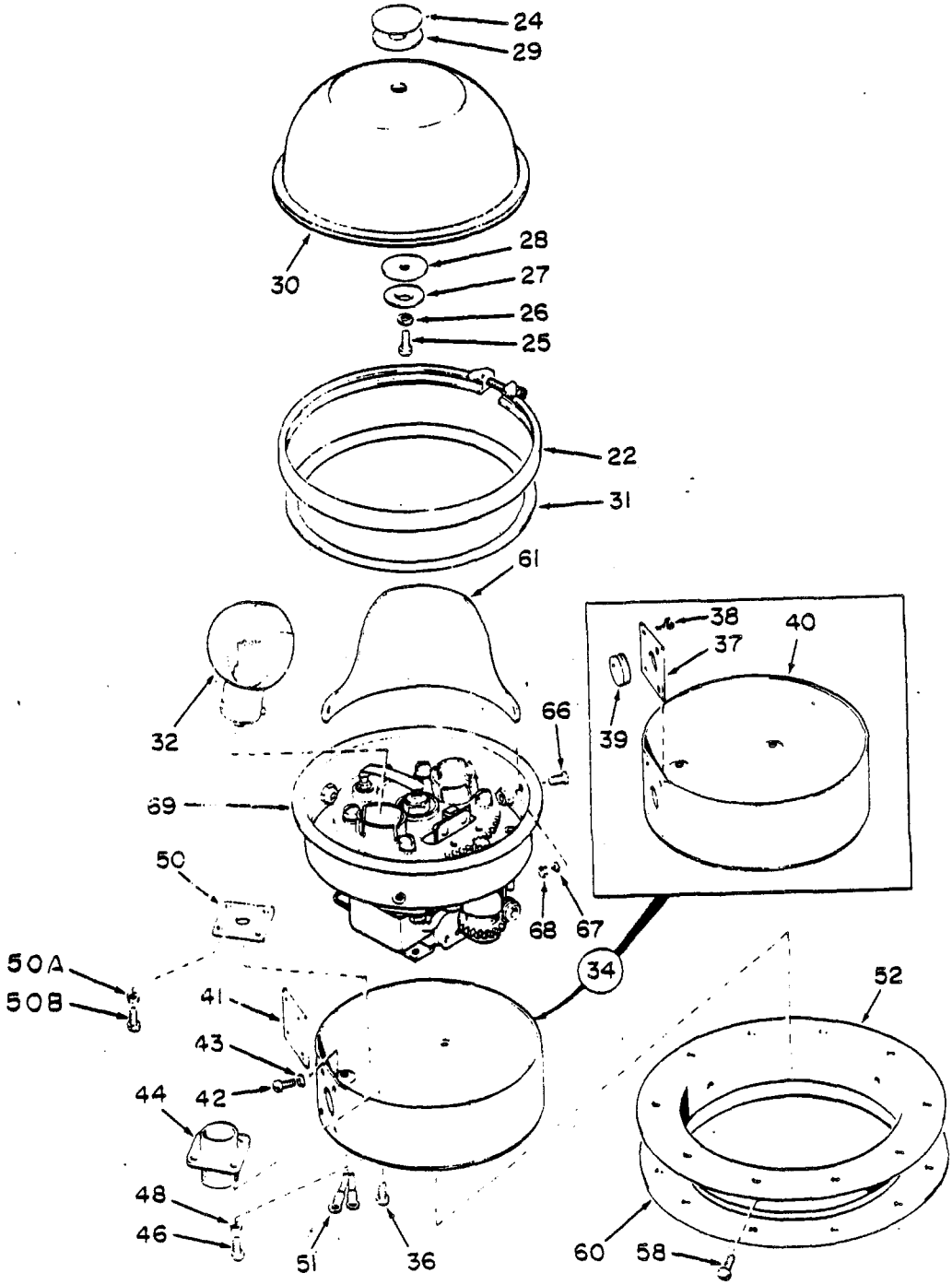
NOMENCLATURE	DESCRIPTION	SOURCE
Scale	Model 2-T	Pelouze Mfg. Co. 1218 Chicago Ave. Evanston, Ill. 60202, or equivalent

Special Equipment
Figure 1001

ILLUSTRATED PARTS LIST

The following is a compilation of the vendor codes with the names and addresses of suppliers for purchased parts used in this illustrated parts list.

CODE	NAME AND ADDRESS
00779	AMP Inc. P. O. Box 3608 Harrisburg, Pa. 17105
12014	Chicago Rivet and Machine Co. 950 S. 25th Avenue Bellwood, Ill. 60104
56878	Standard Pressed Steel Co. Benson East Jenkintown, Pa. 19046
57771	Edwin B. Simpson Co., Inc. 900 Sylvan Ave. Bay Port, N. Y. 11705
71087	Boots Aircraft Nut Division Townsend Company 1224 E. Warner Ave. Santa Anna, Calif. 92707
72962	ESNA Division of Amerace Corp. 2330 Vauxhall Road Union, N. J. 07083
73957	Groov-Pin Corp. 1125 Hendricks Causeway Ridgefield, N. J. 07657



Aircraft Navigational Rotating Warning Light - Exploded View
IPL Figure 1

FIG.	ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY	
1	-1	G8400A12	AIRCRAFT NAVIGATIONAL ROTATING WARNING LIGHT	A	RF	R
	-2	G8400A24	AIRCRAFT NAVIGATIONAL ROTATING WARNING LIGHT	B	RF	R
	-3	G8400A3-12	AIRCRAFT NAVIGATIONAL ROTATING WARNING LIGHT	C	RF	R
	-4	G8400A3-24	AIRCRAFT NAVIGATIONAL ROTATING WARNING LIGHT	D	RF	R
	-5	G8400A8-12	AIRCRAFT NAVIGATIONAL ROTATING WARNING LIGHT	E	RF	R
	-6	G8400A8-24	AIRCRAFT NAVIGATIONAL ROTATING WARNING LIGHT	F	RF	R
	-7	G8400A9-24	AIRCRAFT NAVIGATIONAL ROTATING WARNING LIGHT	G	RF	R
	-8	G8400A10-24	AIRCRAFT NAVIGATIONAL ROTATING WARNING LIGHT	H	RF	R
	-9	G8400A11-24	AIRCRAFT NAVIGATIONAL ROTATING WARNING LIGHT	J	RF	R
	-10	G8400A12-12	AIRCRAFT NAVIGATIONAL ROTATING WARNING LIGHT	K	RF	R
	-11	G8400A13-24	AIRCRAFT NAVIGATIONAL ROTATING WARNING LIGHT	L	RF	R
	-12	G8400A14-24	AIRCRAFT NAVIGATIONAL ROTATING WARNING LIGHT	M	RF	R
	-13	G8400A15-24	AIRCRAFT NAVIGATIONAL ROTATING WARNING LIGHT	N	RF	R
	-14	G8400A21-24	AIRCRAFT NAVIGATIONAL ROTATING WARNING LIGHT	P	RF	R
	-15	G8400A22-24	AIRCRAFT NAVIGATIONAL ROTATING WARNING LIGHT	Q	RF	R
	-16	G8400A23-24	AIRCRAFT NAVIGATIONAL ROTATING WARNING LIGHT	R	RF	R
	-17	G8400A24-24	AIRCRAFT NAVIGATIONAL ROTATING WARNING LIGHT	S	RF	R
	-18	G8400A31-24	AIRCRAFT NAVIGATIONAL ROTATING WARNING LIGHT	T	RF	R
	-19	G8400A36-24	AIRCRAFT NAVIGATIONAL ROTATING WARNING LIGHT	U	RF	R
	-20	G8400A37-24	AIRCRAFT NAVIGATIONAL ROTATING WARNING LIGHT	V	RF	R
	-20A	G8400A39-24	AIRCRAFT NAVIGATIONAL ROTATING WARNING LIGHT	W	RF	R
	-20B	G8400A41-24	AIRCRAFT NAVIGATIONAL ROTATING WARNING LIGHT	X	RF	R

- Item Not Illustrated

FIG.	ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY	
1	-20C	G8400A43-24	AIRCRAFT NAVIGATIONAL ROTATING WARNING LIGHT	Y	RF	R
	-20D	G8400A45-12	AIRCRAFT NAVIGATIONAL ROTATING WARNING LIGHT	Z	RF	R
	-20E	G8400A47-24	AIRCRAFT NAVIGATIONAL ROTATING WARNING LIGHT	AA	RF	R
	-20F	G8400A-49-24	AIRCRAFT NAVIGATIONAL ROTATING WARNING LIGHT	AB	RF	R
	21	DELETE				
	22	A7635A	. BAND, LENS RETAINING ASSEMBLY		1	R
	-23	A7942	. LENS AND PLUG ASSEMBLY	A-P,R-V X,Y	1	R
	-23A	A7942-1	. LENS AND PLUG ASSEMBLY	W,AA	1	R
	-23B	A7942-2	. LENS AND PLUG ASSEMBLY	Z	1	R
	-23C	21760-4	. LENS, COVER ASSEMBLY	AB	1	R
	-23D	A7633-10	. LENS	Q	1	R
	24	A7941	. . PLUG, DRAIN HOLE	A-P,R-AB	1	R
	25	MS35206-226	. . SCREW, MACHINE	A-P,R-AA	1	R
	-25A	MS35206-225	. . SCREW, MACHINE	AB	1	R
	26	MS35338-41	. . WASHER, LOCK	A-P,R-AA	1	R
	-26A	MS35333-37	. . WASHER, LOCK	AB	1	R
	27	A4253-1	. . WASHER	A-P,R-AB	1	R
	28	A3934	. . WASHER	A-P,R-AB	1	R
	29	A8966-1	. . GASKET, DRAIN HOLE PLUG	A-P,R-AA	1	R
	-29A	A8966-2	. . GASKET, DRAIN HOLE PLUG	AB	1	R
	30	B7633-10	. . LENS	A-P,R-V X,Y	1	R
	-30A	B7633-11	. . LENS	W, AA	1	R
	-30B	B7633-12	. . LENS	Z	1	R
	-30C	B7633-18	. . LENS	AB	1	R
	31	A7632	. GASKET, LENS	K	1	R
	32	*A7079B12	. LAMP, INCANDESCENT (DSI, DS2)	A,C,E,K Z	2	R
	-33	*A7079B24	. LAMP, INCANDESCENT (DS1,DS2)	B,D,F,G, H,J,L-V, X,Y,AA, AB	2	R
	34	B7639-4	. COVER, MOTOR	A,B,E-Q, S-AB	1	R

*Light assemblies supplied less lamps, item number 32 above, are identified by the suffix letter L after the model designation.

- Item Not Illustrated

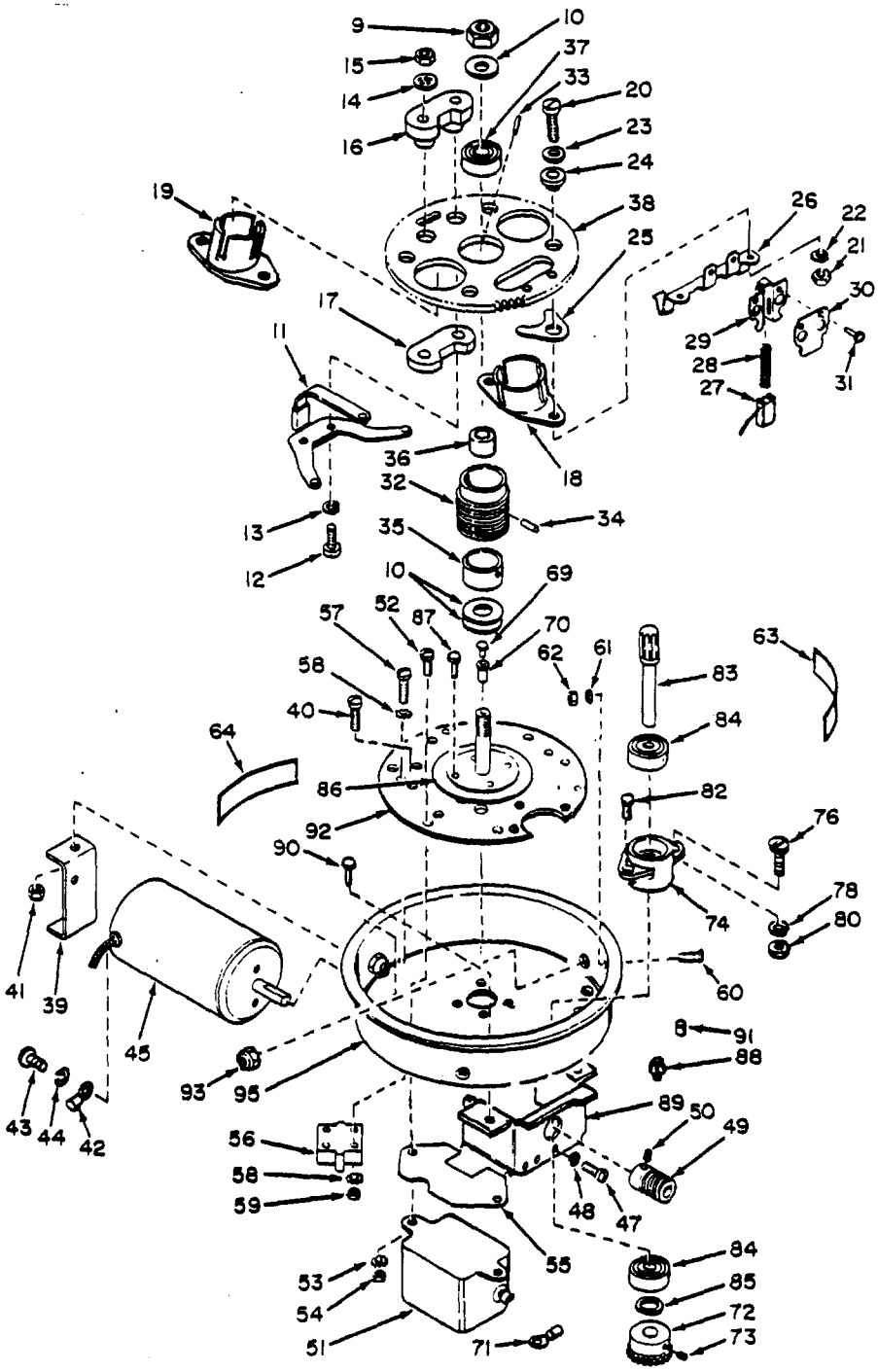
FIG.	ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY	
1	-35	A8107-1	. COVER ASSEMBLY, MOTOR..... (ATTACHING PARTS)	C,D,R	1	R
	36	MS35206-227	. SCREW, MACHINE..... ---*---		3	R
	37	A7641-5	. . PLATE, COVER..... (ATTACHING PARTS)	C,D,R	2	R
	38	R4012	. . RIVET, BRAZIER HD, TUB AL 1/8 x 5/32 IN LG, (V12014) (GRIMES STOCK CODE RV304)	C,D,R	4	R
	39	MS35489-4	. . GROMMET.....	C,D,R	2	R
	40	B7639-4	. . COVER, MOTOR.....	C,D,R	1	R
	41	#A7641	. PLATE, COVER..... (ATTACHING PARTS)	A,B,E-Q, S-AB	1	R
	42	MS35206-225	. SCREW, MACHINE.....	A,B,E-Q, S-AB	2	R
	43	MS35338-41	. WASHER, LOCK..... ---*---	A,B,E-Q, S-AB	2	R
	44	41-0441-1	. CONNECTOR ASSEMBLY (P1).....	A,B,E-M, P,Q,S,T, U,W-AB	1	R
	-45	41-0806-1	. CONNECTOR ASSEMBLY (P1)..... (ATTACHING PARTS)	N,V	1	R
	46	MS35265-40	. SCREW, MACHINE.....	A,B,E-Q, S,T,U, W-AB	4	R
	-47	MS24693S31	. SCREW, MACHINE.....	N,V	2	R
	48	MS35338-42	. WASHER, LOCK.....	A,B,E-Q, S,T,U, W-AB	4	R
	-49	MS21042-04	. WASHER, LOCK..... ---*---	N,V	2	R
	50	A7641-7	. PLATE COVER..... (ATTACHING PARTS)	N,V	1	R
	50A	MS35338-41	. WASHER, LOCK.....	N,V	2	R
	50B	MS35206-225	. SCREW, MACHINE..... ---*---	N,V	2	R

#Light assemblies supplied with alternate cover plate A7641-3 attached to the cover with rivets substituted for item number 40 above are identified by the suffix letter X after the model designation.

- Item Not Illustrated

FIG.	ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY	
1	51	MS25036-103	. TERMINAL.....	R	2	R
	52	B7640-1	. FLANGE, MOUNTING.....	C-K,N,Z	1	R
	-53	B8411-1	. FLANGE, MOUNTING.....	Q,R	1	R
	-54	B8917-1	. FLANGE, MOUNTING.....	S,W,X,AA	1	R
	-55	20777	. FLANGE, MOUNTING.....	T	1	R
	-56	20777-1	. FLANGE, MOUNTING.....	U,Y,AB	1	R
	-57	41-0782-1	. FLANGE, MOUNTING.....	V	1	R
			(ATTACHING PARTS)			
	58	MS35206-228	. SCREW, MACHINE.....	C-K,N S-AB	3	R
	-59	MS35206-261	. SCREW, MACHINE.....	Q,R	6	R
			---*---			
	60	A8918-1	. GASKET.....	S,U,X,Y	1	R
	61	D8916-1	. BAFFLE.....	G	1	R
	-62	D8916-2	. BAFFLE.....	H	1	R
	-63	D8916-4	. BAFFLE.....	J	1	R
	-64	D8916-5	. BAFFLE.....	M	1	R
	-65	33925-1	. BAFFLE.....	L	1	R
			(ATTACHING PARTS)			
	66	MS24693-2	. SCREW, MACHINE.....		2	R
	67	MS35337-40	. WASHER, LOCK.....		2	R
	68	MS20341-4S	. NUT, HEX.....		2	R
			---*---			
	69	32251-1	. MECHANISM ASSEMBLY..... (See IPL Fig. 2 for details)	A,E,K,Z	1	R
	-70	32251-2	. MECHANISM ASSEMBLY..... (See IPL Fig. 2 for details)	B,F,G,H, J,L,M,S, T,U,W,X, Y,AA,AB	1	R
	-71	32251-3	. MECHANISM ASSEMBLY..... (See IPL Fig. 2 for details)	C	1	R
	-72	32251-4	. MECHANISM ASSEMBLY..... (See IPL Fig. 2 for details)	D	1	R
	-73	32251-5	. MECHANISM ASSEMBLY..... (See IPL Fig. 2 for details)	P,Q	1	R
	-74	32251-6	. MECHANISM ASSEMBLY..... (See IPL Fig. 2 for details)	R	1	R
	-75	32251-9	. MECHANISM ASSEMBLY..... (See IPL Fig. 2 for details)	N,V	1	R

- Item Not Illustrated



Mechanism Assembly - Exploded View
IPL Figure 2

FIG.	ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY	
2	-1	32251-1	MECHANISM ASSEMBLY..... (See IPL Fig. 1 for NHA)	A,E,K,Z	RF	R
	-2	32251-2	MECHANISM ASSEMBLY..... (See IPL Fig. 1 for NHA)	B,F,G,H, J,L,M,S, T,U,W,X, Y,AA,AB	RF	R
	-3	32251-3	MECHANISM ASSEMBLY..... (See IPL Fig. 1 for NHA)	C	RF	R
	-4	32251-4	MECHANISM ASSEMBLY..... (See IPL Fig. 1 for NHA)	D	RF	R
	-5	32251-5	MECHANISM ASSEMBLY..... (See IPL Fig. 1 for NHA)	P,Q	RF	R
	-6	32251-6	MECHANISM ASSEMBLY..... (See IPL Fig. 1 for NHA)	R	RF	R
	-7	32251-9	MECHANISM ASSEMBLY..... (See IPL Fig. 1 for NHA)	N,V	RF	R
	-8	31710	. GEAR ASSEMBLY, LAMP..... (ATTACHING PARTS)		1	R
	9	22FT428	. NUT, LOCK (V56878) (GRIMES STOCK CODE SN447)		1	R
	10	A8401-1	. WASHER..... ---*---		3	R
	11	41-1653-1	. . CONTACT ASSEMBLY..... (ATTACHING PARTS)		1	R
	12	MS35206-218	. . SCREW, MACHINE.....		2	R
	13	MS35338-40	. . WASHER, LOCK.....		2	R
	14	MS35333-36	. . WASHER, LOCK.....		2	R
	15	MS35649-242	. . NUT, HEX..... ---*---		2	R
	16	11702	. . INSULATOR.....		1	R
	17	11704	. . INSULATOR.....		1	R
	18	11705	. . LAMPHOLDER AND FERRULE ASSEMBLY		1	R
	19	15541	. . LAMPHOLDER AND FERRULE ASSEMBLY (ATTACHING PARTS)		1	R
	20	55-0206-16	. . SCREW, MACHINE 4-40 x 7/16 IN LG, SL PAN HD STL		4	R
	21	MS35649-242	. . NUT, HEX.....		4	R
	22	MS35338-40	. . WASHER, LOCK.....		4	R
	23	MS27183-4	. . WASHER, FLAT..... ---*---		4	R
	24	11846-4	. . BUSHING.....		4	R
	25	11737-1	. . INSULATOR.....		4	R
	26	37642	. . BRACKET, MOUNTING.....		1	R
	27	15522-3	. . BRUSH, ELECTRICAL.....		1	R

- Item Not Illustrated

FIG.	ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY	
2	28	A9123-1	. . SPRING, BRUSH.....		1	R
	29	A9117-1	. . BRACKET.....		1	R
	30	A9122-1	. . PLATE.....		1	R
			(ATTACHING PARTS)			
	31	MS20450C8-4	. . RIVET.....		2	R
			---*---			
	32	11738	. . HUB.....		1	R
			(ATTACHING PARTS)			
	33	79-012-062-0312	. . PIN, ROLL (V72962) (GRIMES STOCK CODE PN130)		2	R
	34	PN430	. . PIN, GROOVE (V73957)..... 1/16 O.D. x 1/8 IN LG STL		1	R
			---*---			
	35	A8424-1	. . SPACER.....		1	R
	36	41-1629-1	. . SPACER.....		1	R
	37	11711	. . BEARING.....		2	R
	38	31731	. . GEAR.....		1	R
	39	A8418-2	. BRACKET, SUPPORT.....		1	R
			(ATTACHING PARTS)			
	40	MS35206-230	. SCREW, MACHINE.....		1	R
	41	MS21044N06	. NUT, SELF-LOCKING.....		1	R
			---*---			
	42	A7164	. TERMINAL, LUG.....		1	R
			(ATTACHING PARTS)			
	43	MS35206-217	. SCREW, MACHINE.....		1	R
	44	MS35333-36	. WASHER, LOCK.....		1	R
			---*---			
	45	A6531	. MOTOR, 12 VOLT (B1).....	A,C,E,K, Z	1	R
	-46	A6458	. MOTOR, 24 VOLT (B1).....	B,D,F,G, H,J,L-Y, AA,AB	1	R
			(ATTACHING PARTS)			
	47	MS35206-213	. SCREW, MACHINE.....		2	R
	48	MS35338-40	. WASHER, LOCK.....		2	R
			---*---			
	49	21067-12	. WORM.....		1	R
			(ATTACHING PARTS)			
	50	AN565D4H2	. SETSCREW.....		2	R
			---*---			
	51	14269	. FILTER, RADIO NOISE.....		1	R
			(ATTACHING PARTS)			
	52	MS35206-230	. SCREW, MACHINE.....		2	R
	53	MS35333-41	. WASHER, LOCK.....		2	R
	54	MS35649-262	. NUT, HEX.....		2	R
			---*---			

- Item Not Illustrated

FIG.	ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY	
2	55	A8413-2	. SPACER, NOISE FILTER.....		1	R
	56	A8559-1	. BLOCK, TERMINAL (TB1)..... (ATTACHING PARTS)	C,D,R		
	57	MS35206-231	. SCREW, MACHINE.....	C,D,R	1	R
	58	MS35333-37	. WASHER, LOCK.....	C,D,R	2	R
	59	NAS671-6	. NUT, HEX..... ---*---	C,D,R	1	R
	60	MS24693S2	. SCREW, MACHINE.....		4	R
	61	MS35338-40	. WASHER, LOCK.....		4	R
	62	MS35649-242	. NUT, HEX.....		4	R
	63	A8108A1	. PLATE, INSTRUCTION.....		1	R
	64	15542	. PLATE, IDENTIFICATION.....		1	R
	-65	22268-1	. BASE ASSEMBLY.....	A,B, E-N,S-AB	1	R
	-66	22268-2	. BASE ASSEMBLY.....	C,D	1	R
	-67	22268-3	. BASE ASSEMBLY.....	P,Q	1	R
	-68	22268-4	. BASE ASSEMBLY.....	R	1	R
	69	55-0295-1	. . CONTACT.....		1	R
	70	A8477-3	. . INSULATOR.....		1	R
	71	31879	. . TERMINAL (V00779) (GRIMES STOCK CODE TE086)	C,D,R	1	R
	72	A8404A4	. . WORM WHEEL AND HUB ASSEMBLY (ATTACHING PARTS)		1	R
	73	AN565D6H3	. . SETSCREW..... ---*---		2	R
	74	11678	. . BEARING RETAINER ASSEMBLY...	A-N,S-AB	1	R
	-75	11678-1	. . BEARING RETAINER ASSEMBLY... (ATTACHING PARTS)	P,Q,R	1	R
	76	MS35206-243	. . SCREW, MACHINE.....	A-N,S-AB	1	R
	-77	MS24693S25	. . SCREW, MACHINE.....	P,Q,R	1	R
	78	MS35338-38	. . WASHER, LOCK.....	A-N,S-AB	1	R
	-79	MS35333-37	. . WASHER, LOCK.....	P,Q,R	1	R
	80	MS20341-8S	. . NUT, HEX.....	A-N,S-AB	1	R
	-81	MS20341-6S	. . NUT, HEX.....	P,Q,R	1	R
	82	AN425A4-5	. . RIVET..... ---*---		2	R
	83	11373	. . SHAFT, PINION.....		1	R
	84	11369	. . BEARING.....		2	R
	85	A6147	. . WASHER.....		1	R
	86	21732	. . FLANGE AND SHAFT ASSEMBLY... (ATTACHING PARTS)		1	R
	87	AN425A4-5	. . RIVET..... ---*---		4	R

- Item Not Illustrated

FIG.	ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY	
2	88	T71D065-632A	. . INSERT (V71087) (GRIMES STOCK CODE NS090)		2	R
	89	A7609	. . SUPPORT..... (ATTACHING PARTS)		1	R
	90	H738	. . RIVET 0.125 DIA x 1/4 IN LG OVAL HD STL (V57771) (GRIMES STOCK CODE RV322)		5	R
			---*---			
	91	A7794-1	. . TUBE, DRAIN.....		2	R
	92	32267	. . PLATE.....		1	R
	93	68NC2-62	. . NUT, CLINCH (V72962)..... (GRIMES STOCK CODE SN196)	A-N,S-AB	3	R
	-94	68NC2-02	. . NUT, CLINCH (V72962)..... (GRIMES STOCK CODE SN372)	P,Q,R	6	R
	95	22266	. . BASE.....	A-N,S-AB	1	R
	-96	22269	. . BASE.....	P,Q,R	1	R

- Item Not Illustrated

REFERENCE DESIGNATOR INDEX

Designator	Part No.	IPL Fig.	Item
B1	A6531	2	45
B1	A6458	2	46
DS1,DS2	A7079B12	1	32
DS1,DS2	A7079B24	1	33
P1	41-0441-1	1	44
P1	41-0806-1	1	45
TB1	A8559-1	2	56

NUMERICAL INDEX

Part Number	Airline Part No.	IPL Fig.	IPL Item	TTL Req
A3934		1	28	1
A4253-1		1	27	1
A6147		2	85	1
A6458		2	46	1
A6531		2	45	1
A7079B12		1	32	2
A7079B24		1	33	2
A7164		2	42	1
A7609		2	89	1
A7632		1	31	1
A7633-10		1	23D	1
A7635A		1	22	1
A7641		1	41	1
A7641-5		1	37	2
A7641-7		1	50	1
A7794-1		2	91	2
A7941		1	24	1
A7942		1	23	1
A7942-1		1	23A	1
A7942-2		1	23B	1
A8107-1		1	35	1
A8108A1		2	63	1
A8401-1		2	10	3
A8404A4		2	72	1
A8413-2		2	55	1
A8418-2		2	39	1
A8424-1		2	35	1
A8477-3		2	70	1
A8559-1		2	56	1
A8918-1		1	60	1
A8966-1		1	29	1
A8966-2		1	29A	1
A9117-1		2	29	1
A9122-1		2	30	1
A9123-1		2	28	1
AN425A4-5		2	82	6
		2	87	
AN565D4H2		2	50	2
AN565D6H3		2	73	2
B7633-10		1	30	1
B7633-11		1	30A	1
B7633-12		1	30B	1
B7633-18		1	30C	1
B7639-4		1	34	2
		1	40	
B7640-1		1	52	1
B8411-1		1	53	1
B8917-1		1	54	1
D8916-1		1	61	1
D8916-2		1	62	1
D8916-4		1	63	1
D8916-5		1	64	1
G8400A3-12		1	3	1
G8400A3-24		1	4	1
G8400A8-12		1	5	1
G8400A8-24		1	6	1
G8400A9-24		1	7	1
G8400A10-24		1	8	1
G8400A11-24		1	9	1
G8400A12		1	1	1
G8400A12-12		1	10	1
G8400A13-24		1	11	1
G8400A14-24		1	12	1
G8400A15-24		1	13	1
G8400A21-24		1	14	1
G8400A22-24		1	15	1
G8400A23-24		1	16	1
G8400A24		1	2	1
G8400A24-24		1	17	1
G8400A31-24		1	18	1
G8400A36-24		1	19	1
G8400A37-24		1	20	1
G8400A39-24		1	20A	1
G8400A41-24		1	20B	1
G8400A43-24		1	20C	1
G8400A45-12		1	20D	1
G8400A47-24		1	20E	1
G8400A49-24		1	20F	1
H738		2	90	5
MS20341-4S		1	68	2
MS20341-6S		2	81	1
MS20341-8S		2	80	1
MS20450C8-4		2	31	2
MS21042-04		1	49	2
MS21044N06		2	41	1
MS24693-2		1	66	2

NUMERICAL INDEX (Continued)

Part Number	Airline Part No.	IPL Fig.	Item	TTL Req
MS24693S2		2	60	4
MS24693S25		2	77	1
MS24693S31		1	47	2
MS25036-103		1	51	2
MS27183-4		2	23	4
MS35206-213		2	47	2
MS35206-217		2	43	1
MS35206-218		2	12	2
MS35206-225		1	25A	5
		1	42	
		1	50B	
MS35206-226		1	25	1
MS35206-227		1	36	3
MS35206-228		1	58	3
MS35206-230		2	40	3
		2	52	
MS35206-231		2	57	1
MS35206-243		2	76	1
MS35206-261		1	59	6
MS35265-40		1	46	4
MS35333-36		2	14	3
		2	44	
MS35333-37		1	26A	4
		2	58	
		2	79	
MS35333-38		2	78	1
MS35333-41		2	53	2
MS35337-40		1	67	2
MS35338-40		2	13	12
		2	22	
		2	48	
		2	61	
MS35338-41		1	26	5
		1	43	
		1	50A	
MS35338-42		1	48	4
MS35489-4		1	39	2
MS35649-242		2	15	10
		2	21	
		2	62	
MS35649-262		2	54	2
NAS671-6		2	59	1
PN430		2	34	1
R4012		1	38	4

Part Number	Airline Part No.	IPL Fig.	Item	TTL Req
T71D065-632A		2	88	2
11369		2	84	2
11373		2	83	1
11678		2	74	1
11678-1		2	75	1
11702		2	16	1
11704		2	17	1
11705		2	18	1
11711		2	37	2
11737-1		2	25	4
11738		2	32	1
11846-4		2	24	4
14269		2	51	1
15522-3		2	27	1
15541		2	19	1
15542		2	64	1
20777		1	55	1
20777-1		1	56	1
21067-12		2	49	1
21732		2	86	1
21760-4		1	23C	1
22FT428		2	9	1
22266		2	95	1
22268-1		2	65	1
22268-2		2	66	1
22268-3		2	67	1
22268-4		2	68	1
22269		2	96	1
31710		2	8	1
31731		2	38	1
31879		2	71	1
32251-1		1	69	1
		2	1	RF
32251-2		1	70	1
		2	2	RF
32251-3		1	71	1
		2	3	RF
32251-4		1	72	1
		2	4	RF
32251-5		1	73	1
		2	5	RF
32251-6		1	74	1
		2	6	RF

NUMERICAL INDEX (Continued)

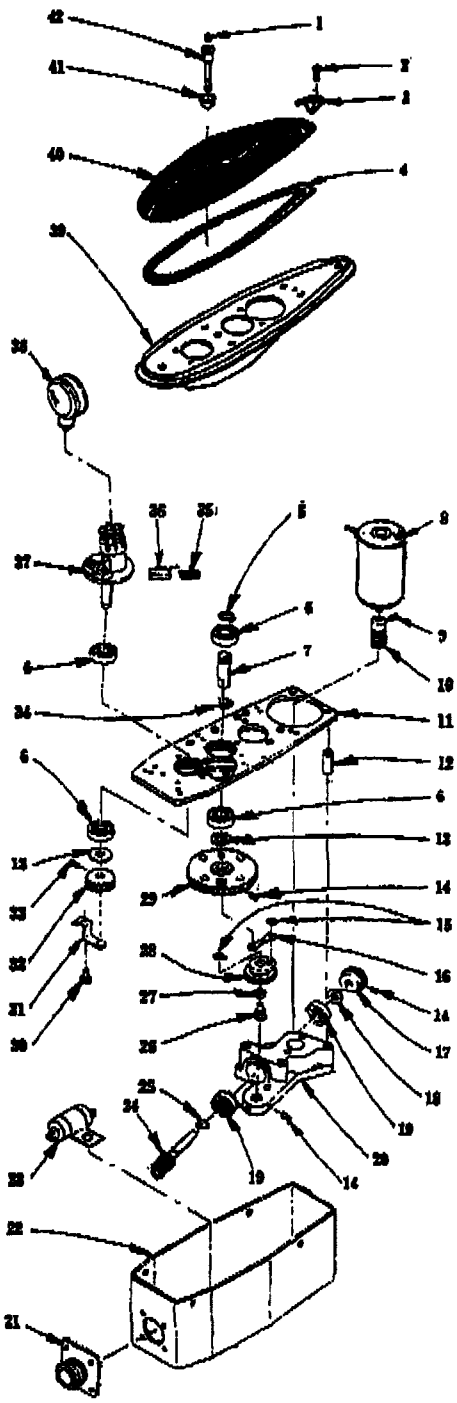
Part Number	Airline Part No.	IPL Fig.	IPL Item	TTL Req
32251-9		1	79	1
		2	7	RF
32267		2	92	1
33925-1		1	65	1
37642		2	26	1
41-0441-1		1	44	1
41-0782-1		1	57	1
41-0806-1		1	45	1
41-1629-1		2	36	1
41-1653-1		2	11	1
55-0206-16		2	20	4
55-0295-1		2	69	1
68NC2-02		2	94	6
68NC2-62		2	93	3
79-012-062-0312		2	33	2

GRIMES
MANUFACTURING COMPANY
URBANA, OHIO 43078 • (513) 652-1431

PARTS BREAKDOWN

MODEL NO. 41905

41905 TANDEM OSCILLATING LIGHT



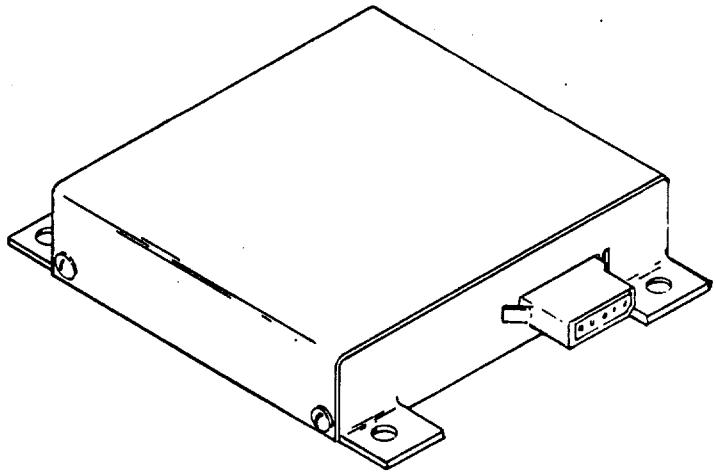
INDEX NO.	ORDER GRIMES P/N	DESCRIPTION
1	AN565D6H4	SET SCREW No.6-32 x ¼" LG KN CUP PT. ALLEN TYPE
2	MS24693C273	SCREW No. 10-32 x 5/8 LG 100° FLAT HD.
3	12531-1	CLIP - LENS RETAINER
4	41-0001	GASKET
5	MS16624-1025	RETAINING RING
6	11711	BEARING
7	10538	SHAFT
8	A-6466	MOTOR 28 VDC (USE ON -1, -4 & -7)
8a	A-6113-1	MOTOR 28 VDC, 400 Hz (USE ON -2)
9	88-062	SET SCREW No. 4-40 x 3/32 LG KN CUP PT.
10	21067-12	WORM (USE ON -1, -4 & -7)
10a	22262-11	WORM (USE ON -2)
11	20530	SUPPORT PLATE ASSEMBLY
12	41-0084	SPACER
13	A-6401-1	WASHER
14	AN565D6H2	SET SCREW No. 6-32 x 1/8 LG KN CUP PT. ALLEN TYPE
15	RR-050	GRIP RING (WALDES No. 5100-12-MD)
16	10543	LINK ARM ASSEMBLY
17	A-6404A-3	WORM WHEEL
18	A-6147	WASHER
19	11389	BEARING
20	30543A-1	SUPPORT
21	MS3102R-10SL-3P	CONNECTOR (USE ON -1, -2 & -4 ONLY)
22	22247-7	COVER
23	12241-2	WIRING COMPONENT SUB-ASSEMBLY (USE ON -1, -4 & -7)
23a	12241-1	WIRING COMPONENT SUB-ASSEMBLY (USE ON -2)
24	12246	WORM GEAR & SHAFT ASSEMBLY
25	RR-050	RETAINING RING (WALDES No. 5100-18-M
26	10513	SHAFT
27	10647	BEARING
28	41-0261-1	CAM & WORM WHEEL ASSEMBLY
29	10539A-2	DRIVE WHEEL ASSEMBLY
30	MS35206-212	SCREW No. 4-40 x 3/16 LG PHIL HD
31	10518-3	CONTACT
32	10527	GEAR
33	AN565D6H3	SET SCREW No. 6-32 x 3/16 LG KN CUP PT ALLEN TYPE
34	MS16625-1052	RETAINING RING
35	A-6123-1	SPRING
36	15522-1	BRUSH - CONTACT
37	20530	LAMPHOLDER ASSEMBLY
38	A-7079E-24	LAMP (24 VOLT)
39	32466	MOUNTING PLATE & COVER ASSEMBLY (INCLUDES ITEM No. 4)
40	D-9961-3	LENS ASSEMBLY (RED)
40a	D-9961-12	LENS ASSEMBLY (CLEAR)
41	13737	WASHER
42	13731-3	SCREW

GRIMES

MAINTENANCE DOCUMENT
WITH
ILLUSTRATED PARTS LIST

STROBE LIGHT FLASHER

PART NUMBER
70-0075-1



GRIMES MANUFACTURING COMPANY

515 NORTH RUSSELL STREET, URBANA, OHIO 43078, U.S.A. TELEPHONE: (513) 652-1431 TELETYPE: (810) 457-2852 TELEX: 205-439

LIGHTING EQUIPMENT FOR THE TRANSPORTATION INDUSTRY

MD70-1

Jul 1/73

GRIMES MANUFACTURING COMPANY
MAINTENANCE DOCUMENT WITH
ILLUSTRATED PARTS LIST
PART NO. 70-0075

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GRIMES MANUFACTURING COMPANY
MAINTENANCE DOCUMENT WITH
ILLUSTRATED PARTS LIST
PART NO. 70-0075

RECORD OF REVISIONS

REV. NO.	ISSUE DATE	DATE INSERTED	BY	REV. NO.	ISSUE DATE	DATE INSERTED	BY	REV. NO.	ISSUE DATE	DATE INSERTED	BY
1	7/1/73	7/1/73	GMC								

GRIMES MANUFACTURING COMPANY
MAINTENANCE DOCUMENT WITH
ILLUSTRATED PARTS LIST
PART NO. 70-0075

LIST OF EFFECTIVE PAGES

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	10	Jul 1/73
	11	Jul 1/73
	12	Jul 1/73

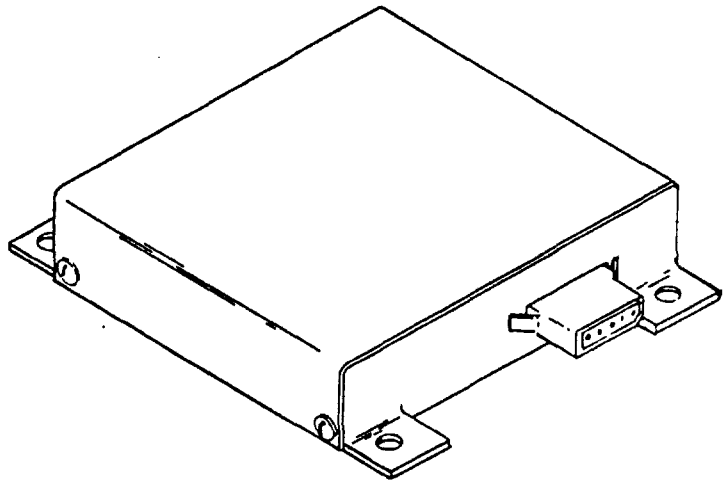
GRIMES MANUFACTURING COMPANY
MAINTENANCE DOCUMENT WITH
ILLUSTRATED PARTS LIST
PART NO. 70-0075

DESCRIPTION AND OPERATION

1. Description

A. Strobe Light Flasher Assembly, part number 70-0075-1, provides control voltage to strobe flashtube power supplies (Ref. Fig. 1).

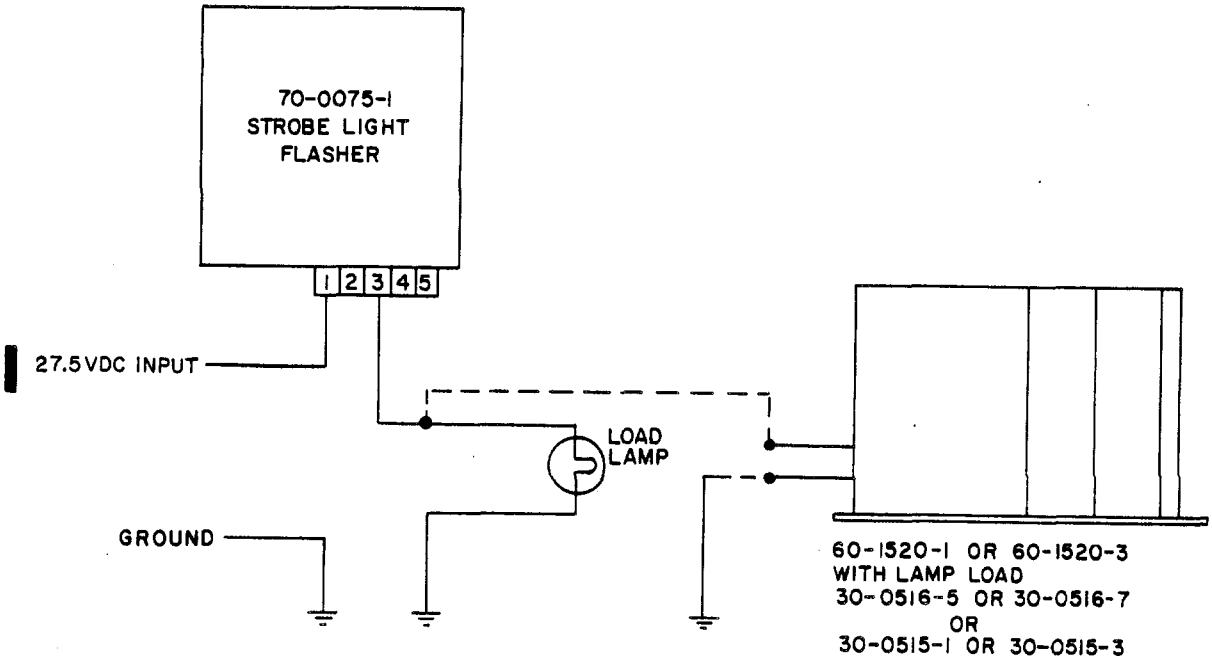
B. The Strobe Light Flasher Assembly provides three each outputs of 27.5 VDC for a period of 900 milliseconds with a resting period of 100 milliseconds at zero voltage, resulting in a flashrate of 60 ±10% flashes per minute.



Strobe Light Flasher Assembly
Figure 1

2. Operation

A. With a 1.0 to 2.0 AMP, 28 VDC incandescent lamp connected to any of the three outputs of the Strobe Light Flasher Assembly and 28 VDC applied to the test set-up shown in Figure 2, the incandescent lamp shall come on for a period of 900 milliseconds and then turn off for a period of 100 milliseconds. An oscilloscope can be used to measure the "on" "off". If either a 60-1520-1 or 60-1520-3 power supply with a 30-0516-5 or -7 light assembly connected, or a 30-0515-1 flashtube position light assembly is used in place of the incandescent lamp the strobe lights will flash each time the input power to the assemblies is interrupted by the Strobe Light Flasher Assembly.



Test Set-Up
Figure 2

B. The zener diode VR1 (Ref. Fig. 4) regulates the 27.5 VDC input power to 15 volts for use by the pulse generator and pulse shaper circuits. Resistor R3 is used as a dropping resistor between the input voltage and the 15 volts zener diode VR1. Capacitor C1 is used to filter the output.

C. The pulse generator develops a pulse with the proper timing to feed the remaining circuits. Resistor R4, transistor Q1, resistors R1 and R5 and capacitor C2 make up a free running unijunction multi-vibrator. The over all period is determined by adjusting resistor R1. Resistors R2 and R6 determine the time that the output of the pulse generator is below the threshold of the input to the pulse shaper. The "off time" is determined by the adjustment of resistor R2. The adjustment of the over all output is dependant on both resistor R1 "on time" and resistor R2 "off time" being set correctly. There is some interreaction between the two controls. After setting both controls it may be necessary to re-adjust one or the other, or both controls to obtain 900 milliseconds "on time" to 100 milliseconds "off time" ratio.

D. The pulse shaper detects the pulse from the generator and creates a well defined pulse that can be used by the pulse amplifier. Transistor Q2 acts as a threshold detector. Transistor Q2 turns off when the input is less than 0.6 volts. This off period represents the output of the flasher. Resistors R7, R8 and R9 and transistor Q3 act as an amplifier to produce a wave shape which is identical to the required output but having a maximum swing of only 14 volts.

E. The pulse amplifier amplifies this pulse from the pulse shaper to produce the 27.5 volt output of 900 milliseconds "on time" and 100 milliseconds "off time". Diode CR1 supplies gate drive to silicon controlled rectifier SCR1 turning SCR1 on when the output of the pulse shaper is high. Rectifier SCR1 will remain on as long as the current through the device remains above the holding current. When the output of the pulse shaper goes to zero volts, capacitor C3 turns transistor Q7 on momentarily diverting the load current of SCR1 through transistor Q4. The current through SCR1 drops to zero and since transistor Q3 is on and there is no gate drive available for SCR1, SCR1 turns off. Transistor Q4 is only on momentarily while current is supplied by the base of Q4 to charge capacitor C3. Resistor R10 is used to discharge C3 when the off period is completed. SCR1 remains off as long as the output of the pulse shaper is zero. This represents the "off time" on the output. The cycle repeats from point on.

F. The radio frequency interference filter (RF1 filter) is designed to reduce the RF1 generated by the pulse amplifier turning on and off. Chokes L3, L7, capacitors C6 and C7 make up the input filter and chokes L1 and L2 and capacitors C5 and C4 make up the output filter.

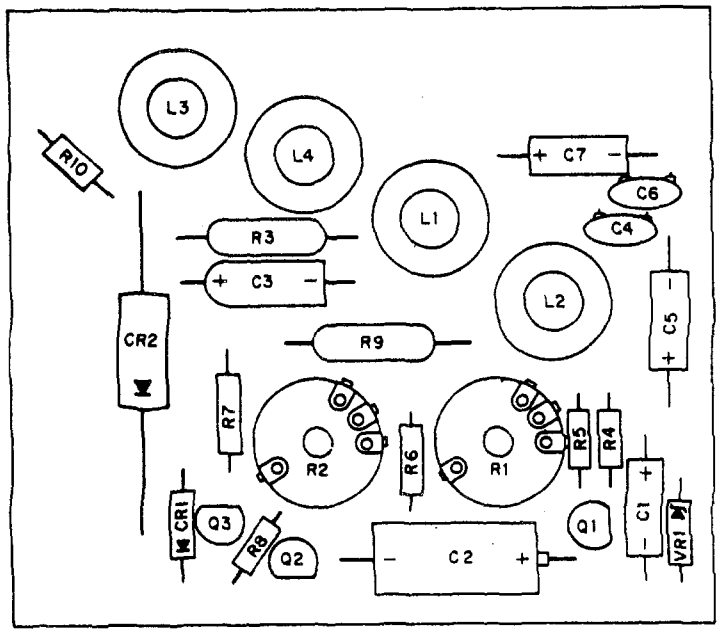
3. Leading Particulars

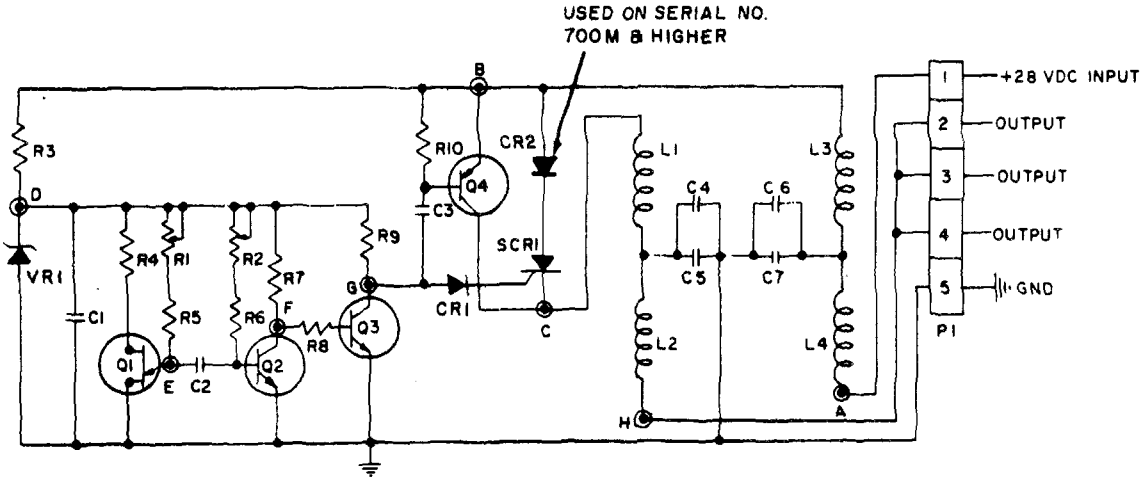
For leading particulars, refer to Figure 3.

Electrical requirements:	
Input voltage	27.5 ±0.25 VDC
Output voltage	27.5 VDC
Cycle Time (Milliseconds):	
On	900
Off	100
Dimensions (inches):	
Length	4.062
Width	3.453
Height	0.781
Weight (pounds):	0.50

Leading Particulars
Figure 3

	ALL WAVESHAPES NON-INVERTED		
TEST POINT	NOMINAL READING 28 VDC INPUT	ABNORMAL READING, CHECK:	SCOPE SETTING
A	26 V / 0 VDC	INPUT VOLTAGE CONNECTIONS L4,L3,Q4,C6,C7, R3, R10	.2 SEC 10 V/CM
B	26 V / 0 VDC	Q4, R10, C3, CR1, R3	.2 SEC 10 V/CM
C	26 V / 0VDC	SCR1, Q4, L1, L2, C4, C5, CR1	.2 SEC 10 V/CM
D	14 V / 0VDC	VR1, C1, R3, R9, CR1, Q3	.2 SEC 10V/CM
E	10V / 0VDC	Q1, C1, C2, VR1, R1, R4 R5, R9, CR1, Q2	.2 SEC 10 V/CM
F	6 V / 0VDC	Q2, C2, R2, R6, R7, R8, Q1, VR1, C1	.2 SEC 10 V/CM
G	14 V / 0VDC	Q3, CR1, C3, C1, Q1, Q2 SCR1, R9, R2, R7, R6, R8	.2 SEC 10 V/CM
H	26 V / 0VDC	SCR1, Q4, L1, L2, C4, C5, CR1	.2 SEC 10 V/CM



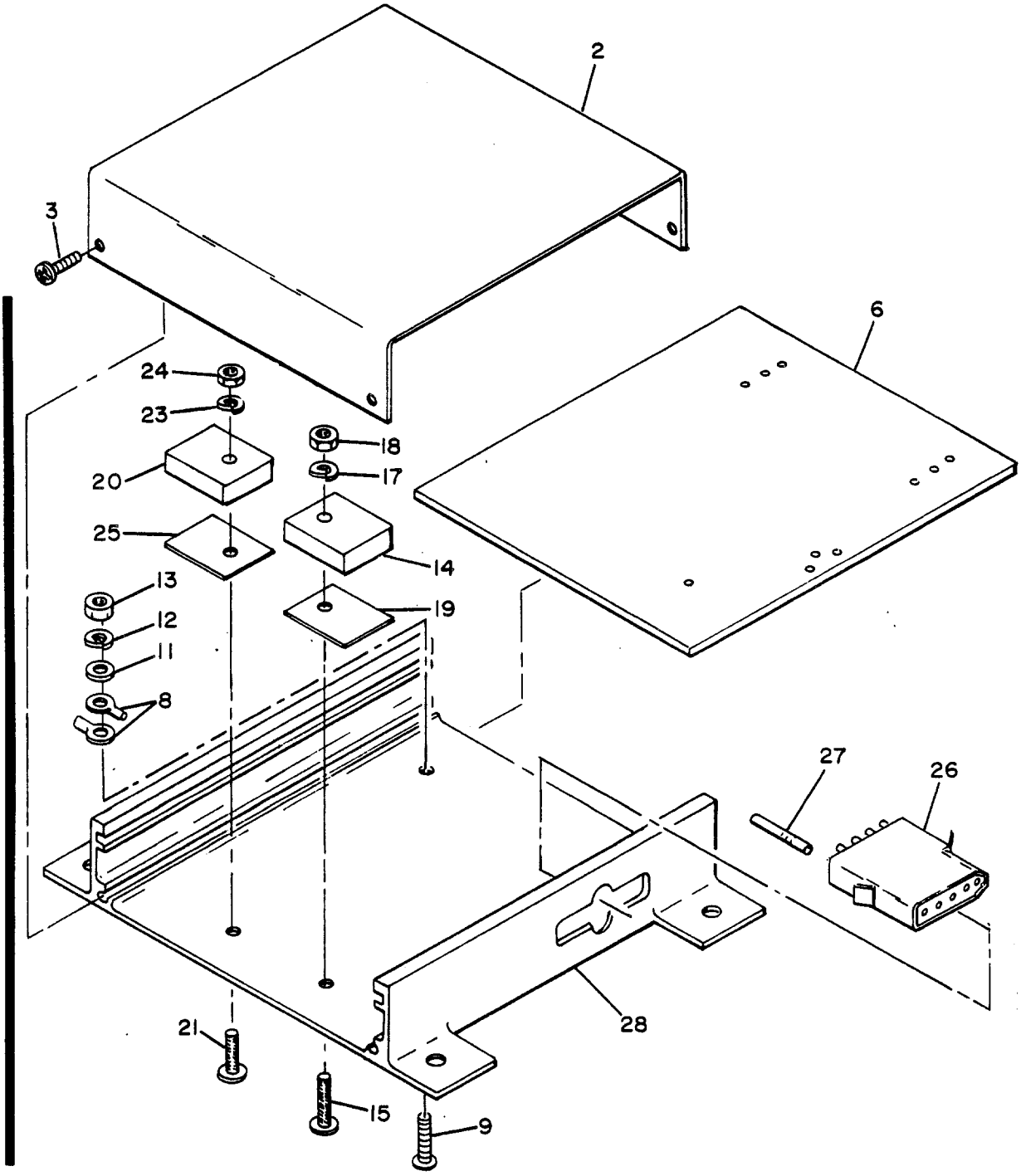


Trouble Shooting Chart
Figure 4

ILLUSTRATED PARTS LIST

The following is a compilation of the vendor codes with the names and addresses of suppliers for purchased parts used in this illustrated parts list.

CODE	NAME AND ADDRESS
00779	AMP, Inc. P. O. Box 3608 Harrisburg, Pa. 17105
01121	Allen-Bradley Company 1201 South 2nd Street Milwaukee, Wis. 53204
01295	Texas Instruments, Inc. Semiconductor Components Div. 13500 North Central Expressway Dallas, Texas 75231
03508	General Electric Company Semiconductor Products Dept. Electronics Park, N. Y. 13201
04713	Motorola Semiconductor Products, Inc. 5005 East McDowell Road Phoenix, Ariz. 85008
05397	Union Carbide Corp. Material Systems Division 11901 Madison Avenue Cleveland, Ohio 44101
56289	Sprague Electric Company North Adams, Mass. 01247
81483	Internal Rectifier Corp. 9220 Sunset Blvd. Los Angeles, Calif. 90069
83761	Molded Rubber and Plastic Corp. 13161 West Glendale Ave. Butler, Wis. 53007
91637	Dale Electronics, Inc. P. O. Box 609 Columbus, Nebr. 68601
99942	Globe Union, Inc. Centralab Semiconductor Div. 4501 North Arden Drive El Monte, Calif. 91734



Strobe Light Flasher Assembly - Exploded View
Figure 5

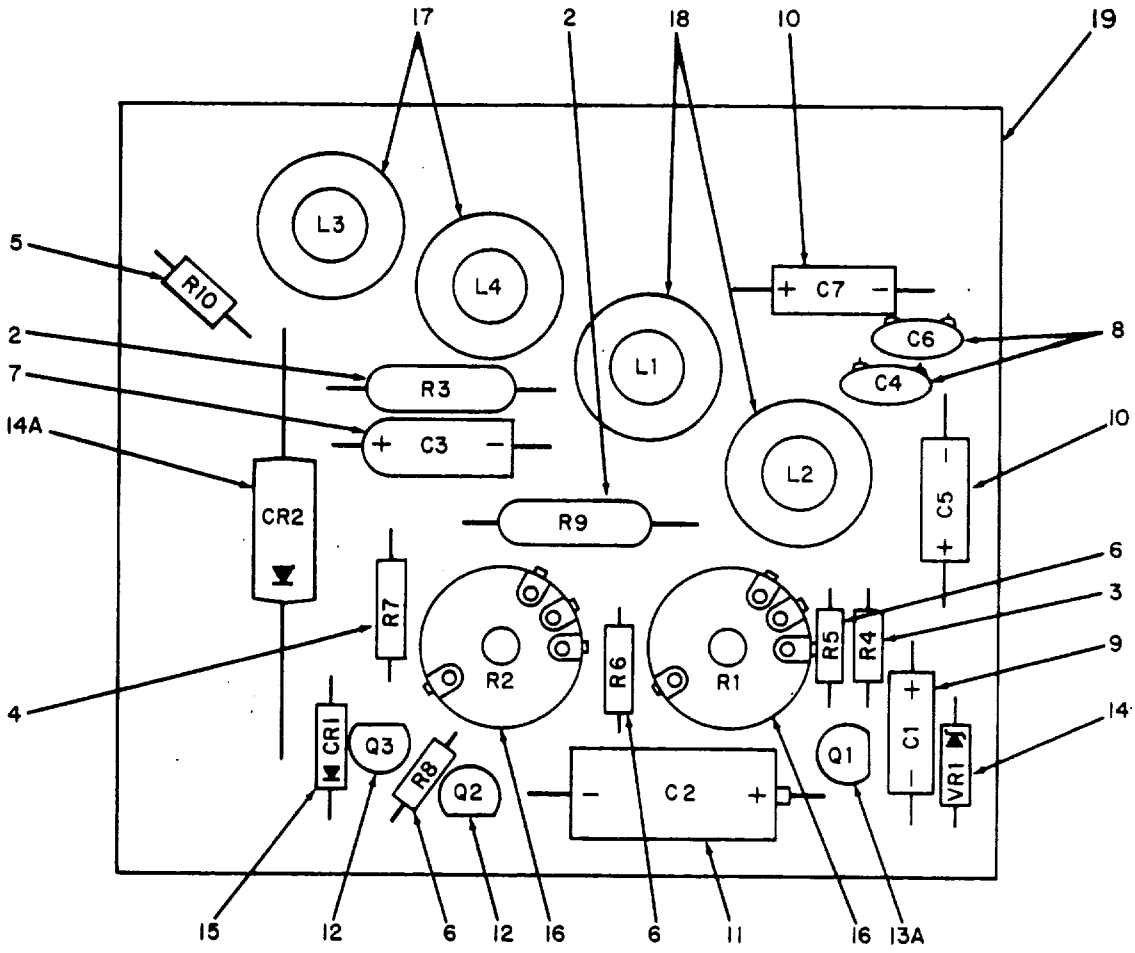
GRIMES MANUFACTURING COMPANY
MAINTENANCE DOCUMENT WITH
ILLUSTRATED PARTS LIST
PART NO. 70-0075

FIG.	ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY	
5	-1	70-0075-1	FLASHER ASSEMBLY, STROBE LIGHT		RF	
	2	71-0188-1	. COVER.....		1	
			(ATTACHING PARTS)			
	3	MS24629-10	. SCREW, MACHINE.....		4	
			---*---			
	-4	71-0196-1	. FLASHER SUBASSEMBLY.....		1	
			(SERIAL NO. EFFECTIVITY #1 THRU #699)			
	-5	71-0329-1	. FLASHER SUBASSEMBLY.....		1	R
			(SERIAL NO. EFFECTIVITY #700M & HIGHER)			
	6	71-0195-1	. . PRINTED CIRCUIT BOARD ASSEMBLY		1	
			(SERIAL NO. EFFECTIVITY #1 THRU #699)			
			(SEE FIG. 6 FOR DETAILS)			
	-7	71-0328-1	. . PRINTED CIRCUIT BOARD ASSEMBLY		1	R
			(SERIAL NO. EFFECTIVITY #700M & HIGHER)			
			(SEE FIG. 6 FOR DETAILS)			
	8	31882	. . TERMINAL (V00779) (GRIMES STOCK CODE TE089)		2	
			(ATTACHING PARTS)			
	9	55-0209-4-6	. . SCREW, MACHINE 4-40 x 3/8 IN. LG 100° FL HD STL		1	R
			(SERIAL NO. EFFECTIVITY #1 THRU #699)			
	-10	55-0209-4-5	. . SCREW, MACHINE 4-40 x 5/16 IN. LG 100° FL HD STL		1	R
			(SERIAL NO. EFFECTIVITY #700M & HIGHER)			
	11	MS27183-4	. . WASHER, FLAT.....		1	
	12	MS35338-40	. . WASHER, LOCK.....		1	
	13	MS20341-4S	. . NUT, HEX.....		1	R
			---*---			
	14	MJE2955	. . TRANSISTOR (Q4) (V04713).....		1	
			(GRIMES STOCK CODE TR212)			
			(ATTACHING PARTS)			
	15	MS24693S5	. . SCREW, MACHINE.....		1	R
			(SERIAL NO. EFFECTIVITY #1 THRU #699)			
	-16	MS24693S4	. . SCREW, MACHINE.....		1	
			(SERIAL NO. EFFECTIVITY #700M & HIGHER)			
	17	MS35338-40	. . WASHER, LOCK.....		1	
	18	MS20341-4S	. . NUT, HEX.....		1	
			---*---			

- Item Not Illustrated

FIG.	ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY	
5	19	60-1521-5	. . INSULATOR..... (SERIAL NO. EFFECTIVITY #1 THRU #699)		1	
	20	2N4442	. . RECTIFIER, SILICON CONTROLLED (SCR1) (GRIMES STOCK CODE RC850) (ATTACHING PARTS)		1	
	21	MS24693S5	. . SCREW, MACHINE..... (SERIAL NO. EFFECTIVITY #1 THRU #699)		1	R
	-22	MS24693S4	. . SCREW, MACHINE..... (SERIAL NO. EFFECTIVITY #700M & HIGHER)		1	
	23	MS35338-40	. . WASHER, LOCK.....		1	
	24	MS20341-4S	. . NUT, HEX..... ---*---		1	
	25	60-1521-5	. . INSULATOR..... (SERIAL NO. EFFECTIVITY #1 THRU #699)		1	
	26	1625-5R	. . RECEPTACLE (P1) (V83761)..... (GRIMES STOCK CODE C06472)		1	
	27	1561	. . SOCKET, TERMINAL (V83761)..... (GRIMES STOCK CODE C0822)		5	
	28	71-0192-1	. . HOUSING..... (SERIAL NO. EFFECTIVITY #1 THRU #699)		1	
	-29	71-0326-1	. . HOUSING..... (SERIAL NO. EFFECTIVITY #700M & HIGHER)		1	R

- Item Not Illustrated



Printed Circuit Board Assembly - Pictorial View
Figure 6

FIG.	ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY	
6	-1	71-0195-1	PRINTED CIRCUIT BOARD ASSEMBLY (SERIAL NO. EFFECTIVITY #1 THRU #699) (SEE FIG. 5 for NHA)		RF	R
	-1A	71-0328-1	PRINTED CIRCUIT BOARD ASSEMBLY (SERIAL NO. EFFECTIVITY #700M & HIGHER) (SEE FIG. 5 for NHA)		RF	R
	2	RS2B270.3-5PCT	. RESISTOR, FIXED, WIRE WOUND 270 OHM, 3 W, 5% (R3,R9) (V91637) (GRIMES 55-0225-27005F)		2	R
	3	CB4715	. RESISTOR, FIXED, CARBON COMP. 470 OHM, ¼ W, 5% (R4) (V01121) (GRIMES 55-0155-4715C)		1	
	4	CB2221	. RESISTOR, FIXED, CARBON COMP. 2.2K OHM, ¼ W, 10% (R7) (V01121) (GRIMES 55-0155-2221C)		1	
	5	CB1031	. RESISTOR, FIXED, CARBON COMP. 10K OHM, ¼ W, 10% (R10) (V01121) (GRIMES 55-0155-1031C)		1	
	6	CB1021	. RESISTOR, FIXED, CARBON COMP. 1K OHM, ¼ W, 10%, (R5,R6,R8) (V01121) (GRIMES 55-0155-1021C)		3	
	7	K2R2C50K	. CAPACITOR, 2.2 mfd, 50 V (C3) (V05397) (GRIMES STOCK CODE CA440)		1	R
	8	DDM103	. CAPACITOR, 0.01 mfd, 150 V (C4,C6) (V99942) (GRIMES STOCK CODE CA212)		2	
	9	150D685X0035B2	. CAPACITOR, 6.8 mfd, 35 V (C1) (V56289) (GRIMES STOCK CODE CA495)		1	
	10	150D475X9050B2	. CAPACITOR, 4.7 mfd, 50 V (C5, C7) (V56289) (GRIMES STOCK CODE CA460)		2	
	11	150D476X0035S2	. CAPACITOR, 47 mfd, 35 V (C2) (V56289) (GRIMES STOCK CODE CA660)		1	
	12	2N3704	. TRANSISTOR (Q2,Q3) (V01295) (GRIMES STOCK CODE TR185)		2	

- Item Not Illustrated

FIG.	ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY	
6	13	2N2647	. TRANSISTOR (Q1) (VO3508) (GRIMES STOCK CODE TR205) (SERIAL NO. EFFECTIVITY #1 THRU #699)		1	
	-13A	2N4893	. TRANSISTOR, UNIJUNCTION (Q1) (VO1295) (GRIMES STOCK CODE TR202) (SERIAL NO. EFFECTIVITY #700 & HIGHER)		1	R
	14	1N4744	. DIODE, ZENER 15vz 1W ±10% (VR1) (VO4713) (GRIMES STOCK CODE RC648)		1	R
	-14A	21PT10	. RECTIFIER (CR2) (V81483) (GRIMES STOCK CODE RC138) (SERIAL NO. EFFECTIVITY #700M & HIGHER)		1	R
	15	1N4004	. DIODE, 400 PIV, 1 AMP (CR1) (VO4713) (GRIMES STOCK CODE RC366)		1	
	16	BA001-654-25K	. POTENTIOMETER, 25K OHM, (R1,R2) (V99942) (GRIMES STOCK CODE RH215)		2	
	17	55-0314-3	. CHOKE (L3,L4).....		2	
	18	55-0314-1	. CHOKE (L1,L2).....		2	
	19	71-0194-1	. BOARD, PRINTED CIRCUIT..... (SERIAL NO. EFFECTIVITY #1 THRU #699)		1	R
	-20	71-0327-1	. BOARD, PRINTED CIRCUIT..... (SERIAL NO. EFFECTIVITY #700M & HIGHER)		1	R

- Item Not Illustrated

GRIMES MANUFACTURING COMPANY
MAINTENANCE DOCUMENT WITH
ILLUSTRATED PARTS LIST
PART NO. 70-0075

REFERENCE DESIGNATOR INDEX

Serial No. Effectivity #1 thru #699

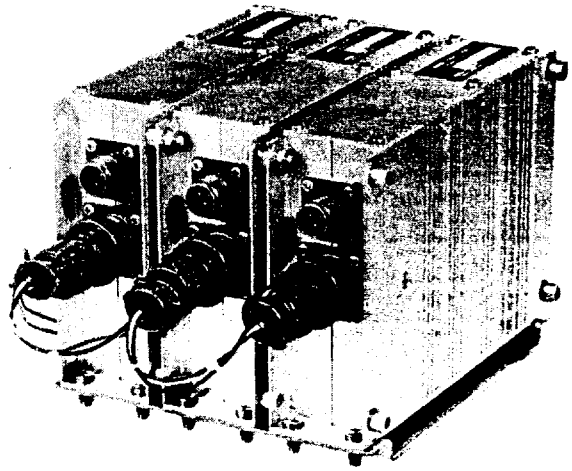
Designator	Part No.	Fig.	Item
C1	150D685X0035B2	5	9
C2	150D476X0035S2	5	11
C3	K2R2C50K	5	7
C4,C6	DDM103	5	8
C5,C7	150D475X9050B2	5	10
CR1	1N4004	5	15
L1,L2	55-0314-1	5	18
L3,L4	55-0314-3	5	17
P1	1625-5R	4	26
R1,R2	BA001-654-25K	5	16
R3,R9	RS2B270.3-5PCT	5	2
R4	CB4715	5	3
R5,R6,R8	CB1021	5	6
R7	CB2221	5	4
R10	CB1031	5	5
Q1	2N2647	5	13
Q2,Q3	2N3704	5	12
Q4	MJE2955	4	14
SCR1	2N4442	4	20
VR1	1N4744	5	14

Serial No. Effectivity #700M & Higher

Designator	Part No.	Fig.	Item
C1	150D685X0035B2	5	9
C2	150D476X0035S2	5	11
C3	K2R2C50K	5	7
C4,C6	DDM103	5	8
C5,C7	150D475X9050B2	5	10
CR1	1N4004	5	15
CR2	21PT10	5	14A
L1,L2	55-0314-1	5	18
L3,L4	55-0314-3	5	17
P1	1625-5R	4	26
R1,R2	BA001-654-25K	5	16
R3,R9	RS2B270.3-5PCT	5	2
R4	CB4715	5	3
R5,R6,R8	CB1021	5	6
R7	CB2221	5	4
R10	CB1031	5	5
Q1	2N4893	5	13A
Q2,Q3	2N3704	5	12
Q4	MJE2955	4	14
SCR1	2N4442	4	20
VR1	1N4744	5	14

GRIMES

STROBE REPAIR MANUAL
PART NO. 60-1755



GENERAL NOTES:

1. CAUTIONS:
   A HIGH VOLTAGE SHOCK HAZARD IS PRESENT ACROSS TERMINALS OF C11 & C12 & PINS A & C OF OUTPUT CONNECTOR (TEST POINTS R & G)
   EXTREME CAUTION SHOULD BE USED WHILE WORKING ON UNIT WITH VOLTAGE APPLIED TO INPUT LEADS. WAIT AT LEAST 15 MINUTES AFTER UNIT IS TURNED OFF BEFORE PERFORMING WORK WITHIN THIS UNIT AND DISCHARGE CAPACITORS C_{11} & C_{12} -
   BEFORE MAKING ANY RESISTANCE OR CONTINUITY CHECKS - DISCHARGE C_{11} & C_{12} - WHEN MEASURING UNKNOWN CIRCUIT VOLTAGES, SET METER & SCOPE FUNCTIONS ON HIGH RANGE---(1KV). INSURE THAT UNIT IS PROPERLY GROUNDED WHILE TROUBLE-SHOOTING UNIT.

2. LAMPCHECK WITHOUT THE REMOVAL OF POWER SUPPLIES FROM AIRCRAFT CAN BE MADE BY INTERCHANGING CABLE PLUGS AT POWER SUPPLY RECEPTACLES. (POWER SUPPLY MUST BE TURNED 'OFF' BEFORE INTERCHANGING PLUGS) -
   IF INTERCHANGE FAILS TO INDICATE LAMP FAILURE, CHECK FOR CONTINUITY & CORRECT WIRING OF CABLES, RECEPTACLE & PLUG PINS & PROPER VOLTAGES ON RECEPTACLE PINS.
   (TEST POINTS: R & G)

3. OSCILLOSCOPE ONLY CAN BE USED TO CHECK NORMAL VOLTAGE READING AS SHOWN - (METER RESPONSES INADEQUATE).

4. DIODE CR4 SHOULD BE CHECKED WITH LAMP DISCONNECTED FOR ACCURATE INDICATION.

5. R12 IS FLASHRATE ADJUST RESISTOR AND IS PRESET TO FAA FLASHRATE REQUIREMENTS. DO NOT ATTEMPT TO CHANGE R12 SETTING UNLESS NATURE OF FAILURE WARRANTS ALIGNMENT.

6. ALL WIRING IN THIS UNIT NO. 20 GUAGE TEFLON INSULATED, MIL-W-16878/E -

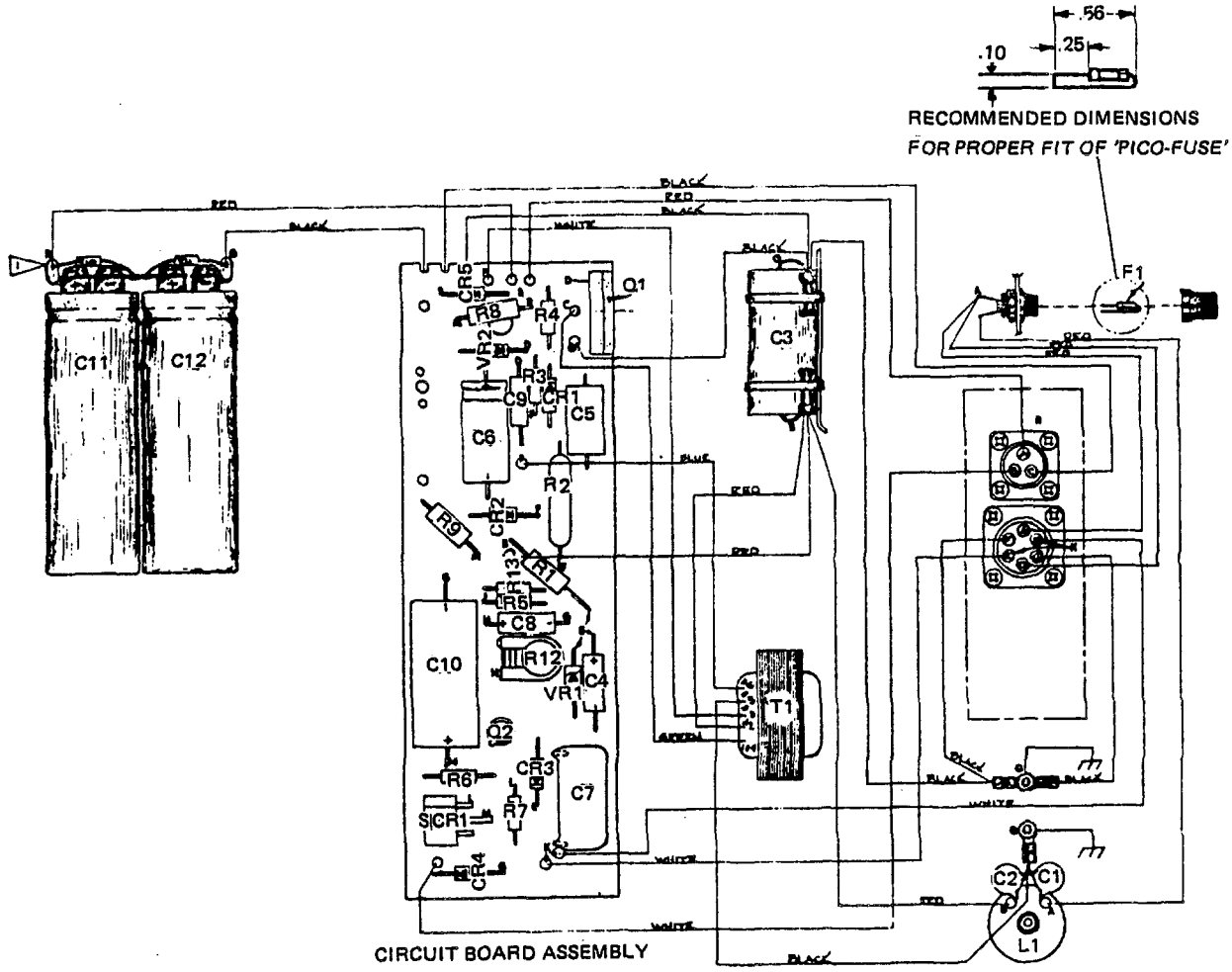
7. THESE COMPONENTS WILL VARY WITH 14 VOLT DC INPUT UNIT 60-1755-3 AND 28 VOLT DC INPUT UNIT 60-1755-1:
   R_1 {-3 100Ω ½ W - ALLEN BRADLEY
   {-1 470Ω ½ W - ALLEN BRADLEY
   R_2 {-3 10Ω 3 W - DALE RS-2B
   {-1 75Ω 3 W - DALE RS-2B
   C_3 {-3 2200 mf@15V SPRAGUE NO. 39D408G015JL4
   {-1 4000 mf@25V SPRAGUE NO. 39D228G025JL4

8. "POLARITY MUST BE OBSERVED"
   POWER SUPPLY WILL BE DAMAGED IF VOLTAGE POLARITY IS NOT OBSERVED----BLACK WIRE IS NEGATIVE AND MUST BE SUITABLY GROUNDED. DO NOT APPLY POSITIVE VOLTAGE TO BLACK WIRE.

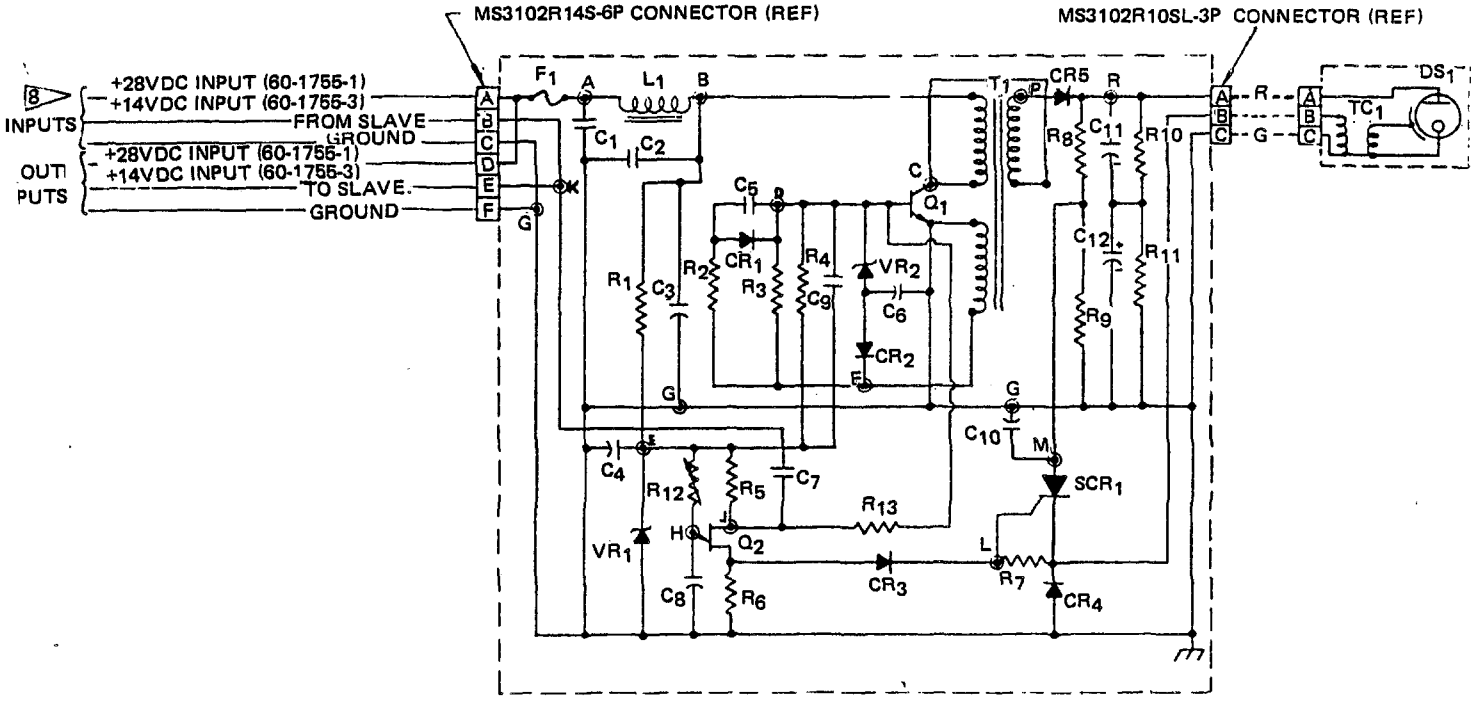
9. TO OBSERVE PULSE MORE CLEARLY INCREASE SCOPE 'INTENSITY' TO FULL.

10. A TIMES-TEN (X10) MULTIPLIER PROBE MUST BE USED TO EXTEND VOLTAGE RANGE OF SCOPE WHEN MEASURING VOLTAGES IN EXCESS OF 100 VOLTS.

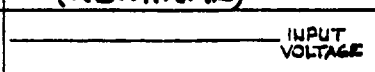
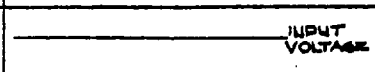
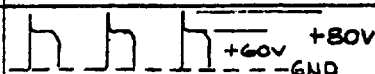
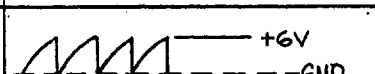
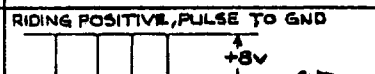
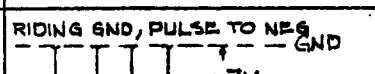
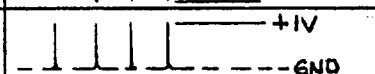
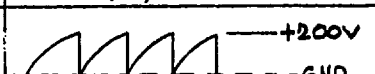
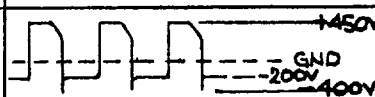
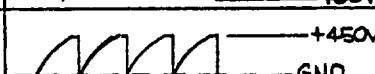
11. ZENER DIODE 'VR2' MAY BE EITHER OF THE FOLLOWING:
    NO. IN5241B - 11 VOLT @ 500 MW
    NO. IN5243B - 12 VOLT @ 500 MW
    NO. IN5243B - 13 VOLT @ 500 MW
    REPLACEMENT ZENER SHOULD BE THE SAME VALUE OF ZENER REMOVED.



WIRING DIAGRAM



SCHEMATIC

ALL WAVESHAPES NON-INVERTED				
TEST POINT	NORMAL READING (NOMINAL)	COMPONENT CHECK LIST (ABNORMAL READINGS)	OSCILLOSCOPE SETTINGS	
A		F1, POWER SUPPLY, INPUT & GROUND CONNECTION INPUT LEAD POLARITY	5V/CM .2m Sec	8
B		L1, C2, C3, CHASSIS GROUND CONNECTION	5V/CM .2m Sec	
C		Q1, VR2, CR2, CR1, C6, VALUES OF R2, R3, R4 T1 & CONNECTIONS	20V/CM .1m Sec	3 11
D		Q1, VR2, CR1, CR2, C5, C6, C9 VALUES OF R2, R3, R4 T1 & CONNECTIONS	10V/CM .1m Sec	3 11
E		VR1, C3, C4, C8, C7, C9, CR4 VALUES OF R1, R4, R5 GROUND CONNECTIONS	5V/CM .1m Sec	
F		VR2, CR1, CR2, C5, C6, VALUES R2, R3 T1 BLUE WIRE TO CR2 T1 BLACK WIRE TO GROUND	10V/CM .1m Sec	3 11
G	GROUND	EXTERNAL AND CHASSIS GROUND CONNECTIONS		8
H		Q2, VR1, C4, C8, C7, C9, R5, R6 R4, CR3, CR4, DIRECTION OF Q2 ADJUSTMENT OF R12	5V/CM .5 Sec	4
J		Q2, VR1, C4, C8, C7, C9, R5, R6, R4, CR3, CR4.	5V/CM .5 Sec	3 4 9
K		Q2, C7, R5, R6	5V/CM .5 Sec	3 9
L		R6, R7, CR3, CR4, SCR1	1V/CM .5 Sec	3 4 9
M		SCR1, C10, CR3, CR4, R7, R8 R9, R10, R11	100V/CM .5 Sec	10
P		CR5, DIRECTION OF CR5 T1 WIRING & CONNECTIONS	200V/CM .1m Sec	3 10
R		POLARITY OF C11, C12 & LEAKAGE VALUE OF R8, R9, R10, R11 T1 & WIRING CONNECTIONS	100V/CM .5 Sec	1 10

	F1	FUSE	PICO FUSE 10 AMP-125V LITTLE FUSE INC or EQUIV.
	T1	TRANSFORMER	GRIMES PART NO. 55-0502-1
	L1	CHOKE	GRIMES PART NO. 55-0304-3
	Q1	TRANSISTOR	NPN GRIMES PART NO. 55-0363-1
	Q2	TRANSISTOR	UNIJUNCTION SPN 2N 2646 GE or EQUIV.
	SCR1	RECTIFIER	SILICON CONTROLLED GRIMES PART NO. 61-0725-1
	VR1	DIODE	ZENER 10V @ 1 W VR10A MOTOROLA or EQUIV.
11	VR2	DIODE	ZENER MOTOROLA or EQUIV.
	CR1	DIODE	IN4004 MOTOROLA or EQUIV.
	CR2	DIODE	IN4004 MOTOROLA or EQUIV.
	CR3	DIODE	IN645 MOTOROLA or EQUIV.
4	CR4	DIODE	IN645 MOTOROLA or EQUIV.
	CR5	DIODE	IN4006 MOTOROLA or EQUIV.
	C1	CAPACITOR	CERAMIC DISK .01 mf @ 150V CENTRALAB NO. DDM-103
	C2	CAPACITOR	CERAMIC DISK .01 mf @ 150V CENTRALAB NO. DDM-103
7	C3	CAPACITOR	ELECTROLYTIC
	C4	CAPACITOR	TANTALUM 6.8 mf @ 35V SPRAGUE NO. K6R8J35K
	C5	CAPACITOR	METAL FILM .047 mf @ 200V SPRAGUE NO. 192P47302
	C6	CAPACITOR	ELECTROLYTIC 50 mf @ 16V SPRAGUE NO. 30D506G016CB
	C7	CAPACITOR	METAL FILM .047 mf @ 80V POTTER NO. 0109-5263
	C8	CAPACITOR	ELECTROLYTIC 6.8 mf @ 35V SPRAGUE NO. K6R8J35K
	C9	CAPACITOR	METAL FILM .0047 mf @ 80V SPRAGUE NO. 192P4720R8
	C10	CAPACITOR	PAPER .22 mf @ 400V SPRAGUE NO. 121P22404S1
	C11	CAPACITOR	ELECTROLYTIC - GRIMES PART NO. 55-0339-321G2C2
	C12	CAPACITOR	ELECTROLYTIC - GRIMES PART NO. 55-0339-321G2C2
7	R1	RESISTOR	CARBON COMPOSITION
7	R2	RESISTOR	WIRE WOUND
	R3	RESISTOR	CARBON COMPOSITION 2.2KΩ ¼W - ALLEN BRADLEY
	R4	RESISTOR	CARBON COMPOSITION 4.7KΩ ¼W - ALLEN BRADLEY
	R5	RESISTOR	CARBON COMPOSITION 470Ω ¼W - ALLEN BRADLEY
	R6	RESISTOR	CARBON COMPOSITION 47Ω ¼W - ALLEN BRADLEY
	R7	RESISTOR	CARBON COMPOSITION 1KΩ ¼W - ALLEN BRADLEY
	R8	RESISTOR	CARBON COMPOSITION 470KΩ ½W - ALLEN BRADLEY
	R9	RESISTOR	CARBON COMPOSITION 470KΩ ½W - ALLEN BRADLEY
	R10	RESISTOR	CARBON COMPOSITION 100KΩ ½W - ALLEN BRADLEY
	R11	RESISTOR	CARBON COMPOSITION 100KΩ ½W - ALLEN BRADLEY
5	R12	RESISTOR	POTENTIOMETER 220K PIHER NO. PT10V-R200K
	R13	RESISTOR	CARBON COMPOSITION 15KΩ ¼W - ALLEN BRADLEY

GRIMES
MANUFACTURING COMPANY
URBANA, OHIO 43078 • (513) 652-1431

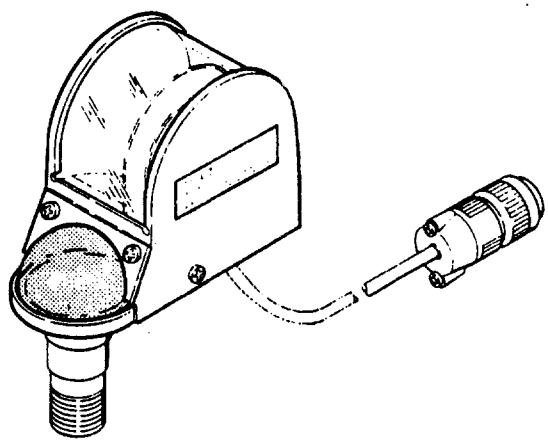
GRIMES

WING POSITION AIRCRAFT NAVIGATIONAL LIGHT

PART NUMBER

30-0863-1	30-0863-5	30-0863-9
30-0863-2	30-0863-6	30-0863-10
30-0863-3	30-0863-7	30-0863-11
30-0863-4	30-0863-8	30-0863-12

COMPONENT MAINTENANCE MANUAL WITH ILLUSTRATED PARTS LIST



GRIMES MANUFACTURING COMPANY
515 NORTH RUSSELL STREET, URBANA, OHIO 43078, U.S.A. • TELEPHONE (513) 652 1431 • TELETYPE: (810) 457-2852 • TELEX 205-439

LIGHTING EQUIPMENT FOR THE TRANSPORTATION INDUSTRY

33-40-74
Mar 15/76

GRIMES MANUFACTURING COMPANY
COMPONENT MAINTENANCE MANUAL
WITH ILLUSTRATED PARTS LIST
PART NO. 30-0863

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GRIMES MANUFACTURING COMPANY
COMPONENT MAINTENANCE MANUAL
WITH ILLUSTRATED PARTS LIST
PART NO. 30-0863

RECORD OF REVISIONS

REV. NO.	ISSUE DATE	DATE INSERTED	BY	REV. NO.	ISSUE DATE	DATE INSERTED	BY	REV. NO.	ISSUE DATE	DATE INSERTED	BY

GRIMES MANUFACTURING COMPANY
COMPONENT MAINTENANCE MANUAL
WITH ILLUSTRATED PARTS LIST
PART NO. 30-0863

LIST OF EFFECTIVE PAGES

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Title Page		Mar 15/76
Record of Revisions	1	Mar 15/76
List of Effective Pages	1	Mar 15/76
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	4	Blank
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	6	Blank
Cleaning	7	Mar 15/76
	8	Blank
Check	9	Mar 15/76
Repair	9	Mar 15/76
	10	Blank
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Illustrated Parts List	15	Mar 15/76
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	18	Mar 15/76
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	20	Blank

GRIMES MANUFACTURING COMPANY
COMPONENT MAINTENANCE MANUAL
WITH ILLUSTRATED PARTS LIST
PART NO. 30-0863

INTRODUCTION

This manual contains shop instructions for testing, trouble shooting, and repairing the components listed on the title page. The instructions are divided into sections as shown in the preceding table of contents.

The instructions in this manual only apply to the assembly part numbers listed on the title page. Insure that the part number on the unit is listed on the title page before performing any of these instructions.

The procedures within this manual are only to be performed by qualified shop mechanics who are familiar with this type of equipment.

The contents of this manual have been verified by the manufacturer prior to the distribution of printed copies.

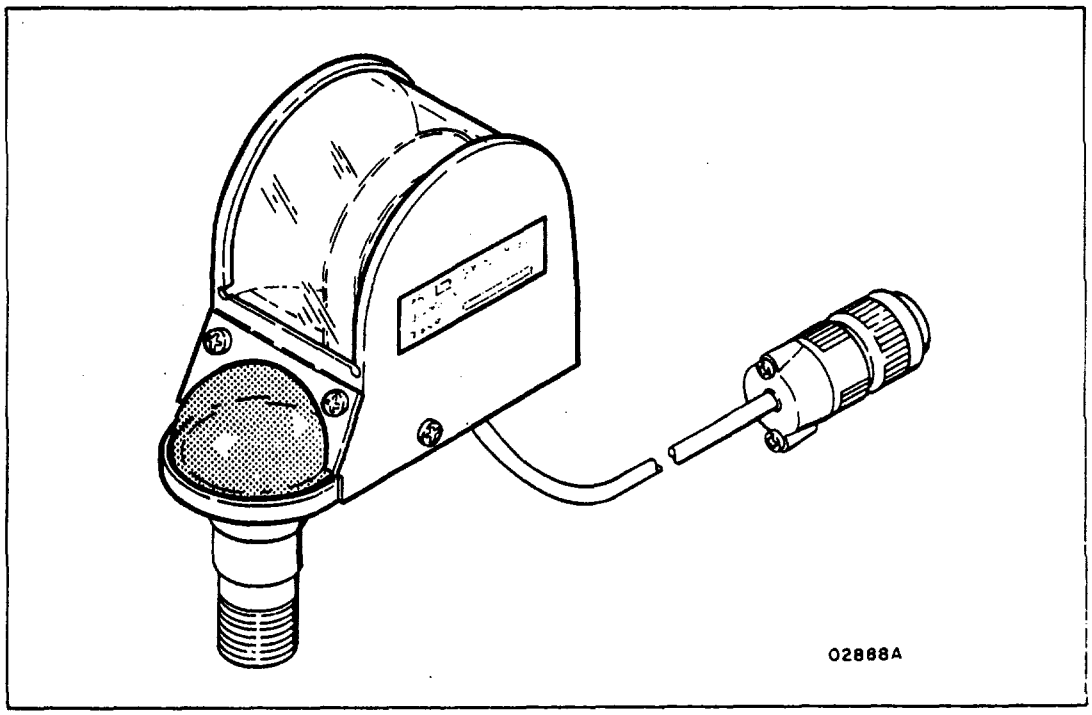
GRIMES MANUFACTURING COMPANY
COMPONENT MAINTENANCE MANUAL
WITH ILLUSTRATED PARTS LIST
PART NO. 30-0863

DESCRIPTION AND OPERATION

1. Description

Wing Position Aircraft Navigational Light, part numbers 30-0863-1 thru -12, are installed on aircraft to provide a flashing source of high intensity illumination to indicate the position of the aircraft (Ref. Fig. 1).

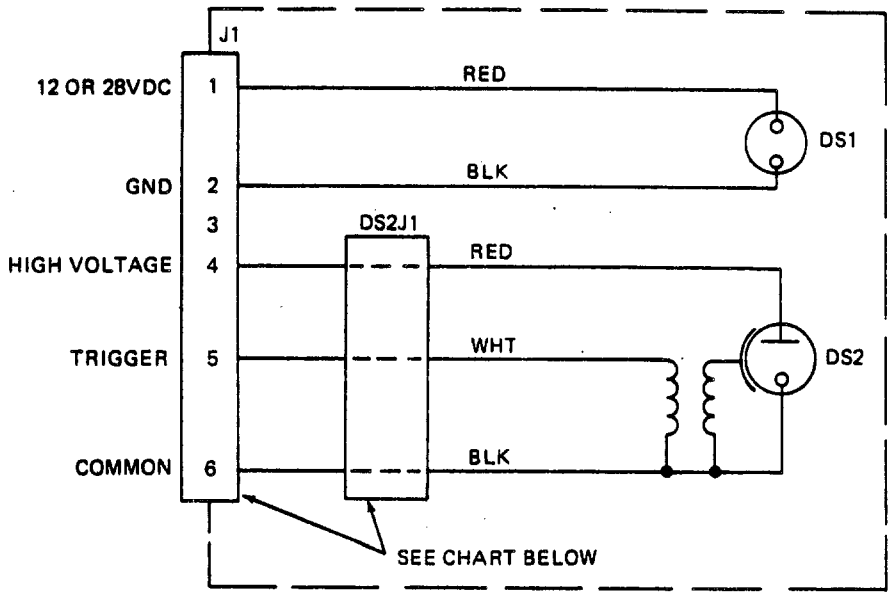
Model differences are in external wiring connections (Ref. Fig. 2) and in lens color (Ref. Fig. 3).



Wing Position Aircraft Navigational Light
Figure 1

2. Operation

The light has two light sources. An incandescent lamp, energized by 12 or 28 VDC as applicable, provides illumination for continuous operation. A flashtube, with an input voltage of 400 VDC and triggered by a 200 volt pulse, operates at a flashrate of 60±10 per minute, determined by the trigger pulses. Refer to figure 2 for electrical connections.



ASSEMBLY	TYPE OF CONNECTION SUPPLIED	
	FOR DS1	FOR DS2
30-0863-1, -2	NONE	CONNECTOR DS2J1
30-0863-3, -4, -5, -7, -8, -9, -10	WIRE PIGTAILS	TERMINAL 31770
30-0863-5, -6	WIRE PIGTAILS	CONTACT 55-0443-5
30-0863-11, -12	CONNECTOR J1	CONNECTOR J1

02689A

Electrical Wiring Diagram
Figure 2

3. Leading Particulars

For leading particulars, refer to Figure 3.

Electrical requirements:

Incandescent lamp:
30-0863-1 thru -8 ..... 28 VDC
30-0863-9 thru -12 ..... 12 VDC
Flashtube:
Input voltage ..... 400 VDC
Trigger pulse ..... 200 VDC

Lens color:
Incandescent lamp:
30-0863-1, -3, -5, -7, -9, -11 ..... AVN red
30-0863-2, -4, -6, -8, -10, -12 .... AVN green
Flashtube:
30-0863-1 thru -6, -9 thru -12 ..... AVN red
30-0863-7, -8 ..... AVN white

Dimensions:
Length ..... 3.95 inches (10.0 cm)max.
Width ..... 1.84 inches (4.7 cm)max.
Height ..... 5.12 inches (13.0 cm)max.
Weight ..... 0.75 pounds (0.34 Kg)max.

Leading Particulars
Figure 3

TESTING AND TROUBLE SHOOTING

1. Connect 12 or 28 VDC to the incandescant lamp wires or connector pins as applicable. If the lamp fails to light, replace lamp (Ref. 250, Fig. 7).

2. Using a 60-2290-1 Strobe Light Power Supply, apply 400 VDC between pins 4 and 6 of connector per Figure 2. Apply a 200 volt trigger pulse for a duration of 2.0 microseconds to pin 5. Flashtube shall illuminate at the repetition rate of the trigger pulses. If the lamp fails to flash, replace flashtube assembly (Ref. 280, Fig. 7).

DISASSEMBLY

NOTE: See Testing and Trouble Shooting to establish the condition of the component or most probable cause of its malfunction. This is to determine the extent of disassembly required, without completely tearing down and rebuilding the component.

1. If only lamp (Ref. 250, Fig. 7) requires replacement, remove screws (210) and lift off retainer (240), lens (220) and gasket (340). Lamp (250) can then be removed.

2. Remove screws (150) and lift off housing assembly (180) from flashtube assembly (280).

3. Cut sealant from lens (160) and remove lens (160) from housing assembly (180), only if required.

4. Peel identification plate (420) from housing assembly (180), only if illegible.

5. If required, remove conduit nut (350) and remove items (360 thru 390) from base assembly (430).

6. Do not attempt to disassemble flashtube assembly (280) beyond replacing ty-raps (330) or connector (320).

CLEANING

1. Refer to figure 4 for a list of cleaning materials.

   NOTE: Equivalent substitutes may be used for listed items.

PART NUMBER	NOMENCLATURE	SPECIFICATION	MANUFACTURER
	Isopropyl alcohol	Federal Specification TT-I-735	
	Dry Cleaning Solvent	Federal Specification P-D-680	
	Acetone	Federal Specification O-A-51	

Cleaning Materials List
Figure 4

1. Clean electrical parts with a clean, lint-free cloth moistened with isopropyl alcohol, Federal Specification TT-I-735, or equivalent. Allow to air dry.

   WARNING: SOLVENT AND ACETONE FUMES ARE TOXIC. PROLONGED INHALATION OF THE FUMES MAY CAUSE ILLNESS.

2. Clean metal parts with dry cleaning solvent, Federal Specification P-D-680, or equivalent.

3. Clean the lamps with acetone, Federal Specification O-A-51, or equivalent.

CHECK

1. Visually inspect lenses (Ref. 160 and 220, Fig. 7) for cracks and discoloration.
2. Visually inspect terminal assembly (390) for a good electrical contact.
3. Visually inspect connector (320) for evidence of arcing between pins.
4. Visually inspect metal parts for distortion and damage.

REPAIR

Repair consists of replacing parts found defective during Testing and Trouble Shooting, and Check procedures.

ASSEMBLY

1. Refer to Figure 7 for an exploded view, and to its parts list for usable on code information. Refer to Figure 5 for materials used during assembly.

2. If flashtube assembly (Ref. 280, Fig. 7) was replaced, make wiring connections per Figure 2.

3. Insert terminal assembly (Ref. 390, Fig. 7), spring (380), insulator (370), and terminal (360) into base assembly (430). Install conduit nut (350).

4. Install new lamp (250).

5. If previously removed, install new pressure sensitive identification plate (420).

6. Install lens (160) into housing assembly (180) and seal inside and outside mating surfaces with sealant.

7. Assemble housing assembly (180), flashtube assembly (280), and base assembly (430). Install screws (150).

8. Install new gasket (340), lens (220), and retainer (240). Secure with screws (210).

9. Perform testing procedures in testing and trouble shooting section.

10. Prepare for storage by wrapping the unit with cushioning material. Enclose the assembly and desiccant in heat sealable film and seal the film using a sealing iron, Military Specification MIL-S-43336. Store the assembly in an area with a temperature range of 65 to 120°F (18 to 49°C).

PART NUMBER	NOMENCLATURE	SPECIFICATION	MANUFACTURER
20-078	Silastic		V71984 Dow Corning South Saginaw Road Midland, MI 48640
	Cushioning material	Military Specification MIL-C-81013	
	Desiccant	Military Specification MIL-D-3464	
	Heat sealable film	Military Specification MIL-F-22191	

Assembly Materials List
Figure 5

SPECIAL TOOLS, FIXTURES AND EQUIPMENT

1. Refer to Figure 6.

NOTE: Equivalent substitutes may be used for listed items.

NAME	PART/MODEL NO.	MANUFACTURER	FIG./SECTION
Strobe Light Power Supply	60-2290-1	Grimes Manufacturing Company	Testing and Trouble Shooting

Special Tools, Fixtures and Equipment
Figure 6

ILLUSTRATED PARTS LIST

General information and instructions for use of the Illustrated Parts List are as follows:

1. The Illustrated Parts List is a breakdown of assemblies, subassemblies, and detail parts of the items listed on the title page. Index numbers on the exploded view illustration accompanying the parts list indicate the general order of disassembly. Component parts are indented in the list to show subordinate relationship to the complete assembly.

2. The Units Per Assembly column of the parts list indicates the quantity of each part required for the next higher assembly.

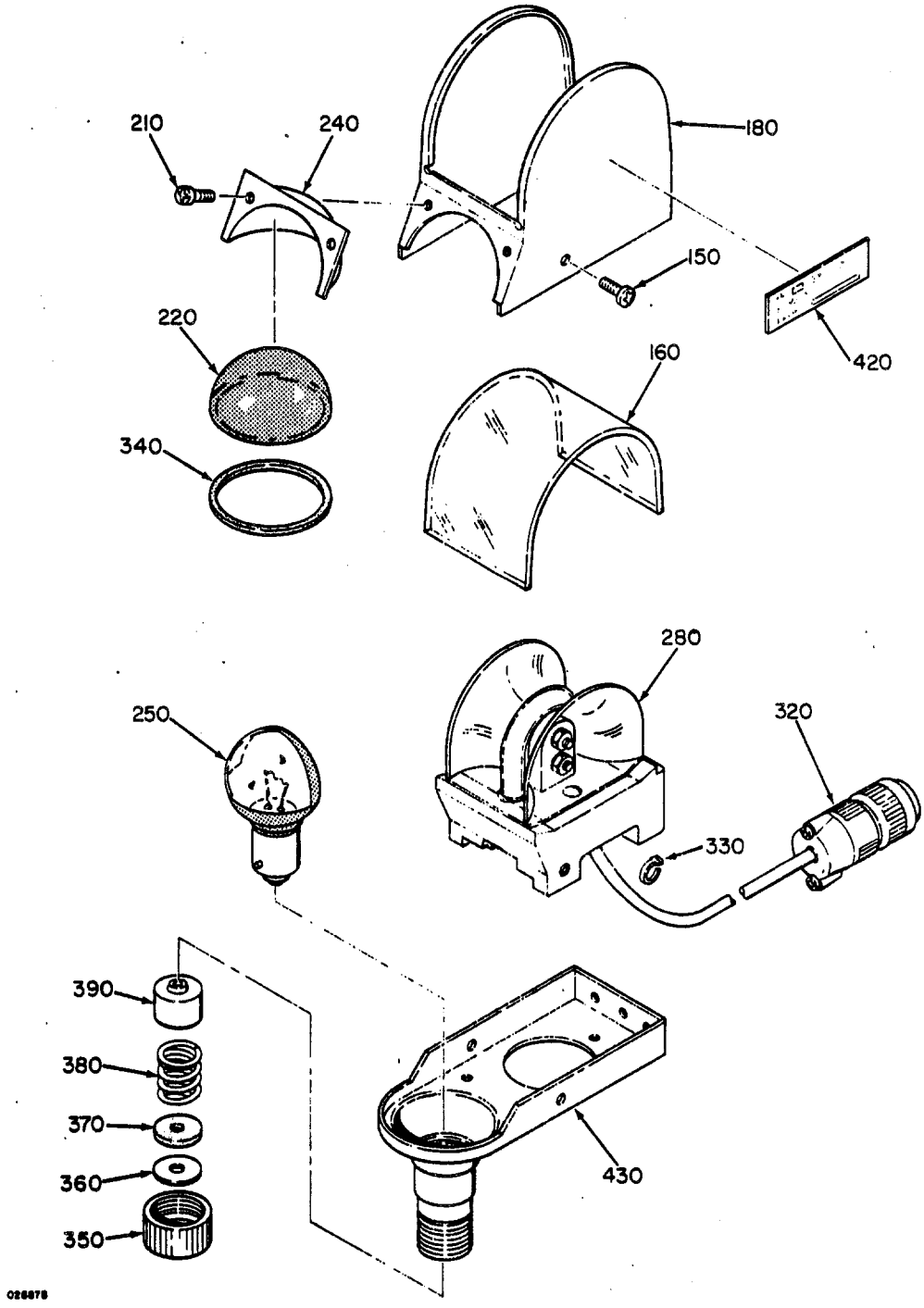
3. Part numbers and description in the parts list identify each part. The index numbers in the parts list refer to the accompanying exploded view illustration.

4. The following is a compilation of the vendor codes with the names and addresses of suppliers for purchased parts used in this illustrated parts list.

VENDOR CODE	NAME AND ADDRESS
V00779	AMP Inc. P. O. Box 3608 Harrisburg, PA 17105
V59730	The Thomas and Betts Company 36 Butler St. Elizabeth, NJ 07207

EQUIPMENT DESIGNATOR INDEX

Equipment Designator	Fig. Item	Equipment Designator	Fig. Item	Equipment Designator	Fig. Item
DS1	7-250	DS2	7-280	DS2	7-310
DS1	7-260	DS2	7-290	DS2J1	7-320
DS1	7-270	DS2	7-300	J1	7-400



Wing Position Aircraft Navigational Light - Exploded View
Figure 7

FIG. ITEM	PART NUMBER	AIRLINE PART NO.	1 2 3 4 5 NOMENCLATURE	EFF CODE	UNITS PER ASSY
7-10	30-0863-1		LIGHT, NAVIGATIONAL, ... AIRCRAFT-WING POSITION (LH) (AVN RED)	A	RF
-20	30-0863-2		LIGHT, NAVIGATIONAL, ... AIRCRAFT-WING POSITION (RH) (AVN GREEN)	B	RF
-30	30-0863-3		LIGHT, NAVIGATIONAL, ... AIRCRAFT-WING POSITION (LH) (AVN RED)	C	RF
-40	30-0863-4		LIGHT, NAVIGATIONAL, ... AIRCRAFT-WING POSITION (RH) (AVN GREEN)	D	RF
-50	30-0863-5		LIGHT, NAVIGATIONAL, ... AIRCRAFT-WING POSITION (LH) (AVN RED)	E	RF
-60	30-0863-6		LIGHT, NAVIGATIONAL, ... AIRCRAFT-WING POSITION (RH) (AVN GREEN)	F	RF
-70	30-0863-7		LIGHT, NAVIGATIONAL, ... AIRCRAFT-WING POSITION (LH) (AVN RED)	G	RF
-80	30-0863-8		LIGHT, NAVIGATIONAL, ... AIRCRAFT-WING POSITION (RH) (AVN GREEN)	H	RF
-90	30-0863-9		LIGHT, NAVIGATIONAL, ... AIRCRAFT-WING POSITION (LH) (AVN RED)	J	RF
-100	30-0863-10		LIGHT, NAVIGATIONAL, ... AIRCRAFT-WING POSITION (RH) (AVN GREEN)	K	RF
-110	30-0863-11		LIGHT, NAVIGATIONAL, ... AIRCRAFT-WING POSITION (LH) (AVN RED)	L	RF
-120	30-0863-12		LIGHT, NAVIGATIONAL, ... AIRCRAFT-WING POSITION (RH) (AVN GREEN)	M	RF
-130	31-3355-1		. LENS ASSEMBLY	A,B, C,D, E,F, J,K, L,M	1

- Item Not Illustrated

FIG. ITEM	PART NUMBER	AIRLINE PART NO.	1 2 3 4 5 NOMENCLATURE	EFF CODE	UNITS PER ASSY
7-140	31-3355-3		. LENS ASSEMBLY	G,H	1
			(ATTACHING PARTS)		
150	MS51957-27		. SCREW, MACHINE		4
			---*---		
160	25-0809-23		. . LENS (AVN WHITE)	A,B, C,D, E,F, J,K, L,M	1
-170	25-0809-21		. . LENS (AVN RED)	G,H	1
180	31-3072-1		. . HOUSING ASSEMBLY		1
-190	31-3376-1		. LENS ASSEMBLY	A,C, E,G, J,L	1
-200	31-3376-2		. LENS ASSEMBLY	B,D, F,H, K,M	1
			(ATTACHING PARTS)		
210	MS51957-13		. SCREW, MACHINE		2
			---*---		
220	A1280-2		. . LENS (AVN RED)	A,C, E,G, J,L	1
-230	A1280-3		. . LENS (AVN GREEN)	B,D, F,H, K,M	1
240	31-3375-1		. . RETAINER		1
250	A7512-24		. LAMP, 28V, 26W (DS1) ...	A,B, C,D, G,H	1
-260	A7512-12		. LAMP, 12V, 26W (DS1) ...	J,K, L,M	1
-270	1524		. LAMP, 28V, 21W (DS1) ...	E,F	1
280	31-3078-1*		. FLASHTUBE ASSEMBLY ..... (DS2)	A,B	1
-290	31-3078-5*		. FLASHTUBE ASSEMBLY ..... (DS2)	C,D, G,H, J,K	1
-300	31-3078-7*		. FLASHTUBE ASSEMBLY ..... (DS2)	E,F	1
-310	31-3078-9*		. FLASHTUBE ASSEMBLY ..... (DS2)	L,M	1
320	MS3106R10SL35		. . CONNECTOR (DS2J1)	A,B	1

- Item Not Illustrated

FIG. ITEM	PART NUMBER	AIRLINE PART NO.	1 2 3 4 5 NOMENCLATURE	EFF CODE	UNITS PER ASSY
7 330	TY3		. . TY-RAP (V59730) ..... (Grimes Stock Code TL050)		1
340	A1257A3		. GASKET		1
350	A1111		. NUT, CONDUIT	C,D, E,F, G,H, J,K, L,M	1
360	60-1058-1		. TERMINAL	C,D, E,F, G,H, J,K, L,M	1
370	A4149		. INSULATOR	C,D, E,F, G,H, J,K, L,M	1
380	A1783		. SPRING	C,D, E,F, G,H, J,K, L,M	1
390	A4490-3		. TERMINAL ASSEMBLY	C,D, E,F, G,H, J,K, L,M	1
-400	1-4807040		. CONNECTOR (J1) ..... (V00779) (Grimes Stock Code C06498)	L,M	1
-410	350547-1		. CONTACT, PINS (V00779) . (Grimes Stock Code C06495)	L,M	5
420	15853-1		. PLATE, IDENTIFICATION ..		1
430	31-3075-1		. BASE ASSEMBLY		1

*These are manufacturing part numbers only. To replace flashtube assembly on any model, order part number 31-3078-3, which is supplied with pigtails for all wires.

- Item Not Illustrated

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OVERHAUL MANUAL

OSM 614/JR/RFC

EMERGENCY LIGHTING UNIT MK.2

PART NO.614-1-03460
Formerly CAT 80024 (Black)

PART NO.614-1-03460-001
Formerly CAT 80024 (Ivory)

Publication OSM 614

This manual complies with the British Civil Airworthiness Requirements Section A, Chapter A6-2. The technical accuracy of this manual has been verified and is certified as correct.

Signed R. Hardcastle.

Date 2nd July, 1970

A.R.B. Design Approval No. AD/1337/54

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THE PLESSEY COMPANY LIMITED
DYNAMICS GROUP
ILFORD ESSEX ENGLAND

Plessey Dynamics

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THE PLESSEY COMPANY LIMITED

DYNAMICS GROUP PRODUCT SUPPORT DIVISION

TECHNICAL PUBLICATIONS DEPARTMENT

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RECORD OF REVISIONS

OVERHAUL MANAUL EMERGENCY LIGHTING UNIT MK.2

OSM 614/JR/RFC

REV No.	ISSUE DATE	DATE INSERTED	BY	REV No.	ISSUE DATE	DATE INSERTED	BY	REV No.	ISSUE DATE	DATE INSERTED	BY

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RECORD OF TEMPORARY REVISIONS

OVERHAUL MANAUL EMERGENCY LIGHTING UNIT MK. 2

TEMPORARY REV. NO.	PAGE NUMBER	ISSUE DATE	BY	DATE REMOVED	BY

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The List of Effective Pages records each page by date. It is recommended that each page of the manual be checked against this List of Effective Pages. Any page which does not check out with this list, either by number or date, shall be discarded.

CHAPTER SECTION	PAGE	DATE	CHAPTER SECTION	PAGE	DATE
33-50-02	Title	July 2/70	33-50-02	501	July 2/70
Address Page	-	July 2/70	Assembly		
List of Effective	1	July 2/70	Fits and	601	July 2/70
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Record of	1	July 2/70	Testing	701	July 2/70
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Record of	1	July 2/70	Fault	801	July 2/70
Temporary	2	Blank	Finding		
Revisions					
			Storage	901	July 2/70
Service	1	July 2/70	Instructions		
Bulletin List	2	Blank			
			Special Tools,	1001	July 2/70
Table of	1	July 2/70	Fixtures and		
Contents	2	Blank	Equipment		
Description,	1	July 2/70	Illustrated	1101	July 2/70
Operation and	2	July 2/70	Parts List	1102	July 2/70
Data	3	July 2/70		1103	July 2/70
				1104	July 2/70
				1105	July 2/70
Dismantling	101	July 2/70		1106	July 2/70
				1107	July 2/70
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SERVICE BULLETIN LIST

Service Bulletin No.	Manual Incorporation Date

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DESCRIPTION, OPERATION AND DATA

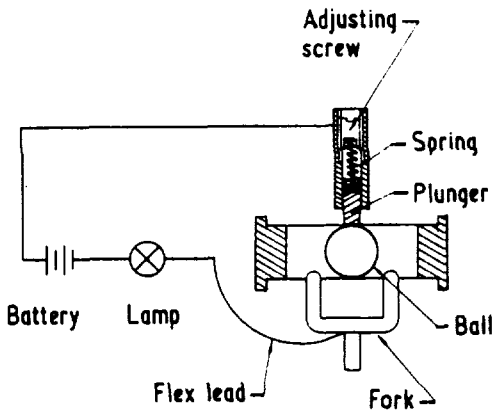
1. Description (Fig. 2)

The Emergency Lighting Units Mk.2 are a compact, self-contained lighting unit, operated by an internal inertia switch which provides automatic illumination inside the aircraft under abnormal landing conditions which may put out of action the normal lighting system.

They are constructed for roof or wall mounting, and are retained in position by a ball click mechanism and bayonet catch in a circular retaining ring. Provision is made for a sealing wire to be fitted by two small cross-drilled bosses, one on the mounting ring and the other on the unit. The wire should be fine tinned copper fuse wire which will break easily and not interfere with the removal of the lamp for use as a hand torch if required in an emergency.

The illumination from the Emergency Lighting Unit Mk.2 is evenly distributed over an angle of 180°.

Cover is provided by two internal dry cells, type 105 to BS.397. The bulb is 2.5 volt, 0.3 amp., with an M.E.S. cap. The initial light intensity exceeds 7.5 lumens and at the end of half-hour of continuous use is not less than 3 lumens. An aluminium reflector is fitted at the base of the bulb. The reflector and bulb are capped by a clear Diakon moulded cover. The mounting ring requires fixing to the aircraft roof or wall, the unit being inserted and retained by the mounting ring. The units are interchangeable and are available in two colours, black or ivory.



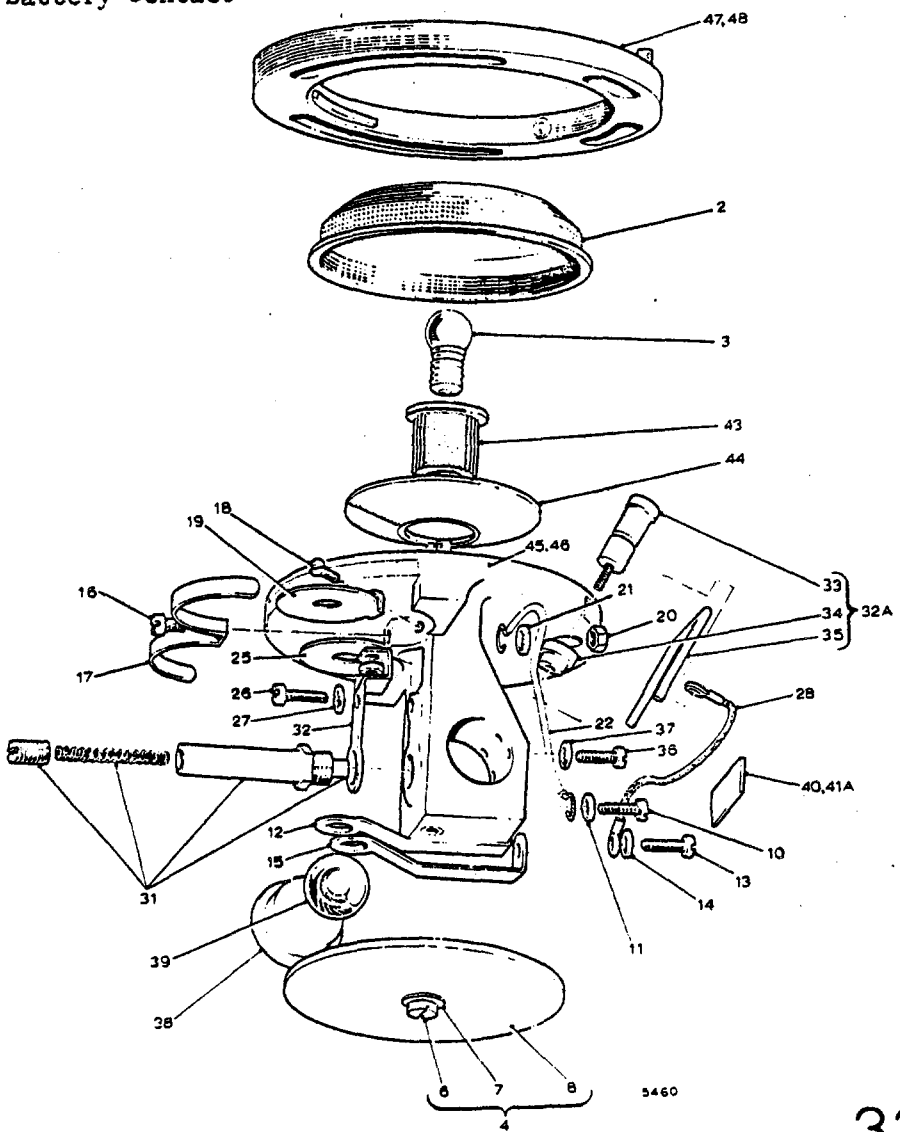
Schematic diagram
Fig.1

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KEY TO FIG.2

2 - Diakon Cover
3 - Bulb
4 - Disc Assembly
10 - 6BA Screw
11 - 6BA Washer
12 - Battery Clips
13 - 6BA Screw
14 - 6BA Washer
16 - 6BA Screws
17 - Spring Clip
18 - 6BA Washer
19 - Battery Contact
20 - 6BA Nut
21 - 6BA Washer
23 - 6BA Counter Screw
25 - Battery Contact
26 - 6BA Nut
27 - Special 6BA Screw
28 - Contact Insulator
31 - Contact Strip
36 - Reset plunger
37 - Spacer
38 - Fork
39 - Adjuster Assembly
40 - 6BA Screw
41 - 6BA Washer
42 - End Plug
43 - Ball
48 - Bulb Holder
51 - Reflector
52) - Body
53)



Exploded view
Fig.2

33-50-02

2. Operation (Fig.1)

The inertia switch element consists of a plated steel ball in an insulating tube and is normally retained in a central position by an adjustable spring-loaded plunger. When the unit is subjected to acceleration, the ball will be displaced against one of the fork prongs and held there by the pressure of the plunger.

Thus an electrical circuit is completed, from the plunger via the ball to the fork. The lamp and battery are connected in series across the form and plunger which forms an electrical circuit whenever the ball is displaced. This causes the lamp to light and it will remain lit until the mechanism is reset by hand. The reset mechanism also operates as the manual 'on/off' switch and comprises of a fork so dimensioned that the inside fits tightly around the ball. When the fork is depressed the ball is centralised and contact is made between the fork and base. As the ball is always in contact with the plunger the circuit between the plunger and form is complete, and the lamp will light. When the fork is withdrawn the ball is retained in a central position by the plunger, but the circuit between the base and the fork will be broken. The switch is now reset and ready for use. The inertia switch is designed to operate in a fore and aft direction only at a positive or negative acceleration between 2 and 4g. This is adjustable and in production is set at 3g, with a test allowance of ±10 per cent.

3. Data

Power supply	2 internal dry cells each 1.5 volt (type 105 to BS.397)
Light output	Not less than 7.5 lumens at commencement of discharge falling to not less than 3 lumens after 0.5 hour use.
Weight	Approximately 8 ozs.
Mounting position	The longitudinal plane of the inertia switch must be kept horizontal and parallel to the fore and aft line of the aircraft. Provided these conditions are complied with the unit may be mounted to any angle in the roof or side wall.
Radio interference	Free to BS.800 and B.C.A.R. Section J, Chapter 6, clause 4.2.
Grading to G100	Altitude and climatic Grade 1 Vibration Grade 3 Compass safe distance 12 in.
Performance	Operates on deceleration with the range between 2-4g with a tolerance of ±10%.
Conditions	Section 1, Clause 5.3, provided that it is installed in accordance with Fig. , of this manual, using 4BA steel screws.

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DISMANTLING

1. General

The items mentioned throughout the text are illustrated in the 'Exploded view of the unit', Fig.1. The number in brackets refer to the code allocated to parts in Fig.1.

2. Dismantling the unit

A. Break the sealing wire and remove the unit from the mounting ring (54,55).

B. Unscrew the clear Diakon moulded cover (2) and remove the bulb (3).

C. Remove the bakelite guard plate and lift out the two dry cells.

NOTE: Further dismantling and subsequent reassembly of the inertia switch must be carried out under scrupulously clean conditions and will impair the adjustment of the unit. The re-adjustment requires the use of a calibrated acceleration table - if this is not available the unit must be returned to the manufacturers for setting.

3. Dismantling of inertia switch

A. Remove the adjusting screw and take out spring and plunger (39).

B. Unscrew reset plunger (36) with the fork (38) pushed fully in and remove. The spacer (37) may now be lifted out and the fork (38) then withdraw.

C. Remove the two plug screws (40), lift out the end plugs (42) and remove the ball (43).

CLEANING

1. General

The inertia switch must be kept scrupulously clean and free of all lubricants.

A. Wipe the switch tube clean from dust, grease or moisture.

B. Wipe the ball clean from dust, grease or moisture.

C. Clean the battery top contact spring.

D. Clean the clear Diakon cover with a lint-free cloth.

WARNING: DO NOT LUBRICATE

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INSPECTION/CHECK

1. In-Situ Checks

   A. The batteries and bulb can be tested while the unit is retained in its mounted position. When the plunger is depressed the lamp should light.

   B. Ensure the unit is firmly retained by the mounting ring.

   C. Ensure the sealing wire is unbroken.

   D. Check visually for damage, corrosion and cracks.

2. Checks necessitating removal of unit

   When the unit has been removed and the inertia switch has been dismantled, carry out the following checks.

   A. Check the switch tube is clean and free from dust, grease and moisture.

   B. Check the condition of the reset fork and adjust if necessary, to make contact with the ball.

   C. Check the tube diameter of the inertia switch exceeds the ball diamter by 0.002 in. to 0.007 in. If the correct clearance cannot be obtained the body must be replaced.

   D. Check the switch tube bore is free from scores or ridges. Replace the body if damaged.

   E. Check the battery terminals for corrosion.

   F. Check visually for damage, corrosion or cracks.

REPAIR

1. General

Repair is by replacement only. Any item found to be damaged should be replaced or the unit returned to the manufacturer or base.

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ASSEMBLY

1. General

When dismantling the inertia switch all work should be carried out in a dust free atmosphere and tools and equipment kept scrupulously clean.

2. Assemble the inertia switch

A. Replace one end plug (42) and screw into position on the body (52,53).

B. Replace the ball (43).

C. Replace the second end plug and screw in position.

D. Fit the fork (38) into the body (52,53).

E. Pass the reset plunger (36) through the aperture in the top of the body.

F. Place the spacer (37) on the stem of the reset plunger (36) with the small end towards the fork (38), fit the end of the flexible lead (34) between the spacer (37) and the fork (38).

G. Screw up the reset plunger tightly.

H. Check the reset plunger operates freely.

J. Assemble the plunger (39) in barrel with shallow hole towards the ball, replace the spring and adjusting screw.

WARNING: DO NOT LUBRICATE

3. Assemble the unit

A. Replace the batteries ensuring the centre connection of the holes are correctly located in the hole in the top contact spring.

B. Replace bakelite guard plate.

C. Carry out an acceleration check on the inertia switch.

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FITS AND CLEARANCES

1. General

All dimensions are in inches.

2. Tube diameter

The tube diameter of the inertia switch must exceed the ball diameter by 0.002 in. to 0.007 in. If this tolerance cannot be obtained the body must be replaced.

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TESTING

1. General

Frequent checks should be carried out on the batteries and bulb to ensure deterioration is kept to a minimum.

2. Test equipment

The operation of the emergency lighting unit must be carried out on an acceleration table.

3. Acceleration test

The operation of the unit must be checked on an acceleration table with the longitudinal axis of the inertia switch mounted radially. The inertia switch should be tested using the foll owing formula.

Formula: $G = r N^2 0.00034$

When r = radius of rotation in feet and N = speed of table in R.P.M.

When r = 7 in. N = 116 for g = 2.7 (Lower limit of operation)

N = 129 for g = 3.3 (Upper limit of operation)

The unit be be tested for operation in both fore and aft directions. After tripping the unit must be capable of being tilted in any direction without the lamp going out.

FAULT FINDING

1. General

The following table is intended as a guide to locate and rectify a fault in the shortest possible time.

2. Table of faults

Fault	Possible cause	Remedy
Lamp remains lit	Ball trapped against fork	Adjust ball and test
Ball will not centralise	Damaged switch tube bore	Replace body
Lamp will not light (manual)	Batteries discharged	Replace
	Bulb ruptured	Replace
	Flexible lead ruptured	Replace or repair
Lamp will not light (acceleration)	Damaged switch tube bore	Test, replace body
	No supply	Check batteries and circuit
	Bulb ruptured	Replace

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STORAGE INSTRUCTIONS

1. General

   The batteries must be stored separately from the units.

2. Storage

   Store the units in a dry, temperate atmosphere, away from injurious fumes.

3. Shelf life

   The shelf life of the emergency lighting unit is 12 months if stored under the correct conditions.

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SPECIAL TOOLS AND EQUIPMENT

1. General

There are no special tools associated with the repair and maintenance of the emergency lighting unit.

2. Special equipment

Testing	-	Acceleration table

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ILLUSTRATED PARTS LIST

1. Introduction

A. Purpose

(1) This list describes the parts required for the Emergency Lighting Unit Mk.2, 614-1-03460 and 614-1-03460-001 and is issued in conjunction with the Overhaul Manual to serve as an aid to disassembly. The list is arranged in order of disassembly and is indented to show the assembly and detail relationship. Attaching parts are listed immediately following the assembly or item they attach and precede detailed parts of that assembly.

B. Usage

(1) Detailed parts list

(a) The first column lists the figure number of the relevant exploded view and index numbers of all parts. Parts and index numbers prefixed by a dash (-) are not illustrated.

(b) The second and third columns list the part numbers and description of all assemblies, sub-assemblies and detail parts. Due to computer complexities, vendors part numbers or specific ordering numbers in excess of fifteen digits are shown in column three. The vendors are listed in para. 'D'.

(c) The fourth column provides for model variations as applicable.

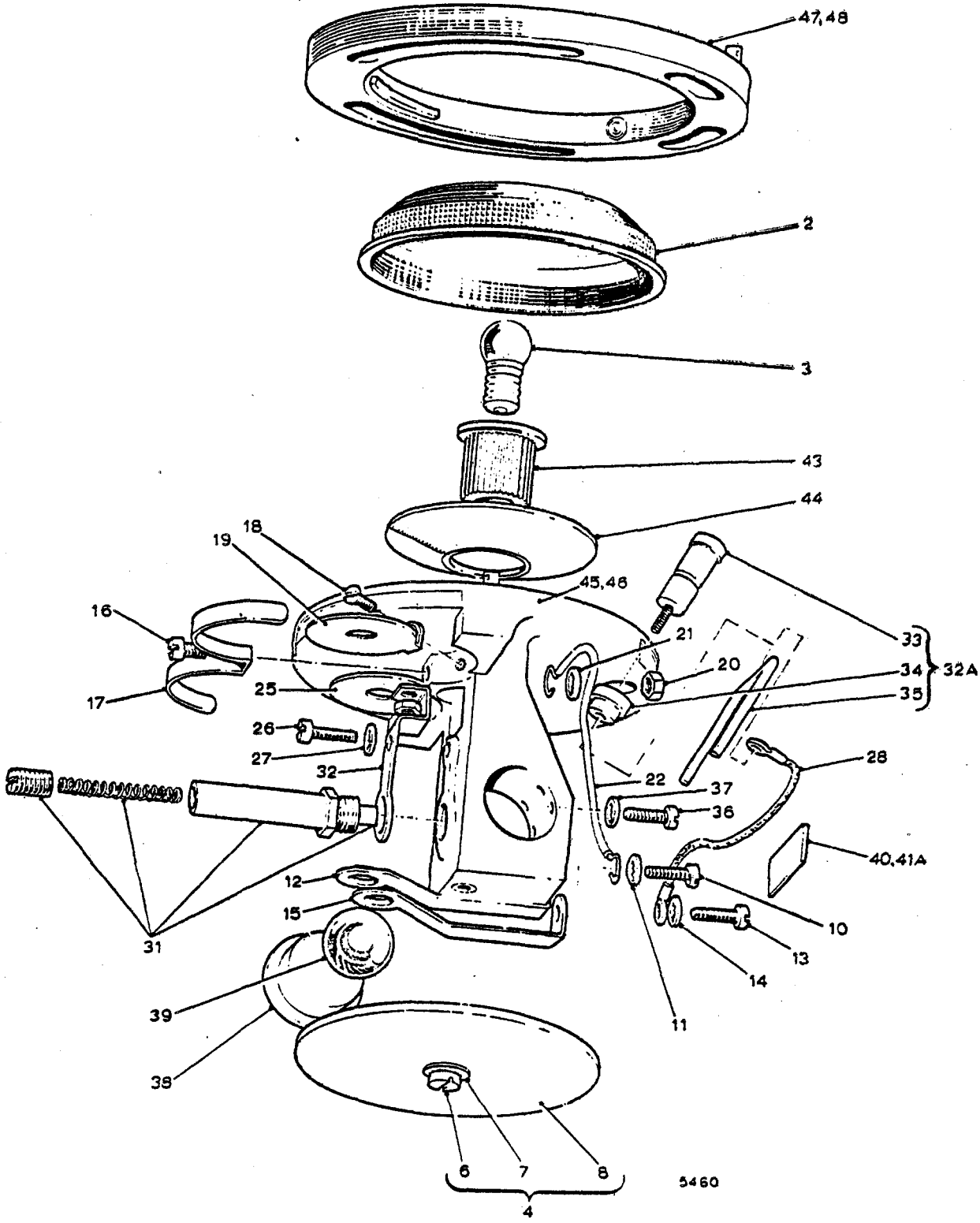
(d) The fifth column shows quantity per assembly.

C. Part numbering system

The current Plessey part numbering system is completely numerical in form, eleven to fifteen digits maximum in length for computerisation purposes the eleven digit numbers are made up of three elements of fixed lengths separated by dashes (-). Suffix numbers of three digits may be added to the third element of an elevem digit number to provide for variations to dimensions, materials, finishes, etc. of the same basic part number.

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Emergency Lighting Unit Mk.2
Fig.1

FIG. ITEM	PART No.	NOMENCLATURE 1 2 3 4 5 6 7	USAGE CODE	UNITS PER ASSY
-1	614-1-03460 OR CAT. 80024	Emergency Lighting Unit - MK. 2 (BLACK)	A	1RF
-1A	614-1-03460-001 or CAT. 80024-1	Emergency Lighting Unit - MK. 2 (IVORY)	B	1RF
2	614-4-03458 or PP. 21960	. Cover - Bulb		1
3	614-4-03498 or CAT. 30074	. Bulb - Filament, E10 fitting 2.5V. 0.3A		1
-4	614-1-03455 or AS6011	. Disc Assembly - Protection		1
5	614-2-03464 or PP. 10457	. . Washer - Tapped 4BA		1
6	614-2-03437 or PP. 21980	. . Screw - Special		1
7	999-4-01560-008 or PP. 11142	. . Washer - Crinkle. 2BA, Phos. Br. "Barber and Colman" Type 1910		1
8	614-2-03432 or PP. 9894	. . Guard		1
-9	614-4-03497 or CAT. 10608	. Battery - 1.5V "Ever Ready" Type U.11 or "Ray-O-Vac" Type 1LP		2

FIG. ITEM	PART No.	NOMENCLATURE 1 2 3 4 5 6 7	USAGE CODE	UNITS PER ASSY
10	991-4-00250-055 or PP. 390	. Screw - Ch. hd. 6 BA x 3/16in. lg. Brass. D.N.P. B.S.57		1
11	999-4-01560-003 or PP.11141	. Washer - Crinkle, 6BA Phos. Br. "Barber and Colman" Type 1904		1
12	614-2-03434 or PP. 21977	. Clip - Battery, L.H.		1
13	991-4-00250-055 or PP. 390	. Screw - Ch. hd., 6BA x 3/16in. lg. Brass, D.N.P. B.S.57		1
14	999-4-01560-003 or PP.11141	. Washer - Crinkle, 6BA, Phos. Br. "Barber and Colman", Type 1904		1
15	614-2-03442 or PP.21978	. Clip - Battery, R.H.		1
16	991-4-00250-005 or PP. 390	. Screw - Ch.hd. 6BA x 3/16in. lg. Brass D.N.P. B.S.57		1
17	614-2-03429 or PP. 21975	. Clip - Spring		1
18	614-2-03468-001 or PP. 2437	. Screw - Csk. hd 6BA x 9/64in. lg. Brass D.N.P. B.S.57		1
19	614-2-03435 or PP. 21974	. Contact - Battery		1
20	991-4-00452-003 or PP.2673	. Nut - Full, 6BA Brass, D.N.P. B.S.57		1

FIG. ITEM	PART No.	NOMENCLATURE 1 2 3 4 5 6 7	USAGE CODE	UNITS PER ASSY
21	999-4-01560-003 or PP. 11141	. Washer - Crinkle, 6BA, Phos. Br. "Barber and Colman", Type 1904		1
-22	998-4-20071-205 or PC. 3	. Wire - Electrical Equipment 1.036, P.V.C. Covered, Black		2 3/4
23	991-4-00268-063 or PP.2567	. Screw -Csk. hd., 6BA x 5/8in. lg. Brass, D.N.P. B.S.57		1
24	991-4-00452-003 or PP. 2673	. Nut - Full, 6BA Brass, D.N.P. B.S.57		1
25	614-2-03435 or PP. 21974	. Contact - Battery		1
26	991-4-00250-055 or PP. 390	. Screw - Ch. hd., 6BA x 3/16in. lg. Brass, D.N.P. B.S.57		1
27	999-4-01560-003 or PP.11141	. Washer - Crinkle, 6BA, Phos. Br. "Barber and Colman", Type 1904		1
-28	614-1-03454 or CAT. 9089	. Braid Assembly - Connection		1
-29	614-2-03466 or PP. 1080	. . Tag - No. 30		2
-30	-	. . Braid - Tinned Copper - Pattern No.5831-43-317 "Saxonia Elect Wire Co."		1 7/8 in

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FIG. ITEM	PART No.	NOMENCLATURE 1 2 3 4 5 6 7	USAGE CODE	UNITS PER ASSY
31	614-1-03465 or A.S. 6288	. Adjuster Assembly		1
32	614-2-03444 or PP. 21973	. Strip - Connection		1
32A	614-1-03662 or AS6289	. Reset - Fork Assembly		1 RF
33	614-2-03431 or PP. 22558	. . Stem - Reset		1
34	614-2-03433 or PP. 22555	. . Stop - Reset		1
35	614-2-03440 or PP. 22557	. . Fork - Reset		1
36	991-4-00250-059 or PP.1331	. Screw - Ch. hd., 6BA x 3/8in. lg. Brass, D.N.P. B.S.57		2
37	999-4-01560-003 or PP. 11141	. Washer - Crinkle, 6BA, Phos. Br. "Barber and Colman", Type 1904		2
38	614-2-03428 or PP. 22556	. Plug - End		2
39	614-4-03523 or PP. 9060	. Bearing - Ball. 5/8in. dia. B.S. 1224 CLASS SB8R		1
40	614-2-03521	. Plate - Name	A	1

FIG. ITEM	PART No.	NOMENCLATURE 1 2 3 4 5 6 7	USAGE CODE	UNITS PER ASSY
-41	614-1-03451 or AS. 6010	. Body Assembly - Black	AR	1RF
41A	614-2-03802	. Plate - Name	B	1
-42	614-1-03451-001 OR AS. 6010-1	. Body Assembly - Ivory	B	1RF
43	614-2-03441 or PP. 21979	. . Insert - Bulb		1
44	614-2-03443 or PP. 21976	. . Reflector		1
45	614-1-03457 or AS. 6009	. . Body - Moulding - Black	A	1
46	614-1-03457-001 or AS. 6009-1	. . Body - Moulding - Ivory	B	1
		NOTE: 614-4-03497 BATTERY WILL NOT BE SUPPLIED AS NORMAL SPARE. SPECIAL ORDER ONLY.		

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LIGHT OVERHAUL

Not Applicable.

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CHAPTER

34

NAVIGATION

de Havilland Inc.
DHC–6 TWIN OTTER
COMPONENT MAINTENANCE MANUAL
CHAPTER 34 – NAVIGATION
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MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B./T.R.
Aviation Instrument Manufacture (AIM)	Directional Indicator Directional Indicator Gyro	AIM 200 Series AIM 400 & AIM 800 510 Series		Oct 1969	
Aero–Scotia Limited	Altimeter	A35–MA–10L–1		Apr 23, 1970	
Aerosonic	Altimeter	101720–01419		Feb 1975	
Wright Instruments was R.C. Allen	Turn and Bank Indicator	M5000–08 (Model RCA 30)			
Edo–Aire	Vertical Speed Indicator	EA–1400 Series		Mar 1972	
Garwin	Vertical Speed Indicator	22–202–01A		Apr 1965	
Kollsman	Altimeter Altimeter Altimeter	D22061 10 012 1845X–4–03 671CPX–6–051	34–10–10	Apr 1965 Apr 1/1959	
Litton Aeronetics	Radio Magnetic Indicator	2105–210L through 2109–2109L		Nov 21/1969	
Mac Leod.	Altimeter	135–13503	34–10	Aug 28/1972	
SIRS Navigation & Smiths Industries	Standby Compass	KCA–0104W	34–25–21 was 34–20–38/53	Jan 20/2001	Smith SIL No. 34–47 dated June 2000

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MAINTENANCE AND OVERHAUL MANUAL

for

AIM 200 SERIES

DIRECTIONAL GYROS

AVIATION INSTRUMENT MANUFACTURING CORPORATION

9033 Monroe Road P. O. Box 12248

Houston, Texas 77017

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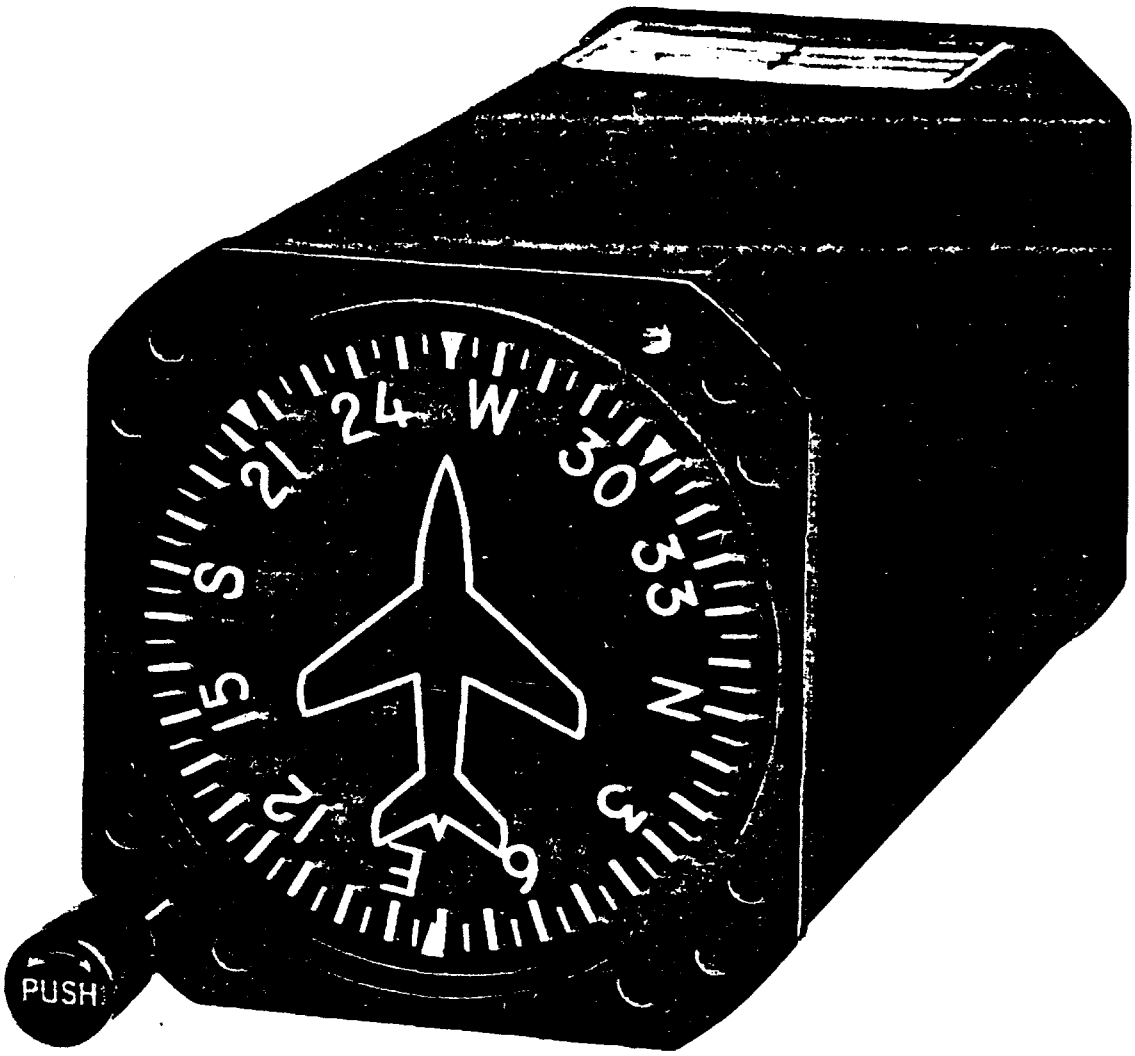


FIGURE 1-1. TYPICAL AIM 200 SERIES DIRECTIONAL GYRO

SECTION 1
GENERAL INFORMATION

1.1 SCOPE

This manual contains maintenance and overhaul procedures for Aviation Instrument Manufacturing Corporation's AIM 200 Series Directional Gyros. Specific models covered are:

AIM 200	AIM 200EDC
AIM 200 (18-380021)	AIM 200EDC (Bezel Mt.)
AIM 200 (CM2675-1)	AIM 200DC (14)
AIM 200E	AIM 200DC (28)
AIM 200E (AeroCom)	AIM 200DC (14) P
AIM 200ED	AIM 200DC (28) P

Additional models will be subsequently covered by the inclusion of Supplemental Data Sheets in the manual.

1.2 GENERAL DESCRIPTION

Although the Directional Gyros described in this manual contain many variations from model to model, the basic theory of operation is common to all units covered.

The AIM 200 Series Directional Gyros are precise, gyroscopic flight instruments designed to furnish the aircraft pilot with a constant directional reference which is not subject to the temporary errors inherent in magnetic compasses.

The function of each instrument is to maintain a stabilized datum reference from which the azimuth movements of an aircraft can be measured. This is accomplished by a universally mounted, high-speed rotor which develops sufficient angular momentum to overcome normal bearing friction and thus becomes stable relative to space. This stability, known as "rigidity in space", resists small forces which attempt to displace the axis of rotation and, consequently, its position in space.

1.2 GENERAL DESCRIPTION (Cont'd)

The instruments described in this manual are identical in function, and differ primarily in the means by which the high-speed rotor movement is achieved. Some models are vacuum-operated, some are ac-operated, and some are dc-operated. Detailed functional descriptions of each model are provided in paragraph 1.3.

In addition to variations in input requirements either of two distinct mechanical design configurations may also be encountered. The two configurations are shown in Figures 1-2 and 1-3.

In the "top-gear" configuration of Figure 1-2, the indicator card is positioned through a large spur-gear/clutch assembly at the top of the gimbal. A smaller spur gear at the top of an intermediate shaft, and two bevel gears at the bottom of the shaft, convert changes in azimuth into angular rotation of the card.

The "bottom-gear" configuration of Figure 1-3 positions the indicator card through a large spur gear at the bottom of the gimbal. A cup-gear/clutch assembly, mounted directly on the card shaft, converts azimuth changes into angular rotation of the card.

The clutch mechanism in both configurations permits resetting the card with minimum repositioning of the gimbal. A caging knob marked "PUSH" is provided on the front panel to simultaneously cage the gyro and to readjust the indicator card to the desired heading.

The diameter of the caging shaft provides a convenient key to determining the internal configuration of the gyro, even with the instrument mounted in a panel. The top-gear configuration has a 1/8 inch shaft, and the bottom-gear configuration uses a 3/16 inch shaft.

All AIM 200 Series instruments fit a standard 3-1/8 inch instrument panel cut-out. The small size of the instruments, combined with their substantially reduced weight, permits panel layouts in accordance with SAE and airline standards.

The instruments are spill-proof and will not tumble regardless of the aircraft's attitude. A self-erecting feature incorporated in each instrument eliminates the need for periodic caging of the rotor, except for the usual heading resets.

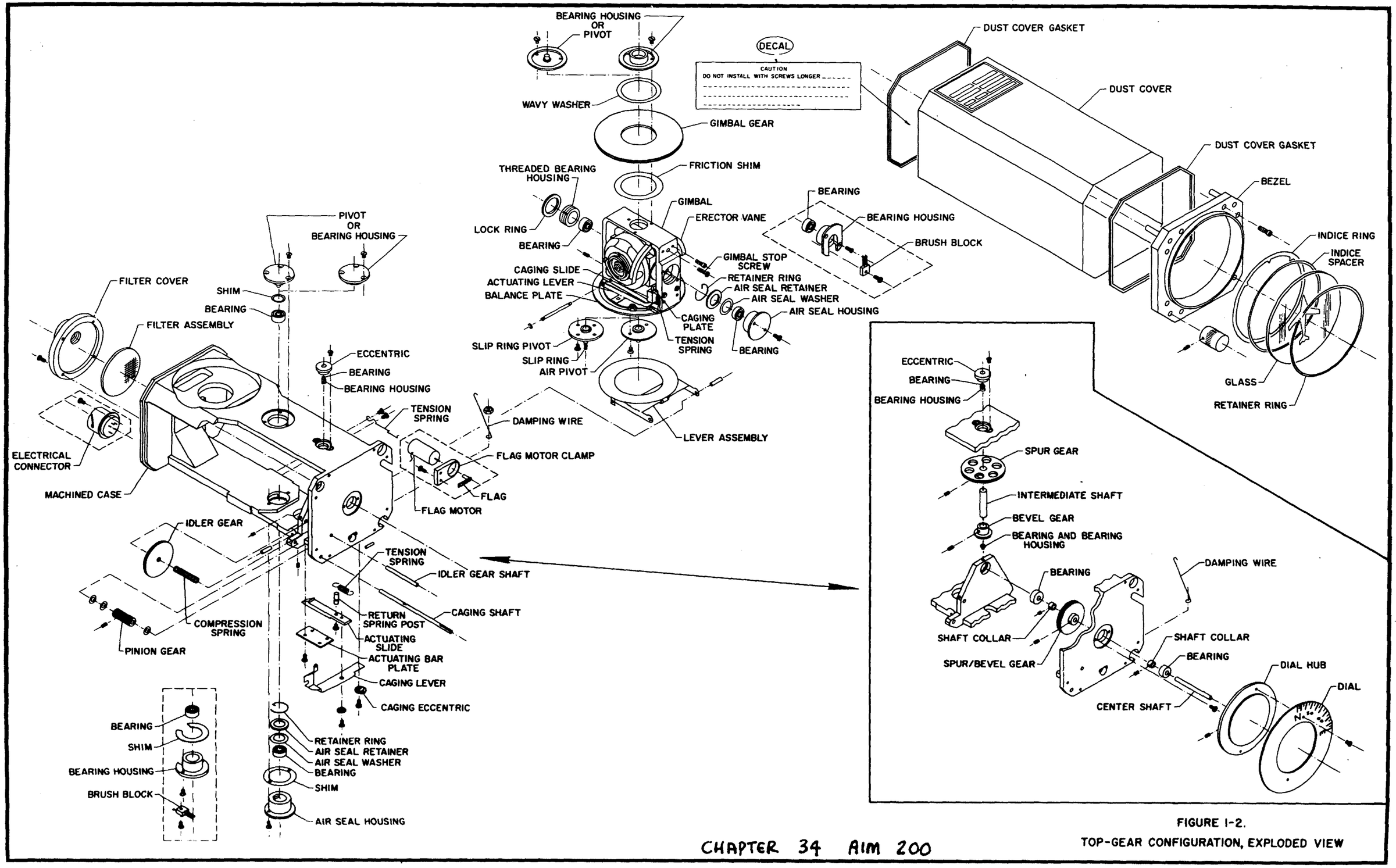


FIGURE 1-2.
TOP-GEAR CONFIGURATION, EXPLODED VIEW

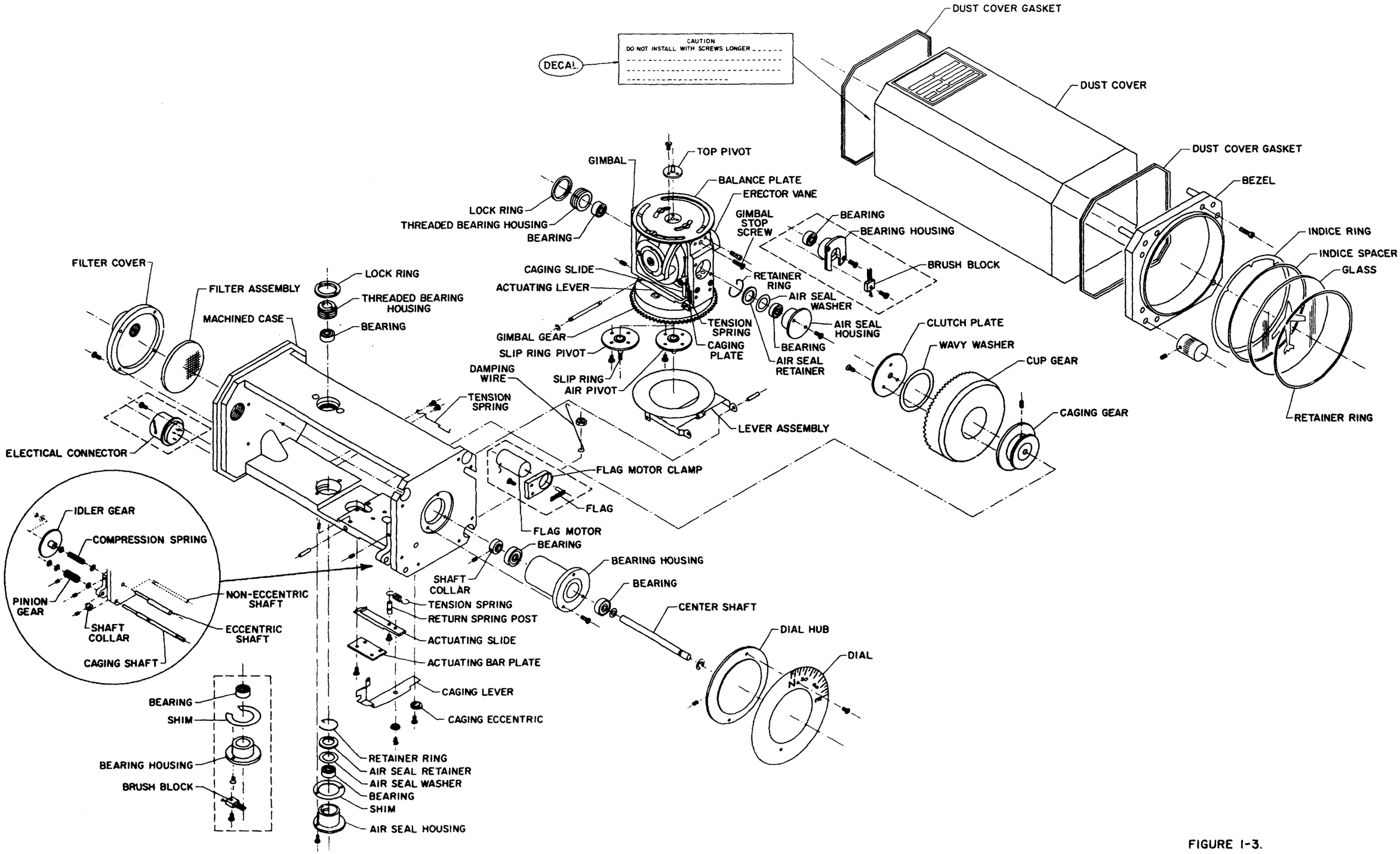


FIGURE 1-3.
BOTTOM-GEAR CONFIGURATION, EXPLODED VIEW

1.3 CONSTRUCTION DETAILS

1.3.1 General

The two basic instrument configurations, top-gear and bottom-gear, are shown in Figures 1-2 and 1-3, respectively. Each illustration is a composite exploded-view drawing of a vacuum instrument, with corresponding electric-instrument components such as the electrical connector, brush blocks, etc., enclosed in dashed areas near their actual location in the instrument. Electronic components, such as resistors, capacitors, diodes, etc., are omitted from both figures, and instead, are shown schematically in Figures 1-4 thru 1-7. In instruments where inverter or flag circuit components are mounted on a component board, refer to the appropriate schematic for parts identification.

The functional center of both vacuum and electric instruments is an accurately balanced, high-speed rotor which is mounted on precision bearings inside an enclosed rotor housing. The rotor housing is suspended from bearings mounted in the gimbal assembly and is free to pivot in the vertical plane up to $\pm 80^{\circ}$ from horizontal. In turn, the gimbal assembly is suspended from bearings mounted in the instrument case so that the over-all assembly has complete freedom of movement about its vertical axis.

1.3.2 Vacuum Instruments

A vacuum system capable of maintaining a suction of 4.5 to 4.7 inches of mercury is connected to the vacuum (outlet) port on the rear of the instrument. This port opens directly into the air sealed instrument case. Air, at normal atmospheric pressure, is then drawn through the AIR INLET filter and along a duct in the bottom of the instrument case to an air seal housing which contains the lower gimbal bearing. The air is then drawn through a duct in the gimbal to a second air seal housing which contains one of the bearings which supports the rotor housing. Air passes through the rotor housing pivot and is directed at the buckets in the rotor periphery, causing the rotor to revolve at very high speed.

Air is exhausted from the rotor housing through two horizontally opposed erector jets, and pushes against a semi-circular erector vane attached to the gimbal. The entire assembly acts as an air valve so that when the spin axis of the rotor is inclined from the horizontal position, one erector

1.3.2 Vacuum Instruments (Cont'd)

jet will be closed while the air being expelled from the opposite erector jet will exert torque about the vertical axis of the gimbal. This action precesses the spin axis of the rotor to the horizontal position so that the opposing jets are opened an equal amount and the gimbal is again stable.

1.3.3 Electric Instruments

Both ac and dc-operated units utilize a 115 vac, 400 Hz. electric rotor. DC-operated units employ a self-contained solid state inverter to produce the required ac drive voltage from the applied dc input.

The input voltage on ac units, and the internally produced drive voltage on dc units, is 115 vac, 400 Hz., single phase power. A capacitor, electrically connected between the two rotor windings, produces the two-phase effect necessary for operation of the rotor.

The rotor drive voltage is applied to leads inside the gimbal through a brush block and slip ring assembly on the bottom of the instrument case. From there, the drive voltage is transferred through a gimbal brush block and slip ring assembly to wiring which leads to the stator inside the rotor housing.

The rotor and hysteresis armature ring are mounted around the fixed stator on precision bearings so that when power is applied to the stator, the desired rotor movement is achieved.

Small impellers are affixed to the top and bottom of the spinning rotor to generate the air flow required in order to utilize the same self-erection system used in the vacuum-driven units.

1.3.4 AIM 200E Rotor and Flag Circuitry

A schematic diagram of the AIM 200E is shown in Figure 1-4A, along with an alternate flag circuit (B) which may also be encountered.

In circuit "A", diode CR1 is used for operation of the dc flag motor, and capacitor C1 produces the two-phase effect necessary for rotor operation. Both components are located in the rear of the instrument case.

With diode CR1 connected at point "1" (Figure 1-4A), the flag is retracted by a feedback voltage generated by the spinning rotor. Therefore, even if adequate power is supplied to the instrument, the warning

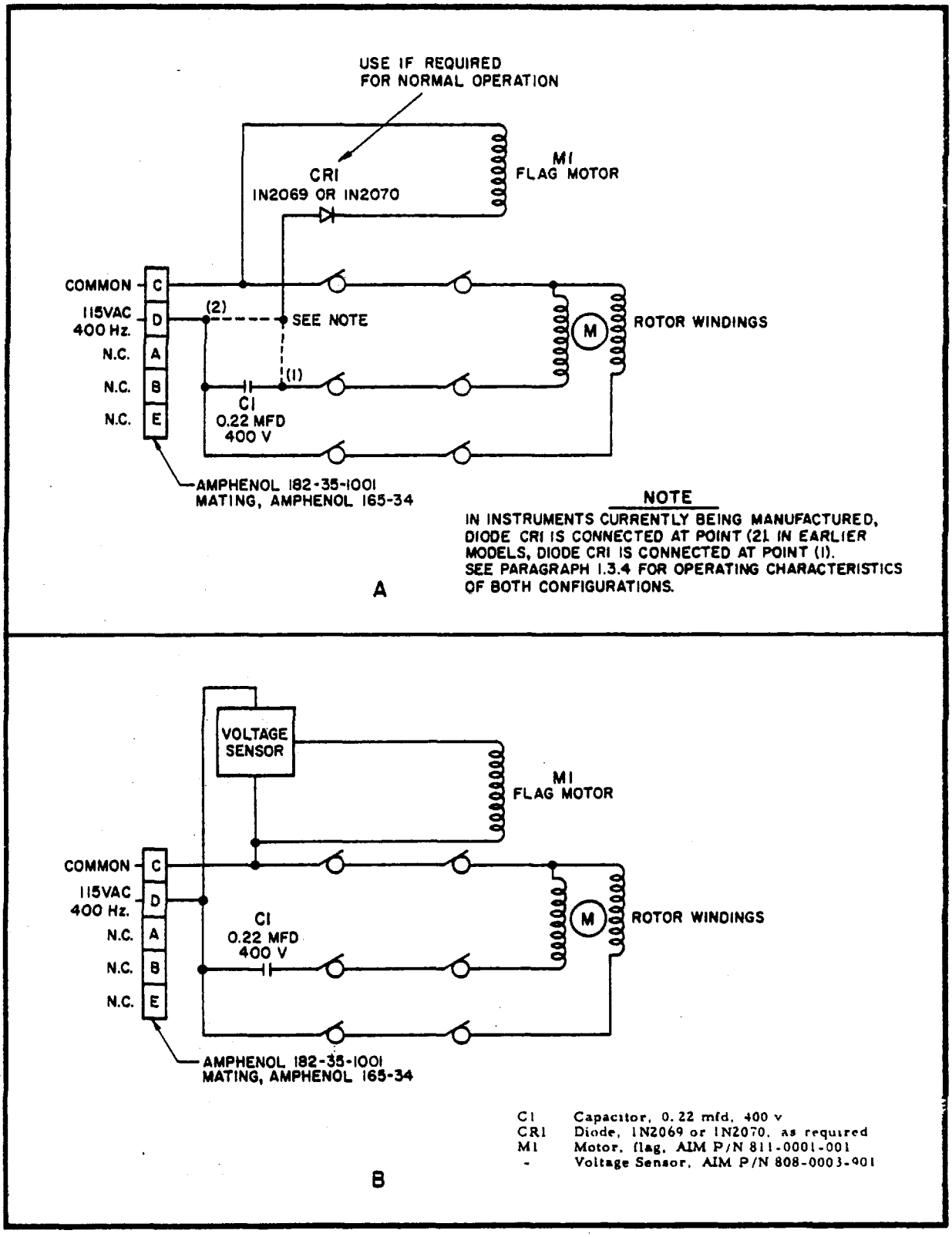


FIGURE 1-4. SCHEMATIC DIAGRAM, AIM 200E

1.3.4 AIM 200E Rotor and Flag Circuitry (Cont'd)

flag will not retract unless the rotor is functioning. With CR1 connected at point "2", the flag is retracted when the applied voltage reaches a pre-determined level, regardless of the rotor speed. Either circuit may be encountered during overhaul.

Alternate circuit "B" (Figure 1-4) includes a voltage sensor network which retracts the flag when the applied voltage reaches a pre-determined level, regardless of the rotor speed.

Operating specifications for circuits "A" and "B" are provided in the Test and Calibration procedures of Section 3.

1.3.5 AIM 200EDC Rotor, Flag, and Inverter Circuitry

A schematic diagram of the AIM 200EDC is shown in Figure 1-5. Choke L1 in the inverter input serves as a transient suppressor and also blocks squarewave noise from feeding back into the dc power source. Diode CR2 provides reverse polarity protection for the inverter circuitry.

CR3 is a 36 v Zener diode which protects against large positive over-voltages. Capacitor C2 stabilizes the dc input voltage to improve the output waveshape.

Circuit operation is sustained by the alternating polarity of feedback windings FB1 and FB2. The resultant output is a 115 vac, 400 Hz., single phase squarewave applied directly to the rotor windings. Capacitor C1 produces the two-phase effect necessary for rotor operation.

Diode CR1 produces the dc voltage required for operation of the flag motor. The output from the inverter alone is insufficient to actuate the flag. As the rotor speed increases, a feedback voltage developed across the rotor winding augments the inverter voltage and actuates the flag.

1.3.6 AIM 200DC (14) Rotor, Flag, and Inverter Circuitry

The AIM 200DC (14), schematic is shown in Figure 1-6A, along with an alternate flag circuit (B) which may also be encountered.

In circuit "A" choke L1 and capacitor C2 in the inverter input serve as a transient suppressor and also block squarewave noise from feeding back into the dc power source. Diode CR2 provides reverse polarity protection for the inverter circuitry.

C1	Capacitor, 0.22 mfd, 400 v
C2	Capacitor, 40 mfd, 35 v, electrolytic
CR1	Diode, 1N2070 or 1N4004, Motorola
CR2	Diode, 1N1115, Texas Instrument
CR3	Diode, Zener, 1N2991A, Texas Instrument
L1	Choke, AIM P/N 803-0001-001
M1	Motor, flag, AIM P/N 811-0001-001
Q1	Transistor, 2N3618 or 2N1560, Motorola
Q2	Transistor, 2N3618 or 2N1560, Motorola
R1	Resistor, 3900 ohm, 1/2 watt
R2	Resistor, 20 ohm, 3 watt
T1	Transformer, AIM P/N 804-0013-001
-	Voltage Sensor, AIM P/N 808-0003-901

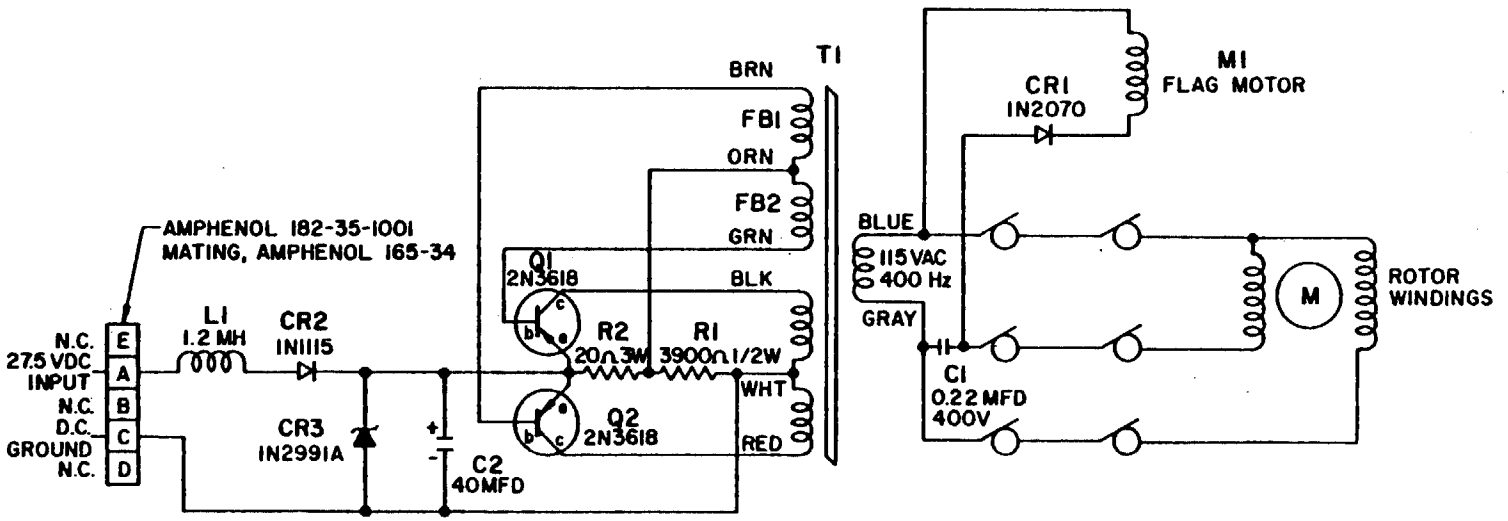


FIGURE 1-5. SCHEMATIC DIAGRAM, AIM 200EDC

1.3.6 AIM 200DC (14) Rotor, Flag, and Inverter Circuitry (Cont'd)

Capacitors C3 and C4 stabilize the dc input voltage to improve the output waveshape, and also assist in suppression of transients. Diode CR3 prevents the voltage across either half of the primary winding from exceeding the supply voltage when the inverter switches from one conducting transistor to the other.

Circuit operation is sustained by the alternating polarity of feedback windings FB1 and FB2. The resultant output is a 115 vac, 400 Hz., single phase squarewave applied directly to the rotor windings. Capacitor C1 produces the two -phase effect necessary for rotor operation. Diode CR1 produces the dc voltage required for operation of the flag motor.

With diode CR1 connected at point "1" (Figure 1-6A), the flag is retracted by a feedback voltage generated by the spinning rotor. Therefore, even if adequate power is supplied to the instrument, the warning flag will not retract unless the rotor is functioning. With CR1 connected at point "2", the flag is retracted when the applied voltage reaches a pre-determined level, regardless of the rotor speed. Either circuit may be encountered during overhaul.

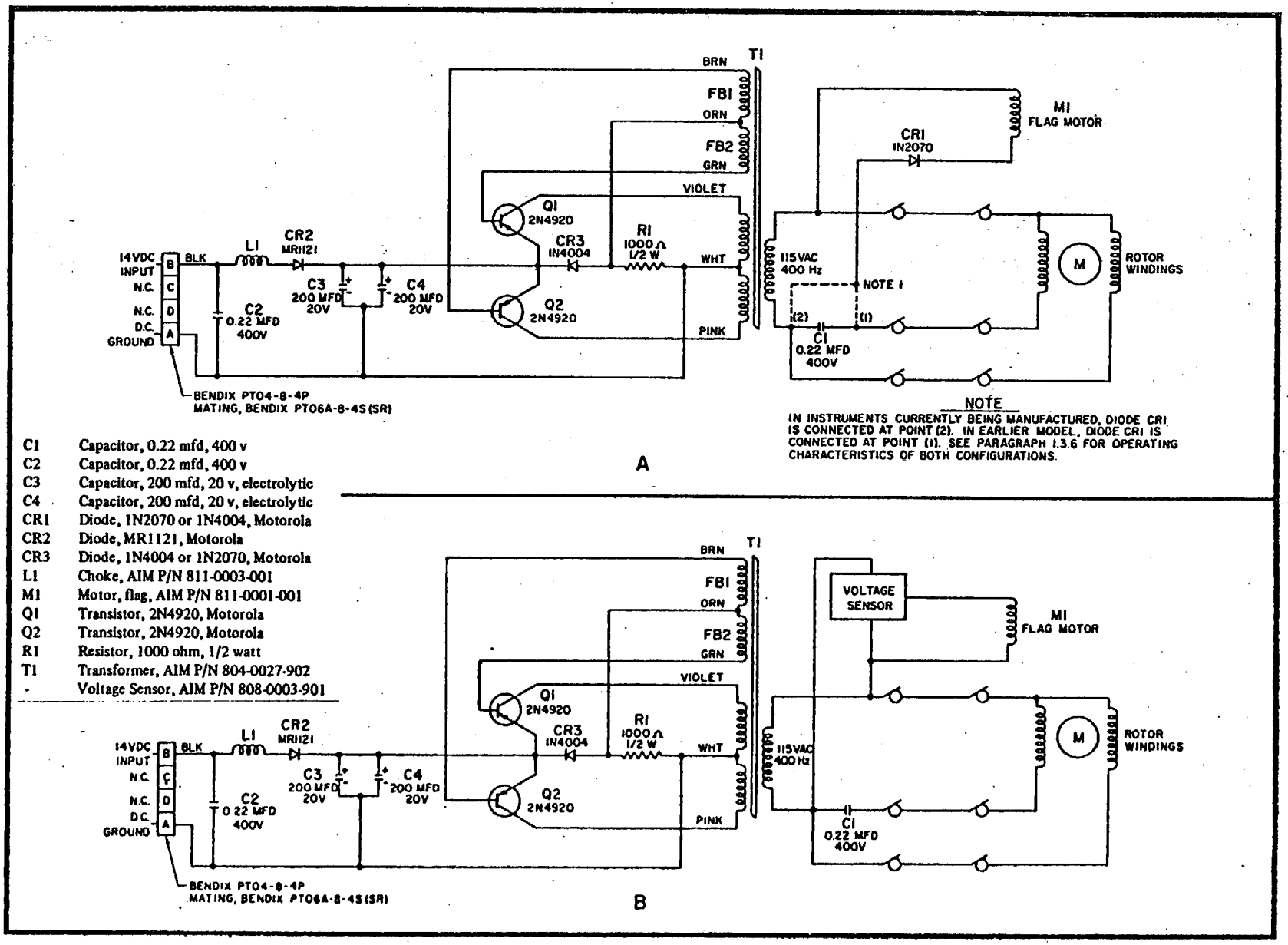
Alternate circuit "B" (Figure 1-6) includes a voltage sensor network which retracts the flag when the applied voltage reaches a pre-determined level, regardless of the rotor speed.

Operating specifications for circuits "A" and "B" are provided in the Test and Calibration procedures of Section 3.

1.3.7 AIM 200DC (28) Rotor, Flag, and Inverter Circuitry

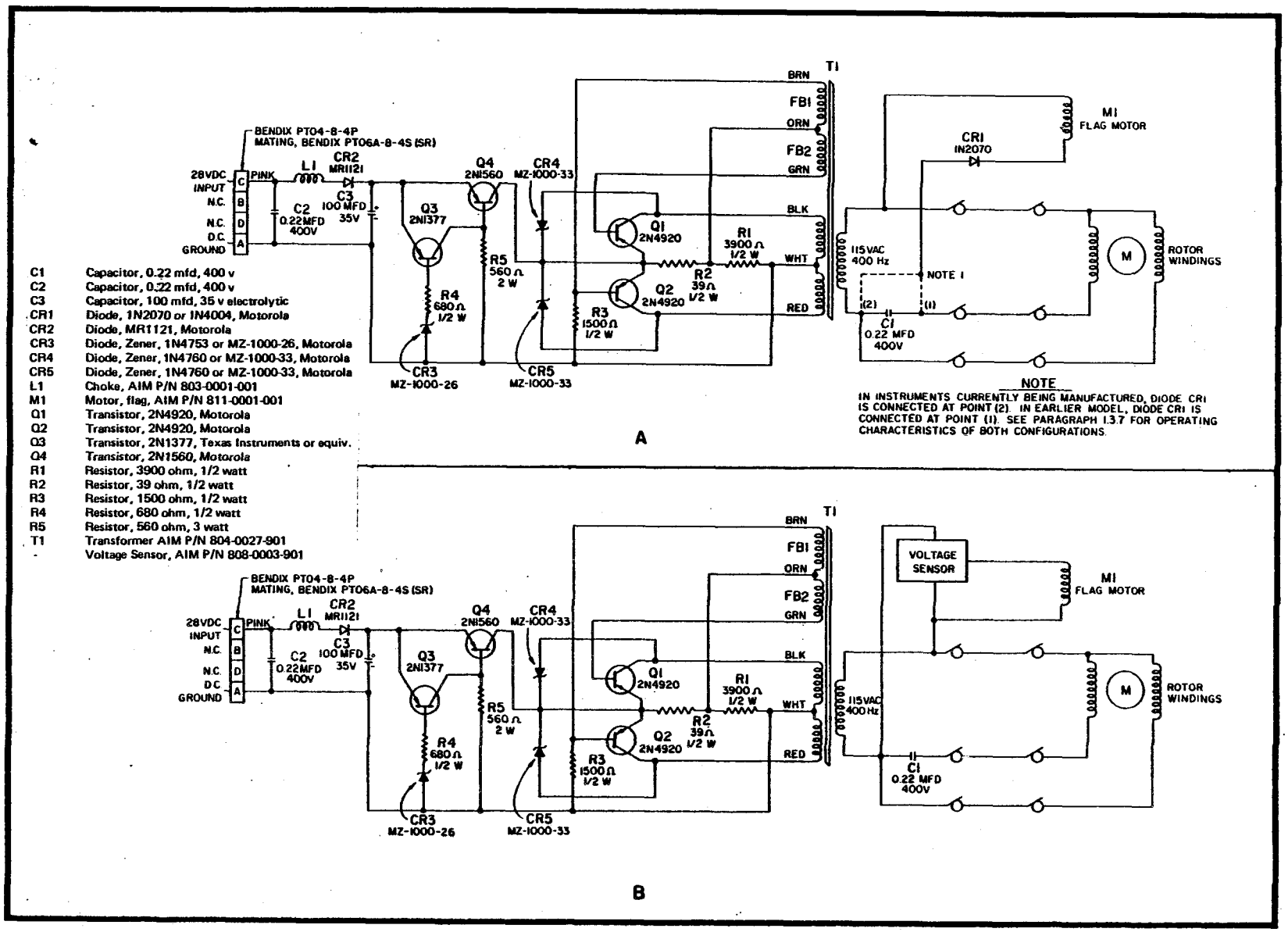
The AIM 200DC (28) schematic is shown in Figure 1-7A, along with an alternate flag circuit (B) which may also be encountered. Choke L1 and capacitor C2 in the inverter input serve as a transient suppressor and also block squarewave noise from feeding back into the dc power source. Diode CR2 provides reverse polarity protection for the inverter circuitry.

Transistors Q3 and Q4 provide transient suppression and also protect against sustained over-voltage conditions at the input. Applied voltage levels in excess of 28 vdc cause Q3 to bias Q4 toward cutoff; thus, the voltage level at the emitters of Q1 and Q2 is maintained constant.



C1 Capacitor, 0.22 mfd, 400 v
C2 Capacitor, 0.22 mfd, 400 v
C3 Capacitor, 200 mfd, 20 v, electrolytic
C4 Capacitor, 200 mfd, 20 v, electrolytic
CR1 Diode, 1N2070 or 1N4004, Motorola
CR2 Diode, MR1121, Motorola
CR3 Diode, 1N4004 or 1N2070, Motorola
L1 Choke, AIM P/N 811-0003-001
M1 Motor, flag, AIM P/N 811-0001-001
Q1 Transistor, 2N4920, Motorola
Q2 Transistor, 2N4920, Motorola
R1 Resistor, 1000 ohm, 1/2 watt
T1 Transformer, AIM P/N 804-0027-902
- Voltage Sensor, AIM P/N 808-0003-901

FIGURE 1-6. SCHEMATIC DIAGRAM, AIM 200DC (14)



C1 Capacitor, 0.22 mfd, 400 v
C2 Capacitor, 0.22 mfd, 400 v
C3 Capacitor, 100 mfd, 35 v electrolytic
CR1 Diode, 1N2070 or IN4004, Motorola
CR2 Diode, MR1121, Motorola
CR3 Diode, Zener, 1N4753 or MZ-1000-26, Motorola
CR4 Diode, Zener, 1N4760 or MZ-1000-33, Motorola
CR5 Diode, Zener, 1N4760 or MZ-1000-33, Motorola
L1 Choke, AIM P/N 803-0001-001
M1 Motor, flag, AIM P/N 811-0001-001
Q1 Transistor, 2N4920, Motorola
Q2 Transistor, 2N4920, Motorola
Q3 Transistor, 2N1377, Texas Instruments or equiv.
Q4 Transistor, 2N1560, Motorola
R1 Resistor, 3900 ohm, 1/2 watt
R2 Resistor, 39 ohm, 1/2 watt
R3 Resistor, 1500 ohm, 1/2 watt
R4 Resistor, 680 ohm, 1/2 watt
R5 Resistor, 560 ohm, 3 watt
T1 Transformer AIM P/N 804-0027-901
- Voltage Sensor, AIM P/N 808-0003-901

FIGURE I-7. SCHEMATIC DIAGRAM, AIM 200DC (28)

1.3.7 AIM 200DC (28) Rotor, Flag, and Inverter Circuitry (Cont'd)

Inverter circuit operation is sustained by the alternating polarity of feedback windings FB1 and FB2. Zener diodes CR4 and CR5 improve the output waveshape by eliminating the leading edge spike caused by the inductive collapse of the transformer primary during switching. The resultant output is a 115 vac, 400 Hz., single phase squarewave applied directly to the rotor windings. Capacitor C1 produces the two-phase effect necessary for rotor operation. Diode CR1 produces the dc voltage required for operation of the flag motor.

With diode CR1 connected at point "1" (Figure 1-7A), the flag is retracted by a feedback voltage generated by the spinning rotor. Therefore, even if adequate power is supplied to the instrument, the warning flag will not retract unless the rotor is functioning. With CR1 connected at point "2", the flag is retracted when the applied voltage reaches a pre-determined level, regardless of the rotor speed. Either circuit may be encountered during overhaul.

Alternate circuit "B" (Figure 1-7) includes a voltage sensor network which retracts the flag when the applied voltage reaches a pre-determined level, regardless of the rotor speed.

Operating specifications for circuits "A" and "B" are provided in the Test and Calibration procedures of Section 3.

1.4 SPECIFICATIONS

Operating Limits	Azimuth; 360° Pitch and Roll; 360° freedom through controlled precession
Drift	Maximum of 3° in 10 minutes for any heading when subjected to roll, pitch, and yaw oscillations with an amplitude of ± 3 degrees about each axis, at a frequency of 5 to 7 oscillations per minute.
Operating Temperature Range	-30°C (-22°F) to +50°C (+122°F)
Rotor Speed	Vacuum; 24,000 rpm, nominal Electric; 23,500 rpm, nominal

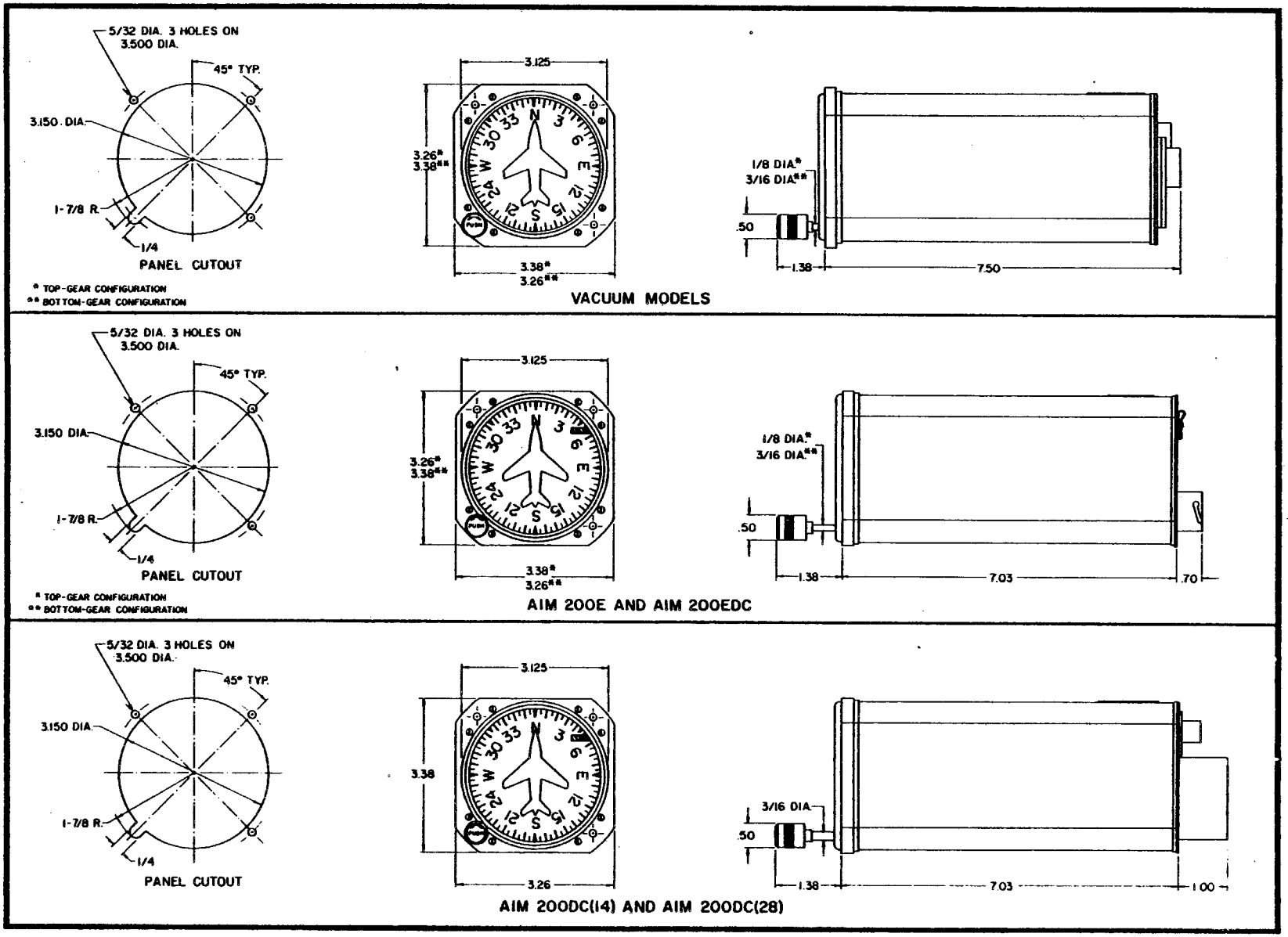


FIGURE I-8. TYPICAL OUTLINE DIMENSIONS

1.4 SPECIFICATIONS (Cont'd)

Heading Indicator	Vertical card presentation with matte white 30° primary markings, 10° secondary markings, and 5° tertiary markings.
Mounting	Standard 3-1/8 in. cutout in shock-mounted panel.
Case Size	See outline drawing, Figure 1-8.
Weight	2.7 lbs. nominal
FAA Specification	TSO-C5c
Vacuum Units Only	
Vacuum Required	4.5 to 5.2 inches of mercury
Air Consumption	1.7 cu. ft./min., nominal
Electric Units Only	
Power Requirements	
AIM 200E	115 vac, 400 Hz., single phase 115 ma nominal running current 140 ma nominal starting current
14 vdc Instruments	14 vdc, 1.0 to 1.4 amps
28 vdc Instruments	28 vdc, 0.5 to 0.7 amps

1.5 GYRO HANDLING*

High gyro removal rate can often be directly related to rough or improper handling. Gyros are delicate instruments and cannot withstand the shock of being dropped, jarred, or struck by other pieces of equipment.

To preclude damage to the gyro, it should be transported to and from the aircraft in its original shipping container. When this procedure is impractical, the gyros should be hand-carried with special care.

Gyros should never be removed while they are running or spinning down. A gyro normally operates between 20,000 to 24,000 rpm and takes 10 or more minutes to run down. If a gyro is removed while it is running and if it is tilted more than 90 degrees, it will develop a gimbal lock. The gimbal will tumble and start to spin. If gimbal lock occurs while the gyro is turning, the gimbal may spin fast enough to damage the gimbal bearings.

*Reprinted from the July-August, 1966 issue of Aviation Mechanics Bulletin published by Flight Safety Foundation, Inc.

1.5 GYRO HANDLING (Cont'd)

Even though a gyro has malfunctioned and is being removed from the aircraft, the gyro must be handled with the same respect due a new one. It is easy to think of a gyro that has malfunctioned as one destined for the scrap pile. This is not so. It can probably be fixed. It is therefore very important that proper handling procedures also be employed during removal.

Gyro handling techniques are summarized as follows: (1) Keep the gyro in the original shipping container as long as possible or provide a well padded, shock-absorbent container for transporting the gyro. (2) Wait at least 10 minutes after removing electrical or vacuum power from the aircraft and/or gyro before removing gyro. Do not remove a gyro while it is running. (3) Lift gyro from the base and carry in an upright position. (4) Handle the gyro with care at all times and avoid subjecting it to shock or vibration.

SECTION 2
OVERHAUL

2.1 GENERAL

Overhaul may be required due to a specific malfunction or merely as a routine step in a periodic maintenance program. Regardless of the reason, the disassembly and overhaul procedures in this section should be closely followed.

Each instrument consists of several distinct subassemblies which may be separately disassembled, cleaned, reassembled and tested. As each assembly is disassembled, the location of each component should be noted so that it can be replaced in the same position. This is particularly true of bearings, pivots, or jewels. Although the same bearing type may be used in several positions, the bearings are designed to provide different amounts of radial play according to their use and location within the instrument.

When handling the circular indicator card, care should be taken to avoid soiling the dial markings. All bearings, pivots, and jewels should be handled with assembly tweezers to avoid contamination. Iridited, oxided, or passivated parts must be secured in final adjusted position by "Glyptal" (G. E. trademark). Solvents used for cleaning must be high grade, such as Chlorothene-Nu (Dow Chemical Co.).

2.2 TOOLS REQUIRED

2.2.1 General

Although the instruments can be completely disassembled and reassembled using only the standard instrument-shop handtools listed in paragraph 2.2.2, special attention should be given to the additional equipment required in paragraph 3.2. This equipment, although not directly used in assembling or disassembling the instruments, must be available to properly calibrate and check-out the instruments' operating characteristics after overhaul.

Construction of the spanner wrenches listed under paragraph 2.2.2 (g) is shown in Figure 2-1. Spanner wrench "B" is used in removing the threaded bearing housing from the gimbal assembly. Spanner "A" is used

2.2.1 General (Cont'd)

in conjunction with spanner "B" to simultaneously hold the lock ring (some models only) in place around it. On bottom-gear instruments, spanners "A" and "B" are also used to remove and install the gimbal bearing housing on top of the instrument.

Spanner "C" is used in removing the threaded housings from each end of the 34B and R3H rotor housings, and in removing the lock rings securing the threaded housings in place.

2.2.2 Handtools

a. Assembly tweezers
b. Eye loupe
c. Selection of small screwdrivers
d. No. 4 and No. 8 Allen wrenches
e. No. 2 and No. 4 Bristol spline wrenches
f. 1/4 inch and 3/16 inch open-end wrenches
g. Spanner wrenches of Figure 2-1

2.2.3 Expendable Supplies

The following expendable supplies should be available before attempting to overhaul the instruments:

a. 1/2 gallon of Chlorothene-Nu (Dow Chemical Co.)
b. Watch paper
c. Blue Glyptal (General Electric Co.)
d. Red Locktite

2.3 DISASSEMBLY PROCEDURES

2.3.1 General

Before proceeding with disassembly of any component, the degree of wear, end play, backlash, and general physical appearance must be checked and noted as an aid in reassembly.

During disassembly, extreme care must be used in the removal of any component. Use of proper tools is important to prevent damage by scratching or marring. Many of the parts are secured with Glyptal and it will be necessary to dissolve the Glyptal before removing these

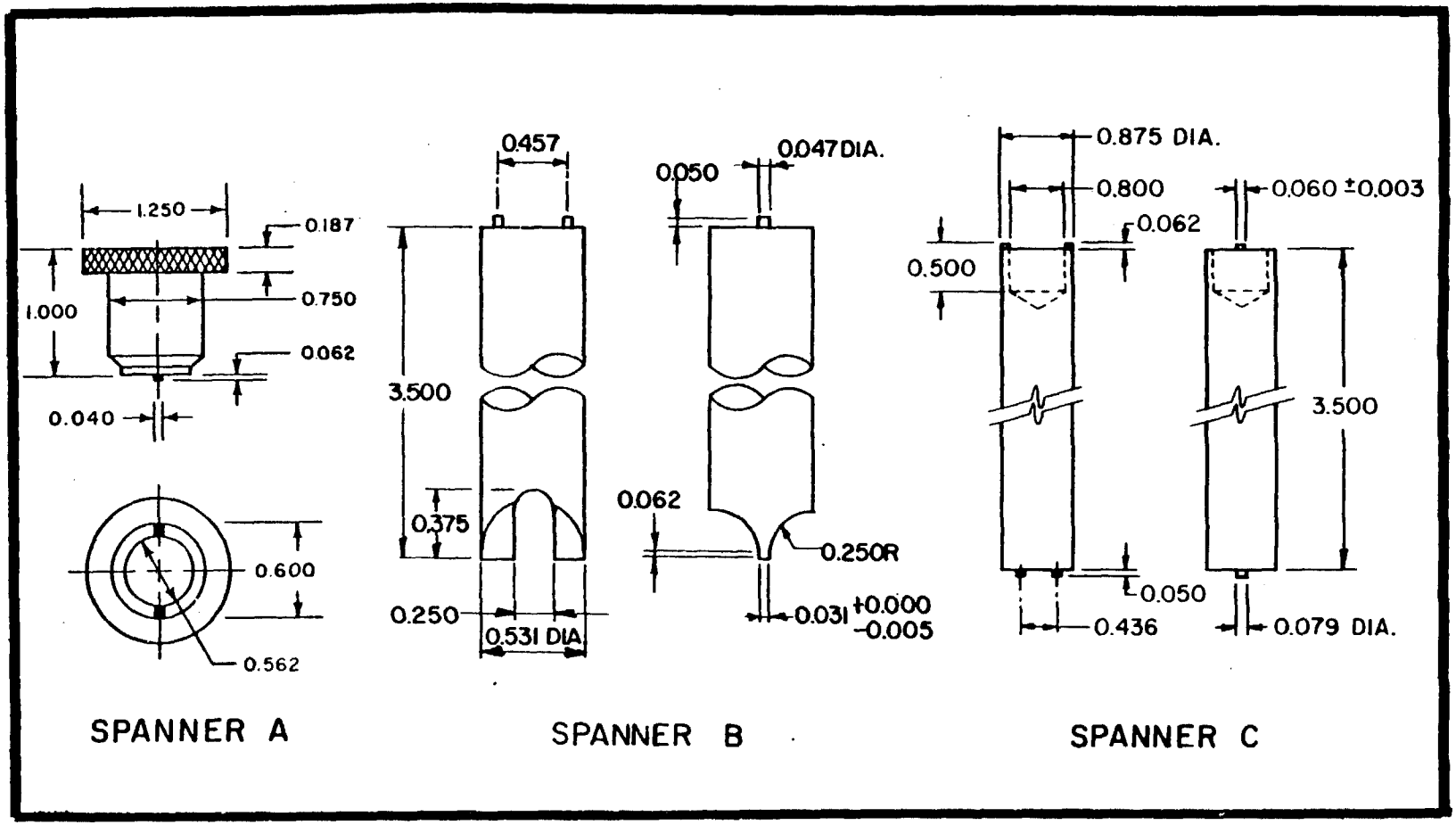


FIGURE 2-1. CONSTRUCTION OF SPECIAL TOOLS

2.3.1 General (Cont'd)

parts. Screws or other attaching parts must be carefully identified during disassembly for correct replacement during reassembly.

Due to delicate rebalancing required, and the precision parts involved, disassembly and overhaul of the rotor and rotor housing assembly is not recommended. Should the rotor become defective and fail to meet the performance requirements set forth in Section 3, return the used rotor housing and pivot assembly to AIM for an exchange discount on a new replacement assembly.

If overhaul of the rotor should become necessary in the field, specific instructions are provided in paragraph 2.6.

2.3.2 Case Access

1. Remove the PUSH knob by loosening the #4-40 spline setscrew which secures the knob to the shaft. A #4 Bristol spline wrench is provided on the rear of the case for this purpose.

NOTE

The #4 Bristol spline wrench is intended to facilitate the rapid installation and removal of the unit from an instrument panel. It should not be used to remove screws inside the instrument due to the possibility of paint flakes contaminating the unit. Instead, an unpainted wrench should be used.

2. Remove the 7 screws securing the bezel assembly to the instrument case. One of the mounting-screw recesses is filled with sealing wax which must be removed. Care should be taken to insure that the front gasket remains in position on the bezel when the bezel is removed. This is done to minimize the possibility of contaminating the unit with paint flakes from the rubber gasket.
3. Carefully remove the dust cover, making sure that the rear gasket remains in position on the rear panel of the instrument housing.
4. When the dust cover has been removed, slip the rear gasket over the rear panel and away from the unit. The front and rear gaskets and the dust cover should be taken to a remote area and thoroughly cleaned of all paint and foreign matter. The gaskets can be cleaned

2.3.2 Case Access (Cont'd)

by stretching until the paint cracks and then scraping the flakes away. The same gaskets can be reused when the dust cover is again installed.

2.3.3 Removal of Gimbal Assembly

1. Type 1, Figure 2-2
    1. Place the instrument in its normal position with the PUSH knob in the lower left corner of the instrument front.
    2. Remove three flat head screws and remove the upper gimbal-bearing housing from the top of the instrument.
    3. Shims are sometimes used inside the bearing housing to reduce gimbal end-play. If shims have been used, retain for use during reassembly.
    4. Turn the instrument over, being careful to avoid damage to the gimbal.
    5. On electric instruments, carefully remove the brush block assembly from the bottom of the case.
    6. Remove the two screws securing the lower bearing housing in place. On vacuum instruments, the housing may contain alignment shims which are used to align the air passage in the housing with the air passage in the instrument case. If shims are included, they should be retained for use during reassembly.
    7. Removal of the lower bearing housing permits access to the two screws securing the pivot to the bottom of the gimbal. When the pivot is lifted into the bearing housing recess, the entire gimbal assembly may be removed.
    8. Disassembly of the upper gimbal-pivot and clutch assembly is not recommended unless specific replacement of component parts is required. If disassembly becomes necessary, proceed as follows:

       Remove the three screws from the gimbal pivot assembly at the top of the gimbal. During disassembly, notice the order in which the gimbal pivot, the washer, the gimbal gear, and the friction shim are removed. First comes the gimbal pivot, then the spring washer, the gimbal gear, and then the friction

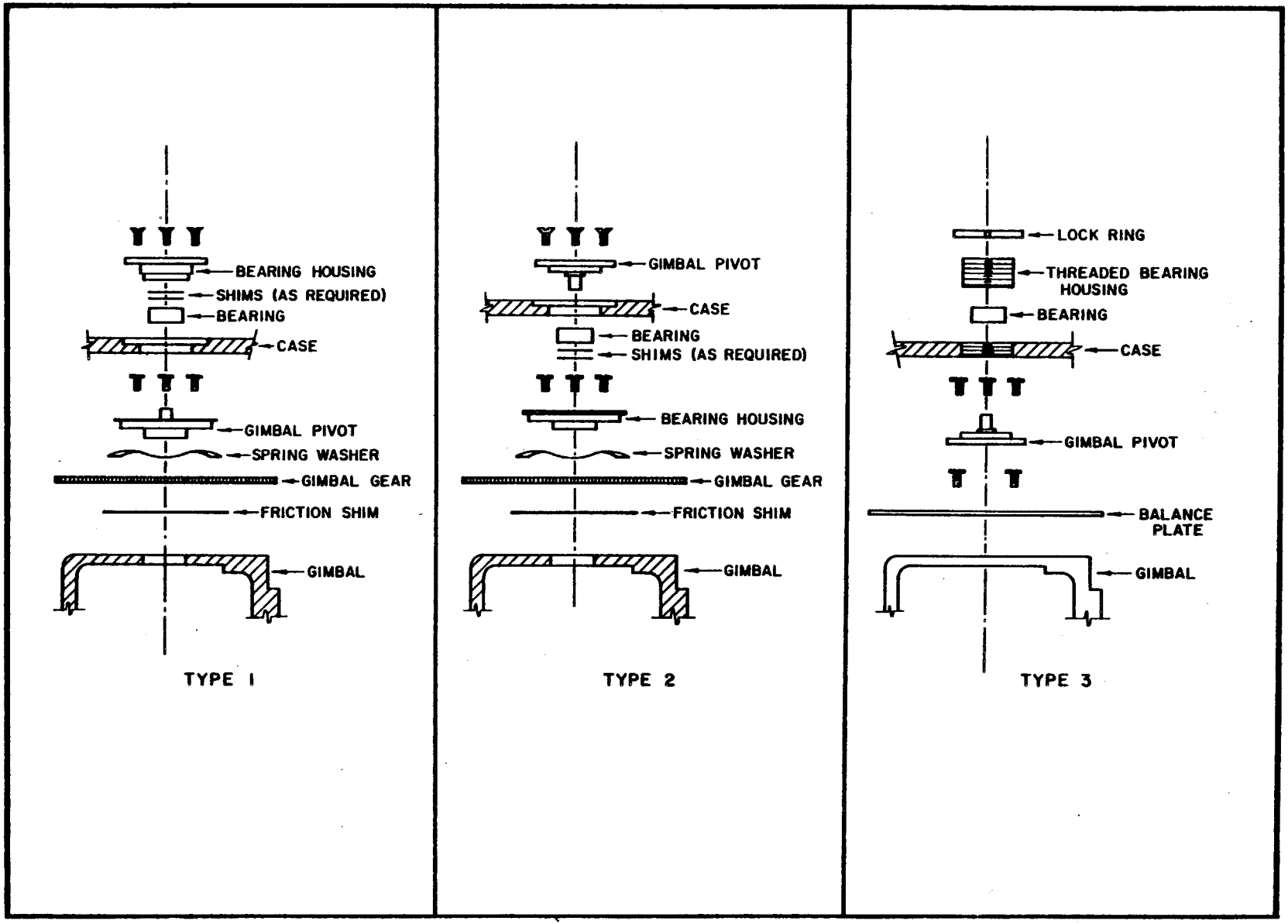


FIGURE 2-2. PIVOT DESIGN VARIATIONS, TOP OF GIMBAL

2.3.3 Removal of Gimbal Assembly (Cont'd)

1. Type 1, Figure 2-2 (Cont'd)

   shim which is mounted between the gimbal gear and the gimbal.

2. Type 2, Figure 2-2

   1. Place the instrument in its normal position with the PUSH knob in the lower left corner of the instrument front.
   2. Remove three flat head screws and remove the upper gimbal-pivot from the top of the instrument.
   3. Remove the bearing from the housing on top of the gimbal. Shims are sometimes used inside the bearing housing to reduce end-play. If shims have been used, retain for use during reassembly.
   4. Turn the instrument over, being careful to avoid damage to the gimbal.
   5. On electric instruments, carefully remove the brush block assembly from the bottom of the case.
   6. Remove the two screws securing the lower bearing housing in place. On vacuum instruments, the housing may contain alignment shims which are used to align the air passage in the housing with the air passage in the instrument case. If shims are included, they should be retained for use during reassembly.
   7. Removal of the lower bearing housing permits access to the two screws securing the pivot to the bottom of the gimbal. When the pivot is lifted into the bearing housing recess, the entire gimbal assembly may be removed.
   8. Disassembly of the bearing housing and clutch assembly at the top of the gimbal is not recommended unless specific replacement of component parts is required. If disassembly becomes necessary, proceed as follows:

      Remove three screws securing the bearing housing to the top of the gimbal. During disassembly, notice the order in which the bearing housing, the spring washer, the gimbal gear, and the friction shim are removed. First comes the bearing housing, then the spring washer, the gimbal gear, and then the friction

2.3.3 Removal of Gimbal Assembly (Cont'd)

2. Type 2, Figure 2-2 (Cont'd)

shim which is mounted between the gimbal gear and the gimbal.

3. Type 3, Figure 2-2

1. Place the instrument in its normal position with the PUSH knob in the lower left corner of the instrument front. Remove the threaded upper gimbal-bearing housing from the top of the instrument case.
2. Removal of the upper bearing permits access to the three screws securing the pivot to the top of the gimbal. Remove these screws and lift the pivot through the opening.
3. Turn the instrument over, being careful to avoid damage to the gimbal.
4. On electric instruments, carefully remove the brush block assembly from the bottom of the case.
5. Remove the two screws securing the lower bearing housing in place. On vacuum instruments, the housing may contain alignment shims which are used to align the air passage in the housing with the air passage in the instrument case. If shims are included, they should be retained for use during reassembly.
6. Removal of the lower bearing housing permits access to the two screws securing the pivot to the bottom of the gimbal. When the pivot is lifted into the bearing housing recess, the entire gimbal assembly may be removed.

2.3.4 Removal of Rotor Housing

1. Loosen the two #2-56 Bristol setscrews holding the erector vane to the gimbal and remove the erector vane. Also loosen the binder head stop screw enough to permit 360° rotation of the rotor housing.
2. On electric instruments, carefully remove the brush block from the side of the gimbal.
3. Remove two screws and remove the bearing housing on the air seal or brush block side of the gimbal.
4. Remove two screws securing the pivot to the side of the rotor.

2.3.4 Removal of Rotor Housing (Cont'd)

5. Remove the threaded bearing housing from the opposite side of the gimbal. On some models, the housing is secured in place with a lock ring. On other models, the housing port is slotted and a clamping screw through the gimbal frame secures the housing in position.
6. Remove three screws and lift the rotor pivot off the rotor housing and out through the threaded opening.

2.3.5 Disassembly of Gear Train, Top-Gear Configuration (Figure 1-2)

1. Remove two #2-56 setscrews holding the indicator card to the main (horizontal) drive shaft.

NOTE

Care should be taken to avoid soiling the dial markings.

2. Loosen the setscrew in the intermediate spur gear. Slide the gear down the shaft so that it no longer engages with the gimbal gear.
3. Spin the gear train slowly and check for freedom and smoothness of rotation.
4. The intermediate shaft is suspended in two precision bearings. A threaded bearing housing at the top of the shaft permits adjustment of the preload on the shaft bearings. On some models, the threaded housing is held in place with a lock nut; on other models the housing is secured with Glyptal. The lock nut must be loosened or the Glyptal dissolved before adjustment can be made.

   The threaded housing is mounted in an eccentric which permits adjustment of the gear mesh between the intermediate gear and the gimbal gear. If desired, the eccentric may be removed without disturbing the preload adjustment.

   With the eccentric removed, the intermediate shaft and its associated gears may easily be lifted from the instrument. Care should be taken that the position of the two gears on the intermediate shaft be noted to insure correct replacement. Unless replacement or adjustment of the bevel gear is required, do not loosen the setscrew holding the gear to the shaft. This simplifies reassembly and eliminates the possibility of reinserting the shaft backwards.

2.3.5 Disassembly of Gear Train, Top - Gear Configuration (Cont'd)

5. The card shaft may be removed by first removing the two screws securing the front bearing in the face of the instrument case.
6. By pressing the combination spur/bevel gear toward the front, the main bearing at the front of the shaft will be pushed out of the case.
7. If the spur/bevel gear and the associated shaft collars are to be removed, note their approximate position along the shaft. Also notice that the flanged face of each collar is toward its respective bearing.
8. When the spur/bevel gear and the shaft collars are loosened on the shaft, the main bearing which supports the rear of the shaft may easily be removed.
9. Removal of the rear bearing permits access to the bearing housing at the base of the intermediate shaft. The housing is secured with Glyptal and a solvent must be used before removal is attempted. By inserting an L-shaped bar into the opening created by removal of the rear bearing, the housing at the base of the intermediate shaft may be easily removed with a slight upward pressure. In turn, the bearing can be removed from the housing in the same way, by pushing through the opening in the bottom and forcing the bearing out of the housing.
10. The small piece of piano wire attached to the case is designed to ride against the card shaft and to damp out any oscillations in the dial due to excessive play in the gear mechanism. If the wire is to be removed, notice its position so that it may be properly re-installed.

2.3.6 Disassembly of Gear Train, Bottom-Gear Configuration (Figure 1-3)

1. Loosen the two #2-56 setscrews securing the dial to the card shaft.

NOTE

Care should be taken to avoid soiling the dial markings.

2. Loosen the three setscrews on the caging gear. Slide the combination cup-gear and caging gear assembly off the card shaft.
3. Loosen one setscrew and remove the shaft collar from the rear of the card shaft.

2.3.6 Disassembly of Gear Train, Bottom-Gear Configuration (Cont'd)

4. Slip the card shaft out through the front of the instrument case.
5. The card-shaft bearing housing contains two bearings, set in a recess in each end. The rear bearing can be removed by inserting a small rod through the front opening. The front bearing may be removed by reversing the procedure and inserting the rod from the rear. The housing may be removed by removing the three retaining screws on the front, then pressing the housing out through the front of the case.

2.3.7 Disassembly of Caging Mechanism

Repair of the caging mechanism should seldom be necessary, and only occasional adjustment should be required. Before proceeding with any repairs or adjustments, the following points should be considered.

In removing the caging shaft, notice the order in which the single metal washer and the two nylon washers are installed. From the rear of the shaft, first comes the metal washer, then a nylon washer, then the pinion gear, then another nylon washer nearer the front. Special care should be taken to avoid loss of these parts during disassembly.

Before loosening the caging eccentric on the bottom of the case, notice its approximate position. The purpose of this eccentric is to permit adjustment of the caging mechanism so that the rotor will be 80 to 90% caged when the idler gear engages the spur gear on the card shaft. Observing the position of the eccentric prior to disassembly will permit reassembly with a minimum of trial and error adjustment.

An additional adjustment of the caging mechanism is possible on some bottom-gear instruments. On these instruments, the idler gear is mounted on an eccentric shaft which may be rotated as required to adjust the gear mesh with the caging gear.

2.3.8 Inspection of Air Seal Housing Assemblies, Vacuum Units Only

A typical air seal housing is shown in Figure 2-3. It consists of the basic housing, the bearing assembly, the air seal washer, the air seal retainer, and a spring type retaining ring.

Two housings of this type are used. One housing is mounted in the

2.3.8 Inspection of Air Seal Housings (Cont'd)

instrument case and serves as a transfer point for the passage of air from the case to the gimbal assembly. The second housing is mounted in the gimbal, and transfers air from the gimbal to the rotor housing. Although the two housings are similar in appearance, they are not identical. For reference purposes, diminsion "A", Figure 2-3 is 0.375 inches on the housing that mounts in the case, and 0.437 inches on the housing that mounts in the gimbal. Extreme care should be taken that each housing is properly identified as to its proper location in the instrument.

Disassemble each air seal housing and check that the air seal washer fits freely over the diameter of its respective pivot assembly without binding. Check that a clean, used bearing will fit the diameter of the pivot assembly with no more than finger pressure applied. If difficulty is encountered, refer to the inspection and repair procedures of paragraph 2.5.

Remove the used bearing and replace the air seal washer in the air seal housing, along with the new bearing to be used. Reassemble the housing and set aside, properly covered, for future use.

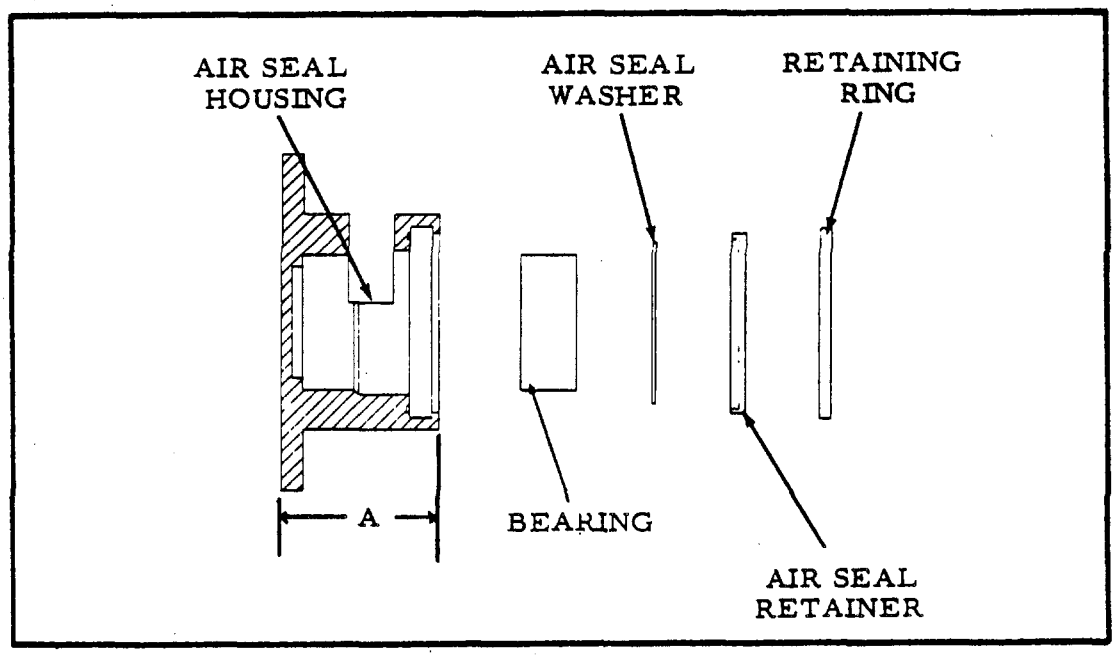


FIGURE 2-3. TYPICAL AIR SEAL HOUSING

2.4 CLEANING

2.4.1 General

Due to the precision components and close tolerances employed in the manufacture of these units, foreign matter can greatly impair their overall operating efficiency and service life. It is therefore recommended that every possible step be taken to insure maximum possible protection of each sub-assembly during disassembly, repair, and reassembly. As each component is removed during disassembly, it should be placed in a dust-free environment and protected with a dustproof cover.

2.4.2 Air Filters, Vacuum Units Only

The instrument air filter on the rear of the unit cannot be cleaned by washing and must be replaced when dirty. This should be done routinely at each overhaul of the instrument and the filter should be inspected after each 100 hours of operation. Access to the filter may be gained by removing the four screws in the AIR INLET cover plate at the rear of the instrument. After the filter has been replaced, reinstall the cover and tighten the screws securely.

The amount of dust, lint, tobacco tars, and other foreign matter reaching the instrument filter may be greatly reduced by the use of an efficient central filter system installed in the aircraft. The Type F-4 Air Filter, available from AIM, is especially designed to filter these undesirable elements from the vacuum system and to effectively extend the service life of any air-driven instrument.

2.4.3 Pivots, Housings, Etc.

During overhaul, all parts should be cleaned carefully to remove oil, dirt, and moisture. If possible, the use of ultrasonic cleaning is highly recommended to insure that all parts with small bores or tapped holes can be effectively cleaned. If this is not possible, component parts such as pivots, bearing housings, shims, etc. should be thoroughly cleaned in a high-grade solvent such as Chlorothene-Nu (Dow Chemical Company), and then thoroughly air dried with clean, low pressure air. If cleaning solvent is used, it must not be allowed to become dirty and must be changed frequently.

2.4.3 Pivots, Housings, Etc. (Cont'd)

Interiors of small holes should be cleaned with pegwood dipped in solvent. The teeth of gears and pinions should be cleaned with a glass fiber brush.

Extreme care should be taken to avoid damage to small or delicate parts during cleaning. In addition, some arrangement must be made to permit identification of each part with respect to its previous location in the instrument. This is particularly true of bearings, pivots, and screws. After cleaning, some provision must be made to adequately protect the parts from damage and dust while awaiting inspection and reassembly.

2.5 INSPECTION AND REPAIR

2.5.1 General

All parts should be thoroughly examined with an eye loupe for any evidence of excessive wear or damage prior to reassembly. Repair of defective parts is recommended only when it can be done without adversely effecting the proper operation of the instrument. If doubt exists as to the operating condition of any part or assembly, refer to the parts list section of this manual and order replacement parts directly from AIM.

During overhaul, examine each part for evidence of corrosion or breakdown in the plating material. Aluminum parts of the gyro are protected by anodize or iridite treatment and stainless steel parts are passivated. If a crocus cloth is used to remove corrosion, or if the plating material appears to be worn through, replate or protect the defective area with a light coat of clear lacquer.

Particular attention should be given to parts which contain internal or external threads. If any evidence of damage to the threads is found, repairs should be made using the correct tap or thread restorer. The part should then be thoroughly recleaned and re-examined prior to assembly.

2.5.2 Bearings

The precision bearings used throughout the instrument are designed to

2.5.2 Bearings (Cont'd)

provide extremely efficient service over long periods of time. Each bearing should be individually examined for evidence of damage. If defects are noted, the entire bearing should be replaced. No attempt should be made to polish the balls, or otherwise repair the separate bearing parts.

Bearings used in this instrument are precision, instrument grade and must not be replaced with inferior substitutes. Each bearing is lubricated with specific quantities and types of lubricants best suited for its individual function. This lubricant improves the performance of the bearings and substantially increases their service life. It is therefore recommended that replacement bearings be ordered directly from AIM in order to insure maximum operating efficiency.

2.5.3 Pivots

The four pivots used to support the gimbal and rotor housing assemblies are specially designed for specific functional locations in the instrument. Each pivot is distinctly constructed so that it must not be interchanged with other pivots during reassembly.

Each pivot or support shaft should be examined carefully for evidence of pits and scoring. Due to the precision fit of their respective bearings, the pivots should seldom incur any type of excessive damage. If small scratches are noted, a light polishing should be all that is necessary to remove them. However, if scoring or other excessive wear is noted, replacement pivots should be secured from AIM.

For information pertaining to the rotor pivots, refer to paragraph 2.6 in this manual.

2.6 ROTOR OVERHAUL

2.6.1 General

As previously stated, disassembly and overhaul of the rotor and rotor housing assembly is not recommended. Due to the precision parts involved, and the high speed of the rotor, reassembly and proper adjustment is extremely critical and should not normally be attempted in

2.6.1 General (Cont'd)

the field. Should the rotor become defective and fail to meet the performance requirements set forth in this manual, the used rotor housing and pivot assembly should be returned to AIM for an exchange discount on a replacement assembly. However, if this is not possible, and disassembly and overhaul does become necessary in the field, the procedures shown in the remainder of Section 2.6 should be followed. Do not attempt to overhaul the rotor unless it fails to meet the operating requirements set forth in Section 3.

2.6.2 Equipment Required

Before disassembling the rotor housing, it should be noted that the following equipment must be available in order to properly readjust the assembly after overhaul. This equipment is in addition to the instrument-shop handtools described in paragraph 2.2.2.

1. Vacuum Rotor Overhaul
    1. Mercury manometer capable of reading up to 6 in. Hg.
    2. Pressure source capable of producing a pressure of 4.7 in. Hg. (approximately 2.5 psi). A vacuum source is also recommended but is not required.
    3. Stop watch
    4. Optical tachometer
    5. Clean, dust-free work area.
2. Electric Rotor Overhaul
    1. 115 vac, 400 Hz., single phase power source
    2. 0-150 ac milliameter
    3. Voltmeter capable of reading 85 vac to 115 vac
    4. Stop watch
    5. Variac power transformer or similar means of varying the supply voltage from 85 to 115 vac
    6. Optical tachometer
    7. Clean, dust-free work area

Additional equipment required for final calibration of the over-all instrument is listed in Section 3 of this manual.

2.6.3 Type R3H Vacuum Rotor (Figure 2-4)

1. Disassembly
   1. Remove the rotor support nut and the four screws holding the two halves of the rotor housing together.
   2. Carefully remove one half of the rotor housing and thread the rotor out of the second half.
   3. To obtain access to the rotor bearings, remove one preload nut from the end of the rotor shaft, and six 1-72 x 3/16 binder head screws securing the bearing plate and the bearing retainer to the end of the rotor.

2. Inspection, Cleaning, and Repair

   Once the rotor is disassembled, check that the buckets in the rotor are free of accumulated dust, tobacco tars, and other foreign matter. Clean the various parts in accordance with procedures set forth in paragraph 2.4. After cleaning, each part must be adequately protected from dust while awaiting re-assembly.

   No attempt should be made to clean, re-oil, or otherwise repair the rotor bearings. If the bearings are defective, they should be replaced.

3. Reassembly and Adjustment
   1. Slip the rotor shaft through the rotor and install one bearing, one spacer, one bearing retainer, one bearing plate, and one preload nut over each end. The bearings must be installed so that the engraved type numbers are not visible. This is imperative with this type bearing.
   2. Installation of the rotor in the housing will be performed during the preload and adjustment procedures. During installation, refer to Figure 2-4 and note the curvature of the rotor buckets with respect to the rotor housing and the position of the air pivot. The rotor must be positioned so that the air entering the housing will be properly directed to achieve maximum rotation.

      On some models, such as that shown in Figure 2-4, a small orifice is cast as a part of the housing to direct air at the rotor buckets. On other models, the orifice is a part of the air

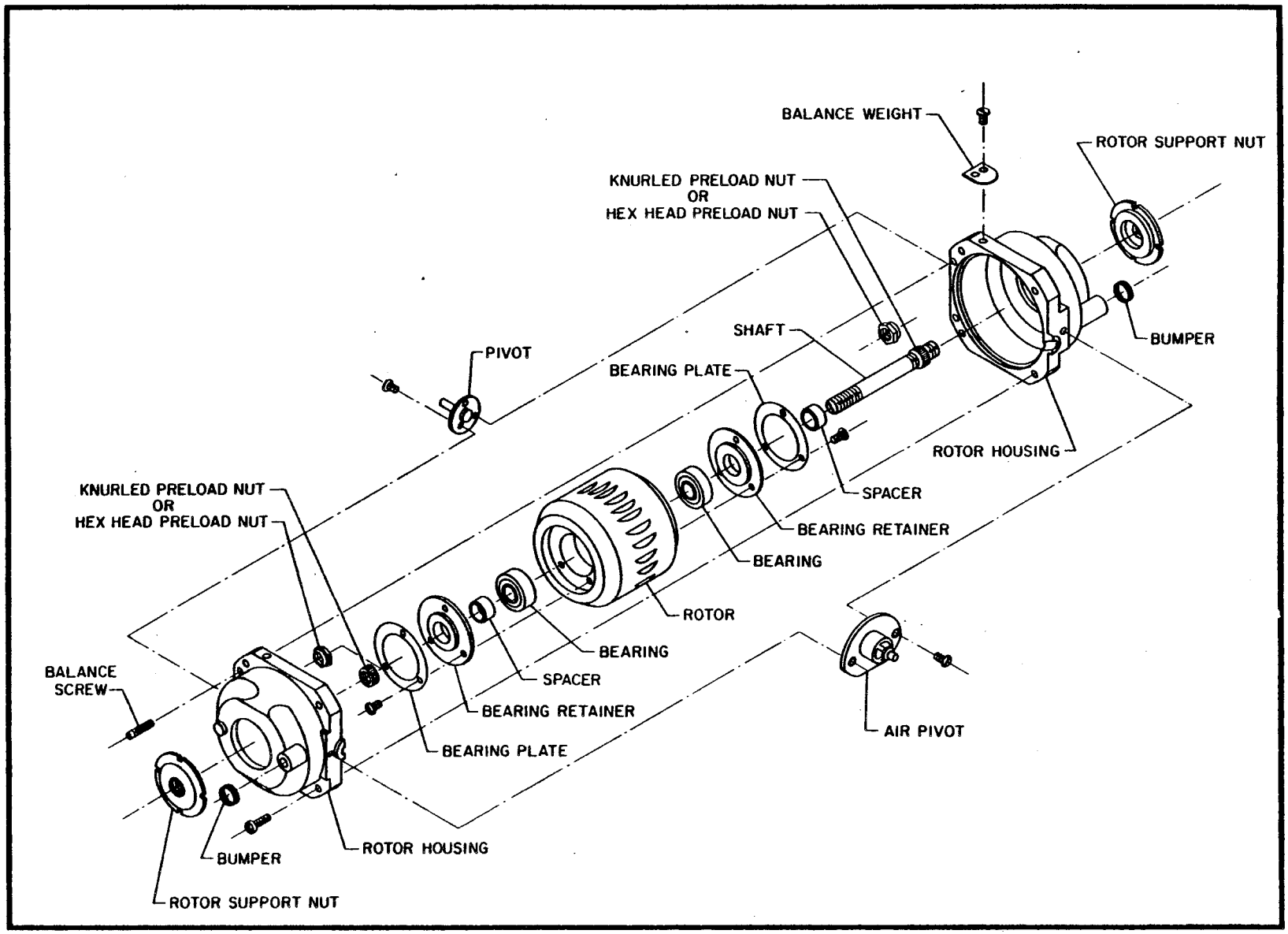


FIGURE 2-4. TYPE R3H VACUUM ROTOR, EXPLODED VIEW

2.6.3. Type R3H Vacuum Rotor (Cont'd)

3. Reassembly and Adjustment (Cont'd)

pivot. In either case, check that the flat side of the air pivot flange is toward the bottom of the instrument and that air flow from the orifice is toward the bottom.

4. Rotor Bearing Preload Adjustment and Run-in Procedures

1. Set the front preload nut tight against the bearing spacer.
2. Carefully tighten the nut on the opposite end until the detectable axial end play between rotor and shaft just disappears. This rotor bearing preload adjustment is very critical and must not be exceeded if normal bearing life is to be realized. At the correct setting, the rotor shaft will spin freely in the rotor assembly and have no detectable end play. To check for proper adjustment, hold the rotor stationary and spin the rotor shaft. If a noticeable roughness is apparent, the preload is set too tight or the bearings are damaged. Do not apply Glyptal to either preload nut at this time.
3. When preload has been completed, install the rotor in the rotor housing as described in paragraph 2.6.3 (3).
4. Install the rotor housing and the air pivot in the gimbal or in a suitable run-in fixture.
5. Run the rotor for 48 hours with 4.5 - 4.7 in. Hg. air pressure applied. Recheck the preload setting after run-in and readjust as required in step 2.
6. Run the rotor for an additional 24 hours and check that the rotor will start and continue running with 0.4 to 0.8 in. Hg. pressure applied to the air pivot. The run-down time should be between 5 and 9 minutes. If the rotor fails to start within these prescribed limits, and run-down time is not as required, the preload nut should be readjusted. If successive rotor starts vary widely, and run-down time will not exceed 5 minutes, the bearings are contaminated or worn and must be replaced.
7. Check that the rotor attains a speed of approximately 28,000 rpm with 4.5 to 4.7 in. Hg. pressure applied to the rotor housing.

2.6.3 Type R3H Vacuum Rotor (Cont'd)

4. Rotor Bearing Preload Adjustment and Run-in Procedures (Cont'd)

8. After it has been established that the rotor meets the requirements of the above paragraphs, apply a small amount of Glyptal to both preload nuts. Avoid excessive Glyptal on the free threads at each end of the rotor shaft.

9. Install the rotor housing in a balancing fixture or in the gimbal to properly locate the rotor in the housing. Balance the assembly by turning the rotor shaft as required to center the rotor in the housing. When proper adjustment has been obtained, secure the rotor shaft and support nuts with Glyptal. Proceed with 2.6.6.

2.6.4 Type 34B Vacuum Rotor (Figure 2-5)

1. Disassembly

1. Remove one strut nut and one lock nut from either end of the rotor strut. Do not disturb the strut nut and lock nut on the opposite end of the rotor.
2. Remove the rotor strut from the rotor housing.
3. Remove four #3-48 screws securing the front and rear halves of the rotor housing.
4. The housing may now be opened to expose the rotor. The rotor bearing outer race assemblies are fitted into the housings in each end of the assembly and may be easily removed. The two bearing housings may also be removed by simply loosening the respective lock rings and threading the bearing housings out of the rotor housing.

2. Inspection, Cleaning, and Repair

Once the rotor housing is disassembled, check that the buckets in the rotor are free of accumulated dust, tobacco tars, and other foreign matter. Clean the various rotor parts in accordance with the procedures set forth in paragraph 2.4. After cleaning, each part must be adequately protected from dust while awaiting reassembly.

No attempt should be made to clean, re-oil, or otherwise repair the rotor bearings. If the bearings are defective, they should be replaced. In addition, no attempt should be made to polish or lap the

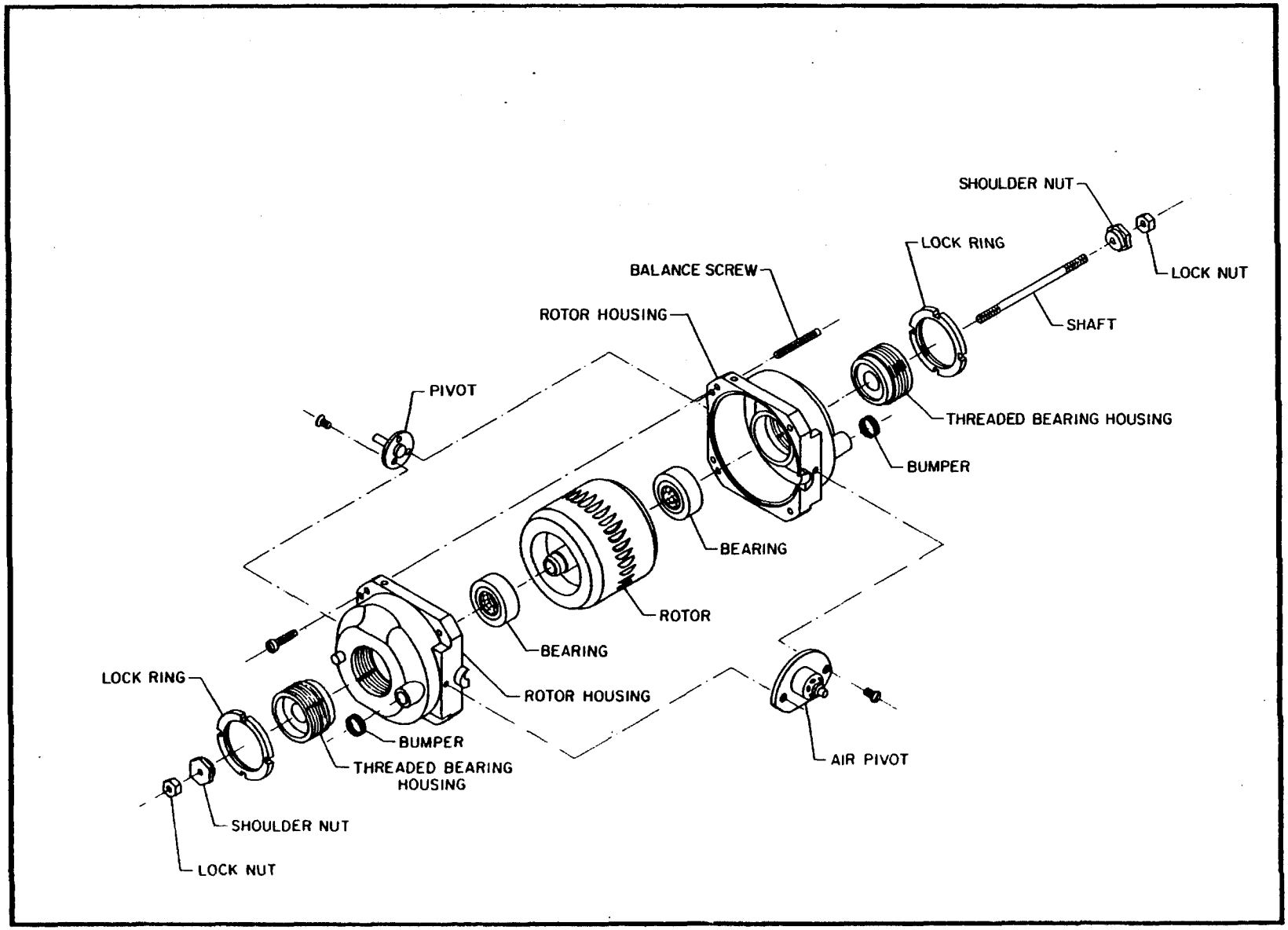


FIGURE 2-5 TYPE 34B VACUUM ROTOR, EXPLODED VIEW

2.6.4 Type 34B Vacuum Rotor (Cont'd)

2. Inspection, Cleaning, and Repair

rotor pivots on the ends of the rotor shaft. These pivots are actually the inner race of the rotor bearings and are manufactured to a precision geometry to match the bearing outer race assemblies. Any attempt at polishing or lapping could change the curvature of the pivot taper, with subsequent damage to the pivot and the bearing. Each pivot should be carefully examined for pits or scoring. If damage is found, a new rotor housing and pivot assembly must be obtained from AIM. The replacement rotor housing and pivot assembly will be completely run-in and ready for installation when received.

3. Reassembly and Adjustment

1. Check the bearing bore in each half of the rotor housing by pressing a clean, used bearing into each bore, using finger pressure only. Each bearing must be a gauge fit.
2. Remove the used bearings from the bore in each half of the rotor housing. Apply a small quantity of Threadlube to the threads of each threaded bearing housing.
3. Thread the bearing housings into their respective halves of the rotor housing approximately three turns.
4. Apply a small quantity of Threadlube to each lock ring, then thread each lock ring onto its respective bearing housing until finger tight.
5. Using instrument tweezers or a similar tool, install the new rotor bearings in their respective housings. Check that each bearing is fully seated in the bottom of its respective housing. Do not handle bearings with bare fingers.
6. Grasp the rotor with watch paper or other high grade lintless tissue and place in position in one half of the rotor housing. Check that the rotor is positioned so that air entering the housing will strike the rotor buckets in the correct direction to obtain maximum rotation.
7. Place the opposite half of the rotor housing in position and check that the air inlet ports on each half correspond.

2.6.4 Type 34B Vacuum Rotor (Cont'd)

3. Reassembly and Adjustment (Cont'd)

8. Attach the back half of the rotor housing to the front half with four screws. Tighten screws and secure with Glyptal.

NOTE

The front and back halves of the rotor housing may be distinguished by the four screw-holes used to hold the two halves together. The holes are threaded in the back half and are not threaded in the front half. Consequently, the four screws should be inserted from the front half toward the back.

9. Position the threaded bearing housings at each end of the rotor shaft so that rotor end play is barely perceptible. Readjust lock rings until finger tight.

10. Mount the side pivot on the rotor housing and insert three attaching screws. Tighten the screws but do not secure with Glyptal since the side pivot must be removed during installation of the rotor housing into the gimbal assembly.

11. Hold the rotor housing so that the spin axis of the rotor is horizontal, the back half of the rotor housing is to the left, the front half is to the right, and the air pivot side is directly visible. Apply Locktite to two attaching screws and mount the air pivot on the rotor housing so that the flat side of the air pivot is toward the bottom.

4. Rotor Bearing Preload Adjustment and Run-in Procedures

1. Place the rotor housing in a suitable run-in fixture. If none is available, install the rotor in the instrument as described in paragraphs 2.7.2 and 2.7.3.

2. Adjust the threaded bearing housings at each end of the rotor until the rotor is centered in the over-all assembly.

3. Apply enough low pressure air at the air pivot or at the AIR INLET port to permit the rotor to start and continue to rotate at approximately 500 rpm. Disconnect air supply hose, then gently shake the assembly to check for excessive rotor bearing end play. If excessive end play is evident, readjust the threaded bearing housings evenly.

2.6.4 Type 34B Vacuun Rotor (Cont'd)

4. Rotor Bearing Preload Adjustment and Run-in Procedures (Cont'd)
    4. Re-attach the air supply hose and recheck end play in the same manner as above. End play is properly adjusted when minutely evident with the rotor spinning at approximately 500 rpm.
    5. When end play is properly adjusted, tighten lock rings and secure with Glyptal.
    6. Insert the rotor strut through the rotor shaft. Install strut nuts and lock nuts on the threaded ends so that equal amounts of threads are showing.
    7. Again attach an air supply hose to the air pivot or AIR INLET port. Tighten strut nuts and lock nuts evenly and sufficiently to permit rotor to start and continue to rotate at an air pressure of 0.5 to 1.0 in. Hg. if the rotor housing is in a run-in rack, or not in excess of 2.25 in. Hg. if it is installed in the instrument. Secure strut nuts and lock nuts in their final adjusted position with Glyptal.
    8. Connect air supply hose and allow the rotor to run for 48 hours at its rated pressure of 4.6 in. Hg.
    9. After the 48-hour run-in period, check that the rotor meets the rotor start, rotor speed, and rotor coast performance tests in Section 3 of this manual. Proceed with paragraph 2.6.6.

2.6.5 Electric Rotor (Figure 2-6)

1. Disassembly
    1. Remove the four screws securing the two halves of the rotor housing.
    2. Carefully separate the two halves and thread the rotor assembly out of the rotor housing using the screwdriver slot in the end of the rotor shaft.
    3. To obtain access to the rotor bearings, remove the impellers from each end, and remove the preload nut and spacer from each end of the rotor shaft. The bearings are protected by a small bearing retainer over each end of the rotor shaft.
    4. Care should be taken to avoid loss of the spacers and bearing

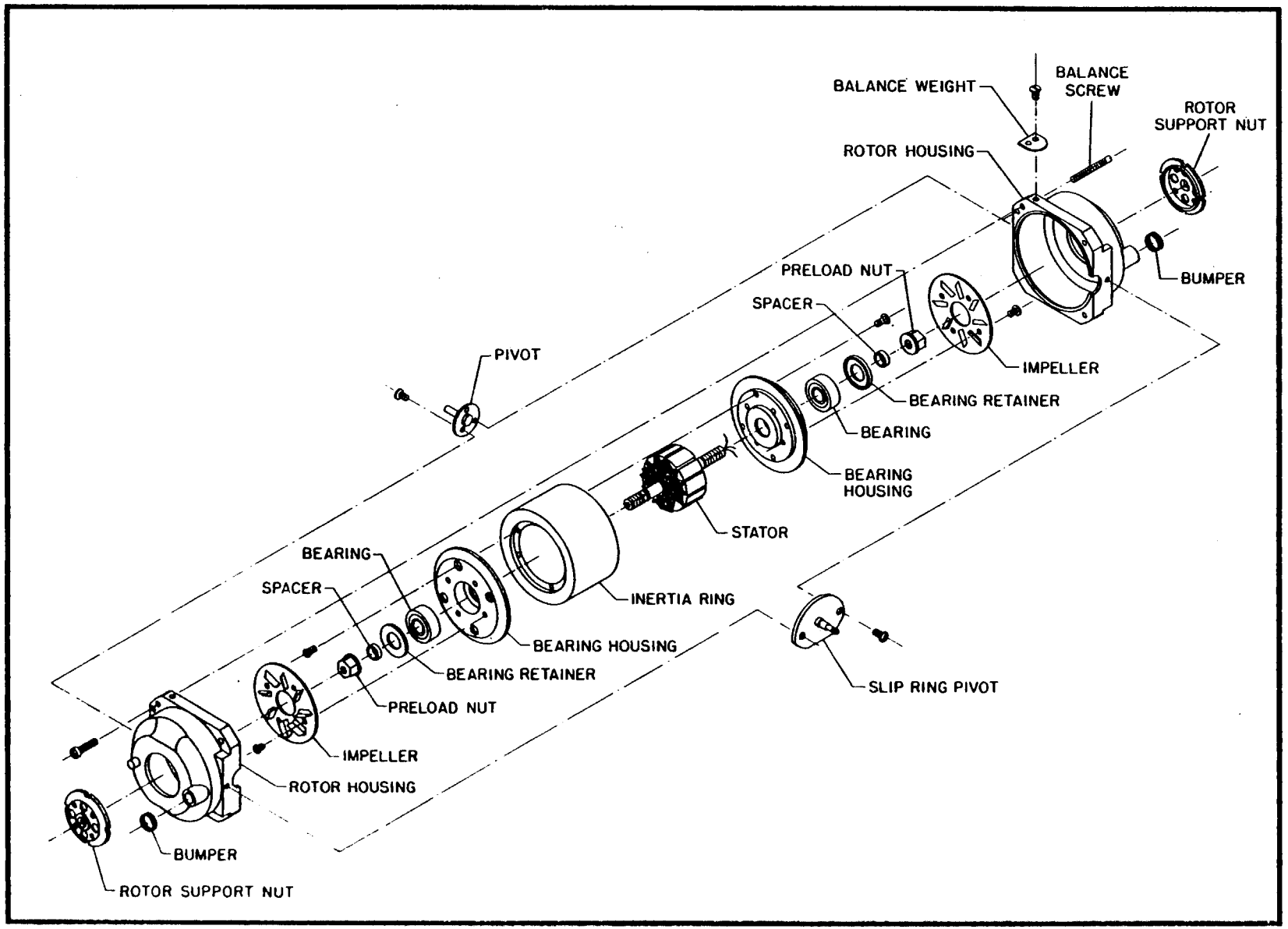


FIGURE 2-6 ELECTRIC ROTOR, EXPLODED VIEW

2.6.5 Electric Rotor (Cont'd)

1. Disassembly (Cont'd)

retainers located between the preload nut and the bearing on each end of the rotor shaft.

NOTE

Removal of the bearing housings on each end of the inertia ring is not normally required, and is not recommended. If either housing is removed, delicate rebalancing of the inertia ring assembly will be required. If the housing must be removed to obtain access to the stator, it is suggested that a mark be made at the interface between the inertia ring and each housing to simplify reassembly and minimize rebalancing required.

2. Inspection, Cleaning, and Repair

Clean the various rotor parts in accordance with the procedures set forth in paragraph 2.4. After cleaning, each part must be adequately protected from dust while awaiting reassembly.

No attempt should be made to clean, re-oil, or otherwise repair the rotor bearings. If the bearings are defective, they should be replaced.

3. Reassembly and Adjustment

1. Install the rotor bearings over each end of the rotor shaft with the word "thrust" toward the center of the rotor.
2. Install the bearing retainers with the recessed side toward the center of the rotor.
3. Reinstall the impellers on each end of the rotor. Tighten all attaching screws securely.
4. Install the spacer and preload nut on each end of the rotor shaft.

4. Rotor Bearing Preload Adjustment and Run-in Procedures

1. Set the preload nut opposite the wire outlet end tight against the bearing spacer.
2. Carefully tighten the nut on the wire outlet end until the detectable axial end play between rotor and shaft disappears. This rotor bearing preload adjustment is very critical and must not be exceeded if normal bearing life is to be realized.

2.6.5 Electric Rotor (Cont'd)

4. Rotor Bearing Preload Adjustment and Run-in Procedures (Cont'd)

At the correct setting the rotor shaft will spin freely in the rotor assembly and have no detectable end play. To check for proper adjustment hold the rotor stationary and spin the rotor shaft. If a noticeable roughness is apparent, the preload is set too tight or the bearings are damaged. Do not apply Glyptal to either preload nut at this time.

3. When preload has been completed, thread the rotor and rotor shaft into the rotor housing and install the rotor support nut.
4. Install the rotor housing and both pivots in the gimbal or in a suitable run-in fixture.
5. Run rotor for 48 hours with 115 vac, 400 Hz., single phase power applied and using a .18-.22mf, 600 v, phase shift capacitor to shift the phase of one winding by 90°. Recheck the preload setting after run-in and readjust as required in paragraph (2) above.
6. Run the rotor for an additional 24 hours and check the rotor start and run-down performance. The rotor must start and continue running with 90 vac, 400 Hz. applied, and run-down time should be between 6 and 10 minutes. If the rotor fails to start at 70 to 90 vac, and run-down time is not within limits, the top preload nut should be readjusted. If successive rotor starts vary more than 15 vac, the bearings are contaminated or worn and must be replaced.
7. Check that the rotor attains a speed of approximately 23,500 rpm with 115 vac, 400 Hz. applied. The rotor should draw approximately 140 milliamperes starting current and approximately 115 milliampers running current.
8. After it has been established that the rotor meets the requirements of the above paragraphs, apply a small amount of Glyptal to both preload nuts. Avoid excessive Glyptal on the free threads at each end of the rotor shaft.
9. Install the rotor housing in a balancing fixture or in the gimbal to properly locate the rotor in the housing. Balance the assembly by turning the rotor shaft as required to center the rotor in the

2.6.5 Electric Rotor (Cont'd)

4. Rotor Bearing Preload Adjustment and Run-in Procedures (Cont'd)

housing. When proper adjustment has been obtained, secure the rotor shaft and the rotor support nuts with Glyptal.

2.6.6 Rotor Housing Static Balancing

1. The rotor housing should be statically balanced inside the instrument. Install two balancing screws from the back of the rotor housing toward the front so that the screws are centered horizontally.
2. Turn the instrument on its side and position the rotor housing so that the rotor strut is vertical.
3. Place a small weight and a piece of tape on a gram scale and cut the tape until the total weight of the two is 3/10 gram.
4. Attach the weight to the top of the rotor housing where the two halves come together.
5. Return the rotor strut to the vertical position and let go. The rotor should not move from this position. As a further check, a screwdriver handle or similar device should be rattled along the instrument case to induce vibrations which will assist in determining any imbalance. If the rotor tends to fall, either to the top or to the bottom, appropriate weight should be added at the four #2-56 tapped holes where the two halves come together.
6. Set the instrument in the upright position with the air passage or slip ring side of the gimbal toward the back of the instrument. The rotor housing should assume about a 10° tilt to the left when viewed from the front of the instrument. Again, a screwdriver handle or similar device rattled on the instrument case, will cause the rotor housing to seek its stable position.
7. A rough adjustment may be accomplished by centering the two balancing screws and shifting the rotor inside the housing until the assembly is approximately balanced. Final adjustment may be accomplished by positioning the two balancing screws as required. Secure the balancing screws with a minimum amount of Glyptal, since additional adjustment may be necessary during the drift and calibration tests in Section 3.

2.7 REASSEMBLY PROCEDURES

2.7.1 General

Throughout the reassembly procedures, extreme care must be taken to prevent damage or contamination of the various component parts and sub-assemblies. When joining two parts, they must not be forced together. As each subassembly is completed, it must be covered while awaiting further installation to a mating assembly or component.

All adjusting screws must be secured in their final adjusted position by use of Glyptal or a similar sealer.

2.7.2 Installation of Rotor in Gimbal Assembly

1. Remove the side pivot from the rotor housing. Carefully position the rotor housing inside the gimbal by placing the air pivot or slip ring into the opening in the gimbal. Install the air seal or slip ring bearing in the gimbal so that the bearing engages the pivot.

   On vacuum instruments, check that the air seal housing is turned properly to permit air flow through the gimbal ductwork. Also check that any shims required to align the opening in the housing with the ductwork in the gimbal are properly installed.

   Install two mounting screws, then tighten and secure with Glyptal. On electric instruments, install the brush block over the slip ring pivot.
2. Place the side pivot through the threaded port in the gimbal and attach to the rotor housing with three screws. Tighten pivot screws and secure with Glyptal.
3. Screw the threaded bearing housing into the gimbal until end play is barely perceptible when moderate hand pressure is exerted toward either pivot.
4. Secure the threaded housing in the gimbal. On some models, a lock ring is provided for this purpose. On other models, the threaded port is slotted toward the top of the gimbal, and a binder head screw, through the gimbal, clamps the housing in place.
5. Position the rotor housing so that the flat side of the flange on the air pivot or slip ring pivot is toward the caging mechanism at the bottom of the gimbal.

2.7.2 Installation of Rotor in Gimbal Assembly (Cont'd)

6. Install the erector vane so that it is an equal distance from each erector jet on the rotor housing. The ends of the erector vane must bisect the erector ports when the spin axis of the rotor is horizontal. The erector vane must not touch the erector jets at any point.

2.7.3 Installation of Gimbal Assembly

The gear train and caging mechanism should be installed and balanced before installation of the gimbal assembly (see paragraphs 2.7.4 thru 2.7.6 for procedures).

1. Insert the air pivot or slip ring pivot into the bearing housing port in the bottom of the instrument case.
2. Carefully place the completed gimbal and rotor assembly into the instrument with the air pivot or slip ring end centered above the lower pivot.
3. Turn the entire instrument over, being careful not to drop the gimbal or the pivot.
4. Mount the pivot to the bottom of the gimbal with two screws inserted through the bearing housing port.
5. Install the bearing housing with two screws and secure with Glyptal.

   On vacuum instruments, check that the air seal housing is turned properly to permit air flow through the instrument ductwork. Also check that any shims required to align the opening in the housing with the ductwork in the instrument are properly installed.

   On bottom-gear instruments, shims are sometimes installed to achieve proper alignment between the gimbal gear and the cup gear. If shims were used prior to disassembly, they should be re-installed.

6. On electric instruments, install the brush block over the slip ring pivot.
7. Return the instrument to its normal upright position and slip the upper pivot or bearing housing (See Figure 2-2) through the port in the top of the instrument. Center the pivot or housing in position on the gimbal and secure with three retaining screws. Secure the screws with Glyptal.

2.7.3 Installation of Gimbal Assembly (Cont'd)

8. On bottom-gear instruments, screw the threaded bearing housing into the instrument case for enough that the assembly will be securely held, and yet loose enough so that it will move slightly up and down when lifted and released.

   On top-gear instruments, install the upper bearing housing or pivot (See Figure 2-2) with three screws and secure with Glyptal.

9. Balance the gimbal by positioning balance screws around the slots in the gimbal balance plate. Provisions have also been made for the installation of additional screws and weights in the #2-56 tapped holes on the side of the gimbal. Repeated trials will be necessary in order to achieve perfect balancing of the assembly. All balancing can be effected by adding or subtracting weight from opposing sides of the assembly.

   Balancing techniques vary according to shop practices. However, it is necessary to point out that trial-and-error methods are always required to obtain near perfect balancing of a precision assembly. During all stages of balancing, assemblies must be vibrated moderately to induce movement and to insure that an absolute minimum of friction between adjacent moving parts is evident.

2.7.4 Reassembly and Adjustment of Caging Mechanism

Reassembly and adjustments of the caging mechanism requires no specific sequence of operations. However, special attention should be given to the following details.

If the caging plate and the caging slide (Figure 1-2 and 1-3) are removed during disassembly, care should be taken to insure that the springs are properly positioned during reassembly. The springs should be stressed so that the caging slide will be pulled clear of the rotor pivot when the caging shaft is released.

When reassembling the caging shaft, check that the associated gears and washers are installed in the order in which they were disassembled. Improper installation of the washers could cause undue wear on the pinion and the related hardware.

2.7.4 Reassembly and Adjustment of Caging Mechanism (Cont'd)

After the caging mechanism is properly assembled, adjust the caging eccentric on the bottom of the instrument until the rotor housing is 80% to 90% caged before the caging gear begins to engage the combination spur/bevel gear on the card shaft. Trial-and-error will be necessary until the proper adjustment is obtained.

2.7.5 Reassembly of Gear Train, Top-Gear Configuration

1. Insert the proper bearing in the brass housing which supports the intermediate shaft. Apply a small amount of Glyptal to the base of the housing and insert the housing in position in the case.
2. Place the intermediate shaft in position along with the associated spur and bevel gears.
3. Insert the bearing, the threaded housing and the eccentric in place at the top of the vertical shaft and secure the eccentric with two binder head screws. A slight amount of end play should be left in the intermediate shaft in order to compensate for case variations when the bezel assembly and dust cover are installed.
4. Position the spur gear near the top of the shaft so that it engages the gimbal drive gear. Tighten the setscrew and secure the gear in place. Check that the spur gear does not bind with the gimbal gear at any place throughout one complete revolution of the gimbal. If binding is evident, loosen two binder -head securing screws and rotate the eccentric on top of the instrument case until the binding is relieved. When proper adjustment has been achieved, secure the eccentric and the two binder-head screws in place with Glyptal.
5. Press the bearing used to support the rear of the card shaft into the proper recess in the instrument case. The bearing must be inserted from the front toward the rear.
6. Insert the card shaft, along with the associated spur/bevel gear and shaft collars into the rear bearing. The rear of the shaft should extend through the rear bearing approximately 1/32 inch.
7. Move one flanged shaft collar along the shaft toward the rear until the collar flange is against the rear bearing. Secure the collar in this position.

2.7.5 Reassembly of Gear Train, Top-Gear Configuration (Cont'd)

8. Slip the card-shaft bearing over the front of the shaft and into position inside the front case. Check that a shaft collar, with its flanged side toward the front, is installed between the spur/bevel gear and the front bearing.
9. Move the shaft collar along the card-shaft toward the front until it is against the rear of the front bearing. Tighten the setscrew and secure the collar in position. Insert two screws in the front face of the instrument casting to secure the bearing in place.
10. Position the spur/bevel gear along the card-shaft toward the rear and the spur gear down the intermediate shaft until they are properly engaged. Secure both gears in their engaged positions.

2.7.6 Reassembly of Gear Train, Bottom-Gear Configuration

1. Insert bearings into ends of card-shaft bearing housing. Insert housing into the instrument case and secure with three retaining screws. Secure screws with Glyptal.
2. Clip the lock ring on the card shaft and install brass washer. Insert the card shaft through the front opening in housing. Care should be taken so as not to dislodge the rear bearing from the housing.
3. Slip the shaft collar, with its flanged side toward the front, on the rear of the center shaft. The collar should be flush against the rear bearing with no noticeable play apparent in the shaft. Tighten the setscrew and secure with Glyptal.
4. Slip the indicator card assembly on the front end of the shaft. To check the balance of the indicator card, rotate the card by hand in both directions. The card should come to a slow even stop without any reverse spin. To correct any imbalance, stick small amounts "mud" (3M Company Sealer EC 612) to the backside of the card. Repeated trials may be necessary to obtain perfect balancing.
5. Slip the combination cup gear and caging gear onto the rear end of the card shaft. Position on the shaft so that the caging gear fully engages with the idler gear when the caging shaft is actuated. Tighten the three setscrews.

   To check the balance of the cup gear, rotate by hand in both directions.

2.7.6 Reassembly of Gear Train, Bottom-Gear Configuration (Cont'd)

The cup gear should come to a slow even stop without any reverse spin. To correct any imbalance, stick small amounts of "mud" to the backside of the cup gear. Repeated trials may be necessary to obtain perfect balancing.

SECTION 3
TEST AND CALIBRATION

3.1 GENERAL

The following test and calibration procedures may be used to either isolate malfunctions in the instrument prior to overhaul, or to checkout and recalibrate the instrument after overhaul has been accomplished. Included with each test are suggested corrective measures which should be employed if the instrument fails to meet the required performance specifications.

3.2 TEST EQUIPMENT REQUIRED

3.2.1 General

1. Scorsby test stand capable of producing roll, pitch, and yaw oscillations with an amplitude of ± 3 degrees about each axis at a frequency of 5 to 7 cycles per minute.
2. Stop watch
3. Clean, dust-free work area

3.2.2 Vacuum Instruments

1. Mercury manometer capable of reading up to 6 in. Hg.
2. Pressure source capable of producing a pressure of 4.7 in. Hg. (A vacuum source is also recommended but is not required.)
3. Either a volumetric flow meter or a similar device capable of measuring approximately 2.0 cfm air consumption.

3.2.3 AC Instruments

1. 115 vac, 400 Hz., single phase power source
2. Variac power transformer or similar means of varying supply voltage from 85 vac to 115 vac.
3. Vacuum-tube Voltmeter
4. 0-200 ac milliameter

3.2.4 DC Instruments

1. 14 or 28 vdc power source, as required
2. Vacuum-tube Voltmeter
3. 0-5 amp dc meter

3.3 ROTOR SPEED TEST, VACUUM INSTRUMENTS

This test is an "open" calibration test and should be performed with the instrument dust cover removed. Apply a pressure line of 4.5 to 4.7 in. Hg. to the AIR INLET port on the rear of the instrument. Allow approximately five minutes for the rotor to gain speed and stabilize.

The rotor should attain a speed of 23,000 rpm or greater if the rotor is installed in the instrument and the instrument ductwork is used. If the rotor is outside of the instrument, and air pressure is applied directly to the air pivot, rotor speed must be in excess of 29,000 rpm.

If the rotor fails to reach the required speed, a new rotor assembly should be installed. If replacement is not possible, overhaul the rotor as described in paragraph 2.6 of this manual.

3.4 ROTOR SPEED TEST, ELECTRIC INSTRUMENTS

This test is an "open" calibration test and should be performed with the instrument dust cover removed.

Insert a milliameter in series with the power source. On ac instruments, use a 0-200 ac milliameter. On dc instruments, use a 0-5 amp dc meter. Apply power to the instrument and allow approximately five minutes for the rotor to gain speed and stabilize. The rotor should attain a speed of 23,000 rpm or greater.

On ac instruments, check for approximately 115 milliamperes running current. On dc instruments, running current should be approximately 1.0 to 1.4 amperes for 14 vdc units, and 0.5 to 0.7 amperes for 28 vdc units.

Rotate the instrument horizontally through 360° and check for any variation in current. Also tilt the rotor to its limits of travel and check for current variation. If current does vary, readjust tension on the appropriate brushes so that the brushes do not drop away from their respective slip ring. The tension on each brush should be between 1/2 and 1-1/2 grams.

3.5 ROTOR COAST TEST

After the conditions described in the Rotor Speed Test have been attained, disconnect electrical power or pressure line from the instrument. Rotor run-down time must be six minutes or more for electric instruments

3.5 ROTOR COAST TEST (Cont'd)

and 4-1/2 minutes or more for vacuum instruments. If the rotor fails to coast the required length of time, replacement or overhaul of the complete rotor should be accomplished.

3.6 STILL RUN DRIFT AND CALIBRATION

1. Mount the instrument in a panel or secure it on a bench so that the bezel is vertical and the instrument will not change its position.
2. Apply appropriate air pressure or electrical power for the remainder of this test. Allow five minutes for the rotor to attain full speed.
3. Set the indicator card on 0° or North heading and allow the gyro to run for 15 minutes. At the end of 15 minutes, the card reading must be between 357° and 3°. If the reading is greater than 3° turn one of the balancing screws shown in Figure 2-4 thru 2-6, counterclockwise. If the reading is less than 357°, turn one of the balance screws clockwise.

   To correct for a 10° change in drift rate, turn each balancing screw, 1-1/2 to 2-1/2 turns. To simplify calibration, the original drift and the correction made should be recorded. This procedure should be repeated and evaluated for the next correction.
4. Repeat the above procedure for headings of 90°, 180°, and 270°. Maximum permissible drift for any cardinal heading is $\pm 3^{\circ}$ in 15 minutes.

   If the instrument fails to maintain the required performance levels, the following items should be checked for proper assembly.

   a. The gear train which drives the card must be free throughout its entire range of rotation. Refer to paragraph 2.7.5 or 2.7.6 for adjustment procedures.
   b. Check the bearings which support the rotor housing for rough spots or excessive preload. Either replace the bearings or adjust the preload as described in paragraph 2.7.2.
   c. Check the bearings which support the gimbal for proper clearance between the gimbal and the case. The gimbal assembly must move up and down when the gimbal is lifted and released. See paragraph 2.7.3 for proper installation.

3.7 ERECTION TEST IN STILL RUN

Mount the instrument securely with the frame placed in a level position. Apply electrical power or air pressure, as required, and allow five minutes for the rotor speed to increase and stabilize. Displace the rotor spin axis 55° from horizontal and check that the rotor automatically erects. If the rotor fails to erect, the rotor is improperly installed or the erector vane is improperly adjusted. For proper installation and adjustment, refer to paragraph 2.7.2.

3.8 CAGING

The rotor must be 80% to 90% caged before the idler gear becomes sufficiently engaged to permit readjustment of the indicator card. When the caging shaft is fully in, the rotor must be fully caged. If adjustment is required, refer to paragraph 2.7.4.

3.9 ROTOR START TEST, VACUUM INSTRUMENTS

To perform this test and those following, the instrument must be completely assembled and sealed. Apply vacuum to the vacuum port on the rear of the instrument. By listening carefully against the case, any rotation of the rotor can be heard. The amount of vacuum required for the rotor to start and continue running should not exceed 2.5 in. Hg.

If the rotor fails to start at the prescribed vacuum, a new rotor assembly should be installed. If replacement is not possible, overhaul the rotor assembly as described in paragraph 2.6.

3.10 ROTOR START TEST, ELECTRIC INSTRUMENTS

3.10.1 AC Instruments

The rotor must start with 90 vac, 400 Hz. applied to the rear connector. This check should be repeated several times. If successive starts vary more than 15 vac, the rotor bearings are worn or contaminated, and should be replaced.

With the flag motor disconnected, check that the starting current is approximately 140 milliamperes and running current is approximately 115 milliamperes. If the rotor fails to conform to the above requirements, a new rotor assembly should be installed. If replacement is not

3.10.1 AC Instruments (Cont'd)

possible, overhaul the rotor assembly as described in paragraph 2.6.

3.10.2 DC Instruments

Check that the running current is approximately 1.0 to 1.4 amperes for 14 vdc instruments and 0.5 to 0.7 amperes for 28 vdc instruments.

If the instrument fails to meet the above requirements, the rotor bearings are worn, or the inverter circuitry is malfunctioning. Use a voltmeter to check that the inverter is producing 115 vac, 400 Hz. output with appropriate 14 vdc or 28 vdc input applied.

If the rotor is at fault, a new rotor assembly should be installed. If replacement is not possible, overhaul the rotor assembly as described in paragraph 2.6.

3.11 SCORSBY TEST

Mount the instrument on a Scorsby Test stand which should be set for 5-7 oscillations per minute at an amplitude of $\pm$ 3 degrees about each axis.

For each cardinal heading, the instrument drift must not exceed 3° in 10 minutes. If drift is excessive, check for possible defects and recalibrate as explained in paragraph 3.6. Also check freedom of the gear train as described in paragraph 2.7.5 or 2.7.6.

3.12 AIR CONSUMPTION TESTS, VACUUM INSTRUMENTS

3.12.1 General

These tests should be performed after the instrument is calibrated because the instrument must be completely assembled and fully sealed. An air volumetric flow meter or similar device must be used to perform the following tests.

3.12.2 Leak Test

Block the AIR INLET port and apply a vacuum of 4.5 in. Hg. to the vacuum port. Air consumption must not exceed 0.2 cfm. If excessive leakage occurs, check the dust cover gaskets, air filter housing, and glass for excessive leakage.

3.12.3 Air Consumption When Running

Apply a vacuum of 4.5 in. Hg. to the vacuum port. Air consumption must not exceed 2.1 cfm. If air consumption is greater than 2.1 cfm, check for internal leaks such as omitted air seals, loose bearing housings, loose pivots, etc.

3.13 FLAG CIRCUIT TESTS, ELECTRIC INSTRUMENTS

Refer to paragraphs 1.3.4 through 1.3.7 for operating characteristics of the various flag circuits.

Flag circuits which include the voltage sensor network (Figures 1-4B, 1-6B, and 1-7B) should be checked for conformance to the following requirements: (1) The flag should retract (raise) when the applied voltage is increased to approximately 102 vac; (2) The flag should remain up until the applied voltage drops below approximately 80 vac.

3.14 APPEARANCE

There should be no bright surfaces on the face of the indicator card. The indicator card, glass, indice, and bezel should be free of scratches or flaking paint. The nameplate and serial number should be clearly legible.

On vacuum instruments, plastic pipe plugs should be installed in both the AIR INLET port and the vacuum port until the instrument is installed in the aircraft.

SECTION 4
PARTS LIST

This section contains exploded-view drawings of both "top-gear" and "bottom-gear" instruments, showing the location of each replaceable part. Tables associated with the drawings identify each component or assembly and list the appropriate AIM part number by which replacement parts should be ordered.

Figures 4-1 and 4-2 are composite drawings of basic vacuum instruments, with corresponding electrical parts shown near their actual location in the instrument.

Many parts are identified by a single callout number, and yet several part numbers are shown in the parts list. Carefully check that the instrument model number, case configuration and type (vacuum or electric) coincide with the instrument being overhauled.

TABLE 4-1. VACUUM AND ELECTRIC INSTRUMENTS (Figures 4-1 and 4-2)

NO.	DESCRIPTION	AIM PART NO.
1	Seal, gasket	610-0012-001
2	Cover	614-0008-901
3	Screw, 3-48 x 3/8, fillister hd., st. st.	—
4	Ring, indice cover	611-0032-901
5	Ring, retainer	611-0009-901
6	Setscrew, 4-40 x 1/8, spline or Allen	—
7	Screw	603-0003-001
8	Hub, dial	634-0001-903
9	Setscrew, 2-56 x 3/32, Bristol, spline, cup pnt.	—
10	Nut, hex, 4-40	—
11	Eccentric, caging lever	659-0001-001
12	Screw, 4-40 x 3/8, flat hd., st. st.	—
13	Spring, torsion	657-0004-001
14	Screw, 2-56 x 1/8, binder hd., st. st.	—
15	Bearing	637-0004-002
16	Setscrew, 4-40 x 3/32. Bristol, spline, cup pnt.	—
17	Gear, spur	631-0014-001
18	Washer, nylon	606-0007-001
19	Spring, compression	657-0005-001
20	Washer	606-0004-001
21	Not used	—
22	Spring, tension	657-0006-002
23	Post, return spring	664-0001-001
24	Slide, actuating	621-0001-001
25	Screw, 2-56 x 1/4, flat hd., st. st.	—
26	Plate, actuating bar	628-0022-001
27	Screw, 0-80 x 3/16, flat hd. st. st.	—
28	Washer, shoulder	606-0020-001
29	Screw, 2-56 x 1/8, flat hd., st. st.	—
30	Shaft	632-0022-001
31	Screw, 2-56 x 3/16, binder hd., st. st.	—
32	Bearing	637-0004-001
33	Vane, erector	618-0012-001
34	Setscrew, 2-56 x 1/4, Bristol, spline, cup pnt.	—
35	Screw, 3-56 x 1/2, binder hd., st. st.	—
36	Screw, 2-56 x 5/16, binder hd., st. st.	—
37	Spring, tension	657-0003-001
38	Spring, tension (Obsolete. Drill, item 39 and replace item 38 with item 37).	—
39	Slide, caging	621-0004-001
40	Plate, caging	628-0018-001
41	Lever, actuating	656-0009-001
42	Shaft	632-0020-001
43	Ring, retainer	611-0026-001
44	Screw, 2-56 x 1/4, binder hd., st. st.	—
45	Housing, bearing	635-0022-003
46	Ring, lock	611-0014-002

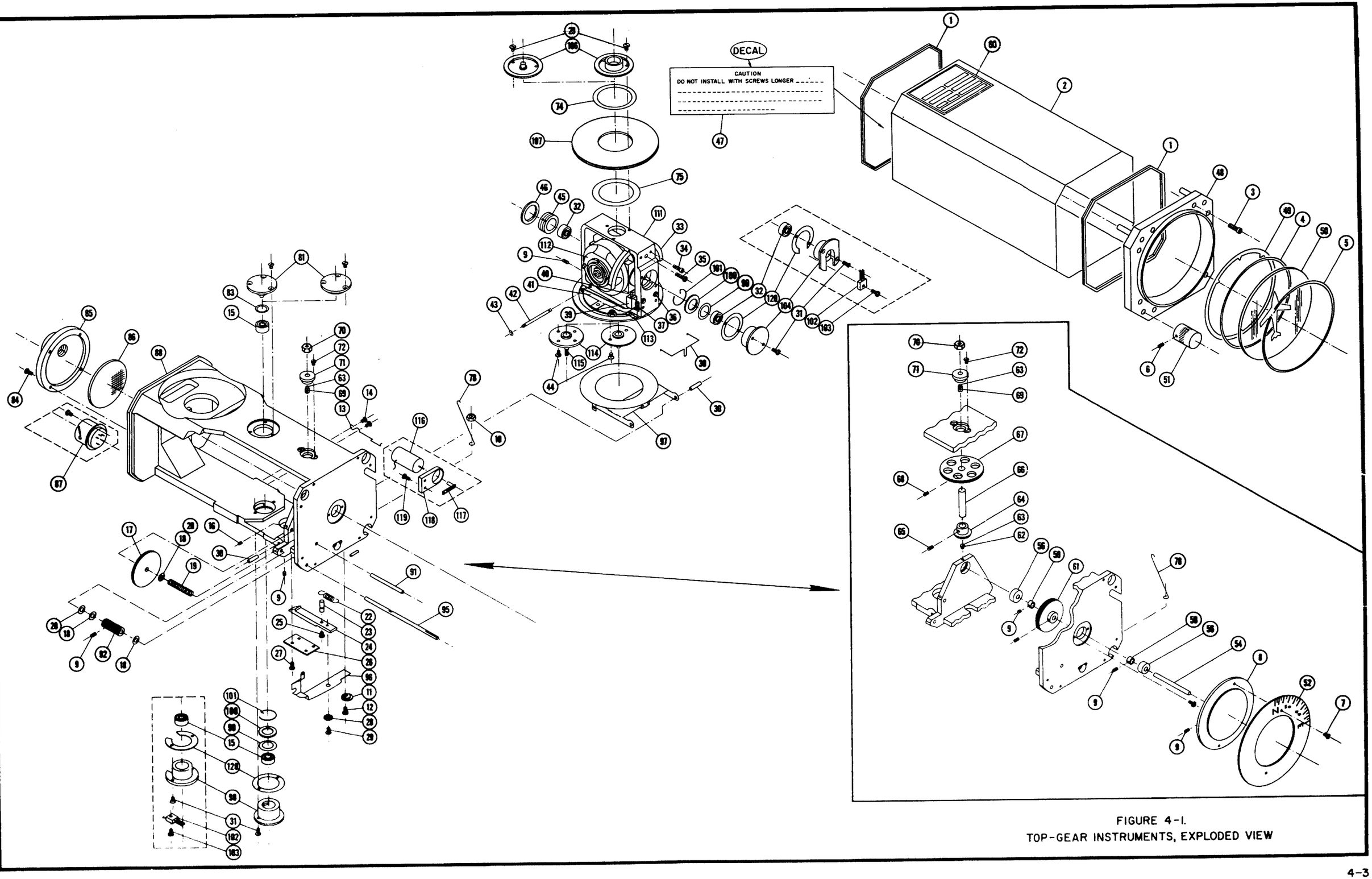


FIGURE 4-1.
TOP-GEAR INSTRUMENTS, EXPLODED VIEW

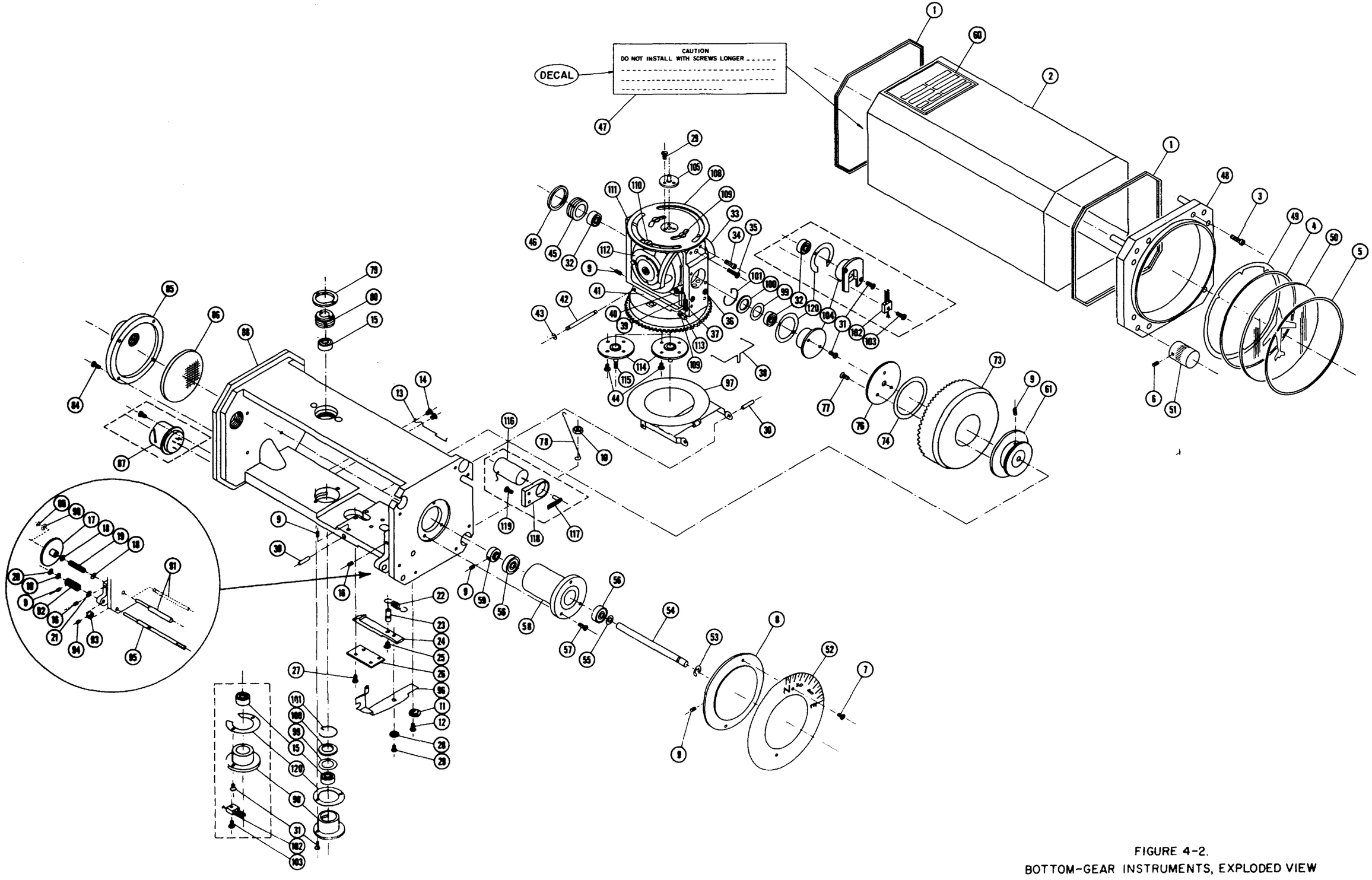


FIGURE 4-2.
BOTTOM-GEAR INSTRUMENTS, EXPLODED VIEW

TABLE 4-1. VACUUM AND ELECTRIC INSTRUMENTS (Cont'd)

NO.	DESCRIPTION	TOP-GEAR CONF. (Fig. 4-1)		BOTTOM-GEAR CONF. (Fig. 4-2)	
		Vacuum	Electric	Vacuum	Electric
47	"CAUTION" Decal	600-0020-001	600-0025-001	600-0020-001	600-0025-001
48	Bezel, w/o glass, w/o indice ring, etc.	653-0023-903	653-0023-903	653-0023-904	653-0023-906
	Bezel Assembly, complete w/glass, indice ring, etc. Specify airframe mfg. gyro P/N.	653-0023-901	653-0023-901	653-0023-902	653-0023-905
49	Ring, indice	611-0033-907	611-0033-907	611-0033-907	611-0033-907
50	Glass, screened				
	AIM 200, 200E, 200ED, 200EDC, 200EDC Bezel Mount, 200DC (14), 200DC (28)	612-0009-001	612-0009-001	612-0009-001	612-0009-001
	P/N 18-380021	612-0009-014	612-0009-014	612-0009-014	612-0009-014
	P/N CM2675-1	612-0009-011	612-0009-011	612-0009-011	612-0009-011
	AIM 200DC (14)P, 200DC (28)P	612-0009-006	612-0009-006	612-0009-006	612-0009-006
51	Knob	633-0005-901	633-0005-901	633-0006-901	633-0006-901
52	Dial, finished				
	AIM 200, 200E, 200ED, 200EDC, 200EDC Bezel Mount, 200DC (14), 200DC (28)	650-0014-903	650-0014-903	650-0014-903	650-0014-903
	18-380021, CM2675-1	650-0007-901	650-0007-901	650-0007-907	650-0007-907
	AIM 200DC (14)P, 200DC (28)P	N/A	N/A	N/A	650-0007-901
53	Ring, Truarc-Waldes	N/A	N/A	611-0029-001	611-0029-001
54	Shaft, center	632-0016-001	632-0016-001	632-0017-001	632-0017-002
55	Washer, brass	N/A	N/A	606-0015-001	606-0015-001
56	Bearing	637-0004-002	637-0004-002	637-0001-001	637-0001-001
57	Screw, 2-56 x 1/4, binder hd., st. st.	N/A	N/A	—	—
58	Housing, bearing	N/A	N/A	635-0069-001	635-0069-001
59	Collar, shaft	617-0001-001	617-0001-001	617-0002-001	617-0002-001
60	Nameplate (Specify gyro model and airframe mfg. no.)	—	—	—	—
61	Gear Assembly	631-0045-902	631-0045-902	631-0053-901	631-0053-901
62	Housing, bearing	635-0014-001	635-0014-001	N/A	N/A
63	Bearing, pivot	637-0005-001	637-0001-001	N/A	N/A
64	Gear, bevel	631-0001-903	631-0001-903	N/A	N/A
65	Setscrew, 2-56 x 3/32, Spline	—	—	N/A	N/A
66	Shaft, intermediate	632-0008-003	632-0008-003	N/A	N/A
67	Gear, spur	631-0003-001	631-0003-001	N/A	N/A
68	Setscrew, 2-56 x 3/32, Spline	—	—	N A	N/A
69	Housing, bearing, threaded	635-0028-002	635-0028-002	N/A	N/A
70	Nut, lock (Some models only)	605-0008-001	605-0008-001	N/A	N/A
71	Eccentric, housing (counterbored for lock nut)	659-0003-001	659-0003-001	N/A	N/A
72	Screw, 2-56 x 1/8, binder hd., st. st.	—	—	N/A	N/A

TABLE 4-1. VACUUM AND ELECTRIC INSTRUMENTS (Cont'd)

NO.	DESCRIPTION	TOP-GEAR CONF. (Fig. 4-1)		BOTTOM-GEAR CONF. (Fig. 4-2)	
		Vacuum	Electric	Vacuum	Electric
73	Gear, crown	N/A	N/A	631-0039-901	631-0039-001
74	Washer, wavy	606-0003-001	603-0003-001	606-0003-001	606-0003-001
75	Washer, friction	606-0001-001	606-0001-001	N/A	N/A
76	Plate, clutch	N/A	N/A	628-0034-001	628-0034-001
77	Screw, 2-56 x 1/4, binder, hd., st. st.	N/A	N/A	—	—
78	Wire damping	823-0002-001	823-0002-001	823-0002-001	823-0002-001
79	Ring, lock	N/A	N/A	611-0014-002	611-0014-002
80	Housing, bearing	N/A	N/A	635-0022-004	635-0022-004
81	Pivot (Some models only)	639-0018-001	639-0018-001	N/A	N/A
	Housing, bearing (Some models only)	635-0071-001	635-0071-001	N/A	N/A
82	Not Used				
83	Shim (as required)	607-0009-001	607-0009-001	N/A	N/A
84	Screw, 3-56 x 1/2, binder hd., st. st.	—	N/A	—	N/A
85	Cover, filter	614-0014-901	N/A	614-0014-902	N/A
86	Filter Assembly	615-0002-901	N/A	615-0002-901	N/A
87	Connector				
	AIM 200E, 200ED, 200EDC (Amphenol 182-35-1001)	N/A	821-0019-901	N/A	821-0019-901
	Mating connector (Amphenol 165-34)	N/A	821-0005-001	N/A	821-0005-001
	AIM 200DC (14), 200DC (28), 200DC (14)P, 200DC (28)P (Bendix PT04-84P)	N/A	821-0047-001	N/A	821-0047-001
	Mating connector (Bendix PT06A-8-45-(SR)	N/A	821-0048-001	N/A	821-0048-001
88	Case Assembly				
	AIM 200, 18-380021, CM2675-1	649-0031-901	N/A	649-0032-901	N/A
	AIM 200E, 200ED	N/A	649-0040-901	N/A	649-0086-901
	AIM 200DC (14), 200DC (28), 200DC (14)P, 200DC (28)P	N/A	N/A	N/A	649-0092-901
89	Ring, Truarc-Waldes (Used only with non-eccentric shaft, Item 91, P/N 632-0010-001)	N/A	N/A	611-0028-001	611-0028-001
90	Washer (Used only with non-eccentric shaft, Item 91, P/N 632-0010-001	N/A	N/A	606-0007-001	606-0007-001
91	Shaft, eccentric (Some models only)	N/A	N/A	632-0012-001	632-0012-001
	Shaft, non-eccentric (Some models only)	632-0009-001	632-0009-001	632-0010-001	632-0010-001
92	Gear, pinion	631-0015-001	631-0015-001	631-0016-001	631-0016-001
93	Collar, shaft NOTE: Order Items 93 and 95 (P/N 632-0006-001) as a set. Do not order separately)	N/A	N/A	617-0003-001	617-0003-001
94	Setscrew, 2-56 x 1/4, Bristol, spline	N/A	N/A	—	—
95	Shaft, caging (For bottom-gear instruments, also see Item 93)	632-0005-001	632-0005-001	632-0006-001	632-0006-001
96	Lever, caging	656-0001-001	656-0001-001	656-0002-001	656-0002-001
97	Lever Assembly, actuating	656-0011-901	656-0011-901	656-0011-902	656-0011-902
98	Housing, bearing	635-0018-901	635-0043-901	635-0018-901	635-0043-901

TABLE 4-1. VACUUM AND ELECTRIC INSTRUMENTS (Cont'd)

NO.	DESCRIPTION	TOP-GEAR CONF. (Fig. 4-1)		BOTTOM-GEAR CONF. (Fig. 4-1)	
		Vacuum	Electric	Vacuum	Electric
99	Washer, air seal	606-0006-901	N/A	606-0006-901	N/A
100	Retainer, air seal	608-0002-001	N/A	608-0002-001	N/A
101	Ring, retainer	611-0007-001	N/A	611-0007-001	N/A
102	Brush Block	N/A	815-0002-001	N/A	815-0002-001
103	Screw, 1-72 x 1/4, Binder hd., st. st.	N/A	—	N/A	—
104	Housing, bearing	635-0011-901	635-0045-001	635-0011-901	635-0045-001
105	Pivot, top	N/A	N/A	639-0004-901	639-0004-901
106	Pivot, top (Some models only)	639-0052-901	639-0052-901	N/A	N/A
	Housing, bearing (Some models only)	635-0033-001	635-0033-001	N/A	N/A
107	Gear, spur	631-0011-001	631-0011-001	N/A	N/A
108	Plate, balance	N/A	N/A	628-0016-001	628-0016-001
109	Screw, 2-56 x 1/8, binder hd., st. st.	N/A	N/A	—	—
110	Screw, balance, 2-56 x 3/16, binder hd., st. st. (as required for balancing)	N/A	N/A	—	—
111	Gimbal, machined NOTE: also order Item 46 if not available from defective gimbal.	651-0007-901	651-0009-901	651-0008-901	651-0032-901
112	Rotor Housing Assembly, complete (See Figures 4-3, 4-4 and 4-5 for detailed parts.)	652-0016-901	652-0052-901	652-0016-901	652-0052-901
113	Terminal, lug	N/A	N/A	817-0002-001	817-0002-001
114	Pivot	639-0002-901	639-0026-001	639-0002-901	639-0026-001
115	Slip Ring	N/A	826-0007-001	N/A	826-0007-001
116	Motor, flag	N/A	811-0001-001	N/A	811-0001-001
117	Indicator Assembly, flag	N/A	648-0029-901	N/A	648-0049-901
118	Clamp, flag motor	N/A	625-0007-901	N/A	625-0007-901
119	Screw, 2-56 x 1/4, binder hd., st. st.	N/A	—	N/A	—
120	Shim, as required (modify for use on electric instruments).	607-0005-001	607-0005-001	607-0005-001	607-0005-001

NOTES

1. For complete rotor housing assembly, consisting of all parts shown below, order P/N 652-0016-901 (brass rotor) or P/N 652-0016-902 (heavy metal rotor). Assembly will be correctly preloaded and will require only minor balancing when installed.
2. For preloaded rotor assembly consisting of items 4, 11, 13, 14, 16, 19 and 23, order P/N 636-0018-901 (brass rotor) or P/N 636-0018-902 (heavy metal rotor).

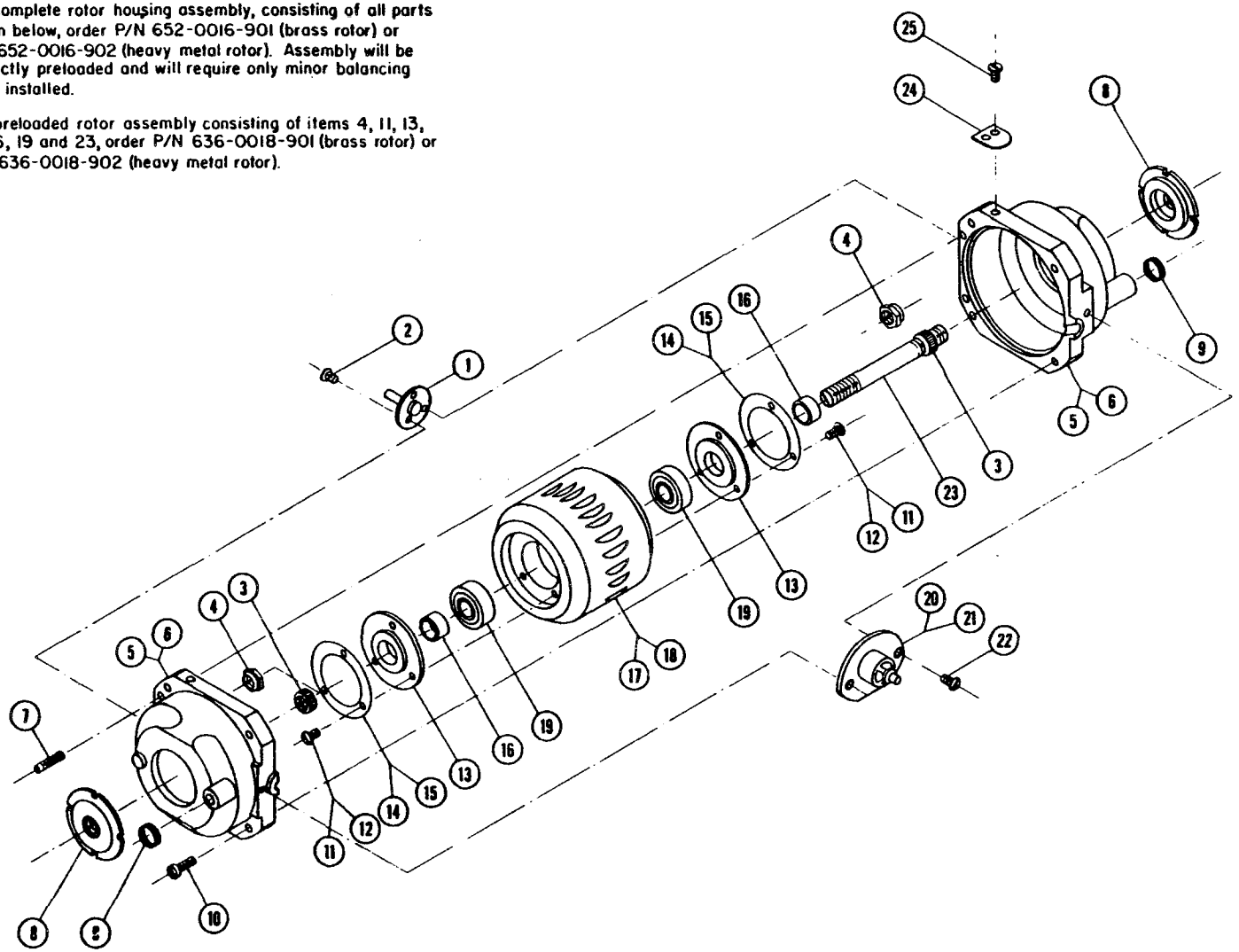


FIGURE 4-3. TYPE R3H VACUUM ROTOR, EXPLODED VIEW

TABLE 4-2. TYPE R3H VACUUM ROTOR (Figure 4-3)

NO.	DESCRIPTION	AIM PART NO.
	NOTE This parts list and the drawing of Figure 4-3 cover several versions of the basic R3H rotor. Where parts are identified by two callout numbers in the illustration, check the part description closely to insure the interchangeability of replacement parts.	
1	Pivot	639-0003-902
2	Screw, 1-72 x 1/8, flat hd., st. st.	—
3	Nut, preload, knurled	605-0012-001
4	Nut, preload, Esna, hex (used only with Item 18)	605-0015-001
5	Rotor Housing (with cast orifice)	652-0005-901
6	Rotor Housing (without cast orifice)	652-0006-901
7	Screw, balance	603-0009-002
8	Nut, rotor support	605-0011-001
9	Bumper, 1/8 x 1/4 I. D. vinyl tubing	—
10	Screw, 3-48 x 3/8, fillister hd., st. st.	—
11	Screw, 1-72 x 3/16, binder hd., st. st. (used only with Item 18)	—
12	Screw, 1-72 x 3/16, flat hd., st. st. (used only with Item 17)	—
13	Retainer, bearing	608-0011-001
14	Plate, bearing (used only with Item 18)	628-0070-001
15	Plate, bearing, with counter-sunk holes for flat-head screws (used only with Item 17)	628-0082-001
16	Spacer, bearing	616-0019-001
17	Rotor, brass, counterbored 3/32 inch to accommodate Items 3, 13 and 15	636-0006-001
	NOTE If defective, replace with Item 4, 18, and 23 as a set.	
18	Rotor, brass, counterbored approx. 5/32 inch to accommodate Items 4, 13 and 14	636-0009-001
19	Bearing	637-0011-004
20	Pivot, air (without orifice insert)	639-0005-901
21	Pivot, air (with orifice insert)	639-0009-901
22	Screw, 2-56 x 1/8, binder hd., st. st.	—
23	Shaft, rotor	632-0064-004
24	Weight, lead, as required for balancing	—
25	Screw, 2-56, length as required, binder hd., st. st.	—

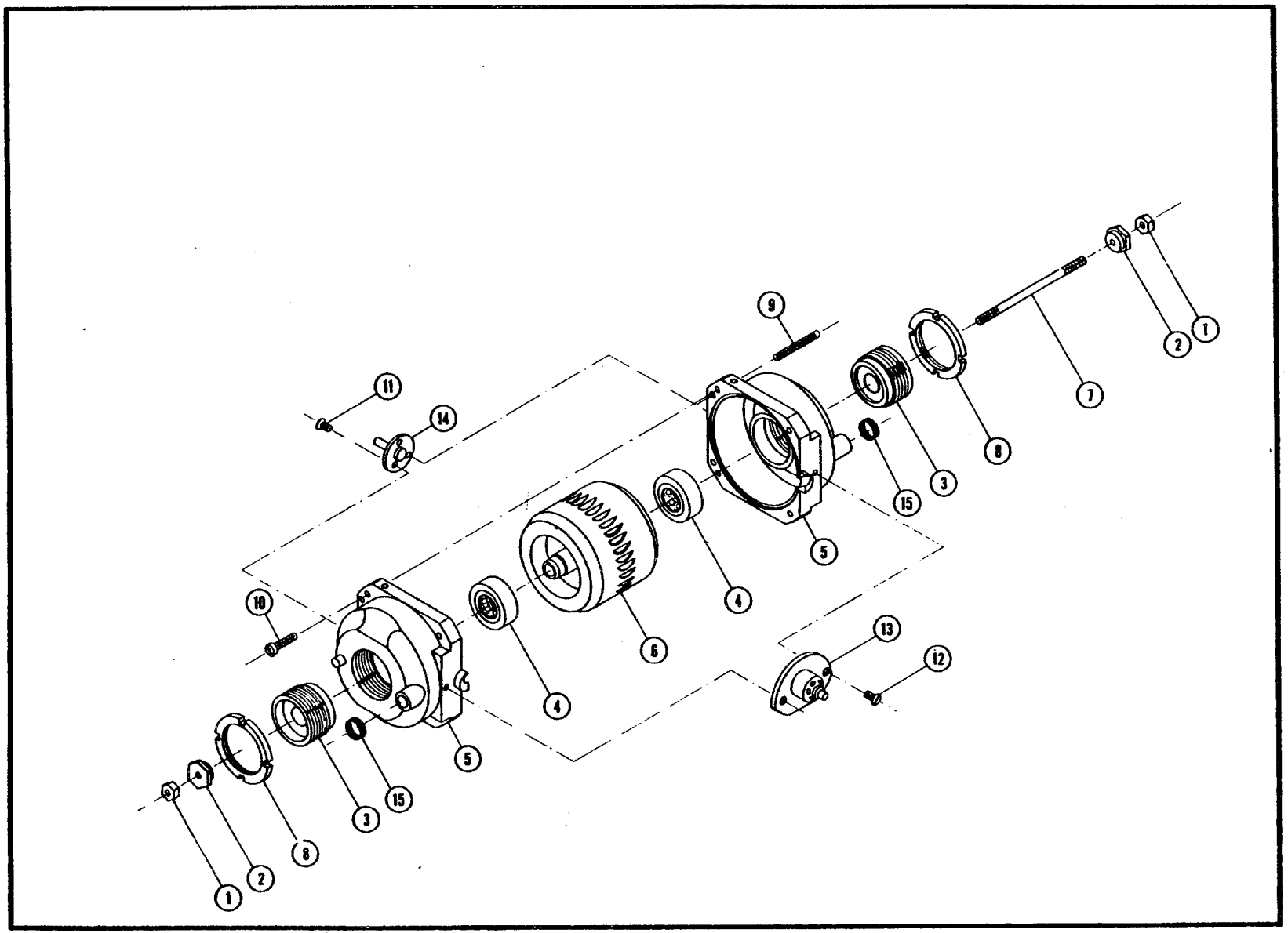


FIGURE 4-4. TYPE 34B VACUUM ROTOR, EXPLODED VIEW

TABLE 4-3. TYPE 34B VACUUM ROTOR (Figure 4-4)

NO.	DESCRIPTION	AIM PART NO.
1	Nut, lock, 3-56	—
2	Nut, shoulder	605-0004-001
3	Housing, bearing, threaded	635-0027-001
4	Bearing	637-0006-001
5	Housing, rotor	652-0004-901
6	Rotor, brass	636-0011-901
7	Shaft	632-0032-001
8	Ring, lock	611-0006-001
9	Screw, balance	603-0009-002
10	Screw, 3-48 x 3/8, fillister hd., st. st.	—
11	Screw, 1-72 x 1/8, flat hd., st. st.	—
12	Screw, 2-56 x 1/8, binder hd., st. st.	—
13	Pivot, air	639-0005-901
14	Pivot	639-0003-901
15	Bumper, 1/8 x 1/4 I. D. vinyl tubing	—

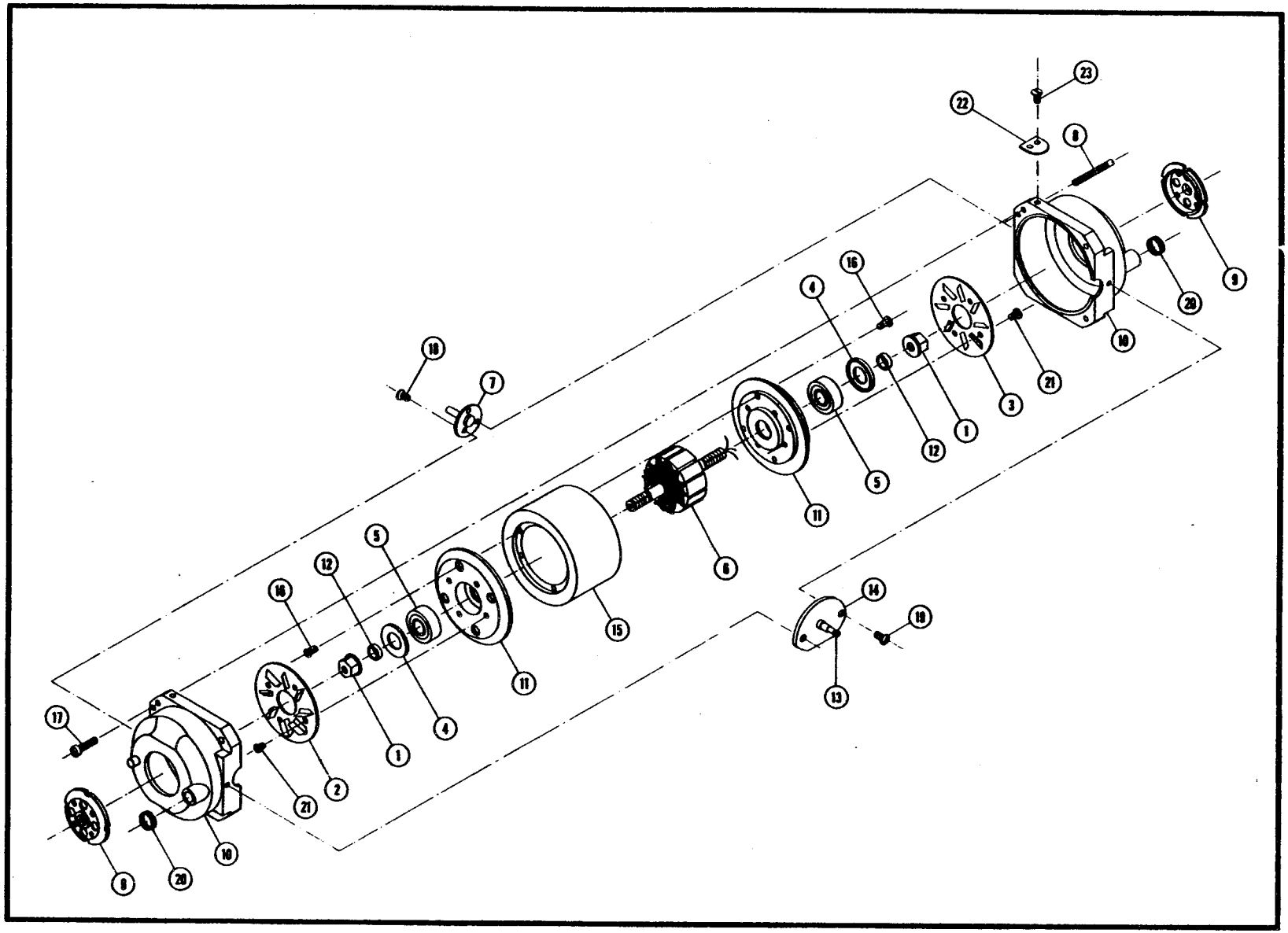


FIGURE 4-5. ELECTRIC ROTOR, EXPLODED VIEW

TABLE 4-4. ELECTRIC ROTOR (Figure 4-5)

NO.	DESCRIPTION	AIM PART NO.
1	Nut, preload	605-0024-001
2	Impeller, large	638-0001-001
3	Impeller, small	638-0001-002
4	Retainer, bearing	608-0010-001
5	Bearing	637-0011-002
6	Stator Assembly	827-0003-901
7	Pivot	639-0003-901
8	Screw, balance	603-0009-002
9	Nut, support	605-0010-001
10	Housing, rotor	652-0026-901
11	Housing, bearing	635-0053-901
12	Spacer, bearing	616-0018-001
13	Slip Ring	826-0007-001
14	Pivot, slip ring	639-0025-001
15	Ring Assembly	611-0020-901
16	Screw, 1-72 x 1/4, fillister hd., st. st.	—
17	Screw, 3-48 x 3/8, fillister hd., st. st.	—
18	Screw, 1-72 x 1/8, flat hd., st. st.	—
19	Screw, 2-56 x 1/8, binder hd., st. st.	—
20	Bumper, 1/8 x 1/4 I. D. vinyl tubing	—
21	Screw, 1-72 x 3/16 binder hd., st. st.	—
22	Weight, lead as required for balancing	—
23	Screw, 2-56, length as required, binder hd., st. st.	—

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OVERHAUL MANUAL

for

AIM 400
SLAVED GYRO DIRECTION INDICATOR SYSTEMS

and

AIM 800
SLAVED GYRO DIRECTION INDICATOR/RMI SYSTEMS

Aviation Instrument Manufacturing Corporation
9033 Monroe Road P.O. Box 12248
Houston, Texas 77017

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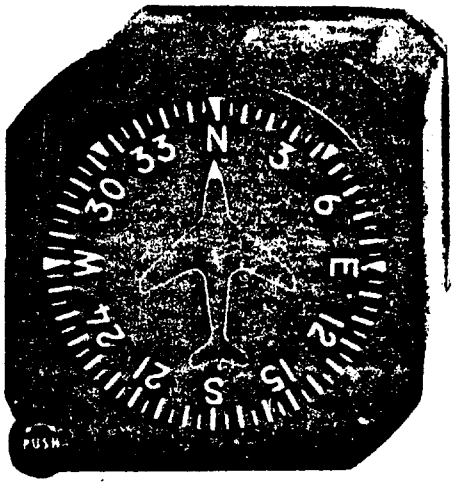
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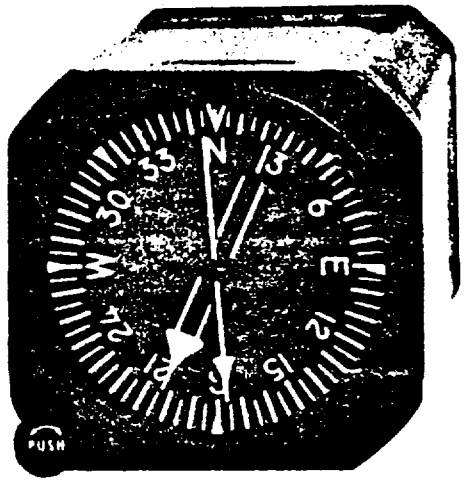
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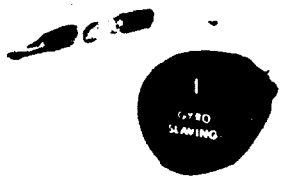
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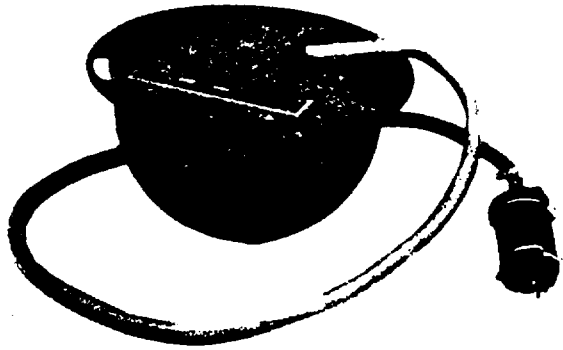
SLAVED GYRO



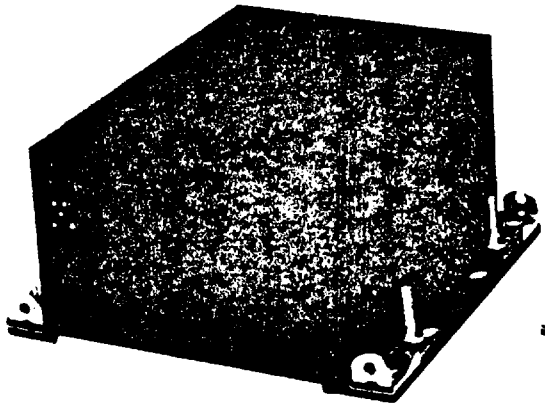
SLAVED GYRO/RMI



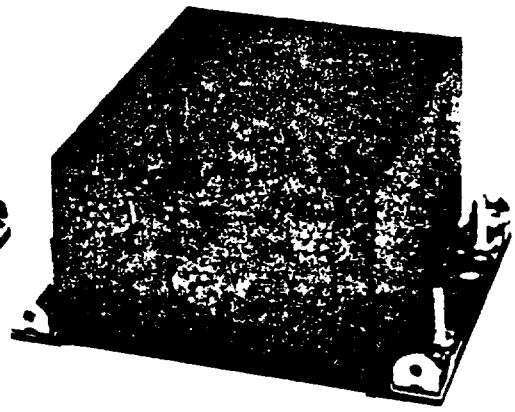
SLAVING INDICATOR



MAGNETIC FLUX DETECTOR



INVERTER



RMI COUPLER

FIGURE 1-1. AIM 400 AND AIM 800 SYSTEMS AND ACCESSORIES

SECTION 1
GENERAL INFORMATION

1.1 SCOPE

This manual contains maintenance and overhaul procedures for Aviation Instrument Manufacturing Corporation's AIM 400 Slaved Gyro Direction Indicator Systems and AIM 800 Gyro Direction Indicator/RMI Systems. Specifications and complete parts lists for the systems and their accessory components are also included.

Although this manual was prepared with considerable attention to detail, no attempt has been made to instruct non-qualified personnel in the specific procedures required to successfully overhaul the instrument. Instead, the manual is intended only as a guide for experienced gyro mechanics.

1.2 GENERAL DESCRIPTION

1.2.1 Over-All Systems

The basic AIM 400 Slaved Gyro Direction Indicator System is designed to furnish the aircraft pilot with a constant directional reference which is not subject to the temporary errors inherent in magnetic compasses nor to the drift errors normally associated with non-slaved gyro instruments.

In addition to providing a constant directional reference, AIM 800 Systems employ either single or dual synchro-driven pointers which utilize ADF/VOR inputs to provide continuous indications of magnetic bearings to specific ground stations.

Both systems contain a gyro direction indicator and an electronic compass. The electronic compass continually compares the gyro indication with the aircraft magnetic heading obtained from a remote flux detector and applies continuous correction as required. This correction is limited to approximately two degrees per minute so that erroneous information generated by the compass in turns and in rough air will not noticeably effect the gyro indication.

1.2.1 Over-All Systems (Cont'd)

The system is provided with a card set knob which permits initial adjustment of the gyro card to coincide with the heading information obtained from the electronic compass. A slaving indicator provides a visual indication at its centered position, that synchronization has been obtained. It also provides a continuous indication of system operation by showing that slaving corrections are being applied to the gyro.

Several variations of the basic AIM 400 and AIM 800 Systems are available to accommodate a wide variety of operational requirements. Directional gyros may be provided with either vacuum-driven or electric rotors. Systems which contain directional gyros with electric rotors are denoted by the suffix "EL" following the system model number.

The various models of both the AIM 400 and AIM 800 Systems are shown in the following table. With one exception, each AIM 400 System has an AIM 800 counterpart which is designed to provide all the functions of the AIM 400 plus the additional feature of either single or dual ADF/VOR pointers. The single exception is the AIM 400 BC which, due to space limitations, does not have an AIM 800 counterpart.

An additional "bootstrap" power heading synchro is available on selected AIM 800 systems. This is required to drive various RMI converters which, in turn, provide VOR pointer inputs to the AIM 800.

1.2.2 Gyro Direction Indicator

The Gyro Direction Indicator used in each system is a precise gyroscopic flight instrument. The purpose of the instrument is to maintain a stabilized datum reference from which the angular movements of an aircraft in azimuth can be measured. This is accomplished by a universally mounted high speed rotor which develops sufficient angular momentum to overcome normal bearing friction and thus becomes stable relative to space. This stability, known as "rigidity in space" resists small forces which attempt to displace the axis of rotation and consequently its position in space.

TABLE 1-1. SYSTEM DESIGNATIONS AND FUNCTIONS

SYSTEM DESIGNATION	GYRO MODEL NO.	GYRO DESCRIPTION					AIM 292 RMI Coupler	REMARKS
		Rotor	ADF/VOR Pointers	Autopilot Output	4-Power Synchro Output	1-Power Synchro Output		
AIM 400	254-92	vac.	0	-	-	-	-	Basic Slaved Gyro and Gyro/RMI Systems.
AIM 800	254-1S	vac.	1	-	-	-	-	
	254-1D	vac.	2	-	-	-	-	
AIM 400 EL	254-1E	elec.	0	-	-	-	-	
AIM 800 EL	254-1ES	elec.	1	-	-	-	-	
	254-1ED	elec.	2	-	-	-	-	
AIM 400A	254-92	vac.	0	-	-	-	X	Basic systems, plus AIM 292 RMI Coupler for operation of a remote servo-driven, card-type RMI instrument.
AIM 800A	254-1S	vac.	1	-	-	-	X	
	254-1D	vac.	2	-	-	-	X	
AIM 400A EL	254-1E	elec.	0	-	-	-	X	
AIM 800A EL	254-1ES	elec.	1	-	-	-	X	
	254-1ED	elec.	2	-	-	-	X	
AIM 400B	293-1	vac.	0	L-2	-	-	-	Basic systems, plus L-2 Autopilot output. Note This series discontinued for new production; however, parts are available.
AIM 800B	293-1S	vac.	1	L-2	-	-	-	
	293-1D	vac.	2	L-2	-	-	-	
AIM 400B EL	293-1E	elec.	0	L-2	-	-	-	
AIM 800B EL	293-1ES	elec.	1	L-2	-	-	-	
	293-1ED	elec.	2	L-2	-	-	-	
AIM 400AB	293-1	vac.	0	L-2	-	-	X	Combines features of "A" and "B" systems above. Note This series discontinued for new production; however parts are available.
AIM 800AB	293-1S	vac.	1	L-2	-	-	X	
	293-1D	vac.	2	L-2	-	-	X	
AIM 400AB EL	293-1E	elec.	0	L-2	-	-	X	
AIM 800AB EL	293-1ES	elec.	1	L-2	-	-	X	
	293-1ED	elec.	2	L-2	-	-	X	
AIM 400C Standard	289-1	vac.	0	-	X	-	-	Basic systems, plus 4-power synchro for heading output to any ARINC instrument. A second synchro (1-power) for an additional heading output is optionally available. Typical usage of the 4-power synchro is to provide heading information to an RMI converter.
Optional	289-2	vac.	0	-	X	X	-	
AIM 800C Standard	289-1S	vac.	1	-	X	-	-	
Optional	289-2S	vac.	1	-	X	X	-	
Standard	289-1D	vac.	2	-	X	-	-	
Optional	289-2D	vac.	2	-	X	X	-	
AIM 400C EL (Std.)	289-1E	elec.	0	-	X	-	-	
Optional	289-2E	elec.	0	-	X	X	-	
AIM 800C EL								
Standard	289-1ES	elec.	1	-	X	-	-	
Optional	289-2ES	elec.	1	-	X	X	-	
Standard	289-1ED	elec.	2	-	X	-	-	
Optional	289-2ED	elec.	2	-	X	X	-	
AIM 400BC	299-1	vac.	0	L-2	-	X	-	Note: This series discontinued for new production; however parts are available.
AIM 400BC EL	299-1E	elec.	0	L-2	-	X	-	
AIM 400D	297-1	vac.	0	G-4	-	-	-	Basic systems, plus heading output to Bendix G-4 or 801A/802A (M-4 Autopilot) Systems. A 4-power synchro for an additional heading output is optionally available on AIM 800D and 800D EL systems.
AIM 800D Standard	297-1S	vac.	1	G-4	-	-	-	
Optional	297-2S	vac.	1	G-4	X	-	-	
Standard	297-1D	vac.	2	G-4	-	-	-	
Optional	297-2D	vac.	2	G-4	X	-	-	
AIM 400D EL	297-1E	elec.	0	G-4	-	-	-	
AIM 800D EL								
Standard	297-1ES	elec.	1	G-4	-	-	-	
Optional	297-2ES	elec.	1	G-4	X	-	-	
Standard	297-1ED	elec.	2	G-4	-	-	-	
Optional	297-2ED	elec.	2	G-4	X	-	-	
AIM 400E	424-1	vac.	0	M-H-14	-	-	-	Basic systems, plus heading output to M-H-14 Autopilot. A 4-power synchro for an additional heading output is optionally available on AIM 800E and 800E EL systems.
AIM 800E Standard	424-1S	vac.	1	M-H-14	-	-	-	
Optional	424-2S	vac.	1	M-H-14	X	-	-	
Standard	424-1D	vac.	2	M-H-14	-	-	-	
Optional	424-2D	vac.	2	M-H-14	X	-	-	
AIM 400E EL	424-1E	elec.	0	M-H-14	-	-	-	
AIM 800E EL								
Standard	424-1ES	elec.	1	M-H-14	-	-	-	
Optional	424-2ES	elec.	1	M-H-14	X	-	-	
Standard	424-1ED	elec.	2	M-H-14	-	-	-	
Optional	424-2ED	elec.	2	M-H-14	X	-	-	
AIM 400F	289-3	vac.	0	400	-	-	-	Basic systems, plus heading output to Cessna 400 Autopilot. An additional 4-power synchro heading output is included in AIM 800F and 800F EL systems.
AIM 800F	289-3S	vac.	1	400	X	-	-	
	289-3D	vac.	2	400	X	-	-	
AIM 400F EL	289-3E	elec.	0	400	-	-	-	
AIM 800F EL	289-3ES	elec.	1	400	X	-	-	
	289-3ED	elec.	2	400	X	-	-	

1.2.2 Gyro Direction Indicator (Cont'd)

Angular movements of the aircraft in azimuth are indicated on a circular vertical dial which is graduated in five degree increments.

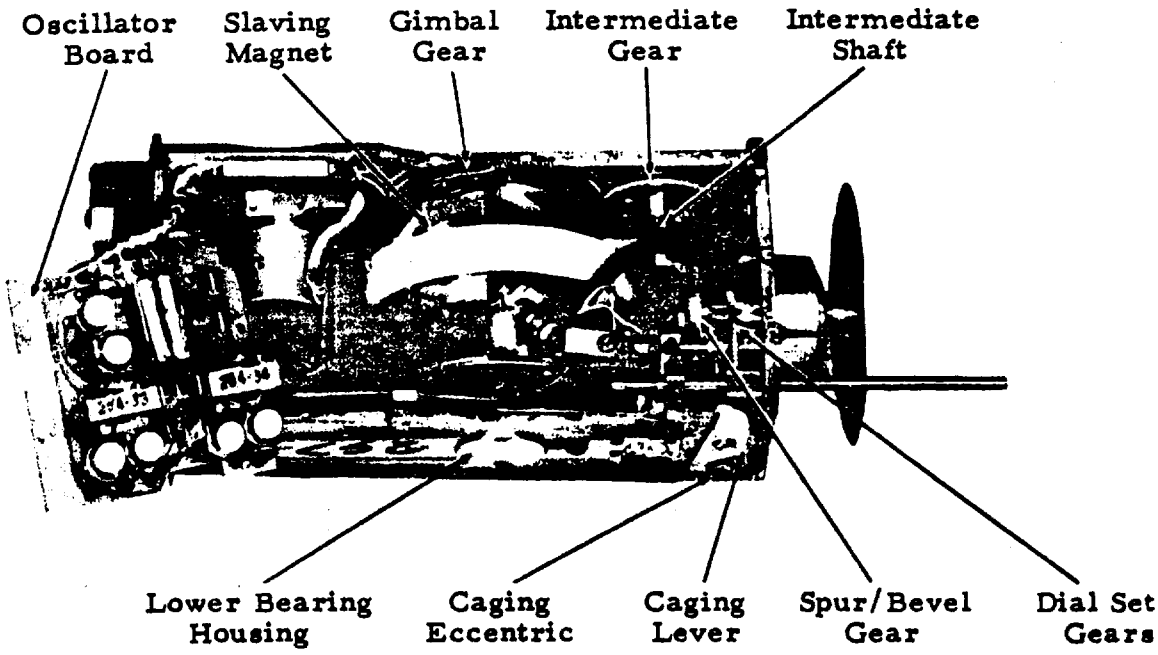
The instrument is compact and fits a standard 3-1/8" instrument panel cutout. The small size of the instrument combined with its substantially reduced weight permits panel layouts in accordance with SAE and airline standards.

The gyro is spillproof and will not tumble regardless of the aircraft's attitude. The instrument incorporates a self erecting feature so that no periodic caging of the gyro inner gimbal is necessary.

The basic internal construction of an AIM slaved gyro is shown in Figure 1-2 along with the indentification of major sub-assemblies and components. Since each of the specialized gyros used in the various systems is actually an adaptation of the same basic design, the model shown is suitable for the purposes of this discussion regardless of the specific gyro to be overhauled.

The functional center of the gyro direction indicator is an accurately balanced high speed rotor which is mounted on precision bearings inside an enclosed rotor housing. The rotor housing is suspended from bearings mounted in the gimbal assembly and is free to pivot in the vertical plane up to $\pm 80^{\circ}$ from horizontal. In turn, the gimbal assembly is suspended from bearings mounted in the instrument case so that the over-all assembly has complete freedom of movement about its vertical axis. Over-all operation of the instrument is as follows:

On vacuum-driven models, a vacuum system capable of maintaining a suction of 4.5 to 4.7 in. Hg. is connected to the vacuum port on the rear of the instrument. This port opens directly into the air-sealed instrument case. Air, at normal atmospheric pressure, is drawn through the AIR INLET filter and along the ducts in the instrument to an air seal housing which contains the lower gimbal bearing. From this point a duct in the gimbal leads to a second air seal housing which contains the bearings for the rotor housing. At this point, air passes through the rotor housing pivot and is directed at the buckets in the rotor periphery, causing the rotor to revolve at very high speed.



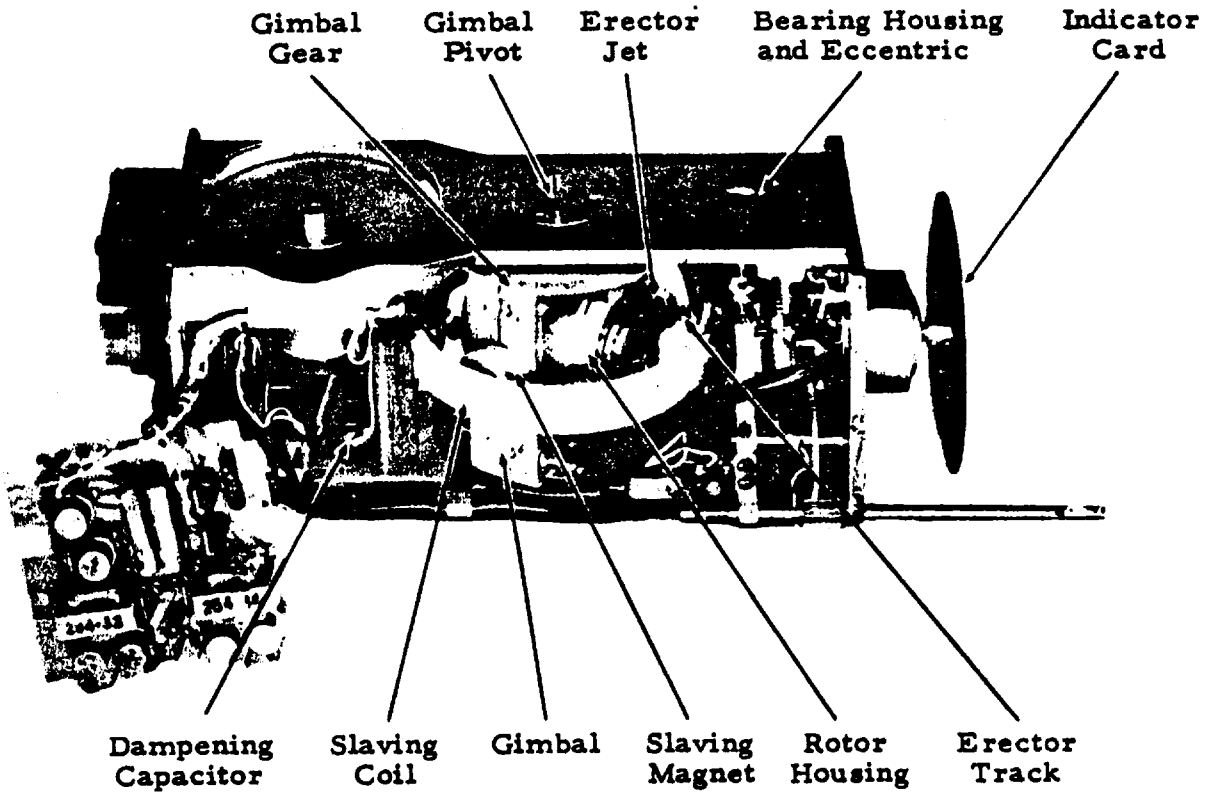


FIGURE 1-2. INTERNAL CONSTRUCTION FEATURES

1.2.2 Gyro Direction Indicator (Cont'd)

Electric models are provided with 115 vac, 400 cps, single phase drive voltage which is applied to the instrument through a 5 pin electrical connector on the rear of the case. A capacitor is then used to obtain the two-phase supply voltage necessary to drive the rotor. The drive voltage is then transferred through brush and slipring assemblies in the bottom of the instrument casting and in the gimbal, to a stator inside the rotor housing. The rotor is mounted around the fixed stator on precision bearings so that when voltage is applied to the stator the desired rotor movement is obtained. Small impellers are attached to the top and bottom of the spinning rotor to generate the air flow required to operate an internal self-erect system.

The self-erect features of the air-driven and electric rotors are identical. Air from the rotor housing is exhausted through two horizontally opposed erector jets and pushes against the semi-circular baffled track attached to the gimbal. The entire assembly acts as an air valve
at when the spin axis of the rotor is inclined from the horizontal
ion, one erector jet will be closed while the air being expelled
the opposite erector jet will exert torque about the vertical axis
e gimbal. This action precesses the spin axis of the rotor to the
zontal position so that the opposing jets are opened an equal amount
the gimbal is again stable.

Azimuth movements of the gimbal assembly are transmitted to the vertical indicator card and to the electronic compass circuitry by means of a precision gear system. A standard gear-driven, synchro resolver continuously monitors the gyro heading, represented by the position of the outer gimbal assembly, and relays this information electrically to the electronic compass circuitry. There the heading obtained from the gyro direction indicator is compared with the heading obtained from the flux detector. Any deviation of the gyro direction indicator heading from that of the flux detector will result in the generation of a corrective signal by the electronic compass. This correction voltage is applied to a slaving coil affixed to the instrument case. The magnetic field generated by this coil acts against a small permanent magnet affixed to one end of the rotor housing shaft. This force, attempting

1.2.2 Gyro Direction Indicator (Cont'd)

to change the pitch position of the rotor housing causes precession of the outer gimbal assembly around its vertical axis. When the position of the gimbal assembly and the resultant heading of the gyro direction indicator corresponds with the magnetic heading information obtained from the flux detector, the corrective voltage generated by the electronic compass circuitry ceases. The gyro heading correction is a continuous process which automatically maintains the gyro heading within 1° of the electronic compass heading.

1.2.3 Electronic Compass

The electronic compass circuitry is housed in the rear section of the gyro direction indicator case. Components are mounted on convenient circuit boards which are easily accessible for maintenance purposes. A block diagram of the compass circuitry is shown in Figure 1-3.

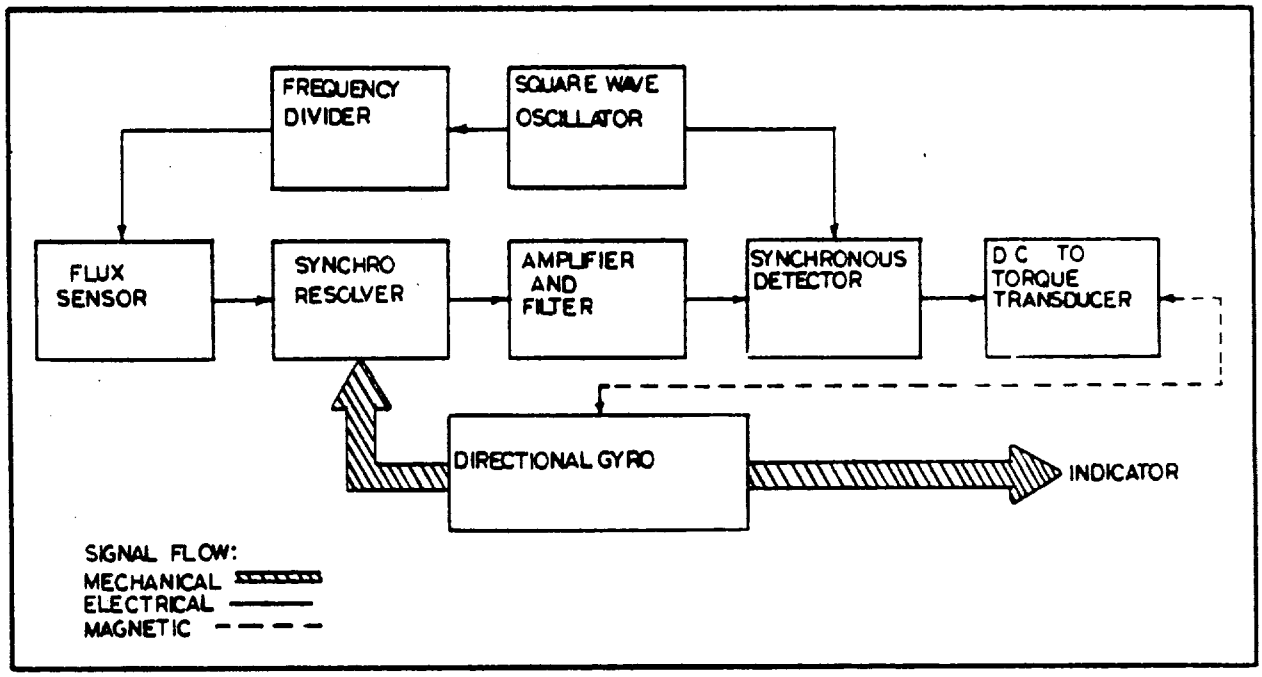


FIGURE 1-3. BLOCK DIAGRAM, ELECTRONIC COMPASS CIRCUITRY

1.2.3 Electronic Compass (Cont'd)

The purpose of the electronic compass is to generate a dc voltage proportional to the angular difference between the actual magnetic heading of an aircraft and that which is indicated by the gyro direction indicator. Operation of the circuit may be most easily understood by beginning with the 1680 cps square wave generator, the output of which is applied to a frequency divider. The 840 cps output of the divider is then applied to a second harmonic magnetic flux sensor which in turn produces a usable signal at a frequency of 1680 cps. The flux detector output may be considered to be equivalent to the stator signal of a synchro resolver in which the rotor is excited. This signal is then applied to the stator of a synchro resolver which serves as a control transformer and a heading error is present at the rotor terminals. This output signal is proportional to the difference between the angular position of the resolver rotor and the angle at which the horizontal component of the earth's magnetic field passes through the flux sensor. The ac error signal, after being amplified and filtered, is applied to a synchronous detector, the output of which is a dc voltage having amplitude and polarity corresponding with the heading error signal. The presence of an error signal, and the subsequent slaving of the directional gyro, is indicated by means of a small voltmeter normally located adjacent to the gyro instrument. Any difference in the gyro heading and that of the electronic compass will result in a deflection of the meter needle either positive or negative depending on the correction required. The meter centers at its null position when synchronization has been obtained.

1.3 CIRCUIT DESCRIPTION

1.3.1 Square Wave Oscillator

A circuit diagram of the 1680 cps square wave oscillator is shown in figure 1-4. The frequency of the oscillator is determined by a high Q series resonant circuit inserted in the feedback network. During the half cycle in which Q3 is conducting, the feedback current path is through diode CR2 and the emitter base junction of transistor Q3. The

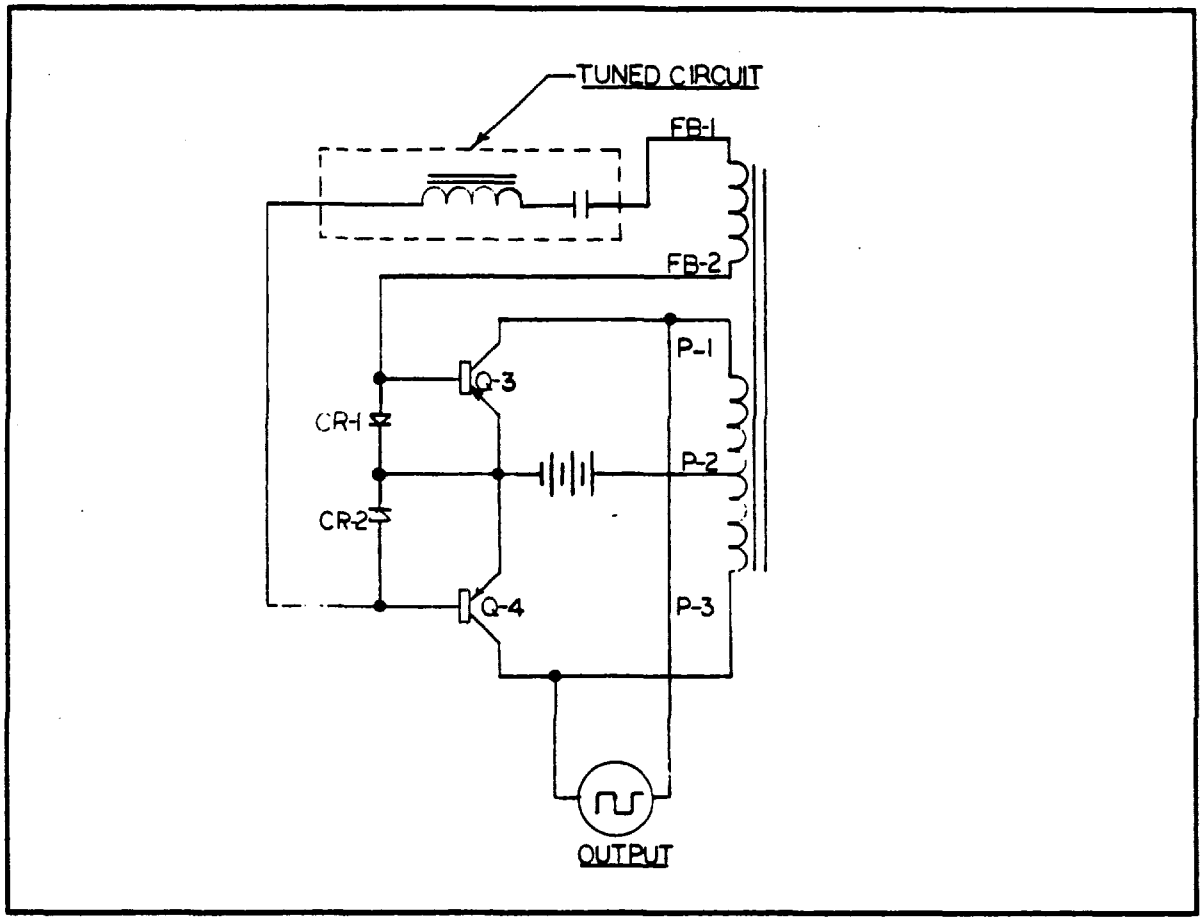


FIGURE 1-4. CIRCUIT DIAGRAM, SQUARE WAVE OSCILLATOR

1.3.1 Square Wave Oscillator (Cont'd)

amplitude of this feedback current is sufficient to drive the transistor into saturation very early in each half cycle. The resultant output is an extremely symmetrical square wave at a frequency of 1680 cps.

1.3.2 Frequency Divider Circuit

The Frequency Divider Circuit is shown in Figure 1-5. The circuit is identical to that of the commonly used saturable core square wave oscillator except that free funning oscillation is prevented by the synchronization pulses derived from the 1680 cps square wave oscillator.

A square wave applied to capacitor C4 is differentiated by the network consisting of C4 and the parallel combination of R7 and R4 to

1.3.2 Frequency Divider Circuit (Cont'd)

provide sync pulses at the center tap of the feedback winding. Assume that transistor Q1 is conducting and that the induced voltage across the feedback winding FB1 is holding Q2 at cutoff. A positive pulse applied to the center tap of the feedback winding will cut off transistor Q1. The same positive pulse applied to the base of Q2 is partially cancelled by

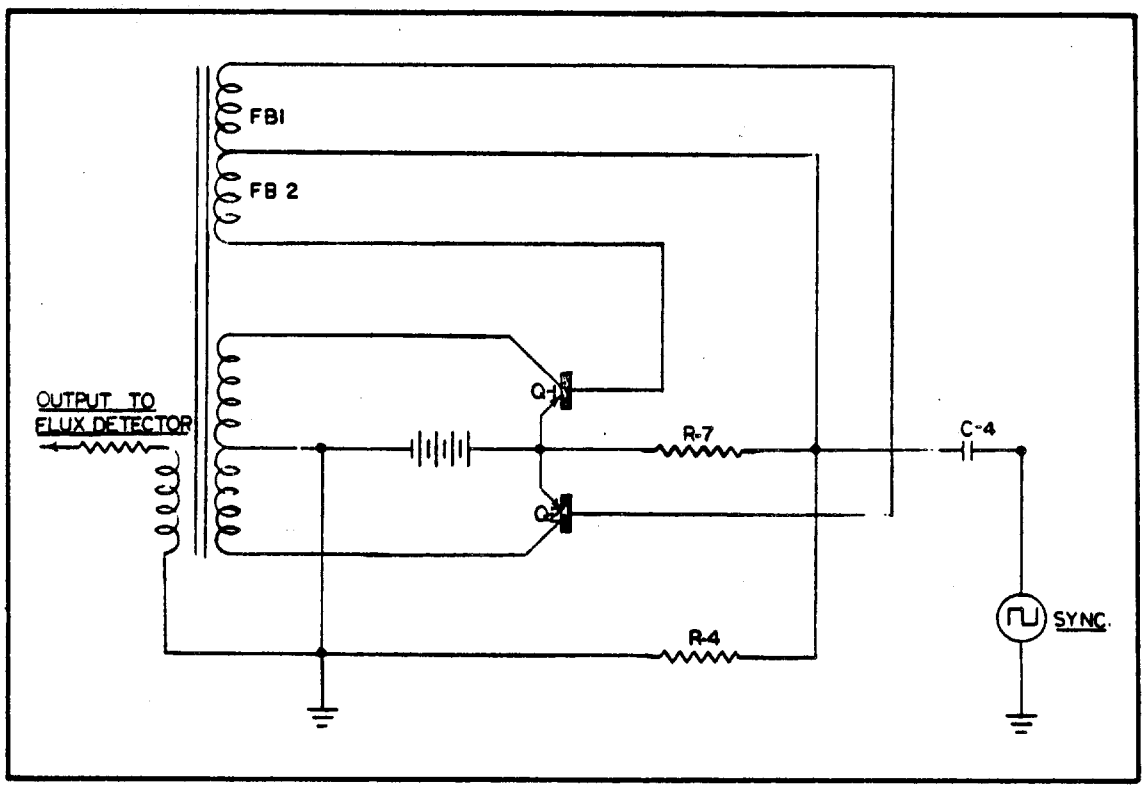


FIGURE 1-5. CIRCUIT DIAGRAM, FREQUENCY DIVIDER CIRCUIT

the collapsing field of feedback coil FB1. The result is that transistor Q2 begins to conduct and transistor Q1 is held at cutoff. A negative pulse applied to the center tap of the feedback winding will merely assist each transistor in maintaining its present state and will consequently have no effect on the output. Thus, the output from the frequency divider is an 840 cps square wave or exactly half the frequency generated by the square wave oscillator.

1.3.3 Magnetic Flux Detector

Operation of the Magnetic Flux Detector may be considered to be

1.3.3 Magnetic Flux Detector (Cont'd)

similar to that of a synchro resolver. The device is capable of shifting the phase of an applied input signal in a direction and magnitude proportional to its relative position with respect to magnetic north. Apart from the wave form being non-sinusoidal, the flux detector output may be considered as equivalent to the stator signal of a synchro resolver in which the rotor is excited. The magnetic flux detector produces a 1680 cps output signal which is the second harmonic of the applied 840 cps input signal.

1.3.4 Synchro Resolver

The output signal from the magnetic flux detector is applied to the windings of a standard synchro resolver mounted in the gyro case. This resolver is mechanically engaged with the large gimbal drive gear so that the heading of the directional gyro is continuously monitored. The synchro resolver electrically compares the heading information obtained from the magnetic flux detector with the mechanical heading information obtained from the gyro. Any difference in the angular position of the two will result in an output voltage across the rotor terminals of the synchro resolver. The phase and amplitude of the resolver output is determined by the direction and amount of correction required.

1.3.5 Amplifier/Filter Circuit

A detailed schematic diagram of the amplifier/filter circuit is shown in Figure 1-6. Since the output of the flux detector is extremely high in harmonic content and the desired 1680 cps signal is severely attenuated, the unwanted signals must be filtered out and the remaining signal must be amplified. Filtering is accomplished by transistors Q7, Q8, capacitors C9 and C10, and resistor R10. The transistors are operated as switches with the switching excitation obtained through resistors R12 and R13 from the collector of the oscillator transistors. During the half cycle in which transistor Q7 is turned on, the energy of the usable signal is being supplied to capacitor C9 and the instantaneous output from the filter is the voltage across C9. During

1.3.5 Amplifier/Filter Circuit (Cont'd)

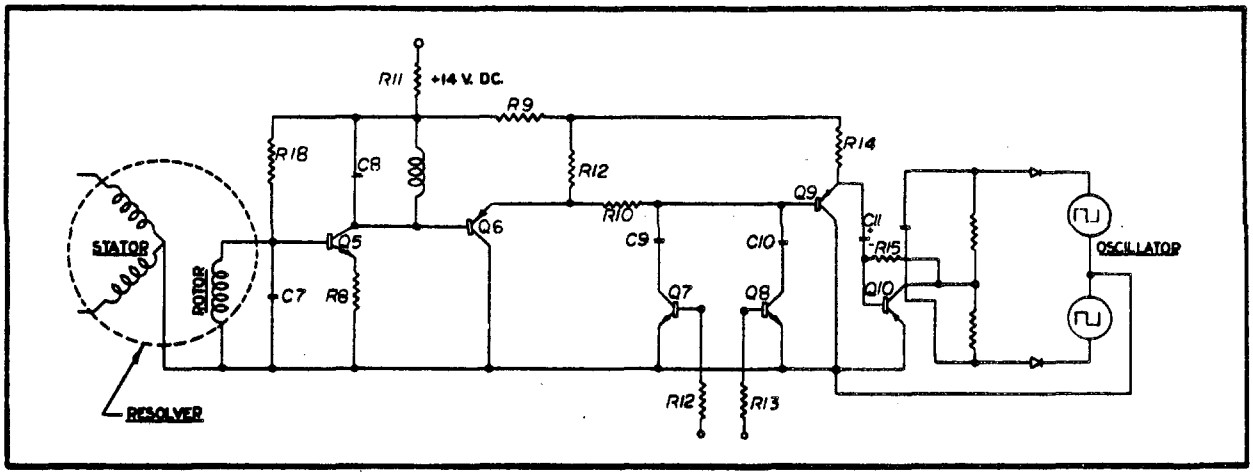


FIGURE 1-6. CIRCUIT DIAGRAM, AMPLIFIER/FILTER CIRCUIT

the other half cycle, switch Q8 is closed and the output voltage is that appearing across capacitor C10. Since the time constants of networks R10-C9, and R10-C10 are much greater than one half cycle of the signal frequency, the output of the synchronous filter is a good square wave.

The square wave output of the synchronous filter is applied to the grounded collector stage transistor Q9 to lower the impedance level. The signal is then applied to the phase detector transistor Q10.

It can be seen that if the voltage applied to the base of Q10 is in phase with the output from the square wave oscillator, the variation in the conductivity of Q10 will result in a greater average current through one-half of the slaving coils than the other. Thus, the direction of torque applied to the inner gimbal assembly is dependent upon the phase relationship between the output of the square wave oscillator and the signal appearing at the base of Q10. The magnitude of this torque is entirely dependent on the magnitude of the signal appearing at the base of Q10.

1.3.6 Electronic Compensator

Compensation of any magnetic compass requires the cancellation of magnetic disturbances which are introduced by magnetic materials

1.3.6 Electronic Compensator (Cont'd)

and electrical equipment fixed to the airframe. By setting up fixed signals and injecting them in addition to the heading signal, the disturbance of the airframe can virtually be eliminated.

The conventional method of compensation is to introduce adjustable magnetic signals (east-west and north-south) in the proximity of the compass element. The method employed in the AIM 400 and AIM 800 systems is to add adjustable electrical signals in series with each flux detector signal. It should be noted that this is a two axis system in which the axes correspond to north-south and east-west.

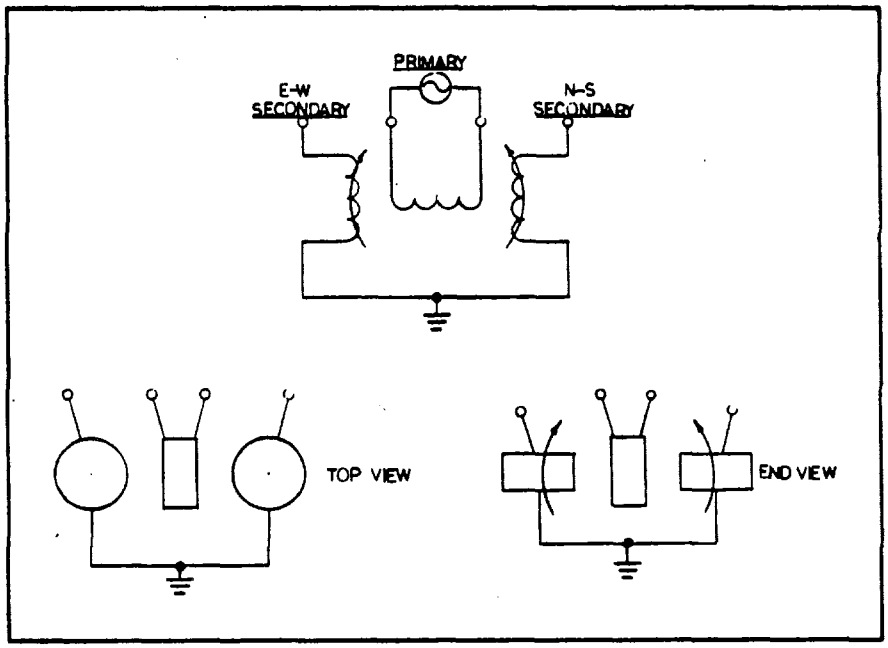


FIGURE 1-7. ELECTRONIC COMPENSATOR

The schematic diagram and physical configuration of the electronic compensator is shown in Figure 1-7. The compensator consists of an air wound transformer with one primary winding and two secondary windings. Each secondary can be rotated to adjust the phase and magnitude of the induced voltage in either the north-south or east-west axes.

The compensator itself is located on the rear of the instrument case. The device is easily accessible and may be adjusted without disassembly of the compensator or the instrument case.

1.3.7 Bootstrap Synchro

Gyros used in AIM 800D and 800E systems are available with an additional "bootstrap" heading synchro designed to supply heading signals to an external differential synchro in an RMI converter. The output of the differential synchro is used to position an ADF/VOR needle on the front of the gyro case. Instruments equipped with the bootstrap synchro are identified by a "-2" designation following the basic model number. These instruments, along with their non-bootstrap counterparts are as follows: 297-2S/297-1S, 297-2D/297-1D, 297-2ES/297-1ES, 297-2ED/297-1ED, 424-2S/424-1S, 424-2D/424-1D, 424-2ES/424-1ES, and 424-2ED/424-1ED.

Due to the size of the bootstrap synchro (size 11 as compared to size 10 of other synchros), it must necessarily be positioned vertically in the rear of the instrument case. Consequently, on all "-2" instruments the slaving synchro is displaced from the rear of the case to a vertical position in the front. See Table 2-1 and Figure 2-0.

1.3.8 RMI Coupler

A schematic diagram of the optional RMI Coupler is shown in Figure 1-9 along with the schematic diagram of a complete AIM 400 system. The schematic for AIM 800 systems is identical to the one shown, with the addition of the synchro-driven ADF/VOR pointers.

The RMI Coupler is actually a servo amplifier which may be used to to drive the heading card of any standard servo-driven RMI. A power source of 26 vac, 400 cps, 8 volt-amperes, is required to operate the coupler circuitry. The 26 vac is internally rectified and filtered so that no additional dc power is required.

The RMI Coupler consists of a three stage servo amplifier with internal rate feedback dampening. Heading information from the gyro slaving resolver is amplified to a sufficient level to operate any of the ARINC standard, servo-driven cards. An auxiliary DC output is provided to actuate a warning flag, if required.

1.4 OPERATING SPECIFICATIONS

NOTE

The following specifications apply to basic system operations only, and do not include the various autopilot outputs and ADF/VOR pointer combinations which are available with many systems.

1.4.1 Electric Gyros

Normal Operating Power	13 VA
Maximum Starting Power	16 VA
Input Voltage	115 vac ± 15%, 400 cps ± 10% single phase, sine or square waveform.
Stability (free gyro)	Can be used as a temporary heading reference if slaving circuitry becomes inoperative.
Rotor Speed	23,500 RPM
Full Scale Slaving Rate	1°/minute, nominal
ADF/VOR Pointer Synchro (s) (AIM 800 Systems only)	Standard ARINC Synchro receiver(s).

1.4.2 Vacuum Gyros

Normal Operating Vacuum	4.5 to 5.2 in. Hg.
Maximum Starting Vacuum	2.25 in. Hg.
Air Consumption	1.8 cubic feet/min.
Stability (free gyro)	Can be used as a temporary heading reference if slaving circuitry becomes inoperative.
Rotor Speed	27,000 RPM
Full Scale Slaving Rate	2°/minute, nominal
ADF/VOR Pointer Synchro (s) (AIM 800 Systems only)	Standard ARINC synchro receiver(s).

1.4.3 Electronic Compass Slaving System

Input Voltage	13.75 or 27.5 vdc (26 volts, 400 cps, 8 VA ac is also required for models used with RMI coupler)
Input Current	0.09 amperes, nominal
Accuracy (fully compensated)	± 1.5 degrees
Heading Drift vs Input voltage Variation	1°/10%
Output	When used with the AIM 292 RMI Coupler, the basic slaved system produces a heading output suitable for driving the heading card of any standard servo-driven RMI.

1.4.4 AIM 254-11 Flux Detector

Input	840 cps reference signal from slaved gyro.
Output	1680 cps signal (second harmonic of 840 cps input) the phase of which is shifted in direction and magnitude proportioned to the relative position of the flux detector with respect to magnetic north.

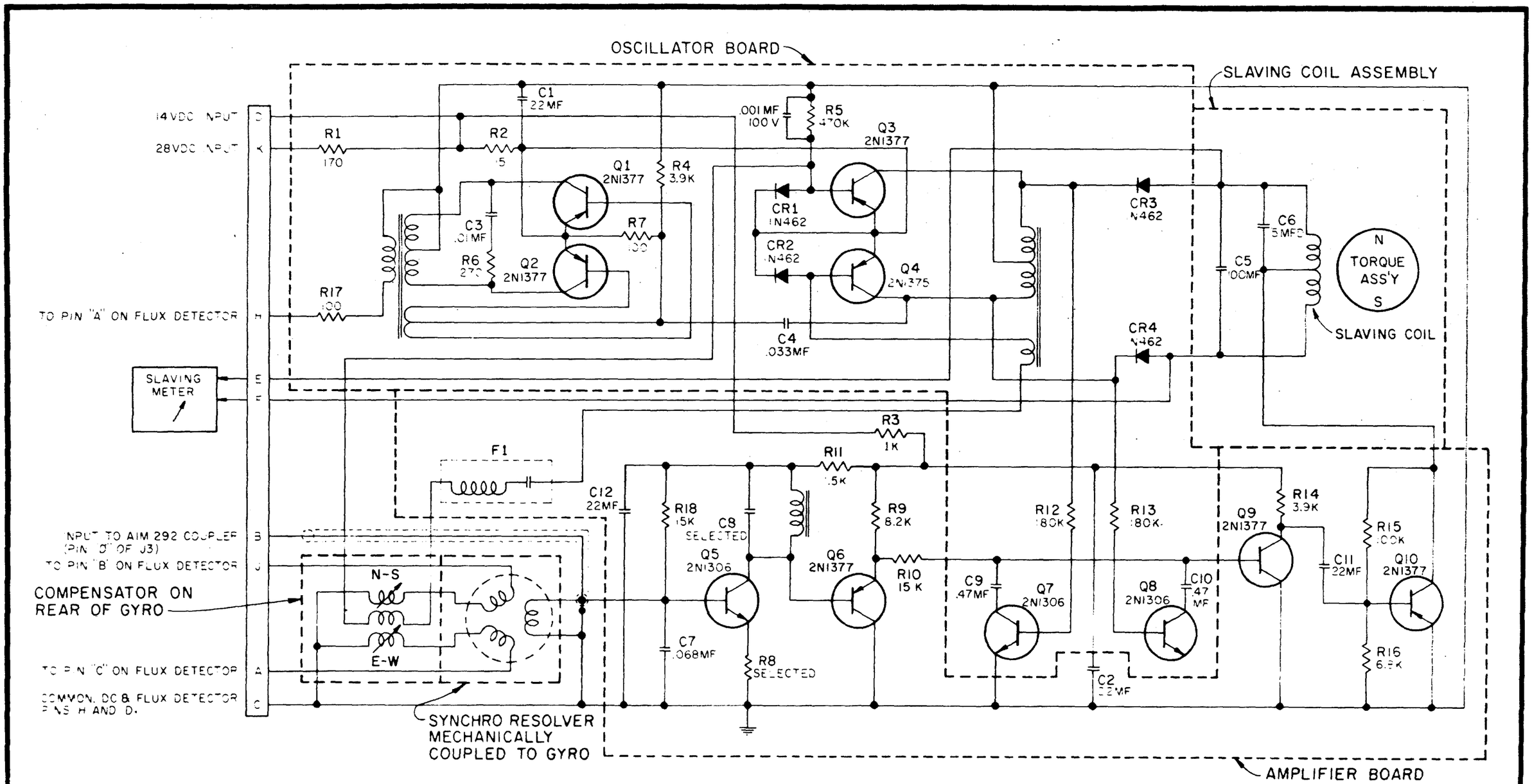
Note

The Flux Detector is a sealed unit and is not repairable in the field. To check for open windings, use a Simpson VOM or equivalent and check for the following DC resistance readings:

Pins "A" to "D" = 0.2 to 5.0 ohms
Pins "H" to "E" = 50 to 200 ohms
Pins "H" to "B" = 50 to 200 ohms

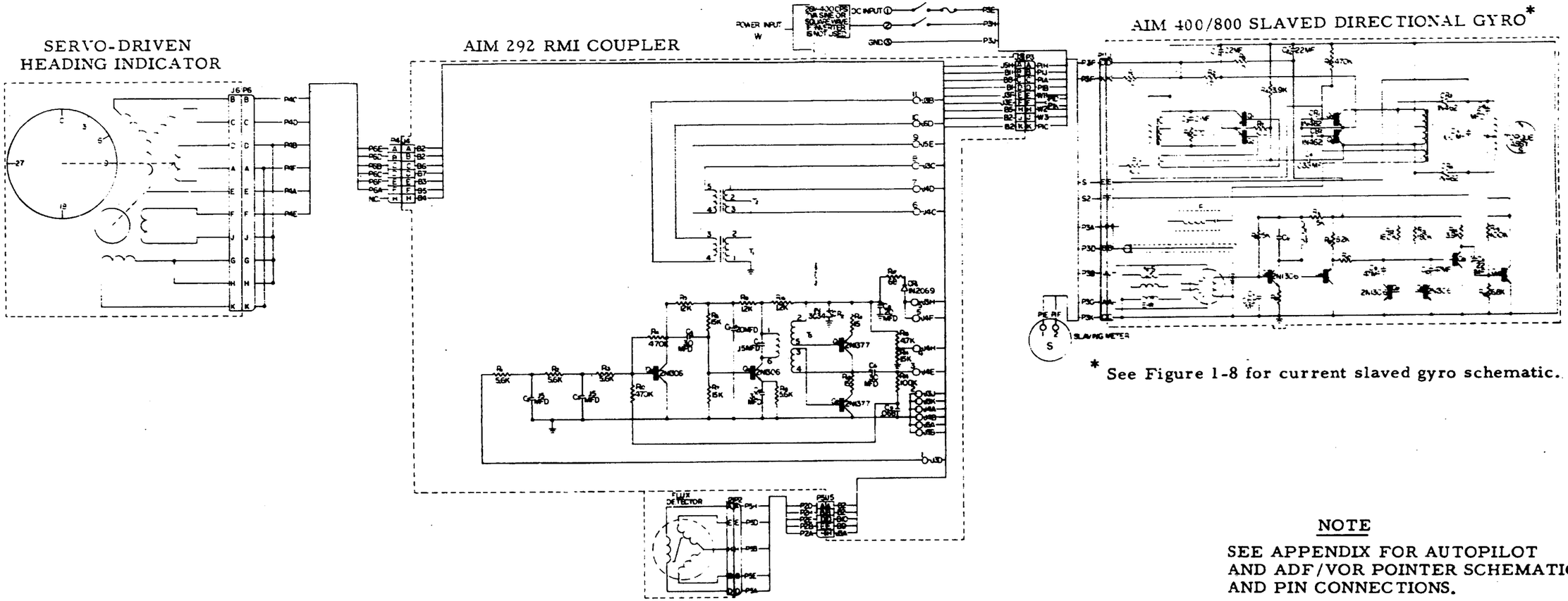
1.4.5 Slaving Indicator

Description	5-0-5 vdc meter with 50,000 ohms across the input terminals.



NOTE:
SEE APPENDIX FOR AUTOPILOT AND ADF/VOR POINTER SCHEMATICS AND PIN CONNECTIONS.

FIGURE 1-8.
SCHEMATIC DIAGRAM, BASIC SLAVED GYRO



* See Figure 1-8 for current slaved gyro schematic.

NOTE

SEE APPENDIX FOR AUTOPILOT AND ADF/VOR POINTER SCHEMATICS AND PIN CONNECTIONS.

FIGURE 1-9.
AIM 400/800 SYSTEM WITH RMI COUPLER

SECTION 2
OVERHAUL AND CALIBRATION
of
ELECTRIC AND VACUUM-DRIVEN GYROS

2.1 GENERAL

This section contains overhaul and calibration procedures for both electric and vacuum driven instruments. Specific procedures which are applicable only to vacuum-driven instruments are identified by "Vacuum Only". Procedures applicable only to electrically-driven gyros are identified by "Electric Only". All steps or procedures not otherwise identified, may be considered applicable to both electric and vacuum driven instruments.

Table 2-1 provides a convenient tabulation of information pertaining to the many gyros covered in this manual. Because of variations in the type, size, and number of synchros used, locations of synchros within the case vary from model to model. The table lists each gyro model number and uses a key letter (A, B, etc.), referenced to the illustration of Figure 2-0, to show the location of each synchro. The functional identification of each synchro is noted in the appropriate column.

Instrument overhaul may be required due to a specific malfunction or merely as a routine step in a periodic maintenance program. Regardless of the reason, the disassembly and overhaul procedures in this section are applicable and should be closely followed.

As each assembly is disassembled, the location of each component should be noted so that it can be replaced in the same position. This is particularly true of bearings, pivots, or jewels. Although the same bearing type may be used in several positions, the bearings are designed to provide different amounts of radial play according to their use and location within the instrument.

When handling the ADF/VOR needles and/or the circular indicator card, care should be taken to avoid soiling the various markings. All bearings, pivots, and jewels should be handled with assembly tweezers

2.1 GENERAL (Cont'd)

to avoid contamination. Iridited, oxided, or passivated parts must be protected against scratching or marring. Self-locking nuts with worn fibers must be replaced. Nuts and screws used for balancing must be secured in final adjusted position by "Glyptal" (G. E. Trademark). Solvents used for cleaning must be high grade such as Chlorothene-Nu (Dow Chemical Co.).

2.2 TOOLS REQUIRED

All routine maintenance or repair work can be accomplished with standard instrument-shop handtools. A pair of assembly tweezers, an eye loupe, a selection of small screwdrivers, a 0.3 gram counterbalance, 1/4" and 3/16" open-end wrenches, #2 and #4 Bristol spline wrenches, and the spanner wrenches of Figure 2-1 are the basic tools which are normally required.

Spanner wrench "A" is used in removing the threaded bearing housing from the gimbal assembly. Spanner "B" is used in conjunction with spanner "A" to simultaneously hold the threaded bearing housing in position in the gimbal and to secure the lock ring (some models only) in place around it.

Spanners "C" and "E" are used in removing the threaded housings from each end of the 34B and R3H rotor housings, respectively. Spanner "D" is used to remove the lock rings securing the threaded housings in place.

2.3 DISASSEMBLY PROCEDURES

2.3.1 General

Before proceeding with disassembly of any component, the degree of wear, end play, backlash, and general physical appearance must be checked and noted as an aid in reassembly.

During disassembly, extreme care must be used in the removal of any component. Use of proper tools is important to prevent damage by scratching or marring. Screws or other attaching parts must be carefully identified during disassembly for correct replacement during reassembly.

TABLE 2-1. SYNCHRO FUNCTIONS AND LOCATIONS (Figure 2-0).

GYRO MODEL NO.	SYNCHRO FUNCTION/LOCATION				
	Position A	Postion B	Position C	Position D	Position E
254-92, 254-1E	Slaving	-	-	-	-
254-1S, 254-1ES	Slaving	1-bar pointer	-	-	-
254-1D, 254-1ED	Slaving	2-bar pointer	-	1-bar pointer	-
289-1, 289-1E	4-power synchro*	Slaving	-	-	-
289-2, 289-2E	4-power synchro	Slaving	1-power synchro	-	-
289-1S, 289-1ES	4-power synchro	1-bar pointer	Slaving	-	-
289-2S, 289-2ES	4-power synchro	1-bar pointer	Slaving	-	1-power synchro
289-1D, 289-1ED	4-power synchro	2-bar pointer	Slaving	1-bar pointer	-
289-2D, 289-2ED	4-power synchro	2-bar pointer	Slaving	1-bar pointer	1-power synchro
289-3, 289-3E	Autopilot	Slaving	-	-	-
289-3S, 289-3ES	4-power synchro	1-bar pointer	Slaving	-	Autopilot
289-3D, 289-3ED	4-power synchro	2-bar pointer	Slaving	1-bar pointer	Autopilot
293-1, 293-1E	Slaving	-	-	-	-
293-1S, 293-1ES	Slaving	1-bar pointer	-	-	-
293-1D, 293-1ED	Slaving	2-bar pointer	-	1-bar pointer	-
297-1, 297-1E	Autopilot	Slaving	-	-	-
297-1S, 297-1ES	Autopilot	1-bar pointer	Slaving	-	-
297-2S, 297-2ES	4-power synchro	1-bar pointer	Slaving	-	Autopilot
297-1D, 297-1ED	Autopilot	2-bar pointer	Slaving	1-bar pointer	-
297-2D, 297-2ED	4-power synchro	2-bar pointer	Slaving	1-bar pointer	Autopilot
299-1, 299-1E	Slaving	1-power synchro	-	-	-
424-1, 424-1E	Autopilot	Slaving	-	-	-
424-1S, 424-1ES	Autopilot	1-bar pointer	Slaving	-	-
424-2S, 424-2ES	4-power synchro	1-bar pointer	Slaving	-	Autopilot
424-1D, 424-1ED	Autopilot	2-bar pointer	Slaving	1-bar pointer	-
424-2D, 424-2ED	4-power supply	2-bar pointer	Slaving	1-bar pointer	Autopilot

*Older models contain a 1-power (size 10) synchro instead of a 4-power (size 11) synchro.

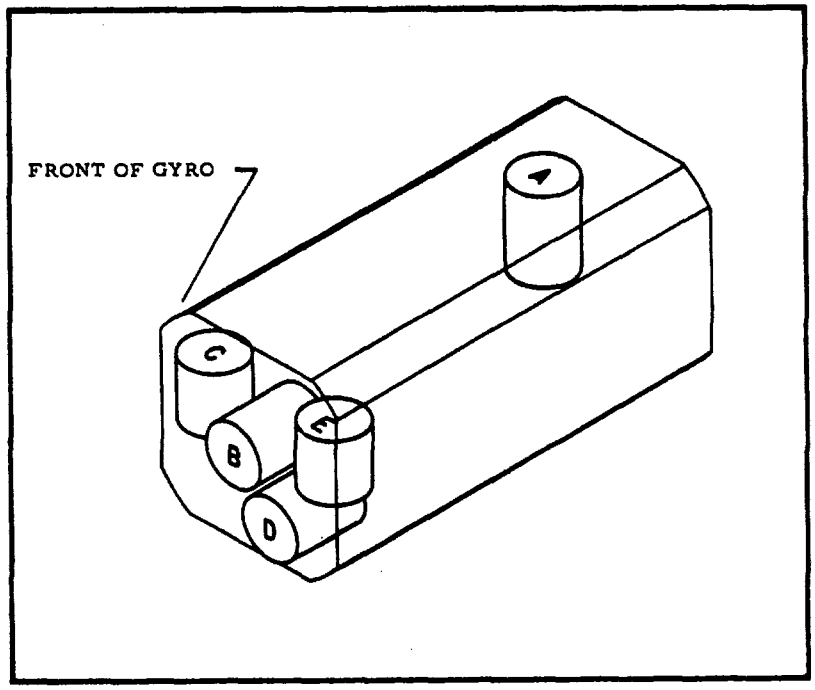


FIGURE 2-0. SYNCHRO LOCATIONS IN THE INSTRUMENT

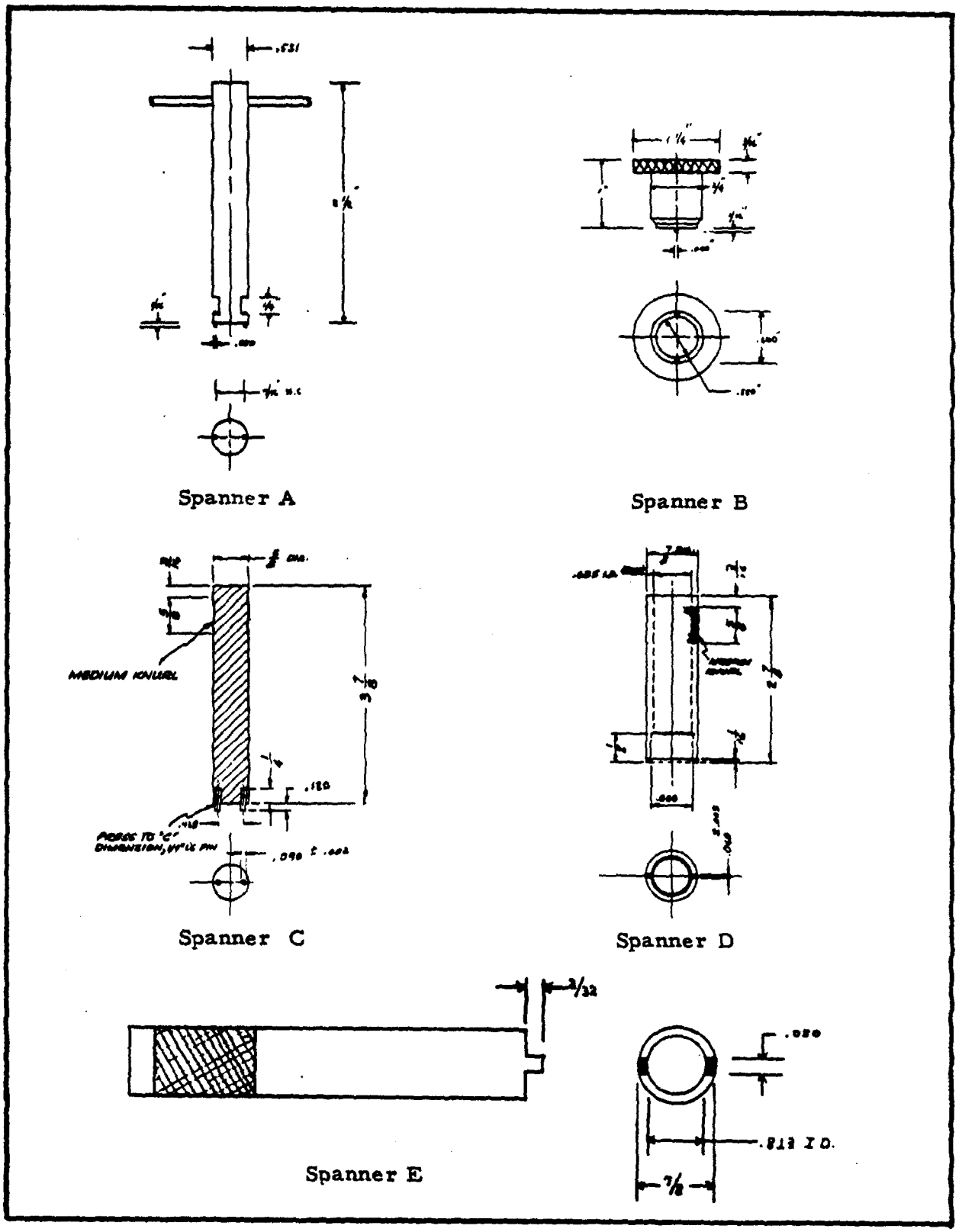


FIGURE 2-1. CONSTRUCTION OF SPECIAL TOOLS

2.3.1 General (Cont'd)

Due to the delicate rebalancing required and the precision parts involved, disassembly and overhaul of the rotor and rotor housing assembly is not recommended. Should the rotor become defective and fail to meet the performance requirements set forth in Section 3, return the used rotor housing and pivot assembly to AIM for an exchange discount on a new replacement assembly.

It should therefore be noted that the following disassembly, cleaning, adjustment, and reassembly procedures do not include provisions for overhaul of the rotor and rotor housing assembly. However, instructions are provided in paragraphs 2.7 and 2.8 for overhaul of the rotor and rotor housing should this become necessary in the field.

If a replacement rotor housing and pivot assembly is secured from AIM, it will be closely balanced and adjusted when received from the factory. Additional balancing or adjustment of the rotor housing may be necessary after assembly in gimbal.

2.3.2 Case Access

(1) Remove the gyro caging knob by loosening the #4-40 spline setscrew which secures the knob to the shaft. A #4 Bristol spline wrench is provided on the rear of the case for this purpose.

NOTE

The #4 Bristol spline wrench is intended to facilitate the rapid installation and removal of the unit from an instrument panel. It should not be used to remove screws inside the instrument due to the possibility of paint flakes contaminating the unit. Instead, an unpainted wrench should be used.

(2) Remove the 7 screws securing the bezel assembly to the main housing. One of the mounting-screw recesses is filled with sealing wax which must be removed. Care should be taken to insure that the front gasket remains in position on the bezel when the bezel is removed. This is done to minimize the possibility of contaminating the unit

2.3.2 Case Access (Cont'd)

with paint flakes from the rubber gasket.

(3) Carefully remove the dust cover, making sure that the rear gasket remains in position on the rear panel of the instrument housing.

(4) When the dust cover has been removed, slip the rear gasket over the rear panel and away from the unit. The front and rear gaskets and the dust cover should be taken to a remote area and thoroughly cleaned of all paint and foreign matter. The gaskets can be cleaned by stretching until the paint cracks and then scraping the flakes away. The same gaskets can be reused when the dust cover is again installed.

2.3.3 Removal of Gimbal Assembly

(1) Remove 3 screws securing the oscillator board to the left rear side of the instrument case.

(2) Using a felt-tip marking pen or similar device, draw an alignment mark across the interface between the gimbal gear and the resolver gear and a second mark between the gimbal gear and the intermediate spur gear. The purpose of these marks is to simplify realignment of the gear train during reassembly.

(3) Remove 4 screws holding the slaving coil to the instrument case.

(4) Place the instrument in its normal position with the caging knob in the lower left corner of the instrument front panel. Remove 3 flat head screws and remove the upper gimbal pivot from the instrument casting (Figure 2-2).

(5) Vacuum Only - Turn the unit over and remove the 2 screws securing the lower (air seal) bearing housing. The housing may contain alignment shims which are used to correctly align the air passage in the housing with the air

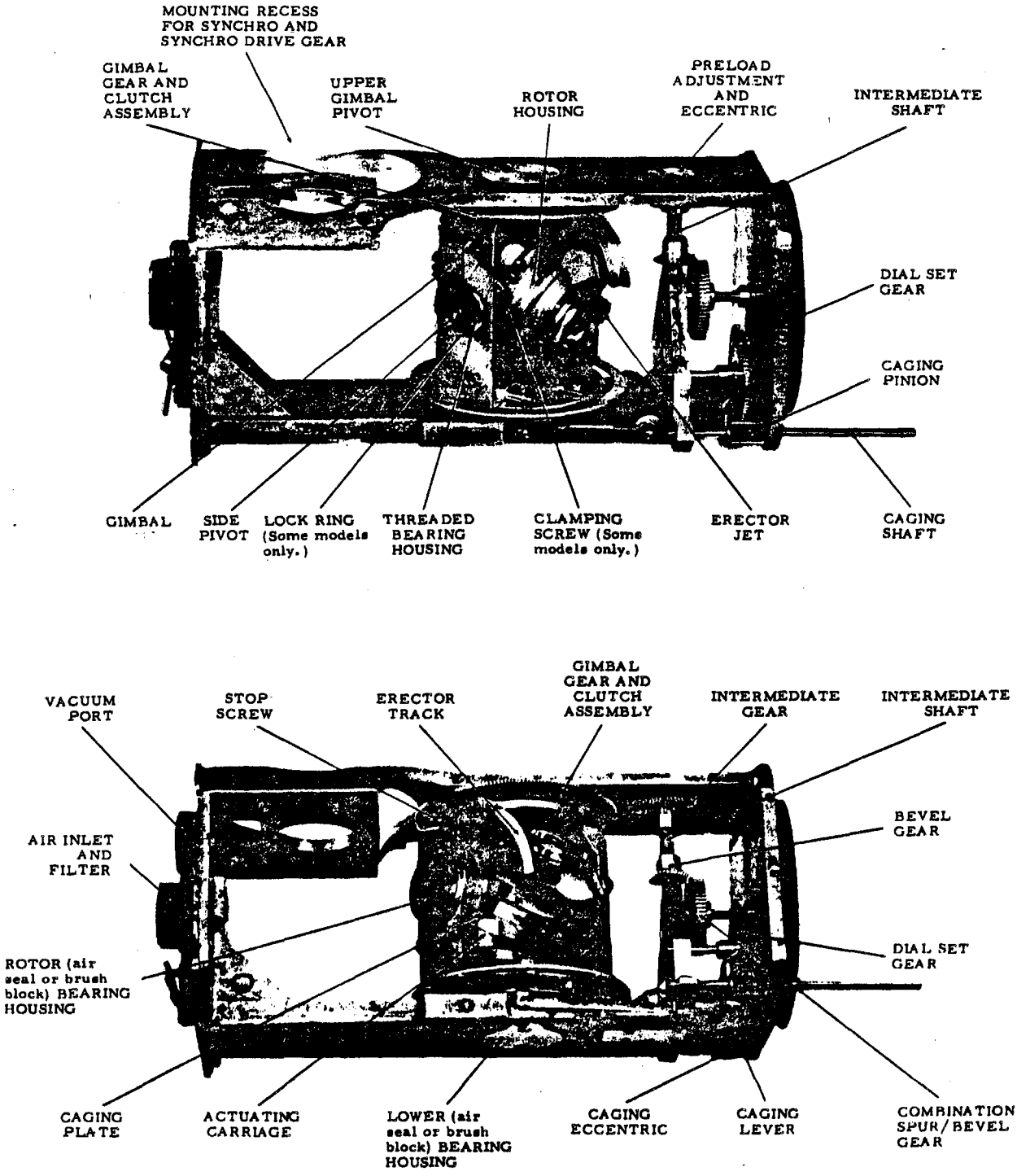


FIGURE 2-2. IDENTIFICATION OF PRIMARY COMPONENTS PARTS

2.3.3 Removal of Gimbal Assembly (Cont'd)

passage in the instrument casting. If shims are included, they should be retained for use during reassembly.

(6) Electric Only - Turn the unit over and remove the gimbal brush block and the two screws securing the lower bearing housing. Remove the lower bearing housing.

(7) Removal of the lower housing permits access to the screws holding the pivot on the bottom of the gimbal. Remove the two pivot screws and lift the pivot off the bottom of the gimbal. When the pivot is lifted into the lower housing recess, the entire gimbal assembly may be removed.

NOTE

The slaving coil must be temporarily removed in order to remove the gimbal. In doing so, care must be taken to avoid unnecessary lead strain which could result in broken electrical connections.

(8) Disassembly of the clutch assembly at the top of the gimbal is not recommended unless specific replacement of component parts is required. If disassembly becomes necessary, proceed as follows:
Remove three screws securing the clutch assembly to the gimbal. During disassembly, notice the order in which the bearing housing, the washer, the gimbal gear, and the friction shim are removed. First comes the bearing housing, then the spring washer, the gimbal gear, and then the friction shim which is mounted between the gimbal gear and the gimbal.

2.3.4 Removal of Rotor Housing

The rotor housing may be removed from the gimbal in much the same manner as the gimbal was removed from the instrument:

(1) Loosen the two #2-56 Bristol setscrews holding the erector track (Figure 2-2) to the gimbal and remove the erector track. Also loosen the binder head stop screw enough to

2.3.4 Removal of Rotor Housing (Cont'd)

permit 360° rotation of the rotor housing.

(2) Vacuum Only - Remove the rotor air seal housing and the two screws which hold the air pivot in place.

(3) Electric Only - Remove the rotor brush block and bearing housing. Also remove the two screws which hold the slip-ring pivot in place.

(4) Remove the slaving magnet by removing the flat head screw holding the magnet to the threaded bearing housing.

(5) Loosen the clamping screw shown in Figure 2-2 and remove the threaded bearing housing from the side of the gimbal.

(6) Remove the three pivot screws and lift the side pivot off the rotor housing and out through the threaded opening. The rotor housing may now be removed from the gimbal.

2.3.5 Disassembly of Gear Trains, General

There are two basic types of gear trains described in the following paragraphs. Paragraphs 2.3.6 (1) and (2) concern the basic gear train used in all AIM 400 gyros. Minor differences in the basic gear train, due to varying output requirements among specific systems, are also explained.

Paragraphs 2.3.6 (3) through 2.3.6 (7) concern the basic gear train used in all AIM 800 single and dual needle gyro/RMI instruments. Minor variations in construction due to varying output requirements, and differences between single and dual pointer instruments are also fully explained.

The purpose of each gear train is the transmission of accurate heading information throughout the instrument. When fully assembled, the gear train maintains the indicator card and all synchros and pointers in a fixed relationship. This relationship is critical and can be lost by loosening a single gear on its shaft. Consequently, before loosening any gear on its supporting shaft, make an alignment mark at the interface between the gimbal gear and its adjacent gears to simplify realignment.

2.3.5 Disassembly of Gear Trains, General (Cont'd)

Under normal operating conditions, the gear train should function in excess of 1,000 hours without defect or loss of efficiency and accuracy. Should a defect occur, and removal of a synchro be required, remove or loosen only that portion of the gear train necessary to obtain access to the defective synchro. Here again, an alignment mark should be placed on adjacent gears to simplify realignment.

Should it become necessary, disassembly or repair of specific drive trains may be accomplished with a minimum of detailed instruction. However, certain areas of disassembly do require some clarification. These areas are fully explained in the following paragraphs. Reference to the associated illustrations will prove helpful in identifying the affected parts.

2.3.6 Disassembly of Specific Gear Trains

1) AIM 254-92 293-1
AIM 254-1E 293-1E

The instrument shown in Figure 2-3 is an AIM 254-92 Slaved Gyro used in the AIM 400 System. For purposes of this discussion, it may be considered identical to AIM 254-1E, 293-1, and 293-1E instruments. The unit contains a synchro resolver which is mounted in the rear of the instrument and is used in the internal slaving circuitry. Both the synchro resolver and the indicator card are driven by the large spur gear at the top of the gimbal assembly. The indicator card is positioned through a simple gear train consisting of the gimbal gear, the intermediate spur gear, the intermediate shaft, the bevel gear, the combination spur/bevel gear, and the card shaft.

To check the drive train for proper operation, loosen the setscrew in the intermediate spur gear (Figure 2-3). Slide the gear down the shaft so that it no longer engages with the gimbal gear. Spin the gear slowly and check for freedom and smoothness of operation.

The intermediate shaft is suspended in two precision bearings. A threaded bearing housing at the top of the shaft permits adjustment of the preload on the shaft bearings. A solvent must be used to

2.3.ó Disassembly of Specific Gear Trains (Cont'd)

1) AIM 254-92 293-1 (Cont'd.)
AIM 254-1E 293-1E

dissolve the Glyptal securing the housing before adjustment can be made. If desired, the eccentric holding the threaded housing may be removed without disturbing the preload adjustment. If the spur gear does not bind with the gimbal gear, and yet the eccentric must be removed, place a mark on the eccentric and a corresponding mark on the instrument casting so that the eccentric can be properly installed with minimum difficulty.

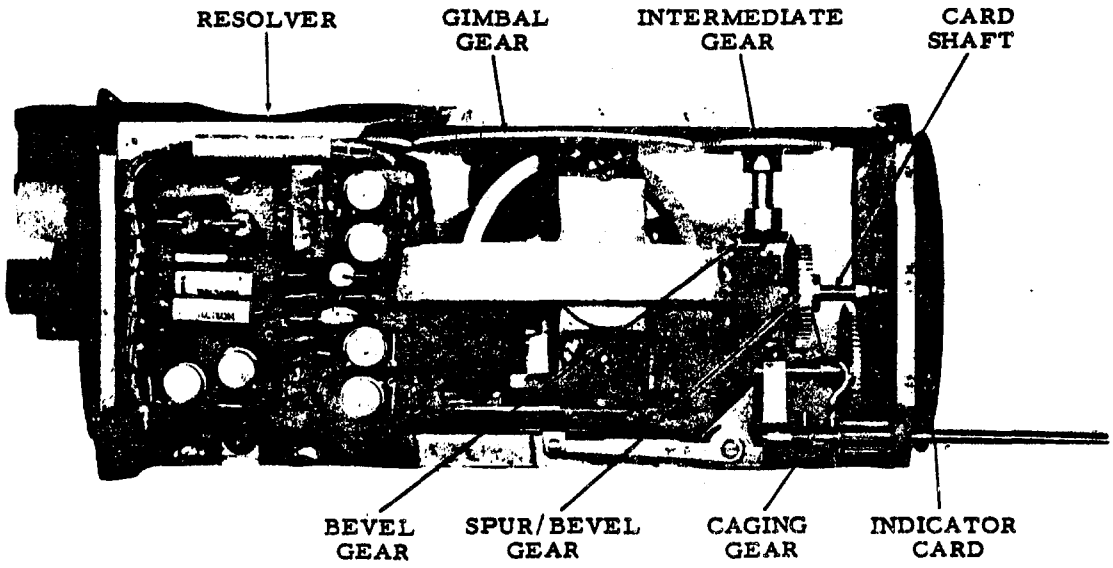


FIGURE 2-3. AIM 254-92 SLAVED GYRO

With the eccentric removed, the intermediate shaft and its associated gears may easily be lifted from the instrument. Care should be taken that the position of the two gears on the intermediate shaft be noted to insure correct replacement. Unless replacement or adjustment of the bevel gear is required, do not loosen the set-screw holding it to its shaft. This simplifies reassembly and eliminates the possibility of reinserting the shaft backwards.

The main horizontal drive shaft may be disassembled by first removing the two securing screws from the front face of the instrument casting. To remove the front bearing, press the combination spur/bevel gear toward the front. If the spur/bevel gear and the

2.3.6 Disassembly of Specific Gear Trains (Cont'd)

1) AIM 254-92 293-1 (Cont'd.)
AIM 254-1E 293-1E

associated shaft collars are to be removed, note their approximate position along the shaft. Also notice that the flanged face of each collar is toward its respective bearing.

Once the spur/bevel gear and the shaft collars are loosened on the shaft, the main bearing which supports the rear of the shaft may easily be removed. Use a small, flat-faced bar, 0.344 inch diameter, and push the bearing from the rear toward the front of the casting.

Removal of the rear bearing permits access to the bearing housing at the base of the intermediate shaft. The housing is secured with Glyptal and a solvent must be used before removal is attempted. By inserting an L-shaped bar into the opening created by removal of the rear bearing, the housing at the base of the intermediate shaft may easily be removed with a slight upward pressure. In turn, the bearing can be removed from the housing in the same way, by pushing through the opening in the bottom and forcing the bearing out of the housing.

The small piece of steel wire attached to the case is designed to ride against the dial shaft and to damp out any oscillation in the dial due to excessive play in the gear mechanism. If the wire is to be removed, notice its position so that it may be properly reinstalled.

2) AIM 289-1 289-3 297-1 424-1 725A Bendix
AIM 289-1E 289-3E 297-1E 424-1E

The instrument shown in Figure 2-4 is an AIM 289-1 Slaved Gyro used in the AIM 400C System. For purposes of this discussion, it may be considered identical to the instruments listed in (2) above. The unit employs one synchro resolver and one synchro transmitter. The resolver is mounted in the front of the unit and is used in the internal slaving circuitry. The synchro transmitter is mounted in the rear of the unit and is used to provide heading information to external systems. Both synchros are driven by the large spur gear at the top of the gimbal assembly. The indicator card and front synchro are positioned through a simple gear train consisting of the gimbal gear, the intermediate spur gear, the intermediate shaft,

2.3.6 Disassembly of Specific Gear Trains (Cont'd)

2) AIM 289-1 289-3 297-1 424-1 725A Bendix (Cont'd.)
AIM 289-1E 289-3E 297-1E 424-1E

the bevel gear, the combination spur/bevel gear, and the double-ended synchro shaft.

The intermediate shaft is suspended in two precision bearings. A threaded bearing housing at the top of the shaft permits adjustment of the preload on the shaft bearings. A solvent must be used to dissolve the Glyptal securing the housing before adjustment can be made. If desired, the eccentric holding the threaded housing may be removed without disturbing the preload adjustment. If the intermediate gear does not bind with the gimbal gear, and yet the eccentric must be removed, place a mark on the eccentric and a corresponding mark on the instrument casting so that the eccentric can be properly installed with minimum difficulty.

With the eccentric removed, the intermediate shaft and its associated gears may easily be lifted from the instrument. Care should be taken that the position of the two gears on the intermediate shaft be noted to insure correct replacement. Unless replacement or adjustment of the bevel gear is required, do not loosen the setscrew holding it to its shaft. This simplifies reassembly and eliminates the possibility of reinserting the shaft backwards.

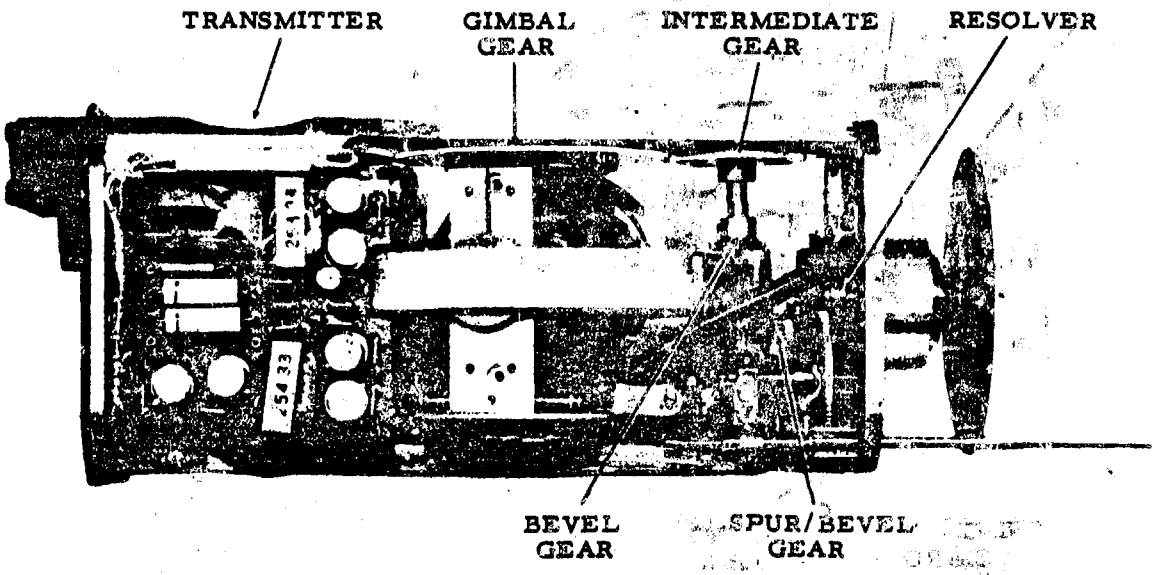


FIGURE 2-4. AIM 289-1 SLAVED GYRO

2.3.6 Disassembly of Specific Gear Trains (Cont'd)

2) AIM 289-1 289-3 297-1 424-1 725A Bendix *(Cont'd.)*
AIM 289-1E 289-3E 297-1E 424-1E

To obtain access to the front synchro, remove two binder head screws holding the synchro housing to the case. Loosen appropriate cable clamps to permit removal of entire assembly through the front of the case. To further disassemble, remove the indicator card and the combination spur/bevel gear, loosen the setscrew holding the synchro in place and remove the synchro through the rear of the housing.

3) AIM 254-1S 293-1S
AIM 254-1ES 293-1ES

The instrument shown in Figure 2-5 is an AIM 254-1S Slaved Gyro/RMI used in the AIM 808 System. For purposes of this discussion it may be considered identical to the instruments listed in 3) above. The unit employs one synchro resolver and one synchro receiver. The synchro resolver is mounted in the rear of the unit and is used in the internal slaving circuitry. The synchro receiver

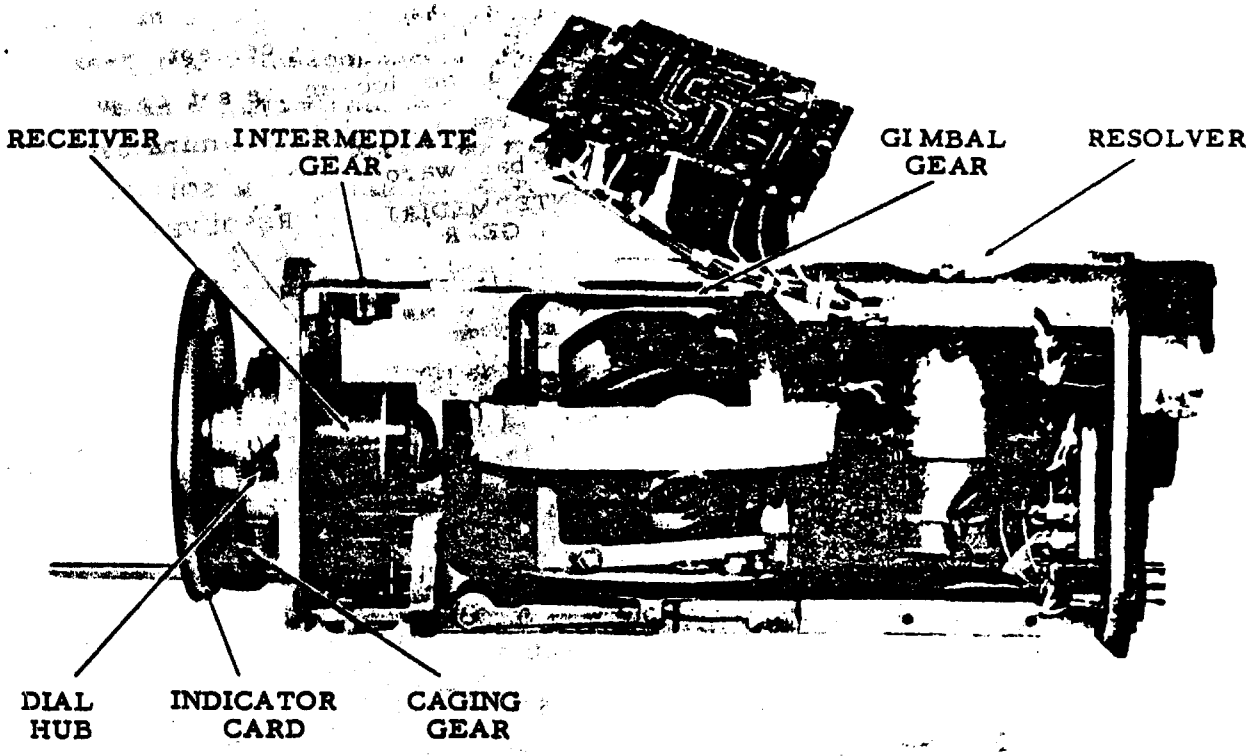


FIGURE 2-5. AIM 254-1S SLAVED GYRO/RMI

2.3.6 Disassembly of Specific Gear Trains (Cont'd)

3) AIM 254-1S 293-1S (Cont'd.)
AIM 254-1ES 293-1ES

is mounted in the front of the instrument and is electrically positioned by signals from an external source.

The synchro resolver and the indicator card are positioned by a simple gear train which runs along the top of the instrument case. The intermediate gear is suspended on two precision bearings on the intermediate shaft. The shaft itself is eccentrically mounted on its base so that by turning the shaft base, gear mesh between the gimbal gear and the intermediate gear may be adjusted. If the intermediate gear does not bind with the gimbal gear, and yet the intermediate shaft must be removed, place a mark on the shaft base and a corresponding mark on the instrument casting so that the shaft can be properly installed with minimum difficulty.

To obtain access to the intermediate gear, the indicator card must first be removed. This is done by removing the press-fitted pointer from its shaft and then removing three flat head screws securing the indicator card to the dial drum.

The shaft on which the dial hub and caging gear are mounted, is attached to the front synchro housing with four binder head screws inserted in slotted holes around the shaft base. These slotted holes permit adjustment of the fore and aft placement of the indicator card to obtain proper gear mesh with the intermediate gear. A screwdriver access hole is provided in the intermediate gear to facilitate adjustment of the top binder head screw.

To obtain access to the front synchro, remove two binder head screws holding the synchro housing to the case. Loosen appropriate cable clamps to permit removal of the entire assembly through the front of the case. To further disassemble, loosen setscrew holding the synchro in place and remove the synchro through the rear of the housing.

The small piece of steel wire attached to the base of the indicator card shaft is designed to ride against the dial drum and to damp out any oscillation in the dial due to excessive play in the gear mechanism. If the wire is to be removed, notice its position so that it may be properly reinstalled.

2.3.6 Disassembly of Specific Gear Trains (Cont'd)

4) AIM 254-1D 293-1D
AIM 254-1ED 293-1ED

The instrument shown in Figure 2-6 is an AIM 254-1D Slaved Gyro/RMI used in the AIM 800 System. This instrument, and those listed in 4) above, are the dual pointer versions of the instruments described in paragraph 3). In each case, one synchro receiver has been added to the front panel to position a second ADF/VOR pointer. The additional synchro is mounted horizontally through the front panel with the shaft toward the rear of the instrument. The rear of the shaft contains a spur gear and the inertial damper which is used to minimize pointer oscillations due to transient external switching. The spur gear engages a second spur gear mounted on the rear of the smaller pointer shaft. This shaft extends through the centrally positioned synchro to the front panel. The shaft is in no way acted upon by the synchro through which it passes.

To obtain access to the intermediate gear and the front bearing assembly, the indicator card must first be removed. This is done by removing the two press-fitted pointers from their respective shafts and removing three flat head screws securing the indicator card to the dial drum.

CAUTION

The inner-most pointer shaft on dual pointer models is extremely delicate and is easily damaged. Exercise extreme care during and after removal of the pointers and indicator card.

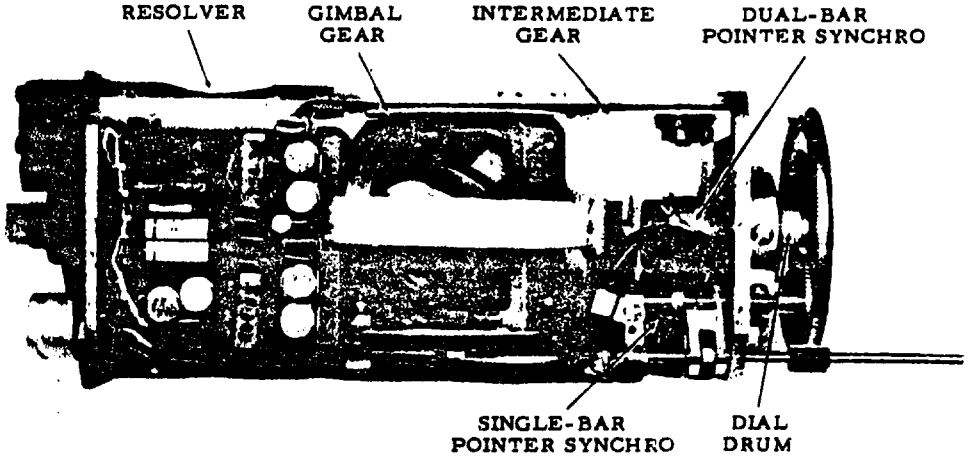


FIGURE 2-6. AIM 254-1D SLAVED GYRO/RMI

2.3.6 Disassembly of Specific Gear Trains (Cont'd)

4) AIM 254-1D 293-1D (Cont'd.)
AIM 254-1ED 293-1ED

Removal of the indicator card permits access to the dial hub, caging gear, and two main bearings mounted on the primary shaft. The entire assembly is held in place by a Truarc ring placed over the end of the primary shaft. The two bearings are fitted inside the hub and may be easily removed.

The primary shaft on which the dial hub and caging gear are mounted, is attached to the front synchro housing with four binder head screws inserted in slotted holes around the shaft base. These slotted holes permit adjustment of the fore and aft placement of the indicator card to obtain proper gear mesh with the intermediate gear. A screwdriver access hole is provided in the intermediate gear to facilitate removal of the top binder head screw.

To remove the single-bar pointer synchro, loosen the #2 Bristol setscrew holding the spur gear and end flange in place on the synchro shaft. Remove the end flange, the damper ring, and the spur gear. The spur gear is secured to the shaft with epoxy. Loosen two #2 Bristol setscrews holding the synchro in its housing on the front panel. Disconnect the appropriate leads from the electrical connector on the rear of the instrument and remove the synchro through the front panel.

To remove the dual-bar pointer synchro, remove both synchro housings from the front panel. Loosen the #2 Bristol setscrew holding the synchro in the housing. An access port is provided for this purpose in the base of the primary shaft. Disconnect appropriate synchro leads and remove the synchro through the rear of the housing. The single-bar pointer shaft which runs through the dual-bar synchro is an integral part of the assembly and cannot be separately replaced.

5) AIM 289-1S 289-3S 297-1S 424-1S
AIM 289-1ES 289-3ES 297-1ES 424-1ES

The instrument shown in Figure 2-7 is typical of AIM 289-1S and 297-1S Slaved Gyro/RMI's used in AIM 800C and 800D systems. For purposes of this discussion, they may be considered identical to the instruments listed in 5) above.

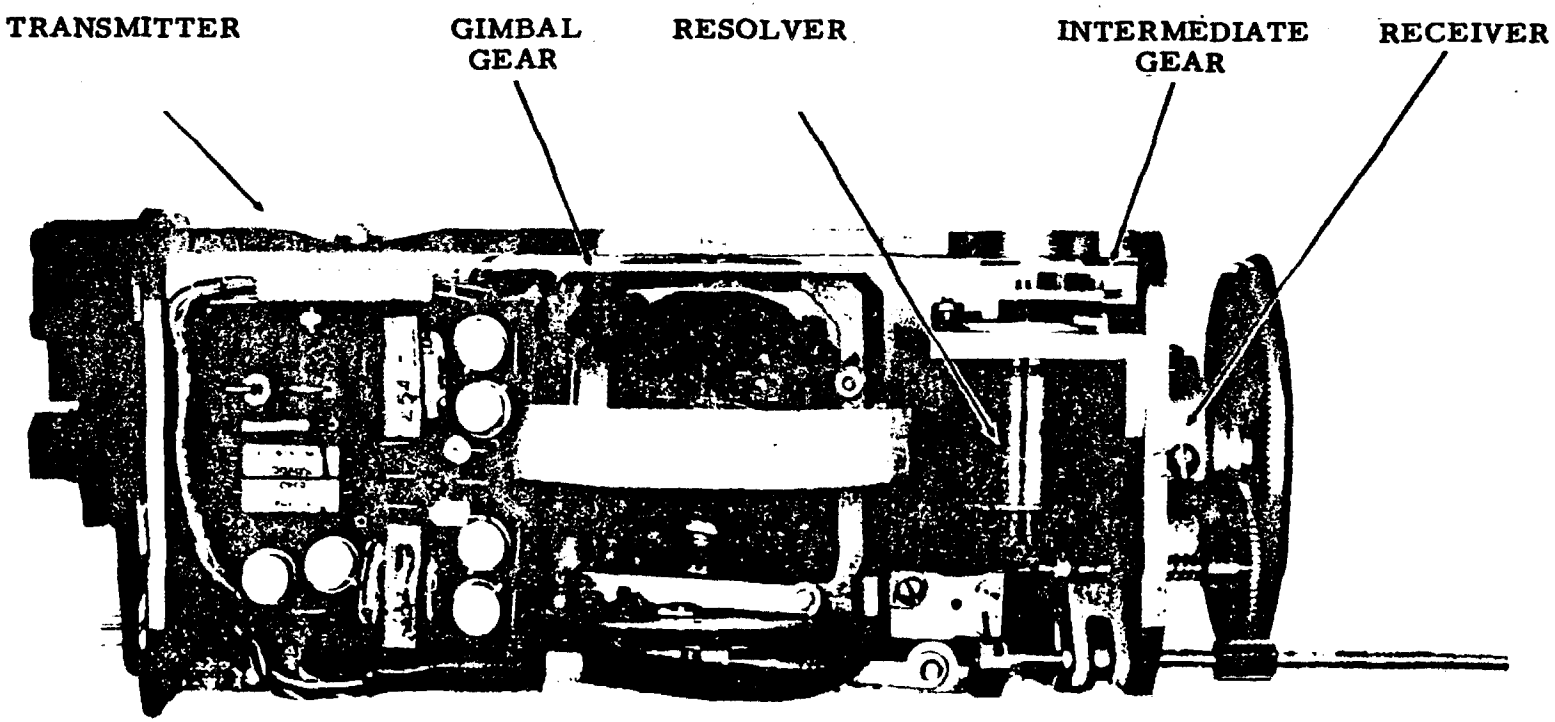


FIGURE 2-7. AIM 289-1S and 297-1S SLAVED GYRO/RMI's

2.3.6 Disassembly of Specific Gear Trains (Cont'd)

5) AIM 289-1S 289-3S 297-1S 424-1S (Cont'd.)
AIM 289-1ES 289-3ES 297-1ES 424-1ES

All of these instruments contain a synchro receiver, resolver, and transmitter. In each case, the synchro receiver is mounted horizontally in the front of the instrument and is electrically positioned by signals from an external source. The synchro resolver used in internal slaving circuitry is mounted vertically in the front of the case and a synchro transmitter which provides heading signals to external systems is mounted in the rear. The AIM 289-3S and 289-3ES instruments employ an additional synchro transmitter (not shown) which is vertically mounted in the front of the case, opposite the slaving resolver.

Note

On earlier models, using size 10 synchros only, synchro functional locations may be found to vary from those indicated.

In all cases, the rear synchro, the indicator card, and the synchro mounted vertically in the front of the unit, are driven by a simple gear train which runs along the top of the instrument case. The intermediate gear is suspended on two precision bearings on the intermediate shaft. The shaft itself is eccentrically mounted on its base so that by turning the shaft base, gear mesh between the gimbal gear and the intermediate gear may be adjusted. If the intermediate gear does not bind with the gimbal gear, and yet the intermediate shaft must be removed, place a mark on the shaft base and a corresponding mark on the instrument casting so that the shaft can be properly installed with minimum difficulty.

To obtain access to the intermediate gear, the indicator card must first be removed. This is done by removing the press-fitted pointer from its shaft and then removing three flat head screws securing the indicator card to the dial hub.

The shaft on which the dial hub and caging gear are mounted, is attached to the front synchro housing with four binder head screws inserted in slotted holes around the shaft base. These slotted holes permit adjustment of the fore and aft placement of the indicator card to obtain proper gear mesh with the intermediate gear. A screw-

2.3.6 Disassembly of Specific Gear Trains (Cont'd)

5) AIM 289-1S 289-3S 297-1S 424-1S (Cont'd.)
AIM 289-1ES 289-3ES 297-1ES 424-1ES

driver access hole is provided in the intermediate gear to facilitate adjustment of the top binder head screw.

To obtain access to the front horizontal synchro, remove two binder head screws holding the synchro housing to the case. Loosen appropriate cable clamps to permit removal of the entire assembly through the front of the case. To further disassemble, loosen set-screw holding the synchro in place and remove the synchro through the rear of the housing.

The small piece of steel wire attached to the base of the indicator card shaft is designed to ride against the dial drum and to damp out any oscillation in the dial due to excessive play in the gear mechanism. If the wire is to be removed, notice its position so that it may be properly reinstalled.

6) AIM 289-1D 289-3D 297-1D 424-1D
AIM 289-1ED 289-3ED 297-1ED 424-1ED

The instruments shown in Figure 2-8 are AIM 289-1D and 297-1D Slaved Gyro/RMI's used in AIM 800C and 800D systems respectively. The instruments are the dual pointer versions of those described in paragraph 5). In each case, one synchro receiver has been added to the front panel to position a second ADF/VOR pointer. The additional synchro is mounted horizontally through the front panel with the shaft toward the rear of the instrument. The rear of the shaft contains a spur gear and an inertial damper which is used to minimize pointer oscillations due to transient external switching. The spur gear engages a second spur gear mounted on the rear of the smaller pointer shaft. This shaft extends through the centrally positioned synchro to the front panel. The shaft is in no way acted upon by the synchro through which it passes.

To obtain access to the intermediate gear and the front bearing assembly, the indicator card must first be removed. This is done by removing the two press-fitted pointers from their respective shafts and removing three flat head screws securing the indicator card to the dial drum.

2.3.6 Disassembly of Specific Gear Trains (Cont'd)

6) AIM 289-1D 289-3D 297-1D 424-1D (Cont'd.)
AIM 289-1ED 289-3ED 297-1ED 424-1ED

CAUTION

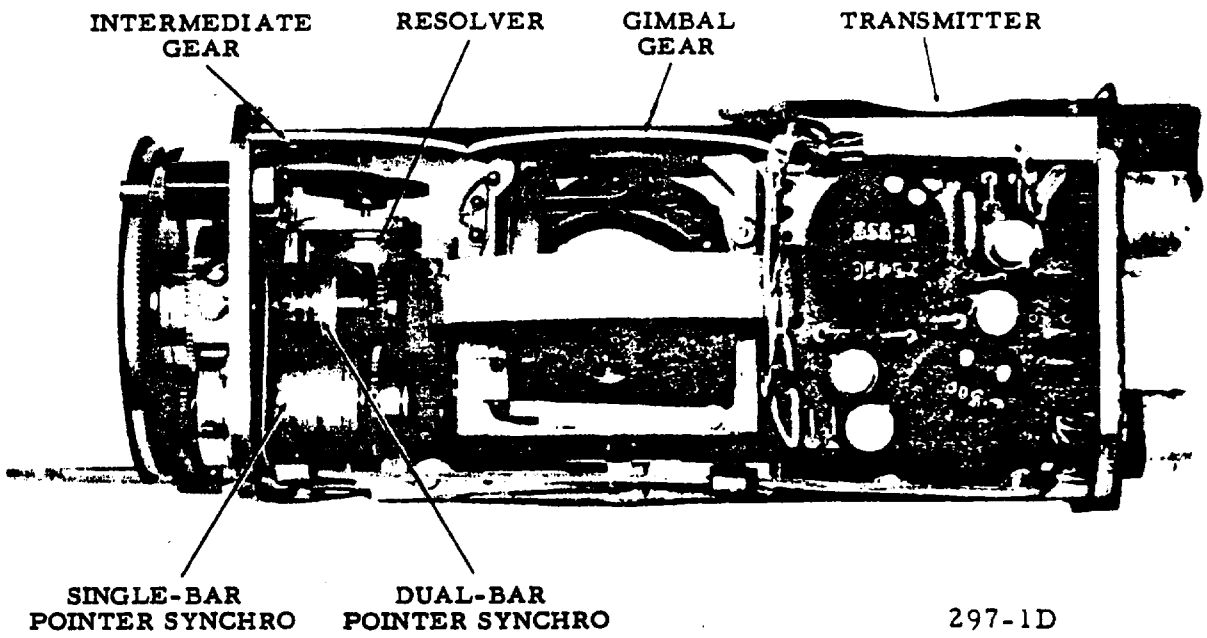
The inner-most pointer shaft on dual pointer models is extremely delicate and is easily damaged. Exercise extreme care during and after removal of the pointers and indicator card.

Removal of the indicator card permits access to the dial hub, caging gear, and two main bearings mounted on the primary shaft. The entire assembly is held in place by a Truarc ring placed over the end of the primary shaft. The two bearings are fitted inside the hub and may be easily removed.

The primary shaft on which the dial hub and caging gear are mounted, is attached to the front synchro housing with four binder head screws inserted in slotted holes around the shaft base. These slotted holes permit adjustment of the fore and aft placement of the indicator card to obtain proper gear mesh with the intermediate gear. A screwdriver access hole is provided in the intermediate gear to facilitate removal of the top binder head screw.

To remove the single-bar pointer synchro, loosen the #22 Bristol setscrew holding the spur gear and end flange in place on the synchro shaft. Remove the end flange, the damper ring, and the spur gear. The spur gear is secured to the shaft with epoxy. Loosen two #2 Bristol setscrews holding the synchro in its housing on the front panel. Disconnect the appropriate leads from the electrical connector on the rear of the instrument and remove the synchro through the front panel.

To remove the dual-bar pointer synchro, remove both synchro housings from the front panel. Loosen the #2 Bristol setscrew holding the synchro in the housing. An access port is provided for this purpose in the base of the primary shaft. Disconnect appropriate synchro leads and remove the synchro through the rear of the housing. The single-bar pointer shaft which runs through the dual-bar synchro is an integral part of the assembly and cannot be separately replaced.



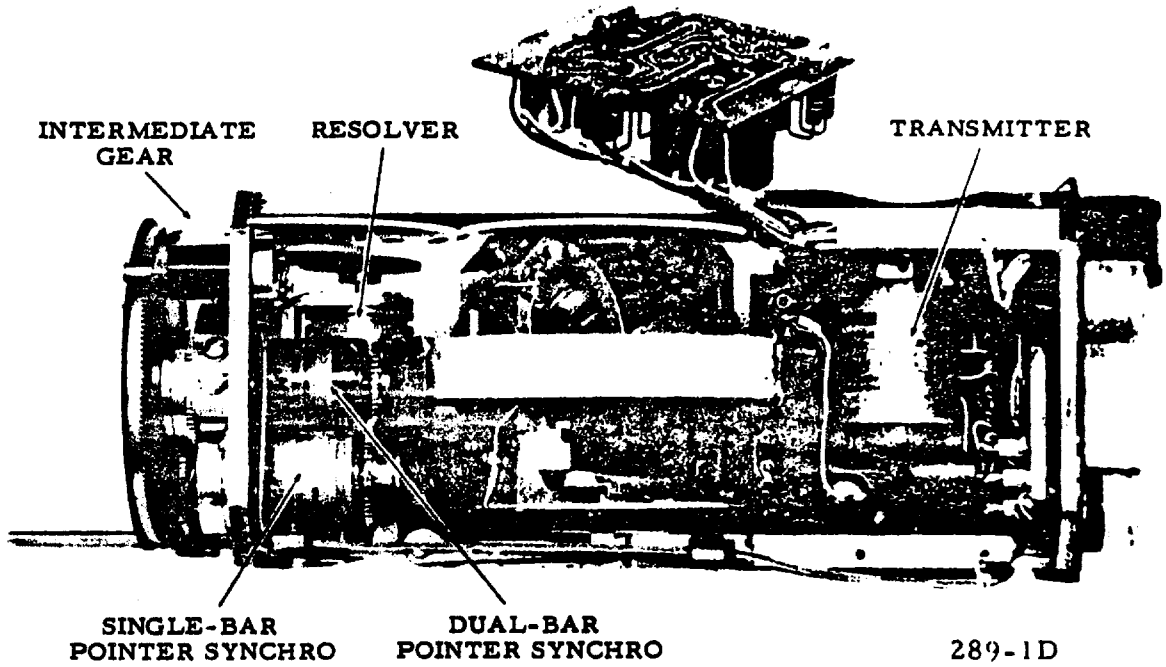


FIGURE 2-8. AIM 289-1D and 297-1D SLAVED GYRO/RMI's

2.3.6 Disassembly of Specific Gear Trains (Con'd)

7) AIM "-2" Instruments

Many of the instruments previously discussed in this section are available in a "-2" configuration, i.e., 297-2D, 424-2ED, etc. These instruments are identical to their counterparts listed in previous paragraphs with the addition of one bootstrap synchro. The additional bootstrap synchro transmitter is vertically mounted in the rear of the instrument case and is driven by the resolver gear. The displaced synchro which is normally mounted in the rear of the unit is then mounted vertically in the front. See Table 2-1 and Figure 2-0.

2.3.7 L-2 Autopilot Pickoff

Instruments designed to provide output signals for use in an L-2 Autopilot are equipped with a specially designed clutch assembly mounted on the synchro transmitter in the rear of the case. The purpose of the unit is to permit the pilot to disengage the L-2 pickoff during turns and to engage the pickoff after the turn is completed. A line drawing of the unit is shown in Figure 2-9.

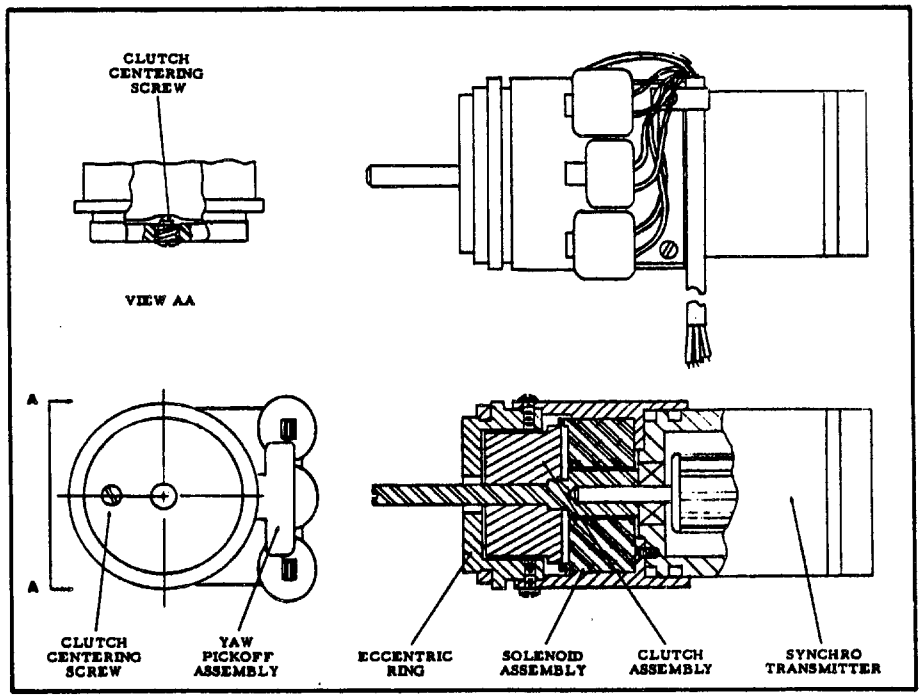


FIGURE 2-9. L-2 AUTOPILOT PICKOFF

2.3.7 L-2 Autopilot Pickoff (Cont'd)

The electrical portion of the L-2 pickoff consists of an armature and three windings which provide an electrical output similar to that of a differential transformer. When the pickoff is engaged, a heading change in one direction will cause an in-phase output and a heading change in the opposite direction will cause an out-of-phase output. These signals are used by the autopilot to initiate corrective action to maintain the selected heading. During turns, power is removed from the solenoid coil inside the clutch assembly to disengage the pickoff. The pickoff is also disengaged by pushing the dial-set knob on the front of the gyro. A normally closed microswitch at the rear of the caging shaft removes power from the solenoid coil when the dial-set knob is depressed.

2.3.8 Disassembly of Caging Mechanisms (Figure 2-2)

Design of the caging mechanism is straight-forward and should require a minimum of specific instructions for disassembly. However, the following phases of the disassembly procedure do require special attention.

On basic slaved gyros (without pointer bars), notice the order in which the single metal washer and the two nylon washers are installed on the caging shaft. From the rear of the shaft, first comes the metal washer, then a nylon washer, then the pinion, then another nylon washer, nearer to the front. Special care should be taken to avoid loss of these parts during disassembly.

On pointer bar models, the sequence of assembly and number of washers is different from that of models without pointer bars. From the rear of the shaft, first come the caging lever, then a metal washer, one arm of an interconnecting bracket, a nylon washer, a setscrew sleeve, a nylon washer, and finally a metal washer.

On pointer bar models, the caging pinion and gear are mounted forward of the front panel. Order of assembly of the caging gear shaft is, from front to back, a lock ring, caging gear, shaft spring, nylon washer, front panel, metal washer, lock ring, interconnecting bracket, nylon washer, shaft spring, nylon washer, and setscrew sleeve.

2.3.8 Disassembly of Caging Mechanisms (Figure 2-2) (Cont'd)

Instruments which provide autopilot outputs are equipped with an extended caging shaft which activates a micro-switch inside the case. The micro-switch automatically disengages the autopilot pick-off when the gyro heading is reset.

Before loosening the caging eccentric on the bottom of the case, notice its approximate position. The purpose of this eccentric is to permit adjustment of the caging mechanism so that the rotor housing is 80 to 90 per cent caged when the dial-set gear engages the caging gear. Observing the position of the eccentric prior to disassembly will permit reassembly with a minimum of trial-and-error adjustment.

2.3.9 Disassembly and Inspection of Air Seal Housings - Vacuum Only

A typical air seal housing assembly is shown in Figure 2-10. It consists of the basic housing, the bearing assembly, the air seal washer, the washer retainer, and a spring type retainer ring.

Two housings of this type are used in the AIM 400 and 800 vacuum driven instruments. One housing is mounted in the instrument casting and serves as a transfer point for the passage of air from the casting to the gimbal assembly. The second housing is mounted in the

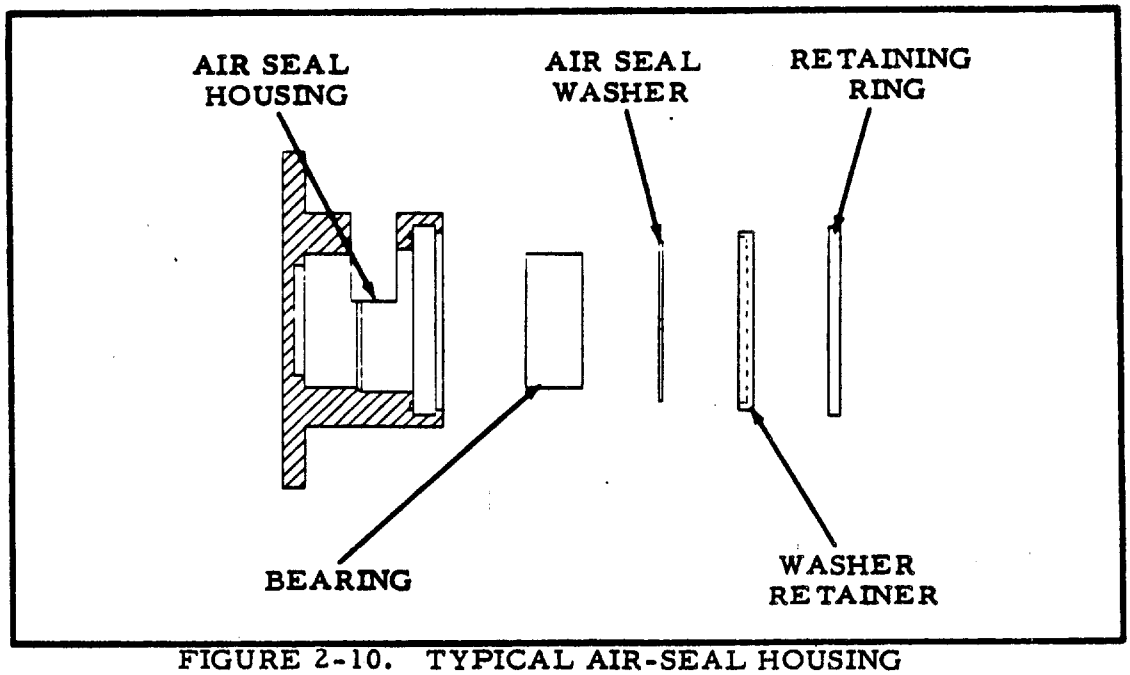


FIGURE 2-10. TYPICAL AIR-SEAL HOUSING

2.3.9 Disassembly and Inspection of Air Seal Housings - Vacuum Only (Cont'd)

gimbal and transfers air from the gimbal to the rotor housing. Although the two housings are similar in appearance, they are not identical. Consequently, extreme care should be taken that each housing is properly identified as to its proper location in the instrument.

Disassemble each air seal housing and check that the air seal washer fits freely over the diameter of its respective pivot assembly without binding. Check that a clean used bearing will fit the diameter of the pivot assembly with no more than finger pressure applied. If difficulty is encountered, refer to the inspection and repair procedures in paragraph 2.5.3.

Remove the used bearing and replace the air seal washer in the air seal housing along with the new bearing to be used. Reassemble the housing and set aside, properly covered, for future use.

2.4 CLEANING

2.4.1 General

Due to the precision components and close tolerances employed in the manufacture of this unit, foreign matter can greatly impair its over-all operating efficiency and service life. It is therefore recommended that every possible step be taken to insure maximum protection of each subassembly during disassembly, repair, and reassembly. As each component is removed during disassembly it should be placed in a dust-free environment and protected with a dust-proof cover.

2.4.2 Air Filters - Vacuum Only

The instrument air filter on the rear of the unit cannot be cleaned by washing and must be replaced when dirty. This should be done routinely at each overhaul of the instrument and the filter should be inspected after each 100 hours of operation. Access to the filter may be gained by removing the four screws in the AIR INLET cover plate at the rear of the instrument. After filter has been replaced, reinstall cover and tighten screws securely.

The amount of dust, lint, tobacco tars, and other foreign matter

2.4.2 Air Filters - Vacuum Only (Cont'd)

reaching the instrument filter may be greatly reduced by the use of an efficient central filter system installed in the aircraft. The Type F-4 Air Filter, available from AIM, is especially designed to filter these undesirable elements from the vacuum system and to effectively extend the service life of any air-driven instrument.

2.4.3 Pivots, Housings, Etc.

During overhaul, all parts should be cleaned carefully to remove oil, dirt, and moisture. If possible, the use of ultrasonic cleaning is highly recommended to insure that all parts with small bores or tapped holes can be effectively cleansed. If this is not possible, component parts such as pivots, bearing housings, shims, etc. should be thoroughly cleaned in a high-grade solvent such as Chlorothene-Nu (Dow Chemical Company), and then thoroughly air dried with clean, low pressure air. If cleaning solvent is used, it must not be allowed to become dirty and must be changed frequently.

Interiors of small holes should be cleaned with pegwood dipped in solvent. The teeth of gears and pinions should be cleaned with a glass fiber brush.

Extreme care should be taken to avoid damage to small or delicate parts during cleaning. In addition, some arrangement must be made to permit identification of each part with respect to its previous location in the instrument. This is particularly true of bearings, pivots, and screws.

After cleaning, some provision must be made to adequately protect the parts from damage and dust while awaiting inspection and reassembly.

2.5 INSPECTION AND REPAIR

2.5.1 General

All parts should be thoroughly examined with an eye loupe for any evidence of excessive wear or damage prior to reassembly. Repair of defective parts is recommended only when it can be done with-

2.5.1 General (Cont'd)

out adversely effecting the proper operation of the instrument. If doubt exists as to the operating condition of any part or assembly, refer to the parts list section of this manual and order replacement parts directly from AIM.

During overhaul, examine each part for evidence of corrosion or breakdown in the plating material. Aluminum parts of the gyro are protected by anodize or iridite treatment and stainless steel parts are passivated. If a crocus cloth is used to remove corrosion or if the plating material appears to be worn through, replate or protect the defective area with a light coat of clear lacquer.

Particular attention should be given to parts which contain internal or external threads. If any evidence of damage to the threads is found, repairs should be made using the correct tap or thread restorer. The part should then be thoroughly re-cleaned and re-examined prior to assembly.

2.5.2 Bearings

The precision bearings used throughout the instrument are designed to provide extremely efficient service over long periods of time. Each bearing should be individually examined for evidence of damage. If defects are noted, the entire bearing should be replaced. No attempt should be made to polish the balls, or otherwise repair the separate bearing parts.

Bearings used in this instrument are precision, instrument grade and must not be replaced with inferior substitutes. Each bearing is lubricated with specific quantities and types of lubricants best suited for its individual function. This lubricant improves the performance of the bearings and substantially increases their service life. It is therefore recommended that replacement bearings be ordered directly from AIM in order to insure maximum operating efficiency.

2.5.3 Pivots

The four pivots used to support the gimbal and rotor housing assemblies are specially designed for specific functional locations

2.5.3 General (Cont'd)

in the instrument. Each pivot is distinctly constructed so that it must not be interchanged with other pivots during reassembly.

Each pivot or support shaft should be examined carefully for evidence of pits and scoring. Due to the precision fit of their respective bearings, the pivots should seldom incur any type of excessive damage. If small scratches are noted, a light polishing should be all that is necessary. However, if scoring or other excessive wear is noted, replacement pivots should be secured from AIM.

For information pertaining to the rotor pivots, refer to paragraphs 2.7.3(2), 2.7.4(2), and 2.8.4 in this manual.

2.6 REASSEMBLY PROCEDURES

2.6.1 General

Throughout the reassembly procedures, extreme care must be taken to prevent damage or contamination of the various component parts and subassemblies. When joining two parts, they must not be forced together. As each subassembly is completed, it must be covered while awaiting further installation to a mating assembly or component.

All adjusting screws must be secured in their final adjusted position by use of Glyptal or a similar sealer.

2.6.2 Installation of Rotor Housing in Gimbal Assembly

(1) Vacuum Only - Remove the side pivot from the rotor housing. Carefully position the rotor housing inside the gimbal by placing the air pivot end into the opening in the gimbal. Install the completed air seal bearing housing with its shim or shims (if originally included) in the gimbal so that the bearing engages the air pivot. Check that the air seal housing is turned properly to permit air flow through the instrument ductwork. Install two mounting screws, then tighten and secure with Glyptal.

(2) Electric Only - Remove the side pivot from the rotor housing.

2.6.2 Installation of Rotor Housing in Gimbal Assembly (Cont'd)

Carefully position the rotor housing inside the gimbal by placing the slip ring pivot into the opening in the gimbal. Install the slip ring bearing housing in the gimbal so that the bearing supports the slip ring pivot. Install two mounting screws and the brush block, then tighten and secure with Glyptal.

(3) Place the side pivot through the threaded port in the gimbal and attach to the rotor housing with three screws. Tighten pivot screws and secure with Glyptal.

(4) Screw the threaded bearing housing into the gimbal until end play is barely perceptible when moderate hand pressure is exerted toward either pivot.

(5) When threaded housing is properly adjusted, insert the clamping screw, washer, and lock nut shown in Figure 2-2. After tightening, check that end play has not changed and secure clamping screw and lock nut with Glyptal.

(6) Position the rotor housing so that the flat side of the air pivot or slip ring pivot flange is toward the caging mechanism at the bottom of the gimbal. When this is done, retighten the stop screw in the top of the gimbal, just above the air seal housing.

(7) Install the erector track so that it is an equal distance from each erector jet on the rotor housing. The ends of the erector track must bisect the erector ports when the spin axis of the rotor is horizontal. The erector track must not touch the erector jets at any point.

(8) Install the slaving magnet on the end of the side pivot with one 2-56 x 3/8" flat head screw. The magnet must be mounted so that the positioning notch is to the right when the rotor spin axis is level.

2.6.3 Installation of Gimbal Assembly in Instrument

(1) Install the gimbal gear and bearing housing on the top of the gimbal assembly in the order described in paragraph 2.3.3. Before securing the bearing housing in place, check that the friction shim is not squeezed between the hub of the bearing housing and the gimbal gear. The inside diameter of the friction shim is large enough so that, when properly installed, the shim will fit over the hub and fill the space between the bearing housing flange and the gimbal gear. When the friction shim is properly positioned, insert the three mounting screws and secure in place with Glyptal.

(2) Insert the air pivot or slip ring pivot into the bearing housing port in the bottom of the instrument case.

(3) Carefully place the completed gimbal and rotor assembly into the instrument with the air pivot or slip ring end centered above the lower bearing pivot.

(4) Turn the entire instrument over, being careful not to drop the gimbal or the pivot.

(5) Mount the air pivot or slip ring pivot to the bottom of the gimbal with two screws inserted through the air seal bearing housing port. Secure the screws with Glyptal.

(6) Vacuum Only - Install the air seal bearing housing with two screws and secure with Glyptal. Check that the air seal housing is properly aligned to permit unobstructed air flow.

NOTE

Shims are sometimes installed at the factory to insure proper alignment of the air passages in the air seal bearing housing. If shims were used prior to disassembly, they should be reinstalled.

(7) Electric Only - Install the slip ring bearing housing with two screws and secure with Glyptal. Install the gimbal brush block.

2.6.3 Installation of Gimbal Assembly in Instrument (Cont'd)

(8) Return the instrument to its normal upright position and install the upper bearing housing. Tighten three screws and secure with Glyptal.

(9) Check that the erector track is properly installed in the gimbal. It must be positioned so that it bisects both erector jets when the gyro is caged. The erector track must not touch the rotor jets at any position.

(10) After the gimbal is fully installed, check that the gimbal gear does not bind with the next gear at any point throughout one complete revolution of the gimbal. If binding is evident, loosen two binder head securing screws and rotate the eccentric on top of the instrument casting until the binding is relieved. When proper adjustment has been achieved, secure the eccentric and the two binder head screws in place with Glyptal.

(11) If the rotor is not properly balanced, refer to paragraph 2.9 before attempting to balance the gimbal.

The gimbal may be balanced by positioning balance screws around the slot in the gimbal base. Provisions have also been made for the installation of additional screws and weights in the #2-56 tapped holes on the side of the gimbal. Repeated trials will be necessary in order to obtain perfect balancing of the assembly. All balancing can be accomplished by adding or subtracting weight from opposing sides of the assembly. Balancing techniques vary according to shop practices. However, it is necessary to point out that trial and error methods are always necessary to obtain near perfect balancing of a precision assembly. During all stages of balancing, assemblies must be vibrated moderately to induce movement and to insure that an absolute minimum of friction between adjacent moving parts is evident.

2.6.4 Reassembly and Adjustment of Gear Train Mechanism

Due to the wide variation in gear train design, no attempt is made to provide specific procedures for reassembly. A full understanding of the information contained in the Disassembly Procedures of paragraph 2.3.6 will be helpful in reassembling the instrument.

If the gear train has been completely disassembled, reassemble the instrument without regard for zeroing synchros at this time. This procedure is fully covered in Section 3 of this manual.

2.6.5 Reassembly and Adjustment of Caging Mechanism

Reassembly of the caging mechanism requires no specific sequence of operations. However, special attention should be given to the following details.

If the caging plate and the nylon actuating carriage (Figure 2-2) are removed during disassembly, care should be taken to insure that the steel wire springs are properly positioned during reassembly. The springs should be tightened down and stressed so that the actuating carriage will be pulled clear of the rotor pivot when the caging shaft is released.

When reassembling the caging shaft, check that the associated pinion and washers are installed in the order described in paragraph 2.3.8. Improper installation of the washers could cause undue wear on the pinion and the related hardware.

After the caging mechanism is properly assembled, adjust the caging eccentric on the bottom of the instrument until the rotor housing is 80 to 90 percent caged before the dial-set gear begins to engage the combination spur/bevel gear on the main horizontal drive shaft. The trial and error method will be necessary until the proper adjustment is obtained.

2.7 OVERHAUL OF VACUUM ROTORS

2.7.1 General

Two types of vacuum rotors and associated housings, designated 34B and R3H, are used interchangeably in both AIM 400 and AIM 800

2.7.1 General (Cont'd)

instruments. Construction of the 34B is shown in Figure 2-11. The two rotors differ primarily in that the 34B utilizes a two part bearing which consists of an outer race assembly mounted in the rotor housing and an inner race which is actually the surface of the rotor shaft. The R3H rotor uses a one piece, non-separable bearing fitted over each end of a stationary rotor shaft and held in place by a knurled preload nut. The inner race and rotor shaft are stationary and the outer race moves with the rotor.

As previously stated in the manual, disassembly and overhaul of the rotor and rotor housing assembly is not recommended. Due to the precision parts involved, and the high speed of the rotor, reassembly and proper adjustment is extremely critical and should not normally be attempted in the field. Should the rotor become defective and fail to meet the performance requirements set forth in this manual, the used rotor housing and pivot assembly should be returned to AIM for an exchange discount on a replacement assembly. However, if

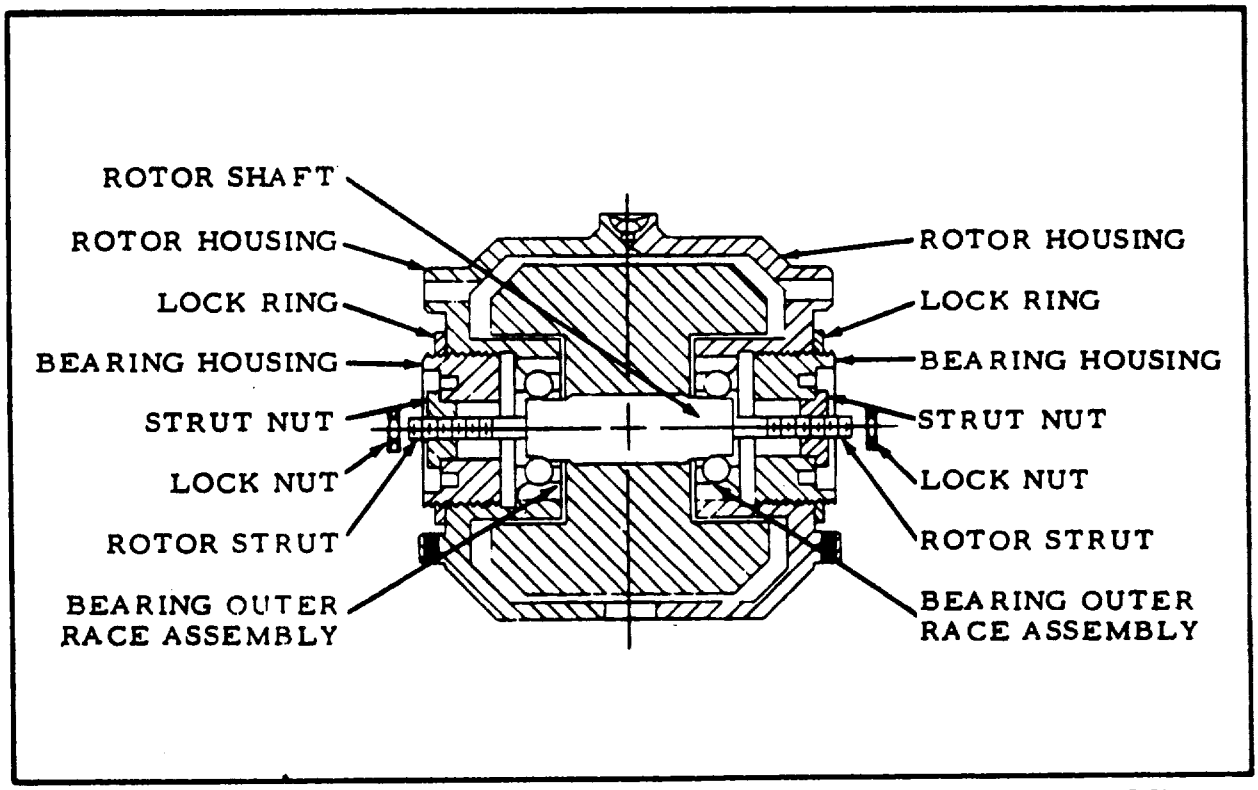


FIGURE 2-11. TYPE 34B ROTOR AND ROTOR HOUSING ASSEMBLY

2.7.1 General (Cont'd)

this is not possible, and disassembly and overhaul does become necessary in the field, the procedures shown in the remainder of Section 2.7 should be followed. Do not attempt to overhaul the rotor unless it fails to meet the operating requirements set forth in Section 3.

2.7.2 Equipment Required

Before disassembling the rotor housing, it should be noted that the following equipment must be available in order to properly readjust the assembly after overhaul. This equipment is in addition to the instrument-shop handtools described in paragraph 2.2.

(1) Mercury monometer capable of reading up to 6 in. Hg.

(2) Pressure source capable of producing a pressure of 4.7 in. Hg. (approximately 2.5 psi). A vacuum source is also recommended but is not required.

(3) Stop Watch.

(4) Clean, dust-free work area.

Additional equipment required for final calibration of the overall instrument is listed in Section 3 of this manual.

2.7.3 Type 34B Rotor and Rotor Housing (Figure 2-11)

1) Disassembly

(1) Remove one strut nut and one lock nut (Figure 2-11) from either end of the rotor strut. Do not disturb the strut nut and lock nut on the opposite end of the rotor strut.

(2) Remove the rotor strut from the rotor housing.

(3) Remove four #3-48 screws securing the front and rear halves of the rotor housing.

(4) The housing may now be opened to expose the rotor. The rotor bearing outer race assemblies are fitted into the housings in each end of the assembly and may be easily removed. The two bearing housings may also be removed by simply

2.7.3 Type 34B Rotor and Rotor Housing (Cont'd)

1) Disassembly (Cont'd)

loosening the respective lock rings (Figure 2-11) and threading the bearing housings out of the rotor housing.

2) Inspection, Cleaning, and Repair

Once the rotor housing is disassembled, check that the buckets in the rotor are free of accumulated dust, tobacco tars, and other foreign matter. Clean the various rotor parts in accordance with the procedures set forth in paragraph 2.4. After cleaning, each part must be adequately protected from dust while awaiting reassembly.

No attempt should be made to clean, re-oil, or otherwise repair the rotor bearings. If the bearings are defective, they should be replaced. In addition, no attempt should be made to polish or lap the rotor pivots on the ends of the rotor shaft. These pivots are actually the inner race of the rotor bearings and are manufactured to a precision geometry to match the bearing outer race assemblies. Any attempt at polishing or lapping could change the curvature of the pivot taper with subsequent damage to the pivot and the bearing. Each pivot should be carefully examined for pits or scoring. If damage is found, a new rotor housing and pivot assembly must be obtained from AIM. The replacement rotor housing and pivot assembly will be completely run-in and ready for installation when received.

3) Reassembly and Adjustment of Rotor Housing

(1) Check the bearing bore in each half of the rotor housing by pressing a clean used bearing into each bore using finger pressure only. Each bearing must be a gauge fit.

(2) Remove the used bearings from the bore in each half of the rotor housing. Apply a small quantity of Threadlube to the threads of each threaded bearing housing.

(3) Thread the bearing housings into their respective halves of the rotor housing approximately three turns.

2.7.3 Type 34B Rotor and Rotor Housing (Cont'd)

3) Reassembly and Adjustment of Rotor Housing (Cont'd)

(4) Apply a small quantity of Threadlube to each lock ring, then thread each lock ring onto its respective bearing housing until finger tight.

(5) Using instrument tweezers or a similar tool, install the new rotor bearings in their respective housings. Check that each bearing is fully seated in the bottom of its respective housing. Do not handle bearings with fingers.

(6) Grasp the rotor with watch paper or other high grade lintless tissue and place in position in one half of the rotor housing. Check that the rotor is positioned so that air entering the housing will strike the rotor buckets in the correct direction to obtain maximum rotation.

(7) Place the opposite half of the rotor housing in place and check that the air inlet ports on each half correspond.

(8) Attach the back half of the rotor housing to the front half with four screws. Tighten screws and secure with Glyptal.

NOTE

The front and back halves of the rotor housing may be distinguished by the four screw-holes used to hold the two halves together. The holes are threaded in the back half and are not threaded in the front half. Consequently, the four screws should be inserted from the front half toward the back.

(9) Position the threaded bearing housings at each end of the rotor shaft so that rotor end play is barely perceptible. Readjust lock rings until finger tight.

(10) Mount the side pivot on the rotor housing and insert three attaching screws. Tighten the screws but do not secure with Glyptal since the side pivot must be removed during installation of the rotor housing into the gimbal assembly.

(11) Hold the rotor housing so that the spin axis of the rotor is

2.7.3 Type 34B Rotor and Rotor Housing (Cont'd)

3) Reassembly and Adjustment of Rotor Housing (Cont'd)

horizontal, the back half of the rotor housing is to the left, the front half is to the right, and the air pivot side is directly visible. Apply Loctite to two attaching screws and mount the air pivot on the rotor housing so that the flat side of the air pivot is toward the bottom.

4) Rotor Bearing Preload Adjustments and Run-in Procedures

(1) Place the rotor housing in a suitable run-in fixture. If none is available, install the rotor in the instrument as described in paragraphs 2.6.2 and 2.6.3.

(2) Adjust the threaded bearing housings (Figure 2-11) at each end of the rotor until the rotor is centered in the over-all assembly.

(3) Apply enough low pressure air at the air pivot or at the AIR INLET port to permit the rotor to start and continue to rotate at approximately 500 rpm. Disconnect air supply hose, then gently shake the assembly to check for excessive rotor bearing end play. If excessive end play is evident, readjust the threaded bearing housings evenly.

(4) Re-attach the air supply hose and recheck end play in the same manner as above. End play is properly adjusted when minutely evident with the rotor spinning at approximately 500 rpm.

(5) When end play is properly adjusted, tighten lock rings and secure with Glyptal.

(6) Insert the rotor strut through the rotor shaft. Install strut nuts and lock nuts on the threaded ends so that equal amounts of threads are showing.

(7) Again attach an air supply hose to the air pivot or AIR INLET port. Tighten strut nuts and lock nuts evenly and sufficiently to permit rotor to start and

2.7.3 Type 34B Rotor and Rotor Housing (Cont'd)

4) Rotor Bearing Preload Adjustments and Run-in Procedures (Cont'd)

(7) continue to rotate at an air pressure of 0.5 to 1.0 in. Hg if the rotor housing is in a run-in rack, or not in excess of 2.25 in. Hg if it is installed in the instrument. Secure strut nuts and lock nuts in their final adjusted position with Glyptal.

(8) Connect air supply hose and allow the rotor to run for 48 hours at its rated pressure of 4.6 in. Hg.

(9) After the 48-hour run-in period, check that the rotor meets the rotor start, rotor speed, and rotor coast performance tests in Section 3 of this manual.

2.7.4 Type R3H Rotor and Rotor Housing (Figure 2-12)

1) Disassembly

(1) Remove the rotor support nut and the four screws holding the two halves of the rotor housing together.

(2) Carefully remove one-half of the rotor housing and thread rotor out of the second half using the screwdriver slot in the upper end of the rotor shaft. Select a screwdriver with a 0.140 maximum face width to avoid damaging threads in the rotor support nut.

(3) To obtain access to the rotor bearings, remove one preload nut from each end of the rotor shaft and six 1-72 x 3/16 binder head screws securing each bearing shield to the ends of the rotor shaft.

2) Inspection, Cleaning, and Repair

Once the rotor is disassembled, check that the buckets in the rotor are free of accumulated dust, tobacco tars, and other foreign matter. Clean the various rotor parts in accordance with the procedures set forth in paragraph 2.4. After cleaning, each part must be adequately protected from dust while awaiting assembly.

2.7.4 Type R3H Rotor and Rotor Housing (Figure 2-12) (Cont'd)

2) Inspection, Cleaning, and Repair (Cont'd)

No attempt should be made to clean, re-oil, or otherwise repair the rotor bearings. If the bearings are defective, they should be replaced.

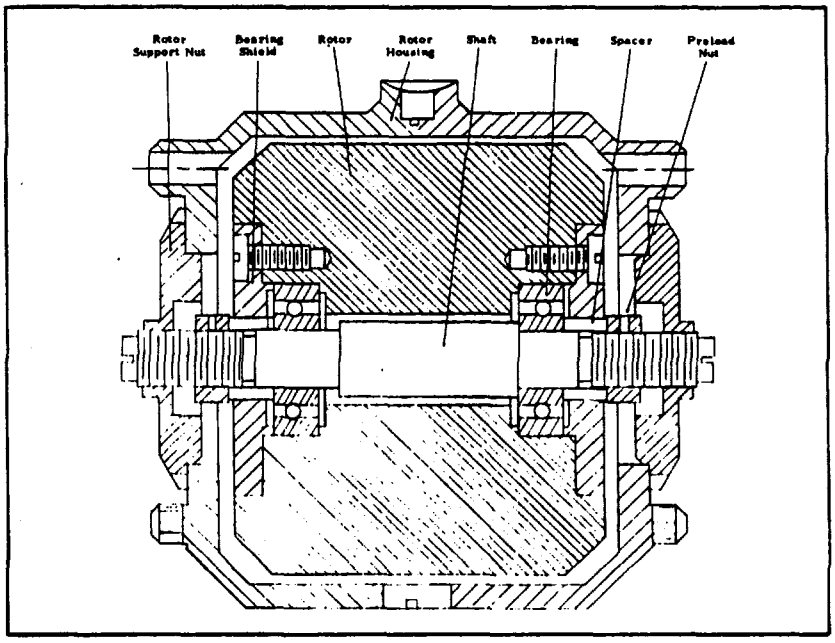


FIGURE 2-12. R3H ROTOR AND ROTOR HOUSING ASSEMBLY

3) Reassembly and Adjustment

(1) If the rotor has been completely disassembled, determine the position in which the rotor must be installed to obtain counterclockwise rotation when viewed from the front of the rotor housing. This may be done by noting the curvature of the buckets in the side of the rotor.

NOTE

The front and back halves of the rotor housing may be distinguished by the four screw holes used to hold the two halves together. The holes are threaded in the back half and are not threaded in the front half. Consequently, the four screws should be inserted from the front half toward the back.

2.7.4 Type R3H Rotor and Rotor Housing (Figure 2-12) (Cont'd)

3) Reassembly and Adjustment (Cont'd)

(2) Slip the rotor shaft through the rotor so that the short bearing surface will be at the front of the housing when the rotor is completely installed.

(3) Install one bearing, one spacer, one bearing shield, and one preload nut over each end of the rotor shaft. The bearings must be installed so that the engraved type numbers are not visible and with the word "thrust" toward the center of the rotor. This is imperative with this type of bearing.

4) Rotor Bearing Preload Adjustment and Run-in Procedures

(1) Set the front preload nut tight against the bearing spacer. This is the end of the shaft with the short bearing surface.

(2) Carefully tighten the nut on the opposite end until the detectable axial end play between rotor and shaft just disappears. This rotor bearing preload adjustment is very critical and must not be exceeded if normal bearing life is to be realized. At the correct setting the rotor shaft will spin freely in the rotor assembly and have no detectable end play. To check for proper adjustment hold the rotor stationary and spin the rotor shaft. If a noticeable roughness is apparent, the preload is set too tight or the bearings are damaged. Do not apply Glyptal to either preload nut at this time.

(3) When preload has been completed, thread the rotor and rotor shaft into the rotor housing and install the rotor support nut.

(4) Install the rotor housing and the air pivot in the gimbal or in a suitable run-in fixture.

(5) Run rotor for 48 hours with 4.5 - 4.7 in. Hg air pressure applied. Recheck the preload setting after run-in and readjust as required in paragraph (2) above.

2.7.4 Type R3H Rotor and Rotor Housing (Figure 2-12) (Cont'd)

4) Rotor Bearing Preload Adjustment and Run-in Procedures (Cont'd)

(6) Run the rotor for an additional 24 hours and check the rotor start and run-down performance. The rotor must start and continue running with 0.4 to 0.8 in. Hg pressure applied to air pivot. The run-down time should be between 5 and 9 minutes. If the rotor fails to start within these prescribed limits, and run-down time is not as required, the rear preload nut should be readjusted. If successive rotor starts vary widely and run-down time will not exceed 5 minutes, the bearings are contaminated or worn and must be replaced.

(7) Check that the rotor attains a speed of approximately 28,000 rpm with 4.5 to 4.7 in. Hg pressure applied to the rotor housing.

(8) After it has been established that the rotor meets the requirements of the above paragraphs, apply a small amount of Glyptal to both preload nuts. Avoid excessive Glyptal on the free threads at each end of the rotor shaft.

(9) Install the rotor housing in a balancing fixture or in the gimbal to properly locate the rotor in the housing. Balance the assembly by turning the rotor shaft as required to center the rotor in the housing. When proper adjustment has been obtained, secure the rotor shaft and the rotor support nuts with Glyptal.

2.8 OVERHAUL AND ADJUSTMENT OF ELECTRIC ROTOR

2.8.1 General

As previously stated in this manual, disassembly and overhaul of the rotor and rotor housing assembly is not recommended. Due to the precision parts involved, and the high speed of the rotor, reassembly and proper adjustment is extremely critical and should not normally be attempted in the field. Should the rotor become defective and fail to meet the performance requirements set forth in this

2.8.1 General (Cont'd)

manual, the used rotor and rotor housing assembly should be returned to AIM for an exchange discount on a replacement assembly. However, if this is not possible, and disassembly and overhaul does become necessary in the field, the procedures shown in the remainder of Section 2.8 should be followed. Do not attempt to overhaul the rotor unless it fails to meet the operating requirements set forth in Section 3 of this manual.

2.8.2 Equipment Required

Before disassembling the rotor housing, it should be noted that the following equipment must be available in order to properly readjust the assembly after overhaul. This equipment is in addition to the instrument-shop handtools described in paragraph 2.2.

(a) 115 vac, 400 cps, single phase power source
(b) 0-150 ma ac milliameter
(c) Voltmeter capable of reading 85 vac to 115 vac
(d) Stop watch
(e) Variac power transformer or similar means of varying supply voltage from 85 to 115 vac
(f) Clean, dust-free work area

2.8.3 Disassembly of Electric Rotor and Rotor Housing (Figure 2-13)

(1) Remove the four screws securing the two halves of the rotor housing.

(2) Carefully separate the two halves and thread the rotor assembly out of the rotor housing using the screwdriver slot in the upper end of the rotor shaft.

(3) To obtain access to the rotor bearings, remove the impellers from each end bell and remove the preload nut and spacer from each end of the rotor shaft. The bearings are protected by a small bearing shield over each end of the rotor shaft.

(4) Care should be taken to avoid loss of the spacers and bearing shields located between the preload nut and the bearing on each end of the rotor shaft.

2.8.3 Disassembly of Electric Rotor and Rotor Housing (Figure 2-13) (Cont'd)

NOTE

Removal of the end bells on each end of the inertia ring is not normally required, and is not recommended. If either end bell is removed, delicate rebalancing of the inertia ring assembly will be required. If the end bells must be removed to obtain access to the stator, it is suggested that a mark be made at the interface between the inertia ring and each end bell to simplify reassembly and minimize rebalancing required.

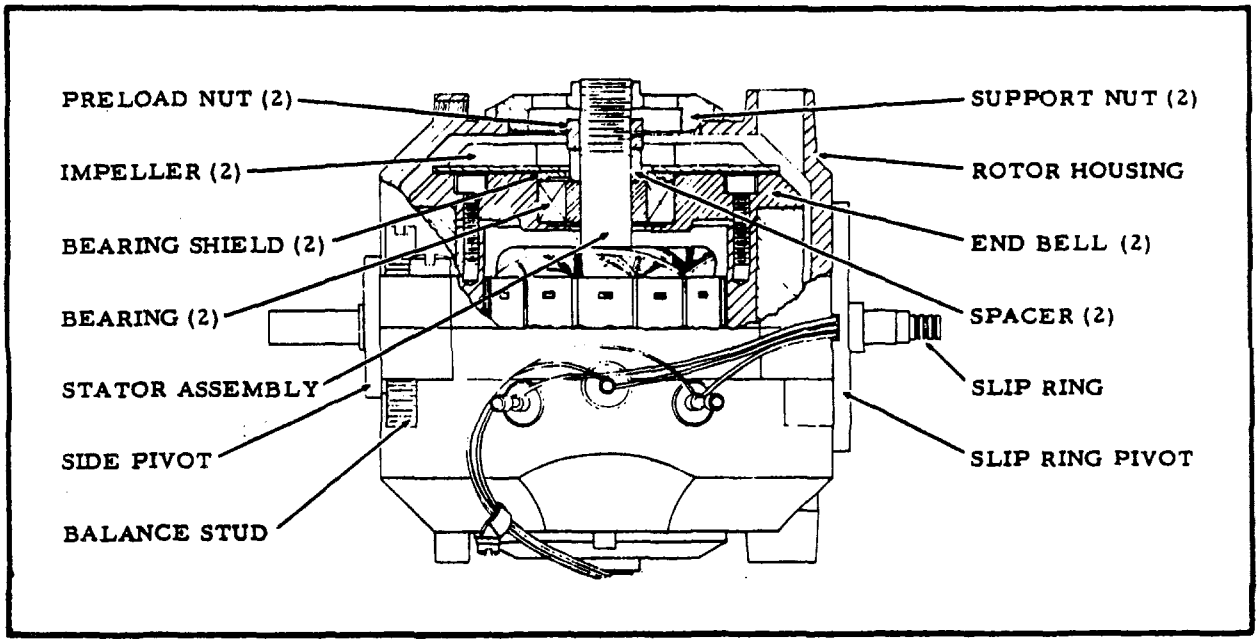


FIGURE 2-13. ELECTRIC ROTOR AND ROTOR HOUSING ASSEMBLY

2.8.4 Inspection, Cleaning, and Repair

Clean the various rotor parts in accordance with the procedures set forth in paragraph 2.4. After cleaning, each part must be adequately protected from dust while awaiting reassembly.

No attempt should be made to clean, re-oil, or otherwise repair the rotor bearings. If the bearings are defective, they should be replaced.

2.8.5 Reassembly and Adjustment

(1) Install the rotor bearings over each end of the rotor shaft with the word "thrust" toward the center of the rotor.

(2) Install the bearing shields with the recessed side toward the center of the rotor.

(3) Reinstall the impellers on each end bell if they were removed during disassembly. Tighten all attaching screws securely.

(4) Install the spacer and preload nut on each end of the rotor shaft.

2.8.6 Rotor Bearing Preload Adjustment and Run-in Procedures

(1) Set the bottom preload nut tight against the bearing spacer. This is the end of the shaft with the short bearing surface.

(2) Carefully tighten the nut on the wire outlet end until the detectable axial end play between rotor and shaft disappears. This rotor bearing preload adjustment is very critical and must not be exceeded if normal bearing life is to be realized.

At the correct setting the rotor shaft will spin freely in the rotor assembly and have no detectable end play. To check for proper adjustment hold the rotor stationary and spin the rotor shaft. If a noticeable roughness is apparent, the preload is set too tight or the bearings are damaged. Do not apply Glyptal to either preload nut at this time.

(3) When preload has been completed, thread the rotor and rotor shaft into the rotor housing and install the rotor support nut.

(4) Install the rotor housing and both pivots in the gimbal or in a suitable run-in fixture.

(5) Run rotor for 48 hours with 115 vac, 400 cps, single phase power applied and using a .18-.22mf, 600 v, phase shift capacitor to shift the phase of one winding by 90°. Recheck the preload setting after run-in and readjust as required in

2-8-6 Rotor Bearing Preload Adjustment and Run-in Procedures (Cont'd)

paragraph (2) above.

(6) Run the rotor for an additional 24 hours and check the rotor start and run-down performance. The rotor must start and continue running with 90 vac, 400 cps applied and run-down time should be between 6 and 10 minutes. If the rotor fails to start at 70 to 90 vac, and run-down time is not within limits, the top preload nut should be readjusted. If successive rotor starts vary more than 15 vac, the bearings are contaminated or worn and must be replaced.

(7) Check that the rotor attains a speed of approximately 23, 500 rpm with 115 vac, 400 cps applied to the rear connector. The rotor should draw approximately 140 milliamperes starting current and 115 milliamperes running current.

(8) After it has been established that the rotor meets the requirements of the above paragraphs, apply a small amount of Glyptal to both preload nuts. Avoid excessive Glyptal on the free threads at each end of the rotor shaft.

(9) Install the rotor housing in a balancing fixture or in the gimbal to properly locate the rotor in the housing. Balance the assembly by turning the rotor shaft as required to center the rotor in the housing. When proper adjustment has been obtained, secure the rotor shaft and the rotor support nuts with Glyptal.

2.9 ROTOR HOUSING STATIC BALANCING

(1) The rotor housing should be statically balanced inside the instrument. Install two balancing screws from the back of the rotor housing toward the front so that the screws are centered horizontally (Figure 2-14).

(2) Turn the instrument on its side and position the rotor housing so that the rotor strut is perpendicular to the earth.

(3) Place a small weight and a piece of tape on a gram scale and

cut the tape until the total weight of the two is 3/10 gram.

(4) Attach the weight to the top of the rotor housing where the two halves come together (Figure 2-14).

(5) Return the rotor strut to the perpendicular position and let go. The rotor should not move from this position. As a further check, a screwdriver handle or similar device should be rattled along the instrument casting to induce vibrations which will assist in determining any imbalance. If the rotor tends to fall, either to the top or to the bottom, appropriate weight should be added at the four #2-56 tapped holes provided for this purpose (A, Figure 2-14).

(6) Set the instrument in the upright position with the air passage or slip ring side of the gimbal toward the back of the instrument. The rotor housing should assume about a 10° tilt to the left when viewed from the front of the instrument. Again, a screwdriver handle or similar device, rattled on

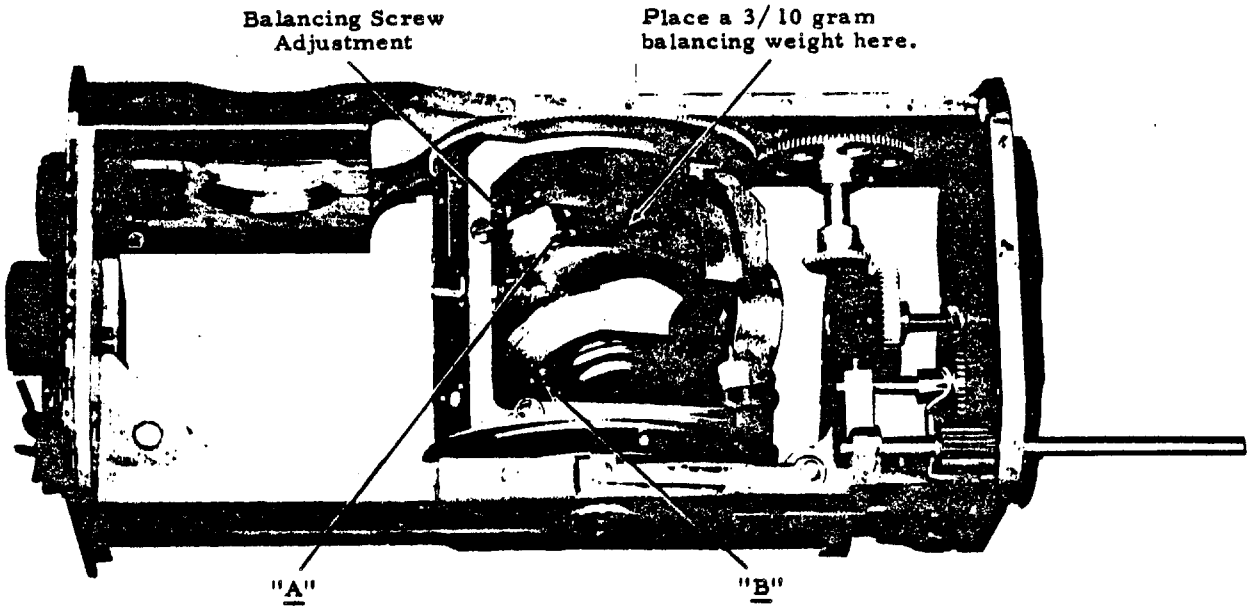


FIGURE 2-14. ROTOR HOUSING BALANCE ADJUSTMENTS

the instrument casting, will cause the rotor housing to seek its stable position.

(7) A rough adjustment may be accomplished by centering the two balancing screws and adding or subtracting weight at the two #1-72 tapped lugs shown in B, Figure 2-14, until the rotor housing is near the correct position. Final adjustment may be accomplished by positioning the two balancing screws as required. Secure the balancing screws with a minimum amount of Glyptal since additional adjustment may be necessary during the drift and calibration tests in Section 3.

SECTION 3

TEST AND CALIBRATION

3.1 TEST AND CALIBRATION

3.1.1 General

The following test and calibration procedures may be used to either isolate malfunctions in the instrument prior to overhaul, or to checkout and recalibrate the instrument after overhaul has been accomplished. Included with each test are suggested corrective measures which should be employed if the instrument fails to meet the required performance specifications.

3.2 TEST EQUIPMENT REQUIRED

3.2.1 General

(a) Scorsby test stand capable of providing roll, pitch, and yaw oscillations with an amplitude of ± 3 degrees about each axis at a frequency of 5 to 7 cycles per minute.

(b) Stop watch

(c) Clean, dust-free work area

3.2.2 Vacuum Only

(a) Mercury manometer capable of reading up to 6 in. Hg

(b) Pressure source capable of producing a pressure of 4.7 in. Hg (A vacuum source is recommended but is not required.)

(c) Either a volumetric flow meter or a similar device capable of measuring approximately 2.0 cfm air consumption

3.2.3 Electric Only

(a) 115 vac, 400 cps, single phase power source

(b) Variac power transformer or similar means of varying supply voltage from 85 vac to 115 vac

3.2.3 Electric Only (Cont'd)

(c) Vacuum tube voltmeter

(d) 0-200 ac milliameter

3.3 MECHANICAL TESTS

3.3.1 Rotor Speed Test - Vacuum Models

This test is an "open" calibration test and should be performed with the instrument dust cover removed. Apply a pressure line of 4.5 to 4.7 in. Hg to the AIR INLET port on the rear panel of the instrument. Allow approximately five minutes for the rotor to gain speed and stabilize.

The rotor should attain a speed of 23,000 rpm or greater if the rotor housing is installed in the instrument and the instrument ductwork is used. If the rotor housing is outside of the instrument, and air pressure is applied directly to the air pivot, rotor speed must be in excess of 29,000 rpm.

If the rotor fails to reach the required speed, a new rotor and rotor housing should be installed. If replacement is not possible, overhaul of the rotor and rotor housing should be accomplished as described in paragraph 2.7 of this manual.

3.3.2 Rotor Speed Test - Electric Models

This test is an "open" calibration test and should be performed with the instrument dust cover removed. Insert a 0-200 ac milliameter in series with 115 vac, 400 cps and apply power to the proper electrical connector on the rear panel of the instrument. Allow approximately five minutes for the rotor to gain speed and stabilize. The rotor should attain a speed of 23,000 rpm or greater.

Check for approximately 115 milliamperes running current. Rotate the instrument horizontally through 360° and check for any variation in current. Also tilt the rotor to its limits of travel and check for current variation. If current does vary, readjust tension on the appropriate brushes so that the brushes do not drop away from their respective slip ring.

3.3.2 Rotor Speed Test - Electric Models (Cont'd)

If the rotor fails to reach the required speed, a new rotor and rotor housing should be installed. If replacement is not possible, overhaul of the rotor and rotor housing should be accomplished as described in paragraph 2.8 of this manual.

3.3.3 Rotor Coast Test

After the conditions described in the Rotor Speed Test have been attained, disconnect electrical power or pressure line from the instrument. Rotor run-down time must be 6 minutes or more for electric models and 4-1/2 minutes or more for vacuum models. If the rotor fails to coast the required length of time, replacement or overhaul of the complete rotor housing should be accomplished.

3.3.4 Still Run Drift and Calibration

(1) Mount the instrument in a panel or secure it on a bench so that the bezel is vertical and the instrument will not change position on the bench.

(2) Apply 115 vac, 400 cps or 4.5 to 4.7 in. Hg air pressure for the remainder of this test. Allow five minutes for the rotor to attain full speed.

(3) Set the dial on 0° or North heading and allow the gyro to run for 15 minutes. At the end of 15 minutes, the dial reading must be between 357° and 3°. If the reading is greater than 3°, turn one of the balancing screws shown in Figure 3-1 counterclockwise. Likewise, if the reading is less than 357°, turn one of the balance screws clockwise.

To correct for a 10° change in drift rate, turn each balancing screw 1-1/2 to 2-1/2 turns. To simplify calibration, the original drift and the correction made should be recorded. This procedure should be repeated and evaluated for the next correction.

(4) Repeat the above procedure for headings of 90°, 180°, and 270°. Maximum permissible drift for any cardinal heading is $\pm 3^{\circ}$ in

3.3.4 Still Run Drift and Calibration (Cont'd)

fifteen minutes.

If the instrument fails to maintain the required performance levels specified in the above test procedures, the following items should be checked for proper assembly.

(a) The gear train which drives the dial must be free throughout its entire range of rotation. If the gimbal gear binds with the intermediate gear, the bearing eccentric on the top of the instrument must be adjusted as described in paragraph 2.6.3 (10).

(b) Check the bearings which support the rotor housing for rough spots or excessive preload. Either replace the bearings or adjust the threaded housing as described in paragraph 2.6.2 (4).

(c) Check the bearings which support the gimbal for proper clearance between the gimbal and the case. The gimbal assembly must move up and down when the gimbal is lifted and released. If the bearings are excessively preloaded, add necessary shims under the lower bearing housing. Refer to paragraph 2.6.3 of this manual.

3.3.5 Erection Test in Still Run

Mount the instrument securely with the frame placed in a level position. Apply 115 vac, 400 cps or 4.5 to 4.7 in. Hg air pressure and allow five minutes for the rotor speed to increase and stabilize. Displace the rotor spin axis 55° from horizontal and check that the rotor housing automatically erects. If the rotor housing fails to erect, the rotor housing is improperly installed or the erector track is improperly adjusted. For proper installation and adjustment refer to paragraph 2.6.2.

3.3.6 Caging

The rotor housing must be 80% to 90% caged before the dial-set

3.3.6 Caging (Cont'd)

gear becomes sufficiently engaged to permit readjustment of the heading card. When the caging shaft is fully in, the rotor housing must be fully caged.

If adjustment is necessary refer to paragraph 2.6.5 in this manual.

3.3.7 Rotor Start Test - Vacuum Only

To perform this test and those following, the instrument must be completely assembled and sealed. Apply a vacuum to the vacuum port on the rear panel. By listening carefully against the case, any rotation of the rotor can be heard. The amount of vacuum required for the rotor to start and continue running should not exceed 2.25 in. Hg.

If the rotor fails to start at the prescribed vacuum, a new rotor and rotor housing should be installed. If replacement is not possible, overhaul of the rotor and rotor housing should be accomplished as described in paragraph 2.7 of this manual.

3.3.8 Rotor Start Test - Electric Only

The rotor must start with 90 vac, 400 cps applied to the rear connector. This check should be repeated several times. If successive starts vary more than 15 vac, the rotor bearings are worn or contaminated and should be replaced.

Check that the starting current is approximately 140 milliamperes and running current is approximately 115 milliamperes. If the rotor fails to conform to the above requirements, a new rotor and rotor housing should be installed. If replacement is not possible, overhaul of the rotor and rotor housing should be accomplished as described in paragraph 2.8.

3.3.9 Scorsby Test

Mount the instrument on a Scorsby test stand which should be set for 5-7 oscillations per minute at an amplitude of ± 3 degrees

3.3.9 Scorsby Test (Cont'd)

about each axis.

For each cardinal heading, the instrument drift must not exceed 3^{o} for 10 minutes. If drift is excessive, check for possible defects and recalibrate as explained in paragraph 3.3.4. Also check freedom of dial and gear train mechanism as described in the appropriate paragraph of section 2.3.

3.3.10 Air Consumption Tests - Vacuum Only

1) General

This test should be performed after the instrument is calibrated because the instrument must be completely assembled and fully sealed. An air volumetric flow meter or similar device must be used to perform the following tests.

2) Leak Test

Block the AIR INLET port and apply a vacuum of 4.5 in. Hg to the vacuum port. Air consumption must not exceed 0.2 cfm. If excessive leakage occurs, check cover gaskets, air filter housing, and glass for leakage.

3) Air Consumption When Running

Apply a vacuum of 4.5 in. Hg to the vacuum port. Air consumption must not exceed 2.1 cfm. If air consumption is greater than 2.1 cfm, check for internal leaks such as omitted air seals, loose bearing housings, loose pivots, etc.

3.3.11 Appearance

There should be no bright surfaces on the face of the dial. The dial, glass, indices, and bezel should be free of scratches or flaking paint. The nameplate and serial number should be clearly legible.

On vacuum instruments, plastic pipe plugs should be installed in both the AIR INLET port and the vacuum port until the instrument is installed in the aircraft.

3.4 ELECTRICAL TESTS AND ADJUSTMENTS

3.4.1 General

Synchro zeroing may be accomplished by either of two methods. The first method is detailed in the following procedures and can be performed using equipment which is readily available in most overhaul shops.

The second method is of particular value where overhaul is performed regularly on a number of different AIM, ARINC instruments. It requires the construction of an ARINC Test Box such as that described in the Appendix of this manual. The test box simplifies synchro zeroing and substantially reduces the amount of time required. Instructions for use of the test box are also included in the Appendix.

3.4.2 ARINC Zeroing Procedures for Synchro Transmitters

1) Null

(1) Connect a vacuum tube voltmeter and a 26 volt, 400 cps power supply to the synchro under test as shown in Figure 3-1.

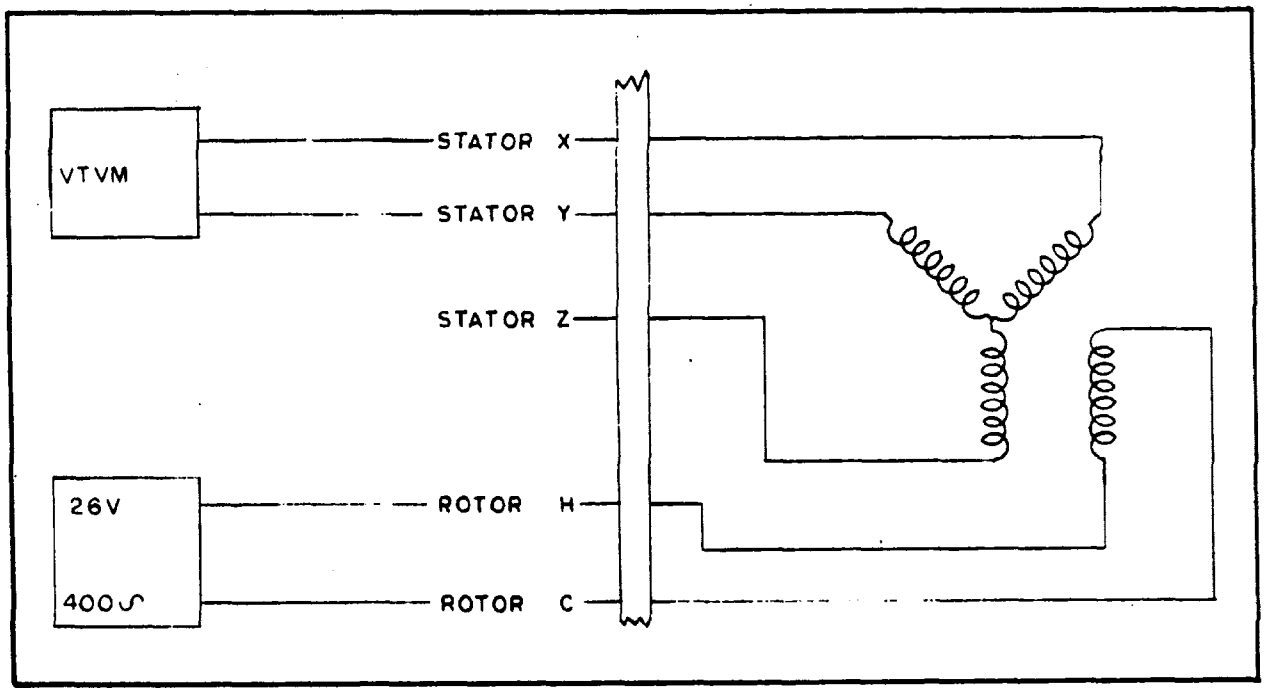


FIGURE 3-1. ARINC ZEROING PROCEDURE, STEP 1

3.4.2 ARINC Zeroing Procedures for Synchro Transmitters (Cont'd)

1) Null (Cont'd)

(2) Rotate the heading gear train until null (minimum voltage) is indicated on the VTVM.

(3) Loosen the gear hub or dial setscrew on the synchro under test.

(4) Hold the synchro shaft and rotate the heading dial to north. Lightly tighten the setscrew.

2) Phase

(1) Change the test circuit to that shown in Figure 3-2.

(2) Rotate the heading card from north to +30° while observing the VTVM. The voltage must be at least 26 volts and must increase from 0° to 30°.

If the voltage is 26 volts or greater at 0°, but decreases from 0° to 30°, reverse the synchro stator x and y leads and repeat steps 1) and 2) above.

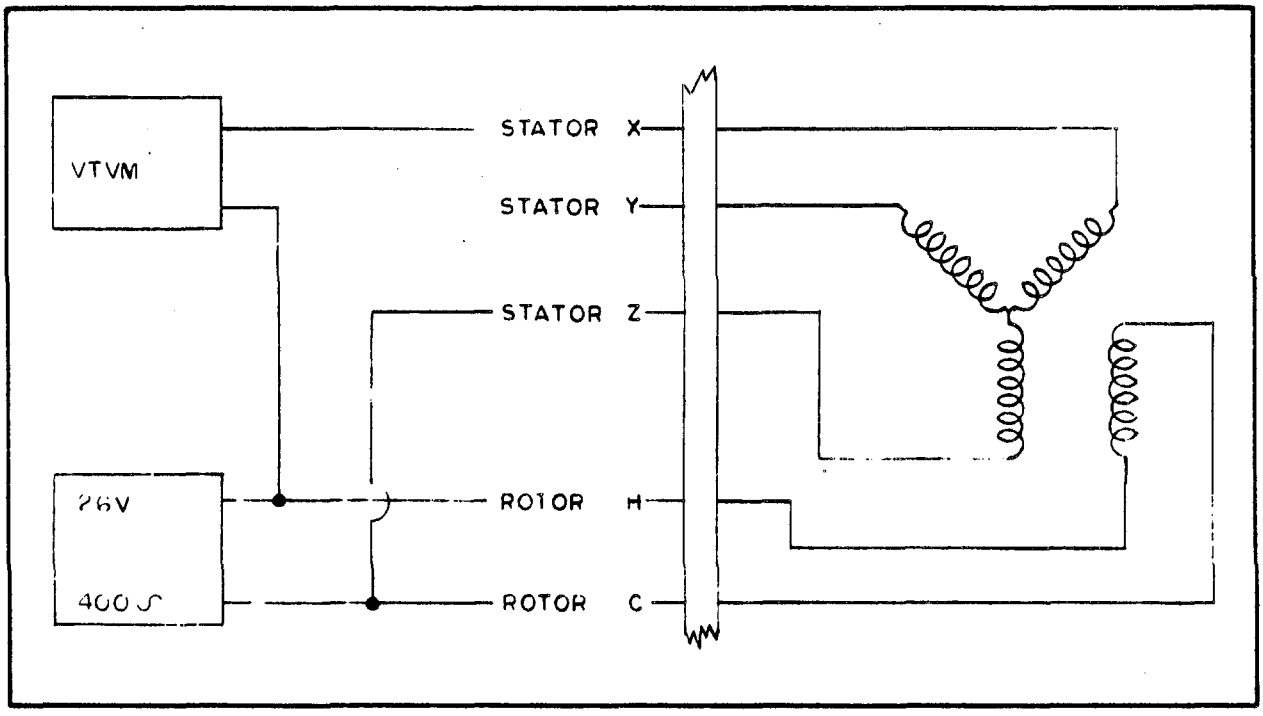


FIGURE 3-2. ARINC ZEROING PROCEDURE, STEP 2

3.4.2 ARINC Zeroing Procedures for Synchro Transmitters (Cont'd)

2) Phase (Cont'd)

(2) If the voltage is less than 26 volts at 0°, loosen the gear hub or dial setscrew and rotate the synchro shaft 180 degrees. Lightly tighten the setscrew and repeat steps 1) and 2) above.

3.4.3 ARINC Zeroing Procedure for Synchro Receivers

Zeroing procedures for ADF/VOR pointers are the same as those for synchro transmitters except that electrical zero is at south instead of north. Consequently, the voltage must be at least 26 volts at 180° and must increase from 180° to 210°.

3.4.4 ARINC Zeroing Procedure for Synchro Resolvers

(1) Construct a test circuit as shown in Figure 3-3.

(2) Set the switch in position 1 and loosen the setscrew which secures the dial to the resolver synchro shaft.

(3) Turn the dial to 0° or north heading.

(4) Hold the dial and turn the shaft until the VTVM reads minimum voltage. Tighten the setscrew holding the dial on the shaft.

(5) Check that null occurs within 1/2 degree of the dial zero.

(6) Set the switch in position 2 and rotate the card and shaft 360°. Observe the VTVM and check that low null (minimum voltage) occurs at north or 0°.

(7) Set the switch in position 3 and rotate the card and shaft 360°. Observe the VTVM and check that low null occurs at east or 90°.

(8) If the low null in step (6) occurs at south, and the low null in step (7) occurs at west, loosen setscrew and turn the synchro shaft 180 degrees while holding the card stationary. Retighten setscrew and repeat steps (6) and (7).

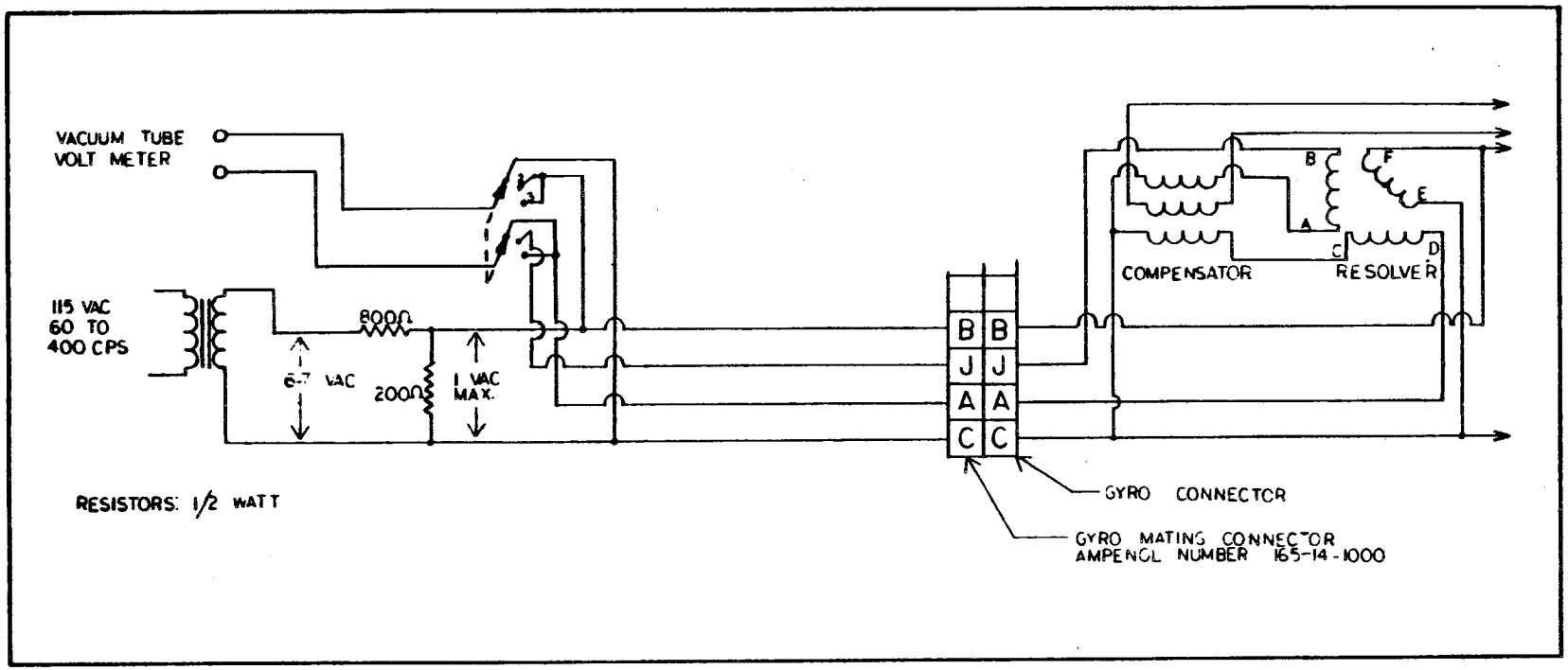


FIGURE 3-3. SYNCHRO RESOLVER CALIBRATION CIRCUIT

3.4.4 ARINC Zeroing Procedures for Synchro Resolvers (Cont'd)

(9) If the low null in step (6) is correct, but the low null in step (7) occurs at 270° or west, reverse wires A and B or blue and yellow on the synchro resolver and repeat steps (6) and (7).

(10) If the corrective measures of steps (8) and (9) fail to bring the desired results, check wiring by reversing pairs of wires as required.

(11) Disconnect wiring to the synchro resolver and use an ohm meter to check continuity between the following pairs of synchro leads:

(a) Black and white

(b) Blue and yellow

(c) Black-white and red-white

Also rotate the shaft while making this check. If continuity exists, check for continuity in the electronic compensator coils. If the continuity fails to check, the synchro must be replaced.

3.5 ADJUSTMENT OF ELECTRONIC COMPENSATOR

3.5.1 Equipment Required

Use a 5-0-5 voltmeter and a magnetic flux detector mounted on a calibrated base as shown in Figure 3-4.

3.5.2 Adjustment Procedure

(1) Set both the gyro card and the flux detector dial to read north.

NOTE

If the gyro is not running, it may be necessary to hold the gyro in the caged position to maintain the desired heading.

(2) Position the flux detector platform until null is obtained on the slaving indicator.

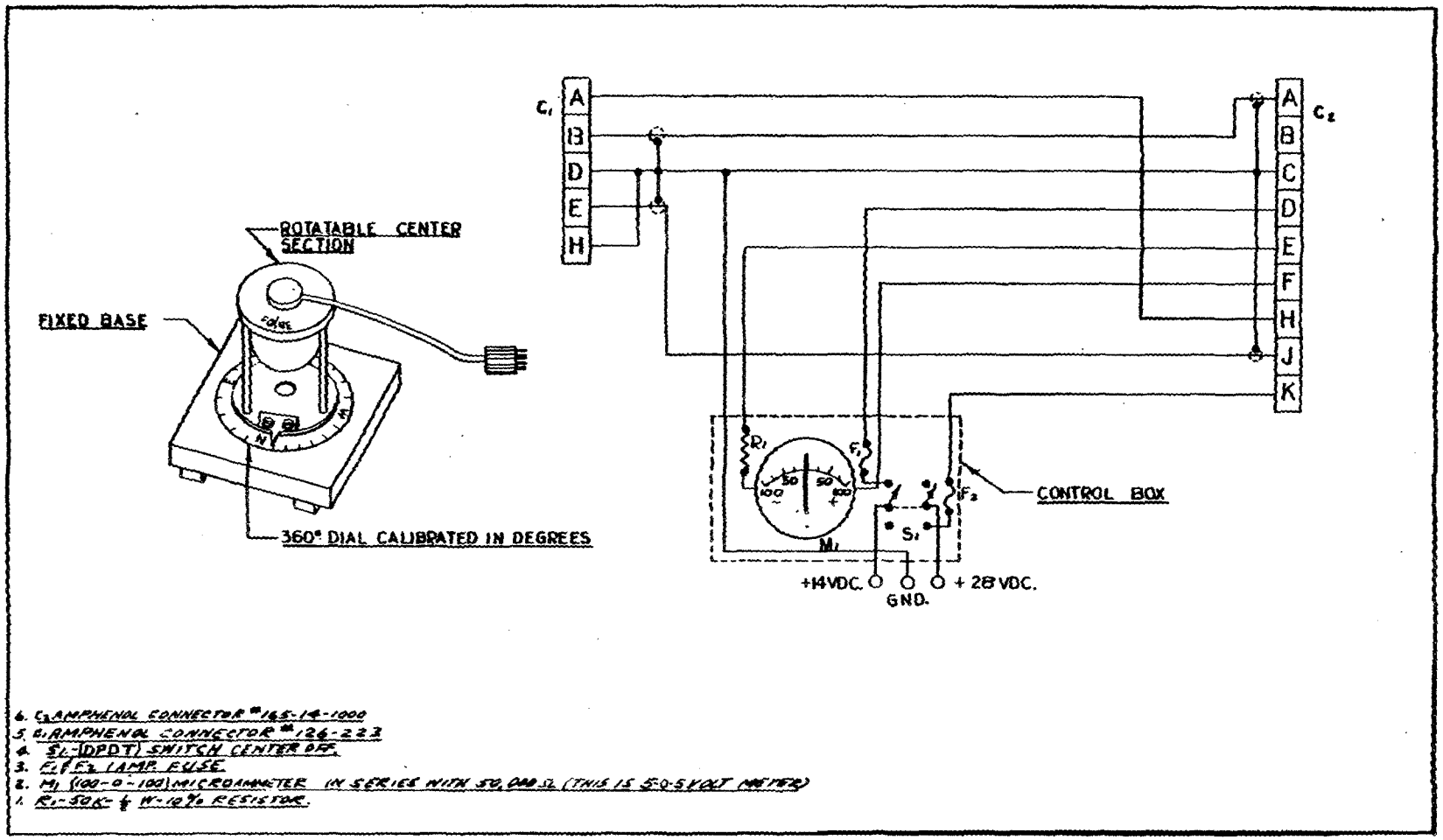


FIGURE 3-4. ADJUSTMENT OF ELECTRONIC COMPENSATORS

3.5.2 Adjustment Procedures (Cont'd)

(3) Rotate the gyro card to 180° and the turntable to the angle near 180° at which null occurs, and note the deviation of the turntable from 180°.

(4) Rotate the turntable to reduce the deviation by 50% and adjust the N-S compensator to again obtain a null on the slaving indicator.

(5) Return the gyro card and flux detector turntable to zero degrees and reposition the platform to obtain null on the slaving indicator.

(6) Rotate the gyro to 180° and the turntable to the angle near 180° at which null occurs, and note the deviation of the turntable from 180°.

(7) Again rotate the turntable to reduce the deviation by 50% and adjust the N-S compensator to obtain a null on the slaving indicator.

(8) Repeat the above procedure until no deviation is noted when the gyro card and flux detector turntable are turned to 180°.

(9) Without moving the flux detector platform, rotate the gyro card and turntable to 270°.

(10) Adjust the E-W compensator to obtain null on the slaving indicator.

(11) Rotate the gyro card to 90° and the turntable to the angle near 90° at which null occurs, and note the deviation of the turntable from 90°.

(12) Rotate the turntable to reduce the deviation by 50% and adjust the E-W compensator to obtain a null on the slaving indicator.

(13) Repeat the above procedures, alternating between 90° and 270° until no deviation is noted.

3.6 TROUBLE-SHOOTING

3.6.1 General

Before attempting to trouble-shoot the system, make certain that the trouble is not caused by loose or improper cable connections, inadequate power or vacuum supply or other external conditions. Test and troubleshooting procedures must be performed with all elements of the system operating, in order to insure the validity of test results. The AIM 254-11 Flux Detector is a sealed unit and is not repairable in the field. To check for open windings, refer to paragraph 2.4.1 (page 1-16) of the manaul. The AIM 292 RMI Coupler used with some systems, is a field repairable unit. The schematic is included in Figure 1-9 (page 1-18) and the component layout and parts list is provided on page 4-25. The gyro internal circuitry is shown schematicaly in Figure 3-5, and parts data is provided on pages 4-20 thru 4-23. The P-10A and P-11 Inverter schematics and parts lists are provided on pages 4-26 and 4-27, respectively.

3.6.2 Equipment Required

(1) Adequate power supplies to provide appropriate supply voltages for specific system under test.

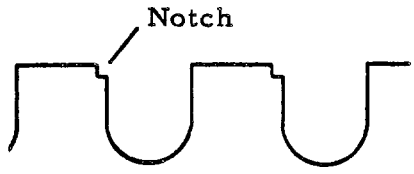
(2) Oscilloscope

(3) VTVM or VOM capable of reading ac and dc voltages from 0.01 volts to 50 volts.

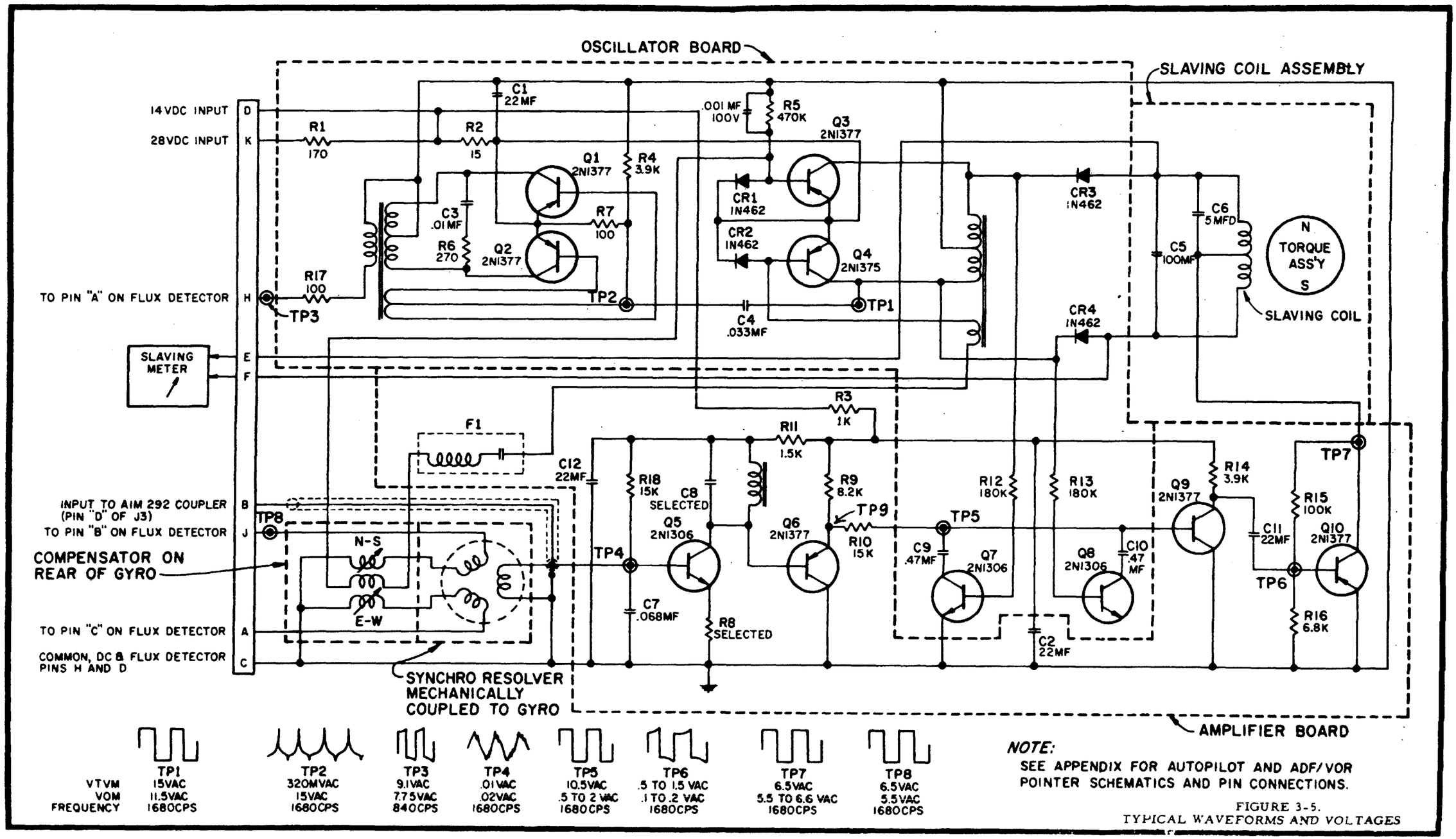
3.6.3 Trouble-Shooting Procedure

Using an oscilloscope and either a VTVM or VOM, check for appropriate readings and waveforms at the test points indicated on the schematic of Figure 3-5. The actual location of each test point is shown in Figure 3-6.

To match the amplifier frequency to the oscillator frequency, select capacitor C8 so that the frequency at TP 9 equals the frequency at TP 1 and produces the waveshape shown.



Select R8 to produce full scale slaving indication (5 vdc across pins E and F) when the heading card is offset 4 degrees in each direction from null.



	TP1	TP2	TP3	TP4	TP5	TP6	TP7	TP8
VTVM	15VAC	320MVAC	9.1VAC	.01VAC	10.5VAC	.5 TO 1.5 VAC	6.5VAC	6.5VAC
VOM	11.5VAC	15VAC	7.75VAC	.02VAC	.5 TO 2 VAC	.1 TO .2 VAC	5.5 TO 6.6 VAC	5.5VAC
FREQUENCY	1680CPS	1680CPS	840CPS	1680CPS	1680CPS	1680CPS	1680CPS	1680CPS

NOTE:
SEE APPENDIX FOR AUTOPILOT AND ADF/VOR POINTER SCHEMATICS AND PIN CONNECTIONS.

FIGURE 3-5.
TYPICAL WAVEFORMS AND VOLTAGES

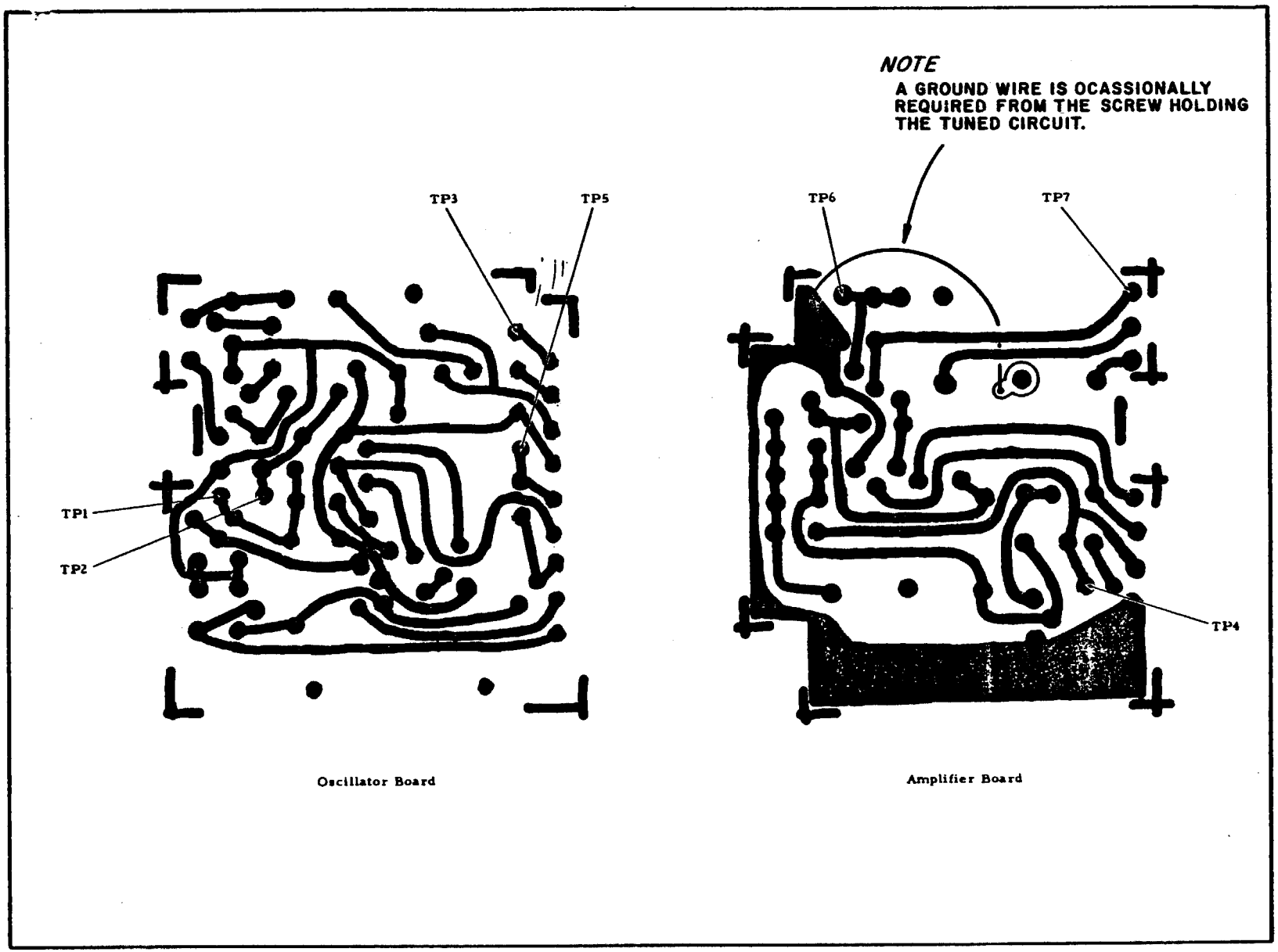


FIGURE 3-6. TEST POINT LOCATIONS

SECTION 4

PARTS LIST AND ILLUSTRATIONS

This section contains drawings of AIM 400 and AIM 800 system components showing the location of each replaceable part. Tables associated with the drawings identify each component or assembly and list the appropriate AIM part number by which replacement parts should be ordered.

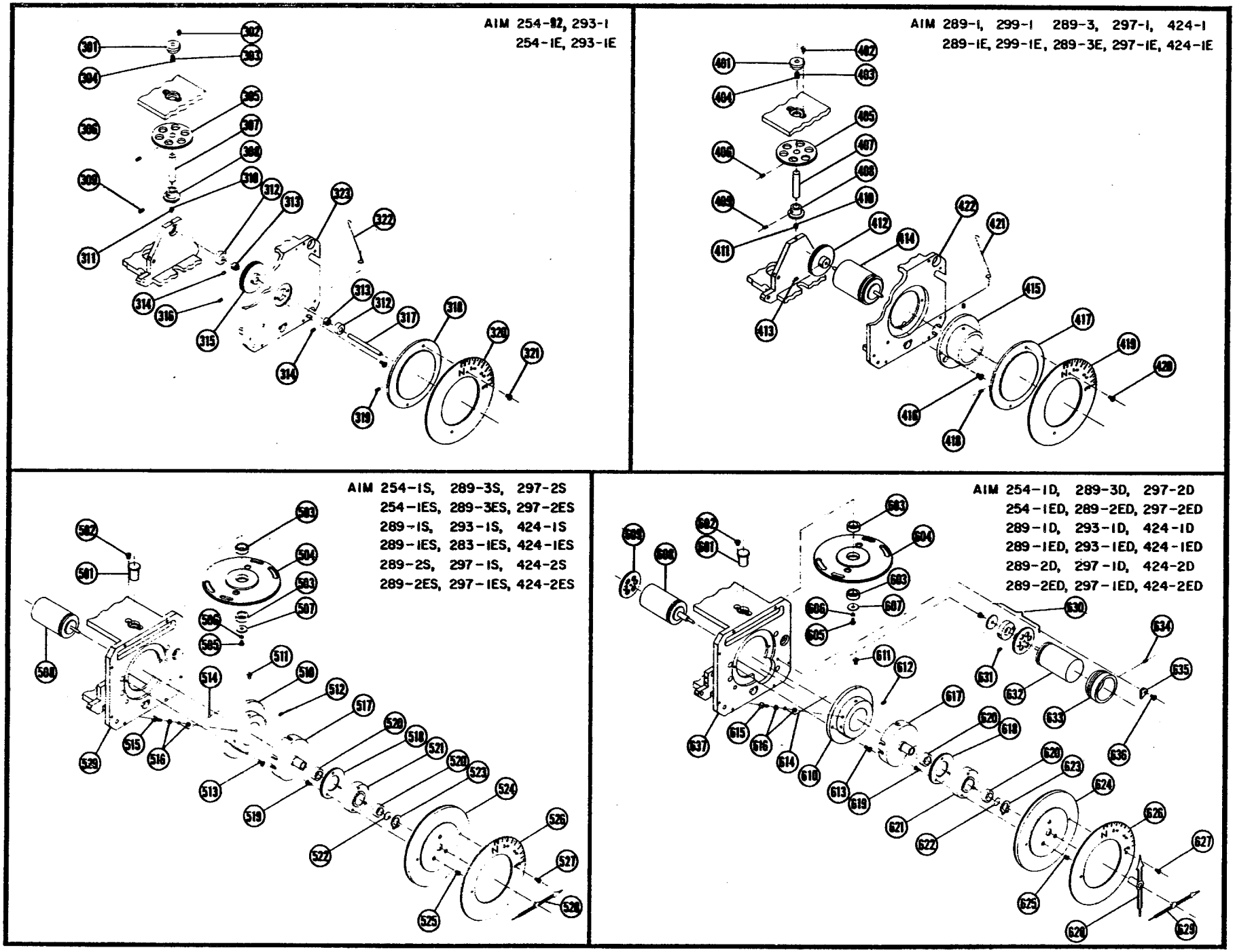
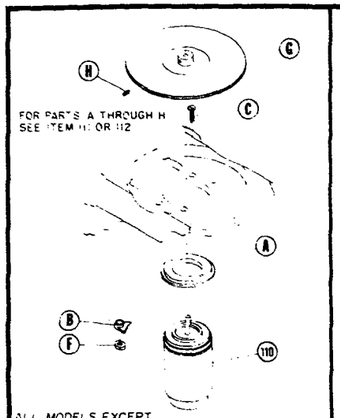
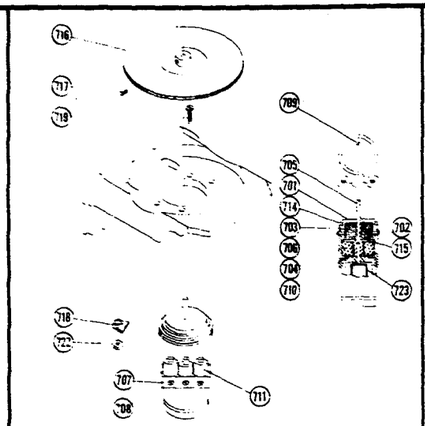


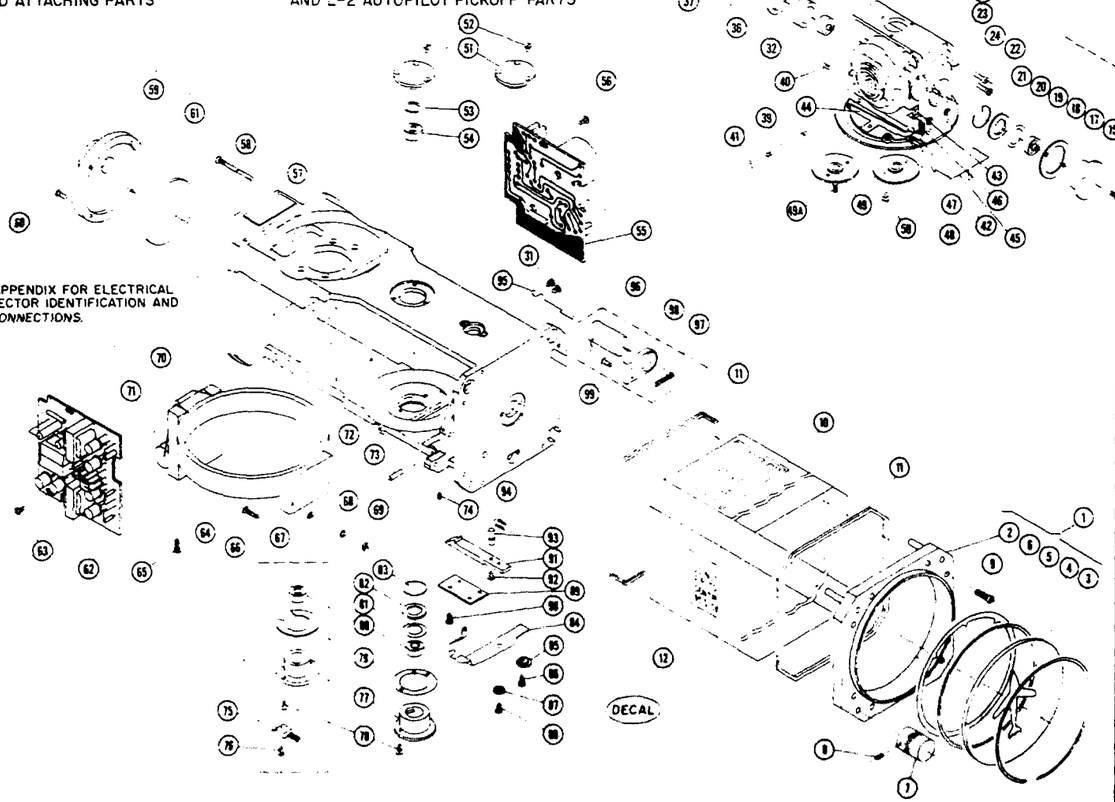
FIGURE 4-1A. DIAL AND POINTER DRIVE MECHANISMS



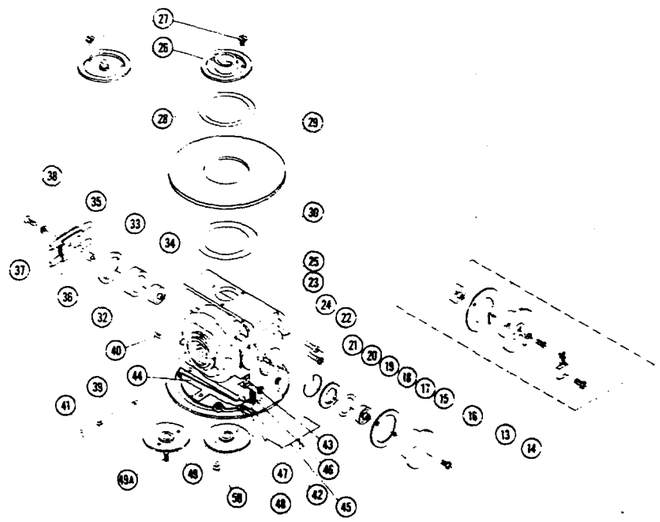


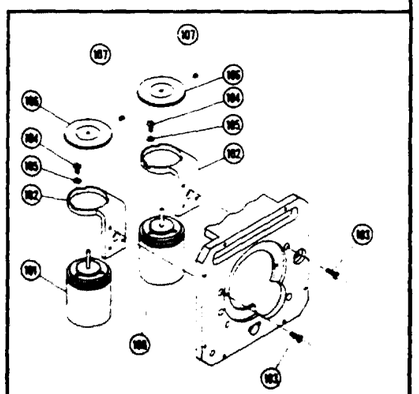
REAR MOUNTED SYNCHRO
AND ATTACHING PARTS

REAR MOUNTED SYNCHRO
AND L-2 AUTOPILOT PICKOFF PARTS

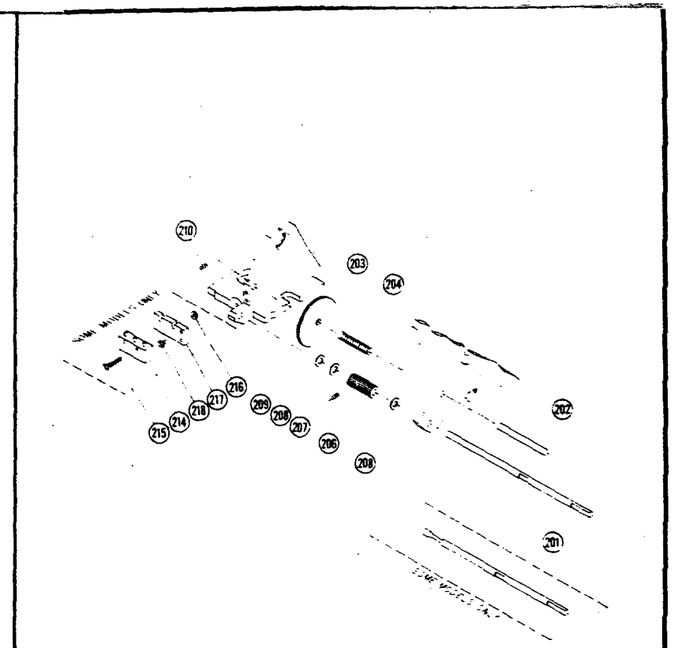


NOTE
SEE APPENDIX FOR ELECTRICAL CONNECTOR IDENTIFICATION AND *PIN CONNECTIONS.*

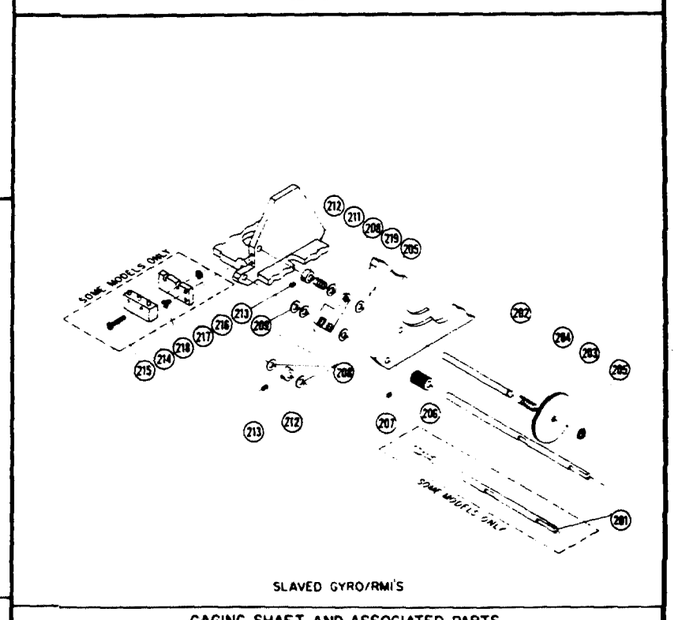




FRONT MOUNTED VERTICAL SYNCHRO(S)
AND ATTACHING PARTS



SLAVED GYRO'S



SLAVED GYRO/RMI'S

CAGING SHAFT AND ASSOCIATED PARTS

FIGURE 4-1B. VACUUM AND ELECTRIC INSTRUMENTS, EXPLODED VIEW

TABLE 4-1. VACUUM AND ELECTRIC INSTRUMENTS

NO.	DESCRIPTION	AIM PART NO.
1	Bezel Assembly, complete w/glass, indice ring, and retainer ring (Specify gyro model number and insignia.)	
	AIM 254-92, 254-1E, 293-1, 293-1E	653-0023-901
	AIM 289-1, 289-2, 289-3, 297-1, 299-1, 424-1 289-1E, 289-2E, 289-3E, 297-1E, 299-1E, 424-1E,	653-0022-902
	All RMI instruments	653-0022-904
2	Bezel, w/o glass, w/o indice ring, etc.	
	AIM 254-92, 254-1E, 293-1, 293-1E	653-0023-903
	AIM 289-1, 289-2, 289-3, 297-1, 299-1, 424-1 289-1E, 289-2E, 289-3E, 297-1E, 299-1E, 424-1E	653-0022-906
	All RMI instruments	653-0022-908
3	Ring, retainer	
	Slaved Gyros	611-0009-901
	Slaved Gyro/RMI's	611-0030-901
4	Glass, screened (Specify gyro model number and insignia.)	612-0009-000
5	Ring, indice cover (Not used on RMI instruments)	611-0032-901
6	Ring, indice (Specify gyro model number and insignia.)	
	Slaved Gyros	611-0033-000
	Slaved Gyro/RMI's	611-0016-901
7	Knob, caging (Use "PUSH" decal P/N 600-0004-001)	633-0005-901
8	Setscrew, 4-40 x 1/8, spline, st. st.	—
9	Screw, bezel mounting	
	AIM 254-92, 254-1E, 293-1, 293-1E: 3-48 x 3/8, fillister hd., st. st.	—
	All other instruments: 3-48 x 1-3/16, fillister hd., st. st.	—
10	Cover, dust	614-0008-901
11	Seal, gasket	610-0012-001
12	Decal, "CAUTION"	
	Vacuum instruments	600-0020-001
	Electric instruments	600-0025-001
13	Brush Block Assembly (Electric only)	815-0002-001
14	Screw 1-72 x 1/4, binder hd., st. st.	—
15	Housing, bearing	
	Vacuum instruments	635-0011-901
	Electric instruments	635-0045-901
16	Screw, 2-56 x 3/16, binder hd., st. st.	—
17	Shim (as required)	
	Vacuum instruments	607-0005-001
	Electric instruments (Modify as required)	607-0005-001
18	Bearing	637-0004-001
19	Washer, air seal (Vacuum only)	606-0006-901
20	Retainer, air seal (Vacuum only)	608-0002-001
21	Ring, retainer (Vacuum only)	611-0007-001
22	Screw, 3-56 x 1/2, binder hd., st. st.	—
23	Vane, erector	618-0005-001
24	Screw, 2-56 x 1/4, Bristol, spline	—
25	Gimbal, machined	
	Vacuum instruments	651-0007-901
	Electric instruments	651-0009-901
26	Pivot (Some models only) (Used with housing, item 51)	639-0052-901
	Housing (Some models only) (Used with pivot, item 51)	635-0033-001
27	Screw, 1-72 x 1/8, binder hd., st. st.	—
28	Washer, wavy	606-0003-001
29	Gear, spur	631-0011-001
30	Washer, friction	606-0001-001
31	Screw, 2-56 x 1/8, binder hd., st. st.	—
32	Housing, bearing	635-0022-003
33	Ring, lock	611-0014-002

TABLE 4-1. VACUUM AND ELECTRIC INSTRUMENTS (Cont'd)

NO.	DESCRIPTION	AIM PART NO.
34	Bearing	637-0004-001
35	Magnet	813-0005-901
36	Spacer	616-0003-001
37	Washer, flat #2	—
38	Screw, 2-56 x 3/8, binder hd., st. st.	—
39	Shaft	632-0020-001
40	Setscrew, 2-56, Bristol spline	—
41	Ring	611-0026-001
42	Slide, caging	621-0004-001
43	Plate, caging	628-0018-001
44	Lever, actuating	656-0009-901
45	Spring, tension (Obsolete. Replace with item 46.)	—
46	Spring, tension	657-0003-001
47	Terminal, lug	817-0002-001
48	Screw, 2-56 x 1/8, binder hd., st. st.	—
49	Pivot	
	Vacuum instruments	639-0002-901
	Electric instruments	639-0026-001
49A	Slip ring	826-0007-001
50	Screw, 2-56 x 1/4, binder hd., st. st.	—
51	Pivot (Some models only) (Use with housing, item 26)	639-0018-001
	Housing (Some models only) (Use with pivot, item 26)	635-0071-001
52	Screw, 2-56 x 1/8, flat hd., st. st.	—
53	Shim (as required)	607-0009-001
54	Bearing	637-0004-002
55	Circuit Board Assembly, amplifier (See Figure 4-5 for detailed components.)	800-0002-901
56	Screw, 2-56 x 3/16, binder hd., st. st.	—
57	Coil Assembly, compensator	812-0026-901
58	Screw, 2-56 x 15/16, binder hd., st. st.	—
59	Cover, filter (Vacuum only)	
	AIM 254-92, 254-1S, 289-1, 289-1S, 289-3, 297-1, 297-1S	614-0014-901
	AIM 254-1D, 289-1D, 289-2S, 289-2D, 289-3D, 297-1D, 297-2D	614-0019-902
	AIM 289-3S, 424-1, 424-1S	614-0019-901
	AIM 424-1D, 424-2S, 424-2D	614-0019-903
60	Screw, 3-56 x 1/2, binder hd., st. st.	—
61	Filter Assembly (Vacuum only)	615-0002-901
62	Circuit Board Assembly, oscillator (See Figure 4-6 for detailed components)	800-0005-901
63	Screw, 2-56 x 3/16, binder hd., st. st.	—
64	Coil Assembly, slaving	
	Slaved Gyros	812-0011-901
	Slaved Gyro/RMI's	812-0011-902
65	Screw, 4-40 x 1/2, binder hd., st. st.	—
66	Screw, 4-40 x 5/8, binder hd., st. st.	—
67	Washer, flat, No. 4, st. st.	—
68	Washer, split, No. 4, st. st.	—
69	Nut, hex, No. 4, st. st.	—
70	Capacitor (C6), 5 mfd, 15 v	802-0059-001
71	Capacitor (C5), 100 mfd.	802-0057-001
72	Lever Assembly, caging	656-0011-901
73	Shaft	632-0022-001
74	Setscrew, 2-56 x 3/32, Bristol, spline	—
75	Brush Block Assembly (Electric only)	815-0002-001
76	Screw, 1-72 x 1/4 binder hd. st. st.	—
76A	Rotor Housing Assembly, complete	
	Vacuum, Type R3H, brass (See Figure 4-2 for details.)	652-0016-901
	Vacuum, Type R3H, heavy metal (See Figure 4-2 for details.)	652-0016-902
	Vacuum, Type 34B (Replace with R3H, See Figure 4-3 for details.)	N/A
	Electric, (See Figure 4-4 for details.)	652-0052-901

TABLE 4-1. VACUUM AND ELECTRIC INSTRUMENTS (Cont'd)

NO.	DESCRIPTION	AIM PART NO.
77	Housing, bearing	
	Vacuum instruments	635-0018-901
	Electric instruments	635-0043-901
78	Screw, 2-56 x 3/16, flat hd., st. st.	—
79	Shim (as required)	
	Vacuum instruments	607-0005-001
	Electric instruments (Modify as required)	607-0005-001
80	Bearing	637-0004-002
81	Washer, air seal (Vacuum only)	606-0006-901
82	Retainer, air seal (Vacuum only)	608-0002-001
83	Ring, retainer (Vacuum only)	611-0007-001
84	Lever, caging	
	Slaved Gyros	656-0001-001
	Slaved Gyros/RMI's	656-0013-901
85	Eccentric, caging lever	659-0001-001
86	Screw, 4-40 x 3/8, flat hd., st. st.	—
87	Washer, shoulder	606-0020-001
88	Screw, 2-56 x 1/8, flat hd., st. st.	—
89	Plate, actuating bar	628-0022-001
90	Screw, 0-80 x 3/16, flat hd., st. st.	—
91	Slide, actuating	621-0001-001
92	Screw, 2-56 x 1/4, flat hd., st. st.	—
93	Post, return spring	664-0001-001
94	Spring, tension	657-0006-002
95	Spring, torsion	657-0004-001
96	Motor, flag (Electric Only)	
	AIM 289-2ES, 289-3ES, 297-2ES, 424-2ES 289-2ED, 289-3ED, 297-2ED, 424-2ED	811-0002-001
	All other electric instruments	811-0001-001
97	Indicator Assembly, flag (electric only)	648-0029-901
98	Clamp, motor (-2 instruments use P/N 625-0008-901)	625-0007-901
99	Screw, 2-56 x 1/4, binder hd., st. st.	—
100	Screw, 2-56 x 1/8, binder hd., st. st.	—
	FRONT MOUNTED VERTICAL SYNCHRO(s) AND ATTACHING PARTS	
101	Synchro	
	AIM 289-2, 289-2E: 1-power transmitter	810-0014-001
	AIM 289, 297, and 424 Series RMI instruments: slaving resolver	810-0011-001
102	Bracket, synchro	613-0024-901
103	Screw, 6-32 x 1/4, binder hd., st. st.	—
104	Screw, 2-64 x 1/8, binder hd., st. st.	—
105	Washer, flat #2	—
106	Gear Assembly	631-0029-901
107	Setscrew, 2-56 x 3/32, Bristol, spline	—
108	Synchro	
	AIM 289-2S, 289-2ES, 289-2D, 289-2ED: 1-power transmitter	810-0014-001
	AIM 289-3S, 289-3ES, 289-3D, 289-3ED: Autopilot transmitter	810-0033-001
	AIM 297-2S, 297-2ES, 297-2D, 297-2ED: Autopilot transmitter	810-0014-001
	AIM 424-2S, 424-2ES, 424-2D, 424-2ED: Autopilot transmitter	810-0013-001

TABLE 4-1. VACUUM AND ELECTRIC INSTRUMENTS (Cont'd)

NO.	DESCRIPTION	AIM PART NO.
	REAR-MOUNTED SYNCHRO AND ATTACHING PARTS	
110	Synchro	
	AIM 254-92, 254-1D, 254-1E, 254-1ED, 254-1S, 254-1ES, — Synchro resolver. Use parts group 111 below.	810-0011-001
	AIM 289-1, 289-1E, 289-1S, 289-1ES, 289-1D, 289-1ED, 289-2, 289-2E, 289-2S, 289-2ES, 289-2D, 289-2ED, 289-3S, 289-3ES, 289-3D, 289-3ED, 297-2S, 297-2ES, 297-2D, 297-2ED, 424-2S, 424-2ES, 424-2D, 424-2ED: Synchro, 4-power transmitter. Use parts group 112 below.	810-0017-001
	AIM 289-3, 289-3E: Synchro, autopilot transmitter. Use parts group 111 below.	810-0033-001
	AIM 297-1, 297-1E, 297-1S, 297-1ES, 297-1D, 297-1ED: Synchro, Autopilot transmitter. Use parts group 111 below.	810-0014-001
	AIM 424-1, 424-1E, 424-1S, 424-1ES, 424-1D, 424-1ED: Synchro, Autopilot transmitter. Use parts group 111 below.	810-0013-001
111	Parts Group (See Item 110 for applicable models.)	
	A. Adapter, synchro	641-0002-001
	B. Bracket, servo	613-0006-001
	C. Screw, 2-56 x 1/2, binder hd., st. st.	—
	D. Not used	—
	E. Not used	—
	F. Nut, hex, 2-56	—
	G. Gear Assembly	631-0018-901
	H. Setscrew, 2-56 x 3/32, Bristol, spline	—
112	Parts Group (See item 110 for applicable models.)	
	A. Adapter, synchro	641-0003-001
	B. Bracket, servo	613-0006-003
	C. Screw, 2-56 x 1/2, binder hd., st. st.	—
	D. Not used	—
	E. Not used	—
	F. Nut, hex, 2-56	—
	G. Gear Assembly	631-0018-902
	H. Setscrew, 2-56 x 3/32, Bristol, spline	—
	CAGING SHAFT AND ASSOCIATED PARTS	
201	Shaft, caging	
	AIM 254-92, AIM 254-1E	632-0005-001
	AIM 293-1, 293-1E	632-0038-001
	AIM 289-1, 289-1E, 289-2, 289-2E, 289-3, 289-3E,	632-0014-001
	AIM 297-1, 297-1E, 424-1, 424-1E	632-0038-002
	AIM 289 Series RMI instruments	632-0014-002
	AIM 293, 297, 299, and 424 Series RMI instruments	632-0038-003
202	Shaft, gear	
	Slaved gyros	632-0009-001
	Slaved gyros/RMI's	632-0061-001
203	Gear, spur	631-0014-001
204	Spring, compression	
	Slaved gyros	657-0005-001
	Slaved gyro/RMI's	657-0027-001
205	Ring, retainer (RMI instruments only)	611-0034-001
206	Gear, pinion	631-0015-001
207	Setscrew, 2-56, Bristol, spline, st. st.	—
208	Washer, nylon	606-0007-001
209	Washer, metal	606-0004-001

TABLE 4-1. VACUUM AND ELECTRIC INSTRUMENTS (Cont'd)

NO.	DESCRIPTION	AIM PART NO.
	CAGING SHAFT AND ASSOCIATED PARTS (Cont'd)	
210	Setscrew, 4-40 x 3/8, Bristol, spline	—
211	Spring, compression (RMI instruments only)	657-0027-002
212	Collar	617-0001-001
213	Setscrew, 2-56 x 3/32, Bristol, spline	—
214	Microswitch (Used on all AIM 293, 297, 299, and 424 Series instruments.)	816-0001-001
215	Screw, 2-56 x 3/8. binder hd., st. st.	—
216	Nut, hex 2-56	—
217	Bracket, Microswitch	613-0007-001
218	Screw, 2-56 x 1/4, binder hd. st. st.	—
219	Link, caging (RMI instruments only)	609-0002-001
	DIAL DRIVE MECHANISM	
	AIM 254-92, 254-1E, 293-1, 293-1E	
301	Eccentric	659-0003-001
302	Screw, 2-56 x 1/8, binder hd., st. st.	—
303	Housing, bearing	635-0028-002
304	Bearing	637-0005-002
305	Gear, spur	631-0003-001
306	Setscrew, 2-56 x 3/32, Bristol, spline	—
307	Shaft	632-0008-003
308	Gear, bevel	631-0001-903
309	Setscrew, 2-56 x 3/32, Bristol spline	—
310	Housing, bearing	635-0014-001
311	Bearing	637-0005-002
312	Bearing	637-0004-002
313	Collar	617-0001-001
314	Setscrew, 2-56 x 3/32, Bristol, spline	—
315	Gear	631-0045-902
316	Setscrew, 2-56 x 3-32, Bristol, spline	—
317	Shaft	632-0016-001
318	Hub, dial	634-0001-903
319	Setscrew, 2-56 x 3-32, Bristol, spline	—
320	Dial, finished	650-0014-903
321	Screw	603-0003-001
322	Wire, damping (Form as required)	—
323	Case Assembly, machined	
	AIM 254-92	649-0055-901
	AIM 254-1E	649-0062-902
	AIM 293-1	649-0088-901
	AIM 293-1E	649-0062-901
	DIAL DRIVE MECHANISM	
	289-1, 289-2 289-3 297-1, 424-1 299-1 289-1E, 289-2E, 289-3E, 297-1E, 424-1E 299-1E	
401	Eccentric	659-0003-001
402	Screw, 2-56 x 1/8, binder hd., st. st.	—
403	Housing, bearing	635-0028-002
404	Bearing	637-0005-002
405	Gear, spur	631-0003-001
406	Setscrew, 2-56 x 3-32, Bristol, spline	—
407	Shaft	632-0008-003
408	Gear, bevel	631-0001-903
409	Setscrew, 2-56 x 3-32, Bristol, spline	—
410	Housing, bearing	635-0014-001
411	Bearing	637-0005-002

TABLE 4-1. VACUUM AND ELECTRIC INSTRUMENTS (Cont'd)

NO.	DESCRIPTION	AIM PART NO.
	DIAL DRIVE MECHANISM (Cont'd)	
412	Gear	631-0045-901
413	Setscrew, 2-56 x 3/32, Bristol, spline	—
414	Synchro, resolver	810-0015-001
415	Ring, flanged	611-0005-001
416	Screw, 4-40 x 1/4, binder hd., st. st.	—
417	Hub, dial	634-0001-902
418	Setscrew, 2-56 x 3-32, Bristol, spline	—
419	Dial, finished	650-0014-903
420	Screw	603-0003-001
421	Wire, damping (Form as required)	—
422	Case Assembly, machined	
	AIM 289-1	649-0054-901
	AIM 289-1E	649-0057-901
	AIM 299-1	649-0054-901
	AIM 299-1E	649-0057-902
	AIM 289-3	649-0054-901
	AIM 289-3E	649-0057-901
	AIM 297-1	649-0054-901
	AIM 297-1E	649-0057-902
	AIM 424-1	649-0053-901
	AIM 424-1E	649-0057-901
	DIAL AND POINTER DRIVE MECHANISM	
	254-1S 289-1S 289-2S 289-3S 293-1S 297-1S 297-2S 424-1S 424-2S 254-1ES 289-1ES 289-2ES 289-3ES 293-1ES 297-1ES 297-2ES 424-1ES 424-2ES	
501	Shaft, bearing	632-0053-001
502	Screw, 2-56 x 1/8, binder hds. st. st.	—
503	Bearing	637-0010-001
504	Gear Assembly	631-0044-901
505	Screw, 2-56 x 3/16, binder hd., st. st.	—
506	Washer, split #2	—
507	Washer, retainer	606-0017-001
508	Synchro, receiver	810-0012-001
509	Not used	—
510	Adapter, synchro	641-0009-001
511	Screw, 4-40 x 3/16, binder hd., st. st.	—
512	Setscrew, 2-56 x 3/32, Bristol, spline	—
513	Screw, 4-40 x 1/4, binder hd., st. st.	—
514	Wire, damping (Form as required)	—
515	Screw, 4-40 x 1/8, binder hd., st. st.	—
516	Washer, flat, #4	—
517	Adapter, bearing	641-0008-001
518	Gear, spur	631-0047-901
519	Screw, 1-72 x 1/8, flat hd., st. st.	—
520	Bearing	637-0010-001
521	Hub, dial	634-0011-001
522	Spacer, bearing	616-0020-001
523	Ring, retainer	611-0035-001
524	Gear, spur	631-0037-901
525	Screw, 1-72 x 1/4, flat hd., st. st.	—
526	Dial, finished	650-0012-901
527	Screw	603-0003-001

TABLE 4-1. VACUUM AND ELECTRIC INSTRUMENTS (Cont'd)

NO.	DESCRIPTION	AIM PART NO.
	DIAL AND POINTER DRIVE MECHANISM (Cont'd)	
528	Indicator Assembly, pointer	648-0012-901
529	Case Assembly, machined	
	AIM 254-1S, 293-1S	649-0075-901
	AIM 254-1ES	649-0076-901
	AIM 289-1S	649-0075-901
	AIM 289-1ES, 293-1ES	649-0076-902
	AIM 289-2S	649-0045-903
	AIM 289-2ES	649-0076-903
	AIM 289-3S	649-0052-901
	AIM 289-3ES	649-0076-903
	AIM 297-1S	649-0075-901
	AIM 297-1ES	649-0076-902
	AIM 297-2S	649-0045-903
	AIM 297-2ES	649-0076-903
	AIM 424-1S	649-0052-901
	AIM 424-1ES	649-0076-902
	AIM 424-2S	649-0045-903
	AIM 424-2ES	649-0076-904
	DIAL AND POINTER DRIVE MECHANISM 254-1D 289-1D 289-2D 289-3D 293-1D 297-1D 297-2D 424-1D 424-2D 254-1ED 289-1ED 289-2ED 289-3ED 293-1ED 297-1ED 297-2ED 424-1ED 424-2ED	
601	Shaft, bearing	632-0053-001
602	Screw, 2-56 x 1/8, binder hd., st. st.	—
603	Bearing	637-0010-001
604	Gear Assembly	631-0044-902
605	Screw, 2-56 x 3/16, binder hd., st. st.	—
606	Washer, split, #2	—
607	Washer, retainer	606-0017-001
608	Synchro, receiver	810-0023-001
609	Gear,	631-0041-901
610	Adapter, synchro (Furnished with item 637)	—
611	Screw, 4-40 x 3/16, binder hd., st. st.	—
612	Setscrew, 2-56 x 3/32, Bristol, spline	—
613	Screw, 4-40 x 1/4, binder hd., st. st.	—
614	Wire, damping (Form as required)	—
615	Screw, 4-40 x 1/8, binder hd., st. st.	—
616	Washer, flat, #4	—
617	Adapter, bearing (Furnished with item 637)	—
618	Gear, spur	631-0047-901
619	Screw, 1-72 x 1/8, flat hd., st. st.	—
620	Bearing	637-0010-001
621	Hub, dial	634-0011-001
622	Spacer, bearing	616-0020-001
623	Ring, retainer	611-0035-001
624	Gear, spur	631-0037-901
625	Screw, 1-72 x 1/4, flat hd., st. st.	—
626	Dial, finished	650-0012-901
627	Screw	603-0003-001
628	Indicator Assembly, pointer	648-0013-901
629	Indicator Assembly, pointer	648-0014-901
630	Gear and Damping Assembly	631-0026-901
631	Setscrew, 2-56 x 3/32, Bristol	—

TABLE 4-1. VACUUM AND ELECTRIC INSTRUMENTS (Cont'd)

NO.	DESCRIPTION	AIM PART NO.
	DIAL AND POINTER DRIVE MECHANISM (Cont'd)	
632	Synchro, receiver	810-0016-001
633	Adapter, synchro	641-0010-001
634	Setscrew, 2-56 x 3/32, Bristol, spline	—
635	Clamp, synchro mount	625-0020-001
636	Screw, 2-56 x 1/4, binder hd., st. st.	—
637	Case Assembly, machined	
	AIM 254-1D	649-0045-901
	AIM 254-1ED	649-0036-901
	AIM 289-1D	649-0045-902
	AIM 289-1ED	649-0036-903
	AIM 289-2D	649-0045-902
	AIM 289-2ED	649-0036-904
	AIM 289-3D	649-0045-902
	AIM 289-3ED	649-0036-904
	AIM 293-1D	649-0045-902
	AIM 293-1ED	649-0036-902
	AIM 297-1D	649-0045-902
	AIM 297-1ED	649-0036-902
	AIM 297-2D	649-0045-902
	AIM 297-2ED	649-0036-904
	AIM 424-1D	649-0045-903
	AIM 424-1ED	649-0036-903
	AIM 424-2D	649-0045-903
	AIM 424-2ED	649-0036-903
	REAR MOUNTED SYNCHRO AND L-2 AUTOPILOT PICKOFF PARTS	
	AIM 293 Series and 299 Series Instruments.	
701	Housing, upper	293-8
702	Housing, lower	1113
703	Assembly, clutch	293-9
704	Assembly, solenoid	293-26
705	Assembly, shaft	293-16
706	Screw, 2-56 x 1/8 binder hd., st. st.	—
707	Setscrew, 2-56 x 1/16, Bristol, spline	—
708	Screw, 2-56 x 3/8, binder hd., st. st.	—
709	Screw, clutch centering	293-22
710	Screw, 2-64 x 1/8, flat hd., st. st.	—
711	Assembly, yaw pickoff	293-29
712	Not Used	—
713	Not Used	—
714	Ring, eccentric	293-19-02
714A	Not Used	—
715	Disk, clutch	293-25-2
716	Gear Assembly(Use Hub, P/N 634-0002-004)	631-0011-001
717	Setscrew, 2-56 x 3-32, Bristol, spline	—
718	Bracket, servo	625-0020-001
719	Screw, 2-56 x 1/2, binder hd., st. st.	—
720	Not Used	—
721	Not Used	—
722	Nut, hex, 2-56	—
723	Synchro, resolver	810-0011-001

TABLE 4-2. TYPE R3H VACUUM ROTOR (Figure 4-2)

NO.	DESCRIPTION	AIM PART NO.
	Note This parts list and the drawing of Figure 4-2 cover several versions of the basic R3H rotor. Where parts are identified by two callout numbers in the illustration, check the part description closely to insure the interchangeability of replacement parts.	
1	Pivot	639-0003-902
2	Screw, 1-72 x 1/8, flat hd., st. st.	—
3	Nut, preload, knurled	605-0012-001
4	Nut, preload, Esna, hex (used only with Item 18)	605-0015-001
5	Rotor Housing (with cast orifice)	652-0005-901
6	Rotor Housing (without cast orifice)	652-0006-901
7	Screw, balance	603-0009-002
8	Nut, rotor support	605-0011-001
9	Bumper, 1/8 x 1/4 I. D. vinyl tubing	—
10	Screw, 3-48 x 3/8, fillister hd., st. st.	—
11	Screw, 1-72 x 3/16, binder hd., st. st. (used only with Item 18)	—
12	Screw, 1-72 x 3/16, flat hd., st. st. (used only with Item 17)	—
13	Retainer, bearing	608-0011-001
14	Plate, bearing (used only with Item 18)	628-0070-001
15	Plate, bearing, with counter-sunk holes for flat-head screws (used only with Item 17)	628-0082-001
16	Spacer, bearing	616-0019-001
17	Rotor, brass, counterbored 3/32 inch to accommodate Items 3, 13 and 15	636-0006-001
	Rotor, heavy metal, counterbored 3/32 inch to accommodate Items 3, 13, and 15	—
	Note If defective, replace with Items 4, 18, and 23 as a set.	
18	Rotor, brass counterbored approx. 5/32 inch to accommodate Items 4, 13 and 14	636-0009-001
	Rotor, heavy metal, counterbored approx. 5/32 inch to accommodate Items 4, 13 and 14	636-0010-901
19	Bearing	637-0011-004
20	Pivot, air (without orifice insert)	639-0005-901
21	Pivot, air (with orifice insert)	639-0009-901
22	Screw, 2-56 x 1/8, binder hd., st. st.	—
23	Shaft, rotor	632-0064-004
24	Weight, lead, as required for balancing	—
25	Screw, 2-56, length as required, binder hd., st. st.	—

NOTES

1. For complete rotor housing assembly, consisting of all parts shown below, order P/N 652-0016-901 (brass rotor) or P/N 652-0016-902 (heavy metal rotor). Assembly will be correctly preloaded and will require only minor balancing when installed.
2. For preloaded rotor assembly consisting of items 4, 11, 13, 14, 16, 19 and 23, order P/N 636-0018-901 (brass rotor) or P/N 636-0018-902 (heavy metal rotor).

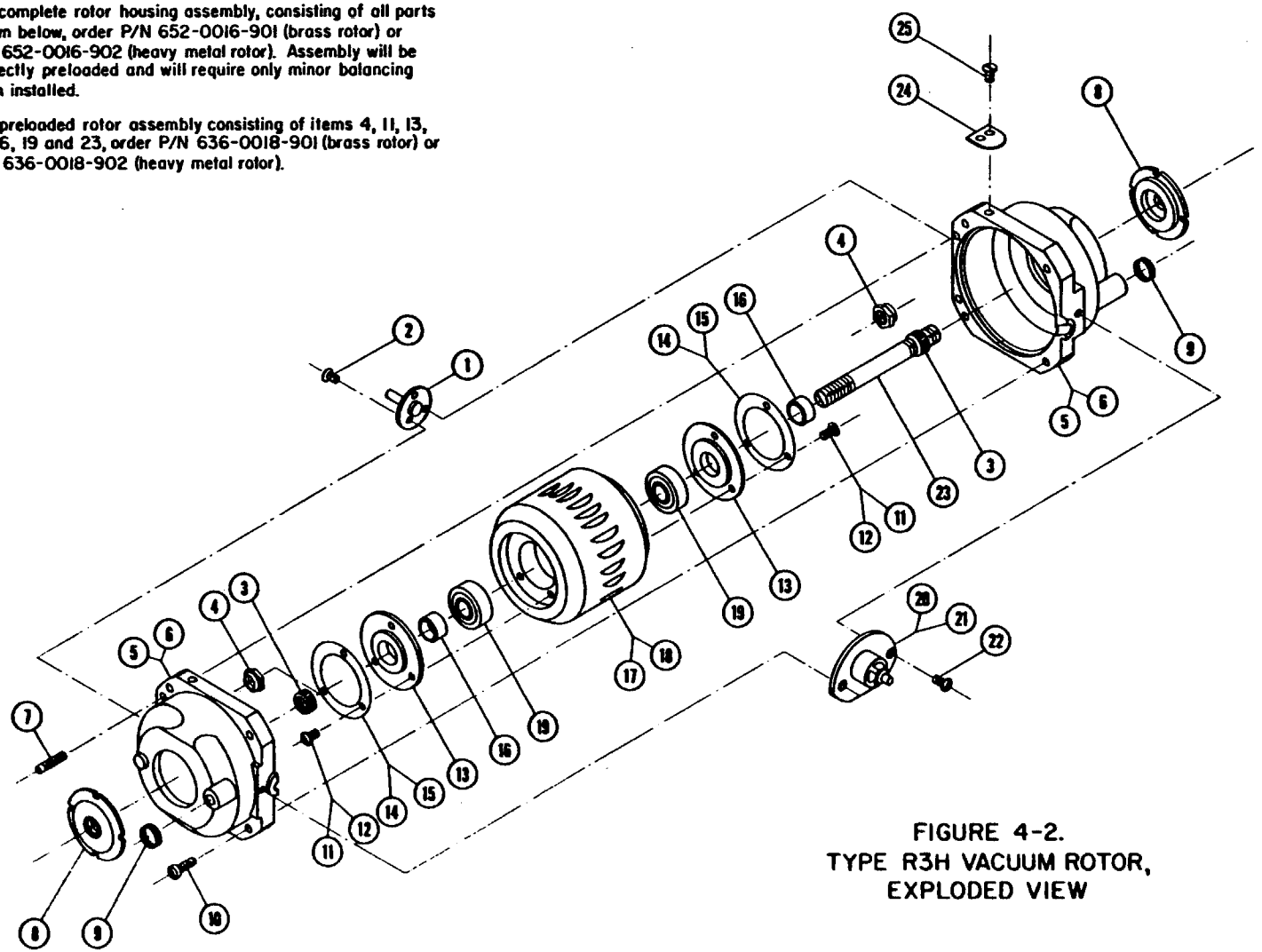


FIGURE 4-2.
TYPE R3H VACUUM ROTOR,
EXPLODED VIEW

TABLE 4-3. TYPE 34B VACUUM ROTOR (Figure 4-3)

NO.	DESCRIPTION	AIM PART NO.
1	Nut, lock, 3-56	—
2	Nut, shoulder	605-0004-001
3	Housing, bearing, threaded	635-0027-001
4	Bearing	637-0006-001
5	Housing, rotor	652-0004-901
6	Rotor, brass	636-0011-901
	Rotor, heavy metal (Replace with complete R3H Rotor Assembly, Figure 4-2)	—
7	Shaft	632-0032-001
8	Ring, lock	611-0006-001
9	Screw, balance	603-0009-002
10	Screw, 3-48 x 3/8, fillister hd., st. st.	—
11	Screw, 1-72 x 1/8, flat hd., st. st.	—
12	Screw, 2-56 x 1/8, binder hd., st. st.	—
13	Pivot, air	639-0005-901
14	Pivot	639-0003-901

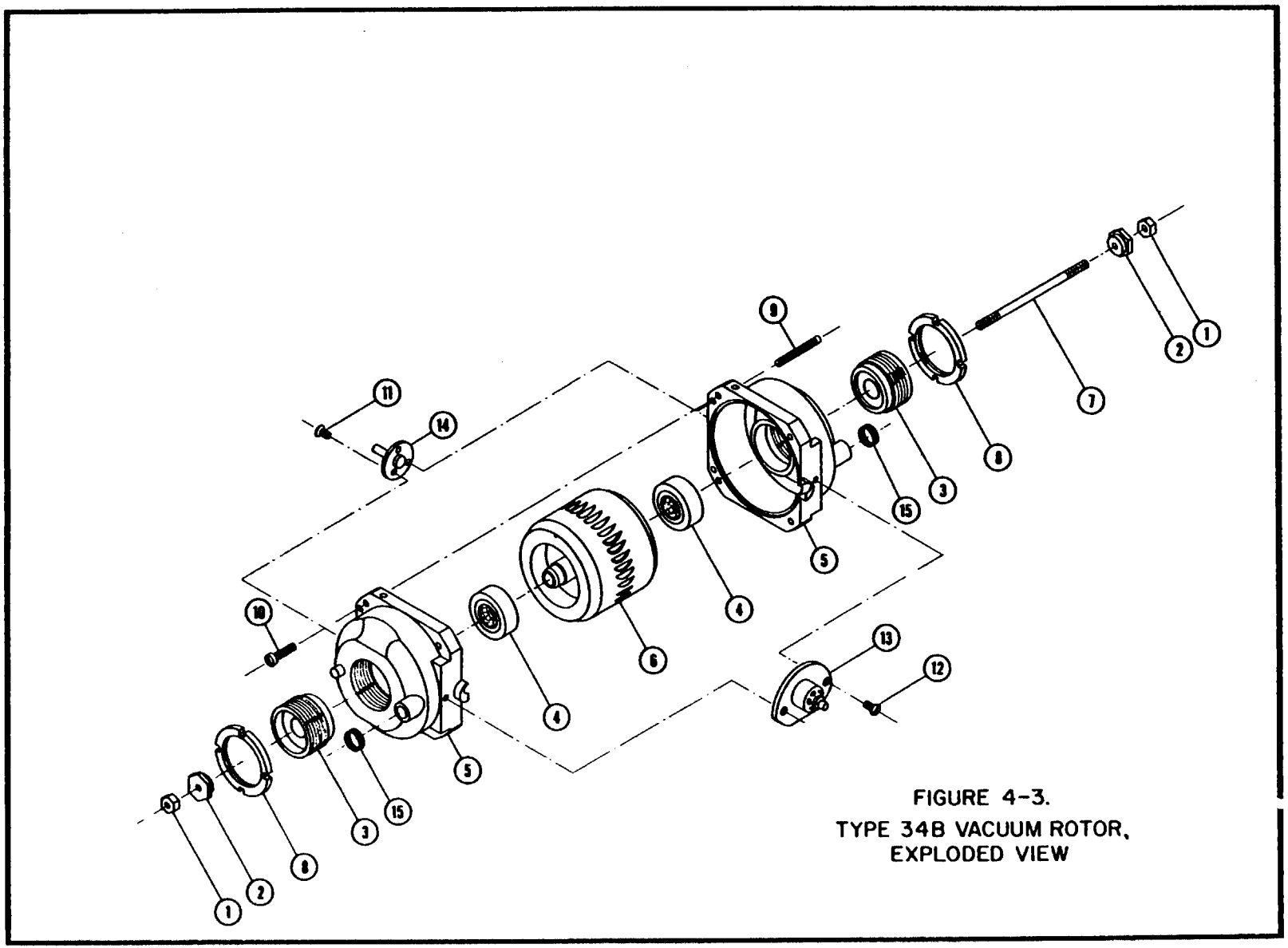


FIGURE 4-3.
TYPE 34B VACUUM ROTOR,
EXPLODED VIEW

TABLE 4-4. ELECTRIC ROTOR (Figure 4-4)

NO.	DESCRIPTION	AIM PART NO.
1	Nut, preload	605-0015-001
2	Impeller, large	638-0001-001
3	Impeller, small	638-0001-002
4	Retainer, bearing	608-0010-001
5	Bearing	637-0011-002
6	Stator Assembly	827-0003-901
7	Pivot	639-0003-901
8	Screw, balance	603-0009-002
9	Nut, support	605-0010-001
10	Housing, rotor	652-0026-901
11	Housing, bearing	635-0053-001
12	Spacer, bearing	616-0018-001
13	Slip Ring	826-0007-001
14	Pivot, slip ring	639-0025-001
15	Ring Assembly	611-0020-901
16	Screw, 1-72 x 1/4, fillister hd., st. st.	—
17	Screw, 3-48 x 3/8, fillister hd., st. st.	—
18	Screw, 1-72 x 1/8, flat hd., st. st.	—
19	Screw, 2-56 x 1/8, binder hd., st. st.	—

NOTES

1. For complete rotor housing assembly order P/N 652-0052-901. Assembly will be correctly preloaded and will require only minor balancing when installed.
2. For preloaded rotor assembly, less rotor housing and attaching parts, order P/N 636-0016-901.

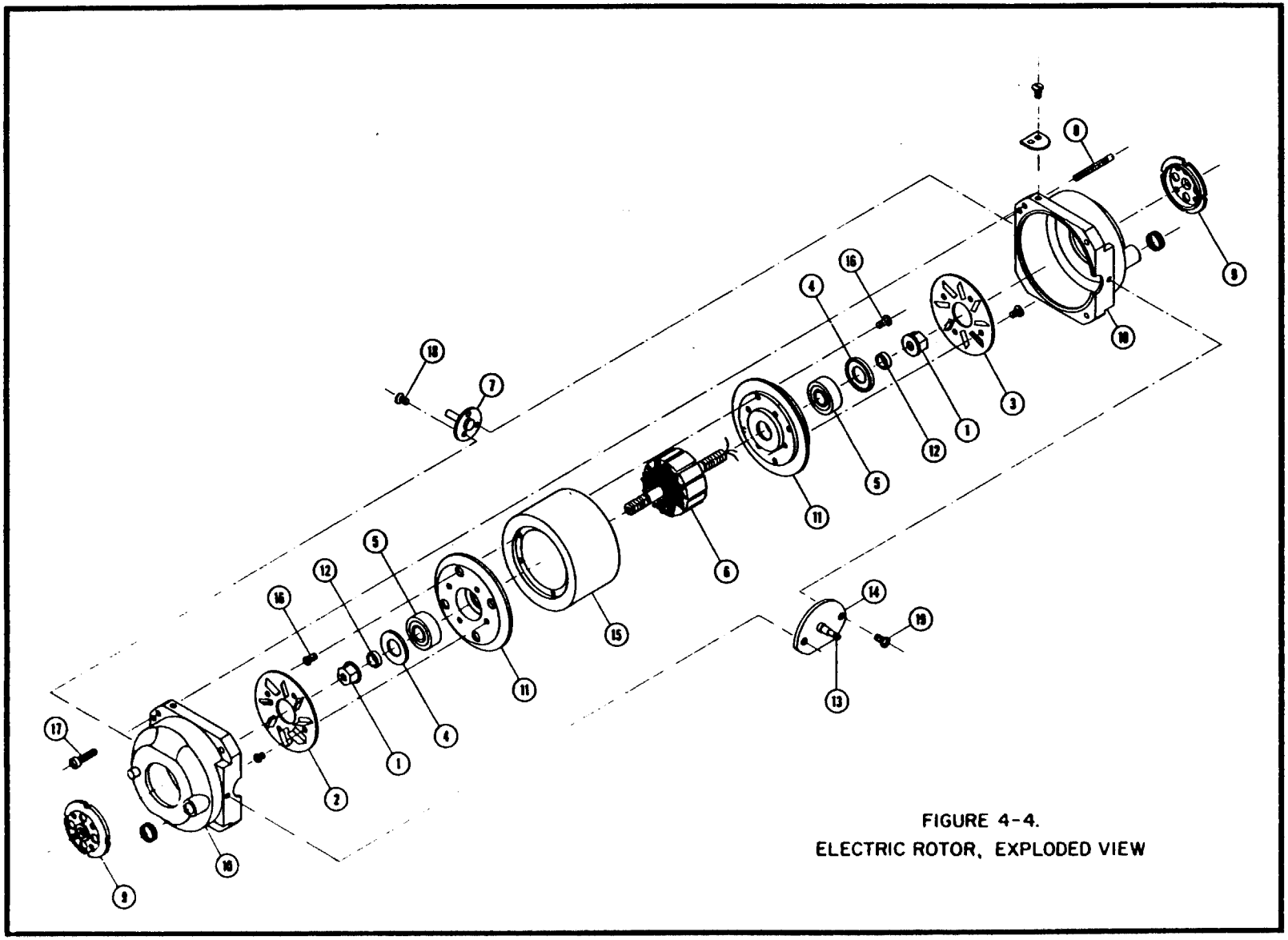


FIGURE 4-4.
ELECTRIC ROTOR, EXPLODED VIEW

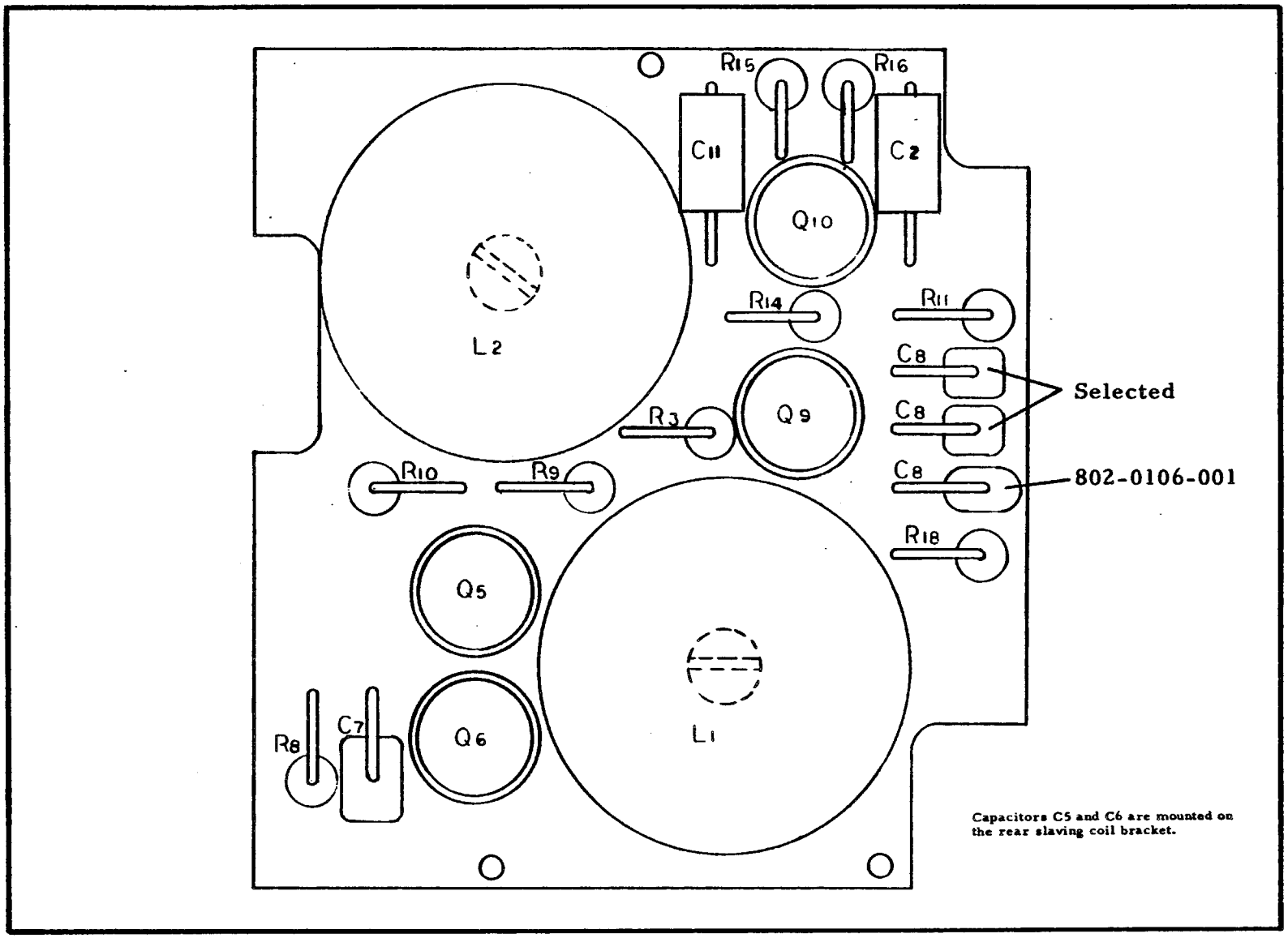


FIGURE 4-5. AMPLIFIER BOARD

TABLE 4-5. AMPLIFIER BOARD (Figure 4-5)

CALLOUT NO.	DESCRIPTION	AIM PART NO.
C2	Capacitor, 22 mfd, 15 v, TAS 22-15, Mallory	802-0077-001
C5	Capacitor, 100 mfd	802-0057-001
C6	Capacitor, 5 mfd, 15 v	802-0059-001
C7	Capacitor, 0.068 mfd	802-0023-001
C8	Capacitor, Selected	—
C11	Capacitor, 22 mfd, 15 v, TAS 22-15 Mallory	802-0077-001
Q5	Transistor, 2N1306, T. I. or equivalent	806-0006-001
Q6	Transistor, 2N1377, T. I. or equivalent	806-0007-001
Q9	Transistor, 2N1377, T. I. or equivalent	806-0007-001
Q10	Transistor, 2N1377, T. I. or equivalent	806-0007-001
R3	Resistor, 1.0k, 10%, 1/2w	801-0032-001
R8	Resistor, Selected	—
R9	Resistor, 8.2k, 10%, 1/2w	801-0043-001
R10	Resistor, 15k, 10%, 1/2w	801-0090-001
R11	Resistor, 1.5k, 10%, 1/2w	801-0034-001
R14	Resistor, 3.9k, 10%, 1/2w	801-0039-001
R15	Resistor, 100k, 10%, 1/2w	801-0056-001
R16	Resistor, 6.8k, 10%, 1/2w	801-0042-001
R18	Resistor, 15k, 10%, 1/2w	801-0090-001
L1	Choke	803-0007-001
L2	Resonant Circuit	808-0001-001
	Amplifier Board Assembly (complete)	800-0002-901

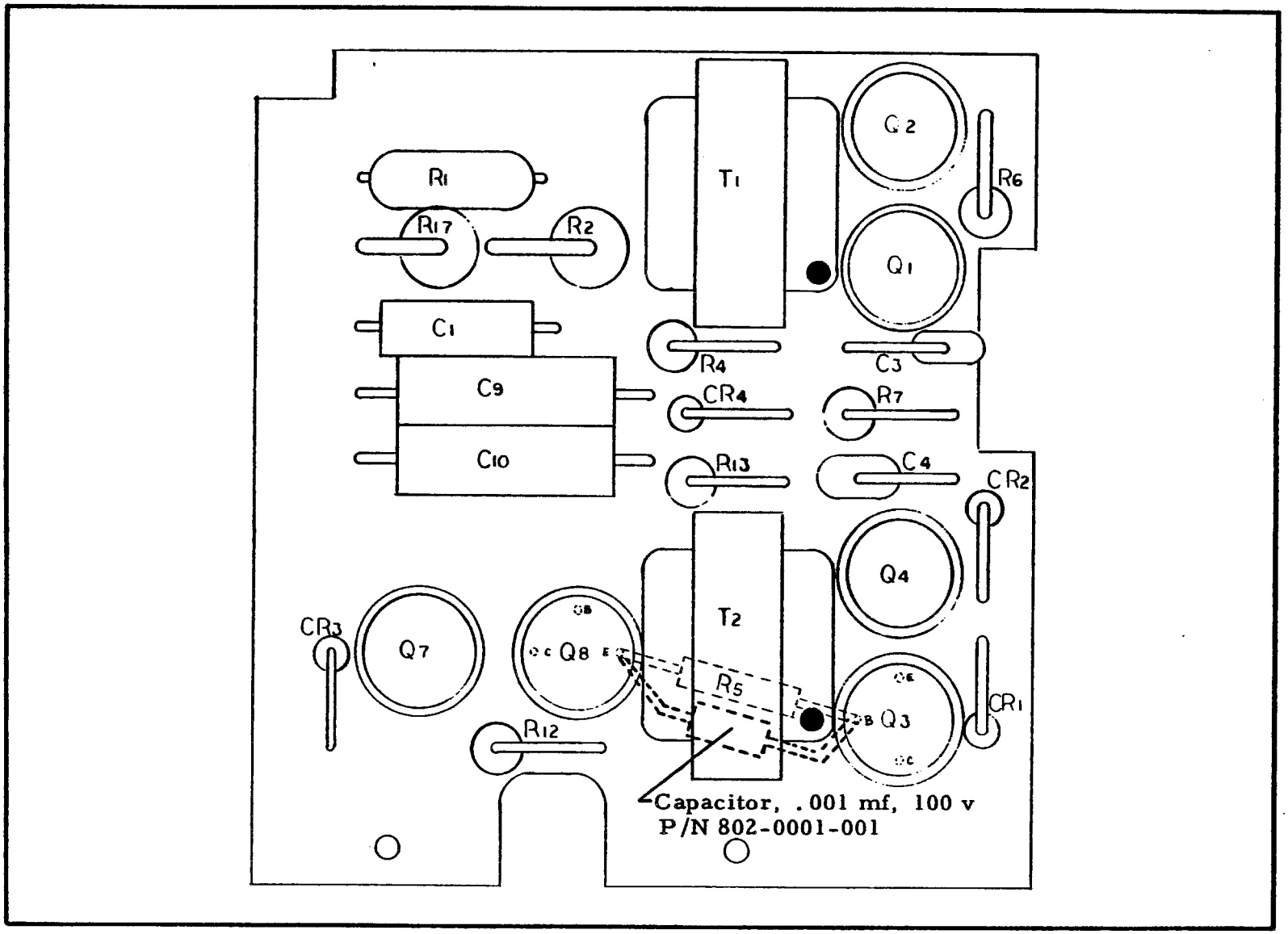


FIGURE 4-6. OSCILLATOR BOARD

TABLE 4-6. OSCILLATOR BOARD (Figure 4-6)

CALLOUT NO.	DESCRIPTION	AIM PART NO.
C1	Capacitor, 22 mfd, 15v, TAS 22-15, Mallory	802-0077-001
C3	Capacitor, 0.01 mfd,	802-0013-001
C4	Capacitor, 0.033 mfd,	802-0019-001
C9	Capacitor, 0.47 mfd,	802-0034-001
C10	Capacitor, 0.47 mfd,	802-0034-001
CR1	Diode, 1N462, Transitron, or equivalent	805-0002-001
CR2	Diode, 1N462, Transitron, or equivalent	805-0002-001
CR3	Diode, 1N462, Transitron, or equivalent	805-0002-001
CR4	Diode, 1N462, Transitron, or equivalent	805-0002-001
Q1	Transistor, 2N1377, T. I. or equivalent	806-0007-001
Q2	Transistor, 2N1377, T. I. or equivalent	806-0007-001
Q3	Transistor, 2N1377, T. I. or equivalent	806-0007-001
Q4	Transistor, 2N1377, T. I. or equivalent	806-0007-001
Q7	Transistor, 2N1306, T. I. or equivalent	806-0006-001
Q8	Transistor, 2N1306, T. I. or equivalent	806-0006-001
R1	Resistor, 170 ohm, 1%, 3W, RLS-2B, Dale	801-0102-001
R2	Resistor, 15 ohm, 10%, 1 W	801-0097-001
R4	Resistor, 3.9k, 10%, 1/2 W	801-0039-001
R5	Resistor, 470k, 10%, 1/2 W	801-0091-001
R6	Resistor, 270 ohm, 10%, 1/2 W	801-0025-001
R7	Resistor, 100 ohm, 10%, 1/2 W	801-0020-001
R12	Resistor, 180k, 10%, 1/2 W	801-0059-001
R13	Resistor, 180k, 10%, 1/2 W	801-0059-001
R17	Resistor, 100 ohm, 10%, 1 W	801-0132-001
T1	Transformer	804-0002-001
T2	Transformer	804-0001-001
	Oscillator Board Assembly (complete)	800-0005-901

TABLE 4-7. AIM 292 RMI COUPLER (Figure 4-7)

CALLOUT NO.	DESCRIPTION	AIM PART NO.
C1	Capacitor, 0.15 mfd, 100v	802-0027-001
C2	Capacitor, 0.15 mfd, 100 v	802-0027-001
C3	Capacitor, 0.15 mfd, 100 v	802-0027-001
C4	Capacitor, 30 mfd, 15 v PTTD-70 Aerovox	802-0121-001
C5	Capacitor, 30 mfd, 15 v PTTD-70, Aerovox	802-0121-001
C6	Capacitor, 30 mfd, 15 v PTTD-70, Aerovox	802-0121-001
C7	Capacitor, 20 mfd, 50 v PTTD-94 Aerovox	802-0070-001
C8	Capacitor, 20 mfd, 50 v PTTD-94, Aerovox	802-0070-001
C9	Capacitor, Selected	802-0023-001
CR1	Diode, 1N2069	805-0011-001
CR2	Diode, Zener, MZ 1000-27	805-0004-001
Q1	Transistor, 2N1377	806-0007-001
Q2	Transistor, 2N1377	806-0007-001
Q3	Transistor, 2N1306	806-0006-001
Q4	Transistor, 2N1306	806-0006-001
R1	Resistor, 5.6k, 5%, 1/2w	801-0088-001
R2	Resistor, 5.6k, 5%, 1/2w	801-0088-001
R3	Resistor, 5.6k, 5%, 1/2w	801-0088-001
R4	Resistor, 470k, 10%, 1/2w	801-0064-001
R5	Resistor, 12k, 5%, 1/2 w	801-0089-001
R6	Resistor, 15k, 5%, 1/2 w	801-0090-001
R7	Resistor, 15 k, 5%, 1/2w	801-0090-001
R8	Resistor, 5.6k, 5%, 1/2w	801-0088-001
R9	Resistor, 1.2k, 5%, 1/2w	801-0086-001
R10	Resistor, 470k, 5%, 1/2w	801-0091-001
R11	Resistor, 15 ohm, 10%, 1/2w	801-0010-001
R12	Resistor, 15 ohm, 10%, 1/2w	801-0010-001
R13	Resistor, 4.7k, 10%, 1/2w	801-0040-001
R14	Resistor, 1.5k, 10%, 1/2w	801-0034-001
R15	Resistor, 100k, 10%, 1/2w	801-0056-001
R16	Resistor, 1.2k, 5%, 1/2w	801-0086-001
R17	Resistor, 68 ohm, 5%, 1/2w	801-0085-001

TABLE 4-7. AIM 292 RMI COUPLER (Cont'd.)

CALLOUT NO.	DESCRIPTION	AIM PART NO.
T1	Transformer	804-0005-001
T2	Transformer	804-0006-001
T3	Transformer	804-0007-001
	Connector, 7 pin, 126-197, Amphenol	821-0011-001
	Mating Connector, 126-196, Amphenol	821-0042-001
	Connector, 9 pin, 126-219, Amphenol	821-0024-001
	Mating Connector, 126-222, Amphenol	821-0034-001
	Connector, 5 pin, 126-216, Amphenol	821-0007-001
	Mating Connector, 126-223, Amphenol	821-0008-001
1	Heat Sink	807-0002-001
2	Insulator, transistor	819-0001-001

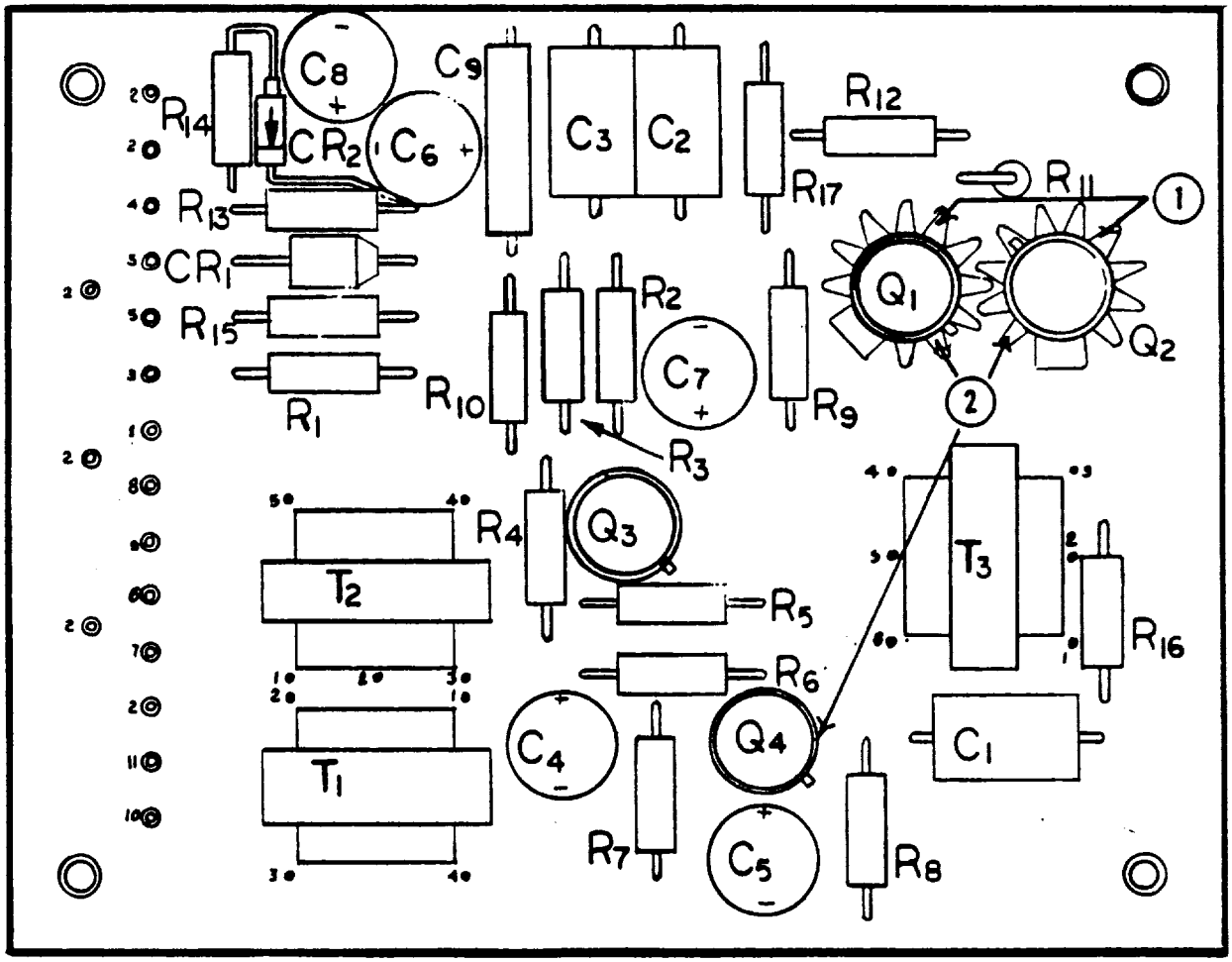


FIGURE 4-7. AIM 292 RMI COUPLER

P-10A

C1	Capacitor, 300 mf, 35 v	802-0058-001
C2	Capacitor, 0.22 mf, 400 v	802-0068-001
CR1	Diode, Zener, 36 v	805-0010-001
CR2	Diode, MR1121	805-0013-001
CR3	Diode, Zener, 68 v	805-0003-001
CR4	Diode, Zener, 68 v	805-0003-001
F1	Fuse, 3 Ampere	818-0001-003
L1	Choke	803-0001-001
Q1	Transistor, 2N1560	806-0009-001
Q2	Transistor, 2N1560	806-0009-001
Q3	Transistor, 2N1377	806-0007-001
Q4	Transistor, 2N1560	806-0009-001
R1	Resistor, 20 ohm, 3 w	801-0136-001
R2	Resistor, 3.9 k, 1/2 w	801-0039-001
T1	Transformer	804-0014-001

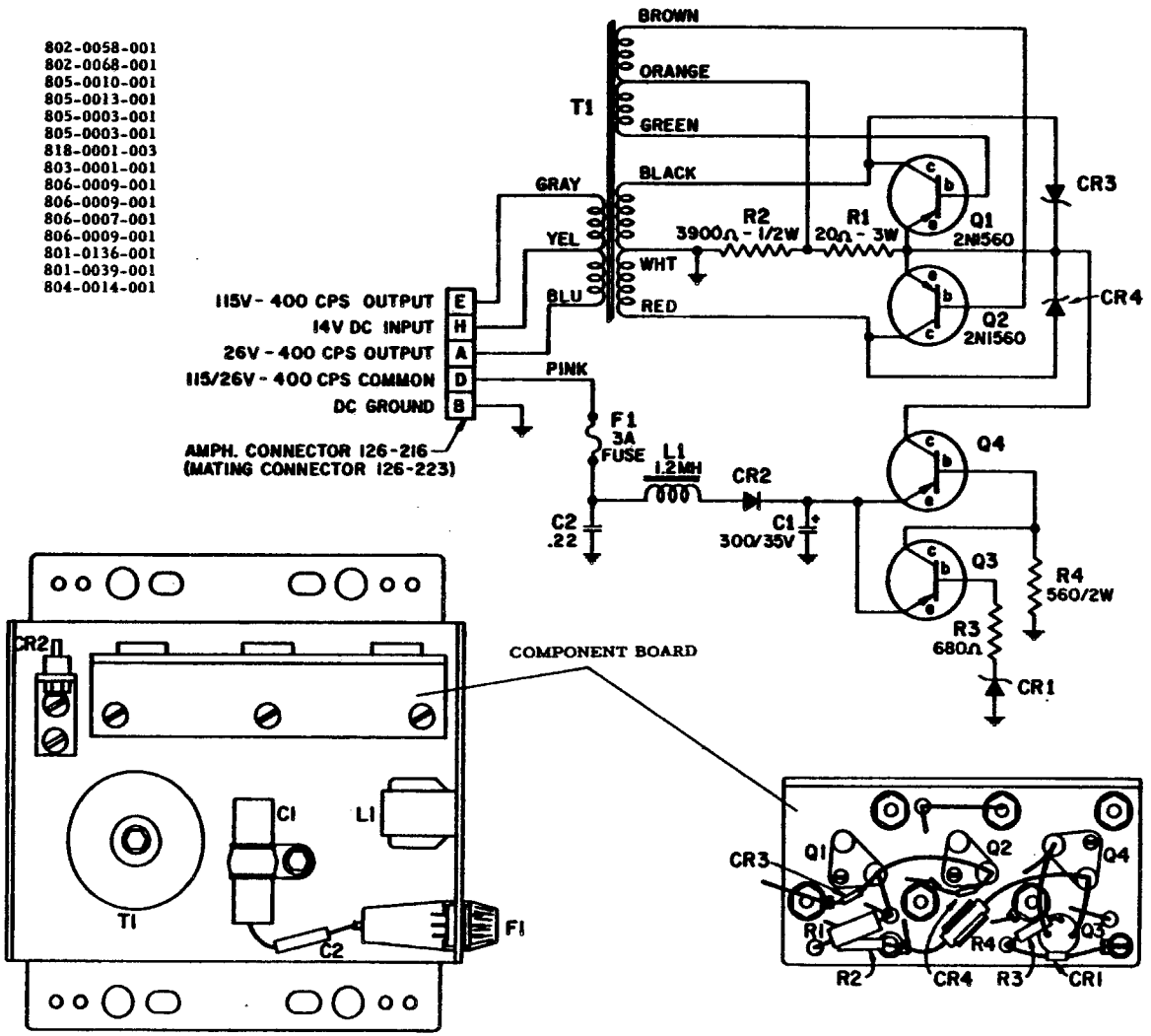
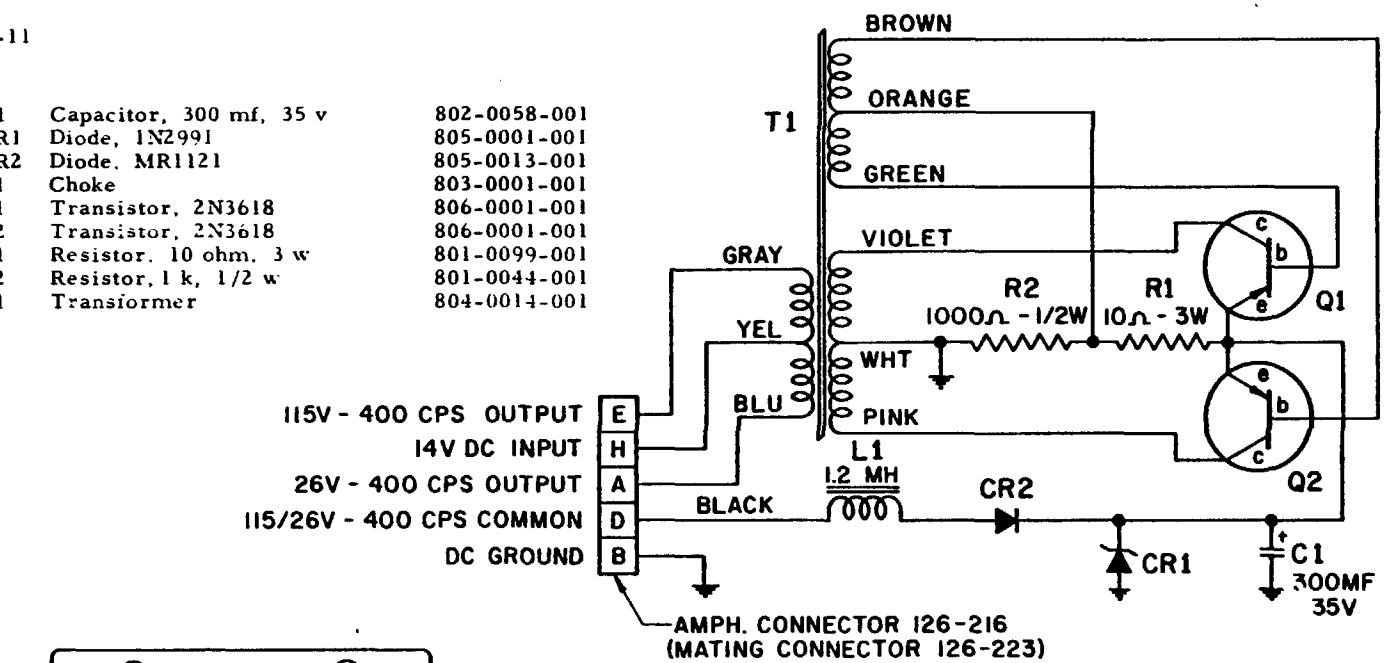


FIGURE 4-8. P-10A INVERTER, SCHEMATIC AND PARTS DATA

P-11

C1	Capacitor, 300 mf, 35 v	802-0058-001
CR1	Diode, 1N2991	805-0001-001
CR2	Diode, MR1121	805-0013-001
L1	Choke	803-0001-001
Q1	Transistor, 2N3618	806-0001-001
Q2	Transistor, 2N3618	806-0001-001
R1	Resistor, 10 ohm, 3 w	801-0099-001
R2	Resistor, 1 k, 1/2 w	801-0044-001
T1	Transformer	804-0014-001



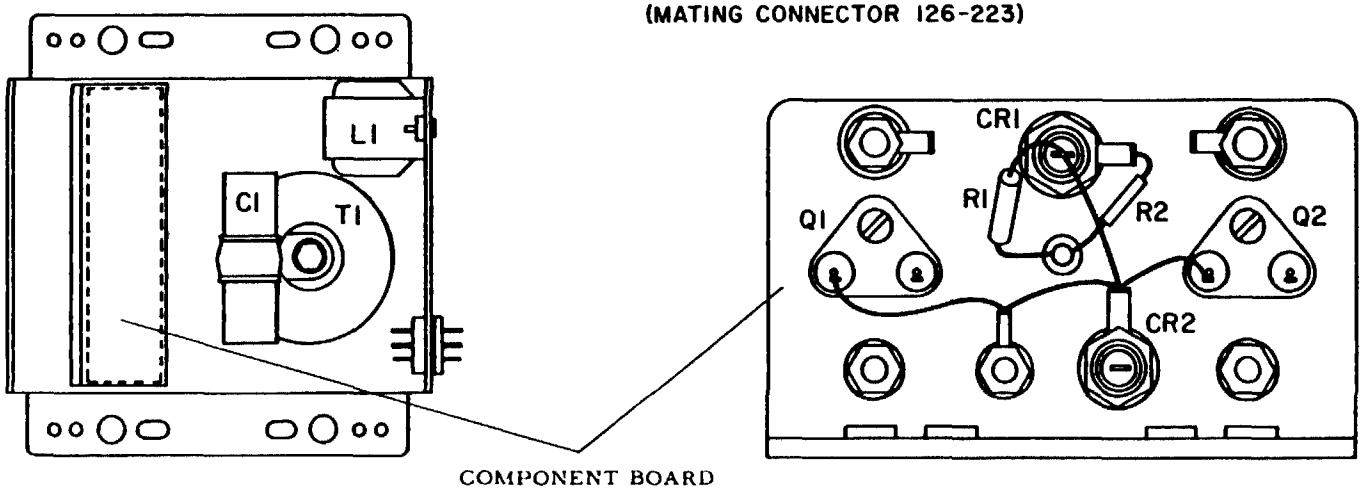


FIGURE 4-9. P-11 INVERTER, SCHEMATIC AND PARTS DATA

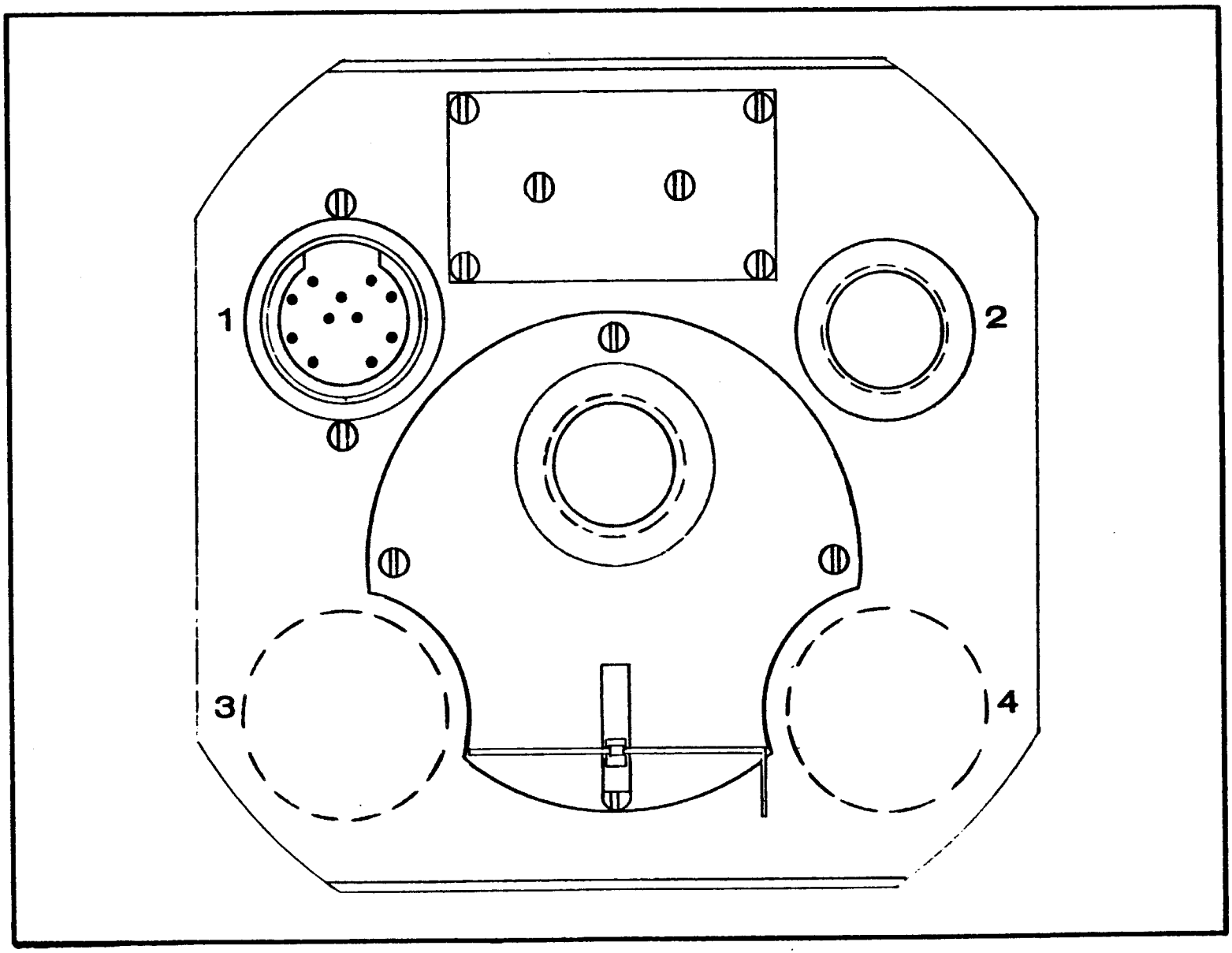
APPENDIX
to the
MAINTENANCE AND
OVERHAUL MANUAL
for
AIM 400 and AIM 800 SYSTEMS

REAR CONNECTOR INFORMATION

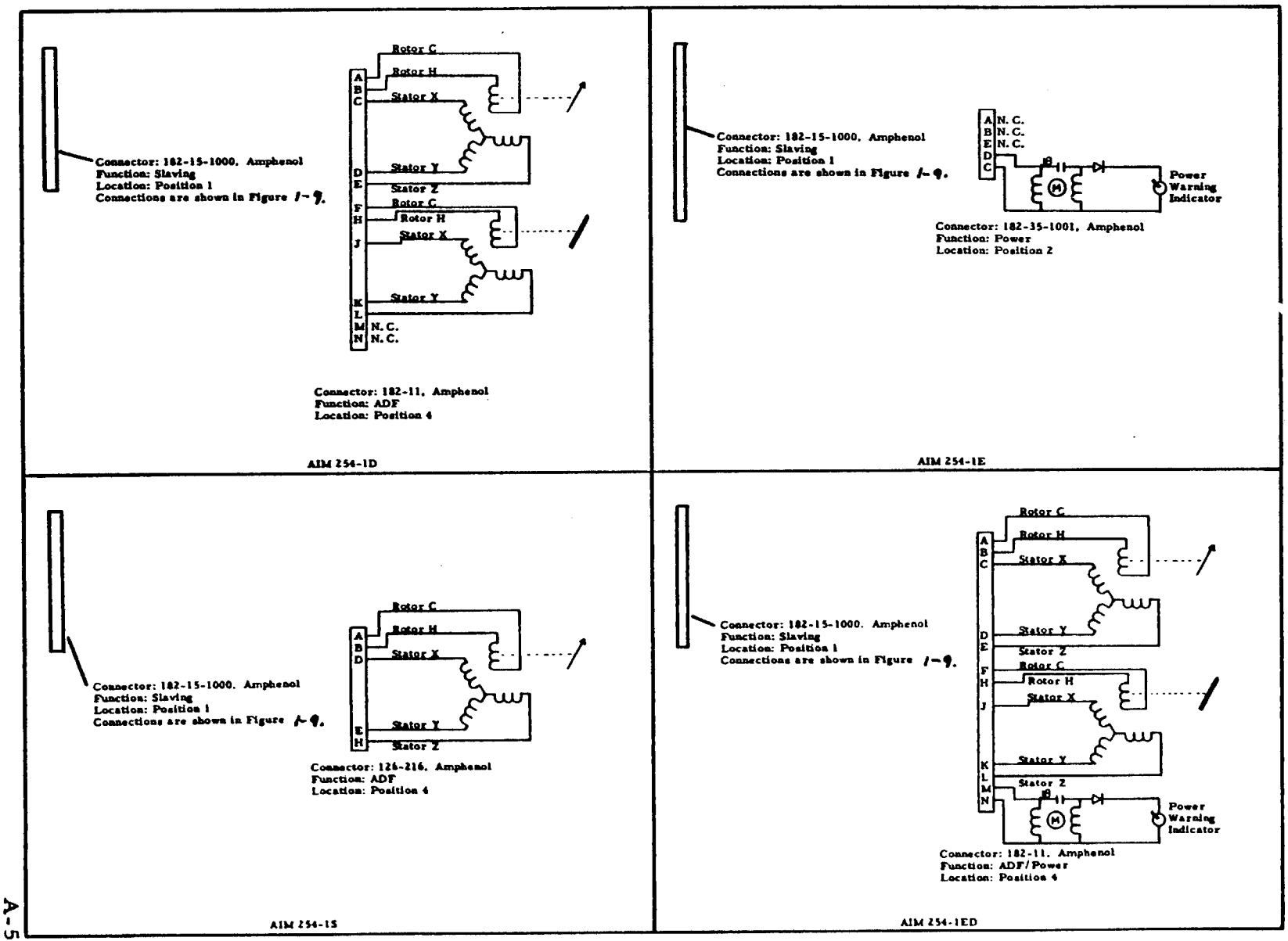
The following reference pages provide specific information as to the number, type, location, and function of electrical connectors on the rear of AIM Slaved Gyro Direction Indicators covered in this manual. This information, along with the schematic diagrams contained elsewhere in the appendix, will assist the field technician in troubleshooting the instrument.

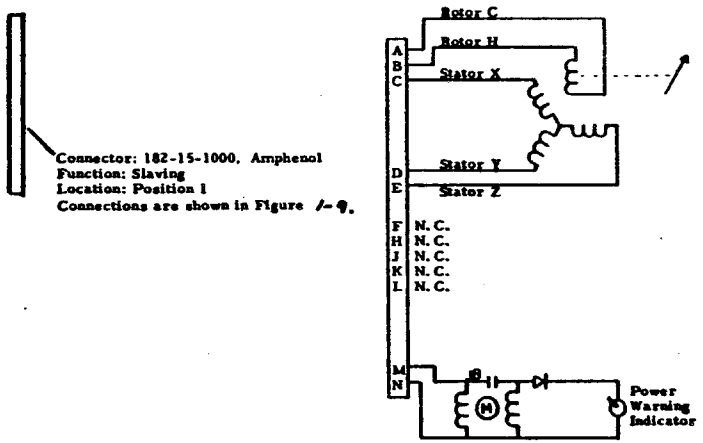
INDEX TO CONNECTOR INFORMATION

Instrument	Page
254-1D, -1E, -1S, -1ED,	A-5
254-1ES, -92, 289-1, -1D,	A-6
289-1E, 289-1S, -1ED, -1ES,	A-7
289-2D, 289-2S, -2ED, -2ES,	A-8
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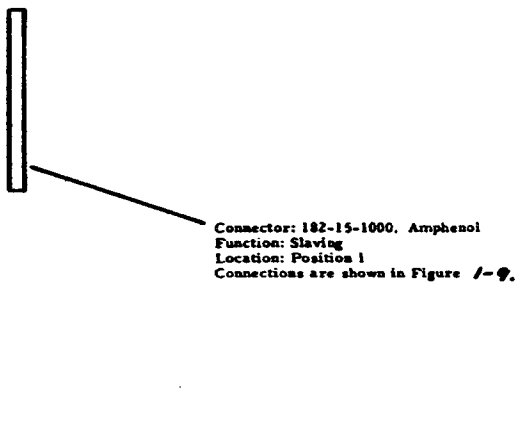


GUIDE TO CONNECTOR LOCATIONS

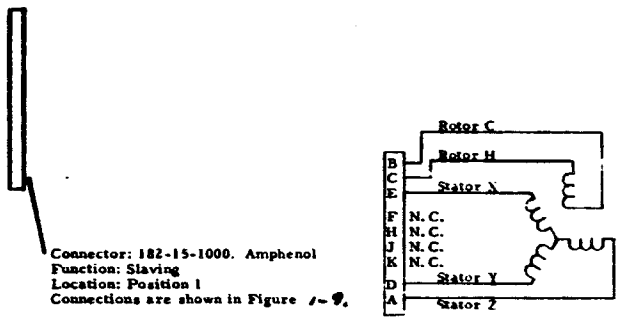

Connector: 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections are shown in Figure 1-9.
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Rotor C
Rotor H
Stator X
Stator Y
N.C.
N.C.
A
B
C
D
E
F
H
J
K
L
M
N
Connector: 182-11, Amphenol
Function: ADF
Location: Position 4
AIM 254-1D
Connector: 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections are shown in Figure 1-9.
A
B
E
D
C
N.C.
N.C.
N.C.
Power
Warning
Indicator
Connector: 182-35-1001, Amphenol
Function: Power
Location: Position 2
AIM 254-1E
Connector: 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections are shown in Figure 1-9.
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
A
B
D
E
H
Connector: 126-216, Amphenol
Function: ADF
Location: Position 4
AIM 254-1S
Connector: 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections are shown in Figure 1-9.
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
A
B
C
D
E
F
H
J
K
L
M
N
Power
Warning
Indicator
Connector: 182-11, Amphenol
Function: ADF/Power
Location: Position 4
AIM 254-1ED



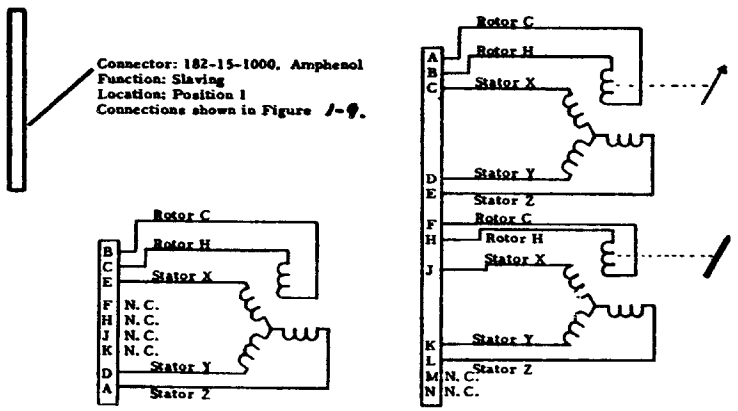
AIM 254-1ES



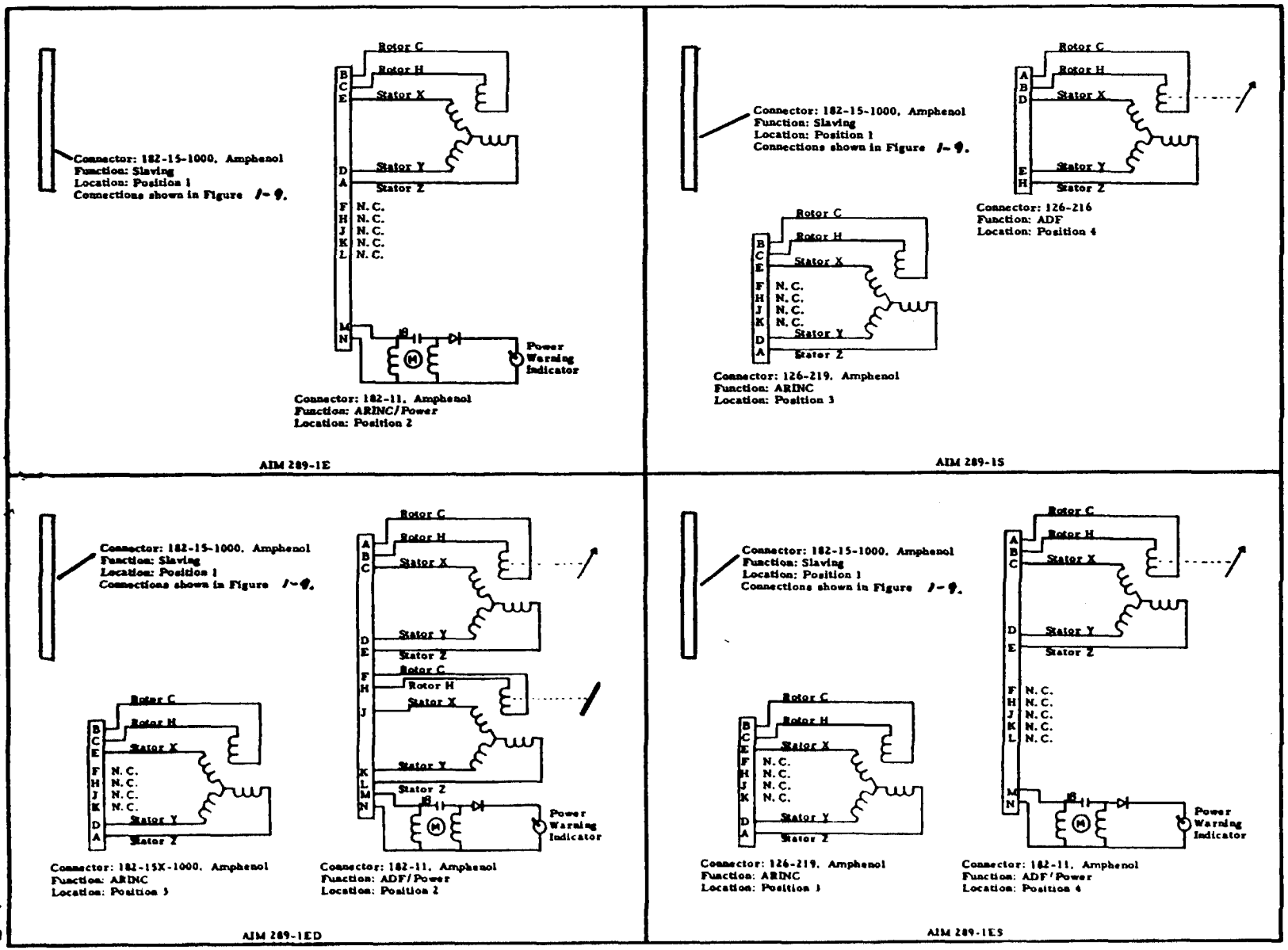
AIM 254-92

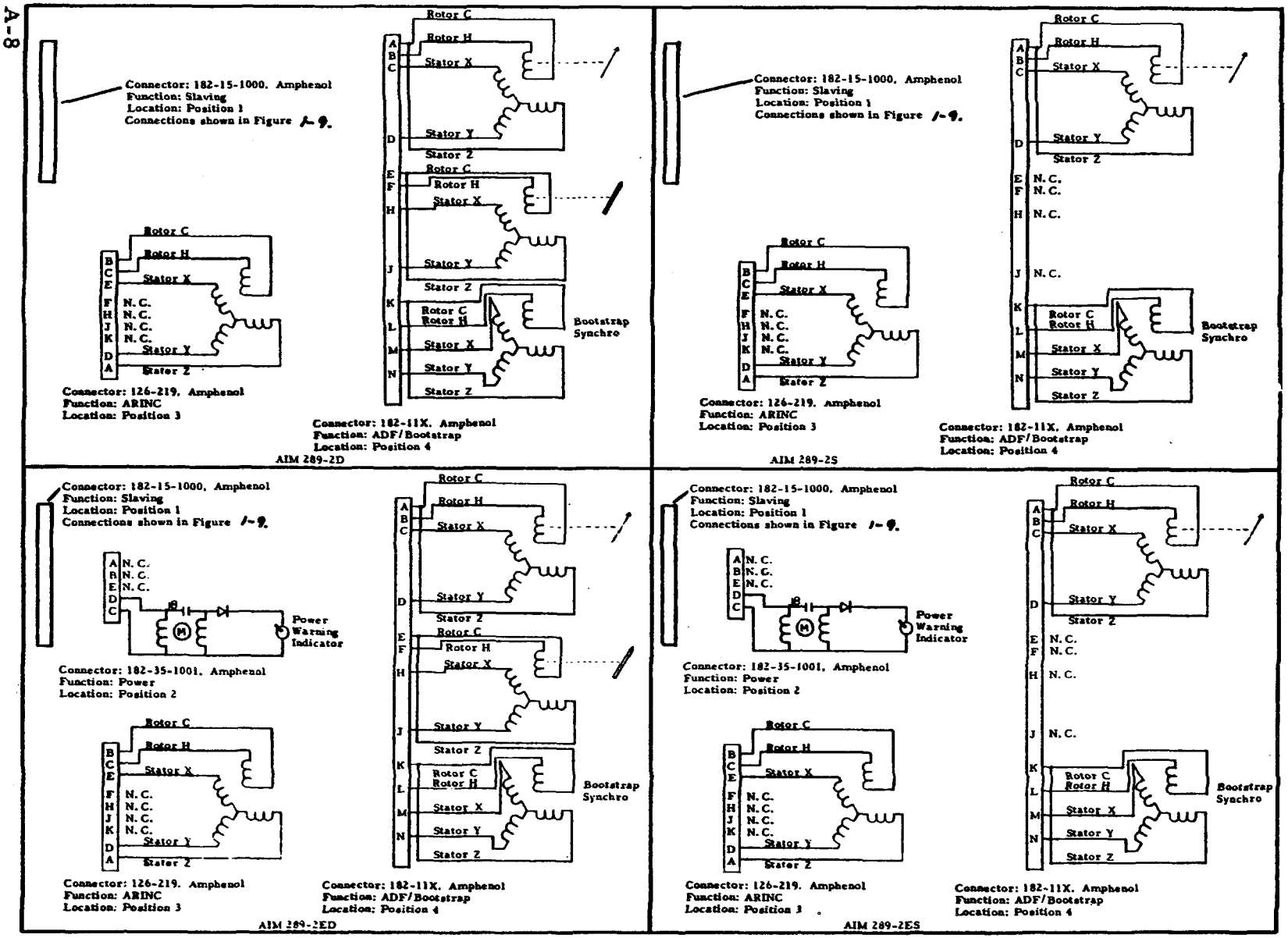


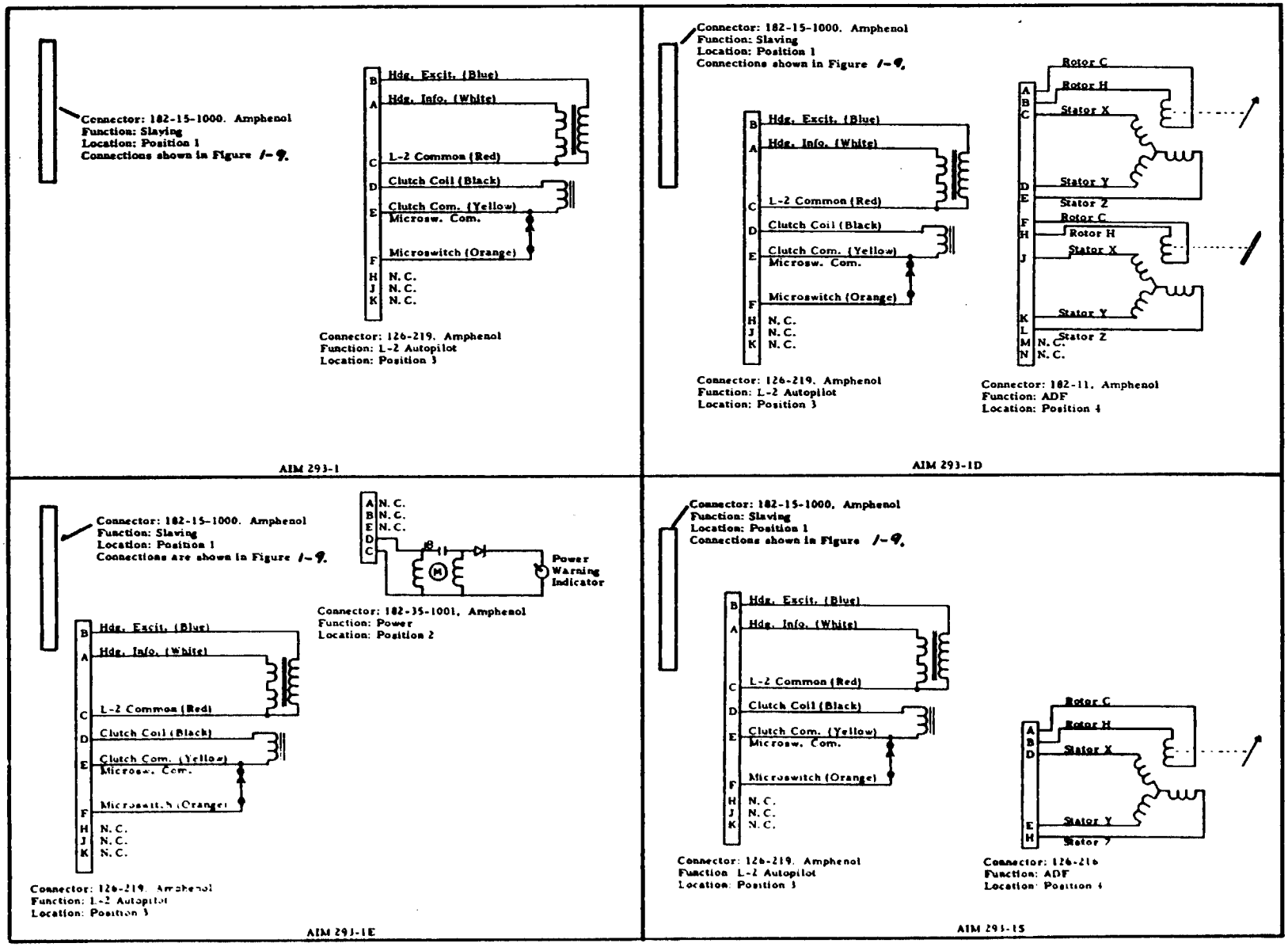
AIM 289-1

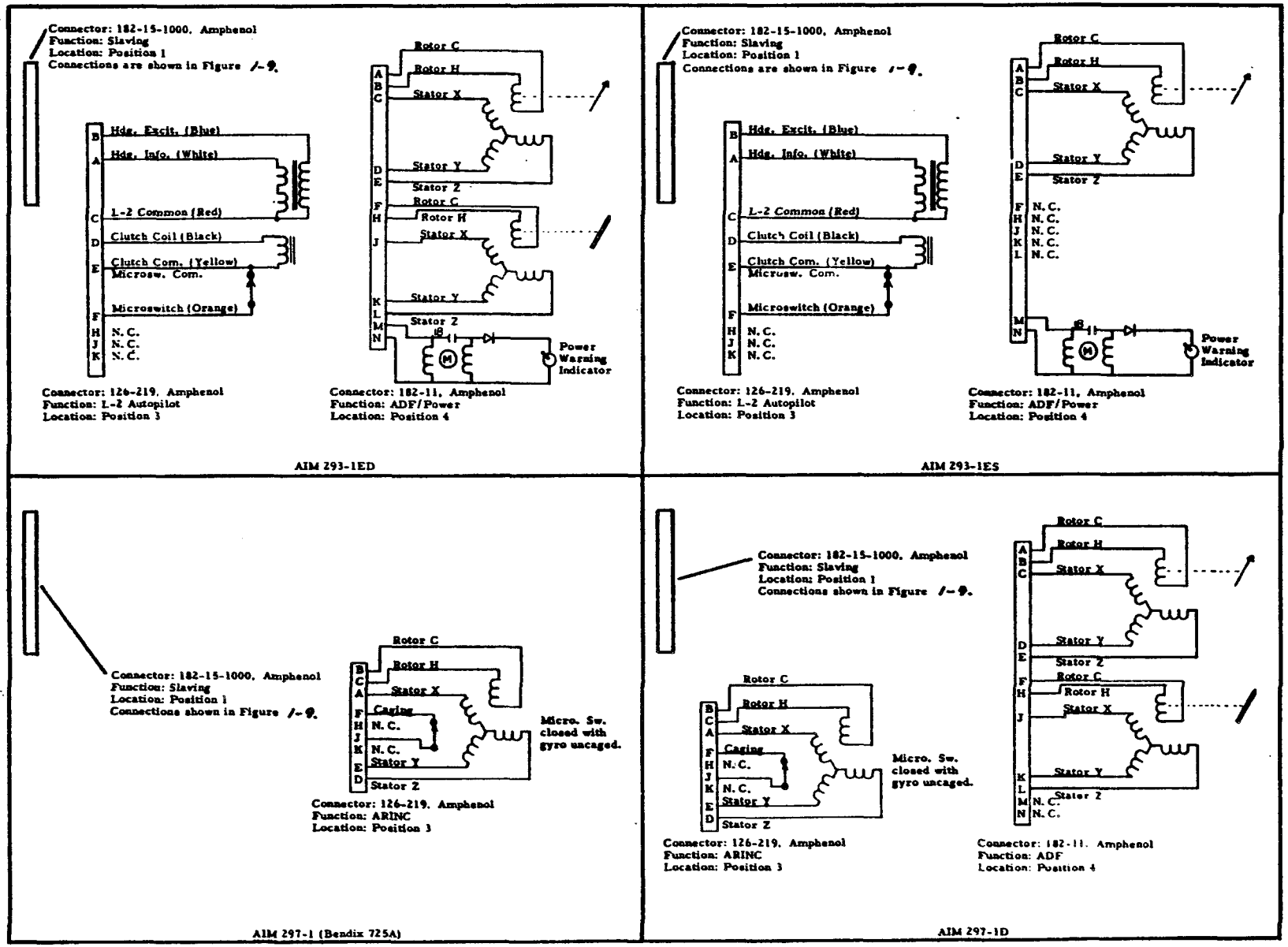


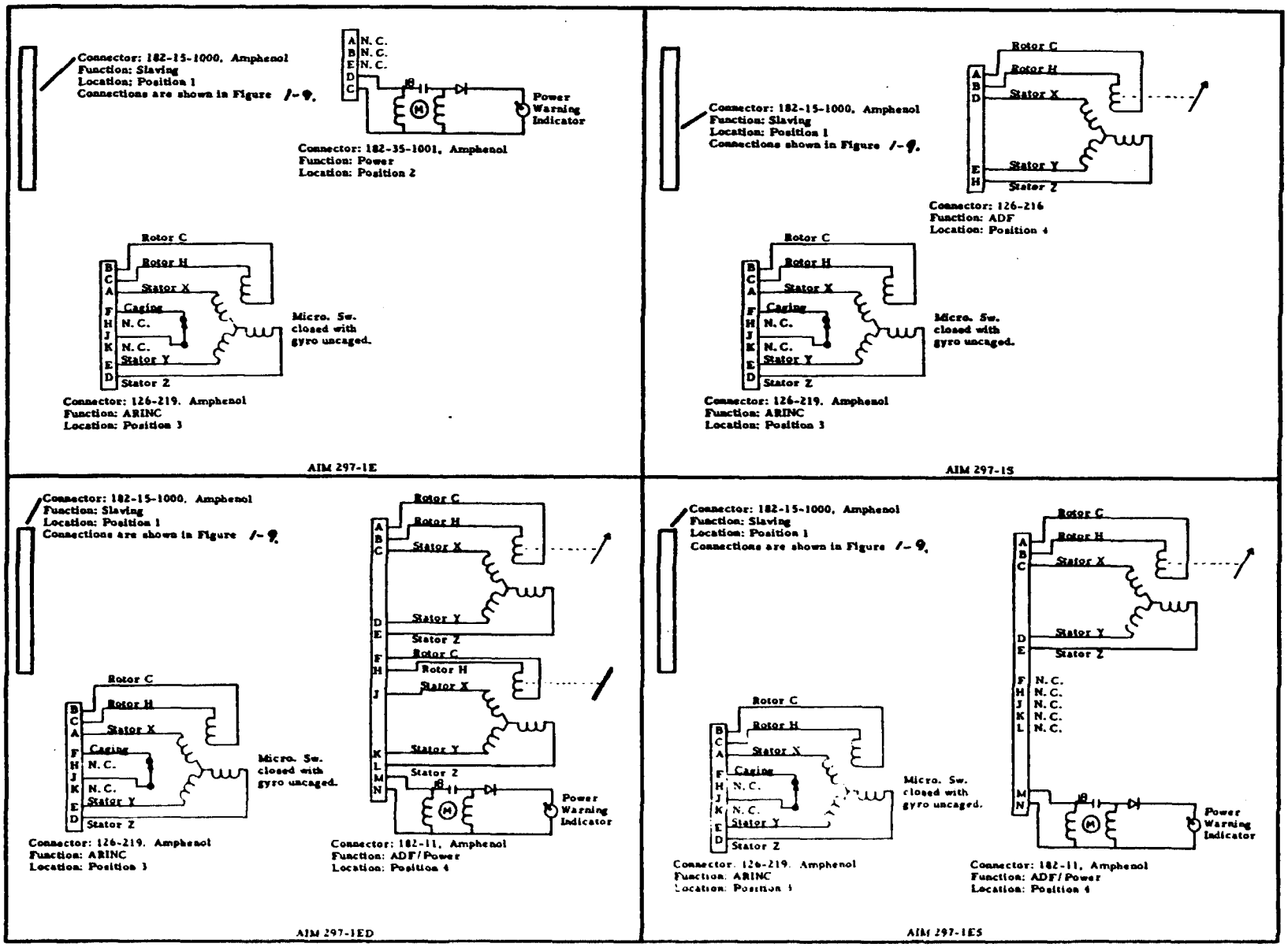
AIM 289-1D

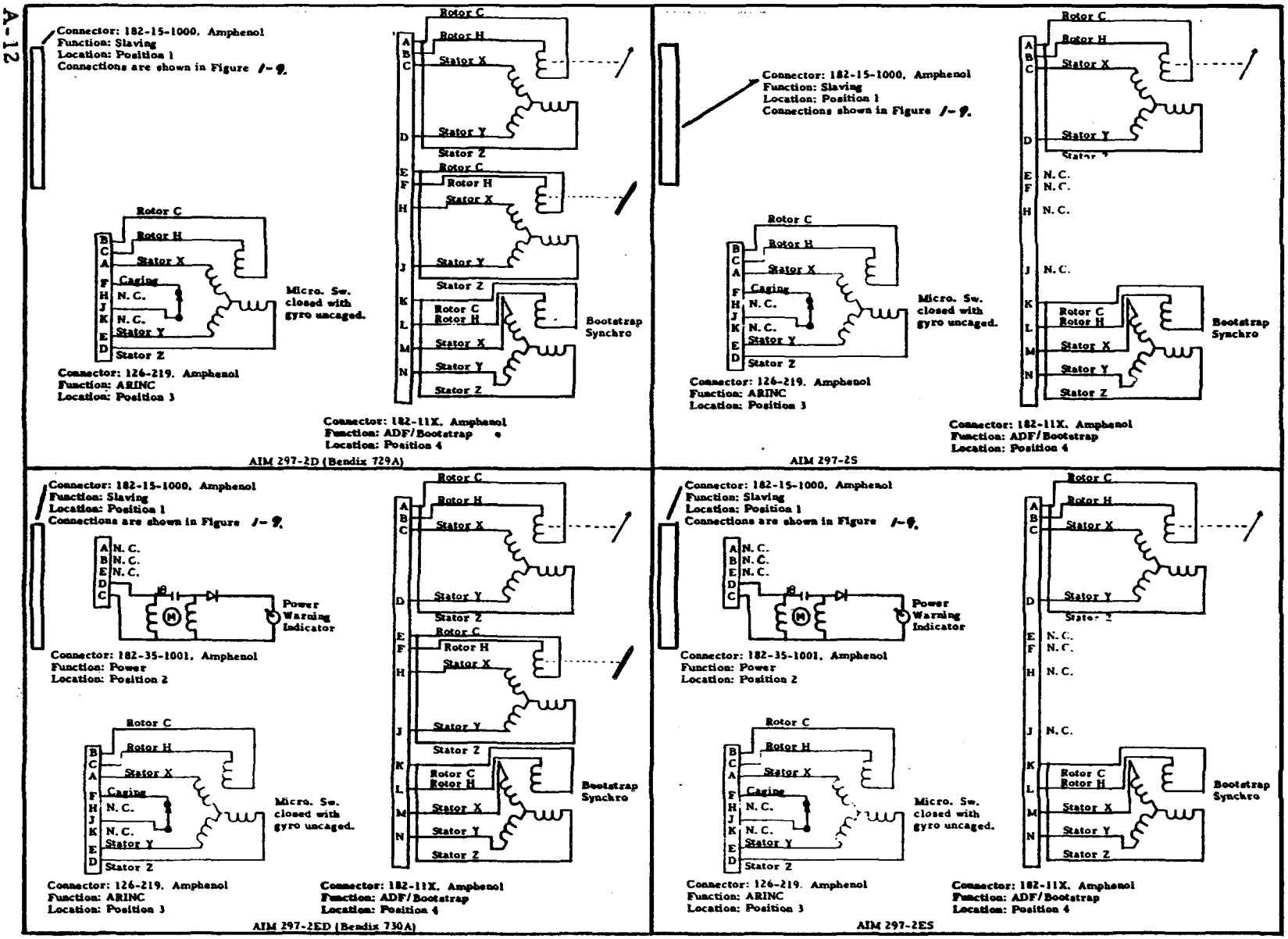

Connector: 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections shown in Figure 1-9.
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
N. C.
N. C.
N. C.
N. C.
N. C.
Power Warning Indicator
Connector: 182-11, Amphenol
Function: ARINC/Power
Location: Position 2
AIM 289-1E
Connector: 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections shown in Figure 1-9.
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Connector: 126-216
Function: ADF
Location: Position 4
N. C.
N. C.
N. C.
N. C.
Connector: 126-219, Amphenol
Function: ARINC
Location: Position 3
AIM 289-1S
Connector: 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections shown in Figure 1-9.
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
N. C.
N. C.
N. C.
N. C.
N. C.
Connector: 182-15X-1000, Amphenol
Function: ARINC
Location: Position 3
Power Warning Indicator
Connector: 182-11, Amphenol
Function: ADF/Power
Location: Position 2
AIM 289-1ED
Connector: 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections shown in Figure 1-9.
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
N. C.
N. C.
N. C.
N. C.
N. C.
Connector: 126-219, Amphenol
Function: ARINC
Location: Position 3
Power Warning Indicator
Connector: 182-11, Amphenol
Function: ADF/Power
Location: Position 4
AIM 289-1ES

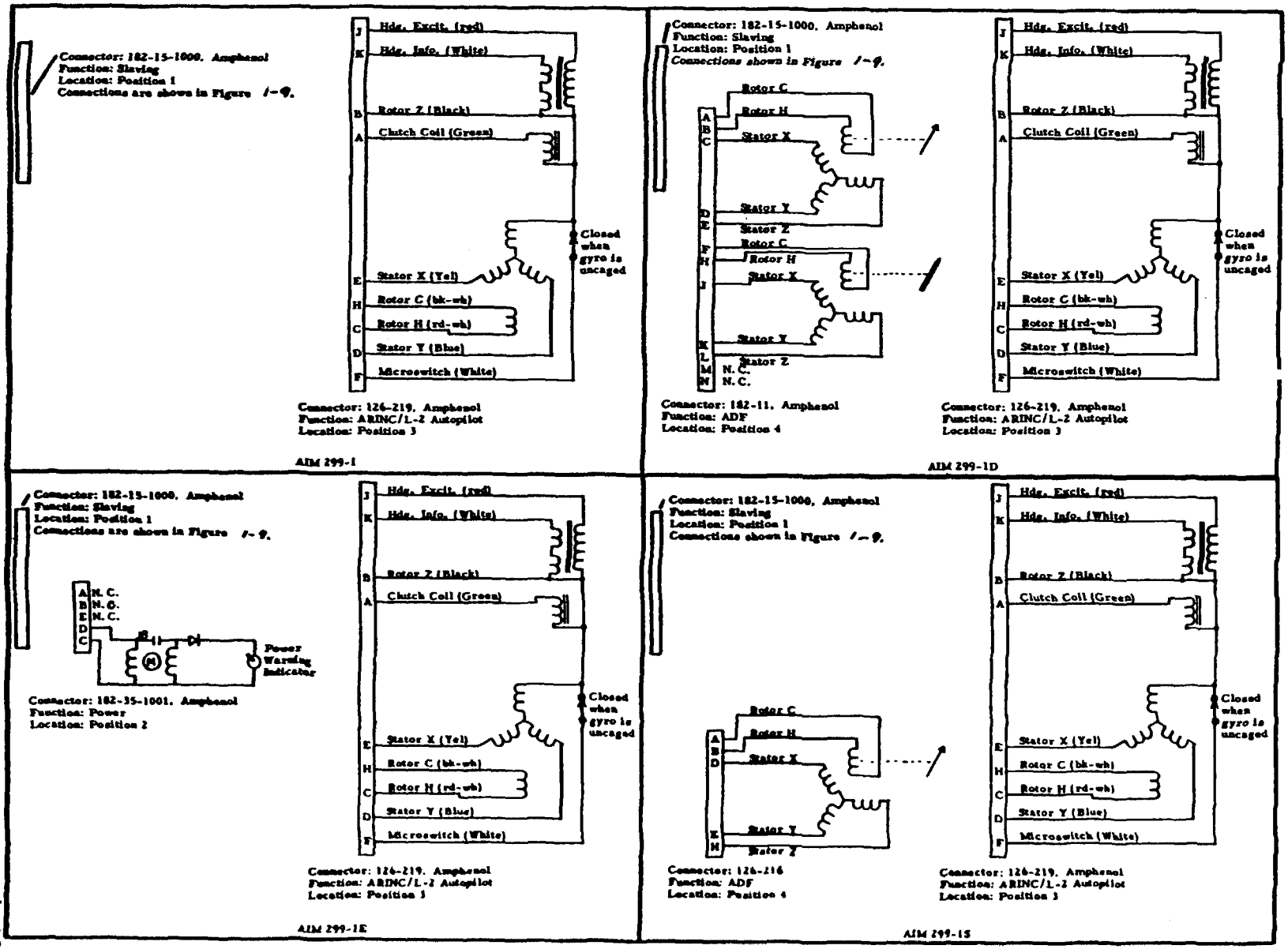

Connector: 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections shown in Figure 1-9.
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
N. C.
Connector: 126-219, Amphenol
Function: ARINC
Location: Position 3
Connector: 182-11X, Amphenol
Function: ADF/Bootstrap
Location: Position 4
Bootstrap Synchro
AIM 289-2D
AIM 289-2S
Power Warning Indicator
Connector: 182-35-1001, Amphenol
Function: Power
Location: Position 2
AIM 289-2ED
AIM 289-2ES

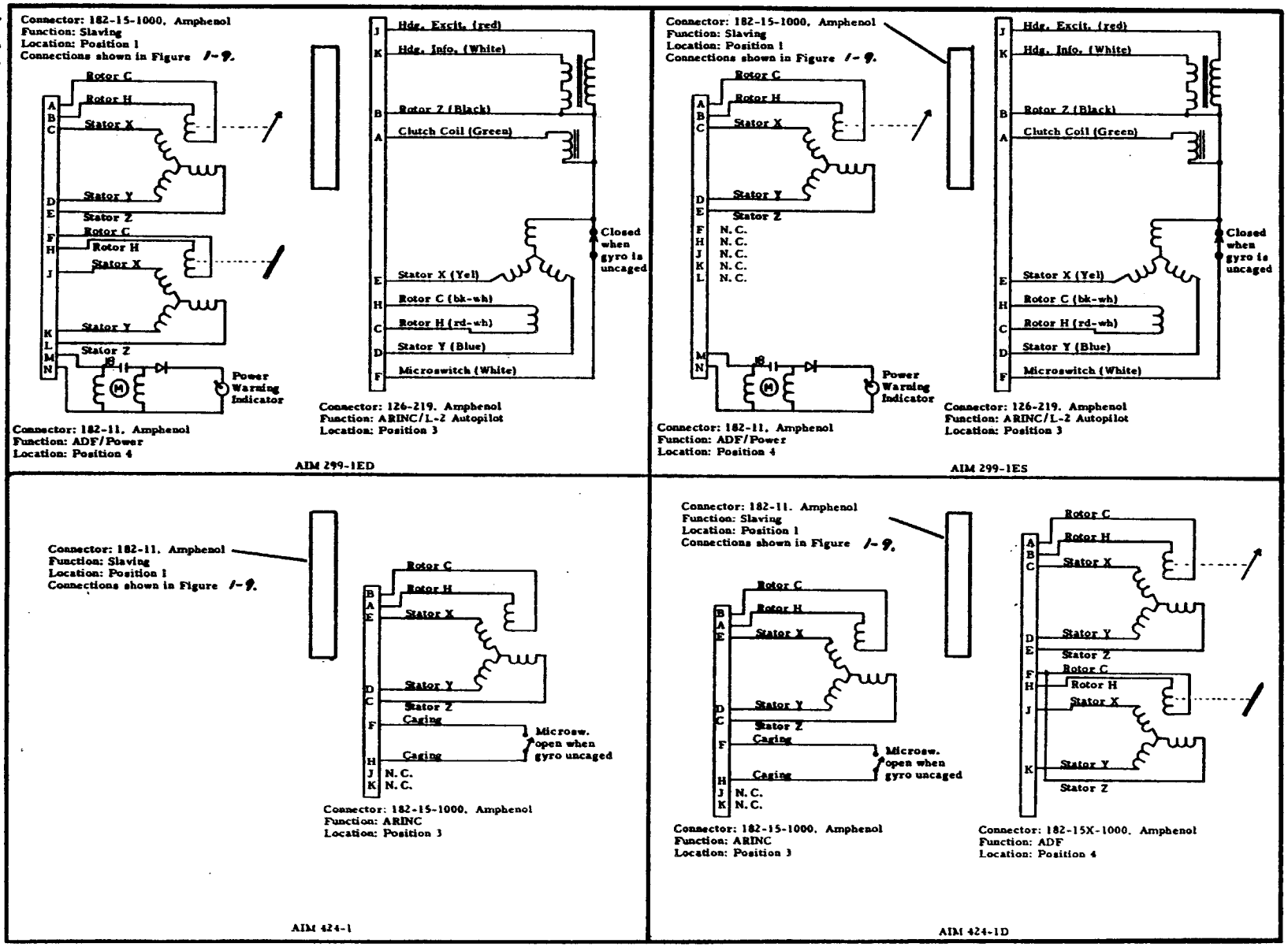

Connector: 182-15-1000. Amphenol
Function: Slaving
Location: Position 1
Connections shown in Figure 1-9.
B Hdg. Excit. (Blue)
A Hdg. Info. (White)
C L-2 Common (Red)
D Clutch Coil (Black)
E Clutch Com. (Yellow) Microsw. Com.
F Microswitch (Orange)
H N.C.
J N.C.
K N.C.
Connector: 126-219. Amphenol
Function: L-2 Autopilot
Location: Position 3
AIM 293-1
Connector: 182-15-1000. Amphenol
Function: Slaving
Location: Position 1
Connections shown in Figure 1-9.
B Hdg. Excit. (Blue)
A Hdg. Info. (White)
C L-2 Common (Red)
D Clutch Coil (Black)
E Clutch Com. (Yellow) Microsw. Com.
F Microswitch (Orange)
H N.C.
J N.C.
K N.C.
Connector: 126-219. Amphenol
Function: L-2 Autopilot
Location: Position 3
A Rotor C
B Rotor H
C Stator X
D Stator Y
E Stator Z
F Rotor C
H Rotor H
J Stator X
K Stator Y
L Stator Z
M N.C.
N N.C.
Connector: 182-11. Amphenol
Function: ADF
Location: Position 4
AIM 293-1D
Connector: 182-15-1000. Amphenol
Function: Slaving
Location: Position 1
Connections are shown in Figure 1-9.
B Hdg. Excit. (Blue)
A Hdg. Info. (White)
C L-2 Common (Red)
D Clutch Coil (Black)
E Clutch Com. (Yellow) Microsw. Com.
F Microswitch (Orange)
H N.C.
J N.C.
K N.C.
Connector: 126-219. Amphenol
Function: L-2 Autopilot
Location: Position 3
A N.C.
B N.C.
E N.C.
D
C
M
Power Warning Indicator
Connector: 182-35-1001. Amphenol
Function: Power
Location: Position 2
AIM 293-1E
Connector: 182-15-1000. Amphenol
Function: Slaving
Location: Position 1
Connections shown in Figure 1-9.
B Hdg. Excit. (Blue)
A Hdg. Info. (White)
C L-2 Common (Red)
D Clutch Coil (Black)
E Clutch Com. (Yellow) Microsw. Com.
F Microswitch (Orange)
H N.C.
J N.C.
K N.C.
Connector: 126-219. Amphenol
Function L-2 Autopilot
Location: Position 3
A Rotor C
B Rotor H
D Stator X
E Stator Y
H Stator Z
Connector: 126-216
Function: ADF
Location: Position 4
AIM 293-1S

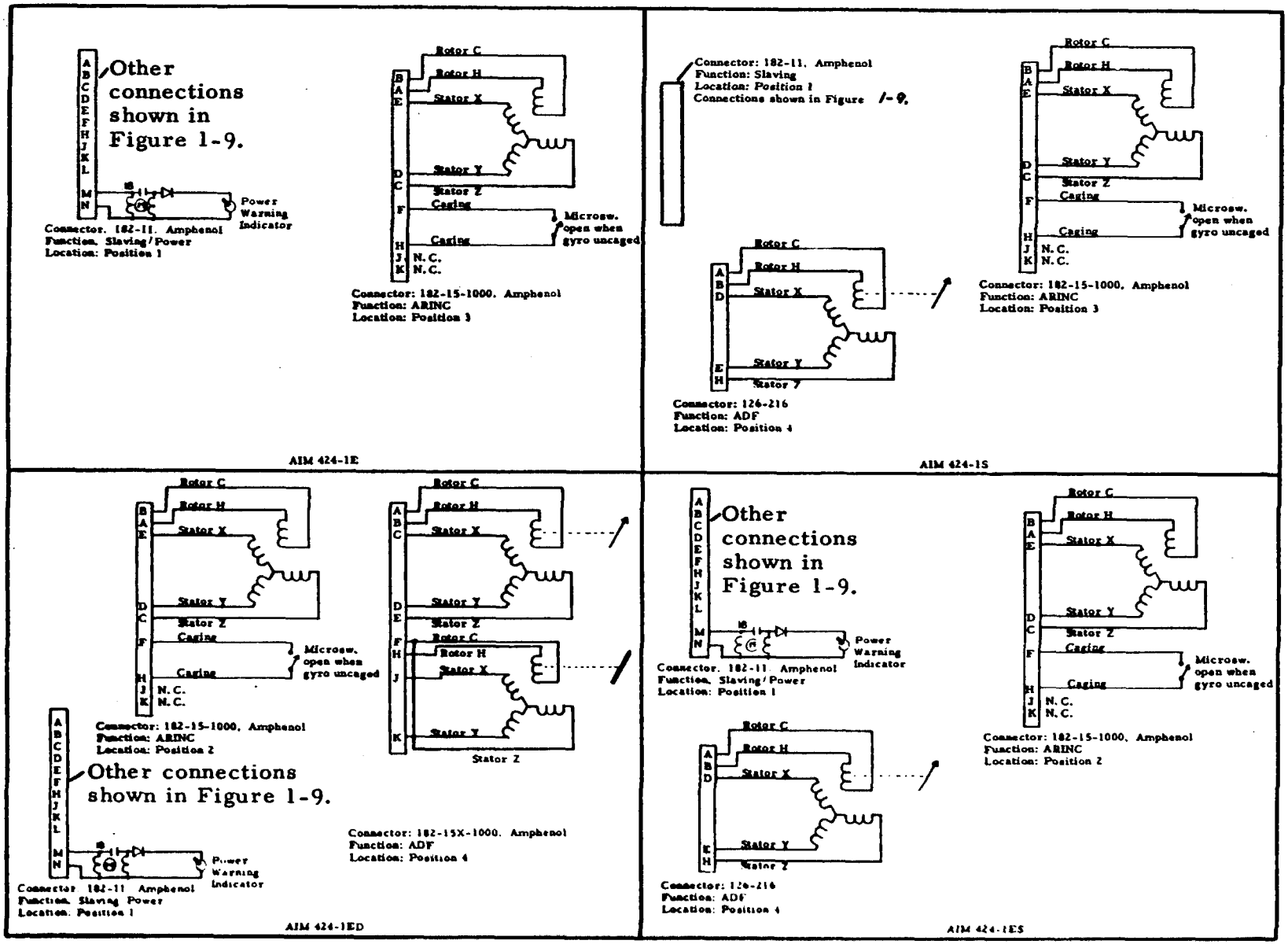

Connector: 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections are shown in Figure 1-9.
Hdg. Excit. (Blue)
Hdg. Info. (White)
L-2 Common (Red)
Clutch Coil (Black)
Clutch Com. (Yellow)
Microsw. Com.
Microswitch (Orange)
N. C.
N. C.
N. C.
Connector: 126-219, Amphenol
Function: L-2 Autopilot
Location: Position 3
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Power Warning Indicator
Connector: 182-11, Amphenol
Function: ADF/Power
Location: Position 4
AIM 293-1ED
AIM 293-1ES
Caging
Micro. Sw. closed with gyro uncaged.
Connector: 126-219, Amphenol
Function: ARINC
Location: Position 3
AIM 297-1 (Bendix 725A)
AIM 297-1D

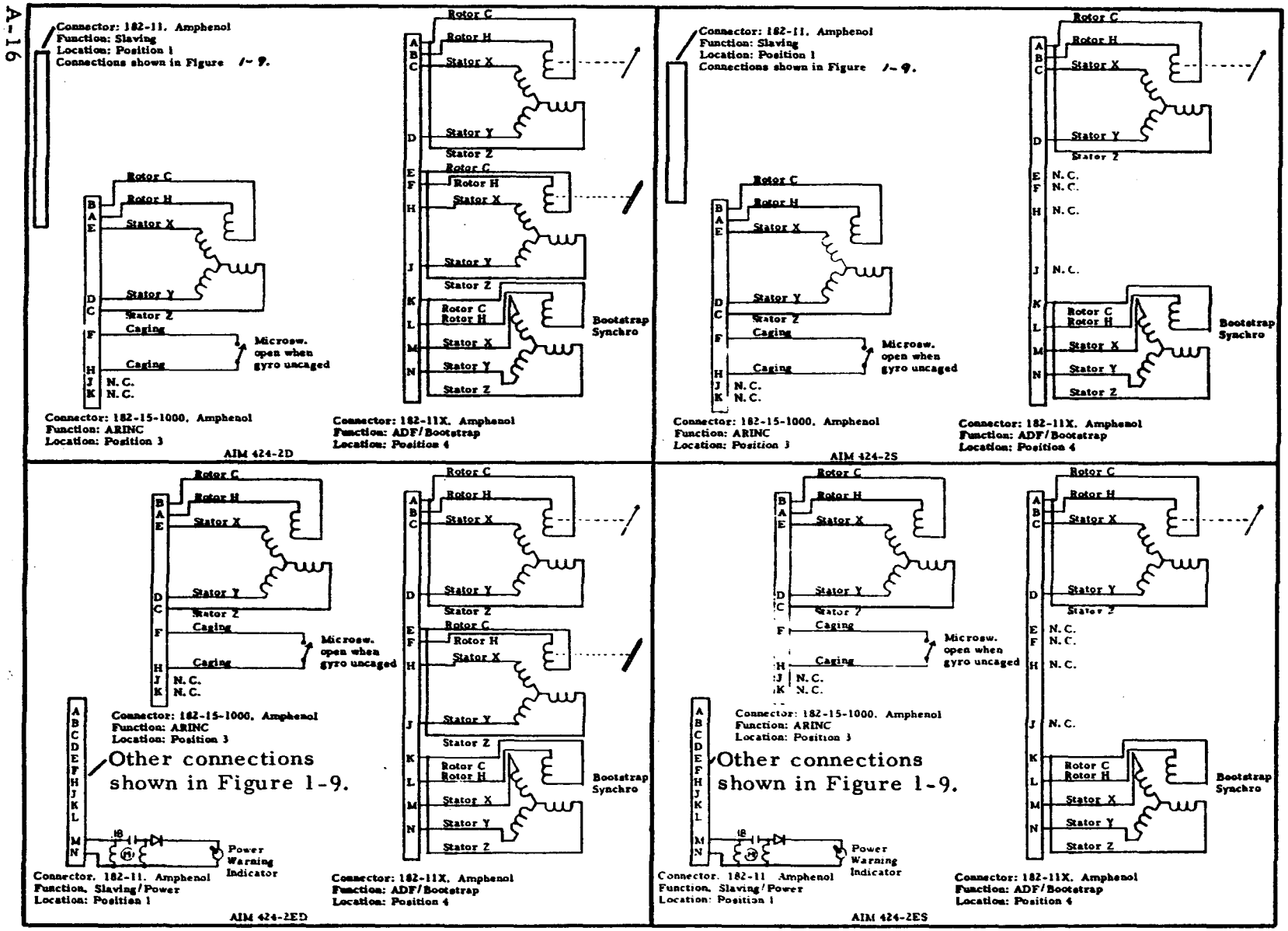

Connector: 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections are shown in Figure 1-9.
A N. C.
B N. C.
E N. C.
D
C
Power Warning Indicator
Connector: 182-35-1001, Amphenol
Function: Power
Location: Position 2
Rotor C
Rotor H
Stator X
B
C
A
Caging
F
H
J
K
N. C.
N. C.
Stator Y
E
D
Stator Z
Micro. Sw. closed with gyro uncaged.
Connector: 126-219, Amphenol
Function: ARINC
Location: Position 3
AIM 297-1E
Connector: 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections shown in Figure 1-9.
Rotor C
Rotor H
A
B
D
Stator X
E
H
Stator Y
Stator Z
Connector: 126-216
Function: ADF
Location: Position 4
Rotor C
Rotor H
Stator X
Caging
N. C.
N. C.
Stator Y
Stator Z
Micro. Sw. closed with gyro uncaged.
Connector: 126-219, Amphenol
Function: ARINC
Location: Position 3
AIM 297-1S
Connector: 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections are shown in Figure 1-9.
Rotor C
Rotor H
Stator X
Caging
N. C.
N. C.
Stator Y
Stator Z
Micro. Sw. closed with gyro uncaged.
Connector: 126-219, Amphenol
Function: ARINC
Location: Position 3
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Power Warning Indicator
Connector: 182-11, Amphenol
Function: ADF/Power
Location: Position 4
AIM 297-1ED
Connector: 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections are shown in Figure 1-9.
Rotor C
Rotor H
Stator X
Caging
N. C.
N. C.
Stator Y
Stator Z
Micro. Sw. closed with gyro uncaged.
Connector: 126-219, Amphenol
Function: ARINC
Location: Position 3
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
F N. C.
H N. C.
J N. C.
K N. C.
L N. C.
M
N
Power Warning Indicator
Connector: 182-11, Amphenol
Function: ADF/Power
Location: Position 4
AIM 297-1ES

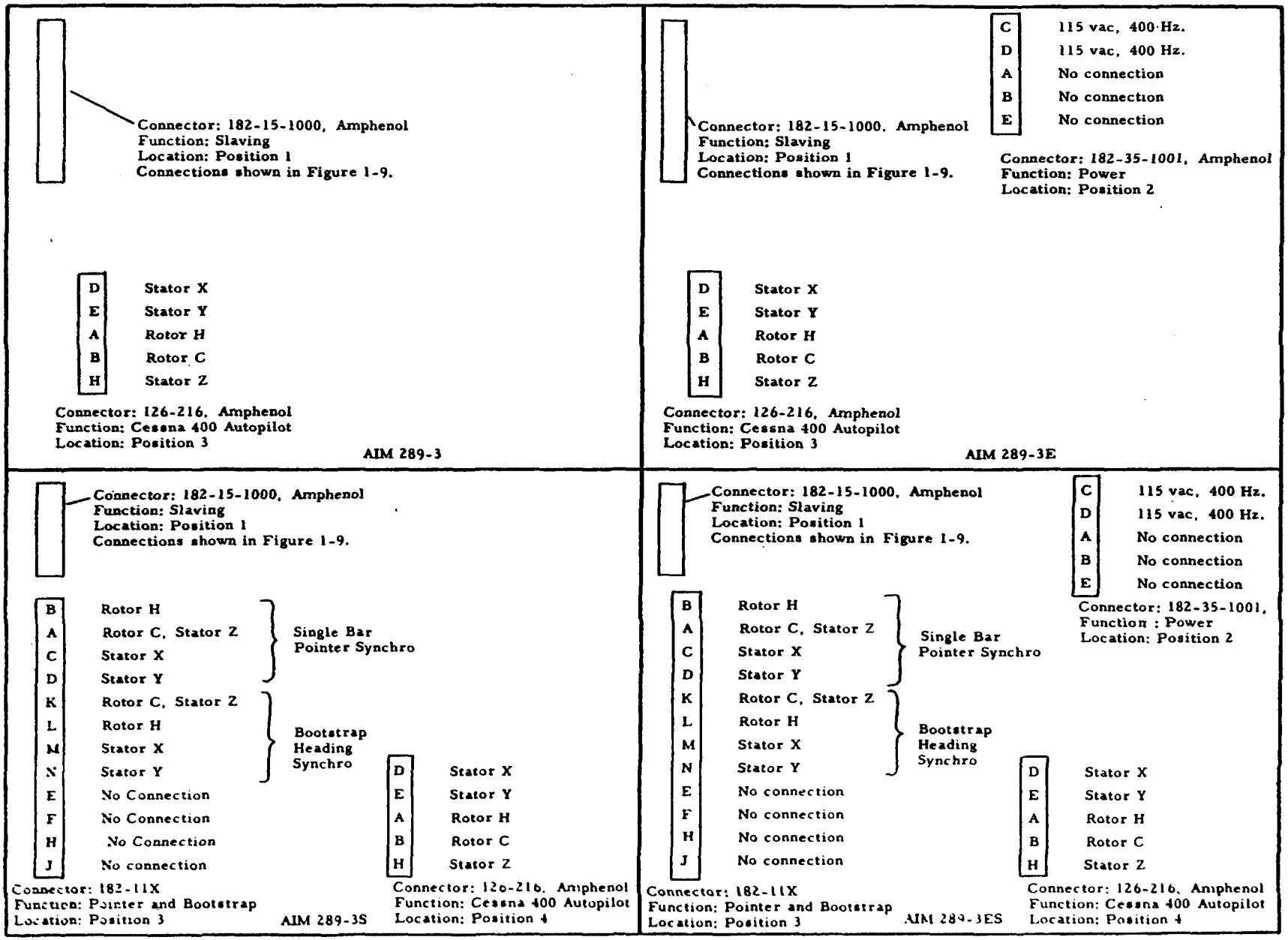

Connector: 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections are shown in Figure /-9.
Rotor C
Rotor H
Stator X
Caging
N. C.
N. C.
Stator Y
Stator Z
Micro. Sw. closed with gyro uncaged.
Connector: 126-219, Amphenol
Function: ARINC
Location: Position 3
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Bootstrap Synchro
Connector: 182-11X, Amphenol
Function: ADF/Bootstrap
Location: Position 4
AIM 297-2D (Bendix 729A)
Connector: 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections shown in Figure /-9.
Micro. Sw. closed with gyro uncaged.
Connector: 126-219, Amphenol
Function: ARINC
Location: Position 3
N. C.
N. C.
N. C.
N. C.
Bootstrap Synchro
Connector: 182-11X, Amphenol
Function: ADF/Bootstrap
Location: Position 4
AIM 297-2S
Connector: 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections are shown in Figure /-9.
N. C.
N. C.
N. C.
Power Warning Indicator
Connector: 182-35-1001, Amphenol
Function: Power
Location: Position 2
Micro. Sw. closed with gyro uncaged.
Connector: 126-219, Amphenol
Function: ARINC
Location: Position 3
Bootstrap Synchro
Connector: 182-11X, Amphenol
Function: ADF/Bootstrap
Location: Position 4
AIM 297-2ED (Bendix 730A)
AIM 297-2ES

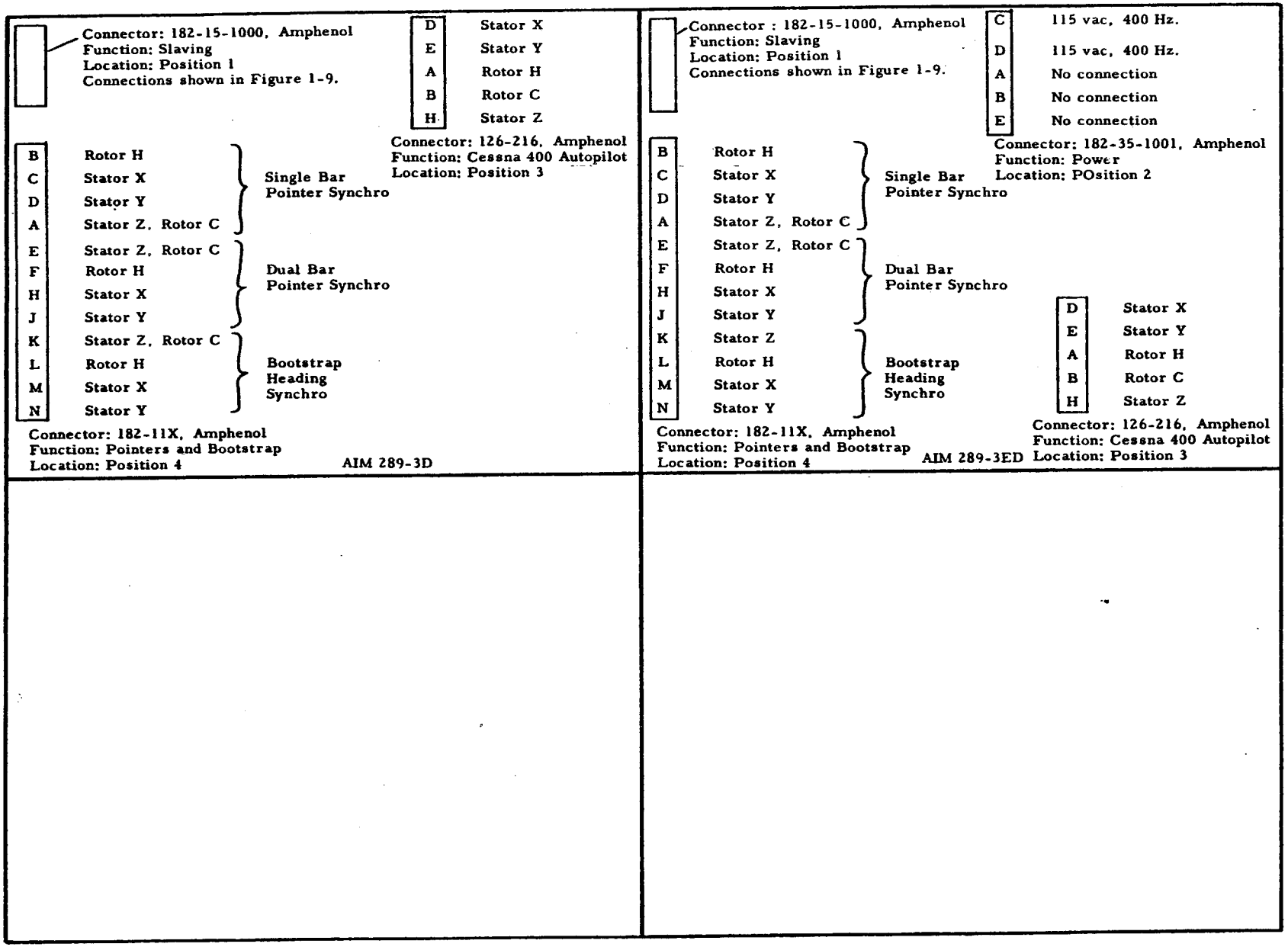

Connector: 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections are shown in Figure 1-9.
J Hdg. Excit. (red)
K Hdg. Info. (White)
B Rotor Z (Black)
A Clutch Coil (Green)
E Stator X (Yel)
H Rotor C (bk-wh)
C Rotor H (rd-wh)
D Stator Y (Blue)
F Microswitch (White)
Closed when gyro is uncaged
Connector: 126-219, Amphenol
Function: ARINC/L-2 Autopilot
Location: Position 3
AIM 299-1
Connector: 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections shown in Figure 1-9.
A Rotor C
B Rotor H
C Stator X
D Stator Y
E Stator Z
F Rotor C
H Rotor H
J Stator X
K Stator Y
L Stator Z
M N. C.
N N. C.
Connector: 182-11, Amphenol
Function: ADF
Location: Position 4
AIM 299-1D
A N. C.
B N. C.
E N. C.
D
C
Power Warning Indicator
Connector: 182-35-1001, Amphenol
Function: Power
Location: Position 2
AIM 299-1E
A Rotor C
B Rotor H
D Stator X
K Stator Y
H Stator Z
Connector: 126-216
Function: ADF
Location: Position 4
AIM 299-1S


Connector: 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections shown in Figure 1-9.
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Power Warning Indicator
Connector: 182-11, Amphenol
Function: ADF/Power
Location: Position 4
Hdg. Excit. (red)
Hdg. Info. (White)
Rotor Z (Black)
Clutch Coil (Green)
Stator X (Yel)
Rotor C (bk-wh)
Rotor H (rd-wh)
Stator Y (Blue)
Microswitch (White)
Closed when gyro is uncaged
Connector: 126-219, Amphenol
Function: ARINC/L-2 Autopilot
Location: Position 3
AIM 299-1ED
Connector: 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections shown in Figure 1-9.
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
N.C.
N.C.
N.C.
N.C.
N.C.
Power Warning Indicator
Connector: 182-11, Amphenol
Function: ADF/Power
Location: Position 4
Hdg. Excit. (red)
Hdg. Info. (White)
Rotor Z (Black)
Clutch Coil (Green)
Stator X (Yel)
Rotor C (bk-wh)
Rotor H (rd-wh)
Stator Y (Blue)
Microswitch (White)
Closed when gyro is uncaged
Connector: 126-219, Amphenol
Function: ARINC/L-2 Autopilot
Location: Position 3
AIM 299-1ES
Connector: 182-11, Amphenol
Function: Slaving
Location: Position 1
Connections shown in Figure 1-9.
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Caging
Caging
N.C.
N.C.
Microsw. open when gyro uncaged
Connector: 182-15-1000, Amphenol
Function: ARINC
Location: Position 3
AIM 424-1
Connector: 182-11, Amphenol
Function: Slaving
Location: Position 1
Connections shown in Figure 1-9.
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Caging
Caging
N.C.
N.C.
Microsw. open when gyro uncaged
Connector: 182-15-1000, Amphenol
Function: ARINC
Location: Position 3
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Connector: 182-15X-1000, Amphenol
Function: ADF
Location: Position 4
AIM 424-1D


Other connections shown in Figure 1-9.
Connector. 182-11. Amphenol
Function. Slaving/Power
Location: Position 1
Power Warning Indicator
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Casing
Casing
Microsw. open when gyro uncaged
N.C.
N.C.
Connector: 182-15-1000. Amphenol
Function: ARINC
Location: Position 3
AIM 424-1E
Connector: 182-11. Amphenol
Function: Slaving
Location: Position 1
Connections shown in Figure 1-9.
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Casing
Casing
Microsw. open when gyro uncaged
N.C.
N.C.
Connector: 182-15-1000. Amphenol
Function: ARINC
Location: Position 3
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Connector: 126-216
Function: ADF
Location: Position 4
AIM 424-1S
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Casing
Casing
Microsw. open when gyro uncaged
N.C.
N.C.
Connector: 182-15-1000. Amphenol
Function: ARINC
Location: Position 2
Other connections shown in Figure 1-9.
Connector. 182-11. Amphenol
Function. Slaving Power
Location. Position 1
Power Warning Indicator
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Rotor C
Rotor H
Stator X
Stator Y
Connector: 182-15X-1000. Amphenol
Function: ADF
Location: Position 4
AIM 424-1ED
Other connections shown in Figure 1-9.
Connector. 182-11. Amphenol
Function. Slaving/Power
Location: Position 1
Power Warning Indicator
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Connector: 126-216
Function: ADF
Location: Position 4
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Casing
Casing
Microsw. open when gyro uncaged
N.C.
N.C.
Connector: 182-15-1000. Amphenol
Function: ARINC
Location: Position 2
AIM 424-1ES


Connector: 182-11, Amphenol
Function: Slaving
Location: Position 1
Connections shown in Figure 1-9.
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Caging
Caging
Microsw. open when gyro uncaged
N.C.
N.C.
Connector: 182-15-1000, Amphenol
Function: ARINC
Location: Position 3
AIM 424-2D
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Bootstrap Synchro
Connector: 182-11X, Amphenol
Function: ADF/Bootstrap
Location: Position 4
Connector: 182-11, Amphenol
Function: Slaving
Location: Position 1
Connections shown in Figure 1-9.
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Caging
Caging
Microsw. open when gyro uncaged
N.C.
N.C.
Connector: 182-15-1000, Amphenol
Function: ARINC
Location: Position 3
AIM 424-2S
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
N.C.
N.C.
N.C.
N.C.
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Bootstrap Synchro
Connector: 182-11X, Amphenol
Function: ADF/Bootstrap
Location: Position 4
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Caging
Caging
Microsw. open when gyro uncaged
N.C.
N.C.
Connector: 182-15-1000, Amphenol
Function: ARINC
Location: Position 3
Other connections shown in Figure 1-9.
Power Warning Indicator
Connector: 182-11, Amphenol
Function, Slaving/Power
Location: Position 1
AIM 424-2ED
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Bootstrap Synchro
Connector: 182-11X, Amphenol
Function: ADF/Bootstrap
Location: Position 4
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Caging
Caging
Microsw. open when gyro uncaged
N.C.
N.C.
Connector: 182-15-1000, Amphenol
Function: ARINC
Location: Position 3
Other connections shown in Figure 1-9.
Power Warning Indicator
Connector: 182-11 Amphenol
Function, Slaving/Power
Location: Position 1
AIM 424-2ES
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
N.C.
N.C.
N.C.
N.C.
Rotor C
Rotor H
Stator X
Stator Y
Stator Z
Bootstrap Synchro
Connector: 182-11X, Amphenol
Function: ADF/Bootstrap
Location: Position 4


Connector: 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections shown in Figure 1-9.
D Stator X
E Stator Y
A Rotor H
B Rotor C
H Stator Z
Connector: 126-216, Amphenol
Function: Cessna 400 Autopilot
Location: Position 3
AIM 289-3
Connector: 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections shown in Figure 1-9.
C 115 vac, 400 Hz.
D 115 vac, 400 Hz.
A No connection
B No connection
E No connection
Connector: 182-35-1001, Amphenol
Function: Power
Location: Position 2
D Stator X
E Stator Y
A Rotor H
B Rotor C
H Stator Z
Connector: 126-216, Amphenol
Function: Cessna 400 Autopilot
Location: Position 3
AIM 289-3E
Connector: 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections shown in Figure 1-9.
B Rotor H
A Rotor C, Stator Z
C Stator X
D Stator Y
Single Bar Pointer Synchro
K Rotor C, Stator Z
L Rotor H
M Stator X
N Stator Y
Bootstrap Heading Synchro
E No Connection
F No Connection
H No Connection
J No connection
Connector: 182-11X
Function: Pointer and Bootstrap
Location: Position 3
AIM 289-3S
D Stator X
E Stator Y
A Rotor H
B Rotor C
H Stator Z
Connector: 126-216, Amphenol
Function: Cessna 400 Autopilot
Location: Position 4
Connector: 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections shown in Figure 1-9.
C 115 vac, 400 Hz.
D 115 vac, 400 Hz.
A No connection
B No connection
E No connection
Connector: 182-35-1001, Function : Power
Location: Position 2
B Rotor H
A Rotor C, Stator Z
C Stator X
D Stator Y
Single Bar Pointer Synchro
K Rotor C, Stator Z
L Rotor H
M Stator X
N Stator Y
Bootstrap Heading Synchro
E No connection
F No connection
H No connection
J No connection
Connector: 182-11X
Function: Pointer and Bootstrap
Location: Position 3
AIM 289-3ES
D Stator X
E Stator Y
A Rotor H
B Rotor C
H Stator Z
Connector: 126-216, Amphenol
Function: Cessna 400 Autopilot
Location: Position 4


Connector: 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections shown in Figure 1-9.
D Stator X
E Stator Y
A Rotor H
B Rotor C
H Stator Z
Connector: 126-216, Amphenol
Function: Cessna 400 Autopilot
Location: Position 3
B Rotor H
C Stator X
D Stator Y
A Stator Z, Rotor C
Single Bar Pointer Synchro
E Stator Z, Rotor C
F Rotor H
H Stator X
J Stator Y
Dual Bar Pointer Synchro
K Stator Z, Rotor C
L Rotor H
M Stator X
N Stator Y
Bootstrap Heading Synchro
Connector: 182-11X, Amphenol
Function: Pointers and Bootstrap
Location: Position 4
AIM 289-3D
Connector : 182-15-1000, Amphenol
Function: Slaving
Location: Position 1
Connections shown in Figure 1-9.
C 115 vac, 400 Hz.
D 115 vac, 400 Hz.
A No connection
B No connection
E No connection
Connector: 182-35-1001, Amphenol
Function: Power
Location: POsition 2
B Rotor H
C Stator X
D Stator Y
A Stator Z, Rotor C
Single Bar Pointer Synchro
E Stator Z, Rotor C
F Rotor H
H Stator X
J Stator Y
Dual Bar Pointer Synchro
K Stator Z
L Rotor H
M Stator X
N Stator Y
Bootstrap Heading Synchro
D Stator X
E Stator Y
A Rotor H
B Rotor C
H Stator Z
Connector: 126-216, Amphenol
Function: Cessna 400 Autopilot
Location: Position 3
Connector: 182-11X, Amphenol
Function: Pointers and Bootstrap
Location: Position 4
AIM 289-3ED

SUPPLEMENTAL DATA SHEET

SUBJECT: Maintenance and Overhaul Manual for AIM 400/800 Slaved Gyro and Slaved Gyro/RMI Systems

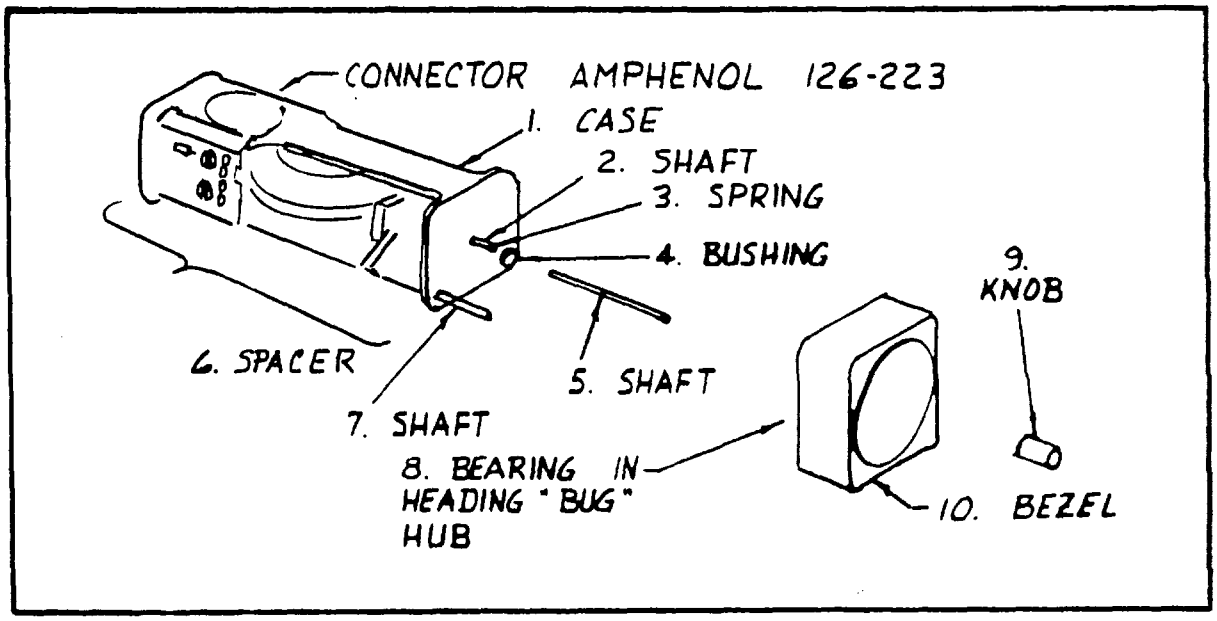
EFFECTIVE: October 1969

AIM 400G and 400G EL Slaved Gyro Systems

The AIM 400G and 400G EL Systems are designed for use with Mitchell Industries, Inc. Century II and Century III Autopilots, and with Piper Aircraft Altimatic II and Altimatic III Autopilots. The AIM 400G System employs an AIM 254-2 (vacuum-driven) gyro and the AIM 400G EL uses the AIM 254-2E (electrically-driven) gyro.

The AIM 254-2 and AIM 254-2E are identical to the AIM 254-92 and AIM 254-1E, respectively, except for the autopilot pickoff parts and the parts noted below. The pickoff parts are identical to those used in the Mitchell 52D54 Directional Gyro, and are fully described in Mitchell Industries 52D54 Maintenance and Overhaul Manual.

ITEM	DESCRIPTION	AIM PART NO.	
		254-2	254-2E
1	Case	649-0050-901	649-0124-901
2	Shaft, center	632-0056-002	632-0056-002
3	Spring	657-0022-001	657-0022-001
4	Bushing	624-0005-001	624-0005-001
5	Shaft	632-0058-001	632-0058-001
6	Spacer	616-0024-001	616-0024-001
7	Shaft	632-0014-001	632-0014-001
8	Bearing	637-0004-001	637-0004-001
9	Knob	633-0005-001	633-0005-001
10	Bezel	653-0063-901	653-0063-901



SUPPLEMENTAL DATA SHEET

SUBJECT: Overhaul Manual for AIM 400/800 Slaved Gyro and Slaved Gyro/RMI Systems

EFFECTIVE: January 1970

1. Correction on P-10A Schematic, Page 4-26

115V-400 CPS Output	E	This part is correct as shown
26V-400 CPS Output	H	
115V/26V-400 CPS Common	A	
28VDC Input	D	
DC Ground	B	

2. Correction on P-11 Schematic, Page 4-27

115V-400 CPS Output	E	This part is correct as shown
26V-400 CPS Output	H	
115V/26V-400 CPS Common	A	
14VDC	D	
DC Ground	B	

3. Additional Information

Subject: Integral Lighting

Integral Lighting is now available on AIM instruments. The parts shown on Page 2 are of interest in overhaul and repair. The "Terminations" shown are typical and vary per Airframe Manufactures requirements.

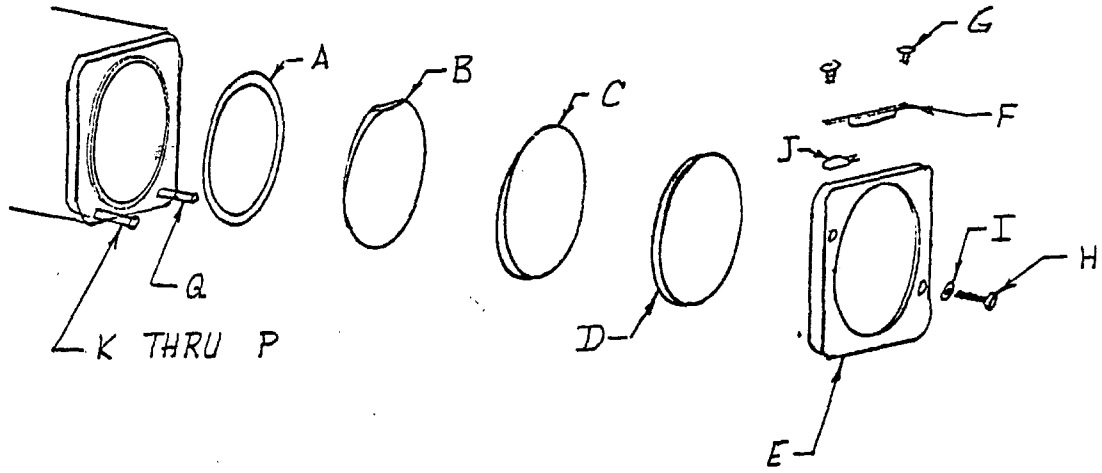
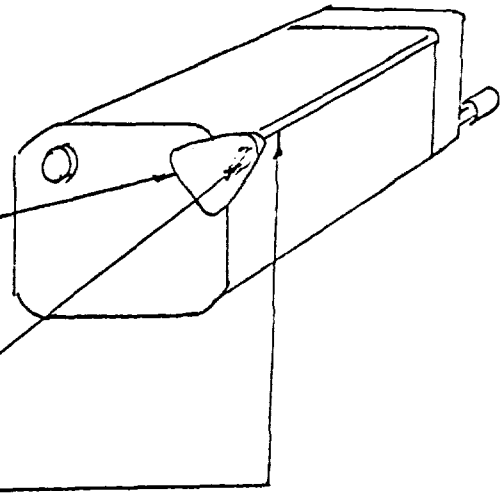


FIGURE 1

ITEM	DESCRIPTION	AIM PART NUMBER
A	Spacer	616-0049-001
B	Glass (Wedge)	612-0017-001
C	Glass (Wedge)	612-0016-001
D	Glass (Flat)	612-0015-001
E	Bezel	653-0071-901
F	Lighting Insert	622-0015-001 Blue-White 28VDC
	Lighting Insert	622-0015-002 Blue-White 14VDC
	Lighting Insert	622-0015-003 Red 5VDC
G	Screw	#4-40 x 1/4 Flat Hd.
H	Screw	#3-48 x 3/4 Fill. Hd.
I	Washer	606-0026-001
J	Circuit Board	800-0027-001
K	Shaft, Caging	632-0005-002
L	Shaft, Caging	632-0014-004
M	Shaft, Caging	632-0014-004
N	Shaft, Caging	632-0038-006
O	Not used for designation	See Table 1
P	Shaft, Caging	632-0038-004
Q	Shaft, Heading Select	632-0058-002
	Case (Not shown)	Ref., Item 315, 422, 529, 637, Page 4-2. Several of the above models require a new case which has two additional tapped holes for wiring hold down devices depending on Airframe Manufactures requirements.

TYPICAL TERMINATIONS

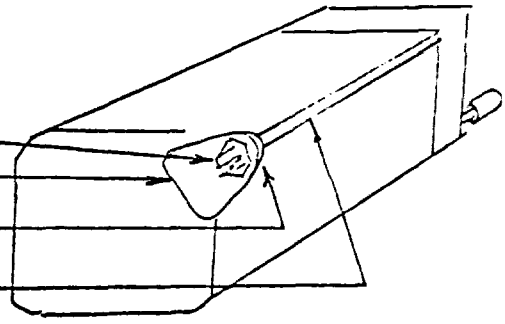


NOTE: Wires from the lighting bezel go into the back of the case then to the power connector.

641-0020-001 Adapter

Not Shown - 821-0051-001 Connector (Male)
Not Shown - 821-0051-002 Connector (Female)
Not Shown - 647-0008-001 Tubing, Thermofit

647-0009-902 Tubing, Wireway

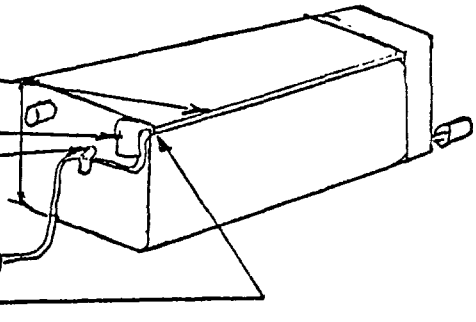


821-0007-001 Connector

641-0019-001 Adapter

Not Shown - 647-0008-001 Tubing, Thermofit

647-0009-902 Tubing, Wireway



647-0009-912 Tubing, Wireway

613-0089-901 Bracket

625-0022-001 Clamp

821-0002-001 Connector

611-0025-001 Ring, Retainer

TABLE 1

*BASIC SYSTEM	*BASIC GYRO MODEL	ITEMS K thru Q in FIG. 1
400 800	254-92 254-1S, 254-1D	K L
400 EL 800 EL	254-1E 254-1ES, 254-1ED	K L
400 C 800 C	289-1 289-1S, 289-2S, 289-1D, 289-2D	M L
400 C EL 800 C EL	289-1E 289-1ES, 289-2ES, 289-1ED, 289-2ED	M L
400 D 800 D	297-1 297-1S, 297-2S, 297-1D, 297-2D	N P
400 D EL 800 D EL	297-1E 297-1ES, 297-2ES, 297-1ED, 297-2ED	N P
400 E 800 E	424-1 424-1S, 424-2S, 424-1D, 424-2D	N P
400 E EL 800 E EL	424-1E 424-1ES, 424-2ES, 424-1ED, 424-2ED	N P
400 F 800 F	289-3 289-3S, 289-3D	M L
400 F EL 800 F EL	289-3E 289-3ES, 289-3ED	M L
400 G 800 G EL	254-2 254-2E	M, Q M, Q

*Additional suffixes will designate lighting and terminations per Airframe Manufactures requirements. Most suffixes have not been assigned at this time.

4. ARINC Zero

Delete Paragraph 3.4.1

Figure 3-1 and Figure 3-2. The 26V, 400Hz supply must not have a common to the volt meter. Many 400Hz supplies and volt meters have a common by way of the 3 prong power cords. We recommend an isolation transformer between the 400Hz supply and the test circuit shown.

SUPPLEMENTAL DATA SHEET

SUBJECT: AIM 400/800 Overhaul Manual

EFFECTIVE: April 1970

REFERENCE: AIM Flux Detector

Do not install AIM Flux Detectors or Flux Detector wiring within 2 feet of an ADF loop. Closer installation may result in noise on the ADF.

Do not install Flux Detectors within 2 feet of electrical wiring. Closer installation could result in error while night flying etc.

Use two ground return wires to the Flux Detector as shown on installation diagrams.

CORRECTION ON: Figure 1-8 (page 1-17)

Figure 3-5 (page 3-15)

To Pin "E" on Flux Detector	J
To Pin "B" on Flux Detector	A

AVIATION INSTRUMENT MANUFACTURING CORPORATION

P. O. BOX 12248

HOUSTON, TEXAS 77017



510 SERIES
ATTITUDE GYROS

AVIATION INSTRUMENT MANUFACTURING CORPORATION

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MAINTENANCE AND OVERHAUL MANUAL

for the

AIM 510 Series

ATTITUDE GYROS

AVIATION INSTRUMENT MANUFACTURING CORPORATION

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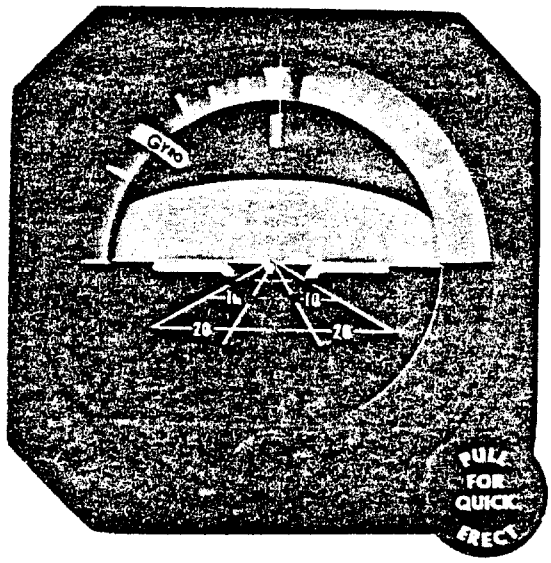


FIGURE 1-1. TYPICAL AIM 510 SERIES, ATTITUDE GYRO

SECTION 1

GENERAL INFORMATION

1.1 SCOPE

This manual contains maintenance and overhaul procedures for electrically operated AIM 510-( ) Series, Attitude Gyros manufactured by Aviation Instrument Manufacturing Corporation. Additional models will be subsequently covered by the inclusion of Supplemental Data Sheets in the front of the manual.

This manual is divided into three basic sections, the first of which is "General Information". This section explains the theory of operation which is common to the instruments covered.

Section 2 contains detailed information pertaining to disassembly, overhaul, reassembly, and checkout of the instruments.

Section 3 contains exploded-view drawings showing the location of each replaceable part. Tables associated with the drawings identify each component or assembly and list the appropriate AIM part numbers by which replacement should be ordered.

1.2 GENERAL DESCRIPTION

Although the instruments described in this manual contain variations from model to model, the basic theory of operation is common to all the units covered.

The AIM 510-( ) Series Attitude Gyros are precise, gyroscopic flight instruments, primarily designed to furnish the aircraft pilot with a visual indication of an aircraft's pitch and roll attitude with respect to the earth.

In order to achieve the desired attitude indication, the instrument must establish and maintain a stabilized datum reference perpendicular to the earth. This is accomplished by a universally mounted, self-erecting, high speed rotor which develops sufficient momentum to overcome normal bearing friction, and thus becomes stable relative to space. This stability, known as "rigidity in space", resists small forces which attempt to displace the axis of rotation, and consequently, its position in space.

The visual presentation displays pitch and roll information by means of a small symbolic airplane, and a horizon pointer bar which is mounted so that it will remain parallel to the true horizon regardless of the aircraft's attitude.

Angular movements of the aircraft in roll are indicated by means of a roll index and circular dial ring which is graduated in both primary and secondary markings. In some series the roll index is attached to the instrument case, and the dial ring moves with the gimbal. In other series the dial ring is attached to the case and the roll index moves with the gimbal. In either application, as the instrument is banked, the degree of bank is indicated by the position of the roll index to the dial ring.

1.3 PRINCIPLES OF OPERATION

Refer to the exploded-view drawings and tables of Section 3 for identification of major subassemblies and components.

The functional center of the instrument is an accurately balanced, high-speed rotor which is mounted on precision bearings inside an enclosed rotor housing. The rotor housing is suspended from bearings mounted in the gimbal assembly and is free to pivot up to $\pm$ 85° in pitch. In turn, the gimbal assembly is suspended from bearings in the rear of the instrument so that the over-all assembly has complete roll freedom about the instrument's longitudinal axis.

The rotor is driven by 400 Hz., single phase power. A capacitor, is electrically connected between the two-phase effect necessary for operation of the rotor.

The rotor drive voltage is applied to leads inside the gimbal support shaft through a brush block and slip ring assembly at the rear of the instrument. Internal wiring is then routed through the gimbal to a second brush block and slip ring assembly at the rotor housing pivot assembly. Three leads carry the drive voltage from the slip ring down through a center shaft in the rotor housing to the stator winding. The rotor and hysteresis armature ring are mounted around the stator on precision bearings so that, when power is applied to the stator, the desired rotor movement is achieved.

Small impellers are affixed to the top and bottom of the spinning rotor to generate the air flow required in order to utilize the self-erection system.

The schematic diagram is shown in Figure 1-2, 1-3 and 1-4

1.4 SPECIFICATIONS

Operating Range:

Pitch	360° freedom through controlled precession
Roll	360° gimbal freedom
Operating Temperature Range:	-30°C(-22°F) to +50°C(+122°F)
Rotor Speed:	22,000 rpm, minimum
Turn Error:	Maximum 3° bank and pitch error resulting from coordinated 180°/minute turn at 180 mph.
Bank & Pitch Indication:	Matte white dial ring & horizon pointer bar marking, arc yellow roll index and symbolic airplane on an earth-sky background.
Intergral Lighting:	Voltage and color for each 510 series instrument is specified on parts list in Section 3.
Mounting:	Standard 3-1/8 in. cut-out in shock mounted panel (See Figure 1-5)
Case Size:	See Figure 1-5.
Weight:	3.0 lbs. nominal
Power Requirements:	21 VA Max.

1.5 GYRO HANDLING

High gyro removal rate can be directly related to rough or improper handling. Gyros are delicate instruments and cannot withstand the shock of being dropped, jarred, or struck by other pieces of equipment.

To preclude damage to the gyro, it should be transported to and from the aircraft in its original container. When this procedure is impractical, the gyro should be hand-carried with special care.

Even though a gyro has malfunctioned and is being removed from the aircraft, the gyro must be handled with the same respect due a new one. It is easy to think of a gyro that has malfunctioned as one destined for the scrap pile. This is not so. It can probably be fixed. It is therefore very important that proper handling procedures also be employed during removal.

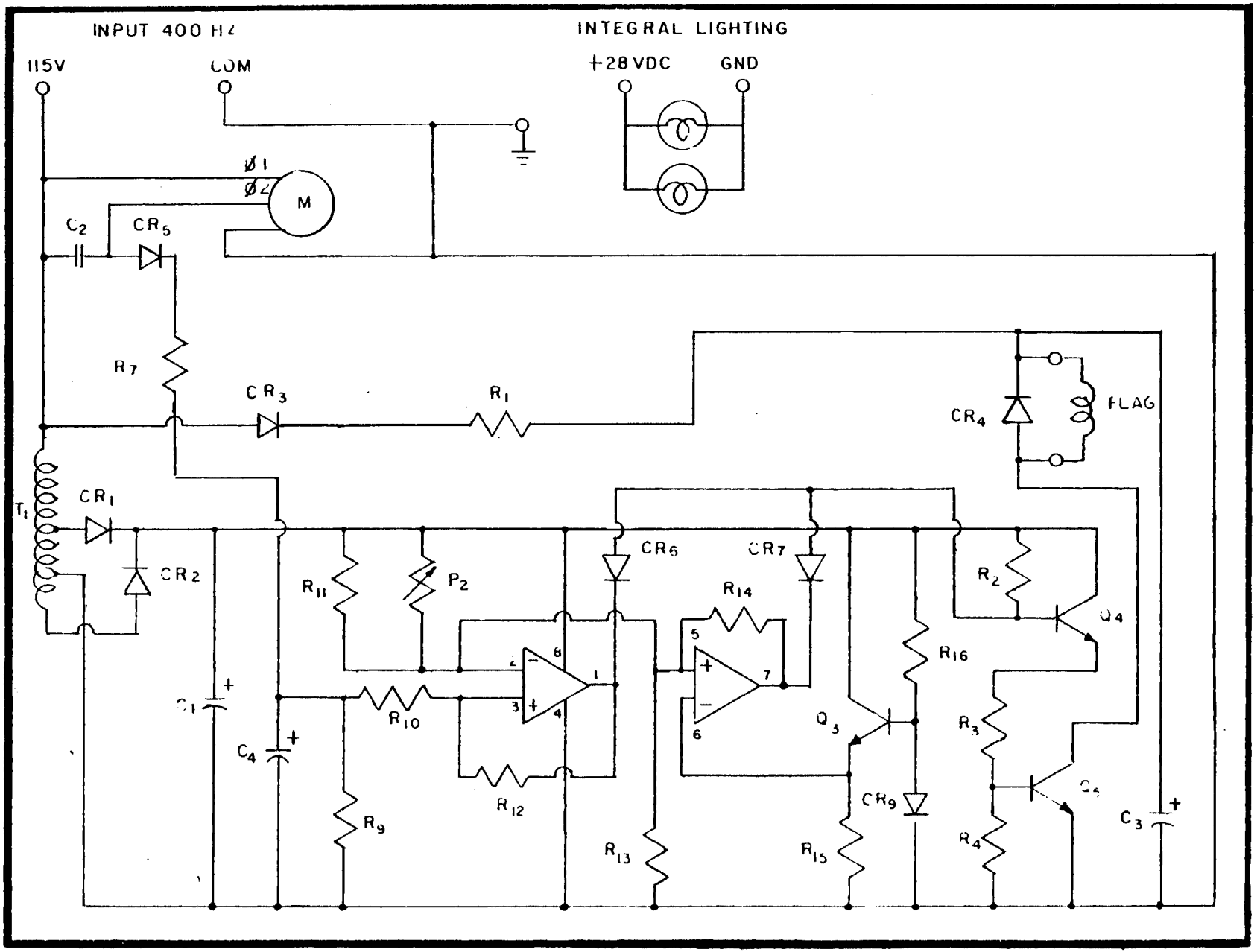


FIGURE 1-2
GYRO SCHEMATIC/WIRING DIAGRAM-115VAC, 400Hz

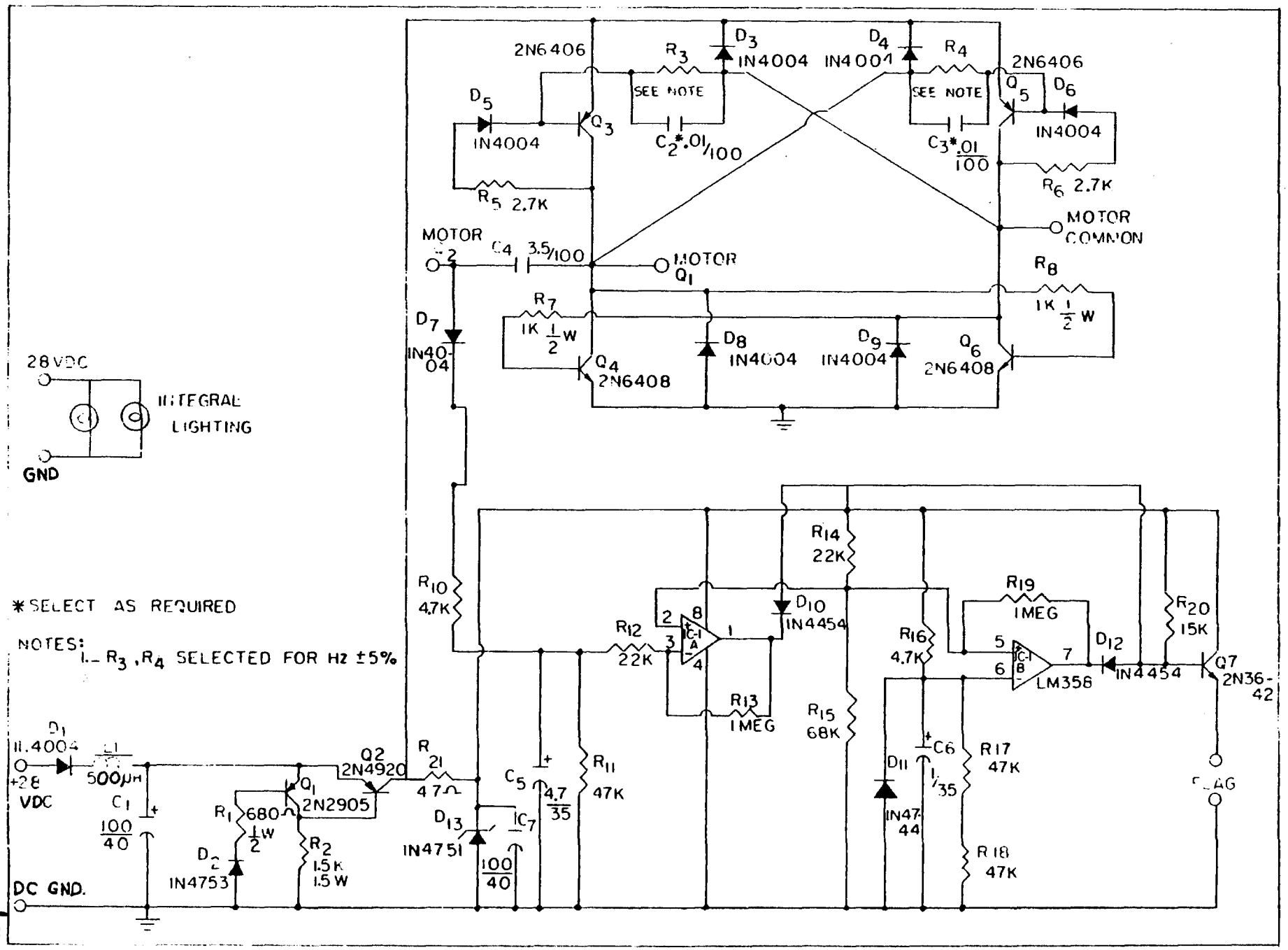


FIGURE 1-3
GYRO SCHEMATIC WIRING DIAGRAM 28VDC

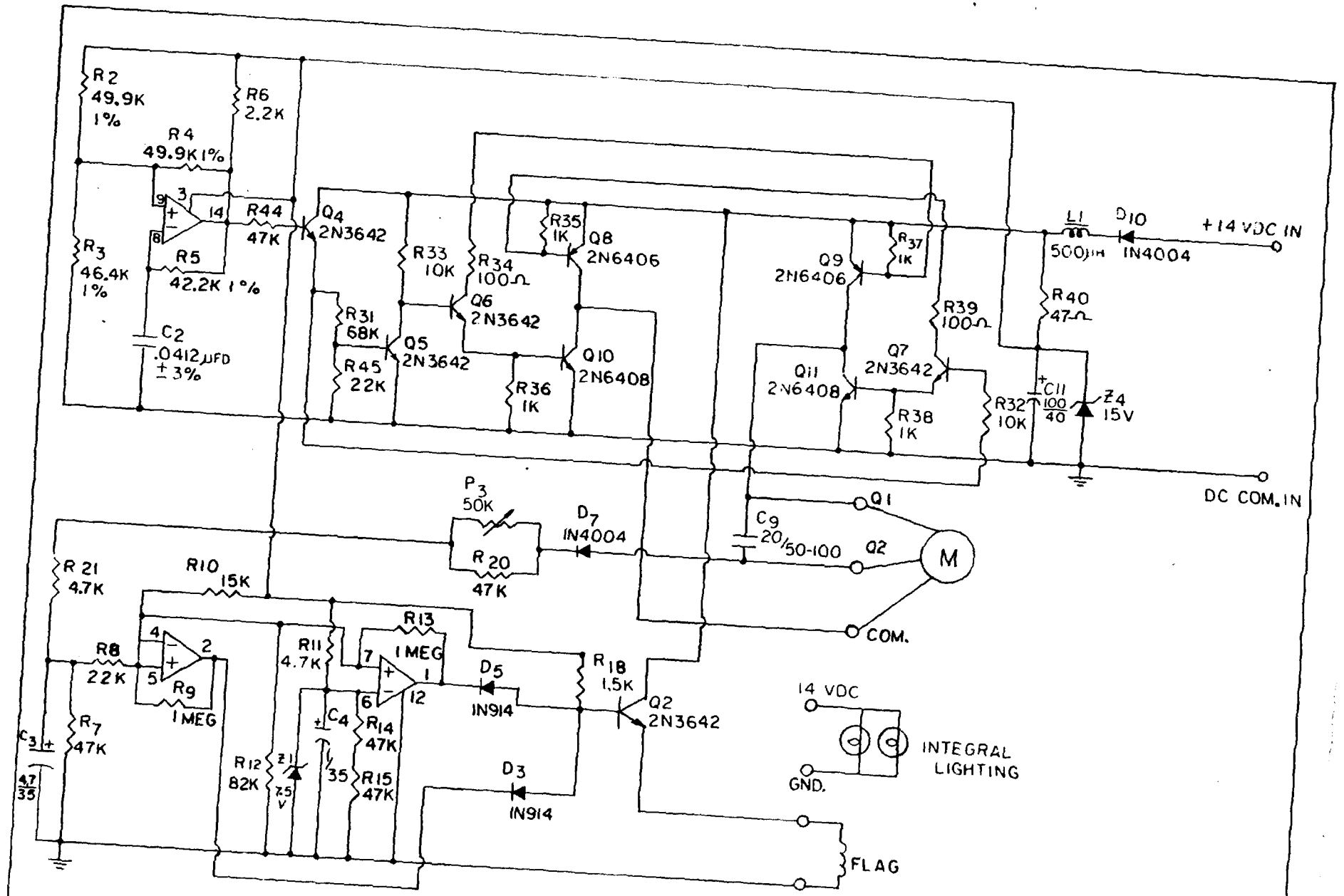

R2
49.9K
1%
R6
2.2K
R4
49.9K 1%
R44
47K
Q4
2N3642
R3
46.4K
1%
R5
42.2K 1%
C2
.0412 μFD
± 3%
R33
10K
R34
100Ω
R35
1K
Q8
2N6406
Q6
2N3642
R31
68K
Q5
2N3642
R45
22K
R36
1K
Q10
2N6408
Q9
2N6406
R37
1K
R39
100Ω
R40
47Ω
L1
500μH
D10
IN4004
+14 VDC IN
Q11
2N6408
Q7
2N3642
R38
1K
R32
10K
C11
100
40
Z4
15V
DC COM. IN
P3
50K
R20
47K
D7
IN4004
C9
20/50-100
Q1
Q2
M
COM.
R21
4.7K
R10
15K
R13
1 MEG
R11
4.7K
R8
22K
R9
1 MEG
R18
1.5K
D5
IN914
Q2
2N3642
14 VDC
INTEGRAL
LIGHTING
GND.
C3
4.7
35
R7
47K
C4
R14
47K
R12
82K
Z1
7.5
V
35
R15
47K
D3
IN914
FLAG

FIGURE 1-4

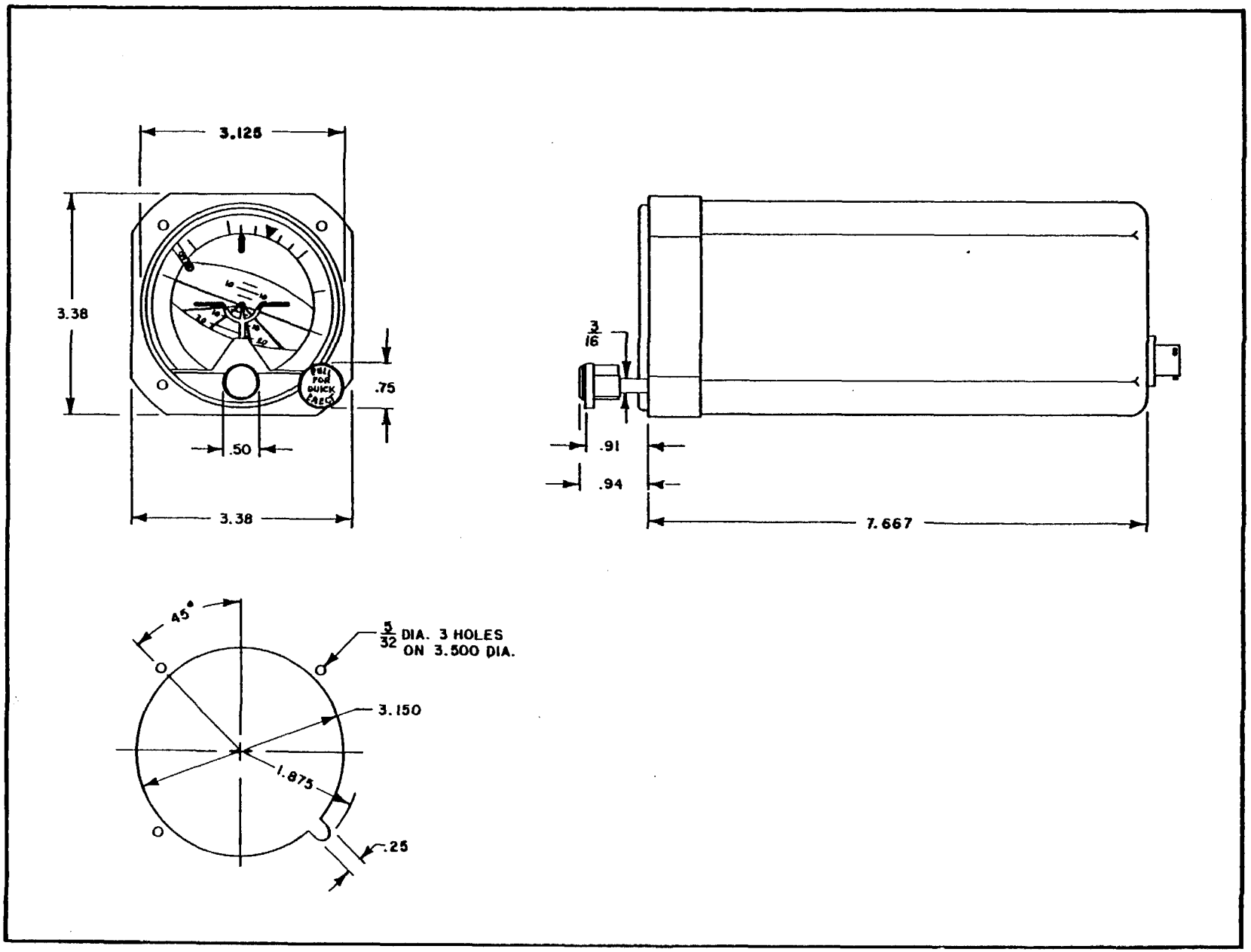


FIGURE 1-5
TYPICAL OUTLINE DIMENSIONS

SECTION 2

OVERHAUL

2.1 GENERAL

Due to the similarity in construction among all AIM 510 Series instruments, overhaul procedures have been consolidated into a single section describing disassembly, reassembly, and calibration. Most procedures contained in this section are common to all instruments, but some sections are applicable only to certain models.

Instrument overhaul may be due to a specific malfunction or merely as a routine step in a periodic maintenance program. Regardless of the reason, the disassembly and overhaul procedures in this section are applicable and should be closely followed.

Each instrument consists of several distinct subassemblies which may be separately disassembled, cleaned, reassembled and tested. Due to the construction of the instrument case, the sequence of disassembly and overhaul set forth in this section should be followed.

As each assembly is disassembled, the location of each component should be noted so that it can be replaced in the same position. When handling the mask, the horizon pointer bar, the roll index, and the circular dial ring, care should be taken to avoid soiling or scratching the various markings. All bearings, pivots and jewels should be handled with assembly tweezers to avoid contamination. Iridited, oxided or passivated parts must be protected against scratching or marring. Self-locking nuts with worn fibers must be replaced. Nuts and screws used for balancing must be secured in the final adjusted position by "Glyptal", 5 minute epoxy maybe used as an alternate. Solvents used for cleaning must be high grade such as Chlorothene-Nu (Dow Chemical Company).

2.2 TOOLS AND EQUIPMENT REQUIRED

2.2.1 General

Although the instrument can be completely disassembled and reassembled using only the standard instrument-shop handtools listed in paragraph 2.2.2, special attention should be given to the additional equipment required under 2.2.3. This equipment, although not directly used in assembling or disassembling the instrument, must be available to properly calibrate and checkout the instrument's operating characteristics after overhaul.

2.2.2 Handtools

All routine maintenance, repair, claibration and checkout may be accomplished with the following basic handtools:

1. Assembly tweezers
2. Eye loupe
3. Selection of small screwdrivers and nut drivers
4. #2, #4, #6 and #8 Bristol Wrench
5. 3/8, 3/16 and 1/2 open-end wrenches

2.2.3 Balancing, Calibration and Checkout Equipment

The following equipment is required to properly balance, calibrate or check out the instrument.

1. Power source capable of adjustment from 80% to 100% of the rated power.
2. Milliameter capable of reading 80% to 100% of the rated current consumption.
3. Stop watch
4. Gram gauge capable of measuring brush tension of 1-1/2, $\pm$1/2 gram.
5. Ultrasonic cleaning equipment (recommended but not required).
6. Test stand capable of holding gimbal assembly in normal position.
7. Suitable work area free from dust.

8. Strobotac

9. Test stand capable of testing roll and pitch within 1/2° accuracy, and capable of applying between 25 and 33 cycles/second at ±.005 in. total displacement to the instrument.

2.2.4 Expendable Supplies

The following expendable supplies should be available before attempting to overhaul the instrument.

1. Chlorothene-Nu (Dow Chemical Company)

2. Watch paper

3. Blue Glyptal (General Electric Company)

4. 5 min. epoxy (Devon Corp.)

5. Amicon Bonding Compound (Amicon Corp). Used on some rotor assemblies.

6. Sealing Tape, Black "Velvet Coated" plastic (Scotch Brand).

2.3 DISASSEMBLY PROCEDURES

2.3.1 General

Before proceeding with disassembly of any component, the degree of wear, end play, backlash, and general appearance must be checked and noted as an aid in reassembly.

During disassembly, extreme care must be used in the removal of any component. Use of proper tools is important to prevent damage by scratching or marring. Screws or other attaching parts must be carefully identified during disassembly for correct replacement during reassembly.

Due to the delicate rebalancing required and the precision parts involved, disassembly and overhaul of the rotor is not recommended. Should the rotor become defective and fail to meet the performance requirements set forth in paragraph 2.8, the used rotor should be returned to AIM for an exchange discount on a new replacement assembly. However, should field overhaul of the rotor become necessary, appropriate instructions are provided in section 2.6.

If a replacement rotor assembly is obtained from AIM, it will be closely balanced and adjusted when received.

2.3.2 Removal of Dust Cover

Remove two binder head screws and sealing tape holding the dust cover to the case. Separate the dust cover from the case by carefully sliding the dust cover gasket with the dust cover.

2.3.3 Removal of Bezel Insert Assembly

1. Move warning flag back to clear the dial ring and secure.

2. Remove the retainer ring securing the bezel insert assembly in the case.

3. Carefully remove the bezel insert assembly by pulling it forward, holding the miniature airplane knob. Care should be taken not to let the components separate from each other during removal.

4. After removal, hold the components together with a small piece of tape, and set aside for future disassembly.

2.3.4 Removal of circuit board Assembly

1. Remove the two binder head screws securing the brush block to the rear of the case.

2. Loosen the nut, or 2 screws on same series, securing the connector to the rear of the case. Slide the connector down and away from the case.

3. Unsolder the two wires from the flag motor and the two wires from the lighting insert. Take note and tag their locations.

4. Remove two binder head screws securing the circuit board assembly to the rear of the case.

5. Remove the circuit board assembly and set it aside for future disassembly. Protect the brush block in some manner to avoid damage.

2.3.5 Removal of Gimbal Assembly

1. Remove the 5/16 nut and lock washer securing the gimbal assembly to the case.

2. Slip the gimbal assembly forward and out of the case.

2.3.6 Disassembly of Gimbal Assembly

Mount the gimbal assembly in a holding fixture and proceed with the following disassembly.

1. Remove the four binder head screws securing the dial to the gimbal and set it aside.

2. Remove the four binder head screws securing the pointer bar assembly to the gimbal and set the pointer bar aside for future disassembly.

3. Remove the two binder head screws securing the mask to the gimbal and set the mask aside.

4. Remove the binder head screw and lock washer securing the pointer bar actuator to the rotor housing assembly and carefully draw the actuator through the hole in the gimbal. Take care to keep the pointer bar actuator and the bushing together.

5. Remove the binder head screw and lock washer securing the pitch cam and bearing housing to the rotor housing assembly.

6. Unsolder the three wires from the brush block on the terminal board at the rear of the gimbal assembly. Note and tag their locations.

7. Remove the binder head screws securing the brush block to the gimbal and carefully remove the brush block. Protect the brushes from damage and set aside.

8. Remove two flat head screws securing the bearing housing and remove the bearing housing and bearings.

9. Rotate the gimbal assembly so the slip ring is down and hold it in position. Remove the bearing pivot and pitch cam.

10. Remove the rotor housing assembly by very carefully rotating the gimbal so the slip ring is in an up position, thus allowing the rotor housing assembly to move down.

CAUTION

Do not allow rotor housing to
fall and damage the slip ring.

Rotate the rotor housing assembly so the slip ring clears the hole in the gimbal and remove the rotor housing assembly.

11. To remove the gimbal support shaft and slip ring, remove four binder head screws securing the support shaft to the gimbal. Carefully lift the terminal plate and unsolder the three wires from the slip ring. Take note and tag their location.

2.3.7 Disassembly of Case Assembly

1. Remove the caging support shaft through the hole provided in the rear of the case.

2. Remove the caging shaft and caging bracket by first removing the setscrew in the retaining collar closest to the front of the case, then the collar closest to the rear. Remove the two setscrews securing the remaining collars and slide the shaft forward and out of the case. Take care not to let the springs recoil causing damage or loss of parts.

3. Remove the binder head screw that holds the flag indicator motor in place and carefully slip it through the opening.

4. Remove two flat head screws securing the lighting insert to the case and carefully remove the lighting circuit board and wires from the case.

2.3.8 Disassembly of Pointer Bar Assembly

Remove the hex nuts securing the pointer bar shaft, bearing retainer, and bearing to each side of the pointer bar. Take note of the number of shims used and their location.

NOTE

Do not remove balance weights

2.4 CLEANING

2.4.1 General

Due to precision components and close tolerances employed in the manufacture of this unit, foreign matter can greatly impair its over-all operating efficiency and service life. It is therefore recommended that every possible step be taken to insure maximum possible protection of each subassembly. As each component is removed during disassemly, it should be placed in a dust-free environment and protected with a dust-proof cover.

2.4.2 Pivots, Housing, Etc.

During overhaul, all parts should be cleaned carefully to remove oil, dirt, and moisture. If possible, the use of ultrasonic cleaning is highly recommended to insure that all parts with small bores or tapped holes can be effectively cleaned. If this is not possible, component parts such as pivots, bearings, shims, etc. should be thoroughly cleaned in high-grade solvent such as Chlorothene-Nu (Dow Chemical Co.), and then air dried with clean low pressure air. If cleaning solvent is used, it must not be allowed to become dirty and must be changed frequently.

Extreme care should be taken to avoid damage to small or delicate parts during cleaning. In addition, arrangements must be made to permit identification of each part with respect to its previous location in the instrument.

After cleaning, provisions must be made to adequately protect the parts from damage and dust while awaiting inspection and reassembly.

2.5 INSPECTION AND REPAIR

2.5.1 General

All parts should be thoroughly examined with an eye loupe for any evidence of excessive wear or damage prior to reassembly. Repair of defective parts is recommended only when it can be done without adversely affecting the proper operation of the instrument. If doubt exists as to the operating condition of any part or assembly, refer to the parts list section of this manual and order replacement parts directly from AIM. During overhaul, examine each part for evidence of corrosion or breakdown in the plating material. Aluminum parts of the gyro are protected by anodize or iridite treatment and stainless steel parts are passivated. If a crocus cloth is used to remove corrosion, or if the plating material appears to be worn through, replace or protect the defective area with a light coat of clear lacquer.

Particular attention should be given to parts which contain internal or external threads. If any evidence of damage to the threads is found, repairs should be made using the correct tap or thread restorer. The part should then be thoroughly re-cleaned and re-examined prior to assembly.

2.5.2 Bearings

The precision bearings used throughout the instrument are designed to provide extremely efficient service over long periods of time. Each bearing should be individually examined for evidence of damage. If defects are noted, the entire bearing should be replaced. No attempt should be made to polish the balls, or otherwise repair the separate bearing parts.

Bearings used in this instrument are precision, instrument grade, and must not be replaced with inferior substitutes. Each bearing is lubricated with specific quantities and types of lubricants best suited for its individual function. This lubricant improves the performance of the bearings and substantially increases their service life. It is therefore recommended that replacement bearings be ordered directly from AIM in order to insure maximum operating efficiency.

2.5.3 Support Shaft, Bearing Housings, and Pivots

Each pivot or support shaft should be examined carefully for evidence of pits and scoring. Due to the precision fit of their respective bearings, the pivots and support shaft should seldom incur any type of ex-

cessive damage. If small scratches are noted, a light polishing should be all that is necessary. However, if scoring or other excessive wear is noted, a replacement pivot or support shaft should be obtained from AIM.

Disassemble each bearing housing and check that a clean used bearing will fit the diameter of the pivot assembly with no more than finger pressure applied.

2.6 ROTOR OVERHAUL

2.6.1 General

As previously stated in this manual, disassembly and overhaul of the rotor assembly is not recommended due to the precision parts involved, and the high speed of the rotor, reassembly and proper adjustment is extremely critical and should not normally be attempted in the field. Should the rotor become defective and fail to meet the performance requirements set forth in this manual, the used rotor assembly should be returned to AIM for an exchange discount on a replacement assembly. However,if this is not possible, and disassembly and overhaul does become necessary in the field, the procedures shown in the remainder of this section should be followed. Do not attempt to overhaul the rotor unless it fails to meet the operating requirements as set forth in paragraph 2.8.

2.6.2 Disassembly of Electric Rotor and Rotor Housing

1. Remove the vanes, the top rotor support nut, and the four rotor cover screws.

2. Unsolder the three rotor leads (Note their location).

3. Carefully remove cover and thread rotor assembly out of the rotor housing using the hex in the lower end of the rotor shaft.

4. To obtain access to the rotor bearings, remove the impellers from each bearing housing and remove the preload nut and spacer from each end of the rotor shaft. The bearings are protected by a small bearing retainer over each end of the rotor shaft.

5. Care should be taken to avoid loss of the spacers and bearing retainers between the preload nut and the bearing, located on each end of the rotor shaft.

NOTE

Removal of the bearing housings on each end of the inertia ring is not normally required and is not recommended. If either bearing housing is removed, delicate rebalancing of the inertia ring assembly will be required. If the bearing housing must be removed to obtain access to the stator, it is suggested that a mark be made at the interface between the inertia ring and each bearing housing to simplify re-assembly and minimize the rebalancing required.

6. On some rotors the bearing housing are bonded to the inertia ring. On others, the bearing housings are mounted to the inertia ring by retaining screws. To remove bonded bearing housing from the inertia ring, place a sharp tool where the two are joined and tap sharply, repeat this tapping procedure in several places around the inertia ring. On other types, simply remove retaining screws and disassemble.

2.6.3 Inspection, Cleaning, And Repair

Clean the various rotor parts in accordance with the procedures set forth in paragraph 2.4. After cleaning, each part must be adequately protected from dust while awaiting reassembly.

No attempt should be made to clean, re-oil or otherwise repair the rotor bearings. If the bearings are defective, they should be replaced.

2.6.4 Reassembly

NOTE

If bonded bearing housings have been removed, center them to inertia ring with Amicon Bonding Compound.

1. Install the rotor bearings over each end of the rotor shaft with the identification marks on the inner race facing outward.

2. Install the bearing retainers with the recessed side toward the center of the rotor.

3. Re-install the impellers on each bearing housing if they were removed during disassembly. The impeller with the longer blades goes on the bottom.

4. Install the spacer and preload nut on each end of the rotor shaft.

2.6.5 Rotor Bearing Preload and Run-in Procedures

1. Set the bottom preload nut tight against the bearing spacer. This is the end of the shaft with the short bearing surface.

2. Carefully tighten the top preload nut until the detectable axial end play between rotor and shaft just disappears. This rotor bearing preload adjustment is very critical and must not be exceeded if normal bearing life is to be realized. At the correct setting the rotor shaft will spin freely in the rotor assembly and have no detectable end play. To check for proper adjustment, hold the rotor stationary and spin the rotor shaft. If a noticeable roughness is apparent, the preload is set too tight or the bearings are damaged.

3. When preload has been completed, thread the rotor shaft into the rotor housing and install the cover, rotor support nut, and resolder leads.

4. Install the rotor housing and both pivots in the gimbal or in a suitable run-in fixture.

5. Run rotor for 48 hours with rated voltage, single phase power applied and using a phase shift capacitor to shift the phase of one winding by 90°. Recheck the preload setting after run-in and readjust as required in paragraph (2) above.

6. If preload had to be reset, run the rotor for an additional 24 hours and check the rotor start performance. The rotor must start and continue running with 80% rated voltage applied. If the rotor fails to start at 80% rated voltage, the top preload nut should be readjusted.

7. Check that the rotor attains a speed of 22,000 rpm min. within 3 minutes max. with rated voltage applied, and that it coasts for 5 minutes minimum after power is removed. If the rundown time is less than 5 minutes, readjust the top preload nut.

8. Install the rotor housing in a balancing fixture or in the gimbal to properly locate the rotor in the housing. Balancing should be accomplished with the vanes installed. Balance the assembly by turning the rotor shaft as required to center the rotor in the housing. When proper adjustment has been achieved, secure the rotor shaft and the rotor support nuts with Glyptal only.

2.6.6 Rotor Vane Adjustment

The electric rotor employs two non-interchangeable vanes, each of which should be adjusted as follows:

1. Vanes must not drag on the rotor housing.

2. Vane clearance at the rotor erector jet should be .010±.005 inch.

2.7 REASSEMBLY PROCEDURES

2.7.1 General

Throughout the reassembly procedures, extreme care must be taken to prevent damage or contamination of the various component parts and subassemblies. When joining two parts, they must not be forced together. As each subassembly is completed, it must be covered while awaiting further installation to a mating assembly or component.

All adjusting screws must be secured in their final adjusted position by use of Glyptal. Five minute epoxy may be used as an alternate.

2.7.2 Installation of Caging Shaft in Case

1. Insert the shaft through the hole provided until it protrudes into the web area. Compress the long return spring slightly and reassemble it over the shaft. Slide the shaft to within about one inch of the rear web in the case.

Depress the spring and insert the caging shaft collars. Slide the shaft through the rear web and assemble the caging bracket, shaft collars, and spring. Fasten the collars in the web area to the shaft with setscrews. Fasten the collars in the caging bracket area with setscrews.

2. Insert the caging bracket support shaft through the hole provided in the rear of the case and secure.

2.7.3 Installation of Flag Motor

1. Insert the flag motor in the area provided and secure with a binder head screw and lock washer.

2. Feed the wires through to the back of the case and temporarily secure.

2.7.4 Reassembly of Pointer Bar Assembly

Secure the pointer bar shaft, bearing cover, bearings, and their required shims to each side of the pointer bar. Care should be taken to shim the pointer bar shaft in the same manner as previously assembled. Check the static balance of the pointer bar. There should be no axial play between the shaft and the pointer bar.

2.7.5 Reassembly of Gimbal Assembly

1. Insert the slip ring wires from the support shaft through the hole provided.

2. Install the support shaft on the gimbal with four binder head screws, leaving them loose.

3. Solder the three wires from the slip ring to the terminal plate as noted during disassembly, and install the terminal plate in the location provided. Mount the support shaft to the gimbal and tighten the four binder head screws.

4. Install the rotor housing assembly in the gimbal by carefully rotating the rotor housing assembly in the reverse direction from that used during disassembly. Rotate the gimbal while holding the rotor housing assembly so the left side of the gimbal is down. Install the pitch cam and bearing housing, and the bearing, and secure with one binder head screw and lock washer. Insert the right bearing pivot. At this time the pivot should just engage the bearing about half way. Rotate the gimbal so the right bearing pivot is down and install the left bearing and bearing housing and secure with two flat head screws. Rotate the gimbal so the left side is down again and set the end play so you can feel only a slight movement of the rotor housing in the gimbal.

5. Install the brush block in the gimbal with one binder head screw. Depress the leads, and rotate them along the gimbal and through the hole provided in the rear of the gimbal. Solder them to the terminal plate in the proper location. Check that the tension on each brush is 1-1/2 $\pm$ 1/2 grams. Rotate the rotor housing assembly $\pm 85^{\circ}$ and check that the brushes do not drop away from the slip ring at any point.

6. Install the pointer bar drive and bushing with one binder head screw and lock washer. Leave this screw slightly loose.

7. Install the mask to the front of the gimbal with two binder head screws.

8. Install the pointer bar assembly to the gimbal with four binder head screws that secure the two bearings to the side of the gimbal.

9. Install the dial to the front of the gimbal with four binder head screws and adjust the dial to produce .03 min. clearance between the dial and the pointer bar.

2.7.6 Reinstallation of Gimbal in Case Assembly

1. Install one support shaft bearing on the gimbal assembly.

2. Install the gimbal in the case through the case bezel opening.

3. Install the second bearing on the support shaft at the rear of the case.

4. Secure the gimbal assembly in the case with a 5/16 nut and lock ring. Take care to set the end play of the two support shaft bearings at 0 to slight end play. Do not over-torque the nut against the bearings. This will damage the bearings. Lock the 5/16 nut in place by bending two tabs on the lock ring against the flats.

2.7.7 Reinstallation of Circuit Board Assembly

1. Mount the circuit board assembly to the case and secure with two binder head screws.

2. Slide the connector wires through the slot provided at the rear of the case and secure the connector to the case.

3. Install the rear brush block to the case. Check that the tension of the brushes is 1-1/2 ± 1/2 grams. Roll the gimbal 360° and check that the brushes do not drop away from the slip ring.

4. Resolder the two wires from the flag motor to their respective points on the circuit board assembly.

5. Install the lighting insert assembly and secure with two flat head screws. Resolder the two wires to their respective points on the circuit board assembly.

2.7.8 Installation of Bezel Insert

1. Carefully insert the bezel insert assembly in the case opening. Take care that the locator in the case and the bezel line up, and secure with the spring retainer.

2.7.9 Balancing Rotor Housing and Gimbal Assembly

1. Mount the instrument on the test stand.

2. Center all calibration screws prior to balancing. Also center the roll and pitch vanes and secure with tape to prevent movement during balancing.

3. Add a 1.7 gram weight to the top of the rotor housing.

4. Place the test stand so that the instrument longitudinal axis is vertical. Balance the rotor housing to a horizontal position by adjusting the rotor center, by means of the hexagon hole in the rotor shaft.

5. Place the test stand so that the instrument longitudinal axis is horizontal. Rotate the gimbal assembly so the inner gimbal axis is vertical and adjust the gimbal assembly balance by adding weight to the adjustment screw on the bottom of the gimbal.

6. Remove the 1.7 gram weight and allow the inner gimbal axis to return to a horizontal position.

7. Balance the gimbal assembly horizontal position by adding weight to either the right or left side of the gimbal. Secure screws and weights with Glyptal.

2.7.10 Installation of Dust Cover

1. Slide the dust cover forward on the case and secure with two binder head screws. Make sure the dust cover gasket is in place.

2.8 FUNCTIONAL TEST AND ADJUSTMENTS

2.8.1 General

The following test and calibration procedures may be used to either isolate malfunctions in the instrument prior to overhaul, or to check-out and recalibrate the instrument after overhaul has been accomplished. Included with each test are suggested corrective measures which should be employed if the instrument fails to meet the required performance specifications. These tests are "open" calibration tests and are performed with the dust cover removed.

2.8.2 Test Equipment Required

Reference Paragraph 2.2.3

2.8.3 Visual Inspection

The following visual checks shall be made prior to testing and again after calibration has been completed.

1. Check that all screws are tightened securely and staked with Glyptal or 5 min. epoxy.

2. Check that all solder joints are secure and properly soldered.

3. Check that the gimbal assembly is free through 360° roll with the rotor housing in the extreme dive and climb positions.

4. Observe the horizon pointer bar and rotor housing for evidence of drag against adjacent parts through ±85° of pitch travel.

5. Check that clearance between symbolic airplane and pointer bar is .032 ± .016.

6. Verify lights burn evenly at rated voltage.

7. Verify dust, lint, and scratches are not visible on instrument display parts when unit is lighted, and viewed from arm's length.

2.8.4 Rotor Start Test

Check that the power consumption is 21va max. at rated voltage. Running current should be slightly less than the starting current.

If the instrument fails to meet the above requirements, the rotor bearings may be worn, or the circuitry may be malfunctioning. Use a voltmeter to check that proper voltage is being applied to the motor. to check the rotor, disconnect the rotor leads from the circuitry and use a 400Hz. variable power supply to check the rotor starting voltage and run-down time as described in paragraph 2.6.5, step 6. Note that power must be applied to the rotor through a phase shift capacitor in series with one rotor winding.

2.8.5 Rotor Speed Test

Apply rated power to the instrument and allow three minutes for the rotor to gain speed and stabilize. The rotor should attain a speed of 22,000 rpm or greater.

2.8.6 Brush Contact Test

Rotate the instrument through 360° of roll and check for any variation in current. Also tilt the rotor housing to its limits of travel and check for current variation. If current does vary, readjust tension on the appropriate brushes so that the brushes do not drop away from their respective slip ring. The tension on each brush should be between 1 1/2 ± 1/2 grams.

2.8.7 Rotor Coast Test

After the conditions described in the Rotor Speed Test of paragraph 2.8.5 have been achieved, disconnect power from the instrument. The rotor run-down time must be 5 minutes or more.

If the rotor fails to coast the required length of time, replacement or overhaul of the complete rotor should be accomplished.

2.8.8 Erection and Calibration Tests

For this test, vibration shall be applied to the instrument to minimize frictional effects.

The frequency shall be between 25 and 33 cycles per second and amplitude between .002 and .005 inch double amplitude.

1. Apply power, manually erect and allow the instrument to settle.

2. After the instrument has reached operating speed, turn power off and rotate the instrument 180° in azimuth within a 10 second period to check bar rise and bank indication. The bar must rise 0° to 2° for helicopter application and 4° to 6° for fixed wing aircraft application. If it does not, adjust the pitch vane balancing screw as shown in Figure 2-1. If the roll indice does not indicate level ±1°, adjust the roll vane balancing screw as shown in Figure 2-1.

3. Check that the pointer bar aligns with the two 90° roll marks on the dial ±1°, and that the roll index aligns with the zero roll mark on the dial ±1°.

4. Cage the instrument and check that the caged position corresponds with the zero position ±2°.

5. Precess the rotor housing to the extreme dive (pointer bar up) and climb (pointer bar down) conditions. The horizon pointer bar must not touch adjacent parts at any point.

6. With power applied, precess the rotor to a 20° right bank condition with the horizon pointer bar centered in pitch.

7. Note the time required for the rotor to return to 10° right bank.

8. With power applied, precess the rotor to a 20° left bank condition with the horizon pointer bar centered in pitch.

9. Note the time required for the rotor to return to 10° left bank. The erection time shall be between 55 seconds and 2 1/2 minutes. If the difference between the two erection times is 60 seconds or more, an adjustment must be made as shown in Figure 2-1.

10. Repeat the above erection tests in the climb and dive positions.

NOTE

If difficulty is encountered in setting either the roll or pitch rates, check for improper bar balance or excessive bearing drag.

2.8.9 Warning Flag Test

For 115 VAC Gyros

1. Set variable 115 Volt, 400 HZ power supply at 115 VAC sine wave. Plug in non-running gyro. Flag must disappear within 45 to 180 seconds.

2. Let gyro attain full speed by running at 115V for 5 minutes.

3. Reset power supply to 105 VAC and interrupt power momentarily. Flag must appear and disappear again within 5 seconds.

4. Slowly reduce voltage. Flag must appear on or before 80 VAC.

NOTE

If flag does not disappear within 45 to 180 sec. adjust P1. (See Fig. 3-6)

If flag does not appear before 80 VAC adjust P2. (See Fig. 3-6)

Detail Setting:

1. With no power to non-running gyro set P1 fully CCW, set P2 approximately mid range.

2. Set variable 115 Volt, 400 HZ power supply between 85 and 90 VAC. Plug in non-running gyro.

3. Slowly adjust P2 to make flag appear and disappear (adjustment of P2 achieved when flag has disappeared).

4. Set P1 fully CW and variable 115 Volt test box to 115 VAC.

5. Turn off power.

6. After allowing rotor to stop, turn power on and start timing the amount of time required for flag to disappear. (If flag has not disappeared before 90 seconds slowly adjust P1 (CCW).

7. Let gyro attain full speed by running at 115 VAC for 5 minutes.

8. Slowly reduce voltage. Flag must appear on or before 80 VAC. (If flag has not appeared adjust P2).

9. After final setting of P1 and P2, perform final inspection test.

For 28 VDC Gyros and 14 VDC Gyros

1. Apply rated voltage to the gyro. The flag must disappear.

2. Slowly reduce the voltage. The flag will appear at approximately 20 VDC for 28 VDC gyros and approximately 11 VDC for 14 VDC gyros.

2.8.10 Spin Test

Tilt the gyro to 10° climb and disconnect power. The gyro gimbal must not spin in roll. The gyro may precess up to ±80° in roll and pitch but must not roll completely over during run-down.

If the gyro spins in roll, the following possible defects should be checked:

1. Check roll and pitch bearings. Replace bearings if defective.

2. Bearings may be excessively preloaded.

3. Rotor bearing preload may be excessive. Check rotor coast performance as described in paragraph 2.7.9.

4. Rotor housing may not possess enough bottom-heaviness. Refer to the balancing procedures of paragraph 2.7.9.

CAUTION

Do not add excess bottom heaviness. This will result in turn errors in flight which may not be apparent on bench test.

2.9 FINAL OPERATIONAL AND APPEARANCE CHECKS

(Recommended Accemptance Test Procedure)

NOTE

The following tests are performed with the dust cover in place.

2.9.1 Presentation

1. Verify lights burn evenly at rated voltage.

2. Verify dust, lint, and scratches are not visible on instrument display parts when unit is lighted and viewed from arm's length.

2.9.2 Rotor Performance Test

1. With 80% rated voltage applied, the unit shall start and continue to run.

2. With rated voltage applied, power consumption shall not exceed 21va.

2.9.3 Settling Test

1. With rated voltage applied, allow three minutes for it to obtain speed with vibration applied to the stand, and then manually quick erect the unit. The unit shall settle within $\pm$1 degree of level in roll and pitch. The applied vibration shall be between 25 and 33 cycles per second and between .002 and .005 inch double amplitude.

2.9.4 Erection Rate Test

1. The erection rates shall be as follows:

ROLL AXIS		PITCH AXIS	
From Left to Left	20° 10°	From Dive to Dive	20° 10°
Time	0'55" to 2'30"	Time	0'55" to 2'30"
From Right to Right	20° 10°	From Climb to Climb	20° 10°
Time	0'55" to 2'30"	Time	0'55" to 2'30"

Maximum difference between left and right and dive and climb shall not exceed 60".

2. The change in roll indications during pitch erection tests must not exceed $\pm 3^\circ$.

3. *The change in pitch indications during roll erection tests must not exceed* $\pm 3^\circ$.

2.9.5 Verticality Test

1. Allowable deviation of bank and pitch indication, directly after azimuth rotation of 180 degrees within 10 seconds shall be as follows:

   (a) Roll shall be $+1^\circ$ of level
   (b) Pitch bar rise shall be 0° to 2° for helicopter application and 4° to 6° for fixed wing aircraft application.

2.9.6 Caging Checks

1. With unit operating at rated voltage, pull quick erect knob, unit shall cage within $\pm 2^\circ$ of its horizontal and vertical 0° position.

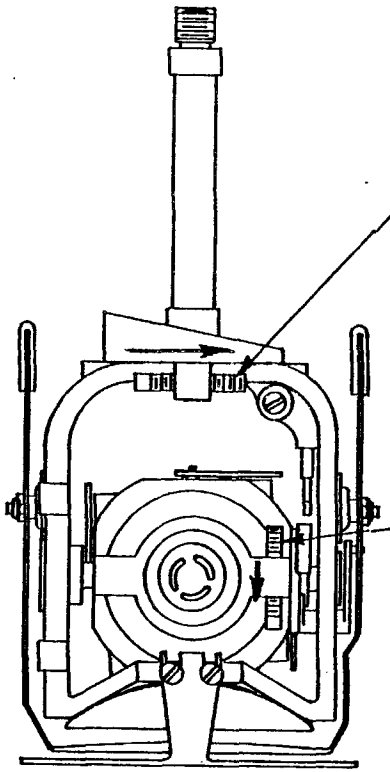
2.9.7 Warning Flag Test

1. Apply rated voltage to the unit. The flag must disappear.

2. Slowly reduce voltage to approximately 20 VDC for 28 VDC Gyros, 11 VDC for 14 VDC Gyros, and 80 VAC for 115 VAC Gyros. Flag must appear on or before stated voltage is reached.

2.9.8 Spin Test

Tilt the gyro to 10° climb and disconnect power. The gyro gimbal must not spin in roll. The gyro may precess up to $\pm 80^\circ$ in roll and pitch but must not roll completely over during run-down.

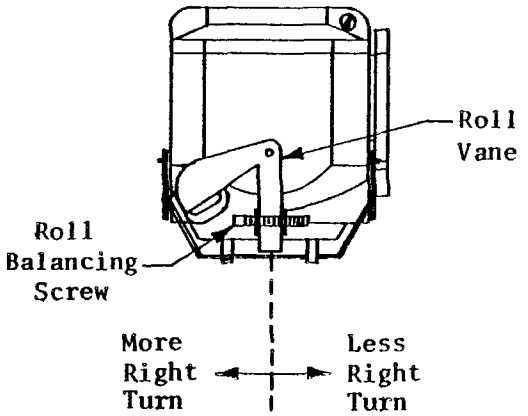


Pitch Erection Rate Adjustment Screw

If dive erection time exceeds climb erection time, adjust screw in direction shown. Reverse adjustment if climb erection time exceeds dive erection time.

Roll Erection Rate Adjustment Screw

If right bank erection time exceeds left bank erection time, adjust screws in direction shown. Reverse adjustment if left bank erection time exceeds right bank erection time.



Front of Instrument

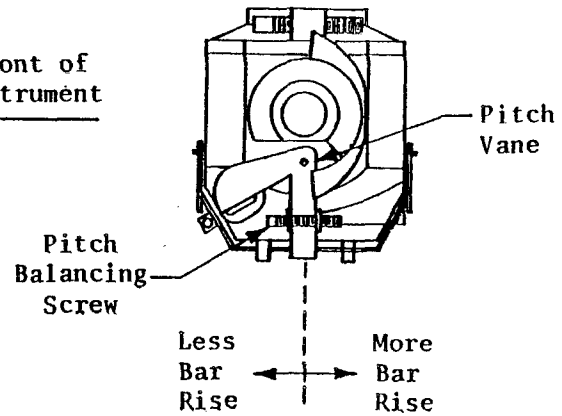


FIGURE 2-1
ERECTION TEST ADJUSTMENTS

SECTION 3

PARTS LIST

This section contains exploded-view drawings of the AIM 510 Series, Attitude Gyro, showing the location of each replaceable part. Tables associated with the drawings identify each component or assembly and list the appropriate AIM part number by which replacement parts should be ordered.

TABLE 3-1. OVER-ALL INSTRUMENT (Figure 3-1)

CALLOUT NUMBER	DESCRIPTION	AIM PART NO.
Ref.	Bezel Insert Assembly (Figure 3-2)	
Ref.	Bezel Insert Assembly (Figure 3-2A)	
Ref.	Gimbal Assembly (Figure 3-3)	
Ref.	Rotor Housing Assembly (Figure 3-4)	
Ref.	Rotor Assembly (Figure 3-5)	
Ref.	Circuit Board Assembly, 115VAC (Figure 3-6)	
Ref.	Circuit Board Assembly, 28VDC (Figure 3-7)	
Ref.	Circuit Board Assembly, 14VDC (Figure 3-8)	
1	Case (510-7A)	649-0196-905
1	Case (510-1A/1B/1C, 510-3A/5A/8A)	649-0196-901
2	Indicator Assembly, flag (510-1A/1B/3A/5A/8A)	648-0167-901
2	Indicator Assembly, flag (510-7A/7B)	648-0170-901
3	Motor, indicator (14VDC gyros)	811-0015-001
3	Motor, indicator	811-0003-001
4	Washer, flat	606-0017-001
5	Screw, 2-56 x 1/8, binder hd., st.st.	603-1256-104
6	Screw, 4-40 x 3/16, flat hd., st.st.	603-1440-306
7	Insert Assy. lighting (510-8A)	622-0015-001
7	Insert Assy. lighting (510-7A)	622-0015-004
7	Insert Assy. lighting (510-7B)	622-0015-008
7	Insert Assy, lighting (510-1A/1B/1C/3A	622-0015-006
8	Circuit Board, lighting contact	800-0027-002
9	Screw, 2-56 x 1/4 binder hd., st.st.	603-1256-108
10	Circuit Board Assy. 115VAC (510-7A/B)(Fig. 3-6)	800-0098-902
10	Circuit Board Assy. 115VAC (510-3A/8A) (Fig. 3-6)	800-0098-901
10	Circuit Board Assy. 14VDC (Figure 3-8)	800-0097-903
10	Circuit Board Assy. 28VDC (Figure 3-7)	800-0108-902
11	Spacer, circuit board	616-0047-001
12	Brush block	815-0001-001
13	Connector (510-7A/7B)	821-0019-905
14	Screw, connector, 3-56 x 1/4, binder hd., st.st.	603-1356-108

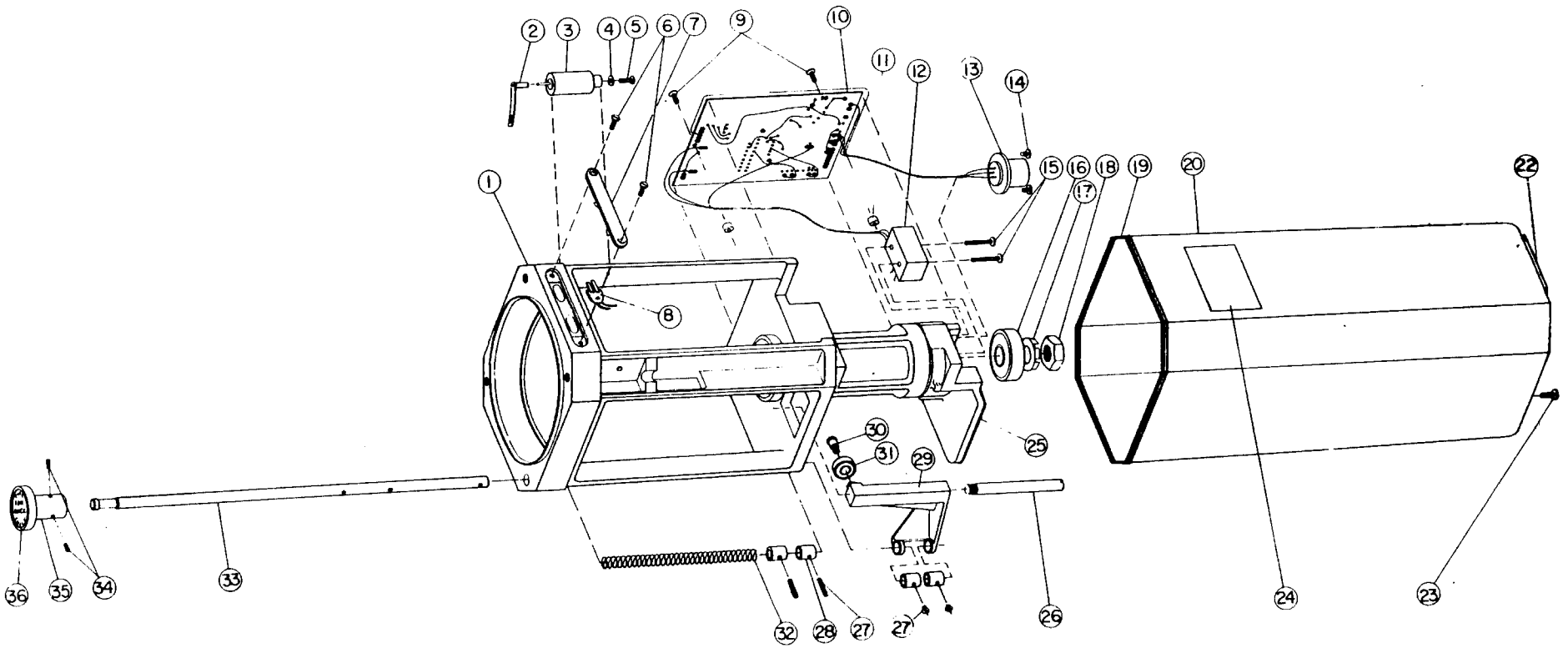


FIGURE 3-1 OVER-ALL INSTRUMENT

TABLE 3-2. BEZEL INSERT ASSEMBLY (Figure 3-2)

CALLOUT NUMBER	DESCRIPTION	AIM PART NO.
1	Knob	633-0002-901
2	Screw, 4-40 x 3/16, setscrew, st.st., spline	603-1440-406
3	Ring, retainer	611-0071-001
4	Plate, bezel (For models without inclinometer or adjustment shaft cover)	628-0228-001
4	Plate, bezel (For models with inclinometer or adjustment shaft cover)	628-0228-002
5	Glass	612-0089-001
6	Spacer	616-0137-001
7	Glass, wedge lighting	612-0084-003
8	Seal, O-ring	610-0074-006
9	Insert, bezel	622-0032-001
10	Indicator, indice, stationary	622-0032-001
10	Indicator, indice, rotating (510-3A) located on gimbal	648-0142-901
11	Shaft, airplane	632-0154-001
12	Indicator, airplane	648-0002-904
13	Plate, cover	628-0227-001
14	Screw, 2-56 x 3/32, flat hd., st.st.	603-1256-306
15	Indicator Assembly, Inclinometer	248-0168-901
16	Screw, 2-56 x 1/8, binder hd., st.st.	603-1256-104

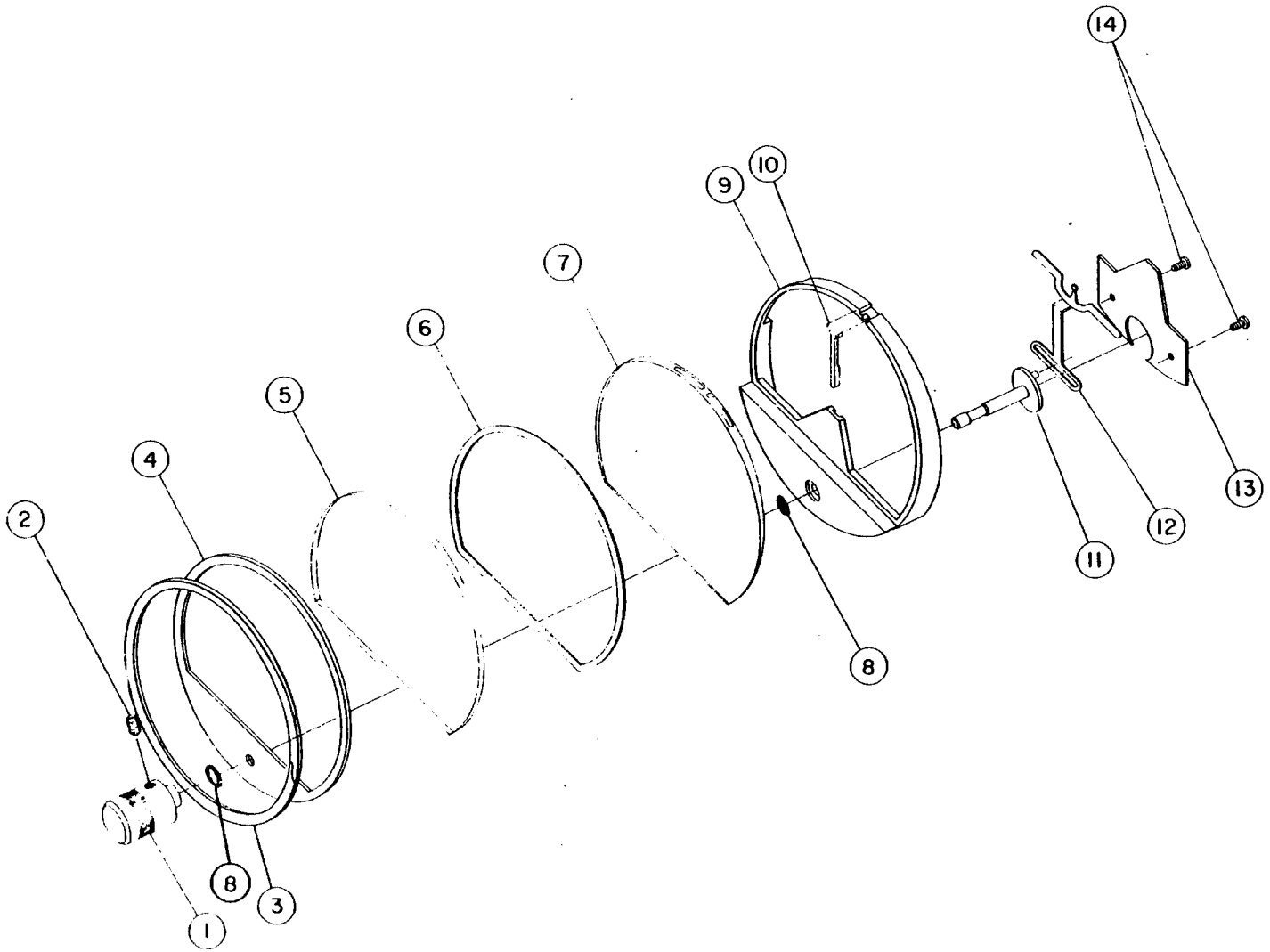


FIGURE 3-2 BEZEL INSERT ASSEMBLY

TABLE 3-2A. BEZEL INSERT ASSEMBLY (Figure 3-2A)

CALLOUT NUMBER	DESCRIPTION	AIM PART NO.
1	Ring, retaining	611-0034-001
2	Washer	606-0004-001
3	Seal "O" Ring	610-0074-006
4	Ring, retainer	611-0071-001
5	Plate, bezel	628-0228-002
6	Glass	612-0089-001
7	Spacer	616-0137-001
8	Glass, wedge lighting	612-0084-003
9	Insert, bezel	622-0032-001
10	Indicator, indice	648-0145-901
11	Shaft, airplane	632-0162-001
12	Indicator, airplane	648-0002-904
13	Plate, cover	628-0227-001
14	Screw, 2-56 x 3/32, flat hd., st.st.	603-1256-306
15	Cover, shaft	614-0152-901
16	Screw, 2-56 x 5/32, fillister hd., st.st.	603-1256-205

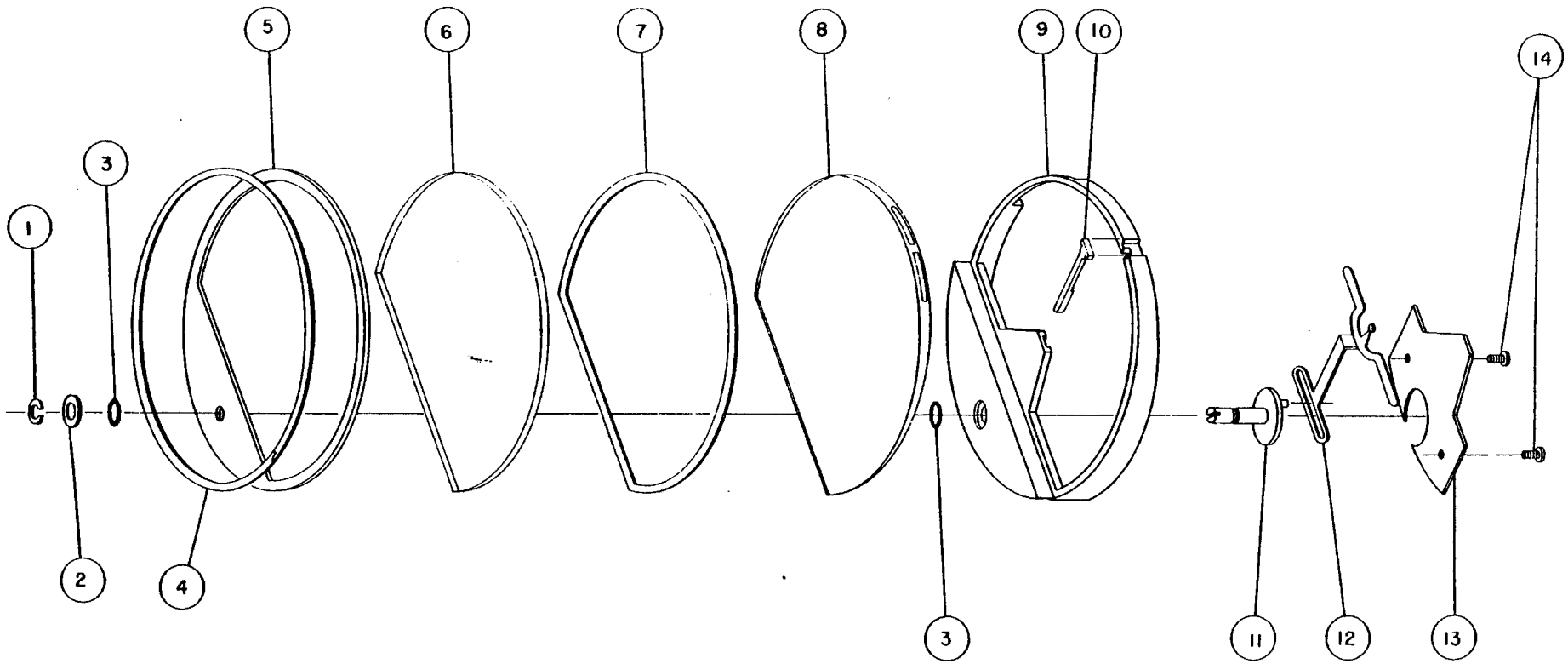


FIGURE 3-2ABEZEL INSERT ASSEMBLY

510-7A/B

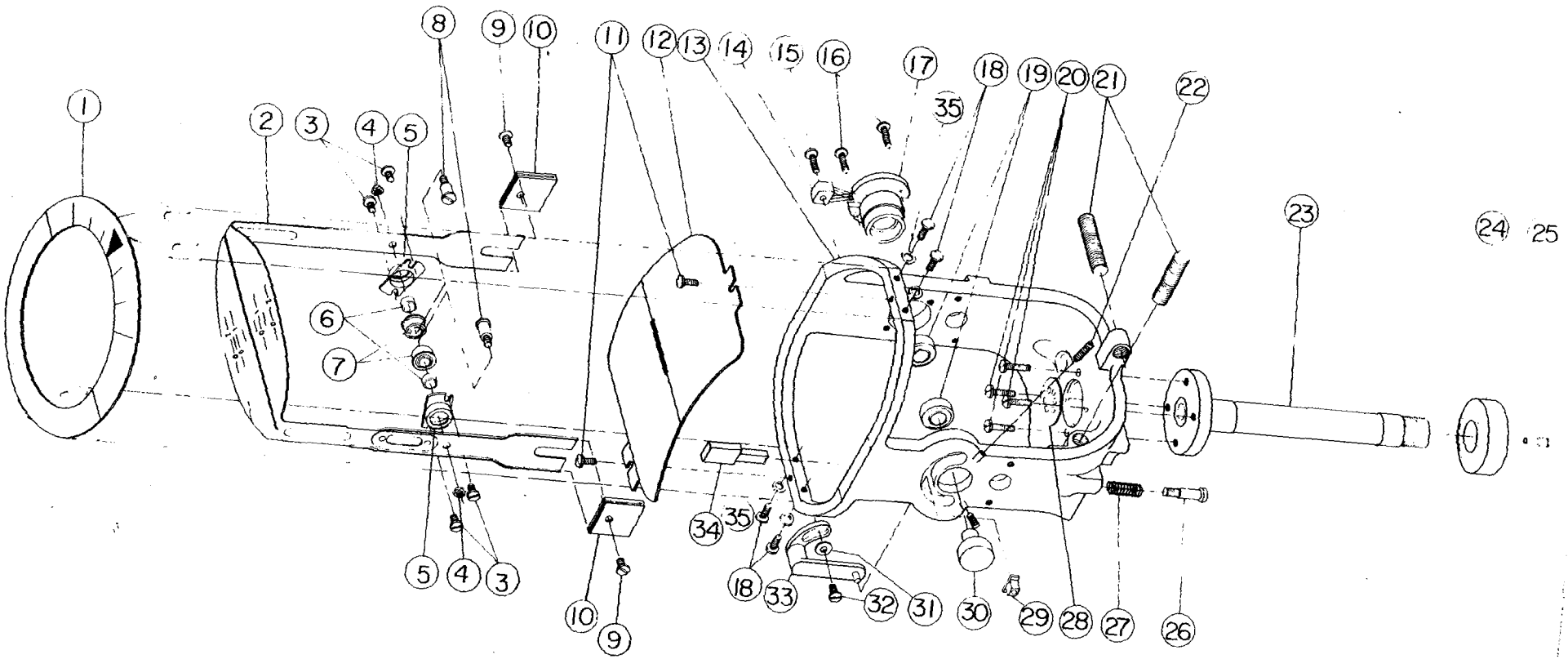


FIGURE 3-3 GIMBAL ASSEMBLY

TABLE 3-3. GIMBAL ASSEMBLY (Figure 3-3)

CALLOUT NUMBER	DESCRIPTION	AIM PART NO.
1	Dial, rotating	650-0086-901
1	Dial, stationary (510-3A) located on bezel insert	650-0073-901
2	Indicator Assembly, pointer bar	648-0141-901
2	Indicator Assembly, pointer bar (510-7A/7B)	648-0169-901
3	Screw, 2-56 x 1/8 binder hd., st.st.	603-1256-204
4	Nut, hex, self locking	605-0040-001
5	Retainer, bearing	608-0026-001
6	Spacer	616-0132-002
7	Bearing, flanged	637-0070-001
8	Shaft, pointer bar	632-0153-001
9	Screw, 2-56 x 3/32, binder hd., st.st.	603-1256-103
10	Weight, balance	626-0021-001
11	Screw, 2-56 x 5/32, binder hd., st.st.	603-1256-105
12	Mask, finished	645-0025-901
13	Gimbal	651-0082-901
14	Brush block	815-0002-001
15	Screw, 2-56 x 5/8, binder hd., st.st.	603-1256-120
16	Screw, 2-56 x 3/16, flat hd., st.st.	603-1256-306
17	Housing, bearing	635-0121-001
18	Screw, 2-56 x 5/32, binder hd., st.st.	603-1256-105
19	Bearing	637-0021-001
20	Screw, 4-40 x 1/4 , binder hd., st.st.	603-1440-108
21	Screw, balance	603-0047-001
22	Screw, 2-56 x 3/8, setscrew, st.st., spline, cup	603-1256-406
23	Shaft, gimbal support	632-0151-902
24	Bearing	637-0071-001
25	Slip ring	826-0002-001
26	Shaft, caging, pitch	632-0152-001
27	Spring, caging	657-0069-001
28	Plate	628-0233-901
29	Bushing, pointer bar	624-0018-901
30	Pivot	639-0083-001
31	Washer, external tooth lock	606-0058-002

TABLE 3-3. GIMBAL ASSEMBLY (Cont'd)

CALLOUT NUMBER	DESCRIPTION	AIM PART NO.
32	Screw, 2-56 x 3/32, binder hd., st.st.	603-1256-103
33	Actuator	642-0020-901
34	Actuator, caging	642-0019-901
35	Washer, #4 brass	
Not Shown	Screw, rotor stop	603-0011-002

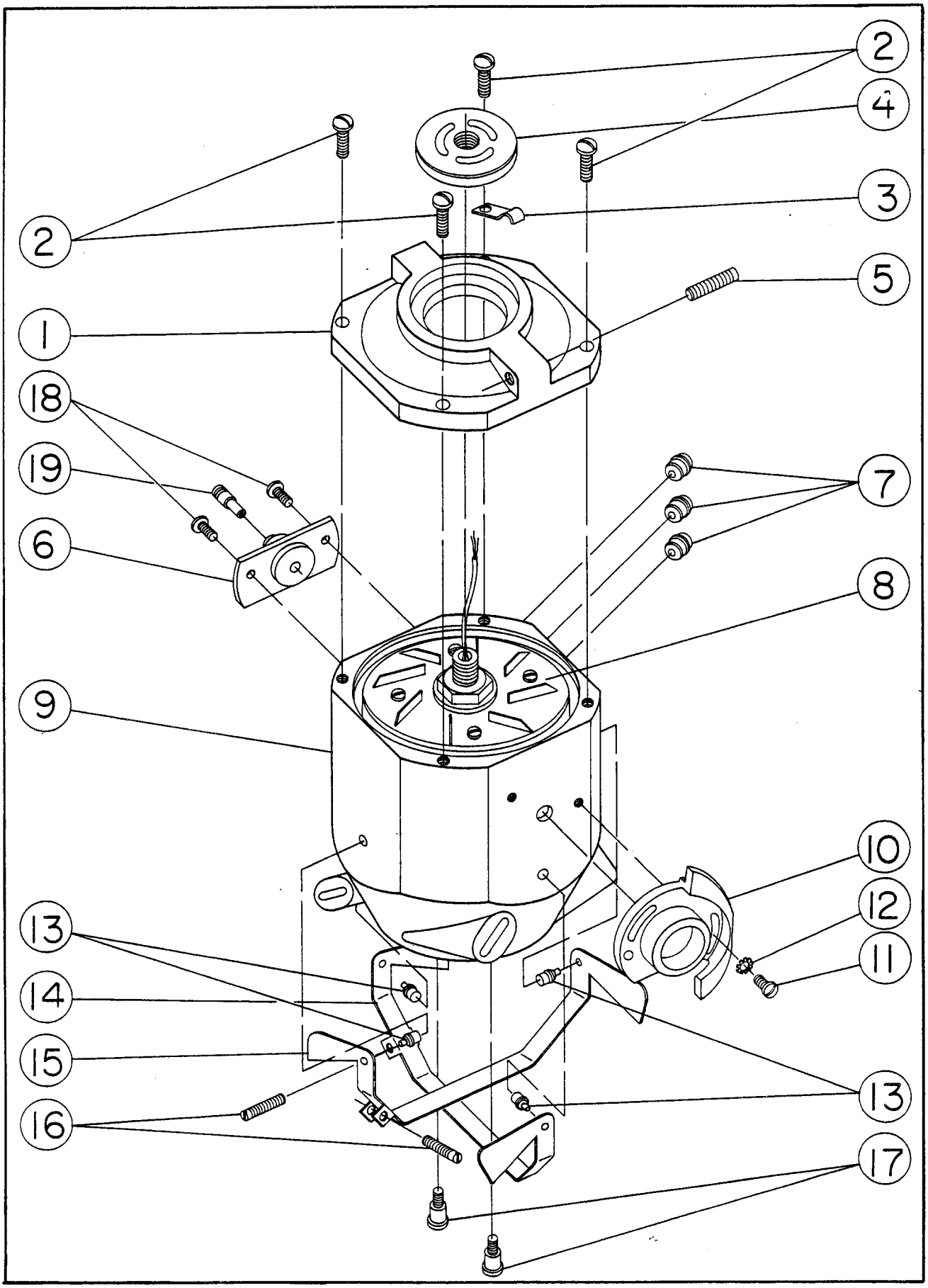


FIGURE 3-4 ROTOR HOUSING ASSEMBLY

TABLE 3-4. ROTOR HOUSING ASSEMBLY (Figure 3-4)

CALLOUT NUMBER	DESCRIPTION	AIM PART NO.
1	Cover, rotor housing	614-0038-903
2	Screw, 3-48 x 5-16, binder hd., st.st.	603-1348-110
3	Clamp	625-0021-001
4	Nut, rotor support	605-0017-002
5	Screw, balance	603-0005-001
6	Pivot	639-0071-901
7	Terminal	817-0011-001
8	Rotor Assembly (Figure 3-5)	
	115VAC (510-3A/7A/7B/8A)	236-0016-902
	14VDC (510-5A)	236-0041-904
	26VAC (510-1A/1B/1C)	236-0041-902
9	Rotor Housing	652-0074-901
10	Pitch Cam and Bearing Housing	640-0021-901
11	Screw, 2-56 x 3/32, binder hd., st.st.	603-1256-103
12	Washer, lock	606-0058-002
13	Pin, vane	620-0094-001
14	Vane, pitch	618-0021-901
15	Vane, roll	618-0021-902
16	Screw, balance, 2-56 x 3/8, brass	603-2256-412
17	Screw, vane stop	603-0011-002
18	Screw, 2-56 x 3/16, binder hd., st.st.	603-1256-106
19	Slip Ring	826-0007-001
20	Weight, vane (fixed wing aircraft)	626-0005-903
	Rivet	602-0008-001

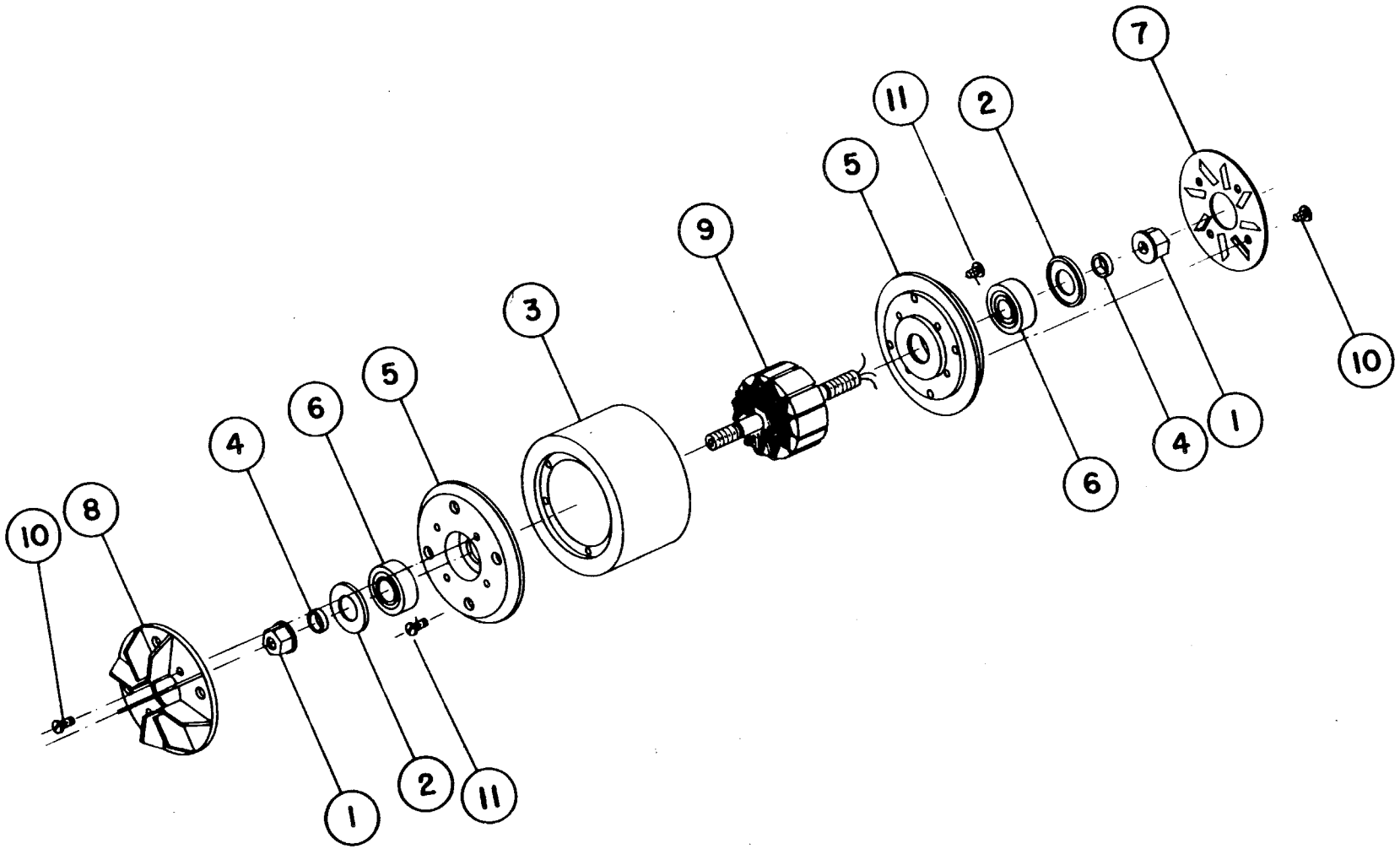


FIGURE 3-5 ROTOR ASSEMBLY

TABLE 3-5. ROTOR ASSEMBLY (Figure 3-5)

CALLOUT NUMBER	DESCRIPTION	AIM PART NO.
1	Nut, preload	605-0024-001
2	Retainer, bearing	608-0010-001
3	Ring Assembly, 115 VAC Gyros	611-0020-901
	14 VDC and 28 VDC Gyros	611-0074-902
4	Spacer	616-0018-001
5	Housing, bearing	635-0053-901
6	Bearing	637-0011-001
7	Impeller	638-0001-002
8	Impeller	638-0002-001
9	Stator	
	115 VAC Gyros	827-0003-001
	14 VDC Gyros	827-0019-001
	28 VDC Gyros	827-0017-001
10	Screw, 1-72 x 3/16, binder hd., st. st.	603-1172-106
11	Screw, 1-72 x 5/16, binder hd., st. st.	603-1172-110
	14 VDC and 28 VDC Gyros	
11	Screw, 1-72 x 3/16, binder hd., st. st.	603-1172-106
	115 VAC Gyros	

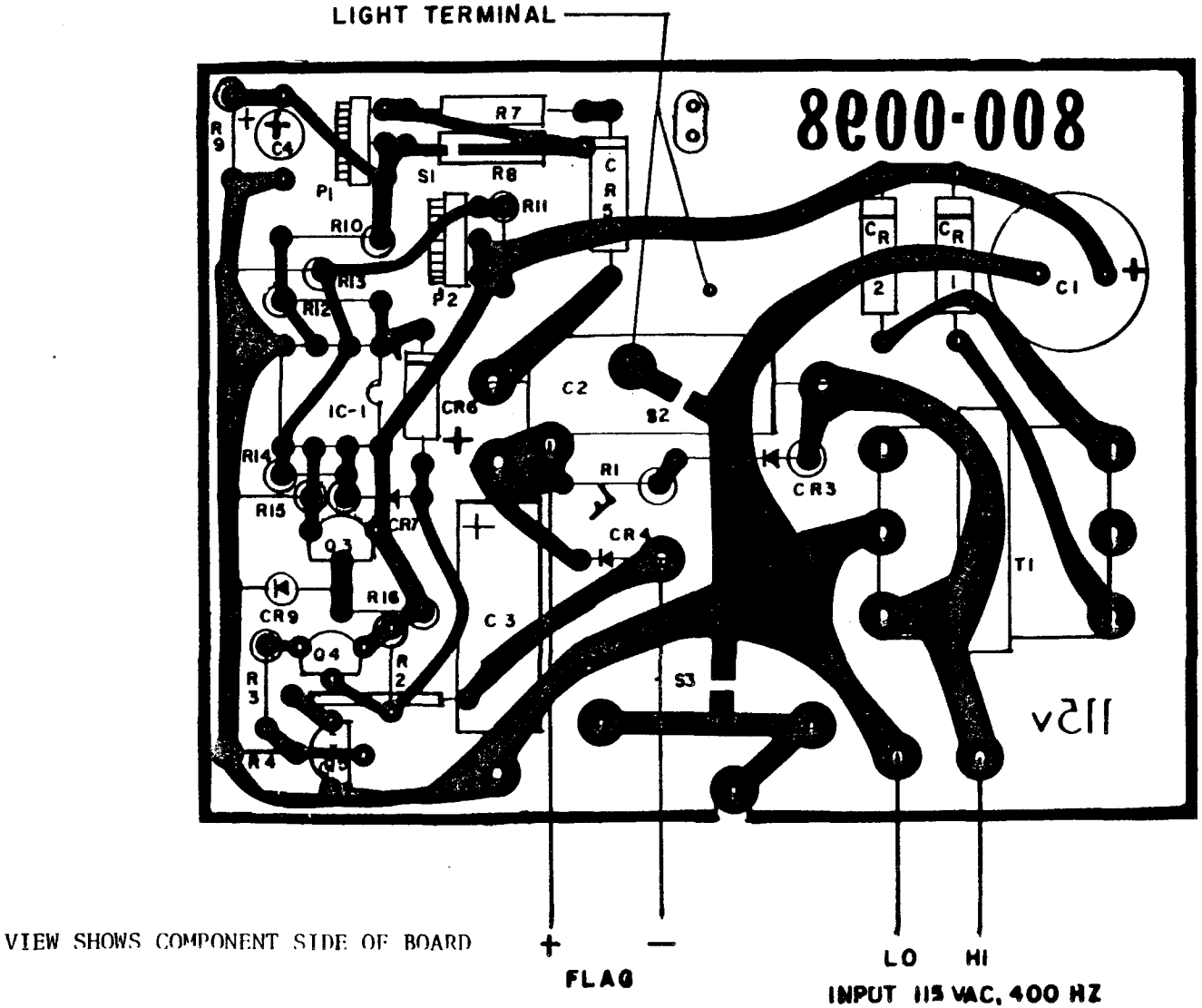
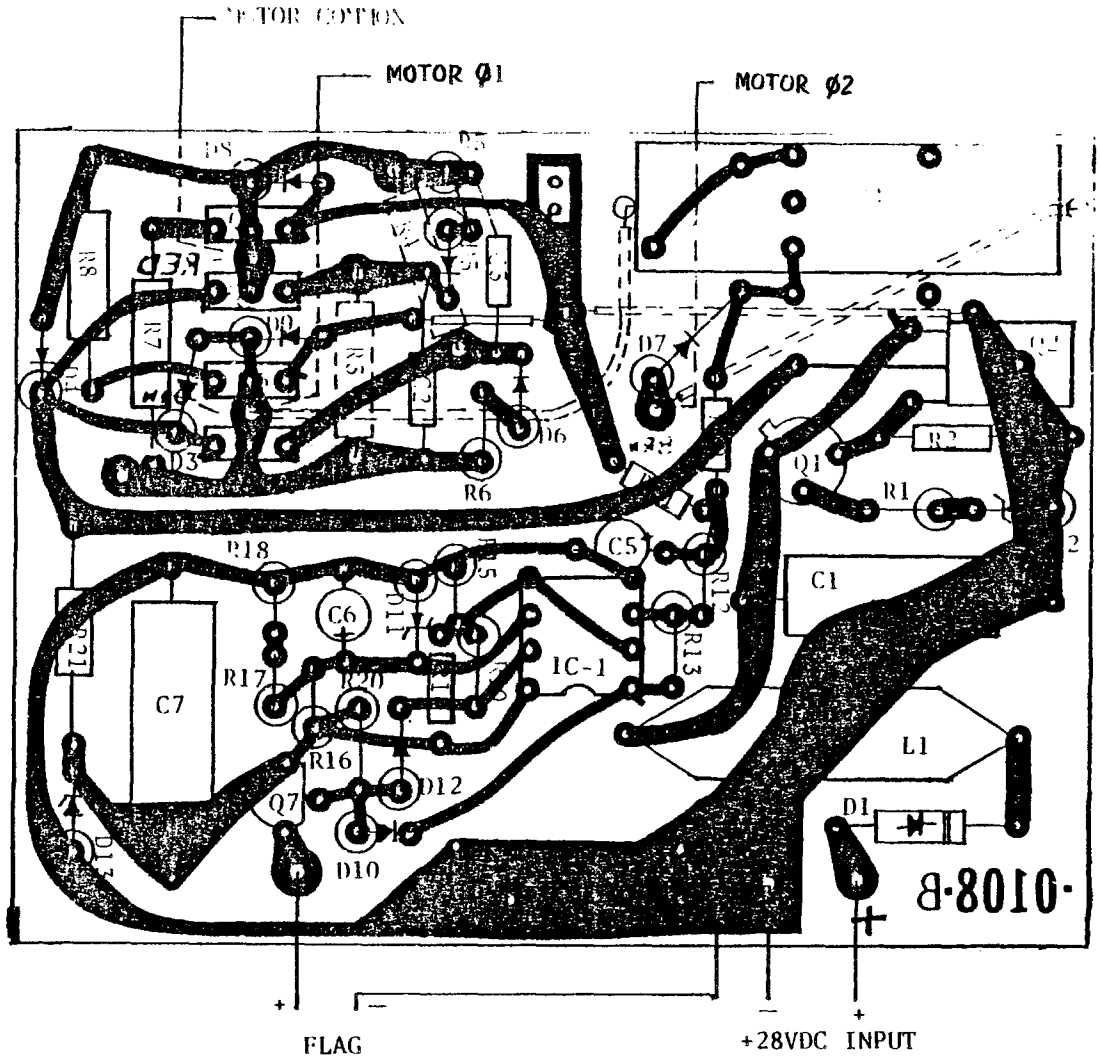


FIGURE 3-6 CIRCUIT BOARD ASSEMBLY, 115 VAC

TABLE 3-6. CIRCUIT BOARD ASSEMBLY, 115VAC (Figure 3-6)

CALLOUT NUMBER	DESCRIPTION	AIM PART NO.
C1	Capacitor, Alytic Mtg. 160/20	802-0203-013
C2	Capacitor, Mylar Axial,.22/400	802-0205-340
C3	Capacitor, Alytic, 5/200	802-0209-001
C4	Capacitor, PC Mtg. 1/35	802-0200-122
CR1,2	Diode, IN4001	805-0202-001
CR3,4,5	Diode, IN4004	805-0202-004
CR6,7	Diode, 1N4454	805-0024-001
CR9	Diode, Optical	805-0204-001
IC-1	Integrated Circuit, LM-358	808-0014-006
P1,2	Potentiometer, 1 MEG	814-0201-016
R1	Resistor, Carb, Comp, 2.2K ohm, 1/2W	801-0205-081
R2	Resistor, Carb, Comp, 47K, 1/4W	801-0203-113
R3	Resistor, Carb, Comp, 10K, 1/4W	801-0203-097
R4,13	Resistor, Carb, Comp, 22K, 1/4W	801-0203-105
R7,12,14	Resistor, Carb, Comp, 1 MEG, 1/4W	801-0203-145
R8,11	Resistor, Carb, Comp, 2.2 MEG, 1/4W	801-0203-153
R9	Resistor, Carb, Comp, 18K, 1/4W	801-0203-103
R10	Resistor, Carb, Comp, 6.8K, 1/4W	801-0203-093
R15,16	Resistor, Carb, Comp, 1K, 1/4W	801-0203-073
Q3,4	Transistor, PN3642	806-0200-011
Q5	Transistor, 2N5551	806-0200-008
T1	Transformer	804-0042-001
S3	Solder Link	

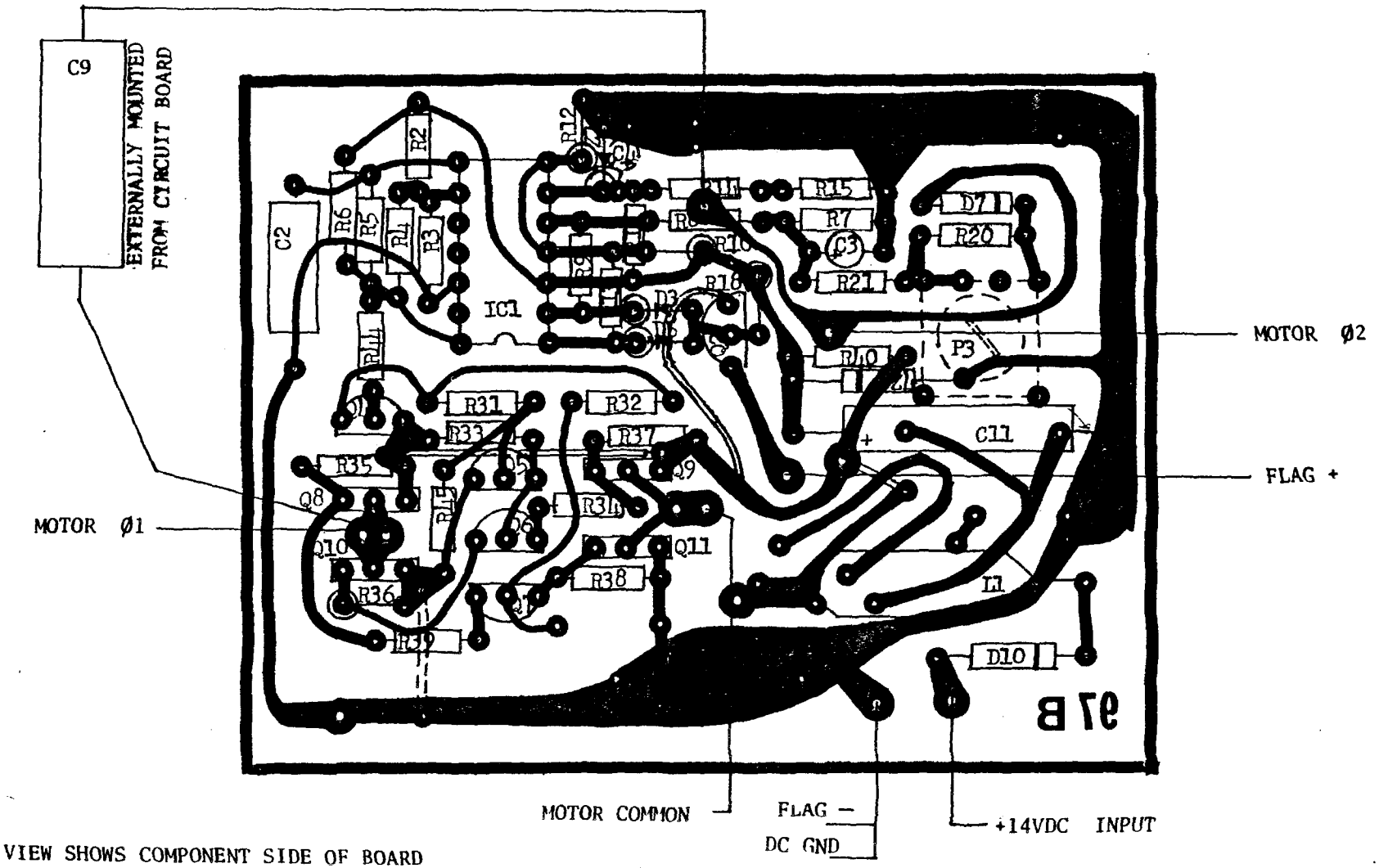


VIEW SHOWS COMPONENT SIDE OF BOARD

FIGURE 3-7 CIRCUIT BOARD ASSEMBLY, 28VDC

TABLE 3-7. CIRCUIT BOARD ASSEMBLY, 28VDC (Figure 3-7)

CALLOUT NUMBER	DESCRIPTION	AIM PART NO.
C1,7	Capacitor, 100/40	802-0112-001
C2,3	*Capacitor, .01/100 (Selected if Necessary)	802-0013-001
C4	Capacitor, 3.5/100	802-0153-001
C5	Capacitor, 4.7/25	802-0200-237
C6	Capacitor, 1/35	802-0200-222
D1,3,4,5 D6,7,8,9	Diode, 1N4004	805-0202-004
D10,12	Diode, Low Current	805-0002-001
D11	Diode, 1N4744, Zener	805-0201-017
D13	Diode, 1N4751, Zener	805-0120-024
D2	Diode, 1N4753, Zener	805-0201-026
IC-1	Integrated Circuit, LM358	808-0014-006
L1	Inductor, 500 uH	803-0010-001
Q1	Transistor, 2N2905	806-0013-001
Q2	Transistor, 2N4920	806-0011-001
Q3,5	**Transistor, 2N6406 (BCE)	806-0201-006
Q4,6	***Transistor, 2N6408 (BCE)	806-0201-007
Q7	Transistor, 2N3642	806-0200-011
R1	Resistor, Carb, Comp, 680 ohm, 1/2W	801-0205-069
R2	Resistor, 1.5K, 1.5W, W.W.	801-0163-001
R3,4	*Resistor, Carb, Comp, Select 1/2W	Select
R5,6	Resistor, Carb, Comp, 2.7K, 1/4W	801-0203-083
R7,8	Resistor, Carb, Comp, 1K, 1/2W	801-0205-073
R10	Resistor, Carb, Comp, 10K, 1/4W	801-0203-097
R16	Resistor, Carb, Comp, 4.7K, 1.4W	801-0203-089
R11,17,18	Resistor, Carb, Comp, 47K, 1/4W	801-0203-113
R12,14	Resistor, Carb, Comp, 22K, 1/4W	801-0203-105
R13,19	Resistor, Carb, Comp,1 MEG, 1/4W	801-0203-145
R15	Resistor, Carb, Comp, 68K, 1/4W	801-0203-117
R20	Resistor, Carb, Comp, 15K, 1/4W	801-0203-101
R21	Resistor, Carb, Comp, 47 ohm, 1/4W	801-0203-041



CIRCUIT BOARD ASSEMBLY, 14VDC

Figure 3-8

TABLE 3-8. CIRCUIT BOARD ASSEMBLY, 14VDC (Figure 3-8)

CALLOUT NUMBER	DESCRIPTION	AIM PART NO.
C2	Capacitor, Prec. .0412 uf	802-0210-002
C3	Capacitor, Tant, 4.7 uf/25V	802-0200-237
C4	Capacitor, Tant, 1 uf/35V	802-0200-222
C9	Capacitor, Tant, 20 mf/50-100V	802-0154-001
C11	Capacitor, Alytic	802-0112-001
D3,5	Diode, 1N4454	805-0002-001
D7,10	Diode, rectifier, 1N4004	805-0202-004
Z1	Diode, Zener, 7.5V MZ1000-10	805-0201-010
Z4	Diode, Zener, 15V 1N4744	805-0201-017
IC-1	Integrated Circuit, LM339	808-0014-003
L1	Inductor, 500 uH	803-0010-001
P3	Potentiometer, Trim, 50K ±30%	814-0205-012
R2,4	Resistor, 1%, RN55 49.9K	801-0210-655
R3	Resistor, 1%, RN55 46.4K	801-0210-649
R5	Resistor, 1%, RN55 42.2K	801-0210-641
R6	Resistor, Carb, 10%, 2.2K	801-0203-081
R7,14,15,20 R44	Resistor, Carb, 10%, 47K	801-0203-113
R8,45	Resistor, Carb, 10%, 22K	801-0203-105
R9,13	Resistor, Carb, 10%, 1 MEG	801-0203-145
R10	Resistor, Carb, 10%, 15K	801-0203-101
R11,21	Resistor, Carb, 10%, 4.7K	801-0203-089
R12	Resistor, Carb, 10%, 82K	801-0203-119
R18	Resistor, Carb, 10%, 1.5K	801-0203-077
R31	Resistor, Carb, 10%, 68K	801-0203-117
R32,33	Resistor, Carb, 10%, 10K	801-0203-097
R34,39	Resistor, Carb, 100 ohm	801-0203-049
R35,36,37,38	Resistor, Carb, 10%, 1K	801-0203-073
R40	Resistor, Carb, 10%, 47 ohm	801-0205-041
Q2,4,5,6,7	Transistor, PN3642	806-0200-011
Q8,9	Transistor, 2N6406	806-0201-006
Q10,11	Transistor, 2N6408	806-0201-007

No. 055

SUPPLEMENTAL DATA SHEET

AIM 510 ( ) Series Horizon Reference Indicator

SUBJECT: 510-7A

EFFECTIVE: 5/16/78

This Supplemental Data Sheet adds the 510-7A to the list of instruments covered by this manual.

The 510-7A is similar to the 510-1A with the exception of the rotor assembly, pointer bar, miniature airplane adjustment, connector, pin connections and circuit-board. Therefore, in the manual where 28VDC is referenced, substitute 115AC, 400 Hz, and where 28VAC, 400 Hz is referenced, substitute 115VAC, 400 Hz.

The tables and figures noted below change for the 510-7A as shown:

Figure 1-2	Schematic/Wiring Diagram	Figure 1-2(B)
Figure 3-2	Bezel Insert Assembly	Figure 3-2(B)
Figure 3-3	Gimbal Assembly	Figure 3-3
Figure 3-6	Circuit Board Assembly	Figure 3-6(A)
Table 3-1	Over-all Instrument	Table 3-1(B)
Table 3-2	Bezel Insert Assembly	Table 3-2(B)
Table 3-3	Gimbal Assembly	Table 3-3(B)
Table 3-4	Rotor Housing Assembly	Table 3-4(A)
Table 3-5	Rotor Assembly	Table 3-5(A)
Table 3-6	Circuit Board Assembly	Table 3-6(A)

AVIATION INSTRUMENT MANUFACTURING CORPORATION

P. O. BOX 12248

HOUSTON, TEXAS 77017

TABLE 3-1 (B) OVER-ALL INSTRUMENT (Figure 3-1)

CALLOUT NUMBER	DESCRIPTION	AIM PART NO.
Ref.	Bezel Insert Assembly (Figure 3-2 (B))	——
Ref.	Gimbal Assembly (Figure 3-3 (B))	——
Ref.	Rotor Housing Assembly (Figure 3-4 (A))	——
Ref.	Rotor Assembly (Figure 3-5 (A))	——
Ref.	Circuit Board Assembly, 115VAC (Figure 3-6 (A))	——
1	Case	649-0196-905
2	Indicator Assembly, flag	648-0167-901
3	Motor, indicator	811-0003-001
4	Washer, flat, #2	606-0017-001
5	Screw, 2-56 x 1/8, binder hd., st. st.	603-1256-104
6	Lighting Insert Assembly	622-0029-002
7	Screw, 2-56 x 3/16, flat hd., st. st.	603-1256-306
8	Circuit Board Assembly,115VAC (Figure 3-6)	800-0098-901
9	Screw, 2-56 x 1/4, binder hd., st. st.	603-1256-108
10	Brush Block	815-0001-001
11	Screw, 2-56 x 5/8, binder hd., st. st.	603-1256-120
12	Connector	821-0019-905
13	Bearing	637-0071-001
14	Nut, Hex	605-0051-002
15	Cover, dust	614-0140-901
16	Screw, 4-40 x 1/2, binder hd., st. st.	603-1440-116
17	Nameplate (Specify model number.)	601-0000-000
18	Label, 115VAC	600-0086-001
19	Label, erecting knob	600-0015-001
20	Knob	633-0011-901
21	Screw, 2-56 x 1/4, setscrew, st. st.	603-1256-408
22	Shaft, caging	632-0141-001
23	Spring, caging	657-0071-001
24	Collar, caging shaft	617-0013-001
25	Screw, 2-56 x 3/32, setscrew, st. st.	603-1256-403

TABLE 3-1 (B) OVER-ALL INSTRUMENT (Cont'd)

CALLOUT NUMBER	DESCRIPTION	AIM PART NO.
26	Bracket, caging	613-0187-901
27		
28	Pin, caging	620-0095-001
29	Bearing	637-0004-002
30	Shaft, pointer bar	632-0153-001
31	Washer, Tab Lock	606-0059-001
32	Spacer, Circuit Board	616-0047-001
33	Screw	603-1356-108

TABLE 3-2(B). BEZEL INSERT ASSEMBLY (Figure 3-2(B))

CALLOUT NUMBER	DESCRIPTION	AIM PART NO.
1		
2		
3	Ring, retainer	611-0071-001
4	Plate, bezel	628-0228-001
5	Glass	612-0089-001
6	Spacer	616-0137-001
7	Glass, wedge lighting	612-0084-003
8	Seal, O-ring	610-0074-006
9	Insert, bezel	622-0032-001
10	Indicator, indice	648-0145- 01
11	Shaft, airplane	632-0162-001
12	Indicator, airplane	648-0002-904
13	Plate, cover	628-0227-001
14	Screw, self-tapping, #2 x 3/16	603-0050-001
15	Ring, Retaining	611-0034-001

TABLE 3-3(B). GIMBAL ASSEMBLY (Figure 3-3)

CALLOUT NUMBER	DESCRIPTION	AIM PART NO.
1	Dial, finished	650-0086-901
2	Indicator Assembly, pointer bar	648-0165-901
3	Nut, hex, self-locking	605-0035-005
4	Retainer, bearing	608-0026-001
5	Spacer	616-0132-002
6	Bearing, flanged	637-0070-001
7	Shaft, pointer bar	632-0153-001
8	Weight, balance	626-0021-001
9	Screw, 2-56 x 3/32, binder hd., st. st.	603-1256-103
10	Mask, finished	645-0025-901
11	Screw, 2-56 x 5/32, binder hd., st. st.	603-1256-105
12	Gimbal	651-0082-901
13	Screw, 2-56 x 1/8, binder hd., st. st.	603-1256-104
14	Brush Block	815-0002-001
15	Screw, 2-56 x 5/8, binder hd., st. st.	603-1256-120
16	Housing, bearing	635-0121-001
17	Screw, 2-56 x 3/16, flat hd., st. st.	603-1256-306
18	Bearing	637-0015-001
19	Pivot	639-0077-001
20	Plate, air passage	628-0233-901
21	Screw, 4-40 x 1/4, fillister hd., st. st.	603-1440-108
22	Screw, balance	603-0047-001
23	Shaft, gimbal support	632-0151-902
24	Bearing	637-0071-001
25	Slip Ring	826-0002-001
26	Shaft, caging, pitch	632-0152-001
27	Spring, caging	657-0069-001
28	Bushing, pointer bar	624-0018-901
29	Actuator	642-0020-901
30	Actuator, caging	642-0019-001
31	Screw, set, 2-56 x 1/4, st.st.	603-1256-406

TABLE 3-4(A) ROTOR HOUSING ASSEMBLY (Figure 3-4)

CALLOUT NUMBER	DESCRIPTION	AIM PART NO.
1	Cover, rotor housing	614-0038-903
2	Screw	
3	Clamp	625-0021-001
4	Nut, rotor support	605-0017-002
5	Screw, balance	603-0005-001
6	Pivot	639-0071-901
7	Terminal	817-0011-001
8	Rotor Assembly (Figure 3-5)	
	AC Instruments	236-0016-902
9	Rotor Housing, HRI	652-0074-901
10	Pitch Cam and Bearing Housing	640-0021-902
11	Screw, 2-56 x 3/32, binder hd., st. st.	603-1256-103
12	Washer, external lock	606-0058-002
13	Pin, vane	620-0094-001
14	Vane, rotor	618-0021-901
15	Vane, rotor	618-0021-902
16	Screw, balance, 2-56 x 3/8, brass	603-2256-412
17	Screw, vane stop	603-0011-002
18	Slip Ring	826-0007-001

TABLE 3-5(A) ROTOR ASSEMBLY (Figure 3-5)

CALLOUT NUMBER	DESCRIPTION	AIM PART NO.
1	Nut, preload	605-0024-001
2	Retainer, bearing	608-0010-001
3	Ring Assembly	611-0020-901
4	Spacer	616-0018-001
5	Housing, bearing	635-0053-901
6	Bearing	637-0066-001
7	Impeller	638-0001-002
8	Impeller	638-0002-001
9	Stator	827-0003-001
10	Screw	603-1172-106

TABLE 3-6(A) CIRCUIT BOARD ASSEMBLY, 115VAC (Figure 3-6(A))

CALLOUT NUMBER	DESCRIPTION	AIM PART NO.
C1	Capacitor, Alytic PC Mtg. 160/20	802-0203-013
C2	Capacitor, Mylar Axial, .22/400	802-0205-340
C3	Capacitor, Alytic, 4/250	802-0209-001
C4	Capacitor, PC Mtg. 1/35	802-0200-122
CR1,2	Diode, 1N4001	805-0202-001
CR3,4,5	Diode, 1N4004	805-0202-004
CR6,7	Diode, 1N4454	805-0024-001
CR9	Diode, Optical	805-0204-001
IC-1	Integrated Circuit, LM-358	808-0014-006
P1,2	Potentiometer, 1 MEG.	814-0200-016
R1	Resistor, Carb, Comp. 680 ohm, 1W	801-0206-069
R2,13	Resistor, Carb, Comp. 47K, 1/4W	801-0203-113
R3	Resistor, Carb, Comp. 10K, 1/4W	801-0203-097
R4	Resistor, Carb, Comp. 22K, 1/4W	801-0203-105
R7	Resistor, Carb, Comp. 470K, 1/4W	801-0202-142
R8;11	Resistor, Carb, Comp. 2.2 Meg, 1/4W	801-0203-153
R9	Resistor, Carb, Comp. 18K, 1.4W	801-0203-103
R10	Resistor, Carb, Comp. 27K, 1/4W	801-0203-107
R12,14	Resistor, Carb, Comp. 1 Meg, 1/4W	801-0203-145
R15,16	Resistor, Carb, Comp. 1K, 1/4W	801-0203-073
Q3,4	Transistor, PN3642	806-0200-011
Q5	Transistor, 2N5551	806-0200-008

SUPPLEMENTAL DATA SHEET

SUBJECT: ADDITIONAL MODELS ADDED FOR 510 SERIES/LIGHT REGULATOR CIRCUIT

EFFECTIVE: JANUARY, 1980

MANUAL EFFECTED: 510 SERIES ATTITUDE GYROS

ADDITIONAL MODELS TO BE ADDED

510-10A
510-10B
510-10C
510-17A
510-17B

DISCLOSURE

510-10A

The 510-10A is the 28VDC input version of the 510-7A. All part listings are identical to the 510-7A, with the following exceptions:

Ref. Table 3.1 CALLOUT NUMBER	DESCRIPTION	NEW AIM P/N
10	Circuit board assy. 28VDC	800-0111-903
13	Connector	821-0047-001
22	Label 28VDC, pin connection	600-0076-001
25	Seal, rear	610-0092-001

Ref. Table 3.4 CALLOUT NUMBER		
8	Rotor assy. 26VAC	236-0041-902

Ref. Table 3.5 CALLOUT NUMBER		
3	Ring assy. 28VDC gyros	611-0074-902
9	Stator 28VDC gyros	827-0017-001
11	Screw, 1-72x5/16 Binder hd, st.st.	603-1172-110

510-10B

The 510-10B is identical to the 510-10A with the following exceptions:

Ref. Table 3.1 CALLOUT NUMBER	DESCRIPTION	NEW AIM P/N
7	Insert assy, lighting	622-0015-008

510-10C

The 510-10C is calibrated for a 9° forward tilt panel. All part listings are identical to the 510-10A.

510-17A/510-17B

The 510-17A/510-17B are replacement models for the 510-7A/510-7B. All part listings are identical to the 510-7A/510-7B with the following exceptions:

Ref. Table 3.1

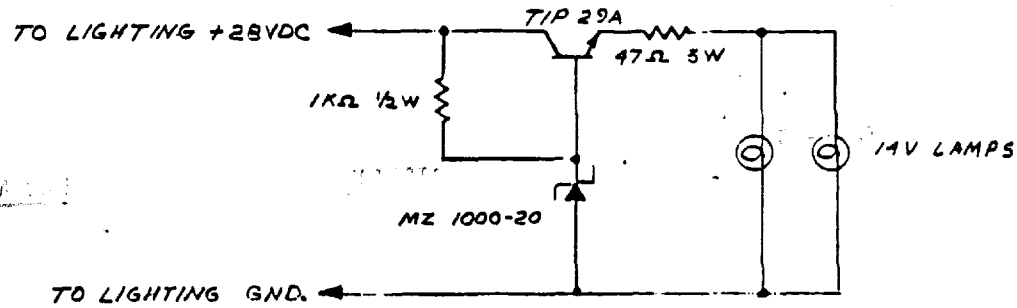
CALLOUT NUMBERS	DESCRIPTION	NEW AIM P/N
13	Connector	821-0102-901
22	Label, pin connection	600-0091-001

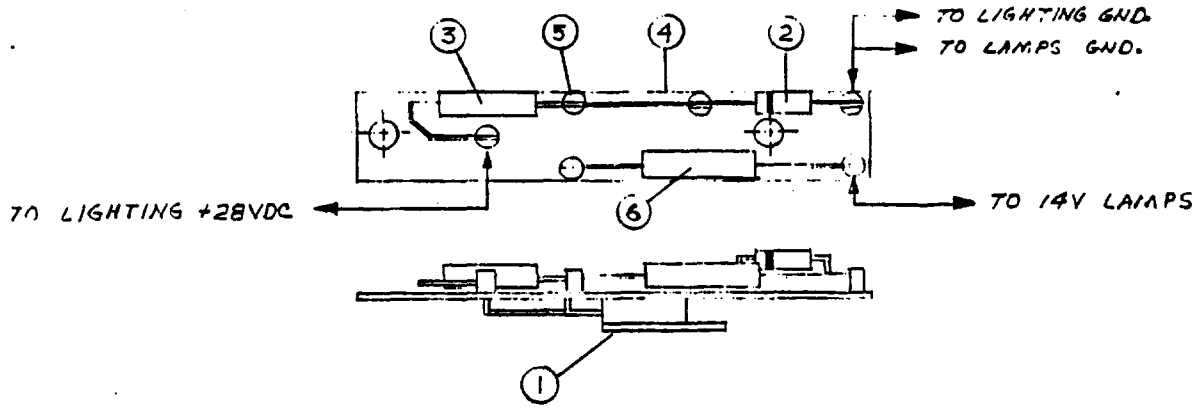
LIGHT REGULATOR CIRCUIT
PART NUMBER 800-0061-903

USAGE

510-7A	510-10B	510-17B
510-7B	510-10C	
510-10A	510-17A	

CIRCUIT BOARD SCHEMATIC





CIRCUIT BOARD ASSEMBLY

ITEM	PART NUMBER	QUANTITY	DESCRIPTION
(1)	806-0023-001	1	Transistor, TIP 29A
(3)	801-0205-073	1	Resistor, 1K, 1/2W
(4)	800-0060-001	1	Circuit Board
(5)	817-0004-001	6	Terminal
(2)	805-0201-020	1	Diode, Zener, MZ1000-20
(6)	801-0161-021	1	Resistor, 47Ω, 3W, W.W.

OVERHAUL MANUAL

ALTIMETER PRESSURE SENSITIVE

A35-MA-10L-1
A35-MA-10L-2

This manual covers all A35-MA-10L-1 and A35-MA-10L-2 Altimeters manufactured by either Aerosonic Corporation or Aero-Scotia Limited with the exception of Altimeters bearing serial numbers NS 348 to NS 431 inclusive. Instruments bearing these serial numbers have a slightly different mechanism and should be returned to the manufacturer for overhaul. This difference in no way affects the operation, serviceability or reliability of the instruments.

Aero-Scotia Limited

18 ELECTRIC STREET

AMHERST, — — NOVA SCOTIA

April 23, 1970

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SECTION I

INTRODUCTION

1-1. **Identification** — The Aerosonic and/or Aero-Scotia instrument part number and serial number are obtained from the nameplate and are required for the complete identification of the equipment.

1-2. **Purpose** — The altimeter measures the existing atmospheric pressure. Since the atmospheric pressure varies with altitude this pressure is indicated on the dial of the instrument in feet of altitude.

1-3. **Description** — The case of the altimeter is of two-piece construction to ensure an airtight seal. The mounting flange of the case is supplied with three mounting openings.

1-4. There are three concentrically arranged pointers. These indicate on a common scale in units of 100 feet, one thousand feet and ten thousand feet respectively. In moving through the entire range of 35,000 feet the long pointer makes thirty-five revolutions, the intermediate pointer performs three and one-half revolutions, and the inverted pointer makes three and one-half tenths of a revolution.

1-5. The outer dial is graduated into single divisions of twenty feet of altitude when measured by the long pointer and estimations can be conveniently made to five feet.

1-6. A Barometric Scale (sub-dial), which is visible through a window on the outer dial, indicates the barometric pressure. The A35-MA-10L-1 model indicates pressure in inches of mercury with a range of 28.1 to 31.0 inches. The A35-MA-10L-2 model indicates pressure in milibars of mercury with a range of 950 to 1050 milibars.

1-7. The adjustment knob, located at the lower left corner of the case provides a means of adjusting the hands and barometric scale simultaneously to correct for changes in atmospheric pressure resulting from changing conditions.

1-8. The pointers, numerals and graduations are painted with white material. Under average conditions of night flying the instrument will be sufficiently luminous to be legible.

SECTION II

OVERHAUL INSTRUCTIONS

2-1. **Special Tools:** None

2-2. Repair, assembly and testing shall be accomplished in a controlled area, Ref. T. O. 00-25-203 of latest date and FED STD-209 of latest issue. The work space requires better than normal housekeeping and segregation from excessive dirt generating operations.

2-3. **Disassembly.**

2-4. Disassembly of Components. (See Figure 2-1).

2-5. **Removal of Bezel.**

a. Wrap a piece of friction tape around the knurled part of knob (2). Hold knob (2) with a pair of pliers and loosen lock nut (3) with a 5/16 inch wrench. Remove knob (2) and lock nut (3) from the adjustment knob stem (32).

b. Back off locking stud screw (4) until the head clears the top flange of bezel (7). Push screw (4) to the left. This disengages locking stud (5) which rides in a recess in adjustment knob stem (32). It is not necessary to remove screw (4) or stud (5).

c. Turn the instrument over and remove the lead seal (6), eight screws (8 and 9) and lock washers (10). Carefully lift the bezel (7) from the case (39).

d. Remove glass (12) and paper gasket (11) from bezel (7).

2-6. **Pointer and Dial Removal**

a. Remove the bezel gasket (13) and spacer ring (14) from the case (39).

b. Pull pointers (16 and 17) and pointer assembly (18) off the front of the transmission mechanism (24).

c. Remove dial (19) by removing two dial screws (20). Lift barometric dial assembly (21) off of transmission mechanism (24).

NOTE: Do not further disassemble barometric dial assembly (21).

2-7. **Transmission Mechanism Removal**

a. Lift barometric setting gear assembly (23) from transmission mechanism (24).

b. Remove tension wire (15). With a sharp pointed instrument, pry free both ends of snap ring (22) and remove.

c. Turn case (39) upside down and allow transmission mechanism (24) and mechanism assembly (25) to fall into the hand. A formed spring ring (26) is also removed.

2-8. **Completing Disassembly of Case**

a. Using a sharp pointed instrument pry both ends of snap ring (36) free and remove snap ring from case (39).

b. From the well at the inside corner of case (39) remove snap ring from *the groove of adjusting knob stem (32). Use a screwdriver to facilitate re*moval.

c. Remove pin (31) from adjusting knob stem (32) and zero setting pinion gear (35) by pressing out part way with tweezers. turn knob a half turn and remove pin.

d. Pull adjusting knob stem (32) out of the front of case (39). Remove from slot at the inside of case (39) a compression spring (33) and zero setting pinion gear (35). Remove "O" ring (34) from the front of case.

e. Install a round punch, 5/16 inch in diameter, through the rear of case (39) and press out filter screen washer (37) and filter screen (38), if damaged.

* CAUTION * Care must be taken to prevent damage to static line inlet connector threads.

2-9 **Transmission Mechanism Disassembly**

a. Remove transmission mechanism (24) from the front of mechanism *assembly (25).*

b. Pull the wheel assembly (1, Figure 2-2) from gear bushing (5).

c. Remove pivot plate assembly by taking out three shouldered screws (3). Separate stem pinion (2) from wheel assembly (7) and remove both.

d. Remove gear assembly (4) from gear bushing (5). The gear bushing is now free of pivot plate sub-assembly (6).

e. Remove gear assembly (8) from the gear plate assembly (9).

NOTE: Inspect gear stud (10) carefully before removing. Do not remove the stud unless bent or excessive wear is detected.

2-10. **Mechanism Disassembly** (See Figure 2-3).

NOTE: Do not remove jewels uless damaged, see paragraph 2-25.

a. From the hub of gear plate (14) remove center pinion (1) with a suitable pinion remover being careful not to damage the handstaff pinion (2).

b. Loosen set screw (12). Remove jewel bushing (3) and handstaff pinion (2).

c. Work the aneroid spring clip (19) from the aneroid and pull the aneroid pin (20). Remove the special screw (22) and diaphragm support nut (23). Remove two screws (49) and slide the diaphragm support plate (48) with diaphragm from the casting. Separate the aneroid assembly (21) from the plate (48).

* CAUTION * Do not separate the two aneroid halves as they are a matched set. Replace with new assembly if damaged.

d. Pull the bearing pin (24) from the bi-metal assembly (27) and remove the mechanism link assembly (25).

e. Loosen two screws (52) and remove two pivot screws (26). Lift the bi-metal support assembly (28) with sector and rocking shaft assembly (30) out of the casting.

f. Loosen screw (29) and pull bi-metal assembly (27) from the bi-metal support assembly (28). Remove the bi-metal support assembly from the sector and rocking shaft assembly (30) by loosening screw (33).

g. Remove counterweight (32) from the crown gear of the sector and rocking shaft assembly (30) by removing a screw (31). Remove a screw (33) and remove the bi-metal counterweight (34).

* CAUTION * Do not further disassemble the sector and rocking shaft assembly.

h. Loosen a screw (52) and withdraw the jewel bushing assembly (39) from the frame (57). Remove crown pinion assembly (43).

i. Remove five bodyfit screws (7) and lift the gear plate assembly (6) from the casting.

j. Lift the transmission gear assembly (15) from the casting.

k. Press the taper pin (16) from the hairspring post (56) and lift the hairspring wheel assembly (17) from the casting. The hairspring (18) may be pressed from the wheel assembly if damaged.

l. Remove a sector guide screw (50) from the sector guide post (51). Do not remove the sector guide post (51) from the frame (57).

m. Loosen a set screw (52) and withdraw the remaining jewel bushing assembly (44) from the frame (57).

n. It is not recommended that the hairspring post (56) be pressed from the frame (57).

o. Do not remove teflon bearings (58) unless damaged.

2-11. **Cleaning, Inspection, Test and Repair**

2-12. General. Examine all the pinion teeth and pivots for wear and corrosion. The jewel setting assemblies should be examined for loose or broken jewels. The aneroid link should be inspected for burrs or out-of-round (ovalized) pivot holes. If the hole is oval shaped or the jewel damaged, replace the link.

2-13. **Cleaning**

2-14. General. All parts should be put in a small wire mesh basket and washed in a watch type cleaning solution then rinsed thoroughly in benzine, Federal Specification VV-B-231, and dried.

2-15. Pinions. The cleaning of pinions both handstaff and intermediate may be facilitated by using a pair of tweezers with a hole in each of the pointed ends. The pinions may be placed in these holes and the teeth brushed satisfactorily.

2-16. Wheel and Hairspring Assemblies. The teeth of the wheel and hairspring assembly and the sector teeth should be brushed. Next transfer the parts to a box containing boxwood sawdust, and there shaken to dry thoroughly. Another brushing must follow this treatment, this time with a dry and clean watchmaker's brush No. 3, which is occasionally rubbed across a piece of prepared chalk.

2-17. Pivots. Pivots are cleaned by pressing them into the end grain of a piece of dry featherwood and twirling the wood between the fingers.

2-18. Pivot Holes. All pivot holes are to be cleaned with care using the pointed end of an orangewood (pegwood) stock which is to be scraped clean frequently. A last touch in the cleaning of pivots is sticking them into dry elder pitch.

2-19. **Inspection**

a. After brushing, the parts are to be looked over with a magnifying glass to make certain that they are truly clean.

b. Inspect all pivots, they should be highly polished and free from scratches. If any damage is apparent, the pivot must be replaced.

c. Inspect all jewels. If a chipped or cracked jewel is found, replace with a new mounted jewel.

d. Inspect the case for cracks or chipped spots.

e. Inspect the hairspring. It should be free from sharp bends or kinks, other than at the ends, and should lie in a level plane.

f. Inspect both ends of link. They should be smooth and free from scratches.

g. Inspect the aneroid assembly. If any damage is detected in the aneroid assembly such as dents, misalignment, lost parts or general wear, replace the assembly as a unit.

2-20. **Storage**

2-21. After inspection, place the parts at once under a small bell jar where they are to be kept for assembly.

2-22. **Testing**

2-23. There is no testing required for dismantled parts.

2-24. **Repair or Replacement**

NOTE: Replacement of parts such as diaphragm, pivots, handstaffs, sectors and gears during overhaul, may disturb the original alignment of the Altimeter and cause erratic altitude readings and excessive friction during initial calibration. Custom or hand fitting replacement parts, plus additional calibration may be required to correct these conditions.

2-25. **Removal and Replacing of Press Jewels**

a. Use a scribe to break out a broken jewel from mounting. Drill out the mount with a No. 53 Tap with a No. 1-72 bottoming tap until jewel works itself out.

NOTE: Use the above method on bushings and rocking shaft. See method outlined in paragraph b. for removing jewel from plate.

b. Using watchmakers bench block for support a round flat nose punch of a diameter slightly smaller than the jewel and press out.

2-26. Replacement of Rocking Shaft Jewels

a. On the sector gear end of the sector and rocking shaft (Figure 2-3) press in the cap jewel (36) and then the hole jewel (35) until flush with the end of the shaft. Stake bushing to shaft.

b. On the large diameter end of the rocking shaft insert rocking shaft spring (38) and cap jewel (37) and then press in the hole jewel (35) until flush with the end of the shaft. Stake the bushing to the shaft.

2-27. Jewel Bushings. The jewel bushing assembly (39) used with the crown pinion assembly (43) and the transmission gear assembly (15) are assembled in the following manner: Insert cap jewel (41), face up, and then press the hole jewel (40) countersunk face up, in until flush with face of bushing. Stake the mounting to the jewel pinion bushing (42). Frame bushing (55) with its hole jewels (53) and cap jewel (54) are assembled in the same manner.

2-28. Frame Center Jewels

a. Frame center jewels (53 and 54) are removed from the gear plate end of the frame (57) with a round flat nose punch slightly small than the diameter of the jewel mount.

b. Replace the jewels (53 and 54) from the gear plate end of the frame by pressing one hole jewel (53) with countersunk side up, one cap jewel (54), and one hole jewel with countersunk side down. Press jewels until first hole jewel is flush with inside surface of frame (57).

2-29. Jewel Bushing. Jewel bushings are assembled by pressing in cap jewel (46) and then hole jewel (45) with countersunk face down until flush with end of jewel bushing (47). Replace the larger mounted jewel (4) by pressing into jewel bushing (5).

2-30. Eccentric Jewel Bushings

a. Press cap jewel (10) and then hole jewel (9), with countersunk face toward the slot in the eccentric jewel setting (11). Press until hole jewel (9) is flush with smaller diameter of jewel setting (11). Stake jewel mountings at both sides of the setting.

b. Eccentric jewel assemblies (8) are set at assembly to obtain correct height and position to insure correct mesh of gear teeth.

2-31. **Lubrication**

2-32. No lubrication is required.

2-33. **Reassembly**

2-34. Reassembly of Mechanism Assembly (See Figure 2-3).

a. Press the assembled frame bushing (55) into the frame (57) with the flush jewel side toward the inside of the frame. Stake the bushing.

b. Install the jewel bushing assembly (39) in the extended arm section of the frame (57). Set the screw (52) to retain the bushing. Refer to paragraph 2-34 j. for adjustment.

c. Work the remaining jewel bushing assembly (39) into the extended arm section of the frame (57), until it is flush with the open side of the arm. Install a screw (52) to secure in position.

d. Install sector guide screw (50) in the sector guide post (51)

e. Assemble mechanism link (25) into the slot of the aneroid assembly (21) and install aneroid pin (20). Lock the pin in position with aneroid spring clip (19).

f. Press the hairspring (18) on the hairspring wheel assembly (17) until it bottoms on the shoulder.

g. Position the hairspring wheel assembly (17) in the jewel of jewel bushing assembly (44) with hairspring side next to the frame. Rotate hairspring wheel assembly (17) until the bent portion of the hairspring is in line with the hole in the hairspring post (56). Install 1/8 inch end of spring in the post and insert taper pin (16). Taper pin must be installed in the same direction as the spring. Cut the taper pin so that approximately 1/8 inch extends beyond each side of the post.

* CAUTION * There should be no sharp bends or kinks in the hairspring (18) where it is pinned, as this weakens leaf and it may break in service. See that hairspring is in a rounded and flat condition.

h. If hairspring (18) is not in position as described, it may be adjusted. Adjustments to correct misalignment of the hairspring should be made with tweezers at point of pinning.

i. Position the transmission gear assembly (15) in the jewel bushing assembly (39).

j. Align the gear plate assembly (6) with the pivots on the wheel gears and assemble the gear plate to the frame (57). Secure the plate with five bodyfit screws (7).

k. Reverse the frame in the holding cup.

l. Adjust jewel bushing assemblies (39) and (44) for proper end shake .003 inch. Tighten the screws (52) on the bushings.

m. Install the crown pinion assembly (43) and adjust jewel bushing assembly (39) for proper end shake, .003 inch. Tighten screw (52) on bushing.

n. Adjust eccentric bushings located in the gear plate assembly (6) for proper mesh of teeth.

o. Assemble the sector and rocking shaft assembly (30) in the following manner: Assembly bi-metal counterweight (34) to the end of the rocking shaft pin and secure with a screw (33). Install two more screws (33) loosely in the rocking shaft (30). Assemble counterweight (32) to the crown gear and secure with screw (31).

p. Install the bi-metal support assembly (28) in the sector and rocking shaft assembly (30). Tighten the set screw (33).

q. Position the sector and rocking shaft assembly (30) in the frame (57) between the pivot screws (26). Use the new pivot screws (26) if they appear to be damaged. Adjust the pivot screws to hold the crown gear in mesh with crown pinion assembly (43). Set the end shake to approximately .0015 inch.

r. Install aneroid assembly (21) in the opening of the diaphragm support plate (48). Assemble diaphragm support nut (23) and special screw (22) to the diaphragm support plate (48). Install this assembly in the frame (57) and secure with two screws (49).

s. Install the bi-metal assembly (27) in the bi-metal support assembly (28). Snug up the screw (29).

t. Mechanism hook-up. Disengage the crown gear, of the sector and rocking shaft assembly (30), and crown pinion assembly (43) by running the sector gear out. Turn the crown pinion assembly (43) gear one and one half revolutions clockwise and engage the crown gear.

NOTE: Care should be taken to keep the gear train in position for the next step in the hook-up.

u. Assemble the mechanism link (25) in the slot of the bi-metal assembly (27) with a bearing pin (24). Adjust the bi-metal so that mechanism link (25) pin opening is aligned with the hole in the aneroid assembly (21) opening. Slide aneroid spring clip (19) between aneroid pin (20) and aneroid assembly (21).

NOTE: Adjust the bi-metal assembly (27) to insure alignment of linkage. Tighten the bi-metal support assembly (28) clamp screw (33).

v. Reverse the frame (57) in the holding cup so that it is positioned gear plate end up.

w. Install the handstaff pinion (2) in the hole jewel (53). Position the jewel bushing assembly (3) into the center bushing (13), with large mounted jewel (4) and jewel bushing (5). Mounted jewel is mounted up. Adjust the bushing (5) to obtain .003 inch end shake of the handstaff pinion (2). Tighten jewel bushing set screw (12).

x. Pinch the hub of center pinion (1) lightly to insure positive fit. Press the center pinion (1) on the shaft of the handstaff pinion (2). There should be .002 to .003 inch clearance between center pin pinion and hub of gear plate assembly.

2-35. Transmission Mechanism (See figure 2-2).

a. Press a new gear stud (10) in the cut-away sector of the gear plate assembly (9), if removed.

NOTE: The top side of the gear plate assembly (9) is the side with the greatest amount of machining and recesses. The bottom is relatively smooth in appearance.

b. Position gear assembly (8) in the gear plate assembly (9) located next to the plate assembly. The gear assembly (8) is located in the small hole, next to the large opening in the center of the pivot plate sub-assembly (6), on the side opposite the locating pin.

NOTE: The top of the pivot sub-assembly (6) is distinguished by the three countersunk holes around the outer edge.

c. Install gear bushings (5), from the top, through the bushing of the pivot plate sub-assembly (6) and press the gear assembly (4) onto the gear bushing (5). Use .003 inch shim between gear bushing and pivot plate. Remove the shim. Note the position of gears with respect to the plate sub-assembly.

d. Install stem pinion (2) through the top of pivot plate sub-assembly (6) and hub of wheel assembly (7). There are two small holes in the inner part of the pivot plate sub-assembly (6). These two holes, one countersunk hole and the center bushing assembly are in line. The hole on the side opposite the aligned countersunk screw hole is the hole on the plate (6) used to install stem pinion (2).

e. Position pivot plate assembly, install wheel assembly (7) in gear plate assembly (9), on the gear stud side of the gear plate. Make sure all pinion stems and staffs are located in their respective pivot points. The three screw hloes should already be aligned. Install three shoulder screws (3). Install wheel assembly (1) on hub of pivot plate.

f. Assemble the bottom opening of the transmission mechanism (24, Figure 2-1) over the center bushing of the gear plate of the mechanism assembly (25).

NOTE: Care must be taken to properly mesh center pinion (1, Figure 2-3) with the gear assembly located inside mechanism assembly (25, Figure 2-1). Rotate transmission mechanism several times to insure meshing of all gears and pinions. Press pointer (16) into handstaff pinion (2, Figure 2-3). Rotate the mechanism in relationship to the transmission mechanism. When properly seated the pointer will turn with the mechanism assembly without binding, sticking, or any irregular motion.

2-36. **Calibration and Checking** (See Figure 2-3)

2-37. Checking for Balance

a. The sector counterweight (32) controls position error at 90 degrees and 270 degrees from the normal operating position.

b. Mount the mechanism in a suitable calibration stand so that wheel assembly is at zero position and place the stand, dial up, on the bench. Lightly press a balanced pointer on handstaff pinion (2) so it indicates zero. With mechanism in the calibration stand and pointer pressed onto the handstaff at an indication of zero, hold the instrument dial vertical with the "0" on top. Tap the stand and note the reading. Turn instrument 180 degrees (this places "0" at bottom) and, after tapping, note indication of pointer. If pointer was moved clockwise (or counterclockwise) by more than 20 feet, check rocking shaft (30) for too much end shake.

c. Hold mechanism dial vertical with "0" on top. Tap stand and note reading. Turn instrument 90 degrees counterclockwise. This places "0" at left (9 o'clock). After tapping, note indication of pointer. If pointer has moved clockwise (plus error) by more than 20 feet, correct error by shifting position of sector counter-weight (32) toward rocking shaft. If error is minus by more than 20 feet, the sector counterweight should be moved away from rocking shaft (30).

2-38. **Temperature Compensation**

NOTE: The instrument without provisions for temperature compensation would read plus in going from room to cold. The aneroid may be considered a spring under load. (The atmospheric pressure being the load.) When the temperature is reduced, the aneroid material becomes stiffer, and stronger and thus resists the load more easily. Since the load remains constant, the aneroid expands and a plus indication is obtained. The rocking shaft, hairspring, and wheel hairspring also tend to become stronger in cold and increase the plus indication. To compensate for this action, a bi-metallic strip is interposed between the aneroid and linkage to rocking shaft. The bi-metal assembly (27) used in this instrument has a "fast" side of brass. Under a change in temperature; the brass side will become either longer or shorter than the other side causing a point on the free end of the bi-metal to swing through an arc. For proper compensation, plane of the bi-metal is approximately 60 degrees to the surface of the aneroid assembly with the brass side down and inclined toward the left, when viewing the mechanism from the rear.

2-39. **Test Equipment**

a. Air chamber. Controlled temperature capable on an overall change of 80 degrees C (144 degrees F) in temperature. This allows testing adjustment of altimeter temperature compensation with the desired degree of accuracy.

b. The mechanism must be placed in suitable calibration stands equipped with four Edward Buzzers. This vibration should be used during all compensation tests.

2-40. Individual Tests

2-41. Place the mechanism in the calibration stand and set pointer to "0".

NOTE: Fluctuations in atmospheric pressure during compensation testing must be taken into account. These changes in pressure may be noted in terms of feet of altitude from another standard altimeter. For instance, if the standard altimeter indicates 500 feet at the start of the compensation test and 530 feet when the test is completed, the mechanism undergoing the compensation test will also have changed plus 30 feet during the same time.

This error must be subtracted algebraically from the reading obtained from the test instrument in order to arrive at true compensation. Record zero reading of instrument(s) and place instrument(s) in cold chamber set at -35 degrees C (-31 degrees F) for a period of 1½ hours. Record scale reading of instrument making correction or changes of atmospheric pressure, indicated by standard altimeter. The instrument is then removed from the cold chamber to room temperature condition and then placed in a dryer for one hour before adjustment. No test readings will be taken until a minimum soak period of 1½ hours has been established.

2-42. Adjustment

a. *If the difference in room and cold reading exceeds the tolerance shown* in Table 2-1, temperature compensation is necessary.

b. Should the mechanism indicate a plus reading in going from room to cold temperature, the mechanism is under compensated and the bi-metal support screw (29, Figure 2-3) should be loosened slightly. Rotate the bi-metal assembly (27) counterclockwise and tighten screw.

c. Should the mechanism indicate a minus reading in going from room to cold, the adjustment is made in a similar manner, but in a clockwise direction. Re-zero pointer and repeat test procedure. To maintain a minimum error at various altitudes it is important to compensate the mechanism as near to zero as possible.

2-43. **Calibration Procedure**

a. The calibration points listed in Table 2-2 are the primary check points to be used during calibration.

b. Either a change of aneroid assembly (21, Figure 2-3) position or a change in the length of the bi-metal support assembly (28) "speeds up" or *"slows down" the mechanism with a corresponding increase or decrease* in the rate of hand rotation between zero and maximum altitude.

c. Shifting the aneroid assembly (21) position changes the speed of rotation at high altitudes more than at low altitudes. Shifting the aneroid toward the shaft of sector and rocking shaft assembly (30) "speeds up" the mechanism while shifting it away from the rocking shaft "slows down" the mechanism.

d. If the aneroid is shifted so that the hand indicates a change of 1000 feet, the change in indications at different altitudes will be approximately as shown in Table 2-3.

e. An increase in bi-metal support assembly (28) length slows down, and a decrease in length speeds up the mechanism througout the entire range. Calibration adjustments for the middle range (10,000 to 25,000 ft.) can be made by raising the support bar (48) to speed up the readings and lowering the bar to decrease the readings.

f. If the bi-metal support assembly (28) length is changed equivalent to 0.005 inch, the change in indications at different altitudes will be approximately as shown in Table 2-4.

g. By using both adjustments, ıe speed of rotation can be selectively increased or decreased in the l , middle, or high ranges.

h. Observe the point where tl crown pinion assembly (43, Figure 2-3) meshes with the crown gear (sector and rocking shaft assembly (30). The point of mesh should be proximately 6-8 teeth, from the end of the crown gear arc at sea le pressure. It is important to have this starting position in order to ha the altimeter reach its maximum range of operation. To adjust the pc ion of the sector gear; hold the sector gear with hand and turn the roc ıg shaft with a pair of pliers as required.

2-44. Mechanism Temperature ımpensation and Calibration Procedure

a. Place the mechanism in th calibration stand and install the 100 ft. pointer at the existing ambient ırometric pressure of the day. (No pressure or vacuum applied).

b. Calibration at this point is ıncerned with the primary check points listed in Table 2-2. If all the pri ry check points are approximately within the tolerances listed, then the ıchanism is considertd to be within the established range and calibrati curve. At this point proceed to temperature compensation under para ıph 2-42.

c. The next step is to place the ıechanism in the test chamber and apply pressure to minus 200 feet or)0 feet below zero feet (29.92 inches of mercury).

d. Decrease pressure to zero ıt (29.92 inches of mercury) and record error. (Room temperature 25 de ıes C). Also record error of other check points in Table 2-2.

e. The next step is to record ı pointer error at -35 degrees C utilizing the procedures outlined in prec ding sub-paragraphs (c) and (d).

NOTE: While a ± 30 fo change is allowable for room to cold reading at zero fe it is recommended that the change be limited, if possible, ± 15 feet or less.

f. If the difference in room and ıld readings exceed the allowable change in Table 2-1, then temperature ıompensation is necessary. Utilize paragraph 2-42 b and 2-42 c. Prior changing the position of the temperature compensator, consideration shou be given to the scale error curve recorded when utilizing Table 2-2. In a event, if adjustment of the temperature compensator is necessary, rec ık the primary check points and/or recalibrate utilizing Table 2-2. Fur r adjustment of the mechanism should be made as required until all rec ngs come within the allowable changes and tolerances specified.

g. In the event that the differe ı in room to cold readings do not exceed the allowable change, proceed th final calibration.

NOTE: The preceding step are considered critical. Make certain the test chamber and ırometer with associated tubing, valves, etc. are free from ıks.

2-45. Adjustments

a. Mount the mechanism in the calibration stand so the aneroid is on the same side as "0" and place it in a pressure chamber so "0" is at the top. By means of knob on the calibration stand, set the hand of the test mechaism so that it will read "0" when the master altimeter or barometer reads "0".

NOTE: If the pointers of the master altimeter are below "0", close the chamber and reduce the pressure until the pointers indicate "0". Note the position of the pointer of these test instruments. If it is not on "0", open the chamber to atmosphere and turn the adjustment knob to reposition the pointers. Repeat the procedure until reading of "0" is obtained. If the pointers of the master are above "0", the procedure is similar to that described above except that the instruments must be subjected to pressure.

b. Close the pressure chamber and slowly decrease the pressure until the master altimeter or barometer indicates a reading equivalent to 10,000 feet.

c. If the mechanism shows a plus or minus indication, remove it and adjust the effective length of the bi-metal support assembly (28) to which the mechanism link (25) is connected. If the mechanism reading is too high move the bi-metal support (28) out of the rocking shaft. If the mechanism readings are too low, move the adjusting arm into the rocking shaft.

d. When the altimeter mechanism reading agrees with that of the master altimeter or barometer at 0 and 10,000 feet, increase pressure to that of room pressure, remove the instrument and stand from the chamber and recheck balance as described previously. When the instrument is balanced within the limits listed above, place the mechanism in a chamber and recheck instrument error at 0 and 10,000 feet. If the error is within tolerance specified, further reduce pressure and record errors at the succeeding check points (20,000 and 30,000 feet).

e. If the mechanism indicates a reading at 35,000 feet above or below that of the master altimeter (after applying the allowed tolerance) remove the mechanism from the chamber and adjust the position of the aneroid assembly (21) in the mechanism body. If the mechanism reading is too high, move the aneroid out (away) from the rocking shaft. The position of the aneroid assembly (21) in relation to distance of the rocking shaft assembly (30) is adjusted in the following manner: To move the aneroid away from the rocking shaft, turn the diaphragm support nut (33) clockwise. To move the aneroid toward the rocking shaft first loosen the aneroid clamping screw (22) with an Allen wrench, then back off the diaphragm support nut the desired amount, move the aneroid assembly toward the rocking shaft and tighten the clamping screw.

f. Shifting the aneroid assembly (21) to correct the indicator at 35,000 feet altitude alters both the "0" position and the setting at 10,000 feet. Therefore, the mechanism must be adjusted again so that it indicates 0 and 10,000 feet in accordance with the steps outlined above.

g. Further adjustment of the mechanism should be made as required until all readings come within the tolerances specified above.

h. Check the backward movement of the mechanism by slowly increasing the pressure until the altimeter indicates a minimum of -2,000 feet, maximum -3,000 feet. The sector and rocking arm shaft assembly (30) must be shifted with pliers and wrench as described above.

2-46. **Case Assembly** (See Figure 2-1)

a. If removed, position the filter screen (38) over the inside of the opening in the bottom of the case (39). Assemble the washer (37) over the screen and press into position and stake.

b. Position the case (39) on its side with the corner well down. Place the snap ring (36) on the upper hub of the pinion gear (35). Position pinion gear with hub facing out in the well of the case. Place compression spring (33) in the well of the case (39) around the neck of gear (35) and also around the snap ring (30).

c. Use a new "O" ring (34) at reassembly.

d. Align the center hole of the pinion gear (35) with the hole in the case (39). Install the unthreaded end of the adjustment knob stem (32) in the case.

e. Align the hole in the pinion gear (35) with the hole in the stem (32) and install the pin (31). Fasten in position by dropping the snap ring (30) in the groove in the neck of the gear (35).

f. Position the snap ring (36) in the innermost groove at the inside of the case (39). The snap ring (36) fits in the vertical groove next to the well corner of the case (39).

g. Install formed spring ring (26) in the case (39) on top of snap ring (36).

2-47. **Reassembly of Major Components**

a. Place the case (39) on the bench with the open end facing up.

b. Install a No. 6-40 x 1 inch screw in the threaded hole of the transmission gear plate (14, Figure 2-3). Suspend the transmission mechanism (24, Figure 2-1) and mechanism assembly (25) by the screw and lower the assembly into the case (39). The locating pin must be in line with the groove adjacent the case well for proper assembly.

c. Compress the transmission and mechanism assembly in the case and install the snap ring (22) in the second groove. The locater of the snap ring fits in the groove opposite the case well.

d. Insert the tension wire (15) between the transmission mechanism and the case in the transmission mechanism slot located diagonally opposite the case well.

e. Remove the pointer (16).

f. Assemble barometric setting gear assembly (23) over the gear stud (10, Figure 2-2) with wheel gear against gear plate.

2-48. Dial Assembly (See Figure 2-1)

a. Position barometric dial assembly (21) on the front of transmission and mechanism assembly.

b. Assemble dial (19) with the opening at the side opposite the gear assembly (23) to the pivot plate assembly of the transmission mechanism with two dial screws (20).

c. Press pointer assembly (18) on the bushing of wheel assembly (1, Figure 2-2) with the inverted arrow pointing to zero.

d. Press pointer assembly (17, Figure 2-1) on the gear bushing (5, Figure 2-2) with the pointer toward zero.

e. Press the center bushing of pointer (16, Figure 2-1) over the handstaff pinion (2, Figure 2-3). This pointer also points toward zero.

f. Install spacer ring (14, Figure 2-1) in the case (39) with the lip of spacer ring resting on the outer edge of case. Make sure the lock at the side of spacer ring is located in the outermost groove of the case.

g. Carefully assemble new bezel gasket (13) around the outer edge of spacer ring (14).

h. Clean and position glass (12) on the gasket (13) place paper gaskets (11) and bezel (7) on the glass.

i. Place one hand over the bezel to prevent it and the glass from falling off. While holding it thus, turn the instrument face down.

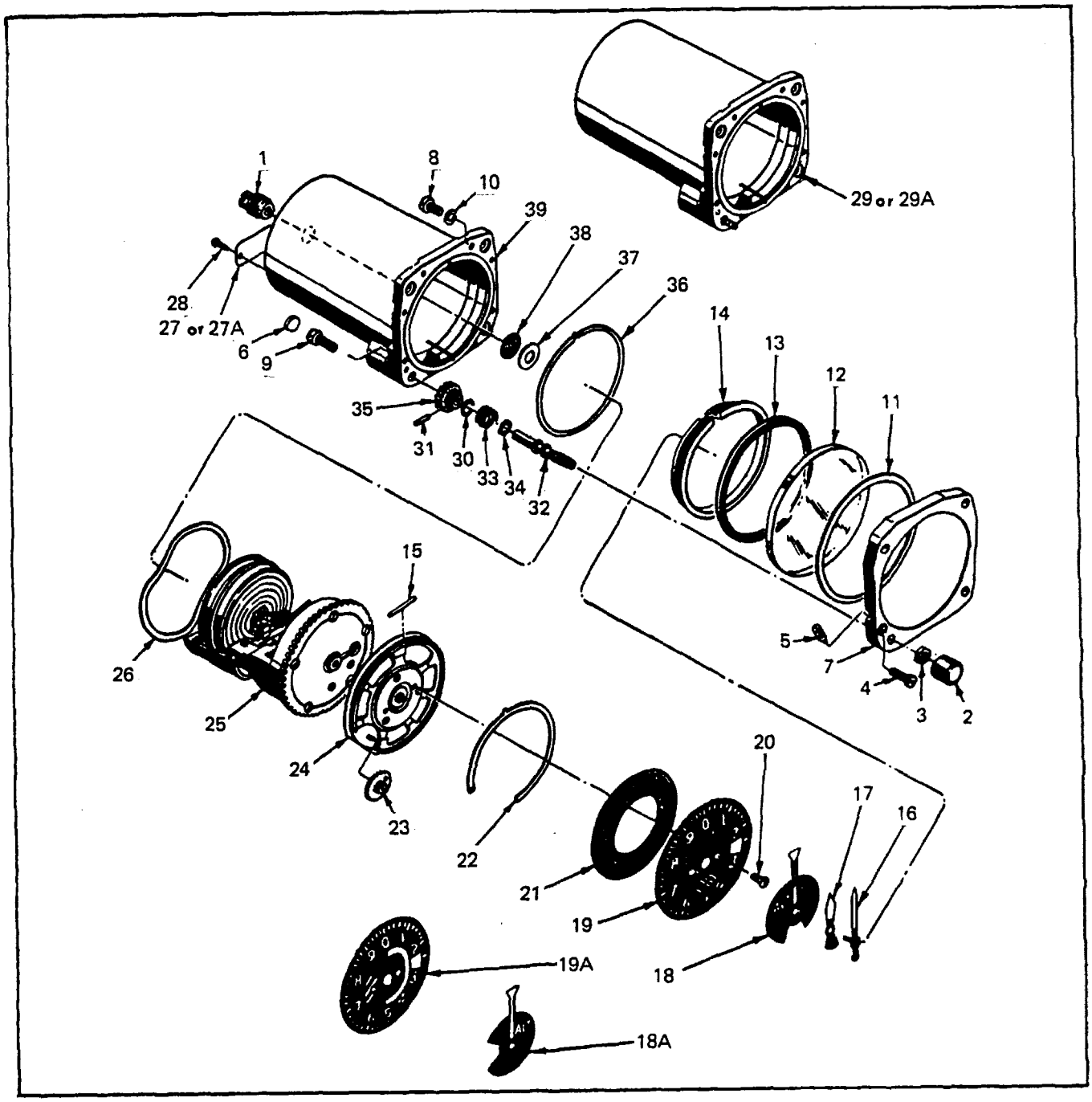
j. Install two diametrically opposite lock washers (10) and screws (8) to hold the bezel to the case. Install the remaining screws (8) each with a lock washer (10) around the case. Install two screws (9), on either side of adjustment knob stem. Tighten all screws by selecting screws in directly opposite positions and bring them up evenly to the tight position. Press a new lead seal (6) into mounting flange.

2-49. Completing Assembly

a. Replace lock nut (3) and the knob (2) on the adjustment knob stem. Hold the knob by covering knurled section with friction tape and grasping with pliers. Tighten knob lock nut against the knob with a 5/16 inch end wrench.

b. Lightly tap the instrument glass to remove friction Note the barometric pressure and compare it with the reading from a standard barometer. If it is necessary to adjust the barometric dial, pull the adjustment knob forward and while holding it in this position turn it to reset the barometric dial. When the desired barometric pressure is indicated, release the knob.

c. Push the locking stud screw (4) to the right to engage the pin, of locking stud (5), that rides in the recess of the knob stem. Screw down the locking screw (4).



1	*Plastic plug*	*16*	*Pointer (100 Ft.)*	*28*	*Drive screw*
2	*Knob*	*17*	*Pointer (1000 Ft.)*	*29*	*Case assembly*
3	*Lock nut*	*18*	*Pointer assembly (10,000 Ft.)*	*29A*	*Case assembly*
4	*Locking stud screw*	*18A*	*Pointer assembly (10,000 Ft.)*	*30*	*Snap ring*
5	*Locking stud*	*19*	*Dial*	*31*	*Pin*
6	*Lead seal*	*19A*	*Dial*	*32*	*Adjusting knob stem*
7	*Bezel*	*20*	*Dial screw*	*33*	*Compression spring*
8	*Screw*	*21*	*Barometric dial assembly*	*34*	*"O" ring*
9	*Screw*	*22*	*Snap ring*	*35*	*Zero setting pinion gear*
10	*Washer*	*23*	*Barometric setting gear assembly*	*36*	*Snap ring*
11	*Gasket*	*24*	*Transmission mechanism*	*37*	*Washer*
12	*Glass*	*25*	*Mechanism assembly*	*38*	*Filter screen*
13	*Bezel gasket*	*26*	*Spring ring*	*39*	*Case*
14	*Spacer ring*	*27*	*Nameplate*		
15	*Tension wire*	*27A*	*Nameplate*		

Figure 2-1. Pressure Altimeter

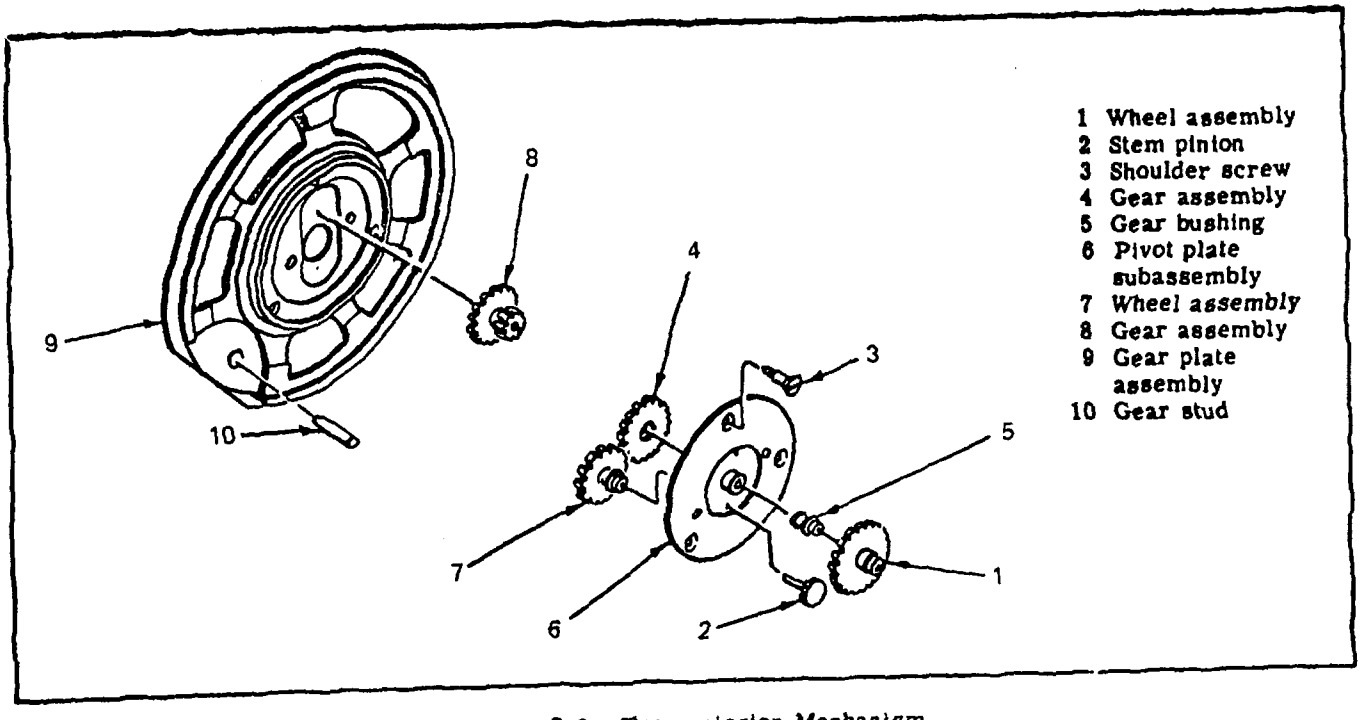
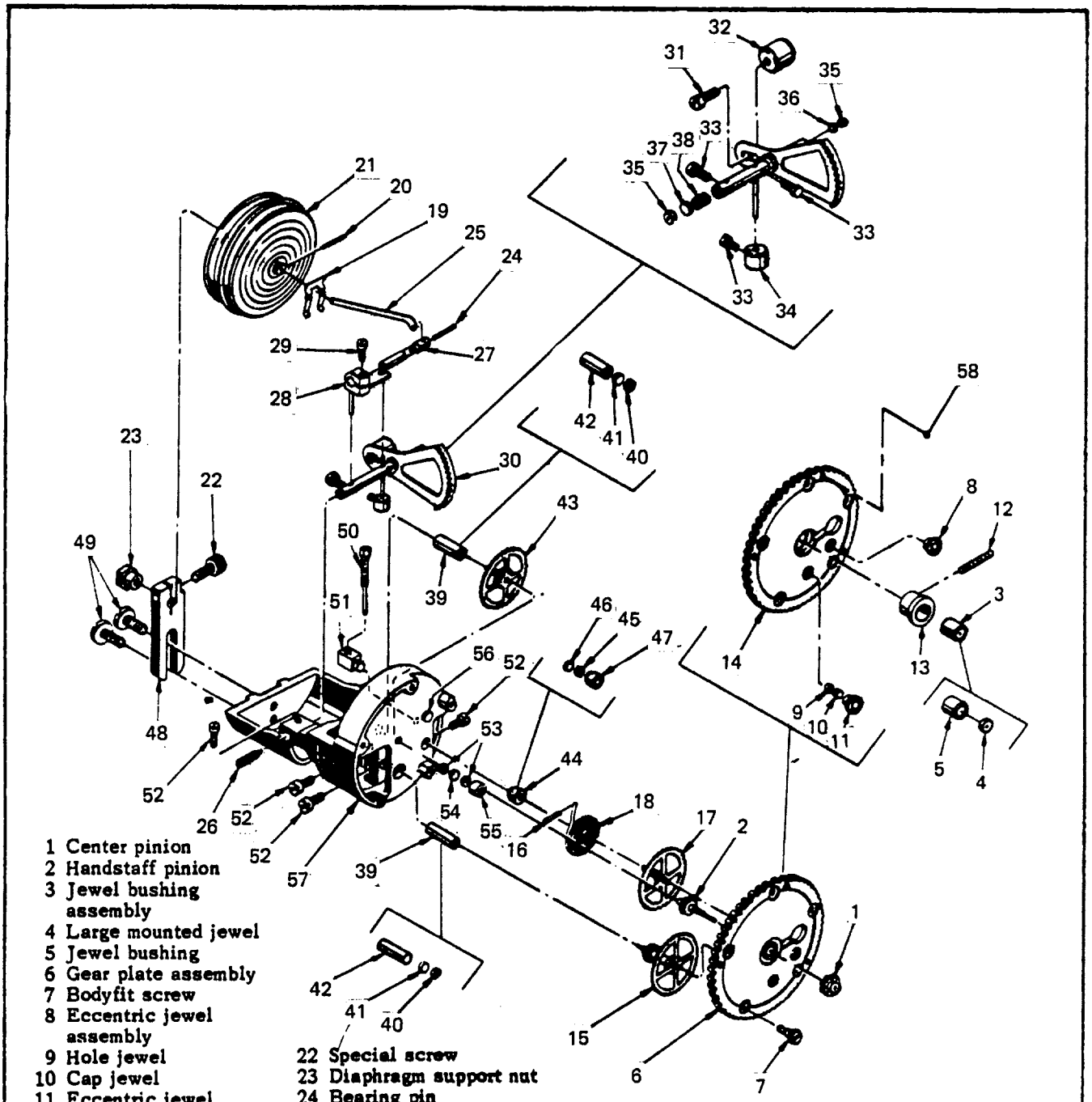


Figure 2-2. Transmission Mechanism



1 Center pinion
2 Handstaff pinion
3 Jewel bushing assembly
4 Large mounted jewel
5 Jewel bushing
6 Gear plate assembly
7 Bodyfit screw
8 Eccentric jewel assembly
9 Hole jewel
10 Cap jewel
11 Eccentric jewel setting
12 Screw
13 Center bushing
14 Gear plate
15 Transmission gear assembly
16 Taper pin
17 Hairspring wheel assembly
18 Hairspring
19 Aneroid spring clip
20 Aneroid pin
21 Aneroid assembly
22 Special screw
23 Diaphragm support nut
24 Bearing pin
25 Mechanism link
26 Pivot screw
27 Bi-Metal assembly
28 Bi-Metal support assembly
29 Screw
30 Sector and rocking shaft assembly
31 Screw
32 Counterweight
33 Screw
34 Bi-Metal counterweight
35 Hole jewel
36 Cap jewel
37 Cap jewel
38 Rocking shaft spring
39 Jewel bushing assembly
40 Hole jewel
41 Cap jewel
42 Jewel pinion bushing
43 Crown pinion assembly
44 Jewel bushing assembly
45 Hole jewel
46 Cap jewel
47 Jewel bushing
48 Diaphragm support plate
49 Screw
50 Sector guide screw
51 Sector guide post
52 Screw
53 Hole jewel
54 Cap jewel
55 Frame bushing
56 Hairspring post
57 Frame
58 Teflon bearings

Figure 2-3. Mechanism Assembly

TABLE 2-1 Room and Cold Tolerances

Altitude in Feet	Allowable Change of Reading in Feet
0	30
6,000	60
12,000	90
18,000	120
25,000	155
35,000	205

TABLE 2-2 Primary Check Point During Calibration

Standard Altitudes	Equivalent Atmospheric Pressure		Scale Error Tolerance 80,000 Feet Altimeters
Feet	Mercury MM	Inches	
0	760.0	29.92	20
10,000	522.6	20.58	80
20,000	349.25	13.75	130
30,000	225.6	8.88	180
35,000	178.8	7.041	205

TABLE 2-3 Aneroid Adjustment Altitude Change

Altitude	Change
10,000 Ft.	100 Ft.
20,000 Ft.	150 Ft.
30,000 Ft.	250 Ft.

TABLE 2-4 Bi-Metal Adjustment Change

Altitude	Change
10,000 Ft.	100 Ft.
20,000 Ft.	150 Ft.
30,000 Ft.	350 Ft.

SECTION III
TEST PROCEDURES

Specification Requirements

Instrument shall be in accordance with FAA TSO-C10b (AS392C).

	Paragraph
Scale Error Room Temperature	3-1
Scale Error Low Temperature	3-2
Hysteresis	3-3
After Effect	3-4
Friction	3-5
Case Leak	3-6
Position Error	3-7
Barometric Scale Error	3-8

3-1. **Scale Error** — With the barometric pressure scale at 29.92 inches of mefcury, the altimeter shall be subjected successively to pressures corrospoding to the altitude specified in Table I up to maximum normally expected operating altitude of the airplane in which the altimeter is to be installed. The reduction in pressure shall be made at a rate not in excess of 20,000 feet per minute to within approximately 2,000 feet of the test point. The test point shall be approached at a rate compatable with the test equipment. The altimeter shall be kept at the pressure corresponding to each test point for at least one minute, but not more than ten minutes, before the reading is taken. The error at all test points must not exceed the tolerance specified in Table I.

3-2.. **Low Temperature** — The instrument shall be exposed to a temperature of -30 degrees C for three hours and while at the temperature shall be tested as described in paragraph 3-1. The change in reading of the indicator from room temperature reading at any tese point shall not exceed the value specified in Table I.

3-3. **Hysteresis** — Not more than 15 minutes after the altimeter's initial exposure to the pressure corresponding to the upper limit of the scale (per paragraph 3-1), and while the subject instruments are still at this pressure the hysteresis test shall commence. Pressure shall be increased at a rate simulating a descent in altitude approximately (but not exceeding) 20,000 fpm until within 3,000 feet of the first point (50% of the maximum altitude). Then the test point shall be approached at a rate of approximately 3,000 fpm. Within ten seconds after the pressure has been stabilized at the test point, the instrument indication shall be within 75 feet of the scale error (paragrph 3-1) reading. The altimeter shall remain at this pressure for at least five minutes, but not more than 15 minutes before pressure shall be further increased at the above rate until the pressure corresponding to the second test point (40% of the maximum altitude) is reached. The Altimeter shall remain at this pressure for at least one minute but not more than ten minutes before the test reading is taken. After the reading has been taken the pressure shall be further increased as specified above, until atmospheric pressure is reached. The reading of the Altimeter at either of the two test points shall not differ from the reading of the Altimeter for the corresponding altitude in the scale error test by more than the tolerance specified in Table II.

3-4. **After Effect** — Not more than five minutes after the completion of the hysteresis test, the pointers shall have returned to their original reading, corrected for any chage in atmospheric pressure within the tolerance specified in Table II.

3-5. **Friction** — The Altimeter shall be subjected to a steady rate of decrease of pressure equivalent to about 750 feet per minute. The change in reading of the pointers due to a light tapping of the instrument noted at the altitude specified in Table III shall be recorded as friction and shall not exceed the tolerance listed in Table III.

3-6. **Case Leak** — A pressure equivalent to 18,000 feet within the case shall not result in leakage exceeding the tolerance shown in Table II during a period of one minute.

3-7. **Position Error** — With atmospheric pressure applied to the instrument, the difference between the pointer indication when the instrument is in normal operating position and when it is in any other position shall uot exceed the tolerance specified in Table II.

3-8. **Barometric Scale Error** — With the ambient pressure constant, various settings of the barometric pressure scale within its range shall cause the pointer to indicate the equivalent altitude differences shown in Table IV within a tolerance of 25 feet.

TABLE I

ALTITUDE PRESSURE

(Ref: U. S. Standard Atmosphere 1962)

Altitude (Feet)	Equivalent Pressure (Inches of Hg.)	Tolerance (Feet)
-1,000	31.02	± 20
0	29.92	20
500	29.38	20
1,000	28.86	20
1,500	28.33	25
2,000	27.82	30
3,000	26.82	30
4,000	25.84	35
6,000	23.98	40
8,000	22.22	60
10,000	20.58	80
12,000	19.03	90
14,000	17.58	100
16,000	16.22	110
18,000	14.94	120
20,000	13.75	130
22,000	12.64	140
25,000	11.10	155
30,000	8.89	180
35,000	7.04	205

TABLE II

TEST TOLERANCES

Test	Tolerance (Feet)
Case Leak Test	± 100
Hysteresis Test	
First Test Point (50% Maximum Altitude)	75
Second Test Point (40% Maximum Altitude)	75
After Effect Test	30

TABLE III

FRICTION

Altitude (Feet)	Tolerance (Feet)
1,000	- 70
2,000	70
3,000	70
5,000	70
10,000	80
15,000	90
20,000	100
25,000	120
30,000	140
35,000	160

TABLE IV

PRESSURE — ALTITUDE DIFFERENCE

Pressure (Inches of Hg.)	Altitude Difference (Feet)
28.10	-1727
28.50	-1340
29.00	- 863
29.50	- 392
29.92	0
30.50	+ 531
30.90	+ 893
30.99	+ 974

ILLUSTRATED PARTS BREAKDOWN

ALTIMETER PRESSURE SENSITIVE

A35-MA-10L-1

A35-MA-10L-2

Aero-Scotia Limited

18 ELECTRIC STREET

AMHERST, — — NOVA SCOTIA

SECTION I

INTRODUCTION

1. This handbook is issued as the basic parts breakdown for Pressure Altimeter, Part Number A35-MA-10L-1 manufactured by Aerosonic Corporation, Clearwater, Florida, and/or Aero-Scotia Limited, Amherst, Nova Scotia.

2. In the parts numbering system the prefix letter indicates: (A) assembly, (SA) sub-assembly, (M) and (P) have no special significance. The first numerical digit indicates the drawing size: (1) A, (2) B, (3) C, (4) D.

3. Abbreviations used are in accordance with MIL-STD-12.

SECTION II

GROUP ASSEMBLY PARTS LIST

Figure & Index No.	Part Number	Description	Units Per Assy
1 -	A35-MA-10L-1	Altimeter	1
1	1604 - 600	Plug, Plastic Black	1
2	P1396	Knob	1
3	P1295	Nut, Lock	1
4	P1294	Screw, Locking Stud	1
5	P1293	Stud, Locking	1
6	P1297	Seal, Lead	1
7	M2098	Bezel	1
		(Attaching Parts)	
8	coml	Screw, 3-56 x 5/16 lg. Fil Hd.	5
	coml	Screw, 3-56 x 1/4 Lg. Fil Hd.	1
9	coml	Screw, 3-56 x 5/8 Lg. Fil Hd.	2
10	P1291	Washer	5
11	P1290	Gasket	1
12	AN5727-14	Glass (P-1059)	1
13	P2046	Gasket, Bezel	1
14	M21327	Ring, Spacer	1
15	M1265	Wire, Tension	1
16	P1499	Pointer 100 Ft.	1
17	P1653	Pointer 1000 Ft.	1
18	11608	Pointer Assy, 10,000 Ft.	1
19	21053	Dial	1
		(Attaching Parts)	
20	P1051	Screw, Dial	2
* 21	SA1680	Dial Assy, Barometric A35-MA-10L-1	1
22	M1075	Ring, Snap	1
23	SA1617	Gear Assy, Barometric Setting	1
24	A4006	Mechanism, Transmission (See Figure 2)	1
25	A3324	Mechanism Assy (See Figure 3)	1
26	S1057	Ring, Spring	1
27	19342	Nameplate	1
		(Attaching Parts)	
28	coml	Screw, Drive No. 2 Type Z	2
29A	A31092	Case Assy	1
30	P1039	Ring, Snap	1
31	M1073	Pin	1

* Note: The Dial Assembly Barometric for the A35-MA-10L-2 is P/N 200059.

Figure & Index No.	Part Number	Description	Units Per Assy
1 - 32	M2048	Stem, Adjusting Knob	1
33	P1041	Spring Compression	1
34	AN6227 - 1	Ring, "O"	1
35	M1070	Gear, Pinion, Zero Setting	1
36	M1046	Ring, Snap	1
37	Coml	Washer, ½ O. D. x 3/16 I. D. x 1/32 thick brass	1
38	P1198	Screen, Filter	1
39	M3311	Case	1

FIGURE 1 – PRESSURE ALTIMETER

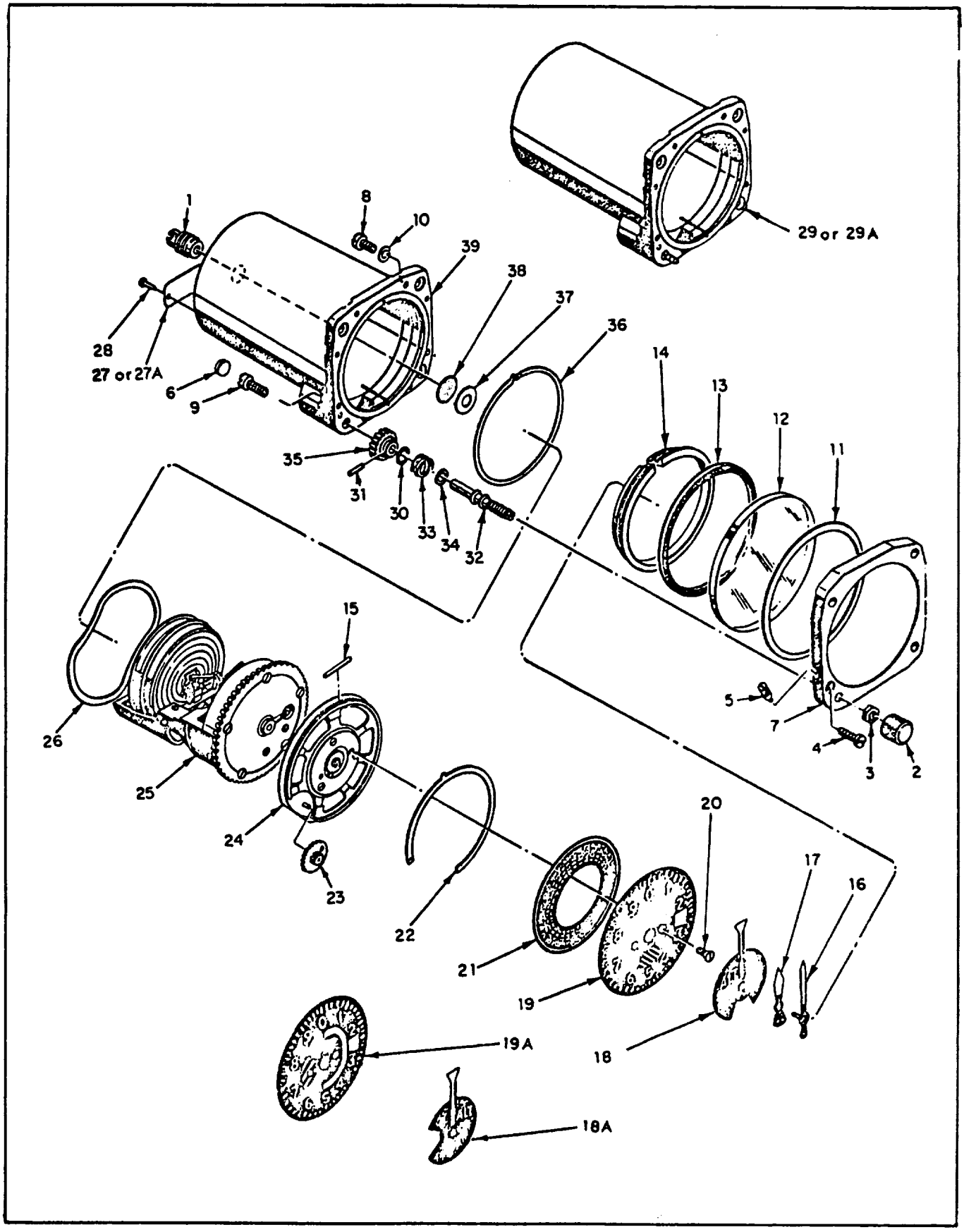


Figure & Index No.	Part Number	Description	Units Per Assy
2 -	A4006	Mechanism, Transmission (For NHA See Figure 1)	Ref.
1	SA1244	Wheel Assy	1
2	M1231	Pinion, Stem 12T	1
2 -	A2052	Plate Assy, pivot (Attaching Parts)	1
3	M1243	Screw, Shoulder	3
4	SA1226	Gear Assy, 24T and 29T	1
5	P1225	Bushing, Gear 1000 Ft.	1
6	SA1221	Sub-Assy, Pivot Plate	1
7	AS1233	Wheel Assy, 48T	1
8	SA1238	Gear Assy, 13T and 40T	1
9	A2059	Plate Assy, Gear	1
10	P1220	Stud, Gear	1

FIGURE 2 — TRANSMISSION MECHANISM

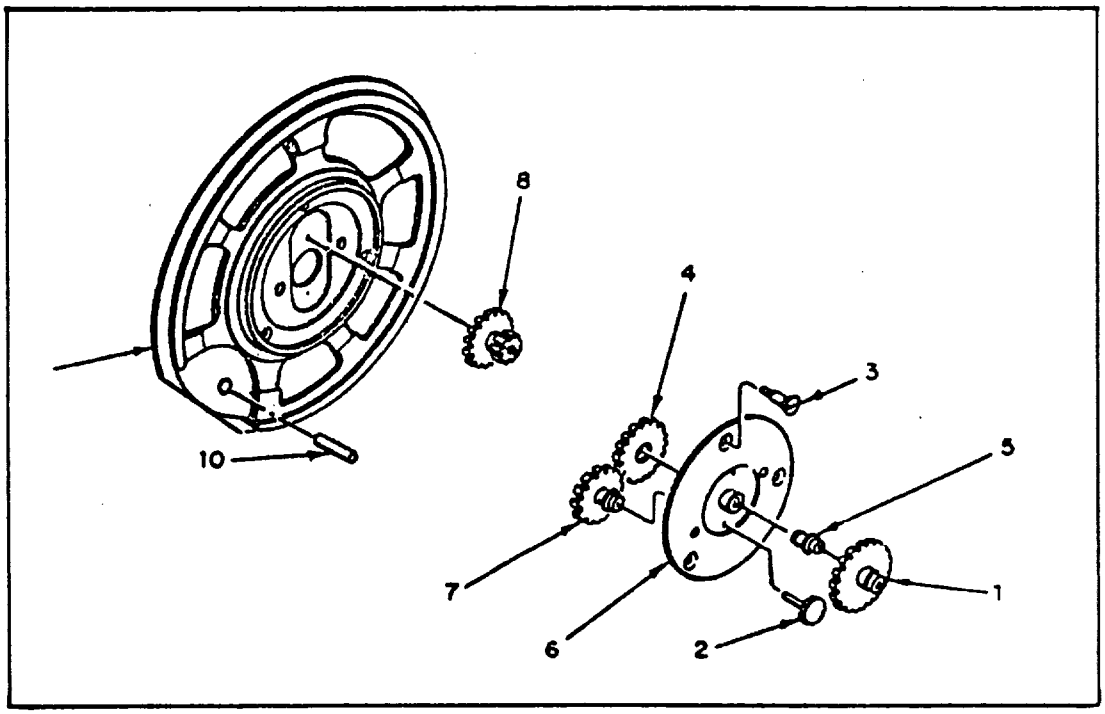
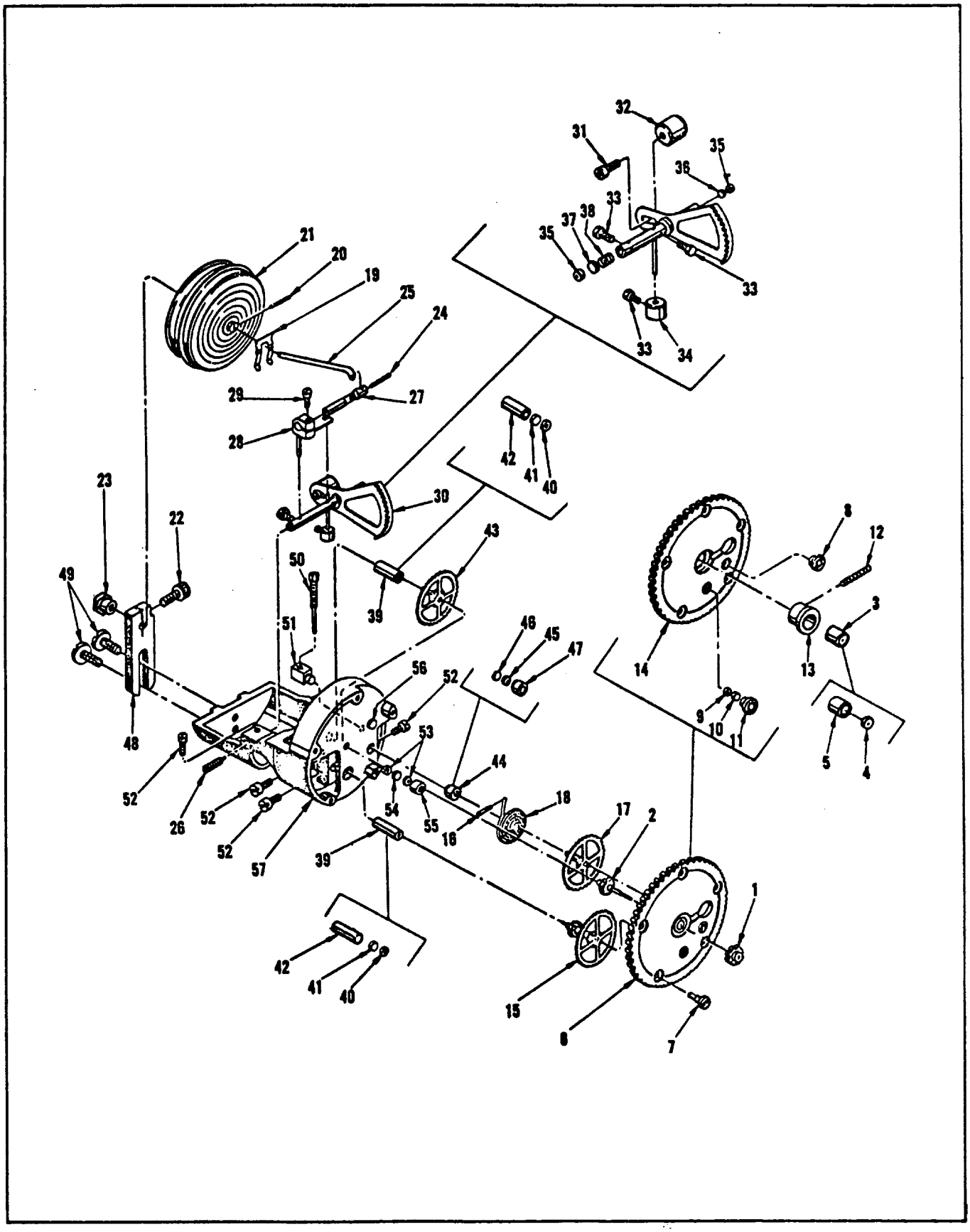


Figure & Index No.	Part Number	Description	Units Per Assy
3-	A3324	Mechanism Assy (For NHA See Figure 1)	Ref.
1	M1200	Pinion, Center	1
2	M1115	Pinion, Handstaff	1
3	A1325	Bushing Assy, Jeweled	1
4	P2007	Jewel, Mounted, Large	1
5	M1212	Bushing, Jewel	1
6	SA1313	Plate, Assy, Gear	1
		(Attaching Parts)	
7	M1386	Screw, Bodyfit	5
8	A1314	Jewel Assy, Eccentric	2
9	P1321	Jewel, Hole, Small	1
10	P1322	Jewel, Cap Small	1
11	M1387	Setting, Jewel Eccentric	1
12	Coml	Screw, Hol, No, 0-80 x 1/8 HH Brass	1
13	P1303	Bushing, Center	1
14	M1237	Plate, Gear	1
15	A1090	Gear Assy, Transmission	1
16	Coml	Pin, Taper No. 3½ Brass	1
17	A1129	Wheel Assy, Hairspring	1
18	P1136	Hairspring	1
19	P1474	Clip, Spring, Aneroid	1
20	P1479	Pin Aneroid	1
21	A13059	Aneroid Assy	1
		(Attaching Parts)	
22	P1612	Screw, Special	1
23	M1384	Nut, Diaphragm Support	1
24	P1191-2	Pin, Bearing	1
25	A1615	Link, Assy, Mechanism	1
26	M1323	Screw, Pivot	2
27	A1622	Bi-Metal Assy	1
28	SA1169	Support Assy, Bi-Metal	1
29	Coml	Screw, Hex Hd. 2-64 x ¼ Br.	1
30	A2133	Shaft Assy, Sector and Rocking	1
31	Coml	Screw, Fil Hd. 2-64 x ¼ Br.	1
32	P1153-3	Counterweight	1
33	Coml	Screw, Hex Hd. 2-64 x 1/8 Br.	1

Figure & Index No.	Part Number	Description	Units Per Assy
3 -	M1390-2	Pin	3
34	P1327-4	Counterweight, Bi-Metal	1
35	P1321	Jewel, Hole, Small	2
36	P1322	Jewel, Cap, Small	1
37	P1389	Jewel, Cap, Extra Small	1
38	P1388	Spring, Rocking Shaft	1
39	A1319	Bushing Assy, Jewel	2
40	P1321	Jewel, Hole, Small	1
41	P1322	Jewel, Cap, Small	1
42	M1085	Bushing, Jewel, Pinion	1
43	A1127	Pinion, Assy, Crown	1
44	A1317	Bushing, Assy, Jewel	1
45	P1321	Jewel, Hole, Small	1
46	P1322	Jewel, Cap, Small	1
47	M1212	Bushing, Jewel	1
48	M1324	Plate, Diaphragm Support (Attaching Parts)	1
49	Coml	Screw, Fil Hd. 8-32 x 3/8 Br.	2
50	M1643	Screw, Sector Guide	1
51	M1642	Post, Sector Guide	1
3 -	SA2212	Frame, Sub-Assy	1
52	Coml	Screw, Fil Hd. 2-64 x ¼ HH Brass	5
53	P1321	Jewel, Hole Small	2
54	P1322	Jewel, Cap, Small	1
55	M1641	Bushing, Frame	1
56	M1385	Post, Hairspring	1
57	M3323	Frame, Machining	1
58	M11363	Bearings, Teflon	3

FIGURE 3 – MECHANISM ASSEMBLY



OVERHAUL MANUAL

WITH

ILLUSTRATED PARTS LIST

ALTIMETER INDICATOR

SERIES

101720 AND 101730

Aerosonic Corporation
1212 North Hercules Avenue
Clearwater, Florida

February 1975

AEROSONIC CORPORATION
OVERHAUL MANUAL
ALTIMETER INDICATOR
(SERIES 101720 AND 101730)

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Illustrated Parts List	1101-1115	Original
	1116 (Blank)	

AEROSONIC CORPORATION
OVERHAUL MANUAL
ALTIMETER INDICATOR
(SERIES 101720 AND 101730)

DESCRIPTION AND OPERATION

1. INTRODUCTION

This manual contains all information required for the overhaul and testing of the Three-Pointer Pressure Altimeters (Series 101720 and 101730) manufactured by Aerosonic Corporation, Clearwater, Florida 33518. Refer to table 1 for altimeter part numbers and leading particulars. Detailed instructions and procedures are given wherever required. When no specific instructions are given in this manual, standard shop practices should be used. Repairable parts are listed in the ILLUSTRATED PARTS LIST section.

2. GENERAL

A. HOW TO USE THIS MANUAL

This manual covers 12 different pressure reporting altimeter units which are dissimilar in each of three respects. To use this manual properly, first determine which of the 12 units is being subjected to overhaul. These units differ as follows:

- Barometric Readout -- Millibar (Mb) Readout, Inches of Mercury (In. Hg) Readout, or Dual (Mb or In. Hg) Readout
- Maximum Range -- 20,000 or 30,000 Feet
- Bezel -- Lighted or Unlighted

After determining the type of unit to be serviced, refer to that section of this manual and proceed with repair. Differences in disassembly/assembly procedures, altitude test points, tolerances and parts as applicable to the different altimeter configurations are noted in the text, tables, and illustrated parts list.

3. PURPOSE OF THE ALTIMETER

These altimeters measure atmospheric pressure as varied with altitude above ground level and provide a readout of that altitude on the dial face.

4. DESCRIPTION

A. Leading Particulars

Leading particulars of the 12 altimeter configurations covered herein are shown in table 1.

B. Electro-Mechanical

(1) The case of the altimeter is of two-piece construction, the case sub-assembly and the bezel assembly. It is airtight when assembled except for a static pressure port at rear of case. The bezel assembly has three counterbored holes for mounting the altimeter to the instrument panel.

Table 1. Leading Particulars

ALT. INDICATOR PART NUMBER	RANGE (FEET)	BAROMETRIC DIAL RANGE		BEZEL ASSY
		IN. OF Hg	MILLIBARS	
101720-01354	-1000 to +20,000	28.1 to 31.0		Unlighted
101720-01355	-1000 to +20,000		946 to 1050	Unlighted
101730-01356	-1000 to +30,000	28.1 to 31.0		Unlighted
101730-01357	-1000 to +30,000		946 to 1050	Unlighted
101720-01383	-1000 to +20,000	28.1 to 31.0	946 to 1050	Unlighted
101720-11384	-1000 to +20,000	28.1 to 31.0		Lighted
101720-11385	-1000 to +20,000		946 to 1050	Lighted
101720-11386	-1000 to +20,000	28.1 to 31.0	946 to 1050	Lighted
101730-01387	-1000 to +30,000	28.1 to 31.0	946 to 1050	Unlighted
101730-01388	-1000 to +30,000	28.1 to 31.0		Lighted
101730-11389	-1000 to +30,000		946 to 1050	Lighted
101730-11390	-1000 to +30,000	28.1 to 31.0	946 to 1050	Lighted

Maximum overall length: 5.367 inches
Maximum width: 3.260 inches
Maximum weight: one pound, two ounces
Lamp Voltage: 5 VDC

(2) Altitude is indicated on the front dial face of the instrument by three concentrically arranged pointers. These indicate on a common scale units of 100 feet, 1,000 feet, and 10,000 feet. (See figures 1 through 4).

(3) The outer dial is graduated into single divisions of twenty feet when measured by the 100-foot pointer, 200 feet with respect to the 1,000-foot pointer and 2,000 feet with respect to the 10,000-foot pointer.

(4) A barometric dial located between dial numerals 2 and 3 indicates and can be corrected to local ground level barometric pressure in inches of mercury or millibars (figures 1 and 3). Altimeters which provide dual barometric readout have a dial assembly that indicates pressure in In. Hg between numerals 2 and 3 and pressure in Mb between numerals 7 and 8 (figures 2 and 4).

(5) A barometric adjusting knob located at the lower left corner, when rotated, will adjust the altimeter pointers and barometric dial(s) simultaneously to correct for changes in ground level pressure.

(6) Power for the lamps in altimeters with lighted bezels is brought in on two leads through the top of the bezel (figures 3 and 4).

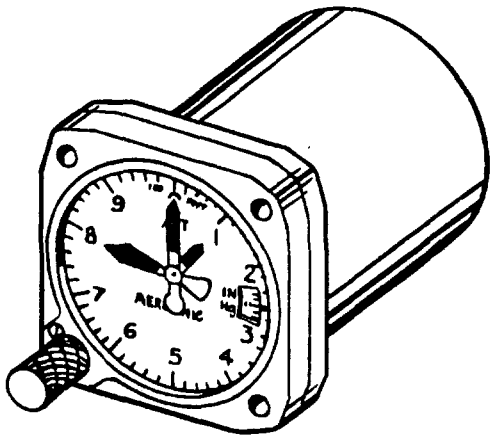


Figure 1. Unlighted, Single Barometric Readout Altimeter

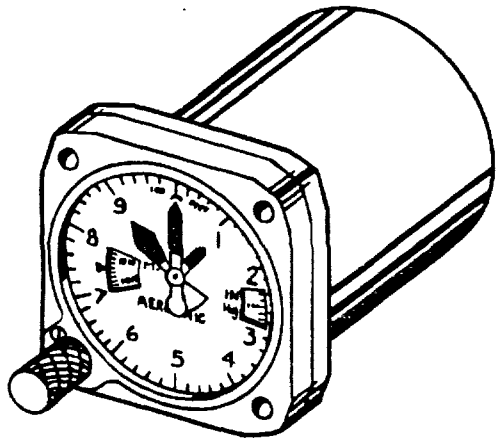


Figure 2. Unlighted, Dual Barometric Readout Altimeter

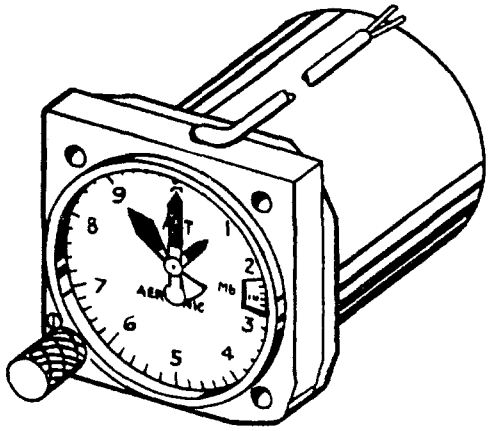


Figure 3. Lighted, Single Barometric Readout Altimeter

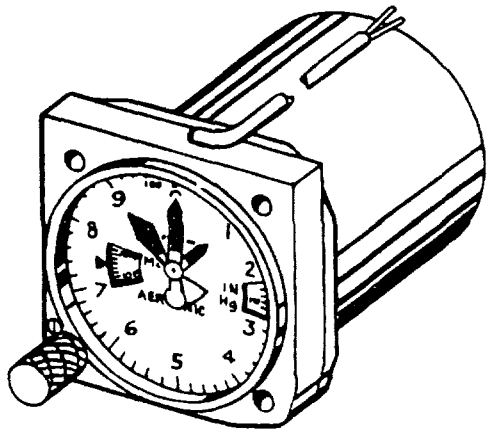


Figure 4. Lighted, Dual Barometric Readout Altimeter

5. THEORY OF OPERATION

Atmospheric pressure exerted upon surfaces of aneroid at zero altitude is greater than the pressure within aneroid. This unequal distribution of pressure causes aneroid to contract. An increase in altitude decreases atmospheric pressure, thereby exerting less pressure upon surfaces of aneroid allowing it to expand. This motion is transferred through mechanism to the transmission assembly, thereby actuating radial movement of instrument pointers.

DISASSEMBLY

1. GENERAL

This section provides instructions for the disassembly of the Pressure Altimeters. These altimeters should be disassembled only when repair is necessary. Unless the altimeter has obviously been damaged to the extent that testing is impossible, perform the tests given in the TESTING section prior to disassembly and determine the degree of repair required.

NOTE: When disassembling, keep parts together and protected from dust and dirt. Handle glass parts using white cotton gloves on edge surface only.

2. DISASSEMBLY PROCEDURES

A. Disassembly of the Altimeter Major Components (See figure 1101).

NOTE: Place appropriate end of altimeter in a suitable support block to protect parts during disassembly.

NOTE: Do not disturb position of aneroid and thermometal assembly (figure 1102-36), or angular relationship of rocking shaft assembly (figure 1102-17) to the aneroid and thermometal assembly unless absolutely necessary for repair. Disturbing the setting of these parts will necessitate recalibration of the unit.

(1) Wrap friction tape around knurled adjusting knob (figure 1101, 2). Hold knob stationary with pliers and loosen knob locknut (3) with a 5/16-inch wrench. Remove knob and locknut from adjustment knob stem (62).

(2) Back off locking stud screw (4) until head clears front face of bezel (7 or 15). Slide screw to the left in its slotted passage to disengage locking stud (5) from adjustment knob stem (62). It is not necessary to remove either screw or stud from bezel unless damaged.

(3) Remove lead seal (6), screws (8), screws (9) and lockwashers (10).

(4) Remove bezel (7) or bezel assembly (-11).

NOTE: Steps 5 and 6 apply only to lighted altimeters (items 15 through 23, shown in the inset in figure 1101).

(5) Separate black paper gaskets (16), bezel spacer (17) and lens (18) from the bezel (15).

(6) Remove screws (20) and light tray assembly (-19). Unless it is necessary to replace one or both of the lamps (22), do not remove filters (23) or unsolder lamps (22) from printed circuit board (21).

NOTE: Step 7 applies only to unlighted altimeters.

(7) Separate lens (25) and paper gasket (24) from bezel (7).

(8) Remove bezel gasket (26) and ring spacer (27) from case (68).

(9) Lift off 100-foot pointer (28), 1,000-foot pointer (29), and 10,000-foot pointer (30).

(10) Remove dial screws (32) and lift off altimeter dial (31) and barometric dial assembly (33).

(11) Remove tension wire (34). Pry both ends of snap ring (35) until free, and remove from case. Remove gear assembly (52) and dial washer (53).

(12) Remove transmission mechanism assembly (-36 or -44) from case.

NOTE: Steps 13 and 14 apply only to altimeters with single barometric readout.

(13) Remove screws (39), gear assembly (40), wheel assembly (41), pinion (42), wheel assembly (43) and pivot plate assembly (38), from gear plate assembly (37).

(14) Remove wheel assembly (41) and pinion from pivot plate assembly.

NOTE: Steps 15 and 16 apply only to altimeters with dual barometric readout.

(15) Remove screws (47), transmission cover assembly (46), gear assembly (48), wheel assembly (49), pinion (50), and wheel assembly (51) from transmission housing assembly (45).

(16) Remove wheel assembly (49) and pinion from transmission cover assembly.

(17) It is not necessary to remove vent plug (54) from vent unless the vent insert is damaged.

(18) Remove mechanical mechanism assembly (55) from case.

(19) Lift spring ring (56) from case.

(20) Washer (66) and filter screen (67) are staked parts and should not be removed unless they have been damaged. Press them from the case and smooth off stake marks in case before replacing washer and filter screen.

(21) Remove lock pin (61) and snap ring (60).

(22) Pull adjustment knob stem (62) from its socket and remove "O" ring (63). Remove compression spring (65) and pinion gear (64) from the case when pulling adjustment knob stem clear.

B. Disassembly of Mechanical Mechanism Assembly (See figure 1102).

(1) Remove pinion (5), screw (7), jewel bushing assembly (6), and hand-staff pinion (8).

(2) Remove pin (18), screw (37) and aneroid and thermometal assembly (-36).

(3) Remove screw (42), two screws (41), clamp bar (39) and thermometal (40).

(4) Remove screws (45 and 46), clamp bar (43) and thermometal support (44) from aneroid assembly (47).

(5) Remove screws (39) and diaphragm support plate (35).

(6) Remove taper pin (19).

(7) Remove screws (4) and gearplate assembly (3).

(8) Remove nut (24), screw (23), pin (21), link (20) and link arm (22).

(9) Remove screw (26), counterweight (25), screw (28) and rocking shaft pin (27).

(10) Remove screw (30) and counterweight (29).

(11) Do not remove pivot pins (31), sector gear (32), or sector gear hair-spring (33) from rocking shaft (34).

(12) Remove taper pin (10) and lift out gear assembly (9).

(13) Remove screw (12), eccentric jewel bushing assembly (11), screw (14), jewel bushing unit (13), screw (16), and eccentric jewel bushing assembly (15) from frame (2).

CLEANING

1. GENERAL

This section gives instructions and recommended procedures for cleaning the altimeter after disassembly.

2. MECHANICAL PARTS

A. General Procedure

CAUTION: DO NOT IMMERSE THE ANEROID ASSEMBLY OR JEWEL ASSEMBLIES CONTAINING HOLE AND CAP JEWELS IN CLEANING OR RINSE SOLUTIONS. (SEE 2C BELOW.) CLEAN ELECTRICAL PARTS AS DESCRIBED IN 3.

(1) Refer to table 201 for solvents and cleaners and their use.

Table 201. Cleaners and Solvents.

SOLVENT/CLEANER	USE
L and R Nofome Cleaning Solution	Cleaning Mechanical Parts
L and R Rinsing Solution L and R Manufacturing Co. Kearney, New Jersey 07032	Rinsing Mechanical Parts
Featherwood (Pithwood)	Cleaning Pivots and Pinions
Watchmaker's Paper	Cleaning Gears and Pinions
Prepared Chalk	Cleaning Gears and Pinions
Tissue, Lint Free, Optical Grade	Cleaning Lenses
Alcohol, Ethyl	Cleaning Lenses
Detergent, Liquid	Cleaning Lenses

(2) Wash parts and hardware in a wire mesh basket immersed in cleaning solution. Rinse the parts and hardware in rinsing solution. (See CAUTION above.) Dry with low pressure air: approximately 25 psi.

(3) Store the cleaned and dried parts under a bell jar until ready for reassembly.

B. Pinions and Pivots

(1) Clean pinions by pressing them into end grain of Featherwood.

(2) Clean pivots by pressing them in the end grain of Featherwood and twirling the wood between the fingers.

C. Jewels

Do not attempt to clean jewels. If they are soiled, replace them with new assemblies. To determine if they are soiled, view them through at least 2X magnification.

D. Gears and Pinions

Brush the gear and pinion teeth with a No. 3 watchmaker's brush occasionnally rubbed across a piece of prepared chalk. Hold the parts being brushed in a piece of watchmaker's paper to keep the brush and the parts from contacting bare skin. Use a clean portion of paper for each part.

3. LIGHT TRAY ASSEMBLY

The light tray assembly is not normally cleaned. If cleaning is required use a brush and low pressure compressed air.

4. LENS

Clean lens with soft lint free tissue moistened with ethyl alcohol. If lens surface is very dirty, clean with a mild solution of liquid detergent and water. Rinse thoroughly and dry with clean low pressure compressed air.

CAUTION: DO NOT RUB OR POLISH LENS SURFACE OR TOUCH WITH BARE FINGERS, SINCE THIS MAY DAMAGE THE OPTICAL COATING. DO NOT STORE COATED LENS IN OR NEAR POLYETHYLENE.

INSPECTION/CHECK

1. GENERAL

This section gives instructions for inspecting the altimeter prior to disassembly, and the individual components after disassembly.

2. INSPECTION PROCEDURES

A. Altimeter Assembly

Inspect the unit prior to disassembly for physical evidence of damage. Check for dents, cracks, broken or damaged indicator parts or electrical wiring defects.

B. Major Components

When the unit has been broken down into its four major assemblies (bezel, transmission, case, mechanism), check for obvious damage. Check movable parts for indication of damage to bearings, bushings and shaft ends.

C. Assemblies

Refer to table 301 for specific assemblies and parts to be inspected.

Table 301. Inspection Chart

NOMENCLATURE	PROCEDURE
Bezel Assembly	Inspect lenses and filters for scratches or other damage.
Light Tray Assembly	Inspect for damaged wires, cracked P.C. board, bad solder connections, and cracked or defective lamps.
Rocking Shaft	Inspect as applicable for distorted or broken link arm, bent or kinked hair-spring, broken or worn teeth on sector gear, chipped or broken jewels, and damaged pivot. This assembly should be replaced as a unit if damaged.
Aneroid Assembly	Check for dents, bent pressure pin and puncture or seal defects. Replace damaged portion of assembly.

Table 301. Inspection Chart (Continued)

NOMENCLATURE	PROCEDURE
Handstaff Pinion	Inspect for worn or damaged teeth and bent or broken handstaff. If damaged, replace with new handstaff pinion.
Pressed-fit Parts (Jewel Assemblies)	Check for chips, broken jewels and for distortion of parts. Replace if damaged. See paragraph 2, ASSEMBLY section, for replacement.

REPAIR

1. GENERAL

This section gives instructions for repair of damaged or defective parts of the equipment.

2. REPAIR PROCEDURES

Electrical and mechanical parts should not be repaired except for the replacement of lamps and for normal realignment, adjustment, and polishing procedures.

NOTE: Replacement of parts such as aneroids, pivots, handstaffs, sectors and gears during overhaul may disturb the original alignment of the altimeter and cause erratic altitude readings and excessive friction during initial calibration.

3. LUBRICATION

No lubrication of parts is recommended.

ASSEMBLY

1. GENERAL

Refer to the figures in the Illustrated Parts List and assemble the altimeter in accordance with the following instructions.

NOTE: Place appropriate end of altimeter in a suitable support block to protect parts during disassembly.

NOTE: Do not disturb position of aneroid and thermometal assembly (figure 1102-36) or angular relationship of rocking shaft assembly (figure 1102-17) to the aneroid unless absolutely necessary for repair. Disturbing the setting of these parts will necessitate recalibrationof the unit.

2. ASSEMBLY PROCEDURES

NOTE: If any jewels, pins, bearings, bushings, gears, or other pressed parts have been disassembled, they should be reassembled using appropriate new parts. Assembly of these parts should be accomplished before other assembly procedures begin.

A. Assembly of Mechanical Mechanism Assembly (See figure 1102).

(1) If previously removed, mount eccentric jewel bushing assembly (11) in frame (2) and secure with screw (12).

(2) If previously removed, mount large jewel bushing unit (13) in frame and secure with screw (14).

(3) If previously removed, mount eccentric jewel bushing assembly (15) in frame and secure with screw (16).

(4) Mount clamp bar (43) and thermometal support (44) on aneroid assembly (47) with screw (45) and screw (46).

(5) Mount clamp bar (39) and thermometal (40) on thermometal support (44) with screws (41) and screw (42).

(6) Insert aneroid and thermometal assembly (-36) into diaphragm support plate (35) and secure with screw (37).

(7) Attach aneroid and thermometal assembly with diaphragm support plate to mechanism frame (2) with screws (38). Make sure aneroid assembly does not touch frame.

(8) Mount crown gear counterweight (29) to partially disassembled rocking shaft assembly (31, 32, 33 and 34) and secure with screw (30).

(9) Insert rocking shaft pin (27) in rocking shaft (34) and secure with screw (28).

(10) Mount rocking shaft counterweight (25) on rocking shaft pin and secure with screw (26).

(11) Insert link arm (22) in rocking shaft and secure with screw (23) and nut (24).

(12) Attach aneroid link (20) to link arm with bearing pin (21). Bend the rear end of the pin.

(13) Insert pivot on opposite side of hairspring of intermediate gear assembly (9) into eccentric jewel bushing assembly (11). Using work plate T21306 to hold gear in place, adjust spring so that is is centered between hairspring guards and wheel moves freely.

(14) Straighten approximately 1/2 inch of the end of intermediate gear assembly (9) hairspring and insert into hole in lower left of frame (2). Pin hairspring to frame with taper pin (10). Cut taper pin and hairspring so they are flush with outside diameter of frame.

(15) Insert forward pivot of intermediate gear assembly (9) into jewel bearing assembly in gearplate assembly (3).

(16) Position gearplate assembly on frame (2) and secure with four screws (4).

(17) Set rocking shaft assembly (-17) in frame with rear pivot pin (31) inserted in eccentric jewel bushing assembly (15) and the forward pivot pin (31) into jewel bearing assembly in gearplate assembly.

(18) Straighten approximately 1/2 inch of the end of sector gear hairspring (33) and insert into hole in upper left side of frame. Pin hairspring to frame with taper pin (19). Insure that coils of hairspring are concentric with rocking shaft (34).

(19) Set endplay of intermediate gear assembly (9) to 0.0005 to 0.001 inch and endplay of rocking shaft assembly (-17) to 0.005 to 0.001 inch by adjusting eccentric jewel bushing assemblies.

NOTE: To obtain proper alignment of intermediate gear assembly (9), loosen screw (12) and rotate eccentric jewel bushing assembly (11). Tighten screw. To obtain proper alignment of rocking shaft assembly (-17), loosen screw (16) and rotate eccentric jewel bushing assembly (15). Tighten screw.

(20) Drop handstaff pinion (8), short journal first, through center hole of gearplate assembly (3) and into jewel bushing (13).

(21) Place jewel bushing assembly (6) onto exposed journal of handstaff pinion (8). Set jewel bushing unit 0.005 to 0.007 inch below face of center bushing in gearplate assembly (3). Set handstaff pinion (8) endplay to 0.0003 to 0.0005 inch. Secure in place with screw (7).

(22) Press hub of 12T center pinion (5) onto handstaff pinion (9) until 0.003 to 0.005 inch clearance from jewel bushing assembly (6) remains.

(23) Calibrate and adjust mechanism assembly as outlined in TESTING section, paragraphs 14 and 15.

B. Assembly of Major Components (See figure 1101).

(1) Insert filter screen (67) with washer (66) into bottom port inside case (68). Stake washer to case.

(2) Slide "O" ring (63) onto unthreaded end of adjustment knob stem (62) until flush with shoulder of stem.

(3) Press snap ring (60) onto pinion gear (64) so snap ring is below pin hole in gear.

(4) Place in order; pinion gear (64) and compression spring (65) into gear well in lower left corner of case. Align center holes of these parts.

(5) Insert adjustment knob stem through aligned center holes of parts in preceeding step. Pin pinion gear (67) to adjustment knob stem with lock pin (61).

(6) Place spring ring (56) into case.

NOTE: Steps 7, 8 and 9 apply only to altimeters with single barometric readout. The front of gear plate assembly (37) is the face with the greatest amount of machining and recesses. The rear face is relatively smooth in appearance.

(7) Position 13T and 40T gear assembly (40) into gear plate assembly. The 13T and 40T gear assembly is located in the small hole, next to the large opening in the center of pivot plate assembly (38) on the side opposite the location pin.

NOTE: The front of pivot plate assembly is distinguished by three countersunk holes around the outer edge.

(8) Install 12T stem pinion (42) through the front of pivot plate assembly and hub of 48T wheel assembly (41). There are two small holes in the inner part of the pivot plate assembly. These holes (one countersunk) and the center bushing assembly are in line. The hole on the side opposite the aligned countersunk screw hole is the hole on the pivot plate assembly used to install stem pinion.

(9) Position pivot plate assembly, and install 48T wheel assembly (41) into gear plate assembly (37) on the gear stud side of the gear plate. Make sure all pinion stems and staffs are located in their respective pivot points. The three screw holes should already be aligned. Install three screws (39). Install 60T wheel assembly (46) on hub of pivot plate assembly.

NOTE: Steps 10, 11 and 12 apply only to altimeters with dual barometric readout. The front of the transmission housing cover (45) is the face with the greatest amount of machining and recesses. The rear face is relatively smooth in appearance.

(10) Position 13T and 40T gear assembly (48) into the transmission housing cover. The gear assembly is located in the small hole, next to the large opening in the center of the transmission housing cover on the side opposite the location pin.

(11) Install 12T stem pinion (53) through the front of transmission housing cover and hub of 48T wheel assembly (52). There are two small holes in the inner part of the transmission housing cover. These holes (one countersunk) and the center bushing assembly are in line. The hole on the side opposite the aligned countersunk screw hole is the hole on the transmission housing cover used to install stem pinion.

(12) Position transmission cover assembly (46), and install 48T wheel assembly (52) into transmission housing assembly on the gear stud side of the gear plate. Make sure all pinion stems and staffs are located in their respective pivot points. The three screw holes should already be aligned. Install three screws (50). Install 60T wheel assembly (54) on hub of pivot plate.

(13) Position transmission mechanism assembly (-36 or -47) on to front of mechanical mechanism assembly (55).

NOTE: Care must be taken to properly mesh 12T center pinion (figure 1102, 5) with 13T and 40T gear assembly (figure 1101, 40 or 48). Rotate transmission mechanism assembly several times to insure meshing of all gears and pinions. Press pointer (28) onto handstaff pinion (figure 1102, 9). Rotate the mechanical mechanism assembly (figure 1101, 55) in relation to the transmission mechanism assembly. When properly seated, the pointer will turn with the mechanical mechanism assembly without binding, sticking, or any irregular motion.

(14) Place the case on the bench with the open end facing up.

(15) Suspend the transmission mechanism assembly and mechanical mechanism assembly over the case, and lower the assembly into the case. The locating pin must be in line with the groove adjacent the case well for proper assembly.

(16) Compress the transmission mechanism assembly and mechanical mechanism assembly in the case, and install snap ring (35) in second groove.

(17) Insert two tension wires (34) between transmission mechanism and case in transmission mechanism assembly slot located diagonally opposite the case well.

(18) Remove 100 foot pointer (28).

(19) Place barometric setting gear assembly (52) with dial washer (53) over the gear stud in gear plate assembly or transmission housing assembly with wheel gear against gear plate assembly and stop, oriented toward center of mechanical mechanism assembly.

(20) Position barometric dial assembly (33) on the front of transmission mechanism assembly with grads for 29.92 IN. Hg, or 1013 Mb. at 12 o'clock.

(21) Assemble altimeter dial (31) with two dial screws (32) and the opening at the side of barometric setting gear assembly (52) opposite the pivot plate assembly or transmission housing cover of the transmission mechanism assembly.

(22) Press 10,000-foot pointer (30) onto the bushing of 60T wheel assembly (46 or 54) with the inverted arrow pointing to zero.

(23) Press 1,000-foot pointer (29) onto the bushing of the pivot plate assembly or transmission housing assembly with the pointer toward zero.

(24) Press the center bushing of 100-foot pointer (28) over handstaff pinion (figure 1102, 9). This pointer also points toward zero.

(25) Install ring spacer (figure 1101, 27) into case with the lip of ring spacer resting on the outer edge of case. Make sure the lock at the side of the ring spacer is located in the outermost groove of the case.

(26) Carefully assemble new bezel gasket (26) around the outer edge of ring spacer (27).

NOTE: Steps 27 and 28 apply to unlighted altimeters only.

(27) Clean and position lens (25) on bezel gasket. Place gasket (24) and bezel (7) on the lens.

(28) Install two diametrically opposite lock washers (10) and screws (9) to hold bezel to the case assembly (-59). Install the remaining four screws (9), each with a lock washer (10), around the case assembly. Install two screws (8), on either side of adjustment knob stem (62). Tighten all screws evenly.

NOTE: Steps 29 through 32 apply to lighted altimeters only. Refer to TESTING section, paragraph 13 for lighting test.

(29) If removal of one or both of the lamps (22) was necessary, position new lamp(s) on printed circuit board (21) and solder the lead to board. Install filter(s) (23).

(30) Attach light tray assembly (-19) to bezel (15) with two screws (20).

(31) Position, in order, one paper gasket (16), bezel spacer (17), paper gasket (16) and lens (18) in bezel.

(32) Place bezel assembly (-11) on case assembly (-59) and install two diametrically opposite lockwashers (10) and screws (9) to hold the bezel assembly to the case assembly. Install the four remaining screws (9), each with a lock washer (10), around the case assembly. Install two screws (8), on either side of adjustment knob stem (62). Tighten all screws evenly.

(33) Install locknut (3) and adjusting knob (2) on adjustment knob stem. Hold the knob by covering knurled section with friction tape and grasping with pliers. Tighten knob locknut against the knob with a 5/16-inch end wrench.

(34) Lightly tap the instrument glass to remove friction. Note the barometric pressure, and compare pressure with the reading from a standard barometer. If it is necessary to adjust the barometric dial assembly (33), pull adjusting knob forward and while holding knob in this position, turn to reset the barometric dial. When the desired barometric pressure is indicated, release knob.

(35) Slide the locking stud screw (4) to the right in its slotted passage to engage the pin of locking stud (5) that rides in the recess of the adjustment knob stem. Screw down the locking stud screw.

Table 501. Paints and Adhesives

ITEM	PAINT/ADHESIVES	USE ON
1	Paint, Dull Black, Color No. 37038, FED STD-595	Dial and pointer base
2	Paint, Matte White, Color No. 37875, FED STD-595	Pointer needles and dial markers
3	Alcoa Thread Lubricant, Aluminum Co. of America Pittsburgh, Pa.	One threaded insert in case sidewall
4	Locktite, Grade EV	All screws on mechanism
5	Glyptal, red General Electric Co. Code Ident 08800	All parts that will vibrate loose

FITS AND CLEARANCES

1. GENERAL

This section tabulates the settings, adjustments and tolerances of movable or mating parts. Refer to table 601 for the listing of movable or mating parts which have specific clearances, end play, or backlash.

Table 601. Clearance, End Play, and Backlash Tolerances

ITEM	INDEX NO.	NAME	CLEARANCE	END PLAY	BACKLASH
1	1102,10	Intermediate Gear Assy	--	.0005-.001	*
2	1102,-17	Rocking Shaft Assy	--	.005-.001	.0004-.0006
3	1102,6	Large Jewel Bushing Unit	.005-.007	--	--
4	1101-38	Pivot Plate Assy	.003	--	--
5	1102,9	Handstaff Pinion	.003-.005	.0003-.0005	**

* By locking rocking shaft, the backlash of intermediate gear assembly must be 30'-50' as measured at tip of pointer.
** By locking intermediate wheel, the backlash of handstaff must be 5-10 feet when measured at the pointer.

TESTING

1. GENERAL

The following procedures are set forth in this section.

Barometric Scale Error Test (Zero Setting Scale Test)
Barometric Scale Adjustment Knob Disengagement Test
Position Error Test
Case Leak Test
Scale Error Test
Hysteresis Test
After Effect Test
Friction Test
Lighting Test
Calibration
Adjustments

Paragraphs 5 through 13 give instructions for testing the altimeter. Test equipment, test specifications, and test conditions are described in paragraphs 2 through 4. These following tests should be performed prior to conducting an overhaul to determine the extent of repair that will be necessary. After the assembly of the altimeter, perform another complete sequence of tests to determine that the altimeter performs as specified.

2. TEST EQUIPMENT

Test equipment required is listed in SPECIAL TOOLS, FIXTURES AND TEST EQUIPMENT. The typical test setup for the altimeter is shown in figure 701.

3. TEST SPECIFICATIONS

Tolerances for major tests are given in table 701.

Table 701. Specific Tolerances for Major Tests

TEST	TOLERANCE FEET
Case Leak	100 per minute
Position Error	±20
Hysteresis	
First test point 25,000 feet	75
Second test point 20,000 feet	75
After Effect Test	30

4. TEST CONDITIONS

Unless otherwise specified, the indicator shall be tested in its normal operating position with the dial vertical. All tests shall be conducted in an environment as follows:

Ambient Temperature	$23^{o}C \pm 5^{o}C$
Atmospheric Pressure	28 to 32 inches of mercury
Relative Humidity	no greater than 55 percent

A typical test configuration is shown in figure 701.

5. BAROMETRIC SCALE ERROR

A. Test shall be conducted with indicator subjected to a constant ambient pressure.

B. Rotate adjustment knob (figure 1101, 2) until the barometric dial(s) (figure 1101, 33) indicate(s) each of the various settings in accordance with table 702. While barometric dial(s) is (are) being adjusted to test setting, the hundred-foot pointer will simultaneously adjust to setting. Record pointer readings at each setting.

C. When pointer reading at each setting has been recorded, determine the difference in altitude between each reading and zero. The differences shall not exceed tolerances listed in table 702.

Table 702. Barometric Scale Error

EQUIVALENT PRESSURE		ALT. DIFFERENCE FROM ZERO (FEET)		TOLERANCE (±FEET)
INCHES OF Hg	MILLIBARS	IN Hg	Mb	
28.10	950	-1727	-1773	25
28.50	964	-1340	-1344	25
29.00	982	- 863	- 920	25
29.50	998	- 392	- 364	25
29.92	1013	0	0	
30.50	1033	+ 531	+ 589	25
30.90	1047	+ 893	+ 856	25
30.99	1049	+ 974	+ 989	25

6. BAROMETRIC SCALE ADJUSTMENT KNOB DISENGAGEMENT TEST

A. Pull out firmly on knurled adjustment knob.

B. Rotate barometric scale with continuous outward pressure applied from 29.92 (1013) to minimum and maximum points on scale and return to 29.92 (1013).

C. Observe that 100-foot pointer moves in conjunction with the barometric scale(s). Failure of pointer to move indicates a defect in mechanism assembly of altimeter.

7. POSITION ERROR TEST

A. Mount altimeter in a position error test stand.

B. Place altimeter in normal operating position and rotate 100-foot pointer to 0-foot indication. Record reading. Rotate altimeter so pointer is at 3, 6, and 9 o'clock indications. Record readings.

C. The difference between pointer indications with indicator in normal operating position and in 3, 6, and 9 o'clock positions, as described above, shall not exceed ±20 feet.

8. CASE LEAK TEST

A. Install a 1/8-27 ANPT male pipe fitting properly lubricated in altimeter static port and connect to vacuum source. Test setup is as shown in figure 701.

B. Depressurize altimeter 18,000 feet and allow to stabilize for one minute. Then clamp hose off and time for 1 minute, using stop watch. Maximum loss must not exceed 100 feet.

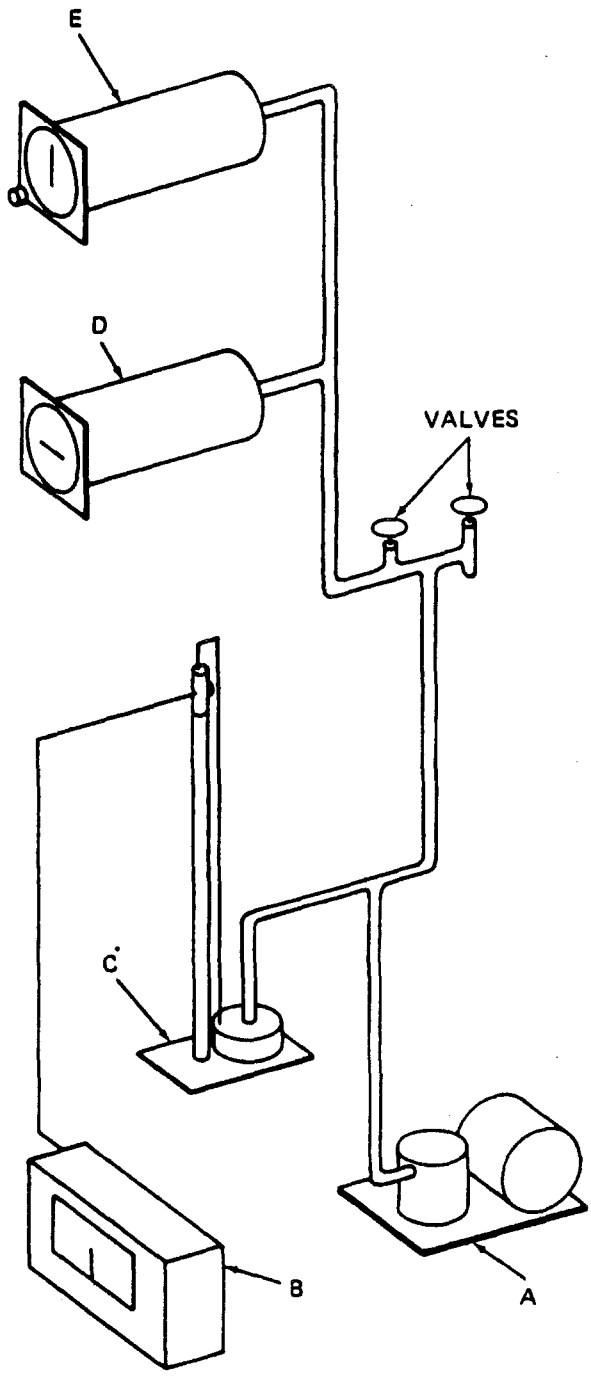
9. SCALE ERROR TEST

NOTE: For a period of not less than twelve hours prior to this test, the altimeter shall not have been exposed to pressures other than those pressures specified in paragraph 4 test conditions.

A. Room Temperature Test

(1) Set the zero setting system for standard sea level pressure (29.92 and/or 1013 on the barometric dial). Be sure the pointers indicate within ±20 feet of the altitude pressure that exists at the location of the tests. Record reading at ambient or atmospheric pressure.

(2) Place the altimeter in an altitude chamber connected to a barometer and a source of vacuum and pressure. Without changing the zero setting, subject the altimeter to pressures specified in table 703. The reduction in pressure shall be made at a rate not in excess of 20,000 feet per minute to within approximately 2,000 feet of each test point. From this point, the test point shall be approached at a rate compatible with the test equipment.



A VACUUM PUMP
B PHOTO SCANNER
C BAROMETER
D RATE OF CLIMB INDICATOR
E ALTIMETER (UNDER TEST)

Typical Test Configuration
Figure 701

(3) The altimeter shall remain at the pressure specified for each test point in table 703 for at least one minute (but not over ten minutes) and be lightly tapped or vibrated before a test reading is taken: scale errors shall not exceed the tolerances specified.

(4) Movement of pointer shall be observed for any irregular motion. From 0 to 20,000 feet or 30,000 feet, depending on the series altimeter under test, the pointer shall not jitter more than 20 feet.

Table 703. Altitude Versus Pressure (As Per NACA Report 1235)

EQUIVALENT PRESSURE			ALTITUDE	TOLERANCE (FEET)	
MM	IN	Mb	FEET	ROOM TEMP.	LOW TEMP.
787.87	31.0185	1050.41	-1,000**	± 20	--
760.00	29.9213	1013.25	0**	20	±40
746.37	29.3846	995.08	500**	20	--
732.93	28.8557	977.17	1,000	20	--
719.70	28.3345	959.52	1,500	25	--
706.65	27.8210	942.13	2,000	30	--
681.14	26.8167	908.12	3,000	30	--
656.38	25.8418	875.10	4,000**	35	--
609.05	23.9782	811.99	6,000	40	60
564.51	22.2249	752.62	8,000	60	--
522.65	20.5769	696.81	10,000**	80	--
483.34	19.0293	644.41	12,000	90	90
446.46	17.5773	595.24	14,000**	100	--
411.90	16.2164	549.15	16,000	110	--
379.53	14.9421	506.00	18,000	120	120
349.25	13.7501	465.63	20,000**	130	--
320.96	12.6363	427.91	22,000	140	--
282.04	11.1035	376.01	25,000**	155	155
225.69	8.8854	300.89	30,000**	180	--

*Allowable change from room temperature scale error test indication

**See paragraph 14A.

B. Low Temperature Test

(1) Condition altimeter to -30°C temperature for 3 hours.

(2) At this temperature, repeat test described in paragraph A, steps 1 through 4. The change in reading from room temperature reading obtained at any test point shall be within tolerance specified in table 703.

(3) If difference between room temperature and cold readings exceeds tolerances, temperature compensation is necessary. Refer to paragraph 15.E.(4).

10. HYSTERESIS TEST

A. Not more than 15 minutes after altimeter has been first subjected to pressure corresponding to the upper limit of its scale and while it is still at this pressure, the hysteresis test shall be started. Increase pressure at a rate equal to decreasing the altitude approximately (but not exceeding) 20,000 feet per minute until pressure indicates altitude is within 3,000 feet of first test altitude shown in table 704. Then approach test point at approximately 3,000 f.p.m. and stop. Within 10 seconds after the pressure has stabilized, the altimeter shall read within 100 feet of the scale error recorded for the first test point. The altimeter shall read within the tolerance specified in table 704.

B. After taking the first reading, increase pressure further at the rate of 3,000 feet per minute until pressure corresponding to second test point altitude is reached. Hold altimeter at this pressure at least one minute, but not longer than ten minutes before taking test reading. The altimeter reading shall not differ from the recorded reading in the scale error test by more than the tolerance specified in table 704.

Table 704. Hysteresis

TEST POINT	ALTITUDE (FEET)	EQUIVALENT ATMOSPHERIC PRESSURE		TOLERANCE (±FEET)
		INCHES OF Hg	MILLIBARS	
*First	14,000	17.5773	595.24	75
*Second	10,000	20.5769	696.81	75
**First	25,000	11.1035	376.01	75
**Second	20,000	13.7501	465.63	75

*101720 Series Altimeters
**101730 Series Altimeters

11. AFTER EFFECT TEST

A. This test procedure shall be performed not more than five minutes after the completion of hysteresis test.

B. With the return of pointers to original ambient readings the error shall not exceed ±30 feet after correction for any change to ambient atmospheric pressure has been made.

12. FRICTION TEST

A. The indicator shall be subjected to a steady rate of decrease in pressure equivalent to about 750 f.p.m. in accordance with table 705. At each test point two readings are to be recorded; the first before tapping instrument and the second after tapping instrument. Friction error shall not exceed tolerance listed in table 705.

Table 705. Friction Error

ALTITUDE (FEET)	TOLERANCE (FEET)
1,000	70
2,000	70
3,000	70
5,000	70
10,000	80
15,000	90
20,000	100
25,000*	120
30,000*	140

*101730 Series Only

13. LIGHTING TEST

The altimeter lighting circuit shall be tested as follows. Connect to five volts dc and see that both lamps light and that all connections are secure. Refer to figure 801, schematic diagram, lighting system, for any necessary information concerning internal circuitry. Replace defective parts.

14. CALIBRATION

A. General

Calibration consists of testing to determine indication errors and preparing calibration charts to denote deviations in pointer readings from dial markings. Adjustments are made when deviations exceed tolerances. Primary calibration check points are shown by double asterisks in the altitude column of table 703.

B. Calibration Procedures

NOTE: Subassembly tests required for calibration are denoted in the adjust procedures when they differ from unit testing techniques.

(1) Perform tests outlined in paragraphs 5, 7 and 9 in this section.

(2) Record test results and denote out-of-tolerance conditions.

(3) Perform required adjustments, then retest to assure in-tolerance conditions.

15. ADJUSTMENTS

A. General

Adjustments are performed with the internal mechanism removed from the case and bezel assemblies but with dial and 100-foot pointer installed. The unit should be mounted in a stand suitable for the test being performed.

B. Preparation for Adjustments (see figures 1101 and 1102).

(1) Position barometric setting gear on stud of transmission mechanism assembly (figure 1101-36 or -44) with setting gear stop centered over bottom of nearest screw on pivot plate assembly (38) or transmission housing assembly (45).

(2) Position barometric dial assembly (30) on shoulder of transmission mechanism assembly with 29.92 (1013) marking in line with center at 3 o'clock position dial plate screw hole.

(3) Position altimeter scale dial (31) over barometric dial with zero marking at 12 o'clock position (top) and secure with two dial screws (32).

(4) With pointers balanced and needles at zero dial indication, sequentially install 10,000-foot pointer (30), 1,000-foot pointer (29) and 100-foot pointer (28) on handstaff pinion (figure 1102, 9).

(5) Observe point-of-mesh between sector gear of rocking shaft assembly (-17) and intermediate gear assembly (9). Point-of-mesh should be approximately 4 teeth from end of gear arc at sea level pressure to permit maximum operating range.

C. Zero Setting Adjustment

Using tweezers, carefully position pointer(s) in line with zero dial marking.

D. Position Error Adjustments (see figure 1102).

(1) This procedure shall be conducted with mechanism subject to vibration.

(2) Position calibration fixture with mechanism assembly in a normal operating position with zero indication of dial at 12 o'clock. Rotate mechanism within fixture until pointer indicates zero.

(3) Lightly tap mechanism and record reading. Rotate calibration fixture clockwise until pointer is at 6 o'clock position. Tap mechanism and record reading. The difference between readings shall not exceed ±20 feet.

(4) If a plus error is indicated, loosen screw (28) and position rocking shaft counterweight (25) away from rocking shaft (34); then tighten screw. If a minus error is indicated, position counterweight toward rocking shaft; then tighten screw. Balance mechanism to specified tolerance.

(5) Rotate calibration fixture until pointer is at 9 o'clock position; then lightly tap mechanism and record reading. Rotate calibration fixture clockwise until pointer is at 3 o'clock position. Tap mechanism and record reading. The difference between readings shall not exceed ±20 feet.

(6) If a plus error is indicated, loosen screw (30) and position crown gear counterweight (29) toward rocking shaft. If a minus error is indicated, position counterweight away from rocking shaft. Tighten screw when mechanism is balanced within specified tolerance.

NOTE: Remove excessive pointer oscillation, if necessary, by increasing tension of sector gear hairspring (33).

(7) Position the calibration fixture with mechanism dial facing up. With pointer at zero lightly tap mechanism to remove friction. If pointer indicates an error, loosen screw (16) and rotate eccentric jewel bushing assembly (15) to correct for excessive endshake of rocking shaft assembly. Tighten nut when mechanism is balanced within specified tolerance.

(8) Repeat procedures as outlined in paragraph D. to insure that mechanism is balanced to within specified tolerance.

E. Scale Error Adjustments

(1) Scale errors at room temperature which exceed tolerance, require adjustments in calibration. Out of tolerance readings between room temperature and cold tests normally require compensation.

(2) Sector Gear Adjustment (see figures 702 and 1102).

(a) The point-of-mesh between the sector pinion and the sector gear of the rocking shaft assembly (figure 1102-17) should be approximately four teeth from the end of the sector gear arc at sea level pressure.

(b) Adjust position of sector gear by holding rocking shaft with rocking shaft holding wrench and turn sector gear with sector gear wrench as required (see figure 702).

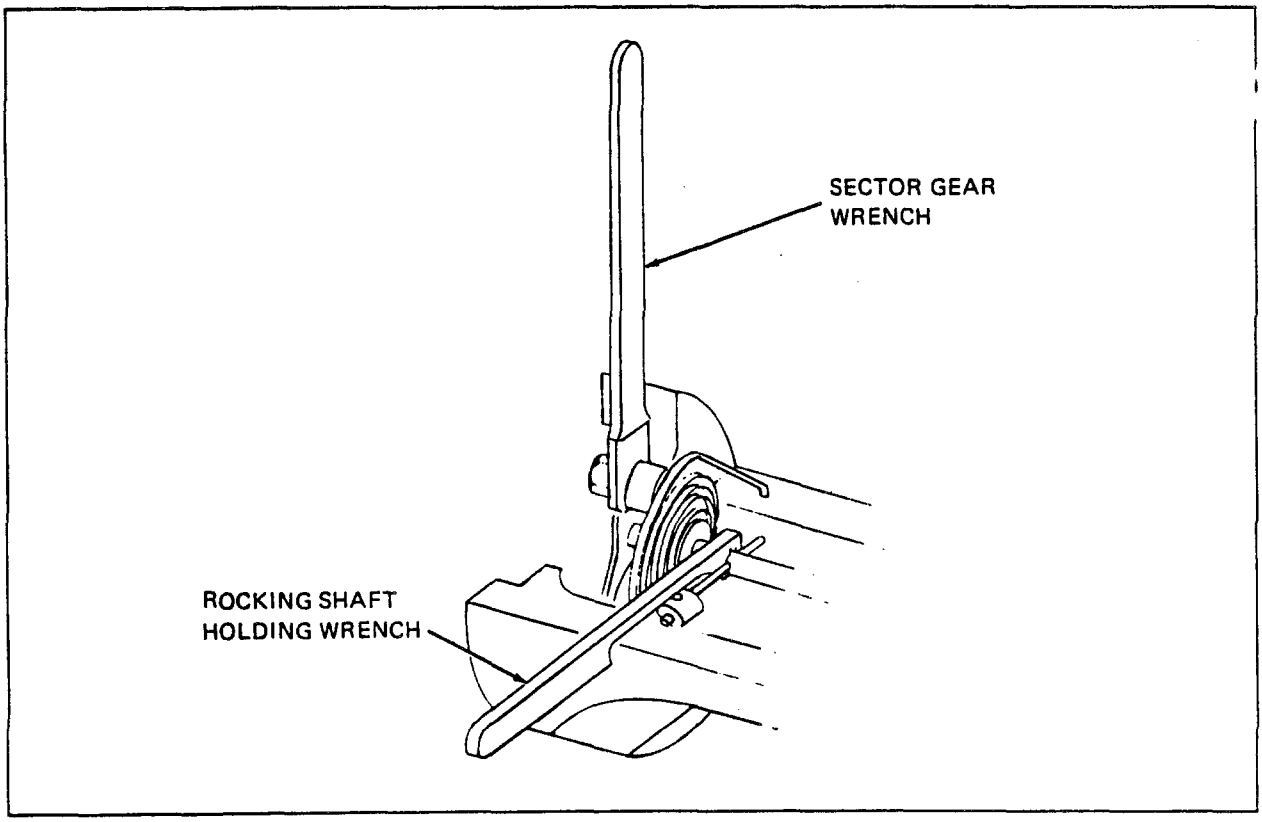
(3) Aneroid and thermometal assembly (figure 1102-35) adjustment notes.

(a) A change in position of either the aneroid assembly or the link arm causes a change in response to the mechanism, and a corresponding change in the rate of pointer rotation between zero and maximum altitude.

(b) The location of the aneroid assembly affects speed of rotation at high altitudes more than at low altitudes. Moving the aneroid toward the rocking shaft assembly increases mechanism reaction speed. Conversely, moving the aneroid assembly toward its support plate slows mechanism response.

(c) Changing link arm settings will cause a change in the speed of rotation throughout the entire range.

(d) Speed of rotation and amount of change can be controlled by use of both adjustments.



Rocking Shaft Sector Gear Adjustment
Figure 702

(4) Temperature Compensation

(a) Altimeters that are not correctly temperature compensated react to lowering temperatures by showing increased or decreased altitude readings on the indicator, depending on length of thermometal on aneroid.

(b) As its temperature is lowered, the metal in the aneroid stiffens. Since the "load" of ambient atmospheric pressure remains constant, the aneroid expands and the transmission gear and the rocking shaft react, causing the indication to change.

(c) To provide a means of temperature compensation, two thermometals (figure 1102, 40) are provided. One "U" shaped pre-adjusted thermometal is on the arm. This one compensates for high range (10,000 to 35,000 ft.). No adjustment should ever be made on this thermometal. One flat thermometal is mounted on the aneroid with means of adjustment provided. This one compensates for low range (0 to 10,000 ft.).

(d) If the mechanism indicates a plus reading when transferred from room temperature to cold temperature, the mechanism is undercompensated. To correct this, loosen two screws (41) in clamp bar (39) and turn screw (42) clockwise. One turn of the screw will cause an approximate 50-foot change in indication. Tighten two screws (41).

(e) If the mechanism indicates a minus reading when transferred from room temperature to cold temperature, the mechanism is overcompensated. To correct this, loosen two screws (41) in clamp bar (39) and turn screw (42) counterclockwise. Then apply force to the thermometal (40) at the link and push toward screw (42). Tighten two screws (41).

(f) The link pin hole in the thermometal should remain as close as possible on the center of the support button on the aneroid assembly (47) at all times. If it is moved off center because of compensation adjustments, screws (45 and 46) in clamp bar (43) should be loosened and the thermometal should be moved in either direction to position the link pin hole in the thermometal at the approximate center of the support button. Tighten screws in clamp bar.

(5) Link Arm and Aneroid Assembly Adjustments (see figure 1102).

(a) Mount the mechanism in the calibration stand so the aneroid is on the same side as "0". Then, place calibration stand with mounted mechanism in a pressure chamber with "0" at top. Set the pointer of the test mechanism, using the knob on the calibration stand, so it will read "0" when the master altimeter or barometer reads "0".

NOTE: If the pointers of the master altimeter are below "0", close the chamber and reduce the pressure until the pointers indicate "0". Note the position of the pointers of these test instruments. If not on "0", open the chamber to atmosphere, and turn the adjustment knob to reposition pointers. Repeat procedure until a reading of "0" is obtained. If the pointers of the master altimeter are above "0", the procedure is similar to that described above, except that the instruments must be subjected to pressure.

(b) Close the pressure chamber and slowly decrease the pressure until the master altimeter or barometer indicates a reading equivalent to 10,000 feet and check the calibration point shown in table 706.

(c) If the mechanism shows a plus or minus indication, remove it and adjust the effective length of the link arm assembly. If the mechanism reading is too fast, move the adjustment arm out of the rocking shaft. If the mechanism readings are too slow, move the adjusting arm into the rocking shaft.

(d) When the altimeter mechanism reading agrees with that of the master altimeter or barometer at zero and 10,000 feet, increase pressure to ambient pressure. Remove mechanism and stand from chamber and recheck balance. When balanced within limits, place mechanism in chamber and recheck error at zero and 10,000 feet. If the error is within tolerance specified, reduce pressure and record errors at the check points of 15,000 and 20,000 feet.

NOTE: Do not use slide on aneroid for calibration purposes unless absolutely necessary, since any change will affect compensation.

(e) If the mechanism indicates a reading at 25,000 feet above or below that of the master altimeter (after applying the allowed tolerance), remove the mechanism from chamber and adjust the position of the aneroid assembly in the mechanism body. If the mechanism reading is too high, move the aneroid away from rocking shaft.

(f) Further adjustment of the mechanism should be made as required until all readings come within the tolerances specified.

(g) Check the backward movement of the mechanism by slowly increasing the pressure until the altimeter indicates a maximum of -1,000 feet.

(h) Repeat scale error test and position error tests to assure altimeter is within tolerance.

Table 706. Link Arm and Aneroid Assembly Calibration Points

ALTITUDE (FEET)	ADJUSTMENT
0	Link Arm
1,000	Link Arm
4,000	Link Arm
8,000	Link Arm
14,000	Aneroid Assembly
20,000	Aneroid Assembly
25,000	Aneroid Assembly
30,000	Aneroid Assembly

TROUBLESHOOTING

1. GENERAL

This section presents general troubleshooting information to assist in locating and correcting any malfunctions in the altimeter.

2. TROUBLESHOOTING PROCEDURES

A. General

Troubleshooting should begin after testing and careful observation of the altimeter's performance. Pointer readings and response times should be recorded for reference. Based on the altimeter's performance, attempt to isolate the malfunctions to altimeter mechanism or case assembly. Malfunctions, probable causes and remedies are listed in table 801.

B. Mechanical Malfunctions

When the malfunction has been isolated, perform a visual inspection of the moving mechanical parts. Typical malfunctions would be gears loose on shafts, binding gears on shafts, defective bearing surfaces, foreign matter, loose pointers, broken or damaged gear teeth.

C. Lighting Malfunctions

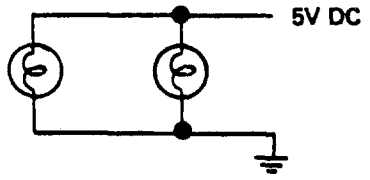
When the malfunction is determined to be the lighting system, first check electrical circuit for loose solder connections, cold solder joints, defective wiring. Refer to schematic diagram (figure 801).

Table 801. Troubleshooting Chart

TROUBLE	PROBABLE CAUSE	REMEDY
Pointer deviates beyond tolerance at constant altitude	Case leaks due to defective or improperly positioned bezel gasket	Reposition or replace gasket
	Defective packing around adjusting knob stem	Replace packing
	Loose static port	Replace or restake port
Pointer not on zero dial indication at ground level	Pointer slipped on shaft	Adjust pointer to zero (per TESTING section, para. 15)

Table 801. Troubleshooting Chart (Continued)

TROUBLE	PROBABLE CAUSE	REMEDY
Pointer fails to return to zero from altitude	Improper balance	Balance (per TESTING section para. 15)
	Binding gears	Inspect and free gears
	Improper gear mesh	Adjust (per TESTING section para. 15)
Pointer travel is erratic	Binding or slipping gears, foreign matter in gear teeth or bearing surfaces	Clean gears and bearing surfaces, adjust end clearances or replace defective parts
Lamps do not light	Lamp burned out. Corroded or defective solder connection at PC board. Defective wiring.	Replace lamp. Remove corrosion or resolder connection. Replace wiring.



Schematic Diagram, Lighting System
Figure 801

STORAGE INSTRUCTIONS

1. GENERAL

This section gives storage instructions and time limits.

2. STORAGE PROCEDURES

Requirements for packaging and storage conform to U.S. Government Specification (MIL-P-116D). A summary of the most often used methods of packing for storage is included.

A. Packaging for Storage

(1) Packaging for immediate use (for mechanical and physical protection only). The instrument shall be enclosed in wrappings, boxes, bags, cartons or other containers as applicable to the extent necessary to provide protection from hazards of contamination and physical damage encountered in general handling, shelf storage and issue. When bags, wraps or other flexible barriers are used, cushioning shall be applied as required to protect the enclosing media. If packed in a rigid container, this container shall be supported by rigid or resilient dunnage as necessary to prevent free movement. Materials in contact with the surface of the instrument shall be as dry as practicable and in accordance with commercial practice.

(2) Packaging for Short Term Storage. (Up to six months.)

The instrument shall be wrapped or padded so that all projections or sharp edges that might damage a barrier bag are covered sufficiently to avoid damage to the bag. The usual method for accomplishing this is to pack the instrument in dunnage in a corrugated paper carton. The corners of the carton should be crushed so that they will not damage the barrier bag.

The dunnage should be either Kim-Pak, rubberized hair, or fiber.

The barrier bag shall be constructed of one or more plies in any manner which will insure water vapor proofness and flexibility. The material must have low water characteristics for use in packaging. Lapping or butting of the component materials of the finished product is

not permitted except in the direction perpendicular to the rolling direction. The lapped areas shall be plainly externally flagged to prevent use of that portion of the roll when a lap or butt weld is made on the finished product, the foil component (if present) or cloth backing (if present). The barrier bag is usually made of canvas covered foil and can be heat sealed airtight.

SPECIAL TOOLS, FIXTURES AND EQUIPMENT

1. GENERAL

This section lists special tools and test equipment necessary for the disassembly, assembly, calibration, and testing of the Series 101720 and 101730 altimeters.

2. SPECIAL TOOLS, FIXTURES, AND EQUIPMENT (refer to table 1001)

Table 1001. Special Tools, Fixtures, and Equipment

EQUIPMENT	USE
Barometer - Haas Type A-1 w/PRS Photo Scanner	Case Leak Test Scale Error Test Position Error Test
Vacuum Pump - Welch Model 1400B and 1402	Case Leak Test Scale Error Test
Rate of Climb Indicator Aerosonic P/N RC-60-MS-10-3 (0-60000 FPM)	Scale Error Test
Stop Watch, 1/10 second	Case Leak Test
Chamber, Vacuum, Aerosonic P/N 9210052	Calibration
Sector Gear Wrench, Aerosonic P/N 9200072	Calibration
Rocking Shaft Holding Wrench, Aerosonic P/N 9200073	Calibration
Screw, hex hd, brass P/N 201806	Calibration
Work Plate, Aerosonic P/N T21306	Intermediate Gear Assembly Hairspring Adjustment

3. PHYSICAL AND ENVIRONMENTAL CONDITIONS

A. Physical Conditions

It is recommended that overhaul be performed on a laminar flow - clean bench, or equal. If this is not available, overhaul is possible in a high grade instrument shop.

B. Environmental Conditions

Work shall be performed at a temperature of 25° C (77°F) and a relative humidity of 85%. Correct for any change from an atmospheric pressure of 29.92 in.Hg or 1013.3 Mb.

ILLUSTRATED PARTS LIST

1. GENERAL

This section lists and illustrates all repairable parts in the altimeters. Parts which are not broken down are not considered repairable. Order parts directly from Aerosonic Corporation or from the appropriate vendor.

2. INTRODUCTION

A. How to Use Parts List.

The Illustrated Parts Breakdown consists of two parts: Numerical Index and Group Assembly Parts List. Use these as follows:

If the part number is known.....Find number in the numerical index and use the cross referenced figure and item number to find the part in the Group Assembly Parts List.

If the part number is not known. Find the appropriate illustration and look up item number in tabular list in Group Assembly Parts List.

B. Numerical Index

The Numerical Index is an alphanumerical list of all parts contained in the Group Assembly Parts List. The list is arranged in the following order by digits from left to right:

First digit:
Letters A - Z
Numerals 0 - 9

Second and succeeding digits:
Space (blank column)
Diagonal (slant)/
Point (period).
Dash (-)
Letters A - Z
Numerals 0 - 9

The Numerical Index is cross-referenced to the Group Assembly Parts List by figure and item number:

C. Group Assembly Parts List:

(1) Part Number Column. The Group Assembly Parts List is a complete, illustrated breakdown of the unit arranged in approximate disassembly order. The part number column contains the part number assigned by the actual manufacturer of the part. Government Standard numbers are used where applicable.

(2) Nomenclature Column. The nomenclature column contains the nomenclature of the item and any amplifying information. The relationship of assemblies, subassemblies, and detail parts is shown by an indentation system. Detail parts are listed beneath their assembly and indented one space to the right. Attaching parts have the same indent as the assembly they attach and are identified by the phrase (ATTACHING PARTS) at the beginning of the listing and the symbol ---*--- at the end of the listing. If a part is a vendor item, a five-digit vendor number preceded by a "V" is given in parentheses. Parts without vendor codes are Aerosonic parts or standard parts.

(3) Units per Assembly Column. The units per assembly column lists the quantity of parts used at that particular location in the assembly.

D. Vendor Codes

Vendor Codes are five-digit numbers identifying manufacturers as listed in Federal Cataloging Handbook H4-1. The following list is a key to these codes:

V11824 MacLeod Instrument Corp.
1212 N. Hercules Ave.
Clearwater, Fla.

3. NUMERICAL INDEX

NUMERICAL INDEX

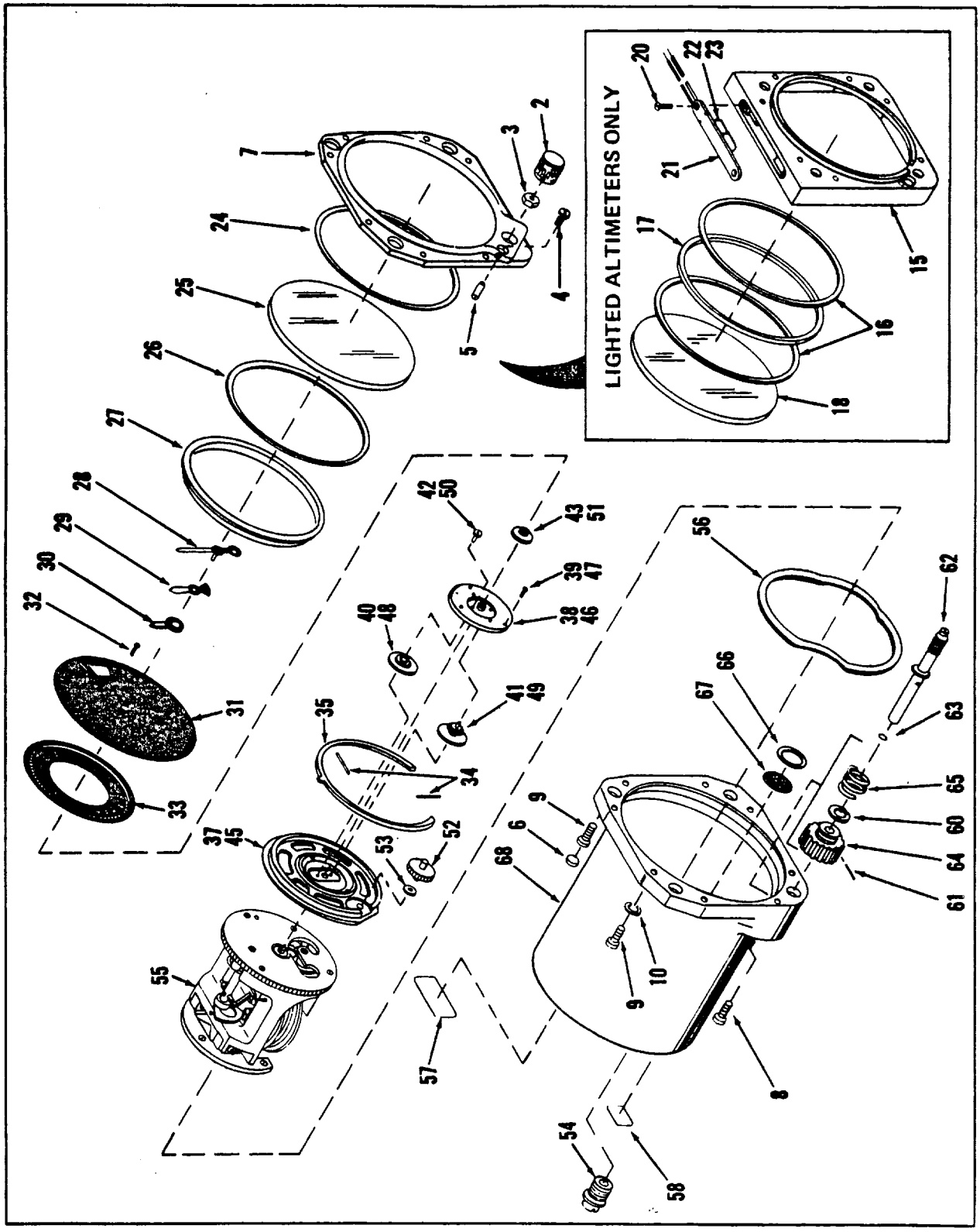
PART NUMBER	FIG. - ITEM	TTL REQ	AIRLINE PART NO.
AN6227-1	1101 63	1	
A1325	1102 6	1	
A1680	1101 33	1	
A2052	1101 38	1	
A2059	1101 37	1	
A4006	1101 -36	1	
CM7216	1101 22	2	
MS16998-10	1102 37	1	
M1073	1101 61	1	
M1075	1101 35	1	
M1200	1102 5	1	
M1208	1102 10	1	
	19	1	
M1231	1101 42	1	
	50	1	
M1243	1101 39	3	
M1265	1101 34	2	
M21327	1101 27	1	
P1039	1101 60	1	
P1051	1101 32	2	
P1059	1101 25	1	
P1153-2	1102 29	1	
P1191-2	1102 18	1	
P1198	1101 67	1	
P12011	1101 58	1	
P1290	1101 16	2	
	24	1	
P1291	1101 10	5	
	-14	REF	
P1297	1101 6	1	
P1394	1101 3	1	
P1653	1101 29	1	
P2046	1101 26	1	
SA1233	1101 41	1	
	49	1	
SA1238	1101 40	1	
	48	1	
SA1244	1101 43	1	
	51	1	
SA1617	1101 52	1	
100045	1101 2	1	

3. NUMERICAL INDEX (continued)

PART NUMBER	FIG. - ITEM	TTL REQ	AIRLINE PART NO.
100058	1102 25	1	
100064	1101 28	1	
100083	1101 4	1	
100106	1101 56	1	
100142	1102 13	1	
100143	1101 65	1	
100144	1102 33	1	
100386	1101 64	1	
101720-01354	1101 -1	1	
101720-01355	1101 -1	1	
101730-01356	1101 -1	1	
101730-01357	1101 -1	1	
101720-01383	1101 -1	1	
101720-11384	1101 -1	1	
101720-11385	1101 -1	1	
101720-11386	1101 -1	1	
101730-01387	1101 -1	1	
101730-01388	1101 -1	1	
101730-11389	1101 -1	1	
101730-11390	1101 -1	1	
11077	1102 4	4	
1191-1	1102 21	1	
13224	1101 30	1	
1324	1102 35	1	
13480	1102 41	2	
	45	1	
1390-1	1102 27	1	
13951-3	1102 42	1	
13953-1	1102 7	1	
13956-3	1101 47	3	
	1102 46	1	
13957-1	1102 23	1	
	26	1	
	28	1	
13957-3	1102 12	1	
	14	1	
	16	1	
13963-3	1102 30	1	
14116	1101 66	1	
14157-3	1101 9	6	
	-13	REF	
14157-10	1101 8	2	
	-12	REF	
14175	1102 15	1	

3. NUMERICAL INDEX (continued)

PART NUMBER	FIG. - ITEM	TTL REQ	AIRLINE PART NO.
14301-2	1102 24	1	
14488-7	1102 38	2	
14570-3	1101 20	2	
14777	1102 11	1	
14821-2	1102 40	1	
14822	1102 43	1	
14823	1102 39	1	
14828	1101 53	2	
1813/22LW-3	1101 23	2	
19859	1101 57	1	
19861	1101 57	1	
200016	1101 62	1	
200059	1101 33	1	
200580	1102 31	2	
201138	1101 17	1	
201149	1101 54	1	
201310-4	1101 -19	1	
201312	1101 21	1	
201421	1101 5	1	
201756-2	1101 31	1	
201762	1102 3	1	
201808	1102 20	1	
201818	1102 44	1	
201821	1102 47	1	
201822	1102 -36	1	
201824	1102 32	1	
201845	1102 9	1	
201890	1102 22	1	
21666	1102 8	1	
300015	1101 59	1	
300181	1101 68	1	
300190	1101 7	1	
32319	1101 18	1	
32675-1	1101 31	1	
32713	1102 34	1	
32757	1101 -11	1	
32783	1101 46	1	
41508	1101 15	1	
41807-2	1102 -17	1	
41808	1102 2	1	
41809-2	1101 55	1	
	1102 -1		
41836	1101 -44	1	
41837	1101 45	1	



Altimeter Indicator
Figure 1101

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT FROM TO	UNITS PER ASSY
1101 -1	(See Table 1101)	ALTIMETER, Pressure Reporting, 3-Pointer (41841-1 thru -3)		1
2	100045	. KNOB, Knurled (V11824)		1
3	P1394	. LOCKNUT, Knob		1
4	100083	. SCREW, Locking stud		1
5	201421	. STUD, Locking (V11824)		1
6	P1297	. SEAL, Lead		1
7	(See Table 1101)	. BEZEL, Instrument, Unlighted (ATTACHING PARTS)		1
8	14157-10	. SCREW, Mach, sltd, filh, 3-56, UNF-2A, sst		2
9	14157-3	. SCREW, Mach, sltd, filh, 3-56, UNF-2A, sst		6
10	P1291	. WASHER, Lock, split		5
		---*---		
-11	(See Table 1101)	. BEZEL ASSEMBLY, Lighted (ATTACHING PARTS)		1
-12	14157-10	. SCREW, Mach, sltd, filh, 3-56, UNF-2A, sst		REF
-13	14157-3	. SCREW, Mach, sltd, filh, 3-56, UNF-2A, sst		REF
-14	P1291	. WASHER, Lock, split		REF
		---*---		
15	41508	. . BEZEL, Instrument Mounting		1
16	P1290	. . GASKET, Paper, black		2
17	201138	. . SPACER, Bezel		1
18	32319	. . LENS, Instrument		1
-19	201310-4	. . LIGHT TRAY ASSEMBLY (ATTACHING PART)		1
20	14570-3	. . SCREW, Mach, sltd, filh, 82°, 3-48, UNC-2A, sst		2
		---*---		
21	201312	. . . BOARD, Printed circuit		1
22	CM7216	. . . LAMP, Incandescent, subminiature, T-1		2
23	1813/22LW-3	. . . FILTER, Lamp, blue		2
24	P1290*	. GASKET, Paper, black		1
25	P1059*	. LENS (MS28105-17)		1
26	P2046	. GASKET, Bezel		1
27	M21327	. SPACER, Ring		1
28	100064	. POINTER, 100 Feet (V11824)		1
29	P1653	. POINTER, 1000 Feet		1
30	13224	. POINTER, 10,000 Feet (Screened)		1

— Item not illustrated

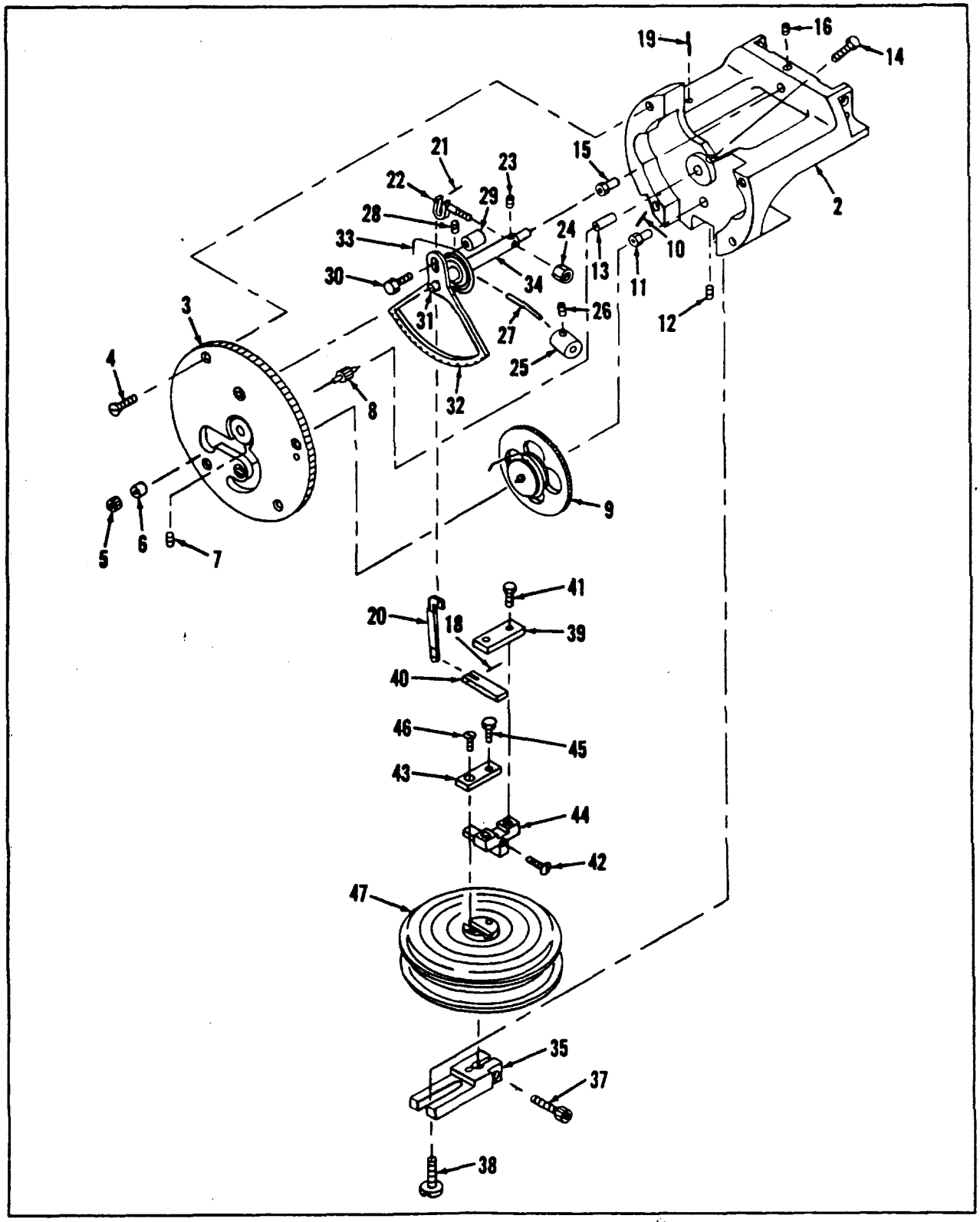
*Used on unlighted altimeters only.

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT FROM TO	UNITS PER ASSY
1101 31	(See Table 1101)	. DIAL, Altimeter		1
		(ATTACHING PARTS)		
32	P1051	. SCREW, DIAL		2
		---*---		
33	(See Table 1101)	. DIAL ASSEMBLY, Barometric		1
34	M1265	. WIRE, Tension		2
35	M1075	. RING, Snap		1
-36	A4006*	. TRANSMISSION MECHANISM ASSEMBLY		1
37	A2059	. . GEARPLATE ASSEMBLY		1
38	A2052	. . PIVOT PLATE ASSEMBLY		1
		(ATTACHING PARTS)		
39	M1243	. . SCREW, Shoulder		3
		---*---		
40	SA1238	. . 13T AND 40T GEAR ASSEMBLY		1
41	SA1233	. . 48T WHEEL ASSEMBLY		1
42	M1231	. . PINION, 12T Stem		1
43	SA1244	. . 60T WHEEL ASSEMBLY		1
-44	41836**	. TRANSMISSION MECHANISM ASSEMBLY		1
45	41837	. . TRANSMISSION HOUSING ASSEMBLY		1
46	32783	. . TRANSMISSION COVER ASSEMBLY		1
		(ATTACHING PARTS)		
47	13956-3	. . SCREW, Mach, sltd, filh, 82°, 1-72, UNF-2A, sst		3
		---*---		
48	SA1238	. . 13T AND 40T GEAR ASSEMBLY		1
49	SA1233	. . 48T WHEEL ASSEMBLY		1
50	M1231	. . PINION, 12T Stem		1
51	SA1244	. . 60T WHEEL ASSEMBLY		1
52	SA1617	. GEAR ASSEMBLY, Barometric Setting		1
53	14828	. WASHER, Dial		2
54	201149	. PLUG, Vent		1
55	41809-2	. MECHANICAL MECHANISM ASSEMBLY (See figure 1102 for breakdown)		1
56	100106	. SPRING RING, Formed (V11824)		1

- Item not illustrated
* Single barometric readout altimeters only. See item number -44 for dual barometric readout.
** Dual barometric readout altimeters only. See item number -36 for single barometric readout.

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT FROM TO	UNITS PER ASSY
1101 57	(See Table 1101)	. PLATE, Identification		1
58	P12011	. DECAL, Caution		1
-59	300015	. CASE ASSEMBLY (V11824)		1
60	P1039	. . RING, Snap		1
61	M1073	. . PIN, Lock		1
62	200016	. . STEM, Adjustment Knob		1
63	AN6227-1	. . "O"-Ring		1
64	100386	. . GEAR, Pinion (V11824)		
65	100143	. . SPRING, Compression (V11824)		1
66	14116	. . WASHER, Flat, Plain		1
67	P1198	. . SCREEN, Filter		1
68	300181	. . CASE, Instrument (V11824)		1

— Item not illustrated



Mechanical Mechanism Assembly
Figure 1102

FIG.	ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT FROM TO	UNITS PER ASSY
1102	1	41809-2	MECHANICAL MECHANISM ASSEMBLY (See figure 1101 for NHA)		1
	2	41808	. FRAME, Machined		1
	3	201762	. GEARPLATE ASSEMBLY (ATTACHING PARTS)		1
	4	11077	. SCREW, Base Bodyfit ---*---		4
	5	M1200	. PINION, Center, 12T		1
	6	A1325	. JEWEL BUSHING ASSEMBLY (ATTACHING PART)		1
	7	13953-1	. SCREW, Mach, spln, soc set, fp, 0-80 UNF-2A, sst ---*---		1
	8	21666	. PINION, Handstaff		1
	9	201845	. GEAR ASSEMBLY, Intermediate (ATTACHING PART)		1
	10	M1208	. PIN, Taper ---*---		1
	11	14777	. ECCENTRIC JEWEL BUSHING ASSEMBLY (ATTACHING PART)		1
	12	13957-3	. SCREW, Mach, spln, soc set, fp, 2-64 UNF-2A, sst ---*---		1
	13	100142	. JEWEL BUSHING UNIT, Large (ATTACHING PART)		1
	14	13957-3	. SCREW, Mach, spln, soc set, fp, 2-64 UNF-2A, sst ---*---		1
	15	14175	. ECCENTRIC JEWEL BUSHING ASSEMBLY (ATTACHING PART)		1
	16	13957-3	. SCREW, Mach, spln, soc set, fp, 2-64 UNF-2A, sst ---*---		1
	-17	41807-2	. ROCKING SHAFT ASSEMBLY (ATTACHING PARTS)		1
	18	P1191-2	. PIN, Bearing		1
	19	M1208	. PIN, Taper ---*---		1

— Item not illustrated

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT FROM TO	UNITS PER ASSY
1102 20	201808	. . LINK, Aneroid (ATTACHING PART)		1
21	1191-1	. . PIN, Bearing		1
		---*---		
22	201890	. . ARM, Link (ATTACHING PARTS)		1
23	13957-1	. . SCREW, Mach, spln, soc set, fp, 2-64 UNF-2A, sst		1
24	14301-2	. . NUT, Hex, self-locking		1
		---*---		
25	100058	. . COUNTERWEIGHT, Rocking shaft (ATTACHING PART)		1
26	13957-1	. . SCREW, Mach, spln, soc set, fp, 2-64 UNF-2A, sst		1
		---*---		
27	1390-1	. . PIN, Rocking shaft (ATTACHING PART)		1
28	13957-1	. . SCREW, Mach, spln, soc set, fp, 2-64 UNF-2A, sst		1
		---*---		
29	P1153-2	. . COUNTERWEIGHT, Crown gear (ATTACHING PART)		1
30	13963-3	. . SCREW, Mach, hex hd, 2-64 UNF-2A		1
		---*---		
31	200580	. . PIN, Pivot		2
32	201824	. . GEAR, Sector		1
33	100144	. . HAIRSPRING, Sector gear		1
34	32713	. . SHAFT, Rocking		1
35	1324	. DIAPHRAGM SUPPORT PLATE		1
-36	201822	. ANEROID AND THEMOMETAL ASSEMBLY (ATTACHING PARTS)		1
37	MS16998-10	. SCREW, Cap, soc hd, hex, alloy stl, cd pl		1
38	14488-7	. SCREW, Mach, sltd, pnh, 8-32 UNC-2A, brs		2
		---*---		
39	14823	. . BAR, Clamp		1
40	14821-2	. . THERMOMETAL (ATTACHING PARTS)		1
41	13480	. . SCREW, Hex hd		2
42	13951-3	. . SCREW, Mach, sltd, bdgh, 0-80 UNF-2A, sst		1
		---*---		

— Item not illustrated

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT FROM TO	UNITS PER ASSY
1102 43	14822	. . BAR, Clamp		1
44	201818	. . SUPPORT, Thermometal (ATTACHING PARTS)		1
45	13480	. . SCREW, Hex hd		1
46	13956-3	. . SCREW, Mach, sltd, flh 82°, 1-72 UNF-2A, sst		1
		---*---		
47	201821	. . ANEROID ASSEMBLY		1

— Item not illustrated

Table 1101. Figure 1101 Parts List Tabulation

Item 1		Item 7	Item 11	Item 31	Item 33	Item 57
PART NO.	GENERAL ASSY	BEZEL, UNLIGHTED	BEZEL, LIGHTED	DIAL, ALTI-METER	DIAL ASSY, BARO-METRIC	PLATE, IDENTIFI-CATION
101720-01354	41843-1	300190		201756-2	A1680	19859
101720-01355	41843-2	300190		201756-2	200059	19859
101730-01356	41843-1	300190		201756-2	A1680	19861
101730-01357	41843-2	300190		201756-2	200059	19861
101720-01383	41483-3	300190		32675-1	32782	19859
101720-11384	41843-1		32757	201756-2	A1680	19859
101720-11385	41843-2		32757	201756-2	200059	19859
101720-11386	41843-3		32757	32675-1	32782	19859
101730-01387	41843-3	300190		32675-1	32782	19861
101730-01388	41843-1		32757	201756-2	A1680	19861
101730-11389	41843-2		32757	201756-2	200059	19861
101730-11390	41843-3		32757	32675-1	32782	19861

AEROSONIC CORPORATION
Clearwater, Florida

March 31, 1976

Difference Data Sheet
for Pressure Altimeter
Part No's. 101730-01398
and -01399
Using Manual for 101720 and 101730 Series

1. GENERAL

The 101730-01398 and -01399 Altimeters are identical to the 101730-01356 and -01357 respectively in the above noted manual except for the dial and 10,000 ft. pointer.

2. PART DIFFERENCES

The following part numbers apply to the noted altimeters, in place of those showin in the illustrated parts list:

Ref.	Part No.	Name
1101-30	21684	Pointer, 10,000 Ft.
-31	21053	Dial

3. TEST REQUIREMENTS

Ref: Pg. 702, para. 5 Barometric Scale Error
After completing the requirements in para's A, B and C, repeat the tests at settings of 29.50 and 30.50 on the baro dial.

AEROSONIC CORPORATION
Clearwater, Florida

March 31, 1976

Difference Data Sheet
for Pressure Altimeter
Part No. 101730-01419
Using Manual for 101720 and 101730 Series

1.0 GENERAL

The 101730-01419 Altimeter is identical to the 101730-01387 in all respects, except for testing. Additional Testing is required for Barometric Scale error.

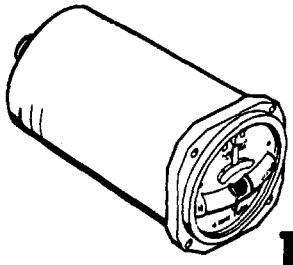
2.0 TEST REQUIREMENTS

Ref: Pg 702, para 5. Barometric Scale Error

After completing the requirements in para's A, B and C, repeat the tests at settings of 29.50 and 30.50 on the baro dial.

R. C. A. Publication No. 1200

SERVICE MANUAL



MODEL RCA 30
TURN AND BANK INDICATOR

R.C.Allen Aircraft Instrument Division

GRAND RAPIDS, MICHIGAN 49503

DESCRIPTION

R. C. Allen Turn and Slip (Turn and Bank) Indicator is a gasket sealed, direct-reading, lateral attitude reference component. The indicator meets the requirements of F.A.A. Specification TSO-C3a and SAE Standard AS395B. The basic instrument is DC operated, inverting 28 VDC or 14 VDC into AC voltage for use by a hysteresis type synchronous motor. Variations include dial color, dial presentation, calibration, connectors, and power failure indication. The coding system is defined in Figure 4.

LEADING PARTICULARS

Operating Voltage	12-14 Vdc or 26-30 Vdc	Overall Length	Code "A" . . 5.860 in. Max. Code "B" . . 5.860 in. Max.
Max Current Drain	260 ma at 28 Vdc or 320 ma at 14 Vdc	Required Mounting Hole Size	2-9/32 in. Max.
Connector Type	Code "A" . . AN3102-10SL-3P (Integral with inverter assembly) Code "B" . . (2) NC terminal lugs	Operating Temperature Range	-54°C (-65.2°F) to 71°C (160°F)

OVERHAUL INSTRUCTIONS

1. Special Tools.

   No special tools are required for the performance of the procedures contained in this publication.

2. Disassembly

   a. Disassembly is accomplished in the same order as the index numbers assigned to the exploded view illustrations (See figures 2 and 3) and as outlined in the following steps.

   Note

   It is recommended that soldered assemblies shall not be unsoldered unless absolutely necessary to replace defective parts.

   b. Unsolder and remove lead wires where necessary for disassembly purposes. When lead wires are to be removed, first make careful note of lead lengths, color coding, and wire routing.

   c. Removal of pivot lock nut (63, figure 2) may be expedited by the use of suitable spanner wrenches.

   d. Maintain all parts of damping assembly (40, 41, figure 2) as a matched set. Do not intermix any of these parts with like parts of other indicators.

   Note

   It is recommended that rotor and bearing assembly (13-22, figure 3)

not be disassembled unless necessary to replace damaged or worn parts. This assembly is dynamically balanced and disassembly of any part will require rebalancing of the assembly.

3. Clean the parts of the indicator in accordance with the following procedure:

CAUTION

The indicator is a precision instrument requiring careful handling. It is recommended that cleaning operations be conducted in an area not subject to excessive temperature variations or high humidity. Following cleaning operations, reassemble parts whenever practicable. When cleaned parts must be set aside pending reassembly, place them under a dust cover or in a clean, covered container.

a. Wash all attaching parts such as screws, nuts, and washers using perchloroethylene, Federal Specification O-P-191. Dry parts with a vacuum source.

b. Do not attempt to clean bearings (49, figure 2, 14 and 19, figure 3). These bearings are double-shielded and should be replaced at each overhaul period.

c. All solder connections which have been subjected to unsoldering operations should be thoroughly cleaned and brushed with perchloroethylene, Federal Specification O-P-191 to remove all traces of solder flux.

d. Polish the glass face of cover assembly (4, figure 2) using a clean, lint-free cloth.

e. Castings, housings, and other like parts may be cleaned with a soft cloth or brush dipped in perchloroethylene, Federal Specification O-P-191 and dried with a vacuum source.

4. Perform the inspection procedure in accordance with the following steps:

a. Visually

Visually inspect all covers, housings, and cast parts for cracks, marred mating surfaces, deformed openings, and stripped threads on studs and tapped holes.

b. Examine all surfaces subjected to friction for excessive wear and surface damage.

c. Inspect all ball bearings for roughness and binding.

d. Check all screws, nuts, washers, and retaining rings for acceptable re-usability.

e. Examine all springs for uniform spacing between loops and overall symmetry. Spring (21, figure 2) shall have a free length of 0.329 inch. Spring (62) shall have a free length of 0.599 inch.

f. Inspect the connector part of inverter assembly (16) for stripped threads and bent pins.

g. Inspect cover assembly (11) for evidences of irreparable damage and punctures.

h. Check the glass (4, figure 2) for scratches, chips, cracks, and discoloration.

i. Check dial (26) and pointer assembly (29) for chipped paint.

j. Inspect the inclinometer (25) for general condition. The enclosed glass ball should roll smoothly from side to side as the inclinometer is tilted and should show no evidence of sticking at the ends.

5. Repair or Replacement

Generally, repair should be limited to the replacement of parts found to be defective during the performance of the inspection procedure outlined in the preceding procedure outlined in the preceding paragraph and as follows.

a. Slightly bent pins on the connector of the inverter assembly (16, figure 2) may be straightened.

b. If any part of the rotor and bearing assembly (13 through 22, figure 3) is found to be defective, and the defective part is replaced, the assembly must be dynamically balanced on its bearings.

c. Replace all deformed attaching parts.

d. Replace gasket (51, figure 2) at each overhaul period.

6. Lubrication. None required.

7. Reassembly (See figures 2 and 3)

Generally, reassembly is accomplished in the reverse order of the index numbers assigned to the exploded view illustrations (figure 2 and 3) and as follows:

a. In the event that motor assembly (13 through 22, figure 3) has been disassembled, it will be necessary to dynamically balance the assembly on its bearings to within a maximum unbalance of 100 micro-ounce inch.

Note

Motor shall be run-in for a minimum of forty-eight hours after preload check.

Micronamic Type EU-2 (or equivalent) balancing machine manufactured by Micro Balancing, Inc, Long Island City, N. Y., is suitable for accomplishing the preceding check.

Preload of motor assembly (13 through 22) shall be adjusted to 0.0012 to 0.0018 inch of movement when a reversing two pound load is applied.

Recheck preload after run-in period and adjust, if required, to original deflection tolerance with screw (17, figure 3). Motor speed shall not be less than 7800 rpm with power from inverter. Secure screw (17) with screw (16) after completing deflection adjustment.

Hand form spring assemblies (23) approximately as shown in figure 3.

Assemble bearings (49, figure 2) and motor and gimbal assembly (78) into frame (72). Adjust trunnion to obtain 0.002 inch endplay as checked with a feeler gauge.

Set spring assembly (23, figure 3) contacts to produce a pressure of 20 ± 5 grams against trunnions (48, figure 2).

Position arm assembly (65) on trunnion (71) as shown in figure 2 and lock in place using bushing (63). Lock remaining trunnion with nut (46).

Note

Bushing (63) and nut (46) securing trunnions (71) and (48) shall be tightened to a torque reading of between five and six inch pounds.

b. When reassembled, apply durable, dull black paint to heads of screws (18, 20, and 33, figure 2).

c. Wire (23) shall be twisted a minimum of two turns at rear of retainer (24).

d. Use one spacer (28) as required for thickness to maintain minimum endplay without binding of pointer pivot (30).

Note

Prior to reassembly of cover assembly (11, figure 2) perform Test Procedures, as outlined in paragraph 8.

8. TEST PROCEDURE

Note

The test procedures described in steps a. thru l. following shall be conducted both prior to and following the reassembly of the cover assembly (11, figure 2).

a. Mount the indicator to be tested on a balancing and leveling fixture capable of simulating the roll characteristics of an aircraft.

b. With the indicator in a leveled position, zero the pointer by adjustment of screw (66). Rotate the instrument 180 degrees about its longitudinal axis. Readjust pointer to zero by noting amount of error and removing half with adjusting screw (66) and half by adjusting trimmer screw (77, figure 2).

c. Rotate the indicator 90 degrees about its longitudinal axis both clockwise and counterclockwise. Check the pointer for zeroing in these positions. If adjustment is required, move trimmer nuts (73) on stud (74).

d. Displace the indicator to the right about its roll axis until the glass ball in the inclinometer (25, figure 2) is just short of its limit. The angle of displacement shall be ± 2 degrees. Repeat the test, displacing the indicator to the left. The same angle shall be noted.

e. Place the indicator in a leveled position with the lower mounting holes in a horizontal plane. Note that the ball rests at the zero mark within 1/32 inch.

Note

Be sure the lower mounting holes, rather than bottom flat of bezel (5), are used as level reference.

f. Displace the indicator about its roll axis so that the ball is at rest at either end of the inclinometer. Not less than one-half of the ball shall be visible when the ball is viewed from a position 12 inches directly in front of the zero mark.

Note

Unless otherwise specified on individual procedural steps following, the indicator shall be gently tapped before a test reading is recorded.

g. The indicator shall be placed in any stationary position. The deviation of the pointer from zero shall not exceed 0.010 inch.

h. Apply voltage stamped on the nameplate of the indicator to the pins of the connector on the inverter assembly (16, figure 2), noting polarity as indicated in figure 1. Repeat step g.

i. With the indicator mounted in a normal leveled flight position and the operating voltage applied to the connector, check the rpm of the gyro rotor using a stroboscopic tachometer. The recommended speed for optimum indicator performance is between 7800 and 8000 rpm.

j. By means of a calibrated milliammeter and a voltmeter, connected between the d-c power source and the indicator, check the current drain of the gyro motor. With 28 V dc applied, the current drain shall not exceed 260 milliamperes; with 12 - 14 V dc applied, the current drain shall not exceed 320 milliamperes.

k. With operating voltage stamped on the nameplate applied, the indicator shall be mounted in a normal position on the turn table and rotated about its vertical axis at a speed suffi-

l. With operating voltage applied, the indicator shall be mounted in a normal position on a turn table and turned on its vertical axis at the rates specified in table I. The comparative pointer deflection shall be as indicated for the listed rates of turning.

Table I. Pointer Sensitivity Data

Rate of Turning (Degrees)	Pointer Tip Deflection (in.)	
	4 Min. Turn	2 Min. Turn
36	1/16 ± 1/64	1/32 ± 1/64
90	5/32 ± 1/64	5/64 ± 1/64
180	5/16 ± 1/64	5/32 ± 1/64
360	5/8 ± 1/16	5/16 ± 1/64
1080	1.0 ± 1/8	11/16 ± 1/16

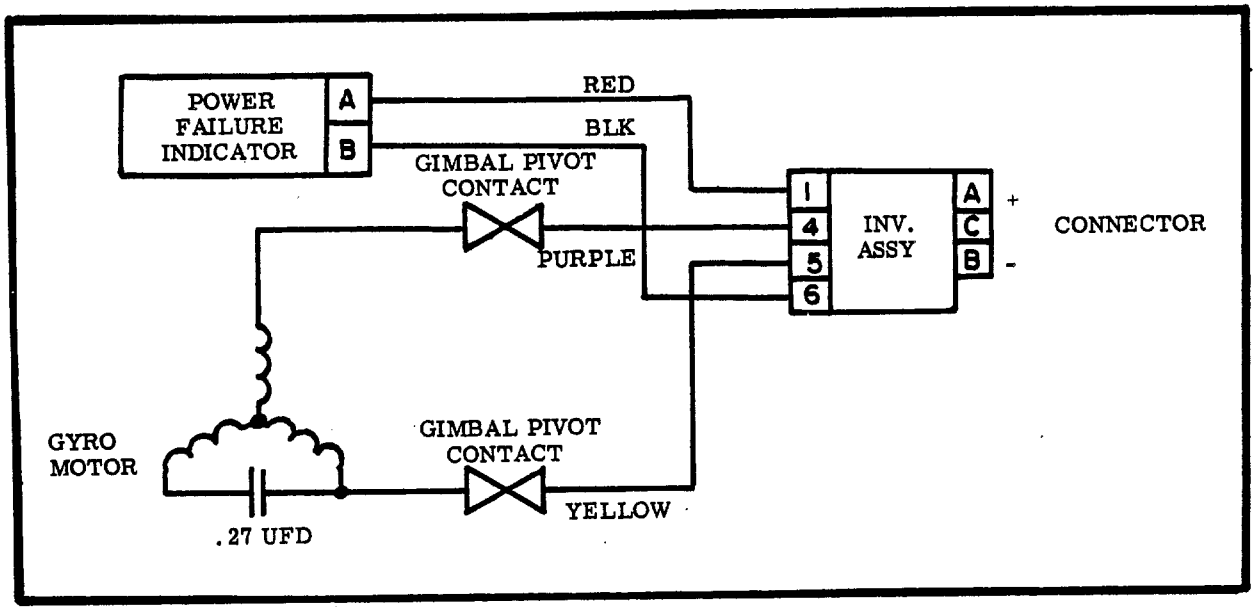


FIGURE 1 WIRING DIAGRAM

9. TROUBLE SHOOTING

Table II outlines troubles, their probable causes, and remedies which may be encountered during the performance of the procedures contained in this publication.

TROUBLE	PROBABLE CAUSE	REMEDY
INDICATOR DRAWS EXCESSIVE CURRENT	Excessive friction in bearings (19 and 14, figure 3).	Replace defective bearings.
	Excessive preloading on bearings (19 and 14).	Adjust motor preload to remove trouble.
BALL REACTION SLUGGISH OR ERRATIC	Defective inclinometer (25, figure 2).	Replace inclinometer.
APPARENT STATIC UNBALANCE OF GIMBAL	Improper adjustment of nuts (73 and 77, figure 2).	Adjust nuts as required.
INDICATING POINTER APPEARS UNSTABLE	Loose linkage to pointer assembly (29, figure 2).	Disassemble, replace faulty parts, and reassemble.
	Insufficient damping.	Disassemble, and check arm assembly (40) and cylinder assembly (41) for cleanliness. Reassemble, checking adjustment.
INDICATING POINTER SLUGGISH (LOW SENSITIVITY)	Insufficient gyro rotor speed. due to excessive friction or preload of rotor bearings.	Replace and/or adjust preload of motor bearings.
	Excessive friction in gimbal bearings (49).	Inspect and replace bearings if required.
	Excessive friction in damper.	Disassemble, and check arm assembly (40) and cylinder assembly (41) for cleanliness. Reassemble, checking adjustment.
NOISY OR VIBRATING ROTOR AND BEARING ASSEMBLY	Improperly balanced assembly.	Rebalance (Step a. under 7.)

TABLE II TROUBLE SHOOTING DATA

FIG. & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	QTY PER ASSY
2-	RCA-30 (Code)	INDICATOR, Turn and Bank	1
	Dial Color Code Presentation	Note: Complete CODE INDENTIFICATION defined by Fig. 4	
	F65	Flourescent Luminescent Dial (Spec. AN-L-1A, ... Color No. 65 - Yellow)	
	P61	Phosphorescent Luminescent Dial (Spec. 14102A, ... Color No. 61 - Green)	
	P64	Phosphorescent Luminescent Dial (Spec. 14102A, ... Color No. 64 - Orange)	
	R65	Radioactive Luminescent Dial (Spec. MIL-L-6770, ... Color No. 65 - Yellow)	
	R22M	Radioactive Luminescent Dial (Spec. TT-R-58, ... 22M - Green)	
	W2	Matte White Markings on Black Dial (Spec. TT-L-58, ... Type 2 - White)	
	WW	Off White Markings on Black Dial (Spec. Wornow ..... White No. 2-100)	
-1	AN500B4-4	. SCREW, No. 4-40 x 1/4 in., Slotted Fil Hd Cd Pl Brass ...	8
-2	A1324	. WASHER, No. 4 Spring Lock	8
	C61903XX	. BEZEL ASSY	1
-3	C61905	. . GASKET, Bezel	1
-4	AN5727-6	. . GLASS	1
-5	C61903	. . BEZEL	1
-6	AN340B6	. NUT, Plain	3
-7	AN9356L	. WASHER - LOCK, Spring	3
-8	AN960C8L	. WASHER, Plain	2
-9	AN936A8	. WASHER, Tooth Lock	2
-10	MS35649-64	. NUT, Plain	4
-11	*M5015-01	. COVER	1
	**M5015-02	. COVER	1
-12	*M5014-01	. PAD, Isolating	1
	**A1259-02	. PAD, Isolating	1
	***M5076 (REF)	. INDICATOR, Turn and Bank Sub Assy	1
-13	AN500B6-5	. . SCREW, No. 6-32 x 5/16 in., Slotted Fil Hd	2
-14	AN9356L	. . WASHER, No. 6 Spring Lock	2
-15	C61901	. . WASHER, Plain	2
-16	*M4276-01	. . INVERTER ASSY - 28 VDC	1
	*M5020-01	. . INVERTER ASSY - 14 VDC	1
	**M5019-01	. . INVERTER ASSY - 28 VDC	1
	**M5021-01	. . INVERTER ASSY - 14 VDC	1
-17	C63909	. . WASHER, Insulating	1
-18	AN515B2-3	. . SCREW, No. 2-56 x 3/16 in.	2
-19	A2573-02 thru -12	. . INDICATING ASSY, Code (A), Fig. 4	1
	A1629-01 thru -11	. . INDICATING ASSY, Code (B), Fig. 4	1
	A4394-01 thru -11	. . INDICATING ASSY, Code (C), Fig. 4	1
	A4396-01 thru -11	. . INDICATING ASSY, Code (D), Fig. 4	1
	A4397-01 thru -11	. . INDICATING ASSY, Code (E), Fig. 4	1
	A4399-01 thru -11	. . INDICATING ASSY, Code (F), Fig. 4	1
	****A5062-01 thru -11	. . INDICATING ASSY	1
	****A4388-01 thru -11	. . INDICATING ASSY	1
-20	AN515B2-2	. . . SCREW, No. 2-56 x 1/8 in. Slotted Rd Hd	1
-21	C64801	. . . SPRING, Restraining	2
-22	*****A2572-01, -02, & -05 thru -08	. . . INCLINOMETER ASSY	1
	*****C64901X	. . . INCLINOMETER ASSY	1

* For Cover with MS type connector
** For Cover with Stud type connector
*** Non Procurable Parts
**** For Power Failure Flag only
***** Procurable only as parts of Item 2-19

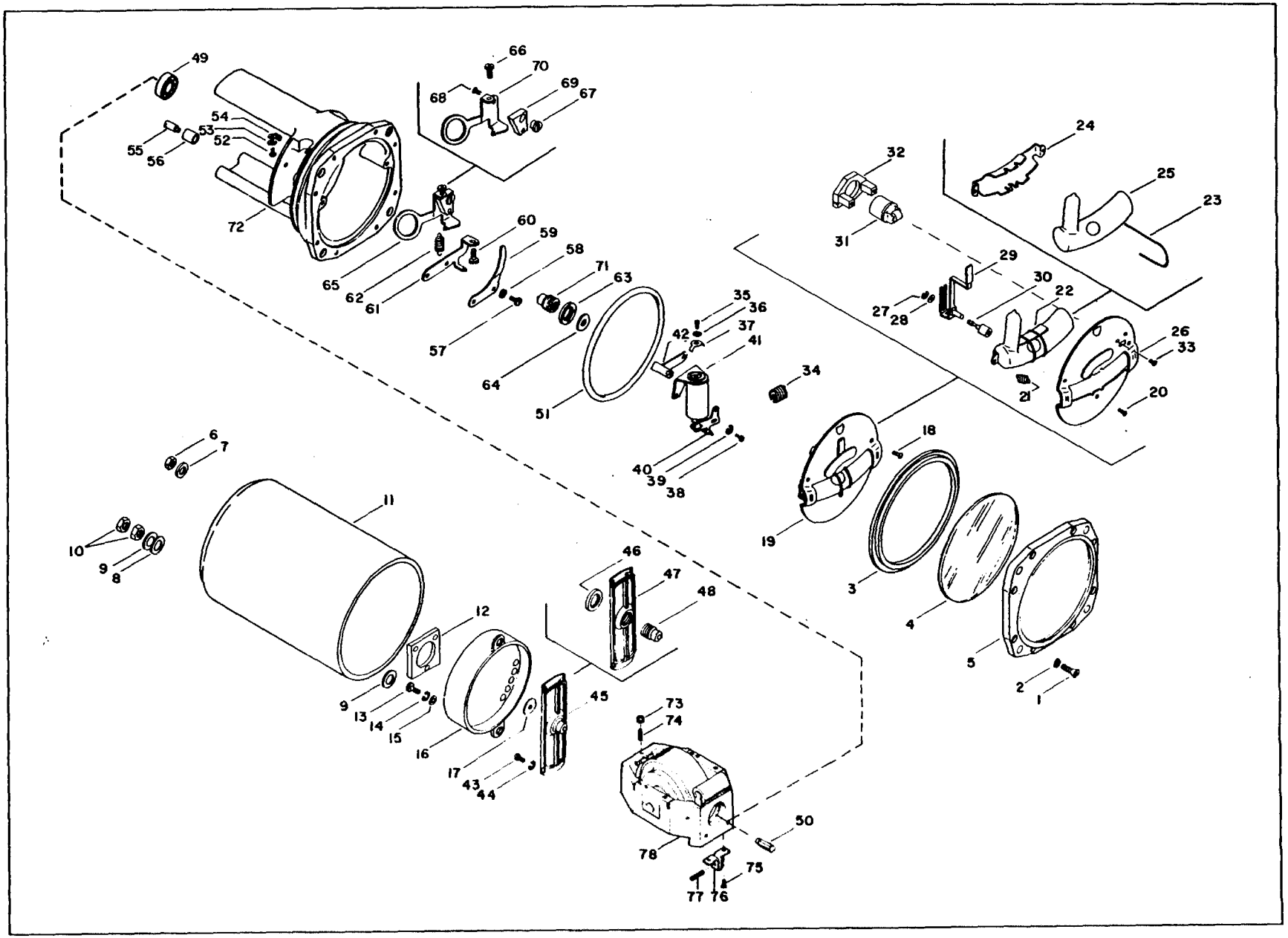


FIGURE 2. MODEL RCA 30 TURN AND BANK INDICATOR

FIG. & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	QTY PER ASSY
2-23	TSWC64702	. . . . WIRE, Dial Assy (W2 Matte White)	2
	A1234-2	. . . . WIRE, Dial Assy (P61 Green)	2
	A1234-3	. . . . WIRE, Dial Assy (P64 Orange)	2
	A1234-4	. . . . WIRE, Dial Assy (R65 Yellow)	2
	A1234-5	. . . . WIRE, Dial Assy (R22 Green)	2
	A1234-6	. . . . WIRE, Dial Assy (WW Off White)	2
	C64702	. . . . WIRE, Dial Assy (F65 Yellow)	2
-24	C64102	. . . . RETAINER, Inclinometer	2
-25	C64901-01	. . . . INCLINOMETER (Black Ball, Background Color - F65 Yellow)	1
	C64901-02	. . . . INCLINOMETER (Black Ball, Background Color - P61 Green)	1
	C64901-03	. . . . INCLINOMETER (Black Ball, Background Color - P64 Orange)	1
	C64901-04	. . . . INCLINOMETER (Black Ball, Background Color - R65 Yellow)	1
	C64901-05	. . . . INCLINOMETER (Black Ball, Background Color - R22 Green)	1
	C64901-06	. . . . INCLINOMETER (Black Ball, Background Color - W2 White)	1
	C64901-07	. . . . INCLINOMETER (Black Ball, Background Color - WW White)	1
	C64901-08	. . . . INCLINOMETER (White Ball, Background Color - Dull Black)	1
	C64901-09	. . . . INCLINOMETER (White Ball, Background Lusterless Black)	1
-26	*A1139-1	. . . . DIAL, Turn and Bank (F65 Yellow)	1
	*A1139-2	. . . . DIAL, Turn and Bank (P61 Green)	1
	*A1139-3	. . . . DIAL, Turn and Bank (P64 Orange)	1
	*A1139-4	. . . . DIAL, Turn and Bank (R65 Yellow)	1
	*A1139-5	. . . . DIAL, Turn and Bank (R22 Green)	1
	*A1139-6	. . . . DIAL, Turn and Bank (W2 Matte White)	1
	*A1139-7	. . . . DIAL, Turn and Bank (WW Off White)	1
	*A1225-1	. . . . DIAL, Turn and Bank (F65 Yellow)	1
	*A1225-2	. . . . DIAL, Turn and Bank (P61 Green)	1
	*A1225-3	. . . . DIAL, Turn and Bank (P64 Orange)	1
	*A1225-4	. . . . DIAL, Turn and Bank (R65 Yellow)	1
	*A1225-5	. . . . DIAL, Turn and Bank (R22 Green)	1
	*A1225-6	. . . . DIAL, Turn and Bank (W2 Matte White)	1
	*A1226-7	. . . . DIAL, Turn and Bank (WW Off White)	1
	*A5023-01	. . . . DIAL, Instrument (F65 Yellow)	1
	*A5023-02	. . . . DIAL, Instrument (P61 Green)	1
	*A5023-03	. . . . DIAL, Instrument (P64 Orange)	1
	*A5023-04	. . . . DIAL, Instrument (R65 Yellow)	1
	*A5023-05	. . . . DIAL, Instrument (R22 Green)	1
	*A5023-06	. . . . DIAL, Instrument (W2 Matte White)	1
	*A5023-07	. . . . DIAL, Instrument (WW Off White)	1
	*A4389-01	. . . . DIAL, Turn and Bank (2 Min.) (F65 Yellow)	1
	*A4389-02	. . . . DIAL, Turn and Bank (2 Min.) (P61 Green)	1
	*A4389-03	. . . . DIAL, Turn and Bank (2 Min.) (P64 Orange)	1
	*A4389-04	. . . . DIAL, Turn and Bank (2 Min.) (R65 Yellow)	1
	*A4389-05	. . . . DIAL, Turn and Bank (2 Min.) (R22 Green)	1
	*A4389-06	. . . . DIAL, Turn and Bank (2 Min.) (W2 Matte White)	1
	*A4389-07	. . . . DIAL, Turn and Bank (2 Min.) (WW Off White)	1
	*A1315-01	. . . . DIAL (Special) (F65 Yellow)	1
	*A1315-02	. . . . DIAL (Special) (P61 Green)	1
	*A1315-03	. . . . DIAL (Special) (P64 Orange)	1
	*A1315-04	. . . . DIAL (Special) (R65 Yellow)	1
	*A1315-05	. . . . DIAL (Special) (R22 Green)	1
	*A1315-06	. . . . DIAL (Special) (W2 Matte White)	1
	*A1315-07	. . . . DIAL (Special) (WW Off White)	1

* Procurable only as parts of Item 2-19

FIG. & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	QTY PER ASSY
2-26	*A1247-01	. . . . DIAL, Turn and Bank (2 Min.) (F65 Yellow)	1
	*A1247-02	. . . . DIAL, Turn and Bank (2 Min.) (P61 Green)	1
	*A1247-03	. . . . DIAL, Turn and Bank (2 Min.) (P64 Orange).....	1
	*A1247-04	. . . . DIAL, Turn and Bank (2 Min.) (R65 Yellow)	1
	*A1247-05	. . . . DIAL, Turn and Bank (2 Min.) (R22 Green)	1
	*A1247-06	. . . . DIAL, Turn and Bank (2 Min.) (W2 Matte White)	1
	*A1247-07	. . . . DIAL, Turn and Bank (2 Min.) (WW Off White)	1
	*A1228-01	. . . . DIAL, Turn and Bank (2 Min.) (F65 Yellow)	1
	*A1228-02	. . . . DIAL, Turn and Bank (2 Min.) (P61 Green)	1
	*A1228-03	. . . . DIAL, Turn and Bank (2 Min.) (P64 Orange).....	1
	*A1228-04	. . . . DIAL, Turn and Bank (2 Min.) (R65 Yellow)	1
	*A1228-05	. . . . DIAL, Turn and Bank (2 Min.) (R22 Green)	1
	*A1228-06	. . . . DIAL, Turn and Bank (2 Min.) (W2 Matte White)	1
	*A1228-07	. . . . DIAL, Turn and Bank (2 Min.) (WW Off White).....	1
	*C64301X-01 thru -06	. . . POINTER AND PIVOT ASSY	1
	*TSWC64301X	. . . POINTER AND PIVOT ASSY	1
-27	C64903	. . . . RING, Retaining.....	1
-28	C64104-1	. . . . SPACER, 0.004 Thk	AR
	C64104-2	. . . . SPACER, 0.006 Thk	AR
	C64104-3	. . . . SPACER, 0.008 Thk	AR
-29	C64103X	. . . . POINTER ASSY (F65 Yellow)	1
	A1290-2	. . . . POINTER ASSY (P61 Green)	1
	A1290-3	. . . . POINTER ASSY (P64 Orange)	1
	A1290-4	. . . . POINTER ASSY (R65 Yellow)	1
	A1290-5	. . . . POINTER ASSY (R22 Green)	1
	A1290-7	. . . . POINTER ASSY (W2 White)	1
	TSWC64103X	. . . . POINTER ASSY (WW White)	1
-30	C64301	. . . . POINTER, Pivot	1
-31	A4360	. . . . INDICATOR ASSY, Power Failure	1
-32	A4359	. . . . BRACKET MOUNTING ASSY	1
-33	A174-11	. . . . SCREW, No. 2-56 x 1/4 in., Slotted Flt Hd Brass ...	2
-34	A3771-02	. . . . SPRING, Rate (5/16 needle deflection for 360°/min. turn)	1
	A3771-03	. . . . SPRING, Rate (5/16 needle deflection for 180°/min. turn)	1
-35	C63506	. . . . SCREW, Damper Adjustment	1
-36	AN936A2	. . WASHER, No. 2 Lock	1
-37	C63109	. . SPRING, Adjustment	1
-38	AN500B4-3	. . SCREW, No. 4-40 x 3/16 in., Slotted Fil Hd	4
-39	AN9354L	. . WASHER, No. 4 Spring Lock	4
	A3775	. . DAMPING ASSY, Instrument	1
-40	**A3776	. . . ARM ASSY, Piston and Damper	1
-41	**C63404X	. . . CYLINDER ASSY, Damper	1
-42	C63110	. . GROUND, Core Front	1
-43	AN500B4-5	. . SCREW, No. 4-40 x 5/16 in., Slotted Fil Hd	4
-44	AN9354L	. . WASHER, No. 4 Spring Lock	4
-45	C63904X-02	. . PLATE ASSY, Rear	1
-46	C63508	. . . LOCKNUT, Pivot	1
-47	C63904	. . . PLATE, Rear	1
-48	A4105-01	. . . TRUNNION ASSY	2
-49	A1817	. . BEARING, Gimbal	2
-50	M3544-02	. . STUD	2
-51	AN6230-10	. . GASKET	1
	M5025-01	. . FRAME ASSY	1
	***M5025-02	. . FRAME ASSY	1
-52	AN515B2-2	. . . SCREW, No. 2-56 x 1/8 in.	1
-53	AN9352L	. . . WASHER, No. 2 Spring Lock	1
-54	C63112	. . . CLAMP, Wire	1

* Procurable only as parts of Item 2-19
** Procurable only as part of P/N A3775
*** For Power Failure Flag only

FIG. & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	QTY PER ASSY
2-55	C63507	. . . STOP, Gimbal	2
-56	C63903-02	. . . BUMPER, Gimbal Stop	2
-57	AN500B2-3	. . . SCREW, No. 2-56 x 3/16 in.	2
-58	AN9352L	. . . WASHER, No. 2 Spring Lock	2
-59	C63102	. . . CLAMP, Pointer Zeroing Arm	1
	C63101X	. . . ANCHORAGE ASSY	1
-60	C63501	. . . . SCREW, Adjusting	1
-61	C63101	. . . . ANCHORAGE, Zeroing Screw	1
-62	C63801	. . . SPRING, Restraining	1
-63	C63504	. . . NUT, Pivot Lock	1
-64	C63909	. . . WASHER, Insulating	1
-65	C63103	. . . ARM ASSY, Pointer Zeroing	1
-66	C63501	. . . . SCREW, Adjusting	1
-67	C63401	. . . . PIVOT, Sensitivity Adjustment Arm	1
-68	AN505B2-5	. . . . SCREW, No. 2-56 x 5/16 in., Slotted Ft Hd	1
-69	C63104	. . . . ARM, Sensitivity Adj.	1
-70	C63103	. . . . ARM, Pointer Zeroing	1
-71	A4105-02	. . . TRUNNION ASSY	1
-72	M5018-01	. . . FRAME	1
-73	A1931-01	. . . NUT, Trimming	AR
	A1931-02	. . . NUT, Trimming	AR
	A1931-03	. . . NUT, Trimming	AR
	A1931-04	. . . NUT, Trimming	AR
-74	A3475	. . . STUD, Trimmer	1
-75	AN500B2-2	. . . SCREW, No. 2-56 x 1/8 in.	2
-76	A1862	. . . BRACKET	1
-77	*A1941-01	. . . SCREW, Trimmer	1
	*A1941-02	. . . SCREW, Trimmer	1
	*A1941-03	. . . SCREW, Trimmer	1
	*A1941-04	. . . SCREW, Trimmer	1
-78	M3556-06	. . MOTOR AND GIMBAL ASSY	1
	M3556-03	. . MOTOR AND GIMBAL ASSY (See figure 3)	1

* Select as required

FIG. & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	QTY PER ASSY
3-	M3556-06	MOTOR AND GIMBAL ASSY (28V Inst)	Ref
	M3556-03	MOTOR AND GIMBAL ASSY (14V Inst)	Ref
-1	C63112	. CLAMP, Wire	2
-2	AN500B2-2	. SCREW	2
-3	A237-03	. CAPACITOR (28 V Inst)	1
	A237-02	. CAPACITOR (14 V Inst)	1
-4	B2892-01	. BRACKET ASSY, Capacitor (28 V Inst)	1
	B2892-02	. BRACKET ASSY, Capacitor (14 V Inst)	1
-5	AN505UB2-4	. SCREW	2
-6	A2284	. BLOCK, Clamping	1
-7	AN500B2-4	. SCREW	2
-8	AN500B2-7	. SCREW	1
-9	A2281	. BLOCK, Clamping	1
-10	AN500B2-4	. SCREW	2
-11	AN500B2-7	. SCREW	1
	T4038-03	. MOTOR ASSY, AC (28V Inst)	1
	T4038-02	. MOTOR ASSY, AC (14V Inst)	1
-12	NAS51-18	. . RING, Retaining	1
-13	A1910	. . WASHER, Retaining	1
-14	A2256	. . BEARING	1
-15	T4022-01	. . ROTOR, Gyro	1

FIG. & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	QTY PER ASSY
3-16	A139-16	. . SETSCREW, Socket, Headless, No. 0-80 x 1/4 in. long	1
-17	A1912	. . SCREW, End Play Adjustment	1
-18	A1911	. . SLEEVE, Motor Shaft	1
-19	A2256	. . BEARING, Ball	1
-20	T4022-01	. . ROTOR, Gyro	1
-21	B2848-04	. . STATOR ASSY (28V Inst)	1
	B2848-03	. . STATOR ASSY (14V Inst)	1
-22	A4087	. . RING, Hysteresis	1
-23	A2871	. SPRING ASSY, Brush	2
-24	A174-04	. SCREW, No. 1-72NF x 3/16 in. lg, Ft Hd	4
-25	M3502	. GIMBAL	1

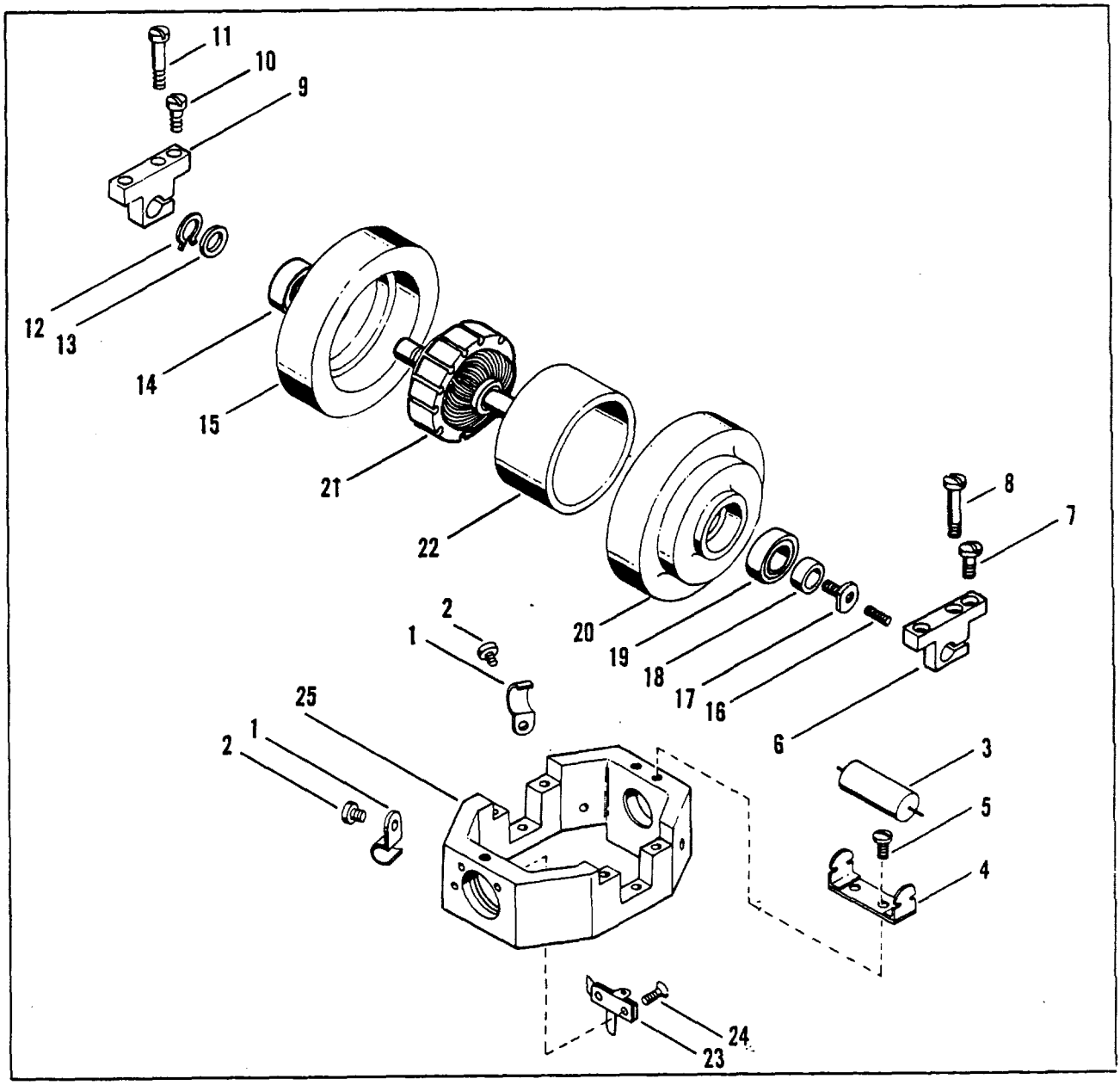


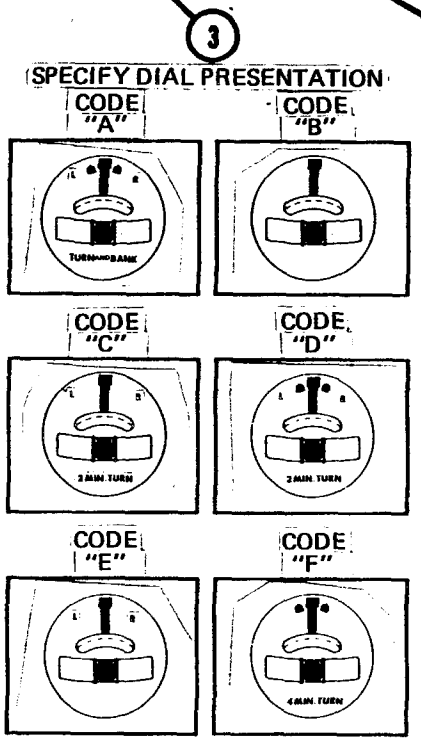
FIGURE 3. GYRO MOTOR ASSEMBLY

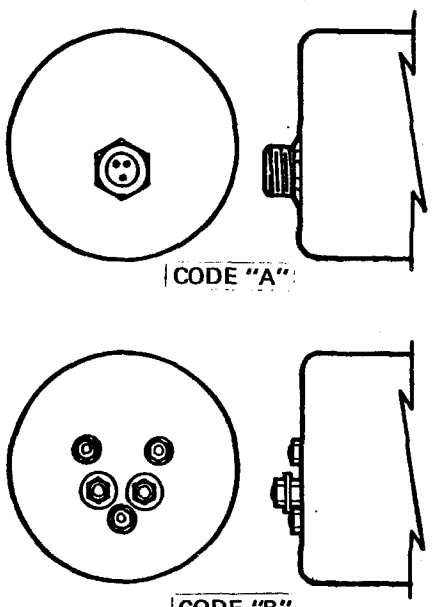
CODING SYSTEM

RCA-30(28 F65 F2 A P)

1. SPECIFY VOLTS. D.C. (either 12 or 28)
2. Specify Dial Color
3. SPECIFY DIAL PRESENTATION
4. SPECIFY CONNECTION
5. Power Failure Indicator Code "P" - Optional
6. Optional

CODE	COLOR	MATERIAL DESCRIPTION
F65	Yellow	Fluorescent Luminescent Dial (Spec. AN-L-1A, Color No. 65)
P61	Green	Phosphorescent Luminescent Dial (Spec. 14102A, Color No. 61)
P64	Orange	Phosphorescent Luminescent Dial (Spec. 14102A, Color No. 64)
R65	Yellow	Radioactive Luminescent Dial (Spec. MIL-L-6770, Color No. 65)
R22M	Green	Radioactive Luminescent Dial (Spec. TT-R-58, Color No. 22M)
W2	Matte White	White markings on black dial (Spec. TT-L-58, Type 2)
WW	Off White	White markings on black dial (Spec. Wornow white, No. 2-100)





Rate of Turn (degrees per minute)	Pointer Tip Deflection (in.)	
	1	2
36	1/32 ± 1/64	1/16 ± 1/64
90	5/64 1/64	5/32 1/64
180	5/32 1/64	5/16 1/64
360	5/16 1/64	5/8 1/16
1080	11/16 1/16	1.0 1/8

Figure 4, Model RCA 30 (Coding System)

TECHNICAL MANUAL

EA-1400 SERIES VERTICAL SPEED INDICATOR



EDO-AIRE WICHITA KANSAS

MARCH 1972

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1400 SERIES

EA-1400 SERIES

VERTICAL SPEED INDICATOR

DESCRIPTION

The EA-1400 series vertical speed indicators covered by these instructions are manufactured by Edo-Aire Wichita Division, Wichita, Kansas. All instruments in the series conform to the requirements of FAA TSO-C8b.

The indicators are direct-acting sensitive differential pressure instruments that measure the rate of change in atmospheric pressure. A metal diaphragm in a sealed capsule is deflected by changing pressure through a calibrated orifice. Diaphragm deflection moves the pointer through a system of levers driving a conventional sector gear, pinion, and hairspring movement. One of the levers is of thermostatic bimetal, to compensate for temperature changes.

The instrument has only four moving parts and nine points of moving contact. The sector gear shaft and pinion shaft run in jewel bearings.

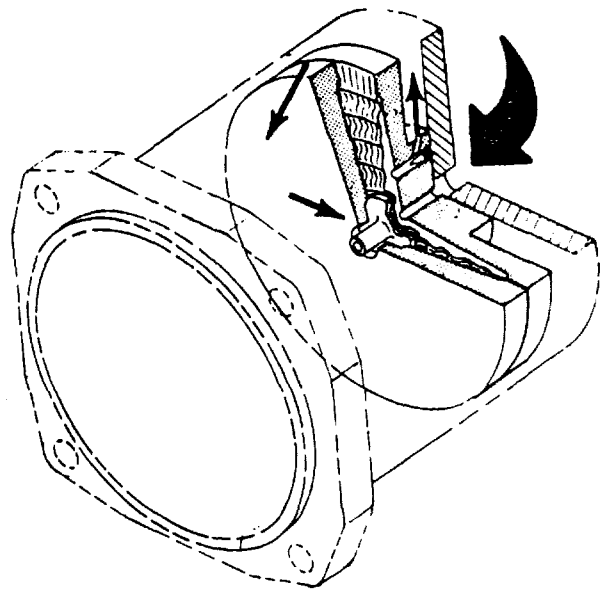
INSTALLATION DATA

Mounting	Bezel, 4 holes for No. 6 screws on 3.50 inch diameter circle; No. 6-32 spring nuts optional.
Case dimensions	Bezel, 3.25 inches square; panel aperture, 3.12 inches minimum diameter; total depth, 1.90 inches.
Weight	0.5 pound
Static pressure connection	Port, 1/8 inch NPT.

HOW IT WORKS

The sketch at right illustrates the function of the diaphragm capsule in sensing vertical speed.

Changes in atmospheric pressure cause air flow through the back of the capsule and the calibrated bleed orifice to the inside of the case until pressure on each side of the diaphragm is equalized. On the ground or in level flight, these changes are slow and cause no deflection of the diaphragm. Climbing or descending, however, produces rates of change in barometric pressure that are greater than the orifice will accommodate. These rapid changes cause pressure differentials on either side of the diaphragm that are proportional to the difference between the rate of barometric pressure change and the rate of equalization through the bleed orifice. The unequal pressures deflect the diaphragm and drive the pointer.



SERVICE INSTRUCTIONS

Unless there is obvious damage to the case or pointer, usually only cleaning and recalibration will be required to restore full serviceability. Disassemble the instrument no farther than necessary to clean and inspect it.

NOTE

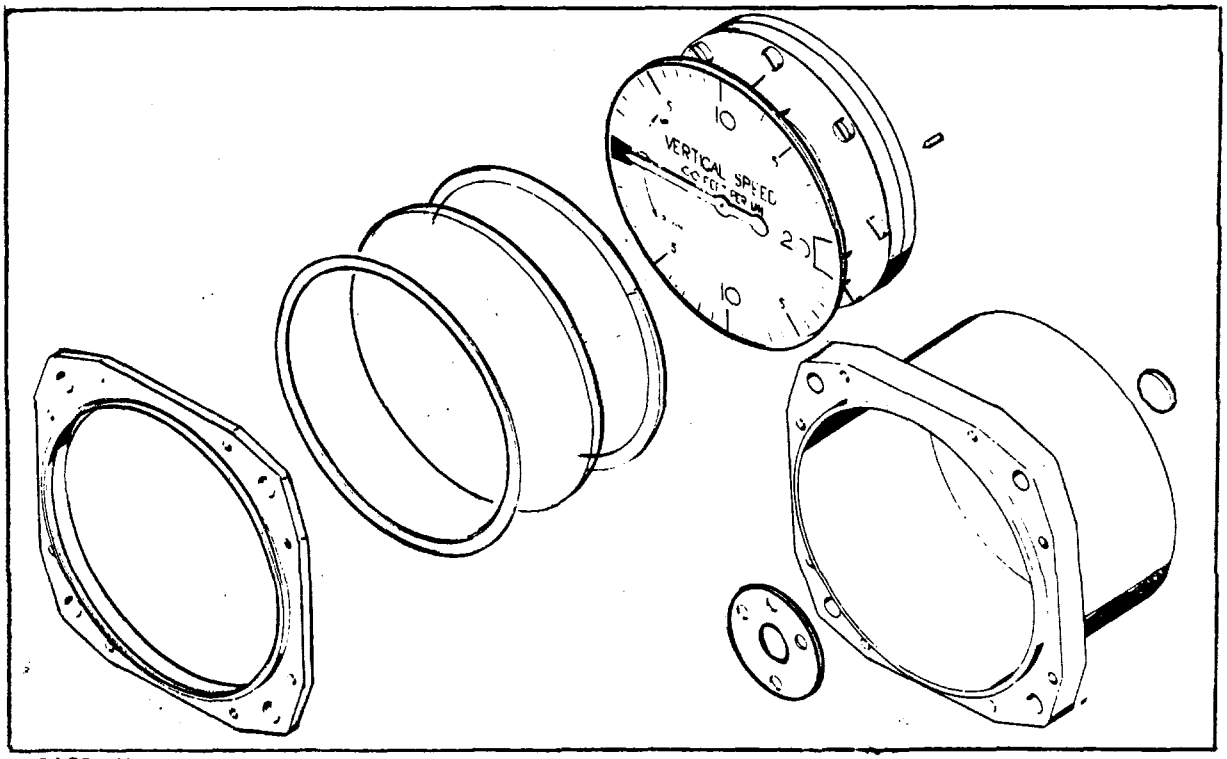
Rocking shafts must be kept with their diaphragm capsules, since the diaphragm lever is selected for proper temperature compensation.

The case should be opened only in an air-conditioned, controlled-access area with temperature not exceeding 80 F and humidity not over 50 percent at 80 F. Personnel should wear lintfree caps and smocks and the disassembled instruments should be protected from contamination by polyethylene bags.

DISASSEMBLY

To remove the case, unscrew the eight screws holding the case to the bezel. Remove the bezel, gaskets, and glass. Then unscrew the three screws, which secure the frame to the case. A slight twist of the assembly in the case may be required to break loose the mechanism from the gasket and case.

The disassembly sequence is essentially as shown in the exploded view illustration. Unless it is necessary to reset a bearing or replace parts, do not separate the rocking shaft and adjusting plate assembly from the post and plate assembly or loosen the hex-head screws that



CASE AND MECHANISM ; SHOWN INITIALLY DISASSEMBLED

fasten the plates together. The position of the adjusting plate on the lower plate is set so that the angle which the rocking shaft makes to a line running through the sector pivot and the handstaff is 15 degrees.

DO NOT DISASSEMBLE THE DIAPHRAGM CAPSULE:

Alignment of the diaphragm is critical and even a slight shift in its position will destroy the linearity of its response.

The purple Glyptol used to secure the attaching screws in the movement assembly and the zero adjust screw in the diaphragm capsule may be released by heating the screws with a miniature soldering iron.

Discard the gaskets, filter, and needle valve.

CLEANING

Clean the case, dial glass, dial, and pointer with a soft cloth moistened in soap and water; soap is preferable to synthetic detergents, some of which will attack polycarbonate plastics. Do not use solvents, particularly chlorinated hydrocarbons, that may attack the plastic case and the lacquer finish on the dial and pointer.

Ultrasonic cleaning using standard cleaning solvents is preferred for the movement. The rocking shaft always should be removed before cleaning the movement and should require cleaning only if the instrument has been grossly contaminated. The movement also may be cleaned in an instrument cleaning machine using alkaline cleaning solutions such as L & R No Fome and L & R Rinsing Solution.

Do not attempt to clean the diaphragm capsule with solvents. If the orifices become clogged, they may be cleaned with suction.

INSPECTION

Visually inspect the case, diaphragm capsule, and movement for damage, particularly damage to the case and backplate that would permit air leaks. Check the hairspring for kinks and sagging; the coils must not touch the plate when the movement is held with the pointer shaft horizontal.

Inspect the pinion gear and sector gear for damaged teeth. There must be no perceptible runout in the pinion shaft or sector gear shaft. Check the mating surfaces of the sector gear actuating lever and the rocking shaft lever for corrosion.

REPAIR

Replacement of defective parts or assemblies is the only authorized repair.

SPECIAL TOOLS AND TEST EQUIPMENT

No special tools are required to service the vertical speed indicators. Test equipment listed in the following table is recommended for calibration and functional test.

NUMBER	NOMENCLATURE
A338A	Manometer, Meriam Instrument Co., Cleveland, Ohio
16-11-2	Altitude Chamber, Ideal-Aerosmith, Cheyenne, Wyoming
--	Certified sensitive altimeter
89C001-001	Calibrating Screwdriver Edo-Aire

DIAPHRAGM CAPSULE REPLACEMENT

To properly compensate for variations in high and low temperature behavior of the diaphragm, three different diaphragm levers are used, one of stainless steel and two of thermostatic bimetal. The correct lever to use with a replacement capsule must be determined after the instrument is assembled, by placing the uncased instrument in an oven at 160 F for one hour and observing the pointer shift. For the test, install the 2100839 stainless steel lever. If the shift is 100 fpm or less, use the 4000 (2101337) bimetal lever. If the shift is 100 to 200 fpm use the 6100 (2101103) bimetal lever. Make sure the bimetal levers are installed so the identification marks etched on the surface will face the zero-adjust screw in the diaphragm hub.

REASSEMBLY

Reassembly is generally in the reverse order of disassembly, except final installation of the case, which is delayed until after calibration. As the instrument is reassembled and adjusted, place a drop of Purple Glyptol or equivalent on each screw.

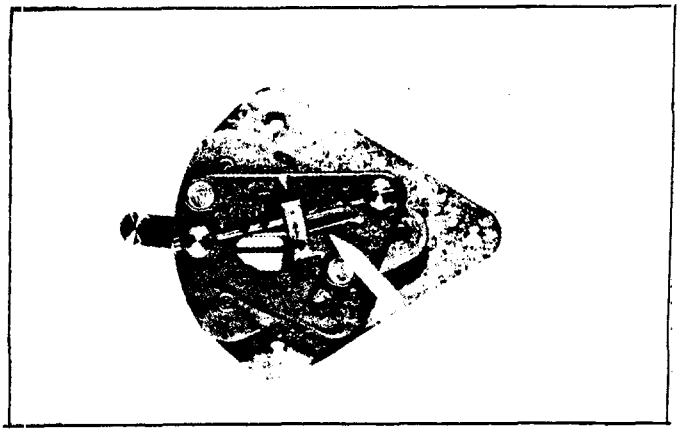
After calibration, seal calibrating hole with RTV 732 or equivalent.

ORIENTATION

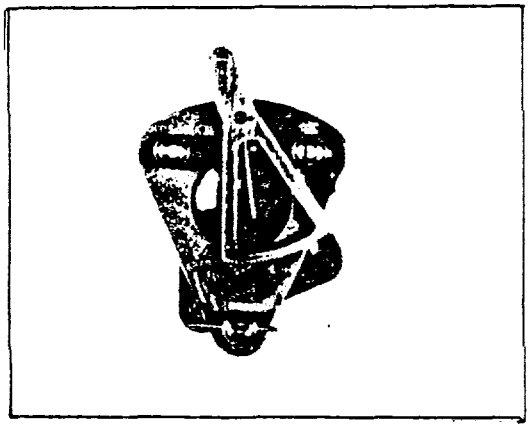
On reassembly, align the backplate, diaphragm capsule, movement, and dial as follows: use the casting number, EA13677, on the diaphragm capsule as a reference. Align the backplate with the capsule so that both the casting number and the backplate placards read alike. Install the movement with the sector gear counterweight over the casting number. Install the dial so the up scale is over the sector gear counterweight.

ROCKING SHAFT INSTALLATION

Before reassembling the movement, make sure the diaphragm lever and rocking shaft lever are perpendicular to each other and that the etched characters on the diaphragm lever face away from the rocking shaft lever. If the diaphragm lever requires adjustment, loosen the clamp screw only enough to permit rotation of the clamp. Take care to avoid transverse movement of the clamp on the rocking shaft, which may alter the temperature compensation and amplification rate. Secure the clamp screw with Purple Glyptol. Set the pivot post adjusting screw that was backed off to remove the rocking shaft so that the shaft moves freely under its own weight and end play does not exceed 0.00025 inch.



BIMETAL DIAPHRAGM LEVER - CHARACTERS ETCHED ON ITS SURFACE IDENTIFY THE SIDE OF THE BI-METAL LEVER THAT MUST COANTACT THE DIAPHRAGM ADJUSTING SCREW FOR CORRECT TEMPERATURE COM-PENSATION.



SECTOR GEAR ENGAGEMENT - THE SECTOR GEAR IS SET AGAINST THE RIGHT-HAND SUPPORT POST AND ENGAGED WITH THE HAIRSPRING FULLY RELAXED.

PINION AND SECTOR GEAR INSTALLATION

Install the pinion gear and spring assembly with the free end of the spring to the left. Before engaging the gears, secure the loose end of the hairspring to the support post. Engage the sector gear and pinion from the left, with the rocking shaft lever in the right hand space between the gear web and the center pin, and the sector gear against the right hand post. If necessary, press the sector gear and pinion shaft bearings in or out to bring end play to 0.001 inch or less with no binding.

TEMPERATURE COMPENSATION ADJUSTMENT

If the adjusting plate and rocking shaft assembly was separated from the plate and post assembly or new assemblies were installed, adjust the temperature compensation as follows:

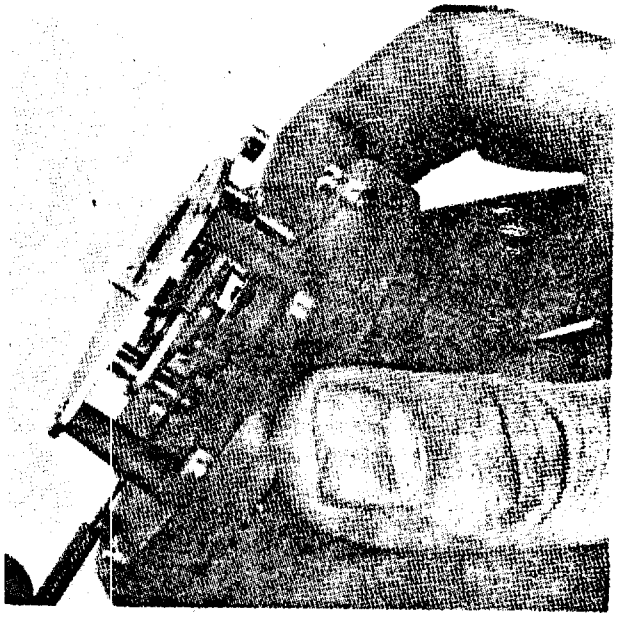
1. Loosen the two hex-head screws on the adjusting plate sufficiently to permit relative motion between the two plates.

2. Insert the shank of a No. 52 drill (0.0635-in. diameter) between the two rocking shaft support posts and the diaphragm adjusting screw.

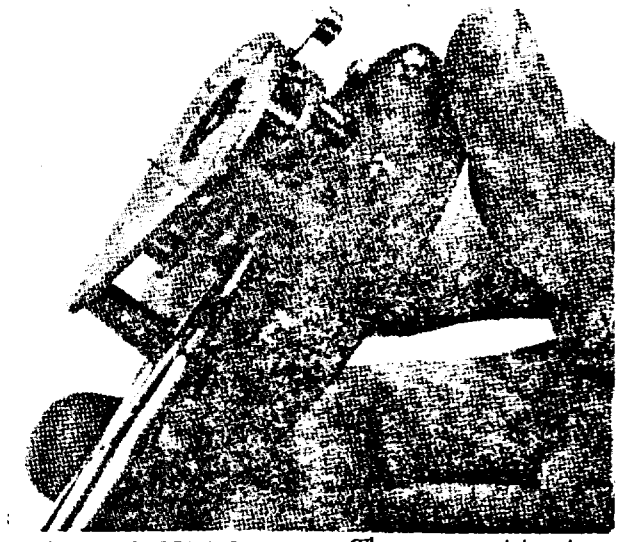
3. Move the adjusting plate until the drill is a snug fit, then tighten the hex-head screws.

ZERO ADJUSTMENT

Adjust the zero setting by turning the diaphragm adjusting screw until the sector gear is centered (14 teeth on each side of the pinion). Secure the adjusting screw with Purple Glyptol.



CHECKING TEMPERATURE COMPENSATION *A No. 52 drill shank should be a snug fit between the diaphragm adjusting screw and the rocking shaft support posts.*



ADJUSTING ZERO POSITION *The zero position is set by turning the diaphragm adjusting screw to center the sector gear with respect to the pinion.*

TEST PROCEDURES

Four tests are required for acceptance of the instrument: a position test, performed without the case installed; calibration and natural lag tests, performed with the case and backplate installed; and a leak test, performed after the assembly is complete and the case sealed. The natural lag test may be performed during calibration if desired.

POSITION TEST

When the instrument is held in various positions other than normal; i.e., inverted, dial face up, dial face down, etc., the pointer must not shift more than 50 fpm. Probable causes for failure are pointer unbalance, particularly if it was refinished, and excessive end play in the rocking shaft or pinion. The pointer may be rebalanced by removing or adding paint to the underside.

CALIBRATION

Calibration of the vertical speed indicator requires a special backplate with a screwdriver in a sealed gland to adjust the needle valve, a case, and a certified sensitive altimeter in an altitude chamber.

To calibrate the indicator, assemble and install calibrating screwdriver. All connections must be airtight. Connect the backplate port to the altitude chamber and a suitable source of vacuum and air pressure. Connections should be made with polyethylene tubing such as Imperial-Eastman Poly-Flow.

NOTE

To prevent leaks past the O-rings in the calibrating screwdriver, keep them lubricated with high-vacuum silicone grease.

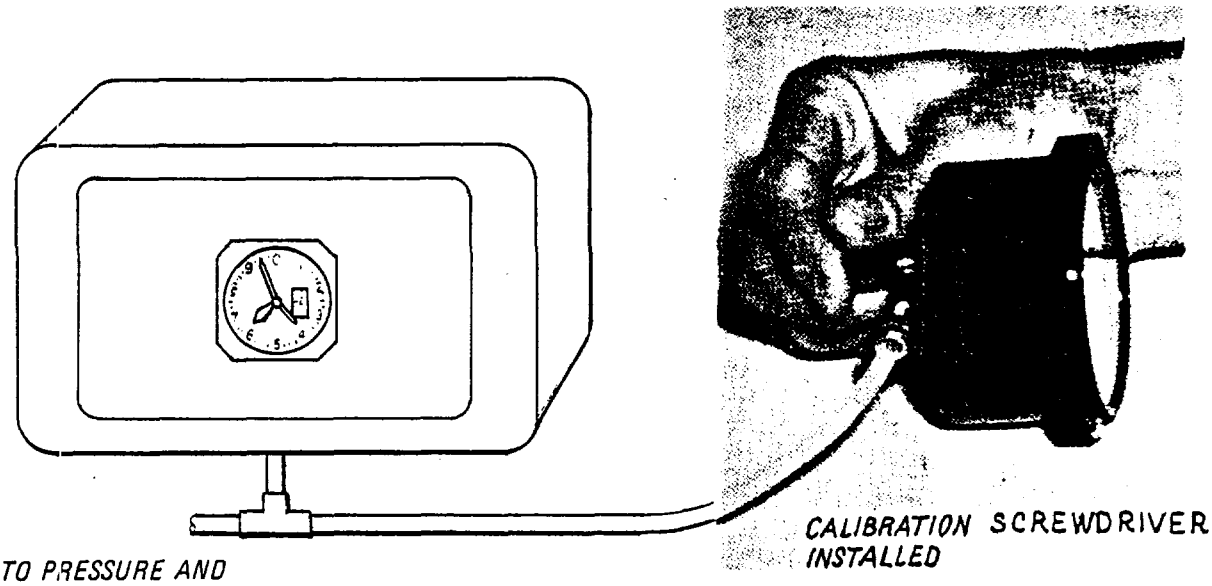
All indicators of the series are calibrated by adjusting the needle valve on the back of the capsule to obtain the vertical speed rates shown in the table on page 6. Set each rate by the instrument under test, start the stopwatch as each starting altitude is crossed, and stop it as each ending altitude is crossed. The elapsed times in the table correspond to the rate tolerances specified in FAA TSO-C8b.

If desired, the altimeter may be read after one minute at each rate and altitude and the tolerance in feet per minute given in the table may be used.

To increase the indicated rate of change, for a low indication, close the valve; to decrease the indicated rate, open the valve. During calibration check that the pointer moves smoothly and responds without undue delay. Jerky pointer motion indicates binding in the movement, usually due to dirt, or a defective hairspring.

After the final assembly and leak test, the calibration should be rechecked at several rates and altitudes, to make sure that the needle valve setting was not disturbed.

CALIBRATION SETUP



VERTICAL SPEED CALIBRATION

Rate FPM	Increase Altitude Start	Increase Altitude End	Decrease Altitude Start	Decrease Altitude End	Time, Sec Each	Tol. FPM
2000 FPM Range						
500	2000	3000	3000	2000	112.2/129.0	35
1000	2000	4000	4000	2000	111.6/129.6	75
1500	2000	4000	4000	2000	67.1/83.2	150
1500	15000	17000	17000	15000	70.6/92.3	200
1500	28000	30000	30000	28000	70.6/92.3	200
3000 RPM Range						
500	2000	3000	3000	2000	112.2/129.0	35
1000	2000	4000	4000	2000	111.6/129.6	75
1500	2000	3500	3500	2000	54.5/66.0	150
2000	2000	4000	4000	2000	52.5/67.5	250
1500	15000	16500	16500	15000	52.0/68.0	200
2000	15000	17000	17000	15000	52.5/67.5	250
1500	28000	29500	29500	28000	52.0/68.0	200
2000	28000	30000	30000	28000	52.5/67.5	250
4000 FPM Range						
500	2000	2500	2500	2000	45.0/75.0	100
1000	2000	3000	3000	2000	48.0/72.0	200
2000	2000	4000	4000	2000	52.1/70.6	300
3000	2000	5000	5000	2000	54.0/66.0	300
2000	15000	17000	17000	15000	52.1/70.6	300
2000	28000	30000	30000	28000	52.1/70.6	300
6000 FPM Range						
500	2000	2500	2500	2000	45.0/75.0	100
1000	2000	3000	3000	2000	48.0/72.0	200
2000	2000	4000	4000	2000	52.1/70.6	300
3000	2000	5000	5000	2000	54.0/66.0	300
4000	2000	6000	6000	2000	54.0/66.0	400
5000	2000	7000	7000	2000	54.0/66.0	500
2000	15000	17000	17000	15000	52.1/70.6	300
4000	15000	17000	17000	15000	27.0/33.0	400
2000	28000	30000	30000	28000	52.1/70.6	300
4000	28000	32000	32000	28000	54.0/66.0	400

NATURAL LAG TEST

With the indicator connected to an altitude chamber, or to a properly calibrated manometer, set up a climb or descent of 1800 fpm for 2000 fpm and 3000 fpm instruments or 2000 fpm for 4000 fpm and 6000 fpm instruments. Suddenly reduce the rate to 0 and simultaneously start the stop watch. The indicator should pass through 200 fpm in 3 to 15 seconds. Repeat in the opposite direction. Lag greater than 15 seconds probably is due to over-tight pivot bearings; sector gear, pinion, or rocking shaft pivot misalignment; or reduced amplification.

To increase amplification and decrease lag, adjust the diaphragm lever toward the sector gear by backing off the rocking shaft pivot nearest the *sector gear and tightening the opposite pivot.*

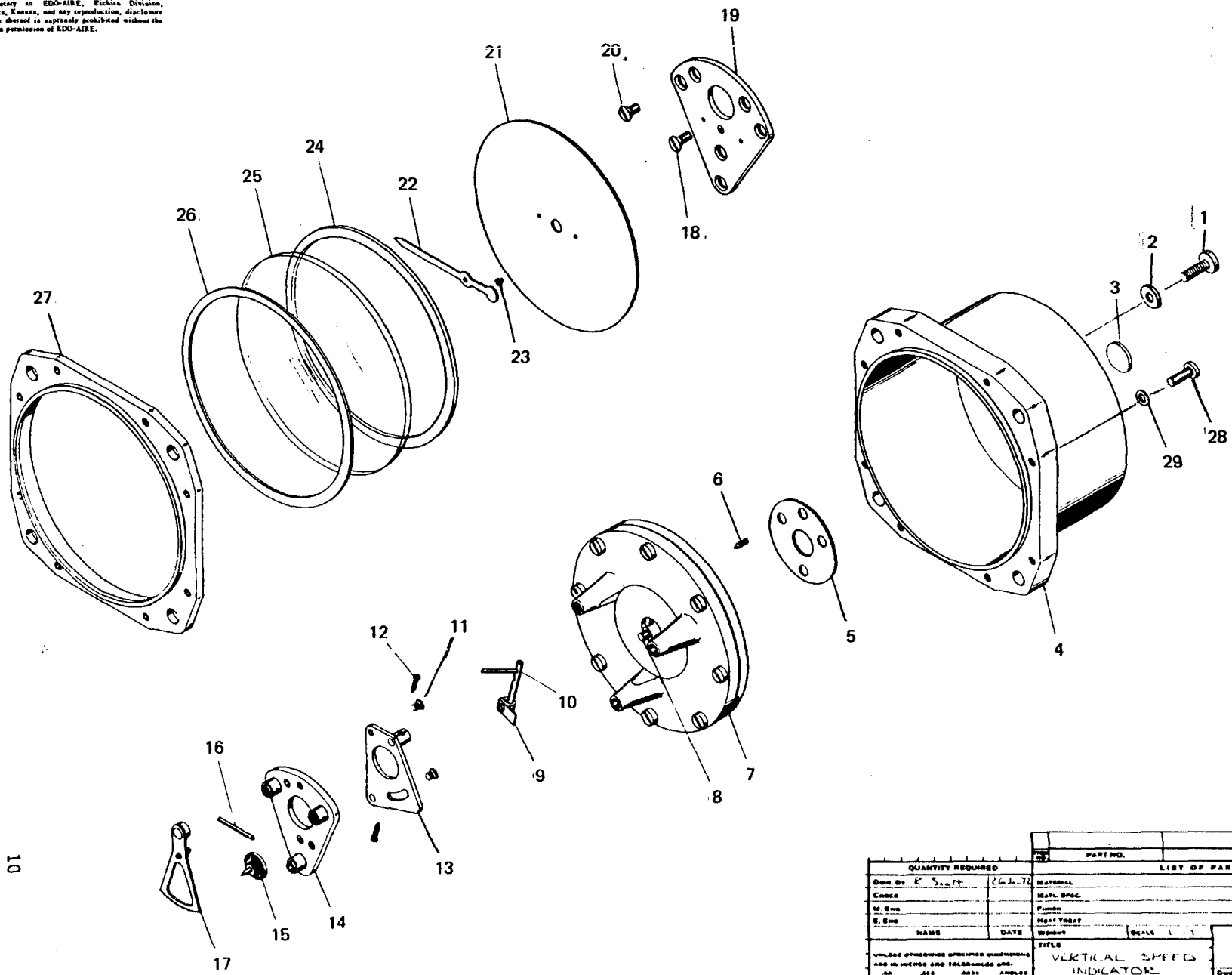
LEAK TEST

The leak test is performed with the instrument completely assembled and the case drive screws installed and sealed, by applying first vacuum and then pressure through the static port and observing pressure changes on a manometer. *Both pressure and vacuum must be applied slowly,* to avoid exceeding full-scale deflection of the indicator.

Apply 15 in. Hg vacuum and hold for 1 minute, then apply 10 in. Hg pressure and hold for one minute. Pressure change indicated by the manometer must not exceed 0.05 in. Hg for either test. If necessary to locate a leak, the instrument may be submerged briefly in mineral spirits or water.

REV	PCN NO.	CHANGE	DATE	CHK.	REV.	PCN NO.	CHANGE	DATE	CHK.	REV.	PCN NO.	CHANGE	DATE	CHK.	REV.	PCN NO.	CHANGE	DATE	CHK.	REV.	PCN NO.	CHANGE	DATE	CHK.
																				A		RELEASE		

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QUANTITY REQUIRED	PART NO.	TITLE
DSN. BY R. Sloan 2-2-72		LIST OF PARTS
CHKD.	MATERIAL	
M. ENG.	MATL. SPEC.	
S. ENG.	FINISH	
NAME DATE	HEAT TREAT	
	WEIGHT SCALE	

UNLESS OTHERWISE SPECIFIED DIMENSIONS AND TOLERANCES ARE: .XX ±.010 .XXX ±.005 .XXXX ±.0002 ANGLES ±0° 30'

TITLE: VERTICAL SPEED INDICATOR EXPLODED VIEW

EDO-AIRE, WICHITA DIVISION, WICHITA KANSAS

DWG. NO. SHEET OF REV. A

PART NO	NEXT ASSY.	MODEL	SYSTEM
DO NOT SCALE DWG.			

NOTES: UNLESS OTHERWISE SPECIFIED

10

INDEX NO.	PART NO.	DESCRIPTION	UNITS PER ASSY.
4	2100944	CASE Assembly	1
25	2700118	. GLASS	1
26	2101014	. Gasket	1
24	2101015	. Gasket	1
27	2101013	. BEZEL	1
		ATTACHING PARTS	
28	3101465	. SCREW, Fillister hd, 4-40x5/16, brass, black oxide	8
29	3101474	. LOCKWASHER, No. 4, split, light series, phosphor bronze, black oxide	8
3	EA13787	. FILTER, Static port (used on 2100096 and 2100926.	1
5	2700313	. GASKET, Capsule-to-case (used on 2100096 and 2100926.	1
	2100597	. MOVEMENT Assembly	1
		ATTACHING PARTS	
20	3101292	. SCREW, Flat head, 80°, slotted, stainless steel 2-56 x 3/16	3
22	2100163	. . POINTER Assembly.	1
21	Note 2	. . DIAL.	1
		ATTACHING PARTS	
23	3100808	. . SCREW, Thin head, brass, flat black	2
	3100809	. . . SCREW, Flat head (pointer stop screw).	1
19	2100471	. . PLATE Assembly, mounting	1
		ATTACHING PARTS	
18	3100833	. . SCREW , Flat head, 82°, steel, cad plated, 2-56 x 1/8	3
14	2100598	. . ASSEMBLY, Plate and post	1
17	2100543	. . GEAR Assembly, sector	1
15	2100599	. . ASSEMBLY, Pinion gear and spring	
		ATTACHING PARTS	
16	2100439	. . PIN, Taper, brass	1
13	2100600	. . ASSEMBLY, Adjusting plate and rocking shaft.	1
		ATTACHING PARTS	
11	3100920	. . SCREW, Hex head, brass, 4-40 x 1/8.	2
12	2100153	. . . . SCREW, Adjusting	2
10	2100601	. . . SHAFT Assembly, rocking	1
	2100776	. . . . CLAMP	1
9	2100839	. . . . LEVER, Diaphragm, stainless steel	AR
	2100151	. . . . LEVER, Diaphragm, bimetal, high range	AR
	2101103	. . . . LEVER, Diaphragm, bimetal, low range	AR
		ATTACHING PARTS	
	3100856	. . . . SCREW, Fillister head, brass 0-80 x 3/16	1
7	21001158	. CAPSULE Assembly, diaphragm	1
		ATTACHING PARTS	

INDEX NO.	PART NO.	1	2	3	4	5	DESCRIPTION	UNITS PER ASSY.
	3100933	.					SCREW, Fillister head, steel, cad plated 4-40 x 7/16	3
2	2700395	.					LOCKWASHER, Split, steel, plated No. 4 (special diameter)	3
6	2100164	.	.				VALVE, Needle	1
8	2100162	.	.				SCREW, Adjusting	1

NOTE: 1
When ordering a replacement nameplate, specify the complete Edo-Aire model number i.e., EA1403-1-EAI, etc., and the airframe manufacturer's part number, if any, as well as the instrument serial number.

NOTE: 2
When ordering a replacement dial, specify the color combination, range, and airframe manufacturer's logotype desired.

GARWIN INC.
1326 SOUTH WALNUT
Phone: HObart 4-4621
WICHITA 13, KANSAS
CABLE: GARWIN

G991 VERTICAL SPEED INDICATOR
Part Number 22-202-01A

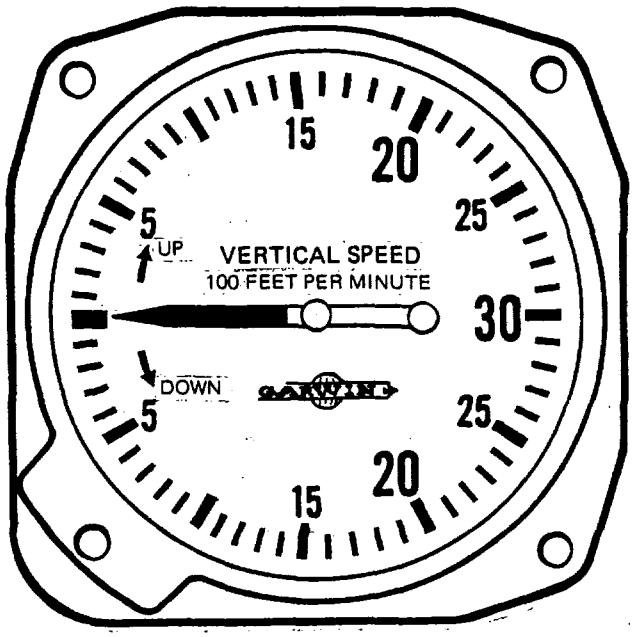


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DESCRIPTION

The Garwin G991 series vertical speed indicator is a temperature compensated instrument. It has a range of from 0 to 3,000 feet per minute, with a zero adjustment screw at the bottom of the case to zero the pointer for diaphragm seasoning. Mounting nuts will not be supplied with the instrument unless the dash number includes an "N". (Example, G991-01N.) The dial color is indicated by the second dash group in the part number as follows:

G-991-01-1A	Dull black with white context
G-991-01-1B	Dull black with yellow fluorescent context (ANLIA)
G-991-01-1C	Dull black with pale green phosphorescent context (14102A)

The weight of the G991 is 17 ounces and the operational and functional test specifications are in accord with CAA-TS0C8a.

Section I

Disassembly, Inspection, Cleaning, Repair and Reassembly.

1. General
   The following special tools and fixtures are required in connection with the work described in this section:
   (1) Vibrating Stand
   (2) Jewelers Stake Set
   (3) Inclined Manometer Test Stand
   (4) Test Dial
   (5) Connection Nipple
   (6) Rocking Shaft Adjustment Tool

2. Disassembly
   A. Removal of Mechanism from the Case
      1. Remove the fitting from the rear of the case.
      2. With a sharp tool, remove the lead seal covering one of the flange mounting screws at the back of the flange.
      3. Remove the eight flange mounting screws, being careful to prevent the flange and glass from dropping off.
      4. Lift the flange, paper gasket, glass and sealing gasket from the case.
      5. Remove the spring and two washers from the adjustment stem.
      6. Remove the hand with a suitable hand remover.
      7. Pry up the retaining ring with a small screw driver and remove it.

8. Remove the two dial screws and lift out the dial.
9. Remove the spring bar.
10. To remove the snap ring, insert a pointed object in the hole of the snap ring and pull away from the case and up.
11. Loosen the three screws at the rear of the case. Set rear of the case on a bench and apply pressure with hand. This will break seal on the diaphragm connector and case and allow mechanism to drop free of the case.

CAUTION

Be extremely careful not to break the pointer staff when removing the mechanism.

12. Remove the loosened screws and with the hand held over the case opening, turn the case upside down. The mechanism will drop out into the hand.

B. Disassembly of the Mechanism Body Assembly
1. Remove the capillary and screw assembly and washer.
2. Remove two screws attaching the diaphragm plate.
3. Remove the shims, if present.
4. Remove the diaphragm assembly from the body. Use extreme care not to injure the diaphragm.
5. Remove the taper pin from the rocking shaft.
6. Back out the pivot screw from the body and lift the shaft assembly out of the mechanism body. Be very careful not to bend either the long or short rocking shaft levers.
7. Remove the taper pin from the sector spring assembly.
8. Remove the three screws from the plate and body.
9. Lift the plate from the body.
10. Lift the sector assembly from the body.
11. Lift the pinion handstaff from the body.
12. Further disassembly of the mechanism body assembly should not be necessary unless the stationary pivot is to be repaired.
13. To remove and replace the stationary pivot, proceed as follows:
    (a) Place the mechanism body casting over a bar with a hole in its end, held in a vise. Drive the pivot out with a pin punch.
    (b) Replace the new pivot to the same depth as the one removed.
14. Instrument is now disassembled for close inspection of pivots, jewels, springs, bushing and diaphragm. Replace necessary parts.

C. Removal of Adjusting Mechanism from Case.

1. It should not be necessary to remove the adjusting mechanism from the case unless a part is broken or unless there is a leak at this point which will affect the operation of the instrument. The case is tested for leaks in accordance with the test specifications in the rear of this manual.
2. A seal washer on the adjustment acts as a seal. If a case leak is indicated here, the washer must be replaced with a new one which has been soaked in castor oil. (AN-JJJ-0316.)
   (a) Push the snap ring from the recess in the adjustment stem pinion. Push out the pin which is found under the snap ring. This will permit removal of the adjustment stem.
   (b) Replace the seal and re-install the adjustment stem and pinion in the case in reverse procedure of disassembly.

3. Inspection, Cleaning, and Repair

A. General - Examine all pinions, sector teeth and pivots for wear and corrosion; jewel setting assemblies for loose or broken jewels; bearing holes and bushings for ovalization (out-of-round); and all other parts for wear or corrosion.

1. Replace all worn and broken or badly corroded parts with new parts. Replace worn bushings. Replace broken or crushed jewels.

B. Cleaning

1. All mechanism parts may be cleaned by washing them in KLEEN-ZIT and rinsing in RINZIT, using any good commercial cleaning machine. Dry with clean, dry, warm air. The diaphragms should not be immersed in the cleaning fluid as some moisture may be retained on the inside. After drying, a light blast of air from a compressed air source may be used to blow off loose dust that may have fallen on the parts. Hairsprings should not be subjected to air from an air hose. All parts, after cleaning, should be placed in a dust-proof container until ready for reassembly.
2. Pinion and sector teeth should be brushed carefully with a No. 3 watchmaker brush, rubbed occasionally across a piece of chalk. The parts being brushed should not come in contact with the hands so should be held in a piece of watchmaker paper which will prevent contact of the parts being brushed with the bare skin and also keep the brush clean. This paper will soil very rapidly so a clean piece should be used with each part.

(a) While brushing, the pinion is best held in a pair of tweezers which has holes drilled in the pointed ends to receive the pivots.

(b) The sector must be handled carefully to avoid bending it. Brushing should always be done in one direction, the same direction which the tool took when cutting the teeth, so any burrs which may have been left by the cutting operation will not be forced into the spaces between the teeth.

3. Pivots are best cleaned by pressing them first into the end grain of a piece of pithwood and twirling the wood between the fingers, then pressing them into a piece of pithwood and twirling them again. If the pivots are corroded, they should be cleaned with a very fine abrasive such as Levigated Alumina mixed with water placed on the end of a pegwood stick and held against the pivot as it turns in a jeweler's lathe. This process should be followed by a thorough washing in clean Naptha and cleaning with pithwood.
4. Jeweled bearings, bushings and bearing holes are best cleaned by twirling the sharpened end of a piece of pegwood in each hole. The stick should be kept clean by sharpening and the twirling process continued until discoloration of the stick is no longer apparent.
5. The capillary assembly cleaning may be accomplished by immersing the entire unit in Naptha and drying with a blast of air. Inspect the assembly to see that the passages through it are unrestricted by holding it up to the light and looking through it with a magnifier.

4. Reassembly

A. Mechanism Plate and Bridge Assembly

1. Replace the sector assembly in the lower jewel.

(a) Secure the hairspring to its post with the tapered pin, adjusting it to have a tension equal to 1 1/2 to 1 3/4 turns. The hairspring should lie in a single plane and the convolutions should not touch.

(b) Adjust the end play of the sector assembly so it is just detectable. Test the mesh of the pinion and handstaff pinion to see if they run freely. See that the sector tracks correctly; that it is not bent or twisted. The teeth end of the sector should ride approximately midway in the handstaff pinion.

2. Replace the handstaff.
   (a) When the plate is screwed on tight, the handstaff must have .001 to .002 end play.

B. Mechanism Body Assembly
1. Replace the rocking shaft assembly. Adjust the pivot so the end play is just detectable. The shaft should move freely when the instrument is moved from side to side.
2. Secure the hairspring to its post with the tapered pin. This should place from 3/4 to 7/8 of a turn tension on the hairspring. The hairspring should lie in a single plane and the convolutions should not touch.

C. Diaphragm Assembly
1. Insert the diaphragm assembly into the body.
2. Insert shims as required under the diaphragm plate and secure them with the two screws.
3. To check the pointer swing, a test pointer should be installed and a check made to see that the pointer swing up and down is equal. This adjustment is made by turning the hexagonal adjusting screw on the diaphragm plate. Turning this screw in or out will equalize the pointer swing.

D. Static Balancing of the Mechanism.
1. Set the pointer on zero with the mechanism in the normal vertical position. Turn the mechanism 180 degrees and check the pointer position. The error shall not exceed fifty feet. To correct an "up" error, move the balance weight on the long rocking shaft lever toward the rocking shaft. To correct a "down" error, move the weight away from the rocking shaft.

5. Calibration
A. Ranging and Zero Adjustment Setting
1. Place a test dial and pointer on the mechanism.
2. Place the hand on zero and check its travel by turning the zero adjustment wheel. The pointer should move through equal angles in both directions. If it does not, remove it and replace it in approximately the center of travel. Continue this procedure until the hand shows an equal deflection on either side of zero. Make certain the hand is perfectly balanced by checking it on a balancing fixture. The pointer deflection should exceed 400 feet minimum on both sides of zero.

3. A check should be made using an inclined manometer to see if the "up" readings are in agreement with the "down" readings.

NOTE

If the reading at 1,000 feet up is equal to the 1,000 feet down reading, all other check points will be satisfactory.

(a) After this check is made, all other calibration will be accomplished after the instrument is assembled, from the outside of the case.

4. Calibration of the assembled instrument is accomplished by installation of the capillary screw assembly, cut to the proper length. Shortening the capillary will result in lower scale reading. In case the readings are too low it will be necessary to install a new capillary screw assembly, and shortening as necessary to secure the proper calibration.
   (a) When shortening the capillary, it is necessary that the following procedure be followed:
      (1) File a small amount from the tube on the capillary.
      (2) Insert a pivot broach in the tube to clean out the hole closed by the filing process.
      (3) Clean the capillary and assemble it for a calibration check.
      (4) Repeat the process until the correct calibration is reached.

B. Case Leak Check
   1. Assemble the instrument in the case and install the dial, pointer, gaskets, glass, and bezel.
   2. Insert a solid plug in the port hole in the rear of the case.
   3. Place in a chamber and apply vacuum to 15,000 feet. The case leak must not be more than 50 feet per minute.
   4. To locate a case leak, connect the instrument to a pressure source, and apply pressure at a rate not to exceed 1,500 feet per minute. Pressurize the case to a maximum of 5 P.S.I. (10.2 in. Hq.) Immerse instrument in water and check for air bubbles.
      (a) A gasket seal compound should be used on the gasket when assembling the mechanism in the case. This assumes an airtight seal at the port.
      (b) A leak at the stem adjustment will necessitate gasket replacement.

6. Tests
   A. Use all the following tests and specifications and tolerances for the functional test.

Table I

Altitude Test Interval Feet	Rate, feet per minute	25°C Ft. /Min. Scale Error	Tolerance Seconds Min.	Max.
2000/3000	500	35	112.1	129.0
2000/3000	1000	75	55.8	64.2
2000/3500	1500	100	56.2	64.4
2000/4000	2000	140	56.1	64.5

Table II

Other Test 25°C	Tolerance Ft/Min.
Zero Setting Tests:	
Leak Test	20
Test Pressure 1.3" Hq. Pressure	100

Table III

Type Tests	Tolerance Ft/Min.
Zero Temperature Change - 10°C & 100°C	100

Lab Test	Min.	Max.
Test Pressure 0.3" Hq. or 250 feet Altitude		
Time from 1900 ft. /min. to 200 ft. /min.	-7 seconds	-10 seconds

	Tolerance Ft/Min.
Position Error	50
Vibration Error	50
Magnetic Properties	
Magnet Deflection	1°

Table IV

Rate Ft/Min.	Up & Down Pressure m m H20	Up & Down Tolerance m m H20
500	9	0.5
1000	18	0.5
1500	27	0.75
2000	36	1.0

INDEX & PARTS LIST

FIGURE AND INDEX NO.	PART NO.	NOMENCLATURE	UNITS PER ASSEMBLY
1-			
1	FFIL-314 1/2B	Screw, Flange	1
2	FFIL-318B	Screw, Flange	5
2B	FFIL-324	Screw, Flange	2
3	KR-3B-BN	Lockwasher	7
4	477KN-3B	Flange, mounting	1
5	900-3	Washer, front	1
6	900-1	Spring	1
7	900-2	Washer, rear	1
8	900-6	Gasket, paper	1
9	900-7	Glass	1
10	900-5	Gasket, sealing	1
11	900-17	Ring, retaining	1
12	G991-907	Hand assembly	1
13	GX-30	Screw, dial	2
14	990-10	Dial, piercing info	7
15	900-14	Spring, top plate mounting	1
16	900-12	Mechanism, snap ring	1
17	900-8	Screw, metering unit base	3
18	900-9	Gasket, metering unit base	1
19	G991-901	Mechanism Assembly	1
20	901-11	Capillary & screw assembly	1
21	901-5	Washer	1
22	901-1	Pin, Hairspring	2
23	586-37	Screw, mechanism plate mounting	3
24	901-7	Machine plate assembly	1
25	901-7-2	Jewel, small	1
26	901-7-1	Jewel, large	1
27	901-6	Pinion, handstaff	1
28	G991-906	Sector assembly	1
29	901-9	Jewel, setting assembly	2
30	FFIL-409-CD	Screw, diaphragm plate	2
31	901-12	Shim	*AR
32	G991-904	Diaphragm and plate assembly	1
33	901-1	Pin, taper	1
34	903-1	Pivot, screw	1
35	G991-908	Shaft assembly, rocking	1
36	FFIL-210	Screw, spring plate	1
37	901-2	Spring	1
38	901-3	Plunger	1
39	901-8	Wheel assembly	1
40	901-4	Plate, spring	1

INDEX & PARTS LIST (Cont'd)

FIGURE AND INDEX NO.	PART NO.	NOMENCLATURE	UNITS PER ASSEMBLY
1-			
41	903-2	Pivot	1
42	G991-903	Body assembly	1
43	900-1	Spring ring	1
44	900-15	Ring, spacer spring	1
45	22-993-544	Case	1
46	900-16-3	Ring snap, aero adjustment	1
47	900-16-2	Pin, zero adjustment	1
48	900-16-1	Pinion	1
49	900-16-4	Washer	1
50	900-16-6	Stem, zero adjustment	1

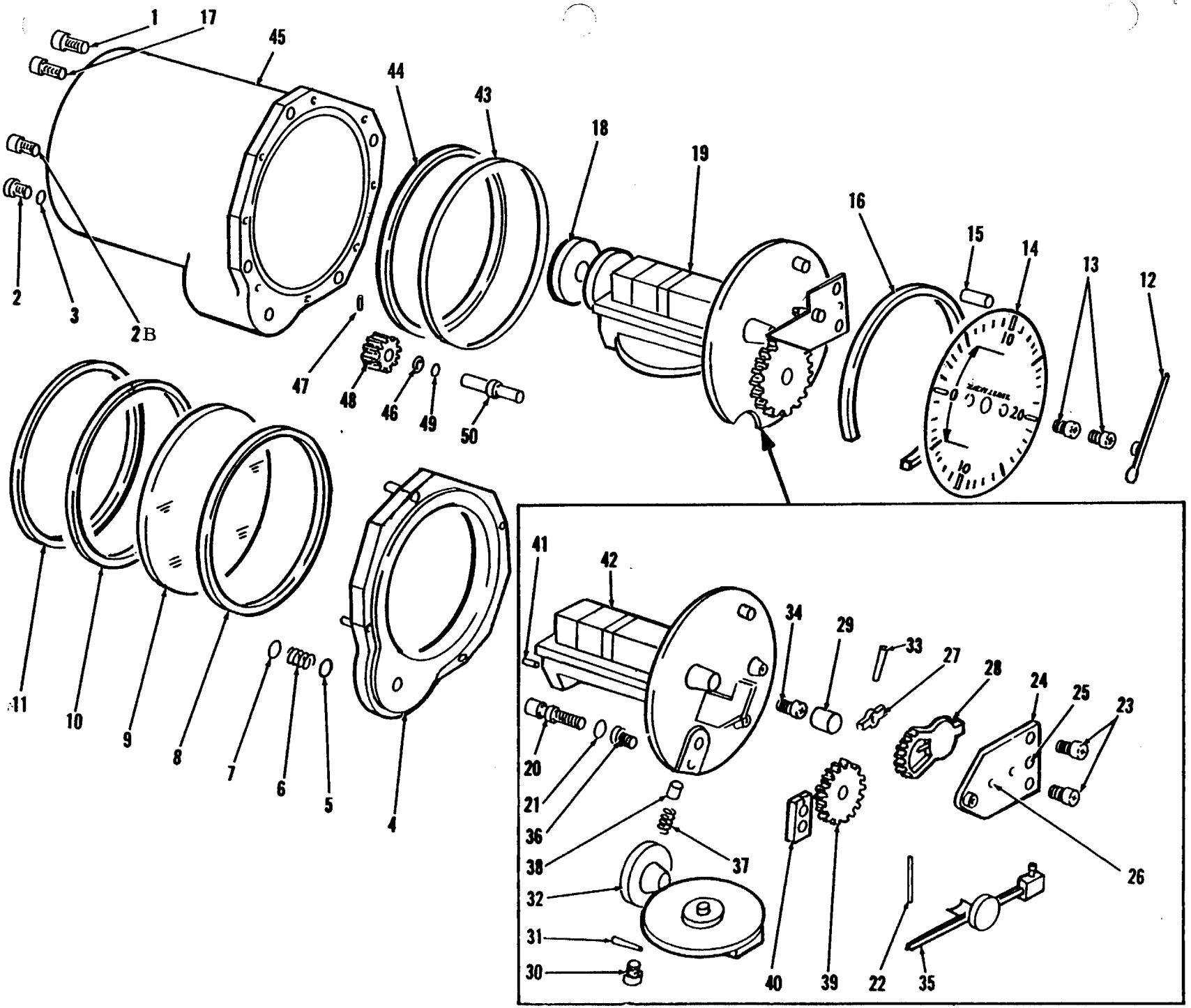
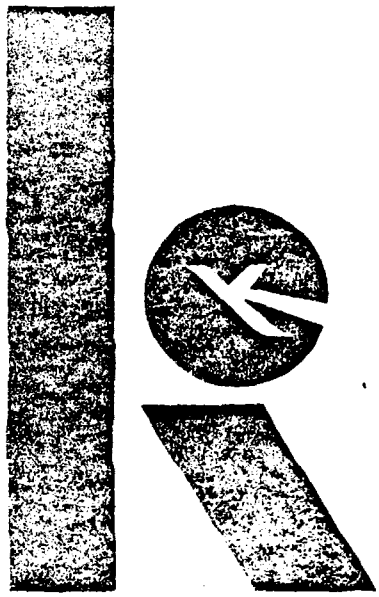

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Figure 1



HANDBOOK

OVERHAUL WITH PARTS

PRESSURE ALTIMETER

D22061 10 012
E22061 04 018
D22061 04 021

THIS PUBLICATION REPLACES S927 DATED SEPTEMBER 1963

S-927A-200-465

THIS MANUAL HAS BEEN PREPARED IN ACCORDANCE WITH SPECIFICATION ATA100 FOR INSERTION BY THE USING AIRLINES IN CHAPTER 5-6 OF THE AIRCRAFT MANUFACTURER'S OVERHAUL MANUAL

Kollsman Instrument Corporation | 80-08 45TH AVENUE, ELMHURST 73, NEW YORK

kollsman instrument corporation

OVERHAUL WITH PARTS

D22061 10 012

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OVERHAUL WITH PARTS

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OVERHAUL WITH PARTS

D22061 10 012

INTRODUCTION

A. General

This manual contains overhaul instructions and the illustrated parts list for Pressure Altimeter D22061 10 012, manufactured by Kollsman Instrument Corporation, Elmhurst 73, New York, U.S.A.

B. Additional Models

Similar models are included on difference data sheets. Overhaul procedures for these additional models are the same as those recommended in this basic manual except for the specific differences noted by the applicable difference data sheets. Difference data sheets will be issued as available, and should be attached to and filed with, this basic manual.

O. DESCRIPTION AND OPERATION

A. Purpose

The altimeter indicates height of an aircraft above a reference point, assuming normal conditions of temperature and pressure prevail.

B. Description

(1) General

The altimeter is a pressure actuated indicator enclosed in an airtight case. It contains dual, pressure sensing aneroids connected to two rocking shafts, each having its own bimetallic compensator.

(2) Leading Particulars

OPERATING ALTITUDE:	-1000 to 50,000 feet
BAROMETRIC SCALE:	28.1 to 31.0 inches Hg
TEMPERATURE RANGE:	-30°C (-22°F) +25°C (+77°F)
WEIGHT:	Approximately 23 ounces
MOUNTING:	Flange mounted

C. Operation

(1) When installed in the aircraft, static air pressure from the pitot-static system is admitted into the airtight case. The aneroid diaphragms respond to changes in pressure by expanding and contracting. Movement of both aneroid diaphragms is transferred to two similar rocking shaft assemblies whose sectors are mutually engaged with a main pinion. Movement from this point is traced to an intermediate pinion, a handstaff pinion, and to the large pointer. Movement of the intermediate pointer and pointer disk is provided by a gear train located in the top plate assembly which is actuated by a pinion on the handstaff assembly. Backlash is eliminated by a hairspring attached to an intermediate shaft assembly in the main gear train below the top plate assembly.

(2) Two pointers and a disk with pointer extension, rotate concentrically about a single, uniformly scaled dial providing an indication in foot altitude. The larger pointer indicates in hundreds of feet, making one revolution for each 1000 foot altitude change. The intermediate pointer indicates in thousands of feet and the disk with pointer extension indicates tens of thousands of feet.

(3) Since meteorological conditions cause variations from the standard atmosphere to which the altimeter has been calibrated, an adjustment is provided to correct for these variations. An external knob,

located in the lower left corner of the mounting flange, engages the barometric dial assembly and the mechanism plate which supports the entire mechanism. Adjustment is made so that the barometric dial assembly will correspond to the actual barometric condition of the area in which the aircraft is located, or will be located upon landing. In this manner, mechanism and pointers will be repositioned to indicate a corrected reading for variations in local barometric pressure.

1. DISASSEMBLY

A. General

Disassembly procedures generally follow the order of index numbers assigned to the exploded views. Disassemble only to the extent necessary for cleaning, adjustment, repair or replacement.

B. Removing Mechanism Assembly From Case (See figure 1101)

(1) Remove knob (3) and knob locknut (4). Remove screws (6 through 8) and lockwashers (9).

(2) With altimeter in dial up position, lift off mounting flange (5), locking plate (11) and items (13 through 15). Carefully remove pointer assemblies (16 and 17) and dial pointer assembly (18).

(3) Remove centering ring (19) and dial screws (21). Lift off center dial (20), spacer (22), spacer ring (23) and shutter (24). Pry out top plate mounting spring (12) and remove snap ring (33). Carefully remove top plate (48) and parts (25 through 32) and (34 through 47). Disassemble items (25 through 32) and (34 through 48) if required.

(4) Carefully slide mechanism assembly (50) from case (64). Lift off center pinion (49).

C. Disassembly of Case Assembly (See figure 1101)

Remove spring ring (52) and snap ring (53). To extract adjustment knob stem (58), remove snap ring (56) and slide out pin (54), lift out pinion (55) and sealing ring (57). Remove items (1 and 2) and (59 through 63) if required.

D. Disassembly of Mechanism (See figure 1102)

(1) Remove taper pin (20) to release tension on hairspring (35). Remove link pin locking springs (1) and link pins (2). Loosen set screws (3) to allow pivot mount assemblies (4) to be backed out, thereby releasing each rocking shaft assembly (5 through 15).

(2) Disassemble rocking shaft assemblies (5 through 15) only if replacement of parts is required. Disturbing the settings of the compensator assemblies (8) and calibration spring and arm assemblies (11) will complicate calibration procedures. If no

adjustments are required, identify each rocking shaft assembly so that it will be reassembled to its individual diaphragm assembly.

(3) Remove set screws (16) and diaphragm assemblies (17).

CAUTION: HANDLE DIAPHRAGMS CAREFULLY AS THEY ARE EASILY DISTORTED. STORE EACH DIAPHRAGM ASSEMBLY WITH ITS INDIVIDUAL ROCKING SHAFT ASSEMBLY.

(4) Remove screws (21), separate mechanism plate (30) from mechanism body (46) and remove interposing parts (31 through 39).

(5) Remove items (40 through 45) from mechanism body (46) and items (18, 19 and 22 through 29) from mechanism plate (30), if necessary.

2. CLEANING

A. General

After mechanism has been disassembled to the extent required, use the following information for cleaning of parts when applicable.

(1) Clean mechanical parts with Eng Sol Spray Type Cleaning Equipment BC-2S and Eng Sol Solution No. 16 as described in paragraph B.

(2) Remove dirt on dial and pointer assemblies using a soft artgum eraser.

(3) Clean glass with lens tissue.

B. Eng Sol Cleaning Procedure

Eng Sol Spray Type Cleaning Equipment BC-2S includes an electrically driven air pump, a pressure gage, a pressure regulator, and an atomizing gun.

(1) Preheat parts to be cleaned for a period of two to five seconds by applying air pressure at a temperature of +69°C (+154°F).

(2) Thoroughly wash surfaces with cleaning fluid. Hold cleaning gun nozzle about one-half inch from part.

(3) Dry parts using warm air under pressure of about 80 PSI from the gun.

3. INSPECTION

A. General

Inspect parts for wear or damage. If defective, determine whether the part is repairable or should be replaced. When damage or excessive wear is found, always check mating parts to determine the source and extent of damage or wear.

B. Visual Inspection

(1) Check pivots and handstaff pinion for excessive wear and protrusion.

(2) Check jewels for chips, cracks or loose settings.

(3) Check hairspring for non-concentric windings and kinks.

(4) Check gear teeth and pinions for excessive wear and damage.

(5) Inspect rotating wheel assemblies and pointers for balance.

(6) Inspect gaskets and sealing rings for tears and deterioration.

(7) Check diaphragm assemblies for perforations and distortions.

(8) Check static connection for loose or torn screen, and dirt accumulation.

(9) Check dial window for chips or scratches.

(10) Ascertain that ends of links have a high polished finish.

(11) Check painted areas, especially dials and pointers, for scratched or chipped finish.

4. REPAIR

A. General

Repair, for the most part, shall constitute replacement with new parts.

B. Painting Mounting Flange and Case

Repaint chipped or scratched surfaces as follows:

(1) Clean grease, oil, and other residue from surface to be painted.

(2) Spray on one coat of zinc chromate primer. Prepare zinc chromate primer by mixing one part by volume of zinc chromate primer with two to 2-1/2 parts of zinc chromate reducer.

(3) Bake freshly primed parts for 30 minutes at +121°C (+250°F).

(4) Remove parts from oven and allow to cool to room temperature.

(5) Spray parts with dull black baking enamel. Prepare dull black baking enamel by mixing two parts by volume of Black Enamel EM393 with one part of Reducer RU-114.

(6) Bake parts in oven for one hour at +171°C (+350°F).

(7) Remove from oven and cool to room temperature.

5. ASSEMBLY

A. General

Reassembly generally follows the reverse order of index numbers assigned to exploded views; details are given below. Fits, clearances and dimensions specified in the following paragraphs apply to those parts and assemblies which required disassembly to effect repair, replacement, or calibration.

B. Lubrication

(1) Lubricate pivots with Univis P-38 low volatility aircraft instrument lubricating oil. The following procedure is recommended:

(a) Fill a standard wooden oil cup, No. 18-504 with lubricant to a level approximately one-half the height of the tip of a No. 67K and D gold tipped oiler. (Oil cup and oiler are manufactured by Hensinger and Gray, New York, N.Y.)

(b) Dip oiler into oil cup and wipe knife edge along pivot toward the rounded edge.

(2) Apply Alcoa thread lubricant to threads of setscrews (16, figure 1102).

(3) Apply a thin film of silicone grease (DC-33) to the three high spots of spring ring (52, figure 1101).

(4) Apply a thin film of Celvacene Medium Vacuum Grease to sealing ring (57, figure 1101).

C. Mechanism Assembly (See figure 1102)

(1) Press jewels (44) and jeweled endstones (45) into mechanism body (46). Stake jeweled endstones at six places equally spaced.

(2) Insert jewel setting assemblies (42 and 43) into mechanism body (46) and secure temporarily with setscrews (41).

(3) Press fit taper pins (40) into mechanism body (46) so that taper pins protrude 0.125 ± 0.025 inch.

(4) Press fit wheel (38) onto intermediate pinion (39), and press fit wheel (31) onto main pinion (32). Wheels shall be concentric within 0.005 inch after assembly.

(5) Press fit parts (33 through 36) onto intermediate shaft (37). Direction of hairspring (35) winding shall be as shown in figure 1102.

(6) Insert intermediate shaft assembly (33 through 37) and pinion assemblies (31 and 32) and (38 and 39) into their respective settings.

(7) Press fit jeweled endstone (29), jewel (28), hairspring post (27) and jewel housing assembly (24) into mechanism plate (30). Stake bearing (26) to mechanism plate. Insert jewel setting assembly (25) into mechanism plate and secure temporarily with screw (22). Assemble setscrew (23) to mechanism plate.

(8) Carefully position mechanism plate (30) onto mechanism body (46) and secure with screws (21). Adjust endplay of pinion assemblies and intermediate shaft assembly as specified in Section 6.

(9) Position eccentric jewel setting assembly (42) as illustrated in figure 501 to allow for proper mesh between wheel (31, figure 1102) and intermediate pinion (39). Rotate gear train manually to check mesh. Adjust jewel setting assembly as necessary to obtain a mesh which is free of binding or excessive backlash. Check endplay of intermediate pinion after adjustment.

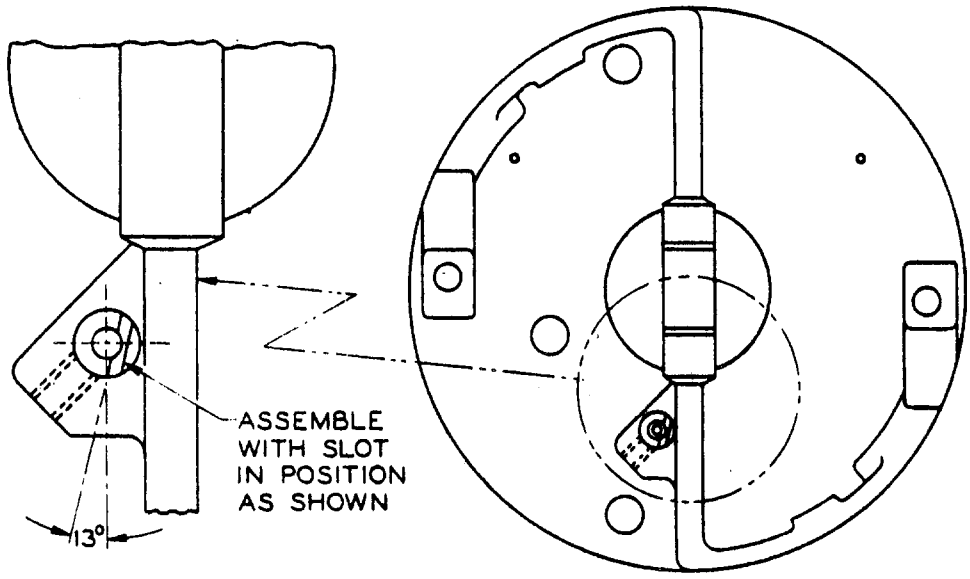


Figure 501. Eccentric Jewel Position

(10) Install handstaff pinion (19) adjusting endplay as specified in Section 6.

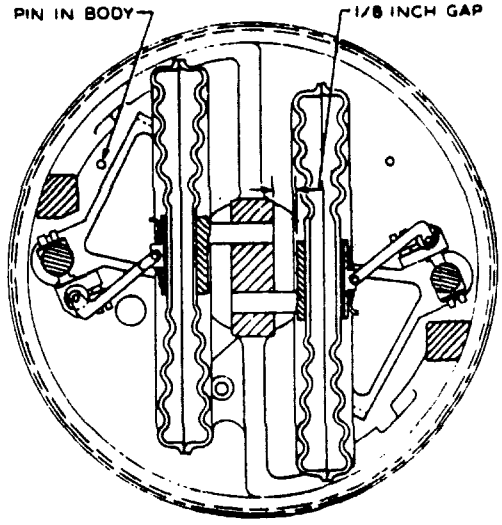
(11) Secure hairspring (35) to hairspring post (27) with the flat side of taper pin mating with the tail of the hairspring. Adjust position of taper pin until the convolutions of hairspring are in a flat plane, parallel to hairspring disk (34). If a new taper pin has been used, clip off any excess material after securing hairspring.

(12) Insert diaphragm assemblies (17) into mechanism body (46) and secure with setscrews (16). Maintain dimensions of diaphragm assemblies as shown in figure 502.

(13) Install pivot mount assemblies (4, figure 1102) and setscrews (3). Position pivot mount assemblies as shown in figure 503.

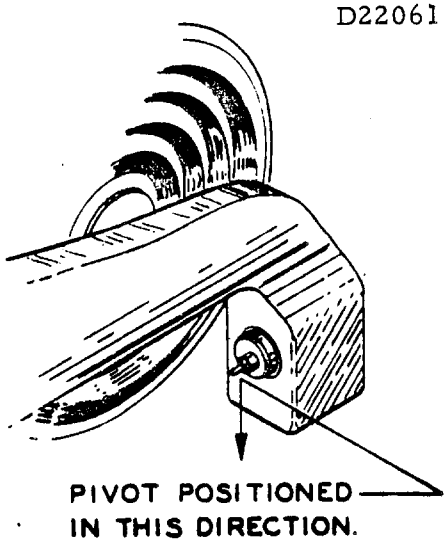
(14) Reassemble rocking shaft assemblies (5 through 15, figure 1102). Refer to figure 504 for dimensions.

(15) Install each rocking shaft assembly (5 through 15, figure 1102) and connect links (6) with link pins (2) and link pin locking springs (1). Adjust endplay of shaft and sector assemblies (15) as specified in Section 6. Set sectors for about a five tooth override on main pinion (32) using Sector Wrenches TE2600-5007 as shown in figure 505. Maintain position of rocking shaft with upper wrench, shifting sector with lower wrench.



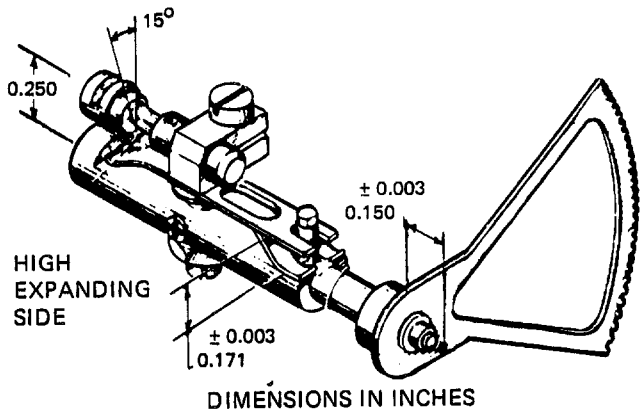
P3936

Figure 502. Diaphragm Position



P1508

Figure 503. Pivot Mount Positions

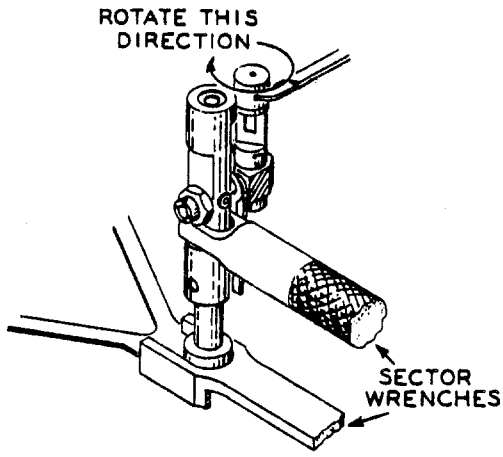


P3096

Figure 504. Rocking Shaft Assembly

(16) Wedge a round toothpick under each sector, lifting each sector out of mesh with main pinion (32, figure 1102). Rotate wheel (36) 1-1/2 to 1-5/8 turns, applying tension to hairspring (35). Holding wheel (36), remove both toothpicks, reengaging the sectors with main pinion (32).

(17) Season mechanism for three hours at -54°C (-65°F) and three hours at +100°C (+212°F) prior to calibration.



P2085

Figure 505. Fitting Sector Wrenches

D. Calibration

(1) General

(a) Unless otherwise specified, conduct calibration procedures at room temperature between +23 and+27°C (+73.4 and +80.6°F) with a relative humidity not exceeding 85 percent.

(b) Unless otherwise specified, the altimeter shall be vibrated or tapped gently prior to taking test readings.

(c) Due to the nature of the mechanism, calibration procedures have been subdivided into specific steps. A initial calibration of each diaphragm is followed by final calibration and temperature compensation. Satisfactory completion of each step determines the accuracy upon which final results depend.

(d) A standard mercurial barometer calibrated to WADC Model Atmosphere 1952 is required. A suitable pressure chamber, temperature test chamber, sources of suction and pressure, and control valves, complete the requirements.

(e) Clamp mechanism into Calibration Stand TE1357-5003.

(2) Initial Calibration

(a) The mechanism assembly has two sections, each having its own diaphragm and rocking shaft assembly. Each section must be calibrated individually. Identify the sections by marking a numeral "1" on one side of the mechanism assembly and numeral "2" on the other side.

(b) To calibrate side 1, remove link pin locking spring (1, figure 1102) and link pin (2) holding link (6) to the diaphragm of side 2. Tie link (6) of side 2 close to shaft and sector assembly (15) so that the link (6) cannot touch the diaphragm.

(c) Attach test pointer onto handstaff pinion (19) to indicate the prevailing atmospheric pressure in foot altitude.

(d) Insert mechanism assembly into pressure chamber and adjust pressure to zero foot altitude. Indication shall be zero; adjust as necessary, using knob on calibration stand.

(e) Apply test altitudes listed in table 501 and record readings.

TABLE 501

INITIAL SCALE ERROR CALIBRATION

Test Altitude (Feet)	Calibration Tolerance (Feet)
0	± 5
3000	20
6000	30
10000	60
20000	90
25000	120
30000	150
35000	155
40000	160
45000	210
50000	230

NOTE: Since only the 1000-foot indicating pointer is used when calibrating, it becomes necessary to count each pointer revolution to keep account of the actual indications.

(f) Correct errors, in excess of the specified tolerances, by shifting position of diaphragm assembly or by altering the effective length of the calibration spring and arm assembly (11). Altering the effective length of the calibration spring and arm assembly will affect the whole range of the mechanism linearly. Shorten the effective length to increase pointer movement (make indications plus); to decrease movement (make indications minus) extend the effective length. Repositioning of the diaphragm assembly is done mainly to affect the high range. Shifting the position of diaphragm assembly inward (towards center of mechanism body) will decrease movement in high range, while slightly increasing movement in the low range (3,000 and 6,000 feet). Moving diaphragm assembly outward will have the opposite affect. The amount of diaphragm assembly movement can be monitored by noting the amount of pointer movement.

NOTE: Whenever a diaphragm assembly or calibration spring and arm assembly move is made, the sector must be repositioned as specified in paragraph C. (15). Pointer indication must also be reset to indicate the prevailing atmospheric pressure.

(g) Reset zero indication at zero foot altitude. Carefully apply pressure to the mechanism to obtain an indication of minus 1,500 feet. If mechanism will not respond sufficiently, adjust sector positions and recheck calibration.

(h) After completing calibration of side 1, pin link (6) of side 2 to its diaphragm assembly (17) and disconnect and tie back link (6) of side 1. Repeat calibration procedures outlined for side 1, keeping in mind that the calibration curves of the two diaphragm assemblies should be calibrated as much alike as possible to avoid difficulties during final calibration.

(3) Upon completion of calibration of sides 1 and 2 adjust load balances as follows:

(a) With link (6) of side 1 disconnected from its diaphragm assembly (17), use sector wrenches on side 1 to align the hole in link (6) with the link pin hole in diaphragm assembly. Link pin (2) of side 1 shall fall into the holes without forcing, and there shall be no pointer movement when the link pin is removed.

(b) With both links (6) connected to their diaphragm assemblies (17), while watching the pointer, carefully push side 1 diaphragm assembly inward until pointer indication has shifted plus 150 feet.

(c) Test load balance by removing link pin of side 1 and noting amount of pointer shift, reinsert link pin, then remove link pin of side 2 noting pointer movement. Amount of pointer shift for both sides shall be approximately equal and shall be between 150 and 300 feet in clockwise direction. Assemble link pin locking springs (1) to each diaphragm assembly.

CAUTION: MOVING THE DIAPHRAGM ASSEMBLIES AT THIS STAGE OF CALIBRATION MUST BE HELD TO A MINIMUM. ASCERTAIN THAT PERPENDICULARITY OF LINK IS MAINTAINED AFTER DIAPHRAGM ASSEMBLY ADJUSTMENT.

(d) Position pointer at zero with altimeter held in normal operating position. Rotate altimeter about its longitudinal axis in 90-degree increments and note pointer indications. Indications shall not vary from the normal position reading in excess of 20 feet. Readjust load balance if requirement is not fulfilled.

(4) Final Calibration

(a) Apply test pressures specified in table 501 and note altimeter indications. With proper initial calibration, adjustments required at this time should be minor and confined to the calibration spring and arm assembly (11, figure 1102) of the side which is causing the error. Recheck position error, and readjust load balance as required.

(b) Check back movement by applying pressure to cause an indication of minus 1,500 foot altitude. If mechanism does not respond sufficiently, failure can be traced to inaccurate positioning of sectors; adjust as necessary and recheck calibration.

TABLE 502

FRICTION TEST

Test Altitude (Feet)	Tolerance (Feet)
1000	± 70
2000	70
3000	70
5000	70
10000	80
15000	90
20000	100
25000	120
30000	140
35000	160
40000	180
50000	250

(c) After tolerances are met, perform friction test using test altitudes listed in table 502. The altimeter shall be subjected to a steady decrease in pressure at a rate of 3000-feet per minute until within approximately 500 feet of each test point. At this point, rate shall be adjusted to 600 feet per minute until test altitude is reached. Hold pressure constant at each test point and note the pointer indication. Vibrate the mechanism assembly and again note pointer indication. The difference between the two indications constitutes friction and shall not exceed the tolerances specified in table 502.

(5) Temperature Compensation

(a) If original setting of compensator assemblies (8, figure 1102) was disturbed, ascertain that compensator assemblies are present to the angle shown in figure 504.

(b) Record pointer indication and ambient pressure. Insert mechanism assembly into a temperature chamber and subject unit to a temperature of +70°C (+158°F) for a period of one hour. Note pointer indication and ambient pressure. Pointer shift shall not exceed +20 feet corrected for any change in ambient pressure.

(c) Allow unit to cool to room temperature. Pointer shall return to original indication corrected for any change in ambient pressure.

(d) Correct compensation error by adjusting angular setting of compensator assemblies. Rotate compensator assemblies in direction shown in figure 505 for excessive plus reading; turn compensator assemblies in the opposite direction for excessive minus reading. Make small adjustments using Compensation Gage TE2953-5017 and recheck compensation.

(e) After compensation errors have been corrected, recheck scale error in accordance with table 501 and recheck position error.

E. Reassembly of Top Plate Mechanism Assembly (See Figure 1101)

(1) Press fit center pinion (49) onto handstaff pinion (19, figure 1102) allowing 0.003 inch clearance from mechanism plate (30).

(2) Press fit locating pins (42, figure 1101) and stake stud gears (43 and 44) to top plate (48).

(3) Assemble wheel assembly (41) to top plate (48).

(4) Assemble items (36 through 39) to plate and bushing assembly (40). Press fit spur gear assembly (34) onto handstaff (39).

(5) Assemble bearing plate assembly (36 through 40) to top plate screws (35).

F. Closing (See figure 1101)

(1) Assemble items (1 and 2) and items (54 through 63) to case 64.

(2) Assemble snap ring (53) and spring ring (52) to case (64).

(3) Slide mechanism assembly (50) into case (64).

(4) Assemble top plate (48) with attached parts, snap ring (33) and

top plate mounting spring (12) to case (64). The three high spots on spring ring (52) shall be opposite the three pads of top plate (48).

(5) Press fit gears (31, 29, and 27) onto pinions (32, 30, and 28) respectively, and assemble to top plate (48).

(6) Manually rotate gear (29) counterclockwise until gear (31) hits stop lever attached to top plate (48).

(7) Assemble setting marker gear (26) and barometric dial assembly (25) to top plate (48), aligning the 31.0 inches of Hg indication with the dial, locating pin-hole at the 3 o'clock position on top plate (48).

(8) Manually rotate gear (29) fully clockwise and check that 28.1 inches of Hg indication of barometric dial assembly (25) aligns with dial, locating-pin hole specified in step (7).

(9) Position barometric dial assembly (25) so that the range is not restricted by stop lever.

(10) Assemble shutter (24), ring spacer (23) and spacer (22).

(11) Assemble center dial (20) and secure to top plate (48) with dial screws (21).

(12) Assemble centering ring (19) to case (64). Position barometric dial assembly (25) to indicate 29.92.

(13) Assemble dial pointer assembly (18) and pointer assemblies (17 and 16) to indicate the prevailing atmospheric pressure.

NOTE: Pointer assembly (16) shall not make contact with a straight edge when it is placed on centering ring (19).

(14) Insert unit in pressure chamber and apply zero foot altitude pressure. Pointer assemblies (16 and 17) and dial pointer assembly (18) shall align with zero indication on center dial (20). Adjust until required indication is obtained.

(15) Assemble sealing gasket (15) and glass (14) to case (64).

(16) Assemble paper gasket (13), locking plate (11) to mounting flange (5) and assemble to case (64) securing with lockwashers (9) and screws (6, 7, 8 and 10). Select thickness of paper gasket (13) to prevent possible leak.

(17) Assemble knob locknut (4) and knob (3) to adjustment knob stem (58) allowing approximately 1/10 of an inch gap between knob locknut (4) and case (64).

(18) Using knob (3) adjust altitude indication to the prevailing atmospheric pressure. Loosen locking screw (10) sufficiently to pull knob (3) outward. Rotate knob (3) until barometric dial assembly (25) indicates 29.92 inches Hg. Push knob (3) back in, securing it into position by tightening locking screw (10).

(19) Rotate knob (3) to ascertain that movement is smooth throughout entire range of barometric dial assembly, and reset to 29.92 inches Hg.

G. Materials Used During Overhaul

Material	Manufacturer or Distributor
(1) Lubricants	
Calvacene Medium Vacuum Grease	Consolidated Electrodynamics Corp., Rochester, New York.
Univis P-38	Esso Standard Oil Co., Pelham 65, New York.
DC-33 Silicone Grease	Dow Corning Corp., Misland, Michigan.
Alcoa Thread Lubricant	Aluminum Co. of America, Pittsburgh, Pa.
(2) Solvents	
Zinc Chromate Primer Zinc Chromate Reducer	Hilo Varnish Corp., Everett, Mass.
Black Enamel EM 393 Reducer RU-114	Egyptian Lacquer Mfg. Co., South Kearney, N.J.

6. FITS AND CLEARANCES

Fits and clearances to be attained during repair and reassembly are listed in table 601. These requirements are applicable to only those parts which were disassembled during overhaul.

TABLE 601

FITS AND CLEARANCES

Nomenclature	Figure	Index No.	
Pins	1102	40	0.125 ± 0.025 inch protrusion
Wheels	1102	31 and 38	Concentric within 0.005 inch
Intermediate Pinion Assy	1102	38 and 39	0.002 to 0.003 inch endplay
Main Pinion Assembly	1102	31 and 32	0.002 to 0.003 inch endplay
Intermediate Shaft	1102	37	0.002 to 0.003 inch endplay
Handstaff Pinion	1102	19	0.002 to 0.003 inch endplay
Shaft and Sector Assy	1102	15	0.002 to 0.003 endplay
Knob Locknut	1101	4	1/10 inch clearance

7. TESTING

A. General

Unless otherwise specified, tests are to be conducted at room temperature between +23 and +27°C (+73.4 and +80.6°F) with relative humidity not exceeding 85 percent. The altimeter shall be tested in normal operating position and, unless otherwise specified, shall be lightly tapped or vibrated prior to taking test readings. Test pressures are in accordance with WADC Model Atmosphere 1952.

B. Zero Setting Scale

Adjust barometric dial assembly to indications specified in table 701. At each setting the altitude reading shall be as specified in table 701 within listed tolerances.

TABLE 701

ZERO SETTING SCALE

Barometric Dial Setting (Inches Hg)	Altitude Reading (Feet)	Tolerance (Feet)
28.13	-1700	± 25
28.54	-1300	± 25
28.96	- 900	± 25
29.49	- 400	± 25
29.92	0	± 25
30.36	+ 400	± 25
30.91	+ 900	± 25

C. Case Leak

Slowly apply suction sufficient to produce indication of 18,000 foot altitude to the static connection. At this point, the connecting tubing shall be completely sealed off. Change in indication observed for a period of 30 seconds shall not exceed 100 feet.

D. Scale Error Test at Room Temperature

NOTE: The altimeter shall not have been subjected to any test involving operation at other than ambient atmospheric pressures for a minimum period of 12 hours prior to the start of this test. The test altitude being set, shall at no time exceed the specific test point.

(1) Set barometric scale to 29.92 inches Hg.

(2) Subject the altimeter to the test altitudes listed in table 702 for not less than one or more than five minutes before applying vibration. Change of pressure shall be made at a rate not exceeding 3000 feet per minute. Scale errors shall not exceed the tolerances specified in table 702.

TABLE 702

FINAL SCALE ERROR TEST

Test Altitude (Feet)	Tolerance (Feet) Room Temperature	*-30°C (-22°F)
0	± 20	± 40
500	20	-
1000	20	-
1500	25	-
2000	30	-
3000	30	-
4000	35	-
6000	40	60
8000	60	-
10000	80	-
12000	90	90
14000	100	-
16000	110	-
18000	120	120
20000	130	-
22000	140	-
25000	155	155
30000	180	-
35000	205	205
40000	230	-
45000	255	-
50000	280	280

* -30°C tolerance represents the allowable change from room temperature readings.

E. Hysteresis and After Effect

Within 15 minutes after altimeter has been subjected to a pressure equal to 50,000 feet, increase pressure at a rate of approximately 3000 feet per minute. Hold pressure at the test altitudes listed in table 703 and read altimeter within time specified. Compare these readings with readings obtained during room temperature scale error test. Readings shall be within the variance specified in table 703.

TABLE 703

HYSTERESIS AND AFTER EFFECT TEST

Altitude (Feet)	Time Before Reading	Permissible Variation (Feet)
50,000	Maintain pressure not longer than 15 minutes	(No Reading)
25,000	Maintain pressure between 5 and 15 minutes	75
20,000	Maintain pressure between 5 and 15 minutes	75
0	Maintain pressure between 1 and 10 minutes	30

F. Position Error

Position pointer at zero with altimeter held in normal operating position. Rotate altimeter about its longitudinal axis in 90-degree increments and note pointer indications. These indications shall not vary from the normal position indication in excess of 20 feet.

G. Friction Test

Perform friction test as specified in Section 5, paragraph D. step (4) (c).

H. Scale Error at -30°C (-22°F)

Place altimeter in a temperature test chamber and subject it to the prescribed temperature for three hours. Repeat procedures specified in paragraph D. Test altitudes and tolerances are listed in table 702.

8. TROUBLESHOOTING

Table 801 lists troubles which may be encountered, their probable cause and suggested remedies.

TABLE 801

TROUBLESHOOTING

Indication	Cause	Remedy
Room temperature scale errors not within tolerances	Incorrect calibration, pointers not properly set	Recalibrate or reset pointers.
Scale error excessive at low temperature	Compensator assemblies not properly set	Adjust compensator assemblies.
Excessive after effect, hysteresis or failure to pass friction test	Excessive friction or defective diaphragm	Check mechanism for excessive friction. Replace diaphragm, if necessary.
Pointer oscillation	Incorrect hairspring tension	Readjust hairspring tension.
Case Leak	Defective gasket, Loose screws	Replace gasket, tighten screws.

9. STORAGE INSTRUCTIONS

A. Preparation

Clean and lubricate parts and subassemblies, as required, before storing.

B. Storing Parts

Store delicate parts in suitable individual containers, preferably plastic, so that no damage will be incurred in handling. Wrap delicate parts in tissue or lintless packing material before packing them in containers.

C. Storing Subassemblies

Store subassemblies in individual containers or boxes. Handle them carefully and wrap and pack them so as to avoid possible damage through shifting in the containers.

D. Storing Complete Units

Place plastic plug into static port and insert unit in separate container with a bag of commercially available desiccant (silica gel).

E. Marking Containers

Mark or tag containers clearly as to contents and condition of the equipment. Containers holding delicate parts should be marked "FRAGILE - DELICATE INSTRUMENT". Complete instrument containers should bear the type number and serial number of the unit and should be dated.

10. SPECIAL TOOLS AND TEST EQUIPMENT

The following tools and fixtures are required for overhaul.

Kollsman Part No.	Nomenclature	Application
TE2953-5017	Compensation Gage and Pointer	Temperature Compensation
TE1357-5003	Calibration Stand	Holding mechanism during calibration
TE2600-5007	Sector Wrenches	Adjusting rocking shaft assembly

11. ILLUSTRATED PARTS LIST

A. General

The illustrated parts list is used for requisitioning, storing, issuing, and readily identifying replaceable parts during maintenance and overhaul operations.

B. Numerical Parts List Index

The numerical parts list index enumerates all parts and assemblies contained in the group assembly parts list. Numbers are arranged in alpha-numerical sequence.

C. Group Assembly Parts List

(1) The group assembly parts list illustrates and lists all parts contained in the unit. Assemblies and their components are listed in the order of disassembly, except for attaching parts. Attaching parts follow immediately the part or assembly being detached, and precede any components of said item. These parts are captioned "Attaching Parts" and the symbol (-*-) separates them from subsequent parts or assemblies in the listing.

(2) Numbers listed are those of Kollsman parts unless otherwise identified as standard MS, AN or NAS, or by manufacturer's identification given parenthetically in the description column. The vendor's code is in accordance with Catalog H4-1, Federal Supply Code for Manufacturers, and is preceded by the letter "V".

(3) All parts are assigned figure and index numbers. The figure number identifies the illustration in which the listed part is contained. The index number references the part on the illustration.

(4) The symbol "AR" appearing in the Units Per Assembly column means "As Required". The symbol "Ref" signifies a second or subsequent listing of the part or assembly.

(5) "No Number" assigned as a part number indicates a part of an assembly shown for illustration purposes only. It is impractical to further breakdown due to manufacturer's assembly procedures and replacement of said items must be made of the next higher assembly as parts of this nature are not procurable.

D. Usage Code

(1) Master coding is used where a breakdown of more than one type instrument is made in one illustrated parts list. Each type instrument is listed with an assigned alphabetical capitalized code letter. The code letter applicable to each type is shown at the beginning of the first parts list and below.

Usable on Code	Part Number
A	D22061 10 012
B	E22061 04 018

(2) All parts and assemblies which are components of the listed types bear the same code letter as that type. The code letter will appear in the Usage Code Column (column 4).

(3) Detail parts are coded to agree with the assembly on which they are used. The code letter assigned to each assembly is shown at the beginning of the parts list involved.

(4) Parts common to both assemblies are listed with the quantity required for one assembly only. They carry no code letter in column 4, indicating that they are identical parts, applicable to all assemblies on that listing.

FIG. & INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	UNITS PER ASSY	USAGE CODE
		PRESSURE ALTIMETER		
1101-	D22061 10 012	ALTIMETER, Pressure	1	A
	E22061 04 018	ALTIMETER, Pressure	1	B
-1	81 22063 0080	. PLATE, Identification	1	A
	81 22064 0010	. PLATE, Identification	1	B
		ATTACHING PARTS		
-2	61 01805 0208	. SCREW, Self tapping, stainless steel, immunized, size 2 x 1/8 in. lg		
		---*---		
-3	371-14	. KNOB	1	
-4	371-13B	. LOCKNUT, Knob	1	
-5	2206BX3	. FLANGE, Mounting	1	
		ATTACHING PARTS		
-6	61 40106 0346	. SCREW, Flat fil head, stainless steel, blackened, 2-56 x 23/32 in. lg	2	
-7	61 40106 0320	. SCREW, Flat fill head, stainless steel, blackened, 3-56 x 5/16 in. lg	1	
-8	61 40106 0322	. SCREW, Flat fil head, stainless steel, blackened, 3-56 x 11/32 in. lg	5	
-9	61 72402 0003	. LOCKWASHER, Light, stainless steel, blackened, for size 3 screw	7	
-10	2206-12	. SCREW, Locking	1	
		---*---		
-11	52 22060 0010	. PLATE, Locking	1	
-12	371S54	. SPRING, Top plate, mounting	1	
* -13	477KN43	. GASKET, Paper, 0.010 in. thick	1	
	477KN43-2	. GASKET, Paper, 0.020 in. thick	AR	
-14	371S107	. GLASS	1	
-15	371-61B	. GASKET, Sealing	1	
-16	2206-904-2	. POINTER ASSEMBLY	1	A
	2206-904-1	. POINTER ASSEMBLY	1	B
-17	2206-905-2	. POINTER ASSEMBLY	1	A
	2206-905-1	. POINTER ASSEMBLY	1	B
-18	84 22063 0201	. DIAL POINTER ASSEMBLY	1	A
	84 22064 0701	. DIAL POINTER ASSEMBLY	1	B
-19	477KN40	. RING, Centering	1	
-20	2206X-03-2	. DIAL, Center	1	A
	83 22064 1801	. DIAL, Center	1	B
		ATTACHING PARTS		
-21	X30	. SCREW, Dial	2	
		---*---		
-22	371-30B	. SPACER	1	A

* To be selected at assembly

FIG. & INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	UNITS PER ASSY	USAGE CODE
		PRESSURE ALTIMETER (CONT)		
1101-	2259-17	. SPACER	1	B
* -23	371-127B	. RING, Spacer, 0.002 in. thick	1	A
	371-127B2	. RING, Spacer, 0.001 in. thick	AR	A
	371-127B3	. RING, Spacer, 0.007 in. thick	AR	A
	371-127B4	. RING, Spacer, 0.008 in. thick	AR	A
	371-127B5	. RING, Spacer, 0.009 in. thick	AR	A
	371-127B6	. RING, Spacer, 0.004 in. thick	AR	A
	371-127B7	. RING, Spacer, 0.005 in. thick	AR	A
	371-127B8	. RING, Spacer, 0.006 in. thick	AR	A
	2259-16	. RING, Dial support	1	B
-24	1845-24	. SHUTTER	1	A
-25	371K904C3	. DIAL ASSEMBLY, Barometric	1	A
	83 33790 5002	. DIAL ASSEMBLY, Barometric	1	B
-26	371-20B	. GEAR, Setting marker	1	A
1101-	371-914	. GEAR ASSEMBLY	1	A
-27	371-59	. . GEAR	1	A
-28	371-54	. . PINION	1	A
1101-	371-903	. GEAR ASSEMBLY	1	A
	2259-903	. GEAR ASSEMBLY	1	B
-29	371-57	. . GEAR	1	A
	2259-10	. . GEAR	1	E
-30	371-25	. . PINION	1	A
	2259-9	. . PINION	1	B
1101-	371-913	. GEAR ASSEMBLY	1	A
	2259-906	. GEAR ASSEMBLY	1	B
-31	371-55	. . GEAR	1	A
	2259-11	. . GEAR	1	B
-32	371-54	. . PINION	1	A
	2259-12	. . PINION	1	B
-33	371S7	. RING, Snap	1	A
	57 22064 0010	. RING, Retaining	1	B
1101-	87 22003 0020	. MECHANISM ASSEMBLY, Top plate	1	A
	87 22064 0020	. MECHANISM ASSEMBLY, Top plate	1	B
-34	371-911	. . GEAR ASSEMBLY, Spur	1	A
	85 22064 0030	. . GEAR ASSEMBLY, Spur	1	B
1101-	371-907	. . PLATE ASSEMBLY, Bearing	1	A
	2259-910	. . PLATE ASSEMBLY, Bearing	1	B
		ATTACHING PARTS		
-35	371-60B	. . SCREW, Bearing plate	3	
		---*---		
-36	371-41	. . . PINION, Intermediate	1	
-37	371-909	. . . WHEEL ASSEMBLY, Intermediate	1	
-38	371-908	. . . WHEEL ASSEMBLY, Intermediate	1	
-39	371-52	. . . HANDSTAFF	1	
-40	371-906	. . . PLATE AND BUSHING ASSEMBLY	1	A
	2259-909	. . . PLATE AND BUSHING ASSEMBLY	1	B
-41	371-910	. . WHEEL ASSEMBLY	1	

* To be selected at assembly

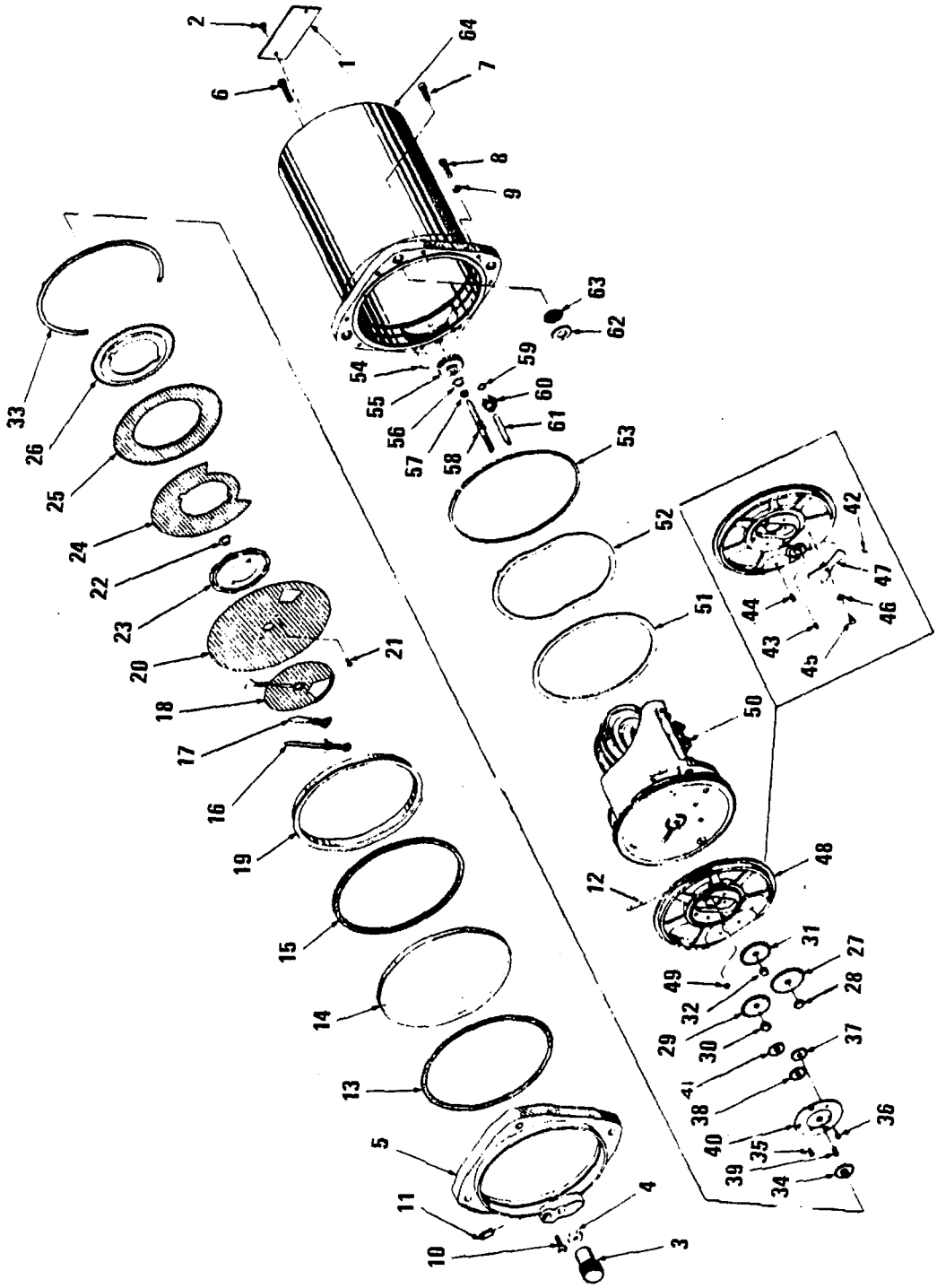


Figure 1101. Pressure Altimeter

FIG. & INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	UNITS PER ASSY	USAGE CODE
		PRESSURE ALTIMETER (CONT)		
1101-	85 22063 0010	. . PLATE ASSEMBLY, Top	1	A
	85 22064 0010	. . PLATE ASSEMBLY, Top	1	B
-42	371-98	. . . PIN, Locating	2	
-43	1845-25	. . . STUD, Gear	2	
-44	371-27	. . . STUD, Gear	1	
-45	2259-7	. . . PIN	1	B
-46	2259-8	. . . WASHER, Spring	1	B
-47	2259-6	. . . STOP	1	B
-48	52 33790 0010	. . . PLATE, Top	1	A
	52 22064 0020	. . . PLATE, Top	1	B
-49	371-53	. PINION, Center	1	
-50	87 22063 0010	. MECHANISM ASSEMBLY (See figure 1102 for breakdown)	1	
-51	46 22064 0010	. GASKET, Mylar	AR	B
-52	371-46	. RING, Spring	1	
-53	371S25	. RING, Snap	1	
1101-	2206CX902	. CASE ASSEMBLY	1	A
	85 22064 0020	. CASE ASSEMBLY	1	B
-54	371-10	. . PIN	1	
-55	1846-3	. . PINION	1	
-56	371-11	. . RING, Snap	1	
-57	74 02501 1001	. . RING, Sealing	1	
-58	2206B2	. . STEM, Adjustment knob	1	
-59	371K121	. . WASHER, Spring	1	A
-60	1845-15	. . GEAR, Idler	1	A
-61	39 22063 0010	. . SHAFT, Idler	1	A
-62	671C134	. . RING, Retaining	1	
-63	671C133	. . SCREEN	1	
-64	2206CX1	. . CASE	1	A
	50 22064 0020	. . CASE	1	B

P11012

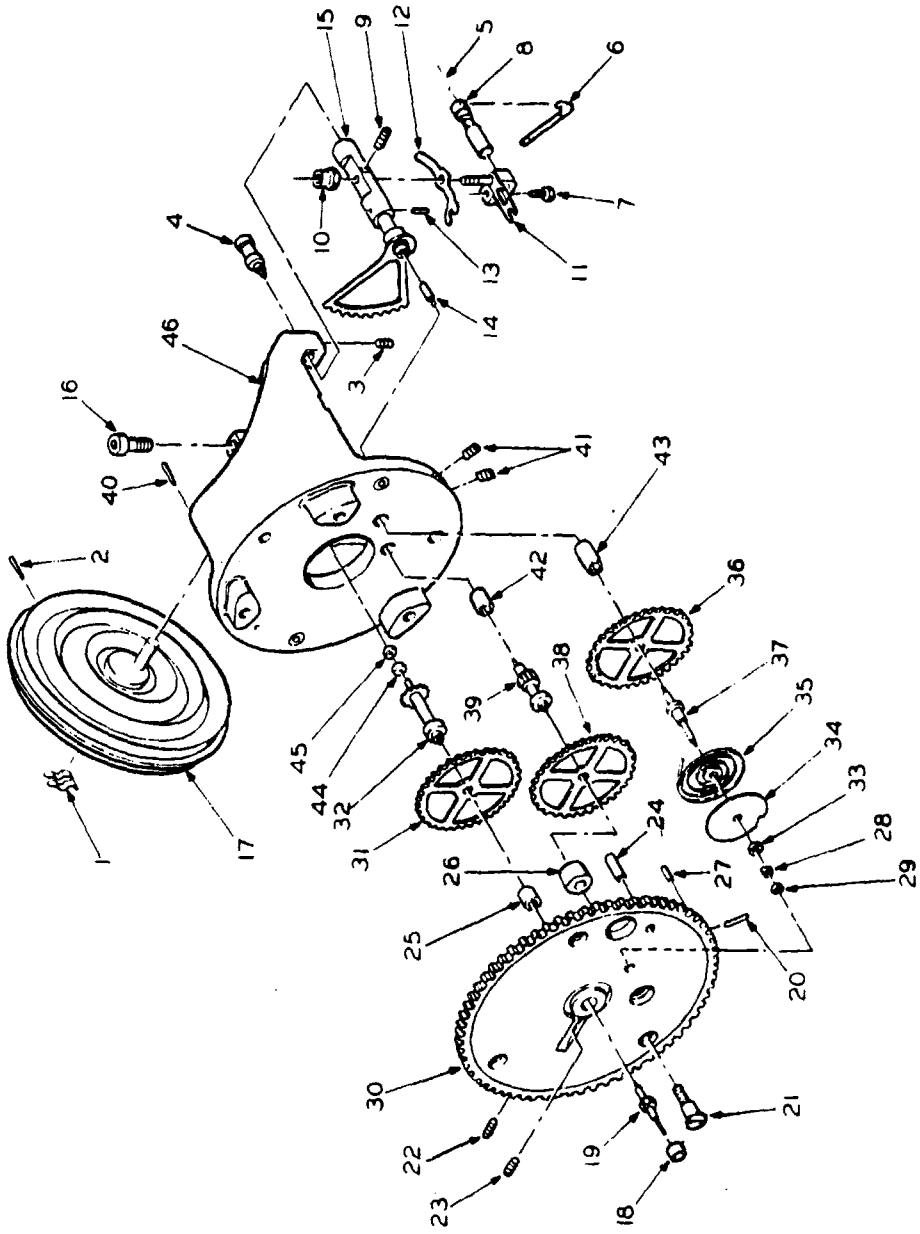


Figure 1102. Mechanism Assembly

FIG. & INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	UNITS PER ASSY	USAGE CODE
		MECHANISM ASSEMBLY		
1102-	87 22063 0010	MECHANISM ASSEMBLY (See figure 1101-53)	Ref	
-1	1357-38	. SPRING, Link pin locking	2	
-2	1357-37	. PIN, Link	2	
-3	61 43005 0208	. SETSCREW, Multiple spline socket head, flat point, stainless steel, immunized, 2-64 x 1/8 in. lg	2	
-4	85 22063 0040	. MOUNT ASSEMBLY, Pivot	2	
1102-	85 22063 0170	. SHAFT ASSEMBLY, Rocking	2	
-5	371-80	. . PIN, Bearing	1	
-6	1357-33C	. . LINK	1	
-7	61 42805 0212	. . SCREW, Multiple spline socket stainless steel, immunized, 2-64 x 3/16 in. lg	1	
-8	1357-915C	. . COMPENSATOR ASSEMBLY	1	
-9	61 43005 0206	. . SETSCREW, Multiple spline socket head, flat point, stainless steel, immunized, 2-64 x 3/32 in. lg	1	
-10	45 22063 0021	. . NUT	1	
-11	85 22063 0160	. . SPRING AND ARM ASSEMBLY, Calibration	1	
-12	56 22063 0040	. . SPRING	1	
1102-	85 22063 0150	. . ROCKING SHAFT SUBASSEMBLY	1	
-13	73 00210 5045	. . . PIN, Dowel	1	
-14	967-100	. . . PIVOT	1	
-15	No Number	. . . SHAFT AND SECTOR ASSEMBLY	1	
-16	61 42805 0424	. SETSCREW, Multiple spline socket head cap, stainless steel, immunized, 4-48 x 3/8 in. lg	4	
-17	40 22063 0010	. DIAPHRAGM ASSEMBLY	2	
-18	1357-903B	. SETTING ASSEMBLY, Jewel	1	
-19	35 22063 0020	. PINION, Handstaff	1	
-20	671B90B	. PIN, Taper	1	
1102-	85 22063 0020	. PLATE ASSEMBLY, Mechanism ATTACHING PART	1	
-21	45 22063 0010	. SCREW	3	
		---*---		
-22	74 45506 1003	. . SCREW	1	
-23	74 45506 1001	. . SETSCREW	1	
-24	85 22063 0200	. . JEWEL HOUSING ASSEMBLY	1	
-25	85 22063 0060	. . SETTING ASSEMBLY, Jewel	1	
-26	32 22063 0010	. . BEARING	1	
-27	73 00415 5004	. . POST, Hairspring	1	

FIG. & INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	UNITS PER ASSY	USAGE CODE
		MECHANISM ASSEMBLY (CONT)		
1102-28	716-50	. . JEWEL	1	
-29	190-15	. . ENDSTONE, Jeweled	1	
-30	52 22063 0022	. . PLATE, Mechanism	1	
1102-	85 22063 0090	. PINION ASSEMBLY, Main	1	
-31	371-75	. . WHEEL	1	
-32	35 22063 0010	. . PINION, Main	1	
1102-	85 22063 0070	. SHAFT ASSEMBLY, Intermediate	1	
-33	57 22063 0060	. . COLLAR, Hairspring	1	
-34	56 22063 0020	. . DISC, Hairspring	1	
-35	1414-12	. . HAIRSPRING	1	
-36	371-75	. . WHEEL	1	
-37	57 22063 0010	. . SHAFT, Intermediate	1	
1102-	85 22063 0080	. PINION ASSEMBLY, Intermediate	1	
-38	371-75	. . WHEEL	1	
-39	35 22063 0030	. . PINION, Intermediate	1	
1102-	85 22063 0102	. BODY ASSEMBLY, Mechanism	1	
-40	371-49.1	. . PIN, Taper	2	
-41	61 43005 0208	. . SETSCREW, Multiple spline socket head, flat point, stainless steel, immunized, 2-64 x 1/8 in. lg	2	
-42	V76-910	. . SETTING ASSEMBLY, Jewel	1	
-43	85 22063 0190	. . SETTING ASSEMBLY, Jewel	1	
-44	716-50	. . JEWEL	3	
-45	190-15	. . ENDSTONE, Jeweled	3	
-46	51 22063 0012	. . BODY, Mechanism	1	

PART NUMBER	FIG. & INDEX NO.	QTY PER ART.
D22061 10 012	1101-	1
E22061 04 018	1101-	1
SHAFT & SECTOR ASSEMBLY	1102-15	2
V76-910	1102-42	1
X30	1101-21	2
1357-33C	1102-6	2
1357-37	1102-2	2
1357-38	1102-1	2
1357-903B	1102-18	1
1357-915C	1102-8	2
1414-12	1102-35	1
1845-15	1101-60	1
1845-24	1101-24	1
1845-25	1101-43	2
1846-3	1101-55	1
190-15	1102-28	4
	1102-45	
2206-12	1101-10	1
2206-904-1	1101-16	1
2206-904-2	1101-16	1
2206-905-1	1101-17	1
2206-905-2	1101-17	1
2206BX3	1101-5	1
2206B2	1101-58	1
2206CX1	1101-64	1
2206CX902	1101-	1
2206X-03-2	1101-20	1
2259-10	1101-29	1
2259-11	1101-31	1
2259-12	1101-32	1
2259-16	1101-23	1
2259-17	1101-22	1
2259-6	1101-47	1
2259-7	1101-45	1
2259-8	1101-46	1
2259-9	1101-30	1
2259-906	1101-	1
2259-909	1101-	1
2259-910	1101-	1
32 22063 0010	1102-25	1
35 22063 0010	1102-31	1
35 22063 0020	1102-19	1

PART NUMBER	FIG. & INDEX NO.	QTY PER ART.
35 22063 0030	1102-39	1
371-10	1101-54	1
371-11	1101-56	1
371-127B	1101-23	1
371-127B2	1101-23	AR
371-127B3	1101-23	AR
371-127B4	1101-23	AR
371-127B5	1101-23	AR
371-127B6	1101-23	AR
371-127B7	1101-23	AR
371-127B8	1101-23	AR
371-13B	1101-4	1
371-14	1101-3	1
371-20B	1101-26	1
371-25	1101-30	1
371-27	1101-44	1
371-30B	1101-22	1
371-41	1101-36	1
371-46	1101-52	
371-49.1	1102-40	
371-52	1101-39	1
371-53	1101-49	1
371-54	1101-28	2
	1101-32	
371-55	1101-31	1
371-57	1101-29	1
371-59	1101-27	1
371-60B	1101-35	3
371-61B	1101-15	1
371-75	1102-30	3
	1102-36	
	1102-38	
371-80	1102-5	
371-903	1101-	1
371-906	1101-40	1
371-907	1101-	1
371-908	1101-38	1
371-909	1101-37	1
371-910	1101-41	1
371-911	1101-34	1
371-913	1101-	1
371-914	1101-	1
371-98	1101-42	

OVERHAUL WITH PARTS

NUMERICAL INDEX

PART NUMBER	FIG. & INDEX NO.	QTY PER ART.
371K121	1101-59	1
371K904C3	1101-25	1
371S107	1101-14	1
371S25	1101-53	1
371S54	1101-12	1
371S7	1101-33	1
39 22063 0010	1101-61	1
40 22063 0010	1102-17	2
45 22063 0010	1102-20	3
45 22063 0021	1102-10	2
46 22064 0010	1101-51	AR
477KN40	1101-19	1
477KN43	1101-13	1
477KN43-2	1101-13	AR
477KN43-3	1101-13	AR
50 22064 0020	1101-67	1
51 22063 0012	1102-46	1
52 22060 0010	1101-11	1
52 22063 0022	1102-29	1
52 22064 0020	1101-51	1
52 37790 0010	1101-48	1
56 22063 0020	1102-34	1
56 22063 0040	1102-12	2
57 22063 0010	1102-37	1
57 22063 0060	1102-33	1
57 22064 0010	1101-33	1
61 01805 0208	1101-2	2
61 32805 0424	1102-16	4
61 40106	1101-7	1
61 40106 0322	1101-8	5
61 40106	1101-6	2
61 42805	1102-7	2
61 43005-0206	1102-9	2
61 43005	1102-3	4
	1102-41	
61 72402 0003	1101-9	7
671B90B	1102-32	1
671C133	1101-63	1
671C134	1101-62	1
716-50	1102-27	4
	1102-44	

PART NUMBER	FIG. & INDEX NO.	QTY PER ART.
73 00210 5045	1102-13	2
73 00415 5004	1102-26	1
74 02501 1001	1101-57	1
74 45506 1001	1102-22	1
74 45506-1003	1102-21	1
81 22063 0080	1101-1	1
81 22064 0010	1101-1	1
83 22064 1801	1101-20	1
83 33740 5002	1101-25	1
84 22063 0201	1101-18	1
84 22064 0701	1101-18	1
85 22063 0010	1101-	1
85 22063 0020	1102-	1
85 22063 0040	1102-4	2
85 22063 0060	1102-24	1
85 22063 0070	1102-	1
85 22063 0080	1102-	1
85 22063 0090	1101-	1
85 22063 0102	1102-	1
85 22063 0150	1101-	2
85 22063 0160	1102-11	2
85 22063 0170	1102-	2
85 22063 0190	1102-43	1
85 22063 0200	1102-23	1
85 22064 0010	1101-	1
85 22064 0020	1101-	
85 22064 0030	1101-34	1
87 22063 0010	1101-50	1
	1102-	Ref
87 22063 0020	1101-	1
87 22064 0020	1101-	
967-100	1102-14	2

DIFFERENCE DATA SHEET INDEX

D22061 10 012

NOTE

OVERHAUL AND TEST PROCEDURES FOR THE MODELS INCLUDED IN THIS SECTION ARE THE SAME AS PROCEDURES FOR THE PRESSURE ALTIMETER D22061 10 012 EXCEPT FOR THE SPECIFIC DIFFERENCES NOTED BY THE APPLICABLE DIFFERENCE DATA SHEET.

Kollsman Part Number	Page
E22061 04 018 ✓	1203
D22061 04 021	1209

DIFFERENCE DATA SHEET

E22061 04 018

THE INSTRUCTIONS CONTAINED IN PRECEDING SECTIONS OF THIS MANUAL APPLY, EXCEPT FOR THE DIFFERENCES LISTED ON THIS SHEET.

SECTION 0. DESCRIPTION AND OPERATION

B. Description

(2) Leading Particulars:

Operating Altitudes: -1000 to 80,000 ft
Barometric Scale: 952 to 1050 MB
Temperature Range: -35°C (-31°F) to +45°C (+113°F)

SECTION 1. DISASSEMBLY

B. Removing Mechanism Assembly from Case

(3) Omit reference to shutter (24), setting marker gear (26), gear (27) and pinion (28).

C. Disassembly of Case Assembly

Add: Remove mylar gasket (51)
Omit reference to items (59 through 61)

SECTION 5. ASSEMBLY

D. Calibration

(2) Initial Calibration

(e) Use table 1201 in lieu of table 501

TABLE 1201

INITIAL SCALE ERROR CALIBRATION

Test Altitude (Feet)	Calibration Tolerance (Feet)
0	10
3000	30
6000	45
10000	60
20000	90
25000	120
30000	150
35000	155
40000	160
45000	210
50000	230
60000	600
70000	900
80000	1125

(2) Adjusting Load Balance

(d) Additional position error test altitude: Dial up position.

(4) Final Calibration

(a) Use table 1202 in lieu of table 501.

(b) Use table 1202 in lieu of table 502.

TABLE 1202

FRICTION TEST

Test Altitude (Feet)	Tolerance (Feet)
1000	70
2000	70
3000	70
5000	70
15000	90
20000	100
25000	120
30000	140
35000	160
40000	180
50000	250
60000	450
70000	650
80000	850

(5) Temperature Compensation

(e) Use table 1201 in lieu of table 501.

E. Reassembly of Top Plate Mechanism Assembly

(2) Assemble items (42 through 47, figure 1101) as shown in figure 1201.

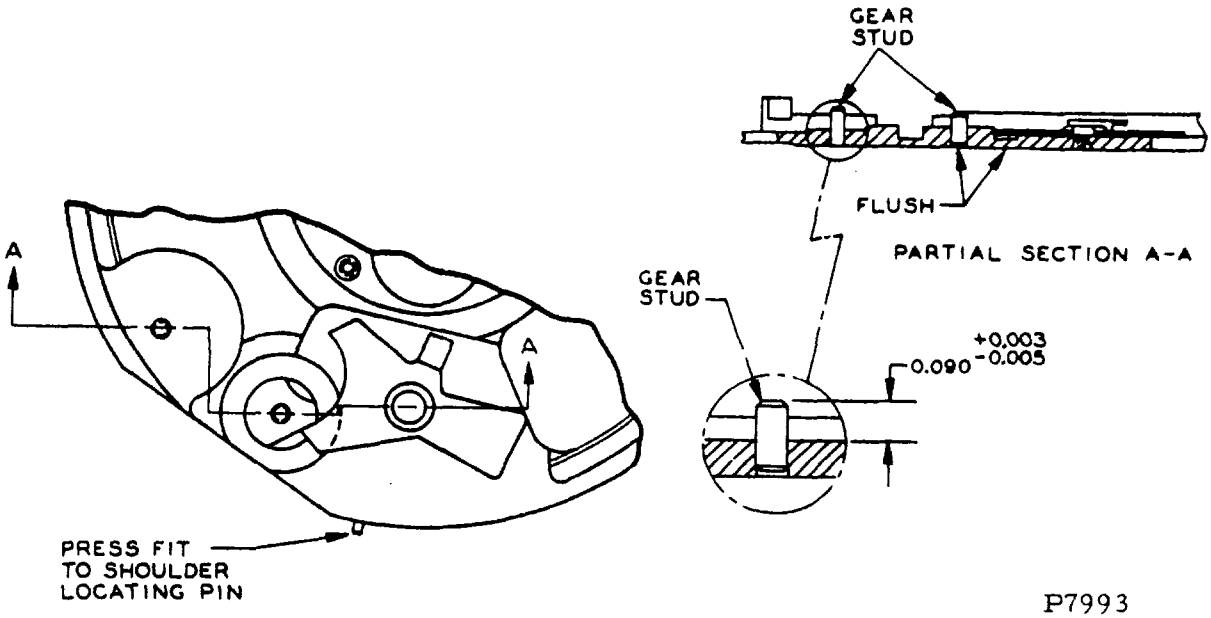


Figure 1202. Top Plate Assembly

F. Closing (See figure 1101)

(1) Omit reference to items (59 through 61).

(2) Add mylar gasket (51).

(5) Omit reference to gear (27) and pinion (28).

(7) Omit reference to setting marker gear (26). Align 1050MB indicator.

(8) Align 952.5MB indication.

(10) Omit reference to shutter (24).

(12) Position barometric dial assembly to indicate 1013.25MB.

(18) Position to 1013.25MB.

(19) Position to 1013.25MB.

SECTION 7. TESTING

B. Zero Setting Scale

Use table 1203 in lieu of table 701.

TABLE 1203

ZERO SETTING SCALE

Barometric Dial Setting (MB)	Altitude Reading (Feet)	Tolerance (Feet)
952.50	1701	25
965.00	1344	25
980.00	920	25
1000.00	384	25
1013.25	0	25
1035.00	589	25
1045.00	856	25
1050.00	989	25

C. Case Leak

Observe for change in indication over a period of one minute in lieu of 30 seconds.

D. Scale Error Test at Room Temperature

(1) Set barometric scale to 1013.25MB.

(2) Use table 1204 in lieu of table 702.

TABLE 1204

FINAL SCALE ERROR TEST

Test Altitude (Feet)	Tolerance (Feet)	
	Room Temperature	-35°C (-31°F) +45°C (+113°F)
0	30	30
500	35	35
1000	35	35
1500	35	35
2000	40	40
2500	45	45
3000	45	45
4000	50	50
5000	55	55
6000	60	60
8000	70	70
10000	80	80
12000	90	90
14000	100	100
15000	105	105
16000	110	110
18000	120	120

TABLE 1204 (CONT)

Test Altitude (Feet)	Tolerance (Feet) Room Temperature	-35°C (-31°F) +45°C (+113°F)
20000	130	130
22000	140	140
25000	155	155
30000	180	180
35000	205	205
40000	230	230
45000	255	255
50000	280	280
55000	600	600
60000	800	800
70000	1200	1200
80000	1500	1500

E. Hysteresis and After Effect

Use table 1205 in lieu of table 703.

TABLE 1205
HYSTERESIS AND AFTER EFFECT

Altitude (Feet)	Time Before Reading	Permissible Variation (Feet)
80,000	Maintain pressure not longer than 15 minutes	-
25,000	Between 5 and 15 minutes	100
20,000	Between 5 and 15 minutes	100
0	Between 1 and 10 minutes	50

F. Position Error

Additional position error test attitude: Dial up position.

G. Friction Test

Use table 1202 in lieu of table 502.

Add: Without vibration decrease pressure from 0 to 80,000 feet altitude at a rate not exceeding 3000 feet per minute.

Observe pointer for irregular motion. Pointer shall not stop and jump more than the amounts specified in table 1206.

TABLE 1206

OPERATIONAL FRICTION TEST

Altitude (Feet)	Pointer Jump (Feet)
0 to 25000	120
25000 to 50000	250
50000 to 80000	850

H. Scale Error at -35°C (-31°F)

Use test altitudes and tolerances specified in table 1204.

Add: I. Scale Error at +45°C (+113°F)

Perform procedure specified in paragraph H. of this difference data sheet except temperature shall be +45°C (+113°F).

DIFFERENCE DATA SHEET

D22061 04 021

THE INSTRUCTIONS CONTAINED IN PRECEDING SECTIONS OF THIS MANUAL APPLY, EXCEPT FOR THE DIFFERENCES LISTED ON THIS SHEET.

0. DESCRIPTION AND OPERATION

B. Description

(2) Leading Particulars:

Operating Altitudes:	-1000 to 50,000 ft
Barometric Scale:	952 to 1050MB
Temperature Range:	-30°C (-22°F) +25°C (+77°F)

5. ASSEMBLY

F. Closing (See figure 1101)

(7) Align 1050MB indication.

(8) Align 965MB indication.

(12) Position barometric dial assembly to indicate 1013.00MB.

(18) Position to 1013.00MB.

(19) Position to 1013.00MB.

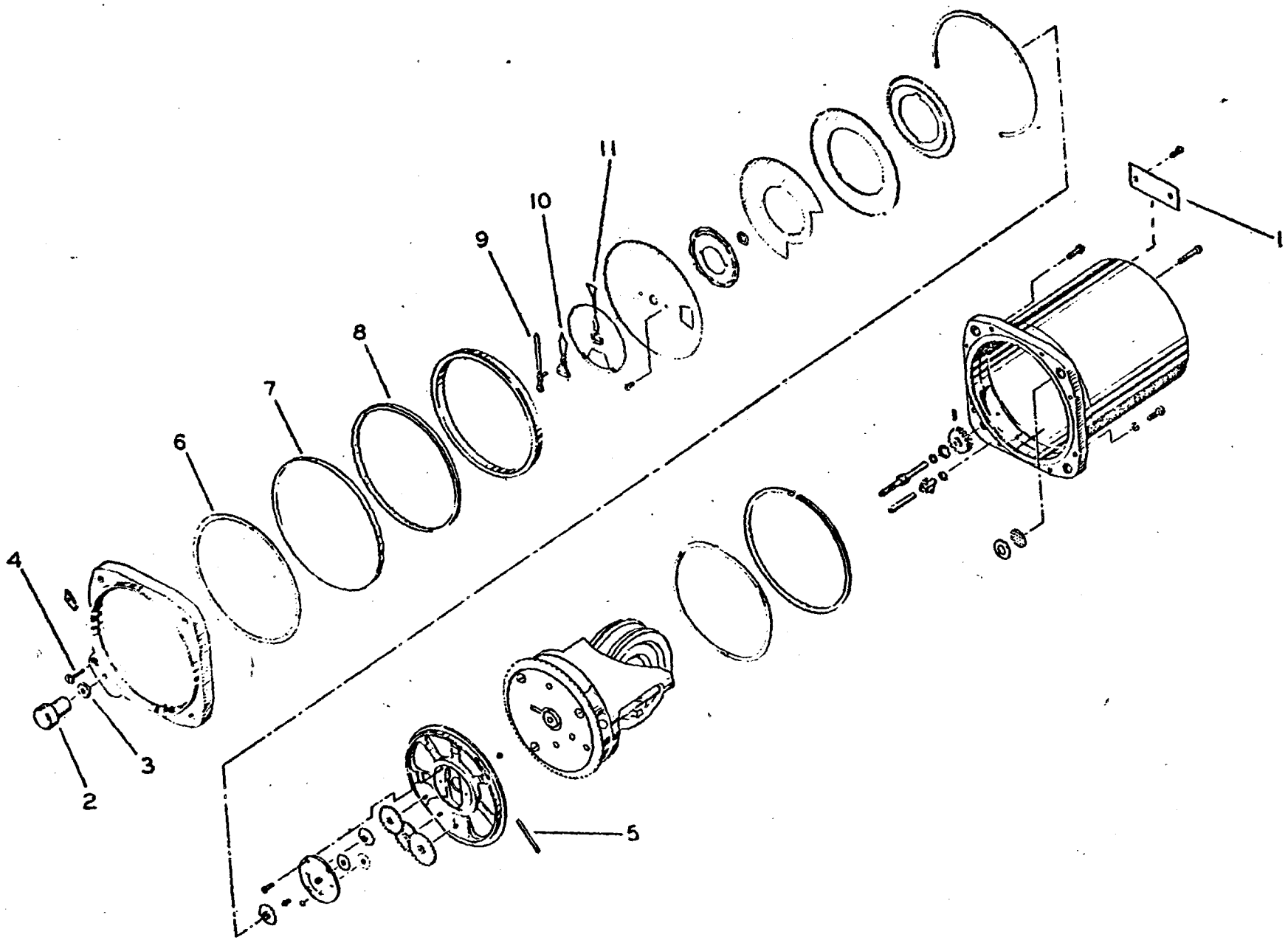
7. TESTING

B. Zero Setting Scale - Use table 1207 in lieu of table 701.

TABLE 1207

ZERO SETTING SCALE

Barometric Dial Setting (MB)	Altitude Reading (Feet)	Tolerance (Feet)
965.00	-1344	±25
1013.00	- 7	25
1050.00	989	25



1209A

SPARE PARTS – PROVISIONING LIST

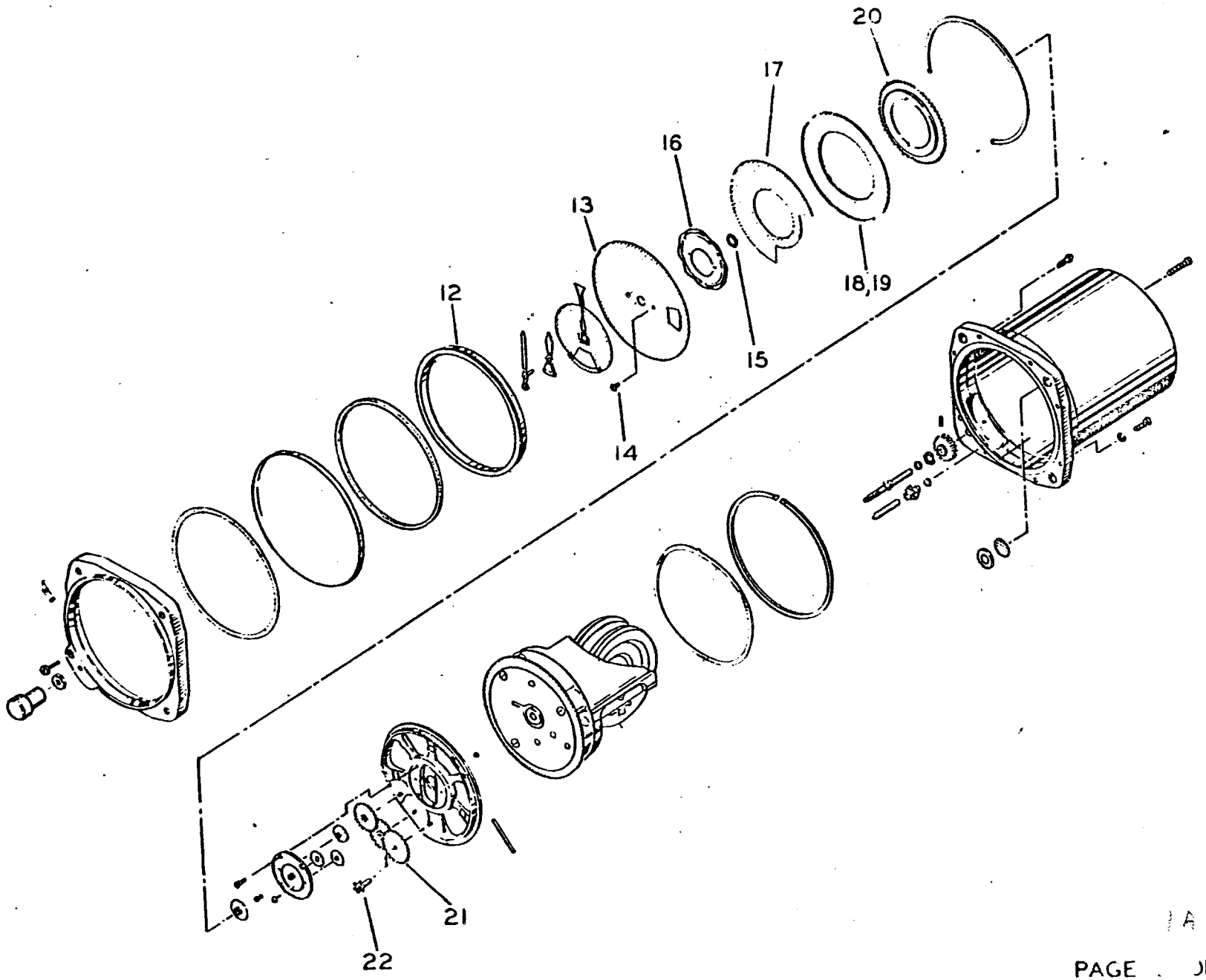
CUSTOMER SERVICE – TECHNICAL DATA SUPPORT

REQ QTY BASED ON 100 UNITS OVERHAUL

FIG. NO.	INDENT	KOLLSMAN P/N	VENDOR P/N	VENDOR CODE	NOMENCLATURE	QTY PER ASSY	QTY PER ART	QTY REC %	LEAD TIME (MO)	EST UNIT PRICE	QTY PROC	REMARKS
	1	D22061 10 012			Altimeter, Press.	1	1		Dwg No.	88 22063	1003	
1	2	81 22063 0080			Plate, Ident	1	1	5	2			
					ATTACHING PART							
	2	61 01805 0208			- - - * - - -							
2	2	371-14			Knob	1	1	10	1			
3	2	371-13B			Locknut, Knob	1	1	10	1			
	2	2206BX3			Flange, Mounting	1	1					
					ATTACHING PARTS							
	2	61 40106 0346			Screw	2	2					
	2	61 40106 0320			Screw	1	1					
	2	61 40106 0322			Screw	5	5					
	2	61 72402 0003			Lockwasher	7	7					
4	2	2206-12			Screw, Locking	1	1	5	1			
					- - - * - - -							
5	2	371S54			Spring, Mounting	1	1	10	1			
	2	52 22060 0010			Plate, Locking	1	1					
6	2	477KN43			Gasket, Paper	AR	1	100	1			*
	2	477KN43-2			Gasket, Paper	AR	AR	100	1			*
	2	477KN43-3			Gasket, Paper	AR	AR	100	1			*
7	2	371S107			Glass	1	1	10	1			
8	2	371-61B			Gasket	1	1	20	1			
9	2	2206-904-2			Pointer Assy	1	1	5	1			
10	2	2206-905-2			Pointer Assy	1	1	5	2			
11	2	84 22063 0201			Dial Pointer Assy	1	1	5	2			

INST TYPE NO. D22061 10 012 DATE: August 27, 1962

* To be selected at assembly


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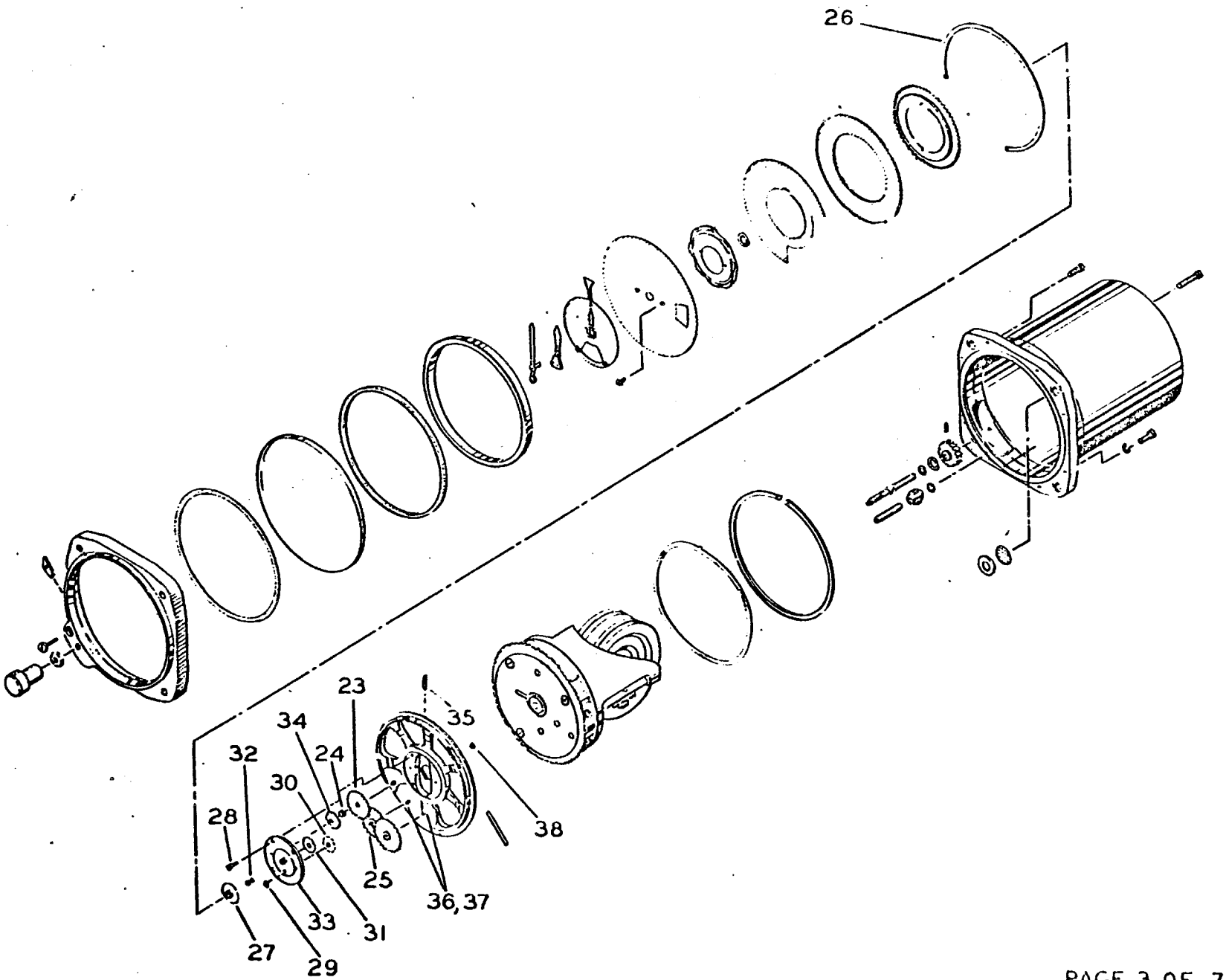
SPARE PARTS – PROVISIONING LIST

CUSTOMER SERVICE – TECHNICAL DATA SUPPORT

REQ QTY BASED ON 100 UNITS OVERHAUL

FIG. NO.	INDENT	KOLLSMAN P/N	VENDOR P/N	VENDOR CODE	NOMENCLATURE	QTY PER ASSY	QTY PER ART	QTY REC %	LEAD TIME (MO)	EST UNIT PRICE	QTY PROC	REMARKS
12	2	477KN40			Ring, Centering	1	1	10	2			
13	2	2206X03-2			Dial, Center	1	1	5	2			
					ATTACHING PART							
14	2	X30			Screw	2	2	10	1			
					- - - * - - -							
15	2	371-30B			Spacer	1	1	10	1			
16	2	371-127B			Ring, Spacer	AR	1	5	2			*
	2	371-127B2			Ring, Spacer	AR	AR	5	1			*
	2	371-127B3			Ring, Spacer	AR	AR	5	2			*
	2	371-127B4			Ring, Spacer	AR	AR	5	1			*
	2	371-127B5			Ring, Spacer	AR	AR	5	2			*
	2	371-127B6			Ring, Spacer	AR	AR	5	1			*
	2	371-127B7			Ring, Spacer	AR	AR	5	1			*
	2	371-127B8			Ring, Spacer	AR	AR	5	2			*
17	2	1845-24			Shutter	1	1	5	2			
	2	371K904C3			Dial Assy, Barometric	1	1					
	3	371K123			Rivet	2	2					
18	3	371-23			Gear, Barometric Dial	1	1	10	2			
19	3	371K08C3			Dial, Barometric	1	1	5	2			
20	2	371-20B			Gear, Setting Marker	1	1	10	2			
	2	371-914			Gear Assy	1	1					
21	3	371-59			Gear	1	1	10	1			
22	3	371-54			Pinion	1	2	10	2			

* To be selected at assembly

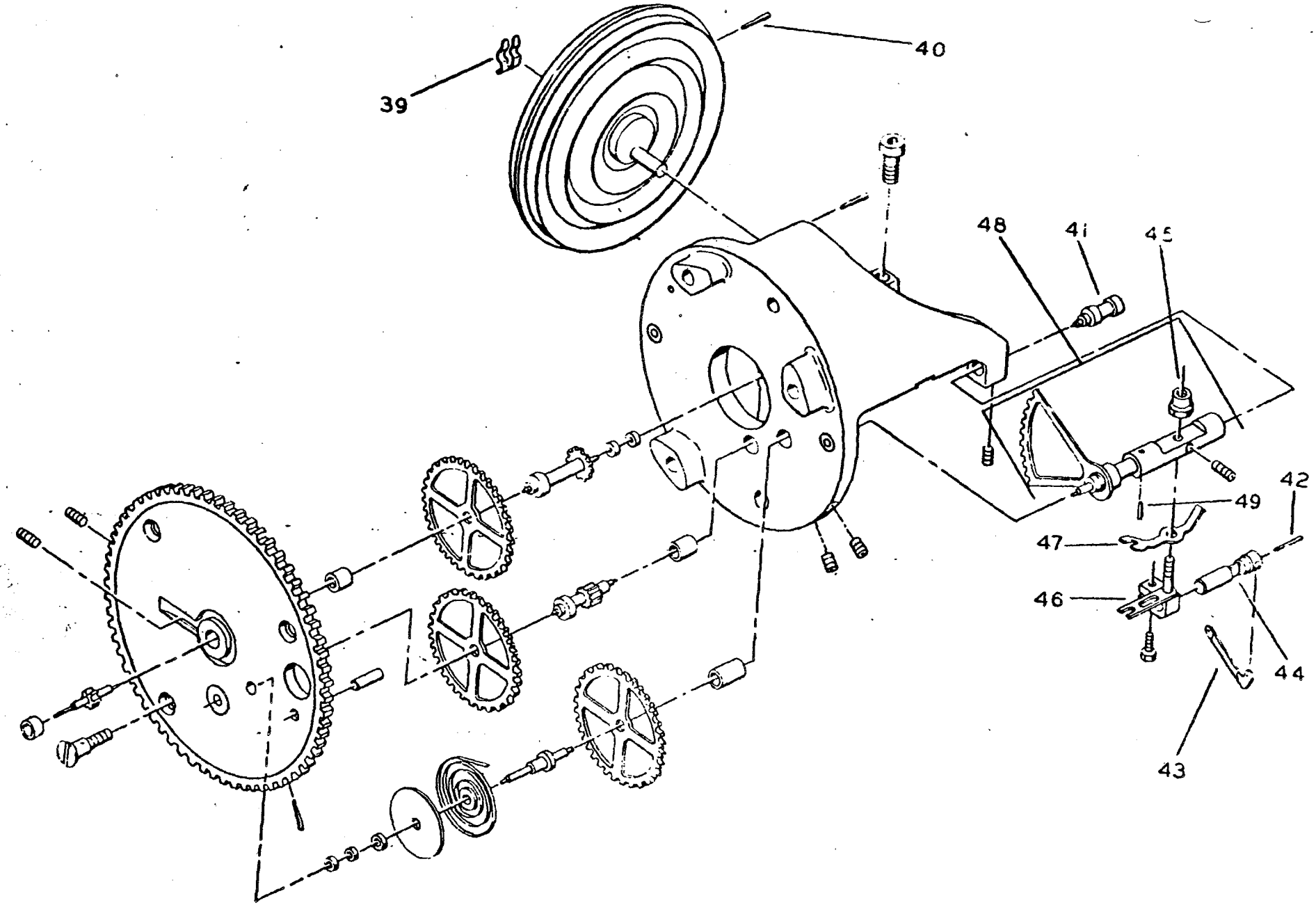

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SPARE PARTS – PROVISIONING LIST

CUSTOMER SERVICE – TECHNICAL DATA SUPPORT

REQ QTY BASED ON 100 UNITS OVERHAUL

FIG. NO.	INDENT	KOLLSMAN P/N	VENDOR P/N	VENDOR CODE	NOMENCLATURE	QTY PER ASSY	QTY PER ART	QTY REC %	LEAD TIME (MO)	EST UNIT PRICE	QTY PROC	REMARKS
	2	371-903			Gear Assy	1	1					
23	3	371-57			Gear	1	1	10	1			
24	3	371-25			Pinion	1	1	10	1			
	2	371-913			Gear Assy	1	1					
25	3	371-55			Gear	1	1	10	1			
	3	371-54			Pinion	1	Ref					
26	2	371S7			Ring, Snap	1	1	10	1			
	2	87 22063 0020			Mech Assy, Top Plate	1	1					
27	3	371-911			Hub and Wheel Assy	1	1	10	1			
	3	371-907			Plate Assy, Top	1	1					
					Bearing							
					ATTACHING PART							
28	3	371-60B			Screw	3	3	5	1			
					- - - * - - -							
29	4	371-41			Pinion, Intmed	1	1	10	1			
30	4	371-909			Wheel and Hub Assy	1	1	10	1			
31	4	371-908			Wheel Assy	1	1	10	1			
32	4	371-52			Handstaff	1	1	10	1			
33	4	371-906			Plate and Bushing Assy	1	1	2	1			
34	3	371-910			Wheel Assy	1	1	10	1			
	3	85 22063 0010			Plate Assy, Top	1	1					
35	4	371-98			Pin, Locating	2	2	5	1			
36	4	1845-25			Stud, Gear	1	1	5	1			


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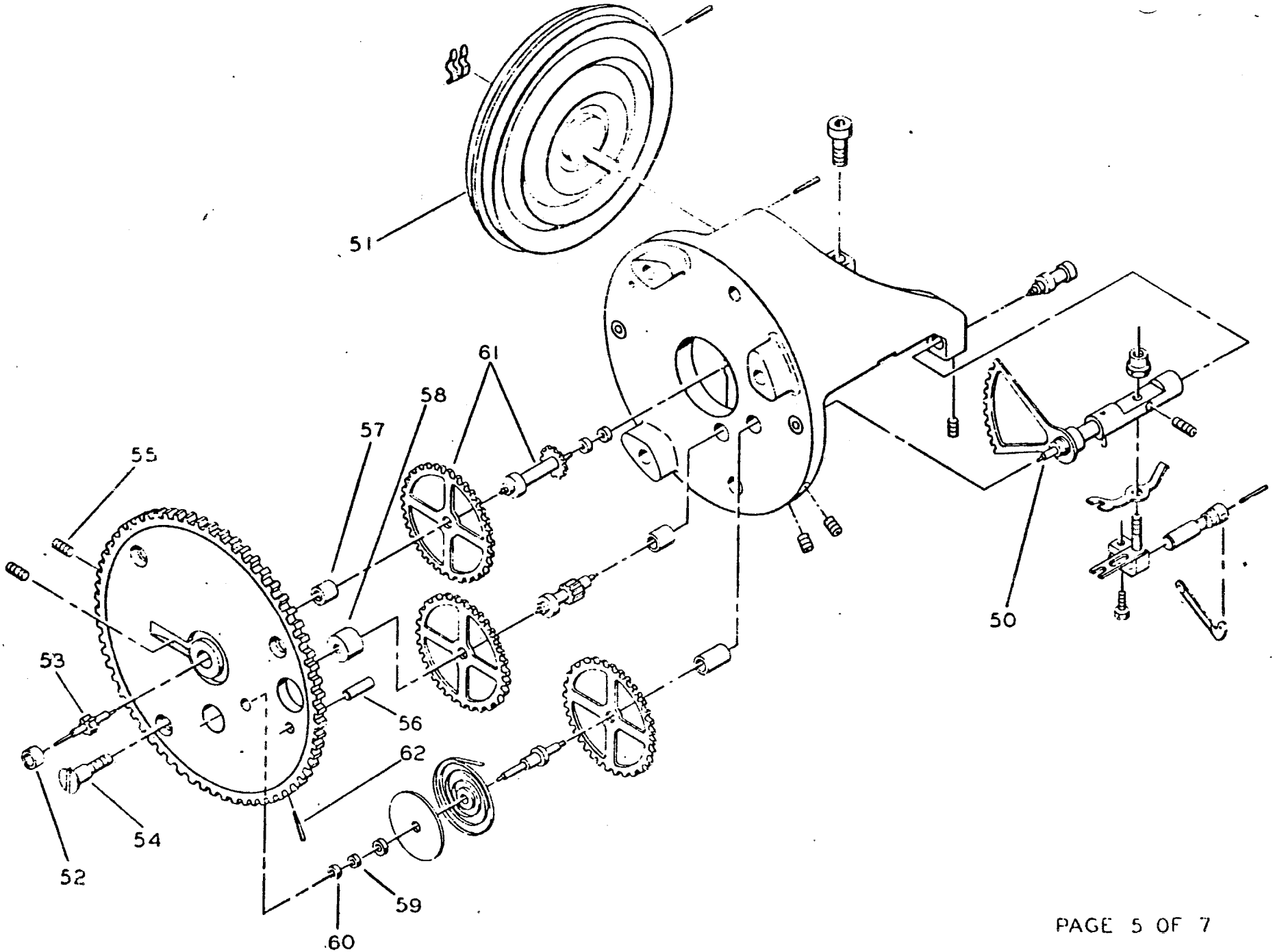
SPARE PARTS – PROVISIONING LIST

CUSTOMER SERVICE – TECHNICAL DATA SUPPORT

REQ QTY BASED ON 100 UNITS OVERHAUL

FIG. NO.	INDENT	KOLLSMAN P/N	VENDOR P/N	VENDOR CODE	NOMENCLATURE	QTY PER ASSY	QTY PER ART	QTY REC %	LEAD TIME (MO)	EST UNIT PRICE	QTY PROC	REMARKS
37	4	371-27			Stud, Gear	1	1	5	1			*
	4	52 37790 0010			Plate, Top	1	1					
38	2	371-53			Pinion, Center	1	1	10	1			*
	2	87 22063 0010			Mechanism Assy	1	1					
39	3	1357-38			Spring	2	2	10	1			
40	3	1357-37			Pin, Link	2	2	5	1			
	3	61 43005 0208			Screw	2	2					
41	3	85 22063 0040			Mount Assy, Pivot	2	2	10	1			
	3	85 22063 0170			Shaft Assy, Rocking	2	2					
42	4	371-80			Pin, Bearing	1	2	5	1			
43	4	1357-33C			Link	1	2	10	2			
	4	61 42805 0212			Setscrew	1	2					
44	4	1357-915C			Compensator Assy	1	2	5	1			
	4	61 43005 0206			Setscrew	1	2					
45	4	45 22063 0021			Nut	1	2	5	2			
46	4	85 22063 0160			Spring and Arm Assy	1	2	10	1			
	5	57 22063 0070			Arm	1	2					
	5	56 22063 0030			Spring	1	2					
47	4	56 22063 0040			Spring	1	2	10	1			
48	4	85 22063 0150			Shaft Assy	1	2	5	3			
49	5	73 00210 5045			Pin, Dowel	1	2	5	1			
	5	716-50			Jewel	1	6	10	1			
	5	190-15			Endstone	1	6	10	1			

* Refer to Page 3

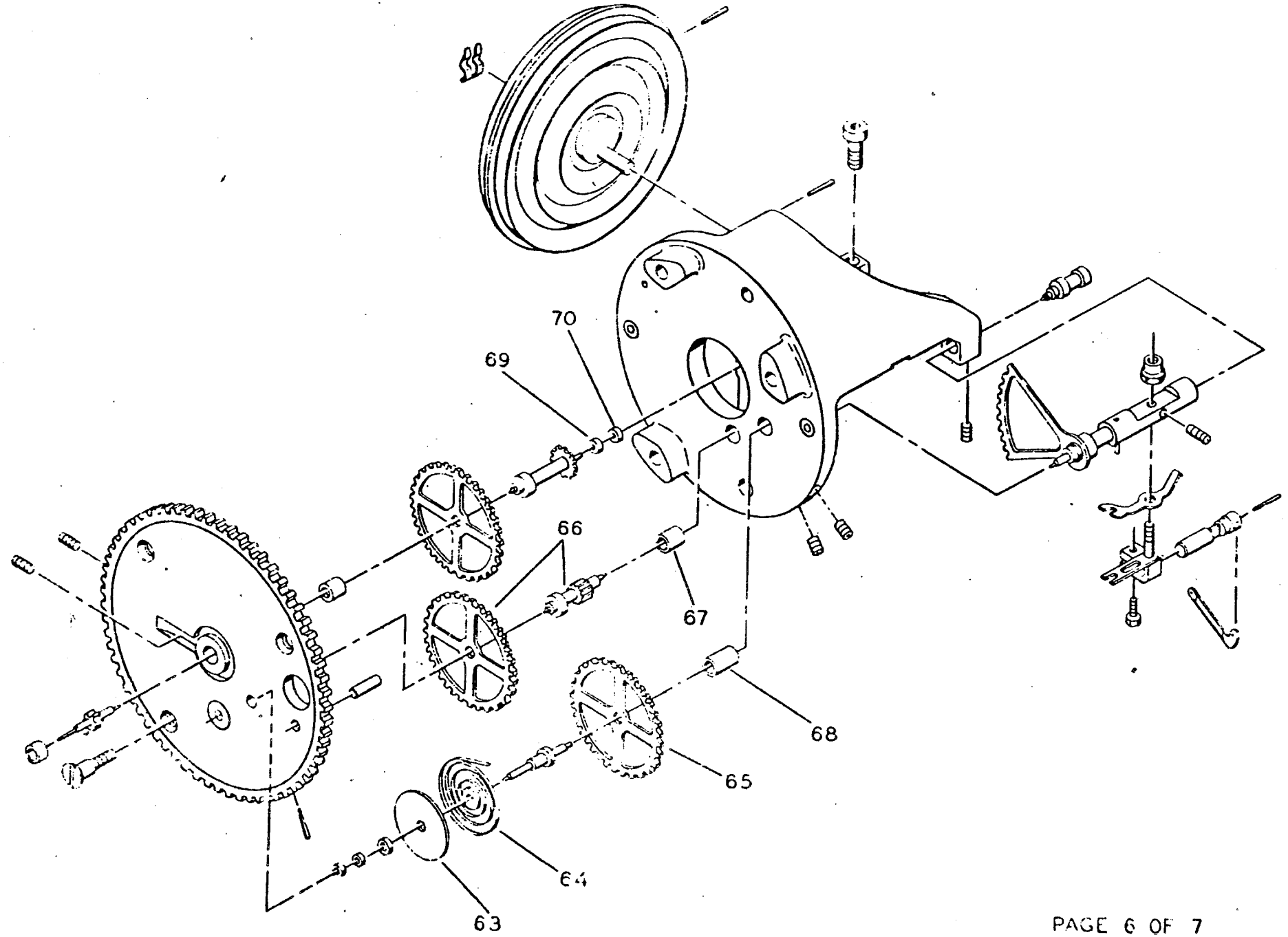

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SPARE PARTS – PROVISIONING LIST

CUSTOMER SERVICE – TECHNICAL DATA SUPPORT

REQ QTY BASED ON 100 UNITS OVERHAUL

FIG. NO.	INDENT	KOLLSMAN P/N	VENDOR P/N	VENDOR CODE	NOMENCLATURE	QTY PER ASSY	QTY PER ART	QTY REC %	LEAD TIME (MO)	EST UNIT PRICE	QTY PROC	REMARKS
50	5	967-100			Pivot	1	2	10	1			
	5	34 22063 0010			Sector	1	2					
	5	57 22063 0080			Shaft	1	2					
	3	61 42805 0424			Screw	4	4					
51	3	40 22063 0010			Diaphragm Assy	2	2	5	1			
52	3	1357-903B			Setting Assy, Jewel	1	1	10	1			
53	3	35 22063 0020			Pinion, Endstf	1	1	10	2			
	3	85 22063 0020			Plate Assy, Mech	1	1					
					ATTACHING PART							
54	3	45 22063 0010			Screw	3	3	5	1			
					- - - * - - -							
55	4	X1983			Screw	1	1	5	2			
	4	74 45506 1001			Setscrew	1	1					
56	4	85 22063 0200			Jewel Housing Assy	1	1	10	1			
57	4	85 22063 0060			Setting Assy, Jewel	1	1	10	2			
58	4	32 22063 0010			Bearing	1	1	20	2			
	4	K1001-4			Post, Hairspring	1	1					
59	4	716-50			Jewel	1	Ref					
60	4	190-15			Endstone	1	Ref					
	4	52 22063 0022			Plate	1	1					
61	3	85 22063 0090			Pinion Assy	1	1	10	2			
62	3	371-49.1			Pin, Taper	1	3	25	1			
	3	85 22063 0070			Shaft Assy	1	1					


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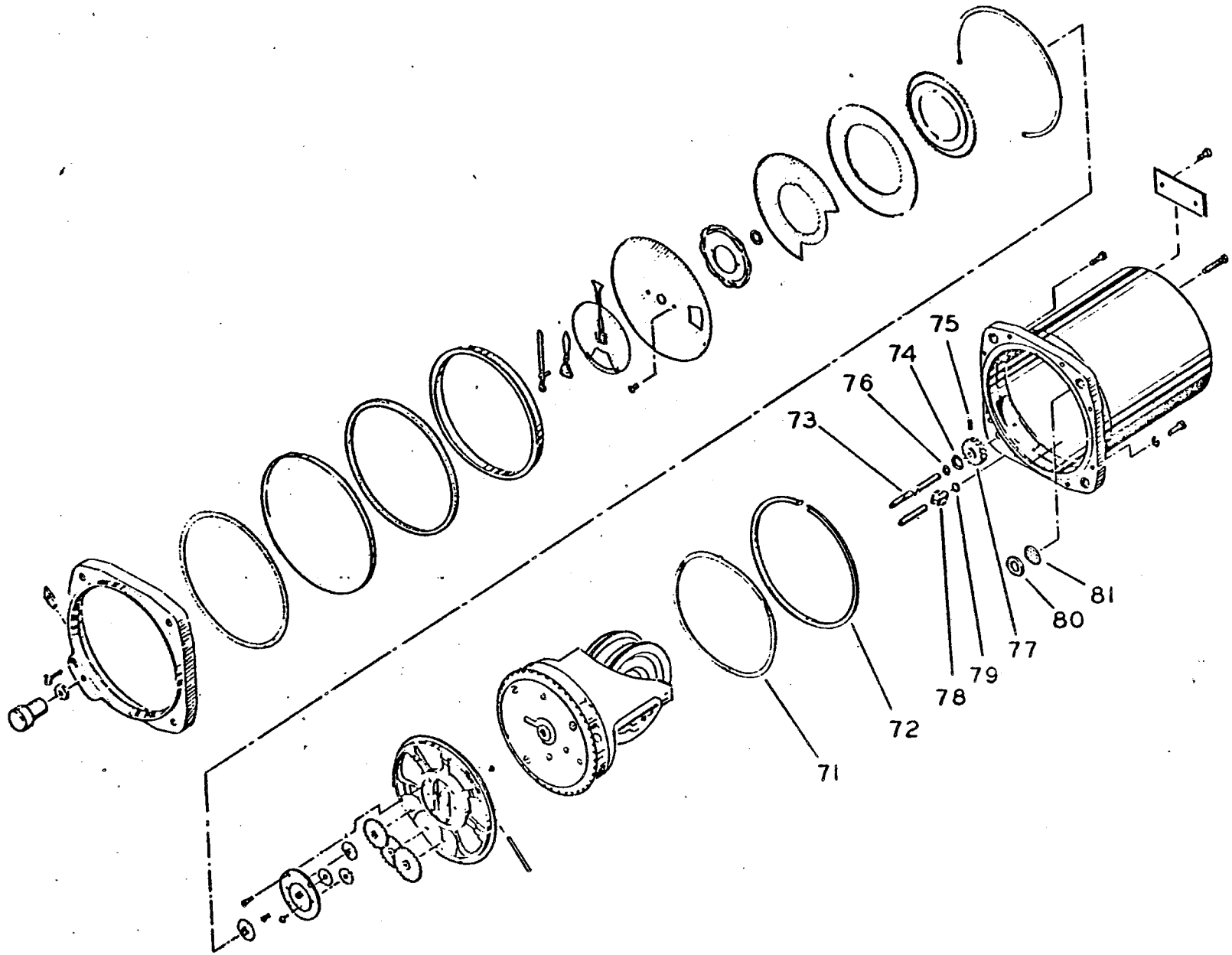
SPARE PARTS – PROVISIONING LIST

CUSTOMER SERVICE – TECHNICAL DATA SUPPORT

REQ QTY BASED ON 100 UNITS OVERHAUL

FIG. NO.	INDENT	KOLLSMAN P/N	VENDOR P/N	VENDOR CODE	NOMENCLATURE	QTY PER ASSY	QTY PER ART	QTY REC %	LEAD TIME (MO)	EST UNIT PRICE	QTY PROC	REMARKS
	4	57 22063 0060			Collar	1	1					
63	4	56 22063 0020			Disc	1	1	5	1			
64	4	1414-12			Hairspring	1	1	10	1			
65	4	371-75			Wheel	1	1	10	1			
	4	57 22063 0010			Shaft	1	1					
66	3	85 22063 0080			Pinion Assy	1	1	10	2			
	3	85 22063 0102			Body Assy	1	1					
	4	371-49.1			Pin, Taper	1	Ref					
	4	61 43005 0208			Setscrew	2	2					
67	4	V76-910			Setting Assy, Jewel	1	1	10	1			
68	4	85 22063 0190			Setting Assy, Jewel	1	1	10	1			
69	4	716-50			Jewel	3	Ref					
70	4	190-15			Endstone	3	Ref					
	4	51 22063 0012			Body, Mech	1	1					
71	2	371-46			Ring, Spring	1	1	10	2			*
72	2	371S25			Ring, Snap	1	1	10	1			*
	2	2206CX902			Case Assy	1	1					
73	3	2206B2			Stem, Adjustment Knob	1	1	5	2			*
74	3	371-11			Ring, Snap	1	1	10	1			*
75	3	371-10			Pin	1	1	5	1			*
76	3	X1687			Ring, Sealing	1	1	20	2			*
77	3	1846-3			Pinion	1	1	10	1			*
78	3	1845-15			Gear	1	1	10	1			*
79	3	371K121			Washer, Spring	1	1	10	1			*
	3	39 22063 0010			Shaft	1	1					

* Refer to Page 7


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SPARE PARTS – PROVISIONING LIST

CUSTOMER SERVICE – TECHNICAL DATA SUPPORT

REQ QTY BASED ON 100 UNITS OVERHAUL

FIG. NO.	INDENT	KOLLSMAN P/N	VENDOR P/N	VENDOR CODE	NOMENCLATURE	QTY PER ASSY	QTY PER ART	QTY REC %	LEAD TIME (MO)	EST UNIT PRICE	QTY PROC	REMARKS
80	3	671C134			Ring, Retaining	1	1	10	1			
81	3	671C133			Screen	1	1	10	1			
	3	2206CX1			Case	1	1					

T.O. 5FS-4-2-23
(Formerly AN 05-30-26)

VENDOR DATA SECTION
ENGINEERING DEPT.

TECHNICAL MANUAL

OVERHAUL

SENSITIVE ALTIMETERS

Kollsman Type Number	AN Type
1845X-4-03	5760-4B
371P-4-01	—
671CLU-4-035	5760-L4B
671CLU-4-038	—
671CLU-8-030	5760-T4A
671CPU-19-015	5760-T2A
671CPX-4-037	5760-4B
671CPX-4-038	—

(KOLLSMAN)

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VENDOR DATA SECTION
ENGINEERING DEPT.

27 MARCH 1950
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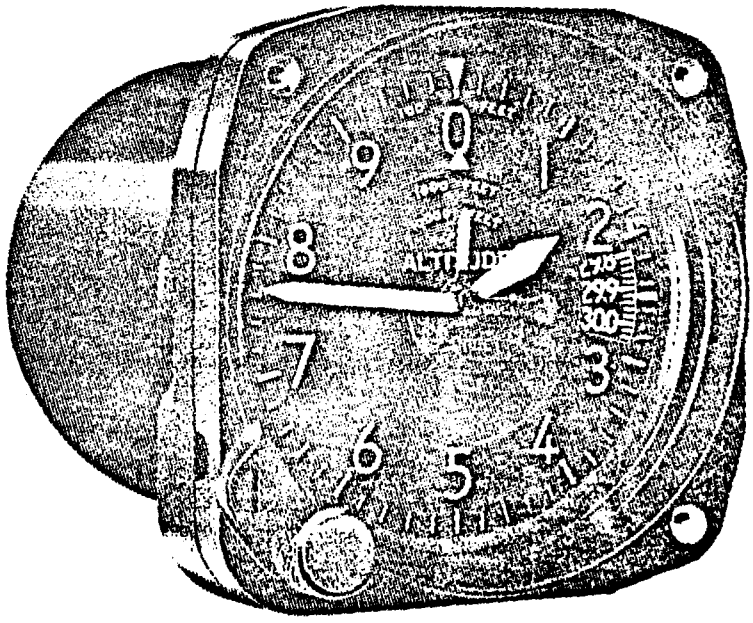


Figure 1—Sensitive Altimeter

SECTION I
INTRODUCTION

1-1. GENERAL.

1-2. This publication covers the overhaul and test procedures for the Sensitive Altimeter manufactured by the Kollsman Instrument Corporation, Elmshurst, New York. (See figure 1-1.)

1-2. The following are the type number designations:

Kollsman Type Number	*AN Type*	*Navy Stock Number*
371P-4-01	—	R88A0352-000-000
671CP-8-016	5760-4A	—

LEADING PARTICULARS

TYPE: 371P-4-01

RANGE: 35,000 feet

BAROMETRIC SCALE: 28.1 to 31.0 inches of mercury

ILLUMINATION:

Dial—AN-L-1
Barometric dial—AN-L-1
Pointers—AN-L-1

TYPE: 671CP-8-016

RANGE: 50,000 feet

BAROMETRIC SCALE: 28.1 to 31.0 inches of mercury

ILLUMINATION:

Dial—AN-L-1 and Matte Green G 6/6
Barometric dial—AN-L-1
Pointers—AN-L-1

Note

Overhaul and test procedures for additional models are included in Section IV by the use of Difference Data Sheets. The procedures are the same as in Sections II and III except for the specific differences noted by the applicable Difference Data Sheets.

1-4. The sensitive altimeter is for use on aircraft to indicate the height of the aircraft above some reference point (generally mean sea level), assuming standard conditions of temperature and pressure. The sensitive altimeter measures the existing ambient pressure. Since atmospheric pressure varies with altitude, this pressure is indicated on the dial in feet of altitude.

1-5. PRINCIPLES OF OPERATION. *(See figure 1-2.)*

1-6. The atmosphere surrounding the earth exerts a pressure due to its weight. This pressure is greatest at sea level (the standard reference point) or points below sea level, but decreases as altitude is increased. Due to meteorological variations, the atmospheric pressure varies over the surface of the earth and over a period of time at a particular location.

1-7. The altimeter operates because of these changes in pressure. When installed in an aircraft, the airtight case is connected to the free air in such a way as to transmit the static pressure to the inside of the case. As pressure within the case decreases with increase in altitude, the forces acting on the diaphragm assembly decrease.

1-8. The diaphragm assembly (1) is compressed by atmospheric pressure since there is no air within the cells. As pressure is decreased, the diaphragm assembly expands and as pressure is increased, the diaphragm compresses. This motion is transmitted to the rocking shaft (2) through the link and calibration arm, then to the large hand through the sector, intermediate pinion wheel (3) and handstaff pinion (4). Movement of the second and third hands comes from the pinion (5) pressed onto the main handstaff through the gear train of the top plate assembly.

1-9. Since pressures are constantly changing, a means of correcting for these changes is incorporated into the instrument. By turning the setting knob (6) at the lower left corner of the indicator, the barometric scale (7) can be set to the existing barometric pressure as received from the weather station. As the knob is turned, the mechanism within the case, as well as the barometric scale and reference marks, also turn. Thus, when the new barometric pressure is set in inches of mercury pressure, the hands of the indicator move the equivalent in feet of altitude. The relationship is based on standard conditions of pressure and temperature. The reference marks indicate barometric pressure in feet of altitude and are used when existing barometric pressure is greater or less than the pressure indicated on the barometric scale.

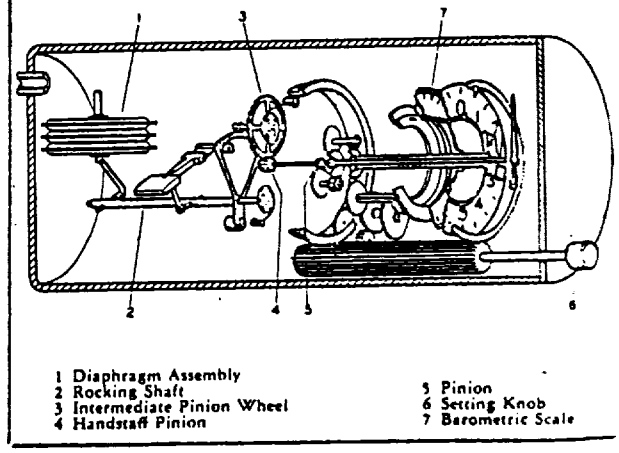


Figure 1-2. Schematic

SECTION II
OVERHAUL INSTRUCTIONS

2-1. SPECIAL OVERHAUL TOOLS REQUIRED.

Tool Number	*Nomenclature*	*Application*	*Figure No.*
TE583A	Calibration stand	To hold the mechanism during calibration	2-1
TE600B	Pressure chamber	Used as the chamber in which to operate the mechanism during calibration	2-2
TE628A	Wheel cleaning fixture	Used to hold the wheel for brushing	2-3
TE630A.1	Balance weight	To set the proper tension into the balance assembly	2-4
TE639	Vernier calibrating tool	Used to adjust the length of the calibration arm	2-5
TE5196	Diaphragm calibrating tool	Used to adjust diaphragm position when calibrating	2-6

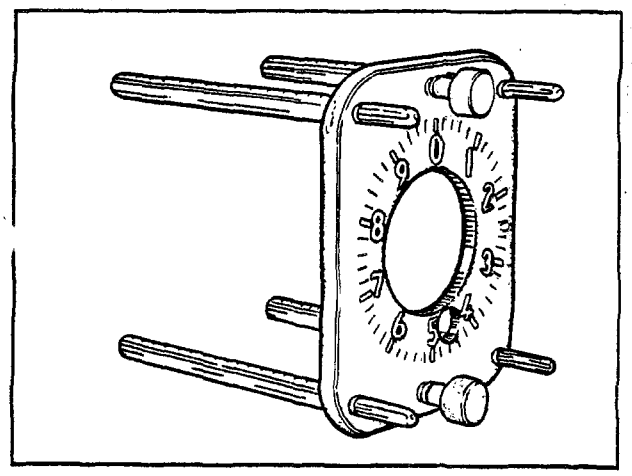


Figure 2-1. Calibration Stand (TE583A)

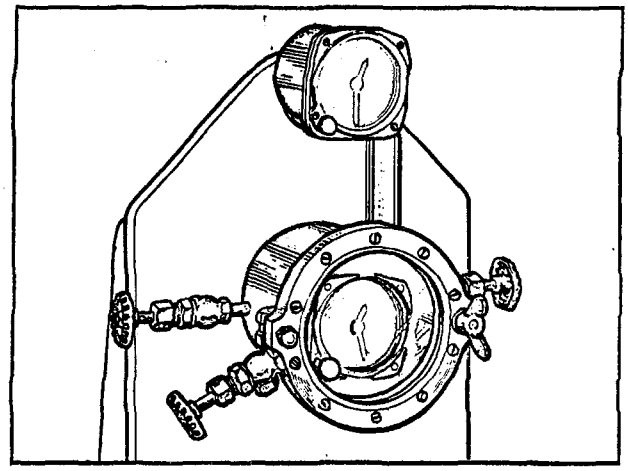


Figure 2-2. Pressure Chamber (TE600B)

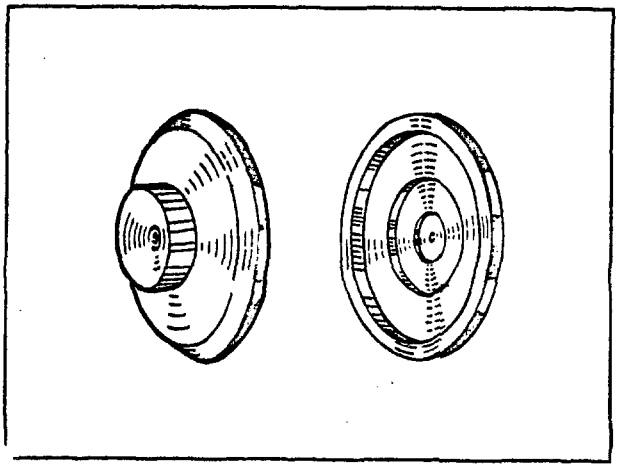


Figure 2-3. Wheel Cleaning Fixture (TE628A)

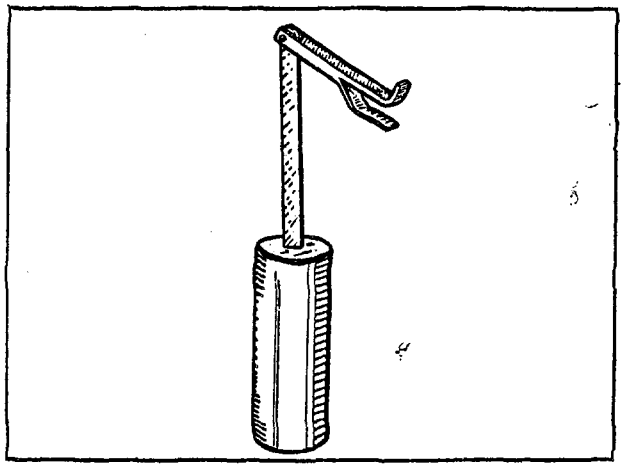


Figure 2-4. Balance Weight (TE630A.1)

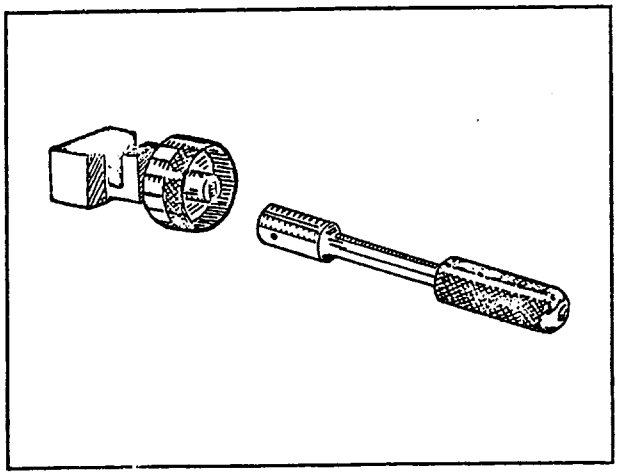


Figure 2-5. Vernier Calibrating Tool (TE639)

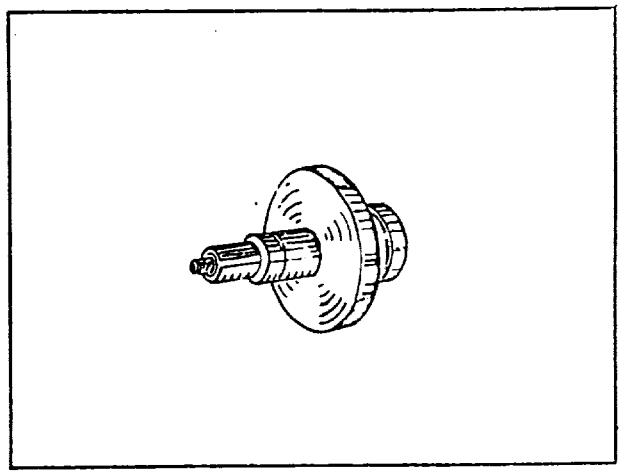
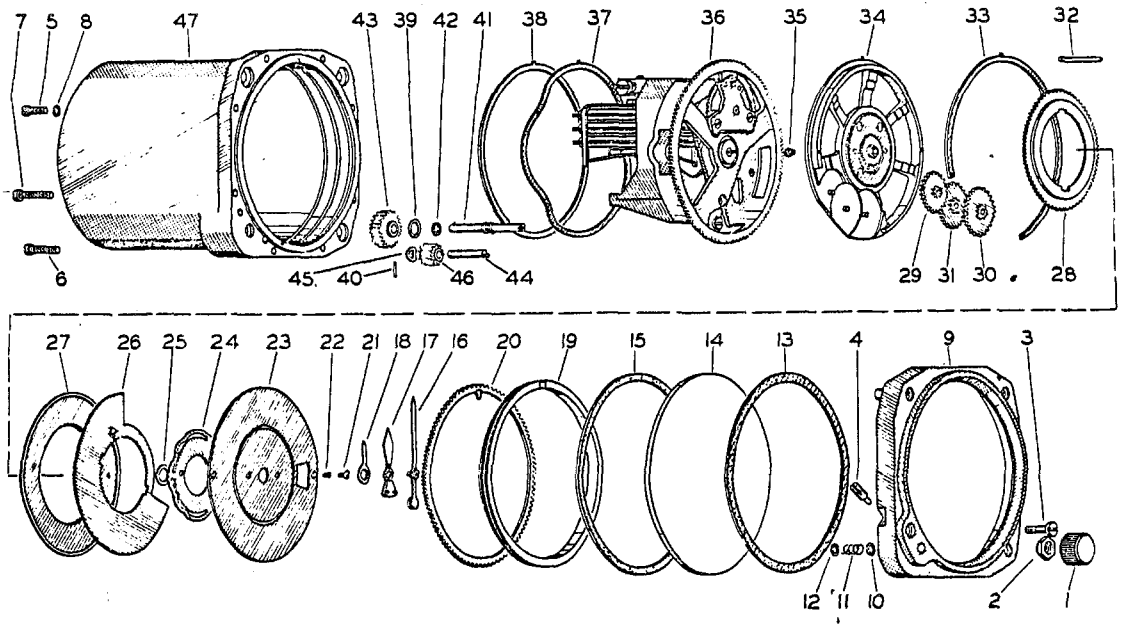


Figure 2-6. Diaphragm Calibrating Tool (TE5196)

2-2. DISASSEMBLY.

2-3. Malfunctioning of the instrument may generally be traced to certain troubles as listed in the following chart:

Trouble	*Probable Cause*	*Remedy*
FRICTION	Dirty pivots or jewels	Disassemble and clean.
	Cracked jewel due to excessive shock	Replace all cracked jewels. A cracked jewel will not only cause friction, but will damage a pivot if not replaced.
	Movable parts tarnished	Disassemble and clean.
	Second hand handstaff binding in bushing of upper bearing due to corrosion	Disassemble and clean.
	Insufficient end play	Reset end play.
	Links are binding, not aligned correctly	The links must work smoothly, without play on the bearing pins, and must be free of burrs.
	Poor bearing pins	The links must work smoothly, without play on the bearing pins, and must be free of burrs.
POINTERS INDICATING INACCURATELY	Shifting of parts due to shock	If no parts are broken, it may only be necessary to reset the barometric scale or recalibrate the instrument.
	Excessive pressures applied to static connection	
CASE LEAKS	Dried out leather washer at the adjustment knob stem	Replace leather washer.
	Dried out sealing gasket around the flange	Replace sealing gasket.
	Porous case	Replace with a new case.
POINTER OSCILLATES UNDER VIBRATION	Insufficient hairspring tension	Increase hairspring tension.
	Loose fitting bearing pins	Replace bearing pins.
	Insufficient tension on balance arm	Increase tension on balance arm.



1 Adjustment Knob
2 Locknut
3 Screw
4 Locking Stud
5 Screw
6 Screw
7 Screw
8 Lockwasher
9 Mounting Flange Assembly
10 Washer
11 Spring
12 Washer
13 Gasket
14 Cover Glass
15 Gasket
16 Large Hand Assembly
17 Intermediate Hand Assembly
18 Third Hand
19 Ring Assembly
20 Setting Ring
21 Dial Screw
22 Pin
23 Dial
24 Spacer
25 Ring
26 Shutter
27 Dial Assembly
28 Gear
29 Gear Assembly
30 Gear Assembly
31 Gear Assembly
32 Spring
33 Ring
34 Mechanism Assembly
35 Pinion
36 Mechanism Assembly
37 Spring Ring
38 Snap Ring
39 Snap Ring
40 Pin
41 Adjustment Knob Stem
42 Washer
43 Pinion
44 Idler Shaft
45 Spring Washer
46 Idler Gear
47 Case

Figure 2-7. Sensitive Altimeter

2-4. REMOVAL OF THE MECHANISM FROM THE CASE. *(See figure 2-7.)*

2-5. TYPE 371P-4-01.

a. Remove the knob (1) and the locknut (2) from the adjustment knob stem.

b. Unscrew the locking stud screw (3) located to the left of the knob stem. Remove the locking stud (4).

c. Remove the flange mounting screws (5, 6 and 7) and lockwashers (8). Lift off the flange (9), front washer (10), spring (11) and rear washer (12). Remove the paper gasket (13), glass (14) and the sealing gasket (15).

d. Remove the large hand (16), the intermediate hand (17) and the third hand (18). Remove the gasket centering ring assembly (19). Lift out the outer setting ring (20).

e. Remove the two dial scerws (21) and lift off the inner dial. Remove the two dial locating pins (22) and lift off the outer dial (23). Remove the spacer (24) and the ring wheel spacer (25). Remove the shutter (26), barometric dial assembly (27) and the setting mark gear (28).

f. Remove the gear assemblies (29, 30 and 31).

g. Remove the top plate mounting spring (32) and the snap ring (33).

h. Before removing the top plate mechanism (34), remove the three bearing plate screws. Lift off the top bearing plate assembly and the wheel assembly.

i. With a pair of parallel jaw pliers, grasp a spoke of the top plate and remove it from the case (47). See paragraph 2-19 for the disassembly and reassembly procedures of the top plate assembly (34).

j. Grasp a spoke of the mechanism body (36) and remove it from the case (47). See paragraph 2-20 for the disassembly and reassembly procedures for the case.

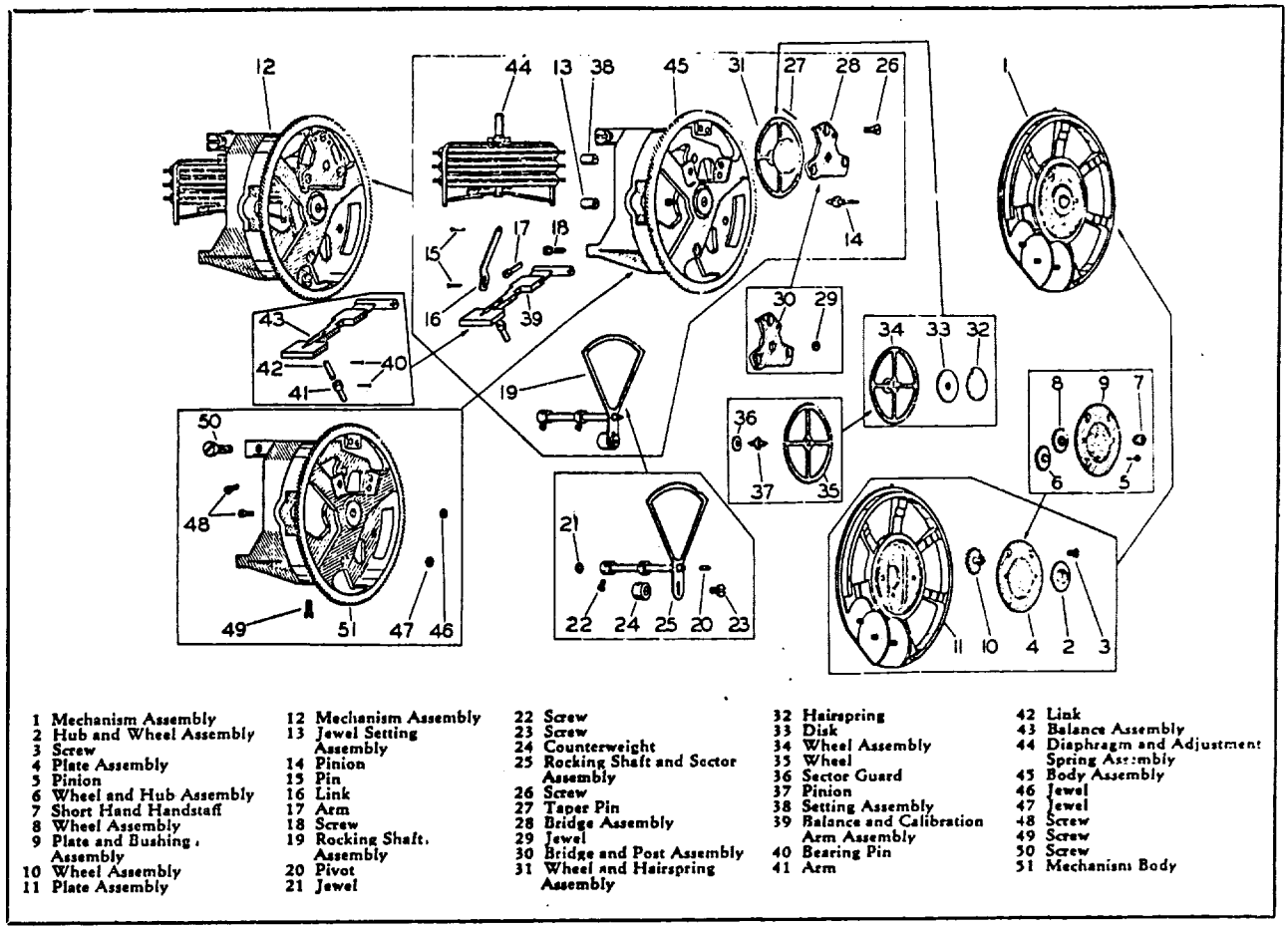
2-6. DISASSEMBLY OF THE MECHANISM. *(See figure 2-8.)*

a. Place the mechanism assembly, diaphragm down, in a suitable assembly stand. Loosen the handstaff jewel assembly clamp screw (48).

b. With the back end of a pair of tweezers, press down on the handstaff (14), pressing the jewel setting assembly (13) from the mechanism body.

CAUTION

Pressure should be applied evenly as any side pressure may break the handstaff.



1 Mechanism Assembly
2 Hub and Wheel Assembly
3 Screw
4 Plate Assembly
5 Pinion
6 Wheel and Hub Assembly
7 Short Hand Handstaff
8 Wheel Assembly
9 Plate and Bushing Assembly
10 Wheel Assembly
11 Plate Assembly
12 Mechanism Assembly
13 Jewel Setting Assembly
14 Pinion
15 Pin
16 Link
17 Arm
18 Screw
19 Rocking Shaft Assembly
20 Pivot
21 Jewel
22 Screw
23 Screw
24 Counterweight
25 Rocking Shaft and Sector Assembly
26 Screw
27 Taper Pin
28 Bridge Assembly
29 Jewel
30 Bridge and Post Assembly
31 Wheel and Hairspring Assembly
32 Hairspring
33 Disk
34 Wheel Assembly
35 Wheel
36 Sector Guard
37 Pinion
38 Setting Assembly
39 Balance and Calibration Arm Assembly
40 Bearing Pin
41 Arm
42 Link
43 Balance Assembly
44 Diaphragm and Adjustment Spring Assembly
45 Body Assembly
46 Jewel
47 Jewel
48 Screw
49 Screw
50 Screw
51 Mechanism Body

Figure 2-8. Mechanism Assembly

c. Lift the center pinion off the mechanism casting.

d. Remove the bearing pin (15) connecting the diaphragm link (16) and calibration arm (17).

e. Remove the bearing pin (40) connecting the balance link (42) and the arm (41).

Note

The two calibration arms (17) and (41) should be left in the rocking shaft (19). These arms are only moved for calibration and balancing.

f. Remove the rocking shaft pivot screw (18).

g. Lift the rocking shaft (19) straight up so the lower pivot clears the jewel, and remove it from the mechanism through the cutout provided in the front of the casting. See paragraph 2-18 for the repair of the rocking shaft assembly.

h. Remove the three bridge assembly mounting screws (26) and carefully pry the bridge loose from the mechanism body. Carefully turn the bridge assembly (28) over toward the center of the mechanism assembly. Holding the bridge assembly firmly at right angles to the mechanism, push the hairspring taper pin (27) free with pliers.

i. With tweezers inserted through the opening in the side of the casting, grip the pinion of the wheel and hairspring assembly (31) and lift it straight up so the lower pivot clears the jewel. Then move the assembly along the channel in the mechanism body and out of the mechanism. See paragraph 2-17 for the repair of the wheel and hairspring assembly.

j. Loosen the wheel jewel assembly clamp screw (48) and remove the jewel setting assembly (38).

Note

The balance assembly (39) and the diaphragm assembly (44) should not be removed from the mechanism body unless they are to be replaced.

k. Loosen the balance assembly clamp screw (49) and remove the balance assembly (39).

l. Loosen the diaphragm mounting screw (50) and remove the diaphragm and adjustment spring assembly (44) from the mechanism body (45).

2-7. FOR TYPE 671CP-8-016—The disassembly procedure for this type altimeter is the same as for type

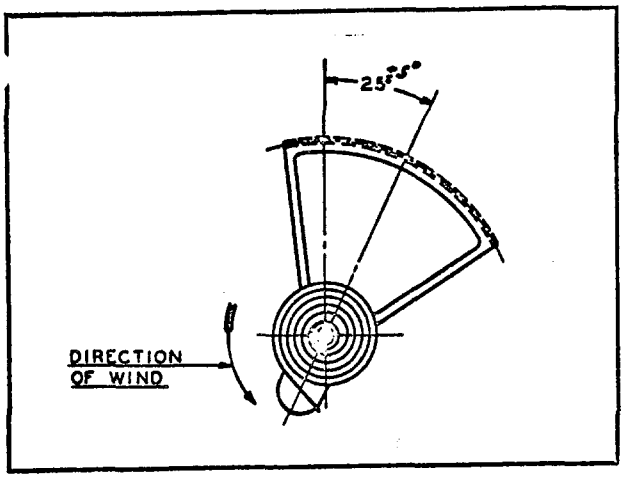


Figure 2-9. Direction of Hairspring on Rocking Shaft

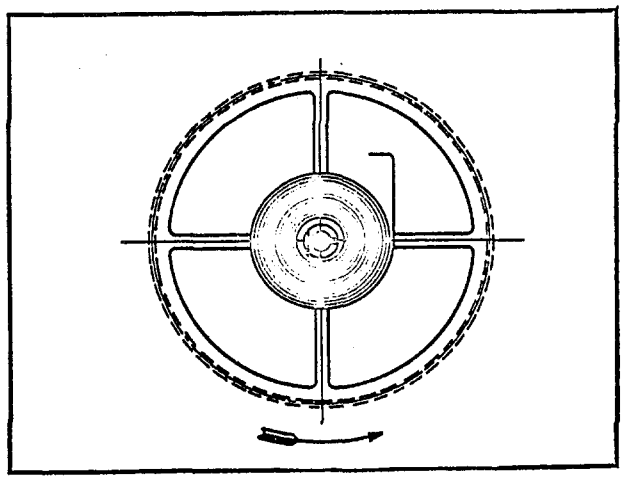


Figure 2-10. Position of Wheel Hairspring

371P-4-01 with one exception. The rocking shaft and sector assembly has a strong hairspring attached to it. Figure 2-9 shows the direction of wind and position of the end of the hairspring so that it will have ¾ to one turn tension when pinned at assembly.

2-8. *(Deleted.)*

2-8A. (Deleted.)

2-9. CLEANING.

2-10. GENERAL—All parts should be cleaned by washing in clean benzine or some other suitable cleaning solution and dried with dry air from a hose. Pivots are cleaned by pressing the pivot into the end grain of dry featherwood and twirling it between the fingers. Jewels and bearing holes are cleaned by twirling the sharpened end of a pegwood stick in the hole. Sector and pinion teeth are cleaned by brushing with a #2 watchmaker's brush dipped in benzine.

2-11. INSPECTION.

a. Inspect all gear teeth for wear or damage.

b. Inspect the jewels for chips or cracks.

c. All pinions and pivots must be free from corrosion and their polished surfaces must have a mirror-like finish.

d. The hairspring must be of proper length and in good condition.

e. The bearing holes in the links must not be worn.

f. Both compensating pins of the aneroid diaphragm must rotate from very light finger pressure.

2-12. TESTING.

2-13. WHEEL AND HAIRSPRING ASSEMBLY.

a. With a pin vise hold the wheel in a vertical plane and check the position of the hairspring. It should be parallel to the disk and the coils should lie in the same plane. (See figure 2-10.)

b. Check the concentricity of the wheel in a truing caliper. Any eccentricity will be apparent by comparison with a fixed guide. The concentricity may also be checked by spinning the wheel in a jeweler's lathe and checking its periphery against a guide.

CAUTION

If the hairspring is mounted on the wheel, do not spin the wheel at high speed as to do so will destroy the hairspring.

2-14. Check that the sector and hairspring are tight on their respective shafts.

2-15. REPAIR.

2-16. JEWELS—To remove a jewel from one of the assemblies, support the unit in a suitable manner and tap it out. Replace the jewel by tapping it into place from the opposite side. The removal and replacement of the rocking shaft assembly jewel is described in paragraph 2-18.

2-17. WHEEL AND HAIRSPRING ASSEMBLY.

a. Hold the wheel assembly in a pin vise. Place a *jeweler's screwdriver between the disk and the hairspring* collet and pry the hairspring from the staff. Before replacing the hairspring, the collet must be squeezed together to assure a tight fit.

b. To remove the wheel pinion, support it on a suitable staking frame and tap it out.

2-18. ROCKING SHAFT ASSEMBLY. *(See figure 2-8.)*—The calibration arms should not be removed from the rocking shaft unless they are damaged.

a. JEWEL—Place the rocking shaft (19), jewel end up, in the clamp similar to that shown in figure 2-11 and hold the clamp in a vise. With a scriber or other sharp pointed tool, break up the jewel (21) and remove

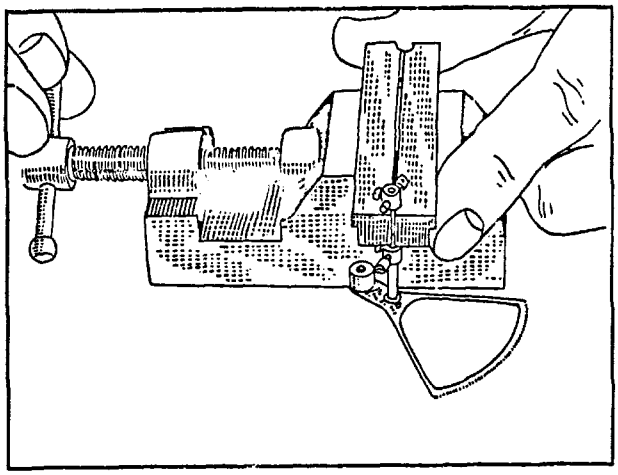


Figure 2-11. Rocking Shaft Held in Clamp

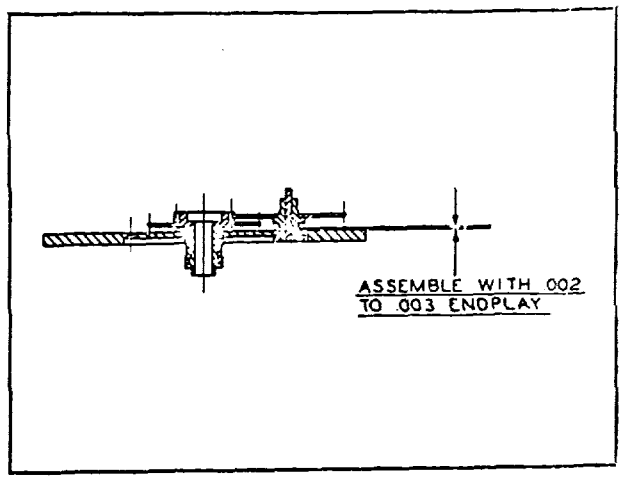


Figure 2-12. Bearing Plate

all fragments. With a No. 53 drill held in a pin vise, drill through the jewel setting. Obtain a 1-72 tap and grind the end flat. Holding it in a pin vise, screw it one or two turns into the jewel setting. Pull the setting out of the shaft. Place a new jewel setting assembly on the shaft so the flat face is up and tap it into place with a suitable punch.

b. PIVOT—Chuck the shoulder of the pivot (20) in a jeweler's lathe and carefully pull the assembly away from the pivot with a slight twisting motion. To replace the pivot, place the rocking shaft in the clamp (as shown above for replacement of jewel) and hold the clamp in a vise. Tap the new pivot into place using a suitable punch.

Note

If the pivot is loose, squeeze the end of the shaft in a collet of a jeweler's lathe to make the hole smaller before pressing in the pivot.

2-19. TOP PLATE ASSEMBLY. *(See figure 2-8.)*

a. HANDSTAFF—Place the bearing plate (4) on a staking frame with the handstaff in a suitable hole and the wheel up. With a suitable punch, tap the short hand handstaff (7) free of the wheel (8). Place the handstaff in a suitable hole in the staking frame so its shoulder rests on the table. Locate the bearing plate (9) on the handstaff, then place the wheel (8) on the staff and tap it in place with a suitable punch. Figure 2-12 shows the arrangement of the parts.

b. REMOVAL OF THE INTERMEDIATE PINION AND WHEEL—While holding the top bearing plate (4) press the staff of the intermediate pinion (5) with the back end of a tweezer until it is flush with the intermediate wheel and hub assembly (6). Place the pointed ends of the tweezers between the bearing plate and the wheel and pry off the wheel and hub assembly.

CAUTION

Use care when prying off the wheel assembly so as not to bend the staff of the pinion.

c. REPLACEMENT OF THE INTERMEDIATE PINION AND WHEEL—Insert the staff of the intermediate pinion (5) in the bearing hole from the front side of the plate. While holding the pinion in place with the finger, place the intermediate wheel and hub assembly (6), shoulder down, on the pinion staff. Place the assembly on the table of a staking frame so the hub of the intermediate wheel and hub assembly is in a suitable hole. Insert a 0.003 inch feeler gage between the intermediate wheel and the bearing plate. Press the pinion down and remove the feeler gage.

d. CHECKING THE ASSEMBLY FOR FRICTION—Reassemble the unit, being careful that the wheel assembly pivots are in the bearing holes when securing the top bearing plate (4) to the top plate (11). Use a short hand with the weighted end cut off and the paint removed. Press the hand onto the handstaff. Hold the assembly so the prepared hand is in a vertical plane, then turn the plate between the fingers. Any friction will be indicated by the tendency of the hand to rotate with the assembly. Any existing friction must be removed before replacing the unit in the case.

2-20. CASE ASSEMBLY. *(See figure 2-7.)*

a. REMOVAL OF THE ADJUSTMENT KNOB STEM AND LEATHER WASHER—Pry the snap ring (39) from the groove and push the pin (40) out of the stem (41). Remove the stem. Examine the leather washer (42). If conditions warrant, replace it.

b. REPLACEMENT OF THE ADJUSTMENT KNOB STEM AND LEATHER WASHER—Before the leather washer is replaced it must be soaked in a hot mixture of the following:

Beeswax	60 parts by weight
Tallow	20 parts by weight
Vaseline	20 parts by weight

c. After soaking in this mixture, withdraw the washer and remove the excess solution. Replace it in the recess of the case smooth side up. Replace the snap ring (39) on the hub of the pinion (43) but not in the

groove. Place the pinion in the recess of the case with the hub toward the front. Insert the stem (41) through the case into the hub of the pinion. Align the holes, insert the pin (40) and secure it with the snap ring (39).

d. REMOVAL OF THE IDLER GEAR—Do not remove the idler gear (46) unless it is absolutely necessary, as the idler shaft (44) must be sealed airtight. If it is necessary, place the case, front down, on a wooden block with the idler shaft over a suitable hole in the block. Tap the idler shaft out of the case with a pin punch.

e. RELACEMENT OF THE IDLER GEAR—Place the case, front up, on the bench. Place the spring washer (45) and the idler gear (46), hub down, in the recess of the case. The spring washer is toward the rear of the case. Insert the shaft (44) through the case tapping it into place with a suitable punch. Place a few drops of a suitable sealing compound on each end of the idler shaft.

2-21. LUBRICATION.

a. A powdered lubricant, if used on each end of the compensating pins of the aneroid diaphragm, will improve the performance and substantially reduce the hysteresis errors of the sensitive altimeter. The lubricant may be purchased from the Alpha Corporation, Greenwich, Conn., as Molykote, Type M.

b. Note in which detent the compensating pins are located. Carefully remove the pins. Fill the detents with the powdered lubricant. Replace the pins and with the fingers, using very little pressure, roll the compensating pins between the two bearing surfaces. Remove the pins and again fill the detent with the lubricant. Repeat this cycle until it is certain that a minute amount of the powdered lubricant is packed into the detent. When properly lubricated, the compensating pins will rotate smoothly from extremely light pressure. Remove the excess lubricant from the surfaces of the compensator and diaphragm centerpiece.

2-22. REASSEMBLY. *(See figure 2-8.)*

2-23. TYPE 371P-4-01.

a. Before assembling the mechanism, check the fit between the center hole of the top plate casting (11) and the center boss of the mechanism body (45).

b. Place the top plate on the mechanism body and check the action by slowly rotating the top plate. There should be no side play and the fit should permit a smooth action.

c. Insert the straight end of the link (16) in the slot of the diaphragm centerpiece and secure it with a new bearing pin (15). Bend and secure the bearing pin so it cannot turn in the bearing hole. Hold the diaphragm assembly (44) so the link hangs down and check the action of the parts by slowly rocking the diaphragm. There should be no play on the bearing pin, yet the parts should not bind.

d. Replace the diaphragm assembly (44) in the mechanism body (45) and secure it with the clamping screw (50). Replace the balance assembly (43) in the mechanism body and secure it with the clamping screw (49).

e. Replace the wheel jewel assembly (38) and secure it with the screw (48).

f. Insert the wheel and hairspring assembly (31), hairspring up, through the cutout in the mechanism body and place the pivot into the lower jewel (38). Hold the bridge assembly (28) over the mechanism and insert the hairspring into the post. Secure it with a new taper pin (27) and cut off the excess pin. The hairspring should be adjusted in such a way that the first leaf is parallel to the bridge plate. Secure the bridge assembly to the mechanism with three mounting screws (26).

CAUTION

Be certain that none of the hairspring convolutions are between the mechanism body and the bridge plate when securing the bridge plate to the mechanism.

g. Adjust the end play of the wheel and hairspring assembly (31) to 0.002 inch by moving the jewel setting assembly (38) in the mechanism body. The hairspring should be evenly spaced between the hairspring disk and the surface of the top plate and all the convolutions should lie in the same plane. Approximately three or four coils of the spring should extend past the disk opposite the hairspring post.

h. Check the freedom of movement of the wheel and hairspring assembly. Place the mechanism body, diaphragm up, on the assembly stand. With the hairspring relaxed, rotate the wheel 1/4 turn and allow it to swing free. It should return to its original position within 1/8 inch.

i. Insert the rocking shaft assembly (19) through the cutout of the mechanism body.

CAUTION

When inserting the rocking shaft, great care must be exercised not to damage the teeth of the sector or wheel assembly.

j. Adjust the rocking shaft assembly by repositioning the pivot screw (18) until an end play of 0.003 inch is obtained.

k. The sector should track approximately in the center of the wheel pinion of the wheel and hairspring assembly (31) and in one plane. Lift up or press down on the spokes of the sector until the correct alignment is obtained.

CAUTION

When checking the tracking of the sector, care must be exercised not to allow the wheel to run out of mesh while tension is applied to the hairspring, as this will cause the wheel to rotate rapidly and damage the hairspring.

l. With the mechanism on the assembly stand, diaphragm up, turn the rocking shaft in a clockwise direction until the sector is disengaged from the wheel pinion and allow the wheel to come to rest with no tension on the hairspring.

m. Hold the rocking shaft in this position by pressing against the counterweight and with a toothpick turn the wheel counterclockwise six revolutions (24 spokes) to apply tension to the hairspring. With this tension maintained on the hairspring, slowly re-engage the sector with the wheel pinion.

CAUTION

After tension has been applied to the hairspring and the wheel pinion engaged with the sector, the sector must be held at all times until the rocking shaft assembly is connected to the diaphragm assembly with the link. If this is not done the hairspring tension will disengage the pinion from the sector and cause damage to the hairspring.

n. With tweezers hold the diaphragm link in line with the slot in the calibration arm of the rocking shaft and slowly move the sector by its countrweight until the bearing hole in the link and the bearing hole in the calibration arm are aligned. Insert a new bearing pin in the aligned holes.

o. With a small pair of needle-nose pliers press the head of the pin until it "bites" into the calibration arm. Bend the pin at the arm and toward the rocking shaft. Test the freedom of the link. It should have no play on the bearing pin but yet should not bind in the calibration arm.

p. A special balance weight (TE630A.1) is necessary in order to adjust the balance arm tension properly. Figure 2-13 illustrates the application of this weight. It should be noted that reference "A" shows a clearance of 1/32 inch between the weight and the mechanism body when the weight is suspended on the balance arm. To correct any error in tension of the balance arm, turn the balance assembly post and secure the balance with the clamp screw (49).

Note

The spring of the balance assembly should follow a straight line from the post to the end of the arm. A slight curve is permissible. If the spring has more than a slight curve after it is set, it may be too weak and the assembly should be checked by placing the altimeter in a pressure chamber and subjecting it to minus 1500 feet, then to the maximum range of the instrument. The balance assembly must not contact the mechanism assembly or the diaphragm.

q. Check the alignment of the balance link assembly with the slot in the arm in the rocking shaft. The balance assembly must be adjusted so that the link is

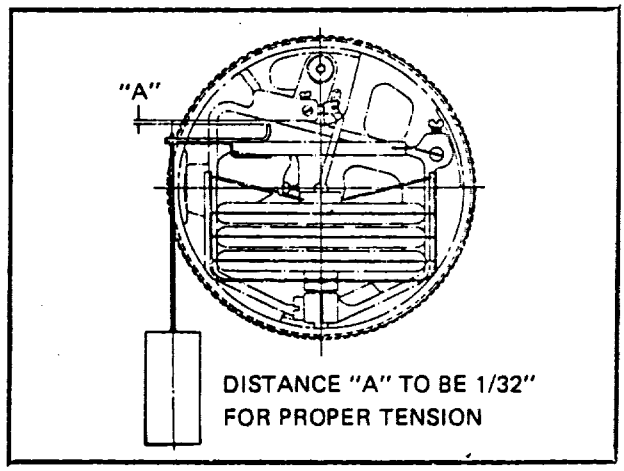


Figure 2-13. Application of Balance Weights

parallel with the slot, so as to move in it without binding. Insert the link in the slot and secure it with a new bearing pin.

r. Place the handstaff pinion (14) into the jewel in the mechanism body. Replace the handstaff jewel assembly (13) and adjust it until an end play of 0.003 inch is obtained. Secure it with the screw (48).

2-24. FOR TYPE 671CP-8-016—The reassembly procedure for type 671CP-8-016 is the same as for type 371P-4-01 with two exceptions.

a. Secure the rocking shaft hairspring so that it has from ¾ to one turn tension.

b. When applying tension to the wheel assembly hairspring as described in paragraphs 2-23 l and m, 6¾ revolutions (27 spokes) tension must be applied to the hairspring for this type of instrument.

2-25. (Deleted.)

2-25A. (Deleted.)

2-26. CALIBRATION.

2-27. CHECKING BEFORE CALIBRATION.

Note

The calibration procedure as outlined in the following paragraphs applies to all altimeters covered in this publication, regardless of their range.

2-28. CHECKING FOR BALANCE—The balance arm on the rocking shaft controls the position error of the instrument in the normal operating position and 180° from this position. The sector counterweight controls

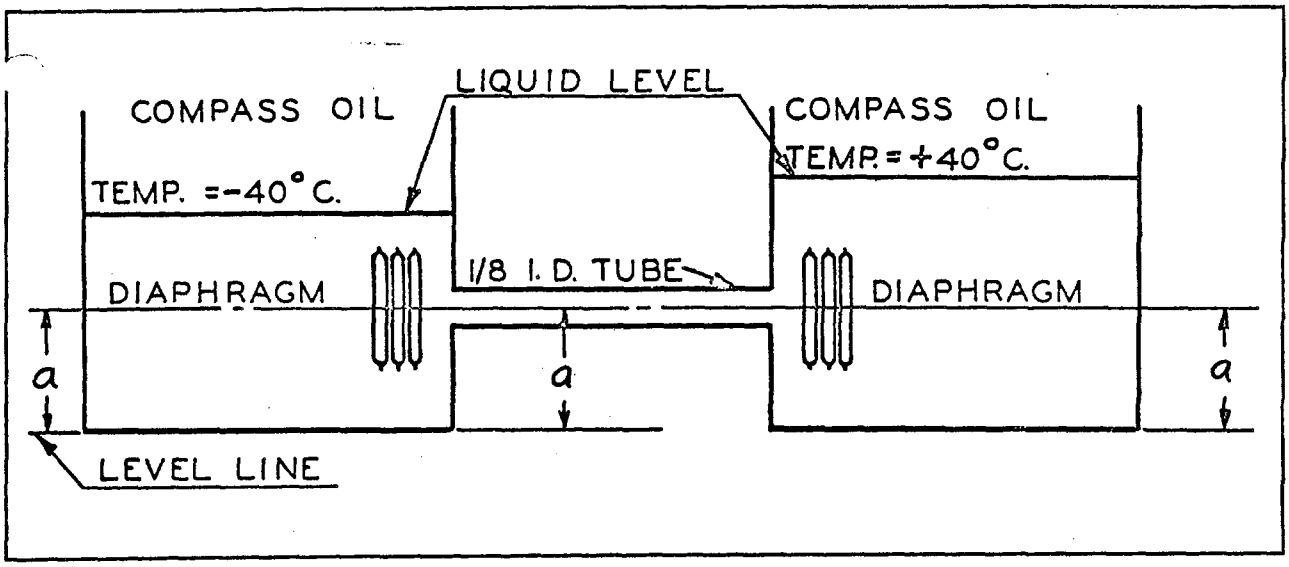


Figure 2-14. Schematic of Compensating Baths

the position error at 90° and 270° from the normal operating position.

a. Mount the mechanism in the calibration stand (TE583A) so the wheel assembly is at the zero position and place the stand, dial up, on the bench. Lightly press a balanced hand on the handstaff so it indicates zero. With the mechanism in the calibration stand and the hand pressed onto the handstaff at an indication of zero, hold the instrument dial vertical with the "0" on top. Tap the stand and note the reading. Turn the instrument 180 degrees (this places the "0" at the bottom) and, after tapping, note the indication of the hand. If the hand has moved clockwise (plus error) by more than 20 feet, correct the error by shortening the effective length of the calibration arm to which the balance is connected. If the error is minus, the effective length of the calibration arm must be increased.

b. Hold the mechanism dial vertical with the "0" on top. Tap the stand and note the reading. Turn the instrument 90 degrees counterclockwise. This places the zero at the left (9 o'clock). After tapping, note the indication of the hand. If the hand has moved clockwise (plus error) by more than 20 feet, correct the error by shifting the position of the sector counterweight toward the rocking shaft. If the error is minus by more than 20 feet, the counterweight should be moved away from the rocking shaft.

c. Alternate between the two adjustments until a maximum position error of ±5 feet is obtained.

2-29. TEMPERATURE COMPENSATION—Temperature compensation of an altimeter is necessary only if the bracket or adjustment nuts have been disturbed, or if the compensator pins have fallen out and their original location cannot be determined.

2-30. TEST EQUIPMENT — Temperature compensation is greatly facilitated if a chamber is used in which the air temperature can be regulated to give an overall change of 80°C (144°F). This allows testing and adjustment of altimeter temperature compensation with the greatest convenience. If such a chamber is not available, the altimeter mechanism can be subjected to the required variation of temperature by first placing it in a cold bath of kerosene or compass liquid, and then in a hot bath; or if only one vessel is available, the cold reading of the mechanism can be taken at room temperature, followed by heating the bath to a temperature +80°C (+144°F) above room temperature before taking the second reading. If liquid baths are used, there should be a third bath maintained at room temperature. The mechanism should be transferred to this bath before being immersed in the extreme temperature bath so as to permit it to change temperature more slowly and avoid cracking jewels.

Note

The procedure for temperature compensation in a chamber in which air temperature can be regulated is the same as that described below for the liquid bath method of temperature compensation.

a. The baths will give different hydro-static pressures at the same depths, according to the specific gravity of the liquid at each temperature. Thus if compass oil is used, the mechanism should be submerged 8 percent deeper in the warm bath than in the cold bath to equalize the hydro-static pressure. However, the need for different immersion depths may be avoided by connecting the two baths with a small tube. (See figure 2-14.) Tests are usually made at +40°C (+104°F) and —40°C (—40°F).

b. Select two vessels, each large enough to contain the mechanism, and connect them with a 1/8-inch copper tube (inside diameter) making certain that the tube

openings in each bath are opposite the center of the diaphragm. Also make sure that the baths are on the same level plane. Fill the vessels with enough liquid to cover the pointer of the mechanism.

c. Liquid in the hot bath can be heated safely by using one or more electric immersion heaters, or by a coil in the bath, through which hot water or steam is circulated.

CAUTION

Avoid fires. Do not heat the bath with an open flame or permit smoking or any spark or flame in the same room. The bath is heated to a temperature well above the flashing and burning points in the case of kerosene and certain volatile and inflammable constituents of the liquid are distilled off during heating. Work in a place with good ventilation and safe exits. Keep an extinguisher, for oil fires, within reach.

d. Liquid in the cold bath can be cooled in a refrigerator, or by a coil in the bath through which a refrigerant is circulated, or by placing in the bath one or more open metal vessels containing carbon dioxide, "dry ice." If the temperature cannot be lowered to —40°C (—40°F) and held there during the test period, raise the temperature of the hot bath until it is +80°C (+176°F) above that of the cold bath.

e. If it is not possible to have a difference of +80°C (+144°F) between the hot and cold baths, a smaller difference may be used, but the allowable change of reading shown in Table I will be proportionately reduced. If the temperature difference is +40°C (+104°F) the allowable change of reading is half the allowable change with an +80°C (+176°F) temperature change.

f. Fluctuations in atmospheric pressure during compensation testing must be taken into account. These changes in pressure may be noted in terms of feet of altitude from another standard altimeter. For instance, if the standard altimeter indicates 140 feet at the start of the compensation test and 170 feet when the test is completed, the mechanisn undergoing the compensation test also will have changed plus 30 feet during the same time. This error must be subtracted algebraically from the reading obtained from the test instrument in order to arrive at the true compensation. In the short period of the bath test, atmospheric pressure variations may or may not occur. Generally they are of such slight magnitude as to be negligible. During a 2-hour ice box test, however, appreciable changes in atmospheric pressure may take place.

2-31. Bring the baths to their proper temperatures [(usually +40°C (+104°F) and —40°C (—40°F)] and stir the liquid in each bath to insure uniform temperature throughout.

a. Place the altimeter mechanism in the calibration stand (TE583A).

b. With the hand at "0", immerse the mechanism in the cold bath for five minutes. Tap the frame lightly and record the reading. Any reading other than zero is an error.

Note

Agitate the liquid before taking a reading. When tapping the mechanism, the strokes should be made vertically. Horizontal tapping may move the mechanism sideways and so shift the sector position.

c. Remove the mechanism, reset to "0" and immerse it in the hot bath for five minutes. Tap the frame again and record the reading.

CAUTION

To avoid cracking jewels, allow the mechanism to warm up at room temperature. This is best done by immersing it in a bath at room temperature before placing it in the hot bath.

d. If the reading in the hot bath does not differ from the reading in the cold bath by more than the tolerances specified in Table I, the temperature compensation is satisfactory and no further adjustment is required.

TABLE I

Temperature Difference	*For 35,000 ft. Altimeters*	*For 50,000 ft. Altimeters*
Degrees Centigrade	*Tolerance Feet*	*Tolerance Feet*
80	+40	+50
60	30	40
40	20	30

Note

Table II shows the progression of error throughout the range of an instrument with the maximum allowable error at zero feet altitude; therefore, to maintain a minimum error at various altitudes, it is important to compensate the diaphragm as near to zero error as possible.

TABLE II

35,000 Foot Altimeters		*50,000 Foot Altimeters*	
Altitude in Feet	*Allowable Change of Reading in Feet*	*Altitude in Feet*	*Allowable Change of Reading in Feet*
0	± 40	0	± 50
6,000	± 70	6,000	±100
12,000	± 90	12,000	±175
18,000	±125	18,000	±275
25,000	±175	25,000	±375
35,000	±250	35,000	±525
		50,000	±750

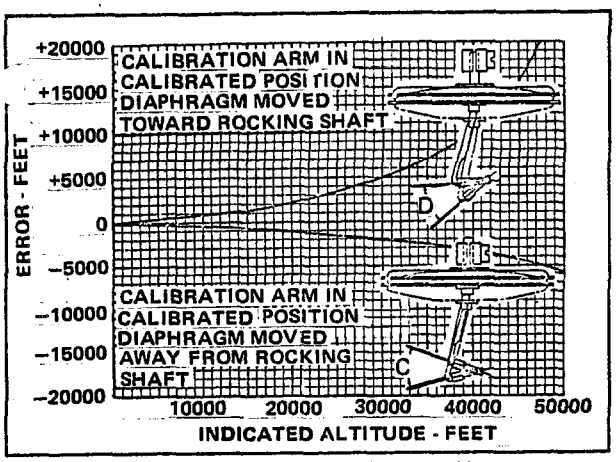


Figure 2-15. Effect of Diaphragm Movement on Calibration

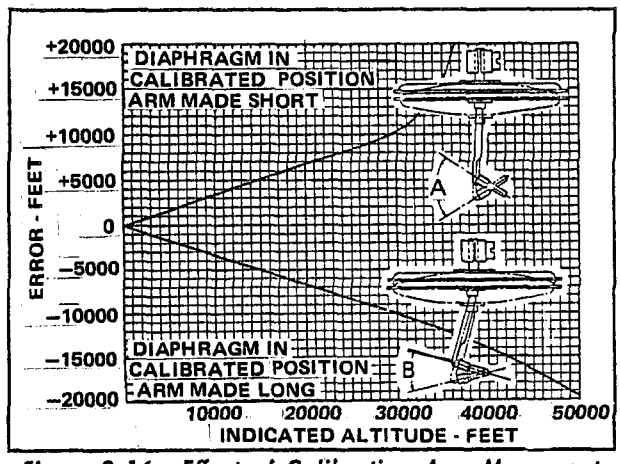


Figure 2-16. Effect of Calibration Arm Movement on Calibration

2-32. If the difference in hot and cold bath readings exceeds the tolerance shown in Table I, adjustment of the temperature compensator is necessary.

a. When the hot bath reading is greater than the cold bath reading by 50 feet or more, move both of the push rods (pins) between the diaphragm and the compensator bracket, into the next notch in the bracket, toward the diaphragm. Move the rods, one at a time by grasping the compensator bracket with tweezers and twisting lightly to spring the bracket away from the end of the rod while shifting the rod by grasping it with another tweezer. A movement of 1 notch gives a correction of from 50 to 65 feet in the reading.

b. When the original hot bath reading is less than 50 feet above the cold bath reading or when the remaining error after shifting the push rods is still clockwise, giving a reading that is too high, turn the diaphragm support nut, between the compensator bracket and the mechanism body, so it moves away from the diaphragm. Turn the second diaphragm support nut, between the compensator bracket and the diaphragm, in the same direction. A ¼ turn of the diaphragm support nut results in a correction of 10 feet.

c. When the hot bath reading is 50 feet or more below the cold bath reading, move each of the push rods to the next notch in the compensator bracket, away from the diaphragm.

d. If the original hot bath reading is less than 50 feet below the cold bath reading, or when the remaining error after shifting the push rods is still less than the cold bath reading, turn the diaphragm support nut, between the compensator bracket and the diaphragm, so it moves toward the diaphragm, then turn the second diaphragm support nut in the same direction.

e. When temperature compensation is completed, if the altimeter was placed in a liquid bath, disassemble the mechanism and clean all parts thoroughly to remove the film of oil, paying particular attention to the hairspring.

Note

Use of the adjustable centerpiece on current altimeters has greatly simplified compensation adjustments. The new centerpiece is made of beryllium copper which is a harder material than was formerly used on the old type centerpiece and, therefore, assures a more friction-free bearing surface for the compensator pins. The compensation procedure is basically the same with the exception that now close adjustments are made with the adjusting screw on the centerpiece instead of the two locknuts which were formerly used. A rough compensation may be obtained by positioning the compensating pins in the dimples of the compensator. Each dimple will correct an error of approximately 60 feet. By increasing the angle between the compensating pins and the centerpiece, a plus error can be corrected. Conversely, a lesser angle will correct a minus error. If the distance between dimples is too great and does not permit satisfactory compensation, it may be further adjusted by turning the screw on the centerpiece. To correct a plus error turn the screw out; to correct a minus error turn the screw in. Each revolution of the screw will correct an error of approximately 80 feet.

2-33. CALIBRATION PROCEDURE.

TABLE III

Standard Altitudes	*Equivalent Atmospheric Pressure*		*Scale Error Tolerance*	
	Mercury		*35,000 ft. Altimeters*	*50,000 ft. Altimeters*
feet	*mm*	*inches*	*feet*	*feet*
0	760.0	29.92	± 25	± 25
5,000	632.4	24.89	40	75
20,000	349.1	13.75	100	150
35,000	178.7	7.04	200	250
50,000	87.3	3.44	—	550

Note

The calibration points listed in Table III are the primary check points to be used during calibration.

2-34. Either a change of diaphragm position or a change in the length of the calibration arm "speeds up" or "slows down" the mechanism with a corresponding increase or decrease in the rate of hand rotation between zero and maximum altitude.

2-35. Shifting the diaphragm position changes the speed of rotation at high altitudes more than at low altitudes. Shifting the diaphragm toward the rocking shaft "speeds up" the mechanism while shifting it away from the rocking shaft "slows down" the mechanism. (See figure 2-15.)

2-36. Changing the length of the calibration arm causes a change in the speed of rotation throughout the range. Adjustment of the calibration arm "speeds up" or "slows down" the mechanism throughout the entire range. (See figure 2-16.)

2-37. By a combination of both adjustments, the speed of rotation can be selectively increased or decreased in the low, middle, or high altitude ranges.

2-38. CALIBRATION RATIOS (35,000 feet).

2-39. The following ratios may be applied when shifting the calibration arm or the diaphragm in relation to the correction obtained in the instrument indication. They are approximate but will help in the calibration procedure. The figures for the calibration arm are based on a final change in reading of the instrument caused by turning the drum of the vernier calibration tool (TE639) one segment. The figures for the diaphragm are based on a final change in reading of the instrument for an initial change in reading, caused by moving the diaphragm.

Method	*Ratio*	*Altitude*
Calibration arm	1 to 1	5,000 feet
Calibration arm	7 to 1	35,000 feet
Diaphragm	1 to 35	5,000 feet
Diaphragm	1 to 1	35,000 feet

2-40. If the calibration arm is adjusted with the vernier calibration tool so the drum moves the distance between two graduations, the change in indication at 5,000 feet will be approximately 20 feet and at 35,000 feet the change will be seven times as great or approximately 140 feet.

2-41. If the diaphragm is shifted so that the hand indicates a change of 350 feet, the change in indication at 35,000 feet will be 350 feet and at 5,000 feet the change will be 35 times less or approximately 10 fee.

2-42. Using the above ratios, corrections in scale readings may be approximately calculated when working with both the calibration arm and diaphragm corrections at the same time.

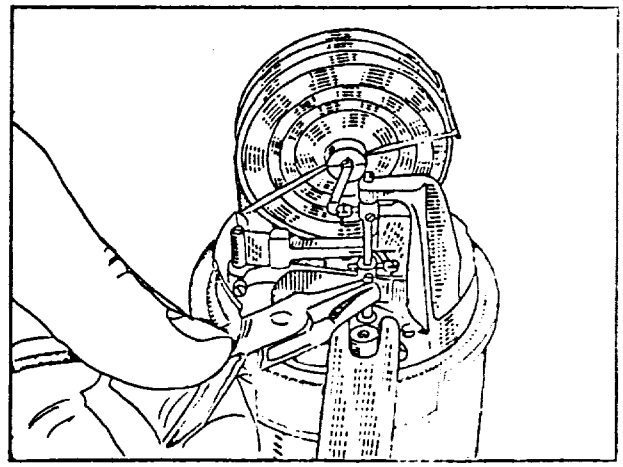


Figure 2-17. Shifting Sector of Rocking Shaft

EXAMPLE

Move arm +20 feet and diaphragm —350 feet

Correction Applied	*Change at 5,000 feet*	*Change at 35,000 feet*
Arm +20 feet	+20 feet	+140 feet
Diaphragm —350 feet	—10 feet	—350 feet
Total Correction	+10 feet	—210 feet

2-43. CALIBRATION RATIOS (50,000 feet range).

2-44. If the calibration is adjusted with the vernier calibration tool so the drum moves the distance between two graduations, the change in indication at different altitudes will be as follows:

approximate change of 20 feet at 5,000 foot indication
approximate change of 100 feet at 20,000 foot indication
approximate change of 150 feet at 35,000 foot indication
approximate change of 350 feet at 45,000 foot indication

2-45. If the diaphragm is shifted so that the hand indicates a change of 1,000 feet the change in indication at different altitudes will be as follows:

a change of 1,000 feet at 50,000-foot indication, created by shifting the diaphragm, causes an

approximate change of 500 feet at 45,000 foot indication
approximate change of 325 feet at 35,000 foot indication
approximate change of 125 feet at 20,000 foot indication
approximate change of 15 feet at 5,000 foot indication

Note

The following are not inflexible rules, but are to be used as a guide in judging irregular pointer movement. From "0" to 25,000 feet, without vibration, the hand must not jump more than an indication of 100 feet, and from 25,000 to 40,000 feet the hand must move smoothly although not necessarily regular when vibration is applied with a type A-11, size 2, 8-volt, Edwards bozzer operating on 60-cycle current.

Note

The following observations are hints as to where friction will be found. If a noticeable sticking or jumping occurs every revolution of the hand, examine the handstaff. In this event the handstaff may be too large. To overcome this, "mike up" several staffs and use the smallest one found. If a noticeable sticking or jumping occurs once in each 12,000 feet of indication, examine the wheel, of the wheel and hairspring assembly for corrosion, a burr between teeth, or a damaged tooth. If a noticeable sticking or jumping occurs once throughout the entire range, examine the sector for corrosion, a burr between teeth, or a damaged tooth.

2-46. Observe the point where the pinion meshes with the sector. The point of mesh should be approximately 1/8 inch from the end of the sector arc at sea level pressure. It is important to have this starting position in order to have the altimeter reach its maximum range of operation. To adjust the position of the sector hold the rocking shaft with the special pliers (figure 2-17) and with the sector wrench turn the sector as required.

2-47. ADJUSTMENTS.

a. Mount the mechanism in the calibration stand (TE583) so the diaphragm is on the same side as "0" and place it in the pressure chamber (TE600B) so "0" is at the top. By means of the knob on the calibration stand, set the hand of the test mechanism so that it will read zero when the master altimeter or barometer reads zero.

Note

If the hands of the master are below "0" close the chamber and reduce the pressure until the hands indicate "0." Note the position of the hand of the test instrument. If it is not on "0" open the chamber to atmosphere and turn the adjustment knob to reposition the hand. Repeat the procedure until the hands of both instruments indicate "0" simultaneously. If the hands of the master are above "0," the procedure is similar to that described above except that the instruments must be subjected to pressure.

b. Close the pressure chamber and slowly decrease the pressure until the master altimeter or barometer indicates a reading equivalent to 5,000 feet.

c. If the mechanism shows a plus or minus indication, remove it and adjust the effective length of the calibration arm to which the diaphragm link is connected. If the mechanism reading is too high, move the calibration arm out of the rocking shaft. If the mechanism reading is too low, move the calibration arm into the rocking shaft. For accurate adjustment of the calibration arm, use the calibration tool (TE639). Clamp the tool into the rocking shaft in a position as high as it will go so the drum rides against the end of the calibration arm. Then tighten the clamp screw.

Note

The clamp screw and screwdriver should be in exact alignment with the calibration arm before the screw is tightened. If they are not, the calibration tool will not be correctly aligned to give accurate adjustment.

d. To move the calibration arm into the rocking shaft loosen the adjusting clamp screw just enough to permit the arm to be moved and turn the vernier drum clockwise. The rim of the drum pushes the calibration arm into the rocking shaft. When the drum is turned the distance between two graduations, it moves the arm sufficiently to change the altimeter reading approximately 20 feet at 5,000 feet altitude. After adjusting the length of the calibration arm, tighten the adjusting clamp screw and remove the calibration tool from the rocking shaft. To move the calibration arm out of the rocking shaft, turn the drum of the calibration tool counterclockwise while gently pressing the end of the calibration arm with the finger to keep the arm in contact with the drum. When the altimeter mechanism reading agrees with that of the master altimeter or barometer at 0 and 5,000 feet, slowly reduce the pressure until the master indicates 20,000 feet and record the indication of the test altimeter. Reduce the pressure to the maximum range of the instrument and note the indication.

e. If the mechanism indicates a reading above or below that of the master altimeter, remove the mechanism and adjust the position of the diaphragm in the mechanism body. If the mechanism reading is too high, move the diaphragm out (away from the rocking shaft). The position of the diaphragm may be accurately adjusted with the tool (TE5196). Screw the end of the tool into the diaphragm centerpiece. Turn the large adjustment knob clockwise until the sleeve contacts the casting. Loosen the diaphragm clamping screw in the mechanism body. To move the diaphragm toward the rocking shaft, turn the adjustment knob counterclockwise. To move the diaphragm away from the rocking shaft, turn the adjustment knob clockwise. Tighten the diaphragm clamping screw and remove the tool.

CAUTION

The amount that the diaphragm may be moved toward the rocking shaft is limited by the balance arm. Do not move the diaphragm too far toward the rocking shaft or its expansion in the high ranges will be stopped by the balance arm.

f. Shifting the diaphragm to correct the indication at maximum altitude alters both the "0" position and the setting at 5,000 feet, therefore, the mechanism must be adjusted again so that it indicates 0 and 5,000 feet in accordance with the steps outlined above.

g. Further adjustment of the mechanism should be made as required until the readings come within the

tolerances specified in Table IV. For calibration purposes, the tolerances in Table IV are less than those specified in Section III, Test Procedures.

TABLE IV

Standard Altitudes	*Equivalent Atmospheric Pressure Hg*		*Scale Error Tolerance*	
			35,000 ft. Altimeters	*50,000 ft. Altimeters*
feet	*mm*	*inches*	*feet*	*feet*
0	760.0	29.92	± 25	± 25
500	746.4	29.39	25	25
1,000	732.9	28.86	40	40
1,500	719.7	28.33	40	40
2,000	706.6	27.82	40	40
2,500	693.8	27.31	40	40
3,000	681.1	26.81	40	40
4,000	656.3	25.84	40	75
5,000	632.4	24.89	40	75
20,000	349.1	13.75	100	150
35,000	178.7	7.04	200	250
40,000	140.7	5.54		350
45,000	110.8	4.36		450
50,000	87.3	3.44		550

h. Check the backward movement of the mechanism by slowly increasing the pressure until the altimeter indicates a minimum of —1,500 feet, maximum —2,500 feet. The sector must be shifted with the special pliers (figure 2-17) and wrench as described in paragraph 2-46, until the above condition exists.

2-48. REPLACING MECHANISM IN CASE. *(See figure 2-7.)*

a. Press the snap ring (38) into the lowest groove with the locating nib in the slot at the top of the case.

b. Place the spring ring (37) on a flat surface. It will be noted that there are three high points located 120 degrees apart. The spring should be placed in the case so that of the three high points, the one at the locating nib faces out toward the dial. It should also be noted that there are three pads or high spots on the underside of the top plate mechanism assembly (34). These pads should be matched with the high points on the spring ring. With the units assembled in the case in this manner, the stresses on the mechanism body will be evenly distributed and the potential source of barometric pressure errors will be eliminated.

c. Lower the mechanism assembly (36) into the case so the sector counterweight is next to the adjustment knob pinion.

Note

Do not replace the top plate mechanism assembly (34) with the top bearing plate or the wheel assembly assembled. First remove these parts.

d. Replace the mechanism top plate so the aligning pin is in the slot of the case. Press it down so the hole in the top plate fits over the boss of the mechanism

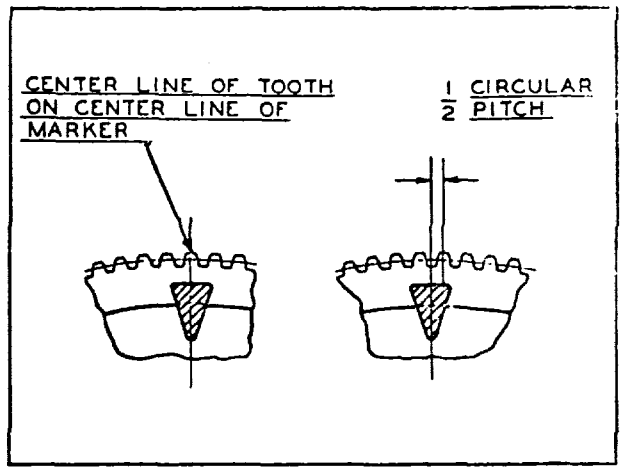


Figure 2-18. Outer Setting Marks

body. Secure the top plate with the snap ring (33). Replace the top plate mounting spring (32) directly opposite the knob stem.

e. With a test knob on the knob stem, check the action of the parts by rotating the mechanism assembly. It should be smooth and slightly stiff without any binding. Improper action of the mechanism assembly may be caused by too tight a mesh between the knob stem pinion (43) and the gear on the mechanism body.

f. Place a 0.005 in. thick slotted shim on the boss of the casting with the handstaff in the slot. With tweezers, press the center pinion, hub up, onto the handstaff until it rests against the shim.

CAUTION

Excessive force should not be used in pressing on the center pinion as the handstaff can easily be broken.

g. Replace the wheel assembly, pinion up, so the gear is in mesh with the center pinion. Lower the top bearing plate onto the top plate making certain that the wheel assembly is in mesh with the handstaff pinion and the wheel assembly pivot is in the pivot hole.

h. Lightly press the short hand onto the handstaff. While holding the top bearing plate in place with the finger, lightly flick the end of the hand. An oscillating, springlike, resistance to movement indicates correct assembly. Secure the top bearing plate to the top plate with three screws.

2-49. OPERATIONAL CHECK.

a. Press the long hand onto the handstaff and place the mechanism in a suitable pressure chamber (TE 600B).

b. Decrease the pressure at a rate of 3,000 feet per minute until an indication of 30,000 feet is reached, then allow the pressure to return to room pressure at the same rate. Note the action of the hand. It should move with a fair degree of smoothness. A slight hesitation is permissible but the hand should not "hang" on

an indication, then suddenly jump to the next point. During this check the instrument should be vibrated with a type A-11, size 2, 8-volt Edwards buzzer operated on 60-cycle current.

c. If any friction is apparent, it is in the top plate mechanism assembly. Determine the cause of malfunctioning by disassembling the top plate mechanism and examining for oxidation or dirt on the handstaff bushing assembly, bearing holes and pivots. Also examine the gear teeth for burrs or damge.

2-50. CLOSING. *(See figure 2-7.)*

a. Replace the center gear assembly (31) meshing it with the idler gear (46). Replace the gear assembly (30) further from the adjustment pinion. Replace the gear assembly (29) that meshes with the adjustment pinion (43).

b. Replace the setting mark gear (28). Replace the barometric dial assembly (27) aligning the reading 29.92 with the rivet hole at the right of the top plate. Replace the shutter (26) locating the lips of the shutter in the slots of the setting mark gear.

c. Replace the outer dial (23) aligning the rivet holes with the holes in the top plate and hold it temporarily in place by inserting a toothpick in each hole. With the dial held in this position, check that the inner setting mark indicates zero and the barometric dial indicates 29.92 with the reference mark on the dial. If the inner setting mark or the barometric dial is not in correct position, the dial (23) must be removed and the mark or barometric dial positioned correctly.

d. Remove one toothpick at a time and secure the outer dial to the top plate with two dial locating pins (22).

e. Replace the third hand hub and wheel assembly, meshing it with the intermediate pinion.

f. Place the wheel spacer ring (25) on the third hand hub and wheel assembly. Replace the spacer (24) and the inner dial (23) and secure it with two screws (21).

g. Replace the outer setting mark (20) so the teeth are in mesh with the idler gear and the reference mark is coincident with the zero indication of the dial. If the original setting mark is not replaced in the instrument, it may be necessary to use another mark having a different relationship between the reference mark and the circular pitch of the teeth. Figure 2-18 illustrates the differences of the two markers. The outer setting marker that gives zero error should be selected and used in the mechanism.

h. Replace the gasket centering ring assembly (19).

i. Replace the small hand (18) with a suitable hand replacing tool. Replace the intermediate hand (17) in the same manner as described for the small hand. Press the large hand (16) on the handstaff so it indicates the same altitude as the master when the barometric scale is set to indicate the existing barometric pressure.

j. With a suitable adjustment knob turn the mechanism so the large hand indicates "0". The intermediate and small hands should also indicate exactly "0". With the finger move the large hand 90 degrees clockwise. This should put the intermediate hand in such a position that the small hand is barely visible along the outside edge. Repeat the procedure by moving the large hand 90 degrees counterclockwise from "0" and note the position of the hands. It should be the same as above but on the opposite side. If the above conditions do not exist, the hand which is out of position may be shifted with a toothpick to the desired position. Turn the mechanism back to its original position.

k. Check to see that the hands do not interfere with each other and that the large hand will clear the glass.

l. Replace the rubber sealing gasket (15), glass (14) and paper gasket (13). Replace the rear washer (12), spring (11) and front washer (10) on the knob stem. Replace the mounting flange assembly (9) and secure it with proper lockwashers (8) and screws (7, 6 and 5).

m. Replace the locknut (2) and knob (1). Lightly tap the instrument glass to remove friction. Note the barometric pressure and compare it with that read from a station barometer. If it is necessary to adjust the barometric dial, pull the adjustment knob forward and while holding it in this position turn it to reset the barometric dial. When the desired barometric pressure is indicated, release the knob.

n. Insert the locking stud (4) into the case so it rides in the recess of the knob stem. Secure it with the locking stud screw (3).

2-51. CHECKING THE MECHANISM FOR LEAKS.

a. Connect a rubber tubing to the static connection and apply suction sufficient to produce a change of reading of the hands of approximately 18,000 feet. At this point, clamp off the tubing and note any change in reading. Over a period of 1 minute, the hand should not move more than 100 feet.

b. If a leak is apparent return the altimeter to atmospheric pressure. Then apply a pressure to move the long hand once around the dial (—1,000 feet). While maintaining this pressure, submerge the instrument in a container of water to determine the location of the leak. A leak around the flange is caused by a dried out or damaged sealing gasket (15). The flange must be removed and the gasket replaced. A leak around the knob stem indicates a dried out leather washer.

c. A leak around the static fitting connection on the rear of case due to damaged or stripped threads may be repaired by drilling out thread cavity and installing heli-coil or reducer bushing. Size will not exceed limits of standard static fitting (⅛ inch I.P.T.). All leak test tolerances must be maintained as outlined in Section III, paragraph 3-18.

SECTION III
TEST PROCEDURES

3-1. VISUAL EXAMINATION—Inspect each instrument for the following:

a. Appearance of the case including chips or cracks.

b. Burred or loose screws.

c. Appearance of the dial and hands.

d. Clearance of the hands.

e. Appearance of the glass for cleanliness and freedom from chips or cracks.

3-2. LUMINOUS PAINT—Each instrument should be checked in darkness. Those parts painted with luminous material should be clearly visible. The instrument should also be checked under ultra-violet light and the same conditions should hold. If the radio-active luminous paint does not meet the above tests, the parts should be repainted in accordance with the prescribed methods.

3-3. INDIVIDUAL TESTS—Unless otherwise specified the instrument shall be tested in normal operating position and shall be lightly vibrated or tapped before a test reading is taken.

3-4. COORDINATION—Set the zero setting pressure scale (barometric scale) to indicate several pressures in inches of mercury selected at random and read the corresponding zero setting altitudes in feet as indicated by the zero setting marks (not the hands). The altitude obtained shall not differ from the altitude corresponding to each pressure by more than the specified tolerance in Table V. Rotate the adjustment knob for one complete revolution of the mechanism to test the mesh for smooth action. There shall be no binding or rough movement of the gears.

3-5. REMEDIAL ACTION—Should the instrument fail to meet this specification, the zero setting marks must be reset as described in paragraph 2-50. If the adjustment knob turns too tightly or grinds, it is an indication of improper mesh between the pinion gear in the case and the mechanism body.

TABLE V

Altitude-Pressure-Table — Feet vs. Inches of Mercury

pressure inches	*0.00*	*0.01*	*0.02*	*0.03*	*0.04*	*0.05*	*0.06*	*0.07*	*0.08*	*0.09*
28.0	1824	1814	1805	1795	1785	1776	1766	1756	1746	1737
28.1	1727	1717	1707	1698	1688	1678	1668	1659	1649	1639
28.2	1630	1620	1610	1601	1591	1581	1572	1562	1552	1542
28.3	1533	1523	1513	1504	1494	1484	1475	1465	1456	1446
28.4	1436	1427	1417	1407	1398	1388	1378	1369	1359	1350
28.5	1340	1330	1321	1311	1302	1292	1282	1273	1263	1254
28.6	1244	1234	1225	1215	1206	1196	1186	1177	1167	1158
28.7	1148	1139	1129	1120	1110	1100	1091	1081	1072	1062
28.8	1053	1043	1034	1024	1015	1005	995	986	976	967
28.9	957	948	938	929	919	910	900	891	881	872
29.0	863	853	844	834	825	815	806	796	787	777
29.1	768	758	749	739	730	721	711	702	692	683
29.2	673	664	655	645	636	626	617	607	598	589
29.3	579	570	560	551	542	532	523	514	504	495
29.4	485	476	467	457	448	439	429	420	410	401
29.5	392	382	373	364	354	345	336	326	318	308
29.6	298	289	280	270	261	252	242	233	224	215
29.7	205	196	187	177	168	159	149	140	131	122
29.8	112	103	94	85	75	66	57	47	38	29
29.9	20	10	+1	− 8	− 17	− 26	− 36	− 45	− 54	− 63
30.0	− 73	− 82	− 91	− 100	− 110	− 119	− 128	− 137	− 146	− 156
30.1	− 165	− 174	− 183	− 192	− 202	− 211	− 220	− 229	− 238	− 248
30.2	− 257	− 266	− 275	− 284	− 293	− 303	− 312	− 321	− 330	− 339
30.3	− 348	− 358	− 367	− 376	− 385	− 394	− 403	− 412	− 421	− 431
30.4	− 440	− 449	− 458	− 467	− 476	− 485	− 494	− 504	− 513	− 522
30.5	− 531	− 54[illegible]	− 549	− 558	− 567	− 576	− 585	− 594	− 604	− 613
30.6	− 622	− 631	− 640	− 649	− 658	− 667	− 676	− 685	− 694	− 703
30.7	− 712	− 721	− 730	− 740	− 749	− 758	− 767	− 776	− 785	− 794
30.8	− 803	− 812	− 821	− 830	− 839	− 848	− 857	− 866	− 875	− 885
30.9	− 893	− 902	− 911	− 920	− 929	− 938	− 947	− 956	− 965	− 974
31.0	− 983	− 992	− 1001	− 1010	− 1019	− 1028	− 1037	− 1046	− 1055	− 1064

3-6. ZERO SETTING—Set the zero setting pressure scale (barometric scale) to indicate 29.92. The reference marks should indicate zero within ±5 feet. Connect the s : pressure connection of the indicator to a mercury barometer and sources of suction and pressure. Apply suction or pressure to bring the barometer to an indication of 29.92 inches of mercury. The hands should indicate zero within ±30 feet.

3-7. REMEDIAL ACTION—If the zero setting pressure scale or reference marks do not come within the prescribed limits, they must be reset.

3-8. SCALE ERROR (ROOM TEMPERATURE 25°C (77°F).

a. Set the zero setting system for standard sea level pressure (barometric dial 29.92). Place the instrument in an altitude chamber which is connected to a barometer and source of suction and pressure.

b. If the barometer indicates more than 29.92 inches of mercury, close the chamber and reduce the pressure until the barometer indicates "0" altitude. Note the position of the hands of the test instrument and if they are not on "0", open the chamber to atmosphere and turn the adjustment knob to reposition them. Repeat the procedure until the hands of the instrument indicates "0" simultaneously with the indication of 29.92 inches of mercury on the barometer.

c. Subject the altimeter successively to the pressures indicated with an asterisk (*) in Table VI at a rate of nge in pressure of approximately 3,000 feet per minute. The altimeter shall remain at the pressure corresponding to each test point for one minute before a test reading is taken except as noted for the hysteresis and after effect test. The scale error shall not exceed the tolerances specified in Table VI. The hysteresis and after effect test shall be performed with this test.

3-9. REMEDIAL ACTION—If the instrument fails to meet this test, it must be recalibrated as described in Section II.

3-10. HYSTERESIS AND AFTER EFFECT—This test must be performed with the scale error test described above. Place the instrument in an altitude chamber which

TABLE VI

Standard Altitudes	*Equivalent Atmospheric Pressure Hg*		*Scale Error Tolerance*	
			35,000 ft. Altimeters	*50,000 ft. Altimeters*
feet	*mm*	*inches*	*feet*	*feet*
0	760.0	29.92	*± 50	*± 50
500	746.4	29.39	50	50
1,000	732.9	28.86	*75	*75
1,500	719.7	28.33	75	75
2,000	706.6	27.82	*100	*100
3,000	681.1	26.81	100	100
4,000	656.3	25.84	*100	*150
5,000	632.4	24.89	100	150
6,000	609.0	23.98	*100	*150
8,000	564.4	22.22	*150	*175
10,000	522.6	20.58	*150	*175
12,000	483.3	19.03	*200	*200
14,000	446.4	17.57	*200	*225
16,000	411.8	16.21	*200	*240
18,000	379.4	14.94	*200	*275
20,000	349.1	13.75	*200	*300
22,000	320.8	12.63	*300	*340
25,000	281.9	11.10	*300	*375
30,000	225.6	8.88	*300	*450
35,000	178.7	7.04	*300	*525
40,000	140.7	5.54	—	*600
45,000	110.8	4.36	—	*675
50,000	87.3	3.44	—	*750

TABLE VII

Test Points	*Standard Altitude in feet*		*Equivalent Atmospheric Pressure (mm Hg)*		*Permissible Variation from Scale Error (ft)*		*Elapsed Time At Test Pressure Before Reading*
	35,000 ft Altimeter	*50,000 ft Altimeter*	*35,000 ft Altimeter*	*50,000 ft Altimeter*	*35,000 ft Altimeter*	*50,000 ft Altimeter*	
First hysteresis test point	16,000	20,000	411.8	349.1	Recorded scale error	Recorded scale error	5 minutes
Second hysteresis test point	18,000	25,000	379.4	281.9	Recorded scale error	Recorded scale error	5 minutes
Upper limits of range	35,000	50,000	178.7	87.3	—	—	1 minute
Third hysteresis test point	18,000	25,000	379.4	281.9	70 feet from "UP" reading	150 feet from "UP" reading	10 minutes
Fourth hysteresis test point	16,000	20,000	411.8	349.1	70 feet from "UP" reading	150 feet from "UP" reading	10 minutes
h hysteresis test point (after effect)	—	—	Existing pressure at ground level		50 feet from reading at start	60 feet from reading at start	5 minutes

is connected to a barometer and a source of suction. Subject the altimeter to a decrease in pressure at a rate corresponding to an increase in altitude of approximately 3,000 feet per minute until the pressure corresponding to the first test point given in Table VII is reached. The instrument shall remain at this pressure for the time specified. The pressure shall be further decreased at the above rate until the pressure corresponding to the second test point given in Table VII is reached. The instrument shall remain at this pressure for the time specified. It shall then be subjected to the pressure corresponding to the upper limits of the range of the instrument and held at this pressure for one minute. Increase the pressure at a rate corresponding to a decrease in altitude of approximately 3,000 feet per minute until the pressure corresponding to the next test point given in Table VII is reached. The instrument shall remain at this pressure for the time specified. Then further increase the pressure until the pressure corresponding to the next test point is reached and hold it at this pressure for the time specified. After the readings have been taken the pressure shall be increased until atmospheric pressure is reached. After completion of the hysteresis test, the hands shall have returned to their original indication, corrected for any change in atmospheric pressure, within the tolerance given in Table VII, as the last test point.

Note

The equipment must be leak-proof during this test.

3-11. REMEDIAL ACTION—If the instrument fails to meet this test the trouble may be corrected by decreasing the tension on the balance arm. Adjustments on the balance arm are very critical as a change of balance tension will affect the static balance as well as calibration; therefore, only very minor adjustments should be made. A misaligned link on the balance arm may also cause an apparent hysteresis error. If the error cannot be corrected by either of the methods described above, the diaphragm assembly must be replaced.

TABLE VIII

Altitude feet	*Tolerance feet*
1,000	± 70
2,000	70
3,000	70
5,000	80
10,000	90
15,000	100
20,000	125
25,000	150
30,000	175
35,000	200
40,000	250
50,000	400

3-12. FRICTION.

a. While holding the pressure constant at any point or points as listed in Table VIII, take two readings; the first before tapping the instrument and the second after tapping it. The change in reading of the hands shall not exceed the tolerances given in Table VIII.

b. While operating the instrument at a rate corresponding to an increase in altitude of approximately 3,000 feet per minute, a further check for friction is as follows:

c. From 0 to 25,000 feet, without vibration, the hand must not jump more than the indicated tolerances given in Table VIII.

d. From 25,000 to 40,000 feet, the movement of the hand must be smooth although not necessarily regular when vibration is applied with a type A-11, size 2, 8-volt Edwards buzzer, operating on 60-cycle current.

e. From 40,000 to 45,000 feet, some leniency is to be exercised and two 100-foot jumps of the hand are permissible when vibration is applied with the above buzzer.

f. Above 45,000 feet, reject the instrument only if the hand sticks, then spins.

g. This test may be combined with the test for scale error.

TABLE IX

Standard Altitudes	*Equivalent Atmospheric Pressure Hg*		*SCALE ERROR TOLERANCE*			
			ROOM TEMPERATURE		*LOW TEMPERATURE (−35°C) Variation from Room Temperature Reading.*	
			35,000 ft Altimeters	*50,000 ft. Altimeters*	*35,000 ft Altimeters*	*50,000 ft Altimeters*
feet	*mm*	*inches*	*feet*	*feet*	*feet*	*feet*
0	760.0	29.92	± 50	± 50	± 40	± 50
6,000	609.0	23.98	100	150	70	100
12,000	483.3	19.03	200	200	90	175
18,000	379.4	14.94	200	275	125	275
25,000	281.9	11.10	300	375	175	375
35,000	178.7	7.04	300	525	250	525
50,000	87.3	3.44	—	750	—	750

3-13. REMEDIAL ACTION—If the instrument fails to meet this test, it must be disassembled and cleaned as described in Section II.

3-14. LOW TEMPERATURE SCALE ERROR—For a period of not less than 6 hours prior to this test, the altimeter shall not have been subjected to any test involving operation at other than atmospheric pressures. The scale error (room temperature) test shall be repeated except that the temperature of the altimeter during the test shall be approximately —35°C (—31°F). The test points shall be those given in Table IX. The change in scale errors of this test from corresponding scale errors of the room temperature test shall not exceed the tolerances specified in Table IX. During this test the friction shall be checked.

3-15. REMEDIAL ACTION—If the instrument fails to meet this test, the diaphragm must be compensated as described in Section II and the instrument recalibrated.

3-16. OVERPRESSURE—The altimeter shall be subjected to an absolute pressure of 50 inches of mercury for a period of 1 hour. For a period of not less than 6 hours following this overpressure, the altimeter shall not be subjected to any operation other than atmospheric pressure. The scale errors shall not vary from the previously noted scale errors by more than the tolerances listed in Table X.

3-17. REMEDIAL ACTION—If the instrument fails this test, it must be disassembled and the cause of malfunctioning determined.

3-17. CASE LEAK—Connect the static pressure connection of the indicator to a source of suction. Apply a suction sufficient to produce a change of indication of the hands of approximately 18,000 feet. With the source closed off during a period of 10 seconds, the difference of indications shall not exceed 100 feet.

3-19. REMEDIAL ACTION—If a leak is indicated, check the instrument and correct for the leak as described in Section II.

3-20. POSITION ERROR TEST—At normal atmospheric pressure, readings shall be taken while the instrument is being tapped lightly in each of several different positions. The change in pointer indication with change in instrument position shall not exceed 20 feet.

3-21. REMEDIAL ACTION—If the instrument fails to meet this test, it must be adjusted for balance as described in Section II.

3-22. USE OF AFTO FORM NO. 139. All altimeters including those in applicable difference data sheets will have AFTO Form No. 139 prepared at every overhaul, recalibration, or technical order compliance. Errors will be noted on the form at all test points outlined in Table VI. This will include points not identified with an asterisk. The form has a general application, therefore points of test other than those noted in Table VI may be ignored. Forms will be attached to the case of each altimeter prior to packaging and shipment.

TABLE X

VARIATION FROM ORIGINAL SCALE ERRORS AFTER SUBJECTION TO 50 INCHES OF MERCURY PRESSURE

Standard Altitude feet	Variation feet
0	±30
500	30
1,000	30
1,500	45
2,000	45
3,000	45
4,000	45
6,000	45
8,000	45
10,000	60
12,000	60
14,000	60
16,000	60
18,000	60
20,000	75
22,000	75
24,000	75
28,000	75
32,000	90
35,000	105
40,000	120
45,000	120
50,000	150

SECTION IV
DIFFERENCE DATA INDEX

Kollsman Type	AN Type	Page No.
671CPX-4-037	5760-4B	23-24
671CLU-4-035	5760-L4B	25-26
671CPU-19-015	5760-T2A	27-28
671CPU-8-030	5760-T4A	29-30
1845X-4-03	5760-4B	31
671CPX-4-038	—	33-34
671CLU-4-038	—	35-36

Note

Overhaul and Test Procedures for the models included in this section are the same as procedures for type 371P-4-01 and 671CP-8-016 Sensitive Altimeters except for the specific differences noted by the applicable Difference Data Sheet. Section II and III contain complete Overhaul and Test Procedure Information.

SENSITIVE ALTIMETER **TYPE 671CPX-4-037, AN TYPE 5760-43**

The instructions contained in preceding sections of this handbook apply except for the specific differences listed in this data sheet.

LEADING PARTICULARS

RANGE: 50,000 feet

BAROMETRIC SCALE: 28.1 to 31.0 inches of mercury

ILLUMINATION:

Dial — AN-L-1

Barometric Dial — AN-L-1

Pointers — AN-L-1

SPECIAL OVERHAUL TOOLS — Same as for type 671CP-8-016.

DISASSEMBLY — Same as for type 671CP-8-016.

CLEANING — Same as for type 671CP-8-016.

INSPECTION — Same as for type 671CP-8-016.

TESTING — Same as for type 671CP-8-016.

REPAIR — Same as for type 671CP-8-016.

LUBRICATION — Same as for type 671CP-8-016.

REASSEMBLY — Same as for type 671CP-8-016.

TEST PROCEDURES — Same as for type 671CP-8-016 with the following exception.

4-1. Zero Setting Scale — The altimeter shall be subjected to atmospheric pressure. The pressure scale shall be set, successively to the values listed in Table I. The altimeter shall be tapped or vibrated lightly and the pointer indication noted. After each reading has been recorded, the difference between the reading at the setting of 29.92 and the other setting shall be found. These differences shall be recorded and compared with the values in the "correct differences" column. The recorded value shall not differ from the correct differences by more than 25 feet at each setting.

TABLE I

Setting Pressure Scale	*Correct Differences*
28.5	1,340
29.92	0

4-2. Low Temperature Scale Error and Table II deleted.

SENSITIVE ALTIMETER

TYPE 671CLU-4-035, AN TYPE 5760L-4C
NAVY STOCK NUMBER R88A0351-011-000

The instructions contained in preceding section of this handbook apply except for the specific differences listed in this data sheet.

LEADING PARTICULARS

RANGE: 50,000 feet

BAROMETRIC SCALE: 28.1 to 31.0 inches of mercury

ILLUMINATION:

Dial — AN-L-1

Barometric Dial — AN-L-1

Hands — AN-L-1

ADJUSTMENT KNOB: Long knob

SPECIAL OVERHAUL TOOLS — Same as for type 671CP-8-016.

DISASSEMBLY — Same as for type 671CP-8-016.

CLEANING — Same as for type 671CP-8-016.

INSPECTION — Same as for type 671CP-8-016.

TESTING — Same as for type 671CP-8-016.

REPAIR — Same as for type 671CP-8-016.

LUBRICATION — Same as for type 671CP-8-016.

REASSEMBLY — Same as for type 671CP-8-016.

TEST PROCEDURES — Same as for type 671CP-8-016 with the following exception.

4-1. Zero Setting Scale — The altimeter shall be subjected to atmospheric pressure. The pressure scale shall be set, successively to the values listed in Table I. The altimeter shall be tapped or vibrated lightly and the pointer indication noted. After each reading has been recorded, the difference between each reading at the setting of 29.92 and the other setting shall be found. These differences shall be recorded and compared with the values in the "correct differences" column. The recorded value shall not differ from the correct differences by more than 25 feet at each setting.

TABLE I

Setting Pressure Scale	*Correct Differences*
28.5	1,340
29.92	0

4-2. Low Temperature Scale Error and Table II deleted.

SENSITIVE ALTIMETER — **TYPE 671CPU-19-015, AN TYPE 5760T2A**

The instructions contained in preceding sections of this handbook apply except for the specific differences listed in this data sheet.

LEADING PARTICULARS

RANGE: 50,000 feet

BAROMETRIC SCALE: 28.1 to 31.0 inches of mercury

ILLUMINATION:

Dial—AN-L-13, AN-L-1 and Matte Green G 6/6

Barometric Dial—AN-L-1

Hands—AN-L-13

SPECIAL OVERHAUL TOOLS — Same as for type 671CP-8-016.

DISASSEMBLY — Same as for type 671CP-8-016.

CLEANING — Same as for type 671CP-8-016.

INSPECTION — Same as for type 671CP-8-016.

TESTING — Same as for type 671CP-8-016.

REPAIR — Same as for type 671CP-8-016.

LUBRICATION — Same as for type 671CP-8-016.

REASSEMBLY — Same as for type 671CP-8-016.

TEST PROCEDURES — Same as for type 671CP-8-016.

SENSITIVE ALTIMETER — **TYPE 671CPU-8-030, AN TYPE 5760Y[illegible].**

The instructions contained in preceding sections of this handbook apply except for the specific differences listed in this data sheet.

LEADING PARTICULARS

RANGE: 50,000 feet

BAROMETRIC SCALE: 28.1 to 31.0 inches of mercury

ILLUMINATION:

Dial—AN-L-1 and Matte Green G 6/6

Barometric Dial—AN-L-1

Hands—AN-L-1

SPECIAL OVERHAUL TOOLS — Same as for type 671CP-8-016.

DISASSEMBLY — Same as for type 671CP-8-016.

CLEANING — Same as for type 671CP-8-016.

INSPECTION — Same as for type 671CP-8-016.

TESTING — Same as for type 671CP-8-016.

REPAIR — Same as for type 671CP-8-016.

LUBRICATION — Same as for type 671CP-8-016.

REASSEMBLY — Same as for type 671CP-8-016.

TEST PROCEDURES — Same as for type 671CP-8-016.

SENSITIVE ALTIMETER — **TYPE 1045X-4-03**
AN TYPE 5760-4

The instructions contained in preceding sections of this handbook apply, except for the specific differences listed in this data sheet.

LEADING PARTICULARS

RANGE: 50,000 feet

BAROMETRIC SCALE: 28.1 to 31.0 inches of mercury

ILLUMINATION:

Dial—AN-L-1 (one piece)
Barometric Dial—AN-L-1
Hands—AN-L-1

SETTING MARKERS: The inner and outer triangular setting markers are eliminated in this design.

SPECIAL OVERHAUL TOOLS

— Same as for type 671CP-8-016.

DISASSEMBLY

— Same as for type 671CP-8-016 except for the omission of the inner and outer setting markers. Because of this the key index numbers will differ.

CLEANING. — Same as for type 671CP-8-016.

INSPECTION — Same as for type 671CP-8-016.

TESTING — Same as for type 671CP-8-016.

REPAIR — Same as for type 671CP-8-016.

LUBRICATION — Same as for type 671CP-8-016.

REASSEMBLY — Same as for type 671CP-8-016, except for omission of inner and outer setting markers.

TEST PROCEDURES — Same as for type 671CP-8-016, with the following exceptions:

a. COORDINATION—Delete paragraph 3-4 and substitute the following:

ZERO SETTING SCALE—The altimeter shall be subjected to atmospheric pressure. The pressure scale shall be set, successively, at the values listed in Table I. The altimeter shall be tapped or vibrated lightly and the pointer indication noted. After the series of readings has been recorded, the difference between the reading at the setting of 29.92 and each other setting, shall be found. These differences shall be recorded and compared with the values in the "correct differences" column. The recorded values shall not differ from the correct differences by more than 25 feet at any setting.

TABLE I

ZERO SETTING MECHANISM

Setting Pressure Scale	*Correct Differences*
28.5	1,340
29.92	0
30.9	893

b. SCALE ERROR AT ROOM TEMPERATURE—Procedures are the same except that reading shall be taken at 500, 1,500 and 3,000 feet in addition to the other test points.

c. HYSTERESIS—Delete paragraph 3-10 and substitute the following:

HYSTERESIS—Not more than 15 minutes after the altimeter has been first subjected to the pressure corresponding to the upper limit of the scale in the Scale Error at Room Temperature test, the pressure shall be increased at a rate corresponding to a decrease in altitude of approximately 3,000 feet per minute until the pressure corresponding to the first test point given in Table II is reached. The altimeter shall remain at this pressure for at least 5 minutes but not more than 15 minutes, before the test reading is taken. After the reading has been taken the pressure shall be further increased at the specified rate until the pressure corresponding to the second test point given in Table II is reached. The altimeter shall remain at this pressure for at least 1 minute but not more than 10 minutes before the test reading is taken. After the reading has been taken, the pressure shall be further increased at the specified rate until atmospheric pressure is reached. The reading of the altimeter at either of the two test points shall not differ, from the reading of the altimeter for the corresponding altitude in the Scale Error test, by more than the tolerance given in Table II.

AFTER EFFECT—Not less than 1 minute and not more than 5 minutes after the completion of the Hysteresis test, the pointers shall have returned to their original reading, corrected for any change in atmospheric pressure, within the tolerance given in Table II as the third test point.

TABLE II

HYSTERESIS

Test Points	*Standard Altitude*	*Equivalent Atmospheric Pressure*	*Permissible Variation*
First point	25,000	11.10	150
Second point	20,000	13.75	150
Third point	—	Ground Level	60

d. OVERPRESSURE — Delete paragraph 3-16 and substitute the following:

OVERPRESSURE — The altimeter shall be subjected to an absolute pressure of 50 inches of mercury for a period of 1 hour. For a period of not less than 6 hours following this overpressure, the altimeter shall not be subjected to any operation other than atmospheric pressure. The scale errors shall not vary from the previously noted scale errors by more than the tolerances listed in Table III.

TABLE III

VARIATION FROM ORIGINAL SCALE ERRORS AFTER SUBJECTION TO 50 INCHES OF MERCURY PRESSURE

Standard Altitude Feet	*Variation Feet*
0	30
500	30
1,000	30
1,500	45
2,000	45
3,000	45
4,000	45
6,000	45
8,000	45
10,000	60
12,000	60
14,000	60
16,000	60
18,000	60
20,000	75
22,000	75
24,000	75
28,000	75
32,000	90
35,000	105
40,000	120
45,000	120
50,000	150

SENSITIVE ALTIMETER **TYPE 671CPX-4-030**

THE INSTRUCTIONS CONTAINED IN PRECEDING SECTIONS OF THIS HANDBOOK APPLY, EXCEPT FOR THE SPECIFIC DIFFERENCES LISTED IN THIS DATA SHEET.

LEADING PARTICULARS

RANGE: 50,000 feet

BAROMETRIC SCALE: 28.1 to 31.0 inches of mercury

ILLUMINATION:

Dial—MIL-L-25142

Barometric Dial—MIL-L-25142

Hands—MIL-L-25142

SPECIAL TOOLS. — Same as for type 671CP-8-016.

DISASSEMBLY — Same as for type 671CP-8-016.

CLEANING — Same as for type 671CP-8-016.

INSPECTION — Same as for type 671CP-8-016.

TESTING — Same as for type 671CP-8-016.

REPAIR OR REPLACEMENT — Same as for type 671CP-8-016.

LUBRICATION — Same as for type 671CP-8-016.

REASSEMBLY — Same as for type 671CP-8-016.

TEST PROCEDURES — Same as for type 671CP-8-016, with the following exceptions:

a. COORDINATION—Delete paragraph 3-4 and substitute the following:

ZERO SETTING SCALE—The altimeter shall be subjected to atmospheric pressure. The pressure scale shall be set, successively, at the values listed in Table I. The altimeter shall be tapped or vibrated lightly and the pointer indication noted. After the series of readings has been recorded, the difference between the reading at the setting of 29.92 and each other setting, shall be found. These differences shall be recorded and compared with the values in the "correct differences" column. The recorded values shall not differ from the correct difference by more than 25 feet at any setting.

b. SCALE ERROR AT ROOM TEMPERATURE—Procedures are the same except that reading shall be taken at 500, 1,500 and 3,000 feet in addition to the other test points.

c. HYSTERESIS—Delete paragraph 3-10 and substitute the following:

TABLE I
ZERO SETTING MECHANISM

Setting Pressure Scale	Correct Differences
28.5	1,340
29.92	0
30.9	893

HYSTERESIS—Not more than 15 minutes after the altimeter has been first subjected to the pressure corresponding to the upper limit of the scale in the Scale Error at Room Temperature test, the pressure shall be increased at a rate corresponding to a decrease in altitude of approximately 3,000 feet per minute until the pressure corresponding to the first test point given in Table II is reached. The altimeter shall remain at this pressure for at least 5 minutes but not more than 15 minutes, before the test reading is taken. After the reading has been taken the pressure shall be further increased at the specified rate until the pressure corresponding to the second test point given in Table II is reached. The altimeter shall remain at this pressure for at least 1 minute but not more than 10 minutes before the test reading is taken. After the reading has been taken, the pressure shall be further increased at the specified rate until atmospheric pressure is reached. The reading of the altimeter at either of the two test points shall not differ, from the reading of the altimeter for the corresponding altitude in the Scale Error test, by more than the tolerance given in Table II.

AFTER EFFECT—Not less than 1 minute and not more than 5 minutes after the completion of the Hysteresis test, the pointers shall have returned to their original reading, corrected for any change in atmospheric pressure, within the tolerance given in Table II as the third test point.

TABLE II
HYSTERESIS

Test Points	Standard Altitude	Equivalent Atmospheric Pressure	Permissable Variation
First Point	25,000	11.10	150
Second Point	20,000	13.75	150
Third Point	0	Ground Level	60

SENSITIVE ALTIMETER **TYPE 671CLU-4-030**

THE INSTRUCTIONS CONTAINED IN PRECEDING SECTIONS OF THIS HANDBOOK APPLY, EXCEPT FOR THE SPECIFIC DIFFERENCES LISTED IN THIS DATA SHEET.

LEADING PARTICULARS

RANGE: 50,000 feet

BAROMETRIC SCALE: 28.1 to 31.0 inches of mercury

ILLUMINATION:

Dial—MIL-L-25142

Barometric Dial—MIL-L-25142

Hands—MIL-L-25142

— Same as for type 671CP-8-016.

DISASSEMBLY — Same as for type 671CP-8-016.

CLEANING — Same as for type 671CP-8-016.

INSPECTION — Same as for type 671CP-8-016.

TESTING — Same as for type 671CP-8-016.

REPAIR OR REPLACEMENT — Same as for type 671CP-8-016.

LUBRICATION — Same as for type 671CP-8-016.

REASSEMBLY — Same as for type 671CP-8-016.

TEST PROCEDURES — Same as for type 671CP-8-016, with the following exceptions:

a. COORDINATION—Delete paragraph 3-4 and substitute the following:

ZERO SETTING SCALE—The altimeter shall be subjected to atmospheric pressure. The pressure scale shall be set, successively, at the values listed in Table I. The altimeter shall be tapped or vibrated lightly and the pointer indication noted. After the series of readings has been recorded, the difference between the reading at the setting of 29.92 and each other setting, shall be found. These differences shall be recorded and compared with the values in the "correct differences" column. The recorded values shall not differ from the correct difference by more than 25 feet at any setting.

b. SCALE ERROR AT ROOM TEMPERATURE—Procedures are the same except that reading shall be taken at 500, 1,500 and 3,000 feet in addition to the other test points.

c. HYSTERESIS—Delete paragraph 3-10 and substitute the following:

TABLE I
ZERO SETTING MECHANISM

Setting Pressure Scale	Correct Differences
28.5	1,340
29.92	0
30.9	893

HYSTERESIS—Not more than 15 minutes after the altimeter has been first subjected to the pressure corresponding to the upper limit of the scale in the Scale Error at Room Temperature test, the pressure shall be increased at a rate corresponding to a decrease in altitude of approximately 3,000 feet per minute until the pressure corresponding to the first test point given in Table II is reached. The altimeter shall remain at this pressure for at least 5 minutes but not more than 15 minutes, before the test reading is taken. After the reading has been taken the pressure shall be further increased at the specified rate until the pressure corresponding to the second test point given in Table II is reached. The altimeter shall remain at this pressure for at least 1 minute but not more than 10 minutes before the test reading is taken. After the reading has been taken, the pressure shall be further increased at the specified rate until atmospheric pressure is reached. The reading of the altimeter at either of the two test points shall not differ, from the reading of the altimeter for the corresponding altitude in the Scale Error test, by more than the tolerance given in Table II.

AFTER EFFECT—Not less than 1 minute and not more than 5 minutes after the completion of the Hysteresis test, the pointers shall have returned to their original reading, corrected for any change in atmospheric pressure, within the tolerance given in Table II as the third test point.

TABLE II
HYSTERESIS

Test Points	Standard Altitude	Equivalent Atmospheric Pressure	Permissible Variation
First Point	25,000	11.10	150
Second Point	20,000	13.75	150
Third Point	0	Ground Level	60

ILLUSTRATED PARTS BREAKDOWN

FOR

SENSITIVE ALTIMETER

671CPX-6-051



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KOLLSMAN INSTRUMENT CORPORATION

80-08 45TH AVE., ELMHURST 73, N.Y.

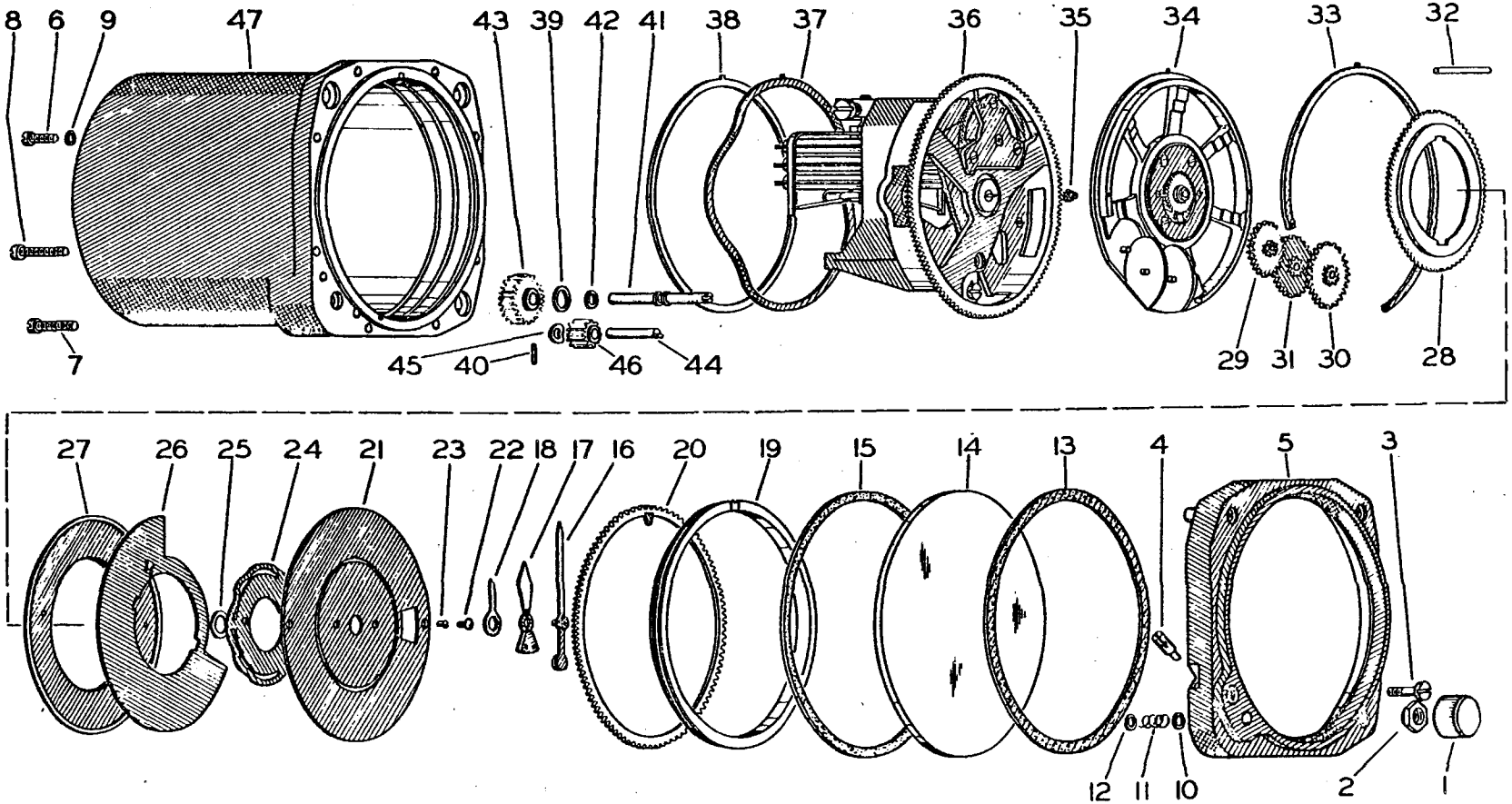


Figure 2. Sensitive Altimeter

Figure & Index Number	Part Number	Description 1 2 3 4 5 6 7	Units per Assy.	Usable on Code
2-	671CPX-6-051	ALTIMETER, Sensitive(50,000 feet)...	1	
-1	371-14	. KNOB, Adjustment.....	1	
-2	371-13B	. LOCKNUT, Black oxidized, size 5-44 threads per inch.....	1	
-3	371-18C	. SCREW, Locking Stud.....	1	
-4	671CK4B	. STUD, Locking.....	1	
-5	671CPU3	. FLANGE, Mounting.....	1	
		ATTACHING PARTS		
-6	FFIL310SS8PX	. SCREW, Stainless steel, blackened, 3-56 x 5/16 in. long.....	1	
-7	FFIL311SS8PX	. SCREW, Stainless steel, blackened, 3-56 x 11/32 in long.....	5	
-8	371-128C	. SCREW, Stainless steel, blackened, 3-56 x 23/32 in. long.....	2	
-9	KR3SS4PX	. LOCKWASHER, Stainless steel, blackened, for size 3 screw.....	7	
-10	371-21B	. WASHER.....	1	
-11	371-12	. SPRING.....	1	
-12	371-21B	. WASHER.....	1	
-13	477KN43	. GASKET, Paper, 2,915 ID x 3.125 OD x 0.010 in. thick.....	AR	
-14	AN5727-14	. GLASS, Cover, (Kollsman Part No. 371S107).....	1	
-15	371-61B	. GASKET, Sealing.....	1	
-16	371-912B7	. HAND ASSEMBLY, Large.....	1	
-17	176-942-9	. HAND ASSEMBLY, Intermediate....	1	
-18	371-32-7	. HAND, Third.....	1	
-19	642K950B	. RING ASSEMBLY, Gasket centering.	1	
-20	371K118B21	. RING, Setting (136 teeth) (as required).....	1	
-20	371K118B23	. RING, Setting (136 teeth) (as required).....	1	
-21	671CK01-3	. DIAL.....	1	
		ATTACHING PARTS		
-22	X30	. SCREW, Dial, size 0-80, black oxidized.....	2	
-23	371-58	. PIN, Dial locating.....	2	
-24	371-30B	. SPACER.....	1	
-25	371-127B	. RING, Wheel spacer.....	1	

Figure & Index Number	Part Number	Description 1 2 3 4 5 6 7	Units per Assy.	Usable on Code
-26	371K24B5	. SHUTTER	1	
-27	371K904C3	. DIAL ASSEMBLY, Barometric	1	
-28	371-20B	. GEAR, Setting mark	1	
-29	371-903	. GEAR ASSEMBLY	1	
-30	371-914	. GEAR ASSEMBLY	1	
-31	371-913	. GEAR ASSEMBLY	1	
-32	371-S54	. SPRING	1	
-33	371S7	. RING, Top plate snap	1	
-34	371S904	. MECHANISM ASSEMBLY, Top plate (See figure 3-1)	1	
-35	371-53	. PINION, Center	1	
-36	940-901	. MECHANISM ASSEMBLY (See figure 3-12)	1	
-37	371-46	. RING, Spring	1	
-38	371S25	. RING, Snap	1	
-39	371-11	. RING, Snap	1	
-40	371-10	. PIN, Drill rod, .041 x .225 in. long	1	
-41	371-9B	. STEM, Adjustment knob	1	
-42	371-45B	. WASHER, Leather, .130 ID x .205 OD x .034 in. thick	1	
-43	371-8	. PINION, Adjustment knob stem (26 teeth)	1	
-44	371-16	. SHAFT, Idler	1	
-45	371K121	. WASHER, Spring	1	
-46	371-15	. GEAR, Idler	1	
-47	671U1B	. CASE	1	

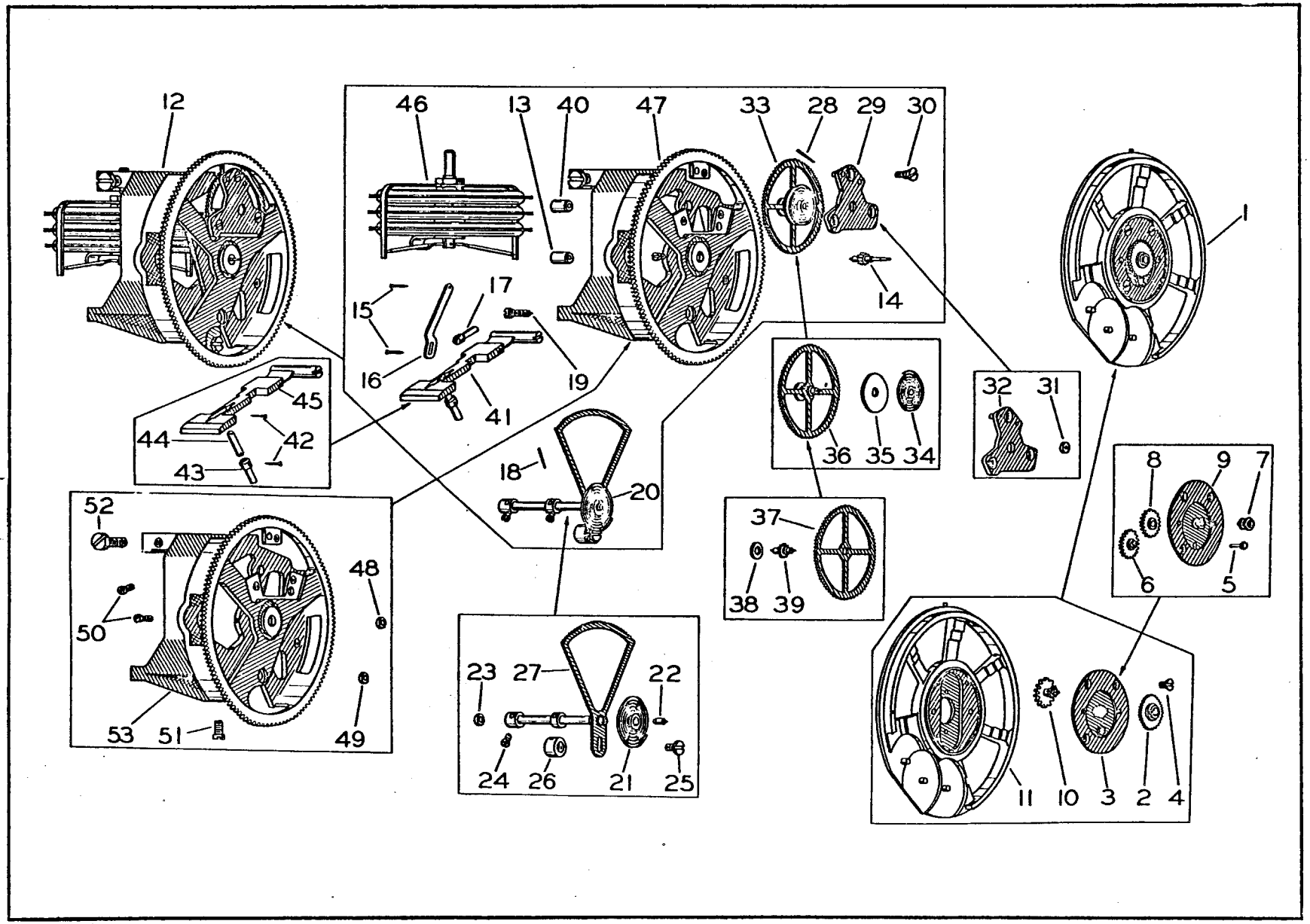


Figure 3. Top Plate Mechanism Assembly and Mechanism Assembly

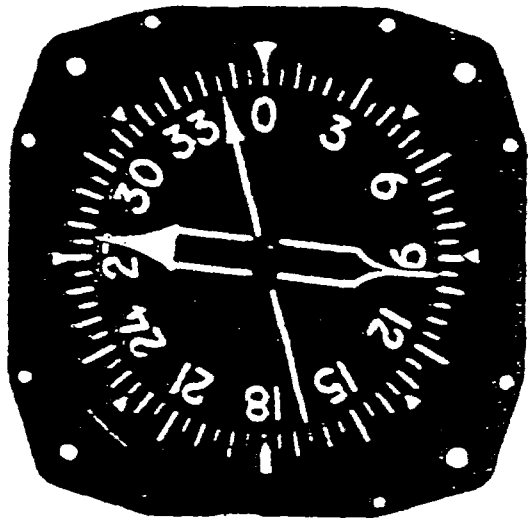
Figure & Index Number	Part Number	Description 1 2 3 4 5 6 7	Units per Assy.	Usable on Code
		TOP PLATE MECHANISM ASSEMBLY AND MECHANISM ASSEMBLY		
3-1	371S904	MECHANISM ASSEMBLY, Top plate (See figure 2-34)	Ref	
-2	371-911	. HUB AND WHEEL ASSEMBLY, Third hand	1	
-3	371-907	. PLATE ASSEMBLY, Top bearing	1	
		ATTACHING PARTS		
-4	371-60B	. SCREW, Brass 1-72 x 0.175 in. long.	3	
-5	371-41	. . PINION, Intermediate	1	
-6	371-909	. . WHEEL AND HUB ASSEMBLY, Intermediate	1	
-7	371-52	. . HANDSTAFF, Short hand	1	
-8	371-908	. . WHEEL ASSEMBLY	1	
-9	371-906	. . PLATE AND BUSHING ASSEMBLY Top bearing	1	
-10	371-910	. WHEEL ASSEMBLY, Top plate mechanism	1	
-11	371S905	. PLATE ASSEMBLY, Top	1	
-12	940-901	MECHANISM ASSEMBLY* (See figure 2-36)	Ref	
-13	371-923	. SETTING ASSEMBLY, Jewel	1	
-14	371-73B	. PINION, Handstaff	1	
-15	371-80	. PIN, Bearing	2	
-16	940-71	. LINK, Diaphragm	1	
-17	940-72	. ARM, Calibration	1	
-18	671B90B	. PIN, Taper	1	
-19	371-78	. SCREW, Pivot	1	
-20	940-915	. SHAFT ASSEMBLY, Rocking	1	
-21	671-73D2	. . HAIRSPRING	1	
-22	371-79	. . PIVOT	1	
-23	371-96	. . JEWEL, Small	1	
-24	FF1L003	. . SCREW, Brass, 0-80 x 3/32 in. long	2	
-25	671-87B	. . SCREW	1	
-26	940-129	. . COUNTERWEIGHT	1	
-27	*No Number	. . ROCKING SHAFT AND SECTOR ASSEMBLY	NP	
-28	20632	. PIN, Taper, Wm. Dixon Co., 32 E. Kenney St., Newark, N.J. (Kollsman Part 371-49.1)	1	
-29	940-931	. BRIDGE ASSEMBLY	1	

Figure & Index Number	Part Number	Description 1 2 3 4 5 6 7	Units per Assy.	Usable on Code
		TOP PLATE MECHANISM ASSEMBLY AND MECHANISM ASSEMBLY		
		ATTACHING PARTS		
-30	371-90B	. SCREW, 2-64 x 0.110 in. long.....	3	
-31	371-96	. . JEWEL, Small.....	1	
-32	*No Number	. . BRIDGE AND POST ASSEMBLY.....	NP	
-33	940-932	. WHEEL AND HAIRSPRING ASSEMBLY.....	1	
-34	371-77	. . HAIRSPRING.....	1	
-35	940-80	. . DISK, Hairspring.....	1	
-36	671-924	. . WHEEL ASSEMBLY.....	1	
-37	371-75	. . . WHEEL (220 teeth).....	1	
-38	176-71	. . . GUARD, Sector.....	1	
-39	671-74B	. . . PINION, Intermediate.....	1	
-40	371-923	. SETTING ASSEMBLY, Jewel.....	1	
-41	709-909C	. BALANCE AND CALIBRATION ARM ASSEMBLY.....	1	
-42	371-80	. . PIN, Bearing.....	2	
-43	371-72	. . ARM, Calibration.....	1	
-44	709-6	. . LINK, Balance.....	1	
-45	371P933B	. . BALANCE ASSEMBLY.....	1	
-46	671CP925	. DIAPHRAGM AND ADJUSTMENT SPRING ASSEMBLY.....	1	
-47	709-911B	. BODY ASSEMBLY, Mechanism.....	1	
-48	371-95	. . JEWEL, Large.....	1	
-49	371-96	. . JEWEL, Small.....	1	
-50	FFIL007	. . SCREW, Brass, 0-80 x 7/32 in. long.....	2	
-51	FFIL207	. . SCREW, Brass, 2-64 x 7/32 in. long.....	1	
-52	FFIL610	. . SCREW, Brass, 6-40 x 5/16 in. long.....	1	
-53	7095B	. . BODY, Mechanism.....	1	

*Parts marked with an asterisk (*) are used for illustration purposes only.

MAINTENANCE—OVERHAUL—PARTS MANUAL

AAR 2100 SERIES
RADIO MAGNETIC INDICATORS



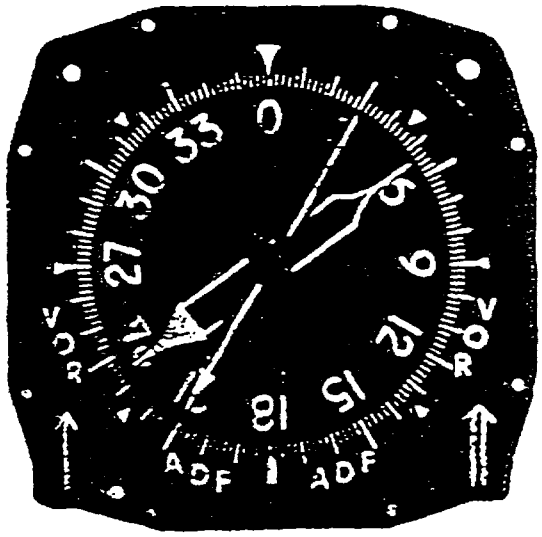
INCLUDES THE FOLLOWING TYPES:

2105—2105L

2107—2107L

2108—2108L

2109—2109L



Litton

Special Devices

Aeronetics Productline

Record of Revisions

RETAIN THIS RECORD IN THE FRONT OF MANUAL.
ON RECEIPT OF REVISIONS, INSERT REVISED PAGES IN THE MANUAL,
AND ENTER DATE INSERTED AND INITIALS

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SERVICE LETTER

TYPE 2105/L RMI

(INSTALLATION SCHEMATIC CORRECTION)

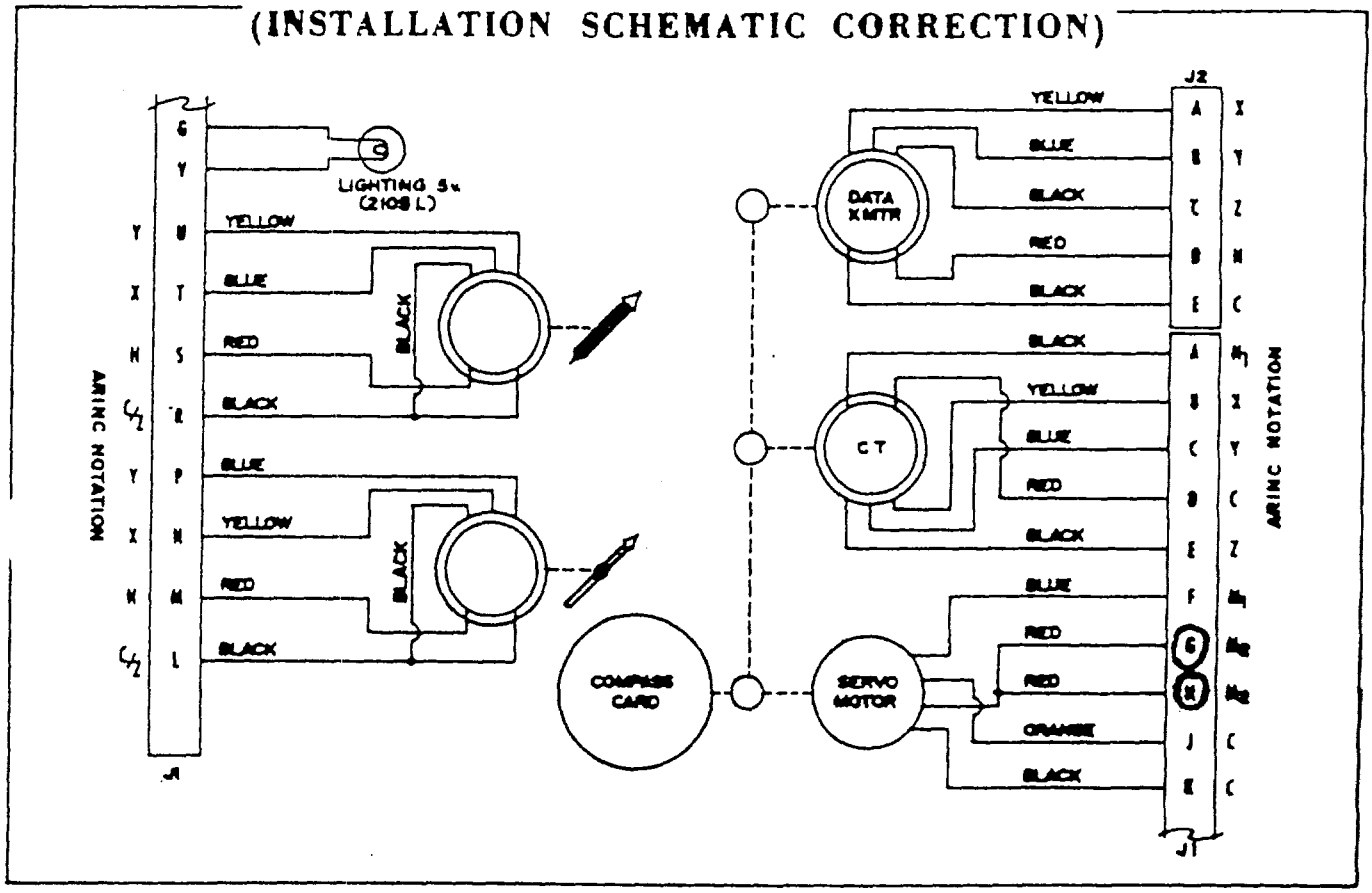


Figure 2–4 Type 2105 and 2105L RMI, Schematic Diagram

Reference: Figure 2-4, we call your attention to the pin connections on "G" and "H" - Please note that in the case of the 2105 unlighted the motor can be wired to either. However, in the case of the 2105L (lighted) the motor must be connected to pin "H" and the lighting to pin "G." Deviation from this procedure will result in a nonfunctioning card, and in case of 5 volt lighting, a burning out of the light bulbs.

Revised schematics will be issued for the 2105L. In the meantime, please note the above.

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SECTION I

GENERAL DESCRIPTION

1.1 SCOPE OF MANUAL

The instruments described in this manual are the AERONETICS, DIVISION OF AAR CORP., 2100 Series Radio Magnetic Indicator (RMI) manufactured in Elk Grove Village, Illinois. This manual includes brief description and operation; overhaul disassembly, repair, reassembly, calibration, and testing procedures; and an Illustrated Parts List for the equipment types covered.

The overhaul procedures presented are intended as step-by-step procedures for overhaul and testing by qualified instrument technicians, working in properly equipped instrument shops.

NOTE: The Illustrated Parts List shall not be used as authority for disassembly without reference to the Overhaul procedures.

1.2 DESCRIPTION AND OPERATION (Refer to Figure 1-1)

The 2100 Series of Radio Magnetic Indicators (RMI) are dual pointer, rotating azimuth instruments displaying both the magnetic heading of the aircraft and the magnetic bearing to a selected radio facility.

The fixed outer dial mask of the indicator is marked with a triangular lubber line, and additional triangular markers at each 45° increment around the full 360° face of the instrument. Behind the mask a narrow single bar pointer, and a wide double bar pointer driven by synchro receivers provide magnetic radio bearing indications in accordance with a rotating inner dial. The inner rotating dial is numerically marked at 30° increments around the dial, and has intermediate graduations in either 5° or 2° increments. The dial repeats the bearing of the selected external compass system.

The 2107 Model has two knobs on the instrument face. These knobs actuate switches which select radio bearing signals from ADF or VOR receiving systems. These bearings will be indicated by either the single or double bar pointer.

1.3 SPECIFICATIONS

WEIGHT:	2105, 2108, 2109	2 lbs. 8 oz.
	2107	2 lbs.12 oz.
	Lighted MOdels add	3 oz.
ELECTRICAL:	26 Volt, 400 Cycle, single phase AC (voltage and frequency tolerances ±10%	
LIGHTING:	5 Volt DC or AC internal red or white.	
ENVIRONMENT:	Temperature range, operating -55°C to +70°C	
HUMIDITY:	95 percent at 70°C	
VIBRATION:	5 to 500 Hz at 5G Max. Acceleration	
ALTITUDE:	-1000 Ft. to 40,000 Ft.	

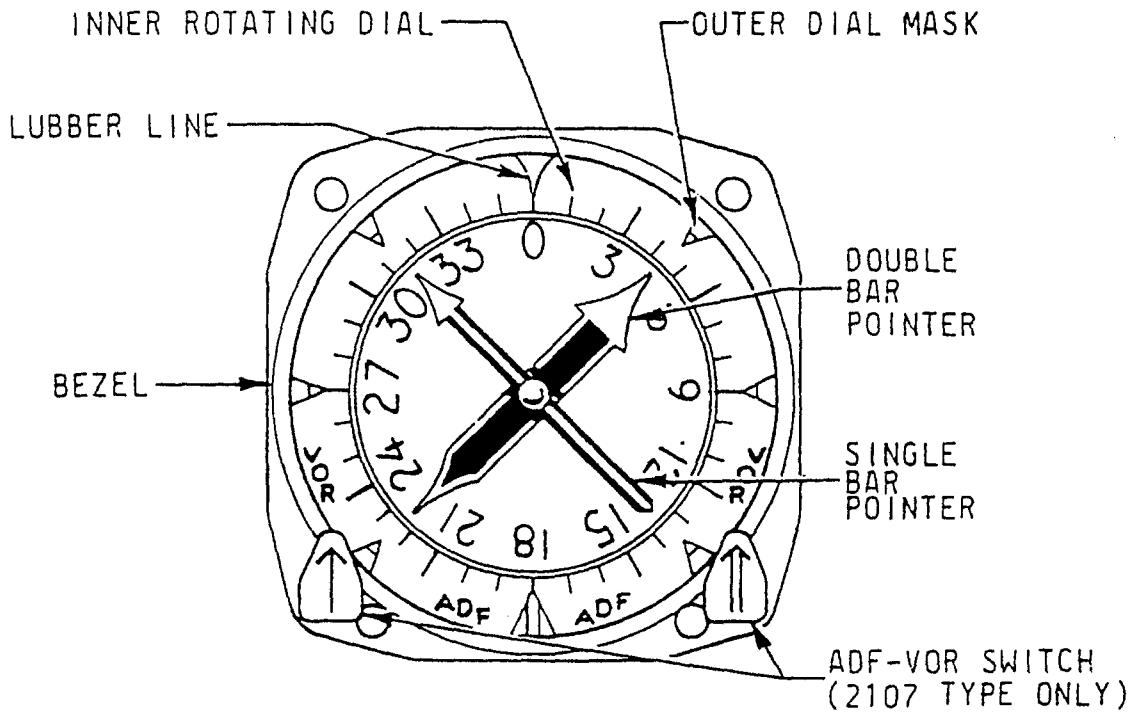


Figure 1–1 2100 Series Radio Magnetic Indicator (Type 2107 shown)

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SECTION 2

INSTALLATION

2.1 RECEIVING EQUIPMENT

Check packing slip for list of units. Unpack carefully checking for damage. Inspect units thoroughly. All claims must be filed with the transportation facility promptly. Retain packing material for proof of claim.

2.2 MOUNTING

The indicator should be mounted in a shock mounted instrument panel cut out as in the applicable figure reference according to type in Table 201.

TABLE 2-1

INSTALLATION AND SCHEMATIC DIAGRAMS

INDICATOR TYPE	INSTALLATION	SCHEMATIC
	FIGURE	FIGURE
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2107-2107L	2-2	2-5
2108-2108L	2-3	2-6
2109-2109L	2-3	2-7

2.3 CONNECTIONS

Table 2-1 indicates the appropriate figure number for the schematic diagram of each type of indicator. This schematic represents the internal components and wiring, and indicates the AIRINC designations for necessary interconnections required to operate the indicator from any gyro stabilized compass system and ADF or OMNI range receiver.

A. The system used to operate the indicator should have some positive identification of power failure or malfunction.

B. Aircraft interconnection cabling to accomodate the indicator should utilize AWG 20 or 22 size wires terminating in the electrical connector indicated on the appropriate schematic drawing referenced in Table 2-1.

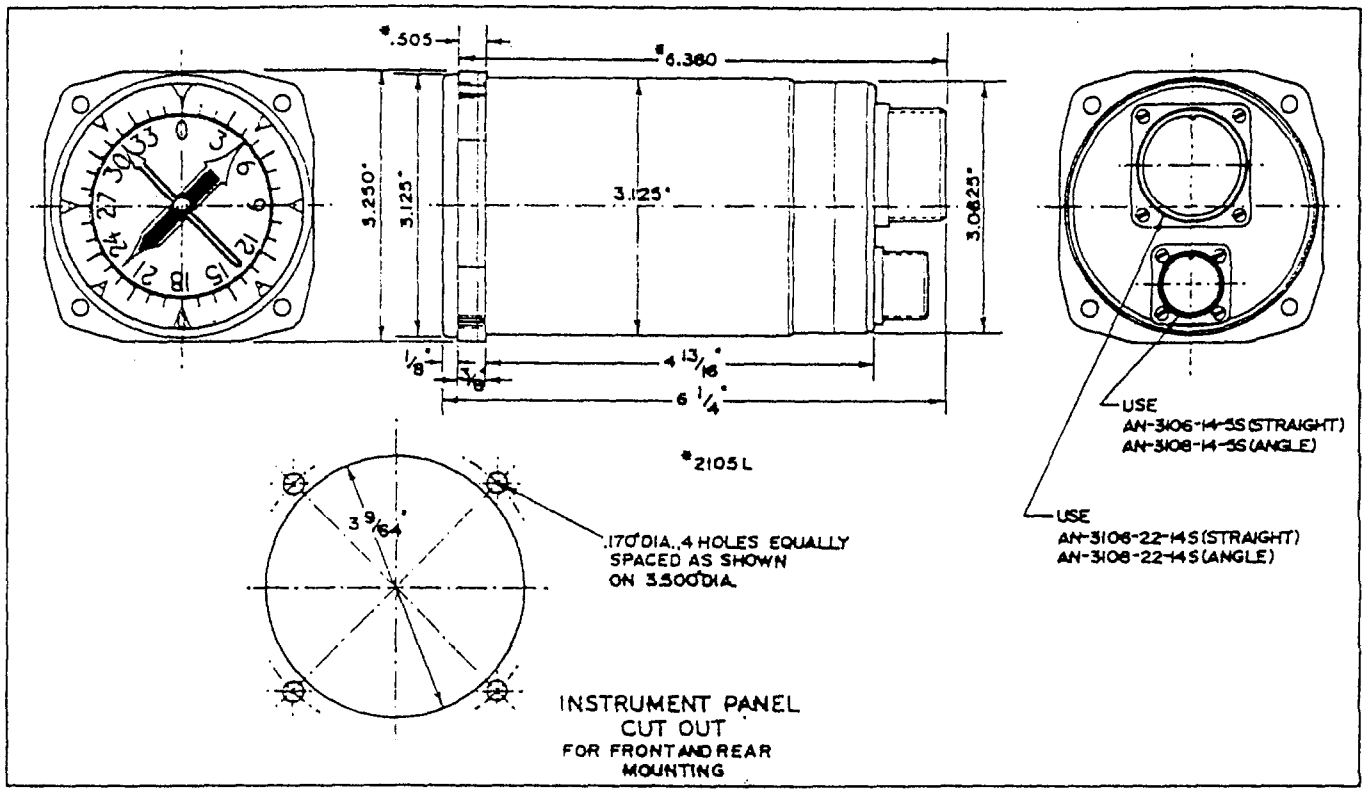


Figure 2–1 Type 2105 and 2105L RMI, Installation Drawing

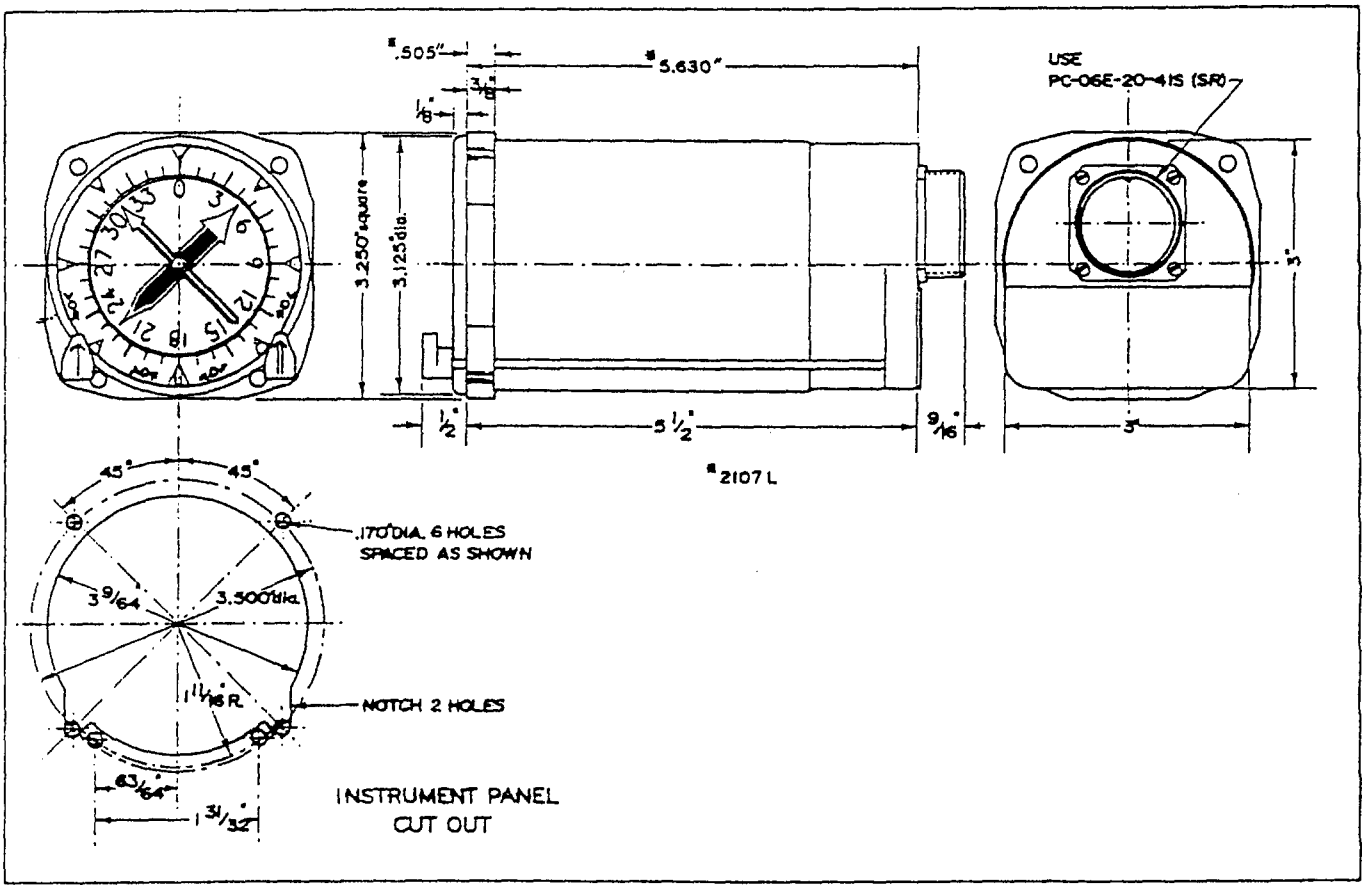


Figure 2–2 Type 2107 and 2107L RMI, Installation Drawing

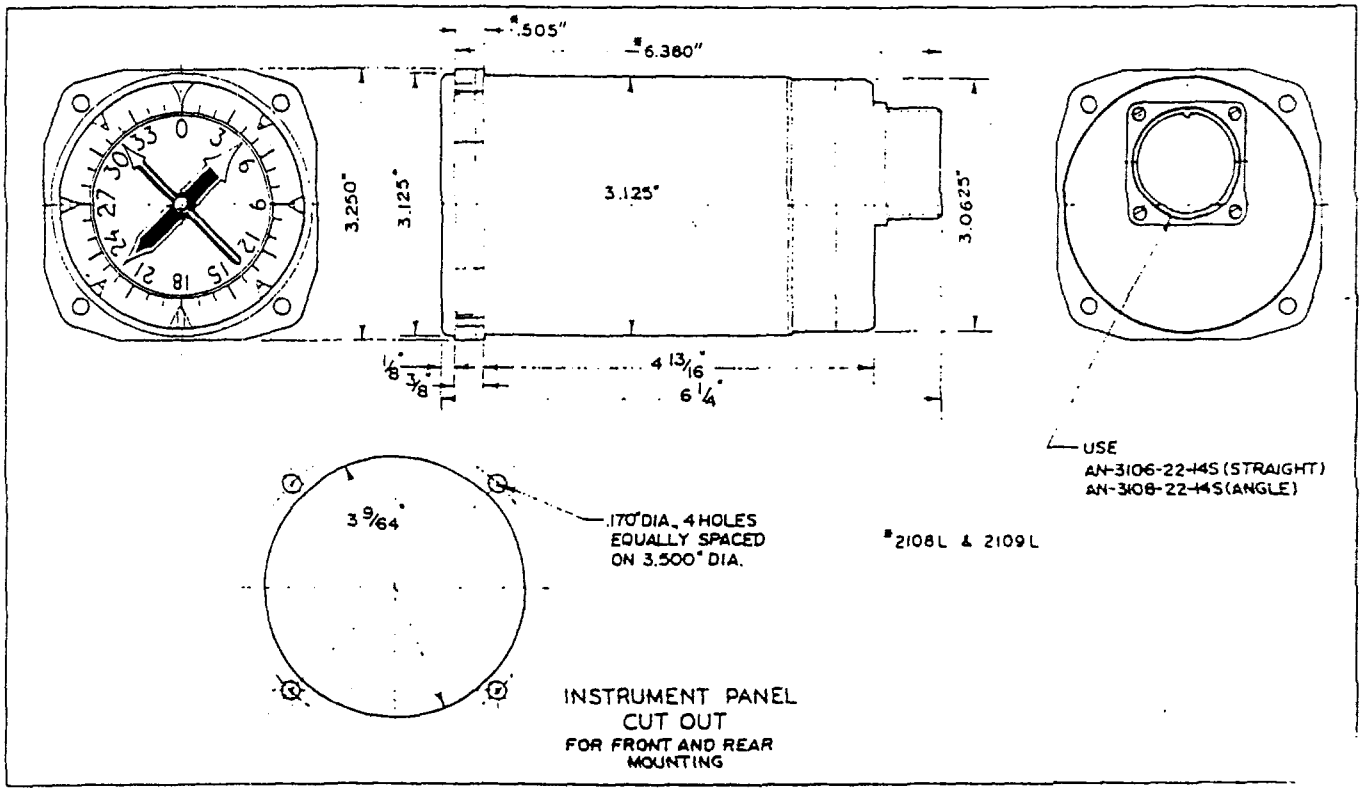


Figure 2–3 Types 2108, 2108L, 2109 and 2109L RMI, Installation Drawing

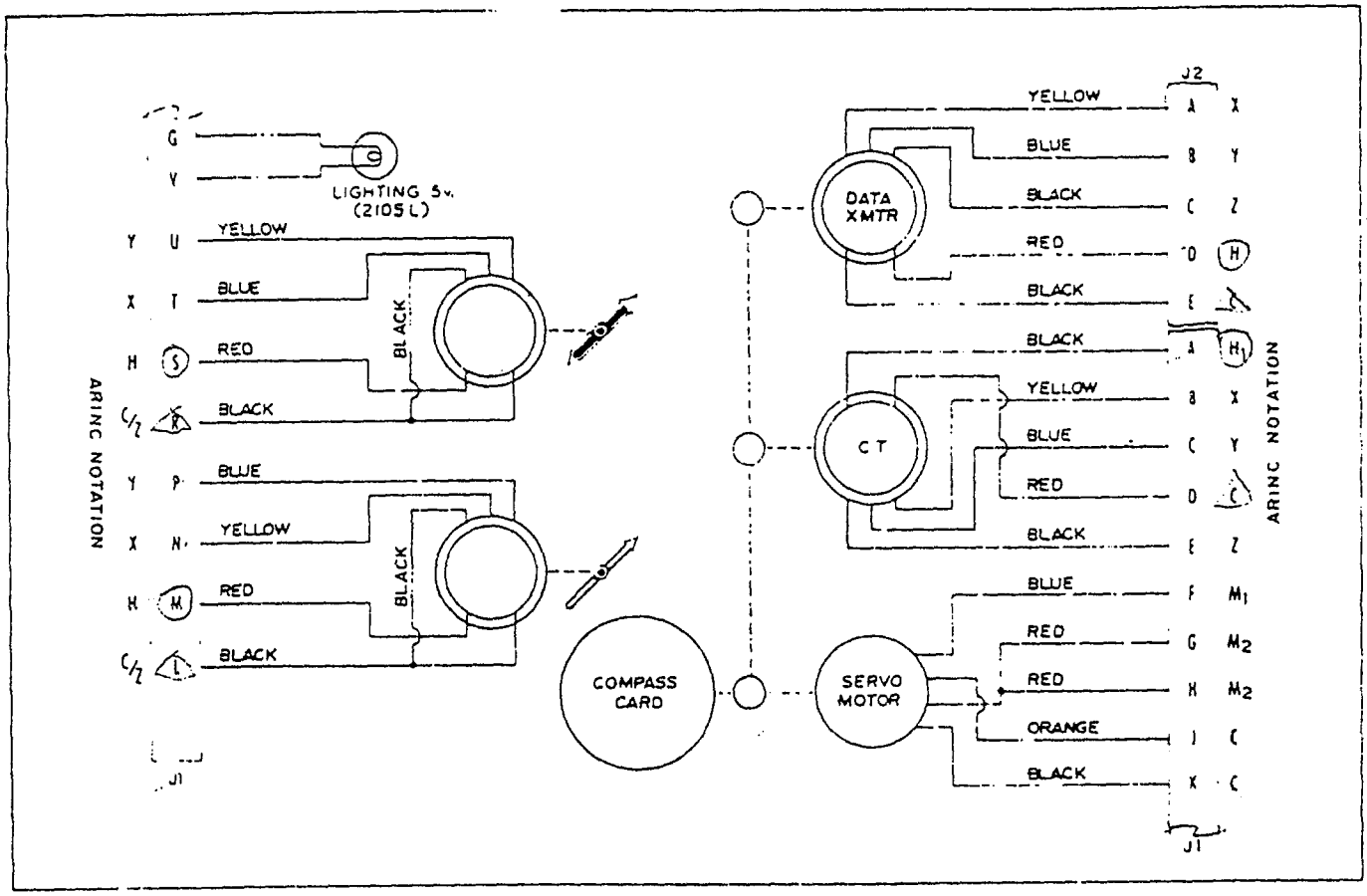


Figure 2–4 Type 2105 and 2105L RMI, Schematic Diagram

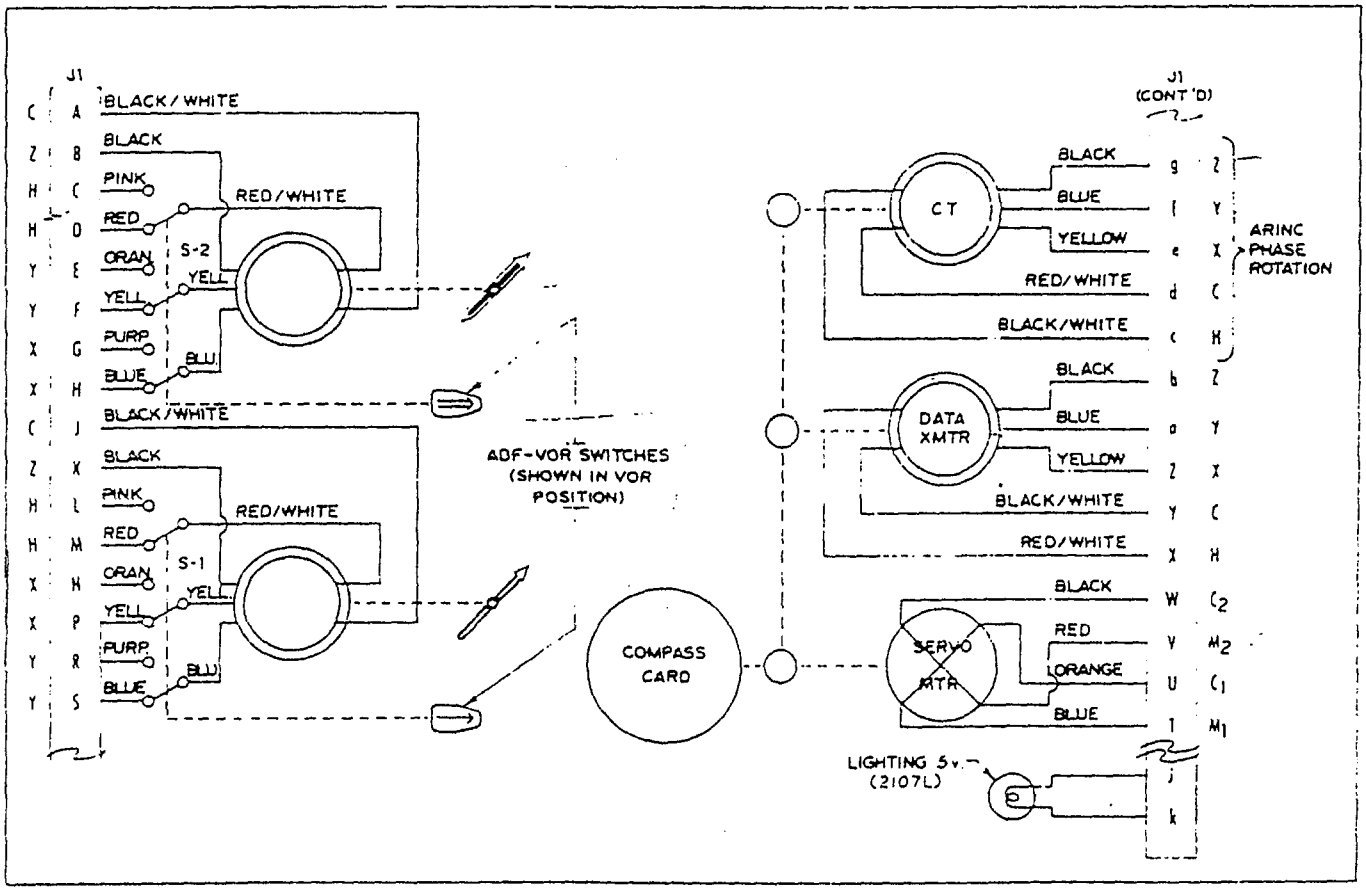


Figure 2–5 Type 2107 and 2107L RMI, Schematic Diagram

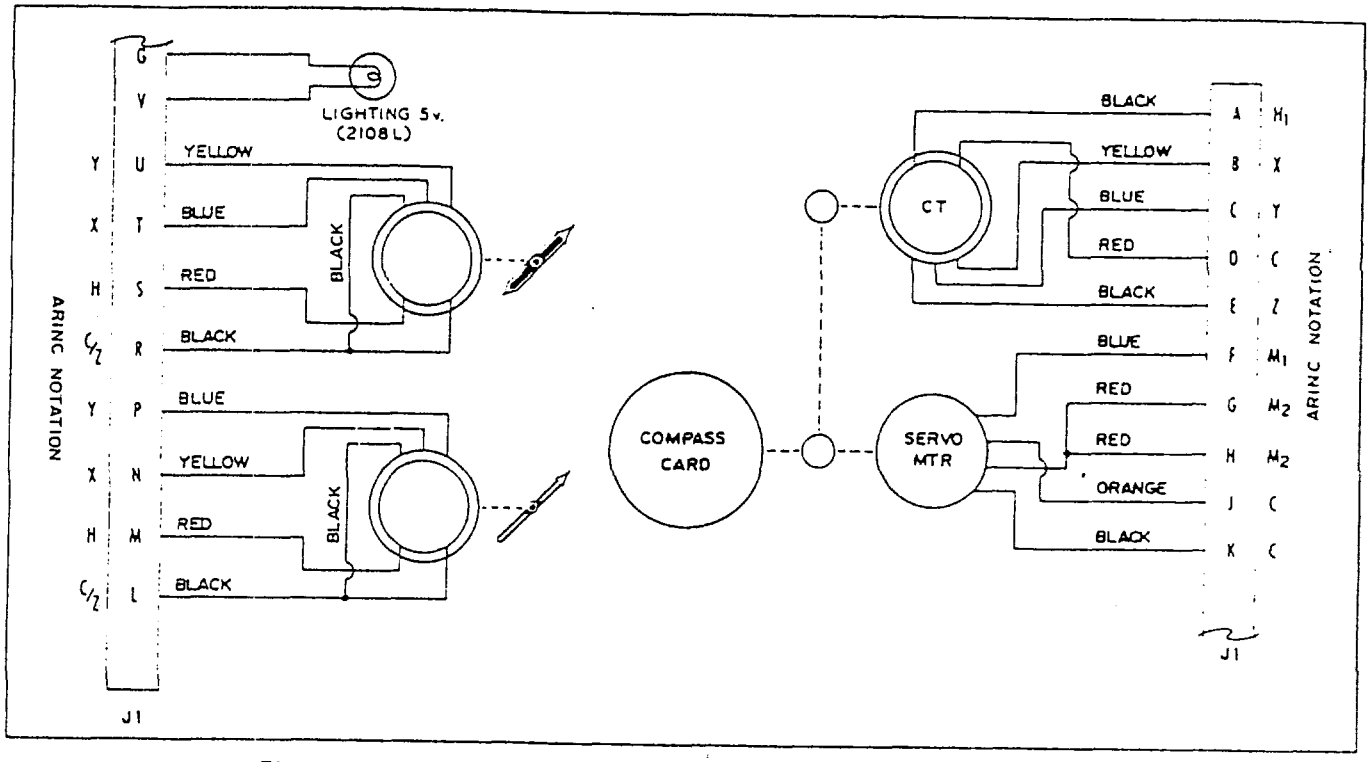


Figure 2–6 Type 2108 and 2108L RMI, Schematic Diagram

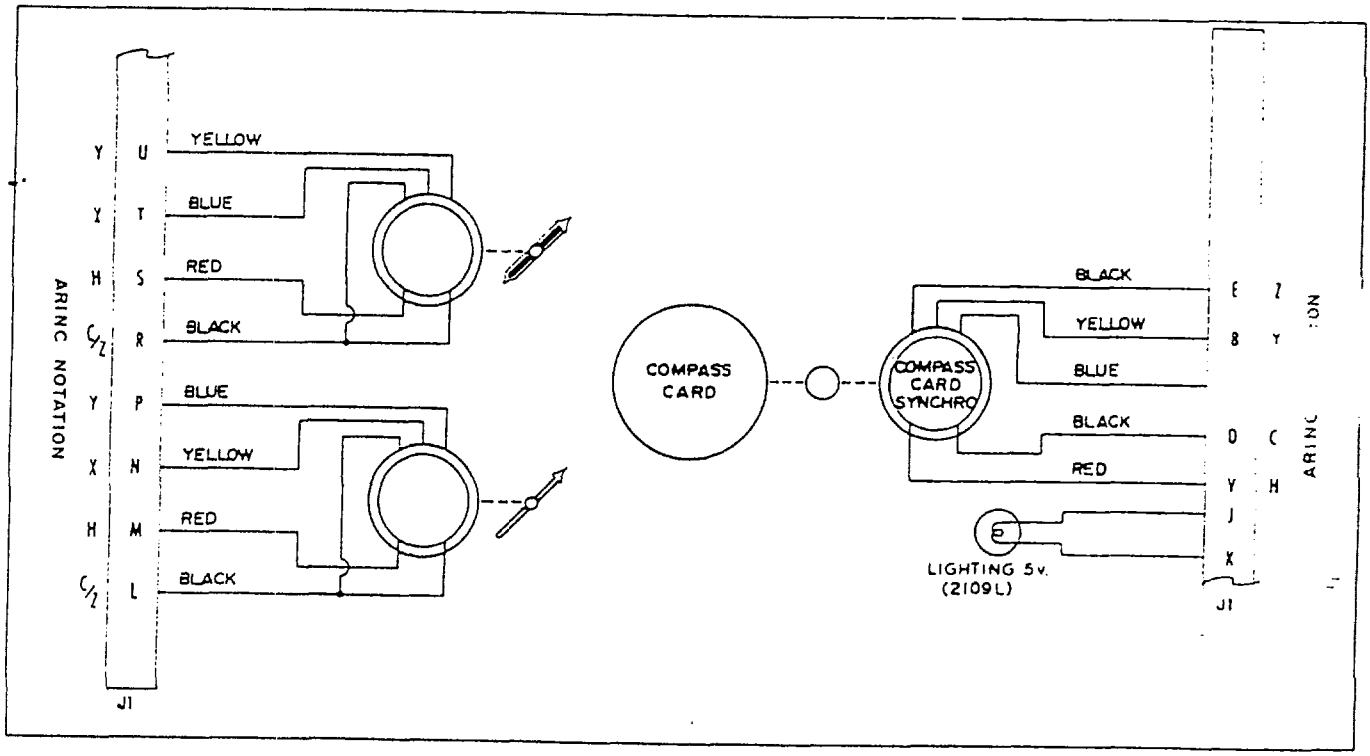


Figure 2–7 Type 2109 and 2109L RMI, Schematic Diagram

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SECTION 3

DISASSEMBLY

3.1 CONSIDERATIONS BEFORE DISASSEMBLY

Before beginning to disassemble the equipment, consider the objective. Complete disassembly to the last piece part is not always required or desirable. Therefore, the extent of disassembly is usually determined by the cause of trouble, except for life overhaul.

CAUTION: DISASSEMBLY SHOULD ONLY BE UNDERTAKEN BY EXPERIENCED INSTRUMENT REPAIRMEN AND IN A CLEAN, DUST FREE AREA.
IF SUCH FACILITIES ARE NOT AVAILABLE THE INSTRUMENT SHOULD BE RETURNED TO THE MANUFACTURER.

A. If a part is known to be defective, study the Detailed Parts List Illustrations and the equipment to determine the simplest approach. By-pass as many steps as possible.

B. Use proper tools and techniques to prevent damage to hardware, finishes, or components.

(1) Tag or otherwise identify all electrical leads and terminals before disconnecting components for removal.

(2) Identify the location and quantity of washers, gaskets, and shims.

(3) Witness mark all adjustable parts to simplify replacement, realignment, and adjustment.

(4) Store all parts in closed containers to protect them from dirt, humidity, mixing, loss or damag

CAUTION: DO NOT BEND, FORCE PARTS, OR DISASSEMBLE ITEMS NOT TAKEN APART IN THE PARTS LIST IN ORDER TO GAIN ACCESS.

3.2 INSTRUMENT TYPE DIFFERENCES

Since this manual covers more than one type of 2100 series instrument, the different procedures will be inserted at the applicable procedural steps. Such steps will be identified by an "*" preceeding the paragraph number or letter.

3.3 DISASSEMBLY

In general the following disassembly procedures are based on the relationship of parts established in the Illustrated Parts List. (Section 10.) Reference to parts is made by the generic noun or phrase, item number, and figure number taken from the parts list. Once a figure has been referenced, only item numbers will be used unless reference to a different figure is required. Immediately after such a reference the original figure will be referred to again and thereafter only item numbers will be used.

A. RADIO MAGNETIC INDICATOR (Ref. Figure 10-1)

Initial disassembly of the Radio Magnetic Indicator consists of removal of the case assembly, the mask, dial and pointers from the mechanical sub-assembly.

*(1) Type 2107 or 2107L Only. Before removing the case from Type 2107 indicators, perform the following steps:

(a) Remove knobs (1 and 2) by loosening two setscrews (3) in each.

(b) Remove rear cover plate (4) by taking out five screws (5).

(c) Remove two retaining rings (6) and withdraw shafts (7) with attached gears (8). Two washers (10) will drop free from each shaft.

(d) If replacement is required, gears (8) can be removed by loosening two setscrews (9) in each.

(2) Remove case assembly (11) by taking out three screws (12) and pulling it straight forward from the mechanism with a slight twisting motion. If repairs are required, the case assembly may be further disassembled as follows:

(a) Remove eight screws and lockwashers (14 and 15) and separate bezel (13), from rear bezel (16) releasing case (19), glass (21) and gaskets (22).

(b) If replacement is required bushings (17) and mounting nuts (18) may be removed from the rear bezel.

*(c) Types 2105L, 2107L, 2108L and 2109L Only. (Lighted Models)

Remove front and rear bezels (12) as in (a) above taking care not to bend terminals or sockets. Remove snap ring (23), rear lighting wedge (24) and gasket (25) from front bezel (13).

CAUTION: Front cover glass (26) and mask ring (27) should only be removed if damaged. This glass is bedded into the bezel with epoxy cement.

The two printed circuit boards (28) with lamps attached are connected with two wires. They may be removed together by taking our four screws (30). The six lamps (29) should not be removed unless inoperative.

(3) Remove presentation group from mechanical sub-assembly as follows:

(a) Remove mask (31) by taking out three screws (32).

(b) Remove pointers (33 and 34) with a suitable hand remover, bushing (35) will be freed.

(c) Remove dial (36) by taking out two screws (37).

NOTE: If more than one indicator is being overhauled, be sure to identify knobs (1 and 2) pointers (33 and 34) and dial (36) for proper reassembly with their respective case and mechanism.

(d) Remove indice mounting ring (38) from the mechanical sub-assembly by taking out three screws (39).

B. MECHANICAL SUB-ASSEMBLY. (Ref. Figure 10-2)

Disassemble the mechanical sub-assembly as follows:

(1) Remove the assemblage of the center bridge and gear assembly, top synchro mounting plate, front synchros, associated gears, and parts as follows:

*(a) Types 2105, 2105L, 2107 and 2107L Only. Remove idler gear assembly (1) by taking out idler gear screw (2) and slipping the idler gear assembly and lockwasher (3) outward. If ball bearing (4) is worn, it may be pressed out of gear (5) with suitable tool.

(b) Remove top synchro mounting plate sub-assembly (6) (with attached parts) and four spring clips (7) by taking out special screw (8) and three mounting posts (9)(using suitable pin wrench).

NOTE: If leads are laced, it may be necessary to cut lacing cords on synchro leads before lifting plate free..

(c) Lift top synchro mounting plate sub-assembly (6) and attached parts straight outward.

CAUTION: USE CARE TO AVOID BENDING OR BURRING OF POINTER SHAFT (10).

(d) Grip pointer shaft (10) with a pin vise and extract it from taper in damper assembly (56, 57, 59).

(2) Disassemble the assemblage of parts attached to the top synchro mounting plate as follows:

*(a) Types 2105, 2105L, 2107 and 2107L Only. Remove collar clamp (12) by loosening screw (13) and pulling clamp free. Remove two synchro clamps (17) by taking out two screws (15) and lockwashers (16). Withdraw control transformer synchro (14) while pulling anti-backlash gear assembly (11) outward from synchro shaft.

*(b) Types 2105, 2105L, 2107, 2107L 2108 and 2108L Only. Remove servo motor assembly (19) with pinion (18) installed by taking out two screws (20) and lockwashers (21), and pulling servo motor to the rear. Remove anti-backlash gear cluster (22) by taking out three screws, lockwashers, and

synchro clamps (27, 28 and 29), loosening screw (24) and taking off collar clamp (23) and pulling synchro assembly (25) carefully straight away from rear of plate, eccentric (26) will be freed.

*(c) Type 2109 and 2109L Only. Remove three screws, lockwashers and synchros clamps (27, 28 and 29). Support the top synchro mounting plate (6) and drop synchro assembly (25) down so gear and hub assembly (30) and damper weight (31) rest on plate. Tap on synchro shaft through gear hub to release tapered synchro shaft, damper weight (31) may be removed from gear and hub assembly (30) by taking off retaining ring (32). Synchro (25) and eccentric (26) will be freed.

(d) Remove synchro assembly (33) by taking out two screws, lockwashers, and synchro lamps (35, 36 and 37); supporting top synchro mounting plate (6); dropping synchro down so that damper weight (38) and gear and hub sub-assembly (40) rest on the plate; then, tap on synchro shaft through gear hub to lease tapered synchro shaft. Synchro eccentric (34) will be freed. The damper weight (38) may be removed from gear and hub (40) by taking off retaining ring (39).

(e) Remove the center bridge and gear assembly (41) from the top synchro mounting plate (6) by taking out three screws, lockwashers, and washers (42, 43 and 44). Lift assembly straight up, gears and pinions (45, 46, 47 and 48) and gear and shaft assembly (49) will be freed.

(3) Type 2107 and 2107L Only. Perform the following preliminary disassembly procedures on the rear portion of Type 2107 indicators:

(a) Remove retaining ring (65) and two washers (66) from cam shafts (64).

(b) Loosen two set screws behind two detent springs (70).

(c) Loosen two setscrews (68) in right and left cams (67). Pull two cam shafts (64) with right and left cam gears (71) attached, straight out from rear of receptacle mounting support (84). Cams will be free.

NOTE: Use care not to lose two balls (69) and springs (70) that will be freed by removal of cam gears, and washers (73) freed by the shafts.

(d) Right or left cam gear (71) may be removed from their cam shafts (64) by loosening two setscrews (72).

(e) Remove six switches (74) by taking off eight nuts (75), four lockwashers (76) and four washers (77) Remove four studs (78) and insulators (79). Two cam stop screws (80) and lockwashers (81) can also be removed from rear plate if necessary.

(4) DISASSEMBLY OF REAR PORTION OF ALL INDICATORS. Disassembly of the rear portion of indicator is as follows:

(a) Remove two screws (55), lockwashers (56) and synchro clamps (57).

(b) Drop synchro assembly (54) down so that damper assembly (50) rests on rear plate (61). Tap on synchro shaft through hub to release tapered synchro shaft.

(c) Remove rear plate (61) by taking out two upper top posts (58) and screw (62) and lockwasher (63).

(d) Two remaining lower top posts (58) may be removed by taking off two nuts or screws (59) and lockwashers (60).

(e) Remove three rear plate mounting posts (82) from receptacle mounting support (83 or 84) with an appropriate pin wrench. Setscrews (85) may be removed from support.

(f) Remove receptacle (86 or 87) from mounting support by taking out four screws (88) and lockwashers (89).

*(g) Type 2105 Only. Remove receptacle (90) by taking out four screws (91) and lockwashers (92).

*(h) Types 2105L, 2107L, 2108L and 2109L Only. Terminal strip (93) may be removed from synchro mounting plate by taking out two screws (94).

C. CENTER BRIDGE AND GEAR ASSEMBLY. (Ref. Figure 10-3).

To disassembly the center bridge and gear assembly proceed as follows:

1. Detach bridge plate (1) by removing three nuts (2) and washers (3), and pulling bridge straight away from bearing plate (6).

2. Separate gear and hub assembly (4) from hub and jewel sub-assembly (7) by removing collar (5) with an appropriate puller. Jewels (10, 11, 12 and 13) may now be removed from the synchro plate (9), bridge (1), bearing plate (6) and hub (8) respectively.

D. DISASSEMBLY BEYOND INSTRUCTIONS:

Disassembly of assemblies not detailed in the preceding instructions shall be considered beyond the scope of this manual. If synchros are to be disassembled, such procedures should be performed according to the manufacturer's recommendations, or in accordance with standard practices. Other sub-assemblies which contain parts joined by staking, riveting, brazing, welding, cementing, or by other permanent means are considered as irreparable since disassembly may be damaging or destructive.

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SECTION 4

CLEANING

4.1 EQUIPMENT AND MATERIALS REQUIRED.

The following equipment and materials are recommended for cleaning the instruments. The materials have been selected for greatest effectivity with the lease danger to personnel and equipment.

CLEANING EQUIPMENT AND MATERIALS

Ultrasonic cleaning equipment (MIL-C-83754)
Waterless ultrasonic instrument cleaning solution
Ultrasonic rinsing solution
Low pressure dry compressed air source
Optical glass cleaner (not diatomous or silconized (MIL-C-43454A).
Camel hair brushes
Soft lint free cloths.

4.2 CLEANING GEARS AND BEARINGS.

Clean gears and bearings that have been removed from sub-assemblies, or are in open structures in a good ultrasonic cleaner. Rinse well and dry thoroughly. Non-stainless, ferrous bearings should be lubricated (see Lubrication in Assembly, Section 7) and wrapped. Place cleaned parts in clean, dry, covered containers.

4.3 CLEANING STRUCTURAL COMPONENTS AND HARDWARE.

Wipe surface dirt from housings, plates, supports, posts, shafts and similar items with clean lint-free cloths. Use a clean area of the cloth for each stroke. Do not use soiled cloths.

A. Immerse parts in cleaning solution. Soak until stain and dirt are loosened.

B. Dislodge stubborn dirt with a camel hair brush.

C. Flush parts with rinsing solution.

D. Dry parts with gentle stream of clean dry air.

E. Store cleaned parts in clean, dry, covered containers.

4.4 CLEANING ELECTRICAL COMPONENTS.

Clean synchros and servo motors by wiping away surface dirt with a clean dry cloth.

CAUTION: DO NOT IMMERSE SYNCHROS OR MOTORS. THIS MANUAL DOES NOT COVER THEIR OVERHAUL.

4.5 CLEANING CASE GLASS OR LIGHTING WEDGES.

Clean case glass inside and out with clean lint-free cloth moistened with a glass cleaner. Use a clean area of cloth for each wiping stroke. Dry glass surfaces and wrap in tissue paper for storage.

NOTE: IF LIGHTING COVER GLASS AND MASK WERE REMOVED, OLD EPOXY CEMENT MUST BE CAREFULLY CLEANED FROM BEZEL LIP BEFORE REPLACING MASK AND GLASS.

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SECTION 5

INSPECTION

5.1 INSPECTION OF DISASSEMBLED PARTS.

TABLE 5-1 INSPECTION PROCEDURE

ITEM	CONDITION	REMEDY
Case, Bezel	Gouged, dented, distorted	Replace if severly damaged Repair minor damage
	Finish scratched or chipped Finish worn through	Touch-up Repaint
Lighting	No Light	Replace leads, terminals or lamps
	Uneven Light	Replace defective lamps
Structural Memers	Irridite finish damaged	Apply irridite
	Threads of tapped holes damaged	Re-tap or replace members if necessary
Case Glass	Scratched, chipped	Replace
	Paint missing from letters	Refill engraved letters
Hardware	Screw threads crossed or worn	Replace
	Screw heads damaged	Replace
	Flat washers burred or bent	Replace
	Setscrew sockets burred	Replace
	Lockwashers deformed or flattened	Replace
Shafts	Scored, bent, or worn	Replace
Bushings	Scored or worn	Replace

TABLE 5-1 INSPECTION PROCEDURE (Con'd)

ITEM	CONDITION		REMEDY
Ball Bearings	Run rough, worn		Replace
Gears	Spur	Teeth worn or burred	Replace
		Pivots worn	Replace
	Anti-back-lash	Fixed gear loose	Replace assembly
		Moveable gears bent	Replace assembly
		Springs missing	Replace springs or assembly
		Teeth worn	Replace assembly
Receptacle	Bent Pins		Straighten pins
	Corrosion		Replace
	Damaged shell or insert		Replace
Synchros	Inoperative or inaccurate		Return to manufacturer for overhaul
Jewels	Chipped, cracked or worn		Replace jewel
Connections	Insulation worn, chafed, charred or broken		Replace damaged leads
	Wire broken		Replace damaged leads
	Solder joints faulty		Rework
	Switches defective		Replace faulty switch
Dial, Pointers, Indice, Knobs	Finish scratched, chipped, discolored		Touch-up or replace as required

TABLE 5-1 INSPECTION PROCEDURE (Cont'd)

ITEM	CONDITION	REMEDY
Damper Assemblies	Damper weight must rotate freely	If tight, remove burrs or ream as required
	Retaining ring missing	Replace missing ring
Bridge and Plate	Worn bearing holes	Repair or replace
	Jewels Loose	Repair or replace
Gaskets	Discard gaskets	Replace gaskets

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SECTION 6

REPAIR AND REPLACEMENT

6.1 REPAIR OF SUB-ASSEMBLIES OR PARTS

Damaged or badly worn parts must be replaced during overhaul to assure reliability through the next service life of the equipment. The following instructions detail repairs which can be made without jeopardizing dependability or performance.

A. EXTERIOR FINISH

If painted surface of case requires refinishing, proceed as follows:

(1) Strip old paint.

(2) Check irridite finish for nicks and scratches; refinish where required.

(3) Paint case, bezel, receptacle mounting support, and rear plate cover with flat black paint per Federal Standard 595, color number 37038.

(4) Touch-up indice points, or other white markings with matte white, Federal Standard 595, color 37875.

B. SYNCHROS AND MOTORS.

Synchros and motors shall be overhauled before being installed during equipment reassembly. Overhaul of motors and synchros shall be accomplished according to procedures specified by the synchro or motor manufacturer, or the item shall be overhauled by the manufacturer's facility.

6.2 REPLACEMENT OF PARTS.

If replacement of parts is necessary, they must be identical to the original. The Illustrated Parts List (Section 10) gives sizes and types of hardware and also the information necessary for ordering identical replacement parts.

CAUTION: Any substitution of parts not identical to the original may result in unsatisfactory operation or damage to the instrument.

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SECTION 7

ASSEMBLY

7.1 ASSEMBLY PROCEDURES.

Assembly procedures are based on the consideration that the equipment has been completely disassembled to the least procurable sub-assembly or individual part as listed in the Illustrated Parts List. Since disassembly to this degree may not be warranted in certain cases, the assembler will be expected to modify the procedures to fit the requirements of the individual piece of equipment. In general, reassembly is the reverse of the disassembly order presented in the parts list. Where a reassembly procedure applies only to particular type(s), an * (asterisk) will precede the paragraph number. Immediately after an * paragraph number the applicable type(s) will be identified. Such steps will be placed ahead of procedures which otherwise apply to all types, and as close as possible to the point of application.

7.2 LUBRICATION.

During reassembly lubricate the equipment as follows:

A. BALL BEARINGS.

Lightly pack ball bearings with high-low temperature instrument grease, Military Specification MIL-G-3278.

B. BEARINGS, BUSHINGS.

Apply a droplet of high-low temperature aircraft instrument lubricating oil Military Specification MIL-L-6058 to bearings and bushings.

C. GEARS.

Brush a thin coating of multi-purpose grease, plate 630AA (Fiske Brothers Refining Co., Newa... N. J.) on all gear teeth, except that no oil should be applied to bearings or teeth of gears (49, 30 or 40, Figures 10-2), or (4, Figure 10-3). Lubricate anti-backlash gear interfaces with high-low temperature aircraft instrument lubricating oil Military Specification MIL-L-6058 inserted with a syringe.

7.3 ASSEMBLY PRECAUTIONS.

During reassembly the following precautions shall be taken:

A. Reassembly shall only be undertaken by qualified personnel and in clean, dust free facilities.

B. No undue force shall be applied in reassembly that might result in damage or mis-alignment of parts.

C. All screws not having lockwashers shall be secured with cement (liquid stake red).

D. All leads shall be secured with lacing tape.

7.4 REASSEMBLY.

A. MECHANICAL SUB-ASSEMBLY, GENERAL (Ref. Figure 10-2).

Reassemble the indicator mechanical sub-assembly as follows:

(1) Place required sleeving over lead groups as noted during disassembly.

(2) Thread leads through receptacle mounting support (83 or 84) and solder proper leads to pins of receptacle(s) (86, 87 and/or 90). Secure receptacle to support with appropriate four screws and lockwashers (88 and 89) or (91 and 92).

(3) Install front pointer synchro assembly (54) on rear plate (61) and secure with two screws, lockwashers, and synchro clamps (55, 56 and 57).

(4) Install two upper top posts (58) in lower holes in rear plate (61) and secure with screws or nuts and lockwashers (59 and 60).

(5) Screw three rear plate mounting posts (82) into receptacle mounting support (83 or 84).

(6) Position assembled rear plate, synchro, and posts on three posts (82) and secure with two lower top posts (58) and screw and lockwasher (62 and 63).

*B. TYPES 2107 and 2107L ONLY, ADF/VOR SWITCHING. (Ref. Figure 10-2.)

Assemble rear portion of these indicators as follows:

(1) Install two switch studs (78) in rear plate (61) and secure with nuts and washers (75 and 77).

(2) Place insulators and switches (79 and 74 on studs and secure with plain washers, lockwashers and nuts (77, 76 and 75).

(3) Mount right and left cam gears (71) on cam shafts (64) and secure with two setscrews (70) in each gear. Place one washer (73) over each shaft and position against face of gears.

(4) Turn setscrews (85) into receptacle mounting support (84) to a depth of about 1/8 inch.

(5) Apply a light coating of Lubriplate 630AA (Fiske Brothers Refining Co., Newark, N. J.) to two detent springs (70).

(6) Insert detent springs (70) into holes in receptacle mounting support (84). Place detent balls (69) on top of springs.

(7) Install shafts (64) through proper holes in support (84) and through appropriate cam (67) placing one washer (66) on each shaft as it is pushed through.

(8) When ends of shafts pass through rear plate (61), place second washer (66) on each and secure with retaining rings (65).

(9) Rotate each cam gear to its ADF detent position (turn left cam gear clockwise, and right cam gear counter-clockwise-as viewed in Figure 2-2). Adjust setscrews (85) to apply adequate spring tension on detent balls to effect positive indexing of gears in ADF detents.

(10) Set cams (67) against stops(80) and tighten + setscrews (68) in each.

C. CENTER BRIDGE AND GEAR ASSEMBLY. (Ref. Figure 10-3).

Reassemble the center bridge and gear assembly as follows:

(1) If jewel (12) has been removed, or required replacement, install in bearing plate (6).

(2) If jewel assembly (11) has been removed, or requires replacement, install in bridge (1).

(3) Insert hub and jewel assembly (7) through jewel (12). Place gear and hub assembly (4) over shaft of hub and jewel assembly (7) and secure with collar (5).

(4) Guide bridge (1) jewel assembly (11) over shaft of hub and jewel assembly (7) and secure bridge to bearing plate (6) with three nuts and lock-washers(2 and 3).

(5) Install jewel (10) in top synchro mounting plate (15).

D. TOP SYNCHRO MOUNTING PLATE ASSEMBLY. (Ref. Figure 10-2.)

Continue assembly of the indicator as follows:

(1) Position damper hub (52) on shaft of front pointer synchro assembly (54). To prevent damage to synchro bearings, support rear end of synchro shaft on a dowel rod in a vise, or by similar means and tap hub onto shaft to set securely. Install damper weight (51) on hub and secure with retaining ring (53). Damper weight must turn with complete freedom.

NOTE: Flange of hub (52) should clear rear plate (61) by not less than 0.025 inch. If hub touches plate or clearance is below minimum install a new hub. New hubs may require reaming from flange side with a 3° reamer to obtain proper seating on shaft.

(2) Apply a thin film of Alcoa Thread Lubricant (Aluminum Company of American, New Kensington, Pa.) on both sides of synchro eccentrics (26 and 34) and place in proper holes in top synchro mounting plate (32) with shoulder of eccentrics entering holes in plate. Position proper synchro assembly (33 and 25) in eccentrics and secure each lightly with two screws, lockwashers and synchro clamps (35, 36, 37; and 27, 28 and 29).

(3) Insert pointer shaft (10) in taper hole in shaft of front pointer synchro assembly (54). Tap shaft with proper tool to seat. True-up shaft if necessary.

NOTE: With synchro installed and shaft in place, end of shaft shall be 0.968 $^{+0.000}_{-0.01}$ inches outward from outer face of synchro mounting plate (61). If dimension is greater (shaft too long) ream the synchro (54) shaft with a 3° reamer until correct dimension is obtained.

(4) Carefully guide top synchro mounting plate assembly (6) into assembly so pointer shaft (10) enters jewel (10 Figure 10-3). When properly oriented and in contact with four top posts (58, Figure 10-2) secure plate with three indice mounting ring posts (9), special mask mounting screw (8) and four spring clips (7) one clip under each post and screw.

(5) Carefully install gear and shaft assembly (49) over pointer shaft (10), into jewel in top plate (10, Figure 10-3).

(6) Install gear and hub sub-assembly (40, Figure 10-2) on shaft of synchro assembly (33) and in engagement with gear and shaft assembly (49) tap hub to seat on shaft.

NOTE: Flange of gear hub (40) should clear top plate (6) by not less than 0.025 inch. If hub touches plate a new unit must be installed. New assemblies may require reaming from flange side with a 3° reamer.

(7) Assemble damper weight (38) on gear and hub sub-assembly (40) and check for complete freedom of rotation. Secure with retaining ring (39).

*E. TYPES 2105, 2105L, 2107 and 2107L ONLY. (Ref. Figure 10-2.)

Install ball bearing (4) in gear (5) forming idler gear assembly (1). Position assembly on top synchro mounting plate (6) with lockwasher (3) and secure with idler gear screw (2). Check for free rotation.

(1) Mount control transformer synchro assembly (14) on rear of top synchro mounting plate assembly (6) with two screws, lockwashers and synchro clamps (15, 16 and 17).

(2) Install anti-backlash gear assembly (11) on shaft of control transformer synchro assembly (14),load gear one or two teeth and slide into engagement with idler gear (5). Slide collar clamp (12) onto hub of gear assembly (11). Be sure full width of both anti-backlash gears (11) is in mesh with idler gear (5) secure clamp (12) by tightening screw (13).

(3) Install anti-backlash cluster gear assembly (22) on shaft of synchro assembly (25) loading lower gear one or two teeth as it is slid into engagement with idler gear (5). Secure gear assembly (22) at best depth of engagement by tightening screw (24) in collar clamp (23).

(4) Install gear and pinion (48) and gear and pinion (47) in top synchro mounting plate (6).

(5) Load large anti-backlash cluster gears (22) one or two teeth, engage pinion of gear and pinion with loaded gears and install in plate (6).

(6) Install gear and pinion (45) in top plate (6) in engagement with pinion of (47) and gear of (46).

(7) Assemble center bridge and gear assemblage prepared in step C above over pointer shaft (10) and shaft of gear and shaft assembly (49) and studs of top plate (6) guiding gear and pinion pivots into their proper bearing holes and maintaining center bridge plate in alignment with thru bridge mounting posts.

(8) Install three screws, lockwashers, and washers (42), 43 and 44) and carefully tighten while checking position of all components. Check gear train for free rotation.

(9) Adjust mesh between gears (40 and 49) to approximately 75 percent of tooth depth by rotating synchro eccentric (34). Secure by tightening two screws (35).

(10) Adjust mesh between top gear of anti-backlash cluster gear assembly (22) and gear of gear and hub assembly (4, Figure 10-3) by rotating synchro eccentric (26, Figure 10-2 to obtain approximately 75 percent of tooth depth. Secure by tightening two screws (27).

*F. TYPES 2108 and 2108L ONLY. (Ref. Figure 10-2.)

Install gear and pinion (48), gear and pinion (47), gear and pinion (46) and gear and pinion (45) in top synchro mounting plate (32). Continue assembly as follows:

(1) Place anti-backlash cluster gear assembly (22) on shaft of synchro assembly (25).

(2) Load anti-backlash gears one or two teeth and slide down to mesh with pinion of gear and pinion (46).

(3) Carefully lower center bridge and gear assemblage prepared in step C above over pointer shaft (10) and shaft of gear and shaft assembly (49) and studs of top plate (6), guiding gear and pinion pivots into their proper bearing holes, and maintaining center bridge plate in alignment with three bridge mounting posts.

(4) Install three screws, lockwashers and washers (42, 43 and 44) and carefully tighten while checking position of all components. Check gear train for free rotation.

(5) Adjust mesh between gears (40) and (49) to approximately 75 percent of tooth depth by rotating synchro eccentric (34, Figure 10-2). Secure by tightening two screws (35).

(6) Adjust mesh between anti-backlash cluster gear assembly (22) and gear of gear and hub assembly (4, Figure 10-3) by rotating synchro eccentric (26, Figure 10-2 to obtain approximately 75 percent of tooth depth. Secure by tightening two screws (27).

*G. TYPES 2109 and 2109L ONLY. (Ref. Figure 10-2.)

Install center bridge and gear assemblage prepared in step C above over pointer shaft (10) and shaft of gear and shaft assembly (49) and studs of top plate (6), guiding gear and pinion pivots into their proper bearing holes and maintaining center bridge plate in alignment with three bridge mounting posts. Continue as follows:

(1) Install three screws, lockwashers and washers (42, 43 and 44) and carefully tighten while checking position of all components. Check for free rotation.

(2) Install damper weight (31) on gear and hub assembly (30) and secure with retaining ring (32). Check for free rotation.

(3) Place weight and gear assembled in step (2) above on shaft of synchro assembly (25) damper weight first sliding gear (30) into mesh with gear and hub assembly (4, Figure 10-3). Tap hub of gear (30, Figure 10-2)to seat on tapered shaft of synchro.

NOTE: Damper weight must clear top synchro mounting plate (6) by at least 0.025 inch and entire width of gear (4, Figure 10-3) must be in mesh with gear (30, Figure 10-2). If gear does not go on shaft far enough for proper engagement, or if hub and gear (30) is new, it may be Necessary to ream from the hub side with a 3° reamer to obtain proper seated position.

(4) Adjust mesh between gear (40 , Figure 10-2) and gear (49) to obtain mesh of approximately 75 percent of tooth depth by rotating synchro eccentric (34). Secure by tightening two screws (35).

(5) Adjust mesh between gear (30) and gear (4, Figure 10-3) to obtain mesh of approximately 75 percent of tooth depth by rotating synchro eccentric (26, Figure 10-2). Secure by tightening two screws (27).

H. MASK DIAL AND POINTERS ASSEMBLY. (Ref. Figure 10-1.)

Assemble the following items to the front of the mechanical sub-assembly:

(1) Attach indice mounting ring (38) to mounting posts (9), Figure 10-2) with flat head screws (39, Figure 10-1).

(2) Place dial (36) on dial hub (8, Figure 10-3), and secure with two screws (37, Figure 10-1). Check all around indice mounting ring (38) through complete rotation of dial (36) for adequate clearance and parallelism between dial and ring.

(3) Install bushing and No. 2 pointer (35 and 34), tap to seat and check for 0.030 ±0.005 clearance at center and each end of pointer in every 30° position. If clearance is too great ream pointer bushing (35) with 3° reamer for required clearance. If clearance is too small replace bushing and check as above.

(4) Install No. 1 front pointer (33) on pointer shaft (10, Figure 10-2) tap to seat and check for 0.015 ±0.005 inch clearance and parallelism between pointer No. 1 (33) and pointer No. 2 (34) point to point and point-to-tail at 30° intervals around the dial. If clearance is too great, ream hub with 3° reamer to obtain required clearance. If clearance is too small, install a new No. 1 pointer and check as above.

(5) Install dial indice ring mask (31, Figure 10-1) over dial and secure to indice mounting ring (38) with three screws (32). Check dial for free movement throughout 360° rotation.

*I TYPES 2105, 2105L, 2107, 2107L, 2108 and 2108L ONLY. (Ref. Figure 10-2.)

Support rear end of shaft running through servo motor (19). Place pinion (18) on shaft and tap to seat. Check for 0.095 ±0.005 inch dimension from face of servo motor adapter plate to outer face of pinion (18). If clearance is too great ream pinion with 3° reamer until required dimension is obtained. If clearance is too small replace pinion, repeating above procedure. Install servo motor (19) on top synchro mounting plate (6), making certain pinion engages properly with gear and pinion (48). Secure motor with two screws and lockwashers (20 and 21).

J. INSPECT INDICATOR ASSEMBLY.

Inspect indicator assembly at this point for free rotation of train gears and dial. Check for any loose or missing hardware. Check electrical leads for neat routing, freedom from stress, secure connections, and containment within the mechanism envelope. Indicator is now ready for calibration and testing procedures.

K. CASE REASSEMBLY. (Ref. Figure 10-1.)

After the indicator has been calibrated and tested as directed in the section on calibration and testing. Complete reassembly as follows:

(1) If case assembly (11) has been disassembled, cleaned and repaired, reassemble by placing proper glass (21) in front bezel (13).

(2) Place proper inner gasket (22) on glass..

(3) Position bezel and glass properly on case (19).

NOTE: Screened lettering on glass for Type 2107 indicators must be relative to the knob shaft holes in the bezel.

(4) Slip rear bezel (16) down over case (19) and position on ears.

(5) Secure rear bezel to front bezel with light screws and lockwashers (14 and 15).

*L. TYPES 2105L, 2107L 2108L and 2109L ONLY. (Ref. Figure 10-2.)

(1) Mount terminal strip (93) to synchro mounting plate (6) using screws (94).

(2) If cover glass wedge (26), (Figure 10-1) and mask (27) were removed or replaced, they must be cemented in position in bezel (13). Carefully, apply 1/64th of an inch bead of epoxy cement on inside lip of bezel.

(3) Insert cover glass wedge and mask in bezel (carefully aligning lamp notches of glass and bezel). CAUTION: Do not allow cement to smear glass. Bake out bezel 2 hours @ 300°F.

(4) Position gasket (25) and lighting wedge glass (24) in front bezel. Secure with snap ring (23).

(5) Install printed circuit boards (28) aligning lamps (29) in correct notches and secure with four screws (30).

*M TYPES 2107 and 2107L ONLY. (Ref. Figure 10-1.)

(1) Install two gears (8) on knob shafts (7) and secure each with two setscrews (9).

(2) Set left cam gear (71, Figure 10-2) counter-clockwise to VOR detent and right cam gear clockwise to VOR detent. Place two washers (10, Figure 10-1) on knob shafts (7) and install shafts and gears (7 and 8) through holes in receptacle mounting plate (84), Figure 10-2). Secure with retaining rings (6, Figure 10-1).

(3) Install rear plate cover (4) on sub-assembly (41) and secure with five screws (5).

(4) Guide case assembly (11, Figure 10-1) over mechanical sub-assembly (41) so knob shafts (7) enter holes in front bezel (13).

(5) Slide case assembly (11) back slowly into place while watching the No. 1 pointer (33). The pointer must not touch glass (21 or 24) when cover is fully engaged with receptacle mounting plate (84, Figure 10-2). If shaft is too long, refer to paragraph D-3 for adjustment.

(6) Secure case assembly (11) with three screws (12).

(7) Place right knob (2) and left knob (1) on respective shafts (7) and secure each in vertical position with two setscrews (3).

N. <u>TYPES 2105, 2105L, 2108, 2108L, 2109 and 2109L ONLY.</u>

(1) Install case assembly (11, Figure 10-1) over mechanical sub-assembly (40, 42 or 43).

(2) Secure case assembly with three screws (12).

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SECTION 8

CALIBRATION AND TESTING

8.1 GENERAL

An AAR-1002 Test Set is used to perform the calibration and test procedures included in this section. (Refer to Figure 9-1 and 9-2.)

8.2 CALIBRATION AND TESTING.

A. Preliminary Procedures

(1) Set power switches on test set to OFF.

(2) Connect test set power cables to single phase 115 volt 60 Hz, and single phase 115 volt 400 Hz power sources.

(3) Connect appropriate test cable - from appropriate RMI connector J1 or J3 on test panel to indicator under test.

(4) If a type 2105 or 2105L indicator is being tested connect appropriate test cable between DATA XMTR connector J2 on test set and data transmitter connector J1 on indicator.

B. POWER APPLICATION.

(1) Set 60 Hz and 400 Hz power switches on (up).

(2) Associated pilot lights should light.

(3) If pilot lights do not light, check associated fuse, power connection and power source.

C. STARTING PROCEDURE.

(1) Set POINTER SWITCHING switch S1 to VOR.

(2) Set MOTOR MODE switch S3 to OFF.

(3) Set ROTOR EXCITATION VOLTAGE switches S4 and S5 to their 26V position. This will energize the No. 1 and No. 2 pointers.

(4) Set COMPASS AND REPEATER FUNCTION switch S6 to SERVO'D CARD position. This will energize the indicator dial compass card. After servo amplifier has warmed-up card will start turning.

(5) After compass card (dial) stops rotating and takes up a heading. Dial of indicator may be calibrated to its appropriate zero or 180° setting by the applicable procedures D and E below.

D. INITIAL ZERO SETTING OF INDICATOR DIAL.

(1) On test set place COMPASS AND REPEATER dial at 0 (zero).

(2) On indicators of type 2105, 2105L, 2107 or 2107L loosen two screws (15, Figure 10-2). On indicators of type 2108, 2108L, 2109 and 2109L loosen two screws (27, Figure 10-2).

(3) Rotate applicable synchro (25 or 14) until dial 0 (zero) is aligned with lubber line point of dial indice ring mask (31, Figure 10-1).

(4) Rotation of test set COMPASS AND REPEATER will result in corresponding rotation of indicator dial to check indicator error.

E. CLOSE TOLERANCE DIAL ZERO SETTING.

(1) Interconnect VTVM and HI, GND jacks on test set.

(2) Set VTVM switch to ON.

(3) Set COMPASS AND REPEATER FUNCTION switch SC to CAL CARD POSITION - This sets up test set repeater master synchro and indicator control transformer or dial synchro into a meter null configeration.

(4) Set test set COMPASS AND REPEATER DIAL to 0°.

(5) DATA XMRT INDICATOR should read 0° (or 180° for 2109 type indicator) and VTVM should read null.

(6) If reading is not exact, carefully adjust applicable synchro (25 or 14, Figure 10-2) until 0° $\pm$0.5° and null readings are obtained.

(7) Tighten two applicable screws (27 or 15, Figure 10-2). Recheck for 0° and null.

F. DIAL FRICTION TEST.

(1) Set COMPASS AND REPEATER FUNCTION switch S6 to the NORMAL-MOTOR position.

(2) Set the VARIABLE 0-50 VOLTS variac for 18 volts.

(3) Increase VARIABLE 0-5 VOLTS from zero volts until indicator dial card begins to rotate. Rotation shall start before 2-volt level is reached.

(4) Reset VARIABLE 0-5 VOLTS to zero volts.

(5) Reset COMPASS AND REPEATER FUNCTION switch to REV-MOTOR position.

(6) Increase VARIABLE 0-5 VOLTS variac until indicator dial begins to rotate. Rotation shall start before 2 volt level is reached.

G. DIAL STANDARD RATE ROTATION CHECK.

(1) Set COMPASS AND REPEATER FUNCTION switch S6 to SERVO'D CARD position.

(2) Set MOTOR MODE switch S3 alternately to CCW-CARD and CW-CARD positions-this puts the test set motorized master synchro into the circuit, turning the DAT XMTR INDICATOR dial at 12° per second (2 RPM) as selected in a clockwise or counter-clockwise direction. The indicator dial shall rotate in the selected direction within 5 percent of the test set dial rate.

(3) Dial shall turn in direction selected by switching with no apparent hesitation or hang-up.

*H. TYPES 2105, 2105L, 2107 and 2107L ONLY. SETTING DATA XMTR SYNCHRO TO ZERO.

(1) Set MOTOR MODE switch to OFF.

(2) Set COMPASS AND REPEATER dial to 0 (zero).

(3) Loosen two screws (27, Figure 10-2).

(4) Carefully turn data transmitter synchro (25, Figure 10-2) in synchro eccentric (26, Figure 10-2) while lightly tapping DATA XMTR INDICATOR in test set until it reads 0 (zero).

CAUTION: SYNCHRO ECCENTRIC MUST NOT BE TURNED DURING SYNCHRO ROTATION OR GEAR MESH SETTING WILL BE ALTERED.

(5) Secure two screws (27, Figure 10-2).

*I. TYPES 2105, 2105L, 2107 and 2107L ONLY. DATA TRANSMITTER ACCURACY CHECK

(1) Set COMPASS AND REPEATER FUNCTION switch S6 to CAL DATA XMTR position.

(2) VTVM at ON; VTVM and HI, GND jacks interconnected.

NOTE: The COMPASS AND REPEATER dial will be 90° off from DATA XMTR INDICATOR reading.

(3) Check for maximum error of ±1.0° at successive 30° settings.

(4) If necessary reset data transmitter synchro as directed in applicable steps of procedure "H" above.

J. CALIBRATION AND TEST OF NO. 2 POINTER.

(1) Set the NUMBER 2 POINTER dial on test set to exactly 0° with MOTOR MODE switch S5 at OFF.

(2) If No. 2 (rear) pointer of indicator does not indicate 0°, loosen two screws (35, Figure 10-2).

(3) Rotate synchro (33, Figure 10-2) until zero indication is obtained.

(4) Tighten two screws (35, Figure 10-2).

(5) Position NUMBER 2 POINTER dial at successive 30° positions and check indicator No. 2 pointer for error.

(6) SET MOTOR MODE switch S6 alternately in 2CCW and 2CW positions.

(7) No. 2 pointer of indicator should rotate at a standard rate of 2 RPM ±50 percent of selected counterclockwise or clockwise direction with no hesitation or hang-up.

K. NO. 2 POINTER FIT TEST.

To check whether or not No. 2 pointer is seated securely on shaft proceed as follows:

(1) Set test set NUMBER 2 POINTER dial to 0.

(2) Set associated ROTOR EXCITATION VOLTAGE switch S5 to OFF.

(3) Set NUMBER 2 POINTER dial to 170°.

(4) Set ROTOR EXCITATION VOLTAGE switch S5 to 26V position.

(5) No. 2 pointer should snap to 170°, check for exact calibration.

L. NO. 2 POINTER DAMPING CHECK.

(1) Set NUMBER 2 POINTER dial on test set to 0° and check that No. 2 pointer on indicator comes to 0°.

(2) Set ROTOR EXCITATION VOLTAGE switch S5 to OFF position.

(3) Set NUMBER 2 POINTER dial on test set to 90°.

(4) Set VARIABLE 0-50 volt variac control to full clockwise position.

(5) Set ROTOR EXCITATION VOLTAGE switch S5 to VARIABLE position.

(6) No. 2 pointer shall snap to 90° and stop oscillating within 6 seconds.

M. No. 1 POINTER FIT AND DAMPING CHECKS.

Repeat procedural steps of K and L above for the No. 1 pointer of indicator, substituting NUMBER 1 POINTER dial and ROTOR EXCITATION VOLTAGE switch S4 as applicable.

N. FINAL OPERATIONAL AND CLEARANCE CHECKS.

(1) Set NUMBER 1 POINTER, NUMBER 2 POINTER and associated ROTOR EXCITATION VOLTAGE switches S4 and S5 to 26V positions.

(2) Set COMPASS AND REPEATER FUNCTION switch S6 to SERVO'D CARD position-this will energize all functions of the indicator under test.

(3) The test set NUMBER 1 POINTER, COMPASS AND REPEATER, and NUMBER 2 POINTER dials may not be positioned at random to make a final check clearance of dial and pointers for proper clearance in all positions.

O. SHUT DOWN.

Set NUMBER 1 POINTER, COMPASS AND REPEATER AND NUMBER 2 POINTER dials to 0; set all switches and controls to OFF or full counterclockwise, Disconnect cables from indicator under test.

*P. TYPES 2105L, 2107L, 2108L and 2109L ONLY. LIGHTING CHECK.

Check for evenness of light. Uneven light or dark areas would indicate a lamp malfunction. A glare area indicates coating chipped from lamp.

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SECTION 9

SPECIAL TOOLS, FIXTURES AND TEST EQUIPMENT

9.1 SPECIAL TOOLS AND FIXTURES.

This manual is intended for use by skilled instrument repairment only. All procedures should be feasible with the normal complement of tools and fixtures found in an instrument shop. Where special tools or fixtures, or unusual procedures would be required, the affected sub-assembly is not indicated as disassembled in either the procedures or parts lists. Such sub-assemblies are to be procured and replaced the same as detail parts. If such sub-assemblies need to be disassembled, serviced, or overhauled; those procedures are to be performed by the applicable manufacturer or according to his instructions.

9.2 TEST EQUIPMENT REQUIRED.

Calibration and test procedures in this manual are performed with the AAR 1002 RMI Test Set. If such a test set is not available, one may be fabricated using the panel layout shown in Figure 9-1, and in accordance with electrical schematic Figure 9-2.

9.3 DESCRIPTION OF AAR-1002 TEST SET. (Ref. Figure 9-1 and 9-2)

The AAR-1002 RMI Test Set is designed for testing and calibrating radio magnetic indicators and contains the necessary power supplies master synchro transmitters, and master indicator.

A. A Ballentine 300 VTVM is incorporated in the top of the test for null detection, and a large dial DATA TRANSMITTER INDICATION used to read the position of the bootstrap synchro transmitter in the indicator under test.

B. Three large dials in the center of the test set panel divided in 360° and fitted with a 0.1 degree vernier are connected to a master synchro transmitter. a large knob in the center of each dial is used for coarse positioning and a small knob on the right of each dial provides a fine adjustments. These dials are right to left:

(1) NUMBER 1 POINTER

(2) COMPASS AND REPEATER

(3) NUMBER 2 POINTER

C. On the left lower side the ROTOR EXCITATION VOLTAGE section contains the following:

(1) Switch S4 providing 26V, OFF and VARIABLE settings.

(2) A 0 to 50 AC VOLTS meter, M1.

(3) A VARIABLE 0-30 VOLTS VARIAC, T3.

(4) Power switches 59 and 58, fuses, and neon indicator pilot lights for 115-volt 60 Hz and 115-volt 400 Hz power inputs.

D. In the lower center the COMPASS AND REPEATER FUNCTION rotary switch S6 provides the following calibration and test positions for card (dial) and bootstrap.

(1) CAL DATA XMTR

(2) CAL CARD

(3) SERVO'D CARD

(4) NORMAL - MOTOR

(5) REV - MOTOR

E. Near the center bottom of the panel POINTER SWITCHING switch, S1 provides VOR or ADF selection.

F. At lower center right a MOTOR MODE switch, S3 controls the master BOOTSTRAP INDICATOR for checking friction error in the indicator under test, providing positions:

(1) OFF

(2) 1 CCW

(3) 1 CW

(4) 2 CCW

(5) 2 CW

(6) CCW-CARD

(7) CW - CARD

G. The lower right section of the test set panel the ROTOR EXCITATION VOLTAGE section contains the following:

(1) Switch S5 providing 26V, OFF, and VARIABLE settings.

(2) A 0-5 AC VOLTS meter M2.

(3) A VARIABLE 0-5 VOLTS variac, T2.

H. In the extreme lower right of the panel two VTVM jacks are mounted for external connection to the H1 and GND jacks in the top (VTVM) panel.

I. At the bottom five electrical connectors provide for cable interconnections with the indicator under test.

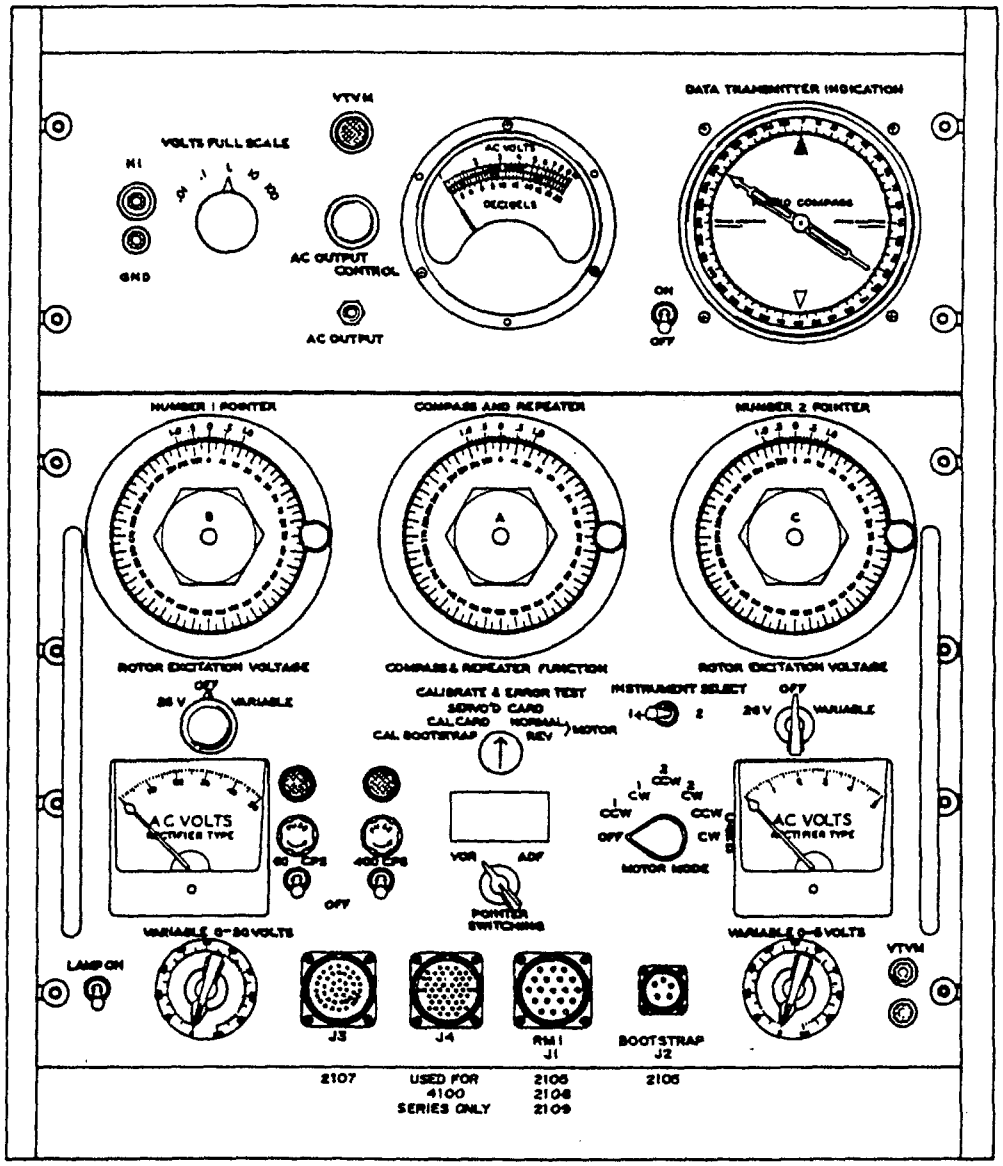


Figure 9–1 AAR–1002 Test Set, Panel Drawing

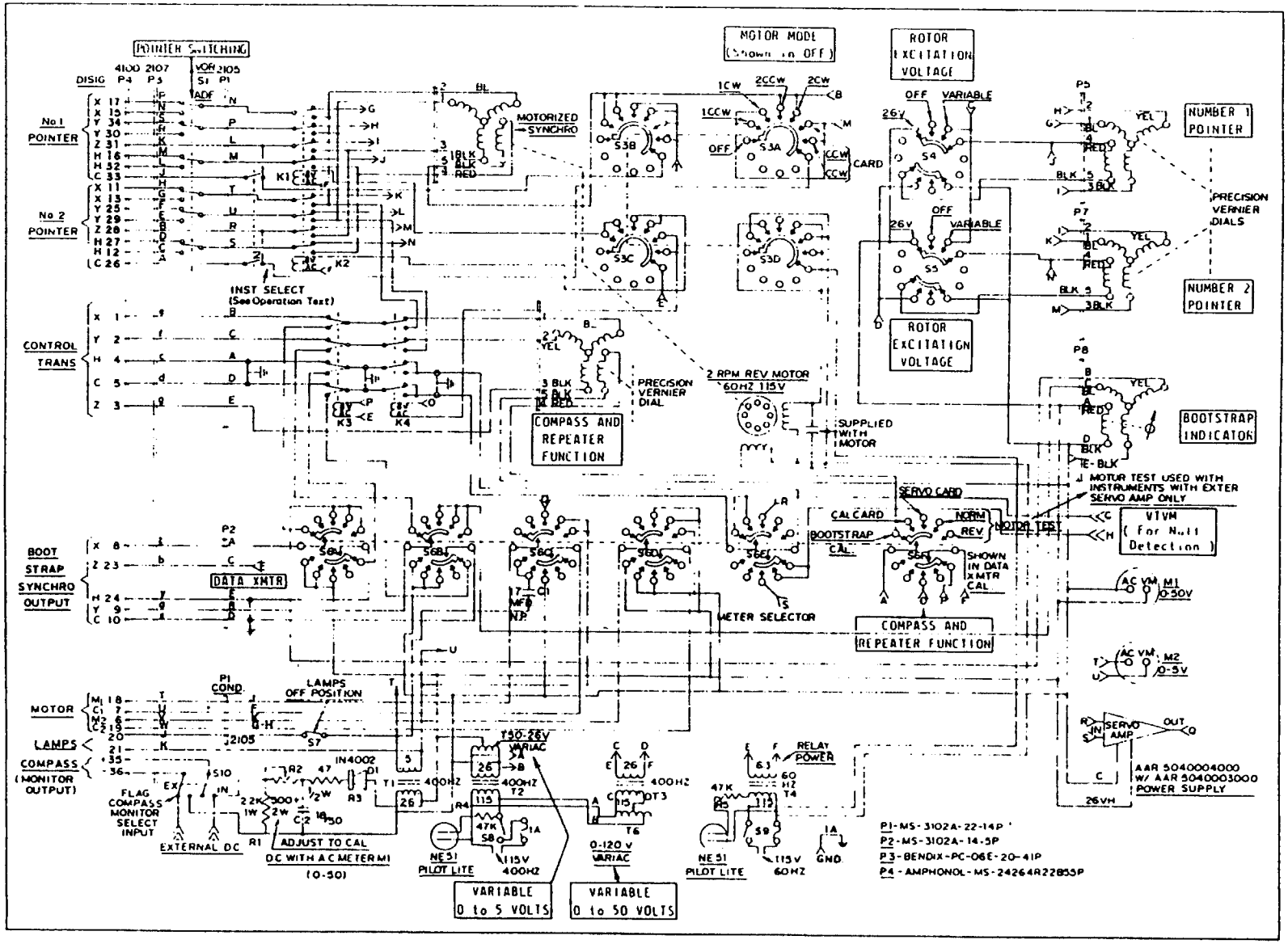


Figure 9–2 AAR–1002 Test Set, Schematic Diagram

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SECTION 10

ILLUSTRATED PARTS

10.1 INTRODUCTION.

A. PURPOSE. The Illustrated Parts List is provided as an aid for provisioning, requisitioning, storing, and issuing replaceable parts of the 2100 Series of RADIO MAGNETIC INDICATORS. The Illustrated Parts List augments the overhaul portion of this manual by illustrating and listing assemblies sub-assemblies, and parts in general disassembly order. The Illustrated Parts List shall not be considered authority for disassembly without reference to overhaul procedures.

B. HOW TO USE THIS PARTS LIST. The Illustrated Parts List is divided into a Detailed Parts List and a Numerical Index supported by exploded views of the equipment. To use this list proceed by the applicable following procedure:

1. If the part number is known, find the part number in the Numerical Index Listings, and use the associated figure and item number to locate the part in the Detailed Parts List or in the referenced figure.

2. If the part number is not known, refer to the figure illustrating the portion of the equipment in which the item is located. Use the associated figure and index number to locate the part in the Detailed Parts List.

C. DETAILED PARTS LIST.

The Detailed Parts List presentation is made up of five columns containing the following details:

(1) FIGURE AND ITEM NO. COLUMN. This column identifies the figure containing the illustration of the item and lists the index number which appears at the outer end of the leader line which terminates at the particular item listed.

(2) PART NUMBER COLUMN. The part number column lists the AERONETICS part number assigned to the particular item. In some instances a group of parts are shown assembled for convenience although no such assembly drawing exists. These groups will be identified as a NO NUMBER group.

(3) NOMENCLATURE COLUMN. The nomenclature column contains the name of item appearing on the manufacturer's part drawing, presented identifying noun or phrase first, followed by the additional modifying information which will assist in describing the item. The major assembly appears flush left on the first line; thereafter, the items removed from that assembly, or any lesser assembly or sub-assembly are indented one unit at a time to show part relationship. Additional information, such as Vendor or Design Manufacturer's part numbers follows the description enclosed in parentheses.

(4) ITEMS PER ASSEMBLY COLUMN. This column records the quantity of the item that is used in each of the assemblies, or sub-assemblies in which it appears. Where more than one item is indicated, the quantity of any attaching parts listed immediately thereafter will be multiplied by that quantity. Where an option between two or more parts is offered and only one item is used, each quantity number will be followed by an asterisk; thus 1*. When the same item is shown in two locations, the quantity will be shown at the first listing, whereas the notation "REF" will appear in the alternate locations.

(5) TYPE USED ON COLUMN. This column identifies the type number of the equipment in which the particular item is used by the last numeral in the type number of the each of the applicable types. Thus: Type 2105 is coded 5; Types 2105 and 2108 are coded 5, 8. Where the part is used on all types no code is used. Lighted model (L) parts will be noted only where parts specifically pertain to lighting. In all other instances where parts are used in both the basic and the lighted instrument, only the basic code (5,7,8, 9) will be used.

D. NUMERICAL INDEX. The numerical Index is made up of three columns containing the following information:

(1) PART NUMBER COLUMN. The part number column lists the part numbers of all items in numerical order: 0 through 9, from left to right.

(2) FIGURE AND ITEM NO. COLUMN. This column lists the figure and item number location of each item in the figure illustrating the part, and in the Detailed Parts List.

(3) ITEMS REQUIRED COLUMN. This column contains the quantity of items used at each location. To find the total quantities of each item, it will be necessary to check the Detailed Parts List for the type of instrument involved.

10.2 DETAILED PARTS LIST

FIG. & ITEM NO.	PART NUMBER	1234567 NOMENCLATURE	ITEMS PER ASSY	TYPE USED ON
10-1-	5202105000	Radio Magnetic Indicator Type 2105 5° Dial		
	5202105002	Radio Magnetic Indicator Type 2105L 5° Dial		
	5202105001	Radio Magnetic Indicator Type 2105 2° Dial		
	5202105003	Radio Magnetic Indicator Type 2105L 2° Dial		
	5202107000	Radio Magnetic Indicator Type 2107 5° Dial		
	5202107002	Radio Magnetic Indicator Type 2107L 5° Dial		
	5202107001	Radio Magnetic Indicator Type 2107 2° Dial		
	5202107003	Radio Magnetic Indicator Type 2107L 2° Dial		
	5202108000	Radio Magnetic Indicator Type 2108 5° Dial		
	5202108002	Radio Magnetic Indicator Type 2108L 5° Dial		
	5202108001	Radio Magnetic Indicator Type 2108 2° Dial		
	5202108003	Radio Magnetic Indicator Type 2108L 2° Dial		
	5202109000	Radio Magnetic Indicator Type 2109 5° Dial		
	5202109002	Radio Magnetic Indicator Type 2109L 5° Dial		
- 1	4160001001	.Knob, White, Left	1*	7
- 1	4160001002	.Knob, Yellow, Left	1*	7
- 1	4160001003	.Knob, Stripped, Left	1*	7
- 2	4160002001	.Knob, White, Right	1*	7
- 2	4160002002	.Knob, Yellow, Right	1*	7
		(Attaching Parts)		
- 3	1362120904	..Setscrew, Spl. Soc. Hd. Cup Pt. Hrd. St. 4-40x1/8"	2	7
		- - - * - - -		
- 4	4070007000	.Rear Plate, Cover	1	7
		(Attaching Parts)		
- 5	1350000508	..Screw, Mach. Flt. Hd. 2-56x1/4" sst.	5	7
- 6	1065144012	..Ring, (Truarc Mfg. Co. PN5144-12)	2	7
		- - - * - - -		
- 7	4020016000	.Shaft, Knob	2	7

FIG.& ITEM NO.	PART NUMBER	1234567 NOMENCLATURE	ITEMS PER ASSY	TYPE USED ON
10-1- 8	4150016000	.Gear, Knob Shaft	2	7
- 9	1362120904	..Setscrew, Spl. Hd. Cup Pt. Hrd St 4-40x1/8"	2	7
		- - - * - - -		
-10	4010018000	.Washer, 0.25000" O.D.x0.125" I.D.x0.017" Thk. sst.	2	7
-11	NO NUMBER	.Case Assembly	1	5,8,9
-11	NO NUMBER	.Case Assembly	1	7
-11	NO NUMBER	.Case Assembly	1	5L,7L 8L,9L
		(Attaching Parts)		
-12	1350000608	.. Screw, Mach. Flat Hd. 3-56x1/4" sst	3	
		- - - * - - -		
-13	4110002001	..Bezel, Front	1	5,8,9
-13	4110002002	..Bezel, Front	1	7
-13	4110003000	..Bezel	1*	7S
-13	4110029000	..Bezel, Front	1	5L,8L 9L
-13	4110029001	..Bezel, Front	1	7L
		(Attaching Parts)		
-14	1320000810	...Screw, Mach. Flat. Fil. 4-48x5/16"sst	8	
-15	1030400425	...Lockwasher, High Collar, Split	8	
		- - - * - - -		
-16	4110001001	..Bezel, Rear	1	5,8,9
-16	4110001002	..Bezel, Rear	1*	7
-16	4110001003	..Bezel, Rear	1*	7
-17	4140011002	..Bushing, Bezel Used on w/4110001002 Rear Bezel	2	7
		(Attaching Parts)		
-18	4010002000	...Nut, Mounting	4	5,8,9
-18	4010002000	...Nut, Mounting (Used w/4110001002 Rear Bezel)	2	7
-18	4010005000	...Nut, Mounting	4	7
		- - - * - - -		
-19	4040005000	..Case	1	
-20	8050002000	..Plate, (Servo'd-Bootstrap) Name	1	5,7
-20	8050002001	..Plate, Name (Servo'd)	1	8
-20	8050002002	..Plate, Name (Plain)	1	9
-21	4220004000	..Glass, "VOR-ADF" Etched	1	7
-21	4220001000	..Glass, Plain	1*	
-21	4220001001	..Glass, H.E.L.R. Non-Glare	1*	5,8,9
-22	4240003000	..Gasket, Inner (AAR050, PN 4240004000)Obs.	1*	
-22	4240003001	..Gasket, Inner	1*	
-23	4210004000	..Ring Snap	1	5L,7L 8L,9L

FIG. & ITEM NO.	PART NUMBER	1234567 NOMENCLATURE	ITEMS PER ASSY	TYPE USED ON
10-1-24	4220033000	..Wedge, Lighting, Glass HEA Non-Glare	1	5L,7L 8L,9L
-25	4240015000	..Gasket, Separating	1	5L,7L 8L,9L
-26	4220032000	..Glass, Cover, VOR-ADF Etched, HEA Non-Glare	1*	5L,7L 8L,9L
-26	4220032001	..Glass, Cover, Plain, HEA Non-Glare	1*	5L,7L 8L,9L
-27	4180039000	..Ring, Mask	1	5L,7L 8L,9L
-28	5040021000	..Board Ass'y, Lamp P.C. (R.H. Blue Lamps)	1*	5L,7L 8L,9L
	1150017000	...Receptacle,(Amp 85862-4)	2	5L,7L 8L,9L
-28	5040021001	..Board Ass'y, Lamp P.C. (R.H. Red Lamps)	1*	5L,7L 8L,9L
	1150017000	...Receptacle (Amp 85862-4)	2	5L,7L 8L,9L
-28	5040022000	..Board Ass'y, Lamp P.C. (L.H. Blue Lamps)	1*	5L,7L 8L,9L
-28	5040022001	..Board Ass'y, Lamp P.C. (L.H. Red Lamps)	1*	5L,7L 8L,9L
-29	3180001003	...Lamp, 5V Blue (L.A.Min.#16)	6*	5L,7L 8L,9L
-29	3180001002	...Lamp, 5V Red (C.M. 8-715-824)	6*	5L,7L 8L,9L
		(Attaching Parts)		
-30	1350000105	...Screw, Mach. Fl. Hd. #0-80x5/32	2	5L,7L 8L,9L
-31	4180001000	..Mask, Dial Indice Ring	1	5,7,8, 9
-31	4180038000	..Mask, Dial Indice Ring	1	5L,7L, 8L,9L
		(Attaching Parts)		
-32	1330000106	...Screw, Mach. Bind Hd, 0-8x3/16"sst	3	
		- - - * - - -		
-33	5010014001	..No. 1 Pointer (Front) S.A. Matte Wht	1*	
-33	5010014002	..No. 1 Pointer (Front) S.A. ANL-1A Fluorescent	1*	
-33	5010014003	..No. 1 Pointer (Front) S.A. Matte Wht Red Tip	1*	

FIG. & ITEM NO.	PART NUMBER	1234567 NOMENCLATURE	ITEMS PER ASSU	TYPE USED ON
10-1-34	5010014004	..No.1 Pointer (Front S.A. Matte White Stripped	1*	
-34	5010015001	..No.2 Pointer (Rear) S.A. Matte White	1*	
-34	5010015002	..No.2 Pointer (rear) S.A. ANL-1A Fluorescent	1*	
-34	5010015003	..No.2 Pointer (Rear) S.A. Matte White-Green Tip	1*	
-35	4140010000	...Bushing, No.2 Pointer	1	
-36	4180002001	..Dial, 2° Matte White with Logo	1*	
-36	4180002002	..Dial, 2° Matte White, no Logo	1*	
-36	4180002003	..Dial, 5° Matte White, no Logo	1*	
-36	4180002004	..Dial, 5° Matte White, with Logo	1*	
-36	4180002005	..Dial, 5° ANL-1A, Fluorescent,with Log	1*	
-36	4180042002	..Dial, 5° Matte White W/N-E-S-W	1*	
-36	4180002006	..Dial, 5° ANL-1A, Fluorescent, no Logo	1*	
-36	4180002007	..Dial, 2° ANL-1A, Fluorescent, no Logo	1*	
-36	4180002008	..Dial, 2° ANL-1A, Fluorescent, no Logo	1*	
-36	4180002009	..Dial, 2° Matte White	1*	
		(Attaching Parts)		
-37	1330000103	...Screw, Mach Bind Hd. 0-80x3/32" sst	2	
		- - - * - - -		
-38	4120002001	..Ring, Indice Mounting	1*	5,7, 8,9
-38	4120002002	..Ring, Indice Mounting	1	5L,7L 8L,9L
		(Attaching Parts)		
-39	1350000608	...Screw, Mach. Flt. Hd. 3-56x1/4" sst	3	5,7
-39	1350000608	...Screw, Mach. Flt. Hd. 3-56x1/4" sst	4	8,9
		- - - * - - -		
-40	5010053000	.Mechanical S.A. (See Fig. 10-2 for Detail Breakdown)	1	5
-40	5010053001	.Mechanical S.A. (See Fig. 10-2 for Detail Breakdown)	1	5L
-41	5010050000	.Mechanical S.A. (See Fig. 10-2 for Detail Breakdown)	1	7
-41	5010050001	.Mechanical S.A. (See Fig. 10-2 for Detail Breakdown)	1	7L
-42	5010054000	.Mechanical S.A. (See Fig. 10-2 for Detail Breakdown)	1	8
-42	5010054001	.Mechanical S.A. (See Fig. 10-2 for Detail Breakdown)	1	8L
-43	5010051000	.Mechanical S.A. (See Fig. 10-2 for Detail Breakdown)	1	9
-43	5010051001	.Mechanical S.A. (See Fig. 10-2 for Detail Breakdown)	1	9L

FIG. & ITEM NO.	PART NUMBER	1234567 NOMENCLATURE	ITEMS PER ASSY	TYPE USED ON
10-2	Reference	.Mechanical S.A. (See Items 40, 41, 42 and 43 Fig. 10-1 for NHA)		
- 1	5010052000	..Idler Gear Assembly	1	5,7
		(Attaching Parts)		
- 2	4010001000	...Screw, Idler Gear	1	5,7
- 3	1030100531	...Lockwasher, No. 5 Med. Split sst	1	5,7
		- - - * - - -		
- 4	4140004001	...Bearing, Ball (Reed PNSCO820-E3)	1	5,7
- 5	4150014000	...Gear	1	5,7
- 6	5010013000	..Synchro Mounting Plate Sub-Assembly (See Fig. 10-3 for Detail Breakdown)	1	
		(Attaching Parts)		
- 7	4200004000	...Clip, Spring	4	
- 8	4010003000	...Screw, Special	1	5,7
- 9	4020009001	...Post, Indice Ring Mounting	3	5,7
- 9	4020009001	...Post, Mounting	4	8,9
		- - - * - - -		
-10	4020011000	..Shaft, Pointer	1	
-11	5010016000	..Gear Assembly, Anti-Backlash	1	5,7
		(Attaching Parts)		
-12	4190003000	...Collar, Clamp	1	5,7
-13	1310000610	...Screw, Mach. Fil Hd. 3-56x5/16" sst	1	5,7
		- - - * - - -		
-14	3260003000	..Synchro Assembly, Control Transformer	1	5,7
		(Attaching Parts)		
-15	1310000610	...Screw, Mach Fil. Hd. 3-56x5/16" sst	2	5,7
-16	1030100325	...Lockwasher, No.3 Med. Split sst	2	5,7
-17	4190002001	...Clamp, Synchro	2	5,7
		- - - * - - -		
-18	4150009000	..Pinion, Motor	1	5,7,8
-19	3250001000	..Motor, Servo	1	5,7,8
		(Attaching Parts)		
-20	1310000610	...Screw, 3-56x5/16" sst, Mach. Fil.Hd.	2	5,7,8
-21	1030100325	...Lockwasher, No.3 Med. Split, sst	2	5,7,8
-22	5010028001	..Gear Assembly, Cluster,Anti-Backlash	1	5,7
-22	5010028002	..Gear Assembly, Cluster,Anti-Backlash	1	8
		(Attaching Parts)		
-23	4190003000	...Collar, Clamp	1	5,7,8
-24	1310000610	...Screw, Mach. Fil Hd 3-56x5/16" sst	1	5,7,8
		- - - * - - -		
-25	3260001000	..Synchro Assembly (Bendix AY203S2E)	1	7,9
-25	3260002000	..Synchro Assembly (Veritron VCX15-4.118L)	1	5
-25	3260009000	..Synchro Assembly (Bendix AY201S-3B	1	8

FIG. & ITEM NO.	PART NUMBER	1234567 NOMENCLATURE	ITEMS PER ASSY	TYPE USED ON
10-2-26	4130008000	..Eccentric, Synchro	1	
		(Attaching Parts)		
-27	1310000614	...Screw, Mach. Fil Hd. 3-56x7/16" sst	2	
-28	1030100325	...Lockwasher, No.3 Med. Split sst	2	
-29	4190001002	...Clamp, Synchro	2	
		- - - * - - -		
-30	5010024002	..Gear and Hub Sub-Assembly	1	9
-31	4130012000	..Weight, Damper	1	9
		(Attaching Parts)		
-32	1065100018	...Ring, Retaining (Truarc Mfg. Co. PN5100-18)	1	9
		- - - * - - -		
-33	3260001000	..Synchro Assembly (Bendix AY203S2E)	1	8,9
-33	3260002000	..Synchro Assembly (Veritron VCX15-4J18L)	1	7
-34	4130008000	..Eccentric, Synchro	1	
		(Attaching Parts)		
-35	1310000614	...Screw, Mach. Fil. Hd. 3-56/7/16"sst	2	
-36	1030100325	...Lockwasher, No.3 Med. Split sst	2	
-37	4190001002	...Clamp, Synchro	2	
		- - - * - - -		
-38	4130012000	..Weight, Damper	1	
		(Attaching Parts)		
-39	1065100018	...Ring, Retaining (Truarc Mfg. Co. PN5100-18)	1	
		- - - * - - -		
-40	5010024001	..Gear and Hub Sub-Assembly	1	5,7,8
-41	5010170000	..Center Bridge & Gear Assembly (See Fig. 10-3 for Detail Breakdown) (Includes Item (49)).	1	
		(Attaching Parts)		
-42	1310000406	...Screw, Mach. Fil Hd. 2-56x3/16" sst	3	
-43	1030100220	...Lockwasher, No.2 Med. Split sst	3	
-44	1041030232	...Washer, No.2 Plain Brass	3	
		- - - * - - -		
-45	5010060000	..Gear and Pinion, Sub-Assembly	1	5,7,8
-46	5010061000	..Gear and Pinion, Sub-Assembly	1	5,7,8
-47	5010059000	..Gear and Pinion, Sub-Assembly	1	5,7,8
-48	5010058000	..Gear and Pinion, Sub-Assembly	1	5,7,8
-49	5010057000	...Gear and Shaft Sub-Assembly (Part of Assembly 41)	1	
-50	5010202000	..Damper Assembly	1	
-51	4130012000	...Weight, Damper	1	
-52	4130014000	...Hub, Damper	1	

FIG. & ITEM NO.	PART NUMBER	1234567 NOMENCLATURE	ITEMS PER ASSY	TYPE USED ON
10-2-		(Attaching Parts)		
-53	1065100018	...Ring, Retaining (Truarc 5100-18)	1	
		- - - * - - -		
-54	3260001001	..Synchro Assembly, Front Pointer (Bendix 3563150-0350)	1	
		(Attaching Parts)		
-55	1310000614	...Screw, Mach Fil. Hd. 3-56x7/16" sst	2	
-56	1030100325	...Lockwasher, No.3 Med. Split sst	2	
-57	4190001001	...Clamp, Synchro	2	
		- - - * - - -		
-58	4020014000	..Post, Top	4	5,8,9
-58	4020014000	..Post, Top	2*	7
-58	4020019000	..Post, Top	2*	7
-59	1310001108	..Screw, Mach. Fil. Hd. 5-44x1/4" sst	2*	7
-59	1020030806	..Nut, Hex Ord. 4-48x3/32 Thk sst	2*	5,8,9
-60	1030100525	..Lockwasher, No.5 Med. Split, sst	2*	7
-60	1030100400	..Lockwasher, No.4 Std. Split, sst	2*	
-60	1030100425	..Lockwasher, No.4 Med. Split, sst	2*	5,8,9
-61	4070003000	..Plate, Rear	1	
		(Attaching Parts)		
-62	1330000810	...Screw, Mach. Fil. Hd. 4-48x5/16" sst	1	
-63	1030100400	...Lockwasher, No.4 Med. Split sst	1	
		- - - * - - -		
-64	4020017000	..Shaft, Cam	2	7
		(Attaching Parts)		
-65	1065144012	...Ring, Retaining (Truarc 5144-12)	1	7
-66	4010018000	...Washer, Plain 0.250 O.D.x0.125 I.D.x0.017" Thk sst	2	7
		- - - * - - -		
-67	4130015001	..Cam, Right	1	7
-67	4130015002	..Cam, Left	1	7
		(Attaching Parts)		
-68	1362120904	...Setscrew, Spl. Hd. Cup Pt. Hrd. Stl. 4-40x1/8"	2	7
		- - - * - - -		
-69	4140016000	..Ball, Detent	2	7
-70	4200006000	..Spring, Detent	2	7
-71	4150017001	..Gear, Cam Right	1	7
-71	4150017002	..Gear, Cam Left	1	7
		(Attaching Parts)		
-72	1362120904	...Setscrew, Spl. Hd. Cup Pt Hrd. 4-40x1/8"	2	7
		*		
-73	4010018000	..Washer, Plain 0.250 O.D.x0.125 I.D.x0.017" Thk. sst	1	7

FIG. & ITEM NO.	PART NUMBER	1234567 NOMENCLATURE	ITEMS PER ASSY	TYPE USED ON
10-2-74	3150001000	..Switch (311SMI MSW)	6	7
		(Attaching Parts)		
-75	1020030504	...Nut, Hex Ord Brs 2-56x1/16" Thk.	8	7
-76	1031100200	...Lockwasher, No.2 Int. TTh. sst	4	7
-77	1041030219	...Washer, Plain 0.250 O.D.xO.125 I.D.x0.017" Thk sst	4	7
-78	4020018000	...Stud, Switch	4	7
		- - - * - - -		
-79	4250007000	..Insulator, Switch		7
-80	1310000910	..Screw, Mach. Fil. Hd. 4-40x5/16" sst	2	7
-81	1030100425	..Lockwasher, No.4 Med. Split sst	2	7
-82	4020010000	..Post, Rear Plate Mounting	3	
-83	4120001001	..Support, Receptacle Mounting	1	5
-83	4120001002	..Support, Receptacle Mounting	1	8,9
-84	4120003000	..Support, Receptacle Mounting	1	7
-85	1362101112	..Setscrew, Spl. Soc. Hd. Cup Pt. 5-44x3/8" sst	2	7
-86	3160004001	..Receptacle (MS-3102C-22-14P)	1	5,8,9
-87	3160005001	..Receptacle (Bendix PC02E-20-41P).	1	7
		(Attaching Parts)		
-88	1310000810	...Screw, Mach. Fil Hd. 4-48x5/16" sst	4	
-89	1030100425	...Lockwasher, No.4 Med. Split sst	4	
		- - - * - - -		
-90	3160008001	..Receptacle (MS3102C-14-5S)	1	5
		(Attaching Parts)		
-91	1310000810	...Screw, Mach. Fil. Hd. 4-48x5/16" sst	4	5
-92	1030100425	...Lockwasher, No.4 Med. Split sst	4	5
		- - - * - - -		
-93	3160017000	..Strip, Terminal	1	5l,7L 8L,9L
		(Attaching Parts)		
-94	1350000103	...Screw, Mach. Fl.Hd. #0-80x3/32" sst	2	5L,7L 8L,9L
		- - - * - - -		

FIG. & ITEM NO.	PART NUMBER	1234567 NOMENCLATURE	ITEMS PER ASSY	TYPE USED ON
10-3-	5010170000	..Center Bridge & Gear Assembly (See Item 41, Fig.10-2 for NHA) (Includes Item (49) Fig. 10-2)	REF.	
- 1	5010056000	...Bridge Plate Sub-Assembly	1	
		(Attaching Parts)		
- 2	1020030203	....Nut, Hex Ord. Brs. 1-72x3/64" Thk.	2	
- 3	1041030125	....Washer, Req. Flt. sst No.1 .025" Thk.	2	
		- - - * - - -		
- 4	5010062000	...Gear and Hub Assembly	1	
- 5	4190004000	...Collar	1	
- 6	4070006000	...Plate Sub-Assembly, Bearing	1	
- 7	5010020000	...Hub, Shaft and Jewel S.A.	1	
- 8	4130017000	....Hub	1	
	5010013000	...Synchro Mounting Plate Sub-Assembly (See Fig.10-2, Item 6) for NHA)	REF.	
- 9	4070004000	....Synchro Mounting Plate	1	
-10	4140009000	....Jewel	1	
-11	4140008000	....Jewel (Part of Ass'y., Item (1))	1	
-12	4140007000	....Jewel (Part of Ass'y., Item (6))	1	
-13	4140009000	....Jewel (Part of Ass'y., Item (7))	1	

*Matched Set

10.3 NUMERICAL INDEX

PART NUMBER	FIG.& ITEM REQ'D	ITEM REQ'D	PART NUMBER	FIG.& ITEM REQ'D	ITEM REQ'D
1020030203	10-3- 2	2	1330000103	10-1-37	2
1020030504	10-2-75	8	1330000106	-32	3
1020030806	-59	2*	1330000810	10-2-62	1
1030000400	-60	2*	1350000508	10-1- 5	5
	-63	2*	1350000608	-12	3
1030100220	-43	3		-39	3
1030100325	-21	2		-39	4
	-28	2	1362101112	10-2-85	2
	-36	2	1362120904	10-1- 3	2
	-16	2		9	2
	-56	2		10-2-72	4
1030100425	-60	2*		-68	2
	-63	1	3150001000	-74	2
	-81	2	3160004001	-86	1
	-89	4	3160005001	-87	1
	-92	4	3160017000	-93	1
1030100525	-60	2*	3180001002	10-1-29	6*
1030100531	- 3	1	3180001003	10-1-29	6*
1030400425	10-1-15	8	3250001000	10-2-19	1
1031100200	10-2-76	4	3260001000	-25	1
1041030125	10-3- 3	2		-33	1
1041030219	10-2-77	8	3260001001	-54	1
1041030232	-44	3	3260002000	-25	1
1065100018	-32	1		-33	1
	-39	1	3260003000	-14	1
	-53	1	3260009000	-24	1
1065144012	10-1- 6	2	4010001000	- 2	1
	10-2-65	2	4010002000	10-1-18	4
1150017000	NSS	2	4010002000	-18	2
1310000406	10-2-42	3	4010003000	10-2- 8	1
1310000610	-13	1	4010005000	10-1-18	4
	-15	2	4010018000	-10	2
	-20	2		10-2-73	1
	-24	1		-66	2
1310000614	-27	2	4020009001	- 9	4
	-35	2	4020009001	- 9	3
	-55	2	4020010000	-82	3
1310000810	-88	4	4020011000	-10	1
	-91	4	4020014000	-58	4*
1310000910	-80	2	4020014000	-58	2*
1310001108	-59	2*	4020016000	10-1- 7	2
1320000810	10-1-14	8	4020017000	10-2-64	2

PART NUMBER	FIG.& ITEM REQ'D	ITEM REQ'D	PART NUMBER	FIG.& ITEM REQ'D	ITEM REQ'D
4020018000	10-2-78	4	4180002004	10-1-36	1*
4020019000	-58	2*	4180002005	-36	1*
4040005000	10-1-19	1	4180002006	-36	1*
4070003000	10-2-61	1	4180002007	-36	1*
4070004000	10-3- 9	1	4180002008	-36	1*
4070006000	- 6	1	4180002009	-36	1*
4070007000	10-1- 4	1	4180038000	-31	1
4110001001	-16	1	4180039000	-27	1
4110001002	-16	1*	4190001001	10-2-57	2
4110001003	-16	1*	4190001002	-29	2
4110002001	-13	1		-37	2
4110002002	-13	1	4190002001	-17	2
4110029000	-13	1*	4190003000	-23	1
4110029001	-13	1*		-12	1
4120001001	10-2-83	1	4190004000	10-3- 5	1
4120001002	-83	1	4200004000	10-2- 7	4
4120002001	10-1-38	1	4200006000	-70	2
4120002002	-38	1	4210004000	10-1-23	1
4120003000	10-2-84	1	4220001000	-21	1*
4130008000	-26	1	4220001001	-21	1*
	-34	1	4220004000	-21	1
4130012000	-31	1	4220032000	-26	1*
	-38	1	4220032001	-26	1*
	-51	1	4220033000	-24	1
4130014000	-52	1	50100013000	10-2- 6	1
4130015001	-67	1	5010013000	10-3-	REF.
4130015002	-67	1	50100014001	10-1-33	1*
4130017000	10-3- 8	1	50100014002	-33	1*
4140004001	10-2- 4	1	50100014003	-33	1*
4140007000	10-3-12	1	50100014004	-33	1*
4140008000	-11	1	50100015001	-34	1*
4140009000	10-3-13	1	50100015002	-34	1*
4140009000	-10	1	50100015003	-34	1*
4140010000	10-1-35	1	50100016000	10-2-11	1
4140011002	-17	2	5010013000	- 6	1
4140016000	10-2-69	2	5010013000	10-1	REF.
4150004000	- 6	1	5010020000	- 7	1
4150009000	-18	1	5010024001	10-2-40	1
4150014000	- 5	1	5010024002	-30	1
4150016000	10-1- 8	2	5010028001	-22	1
4150017001	10-2-71	1	5010028002	-22	1
4150017002	-71	1	5010050000	10-1-41	1
4160001001	10-1- 1	1*	5010050001	-41	1
4160001002	- 1	1*		10-2-	REF.
4160001003	- 1	1*	5010051000	10-1-43	1
4160002001	- 2	1*	5010051001	-43	1
4160002002	- 2	1*		10-2	REF.
4180001000	-31	1	5010052000	- 1	1
4180002001	-36	1*	5010053000	10-1-40	1
4180002002	-36	1*	5010053001	-40	1
4180002003	-36	1*		10-2-	REF.

PART NUMBER	FIG.& ITEM REQ'D	ITEM REQ'D	PART NUMBER	FIG.& ITEM REQ'D	ITEM REQ'D
5010054000	10-1-42	1			
5010054001	10-1-42	1*			
5010054000	10-2-	REF.			
5010056000	10-3- 1	1			
5010057000	10-2-49	1			
5010058000	-48	1			
5010059000	-47	1			
5010060000	-45	1			
5010061000	-46	1			
5010062000	10-3- 4	1			
5010170000	-41	1			
	10-1-	REF.			
5010202000	10-2-50	1			
5040021000	10-1-28	1*			
5040021001	-28	1*			
5040022000	-28	1*			
5040022001	-28	1*			
5202105000	10-1-	End Item			
5202105001		" "			
5202105002		" "			
5202105003		" "			
5202107000		" "			
5202107001		" "			
5202107002		" "			
5202107003		" "			
5202108000		" "			
5202108001		" "			
5202108002		" "			
5202108003		" "			
5202109000		" "			
5202109001		" "			
5202109002		" "			
5202109003		" "			
8050002000	10-1-20	1			
8050002001	-20	1			
8050002002	-20	1			

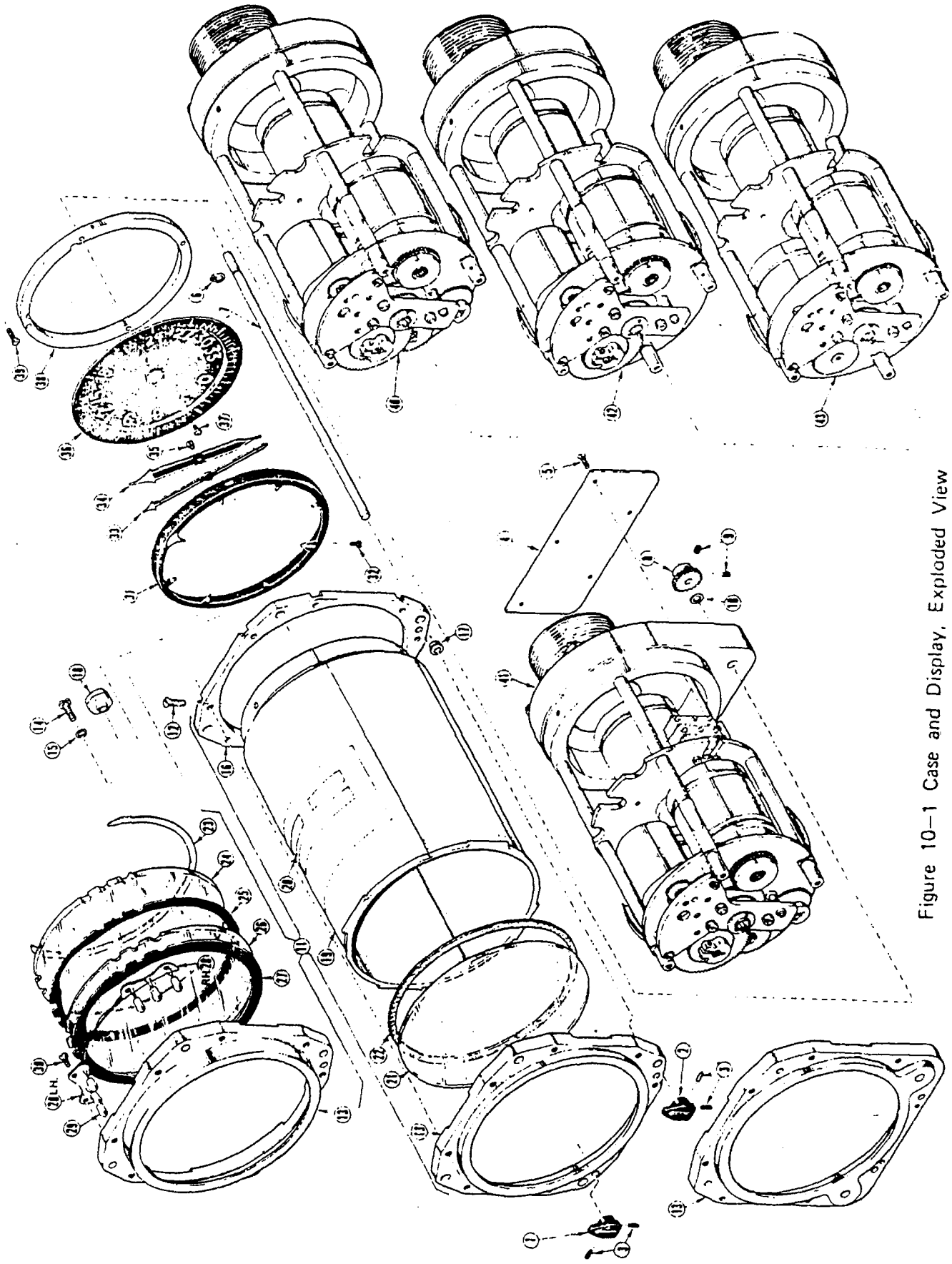


Figure 10–1 Case and Display, Exploded View

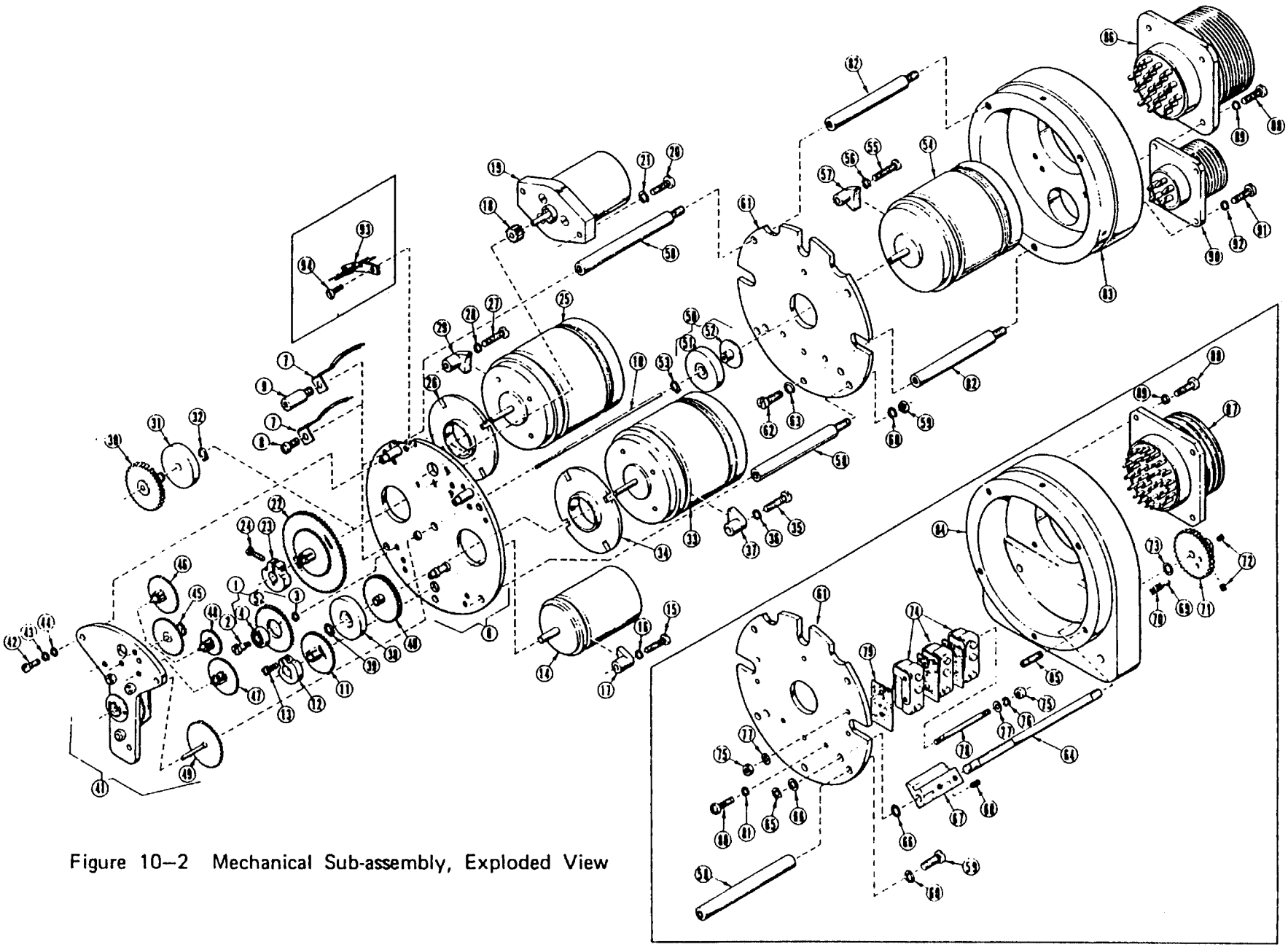


Figure 10–2 Mechanical Sub-assembly, Exploded View

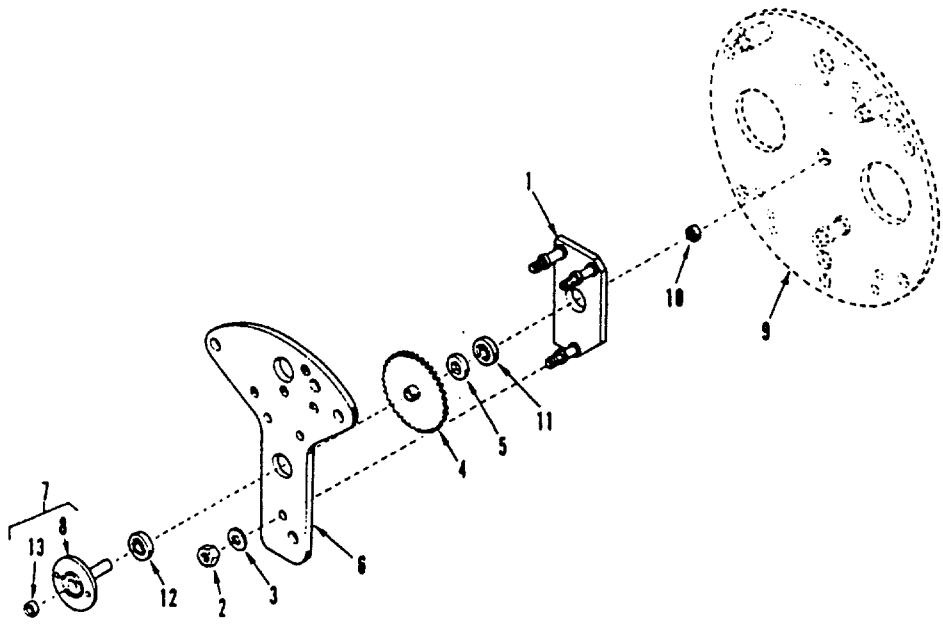


Figure 10–3 Center Bridge and Gear Assembly, Exploded View

OVERHAUL MANUAL

WITH

ILLUSTRATED PARTS LIST

FOR

PRESSURE ALTIMETER, MODELS

120-( ) & 135( )

And Model Suffix Part Numbers

-12002-0105	-12008-9	-13502-0201	-13508-1
-12002-0106	-12008-13	-13502-0202	-13508-5
-12003	-12009-1000	✓-13503	-13522-1000
-12003M	-12009-2000	-13503M	-13522-1100

PART NO. 135 - 13503

MAC LEOD INSTRUMENT CORPORATION.
Clearwater, Florida.

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135-13503 Alt. Ind.

MAC LEOD INSTRUMENT CORPORATION
OVERHAUL MANUAL
ALTIMETER INDICATOR, 120 (series), 135 (series)

RECORD OF REVISIONS

LOCATION

ASSIGNED TO (JOB TITLE)

REV. NO.	INSERTION DATE	BY	REV. NO.	INSERTION DATE	BY	REV. NO.	INSERTION DATE	BY	REV. NO.	INSERTION DATE	BY
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RETAIN THIS RECORD IN THE FRONT OF MANUAL OR CHAPTER ON RECEIPT OF REVISIONS, INSERT REVISED PAGES IN THE MANUAL, AND ENTER REVISION NUMBER, DATE INSERTED, AND INITIALS

LIST OF EFFECTIVE PAGES

REVISION A: Effective date 28 August 1972

INSERT REVISED PAGES, DESTROY SUPERSEDED PAGES.

TOTAL NUMBER OF PAGES IN THIS MANUAL IS 38 , CONSISTING OF:

Chapter/ Section	Page	Issue
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34-10	ii	A
34-10	iii thru iv	Original
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34-10	28 and 29	A
34-10	30	Original
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34-10	34 (Blank)	Original

MAC LEOD INSTRUMENT CORPORATION
OVERHAUL MANUAL
ALTIMETER INDICATOR, 120 (series), 135 (series)

INTRODUCTION

1. This manual presents overhaul instructions with an illustrated parts list for the Altimeter Indicator, part numbers (Refer to table 1), manufactured by the Mac Leod Instrument Corporation (11824) located in Fort Lauderdale, Florida.

2. It is not recommended that indicator covered in this manual be disassembled routinely during overhaul or repair of system in which it is installed. Disassembly for repair should be undertaken only when testing of instrument indicates a malfunction, and then only to the extent necessary to correct the apparent trouble.

DESCRIPTION AND OPERATION

1. Description (Refer to figure 2.)

   A. The altimeter indicator measures atmospheric pressure encountered in altitude variations. Altimeter provides a visual indication of its carrier's altitude in terms of feet above sea-level.

   B. The case of indicator is airtight when assembled except for a static pressure port at rear of case. It is secured to instrument panel with three screws inserted in openings provided in case flange.

   C. Instrument contains three pointers which indicate altitude in unit measurements, respectively. Pointers are as follows: hundred-foot pointer (18), thousand-foot pointer (19) and ten thousand-foot pointer (20).

   D. Altimeter dial (22) is graduated in minor increments of twenty-foot intervals with major increments of one hundred-foot intervals when measured by the hundred-foot pointer (18). Dial numerals, one through ten (zero), indicate multiples of unit measurements of pointer being observed.

   E. The barometric dial assembly (24), visible through cut-out in altimeter dial, indicates the barometric pressure standard. (Refer to table 1.)

   F. Altimeter and barometric dial markings are matte white or fluorescent color on a dull black background. The indicating end of pointers are matte white or fluorescent color with a dull black pivotal section. (Refer to table 11.)

   G. A striped white or fluorescent colored area on altimeter dial face is provided as a warning display. Only indicators containing a ten-thousand foot pointer disc will have warning display capabilities. (Refer to tables 1 and 11)

Table 1. Leading Particulars

Altimeter Indicator Part Number	Range (feet)	Barometric Dial Range	
		Inches of Hg	Millibars
12002-0105	-1000 to +20,000	28.1 to 31.0	
12002-0106	-1000 to +20,000		946 to 1050
12003	-1000 to +20,000	28.1 to 31.0	
12003M	-1000 to +20,000		946 to 1050
12008-9	-1000 to +20,000	28.1 to 31.0	
12008-13	-1000 to +20,000		946 to 1050
12009-1000	-1000 to +20,000	28.1 to 31.0	
12009-2000	-1000 to +20,000	28.1 to 31.0	
13502-0201	-1000 to +35,000	28.1 to 31.0	
13502-0202	-1000 to +35,000		946 to 1050
13503	-1000 to +35,000	28.1 to 31.0	
13503M	-1000 to +35,000		946 to 1050
13508-1	-1000 to +35,000	28.1 to 31.0	
13508-5	-1000 to +35,000		946 to 1050
13522-1000	-1000 to +35,000	28.1 to 31.0	
13522-1100	-1000 to +35,000		946 to 1050
Maximum overall length: 5.242 inches Maximum width: 3.260 inches Weight: one pound two ounces			

2. Operation (Refer to figure 2.)

A. Meteorological variations cause atmospheric pressure to constantly change. Position of indicator pointers, with respect to zero, must be adjusted to compensate for this change. Design of indicator provides an adjustment knob (5) for setting ambient barometric pressure while pointers simultaneously adjust to this setting.

B. Ascertain ambient barometric pressure from a mercurial barometer. Rotate adjustment knob until the barometric dial assembly (24) indicates ambient reading in cut-out of altimeter dial (22). The hundred-foot pointer (18) will simultaneously adjust to this setting.

3. Theory of Operation

Atmospheric pressure exerted upon surfaces of aneroid at zero altitude is greater than the pressure within aneroid. This unequal distribution of pressure causes aneroid to contract. An increase in altitude decreases atmospheric pressure, thereby exerting less pressure upon surfaces of aneroid allowing it to expand. This motion is transferred through mechanism to the transmission assembly, thereby actuating radial movement of instrument pointers.

DISASSEMBLY

1. General

   A. Figures 2 and 3 are exploded view illustrations of the indicator. Index numbers are listed in disassembly order of appearance. Parts which are illustrated in assembled form are considered inseparable and nonreparable and should be replaced as an assembly if necessary.

   B. Before disassembly, test the indicator in accordance with TESTING to determine the extent of overhaul required.

   C. When disassembling, keep parts together and protected from dust and dirt.

   D. Do not hold glass parts so that finger marks on surfaces result. Handle glass on edges only.

2. Bezel Assembly (Refer to figure 2.)

   A. Remove vent plug (3) from static pressure port at rear of case (46).

   B. Wrap friction tape around adjustment knob (5). Place wrench on knob locknut (6), and with pliers gripping knob, loosen locknut. Remove knob and locknut from adjustment stem (42).

   C. Back-off locking stud screw (13) mounted in bezel (14). Position locking stud screw to left side of elongated hole, thereby disengaging locking stud (12) from adjustment stem (42).

   D. Remove six screws (9), lockwashers (10), and two screws (11). Separate bezel assembly (8) from front of case (46).

   E. Separate gasket (15), glass (16) and bezel gasket (17) from bezel (14).

3. Pointers and Dials

   A. Carefully remove hundred-foot pointer (18), thousand-foot pointer (19), and ten thousand-foot pointer (20) from face of indicator.

   B. Separate spacer ring (21) from case (46).

   C. Remove two dial screws (23). Separate altimeter dial (22) and barometric dial assembly (24) from transmission housing cover assembly (30).

4. Transmission and Mechanism Assembly

   A. Separate barometric setting gear assembly (25) from transmission housing assembly (35).

   B. Rotate eccentric locking pin (26), as required, until tension is relieved on snap ring (27). Remove snap ring from inner groove of case.

C. Separate spur gear unit (28) from transmission housing cover assembly (30).

D. Rotate adjustment stem (42) until clearance hole in transmission housing assembly (35) is aligned with No. 6–40 threaded hole in gear plate assembly (25, figure 3). Insert screw (used for disassembly purposes only) No. 6–40 UNF–2A x 2 inches long in threaded hole and carefully remove both transmission assembly (29) and mechanism assembly (36) from inner case (46). Remove screw No. 6–40 UNF–2A x 2 inches long from mechanism.

E. Remove three shoulder screws (31) from transmission housing assembly (35). Separate transmission housing cover assembly (30) from transmission housing assembly (35). Care should be taken when cover is separated from housing, thereby preventing damage to journals of shafts within housing.

F. Separate gear assembly (32) from transmission housing assembly (35).

NOTE: Wheel and hub assembly (33) and stem pinion (34) should be disassembled only when defect is noted.

G. If defect is noted, press stem pinion (34) from wheel and hub assembly (33).

H. Remove spring ring (37) and snap ring (38) from inner groove of case (46).

5. Adjustment Stem

Remove pin retainer ring (40) from hub of zero setting gear (45). Press gear lock pin (41) from zero setting gear and adjustment stem (42). Pull adjustment stem from case (46). Remove zero setting gear and compression spring (44) from inner case cavity. Separate packing (43) from shoulder of adjustment stem.

6. Mechanism Assembly (Refer to figure 3.)

A. Handstaff Pinion

Separate center pinion (2) from large jewel bushing (3). Loosen screw (4) and remove jewel bushing and handstaff pinion (5) from gear plate assembly (25).

B. Rocking Shaft Assembly

(1) Press clock taper pin (6) from frame subassembly (30). Remove bearing pin (7) and separate link arm and link subassembly (14) from aneroid assembly (23).

(2) Loosen nut (10, figure 1). Back-off pivot screw (11, figure 1) until rocking shaft assembly (8) is disengaged. Remove sector gear end of rocking shaft assembly from eccentric jewel in gear plate assembly (25).

(3) Loosen screws (10) and (12). Separate rocking shaft counterweight (9) and rocking shaft pin (11) from rocking shaft subassembly (22).

(4) Remove elastic stop nut (13). Loosen screw (15) and separate link arm and link subassembly (14) from rocking shaft subassembly.

(5) Remove bearing pin (16) thereby disengaging mechanism link (17) from link arm (18).

(6) Remove screw (20) from sector gear of rocking shaft and remove sector gear counterweight (19).

NOTE: Further disassembly of rocking shaft subassembly is not recommended.

C. Intermediate Gear Assembly

(1) Remove four screws (26) and separate gear plate assembly (25) from frame subassembly (30).

(2) Press clock taper pin (27) from frame subassembly (30). Separate intermediate gear assembly (28) from gear plate assembly (25).

(3) Loosen screw (9, figure 1) and remove large jewel bushing (29) from center of frame subassembly.

CLEANING

1. General

Place all parts in a small wire mesh basket and wash in a watch type cleaning solution. Then rinse thoroughly in benzine (Federal Specification VV-B-231) and dry.

CAUTION: DO NOT IMMERSE JEWEL ASSEMBLIES IN BENZINE. SOME FLUID MAY BECOME TRAPPED INSIDE.

2. Gears and Pinions

A. Carefully brush all gear teeth with a No. 3 watchmaker's brush occasionally rubbing across a piece of prepared chalk. Hold the parts being brushed in a piece of watchmaker's paper keeping the brush clean and preventing it and the parts being brushed from coming in contact with the bare skin. This paper will soil very rapidly. Use a clean portion for each part.

B. Clean pinion of handstaff by pressing it into end grain of dry featherwood (pith wood).

3. Pivots

Clean pivots by pressing them into end grain of a piece of featherwood.

4. Jewels

Replace dirty jewel assemblies with new jewel assemblies.

INSPECTION AND CHECK

1. General

A. Check all jewels for cracks and flaws. Examine the pivots and check for polish, size and straightness.

B. Examine sector gear for broken or nicked teeth. Examine the handstaff pinion for pivot finish, trueness and condition of teeth.

C. Examine aneroid for bent edges and dents or nicks.

D. Check link for burrs and general wear.

E. Replace all gaskets and packings.

F. Check for sharp bends or kinks in hairspring.

G. In the event any parts do not meet preceding requirements, they should be replaced.

H. After inspection, place parts in a dust and moisture free container until reassembly.

REPAIR AND REPLACEMENT

Repair procedure should be confined to realignment and polishing. Parts needing further work should be replaced. (Refer to table 2. Inspection Chart.)

Table 2. Inspection Chart

Figure and Index Number	Nomenclature	Procedure
Figure 3, 8	Rocking Shaft Assembly	Inspect as applicable for distorted or broken link arm, bent or kinked hairspring, broken or worn teeth on sector gear, chipped or broken jewels, and damaged pivot. If damaged this assembly should be replaced as a unit.
Figure 3, 23	Aneroid Assembly	Check for dents, puncture or seal defects. Replace entire assembly if damaged.
Figure 3, 5	Handstaff Pinion	Inspect for worn or damaged teeth and bent or broken handstaff. If damaged replace with new handstaff pinion.
Figure 3, 28	Intermediate Gear Assembly	Inspect for worn or damaged teeth. Check hairspring for bent or kinked convolutions. Replace entire assembly if damaged.
Figure 2, 25 28 32 33 34	Barometric Setting Gear Assembly Spur Gear Unit Gear Assembly Wheel and Hub Assembly Stem Pinion	Inspect gears for worn or damaged teeth. Replace item if damaged.

ASSEMBLY

1. Lubrication

   Indicator requires no lubrication.

2. General

   Refer to applicable figure and assemble indicator in reverse order of disassembly as outlined by index numbers on illustration.

3. Mechanism Assembly (Refer to figure 3.)

   A. Intermediate Gear Assembly

      (1) Insert large jewel bushing (29) in center bore of frame subassembly (30). Observe that bushing is flush with surface of inner frame. Secure in position with screw (9, figure 1).

(2) Place journal of intermediate gear assembly (28), opposite hairspring end, in jewel bushing assembly (8, figure 1).

(3) Insert free end of gear assembly hairspring in applicable hole in altimeter frame (12, figure 1). Secure in position with clock taper pin (27).

(4) Align and insert free journal of intermediate gear assembly in eccentric jewel unit of gear plate assembly (25). Secure gear plate assembly to frame subassembly (30) with four screws (26).

CAUTION: PRIOR TO TICHTENING SCREWS (26) OBSERVE THAT INTERMEDIATE GEAR ASSEMBLY HAS SUFFICIENT ENDSHAKE, THEREBY PREVENTING POSSIBLE DAMAGE TO JEWEL OR DISTORTION OF JOURNALS.

(5) Adjust endshake in accordance with table 4.

B. Aneroid Assembly

Attach threaded centerpiece of aneroid assembly (23) to aneroid support (4, figure 1) with two hex nuts (24). Slot of centerpiece, opposite threaded centerpiece, should be parallel to base of frame.

C. Rocking Shaft Assembly

(1) Secure sector gear counterweight (19) to sector gear of rocking shaft with screw (20).

(2) Align bearing holes of link arm (18) and mechanism link (17) and insert bearing pin (16). Press flat end of pin flush to surface of link arm; then bend opposite end approximately 45 degrees to plane of link arm.

(3) Insert threaded section of link arm (18) in upper clearance hole of rocking shaft subassembly (22) and secure with screw (15). Attach elastic stop nut (13) to threaded section of link arm.

(4) Secure rocking shaft counterweight (9) to end of rocking shaft pin (11) with screw (10). Insert free end of rocking shaft pin in lower clearance hole of shaft and secure with screw (12).

(5) Insert journal, on sector gear end of rocking shaft assembly, in eccentric jewel mounted in gear plate assembly (25). Align opposite end of rocking shaft with pivot screw into end jewel of rocking shaft.

D. Handstaff Pinion

(1) Insert mechanism link (17) in slot of aneroid assembly (23). Align bearing holes of both items and insert bearing pin (7). Press flat end of pin flush to surface of aneroid centerpiece; then bend opposite end approximately 45 degrees to plane of centerpiece.

(2) Insert free end of rocking shaft hairspring (21) in hole provided in altimeter frame (12, figure 1) and secure with clock taper pin (6).

(3) Pass short journal of handstaff pinion (5) through center of gear plate assembly (25) and insert journal in large jewel bushing (29).

(4) Place large jewel bushing (3) on other end of handstaff pinion. Insert bushing in center bore of gear plate and secure with screw (4). Observe that intermediate gear assembly (28) is properly engaged with handstaff pinion.

(5) Adjust endshake of handstaff pinion by loosening screw (9, figure 1) and varying axial position of large jewel bushing (29). Adjust gear mesh with intermediate gear assembly (28) by radially adjusting intermediate gear eccentric jewel assembly mounted in gear plate. (Refer to table 4.)

(6) Adjust rocking shaft endshake using pivot screw (11, figure 1). Adjust sector gear and intermediate gear mating by radially adjusting rocking shaft eccentric jewel assembly mounted in gear plate assembly (25).

(7) Set endshake and gear mesh in accordance with table 4. When endshake of rocking shaft assembly is within specified tolerance secure pivot screw with nut (10, figure 1).

(8) Press center pinion (2) on section of handstaff pinion extending from gear plate assembly.

4. Transmission Assembly (Refer to figure 2.)

A. Place stem pinion (34) in bushing hole of transmission housing cover assembly (30) with 0.002 inch thick shim stock between gear of pinion and housing. Press wheel and hub assembly (33) on pinion shaft extending from opposite side of housing. Observe that stem pinion is properly meshed with mating cetner gear of cover assembly. Remove shim stock and check stem pinion endshake in accordance with table 4.

B. Insert journal, on pinion end of gear assembly (32), in bushing hole of transmission housing cover assembly (30).

C. Align bearing holes of transmission housing assembly (35) with journals of mounted gears in cover assembly. When journals of gear assembly (32) and stem pinion (34) are properly inserted in bearing holes of housing attach three shoulder screws (31). Observe that screws are evenly tightened, thereby preventing distortion to journals.

NOTE: Check rotary movement of gears for evidence of binding. Movement of gears shall be smooth and non-erratic.

D. Place spur gear unit (28) on shoulder of center bushing of cover assembly. Observe that spur gear is properly meshed with stem pinion (34).

E. Place transmission assembly in a clean container until calibration of mechanism assembly has been satisfactorily completed.

5. Calibration (Refer to figure 3.)

A. General

(1) Place a hundred-foot pointer (18, figure 2), used for testing purposes, on journal of handstaff pinion (5).

(2) Using a soft material, carefully bend outer radius of sector gear of rocking shaft assembly (8) until disengaged from mating intermediate gear assembly (28). Rotate test pointer approximately thirty six counterclockwise revolutions, thereby loading hairspring of intermediate gear. When hairspring is loaded, as specified, engage sector gear with intermediate gear.

NOTE: Sector gear of rocking shaft assembly shall have a sufficient travel to permit test pointer to indicate - 1000 feet on altimeter dial (22, figure 2).

(3) Radial movement of rocking shaft assembly shall produce an even rotation of pointer. If erratic or uneven pointer movement is observed, check mechanism for improper gear mesh and insufficient endshake in accordance with table 4.

NOTE: Correction to faulty gear train movement, if required, shall be made before proceeding further with calibration.

(4) All calibration readings shall be recorded while mechanism is being subjected to vibration using Edwards Vibrators, No. 1983, or equivalent.

(5) Remove test pointer.

B. Ranging (Refer to figure 3.)

(1) Mount mechanism on a standard altimeter calibration fixture.

(2) Attach altimeter dial (22, figure 2), used for testing purposes, to front face of fixture with two dial screws (23, figure 2).

(3) Press hundred-foot pointer (18, figure 2), used for testing purposes onto journal of handstaff pinion (5).

(4) Place mechanism in an altitude chamber. A master altimeter should be either in chamber or in some way connected to chamber.

(5) Observe ambient reading of master altimeter; then rotate mechanism assembly within calibration fixture until pointer indicates corresponding ambient reading on dial.

(6) Seal altitude chamber.

(7) Apply pressure in accordance with table 3. Readings at each test point, for both mechanism and master altimeter, shall be recorded.

(8) If mechanism readings, as compared to master altimeter, indicate a minus error in low range and a plus error in high range, loosen two nuts (24) and increase the distance between the aneroid assembly (23) and rocking shaft assembly (8). Tighten nuts securing aneroid and range mechanism, as outlined in paragraphs (4) through (7) above, to check adjustment made with aneroid assembly.

(9) If mechanism readings, as compared to master altimeter, indicate a plus error in low range and a minus error in the high range, loosen two nuts (24) and decrease the distance between aneroid assembly (23) and rocking shaft assembly (8). Tighten nuts securing aneroid assembly and range mechanism, as outlined in paragraphs (4) through (7) above, to check adjustment made with aneroid assembly.

NOTE: Whenever the effective length of mechanism link (17) has been altered, due to adjustment of aneroid assembly, freedom of link movement shall be checked.

(10) If mechanism readings indicate a consistant plus error throughout entire range loosen screw (15) and rotate elastic stop nut (13) approximately one revolution counterclockwise. Push stop nut toward rocking shaft subassembly (22) until contact is made. Tighten screws (15) and range mechanism, as outlined in paragraphs (4) through (7) above, to check adjustment made to effective length of link arm and link subassembly (14).

(11) If mechanism readings indicate a consistant minus error throughout entire range loosen screw (15) and rotate elastic stop nut (13) approximately one revolution clockwise. Tighten screw (15) and range mechanism, as outlined in paragraphs (4) through (7) above, to check adjustment made to effective length of link arm and link subassembly (14).

(12) When all tests points are satisfactorily within tolerances specified in table 3, apply glyptal to all screws and nuts.

Table 3. Ranging Chart

Altitude (feet)	Equivalent Atmospheric Inches of Hg	Pressure Millibars	Tolerance (± feet) Room Temperature
-1,000	31.0185	1050.41	20
0	29.9213	1013.25	20
500	29.3846	995.08	20
1,000	28.8557	977.17	20
1,500	28.3345	959.52	25
2,000	27.8210	942.13	30
3,000	27.8167	908.12	30
4,000	25.8418	875.10	35
6,000	23.9782	811.99	40
8,000	22.2249	752.62	60
10,000	20.5769	696.81	80
12,000	19.0293	644.41	90
14,000	17.5773	595.24	100
16,000	16.2164	649.15	110
18,000	14.9421	506.00	120
20,000	13.7501	465.63	130
22,000*	12.6363	427.91	140
25,000*	11.1035	376.01	155
30,000*	8.8854	300.89	180
35,000*	7.0406	238.42	205

*135 (series) only

C. Temperature Compensation

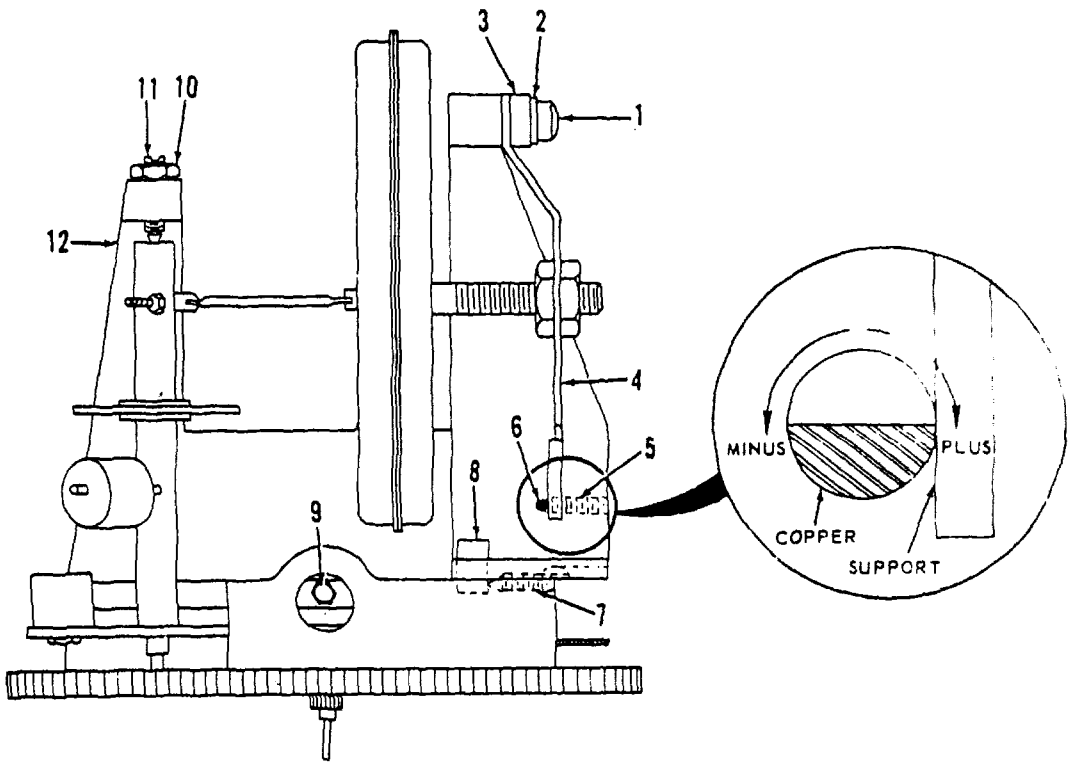
(1) Observe reading of master altimeter corrected for ambient barometric pressure

(2) Rotate mechanism within calibration fixture until pointer indicates corresponding ambient reading on dial.

(3) Record reading at room temperature, then place mechanism in a cold chamber -35°C (-31°F) for a period of one hour. Record second reading.

(4) The change in reading at room temperature and reading at cold temperature shall not exceed ± 40 feet.

NOTE: Readings shall be corrected to compensate for barometric pressure change during one hour period in cold chamber. Changes in pressure may be noted in terms of feet altitude. If the master altimeter indicates 500 feet at the start of compensation test and 530 feet at completion of test, the



1. Screw
2. Lockwasher
3. Spacer
4. Aneroid support
5. Screw
6. Temperature compensator
7. Screw
8. Jewel bushing assembly
9. Screw
10. Nut
11. Pivot screw
12. Altimeter frame

Frame Subassembly (Temperature Compensation)
Figure 1

mechanism undergoing test will have changed plus 30 feet. Subtract this error algebraically from reading obtained to arrive at corrected compensation reading.

(5) If the difference between room temperature reading and cold temperature reading exceeds ±40 feet, adjustment of temperature compensator (6, figure 1) will be necessary. Proceed as follows:

(6) Loosen screw (5, figure 1). Insert a jeweler's screwdriver in slotted end of compensator. Correct error by rotating compensator. (Refer to figure 1.)

NOTE: A fifteen degree rotation of temperature compensator will correct an error of approximately seventy five feet, respectively.

(7) Tighten screw securing compensator and repeat test as outlined in paragraph (1) through (4) above.

(8) When mechanism is satisfactorily within tolerances specified, apply glyptal to screw (5, figure 1.)

D. Position Error (Refer to figure 3.)

(1) This procedure shall be conducted with mechanism subjected to vibration.

(2) Position calibration fixture with mechanism assembly in a normal operating position with zero indication of dial at 12 o'clock. Rotate mechanism within fixture until pointer indicates zero.

(3) Lightly tap mechanism and record reading. Rotate calibration fixture clockwise until pointer is at 6 o'clock position. Tap mechanism and record reading. The difference between readings shall not exceed ±20 feet.

(4) If a plus error is indicated, loosen screw (12) and position rocking shaft counterweight (9) away from rocking shaft subassembly (22); then tighten screw. If a minus error is indicated, position counterweight toward rocking shaft; then tighten screw. Balance mechanism to specified tolerance.

(5) Rotate calibration fixture until pointer is at 9 o'clock position; then lightly tap mechanism and record reading. Rotate calibration fixture clockwise until pointer is at 3 o'clock position. Tap mechanism and record reading. The difference between readings shall not exceed ±20 feet.

(6) If a plus error is indicated, loosen screw (20) and position sector gear counterweight (19) toward rocking shaft subassembly (22). If

a minus error is indicated, position counterweight away from rocking shaft. Tighten screw (20) when mechanism is balanced within specified tolerance.

NOTE: Remove excessive pointer oscillation, if necessary, by increasing tension of rocking shaft hairspring (21).

(7) Position the calibration fixture with mechanism dial facing up. With pointer at zero lightly tap mechanism to remove friction. If pointer indicates an error, loosen nut (10, figure 1) and adjust pivot screw (11, figure 1) to correct for excessive endshake of rocking shaft assembly (8). Tighten nut when mechanism is balanced within specified tolerance.

(8) Repeat procedures as outlined in paragraph D. to insure that mechanism is balanced to within specified tolerance.

6. Final Check

A. Ranging

Repeat ranging procedures as outlined in paragraph 5.B. making adjustments where applicable.

B. Temperature Compensation

Repeat compensation procedures as outlined in paragraph 5.C. making adjustments where applicable.

C. Endshake and Gear Mesh

(1) Movement of pointer shall be smooth and non-erratic. Check endshake and gear mesh in accordance with table 4.

(2) Remove test pointer and dial; then separate mechanism assembly from calibration fixture.

(3) Apply glyptal to all screws and nuts not secured to mechanism with a mechanical fastener.

7. Case Assembly (Refer to figure 2.)

A. Adjustment Stem

(1) Place a new packing (43) on shoulder of unthreaded end of adjustment stem (42). Insert unthreaded end of stem through hole in open end of case (46).

(2) As stem begins to protrude through inner surface of case cavity, place compression spring (44) and zero setting gear (45) on stem. Push stem in bearing hole of cavity.

(3) Position pin retainer ring (40) around hub of gear. Align holes of adjustment stem and zero setting gear; then press in gear lock pin (41).

(4) Adjust pin retainer ring (40) to secure lock pin (41) in position.

B. Transmission and Mechanism Assembly

(1) Insert snap ring (38) in innermost groove of case (46). Position spring ring (37) over snap ring.

(2) Carefully position transmission assembly (29) over gear plate assembly (25, figure 3) and align center pinion (2, figure 3) in center opening of transmission assembly. Insert center pinion in opening and mesh pinion with gear assembly (33). Transmission assembly should now be seated on gear plate assembly with handstaff pinion (5, figure 3) centrally located within transmission housing cover assembly.

(3) To facilitate installation of transmission and mechanism assemblies into case (46) align clearance hole in transmission housing assembly (35) with No. 6-40 threaded hole in gear plate assembly (25, figure 3); then insert screw (used for installing purposes only) No. 6-40 UNF-2Ax2 inches long in threaded hole of transmission housing assembly.

(4) Align locating pin on outer edge of transmission housing assembly (35) with locating slot of inner case. Carefully lower transmission assembly (29) and mechanism assembly (36) into case (46).

(5) Insert snap ring (27) in upper groove of inner case (46).

(6) Insert eccentric locking pin (26), as required, in transmission housing assembly (35) and radially adjust pin for proper tension.

(7) Remove installation screw.

(8) Place barometric setting gear assembly (25) on housing stud. Observe that zero setting gear (45) and barometric setting gear assembly are properly meshed.

(9) Rotate adjustment stem (42) clockwise and counterclockwise. Rotary movement of gears shall be smooth and non-erratic.

C. Pointers and Dials

(1) Position barometric dial assembly (24) on transmission housing cover assembly (30); then place altimeter dial (22) over barometric dial with numeral six oriented in close proximity to zero setting gear (45). Secure altimeter dial to cover assembly with two dial screws (23).

(2) Assemble pointer to mechanism each indicating zero on altimeter dial. Proceed as follows:

(3) Press ten thousand-foot pointer (20) and thousand-foot pointer (19) on center bushing of transmission assembly (29). Press the hundred-foot pointer (18) on handstaff pinion (5, figure 3) centrally located within center bushing.

(4) Position spacer ring (21) on rim of case (46).

D. Bezel Assembly

(1) Place bezel gasket (17) on case rim.

(2) Clean both surfaces of glass (16) and position on bezel gasket. Place gasket (15) on outer surface of glass.

(3) Insert threaded section of adjustment stem (42) in applicable hole in bezel (14). Attach bezel to case with six screws (9), lockwashers (10) and two scres (11).

(4) Turn knob locknut (6) and adjustment knob (5) onto threaded section of adjustment stem (42). When heighth of knob is adjusted in accordance with table 4, secure in position by turning locknut in a counterclockwise direction while holding knob in a stationary position.

(5) Observe reading of master altimeter for ambient altitude; then rotate adjustment knob (5) until pointers indicate corresponding altitude on dial.

(6) Observe reading of a mercurial barometer; then pull adjustment knob outward and rotate until barometric dial assembly (24) indicates corresponding reading in altimeter dial cut-out. Release knob.

(7) Position locking stud screw (13) towards adjustment stem and tighten, thereby securing locking stud (12).

FITS AND CLEARANCE

This section lists fits and clearances which should be observed and maintained for the proper operation of indicator. (Refer to table 4.)

Table 4. Fits and Clearances

Description		Fits or Clearances (inches)		
		Fig.-Item	Normal	Tolerance
Endshake	Intermediate gear assembly	3 - 28	0.003	0.002 - 0.004
	Rocking shaft assembly	3 - 28	0.002	0.001 - 0.003
	Handstaff pinion	3 - 5	0.003	0.002 - 0.004
	Stem pinion	2 - 34	0.003	0.002 - 0.004
Gear mesh	Sector gear of rocking shaft subassembly with intermediate gear assembly	3 - 22	0.0002	0.0001-0.0003
	Intermediate gear assembly with handstaff pinion	3 - 28	0.0002	0.0001-0.0003
Play	Mechanism link with bearing pin (7 and 16, figure 3	3 - 17	0.005	0.004 - 0.006 (loose)
Clearance	End of adjustment knob to bezel (14, figure 2)	2 - 5	0.900	0.890 - 0.910

TESTING

1. Test Conditions

   A. Unless otherwise specified, the indicator shall be tested in its normal operating position with the dial vertical.

   B. All tests shall be conducted in an environment as follows:

Ambient Temperature	$23^{\circ} \pm 5^{\circ}C$
Atmospheric Pressure	28 to 32 inches of Hg
Relative Humidity	No greater than 55%

   C. All test readings shall be recorded while instrument is being subjected to vibration using Edwards Vibrators, No. 1983, or equivalent.

2. Test Equipment

   Test equipment required is listed in SPECIAL TOOLS, FIXTURES, AND EQUIPMENT section.

3. Test Procedures

   Visually inspect the indicator to verify that workmanship conforms to aerospace equipment. This inspection shall include a check of overall appearances of

finish and tightness of fastenings, cleanliness and proper alignment of mechanical parts. The indicator window shall have no defects that could impair or distort reading of dials.

4. Scale Error at Room Temperature

A. Indicator shall not have been operated at other than approximately 29.92 inches of Hg and at an ambient temperature of approximately 25°C for a period of not less than twelve hours prior to this test.

B. Place indicator in an altitude chamber. A master altimeter should be either in chamber or in some way connected to chamber.

C. Rotate adjustment knob (5, figure 2) until 29.92 inches of Hg is indicated on barometric dial assembly (24, figure 2). The barometric dial shall remain at this setting while indicator is successively subjected to the pressures specified in table 5. Reduction in pressure shall be made at a rate not in excess of 20, 000 fpm to within approximately 2, 000 feet of test point. Indicator shall remain at pressure corresponding to each test point for at least one minute but not more than ten minutes before reading is recorded. Error at each test point shall not exceed tolerance specified in table 5.

Table 5. Scale Error Chart

Altitude (feet)	Inches of Hg	Millibars	Tolerance (± feet)	
			Room Temperature	-35°C (-31°F)
-1, 000	31.0185	1050.41	20	--
0	29.9213	1013.25	20	40
500	29.3846	995.08	20	--
1, 000	28.8557	917.17	20	--
1, 500	28.3345	959.52	25	--
2, 000	27.8210	942.13	30	--
3, 000	26.8167	908.12	30	--
4, 000	25.8418	875.10	35	--
6, 000	23.9782	811.99	40	60
8, 000	22.2249	752.62	60	--
10, 000	20.5769	696.81	80	--
12, 000	19.0293	644.41	90	90
14, 000	17.5773	595.24	100	--
16, 000	16.2164	549.15	110	--
18, 000	14.9421	506.00	120	120
20, 000	13.7501	465.63	130	--

Table 5. Scale Error Chart (continued)

Altitude (feet)	Inches of Hg	Millibars	Tolerance (±feet)	
			Room Temperature	-35°C (-31°F)
22,000*	12.6363	427.91	140	--
25,000*	11.1035	376.01	155	155
30,000*	8.8854	300.89	180	--
35,000*	7.0406	238.42	205	205
*135 (series) only				

5. Hysteresis

A. This test shall be performed not more than fifteen minutes after indicator has been subjected to the pressure corresponding to the upper limit test point. While indicator is still at this pressure proceed as follows:

B. Increase pressure at a rate simulating a descent in altitude of approximately (but not exceeding) 20,000 fpm until within 3,000 feet of first test point. (Refer to table 6.) Approach this test point at a rate of approximately 3,000 fpm. Within ten seconds after pressure has been stabilized at this test point, indicator reading shall be within 100 feet of scale error as specified in table 5.

Table 6. Hysteresis Chart

Test Point	Altitude (feet)	Equivalent Atmospheric Pressure		Tolerance (±feet)
		Inches of Hg	Millibars	
First	25,000*	11.1035	376.01	75
	14,000	17.5773	595.24	75
Second	20,000*	13.7501	465.63	75
	10,000	20.5769	696.81	75
*135 (series) only				

C. Indicator shall remain at this pressure for at least five minutes but not more than fifteen minutes before test reading is taken.

D. Pressure shall be increased, at the above rate, until the pressure corresponding to the second test point is reached. Indicator shall remain at this pressure for at least one minute but not more than ten minutes before test reading is taken.

E. Pressure shall be increased, at the above rate, until ambient atmospheric pressure is reached. The indicator reading at each test point shall not exceed tolerance specified in table 6.

6. After Effect

A. This test procedure shall be performed not more than five minutes after the completion of hysteresis test.

B. With the return of pointers to original ambient readings the error shall not exceed ± 30 feet after correction for any change to ambient atmospheric pressure has been made.

7. Friction

The indicator shall be subjected to a steady rate of a decrease in pressure equivalent to about 750 fpm in accordance with table 7. At each test point two readings are to be recorded; the first before tapping instrument and the second after tapping instrument. Friction error shall not exceed tolerance listed in table 7.

Table 7. Friction Error Chart

Altitude (feet)	Tolerance (± feet)
1, 000	70
2, 000	70
3, 000	70
5, 000	70
10, 000	80
15, 000	90
20, 000	100
25, 000*	120
30, 000*	140
35, 000*	160
*135 (series) only	

8. Case Leakage

Connect the static pressure port of indicator to a source of pressure. Apply pressure, equivalent to 18, 000 feet, to case. Ath this point clamp off connection from pressure source. Record any change in reading during a one minute inerval. Case leakage shall not exceed 100 feet.

9. Position Error

A. Test shall be performed with indicator mounted on a position error fixture.

B. Readings shall be recorded with indicator in a vertical position with dial up and another in a normal operating position.

C. Additional readings shall be taken with the hundred-foot pointer (18, figure 2) at 12, 3, 6, and 9 o'clock positions. These readings shall be recorded.

D. The difference between pointer indications with indicator in a normal operating position and in around the clock positions, as described above, shall not exceed ±20 feet.

10. Barometric Scale Error

A. Test shall be conducted with indicator subjected to a constant ambient pressure.

B. Rotate adjustment knob (5, figure 2) until the barometric dial assembly (24, figure 2) indicates each of the various settings in accordance with table 8. While barometric dial is being adjusted to test setting, the hundred-foot pointer will simultaneously adjust to setting. Record pointer readings at each setting.

C. When pointer reading at each setting has been recorded, determine the difference in altitude between each reading and zero. The differences shall not exceed tolerances listed in table 8.

Table 8. Barometric Scale Error Chart

Equivalent Pressure		Altitude Difference From Zero (feet)	Tolerance (±feet)
Inches of Hg	Millibars		
28.10	950	-1727	25
28.50	964	-1340	25
29.00	982	- 863	25
29.50	998	- 392	25
29.92	1013	0	
30.50	1033	+ 531	25
30.90	1047	+ 893	25
30.99	1049	+ 974	25

11. Scale Error at Low Temperature

A. The indicator shall be exposed to a temperature of -35°C (-31°F) for a period of three hours minimum.

B. While at this temperature the indicator shall be subjected to similar test as outlined in paragraph 4., except the change in reading as compared to reading at room temperature at each test point, shall not exceed applicable tolerances specified in Table 5.

TROUBLESHOOTING

1. General

This section presents general troubleshooting information to assist in locating and correcting any malfunctions of the indicator. A troubleshooting chart, table 9, is provided for reference.

2. Troubleshooting Procedure

A. Troubleshooting should begin after testing and careful observation of indicator performance. Pointer readings should be recorded for reference. Based on indicator performance, attempt to isolate the malfunction to altimeter mechanism or case assembly.

B. When the malfunction has been isolate, check for mechanical malfunctions. This can be done quickly by inspection. Typical malfunctions would be loose gears on shafts, binding gears, defective jewels, foreign matter in jewels, loose pointers on dial, broken or damaged gear teeth, etc.

Table 9. Troubleshooting Chart

Trouble	Probable Cause	Remedy
Mechanism fails to respond properly.	Dirt or other foreign matter on gear teeth.	Remove and clean gears with benzine cleaning solution.
	Incorrectly adjusted gear train mesh.	Refer to fits and clearances, table 4.
Altimeter will not maintain a constant reading.	Aneroid leakage.	Replace aneroid assembly (23, figure 3).
Hundred-foot pointer (18, figure 2) fails to read - 1000 feet.	Insufficient sector gear travel.	Correct condition by referring to Assembly, paragraph 5.A.(2) and (3).
Hundred-foot pointer (18, figure 2) oscillates on indication.	Excessive endshake of rocking shaft assembly (8, figure 3).	Adjust endshake in accordance with Assembly, paragraph 3.D.(6).
Instrument indicates a minus error in low range and a plus error in high range.	Aneroid assembly (23, figure 3) oriented too close to rocking shaft assembly (18, figure 3).	Correct error in accordance with Calibration, paragraph 5.B.(8).

Table 9. Troubleshooting Chart (continued)

Trouble	Probable Cause	Remedy
Instrument indicates a plus error in low range and a minus error in high range.	Aneroid assembly (23, figure 3) oriented to far from rocking shaft assembly (8, figure 3).	Correct error in accordance with Cablibration, paragraph 5.B. (9).
Instrument indicates a consistant plus or minus error throughout entire range.	Improper setting of link arm and link subassembly (14, figure 3).	Correct error in accordance with Calibration, paragraph 5.B. (10) for consistant plus error, paragraph 5.B. (11) for consistant minus error.

PACKAGING AND STORAGE

1. Packaging and Storage Instructions

Requirements for packaging and storage conform to U. S. government specification (MIL-P-116D). A summary of the most often used methods of packing for storage is included.

A. Packaging for Storage

(1) Packaging for immediate use (for mechanical and physical protection only).

The instrument shall be enclosed in wrappings, boxes, bags, cartons or other containers, as applicable, to the extent necessary to provide protection from hazards of contamination and physical damage encountered in general handling, shelf storage and issue. When bags, wraps, or other flexible barriers are used, cushioning shall be applied as required to protect the enclosing media. If packaged in a rigid container this container shall be supported by rigid or resilient dunnage as necessary to prevent free movement. Materials in contact with the surface of the instrument shall be as dry as practicable and in accordance with commercial practice.

(2) Packaging for Short Term Storage (up to six months)

The instrument shall be wrapped or padded so that all projections or sharp edges that might damage a barrier bag are covered sufficiently to avoid damage to the bag. The usual method for accomplishing this is to pack the instrument in dunnage in a corrugated

paper carton. The corners of the carton should be crushed so that they will not damage the barrier bag. The dunnage should be either Kim-Pak, rubberized hair or fiber. The barrier bag shall be constructed of one or more plies in any manner which will insure water vapor proofness and flexibility. The material must have low water transmission characteristics for use in packaging. Lapping or butting of the component materials of the finished product is not permitted except in the direction perpendicular to the rolling direction. The lapped areas shall be plainly externally flagged to prevent use of that portion of the roll when a lap or butt weld is made on the finished product, the foil component (if present) or cloth backing (if present). The barrier bag is usually made of canvas covered foil and can be heat sealed airtight.

(3) Packaging for Long Term Storage (up to nine years)

For a long term storage the item should be packed as in paragraph (2), however, a desiccant and humidity indicator shall also be included within the bag. This package shall be opened and checked at three year intervals and if the humidity indicator has changed color the desiccant and the humidity indicator should be replaced, the instrument checked for damage from moisture and then resealed in the bag. If the humidity indicator has not changed color, the bag should simply be resealed. A bag is usually good for about three resealings or nine years.

B. Storage

(1) When the instrument is removed from the carrier the vent plug (3, figure 2) should be inserted immediately to prevent foreign matter from entering the connection openings. If this plug is not available, the static port should be sealed in some manner.

(2) When packaging for storage instructions are closely followed, no special storage conditions are required except a dry area where the instrument will be protected from being crushed.

SPECIAL TOOLS, FIXTURES, AND EQUIPMENT

1. Test Equipment

Edwards' Vibrator, No. 1983, manufactured by the Edwards Company, Incorporated, located in Norwalk, Connecticut.

2. Materials Used in Repair and Calibration of Indicator

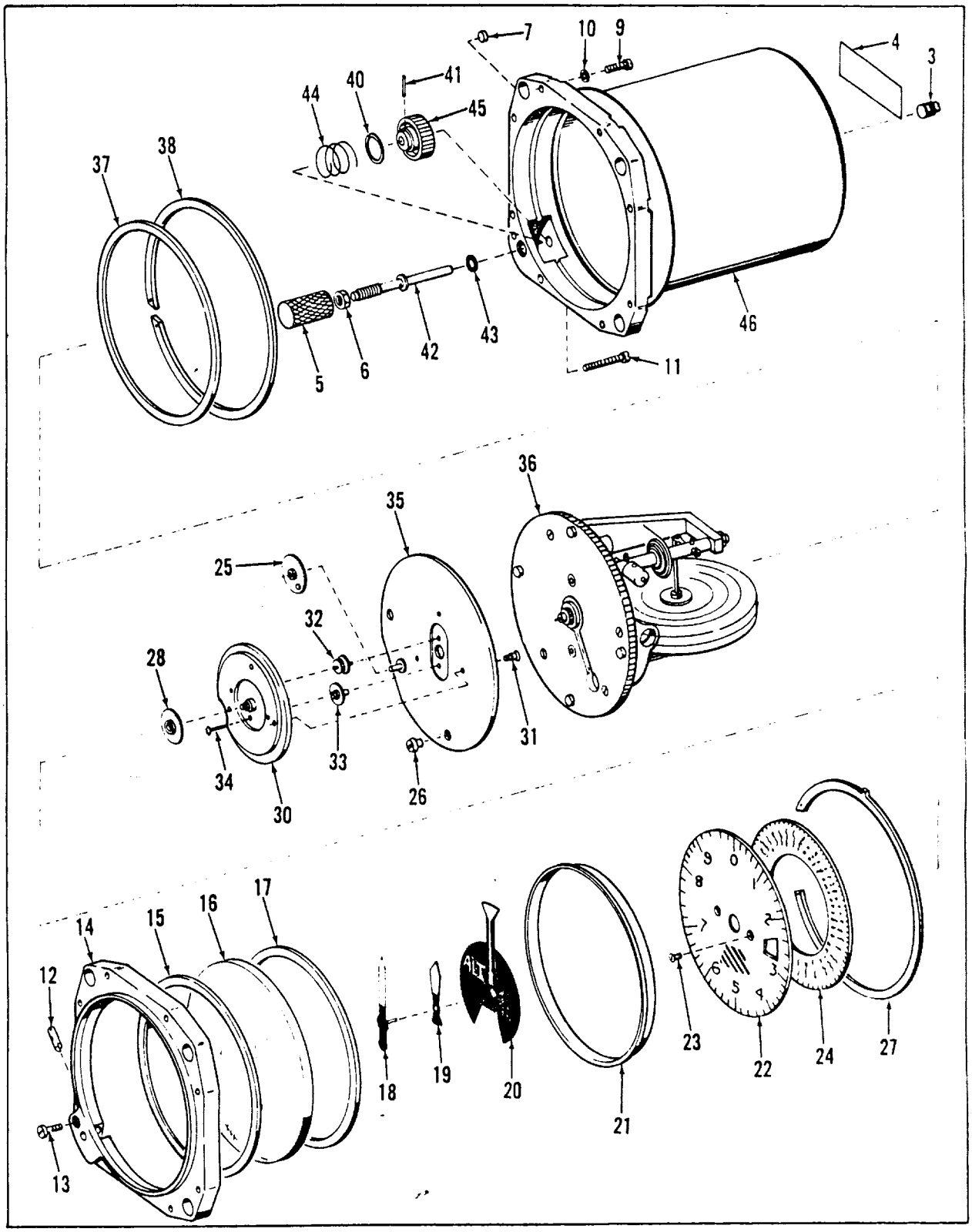
Benzine (Federal Specification VV-B-231)
Purple Glyptal, ZV-903, General Electric
Compressed air, clean, filtered, 20 psi maximum
Standard Calibration fixture

ILLUSTRATED PARTS LIST

Replaceable parts for the altimeter indicator are listed in disassembly order of appearance keyed to illustrations. (Refer to figures 2 and 3.) Parts numbers listed originate with Mac Leod Instrument Corporation (11824). The nomenclature of a vendor-supplied item includes a five digit manufacturers supply code as listed in Cataloging Handbook H4-1. (Refer to table 10.)

Table 10. Vendor Code

Vendor Code	Vendor Name and Address
79555	S. S. White Dental Mfg. Co. Philadelphia, Pa. 19107



Altimeter Indicator (Exploded View)
Figure 2

FIG. ITEM	PART NUMBER	1234567 NOMENCLATURE	EFFECT FROM TO	UNITS PER ASSY	
2-1	(See table 11)	INDICATOR, Altimeter		1	
-2	(See table 11)	.GENERAL ASSEMBLY		1	
3	1604-600	.PLUG, Vent (V79555)		1	
4	(See table 11)	.PLATE, Identification		1	
5	(See table 11)	.KNOB, Adjustment		1	
6	COML	.LOCKNUT, Knob, 5-44 UNG-2 brass, black oxide		1	
7	P1297	.SEAL, Lead		1	
-8	200053	.BEZEL ASSEMBLY (ATTACHING PARTS)		1	
9	COML	.SCREW, Machine, fillister head, 3-56 UNF-2A x 5/16 lg, brass, black oxide		6	
10	COML	.WASHER, Lock, split, No.3, brass, black oxide		6	
11	COML	.SCREW, Machine, slotted fillister head, 3-56 UNF-2A x 3/4 lg, brass, black oxide		2	
		---*---			
12	100083	..STUD, Locking		1	
13	P1394	..SCREW, Stud, locking		1	
14	M2098	..BEZEL		1	
15	P1290	.GASKET		1	R
16	P1059	.GLASS		1	
17	P2046	.GASKET, Bezel		1	
18	100064	.POINTER, hundred-foot		1	
19	P1653	.POINTER, thousand-foot		1	
20	(See table 11)	.POINTER, Ten thousand-foot		1	
21	M21327	.RING, Spacer		1	
22	(See table 11)	.DIAL, Altimeter (ATTACHING PARTS)		1	
23	P1051	.SCREW, Dial		2	
		---*---			
24	(See table 11)	.DIAL ASSEMBLY, Barometric		1	
25	SA 1617	.GEAR ASSEMBLY, Barometric setting		1	
26	200025	.PIN, Locking, eccentric		AR	
27	100135	.RING, Snap		1	
28	SA 1244	.SPUR GEAR UNIT		1	
-29	300206	.TRANSMISSION ASSEMBLY		1	R
30	300200	..COVER ASSEMBLY, Transmission housing		1	R

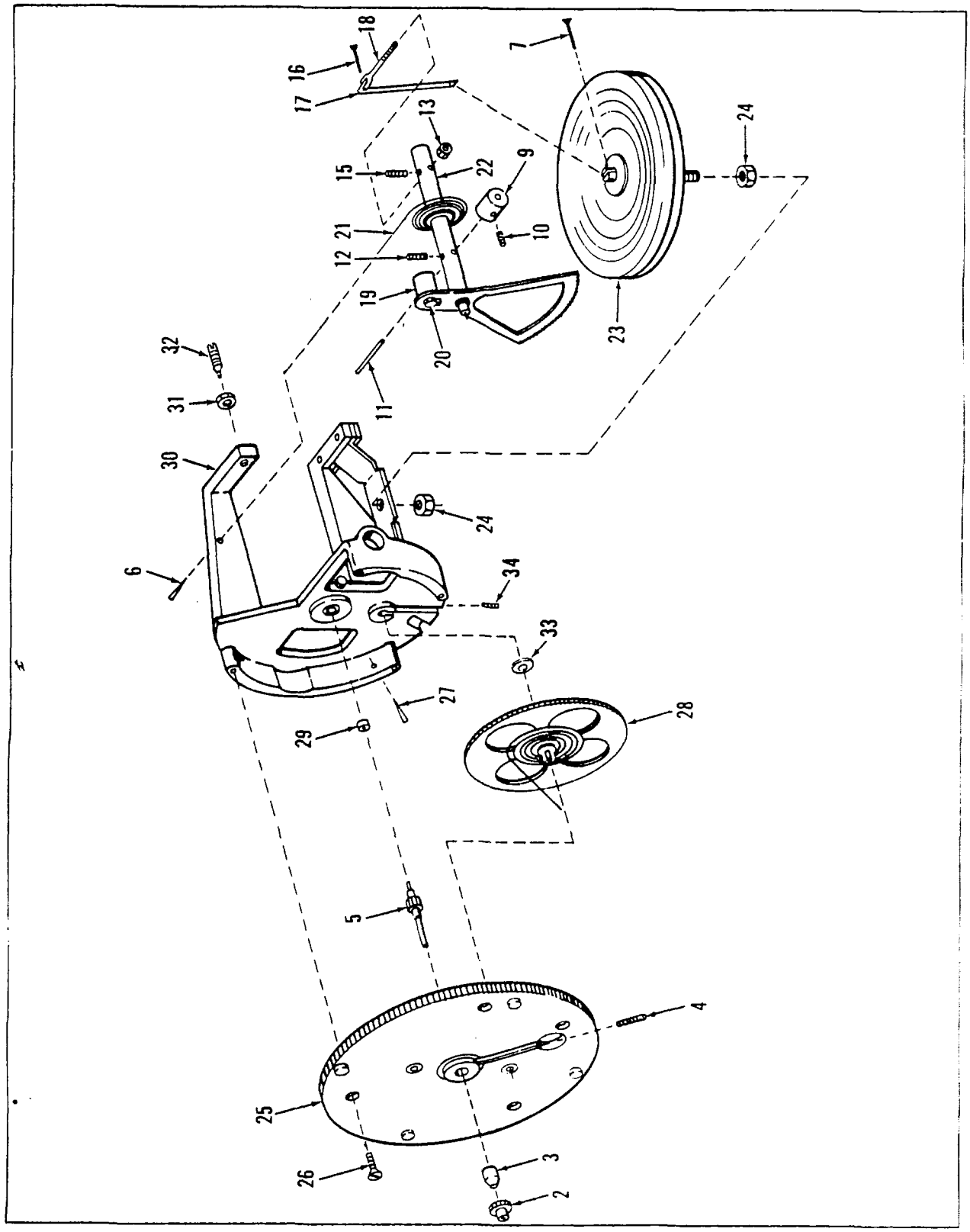
-Item not illustrated

FIG. ITEM	PART NUMBER	1234567 NOMENCLATURE	EFFECT FROM TO	UNITS PER ASSY
2-		(ATTACHING PARTS)		
31	M1243	. . SCREW, Shoulder		3
		----*----		
32	SA 1238	. . GEAR ASSEMBLY		1
33	SA 1233	. . WHEEL AND HUB ASSEMBLY		1
34	M1231	. . PINION, Stem		1
35	300207	. . HOUSING ASSEMBLY, Transmission		1
36	400009	. MECHANISM ASSEMBLY (Refer to Figure 3 for breakdown)		1
37	100106	. RING, Spring		1
38	100130	. RING, Snap		1
-39	300015	. CASE ASSEMBLY		1
40	P1039	. . RING, Retainer, pin		1
41	M1073	. . PIN, lock, gear		1
42	200016	. . STEM, Adjustment		1
43	AN6227-1	. . PACKING, Preformed		1
44	100143	. . SPRING, Compression		1
45	100050	. . GEAR, Setting, zero		1
46	300081	. . CASE		1

– Item not illustrated

Table 11. Figure 2 Parts List Tabulation

Item 1 Altimeter Indicator	Item 2 General Assembly	Item 4 Identification Plate	Item 5 Adjust-ment Knob	Item 20 Ten thousand-foot Pointer	Item 22 Altimeter Dial	Item 24 Barometric Dial Assembly
12002-0105	400025	100115	100045	13224	200015	A1680
12002-0106	400026	100116	100045	13224	200015	200059
12003	400028	100089	100045	21688	P2222	A1680
12003M	400029	100119	100045	21688	P2222	200059
12008-9	400062	100132	P1296	13224	200072	A1680
12008-13	400063	100132	P1296	13224	200072	200059
12009-1000	400056	19358	P1296	21689	P2012	A1618
12009-2000	400057	19356	P1296	21688	P2222	A1680
13502-0201	400027	100117	100045	200014	21053	A1680
13502-0202	400055	100156	100045	200014	21053	200059
13503	400030	100120	100045	21684	21053	A1680
13503M	400031	100121	100045	21684	21053	200059
13508-1	400058	100131	P1296	13224	200072	A1680
13508-5	400061	100131	P1296	13224	200072	200059
13522-1000	400064	100145	100045	200079	200078	A1680
13522-1100	400065	100146	100045	200079	200078	200059



Altimeter Mechanism Assembly (Exploded View)
Figure 3

FIG. ITEM	PART NUMBER	1234567 NOMENCLATURE	EFFECT FROM TO	UNITS PER ASSY	
3-1	400009	MECHANISM ASSEMBLY, Altimeter (Refer to figure 2 for NHA)		RF	
2	M1200	.PINION, Center		1	
3	A1325	.JEWEL BUSHING, Large (ATTACHING PARTS)		1	
4	COML	.SCREW, Socket set, cup point, 0-80 UNF-2Ax1/16 lg, sst ---*---		1	
5	200075	.PINION, Handstaff		1	R
6	COML	.PIN, Taper, clock, No. 3-1/2, brass		2	
7	P1191-2	.PIN, Bearing		2	
-8	300064	.SHAFT ASSEMBLY, Rocking		1	
9	100058	..COUNTERWEIGHT, Rocking shaft (ATTACHING PARTS)		1	
10	COML	..SCREW, Socket set, cup point, 2-64 UNF-2A x 1/8 lg, sst ---*---		3	
11	M1390-2	..PIN, Rocking shaft (ATTACHING PARTS)		1	
12	COML	..SCREW, Socket set, cup point, 2-64 UNF-2A x 1/8 lg, sst ---*---		RF	
13	F92-1660-12	..STOP NUT, Elastic		1	
-14	21784	..LINK ARM AND LINK SUBASSEMBLY (ATTACHING PARTS)		1	
15	COML	..SCREW, Socket set, cup point, 2-64 UNF-2A x 1/8 lg, sst ---*---		RF	
16	P1191-2	...PIN, Bearing		RF	
17	12374	...LINK, Mechanism		1	
18	21667	...ARM, Link		1	
19	100059	..COUNTERWEIGHT, Sector gear (ATTACHING PARTS)		1	
20	COML	..SCREW, Machine, hexhead 2-64 UNF-2A x 1/4 lg, brass ---*---		1	

- Item not illustrated

FIG. ITEM	PART NUMBER	1234567 NOMENCLATURE	EFFECT FROM TO	UNITS PER ASSY	
3-21	100144	..HAIRSPRING, Rocking shaft		1	
22	300079	..SHAFT SUBASSEMBLY, Rocking		1	
23	20030	.ANEROID ASSEMBLY (ATTACHING PARTS)		1	
24	COML	.NUT, Hex, 6-40 UNF-2Ax 7/64 thick brass		2	
		---*---			
25	200011	.PLATE ASSEMBLY, Gear (ATTACHING PARTS)		1	
26	COML	.SCREW, Machine, slotted, 82° flat head, 3-56 UNF-2Ax1/4 lg, sst		4	
		---*---			
27	COML	.PIN, Taper, clock No. 3-1/2		RF	
28	200086	.GEAR ASSEMBLY, Intermediate		1	
29	100142	.BUSHING, Jewel, large		1	
30	300052	.FRAME SUBASSEMBLY (Refer to figure 1.)		1	
31	COML	.NUT, Hex, DC, 2-64UNF-2B 1/16 thk x 3/16w, brs		1	R
32	M1323	.SCREW, pivot		1	R
33	100138	.JEWEL BUSHING ASSY		1	R
34	COML	.SCREW, Allen socket set, cup pt. 2-64 UNF-2A x 1/4 lg, sst		1	R
				1	R

- Item not illustrated

SIRS NAVIGATION LTD.

U8429

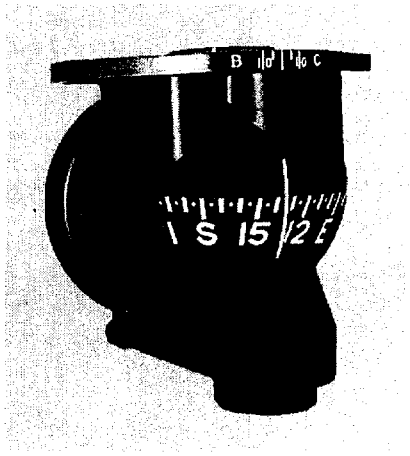
186A Milton Road, Swanscombe, Kent. DA10 ONN. England
Tel: +44 (0)1322-383672 Fax: +44 (0)1322-382418 email: sales@sirs.co.uk
website: www.sirs.co.uk

COMPONENT MAINTENANCE MANUAL WITH ILLUSTRATED PARTS LIST

STANDBY COMPASS

Type

KCA0101C*	KCA0104FY	KCA0112W
KCA0101W	KCA0105W	KCA0113W
KCA0102C*	KCA0106W	KCA0113 FY
KCA0102W*	KCA0107W	KCA0114W
KCA0104W	KCA0109W	WL1001KCA1
	KCA0110W	



This Manual supersedes in entirety, the previous documents published by Smiths Industries.
Codes indicated * are obsolete

ISSUE 10: January 2001

RECORD OF REVISIONS

REV. No.	ISSUE DATE	INSERTED		REV. No.	ISSUE DATE	INSERTED	
		DATE	BY			DATE	BY
1	JANUARY 1976		S.I.				
2	APRIL 1979		S.I.				
3	AUGUST 1984	SEPTEMBER 1984	S.I.				
4	FEBRUARY 1985	APRIL 1985	S.I.				
5	APRIL 1985	JUNE 1985	S.I.				
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Temp REV. No.	ISSUE DATE	INSERTED		REMOVED		PAGE No.
		DATE	BY	DATE	BY	

SERVICE BULLETIN LIST

SB/AEB	INCLUDED IN REVISION	DATE OF INCORPORATION	TITLE
34-180	2	NO EFFECT	EMBODIMENT OF MOD.01 FOR ALL MODELS EXCEPT KCA0109W
34-730	7	MAY 1988	EMBODIMENT OF MOD.02 FOR KCA0101W
34-731	7	MAY 1988	EMBODIMENT OF MOD.02 FOR KCA0104W
34-731	7	MAY 1988	EMBODIMENT OF MOD.02 FOR KCA0104FY
34-732	7	MAY 1988	EMBODIMENT OF MOD.02 FOR KCA0105W
34-733	7	MAY 1988	EMBODIMENT OF MOD.02 FOR KCA0106W
34-734	7	MAY 1988	EMBODIMENT OF MOD.02 FOR KCA0112W
34-735	7	MAY 1988	EMBODIMENT OF MOD.02 FOR KCA0113W
34-735	7	MAY 1988	EMBODIMENT OF MOD.02 FOR KCA0113FY
34-736	7	MAY 1988	EMBODIMENT OF MOD.02 FOR KCA0114W
34-737	7	MAY 1988	EMBODIMENT OF MOD.02 FOR WL1001KCA1

COMPONENT MAINTENANCE MANUAL
KCA***** & WL1001KCA1 Series

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INTRODUCTION

1. General

A. This manual is written to the ATA specification 100 and in AECMA simplified English. SI units of measurement are used with imperial units in parentheses.

B. The manual describes physical and technical issues concerning the compass and gives the necessary information to perform overhaul of the compass units listed on the title page.

C. This manual concentrates on compasses manufactured to a 'MOD.02' build level. MOD.02 compasses were introduced in 1988 and no MOD.01 compasses have been built since that date. All compasses overhauled by SIRS Navigation Ltd., are modified to MOD.02. It is strongly recommended that all MOD.01 compasses are modified to type MOD.02 when submitted for Repair/Overhaul. Where differences occur in this manual between the two MOD Levels, the initial information is for type MOD.02 and the variations are explained for MOD.01

D. The manual does not describe maintenance on the component when it is installed on the aircraft. The compass is a sealed unit and should be repaired by the manufacturer or an approved repair agent.

E. Only approved persons with the necessary skills must be used for the maintenance procedures described in this manual

F. This manual contains:
- Technical data for the component.
- Maintenance and repair procedures for the component.
- An Illustrated parts list (IPL) . Parts are identified in all sections of the manual by an IPL Figure and an item number.

G. The 'Disassembly', 'Testing', 'Fault Isolation' and 'Assembly Procedures' detailed within this manual have been verified by actual performance.

H. SIRS Navigation Ltd. Purchased, in 1994, all rights to the compass products from 'Smiths Industries'. All issues relating to the compass or this overhaul manual should be directed to SIRS Navigation Ltd.

2. How to use this manual

A. Make sure the manual contains the information applicable to your component. Look on the title page for the part number.

B. If you need to identify a part or find a part number refer to the IPL which has an introduction to detail the procedure

The instructions in this manual must be used for all the component maintenance. Read all the applicable WARNINGS and CAUTIONS before you work on the component.

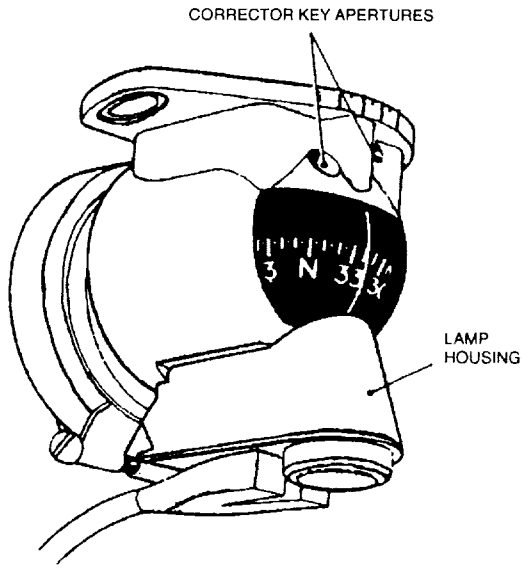
DESCRIPTION AND OPERATION

A. General

The standby compasses (fig.1) are self-contained magnetic units which provide a constant indication of aircraft heading. Usually mounted in the pilots field of vision, they are designed to be fitted at or above eye level.

Aircraft heading is read direct from a compass card against a vertical lubber line engraved on the inside of the compass bowl. The compass card is illuminated by a non-magnetic lamp through a coloured filter.

Magnetic correctors are fitted to enable errors, due to coefficients 'B' and 'C', to be corrected.



General View
fig. 1

The complete compass may be rotated on its fixing screws to correct errors due to coefficient 'A'.

B. Description.

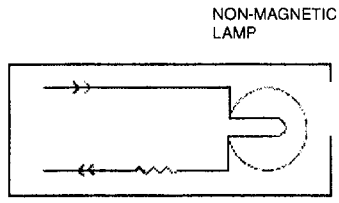
The compass card is of conic section with markings at intervals on the outside face. It is attached to a dome carrying a cobalt magnet and pivot. The pivot locates in a sapphire cup mounted in a stem assembly, which is secured to the compass bowl by a bracket.

The compass bowl forms the main body of the compass and is a transparent plastic moulding painted on the outside surface except for a clear portion at the front through which the compass card is viewed. A small translucent portion at the base allows the compass card to be illuminated.

The compass bowl is filled with silicone fluid to dampen the movement of the compass card. Bellows, clamped to the rear of the compass bowl, allow for expansion and contraction of the fluid due to changes in temperature and pressure.

A filling plug, disc and washer are located at the front of the compass bowl beneath the 'Horizontal Corrector Assembly' which includes a mounting plate with a scale in 5 deg increments engraved on the front edge to measure the coefficient 'A' correction. The horizontal correctors, for coefficients 'B' and 'C', consist of small bar magnets in the gear shafts of the corrector mechanism. Indicator lines on the end of the gear shafts identify the position of the magnets. Any rotation of the gear shafts can be seen on top of the mounting plate as an angular difference between the indicator lines and the associated index lines. The correctors are at the magnetic null, or neutral position, when the indicator lines and index lines are aligned. The correctors are adjusted by means of a key inserted into apertures in the front of the bowl. 'B' and 'C' engravings on the front edge of the mounting plate identify the apertures.

The lamp housing is a plastic moulding secured to the base of the bowl *(Compasses built to pre-MOD 02 standards have the Lamp Housing attached by four screws. MOD 02 compass are held in place by a clip action).* The D.C. supply is fed to the lamp via a lead and socket assembly which clips on to two connection pins on the underside of the lamp housing. The non-magnetic lamp fits into a lamp spring and is secured in position by a retaining cap. The lamp circuit is shown in fig. 2.



Lamp circuit
fig. 2

C. Operation

The compass 'Electrical Lead Assembly' (CE2-A26), should be connected to the aircraft electrical power supply before installation of the compass.

The compass should be installed into its correct position and secured using two suitable screws with a head diameter no greater than 6.9mm (0.27").

CAUTION: THE SECURING SCREWS SHOULD BE 'NON-MAGNETIC' AND MUST NOT BE OVERTIGHTENED.

IMPORTANT: REFERENCE SHOULD BE MADE TO THE INSTALLATION DRAWING FOR DETAILED INFORMATION CONCERNING THE COMPASS.

The compass requires no power to operate, other than that provided for illumination, and it will start to indicate a heading as soon as it is installed into its correct position.

The compass will need to be adjusted to compensate for magnetic deviations caused by the aircraft or local components or instruments. A correction procedure for this compass is described in detail in section 11001 of this manual.

D. Leading Particulars

Name:	Standby Compass		
Code:	Refer to title page		
Size:	57.2mm (2.25in) x 58.0mm (2.29in) x 52.4mm (2.07in)		
Weight:	0.113kg (4 oz) including lead and socket		
Electrical supply:	28V d.c. (except models: KCA0107W & WL1001KCA1 = 5V d.c.)		
Ambient Operating Temperature:	-40°C to 85°C (except models to MOD.01 = -40°C to 70°C)		
Value of resistor in lamp circuit:	KCA0104FY, KCA0104W, KCA0105W, KCA0106W and KCA0109W	330	Ω
	KCA0112W	820	Ω
	KCA0110W and KCA0114W	47	Ω
	KCA0113W and KCA0113FY	390	Ω
	WL1001KCA1, KCA0107W, KCA0101C, KCA0101W, KCA0102C and KCA0102W	None	

Testing & Fault Isolation

A. General

This section is arranged to identify and rectify those faults, which are likely to occur when the compass is in service.

NOTE: Whenever any adjustment, repair or component replacement has been carried out, the unit must be subjected to the complete series of tests* described within this section. *(* Other than the replacement of Lamp – 360)*

The magnetic tests detailed within this section that can be applied to the compass in service are to be used as a guide and for reference purposes only. Accurate magnetic tests can only be carried out within an approved magnetic test facility.

The faults most likely to occur in service are:

(i) Directional Error
(ii) Failure of illumination.
(iii) Slow Movement of the Compass Card
(iv) Fluid Loss/Air Bubble
(v) Magnetic Correction Problems

(i) Directional Error.

The compass may appear to have an incorrect heading. This may be due to one or a combination of the following problems.

a) Excessive Friction within the Compass preventing the card from rotating freely. (See 'para iii' to verify if this is the problem)
b) Magnetic error with the main compass magnet, mounted within the compass card
c) Magnetic error within the Corrector Assembly (160) (See 'para v' to verify if this is the problem)

(ii) Failure of illumination.

If the compass unit fails to illuminate, carry out the following procedure identified within figure 3.

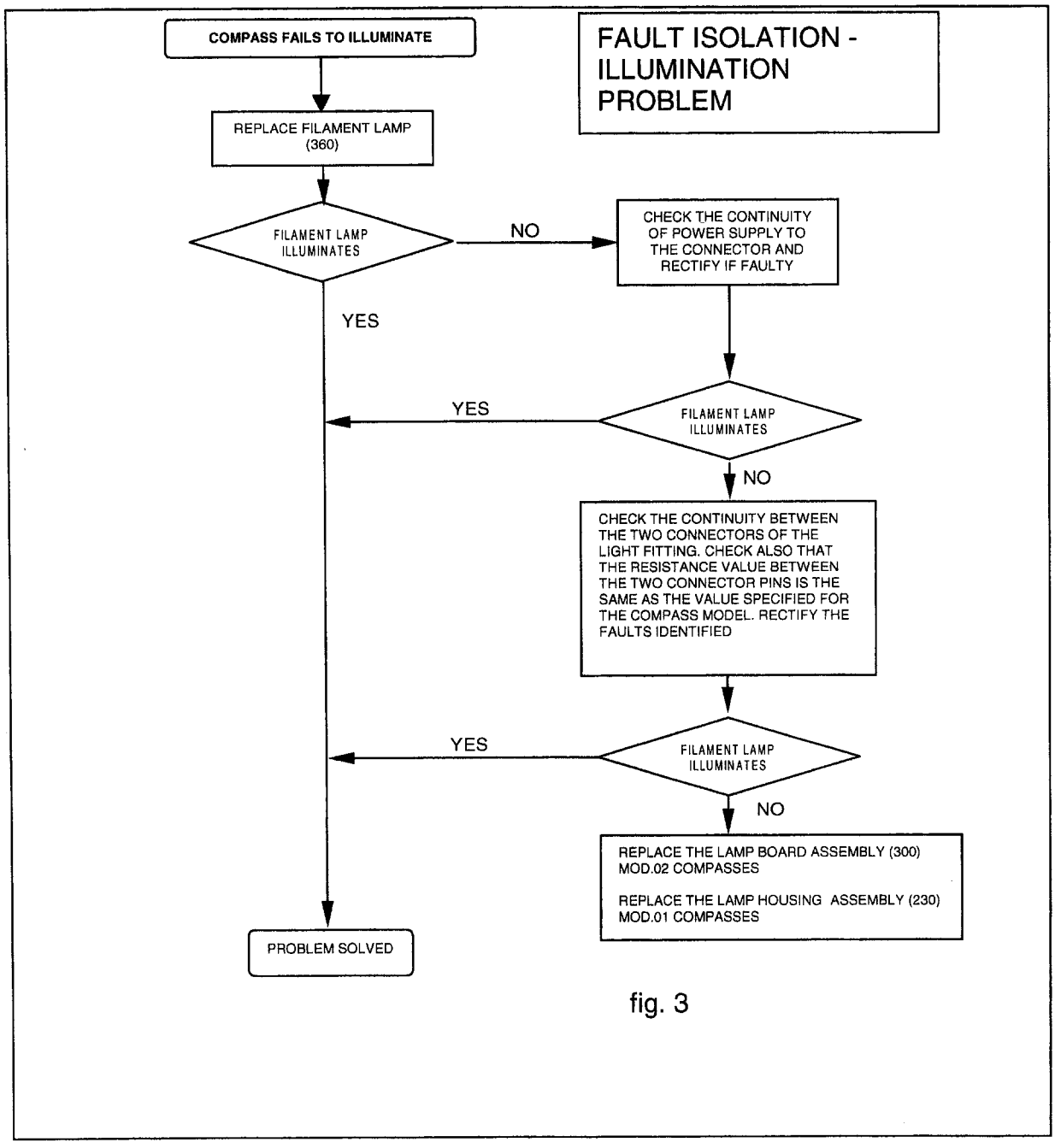

COMPASS FAILS TO ILLUMINATE
FAULT ISOLATION - ILLUMINATION PROBLEM
REPLACE FILAMENT LAMP (360)
FILAMENT LAMP ILLUMINATES
NO
CHECK THE CONTINUITY OF POWER SUPPLY TO THE CONNECTOR AND RECTIFY IF FAULTY
YES
YES
FILAMENT LAMP ILLUMINATES
NO
CHECK THE CONTINUITY BETWEEN THE TWO CONNECTORS OF THE LIGHT FITTING. CHECK ALSO THAT THE RESISTANCE VALUE BETWEEN THE TWO CONNECTOR PINS IS THE SAME AS THE VALUE SPECIFIED FOR THE COMPASS MODEL. RECTIFY THE FAULTS IDENTIFIED
YES
FILAMENT LAMP ILLUMINATES
NO
REPLACE THE LAMP BOARD ASSEMBLY (300) MOD.02 COMPASSES
REPLACE THE LAMP HOUSING ASSEMBLY (230) MOD.01 COMPASSES
PROBLEM SOLVED

fig. 3

iii Slow Movement of the Compass Card

This problem will be noticed as slow movement of the card assembly during minor alterations of the aircraft heading. The card may appear to be frozen in one position for small changes of aircraft heading.

To identify if the compass is faulty, the following procedure should be followed.

a) Remove the compass from the aircraft
b) Place the compass, in its normal operating attitude, on a non-magnetic stand or table in an area away from any magnetic disturbance.
c) Align the compass to a north facing position.
d) With the use of a small magnet, deflect the compass card by 5°, allow the card to settle and then remove the small magnet. The card should return to within 1° of the original heading.
e) Repeat this test for each main cardinal points
f) If the compass fails this test, the unit should be repaired or replaced.
g) If the compass passes this test, it is unlikely that there is a problem with the instrument and there may be a problem with a component located close to the compass that is magnetically affecting the compass.

(iv) Fluid Loss/Air Bubble

This problem will be noticed as the appearance of an air bubble within the bowl of the compass unit. It is unlikely that there will be evidence of fluid the outside of the compass, due to its evaporation.

The appearance of a small bubble does not render the compass inaccurate, but the compass unit should be repaired or replaced at the earliest opportunity.

The appearance of a large air bubble may render the compass inaccurate. The compass should always be repaired or replaced.

v) **Magnetic Correction Problems**

This problem will be noticed by a difficulty in correcting the compass unit once it has been installed within an aircraft and during the 'aircraft swing' procedure.

To identify if the compass may have 'magnetic correction problems', the procedure detailed below should be followed...

These tests are specified for guidance purposes only and do not relate exactly to the product test specification. The tests are not being carried out in an approved magnetic test facility and it is therefore considered that the results obtained will not be exact. The results will however indicate if there are any problems associated with the compass.

a) Remove the compass from the aircraft

b) Re-set the magnetic correctors to their neutral position*

** reference to the Installation Instructions, section 13000, is recommended before carrying out these tests*

c) Place the compass, in its normal operating attitude, on a non-magnetic stand or table in an area away from any magnetic disturbance.

d) Align the compass to a North facing position.

e) With the use of the Corrector Key (220), place the Key in Corrector hole 'C', engage the key with the shaft and rotate. The compass card should deflect as the Corrector Key (220) is rotated. The card will reach a maximum deflection on one side of North and it will then return through North and reach a maximum deflection on the other side of North, before returning to its original position. Note the deflection of the compass card while rotating the key. The card should deflect from North by 25 to 35°and the magnitude of deflection, either side of North should be approximately equal.

f) If the card deflection is within the tolerance band stated above, then the correction operation for North is within specification

g) Repeat this operation for the South heading. The maximum deflections recorded for the North and South positions should be close and within 5 degrees of each other.

h) Repeat this operation for the East and West positions but insert the key into the 'B' corrector Hole. The deflections recorded for East and West should be the same as specified for North.

i) If the compass fails this test, the correction facility is faulty and the unit should be repaired or replaced by the manufacturer or at an approved repair facility.

j) If the compass passes this test, it is unlikely that there is a magnetic correction problem.

Performance Testing

1. GENERAL

The following tests are those, which must be carried out after overhaul or whenever any component has been renewed or repaired (unless stated otherwise). They are also the only tests necessary to establish the serviceability of a standby compass.

Tests should be carried out in an area that has been approved for magnetic testing.

Unless otherwise stated, the tests must be done within these conditions:
Room temperature (15 to 25°C)

NOTE: The following magnetic conditions are those existing in Southern England. The performance at other locations may require amendment and should be determined.

Magnetic conditions-horizontal field intensity of 0.18 oersted attracting a North seeking pole toward the magnetic North and a vertical field intensity of 0.44 oersted attracting a North seeking pole downward.

Mounting plate horizontal and uppermost.

2. EQUIPMENT REQUIRED

Items 1 to 6,12 and 15 to 17 of section 9001 'SPECIAL TOOLS, FIXTURES AND EQUIPMENT'.

3. PROCEDURE

WARNING: DO NOT SUBJECT THE COMPASS TO A TEMPERATURE IN EXCESS OF +85°C *(OR +70°C. MOD.01 COMPASSES)*

A. Silicone Fluid

(1) Place the compass in the vacuum chamber standing the unit on its bellows. Place the vacuum chamber in the oven and maintain the temperature at 30°C for 4 hours, then reduce the pressure to 4 in. Hg absolute, for an hour, after which time return the pressure to normal.

(2) Remove the compass and examine the fluid; there must be no bubbles, sediment, cloudiness or discoloration. Also there must be no fluid leakage.

B. **Electrical**

(1) Remove the lamp retaining cap and lamp from the lamp housing.

(2) Using the insulation tester, check that the insulation resistance between the two connecting pins is not less than 20 megohms at 500 V D.C.

(3) Return the lamp and lamp-retaining cap to the lamp housing

(4) Connect the insulation tester between the two connecting sockets of the lead and socket assembly (310) and check that the insulation resistance is not less than 20 megohms at 500 V D.C.

NOTE: The following test should be carried out in a darkened room.

(5) Connect the lead and socket assembly to the connecting pins on the lamp housing and connect the 28 V or 5 V D.C. supply (dependant on unit type) to the lead.

(6) Switch on the supply and observe that the compass card markings and the lubber line are illuminated and clearly visible.

(7) Switch off and disconnect the supply.

C. **Temperature**

(1) Subject the compass to a temperature of between -38 and -42°C for three hours in the refrigerator.

(2) Remove the compass and allow it to return to room temperature; this will take approximately two hours.

(3) Ensure that there is no sign of cracks, fluid leakage, discoloration or bubbles within the compass.

(4) Place the compass in an oven and increase the temperature from room temperature to +85°C ± 2°C *(MOD 01 COMPASSES +70°C ± 2°C)*, at a steady rate for a period of four hours. Maintain this temperature for one hour.

(5) Repeat the procedures as detailed in paragraphs (2) and (3).

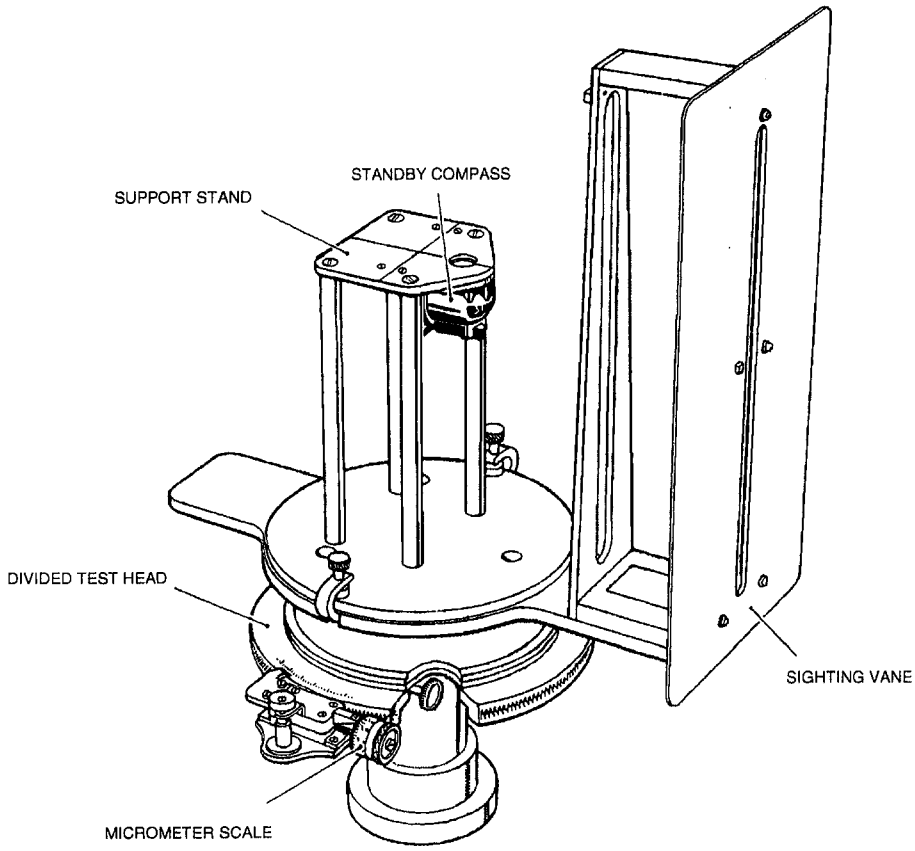
D. **Directional Errors** (Refer to fig.1001)

(1) Ensure that the 'B' and 'C' correctors are set to the neutral position i.e. the indicator lines are aligned exactly with the index lines.

NOTE: A misalignment of 0.25mm (0.010"), i.e. the width of an index line, will produce a deviation error in the compass of approximately 2.5 deg.

(2) Set the divided test head and its micrometer scale to zero.

(3) Place the standard magnetic needle on the sighting vane and, using the coarse and fine controls beneath the turn-table, align the sighting vane with the magnetic meridian.



Directional Error Test Jig
Fig. 1001

(4) Mount the compass in the support stand and place the support stand on the sighting vane. Viewing through the sighting vane, adjust the support stand until the lubber line is aligned with the magnetic meridian.
(5) Again viewing through the sighting vane, turn the test head to align the compass card cardinal headings with the lubber line and at each cardinal heading note the error from the divided test head scale.
(6) Ensure that:

(a) The individual errors obtained do not exceed 2°
(b) The algebraic sum of the errors N + S and E + W respectively do not exceed 5°.
(c) The algebraic difference of the errors N - S and E - W respectively do not exceed 5°.

E. **Time of Swing**

(1) Using the deflector magnets, deflect the compass card through 30°, maintaining the deflection for at least 10 seconds to allow the liquid to settle.

(2) Remove the deflector magnets to allow the compass card to return to its original reading. The time for the card to rotate back by 25° (to the 5° mark) should be between 1.4 to 1.8s.

F. **Friction Error**

(1) Using the deflector magnets, deflect the card through 5° deg and maintain the deflection for 10 seconds.

(2) Remove the deflector magnets and allow the compass card to settle. Record the settling position.

(3) Repeat (1) and (2) but deflect the compass card in the opposite direction. The angular difference between the two settling positions must not exceed 2.5°.

G. **Horizontal ('B' and 'C') Correctors**

(1) Ensure that all correctors are exactly at neutral.

(2) Align the lubber line with N on the compass card.

(3) Rotate the 'C' corrector through 90°, i.e. the indicator lines must be at 90° to the index lines.

(4) Record the deflection of the compass card.

(5) Repeat (3) and (4) but rotate the 'C' corrector in the opposite direction. Check that the compass card deflects not less than 25° from each side of the lubber line and that the difference between the two deflections does not exceed 4°. (Return the correctors to the neutral position)

(6) Align the lubber line with E on the compass card.

(7) Repeat the procedure detailed (1) to (5) inclusive but in this case rotate the 'B' corrector.

(8) Remove the support stand, with the compass attached, from the divided test head.

H. **Angle of Tilt**

(1) Mount the tilt stand, with the support stand and the compass attached, on the divided test head or any other level surface capable of being rotated through 360° in azimuth.

(2) Tilt the compass forward to an angle of 20° from the vertical. *(MOD 01 COMPASSES 18 deg.).*

(3) Slowly rotate the compass through 360° and observe that the compass card is free to rotate on its pivot.

J. **Parallax**

(1) Note the exact compass heading when viewed from directly in front.

(2) Without disturbing the compass, check that when released from 22.5°, left and right of the lubber line, the readings do not vary by more than 2.5° from that noted in (1).

DISASSEMBLY

1. GENERAL

The work should be carried out in a clean, dust free atmosphere, and absolute cleanliness of workbench, components and tools must be maintained throughout. Protect components as they are removed and observe the normal precautions regarding the correct use of tools and cleaning fluids.

During each overhaul a new bellows gasket (60), filling washer (200) and filling plug disc (210) must be fitted.

2. EQUIPMENT REQUIRED

Non Magnetic Screwdrivers, Clean Glass Container (up to 100ml).

3. PROCEDURE

A. Horizontal Corrector Assembly (160)

(1) Hold the compass in an upright position.

(2) Withdraw the four screws (170) securing the horizontal corrector assembly and mounting plate to the compass bowl (180) and remove the assembly.

B. Bellows Assembly (10)

(1) Unscrew the filling plug (190). Extract and discard the filling plug disc (210) and filling plug washer (200)

(2) Expel the fluid into a small, clean, glass container by gentle manipulation of the bellows. Seal the glass container and store in a cool, dry, dark place.

(3) Melt the solder locking the nut (40) and release the screw (30) securing the bellows retaining clip (20) to the compass bowl (180). Gently spring open the ends of the retaining clip and remove it from the compass bowl, together with the retaining clip packing piece (50). Remove the bellows (10) and the bellows gasket (60). Remove the compensating ring (70) (All codes except KCA0109W).

NOTE: If the bellows or bellows gasket adhere to the compass bowl, gently prise off, taking care not to damage the bellows or bowl seating.

(4) Discard the bellows gasket (60).

C. **Stem Assembly (80) and Compass Card (130)**

CAUTION: THE STEM ASSEMBLY AND THE COMPASS CARD ASSEMBLY ARE BOTH VERY DELICATE. TAKE CARE NOT TO DAMAGE THEM.

(1) Remove the two screws (90) securing the bracket of the stem assembly (80) to the compass bowl (180). Give support to the stem bracket during this procedure, as the assembly will tilt when the screws are released. This may damage the card assembly. Remove the stem assembly and compass card (130) from the compass bowl.

(2) Carefully lift the compass card from the stem assembly and store safely.

D. **Lamp Housing Assembly** (290)

(1) Unscrew the cap (370) and withdraw the bulb (360) from the locating spring.

(2) Unclip the lamp housing assembly (290) From the compass bowl and remove the assembly. *(MOD 01 COMPASSES, Remove the four screws (240 & 250)*

E. **Lead and Socket Assembly** (380)

NOTE: This item does not sub-divide into any individual components. The item may not always be returned with the compass for repair as it may be attached to the aircraft.

CLEANING

Items required to assist with the cleaning procedures are detailed within fig 4001 below.....

Nomenclature	Vendor
Silicone fluid (Viscosity 3 cs ± 10%).	SIRS Navigation Ltd, 186a Milton Road, Swanscombe, Kent. DA10 0NN
Electrical Cleaner (Ambersil FE10) NATO Code: 6850-99-6636478 Grease (DTD 5598 or Castrol LM)	Commercially available

Cleaning Agents
fig. 4001

1. PROCEDURE

WARNING: CERTAIN CLEANING FLUIDS ARE FLAMMABLE AND TOXIC.

A. Stem Assembly (80)

(1) Wash in Electrical Cleaner and dry in a jet of clean, dry air.

(2) Polish the sapphire cup using peg wood.

B. Horizontal Corrector Assembly (160)

(1) Spray Gear Components with Electrical cleaner.
(Avoid Electrical Cleaner contact with the label)

(2) Dry in a jet of clean, dry air.

(3) Lightly lubricate the corrector gear spindles with grease.

C. **Lamp Housing** (290)

(1) Clean the lamp housing components and circuit board (MOD.02) with a lint-free cloth moistened with Electrical Cleaner.

(2) Dry with a jet of clean, dry air.

D. **Compass Bowl** (180)

CAUTION: DO NOT USE ANY SOLVENT BASED CLEANING FLUIDS TO CLEAN THE COMPASS BOWL, THE SOLVENT WILL DAMAGE THE PLASTIC MATERIALS USED FOR THE COMPASS CONSTRUCTION.

(1) Wipe the bowl clean with a dry, clean, lint-free cloth. If excessively dirty, use a solution of mild detergent and warm water. The bowl should then be rinsed and dried with a clean, dry air jet.

E. **Compass Card Assy** (130)

This item will be covered with a film of silicone fluid. It is not advisable to carry out a specific cleaning operation as this may damage the card. It should be stored in a container of clean 'Silicon fluid' until required for use.

F. **Components**

The remaining components should be carefully cleaned in a solution of mild detergent and warm water. The components should be rinsed then dried with a clean, dry air jet.

INSPECTION / CHECKS

1. GENERAL PROCEDURE

The following procedures also apply to new components. Additional inspection necessary is given in paragraph 3.

A. All Components

Examine, as applicable, for:

(1) Cleanliness.
(2) Distortion.
(3) Cracks (visual unless otherwise stated).
(4) Corrosion, including deterioration of protective finish.
(5) Scores.
(6) Dents.
(7) Evidence of wear (visual unless otherwise stated).
(8) Serviceability of items not disassembled.

B. Electrical Components

Examine for:

(1) Deterioration of wiring and insulation.
(2) Security of all connections, soldered or otherwise.
(3) Evidence of overheating.

2. EQUIPMENT REQUIRED

Items 18 and 21 of 'SPECIAL TOOLS, FIXTURES AND EQUIPMENT'. (section 9001)

3. DETAILED PROCEDURE

A. **Compass Bowl** (IPL item 180)

(1) Examine carefully for cracks, distortion, stripped threads or any other damage.

(2) Check the bowl for optical clarity at the point where the light from the lamp shows through.

(3) If unserviceable, replace the bowl.

B. **Stem Assembly** (80)

(1) Using a binocular microscope carefully examine the Sapphire bearing cup on the Stem Assembly (80). The cup must be free from cracks, flaws or any other damage. The junction between the sapphire and the cup holder at the bottom of the conical section should be free from burrs or contamination.

(2) Using the microscope, examine the sloping inner surface of the cupholder for cracks, scores and other damage.

(3) Replace the Stem Assembly (80) if the item is deemed unserviceable.

C. **Compass Card Assembly** (130)

(1) Examine the card carefully for distortion and check the security of the cobalt magnet.

(2) Using the microscope, examine the pivot for wear. The tip of a pivot in good condition will have a spherical radius of 0.13mm (0.005"). The tip of the pivot should not show any sign of wear.

(3) Replace the compass card if it is damaged or distorted. If the pivot is worn, replace as described in the section REPAIR - (section 6001).

D. **Lamp Housing Assembly** (290)

(1) Observe that the spring is captive and undistorted.

(2) Check that the coloured filter is captive within its holder and that it is not damaged or cracked.

(3) Using an ohmmeter, check that the value of the resistor relative to the compass type is correct. See fig. 5001

330 ± 33 ohms:	KCA0104W, KCA0105W, KCA0109W, KCA0104FY, KCA0106W	Fig. 5001
820 ± 82 ohms:	KCA0112W	
390 ± 8 ohms	KCA0113W, KCA0113FY	
47 ± 4.7 ohms	KCA0110W, KCA0114W	
Compass WL1001KCA1 does not have a resistor.		

(4) If the spring, filter or resistor is unserviceable, replace the Lampboard assembly as described in section 'REPAIR' Pages 6001 onward *(MOD.01 replace the complete Lamphousing Assembly - 230)*

E. Horizontal Corrector Assembly (160)

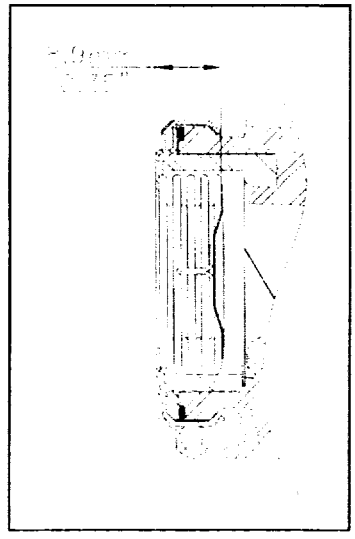
(1) Using the corrector key, rotate the corrector mechanisms two or three turns; they must turn smoothly but with sufficient inherent friction to prevent them being disturbed by shock or vibration.

(2) An unserviceable corrector mechanism must be renewed.

F. Bellows Assembly (10)

(1) The depth of the Bellows should be 8.9mm (0.35") as shown in fig. 5002. If the dimension is different, rectify as specified in the 'Repair' section.

(2) Check the condition of the paintwork of the bellows, particularly for signs of blistering or flaking.



Depth of bellows
Fig. 5002

G. **Paintwork**

(1) Inspect all paint for signs of peeling or blistering.

(2) Renew paintwork where necessary as described in 'REPAIR'.

H. **Silicone Fluid**

(1) If there are signs of cloudiness, sediment or discoloration, discard the fluid.

(2) If the fluid is clean and clear, place it in a suitable container and reduce it to a temperature of -40°C in a refrigerator. Discard the fluid if it appears cloudy at this temperature.

REPAIR

1. GENERAL

Faulty parts should be replaced by approved spares, only after inspection for serviceability. These spare components are available from SIRS Navigation Ltd.

After any component has been renewed or repaired, carry out the full procedure as detailed in the section TESTING unless stated otherwise.

Electrical connections should be made with approved solder using the smallest amount necessary to achieve an efficient joint.

Material	Supplier	Required For
Paint, air drying - matt black Code L481	SIRS Navigation Ltd	Compass Bowl. All Models except type KCA0106W
Paint, air drying - grey, Code L481G	SIRS Navigation Ltd	Compass Bowl. Model type KCA0106W
Paint, White Enamel	Commercially available	Lubber Line on Compass Bowl
White Spirit	Commercially available	Lubber Line on Compass Bowl

Materials, Figure 6001

1. PROCEDURE

A. Card Assembly (130)

There is no repair procedure specified for this item. It is recommended that a new Card Assembly is fitted if a problem exists. The new card assembly will be supplied magnetised to the correct level and balanced.

B. Lamp Housing Assembly (290)

If components within the lamp housing assembly (290) are faulty, a new Lampboard Assembly (300) will be required *(MOD.02 only*)*. The existing assembly can be removed by pushing up the connection pins and threaded boss through the plastic moulding. The replacement item is fitted in the reverse way. It may be useful to gently open the moulding at the entry face to allow easier entry of the Lamp board assembly.

** For Pre MOD.02 compasses, the complete LampHousing Assembly should be replaced*

C. Bellows (10)

If the depth of the bellows is less than 8.9mm (0.35"), extend the dimension by running a suitably tapered piece of peg wood round the outer convolutions. If the dimension is greater, gently compress the assembly until the correct dimension is achieved.

D. Paintwork

CAUTION: ON NO ACCOUNT SHOULD CLEANSING FLUIDS OR PAINT THINNERS BE ALLOWED TO CONTACT THE BOWL.

DO NOT SUBJECT THE BOWL TO TEMPERATURES IN EXCESS OF 85°C.

(1) **Compass Bowl** (180)

Retouch where necessary with the specified paint and dry in the electric oven at +85°C for a period of 1 hour or Air Dry for 12 hours.
(Pre MOD.02 Compasses +70° C for 1.5 hours)

(2) **Lubber line**

(a) If necessary, remove original paint by careful use of White Spirit

(b) Using a pointed piece of peg wood or suitable alternative apply the appropriate paint to fill the lubber line groove, remove any excess paint with a cloth impregnated with white spirit.

(c) Dry in the electric oven at +85°C for a period of 1 hour or Air Dry for 12 hours
(Pre MOD.02 Compasses +70° C for 1.5 hours)

ASSEMBLY

1. GENERAL PROCEDURE

The work should be carried out in a clean, dust free atmosphere and in an area free from magnetic interference. Absolute cleanliness of workbench, components and tools must be maintained throughout.

Precautions must be taken when using electrical equipment in the vicinity of the divided test head KTQ-0121. Also, the movement of items constructed of ferrous materials should be avoided.

During each overhaul a new bellows gasket, filling washer and filling plug disc must be fitted.

2. EQUIPMENT REQUIRED

Items 1 to 10, 13, and 15 to 20 of section 9001 'SPECIAL TOOL, FIXTURES AND EQUIPMENT'.

Materials

Material	Supplier	Required For
Silicone fluid (viscosity 3 centistokes 10%)	SIRS Navigation Ltd	Compass Bowl Fluid
Balancing paste 9415	SIRS Navigation Ltd	Compass Card
Balancing paste thinners, 8590X1	SIRS Navigation Ltd	Balancing Paste
Filter paper, 234/0337-10	SIRS Navigation Ltd	Silicone Fluid
Electrical Cleaner (Ambersil FE10) NATO Code: 6850-99-6636478	Commercially available	Soldered Joints
60/40 cored solder		Soldered Joints
Vibratite VC3	SIRS Navigation Ltd	Thread Locking where specified

Fig.7001

3. PROCEDURE

A. Magnetising the Compass Card (130)

The compass card will already be magnetised by the manufacturer to the correct value.

If a repair agent specifically wishes to re-magnetise the card, specific instructions can be supplied by SIRS Navigation Ltd including information concerning the latest equipment available.

B. Balancing the Compass Card

NOTE: The compass card is balanced during manufacture so that the N-S axis dips 1 ± 1 deg at its North-seeking end, i.e. S on the card. This condition applies to latitude 51 deg North where the vertical force of the Earth's magnetic field is 0.44 oersted. The E-W axis of the card should be horizontal ± 1 deg.

(1) Using the bubble protractor and the magnetic needle, adjust the balancing bowl 3254 LMT to the angle required for the latitude concerned i.e. the angle to which the card should balance.

(2) Fill the bowl with alcohol. Invert the compass card in the alcohol to prevent air being trapped in the dome. With the compass card still submerged, turn it upright and locate the Using the bar and adjustable pointer, check the level of compass card.

(3) Using the bar and adjustable pointer, check the level of compass card. If the compass card is not level with the rim of the balancing bowl note the 'high' spot and carry out the procedure detailed in 3.B. (4 to 6).

If the balance is satisfactory, carry out the procedure detailed in 3.B. (4) and (7) then continue with procedure 3.C.

(4) Remove the compass card from the balancing bowl and dry thoroughly in a jet of clean, dry air.

(5) Apply a small quantity of the approved balancing paste to the inner face of the compass card at the 'high' position. Surface dry with a jet of clean, dry air.

(6) Repeat the procedure described in 3.B. (3 to 5) until the card is correctly balanced.

(7) Accurately weigh the compass card; the dry weight must not exceed 2.8g.

C. Checking the Heading Errors (Refer to fig. 7002)

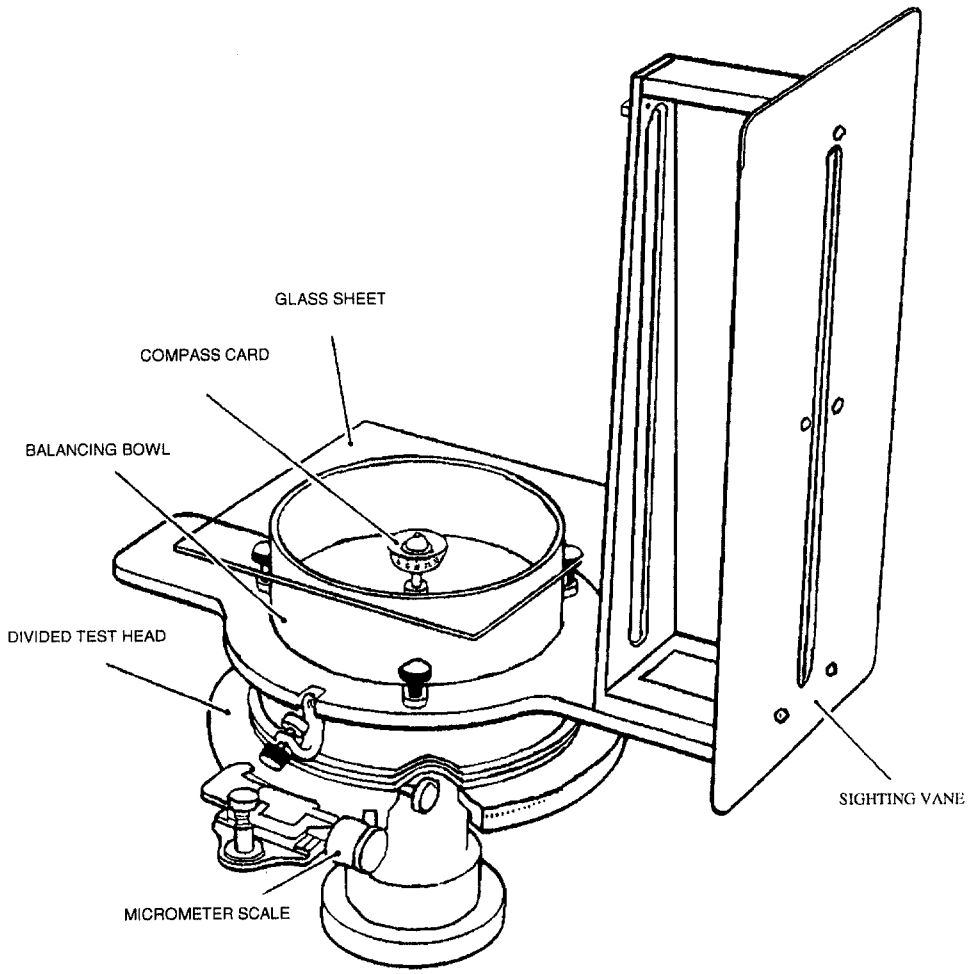
(1) Place the balancing bowl on the sighting vane attached to the divided test head.

(2) Exactly centralise the stem sapphire over the centre line engraved on the lower limb of the sighting vane and clamp the bowl firmly in position.

CAUTION: THE BOWL MUST NOT BE DISTURBED DURING THE FOLLOWING PROCEDURE.

(3) Set the micrometer scale on the test head to zero. Using the standard magnetic needle 3252 LMT placed diametrically across the bowl, align the sighting vane with the magnetic meridian, adjusting the coarse and fine controls beneath the test head turn-table.

(4) Place the compass card in the balancing bowl and cover the bowl with a sheet of glass.



Checking heading errors
Fig. 7002

(5) Rotate the test head very slowly to align each of the four cardinal points, in turn, with the sighting vane. Note the test head reading at each heading; the error must not exceed ± 1°. If the headings are not within these limits the card assembly should be replaced.

D. Stem Assembly (80) and Compass Card (130)

(1) Position the bracket of the stem assembly in the compass bowl (180) and secure with two non-magnetic screws (90).

(2) Place the sapphire checking plate 3256 LMT on top of the compass bowl with the aperture nearest the front of the compass. Secure the sapphire checking plate with the two knurled screws.

(3) Illuminate the inside of the compass bowl and view through the aperture in the sapphire checking plate, observing that the bearing cup in the stem sapphire is aligned with the aperture. If it is not, carefully bend the vertical stem of the Stem Bracket Assembly with a pair of small pliers until it is so.

(4) Unscrew the two knurled screws securing the sapphire checking plate to the compass bowl and remove the plate. Unscrew the two screws (90) securing the bracket of the stem assembly to the compass bowl and remove the stem assembly.

(5) Place the compass card in position on the stem and insert the assembly into the compass bowl. Secure with two non-magnetic screws (90).

(6) Ensure the compass card can rotate freely within the compass bowl.

(7) Note the exact compass heading when viewed from directly in front.

(8) Without disturbing the compass check that when viewed from 22 1/2°, left and right of the lubber line, the readings do not vary by more than 2.5° from that noted in (7).

If the value exceeds the specification limits described, re-examine the central location of the Stem Assembly.

E. Bellows Assembly

NOTE: The bellows gasket (60) should be soaked in silicone fluid for a period of 1 hour prior to assembly.

CAUTION: Do not damage the bellows gasket with sharp edges of the assembly components.

(1) Place the compensating ring (70) (*all codes except KCA 0109W*) and a new bellows gasket (60) in their recesses in the rear of the compass bowl (180). See figure 5002.

(2) With the lug in the centre of the bellows facing outwards, position the bellows on the rear of the compass bowl.

(3) Place the bellows retaining clip (20) in position, with the ends lowermost.

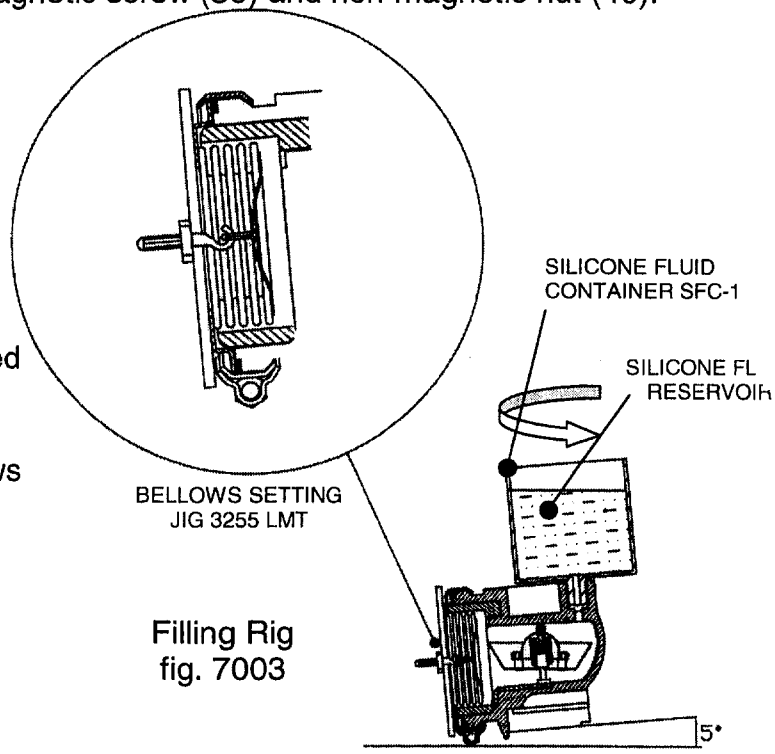
(4) Insert the retaining clip packing piece (50) under the ends of the clip and secure the clip with the non-magnetic screw (30) and non-magnetic nut (40).

NOTE: When assembled, the gap between the ends of the Bellows retaining clip must be not less than 0.8 mm (1/32")

F. Filling (Refer to fig.7003)

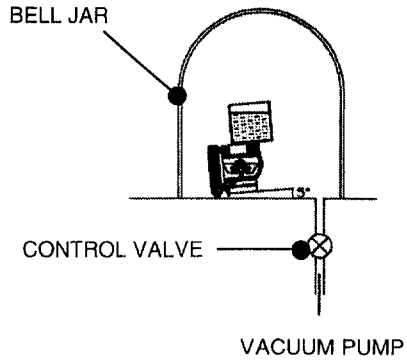
NOTE: The process should be carried out at a temperature of 20°C ± 2°C

(1) Fit the hooked rod of the bellows setting jig 3255 LMT to the lug on the bellows diaphragm.



Filling Rig
fig. 7003

The equipment detailed is an example of a 'Filling Rig' that may be used. Alternative similar facilities may also be permissible. SIRS can provide technical support with this issue.



(2) Place the distance-piece, given in the table fig. 7004, between the jig and the bellows diaphragm. The distance represents the dimension shown in fig.5002

Fluid temperature (°C)	Length of distance-piece
20	8.9mm (0.350")

fig.7004

(3) Screw the knurled nut on to the hooked rod until the distance piece is lightly gripped between the diaphragm and the jig bar.

NOTE: The following procedure is specified as a guide to explain one method to fill the compass bowl and de-gass all soluble air. Other methods are suitable providing the vacuum levels and durations are maintained. Specialist advice is available from SIRS Navigation Ltd.

(4) Assemble the 'Silicone Fluid Container' to the compass bowl by screwing the container into the filler plug hole.

(5) Place the assembly into a vacuum chamber and fill the container with 35ml of clean silicone fluid. The bowl should be inclined at an angle of 5° to the horizontal, to help allow the air bubbles to escape.

(6) Reduce the pressure of the Vacuum chamber to 2 in Hg for a period of approximately 30 seconds. This will remove the majority of the air within the compass.

(7) Allow the pressure to return to the atmospheric level and add some more fluid to the container to ensure that the filler plug hole is always covered.

(8) Reduce the pressure of the Vacuum chamber to 2 in Hg for a period of approximately 1.5 hours to remove the remainder of the soluble air.

(9) **NOTE:** The following procedure must be carried out in the shortest possible time.

Immediately after opening the vacuum chamber unscrew the 'silicone fluid container', ensuring that the filler plug hole remains full of fluid. Fit the filling washer (200), filling plug disc (210) and filling plug (190) using the torque screwdriver tighten the filler plug with a torque of 2880 gf/cm (40 ozf).

CAUTION: ONLY A PLASTIC FILLER PLUG MUST BE USED. ANY OTHER MATERIAL MAY CAUSE DAMAGE TO THE BOWL.

Remove the setting jig and return the compass to the vacuum chamber, standing the instrument on its bellows.

(10) Subject the compass to a vacuum of 4 in Hg absolute for 20 minutes. Observe that no bubbles appear in the fluid. If any bubbles do appear, remove the filling plug, plug disc and plug washer and repeat the procedure described at the beginning of this section.

(11) If the fluid is satisfactory, lock the threads of the nut (40) and screw (30) securing the bellows retaining clip (20) using the approved multicore solder.

G. **Horizontal Corrector Assembly** (160)

NOTE: APPLY VIBRATITE VC3 TO THREADS OF THE FOUR SCREWS (170) AND SPREAD COMPLETELY AROUND THE THREADS. ALLOW TO DRY COMPLETELY BEFORE ASSEMBLY (APPROXIMATELY ONE HOUR). WHEN DRY, THE THREADS OF THE SCREWS SHOULD BE AT LEAST HALF FILLED.

(1) Position the horizontal corrector assembly on top of the compass bowl and secure with four non-magnetic screws (170).

(3) Using the corrector key, set the 'B' and 'C' correctors at neutral.

H. **Lamp Housing Assembly** (230)

(1) Position the lamp housing (230) on the base of compass bowl and clip-on. *(MOD 01 Compasses, fasten in place with 4 screws 240 & 250)*

(2) Insert the bulb (350) into the retaining spring and fit the cap (370).

J. **Lead and Socket Assembly** (380)

(1) Fit a new lead and socket assembly (380).

K. **Testing**

(1) Carry out the full procedure on the compass as described in TESTING pages 1001 onwards.

SPECIAL TOOLS, FIXTURES AND EQUIPMENT

1. GENERAL

Items with an LMT part number are for local manufacture. Full manufacturing information for these items may be obtained from SIRS Navigation Ltd. When requesting information, please quote the part number. Precautions must be taken when using electrical equipment in the vicinity of the divided test head. Also the movement of items constructed of ferrous materials should be avoided during the testing of a compass. Throughout overhaul and repair, observe absolute cleanliness of workbench, tools and equipment. The procedure in TESTING should be carried out at a temperature between 15 and 25°C.

2. ELECTRICAL SUPPLIES

5 or 28 V D.C

Tools, Fixtures and Equipment – Next page

3). TOOLS, FIXTURES AND EQUIPMENT

Item	Description	Part No. or Ref.	Vendor
1	Divided test head	KTQ-0121	SIRS Navigation Ltd, 186a Milton Road, Swanscombe, Kent, DA10 0NN
2	Sighting vane adapter	KTQ-0122	
3	Tilt stand adapter D	KTQ-0124	
4	Support stand adapter E	KTQ-0125	
5	Corrector key	CE2-40	
6	Standard Magnetic Needle	3252 LMT	
7	Balancing bowl	3254 LMT	
8	Bellows setting jig	3255 LMT	
9	Sapphire checking plate	3256 LMT	
10	Filling Rig	3257 LMT	
11	Ohmeter		Commercially Available
12	Insulation tester (500 V d.c. 20MΩ)		
13	Vacuum chamber. Capable of maintaining 2 in Hg absolute. Minimum internal dimensions 305mm cube.		
14	Peg wood stick		SIRS Navigation Ltd

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Item	Description	Part No. or Ref.	Vendor
15	Electric oven. Capable of maintaining an even +85°C. Minimum internal dimensions 300mm cube.		Commercially Available
16	Refrigerator. Capable of maintaining an even -40°C. Minimum internal dimensions 305mm cube. Bubble protractor		
17	Deflector magnets. Two small bar magnets with the same dimensions.		
18	Vernier gauge		
19	Torque screwdriver. Capable of applying 445 gf/cm (40 ozf in).		
20	Variac, (variable transformer)		
21	Binocular microscope (X 30 magnification)		

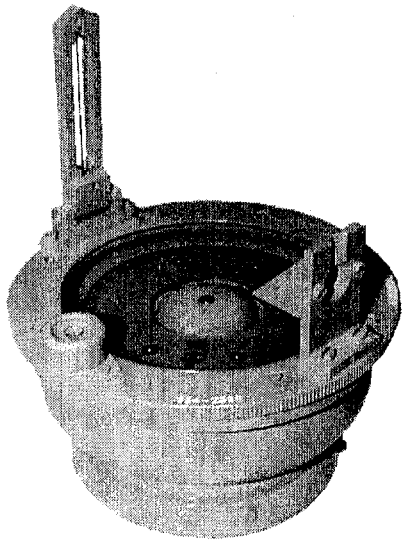
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SPECIAL TOOLS REQUIRED FOR COMPASS ADJUSTMENT

Once the compass is installed, the instrument should be adjusted to compensate for the magnetic interference from the aircraft or local components. The procedure to adjust the compass is described within section ' Special Procedures', section 11001 onwards.

To carry out the compass adjustment the following tools are recommended:

PART NUMBER	DESCRIPTION	SUPPLIER	PAGE BLOCK WHERE USED	REQUIRED/ RECOMENDED	COMMENTS
CE2-40	CORRECTOR KEY	SIRS NAVIGATION LTD	11001	REQUIRED	SUPPLIED WITH NEW COMPASS, BUT ALSO AVAILABLE AS A SPARE ITEM
954-2399	STANDARD COMPASS FOR 'COMPASS SWING'	SIRS NAVIGATION LTD	11001	RECOMENDED	SEE FIG 9001 *A SPECIAL NON-MAGNETIC TRIPOD SHOULD ALSO BE USED WITH THIS COMPASS.*



STANDARD COMPASS
FOR 'COMPASS SWING'
Type: 954-2399

Fig. 9001

COMPONENT MAINTENANCE MANUAL
KCA*** & WL1001KCA1 Series**

STANDBY COMPASS
ILLUSTRATED PARTS LIST

WARNING: ONLY SPARES AND COMPONENTS SPECIFIED BY SIRS NAVIGATION SHOULD BE USED.

NOTE:

ORDERING

Certain spare parts listed in the IPL are manufactured by other contractors and have the manufacturer's number or British Standards reference quoted in addition to the part number under which SIRS Navigation supply.

When ordering from SIRS Navigation please quote the SIRS part number, the other manufacturers number or British Standards reference and the code number of the LRU, on all orders of enquiries.

When ordering from other manufacturers please quote the manufacturers and / or British Standards reference only.

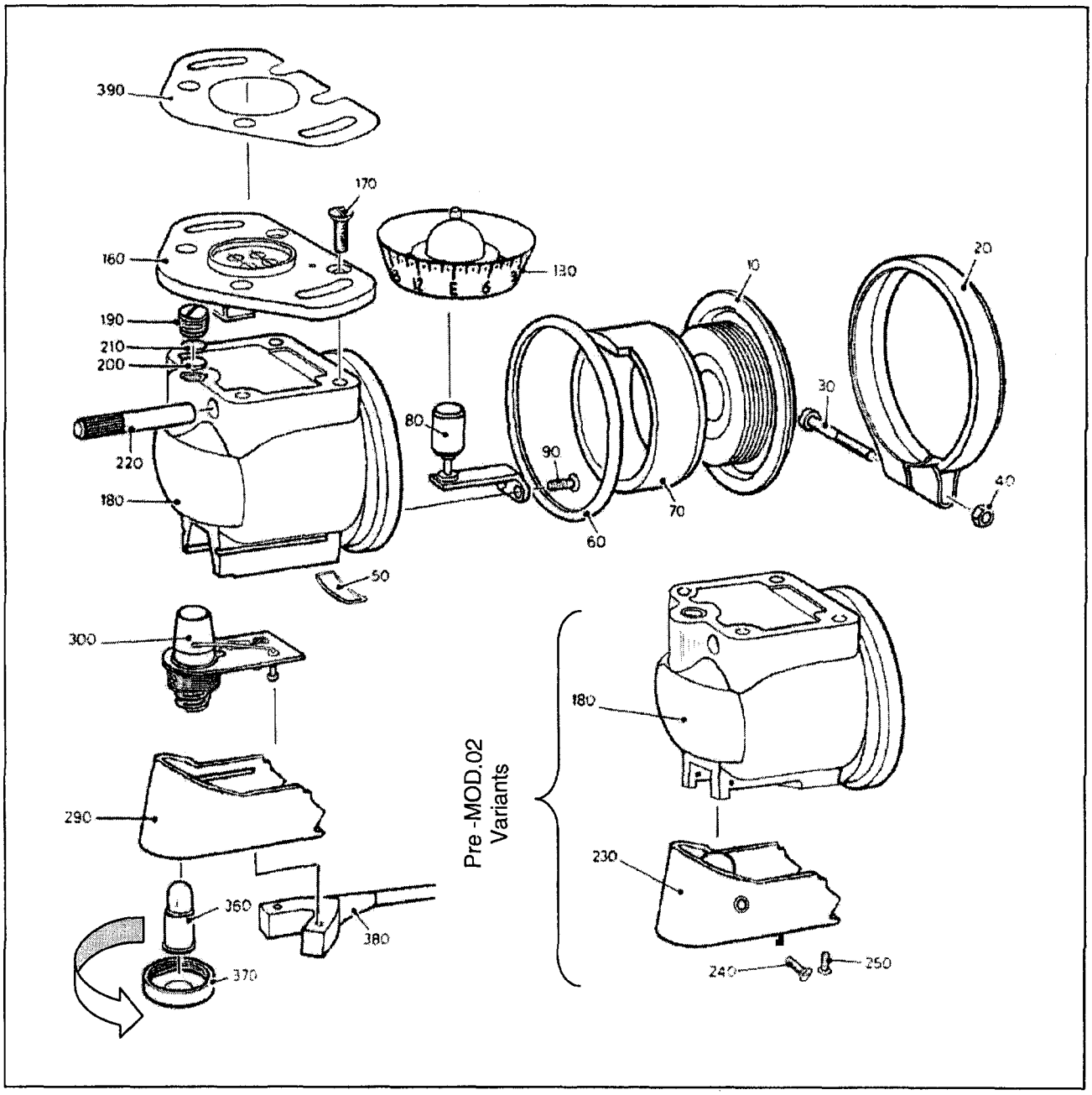
GENERAL

The illustrated parts list provides information and identification of replaceable parts and assemblies of units covered by this manual. The information consists of a vendor's code list, a detailed parts list and a numerical index. The abbreviation used for British Associated screw threads is – BA.

NOTE: It is strongly recommended that MOD.01 compasses are upgraded to build level MOD.02 during a Repair or Overhaul operation. The additional components required for this conversion are shown in fig. 10001 below.

Item	Description	Qty		Item	Description	Qty
70	Compensating Ring	1		300	Lampboard Assembly	1
130	Card Assembly	1		390	Label	1
180	Bowl	1				
290	Housing	1				

fig. 10001



Spares Details
Fig. 10002

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KCA***** & WL1001KCA1 Series

FIG. ITEM	PART NUMBER	AIRLINE PART NUMBER	INDENT	NOMENCLATURE	USAGE FROM TO	UNITS PER ASSY.
1-						
-1A	KCA0101C		1	OBSOLETE	A	-
-1B	KCA0102C		1	OBSOLETE	B	-
-1C	KCA0102W		1	OBSOLETE	C	-
-1D	KCA0107W		1	COMPASS (MOD 01)	D	RF
-1E	KCA0109W		1	COMPASS (MOD 01)	E	RF
-1F	KCA0110W		1	COMPASS (MOD 01)	F	RF
-1G	KCA0101W		1	COMPASS (MOD 01, 02)	G	RF
-1H	KCA0104W		1	COMPASS (MOD 01, 02)	H	RF
-1J	KCA0104FY		1	COMPASS (MOD 01, 02)	J	RF
-1K	KCA0105W		1	COMPASS (MOD 01, 02)	K	RF
-1L	KCA0106W		1	COMPASS (MOD 01, 02)	L	RF
-1M	KCA0112W		1	COMPASS (MOD 01, 02)	M	RF
-1N	KCA0113W		1	COMPASS (MOD 01, 02)	N	RF
-1P	KCA0113FY		1	COMPASS (MOD 01, 02)	P	RF
-1Q	KCA0114W		1	COMPASS (MOD 01, 02)	Q	RF
-1R	WL1001KCA1		1	COMPASS (MOD 01, 02)	R	RF
10	CE2-A124		2	BELLOWS	D-K, M-R	RF
10A	CE2-A124G		2	BELLOWS (Grey)	L	RF
20	CE2-A122		2	CLIP, BELLOWS RETAINING	D-K, M-R	1
20A	CE2-A122G		2	CLIP, BELLOWS RETAINING (GREY)	L	1
30	910012		2	SCREW, 6BA x 7/8 IN. LG. CH/HD. BRASS CAD.PLATE	D-R	1
40	920006		2	NUT, 6BA BRASS CAD.PLATE	D-R	1
50	CE2-44		2	PIECE, PACKING	D-R	1
60	CE2-110		2	GASKET, BELLOWS	D-R	1
70	CE2-109		2	RING, COMPENSATING	D-R	1
80	CE2-A126		2	STEM ASSEMBLY	D-R	1
90	910210		2	SCREW, 8BA x 7/32 IN. LG. C'SK/HD. NICKEL SILVER	D-R	2
130	CE2A127		2	CARD ASSEMBLY, (WHITE LEGEND)	D-R	1

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FIG. ITEM	PART NUMBER	AIRLINE PART NUMBER	INDENT	NOMENCLATURE	USAGE FROM TO	UNITS PER ASSY.
130A	CE2A128		2	CARD ASSEMBLY, (FLUORESCENT YELLOW LEGEND)	JP	1
160	CE2A36-1		-	CORRECTOR ASSEMBLY, HORIZONTAL - OBSOLETE	-	-
160A	CE2-A41		2	CORRECTOR ASSEMBLY, HORIZONTAL	G	1
160B	CE2-A37		-	CORRECTOR ASSEMBLY, HORIZONTAL - OBSOLETE	-	-
160C	CE2-A43		-	CORRECTOR ASSEMBLY, HORIZONTAL - OBSOLETE	-	-
160D	CE2-A22		2	CORRECTOR ASSEMBLY, HORIZONTAL (PRE-MOD 02)	H	1
160E	CE2-A51		2	CORRECTOR ASSEMBLY, HORIZONTAL (PRE-MOD 02)	K	1
160F	CE2-A59		2	CORRECTOR ASSEMBLY, HORIZONTAL (PRE-MOD 02)	E	1
160G	CE2-A60		2	CORRECTOR ASSEMBLY, HORIZONTAL (PRE-MOD 02)	D	1
160H	CE2-A67		2	CORRECTOR ASSEMBLY, HORIZONTAL (PRE-MOD 02)	M	1
160J	CE2-A69		2	CORRECTOR ASSEMBLY, HORIZONTAL (PRE-MOD 02)	N	1
160K	CE2-A63		2	CORRECTOR ASSEMBLY, HORIZONTAL (PRE-MOD 02)	F	1
160L	CE2-A77		2	CORRECTOR ASSEMBLY, HORIZONTAL (PRE-MOD 02)	J	1
160M	CE2-A95		2	CORRECTOR ASSEMBLY, HORIZONTAL (PRE-MOD 02)	R	1
160N	CE2-A55		2	CORRECTOR ASSEMBLY, HORIZONTAL (PRE-MOD 02)	L	1

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FIG. ITEM	PART NUMBER	AIRLINE PART NUMBER	INDENT	NOMENCLATURE	USAGE FROM TO	UNITS PER ASSY.
160P	CE2-A79		2	CORRECTOR ASSEMBLY, HORIZONTAL (PRE-MOD 02)	P	1
160Q	CE2-A74		2	CORRECTOR ASSEMBLY, HORIZONTAL (PRE-MOD 02)	Q	1
160R	CE2-A129		2	CORRECTOR ASSEMBLY, HORIZONTAL (MOD 02)	G-K M-R	1
160S	CE2-A129G		2	CORRECTOR ASSEMBLY, HORIZONTAL (MOD 02 - GREY)	L	1
170	910207		2	SCREW, 6BA x 11/32" LG. C'SK/HD. DURAL BLACK ANODISED	D-R	4
180	CE2-50		2	BOWL - OBSOLETE	-	-
180A	CE2-56		2	BOWL (PRE-MOD 02)	DE G-R	1
180B	CE2-117		2	BOWL (MOD 02)	D-K,M-R	1
180C	CE2-117G		2	BOWL - GREY (MOD 02)	L	1
180D	CE2-130		2	BOWL	G	1
190	CE2-111		2	PLUG, FILLING	D-R	1
200	CE2-22		2	WASHER	D-R	1
210	CE2-23		2	DISC, FILLER PLUG	D-R	1
220	CE2-40		2	KEY, CORRECTOR	D-R	1
230	CE2-A49		2	HOUSING ASSEMBLY, LAMP (PRE-MOD 02)	EK	1
230B	CE2-A57		2	HOUSING ASSEMBLY, LAMP (PRE-MOD 02)	D	1
230C	CE2-A66		2	HOUSING ASSEMBLY, LAMP (PRE-MOD 02)	M	1
230D	CE2-A70		2	HOUSING ASSEMBLY, LAMP (PRE-MOD 02)	NP	1

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FIG. ITEM	PART NUMBER	AIRLINE PART NUMBER	INDENT	NOMENCLATURE	USAGE FROM TO	UNITS PER ASSY.
230	CE2-A49		2	HOUSING ASSEMBLY, LAMP (PRE-MOD 02)	EK	1
230B	CE2-A57		2	HOUSING ASSEMBLY, LAMP (PRE-MOD 02)	D	1
230C	CE2-A66		2	HOUSING ASSEMBLY, LAMP (PRE-MOD 02)	M	1
230D	CE2-A70		2	HOUSING ASSEMBLY, LAMP (PRE-MOD 02)	NP	1
230E	CE2-A64		2	HOUSING ASSEMBLY, LAMP (PRE-MOD 02)	F	1
230F	CE2-A23		2	HOUSING ASSEMBLY, LAMP (PRE-MOD 02)	JL	1
230G	CE2-A96		2	HOUSING ASSEMBLY, LAMP (PRE-MOD 02)	R	1
240	910311		2	SCREW, 8BA x 5/32 IN. LG. C'SK/HD. DURAL BLACK ANODISED (PRE-MOD 02)	DEF H-R	2
250	901312		2	SCREW, 8BA x 11/32 IN. LG. C'SK/HD. DURAL BLACK ANODISE (PRE-MOD 02)	DEF H-R	2
290	CE2-101		2	HOUSING, (MOD.02)	G-R	1
290A	CE2-101G		2	HOUSING, GREY (MOD.02)	G-R	1
300	CE2A121-1		3	LAMP BOARD ASSY, (MOD 02)	HJL	1
300A	CE2A121-2		3	LAMP BOARD ASSY, (MOD 02)	K	1
300B	CE2A121-3		3	LAMP BOARD ASSY, (MOD 02)	Q	1
300C	CE2A121-4		3	LAMP BOARD ASSY, (MOD 02)	NP	1
300D	CE2A121-5		3	LAMP BOARD ASSY, (MOD 02)	M	1
300E	CE2A121-6		3	LAMP BOARD ASSY, (MOD 02)	R	1

FIG. ITEM	PART NUMBER	AIRLINE PART NUMBER	INDENT	NOMENCLATURE	USAGE FROM TO	UNITS PER ASSY.
360	ZV-3335		3	BULB, 28V 0.04 AMP NON-MAGNETIC	D-Q	1
360A	ZV-9486		3	BULB, 6V 0.2 AMP NON-MAGNETIC	DR	1
370	CE2A25		3	CAP	DEF H-K M-R	1
370A	CE2A25G		3	CAP - GREY	L	1
380	CE2A26		2	LEAD ASSY AND SOCKET (2.0m) *STANDARD LENGTH*	DEF H-R	1
380A	CE2A52-1		2	LEAD ASSY AND SOCKET (6 ft.) *OBSOLETE – USE CE2-A26*	DEF H-R	1
380B	CE2A52-2		2	LEAD ASSY AND SOCKET (2.5m) *ALTERNATIVE LENGTH*	DEF H-R	1
380C	CE2A52-3		2	LEAD ASSY AND SOCKET (11 FT.) *ALTERNATIVE LENGTH*	DEF H-R	1
390	CE2-108-1		2	LABEL – CORRECTOR ASSY COMPASS - KCA0101W (MOD.02)	G	1
390B	CE2-108-2		2	LABEL – CORRECTOR ASSY COMPASS - KCA0104W (MOD.02)	H	1
390C	CE2-108-3		2	LABEL – CORRECTOR ASSY COMPASS - KCA0104FY (MOD.02)	J	1
390D	CE2-108-4		2	LABEL – CORRECTOR ASSY COMPASS - KCA0105W (MOD.02)	K	1
390E	CE2-108-5		2	LABEL – CORRECTOR ASSY COMPASS - KCA0106W (MOD.02)	L	1
390F	CE2-108-8		2	LABEL – CORRECTOR ASSY COMPASS - KCA0112W (MOD.02)	M	1
390G	CE2-108-9		2	LABEL – CORRECTOR ASSY COMPASS - KCA0113W (MOD.02)	N	1
390H	CE2-108-10		2	LABEL – CORRECTOR ASSY COMPASS - KCA0113FY (MOD.02)	P	1
390J	CE2-108-11		2	LABEL – CORRECTOR ASSY COMPASS - KCA0114FY (MOD.02)	Q	1
390K	CE2-108-12		2	LABEL – CORRECTOR ASSY COMPASS - WL1001KCA1 (MOD.02)	R	1

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SPECIAL PROCEDURES

COMPASS MAGNETIC CORRECTION

A. General

The compass is provided with a compensating system, which will enable you to eliminate, some of the magnetic disturbances created by the mechanical and electrical characteristics of the aircraft.

Compass magnetic correction can be achieved by using the special corrector key (220) and inserting it into either of the two holes located on the front face of the compass. The engagement of the key and rotation will provide approximately 30 to 35 degrees of compensation. An indication of the correction setting is seen from the top of the compass.

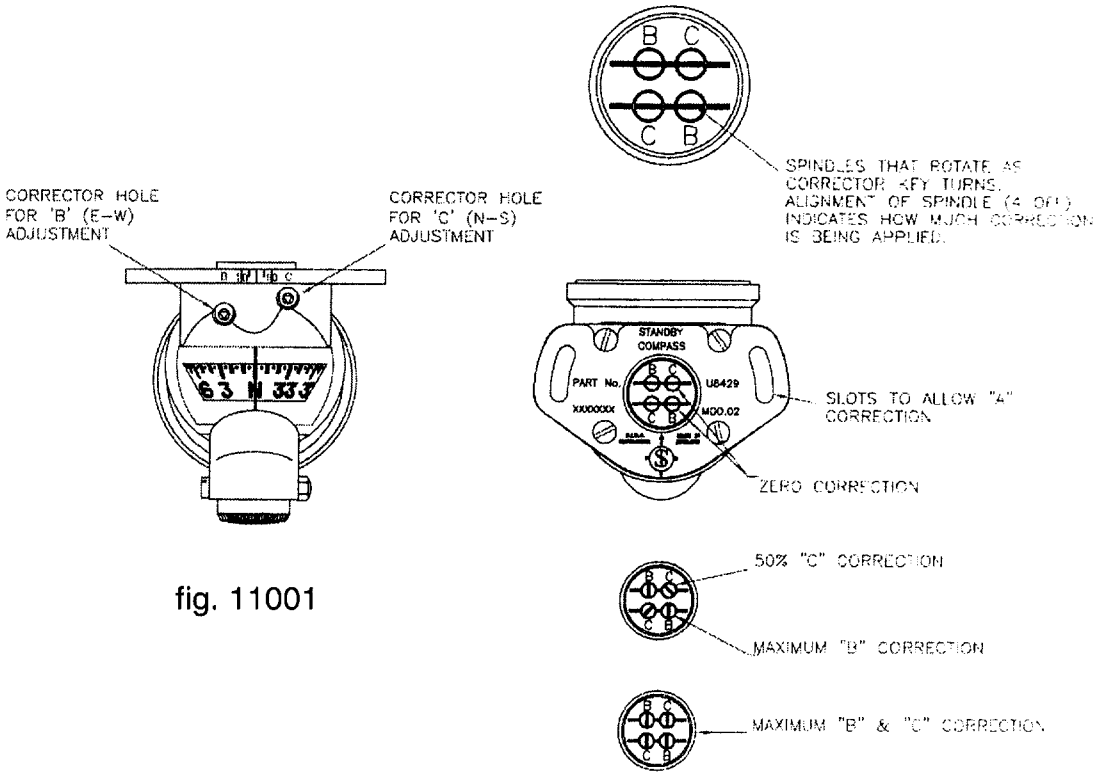


fig. 11001

ADJUSTING THE COMPASS

Before your compass can be adjusted the aircraft must be capable of being accurately aligned to the main cardinal headings.

The use an another calibrated compass outside the aircraft or the use of a 'compass rose' on the ground, to determine the cardinal points is advised. (See 'special tools' section, pages 9001 onwards)

NOTE: These following notes should be used for guidance only; in-house procedures may be different from these described and should be used as the prime reference for the correction activity.

CORRECTION EAST/WEST ('B' Coefficient)

1) Align the aircraft to face East, insert the Corrector Key provided, into the Left hand hole at the front of the compass, designated 'B' and rotate the key in either direction until the East heading of the card is aligned with the Index line.

2) Align the aircraft to face West and check that the West heading of the card is aligned with the Index line; any error may be corrected by readjusting the correctors to remove HALF the error shown.

3) The process of adjustment between East and West should be repeated and the error halved each time to reduce the final deviation value to a level that complies with the aircraft specification.

CORRECTION NORTH/SOUTH ('C' Coefficient)

1) Align the aircraft to face North, insert the Corrector Key provided, into the Right hand hole at the front of the compass, designated 'C' and rotate the key in either direction until the North heading of the card is aligned with the Index line.

2) Align the aircraft to face South and check that the South heading of the card is aligned with the Index line, any error may be corrected by re-adjusting the correctors to remove HALF the error shown.

3) The process of adjustment between North and South should be repeated and the error halved each time to reduce the final deviation value to a level that complies with the aircraft specification.

NOTE: **Adjustment of the east-west setting does not affect the North South values and visa-versa.**

If the compass cannot be corrected to comply with the correct specification, there could be a problem with either:

1) The compass correction facility is not functioning correctly or

2) The aircraft has a magnetic influence that is higher than that which can be corrected by the Standby Compass.

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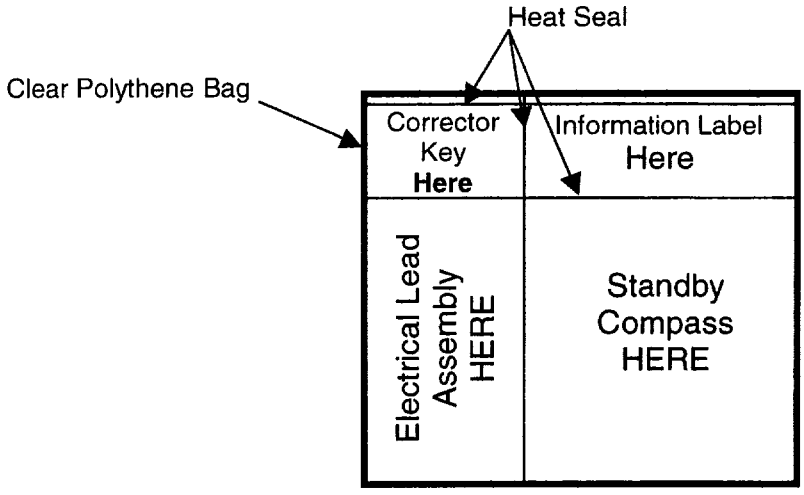
STORAGE INSTRUCTIONS

NOTE: These instructions are applicable to temperate and tropical climates. The packaging is adequate for storage and transit purposes.

1. PACKAGING PROCEDURE

A. Record the compass details, shown on the unit-mounting flange.

B. Place the Compass unit in a clear polythene bag together with the corrector Key (220) and Electrical Lead assembly (380).



C. Partially heat-seal the bag, expel as much air as possible and complete the seal.

D. Place the polythene bag in an ATA 300 category 2 foam-lined container. If necessary add packing to ensure that the components fit securely into the shock-resistant material.

F. Close the container lid and secure with waterproof adhesive tape.

G. Secure to the container a label giving the following information:

(1) Name, code and serial number of the unit.
(2) Modification state.
(3) Date of last overhaul.
(4) Batch Number.
(5) Shelf Life.

Protect the label with transparent adhesive tape or film.

2. STORAGE CONDITIONS AND STORAGE LIFE

For this information refer to publication SAV/OH/SPR, available from SIRS Navigation Ltd.

STORAGE LIMITING PERIOD

The compass can be stored up to 5 years before being re-certified.

A. Remove unit from packing.

B. Examine unit visually for signs of corrosion or damage.

C. Carry out serviceability tests described in TESTING.

D. Pack in accordance with para. 1.

Following the re-certification, the compass can be stored for a further 5 years.

After 10 years of storage the compass should be overhauled to replace the Silicone fluid and Bellows Gasket.

Service Information Letter

HEATHROW AIRPORT – LONDON U.K. • MELBOURNE AUSTRALIA • CLEARWATER FLORIDA U.S.A.

STANDBY COMPASSES

TRANSFER OF SUPPORT RESPONSIBILITIES

Effectivity: All aircraft equipped with Standby Compasses supplied by Smiths Industries Aerospace

Equipment Affected:

KCA0101C	KCA0104W	KCA0107W	KCA0113FY
KCA0101W	KCA0104FY	KCA0109W	KCA0113W
KCA0102C	KCA0105W	KCA0110W	KCA0114W
KCA0102W	KCA0106W	KCA0112W	WL1001KCA1

Reference: Smiths Industries Overhaul Manual 34-25-21

Introduction:

In November 1993 Smiths Industries Aerospace and Defence Systems Ltd. (SI) agreed the sale of the Standby Compass business to SIRS Navigation Ltd. (SIRS) and at that time also advised the manufacturers of aircraft to which the compasses were then being fitted of this arrangement. Subsequently SI have continued to offer support services, however, these will cease on the 31st July 2000. SIRS meanwhile have developed a comprehensive support capability and will, as the designer and manufacturer under the UK Civil Airworthiness Authority's approval, be the prime source of all support after 31st July 2000.

The only exception to the above will be the AOG service, which SI will continue to provide on behalf of SIRS until further notice.

Recommendation:

Orders for new compasses, component parts, repairs, testing and all other support functions (including technical matters) should be directed to SIRS at the address detailed on page 2. Orders currently placed upon SI, or any received prior to 1st August 2000, will be satisfied by SI, where practicable. Any orders that SI have not satisfied by 1st August 2000 and any received after that date will be passed to SIRS for action and the customers so advised.

SMITHS INDUSTRIES *Aerospace*

Product Support enquiries should be directed to one of the Regional Customer Support Centres listed below.

FOR EUROPE, AFRICA, INDIA AND MIDDLE EAST CONTACT
Smiths Industries Aerospace
Northolt Road, Heathrow Airport – London,
Hounslow, England
Telephone: + 44 20 8759 9121
Facsimile: + 44 20 8759 9129 Sita LHRSICR

FOR AUSTRALASIA AND THE FAR EAST CONTACT
Smiths Industries Aerospace
P.O. Box 57, 153 Park Street,
South Melbourne, Victoria, 3205 Australia
Telephone: + 61 3 9699 8322
Facsimile: + 61 3 9690 5605

FOR THE AMERICAS CONTACT
Smiths Industries Aerospace
P.O. Box 9013, Clearwater, FL 33758
United States of America
Telephone: + 1 (727) 539 1631
Facsimile: + 1 (727) 539 0680

Service Information Letter

HEATHROW AIRPORT – LONDON U.K. • MELBOURNE AUSTRALIA • CLEARWATER FLORIDA U.S.A.

A Component Maintenance Manual produced by SIRS will replace the existing SI Overhaul Manual (34-25-21). Arrangements are being made for the technical document distribution department or technical library of each of SI's customers to obtain the required number of CMM's from SIRS. Individual manual holders need not and should not contact SIRS directly.

The SI ATA 200 listing for all Standby Compasses will no longer be updated and should be discarded. It has been agreed however, that SIRS will retain all of the SI component Part Numbers at least until after the transfer period.

All references to Standby Compasses in the SI "Overhaul and Storage Period Recommendations" (OH/SPR) should be ignored after the 31st July 2000.

For any aspect of support after 31st July 2000 (except AOG) please contact:-

SIRS Navigation Ltd.
186a Milton Road
Swanscombe
Kent DA10 OLX
England

Tel. No. +44 (0) 1322 383 672
Fax No. +44 (0) 1322 382 418

CAGE/FSCM: U8429

For AOG support for the Standby Compass, Operators should continue to contact Smiths Industries on one of our 24 hour AOG telephone numbers (+1 (727) 539 1631 for the Americas or +44 20 8759 9121 for the rest of the world).

This Service Information Letter has been produced in conjunction with SIRS Navigation Ltd.

SMITHS INDUSTRIES *Aerospace*

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CHAPTER 35

OXYGEN

de Havilland Inc.
DHC–6 TWIN OTTER
COMPONENT MAINTENANCE MANUAL
CHAPTER 35 – OXYGEN
TABLE OF CONTENTS

MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B./T.R.
Adams Rite Sabre (ARS)	Portable Oxygen Cylinder Assembly	900–700–039–04, –06, –12 & –29	35–31–08	Nov 20/1986	ARS SP 0002 dated May 18/1995
Alar Products	Continuous Flow Oxygen Regulator	A–2000W			
Scott	Portable Oxygen Breathing Equipment	5500 & 5600	35–30–78	May 31/1989	
	Cylinder and Valve Assembly	6350 Series	35–21–19	Jun 1/1981	
	Cylinder and Valve Assembly	6350 Series	35–21–20 was 35–20–120	Oct 15/1986	
Zep Aero	Oxygen Cylinder	ZC–268–111–30		Jun 1966	

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ADAMS RITE SABRE
INTERNATIONAL

540 W. Chevy Chase Drive
Glendale, California

PORTABLE OXYGEN CYLINDER ASSEMBLY MODEL 4113

PART NUMBERS

900-700-039-04
900-700-039-06
900-700-039-12
900-700-039-29

Overhaul Manual
With
Illustrated Parts List

ADAMS RITE SABRE
INTERNATIONAL

540 W. Chevy Chase Drive
Glendale, California

TO: HOLDERS OF PORTABLE OXYGEN CYLINDER ASSEMBLY, MODEL 4113,
OVERHAUL MANUAL WITH ILLUSTRATED PARTS LIST,
MANUAL NO. 35-31-08

REVISION NO. 1 DATED NOV 20/86

HIGHLIGHTS

Revised pages are outlined below together with highlights of this revision. Remove affected pages and enter Revision No. 1, dated Nov 20/86 to the Record of Revisions page. This revision basically adds a new configuration, Part No. 900-700-039-29 to the manual.

Page No.	Description of Change	Effectivity
Title Page	Added new part no. 900-700-039-29.	
Record of Revisions	Added Rev. No. 1.	
List of Effective Pages 1 and 2	Updated to reflect changed pages.	
1	Added new part number, -29, to text.	
4, 101	Added item 12B and -29 to text.	
501	Added items 12B, -29 and NOTE to text.	
505	Added -29 to text.	
506	Added NOTE relating to -29 to text. In steps (5) and (6) identified outlets (12) and (14).	

Page No.	Description of Change	Effectivity
507	Added -29 to Table 501. Identified items 12, 14 in Table. In step (5) identified outlets (12A) and (14A).	
508	In Table 502 identified items (12A) and (14A). Added NOTE. Identified outlets (12A) and (14A).	
509	Identified outlets (12A) and (14A).	
510	Added item (12B).	
702	Added -29 to text. Added NOTE. Identified outlets (12), (12A), (14), (14A).	
801,802	Added item (12B).	
901	Added -29 to text.	
1101	Added vendor code 02217.	
1103	Added items -1C, -12B and usage code D to parts list. Corrected item 14 part number.	

SABRE INDUSTRIES,INC.

OVERHAUL MANUAL WITH IPL

PART NO. 900-700-039

RECORD OF REVISIONS

REV. NO.	ISSUE DATE	DATE INSERTED	BY	REV. NO.	ISSUE DATE	DATE INSERTED	BY
1	Nov 20/86	Nov 20/86	SI				

SABRE INDUSTRIES,INC.
OVERHAUL MANUAL WITH IPL

PART NO. 900-700-039

LIST OF EFFECTIVE PAGES

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SABRE INDUSTRIES,INC.
OVERHAUL MANUAL WITH IPL

PART NO. 900-700-039

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DESCRIPTION AND OPERATION

1. Description

A. This publication is issued as the basic overhaul manual for the Portable Oxygen Cylinder Assemblies, Model 4113, Part Number 900-700-039-04, -06, -12, and -29, manufactured by Sabre Industries, Inc., Burbank California.

B. The Oxygen Cylinder Assemblies are designed to provide supplemental oxygen to the passengers and cabin attendants of a commercial airliner as required by Federal Regulations.

C. The Oxygen Cylinder Assemblies (Figure 1) consist of a high pressure oxygen storage cylinder (4.25 cubic feet for the 900-700-039-04, -29 Assemblies and 11.0 cubic feet for the 900-700-039-06, -12 Assemblies), and On-Off Pressure Reducer, a safety outlet of the replaceable frangible disc type, a fill and check valve, a supply pressure gage and quick disconnect constant flow outlet fittings. The Oxygen Cylinder Assemblies also have a carrying strap. The Oxygen Cylinder Assemblies are shown in Figure 1 in a functional diagram with the various sections identified by function.

NOTE: This Oxygen Cylinder Assembly 900-700-039-29 has one constant flow and one demand flow quick disconnect outlet fitting.

D. The ON and OFF positions of the Pressure Reducer and the various ports in the body of the Pressure Reducer are marked to indicate the proper usage.

2. Operation

A. The Oxygen Cylinder Assemblies can be filled with high pressure oxygen through the fill check valve on the Pressure Reducer body by removing the cap on the valve and attaching a supply source. The check valve allows flow into the cylinder only and an additional seal in the valve cap assures that no leakage occurs from the fill and check valve. If the cylinder should become dangerously over-pressurized, the frangible disc in the safety device will rupture and vent. See TABLE 1 for the maximum fill pressures and the pressure ranges in which the safety device will rupture.

B. To obtain a flow of oxygen from the Oxygen Cylinder Assemblies, turn the On-Off knob on the Pressure Reducer counterclockwise to the "ON" position (Figure 1 shows the Pressure Reducer in the "ON" position). The main valve (seat, ball, and ball assist spring) is opened by the force of the On-Off spring pushing down on the On-Off piston which makes contact with the relief valve to push the ball off its seat. Oxygen will flow past the ball

into the outlet ports. The sensing chamber simultaneously becomes pressurized through the sensing port. When the pressure force in the sensing chamber balances the force of the piston spring, the piston and On-Off piston will rise, thereby allowing the relief valve to rise and the ball to approach the seat. The flow in the outlet ports will be at regulated pressures and will depend on the force applied by the piston spring. The unit will maintain an outlet pressure between 40 and 60 pounds per square inch gage and will deliver a flow between 0 and 20 liters per minute at any inlet pressure within the range of 200 to 1850 pounds per square inch gage. The ball will modulate to allow oxygen flow in proportion to the demand and will shut off when the demand is zero. A relief valve is incorporated in the Pressure Reducer to exhaust to atmosphere any excess pressure that may occur in the regulated outlet system. When the outlet ports are subjected to excess pressure, the piston and On-Off piston will rise against the piston spring force until the ball seats and seals the inlet; moves free of the O-ring on the relief valve. Oxygen will flow through the sensing port, past the relief valve, through the vent passage, and out through the clearances in the parts of the upper housing and On-Off knob.

C. The outlet flow is stopped by turning the On-Off knob clockwise to OFF. When the On-Off knob is rotated clockwise, the On-Off rod slides upward on the cam which is indexed to the On-Off knob, to pick up and move the On-Off piston upward. This action allows the force of the ball assist spring to move the relief valve and ball upward. The relief valve is now completely free of the ball and the ball is seated on the seat when the On-Off knob is in the "OFF" position. The sealing force is provided by the inlet pressure and the ball assist spring.

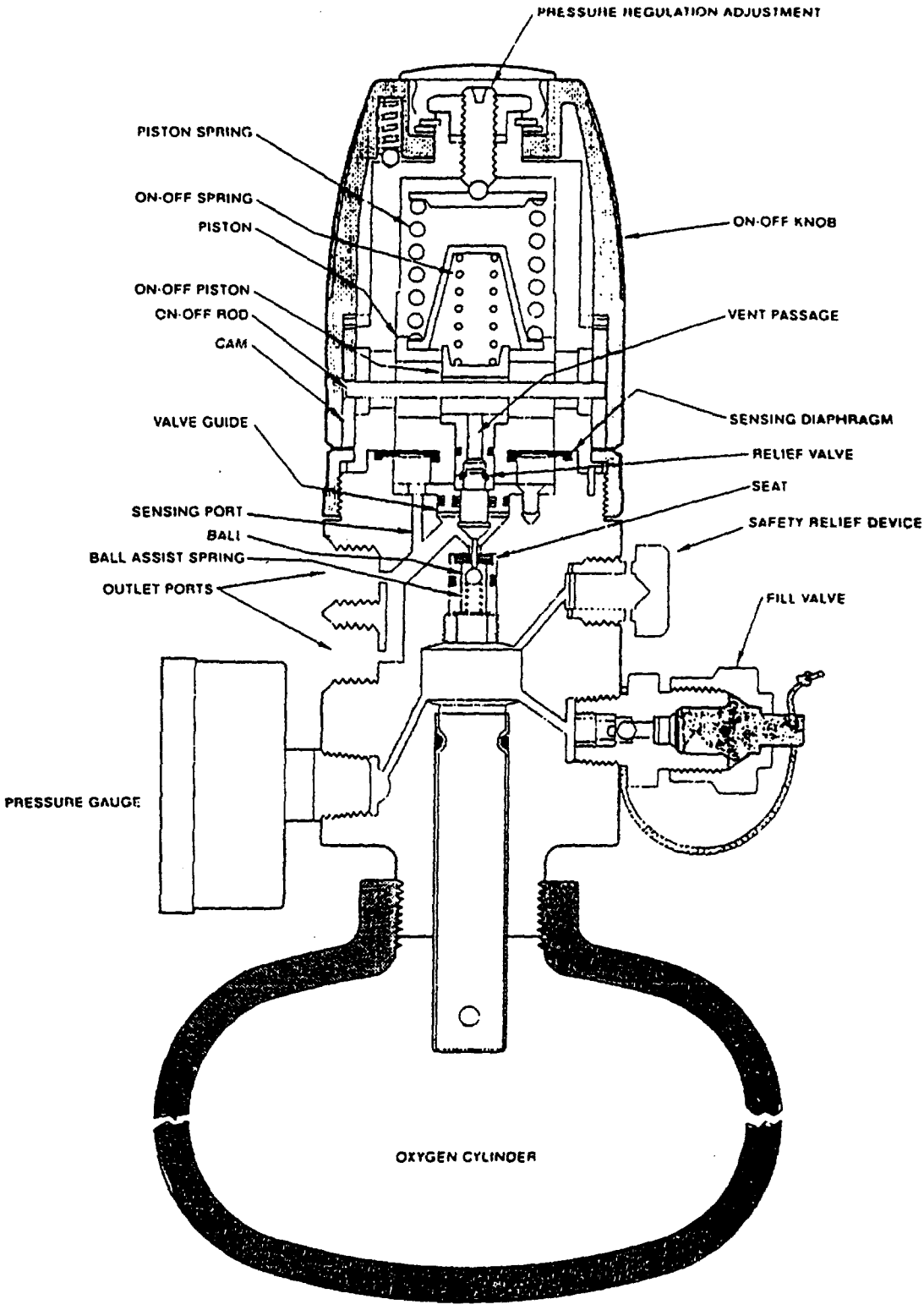
3. Leading Particulars

Refer to TABLE 1 for reference to the characteristics and capabilities of the unit.

4. Maintenance Recommendations

A. Make a preflight visual check of the pressure gage on the Oxygen Cylinder Assembly to insure a sufficient oxygen supply.

B. The overhaul period is indefinite. The unit need not be overhauled as long as the tests specified in Oxygen Cylinder Assembly Test (see TESTING) can be successfully performed and there is no visible damage to the unit.



Functional Diagram of Oxygen Cylinder Assembly.
Figure 1.

TABLE 1

LEADING PARTICULARS	
Operating Medium	Gaseous Oxygen
Operating Temperature Range	-40 to +160 degrees Fahrenheit
Inlet Operating Pressure	200 to 1850 pounds per square inch gage
Regulated Outlet Pressure	50 pounds per square inch gage nominal
Outlet Flow	
Outlet #1 (Ref. 12, IPL Fig. 1)	2.7 liters minimum NTPD at sea level
Outlet #1 (Ref. 12A, IPL Fig. 1)	8.4 liters minimum NTPD at sea level
Outlet #1 (Ref. 12B, IPL Fig. 1)	Demand flow (non-orificed)
Outlet #2 (Ref. 14, IPL Fig. 1)	5.0 liters minimum NTPD at sea level
Outlet #2 (Ref. 14A, IPL Fig. 1)	2.7 liters minimum NTPD at sea level
Outlet System Relief Valve	50 liters per minute at 150 pounds per square inch gage
Safety Device Rupture Pressure	2700 to 3000 pounds per square inch gage
Fill Valve Connection	Per SAE Aerospace Standard AS 1046
Maximum Fill Pressure	1980 pounds per square inch gage maximum
DOT Rating of Cylinder: (900-700-039-04, -29) (900-700-039-06, -12)	 3AA1800 3AA1800
Weight: (900-700-039-04, -29)	 4.3 pounds maximum (uncharged) 4.8 pounds maximum (charged)
(900-700-039-06, -12)	6.5 pounds maximum (uncharged) 7.5 pounds maximum (charged)

DISASSEMBLY

NOTE: Prior to complete disassembly, if malfunction is suspected, inspect visually and/or perform necessary functional tests and overhaul procedures to determine cause, and remedy.

1. Disassembly of Part Number 900-700-039-04, -06, -12 and -29 (see IPL Figure 1)

A. Remove clamp (2) from cylinder (4) or (4A).

B. Using a suitable holding fixture, clamp cylinder (4) or (4A) securely in a vise.

C. Position a mating disconnect into outlets (12), (12A), (12B), (14) or (14A), and slowly turn Pressure Reducer (3) to ON. Verify that cylinder (4) or (4A) is empty of oxygen.

CAUTION: OXYGEN SHALL BE VENTED SLOWLY AND SHALL BE REMOTE FROM ANY POSSIBLE SOURCE OF IGNITION.

D. Remove Pressure Reducer (3) from cylinder (4) or (4A). See separate instructions below for detailed disassembly of the Pressure Reducer.

E. Remove strap (5) and install a cover (not illustrated) on cylinder opening to prevent contamination.

F. Remove the check valve assembly (6) from the Pressure Reducer (3) and remove the loop end of braid (8) from the check valve assembly (6). Slip the loop end of braid (8) through sleeve (9) and remove sleeve (9) from braid (8).

G. Remove cap (10) from the check valve assembly (6), untie the knot on one end of braid (8), and slip braid (8) through the hole in plug (11). Remove plug (11).

H. Remove outlets (12, 12A, 12B, 14 and 14A), gage (13) from Pressure Reducer (3). Do not remove vent port (15), washer (16), and rupture disc (17) from the Pressure Reducer unless disc (17) has ruptured.

I. Do not remove identification plate (18) or instruction plate (19) unless replacement is necessary.

2. Disassembly of Part Number 904-002-527-02 (See IPL Figure 2) (For next higher assembly, see IPL Figure 1.)

A. Remove plug (3), nut (4), setscrew (5), ball (6), retaining ring (8), washer (9), and washer (10). Discard washer (10).

B. Remove knob (7), ball (11), spring (12), washer (13), washer spring (14), On-Off rod (15), and cam (16). Discard washer (13).

C. Remove end cap (17). Remove and discard O-ring (18).

D. Piston spring (22) exerts force to separate housing (20), and inlet body (43), which are held together by ring retainer (19). Use an arbor press to hold housing (20) to inlet body (43) while removing ring retainer (19). Then release pressure on arbor press, and allow piston spring (22) to expand.

E. Remove housing (20), washer (46), retainer plate (21), piston spring (22), washer (48), spring retainer (23), On-Off spring (24), piston (25), O-ring (26), piston (27) and diaphragm (28). Discard O-ring (26) and diaphragm (28).

F. Remove screws (30), and valve guide (29) with O-ring (31), retainer (32), relief valve (33), and O-rings (47 and 49) still attached. Discard screws (30).

G. Remove O-ring (31), retainer (32), and relief valve (33) from valve guide (29). Discard O-ring (31), retainer (32), and O-rings (47 and 49).

H. Using wrench 197T41, remove setscrew (35), filter (36), and seat assembly (42A). Discard filter (36) and seat assembly (42A).

I. Do not remove pin (44) unless replacement is necessary. If replacement is necessary, discard pin (44).

J. Do not remove decal (45) from plug (3) unless replacement is necessary.

CLEANING

NOTE: The Pressure Reducers are oxygen breathing equipment, and must be cleaned and assembled in an area where normal conditions of cleanliness are maintained at all times. All tools, fixtures, and test equipment in this area must be free from hydrocarbon contamination and moisture.

WARNING: ALL PARTS, INCLUDING NEW PARTS, MUST BE CLEANED BEFORE ASSEMBLY. SPECIAL ATTENTION MUST BE GIVEN TO HYDROCARBON RESIDUES BECAUSE OF THEIR DANGEROUS PROPERTY OF BREAKING INTO SPONTANEOUS COMBUSTION UPON CONTACT WITH GASEOUS OXYGEN.

THE PRESSURIZED GAS OR AIR SUPPLY USED TO DRY THE PARTS MUST BE FREE FROM HYDROCARBON CONTAMINATION AND MOISTURE.

1. Wash all metallic parts in trichloroethane or perchlorethylene (MIL-T-81533A), and dry with noncontaminated, dry, pressurized gas or air.

   WARNING: USE SOLVENTS IN A WELL VENTILATED AREA, AVOID PROLONGED INHALATION OF FUMES. KEEP AWAY FROM OPEN FLAME. AVOID CONTACT WITH RUBBER COMPOUND PARTS.

2. Force solvent through all holes. With the parts held on clean paper, spray the solvent through apertures and passages. Using a 20-power magnifier, check the residue for foreign matter. Repeat this procedure until no contamination is evident. Dry parts with noncontaminated, dry, pressurized gas or air.

3. Wash all nonmetallic parts in a solution of detergent in distilled water. Rinse in distilled water, and dry with noncontaminated, dry, pressurized gas or air.

TABLE 201

CLEANING MATERIALS AND COMPOUNDS
Distilled water.
Commercial liquid detergent.
Dry, pressurized gas not contaminated with hydrocarbons.
Trichloroethane or perchlorethylene per MIL-T-81533A.

INSPECTION/CHECK

1. Visually inspect the oxygen cylinder for corrosion, nicks, cuts, dents, and damaged threads. The extent of allowable dmaage is specified in the Code of Federal Regulations, Title 49, Paragraph 174.34.

2. Inspect the Pressure Reducer body and components for damaged threads, broken or distorted springs, cut or flattened O-rings, damaged sealing surfaces, nicks, cuts and scratches. Give special attention to seat assembly (Ref. 42A, IPL Figure 2), piston (27) and ON-OFF piston (25). See CLEANING and REPAIR where applicable to correct these defects.

REPAIR

1. Except for minute scratches that can be polished out with crocus cloth (Federal Specification P-C-458), repair of detail parts is not practicable.

2. Replace all damaged parts.

3. The repair of the Oxygen Cylinder (Ref. 4 or 4A, IPL Figure 1) is specified in the Code of Federal Regulations, Title 49, Paragraph 174.34.

NOTE: Welding or metal spinning the Oxygen Cylinder is prohibited.

ASSEMBLY

WARNING: THE CLEANLINESSS REQUIREMENTS OF CLEANING MUST BE OBSERVED DURING THE ENTIRE ASSEMBLY OF THIS UNIT IN ORDER TO PREVENT DANGEROUS HYDROCARBON CONTAMINATION.

1. Assembly of Part Number 904-002-527-02

A. If pin (Ref. 44, IPL Figure 2) was removed, place inlet body (43) in a padded vise and assemble pin (44) into hole on face of body using Punch 147T270. The height of the pin from face of inlet body must be between 0.050 and 0.060 inches.

B. Install seat assembly (42A) into inlet body (43) with plastic end of (42A) pointing down into body (43).

C. Install filter (36) into inlet body (43) flat against seat assembly (42A).

D. Using wrench 197T41, install setscrew (35) into body (43) and torque to 50 pound-inches.

E. Deleted.

F. Deleted.

G. Deleted.

H. Deleted.

I. Using Scotch Brand Pipe Thread Sealant Tape on threads, install gage (13). Apply a thin coat of Krytox 240 AZ on the surface of vent port (15) that contacts rupture disc (17). Install washer (16), rupture disc (17), and vent port (15) into inlet body (Ref. 43, IPL Figure 2) and torque vent port (15) to 150-175 pound-inches.

NOTE: Thread vent port (Ref. 15, IPL Figure 1) into body (Ref. 43, IPL Figure 2) until hand tight. Torque vent port to 150-175 pound-inches.

J. (For Part Number 900-700-039-04, -06, -29). Prior to installing outlet (14, 12 and 12B) onto the Pressure Reducer (3), perform the following. Then install outlets 14, 12 and 12B using Scotch Brand Pipe Thread Sealant Tape.

NOTE: On cylinder assembly 900-700-039-29, outlet (12B) is a demand flow outlet; therefore, no testing is required for this outlet.

NOTE: An adapter, Fluid Power, Inc. (FSC99227), Part No. 2305, must be connected to outlets (12, 14) when measuring flow values.

(1) Connect a regulated oxygen pressure source, capable of delivering 50 ± 1 pounds per square inch gage, to the Pressure Reducer side of outlet (14) and a flowmeter to the other side of outlet (14).

(2) Apply a pressure of 50 ± 1 pounds per square inch gage to outlet (14) and measure a flow of 5.0 to 5.5 liters per minute. If the correct flow cannot be obtained, replace outlet (14).

(3) Repeat steps (1) and (2) using outlet (12). The flow shall be 2.7 to 3.0 liters per minute. If the correct flow cannot be obtained replace outlet (12).

K. (For Part Number 900-700-039-12). Prior to installing outlet (14A and 12A) onto the Pressure Reducer (3), perform the following. Then install outlets (14A) and (12A) using Scotch Brand Pipe Thread Sealant Tape.

NOTE: An adapter, Fluid Power, Inc. (FSC 99227), Part No. 2305, must be connected to outlets (12A, 14A) when measuring flow values.

(1) Connect a regulated oxygen pressure source, capable of delivering 50 ± 1 pounds per square inch gage, to the Pressure Reducer side of outlet (14A) and a flowmeter to the other side of outlet (14A).

(2) Apply a pressure of 50 ± pounds per square inch gage to outlet (14A) and measure a flow of 2.7 to 3.0 liters per minute. If the correct flow cannot be obtained, replace outlet (14A).

(3) Repeat steps (1) and (2) using outlet (12A). The flow shall be 8.4 to 9.3 liters per minute. If the correct flow cannot be obtained, replace outlet (12A).

L. Install plug (11) into cap (10). Insert braid (8) through hole in plug (11) and tie a knot on the plug end of braid (8). Make a loop on the other end of braid (8), insert the loop of braid (8) through sleeve (9), and tie a knot on the sleeve end of braid (8).

M. Clip off excessive braid from the knots on both ends of braid (8) and carefully apply heat to melt loose ends of braid (8) together. Attach the loop end of braid (8) onto the check valve assembly (6).

N. Perform the Check Valve Assembly Test as follows:

(1) Connect the check valve assembly (6) to the oxygen supply.

(2) Apply 1850 ± 50 pounds per square inch gage, then apply 100 ± 10 pounds per square inch gage. Leakage through the check valve assembly (6) must not exceed 100 standard cubic centimeters per minute at either pressure.

O. After the successful completion of the above test, replace cap (10) and torque cap (10) to 90-100 pound-inches.

P. Remove the check valve assembly (6) from the test setup.

Q. Apply Scotch Brand Pipe Thread Sealant Tape to the threads on the check valve assembly (6) and screw body into inlet body (Ref. 43, IPL Figure 2) FILL port.

R. Perform the Pressure Reducer Main Valve Seat Test as follows:

(1) Mount the unit into a test setup similar to that shown in Figure 701.

(2) Insert Test Fixture 79T65, using the appropriate nut that fits on the 1/2 inch NPT inlet port. Tighten knurled nut hand tight.

(3) Connect the inlet test fitting to the primary pressure source.

(4) Apply 1850 pounds per square inch gage, and allow a 3-minute period for the main seat ball (Ref. 40, IPL Figure 2) to seat. Using Leak Detector Solution (MIL-L-25567), check for main seat leakage.

CAUTION: DO NOT PUSH THE MAIN SEAT BALL (40) OFF SEAT MANUALLY AT 1850 POUNDS PER SQUARE INCH GAGE.

(5) If no leakage is evident, reduce inlet pressure to 100 pounds per square inch gage, and recheck for leakage.

(6) If no leakage is evident, reduce inlet pressure to zero. Install O-ring (47) in the inside diameter groove in valve guide (29).

S. Install O-ring (49) in the outside diameter groove of valve guide (29). Install relief valve (33) through valve guide (29).

T. Install retainer (32) and O-ring (31) on the end of relief valve (33). Lubricate the relief valve with Krytox 240 AZ. Insert the subassembly (items 29, 31, 32 and 33) into the inlet body (43) so that the smaller diameter of relief valve (33) (when depressed) pushes ball (40) off seat. Secure with screws (30).

U. Install O-ring (26) on piston (25) and lubricate with Krytox 240 AZ.

V. Insert piston (25) into the ID of piston (27) and align the holes in the two pistons.

W. Apply Krytox 240 AZ to the smooth side of diaphragm (28). Install diaphragm (28) onto piston (27) making sure that the smooth side of diaphragm (28) is placed against piston (27).

X. Install setscrew (5) in housing (20).

CAUTION: THE END OF SETSCREW (5) MUST BE FLUSH WITH THE INSIDE SURFACE OF HOUSING (20).

Y. Lubricate the inside diameter of housing (20) (up to the slots) with Krytox 240 AZ.

Z. Apply Halocarbon 25-5S grease to ball (6) and place ball in cup of setscrew (5).

AA. Install retainer plate (21) in housing (20). Insure that the countersink in retainer plate (21) locates on ball (6).

BB. Install washer (46) on plate (21) and insert piston spring (22) into the inner diameter of housing (20). Insure that piston spring (22) locates on retainer plate (21).

CC. Install washer (48) over spring retainer (23). Install spring retainer (23) in the inner diameter of spring (22).

DD. Install spring (24) into spring retainer (23).

EE. Position the diaphragm-piston assembly (items 25, 26, 27 and 28) into the bore of housing (20). Align the holes in the pistons with the slots in housing (20).

CAUTION: STEPS FF, GG, AND HH ARE VERY CRITICAL. USE EXTREME CARE TO AVOID MALFUNCTION OF THE PRESSURE REDUCER.

FF. Place retainer ring (19) on a slotted plate in an arbor press.

GG. Place the housing assembly from step (EE) under the arbor press with open end up.

HH. Place the subassembly from step (T) over piston (27), and under the ram of the arbor press. Insure that hole in body (20) is in position to mate with spirol pin (44) in inlet body (43). Depress the ram until the flange of retainer (23) can be seen through the slots in housing (20). Using tweezers, position flange of retainer (23) into the guide diameter of piston (27).

II. Push downward on inlet body (43) until it registers into the bore of housing (20), and the spirol pin (44) enters the mating hole in flange of housing (20).

JJ. While holding the ram of the arbor press down so that the upper and lower assemblies of the Pressure Reducer mate, bring retaining ring (19) upward and engage the threads of inlet body (43). Tighten retaining ring (19) by hand. Release the ram of the arbor press.

KK. Check the assembly to make certain the holes in piston (27) align with the slots in housing (20).

LL. Using a strap wrench, tighten retaining ring (19).

MM. Apply Halocarbon 25-5S grease to the bottom flange of cam (16) and to the bottom of the cam slots (2 places).

NN. Assemble cam (16) over housing (20), and insert rod (15) through slots in cam (16), housing (20) and piston (27).

OO. Install washer (13) over hub of housing (20).

PP. Install spring washer (14) concave side up over housing (20).

QQ. Apply Halocarbon 25-5S grease to ball (11), and place it into the detent countersink in the top of housing (20) so that ball (11) is positioned in the detent that is opposite of spring (12) when knob (7) is in the OFF position.

RR. Apply Halocarbon 25-5S grease to detent spring (12), and insert spring into counterbore in knob (7).

SS. Install knob (7) over housing (20) in the OFF position so that spring (12) will mate with ball (11).

TT. Install washer (10) and flat washer (9) into the counterbore of knob (7). Secure knob to housing (20) with retaining ring (8).

UU. Install lock nut (4) on setscrew (5) hand-tight only.

VV. Install button plug (3) and decal (45).

2. Assembly of Part Number 900-700-039-04, -06 and -29

A. If identification plate or instruction plate (Ref. 18 or 19, IPL Figure 1) were removed, replace.

B. Calibrate the Pressure Reducer Assembly (For Part Number 909-700-039-04, -06, -29) as follows:

NOTE: An adapter, Fluid Power, Inc. (FSC99227), Part No. 2305, must be connected to outlets (12, 14) when measuring flow values.

NOTE: On Cylinder Assembly 900-700-039-29, outlet (12B) must be capped for this calibration. Insure that outlet (12B) does not leak.

(1) With the appropriate nut of Test Fixture 79T65 on the inlet port of the Pressure Reducer Assembly (3), mount the unit in a test setup similar to that shown in Figure 701.

(2) Connect both outlet ports (Ref. 12, 14, IPL Figure 1) of the Pressure Reducer Assembly (3) to the flowmeter fittings.

(3) With On-Off knob (Ref. 7, IPL Figure 2) in the OFF position, apply 200 pounds per square inch gage to the inlet port. There must be no audible leakage.

(4) Turn On-Off knob (7) to ON. The unit will open and begin to regulate (see outlet gage and flowmeter).

(5) With valve #4 open, valve #1 closed, subject the Pressure Reducer to the inlet pressure listed in TABLE 501, remove button plug (Ref. 3, IPL Figure 2), and adjust regulated pressure as necessary using setscrew (5). Turn setscrew (5) clockwise to increase and counterclockwise to decrease pressure. Repeat until the flow is within the limits of TABLE 501 for outlet (12) and the outlet pressure on gage connected to outlet (14) is within 50 $\pm$5 pounds per square inch. Make certain that there is no leakage at the disconnect fittings since this would affect the pressure reading. If the flow and pressure requirements cannot be obtained simultaneously, the outlet disconnects should be removed from the pressure reducer and rechecked per flow test in ASSEMBLY. Since the adjustment of setscrew (5) affects the flows of Steps (5) and (6), it is necessary to repeat Steps (5) and (6) until both flow requirements are met without further adjustment.

(6) With valve #1 open, valve #4 closed, subject Pressure to the inlet pressure listed in TABLE 501, remove button plug (Ref. 3, IPL Figure 2), and adjust regulated pressure as necessary using setscrew (5). Turn setscrew (5) clockwise to increase and counterclockwise to decrease pressure. Repeat until the flow is within the limits of TABLE 501 for outlet (14). Since the adjustment of setscrew (5) affects the flows of Steps (5) and (6), it shall be necessary to repeat Steps (5) and (6) until both flow requirements are met without further adjustment.

TABLE 501

PRESSURE AND FLOW (900-700-039-04, -06, -29)		
Inlet Pressure (pounds per square Inch gage	Flow (O_2) (liters per minute)	
	Min.	Max.
1800 ± 100	(Ref. 12, IPL Fig. 1) (Ref. 14, IPL Fig. 1)	

C. Calibrate Pressure Reducer Assembly (For Part Number 900-700-039-12) as follows:

(1) With the appropriate nut of Test Fixture 79T65 on the inlet port of the Pressure Reducer Assembly (3) mount the unit in a test setup similar to that shown in Figure 701.

(2) Connect both outlet ports (Ref. 12A, 14A, IPL Figure 1) of the Pressure Reducer Assembly (3) to the flowmeter fittings.

(3) With On-Off knob (Ref. 7, IPL Figure 2) in the OFF position, apply 200 pounds per square inch gage to the inlet port. There must be no audible leakage.

(4) Turn On-Off knob (7) to ON. The unit will open and begin to regulate (see outlet gage and flowmeter).

NOTE: An adapter, Fluid Power, Inc. (FSC 99227) Part No. 2305, must be connected to outlets (12A, 14A) when measuring flow values.

(5) With valve #4 open, valve #1 closed, subject the Pressure Reducer to the inlet pressure listed in TABLE 502, remove button plug (Ref. 3, IPL Figure 2), and adjust regulated pressure as necessary using setscrew (5). Turn setscrew (5) clockwise to increase and counterclockwise to decrease pressure. Repeat until the flow is within the limits of TABLE 502 for outlet (12A) and the outlet pressure on gage connected to outlet (14A) is within 50 ±5 pounds per square inch. Make certain that there is no leakage at the disconnect fittings since this would affect the pressure reading. If the flow and pressure requirements cannot be obtained simultaneously, the outlet disconnects should be removed from the pressure reducer and rechecked per the flow test in ASSEMBLY. Since the adjustment of setscrew (5) affects the flows of Steps (5) and (6), it is necessary to repeat Steps (5) and (6) until both flow requirements are met without further adjustment.

(6) With valve #1 open, valve #4 closed, subject Pressure Reducer to the inlet pressure listed in TABLE 502, remove button plug (Ref. 3, IPL Figure 2), and adjust regulated pressure as necessary using setscrew (5). Turn setscrew (5) clockwise to increase and counterclockwise to decrease pressure. Repeat until the flow is within the limits of TABLE 502 for outlet (14A). Since the adjustment of setscrew (5) affects the flows of Steps (5) and (6), it shall be necessary to repeat Steps (5) and (6) until both flow requirements are met without further adjustment.

TABLE 502

PRESSURE AND FLOW (900-700-039-12)			
Inlet Pressure (pounds per square inch gage)	Flow (O_2) (liters per minute)		
	Min.		Max.
1800 ±100	8.4 2.7	(Ref. 12A, IPL Fig. 1) (Ref. 14A, IPL Fig. 1)	9.3 3.0

D. Perform the Pressure Reducer Assembly Test as follows:

NOTE: An adapter, Fluid Power, Inc. (FSC 99227), Part No. 2305, must be connected to outlets (12, 14) when measuring flow values.

NOTE: On Cylinder Assembly 900-700-039-29, outlet (12B) must be capped for this calibration. Insure that outlet (12B) does not leak.

(1) Flow Regulation Test (for Part Number 900-700-039-04, -06, -29)

(a) Mount the Assembly in a test setup similar to that shown in Figure 701.

(b) Connect the Assembly constant flow disconnects (Ref. 12, 14, IPL Figure 1) through flowmeter #6.

(c) With On-Off knob (Ref. 7, IPL Figure 2) in the ON position, valve #4 open, valve #1 closed, the Assembly must be subjected to and comply with the requirements of TABLE 501 for outlet (12). Close valve #4, open valve #1, and repeat the test for outlet (14).

(2) Flow Regulation Test (For Part No. 900-700-039-12)

NOTE: An adapter, Fluid Power, Inc. (FSC 99227), Part No. 2305, must be connected to outlet (12A, 14A) when measuring flow values.

(a) Mount the Assembly in a test setup similar to that shown in Figure 701.

(b) Connect the Assembly constant flow disconnects (Ref. 12A, 14A, IPL Figure 1) through flowmeter #6.

(c) With On-Off knob (Ref. 7, IPL Figure 2) in the ON position, valve #4 open, valve #1 closed, the Assembly must be subjected to and comply with the requirements of TABLE 502 for outlet (12A). Close valve #4, open valve #1, and repeat the test for outlet (14A).

(3) On-Off Test

(a) Mount the Assembly in a test setup similar to that shown in Figure 701.

(b) With valves #1 and #4 closed and with an inlet pressure of 1800 ±100 pounds per square inch gage applied, turn On-Off knob (Ref. 7, IPL Figure 2) to OFF.

(c) Outlet pressure shall decay to zero.

(d) Repeat this test with an inlet pressure of 200 ±25 pounds per square inch gage.

(4) Internal Leakage Test

(a) Mount the Assembly in a test setup similar to that shown in Figure 701.

(b) Turn On-Off knob (Ref. 7, IPL Figure 2) to OFF.

(c) Seal the Assembly in the sealed chamber with valve #1 and #4 closed and valve #3 open. With an inlet pressure of 1800 ±100 pounds per square inch gage applied, there must be no leakage as indicated by flowmeter #3.

(d) Repeat this test with an inlet pressure of 100 ±10 pounds per square inch gage.

(e) With an inlet pressure of 1800 ±100 pounds per square inch gage applied, there shall be no leakage as indicated by flowmeter #3.

(5) External Leakage Test

(a) Mount the Assembly in a test setup similar to that shown in Figure 701.

(b) Turn On-Off knob (Ref. 7, IPL Figure 2) to ON.

(c) Seal the Assembly in the leakage test chamber with valve #3 open and with outlets (Ref. 12, 12A, 12B, 14, 14A, IPL Figure 1) disconnected.

(d) With an inlet pressure of 1800 ±100 pounds per square inch gage applied, there shall be no leakage as indicated by flowmeter #3.

(e) Repeat this test with an inlet pressure of 100 ±10 pounds per square inch gage.

(6) Gage Accuracy Test

(a) Mount the Assembly in a test setup similar to that shown in Figure 701.

(b) Turn On-Off knob (Ref. 7, IPL Figure 2) to OFF and apply an inlet pressure of 2000, 1500, 1000, and 500 pounds per square inch gage.

(c) The gage on the Assembly shall indicate the correct pressures within ±60 pounds per square inch gage.

E. Using a suitable holding fixture, clamp cylinder (Ref. 4 or 4A, IPL Figure 1) securely in a vise. Remove protective cover (not illustrated) from cylinder (4) or (4A).

F. Install O-ring (Ref. 18, IPL Figure 2) and cap (17).

G. Place the carrying strap (Ref. 5, IPL Figure 1) loop over the neck of the cylinder (4 or 4A). Apply Scotch Brand Pipe Thread Sealant Tape to the threads of the Pressure Reducer (3). Apply a film of Krytox 240 AZ over the Sealant Tape to prevent galling. Install the Pressure Reducer (3) into the neck of cylinder (4) or (4A). Torque the Pressure Reducer (3) to 400 to 450 in-lbs.

H. Install clamp (2). Clamp screw is to be oriented 90 degrees in either direction away from the face of the gage (13).

I. Remove the Oxygen Cylinder Assembly from the vise.

J. Perform the Oxygen Cylinder Assembly Test (see TESTING).

K. Store or ship the Oxygen Cylinder Assembly (see STORAGE INSTRUCTIONS).

TABLE 503

ASSEMBLY MATERIALS AND COMPOUNDS*	
Halocarbon Grease, Series 25-5S	Halocarbon Products Corporation Hackensack, New Jersey
Scotch Brand Pipe Thread Sealant	Minnesota Mining and Mfg. St. Paul, Minnesota
Leak Detector Solution	MIL-L-25567, Type I
Krytox 240 AZ Fluorinated Grease	Petroleum Chemicals Division E. I. duPont de Nemours & Co. Wilmington, DE 19898

*Equivalent Materials/Components may be used.

FITS AND CLEARANCES

1. The height of the pin (Ref. 44, IPL Figure 2) from face of inlet body must be between 0.050 and 0.060 inches.

2. Torque the Pressure Reducer (Ref. 3, IPL Figure 1) to 400-450 lb-in.

TABLE 601

FITS AND CLEARANCES								
Figure and Item Number	Dim.	DESIGN (MANUFACTURING) LIMITS				SERVICE (WEAR) LIMITS		
		Diameter		Diametrical Clearance		Service Limits		
		Min.	Max.	Min.	Max.	Min.	Max.	Clearance
2-16	ID	1.562	1.567	0.002	0.010		1.572	0.020
2-20	OD	1.557	1.560			1.552		
2-20	ID	1.062	1.064	0.007	0.011		1.066	0.015
2-27	OD	1.053	1.055			1.051		

TESTING

WARNING: THE CLEANLINESS REQUIREMENTS OF CLEANING MUST BE OBSERVED DURING ALL TESTING OF THE PRESSURE REDUCER IN ORDER TO PREVENT HAZARDOUS HYDROCARBON CONTAMINATION.

1. Test Equipment and Conditions

A. Equipment

The equipment necessary to test the Pressure Reducer consists of a Test Stand, as shown in Figure 701.

Test equipment tolerances are as follows:

(1) Pressure Gages ± 2 percent

(2) Flowmeters ± 1 percent

B. Conditions

All tests are to be performed at an atmospheric pressure of between 28 and 32 inches of mercury, at temperatures of between plus 60 degrees and plus 90 degrees Fahrenheit, and a relative humidity of not more than 95 percent.

2. Oxygen Cylinder Assembly Test

A. Leakage Test

(1) With On-Off knob (Ref. 7, IPL Figure 2) in the OFF position, remove cap (Ref. 10, IPL Figure 1), and connect the oxygen supply to the Oxygen Cylinder Assembly fill check valve using fill adapter, Sabre Industries Part No. 525-900-085 or equivalent.

CAUTION: THE SABRE INDUSTRIES FILL VALVE AND FILL VALVE ADAPTER COMPLY WITH THE LATEST REQUIREMENTS OF SAE AEROSPACE STANDARD AS 1046. SOME OF THE EARLIER FILL VALVE ADAPTERS OF OTHER MANUFACTURERS MAY NOT COMPLY WHICH COULD RESULT IN AN IMPROPER FIT. IF THIS OCCURS, OBTAIN A SABRE INDUSTRIES FILL VALVE ADAPTER, PART NO. 525-900-085.

(2) Fill the Oxygen Cylinder Assembly to 1850 ± 50 pounds per square inch gage.

(3) Check the Oxygen Cylinder Assembly for leakage using Leak Detector Solution conforming to MIL-L-22567, Type 1.

(4) No leakage is allowed from the Oxygen Cylinder Assembly or its components.

(5) Disconnect oxygen supply and replace cap (Ref. 10, IPL Figure 1). Torque cap (10) to 90-100 lb-in and check for no leakage.

NOTE: It is not necessary to perform para. B, C, or D, below during routine filling of the Oxygen Cylinder Assembly (Ref. 1, 1A, 1B, IPL Figure 1).

B. Flow Test (For Part Number 900-700-039-04, 06, -29)

NOTE: An adapter, Fluid Power, Inc. (FSC 99227), Part No. 2305, must be connected to outlets (12, 14) when measuring flow values.

NOTE: On Cylinder Assembly 900-700-039-29, outlet (12B) must be capped for this calibration. Insure that outlet (12B) does not leak.

(1) Connect the Oxygen Cylinder Assembly to a test setup similar to that shown in Figure 701, less the Leak Chamber and regulated pressure source.

(2) Connect the constant flow outlets (Ref. 12, 14, IPL Figure 1) through flowmeter #6.

(3) With On-Off knob (Ref. 7, IPL Figure 2) in the ON position, valve #4 open, valve #1 closed, the Oxygen Cylinder Assembly must be subjected to and comply with the requirements of TABLE 501 for outlet (12). Close valve #4, open valve #1, and repeat the test for outlet (14).

C. Flow Test (For Part Number 900-700-039-12)

NOTE: An adapter, Fluid Power, Inc. (FSC 99227), Part No. 2305, must be connected to outlets (12A, 14A) when measuring flow values.

(1) Connect the Oxygen Cylinder Assembly to a test setup similar to that shown in Figure 701, less the Leak Test Chamber and regulated pressure source.

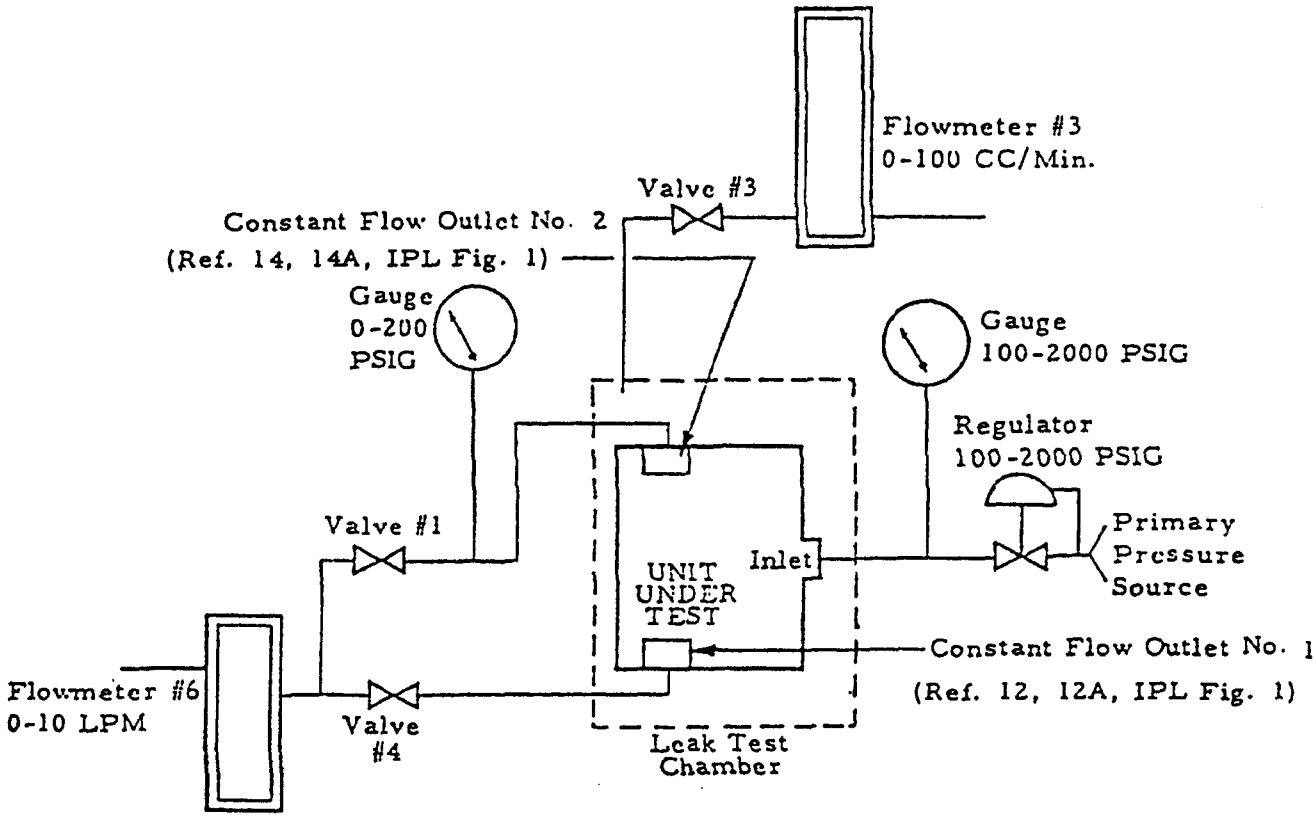
(2) Connect the constant flow outlets (Ref. 12A, 14A, IPL Figure 1) through flowmeter #6.

(3) With On-Off knob (Ref. 7, IPL Figure 2) in the ON position, valve #4 open, valve #1 closed, the Oxygen Cylinder Assembly must be subjected to and comply with the requirements of TABLE 502 for outlet (12A). Close valve #4, open valve #1, and repeat the test for outlet (14A).

D. Cylinder Pressure

(1) Record the pressure and leave the Oxygen Cylinder Assembly pressurized for a minimum of 14 days.

(2) The pressure in the cylinder shall not decay more than 50 pounds per square inch gage by the end of 14 days.



Schematic for Test Stand.
Figure 701.

TROUBLESHOOTING

Refer to TABLE 801 for assistance in determining and correcting the cause of pressure reducer regulator malfunction.

TABLE 801 (Sheet 1 of 2)

TROUBLESHOOTING CHART		
PROBLEM	PROBABLE CAUSE	REMEDY
1. Inward or outward leakage.	A. Leakage of main valve seat due to:	
	Damaged seat assembly (42A).	Replace seat assembly (42A).
	B. Leakage of pressure due to:	
	Gage (Ref. 13, IPL Figure 1), Check Valve Assy (Ref. 6, IPL Figure 1), Outlet Quick Disconnect (Ref. 12, 12A, 12B, 14, 14A, IPL Figure 1), and Vent Port (Ref. 16, IPL Figure 1) not sealed.	Tighten or reseal threads.
	Spring (Ref. 22, IPL Figure 2) damaged or distorted.	Replace spring (22).
	Pressure Reducer not assembled correctly.	Reassemble. Pay particular attention to positioning of parts and application of sealants and lubricants.
2. Outlet pressure does not decay to zero when the reducer is turned to the OFF position with inlet pressure applied.	Faulty relief valve (Ref. 33, IPL Figure 2).	Replace relief valve (33).

TABLE 801 (Sheet 2 of 2)

TROUBLESHOOTING CHART		
PROBLEM	PROBABLE CAUSE	REMEDY
3. Flows do not meet requirements of TABLE 501 or 502.	A. Pressure reducer is out of adjustment.	Readjust setscrew (Ref. 5, IPL Fig. 2).
	B. Faulty self-sealing quick disconnects (Ref. 12, 12A, 12B, 14, or 14A, IPL Figure 1).	Replace self-sealing quick disconnects (12, 12A, 12B, 14 or 14A).

STORAGE INSTRUCTIONS

1. The pressure in the cylinder must be 1850 ± 50 pounds per square inch gage with the On-Off knob in the OFF position. Tag the cylinder as follows:

   WARNING: DO NOT ALLOW CONTAMINANTS OF ANY KIND TO BE USED ON OR ABOUT THE OXYGEN CYLINDER ASSEMBLY.

2. Place male or female plastic protectors over all exposed openings on the Oxygen Cylinder Assembly and place the Oxygen Cylinder Assembly into a plastic bag. Pack in a padded carton for storage or shipment. Seal the carton and tag with the Oxygen Cylinder Assembly part number, serial number, and test data.

3. The Oxygen Cylinder Assembly may be stored indefinitely at ambient temperatures within the range of -65 to 165 degrees Fahrenheit. Any Oxygen Cylinder Assembly stored for 36 months or longer should be subjected to, and comply with, the requirements of the Oxygen Cylinder Assembly Test (see TESTING) before being placed in service.

4. In addition to the above recommendations, the Oxygen Cylinder Assembly is subject to the test requirements and regulations required by the U.S. Department of Transportation for cylinders with a rating of 3AA1800 for the 900-700-039-04, -29 Oxygen Cylinder Assemblies and 3AA1800 for the 900-700-039-06, -12 Oxygen Cylinder Assemblies. These requirements are contained in Title 49, Code of Federal Regulations.

   NOTE: The 3AA Cylinders shall be retested every 5 to 10 years. Refer to Title 49, Code of Federal Regulations for the specific service life and retest period. The preceding information is reflected in the current (January 1, 1969) Title 49, Code of Federal Regulations and is subject to change.

SPECIAL TOOLS, FIXTURES AND EQUIPMENT

WARNING: THE CLEANLINESS REQUIREMENTS OF CLEANING MUST BE OBSERVED TO PREVENT HAZARDOUS HYDROCARBON CONTAMINATION OF THE EQUIPMENT LISTED IN TABLE 1001.

TABLE 1001

SPECIAL TOOLS, FIXTURES AND EQUIPMENT	
TOOL NUMBER	NOMENCLATURE
79T65	Test Fixture
147T270	Punch
197T41	Wrench
525-900-085*	Fill Valve Adapter

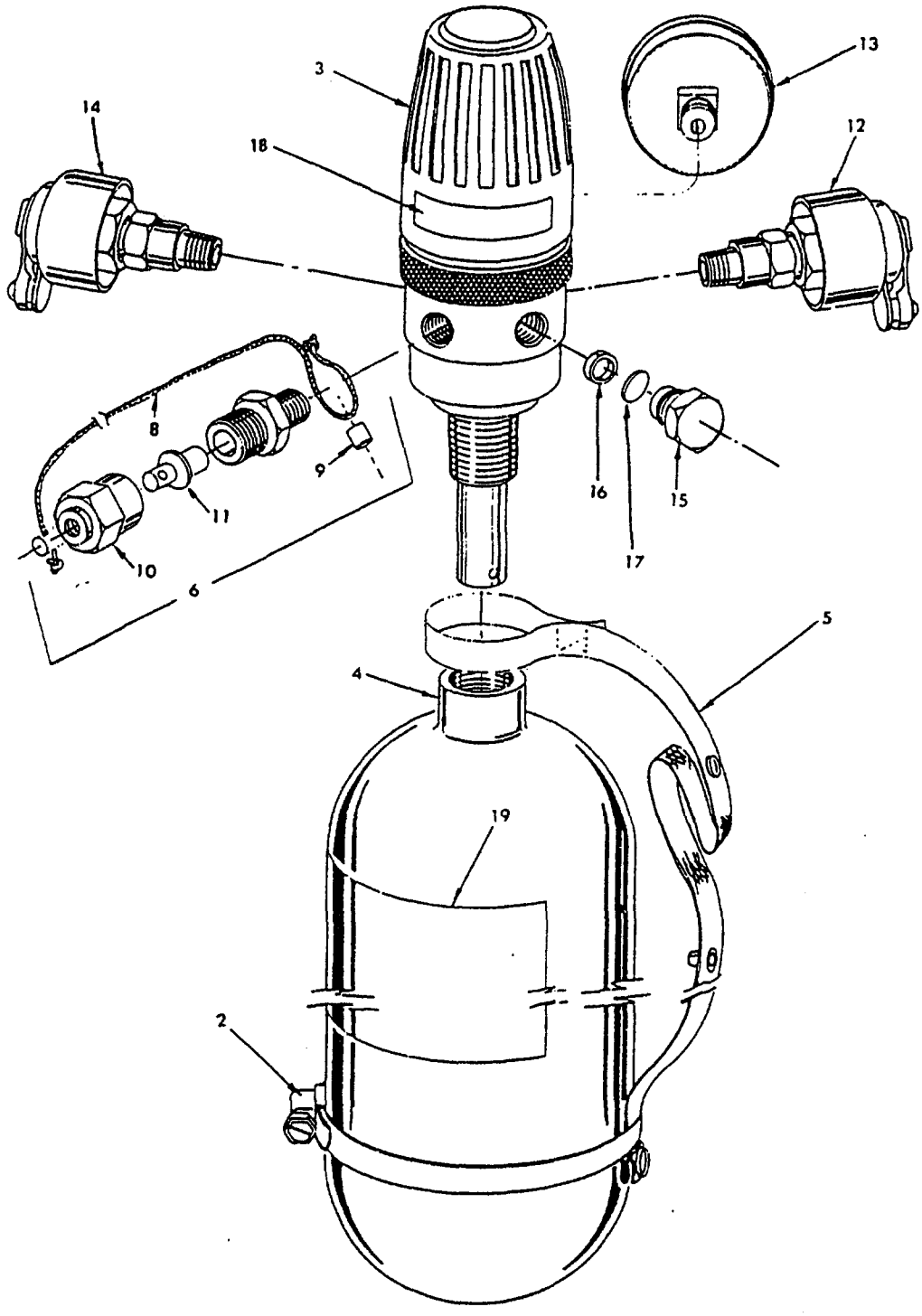
*Refer to CAUTION note, para. 2.A. in the TESTING section of this manual.

ILLUSTRATED PARTS LIST

1. Vendor Code

Vendor Code	Manufacturers' Names and Addresses
00287	C E M CO, Inc. 24 School Danielson, Connecticut 06239
08484	Breeze Corp. Inc. 700 Liberty Avenue Union, New Jersey 07083
79136	Waldes Kohinoor, Inc. 47-16 Austel Place Long Island City, New York 11101
02217	Puritan-Bennett 111 Penn Street El Segundo, California 90245

2. Parts List (See IPL Figure 1.)

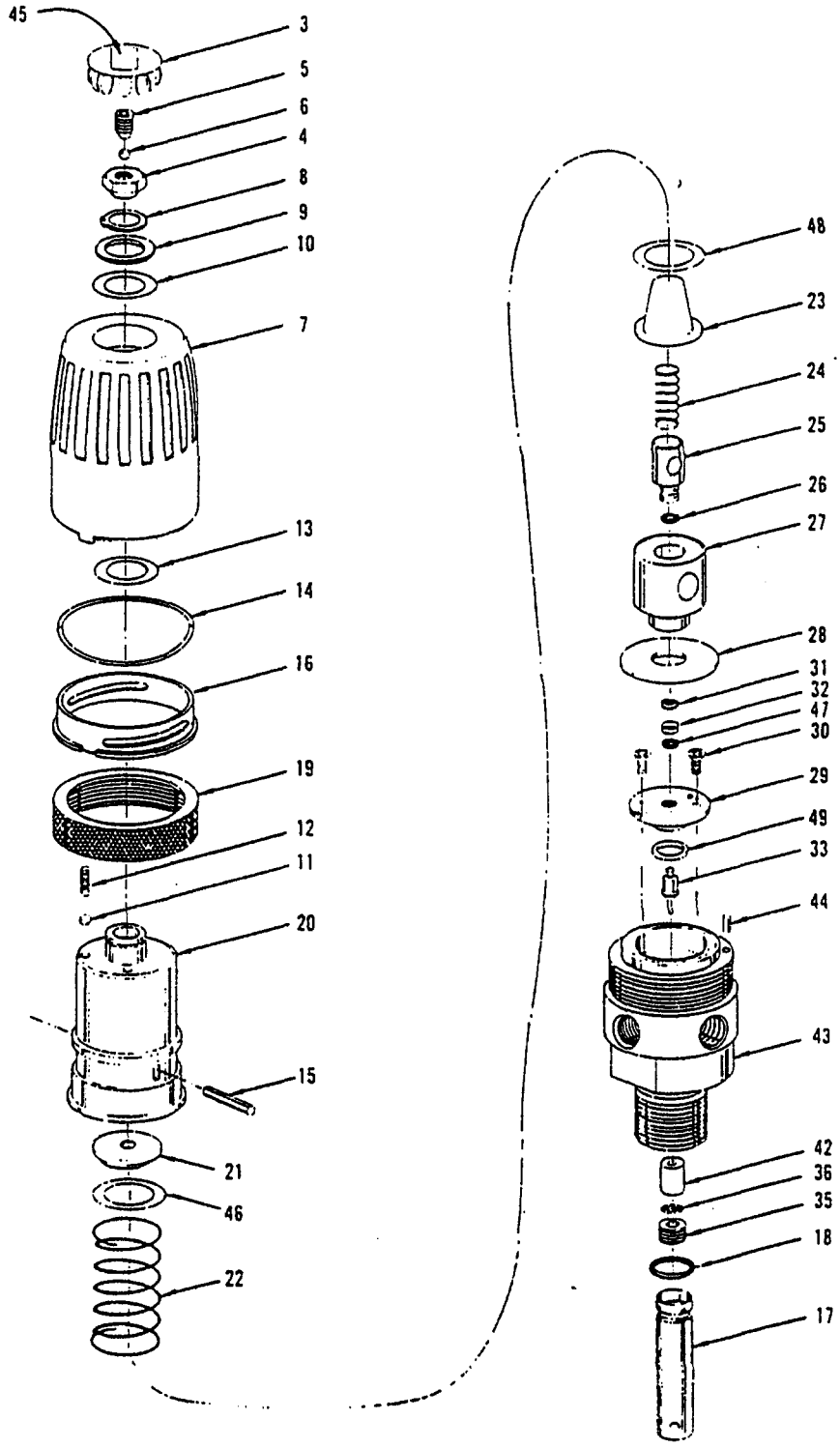


Portable Oxygen Cylinder Assembly.
Figure 1.

PART NO. 900-700-039

Fig. Item	Part Number	Nomenclature 1 2 3 4 5 6 7	Usage Code	Units per Assy
1-1	900-700-039-04	CYLINDER ASSY, OXYGEN PORTABLE	A	RF
-1A	900-700-039-06	CYLINDER ASSY, OXYGEN PORTABLE	B	RF
-1B	900-700-039-12	CYLINDER ASSY, OXYGEN PORTABLE	C	RF
-1C	900-700-039-29	CYLINDER ASSY, OXYGEN PORTABLE	D	RF
2	QS200M56S	. CLAMP (V08484) (510-900-003-01)		1
3	904-002-527-02	. REDUCER, PRESSURE, ON-OFF OXYGEN (For details see FIGURE 2)		1
4	904-002-475-04	. CYLINDER	A,D	1
-4A	904-002-475-07	. CYLINDER	B,C	1
5	904-002-588	. STRAP, CARRYING		1
6	585-900-015	. VALVE ASSY, CHECK		1
-7	904-003-170	. . ASSEMBLY, CAP RETAINER		1
8	023-900-001	. . . BRAID		1
9	440-900-003-09	. . . SLEEVE		1
10	525-900-038	. . . CAP		1
11	904-003-169	. . . PLUG		1
12	525-900-093-01	. OUTLET (NO. 1), QUICK-DISCONNECT, SELF-SEALING	A,B	1
-12A	525-900-093-07	. OUTLET (NO. 1), QUICK-DISCONNECT, SELF-SEALING	C	1
-12B	110111-09	. OUTLET (NO. 1), QUICK-DISCONNECT, SELF-SEALING (V02217) (525-900-052-01)	D	1
13	530-900-004	. GAGE		1
14	525-900-093-03	. OUTLET (NO. 2), QUICK-DISCONNECT, SELF-SEALING	A,B,D	1
-14A	525-900-093-04	. OUTLET (NO. 2), QUICK-DISCONNECT, SELF-SEALING	C	1
15	525-900-087	. PORT, VENT		1
16	447-900-032	. WASHER		1
17	904-003-415	. DISC, RUPTURE		1
18	539-900-022	. PLATE, IDENTIFICATION		1
19	539-900-043	. PLATE, INSTRUCTION		1

-Item not illustrated.



On-Off, Oxygen Regulator, Pressure Reducer.
Figure 2.

Fig. Item	Part Number	Nomenclature 1 2 3 4 5 6 7	Usage Code	Units per Assy
2-1	904-002-527-02	REDUCER, PRESSURE, ON-OFF OXYGEN REGULATOR (For NHA, see FIGURE 1)		RF
2	(Deleted)			
3	525-950-109	. PLUG, BUTTON		1
4	415-900-023	. NUT		1
5	435-622-610	. SETSCREW, HEADLESS, HEXAGON SOCKET, CUP POINT, STEEL, CADMIUM PLATED, 1/4-28UNF-3A x 5/8		1
6	595-601-125	. BALL		1
7	150-900-029	. KNOB, ON-OFF		1
		Attaching Parts		
8	5100-56H PASSIVATE	. RING, RETAINING (V79136) (425-603-056)		1
9	447-900-026-01	. WASHER, FLAT		1
10	447-900-027-01	. WASHER		1
		- - - * - - -		
11	595-601-125	. BALL		1
12	577-900-058	. SPRING, DETENT		1
13	447-900-027-01	. WASHER		1
14	577-900-059	. SPRING, WASHER		1
15	420-900-017	. ROD, ON-OFF		1
16	904-002-522	. CAM		1
17	040-900-036	. CAP, END		1
18	A12TH1217	. O-RING (V95272)(560-634-012)		1
19	904-002-521	. RETAINER, RING		1
20	904-002-464	. HOUSING		1
21	904-002-465	. PLATE, RETAINER		1
22	577-900-105	. SPRING, PISTON		1
23	904-002-472	. RETAINER, SPRING		1
24	577-900-051	. SPRING, ON-OFF		1
25	904-002-470	. PISTON, ON-OFF		1
26	A6TH1166	. O-RING (V95272)(560-625-006)		1
27	904-002-466	. PISTON		1
28	517-900-001	. DIAPHRAGM		1
29	595-900-036	. GUIDE, VALVE		1

Fig. Item	Part Number	Nomenclature 1 2 3 4 5 6 7	Usage Code	Units per Assy
		Attaching Parts		
30	435-633-203	. SCREW, MACHINE, FLAT HEAD 100 DEGREE, CROSS RECESSED 4-40 NC-2A x 3/16		2
		- - - * - - -		
31	A3TH1165	. O-RING (V95272)(560-618-003)		1
32	904-002-598-01	. RETAINER		1
33	585-900-027	. VALVE, RELIEF		1
34	Deleted			
35	435-900-041	. SETSCREW		1
36	520-900-010	. FILTER		1
37	Deleted			
38	Deleted			
39	Deleted			
40	Deleted			
41	Deleted			
42	Deleted			
42A	904-003-175	. SEAT ASSEMBLY		1
43	904-002-759	. BODY, INLET		1
44	062-0187HBS	. PIN, SPIROL (V00287) (420-601-003)		1
45	159-900-028	. DECAL		1
46	447-900-027-06	. WASHER		1
47	A8TH1166	. O-RING (V95272)(560-625-008)		1
48	447-900-027-06	. WASHER		1
49	A12TH1217	. O-RING (V95272)(560-634-012)		1

LIGHT OVERHAUL

1. Inspection and Test

Any Oxygen Cylinder Assembly that can pass a visual inspection for obvious external damage, and comply with the Oxygen Cylinder Assembly Test in TESTING, is suitable for use.

2. Troubleshooting

Defects can be located by using the Troubleshooting Chart, TABLE 801, in conjunction with TESTING.

3. Repair

TABLES 1301 and 1302 indicate the various sections of the Oxygen Cylinder Assembly (Ref. 1-1, -1A, or -1B, IPL Figure 1) and the Pressure Reducer (Ref. 2-1, IPL Figure 2) that can be independently repaired and the necessary calibration and testing required to insure that the particular assembly involved has been returned to usable condition.

TABLE 1301

REPAIR OF OXYGEN CYLINDER ASSEMBLY (900-700-039-04, -06, -12, -29)		
Item Numbers of parts to be removed (See IPL Figure 1)	Disassembly per indicated steps of DISASSEMBLY	Assemble per indicated steps of ASSEMBLY
2 thru 5	1A thru 1E	2E, 2G thru 2J
6, 8 thru 11	1A thru 1C, 1F, 1G	1L thru 1Q, 2J
12, 12A, 12B, 14, 14A	1A, 1B, 1C, 1H	1J, 1K, 2J
13	1A, 1B, 1C, 1H	1I, 2J
15 thru 17	1A, 1B, 1C, 1H	1I, 2J
18, 19	1I	2A

TABLE 1302

REPAIR OF PRESSURE REDUCER REGULATOR		
Item Numbers of parts to be removed (See IPL Figure 2)	Disassemble per indicated steps of DISASSEMBLY	Assemble per indicated steps of ASSEMBLY
3 and 45	2A, 2J	1VV
3 thru 16	2A, 2B	1X, 1Z, 1MM thru 1VV, 2B thru 2G, 2I, 2J
3 thru 28 (except 17 and 18)	1B thru 1E, 2A thru 2E	1U thru 1VV, 2B thru 2G, 2I, 2J
3 thru 33 (except 17 and 18)	1B thru 1E, 2A thru 2G	1S thru 1VV, 2B thru 2G, 2I, 2J
17 and 18	1B thru 1E, 2C	2E thru 2G, 2I, 2J
35 thru 44	Complete Assembly	Complete Assembly

ADAMS RITE SABRE
INTERNATIONAL
540 WEST CHEVY CHASE DRIVE
GLENDALE, CALIFORNIA 91204, USA

SERVICE PROCEDURE

OXYGEN - PORTABLE
- CYLINDER ASSEMBLY, CONSTANT FLOW -
PART NUMBER 900-700-039-021

1. Effectivity

This service procedures affects all PN 900-700-039-021 constant flow portable oxygen cylinder assemblies manufactures by Adams Rite Sabre International (formerly Sabre Industries) of Glendale, California.

2. Reason

An overhaul manual specifically written for this end item does not exist.

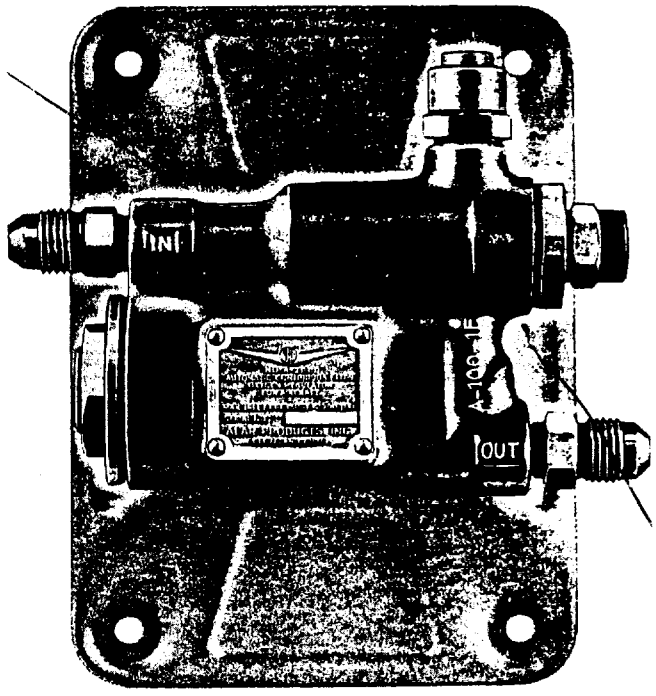
3. Instructions

To service this product, refer to IPL Figure 1, on page 1103 of Adams Rite Sabre International "Overhaul Manual With Illustrated Parts List," 35-31-08, and incorporate the following changes:

Fig. Item	Part Number	Nomenclature	Usage Code	Units Per Assy
-1D	900-700-039-21	CYLINDER ASSY, Oxygen, portable	E	RF
4	904-002-475-04	. CYLINDER	A, D, E	1
-12C	525-900-093-BN	. OUTLET, (No. 2)	E	1
-14B	525-601-002	. PLUG, Pipe 1/8 NPT hex socket (Outlet No. 1)	E	1

HANDBOOK
OF
INSTRUCTIONS
for

ARMY TYPE A-11, AN-6010-1A
ALAR A-100 AND A-2000
CONTINUOUS FLOW OXYGEN REGULATORS



ALAR PRODUCTS INC.
9100 Valleyview Road
Macedonia, Ohio 44056
A/C 216 - 467-4151

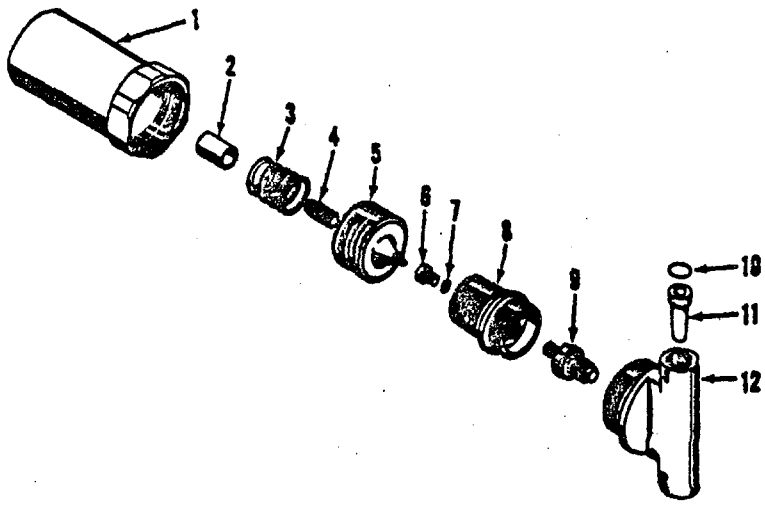
A L A R I N C .

Supplement
to Handbook of Instructions
for
ALAR OXYGEN REGULATORS

ALAR PRODUCTS INC.

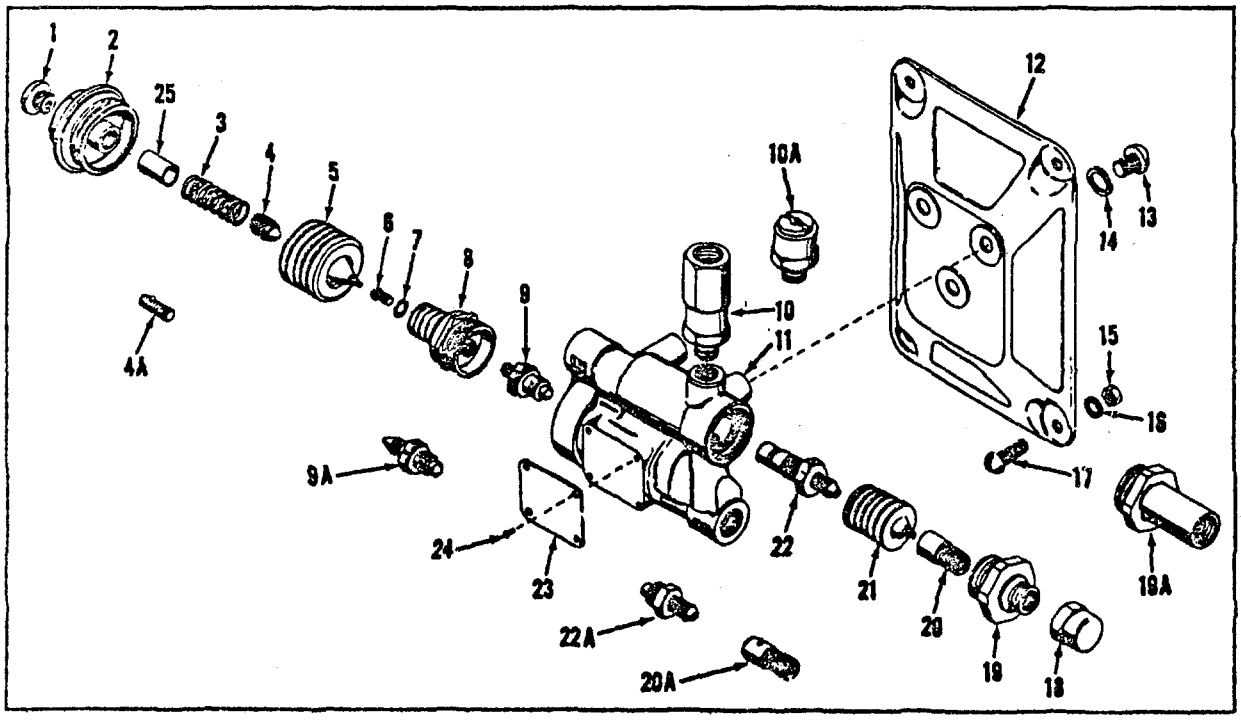
ALAR PRODUCTS INC.
9100 Valleyview Road
Macedonia, Ohio 44056
A/C 216 - 467-4151

ONE-STAGE REGULATOR – MODEL 5505A



Item No.	Part No.	Description	No. Req.
1	5505B12	HOUSING ASSEMBLY	1
2	5505A20	BUSHING	1
3	5505A22	*SPRING*	1
4	5505A18	SCREW, Adjustment	1
5	5505A17	BELLOWS ASSEMBLY, Compensating	1
6	5505A21	SCREW, Sealing	1
7	5903-1/2	O-RING	1
8	5505A10	BELLOWS ASSEMBLY, Actuating	1
9	5505A6	VALVE ASSEMBLY	1
10	3011-72	RETAINING RING	1
11	3011-339	FILTER	1
12	5505B3	BODY	1

TWO-STAGE REGULATORS



Item No.	Part No.	Name	Model Code	No. Req.
1	A-100-6	CAP, Adjustment, second stage	A, C, E, F, H, J, L, N	1
	5505A24	CAP, Adjustment, second stage	B, D, G, I, K, M, O	1
2	A-100-5	CAP, Body, second stage	A, C, E, F, H, J, L, N	1
	5505A16	CAP, Body, second stage	B, D, G, I, K, M, O	1
3	A-100-18	SPRING, Minimum pressure	A, C, F, H, J, L, N	1
	5505A22	SPRING, Minimum pressure	B, D, G, I, K, M, O	1
4	A-100-7	SCREW, Adjustment, second stage	A, C, E, F, H, J, L, N	1
4A	5505A18	SCREW, Adjustment, second stage	B, D, G, I, K, M, O	1
5	A-100-D	BELLOWS ASSEMBLY, Compensating	A, C, F, H, J, L, N	1
	B-100-D	BELLOWS ASSEMBLY, Compensating	E	1
	5505A17	BELLOWS ASSEMBLY, Compensating	B, D, G, I, K, M, O	1
6	5505A21	SCREW, Sealing	A, B, C, D, G, H, I, J, K, M, O	1
7	5903-1/2	O-RING	A, B, C, D, G, H, I, J, K, M, O	1
8	5525A4	BELLOWS ASSEMBLY, Actuating	A, B, C, D, H, I, J, K	1
	A-100-E	BELLOWS ASSEMBLY, Actuating	E, F, L, N	1
	5505A10	BELLOWS ASSEMBLY, Actuating	G, M, O	1
9	5505A6	VALVE ASSEMBLY, Second stage	A, B, C, D, G, H, I, J, K, M, O	1
9A	B-100-G	VALVE ASSEMBLY, Second stage	E	1
	A-100-G	VALVE ASSEMBLY, Second stage	F, L, N	1
10	3007-1	VALVE ASSEMBLY, Relief	A, B, H, I, L, M, N, O	1
	A-100-K	VALVE ASSEMBLY, Relief	C, D, F, G, J, K	1
10A	B-100-K	VALVE ASSEMBLY, Relief	E	1
11	A-100-1F-2M	BODY	A, B, C, D, F, G, H, I, J, K, L, M, N, O	1
	A-100-1F	BODY	E	
12	A-100-10	PLATE, Mounting	A, B, C, D, E, F, G, H, I, J, K, L, M, N, O	1
13	A-100-11	SCREW, Mounting plate	A, B, C, D, E, F, G, H, I, J, K, L, M, N, O	3
14	AN936B416	WASHER, Lock, mounting plate	A, B, C, D, E, F, G, H, I, J, K, L, M, N, O	3
15	AN340B10	NUT, Installation	E	4
16	AN936A10-B	WASHER, Lock, installation	E	4
17	AN515B10-8	SCREW, Installation	E	4
18	A-100-3	CAP, Adjustment, first stage	E, F, G, H, I, J, K, L, M, N, O	1
19	A-100-2	CAP, First stage	E, F, G, H, I, J, K, L, M, N, O	1
19A	3016-1	CAP, First stage	A, B, C, D	1
20	A-100-4	SCREW, Adjustment, first stage	E, F, G, H, I, J, K, L, M, N, O	1
20A	3016-2	SCREW, Adjustment, first stage	A, B, C, D	1
21	A-100-A	BELLOWS ASSEMBLY, Regulating	A, B, C, D, F, G, H, I, J, K, L, M, N, O	1
	B-100-A	BELLOWS ASSEMBLY, Regulating	E	1
22	A-2000-B	VALVE ASSEMBLY, First stage	A, B, C, D, F, G, H, I, J, K, L, M, N, O	1
22A	B-100-B	VALVE ASSEMBLY, First stage	E	1
23	1000	PLATE, Name	A, B, C, D	1
	B-100-8	PLATE, Name	E	1
	A-2000-5	PLATE, Name	F, G, H, I, J, K, L, M, N, O	1
24	AN535-00-35	SCREW, Drive	A, B, C, D, E, F, G, H, I, J, K, L, M, N, O	4
25	5505A20	BUSHING	B, D, G, I, K, M, O	1

NOTE: A100 and B100 part numbers are interchangeable.

MODEL IDENTIFICATION

Code	Model	Code	Model	Code	Model	Code	Model
A	3014	E	B100	I	A2000WA	M	A2000YA
B	3014A	F	A2000	J	A2000W1	N	A2000Y1
C	3016	G	A2000A	K	A2000W1A	O	A2000Y1A
D	3016A	H	A2000W	L	A2000Y		

NOTE: Models B100, A2000, A2000Y, and A2000Y1 are covered by instructions in basic handbook.

Actuating bellows (8) is mechanically connected to the second stage valve (9A) by means of a socket head screw on the valve stem.

During disassembly, after removing (1) thru (7), (25) may remain with (2) or (5), loosen bellows (8) but do not remove. Simultaneously back out bellows (8) while turning in valve stem by means of long series socket screw key for No. 10 set screw (3/32 hex). The reverse proceedure must be followed during reassembly. Place bellows in position to install, start threaded valve stem into bellows, "back" into place approximately 7 turns (relative to the bellows (8)) while turning bellows into place.

Threaded connection between valve and bellows provides an adjustment for minimum or "ground level" pressures. Turning the valve stem in (clockwise) will lower minimum presssures, out (counterclockwise) will raise them. Pressures will change about five (5) psi for one (1) turn with assemblies using the 5505A10 Bellows Assy, and about 10 psi for one (1) turn with the 5525A4 Bellows Assy.

Altitude in feet Above Sea Level	Delivery Pressure PSI Absolute	Flow at Alt. L/Min STP Conditions
0	19.5 ±2.5	1.1 ±0.2
10,000	24.0 ±2.5	2.1 ±0.2
20,000	33.5 ±2.5	3.0 ±0.2
30,000	40.0 ±2.5	3.6 ±0.2

Table III. Delivery Table for Models A-2000-W, A-2000-WA, A-2000W1, A-2000-W1A, 3014, 3014A, 3016, 3016A

The A-2000W, 3014 and 3016 series of regulators are designed to provide oxygen flows in accordance with CAR amendment 4b-3 to altitudes of 30,000 ft. Performance should be in accordance with Table III.

First Stage pressure is adjusted to maintain 45 to 75 psi.

Recommend Test Set-Up of fig. 4, rather than fig. 3, in basic handbook. It is more versatile and can be used for all models; fig. 3 is suitable for A-2000, A-2000Y, A-2000Y1, and B100 only.

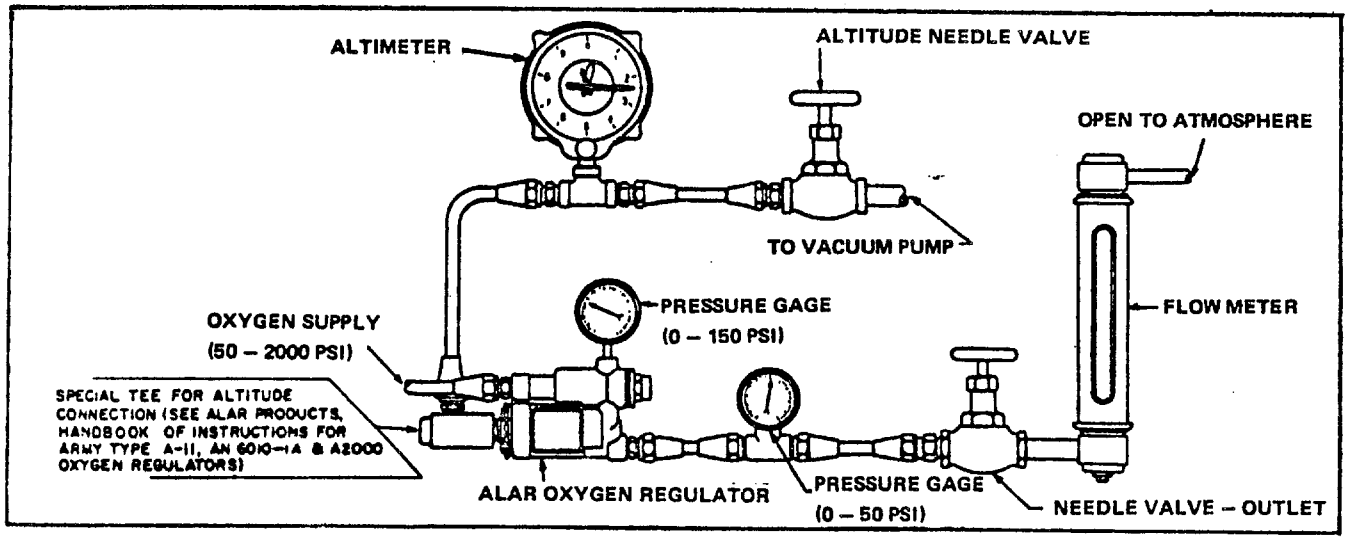


Figure 4. Regulator Test Set-Up.

MODEL 5505A ONLY

For 5505A, inlet pressure range is 50 to 75 psi, output pressures to be in accordance with Table IV.

Altitude in feet Above Sea Level	Delivery Pressure PSI Absolute	Flow at Alt. L/Min STP Conditions
0	19.5 ±2.5	1.1 ±0.2
10,000	20.5 ±2.5	1.8 ±0.2
14,000	22.5 ±2.5	2.0 ±0.2
17,000	24.0 ±2.5	2.1 ±0.2
20,000	25.6 ±2.5	2.2 ±0.2
30,000	29.0 ±2.5	2.6 ±0.2

Table IV, Delivery Table for Model 5505A

ALAR OXYGEN REGULATORS

Types A-2000, A-100, AN-6010-1, and USAAF A-11

INTRODUCTION

The ALAR regulator is an automatic, altitude compensating, continuous flow, multiple person, high pressure oxygen regulator. The purpose of this regulator is to reduce the pressure of oxygen in supply cylinders to a lower and more suitable working pressure and to automatically regulate this working pressure so that the proper amount of oxygen will be supplied to passengers and crew members of aircraft through fixed orifices in accordance with predetermined altitude and physiological requirements. These requirements were established by the Aero-Medical Unit of the Air Materiel Command, United States Army Air Forces, Wright Field, Dayton, Ohio, and are set forth in Army-Navy Specification AN-R-15a.

It must be emphasized that an ALAR Oxygen Regulator is a pressure regulator ONLY, and consequently does not directly regulate oxygen flow, the actual flow of oxygen being metered to each potential user by means of fixed orifices connected to the distribution system at each respective station. The regulator has ultimate control over the flow in that it maintains the required predetermined pressure behind each orifice, regardless of the number of metering orifices opened to oxygen flow.

The various models of the ALAR regulator are summarized briefly in Table I:

TABLE I

Type	Inlet Pressure Range	Altitude Operating Range	Maximum Flow Range L/Min. at 70F, 760mm
USAAF A-11	50 - 500 p.s.i.	8,000 - 30,000 ft.	0 - 36
Army-Navy AN-6010-1	50 - 500 p.s.i.	8,000 - 30,000 ft.	0 - 36
Alar A-100 Serial Nos. 0-999 inc.	50 - 500 p.s.i.	8,000 - 30,000 ft.	0 - 48
Serial Nos. from 1,000 on	50 - 500 p.s.i.	sea level - 30,000 ft.	0 - 48
Alar A-2000	35 - 2200 p.s.i.	sea level - 30,000 ft.	0 - 48

It will be noted that the A-2000 and A-100 regulators provide flow down to sea level, maintaining the flow obtained at 10,000 ft. in this range, while the A-11 and AN-6010-1 do not supply oxygen below about 8,000 ft. In addition, the A-2000 and A-100 will maintain greater flows without loss of distribution pressure, and the A-2000 will operate at inlet pressures up to 2200 p.s.i.

The ALAR regulator will, of course, supply increasing amounts of oxygen at altitudes above 30,000 ft., this altitude being the maximum at which the regulator is normally checked.

The ALAR regulators are completely automatic with no means of manual control necessary nor provided. NO MAINTENANCE IS REQUIRED, AND ANY ADJUSTMENTS MADE WITHOUT THOROUGH TESTS WITH CALIBRATED TEST EQUIPMENT WILL LEAD TO IMPROPER PERFORMANCE. Extreme conditions of high temperature, shock, age, or contaminated oxygen require tests and possible repair and calibration.

GENERAL CONSTRUCTION AND OPERATION

Basic components of the ALAR regulators and their function are as follows: (Reference is made to the cross section drawing and indicated part numbers shown on Figure 1.)

1. Forged aluminum regulator body (A-100-1F) housing all components of the regulator and having three mounting lugs to which the optional mounting plate (A-100-10) may be attached. The body has been forged solid and the interior cavities formed by machining in order that maximum density may be obtained to prevent leakage. Inlet and outlet bosses are tapped 1/8NPT so that standard fittings may be used for connecting the regulator to supply and distribution systems. Type AN-816 aluminum fittings (A-100-13) for 5/16 in. O.D. tubing are customarily supplied except for the inlet fitting of the A-2000 regulators. The same type fitting, but for 3/16 in O.D. tubing, is supplied on the inlet of the A-2000.

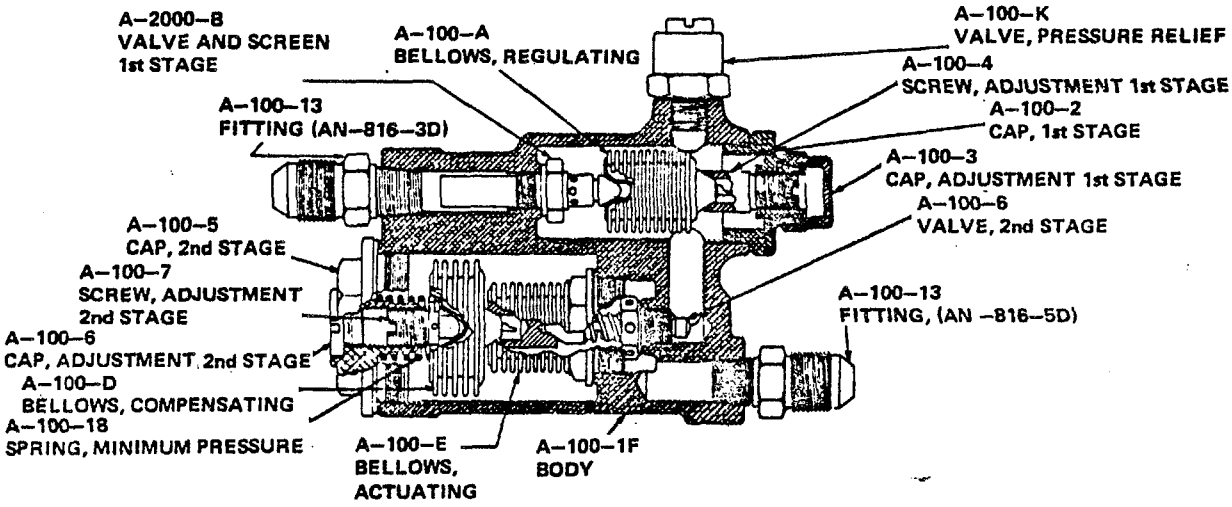


Figure 1

2. First stage or inlet pressure reduction system which reduces the widely varying inlet pressure to a first stage pressure varying not more than 30 p.s.i. In the A-2000 this system consists of a high pressure or first stage valve (A-2000-B) incorporating a very fine mesh screen to prevent entry of foreign particles, a pressure sensitive means of regulating bellows (A-100-A), a first stage adjustment screw (A-100-4), a first stage cap (A-100-2), and first stage adjustment cap (A-100-3). This regulating bellows is completely evacuated and sealed so that temperature changes will not affect regulation and any pressure change in the space surrounding this bellows will cause it to lengthen or collapse, thus opening and closing the valve, thereby producing the desired pressure regulation. The A-100, A-11 and AN-6010-1 regulators are the same except for the smaller first stage valve (A-100-B) protected by a separate screen (A-100-C).

3. Pressure relief valve (A-100-K) connected to the first stage chamber and serving as protection against valve leakage which might cause regulator failure. These valves have been set to open at a pressure between 110 and 150 p.s.i. Older model pressure relief valves (A-100-F) have been supplanted by this newer, improved model.

4. Actuating or delivery pressure regulating system which maintains the pressure level in the distribution system connected to the regulator outlet. Parts of this system are a second stage valve (A-100-G) and a pressure sensitive means or actuating bellows (A-100-E). Distribution system pressures acting on the inside of this bellows will cause it to expand or contract which will close or open the the valve until the force developed by the distribution pressure counterbalances the spring and variable atmospheric forces on the outside of the bellows.

5. Altitude compensating system having an atmospheric sensitive element which loads and unloads the delivery pressure regulating system in accordance with the altitude. This system consists of an evacuated compensating bellows (A-100-D), a second stage adjustment screw (A-100-7) and a second stage cap (A-100-5) with adjustment screw cap (A-100-6). In addition to being compressed by atmospheric pressure, this altitude compensating bellows is compressed between the actuating bellows and the adjustment screw so that any changes in atmospheric pressure will change the force on the actuating bellows thereby changing the pressure level in the distribution system.

6. Minimum pressure regulating system which takes up control of the delivery pressure system when the altitude drops below 10,000 feet and maintains the 10,000 foot oxygen delivery pressure on down to sea level. This system consists of a minimum pressure spring (A-100-18) compressed between the compensating bellows (A-100-D) and the second stage cap (A-100-5) and is incorporated in the A-2000 and ALAR A-100 regulators only.

NOTE: The AN-6010-1 regulators supplied to the United States Army Air Forces bore the Part No. " B-100," and many of the components of the regulator were numbered " B-100-" with a final letter or number to identify the component. The " B-100-" components are interchangeable with the " A-100-" components, differing only in minor construction features, and are now designated as " A-100-" components.

The ALAR regulators have been designed to provide long life and to have permanent adjustment for a minimum of inspection and maintenance. Non-metallic parts are kept to an absolute minimum and all exposed parts are made of non-corrosive materials. Permanent adjustment is obtained in the following manner: by using metal to metal sealing surfaces throughout, by having all reacting forces operate in line, by friction-locked adjustment screws, and by fixed spring location.

The delivery pressures to which the ALAR regulators are adjusted are shown in Table II. The pressures are those which will give physiologically adequate oxygen flow at all altitudes for an inactive person when the flow is metered through an 0.016 inch diameter metering orifice. Any deviation from the 0.016 inch diameter orifice will give a variation in Table II flows directly proportional to the change in orifice area. Thus, if some person such as a crew member required double the oxygen at all altitudes due to higher level of activity, he would, by connecting to the distribution system through a metering orifice of twice the area (0.023 in. dia.), receive the proper oxygen flow. The pressure tolerances indicated in Table II are specified to cover variations due to combinations of inlet pressure, temperature, flow demand, and vibration.

TABLE II

Altitude in Ft. above Sea Level	Delivery Pressure p.s.i. Absolute	Flow at Altitude in L/min. (Corrected to 760mm & 70 F) Thru 0.016" Dia. Orifice
0	19.5 ± 2.0	1.1 ± 0.2
10,000	18.5 ± 2.0	1.6 ± 0.2
20,000	23.1 ± 2.5	2.0 ± 0.2
30,000	26.5 ± 2.5	2.4 ± 0.2

INSTALLATION

The ALAR A-2000 is installed between the oxygen supply and the oxygen distribution systems. The supply can be at any pressure between 35 and 2200 p.s.i. and the oxygen flow taken from the distribution line can be anything from 0 to 48 liters per minute per regulator. The A-100 regulator will supply the same oxygen flow, but the inlet pressure must not exceed 500 p.s.i. The A-11 and AN-6010-1 also operate at a maximum inlet pressure of 500 p.s.i. but the oxygen flow should not exceed 36 liters per minute per regulator. The manner in which this flow is taken, whether it be through small or large metering orifices, has no effect on the regulator. Additional regulators may be installed in parallel to meet oxygen flow requirements in excess of the capacity of one regulator.

The oxygen line connecting supply cylinders to regulator inlet should be of sufficient strength to withstand the supply pressure, and the distribution line should be of sufficient size to handle the flow. Standard 5/16 in. O.D. metallic tubing will handle the full capacity of one ALAR regulator for lengths up to thirty feet without serious pressure drop.

Mounting dimensions are shown in Figure 2, and apply to all ALAR regulators.

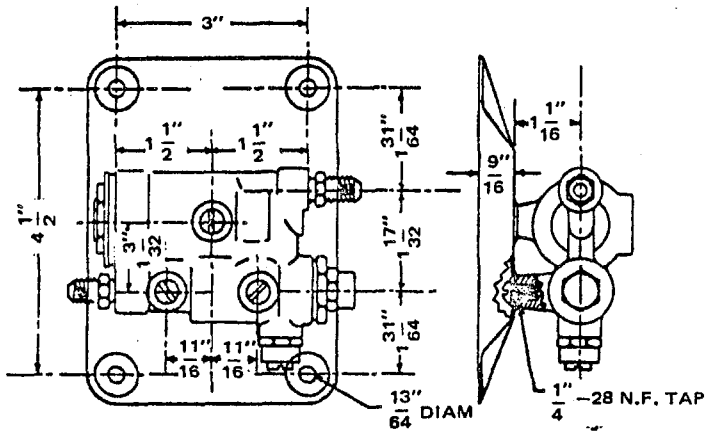


Figure 2

CAUTIONS

Care must be taken to see that the pressure supplied to the regulator does not exceed that for which the regulator is intended.

Under no circumstances should the outlet of an ALAR regulator be connected to an oxygen source which will create a pressure on the outlet side of the regulator greater than 40 p.s.i.

It is very important that all moisture and foreign particles be removed from the oxygen lines before a regulator is installed.

SPECIAL PRECAUTION:

EXTREME CARE MUST BE EXERCISED TO PREVENT ANY OIL OR GREASE FROM COMING IN CONTACT WITH OXYGEN EQUIPMENT, SINCE SPONTANEOUS COMBUSTION MIGHT OCCUR. SPECIAL COMPOUNDS ARE AVAILABLE FOR USE WITH HIGH PRESSURE OXYGEN.

INSPECTION AND TESTS

Although ALAR Oxygen Regulators are designed to operate several years without

inspection or maintenance, unusual conditions of use may warrant an inspection test. Actual failure of a regulator part or loss of calibration will require removal from the airplane and complete examination on a calibration stand. However, there are several inspection tests which can be performed while the regulator is installed in the aircraft.

The delivery pressure can be measured by substituting an accurate pressure gage for an oxygen mask and plugging into one of the outlets---preferably one nearest the regulator to eliminate false readings due to line drop. At least three other outlets for each regulator installed in the distribution system should be open and flowing in order to eliminate the slight elevation of pressure which occurs at zero flow in pressure regulators of this type due to forces necessary to effect 100% shut-off at the valve seat. Pressures thus obtained may then be compared with those of Table II to give an indication of performance at the altitude at which the reading is made. Also, the effect on full flow capacity pressure will be indicated by opening all outlets handled by the regulators being tested. Naturally this gives only one pressure measurement to indicate over-all performance, unless the pressures are taken in flight and over a sufficient range in altitudes to give more than one comparative reading. Extreme care must be taken to always correct for barometric pressure and convert to the absolute scale as indicated in Table II. The pressure gage should be accurate to within 1/4 p.s.i., otherwise a mercury manometer should be employed. Since the regulator is of simple direct acting design, a correct pressure reading for one altitude is a good indication of correct calibration for all altitudes.

The only other type of test that can be conducted on the regulator while installed, is a leakage test which can be made with soap solution or observed by pressure drop in the system isolated from the supply cylinders. From the above leakage and delivery pressure tests, the following regulator failures will be indicated:

1. Delivery pressures which are slightly out of limits given in Table II indicate loss of adjustment by the altitude compensating or minimum pressure regulating systems.

2. Excessively high delivery pressures at low flow (one or two outlets open) indicates dirt on the second stage valve seat (A-100-G). Some pressure elevation at zero flow is to be expected.

3. Excessively high pressure at full flow (20 passenger outlets or equivalent open) indicates loss of vacuum in the compensating bellows (A-100-D).

4. Exact location of leakage will be indicated by soap bubble test except at the second stage adjustment cap where internal leakage at the actuating bellows (A-100-E) is indicated. Also, leakage at the relief valve openings may indicate failure other than at the relief valve seat.

5. A small but steady leak at the relief valve indicates loss of adjustment of first stage, dirt on the first stage valve seat, or dirt on the relief valve seat.

6. A large flow from the relief valve indicates a break in the regulating bellows (A-100-A).

Any of the above outlined failures except leakage at fittings, which can be stopped by tightening, require that the regulator be dismantled from the plane before repair or recalibration can be made.

REPAIR AND CALIBRATION

IT IS RECOMMENDED THAT, IF REPAIR AND CALIBRATION ARE NECESSARY, THE REGULATOR BE RETURNED TO THE MANUFACTURER. However, if conditions require calibration be done by the user, the following paragraphs describe a simple method of recalibration.

Tools required for assembly and disassembly are a set of extra deep socket wrenches, small screw driver, and adjustable wrench. Any damaged assemblies must be replaced with a new assembly. On re-assembly, care must be taken to keep the regulator free from loose particles, oil, or dirt; and all aluminum to aluminum threads must be treated with an anti-sieze compound suitable for use with oxygen.

A simplified calibration set-up is shown in Figure 3, and the basic equipment required consists of the following:

1. A 35 to 2200 p.s.i. source of oxygen that may be accurately controlled at pressures up to 500 p.s.i.

2. A 0 to 150 p.s.i. pressure gage for connecting into the relief valve opening for measuring first stage pressures.

3. A 0 to 30 p.s.i. calibrated gage or equivalent mercury manometer to be installed in the outlet line for measuring regulator delivery pressures.

4. An altimeter, mercury manometer or vacuum gage to measure altitude conditions for calibration. It will be necessary to place the altimeter in a bell jar unless it has a well-constructed airtight case.

5. A globe valve to shut off altimeter and connection to second stage cap while leakage tests are being conducted.

6. A large capacity manual control needle valve having oilfree packing.

7. A source of vacuum capable of maintaining a vacuum of at least 22 inches of mercury with a flow of four cubic feet per minute.

8. Five special adapters will have to be made: (1) to connect the first stage pressure gage to the relief valve opening (5/16-32 NEF thread), (2), (3) and (4) are outlet fittings to house metering orifices equivalent to low and high flow distribution line conditions, and (5) a special Tee to connect the second stage adjustment cap opening (5/16-32 NEF thread) with a line leading to the downstream side of the metering orifice, one branch of the Tee being left open to prevent back pressures on the actuating and compensating bellows. The opening may be closed with a finger when altitude tests are conducted.

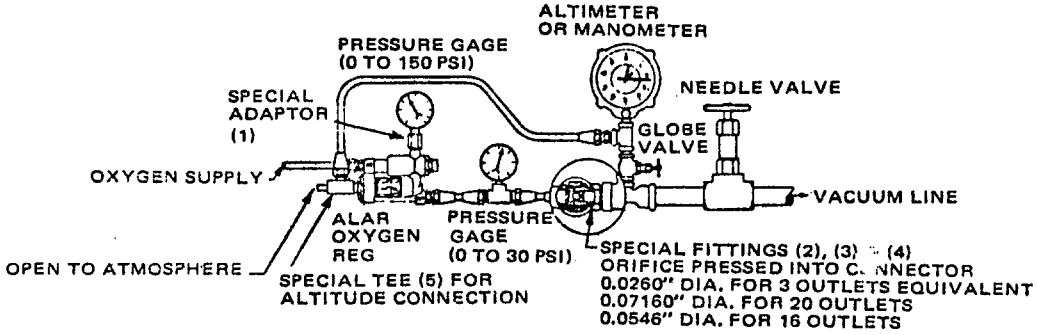


Figure 3

The calibration procedure is as follows:

1. Install the 3 outlet orifice in the line, adjust the oxygen inlet pressure to 90-110 p.s.i. and open the vacuum line sufficiently to remove the back pressure from the altitude gage and connection to the second stage cap. Then observe the first stage pressure on the gage installed in the relief valve opening. This pressure should be between 58 and 62 p.s.i. for A-2000 regulators and should be 65 to 70 p.s.i. for the A-100. If this pressure is not within the proper limits, shut off the inlet pressure, remove the first stage adjustment cap and turn the screw to a point where the pressure is within these limits when the inlet pressure is reapplied.

Adjustment of A-11 and AN-6010-1 regulators is the same as for the A-100 except that A-11 regulators may have first stage pressures as high as 80 p.s.i.

2. Manipulate the vacuum line valve to a point where an altitude reading of 20,000 feet is obtained, and observe the delivery pressure as indicated by the gage in the outlet line. If the delivery pressure does not agree with Table II, remove the vacuum line (atmospheric) connection from the second stage adjustment screw opening, and turn the adjusting screw to a point where the desired pressure is obtained upon re-application of the 20,000 ft. vacuum.

3. Check the delivery pressure against Table II for the other altitudes given for the full range of inlet pressures, and for flow orifices of diameters equivalent to 3 and 20 outlets (3 and 15 outlets for A-11 and AN-6010-1).

4. First stage pressures of A-2000 regulators should not drop below 27 p.s.i., and not below 40 p.s.i. for A-100 regulators, under any conditions of inlet pressure or flow.

5. The valve mechanism is tested for leakage by imposing the maximum inlet pressure and shutting off the vacuum control valve. If there is a continuous rise in pressure indicated on either gage, a valve leak is indicated. Leakage around caps and fittings may be checked by shutting off the supply and observing if the pressure readings drop. For these leakage tests, close the globe valve shutting off the altimeter and connection to second stage cap. Care must be taken so that no leakage occurs through the valves and fittings connected to the regulator.

It is advisable that a final leakage test with the relief valve in place be conducted with separate equipment involving fewer valves and fittings and utilizing a very accurate inlet pressure gage capable of indicating pressure changes of one pound per square inch. An inlet pressure of 500 p.s.i. is suitable for all regulators.

The inlet pressure gage should be connected to the regulator on a line with a valve so arranged that the system may be charged to the desired pressure and then disconnected from the oxygen supply. Any leakage will be indicated by a drop in inlet pressure. Some variation in the inlet pressure will be caused by temperature changes such as that occurring when an oxygen line is suddenly charged to a high pressure. A few minutes delay in making initial observations will allow equilibrium conditions to be established and minimize the effect of temperature changes.

Leakage to the outlet may be determined at the same time by connecting a 0 to 30 p.s.i. pressure gage to the outlet of the regulator. Internal volume of this gage and connecting tubing should not exceed two cubic inches.

With a gage and connecting tubing have an internal volume of five cubic inches, inlet pressure decrease due to leakage must not exceed 3.5 p.s.i. in 15 minutes.

Leakage to the outlet shall be such that the pressure indicated on the outlet gage shall not exceed 15 p.s.i. when leakage tests are conducted at a barometric pressure of approximately 760 millimeters of mercury. Inasmuch as the A-2000 and A-100 regulators provide a minimum pressure to allow flow at sea level and some pressure elevation occurs when no oxygen is flowing through the regulator, the initial pressure indicated by the outlet pressure gage will range from 8 to 12 p.s.i.

All pressures referred to in the above calibration procedure are gage pressures at sea level. Since the ALAR regulators are designed to maintain definite Absolute pressures, and tests made at altitudes appreciable above sea level will increase gage pressures by an amount equivalent to the atmospheric pressure decrease.

The ALAR oxygen regulator design has had sufficient laboratory and service tests to verify that the above calibration test with replacement of damaged assemblies will fit the regulator for continued service. Should difficulty be experienced in conducting the above tests, contact the manufacturer for further information.

MANUAL

COMPONENT MAINTENANCE MANUAL WITH IPL

PORTABLE OXYGEN BREATHING EQUIPMENT

5500 SERIES
5600 SERIES

H-78

SCOTT®

35-30-78
T-1
Jan 25/83

SCOTT AVIATION • A FIGGIE INTERNATIONAL COMPANY
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PRINTED IN U.S.A.

SCOTT

TO: HOLDERS OF PORTABLE OXYGEN BREATHING EQUIPMENT
(5500 SERIES AND 5600 SERIES)

COMPONENT MAINTENANCE MANUAL WITH IPL

REVISION NO. 10 DATED MAY 31, 1989

HIGHLIGHTS

Pages which have been revised are outlined below with the highlights of the revision. Please delete the affected pages and enter Revision No. 10 dated May 31/89 to the Record of Revision Sheet.

Chapter/Section and Page No.	Description of Change	Effectivity
35-30-78 Record of Revisions List of Effective Pages	Revised to reflect current revision	All Models
35-30-78 Page 4	Added "Y" configuration in Constant Flow Settings column	5600 Series
35-30-78 Page 6	Revised figure 4 to show proper configuration	All Models
35-30-78 Page 104	Part number 36728-01 was 36738-01 in NOTE following step (6); added 0.7 and 4.5 flow data to Figure 102	All Models
35-30-78 Page 301 and 302	Added 800649 Pressure Demand regulator to paragraph 3 title; added new steps B. and C.; renumbered existing steps; revised step A. to reflect items 12 and 9; editorial change	All Models and 5600 Series
35-30-78 Page 304	Editorial change	All Models
35-30-78 Page 401	Deleted Di-Sanite and added Fisan-Enzodent in Table 401	All Models
35-30-78 Page 403	Fisan-Enzodent was Di-Sanite	All Models

HIGHLIGHTS (CONT'D)

Chapter/Section and Page No.	Description of Change	Effectivity
35-30-78 Page 701	Added lockwire to Table 701	All Models
35-30-78 Page 703 through 708	Body item number (49 or 49A) was (49)	All Models
35-30-78 Page 705	Added item 14A two places and lockwire data in step K.; editorial change	All Models
35-30-78 Page 706, 707 and 708	Added items 12, 15 and 9 to step F.; editorial change; added steps G., H. and I; relocated material	5600 Series
35-30-78 Page 901	Added index number to Figure 902	All Models
35-30-78 Page 1002	Added vendor code V21343; name and address	All Models
35-30-78 Page 1007	Added "Y" configuration to Constant Flow Setting column	5600 Series
35-30-78 Page 1009 through 1037	Revised and added part numbers; revised IPL Figure 3 to incorporate breakdown of pressure demand cover assembly; incorporated editorial changes; relocated material	All Models
35-30-78 Page 7, 101, 102, 103, 105, 106, 107, 108, 109, 110, 403, 602, 706, 708	Added metric equivalent values	All Models

RECORD OF REVISIONS

REV NO.	ISSUE DATE	DATE INSERTED	BY	REV NO.	ISSUE DATE	DATE INSERTED	BY
1	Dec 18/64						
2	Feb 23/65						
3	Mar 1/67						
4	Mar 16/68						
5	Sep 1/69						
6	May 15/73						
7	Dec 31/79						
8	Jan 25/83						
9	Jan 31/86						
10	May 31/89						

SCOTT

5500 & 5600 SERIES
COMPONENT MAINTENANCE MANUAL WITH IPL

RECORD OF TEMPORARY REVISIONS

TEMPORARY REV. NO.	PAGE NUMBER	ISSUE DATE	BY	DATE REMOVED	BY

SERVICE BULLETIN LIST

NUMBER	REV	DATE INCORP	BY	NUMBER	REV	DATE INCORP	BY
35-48		Jan 25/83	Scott				

LIST OF EFFECTIVE PAGES

Insert latest revised pages, destroy superseded pages.
*The asterisk indicates pages revised by the current revision.

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Temporary Revisions	TR-1	Jan 25/83
Service Bulletin List	SB-1	Jan 25/83
List of Effective Pages	*LEP-1	May 31/89
	*LEP-2	May 31/89
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5500 & 5600 SERIES
COMPONENT MAINTENANCE MANUAL WITH IPL

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5500 & 5600 SERIES
COMPONENT MAINTENANCE MANUAL WITH IPL

INTRODUCTION

This manual establishes the proper maintenance procedures which shall be followed by user maintenance, overhaul and service personnel when performing any type of service on the 5500 Series and 5600 Series Portable Oxygen Units described herein.

It is the primary intent of this manual:

a. To specify proper safety regulations to be followed during performance of service on oxygen equipment used in aviation applications.

b. To establish proper sequence of operations to be performed on the defined equipment.

c. To provide the user with the data necessary to properly maintain, check, test and repair the equipment.

The following WARNINGS are presented to inform the user of this manual of the requirements which shall be adhered to when performing service procedures on this equipment. Additional WARNINGS will be found in the procedural steps in the manual.

WARNING: ANY SERVICE OR OVERHAUL PERFORMED ON THIS APPARATUS SHALL BE DONE ONLY BY THOSE FACILITIES EXPERIENCED IN, OR BY PERSONNEL KNOWLEDGEABLE IN AVIATION OXYGEN EQUIPMENT. IF NONE ARE KNOWN, CONTACT SCOTT AVIATION OR ITS DISTRIBUTORS FOR NAMES OF AUTHORIZED SERVICE CENTERS.

WARNING: ALL PROCEDURES DESCRIBED IN THIS MANUAL SHALL BE PERFORMED IN AN AREA FREE OF OIL, GREASE, FLAMMABLE SOLVENTS OR OTHER COMBUSTIBLE MATERIALS. SUCH MATERIALS, AS WELL AS DUST, LINT, AND FINE METAL FILINGS ARE ALL POTENTIAL COMBUSTIBLES WHICH MIGHT, WHEN EXPOSED TO OXYGEN UNDER PRESSURE IGNITE AND RESULT IN AN EXPLOSION AND/OR FIRE.

WARNING: DO NOT ALLOW OIL, GREASE, FLAMMABLE SOLVENTS, OR OTHER COMBUSTIBLE MATERIALS TO COME IN CONTACT WITH PARTS THAT WILL BE EXPOSED TO PRESSURIZED OXYGEN. SUCH MATERIALS, AS WELL AS DUST, LINT, AND FINE METAL FILINGS ARE ALL POTENTIAL COMBUSTIBLES WHICH MIGHT, WHEN EXPOSED TO OXYGEN UNDER PRESSURE, IGNITE AND RESULT IN AN EXPLOSION.

Verification

Section	Date
Testing and Fault Isolation	October 14, 1982
Disassembly	October 14, 1982
Assembly	October 14, 1982

PORTABLE OXYGEN BREATHING EQUIPMENT

DESCRIPTION AND OPERATION

1. General

   A. This manual provides overhaul instructions with illustrated parts list for the 5500 series and 5600 series Portable Oxygen Breathing Units.

   B. The instructions in this manual apply to all assemblies unless specific reference is made to a particular part number.

2. Description

   A. Each of the various assemblies (see figure 1) consists of an oxygen cylinder (1), pressure regulator (2), "ON-OFF" valve (3), relief valve (4), safety plug (5), charging valve (6), constant flow mask outlet assembly (7), and gauge (8). In addition the 5600 series contains a demand type or pressure demand type oxygen regulator (9). The part number of a particular assembly is determined by the part numbers of the various components that make up the assembly.

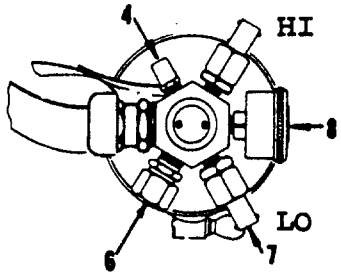
3. Leading Particulars. See figures 2 and 3 for leading particulars.

4. Purpose of Equipment

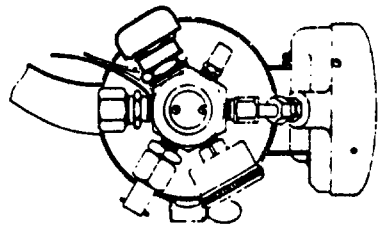
   A. This equipment provides a portable oxygen breathing source. The 5500 series contains outlet assemblies used to adapt a rebreather type mask. The rebreather type mask provides the user with supplementary oxygen for high altitude breathing and/or therapeutic use. The 5600 series provides oxygen for the above uses and, in addition, provides a walk-around oxygen supply for a demand type mask suitable for smoke and fume protection.

5. Typical Installation

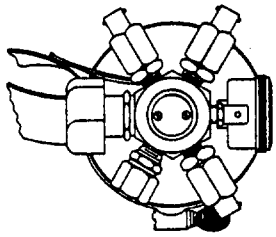
   A. All assemblies are completely portable and have a carrying strap. They should be stored in a convenient and accessible location.



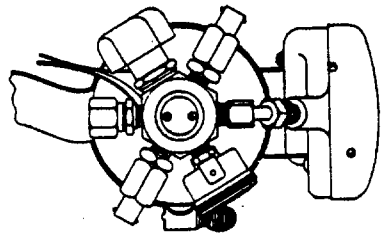
Two Constant Flow Outlets



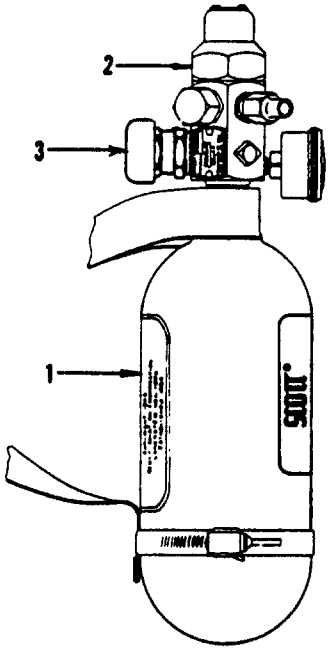
One Constant Flow Outlet



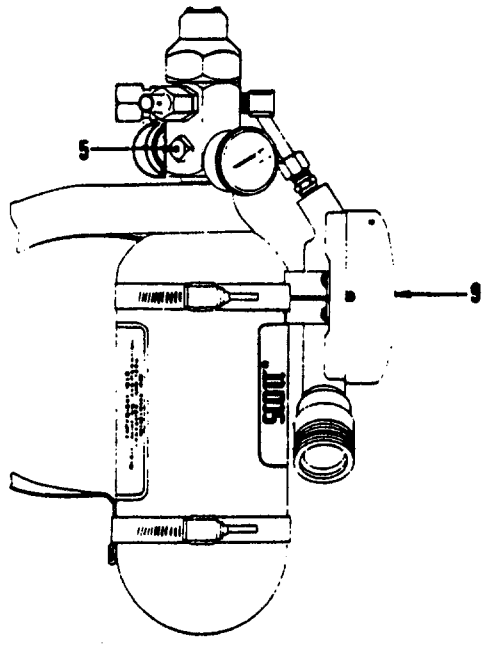
Three Constant Flow Outlets



Two Constant Flow Outlets



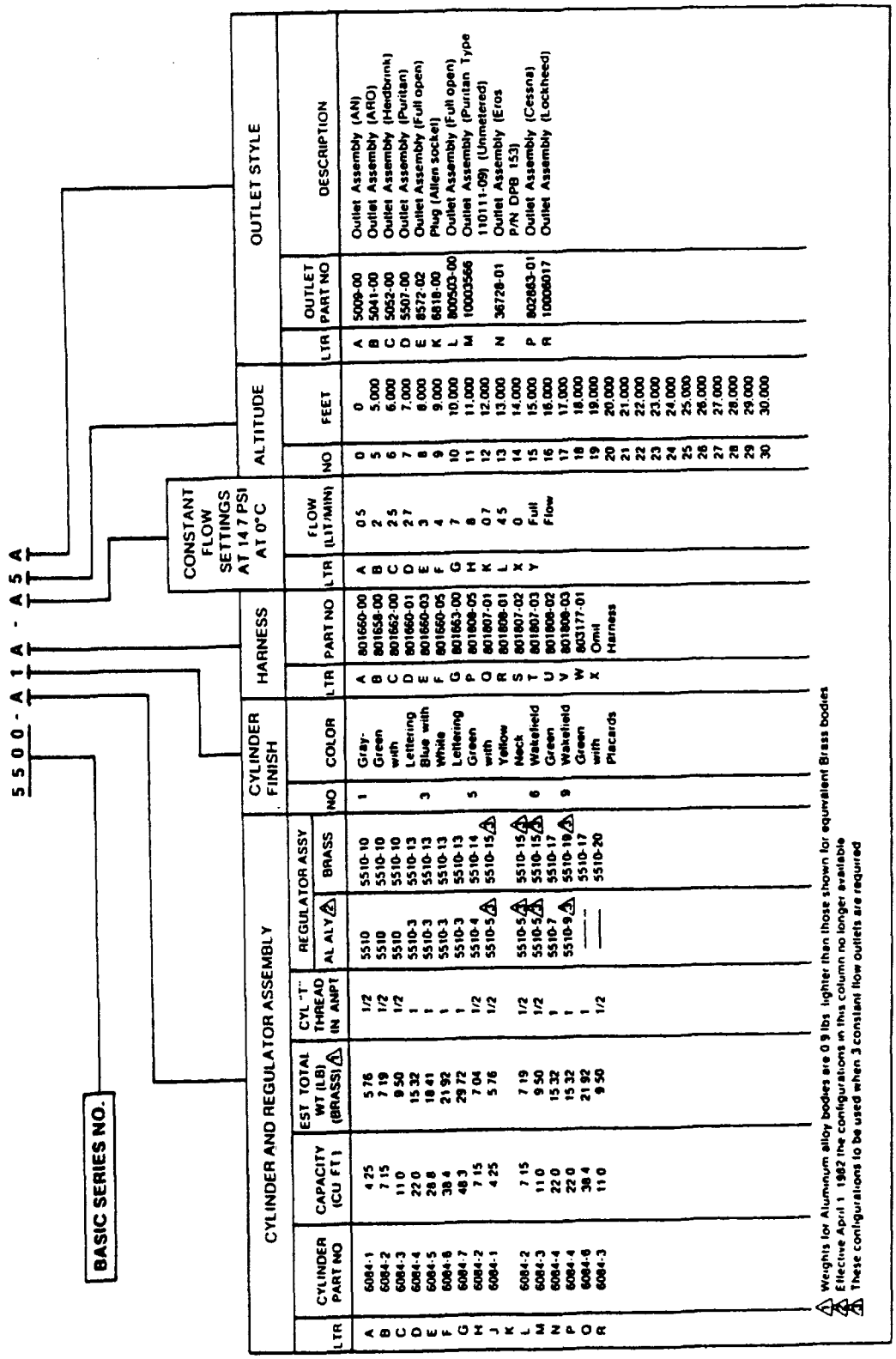
5500 Series



5600 Series

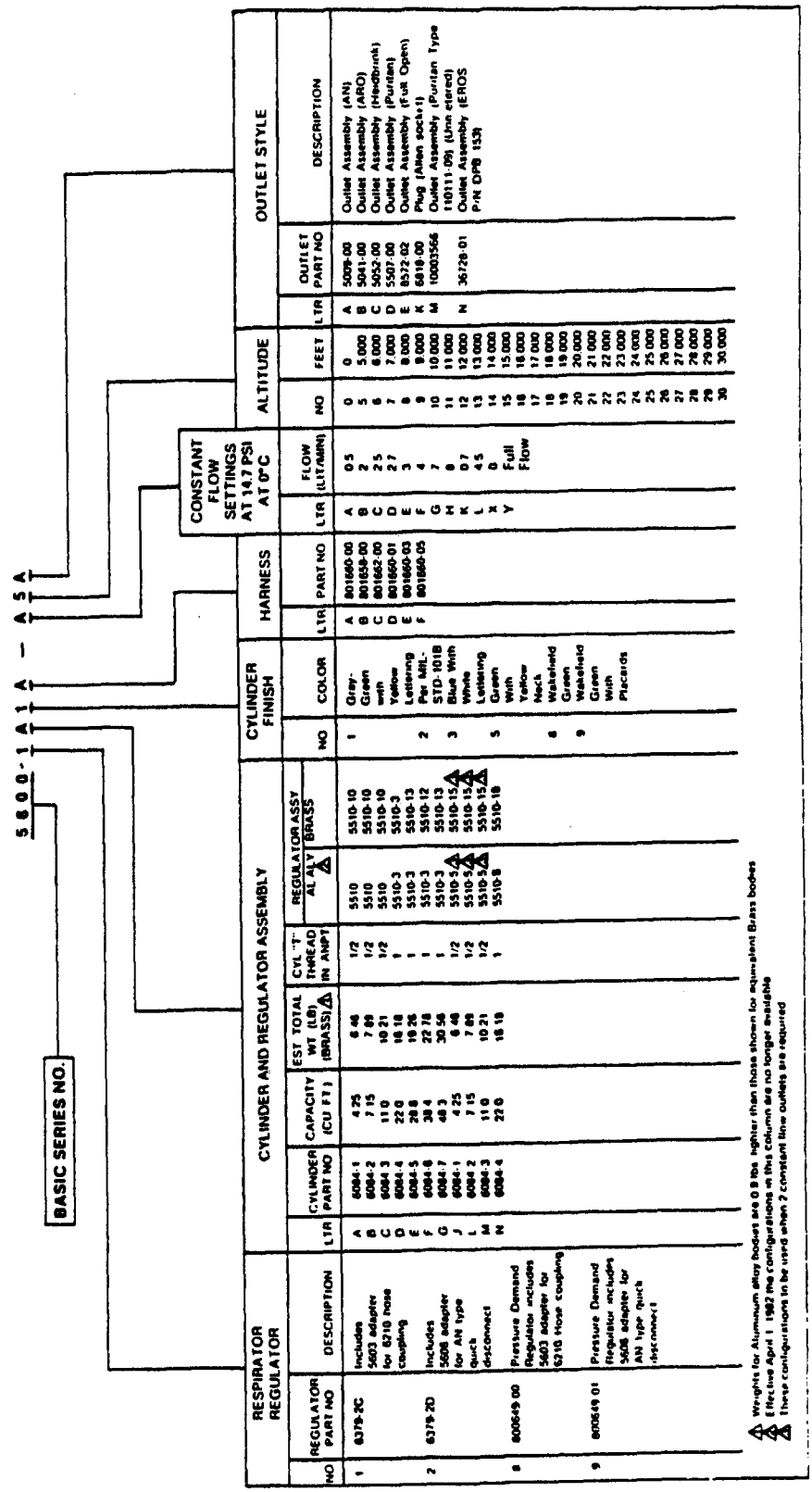
1. CYLINDER
2. PRES REGULATOR
3. "ON-OFF" VALVE
4. RELIEF VALVE (LOW PRESS)
5. SAFETY PLUG
6. CHARGING VALVE
7. OUTLET ASSEMBLY
8. PRESSURE GAUGE
9. DEMAND REGULATOR

Portable Oxygen Breathing Equipment
Figure 1



Leading Particulars (Sheet 1 of 2)
Figure 2

ORIGINAL
As Received By
ATP



Leading Particulars (Sheet 2 of 2)
Figure 2

ORIGINAL
As Received By
ATP

6. Overall Operation

   A. Oxygen is supplied from the high pressure cylinder to the pressure regulator. The safety plug, pressure gauge and "ON-OFF" valve are exposed to cylinder pressure. The "ON-OFF" valve controls the flow of oxygen from the cylinder to the regulating mechanism in the regulator body. It also controls the flow of oxygen from the charging valve to the cylinder.

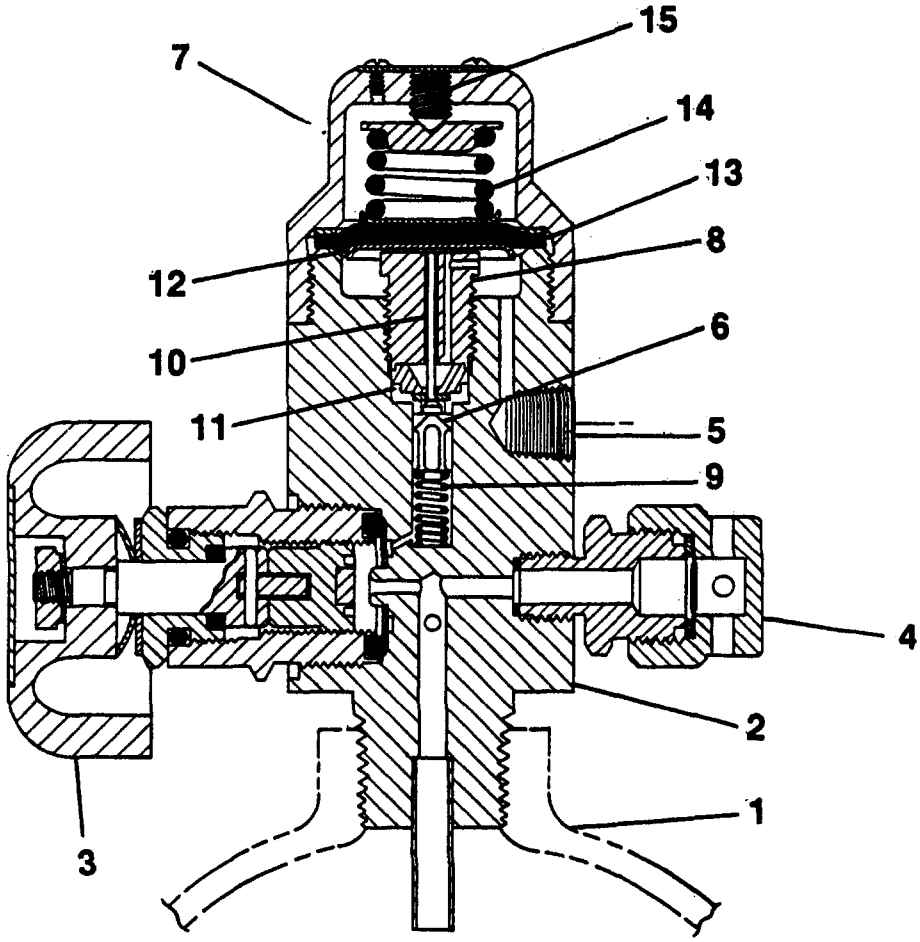
      When the valve is in the "OFF" position, oxygen cannot flow through the regulator. The safety plug contains a fusible alloy and burst disc. In the event of excessive heat, the fusible alloy melts, and with subsequent pressure rise, the safety disc ruptures and allows cylinder oxygen to be vented to atmosphere. The pressure gauge indicates the pressure of the oxygen in the cylinder.

   B. When the "ON-OFF" valve is open, oxygen flows into the upper portion of the regulator body, which contains the pressure reducing mechanism. It reduces the cylinder oxygen pressure to a lower pressure which is suitable to supply a rebreather type mask, through the outlet assemblies, or a demand regulator.

   C. The regulator contains a charging valve assembly which enables the cylinder to be filled (recharged) with high pressure oxygen. A relief valve is located in the low pressure portion of the regulator to protect the regulating mechanism against over pressurization.

7. Detailed Operation.

   A. "ON-OFF" Valve. The "ON-OFF" valve (3, figure 4) is a rotary type valve installed in the high pressure portion of the pressure regulator. Rotation of the valve knob in a clockwise direction causes the valve head assembly to seat against a port in the regulator body, thus preventing flow to the upper portion of the regulator. Rotation of the knob in a counterclockwise direction opens the port and allows oxygen to enter the pressure regulating mechanism.



1. CYLINDER
2. REGULATOR
3. "ON-OFF" VALVE
4. SAFETY PLUG
5. OUTLET ASSEMBLY
6. THRUST PIN GUIDE
7. CASE
8. SEAT HOLDER
9. SPRING
10. THRUST PIN
11. SEAT
12. THRUST PLATE
13. DIAPHRAGM
14. SPRING
15. ADJUSTING SCREW

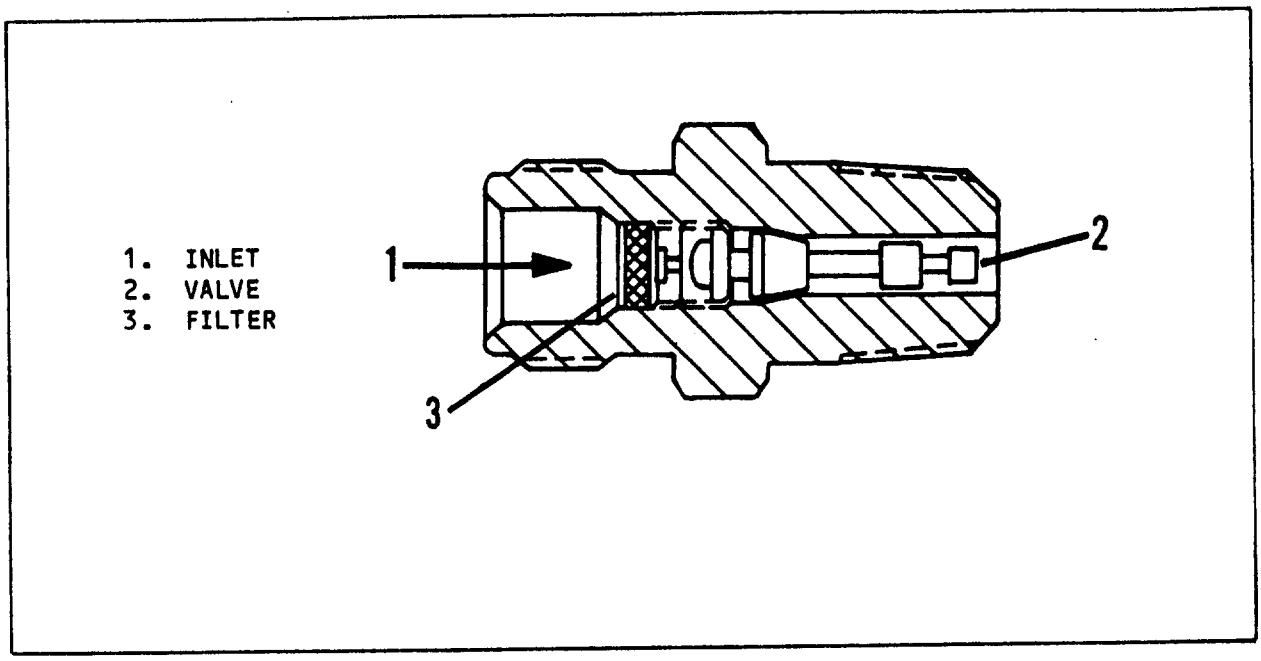
Regulator Cross Section
Figure 4

B. Safety Plug. The safety plug (4, figure 4) is installed in the high pressure portion of the regulator. The center of the plug is filled with a low melting point metal alloy. In the event of fire, the alloy melts and with subsequent pressure rise, the safety disc ruptures and allows the oxygen to vent to atmosphere, thus preventing a hazardous pressure build up in the cylinder.

C. Pressure Gauge. The pressure gauge (8, figure 1) is installed in the high pressure portion of the regulator. It indicates the pressure of the oxygen in the high pressure cylinder, thus giving an indication of the amount of available oxygen.

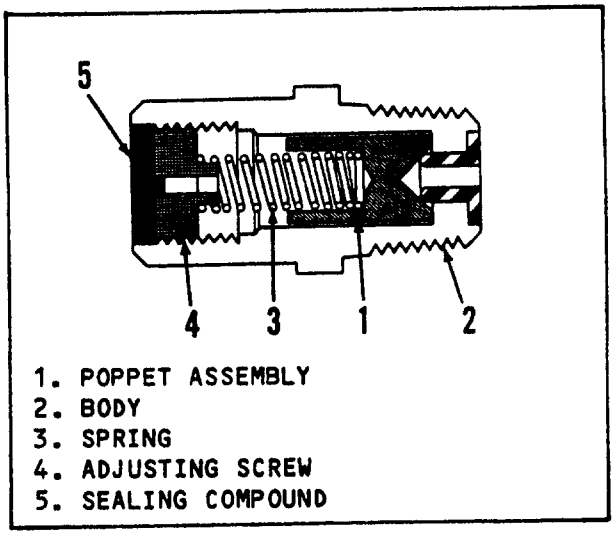
D. Pressure regulator. Pressure regulator (see figure 4) reduces high pressure oxygen to a lower pressure. When the "ON-OFF" valve is open, oxygen flows to the pressure reducing mechanism. It performs in the following manner. High pressure oxygen and spring (9) act upward on thrust pin (10). These forces act to seat the pin against valve seat (11) to prevent flow out of the regulator. The other end of the pin rests against thrust plate (12) and diaphragm (13). One side of the diaphragm is acted upon by spring (14) and the other side is acted upon by outlet pressure. The spring acts downward and tends to move thrust pin (10) away from seat (11). Outlet oxygen pressure acts upward on the diaphragm to counter the spring pressure. Oxygen will flow through the regulator as long as the force of spring (14) exceeds the outlet pressure and forces tending to move thrust pin (10) against its seat. However, an increase in outlet pressure counter-balances spring (14), and thrust pin (10) is forced toward its seat by inlet oxygen pressure and spring (9) until a condition of equilibrium is established and regulator pressure is maintained. Spring (14) is preset to maintain an outlet pressure of approximately 55 psi (0.38 MPa).

E. Charging valve assembly. Charging valve assembly (see figure 5) is used to fill the oxygen cylinder with high pressure oxygen. Since it is located in the upper portion of the regulator, the "ON-OFF" valve must be open to allow oxygen to flow into the cylinder. High pressure oxygen applied at charging valve inlet (1) forces valve (2) away from its seat, and oxygen flows through porting into the high pressure cylinder. The valve seats against its housing to prevent flow out of the cylinder. A cap installed on the charging valve prevents seepage past valve (2).



Charging Valve Assembly
Figure 5

F. Relief Valve. Relief valve (see figure 6) is installed in the low pressure portion of the regulator. The relief valve serves as a safety device to prevent excessive outlet pressure build-up. In the event of excessive outlet pressure poppet assembly (1) is forced away from it seat in body (2), and oxygen is vented through the openings in the body. When pressure drops to an acceptable value, spring (3) forces the poppet against its seat, thus stopping the flow of oxygen.



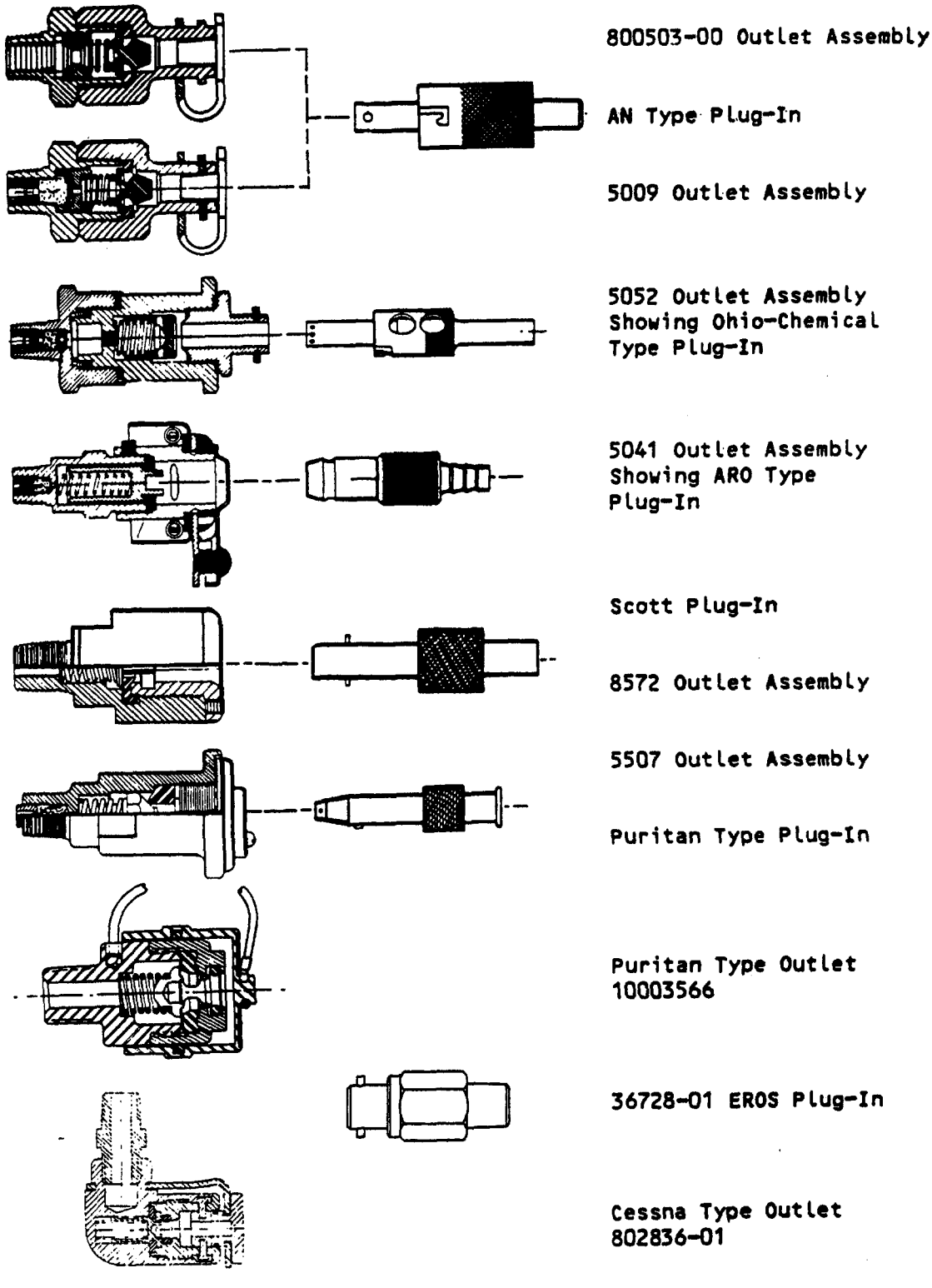
Relief Valve
Figure 6

G. Outlet Assemblies. Different outlet assemblies are available. The type used on a particular installation is dependent on the type of mask insert to be used. Each outlet is similar in that it contains an internal check valve and an oxygen hose plug-in adapter. Part number 8572, 10003566, 36728-01 and 800503-00 are unrestricted flow outlets. All other outlets contain glass cord for metering flow. When a plug-in is inserted in an outlet, it opens the check valve and allows flow into a mask.

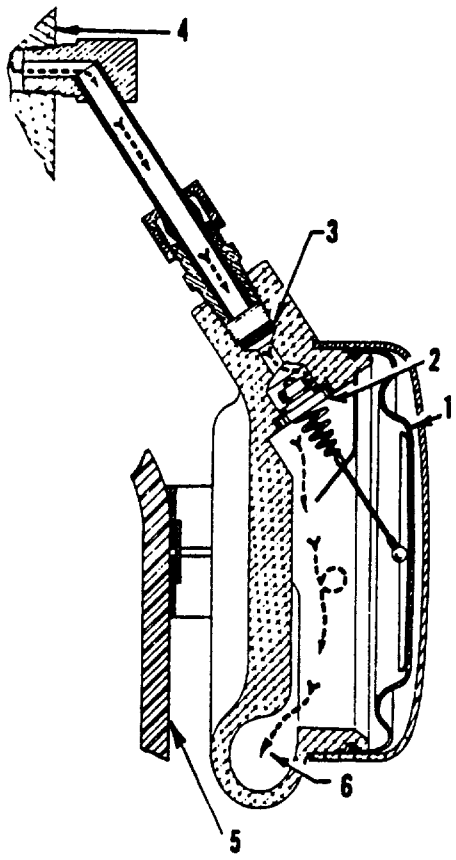
H. Two outlet assemblies are provided on most 5500 series assemblies although one and three outlets may also be found. The 5600 series may contain one or two outlet assemblies. Different outlet assemblies are illustrated in figure 7.

I. Demand Regulator (See figure 8.) The 5600 series contains a demand type regulator. The inlet of the regulator is connected to one of the pressure reducer outlet openings. The demand regulator allows oxygen to flow, on demand, to a demand type mask. Inhalation in the demand mask withdraws oxygen from the body of the demand regulator. This causes a pressure drop in the regulator case which allows atmospheric pressure, acting on the outside of diaphragm (1), to force the diaphragm inward against the stem of valve (2). This action opens the valve and causes oxygen to enter the regulator body, thus raising the pressure in the regulator body. The increased pressure moves the diaphragm away from the valve stem, thus stopping the flow of oxygen. The regulator functions in this manner to supply oxygen on demand.

J. Pressure Demand Regulator. (See figure 8.) This unit is similar to the demand regulator described in step 9 except that the cover has a slide lever to select demand or pressure-demand modes. In the pressure-demand mode the diaphragm is slightly loaded with a spring. This causes the regulator to build up a positive pressure before shut-off. Masks used with this regulator must have compensated exhalation valves.



Available Outlet Assemblies with Plug-Ins
Figure 7



1. DIAPHRAGM
2. DEMAND VALVE
3. FILTER
4. REGULATOR
5. CYLINDER
6. OUTLET PORT TO DEMAND MASK

Demand Regulator
Figure 8

TESTING AND FAULT ISOLATION

1. Testing

WARNING: IN ALL PROCEDURES LISTED BELOW, OXYGEN IS SPECIFIED AS THE TEST GAS. WATER PUMPED NITROGEN OR OIL-FREE AIR MAY BE SUBSTITUTED, BUT RESULTS MUST BE CONVERTED PRIOR TO BEING COMPARED WITH THE RESULTS SPECIFIED FOR OXYGEN. DO NOT, UNDER ANY CIRCUMSTANCES, USE OIL PUMPED GAS AS THIS WILL CAUSE CONTAMINATION OF THE REGULATOR AND TEST EQUIPMENT. OIL, EVEN IN MINUTE QUANTITY, COMING IN CONTACT WITH OXYGEN MAY CAUSE AN EXPLOSION OR FIRE.

NOTE: Table 101 lists the consumable materials necessary for testing. Equalvent materials may be used.

MATERIAL	DESCRIPTION	MANUFACTURER*	REFER TO TESTING PARAGRAPH
Leak Test Solution	Snoop (MIL-L-25567)	V18034	1.C.(2) 1.F.(12) 1.C.(5) 1.G.(2) 1.C.(6)
Oxygen	MIL-O-27210, Type I	V07098	All

*Refer to Illustrated Parts List, paragraph 1.E for Vendor's Code

List of Consumable Materials for Testing
Table 101

NOTE: The equipment required to perform testing procedures are listed on each of the figures in this section. With the exception of equipment listed with Scott part numbers, all test equipment is considered to be "standard" in oxygen repair shops. Equivalent equipment may be used.

A. All tests shall be conducted with a cylinder pressure of 1800 +50, -0 psi (12.41 + 0.34, -0 MPa). Fully charge the cylinder to 1800 +50, -0 psi (12.41 + 0.34, -0 MPa) in accordance with the following instructions.

(1) Check the pressure shown on the pressure gauge. If it indicates less than 1800 +50, -0 psi (12.41 + 0.34, -0 MPa), the cylinder shall be charged.

(2) Use an oxygen charging system as shown in figure 101.

(3) Open the "ON-OFF" valve fully, and remove the cap from the charging valve.

(4) Connect the supply cylinder set up (see figure 101) to the charging valve.

(5) Slowly open the supply cylinder valve, charging at a rate not to exceed 300 psi (2.07 MPa) per minute. Compare the indications of the gauge on the unit and the gauge of the supply cylinders. When the pressure in the breathing oxygen cylinder equals the supply cylinder pressure, close the supply cylinder valve. Allow the cylinder to cool, and recheck the pressure shown on the pressure gauge. The cylinder shall contain 1800 +50, -0 psi (12.41 + 0.34, -0 MPa) at not over 70°F (21.1°C).

B. Relief Valve

(1) Connect the relief valve to a suitable oxygen pressure source.

(2) Apply 90 psi (0.62 MPa) to the relief valve. Valve must hold 90 psi (0.62 MPa).

(3) Increase pressure to 135 psi (0.93 MPa). Relief valve must flow fully.

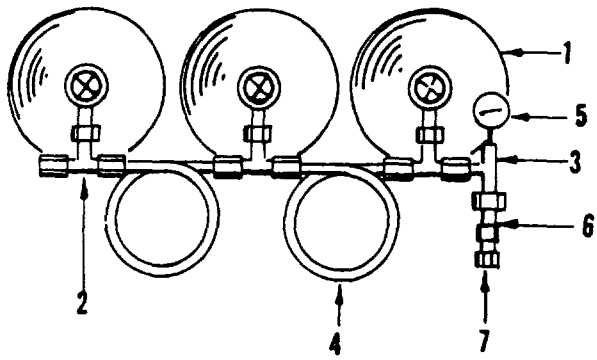
(4) Reduce pressure to 90 psi (0.62 MPa). Valve must reseat.

C. Outlet Assemblies

(1) Connect the appropriate outlet assembly to a suitable oxygen pressure source.

(2) Apply 55 ± 2 psi (0.38 ± 0.01 MPa)to the outlet assembly and apply leak test solution to all body joints and the outlet port. Bubbles indicate leaks which must be corrected.

(3) Insert the appropriate mask plug-in into the outlet. The plug-in must be securely held and allow oxygen to flow.



1. SUPPLY CYLINDERS
2. TEE, P/N 6258
3. TEE, P/N 6145
4. PIGTAIL, P/N 5082
5. OXYGEN GAUGE 0-2000 PSI (0 - 13.79 MPa)
6. REFILL COUPLING, P/N 5020
7. CONNECT CHARGING VALVE OF PORTABLE BREATHING UNIT TO REFILL COUPLING

Setup for Recharging Portable Breathing Unit
Figure 101

(4) Shut off the oxygen supply to the outlet assembly. Connect a suitable flowmeter to the mask plug-in. Apply an inlet pressure of 55 ± 2 psi (0.38 ± 0.01 MPa). The flow for a particular outlet is determined by the coding of the 5500 or 5600 part numbers (see figure 2 and 3) of which the outlet is a part. This code is also stamped on the hexagonal base of each outlet. When flow settings differ on outlets of one 5500 or 5600 unit, "LO" flow and "HI" flow are indicated on the appropriate outlet assemblies. At ground level, outlet flows must agree with the values listed in figure 102 for the particular flow and altitude markings. If flows to not agree, adjust the outlet assembly in accordance with the following instructions.

(5) Check for external leakage at the joint of the outlet and the mask plug-in using leak test solution. No leakage is allowed.

(6) Remove the plug-in and check for leakage at the outlet port using leak test solution. No leakage is allowed.

NOTE: Outlet assemblies, part numbers 10003566, 8572, 36728-01 and 800503-00 are unrestricted flow outlets and do not contain glass cord packing.

(a) Remove the oxygen supply from the outlet assembly.

(b) Flow adjustment is accomplished by compressing the glass cord. This is done by threading the adjusting screw into the outlet. This action serves to decrease flow. Adjust and test outlets until desired flow is obtained.

ALTITUDE FLOW LITERS/MINUTE (STPD) (760 mm Hg, 0°C)	ALTITUDE - FEET X 1000					
	5	10	15	20	25	30
	REQUIRED GROUND LEVEL FLOW SETTING IN LITERS/MINUTES (NTPD) (760 mm Hg, 21°C) PERMISSIBLE TOLERANCE ±5%					
0.5	0.74	0.86	0.91	0.96	1.00	1.08
0.7	0.96	1.10	1.15	1.20	1.24	1.32
2.0	2.51	2.65	2.72	2.80	2.84	2.89
2.5	3.07	3.21	3.30	3.40	3.44	3.47
2.7	3.37	3.48	3.58	3.65	3.72	3.78
3.0	3.72	3.85	3.97	4.08	4.14	4.22
4.0	4.83	4.98	5.10	5.21	5.30	5.38
4.5	5.31	5.48	5.65	5.80	5.90	6.00
7.0	8.40	8.52	8.71	8.81	8.91	9.02
8.0	9.58	9.71	9.92	10.02	10.12	10.25

NOTE: Interpolate given values to obtain flow settings for altitudes between given altitudes.

Outlet Assembly Setting
Figure 102

NOTE: Since glass cord will not expand once compressed, removal of adjusting screw will not alter flow. Adjustment should be done with care. The only method for increasing flow is to remove the compressed glass cord and repack the outlet assembly.

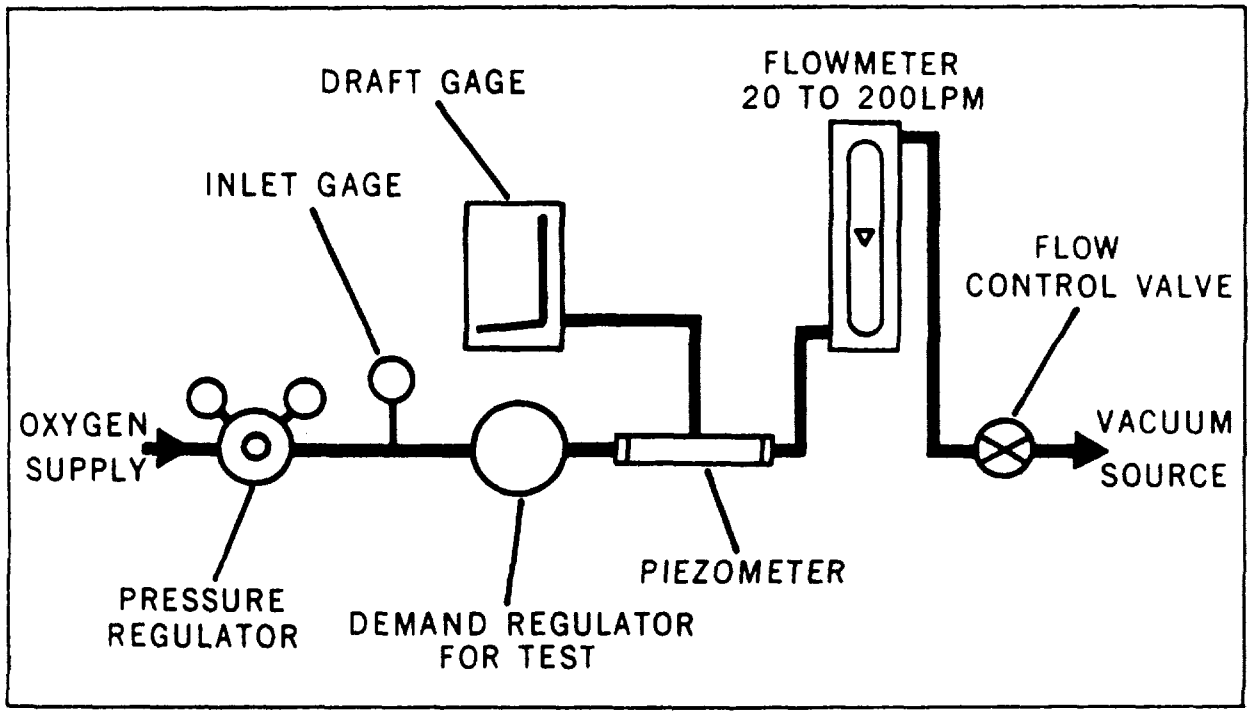
D. 6379-2 Series Demand Regulator Test. (See figure 103.)

(1) Connect an assembled regulator to the test setup shown in figure 103.

(2) With inlet pressure of 35 psi (0.24 MPa), adjust flow control valve for a minimum flow of 20 liters per minute. Resistance, indicated on draft gauge, shall not be greater than 0.7 inches (17.78 mm) of water.

(3) With inlet pressure of 85 psi (0.59 MPa), adjust flow control valve for a minimum flow of 125 liters per minute. Resistance, indicated on draft gauge, shall not be greater than 2.0 inches (50.8 mm) of water.

NOTE: The regulated inlet pressure must be maintained during test.



Test Setup for Demand Regulator P/N 6379
Figure 103

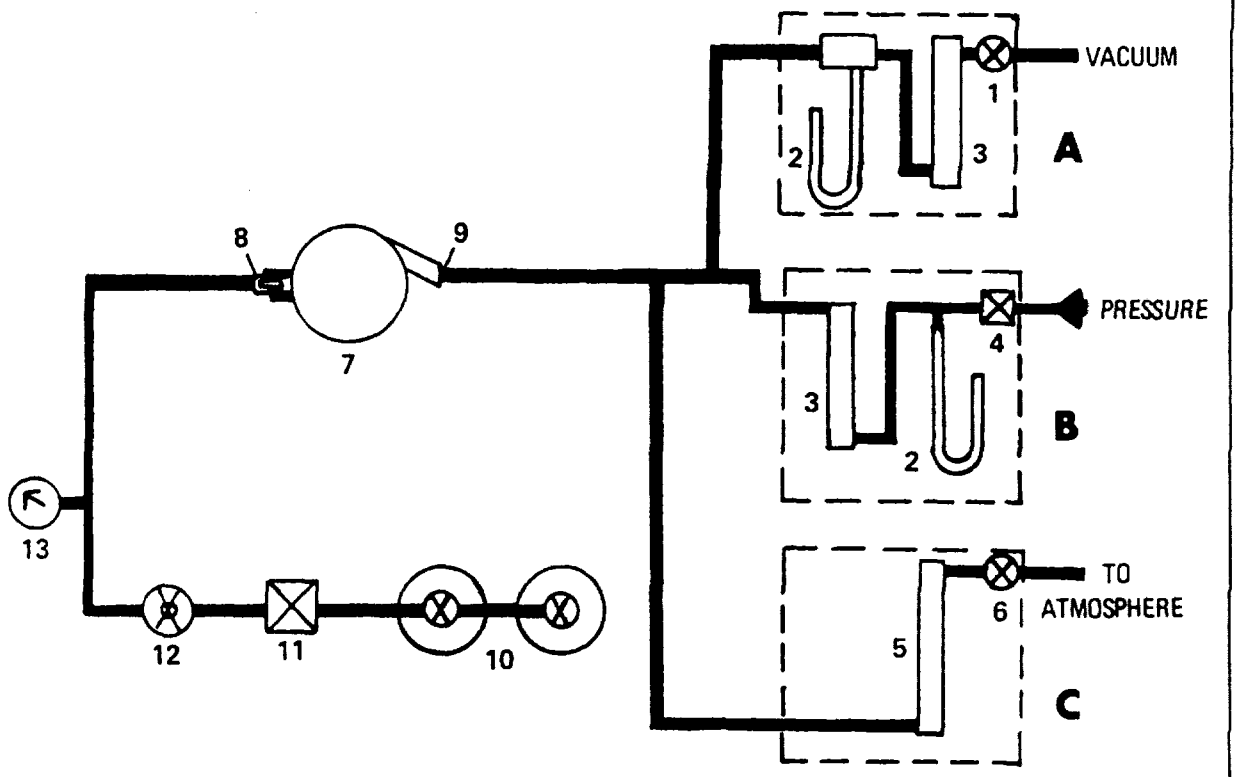
E. 800649 Pressure/Demand Regulator Tests

(1) Proof Pressure Test
(a) With the selector switch in the "DEMAND" position, apply 125 psi (0.86 MPa) to the inlet port and hold for two minutes. Relieve the pressure. There shall be no evidence of damage, deterioration, or permanent set. Acceptable performance of the unit in the following tests will indicate conformance to this requirement.

(2) Overpressure Test (See figure 104, Parts A and B)
(a) Seal the regulator assembly inlet port, keeping the selector switch in the "DEMAND" position.
(b) Apply a negative (vacuum) pressure of 29 inches (736.6 mm) H_2O to the outlet port for two minutes per Part A, then relieve the pressure.
(c) Apply a positive pressure of 24 inches (609.6 mm) H_2O to the outlet port for two minutes per Part B, then relieve the pressure.
(d) Carefully remove the regulator cover and inspect for integrity of the diaphragm tie cord and for damage (bending) of the diaphragm plate.
(e) Replace the regulator cover and proceed with the following tests.

(3) Inward Leakage (See figure 104, Part A)
(a) Seal the regulator assembly inlet port, keeping the selector switch in the "DEMAND" position.
(b) Apply a negative (vacuum) pressure of 1 inch (25.4 mm) H_2O as indicated on manometer (2) to the outlet port.
(c) Leakage, as measured on flowmeter (3), shall not exceed 100 cc/min.

(4) Outward Leakage (See figure 104, Part B)
(a) Seal the regulator assembly inlet port, keeping the selector switch in the "DEMAND" position.
(b) Apply a positive pressure of 12 inches (304.8 mm) H_2O as indicated on manometer (2) to the outlet port.
(c) Leakage, as indicated on flowmeter (3), shall not exceed 100 cc/min.



1. NEEDLE VALVE
2. MANOMETER (0-30 in.) (0-762 mm) H_2O
3. FLOWMETER (0-150 cc/min.) (0-100 LPM)
4. PRESSURE REGULATOR
5. FLOWMETER (0-15 cc/min.)
6. CONTROL VALVE
7. 800649 REGULATOR UNDER TEST
8. REGULATOR INLET
9. REGULATOR OUTLET
10. OXYGEN SOURCE
11. PRESSURE REDUCER
12. SLOW OPENING VALVE
13. GAUGE (0-200 psi) (0-1.38 MPa)

A. Setup for Overpressure Test (Para. 1.E. (2)) and Inward Leakage Test (Para. 1.E. (3)).

B. Setup for Outward Leakage TEst (Para. 1.E. (4)).

C. Setup for Outlet (Valve Seat) Leakage (Para. 1.E. (5)).

Flow, Leakage and Pressure Tests Setups
Figure 104

(d) Remove the seal from the regulator assembly inlet.

(5) Outlet (Valve Seat) Leakage (See figure 104, Part C)
(a) With he selector switch in the "DEMAND" position, regulator inlet (8) connected to oxygen source (10) and regulator outlet (9) connected as shown in Part C, open valve (12) until 35 psi (0.24 MPa) is indicated on gauge (13).
(b) Open control valve (6); leakage, as indicated on flowmeter (5), shall not exceed 10 cc/min.
(c) Increase pressure until 75 psi (0.52 MPa) is indicated on gauge (13).
(d) Leakage, as indicated on flowmeter (5), shall not exceed 10 cc/min.

(6) Flow Tests (See figure 104.)
(a) With the selector switch in the "DEMAND" position, regulator inlet (8) connected to oxygen source (10) and regulator outlet (9) connected as shown in Part A, open valve (12) until 35 psi (0.24 MPa) is indicated on gauge (13).
(b) Slowly open needle valve (1) until 20 LPM is indicated on flowmeter (3). Manometer (2) shall indicate a maximum of -.75 inches (-19.06 mm) H_2O.
(c) Continue to open needle valve (1) until 70 LPM is indicated on flowmeter (3). Manometer (2) shall indicate a maximum of -1.55 inches (-39.37 mm) H_2O.
(d) Open needle valve (1) until 100 LPM is indicated on flowmeter (3). Manometer (2) shall indicate a maximum of -2.00 inches (-50.8 mm) H_2O. Shut off oxygen supply at valve (12).
(e) Place selector switch in the "PRESSURE DEMAND" position with the regulator still connected as in step (a) above.
(f) Slowly open needle valve until 20 LPM is indicated on flowmeter (3). Manometer (2) shall indicate between +0.5 and +2.0 inches (+12.7 and +50.8 mm) H_2O.
(g) Open needle valve until 100 LPM is indicated on flowmeter (3). Manometer (2) shall indicate between +0.5 and +2.0 inches (+12.7 and +50.8 mm) H_2O.

(h) Slowly close needle valve until 10 cc/min is indicated on flowmeter (3). Manometer (2) shall indicate between +0.5 and +2.5 inches (+12.7 and +63.5 mm) H_2O.

(i) Shut off the supply at slow opening valve (12) and disconnect regulator (7) from the test setup.

F. 5510 Series Regulator Adjustment and Test.

NOTE: Before testing the regulator assembly, make sure it is completely assembled with tested components.

(1) Remove relief valve from regulator and install a 0-100 psig (0.69 MPa) pressure gauge in its place.

(2) Turn the regulator on-off valve to the "ON" position then turn the valve to the "OFF" position.

(3) Vent the upper section of the regulator by engaging a mask plug-in into an outlet and letting the oxygen vent. If no constant flow outlet is used on the regulator, attach a threaded adapter and needle valve to one of the plugged outlet ports. Vent through the needle valve.

(4) Repeat steps (2) and (3) a total of ten times.

(5) Adjust the regulator outlet pressure by turning screw (35, IPL figure 9) as necessary to obtain 55 $\pm$ 2 psi (0.38 $\pm$ 0.01 MPa) pressure as indicated on the gauge attached to the regulator relief valve port. Regulator must be flowing through an outlet while the pressure is being adjusted. If no outlet is being used, use an adapter and needle valve (cleaned for oxygen service) and flow approximately 4 LPM.

(6) Connect a 10 liter per minute flow meter to a suitable mask plug-in and turn the on-off valve to the "ON" position, then connect the mask plug-in to an outlet. Flow, as indicated on the attached flowmeter, must be in accordance with figure 102.

(7) Remove the mask plug-in and check the regulator outlet pressure. Lock-up pressure shall not exceed 75 psi (0.52 MPa).

(9) Turn the regulator on-off valve to the "OFF" position and replace the 0-100 psi (0-0.69 MPa) pressure gauge with the regulator valve.

(10) Repeat steps (1) through (9) a total of three times at 24 hour intervals. Then torque the relief valve per Table 801.

NOTE: The 24-hour time interval is recommended to permit component parts to settle.

(11) Turn the regulator on-off valve to the "ON" position.

(12) Use leak test solution to leak test all regulator joints and outlet ports. Manipulate mask plug-in to simulate use during test. No leakage is allowed. If outlets, gauge or relief valve joints leak, retorque until leak is eliminated. Maximum torque must not exceed values listed in Table 801. If charging valve assembly leaks, retorque until leak is eliminated. Maximum torque must not exceed value listed in Table 801.

NOTE: Always relieve pressure when retorquing fittings.

G. Final Test of Complete Unit.

(1) Turn the regulator on-off valve to the "ON" position.

(2) Use leak test solution to leak test all regulator joints, connections and outlet ports. Check On-Off valve stem area for leakage while turning valve from fully "ON" to "OFF" position and from fully "OFF" back to "ON" position. Manipulate mask plug-in to simulate use during test. No leakage is allowed.

(3) Perform a functional test of the unit by connecting a mask to each of the outlets to assure flow of oxygen. If the unit is a 5600, connect a mask to the demand regulator and don the mask and breathe to assure regulator operation.

2. Fault Isolation

A. See figure 105 for a chart containing troubles, probable causes and remedies.

TROUBLE	PROBABLE CAUSE	REMEDY
A. Leakage		
(1) Leakage at joint between outlet assembly (26, IPL figure 2), relief valve (32, IPL figure 9), or gauge (31 or 31A) and body (49)	(a) Units not assembled to body using sealing tape	Reassembly to body per Assembly, paragraph 2.B, 2.E or 2.F
	(b) Units not tight enough in body	Retorque per Table 801
(2) Leakage at joint between charging valve assembly (24) body and body (49)	(a) Unit not assembled to body using sealing tape	Reassemble to body per Assembly, paragraph 2.C
	(b) Unit not tight enough in body	Retorque per Table 801
(3) Leakage at joint between safety plug (28) and body (49)	(a) Unit not tight enough in body	Retorque per Table 801
	(b) Defective disc (29, IPL figure 9) or washer (30)	Inspect periphery of washer and disc for smoothness. Replace if necessary and retorque per Table 801
(4) Leakage past core of charging valve assembly (24)	(a) Loose or defective core	Replace charging valve assembly
(5) Leakage at joint between bushing (19) and body (49)	(a) Unit not tight enought in body	Retorque per Table 801
	(b) Defective packing (18)	Replace packing

Trouble Shooting Chart
Figure 105 (Sheet 1 of 4)

TROUBLE	PROBABLE CAUSE	REMEDY
A. Leakage (Cont'd)		
(6) Leakage between bushing (19, IPL figure 9) and nut (13)	(a) Loose nut (13, IPL figure 9)	Tighten nut
	(b) Defective packing (14)	Replace packing per Assembly, paragraph 2.K
(7) Leakage between stem assembly (15) and nut (13)	(a) Faulty seat (16)	Replace seat
	(b) Contamination	Clean seal
(8) Demand regulator (7, IPL figure 2) leaks	(a) Contamination on gasket (24, IPL figure 3)	Disassemble demand valve assembly and clean
	(b) Defective demand valve assembly (20) or gasket (24)	Replace demand valve assembly and/or gasket
B. Relief Pressure		
(1) Relief valve (32, IPL, figure 9) does not relieve at proper pressure	(a) Worn parts or contamination	Replace relief valve
C. Oxygen Shut Off		
(1) On-Off valve fails to shut off oxygen in "OFF" position	(a) Faulty head assembly (17 or 17A, IPL figure 9)	Replace head assembly per Assembly, paragraph 2.I

Trouble Shooting Chart
Figure 105 (Sheet 2 of 4)

TROUBLE	PROBABLE CAUSE	REMEDY
D. Outlet Pressure		
(1) Regulator assembly (38, IPL figure 2) fails to provide proper outlet pressure	(a) Regulator assembly not adjusted properly	Readjust regulator assembly per Testing, paragraph 1.F
(2) Regulator assembly (38) fails to hold proper outlet pressure	(a) Defective seat (44 or 44A, IPL figure 9) or pin (45)	Inspect seat and pin per Assembly, paragraph 2.O
	(b) Diaphragm (41) defective	Replace diaphragm
	(c) Diaphragm not sealed to body	Reassemble diaphragm per Assembly, paragraph 2.Q
E. Draft and Flow Requirements		
(1) Outlet assembly (28, IPL figure 2) does not allow proper flow	(a) Worn parts	Inspect parts; replace as necessary
	(b) Parts not properly assembled	Disassemble parts and reassemble properly per Assembly, paragraph 1
(2) Demand regulator (7, IPL figure 2) fails to meet draft and flow requirements	(a) Demand valve assembly (20, IPL figure 3) sticking	Replace demand valve assembly
	(b) Diaphragm (10) punctured	Install new diaphragm per assembly, paragraph 3.E
	(c) Diaphragm (10) not properly assembled to case (28)	Reinstall diaphragm per Assembly, paragraph 3.E

Trouble Shooting chart
Figure 105 (Sheet 3 of 4)

TROUBLE	PROBABLE CAUSE	REMEDY
F. Plug-In Retention		
(1) Outlet assembly (28, IPL figure 2) does not hold plug-in securely	(a) Worn parts	Inspect parts; replace as necessary
	(b) Parts improperly assembled	Disassemble outlet and reassemble properly per Assembly, paragraph 1

Trouble Shooting Chart
Figure 105 (Sheet 4 of 4)

DISASSEMBLY

WARNING: THE OXYGEN CYLINDER SHALL BE COMPLETELY DISCHARGED PRIOR TO PERFORMING ANY DISASSEMBLY.

NOTE: The instructions in paragraphs 1 and 2 list the steps necessary to disassemble each of the Portable Oxygen Breathing Assemblies into major components. Instructions for disassembly of the components are listed in paragraphs 3 through 5.

CAUTION: TO PREVENT POSSIBILITY OF THREAD GALLING, THE REGULATOR BODY SHOULD NOT BE REMOVED FROM THE CYLINDER UNLESS THE CYLINDER IS DUE FOR HYDROSTATIC RETESTING, OR CYLINDER CONTAMINATION IS SUSPECTED.

NOTE: See Testing and Fault Isolation, to establish the condition of the unit or most probable cause of its malfunction. This is to determine the extent of disassembly required without completely tearing down and rebuilding the unit.

1. 5500 Series. (See IPL figure 2.)

   A. Do not attempt to remove regulator (38) from cylinder (60) until all external components have been removed from the regulator.

   B. Identification plate (35) is attached to regulator (38) with drive screws (37). Plates (43, 44 and 44A) are attached by an adhesive. Removal of these plates is not ordinarily required.

   C. Remove clamp (24) and sling (17).

   D. Unscrew and remove outlet assemblies (28).

2. 5600 Series. (See IPL figure 2.)

   A. Remove clamp (24) and sling (17).

   B. Do not attempt to remove regulator (38) from cylinder (60) until all components have been removed from the regulator.

   C. Remove screws (11). Remove clamp (14) to remove bracket (13).

   D. Unthread nut of connector assembly (3). Unthread connector assembly (3) from regulator (7).

E. Unthread elbow assembly (4) and outlet assembly (28) from regulator (38).

F. Identification plate (35) is attached to regulator (38) with two drive screws (37). Instruction plates (43, 44 and 44A) are attached by an adhesive. Removal of these plates is not ordinarily required.

3. 6379 and 800649 Series Demand and Pressure Demand Oxygen Regulators, (See IPL figure 3.)

A. Remove screws (7), and pull cover assembly (6) or cover (14) off case (28). Removal of plates (8, 11 or 12) is not normally required. If removal is necessary, drill out rivets (10 or 13). Remove plate (9) only if damaged.

B. Slightly compress spring (13A) and remove from cover (15) and the lever of plate and lever assembly (13B), then remove the plate and lever assembly.

C. Disconnect and remove spring (13C) from button (13D) then remove the button from cover (15).

D. Remove cord (17) and take diaphragm assembly (16) off case (28).

E. Unthread screws (19), and remove deflector (18).

F. Remove screws (21) and washers (22 and 23). Pull valve assembly (20) out of case (28). Remove gasket (24).

G. Remove screen (27) from the inlet port of case (28) only if necessary.

H. Unscrew adapter (25 or 26) from the outlet port of case (28).

I. If bracket on case (28) appears damaged, drill out attaching rivets. Do not remove the bracket if it is undamaged.

4. Outlet Assemblies.

A. Part No. 5041. (See IPL figure 4.) Unthread screw (6). Remove screen (7), and pick glass cord (8) out of body (12). Remove screen (9), if necessary. Unscrew nut (3), and remove cover (2). Slide cap (4) and washer (5) off case (18). Remove screw (11). Unthread body (12) from case (18). Take spring (13), valve (14), and seat (15) out of case (18). Remove latch springs (16) and pins (17).

B. Part No. 5009. (See IPL figure 5.) Remove cover (3). Remove screw (4), screen (5) and pick glass cord (6) out of stud (8). Unthread stud (8) from receptacle (19). Remove valve (11), spring (13), and gasket (10). Thread flow port (14) out of stud (8). Remove gasket (18). Snap ring (16) out of flow port (14) and remove filter (17).

C. Part No. 800503-00. (See IPL figure 5.) Remove cover (3). Unscrew stud (8) from receptacle (19). Remove valve (11), spring (13) and gasket (10). Thread flow port (15) out of stud (8). Remove gasket (18) from stud (8).

D. Part No. 5507 and 5533. (See IPL figure 7.) Remove screw (2) and screen (4). Remove glass cord (3) and screen (4) from body (12). Unthread guide assembly (6). Remove washer (7) from guide assembly (6). Remove washers (8 and 9), seat (10), and spring (11) from body (12).

E. Part No. 5052. (See IPL figure 8.) Remove screw (2). Remove screen (4), and pick glass cord (3) out of base (7). Take screen (4) and washer (5) out of base (7). Unthread base (7) from body (13). Remove gasket (8). Unthread seat (10). Remove gasket (11). Take retainer (12) and spring (9) out of body (13).

F. Part No. 8572. (See IPL figure 6.) Unscrew body assembly (2) from adapter (9). Remove gasket (5), poppet (6), spring (7), and filter (8) from adapter (9).

G. Part No. 802863-02. (See IPL figure 10.) Disassemble as follows:
   (1) Unthread nipple (2) from body (15) only if damaged or leakage has been noted.
   (2) Push in and turn plug assembly (4 through 6) counterclockwise to remove. Pull cover (4) off plug (6) and body (15) then remove packing (5) from the plug and discard the packing.
   (3) Unthread sleeve and pin assembly (8 and 9) from body (15). Remove pins (8) from sleeve (9).

   NOTE: Use of plug (6) may aid in unthreading the sleeve and pin assembly.

(4) Remove seal (10), retainer (11) and packing (12) from sleeve (9) and discard the seal and packing.
(5) Remove poppet (13) and spring (14) from body (15).

5. 5510 Series Regulator Assembly. (See IPL figure 9.)

NOTE: The regulator should not be removed from the cylinder for disassembly. Disassembly of the regulator body from the cylinder should not be attempted until completion of the disassembly instructions listed below.

A. Unthread screws (34) and remove plate (33). Remove screw (35).

B. Unthread and remove case (36 or 36A). Lift guide (37), spring (38), plate (39), ring (40), diaphragm (41), and plate (42) out of body (49 or 49A).

C. Unscrew and remove holder (43). Remove seat (44 or 44A), pin (45), guide (46), and spring (47).

D. Unthread and remove plug (28). Remove disc (29) and washer (30).

E. Remove on-off valve by unthreading it from the regulator body. Use a wrench on the flats of the hexagonal portion of the valve body. Remove filter (21), if necessary, or plug (20).

F. Peel plate (7) off handle (8). Remove nut (9) and washer (10). Pull handle (8) off stem assembly (15).

G. Remove washers (11 and 12).

H. Unthread nut (13). Remove packing (14 or 14A) and seat (16).

I. Using stem assembly (15), back head assembly (17 or 17A) out of bushing (19).

J. Remove packing (18 or 18A).

K. Unthread relief valve (32) from body (49 or 49A).

L. Remove the sealing tape compound on threads of relief valve (32).

M. Remove cap (22). Seat (23) is cemented to the cap. Unthread and remove charging valve assembly (24), then remove filters (25 and 27).

N. Remove gauge (31 or 31A) by using a thin wrench on the flats of the square at the rear of the case.

O. Removal of regulator body (49 or 49A) from the cylinder is not recommended and is not usually required. If removal is essential, install the unit in a suitable holding fixture and use wrench (1) to remove the regulator body from the cylinder. Remove drain tube (48, IPL figure 9) only if it is damaged.

CLEANING

WARNING: DO NOT ALLOW OIL, GREASE, FLAMMABLE SOLVENTS, OR OTHER COMBUSTIBLE MATERIALS TO COME IN CONTACT WITH PARTS THAT WILL BE EXPOSED TO PRESSURIZED OXYGEN. SUCH MATERIALS, AS WELL AS DUST, LINT, AND FINE METAL FILINGS ARE ALL POTENTIAL COMBUSTIBLES WHICH MIGHT, WHEN EXPOSED TO OXYGEN UNDER PRESSURE, IGNITE AND RESULT IN AN EXPLOSION.

1. Using the material listed in Table 401, perform the cleaning procedures outlined in the following paragraphs.

NOTE: Equivalent materials may be used.

MATERIAL	DESCRIPTION	MANUFACTURER*	REFER TO PARAGRAPH
Acid/Odor Neutralizer	Fisan-Enzodent	V44389	1.A.(5)
Phosphoric - Isopropyl Mixture	Phosphoric Acid Isopropyl Alcohol (50% of each by Vol)	V70829 NOTE: Purchased separately	1.A.(3)
1,1,1 Trichloro-ethane	MIL-T-81533 FED SPEC. O-T-620	V71984	1.A.(4) 1.A.(8) a., b., c. 1.B.(2)

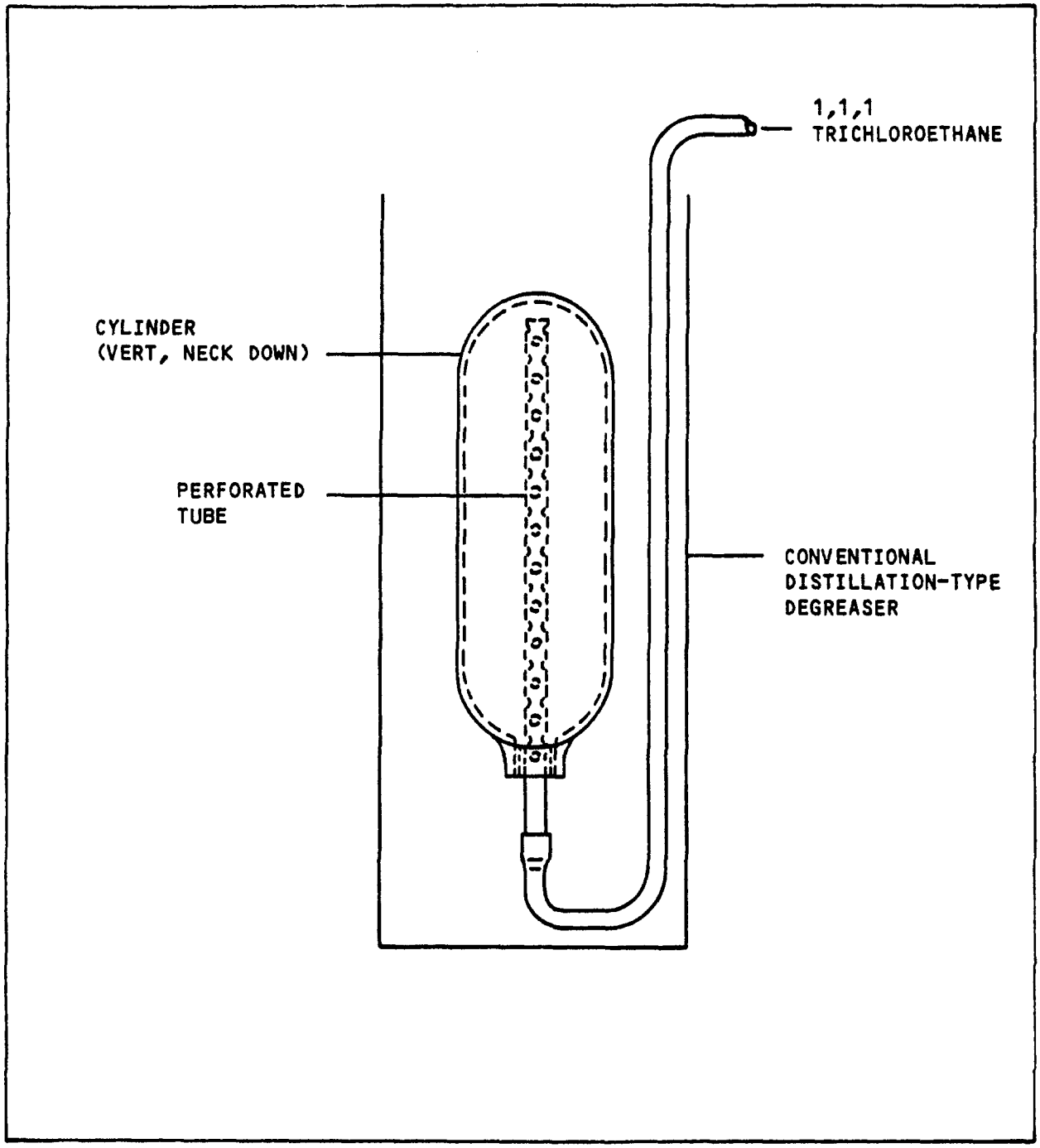
*Refer to Illustrated Parts List, paragraph 1.E for Vendor's Code.

List of Cleaning Materials
Table 401

A. After inspecting cylinder in accordance with Check perform the following cleaning procedure:

NOTE: This procedure will remove any organic impurities which are soluble in 1,1,1 Trichloroethane.

(1) Wire brush the cylinder neck threads to remove sealing compounds or rust.
(2) Shake out cylinder to remove any loose foreign matter.
(3) Apply a solution (50% by volume of phosphoric acid isopropyl alcohol) by brush to the area wire brushed, exercising care to prevent excessive application from running into the cylinder.



Cleaning Setup
Figure 401

WARNING: USE 1,1,1 TRICHLOROETHANE IN A WELL VENTILATED AREA ONLY. AVOID PROLONGED OR REPEATED CONTACT WITH SKIN AND INHALATION OF TOXIC VAPORS

(4) Utilizing a cleaning setup as illustrated in figure 401, place the cylinder, with neck down, in vertical position over the perforated tube (the diameter and length of the tube will be determined by the particular size of the cylinder being cleaned). Pump 1,1,1 Trichloroethane, slightly below its boiling point, through the tube thoroughly spraying the interior of the cylinder being cleaned for a period of three minutes. Remove cylinder from tube and allow complete drainage of 1,1,1 Trichloroethane into drain.

(5) After completion of step (4), and using a cleaning setup similar to the setup illustrated in figure 401, pump a solution of Fisan-Enzodent (8 ounces (.227 kg) per each gallon (3.8 l) of water), at a temperature of 180°F (82.2°C), through the tube, thoroughly spraying the interior of the cylinder being cleaned for a period of three to five minutes. Accomplishment of step (5) will neutralize any acid constituents and destroy odor.

(6) After completion of step (5), and using a cleaning setup similar to the setup illustrated in figure 401, pump water (at city pressure) at 160°F (71.1°C), through the tube, thoroughly spraying the interior of the cylinder being cleaned for a period of two minutes to remove any traces of alkaline residue.

(7) After completion of step (6), and using a cleaning setup similar to the setup illustrated in figure 401, dry the interior of the cylinder with forced air heated to a temperature of 212°F (100.0°C), for a period of three to five minutes.

(8) After completion of step (7), and after the cylinder has cooled to room temperature, reinspect the cylinder in accordance with Check.

NOTE: The cleaning process used should be checked initially and periodically as follows:

a. Pour 50cc of anhydrous, chemically pure, 1,1,1 Trichloroethane into the processed cylinder. Cap and shake well for one to two minutes.

b. Remove cap and pour flushings into a clean Erlenmeyer flask. Distill the 1,1,1 Trichloroethane in a water bath. After the 1,1,1 Trichloroethane has been distilled, examine residue in flask. If oil marks are visible, check cleaning solutions, implements and pressure.

c. After completion of steps (a) and (b), and using a cleaning setup similar to the setup illustrated in figure 401, clear all traces of 1,1,1 Trichloroethane from the interior of the cylinder by blowing with dry, clean, oil-free air.

B. After inspecting the valve assembly in accordance with Check, perform the following cleaning procedure.

WARNING: DO NOT ALLOW OIL, GREASE, FLAMMABLE SOLVENTS, OR OTHER COMBUSTIBLE MATERIALS TO COME IN CONTACT WITH PARTS THAT WILL BE EXPOSED TO PRESSURIZED OXYGEN. SUCH MATERIALS, AS WELL AS DUST, LINT, AND FINE METAL FILINGS ARE ALL POTENTIAL COMBUSTIBLES WHICH MIGHT, WHEN EXPOSED TO OXYGEN UNDER PRESSURE, IGNITE AND RESULT IN AN EXPLOSION.

(1) Remove dirt and foreign particles from equipment by wiping with a clean lint-free cloth, or by blowing with clean oil-free air or nitrogen.

WARNING: USE 1,1,1 TRICHLOROETHANE IN A WELL VENTILATED AREA ONLY. AVOID PROLONGED OR REPEATED CONTACT WITH SKIN AND INHALATION OF TOXIC VAPORS.

(2) Metal parts which come in contact with oxygen and have become contaminated with grease can be cleaned by using a vapor degreasing method with 1,1,1 Trichloroethane. Blow clean and dry with a stream of clean dry, oil-free air.

(3) Non-metallic parts such as silicone and rubber components may be cleaned by using an ultrasonic detergent and water cleaning system. Rinse parts in clean water and dry thoroughly before reassembly.

CHECK

1. Inspect exterior of cylinder for indications of abuse, dents and bulges.

2. Inspect neck of cylinders for cracks and distortion or damaged threads.

3. Inspect all cylinders for peeling external paint and obscure markings.

4. Inspect all high pressure cylinders for last date of hydrostatic test and type. If hydrostatic testing is required, tests shall be in accordance with prescribed procedures by facilities holding a current, valid DOT Approval.

   NOTE: DOT Type 3HT cylinders require hydrostatic retesting every 3 years. DOT type 3A and 3AA cylinders require hydrostatic retesting every 5 years. Under certain usage conditions, DOT type 3A and 3AA cylinders may be retested at 10 year intervals. Refer to the current tariff of the "HAZARDOUS MATERIAL REGULATIONS OF THE DEPARTMENT OF TRANSPORTATION" (49 CFR 170) paragraph 173.34 (e) (15) for eligibility requirements.

   NOTE: For Cylinder Inspection and Hydrostatic Retest, the use of Compressed Gas Association (CGA) pamphlets C-1, C-5, C-6, C-8 are recommended. These are available from:

   CGA, INC.
   1235 Jefferson Davis Highway
   Arlington, VA 22202

5. Inspect the interior for defects which might render the cylinder unsafe.

6. Inspect the interior of cylinders for rust spots, improper parkerizing, or surface blemishes.

7. Inspect valves and/or regulator for cracks, nicks, dents, or burrs which might cause malfunction.

8. Inspect valve seats for scoring.

9. Inspect all threads of valves and/or regulators for damage.

10. Inspect overall condition of all components.

REPAIR

NOTE: Table 601 lists the consumable materials required for repair. Equivalent materials may be used.

MATERIAL	DESCRIPTION	MANUFACTURER*	REFER TO PARAGRAPH
Chromic Acid	Chromic Acid	V72658	4.E
Phosphoric Acid	Phosphoric Acid	V70829	4.C, 4.E
Phosphate Coating	Zn PO_4	V44389	4.C

*Refer to Illustrated Parts List, paragraph 1.E for Vendor's Code.

Consumable Materials for Repair
Table 601

1. Repair of parts, other than removing burrs, is not recommended. If a part is in need of repair, discard it and replace the part.

2. Replace all gaskets, washers, packings, diaphragms, non-metallic valve seats and filter screens at each overhaul.

3. Replace cylinders that show signs of abuse, dents, bulges, cracks, distortion, damaged threads, and/or defects which might render the cylinder unsafe (refer to Check, steps 3, 4, 5 and 7).

   NOTE: DOT 3HT Type cylinders must be discarded at the end of twenty-four years from original test date or 4,380 pressurizations, whichever occurs first.

4. Cylinders that require interior protective treatment may be reparkerized as follows: (Refer to Check, step 6).

   A. Sandblast cylinders internally and externally using fine grit shot.

   B. Rinse cylinder in clean water.

C. Apply a phosphate coating to the interior of the cylinder either by dipping or spraying. For dip-coating, a three minute minimum dip is recommended; for spray-coating, one minute minimum is recommended.

NOTE: The balanced aqueous solution of phosphoric acid, phosphates, and accelerating agents produces a uniform water insoluble crystalline coating varying from gray to black in color.

D. Rinse cylinder in clean water.

E. Rinse cylinder in hot chromic acid (140 to 210°F) (60.0 to 98.9°C).

NOTE: The pH of the chromic acid rinse will be maintained between 2 and 4 by the addition of flake chromic acid of a mixture of chromic and phosphoric acids.

F. Dry the cylinder by using warm air or a drying oven.

NOTE: For maximum corrosion resistance, coating weights of 400 mg/sq. ft. (0.43 mg/cm^2) are usually adequate. This coating weight may be reduced to 200 mg/sq. ft. (0.22 mg/cm^2) if an activator (titanium salts) is used. The coating weight may be deceptive if loosely adherent deposits are obtained, since loosely adherent deposits give inferior performance. Finely crystalling zinc phosphate coatings provide the best corrosion resistance.

G. If the exterior finish is removed, it must be recoated with 1000 mg/sq. ft. min. (1.08 mg/cm^2 min.) phosphate, and primed per MIL-P-8585A, color Y.

5. Remark and/or repaint cylinders in acccordance with information outlined in figure 2.

ASSEMBLY

NOTE: Table 701 lists the consumable materials necessary for assembly. Equivalent materials may be used except for oxygen lubricant.

MATERIAL	DESCRIPTION	MANUFACTURER*	REFER TO PARAGRAPH
Thread Sealing Tape	Permacel No. 412	V99742	1.G(5), 2.A, 2.B, 2.C, 2.E, 2.F, 4.B, 4.C
Adhesive	Insa-Lute Adhesive No. 1	V80703	2.D
Loctite Sealant	Loctite, Grade C	V05972	2.R
Dow Corning Adhesive	Dow Corning Adhesive No. A-4000	V71984	3.E
Oxygen Lubricant	Krytox 240AC	V18873	1.G (2), 1.G (4), 2.G, 2.H, 2.I, 2.K
Loctite Sealant	Loctite 222	V05972	1.G (3)
Oxygen	MIL-O-27210, Type I	V07098	3.C
Lockwire	MS20995C20	-----	2.K

*Refer to Illustrated Parts List, paragraph 1.E for Vendor's Code

List of Consumable Materials for Assembly
Table 701

1. Outlet Assemblies

   A. Part No. 8572. (See IPL figure 6.) Place filter (8), spring (7), poppet (6) and gasket (5) in adapter (9) and thread body assembly (2) into adapter (9).

   B. Part No. 5052. (See IPL figure 8.) Place retainer (12) and spring (9) in body (13). Place gasket (11) on seat (10), and thread base (7) onto the body. Install washer (5) and screen (4) in base (7). Pack glass cord (3) into the opening of base (7). Install screen (4) and screw (2).

   C. Part No. 5507. (See IPL figure 7.) Place spring (11), seat (10) and washers (8 and 9) in body (12). Place washer (7) in guide assembly (6), and screw guide assembly (6) into body (12). Place screen (4) into body (12), and pack glass cord (3) into the body. Install screen (4) and screw (2).

   D. Part 5009. (See IPL figure 5.) Place filter (17) on flow port (14), and hold in place by installing ring (16). Install gasket (18) in stud (8), and thread flow port (14) into stud (8). Install gasket (10), valve (11), and spring (13) into receptacle (19). Thread stud (8) into receptacle (19). Pack glass cord (6) into stud (8). Thread screw (4) into stud fitting (8) and install cover (3).

   E. Part No. 800503-00. (See IPL figure 5.) Install gasket (18) in stud (8) and thread flow port (15) into stud (8). Install gasket (10), valve (11), and spring (13) into receptacle (19). Thread stud (8) into receptacle (19). Place plug of cover (3) into open port of receptacle (19).

   F. Part No. 5041. (See IPL figure 4.) Position pins (17) on case (18), and hook springs (16) over the grooved ends of the pins. Install seat (15), valve (14), and spring (13) in case (18). Slide washer (5) and cap (4) onto case (18). Assemble nut (3) and cover (2); then thread nut (3) onto case (18). Place screen (9) into the opening of body (12). Pack glass cord (8) into the opening and install screen (7) and screw (6).

G. Part No. 802863-02. (See IPL figure 10). Reassemble as follows:

(1) Place spring (14) in poppet (13); install in body (15).
(2) Sparingly apply a wipe coat of Krytox to packing (12) and install in sleeve (9). Install insert (11) and seal (10) in sleeve (9).
(3) Insert pins (8) in sleeve (9). Apply Loctite 222 to the external threads of sleeve (9) and thread the sleeve into body (15), being sure the pins remain in the sleeve.

NOTE: Use of plug (6) will aid in threading the sleeve into the body.

(4) Sparingly apply a wipe coat of Krytox to packing (5) and install in the groove in plug (6). Install cover (4) on body (15) and plug (6), then install and seat plug (6) in sleeve (9).
(5) Apply 1-1/2 turns of thread sealing tape to nipple (2) in the direction of the thread spiral, beginning at the first thread. In no case shall the tape extend beyond the first thread. Trim off excess tape. Thread nipple (2) into body (15).

2. 5510 Series Regulator Assemblies. (See IPL figure 9.)

NOTE: Regulator body (49 or 49A)) must be assembled to a cylinder before assembly of the regulator.

A. If regulator body (49 or 49A)) was removed from a cylinder, make sure drain tube (48) is pressed into body (49 or 49A). Place the appropriate cylinder in a suitable holding fixture and wrap 1-1/2 turns of thread sealing tape to body (49 or 49A), in the direction of the thread spiral, beginning with the first thread. Trim off excess tape. Tighten body (49 or 49A) into cylinder using wrench (1, figure 901). Torque all bodies per Table 801. Position body so that writing on cylinder will be in appropriate position when unit is assembled.

B. Wrap 1-1/2 turns of thread sealing tape to gauge (31 or 31A, IPL figure 9) in the direction of the thread spiral, beginning with the first thread. In no case shall the tape extend beyond the first thread. Trim off excess tape. Thread gauge (31 or 31A) into body (49 or 49A). Use a thin wrench on the gauge pipe connection square. Torque per Table 801.

C. Wrap 1-1/2 turns of thread sealing tape to valve assembly (24) in the direction of the thread spiral, beginning with the first thread. In no case shall the tape extend beyond the first thread. Trim off excess tape. Assemble valve assembly (24) to regulator body (49 or 49A) after installing filters (25) and (27). Torque per Table 801.

D. If necessary, cement seat (23) to cap (22) using adhesive. Coat seat (23) and cap (22) with Insa-Lute adhesive, then join and allow parts to air dry. Thread cap (22) with seat (23) onto charging valve assembly (24) after adhesive has thoroughly dried.

E. Wrap 1-1/2 turns of thread sealing tape to relief valve (32) in the direction of the thread spiral, beginning with the first thread. In no case shall the tape extend beyond the first thread. Trim off excess tape. Install valve in body (49 or 49A). Do not tighten valve at this time. It is necessary to remove relief valve when testing regulator assembly. When valve is finally installed, torque per Table 801.

F. Wrap 1-1/2 turns of thread sealing tape to appropriate outlet assemblies in the direction of the thread spiral, beginning with the first thread. In no case shall the tape extend beyond the first thread. Trim off excess tape. Install the appropriate outlet assemblies at this time. Torque outlets per Table 801.

G. Insert filter (21) in opening of body (49 or 49A) such that opening in filter is over the raised portion of seat. Apply a wipe coat of Krytox to packing (18) then install bushing (19) or plug (20) in opening of body (49 or 49A). Tighten bushing until it bottoms on body (49 or 49A). Observe that filter (21) is not wrinkled.

H. Apply a wipe coat of Krytox to stem of stem assembly (15).

I. Apply a wipe coat of Krytox to threaded area of head assembly (17) and install head assembly (17) in bushing (19) using stem assembly (15) to thread head assembly (17) into bushing (19).

J. Install seat (16) on stem assembly (15) and push seat (16) into bushing (19).

K. Apply a wipe coat of Krytox to packing (14 or 14A), then assemble packing (14 or 14A) on nut (13) and thread nut (13) into bushing (19). Lockwire nut (13) to body (49 or 49A) per the applicable instructions of MS33540.

L. Place washers (11 and 12) on stem assembly (15). Assemble handle (8) and attach it to stem assembly (15) with washer (10) and nut (9). Press plate (7) on handle (8).

M. Position washer (30) and disc (29) in the opening of body (49) and torque safety plug (28) per Table 801.

N. Place spring (47) and guide (46) in body (49 or 49A).

O. Inspect the center hole of seat (44) and the seating area of pin (45) with a magnifying glass or microscope. These areas must be smooth and clean without cracks, nicks, or burrs. Insert pin (45) in seat (44) and place the assembly into body (49 or 49A).

P. Inspect the thread of holder (43) with a magnifying glass or microscope. Make sure that the first thread does not have a sharp leading edge and that the entire thread is free of burrs and rough edges. Torque holder (43) into body (49 or 49A) per Table 801. Over-torquing may result in damage to seat (44).

Q. Place plate (42), diaphragm (41), three rings (40), plate (39), spring (38) and guide (37) in position in the regulator body.

NOTE: Three slip rings (40) are normally required to properly seal diaphragm (41) while engaging a maximum number of threads of case (36). The number of rings (40) may be altered if necessary to accomplish this.

R. Thread case (36) onto body (49 or 49A). Tighten case (36) until it bottoms on body (49 or 49A)). Install screw (35) loosely. When ready to test unit, apply Loctite, Grade C to setscrew (35) then adjust unit before Loctite sets up.

NOTE: Do not install plate (33) and screws (34) until completion of Testing.

3. Part No. 6379 and 800649 Series Demand and Pressure/Demand Oxygen Regulators. (See IPL figure 3).

A. Thread adapter (25 or 26) onto the outlet port of case (28).

B. Install screen (27) in the inlet port of case (28).

C. Install gasket (24) and attach valve assembly (20) to case (28), using washers (22 and 23) and screws (21). Connect a supply of oxygen to the inlet port, and adjust oxygen pressure to 85 psi (0.59 MPa). Cover sealing area of valve assembly (20) with a small amount of clean water. Bubbles indicate leakage which must be corrected. After successful completion of this test, remove the oxygen source, dry the regulator by blowing with clean, dry, water-pumped air, and continue reassembly.

D. Attach deflector (18) to case (28) with screws (19). Clearance must be noted between the demand valve and the deflector. Lack of clearance will cause the demand valve to open.

E. Install diaphragm assembly (16) over case (28) so that diaphragm edge extends to edge of machined surface beyond groove. Wrap cord (17) around diaphragm at groove in case four full turns and tie securely. The diaphragm must lay smoothly without wrinkles or folds. Apply Dow Corning adhesive over knot tied in cord (17).

F. Rivet plates (8, 11 and/or 12) to cover (14 and/or 15) with rivets (10 and 13). Install plate (9) if it was removed.

G. Install button (13D) in cover (15), then attach spring (13C) to the narrow slots in the button inside the cover.

H. Install plate and lever assembly (13B) in cover (15) with the lip of the lever in the recess slot in cover (15). Place one end of spring (13A) in the hole in the lever of plate and lever assembly (13B) and the other end in the hole nearest the closed face of cover (15).

NOTE: Spring (13A) shall measure 3-1/4 in. (8.25 cm), tip-to-tip, prior to installation.

I. Assemble cover assembly to case (28) with screws (7).

4. 5600 Series. (See IPL figure 2.)

NOTE: All components of the 5600 Series must be completely tested prior to assembly. Instructions for the testing of components are listed under Testing.

A. With regulator (38) assembled to cylinder (45), place loop of sling (17) over regulator (38) onto neck of cylinder (45).

B. Wrap 1-1/2 turns of thread sealing tape to elbow assembly (4) in the direction of the thread spiral, beginning with the first thread. In no case shall the tape extend beyond the first thread. Trim off excess tape. Thread the elbow assembly into regulator (38).

C. Wrap 1-1/2 turns of thread sealing tape to connector assembly (3) in the direction of the thread spiral, beginning wih the first thread. In no case shall the tape extend beyond the first thread. Trim off excess tape. Thread the connector assembly into regulator (7).

D. Assemble bracket (13) to regulator (7) with screws (11) and washers (12), then align this unit on the cylinder and unite elbow assembly (4) to connector assembly (3).

E. Connect bracket (13) to cylinder (45) by installing clamp (14), then secure loose end of sling (17) to the cylinder with clamp (24).

F. If necessary, attach identification plate (35) to regulator with screws (37). Affix instruction plates (43, 44 and 44A) to cylinder (45), if necessary.

NOTE: Outlet assemblies (28) are normally assembled to regulator (38) when regulator is reassembled.

5. 5500 Series. (See IPL figure 2.)

NOTE: All components of the 5500 Series must be completely tested prior to final assembly. Refer to Testing instructions.

A. With regulator (38) assembled to cylinder (45), place loop of sling (17) over regulator (38) onto neck of cylinder (45). Secure loose end of sling (17) to cylinder (45) with clamp (24).

B. If necessary, attach identification plate (35) to regulator with screws (37). Affix instruction plates (43, 44 and 44A) to cylinder (45), if necessary.

NOTE: Outlet assemblies (28) are normally assembled to regulator (38) when regulator is reassembled.

6. Storage Instructions

A. Make sure on-off valve assembly is completely closed prior to placing the assembly in storage.

B. Plug all openings with suitable dust caps and wrap the unit in a clean plastic bag to prevent dust accumulation. Do no use preservative coatings of any type.

C. Make sure that cylinder pressure is always a minimum of 200 psi (1.38 MPa).

FITS AND CLEARANCES

1. Table 801 presents the torque values necessary to assemble the unit.

UNIT	TORQUE lbf• in. (N•m)
Outlet assemblies (28, IPL figure 2)	*40-80 (4.5-9.0)
Charging Valve Assembly (24, IPL figure 9)	*60-250 (6.8-28.2)
Safety Plug (28, IPL figure 9)	150 (16.9)
Gauge (31 or 31A, IPL figure 9)	**40 (4.5)
Relief Valve (32, IPL figure 9)	*25-50 (2.8-5.6)
Seat Holder (43, IPL figure 9)	*50-125 (5.6-14.1)
Regulator Body (49, IPL figure 9) All except P/N 5053-03 & 5053-13 (1/2 ANPT)	1200 (135.6)
P/N 5053-03 & 5053-13 (1 ANPT)	1800 (203.4)

*Torque to minimum values. If leakage occurs, retorque to a higher value but do not exceed the maximum.

***Determined by orientation.*

Assembly Torque Values
Table 801

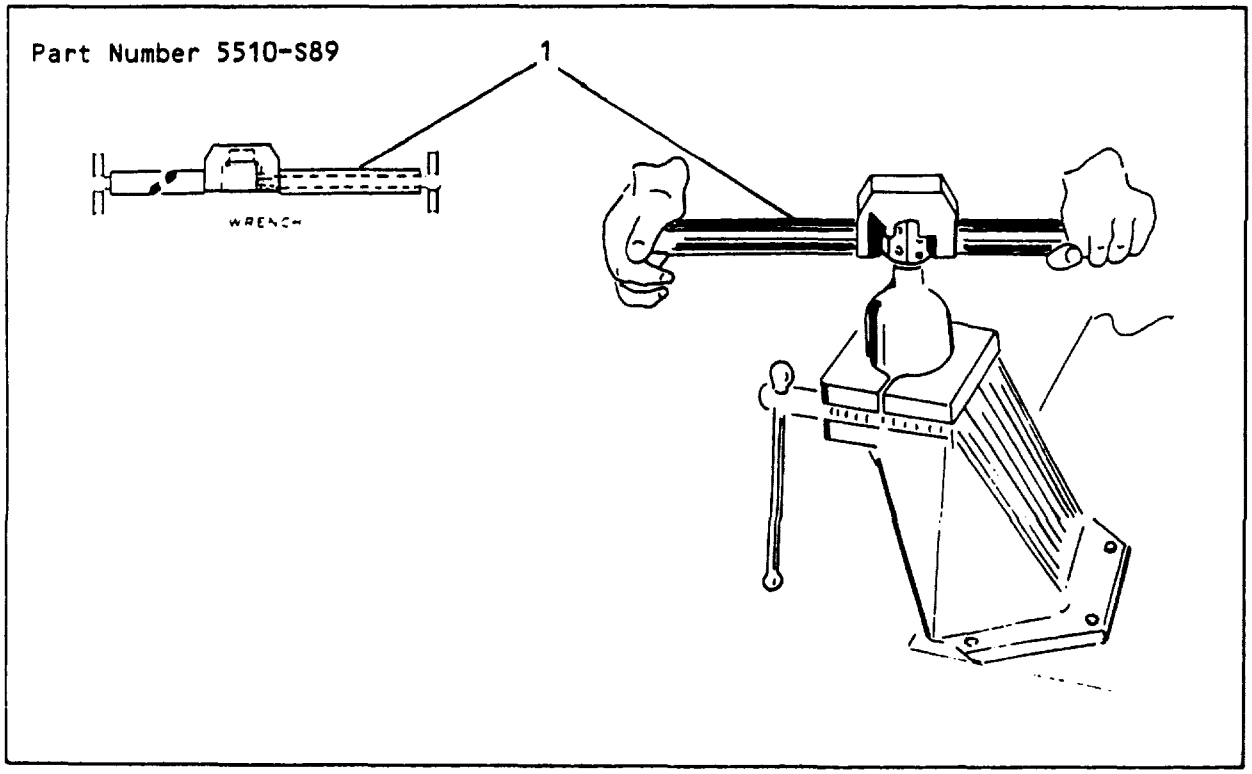
SPECIAL TOOLS, FIXTURES AND EQUIPMENT

1. All special tools required to overhaul the portable oxygen breathing equipment are listed in figure 901 and illustrated in figure 902. Equivalent tools may be used.

INDEX NO.	PART NO.	NOMENCLATURE	USE
1	5510-S89	Wrench	Used to turn regulator body (49 or 49A, IPL figure 9) into cylinder (43, IPL figure 2)
2	Deleted		

NOTE: All special tools listed are manufactured by Scott Aviation, Lancaster, New York.

Special Tools
Figure 901



Special Tools
Figure 902

ILLUSTRATED PARTS LIST

1. This Illustrated Parts List lists and describes the parts of the 5500 Series and 5600 Series, Portable Oxygen Breathing Units.

   A. The Illustrated Parts List consists of nine parts listings and nine completely indexed drawings. The breathing units are followed immediately by their component parts, properly indented thereunder, to show their relationship to the units.

   B. The quantities listed in the "UNITS PER ASSY" column are, in the case of assemblies, the total quantity used per breathing unit at the location indicated, while the component parts indented under the assemblies are the quantity used per assembly. The quantities specified, therefore, are not necessarily the total used per breathing unit. See the Numerical Index for the total used per breathing unit. It should be noted that the index quantity only reflects the use of one outlet assembly. If more than one outlet is present, quantitites must be adjusted accordingly.

   C. The part numbers listed in the "PART NUMBER" column are Scott Aviation part numbers except standard parts, which are listed by "MS" and "AN" part numbers, and vendor items which are listed by vendor part numbers.

   D. When the quantity of a part is to be selected as required, the abbreviation "AR" will appear in the "UNITS PER ASSY" column.

   E. A six place code following the description of a part indicates the manufacturer of that part. Standard parts and parts carried under Scott part numbers have no six place vendor code. The following list contains the codes, and names and addresses of manufacturers supplying items or articles for the breathing unit. This listing includes the vendor's code presented in Table 101, 401, 601 and 701.

VENDOR'S CODE

CODE	NAME AND ADDRESS
V00287	CEM Co., Inc. Danielson, Conn.
V05972	American Sealants Co. Hartford, Conn.
V07098	Linde Division of Union Carbide Tonawanda, New York
V14674	Corning Glass Works Corning, New York
V18034	Nupro 4800 East 345th St. Willoughby, Ohio
V18873	E.I. DuPont DeNemours & Company, Inc. Petroleum Chemicals Division Wilmington, Delaware
V21343	Owens-Corning Fiberglass Corp. Huntington, Pennsylvania
V44389	Oakite Products Berkeley Heights, New Jersey
V45722	Parker Kaylon Division of General American Transportation Corp., Clifton, New Jersey
V49315	Puritan Equipment, Inc. Lenexa, Kansas
V66295	Wittek Manufacturing Co. Chicago, Illinois
V71984	Dow Corning Corp. Midland, Michigan
V78189	Shakeproof Division of Illinois Tool Works Inc. Elgin, Illinois
V80703	Sauereisen Cements Co. Pittsburgh, Pennsylvania

VENDOR'S CODE - continued

CODE	NAME AND ADDRESS
V81168	Linear, Inc. Philadelphia, Pennsylvania
V99742	Johnson and Johnson Inc. Permacel Division New Brunswick, New Jersey

F. The following effect codes have been assigned to the items contained in IPL figure 1.

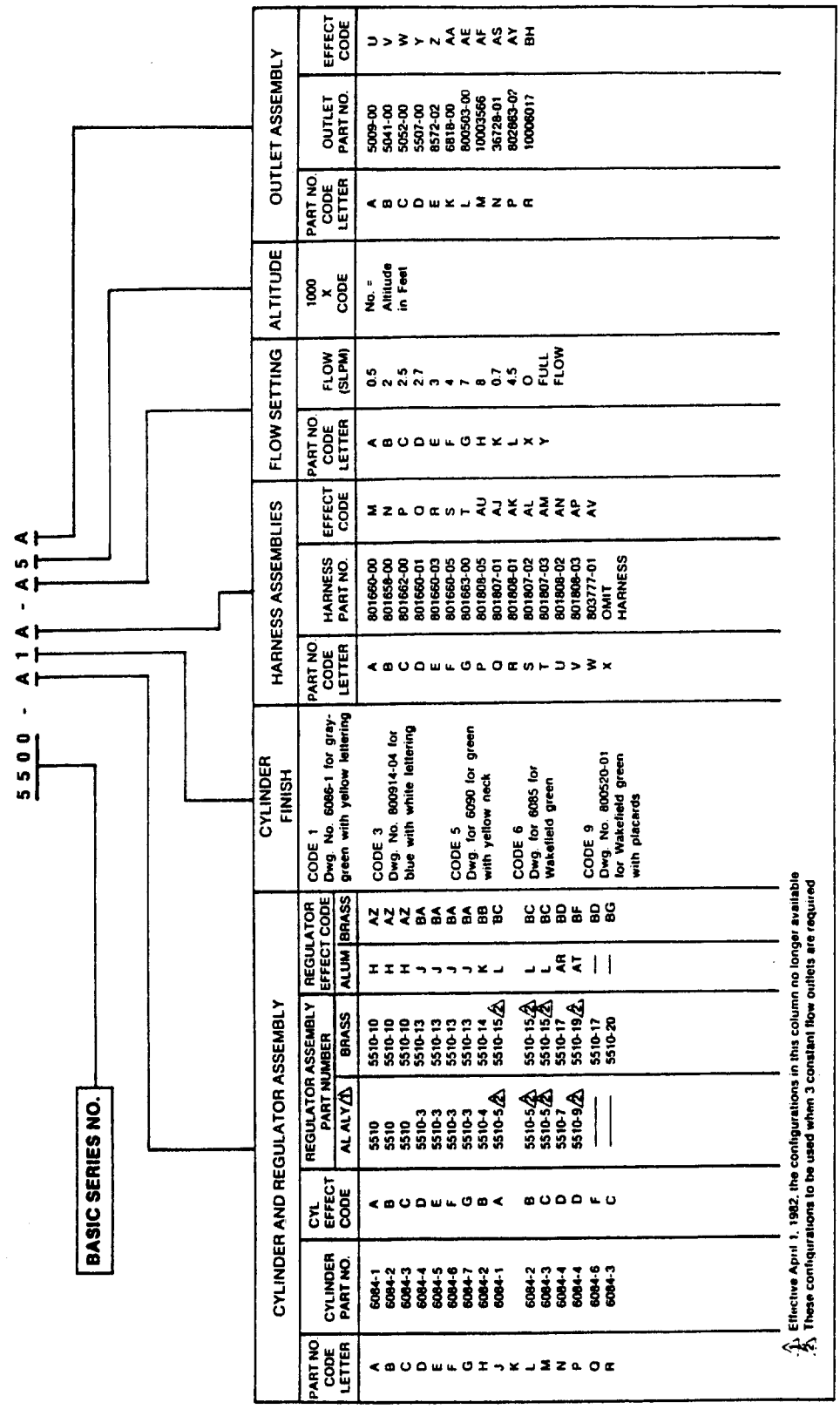
PART NO.	EFFECT CODE
5500 SERIES & 5600 SERIES	Select applicable codes from listings in IPL figure 1.
Select effect code from IPL figure 1	1
Used on 5600 Series	2
Used on 5600 Series with 6084-1, 6084-2 and 6084-3 cylinders	3
Used on 5600 Series with 6084-4 cylinder	4
Used on 5600 Series with 6084-5 cylinder	5
Used on 5600 Series with 6084-6 and 6084-7 cylinder	6
Used on 5500 and 5600 Series with 6084-1, 6084-2 and 6084-3 cylinders	7
Used on 5500 and 5600 Series with 6084-4 cylinder	8
Used on 5500 & 5600 Series with 6084-5, 6084-6 and 6084-7 cylinders	9
Used on 5500 Series with 801663-00 Strap Assembly	10
Used on 5500 Series	11

2. How to use this Illustrated Parts List

A. If neither the part number nor the nomenclature is known, the part can be found by comparison with the exploded view illustration. When located on the illustration, the item number will refer to the line in the Illustrated Parts List with the part number and the nomenclature.

B. If the part number is known, refer to the Numerical Index and find the part number. Opposite the part number is the figure and item number which refers to the Illustrated Parts List. Proper nomenclature is opposite the item number on the Group Assembly Parts List page.

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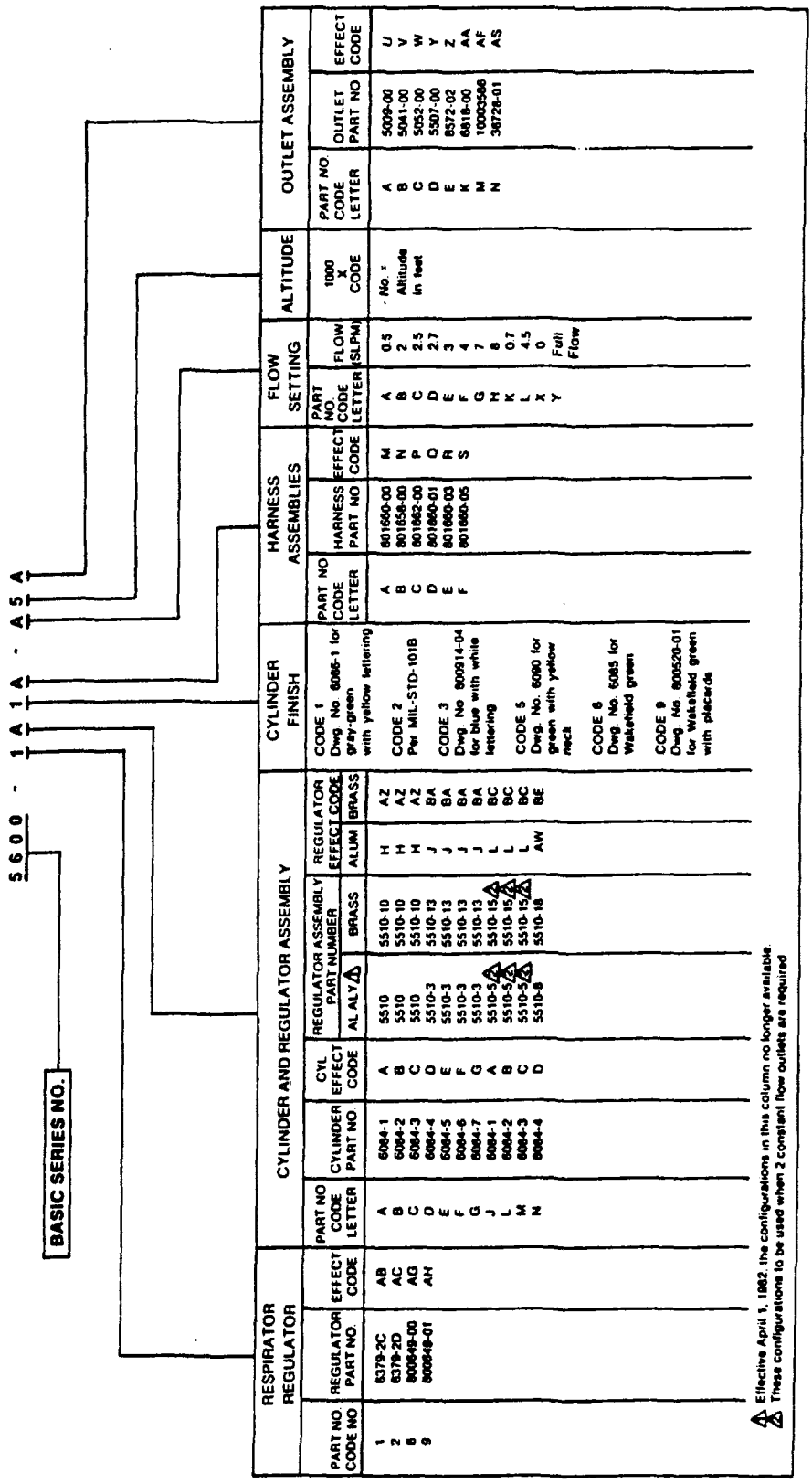


CYLINDER AND REGULATOR ASSEMBLY						CYLINDER FINISH	HARNESS ASSEMBLIES			FLOW SETTING	ALTITUDE	OUTLET ASSEMBLY		
PART NO CODE LETTER	CYLINDER PART NO.	CYL EFFECT CODE	REGULATOR ASSEMBLY PART NUMBER		REGULATOR EFFECT CODE		PART NO CODE LETTER	HARNESS PART NO.	EFFECT CODE	PART NO. CODE LETTER	1000 X CODE	PART NO. CODE LETTER	OUTLET PART NO.	EFFECT CODE
			ALALY⚠	BRASS	ALUM	BRASS								
A	6084-1	A	5510	5510-10	H	AZ	A	801660-00	M	A	No. = Altitude in Feet	A	5009-00	U
B	6084-2	B	5510	5510-10	H	AZ	B	801658-00	N	B		B	5041-00	V
C	6084-3	C	5510	5510-10	H	AZ	C	801662-00	P	C		C	5052-00	W
D	6084-4	D	5510-3	5510-13	J	BA	D	801660-01	Q	D		D	5507-00	Y
E	6084-5	E	5510-3	5510-13	J	BA	E	801660-03	R	E		E	8572-02	Z
F	6084-6	F	5510-3	5510-13	J	BA	F	801660-05	S	F		K	6818-00	AA
G	6084-7	G	5510-3	5510-13	J	BA	G	801663-00	T	G		L	800503-00	AE
H	6084-2	B	5510-4	5510-14	K	BB	P	801808-05	AU	H		M	10003566	AF
J	6084-1	A	5510-5⚠	5510-15⚠	L	BC	Q	801807-01	AJ	K		N	36728-01	AS
K							R	801808-01	AK	L		P	802863-07	AY
L	6084-2	B	5510-5⚠	5510-15⚠	L	BC	S	801807-02	AL	X		R	10006017	BH
M	6084-3	C	5510-5⚠	5510-15⚠	L	BC	T	801807-03	AM	Y				
N	6084-4	D	5510-7	5510-17	AR	BD	U	801808-02	AN					
P	6084-4	D	5510-9⚠	5510-19⚠	AT	BF	V	801808-03	AP					
Q	6084-6	F	———	5510-17	—	BD	W	803777-01	AV					
R	6084-3	C	———	5510-20	—	BG	X	OMIT HARNESS						

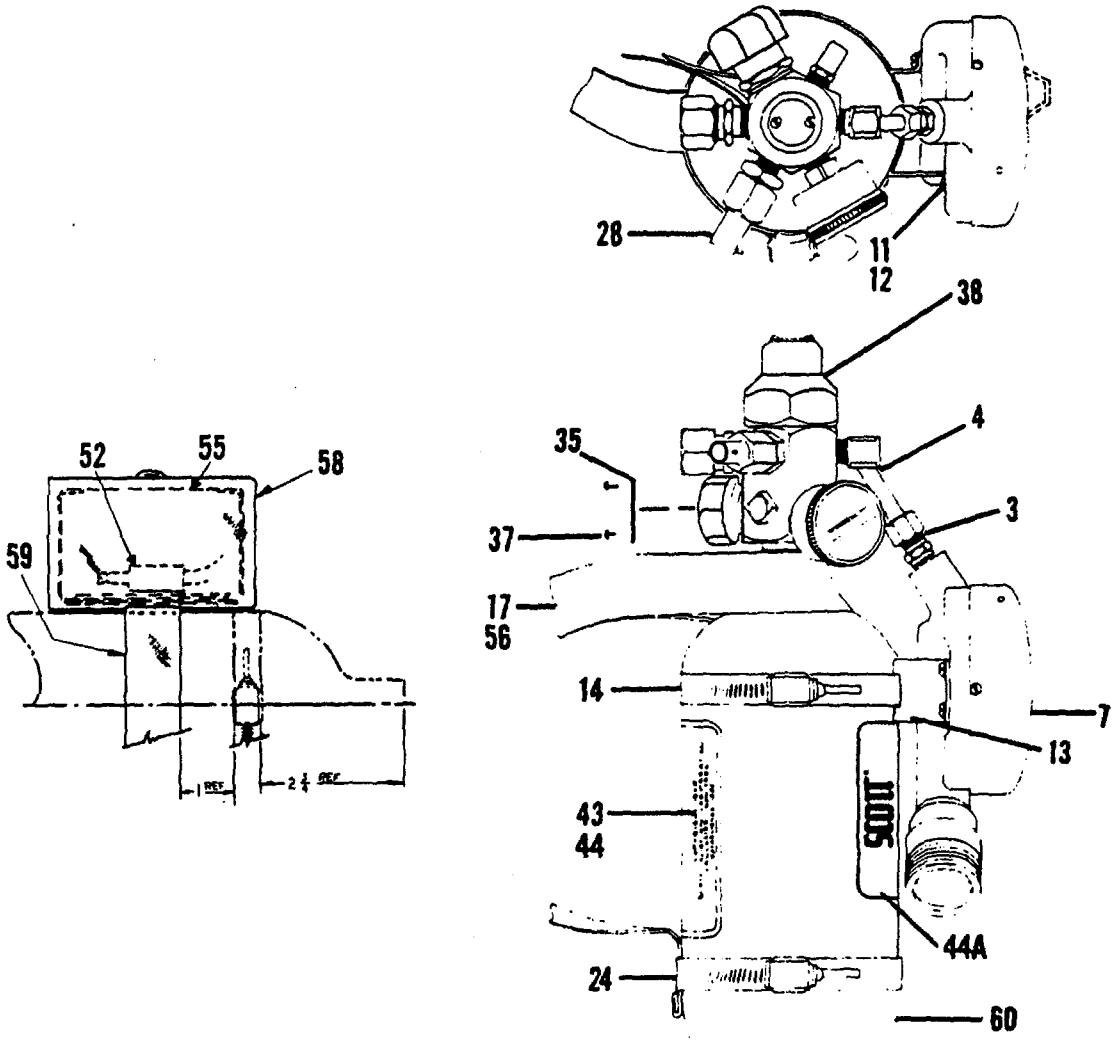
5500	A1A	A5A	FLOW (SLPM)
			0.5
			2
			2.5
			2.7
			3
			4
			7
			8
			0.7
			4.5
			0
			FULL FLOW

⚠ Effective April 1, 1982, the configurations in this column no longer available
⚠ These configurations to be used when 3 constant flow outlets are required

Effect Code (Sheet 1 of 2)
Figure 1



Effect Code (Sheet 2 of 2)
Figure 1



Oxygen Breathing Unit 5500 and 5600 Series
Figure 2

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY
2-1	5500 SERIES		PORTABLE OXYGEN BREATHING UNIT	1	RF
-2	5600 SERIES		DUAL PURPOSE OXYGEN BREATHING UNIT	1	RF
3	5602		. CONNECTOR ASSEMBLY	2	1
4	5601		. ELBOW ASSEMBLY	3	1
-5	5601B		. ELBOW ASSEMBLY	4,5	1
-6	5601C		. ELBOW ASSEMBLY	6	1
7	6379-2C		. REGULATOR-OXYGEN, DEMAND (SEE IPL FIGURE 3 FOR BREAKDOWN)	AB	1
-8	6379-2D		. REGULATOR-OXYGEN, DEMAND (SEE IPL FIGURE 3 FOR BREAKDOWN)	AC	1
-9	800649-00		. REGULATOR ASSY-OXYGEN, PRESSURE/DEMAND (SEE IPL FIGURE 3 FOR BREAKDOWN)	AG	1
-10	800649-01		. REGULATOR ASSY-OXYGEN, PRESSURE-DEMAND (SEE IPL FIGURE 3 FOR BREAKDOWN) (ATTACHING PARTS)	AH	1
11	59602-00		. SCREW	2	4
12			DELETED ----*----		
13	10001296		. BRACKET	2	1
14	WWD122		. CLAMP (V66295)	3	1
-15	WWD176		. CLAMP (V66295)	4	1
-16	WWD224		. CLAMP (V66295)	5,6	1
17	801660-00		. SLING STRAP (SUPER-SEDES P/N 5017)	M	1
-18	801658-00		. STRAP ASSEMBLY (SUPER-SEDES P/N 21441)	N	1
-19	801662-00		. SLING ASSEMBLY (SUPER-SEDES P/N 21442)	P	1
-20	801660-01		. STRAP ASSEMBLY (SUPER-SEDES P/N 5017-1)	Q	1
-21	801660-03		. STRAP ASSEMBLY (SUPER-SEDES P/N 5017-3)	R	1
-22	801660-05		. STRAP ASSEMBLY (SUPER-SEDES P/N 5017-5)	S	1
23	801663-00		. STRAP ASSEMBLY (SUPER-SEDES P/N 12203) (ATTACHING PARTS)	T	1
24	WWD120		. CLAMP (V66295)	7	1
-25	WWD176		. CLAMP (V66295)	8	1
-26	WWD224		. CLAMP (V66295)	9	1

- ITEM NOT ILLUSTRATED

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY	
2-27	WWD224		. CLAMP (V66295)	10	2	
			----*----			
28	5041		. OUTLET ASSY (SEE IPL FIGURE 4 FOR BREAKDOWN)	V	1	
-29	5009-00		. OUTLET ASSY (SEE IPL FIGURE 5 FOR BREAKDOWN)	U	1	
-30	5507		. OUTLET ASSY (SEE IPL FIGURE 7 FOR BREAKDOWN)	Y	1	
-31	5052		. OUTLET ASSY (SEE IPL FIGURE 8 FOR BREAKDOWN)	W	1	
-32	8572-02		. OUTLET ASSY (SEE IPL FIGURE 6 FOR BREAKDOWN)	Z	1	
-33	6818		. PLUG-PIPE	AA	1	
-34	800503-00		. OUTLET ASSY (SEE IPL FIGURE 5 FOR BREAKDOWN)	AE	1	
-34A	36728-01		. OUTLET	AS	1	
-34B	802863-02		. OUTLET ASSY (SEE IPL FIG. 10 FOR BREAKDOWN)	AY	1	
-34C	10006017		. OUTLET ASSEMBLY	BH	1	R
35	5057		. PLATE-IDENTIFICATION	11	1	
-36	5057-1		. PLATE-IDENTIFICATION (ATTACHING PARTS)	2	1	
37	U0X1-8		. SCREW-DRIVE-TYPE U NO. 0 BY 1/8 IN. LG (V45722)	11,2	2	
			----*----			
38	5510		. REGULATOR ASSY-OXYGEN (SEE IPL FIGURE 9 FOR BREAKDOWN)	H	1	
-38A	5510-10		. REGULATOR ASSY-OXYGEN (SEE IPL FIGURE 9 FOR BREAKDOWN) (SB35-48)	AZ	1	
-39	5510-3		. REGULATOR ASSY-OXYGEN (SEE IPL FIGURE 9 FOR BREAKDOWN)	J	1	
-39A	5510-13		. REGULATOR ASSY-OXYGEN (SEE IPL FIGURE 9 FOR BREAKDOWN) (SB35-48)	BA	1	
-40	5510-4		. REGULATOR ASSY-OXYGEN (SEE IPL FIGURE 9 FOR BREAKDOWN)	K	1	
40A	5510-14		. REGULATOR ASSY-OXYGEN (SEE IPL FIGURE 9 FOR BREAKDOWN) (SB35-48)	BB	1	

- ITEM NOT ILLUSTRATED

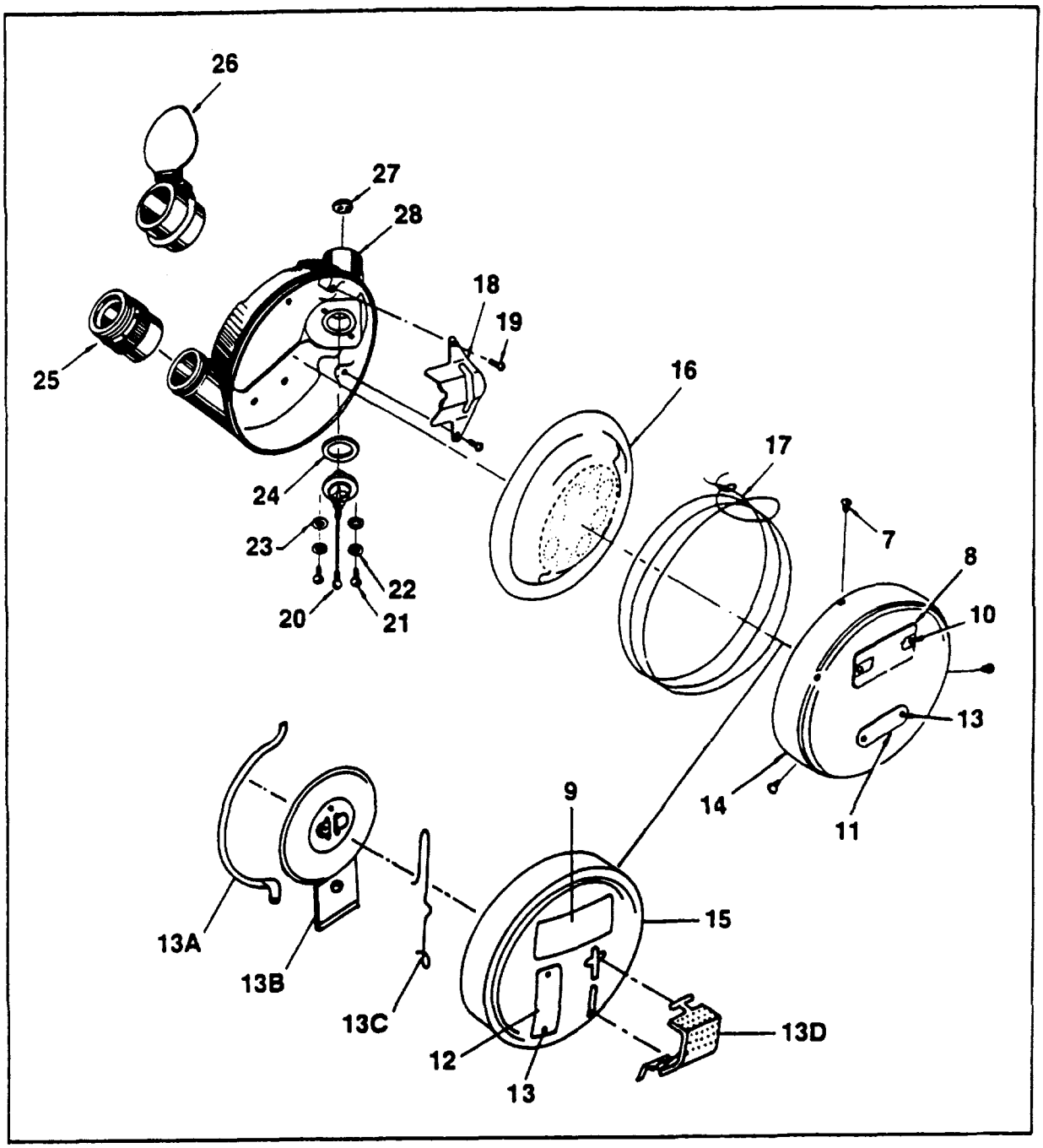
FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY	
2-41	5510-5		. REGULATOR ASSY-OXYGEN (SEE IPL FIGURE 4 FOR BREAKDOWN)	L	1	
-41A	5510-15		. REGULATOR ASSY-OXYGEN (SEE IPL FIGURE 9 FOR BREAKDOWN) (SB35-48)	BC	1	
-42			DELETED			
-42A	5510-7		. REGULATOR ASSY-OXYGEN IPL FIGURE 9 FOR BREAKDOWN)	AR	1	
-42B	5510-17		. REGULATOR ASSY-OXYGEN (SEE IPL FIGURE 9 FOR BREAKDOWN) (SB35-48)	BD	1	
-42C	5510-8		. REGULATOR ASSY-OXYGEN (SEE IPL FIGURE 9 FOR BREAKDOWN)	AW	1	
-42D	5510-18		. REGULATOR ASSY-OXYGEN (SEE IPL FIGURE 9 FOR BREAKDOWN) (SB-35-48)	BE	1	
-42E	5510-9		. REGULATOR ASSY-OXYGEN (SEE IPL FIGURE 9 FOR BREAKDOWN)	AW	1	
-42F	5510-19		. REGULATOR ASSY-OXYGEN (SEE IPL FIGURE 9 FOR BREAKDOWN) (SB35-48)	BF	1	
-42G	5510-20		. REGULATOR ASSY-OXYGEN (SEE IPL FIGURE 9 FOR BREAKDOWN)	BG	1	R
43	5608		. PLATE-INSTRUCTION	2	1	
44	10006936		. PLATE-INSTRUCTION	11	1	R
44A	10005922		. DECAL	2,11	1	R
-45	10003566		. COUPLING-OXYGEN	AF	1	
-46	801807-01		. MASK, STORAGE BAG AND HARNESS ASSEMBLY	AJ	1	
-47	801808-01		. MASK, STORAGE BAG AND HARNESS ASSEMBLY	AK	1	
-48	801807-02		. MASK, STORAGE BAG AND HARNESS ASSEMBLY	AL	1	
-49	801807-03		. MASK, STORAGE BAG AND HARNESS ASSEMBLY	AM	1	
-50	801808-02		. MASK, STORAGE BAG AND HARNESS ASSEMBLY	AN	1	
-51	801808-03		. MASK, STORAGE BAG AND HARNESS ASSEMBLY	AP	1	

- ITEM NOT ILLUSTRATED

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY
2-51A	801808-05		. MASKS, STORAGE BAG AND HARNESS ASSEMBLY	AU	1
-51B	803177-01		. MASKS, STORAGE BAG AND HARNESS ASSEMBLY	AV	1
52	14807		. . CONNECTOR	AJ,AK	1
-53	5065-10		. . CONNECTOR	AL,AN	1
-53A	5065-10		. . CONNECTOR	AU,AV	2
-54	29559		. . NIPPLE	AM,AP	1
55	59270-00		. . MASK ASSEMBLY	AJ-AP	1
-55A	59270-00		. . MASK ASSEMBLY	AU	2
-55B	28672-211		. . MASK ASSEMBLY	AV	2
56	801660-00		. . STRAP-SLING	AK,AN, AP,AU, AU, AV	1
57	801662-00		. . SLING ASSEMBLY	AJ,AL, AM	1
58	801809-01		. . BAG ASSY-STORAGE, MASK	AJ-AP, AV	1
-58A	801809-01		. . BAG ASSY-STORAGE, MASK (ATTACHING PARTS)	AU	2
59	36879-01		. . FASTENER	AJ-AP AU,AV	1
			----*----		
60	*6084-3		. CYLINDER-OXYGEN (11.00 CU. FT.)	C	1
-61	*6084-1		. CYLINDER-OXYGEN (4.25 CU. FT.)	A	1
-62	*6084-2		. CYLINDER-OXYGEN (7.15 CU. FT.)	B	1
-63	*6084-4		. CYLINDER-OXYGEN (22.00 CU. FT.)	D	1
-64	*6084-5		. CYLINDER-OXYGEN (28.8 CU. FT.)	E	1
-65	*6084-6		. CYLINDER-OXYGEN (38.4 CU. FT.)	F	1
-66	*6084-7		. CYLINDER-OXYGEN (48.3 CU. FT.)	G	1

*For ordering spare cylinders it is necessary to use the cylinder part number and cylinder finish number (see IPL figure 1) to provide proper identification of the finished cylinder.

- ITEM NOT ILLUSTRATED



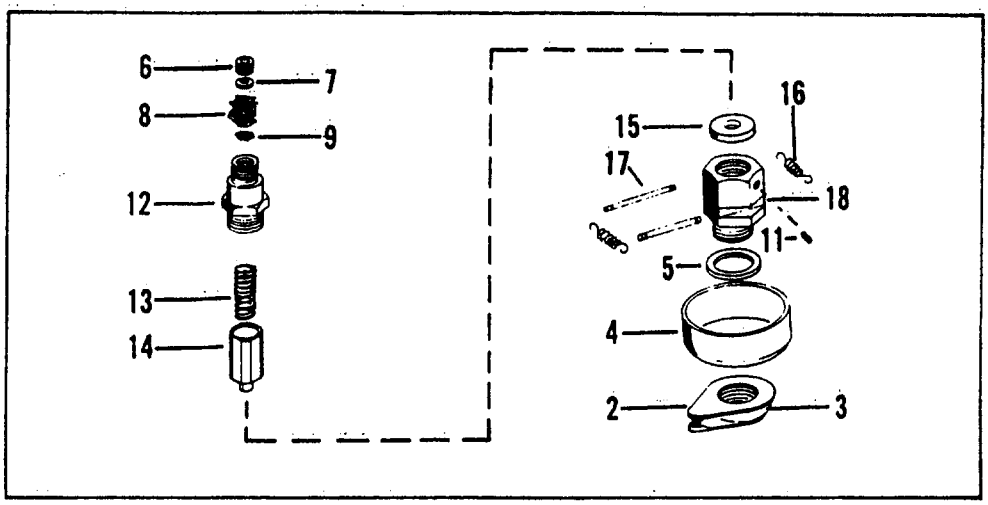
Demand/Pressure Demand Oxygen Regulators, 6379 Series/800649 Series
Figure 3

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY	
3-1	6379-2C		REGULATOR-OXYGEN-DEMAND (SEE ITEM 7, IPL FIGURE 2 FOR NHA)	AB	RF	
-2	6379-2D		REGULATOR-OXYGEN-DEMAND (SEE ITEM 8, IPL FIGURE 2 FOR NHA)	AC	RF	
-3	800649-00		REGULATOR-OXYGEN-PRESSURE/DEMAND (SEE ITEM 9, IPL FIGURE 2 FOR NHA)	AG	RF	
-4	800649-01		REGULATOR-OXYGEN-PRESSURE/DEMAND (SEE ITEM 10, IPL FIGURE 2 FOR NHA)	AH	RF	
-5	6050C		. COVER ASSEMBLY	AB,AC	1	
6	800651-00		. COVER ASSEMBLY	AG,AH	1	
			(ATTACHING PARTS)			
7	MS33506-212		. SCREW	AB,AC AG,AH	3	
			----*----			
8	6375-4		. . PLATE-ID	AB,AC	1	
9	10001297		. . PLATE-ID	AG,AH	1	
			(ATTACHING PARTS)			
10	MS20470A2-2		. . RIVET	AB,AC	2	
			----*----			
11	6378		. . PLATE-INST	AB,AC	1	
12	6597		. . PLATE-INST	AG,AH	1	
			(ATTACHING PARTS)			
13	MS20470A2-2		. . RIVET	AB,AC, AG,AH	2	
			----*----			
13A	6586		.. SPRING-COMPRESSION	AG,AH	1	R
13B	6588		.. PLATE AND LEVER ASSY	AG,AH	1	R
13C	6583		.. SPRING-SLIDE BUTTON	AG,AH	1	R
13D	6584		.. BUTTON-SLIDE	AG,AH	1	R
14	6050-1		. . COVER-CASE	AB,AC	1	
15	6582		. . COVER-CASE	AG,AH	1	
16	13374-00		. DIAPHRAGM ASSY	AB,AC, AG,AH	1	
			(ATTACHING PARTS)			
17	A1215-1		. CORD-DIAPHRAGM	AB,AC, AG,AH	1	
			----*----			

- ITEM NOT ILLUSTRATED

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY
3 18	A1126		. DEFLECTOR	AB,AC, AG,AH	1
			(ATTACHING PARTS)		
19	9036		. SCREW	AB,AC, AG,AH	2
			----*----		
20	6055E		. VALVE ASSY-DEMAND	AB,AC, AG,AH	1
			(ATTACHING PARTS)		
21	MS35206-213		. SCREW	AB,AC, AG,AH	2
22	MS35333-36		. WASHER	AB,AC, AG,AH	2
23	6066-00		. WASHER-FLAT	AB,AC, AG,AH	2
			----*----		
24	A1120B		. GASKET-DEMAND VALVE SEAT	AB,AC, AG,AH	1
25	5603-00		. ADAPTER	AB,AG	1
26	5606-00		. ADAPTER	AC,AH	1
27	6812-00		. SCREEN-REGULATOR INLET	AB,AC AG,AH,	1
28	5607-01		. CASE-REGULATOR	AB,AC, AG,AH	1

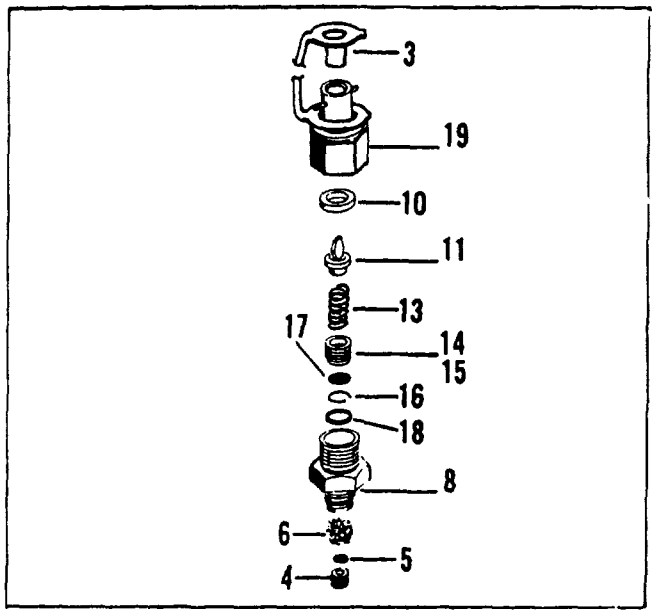
- ITEM NOT ILLUSTRATED



Outlet Assembly, P/N 5041
Figure 4

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY
4-1	5041		OUTLET ASSY (SEE ITEM 28, IPL FIGURE 2 FOR NHA)	V	RF
2	29558-1		. COVER-DUST (ATTACHING PARTS)	V	1
3	29557		. NUT (SUPPLIED AS PART OF 5041-1) ----*----	V	1
4	5042-1		. CAP	V	1
5	5042-2		. WASHER	V	1
6	5014-1		. SCREW-ORIFICE ADJ	V	1
7	5013-1		. SCREEN	V	1
8	EC9-5U		. CORD (V21343)	V	AR
9	5013-1		. SCREEN	V	1
-10	5041-1		. COUPLING ASSEMBLY	V	1
11	29567		. . SETSCREW	V	1
12	29550		. . BODY	V	1
13	29551		. . SPRING	V	1
14	29552		. . VALVE	V	1
15	29553-1		. . SEAT-VALVE	V	1
16	29555		. . SPRING-LATCH	V	2
17	29556		. . PIN-LATCH	V	2
18	29554		. . CASE	V	1

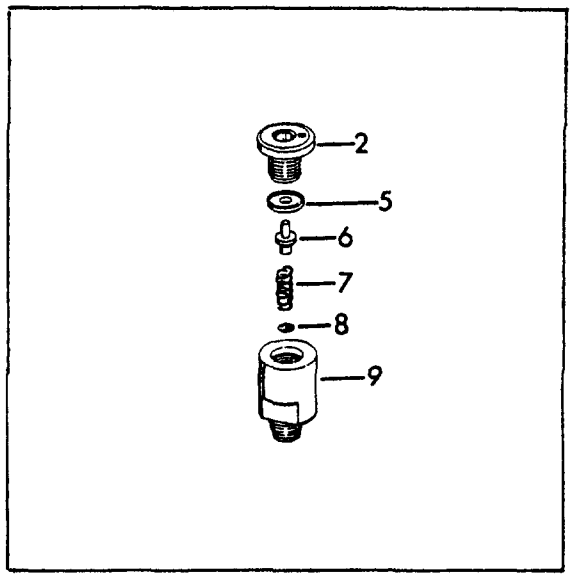
- ITEM NOT ILLUSTRATED



Outlet Assembly, P/N 5009 and 800503-00
Figure 5

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY
5-1	5009-00		OUTLET ASSY (SEE ITEM 29, IPL FIGURE 2 FOR NHA)	U	RF
-2	800503-00		OUTLET ASSY (SEE ITEM 34, IPL FIGURE 2 FOR NHA)	AE	RF
3	59447-00		. COVER-DUST	AE,U	1
4	5014		. SCREW-ORIFICE ADJ	U	1
5	5013		. SCREEN-RETAINING	U	1
6	EC9-5U		. CORD (V21343)	U	AR
-7	5009-01		. OUTLET ASSEMBLY	U	1
8	10001494		. . STUD	AE,U	1
-9			DELETED		
10	5065-8		. . GASKET	AE,U	1
11	24823		. . VALVE	AE,U	1
-12			DELETED		
13	5065-6		. . SPRING	AE,U	1
14	10001493		. . FLOW PORT	U	1
15	10001112		. . FLOW PORT	AE	1
16	5065-2		. . RING-RETAINING	U	1
17	5065-4		. . FILTER-OUTLET	U	1
18	5065-3		. . GASKET	AE,U	1
19	24825		. . RECEPTACLE	AE,U	1

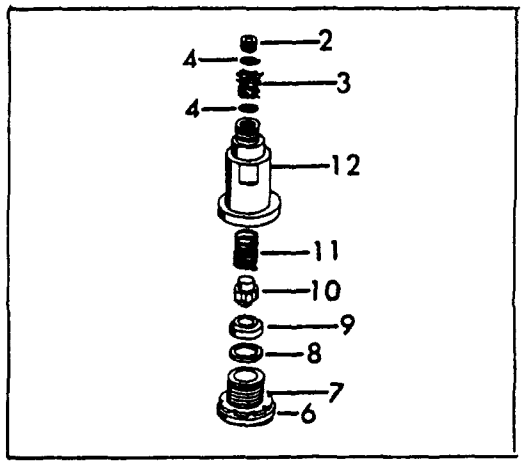
- ITEM NOT ILLUSTRATED



Outlet Assembly, P/N 8572
Figure 6

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY
6-1	8572-02		OUTLET ASSY (SEE ITEM 32, IPL FIGURE 2 FOR NHA)	Z	RF
2	802233-01		. BODY AND PIN ASSEMBLY	Z	1
-3	27434-01		. . PIN-SPIROL (V00287)	Z	1
-4	10005326		. . WASHER	Z	1
-5	10005272		. . BODY	Z	1
6	8579-00		. GASKET	Z	1
7	8578-00		. POPPET	Z	1
8	8569-1		. SPRING	Z	1
9	A1119		. FILTER-INLET	Z	1
10	8587-01		. ADAPTER	Z	1

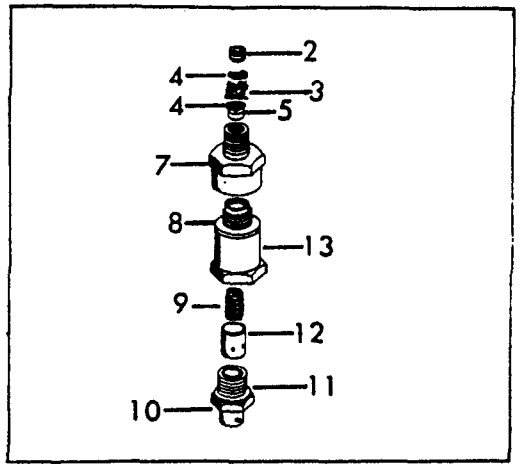
- ITEM NOT ILLUSTRATED



Outlet Assembly, P/N 5507
Figure 7

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY
7-1	5507		OUTLET ASSY (SEE ITEM 30, IPL FIGURE 2 FOR NHA)	Y	RF
2	5014-1		. SCREW-ORIFICE ADJ	Y	1
3	EC9-5U		. CORD (V21343)	Y	AR
4	5013-1		. SCREEN	Y	2
-5	5533		. OUTLET SUBASSEMBLY	Y	1
6	210331		. . GUIDE ASSEMBLY - INSERT (V49315)	Y	1
7	832100		. . WASHER-LOCK (V49315)	Y	1
8	832402		. . WASHER-RET (V49315)	Y	1
9	614010		. . WASHER-SEAT (V49315)	Y	1
10	520058		. . SEAT (V49315)	Y	1
11	833012		. . SPRING (V49315)	Y	1
12	5533-1		. . BODY	Y	1

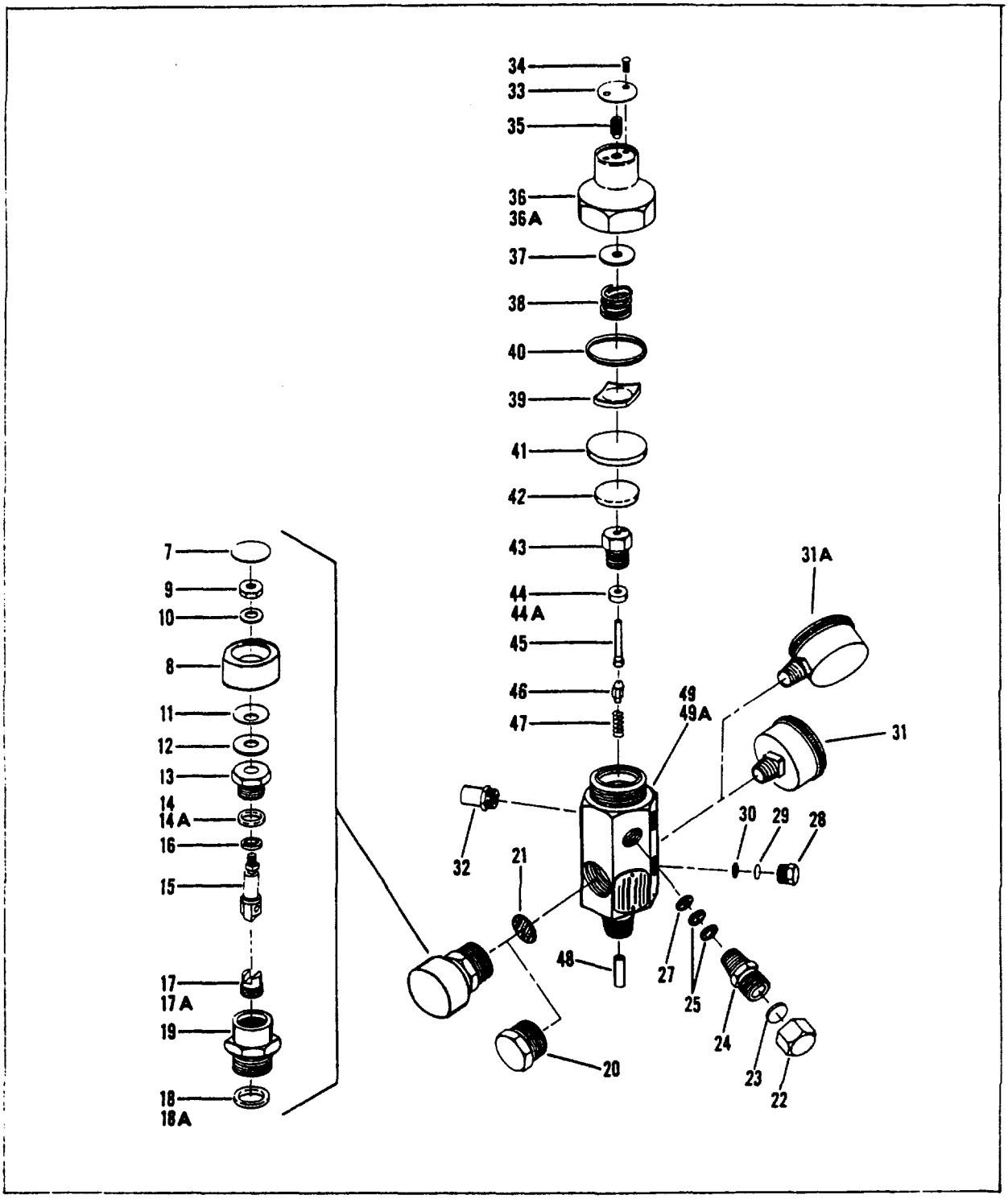
- ITEM NOT ILLUSTRATED



Outlet Assembly, P/N 5052
Figure 8

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY
8-1	5052		OUTLET ASSY (SEE ITEM 31, IPL FIGURE 2 FOR NHA)	W	RF
2	5014		. SCREW-ORIFICE ADJ	W	1
3	EC9-5U		. CORD (V21343)	W	AR
4	5013		. SCREEN	W	2
5	5058		. WASHER	W	1
-6	5052-2		. COUPLING	W	1
7	5067-1		. . BASE	W	1
8	5067-2		. . GASKET-BODY	W	1
9	5067-4		. . SPRING	W	1
10	5067-7		. . SEAT-VALVE	W	1
11	5067-6		. . GASKET-VALVE SEAT	W	1
12	5067-5		. . RETAINER	W	1
13	5067-3		. . BODY	W	1

- ITEM NOT ILLUSTRATED



Oxygen Regulator Assembly, 5510 Series
Figure 9

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY
9-1	5510		REGULATOR ASSY-OXYGEN (SEE ITEM 38, IPL FIGURE 2 FOR NHA) (SUPERSEDED BY 5510-10 SB35-48)	H	RF
-1A	5510-10		REGULATOR ASSY-OXYGEN (SEE ITEM 38A, IPL FIGURE 2 FOR NHA) (SUPERSEDES 5510 SB35-48)	AZ	RF
-2	5510-3		REGULATOR ASSY-OXYGEN (SEE ITEM 39, IPL FIGURE 2 FOR NHA) (SUPERSEDED BY 5510-13 SB35-48)	J	RF
-2A	5510-13		REGULATOR ASSY-OXYGEN (SEE ITEM 39A, IPL FIGURE 2 FOR NHA) (SUPERSEDES 5510-3 SB35-48)	BA	RF
-3	5510-4		REGULATOR ASSY-OXYGEN (SEE ITEM 40, IPL FIGURE 2 FOR NHA) (SUPERSEDED BY 5510-14 SB35-48)	K	RF
-3A	5510-14		REGULATOR ASSY-OXYGEN (SEE ITEM 40A, IPL FIGURE 2 FOR NHA) (SUPERSEDES 5510-4 SB35-48)	BB	RF
-4	5510-5		REGULATOR ASSY-OXYGEN (SEE ITEM 41, IPL FIGURE 2 FOR NHA) (SUPERSEDED BY 5510-15 SB35-48)	L	RF
-4A	5510-15		REGULATOR ASSY-OXYGEN (SEE ITEM 41A, IPL FIGURE 2 FOR NHA) (SUPERSEDES 5510-5 SB35-48)	BC	RF
-5			DELETED		
-5A	5510-7		REGULATOR ASSY-OXYGEN (SEE ITEM 42A, IPL FIGURE 2 FOR NHA) (SUPERSEDED BY 5510-17 SB35-48)	AR	RF
-5B	5510-17		REGULATOR ASSY-OXYGEN SEE ITEM 42B, IPL FIGURE 2 FOR NHA) (SUPERSEDES 5510-7 SB35-48)	BD	RF
-5C	5510-8		REGULATOR ASSY-OXYGEN (SEE ITEM 42C, IPL FIGURE 2 FOR NHA) (SUPERSEDED BY 5510-18 SB35-48)	AW	RF

- ITEM NOT ILLUSTRATED

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY	
9-5D	5510-18		REGULATOR ASSY-OXYGEN (SEE ITEM 42D IPL FIGURE 2 FOR NHA) (SUPERSEDES 5510-8 SB35-48)	BE	RF	
-5E	5510-9		REGULATOR ASSY-OXYGEN (SEE ITEM 42E, IPL FIGURE 2 FOR NHA) (SUPERSEDED BY 5510-19 SB35-48)	AT	RF	
-5F	5510-19		REGULATOR ASSY-OXYGEN (SEE ITEM 42F, IPL FIGURE 2 FOR NHA) (SUPERSEDES 5510-9 SB35-48)	BF	RF	
-5G	5510-20		REGULATOR ASSY-OXYGEN (SEE ITEM 42G, IPL FIGURE 2 FOR NHA)	BG	RF	R
-6	5520-09		. VALVE KIT-ON-OFF (SUPERSEDED BY 5520-17)	H,J,L, AR,AW, AT	1	
-6A	5520-17		. VALVE KIT-ON-OFF (SUPERSEDES 5510-09) (SB35-48)	AZ,BA, BC,BD, BE,BF, BG	1	
7	22427-1		. . PLATE-INST	H,J,L, AR,AW, AT,AZ, BA,BC, BD,BE, BF,BG	1	
8	23274-3		. . HANDLE	H,J,L, AR,AW, AT,AZ, BA,BC, BD,BE, BF,BG		
			(ATTACHING PARTS)			
9	AN345-10		. . NUT	H,J,L, AR,AW, AT,AZ, BA,BC, BD,BE, BF,BG	1	

- ITEM NOT ILLUSTRATED

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY
9-10	1110-00		. . WASHER-LOCK (V78189)	H,J,L, AR,AW, AT,AZ, BA,BC BD,BE, BF,BG	1
			----*----		
11	22445-1		. . WASHER-BOWED, SPRING	H,J,L, AR,AW, AT,AZ, BA,BC, BD,BE, BF,BG	1
12	5511		. . WASHER-FLAT	H,J,L, AR,AW, AT,AZ, BA,BC, BD,BE, BF,BG	2
13	23394-01		. . NUT-PACKING	H,J,L, AR,AW, AT,AZ, BA,BC, BD,BE, BF,BG	1
14	59598-00		. . PACKING-PERFORMED (SUPERSEDED BY 55620-01) (SB35-48)	H,J,L, AR,AW, AT	1
14A	55620-01		. . PACKING-PERFORMED (SUPERSEDES 59598-00) (SB35-48)	AZ,BA, BC,BE, BF,BG	1
15	5513		. . STEM ASSEMBLY	H,J,L, AR,AW, AT,AZ, BA,BC, BD,BE, BF,BG	1
16	5517		. . SEAT-TEFLON	H,J,L, AR,AW, AT,AZ, BA,BC, BD,BE, BF,BG	1

- ITEM NOT ILLUSTRATED

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY
9 17	5518		. . HEAD ASSEMBLY-VALVE (SUPERSEDED BY 802883-01) (SB35-48)	H,J,L, AR,AW, AT	1
17A	802883-01		. . HEAD ASSEMBLY-VALVE (SUPERSEDES 5518) (SB35-48)	AZ,BA, BC,BD, BE,BF, BG	1
18	18037-01		. . PACKING-PREFORMED (SUPERSEDED BY 55620-02) (SB35-48)	H,J,L, AR,AW, AT	1
18A	55620-02		. . PACKING-PREFORMED (SUPERSEDES 18037-01) (SB35-48)	AZ,BA, BC,BD, BE,BF, BG	1
19	23393-1		. . BUSHING-VALVE ADAPTER	H,J,L, AR,AW, AT,AZ, BA,BC, BD,BE, BF,BG	1
20	13166-00		. PLUG-ON-OFF VALVE	K,BB	1
21	5522-00		. FILTER	H,J,K, L,AR, AW,AT, AZ,BA, BB,BC, BD,BE, BF,BG	1
22	5016-00		. CAP-FILTER	H,J,K, L,AR, AW,AT, AZ,BA, BB,BC, BD,BE, BF,BG	1
23	5023-00		. SEAT-FILLER CAP	H,J,K, L,AR, AW,AT, AZ,BA, BB,BC, BD,BE, BF,BG	1

- ITEM NOT ILLUSTRATED

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY
9 24	5093-01		. VALVE ASSY CHARGING	H,J,K, L,AR, AW,AT, AZ,BA, BB,BC, BD,BE, BF,BG	1
25	8385-00		. FILTER	H,J,K, L,AR, AW,AT, AZ,BA, BB,BC, BD,BE, BF,BG	1
-26	8385-00		. FILTER	H,J,L, AR,AW, AT,AZ, BA,BC, BD,BE BF,BG	1
27	8384-00		. FILTER	H,J,K, L,AR, AW,AT, AZ,BA, BB,BC, BD,BE, BF,BG	1
28	6363-01		. PLUG-SAFETY	H,J,K, L,AR, AW,AT, AZ,BA, BB,BC, BD,BE, BF,BG	1
29	6364-00		. DISC-SAFETY PLUG	H,J,K, L,AR, AW,AT, AZ,BA, BB,BC, BD,BE, BF,BG	1

- ITEM NOT ILLUSTRATED

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY	
9 30	6370-00		. WASHER-SAFETY PLUG	H,J,K, L,AR, AW,AT, AZ,BA, BB,BC, BD,BE, BF,BG	1	
31	2661-03		. GAUGE-PRESSURE	H,J,K, L,AT, AZ,BA, BB,BC, BF	1	
31A	802821-01		. GAUGE-PRESSURE	AR,AW, BD,BE, BG	1	
32	5043-14		. VALVE-RELIEF	H,J,K, L,AR, AW,AT, AZ,BA, BB,BC, BD,BE, BF,BG	1	
33	5056-00		. PLATE-ID	H,J,K, L,AR, AW,AT, AZ,BA, BB,BC, BD,BE, BF,BG		
			(ATTACHING PARTS)			
34	59553-00		. SCREW	H,J,K, L,AR, AW,AT, AZ,BA, BB,BC, BD,BE, BF,BG	2	R
			----*----			
35	37008-01		. SETSCREW - LOC-WEL	H,J, AR,AW, AT,AZ, BA,BB, BC,BD, BE,BF, BG	1	

- ITEM NOT ILLUSTRATED

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY
9 36	5005-01		. CASE-SPRING (SUPERSEDED BY 5005-03) (SB35-48)	H,J,K, L,AR, AW,AT	1
36A	5005-03		. CASE-SPRING (SUPERSEDES 5005-01) (SB35-48)	AZ,BA, BB,BC, BD,BE, BF,BG	1
37	8561-00		. GUIDE-SPRING	H,J,K, L,AR, AW,AT, AZ,BA, BB,BC, BD,BE, BF,BG	1
38	5003-00		. SPRING-ADJUSTING	H,J,K, L,AR, AW,AT, AZ,BA, BB,BC, BD,BE, BF,BG	1
39	5034-00		. PLATE-DIAPHRAGM	H,J,K, L,AR, AW,AT, AZ,BA, BB,BC, BD,BE, BF,BG	1
40	5033-00		. RING-SLIP	H,J,K, L,AR, AW,AT, AZ,BA, BB,BC, BD,BE, BF,BG	3
41	5032-01		. DIAPHRAGM	H,J,K, L,AR, AW,AT, AZ,BA, BB,BC, BD,BE, BF,BG	1

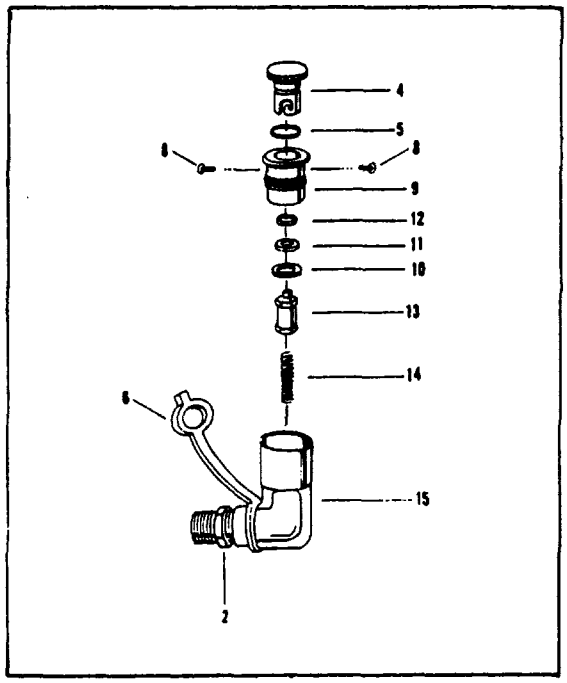
- ITEM NOT ILLUSTRATED

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY
9 42	5031-00		. PLATE-THRUST	H,J,K, L,AR, AW,AT, AZ,BA, BB,BC, BD,BE, BF,BG	1
43	5030-01		. HOLDER-SEAT	H,J,K, L,AR, AW,AT, AZ,BA, BB,BC, BD,BE, BF,BG	1
44	5029-00		. SEAT (SUPERSEDED BY 803129-01) (SB35-48)	H,J,K, L,AR, AW,AT	1
44A	803129-01		. SEAT (SUPERSEDES 5029-00) (SB35-48)	AZ,BA, BB,BC, BD,BE, BF,BG	1
45	5028-00		. PIN-THRUST	H,J,K, L,AR, AW,AT, AZ,BA, BB,BC, BD,BE, BF,BG	1
46	5002-00		. GUIDE-THRUST	H,J,K, L,AR, AW,AT, AZ,BA, BB,BC, BD,BE, BF,BG	1
47	5027-00		. SPRING-MARGINAL	H,J,K, L,AR, AW,AT, AZ,BA, BB,BC, BD,BE, BF,BG	1

- ITEM NOT ILLUSTRATED

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY
9 48	5018-00		. TUBE-DRAIN	H,J,K, L,AR, AW,AT, AZ,BA, BB,BC, BD,BE, BF,BG	1
49	5053-07		. BODY-REGULATOR (SUPERSEDED BY 27170-01) (SB35-48)	H,K	1
49A	27170-01		. BODY-REGULATOR (SUPERSEDES 5053-07) (SB35-48)	AZ,BB, BG	1
-50	5053-03		. BODY-REGULATOR (SUPERSEDED BY 27170-04) (SB35-48)	J,AR, AW	1
-50A	27170-03		. BODY-REGULATOR (SUPERSEDES 5053-03) (SB35-48)	BA,BD, BE	1
-51	5053-09		. BODY-REGULATOR (SUPERSEDED BY 27170-02) (SB35-48)	L	1
-51A	27170-02		. BODY-REGULATOR (SUPERSEDES 5053-09) (SB35-48)	BC	1
-52	5053-15		. BODY-REGULATOR (SUPERSEDED BY 27170-04) (SB35-48)	AT	1
-52A	27170-04		. BODY-REGULATOR (SUPERSEDES 5053-15) (SB35-48)	BF	1

ITEM NOT ILLUSTRATED



Outlet Assembly P/N 802863-02
Figure 10

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY
10-1	802863-02		OUTLET ASSY-OXYGEN	AY	RF
2	AN911-1D		. NIPPLE	AY	1
-3	802874-01		. PLUG ASSY-DUST	AY	1
4	59477-01		. . COVER-DUST	AY	1
5	36862-05		. . PACKING-PREFORMED	AY	1
6	802877-01		. . PLUG-DUST	AY	1
-7	802061-00		. SLEEVE AND PIN ASSY	AY	1
8	10004844		. . PIN	AY	2
9	10004845		. . SLEEVE-INSERT	AY	1
10	10004840		. SEAL	AY	1
11	10004841		. RETAINER	AY	1
12	MS9068-008		. PACKING-PREFORMED	AY	1
13	10004839		. POPPET	AY	1
14	10004838		. SPRING	AY	1
15	10005750		. BODY-OUTLET	AY	1

- ITEM NOT ILLUSTRATED

PART NUMBER	AIRLINE PART NUMBER	FIGURE	ITEM	TTL REQ
A1119		6	9	1
A1120B		3	24	1
A1126		3	18	1
A1215-1		3	17	1
AN345-10		9	9	1
AN911-1D		10	2	1
EC9-5U		4	8	AR
		5	6	
		7	3	
		8	3	
MS20470A2-2		3	10	4
		3	13	
MS33506-212		3	7	3
MS35206-213		3	21	2
MS35333-36		3	22	2
MS9068-008		10	12	1
UOX1-8		2	37	2
WWD120		2	24	1
WWD122		2	14	1
WWD176		2	-15	2
		2	-25	
WWD224		2	-16	2
		2	-26	
		2	-27	
10001112		5	15	1
10001296		2	13	1
10001297		3	9	1
10001493		5	14	1
10001494		5	8	1
10003566		2	-45	1
10004838		10	14	1
10004839		10	13	1
10004840		10	10	1
10004841		10	11	1
10004844		10	8	2
10004845		10	9	1
10005272		6	-5	1
10005326		6	-4	1
10005750		10	15	1
10005922		2	-34C	1
10006017		2	44A	1
10006936		2	44	1
1110-00		9	10	1

PART NUMBER	AIRLINE PART NUMBER	FIGURE	ITEM	TTL REQ
13166		9	20	1
13374-00		3	16	1
14807		2	52	1
18037-01		9	18	1
210331		7	6	1
22427-1		9	7	1
22445-1		9	11	1
23274-3		9	8	1
23393-1		9	19	1
23394-01		9	13	1
24823		5	11	1
24825		5	19	1
2661-03		9	31	1
27170-01		9	49A	1
27170-02		9	-51A	1
27170-03		9	-50A	1
27170-04		9	-52A	1
27434-01		6	-3	1
28672-211		2	-55B	2
29550		4	12	1
29551		4	13	1
29552		4	14	1
29553-1		4	15	1
29554		4	18	1
29555		4	16	2
29556		4	17	1
29557		4	3	1
29558-1		4	2	1
29559		2	-54	1
29567		4	11	1
36728-01		2	-34A	1
36862-05		10	5	1
36879-01		2	59	1
37008-01		9	35	1
5002-00		9	46	1
5003-00		9	38	1
5005-01		9	36	1
5005-03		9	36A	1
5009-00		2	-29	1
		5	-1	RF
5009-01		5	-7	1
5013		5	5	1
		8	4	2

PART NUMBER	AIRLINE PART NUMBER	FIGURE	ITEM	TTL REQ
5013-1		4	7	1
		4	9	1
		7	4	2
5014		5	4	1
		8	2	1
5014-1		4	6	1
		7	2	1
5016		9	22	1
5018		9	48	1
5023		9	23	1
5027		9	47	1
5028-00		9	45	1
5029-00		9	44	1
5030-01		9	43	1
5031-00		9	42	1
5032-01		9	41	1
5033-00		9	40	3
5034-00		9	39	1
5041		2	28	1
		4	-1	RF
5041-1		4	-10	1
5042-1		4	4	1
5042-2		4	5	1
5043-14		9	32	1
5052		2	-31	1
		8	-1	RF
5052-2		8	-6	1
5053-03		9	-50	1
5053-07		9	49	1
5053-09		9	-51	1
5053-15		9	52	1
5056-00		9	33	1
5057		2	35	1
5057-1		2	-36	1
5058		8	5	1
5065-10		2	-53	1
		2	-53A	2
5065-2		5	16	1
5065-3		5	18	1
5065-4		5	17	1
5065-6		5	13	1
5065-8		5	10	1
5067-1		8	7	1
5067-2		8	8	1

PART NUMBER	AIRLINE PART NUMBER	FIGURE	ITEM	TTL REQ
5067-3		8	13	1
5067-4		8	9	1
5067-5		8	12	1
5067-6		8	11	1
5067-7		8	10	1
5093-01		9	24	1
520058		7	10	1
5500 SERIES		2	-1	1
5507		2	-30	1
		7	-1	RF
5510		2	38	1
		9	-1	RF
5510-10		2	38A	1
		9	-1A	RF
5510-13		2	-39A	1
		9	-2A	RF
5510-14		2	-40A	1
		9	-3A	RF
5510-15		2	-41A	1
		9	-4A	RF
5510-17		2	-42B	1
		9	-5B	RF
5510-18		2	-42D	1
		9	-5D	RF
5510-19		2	-42F	1
		9	-5F	RF
5510-20		2	-42G	1
		9	-5G	RF
5510-3		2	-39	1
		9	-2	RF
5510-4		2	-40	1
		9	-3	RF
5510-5		2	-41	1
		9	-4	RF
5510-7		2	-42A	1
		9	-5	RF
5510-8		2	-42C	1
		9	-5C	RF
5510-9		2	-42E	1
		9	-5E	RF
5511		9	12	2
5513		9	15	1
5517		9	16	1
5518		9	17	1

PART NUMBER	AIRLINE PART NUMBER	FIGURE	ITEM	TTL REQ.
5520-09		9	-6	1
5520-17		9	-6A	1
5522-00		9	21	1
5533		7	-5	1
5533-1		7	12	1
55620-01		9	14A	1
55620-02		9	18A	1
5600 SERIES		2	-2	1
5601		2	4	1
5601B		2	-5	1
5601C		2	-6	1
5602		2	3	1
5603		3	25	1
5606		3	26	1
5607-01		3	28	1
5608		2	43	1
59270-00		2	55	1
		2	-55A	2
59447-00		5	3	1
59477-01		10	4	1
59553-00		9	34	2
59598-00		9	14	1
59602-00		2	11	4
6050-1		3	14	1
6050C		3	-5	1
6055E		3	20	1
6066-00		3	23	1
6084-1		2	-61	1
6084-2		2	-62	1
6084-3		2	60	1
6084-4		2	-63	1
6084-5		2	-64	1
6084-6		2	-65	1
6084-7		2	-66	1
614010		7	9	1
6363-01		9	28	1
6364-00		9	29	1
6370-00		9	30	1
6375-4		3	8	1
6378		3	11	1
6379-2C		2	7	1
		3	-1	RF
6379-2D		2	-8	1
		3	-2	RF

PART NUMBER	AIRLINE PART NUMBER	FIGURE	ITEM	TTL REQ
6582		3	15	1
6583		3	13C	1
6584		3	13D	1
6586		3	13A	1
6588		3	13B	1
6597		3	12	1
6812		3	27	1
6818		2	-33	1
800503-00		2	-34	1
		5	-2	RF
800649-00		2	-9	1
		3	-3	RF
800649-01		2	-10	1
		3	-4	RF
800651-00		3	6	1
801658-00		2	-18	1
801660-00		2	17	1
		2	56	1
801660-01		2	-20	1
801660-03		2	-21	1
801660-05		2	-22	1
801662-00		2	-19	1
		2	57	1
801663-00		2	-23	1
801807-01		2	-46	1
801807-02		2	-48	1
801807-03		2	-49	1
801808-01		2	-47	1
801808-02		2	-50	1
801808-03		2	-51	1
801808-05		2	-51A	1
801809-01		2	58	1
		2	-58A	
802061-00		10	-7	1
802233-01		6	2	1
802821-01		9	31A	1
802863-02		2	-34B	1
		10	-1	RF
802874-01		10	-3	1
802877-01		10	6	1
802883-01		9	17A	1
803129-01		9	44A	1
803177-01		2	-51B	1
832100		7	7	1

PART NUMBER	AIRLINE PART NUMBER	FIGURE	ITEM	TTL REQ
832402		7	8	1
833012		7	11	1
8384-00		9	27	1
8385-00		9	25	1
		9	-26	1
8561		9	37	1
8569-1		6	8	1
8572-02		2	-32	1
		6	-1	RF
8678-00		6	7	1
8579-00		6	6	1
8587-01		6	10	1
9036		3	19	2

MANUAL

MAINTENANCE

CYLINDER AND VALVE ASSEMBLY
6350 SERIES

35-21-19

H-119

Nov 15/74

SCOTT® ATO

SCOTT AVIATION, A Division of A-T-O Inc. ● 225 ERIE STREET ● LANCASTER, NEW YORK 14086

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MAINTENANCE MANUAL

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Service Bulletin List	Nov 15/74	*4	June 1/81
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*Table of Contents	June 1/81	8	Nov 15/74
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IMPORTANT WARNINGS

The following WARNINGS are presented to inform the user of this manual of the requirements which shall be adhered to when performing service procedures on this equipment. Additional WARNINGS will be found in the procedural steps in the manual.

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WARNING: DO NOT ALLOW OIL, GREASE, FLAMMABLE SOLVENTS, OR OTHER COMBUSTIBLE MATERIALS TO COME IN CONTACT WITH PARTS THAT WILL BE EXPOSED TO PRESSURIZED OXYGEN. SUCH MATERIALS, AS WELL AS DUST, LINT, AND FINE METAL FILINGS ARE ALL POTENTIAL COMBUSTIBLES WHICH MIGHT, WHEN EXPOSED TO OXYGEN UNDER PRESSURE, IGNITE AND RESULT IN AN EXPLOSION.

CYLINDER AND VALVE ASSEMBLY

1. Description and Operation

A. General

(1) This manual provides maintenance instructions for the 6350 Series Cylinder and Valve Assemblies (see figure 1). The complete part number of any particular cylinder and valve assembly is an eight to eleven place combination of numbers and letters. An example part number and an explanation of the various numbers and letters which make up a part number are shown in figures 2, 3, and 4.

The cylinder and valve assemblies, although similar in design and appearance, are used for various applications. The major applications are to supply oxygen at altitudes where oxygen is required for breathing.

B. Purpose of Equipment

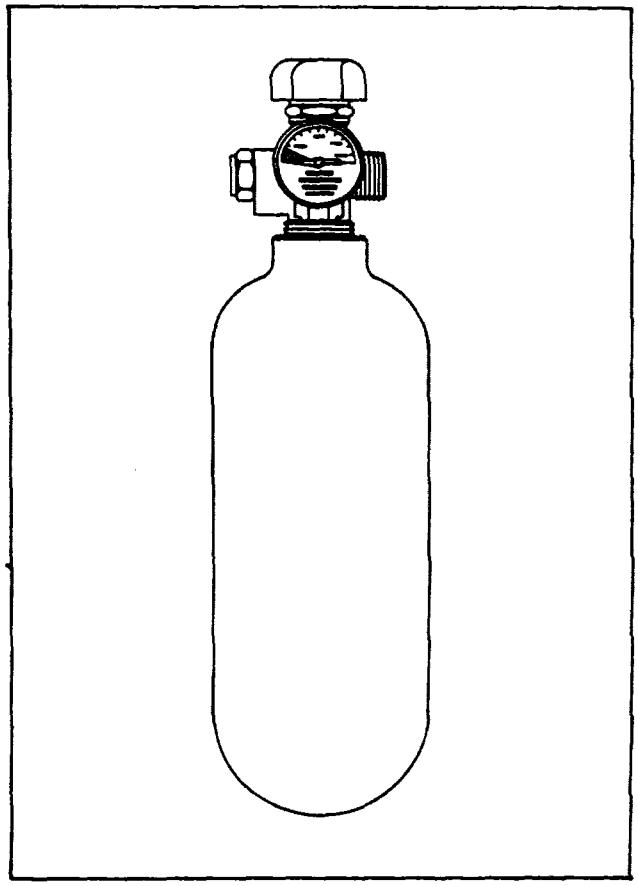
(1) To furnish a predetermined supply of oxygen, dependent on the size of the cylinder.

(2) The valves covered in this manual are manually operated "on-off" oxygen valves which are designed with a slow opening feature. The valves are nominally rated for 2000 psi service.

(3) To furnish a shut-off valve for turning the oxygen supply "ON" or "OFF".

(4) To furnish a safety device to vent excessive pressure in oxygen cylinders.

(5) To furnish, on some models, a gauge to visually monitor the supply of oxygen.



6350 Series Cylinder and Valve Assembly
Figure 1

6350 A1 - A - A

BASIC PART NO. 6350

A1 — SEE FIGURE 4

A — SEE FIGURE 3

DESIGNATION	CYLINDER PART NO.	CYLINDER CAPACITY (CU FT)	WEIGHT IN POUNDS EMPTY	WEIGHT IN POUNDS CHARGED	DOT RATING
A1	6084-5	28.8	13.69	16.08	3AA-1800
A2	6084-6	38.4	16.47	19.62	3AA-1800
A3	6084-3	11.0	6.18	7.09	3AA-2100 or 3AA-1800
A4	6084-4	22.0	10.13	11.97	3AA-1800
A5	6084-7	48.3	23.37	27.37	3AA-1800
A6	6084-8	54.0	27.00	32.52	3AA-2250
A7	6084-9	63.5	27.50	32.76	3AA-1800
A8	6084-12	107.0	48.00	56.90	3AA-1800
A11	6084-10	73.0	30.50	36.56	3AA-1800
A12	6084-11	91.0	42.00	49.55	3AA-1800
A13	6084-1	4.25	3.00	3.35	3AA-2100 or 3AA-1800
A14	6084-2	7.15	4.19	4.79	3AA-2100 or 3AA-1800
A15	27126	11.5	11.50	14.79	3AA-2150
A16	6084-16	15.20	7.30	9.10	3AA-2100
A20	6084-20	11.00	5.25	6.16	3AA-1800
A22	6084-26	39.4	13.00	16.27	3HT-1850
A25	6084-27	49.8	15.25	19.39	3HT-1850
A27	6084-29	66.0	19.00	24.98	3HT-1850
A33	6084-33	76.5	21.70	28.00	3HT-1850
A34	6084-34	115.0	33.00	42.55	3HT-1850

NOTE: A1 through A20 are lightweight cylinders (Type 3AA).
A22 through A34 are super-lightweight cylinders (Type 3HT).

Charged weight of cylinders is calculated with cylinders charged to 1800 psig with oxygen per MIL-O-27210 Type 1.

Cylinder Type
Figure 2

6350 A1 - A - A

BASIC PART NO.

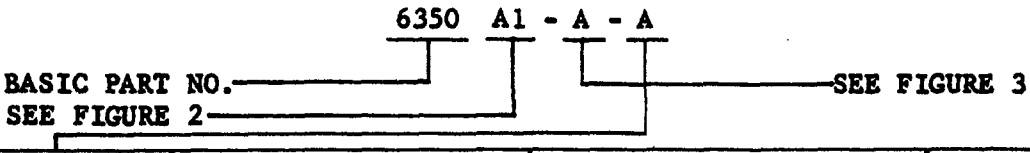
SEE FIGURE 2

SEE FIGURE 4

DESIGNATION	OXYGEN VALVE ASSEMBLY P/N NON-SLOW OPENING	SLOW OPENING OXY CYLINDER VALVE ASSY P/N	WEIGHT (lbs)
X	CYLINDER ONLY - NO VALVE		
A	802777-06 (1)		1.76
AA	802780-06 (2)		
BB	810850-1B		1.79
CC		10850-12	1.55
DD		810850-10	1.77
EE		810850-1A	1.79
FF		10850-11	1.56
GG		10850-36	1.31
LL		10850-21	1.46
NN		10850-35	1.15
O	802777-02 (1) (4)		1.81
	802777-05 (1) (3)		1.81
OO	802780-05 (2)		1.55
TV	802777-03 (1)		1.84
UU		10850-16	1.61
WW		10850-18	1.57
AAA		10850-31	1.26
SSS		10850-17	1.61
TTT		10850-57	
UUU		10850-67	
VVV		10850-58	
YYY		10850-19	1.58

(1) 1 Inch Valve.
(2) 1/2 Inch Valve.
(3) Use with 3AA 1800 Cylinders.
(4) Use with 3HT 1850 Cylinders.

Valve Type
Figure 3



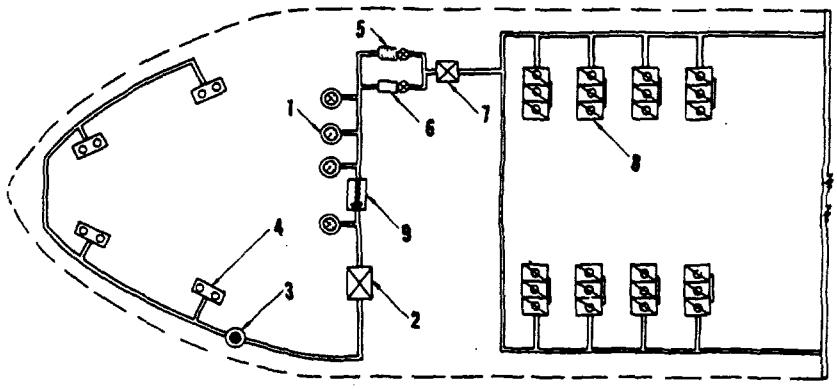
DESIGNATION	CYLINDER COLOR	CYLINDER LETTERING COLOR	OXYGEN
A	Green	No Lettering	X
B	Green	Yellow (For 3AA)	X
C	Green	Yellow (For 3HT)	X
E	Green & Yellow	None	X
F	Gray Green	No Lettering	X
G	Gray Green	Yellow	X
H	Gray Green	Yellow	X
Z	Green	White	X
AA	Green & Yellow	None	X
AD	Green	White	X
AE	Blue	None	X
AF	Blue	White (For 3AA)	X
AG	Blue	White (For 3HT)	X
AH	Blue	White	X
AJ	Green	Yellow (For 3AA)	X
AK	Green	Yellow (For 3HT)	X
AM	Green	Yellow	X
AN	Lt. Green with White Band	White	X

NOTE: 1. Designation AK and AM are identical except for positioning of stenciled information.

Cylinder Finish
Figure 4

C. Typical Installation

(1) A typical installation of the cylinder valve is shown in figure 5. A slow opening cylinder valve assembly is installed on each high pressure oxygen cylinder (1). The valves provide for manual, positive opening and closing of the oxygen system.



1. HIGH PRESSURE OXYGEN SOURCE WITH SLOW OPENING CYLINDER VALVE ASSEMBLY
2. PRESSURE REGULATOR
3. SLOW OPENING LINE VALVE
4. DILUTER DEMAND REGULATORS
5. ANEROID OPERATED OXYGEN SYSTEM RELEASE VALVE
6. ELECTRICALLY OPERATED OXYGEN SYSTEM RELEASE VALVE
7. AUTOMATIC CONSTANT FLOW PRESSURE REGULATOR
8. PASSENGER MASK COMPARTMENT DOOR
9. CHECK VALVE

Typical Installation
Figure 5

D. Operation

(1) Operation of all cylinder and valve assemblies is identical. The high pressure air or oxygen within the cylinder is released at the fitting when the shut-off valve is opened. The oxygen supply is maintained within the cylinder when the shut-off valve is closed.

(2) The cross section illustrated in figure 6 is representative of all the slow opening oxygen cylinder valve assemblies. With the valves installed in a high pressure oxygen cylinder, and valve handle (6) closed (full clockwise), the oxygen is contained in the cylinder through the action of valve plug (2) and valve seat assembly (3). When valve handle (6) is opened (full counter-clockwise), valve seat assembly (3) is raised away from inlet (1) thereby allowing oxygen flow to outlet (5). The valves are equipped with safety outlet assemblies (4). The safety outlet assemblies are preset to rupture at 2500 to 2775 psi in order to vent oxygen in the event of system overpressurization. A cylinder pressure gauge (7) is provided on some cylinder valve assemblies to indicate cylinder pressure.

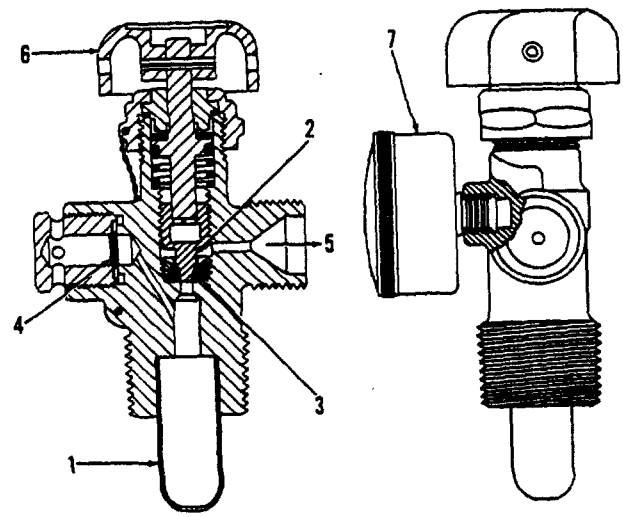
(3) These valves restrict flow only during the initial opening phase, and will prevent a downstream dead-ended system from being brought up to system pressure too rapidly.

NOTE: Rapid pressurization of a system is adiabatic in nature and may result in a potentially hazardous temperature rise.

There is no appreciable increase in flow through the valve when opened more than 3 turns. As with all valves, it should be opened fully and then backed off about 1/4 of a turn. Note, however, that the valve can be forced open more than 3-1/2 turns, but this begins to compress the sealing spring and results in an immediate increase in torque required to operate the valve. This should be avoided. Similarly, from a shut-off position, the valve handle can be further tightened approximately another 1/4 turn. This too is accompanied by an increase in torque required and does not enhance the sealing of the valve. This is the result of the KEL-F seat which will cold-flow with the application of additional torque. The packing on the rotating stem seals by the combined action of a spring and internal gas pressure. Application of sufficient axial force (push) on the valve handle can result in unseating of this seal and ensuing leakage, but only as long as this unseating force is maintained.

VALVE CHARACTERISTICS:

1.	Torque to open or close	15 inch pounds (1.7N·m) (Maximum)
2.	Torque to operate	7 inch pounds (.8N·m) (Average)
3.	Full open position	3-1/2 turns (Approximate)



1. INLET
2. VALVE PLUG
3. VALVE SEAT ASSEMBLY
4. SAFETY OUTLET ASSEMBLY
5. VALVE OUTLET
6. VALVE HANDLE
7. CYLINDER PRESSURE GAUGE

Slow Opening Oxygen Cylinder Valve Assembly
Figure 6

2. Trouble Shooting

A. Do not attempt to repair a defective cylinder and valve assembly in the field. If the assembly is defective (leakage, or failure to open or close) return the assembly to a qualified overhaul depot.

3. Maintenance Practices

A. Servicing

(1) No servicing is required.

B. Removal/Installation

WARNING: DO NOT ATTEMPT TO REMOVE A VALVE ASSEMBLY THAT IS PRESSURIZED AT ANY PORT. DEPLETE OXYGEN PRESSURE BEFORE DISCONNECTING THE FITTINGS AT ANY PORT. DO NOT REMOVE CYLINDER VALVES FROM CYLINDERS. IF OVERHAUL IS REQUIRED, RETURN THE ENTIRE ASSEMBLY TO A QUALIFIED OVERHAUL DEPOT.

(1) All valves are mounted by threading the valve directly into a high pressure oxygen cylinder. An oxygen line connection is made from the outlet port. On some valves containing a safety outlet assembly, piping is installed from this assembly to a safe disposal point (over board).

(2) Use care to prevent distortion of fittings or tubing when removing or installing the cylinder and valve assembly.

C. Adjustment/Test

(1) There are no adjustments for the cylinder and valve assembly.

(2) Tests are listed under Inspection/Check.

D. Inspection/Check

(1) Note the pressure on the pressure gauge. The gauge must indicate the oxygen pressure inside the cylinder.

(2) Apply leak test solution, Specification MIL-L-25567, to the valve stem opening in the valve body and at all connections. Bubbles indicate leakage. Leakage at fittings may be corrected by tightening the applicable fitting. Always bleed pressure before retightening any fitting. If leakage still exists, do not attempt to repair the assembly in the field. Replace the assembly, and send the defective unit to a qualified overhaul depot.

(3) Every cylinder is metal stamped near the threaded opening with the date (month-year) of manufacture and last hydrostatic test. The cylinder should be retested at those intervals specified in the hazardous materials regulations of the Department of Transportation (DOT), Current Tariff No. Return to overhaul if retest is indicated.

4. Cleaning/Painting

A. Clean the outside of the cylinder and valve assembly with a dry cloth. Touch up to cover nicks or scratches may be accomplished in accordance with standard practice. However, all ports and threads must be plugged or masked to prevent solvent, paint or other foreign material from entering the valve.

5. Approved Repairs

A. Do not attempt to repair a defective cylinder and valve assembly in the field. Replace the assembly and return the replaced assembly to a qualified overhaul depot.

MANUAL

OVERHAUL

CYLINDER AND VALVE ASSEMBLY
6350 SERIES

35-21-20

Oct 15/86

H-120

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SCOTT

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CYLINDER AND VALVE ASSEMBLY

1. Description and Operation

A. General

(1) This manual provides overhaul instructions with illustrated parts list for the 6350 Series Cylinder and Valve Assemblies (see figure 1). The complete part number of any particular cylinder and valve assembly is an eight to eleven place combination of numbers and letters. An example part number and an explanation of the various numbers and letters which make up a part number are shown in figures 2, 3, and 4.

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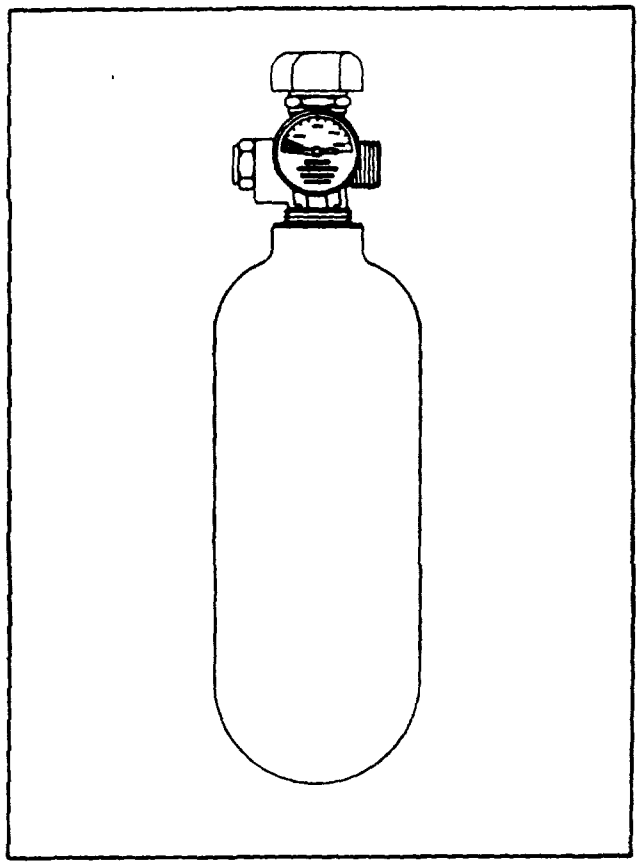
B. Purpose of Equipment

(1) To furnish a predetermined supply of oxygen, dependent on the size of the cylinder.

(2) The valves covered in this manual are manually operated "on-off" oxygen valves which are designed with a slow opening feature. The valves are nominally rated for 2000 psi service.

(3) To furnish a shut-off valve for turning the oxygen supply "ON" or "OFF".

(4) To furnish a safety device to vent excessive pressures in oxygen cylinders.



6350 Series Cylinder
and Valve Assembly
Figure 1

6350 A1 - A - A

BASIC PART NO. — 6350

A1 — DESIGNATION

A — SEE FIGURE 4

A — SEE FIGURE 3

DESIGNATION	CYLINDER PART NO.	CYLINDER CAPACITY (CU FT)	WEIGHT IN POUNDS EMPTY	WEIGHT IN POUNDS CHARGED	DOT RATING
A1	6084-5	28.8	13.69	16.08	3AA-1800
A2	6084-6	38.4	16.47	19.62	3AA-1800
A3	6084-3	11.0	6.18	7.09	3AA-2100 or 3AA-1800
A4	6084-4	22.0	10.13	11.97	3AA-1800
A5	6084-7	48.3	23.37	27.37	3AA-1800
A6	6084-8	54.0	27.00	32.52	3AA-2250
A7	6084-9	63.5	27.50	32.76	3AA-1800
A8	6084-12	107.0	48.00	56.90	3AA-1800
A11	6084-10	73.0	30.50	36.56	3AA-1800
A12	6084-11	91.0	42.00	49.55	3AA-1800
A13	6084-1	4.25	3.00	3.35	3AA-2100 or 3AA-1800
A14	6084-2	7.15	4.19	4.79	3AA-2100 or 3AA-1800
A15	27126	11.5	11.50	14.79	3AA-2150
A16	6084-16	15.20	7.30	9.10	3AA-2100
A20	6084-20	11.00	5.25	6.16	3AA-1800
A22	6084-26	39.4	13.00	16.27	3HT-1850
A25	6084-27	49.8	15.25	19.39	3HT-1850
A27	6084-29	66.0	19.00	24.98	3HT-1850
A33	6084-33	76.5	21.70	28.00	3HT-1850
A34	6084-34	115.0	33.00	42.55	3HT-1850

NOTE: A1 through A20 are lightweight cylinders (Type 3AA).
A22 through A34 are super-lightweight cylinders (Type 3HT).

Charged weight of cylinders is calculated with cylinders charged to 1800 psig with oxygen per MIL-O-27210 Type 1.

Cylinder Type
Figure 2

6350 A1 - A - A

BASIC PART NO. — 6350

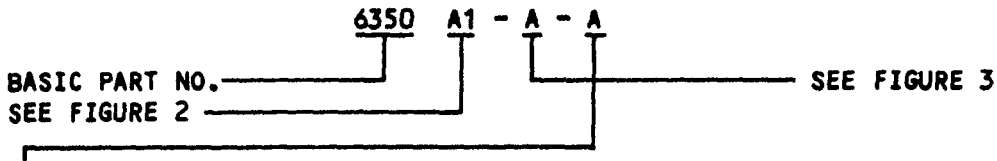
SEE FIGURE 2 — A1

SEE FIGURE 4 — A

DESIGNATION	OXYGEN VALVE ASSEMBLY P/N NON-SLOW OPENING	SLOW OPENING OXY CYLINDER VALVE ASSY P/N	WEIGHT (lbs)
X	CYLINDER ONLY - NO VALVE		
A	802777-06 (1)		1.76
AA	802780-06 (2)		
BB		810850-1B	1.79
CC		10850-12	1.55
DD		810850-10	1.77
EE		810850-1A	1.79
FF		10850-11	1.56
GG		10850-36	1.31
LL		10850-21	1.46
NN		10850-35	1.15
O	802777-02 (1) (4)		1.81
	802777-05 (1) (3)		1.81
OO	802780-05 (2)		1.55
TV	802777-03 (1)		1.84
UU		10850-16	1.61
WW		10850-18	1.57
AAA		10850-31	1.26
SSS		10850-17	1.61
TTT		10850-57	
UUU		10850-67	
VVV		10850-58	
YYY		10850-19	1.58

(1) 1 Inch Valve.
(2) 1/2 Inch Valve.
(3) Use with 3AA 1800 Cylinders.
(4) Use with 3HT 1850 Cylinders.

Valve Type
Figure 3



DESIGNATION	CYLINDER COLOR	CYLINDER LETTERING COLOR	OXYGEN
A	Green	No Lettering	X
B	Green	Yellow (For 3AA)	X
C	Green	Yellow (For 3HT)	X
E	Green & Yellow	None	X
F	Gray Green	No Lettering	X
G	Gray Green	Yellow	X
H	Gray Green	Yellow	X
Z	Green	White	X
AA	Green & Yellow	None	X
AD	Green	White	X
AE	Blue	None	X
AF	Blue	White (For 3AA)	X
AG	Blue	White (For 3HT)	X
AH	Blue	White	X
AJ	Green	Yellow (For 3AA)	X
AK	Green	Yellow (For 3HT)	X
AM	Green	Yellow	X
AN	Lt. Green with White Band	White	X

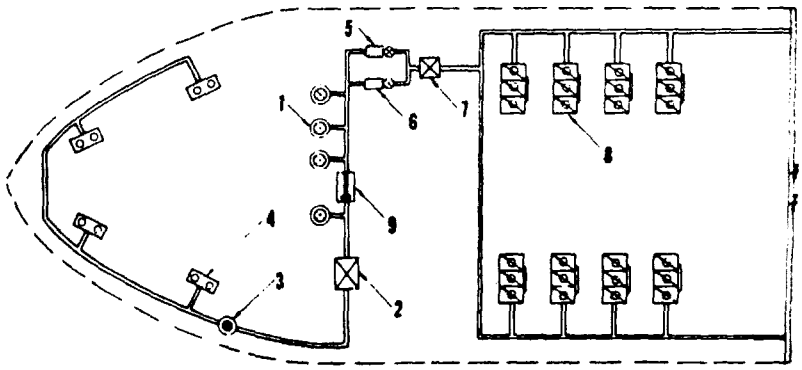
NOTE: 1. Designation AK and AM are identical except for positioning of stenciled information.

Cylinder Finish
Figure 4

(5) To furnish, on some models, a gauge to visually monitor the supply of oxygen.

C. Typical Installation

(1) A typical installation of the cylinder and valve assembly is shown in figure 5. A slow opening cylinder valve assembly is installed on each high pressure oxygen cylinder (1). The valves provide for manual, positive opening and closing of the oxygen system.



1. HIGH PRESSURE OXYGEN SOURCE WITH SLOW OPENING CYLINDER VALVE ASSEMBLY
2. PRESSURE REGULATOR
3. SLOW OPENING LINE VALVE
4. DILUTER DEMAND REGULATORS
5. ANEROID OPERATED OXYGEN SYSTEM RELEASE VALVE
6. ELECTRICALLY OPERATED OXYGEN SYSTEM RELEASE VALVE
7. AUTOMATIC CONSTANT FLOW PRESSURE REGULATOR
8. PASSENGER MASK COMPARTMENT DOOR
9. CHECK VALVE

Typical Installation
Figure 5

D. Operation

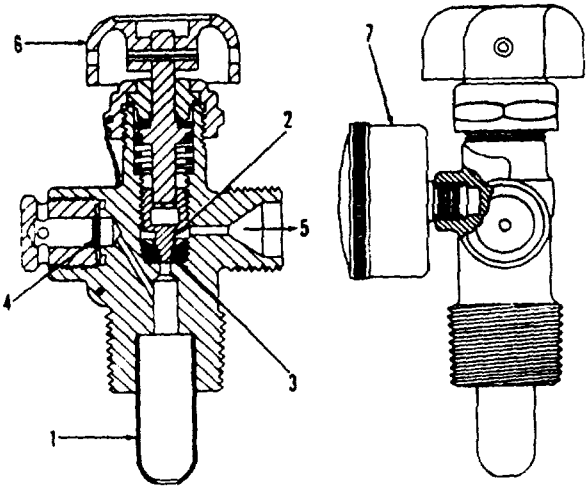
(1) Operation of all cylinder and valve assemblies is identical. The high pressure air or oxygen within the cylinder is released at the fitting when the shut-off valve is opened. The oxygen supply is maintained within the cylinder when the shut-off valve is closed.

(2) The cross section illustrated in figure 6 is representative of all the slow opening oxygen cylinder valve assemblies. With the valves installed in a high pressure oxygen cylinder, and valve handle (6) closed (full clockwise), the oxygen is contained in the cylinder through the action of valve plug (2) and valve seat assembly (3). When valve handle (6) is opened (full counterclockwise), valve seat assembly (3) is raised away from inlet (1) thereby allowing oxygen flow to outlet (5). The valves are equipped with safety outlet assemblies (4). The safety outlet assemblies are preset to rupture at 2500-2775 psi in order to vent oxygen in the event of system overpressurization. A cylinder pressure gauge (7) is provided on some cylinder valve assemblies to indicate cylinder pressure.

(3) These valves restrict flow only during the initial opening phase, and will prevent a downstream dead-ended system from being brought up to system pressure too rapidly.

NOTE: Rapid pressurization of a system is adiabatic in nature and may result in a potentially hazardous temperature rise.

There is no appreciable increase in flow through the valve when opened more than 3 turns. As with all valves, it should be opened fully and then backed off about 1/4 of a turn. Note, however, that the valve can be forced open more than 3-1/2 turns, but this begins to compress the sealing spring and results in an immediate increase in torque required to operate the valve. This should be avoided. Similarly, from a shut-off position, the valve handle can be further tightened approximately another 1/4 turn. This too is accompanied by an increase in torque required and does not enhance the sealing of the valve. This is the result of the KEL-F seat which will cold-flow with the application of additional torque. The packing on the rotating stem seals by the combined action of a spring and internal gas pressure. Application of sufficient axial force (push) on the valve handle can result in unseating of this seal and ensuing leakage, but only as long as this unseating force is maintained.



1. INLET
2. VALVE PLUG
3. VALVE SEAT ASSEMBLY
4. SAFETY OUTLET ASSEMBLY
5. VALVE OUTLET
6. VALVE HANDLE
7. CYLINDER PRESSURE GAUGE

Slow Opening Oxygen Cylinder Valve Assembly
Figure 6

VALVE CHARACTERISTICS:

1.	Torque to open or close	15 inch pounds (1.7N.m) (Maximum)
2.	Torque to operate	7 inch pounds (.8N.m) (Average)
3.	Full open position	3-1/2 turns (Approximately)

2. Disassembly

WARNING: DISCHARGE CYLINDER PRESSURE PRIOR TO REMOVAL OF VALVE ASSEMBLY.

NOTE: Refer to the "EFFECT CODE" column of the Group Assembly Parts List for the parts applicable to the part number valve assembly being disassembled. Disregard instructions concerning parts that are not used on the valve being disassembled.

A. Disassemble any 6350 Series Cylinder and Valve Assembly by unthreading valve assembly (7 or 8, IPL figure 1) from cylinder (9). Remove indentification plate (2) from the cylinder if required.

B. Disassemble the 802777 and 802780 Oxygen Valve Assemblies as follows (see IPL figure 2).

(1) Unthread and remove gauge (7) and safety relief assembly (8 or 20); then adaptor (9) and insert (10).

(2) Unthread connection (12); then remove gasket (13) and disc (14), only if the disc is ruptured.

(3) Disassemble valve assembly (20 through 35) as follows:

a. Unthread cap (21); then remove washer (22) and disc (23), only if the disc is ruptured.

b. Remove handwheel (24) by removing nut (25) and cup (26); then remove spring (27).

c. Remove washer (28) from body (35).

d. Unthread and remove nut (29); then remove follower (30) and packings (31 and 32) from nut (29).

e. Unthread and remove stem assembly (33) and plug assembly (34) from body (35).

C. Disassemble the 810850 or 10850 Slow Opening Oxygen Valve Assemblies as follows (see IPL figure 3).

(1) Remove gauge (3 or 4) from body (100 or 101) by removing screws (5) and washers (7).

(2) Remove ring (8), packing (9) and sleeve (10).

(3) Remove safety plug assembly (12 through 14), if applicable. Remove plug (12), disc (13 or 13A) and gasket (14) from body (100 or 101).

NOTE: Use driver (3 or 4, figure 1001), as applicable, to remove retainers in steps (4) through (12) below.

(4) Remove safety outlet assembly (16 through 20), if applicable. Remove gasket (20), disc (19 or 19A), retainer (18), and insert (17) from nut (16).

(5) Remove safety outlet assembly (25 through 29), if applicable. Remove gasket (29), disc (28 or 28A), retainer (27), and insert (26) from nut (25).

(6) Remove safety outlet assembly (31 through 37), if applicable and disassemble as follows:

a. Unthread cap assembly (31) from the safety outlet assembly and remove screw (32).

b. Remove gasket (37), disc (36 or 36A), retainer (35) and insert (34) from nut (33).

(7) Remove safety outlet assembly (39 through 43), if applicable. Remove gasket (43), disc (42 or 42A), retainer (41), and insert (40) from nut (39).

(8) Remove safety outlet assembly (45 through 49), if applicable. Remove gasket (49), disc (48 or 48A), retainer (47), and insert (46) from nut (45).

(9) Remove safety outlet assembly (51 through 55), if applicable. Remove gasket (55), disc (54 or 54A), retainer (53), and insert (52) from fitting (51).

(10) Remove safety outlet assembly (57 through 63), if applicable and disassemble as follows:

a. Unthread cap assembly (57) from the safety outlet assembly and remove screw (58).

b. Remove gasket (63), disc (62 or 62A), retainer (61), and insert (60) from nut (59).

(11) Remove safety outlet assembly (65 through 71), if applicable and disassemble as follows:

a. Unthread cap assembly (65) from the safety outlet assembly and remove screw (66).

b. Remove gasket (71), disc (70 or 70A), retainer (69), and insert (68) from nut (67).

(12) Remove safety outlet assembly (73 through 77), if applicable. Remove gasket (77), disc (76 or 76A), retainer (75) and insert (74) from nut (73).

(13) Disassemble body assembly (82 through 101) as follows:

a. Remove plate (82).

b. Remove handle (83) by driving out pin (84).

c. Unthread and remove retainer (85). Remove guide (86) and packing (88) or washer (89).

d. Remove stem assembly (90) from body (100 or 101).

e. Remove washers (92 and 93), spring (94) and washer (95) from body (100 or 101).

f. Unthread valve plug (96) and valve seat assembly (97).

NOTE: Use tee wrench (1, figure 1001) to remove plug (96, IPL figure 3). Use valve seat wrench (2, figure 1001) to remove valve seat assembly (97, IPL figure 3).

g. Unthread plug (98) from body (100 or 101).

h. Unthread gauge guard (99) from body (100).

3. Cleaning

Note: Using the cleaning materials listed in Table I, perform the cleaning procedures outlined in the following paragraphs. Equivalent materials may be used.

MATERIAL	DESCRIPTION	MANUFACTURER*	REFER TO PARA.
Neutralizing Agent	Fisan Enzodent	V44389	3.A.(5) 3.B.(2)
Degreasing Agent	1,1,1 Trichloroethane (MIL-T-81533)	V91784	3.A.(4) 3.A.(8)(a)
Corrosion Inhibitor	Phosphoric Acid Isopropyl Alcohol (50% of each by Vol.)	V70829 NOTE: Purchased Separately	3.A.(3)

*Refer to Illustrated Parts List, paragraph 12.A.(4) for Vendor's Codes.

List of Cleaning Materials
Table I

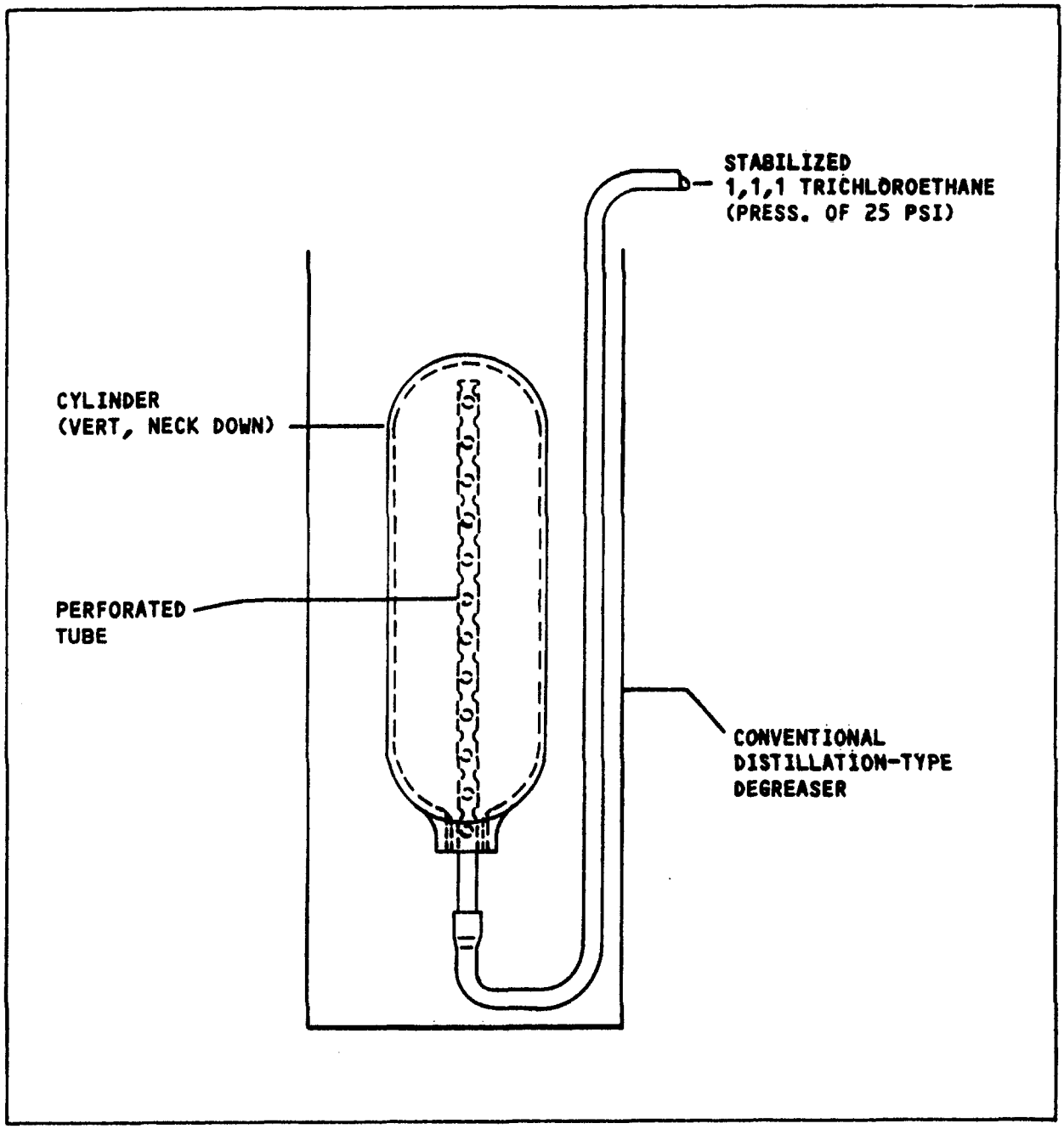
A. After inspecting cylinders in accordance with Inspection/Check, perform the following cleaning procedure.

NOTE: This procedure will remove any organic impurities which are soluble in 1,1,1 Trichloroethane.

(1) Wire brush the cylinder neck threads to remove sealing compounds or rust.

(2) Shake out cylinder to remove any loose foreign matter.

(3) Apply a solution (50% by volume of phosphoric acid/isopropyl alcohol) by brush to the area wire brushed, exercising care to prevent excessive application from running into the cylinder.



Cleaning Setup
Figure 201

WARNING: USE 1,1,1 TRICHLOROETHANE IN A WELL VENTILATED AREA ONLY. AVOID PROLONGED OR REPEATED CONTACT WITH SKIN AND INHALATION OF TOXIC VAPORS.

(4) Utilizing a cleaning setup as illustrated in figure 201, place the cylinder, with neck down, in vertical position over the perforated tube (the diameter and length of the tube will be determined by the particular size of the cylinder being cleaned). Pump stabilized 1,1,1 trichloroethane, slightly below its boiling point, through the tube, thoroughly spraying the interior of the cylinder being cleaned for a period of three minutes. Remove cylinder from tube and allow complete drainage of 1,1,1 trichloroethane into drain.

(5) After completion of step (4), and using a cleaning setup similar to the setup illustrated in figure 201, pump a solution of Fisan Enzodent (8 ounces per each gallon of water), at a temperature of 180°F, through the tube thoroughly spraying the interior of the cylinder being cleaned for a period of three to five minutes. Accomplishment of this step will neutralize any acid constituents and destroy odor.

(6) After completion of step (5), and using a cleaning setup similar to the setup illustrated in figure 201, pump water (at city pressure) at 160 to 180 degrees F, through the tube thoroughly spraying the interior of the cylinder being cleaned for a period of two minutes to remove any traces of alkaline residue.

(7) After completion of step (6), and using a cleaning setup similar to the setup illustrated in figure 201, dry the interior of the cylinder with forced air heated to a temperature of 212°F, for a period of three to five minutes.

(8) After completion of step (7), and after the cylinder has cooled to room temperature, reinspect the cylinder in accordance with Inspection/Check.

NOTE: The cleaning process used should be checked initially and periodically as follows.

a. Pour 50cc of anhydrous, chemically pure, 1,1,1 Trichloroethane into the processed cylinder. Cap and shake well for one to two minutes.

b. Remove cap and pour flushings into a clean Erlenmeyer flask. Distill the 1,1,1 Trichloroethane in a water bath. After the 1,1,1 Trichloroethane has been distilled, examine residue in flask. If oil marks are visible, check cleaning solutions, implements and pressure.

c. After completion of steps (a) and (b), and using a cleaning setup similar to the setup illustrated in figure 201, clear all traces of the 1,1,1 Trichloroethane from the interior of the cylinder by blowing with dry, clean, oil-free air.

B. After inspecting the valve assembly or regulator assembly in accordance with Inspection/Check, perform the following cleaning procedure.

WARNING: DO NOT ALLOW OIL, GREASE, FLAMMABLE SOLVENTS, OR OTHER COMBUSTIBLE MATERIALS TO COME IN CONTACT WITH PARTS THAT WILL BE EXPOSED TO PRESSURIZED OXYGEN. SUCH MATERIALS, AS WELL AS DUST, LINT, AND FINE METAL FILINGS ARE ALL POTENTIAL COMBUSTIBLES WHICH MIGHT, WHEN EXPOSED TO OXYGEN UNDER PRESSURE, IGNITE AND RESULT IN AN EXPLOSION.

(1) Remove dirt and foreign particles from equipment by wiping with a clean lint-free cloth, or by blowing with clean oil-free air or nitrogen.

WARNING: USE 1,1,1 TRICHLOROETHANE IN A WELL VENTILATED AREA ONLY. AVOID PROLONGED OR REPEATED CONTACT WITH SKIN AND INHALATION OF TOXIC VAPORS.

(2) Metal parts which come in contact with oxygen and have become contaminated with grease can be cleaned by using a vapor degreasing method with stabilized 1,1,1 Trichloroethane. Blow clean and dry with a stream of clean, dry, oil-free air or nitrogen.

(3) Non-metallic parts such as silicone and rubber components may be cleaned by using an ultrasonic detergent and water cleaning system. Rinse parts in clean water and dry thoroughly before reassembly. Do not use chlorinated solvents with non-metallic parts.

4. Inspection/Check

NOTE: For Cylinder Inspection and Hydrostatic Retest, the use of Compressed Gas Association (CGA) pamphlets E-1, C-5, C-6, C-8 are recommended. These are available from:

CGA, INC.
1235 Jefferson Davis Highway
Arlington, VA 22202

A. Inspect exterior of cylinder for indications of abuse, dents and bulges.

B. Inspect neck of cylinders for cracks and distortion or damaged threads.

C. Inspect all cylinders for peeling external paint and obscure markings.

D. Inspect all high pressure cylinders for last date of hydrostatic test and type. If hydrostatic testing is required, test in accordance with Testing, step A.

NOTE: DOT Type 3HT cylinders require hydrostatic retesting every 3 years. DOT type 3A and 3AA cylinders require hydrostatic retesting every 5 years. Under certain usage conditions, DOT type 3A and 3AA cylinders may be retested at 10 year intervals. Refer to the current tariff of the "HAZARDOUS MATERIAL REGULATIONS OF THE DEPARTMENT OF TRANSPORTATION" (49 CFR 170) paragraph 173.34 (e) (15) for eligibility requirements.

E. Inspect interior of cylinders for defects which might render the cylinder unsafe.

NOTE: Inspect the interior of cylinders with the aid of a small electric light to give complete visibility of interior.

F. Inspect the interior of cylinders for rust spots, improper parkerizing, or surface blemishes.

G. Inspect valve and/or regulator for cracks, nicks, dents, or burrs which might cause malfunction.

H. Inspect valve seats for scoring.

I. Inspect all threads of valves and/or regulator for damage.

J. Inspect overall condition of all components.

5. Repair

NOTE: Table II lists the consumable materials for repair. Equivalent materials may be used.

MATERIAL	DESCRIPTION	MANUFACTURER*	REFER TO PARA.
Chromic Acid	Chromic Acid	V72658	5.B(5)
Phosphoric Acid	Phosphoric Acid	V70829	5.B(3)
Phosphate	Zn PO_4	V44389	5.B(3)

*Refer to Illustrated Parts List, paragraph 12.A(4) for Vendor's Codes.

List of Consumable Materials for Repair
Table II

A. Replace cylinders that show signs of abuse, dents, bulges, cracks, distortion, damaged threads, and/or defects which might render the cylinder unsafe (refer to Inspection/Check, steps A,B,C, and E).

NOTE: DOT type 3HT Type cylinders must be discarded and replaced at the end of twenty-four years following date of original test or 4,380 pressurizations, whichever occurs first.

B. Cylinders that require interior protective treatment may be reparkerized as follows (refer to Inspection/Check, step F).

(1) Sandblast cylinders internally and externally using fine grit shot.

(2) Rinse cylinder in clean water.

(3) Apply a phosphate coating to the interior of the cylinder either by dipping or spraying. For dip-coating, a three minute minimum dip is recommended; for spray-coating, one minute minimum is recommended.

NOTE: The balanced aqueous solution of phosphoric acid, phosphates, and accelerating agents produce a uniform water insoluble cyrstalline coating varying from gray to black in color.

(4) Rinse cylinder in clean water.

(5) Rinse cylinder in hot chromic acid (140 to 210°F) (60 to 99°C).

NOTE: The pH of the chromic acid rinse will be maintained between 2 and 4 by the addition of flake chromic acid or a mixture of chromic and phosphoric acids.

(6) Dry the cylinder by using warm air or a drying oven.

NOTE: For maximum corrosion resistance, coating weights of 400 mg/sq. ft. are usually adequate. This coating weight may be reduced to 200 mg/sq. ft. if an activator (titanium salts) is used. The coating weight may be deceptive if loosely adherent deposits are obtained, since adherent deposits give inferior performance. Finely crystalline zinc phosphate coatings provide the best corrosion resistance.

C. Remark and/or repaint cylinders in accordance with information outlined in figure 4.

D. 802777 and 802780 Oxygen Valve Assemblies (see IPL figure 2).

(1) Repair of parts is not recommended. Replace washer (28), follower (30), packings (31 and 32), plug assembly (34) and obviously defective parts at overhaul.

E. 10850 or 810850 Slow Opening Oxygen Cylinder Valve Assembly (see IPL figure 3).

(1) Repair of parts is not recommended. Replace packing (9), disc (13, 13A, 19, 19A, 28, 28A, 36, 36A, 42, 42A 48, 48A, 54, 54A, 62, 62A, 70, 70A, or 76), gasket (14, 20, 29, 37, 43, 49, 55, 63, 71, or 77), identification plate (82), pin (84), packing (88), washers (89 and 92), stem assembly (90) and valve seat assembly (97).

6. Assembly

NOTE: Table III lists the consumable materials required for reassembly.

MATERIAL	DESCRIPTION	MANUFACTURER	REFER TO PARA.
Sealing Tape	Permacel Tape No. 412	V99742	6.A.(2) 6.A.(20) 6.B.(5) 6.C.
Alpha Molykote	No. 106	V94499	6.A.(4)
Oxygen Lubricant	Krytox 240AC	V19898	6.A.(6) 6.A.(7) 6.A.(8) 6.A.(10)b 6.A.(11)b 6.A.(12)b 6.A.(13)b 6.A.(14)b 6.A.(15)b 6.A.(16)b 6.A.(17)b 6.A.(18)b 6.A.(19)b
Lock Wire	MS20995C20	------	6.A.(9)
Temp-Alarm Paint	Torque Paint Temperature-Alarm Type 43E	V82682	6.A.(20)

*Refer to Illustrated Parts List, paragraph 12.A(4) for Vendor's Codes.

NOTE: Equivalent materials may be used, except for oxygen lubricant.

Recommended Consumable Materials for Assembly
Table III

NOTE: Refer to the "EFFECT CODE" column of the Group Assembly Parts List for the parts applicable to the part number valve assembly being reassembled. Disregard instructions concerning parts that are not used on the valve assembly being reassembled.

A. Assemble the 810850 or 10850 Slow Opening Oxygen Cylinder Valves as follows (see IPL figure 3).

(1) Thread gauge guard (99) onto body (100).

(2) Wrap 1-1/2 turns of thread sealing tape to plug (98) in the direction of the thread spiral, beginning with the first thread. In no case shall the tape extend beyond the first thread. Trim off excess tape. Thread the plug into body (101).

(3) Thread valve seat assembly (97) into the valve body until seated. Torque tighten the valve seat assembly per Table IV, using valve seat wrench (2, figure 1001).

(4) If threads of valve plug (96, IPL figure 3) are uncoated or coating is worn off, apply a very light coat of molykote to the threads and bake at 260°F for one hour. Thread valve plug (96) into body (100 or 101). Thread valve plug (96) into valve body using tee wrench (1, figure 1001).

(5) Place washer (95, IPL figure 3) and spring (94) into body (100 or 101).

(6) Apply a thin film of oxygen lubricant to surfaces of washers (92 and 93) and place the washers on top of spring (94).

NOTE: Observe correct order of washers (92 and 93); washer (92) is non-metallic.

(7) Apply a thin film of oxygen lubricant to face of gasket on stem assembly (90) and place the stem assembly into body (100 or 101). Place washer (89) on stem assembly (90).

(8) Apply a wipe coat of oxygen lubricant to packing (88) and place packing into groove of guide (86).

(9) Position guide (86) and secure in place by threading retainer (85) into body (100 or 101). Torque retainer (85) per Table IV. Lockwire the retainer to the body per applicable instructions of MS33540.

CAUTION: THE TORQUE VALUES LISTED IN TABLE IV SHALL BE STRICTLY ADHERED TO WHEN INSTALLING RETAINERS. TORQUE VALUES DEPEND ON THE TYPE OF SAFETY DISC BEING INSTALLED.

(10) Reassemble safety outlet assembly (73 through 77) as follows:

a. Position disc (76 or 76A) and gasket (77) into retainer (75).

b. Apply a wipe coat of oxygen lubricant to exposed surface of gasket (77).

c. Thread retainer (75) into body (100 or 101) using driver (3 or 4, figure 1001) and torque per Table IV.

d. Position insert (74, IPL figure 3) in nut (73) and thread nut (73) into body (100 or 101). Lockwire the nut into the valve body per applicable instructions of MS33540.

(11) Reassemble safety outlet assembly (65 through 71) as follows:

a. Position gasket (71) and disc (70 or 70A) into retainer (69). Convex side of gasket (71) shall be out.

b. Apply a wipe coat of oxygen lubricant to exposed surface of gasket (71).

c. Thread retainer (69) into body (100 or 101) using driver (3 or 4, figure 1001) and torque per Table IV.

d. Position insert (68, IPL figure 3) in nut (67) and thread nut (67) into body (100 or 101). Lockwire the nut into the valve body per applicable instructions of MS33540.

e. Secure cap assembly (65) to nut (67) with screw (66). Thread the cap assembly onto end of nut (67) after completion of testing.

(12) Reassemble safety outlet assembly (57 through 63) as follows:

a. Position gasket (63) and disc (62 or 62A) into retainer (61).

b. Apply a wipe coat of oxygen lubricant to exposed surface of gasket (63).

c. Thread retainer (61) into body (100 or 101) using driver (3 or 4, figure 1001) and torque per Table IV.

d. Position insert (60, IPL figure 3) in nut (59) and thread nut (59) into body (100 or 101). Lockwire the nut into the valve body per applicable instructions of MS33540.

e. Secure cap assembly (57) to nut (59) with screw (58). Thread the cap assembly onto end of nut (59) after completion of testing.

(13) Reassemble safety outlet assembly (51 through 55) as follows:

a. Postion gasket (55) and disc (54 or 54A) into retainer (53).

b. Apply a wipe coat of oxygen lubricant to exposed surface of gasket (55).

c. Thread retainer (53) into body (100 or 101) using driver (3 or 4, figure 1001) and torque per Table IV.

d. Position insert (52, IPL figure 3) in fitting (51) and thread fitting (51) into body (100 or 101). Lockwire the fitting into the valve body per applicable instructions of MS33540.

(14) Reassemble safety outlet assembly (45 through 49) as follows:

a. Position gasket (49) and disc (48 or 48A) into retainer (47).

b. Apply a wipe coat of oxygen lubricant to exposed surface of gasket (49).

c. Thread retainer (47) into body (100 or 101) using driver (3 or 4, figure 1001) and torque per Table IV.

d. Position insert (46, IPL figure 3) in nut (45) and thread nut (45) into body (100 or 101). Lockwire the nut into the valve body per the applicable instructions of MS33540.

(15) Reassemble safety outlet assembly (39 through 43) as follows:

a. Position gasket (43) and disc (42 or 42A) into retainer (41).

b. Apply a wipe coat of oxygen lubricant to exposed surface of gasket (43).

c. Thread retainer (41) into body (100 or 101) using driver (3 or 4, figure 1001) and torque per Table IV.

d. Position insert (40, IPL figure 3) in nut (39) and thread nut (39) into body (100 or 101). Lockwire the nut into the valve body per the applicable instructions of MS33540.

(16) Reassemble safety outlet assembly (31 through 37) as follows:

a. Position gasket (37) and disc (36 or 36A) into retainer (35).

b. Apply a wipe coat of oxygen lubricant to exposed surface of gasket (37).

c. Thread retainer (35) into body (100 or 101) using driver (3 or 4, figure 1001) and torque per Table IV.

d. Position insert (34, IPL figure 3) in nut (33) and thread nut (33) into body (100 or 101). Lockwire the nut into the valve body per the applicable instructions of MS33540.

e. Secure cap assembly (31) to nut (33) with screw (32). Thread the cap assembly onto end of nut (33) after completion of testing.

(17) Reassemble safety outlet assembly (25 through 29) as follows:

a. Position gasket (29) and disc (28 or 28A) into retainer (27).

b. Apply a wipe coat of oxygen lubricant to exposed surface of gasket (29).

c. Thread retainer (27) into body (100 or 101) using driver (3 or 4, figure 1001) and torque per Table IV.

d. Position insert (26, IPL figure 3) in nut (25) and thread nut (25) into body (100 or 101).

(18) Reassemble safety outlet assembly (16 through 20) as follows:

a. Postion gasket (20) and disc (19 or 19A) into retainer (18).

b. Apply a wipe coat of oxygen lubricant to exposed surface of gasket (20).

c. Thread retainer (18) into body (100 or 101) using driver (3 or 4, figure 1001) and torque per Table IV.

(19) Reassemble safety plug assembly (12 through 14) as follows:

a. Position gasket (14) and disc (13 or 13A) into plug (12).

b. Apply a wipe coat of oxygen lubricant to exposed surface of gasket (14).

c. Thread plug (12) into body (100 or 101) and torque per Table IV.

(20) Apply a wipe coat of oxygen lubricant to packing (9). Place ring (8), packing (9) and sleeve (10) on stem of gauge (3). Secure gauge (3) to body (101) with screws (5 or 6) and washers (7). Cover screw (5 or 6) heads with Temp-Alarm paint.

(21) Wrap 1-1/2 turns of thread sealing tape to gauge (4) in the direction of the thread spiral, beginning with the first thread. In no case shall the tape extend beyond the first thread. Trim off excess tape. Thread the gauge into body (101).

(22) Test the partially assembled slow opening oxygen cylinder valve assembly in accordance with Testing.

(23) Complete assembly by securing handle (83) to stem assembly (90) with roll pin (84). Secure identification plate (82) to handle (83).

B. Assemble the 802777 and 802780 Oxygen Valve Assemblies as follows (see IPL figure 2).

(1) Assemble valve assembly (20 through 35) as follows:

a. Thread plug assembly (34) into body (35).

b. Place stem assembly (33) in body (35); then place packing (32) in nut (29) and thread the nut into the body.

c. Install packing (31) and follower (30) on stem assembly (33) and carefully depress into nut (29). Place washer (28) over nut (29).

d. Place handwheel (24) on stem assembly (33); then place spring (27) over the stem into the handwheel. Secure handwheel with cup (26) and nut (25).

e. If disassembled, insert disc (23) and washer (22) in cap (21) and thread the cap onto body (35). Thread cap (20) onto body (35).

(2) If disassembled, insert disc (14) and gasket (13) in connection (12). Thread the connection onto body (35) and torque per Table IV.

(3) Place insert (10) in adaptor (9) and thread the adaptor into connection (12).

(4) Thread safety relief assembly (8) onto body (35).

(5) Wrap 1-1/2 turns of thread sealing tape to gauge (7) in the direction of the thread spiral, beginning with the first thread. In no case shall the tape extend beyond the first thread. Thread the gauge into body (35).

C. Assemble the 6350 Series Cylinder and Valve Assembly as follows (see IPL figure 1).

NOTE: Wrap thread sealing tape to valves, prior to mating with cylinders in the direction of the thread spiral, beginning with the first thread. In no case shall the tape extend beyond the first thread. Trim off excess tape. Wrap two turns of tape on threads of valves requiring 100 pound-feet torque and three turns on threads of valves requiring 150 pound-feet.

(1) Secure plate (2) to cylinder (9).

(2) Thread appropriate valve assembly (7 or 8) into appropriate cylinder (9), torque the valve assembly per Table IV.

7. Fits and Clearances

A. Table IV presents the torque values necessary to assemble the units.

UNIT	TORQUE (Newton meters)
Plug (12, IPL figure 3)	*100 to 400 pound-inches (11,3-45,2)
Retainer (18, IPL figure 3)	**275/375 pound-inches (31/42) max.
Retainer (27, IPL figure 3)	**275/375 pound-inches (31/42) max.
Retainer (35, IPL figure 3)	**275/375 pound-inches (31/42) max.
Retainer (41, IPL figure 3)	**275/375 pound-inches (31/42) max.
Retainer (47, IPL figure 3)	**275/375 pound-inches (31/42) max.
Retainer (53, IPL figure 3)	**275/375 pound-inches (31/42) max.
Retainer (61, IPL figure 3)	**275/375 pound-inches (31/42) max.
Retainer (69, IPL figure 3)	*300 to 400 pound-inches (33,9-45,2)
Valve Body (19, IPL figure 2)	150 pound-feet (204)
Valve Body (100, IPL figure 3)	150 pound-feet (204)
Valve Body (101, IPL figure 3)	150 pound-feet (204)
Valve Seat Assy (97,IPL figure 3)	140 pound-inches (15,8)
Retainer (75, IPL figure 3)	**275/375 pound-inches (31/42)max.
Retainer (85, IPL figure 3)	300 pound-inches (33,9)
Connection (12, IPL figure 2)	300 pound-inches (33,9) maximum

*Torque components to minimum values. If leakage occurs, retorque to a higher value, but do not exceed the maximum.

**Torque retainer to 275 pound-inches (31N.m) maximum when installing disc, P/N 10003742 (silver) or to 375 pound-inches (42.3 N.m) when installing disc, P/N 10006001 (bronze).

Assembly Torque Values
Table IV

8. Testing

WARNING: IN ALL PROCEDURES LISTED BELOW, OXYGEN IS SPECIFIED AS THE TEST GAS. WATER PUMPED NITROGEN OR OIL-FREE AIR MAY BE SUBSTITUTED, BUT RESULTS MUST BE CONVERTED PRIOR TO BEING COMPARED WITH THE RESULTS SPECIFIED FOR OXYGEN. DO NOT, UNDER ANY CIRCUMSTANCES, USE OIL PUMPED GAS AS THIS WILL CAUSE CONTAMINATION OF THE VALVE AND TEST EQUIPMENT. OIL, EVEN IN MINUTE QUANTITY, COMING IN CONTACT WITH OXYGEN MAY CAUSE AN EXPLOSION OR FIRE.

NOTE: Table V lists the consumable materials for testing. Equivalent materials may be used.

MATERIAL	DESCRIPTION	MANUFACTURER*	REFER TO PARAGRAPH
Oxygen	MIL-O-27210, *Type 1*	V07098	All Testing
Leak Test Solution	Sodium Chromate; 5cc per gallon of water	V72658	8.C(3), 8.D(4), 8.D(6), 8.E(3)

*Refer to Illustrated Parts List, paragraph 12.A(4) for Vendor's Codes.

List of Consumable Materials for Testing
Table V

A. If required, subject the cylinders to hydrostatic testing in accordance with CGA Pamphlet C-1 and Hazardous Materials Regulations of Department of Transportation (DOT), Current Tariff No.

B. Facilities performing such tests shall hold a current, valid DOT Approval.

C. After reassembly of the 802777 and 802780 Oxygen Valve Assemblies perform a leak test in accordance with the following procedure.

(1) Close the valve.

(2) Apply pressure to the valve inlet (cylinder port).

(3) Submerge the valve in a leak test solution. No leakage shall be evident.

D. After reassembly of the 10850 or 810850 Oxygen Cylinder Valve, perform the following test:

(1) Attach a 2000 psi oxygen source to the inlet of the oxygen valve assembly through a suitably attached flexible hose or equivalent. Air or nitrogen, equivalent in dryness and cleanliness to MIL-O-27210 may be substituted for oxygen.

(2) Manually close (full clockwise) the valve at control stem (90, IPL figure 3) fingertight.

(3) If the valve is equipped with a pressure gauge, remove the gauge bezel and lens before continuing.

(4) Completely submerge the valve in leak test solution.

(5) With the valve submerged, apply 1850 $^{+0}_{-50}$ psi to the inlet. Check the valve for leakage for two minutes. Leakage as indicated by bubbles must be corrected before continuing.

(6) Remove the valve from the leak test solution, suitably cap the valve outlet, open the valve (two revolutions counterclockwise) and completely submerge the valve for three minutes. Leakage as indicated by bubbles must be corrected before continuing.

(7) Remove the valve from the solution, manually close the valve and remove the outlet cap or plug installed in step (6).

(8) Check the torque required to open and close the pressurized valve from cracked to full open. The torque shall not exceed 15 pound-inches (1,70 N.m).

(9) Shut off and remove the external oxygen source.

(10) Dry the valve thoroughly with a stream of clean, dry, oil-free air. Insure that inside gauge mechanism is dry. Replace the gauge lens and bezel if required.

(11) Complete assembly of the oxygen valve assembly (refer to Assembly, Step A.(15)).

E. After reassembly of cylinder and valve assembly, perform a leakage test in accordance with the following procedure.

(1) Charge cylinder to full operating pressure at a rate not to exceed 300 psi per minute.

(2) Allow cylinder to cool to room temperature and "top off" if necessary.

(3) Submerge the valve assembly and cylinder neck in leak test solution for two minutes, and check for leakage. No leakage shall be evident.

NOTE: If cylinder and valve assembly is equipped with a gauge, remove the gauge bezel and lens prior to submerging in leak test solution.

(4) Check accuracy of valve or regulator gauge to master gauge. Accuracy to be ± 50 psi.

(5) Record valve gauge indication and date of charging.

(6) Store cylinder and valve assembly for a minimum of 72 hours. During this period check gauge indication against recorded indication. These indications shall be identical.

(7) Check gauge indication against recorded indication. These indications shall be identical.

(8) Dry cylinder and valve assembly thoroughly with low pressure oil-free air. Be sure gauge is dry internally.

9. Trouble Shooting

A. See Figure 801 for trouble shooting chart.

TROUBLE	PROBABLE CAUSE	REMEDY
Improper indication on pressure gauge of 802777 or 802780 oxygen valve assembly	Faulty pressure gauge (3, IPL figure 2)	Replace pressure gauge
Leakage at gauge (3, IPL figure 2)	Pressure gauge (3) loose	Tighten pressure gauge
Leakage at valve stem (14)	Faulty washer (11)	Replace washer
	Faulty valve stem (14)	Replace valve stem
	Faulty valve plug assembly (17)	Replace valve plug assembly
Leakage at cylinder neck when oxygen valve assembly is mated with cylinder	Damaged cylinder threads	Replace cylinder
	Damaged threads on oxygen valve assembly	Replace oxygen valve assembly
Leakage between stem assebly (90, IPL figure 3) and guide (86)	Faulty stem assy (90, IPL figure 3) or spring (94)	Replace defective part
	Faulty seat on guide (86)	Replace guide
Leakage between guide (86) and retainer (85)	Faulty packing (88) or washer (89)	Replace packing; retorque retainer
Leakage past valve seat assembly (97)	Faulty valve seat assembly (97)	Replace valve seat assembly
	Faulty plug (96)	Replace plug
	Defect in body (100 or 101)	Replace body
	Valve seat assembly (97) insufficiently torqued	Torque per Table IV

Trouble Shooting Chart (Sheet 1 of 2)
Figure 801

TROUBLE	PROBABLE CAUSE	REMEDY
Leakage at safety outlet assembly	Ruptured disc (13, 13A, 19, 19A, 28, 28A, 36, 36A, 42, 42A, 48, 48A, 54, 54A, 62, 62A, 70, 70A, 76 or 76A)	Replace disc
	Loose plug (12), fitting (51) or nut (16, 25, 33, 39, 45, 59, 67, or 73)	Tighten plug, fitting or nut
	Defective gasket (14, 20, 29, 37, 43, 49, 55, 63, 71 or 77)	Replace gasket
Leakage at gauge connection	Faulty packing (9)	Replace packing
	Loose gauge (4)	Tighten gauge
	Loose gauge (3)	Tighten screws (5)

Trouble Shooting Chart (Sheet 2 of 2)
Figure 801

10. Storage Instructions

A. Seal all valve/regulator ports with clean metal or polyvinyl chloride (PVC) caps or plugs to prevent foreign matter from entering the valve. Store in sealed polyethylene or polyvinyl bag.

B. Do not use any preservative coating on valves.

C. Charge cylinders until a gauge indication is available (approximately 150 psi).

11. Special Tools, Fixtures and Test Equipment

A. All special tools, fixtures and test equipment required for overhaul are listed in figure 1001 and illustrated in figure 1002 and are manufactured by Scott Aviation, Lancaster, New York.

FIGURE 1002 ITEM NO.	PART NUMBER	PART NAME	APPLICATION
1.	10850-T91-1	Tee Wrench	Used to install/remove valve plug (96, IPL figure 3)
2.	10850-T91-2	Valve Seat Wrench	Used to install/remove valve seat assembly (97, IPL figure 3)
3.	10850-T91-3	Driver	Used to install/remove retainers (18, 27, 35, 41, 47, 53, 61, 69 and 75, IPL figure 3) in valve assemblies using discs (19, 28, 36, 42, 48, 54, 62, 70 and 76)
4.	2786-S52-1	Driver	Used to install/remove retainers (18, 27, 35, 41, 47, 53, 61, 69 and 75, IPL figure 3) in valve assemblies using discs (19A, 28A, 36A, 42A, 48A, 54A, 62A, 70A and 76A)

Special Tools, Fixtures and Test Equipment List
Figure 1001

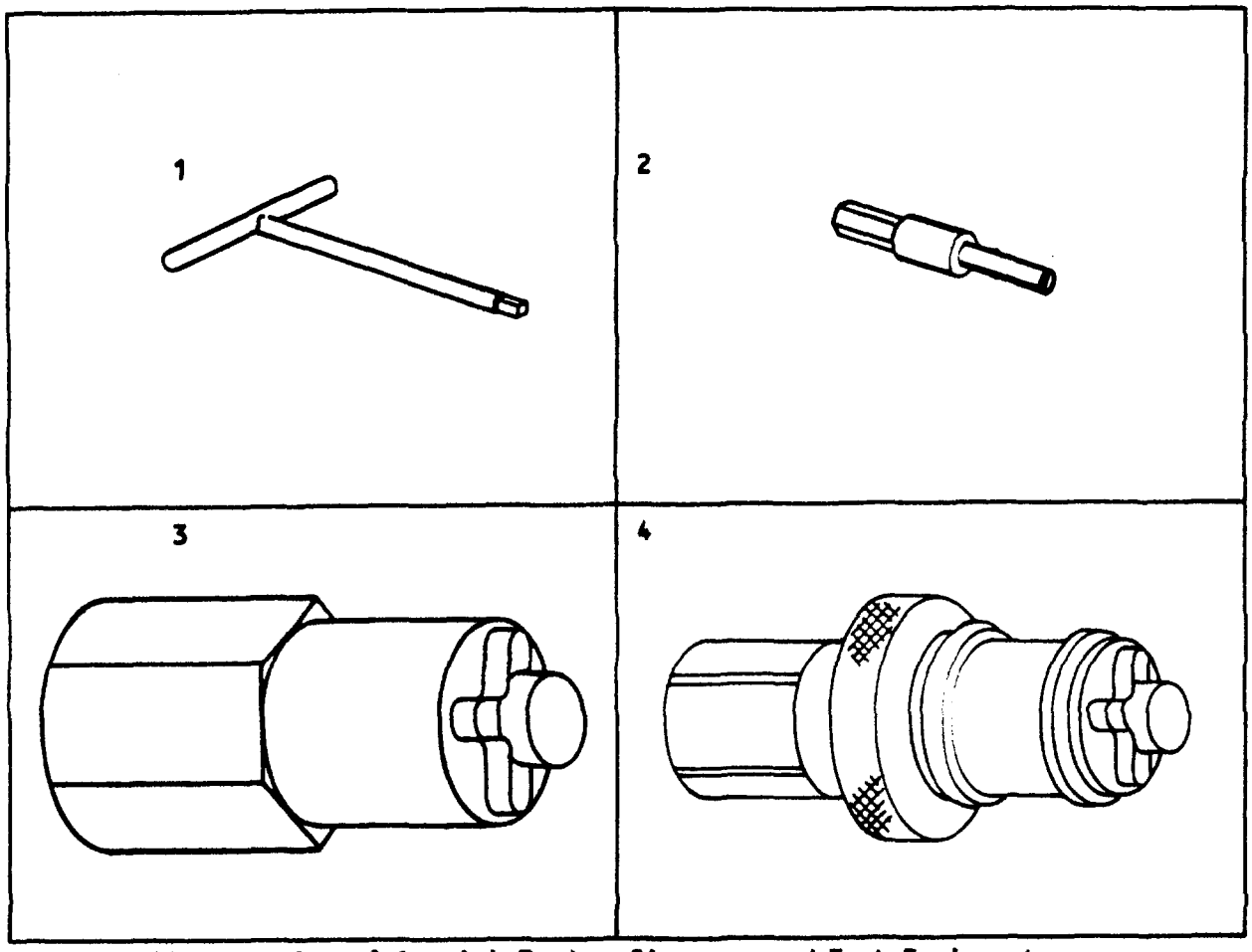


Illustration of Special Tools, Fixtures and Test Equipment
Figure 1002

12. Illustrated Parts List

NOTE: Some models of the slow opening valve assemblies have been discontinued, but repair parts are available. The complete new replacement assemblies are directly interchangeable with the superseded assemblies.

MODEL	SUPERSEDED BY
27876	810850-10
58537	810850-1A
58538	810850-1B
6449M	802777 and 802780

A. This Illustrated Parts List lists and describes the parts for the 6350 Series Cylinder and Valve Assemblies (see IPL figure 1), the 802777 and 802780 Series Oxygen Valve Assemblies (see IPL figure 2), and 10850, 810850 Series Slow Opening Oxygen Cylinder Assemblies (see IPL figure 3).

(1) The Group Assembly Parts List consists of parts listings and completely indexed drawings. The particular valve/regulator assembly is followed immediately by its component parts, properly indented thereunder, to show their relationship to the assembly.

(2) The quantities listed in the "UNITS PER ASSY" column are, in the case of assemblies, the total quantity used per cylinder and valve assembly at the location indicated, while the component parts indented under the assemblies are the quantity used per assembly. The quantities specified, therefore, are not necessarily the total used per cylinder and valve assembly.

(3) The part numbers listed in the "PART NUMBER" column are Scott Aviation part numbers except standard parts, which are listed by "MS" and "AN" part numbers, and vendor items, which are listed by vendor part numbers. Commercial hardware available at commercial sources is identified by the abbreviation "COML" in the "PART NUMBER" column.

(4) A six place code, following the description of a part, indicates the manufacturer of that part. Standard parts and parts carried under Scott part numbers have no vendor's code. The following list contains the codes, and names and addresses of manufacturers supplying items or articles for the cylinder and valve assemblies. This listing includes the vendor codes presented in Tables I, II, III and V.

VENDOR'S CODE

CODE	NAME AND ADDRESS
V02697	Parker Seal Co. Division of Parkerhannifin Corp. Lexington, Kentucky
V04666	Robbins Aviation, Inc. Vernon, California
V07098	Union Carbide Corp. Linde Division Tonawanda, New York
V19898	E.I. DuPont De Nemours and Co., Inc. Wilmington, Delaware
V31879	Thermo Valves Corp. Mountain View, California
V44389	Oakite Products, Inc. Berkeley Heights, New Jersey
V70829	J.T. Baker Chemical Co. N. Phillipsburg, New Jersey
V72658	Allied Chemical Corp. Industrial Chemical Division Morristown, New Jersey
V72962	Elastic Stop Nut Division of Amerace Esna Corp. Union, New Jersey
V82682	Tempil Div. Big Tree Industries Inc. South Plainfield, New Jersey
V91784	Hooker Chemical Corp. Niagara Falls, New York
V94499	Dow Corning Corp. Alpha Molykote Plant Stamford, Connecticut
V99742	Johnson and Johnson, Inc. Permacel Division New Brunswick, New Jersey

B. How to use this Illustrated Parts List.

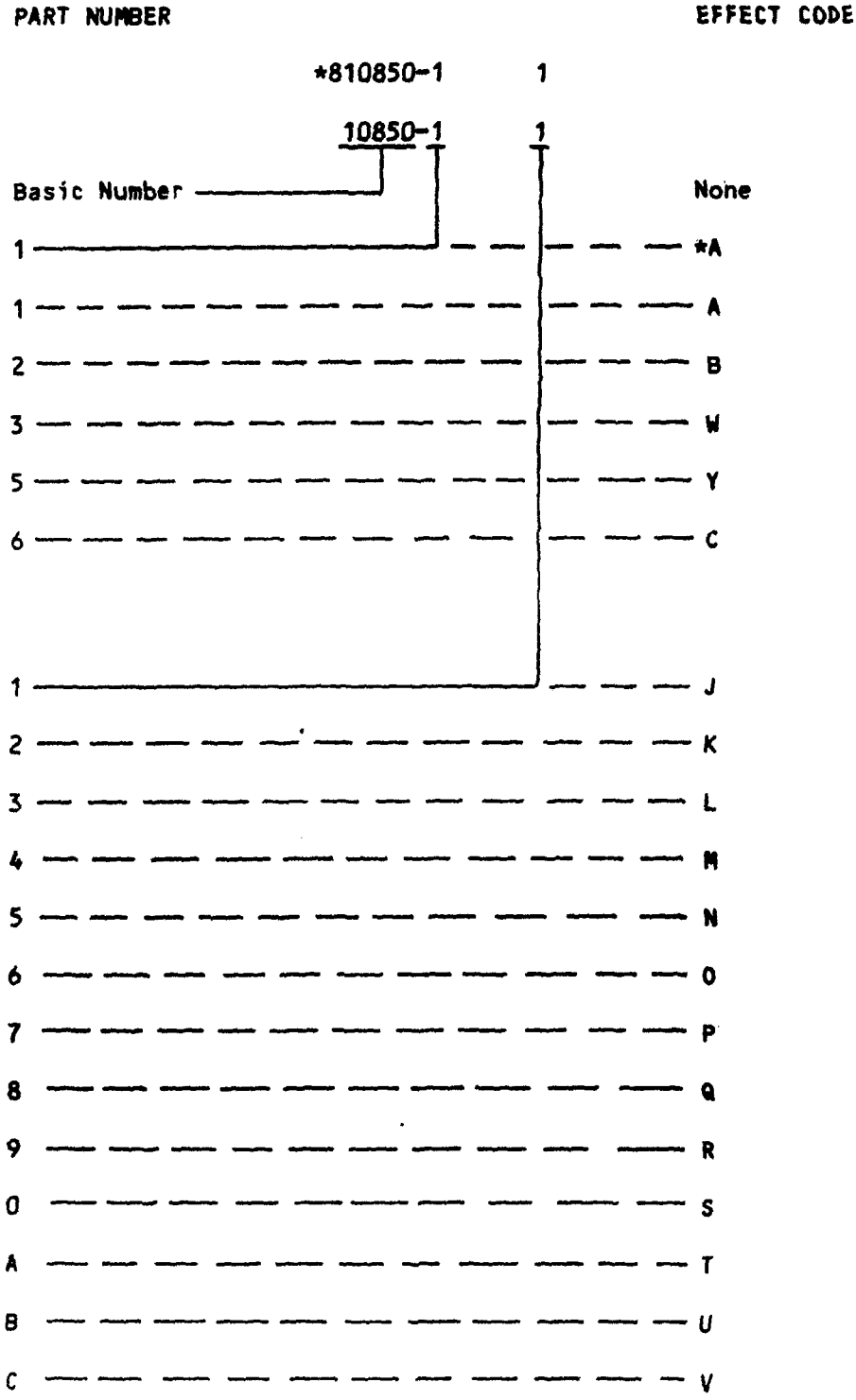
(1) If neither the part number nor the nomenclature is known, the part can be found by comparison with the exploded view illustration. When located on the illustration, the index number will refer to the line in the Group Assembly Parts List with the part number and the nomenclature.

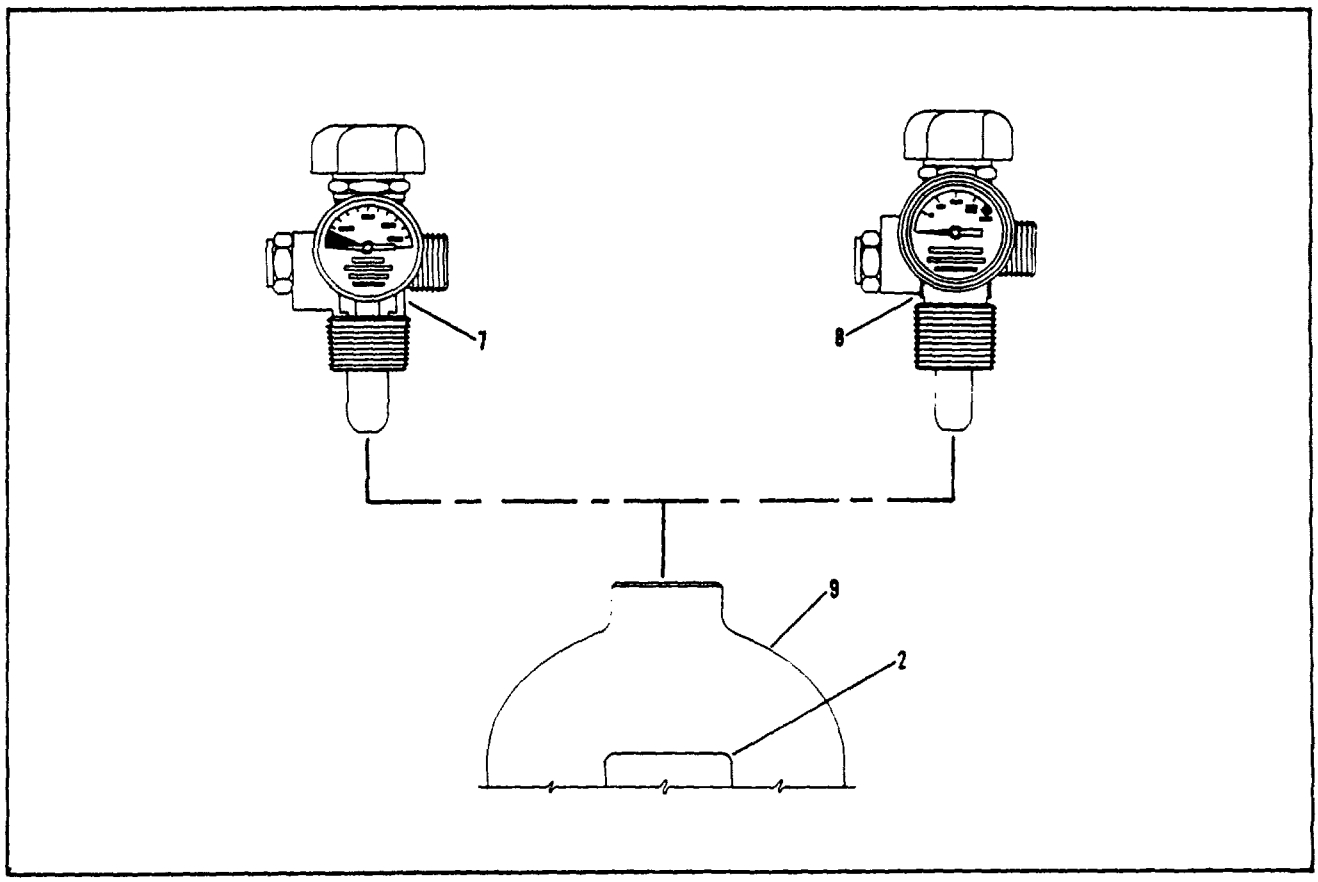
C. How to determine the applicable "EFFECT CODE".

(1) Parts used on only one part number oxygen valve assembly (see IPL figure 2) are indicated by a letter symbol immediately following the description of a part in the "EFFECT CODE" column. An explanation of the letter symbols used is outlined below. In cases when the "EFFECT CODE" column has been left blank, parts listed are common to all oxygen valve assemblies.

PART NUMBER	EFFECT CODE
802777-02	A
802777-03	B
802777-05	C
802777-06	D
802780-05	E
802780-06	F

(2) Note the part number of the particular Slow Opening Valve Assembly (see IPL figure 3) being overhauled, and determine the "EFFECT CODE" letters applicable. For example, if the part number is 10850-11, the "EFFECT CODE" letters are A and J in the "EFFECT CODE" column. In addition to those parts, the particular assembly would use all parts having a blank "EFFECT CODE" column.


PART NUMBER
EFFECT CODE
*810850-1
1
10850-1
1
Basic Number
None
1
*A
1
A
2
B
3
W
5
Y
6
C
1
J
2
K
3
L
4
M
5
N
6
O
7
P
8
Q
9
R
0
S
A
T
B
U
C
V

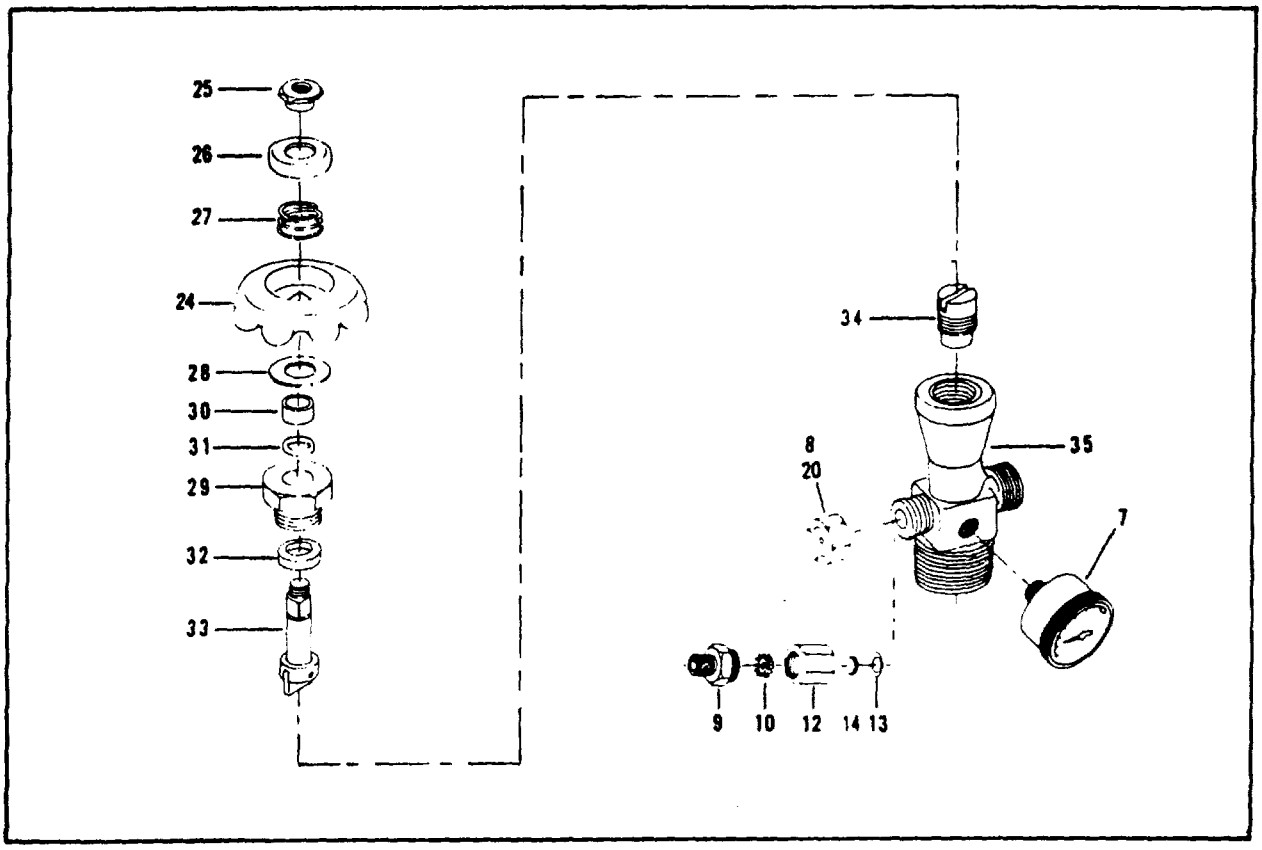


Cylinder and Valve Assembly
Figure 1

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY
1-1	6350 SERIES		CYLINDER AND VALVE ASSY (SEE FIGURE 3)		1
2	10001301		. PLATE-IDENTIFICATION		1
-3	6449M SERIES		. VALVE ASSY-OXYGEN (SUPERSEDED BY 802777 AND 802780)		1
-3A	802777 SERIES		. ON-OFF OXYGEN VALVE ASSY (SUPERSEDES 6449M SERIES) (SEE IPL FIGURE 2 FOR BREAKDOWN)		1
-3B	802780 SERIES		. ON-OFF OXYGEN VALVE ASSY (SUPERSEDES 6449M SERIES) (SEE IPL FIGURE 2 FOR BREAKDOWN)		1
-4	*27876		. OXYGEN CYLINDER VALVE ASSY-SLOW OPENING (V04666 PART NO. ROV600) (SUPERSEDED BY 810850-10)		1
-5	*58537		. OXYGEN CYLINDER VALVE ASSY-SLOW OPENING (V04666 PART NO. ROV600-1B) (SUPERSEDED BY 810850-1A)		1
-6	*58538		. OXYGEN CYLINDER VALVE ASSY-SLOW OPENING (V04666 PART NO. ROV600-6) (SUPERSEDED BY 810850-1B)		1
7	10850 SERIES		. OXYGEN CYLINDER VALVE ASSY-SLOW OPENING (SEE IPL FIGURE 3 FOR BREAKDOWN)		1
8	810850 SERIES		. OXYGEN CYLINDER VALVE ASSY-SLOW OPENING (SEE IPL FIGURE 3 FOR BREAKDOWN)		1
9	6084 SERIES		. CYLINDER (SEE FIGURE 2)		1

*PARTS AVAILABLE FROM:
ROBBINS AVIATION (V04666)
VERNON, CALIFORNIA

- ITEM NOT ILLUSTRATED



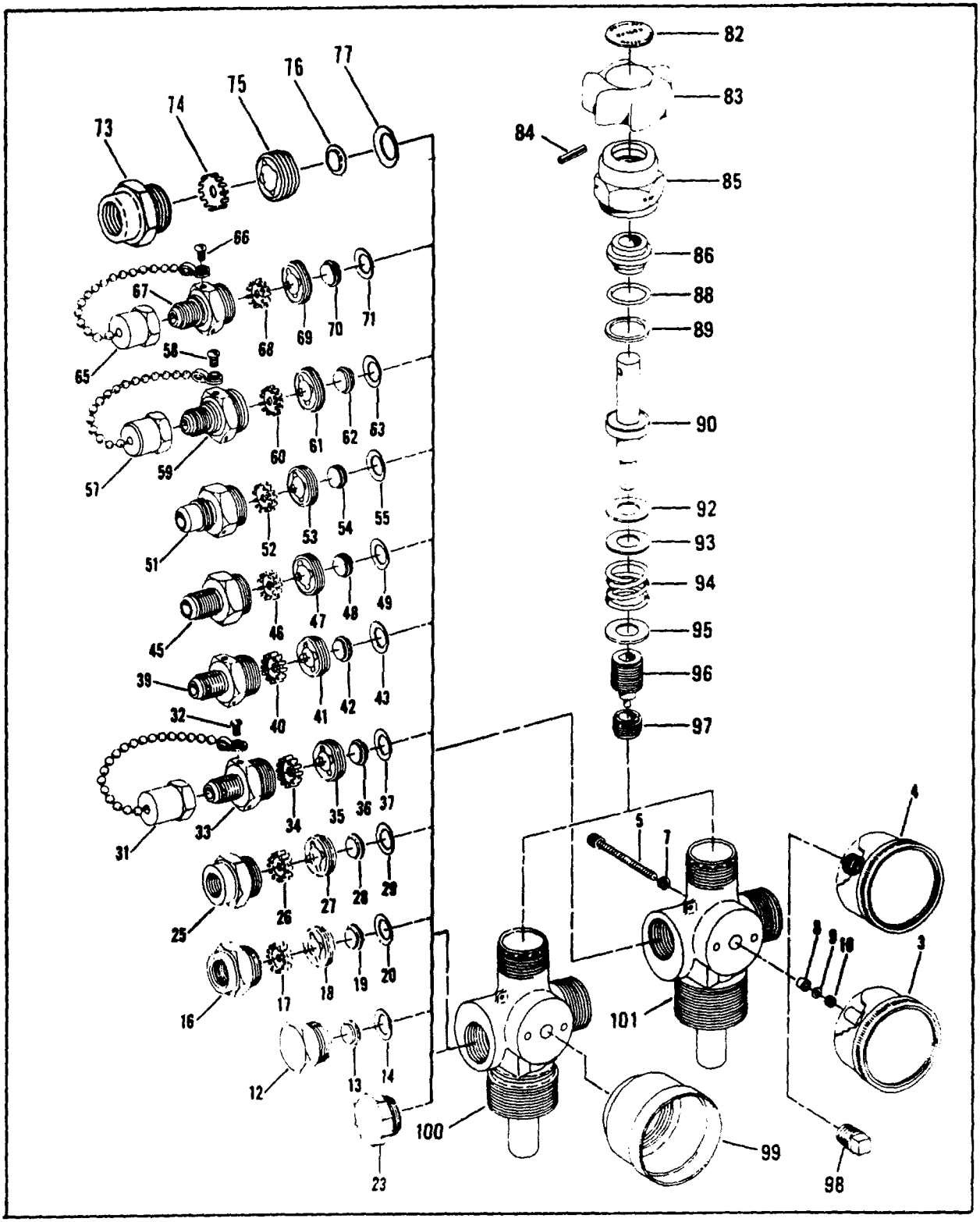
Oxygen Valve Assembly
Figure 2

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY
2-1	802777-02		ON-OFF OXYGEN VALVE ASSY-1" (SEE IPL FIGURE 1,ITEM -3A FOR NHA)	A	RF
-2	802777-03		ON-OFF OXYGEN VALVE ASSY-1" (SEE IPL FIGURE 1,ITEM -3A FOR NHA)	B	RF
-3	802777-05		ON-OFF OXYGEN VALVE ASSY-1" (SEE IPL FIGURE 1,ITEM -3A FOR NHA)	C	RF
-4	802777-06		ON-OFF OXYGEN VALVE ASSY-1" (SEE IPL FIGURE 1,ITEM -3A FOR NHA)	D	RF
-5	802780-05		ON-OFF OXYGEN VALVE ASSY-1/2" (SEE IPL FIGURE 1, ITEM -3B FOR NHA)	E	RF
-6	802780-06		ON-OFF OXYGEN VALVE ASSY-1/2" (SEE IPL FIGURE 1, ITEM -3B FOR NHA)	F	RF

- ITEM NOT ILLUSTRATED

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY	
2 7	2661-03		. GAUGE		1	
8	802776-01		. SAFETY RELIEF ASSEMBLY	A	1	
9	10005594		. ADAPTOR	D,F	1	
10	6572		. INSERT	D,F	1	
-11	802779-02		. SAFETY RELIEF ASSEMBLY	F	1	
-11A	802779-01		. SAFETY RELIEF ASSEMBLY	D	1	R
12	10005574		. . CONNECTION	D,F	1	
13	6555-00		. . GASKET	D,F	1	
14	7171-00		. . DISC	F	1	
14A	10003742		. . DISC	D	1	R
-15	36809-01		. VALVE ASSEMBLY-OXYGEN	A,D	1	
-16	36809-02		. VALVE ASSEMBLY-OXYGEN	C	1	
-17	36809-03		. VALVE ASSEMBLY-OXYGEN	F	1	
-18	36809-04		. VALVE ASSEMBLY-OXYGEN	E	1	
-19	36809-05		. VALVE ASSEMBLY-OXYGEN	B	1	
20	2541-12A-3000		. . CAP-SAFETY (V31879)	CE	1	
-21	36809-31		. . CAP-SAFETY-VENT TYPE	B	1	
-22	36809-28		. . WASHER	B	1	
-23	36809-29		. . DISC	B	1	
24	36809-16		. . HANDWHEEL ATTACHING PARTS		1	
25	36809-17		. . NUT		1	
26	36809-20		. . CUP-SPRING		1	
			----*----			
27	36809-19		. . SPRING-HELICAL-COMPRESSION		1	
28	36809-21		. . WASHER		1	
29	36809-12		. . NUT-PACKING		1	
30	36809-24		. . FOLLOWER		1	
31	36809-25		. . PACKING		1	
32	36809-18		. . PACKING		1	
33	2451-35		. . STEM ASSEMBLY (V31879)		1	
34	2451-45K		. . PLUG ASSEMBLY (V31879)		1	
35	36809-26		. . BODY-1" NGT	A-D	1	
-36	36809-27		. . BODY-1/2" NGT	E,F	1	

- ITEM NOT ILLUSTRATED



Slow Opening Oxygen Cylinder Valve Assembly
Figure 3

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY	
3 -1	810850		SLOW OPENING OXYGEN CYLINDER VALVE ASSEMBLY (SEE IPL FIG. 1, ITEM 8 FOR NHA)		RF	
-2	10850		SLOW OPENING OXYGEN CYLINDER VALVE ASSEMBLY (SEE IPL FIG. 1, ITEM 7 FOR NHA)		RF	
3	21217		. GAUGE-PRESSURE	*A,A	1	
4	2661-03		. GAUGE-PRESSURE	A	1	
			ATTACHING PARTS			
5	AN500D6-22		. SCREW	*A	2	
-6	18565		. SCREW	A	2	
7	18600		. WASHER	*A,A	2	
			----*----			
8	22152-1		. RING-BACKUP	*A,A	1	
9	MS9068-006		. PACKING-PREFORMED	*A,A	1	
10	22151-1		. SLEEVE	*A,A	1	
-11	2814-00		. SAFETY PLUG ASSEMBLY	J	1	
12	21077		. . PLUG	J	1	
13	10003742		. . DISC	J	1	
13A	10006001		. . DISC	J	1	R
14	6555-00		. . GASKET	J	1	
-15	10689-00		. SAFETY OUTLET ASSEMBLY	K	1	
16	2787-00		. . NUT	K	1	
17	6572-00		. . INSERT	K	1	
18	2786-00		. . RETAINER	K	1	
19	10003742		. . DISC	K	1	
19A	10006001		. . DISC	K	1	R
20	6555-00		. . GASKET	K	1	
-21	2793		. SAFETY OUTLET ASSEMBLY (SUPERSEDED BY 22608-1)	L	RF	
-22	2794		. SAFETY OUTLET ASSEMBLY (SUPERSEDED BY 22606-1)	M	RF	
23	NO NUMBER		. PLUG-SHIPPING	N	RF	
-24	10722-00		. SAFETY OUTLET ASSEMBLY	O	1	
25	10723-00		. . NUT	O	1	
26	6572-00		. . INSERT	O	1	
27	2786-00		. . RETAINER	O	1	
28	10003742		. . DISC	O	1	
28A	10006001		. . DISC	O	1	R
29	6555-00		. . GASKET	O	1	

- ITEM NOT ILLUSTRATED

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY	
3-30	22606-01		. SAFETY OUTLET ASSEMBLY	P	1	
31	11272-00		. . CAP ASSEMBLY	P	1	
			ATTACHING PARTS			
32	MS35206-213		. . SCREW	P	1	R
			----*----			
33	22605-03		. . NUT	P	1	
34	6572-00		. . INSERT	P	1	
35	2786-00		. . RETAINER	P	1	
36	10003742		. . DISC	P	1	
36A	10006001		. . DISC	P	1	R
37	6555-00		. . GASKET	P	1	
-38	22608-01		. SAFETY OUTLET ASSEMBLY	Q	1	
39	22605-03		. . NUT	Q	1	
40	6572-00		. . INSERT	Q	1	
41	2786-00		. . RETAINER	Q	1	
42	10003742		. . DISC	Q	1	
42A	10006001		. . DISC	Q	1	R
43	6555-00		. . GASKET	Q	1	
-44	22608-02		. SAFETY OUTLET ASSEMBLY	R	1	
45	22759-00		. . NUT	R	1	
46	6572-00		. . INSERT	R	1	
47	2786-00		. . RETAINER	R	1	
48	10003742		. . DISC	R	1	
48A	10006001		. . DISC	R	1	R
49	6555-00		. . GASKET	R	1	
-50	800843-00		. SAFETY OUTLET ASSEMBLY	S	1	
51	10001581		. . FITTING-ADAPTER	S	1	
52	6572-00		. . INSERT	S	1	
53	2786-00		. . RETAINER	S	1	
54	10003742		. . DISC	S	1	
54A	10006001		. . DISC	S	1	R
55	6555-00		. . GASKET	S	1	
-56	800844-00		. SAFETY OUTLET ASSEMBLY	T	1	
57	11272-00		. . CAP ASSEMBLY	T	1	
			ATTACHING PARTS			
58	MS35206-213		. . SCREW	T	1	R
			----*----			
59	10001611		. . NUT	T	1	
60	6572-00		. . INSERT	T	1	
61	2786-00		. . RETAINER	T	1	
62	10003742		. . DISC	T	1	
62A	10006001		. . DISC	T	1	R
63	6555-00		. . GASKET	T	1	

- ITEM NOT ILLUSTRATED

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY	
3-64	800844-01		. SAFETY OUTLET ASSEMBLY	U	1	
65	11272-01		. . CAP ASSEMBLY	U	1	
			ATTACHING PARTS			
66	MS35206-213		. . SCREW	U	1	R
			----*----			
67	10001612		. . NUT	U	1	
68	6572-00		. . INSERT	U	1	
69	2786-00		. . RETAINER	U	1	
70	10003742		. . DISC	U	1	
70A	10006001		. . DISC	U	1	R
71	6555-00		. . GASKET	U	1	
-72	801153-00		. SAFETY OUTLET ASSEMBLY	V	1	
73	10002536		. . NUT	V	1	
74	6572-00		. . INSERT	V	1	
75	2786-00		. . RETAINER	V	1	
76	10003742		. . DISC	V	1	
76A	10006001		. . DISC	V	1	R
77	6555-00		. . GASKET	V	1	
-78	800887-00		. BODY ASSEMBLY	*A	1	
-79	10861-01		. BODY ASSEMBLY	A	1	
-80	10861-02		. BODY ASSEMBLY	B	1	
80A	10861-03		. BODY ASSEMBLY	W	1	
80B	10861-05		. BODY ASSEMBLY	Y	1	
-81	10861-06		. BODY ASSEMBLY	C	1	
82	22427-01		. . PLATE-IDENTIFICATION		1	
83	23274-01		. . HANDLE-VALVE		1	
			ATTACHING PARTS			
84	79-022-094-0750		. . PIN-ROLL (V72962)		1	
			----*----			
85	10685-00		. . RETAINER		1	
86	10001810		. . GUIDE-STEM	*A	1	
-87	10683-00		. . GUIDE-STEM	A,B,C, W,Y	1	
88	2-14COMP77-545		. . PACKING-PREFORMED (V02697)	*A	1	
89	10686-00		. . WASHER	A,B,C, W,Y	1	
90	800994-00		. . STEM ASSEMBLY	*A	1	
-91	10688-01		. . STEM ASSEMBLY	A,B,C, W,Y	1	
92	10699-00		. . WASHER-THRUST		1	
93	10698-00		. . WASHER-THRUST		1	
94	2813-00		. . SPRING		1	
95	2781-00		. . WASHER	A,B,C, W,Y	1	

- ITEM NOT ILLUSTRATED

FIG. ITEM	PART NUMBER	AIRLINE STOCK NO.	NOMENCLATURE 1234567	EFF CODE	UNITS PER ASSY
3 96	11225-00		. . PLUG-VALVE		1
97	11232-01		. . VALVE SEAT ASSEMBLY		1
98	6818-01		. . PLUG-PIPE	C	1
99	10001813		. . GUARD-GAUGE	*A	1
100	800886-00		. . BODY AND TUBE ASSEMBLY	*A	1
101	23310-01		. . BODY AND TUBE ASSEMBLY	A	1
-102	23310-03		. . BODY AND TUBE ASSEMBLY	B,C, W	1
-103	23310-15		. . BODY AND TUBE ASSEMBLY	Y	1

- ITEM NOT ILLUSTRATED

OVERHAUL INSTRUCTIONS

FOR

ZEP AERO

HIGH PRESSURE CYLINDER

TYPE ZC 268-111-30

ZEP AERO
111 Penn Street
El Segundo, California 90245, U.S.A.

June 15, 1965
Rev. "A" Jan 1966
Rev. "B" June 1966

RECOMMENDED PROCEDURE FOR RECONDITIONING HIGH PRESSURE CYLINDERS PER ICC REGULATIONS

1. Inspect cylinders visually to determine advisability of reconditioning.

2. OVERHAUL - Disassembly

   A. Clamp the cylinder in a suitable holding device, with the valve upward.

   B. Slowly open the valve handle to bleed off the cylinder pressure.

   Caution: Never attempt to remove or tighten a cylinder valve when there is pressure in the cylinder.

   C. Overhaul valve, and test.

3. Inspect threads and interior.

4. Inspect cylinder interior and exterior for dents and corrosion with inspection light.

5. TESTING

   A. All light weight cylinders must be tested every 3 years and must be destroyed after 12 years use. Date stamp and hydrostatic test stamp must be inserted around the top of dome very lightly.

   B. All standard weight cylinders must be hydrostatic tested every 5 years. Date stamp, hydrostatic test stamp will be stamped under the last test dates.

6. If interior is rusty, the procedure outlined below shall be followed:

   A. Pour in a solution containing 1 gallon Solar Scale Remover D4-08 Compound diluted with 2 to 3 parts water. Leave for a period of 10 to 15 minutes; empty, and flush with hot water. (NOTE: D4-08 compound can be re-used until it becomes weak.)

   B. Pour in a second solution comprised of 3 ounces of Solar Neutralizer A-6 Compound diluted with 1 gallon of hot water, and leave for a period of 2 minutes. Flush with hot water.

   C. Use a third solution composed of 3 ounces of Solar Phosphate Compound A-7 diluted with 1 gallon hot water, and leave for a period of 2 minutes. Empty, but do not flush. Place on drier and allow to dry completely.

7. Inspect interior with inspection light.

8. Purge and install reconditioned valve, torque down, and clean off excess lubricant.

9. Charge, leak check, halogen test, and prepare for paint.

10. Paint with 1 coat Zinc Chromate Primer and 2 coats of light green lacquer.

11. Stencil with correct stencil, stamp off, top off, and leak check; apply overhaul decal.

CHAPTER 36

PNEUMATIC

MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B./T.R.
Bendix	Pressure Regulating Valve	38E59-1A through -6A			
	Valve	691-14A			
Custom Components	Switch	1G198 (DHC SC 70019-17)		Sep 12/1969	
	Vacuum Pressure	32V29 (DHC SC 70036-1)	36 37-20-01	Nov 29/1968	
General Connectors	Peri-Seal Pneumatic Connectors	26A423 and others			
Janitrol Aero	Regulator Valve Assembly	B40D85		Sep 1967	
U.O.P. Instruments	Pressure Switch	MDB620-1		Jun 12/1969	

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PUB. No. 38U-23-668B

OVERHAUL INSTRUCTIONS with PARTS BREAKDOWN

Bendix

REGULATING & RELIEF VALVE

TYPE NOS.

38E59-1A
38E59-2A
38E59-3A
38E59-4A
38E59-5A
38E59-6A

TABLE OF LEADING PARTICULARS

	38E59-1A	38E59-2A	38E59-3A	38E59-4A	38E59-5A	38E59-6A
Regulated Pressure	18.0±1.0 PSIG	18.0±1.0 PSIG	18.0±1.0 PSIG	16.5±1.0 PSIG	10.0±1.0 PSIG	15.0±1.0 PSIG
Input Pressure	30 - 150 PSIG	30 - 150 PSIG	30 - 150 PSIG	30 - 150 PSIG	30 - 150 PSIG	30 - 150 PSIG
Rated Capacity	20 SCFM	20 SCFM	20 SCFM	20 SCFM	20 SCFM	20 SCFM
Air Temperature	-65°F to 550°F	-65°F to 550°F	-65°F to 550°F	-65°F to 550°F	-65°F to 550°F	-65°F to 550°F
Relief Valve Cracking Pressure	22.0±0.75 PSIG	22.0±0.75 PSIG	22.0±0.75 PSIG	22.0±0.75 PSIG	13.0±0.75 PSIG	20.0±0.5 PSIG
Weight	1.65 lbs.	1.75 lbs.	1.75 lbs.	1.65 lbs.	1.65 lbs.	1.65 lbs.
Mounting Bracket		X				
Check Valve			X			

Bendix Utica Division
Utica, New York

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1. DISASSEMBLY

Disassembly in the same order as the key index numbers assigned to the exploded view illustration. Figure 1.

a. Remove nuts (1), washers (3) and bolts (2) from housing (25).

b. Remove adapters (4), gaskets (5) from housing (25).

c. Disassembly of cover (10) with items (11) and (12) intact can be accomplished by holding unit in hand and removing bolts (6) and washers (7).

NOTE

Springs (15) and (17) under cover (10) create no hazard since their load will be dissipated when bolts (6) are backed out.

d. Hold unit in an upright position. Remove cover (8) and gasket (9).

Lift cover (10) from housing (25). Remove items (13) through (18).

e. Hold rod (20) with a suitable device being sure not to damage it while removing nut (19).

f. Remove rod (20) and items (21) through (24).

g. Remove ring (26) from rod (20).

NOTE

Item 4A is a check valve peculiar to the 38E59-3A only.
Item 22 is a spacer peculiar to the 38E59-4A only. This is used in place of item (13).
Item 27 is a mounting bracket peculiar to the 38E59-2A only.

2. CLEANING

a. Thoroughly wash all parts with a suitable cleaning solvent. Dry all parts with a clean cloth.

3. INSPECTION

Inspect all parts for damage. Check rod (20) for scratches.

Check retainer seat for smoothness of surface.

Check springs for distortion or damage.

Check all threads for condition and cleanliness.

Check diaphragm (23) for punctures or distortion.

4. REPAIR AND REPLACEMENT

a. Replace all worn or damaged parts.

b. Replace all "O" Rings and gaskets.

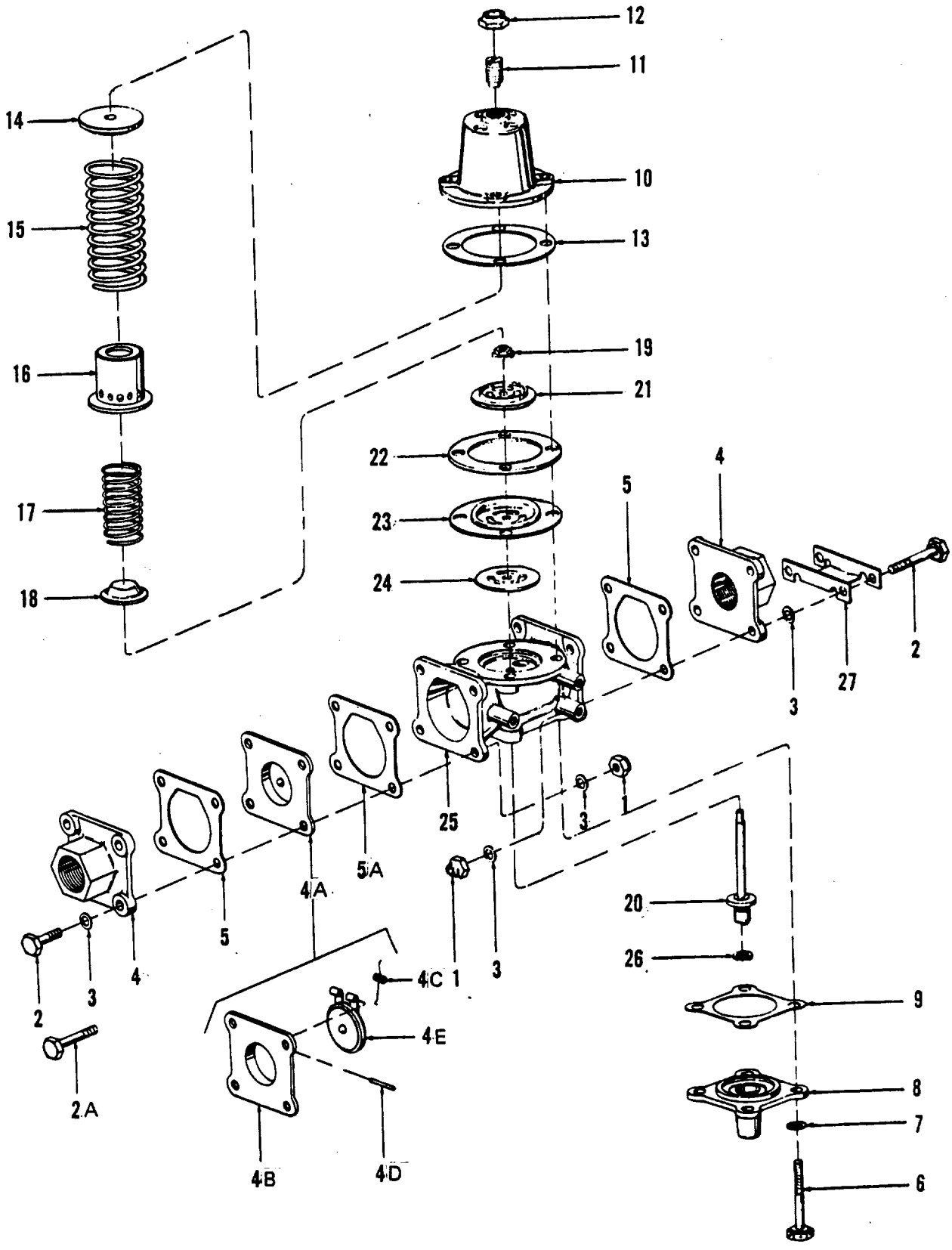

12
11
14
10
15
13
19
16
21
22
17
23
24
18
4
5
2
27
3
25
1
4A
5A
5
20
26
4
3
2
4C
1
3
9
4E
8
7
2A
4B
4D
6

FIGURE 1

5. REASSEMBLY

a. Reassembly is basically the reverse of disassembly.

CAUTION

When replacing nut (19) on rod (20) use care when holding rod to avoid damage while tightening nut.

b. When installing cover (10) be sure adjusting screw is lined up properly in retainer (14) before tightening bolts (6).

c. Reassembly of item 4 is the same in all models with the exception of the 38E59-3. This model incorporates a flapper valve assembly.

If flapper valve is damaged replace complete assembly.

The position of the flapper valve assembly (4A) is shown in the exploded view.

6. TEST PROCEDURE

Install Valve Assembly in test set up shown in Figure 2.

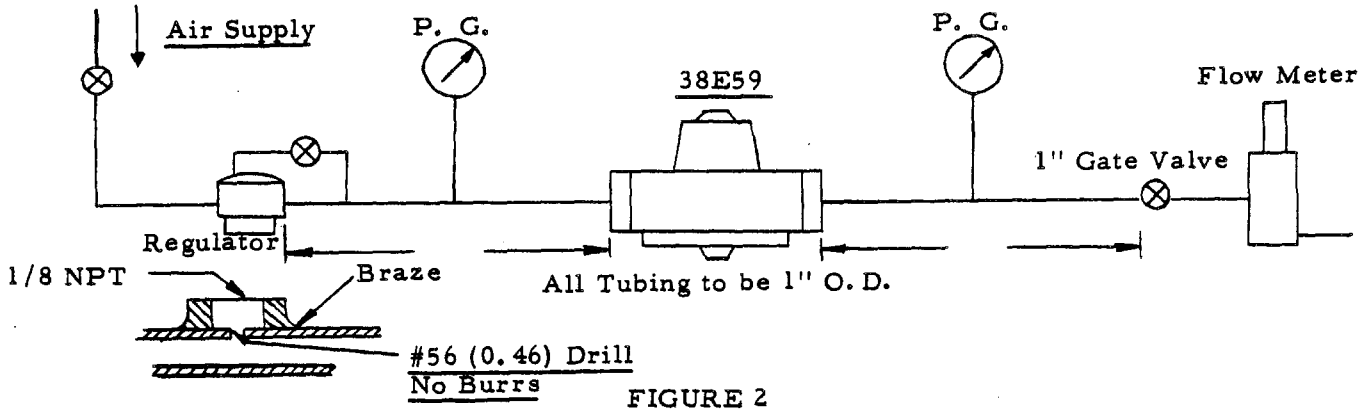


FIGURE 2

a. CALIBRATION

The valve setting stated in Initial Setting is for guidance only in making initial setting. Readjustment will be necessary to meet the requirements of minimum flow.

b. SETTING (INITIAL)

Adjust the power spring adjustment screw to maintain the following regulated or discharge pressure when flowing 20 ±1/2 scfm at inlet pressure of 30 ±1 psig:

17.5 ±.5 psig	38E59-1, 2 & 3
16.5 ±.08 psig	38E59-4
10.0 ±0.5 psig	38E59-5
15.0 ±.05 psig	38E59-6

c. MINIMUM FLOW

With inlet pressure of 90 $\pm$1 psig and flow of 5 $\pm$1/2 scfm the regulated pressure should be:

18.0 $\pm$0.75 psig	38E59-1, 2 & 3
16.5 $\pm$.08 psig	38E59-4
10.0 $^{+.080}_{-.050}$ psig	38E59-5
15.0 $^{+.080}_{-.050}$ psig	38E59-6

d. FINAL SETTING

With inlet pressure of 30 $\pm$1 psig and air flow of 5 $\pm$1/2 scfm the regulated pressure should be:

18 $\pm$1 psig	38E59-1, 2 & 3
16.5 $\pm$.08 psig	38E59-4
10.0 $^{+.080}_{-0}$ psig	38E59-5

With inlet pressure of 50 $\pm$1 psig and flow of 5 $\pm$1/2 scfm the regulated pressure should be:

15 $^{+.080}_{-0.5}$ psig	38E59-6

e. CRACK AND RESEAT PRESSURE TEST

38E59-1, 2, 3 & 4

Install valve assembly as shown in Figure 3.

Gradually increase the pressure to 22 psig and the relieving flow should be 12 scfh minimum.

Decrease the pressure to 18 psig and the leakage flow will be 5 scfh maximum.

38E59-5

Install valve assembly as shown in Figure 3.

Gradually increase the pressure to 13 psig and the relieving flow should be 12 scfh minimum.

Decrease the pressure to 10 psig and the leakage flow will be 5 scfh maximum.

38E59-6

Install valve assembly as shown in Figure 3.

Gradually increase the pressure to 20 psig and the relieving flow should be 12 scfh minimum.

Decrease the pressure to 15 psig and the leakage flow will be 5 scfh maximum.

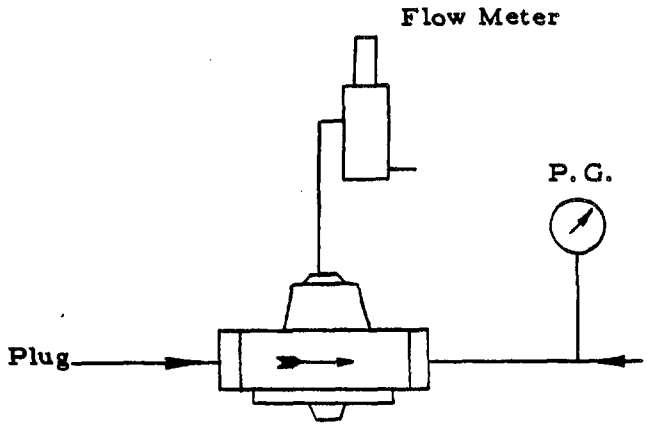


FIGURE 3

f. CHECK VALVE TEST

38E59-3 only

Install valve assembly as shown in Figure 4.

The flapper valve must open freely when pushed lightly with a blunt rod.

The flapper valve must remain closed regardless of position when not in operation.

Plug the outlet of the 38E59 and connect the inlet to a pressure line. Apply 18 psig pressure. Using liquid soap check around the check valve flanges for leakage. This should not exceed one bubble per second at any point.

Remove the plug from the outlet connection and connect the inlet to a suction source.

Apply 6" Hg. suction and close the shut-off valve. The mercury in the manometer must not fall faster than 0.25" Hg. in one minute - equivalent to 2.5 cc/min. leakage of sea level free air.

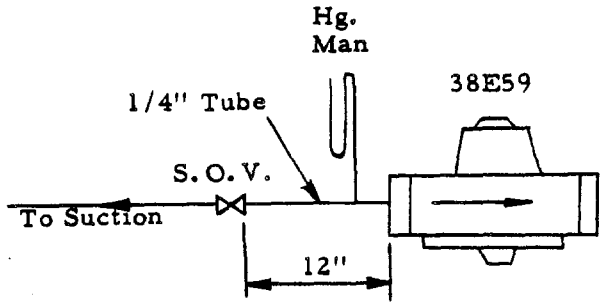


FIGURE 4

Fig. No. & Item No.	PART NUMBER	DESCRIPTION	Qty. per Assembly					
			38E59-1A	38E59-2A	38E59-3A	38E59-4A	38E59-5A	38E59-6A
1-	38E59-1A	Valve Assy. Regulating and Relief	1	-	-	-	-	-
1-	38E59-2A	Valve Assy. Regulating and Relief	-	1	-	-	-	-
1-	38E59-3A	Valve Assy. Regulating and Relief	-	-	1	-	-	-
1-	38E59-4A	Valve Assy. Regulating and Relief	-	-	-	1	-	-
1-	38E59-5A	Valve Assy. Regulating and Relief	-	-	-	-	1	-
1-	38E59-6A	Valve Assy. Regulating and Relief	-	-	-	-	-	1
- 1	645213B28	Nut, Lock	8	8	8	8	8	8
- 2	AN104612	Bolt, Hex HD	8	8	4	8	8	8
- 2A	AN104614	Bolt, Hex HD	-	-	4	-	-	-
- 3	AN960C10L	Washer, Flat	16	12	16	16	16	16
- 4	2481022	Adapter, Valve	2	2	2	2	2	2
- 4A	2481594	Housing Assy., Flapper	-	-	1	-	-	-
- 4B	2481591	Housing, Flapper	-	-	1	-	-	-
- 4C	646683	Spring	-	-	1	-	-	-
- 4D	97112-2	Pin	-	-	1	-	-	-
- 4E	646681	Flapper Assy.	-	-	1	-	-	-
- 5	2481044	Gasket, Valve Adapter	2	2	-	2	2	2
- 5A	2481737	Gasket, Valve Adapter	-	-	3	-	-	-
- 6	MS20073-03-21	Bolt, Hex HD	4	4	4	4	4	4
- 7	AN960C10L	Washer, Flat	4	4	4	4	4	4
- 8	2481043	Cover, Reg. Valve	1	1	1	1	1	1
- 9	2481042	Gasket, Reg. Valve Cover	1	1	1	1	1	1
-10	2481023	Cover, Relief Valve	1	1	1	1	1	1
-11	2481040	Screw, Valve Spring ADJ	1	1	1	1	1	1
-12	645167P624	Nut, Lock Thin	1	1	1	1	1	1
-13	2481065	Gasket, Relief Valve Cover	1	1	1	-	1	1
-14	2481045	Retainer, Valve Spring	1	1	1	1	1	1

Fig. No. & Item No.	PART NUMBER	DESCRIPTION	Qty. per Assembly					
			38E59-1A	38E59-2A	38E59-3A	38E59-4A	38E59-5A	38E59-6A
-15	2481037	Spring, Air Valve	1	1	1	1	-	-
-15	2481630	Spring, Air Valve	-	-	-	-	1	-
-15	2482107	Spring, Air Valve	-	-	-	-	-	1
-16	2481039	Housing, Air Valve Spring	1	1	1	1	1	1
-17	2481038	Spring, Air Valve Relief	1	1	1	1	-	-
-17	2481812	Spring, Air Valve Relief	-	-	-	-	-	1
-17	2481631	Spring, Air Valve Relief	-	-	-	-	1	-
-18	2481053	Retainer Actuating Valve Spring	1	1	1	1	1	1
-19	645036-632	Nut, Lock	1	1	1	1	1	1
-20	2481049	Rod, Actuating	1	1	1	1	1	1
-21	2481050	Seat, Valve	1	1	1	1	1	1
-22	2481649	Spacer, Relief Cover	-	-	-	1	-	-
-23	2481052	Diaphragm, & Plate, Complete	1	1	1	1	1	1
-24	2481046	Plate, Diaphragm Retainer	1	1	1	1	1	1
-25	2481062	Housing, Valve	1	1	1	1	1	1
-26	645096L004B	Ring, Sealing	1	1	1	1	1	1
-27	2481260	Bracket, Mounting	-	2	-	-	-	-

PUB. NO. 38U-23-632A

Bendix

Utica Division

OVERHAUL INSTRUCTIONS WITH PARTS BREAKDOWN

SUCTION RELIEF VALVE PART NUMBERS

691-2B	691-11A
691-12A	691-13A
691-14A	691-15A
691-16A	691-17A

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UTICA DIVISION • UTICA 1, NEW YORK

OVERHAUL INSTRUCTIONS WITH PARTS BREAKDOWN

SUCTION RELIEF VALVE TYPE NUMBERS

691-2B 691-11A
691-12A 691-13A
691-14A 691-15A
691-16A 691-17A

TABLE OF LEADING PARTICULARS

Model No.	Setting Range	Factory Setting	Port Size	Fitting Type
691-2B	4. to 7.5"Hg.	5" Hg.	3/8 PT	Female Pipe Thd.
691-11A	2.5 to 4"Hg.	2.8" Hg.	3/8 PT	Female Pipe Thd.
691-12A	4.5 to 7"Hg.	5." Hg.	9/16-18NF3	AND10050-6
691-13A	4.5 to 7"Hg.	5" Hg.	3/8 PT	Female Pipe Thd.
691-14A	4.0 to 7"Hg.	6" Hg.	9/16-18NF3	AND10050-6
691-15A	2.5 to 4.5"Hg.	3.9" Hg.	3/8 PT	Female Pipe Thd.
691-16A	8.5 to 11"Hg.	10" Hg.	9/16-18NF3	AND10050-6
691-17A	2 to 4.5"Hg.	2.8" Hg.	9/16-18NF3	AND10050-6

1. SPECIAL TOOLS. None.

2. DISASSEMBLY. (Refer to Figure 2).

A. Hold the adjusting nut (2) and unscrew the self-locking nut (1) from the adjusting screw (13) with a suitable wrench.

B. Remove the adjusting nut (2), from the adjusting screw (13).

C. Unscrew the valve seat retainer (3), from the valve housing (15).

D. Remove the screen (4), from the valve seat retainer (3).

E. Remove the valve seat (5), the gasket (6), the valve (7), and the valve spring (8), from the housing (15).

F. Remove the guide assembly (11), together with the adjusting screw (13), with the assembled spring retainer (12), from the valve housing (15).

G. Remove the sealing washer (9), and "O" Ring (10), from the top of the adjusting screw (13).

NOTE

Do not disassemble the guide assembly. If either the spring guide or self-locking clinch nut is damaged replace the entire guide assembly.

H. If necessary, unscrew the guide assembly (11), from the bottom of the adjusting screw (13).

I. Unscrew spring retainer (12), from the adjusting screw (13).

J. If necessary, take out screws (14), and remove the two nameplates.

3. CLEANING. Wash all parts of the suction relief valve in unleaded gasoline or any other suitable solvent.

CAUTION

Do not use Carbon Tetrachloride; its use results in corrosion of the parts.

4. INSPECTION. Inspect the valve housing for cracks, breaks and scored or corroded chambers. Check the "O" Ring, sealing washer, and gasket for cracks and breaks. Examine all threaded parts for stripped threads. Inspect the hollow valve for scored surfaces. Inspect the screen for punctures.

5. REPAIR OR REPLACEMENT. Replace any damaged parts found; replace all gaskets at every overhaul.

6. LUBRICATION.

A. For all valves - Prior to reassembly apply a film of Pioneer No. 8 Instrument oil to "O" ring. Also apply Parker Threadlube 6PB to housing threads before reassembling seat retainer.

B. For Model 691-2B only - In addition to the above, lubricate the 691-2B valve with #60 oil.

CAUTION

On models other than the 691-2B, all parts except those indicated in paragraph 6A above, must be reassembled dry.

7. REASSEMBLY.

A. Replace the spring retainer (12), on the adjusting screw (13), shoulder upward. Replace the guide assembly (11), on the bottom of the adjusting screw (13).

B. Replace the sealing washer (9), and "O" ring (10), on top of the adjusting screw (13). See paragraph 6.

C. Insert the adjusting screw (13), with the assembled spring retainer (12), guide assembly (11), "O" ring (10), and sealing washer (9), into and through the valve housing (15), so that the top of the adjusting screw (13), protrudes above the top of the housing (15).

D. Assemble the adjusting nut (2), over the protruding adjusting screw key (13). Secure the adjusting nut in place with the self-locking nut (1).

E. Place the gasket (6), over the valve seat (5).

F. Insert the valve spring (8), into the interior of the valve housing and over the circular shoulder on the bottom of the spring retainer (12).

CAUTION

Be sure to fit the valve spring properly over the spring retainer shoulder.

G. Place the hollow valve (7), over the valve spring (8). Carefully compress the valve and spring until the valve enters the chamber. Hold in place with the index finger of one hand.

H. Thrust the index finger of the other hand through the valve seat (5), to control the valve (7), and valve spring (8).

I. Place the screen (4), against the valve seat (5).

J. Screw the valve seat retainer (3) on the valve housing (15).

K. If nameplates were removed, replace and secure with screws (14).

8. TEST PROCEDURE.

A. At any time that adjustment of the Suction Relief Valve is specified during the test procedure, proceed as follows: hold the knurled adjusting nut tightly with the left hand to prevent it from turning. Then loosen the upper self-locking nut about one-quarter turn with a suitable wrench. Turn the adjusting nut counterclockwise to increase suction or clockwise to decrease suction.

NOTE

During all tests, the valve adjusting nut and top self-locking nut must be drawn tight. The nameplate screw holes must be airtight and the valve seat and screw retainer must be tightened to normal position. Check for stability at each setting by partially blocking off the inlet screen by hand to increase suction approximately one inch. The suction should immediately return to original setting without hunting or fluctuating when the hand is removed.

B. With the exception of model 691-2B, the 691 type suction relief valve must be assembled dry and tested in a room free of oil vapors to preclude the entrance of oil vapor either into the suction relief valve or the companion dry air pump. An AN 6237-1 Filter must be connected between the Suction Relief Valve and the pump inlet port to preclude entrance of dust and dirt into the pump.

NOTE

For all tests run the pump at 27.5 ± 0.25 Volts.

C. Model 691-2B.

C-1 Set up unit as per schematic with Bendix Dry Air Pump 1511. (Refer to Figure 1).

C-2 Adjust the suction to 4.5 ± 0.1 Hg. with no flow through the air flowmeter. The suction gage should not increase more than 1.3 in. Hg.

C-3 Adjust the suction to 6.1 ± 0.1 in. Hg. with 1.125 ± 0.125 CFM flowing through the air flowmeter. The suction gage should not fluctuate more than 0.5 in. Hg.

C-4 Adjust the suction to 7.0 ± 0.2 in. Hg. with 1.125 ± 0.125 CFM flowing through the air flowmeter. The suction gage should not fluctuate more than 0.5 in. Hg.

C-5 Adjust the suction to 5.0 ± 0.1 in. Hg.

NOTE

This is the final setting of this model valve.

D. Models 691-11, 691-15, and 691-17.

D-1 Set up unit as per schematic with Bendix Dry Air Pump 1511. (Refer to Figure 1).

D-2 Adjust the suction to 2.0 ± 0.25 in. Hg. with no flow through the air flowmeter. The suction gage should not fluctuate more than ± 0.1 in.. Hg.

D-3 Adjust the suction to 4.5 ± 0.25 in. Hg. with no flow through the air flowmeter. The suction gage should not fluctuate more than ± 0.1 in. Hg.

D-4 Adjust the suction to 2.8 ± 0.1 in. Hg. for the 691-11 valve; 3.9 ± 0.1 in. Hg. for the 691-15 valve; 2.8 ± 0.1 in. Hg. for the 691-17 valve; with 2.3 ± 0.1 CFM flowing through the air flowmeter. The suction gage should not fluctuate more than ± 0.1 in. Hg.

NOTE

This is the final setting of these model suction relief valves.

D-5 After making setting of 2.8 ± 0.1 in. Hg. for the 691-11 valve; 3.9 ± 0.1 in. Hg. for the 691-15 valve; 2.8 ± 0.1 in. Hg. for the 691-17 valve; increase the air flow in the pipe leading to the valve until the valve suction is 1.8 ± 0.1 in. Hg. Clamp on adapter to the valve relief port and measure leakage flow by means of a suitable air flowmeter. Maximum allowable leakage is 0.20 CFM.

E. Models 691-12, 691-13 and 691-14.

E-1 Set up unit as per schematic with Bendix Dry Air Pump 1511. (Refer to Figure 1).

E-2 Adjust the suction to 4.0 ± 0.25 in. Hg. with no flow through the air flowmeter. The suction gage should not fluctuate more than ± 0.1 in. Hg.

E-3 Adjust the suction to 7.0 ± 0.25 in. Hg. with no flow through the air flowmeter. The suction gage should not fluctuate more than ± 0.1 in. Hg.

E-4 Adjust suction to 5.0 ± 0.1 in. Hg. for models 691-12 and 691-13; 6.0 ± 0.1 in. Hg. for the 691-14 valve; with 0.85 ± 0.1 CFM flowing through the air flowmeter. The suction gage should not fluctuate more than ± 0.1 in. Hg.

NOTE

This is the final setting for these model valves.

E-5 After making setting of 5.0 ± 0.1 in. Hg. for models 691-12 and 691-13; 6.0 ± 0.1 in. Hg. for the 691-14 valve; increase air flow in pipe leading to the valve until the valve suction is 4.0 ± 0.1 in. Hg. Clamp an adapter to the valve relief port and measure leakage flow by means of a suitable air flowmeter. Maximum allowable leakage is 0.25 CFM.

F. Model 691-16.

F-1 Set up unit as per schematic with Bendix Dry Air Pump 1511. (Refer to Figure 1).

F-2 Adjust the suction to 8.5 ± 0.25 in. Hg. with no flow through the air flowmeter. The suction gage should not fluctuate more than ±0.1 in. Hg.

F-3 Adjust the suction to 11.0 ± 0.25 in. Hg. with no flow through the air flowmeter. The suction gage should not fluctuate more than ± 0.1 in. Hg.

F-4 Adjust the suction to 10 ± 0.1 in. Hg. with 0.85 ± 0.1 CFM flowing through the air flowmeter. The suction gage should not fluctuate more than ± 0.1 in. Hg.

NOTE

This is the final setting for the 691-16.

F-5 After making setting of 10 ± 0.1 in. Hg. increase air flow in pipe leading to the valve until the valve suction is 8.5 ± 0.1 in. Hg. Clamp adapter to the valve relief port and measure leakage flow by means of suitable air flowmeter. Maximum allowable leakage is 0.25 CFM.

NOTE

Adapter for leakage test should cover tie wire holes in screen cap.

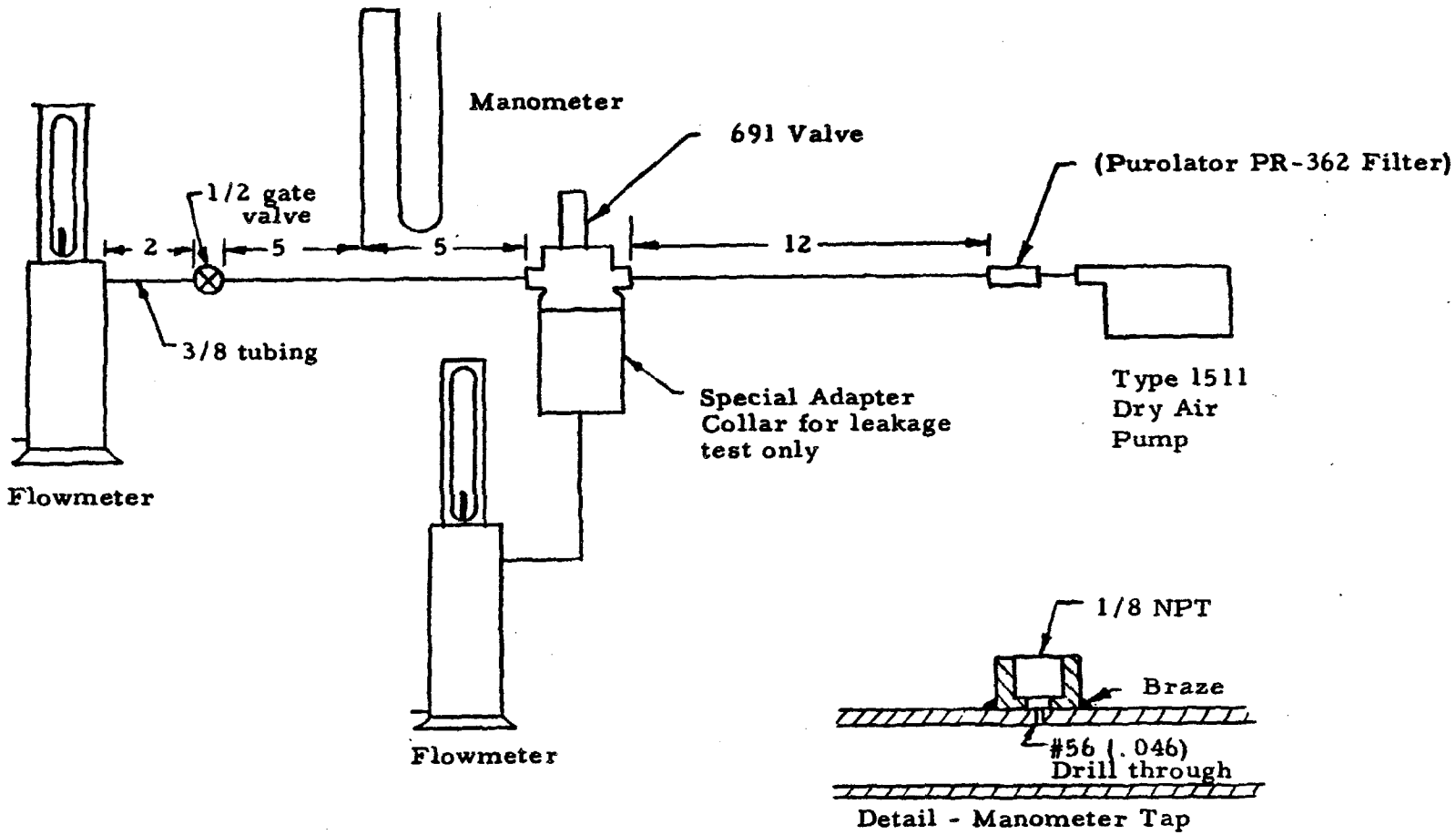


FIGURE 1 TEST SET UP

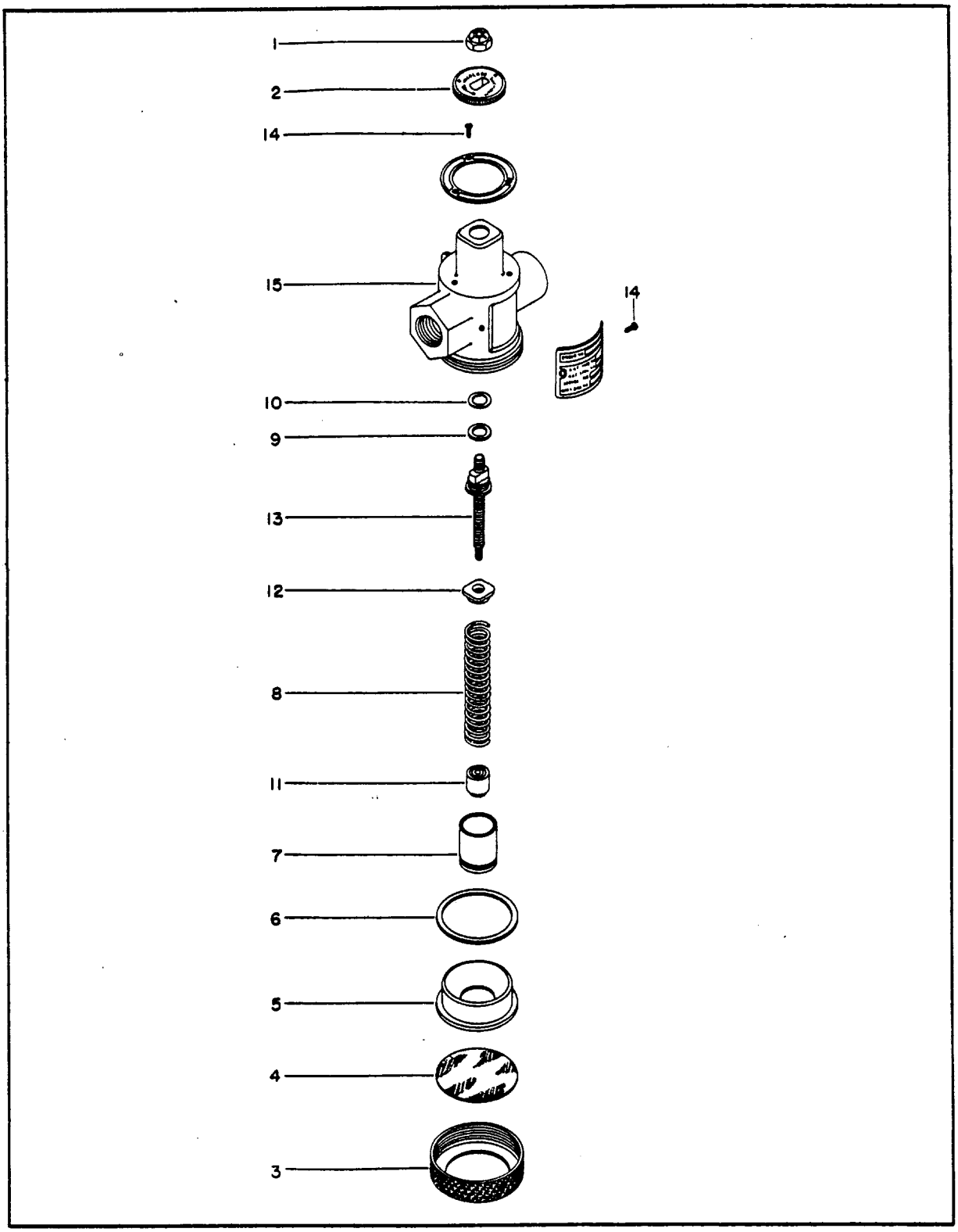


FIGURE 2 - Exploded View - Suction Relief Valve - 691

9. PARTS BREAKDOWN

FIG.	PART NO.	DESCRIPTION	691-2B	691-11A	691 12A	691-13A	691-14A	691-15A	691-16A	691-17A
1	MS20364-1032	Nut, Self-locking (45501-4)	1	1	1	1	1	1	1	1
2	829373	Nut, Adjusting	1	1	1	1	1	1	1	1
3	829377	Retainer, Valve Seat	1	1	1	1	1	1	1	1
4	73985	Screen	1	1	1	1	1	1	1	1
5	829376	Seat, Valve	1	1	1	1	1	1	1	1
6	115772	Gasket	1	1	1	1	1	1	1	1
7	115553	Valve	1							
7	829375	Valve		1	1	1	1	1	1	1
8	829374	Spring, Valve		1				1		1
8	115922	Spring, Valve	1		1	1	1			
8	649241	Spring, Valve							1	
9	114385	Washer, Sealing	1	1	1	1	1	1	1	1
10	890015-5	Ring, "O", Packing	1	1	1	1				
10	645001V010C	Gasket, "O" Ring					1	1	1	1
11	830137	Guide Assembly	1	1	1	1	1	1	1	1
12	829370	Retainer, Spring	1	1	1	1	1	1	1	1
13	829371	Screw, Adjusting	1	1	1	1	1	1	1	1
14	22996-1	Screw, Self-tapping	5	5	5	5	5		5	5
14	22996-16	Screw, Self-tapping						5		
15	115713	Housing, Valve	1	1		1		1		
15	842282	Housing, Valve			1		1		1	1

CUSTOM COMPONENT SWITCHES, INC.
21111 PLUMMER ST. CHATSWORTH, CALIF.

GAGE PRESSURE SWITCH 1G198, -2, -3 OVERHAUL MANUAL

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CUSTOM COMPONENT SWITCHES, INC.
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GAGE PRESSURE SWITCH 1G198, -2, -3 OVERHAUL MANUAL

1. DESCRIPTION AND OPERATION

Models 1G198, 1G198-2, and 1G198-3 are pressure actuated switches designed to sense gage pressure. Pressure is applied to a diaphragm. The resultant force created by the gage pressure on the diaphragm is conveyed to a negative rate disc spring by the diaphragm. When the increasing gage pressure reaches a preset actuation point, the disc spring snaps over center allowing the pressure plate to actuate the electrical assembly. Upon decreasing gage pressure, at a preset value below the actuation point, the disc spring snaps back to its original position returning the pressure plate and electrical assembly to their original positions.

TABLE I LEADING PARTICULARS

Service Media.....Air
Actuation Points:

Model	Increasing Pressure	Decreasing Pressure
1G198	At 20 ±2 PSIG	At 15 ±2 PSIG
1G198-2	At 17 ±1 PSIG	At 14 ±1 PSIG
1G198-3	At 1.5 ±.5 PSIG	At .5 ±.5 PSIG

Proof Pressure.....262 PSIG
Ambient Temperature Range.....-54°C to +121°C
-65°F to +250°F
Pressure Port.....Per AND10050-4
7/16-20 UNF-3B
Mounting Provisions.....Two .199 inch dia. holes
on 1.25 inch centers
Electrical Data:
Switching Element.....SPDT
Current.....5 amps resistive at 28 VDC
Receptacle.....Per MS3102-10SL-3P
mates with MS3106-10SL-3S
Overall Dimensions:
Height.....3.50 inches max
Width & Depth.....1.87 inches typ
Weight.....4 ounces est

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2. DISASSEMBLY (See Figures 3 and 4)

A. Cut and remove lockwire from electrical assembly [13], port cap [2], and body [11].

NOTE: Observe method used to lockwire unit. Use same method to replace lockwire during assembly.

B. Using a 66-4 tool, remove electrical assembly [13] from body [11]. Remove O-ring [12] from electrical assembly [13].
C. Using a 66-1 tool and a 66-56 tool, remove body [11] from port cap [2].
D. Remove pressure plate [8], disc spring [9], register ring [10], diaphragm [7], O-ring [6], adjustment shoe [5], and helical spring [4] from port cap [2] or body [11].
E. Using a 66-5 tool, remove adjustment screw [3] from port cap [2].

3. CLEANING

A. Clean all metal parts with dry cleaning solvent per Federal Specification P-D-680, Type 1, or equivalent; use a stiff bristle brush and/or a clean, lint-free cloth.

WARNING: AVOID SOLVENT CONTACT WITH SKIN AND AVOID BREATHING SOLVENT VAPORS. OBSERVE FIRE PRECAUTIONS.

B. Dry parts thoroughly with moisture free, compressed air, and/or allow to air dry.

4. INSPECTION/CHECK (See Figures 1, 2, and 4)

A. Inspect all machined surfaces for cracks, burrs, nicks, corrosion, or any other condition which could cause a malfunction in service.
B. Inspect all threaded parts for crossed or stripped threads.
C. Check all plated parts for deterioration.
D. Check helical spring [4] for distortion, length, and rate.
(1) Roll spring on flat surface; there must be no wobble.
(2) Free length should be .360/.390 inch.
(3) With spring deflected to solid height, reaction force should be approximately 4.2 pounds.
E. Using an ohmmeter or other suitable device, check electrical circuitry of electrical assembly [13].
(1) With electrical assembly [13] in the deactuated position there must be a closed circuit between receptacle pins A and B, also an open circuit between pins A and C.

(2) Actuate electrical assembly [13] by applying slight pressure to actuating plunger of assembly.
(3) With electrical assembly [13] actuated there must be a closed circuit between receptacle pins A and C; also an open circuit between pins A and B.

F. Test dielectric strength of electrical assembly [13].
(1) With output limited to 18 milliamperes, apply 1000 volts RMS 60 cycles between each receptacle pin and the receptacle shell for a period not to exceed one minute.

CAUTION: THE OUTPUT CURRENT MUST BE LIMITED DURING THIS TEST AS A PRECAUTIONARY MEASURE IN ORDER TO PREVENT PERMANENT DAMAGE TO THE ASSEMBLY.

(2) There must be no arcing.
(3) Maximum permissible leakage is 2 milliamperes.

G. Inspect nameplate [14] for legibility and security of attachment to body [11].

5. REPAIR (See Figure 4)

A. Adjustment screw [3] and electrical assembly [13] contain nylon locking inserts. If required, these inserts should be removed and replaced with new nylon pellets of appropriate size.
B. Remove any minor nicks, corrosion, or burrs from aluminum parts with an aluminum oxide abrasive cloth per Federal Specification P-C-451.
C. Remove defects from stainless steel parts using crocus cloth per Federal Specification P-C-458, grade 600 or finer.
D. Repair minor thread damage by carefully chasing threads with an appropriate tap or die.
E. Replace any parts on which the plating has deteriorated.
F. Replace all parts that cannot be made serviceable by steps 5.A. thru 5.D.

6. ASSEMBLY (See Figures 1 thru 4)

A. Apply a thin film of lubricant to O-rings [6 and 12].

NOTE: Recommended lubricant is FS1281 manufactured by Dow Corning Corp., Midland, Michigan (V71984).

B. Using a 66-5 tool, thread adjustment screw [3] into port cap [2]. Thread as far as possible; then back off 1/4 turn.
C. Install helical spring [4], adjustment shoe [5], O-ring [6], and diaphragm [7] into port cap [2].
D. Install register ring [10], disc spring [9], and pressure plate [8] into body [11].
E. Using 66-1 and 66-56 tools, assemble body [11] to port cap [2]. Tighten to 15 foot pounds torque.

CAUTION: DO NOT EXCEED 15 FOOT POUNDS TORQUE.

F. Install and synchronize electrical assembly [13].
(1) Place O-ring [12] around electrical assembly [13].
(2) Connect the partially assembled unit to a test setup such as shown in Figure 2.
(3) Increase test pressure to actuate disc spring [9] and hold pressure.
(4) Using a 66-4 tool, thread electrical assembly [13] into body [11] until assembly actuates.

CAUTION: INTERNAL DAMAGE TO ELECTRICAL ASSEMBLY [13] CAN RESULT IF IT IS THREADED TOO FAR.

(5) Reduce test pressure to zero.
(6) Thread electrical assembly [13] an additional 1/6 turn (60°) into body [11].

NOTE: Electrical assembly [13] is now synchronized and should not be rotated again.

G. After unit has been tested and adjusted per paragraph 8, lockwire electrical assembly [13] and port cap [2] to body [11]. Use wire per MS20995C32 or MS20995F32 installed per MS33540.

7. FITS AND CLEARANCES (Not Applicable)

8. TESTING (See Figures 1 thru 4)

A. Connect the completely assembled unit between the valves of a test setup such as shown in Figure 2. The inlet manifold should be connected to a source of clean, dry, compressed air which delivers at least 262 PSIG.
B. Test unit for leakage by slowly applying 262 PSIG to pressure port. Shut off inlet valve and maintain a static pressure head for one minute. If leakage occurs, refer to paragraph 9, TROUBLE SHOOTING.

CAUTION: DO NOT EXCEED MAXIMUM INLET PRESSURE OF 262 PSIG.

C. Test unit operating limits.
(1) With test lamp circuit connected to receptacle, slowly increase test pressure to pressure port until the circuit between receptacle pins A and B opens (A-C closes). Note the exact gage reading the instant this occurs.
(2) Slowly decrease the test pressure until the circuit between receptacle pins A and B closes (A-C opens). Note the exact gage reading the instant this occurs.
(3) If required, adjust unit operation to conform with data given in Table II. Using a 66-5 tool, rotate adjustment screw [3] in small increments and repeat steps 8.C.(1) and 8.C.(2). To increase pressure settings, rotate adjustment screw [3] counterclockwise; to decrease settings, turn clockwise.

D. Test dielectric strength of electrical assembly [13].
(1) With output limited to 18 milliamperes, apply 1000 volts RMS 60 cycles between each receptacle pin and the receptacle shell for a period not to exceed one minute.

CAUTION: THE OUTPUT CURRENT MUST BE LIMITED DURING THIS TEST AS A PRECAUTIONARY MEASURE IN ORDER TO PREVENT PERMANENT DAMAGE TO THE ASSEMBLY.

(2) There must be no arcing.
(3) Maximum permissible leakage is 2 milliamperes.

TABLE II UNIT OPERATING CHARACTERISTICS

MODEL	TEST PRESSURE	PRESSURE PSIG	CIRCUIT	
			A-B	A-C
1G198	Increasing	At 20 ±2	Opens	Closes
	Decreasing	At 15 ±2	Closes	Opens
1G198-2	Increasing	At 17 ±1	Opens	Closes
	Decreasing	At 14 ±1	Closes	Opens
1G198-3	Increasing	At 1.5 ±.5	Opens	Closes
	Decreasing	At .5 ±.5	Closes	Opens

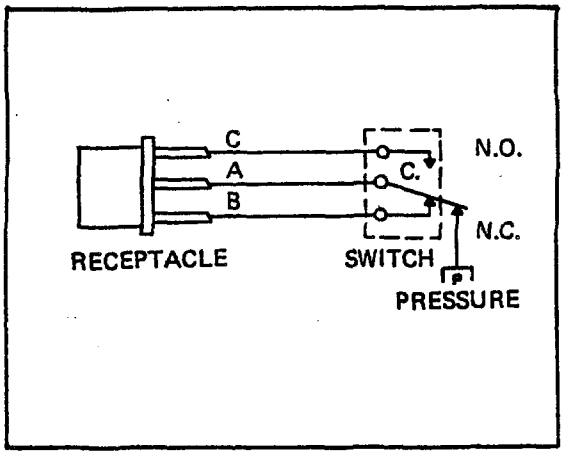


FIGURE 1 ELECTRICAL SCHEMATIC

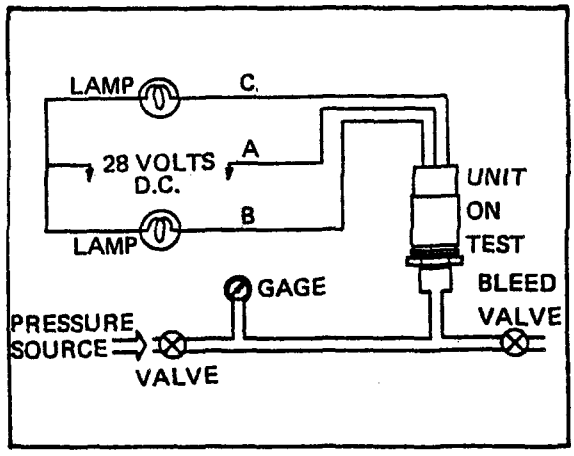


FIGURE 2 SUGGESTED TEST SETUP

9. TROUBLE SHOOTING (See Figure 4)

TABLE III

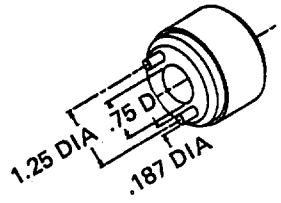
TROUBLE	PROBABLE CAUSE	REMEDY
Leakage	Defective O-ring [6]	Replace O-ring [6].
	Ruptured diaphragm [7]	Replace diaphragm [7].
Unit fails to operate or operate within pressure limits	Defective electrical assembly [13]	Check per paragraphs 4.E. and 4.F. If defective, replace electrical assembly [13].
	Defective disc spring [9]	Replace disc spring [9].
	Improper adjustment screw [3] setting	Readjust adjustment screw [3] per paragraph 8.C.
	Incorrect synchronization of electrical assembly [13]	Resynchronize electrical assembly [13] per paragraph 6.F.

10. STORAGE INSTRUCTIONS

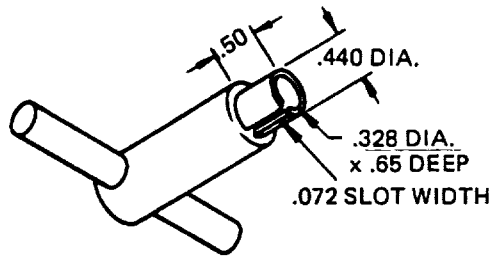
Cap pressure port and electrical receptacle with closures per MIL-C-5501. Place unit in a suitable plastic bag and/or corrugated cardboard container.

11. SPECIAL TOOLS (See Figure 3)

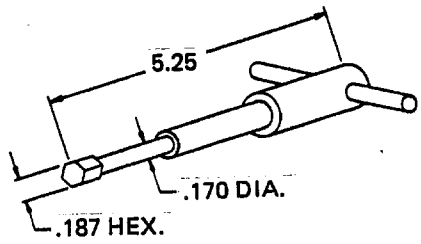
Tools similar to those shown in Figure 3 will aid in the assembly, disassembly, and adjustment of the unit. These tools may be made in the average machine shop, or they may be procured from Custom Aviation Supply under part numbers 66-1, 66-4, 66-5, and 66-56.



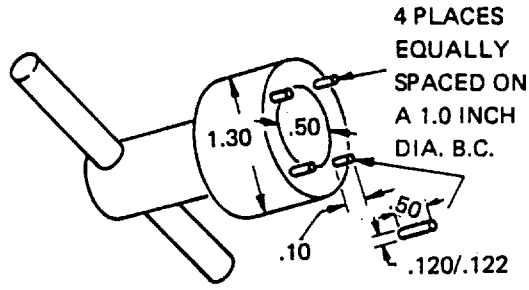
66-1 PORT CAP TOOL



66-4 ELECTRICAL ASSEMBLY TOOL



66-5 ADJUSTMENT SCREW TOOL



66-56 BODY ASSEMBLY TOOL

FIGURE 3 TOOLS

GAGE PRESSURE SWITCH 1G198, -2, -3 OVERHAUL MANUAL

12. ILLUSTRATED PARTS LIST

A. The illustrated parts list provides identification and spare parts ordering information. Order parts by part number and nomenclature.

B. Supplier codes in the parts list nomenclature column are obtained from the Federal Cataloging Handbook H4-1. Table V cross-references these codes with the manufacturer's name and location.

TABLE V

CODE	MANUFACTURER
V83259	Parker Seal Company Culver City, California

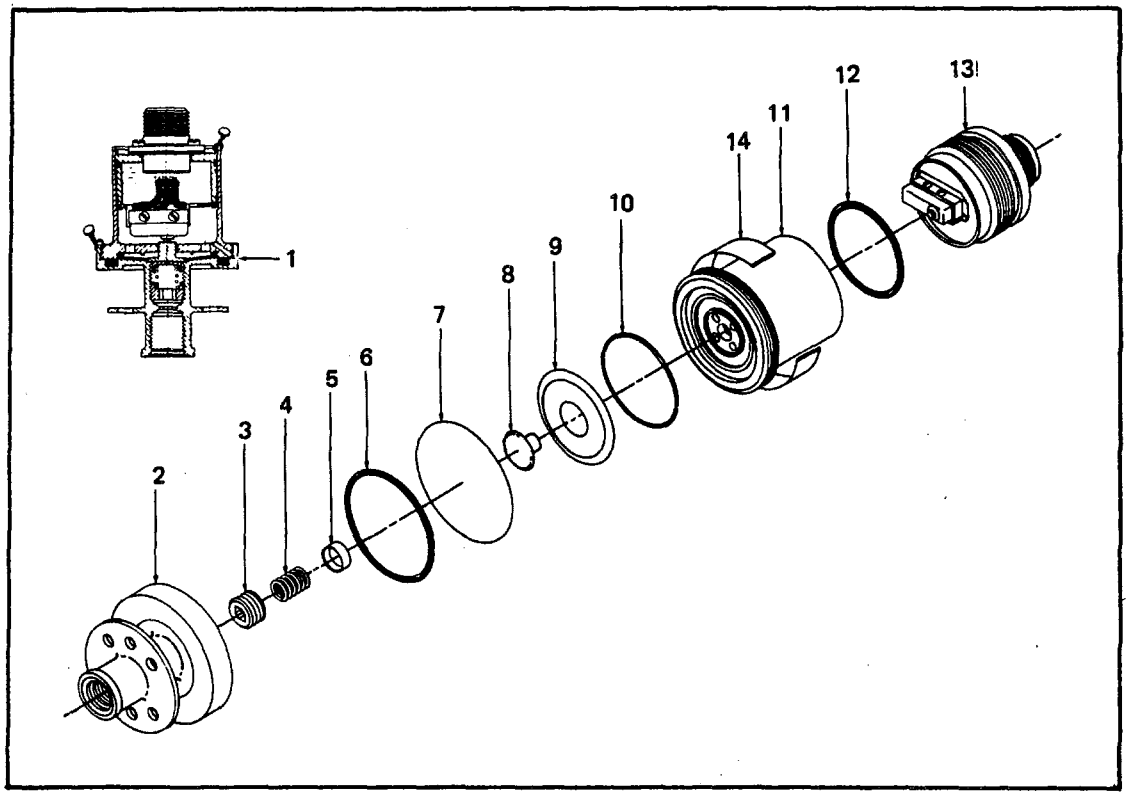


FIGURE 4 EXPLODED VIEW - GAGE PRESSURE SWITCH 1G198, -2, -3

GAGE PRESSURE SWITCH 1G198, -2, -3 OVERHAUL MANUAL

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM TO	UNITS PER ASSY
4 1	1G198-*	SWITCH-GAGE PRESSURE		RF
2	14-289	. Cap-Port		1
3	29-20	. Screw-Adjustment		1
4	1-1	. Spring-Helical		1
5	30-1	. Shoe-Adjustment		1
6	ARP568-220	. Packing, O-ring Comp. S604-7 V83259 CCS P/N 80-220-2		1
7	31-129	. Diaphragm		1
8	32-21	. Plate-Pressure		1
9		. Spring-Disc		1
	2-116-4-198	1G198		
	2-116-4-198-2	1G198-2		
	2-112-4-198-3	1G198-3		
10		. Ring-Register		1
	54-9	1G198, -2		
	54-104	1G198-3		
11		. Body		1
	12-166	1G198, -2		
	12-8-1	1G198-3		
12	ARP568-026	. Packing, O-ring Comp. S604-7 V83259 CCS P/N 80-026-2		1
13	46-27-2	. Assembly-Electrical		1
14		. Nameplate		1
	10-1G198-11	1G198		
	10-1G198-2-11	1G198-2		
	10-1G198-3-11	1G198-3		

CUSTOM COMPONENT SWITCHES, INC.
21111 PLUMMER ST. CHATSWORTH, CALIF.

VACUUM PRESSURE SWITCH 32V29 OVERHAUL MANUAL

DeHavilland P/N DHC SC 70036-1

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CUSTOM COMPONENT SWITCHES, INC.
21111 PLUMMER ST. CHATSWORTH, CALIF.

VACUUM PRESSURE SWITCH 32V29 OVERHAUL MANUAL

1. DESCRIPTION AND OPERATION

Model 32V29 is a pressure actuated switch designed to sense pressures below ambient pressure. Varying pressures are applied to opposite sides of a diaphragm. The resultant force, created by the difference between vacuum and ambient pressure on the diaphragm, is conveyed to a negative rate disc spring by a pressure plate. When the pressure difference increases to a preset actuation point, the disc spring snaps over center allowing the pressure plate to move the switch actuator assembly which actuates the electrical switching element. When the pressure difference decreases to a preset value below the actuation point, the disc spring snaps back to its original position returning the pressure plate, switch actuation assembly, and electrical switching element to their original positions.

This model is used on DeHavilland DHC-6 Twin Otter aircraft to provide warning of low suction for vacuum driven instruments.

TABLE I. LEADING PARTICULARS

Service Medium	Air
Actuation Points:	
Increasing Vacuum	By 4.7 inches Hg
Decreasing Vacuum	By 4.2 inches Hg
Proof Vacuum	10 inches Hg
Ambient Temperature Range	-65°F to +160°F
Pressure Connection	Per AND10050-4 7/16-20 UNF-3B THD
Electrical Data:	
Switching Element	SPDT hermetically sealed
Current	4 amps resistive at 28 VDC
Receptacle	Per MS33678-10SL-3P mates with MS3106-10SL-3S
Mounting Provisions	Two .195/.200 inch dia. holes on 3.00 inch centers
Overall Dimensions:	
Height	3.75 inches
Width	3.52 inches
Depth	3.12 inches
Weight	15 ounces

2. DISASSEMBLY (See Figure 3)

A. Cut and remove lockwire from screws [2 and 4], vent plug [13], lock [9], and port cap [14].

NOTE: To facilitate reassembly, observe method used to lockwire switch. Use same method to replace lockwire during final assembly.

B. Remove screws [2 and 4] and nuts [5] from port cap [14] and mounting bracket [3]. Detach mounting bracket [3] and upper half of unit from port cap [14].
C. Remove diaphragm [7], O-ring [6], adjustment shoe [15], helical spring [12], and lock [9] from port cap [14].
D. Using a 3/16 inch Allen wrench, remove adjustment screw [10] from port cap [14]. Remove O-ring [11] from adjustment screw [10].
E. Remove O-rings [6 and 16] and tube [17] from body assembly [23]. Carefully disengage lower arm of switch actuator assembly from undercut at top of pressure plate assembly [8]. Remove pressure plate assembly [8] and disc spring [22] from body assembly [23].

NOTE: It is recommended that O-rings [6, 11, and 16] and diaphragm [7] be replaced at each overhaul.

F. Do not disassemble unit further unless repair or replacement of a component is indicated by INSPECTION/CHECK, paragraph 4, or TROUBLE SHOOTING, paragraph 9. If disassembly is required, continue with steps 2.G. thru 2.I.
G. Unsolder and separate case [25] from body assembly [23]. Unsolder and remove screw [27] and safety wire eyelet [26]. Unsolder leads between switch [18] and receptacle [21].
H. If receptacle [21] requires replacement, unsolder and remove from case [25].
I. If switch [18] requires replacement, carefully break the epoxy bonds between screws [19], nuts [24], switch [18], and switch holder on body assembly [23]. Remove screws [19] and nuts [24] holding switch [18] to switch holder.

3. CLEANING

A. Clean all metal parts with dry cleaning solvent per Federal Specification P-D-680, Type 1, or equivalent; use a stiff bristle brush and/or a clean, lint-free cloth.

WARNING: AVOID SOLVENT CONTACT WITH SKIN AND AVOID BREATHING SOLVENT VAPORS. OBSERVE FIRE PRECAUTIONS.

B. Dry parts thoroughly with moisture free compressed air, or allow to air dry.

4. INSPECTION/CHECK (See Figures 1, 2, and 3)

A. Inspect all machined surfaces for cracks, nicks, burrs, corrosion, or any other condition which could cause a malfunction in service.
B. Inspect all threaded parts for crossed or stripped threads.
C. Check all plated parts for deterioration.

D. Check helical spring [12] for distortion, length, and rate.
(1) Roll spring on flat surface; there must be no wobble.
(2) Free length should be .485/.515 inches.
(3) With spring deflected to solid height, reaction force should be 5.5 pounds.

E. Using an ohmmeter or other suitable device, check switch [18] and/or electrical circuitry.
(1) With switch [18] in the deactuated position, there must be a closed circuit between "NC" and "C" terminals (circuit A-B), and an open circuit between "NO" and "C" terminals (circuit B-C).
(2) Gradually depress actuating plunger of switch [18] until it actuates.

CAUTION: INTERNAL DAMAGE TO SWITCH [18] CAN RESULT IF ACTUATING PLUNGER IS DEPRESSED TOO FAR.

(3) With switch [18] actuated, there must be a closed circuit between "NO" and "C" terminals (circuit B-C) and an open circuit between "NC" and "C" terminals (circuit A-B).

F. Test dielectric strength of receptacle [21].
(1) With current limited to 18 milliamperes, apply 1000 volts RMS 60 cycles between receptacle pins and receptacle shell for a period not to exceed one minute.

CAUTION: OUTPUT CURRENT MUST BE LIMITED TO PREVENT PERMANENT DAMAGE TO PART.

(2) There must be no arcing.
(3) Maximum permissible leakage is 2 milliamperes.

5. REPAIR (See Figure 3)

A. Adjustment screw [10] contains a nylon locking insert. If required, this insert should be removed and replaced with a new nylon pellet of equal size.
B. Remove any minor nicks, corrosion, or burrs from aluminum parts with aluminum oxide abrasive cloth per Federal Specification P-C-451.
C. Remove defects from stainless steel parts using crocus cloth per Federal Specification P-C-458, grade 600 or finer.
D. Repair minor thread damage by carefully chasing threads with an appropriate tap or die.
E. Replace any parts on which the plating has deteriorated.
F. Replace all parts that cannot be made serviceable by steps 5.A. thru 5.D.

6. ASSEMBLY (See Figures 1, 2, and 3)

A. If switch was completely disassembled continue with step 6.B., otherwise skip to step 6.Q.

B. Solder leads to receptacle [21]. Use 95% Sn/5% Sb solder and wire per specification MIL-W-16878, Type E, size 20.

C. If receptacle was removed, insert leads through hole in case [25]. Solder switch [18] to leads using Figure 1 as reference for circuitry. Use 60% Sn/40% Pb solder.

D. Check dielectric strength and circuitry using steps 4.E. and 4.F.

E. Mount switch [18] to switch holder on body assembly [23] using screws [19] and nuts [24].

NOTE: Screws [19] should be snug, not tight, in order to facilitate final positioning of switch [18].

F. Apply lubricant (See Table II, Item 1) to O-rings [6, 11, and 16].

G. Install tube [17], O-rings [6 and 16], disc spring [22] and pressure plate assembly [8] in body assembly [23].

NOTE: Make certain that lower arm of switch actuator assembly is registered in undercut at top of pressure plate.

H. Install O-ring [6] and diaphragm [7] in port cap [14].

I. Assemble port cap [14] and mounting bracket [3] to body assembly [23] using screws [2 and 4] and nuts [5].

J. Install O-ring [11] on adjustment screw [10]. Using a 3/16 inch Allen wrench, thread adjustment screw [10] into port cap [14] far enough to provide a pressure seal.

K. Mount the partially assembled unit in a test setup such as shown in Figure 2 and adjust switch [18] actuation.

(1) Slowly apply sufficient negative pressure to actuate disc spring [22] and hold.

(2) With disc spring [22] maintained in the actuated position, move switch [18] toward actuator arm until switch [18] actuates, as indicated by test light circuit. Advance switch [18] an additional .004-.008 inch toward actuator arm. Tighten mounting screws [19] being careful that switch [18] does not move.

CAUTION: INTERNAL DAMAGE TO SWITCH [18] CAN RESULT IF THE .008 INCH OVERTRAVEL LIMIT IS EXCEEDED.

(3) If switch mounting holes do not provide sufficient movement, carefully bend actuator arm(s) as required.

CAUTION: DO NOT APPLY ANY FORCE TO WOBBLEFRAM (SMALL DIAPHRAGM IN SWITCH ACTUATOR ASSEMBLY) WHILE BENDING ACTUATOR ARM(S).

(4) Increase pressure to ambient and remove unit from test setup.

L. Use epoxy (See Table II, Item 2) to bond switch [18] and nuts [24] to switch holder, and heads of screws [19] to switch [18]. Cure epoxy per manufacturer's instructions.

M. Remove screws [2 and 4]. Detach upper half of unit from port cap [14]. Remove diaphragm [7], O-rings [6 and 16], tube [17], pressure plate assembly [8], and disc spring [22] from port cap [14].

N. If receptacle [21] was removed, solder it to case [25] using 60% Sn/40% Pb solder.

O. Solder case [25] to body assembly [23] using 60% Sn/40% Pb solder.

P. Before installing screw [27] and safety wire eyelet [26], place switch housing unit in an oven and bake at 250°F for 30 minutes to remove all moisture. To prevent contamination install safety wire eyelet [26] and screw [27] immediately after unit cools to handling temperature. Solder screw [27] and safety wire eyelet [26] to case [25]. Use 60% Sn/40% Pb solder to hermetically seal unit.

Q. Install disc spring [22], pressure plate assembly [8], tube [17], and O-rings [6 and 16] in body assembly [23].

NOTE: Make certain that lower arm of switch actuator assembly is registered in undercut at top of pressure plate assembly [8].

R. Install adjustment shoe [15], O-ring [6], and diaphragm [7] into port cap [14].

S. Using screws [2 and 4] and nuts [5], secure mounting bracket [3] and port cap [14] to body assembly [23]. Tighten screws [2 and 4] to 22-24 inch pounds torque.

CAUTION: DO NOT EXCEED 24 INCH POUNDS TORQUE.

T. Install helical spring [12] into port cap [14].

U. Using a 3/16 inch Allen wrench, thread adjustment screw [10], with O-ring [11] on it, into port cap [14].

V. After unit has been tested and adjusted per paragraph 8, install vent plug [13] into pressure port marked "VENT".

TABLE II RECOMMENDED MATERIALS

ITEM	DESCRIPTION	MANUFACTURER
1	G624 Compound Lubricant	General Electric Co. Waterford, N.Y. (V01139)
2	Stycast 2651 & Catalyst 9 Epoxy	Emerson & Cuming, Inc. Canton, Mass. (V04552)

W. Install lock [9] into adjustment screw [10] and lockwire lock [9] to port cap [14]. Lockwire vent plug [13] to heads of a pair of screws [4]. Also lockwire screws [2 and 4] in groups of two. Use lockwire per MS20995C32.

7. FITS AND CLEARANCES (Not applicable)

8. TESTING (See Figures 1, 2, and 3)

A. Connect the completely assembled unit between the valves of a test setup such as shown in Figure 2. The "VAC" pressure port should be connected to a negative pressure source which delivers at least 10 inches mercury vacuum.

B. Test unit for leakage by applying 10 inches mercury vacuum to pressure port marked "VAC". Shut off inlet valve and maintain a static pressure head for one minute. If leakage occurs, refer to paragraph 9, TROUBLE SHOOTING.

CAUTION: DO NOT EXCEED MAXIMUM INLET VACUUM OF 10 INCHES MERCURY.

C. Test unit operating limits.
(1) With test light circuit connected to receptacle [21], slowly increase vacuum to "VAC" port until circuit connected between receptacle pins B and C closes (A-B opens). Note the exact gage reading the instant this occurs.
(2) Reduce vacuum slowly until circuit connected between receptacle pins A and B closes (B-C opens). Note the exact gage reading the instant this occurs. Reduce vacuum to ambient.
(3) If required, adjust switch operation to conform with the data given in Table III by rotating adjustment screw [10] in small increments and repeating steps 8.C.(1) and 8.C.(2). To increase pressure settings, turn adjustment screw counterclockwise; to decrease settings, turn clockwise.

D. Test dielectric strength of receptacle [21] per paragraph 4.F.

TABLE III SWITCH OPERATING CHARACTERISTICS

TEST VACUUM	VACUUM INCHES OF MERCURY	CIRCUIT	
		A-B	B-C
Increasing	By 4.7	Opens	Closes
Decreasing	By 4.2	Closes	Opens

VACUUM PRESSURE SWITCH 32V29 OVERHAUL MANUAL

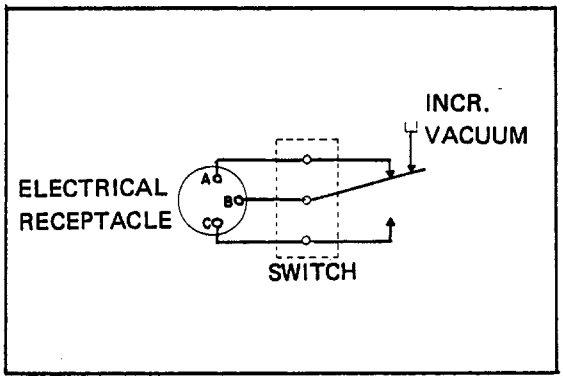


FIGURE 1 ELECTRICAL SCHEMATIC

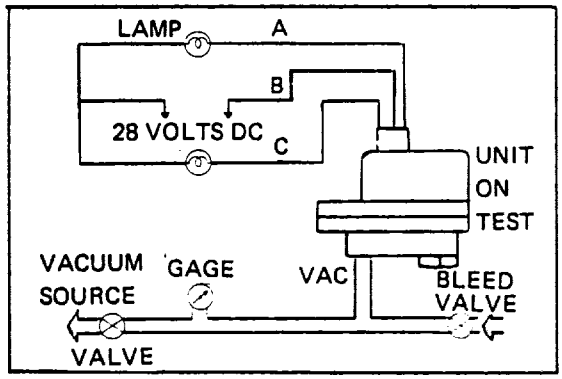


FIGURE 2 SUGGESTED TEST SETUP

9. TROUBLE SHOOTING (See Figure 3)

TABLE IV

TROUBLE	PROBABLE CAUSE	REMEDY
Leakage	Loose screws [2 and 4]	Tighten screws [2 and 4] per paragraph 6.S.
	Defective O-ring(s) [6, 11, and/or 16]	Replace defective O-ring(s).
	Defective diaphragm [7].	Replace diaphragm [7].
	Defective body assembly [23]	Replace body assembly [23].
Switch fails operate or operate within pressure limits	Defective electrical circuitry	Check circuitry per paragraphs 4.E. and 4.F. Replace or repair defective component.
	Improper adjustment screw [10] setting	Readjust adjustment screw [10] per paragraph 8.C.
	Defective diaphragm [7]	Replace diaphragm [7].
	Incorrect synchronization of switch [18]	Resynchronize switch [18] per para. 6.K.
	Defective disc spring [22]	Replace disc spring [22].

10. STORAGE INSTRUCTIONS

Cap pressure port and electrical receptacle with closures per MIL-C-5501. Place switch in a suitable plastic bag and/or corrugated cardboard container.

11. SPECIAL TOOLS

No special tools are required.

12. ILLUSTRATED PARTS LIST

A. The Illustrated Parts List provides identification and spare parts ordering information. Order parts by part number and nomenclature.
B. Supplier codes in the parts list nomenclature column are obtained from the Federal Cataloging Handbook H4-1. Table V cross-references these codes with the manufacturer's name and location.

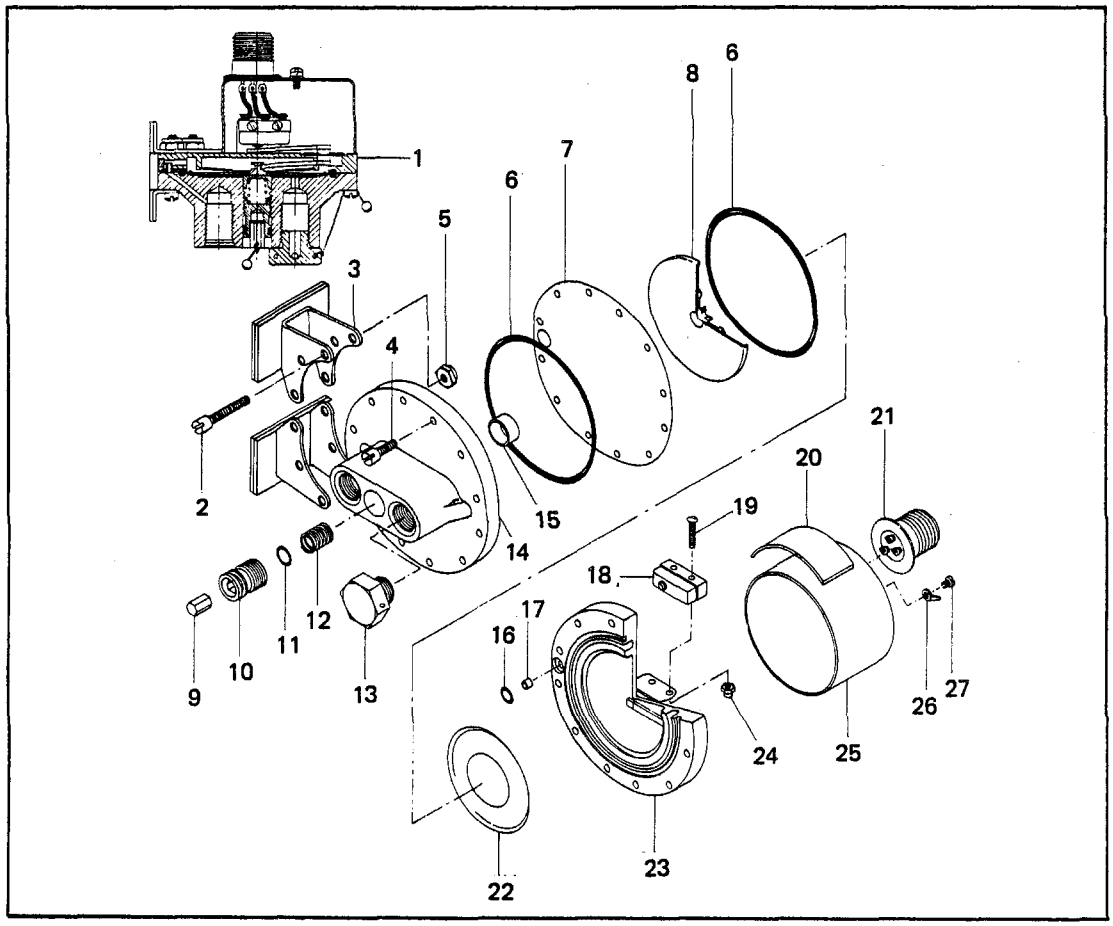


FIGURE 3 VACUUM PRESSURE SWITCH - MODEL 32V29 EXPLODED VIEW

VACUUM PRESSURE SWITCH 32V29 OVERHAUL MANUAL

TABLE V

CODE	MANUFACTURER
V56878	Standard Pressed Steel Company Jenkintown, Pennsylvania
V83259	Parker Seal Co., Culver City, Calif.
V91929	Minneapolis-Honeywell Regulator Co. Micro-Switch Div., Freeport, Illinois

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT FROM TO	UNITS PER ASSY
4 1	32V29	SWITCH-VACUUM PRESSURE		RF
2	AN503-6-14	. Screw, CCS P/N 56-44		6
3	36-98	. Bracket-Mounting		1
4	56-26	. Screw		6
5	MS20365-632C	. Nut, CCS P/N 47-54		6
6	2-35	. Packing, O-ring Comp. S604-7, V83259 CCS P/N 80-035-2		2
7	31-108	. Diaphragm		1
8	32-68	. Assy-Pressure Plate		1
9	50-5	. Lock		1
10	29-17	. Screw-Adjustment		1
11	2-11	. Packing, O-ring Comp. S604-7, V83259 CCS P/N 80-011-2		1
12	1-38	. Spring-Helical		1
13	28-26	. Plug-Vent		1
14	14-141	. Cap-Port		1
15	30-3	. Shoe-Adjustment		1
16	2-5	. Packing, O-ring Comp. S604-7, V83259 CCS P/N 80-005-2		1
17	53-20	. Tube		1
18	22SM22T	. Switch, V91929 CCS P/N 79-1		1
19	AN515-2-8	. Screw, CCS P/N 56-34		2
20	10-32V29-2	. Nameplate		1
21	MS33678-10SL-3P	. Receptacle CCS P/N 74-22		1
22	2-3212-2-29	. Spring-Disc		1
23	17-158	. Assembly- Body		1
24	21FA-256	. Nut, V56878 CCS P/N 47-3		2
25	16-94	. Case		1
26	59-1	. Eyelet-Safety Wire		1
27	MS24649-10	. Screw, CCS P/N 56-21		1

GENERAL CONNECTORS CORPORATION

Peri-Seal Flexible Pneumatic Duct Connectors & Bulkhead Seals

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HOW TO ORDER

Peri-Seal products are available for immediate shipment from stock direct from the General Connectors Corporation factory, 233 W. Orange Grove Avenue (P. O. Box 575), Burbank, California, U.S.A. Phone: Area Code 213-842-7151; Cable address: Genaero, Burbank, California, U.S.A.

GENERAL CONNECTORS CORPORATION

Peri-Seal Flexible Pneumatic Duct Connectors & Bulkhead Seals

GENERAL DESCRIPTION

1. The Peri-Seal Connector, designed and built by General Connectors Corporation, is a flexible, 95% metallic duct connector, approved for use in pneumatic/air conditioning/ice protection systems of the Douglas DC-8, DC-9, Boeing 727 and other aircraft. The major design consideration was safety. The Peri-Seal was also designed to create a simple device to replace bellows type duct connectors which eliminated the possibility of a catastrophic failure. These assemblies may be easily serviced at the user's facility.

2. Peri-Seal sealing elements are interchangeable for use on any aircraft equipped with the connector or bulkhead seal where nominal duct sizes are similar.

3. These connectors are designed to withstand dynamic movement under all operating conditions. They are used to compensate for misalignment and to absorb contraction and expansion due to heating, cooling and system vibration.

4. The Peri-Seal Connector assembly for the DC-8, 727 and 707 is joined to the aircraft duct system by means of stainless steel end flanges welded to sleeves on which the seal is accomplished. End flanges are of several types as required to mate to the aircraft ducting. In the DC-9 version of the Peri-Seal connector, sealing is accomplished directly on the aircraft duct ends.

5. The Peri-Seal Connector consists of two fiberglass reinforced silicone rubber sealing elements (Peri-Seals) retained in a stainless steel housing. A flared center section housing permits deflection of either the duct or housing body. This unique construction, mostly of metal, is not subject to the degree of failure and damage of bellows type connectors. The Peri-Seals are symmetric and interchangeable. Expansion and contraction of the connector is accomplished by sliding of sleeves or ducting within the inside periphery of the Peri-Seals.

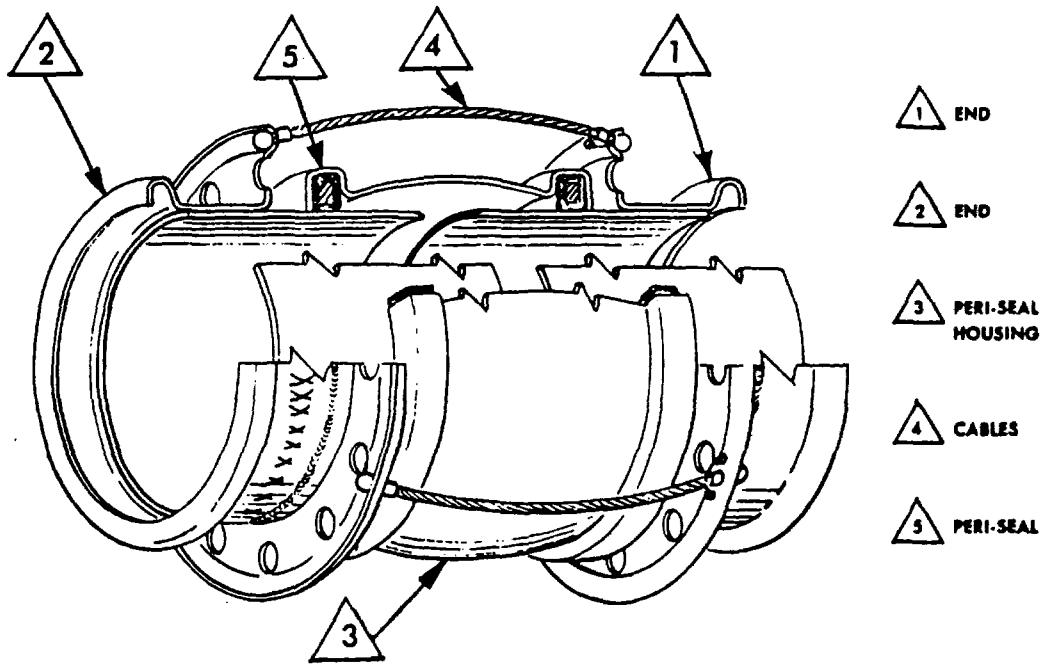
6. Part identification is electro-etched on the outer surface of the housing and includes the General Connector trademark, part number and the applicable airframe manufacturer's part number.

7. Peri-Seals are lubricated prior to assembly and packaged in individual plastic envelopes. Further lubrication prior to installation is not required. Lubrication should not be removed prior to installation.

8. Assemblies and Peri-Seals should be stored in a clean, dry area in their individual plastic wrappings. When so stored, they have an indefinite shelf life.

DC-8 Peri-Seal Connectors
Pneumatic, Air Conditioning & Ice Protection System Flexible Connectors

Douglas Part No. 7594294 and 7645446
General Connectors Corporation Part No. 26A423



ASSEMBLY & COMPONENTS PARTS LIST

GCC Assembly Number	Aircraft Mfg. Drawing No.	1 END	2 END	3 Peri-Seal Housing	4 Cables	5 Peri-Seal
26A423-1	7594294-1	26A424-11	26A424-11	26A428-11	26A429-11	26A430-11
26A423-501	7594294-501	26A424-13	26A424-15	26A428-13	26A429-11	26A430-13
26A423-503	7594294-503	26A424-17	26A424-17	26A428-15	26A429-13	26A430-15
26A423-505	7594294-505	26A424-19	26A424-19	26A428-17	26A429-13	26A430-17
26A423-507	7594294-507	26A424-21	26A424-23	26A428-19	26A429-13	26A430-19
26A423-509	7594294-509	26A424-23	26A424-23	26A428-19	26A429-13	26A430-19
26A423-511	7594294-511	26A424-25	26A424-25	26A428-21	26A429-17	26A430-21
26A423-513	7594294-513	26A424-27	26A424-27	26A428-23	26A429-19	26A430-23
26A423-519	7594294-519	26A425	26A424-19	26A428-17	26A429-13	26A430-17
26A423-525	7594294-525	26A427	26A424-29	26A428-25	26A429-17	26A430-25
26A423-529	7594294-529	26A424-15	26A424-15	26A428-13	26A429-11	26A430-13
26A423-511	7594294-535	26A424-25	26A424-25	26A428-21	26A429-17	26A430-21
26A423-537	7594294-537	26A424-31	26A424-31	26A428-27	26A429-23	26A430-19
26A423-513	7594294-539	26A424-27	26A424-27	26A428-23	26A429-19	26A430-23
26A423-500	7645446	26A424-33	26A424-33	26A428-21	26A429-17	26A430-21
26A423-541	7594294-541	26A424-21	26A424-21	26A428-19	26A429-13	26A430-19
26A423-543	7645446-501	26A424-35	26A424-35	26A428-21	26A429-17	26A430-21

DC-8 PERI-SEAL SPECIFICATION TABLE

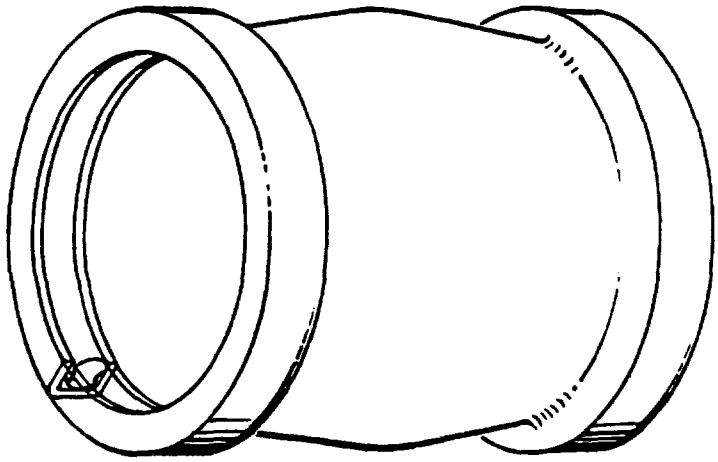
GENERAL CONNECTORS CORPORATION

DC-8 PERI-SEAL CONNECTOR SPECIFICATION TABLE

PART NO.	NOMINAL I.D. IN INCHES	WEIGHT POUNDS	INSTALLED LENGTH IN INCHES	MOVEMENT FROM INSTALLED LENGTH			PRESSURE DECAY 90 TO 60 PSIG MUST TAKE LONGER THAN (SECONDS)	FLOWMETER LEAKAGE AT 90 PSIG MAX. IN LBS. PER MIN.
				COMPRESSION	ELONGATION	OFFSET		
26A423-	2 1/4	.76	4 1/2	3/16	3/16	1/8	17	.007
-500	5	2.22	5 1/2	9/16	3/16	1/8	52	.015
-501	2 1/2	.90	4 1/2	3/16	3/16	1/8	19	.0075
-503	3	1.11	5 1/2	3/8	1/8	1/8	27	.009
-505	3 1/2	1.36	5 1/2	1/2	1/8	1/8	31	.010
-507	4	1.66	5	1/2	1/8	1/8	32	.012
-509	4	1.72	5	1/2	1/8	1/8	32	.012
-511	5	2.22	6 1/2	1/2	3/16	1/8	52	.015
-513	5 1/2	2.44	6 1/2	1/2	3/16	1/8	57	.016
-519	3 1/2	1.20	5 11/16	1/2	1/8	1/8	31	.010
-525	3 1/2 3 3/4	1.14	5 1/2	1/2	1/8	5/16	37	.0105
-529	2 1/2	.97	4 1/2	3/16	3/16	1/8	19	.0075
-537	4	1.72	7 1/2	3/4	1/4	1/4	50	.012
-541	4	1.30	5	1/2	1/8	1/8	32	.012

PRESSURES: INTERNAL – OPERATING 45 PSIG, PROOF – 90 PSIG, BURST – PSIG

DC-9 PERI-SEAL CONNECTORS
Air Conditioning & Ice Protection Duct Connector
General Connectors Corporation Part No. DC9423



ASSEMBLY & COMPONENT PARTS LIST

ASSEMBLY NO. (HOUSING & SEALS)	NOMINAL I.D. INCHES	LENGTH	HOUSING NO.	PERI-SEAL (2 REQUIRED)
DC9423-100S	1.00	3.12	DC9423-100	26A430-27
-125S	1.25	3.12	-125	-41
-150S	1.50	3.12	-150	-29
-200S	2.00	3.12	-200	-31
-250S	2.50	3.12	-250	-13
-300S	3.00	3.12	-300	-15
-450S	4.50	4.50	-450	-33

GENERAL DESCRIPTION

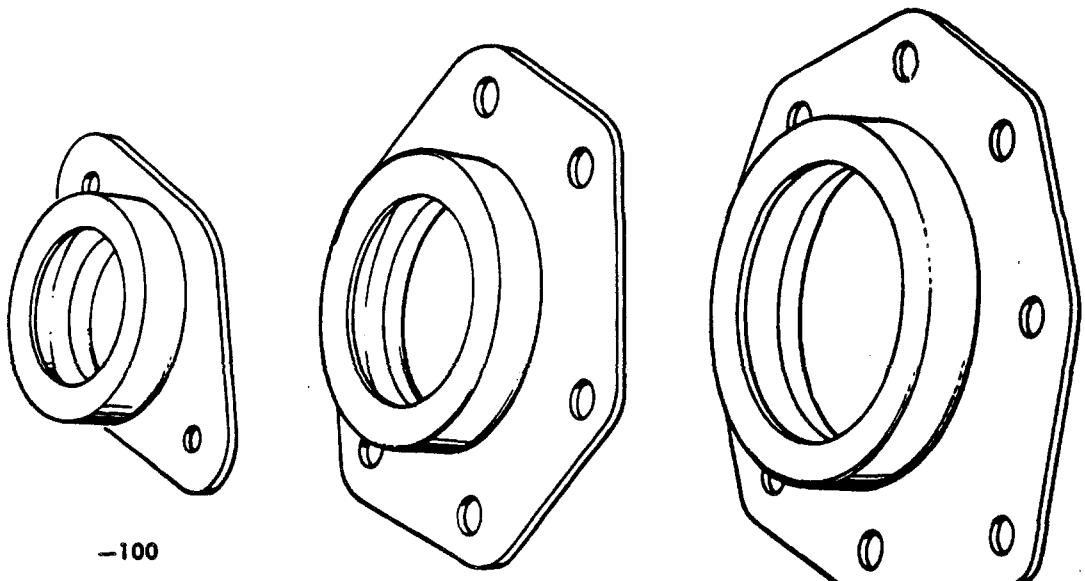
The DC-9 Peri-Seal Connector is a simplified version of the DC-8 design, consisting of a stainless steel housing and two Peri-Seal sealing elements. The assembly is intended to be installed directly on the ducting installed in the aircraft.

Peri-Seals are interchangeable, size for size, for DC-8 Peri-Seals and carry the same part numbers

Overhaul and installation procedure is the same as detailed for the DC-8 Peri-Seal housing.

GENERAL CONNECTORS CORPORATION

Douglas DC-9
Bulkhead Seals – Ice Protection System
General Connectors Corporation Part No. DC9475



–100

–150

–200
–250

ASSEMBLY & COMPONENTS PARTS LIST

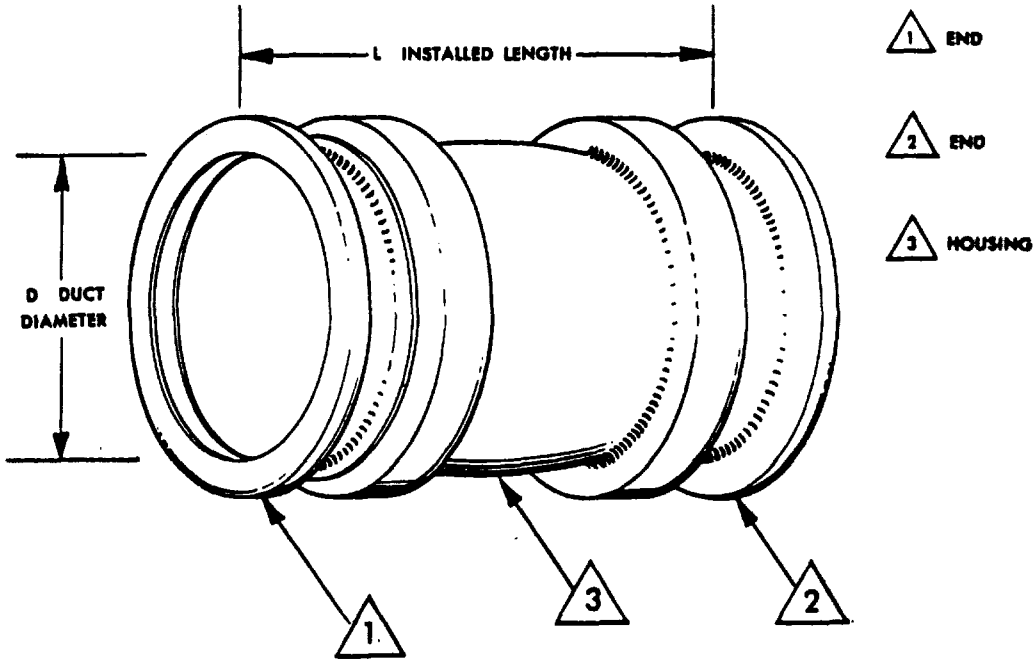
ASSEMBLY NO. (HOUSING & PERI-SEAL)	NOMINAL I.D. INCHES	BULKHEAD SEAL HOUSING NO.	PERI-SEAL PART NO.
DC9475-100S	1"	DC9475-100	26A430-27
DC9475-150S	1½"	DC9475-150	26A430-29
DC9475-200S	2"	DC9475-200	26A430-31
DC9475-250S	2½"	DC9475-250	26A430-13

GENERAL DESCRIPTION

A Bulkhead Seal consists of a stainless steel housing with a flange for attachment to the bulkhead. The housing contains a single Peri-Seal. Sealing is accomplished on the outer surface of the aircraft ducting. Peri-Seals are replaceable by removing the bulkheal seal housing at the adjacent duct joint.

GENERAL CONNECTORS CORPORATION

Boeing 707 and 720 Peri-Seal Connector
Air Conditioning & Anti-Icing System Flexible Connectors
Boeing Part No. 10-3273
General Connectors Part No. 14A424



ASSEMBLY & COMPONENTS PARTS LIST

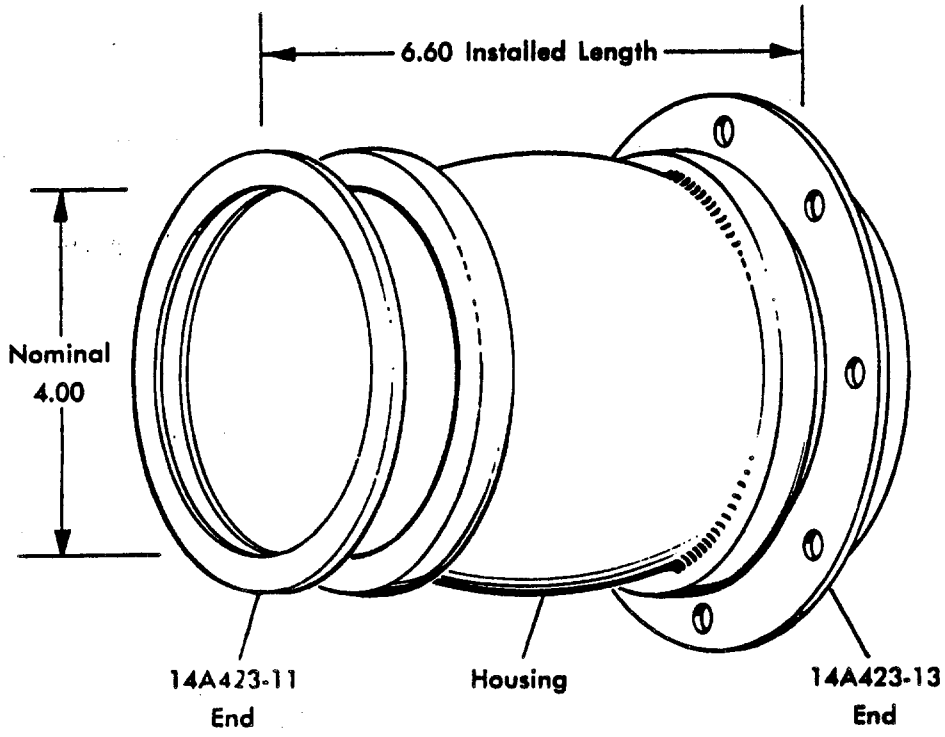
Assembly No.	Aircraft Mfg. Drawing No.	D Inches	L Inches	1	2	3	"Peri-Seal" 2 Req'd.
14A424	10-3273	6.00	5.10	14A425-21	14A425-19	14A426-17	26A430-37
14A424-1	10-3273-1 & 5	5.00	5.10	14A425-17	14A425-15	14A426-15	26A430-21
14A424-6	10-3273-6 & 8	3.00	3.75	14A425-13	14A425-13	14A426-13	26A430-15
14A424-7	10-3273-7	2.75	3.75	14A425-11	14A425-11	14A426-11	26A430-39

NOTE: Flanges are Janitrol (Div. Midlands-Ross) Nos. 29C71 or 43C50, except 14A424-7 only which is per BAC F226-278.

GENERAL DESCRIPTION

This Peri-Seal duct connector consists of two stainless steel tubes with flanged ends and a housing containing two Peri-Seals. Refer to Overhaul Instructions for the correct method of replacing Peri-Seals.

Boeing 727 Peri-Seal Connector
Auxiliary Power Unit Flexible Connector
General Connectors Corporation Part No. 14A423



ASSEMBLY & COMPONENTS PARTS LIST

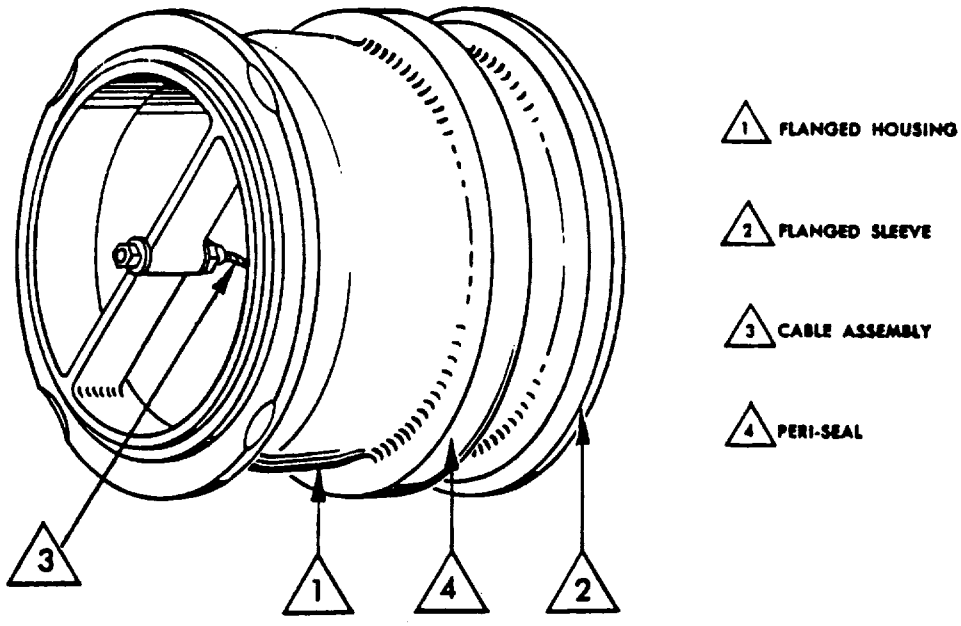
PART NO.	DESCRIPTION
14A423-11	End (with Marman Flange 55342-1-400)
14A423-13	End (with Marman Flange 55342-1-400)
26A430-19	Peri-Seal — two required
26A428-27	Housing
14A423-401	Sub-assembly, consisting of one 14A423-11 End, one 26A428-27 Housing and two 26A430-19 Peri-Seals.
14A423	Assembly, consisting of one each 14A423-11 and 14A423-13 Ends, one 26A428-27 Housing and two 26A430-19 Peri-Seals.

GENERAL DESCRIPTION

The Boeing 727 Peri-Seal Connector is similar to the DC-8 Connector in that it consists of a stainless steel housing and two flanged ends. Peri-Seals are interchangeable, size for size, for use in all other Peri-Seal connectors in service on any type of aircraft.

SUD AVIATION
Caravelle

Peri-Seal Flexible Duct Connector
Sud Part No. 210-74-12: Series
General Connectors Corporation Part No. 12A423 Series



ASSEMBLY & COMPONENT PARTS LIST

Assembly No.	Mfg. Assy. No.	Nominal I.D. "	(1) Flanged Housing	(2) Flanged Sleeve	(3) Cable Assy.	(4) Peri-Seal
12A423-169	210-74-12-169	2.87	12A424-69	12A425-69	12A426-69	26A430-15
12A423-180	210-74-12-180	2.87	12A424-80	12A425-80	12A426-80	26A430-15
12A423-188	210-74-12-188	2.87	12A424-88	12A425-88	12A426-88	26A430-15
12A423-195	210-74-12-195	2.87	12A424-95	12A425-95	12A426-95	26A430-15

GENERAL DESCRIPTION

This Peri-Seal application consists of a single Peri-Seal sealing element in a stainless steel, flanged housing. Sealing is accomplished on the surface of a mating sleeve, similarly flanged. The unit is restrained by an internal cable assembly positioned between a vane in each flanged component.

OVERHAUL INSTRUCTIONS

The overhaul of a "Peri-Seal" Connector is accomplished by replacement of the worn "Peri-Seals". Replacement can be accomplished with ordinary hand tools by semi-skilled personnel.

The "Peri-Seals" are the only components which require periodic maintenance and replacement.

1. *Connector Disassembly into Component Parts*
   a. Cut and remove safety wires on one end only. (DC-8 only.)
   b. Remove the three retaining cables from detent slots. (DC-8 only.)
   c. Carefully extract ends from housing.
   d. Remove "Peri-Seals".
      Note: Exercise care not to damage surface of seal retaining groove.

2. *Cleaning of all components.*
   a. Use toluene or a ketone based solvent.
   b. Wipe all components dry with a non-linting cloth.
      Note: Make sure all foreign matter is removed from seal housing.

3. *Inspection of metal components.*
   Examine metal components for scratches, burrs, or other defects which might interfere with proper operation of the "Peri-Seal" Connector. Examine the flanges per manufacturer's maintenance instructions.

4. *Installation of new "Peri-Seals".*
   a. Remove "Peri-Seals" from plastic envelope. Avoid contamination. "Peri-Seals" are prelubricated and require no further lubrication.
   b. Insert "Peri-Seals" into seal retaining grooves. "Peri-Seals" are identical and symmetrical. No special instructions are required as to position and seating of "Peri-Seals".

5. *Reassembly of Connector.* (All except DC-9)
   a. Place one flange face down on a clean surface (plastic flange cover or other suitable protective material must be used). Center housing over sleeve and push down evenly. Under certain combinations of tolerances, the fit will be tight. By slightly canting the housing and using the fingers inside the housing to depress the seal, assembly is easily accomplished.
   b. Repeat operation (a) on other end.
   c. Rotate ends to align cable keyhole slots with alignment marks on housing. (DC-8 only)

d. Insert retaining cable shank terminal partially through hole in end collar. Position cable terminal in slot with end collar between the ball and shank. (DC-8 only)

e. Insert safety wire through collar holes and twist to lock. Be sure safety wire is installed between cable terminal and collar keyhole. Repeat on all retaining cables. (DC-8 only)

INSTALLATION PROCEDURE

1. *Offset* — Offset should be kept to an absolute minimum per specifications given in individual part description pages.

2. *Torque* — Any torque or twist in the retaining cables on DC-8 "Peri-Seals" will reduce the elongation capabilities of the unit. After the "Peri-Seal" Connector is lightly secured in place, align cables with lines scribed on "Peri-Seal" housing and complete tightening of connector. Torque is not a factor in other versions of the "Peri-Seal" connector.

3. *"Peri-Seal" Condition* — "Peri-Seals should be free from all signs of cuts and abrasion indicating damage to the fiberglass fabric. Avoid contacting the "Peri-Seal" with any sharp tools or instruments while making visual check. "Peri-Seals" are prelubricated. Do not contaminate or remove lubricant from the sealing surfaces.

4. *End Flange Condition* — Inspect flanges per their manufacturers' respective overhaul manuals. CAUTION: Avoid contact with any sharp tools, instruments, or abrasives on the sealing surfaces during installation of duct connectors to assure maximum service life from connector.

5. *Tightening End Flanges* — Cable collars on DC-8 "Peri-Seals" are provided with spanner wrench holes to facilitate torquing of NUCO threaded flanges. CAUTION: Apply the adjustable Spanner Wrench (P/N26A440) from the flange side only.

6. *Installation Guides* — (DC-8 Parts)

   a. Electroetched on the "Peri-Seal" Housing.



   b. Electroetched on Sleeve O.D.



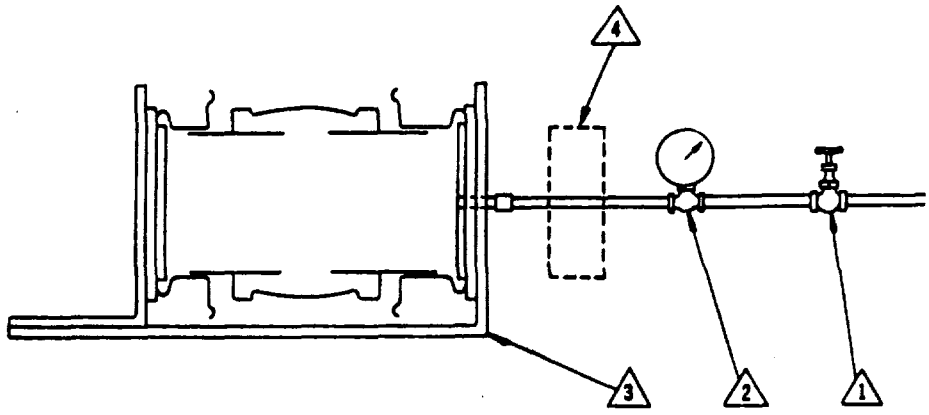
c. Electroetched on "Peri-Seal" Housing.

BEFORE CLAMP ALIGN ▮ IS TIGHTENED CABLE

It is important that these guides be followed to facilitate proper installation and operation of the DC-8 units.

PRESSURE TESTING (DC-8 "Peri-Seals")

Tests for leakage of new connectors or connectors containing new "Peri-Seals" may be performed as listed below. Testing of connectors containing used seals should only be performed at the appropriate system operating temperature as leakage may be above normal if testing is performed with cold air.



(1) PRESSURE REGULATOR 0 TO 100 PSIG

(2) PRESSURE GAGE 0 TO 100 PSIG

(3) TEST FIXTURE

(4) FLOWMETER (Optional test method)

INSTRUCTIONS

1. Install "Peri-Seal" Connector in test fixture as indicated in the Figure. Part must be restrained at the installed length.
2. Set pressure regulator above 90 PSIG.
3. Close valve! Use stop watch to time pressure drop from 90 psig until the minimum time specified in the table below is reached. If the pressure is above 60 psig, the part is satisfactory.
4. When using flowmeter, read leakage and refer to DC-8 Specification Table, where applicable.

NOTE: It is suggested that the test fixture be provided with a protective cage for safety.

Peri-Seals Part No. List

PART NO.	NOMINAL I.D. INCHES	PART NO.	NOMINAL I.D. INCHES
26A430-27	1.00	26A430-49	4.75
26A430-41	1.25	26A430-21	5.00
26A430-29	1.50	26A430-51	5.25
26A430-43	1.75	26A430-25	5.50
26A430-31	2.00	26A430-53	5.75
26A430-11	2.25	26A430-37	6.00
26A430-13	2.50	26A430-55	6.25
26A430-39	2.75	26A430-35	6.50
26A430-15	3.00	26A430-57	6.75
26A430-45	3.25	26A430-59	7.00
26A430-17	3.50	26A430-61	7.25
26A430-25	3.75	26A430-63	7.50
26A430-19	4.00	26A430-65	7.75
26A430-47	4.25	26A430-67	8.00
26A430-33	4.50	26A430-69	8.25

Peri-Seals are individually packaged and lubricated. No further lubrication is required.

WARRANTY

The metallic components of all Peri-Seal Connectors and Bulkhead seals are warrantied for 2,000 service hours to be free from defects due to material and workmanship. Under normal usage the metallic components should last the life of the airframe. The non-metallic Peri-Seals are warrantied for a minimum of 1500 service hours when installed per the limits as outlined by the airframe manufacturer, or for 2 years from the date of delivery. Warrantees will terminate upon the earliest expiration of service hours or storage date.

Any Peri-Seal, together with the Connector, which fails under the hours of operation defined above, should be tagged with the number of service hours and returned to General Connectors Corporation, 233 W. Orange Grove Ave., Burbank, California, U.S.A. Upon inspection approval at the factory, General Connectors Corporation will repair or replace with a new part. No charge will be made for the returned item when under the warranty.

MAINTENANCE INSTRUCTIONS FOR :

REGULATOR VALVE ASSEMBLY

PART NO. B40D85

JANITROL AERO

COLUMBUS , OHIO

HEAT TRANSFER AND CONTROL PRODUCTS FOR THE AEROSPACE INDUSTRY

LITHO IN USA 1E 65

№ B40D85.

TABLE I. LEADING PARTICULARS

Envelope size (inches)	3.250 x 2.375 x 4.250
Weight (pounds)	0.90 lb (max.)
Ambient air temperature range	0°F to 160°F
Altitude range (feet)	Sea level to 40,000
Air inlet pressure range	5.0-80 psig
Downstream pressure range (in. Hg)	4.5-5.5
Inlet and outlet size	1/2 in. tube

1. INTRODUCTION.

2. GENERAL. These instructions provide overhaul procedures for Regulator Valve Assembly, Part No. B40D85, manufactured by Janitrol Aero Division, Midland-Ross Corporation, Columbus, Ohio.

3. DESCRIPTION.

4. GENERAL. The B40D85 Valve (see figure 1) is designed for use in a system providing positive ambient pressure to aircraft instruments. It regulates against a nominal fixed flow of 0.3 pounds per minute. With inlet pressures of 5 to 80 psig it reduces to 4.5 to 5.5 in. Hg.

5. DISASSEMBLY. (See figure 2.)

NOTE

It is recommended that the valve assembly be overhauled after every 500 hours of operation.

a. Disassemble the valve assembly in the same order as the index numbers assigned to the exploded view illustration, figure 2, observing the following special instructions:

b. Attaching parts have been assigned index numbers immediately following parts they attach. For example, it will be necessary to remove the screws (2) to free the cap (1).

c. All O-ring packings (10 and 11) must be replaced at each overhaul.

d. The inlet valve stem (8) and inlet valve seat (9) are matched parts and must be replaced as an assembly.

6. CLEANING. (See figure 2.)

a. Wash all metal parts in dry-cleaning solvent, Federal Specification P-D-680. If foreign material is difficult to remove, use a soft bristle brush to aid in the cleaning process. Dry parts thoroughly with filtered, compressed air.

b. Wipe the diaphragm assembly with a clean, dry, lint-free cloth.

CAUTION

Do not use any type of solvent on the diaphragm assembly (6).

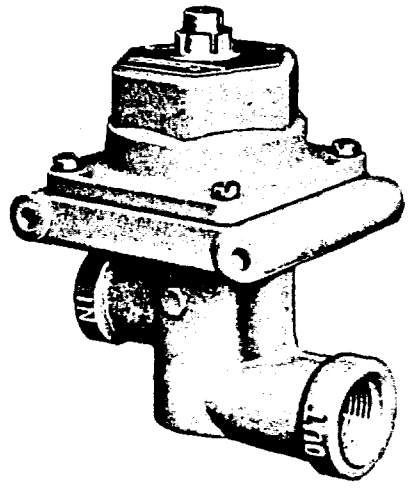
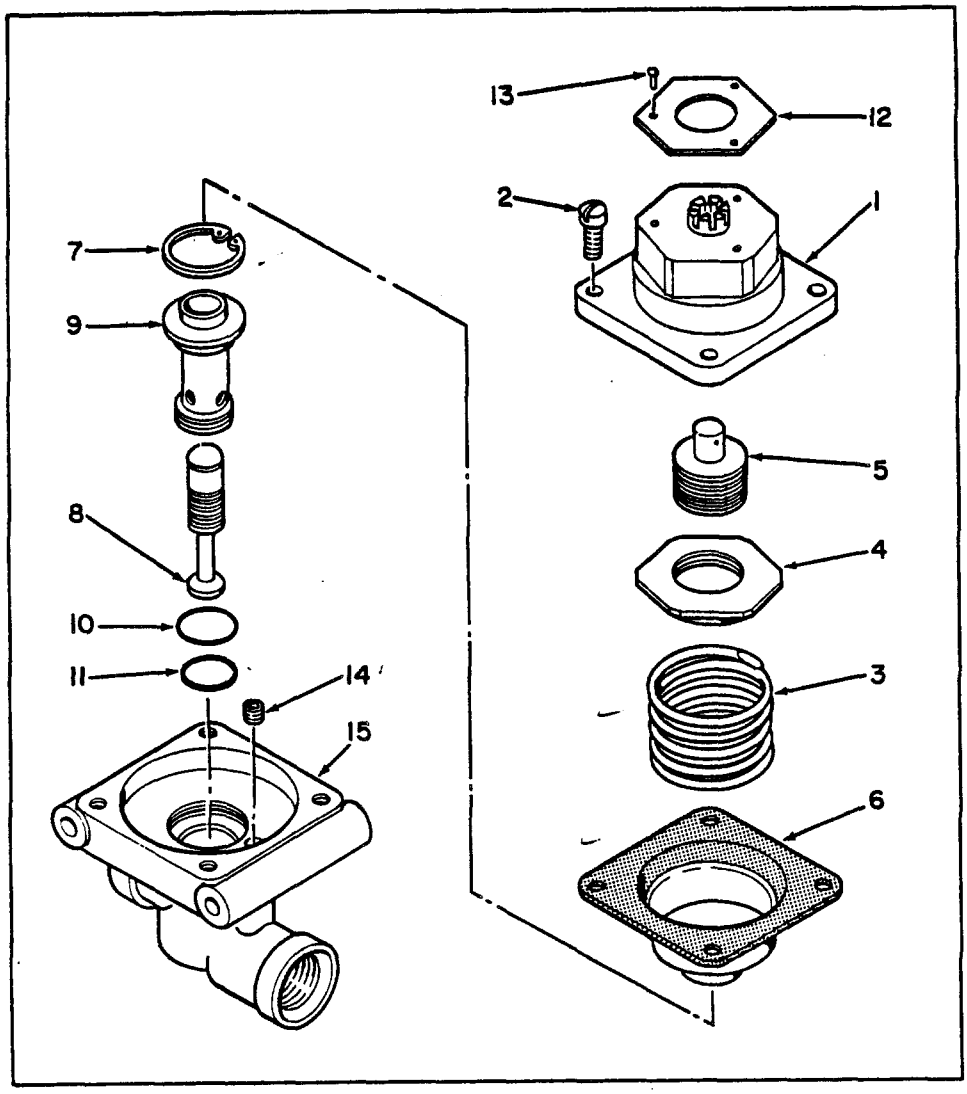


Figure 1. Regulator Valve Assembly



1. Regulator cap
2. Machine screw
3. Spring
4. Spring guide
5. Adjusting screw
6. Diaphragm assembly
7. Retaining ring
8. Inlet valve stem
9. Inlet valve seat
10. Preformed packing
11. Preformed packing
12. Identification plate
13. Rivet
14. Jet
15. Valve body

Figure 2. Exploded View of Regulator Valve Assembly

7. INSPECTION. (See Table II.)

8. LUBRICATION. No lubrication is required.

9. REASSEMBLY. (See figure 2.)

a. Reassembly is the reverse of disassembly.

b. Install plug jet (14) in body (15) before reassembly of entire valve assembly.

10. TESTING.

11. TEST EQUIPMENT REQUIRED.

a. Inlet Air Regulator, 0-160 psig

b. Pressure Gage, 0-160 psig

c. Mercury Manometer

d. Orifice, ~~0.169 - 0.178~~ 0.160 - 0.163 in. diameter

e. Approximately 3 feet of 1/2-inch diameter tubing

f. A 150 psig air pressure source capable of delivering 0.5 lb/min flow

12. TEST PROCEDURE. (See figure 3.)

a. With valve installed in test setup, introduce air at a pressure of 5.0 psig at the valve inlet port.

b. Maintain 5.0 psig pressure at valve inlet and adjust regulator to obtain a downstream pressure of 4.7 in. Hg.

c. Without further adjustment of valve, increase inlet pressure to 80 psig. Downstream pressure shall not exceed 5.5 in. Hg.

TABLE II. INSPECTION PROCEDURES

INDEX NO. (See Fig. 2)	NOMENCLATURE	INSPECTION PROCEDURES
1	Regulator Cap	Inspect for distortion, cracks and rough sealing surface. Inspect for damaged screw threads. Replace for any of these conditions.
3	Spring	Check visually for cracks. Replace if cracks are found.
4	Spring Guide	Check for wear or visible damage. Replace for either condition.
5	Adjusting Screw	Check for broken or stripped threads. Replace for either condition.
6	Diaphragm Assy	Check for distortion or visible damage. Replace for either condition.
8, 9	Inlet Valve Assy	Check valve stem (8) and seat (9) for visible wear patterns. Replace entire inlet valve assembly if either part is damaged.
14, 15	Body Assembly	Check body (15) for cracks, distortion, damaged threads and rough sealing surface. Inspect jet (14) for visible damage. Replace body assembly for any of these conditions.
ALL	Hardware	Check for visible damage. Replace as required.

d. Decrease inlet pressure to 5.0 psig. Downstream pressure shall not be less than 4.5 in. Hg.

e. Increase inlet pressure to 80 psig. Downstream pressure shall not be less than 4.5 in. Hg or more than 5.5 in. Hg.

NOTE

In instances where the tolerance range of the valve is significantly less than 5.0 ±0.5 in. Hg, the final adjustment should place the actual tolerance an equal amount from the upper and lower allowable limits.

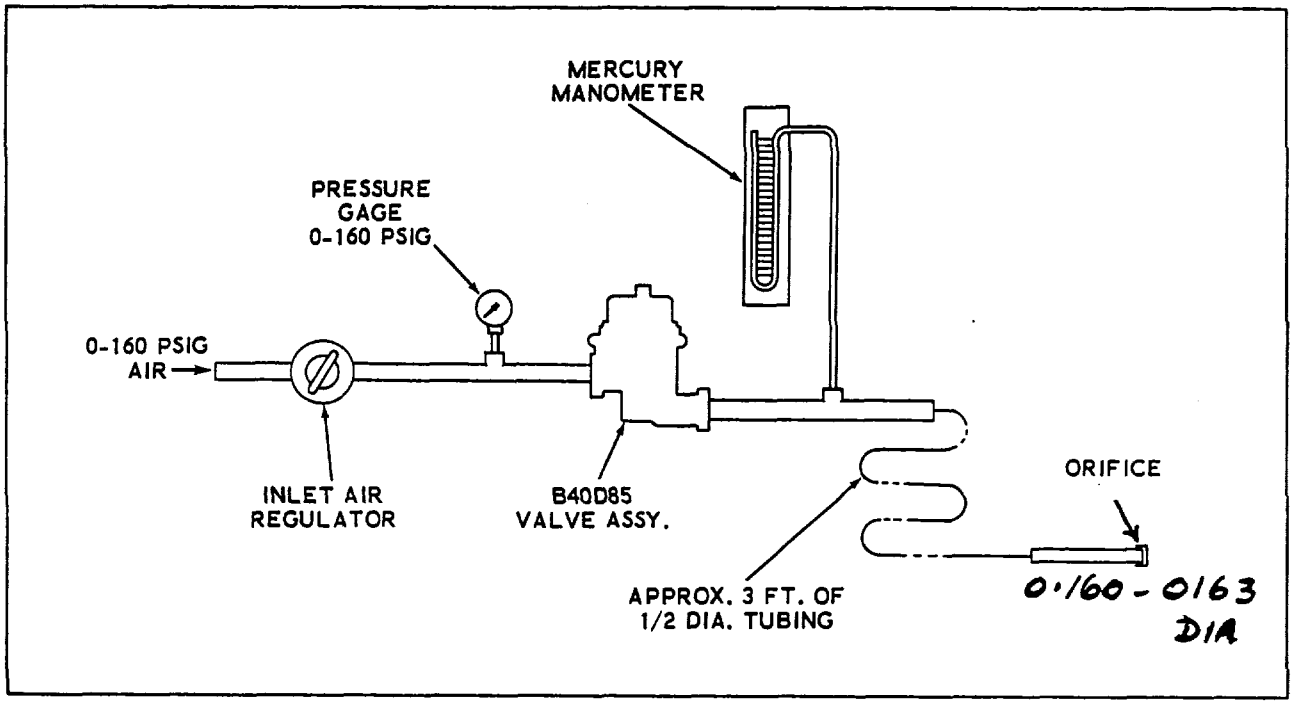


Figure 3. Test Setup

Refer to Figure 2 for Parts Illustration

INDEX NUMBER	PART NUMBER	NOMENCLATURE	UNITS PER ASSY
	B40D85	VALVE ASSEMBLY, Regulator	1
1	22D85	. CAP, Regulator	1
		(ATTACHING PARTS)	
2	21D94	. SCREW, Machine	4
		- - - - * - - - -	
3	41D51	. SPRING	1
4	47D24	. GUIDE, Spring	1
5	47D25	. SCREW, Adjusting	1
6	47D46	. DIAPHRAGM ASSEMBLY	1
7	MS16629-1087	. RING, Retaining	1
	47D41	. VALVE ASSEMBLY, Inlet (matched assembly)	1
8	47D40	. . STEM, Inlet valve	NP
9	23D35	. . SEAT, Inlet valve	NP
10	CG25C85	. PACKING, Preformed	1
11	P25C85	. PACKING, Preformed	1
12	D23D52	. PLATE, Identification	NP
		(ATTACHING PARTS)	
13	MS16535-23	. RIVET, Tubular	3
		- - - - * - - - -	
	47D57	. BODY ASSEMBLY, Valve	1
14	47D58	. . JET, Plug	1
15	47D17	. . BODY, Valve	1

NP - Denotes not procurable as a separate part.

Litho in U.S.A.

Instruction Part No. 50D83
September 1967

OVERHAUL INSTRUCTIONS FOR

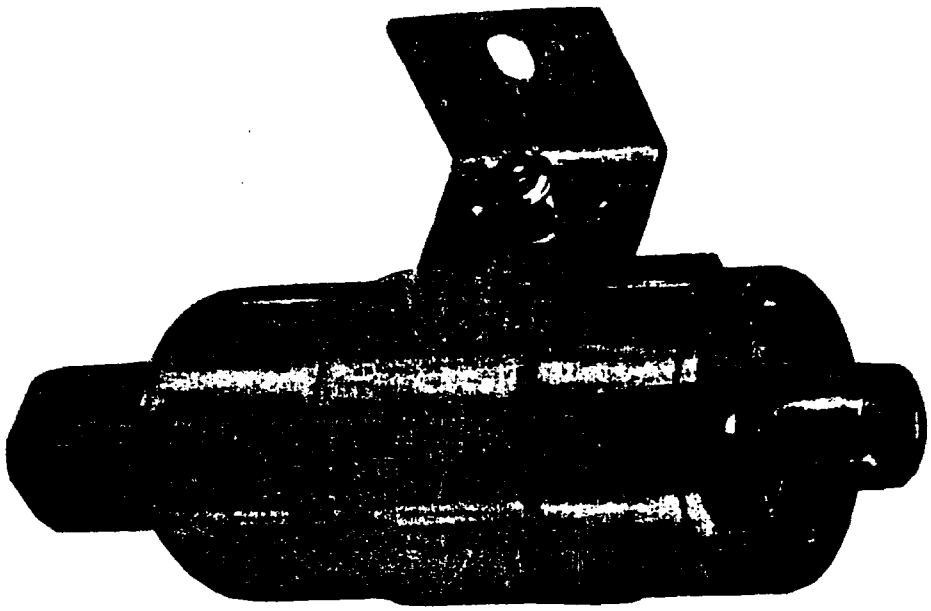
U. O. P. INSTRUMENTS PRESSURE SWITCH

TYPE MDB-620-1

PRESSURE SWITCH NO. MDB-620-1, OVERHAUL INSTRUCTIONS

DESCRIPTION

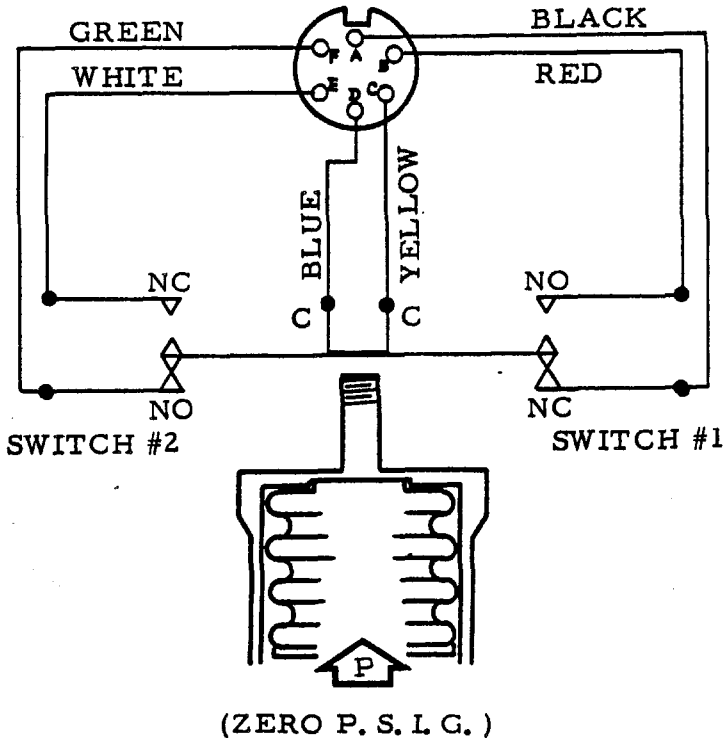
1 The pressure switch covered by these overhaul instructions is a pneumatically operated type with a pressure port on the lower end of the main housing and an electrical connector receptacle on top of the main housing (see Figure 1). Installed within the main housing are two independently wired microswitches (see Figure 2), adjusted to operate as follows: No. 1 switch to actuate between 23 and 27 p. s. i. g. decreasing pressure and reset at 30 p. s. i. g., on increasing pressure. No. 2 switch to actuate between 18 and 22 p. s. i. g. decreasing pressure, and reset by 25 p. s. i. g. on increasing pressure. A removable mounting bracket is provided with an insulator between the bracket and main housing to protect the switch from excessive vibration and shock.



Pressure Switch
Figure 1

TABLE OF LEADING PARTICULARS

TEMPERATURE RATING	-	-65°F to +250°F
ELECTRICAL RATING	-	1 AMP @ 28 V. D. C.
SYSTEM PRESSURE	-	80 P. S. I. G.
PROOF PRESSURE	-	160 P. S. I. G.
OPERATING CHARACTERISTICS	-	No. 1 switch actuates at 23/27 p. s. i. g. on decreasing pressure, reset by 30 p. s. i. g. No. 2 switch actuates at 18/22 p. s. i. g., reset by 25 p. s. i. g.



Wiring Schematic
Figure 2

DISASSEMBLY (see Figure 3)

NOTE

Do not attempt to remove bellows assembly (B.) or to disassemble beyond step J. below, as specialized equipment is necessary to reinstall and calibrate.

2 A. Cut lockwire (1) and remove screws (2).

B. Lift electrical connector receptacle (4) to allow access to pin wiring (3).

C. Disconnect wires (3) from connector pins. Remove electrical connector receptacle (4).

D. Remove housing top cap (5).

E. Remove cap (6) from switch head (10).

F. Carefully remove switch actuator (7) from piston cup assembly (13). Remove and discard heli-coil insert (8) from switch actuator (7).

G. Slacken set screw (9) in switch head (10), unscrew and remove switch head (10).

H. Remove micro-switches (11) from switch head (10), by removing two screws (12) retaining each micro-switch.

I. Disconnect wiring (3) from each micro-switch.

J. Do not attempt any further disassembly.

CLEANING

3 A. Clean all metal parts in dry cleaning solvent and dry with compressed air.

INSPECTION

4 A. Visually inspect all metal parts for damage affecting serviceability.

(1) Check housing for cracks or distortion.

(2) Check surfaces of all parts having relative motion for scoring or uneven wear.

REPAIR

5 Repair is limited to replacement of micro-switches, wiring, or electrical connector receptacle.

ASSEMBLY (see Figure 3)

6 A. Install micro-switches (11) to switch head (10) using four screws (12). Lock screws (12) using Loctite "C".

B. Solder wires (3) to micro-switch contacts (see Figure 2).

C. Install switch head (10) to main housing. Adjust switch head (10) to its approximate final position. Do not lock.

D. Using a new heli-coil lock insert (8), install switch actuator (7). Adjust to approximate final position.

E. Before proceeding with further assembly, carry out calibration procedure outlined in paragraph 7.

F. Reinstall switch head cap (6) and main housing cap (5).

G. Draw wires (3) through hole in cap (5) and resolder wires to electrical connector receptacle (4), (see Figure 3).

H. Install electrical connector receptacle (4) to main housing using four screws (2). Wirelock screws (2).

CALIBRATION

7 A. Apply controlled and gaged pressure, and by adjustment of switch head (10), adjust until actuation of micro-switch No. 1 occurs before 30 p.s.i.g. on increasing pressure, and resets between 23 and 27 p.s.i.g. on decreasing pressure.

B. Decrease pressure below 15 p.s.i.g., then increase pressure and adjust switch actuator (7) until actuation of micro-switch No. 2 occurs before 25 p.s.i.g., and resets between 18 and 22 p.s.i.g. on decreasing pressure.

C. Return pressure to zero.

D. Apply proof pressure of 160 p.s.i.g.

E. Return pressure to zero.

F. Repeat steps A. and B.

G. Return pressure to zero and tighten set screw (9) to lock switch head (10).

TROUBLE SHOOTING

8 Due to the basic simplicity of this switch no special trouble shooting is required.

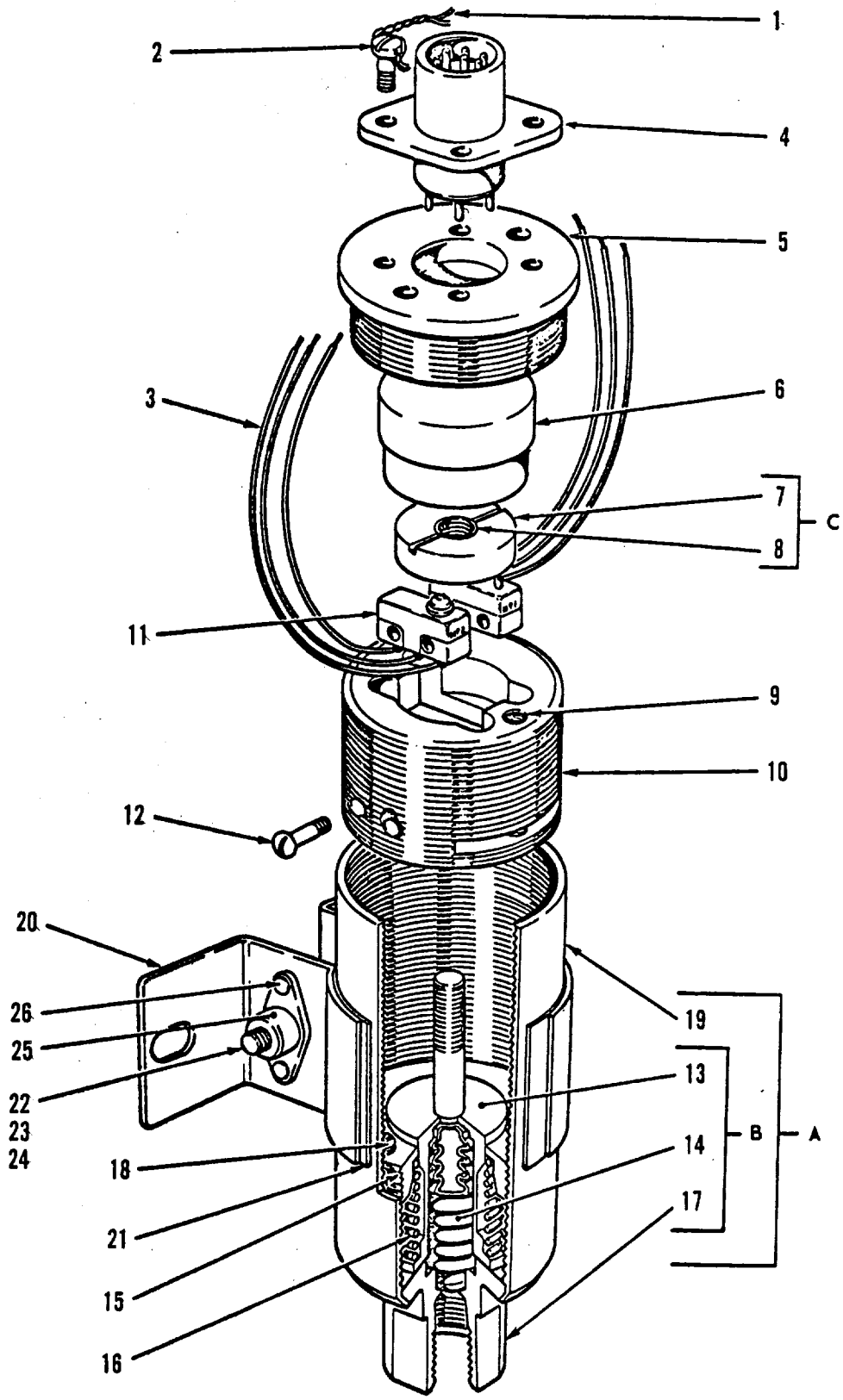
STORAGE INSTRUCTIONS

9 Cap pressure port and electrical connector receptacle to keep out foreign matter during storage.

PRESSURE SWITCH NO. MDB-620-1 ILLUSTRATED PARTS LIST

ITEM NO.	UNIT PER ASSY	DESCRIPTION	PART NUMBER
1	A/R	Lockwire	MS20995C20
2	4	Fil. HD. Mach. Screw	AN500A4-4
3	6	Elec. Wire (4" Length, Teflon Coated, No. 22 Gauge Tensolite)	
4	1	Elec. Connector (Cannon)	MS3110-E10-6P
5	1	Cap W/Nylock	20935
6	1	Cap Switch Head	20969-1
7	1	Switch Actuator	20924
8	1	Heli-Coil Lock Insert	19056-43
9	1	Hex-Socket Set Screw	AN565D6H4
10	1	Switch Head	20923
11	2	Micro-switch	ISM144
12	4	Round Hd. Screw (Rework)	20937
13	1	Piston Cup	20920
14	1	Bellows	21083
15	1	Seat - Spring Adjustment	20922
16	1	Spring	20927
17	1	Fitting Base	20919
18	1	Hex. Socket Set Screw	AN565D4H3
19	1	Main Housing	20921
20	1	Mounting Bracket	20917

ITEM NO.	UNIT PER ASSY	DESCRIPTION	PART NUMBER
21	1	Bracket Insulator	20930
22	1	Bracket Spacer	20926
23	1	Fil. Hd. Mach. Screw	AN501-10-18
24	A/R	Flat Washer	AN960PD10L
25	1	Self Locking Nut - Plate	AN366DF-1032A
26	2	Flat Hd. Rivet	MS20426A3-4
27	1	Name Plate	21417
A	1	Main Housing Assembly	20932
B	1	Fitting Base and Bellows Assy	20931
C	1	Actuator Sub Assembly	20934



Exploded view.
Figure 3

CHAPTER

52

DOORS

de Havilland Inc.
DHC-6 TWIN OTTER
COMPONENT MAINTENANCE MANUAL
CHAPTER 52 - DOORS
TABLE OF CONTENTS

MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B./T.R.
Adams Rite	Locks Door and Related Handles and Latches	AR24B9 or AR24B12			
Eldec	Proximity Switch	8-240-04	52-70-02	May 1/1979	

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--- ADAMS RITE MFG. CO. -----

Locks Door, and Related Handles & Latches.

Part No. AR 24B9 or
Part No. AR 24B12.
Part No. AR83-2-60
Part No. AR87-6-0

INSPECTION—MAINTENANCE

INSPECTION, TESTING, QUALITY CONTROL

Our products are best known for quality. A quality control system in accordance with MIL-Q-5923 is maintained under a Chief of Quality Control. The regular facilities of all U.S. Government Inspectors are available.

MAINTENANCE—ROUTINE

Maintenance of our aircraft hardware generally consists of simple lubrication, checking for visible signs of wear and tightening screws, approximately every 500 flight hours (for Overhaul instructions see procedures described with each repairable item):

(1) Tighten all screws including cover-plate screws, handle set-screws, cylinder set-screws and mounting screws, or threaded fittings.

(2) Lubricate:

Bolts—generously apply grease (ANG-21 or equivalent) to exposed surfaces. Work bolt in and out of case several times then wipe off excess grease.

Hubs—apply 2 or 3 drops of light weight oil between exposed hub and case. Rotate hub several times and wipe off excess oil from exposed surfaces.

Cylinder Assemblies—apply small amount of graphite through keyway to internal parts of cylinders. NEVER USE OIL OR GREASE TO LUBRICATE CYLINDERS.

Valve Assemblies—no lubrication required.

HOW TO ORDER

Please order all items by part number, including complete dash numbers, type, finish, keying and strikes required, all of which are explained in Leading Particulars for every item in this manual.

See the Glossary of "Lockwords" immediately following the Introduction for explanation of technical terms applied to locks, latches and hand hardware.

FINISHES:

Finishes are usually indicated and are the most suitable for each item described. If we have not shown a finish, or if you wish to deviate from the finishes normally called out, we will work to your specification, wherever possible.

KEYING:

Key numbers are specified for some of the items in this manual to indicate that these items will always be furnished with the same keying. When key numbers are not shown, it is necessary that you tell us whether you want lock cylinders on your orders "keyed alike", "keyed different" or "master keyed". See Glossary of "Lockwords", page viii. One key supplied with locks unless otherwise specified. Spare keys available on order.

DELIVERY DATES:

Our customers' delivery requirements differ widely and therefore we seldom stock complete assemblies; however, we do maintain a substantial inventory of basic components. Please allow sufficient lead time in placing your orders to provide for completion of the items you require.

TERMS OF SALE:

Net 30 days FOB our plant, Glendale, California. Extra charge may be made for export packing or special preservation packing.

MODIFICATION SERVICE:

Should modification specifications call for replacements not covered in our Master Index, please consult us. Our design group is eminently qualified to show you how to adapt existing Adams Rite products to your needs, or if necessary, to design new products to your specifications.

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KEY — For operating cylinders.

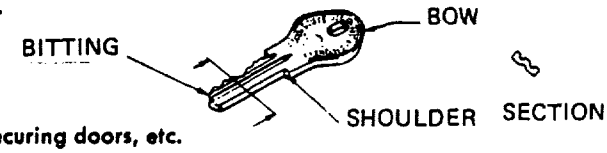
CHANGE KEY: Key for individual cylinders.

KEYED ALIKE: All cylinders may be operated by same key.

KEYED DIFFERENT: Each cylinder or group of cylinders uses different key.

MASTER KEY: Key to open a cylinder or group of cylinders which may be set to different change keys.

MASTER KEYED: All cylinders in a group operated by one master key although all cylinders may be keyed different.



LAZY CAM — *See Cylinder*

LATCH — Non-locking spring-loaded fastener for securing doors, etc.

DEAD LATCH: Latch in which bolt can be positively stopped.

LEVER — *See Handle*

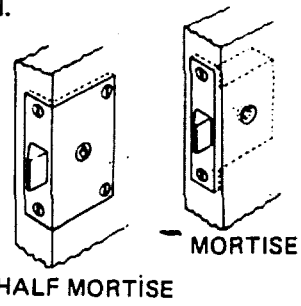
LOCK — Fastener operated primarily or secondarily by key or equivalent, for securing doors, etc.

DEAD LOCK: Lock in which bolt can be positively stopped.

LOCK BAR — Part used to stop bolt or handles from operating.

MORTISE — To set a lock, etc., flush into the edge of the door, etc.

HALF-MORTISE: To set a lock, etc., into the face of a door, etc., may be flush to face, or with flange on surface.



PULL — A fixed hand or finger grip.



SHAFT — *See Spindle*

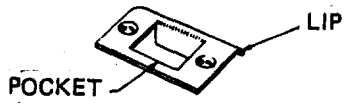
SPINDLE — Central shaft or square bar used to operate mechanism; usually fastened to handle and inserted in hub to operate lock or latch.

SPRING — Flat, coil, tension, compression and torsion used to actuate or retain bolts and other parts of locks.

STRIKE — Plate usually mounted on door jamb to accept bolt and protect jamb from damage.

THUMB TURN — Small Handle

TONGUE — *See Bolt*

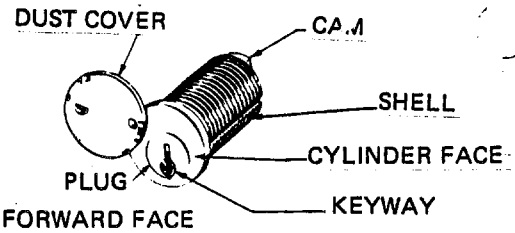


TUMBLER — Part of a cylinder see cylinder

GLOSSARY OF LOCKWORDS

CYLINDER *(continued)*

SLABBING: Flat milled on one or both sides of shell to prevent rotation.

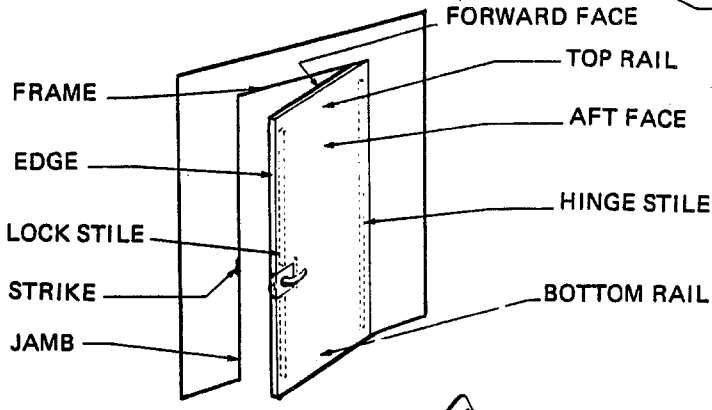


DEAD BOLT *See Bolt*

DEAD LATCH *See Latch*

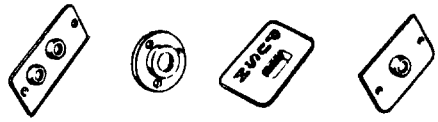
DEAD LOCK *See Lock*

DOOR



ESCUTCHEON Trim plate or handle mounting plate.

FLAP A flush handle usually of the push-pull type.



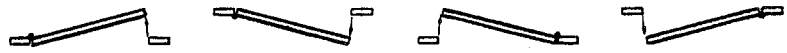
FREE-TURNING Feature of design which permits disengagement of a handle from spindle or shaft.

HAND OF DOOR The description of the door operation. Taken from position **Inside** airplane **looking forward.**

LEFT HAND: Door hinges on or slides toward left.

RIGHT HAND: Door hinges on or slides toward right.

SWING: Door may swing forward, (or away from), or aft, (or toward), the viewer.

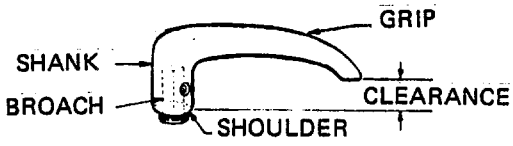


Illustrations shown with viewer looking forward.

LEFT HAND, FWD. | LEFT HAND, AFT. | RIGHT HAND, FWD. | RIGHT HAND, AFT

HANDLE Hand or finger grip for operating lock of door as lever, tee, ring, drop, offset, etc.

HUB Component of mechanism used for actuating bolt, lockbar, etc., into which spindle is inserted.

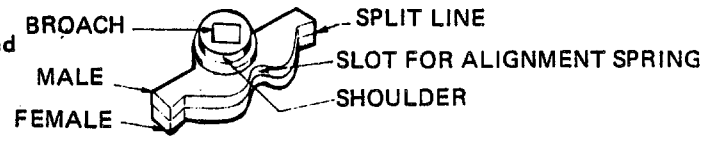


DOUBLE-ACTION: Turns both directions to actuate bolt.

SINGLE-ACTION: Turns in one direction to actuate bolt.

SOLID: One Piece.

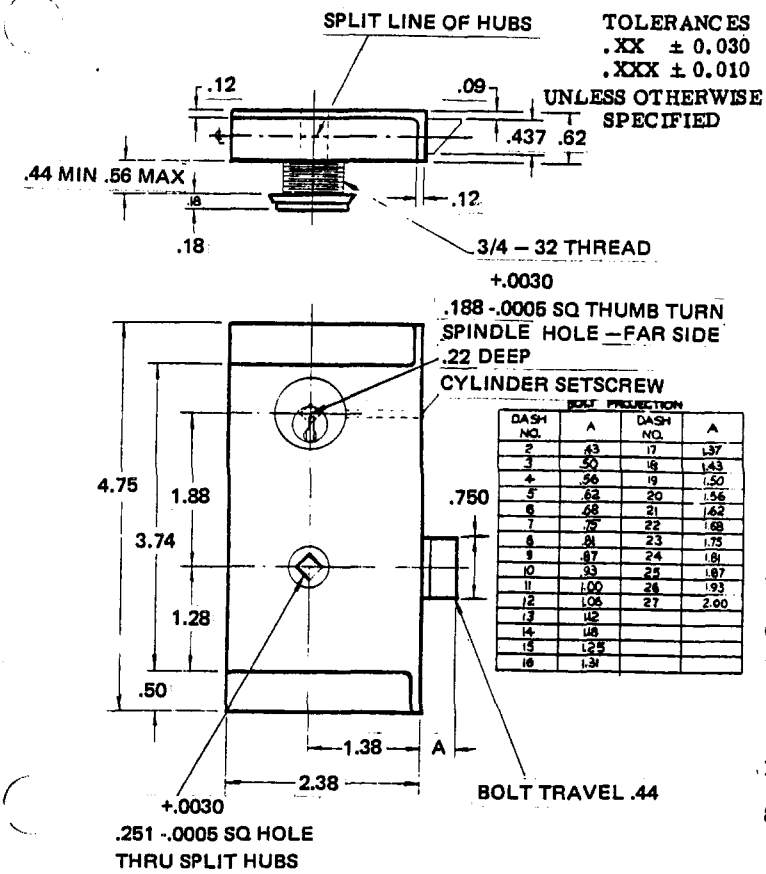
SPLIT: Two piece, male and female, for independent actuation from either side.



KEEPER *See Strike*

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BOLT PROJECTION

DASH NO.	A	DASH NO.	A
2	.43	17	1.37
3	.50	18	1.43
4	.56	19	1.50
5	.62	20	1.56
6	.68	21	1.62
7	.75	22	1.68
8	.81	23	1.75
9	.87	24	1.81
10	.93	25	1.87
11	1.00	26	1.93
12	1.06	27	2.00
13	1.12		
14	1.18		
15	1.25		
16	1.31		

SCALE
APPROX. 1/2 SIZE

AR24 SHOWN
AR25 OPPOSITE HAND

LEADING PARTICULARS

USE: . . . . . Heavy duty installations on interior or exterior doors. Adaptable to almost universal installation with wide variety of handles and escutcheons.

MATERIALS: . Case and cover - aluminum alloy; bolt and hubs - steel; cylinder - brass.

FINISH: . . . . Bolt face - polished; cylinder - chrome plated; unless otherwise specified.

OPERATION: . Rotate hubs approximately 35 degrees either direction to retract bolt. Lock or unlock by key or thumb-turn. Use with separate spindles meeting at split-line of hubs when locking of outer handle only required. Inner handle remains operable. When solid spindle is used, handles work together. Bolt always free to latch. Hubs support handles against dropping.

WEIGHT: . . . Approximately 0.62 lb.

EXAMPLE OF PART NUMBERS: . . AR24-2 TY 1: Lock with 0.43 inch bolt projection; bevel and case type as shown in drawing.
AR24B2 TY 1: same as above, reverse bevel bolt.

KEYING: . . See Introduction; Keying paragraph, page iv.

STRIKE: . . . See AR52 (page 1-47). Not included.

OVERHAUL PROCEDURE

1. Disassemble in order of keyed index numbers as shown on exploded view illustration.

NOTE

Insert key in locked cylinder; retract key one notch; key may then be used to unscrew cylinder from case. Do not exert extreme pressure. Be sure setscrew is fully disengaged from cylinder.

2. Wash all parts in solvent per Federal P-S-661, or equivalent.

CAUTION

Do not immerse cylinders in any liquid to clean. Use air hose.

3. Inspect all parts for signs of visible wear.
4. Replace worn or damaged parts.
5. Polish out scratches on exposed surfaces.
6. Lubricate with grease per MIL-G-3278A, or equivalent.

WARNING

Do not use oil or grease as a lubricant for cylinder - use powdered graphite only.

7. Reassemble in the reverse order of disassembly.

NOTE

Be sure stirrup on cover assembly (5) mates with pin on lockbar (8).

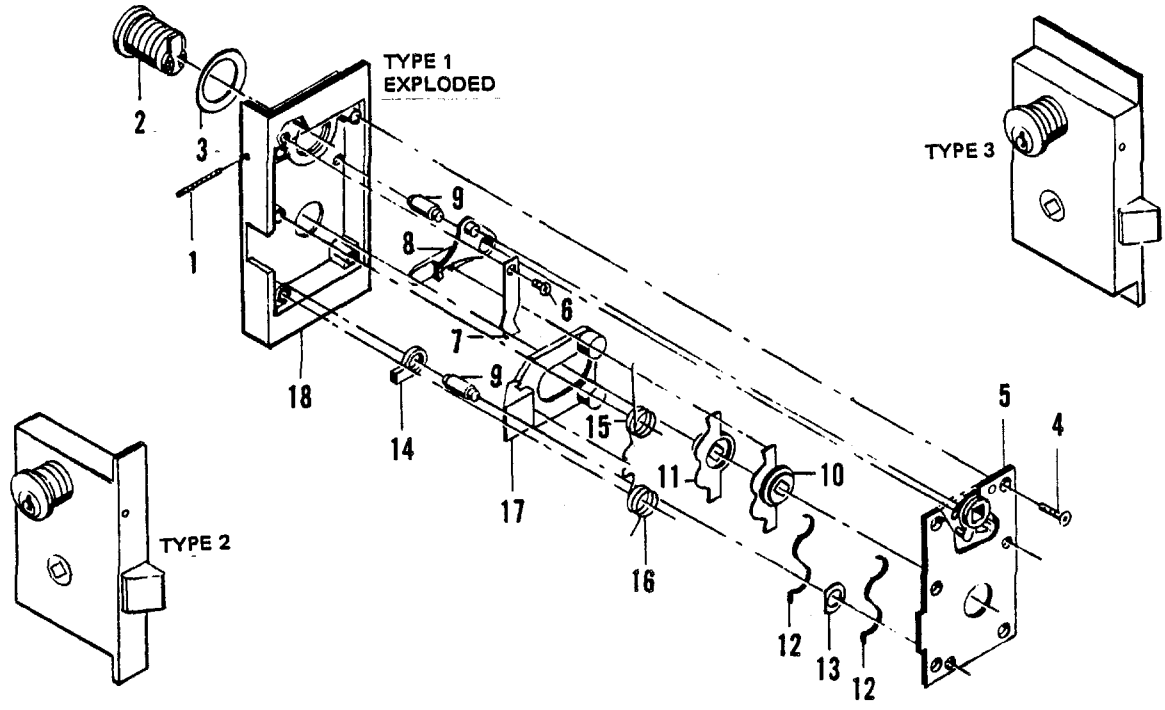
8. Check operation for conformance to Leading Particulars Operation.

CAUTION

Be sure both hubs can operate independently when separate spindles used.

MAINTENANCE

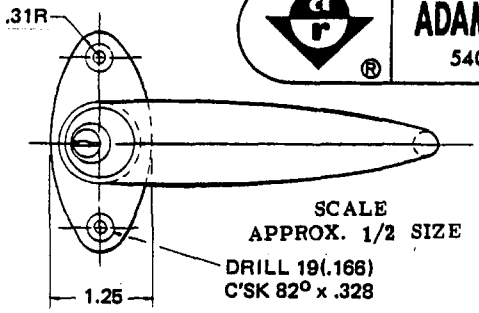
See Introduction; Maintenance paragraph, page iii.



PARTS LIST

INDEX NO.	PART NO.	PART NAME	QTY REQ	USABLE ON ASSEMBLY
1	AN565D6H16	SCREW	1	AR 24; AR 25
2	AR9-1 TY3.	CYLINDER, PIN W/1 KEY	1	AR 24; AR 25
3	AR298	WASHER, CYLINDER	1	AR 24; AR 25
4	AN505-6R9	SCREW	5	AR 24; AR 25
5	LY179	COVER	1	AR 24
	LY183	COVER	1	AR 25
6	AN515-4R3	SCREW, SPRING	1	AR 24; AR 25
7	LS200	SPRING, LOCKBAR	1	AR 24; AR 25
8	LY420-3	LOCKBAR	1	AR 24
	LY419-3	LOCKBAR	1	AR 25
9	LP530	PIN, CASE	2	AR 24; AR 25
10	LY438	HUB	1	AR 24; AR 25
11	LY437	HUB	1	AR 24; AR 25
12	LS201	SPRING, HUB	2	AR 24; AR 25
13	AN960-416L	WASHER	1	AR 24; AR 25
14	LX301	SPACER, HUB SPRING	1	AR 24; AR 25
15	LS202	SPRING, BOLT	1	AR 24
	LS204	SPRING, BOLT	1	AR 25
16	LS205	SPRING, BOLT	1	AR 24
	LS203	SPRING, BOLT	1	AR 25
17	LY219-*	BOLT	1	AR 24; AR 25
18	LC240 TY**	CASE	1	AR 24
	LC242 TY**	CASE	1	AR 25

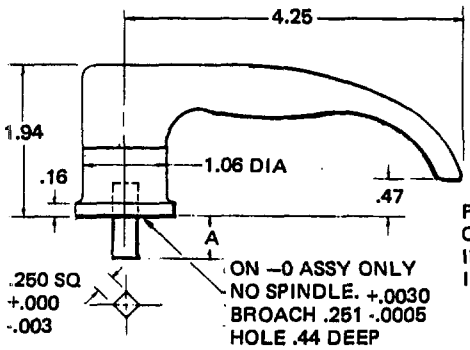
* Bolt assembly dash number corresponds to Lock Assembly dash number.
** Type (TY) number of case corresponds to type (TY) number of Lock Assembly.



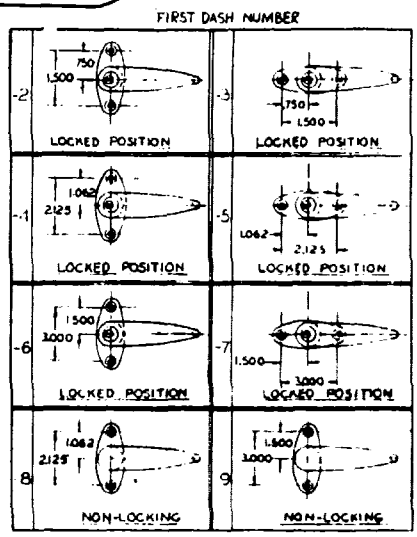
TOLERANCES
.XX ± 0.030
.XXX ± 0.010
UNLESS OTHERWISE SPECIFIED

SECOND DASH NUMBER

DASH NO	A	DASH NO	A
0	NONE	48	1.12
20	.25	50	1.19
22	.31	52	1.25
24	.38	54	1.31
26	.44	56	1.38
28	.50	58	1.44
30	.56	60	1.50
32	.62	62	1.56
34	.69	64	1.62
36	.75	66	1.69
38	.81	68	1.75
40	.88	70	1.81
42	.94	72	1.88
44	1.00	74	1.94
46	1.06	76	2.00



FOR SPINDLE LENGTHS BETWEEN OR BEYOND VALUES GIVEN, EQUATE IN UNIFORM INCREMENTS AS INDICATED



LEADING PARTICULARS

USE: . . . . . Heavy-duty locking handles to operate locks or latches, including those shown elsewhere in this catalog, on interior or exterior doors. Also non-locking handles.

MATERIALS: . . Handle and escutcheon - aluminum alloy; pin cylinder - brass, disc cylinder - zinc; spindle - steel.

FINISH: . . . . . Handle and escutcheon - full polish; cylinder face - chrome plated.

OPERATION: . . Dead-locking handle and spindle securely locks to escutcheon; free-turning handle disengages from spindle when locked, with handle and spindle turning independently in escutcheon. Free-turning handle retained in locked position by light spring.

WEIGHT: . . . . Approximately 0.52 lb. (AR83-2-0)

EXAMPLE OF PART NUMBERS: . . . AR83-2-24: Dead-locking handle locking perpendicular to escutcheon, 1.500 inches between mounting holes, 0.38 inch spindle projection.
AR83-2-24F: Free-turning handle, 1.500 inches between mounting holes, 0.38 inch spindle projection.
AR83C2-24F: Free-turning handle with cylinder dust cover, 1.500 inches between mounting holes, 0.38 inch spindle projection.
AR83-8-0: Non-locking handle, broached for spindle, 2.125 inches between mounting holes.

KEYING: . . . . Must be specified on order. See Introduction, Keying paragraph, page iv.

(NOTE: Suffix "F" for Free-turning handle; insert "C" for cylinder with dust-cover.)

OVERHAUL PROCEDURE

1. Disassemble in order of keyed index numbers as shown on exploded view illustration.
   1a1. Code AW thru FW and AX thru FX: To remove lockbar (7) from FREE-TURNING assemblies, first rotate key in cylinder until spindle is engaged with handle; remove springs (5 and 6); lockbar (7) will slide free through large opening in case (11).
   1a2. Code AS thru FS and AT thru FT: To remove lockbar (7) from DEAD-LOCKING assemblies, first remove cylinder (10) from case asssembly (11).
   1b. To remove case-pins (9) use small drill in drill-press or hand drill motor.
2. Wash all parts in solvent per Federal P-S-661, or equivalent.

WARNING

Do not immerse cylinders in any liquid to clean. Use compressed air.

3. Inspect all parts for signs of visible wear.
4. Replace worn or damaged parts.
5. Polish out scratches on exposed surfaces.
6. Lubricate with grease per MIL-G-3278A, or equivalent.

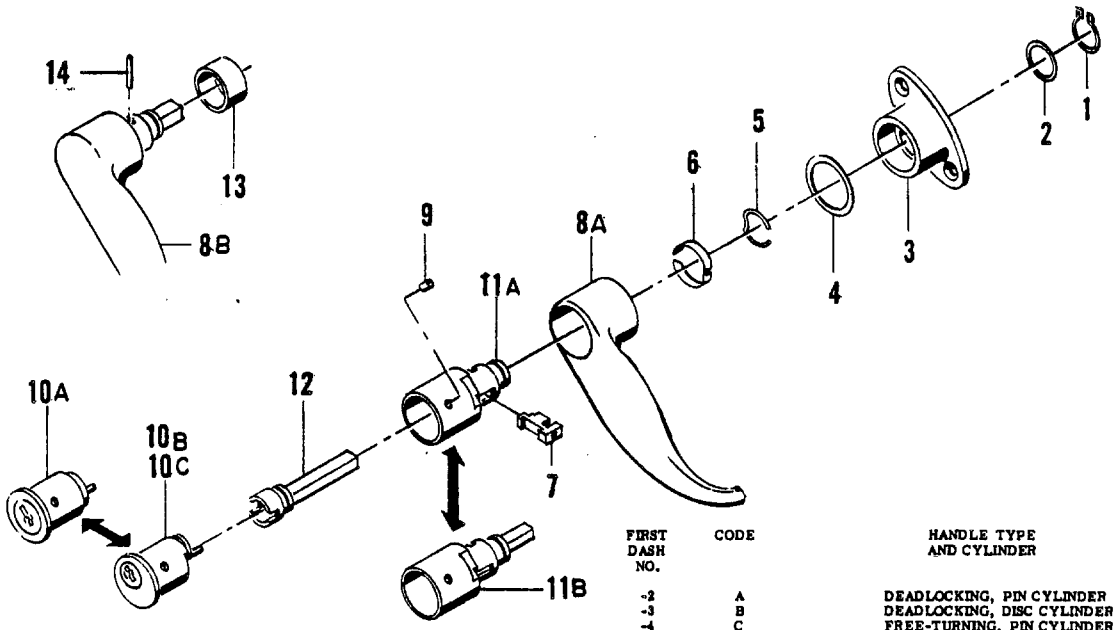
WARNING

Do not use oil or grease as a lubricant for cylinder - use powdered graphite only.

7. Reassemble in the reverse order of disassembly.
8. Check operation for conformance to Leading Particulars Operation.

MAINTENANCE

See Introduction; Maintenance paragraph, page iii.



FIRST DASH NO.	CODE
-2	A
-3	B
-4	C
-5	D
-6	E
-7	F
-8	G
-9	H

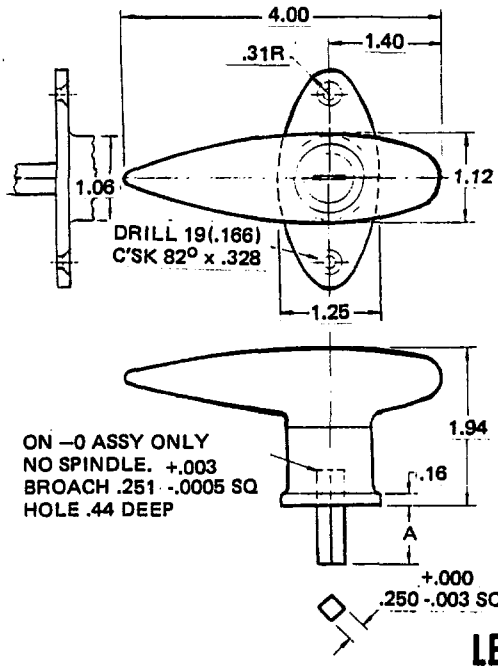
HANDLE TYPE AND CYLINDER	CODE
DEADLOCKING, PIN CYLINDER	S
DEADLOCKING, DISC CYLINDER	T
FREE-TURNING, PIN CYLINDER	W
FREE-TURNING, DISC CYLINDER	X
NON-LOCKING, WITH SPINDLE	Y
NON-LOCKING, NO SPINDLE	Z

For second dash number, see table on Engineering Drawing opposite page.
Examples of coded part numbers: AR83-2-24F w/pin cylinder = AW
AR83-8-0 (non-locking) = GZ
NOTE: Dust Cover symbol "C" is disregarded in handle assembly number code.

PARTS LIST

INDEX NO.	PART NO.	PART NAME	QTY REQ	USABLE ON CODE
1	NAS670-43	TRUARC	1	all assemblies
2	XW48-2	WASHER	AS REQ	all assemblies
3	LE80-2-500	ESCUTCHEON	1	AW, AX, BW, BX
	LE80-2-501	ESCUTCHEON	1	AS, AT
	LE80-2-502	ESCUTCHEON	1	BS, BT
	LE80-4	ESCUTCHEON	1	GY, GZ
	LE80-4-500	ESCUTCHEON	1	CW, CX, DW, DX
	LE80-4-501	ESCUTCHEON	1	CS, CT
	LE80-4-502	ESCUTCHEON	1	DS, DT
	LE80-5	ESCUTCHEON	1	HY, HZ
	LE80-5-500	ESCUTCHEON	1	EW, EX, FW, FX
	LE80-5-501	ESCUTCHEON	1	ES, ET
	LE80-5-502	ESCUTCHEON	1	FS, FT
4	LJ1-2	WASHER	1	AW, AX, BW, BX, CW, CX, DW, DX, EW, EX, FW, FX
	LJ425-2	WASHER	1	AS, AT, BS, BT, CS, CT, DS, DT, ES, ET, FS, FT, GY, GZ, HY, HZ
5	LS244	SPRING, HANDLE	1	AW, AX, BW, BX, CW, CX, DW, DX, EW, EX, FW, FX
6	LS228	SPRING, LOCKBAR	1	AW, AX, BW, BX, CW, CX, DW, DX, EW, EX, FW, FX
7	LR325-2	LOCKBAR	1	AW, BW, CW, DW, EW, FW
	LR326-2	LOCKBAR	1	AT, BT, CT, DT, ET, FT
	LR327-2	LOCKBAR	1	AS, BS, CS, DS, ES, FS
	LR328-2	LOCKBAR	1	AX, BX, CX, DX, EX, FX
8A	LF117-2	HANDLE	1	all except GY, GZ, HY, HZ
8B	LY543-2-*	HANDLE SUBASSEMBLY	1	GY, HY
	LY543-20	HANDLE SUBASSEMBLY	1	GZ, HZ
9	LP353-2	PIN, CASE	2	all except GY, GZ, HY, HZ
10A	CY15	CYLINDER, DISC W/1 KEY.	1	AT, AX, BT, BX, CT, CX, DT, DX, ET, EX, FT, FX
10B	CY15-6	CYLINDER, PIN W/1 KEY.	1	AW, BW, CW, DW, EW, FW
10C	CY15-12	CYLINDER, PIN W/1 KEY.	1	AS, BS, CS, DS, ES, FS
11A	LC68-2-2	CASE	1	AX, BX, CX, DX, EX, FX
	LC68-3-2	CASE	1	AW, BW, CW, DW, EW, FW
	LC69-2-2	CASE	1	AS, AT, BS, BT, CS, CT, DS, DT, ES, ET, FS, FT
11B	LY537-*	CASE ASSEMBLY	1	AS, AT, BS, BT, CS, CT, DS, DT, ES, ET, FS, FT
12	LY538-*	HUB ASSEMBLY	1	AW, AX, BW, BX, CW, CX, DW, DX, EW, EX, FW, FX
13	LT303	TUBE	1	GZ, HZ
14	XP188-4-9	GROOV-PIN	1	GZ, HZ

* Dash numbers denote spindle projection and correspond to second dash number of final assembly, except -0.



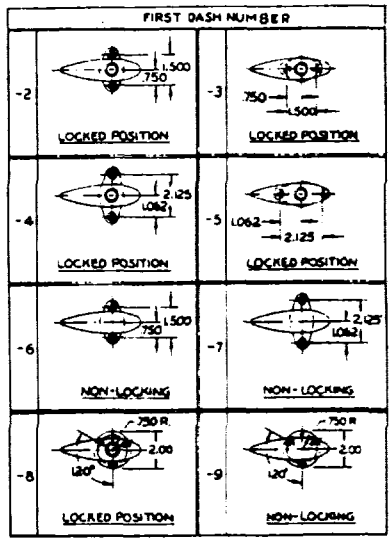
TOLERANCES
.XX ± 0.030
.XXX ± 0.010
UNLESS OTHERWISE SPECIFIED

SCALE
APPROX. 1/2 SIZE

SECOND DASH NO.

DASH NO.	A	DASH NO.	A
0	NONE	48	1.12
20	.25	50	1.19
22	.31	52	1.25
24	.38	54	1.31
26	.44	56	1.38
28	.50	58	1.44
30	.56	60	1.50
32	.62	62	1.56
34	.69	64	1.62
36	.75	66	1.69
38	.81	68	1.75
40	.88	70	1.81
42	.94	72	1.88
44	1.00	74	1.94
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FOR SPINDLE LENGTHS BETWEEN OR BEYOND VALUES GIVEN, EQUATE IN UNIFORM INCREMENTS AS INDICATED



LEADING PARTICULARS

USE: . . . . . Heavy-duty locking handles to operate locks or latches, including those shown elsewhere in this catalog, on interior or exterior doors. Also non-locking handles.

MATERIALS: . . Handle and escutcheon - aluminum alloy; pin cylinder - brass, disc cylinder - zinc; spindle - steel.

FINISH: . . . . Handle and escutcheon - full polish; cylinder face - chrome plated.

OPERATION: . . Dead-locking handle and spindle securely locks to escutcheon; free-turning handle disengages from spindle when locked, with handle and spindle turning independently in escutcheon. Free-turning handle retained in locked position by light spring.

WEIGHT: . . . Approximately 0.40 lb.

EXAMPLE OF PART NUMBERS: . . AR87-2-24: Dead-locking handle locking perpendicular to escutcheon, 1.500 inches between mounting holes, 0.38 inch spindle projection.
AR87-2-24F: Free-turning handle, 1.500 inches between mounting holes, 0.38 inch spindle projection.
AR87C2-24F: Free-turning handle with cylinder dust cover, 1.500 inches between mounting holes, 0.38 inch spindle projection.
AR87-9-0: Non-locking handle, broached for spingle, round escutcheon.
(NOTE: Suffix "F" for Free-turning handle; insert "C" for cylinder with dust cover.)

KEYING: . . . . Must be specified on orders. See Introduction, Keying paragraph, page iv.

OVERHAUL PROCEDURE

1. Disassemble in order of keyed index numbers as shown on exploded view illustration.
   1a1. Code AW thru DW and GW; AX thru DX and GX: To remove lockbar (7) from FREE-TURNING assemblies, first rotate key in cylinder until spindle is engaged with handle; remove springs (5 and 6); lockbar (7) will slide free through large opening in case (11).
   1a2. Code AS thru DS and GS; AT thru DT and GT: To remove lockbar (7) from DEAD-LOCKING assemblies, first remove cylinder (10) from case assembly (11).
   1b. To remove case-pins (9), use small drill in drill-press or hand drill motor.
2. Wash all parts in solvent per Federal P-S-661, or equivalent.

WARNING

Do not immerse cylinders in any liquid to clean. Use compressed air.

3. Inspect all parts for signs of visible wear.
4. Replace worn or damaged parts.
5. Polish out scratches on exposed surfaces.
6. Lubricate with grease per MIL-G-3278A, or equivalent.

WARNING

Do not use oil or grease as a lubricant for cylinder - use powdered graphite only.

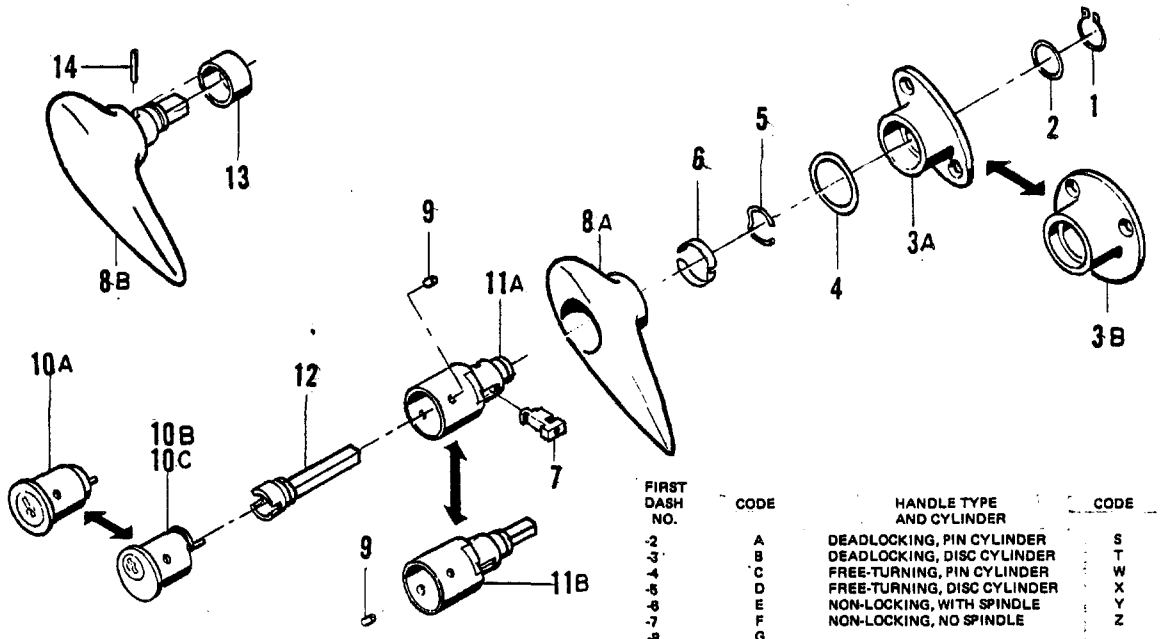
7. Reassemble in the reverse order of disassembly.
8. Check operation for conformance to Leading Particulars Operation.

MAINTENANCE

See Introduction: Maintenance paragraph, page iii.

ADAMS RITE MANUFACTURING COMPANY

540 W. CHEVY CHASE DR., GLENDALE 4, CALIF.



FIRST DASH NO.	CODE	HANDLE TYPE AND CYLINDER	CODE
-2	A	DEADLOCKING, PIN CYLINDER	S
-3	B	DEADLOCKING, DISC CYLINDER	T
-4	C	FREE-TURNING, PIN CYLINDER	W
-5	D	FREE-TURNING, DISC CYLINDER	X
-6	E	NON-LOCKING, WITH SPINDLE	Y
-7	F	NON-LOCKING, NO SPINDLE	Z
-8	G		
-9	H		

For second dash number, see table on Engineering Drawing on opposite page and footnote* at end of parts list.

Examples of coded part numbers: AR87-2-24F w/pin cylinder = AW
AR87-6-0 (non-locking) = EZ

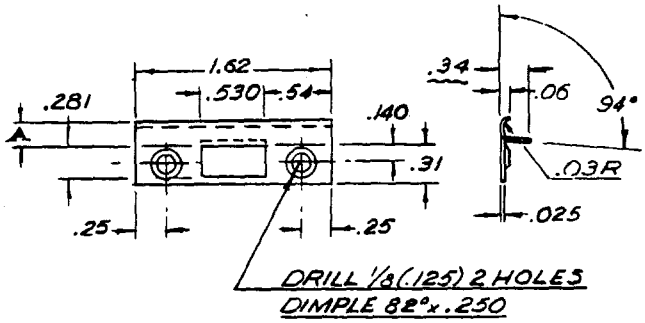
NOTE: Dust cover symbol "C" is disregarded in handle assembly number code.

PARTS LIST

INDEX NO.	PART NO.	PART NAME	QTY RFQ	USABLE ON CODE
1	NAS670-43	TRUARC	1	all assemblies
2	XW48-2	WASHER	AS REQ	all assemblies
3A	LE80-2-500	ESCUTCHEON	1	AW,AX,BW,BX
	LE80-2	ESCUTCHEON	1	FY,FZ
	LE80-2-501	ESCUTCHEON	1	AS,AT
	LE80-2-502	ESCUTCHEON	1	BS,BT
	LE80-4	ESCUTCHEON	1	FY,FZ
	LE80-4-500	ESCUTCHEON	1	CW,CX,DW,DX
	LE80-4-501	ESCUTCHEON	1	CS,CT
3B	LE279	ESCUTCHEON	1	HY,HZ
	LE279-500	ESCUTCHEON	1	GS,GT
	LE279-501	ESCUTCHEON	1	GW,GX
4	LJ1-2	WASHER	1	AW,AX,BW,BX,CW,CX,DW,DX GW,GX
	LJ425-2	WASHER	1	AS,AT,BS,BT,CS,CI,DS,DT,EY EZ,FY,FZ,GS,GT,HY,HZ
5	LS244	SPRING, HANDLE	1	AW,AX,BW,BX,CW,CX,DW,DX GW,GX
6	LS228	SPRING, LOCKBAR	1	AW,AX,FW,FX,CW,CX,DW,DX GW,GX
7	LR325-2	LOCKBAR	1	AW,BW,CW,DW,GW
	LR326-2	LOCKBAR	1	AT,BT,CT,DT,GT
	LR327-2	LOCKBAR	1	AS,BS,CS,DS,GS
	LR328-2	LOCKBAR	1	AX,BX,CX,DX,GX
8A	LF120-21	HANDLE	1	all except EY, EZ,FY,FZ,HY,HZ
8B	LY545-2	HANDLE ASSEMBLY	1	EY,FY,HY
	LY545-2-0	HANDLE ASSEMBLY	1	EZ,FZ,HZ
9	LP353-2	PIN, CASE	2	all except EY,EZ,FY,FZ,HY,HZ
10A	CY15	CYLINDER, DISC W 1 KEY	1	AT,AX,BT,BX,CT,CX,DT,DX GT,GX
10B	CY15-6	CYLINDER, PIN W 1 KEY	1	AW,BW,CW,DW,GW
10C	CY15-12	CYLINDER, PIN W 1 KEY	1	AS,BS,CS,DS,GS
11A	LC68-2-2	CASE	1	AX,BX,CS,DX,GX
	LC68-3-2	CASE	1	AW,BW,CW,DW,GW
	LC69-2-2	CASE	1	see footnote (**)
11B	LY537-*	CASE ASSEMBLY	1	AS,AT,BS,BT,CS,CT,DS,DT GS,GT
12	LY538-*	HUB ASSEMBLY	1	AW,AX,BW,BX,CW,CX,DW BX,GW,GX
13	LT303	TUBE	1	EZ,FZ,HZ
14	XP188-4-9	GROOVE,PIN	1	EZ,FZ,HZ

*Dash numbers denote spindle projection and correspond to second dash number of final assembly, except -0.

**LC69-2-2 is used when no spindle is required (-0), except code EZ, FZ and HZ.



SCALE
APPROX. 2/3 SIZE

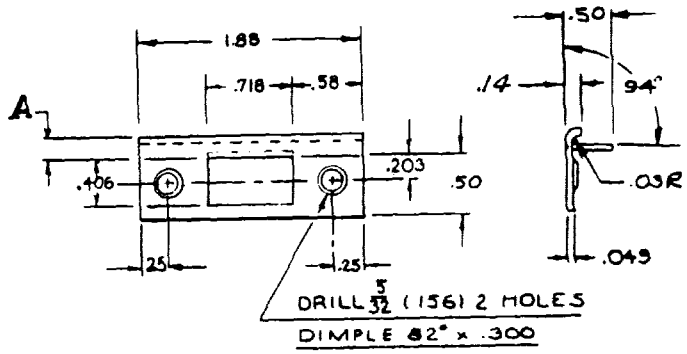
AR50, 51, 52

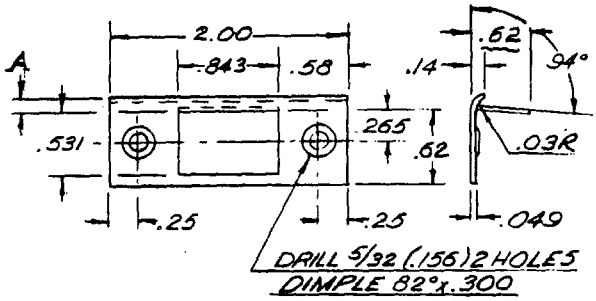
DASH	A
3	.19
4	.25
5	.31
6	.38
7	.44
8	.50
9	.56
10	.62
11	.68
* 12	.75

*NOT USED ON AR50

AR50

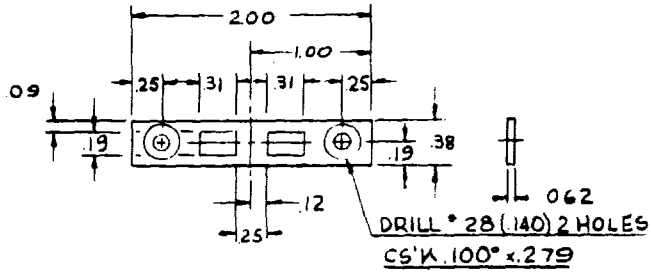
AR51





TOLERANCES
.XX ± 0.030
.XXX ± 0.010
ANGULAR ± 1/2

AR52



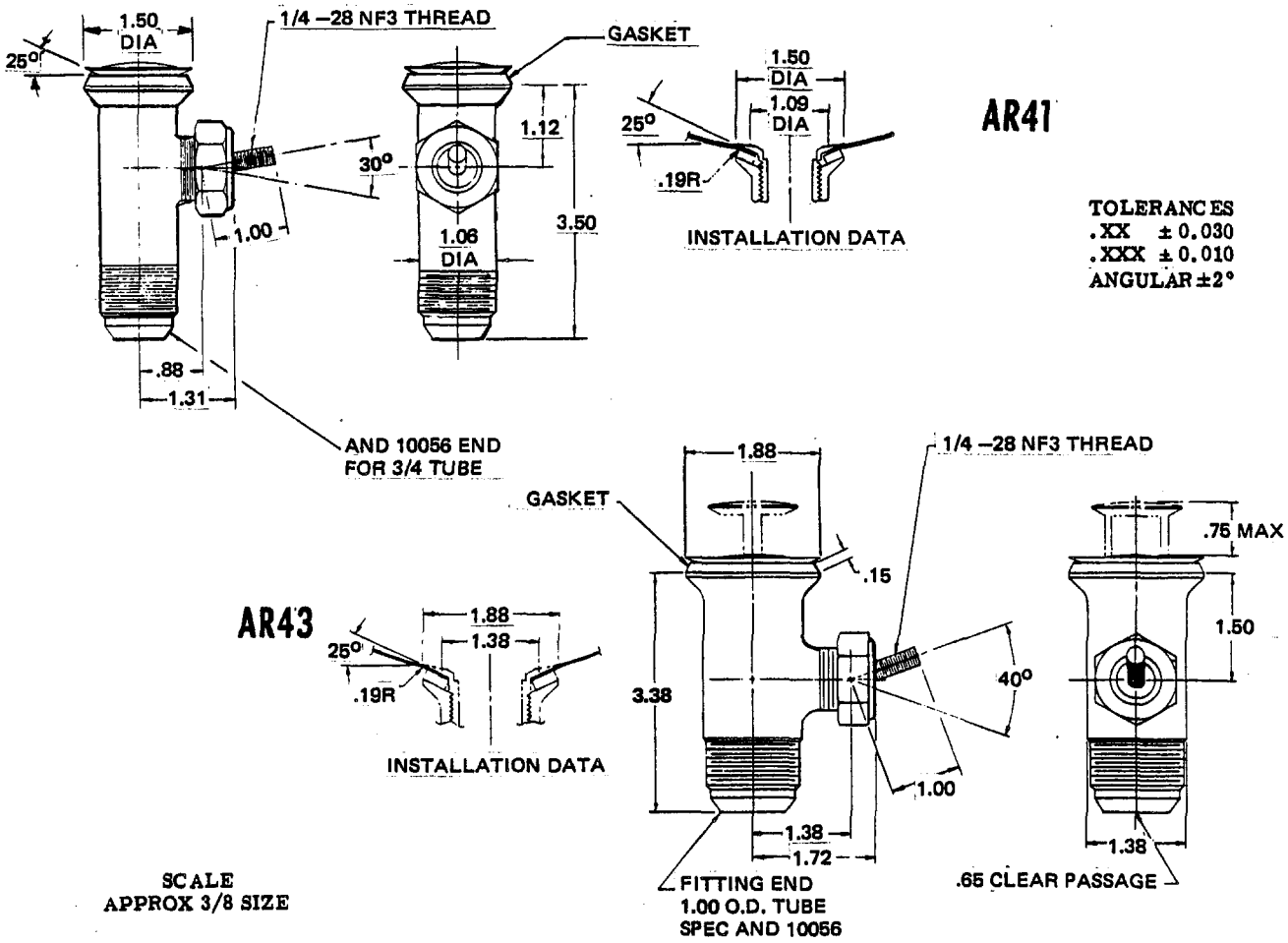
LEADING PARTICULARS AR61

(NOT REPAIRABLE)

USE: . . . . . With bolt type latches and locks shown elsewhere in this catalog.
MATERIAL: . . Corrosion resistant steel, except AR61 - cold-roll steel.
FINISH: . . . . AR50, AR51, AR52 - polish; AR61 - cadmium plated.

EXAMPLE OF PART NUMBER: . . . AR52-3: Strike for latch installed in center of 0.75 inch thick door and having 0.437 x 0.750 inch bolt.

ADAMS RITE MANUFACTURING COMPANY
540 W. CHEVY CHASE DR., GLENDALE 4, CALIF.



LEADING PARTICULARS

USE: . . . . . Sturdy, pop-up type drain valves for lavatory and galley basins.
MATERIALS: . Brass; gaskets - synthetic rubber.
FINISH: . . . . Exposed surfaces - chrome plated.
OPERATION: . Actuate lever-arm with conventional lift or lever, or by remote control, to close or open drain valve. AR41 plug is removable for cleaning by turning counterclockwise and lifting. Valve seat must be tightened down to the limit to allow full indicated travel of lever.

WEIGHT: . . . . AR41 - 0.88 lb; AR43 - 1.19 lbs.

OVERHAUL PROCEDURE

1. Disassemble in order of keyed index numbers as shown on exploded view illustration.

NOTE

VL251 plug (4B) may be removed for cleaning without disassembling valve by turning 90 degrees counterclockwise and lifting out.

2. Wash all parts in solvent per Federal P-S-661, or equivalent.
3. Inspect all parts for signs of visible wear.
4. Replace worn or damaged parts.
5. Polish out scratches on exposed surfaces.
6. Reassemble in the reverse order of disassembly.
7. Check operation for conformance to Leading Particulars Operation.

MAINTENANCE

See Introduction; Maintenance paragraph, page iii.

Overhaul Manual

PROXIMITY SWITCH ASSEMBLY

Part No.

8-240-04

Document No. 790508

ELDEC CORPORATION
LYNNWOOD, WASHINGTON

52-70-02
MAY 1/79

LIST OF EFFECTIVE PAGES

PAGE	DATE	PAGE	DATE	PAGE	DATE
Title Page	May 1/79				
List of Effective Pages	May 1/79				
Record of Revisions/ Record of Temporary Revisions/ Service Bulletin List	May 1/79				
Table of Contents/ Policy Statement	May 1/79				
FRONTISPIECE	May 15/79				
1	May 1/79				
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4	May 1/79				
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6	May 1/79				

RECORD OF REVISIONS

REV NO.	ISSUE DATE	DATE INSERTED	BY	REV NO.	ISSUE DATE	DATE INSERTED	BY
	May 1/79	Aug 21/02	ATP/MG				

RECORD OF TEMPORARY REVISIONS

TEMPORARY REV NO.	PAGE NUMBER	ISSUE DATE	BY	DATE REMOVED	BY

SERVICE BULLETIN LIST

Service Bulletin Number	Revision Number	Date Bulletin Incorporated into Manual

ELDEC CORPORATION
LYNNWOOD, WASHINGTON

OVERHAUL MANUAL
PART NUMBER 8-240-04

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Trouble Shooting	5
Storage Instructions	5
Special Tools, Fixtures, and Equipment	5

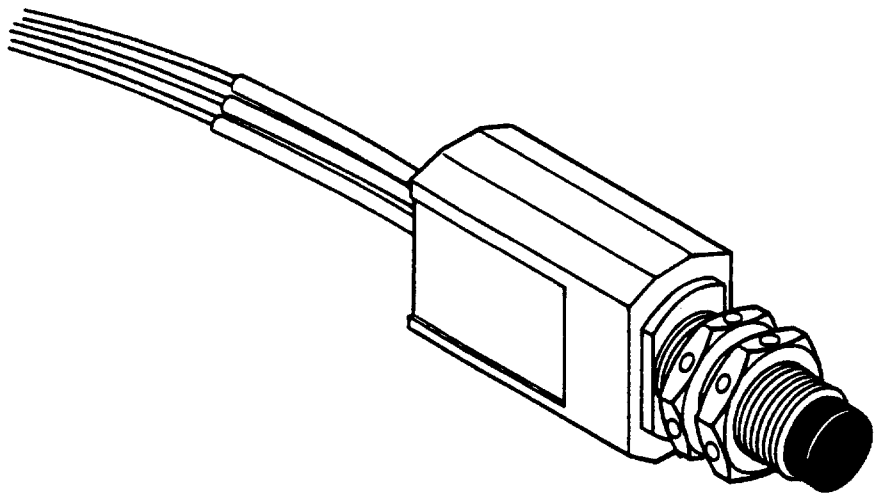
POLICY STATEMENT

1. The overhaul instructions contained in this manual provide descriptive information, special procedures, and data pertaining to work done on the units identified on the title page. These instructions pertain to the units after they have been removed from the aircraft. The manual has been prepared for the experienced shop mechanic who normally performs shop work and not for the aircraft service mechanic who normally works on units while they are installed in the aircraft.

2. Every effort has been taken to provide complete and accurate overhaul instructions. However, if a situation should arise that is not adequately covered by this manual, please contact ELDEC Corporation for specific information at the following address:

Service Representative
ELDEC Corporation
P.O. Box 100
Lynnwood, WA 98036

Telephone: (206) 743-1313
Telex: 328-959
TWX: 910-449-2855



8-240 Proximity Switch
Figure 1

1. Description and Operation

A. Description

(1) The ELDEC Proximity Switch Assembly, PN 8-240-04, shown in Figure 1, is an all solid state self-contained unit that changes state (switches) when a moveable metal target (actuator) comes within the actuating point of the fixed sensor. The proximity switch (hereafter referred to as assembly) performs the same function as a mechanical switch, but does not require physical contact.

(2) The entire assembly is contained within a single molded epoxy case. Electrical interface is provided through three separate leads, 3 feet in length. The output, depending on part number and requirements, consists of a normally open or normally closed switch closure to ground (see Figure 2 for leading particulars).

B. Operation

The assembly contains a sensor coil driven by an oscillator. As a target is brought into the proximity of the magnetic field generated by and surrounding the sensor coil, eddy currents are produced in the target. These eddy currents result in losses, absorbing energy from the magnetic field. When these losses increase beyond a set value (as the target is brought nearer the sensor coil), the oscillator is disabled. A detector/comparator circuit detects the presence or absence of oscillation and switches the output transistor on or off.

2. Disassembly

Sealed assembly, disassembly not required.

3. Cleaning

Clean dirt, oil, or grease from assembly with a clean cloth dampened with commercial Stoddard solvent.

WARNING: VENTILATE WORK AREA WHEN USING SOLVENT. AVOID CONTACT WITH SKIN. WEAR RUBBER GLOVES. OBSERVE ALL SAFETY AND FIRE PRECAUTIONS.

4. Inspection

Inspect assembly for damage, wear, broken leads, corrosion and deterioration.

OPERATING CHARACTERISTICS	
Actuation Point Ferrous Metals Non-Ferrous Metals	 0.10" + 0.010" 0.05" typical
Differential Travel	<0.005"
Repeatability	-0.005"; +0.015"
Response Time	<3ms
Switching Rate	>20,000 cpm
ELECTRICAL CHARACTERISTICS	
Input Voltage	24 Vdc
Input Current	35mA (max)
Load Rating	0.25 amp Resistive (max)
Voltage Drop	2.0 Vdc (max) @ 0.2 Amp
Output State	N.C. Target Away
Output Configuration	Switch closure to GND
Short Circuit Protection	Momentary
Reverse Polarity	Protected
ENVIRONMENTAL CAPABILITIES	
Temperature	
Operating	-65°F to +180°F
Environment	DO-138: AASAAAEWHDXS
PHYSICAL CHARACTERISTICS	
Weight: w/Leads and Mtg Hardware	2.3 oz.
Case	Molded Epoxy
Barrel	15/32-32NS Thread Stainless Steel
Termination	3 each AWG No. 20 wire leads per MIL-W-16878, 3 feet long
MTBF	200,000 Hours

Leading Particulars
Figure 2

5. Repair

Sealed assembly. Repair not required. Replace if defective.

6. Assembly

Not required.

7. Fits and Clearances

Special fits and clearances not required.

8. Testing

This section provides functional test procedures for the assembly. If any out-of-limit conditions are observed, replace switch assembly.

A. Test Equipment Required

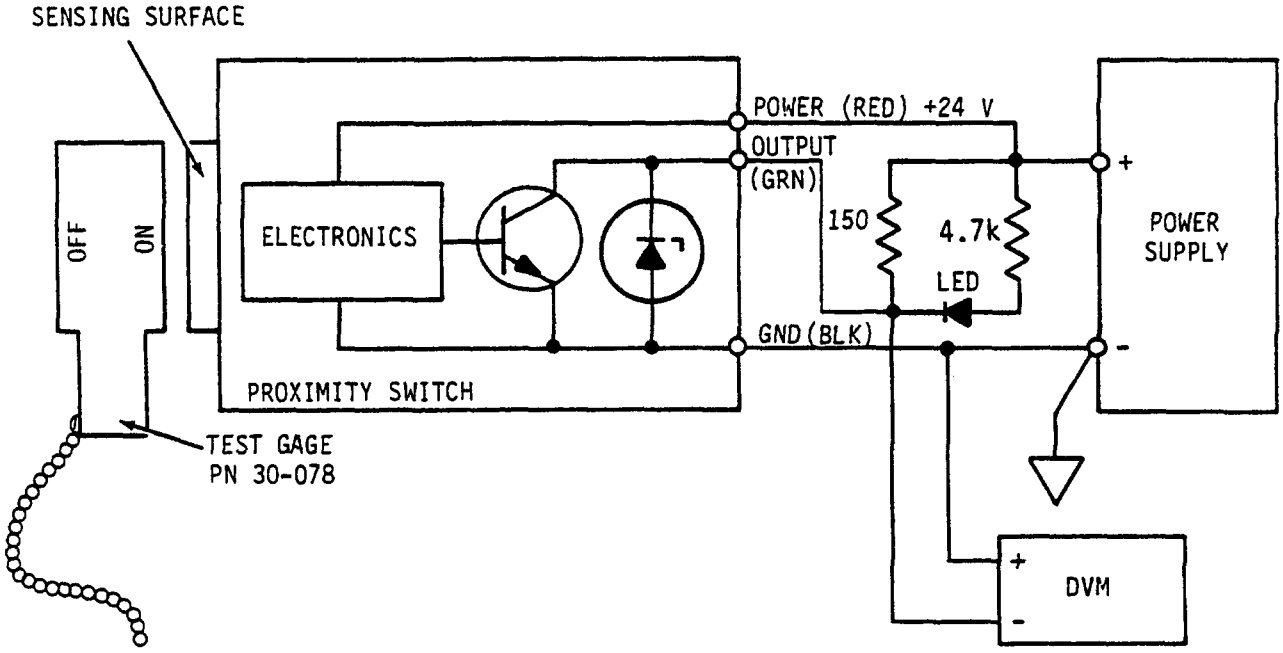
NOTE: Equipment of equivalent accuracy or specifications may be used.

ITEM	NAME	MODEL	MFR.
1	Proximity Switch Test Gage	30-078	ELDEC
2	Power Supply, 30 Vdc, 1 Amp		
3	Diode, Light Emitting (LED)	550-0405	DIALCO
4	Resistor, 4.7K, 1/4W, 5%	RCR07G472JS	ALLEN-BRADLEY
5	Resistor, 150 Ohm, 10W, 5%	HL-10, 150 ±5%	DALE
6	DVM	8000A	Fluke

Test Equipment List
Figure 3

B. Test Setup

Connect equipment as shown in Figure 4. Energize power supply and set its output to +30V dc (max.) with a 200mA load. The LED shall be illuminated when target is not present.



Test Set-Up
Figure 4

C. Proximity Switch Functional Test Procedures

(1) Place the OFF side of the test gage against the sensor face. Verify that the output is equal to or less than 2V and the LED remains illuminated.

(2) Place the ON side of the test gage against the sensor face. The LED should extinguish.

(3) Set power supply voltage to 18V dc (min.) and repeat Steps 1 and 2, disregarding voltage check in step (1).

(4) Testing is complete. Turn off power supply and disconnect assembly.

9. Troubleshooting

Not required. Replace if assembly does not meet requirements under TESTING (Paragraph 8).

10. Storage Instructions

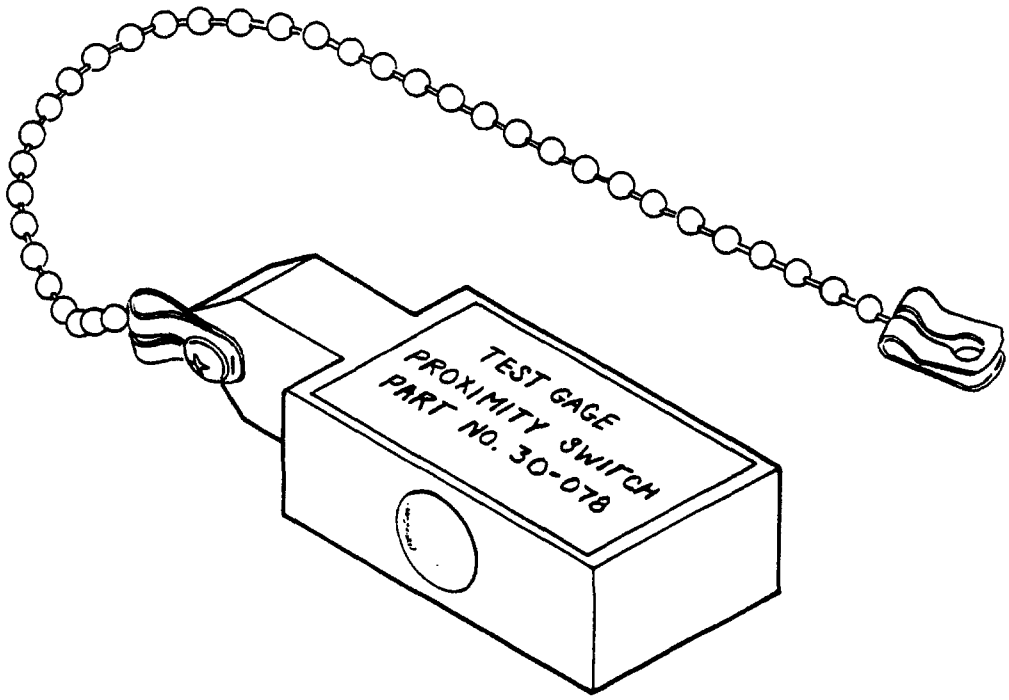
Package assembly in a polyethylene bag or wrap. Seal in a commercial carton and store in a cool, dry place.

11. Special Tools, Fixtures, and Equipment

A. The following special tool is suggested for testing the assembly.

(1) Test Gage, Proximity Switch, ELDEC PN 30-078.

B. The Test Gage (Figure 5) may be purchased from ELDEC, or fabricated locally using two plastic shims, 0.08" (actuate) and 0.12" (deactuate) thick laminated to a 1/2" X 1/2" X 0.05" steel target.



Test Gage, Part No. 30-078
Figure 5

CHAPTER

61

PROPELLERS/ PROPULSORS

MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B./T.R.
Bendix	Tachometer Indicator (Propeller) Old P/N New P/N	34108C1AF13-1A3 & 34108CIAL-13-1A3 3571260-8002		Jun 16/1970	
Woodward	*Governor*	*Bulletin 33528E*			

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Overhaul data for propellers is contained in Hartzell Propeller Overhaul Instructions No. 118B supplied separately.

Overhaul data for Woodward propeller governors is not included in this volume, since overhaul requires special test equipment and must be performed at airworthiness - authority approved facilities only. the following facilities have been approved and have the necessary test equipment to overhaul Woodward governors:

Airwork Corporation, Millville, New Jersey, U.S.A.

Hamilton Standard West Coast Division, Long Beach, California, U.S.A.

Hoffman Gm b H and Co. KG, Rosenheim, Germany.

Southwest Airmotive Company, Dallas, Texas, U.S.A.

United Aircraft of Canada Limited, Longueuil, Quebec, Canada.

Woodward Governor Company, Rockford, Illinois, U.S.A.

It is suggested that any operator, who has airworthiness - authority approved facilities for propeller governor overhaul, should contact the Woodward Governor Company directly for any required overhaul information.

Woodward also has a factory exchange replacement program, details of which are given in Bulletin 33528E included in this Chapter.

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TACHOMETER INDICATOR 34108C1AF13-1A3

This manual also applies to Part No. 34108C1AL13-1A3 and Part No. 3571260-8002, the radial markings being the only difference.

Overhaul with Parts Breakdown

Publication No. 70-7-1

Bendix
Flight & Engine Instruments Division
South Montrose, Pa. 18843

THE BENDIX CORPORATION - FLIGHT & ENGINE INSTRUMENTS DIVISION

OVERHAUL INSTRUCTIONS WITH PARTS BREAKDOWN

34108C1AF13-1A3

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OVERHAUL INSTRUCTIONS WITH PARTS BREAKDOWN

34108C1AF13-1A3

1. Description and Operation.

The 34108C1AF13-1A3 tachometer indicator is a hermetically sealed, unlighted instrument. It consists of a synchronous motor, a gear train assembly, a drag cup, two pointers and a graduated dial mounted in a 2 inch diameter case.

The indicator is normally connected electrically to a remotely located tachometer generator to form a complete system. Any change in the frequency of the generator (caused by the function being measured) will cause the synchronous motor to change speed. The pointers are mounted on shafts driven by the gear train assembly and the drag cup, which acts as a slipping clutch. In moving over the dial range, the pointers provide a visual indication of the function being measured.

The sub-dial facilitates reading indications between the main dial divisions.

The clamp-on mounting feature used allows the indicator to be rotated in order that all pointers on the instrument panel will be aligned under normal operating conditions with all pointers horizontal to the left. Any deviation from normal (indicated by a pointer dropping out of alignment) will be readily apparent.

The indicator will withstand vibration up to 2 g's.

Table 1. Leading Particulars

Operating Temperature . . .	-54°C to +71°C
Power Requirements	Generator to MIL-G-26611 or MIL-G-9398
Weight	0.9 lbs.
Accuracy	.5%

2. Disassembly.

A. Disassemble the indicator according to the following procedure: (refer to figure 2)

(1) Remove screw (2).

(2) Lift identification plate (1) over connector (4).

(3) Unsolder eyelet (3) and remove from end cover (6).

(4) Heat edge of case and glass assembly (8) around end cover (6) to melt solder holding end cover in place, and with a wire hook or other suitable tool inserted into eyelet hole, pull cover from case and glass assembly.

NOTE: Do not disassemble connector (4) or nameplate nut (5) from end cover unless necessary to replace a damaged part.

(5) Unsolder wires from connector (4).

(6) Remove compression ring.

(7) Clean excess solder from inner diameter of case and glass assembly (8) and withdraw indicator mechanism from assembly.

NOTE: Do not disassemble case and glass assembly (8) unless necessary to replace a damaged part.

(8) Remove dial spacer (12) from case and glass assembly (8).

(9) Remove pointer and hub assembly (13) by turning pointer against stop and gently continuing rotation and pulling pointer and hub assembly away from dial (15).

CAUTION: USE CARE TO AVOID BENDING POINTER STOP WHEN REMOVING POINTER AND HUB ASSEMBLY (13).

(10) Remove two dial screws (16).

(11) Insert a strip of thin, flat steel beneath dial (15) directly under pointer assembly (14) and carefully pry pointer assembly loose.

(12) Remove two screws (18) and washers (19) to separate gear train assembly (16) from motor housing (39).

CAUTION: USE CARE IN REMOVING GEAR TRAIN ASSEMBLY (17) TO AVOID DAMAGE TO THE PROTRUDING ENDS OF SHAFTS.

(13) Loosen screw (21) to remove return path assembly (26).

NOTE: Magnet assembly (27) should not be exposed to an open circuit. To avoid such exposure during disassembly, slide the magnet assembly directly from the indicator into magnet keeper 1489036-1. Place magnet and keeper in a non-magnetic container or on a non-magnetic surface.

(14) Remove screw (28) and disc (29) and slide magnet assembly (27) off starter and shaft assembly (35).

NOTE: Do not disassemble magnet assembly (27) unless it is necessary

to replace a damaged part.

(15) Slide spacer (36), motor rotor assembly (37), and ball bearings (39) from shaft of starter and shaft assembly (35).

NOTE: Stator assembly (38) is secured in housing by shrink fit. If removal is necessary the housing must be heated.

B. Disassemble the gear train assembly (17) according to the following procedure: (refer to figure 3)

(1) Remove three screws (2) and lock washers (3) and loosen rear plate assembly (1).

(2) Unsolder outer end of hairspring (10) from hairspring plate (6).

(3) Remove screw (7) and washer (8) to release hairspring plate (6).

NOTE: Do not disassemble jewel (4) from rear plate (5) unless necessary to replace a damaged part.

(4) Slide hub, gear and shaft assembly (9) out of front plate assembly (14).

CAUTION: USE CARE IN DISASSEMBLING GEAR TRAIN ASSEMBLY TO AVOID DAMAGE TO SHAFT PIVOTS, JEWELS, AND TEETH OF GEAR AND PINION.

(5) Remove hairspring (10) from shaft (13).

(6) Balance spring (11) need not be removed.

(7) Remove roll pin (15) and bushing and shaft assembly (17).

NOTE: Do not disassemble jewel (16) from plate assembly (22) unless necessary to replace a damaged part.

Do not disassemble bushing and shaft assembly (17) unless necessary to replace a damaged part.

3. Cleaning.

A. Clean main assembly of indicator according to the following instructions:

WARNING: USE SOLVENT IN A WELL VENTILATED AREA. DO NOT INHALE SOLVENT VAPORS OR ALLOW SOLVENT TO COME IN CONTACT WITH THE SKIN. KEEP SOLVENT AWAY FROM OPEN FLAME.

(1) Clean all metal parts with an approved solvent or use Naptha.

(2) Wash the dial (15) and cover glass (10) with a pure soap and water using care not to damage dial markings. Rinse and dry.

(3) Clean ball bearings (39) with Naptha or an approved solvent. Dry thoroughly. Do not handle ball bearings with bare fingers.

(4) Keep parts clean and free from dust particles.

B. Clean gear train assembly according to the following instructions:

(1) Clean pivots of shafts by inserting them into a piece of pithwood.

(2) Clean jewels (7 and 16) with a piece of soft pegwood freshly tapered for each jewel.

(3) Clean the teeth of pinion (18) and gear and cup assembly (12) with a stiff hair brush or glass fiber brush.

(4) Clean metal parts with Naptha or an approved solvent. Dry in accordance with standard shop practice.

(5) Keep parts clean and free from dust particles until reassembled.

4. Inspection/Check.

A. Inspect main assembly of indicator according to following steps:

(1) Inspect all parts for visible wear, damage, or defects.

(2) Inspect washers for scratches, scoring or damage.

(3) Inspect threads for stripping or burrs.

(4) Inspect lead wires for breaks.

(5) Inspect insulation for damage, breakdown or frayed material.

(6) Inspect pins of connector (4) for bending, breaks or loosening.

(7) Inspect case and glass assembly (8) for leaks, corrosion, dents or damage to case.

(8) Inspect glass (10) for chips or cracks.

(9) Inspect dial (15) and pointers (13 and 14) for chipped paint.

(10) Inspect bearings (39) for damage, wear or foreign material.

B. Inspect gear train assembly according to the following steps:

(1) Inspect jewels (7 and 16) under magnification for cracks or wear.

(2) Inspect teeth of pinion (18) for breaks, stripping, burrs or foreign material.

(3) Inspect teeth of gear and cup assembly (12) for breaks, stripping, burrs or foreign material.

(4) Inspect hairspring (10) for twisting or distortion, or improperly wound convolutions.

5. Repair.

No repair of any parts is recommended. Replace any parts found in inspection to be defective.

6. Assembly.

A. Assemble the gear train assembly according to the following instructions: (refer to figure 3)

CAUTION: USE CARE IN HANDLING AND ASSEMBLING GEAR TRAIN ASSEMBLY. TEETH OF PINION (18), TEETH OF GEAR AND CUP ASSEMBLY (12), PIVOTS OF SHAFTS (13 and 20), AND JEWELS (4 and 16) ARE DELICATE AND CAN BE EASILY DAMAGED.

(1) Assemble jewels (19) with high surface toward bottom jewel housings in bushing (21). Assemble pinion (18) on end of bushing with tapered end. Adjust opposite jewel for end play of shaft of 0.003 to 0.005 inch. Press on pinion (18) to allow clearance of 0.025 inch between inner face of pinion and opposing face of bushing (21). Hand taper ream hub of pinion if necessary.

(2) Press in bushing and shaft assembly (17) flush to 0.002 inch below rear surface of front plate (22).

(3) Press shaft (13) into gear and cup assembly (12) with 0.215 inch length pivot extending from gear on the side on which balance wheel is staked. Press in shaft (13) until shoulder of large diameter of shaft at front extends 0.401 inch beyond front surface of washer on front of hub of gear and cup assembly (12).

(4) Position hairspring (10) into gear and cup assembly (12) with 0.215 inch length pivot extending from gear on side on which balance wheel is staked (toward rear in exploded view illustration). Press in shaft (13) until shoulder of large diameter of shaft at front extends 0.401 inch beyond front surface of washer on front of hub of gear and cup assembly (12).

(5) Position hairspring (10) on shaft (13) as follows:

(a) View cup and gear assembly (12) from rear with the center of hole, which has been pressed into one of three gear spokes in a vertical position. Place hairspring (10) on shaft (13) so that free end of hairspring points clockwise from vertical.

(b) Maintain this position and press hub of hairspring (10) against hub of gear and cup assembly (12). Hairspring must be parallel to main gear; in free condition hairspring must be centered with shaft.

(c) Locate outer end of hairspring so that coils are equally spaced when the spring is wound up approximately 150 degrees. This adjustment is made by bending outer end of spring while free and after soldered to hairspring plate (6).

(6) Press in pin (15) so that they extend 0.130 inch from rear surface of plate assembly (22).

(7) Press in bushing and shaft assembly (17) flush to 0.002 inch below rear surface of front plate assembly (14).

(8) If jewel (16) was removed, press in place with high point of jewel toward rear of front plate assembly (14).

(9) If jewel (4) was removed press in with high point of jewel toward front of rear plate (5).

(10) Assemble front plate assembly (14), hub, gear and shaft assembly (9), and rear plate assembly (1).

(11) Adjust jewel (16) for 0.0013 to 0.0020 inch end play of shaft (13).

(12) Solder end of hairspring (10) to hairspring plate (6). Bend and readjust as necessary to insure that coils are equally spaced when hairspring is wound up approximately 150 degrees.

B. Assemble the main indicator assembly according to the following instructions: (refer to figure 2)

(1) If stator assembly (38) was removed from housing (40), reassemble as follows:

(a) Place housing in oven at 200°F (±20°F) for a period of two hours.

(b) Immerse stator assembly in dry ice for a period of two hours.

(c) Within five minutes after removal of parts from oven and dry

ice, insert stator into housing.

(2) Completely demagnetize motor rotor assembly (37) with magnetreater model 990. Using magnet charger 107A with fixture 1489486, fully remagnetize motor rotor assembly. Fixture 1449486 must be used in order to obtain desired magnetic path to assure proper motor starting characteristics. Demagnetize to a field strength of 380 to 420 gauss. Insert motor rotor assembly into magnet keeper 1489071 or install it immediately into motor assembly.

(3) Install spacers (36) and motor rotor assembly (37) on shaft of starter and shaft assembly (35).

(4) Place one bearing (39) on shaft of starter and shaft assembly (35) with flanged edge of bearing against spacer (36).

(5) Insert bearing mounted on shaft into seat at rear of motor housing (40).

(6) Place second bearing (39) on shaft on front side of motor housing (40) with flanged edge of bearing toward front of indicator.

(7) If magnet assembly (27) has been exposed to an open magnet circuit, it must be remagnetized. First demagnetize magnet assembly completely using model 990 magnetreater. Then place magnet assembly in magnet charger model 107A with fixture 1489041-1 and charge to full strength. Discharge maximum dc current through magnet charger winding. Remove magnet assembly from magnet charger directly into magnet keeper 1489036-1. Take care to avoid exposure to an open magnetic circuit. Do not remove magnet assembly from magnet keeper until ready to place in return path (26) in indicator.

NOTE: In order to stabilize magnet assembly (27), immerse magnet assembly (in its keeper) in dry ice for two hours, then immerse in boiling water for ten minutes. Repeat cycle a minimum of four times.

NOTE: If compensating discs (31 and 32) are replaced, they must be replaced with equal diameter discs to those removed.

(8) Assemble magnet assembly (27) on shaft extending through housing (40). To avoid demagnetization, place magnet assembly directly on to shaft from magnet keeper.

(9) Adjust end play of motor 0.0013 to 0.0020 inch with 8 oz. reversing gage load and tighten setscrew (28) against disc (29).

(10) Fit drag cup assembly (20) on shaft of gear train assembly (17). A replacement drag cup assembly may require reaming.

(11) Fasten gear train assembly (17) to motor housing (40) using screws (18) and washers (19).

(12) Install dial (15) on gear train assembly using dial screws (16).

NOTE: Apply purple glyptal lacquer to dial screw holes in gear train assembly by placing a drop of glyptal lacquer to end of a wire and placing it in screw hole. Spread glyptal in hole with wire. Add a second drop of glyptal to hole in same manner.

(13) Press pointers (13 and 14) in place on their respective shafts. If new pointers are used they may require reaming with a 3 degree, 3 flute standard taper reamer to achieve a positive fit on shaft.

(14) Connect leads of stator to connector (4) according to wiring diagram (see figure 1)

NOTE: If drag cup magnet has been remagnetized and thermocycled, before recalibrating, the return path should be positioned forward against the rear plate, connected to a generator and operated at 4200 RPM. In this condition, demagnetize the drag cup magnet until the pointer indicates 92 to 93% RPM. Recalibrate.

(15) Connect indicator to tachometer generator TT3 or equivalent. Adjust smoothness of motor when running at low (75 to 100 rpm) speeds. This is accomplished by adjusting screw (24). Lock screw in place after adjustment with locking nut (25).

(16) Place entire mechanism into case and glass assembly (8). Position rear cover in place and tape securely together.

(17) Conduct tests outlined under section 8, Testing, for room temperature starting, scale error, friction error and position error.

(18) If indicator meets all test requirements, remove tape, clean case and cover of any tape residue. If connector (4) was removed solder in place in end cover (6).

(19) Line up end cover so that polarizing key of connector (4) is within 2 degrees of top centerline of dial (15).

(20) Solder end cover (6) in place in case (11).

(21) Connect indicator to dual valve manifold that is connected to both a vacuum pump and a source of helium. Evacuate indicator to a pressure of 50 microns. With vacuum maintained, bake indicator at 71° to 79°C (160° to 175°F) for twelve hours.

(22) Switch valve to dry helium source, backfill and seal indicator by

soldering eyelet (3) in place.

NOTE: Helium used shall be at least 98 percent pure, dust free and shall contain not more than 0.006 milligrams of water vapor per liter (dew point -65°C (-85°F) at filling pressure.

7. Fits and Clearances.

All applicable fits and clearances are called out in assembly procedures.

8. Testing.

A. Unless otherwise specified for an individual test following conditions shall be observed for testing:

(1) All tests shall be conducted at atmospheric pressure (approximately 29.9" Hg.) and at room temperature (approximately +25°C).

(2) Indicator shall be tested in its normal operating position (dial surface shall be held in a vertical plane).

(3) All voltages noted herein are alternating current root-mean-square values. Voltmeter used to measure voltages shall be of a type which is free from frequency error.

(4) Indicator shall be gently tapped or vibrated before a test reading is taken.

B. The indicator shall be subjected to the following tests:

(1) Room temperature starting.

Connect indicator to TT3 generator or an equivalent variable frequency power supply. Supply voltage shall be a maximum of 0.0035 times frequency in cycles per minute. Frequency of supply shall be increased from 0 cycles per minute to a maximum of 150 cycles per minute. Reading shall not be less than 2.5 percent RPM at 150 cycles per minute input.

(2) Scale error.

Connect indicator to TT3 generator and test at points of scale listed in table 2. Test shall be made by setting generator at speed shown and reading error from indicator, or by setting the indicator at desired reading and reading error in generator speed whichever is more convenient. Errors at test points shall not exceed tolerances specified in table 2. When speed is held constant at any point of scale (above 5.0 percent RPM) pointer shall not oscillate over a range greater than 0.5 percent RPM from 3.5 to 15

percent RPM and 0.3 percent RPM from over 15 to 100 percent RPM as shown on indicator.

(3) Friction error.

Indicator shall be set at 5, 20, 40, 85, and 100 percent RPM graduations. After each setting indicator shall be gently tapped and change in indication noted. Change shall not exceed 1.5 percent RPM at 5 percent RPM graduation, and 0.5 percent RPM at 40, 70, 85 and 100 percent graduations. This test may be combined with scale error test.

(4) Position error.

Indicator shall be operated at 100 percent RPM while indicator is in normal operating position. Indicator reading shall be noted. Maximum deviation from normal position reading, when tested in the following positions, shall not exceed 0.3 percent RPM.

(a) Rotated from normal position through 45 degrees to rear (dial tilted 45° back from vertical position).

(b) Rotated from normal position through 45 degrees to front (dial tilted 45° forward from vertical position).

(c) Rotated from normal position through 45 degrees to right (dial vertical).

(d) Rotated from normal position through 45 degrees to left (dial vertical).

(5) Pointer alignment.

Indicator shall be operated so main pointer will indicate 90 and 96 percent RPM respectively. Sub-dial pointer shall then correspondingly indicate 0 and 6 respectively, within 0.2 percent RPM.

(6) Sealing.

Indicator shall be tested for leaks by means of a mass spectrometer type of helium leak detector. Total leak rate shall not exceed 0.1 micron-cubic foot per hour.

(7) Fogging.

Indicator shall be placed in a controlled ambient temperature of 85°C +5°C for minimum period of two hours. Within ten seconds after removal from oven, immerse indicator to depth of ¾ inch (cover glass down) in ice water bath maintained at 0° to 5°C. After 5 minutes remove indicator and quickly wipe dry. Inspect cover glass and dial

immediately for evidence of fog. Evidence of fog is cause for rejection.

As an alternate method, indicator may be placed in a controlled oven with temperature maintained at 71°C ±2°C for a minimum of one hour. Remove indicator and while still at this temperature, rub an ice cube on indicator glass for a period of one to two minutes. Wipe glass dry and inspect indicator for evidence of water or oil fog. Evidence of fog is cause for rejection.

Table 2. Calibration Data

Generator Speed RPM	Current Indication Percent RPM	Scale Error Percent RPM ± Indicated	Tolerance Generator RPM Limits
0	0	0.5	
210	5	0.5	189 - 231
420	10	0.5	339 - 441
630	15	0.5	609 - 651
840	20	0.5	819 - 861
1260	30	0.6	1235 - 1285
1680	40	0.8	1647 - 1713
2100	50	0.8	2067 - 2133
2520	60	0.8	2487 - 2553
2940	70	0.8	2907 - 2973
3150	75	0.5	3129 - 3171
3360	80	0.5	3339 - 3381
3570	85	0.5	3549 - 3591
3780	90	0.5	3759 - 3801
3990	95	0.5	3969 - 4011
4200	100	0.5	4179 - 4221
4410	105	0.5	4389 - 4431
4620	110	0.5	4599 - 4641

9. Trouble Shooting.

Table 3 contains a list of possible defects that may become evident in the indicator. It lists possible causes and steps to correct them.

Table 3. Trouble Shooting

Trouble	Probable Cause	Remedial Steps
Indicator fails position error test. Right or left.	Hairspring out of position.	Reposition hairspring.
Indicator does not meet minimum starting speed requirement.	Screw (24) out of position in return path (26).	Adjust screw (24) until proper speed is obtained.
	Motor rotor assembly (37) demagnetized.	Remagnetize as called out in paragraph.
Indicator fails scale error test.	Incorrect balance, hairspring out of position.	Reposition hairspring.
Indicator fails friction error test.	Dirt on shaft or pivots.	Clean properly.
Indicator fails fogging test.	Moisture or excessive oil.	Open indicator, bake in oven at 71°C to 79°C (160°F to 175°F) for 12 hours.

DIRECTION OF ROTATION OF MAGNET FOR PHASE SEQUENCE B-A-C WHEN VIEWED FROM REAR END OF MOTOR

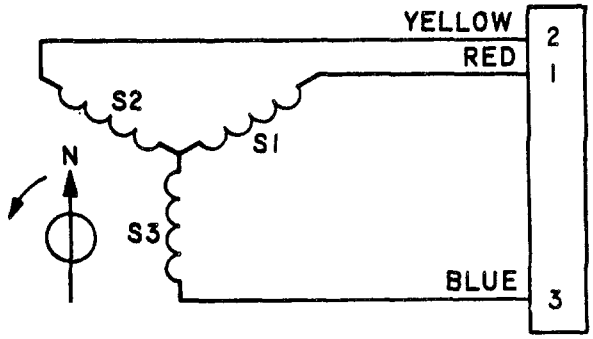


Figure 1. Wiring Diagram

10. Storage Instructions.

Prepare indicator for storage or shipment by placing protective cap, part no. 1489206-12 over connector (4). Using a cardboard box of suitable size, cushion indicator with a sufficient amount of dunnage to prevent any damage during shipment. Make certain that glass (10) is well protected. Seal box with a standard cloth or paper tape.

11. Special Tools, Fixtures and Equipment.

The following listing contains special tools required to overhaul and test indicator. If listed tools are not available, a suitable equivalent may be used. Unless otherwise indicated tools listed are manufactured by The Bendix Corporation.

Table 4. Special Tools and Test Equipment

Part No.	Nomenclature	Application
1489036-1	Magnet Keeper	To hold magnet assembly (27) at disassembly.
1489041-1	Magnetizing Fixture	To hold magnet assembly (27) in magnet charger model 107A.
1489071	Magnet Keeper	To hold motor rotor assembly (37) at disassembly.
1489486	Magnetizing Fixture	To hold motor rotor assembly (37) in magnet charger.
Model 107A	Magnet Charger Radio Frequency Lab. Boonton, N.J.	To remagnetize magnet assembly (27) and motor rotor assembly (37).
Model 990	Magnetreater Radio Frequency Lab. Boonton, N.J.	To demagnetize magnet assembly (27) and motor rotor assembly (37).
MIL-G-26611 MIL-G-9398	Generator	To supply power for indicator tests.

Table 4. Special Tools and Test Equipment (Continued)

Part No.	Nomenclature	Application
Model 24-120A	Helium Leak Detector Consolidated Electro-Dynamics Corp. Pasadena, Calif.	To perform helium leak check.

3L108C1AF13-1A3

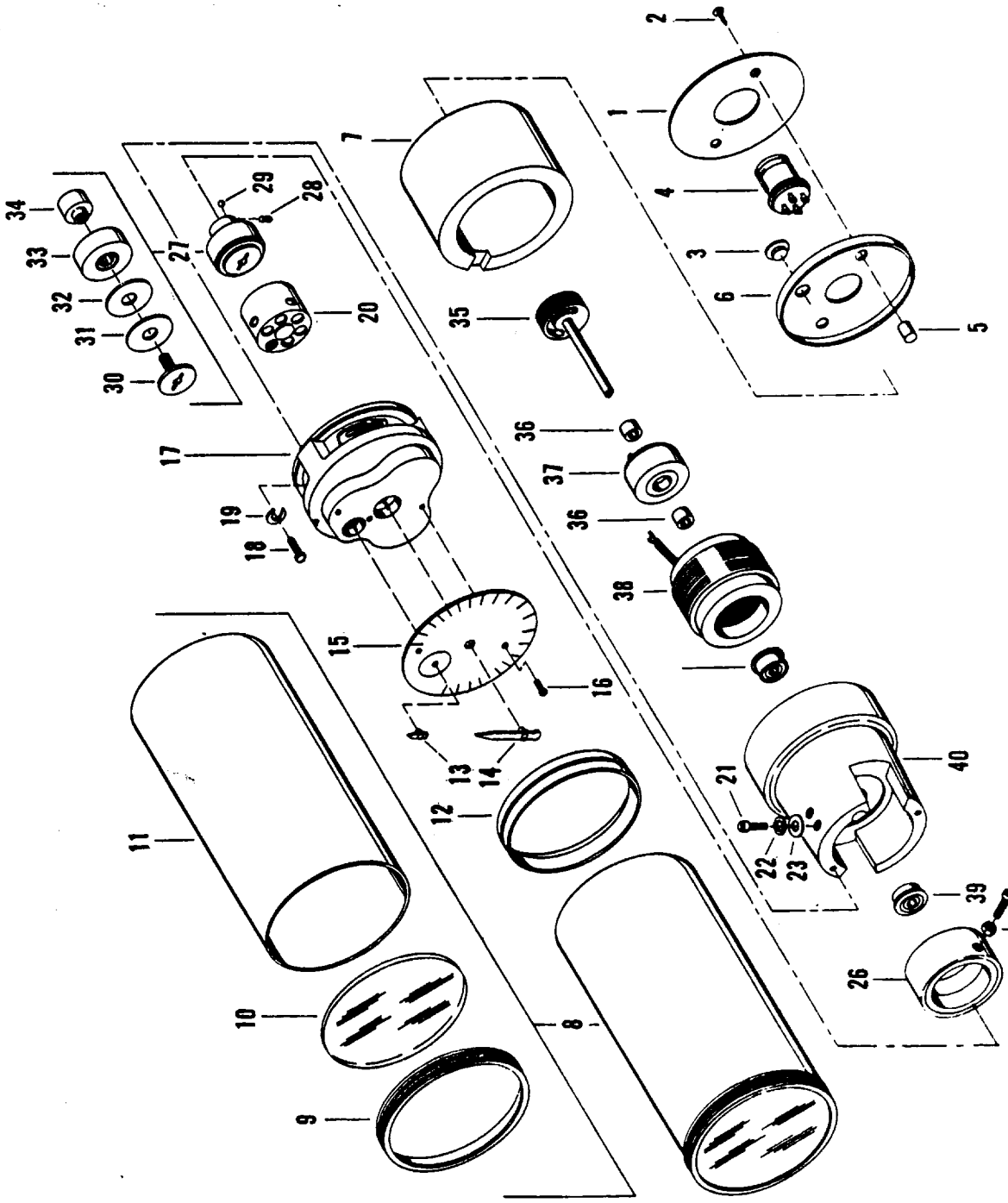


Figure 2. Tachometer Indicator

34108C1AF13-1A3

12. Illustrated Parts List.

FIG. ITEM	PART NUMBER	1234567 NOMENCLATURE	UNITS PER ASSY.
2 -	34108C1AF13-1A3	Tachometer Indicator	
- 1	2272280-0003	.Plate, Identification (Attaching Part)	1
- 2	3027-0103-320	.Screw	2
		---*---	
- 3	1492991-1	.Eyelet	1
- 4	2270343-0001	.Connector	1
- 5	1493274-1	.Nut, Nameplate	2
- 6	1485804-0005	.End Cover	1
- 7	1490063-2	.Ring, Compression	1
- 8	1485773-1	.Case and Glass Assembly	1
- 9	1492120-1	..Ring, Front	1
-10	1490785-1	..Glass	1
-11	1485772-1	..Case	1
-12	1485869-1	.Spacer, Dial	1
-13	2270375-001	.Pointer and Hub Assembly	1
-14	1488182-1	.Pointer Assembly	1
-15	H341C1AL	.Dial (Attaching Part)	1
-16	1489266-125	.Screw, Dial	2
		---*---	
-17	1490066-005	.Gear Train Assembly (Attaching Parts)	1
-18	1490637-1	.Screw	2
-19	1490027-1	.Washer	2
		---*---	
-20	1260205-3	.Drag Cup Assembly	1
-21	3003-0412-120	.Screw, Fillister Head	2
-22	3052-04-21	.Washer, Lock	2
-23	3055-125-2-23	.Washer, Flat	2
-24	3003-0412-130	.Screw	1
-25	3060-04-20	.Nut	1
-26	1494934	.Return Path Assembly	1
-27	1490068-3	.Magnet Assembly (Attaching Parts)	1
-28	3017-0404-131	.Screw	1
-29	1488759-1	.Disc	1
		---*---	
-30	1494117-0004	..Screw	1
-31	1492865-0001	..Disc	1
-32	1492866-0001	..Disc	1
-33	1490067-0001	..Magnet	1
-34	1493116-0003	..Hub	1
-35	1494980	.Starter and Shaft Assembly	1

34108C1AF13-1A3

FIG. ITEM	PART NUMBER	1234567 NOMENCLATURE	UNITS PER ASSY.
2 -36	1485785-3	.Spacer	2
-37	1497000	.Motor Rotor Assembly	1
-38	1497001	.Stator Assembly	1
-39	1494984	.Bearing, Ball	2
-40	1494895	.Housing, Motor	1

FIG. ITEM	PART NUMBER	1234567 NOMENCLATURE	UNITS PER ASSY.
3 -	1490066-005	Gear Train Assembly	1
- 1	1490049-1	.Plate, Rear Assembly (Attaching Parts)	1
- 2	3002-0209-120	.Screw	3
- 3	3050-02-21	.Washer	3
		---*---	
- 4	1494116	..Jewel	1
- 5	1490022-1	..Plate, Rear	1
- 6	1485649-1	.Plate, Hairspring (Attaching Parts)	1
- 7	3042-0204-120	.Screw	1
- 8	3055-094-5-23	.Washer, Flat	1
		---*---	
- 9	1490047-005	.Hub, Gear & Shaft Assembly	1
-10	1494983	..Hairspring	1
-11	1488472-2	..Spring, Balance	AR
-12	1490046-0001	..Gear and Cup Assembly	1
-13	1490061-0001	..Shaft	1
-14	1490091-1	.Front Plate Assembly	1
-15	MS171432	..Roll Pin	1
-16	1494116	..Jewel	1
-17	1486711-1	..Bushing and Shaft Assembly	1
-18	1490949-1	...Pinion Assembly	1
-19	1481927-1	...Jewel	2
-20	1490062-1	...Shaft	1
-21	1490035-1	...Bushing	1
-22	1492659-003	...Plate Assembly	1

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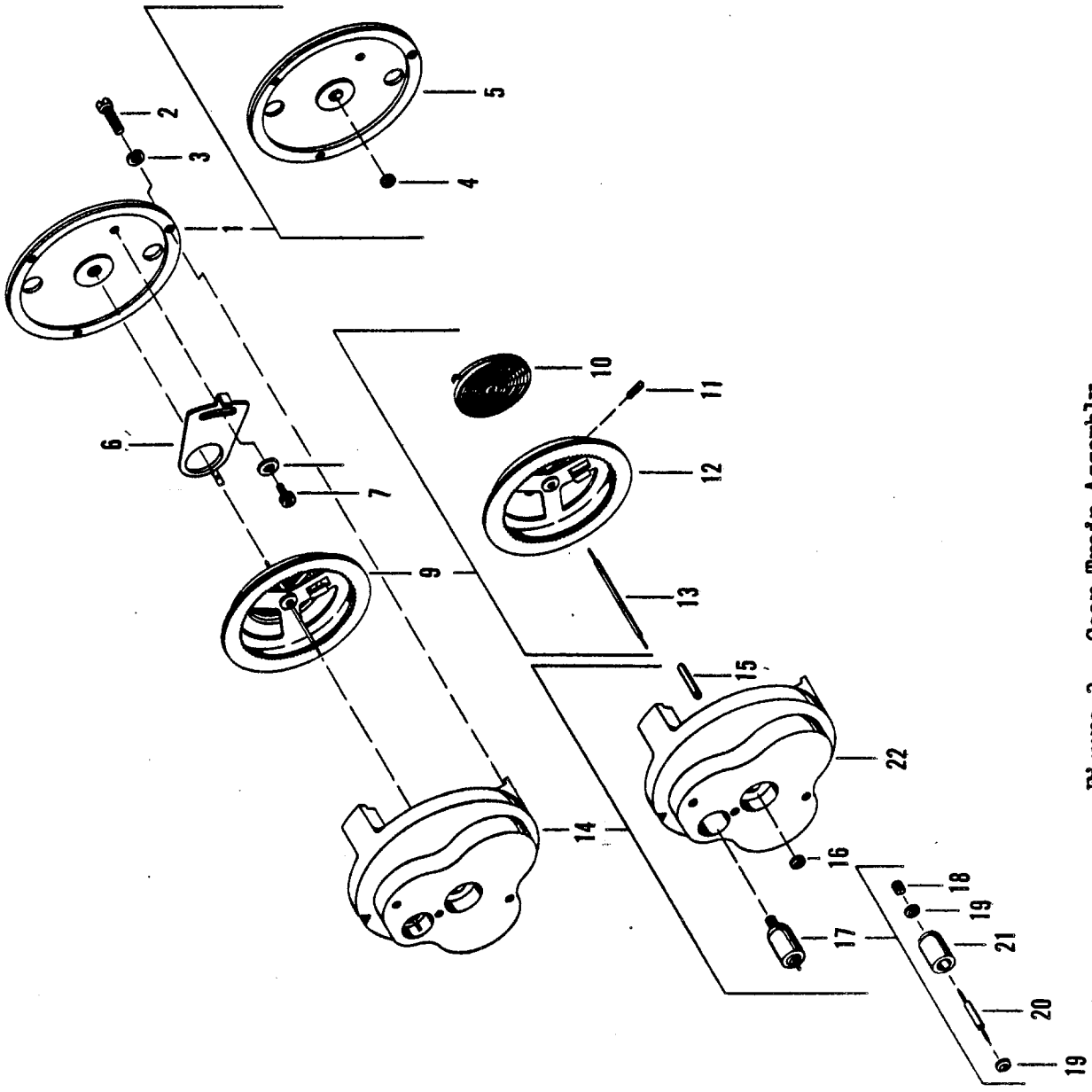


Figure 3. Gear Train Assembly

WOODWARD

BULLETIN 33528E

AIRCRAFT PROPELLER GOVERNOR, SYNCHRONIZER AND UNFEATHERING ACCUMULATOR APPLICATION, MODERNIZATION, AND EXCHANGE GUIDE

WOODWARD GOVERNOR COMPANY
AIRCRAFT CONTROLS DIVISION · HYDRAULIC TURBINE CONTROLS DIVISION
ROCKFORD, ILLINOIS, U.S.A.

ENGINE AND TURBINE CONTROLS DIVISION, FORT COLLINS, COLORADO, U.S.A. JAPAN BRANCH, TOKYO, JAPAN

SUBSIDIARIES:

WOODWARD GOVERNOR (U.K.) LIMITED
SLOUGH, BUCKS, ENGLAND

WOODWARD GOVERNOR NEDERLAND N.V.
HOOFDDORP THE NETHERLANDS

WOODWARD

AIRCRAFT PROPELLER GOVERNOR,

SYNCHRONIZER AND UNFEATHERING ACCUMULATOR

APPLICATION, MODERNIZATION AND EXCHANGE GUIDE

Outdated or worn propeller governors, unfeathering accumulators and automatic synchronizer components may be exchanged at a flat cost for factory remanufactured models that have newest improvements for best speed control.

To order exchange replacements, issue your purchase order to Rockford for the desired items, indicating that these are to replace old units (specifying part numbers and preferably the aircraft/engine/propeller hub model designations). Fresh exchange units will be shipped immediately and you will be invoiced at the flat rate. Return the old units prepaid to our main plant at 5001 North Second Street, Rockford, Illinois 61101. You can reuse our shipping container if you wish.

For twin engine aircraft, replace both governors if we specify pairs only. There is a notable difference in response rate (stability, sensitivity, etc.) between some governor models, if mixed. Matched governor pairs will be furnished. For less common and foreign governor models not listed, please contact Rockford for information.

Factory remanufactured controls carry the standard new part warranty. This provides for F.O.B. factory repair of any defects resulting from improper material or workmanship when installed and used in the manner intended and for as long as it is so used. Governor and accumulator TBO is the same as that specified for the engine except turboprop governor TBO is 1500 hours for the first overhaul and 2200 hours thereafter.

All prices are list per unit, F.O.B. Rockford, Illinois, subject to change without notice (May 1969). Exchange prices presume returned units are in usable condition.

WOODWARD GOVERNOR COMPANY

ROCKFORD, ILLINOIS

815 877-7441

Woodward Propeller Governors

Overhaul of Woodward propeller governors requires special test equipment and must be performed at airworthiness-authority approved facilities only. The following facilities have been approved and have the necessary test equipment to overhaul Woodward governors:

Airwork Corporation, Millville, New Jersey, U.S.A.

Hamilton Standard West Coast Division, Long Beach, California, U.S.A.

Hoffman GmbH and Co., KG, Rosenheim, Germany.

Southwest Airmotive Company, Dallas, Texas, U.S.A.

United Aircraft of Canada Limited, Longueuil, Quebec, Canada.

Woodward Governor Company, Rockford, Illinois, U.S.A.

It is suggested that any operator, who has airworthiness-authority approved facilities for propeller governor overhaul, should contact the Woodward Governor Company directly for any required overhaul information.

Woodward also has a factory exchange replacement program, details of which are given in Bulletin 33528E attached.

Governor	Page	Governor	Page	Governor	Page	Governor	Page	Governor	Page
210060	8	B210310	6	210415	13, 14	210473	20	210575	11
210065	13	C210310	5	210417	20	210474	12	210576	11
B210065	13	A210315	18	210418	20	210486	12	210577	19
210075	5	210335	8	210419	8	210491	9	210578	20
210080	19	210340	13, 14	210428	5	210492	11, 19	A210578	11
210085	9	D210340	12	210433	9	A210492	11	210584	5
210105	13, 15	E210340	4	B210434	20	210493	9	210585	5
B210105	13, 19	210345	13, 14	210436	16	210497	9	210586	5
D210105	12	B210345	18	A210438	15	210498	10, 20	210587	5
H210105	18	D210345	12	B210438	10	A210499	15	210589	18
N210105	4	E210345	4	210439	6, 17	B210499	10	210594	17
210125	9	210350	8	C210439	16	210505	7	210595	17
210150	9	210355	10	D210439	10	210506	7	210596	17
210155	15	B210355	6	210443	16	210507	11, 18, 19	210597	17
210159	9	C210355	15	210444	15	A210507	11, 18, 20	210599	11
210163	9	E210355	6	A210444	17	210508	18, 19	210624	11
210175	8	210360	12	B210444	16	210513	6	405690	18
210180	9	210365	9	210446	15	A210513	5	407545	18
210185	20	210380	19	A210446	16	210514	6	1000-007	13
A210185	20	210385	9	B210446	15, 16	210515	6	1604-014	13
210190	9	210390	18	C210446	17	210516	6	8005-004	18
210195	12	A210390	10, 20	210452	8	210528	11	8005-005	18
210205	7	210400	4, 5	A210452	13, 14	A210528	11	8005-006	18
210235	8	210401	5	B210452	18	210529	16	8005-008	18
210240	12	210402	7	C210452	8	A210529	15, 16	34-825	8
210245	5	210403	4	D210452	4, 14	B210529	17	34-828-01	13
210250	20	B210403	6	F210452	18	C210529	10	1M12	4
210260	20	C210403	5	G210452	14	210533	5	4M12	13
210270	14	210404	7	H210452	12	210536	18	B-4	19
210275	12	210405	4	J210452	13	A210536	18	B4-3	8
210280	14, 15	210406	9	K210452	19	210546	20	C3	7
210290	13, 15	B210409	6	P210452	12	210556	10	C219D2	14
210300	12	B210410	6	210453	18	210567	11	C290D2	13, 14
210305	20	210412	5	210456	10	210568	18		
A210305	20	210413	19	210462	14	210569	11		
210310	4	210414	19	A210462	13	210574	18		

WOODWARD

STANDARD AND OPTIONAL REPLACEMENT GOVERNOR DESIGNATION

AIRCRAFT	GOVERNOR NOW INSTALLED	MODERNIZE TO LATER CONFIGURATION	UNIT EXCH. COST	MODERNIZATION OPTIONS AVAILABLE	UNIT EXCH. COST
Aero Commander (Meyers) 200, 200A, 200B, 200C With non-counter-weighted propeller 2A36C C2YF-1 (Cont. O-470/IO-470)	N210105 (Set for press. to increase pitch) Obsolete-discontinued	E210345 Remodel by conversion to oil damped pilot valve. Stops RPM surge/un-steadiness.	$115.		
	E210345	E210345 Update to latest revision.	$ 69.		
200, 200A, 200B, 200C w/Hartzell counter-weighted propeller 82XF-1 A2XF-1	N210105 (Set for press. to decrease pitch) Obsolete-discontinued	E210340 Remodel by conversion to oil damped pilot valve. Stops RPM surge/un-steadiness.	$115.		
	E210340	E210340 Update to latest revision.	$ 69.		
200D	E210345	D210452 Update to new model standard.	$ 69.		
(Cont. IO-520A)	D210452	D210452 Update to latest revision.	$ 69.		
Aero Commander 500	210400 Obsolete-discontinued	210405 Remodel by conversion to vibration damped head. Stops RPM surge. (Pairs only)	$129.		
	1M12 (surplus-discontinued)	210405 Update to new model standard. Stops RPM surge. (Ref. Aero Comm. service letter 89) (Pairs only)	$250.		
(Lyc. O-540)	210405	210405 Update to latest revision.	$ 97.		
Aero Commander 500A	210310 Obsolete-discontinued	210403 Remodel by conversion to new speed control head. Better Synchronization. (Pairs only)	$129.		
(Cont. IO-470)	210403	210403 Update to latest revision.	$ 97.		

WOODWARD

STANDARD AND OPTIONAL REPLACEMENT GOVERNOR DESIGNATION

AIRCRAFT	GOVERNOR NOW INSTALLED	MODERNIZE TO LATER CONFIGURATION	UNIT EXCH. COST	MODERNIZATION OPTIONS AVAILABLE	UNIT EXCH. COST
Aero Commander "Shrike" 500B 500U 500S	210400	210428 Remodel by conversion to vibration damped head. Improves basic synchronization.	$154.	(RH) 210585 (LH) 210586 Remodel for automatic synchronizer. Conversion adds speed sensing pickups plus speed trimmer head to RH slave governor. (Pairs only)	$450. $270.
See below if aircraft has prop. unfeathering system	210428	210428 Update to latest revision.	$ 97.		
	210585 (Synchronizer slave governor/right hand)	210585 To latest change.	$240.		
(Lyc. IO-540)	210586 (Synchronizer master governor/left hand)	210586 To latest change.	$154.		
With prop. unfeathering pumps.	210401 (Unfeathering Type)	210412 Remodel by conversion to vibration damped head. Improves basic synchronization.	$154.	(LH) 210584 (RH) 210587 Remodel for automatic synchronizer. Conversion adds speed sensing pickups plus speed trimmer head to RH slave governor. (Pairs only)	$270. $450.
	210412 (Unfeathering Type)	210412 Update to latest revision.	$ 97.		
	210584 (Synchronizer/Unfeathering master governor/left hand)	210584 To latest change.	$154.		
	210587 (Synchronizer/Unfeathering slave governor/ right hand)	210587 To latest change.	$240.		
Aero Commander 520 560 560A 560E 680 680E 720	210075 or 210245 Obsolete-discontinued	C210403 Remodel by conversion to oil damped pilot valve. Improves basic synchronization. (Ref. Aero Comm. service change Bull. 48A) (Pairs only)	$197.	(LH) A210513 (RH) 210533 Remodel for automatic synchronizer. Conversion adds speed sensing pickups plus speed trimmer head to RH slave governor. (Pairs only)	$270. $450.
	C210310 Obsolete-discontinued	C210403 Remodel by conversion to new speed control head. Improves basic synchronization. (Pairs only)	$129.		
	C210403	C210403 Update to latest revision.	$ 97.		
	A210513 (Synchronizer master governor/left hand)	A210513 To latest change.	$154.		
(Lyc. GO-435, 480, GSO-480)	210533 (Synchronizer slave governor/right hand)	210533 To latest change.	$240.		

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STANDARD AND OPTIONAL REPLACEMENT GOVERNOR DESIGNATION

AIRCRAFT	GOVERNOR NOW INSTALLED	MODERNIZE TO LATER CONFIGURATION	UNIT EXCH. COST	MODERNIZATION OPTIONS AVAILABLE	UNIT EXCH. COST
Aero Commander 560F 680F 680FL 680FLP (See below if aircraft has prop unfeathering system.) (Lyc. IGSO-540)	B210310 Obsolete-discontinued	B210403 Remodel by conversion to new speed control head. Improves basic synchronization. (Pairs only)	$129.	(LH) 210513 (RH) 210514 Remodel for automatic constant speed prop. sychronizer. Conversion adds speed sensing pickups plus speed trimmer head to RH slave governor. (Pairs only)	$270. $450.
	B210403	B210403 Update to latest standard revision.	$ 97.		
	210513 (Synchronizer master governor/left hand)	210513 To latest change.	$154.		
	210514 (Synchronizer slave governor/right hand)	210514 To latest change.	$240.		
With prop unfeathering pumps.	B210410 (Unfeathering type) Obsolete-discontinued	B210409 Remodel by conversion to new speed control head. Improves basic synchronization. (Pairs only)	$129.	(LH) 210515 (RH) 210516 Remodel for automatic constant speed prop. synchronizer. Conversion adds speed sensing pickups plus speed trimmer head to RH slave governor. (Pairs only)	$270. $450.
	B210409 (Unfeathering type)	B210409 Update to latest standard revision.	$ 97.		
	210515 (Synchronizer master/unfeathering governor, left hand)	210515 To latest change.	$154.		
	210516 (Synchronizer slave/unfeathering governor, right hand)	210516 To latest change.	$240.		
Beagle Series 1 B. 206 (Cont. GIO-470)	B210355 (Accumulator/unfeathering type) Obsolete-discontinued	E210355 Increased R.V. pressure/ Improved prop. control.	$ 97.		
Series 2 B. 206 (Cont. GTSIO-520C)	210439 (Accumulator/unfeathering type)	210439 To latest change.	$ 97.		

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STANDARD AND OPTIONAL REPLACEMENT GOVERNOR DESIGNATION

AIRCRAFT	GOVERNOR NOW INSTALLED	MODERNIZE TO LATER CONFIGURATION	UNIT EXCH. COST	MODERNIZATION OPTIONS AVAILABLE	UNIT EXCH. COST
Beech D18S E18S 9700 G18S H18	L210404 R210404 (Accumulator unfeathering type)	L210404 R210404 Update to latest standard revision.	$169.	L210505 R210505 Remodel for automatic constant speed prop. synchronizer. Conversion adds speed sensing pick-up to governor. (Pairs only)	$365.
Three Blade Propellers & Unfeathering Accumulators	C3 (surplus)	L210404 R210404 (Accumulator unfeathering type governor.) Update to new model standard. (Pairs only)	$365.	L210505 R210505 Synchronizer/accumulator unfeathering type governor. (Pairs only)	$470.
(P & W R-985)	L210505 R210505 (Synchronizer/accumulator unfeathering type)	L210505 R210505 To latest change.	$225.		
D18S E18S 9700 G18S H18 Three Blade Propellers & unfeathering pumps.	L210402 R210402 (Pump unfeathering type)	L210402 R210402 Update to latest revision.	$154.	L210506 R210506 Remodel for automatic constant speed prop. synchronizer. Governor remains pump unfeathering type. (Pairs only)	$325.
	L210205 R210205 (Old pump unfeathering type) Obsolete-discontinued	L210402 R210402 Conversion to new speed control head. Improves basic synchronization. (Pairs only)	$169.		
	C3 (surplus)	L210402 R210402 (Pump or crossover unfeathering type governor (Pairs only)	$325.	L210506 R210506 Synchronizer/pump unfeathering type governor. (Pairs only)	$405.
	L210506 R210506 (Synchronizer, pump unfeathering type)	L210506 R210506 To latest change.	$197.		

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STANDARD AND OPTIONAL REPLACEMENT GOVERNOR DESIGNATION

AIRCRAFT	GOVERNOR NOW INSTALLED	MODERNIZE TO LATER CONFIGURATION	UNIT EXCH. COST	MODERNIZATION OPTIONS AVAILABLE	UNIT EXCH. COST
Beech "Bonanza" Series H35 J35 K35 M35 N35 P35 With Beech Propeller (Cont. O-470/IO-470)	210175 210235 Obsolete-discontinued	210419 Remodel by conversion to oil damped pilot valve. Stops RPM surge/unsteadiness.	$142.		
	210350 210419	210419 To latest change.	$ 69.		
33 A33 B33 C33 E33 H35 J35 K35 M35 N35 P35 With Flottorp or McCauley Propeller	34-825 (surplus)	210452 Update to new model standard.	$ 92.		
	210452 (2625 RPM)	210452 To latest change.	$ 69.		
C33A E33A (Cont. IO-520B)	C210452 (2700 RPM)	C210452 To latest change.	$ 69.		
S35 V35 V35A 36 (Cont. TSIO-520-D/ IO-520-B)	C210452 (2700 RPM)	C210452 To latest change.	$ 69.		
Beech "Mentor" Series A45 D45 (Cont. O-470-13/ O-470-4)	210060	210060 Update to latest revision. Stops RPM surge/unsteadiness.	$ 97.		

STANDARD AND OPTIONAL REPLACEMENT GOVERNOR DESIGNATION

AIRCRAFT	GOVERNOR NOW INSTALLED	MODERNIZE TO LATER CONFIGURATION	UNIT EXCH. COST	MODERNIZATION OPTIONS AVAILABLE	UNIT EXCH. COST
Beech "Twin Bonanza" Series C50 With 2-Blade Propeller	210085 Obsolete-discontinued	210159 Remodel for increased sensitivity to engine speed changes. Improves basic synchronization. (Pairs only)	$ 97.	210163 Remodel for automatic constant speed prop synchronizer. Conversion adds speed sensing pick-up to governor. (Pairs only)	$510.
	210159	210159 To latest change.	$ 97.		
(Lyc. G0-480)	210163 (Synchronizer Type)	210163 To latest change.	$154.		
C50 Converted to 3-Blade Propellers	210085 210159 (Pump/unfeathering Type)	210406 Remodel to oil damped pilot valve and integral accumulator unfeathering shutoff valve. (Pairs only)	$169.	210491 Remodel for accumulator unfeathering and constant speed prop. synchronizer. Conversion adds speed sensing pickup to governor.	$240.
	210406 (Accumulator/Unfeathering Type)	210406 To latest change.	$ 97.		
(Lyc. G0-480)	210491 (Synchronizer/Unfeathering Type)	210491 To latest change.	$129.		
D50 E50 F50 G50 H50 J50 (Queen Air) 65 A65 See below if aircraft has propeller unfeathering system. (Lyc. G0-480) GS0-480 IGS0-480	210125 210150 210180 210190 Obsolete-discontinued	210385 Remodel by conversion to oil damped pilot valve. Improves basic synchronization. (Pairs only.) NOTE: Do not use if aircraft has unfeathering accumulators. See below.	$138.	210493 Remodel for automatic constant speed prop. synchronizer. Conversion adds speed sensing pick-up to governor. (Pairs only)	$197.
	210365 210385	210385 Update to latest revision. NOTE: Do not use if aircraft has unfeathering accumulators. See below.	$ 69.		
	210493 (Synchronizer Type)	210493 To latest change.	$115.		
With Unfeathering Accumulators.	210190 210365 210385	210433 Remodel to update unfeathering system. Conversion adds integral shutoff valve and oil damped pilot valve. Eliminates external valve and linkages. (Pairs only)	$169.	210497 Remodel for automatic constant speed prop. synchronizer and accumulator unfeathering. (Pairs only)	$240.
	210433 (Unfeathering Type)	210433 To latest change.	$ 97.		
	210497 (Synchronizer/Unfeathering Type)	210497 To latest change.	$129.		

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STANDARD AND OPTIONAL REPLACEMENT GOVERNOR DESIGNATION

AIRCRAFT	GOVERNOR NOW INSTALLED	MODERNIZE TO LATER CONFIGURATION	UNIT EXCH. COST	MODERNIZATION OPTIONS AVAILABLE	UNIT EXCH. COST
Beech "Baron" Series 55 A55 B55	210355 (Accumulator/unfeathering Type) Obsolete-discontinued	B210438 Remodel by conversion to spring damped head. Improves basic synchronization.	$115.	B210499 Remodel for automatic constant speed prop. synchronizer. Conversion adds speed sensing pick-up to governor. (Pairs only)	$225.
	B210438 (Accumulator/unfeathering Type)	B210438 To latest change.	$ 97.		
(Cont. IO-470)	B210499 (Synchronizer/unfeathering Type)	B210499 To latest change.	$129.		
C55 D55	D210439 (Accumulator/unfeathering Type)	D210439 To latest change.	$97.	C210529 Remodel for automatic constant speed prop. synchronizer. Conversion adds speed sensing pick-up to governor. (Pairs only)	$225.
(Cont. IO-520)	C210529 (Synchronizer/unfeathering Type)	C210529 To latest change.	$129.		
Beech "Turbo Baron" 56TC "Duke" 60	210456 (Accumulator/unfeathering Type)	210456 To latest change.	$ 97.	210556 Remodel for automatic constant speed prop. synchronizer. Conversion adds speed sensing pick-up to governor. (Pairs only)	$270.
(Lyc. TIO-541)	210556 (Synchronizer/unfeathering Type)	210556 To latest change.	$129.		
Beech "Queen Air" Series 80 A80 B80 88	A210390 Accumulator/unfeathering Type)	A210390 To latest change.	$ 97.	210498 Remodel for automatic constant speed prop. synchronizer. Conversion adds speed sensing pick-up to governor. (Pairs only)	$225.
(Lyc. IGSO-540)	210498 (Synchronizer/unfeathering Type)	210498 To latest change.	$129.		

STANDARD AND OPTIONAL REPLACEMENT GOVERNOR DESIGNATION

AIRCRAFT	GOVERNOR NOW INSTALLED	MODERNIZE TO LATER CONFIGURATION	UNIT EXCH. COST	MODERNIZATION OPTIONS AVAILABLE	UNIT EXCH. COST
Beech "KingAir" Series 90	210492 (Primary prop. governor non-reversing type)	210492 Update to latest revision.	$115.	210528 Remodel for automatic constant speed prop. synchronizer. Conversion adds speed sensing pick-up to governor. (Pairs only)	$225.
Non-reversing props (UACL PT6A-6)	210507 (Power turbine overspeed prop. governor)	A210507 Update to latest revision.	$115.		
	210528 (Primary prop. governor synchronizer/non-reversing type)	210528 Update to latest revision.	$129.	A210578 Remodel for reversing prop. (Pairs only)	$510.
90 A90 B90 Non-reversing props (UACL PT6A-20)	A210492 (Primary prop. governor non-reversing type)	A210492 Update to latest revision.	$115.	A210528 Remodel for automatic synchronizer. (Pairs only)	$225.
	A210528 (Primary prop. governor. Synchronizer/non-reversing type)	A210528 Update to latest revision.	$129.		
A90 B90	210507 (Power turbine overspeed prop. governor)	A210507 Update to latest revision.	$115.		
Reversing props/ governors. (UACL PT6A-20)	210567 (Primary prop. governor reversing/synchronizer/ remote pitch lock type) Obsolete-Discontinued	A210578 Remodel by conversion to attached solenoid shutoff valve. Eliminates remote shutoff valve and external plumbing. (Pairs only)	$510.		
See below if aircraft has propeller auto-feather.	210569 (Primary prop. governor. Reversing/remote pitch lock type) Obsolete-Discontinued	210599 Remodel by conversion to attached solenoid shutoff valve. Eliminates remote shutoff valve and external plumbing.	$485.	A210578 Remodel for automatic constant speed prop. synchronizer. Conversion adds speed sensing pick-up to governor. (Pairs only)	$510.
	210575 (Primary prop. governor. Reversing/pitch lock type) Obsolete-Discontinued	210599 Remodel for increased stability. (Pairs only)	$197.	A210578 Remodel for automatic synchronizer. (Pairs only)	$325.
	210576 (Primary prop. governor. Reversing/synchronizer/pitch lock type) Obsolete-Discontinued	A210578 Remodel for increased stability. (Pairs only)	$225.		
	A210578 (Primary prop. governor. Reversing/synchronizer/pitch lock type)	A210578 Update to latest revision.	$225.		
	210599 (Primary prop. governor. Reversing/pitch lock type)	210599 Update to latest revision.	$197.		
Beech 99 B90	210599 (Primary prop. governor. Reversing/pitch lock type)	210599 To latest change.	$197.		
W/Auto-feather system. (UACL PT6A-20)	210624 (Power turbine overspeed prop. governor. Auto-feather/ synchronizer type.)	210624 To latest change. Minus optional synchronizer speed pickup P/N 5430-904.	$197.	210624 To latest change. Plus synchronizer pickup installed/ tested.	$282.

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STANDARD AND OPTIONAL REPLACEMENT GOVERNOR DESIGNATION

AIRCRAFT	GOVERNOR NOW INSTALLED	MODERNIZE TO LATER CONFIGURATION	UNIT EXCH. COST	MODERNIZATION OPTIONS AVAILABLE	UNIT EXCH. COST
Beech "Travel Air" Series 95 B95 B95A D95A E95	210195 210300 Obsolete-Discontinued	210360 Remodel by conversion to oil damped pilot valve. Improves basic synchronization. (Pairs only)	$142.	210474 Remodel for automatic constant speed prop. synchronizer. Conversion adds speed sensing pick-up to governor. (Pairs only)	$225.
See below if aircraft has propeller unfeathering system. (Lyc. O-360 IO-360)	210360	210360 To latest change.	$ 69.		
	210474 (Synchronizer Type)	210474 To latest change.	$115.		
With Unfeathering Accumulators	210240 (Unfeathering Type)	210240 To latest change.	$97.	210486 Remodel for automatic constant speed prop. synchronizer. Conversion adds speed sensing pick-up to governor. (Pairs only)	$225.
	210360	210240 Remodel to update unfeathering system. Conversion adds integral shutoff valve. Eliminates external valve and linkages. (Pairs only)	$154.		
	210486 (Synchronizer/Unfeathering Type)	210486 To latest change.	$129.		
Bellanca 14-19-2 **Bellanca** 260 With McCauley Prop. Cont. (O-470 IO-470)	D210105 (Set pressure to increase pitch) Obsolete-Discontinued	D210345 Remodel by conversion to oil damped pilot valve. Stops RPM surge/unsteadiness.	$115.		
	D210345	D210345 To latest change.	$ 69.		
14-19-2 w/ Hartzell counterweighted propeller 82 XF-1 A2 XF-1	D210105 (Set pressure to decrease pitch) Obsolete-Discontinued	D210340 Remodel by conversion to oil damped pilot valve. Stops RPM surge/unsteadiness.	$115.		
	D210340	D210340 To latest change.	$ 69.		
260A 260B 260C (Cont. IO-470)	H210452 (2625 RPM)	H210452 To latest change.	$ 69.		
Bellanca "Viking" 300 (Cont. IO-520D)	P210452 (2850 RPM)	P210452 To latest change.	$ 69.		
Britten Norman "Islander" BN-2 (Lyc. O-540 E4C5)	210275 (Unfeathering Type)	210275 To latest change.	$ 97.		

STANDARD AND OPTIONAL REPLACEMENT GOVERNOR DESIGNATION

AIRCRAFT	GOVERNOR NOW INSTALLED	MODERNIZE TO LATER CONFIGURATION	UNIT EXCH. COST	MODERNIZATION OPTIONS AVAILABLE	UNIT EXCH. COST
Cessna 180 182 All series With McCauley Prop. or Hartzell	B210065 B210105 (Set for Press to increase pitch) Obsolete-Discontinued	A210452 Remodel by conversion to oil damped pilot valve. Stops RPM surge/unsteadiness.	$ 82.		
82XF-6 C2YF-1	210345 210415 A210452	A210452 Update to new model standard.	$ 69.		
(Cont. O-470)	34-828-01 C290D2	A210452 Update to new model standard.	$ 92.		
180 182 (Early Series) With Hartzell Counterweighted Propeller	210065 210105 (Set for Press. to decrease pitch) Obsolete-Discontinued	210340 Remodel by conversion to oil damped pilot valve. Stops RPM surge/unsteadiness.	$115.		
A2XF-1 82XF-1	210290 210340	210340 To latest change.	$ 69.		
	4M12 Obsolete-Discontinued	210340 Update to new model standard.	$154.		
Cessna 185 Series	210345 A210452	A210452 Update to new model standard.	$ 69.		
(Cont. IO-470)	1000007 1604014 34-828-01	A210452 Update to new model standard.	$ 92.		
A185E A188	J210452 A210462	A210462 (2850 RPM) Update to new model standard.	$ 69.		
(Cont. IO-520D)	34-828-01 C290D2	A210462 (2850 RPM) Update to new model standard.	$ 92.		
Cessna 188	A210452	A210452 To latest change.	$ 69.		
(Cont. O-470)	34-828-01 C290D2	A210452 Update to new model standard	$ 92.		

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STANDARD AND OPTIONAL REPLACEMENT GOVERNOR DESIGNATION

AIRCRAFT	GOVERNOR NOW INSTALLED	MODERNIZE TO LATER CONFIGURATION	UNIT EXCH. COST	MODERNIZATION OPTIONS AVAILABLE	UNIT EXCH. COST
Cessna 205 All Series with Hartzell Counter-weighted Propeller A2XF-1 (Cont. IO-470)	210340	210340 To latest change.	$ 69.		
205 with McCauley Propeller	A210452 (2625 RPM)	A210452 To latest change.	$ 69.		
Cessna 206 P206 P206A P206B P206C U206 U206A (Cont. IO-520A	D210452 (2700 RPM)	D210452 To latest change.	$ 69.		
	C290D2	D210452	$ 92.		
TP206A TP206B TP206C TU206A TU206B TU206C (Cont. TSIO-520C)	G210452 (2700 RPM)	G210452 To latest change.	$ 69.		
	C290D2	G210452	$ 92.		
U206B U206C (Cont. IO-520F)	210462 (2850 RPM)	210462 To latest change.	$ 69.		
	C290D2	210462	$ 92.		
Cessna 210 210A 210B 210C With McCauley Prop. (Cont. IO-470)	210270 (Set for Press to increase pitch) Obsolete-Discontinued	A210452 Remodel by conversion to oil damped pilot valve. Stops RPM surge/unsteadiness.	$ 82.		
	210345 210415 A210452	A210452 To latest change.	$ 69.		
210 210A 210B 210C	210270 (Set for press to decrease pitch) Obsolete-Discontinued	210340 Remodel by conversion to oil damped pilot valve. Stops RPM surge/unsteadiness.	$115.		
With Hartzell Counter-weighted Prop. A2XF-1	210280 210340	210340 To latest change.	$ 69.		
210D 210E 210F 210G 210H 210J (Cont. IO-520A)	D210452 (2700 RPM)	D210452 To latest change.	$ 69.		
	C290D2	D210452	$ 92.		
T210F T210G T210H T210J (Cont. TSIO-520C)	G210452 (2700 RPM)	G210452 To latest change.	$ 69.		
	C290D2 C219D2	G210452	$ 92.		

STANDARD AND OPTIONAL REPLACEMENT GOVERNOR DESIGNATION

AIRCRAFT	GOVERNOR NOW INSTALLED	MODERNIZE TO LATER CONFIGURATION	UNIT EXCH. COST	MODERNIZATION OPTIONS AVAILABLE	UNIT EXCH. COST
Cessna 310-310N	210105 210155 Obsolete-Discontinued	210444 Remodel by conversion to oil damped pilot valve and vibration damped head. Improves basic synchronization.	$154.	A210438 Convert to prop. accum. unfeathering. Modification adds integral shutoff valve. (Pairs only)	$183.
Cessna 320-320C See below if aircraft has prop. unfeathering system.				210446 Remodel for automatic constant speed prop synchronizer. Conversion adds speed sensing pickup to governor. (Pairs only)	$210.
				A210499 Remodel for prop. automatic synchronizer and accum. unfeathering. (Pairs only)	$240.
	210280 210290 Obsolete-Discontinued	210444 Remodel by conversion to vibration damped flyweight head. Improves basic synchronization.	$115.	A210438 Convert to prop. accum. unfeathering. Modification adds integral shutoff valve. (Pairs only)	$154.
				210446 Remodel for automatic constant speed prop. synchronizer. Conversion adds speed sensing pickup to governor. (Pairs only)	$183.
				A210499 Remodel for prop. automatic synchronizer and accum. unfeathering. (Pairs only)	$210.
(Cont. O-470 IO-470 TSIO-470)	210444	210444 To latest change.	$ 79.	210446 Remodel for automatic synchronizer. Conversion adds speed sensing pickup to governor. (Pairs only)	$183.
	C210355 (Unfeathering Type) Obsolete-Discontinued	A210438 Remodel by conversion to vibration damped head. Improves basic synchronization.	$115.	A210499 Remodel for automatic constant speed prop. synchronizer. Conversion adds speed sensing pickup to governor. (Pairs only)	$210.
With unfeathering accumulators	A210438 (Unfeathering Type)	A210438 To latest change.	$ 97.		
	A210499 (Synchronizer/unfeathering Type)	A210499 To latest change.	$129.		
320D 320E 320F See below if aircraft has prop. unfeathering system. (Cont. TSIO-520)	B210446 (Synchronizer Type)	B210446 To latest change.	$115.		
With unfeathering accumulators	A210529 (Synchronizer/unfeathering Type)	A210529 To latest change.	$129.		

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STANDARD AND OPTIONAL REPLACEMENT GOVERNOR DESIGNATION

AIRCRAFT	GOVERNOR NOW INSTALLED	MODERNIZE TO LATER CONFIGURATION	UNIT EXCH. COST	MODERNIZATION OPTIONS AVAILABLE	UNIT EXCH. COST
Cessna "Skymaster" (All Series 336 337 (See below if aircraft does not have prop unfeathering system). (Cont. IO-360 TSIO-360)	210436 (Unfeathering Type)	210436 To latest change.	$ 97.	210529 Remodel for automatic constant speed prop. synchronizer. Conversion adds speed sensing pick-up to governor. (Pairs only)	$225.
	210529 (Synchronizer/unfeathering Type)	210529 To latest change.	$129.		
Without unfeathering accumulators.	210443	210443 To latest change.	$ 69.	210436 Convert to prop. accumulator unfeathering. Modification adds integral shutoff valve. (Pairs only)	$154.
				A210446 Remodel for automatic constant speed prop. synchronizer. Conversion adds speed sensing pick-up to governor. (Pairs only)	$183.
				210529 Remodel for prop. automatic synchronizer and accumulator unfeathering. (Pairs only)	$225.
	A210446 (Synchronizer Type)	A210446 To latest change.	$115.	210529 Convert to prop. accumulator unfeathering. (Pairs only)	$225.
Cessna 401 (All Series) 402 See below if aircraft has prop. unfeathering system. (Cont. TSIO-520)	B210444	B210444 To latest change.	$ 79.	B210446 Remodel for automatic constant speed prop. synchronizer. (Pairs only)	$183.
	B210446 (Synchronizer Type)	B210446 To latest change.	$115.		
With unfeathering accumulators.	C210439 (Unfeathering Type)	C210439 To latest change.	$ 97.	A210529 Remodel for automatic constant speed prop. synchronizer. (Pairs only)	$225.
	A210529 (Synchronizer/unfeathering Type)	A210529 To latest change.	$129.		

STANDARD AND OPTIONAL REPLACEMENT GOVERNOR DESIGNATION

AIRCRAFT	GOVERNOR NOW INSTALLED	MODERNIZE TO LATER CONFIGURATION	UNIT EXCH. COST	MODERNIZATION OPTIONS AVAILABLE	UNIT EXCH. COST
Cessna 411 (All Series) (See below if aircraft does not have prop. unfeathering system).	210439 (Unfeathering Type)	210439 To latest change.	$ 97.	B210529 Remodel for automatic constant speed prop. synchronizer. Conversion adds speed sensing pick-up to governor. (Pairs only)	$225.
(Cont. GTSI0-520C)	B210529 (Synchronizer/unfeathering Type)	B210529 To latest change.	$129.		
Without unfeathering accumulators.	A210444	A210444 To latest change.	$ 79.	210439 Convert to prop. accumulator unfeathering. Modification adds integral shutoff valve. (Pairs only)	$154.
				C210446 Remodel for automatic constant speed prop. synchronizer. Conversion adds speed sensing pick-up to governor. (Pairs only)	$183.
				B210529 Remodel for automatic synchronizer and accumulator unfeathering. (Pairs only)	$225.
	C210446 (Synchronizer Type)	C210446 To latest change.	$115.	B210529 Convert to prop. accumulator unfeathering. (Pairs only)	$225.
Cessna (All Series) 421 (See below if aircraft has prop. unfeathering system.)	210594	210594 Advanced to newest standard revision.	$ 79.	210595 Remodel for automatic constant speed prop. synchronizer. Conversion adds speed sensing pick-up to governor. (Pairs only)	$197.
(Cont. GTSI0-520D)	210595 (Synchronizer Type)	210595 Advanced to newest revision.	$129.		
With unfeathering accumulators.	210596 (Unfeathering Type)	210596 Advanced to newest revision.	$ 97.	210597 Remodel for automatic synchronizer. Conversion adds speed sensing pickup to governor. (Pairs only)	$225.
	210597 (Synchronizer/unfeathering Type)	210597 Advanced to newest revision.	$129.		

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STANDARD AND OPTIONAL REPLACEMENT GOVERNOR DESIGNATION

AIRCRAFT	GOVERNOR NOW INSTALLED	MODERNIZE TO LATER CONFIGURATION	UNIT EXCH. COST	MODERNIZATION OPTIONS AVAILABLE	UNIT EXCH. COST
DeHavilland "TurboBeaver" DHC-2 MK. 3 (UACL PT6A-6 PT6A-20)	210507 (Power turbine overspeed prop governor)	A210507 Advanced to newest revision.	$115.		
	210508 (Primary prop governor non-reversing type)	210508 Advanced to newest revision.	$115.	210574 Remodel for reversing prop.	$490.
	210574 (Primary prop governor-reversing/pitch lock type)	210574 Advanced to newest revision.	$197.		
DeHavilland "Twin Otter" DHC-6 With reversing props/ governors (UACL PT6A-20)	210536 (Power turbine overspeed prop governor)	A210536 Advanced to newest revision.	$115.		
	210568 (Primary prop governor-remote pitch lock type) Obsolete-Discontinued	210574 Conversion to attached solenoid shutoff valve. Eliminates remote shutoff valve and external plumbing. (Pairs only)	$490.		
	210574 (Primary prop governor-reversing/pitch lock type)	210574 Advanced to newest revision.	$197.	210589 Remodel for automatic constant speed prop. synchronizer. Conversion adds speed sensing pickup to governor. (Pairs only)	$325.
Dornier D028D "Sky Servant" (LYC IGS0-540AIE)	210390 (Unfeathering Type)	210390 Advanced to newest revision.	$ 97.		
Lear Jet 23 24 25 (GE CJ610)	405690 407545 8005-004 (Overspeed fuel governor)			8005-005 Remodel for automatic turbojet synchronizer. Conversion adds speed sensing pickup to governor. (Pairs only)	$345.
	8005-008 (Overspeed fuel governor)			8005-006 Remodel as above.	$345.
Maule "Rocket" M-4-210 (Cont. I0-360)	F210452	F210452 Advanced to newest revision.	$ 69.		
Maule M-4-220 (All Series) (Franklin 6A-350-CI)	210453	210453 Advanced to newest revision.	$ 69.		
Mooney "Mark 21" Series M20A (Lyc. 0-360)	H210105 Obsolete-Discontinued	A210315 Conversion to oil damped pilot valve. Steadies RPM.	$142.		
	A210315	A210315 Advanced to newest revision.	$ 69.		
M20B	B210345	B210345 Advanced to newest revision.	$ 69.		
M20C M20D	B210452	B210452 Advanced to newest revision.	$ 69.		

STANDARD AND OPTIONAL REPLACEMENT GOVERNOR DESIGNATION

AIRCRAFT	GOVERNOR NOW INSTALLED	MODERNIZE TO LATER CONFIGURATION	UNIT EXCH. COST	MODERNIZATION OPTIONS AVAILABLE	UNIT EXCH. COST
Navion Series D E F G (Cont. O-470 I0-470)	B210105 Obsolete-Discontinued	210380 Conversion to oil damped pilot valve. Steadies RPM.	$142.		
	210380	210380 Advanced to newest revision.	$ 69.		
Series H (Cont. I0-520B)	K210452	K210452 Advanced to newest revision.	$ 69.		
Pilatus "Turbo Porter" PC-6/B-H2 (UACL PT6A-6)	210492 210508 (Primary prop. governors).	210508 Update to latest revision	$115.	210577 Remodel to reversing/pitch lock type governor.	$485.
	210507 (Power turbine overspeed prop. governors).	A210507 Update to latest revision.	$115.		
PC-6/B1-H2 (UACL PT6A-20)	A210507 (Power turbine overspeed prop. governor).	A210507 Update to latest revision.	$115.		
	210577 (Primary prop. governor. Reversing/pitch lock type).	210577 Update to latest revision.	$197.		
Piper "Apache" Series PA23-150 PA23-160	210080	210413 Conversion to sleeve pilot valve. Faster feathering. (Pairs only)	$142.	210414 Convert to prop. accumulator unfeathering. Modification adds integral shutoff valve. (Pairs only)	$183.
	210080	210080 Advanced to newest revision.	$ 69.		
See below if aircraft has prop. unfeathering system. (Lyc. O-320)	210413	210413 Advanced to newest revision.	$ 69.	210414 Convert to prop. accumulator unfeathering. Modification adds integral shutoff valve. (Pairs only)	$154.
With unfeathering accumulators.	210414 (Unfeathering Type)	210414 Advanced to newest revision.	$ 97.		

WOODWARD

STANDARD AND OPTIONAL REPLACEMENT GOVERNOR DESIGNATION

AIRCRAFT	GOVERNOR NOW INSTALLED	MODERNIZE TO LATER CONFIGURATION	UNIT EXCH. COST	MODERNIZATION OPTIONS AVAILABLE	UNIT EXCH. COST
Piper "Aztec" Series PA23-250 With HC-82XK-2 Props Only	D-4 (Surplus)	210473 Update to new model standard. Stops RPM surge/unsteadiness. Improved synchronization. (Pairs only) Requires engine installation kit. #213306 at $90. list. (One kit required per aircraft)	$169.		
(Lyc. O-540 IO-540)	210418 210473	210473 Advanced to newest revision.	$ 79.		
Piper "Comanche" Series PA24-180	210185 210250 210260 Obsolete-Discontinued	210305 Conversion to oil damped pilot valve. Stops RPM surge/unsteadiness.	$142.		
Lyc. O-360)	210305	210305 Advanced to newest revision.	$ 69.		
PA24-250 with McCauley Prop.	A210185 (Set for press. to increase pitch.) Obsolete-Discontinued	A210305 Conversion to oil damped pilot valve. Stops RPM surge/unsteadiness.	$142.		
(Lyc. O-540)	A210305	A210305 Advanced to newest revision.	$ 69.		
PA24-250 with Hartzell counter-weighted propeller	A210185 (Set for press. to decrease pitch.) Obsolete-Discontinued	210417 Conversion to oil damped pilot valve. Stops RPM surge.	$142.		
82XK-1 A2XK-1	210417	210417 Advanced to newest revision.	$ 69.		
Swearingen "Excalibur" Modified Beech 50	A210390 (Unfeathering Type)	A210390 To latest change.	$ 97.	210498 Remodel for automatic constant speed prop. synchronizer. Conversion adds speed sensing pick-up to governor. (Pairs only)	$210.
(Lyc. IGSO-540)	210498 (Synchronizer/unfeathering Type)	210498 To latest change.	$129.		
Swearingen Series 800 Modified Beech 65	B210434 (Unfeathering Type)	B210434 To latest change.	$ 97.	210546 Remodel for automatic constant speed prop. synchronizer. Conversion adds speed sensing pick-up to governor. (Pairs only)	$210.
(Lyc. IO-720)	210546 (Synchronizer/unfeathering Type)	210546 To latest change.	$129.		
Swearingen "Merlin 2" SA-26T With reversing propellers/governors. (UACL PT6A-20)	A210507 (Power turbine overspeed prop. governor)	A210507 Update to latest revision.	$115.		
	210578 (Primary prop. governor-reversing/synchronizer/pitch-lock type)	210578 Update to latest revision.	$197.		

REPLACEMENT SYNCHRONIZER - SYNCHROPHASER COMPONENTS
(Prices listed are unit exchange)

AIRCRAFT	CONTROL BOX	ACTUATOR	ROD END
Aero Commander 500B, U, S. 560A, E, F. 680, 680E, F, FL, FLP.	213350 $182.	213100 $136.	NOT REQD.
680T, V, W.	6852-902 (PHASER) $345.	213100 $136.	213447 $ 69.
Beech 18 series 55 series 95 series	213350 $182.	213100 $136.	213447 $ 69.
50 series 65 series 80 series 88 90, A90 w/out prop. revers.	213350 $182.	213100 $136.	213446 $ 69.
A90, B90 with prop. revers. 99	213350 $182.	5485-020 $154.	213446 $ 69.
Cessna 310 series 320 series 401 series 402 series 411 series 421 series	213433 $168.	213100 $136.	213447 $ 69.
336 337 series	213433 $168.	213100 $136.	213448 $ 69.
Lear Jet 23 24 24A	8900-084 $172. (replaces 8900-008)	5485-010 $154.	5333-007 (10-32 THRD.) $100. 5333-010 (1/4-28 THRD.) $100.
24B 25	8900-084 $172.	5485-010 $154.	5333-012 $ 55.
Mooney MU-2B S/N 1 thru 24	213350 $182.	213100 $136.	213447 (1/4-28 THRD.) $ 69.
MU-2B S/N 25 and later	213350 $182.	213100 $136.	5333-008 (10-32 THRD.) $ 83.
Swearingen Excalibur series	213350 $182.	213100 $136.	213447 $ 69.
Queen Air 800	213350 $182.	213100 $136.	213446 $ 69.
Merlin II	213350 $182.	213100 $136.	213446 $ 69.

WOODWARD

REPLACEMENT PROPELLER UNFEATHERING ACCUMULATORS (TBO SAME AS ENG)

AIRCRAFT	WOODWARD ACCUMULATOR NOW INSTALLED	MODERNIZE TO LATER CONFIGURATION	UNIT EXCH. COST
Beagle B. 206 (GI0-470) Series I	210320 213226 213325 Obsolete-discontinued	8907-001 Update to new model standard.	$43.
	8907-001	8907-001 To latest change.	$38.
Beagle B. 206 (GTSI0-520) Series II	8907-007	8907-007 To latest change.	$38.
Beech 18 series	210320 213134 213226 213325 Obsolete-discontinued	8907-001 Update to new model standard.	$43.
	8907-001	8907-001 To latest change.	$38.
Beech C50	210320 213226 213325 Obsolete-discontinued	8907-001 Update to new model standard.	$43.
	8907-001	8907-001 To latest change.	$38.
Beech 56TC 60	8907-001	8907-001 To latest change.	$38.
Cessna 310 - 310I 336	210320 213226 213265 213325 Obsolete-discontinued	8907-001 Update to new model standard.	$43.
	8907-001	8907-001 To latest change.	$38.
Cessna 310 J, K, L, N 320 - 320C	213330, 213239, 213265 Obsolete-discontinued	8907-002 Update to new model standard.	$43.
	8907-002	8907-002 To latest change.	$38.
Cessna 320 D, E, F 401 series 402 series	213420 Obsolete-discontinued	8907-004 Update to new model standard.	$43.
	8907-004	8907-004 To latest change.	$38.
Cessna 337 series	213335 Obsolete-discontinued	8907-005 Update to new model standard.	$43.
	8907-005	8907-005 To latest change.	$38.
Cessna 411 series 421 series	213270, 213250, 213335 Obsolete-discontinued	8907-003 Update to new model standard.	$43.
	8907-003	8907-003 To latest change.	$38.
Piper PA23-150, 160	210320 213226 213325 Obsolete-discontinued	8907-001 Update to new model standard.	$43.
	8907-001	8907-001 To latest change.	$38.

CHAPTER

71

POWERPLANT

MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B./T.R.
DHC	Intake Deflector Actuator	Part of C6EC1055	71–60–01	Dec 14/1981	
Barry Controls	Engine Mount	7350721	71–20–01	Mar 1/1980	
Wright Components	Air Valve	15328	71–20–1	Apr 14/1978	

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De Havilland Canada

DHC-6 TWIN OTTER

OVERHAUL MANUAL

INTAKE DEFLECTOR ACTUATORS

THE DE HAVILLAND AIRCRAFT OF CANADA LIMITED
DOWNSVIEW ONTARIO

JUL 15/69

De Havilland Canada

DHC-6 TWIN OTTER

OVERHAUL MANUAL
PART OF C6EC1055-3

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De Havilland Canada

DHC-6 TWIN OTTER
OVERHAUL MANUAL
PART OF C6EC1055-3

RECORD OF REVISIONS

Retain this record in the front of the manual. On receipt of revisions, insert revised pages in the manual and enter the revision number, revision date, insertion date; and initials of person incorporating the revision, in the appropriate block on the revision record.

Rev. No.	Rev. Date	Insertion Date	By
1	20 MAR 74	22 APR. 74	R.M
2	14 DEC. 81	21 MAR. 83	DHC

Rev. No.	Rev. Date	Insertion Date	By

LIST OF EFFECTIVE PAGES

Reference	Page	Date
Title	1	Jul 15/69
Effective Pages	*1	Dec 14/81
Record of Revisions	1	Jul 15/69
Introduction	1	Jul 15/69
Contents	1	Jul 15/69
71-60-01	1	Mar 20/74
71-60-01	2	Jul 15/69
71-60-01	3	Jul 15/69
71-60-01	*4	Dec 14/81
71-60-01	5	Jul 15/69
71-60-01	*6	Dec 14/81
71-60-01	7	Jul 15/69
71-60-01	8	Jul 15/69
71-60-01	* 9	Dec 14/81
71-60-01	*10	Dec 14/81
71-60-01	11	Jul 15/69
71-60-01	*12	Dec 14/81
71-60-01	*13	Dec 14/81

The asterisk (*) indicates pages revised, added or deleted by current revision.

INTRODUCTION

This manual contains instructions for the overhaul of the De Havilland Intake Deflector Actuators (Part of C6EC1055-3).

INTAKE DEFLECTOR ACTUATORS PART OF C6EC1055-3

1. Description and Operation

A. Physical Characteristics

The intake deflector actuator consists of a cylinder, which includes a threaded spigot suitable for connection of 1/4-inch flared tube fittings, a piston with two sets of piston rings, an adapter to permit mounting of the actuator on an engine intake duct, and a turnbuckle assembly for connection to an intake deflector.

LH and RH actuators are similar except that the adapters are handed and the bores of the threaded spigots differ in diameter. The spigot used on the LH actuator has a bore of 0.125 inch. That used on the RH actuator has a bore of 0.093 inch.

B. Operation

The unit is used to position a snow deflector in an engine air intake duct. One LH and one RH actuator is required to operate the deflector in each engine nacelle. Each actuator is extended by air pressure and is retracted by the integral compression spring which returns the piston to the head end of the cylinder when the air pressure is released.

The difference in bore between the threaded spigots used on the LH and RH actuators compensates for the difference in length of the air pressure supply lines to insure that the actuators operate at approximately the same speed.

C. Leading Particulars

The leading particulars of the actuator are shown in Table 1.

Table 1

Leading Particulars

Operating Air Pressure	35 ± 5 psi
Stroke	3.26/3.34 in.

2. Disassembly

A. Disassemble Intake Deflector Actuator (Figure 3)

(1) Cut and remove lockwire from cylinder (3, 4, 5, 6, 14A) and adapter (25, 26, 27, 28).

(2) Unscrew and remove cylinder from adapter, using a suitable strap wrench positioned at the top or bottom of the cylinder.

CAUTION: WRENCH MUST NOT BE POSITIONED AT ANY INTERMEDIATE POINT ALONG THE CYLINDER AS THIS MAY RESULT IN DEFORMATION OF CYLINDER WALLS.

(3) Do not remove label (7, 8, 9, 10) or spigot (11, 12) from cylinder unless replacement is required after inspection. Do not remove nipple (14B) from cylinder (14A) unless replacement is required.

(4) If label requires replacement, remove by softening with methyl ethyl ketone (refer to Table 2) and scraping off with a wooden or plastic scraper. Remove all traces of old adhesive using a lint-free cloth moistened with xylene.

WARNING: USE METHYL ETHYL KETONE AND XYLENE IN A WELL-VENTILATED AREA. AVOIDS BREATHING FUMES. AVOID SKIN CONTACT. KEEP AWAY FROM FLAME.

(5) If spigot requires replacement, remove attaching rivets (13) and soften sealant between faying surfaces of spigot and cylinder with methyl ethyl ketone. Remove spigot and remove all traces of old sealant from cylinder using methyl ethyl ketone.

(6) Slide adapter (25, 26, 27, 28) and spring (15) off turnbuckle assembly (16).

(7) Disconnect turnbuckle assembly from piston (24) by removing bolt (17), washers (18) and nut (19).

(8) Do not disassemble turnbuckle assembly unless inspection shows that a rod end (21) requires replacement. In which case, remove rivet (20) locking defective rod end to turnbuckle (22) and unscrew rod end from turnbuckle.

(9) Do not remove ring sets (23) from piston (24) unless replacement is required after inspection. If a ring set requires replacement, carefully lift piston rings and corrugated expander out of piston groove and slide off piston.

(10) Lift plate (29) out of alternative adapter (26, 28).

Table 2

Disassembly Materials and Compounds

MATERIAL	SPECIFICATION OR MANUFACTURER
Methyl Ethyl Ketone Xylene	TT-M-261 TT-X-916

3. Cleaning

A. General

(1) Clean all parts with a lint-free cloth moistened with solvent (refer to Table 3).

WARNING: USE SOLVENT IN A WELL-VENTILATED AREA. AVOID BREATHING FUMES. AVOID SKIN CONTACT. KEEP AWAY FROM FLAME.

(2) Use a soft-bristle brush moistened with solvent to clean areas difficult to reach with a cloth.

CAUTION: DO NOT IMMERSE ROD ENDS (21, FIGURE 3), CYLINDER ASSEMBLIES (3, 5), OR RING SETS (23) IN SOLVENT.

(3) After cleaning, dry parts thoroughly using a clean, lint-free cloth.

Table 3

Cleaning Materials and Compounds

MATERIAL	SPECIFICATION OR MANUFACTURER
Solvent	P-D-680

4. Inspection/Check (Figure 3)

A. General

(1) Inspect all parts for obvious wear, damage or corrosion.

(2) Inspect threaded parts for damaged, stripped or crossed threads.

(3) Check label (7, 8, 9, 10) for security and legibility.

(4) Inspect anodized surfaces for scratches and abrasions.

(5) Inspect bore of cylinder for scoring.

(6) Check that bearings of rod ends (21) rotate freely with no binding or roughness.

(7) Check spring (15) for distortion by rolling on a flat surface and for squareness of ground ends. Check that load rate is approximately 36 lb with a deflection of 4.5 inches.

(8) Check that ring sets (23) rotate freely in grooves of piston (24). If rings do not rotate freely, inspect piston grooves for burrs or other damage, and for dirt. Clean as necessary (refer to paragraph 3).

5. Repair

A. General

(1) Replace all parts that do not pass inspection and are damaged beyond simple repair.

(2) Lightly hone out scores from cylinder bore to maximum diameter of 2.010 inches.

(3) Smooth out minor damage to other surfaces of aluminum alloy parts using fine aluminum oxide or silicon carbide abrasive cloth (refer to Table 4).

(4) Touch up aluminum alloy surfaces with chemical film Alodine 1200S in accordance with manufacturer's directions.

NOTE: Touched-up areas will be golden-brown instead of the original blue.

Table 4

Repair Materials and Compounds

MATERIAL	SPECIFICATION OR MANUFACTURER
Abrasive Cloth (Grit No. 320)	P-C-451
Chemical Film Alodine 1200S	Amchem Products

6. Assembly

A. Assemble Intake Deflector Actuator (Figure 3)

(1) Insert plate (29) into alternative adapter (26, 28) to provide a seat for spring (15).

(2) Lightly smear piston rings (23) with silicone grease (refer to Table 5), and assemble to piston (24) by carefully sliding one expander and piston ring over piston into piston ring groove. Following same procedure install expander and piston ring into second groove of piston. Check that rings rotate freely in grooves of piston and then align rings so that gaps in rings are approximately 180° apart.

(3) Assemble rod ends (21) to turnbuckle (22) as shown in Figure 1. Lock rod ends in place using rivets (20).

(4) Connect turnbuckle assembly (16) to piston (24) using bolt (17), washers (18) and nut (19).

(5) Assemble spigot (11, 12) to cylinder (14), as follows:

(a) Remove all traces of old sealant from faying surfaces using methyl ethyl ketone.

WARNING: USE METHYL ETHYL KETONE AND TRICHLORETHYLENE IN A WELL-VENTED AREA, AVOID BREATHING FUMES, AVOID SKIN CONTACT, KEEP AWAY FROM FLAME.

(b) Thoroughly clean faying surfaces of spigot and cylinder with a soft bristle brush or lint-free cloth moistened with trichloroethylene, and dry with a clean, lint-free cloth before trichloroethylene evaporates.

(c) Apply a thin layer of sealant to faying surface of spigot and secure spigot to cylinder using rivets (13).

WARNING: USE SEALANT IN A WELL-VENTILATED AREA, AVOID BREATHING FUMES, AVOID SKIN CONTACT, KEEP AWAY FROM FLAME.

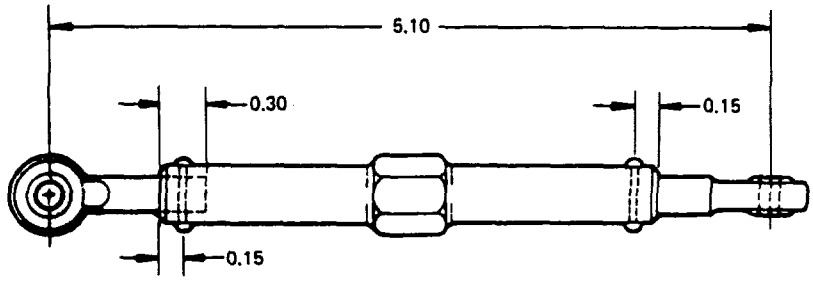
(d) Remove any excess sealant from spigot and cylinder using methyl ethyl ketone.

(5A) Install nipple (14B) in top of cylinder (14A).

(6) Install replacement label (7, 8, 9,10) as follows:

(a) Thoroughly clean surface of cylinder where label is to be installed, using a lint-free cloth moistened with trichlorethylene, and dry with a clean, lint-free cloth before trichloroethylene evaporates.

(b) Remove paper backing from new label. Apply label to cylinder, rubbing down carefully with a plastic applicator to remove all air trapped under label.



NOTES:

SCREW ROD ENDS INTO TURNBUCKLE TO OBTAIN INSERTION AND PIN-CENTRE DIMENSIONS INDICATED, WITH ROD ENDS AT 90° TO ONE ANOTHER.

DRILL NO. 51 (0.067 IN. DIA) THROUGH ROD ENDS AND TURNBUCKLE TO INSTALL LOCKING RIVETS AT POSITIONS INDICATED.

ALL LINEAR DIMENSIONS IN INCHES; TOLERANCE ±0.01.

Assembly of Rod Ends to Turnbuckle

Figure 1

(c) Seal all edges of label with a light, overlapping ribbon of edge sealer.

WARNING: USE EDGE SEALER IN A WELL-VENTILATED AREA. AVOID BREATHING FUMES. AVOID SKIN CONTACT. KEEP AWAY FROM FLAME.

(7) Insert piston (24) with attached turnbuckle assembly (16) fully into cylinder (3, 4, 5, 6, 14A), compressing ring sets (23) to facilitate entry into cylinder bore.

(8) Slide spring (15) over turnbuckle assembly and into cylinder bore.

(9) Apply a small quantity of anti-galling compound to threads of cylinder, check that plate (29) is installed in alternative adapter (26, 28) if appropriate. Screw cylinder (14A) into adapter and hand tighten insuring that not less than six full threads are engaged. Screw cylinder (3, 4, 5, 6) into adapter using a suitable strap wrench positioned at the top or bottom of the cylinder.

CAUTION: WRENCH MUST NOT BE POSITIONED AT ANY INTERMEDIATE POINT ALONG THE CYLINDER AS THIS MAY RESULT IN DEFORMATION OF CYLINDER WALLS.

(10) Lock cylinder to adapter using wire MS20995C51.

(11) Perform functional test procedure after reassembly.

Table 5

Assembly Materials and Compounds

MATERIAL	SPECIFICATION OR MANUFACTURER
Silicone Grease	3-GP-605A
Methyl Ethyl Ketone	TT-M-261
Trichlorethylene	MIL-T-7003
Sealant EC800	Minnesota Mining and Manufacturing Co.
Edge Sealer Scotchcal #3950	Minnesota Mining and Manufacturing Co.
Anti-Galling Compound	TT-A-580
Wire	MS20995C51

7. Fits and Clearances

Not applicable.

8. Testing

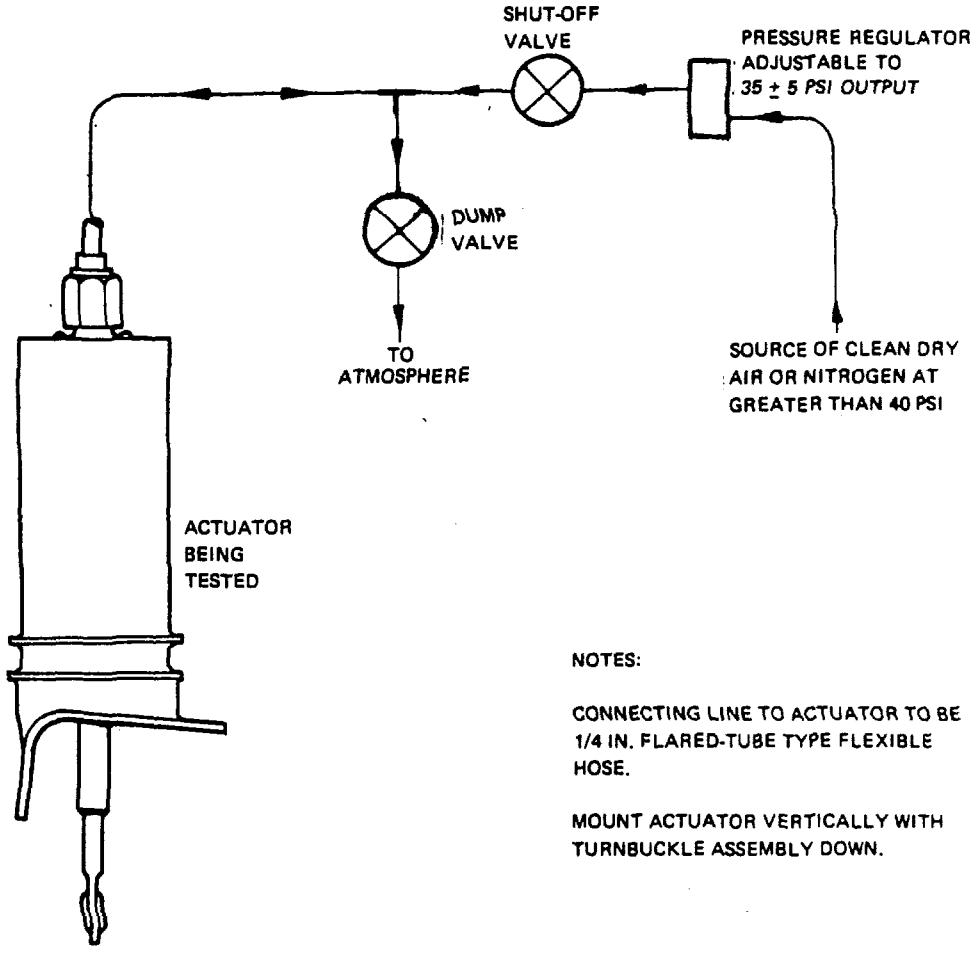
NOTE: It is recommended that the actuator be subjected to the functional test procedure before installation into an aircraft.

A. Test Equipment

Test equipment required to perform the functional test procedure is indicated in Figure 2.

B. Preparation for Test (Figure 2)

(1) Close shutoff valve and open dump valve.



Schematic Test Setup

Figure 2

(2) Connect actuator to test setup.

(3) Apply air or nitrogen pressure to test setup and set pressure regulator to 35 ± 5 psi.

(4) Close dump valve.

C. Test Procedure

(1) Measure projection of turnbuckle assembly beyond adapter and record for use in steps (7) and (8).

(2) Open shutoff valve.

(3) Actuator must extend smoothly to reach full extension in less than 3 seconds.

(4) Measure extended projection of turnbuckle assembly beyond adapter, using the same reference points as in step (1), and record for use in step (8).

(5) Check for leaks between spigot and cylinder using detergent (refer to Table 6).

(6) Close shutoff valve and open dump valve.

(7) Actuator must retract smoothly until projection of turnbuckle assembly beyond adapter is the same as that recorded in step (1).

(8) Check stroke by subtracting projection recorded in step (1) from that recorded in step (4). Stroke must be between 3.26 and 3.34 inches.

D. Shut-down After Test

(1) Shut off air or nitrogen pressure to test setup and close pressure regulator.

(2) Open shutoff valve.

(3) Disconnect actuator from test setup.

E. Test Results

(1) Actuators which meet the requirements of the functional test procedure, may be put into service.

(2) If any actuator fails to meet the requirements of the functional test procedure, refer to the trouble shooting procedure.

Table 6

Test Materials and Compounds

MATERIAL	SPECIFICATION OR MANUFACTURER
Detergent, Leak-Tec, Formula No. 277C	American Gas and Chemicals Co. Inc.

9. Trouble Shooting

A. If the actuator fails to meet the requirements of the functional test procedure, refer to Table 7 to determine the possible cause and correction for the malfunction.

Table 7

Trouble Shooting Information

TROUBLE	POSSIBLE CAUSE	CORRECTION
1. Actuator fails to extend, or extension is not smooth or too slow.	Dirt in cylinder bore.	Clean cylinder bore.
	Cylinder bore scored.	Lightly hone cylinder bore, or replace cylinder.
	Rings tight in piston grooves.	Clean rings and piston grooves.
		Deburr piston grooves.
		Lightly polish sides of rings.
	Rings incorrectly assembled in piston grooves.	Check that each groove has one ring and a corrugated expander, and that ring gaps are approximately 180° apart.
2. Leakage between spigot and cylinder.	Breakdown of sealant film between spigot and cylinder.	Disassemble spigot from cylinder. Clean, apply fresh sealant, and reassemble.
3. Actuator fails to retract or retraction is not smooth.	Broken spring.	Replace spring.
	Piston jamming in cylinder bore.	Refer to Trouble 1.
4. Stroke out of tolerance.	Dirt in actuator.	Disassemble, clean and reassemble actuator.

10. Storage Instructions

A. Preparation

(1) Cap threaded spigot or nipple.

(2) Wrap intake deflector actuator in water vapor resistant barrier material, including a desiccant (refer to Table 8).

(3) Affix label giving following information:

(a) Identification.

(b) Date of overhaul.

(c) Inspection.

Table 8

Storage Materials and Compounds

MATERIAL	SPECIFICATION OR MANUFACTURER
Barrier Material	MIL-B-121
Desiccant	MIL-D-3464

11. Special Tools

No special tools are required. Overhaul of the actuator can be accomplished with the use of tools, fixtures and other equipment normally available at overhaul facilities.

12. Illustrated Parts List

A. For explanation of vendor codes used in the illustrated parts list, refer to Table 9.

Table 9

Vendor Codes

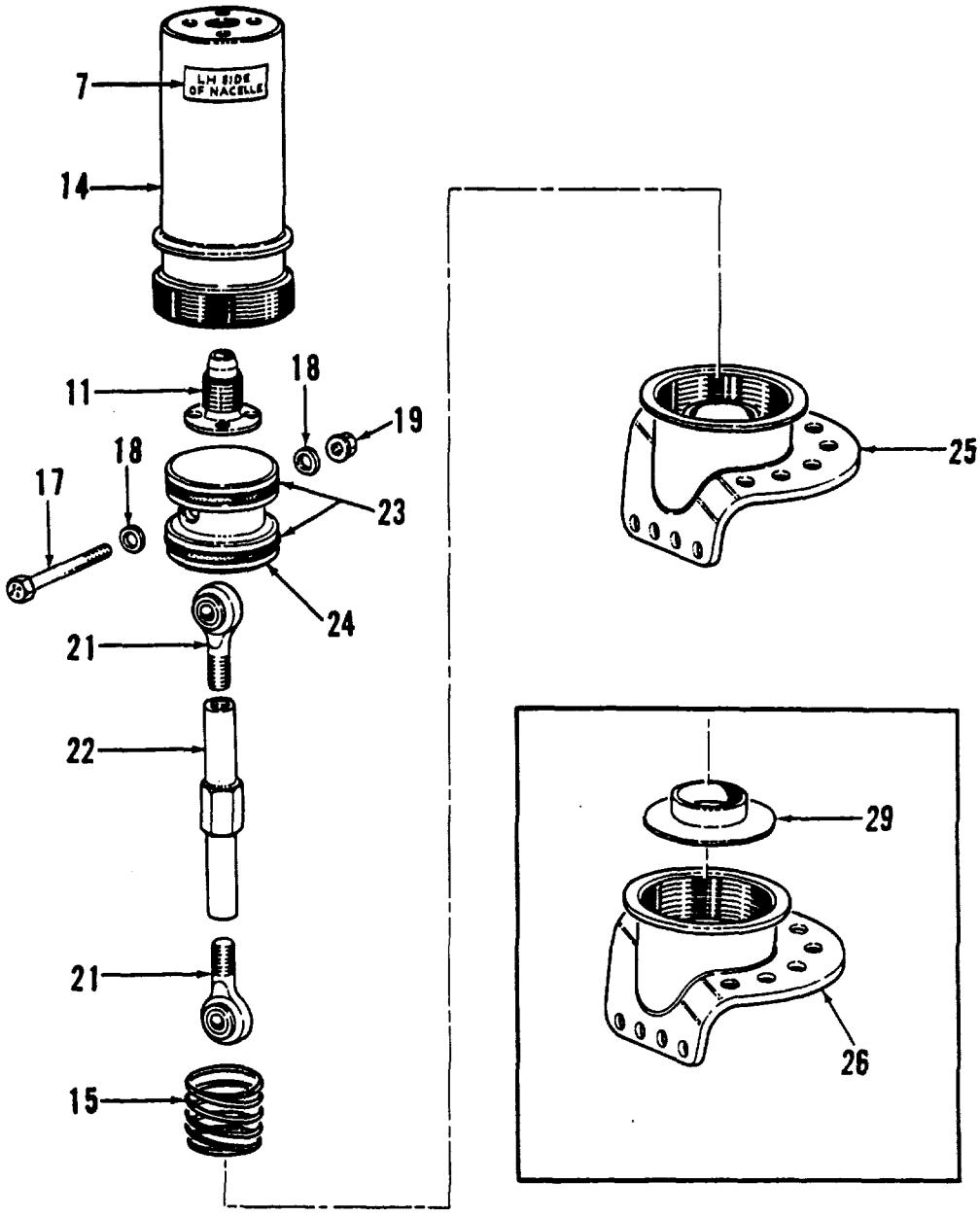
CODE	VENDOR NAME AND ADDRESS
22808	United Products Co., Ft Wayne, Indianna, U.S.A.
07128	Royal Industries, Tetrafluor Div., El Segunda, Calif., U.S.A.

B. For explanation of usage codes, used in the illustrated parts list, refer to Table 10.

Table 10

Usage Codes

CODE	USED ON
A	LH actuator with riveted pipe connection.
B	LH actuator with integral pipe connection.
C	RH actuator with riveted pipe connection.
D	RH actuator with integral pipe connection.



Exploded View

Figure 3

FIGURE & INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	UNITS PER ASSY	USAGE ON CODE
3				
-1	NO NUMBER	ACTUATOR, INTAKE DEFLECTOR, LH	1	A, B
-2	NO NUMBER	ACTUATOR, INTAKE DEFLECTOR, RH	1	C, D
-3	C6EC1063-1	. CYLINDER ASSEMBLY, ACTUATING (for future procurement use C6EC1123-1)	1	A
-4	C6ECM1037-3	. CYLINDER, ACTUATING (for future procurement use C6EC1123-1)	1	B
-5	C6EC1063-3	. CYLINDER ASSEMBLY, ACTUATING (for future procurement use C6EC1123-1)	1	C
-6	C6ECM1037-1	. CYLINDER, ACTUATING (for future procurement use C6EC1123-1)	1	D
7	C6EC1111-27	. . LABEL	1	A
-8	C6EC1111-31	. . LABEL (Spanish) (Alternative item)	1	A
-9	C6EC1111-29	. . LABEL	1	C
-10	C6EC1111-33	. . LABEL (Spanish) (Alternative item)	1	C
11	C6ECM1062-27	. . SPIGOT, THREADED	1	A
-12	C6ECM1062-29	. . SPIGOT, THREADED	1	C
		ATTACHING PARTS		
-13	MS20426AD4	. . RIVET	4	A, C
		---x---		
14	C6ECM1112-27	. . CYLINDER	1	A, C
-14A	C6EC1123-1	. CYLINDER ASSEMBLY (replaces C6EC1063-1, C6EC1063-3, C6ECM1037-1 and C6EC1037-3)	1	
-14B	AN816-4D	. . NIPPLE	1	
15	C6EC1038-27	. SPRING, COMPRESSION	1	
-16	C6EC1034-1	. TURNBUCKLE ASSEMBLY	1	
		ATTACHING PARTS		
17	AN3-6A	. BOLT	1	
18	AN960-10L	. WASHER	2	
19	MS21042-3	. NUT	1	
		---x---		
-20	MS20470AD2	. . RIVET	2	
21	DSC4-3A	. . ROD END	2	
22	C6ECM1035-27	. . TURNBUCKLE	1	
23	UPC20062-326	. RING SET, PISTON (Consisting of two rings and corrugated expander) (22808) (for future procurement use C6SC1113-27)	2	
-23	C6SC1113-27	. RING, PISTON (replaces UPC20062-326)	2	
-23	TF501-7032	. RING SET, PISTON (consisting of two rings and expanders (07128) (replaces C6SC1113-27 and UP20062-326)	2	
24	C6ECM1036-27	. PISTON	1	
25	C6ECM1044-27	. ADAPTER, MACHINED, LH	1	A, B
26	C6Z1115-1	. ADAPTER, WELDED, LH (Alternative item)	1	A, B

NOTE: - preceding index number indicates item not illustrated.

FIGURE & INDEX NO.	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	UNITS PER ASSY	USAGE ON CODE
3				
-27	C6ECM1044-28	• ADAPTER, MACHINED, RH	1	C,D
-28	C6Z1115-2	ADAPTER, WELDED, RH (Alternative item)	1	C,D
29	C6Z1151-27	PLATE, FLANGED, SPRING RETAINER (Used with C6Z1115-1 and -2)	1	

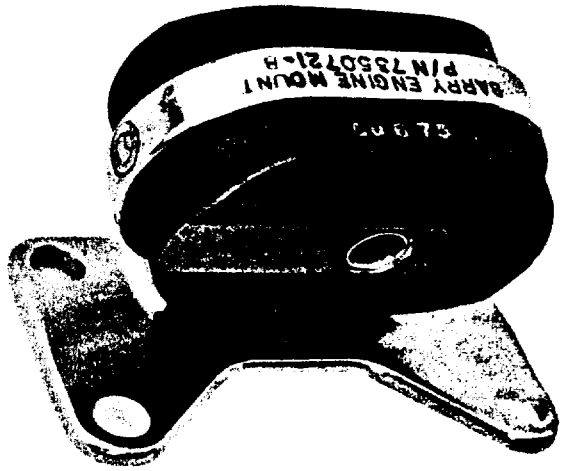
NOTE: - preceding index number indicates item not illustrated.

BARRY™ CONTROLS
VIBRATION · SHOCK · NOISE

BARRY CONTROLS / DIVISION OF BARRY WRIGHT CORPORATION

TYPE 7350721

ENGINE VIBRATION ISOLATOR



COMPONENT MAINTENANCE MANUAL
WITH
ILLUSTRATED PARTS LIST

This Manual supersedes all previously issued Robintech Overhaul Manuals for Type 350721 Isolators.

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BARRY CONTROLS

COMPONENT MAINTENANCE MANUAL
TYPE 7350721

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INTRODUCTION

1. SCOPE OF THIS MANUAL

This manual has been prepared by Barry Controls Division of Barry Wright Corporation, Burbank, California, in accordance with Air Transport Association (ATA) Specification 100. Contained in this manual are shop verified procedures to enable a qualified mechanic to restore the Type 7350721 engine vibration isolator to serviceable condition. This manual is intended for shop overhaul and not line maintenance. Refer to the aircraft manufacturer's maintenance manual for removal and installation procedures.

2. SERVICE OR OVERHAUL LIFE

Barry Controls has determined from analysis of isolators that were removed from service at various flight hours and through laboratory tests that isolator service life is consistent with the PT6A engine overhaul cycle - based on normal aircraft useage. Operators who consistently get high time from their engines have good flight and maintenance procedures which are also beneficial to isolator service life.

The isolators will provide good service for engine TBO but they rarely last twice engine TBO. Therefore, it is suggested that these isolators be removed at engine overhaul and replaced with new isolators, or overhauled in accordance with the detailed procedures specified in this manual. This is economical because the engine is already off the aircraft and the isolators can easily be changed. It also assures optimum isolator performance when the overhauled engine is installed.

Barry Controls has set up an exchange program for these isolators where used isolators which are acceptable for overhaul will be replaced on an exchange basis with overhauled, zero time, fully warranted isolators.

DESCRIPTION AND OPERATION

1. DESCRIPTION

A. Barry Controls Type 7350721 Engine Vibration Isolators provide attachment for Pratt and Whitney PT6A-20 and PT6A-27 turboprop engines to the de Havilland DHC-6 Twin Otter and other aircraft. They minimize the transmission of powerplant/propeller noise and vibration to the airframe and also reduce airframe vibration transmitted to engine. Three isolators are required for each engine. All isolators on an aircraft should have the same part number.

NOTE: Isolator 7350721-7 supersedes isolators 7350721-1, 7350721-5, and 7350721-6 used on the PT6A-20 engine. Isolator 7350721-7 is alternate and replacement for 7350721-8 on the PT6A-20 engine.

Isolator 7350721-8 can be substituted for isolator 7350721-7 for use on the PT6A-20 engine, but isolator 7350721-8 cannot be substituted for isolator 7350721-7 on the PT6A-27 engine.

B. Each isolator consists of two matched resilient cores installed on a steel housing so that the cores can be visually inspected. The cores are manufactured from Butyl elastomer vulcanize bonded between two metal plates. All primary structural components are passivated stainless steel. The isolator is held together by a stud that is flared on one core and press fit into the other core.

C. The isolator housing is connected to the engine with four bolts. A gasket must be used between the isolator and engine pad to prevent bottoming out of attach bolts or shear pilot which could damage isolator or engine. A single mounting bolt through the stud and core assemblies connects the isolator to the airframe.

2. OPERATION

Engine propulsive forces are transmitted from the engine pad to the isolator housing, through the core assemblies to the mounting bolt, and into the airframe. Propeller/powerplant shock and vibration are reduced by the controlled spring rate and damping properties of the core assemblies, while the propulsive forces are passed to the airframe.

3. VISUAL CHECK OF INSTALLED ISOLATORS

A. The isolators can be visually checked for condition and installation on the aircraft as follows (Ref: IPL Figure 1 for component nomenclatures):

3.A. (Continued)

(1) Visually check core assemblies for indications of bond failure, separations, excessive deflection, or elastomer damage.

(2) Check mounting bolts for tightness and safety.

(3) Visually check housing for damage and cracks.

COMPONENT	LENGTH	WIDTH	HEIGHT	WEIGHT
7350721-7	2.35 INCH	4 INCH	2.88 INCH	1.6 LBS.
7350721-8	2.35 INCH	4 INCH	2.88 INCH	1.6 LBS.

LEADING PARTICULARS
FIGURE 1

DISASSEMBLY

1. GENERAL

The exploded view illustration (Ref: IPL Fig. 1) provides the basic component information to disassemble the 7350721-7 and 7350721-8 engine vibration isolators. Read all notes and procedures to simplify disassembly and prevent equipment damage or personal injury.

2. REQUIRED SPECIAL TOOLS FOR DISASSEMBLY

None

3. DISASSEMBLY PROCEDURE

A. Disassemble the isolator as follows (Ref: IPL, Fig. 1):

(1) The core (2) is press fit on stud (3). Pull core off stud by hand or use soft mallet to tap housing away from core.

(2) Remove core (8) and stud (3) from housing (4).

(3) Remove bumper tube (6) from stud (3).

(4) Hold protruding end of stud (3) and drill out flared portion of stud (3) in core (8) and discard stud.

CAUTION: WHEN DRILLING, BE CAREFUL NOT TO DAMAGE CORE (8) OR THE CORE MAY HAVE TO BE REPLACED.

(5) Remove gasket (5) and discard.

(6) Remove spring pin (-7) from housing where applicable.

CLEANING

1. CLEANING MATERIALS REQUIRED

Refer to Fig. 201 for required cleaning materials.

MATERIAL/EQUIPMENT	SOURCE
Isopropyl Alcohol	Commercially Available
Brush, Stiff-bristle Non-metallic	Commercially Available
Cloth, Lint-free	Commercially Available
Cloth, Crocus	Federal Spec. P-C-458
Methyl-Ethyl-Ketone	Federal Spec. TT-M-261
Pad, Bronze Wool, Fine	Commercially Available
Pads, Scotch Brite, General Purpose, 7447	Minnesota Mining & Mfg.
Pads, Scotch Brite, Ultra Fine, 7448	Minnesota Mining & Mfg.
Solvent, Stoddard	Federal Spec. P-D-680, Type I

NOTE: When listed items are not available, equivalent substitutes may be used.

Cleaning Materials
Figure 201

2. CLEANING PROCEDURE

A. Cleaning of core assembly and nylon bumper tube.

CAUTION: DO NOT USE TOLUENE, OR SIMILAR SOLVENTS FOR CLEANING. NEVER IMMERSE BONDED PARTS IN CLEANING COMPOUNDS OR DAMAGE TO THE ELASTOMER AND THE ELASTOMER-TO-METAL BOND MAY RESULT.

WARNING: ISOPROPYL ALCOHOL IS FLAMMABLE AND MUST NOT BE USED NEAR HEAT OR OPEN FLAME. IT IS A TOXIC SOLVENT. INHALATION OF VAPORS OR PROLONGED CONTACT WITH LIQUID SHOULD BE AVOIDED.

(1) Clean oil, grease, and grime from the core assembly and bumper tube with a clean cloth or stiff-bristle brush moistened with isopropyl alcohol.

NOTE: Fine bronze wool pads or crocus cloth may be used to remove stubborn accumulations of foreign material.

(2) Immediately dry with a clean, dry, lint-free cloth.

B. Cleaning of non-bonded all metal parts.

WARNING: STODDARD SOLVENT AND METHYL-ETHYL-KETONE (MEK) ARE FLAMMABLE AND MUST NOT BE USED NEAR HEAT OR OPEN FLAME. THESE ARE TOXIC SOLVENTS. INHALATION OF VAPORS OR PROLONGED CONTACT WITH THESE LIQUIDS SHOULD BE AVOIDED.

(1) Clean metal parts by vapor degreasing or washing in clean Stoddard solvent or MEK.

(2) Use a stiff-bristled non-metallic brush to remove foreign matter accumulations. Use fine bronze wool pads, Scotch Brite pads, or crocus cloth to remove stubborn foreign matter accumulations.

(3) Repeat step (1) above.

(4) Dry metal parts with a clean lint-free cloth or oil-free compressed air at 20 psig maximum.

(5) If further cleaning is necessary, clean metal surfaces by vapor blasting in accordance with the following procedures.

(a) Vapor blast to remove heavy residue or corrosion.

(b) After vapor blasting, clean parts by vapor degreasing or washing in clean Stoddard solvent or MEK per step (1) of this paragraph.

(c) Dry parts with a clean, lint-free cloth or oil-free compressed air at 20 psig maximum.

INSPECTION/CHECK

1. GENERAL

A. Inspect all parts for nicks, cracks, scratches, corrosion, fretting, and galling.

NOTE: Conduct inspections under a strong light, preferably using a 10X magnification.

B. Inspect applicable detail parts of the engine vibration isolator in accordance with requirements contained in FITS AND CLEARANCES.

C. Perform dimensional inspections using standard inspection equipment. REFER TO FIG. 301 FOR SPECIFIC INSPECTION/CHECKS.

NOTE: In Fig. 301, where magnetic particle inspection is specified, perform inspection in accordance with Military Specification MIL-I-6868 or equivalent procedure.

NOMENCLATURE FIGURE AND ITEM NUMBER	METHOD OF INSPECTION	CHECK	REQUIREMENTS
Spring Pin	Visual	Distortion	Replace if damaged
NOTE: Spring pin is applicable only to early model housing. Current housing has cast pin. Both have same part number and are interchangeable.			
Bumper Tube	Visual	Nicks, burrs, scratches.	If significant visual damage, replace.
Housing	Dimensional	Wear	Refer to FITS AND CLEARANCES. If limits are exceeded, replace.
	Visual	Scratches, nicks, burrs	Reworked area cannot exceed 0.020 inch depth or 15% of any surface or perimeter after removal of scratches, nicks and burrs.

INSPECTION REQUIREMENTS
FIGURE 301 (SHEET 1 OF 2)

NOMENCLATURE FIGURE AND ITEM NUMBER	METHOD OF INSPECTION	CHECK	REQUIREMENTS
Housing (Continued)	Magnetic particle	Indications	Surface indications within requirements of visual inspection may be reworked. If exceeded, discard part.
Core	Dimensional	Wear	Refer to FITS AND CLEARANCES; if limits are exceeded replace core assemblies. NOTE: New cores are not to be mixed with inservice cores.
	Test	Wear	Refer to TESTING; if deflection is not within tolerance, replace both core assemblies.
	Visual	Separation	Separations between metal plate and elastomer must not exceed 1 inch length or 1/16 inch depth. Replace if exceeded.
		Sponginess or swelling of elastomer	Replace the core assembly if any evidence of sponginess or swelling is noted. This condition is generally caused by prolonged contact of the isolator with noncompatible fluids.
		Elastomer for abrasion, cuts, tears or gouges.	Minor abrasion is acceptable. Replace core if there is major abrasion or any evidence of cuts, tears or gouges.
Stud			Replace at each overhaul
Gasket			Replace at each overhaul

INSPECTION REQUIREMENTS
FIGURE 301 (SHEET 2 OF 2)

REPAIR

1. GENERAL

A. Replace all worn or damaged parts which cannot be reworked to meet inspection requirements. Only spare parts of the latest configuration are available. These parts upgrade the assembly and are compatible with all previous components. Isolator assemblies and some components may be returned to Barry Controls for overhaul.

B. Identification may become obliterated during rework; if needed, identify or tag items prior to rework.

C. All magnetic particle inspection is in accordance with Military Specification MIL-I-6868 or equivalent.

CAUTION: ALL REWORK TO DAMAGED AREAS MUST BE ACCOMPLISHED WITH HAND TOOLS. GRINDING OR MACHINING IS PROHIBITED EXCEPT WHEN SPECIFICALLY CALLED OUT IN THE PROCEDURE.

ITEM	PART NUMBER	MANUFACTURER/SPEC.
Bronze Wool Pads	Fine	Brillo Manufacturing Co. Brooklyn, New York
File	Fine	Optional
Sandpaper	Fine	Optional
Whetstone (not Oilstone) or Carborundum		Optional

NOTE: Equivalent substitutes may be used for above listed items.

REPAIR MATERIALS
FIGURE 401

2. HOUSING

A. Remove cracks, nicks and burrs using a file, whetstone, fine sandpaper or crocus cloth, maintaining a 125 RMS finish. Reworked areas must not exceed 0.020 inch depth or 15% of any surface or perimeter.

B. There are two types of housings, one with a spring pin inserted through the body and the latest production type with the pin cast on the housing. Part number 7351256-2 is used for both types. Should the cast pin become worn beyond tolerances shown in FITS AND CLEARANCES the housing can be reworked as follows:

(1) Grind or machine remnants of cast pin flush to both surfaces of housing.

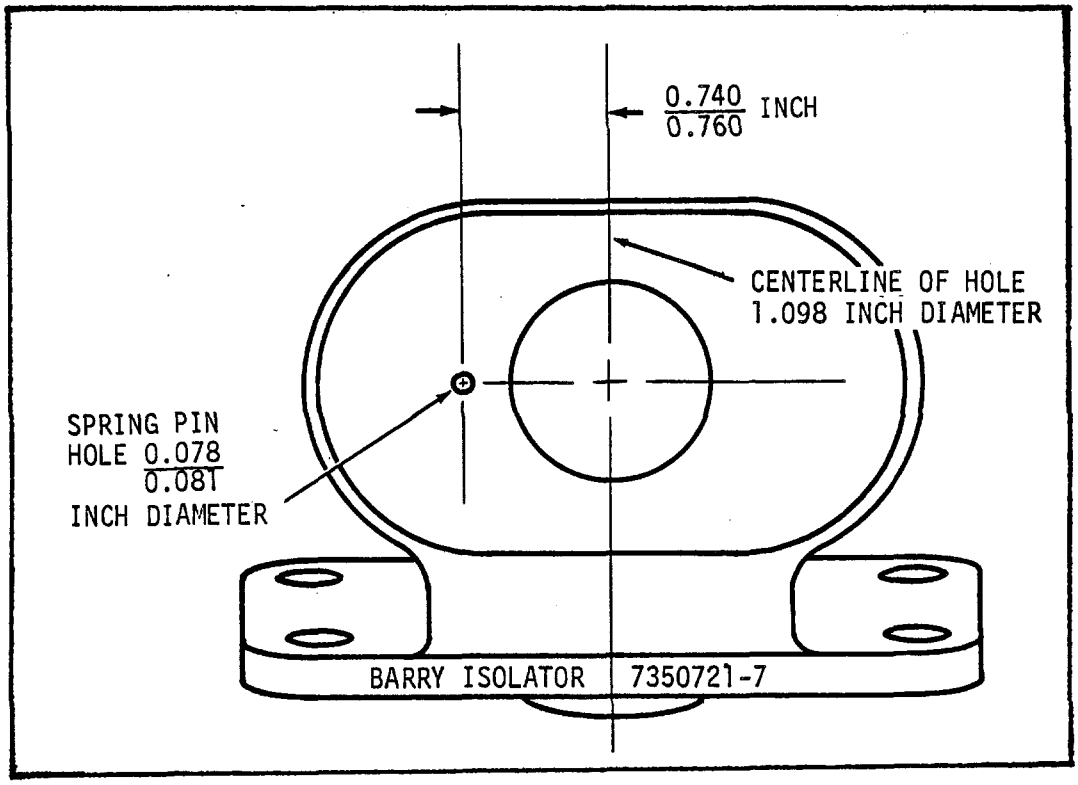
(2) Machine a spring pin hole as shown in Figure 402. Break sharp edges .010 inch.

C. Clean as specified in CLEANING.

D. Magnetic particle inspect.

E. Passivate in accordance with Federal Specification QQ-P-35, or equivalent.

NOTE: Passivate all housings whether or not repairs are made to the housing.



HOUSING REWORK
FIGURE 402

ASSEMBLY

1. GENERAL

   A. The engine vibration isolator assembly instructions are for the latest configuration. It is suggested that all isolators be modified to these configurations. However, older components can be used if they conform to the inspection and tolerance requirements. Therefore, it is possible that some instructions will not apply. Item numbers in these instructions refer to the exploded view illustrations of Figure 1 of the Illustrated Parts List.

   B. Read all notes and cautions to help simplify assembly and prevent equipment damage or personal injury.

2. SPECIAL TOOLS REQUIRED

   A. None required.

3. ASSEMBLY PROCEDURE

   NOTE: Install only mated pairs of cores. Reference TESTING in this manual. Any pair of new cores is considered mated without testing.

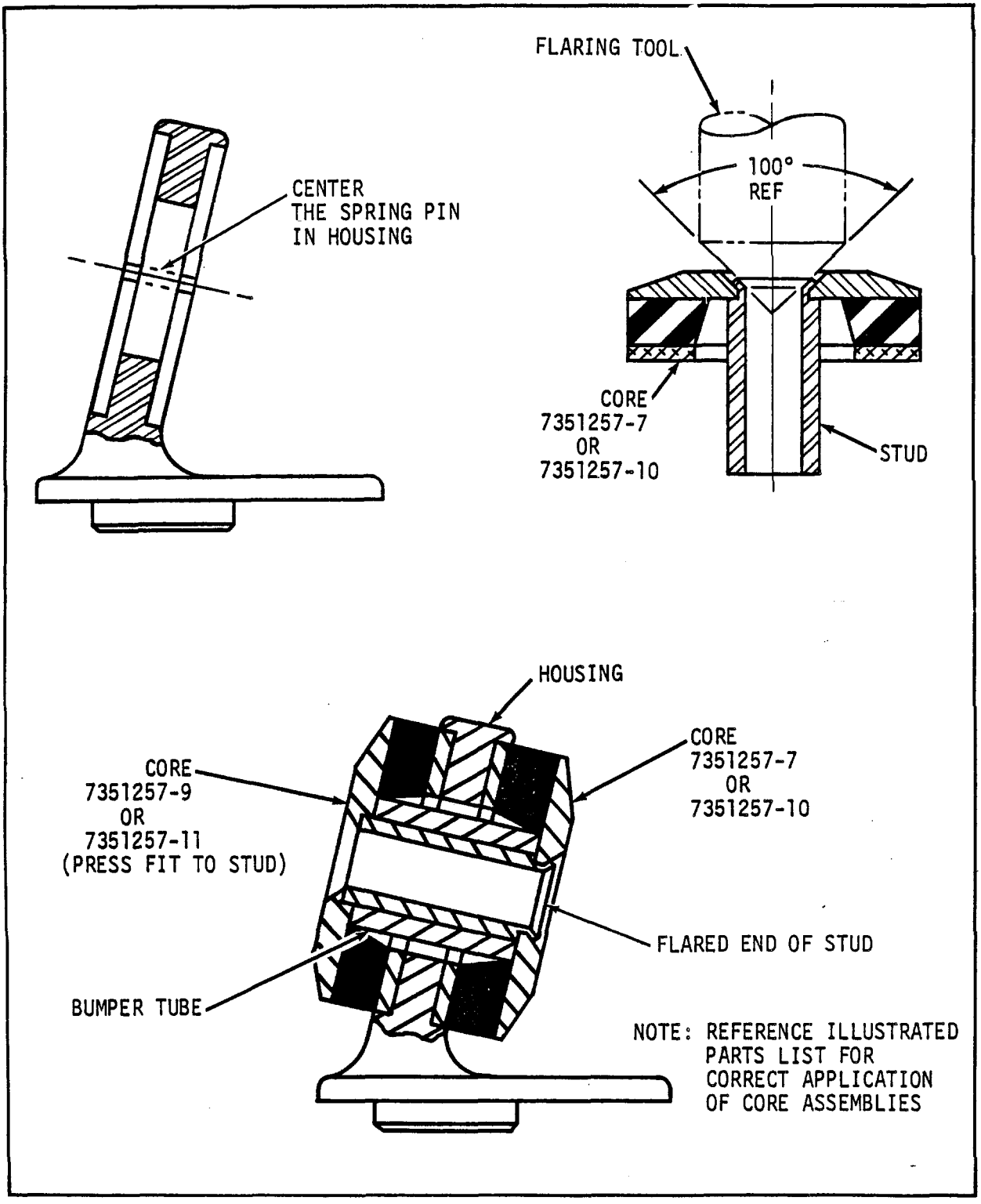
   A. Press the spring pin (7) into the housing (4) for all housings without the cast pin on housing. See Figure 501.

   B. Insert small end of stud (3) into core (8) as shown in Figure 501.

      (1) Flare the stud in the countersink of core (8) with 100° flare tool. See Figure 501.

   NOTE: FLARE STUD ONLY ENOUGH TO HOLD CORE SO IT WILL NOT COME OFF THE STUD. TOO MUCH FLARE COULD CRACK THE STUD. THE DEEP COUNTERSINK IN THE CORE IS TO ENSURE THE FLARED END OF THE STUD IS BELOW THE SURFACE OF THE CORE.

   C. Install bumper tube (6) over stud and place subassembly on housing (4) as shown in Figure 501, aligning the pin on the housing with the hole in the core.



ASSEMBLY
FIGURE 501

NOTE: The spring pin used on housing P/N 7351256-2 (Ref: 4, IPL Fig. 1) and the cast pin used on the current production housing assure correct sub-assembly orientation and do not carry load. The blind hole in the current production core assemblies has been enlarged to simplify assembly. If core assemblies with a smaller diameter blind hole are to be installed on the cast pin housing, enlarge blind hole with a 5/32 inch drill to facilitate installation.

D. Press fit the core (2) onto stud (3).

E. To keep the press fit core (2) on the stud (3) for handling and storage purposes, place a plastic bonding tie strap or equivalent through the stud hole and secure it around the two cores. In some instances the press fit is not sufficient to hold the isolator together. This happens occasionally and is considered normal. The isolator can be used as is if this occurs.

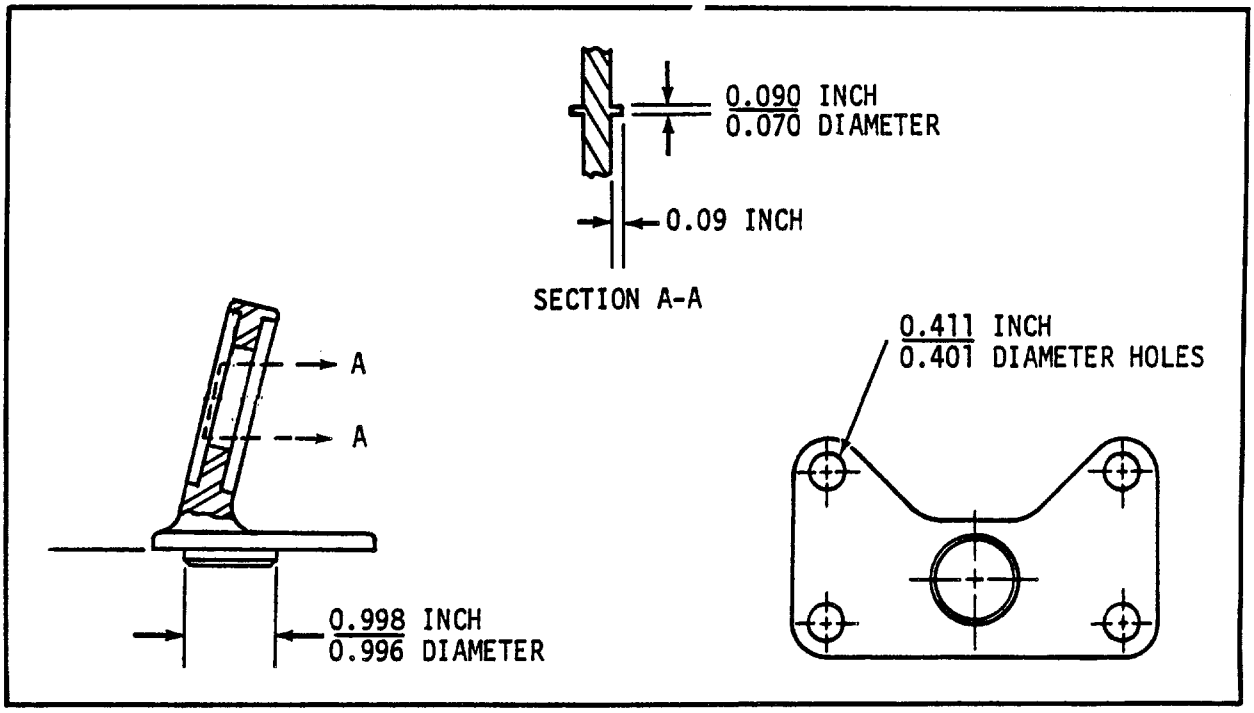
F. Install new gasket (5) on housing.

FITS AND CLEARANCES

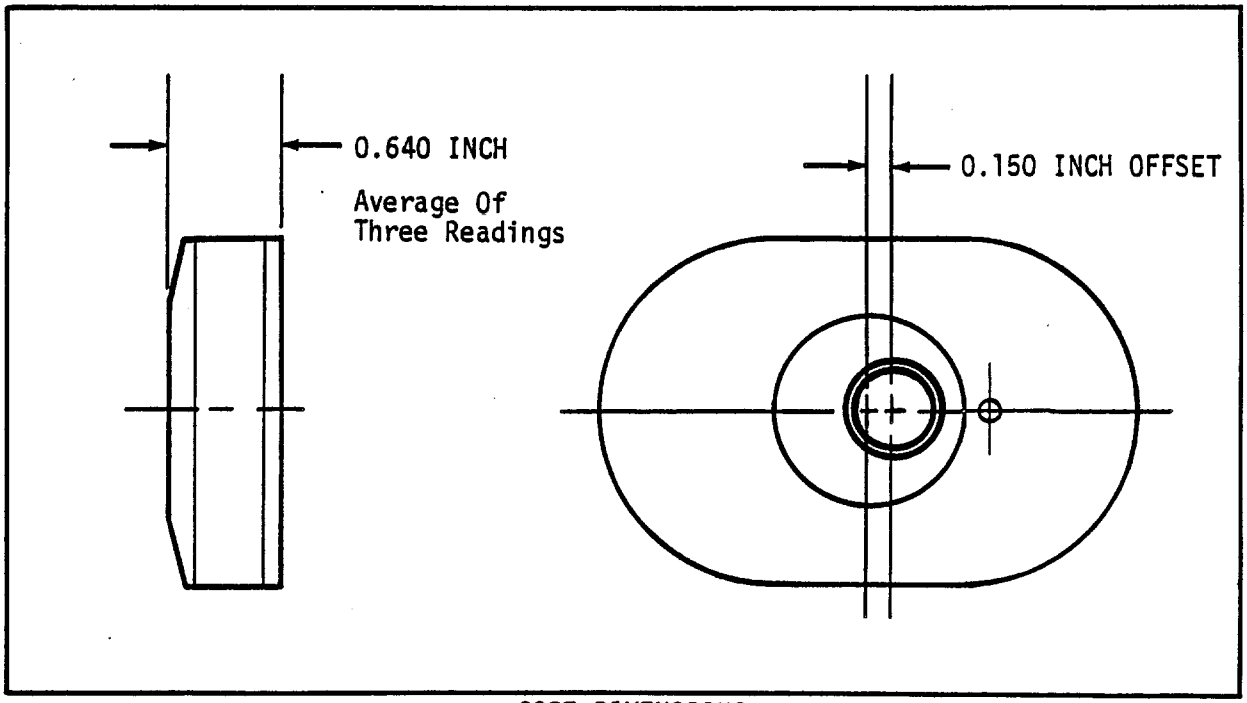
Figure 601 contains the fits and clearances for the 7350721-7 and 7350721-8 Engine Vibration Isolators.

NOMENCLATURE, ITEM NUMBER AND FIGURE NUMBER	DESIGN MANUFACTURING LIMITS (INCHES) DIMENSION		SERVICE WEAR LIMITS (INCHES) DIMENSION	
	MIN	MAX	MIN	MAX
Housing, Mounting Holes Diameter (IPL 4, Fig. 1) (Ref. Fig. 603)	0.401	0.411		0.416
Housing, (Shear Boss at Bottom of Flange) O.D. (IPL 4, Fig. 1) (Ref. Fig. 603)	0.9960	0.9980	0.9935	
Pin Diameter(Cast on Housing) Pin Height (IPL 4, Fig. 1) (Ref. Fig. 603)	0.070 0.060	0.090 0.120	0.050 0.050	
Core (All) Thickness Average of Three Readings Offset (IPL 2,8, Fig. 1) Ref. Fig. 604)	0.630 0.140	0.650 0.160	0.610 0.130	0.670 0.170

FITS AND CLEARANCES
FIGURE 601



HOUSING DIMENSIONS
FIGURE 603



CORE DIMENSIONS
FIGURE 604

TESTING

1. GENERAL

The following test procedure is for used core assemblies to establish serviceable cores when rebuilding isolators(REF: IPL 2, 8, Fig. 1).

NOTE: Core assemblies removed from an isolator are to be retained as a matched pair, tested and, if qualified reinstalled as a matched pair. It is recommended if one of the pair fails inspection or test, both cores be replaced.

2. TEST PROCEDURE

A. Test procedure for a matched pair of core assemblies consisting of P/N 7351257-7 and P/N 7351257-9, one each.

1) Install a pair of core assemblies in Test fixture T13051 as shown in Figure 701. Tighten the three 1/4 inch bolts which hold the fixture together so that the spacer tubes are clamped between the two outer plates of the fixture. This controls the 1.115/1.125 inch dimension and assures that the cores are properly pre-compressed for Test.

B. Flex core assemblies to 600 pounds, three times.

C. Apply 200 pound preload. Set dial indicator to zero while maintaining preload.

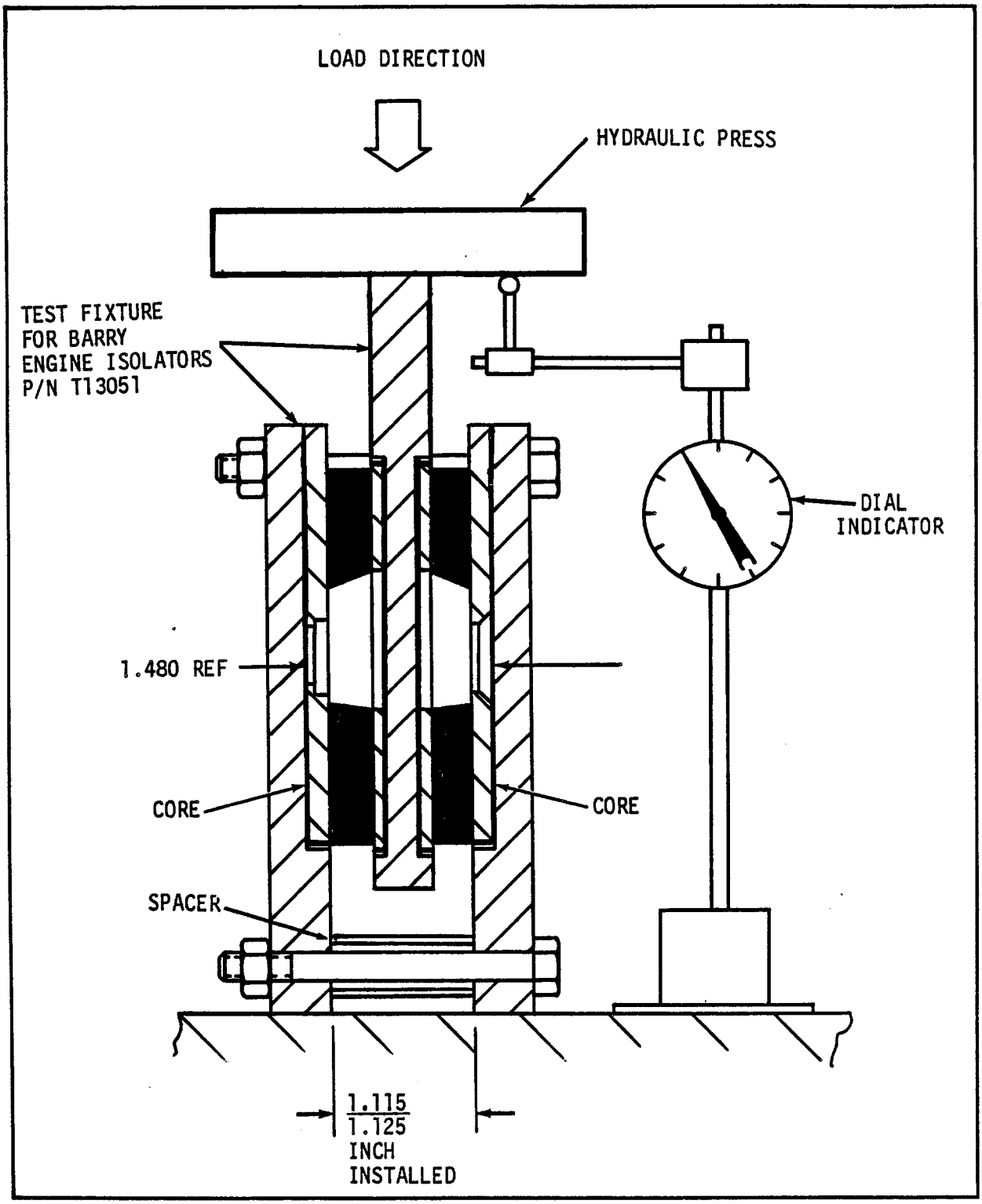
D. Increase load to 600 pounds. Hold cores in this position for one minute. Note that the load will slowly drop below 600 pounds.

E. Return load to 600 pounds. Read deflection on dial indicator.

1) Deflection between 200 pound and 600 pound load should be 0.108-0.140 inches one minute after loading. If deflection is outside of tolerance, replace core assemblies.

F. Visually inspect the core assemblies while the 600 pound load is applied. Reject core if any separations in elastomer or at elastomer to metal bond exceed 1.0 inch length or 1/16 inch depth.

G. Tag or bag core assemblies as a matched pair.



CORE ASSEMBLY TEST
FIGURE 701

3. TEST PROCEDURE

A. Test procedure for a matched pair of core assemblies consisting of P/N 7351257-10 and P/N 7351257-11, one each.

1) Install a pair of core assemblies in Test fixture T13051 as shown in Figure 701. Tighten the three 1/4 inch bolts which hold the fixture together so that the spacer tubes are clamped between the two outer plates of the fixture. This controls the 1.115/1.125 inch dimension and assures that the cores are properly pre-compressed for Test.

B. Flex core assemblies to 400 pounds, three times.

C. Apply 40 pound preload. Set dial indicator to zero while maintaining preload.

D. Increase load to 400 pounds. Hold cores in this position for one minute. Note that load will slowly drop below 400 pounds.

E. Return load to 400 pounds. Read deflection on dial indicator.

1) Deflection between 40 pound and 400 pound load should be 0.138-0.168 inches one minute after loading. If deflection is outside of tolerance, replace core assemblies.

F. Visually inspect the core assemblies while the 400 pound load is applied. Reject core if any separations in elastomer or at elastomer to metal bond exceed 1.0 inch length or 1/16 inch depth.

G. Tag or bag core assemblies as a matched pair.

STORAGE INSTRUCTIONS

1. Storage is estimated at five years under ideal conditions. Ideal conditions are defined as follows:

   A. Individually wrap isolators in a flexible, waterproof, grease proof barrier material MIL-B-121 or equivalent commercially available material or paper.

   NOTE: Plastic bags should not be used for long term storage to avoid the possibility of moisture condensation.

   B. No contact with petroleum-based fluids or solvents.

   C. No exposure to direct sunlight.

   D. No exposure to extremes in temperature or humidity.

2. Storage is estimated at four years under normal conditions.

SPECIAL TOOLS, FIXTURES AND EQUIPMENT

1. Only one special fixture is required for overhaul of the 7350721-7 and 7350721-8 engine vibration isolator. This fixture is required to test used cores as described in the TESTING section of this manual.

NOMENCLATURE	PART NUMBER	SOURCE
Core Test Fixture	T13051	Barry Controls Division Barry Wright Corporation Burbank, California

Special Tools, Fixtures and Equipment
Figure 1001

ILLUSTRATED PARTS LIST

1. GENERAL

The illustrated parts list consists of an itemized parts breakdown which is illustrated as necessary to identify the parts.

2. FIGURE ITEM COLUMN

The number listed under "Figure" is the figure number of the exploded view that illustrates the listed parts. The numbers listed under "Item" identify the parts in the illustration. Where a part is not illustrated, the item number of that part will be preceded with a dash (-). Item numbers with alpha varients show modification or configuration differences from the basic item number.

3. NOMENCLATURE COLUMN

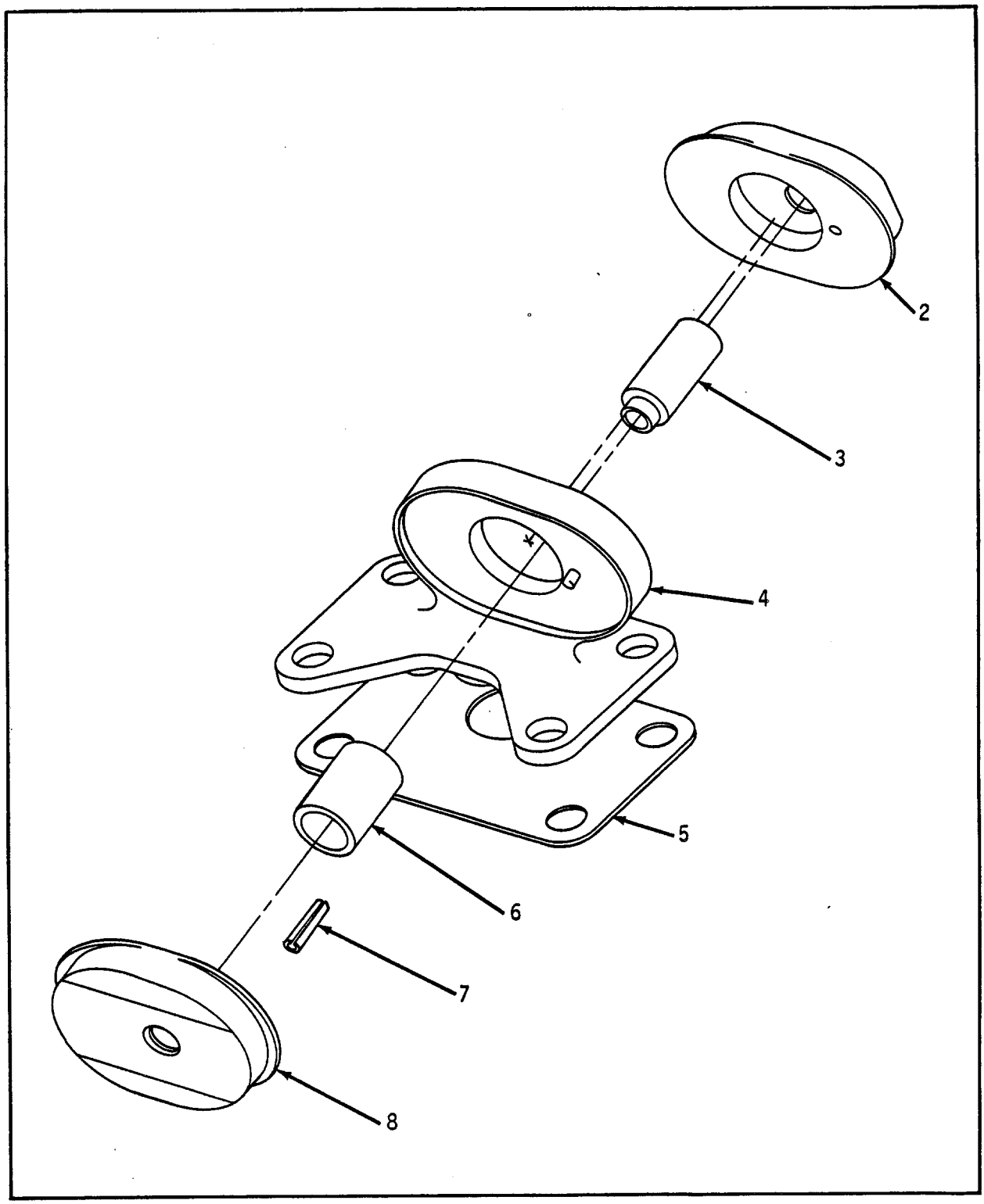
The nomenclature used for each part is the same as that given for the title of the manufacturer's drawing with any necessary qualifying description. Nomenclatures listed are intended to show the relationship of a part with its assembly.

4. EFFECT CODE COLUMN

When two or more main assembly variations are listed, a different "usable on" code letter is assigned to each main assembly and is listed in the Effect Code Column. All components peculiar to an assembly are identified by the same code letter as the appropriate main assembly. Components with different code letters are not interchangeable between main assemblies unless designated interchangeable in the Nomenclature column. The column is left blank opposite a part that is common to all main assemblies.

5. UNITS PER ASSEMBLY COLUMN

The quantities listed in this column are the number of units required per assembly. For bulk items, the letters "AR" are entered to indicate "as required". The letters "RF" are entered to indicate that item is listed only for reference purposes.



7350721-7 ENGINE VIBRATION ISOLATOR
FIGURE 1

FIG. ITEM	PART NUMBER	NOMENCLATURE 1234567	EFFECT CODE	UNITS PER ASSY.
-1	7230721-1	ISOLATOR, Engine Vibration (Superseded by 7350721-5)	A	RF
-1A	7350721-5	ISOLATOR, Engine Vibration (Supersedes 7350721-1) (Superseded by 7350721-6)	B	RF
-1B	7350721-6	ISOLATOR, Engine Vibration (Supersedes 7350721-5) (Superseded by 7350721-8)	C	RF
-1C	7350721-8	ISOLATOR, Engine Vibration (For P&W PT6A-20 Engine) (Supersedes 7350721-6)	D	RF
-1D	7350721-7	ISOLATOR, Engine Vibration (For P&W PT6A-27 Engine) (Also alternate and replacement for 7350721-8)	E	RF
-2	MB5633	.CORE (Superseded by 7351257-4)	A	1
-2A	7351257-4	.CORE (Supersedes MB5633) (Superseded by 7351257-6)	B	1
-2B	7351257-6	.CORE (Supersedes 7351257-4) (Superseded by 7351257-11)	C	1
-2C	7351257-11	.CORE (Supersedes 7351257-6) (Used on P/N 7350721-8)	D	1
2D	7351257-9	.CORE (Used on P/N 7350721-7)	E	1
3	7351261-1	.STUD		1
4	7351256-2	.HOUSING (Latest Configuration with Pin Cast on Housing. Part retains same Number)		1
-5	7350723	.GASKET (Superseded by R20702-2)		1
5A	R20702-2	.GASKET (Supersedes 7350723)		1
6	7351260-1	.TUBE, Bumper		1
7	MS171465	.PIN, Spring (Not used with latest Housing Configuration)		1
-8	MB5633	.CORE (Superseded by 7351257-3)	A	1
-8A	7351257-3	.CORE (Supersedes MB5633) (Superseded by 7351257-5)	B	1
-8B	7351257-5	.CORE (Supersedes 7351257-3) (Superseded by 7351257-10)	C	1
-8C	7351257-10	.CORE (Supersedes 7351257-5) (Used on P/N 7350721-8	D	1
8D	7351257-7	.CORE (Used on P/N 7350721-7)	E	1
		NOTE: Isolator P/N 7350721-8 has green color coded core surfaces. Isolator P/N 7350721-7 has yellow color coded core surfaces.		

- ITEMS NOT ILLUSTRATED

WRIGHT COMPONENTS INC.

OVERHAUL INSTRUCTIONS

VALVE NO. 15328

1. DESCRIPTION AND DATA

A DESCRIPTION

(Refer to Fig. 1)

The valve covered by these overhaul instructions is a solenoid operated three way valve with a supply port on the lower end of the valve body, a control port on one side of the valve, and an exhaust port to atmosphere. The solenoid coil assembly is attached to the headplate of the valve. With the coil assembly de-energized, the supply port is closed by the action of a spring and plunger assembly holding the ball on to its valve seat. When the coil assembly is energized, the plunger assembly is withdrawn clear of the ball, supply pressure seats the ball on to its valve seat closing the exhaust port to atmosphere, and allowing supply pressure to pass through the control port.

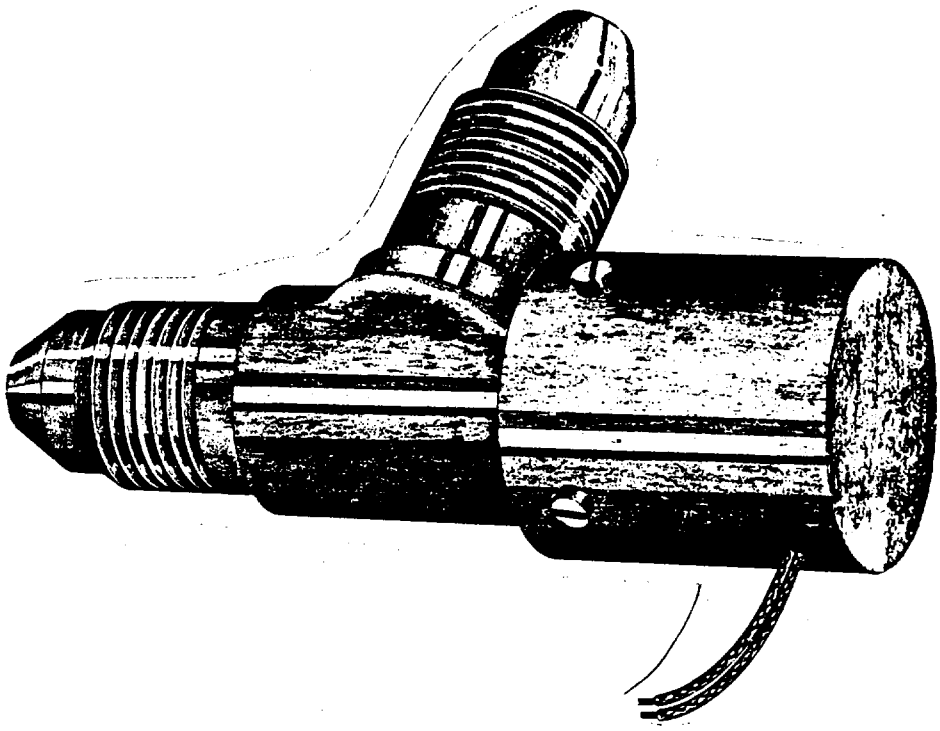


FIGURE 1 SHUTOFF VALVE No. 15328

B DATA

Type - Solenoid operated valve

Fluid Media - Air

Operating Pressure - 35/70 PSI

Proof Pressure - 140 PSI

Burst Pressure - 210 PSI

Temperature - +400 to 450°F

Voltage - 18 - 28V DC.

Current - 1.5 amp max at 30V DC and 76°F.

Duty - 7 seconds on, 1 hour off.

2. DISASSEMBLY

A PROCEDURE

(Refer to Fig. 2)

(1) Remove four screws (1) and slide coil assembly (2) from headplate (7).

(2) Remove shim (3), spring (4) and plunger assembly (5) from headplate (7).

(3) Remove four screws (6) and lift out headplate (7) from valve body.

(4) Carefully remove O-ring (8) valve seat (9), ball (10) spacer (11) valve seat (12), O-ring (13) and spacer (14) from valve body (15).

3. CLEANING

A Clean all metal parts (except coil assembly) in trichlorethylene or similar cleaning solution, and dry with compressed air.

4. INSPECTION

A PROCEDURE

(1) Inspect plunger assembly, valve seats and ball for damage such as visible score marks or pitting. Replace defective parts.

(2) Inspect coil assembly for obvious damage. Measure resistance of coil Allowable limits 38 - 42 ohms at 76°F.

(3) Check spring value rated at 6.7 lb/inches (0.36 lb at .25 ± .005 inch).

5. REPAIR

A Repair is limited to replacement of defective parts.

6. ASSEMBLY

A PROCEDURE

(Refer to Fig. 2)

(1) Install spacer (14) to valve body (chamferred inside diameter must face supply port). Assemble new O-ring (13) to valve seat (12) and carefully insert into valve body ensuring that seat faces top.

(2) Install spacer (11) and ball (10) on valve seat.

(3) Assemble new O-ring (8) to valve seat (9) and carefully insert into valve body ensuring that seat faces down.

(4) Install headplate (7) and secure to valve body with four screws (6).

(5) Install plunger assembly (5), spring (4) and shim (3) to headplate.

NOTE: If plunger assembly (5) was replaced, stone or trim the end of push-rod to .297/.296 inches.

(6) Slide coil assembly (2) on headplate and valve body, and secure to headplate with four screws (1).

7. TESTING

A PROCEDURE

(Refer to Fig. 2)

(1) Connect coil wires to electrical power source 18 - 28 volts DC.

(2) Connect supply port to a gauged clean air supply.

(3) Connect 0 - 200 PSI gauge to control port.

(4) Apply air pressure at 35 - 70 PSI to supply port. Energise coil assembly.

Check that gauge reading at control port is within 5 PSI of pressure applied at supply port, and that gauge shows balanced pressure within 1 - 3 seconds. A valve that is sluggish should be rejected.

(5) De-energize coil assembly. Increase pressure at supply port to 140 PSI and ensure that valve remains closed at applied pressure. Allowable leakage is .001 lbs/min at control port and .10 lbs/min at exhaust port.

8. TROUBLE SHOOTING

A No special trouble shooting instructions are required.

9. STORAGE INSTRUCTION

A Cap supply port and control port. Tape exhaust port on valve body. Tape assembly coil wires.

10. ILLUSTRATED PARTS LIST

FIG. & INDEX NO.	PART NO.	NOMENCLATURE	USAGE ON CODE	UNITS PER ASSEMBLY
2- -1 & -6	AN500C4-3	Screw, Fill Head		8
-2	21039	Coil Assembly		1
-3	21087	Shim		1
-4	20378	Spring		1
-5	21044	Plunger Assembly		1
-7	21047	Headplate		1
■ -8 & -13	90001-008	O-ring		2
-9 & -12	21048	Valve Seat		2
■ -10	MS19060-17	Ball		1
-11	20333	Spacer		1
-14	20334	Spacer		1
-15	21049	Valve Assembly Body		1

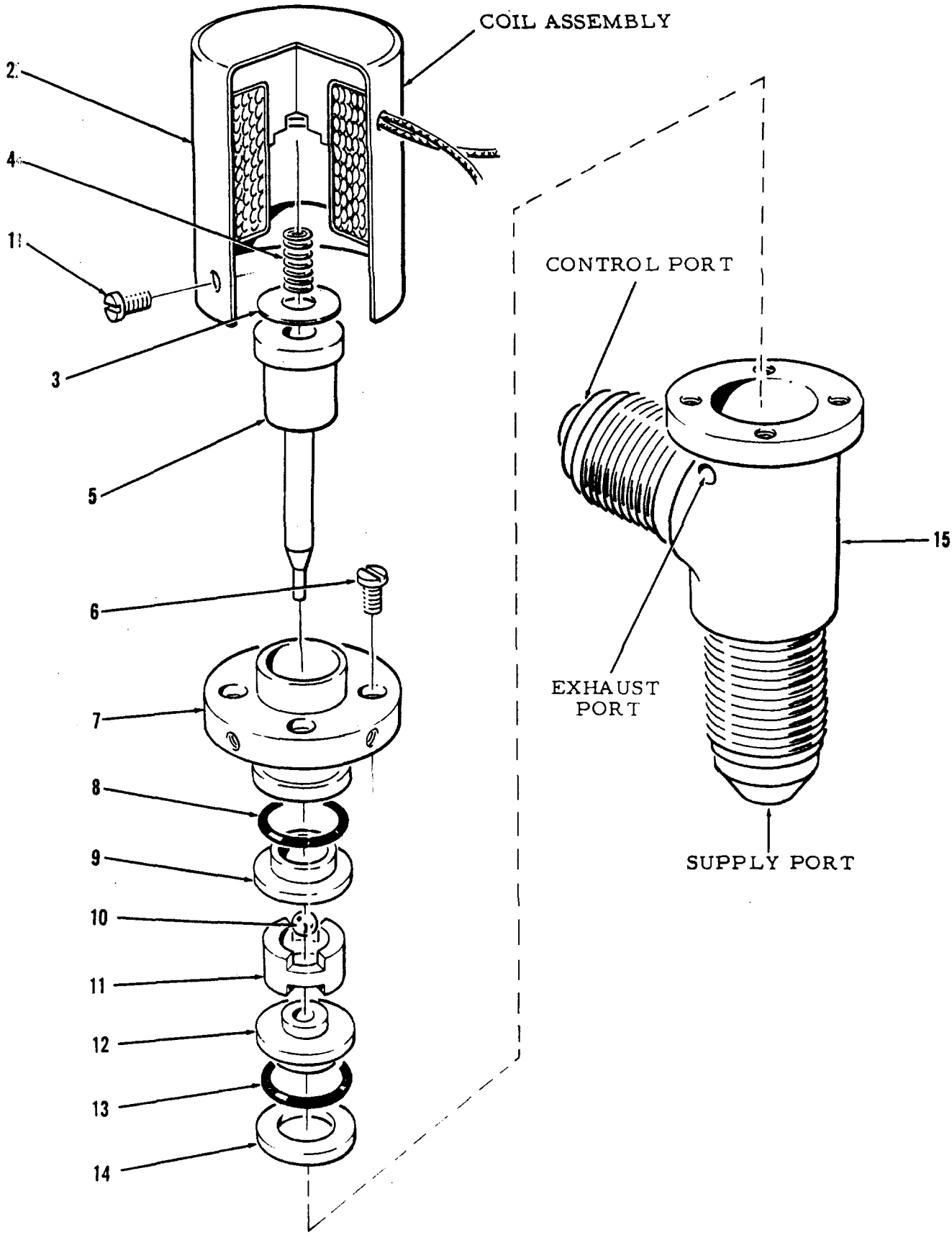


Figure 2. Exploded View of Valve No. 15328

CHAPTER

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ENGINES

Overhaul data for engine is contained in Pratt Whitney Aircraft PT6A-20 Engine Overhaul Manual No. 3011403 (Ser 100/200) or PT6A-27 Engine Overhaul Manual No. 3013242 (Ser 300). This data is supplied separately by Pratt and Whitney.

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CHAPTER

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ENGINE FUEL AND CONTROL

MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B./T.R.
Bendix	Fuel Flow Indicator Old P/N New P/N	 25514-B25A-3-A3 3571810-2001 (C6SC1036-1)	31-00-		
	Transmitter Fuel Flow	9133-25-B1	73-30-5	Nov 1/1968	
Sundstrand	Power Driven Rotary Pump	025323-402 through -402D	73-10-04	Mar 1/1995	
Wright Components	Fuel Shutoff Solenoid Valve	15410		Apr 4/1978	

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25514-B25A-3-A3
Fuel Flow Indicator

Overhaul With
Parts Breakdown



Flight & Engine
Instruments
Division

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FUEL FLOW INDICATOR

PART NUMBER 25514-B25A-3-A3

DESCRIPTION AND OPERATION

The fuel flow indicator 25514-B25A-3-A3 is a precision instrument designed to provide readings of rate of fuel flow in terms of pounds per hour. The indicator operates from electrical signals generated by a mating synchro type transmitter which monitors the actual flow of the fuel.

Simplified construction contributes to the accuracy and reliability of the indicator. The dial is attached to a mounting plate that, in turn, is directly secured on the front end of the Autosyn synchro assembly powering the unit. The shaft of the synchro extends through the dial; the pointer is affixed directly on the shaft. The pointer, mounted on the synchro shaft, constitutes sole moving component of indicator.

TABLE I

LEADING PARTICULARS

Operating Voltage	26 volts
Rated Frequency	400 cps
	single-phase
Range	60 to 500 pph
Dial Spread	240 degrees
Temperature Range	-65 to +159.8°F
	(-54 to +71°C)

DISASSEMBLY

(Refer to figure 1.)

A. Remove protective cap (1).

B. Identification plate (2) is cemented to end cover (7). Do not remove identification plate unless it is defective. To remove a defective identification plate, loosen edge with knife; then peel plate free.

C. Attach a mating connector (DM9700-7S of Deutsch Co., Electronics Components Division, Banning, Calif., Federal Supply Code No. 11139 or equivalent) to the receptacle (6) of the indicator. Place indicator on a hot plate or in an induction coil to heat the soldered bond joining outer edge of end cover (7) to inner circumference at rear end of case and glass assembly (9). When the solder has melted sufficiently that the plating will not be peeled from plated surfaces of end cover or case (12), use the mating connector to pull the end cover assembly free. Do not use excessive heat or force which could result in separating receptacle from end cover which is unnecessary unless one of these components is defective. Remove all excess solder from inside of case.

D. Withdraw mechanism straight out from case and glass assembly (9) and remove the spacer (13).

E. Unsolder and remove eyelet (3), but do not disassemble the end cover assembly (5) or the case and glass assembly (9) unless necessary to replace a defective part.

F. Unsolder leads from terminal pins of receptacle (6), remove all excess solder.

G. Remove the pointer assembly (14) by pulling it straight away from dial (16) with fingers or use a suitable tool. Do not pry pointer sideways: this might result in damage to the pointer, dial, or shaft.

H. Remove screws (17) and detach dial plate (18) from synchro assembly (19).

CLEANING

A. Clean all metal parts, except as noted in the following procedures, in solvent. Dry thoroughly. Keep parts free from dust particles.

WARNING

Use solvent in a well ventilated area. Do not inhale vapors or allow solvent to come in contact with the skin. Keep solvent away from open flame.

CAUTION

Do not immerse the synchro assembly (19) in solvent or allow solvent to enter interior portions of synchro assembly.

B. Be certain no deposits of grease or other foreign matter remain on terminal pins or insulation of receptacle (6).

C. Wash cover glass (11) and dial (16) in pure soap and water taking care to avoid damage to dial markings. Dry parts thoroughly. Polish cover glass with a soft lint free cloth. Keep parts free from finger marks.

D. Clean pointer assembly (14) with art gum or other similar soft eraser.

E. Clean exterior surfaces as well as the leads of synchro assembly (19) with solvent. Wipe away all film residue which remains as solvent dries.

INSPECTION

A. Inspect all parts for cracks, breaks, wear and any other obvious defects or damage.

B. Inspect the receptacle (6) for bent, broken, or loosened terminal pins for cracked or loosened insulation and for bent or damaged shell.

C. Inspect end cover (7) for damaged edges.

D. Inspect cover glass (11) for chips, cracks, and discoloration.

E. Inspect case (12) for distortion and for damaged ends.

F. Examine spacer (13), pointer assembly (14), and dial (16) for pin holes, scratches, or other damage to paint. Be sure parts are free from stains and discoloration.

G. Inspect leads of synchro assembly (19) especially at points of entry into synchro housing for crimps, breaks, and damaged insulation.

H. Dielectric Test of Synchro Assembly (19). Test dielectric strength of synchro assembly as follows. Using insulation breakdown test set 13700-1-C, apply a potential of 500 volts (rms) at a commercial frequency for a minimum period of five seconds across a stator lead and ground (housing) and then across a rotor lead and ground (shaft). There shall be no electrical breakdown of insulation. Failure of test requires replacement of the synchro assembly.

I. Leak Test of Case and Glass (9) and End Cover (5) Assemblies. Use components of hermetic sealing stand 13693-1-B to seal off rear end of assembly. Evacuate interior of the assembly to 50 microns or less absolute pressure. Use the helium leak detector, Model 24-120A, to measure rate of helium leakage through the assembly. The leak rate shall not exceed 1.0 micron-cubic-foot per hour. If leak rate is excessive, repair as required by reworking the faulty soldered joint or by replacing the defective component.

REPAIR AND REPLACEMENT

A. No repair of components is recommended. Replace any part disclosed by inspection or testing to be defective.

B. Replace identification plate if removed.

ASSEMBLY

A. If case assembly (9) was disassembled, proceed as follows. While inserting cover glass (11) and case (12) into front ring (10) insert a ring of solder under cover glass along edge joining front ring and case; use solder conforming to Specification QQ-S-571, Comp SN63, Form W, 0.06 dia. and an activated resin flux such as part number 1544 of the Kester Solder Company, 4201 Wrightwood Avenue, Chicago, Ill. 60639, Federal Supply Code No. 75297 or equivalent. Place parts in an induction coil or on a hot plate and heat to effect a proper soldered bond. Add additional solder if required, but do not permit excess solder to remain on rear surface of front ring or on outer circumference of the case. Allow the assembly to cool undisturbed. Perform leak test outlined in step I of Section 31-00-4, Inspection to determine if proper sealing has been achieved.

B. If the end cover assembly (5) was disassembled, proceed as follows. Place the end cover (7) on a flat surface, rear side (as shown in exploded view) up. Center evacuation hole in twelve o'clock or zero degree position. Insert receptacle (6) into end cover with polarizing key at 62 ± 3 degree position. Maintain these relative positions and use an induction coil, hot plate, or torch to solder parts together. Use solder conforming to Specification QQ-S-571, comp Sn50, Form W, 0.06 dia. and the flux specified in step A. Allow assembly to cool undisturbed. Perform leak test outlined in step I of Section 31-00-4, Inspection, to assure that proper sealing has been achieved.

C. Secure dial plate (18) on synchro assembly (19). Make certain pilot on synchro housing is seated squarely in recess in dial plate; secure with screws (17).

D. Secure dial (16) on dial plate (18) with dial screws (15).

E. Assemble a piece of tubing (4) over each synchro assembly lead. Pass leads back through compression ring (8) and solder leads to terminal pins of receptacle (6) in compliance with Table II, Wiring Data. Make certain there is no excess solder on connections and that there are no cold solder joints. Thoroughly clean away all flux. Fit tubing down over receptacle pins.

F. Calibrate unit as follows. Connect the mechanism assembly to the synchro servoed test transmitter 13695-2-A and impose electrical zero. Tap the synchro assembly lightly to overcome the effects of friction so rotor will assume the true EZ position. With the rotor held in this position, press on the pointer assembly (14) with tip centered on EZ reference mark. (Refer to Table III, Calibration Data.)

G. Perform the following tests outlined in Section 31-00-7, Testing.

Step	Test
B (2)	Electrical Zero Test
B (3)	Scale Error and Friction Error Test
B (4)	Position Error Test

In the event of failure of any of these tests, check for probable cause and correct as required in accordance with following tabulation.

Test Failed	Probable Cause	Corrective Procedure
Electrical Zero	Improper placement of pointer on shaft.	Refer to Step D
	Faulty synchro.	Replace synchro.
Scale Error	Pointer not tight on shaft.	Affix pointer on shaft.
	Improper E-Z adjustment.	Refer to Step D.
	Dial not in proper position.	Reposition dial as required.
	Faulty synchro	Replace synchro.
Friction Error	Pointer drag against dial or glass.	Reposition pointer on shaft.
	Excessive end play or other fault in synchro.	Replace synchro.

H. Final Assembly. When each test of step G has been concluded with the mechanism within tolerance, proceed as follows. Use a vacuum hose as necessary to remove any lint and dust from the mechanism and from inside of the case and glass assembly (9). Perform a final inspection to insure that there are no finger marks or other imperfections on inside of cover glass (11). Make certain there are no imperfections in the paint on spacer (13), pointer assembly (14), dial screws (15), or dial (16). Insert spacer and mechanism into the case assembly. Insert end cover assembly (5) against the compression ring (8) in such position that polarizing key of receptacle is within 5 degrees of vertical centerline of the dial. Maintain this relative position and apply an axial force of from 8 to 12 pounds to end cover to press it into proper position.

Maintain this force and solder outer edge of end cover to inner circumference of case all around using solder conforming to Specification QQ-S-571, Comp Sn63, Form W, 0.06 dia. and the flux specified in step A.

I. Perform sealing test outlined in step B (5) of Section 31-00-7, Testing, to assure that a proper hermetic seal has been achieved. Connect instrument to the vacuum pump, Hyper-Vac Model 25A, and evacuate the unit to a pressure of 500 or less microns. With vacuum maintained, bake unit at 160°F for two hours. Then backfill the unit to a pressure of approximately one atmosphere with dry helium. Helium used for backfill shall be at least 98 percent pure, dust free, and shall contain not more than 0.006 milligrams of water vapor per liter (dew point -65°C) at the filling pressure. Seal unit by soldering in eyelet (3) using solder conforming to Specification QQ-S-571, Comp Sn63, Form W, 0.03 dia. and flux specified in step A.

J. Touch up any unpainted portions of case (12) using black epoxy paint such as that manufactured by the Desoto Chemical Coatings Co., Inc., 8600 River Road, Pennsauken, J.J. 08110 (Federal Supply Code 70947).

TABLE II

WIRING DATA

Synchro Lead	Terminal Pin In Electrical Receptacle
Rotor	
Black/White	1
Red/White	2
Stator	
Black	1
Yellow	3
Blue	4

TESTING

A. Test Conditions. Unless otherwise specified, perform the tests outlined in step B under the following conditions.

(1) Standard atmospheric conditions. Perform tests at atmospheric pressure, approximately 29.92 inches Hg. and at room temperature, approximately 77°F or 25°C.

(2) Attitude. Test indicator in the normal upright operating position with the plane of the dial vertical.

(3) Power Supply. Perform tests using 26 ± 1 volt, single phase, 400 ± 5 cps ac power.

(4) Electrical Zero. If the synchro servoed test transmitter 13695-2-A is not available, determine electrical zero in accordance with the procedures of Specification MIL-I-7057, paragraph 4.5.3.

(5) Vibration. Prior to taking a test reading, vibrate the indicator lightly by hand.

B. Tests. Perform the following tests.

(1) Dielectric Strength. Use the insulation breakdown test set 13700-1-C, to apply a potential of 200 volts (rms) at a commercial frequency for a minimum period of five seconds between any pin of receptacle (6) and ground (indicator case (12)). There shall be no breakdown of insulation. In the event of failure, make certain there are no trailing wire ends or deposits of foreign matter causing shorting at the receptacle. Replace a defective synchro assembly (19) if that is the cause of failure.

(2) Electric Zero. Connect the indicator to the synchro servoed test transmitter 13695-2-A and impose electrical zero. The tip of pointer assembly (14) shall be within 0.010 inch of the electrical zero reference mark on the dial (16). (Refer to Table III, Calibration Data.) If the synchro servoed test transmitter 13695-2-A is not available, refer to paragraph (4) of step A for method of determining electrical zero. In event of failure of test, refer to step G of Section 31-00-6, Reassembly.

(3) Scale Error and Friction Error. Connect indicator to synchro servoed test transmitter 13695-2-A. Adjust test transmitter to bring its pointer assembly (14) successively to each test point specified in Table III, Calibration Data. At each test point, take two readings: the first before and the second after the indicator is lightly tapped. The difference between the two readings represents friction error which shall not exceed the friction error tolerance specified in Table III. The second

reading shall not differ from the specified test point reading by an amount greater than the scale error tolerance of Table III. In event of failure of either test, refer to step G of Section 31-00-6, Reassembly. The following position error test can be performed concurrently with this test.

(4) Position Error Test. With the indicator connected to the synchro servoed test transmitter 13695-2-A. Adjust the test transmitter to center the pointer assembly (14) on the electrical zero reference mark. Now, hold the indicator in any position. The change in indication caused by changing the position of the indicator, shall not exceed the position error tolerance as specified in Table III, Calibration Data. In the event of failure of test, refer to step G of Section 31-00-6, Reassembly.

(5) Sealing Test. Use the helium leak detector, Model 24-120A, to measure the rate of helium leakage from the indicator case. At a pressure differential of one atmosphere, leak rate shall not exceed 1.0 micron-cubic-foot per hour. If leak rate is excessive, correct by either replacing the defective component or reworking the faulty soldered joint.

TABLE III

CALIBRATION DATA

SYNCHRO SERVOED TEST TRANSMITTER SETTING (DEGREES)	DESIRED INDICATOR READING (PPH)	SCALE ERROR TOLERANCE (DEGREES)
61.2	60	1.6
75.9	100	1.6
125.6	200	1.6
180.0 EZ	300	1.6
237.0	400	1.6
299.2	500	1.6
Friction Error Tolerance		1.6
Position Error Tolerance		1.6

SPECIAL TOOLS, FIXTURES AND EQUIPMENT

PART NUMBER	NOMENCLATURE	APPLICATION
13693-1-B	Hermetic Sealing Stand	Used in testing, evacuation, filling and sealing case of indicator.
13695-2-A	Synchro Servoed Test Transmitter	Used to calibrate and test indicator
13700-1-C	Insulation Breakdown Test Set	Used in performing dielectric strength tests.

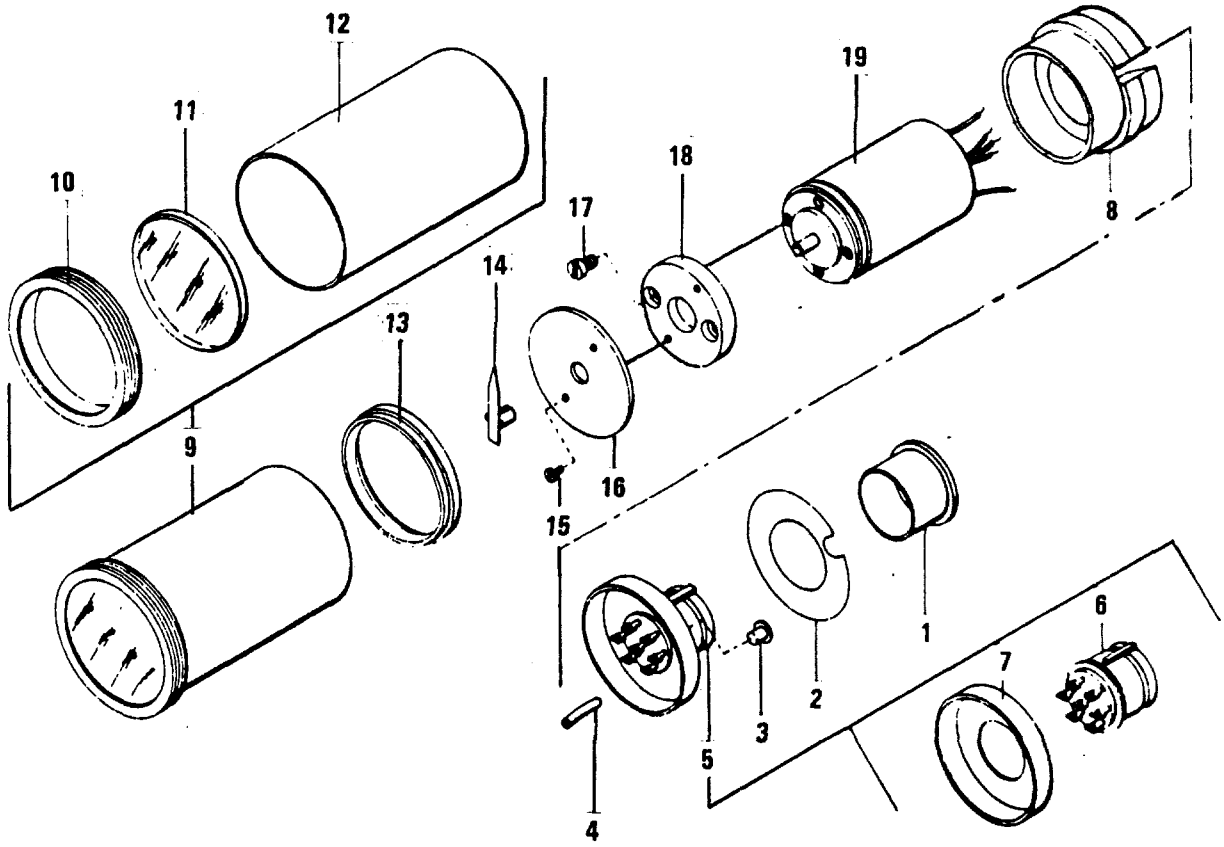


Figure 1. Fuel Flow Indicator, 25514B25A3A3

PARTS BREAKDOWN

Figure and Index Number	Part Number	Nomenclature 1 2 3 4 5 6 7	Units Per Assy.	Useable on Code
1-	25514B25A3A3	INDICATOR, Fuel flow	1	
-1	1489206-12	. CAP, Protective	1	
-2	1494326	. PLATE, Identification	1	
-3	1492991-1	. EYELET	1	
-4	3070-11-1-40	. TUBING	5	
-5	1494327	. END COVER ASSEMBLY	1	
-6	1490891-1	. . RECEPTACLE	1	
-7	1490329-5	. . COVER, End	1	
-8	1490333-2	. RING, Compression	1	
-9	1492374-1	. CASE AND GLASS ASSEMBLY	1	
-10	1206675-1	. . RING, Front	1	
-11	1206677-1	. . GLASS, Cover	1	
-12	1490327-2	. . CASE	1	
-13	1206680-1	. SPACER	1	
-14	1492016-1	. POINTER ASSEMBLY	1	
-15	1489266-140	. SCREW, Dial	2	
-16	A255B25A	. DIAL	1	
-17	3016-0406-120	. SCREW	2	
-18	1480981-2	. PLATE, Dial	1	
-19	1497552	. SYNCHRO ASSEMBLY	1	

Overhaul and Parts Data

Overhaul Instructions with Parts Breakdown

Transmitter,
Fuel Flow

Bendix Type 9133

Bendix

Instruments & Life Support Division

ISSUE DATE: 1 MARCH 1968
(Superseding in part
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Rev. No. 1 dated 1 November 1968

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OVERHAUL MANUAL - PUBLICATION NO. 3874-67

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INTRODUCTION

1. General. This manual contains descriptive data, overhaul instructions, test procedures and illustrated parts breakdown for the Fuel Flow Transmitter, Bendix Type 9133-54-B1. See Figure 1. This equipment is manufactured by the Instruments and Life Support Division of The Bendix Corporation, Davenport, Iowa.

2. Additional Models. Models very similar, or identical except for minor modifications, will be included in Difference Data Sheets. Overhaul procedures for these additional models are the same as those recommended in this basic manual except for the specific differences noted by the applicable Difference Data Sheets. Difference Data Sheets will be issued as available and should be attached to and filed with this basic manual.

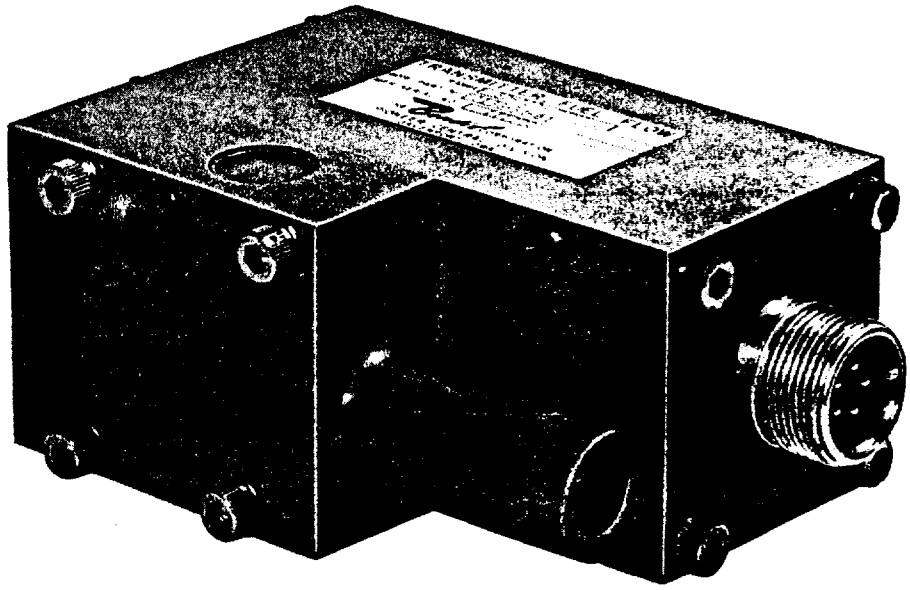


FIGURE 1. THREE-QUARTER VIEW - FUEL FLOW TRANSMITTER, BENDIX TYPE 9133-54-B1

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INTRODUCTION

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DESCRIPTION AND OPERATION

1. General.

   A. This equipment is manufactured by the Instruments & Life Support Division of Bendix Aviation Corporation, Davenport, Iowa.

2. Description.

   A. The Fuel Flow Transmitter, Bendix Type 9133-54-B1, measures the rate of fuel flow and transmits an electrical signal to an indicator.

3. Operation.

   A. The Fuel Flow Transmitter is inserted in the line through which fuel flows. The fuel is routed through the chamber in the body of the transmitter and deflects a pivoted vane. This deflection increases with the rate of fuel flow. The vane deflection is transmitted through a magnetic coupling to a synchro transmitter which rotates in accordance. The degree of the synchro transmitter rotation is converted to an electrical signal which is transmitted to an indicator.

4. Leading Particulars.

   A. The leading particulars of the equipment are given in Table I.

TABLE I
TABLE OF LEADING PARTICULARS

Instrument Weight	2.0 lbs
Range-lbs/hr	50-350
Operating Temperature Range.	Satisfactory Operation Within Temp. Range of +70°C to -55°C (+158°F to -65°F)
Power Requirements	26 volts, 400 cycles ±10%, single phase
Power Rating	3.25 VA at 0.18 power factor
Working Pressure	200 psi maximum
Accuracy	Within 5 pounds per hour over entire range

DISASSEMBLY

1. Separation of Connection Housing from Mechanism. See Figure 3.

   A. Remove sealing decals (2). Remove the plugs (3) from the fuel flow ports. Remove the lockwire (10) and four screws (11) and lift off the connection housing (9). Remove the pin (13) from the housing (53). Remove the packing (12) from the connection housing.

2. Removal of the Relief Valve. See Figure 3.

   A. Remove the retaining ring (4) which holds the relief valve plug (5), spring (7) and relief valve (8). Remove the packing (6) from the relief valve plug.

3. Removal of Cover and Receptacle Assembly. See Figure 3.

   A. Remove the cap (14) from the receptacle. Remove the four screws (16) and lockwashers (17) and lift out the cover and receptacle assembly (15).

   B. Remove the packing (18) from the cover, but do not separate the cover and receptacle, which are cemented together.

   C. Do not unsolder the leads of the synchro transmitter (19) from the receptacle unless the synchro transmitter and/or cover and receptacle assembly (15) are being replaced.

4. Removal of Synchro Transmitter and Bar Magnet Assembly. See Figure 3.

   A. Remove three screws (21) which secure the clamp (20) to the housing (53). Carefully withdraw the synchro transmitter (19) with the bar magnet assembly (22) and clamp (20) affixed to it.

   B. Loosen the two setscrews (23) and ease the bar magnet assembly (22) off the synchro transmitter shaft. Remove the clamp (20) from the synchro transmitter.

      CAUTION: WHEN REMOVING THE BAR MAGNET ASSEMBLY FROM THE SYNCHRO TRANSMITTER SHAFT, PUSH SHAFT OUT OF THE BAR MAGNET TO PREVENT DAMAGE TO SYNCHRO BEARINGS DUE TO EXCESSIVE AXIAL FORCE.

      CAUTION: DO NOT DISASSEMBLE THE SYNCHRO TRANSMITTER (19). IF INDICATOR READINGS ARE UNSATISFACTORY AND THE DIFFICULTY IS TRACED TO THE SYNCHRO TRANSMITTER, REPLACE IT AS A UNIT.

5. Disassembly of the Mechanism. See Figure 3.

   A. Remove the lockwire (25) and four screws (26) and lift off the cover retainer (24). Remove the housing cover (27) from the housing (53) using Cover Puller 31TF10538. Remove the packing (28) from the housing cover.

   B. Loosen setscrew (31) and slide the spring and hub assembly (30) and spring adjusting plate assembly (32) from the vane shaft (49).

C. Remove screw (33), lockwasher (34) and washer (35) which secure the outer end of spring and hub assembly (30) to the spring adjusting plate assembly (32) and separate the two assemblies.

6. Disassembly of Vane and Drive Assembly. See Figure 3.

A. Loosen setscrew (46) and slide the ring magnet assembly (45) off the vane shaft (49).

NOTE: Do not disassemble the ring magnet assembly (45).

B. Remove three screws (38) and lift off the housing cover (37).

NOTE: The housing cover (37) is part of the matched housing assembly (36), which also includes the vane housing barrier (40) and vane housing (43). If any of these three components are being replaced, it is necessary to replace the entire matched housing assembly (36).

C. Carefully slide the vane (47) and the vane shaft (49) out of the vane housing (43). Loosen two setscrews (48) and slide the vane shaft (49) out of the vane (47).

NOTE: The vane, shaft and magnet assembly (44) is a matched assembly, consisting of the ring magnet assembly (45), vane (47) and vane shaft (49). If any of these three components are being replaced, it is necessary to replace the entire matched vane, shaft and magnet assembly (44).

D. Remove two screws (41) and remove the vane housing barrier (40) from the vane housing (43), if necessary.

E. Remove ball bearing (50) and screw (52) from the vane housing (43).

CLEANING

CAUTION: AFTER DISASSEMBLY, IT IS ESSENTIAL TO KEEP ALL PARTS ABSOLUTELY CLEAN AND FREE OF DIRT OR MOISTURE. USE PROTECTIVE COVERS.

1. General.

A. Moving parts, or parts in contact with moving action in normal operation, should be cleaned with an approved cleaning solution such as trichlorethylene, Stock No. 8500-950500, or naptha aliphatic, Federal Specification No. TT-N-95. After cleaning, dry with warm air.

B. Brush castings with cleaning solution.

C. Remove all traces of oil or grease from electrical parts with cleaning solution.

D. Clean pivot holes with orangewood stick.

E. Clean small parts sonically with Bendix SEC1420-A system or spray with cleaning solution called out in paragraph 1A and dry with warm air.

F. Clean ball bearing using Ball Bearing Cleaning Kit QB70606-3 and Bearing Cleaning Solution QB14634-1.

CAUTION: IMMEDIATELY AFTER CLEANING, OIL BEARING LIGHTLY TO PREVENT CORROSION. KEEP BEARING CLEAN.

2. Vent Holes. See Figure 3.

A. Examine the vent holes in the housing cover (37) and the vane housing (43) to be sure there is no obstruction.

INSPECTION

1. General.

A. After cleaning, inspect all parts for damage, wear, or other defects. Check components for tightness in assemblies that have not been disassembled. Inspect screws and washers for damage and wear. Check the electrical connector receptacle for broken pins, stripped or burred threads or corrosion.

B. Inspect ball bearing for flat spots, roughness and excessive wobble between inner and outer races.

REPAIR

1. Relief Valve.

A. If any part included in the assembly of the relief valve is corroded or damaged, replace it. The face of the relief valve must be smooth to prevent leakage and the spring must be in good condition providing proper tension. Check the relief valve spring for compression by applying a compression load of 4 ounces ±0.10 ounce. The length of the compressed spring must be 0.664 ±0.005 inches. If the spring does not measure within tolerance, replace it with a new spring.

2. Synchro Transmitter.

A. Before reassembly, check the resistance of the synchro transmitter as described in TESTING, Paragraph 3A.

3. Demagnetizing Magnets.

   A. Demagnetize the magnets with a suitable Demagnetizer, such as Bendix No. 13290-1-A. To demagnetize, first hold the bar magnet assembly between the two arms of the demagnetizer. Revolve the assembly in at least two planes with respect to the demagnetizing poles, and then withdraw the assembly slowly, along a straight line and at right angles to the demagnetizer field. Repeat this procedure with the ring magnet. This precaution is necessary since it is comparatively difficult to determine accurately the actual polarity of such small objects. The line of magnetism between poles must be at right angles to the demagnetizing flux to insure fullest effect.

4. Remagnetizing Bar Magnet.

   A. Remagnetize the bar magnet assembly to full strength using Magnet Charger Model 107A, manufactured by the Radio Frequency Laboratories, Inc., Boonton, N. J., together with Magnetizing Jig, QB71063-1, and Magnetizing Adapter, QB71063-10. For proper concentration of the lines of force, be sure that the center lines of the magnetizer poles line up with the center lines of the magnet. After remagnetizing, place the magnet in Magnet Keeper QB70735-4.

5. Remagnetizing Ring Magnet.

   A. Use the magnet charger mentioned in paragraph 5A together with Magnetizing Jig QB71063-1 and repeat the procedure of the preceding paragraph to remagnetize the ring magnet. After remagnetizing, place the ring magnet in Magnet Keeper QB2674-1.

ASSEMBLY

1. Reassembly of Vane and Drive Assembly. See Figure 3.

   CAUTION: BEFORE REASSEMBLY, CAREFULLY EXAMINE ALL CONTACT SURFACES OF MOVING PARTS FOR BURRS OR CHIPS. THESE SURFACES MUST BE CLEAN AND SMOOTH TO INSURE CORRECT OPERATION OF THE TRANSMITTER.

   A. Carefully insert ball bearing (50) into vane housing (43) and make sure that the bearing flange is seated against the vane housing.

   B. Apply castor oil to the threads of screws (11, 16, 21, 26, 33, 38 and 41). If vane housing barrier (40) has been removed, place it in position in the vane housing (43) as determined by the two dowel pins (42). Use Alignment Gage 31TF10644 to align the barrier in the vane housing before tightening two screws (41).

NOTE: See "NOTE" following paragraphs 6B and 6C in DISASSEMBLY.

C. To check end play of vane shaft (49) in housing assembly (36), set vane shaft only (minus vane) against bearing with 0.0015 shim between bearing and shaft shoulder. Assemble and tighten housing cover (37) with screws (38). This adjustment should position the vane shaft for an end play of 0.001 to 0.002 inch.

D. Carefully insert the vane shaft (49) in the vane (47) and position it so that the edge of the vane towards the larger end of the shaft is 0.022 ±0.005 inch from the shoulder on the shaft, and that the two setscrews (48) are aligned with the flat on the vane shaft. Tighten the two setscrews to secure the vane in position. When looking at the larger end of the vane shaft, the vane blade should be to the right of the setscrews.

CAUTION: IT IS IMPERATIVE NOT TO BEND OR SCORE THE VANE SHAFT OR DAMAGE THE VANE, IN ORDER TO MAINTAIN A PROPER FIT WITH THE INSIDE CIRCULAR WALL OF THE HOUSING AND THE MATING SURFACE OF THE VANE HOUSING BARRIER.

E. Carefully insert the larger end of the vane shaft (49) through the ball bearing (50) in the vane housing (43).

F. Slide the housing cover (37) over the smaller end of the vane shaft (49) and into position against the vane housing (43) as determined by the two dowel pins (39). It may be tapped lightly with a fiber mallet to seat it on the dowel pins. Secure the housing cover to the vane housing with three screws (41). Vane shaft end play is 0.001 to 0.002 inch.

NOTE: Examine that clearance around vane is equalized.

G. Rotate the vane (47) and vane shaft (49) and test for friction. If there is stickiness or unevenness, first examine the housing assembly and make certain that the housing cover (37) is lying flat. If the cover is satisfactorily positioned, remove it and examine ball bearing (50) for wear or damage or for incorrect reassembly if it were replaced. Examine the vane shaft (49) for wear, damage or misalignment. Check to make sure bearing is not cocked.

H. Position the ring magnet assembly (45) on the larger end of the vane shaft (49) with the setscrew (46) aligned with the flat on the shaft and the ring magnet assembly hub flush against the shoulder on the shaft. Apply American Sealants Co. "Locktite" Grade AAV to setscrew (46). Tighten the setscrew to secure the ring magnet assembly in position.

I. Apply American Sealants Co. "Locktite" Grade A to threads of screw (52) before assembling into housing (43).

2. Reassembly of the Mechanism. See Figure 3.

A. Ease the vane and drive assembly (29) into the housing (53) until its leading edge butts against the shoulder in the housing.

B. Align the slot in the vane housing barrier with the dowel pin hole in the bottom of the housing (53). Carefully tap the dowel pin (13) into place with a fiber mallet so that it projects approximately 1/4 inch.

C. Insert outer end of spring of spring hub assembly (30) into spring clamp of spring adjusting plate assembly (32) to the adjustment scribe mark on the spring. Secure the spring in the clamp with screw (33), lockwasher (34) and washer (35).

D. Place the hub of the spring and hub assembly (30) on the extended end of the vane shaft (49) with the end of the hub flush with the end of the vane shaft and the back of the spring adjusting plate assembly (32) flush against the housing cover (37).

E. Rotate the spring hub until the setscrew (31) aligns with the flat on the vane shaft (47) and tighten the setscrew.

F. Carefully insert the housing cover (27) with packing (28) in the housing (53) so that the slot in the face of the cover aligns with the mating boss on the spring adjusting plate assembly (32).

NOTE: Use Dow Corning DC7 silicone grease on "O" ring prior to assembly.

G. Place cover retainer (24) in position on the end of housing (53) and secure with four screws (26).

NOTE: Do not lockwire screws (26) until unit has been calibrated and tested.

3. Reassembly of Synchro Transmitter and Bar Magnet Assembly. See Figure 3.

A. Replace clamp (20) in retaining groove on synchro transmitter (19).

B. Slide the bar magnet assembly (22) on the end of the synchro transmitter shaft until the end of the hub is flush with the end of the shaft and tighten two setscrews (21) to secure it.

C. Carefully insert the synchro transmitter (19) and bar magnet assembly (22) into the housing (53) and secure in place by attaching the clamp (20) to the housing with three screws (21).

CAUTION: BACKUP PRESSURE ON OTHER END OF SHAFT TO PREVENT DAMAGE TO BEARINGS OF SYNCHRO.

4. Reassembly of the Cover and Receptacle Assembly. See Figure 3.

A. If the synchro transmitter (19) and/or cover and receptacle assembly (15) were replaced, solder synchro lead wires to the receptacle pins as shown in Figure 2.

B. Solder electrical connections with Eclipsaloy No. 9, Grade 10 solder. This rosin-core solder consists of 63 percent tin and 37 percent lead and has a melting temperature of 181°C. Solder conforming to Federal Specification QQ-S-571, having a similar composition and melting range, may be used.

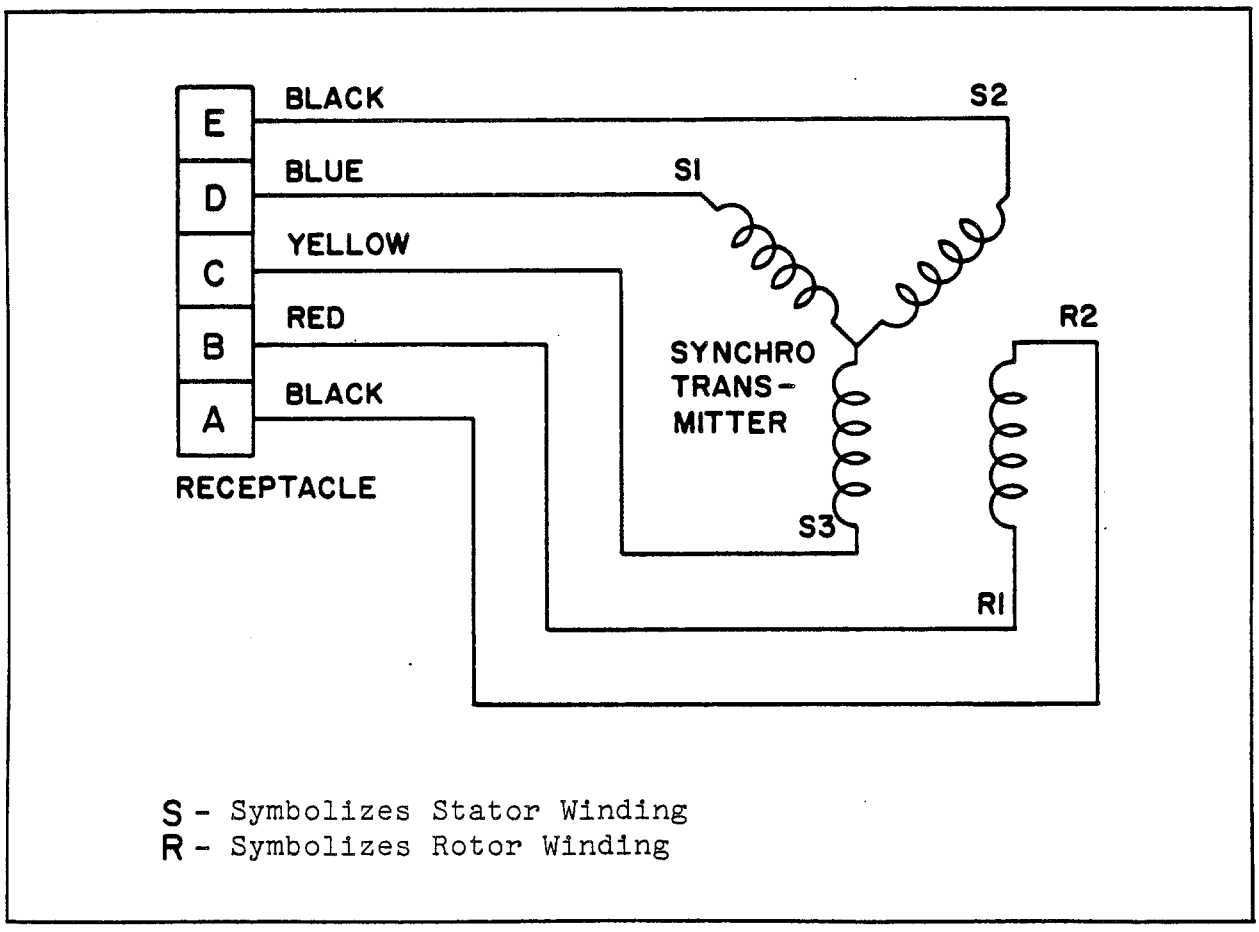


FIGURE 2. SCHEMATIC WIRING DIAGRAM

C. Insert the cover and receptacle assembly (15) with packing (18) in end of housing (53) with the polarizing key of the receptacle at the top and secure in place with four screws (16) and lockwashers (17).

NOTE: Use Dow Corning DC7 silicone grease on "O" ring before assembly.

5. Reassembly of Relief Valve. See Figure 3.

A. Insert the relief valve (8) in the connection housing (9) with the central raised portion of the valve toward the spring.

B. Insert relief valve spring (7) and relief valve plug (5) with packing (6) in the connection housing. Make sure that the spring coils fit on the plug extension and that the spring is not cocked.

C. Depress the relief valve plug (5) using Compression Tool 31TF10540 and insert the retaining ring (4) in the groove in the connection housing (9) to hold the relief valve assembly in place.

6. Reassembly of Connection Housing. See Figure 3.

A. Place the packing (12) in the groove in the connection housing (9).

NOTE: Use Dow Corning DC7 silicone grease sparingly on "O" ring before assembly.

B. Place the connection housing (9) on the housing (53), aligning it with the dowel pin (13) and attach it with four screws (10).

NOTE: Do not replace cap (14), plugs (3), lockwires (10 and 25) and sealing decals (2) until all tests have been completed.

FITS AND CLEARANCES

No fits and clearances are required other than those already mentioned.

TESTING

1. General.

A. Whenever the pressure and temperature conditions for the test are not definitely specified, it is understood that the test is to be made at atmospheric pressure of 29.92 ±2 inches of Hg. and room temperature of +25°C ±5°C.

When pressure and temperature differ from these values, proper allowances shall be made for the differences.

B. The fuel flow transmitter shall be mounted with its longitudinal axis vertical and the inlet in the lower position.

C. The indicator and transmitter shall be connected to a 26 volt, 400 cycle single-phase power supply.

D. Unless otherwise specified during all tests the transmitter shall be vibrated at a frequency of 1500 to 2000 CPM and an amplitude of 0.002 to 0.005 inch total excursion from positive maximum to negative maximum.

E. The fuel used for conducting tests shall be aviation gasoline, grade 115/145, Federal Specification MIL-F-5572. The specific gravity of the fuel shall be 0.715 ±0.003 at a temperature of 20°C ±2°C.

NOTE: For conversion purposes, one gallon of gasoline at specific gravity of 0.72 weighs six pounds.

F. Measurements requiring the use of a Vacuum Tube Volt Meter shall be made with a precision VTVM calibrated to 1% of actual value.

2. Tests.

A. Electrical Breakdown.

WARNING: THE ELECTRICAL BREAKDOWN TEST SHALL NOT BE PERFORMED IN A ROOM WHERE FLAMMABLE VAPORS ARE PRESENT.

(1) Use Insulating Tester 31TJ2179-2 to apply 200 volts, 60Hz between each pin of the receptacle and housing. Increase the voltage at a uniform rate to the test value and maintain for 5 seconds, then reduce to zero. This test shall cause no insulation breakdown.

(2) Use the Insulating Tester 31TJ2179-2 to apply 500 VDC between all pins of the receptacle and housing for a period of 5 seconds. The insulation resistance shall be not less than 10 megohms.

B. Excitation.

(1) The current drawn by the transmitter shall be 105 ±20 milliamperes.

C. Scale Error and Friction Test.

(1) Connect the instrument to the Fuel Flow Test Stand 31TF2237-1 and test for scale errors at the flow rate

tabulated in Table II. The test shall be made by subjecting the transmitter to the flows specified, first with rates of flow increasing, then with rates of flow decreasing. With the rate of flow increasing, the rate shall be brought up to, but shall not exceed the rate specified and with the rate of flow decreasing, the rate shall be brought down to, but shall not fall below the rate specified. The errors at the test points shall not exceed 5 pounds per hour or 3.83 indicator degrees, and the difference between the reading on the increasing rate of flow and the reading on the decreasing rate of flow at each test point shall not exceed 3.5 pounds per hour or 2.68 indicator degrees.

TABLE II

Flow Rate PPH	Dial Calibration DEG
50	64.97
100	103.31
150	141.66
200	180.00
250	218.34
300	256.69
350	295.03

D. Leak Test.

(1) The transmitter shall be tested for leaks with Flowmeter Leak Tester 31TF2227-1 immediately after the scale error test while the flow chamber is still moist from fuel, but with all the free fuel drained out. The flow chamber shall be subjected to a pressure of 200 psi. With the air supply disconnected, there shall be no more than 0.125 psi change in pressure over a period of five minutes. The piping from the air supply and to the gauge shall be as short as practicable and have an inside diameter not exceeding 1/4 inch.

E. Position Error.

(1) Readings of the standard indicator shall be taken with the transmitter in any position but the normal testing position as specified in paragraph 1B. These position readings shall not differ from the normal position readings by more than 5 pounds per hour or 3.83 indicator degrees.

NOTE: This test may be combined with the Scale Error Test.

3. Synchro Transmitter.

A. Check the resistance of the synchro transmitter, using a standard ohmmeter. The resistance across any two leads of the stator should be 6.7 ohms ±10% for the 1610122-1 and 3.8 ohms ±20% for the 1610122-2. The resistance of the rotor shall be 16 ohms ±10% for the 1610122-1 and 9.3 ohms ±20% for the 1610122-2. If the synchro transmitter does not meet these requirements, it must be replaced with a new assembly.

4. Calibration.

A. To calibrate the transmitter, proceed as follows:

(1) Set transmitter at full flow (vane against stop), loosen clamp screws (21) and rotate the synchro using Adjusting Tool 31TF10539 to obtain a reading of 300° on calibration dial.

(2) Set flow rate at 50 lbs and adjust pre-tension of spring by rotating housing cover (27) using Calibrating Tool 31TF10537 to obtain a reading of 65° on calibration dial.

(3) Tighten all screws and run a Scale Error Test.

(4) If error at high end of flow rate is too low, loosen screw (33) and set spring clamp toward end of spring.

(5) If error at high end of flow rate is too high, set spring clamp further away from end of spring to stiffen spring.

(6) Repeat the Scale Error Test and centralize the error curve by rotating the synchro housing.

(7) If error curve is out of tolerance in mid portion of flow rate repeat steps (1) through (6) with full flow set above or below 300°.

NOTE: If error curve droops at the high end of the error curve, a lower full flow indicator angle will pick it up.

5. Test Equipment.

A. The Fuel Flow Test Stand, type 31TF2237-1 is supplied with factory calibrated master transmitter equipment for testing purposes.

TROUBLE SHOOTING

1. See Table III, Trouble Shooting Chart.

TABLE III

TROUBLE SHOOTING CHART

TROUBLE	PROBABLE CAUSE	REMEDY
Out of calibration.	Rate spring (30) out of calibration. Spring torque to be 147 ±3 gram-centimeters at scribe mark when deflected through 270°.	Calibrate rate spring (30) as required, using Torsion Spring Tester Model 7358 and Spring Adapter 31TF10541.
Failure of Electrical Breakdown Test.	Shorted or grounded synchro transmitter (19). Faulty wiring.	Replace the synchro transmitter. Repair wiring.
Extreme calibration error.	Relief valve (8) not seated properly.	Check and reassemble the relief valve.
Inoperative	A. Friction B. Locked Vane (47).	A. Check for friction and end play. B. Check for burrs on the vane and housing.

STORAGE INSTRUCTIONS

1. Oven dry the flowmeter, at a moderate temperature, to remove all moisture.
2. Cap the inlet and outlet ports of the transmitter.
3. Clean the unit with a clean cloth.
4. Place the unit in a polyethylene bag.
5. Cushion the bottom of a suitable corrugated carton with hair cushioning.
6. Place the unit contained in a polyethylene bag in carton and surround with hair cushioning.
7. Close and tape seal the carton. Label the carton as to content and date of packing.

NOTE: Units which remain in storage or are inoperative beyond 12 months must be tested, inspected and lubricated where applicable prior to operation. To prevent expiration of the shelf life during the interval between shipment and factory installation, it is recommended that the customer schedule orders for equipment so as not to exceed 6 months storage time. Only this type of control will assure operators of satisfactory service life. In the event that shelf life is exceeded, such units must be returned to Instruments & Life Support Division for rework, at the customer's expense, to renew warranty of the equipment.

SPECIAL TOOLS, FIXTURES AND EQUIPMENT

TABLE IV

PART NO.	NOMENCLATURE
QB2674-1	Ring-Magnet Keeper
QB14634-1	Bearing Cleaning Solution
QB70606-3	Bearing Cleaning Kit
QB70735-4	Keeper-Magnet
QB71063-1	Magnetizing Jig
QB71063-10	Magnetizing Adapter
13290-1-A(or equiv.)	Demagnetizer
31TF10537	Tool-Calibrating
31TF10538	Puller-Cover
31TF10539	Tool-Adjusting
31TF10540	Tool-Compression
31TF10541	Adapter-Spring
31TF10644	Alignment-Gage
31TJ2179-2	Tester-Insulation
31TF2227-1	Tester-Flowmeter Leak
31TF2237-1	Fuel Flow Test Stand
THE FOLLOWING STANDARD EQUIPMENT OR EQUAL IS REQUIRED AND MAY BE PURCHASED FROM OUTSIDE VENDORS	
Model 107A or Equivalent	Magnet Charger Radio Frequency Labs, Inc. Boonton, New Jersey
Model 7358	Torsion Spring Tester John Chatillon and Sons New York, New York
Weston 779 or Equivalent	Volt-Ohm-Milliammeter Weston Instruments Division of Daystrom, Inc. Newark, New Jersey

ILLUSTRATED PARTS LIST

1. Figure 3 illustrates the subassemblies and parts of the Flow Meter Transmitter Types 9133-54-B1 and 9133-25-B1 indexed in disassembly order.

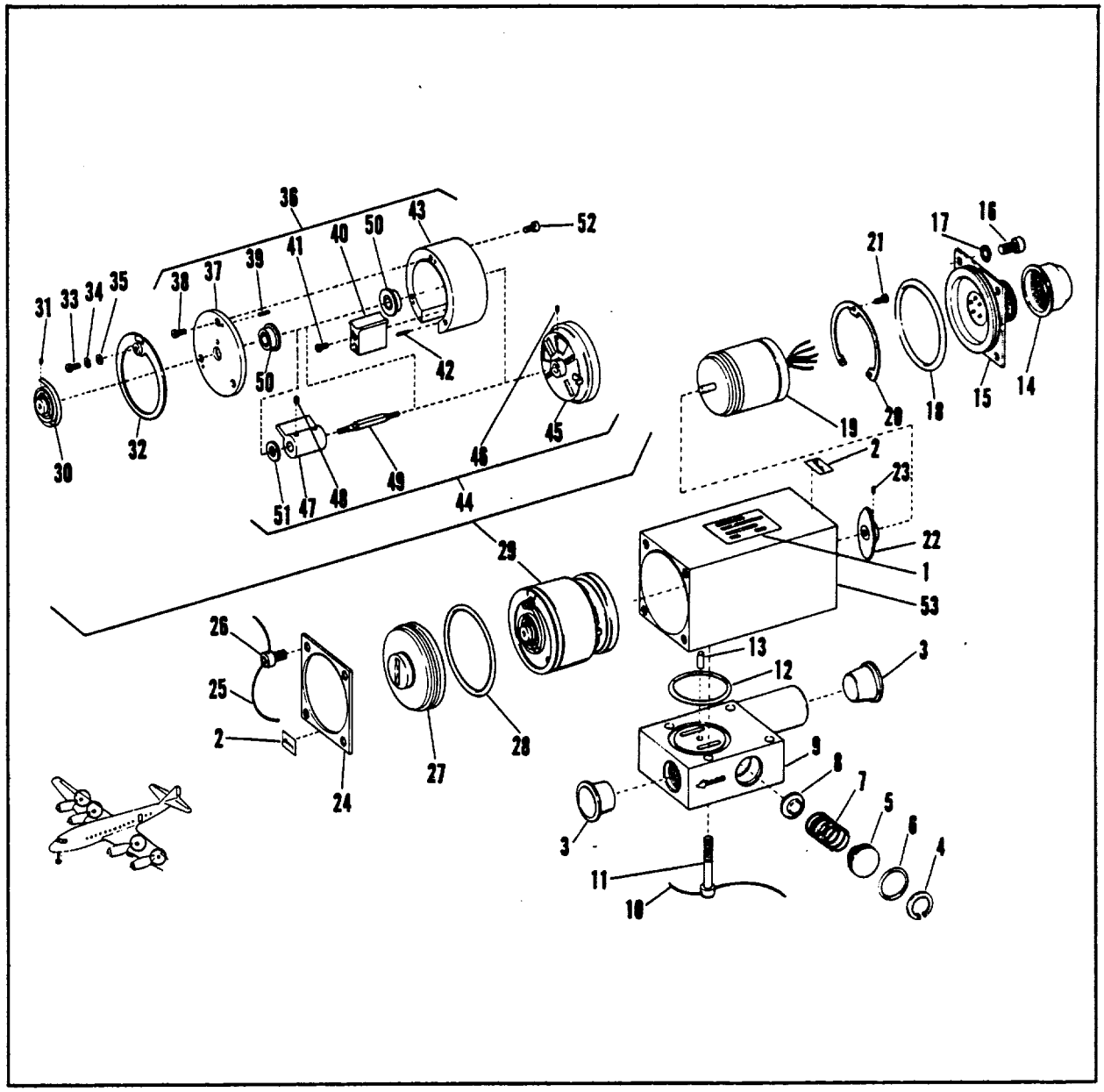


FIGURE 3. EXPLODED VIEW - FUEL FLOW TRANSMITTER, TYPES 9133-54-B1 and 9133-25-B1

	Fig.& Index No.	Part Number	Nomenclature 1 2 3 4 5 6 7	Usage Code	Units Per Assy
	3-	9133-54-B1	TRANSMITTER ASSEMBLY, Fuel Flow	A	
	3-	9133-25-B1	TRANSMITTER ASSEMBLY, Fuel Flow	B	
	-1	1610310-1	. PLATE, Identification		1
	-2	1619961-1	. DECAL		2
	-3	1612233-1	. PLUG, Protective		2
	-4	TIR-68SS	. RING, Internal Retaining		1
	-5	1611639-1	. PLUG, Relief Valve		1
	-6	MS29513-15	. PACKING, "O" Ring		1
	-7	1611638-1	. SPRING, Relief Valve		1
	-8	1611637-1	. VALVE, Relief	A	
		1611637-2	. VALVE, Relief	B	
	-9	1609892-1	. HOUSING, Connection		1
			(ATTACHING PARTS)		
	-10	MS20995-C20	. WIRE, Lock		AR
	-11	DASH-0-1020SS	. SCREW		4
			-----*-----		
	-12	MS29513-122	. PACKING, "O" Ring		1
	-13	PRSS-1261-36B	. PIN, Dowel		1
	-14	813960-17	. CAP, Shipping		1
	-15	1609877-1	. COVER AND RECEPTACLE ASSY		1
			(ATTACHING PARTS)		
	-16	ASH-0-1006SS	. SCREW		4
	-17	LW-0-10SS	. WASHER, Lock		4
			-----*-----		
	-18	MS29513-131	. PACKING, "O" Ring		1
R	-19	1610122-2	. SYNCHRO TRANSMITTER		1
R		1610122-1	. SYNCHRO TRANSMITTER		1
			(on some older units)		
			(ATTACHING PARTS)		
	-20	1609890-1	. CLAMP, Rim Clenching		1
	-21	FFIL-0-303SS	. SCREW		3
			-----*-----		
	-22	PB-22089-2	. MAGNET ASSEMBLY, Bar		1
			(ATTACHING PARTS)		
	-23	HCS-0-402RS	. SCREW, Set		2
			-----*-----		
	-24	1612666-1	. RETAINER, Cover		1
			(ATTACHING PARTS)		
	-25	MS20995-C20	. WIRE, Lock		AR
	-26	DASH-0-1010SCP	. SCREW		4
			-----*-----		
	-27	1612667-1	. COVER, Housing		1
	-28	MS29513-131	. PACKING, "O" Ring		1
	-29	1612813-4	. VANE AND DRIVE ASSEMBLY	A	1
		1612813-5	. VANE AND DRIVE ASSEMBLY	B	1
	-30	1610155-1	. . SPRING AND HUB ASSEMBLY	A	1
		1610155-4	. . SPRING AND HUB ASSEMBLY	B	1
			(ATTACHING PARTS)		
	-31	1612419-8	. . SCREW, Set		1
			-----*-----		

Fig.& Index No.	Part Number	Nomenclature 1 2 3 4 5 6 7	Usage Code	Units Per Assy
3-32	1609882-1	. . PLATE ASSEMBLY, Spring Adjusting (ATTACHING PARTS)		1
-33	FFIL-0-203SS	. . SCREW		1
-34	LW-0-2SS	. . WASHER, Lock		1
-35	W-0-2SS	. . WASHER		1
		-----*-----		
-36	1612814-4	. . HOUSING ASSEMBLY	A	1
	1612814-7	. . HOUSING ASSEMBLY	B	1
-37	1612815-1	. . . COVER, Housing (ATTACHING PARTS)		1
-38	FFIL-0-304SS	. . . SCREW		3
		-----*-----		
-39	PRSS-636-15B	. . . PIN, Dowel		2
-40	1610112-1	. . . BARRIER, Vane Housing (ATTACHING PARTS		1
-41	FFIL-0-304SS	. . . SCREW		2
		-----*-----		
-42	PRSS-636-15B	. . . PIN, Dowel		2
-43	1609883-2	. . . HOUSING, Vane		1
-44	1611548-2	. . VANE, SHAFT AND MAGNET ASSEMBLY		1
-45	1609889-1	. . . MAGNET ASSEMBLY, Ring (ATTACHING PARTS)		1
-46	1612419-10	. . . SCREW, Set		1
		-----*-----		
-47	1611549-1	. . . VANE (ATTACHING PARTS)		1
-48	1612419-10	. . . SCREW, Set		2
		-----*-----		
-49	1612816-1	. . . SHAFT, Vane		1
-50	1612296-1	. . BEARING, Ball		2
-51	1603660-57	. . WASHER |		
	794842-2	. . WASHER |— SELECT		AR
	794842-3	. . WASHER | AT		
	794842-4	. . WASHER | ASSEMBLY		
-52	ASH-0-304SS	. . SCREW		1
-53	1609875-1	. HOUSING		1

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DIFFERENCE DATA SHEET FOR FUEL FLOW TRANSMITTER, TYPE 9133-25-B1

NOTE: Descriptive data and instructions covered in this section are the same as those for Type 9133-54-B1, covered in the previous sections, except for the specific differences noted.

DESCRIPTION AND OPERATION

1. In general the description and operation is the same as for Type 9133-54-B1. The major difference is in the vane and drive assembly components.

DISASSEMBLY

1. Same as for Type 9133-54-B1.

CLEANING

1. Same as for Type 9133-54-B1.

INSPECTION

1. Same as for Type 9133-54-B1.

REPAIR

1. Same as for Type 9133-54-B1.

ASSEMBLY

1. Same as for Type 9133-54-B1.

FITS AND CLEARANCES

1. Same as for Type 9133-54-B1.

TESTING

1. Testing is, in general, the same as for Type 9133-54-B1 except for the following:

   A. General - paragraph E. The fuel JP-4 per MIL-F-5624 used for conducting tests shall have a specific gravity of 0.775 ±0.005 at a temperature of $20^{\circ} \pm 2^{\circ}$C.

B. Tests - paragraph A. Electrical Breakdown.

(1) Use the Insulating Tester 31TF2179-2 to apply 550 volts 60 Hz at all pins of the electrical receptacle connected together and the housing for 5 seconds. This test shall cause no insulation breakdown.

C. Scale Error and Friction Test - paragraph C.

(1) The instrument shall be tested at the flow rates tabulated in Table V. The test shall be made by subjecting the transmitter to the flows specified, first with rates of flow increasing, then with rates of flow decreasing. With the rate of flow increasing, the rate shall be brought up to, but shall not exceed the rate specified and with the rate of flow decreasing, the rate shall be brought down to, but shall not fall below the rate specified. The errors at the test points shall not exceed the tolerances listed in Table V, and the difference between reading on the increasing rate of flow and reading on the decreasing rate of flow at each test point shall not exceed 2.5 indicator degrees.

TABLE V.

Flow Rate (PPH)	Dial Calibration (Degrees)	Room Temp Tolerances		High-Low Temp Tolerances	
		Flow Rate ±(PPH)	Indicator (Degrees)	Flow Rate ±(PPH)	Indicator ±(Degrees)
50	58.5	10	±2.7	15	4.2
100	75.9	6	±2.8	13	5.9
150	99.9	5	±2.5	11	5.5
200	125.6	4	±2.1	10	5.3
250	152.8	4	±2.2	12	6.6
300	180.0	5	±2.8	15	8.5
350	208.5	6	+2.1,-3.4	17	9.7
400	237.0	7	+3.6,-4.1	20	11.8
450	267.9	8	+4.5,-5.0	20	12.5
500	299.2	10	+5.8,-6.3	20	12.5

D. Position Error Test - paragraph E.

(1) Readings of the standard indicator shall be taken with the transmitter in any position but the normal testing position as specified in paragraph 1B. These position readings shall not differ from the normal position readings by more than 3.5 indicator degrees.

NOTE: This test may be combined with the Scale Error Test.

E. Calibration - paragraph A, step (2).

(1) Set flow rate at 50 lbs and adjust pre-tension of spring by rotating housing cover (27) using calibrating tool 31TF10537 to obtain a reading of 58.5° on calibration dial.

TROUBLE SHOOTING

1. Same as for Type 9133-54-B1.

STORAGE INSTRUCTIONS

1. Same as for Type 9133-54-B1.

SPECIAL TOOLS, FIXTURES AND EQUIPMENT

1. Same as for Type 9133-54-B1.

ILLUSTRATED PARTS LIST

1. Figure 3 illustrates the Fuel Flow Transmitter. The associated parts list, through the Usable On Code, depicts the part differences between the units covered.

INFORMATION SUBJECT TO EXPORT CONTROL LAWS

THIS DOCUMENT CONTAINS INFORMATION SUBJECT TO THE INTERNATIONAL TRAFFIC IN ARMS REGULATION (ITAR) AND/OR THE EXPORT ADMINISTRATION REGULATION (EAR) WHICH MAY NOT BE EXPORTED, RELEASED, OR DISCLOSED TO FOREIGN NATIONALS INSIDE OR OUTSIDE THE UNITED STATES WITHOUT FIRST OBTAINING REQUIRED U.S. GOVERNMENT APPROVAL OR A VALIDATED EXPORT LICENSE. A VIOLATION OF THE ITAR OR EAR MAY BE SUBJECT TO A PENALTY OF UP TO 10 YEARS IMPRISONMENT AND A FINE OF $100,000 UNDER 22 U.S.C. 2778 OR SECTION 2410 OF THE EXPORT ADMINISTRATION ACT. INCLUDE THIS NOTICE WITH ANY REPRODUCED PORTION OF THIS DOCUMENT.

OVERHAUL MANUAL
WITH ILLUSTRATED PARTS LIST

POWER DRIVEN ROTARY PUMP

PART NUMBER

025323-402
025323-402A
025323-402B
025323-402C
025323-402D

NOTICE

- REPAIRS AND MAINTENANCE OF EQUIPMENT COVERED IN THIS MANUAL MUST BE PERFORMED AS SPECIFIED IN THIS MANUAL
- REPAIRS AND MAINTENANCE MUST BE PERFORMED BY TECHNICALLY COMPETENT PERSONNEL UTILIZING TOOLING AND TEST EQUIPMENT SPECIFIED IN THIS MANUAL.
- REPAIRS AND MAINTENANCE MUST BE PERFORMED IN A REPAIR FACILITY APPROVED BY THE APPROPRIATE GOVERNING AIRWORTHINESS AUTHORITY USING ONLY PARTS AUTHORIZED IN THIS MANUAL.
- FAILURE TO COMPLY WITH THE ABOVE STANDARDS AND REQUIREMENTS MAY POSE A SAFETY HAZARD, ADVERSELY AFFECT OPERATION OF THE EQUIPMENT, AND JEOPARDIZE WARRANTIES.

SUNDSTRAND CORPORATION
ROCKFORD, ILLINOIS

ORIGINAL ISSUE MAR 1/73
REVISION 8 MAR 1/95

TO: Holders of Overhaul Manual with Illustrated Parts List, 73–10–04 (P&WC Manual P/N 3020549) for Sundstrand Power Driven Rotary Pump (P/N 025323–402 Series) Issued March 1, 1973.

Revision 8, dated March 1, 1995

HIGHLIGHTS

Shown below are highlights of the significant changes and the affected pages contained in this revision. Remove the used affected pages and put the new affected pages into the manual as shown on the List of Effective Pages.

We recommend that you put this revision into your manual without delay. Mark the Record of Revisions sheet with the new revision number and date, and write your initials on the Record of Revisions sheet in the appropriate spaces after you have put the revised pages in your manual.

Please call Shirley A. Tooze, (815) 226-6000, TWX: 910-631-3458, TELEX: 25-7496, FAX: (815) 966–8525, or write to Sundstrand Aerospace, Technical Publications Department 768–1, 4747 Harrison Avenue, P.O. Box 7002, Rockford, IL 61125-7002, if you have any questions about this revision.

Page Number(s)	Description of Change
Disassembly, 101	Added the disposition requirements for the seal at overhaul and repair.
Repair, 403 and 405; Fits and Clearances, 602	Expanded check requirements for the gearset to include inspection for erosion.
Assembly, 501; Special Tools, Fixtures, and Equipment, 1001 and 1002	Deleted pin driver T–013242T1 from the list of special tools and fixtures. This particular pin driver is not required for maintenance of the pump.
Assembly, 502	Added a requirement to clean the seal surfaces before assembly with lubrication fluid.
Testing, 702; Special Tools, Fixtures, and Equipment, 1001	Correctly identified the inlet adapter to correspond with test fixture requirements.
Testing, 703 and 705	Updated the testing procedures to meet the latest engineering requirements.
Trouble-shooting, 801	Deleted troubleshooting procedures for bypass pressure requirements to correspond with the latest testing requirements. Expanded correction criteria for pump leaks. The seals are not 100% replaceable items. They may be lapped if leakage is evident during testing. If lapping does not correct the leakage problem, then the seals may be replaced.

Light Overhaul, 1301	Reidentified the grade of aloxite resinoid stone used to dress the carbon seal to correspond with that used in the repair procedures.

NOTICE OF MISSING INFORMATION

Issue\Section 73-10-04

Page Number(s) Record of Revisions

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Issue\Section 73-10-04

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LIST OF EFFECTIVE PAGES

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	605	Oct 1/81
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	703	Mar 1/95
	704	Mar 1/95
	705	Mar 1/95
	706	Deleted
Troubleshooting	801	Mar 1/95
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Illustrated Parts List	1101	Oct 1/81
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	1105	Aug 1/91
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Light Overhaul	1301	Mar 1/95

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Issue\Section 73-10-04

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Issue\Section 73-10-04

Page Number(s) Table of Contents

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Page Number(s) 1

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Issue\Section 73-10-04 (Description and Operation)

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Issue\Section 73-10-04 (Description and Operation)

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Issue\Section 73-10-04 (Description and Operation)

Page Number(s) 4

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DISASSEMBLY

1. General

   A. Disassembly of the pump is generally in the order of sequence numbers assigned to the exploded view, Ref. IPL Fig. 1, in the ILLUSTRATED PARTS LIST section. The stationary bearings and gears are a matched set. These parts should be retained in sets for reinstallation in the position from which they were removed if they are found to be serviceable. The filter bypass valve sleeve and piston and regulating valve sleeve and piston are not matched pairs; however, they should be kept together to maintain the seating pattern developed through operation of the valve on the seat.

   B. Locating pins, studs, and thread inserts need not be removed at overhaul unless inspection reveals the part must be replaced.

   C. All preformed packings and retaining rings are 100 percent replacement items.

2. Disassembly Procedures

   WARNING: WEAR GOGGLES WHEN REMOVING LOCKWIRE.

   CAUTION: DO NOT MIX PARTS BETWEEN PUMPS.

   A. Pumping Element and Seals

      CAUTION: DO NOT REUSE RETAINING RING (3).

      (1) Pull pump drive coupling (2A, IPL Fig. 1) off drive gear spline. Remove and discard retaining ring (3). Do not remove spring pin (2J) from coupling (2) unless necessary for replacement as applicable.

      (2) Remove bolts (5A and 6A) and washers (7) and lift off front cover (4A).

      (3) Remove internal retaining ring (8) and press seal (9) out of front cover (4A) from the back side. Remove and discard preformed packings (10, 11, and 12). At overhaul, discard seal (9). At repair (for pumps returned for fuel leaks), lap seal (9) (refer to REPAIR) and test for leaks. If a leak is evident, replace the seal (refer to TROUBLESHOOTING).

         CAUTION: BEARINGS MUST BE REMOVED SIMULTANEOUSLY IN PAIRS TO PREVENT DAMAGE BY SPRING PINS (14). DURING DISASSEMBLY, ACCOUNT FOR THE TWELVE BEARING SPRINGS (18) TO BE SURE NONE HAVE BECOME LODGED IN AN INTERNAL PASSAGE WITHIN THE PUMP HOUSING.

      (4) Place the pump housing on end; matched bearing set (13A) and matched gearset (15A) should slide out easily. If not, gently tap the body face with a soft head mallet to dislodge parts. Continue tapping face to dislodge drive and driven bearings (16A and 17A), permitting removal of bearing springs (18). Remove and discard preformed packings (19).

(5) Identify driven gear of matched gearset (15A) for reference at reassembly to be sure gear is installed with same face of gear towards matched bearing set (13A).

(6) Do not remove spring pins (14) from matched bearing set (13A) or drive and driven bearings (16A or 17A) unless replacement is necessary.

(7) Pull drive coupling (22J) from drive gear of matched gear set (15A). Remove and discard retaining ring (22M) from internal spline of drive gear of matched gearset (15A).

B. Discharge Filter

WARNING: WEAR GOGGLES WHEN REMOVING SAFETY WIRE.

Cut lockwire and remove discharge filter cover (23A), preformed packing (24), discharge filter (26), and preformed packing (27). Discard preformed packings (24 and 27).

C. Inlet Adapter

(1) Remove inlet adapter (27J) by removing bolts (27P) and washers (27T). Remove and discard performed packing (27V).

(2) Do not remove stepped studs (27M) from inlet adapter (27J) unless replacement is necessary. Refer to REPAIR for replacement instructions.

D. Inlet Filter

(1) The inlet filter will come out as an assembly. Remove inlet filter cover assembly (28). Remove and discard preformed packings (31 and 32).

(2) Remove bolt (33), spring (34), washer (35), seal washer (36), and inlet filter (37).

(3) Do not remove insert (30) from inlet filter cover assembly (28) or spring pin (38) from inlet filter (37) unless replacement is necessary. Refer to REPAIR for replacement of insert (30) and for replacement of spring pin (38).

E. Bypass Pressure Regulating Valve

Remove valve cap (39), preformed packing (40), regulating valve spring (41), valve piston (42), valve sleeve (43), and preformed packing (44). Discard preformed packings (40 and 44).

NOTE: Valve piston and valve sleeve are not a matched set; however, they should be kept together to retain any wear pattern that may have developed during operation.

NOTICE OF MISSING INFORMATION

Issue\Section 73-10-04 (Disassembly)

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Issue\Section 73-10-04 (Cleaning)

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Issue\Section 73-10-04 (Inspection/Check)

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REPAIR

CAUTION: ENSURE PARTS ARE THOROUGHLY CLEANED AFTER DEBURRING, LAPPING, OR POLISHING.

1. Valve Pistons and Valve Sleeves

Minor damage to the valve pistons (42 and 48, IPL Fig. 1) or valve sleeves (43 and 49) may be removed with a hard stone or fine abrasive paper. Remove only enough material to restore surface to its original contour.

2. DELETED

3. Bearings

Dress faces (gear contact surfaces) lightly to remove scoring on drive and driven bearings (16A and 17A, IPL Fig. 1) and matched bearing set (13A). Use an Aloxite Resinoid Stone, Part Number A–800–FB (obtainable from Sticks and Stones Unlimited Incorporated, 1800 E. Northwest Parkway, Southlake, TX 76092).

Proceed as follows:

A. Be sure stone is true and flat.

B. Move bearing through a figure 8 motion while pressing lightly against stone.

C. Periodically rotate bearing through an arc while dressing.

D. Flatness, squareness, length, and parallelism must be as specified in Fig. 601.

NOTE: Drive and driven bearings (16A and 17A, IPL Fig. 1) do not have length and parallelism requirements.

4. Gears

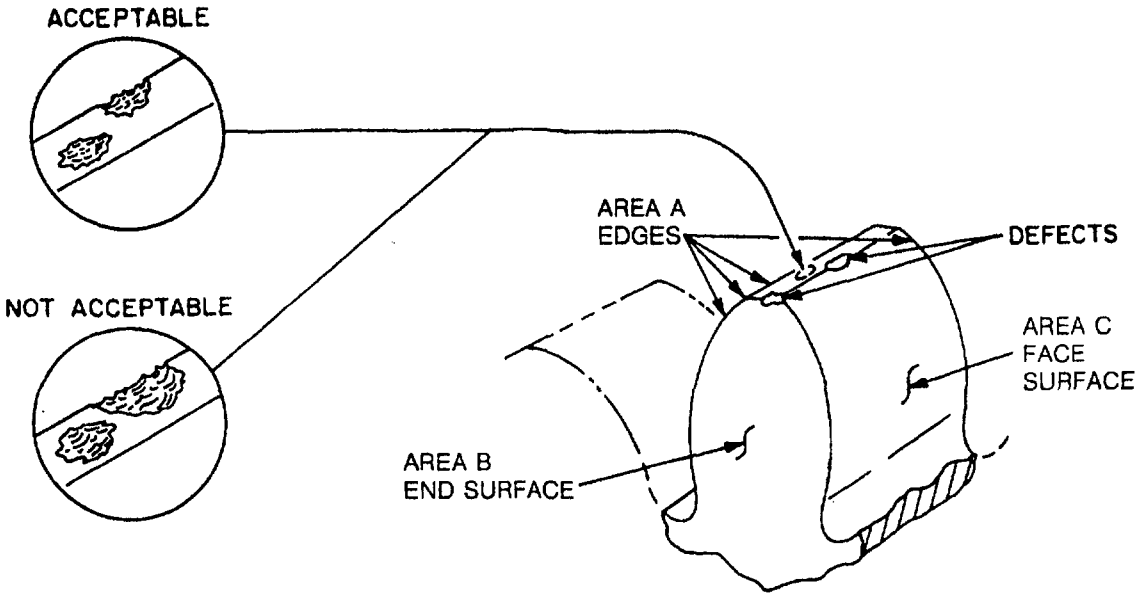
Repair gears as follows, maintaining the requirements shown in Fig. 601.

NOTE: Normal burnishing and circumferential scoring of gear end surfaces (Ref Fig. 401, Area B or Fig. 404, Area D) is acceptable, if gearset is maintained with original bearings.

A. Lightly dress journals with crocus cloth while rotating gear in a lathe.

B. Refinish end surfaces with an Aloxite Resinoid Stone, Part Number A–800–FB (obtainable from Sticks and Stones Unlimited Incorporated, 1800E. Northwest Parkway, Southlake, TX 76092). If defects cannot be removed, replace the gearset.

NOTE: End surfaces of reused matched gearset must be refinished to 4 microinches root mean square if bearings (16A and 17A, IPL Fig. 1) or bearing set (13A) is replaced.



A–67853

Gear Tooth Damage Limits
Figure 401

C. Blend chips or nicks in tooth edges (Ref Fig. 401, Area A or Fig. 404, Area A) with a hard stone. Remove rough edges or high spots that could damage mating gear tooth surfaces.

NOTE: This repair should not exceed 50 percent of any one tooth edge. Such repair on consecutive teeth within the same circumferential area is not permissible. No repair is allowed on the face surfaces (Ref Fig. 401, Area C or Fig. 404, Areas B and C).

D. Lap seal surfaces on the ends of the gear journals to restore the 4 micro-inch root mean square, 2 light band finish. A maximum of 0.0003 inch may be removed.

5. Inserts

Remove and replace inserts (30, 56 and 57, IPL Fig. 1) if damaged. Install new inserts 1/4 to 1 full turn below the countersink using standard helicoil installation kit. Remove tang.

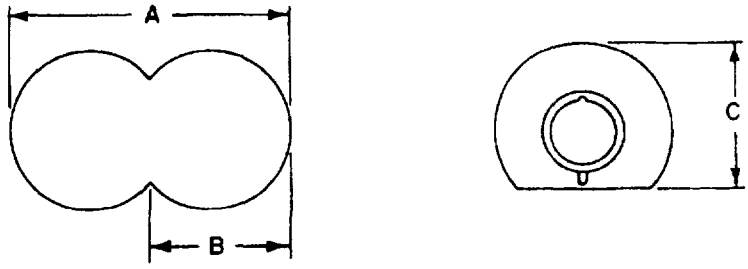
6. Pins

A. If damaged, remove and install spring pin (28) in inlet filter (37). Make sure pin bottoms in inlet filter.

B. If damaged, remove and install headless pins (55) in pump housing (58A). Install pins to protrude from pump housing surface 0.340 ± 0.030 inch.

7. Bearing Installation

Fit new drive and driven bearings (16A and 17A) and bearing set (13A) to bores in pump housing (58A) according to Figure 402. Lap bearing flats if necessary, to obtain correct bearing-to-bore fit according to Fig. 402.



A–16600–3

NOTES

A Housing bore dimension.
B Bearing cavity dimension.
C Bearing width dimension.

PROCEDURES

Bearings must fit housing bore with 0.0002 inch to 0.0006 inch clearance between bearing flats. Fit bearings to housing bore as follows:

A. Measure housing bore and record as dimension A.

B. Divide dimension A by two to obtain dimension B.

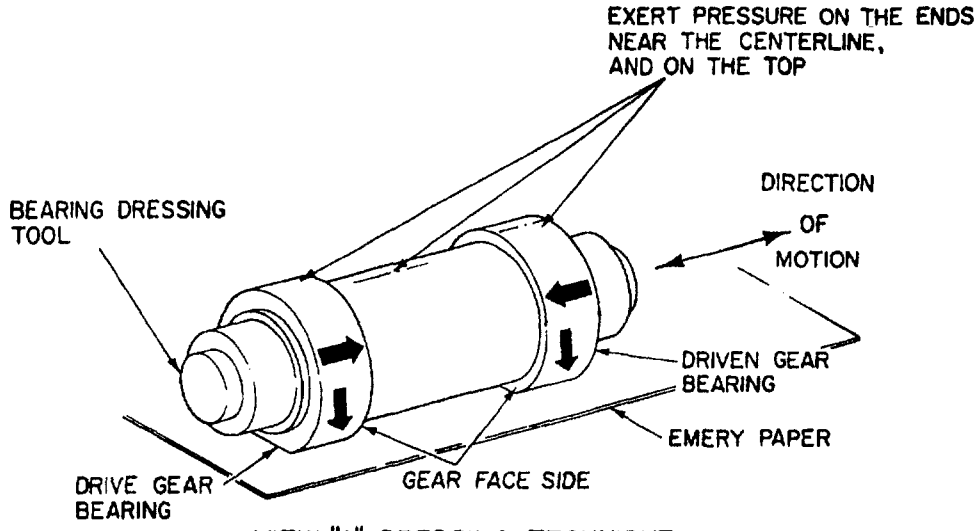
C. To obtain dimension C, select new drive and driven bearings (16 and 17, IPL Fig. 1) or matched bearing set (13) at a width of 0.0001 inch to 0.0003 inch less than dimension B. If necessary, touch-lap bearing flats according to Fig. 403 to obtain correct bearing-to-bore fit.

Fitting Bearings to Housing Bore
Figure 402

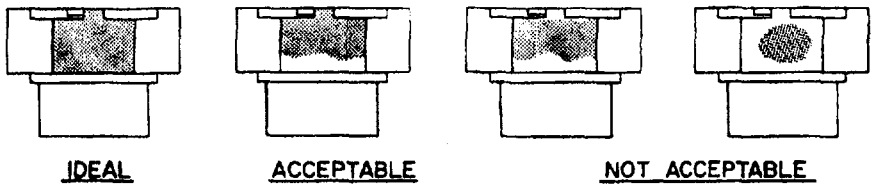
8. Stud Installation

A. If necessary, remove stepped studs (27M) from inlet adapter (27J). Turn in new studs to 0.460 to 0.480 inch height.

B. If necessary, remove and replace locked-in studs (54A) in pump housing (58A) according to Fig. 405.



VIEW "A" DRESSING TECHNIQUE



VIEW "B" INSPECTION LIMITS

A–28413

PROCEDURES

After determining correct bearing width (Fig. 402, dimension B), if necessary, touch-lap bearings to obtain a bearing width within limits stated in Fig. 402 as follows:

A. Place both bearings of a pair or set on small diameter of bearing dressing tool SF97–1019.

NOTE: If bearing dressing tool SF97–1019 is not available, a suitable dressing tool can be obtained by grinding or machining down the gear teeth of a drive or driven gear of matched gear set (15A, IPL Fig. 1) to gain clearance for dressing bearing flats.

B. Dress bearing flats a maximum of four strokes on 320 or 400 grit abrasive paper (View "A"). Half the strokes are to be performed with horizontal movement force against driven gear bearing, and half the strokes with force against drive gear bearing.

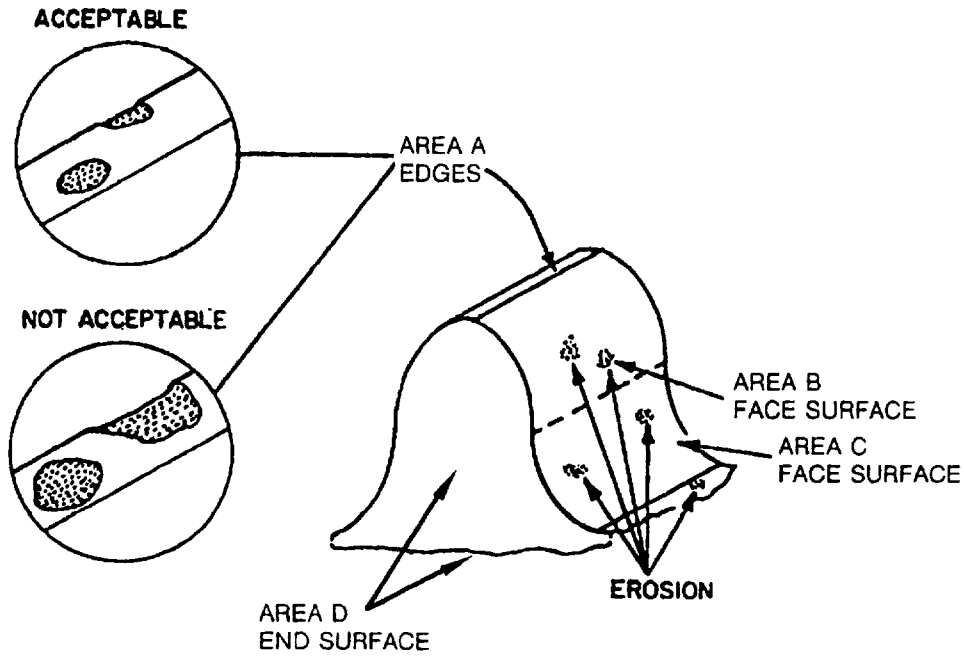
Dressing and Polishing Bearing Flats
Figure 403 (Sheet 1 of 2)

C. Polish bearing flats on flat Aloxite stone a maximum of four strokes until bearing flats are polished to acceptable limits of View "B". Half the polishing strokes are to be performed with horizontal movement force against driven gear bearing, and half the strokes with force against drive gear bearing.

D. Clean bearings according to CLEANING.

E. Inspect bearings. Each bearing must meet acceptance criteria (View "B") and must be within limits stated in Fig. 402.

Dressing and Polishing Bearing Flats
Figure 403 (Sheet 2 of 2)



A-67854

Gear Tooth Erosion Limits
Figure 404

9. Insert Ring

A. If necessary, remove and replace insert ring (59) in pump housing (58A) as follows:

WARNING: USE CARE WHEN HANDLING HEATED PARTS. WEAR GLOVES AND OTHER PROTECTIVE CLOTHING.

(1) Heat pump housing (58A) to 227° to 232°C (440° to 450°F).

(2) Using standard bearing puller, remove insert ring (59).

(3) Remove scoring from housing bore with 400 grit lapping paper.

WARNING: LOCTITE SEALANT AND PRIMER ARE TOXIC. USE IN WELL VENTILATED AREA. PREVENT EYE AND SKIN CONTACT AND DO NOT BREATHE VAPORS. IN CASE OF EYE CONTACT, FLUSH WITH WATER AND SEEK MEDICAL ATTENTION. IN CASE OF SKIN CONTACT, WASH WITH SOAP AND WATER.

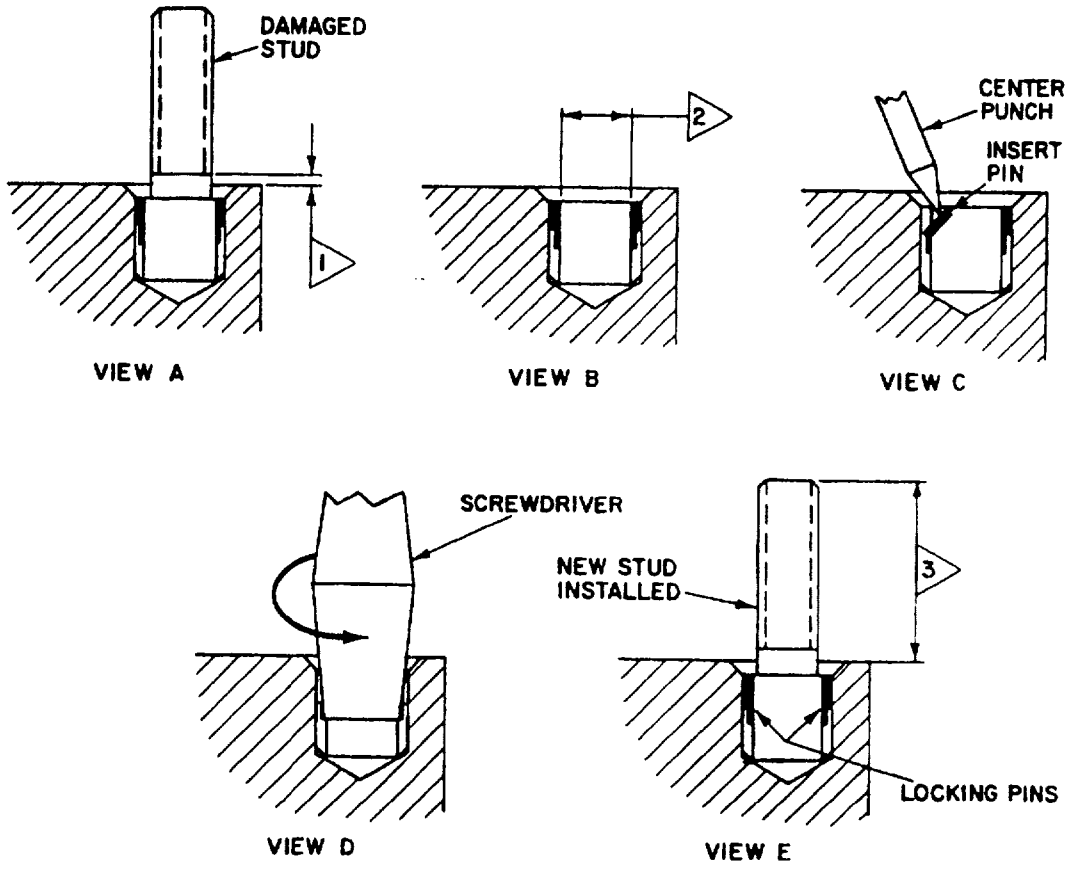
(4) Apply a thin coat of Locquic primer, grade "N" (available from Loctite Corp., 115 North Mountain Rd., Newington, CT 06111) to the housing bore and OD of new insert ring (59). Allow to air dry for 15 minutes.

(5) Apply Loctite retaining compound, 262 (available from Loctite Corp., 115 North Mountain Rd., Newington, CT 06111) in a smooth, thin coat to the OD of insert ring (59).

(6) Press insert ring (59) into pump housing (58A) bore until bottomed.

10. Seals

If required, touch-lap seal (9, IPL Fig. 1) before assembly according to Fig. 406.



A–60051

NOTES AND DIMENSIONS

1 Noted dimension, 0.030 to 0.060 inch above surface of housing.

2 Noted dimension, 0.266 inch diameter hole through stud.

3 Noted dimension, 0.745 to 0.775 inch above housing surface.

PROCEDURE

CAUTION: DO NOT DAMAGE MACHINED SURFACES OF HOUSING WHEN REMOVING LOCKED-IN STUDS.

A. Cut off damaged stud (View A) above surface of housing according to 1 .

B. Using staking fixture (Ref SPECIAL TOOLS, FIXTURES, AND EQUIPMENT, Fig. 1001) in position on studs, drill through center of remaining part of stud (View B) according to 2 .

Stud Removal and Installation
Figure 405 (Sheet 1 of 2)

C. Use a suitable size punch to bend locking pins inward (View C) and break off.

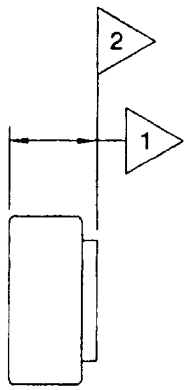
WARNING: WHEN USING COMPRESSED AIR FOR CLEANING OR DRYING, REGULATE PRESSURE TO 29 POUNDS PER SQUARE INCH OR LESS. WEAR GOGGLES OR FACE SHIELD TO PROTECT EYES.

D. Remove remaining shell of stud out from cover with a screwdriver (View D). Airblow to remove chips. Inspect threads for damage; if necessary, chase threads with a 0.375–16UNC–3A tap.

E. Clean according to CLEANING.

F. Using staking driver (Ref SPECIAL TOOLS, FIXTURES, AND EQUIPMENT, Fig. 1001), install new locked-in studs (54A, IPL Fig. 1) according to MS51835 and 3 .

Stud Removal and Installation
Figure 405 (Sheet 2 of 2)



A-27960-1

NOTES AND DIMENSIONS

1 Minimum dimension after lapping, 0.360 inch.

2 Noted surface to be flat within 0.000035 inch (3 light bands).

PROCEDURES

A. Lap face of seals (9, IPL Fig. 1) according to the following:

(1) Touch-lap Aloxite Resinoid stone on 4/0 polishing paper on a surface plate to clean.

(2) Hand lap carbon seal face (dry) on a flat Aloxite Resinoid stone. Lightly polish in a figure 8 motion.

(3) Clean carbon seal face by wiping with a clean soft cloth.

(4) Inspect seal according to 1 and 2 .

Touch-Lapping of Seals
Figure 406

ASSEMBLY

1. Consumable Materials

The following is a list of consumable materials required during overhaul:

Cloth, Crocus	Specification No. P-C-458
Fluid, Lubrication	Specification No. MIL-H-5606
Fluid, Calibrating	Specification No. MIL-C-7024, Type II
Paper, Fine Abrasive	Grade 4/0 Minnesota Mining and Manufacturing Company, St. Paul, MN 55144-1000
Petrolatum, Technical	Specification No. VV-P-236
Solvent, Dry-Cleaning	Specification No. P-D-680, Type II
Stone, Aloxite Resinoid	Part Number A-800-FB Sticks and Stones Unlimited Incorporated 1800 E. Northwest Parkway Southlake, TX 76092
Stone, Hard Arkansas	Specification SS-S-736, Type I

2. Assembly Procedures

A. Pumping Element and Seals

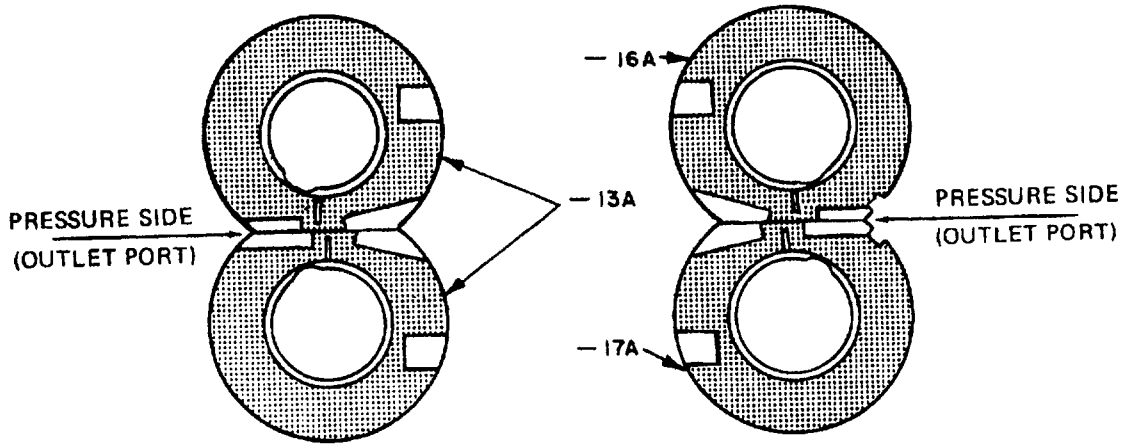
(1) If removed, press spring pin (14, IPL Fig. 1) into driven bearing (16A) and into drive bearing of matched bearing set (13A) as follows:

(a) Position drive bearing (16A) or driven bearing of matched bearing set (13A) into fixture (Ref SPECIAL TOOLS, FIXTURES, AND EQUIPMENT, Fig. 1001).

(b) Using a pin driver, press spring pin (14, IPL Fig. 1) into drive bearing (16A) or driven bearing of matched bearing set (13A) until bottomed.

(2) Install preformed packings (19) onto drive and driven bearings (16A and 17A) and bearing springs (18) into holes in bearings and position bearings in pump housing assembly (53A). (Ref Fig. 501 for proper bearing installation.)

NOTE: To ease installation of drive and driven bearings (16A and 17A, IPL Fig. 1) into pump housing assembly (53A), retain bearing springs (18) in holes with a small amount of petrolatum. To prevent damaging preformed packings, lubricate with petrolatum before installation.



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Bearing Installation
Figure 501

(3) Install matched gearset (15A) and matched bearing set (13A) into the pump housing (53A). (Ref Fig. 501 for proper bearing installation.)

NOTE: When installing driven gear of matched gearset (15A, IPL Fig. 1) be sure identified face of gear (Ref DISASSEMBLY) is towards matched bearing set (13A). Lubricate gears with lubrication fluid (MIL-H-5606).

(4) Install preformed packings (11 and 12) into pump housing assembly (53A). Install front cover (4A) and secure with washers (7) and bolts (5A and 6A). Torque bolts (Ref FITS AND CLEARANCES, Fig. 603).

(5) Install preformed packing (Ref 10, IPL Fig. 1) in recess in pump cover (4).

CAUTION: USE CARE WHEN INSTALLING SEAL AS CARBON INSERT CHIPS EASILY. TOUCH LAP SEAL ACCORDING TO REPAIR, FIGURE 406 BEFORE ASSEMBLY.

(6) Clean seal (9) face by wiping with a clean, soft cloth made wet with Military Specification MIL-H-5606 lubrication fluid. Using seal driver (Ref SPECIAL TOOLS, FIXTURES, AND EQUIPMENT, Fig. 1001), press seal (9) into cover bore. Install retaining ring (8) into cover bore.

NOTE: Internal retaining ring is installed with the sharp edge towards the outside.

CAUTION: RETAINING RING (3) IS INSTALLED CLOSED END FIRST TO PREVENT DISTORTION AND LOSS OF RETENTION ABILITY.

CAUTION: DO NOT APPLY GREASE OR ANTIFRETTING COMPOUND TO THE COUPLING AND DRIVE GEAR SPLINES. THE SPLINES ARE LUBRICATED WITH OIL SUPPLIED BY THE ENGINE DURING ACTUAL OPERATION. APPLYING GREASE OR ANTIFRETTING COMPOUND WILL RESTRICT OIL SUPPLY AND ACCELERATE SPLINE WEAR.

(7) Install a new retaining ring (3) in coupling). If removed, install new spring pin (2J) into coupling (2B). Lubricate splines of coupling and drive gear of matched gearset (15A) with lubrication fluid (MIL-H-5606). Install coupling over drive gear of matched gear set, ensuring that retaining ring is firmly seated in retaining ring groove of drive gear spline.

B. Bypass Pressure Regulating Valve

(1) Install preformed packing (44) on valve sleeve (43). Install the valve sleeve (43), valve piston (42), and spring (41) in the bypass valve port in the pump housing assembly (53A).

(2) Install preformed packing (40) on valve cap (39). Install valve cap in pump housing assembly (53) and torque valve cap (Ref FITS AND CLEARANCES, Fig. 603).

C. Discharge Filter Bypass Valve

(1) Install preformed packing (50, IPL Fig. 1) on valve sleeve (49). Install the valve sleeve (49), valve piston (48), and bypass valve spring (47) in the discharge filter bypass port in the pump housing assembly (53A).

NOTE: Bypass valve spring (47) is coated with green dye for identification.

(2) Install preformed packing (46) on valve cap (45). Using special socket wrench (Ref SPECIAL TOOLS, FIXTURES, AND EQUIPMENT, Fig. 1001), install cap in pump housing assembly (53A, IPL Fig. 1). Torque valve cap (Ref FITS AND CLEARANCES, Fig. 603).

(3) Install preformed packing (50M, IPL Fig. 1) on plug (50J). Install plug in pump housing assembly (53A) and torque plug (Ref FITS AND CLEARANCES, Fig. 603).

D. Discharge Filter

(1) Install preformed packing (27, IPL Fig. 1) in discharge filter (26) and install in pump housing assembly (53A).

(2) Install preformed packing (24) on discharge filter cover (23A). Install in pump housing assembly (53A) and torque discharge filter cover (Ref FITS AND CLEARANCES, Fig. 603).

E. Inlet Filter

(1A) Position inlet filter (37, IPL Fig. 1) into holding fixture (Ref SPECIAL TOOLS, FIXTURES, AND EQUIPMENT, Fig. 1001).

(1B) Using a pin driver (Ref SPECIAL TOOLS, FIXTURES, AND EQUIPMENT, Fig. 1001), press new spring pin (38, IPL Fig 1) into inlet filter (37) until bottomed.

(2) Install inlet filter (37), seal washer (36), washer (35), spring (34), and bolt (33) onto inlet filter cover assembly (28). Torque bolt (33) (Ref FITS AND CLEARANCES Fig. 603).

(3) Install preformed packings (31 and 32, IPL Fig. 1) on inlet filter cover assembly (28) and install assembled inlet filter into pump housing assembly (53A). Torque inlet filter cover assembly (28) (Ref FITS AND CLEARANCES, Fig. 603).

F. Inlet Adapter

Install preformed packings (27V, IPL Fig. 1) onto inlet adapter (27J). Install inlet adapter (27J) into pump housing assembly (53A) and secure using washers (27T) and bolts (27P). Torque bolts (Ref FITS AND CLEARANCES, Fig. 603)

G. Drive Coupling

Install retaining ring (22M, IPL Fig. 1) into drive gear of matched gearset (15A) (closed end first). Install drive coupling (22J) into drive gear of matched gearset (15A).

H. Identification Plate

If removed, secure identification plate (51, IPL Fig. 1) to pump housing with drive screws (52).

FITS AND CLEARNCES

1. General

Fits and clearances and acceptable wear limits for the pump are given in Fig. 601. Wear location is shown in Fig. 602 with reference to Fig. 601. Assembly torque values are given in Fig. 603. Spring specifications are given in Fig. 604.

ITEM	DIMENSION, CLEARANCE, OR TOLERANCE
Pump drive coupling (2A, IPL Fig. 1)	
Internal spline	*0.005 inch max.
External spline	Measure over two 0.0959 to 0.0961 inch diameter pins. Minimum dimension, 0.7328 inch.
Bearing surfaces of matched bearing set (13A, IPL Fig 1), drive bearing (16A), and driven bearing (17A)	Pits within 3/64 of an inch of the outer edge must not exceed 0.0070 inch in depth and 0.0625 inch in diameter, or equivalent area. Pits having a depth between 0.005 inch to 0.010 inch must not exceed 1/8 of an inch in diameter, or equivalent area. Pits having a depth between 0.010 to 0.015 inch must not exceed 1/16 of an inch in diameter, or equivalent area. Surface pitting less than 0.005 inch in depth is acceptable in any amount, if it does not create a bypass passage from the high pressure to the low pressure area.
Flat surfaces (contacting gears only)	Flat within 0.0003 inch (max) and square with bore within 0.0003 inch (max).
Bore ID	0.5645 inch (max). (Ref A, Fig. 602).
	* Difference between worn and unworn surface.

Fits and Clearances
Figure 601 (Sheet 1 of 2)

ITEM	DIMENSION, CLEARANCE, OR TOLERANCE
Matched Bearing set (13A, IPL Fig. 1) lengths	Equal within 0.0002 inch (max) (Ref B, Fig. 602).
Face surfaces	Parallel within 0.0002 inch.
Matched Gear set (15A, IPL Fig. 1)	
Internal spline	*0.004 inch max.
External spline (drive gear)	Measure over two 0.0599 to 0.0601 inch diameter pins. Minimum dimension, 0.3896 inch.
Gear width	Equal within 0.0002 inch (max). Minimum width, 0.3526 inch (Ref C, Fig. 602.)
Gear OD	OD of gear teeth shall not be less than 1.1649 inches.
Gear teeth (Ref Fig. 401)	Area A - Chips or nicks on tooth edges must not exceed an area 0.030 in. by 0.007 in. by 0.007 in. deep and should not extend more than halfway (circumferentially) across tip. Area B - Gears having chips or nicks on one or both end surfaces are acceptable, if the defects can be removed by lapping, and dimensions and surface finish can be maintained. Area C - Gears having scuff marks on tooth faces in excess of 125 micro-inches RMS shall be rejected.
Gear Teeth (Ref Fig. 404)	Area A - Erosion not to extend more than halway (circumferentially) across the width of the tooth tip. Area B (Tooth Face Surface) - Erosion not to exceed 0.010 inch (0.254 millimeter) depth. Area C - Erosion not to exceed 0.020 inch (0.508 millimeter) depth. NOTE: If there is evidence of cavitation erosion which undermines any surface, the gears must be replaced. Area D - Evidence of overheating. (Discoloration that cannot be removed with light polishing.)
Gear journals	Minimum diameter, 0.5602 inch (Ref D, Fig. 602.) *Difference between an unworn and worn surface.

Fits and Clearances
Figure 601 (Sheet 2 of 3)

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Issue\Section 73-10-04 (Fits and Clearances)

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TESTING

1. Test Requirements

Test Equipment Required.

WARNING: CALIBRATING FLUID IS TOXIC AND FLAMMABLE. DO NOT BREATHE VAPORS. USE IN WELL VENTILATED AREA FREE FROM SPARKS, FLAME, OR HOT SURFACES. WEAR SPLASH GOGGLES, SOLVENT-RESISTANT GLOVES, AND OTHER PROTECTIVE GEAR. IN CASE OF EYE CONTACT, FLUSH WITH WATER AND SEEK MEDICAL ATTENTION. IN CASE OF SKIN CONTACT, WASH WITH SOAP AND WATER.

A. A test stand, equipped with a motor with a minimum rating of 5 horsepower, capable of driving the pump at speeds up to 6500 revolutions per minute, supplying test fluid filtered to 10 microns, at controlled pressures and temperatures, and as follows, is required:

Rotation:	Clockwise viewing pump drive end
Fluid:	Military Specification MIL-C-7024, Type II
Inlet Pressure:	0 to 100 pounds per square inch gage
Discharge Pressure:	0 to 1,500 pounds per square inch gage
Bypass Pressure:	0 to 100 pounds per square inch gage
Accuracy of Measurements:	
*Pressure	2 percent or 0.5 pounds per square inch, whichever is greater
*Flow	2 percent, using rotometer or turbine flowmeter
*Speed	1 percent
Fuel Temperature (measured before inlet to pump):	
Break-in	16° to 32°C (60° to 90°F)
Performance Test	24° to 29°C (75° to 85°F)

* At the point of operation

B. A port block to provide a connection for the bypass return line during testing (Ref SPECIAL TOOLS, FIXTURES, AND EQUIPMENT).

C. A filter bypass valve fixture for testing the filter bypass valve (Ref SPECIAL TOOLS, FIXTURES, AND EQUIPMENT).

D. An inlet port adapter to provide a connection for the inlet line during testing of the power driven rotary pump (Ref SPECIAL TOOLS, FIXTURES, AND EQUIPMENT).

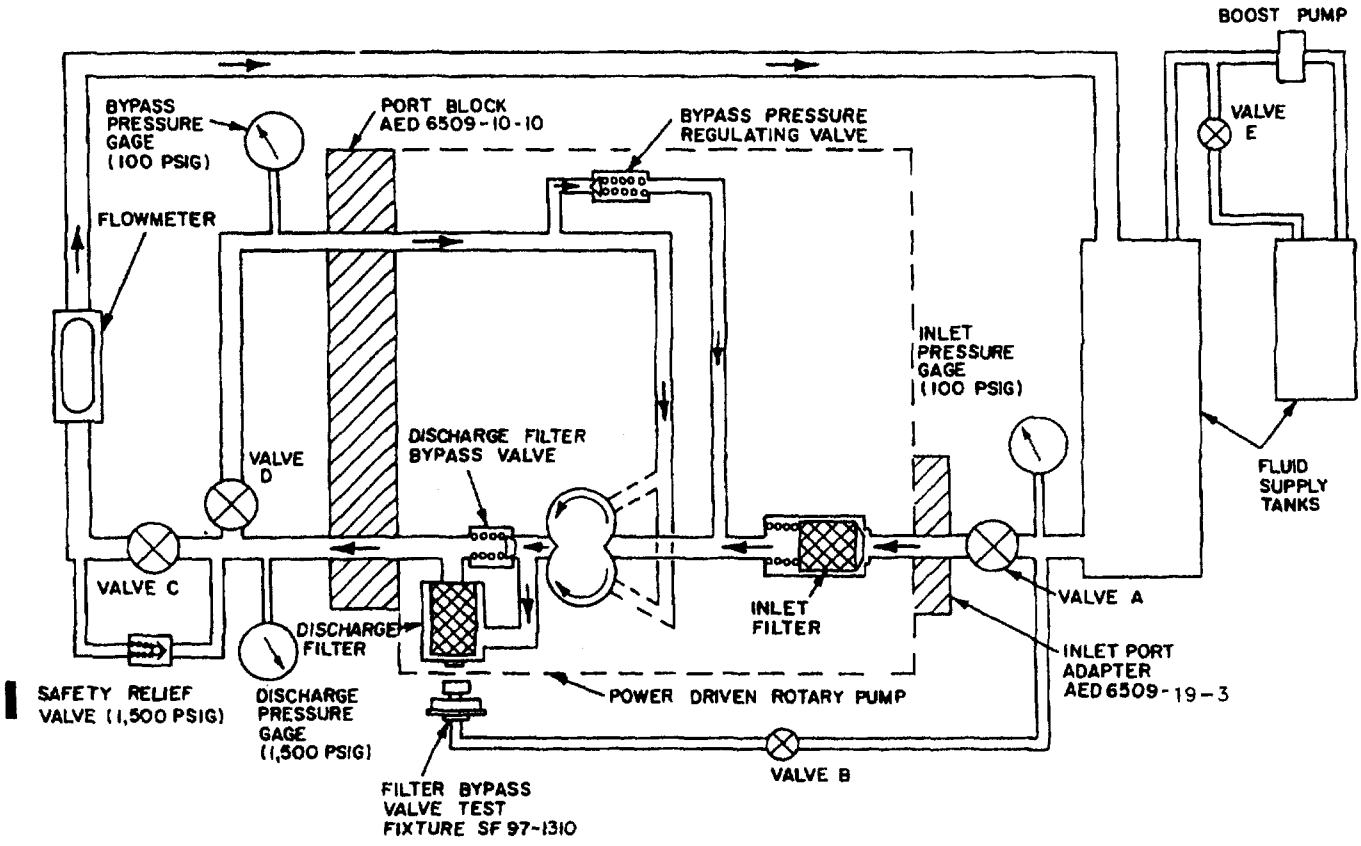
2. Test Procedures

A. Break-in

(1) Remove the discharge filter cover (23A) and discharge filter (26) from the pump. Reinstall only the discharge filter cover (23A) and preformed packing (24) in the pump.

(2) Install port block (Ref 2, Fig. 1002) on the governor end of the pump using four 1/4–inch flat washers and four 1/4–inch –28UNF–3A nuts.

(3) Install inlet adapter (Ref 4, Fig. 1002) on the inlet port using two 1/4-20UNC bolts 1/2 inch long. Install the pump on the test stand in a position resembling its engine-mounted position as nearly as possible (discharge filter cover down). Connect fuel lines to ports as shown in Fig. 701. Refer to Fig. 4, DESCRIPTION AND OPERATION for identification of ports and mounting dimensions.



A–27969–1

Typical Test Schematic
Figure 701

WARNING: CALIBRATING FLUID IS TOXIC AND FLAMMABLE. DO NOT BREATHE VAPORS. USE IN WELL VENTILATED AREA FREE FROM SPARKS, FLAME, OR HOT SURFACES. WEAR SPLASH GOGGLES, SOLVENT-RESISTANT GLOVES, OR OTHER PROTECTIVE GEAR. IN CASE OF EYE CONTACT, FLUSH WITH WATER AND SEEK MEDICAL ATTENTION. IN CASE OF SKIN CONTACT, WASH WITH SOAP AND WATER.

(4) Start boost pump; then operate pump to purge air from the system to be sure all parts of the pump are immersed in calibrating fluid.

(5) Operate the pump according to either method in Fig. 702, as follows:

(a) Open valve A, close valves B and D, and adjust valve C for the required discharge pressure.

(b) With the boost pump operating, adjust valve E to maintain the inlet pressure at 10 to 20 pounds per square inch gage and inlet temperature at 16° to 32°C (60° to 90°F) for break-in.

(c) Bearing temperature may be measured during break-in using a thermometer or thermocouple temporarily attached to the side of the pump housing. "Hot spots" can also be determined by feeling the pump housing by hand. If the bearing temperature rises 5.5°C (10°F) above the fuel inlet temperature or if the torque or outlet pressure is unsteady, reduce the pump speed and pressure until the bearing temperature falls within the specified limit and the pressure and torque can be held steady. If only rubber parts were replaced, no break-in run is required. If metal parts were replaced (body, gears, or bearings), the complete run-in is required.

METHOD I

PUMP SPEED (± 10 rpm)	DISCHARGE PRESSURE (± 10 psig)	TIME (MINUTES)
2,000	200	2
2,000	350	2
2,000	500	2
6,350	500	2
6,350	700	2
6,350	900	2

METHOD II

NOTE: Open valve C (Ref Fig. 701) fully at start and at each increase in speed.

PUMP SPEED (rpm)	DISCHARGE PRESSURE (psig)	TIME (MINUTES)
1,725	200	2
	350	2
	500	2
3,450	500	2
	700	2
	900	2

NOTE: The transition rate between conditions shall be as follows:
Speed: 150 rpm sec max
Pressure: 50 psi sec max

Break-in Schedule
Figure 702

(6) Perform surge test as follows:

(a) Set pump speed at 6,350 revolutions per minute and inlet pressure at 5 to 10 pounds per square inch gage.

(b) Adjust valve C to surge discharge pressure from 800 to 1,200 pounds per square inch gage (three times).

B. Discharge Filter Bypass Valve Check

(1) Shut off boost pump and pump under test. Remove discharge filter cover (23A, IPL Fig. 1), and install the Filter Bypass Valve Test Fixture (Ref 3, Fig. 1002) in place of the filter and cover. Connect line between valve B and the fixture. Disconnect the line from the pump discharge port.

(2) Start boost pump; then operate pump to purge air from the system to be sure all parts of the pump are immersed in calibrating fluid.

(3) With valve A closed and valve B open, increase the inlet pressure by opening valve E until a steady flow is noted from the discharge port.

(4) Reduce inlet pressure to 0 pounds per square inch gage. Increase pressure slowly to 10 pounds per square inch gage. Leakage from the discharge port shall not exceed 50 cubic centimeters per minute.

(5) Adjust valve E to increase the inlet pressure slowly until the valve cracks as indicated by an increase in flow from the discharge port. Cracking pressure shall be 15.0 to 25.0 pounds per square inch gage.

(6) Shut off boost pump and pump under test. Disconnect line between valve B and the test fixture. Remove fixture from pump. Disconnect line between valve B and the test fixture. Remove the fixture from the pump. Reconnect discharge port line. Reinstall the discharge filter (26, IPL Fig. 1). Torque discharge filter cover (Ref FITS AND CLEARANCES, Fig. 603).

C. Pump Performance

WARNING: CALIBRATING FLUID IS TOXIC AND FLAMMABLE. DO NOT BREATHE VAPORS. USE IN WELL VENTILATED AREA FREE FROM SPARKS, FLAME, OR HOT SURFACES. WEAR SPLASH GOGGLES, SOLVENT-RESISTANT GLOVES, AND OTHER PROTECTIVE GEAR. IN CASE OF EYE CONTACT, FLUSH WITH WATER AND SEEK MEDICAL ATTENTION. IN CASE OF SKIN CONTACT, WASH WITH SOAP AND WATER.

(1) Start boost pump; then operate pump to purge air from the system to be sure all parts of the pump are immersed in calibrating fluid.

(2) Operate the pump according to Fig. 703, as follows:

(a) Open valve A, close valve B, and adjust valve C for the required discharge pressure.

(b) Maintain the inlet pressure at 0 to 1 pound per square inch gage and inlet temperature at 24° to 29°C (75° to 85°F).

(c) Pump flow rate must exceed the requirements given in Fig. 703.

PUMP SPEED (rpm)	DISCHARGE PRESSURE (psig)	FLOW RATE (pph)
810 6,350	75 ± 5 850	213 1,605

Pump Performance
Figure 703

D. DELETED.

E. Seal Leakage

(1) Install a new discharge filter assembly (Ref 25, IPL Fig. 1) (Ref ASSEMBLY).

(2) With valve A (Fig. 701) open and valves B and D closed, operate the pump at 6,350 revolutions per minute and adjust valve C for 850 pounds per square inch gage discharge pressure.

(3) Adjust valve E to increase the inlet pressure to 50 pounds per square inch gage for 3 minutes.

(4) Leakage from the seal drain port shall not exceed 5 drops per minute, and there shall be no leakage from the casting or parting line.

TROUBLESHOOTING

1. General

The troubles covered in this section are those which can be located using overhaul shop test equipment. They do not include those troubles which might develop in related equipment and may appear to be the fault of the pump. They include troubles apt to be found in after-overhaul test and in equipment prematurely removed from service.

2. Troubleshooting Chart

Troubles most likely to occur in the pump are listed in Fig. 801 along with their possible cause, isolation procedure, and correction.

PUMP FLOW RATE OR OUTLET PRESSURE BELOW MINIMUM REQUIREMENT

POSSIBLE CAUSE	ISOLATION PROCEDURE	CORRECTION
Gear set defective	Disassemble and inspect parts	Replace the gear set.
Bearings or bearing set defective	Disassemble and inspect parts	Replace defective bearings.

PUMP LEAKS

POSSIBLE CAUSE	ISOLATION PROCEDURE	CORRECTION
Seals defective	Disassemble and inspect parts	Touch-lap seals (Ref Fig. 406, REPAIR). Replace seals if lapping does not eliminate leakage.
Preformed packings defective	Disassemble and inspect parts	Replace preformed packings.
Castings defective	Disassemble and inspect parts	Replace housing or cover.

Troubleshooting Chart
Figure 801 (Sheet 1 of 2)

DISCHARGE FILTER BYPASS VALVE PRESSURE EXCEEDS REQUIRMENTS

POSSIBLE CAUSE	ISOLATION PROCEDURE	CORRECTION
Wrong spring	Disassemble and inspect to be sure spring is green in color.	Install correct (green) spring.
Piston binding in sleeve	Disassemble and inspect parts	Clean, repair, or replace parts.

DISCHARGE FILTER BYPASS VALVE LEAKAGE EXCESSIVE

POSSIBLE CAUSE	ISOLATION PROCEDURE	CORRECTION
Piston binding in sleeve	Disassemble and inspect parts	Clean, repair, or replace parts.
Bad seat	Disassemble and inspect parts	Lap or replace defective parts.

Troubleshooting Chart
Figure 801 (Sheet 2 of 2)

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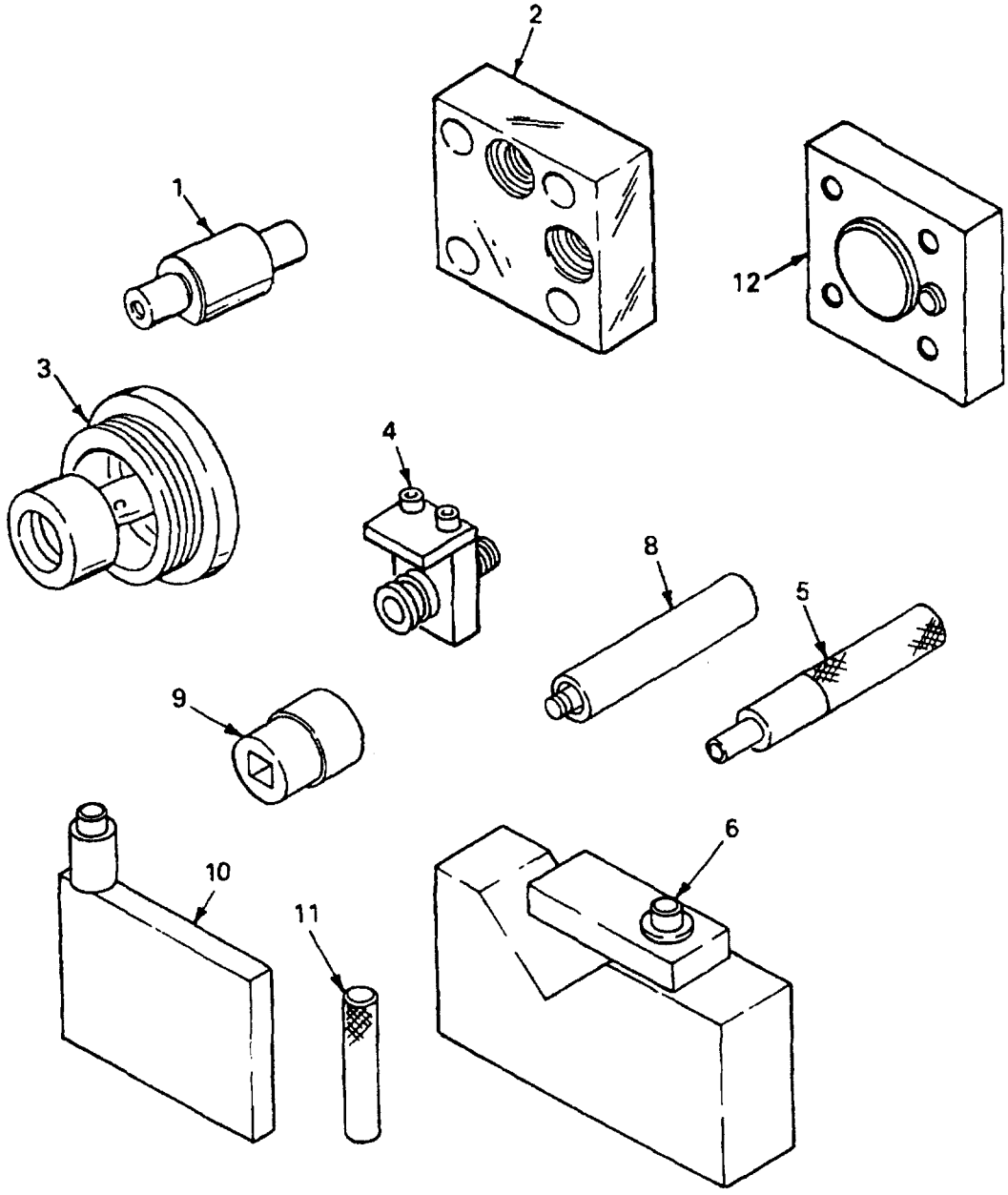
SPECIAL TOOLS, FIXTURES, AND EQUIPMENT

1. General

Special tools and fixtures required for overhaul and test of the pump are listed in Fig. 1001 and illustrated in Fig. 1002.

FIG. 1002 INDEX NO.	PART NO.	NOMENCLATURE	USE
1	SF97–1019	Tool, Bearing Dressing	Dress bearing flats during repair and assembly.
2	AED6509–10–10	Block, Port	Provide connection for bypass return during testing.
3	SF97–1310 or 97–1372	Fixture, Filter Bypass Valve Test	Replaces filter during test of filter bypass valve.
4	AED6509–19–3	Adapter, Inlet	Provide connection for inlet line during test.
5	DJS–23609	Driver, Staking	Used to install studs in pump housing.
6	FDS–22868	Fixture, Assembly	Used to hold bearings during pin installation.
7	T-013242–T1	DELETED (Driver, Pin)	
8	AKS–24288	Driver, Seal	Used to install seal into cover and pump housing assembly.
9	WAS–37524	Wrench, Special Socket	Used to remove and install valve cap.
10	024922–100–M2	Fixture, Holding	Used to hold inlet filter during pin installation.
11	025028–100–M2	Driver, Pin	Used to install pin in inlet filter.
12	FTS–23608	Fixture, Staking	Used as a guide for drilling during stud removal.

Special Tools and Fixtures
Figure 1001



A–40611–2

Special Tools and Fixtures
Figure 1002

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The above has been ordered from the source.
As soon as it is received, ATP will reissue
this fiche to include the above.

LIGHT OVERHAUL

1. General

Pumps which are prematurely removed from service due to a minor malfunction within the following categories may be repaired, tested, and returned to service.

2. Procedures

A. Seal(s) Leak

(1) Remove seal from pump as described in DISASSEMBLY.

(2) Lightly dress the carbon seal face on an Aloxite Resinoid stone, grade A-800-F-B, using a figure 8 motion.

(3) Clean seal as described in CLEANING.

(4) Reinstall seal and retainer as described in ASSEMBLY.

B. Discharge Filter Bypass Valve and/or Bypass Pressure Regulating Valve Leakage

(1) Disassemble valve as described in DISASSEMBLY.

(2) Inspect piston and sleeve for contamination, burrs, or scoring that would cause piston to hang-up.

(3) Repair as described in REPAIR.

(4) Inspect piston for complete contact wear pattern with seat in sleeve.

(5) If complete wear pattern is not evident, lightly lap the piston and sleeve together until complete contact is obtained.

(6) Clean parts as described in CLEANING.

(7) Reassemble valve as described in ASSEMBLY.

C. High/Low Filter Bypass Pressure

(1) Disassemble valve as described in DISASSEMBLY.

(2) Install new filter bypass valve spring and reassemble parts as described in ASSEMBLY.

D. High/Low Bypass Pressure Regulating Valve Pressure

(1) Disassemble valve as described in DISASSEMBLY.

(2) Install new regulating valve spring and reassemble parts as described in ASSEMBLY.

WRIGHT COMPONENTS

COMPONENT MAINTENANCE MANUAL

FUEL SHUTOFF SOLENOID VALVE
PART NO. 15410

Wright Components Inc., Clifton Springs, New York 14432

4 APRIL 1978

REPAIR PROCEDURE

for

P/N 15410

Valve, Solenoid Fuel Shutoff, N.C.

4 April 1978

Prepared by: Arthur V. Goodwin
Chief Engineer

Wright Components, Inc.
36 Broad Street
Clifton Springs, New York 14432

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ATP-15410, Rev. A (3 sheets)		

1.0 Scope

This procedure delineates the necessary steps to identify the cause of failure and to correct the failure in an orderly fashion. This procedure is broken into four sections:

Disassembly

Inspection/Replacement

Assembly and

Test

2.0 Disassembly

CAUTION: Under no circumstances shall the solenoid be unscrewed from the body without the solenoid being energized at 18 to 24 VDC.

2.1 Lockwire Removal

The lockwire shall be cut from both the solenoid assembly and the body assembly. The lockwire shall be removed and discarded assuring that no lockwire is allowed into the outlet or inlet port.

2.2 The solenoid shall be energized by applying a voltage of 18 to 24 VDC to pins A and B of the electrical connector. The appropriate mating connector shall be used.

2.3 While the solenoid is energized, the solenoid assembly shall be unscrewed from the body assembly using a strap wrench. Care shall be exercised in assuring that the strap wrench does not apply pressure to the lockwire loop which is on the solenoid assembly.

2.4 After the solenoid has been removed from the body, the

solenoid assembly shall be deenergized. When the solenoid is deenergized, the operator shall assure that the solenoid plunger assembly *does not fall onto a hard surface.*

3.0 Inspection/Replacement

All critical surfaces which include the O-rings, valve seats and plunger assemblies, shall be inspected under at least 5X magnification.

3.1 Inspection of Plunger Assembly

The plunger assembly shall be inspected for nicks and cuts of the O-ring at its seating surface. The plunger shall be inspected for evidence of scratches, nicks and burrs on its outside diameter and in the spring cavity. If there is any evidence of any scratches, nicks and burrs on the plunger assembly or cuts and nicks on the O-ring sealing surface, the plunger assembly shall be replaced.

3.2 Body Assembly

The body assembly shall be inspected for nicks, cuts or burrs at the seat edge. Also, the O-ring sealing surface shall be inspected for evidence of nicks, burrs or scratches. Both the inlet and outlet bosses shall be inspected to assure that there are no nicks, cuts or burrs at the O-ring seal area. If there is any evidence of nicks, cuts or burrs at these sealing surfaces, the body assembly shall be replaced. Also, the .400/.401" dimension, as shown per Figure 1 of this procedure, shall be inspected. If this dimension is not met, the body assembly shall be replaced.

3.3 Spring

The spring shall be visually inspected for breaks and for loss of load. The spring should yield a load of 2.0 lbs. at .350 ±.003". If these criteria are not met, the spring shall be replaced.

3.4 Solenoid Assembly

The solenoid assembly shall be inspected for evidence of burrs or scratches in the solenoid bore. Also, the O-ring seal lands of the solenoid assembly shall be visually inspected for scratches, nicks or burrs. If cleaning bore is required to allow visual inspection, the bore shall be cleaned with a lint-free wiper using Freon TF, butyl or ethyl alcohol or water. If there is any evidence of nicks, scratches or burrs, the solenoid assembly shall be replaced. The connector shall be inspected for evidence of dirt and pin misalignment. The pins may be straightened to a small extent as a repair. The resistance of the solenoid shall be measured and shall be between 35 to 40 ohms at 76°F. If the solenoid is warm, this resistance may be slightly higher. If this is the case, the solenoid shall be allowed to cool and the resistance measured at room temperature. If the solenoid resistance exceeds 40 ohms at 76°F, it shall be replaced.

3.5 O-ring

The O-ring shall be removed from the solenoid assembly and replaced. Care shall be exercised in replacing this O-ring

to assure that it is not nicked or scratched as it is placed over the threads. The O-ring shall be well lubricated with silicone grease or equivalent. After placement on the solenoid assembly, the O-ring shall be visually inspected to assure that it is not twisted or has any nicks or cuts.

4.0 Assembly

Prior to assembly, all parts shall be thoroughly cleaned using butyl alcohol, ethyl alcohol, Freon TF or water. Isopropyl alcohol, Dowclean, Trichlorethylene, MEK, Zylol or acetone shall not be used for cleaning. The O-ring shall be well lubricated along with the threads on the body assembly and on the solenoid assembly. Silicone grease or equivalent may be used.

4.1 The solenoid shall be energized at 18 to 24 VDC and the plunger assembly and spring shall be installed into the solenoid and pushed into the bore until the solenoid retains the parts.

4.2 The solenoid shall be screwed into the body assembly. Care shall be exercised in assuring that the O-ring is not pinched or cut during assembly. This can be accomplished by screwing in the solenoid assembly a half a turn and backing the solenoid out a quarter of a turn. This procedure shall be followed until the solenoid assembly is fully assembled to the body assembly. There shall be no evidence of a gap between the solenoid assembly and the body assembly at their faying surface. The solenoid assembly may be tightened using a strap wrench at a torque not to exceed 50 in.-lbs.

4.3 The solenoid assembly shall be relockwired to the body assembly.

4.4 The solenoid shall be deenergized.

5.0 Test

The assembled solenoid valve shall be tested to the requirements of ATP-15410.

WRIGHT COMPONENTS, INC.

RECOMMENDED SPARE PARTS LIST

P/N 15410

Part No.	Nomenclature	RSP/100 Valves
15410	Valve Assembly	0
24581	Body Assembly	1
24583	Body	0
24612	Body Casting	0
24582	Seat	0
24580	Solenoid Assembly	1
22941	Spring	1
24584	Plunger Assembly	1
24585	Plunger	0
21186	Seal Housing	0
21187	Seal Retainer	0
MS29513-004	O-ring	3
MS29513-021	O-ring	3
90018-16	Nameplate	1
MS20995C20	Lockwire	A/R
RC-10	R.C. Cap	0
-4	Tapered CaPlug	0

RSP/100 valves is the recommended Spare Parts Quantity for 100 valves in use. If the quantity is any part of 100 units, the quantities listed pertain.

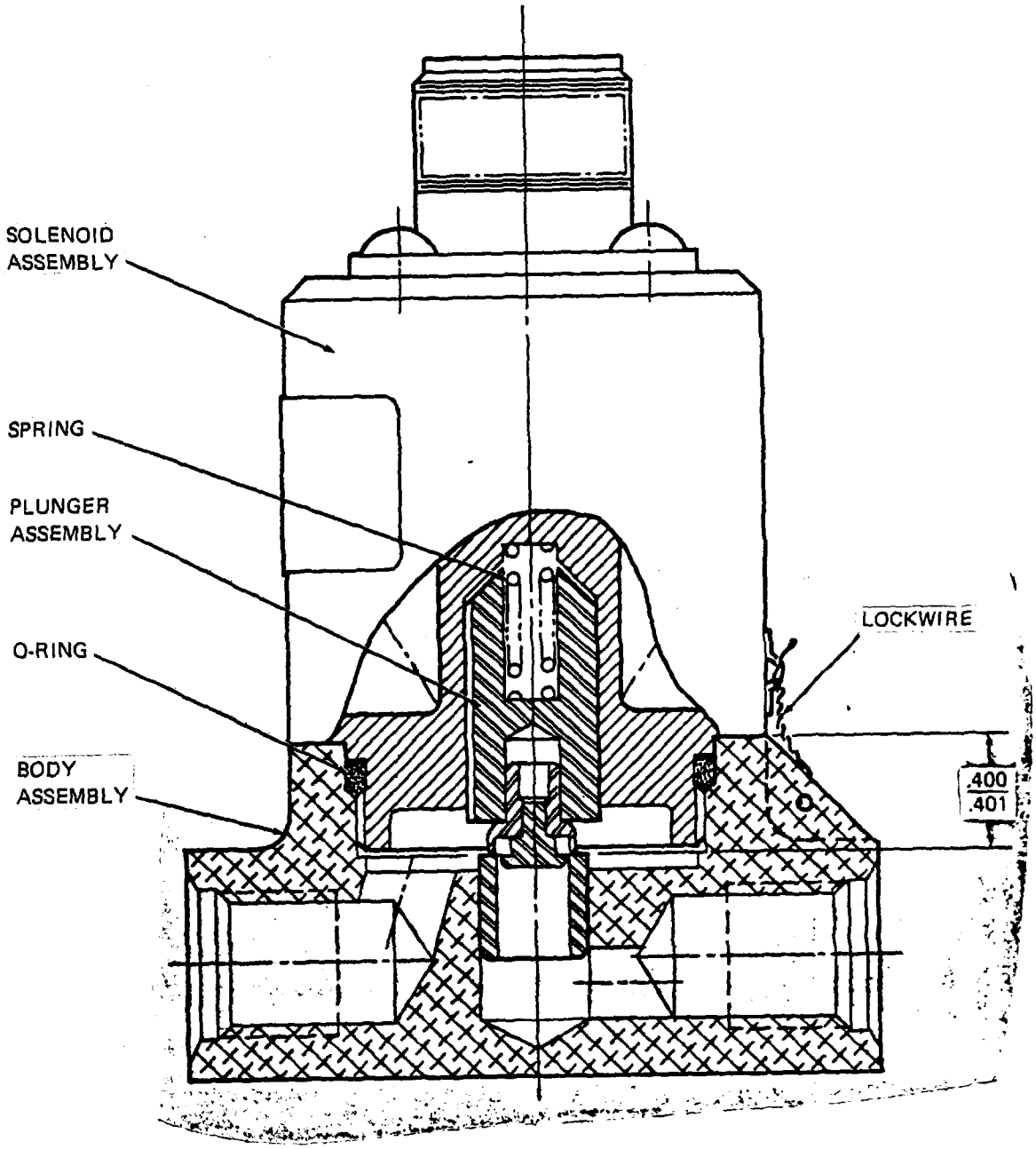


FIGURE 1

Repair Procedure
P/N 15410

ATP-15410

ACCEPTANCE TEST PROCEDURE for WCI P/N 15410

1.0 Scope

This Acceptance Test Procedure defines the test criteria to which each valve must be subjected and passed prior to shipment.

2.0 Test Conditions

Fluid: MIL-F-7024, (Calibration Fluid)
Fluid Temperature: 80°F ±20°F
Ambient Temperature: 75°F ±15°F

3.0 Tests

The following are the tests to be performed and the requirements thereof.

3.1 Examination of Product

The test valve shall be examined against WCI drawing 15410. The valve shall also be examined for defects, flaws and workmanship.

Requirements

The test valve shall meet all of the drawing requirements of 15410. The valve shall have no physical defects or flaws and shall exhibit good workmanship.

3.2 Proof Pressure

With the outlet port capped, and the solenoid energized at 18 VDC ±2 VDC, the inlet pressure shall be set to 77 ±2 psig. This pressure shall be held for a time period of not less than 1 minute while the valve is observed for evidence of external leakage or physical deformation.

Requirements

There shall be no external leakage during this test. Successful completion of the proof pressure test herein shall be constituted by the subsequent successful completion of the performance tests.

3.3 Actuation Voltage

With the test setup in accordance to Figure 1 of this procedure

and the inlet pressure at 50 psig, and the flow set to 380 PPH (60 GPH), the voltage to the solenoid shall be slowly increased from 0 VDC until the valve opens. The voltage at which the valve opens shall be measured and recorded.

Requirements

The opening voltage shall not exceed 15 VDC.

3.4 Pressure Drop

The pressure drop across the opened test valve shall be measured and recorded at a flow of 380 PPH (60 GPH). The pressure drop shall be measured as the gross pressure drop minus the tare pressure drop. Tare pressure drop shall be measured as the pressure drop incurred when the valve is replaced in the same test setup by the equivalent length of .172" dia. (I.D.) tubing.

Requirements

The pressure drop shall not exceed 6.4 psid at 380 PPH.

3.5 Internal Leakage

With the valve closed and the supply pressure set at 50 ±5 psig, the internal leakage shall be measured and recorded after a one minute wait for a period of one minute.

Requirements

The internal leakage as measured over the second minute shall be less than 1 drop in that minute.

3.6 Coil Resistance

The coil resistance shall be measured and recorded at room temperature.

Requirements

The coil resistance shall not be less than 35 ohms at 76°F.

3.7 Insulation Resistance

The insulation resistance of the current carrying pins of the connector and case ground shall be measured and recorded at 500 VDC ±50 VDC. The insulation resistance shall be measured as the current leakage at that voltage.

Requirements

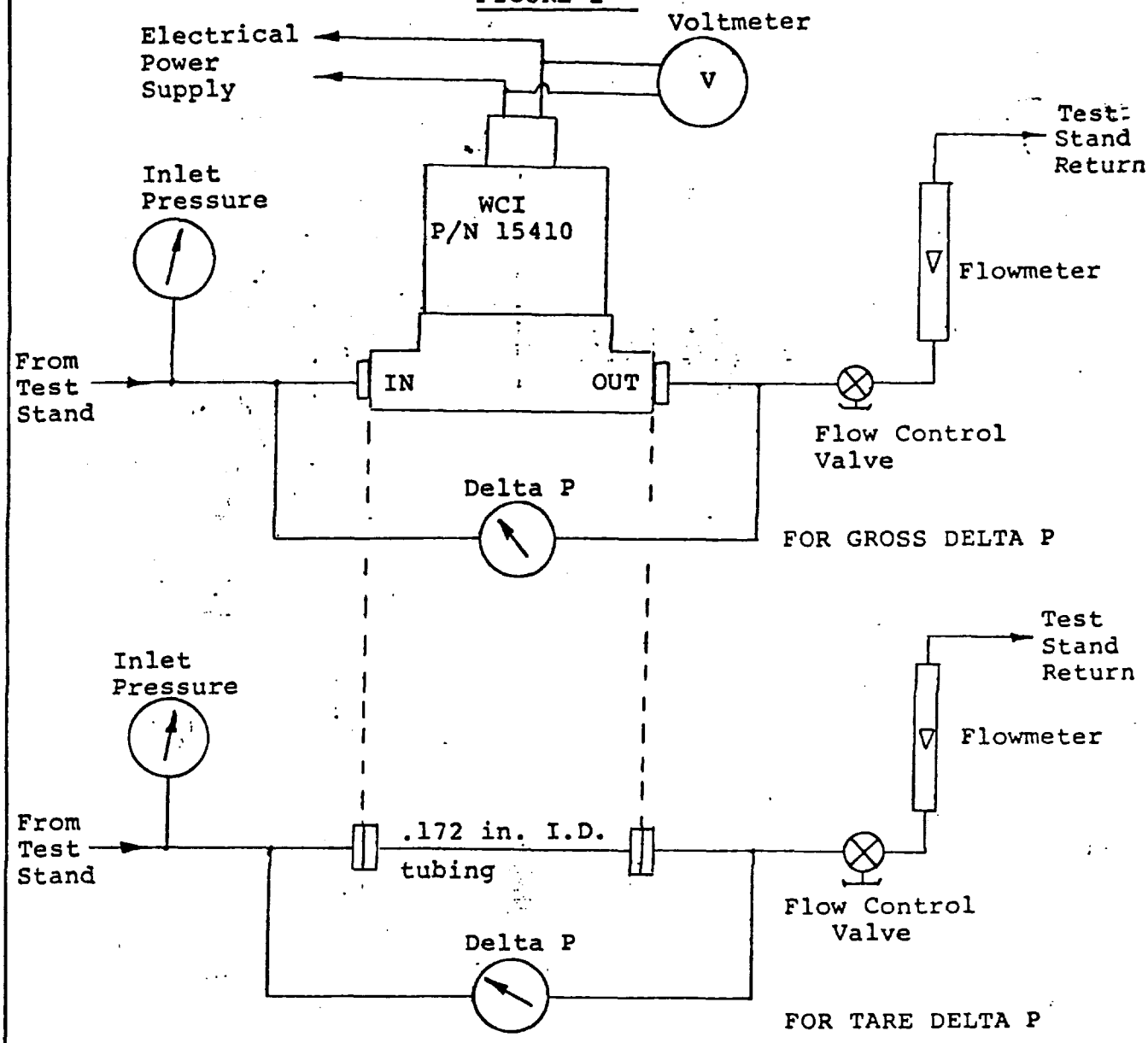
The current leakage at 500 VDC ±50 VDC shall not exceed

500 microamps. (100 megohms max.)

4.0 Preparation for Delivery

The test fluid shall be shaken from the valve fittings and clean plastic port plugs shall be placed on both the inlet and outlet fittings. The valve shall be then placed into a clean plastic bag which shall be appropriately sealed. Each valve shall be placed into a Jiffy-bag and boxed for shipment.

FIGURE 1



CHAPTER

77

ENGINE INDICATING

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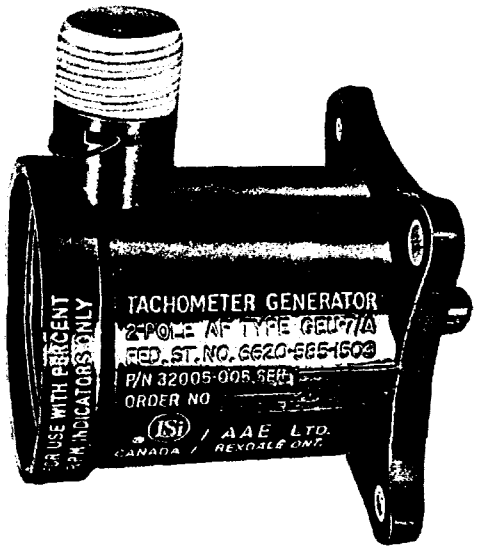
MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B./T.R.
Aircraft Appliances	Tachometer Generator	32005-005 (GEU7A)			
	Tachometer Generator	32005-007 through -037		Aug 1997	
Bendix	Torque Pressure Transmitter	Old P/N 25122-A-121A5-1 New P/N 3567749-7103 (C6SC1084-5)		May 25/1970	
	Torque Pressure Indicator	Old P/N 25122-A-121C-2B3 New P/N 3571212-0003 (C6SC1090)	31-00-		
	Tachometer Indicator	Old P/N 34107CIAG13-1A3 New P/N 3571260-7001 (C6SC1029-3)		Mar 25/1970	
	Indicators	Old P/N 25510B25B8A3 25514B25A3A3 & 25516C96A14A3 New P/N 3571810-0003 3571810-2001 3571810-8001	77-10-40	Oct 2/1987	
Meggitt Avionics / Edison	Torque Pressure Indicator	217-03221	77-10-2	Mar 1/1967	
	Torque Pressure Ind.	217-09261	77-10-81	Jul 1/1972	
	Torque Pressure Transmitter	318-02020	77-10-34	Feb 1/1969	
	Torque Pressure Transmitter	418-01064	77-10-42	Jul 1/1972	
General Electric	Tachometer Indicator	8DJ81CCL2, 8DJ81CCM2	77-10-4	Dec 30/1966	
Lewis	Temperature Indicator	152B206	31-00-	Dec 16/1968	
Smith	Indicator Turbine Temperature	PW727MV/BU39/700 (C6SC1085-5)	77-20-205/5	Jan 15/1991	

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FILE NO. 3201

OVERHAUL INSTRUCTIONS WITH PARTS BREAKDOWN

TACHOMETER GENERATOR MODEL 32005-005



ISi® CANADA

AIRCRAFT APPLIANCES & EQUIPMENT LTD.

585 Dixon Road *Rexdale, Ontario, Canada*

DIVISION OF LEAR SIEGLER, INC., POWER EQUIPMENT DIVISION.

PRICE $2.00 PER COPY

INTRODUCTION

This publication contains overhaul instructions and a Group Assembly Parts List for the Tachometer Generator, Model 32005-005. Included are disassembly, inspection, reassembly, lubrication, repair and test instructions. This manual is intended for use by experienced maintenance personnel; therefore, coverage is limited to essentials. All information contained herein is of a general nature. Common shop practices, known and used every day by experienced technicians, have been omitted.

Table 1. Leading Particulars

Weight, max. net (pounds) 0.80	Voltage
Rotation (viewed from drive end). CCW or CW	4200 RPM; with 40 ohm wye connected resistive load . . . . . 21 ± 0.5
Phase. 3	1000 RPM; with 20 ohm wye connected resistive load . . . . . 3.5 (Min.)
Phase Rotation CCW . . . . . B-A-C CW . . . . . A-B-C	Mounting, to mate with . . . . . AND 20005 Type XV-B
Rating . . . . . Continuous Duty	Number of Holes 4
Power Output 13VA	Hole Diameter. . . . . 0.280 to 0.287
Type 2-Pole	Dimensions (Inches) Overall Length . . . . . 3.0 Drive Shaft (Square). 0.244

DISASSEMBLY

Special Tools: The special tools for overhaul of the tachometer generator are listed below. The proper application of each tool is given in the text.

Part Number	Nomenclature
70571-1	Magnet Keeper
70572-1	End Play Checking Fixture
70573-1	Retaining Ring Installation Tool

General: Disassembly procedures should follow the sequence of index numbers on the exploded view illustration. Special instructions are given to procedures which are not apparent in the exploded view.

a. (Figure 1) Remove pins (2) and unsolder ground lead from retaining ring (3). Remove retaining ring (3) by prying up outer edge being careful not to damage ground lead. Remove the paint from the end bell (1) edge and inner surface of the stator housing assembly (12). Press the complete rotor and shaft assembly out of the stator by pressing on the drive end bearing. Disassemble individual parts as indicated except the stator housing assembly (12).

NOTE

The rotor should be placed where it will not pick up metal chips, filings, or other foreign material.

CLEANING PROCEDURE

General: Clean all metal parts except the stator housing assembly with cleaning solvent, Federal Specification P-S-661. Use a bristle brush to aid in cleaning if necessary. Dry parts with filtered compressed air. Do not immerse stator housing assembly in solvent. Blow dust and other foreign particles out of the stator, then wipe with a cloth moistened in the solvent. Scrape loctite from the bearing area.

INSPECTION AND REPAIR

Stator.

a. The stator windings of the generator shall be checked for resistance between phases A, B and C. The resistance measured between phases shall measure 28.0 ohms maximum at 77°F (25°C). The maximum phase resistance variation shall not differ by more than one ohm. Should the stator be defective, replace the stator housing assembly (12).

b. Visually inspect connector insert (13). If defective, replace along with insulation sleeves (15). Visually inspect connector retaining ring (14). If the connector insert (13) is damaged and must be replaced, remove the retaining ring (14) and cut the stator leads close to the connector insert. Place new insulation sleeves (15) over the lead wires, then solder stator leads to terminal pins with high temperature solder (99.8% tin). Slide sleeving over soldered connections and heat shrink the sleeving to size. Place connector insert (13) in the housing and secure with retaining ring (14). Dress the stator leads between stator end turns and housing, secure with RTV 732 adhesive.

NOTE

The leads are identified: "A" - red; "B" - Yellow; "C" - Blue. Solder "A" and "B" to respective connector insert terminal pins.

Rotor: Inspect rotor (11) for damage. Bearing journals and OD of rotor should be concentric with each other within 0.001 total indicator reading. Replace if not within these tolerances.

Bearings: Replace bearings (10) at each overhaul.

Drive Shaft Pin: Replace pin (9) at each overhaul.

Drive Shaft: Replace if damaged.

Retaining Ring: Replace Ring (3) at each overhaul.

Roll Pins: Replace pins (2) at each overhaul.

REASSEMBLY

Procedure: Refer to figure 1 for relative position of component parts. Special notes are as follows:

a. When installing the bearings (10), make sure that the grooves are facing away from the rotor magnet. Insert 1/8" length of Super Mil ASU M100 grease as a plug in the drive end hole of the rotor shaft. Insert the drive shaft into the rotor shaft. Install the drive shaft pin (9) making sure that the open side of the roll pin is facing the rotor magnet and that the ends of the roll pin protrude an equal amount on each side of the rotor shaft.

b. Clean and lightly prime bearing outer race (drive end) and the portion of the housing where the bearing seats with Locquic grade N primer. Do not handle primed surfaces.

c. Fully magnetize the rotor with the poles of the rotor and magnetizer aligned, then slide the rotor into the magnet keeper P/N 70571-1 and install in unit making sure not to take the

rotor through air. The magnet keeper is designed to fit on the end of the stator housing assembly with the protruding barrel down inside the stator windings. Any suitable commercial magnetizer can be used.

NOTE

To insure minimum harmonic output of the generator, the rotor must be correctly aligned when being magnetized. Use a compass or other suitable means to locate the polarity and the centre of the rotor poles for proper alignment.

d. Place end-play checking fixture P/N 70572-1 on the end of the stator housing assembly to determine the number of shims required. See table below.

End Play Fixture Reading	No. of Shims Required
.0000 - .0050	0
.0051 - .0150	1
.0151 - .0250	2
.0251 - .0350	3
Over .0351	4

e. Using Super Mil ASU M100 grease, attach the bearing lock (6) to exposed bearing making sure that the dogs enter the slots in the bearing. Dress blue lead "C" up through the hole in the end bell. Use the same type of grease to hold the shim(s) (4) and then wavy washer (5) in place in the end bell (1) while installing the end bell. Be sure that the key on the bearing lock (6) enters the slot in the end bell (1) and that it does not slip out of the slots in the bearing. Install the end bell.

f. Push the rotor assembly (7) along with the end bell partially out of position (1/8" approx.) Place 3 small drops of loctite, Hot Strength 306 adhesive on the bearing surface of the housing. Push the rotor assembly and the end bell into their proper position. Clean excess adhesive off of the bearing and housing with a clean, dry cloth. Be sure no loctite is permitted to enter the bearing.

g. Press in retaining ring (3) with retaining ring installation tool P/N 70573-1. Be careful not to damage the ground lead.

h. Prior to grounding the "C" lead, make an insulation breakdown test. Apply a potential of 250 volts AC, 60 cycle for five seconds between the individual electrical pins and the metal parts of the stator housing. There shall be no breakdown of insulation during this test.

i. Solder the ground lead "C" to the retaining ring (3) with high temperature solder (99.8% tin).

j. Press the roll pins (2) in the housing.

k. Paint all exterior surfaces except the mounting pad and the connector threads with 1 coat of Sherwin Williams primer E42AP7 with V66KP15 converter, and 1 coat of Enamel, black F55BP12 with V66KP11 converter.

TEST PROCEDURE

Standard Test Conditions: Unless otherwise specified, standard test conditions shall be 77°F (25°C). Voltages shall be measured with rms indicating instruments which draw no appreciable current (1000 ohm per volt min.) and which are free from frequency errors.

Phase Rotation: Connect the tachometer generator to a suitable phase rotation indicator and check the phase rotation. Correct phase sequence shall be B-A-C when the generator drive shaft is rotated in a counter-clockwise direction (viewed from the drive shaft end).

Performance Tests.

a. Connect the tachometer generator to a load of three resistances as directed in Table II. While operating the generator at 4200 rpm, short circuit the generator output 5 times for 1 second on and 4 seconds off. Drive the generator at the speed given and check to see that the output voltage is within limits per Table II.

b. If output voltage is below the minimum limits, the rotor must be removed from the stator housing assembly and remagnetized per paragraph "c" under REASSEMBLY.

c. If the output voltage exceeds the maximum limit, use the following procedure to calibrate the generator output voltage.

Use a variable 0-50 volt 60Hz 50 VA power supply that is isolated from the ground. Connect the supply to leads A and B of the tachometer generator through a momentary push button switch which will also disconnect the load bank and voltmeter when depressed.

Adjust the supply to zero and operate the generator at 4200 rpm. Keep pulsing the 60Hz power into the generator while slowly increasing the supply voltage until the generator output voltage is seen to drop. Recheck the generator rated output and if still too high, repeat the discharge procedure.

Table II. Performance Test Data

GENERATOR RPM (Drive Shaft Speed)	LOAD RESISTORS	LOAD (OHMS) EACH RESISTOR	CONNECTION LOAD	EACH TERMINAL VOLTAGE (VOLTS) Measured At Generator Terminals
4,200	3	40	Y	21 ± 0.5
1,000	3	20	Y	3.5V Min.

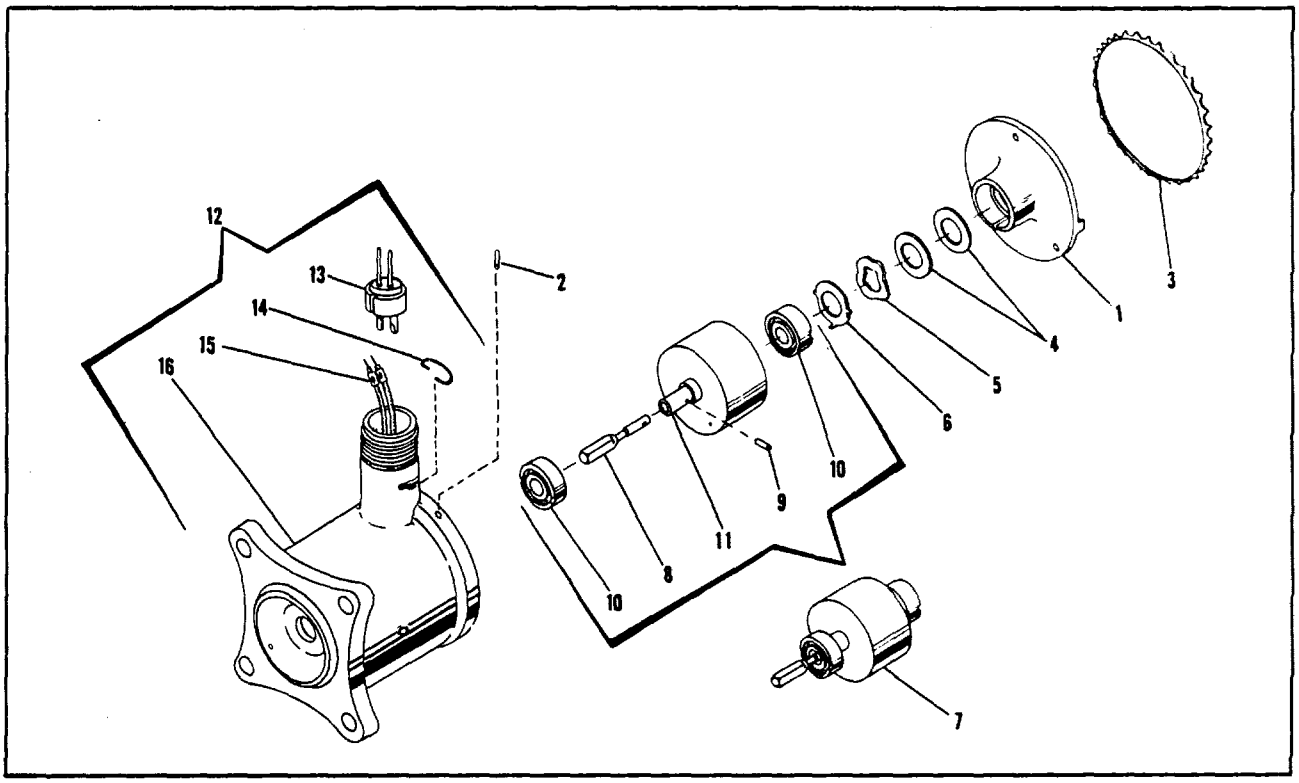


Figure 1. Exploded View of Model 32005-005 Tachometer Generator

GROUP ASSEMBLY PARTS LIST

FIG. & INDEX NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
1-	32005-005	GENERATOR ASSY, Tachometer	1	
-1	50454-1	. END BELL	1	
		(ATTACHING PARTS)		
-2	49312-2	. PIN, Roll (52-012-062-0312)	2	
-3	49310-1	. RING, Retaining		
		- - - - - - * - - - - - -		
-4	49825-2	. WASHER, Shim	A/R	
-5	05-378100	. WASHER, Spring Tension	1	
-6	10690-1	. WASHER, Keying	1	
-7	50531-1	. ROTOR, Assembly	1	
-8	10584-1	. . SHAFT, Drive		
		(ATTACHING PARTS)		
-9	49312-1	. . PIN, Drive Shaft (79-081-078-0375)	1	
		- - - - - - * - - - - - -		
-10	49204-1	. . BEARING, Ball	2	
-11	50456-1	. . ROTOR	1	
-12	70496-1	. STATOR, Housing Assembly	1	
-13	10663-1	. . CONNECTOR, Insert	1	
		(ATTACHING PARTS)		
-14	10634-1	. . RING, Retaining, Connector	1	
		- - - - - - * - - - - - -		
-15	49823-1	. . SLEEVE, Insulation	2	
-16		. . STATOR, Housing	NP	

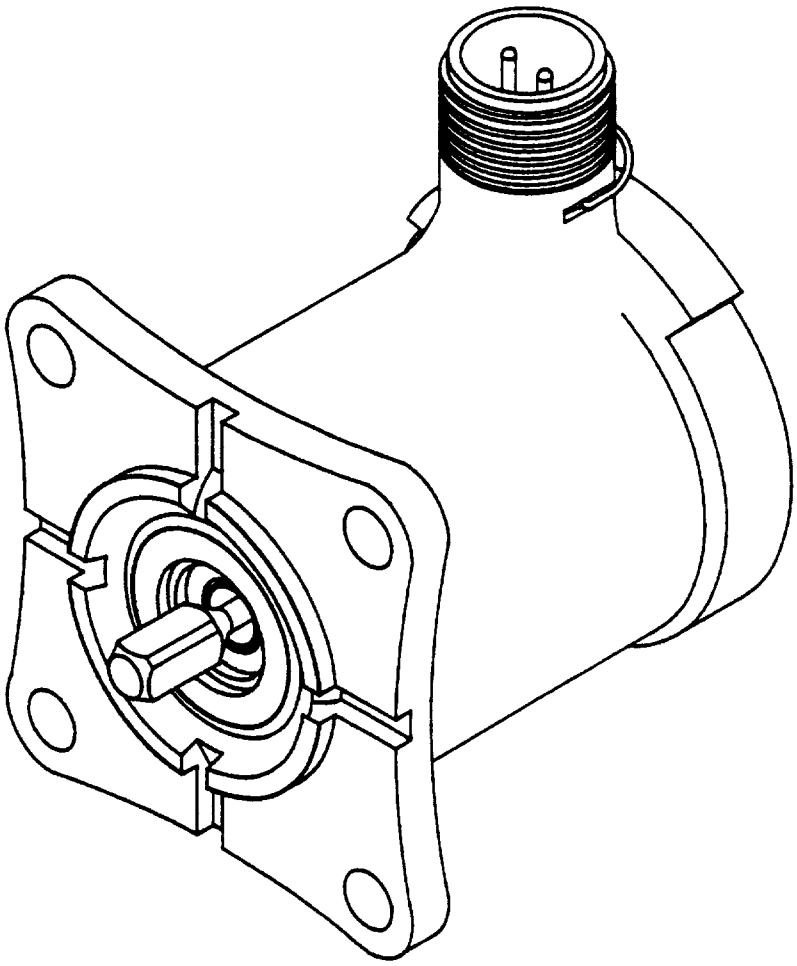
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M-7084
AUGUST, 1997
(SUPERCEDES FILE NO. 3206)

OVERHAUL INSTRUCTIONS
WITH
PARTS BREAKDOWN

TACHOMETER GENERATOR MODELS

32005-007, -008, -023, -025, -026, -030, -034 AND -037



RECORD OF REVISIONS

REV. NO.	ISSUE DATE	DATE INSERTED	BY	REV. NO.	ISSUE DATE	DATE INSERTED	BY	REV. NO.	ISSUE DATE	DATE INSERTED	BY

1. RETAIN THIS RECORD IN THE FRONT OF THE MANUAL.

2. ON RECEIPT OF REVISIONS, INSERT REVISED PAGES IN THE MANUAL, AND ENTER REVISION NUMBER, DATE INSERTED, AND INITIALS.

3. AS OF THE DATE OF THIS ISSUE THERE IS NO FACTORY-MAINTAINED REVISION SERVICE TO MAINTENANCE ORGANIZATIONS. IT IS THE RESPONSIBILITY OF THE TECHNICIAN OR FACILITY TO VALIDATE THE STATUS OF THIS DOCUMENT.

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PART 1

DESCRIPTION AND OPERATION

GENERAL

1. This publication contains overhaul instructions and a Group Assembly Parts List for Aircraft Appliances & Equipment Limited Tachometer Generator Models 32005-007, -008, -023,-025, -026, -030, -034 and -037. The manual describes the overhaul instructions for the model 32005-007. The differences in overhaul instructions between this model and the other models are described in Part 9 - DATA DIFFERENCE SHEETS.

THEORY OF OPERATION

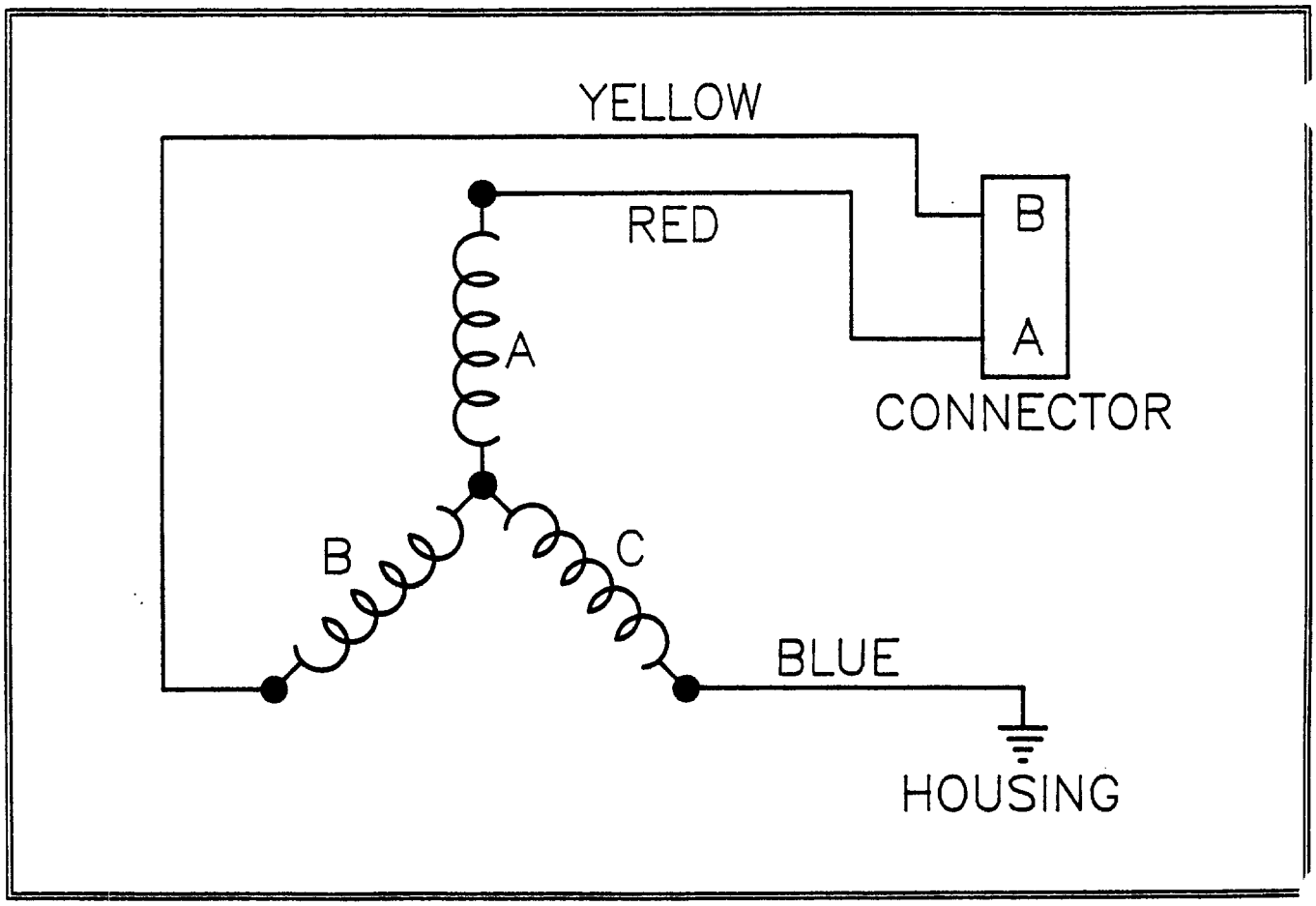
2. Tachometer generators are used in aircraft for the purpose of providing an indication of engine speeds. The tachometer generator is mounted on the accessory pad of each engine and is connected electrically with one or two associated synchronous motor indicators (not supplied with the generator). The indicators are located on the aircraft instrument panels.

3. As the rotor of the tachometer generator is turned by the engine, the magnetic field created by the rotor's permanent magnet rotates in the stator and induces an electromotive force or voltage in the three-phase stator windings. The frequency of the output voltage is directly proportional to drive speed. Since the indicators used with the tachometer generators are frequency sensitive, an accurate means of determining engine speeds is thereby provided. The generated voltage at any speed need only be above the minimum value necessary to actuate the indicator. Table 1-1 shows the Leading Particulars for the tachometer generator. The schematic diagram of the tachometer generator can be seen in Figure 1-1.

TABLE 1-1 LEADING PARTICULARS

Weight, (approx. pounds)	.97
Rotation (viewed from drive end)	CCW or CW
Phase	3
Phase Rotation CCW	B-A-C
CW	A-B-C
Rating	Continuous Duty
Power Output	13VA
Type	2-Pole
DIMENSIONS (INCHES)	
Overall length	3.0
Drive Shaft (Square)	0.244
VOLTAGE (VOLTS AC)	
4200 RPM; with 40 ohm wye connected resistive load	21± 0.5
1000 RPM; with 20 ohm wye connected resistive load	3.5 min
MOUNTING	AND 20005 TYPE XV-B

FIGURE -1-1 SCHEMATIC DIAGRAM



PART 2

DISASSEMBLY

PROCEDURE

1. Remove three roll pins (Figure 8-1, Item 2) from endbell (1) using a drive pin punch (see Table 7-1, Item 1), discard roll pins.

2. Press rotor assembly (5) and endbell (1) out of stator housing assembly (11) by pressing on the driveshaft end.

3. Remove the endbell (1) from the rotor assembly (5). Remove shims (3) and spring washer (4) from the endbell. Discard shims (3) and spring washer (4).

4. Remove the bearings (8) from the rotor assembly using a suitable bearing puller, discard bearings (8).

5. Remove sleeving (9) from the rotor shaft. Using a drive pin punch (Table 7-1, Item 1) remove drive shaft pin (7) discard pin (7) and sleeve (9). Remove drive shaft.

6. Do not disassemble stator housing assembly (11) unless a defect is detected. If necessary disassemble and repair the stator housing assembly as per Part 4.

PART 3

CLEANING PROCEDURE

GENERAL.

1. Clean all metal parts except the stator assembly with cleaning solvent, Federal Specification P-D-680. Use a bristle brush to aid in cleaning if necessary. Dry parts with filtered compressed air. Do not immerse stator assembly in solvent. Blow dust and other foreign particles out of the stator, then wipe with a cloth moistened in the solvent.

2. Remove any metal particles attracted to the rotor by the permanent magnet.

PART 4

INSPECTION AND REPAIR

INDIVIDUAL COMPONENT INSPECTION

1. Perform inspection of individual components in accordance with Table 4-1

TABLE 4-1

Part List Item Figure 8-1	Description	Inspection
11	Stator, Housing Assembly	The stator windings of the generator shall be checked for resistance between Phases A, B and C. The resistance measured between phases shall measure 28.0 ohms maximum at 77°F(25°C). The maximum phase resistance variation shall not differ by more than one ohm from each other. Perform dielectric test in accordance with paragraph 2. Inpsect bearing bore of housing for wear. Diameter must be within 0.7502/+0.0004/-0.0000 inches. Replace if defective.
1	Endbell	Inspect bearing bore of endbell for wear. Diameter must be within 0.7502/+0.0004/ -0.0000 inches. Replace if defective.
10	Rotor	Check pin hole in shaft for evidence of excessive wear. Bearing journals and O.D. of rotor should be concentric with each other within 0.001 total indicator reading. Inspect bearing journal diameter for wear. Diameters must be within 0.2502 /+0.0000/ -0.0002 inches. Replace if defective.
6	Shaft, Drive	Inspect drive shaft surface for cracks, excessive wear on square drive section or pin hole. Replace if defective.
13	Connector, Insert	Visually inspect the receptacle. Replace if defective in accordance with instructions below.
-	Miscellaneous Parts	Visually inspect remaining parts. Replace if defective.

NOTE

Item 10 will have surface imperfections from the casting process. These should not be mistaken for defects. The rotor magnet casting should be inspected visually for cracks, chips or looseness to the shaft.

STATOR DIELECTRIC TEST

2. In order to perform a dielectric test, the ground ring (12) must not be in contact with the housing. To remove the ground ring first remove any RTV732 adhesive which is on the ground ring.

NOTE

Phase C (blue leadwire) leadwire is soldered to the ground ring. Do not damage the soldered joint when removing the RTV732 adhesive.

3. - Pull the ground ring out of the housing.

4. Once removed support the ground ring on a non-conductive surface so that it is not in contact with the housing.

5. Apply a potential of 250 volts AC, 60 Hz for five seconds between the individual electrical pins and the metal parts of the stator housing. There shall be no evidence of insultation breakdown during this test.

NOTE

If the dielectric tester has an adjustable trip setting, set the trip at 5 mA.

6. Reinstall the ground ring in the housing. Press the stator leadwires between the end turns and the housing. Secure the leadwires with RTV732 adhesive.

NOTE

Ensure that the RTV732 adhesive does not extend above the ground ring and prevent improper seating of the endbell against the ground ring.

REPAIR

7. Repair is limited to replacement of the stator housing assembly (11) connector insert (13). The stator winding is permanently fixed to the housing and is not repairable.

8. If the connector insert (13) is damaged and must be replaced remove the retaining ring (14) and pull the connector insert up and out of the housing. Cut the stator leads close to the connector insert. Place new insulation sleeves (15) over the leadwires, then solder the stator leads to the terminal pins with high temperature solder, Sn95Sb05, Kester P/N 24-0001-0027 or equivalent.

NOTE

The leadwires are identified "A" - red; "B" - yellow; "C" - blue; solder "A" and "B" to respective connector insert terminal pins.

9. Slide sleeving over soldered connections and head shrink the sleeving to size. Place connector insert in the housing and secure with retaining ring (14).

10. Perform dielectric test in acordance with the procedure above.

PART 5

REASSEMBLY

ROTOR REASSEMBLY

1. Slide sleeve (Figure 8-1, Item 9) over rotor shaft drive end. Roll sleeve back on itself so as not to cover drive shaft pin hole. Press bearings (8) onto rotor shaft (10). Insert a 1/8" length of grease P/N 13CF (MIL-G-25013E), manufactured by Royal Lubricants, as a plug in drive end hole of rotor shaft. Insert the drive shaft (6) into the rotor shaft. Install the drive shaft pin (7) making sure that the open side of the roll pin is facing the rotor magnet and that the ends of the roll pin protrude an equal amount on each side of the rotor shaft. Grease the rotor shaft pin hole until the grease purges out between drive shaft and rotor shaft. Roll sleeve (9) over drive pin and position 1/32 inch from the bearing.

NOTE

Check the flexability of the drive shaft (6) of Rotor assembly (5) per paragraphs 2 and 3. If out of limits, replace the defective parts.

2. The face of the shaft shall be free to move 0.016 inch in any direction about the centre line of the rotor. The free axial play shall not exceed 0.021 inch.

3. The shaft rotational backlash about its longtudinal axis shall not exceed 10 angular degrees.

4. Fully magnetize the rotor with the poles of the rotor and magnetizer (Table 7-1, Item 3) aligned, then slide the rotor into the magnet keeper (Table 7-1, Item 2) and install in stator housing assembly making sure not to take the rotor through air. The magnet keeper is designed to fit on the end of the stator housing assembly with the protruding barrel down inside the stator windings.

NOTE

To ensure minimum harmonic output of the generator, the rotor must be correctly aligned when being magentized. Use a compass or other suitable means to locate the polarity and the centre of the rotor poles for proper alignment.

5. Determine the proper number of shims (3) required using the SHIMMING PROCEDURE, paragraphs 8 to 13.

6. Using grease, P/N 13CF, to hold shims (3) and spring washer (4) in place, install end bell (1). Rotate end bell 15° approximately so as to misalign existing pin holes and drill three new holes (.078/.081 dia.) using existing holes in housing as pilots. Install three roll pins (2).

NOTE

Make sure that the end bell is properly seated before drilling. Do not enlarge existing holes in housing.

7. Paint all exterior surfaces except the mounting pad and the connector threads with 1 coat of a good commercial black enamel.

SHIMMING PROCEDURE

8. Shims (3) are used so that the spring washer (4) will always be compressed the same amount and therefore always provide a fixed axial preload on the bearings.

9. The number of shims required can be determined using one of the two methods below.

METHOD A

10. Push shimming fixture (Table 7-1, item 4) into the back of the housing until it firmly seats against the ground ring, see Figure 5-1. The fixture will center the bearing and rotor.

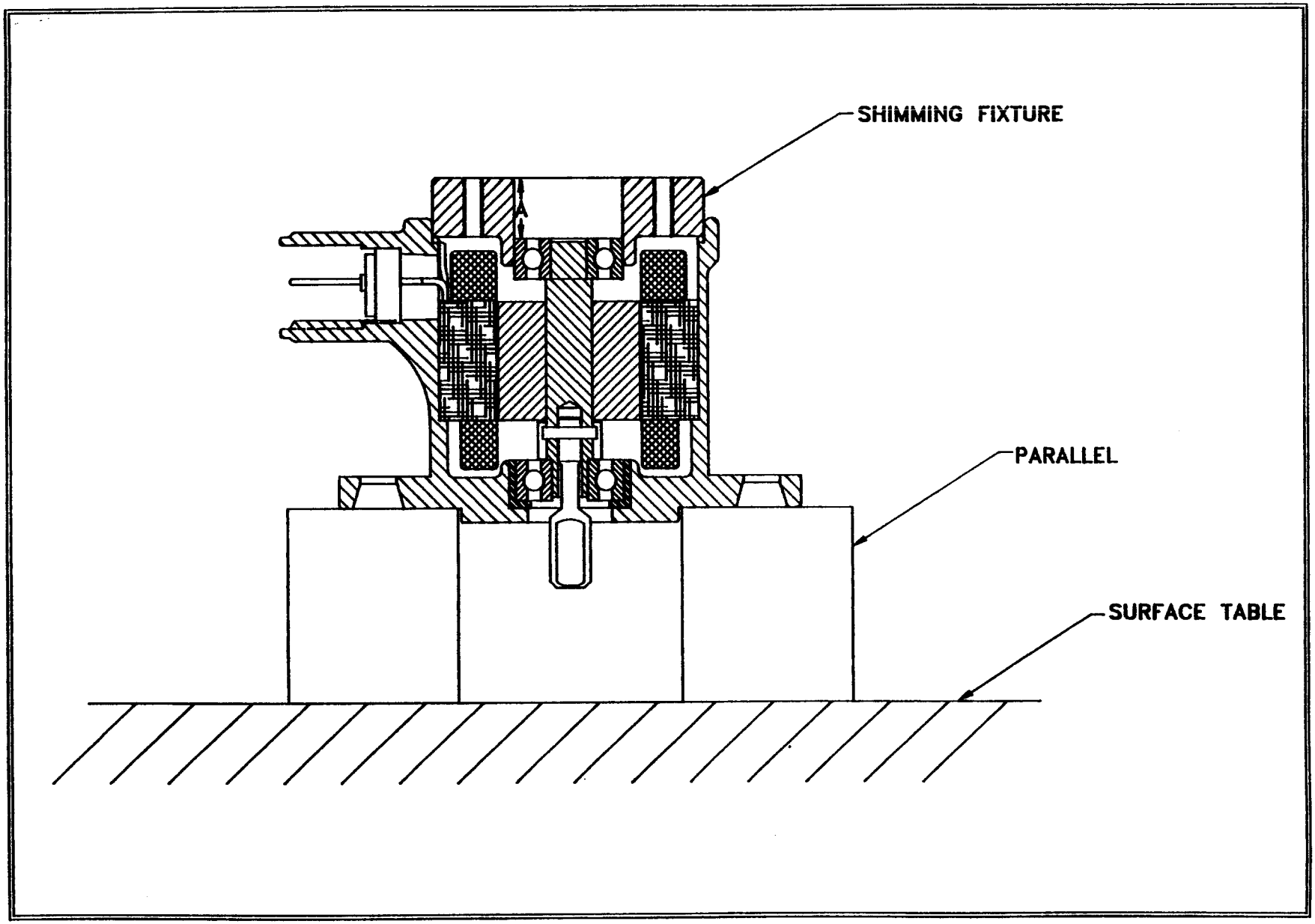


FIGURE 5-1

11. Using a depth micrometer, measure dimension A at four equally spaced postions around the outside of the bearing. Calculate the average of the four measurements and use Table 5-1 to determine the number of shims (3) required.

12. Two #4-40 screws can be installed in the shimming fixture to facilitate removal from the housing.

METHOD B

13. Place end play checking fixture (Table 7-1, item 5) on the end of the stator housing assembly, ensure that the fixture is seated against the ground ring (12). Apply the reading on the end play checking fixture to Table 5-2 to determine the number of shims (3) required.

NOTE

The end plug checking fixture (Table 7-1, item 5) should be zeroed each time prior to use. Place the end play checking fixture on the zeroing fixture (Table 7-1, item 6) and adjust the indicator dial to zero.

TABLE 5-1

DIMENSION A (INCHES)	NUMBER OF SHIMS REQUIRED
0.4300 - 0.4350	0
0.4351 - 0.4450	1
0.4451 - 0.4550	2
0.4551 - 0.4650	3
OVER 0.4651	4

TABLE 5-2

END PLAY FIXTURE READING	NUMBER OF SHIMS REQUIRED
0.0000 - 0.0050	0
0.0051 - 0.0150	1
0.0151 - 0.0250	2
0.0251 - 0.0350	3
OVER 0.0351	4

PART 6

TEST PROCEDURE

STANDARD TEST CONDITIONS

1. Unless otherwise specified, standard test conditions shall be 77°F (25°C). Voltages shall be measured with rms indicating instruments which draw no appreciable current (1000 ohm per volt min.) and which are free from frequency errors.

PHASE ROTATION TEST

2. Connect the tachometer generator to a suitable phase rotation indicator and check the phase rotation. Correct phase sequence shall be B-A-C when the generator drive shaft is rotated in a counter clockwise direction (viewed from the drive shaft end).

PERFORMANCE TEST

3. Connect the tachometer generator to a load comprised of three resistors as directed in Table 6-1. While operating the generator at 4200 rpm, short circuit the generator output 5 times for 1 second and 4 seconds off. Drive the generator at the speed given and check to see that the output voltage is within limits of Table 6-1.

4. If the output voltage is below the minimum limits, the rotor must be removed from the stator housing assembly and remagentized per paragraph 4 under REASSEMBLY.

5. If the output voltage exceeds the maximum limit, use the following procedure to calibrate the genrator output voltage.

CALIBRATION PROCEDURE

6. Use a variable 0-50 volt, 60 Hz, 50 VA minimum power supply that is isolated from the ground. Connect the supply to leads A and B of the tachometer generator through a momentary push button switch which will also disconnect the load bank and voltmeter when depressed.

7. Adjust the supply to zero and operate the generator at 4200 rpm. Keep pulsing the 60 Hz power into the generator while slowly increasing the supply voltage until the generator output voltage is seen to drop. Recheck the generator rated output and if still too high, repeat the discharge procedure.

TABLE 6-1 PERFORMANCE TEST DATA

GENERATOR RPM (Drive Shaft Speed)	LOAD RESISTORS	LOAD (OHMS) EACH RESISTOR	LOAD CONNECTION	EACH TERMINAL VOLTAGE (VOLTS) Measured at Generator Terminals
4,200	3	40	Y	21 ± 0.5
1,000	3	20	Y	3.5V Min.

PART 7

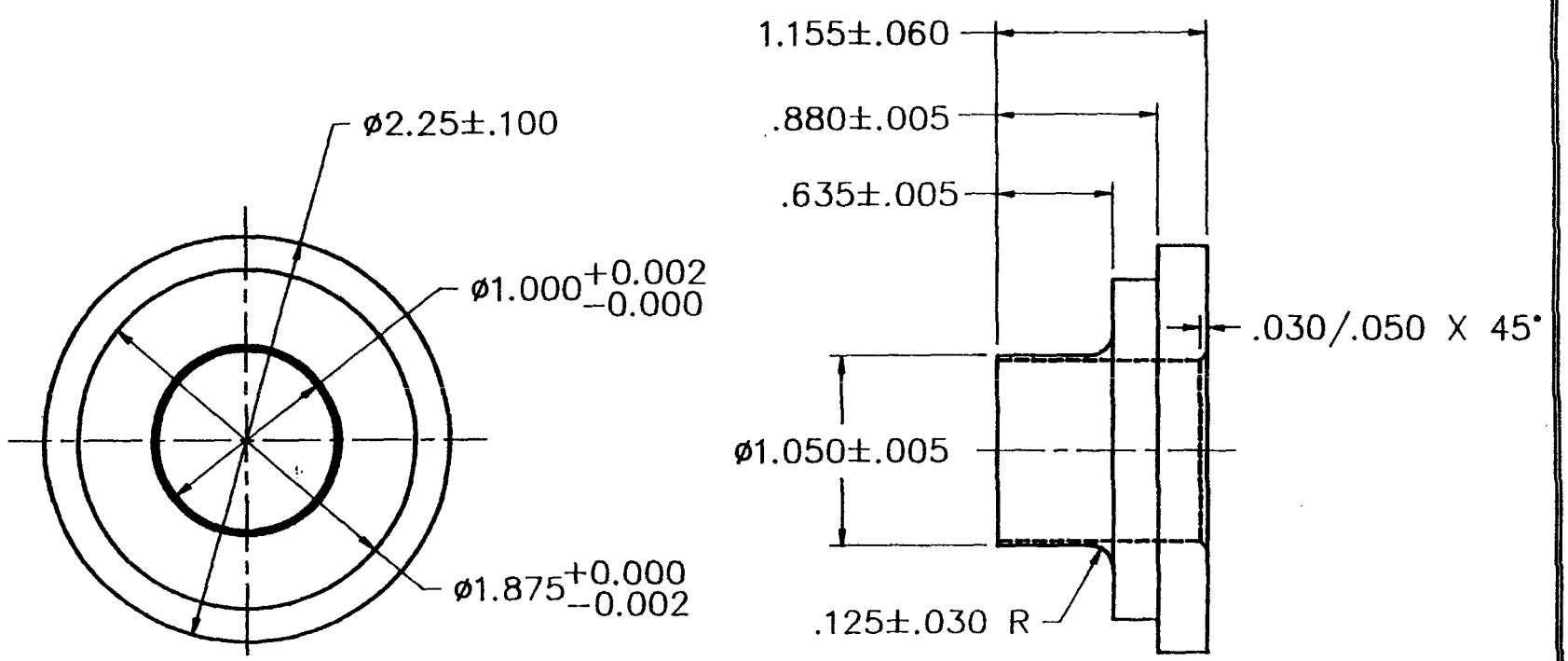
SPECIAL TOOLS

GENERAL

1. Table 7-1 lists the special tools required for repair/overhaul of the tachometer generator.

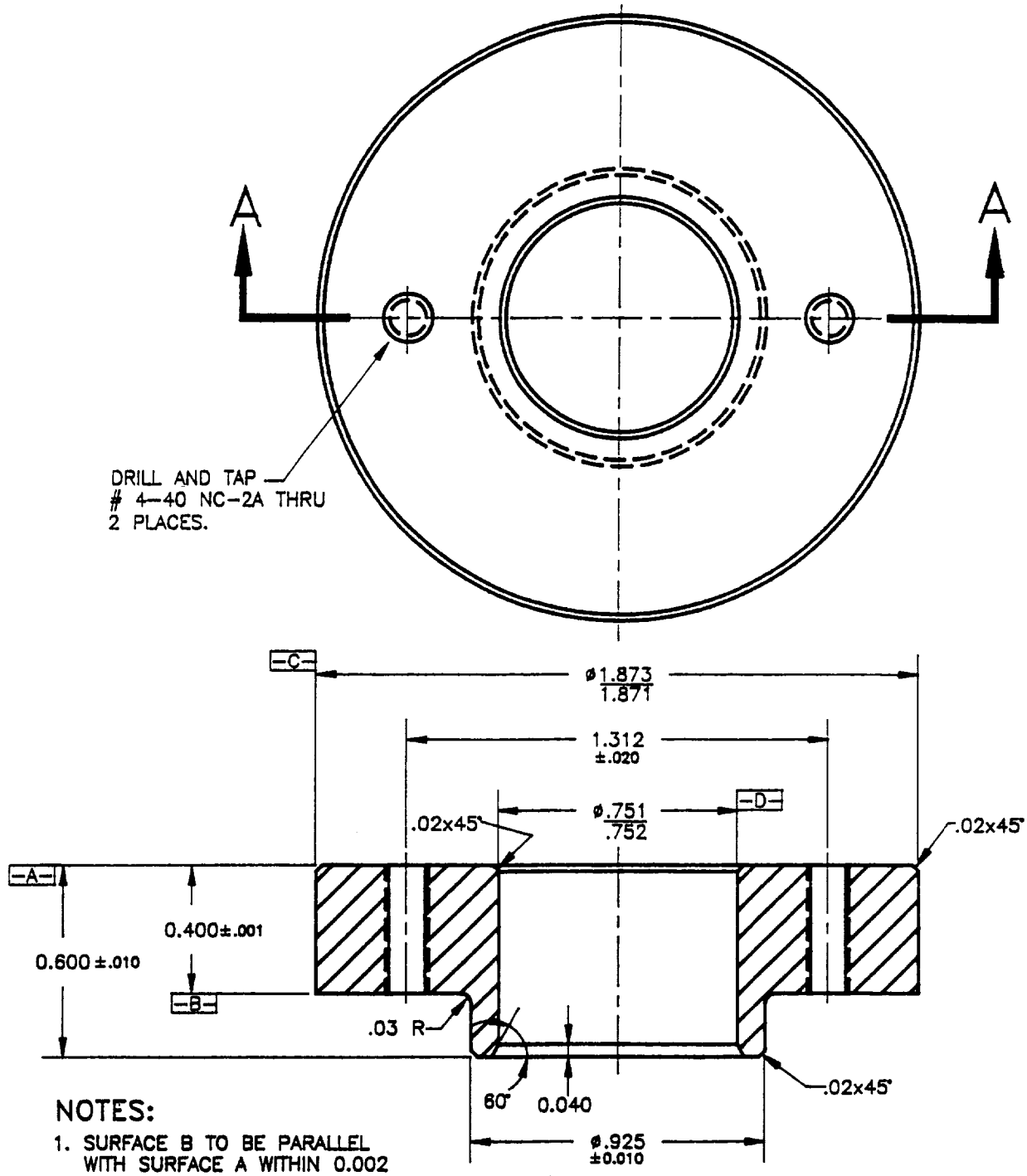
TABLE 7-1

ITEM	TOOL PART NUMBER	DESCRIPTION	SOURCE OF SUPPLY	FIGURE NUMBER
1	Commercial	1/16 Inch Drive Pin Punch	Commercially Available	----
2	370571-1	Magnet Keeper	AAE	7-1
3	Commercial	Magnetizer, Two Pole	Commercially Available	----
4	880025	Shimming Fixture	AAE	7-2
5	370572-1	End Play Checking Fixture	AAE	----
6	880024	Zeroing Fixture	AAE	7-3



1. BREAK ALL SHARP EDGES.
2. MATERIAL: STEEL, AISI C-1010
3. SCALE: 1=1
4. ALL DIMENSION IN INCHES.

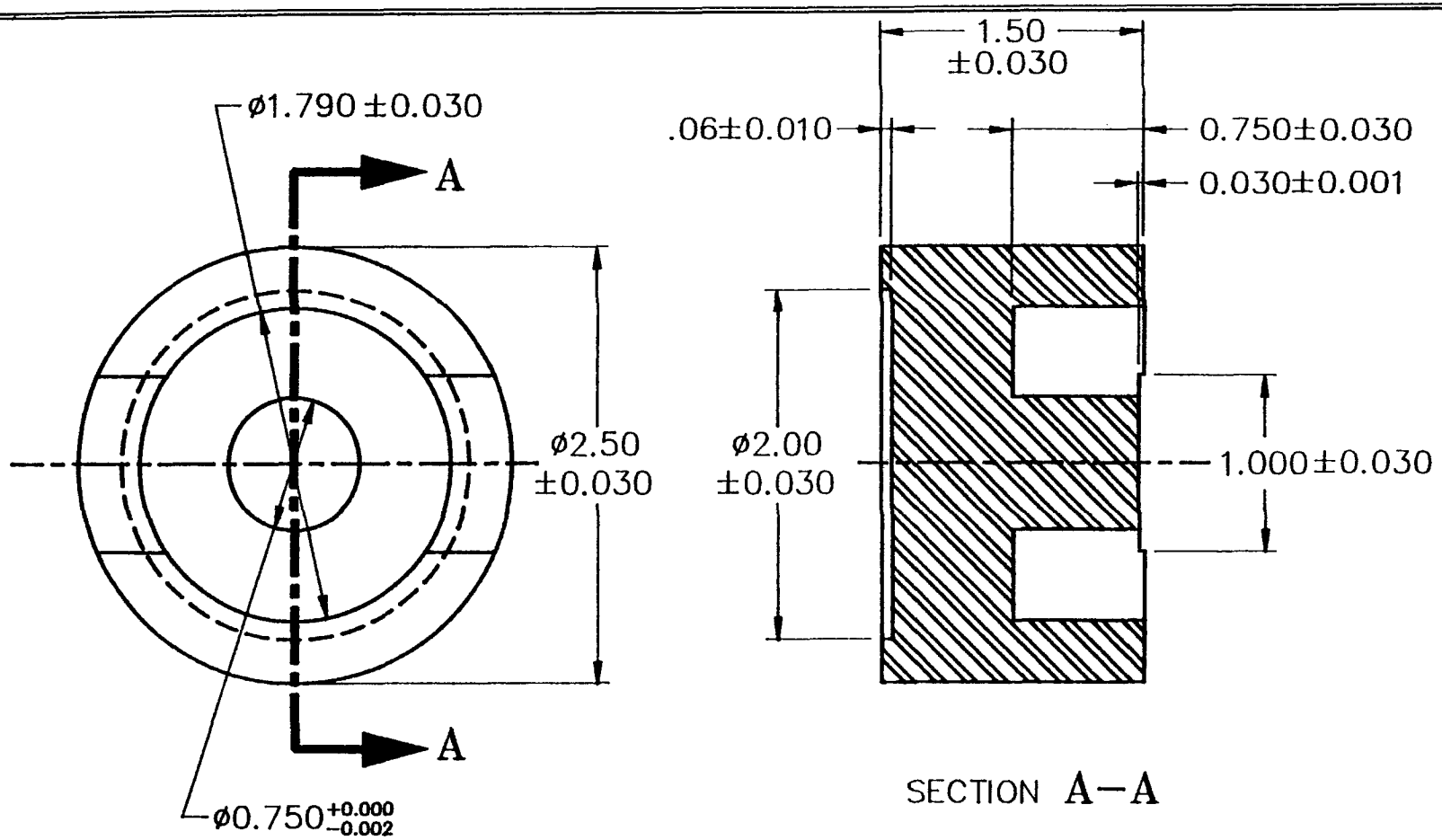
FIGURE 7-1



NOTES:

1. SURFACE B TO BE PARALLEL WITH SURFACE A WITHIN 0.002
2. DIAMETERS C AND D TO BE SQUARE WITH SURFACE A WITHIN 0.002
3. MATERIAL: STEEL, AISI 1018/1020
4. SCALE IS 2=1.
5. ALL DIMENSIONS ARE IN INCHES.

FIGURE 7-2



NOTES:

1. REMOVE SHARP EDGES AND DEBURR.
2. MATERIAL: STEEL, AISI 1018/1020
3. SCALE: 1=1
4. ALL DIMENSIONS IN INCHES.

FIGURE 7-3

PART 8

ILLUSTRATED PARTS BREAKDOWN

GENERAL

1. Refer to Figure 8-1 and 8-2 for the tachometer generator parts breakdown.

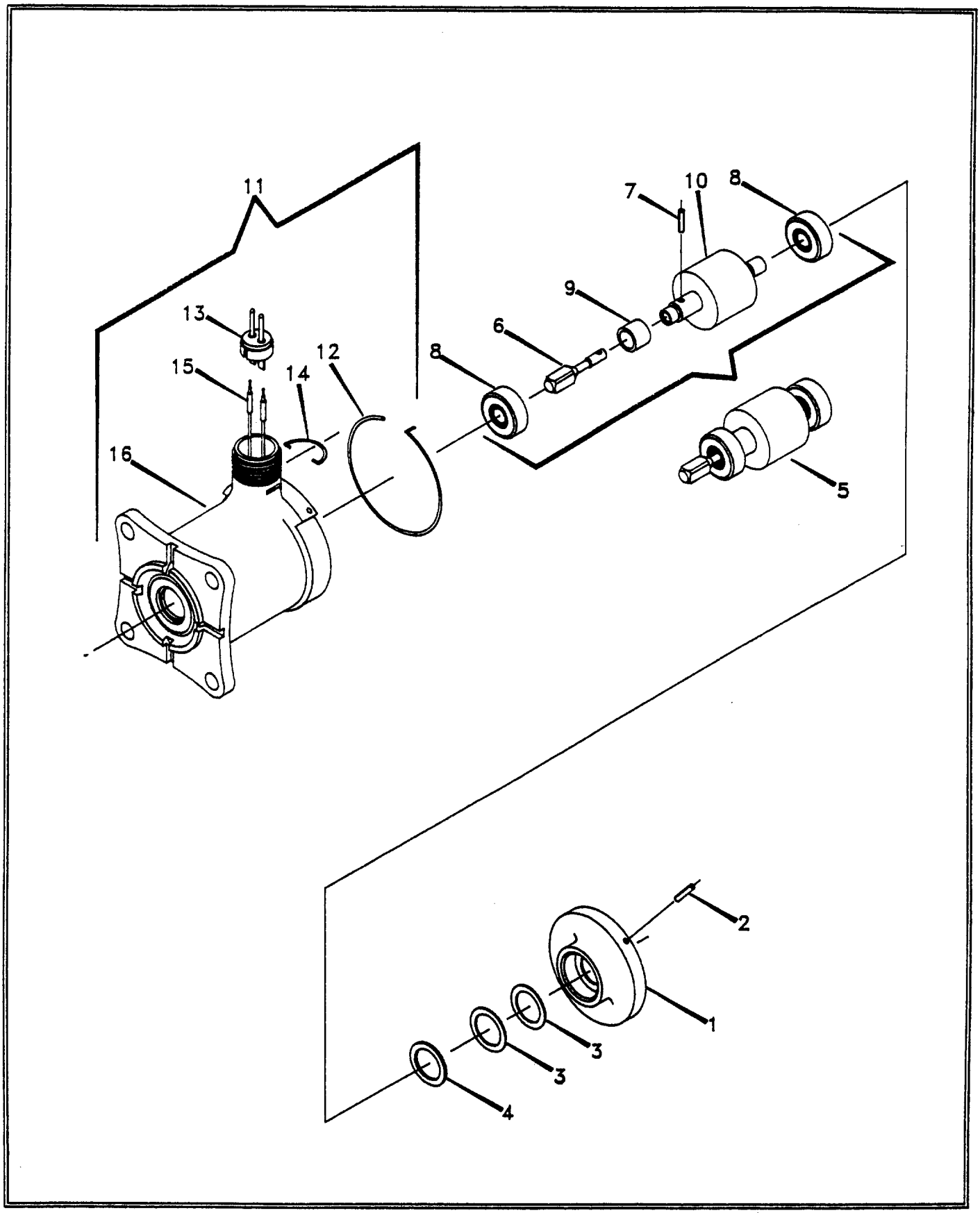


FIGURE 8-1

FIGURE and INDEX NUMBER	GROUP: Tachometer Generator MAJOR ASSEMBLY: General Assembly PART NUMBER	1 2 3 4 5 NOMENCLATURE	Units per Assy	Usage on Code
8 -1-	32005-007	Generator Assy, Tachometer	Ref	A
	32005-025	Generator Assy, Tachometer	Ref	B
	32005-030	Generator Assy, Tachometer	Ref	C
	32005-034	Generator Assy, Tachometer	Ref	D
	32005-037	Generator Assy, Tachometer	Ref	E
-1	850583-1	. Endbell	1	A,B,E
	880011	. Endbell	1	C,D
		(Attaching Parts)		
-2	849312-1	. Pin, Roll (79-018-078-0375)	3	
		----------*----------		
-3	849825-3	. Washer, Shim	A/R	
-4	811087-7	. Washer, Spring	1	
-5	710925-1	. Rotor Assembly	1	A,E
	710925-2	. Rotor Assembly	1	B
	780011	. Rotor Assembly	1	C,D
-6	810584-1	. . Shaft, Drive	1	A,C,D,E
	712939	. . Drive Shaft and Bushing Assembly	1	B
	814224-1	. . . Shaft Drive	1	B
	811101-2	. . . Bushing	1	B
		(Attaching Parts)		
-7	849312-1	. . Pin, Drive Shaft (79-018-078-0375)	1	
		----------*----------		
-8	849207-1	. . Bearing, Ball	2	
-9	810861-1	. . Sleeve	1	
-10	850590-1	. . Rotor (Alternate 780005)	1	A,B,E
	880009	. . Rotor (Alternate 780006)	2	C,D
-11	770606-1	. Stator, Housing Assy	1	A,B
	780003	. Stator, Housing Assy	1	C
	780007	. Stator, Housing Assy	1	D
	780009	. Stator, Housing Assy	1	E
-12	849315-1	. . Ring, Ground	1	
-13	810663-1	. . Connector, Insert	1	
		(Attaching Parts)		
-14	810634-1	. . Ring, Retaining	1	
		----------*----------		
-15	849823-1	. . Sleeve, Insulation	2	
-16		. . Stator, Housing	1	

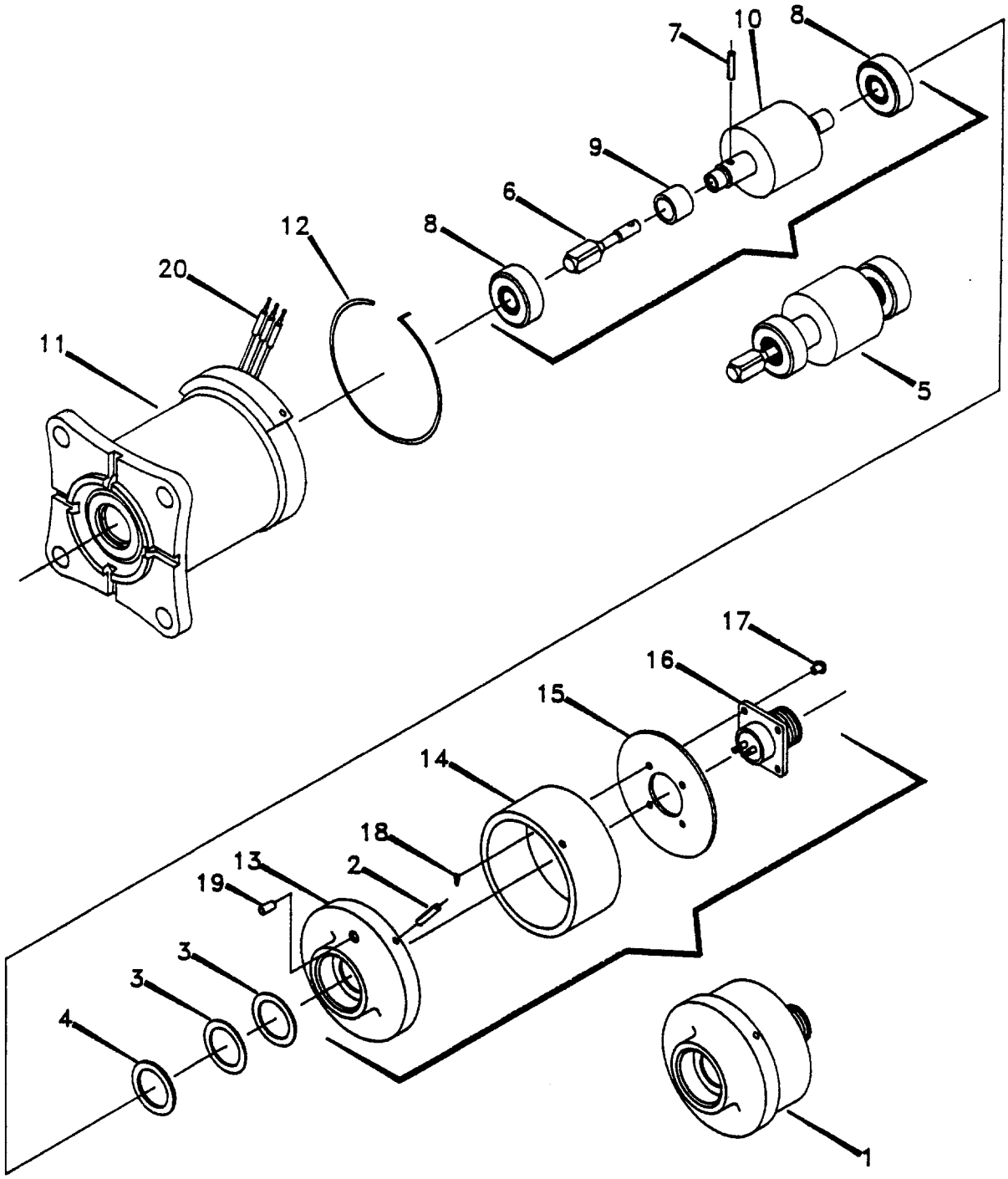


FIGURE 8-2

FIGURE and INDEX NUMBER	GROUP: Tachometer Generator MAJOR ASSEMBLY: General Assembly PART NUMBER	1 2 3 4 5 NOMENCLATURE	Units per Assy	USAGE ON CODE
8- 2-	32005-008	Generator Assy, Tachometer	REF	A
	32005-023	Generator Assy, Tachometer	REF	B
	32005-026	Generator Assy, Tachometer	REF	C
-1	711327-2	. Bracket Assy, Receptacle Mtg.	1	A
	712802	. Bracket Assy, Receptacle Mtg.	1	B
	712802-1	. Bracket Assy, Receptacle Mtg.	1	C
		(Attaching Parts)		
-2	849312-6	. Pin, Roll (79-018-078-0500)	3	
		----------*----------		
-3	849825-3	. Washer, Shim	A/R	
-4	811087-7	. Washer, Spring Tension	1	
-5	710925-1	. Rotor Assy	1	
-6	810584-1	. . Shaft, Drive	1	
		(Attaching Parts).		
-7	849312-1	. . Pin, Drive Shaft (79-018-078-0375)	1	
		----------*----------		
-8	849207-1	. . Bearing, Ball	2	
-9	810861-1	. . Sleeve	1	
-10	850590-1	. . Rotor	1	
-11	770589-1	. Stator, Housing Assy	1	
-12	849315-1	. Ring, Ground	1	
	711327-2	. Bracket Assy (See Item 1)	REF	A
	712802	. Bracket Assy (See Item 1)	REF	B
	712802-1	. Bracket Assy (See Item 1)	REF	C
-13	850629-1	. . End Bell	1	
-14	711325	. . Bracket, Receptacle Mtg.	1	A
	813970	. . Bracket, Receptacle Mtg.	1	B,C
-15	810782-2	. . Nameplate (Not req'd on later units)	1	
-16	PCO2H-8-2P	. . Connector, Receptacle (Bendix)	1	A
	PCO2E-8-2P	. . Connector, Receptacle (Bendix)	1	B
	PT02A-8-2P	. . Connector, Receptacle (Bendix)	1	C
		(Attaching Parts)		
-17	849313-2	. . Rivet	4	
		----------*----------		
-18	849311-1	. . Lug, Ground	1	
-19	849828-1	. . Sleeve, Insulation	1	
-20	849823-1	. Sleeve, Insulation	3	

PART 9

DATA DIFFERENCE SHEET

GENERAL

1. The following Data Difference Sheets describe the difference in repair/overhaul instructions for the models 32005-008, -023, -025, -026, -030, -034, and -037.

TACHOMETER GENERATOR 32005 SERIES	
DATA DIFFERENCE SHEET	MODEL 32005-008

DESCRIPTION AND OPERATION

1. Same as for Model 32005-007 except the connector is located at the back of the generator and overall length is 3.82 inches.

DISASSEMBLY

2. Same as for Model 32005-007 except after removing the three roll pins (2) remove the receptacle mounting bracket (14) and the RTV insulation from the rear of the endbell (13) before removing the endbell.

CLEANING

3. Same as for Model 32005-007.

INSPECTION AND REPAIR

4. - Same as for Model 32005-007 except generators with Serial Number 95292 or less have not been modified with the new ground ring (12); therefore if the stator housing assembly is defective, and replaced with a new housing, install a new ground ring (12). Leave the ground lug (18) in place but do not connect the stator lead to the lug.

5. If the stator housing assembly is not damaged, caution must be used to prevent the end bell from touching the stator housing when performing the dielectric test. Also, generators with Serial No. 95292 or less without the letter "R" stamped after the serial number must be modified per Service Bulletin #165 Rev. A.

6. Visually inspect receptacle mounting bracket assembly (1). If defective, replace along with insulation sleeves (20). Cut the stator leads close to the receptacle terminal pins.

TACHOMETER GENERATOR 32005 SERIES	
DATA DIFFERENCE SHEET	MODEL 32005-008

REASSEMBLY

7. Same as for Model 32005-007 except after rotating end bell assembly and drilling 3 new pin holes, remove receptacle mounting bracket (14), deburr holes and blow out loose metal chips.

TEST PROCEDURE

8. Same as for Model 32005-007.

SPECIAL TOOLS

9. Same as for Model 32005-007.

TACHOMETER GENERATOR 32005 SERIES	
DATA DIFFERENCE SHEET	MODEL 32005-023

DESCRIPTION AND OPERATION

1. Same as the model 32005-008 except overall length is 3.97 inches.

DISASSEMBLY

2. Same as the model 32005-008.

CLEANING

3. Same as the model 32005-008.

INSPECTION AND REPAIR

4. Same as the model 32005-008.

REASSEMBLY

5. Same as the model 32005-008.

TEST PROCEDURE

6. Same as the model 32005-008.

SPECIAL TOOLS

7. Same as the model 32005-008.

TACHOMETER GENERATOR 32005 SERIES	
DATA DIFFERENCE SHEET	MODEL 32005-025

DESCRIPTION AND OPERATION

1. The 32005-025 tachometer genrator is the same as the 32005-007 except that the tach generator uses a special drive shaft that has a nylon square driving surface This nylon bushing can be removed and replaced with a new piece when worn or cracked without disassembling the tach generator.

DISASSEMBLY

2. Same as the model 32005-007.

CLEANING

3. Same as the model 32005-007.

INSPECTION AND REPAIR

4. Same as the model 32005-007 except use the following procedure to replace damaged nylon Bushings:

a) Remove the old nylon square material. Clean any adhesive or bonding agent which may be adhered to the stainless steel drive, using any chlorothene or a cleaner which will not leave a residue when dry.

b) Apply Loctite Activator No. 7075 to the drive shaft, wait five minutes. Apply Loctite Adhesive No. 325 to the nylon bushing.

c) Slide new nylon bushing quill onto shaft.

d) Allow 48 hours for full cure.

TACHOMETER GENERATOR 32005 SERIES	
DATA DIFFERENCE SHEET	MODEL 32005-025

REASSEMBLY

5. Same as model 32005-007.

TEST PROCEDURE

6. Same as Model 32005-007.

SPECIAL TOOLS

7. Same as Model 32005-007.

TACHOMETER GENERATOR 32005 SERIES	
DATA DIFFERENCE SHEET	MODEL 32005-026

DESCRIPTION AND OPERATION

1. Same as the Model 32005-008 except overall length is 3.97 inches.

DISASSEMBLY

2. Same as the Model 32005-008.

CLEANING

3. Same as the Model 32005-008.

INSPECTION AND REPAIR

4. Same as the Model 32005-008.

REASSEMBLY

5. Same as the Model 32005-008.

TEST PROCEDURE

6. Same as the Model 32005-008.

SPECIAL TOOLS

7. Same as the Model 32005-008.

TACHOMETER GENERATOR 32005 SERIES	
DATA DIFFERENCE SHEET	MODEL 32005-030

DESCRIPTION AND OPERATION

1. The Model 32005-030 is the same as the model 32005-007 except for overall length is 2.06 inches and the connector is offset 15° from the centerline.

DISASSEMBLY

2. Same as the Model 32005-007.

CLEANING

3. Same as the Model 32005-007.

INSPECTION AND REPAIR

4. Same as the Model 32005-007.

REASSEMBLY

5. Same as the Model 32005-007.

TEST PROCEDURE

6. Same as the Model 32005-007.

SPECIAL TOOLS

7. Same as the Model 32005-007.

TACHOMETER GENERATOR 32005 SERIES	
DATA DIFFERENCE SHEET	MODEL 32005-034

DESCRIPTION AND OPERATION

1. Same as the Model 32005-030 except the connector is in line with the centerline.

DISASSEMBLY

2. Same as the Model 32005-030.

CLEANING

3. Same as the Model 32005-030.

INSPECTION AND REPAIR

4. Same as the Model 32005-030.

TEST PROCEDURE

5. Same as the Model 32005-030.

SPECIAL TOOLS

6. Same as the Model 32005-030.

TACHOMETER GENERATOR 32005 SERIES	
DATA DIFFERENCE SHEET	MODEL 32005-037

DESCRIPTION AND OPERATION

1. Same as the Model 32005-007.

DISASSEMBLY

2. Same as the Model 32005-007.

CLEANING

3. Same as the Model 32005-007.

INSPECTION AND REPAIR

4. Same as the Model 32005-007.

REASSEMBLY

5. Same as the Model 32005-007.

TEST PROCEDURE

6. Same as the Model 32005-007.

SPECIAL TOOLS

7. Same as the Model 32005-007.

THE BENDIX CORPORATION – FLIGHT AND ENGINE INSTRUMENTS DIVISION

OVERHAUL INSTRUCTIONS WITH PARTS BREAKDOWN

7749-121A5-1 and 7749-122A5-1

NEW PART NO. 3567749 - 7103

1. Description and Operation.

The 7749-121A5-1 and 7749-122A5-1 transmitters are hermetically sealed, bellows type instruments. They are used in conjunction with remotely located indicators to provide a visual indication of engine oil pressure. The instruments are designed to be mounted directly on the engine.

The shaft of the Autosyn in the transmitter is linked, by means of a rocker arm and a sector assembly, to the bellows assembly in such a manner that a rotary displacement of the shaft will be produced when pressure variations cause the bellows to deflect.

The Autosyns of the transmitters are electrically connected to remotely located indicators which translate the bellows deflection into visual indications of the pressure at the point of measurement.

Table 1. Leading Particulars

Pressure Range	
7749-121A5-1	0 to 65 psi
7749-122A5-1	0 to 125 psi
Temperature Range	-54°C to +165°C (operating) -54°C to +232°C (exposure)
Power Requirements	26VAC 400 Hz
Accuracy	Approx. 1% of full scale
Vibration	20g to 2000 Hz

2. Disassembly

A. Disassemble the transmitter according to the following procedure: (Refer to figure 1.)

(1) Remove screw (1) and identification plate (2).

(2) Cut off evacuation tube in end cover assembly (6) just below point where it is pinched off. With electrical receptacle end of transmitter held down, apply just enough air pressure to evacuation tube to force silicon fluid from transmitter when pressure is released.

(3) Mount transmitter in a lathe and machine away weld on both ends of case. Place transmitter, receptacle end down, in a suitable container to allow remaining fluid to drain from case.

(4) Remove mechanism from transmitter case (5).

(5) Disconnect leads from receptacle in end cover assembly (6).

(6) Capillary tubing from vent bellows assembly (45) is connected to

capillary tubing from end cover assembly (6) by a silver brazed joint. Shield from mechanism as necessary and, using a torch, melt silver braze to separate ends of tubing.

(7) Separate capillary tubing from pressure bellows assembly (48) in the same manner as described in step (6).

(8) Remove slotted head screw (3) and eccentric bushing (4) from end cover assembly (6).

(9) Remove spacer posts (8) and lock washers (9).

(10) Remove screws (10), lock washers (11) and special washers (12) to free mechanism assembly (7).

(11) Remove screws (13), lock washers (14), washers (15), spring clamps (16) and washers (17).

(12) Loosen screws (19 and 21) and slide bearings (18 and 20) away from pivots of sector assembly (22).

(13) Remove screws (25) and lock washers (26) and remove synchro retainer (24).

(14) Remove screws (28), lock washers (29) and flat washers (30).

NOTE: Do not remove nut (32) and spur pinion (33) unless necessary to replace a damaged or worn part.

(15) Remove tubing (35) from leads of synchro (34).

(16) Remove support posts (36).

(17) Remove screws (38) and lock washers (39) from torsion bar clamps (37).

(18) Remove bearing holder (40), bearings (41) and bearing spacer (42) from rocker arm assembly (49).

(19) Remove hex nut (43) and overpressure screw (44) from pressure bellows (48).

(20) Remove screws (46) and lock washers (47) to free vent bellows assembly (45) and pressure bellows assembly (48).

3. Cleaning

A. Cleaning parts of transmitter according to the following instructions:

WARNING: USE SOLVENT IN A WELL VENTILATED AREA. DO NOT INHALE SOLVENT

VAPORS OR ALLOW SOLVENT TO COME IN CONTACT WITH THE SKIN. KEEP SOLVENT AWAY FROM OPEN FLAME.

CAUTION: DO NOT IMMERSE SYNCHRO ASSEMBLY (34) IN SOLVENT OR ALLOW SOLVENT TO ENTER INTERIOR OF SYNCHRO.

(1) Clean all metal parts with naptha or an approved solvent.

(2) Clean exterior of synchro assembly (34) with a cloth moistened in naptha. Make certain that leads are clean.

(3) Clean teeth of sector assembly (22) and intermeshing teeth of spur pinion (33) with a stiff hair brush or glass fiber brush. Make certain that teeth are free from burrs and foreign matter.

4. Inspection/Check.

A. Inspect transmitter assembly according to the following instructions:

(1) Inspect all parts for visible wear, damage or defects.

(2) Inspect washers for scratches, scoring or damage.

(3) Inspect threads for stripping or burrs.

(4) Inspect end cover assembly (6) for broken, bent or loose terminal pins, damaged or loose insulation and defective threads.

(5) Inspect synchro assembly (34) for crimped, broken or worn leads at point of entry into synchro housing.

(6) Inspect bellows assemblies (45 and 48) for dents, cracks or deformed bellows.

5. Repair.

No repair of parts is recommended. Replace any parts that inspection discloses to be defective.

6. Assembly.

A. Assemble the transmitter according to the following instructions:

(1) Braze tubing from pressure bellows assembly (48) to mounting base (50). Wash to remove flux.

(2) Assemble bellows assemblies (45 and 48) to rocker arm assembly (49) using screws (46) and lock washers (47).

(3) Bend capillary tubing to align torsion bar of rocker arm assembly (49) with "V" grooves in mounting base (50).

(4) Place bearings (41) and bearing spacer (42) in bearing holder (40) and position on end of torsion bar.

(5) Fasten torsion bar in place using torsion bear clamps (37), lock washers (39) and screws (38). Do not tighten screws. Pull clamps down evenly.

(6) Install four support posts (36).

CAUTION: DO NOT ROTATE SYNCHRO (34) IN COUNTERCLOCKWISE DIRECTION, NOR IN CLOCKWISE DIRECTION MORE THAN 1¼ TURNS FROM REST POSITION. SYNCHRO SPRING MAY BE DAMAGED.

(7) If spur pinion (33) and nut (32) were removed, reassemble using a sealant, MS22473, Grade E, to lock nut in place.

(8) Assemble synchro (34) eccentric ring (27) and synchro retainer (24) using screws (25) and lock washers (24).

(9) Clamp assembled synchro and eccentric ring to supporting plate (31) with screws (28), lock washers (29) and flat washers (30).

(10) Position sector assembly (22) in null adjust arm (23). Tighten socket head screw (19) to hold bearing (19) in place. Adjust bearing (20) for end play of 0.002 to 0.004 inch. Tighten socket head screw (21).

(11) Fasten null adjust arm assembly to supporting plate (31) using screws (13), lock washers (14), washers (15), spring clamps (16) and block clamps (17). Adjust mesh for minimum friction. Backlash must be less than 2.5^{o} maximum synchro rotation.

(12) Bake assembly completed to this point at 450^{o} for 2 hours.

(13) Position mechanism assembly (7) on supporting posts (36) and assemble spacer posts (8) and lock washers (9). Pin on end of rocker arm assembly (49) must be positioned between pins of sector assembly (22).

(14) Hold transmitter assembly so that it is viewed from receptacle end. Position pin of rocker arm assembly (49) at left side of slot in supporting plate (31). With rocker arm assembly in this position securely tighten screws (38) to secure torsion bar clamps (37).

(15) Silver braze tube from vent bellows assembly (45) to tube in end cover assembly (6).

(16) Adjust pin assembly on rocker arm assembly (49) for minimum possible clearance that will not cause excess friction. Clearance is to be 0.002 inch maximum.

(17) Connect mechanism to synchro servoed test indicator 13647-3-A with test cable QB72260-1. Attach pressure fitting to dead weight tester type 460.

(18) Set and lock range adjustment at an initial setting.

(19) Rotate the synchro to a point where low end of range is 20^{o}.

(20) Apply rated pressure to pressure fitting and check indicator reading. (See table 2. Calibration data) If adjustment is required, move range pin out to increase range and in to decrease range.

(21) Return pressure to zero psi and check. Synchro and/or range adjustment may require slight additional adjustment to obtain the 20^{o} to 340^{o} range.

(22) Check all points of calibration indicated in table 2. If necessary, reposition rocker arm slightly to obtain a linear calibration. For a small amount of movement use shim (12) or for larger amount move torsion bar of rocker arm assembly (49). Move rocker arm assembly "downscale" to raise midscale readings and "upscale" to lower midscale readings.

(23) Set overpressure stop (screw 44) at 360^{o} with 10% to 20% overpressure applied and lock in place with hex nut (43).

(24) Bake unit at 450^{o} for 4 hours. At end of period apply rated pressure to unit and check for proper operation.

(25) Assemble tubing (35) over synchro wires and solder synchro wires to receptacle terminals as shown in table 4. wiring data.

(26) Slide case (5) carefully over mechanism from mounting base (50) end.

NOTE: Be sure that null adjust mechanism is engaged and wiring is clear of moving components.

(27) Tack weld case (5) to end cover (6) in 3 or 4 spots and adjust mechanism so that zero travel of 20^{o} in both directions can be obtained.

(28) Tack weld mounting base (50) to cover in 3 or 4 spots.

(29) Check calibration of transmitter for proper function.

(30) If all functions are normal, complete welding operations using a Heliarc Welder or equivalent.

(31) After welding recheck zero travel for $+7^{o}$ minimum travel.

(32) Evacuate transmitter to 500 microns pressure or less and backfill.

with silicone fluid until transmitter weighs 658 grams. This is an addition of approximately 73 grams of silicone fluid.

NOTE: Silicone fluid consist of a mixture of equal parts of Dow Corning type 330 fluid with a viscosity of 50 centistokes at 25°C and Dow Corning type 510 fluid with a viscosity of 1000 centistokes at 25°C. This mixture has a viscosity of approximately 200 centistokes at 25°C and will withstand temperature extremes to which transmitter may be exposed.

(33) Leak check transmitter using Helium Leak Detector Model 24-120A. Leak rate shall not exceed 0.1 micron cubic foot per hour.

(34) Clean transmitter to remove oil, welding scale and any foreign matter.

(35) Attach identification plate (1) using screws (2).

7. Fits and Clearances.

All applicable fits and clearances are called out in assembly procedures.

8. Testing.

A. Unless otherwise specified for an individual test testing is to be done at atmospheric conditions (approximately 29.92 inches Hg.) and room temperature (approximately 25°C (77°F)).

B. Transmitter with long axis horizontal and letters VENT in upright position, shall be tested using Synchro Servoed Test Indicator 13647-3-A or an equivalent.

C. The indicator and transmitter shall be connected to a 26 volt 400 Hz source and shall be vibrated during all tests unless otherwise specified.

D. Observing preceding conditions perform following tests on transmitter.

(1) Dielectric Strength. Apply 250 volts at a commercial frequency between any pin of the receptacle and ground. There shall be no breakdown of insulation.

(2) Scale Error. Test transmitter for scale errors at test points specified in table 2. calibration data; first with pressure increasing then with pressure decreasing. With pressure increasing, pressure shall be brought up to, but shall not exceed, pressure specified to given desired reading and with pressure decreasing, pressure shall be brought down to, but shall not fall below, pressure specified to give desired reading. Errors at test points shall not exceed tolerance specified.

(3) Friction. Test Transmitter for friction at every test point spec-

ified in table 2. calibration data. Increase pressure to bring pointer approximately to desired reading. Take two readings, first before transmitter is vibrated or tapped and second after. Difference between two readings shall not exceed tolerance given.

(4) Position Error. Subject transmitter to pressure specified in table 2. Reading of indicator, taken while transmitter is held at any desired position, shall not differ from readings taken while transmitter is held in any other position by more than tolerance given in table 2.

(5) Leak Test. Test transmitter for leakage using helium leak detector model 24-120A. Leak rate shall not exceed 0.1 micron-cubic foot per hour at a pressure differential of approximately one atmosphere.

Table 2. Calibration Data

7749-121A5-1			7749-122A5-1		
Test Pressure PSI	Indicator Degrees	Tolerance Degrees ±	Test Pressure PSI	Indicator Degrees	Tolerance Degrees ±
0	20.0	8.3	0	20.0	8.3
10	69.2	8.3	20	71.2	8.3
20	118.5	5.8	40	122.4	5.8
30	167.7	5.8	60	173.6	5.8
40	216.9	3.4	80	224.8	3.4
50	266.2	1.4	100	276.0	1.4
60	315.4	3.4	120	327.2	3.4
65	340.0	4.4	125	340.0	4.4
OP Stop	360.0	10.0			
Friction Error		1.6°	Friction Error		1.6°
Position Error	At 30 PSI	1.6°	Position Error	At 50 PSI	1.6°

9. Trouble Shooting.

Table 3 contains a list of possible defects that may become evident in the indicator. It lists possible causes and steps to correct them.

Table 3. Trouble Shooting

Trouble	Probabe Cause	Remedial Steps
No indication on indicator when current is applied.	Open circuit.	Check for loose connection at solder joints or broken wire.
Readings are out of tolerance.	Gear friction.	Check mesh of pinion and sector teeth.
	Improper zero setting.	Repeat calibration procedure.
Transmitter fails dielectric strength test.	Faulty synchro or connector pins shorted.	Check connector for shorts. Test synchro windings at 500 volts with test set 13700-1-C.

Table 4. Wiring Data

Wire Color		Receptacle Pin
Stator	Black	A
	Yellow	C
	Blue	D
Rotor	Black/White	A
	Red/White	B

10. Storage Instructions.

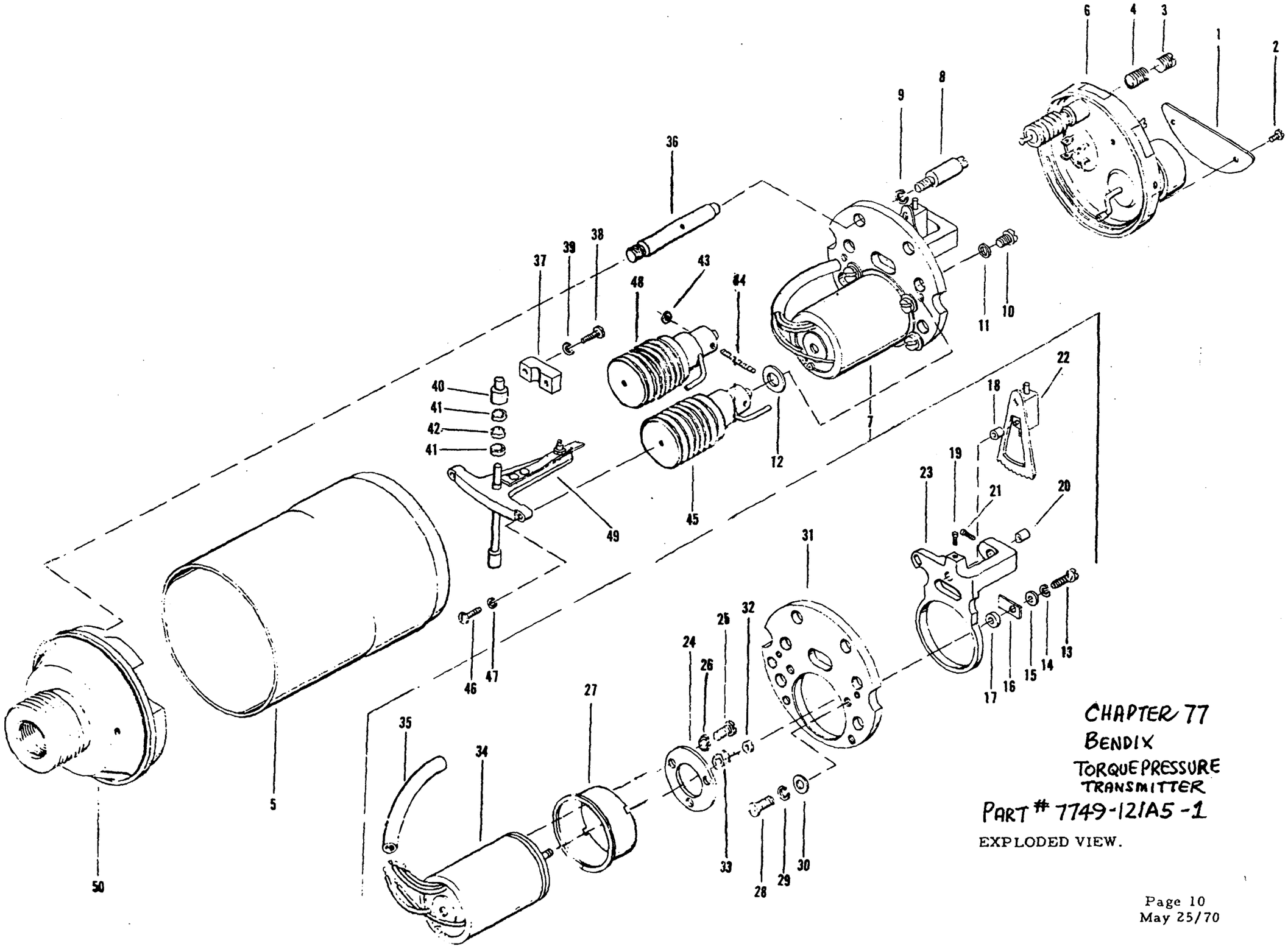
The transmitter should be stored in a suitable cardboard box of an appropriate size. Cushion the transmitter in the box with a commercial dunnage such as Kimpack.

11. Special Tools, Fixtures and Equipment.

The following listing contains the special test equipment necessary to overhaul and test the transmitter. If the listed equipment is not available a suitable equivalent may be used. The tools listed are manufactured by The Bendix Corporation unless otherwise indicated.

Table 5. Test Equipment

Part No.	Nomenclature	Application
QB72260-1	Test Cable	Used to connect transmittor to test indicator 13647-3-A.
13647-3-A	Synchro Servoed Test Indicator	Used in assembly to set mechanism calibration. Used to test calibration.
13700-1-C	Insulation Breakdown Test Set	Used to test for insulation failure and shorted wires.
Model 24-12A	Helium Leak Detector Consolidated Engineering Pasadena, Calif.	Used to test transmitter for case leakage.
Model 25 Hyper Vac	Vacuum Pump Central Scientific Co. Chicago, Ill.	Used to evacuate transmitter.
Type 460	Dead Weight Tester Amthor Testing Instrument Co. Brooklyn, N.Y.	Used with 13647-3-A to test calibration.



CHAPTER 77
BENDIX
TORQUE PRESSURE
TRANSMITTER
PART # 7749-121A5-1

EXPLODED VIEW.

12. Illustrated Parts List.

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	UNITS PER ASSY.
1 -	7749-121A5-1	Transmitter Assembly	
1 -	7749-122A5-1	Transmitter Assembly	
- 1	1490762	. Plate, Identification	1
		(Attaching Parts)	
- 2	1489250-2-2	. Screw, Self Tapping	2
		----*----	
- 3	1494095	. Screw, Slotted Head	1
- 4	1482368-1	. Brushing, Eccentric	1
- 5	1496262-0001	. Case, Transmitter	1
- 6	1496285-0001	. End Cover Assembly	1
- 7	1496281-0001	. Mechanism Assembly	1
		(Attaching Parts)	
- 8	1498269-0001	. Post, Spacer	4
- 9	3050-04-21	. Washer, Lock	4
- 10	3002060-5120	. Screw	2
- 11	3050-06-21	. Washer, Lock	2
- 12	1489213-3	. Washer, Special	AR
		----*----	
- 13	3016021-0120	. . Screw	2
- 14	3050-02-21	. . Washer, Lock	2
- 15	3055-094-4-23	. . Washer	2
- 16	1482393-1	. . Spring Clamp	2
- 17	1482392-1	. . Block Clamp	2
- 18	1496248-0002	. . Holder and Bearing Assembly	1
		(Attaching Parts)	
- 19	3017030-6131	. . Socket Head Screw	2
		----*----	
- 20	1496248-0001	. . Holder and Bearing Assembly	1
		(Attaching Parts)	
- 21	3017030-6131	. . Socket Head Screw	2
		----*----	
- 22	1496291-0001	. . Sector Assembly	1
- 23	2270462-0001	. . Null Adjust Arm	1
- 24	1496245-0001	. . Retainer, Synchro	1
		(Attaching Parts)	
- 25	3008020-4120	. . Screw	3
- 26	3050-02-21	. . Washer, Lock	3
		----*----	
- 27	1496245-0001	. . Ring, Eccentric	1
		(Attaching Parts)	
- 28	3016030-5120	. . Screw	4

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	UNITS PER ASSY.
- 29	3050-03-21	. . Washer, Lock	4
- 30	3055-109-4-23	. . Washer, Flat	4
- 31	1496263-0001	. . Plate, Supporting	1
- 32	1219366-1	. . Nut, Special	1
- 33	1215512-0001	. . Pinion, Spur	1
- 34	1497919-0001	. . Synchro	1
- 35	1489330-1000	. . Tubing, Teflon	1
- 36	1496244-0001	. Post, Support	4
- 37	1492421-0005	. Clamp, Torsion Bar	2
		(Attaching Parts)	
- 38	3015-0307-120	. Screw	4
- 39	3050-03-21	. Washer, Lock	4
		----*----	
- 40	1498558-0001	. Holder, Bearing	1
- 41	2270291-0001	. Bearing, Ball	2
- 42	1498556-0001	. Spacer, Bearing	1
- 43	3063-02-20	. Nut, Hex	1
- 44	3018-0224-213	. Screw, Overpressure	1
- 45	1498353-0001	. Bellows Assembly (Vent)	1
		(Attaching Parts)	
- 46	3016-0208-120	. Screw	1
- 47	3050-02-21	. Washer, Locking	1
		----*----	
- 48	1498351-0001	. Bellows Assembly (Pressure)	1
		(Attaching Parts)	
- 46	3016-0208-120	. Screw	1
- 47	3050-02-21	. Washer, Locking	1
		----*----	
- 49	1498555-0004	. Rocker Arm Assembly	1
- 50	1496265-0001	. Base, Mounting	1

PUBLICATION NO. MDSP 66-12-6

OVERHAUL

WITH

PARTS BREAKDOWN

SINGLE SYNCHRO INDICATORS

25122- SERIES

TYPE NUMBERS

NEW PART NO. 3571212-0003

THE BENDIX CORPORATION

FLIGHT & ENGINE INSTRUMENTS DIVISION

SOUTH MONTROSE, PENNSYLVANIA

18843

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SINGLE SYNCHRO INDICATORS

25122- SERIES TYPE NUMBERS

DESCRIPTION AND OPERATION

Bendix indicators identified by type numbers in the 25122- series are precision instruments designed to provide visual readings of any function that can be monitored by a mating synchro type of transmitter.

The indicators are of simplified construction to provide units capable of extended periods of maintenance free service. They can be readily disassembled, however, whenever maintenance is required.

The indicator incorporates a dial mounted on the forward end of an Autosyn synchro assembly.

Dial readings are indicated by a pointer that transverses the dial. The hub of the pointer extends through the dial and is affixed on the synchro shaft; this constitutes to sole moving component.

These components and their mounting hardware are hermetically sealed in a two-inch clamp-on case.

LEADING PARTICULARS

The function indicated, the range and the dial spread of the model of indicators covered by this manual are listed in Table I. The following data applies to all units covered by the manual.

Operating Voltage	26 volts ac
Rated Frequency	400 cps
Case Size	2-inch dia.
Temperature Range	-54 to +71°C

TABLE I

LEADING PARTICULARS

Indicator Type Number	Function Indicated	Range	Dial Spread (Degrees)
25122-A1A-1-A2	Fuel Pressure	0-25 psi	320
25122-A2C-1-A1	Oil Pressure	0-200 psi	320
25122-A2J-1-A2	Torque Pressure	0-200 psig	320
25122-A10B-1-A1	Oil Pressure	0-300 psi	320
25122-A15A-1-A2	Pressure	0-50 psi	320
25122-A15H-2-A2	Pressure	0-50 psi	320
25122-A17F-2-A3	Pressure	0-500 psig	320
25122-A23E-2-A2	Pneumatic Pressure	0-5000 psi	320
25122-A23F-2-A2	HIDR Pressure	0-350 kg/cm^2	318.67
25122-A37C-1-A1	Fuel Pressure	0-1000 psi	320
25122-A27E-2-A3	Pressure	0-1000 psig	320
25122-A28C-1-A2	Clutch Pressure	0-1500 psi	320
25122-A29B-2-A2	Pressure	0-2000 psi	320
25122-A30D-1-A2	Fuel Pressure	0-100 psi	320
25122-A30E-1-A1	Oil Pressure	0-100 psi	320
25122-A37A-1-A1	Hydraulic Pressure	0-4000 psi	320
25122-A37B-1-A1	Pressure	0-4000 psi	320
25122-A37M-2-A2	Hydraulic Pressure	0-4000 psi	320
25122-A40A-1-A3	Oil Pressure	0-150 psi	320
25122-A56A-1-A2	Pressure	0-5 lbs. sq. in.	165
25122-A73A-2-A1	Pressure	0-5 lbs. sq. in.	165
25122-B3B-2-A2	Fuel Flow	100-1500 pph	278
25122-B3C-4-A2	Fuel Flow	0-1400 lb. hr.	260.5
25122-B4A-1-A1	Fuel Flow	100-2000 pph	285
25122-B5D-2-A2	Fuel Flow	50-350	220.5
25122-B7A-1-A1	Fuel Flow	300-3000 pph	278.25
25122-B16A-1-A1	Fuel Flow	0-12000 pph	330
25122-B16E-1-A2	Fuel Flow	0-12000 pph	330
25122-B22C-1-A1	Fuel Flow	0-12000 pph	330
25122-B25A-2-A2	Fuel Flow	50-500 lbs. per hr.	240.7
25122-B25B-2-A2	Fuel Flow	50-500 lbs. per hr.	240.7
25122-B54A-2-A2	Fuel Flow	10-350 pph	263.06
25122-B57A-1-A2	Fuel Flow	500-15000 pph	314
25122-C11A-1-A2	Rev. Per. Min.	500-4000 rpm	330
25122-C72A-17-A3	Gross Weight	60000-140000 lb.	320
25122-C73A-18-A3	Fuel Quantity	0-19000 lb.	266
25122-C76A-2-A3	Shaft Horse Power	0-600 shp	292

DISASSEMBLY

NOTE

Two basic types of construction are encountered in the 25122- series indicators. They can be readily distinguished by the dial. Early model indicators incorporate a flat metal dial secured in position by two dial screws. Refer to figure 1. Later model units incorporate a preformed nylon dial secured in position with locking cement and requiring no dial screws. Refer to figure 2. Determine the type of unit under work, refer to the corresponding exploded view, and observe the applicable procedures.

A. Remove shipping cap (1), retaining ring (2), and identification plate (3).

B. Attach a mating connector (MS3106-14S-2S or MS3108-14S-2S) to electrical receptacle (6).

C. Use a torch to heat the soldered bond that secures the end cover assembly (5) in the rear end of the case assembly (10). When the solder has melted sufficiently that the plating will not be stripped from the end cover (7) or the case (13), use the connector to pull the end cover free.

D. Unsolder and remove the closed end eyelet (4), but do not disassemble the end cover or case assemblies unless necessary to replace a defective part.

E. If it is necessary to separate the components of the case assembly (10), place it on a hot plate or in an induction coil and heat until the solder flows sufficiently that the case (13) can be detached from the bezel (11). Remove excess solder from the components. If necessary, separate the receptacle assembly (6) from the end cover (7) in a similar manner or use a torch to melt the solder bond.

F. Carefully withdraw the mechanism assembly straight out from the case assembly (10).

G. Unsolder and disconnect the leads from the terminal pins of the receptacle (6). Remove excess solder from pins. Remove rear spacer (8).

H. Remove the dial spacer (9) from the case assembly (10).

I. Use the pointer remover 310A to lift the pointer (14) straight away from the dial

NOTE

Steps J and K apply to units with flat metal dials and dial screws. (Refer to figure 1.)

J. Dial screws (15) are secured with locking cement. Break the seal to remove the screws. Remove dial (16).

NOTE

Step L refers to units having preformed nylon dials requiring no dial screws. (Refer to figure 2.)

L. Do not remove dial (15) from synchro (16) unless it is necessary to replace a defective part. Dial is secured to synchro with Pliobond cement. Break the seal to separate the components.

CLEANING

A. Clean all parts except as mentioned in cleaning solvent. Use a soft brush; dry parts thoroughly. Keep parts free from dust particles until reassembled.

WARNING

Use solvent in a well ventilated area. Do not inhale solvent vapors or allow solvent to come in contact with the skin. Keep solvent away from open flame. Do not conduct insulation breakdown test in the immediate vicinity of open solvent.

CAUTION

Do not immerse synchro assembly in solvent or allow solvent to enter interior of synchro.

B. Clean exterior portions of synchro including leads with a lint free cloth dampened with solvent.

C. Be certain that any deposits of grease and other foreign matter are removed from the terminal pins, insulation, and threads of the receptacle assembly.

D. Clean pointer assembly with a soft eraser such as art gum.

C. Wash glass with pure soap and water. Rinse, dry, and keep free from finger marks until reassembled.

E. Carefully clean dial with a lint free cloth dampened in soap and water; avoid damage to dial markings. Rinse, dry, and keep free from finger marks until reassembled.

INSPECTION

A. Visually inspect all metallic parts, as applicable, for breaks, cracks, nicks, scratches, scoring, stripped or crossed threads, corrosion, distortion, worn plating, pitting, gouging, or other obvious defects.

B. Inspect receptacle for bent, broken, or loosened terminal pins, for cracked or loosened insulation and for damaged threads.

C. Inspect glass for chips, cracks, and discoloration.

D. Inspect dial and pointer for damaged or discolored paint.

E. Inspect leads of synchro assembly, especially at points of entry into synchro, for crimps, breaks, and damaged insulation.

TESTING OF SUB-ASSEMBLIES

A. Perform following tests.

B. Synchro assembly - insulation breakdown test. Using insulation breakdown test set 13700-1-C, apply a potential of 500 volts rms at a commercial frequency for a minimum period of five seconds across a rotor lead and ground (shaft) and then across a stator lead and ground (housing). There must be no electrical breakdown of insulation. Failure of the test requires replacement of the defective synchro.

C. Leak test - case assembly and end cover assembly. Use helium leak detector, Model 24-120A, to test these assemblies for leaks. Evacuate interior of each assembly to approximately 50 microns absolute pressure. Leak rate must not exceed 0.1 micron-cubic-foot per hour. If the leak rate is excessive, repair by reworking the faulty soldered joint or by replacing the defective component. If a helium leak detector is not available, perform the following immersion test of these assemblies. Install the assembly in the clamping fixture of hermetic sealing stand 13693-1-B or other suitable device so openings are sealed. Connect the outlet of the clamping fixture to a source of air. Apply a pressure of 15 psi and immerse the part in water. Any bubbles emanating from the interior of the assembly are evidence of leakage. Correct as required.

REPAIR OR REPLACEMENT

A. Repair of parts is not recommended. Replace any component disclosed by inspection or testing to be defective.

LUBRICATION

A. None required.

ASSEMBLY

A. If the components of the case assembly (10) were separated, install the case (13) and glass (12) in position in the bezel (11). Place a ring of solder having a melting range of 375 to 416°F (180 to 213°C) under the glass. Place the assembled components on a hot plate or in an induction coil and heat to effect a proper solder bond. If necessary, add additional solder. Do not permit excess solder to remain on rear surface of bezel or outer circumference of case. Allow the assembly to cool undisturbed. Perform leak test of step C - Testing of Sub-Assemblies.

B. If the components of the end cover assembly (5) were separated, solder the receptacle into the end cover in a manner similar to that described in step A. (It is not necessary to maintain any specified angular relationship between the polarizing key of the receptacle and the opening for the closed end eyelet in the end cover.) Perform leak test of step C - Testing of Sub-Assemblies.

NOTE

The procedures of steps C, D, and E apply to units with a flat metal dial and dial screws. (Refer to figure 1.)

C. Secure dial plate (18) to synchro assembly (19) with two attaching screws (17).

D. Pass synchro leads back through rear spacer (8); attach and solder leads to terminal pins of connector (6) in accord with Table II, Wiring Data. Clean joints to remove flux.

E. Secure dial (16) to dial plate with two dial screws (15).

NOTE

The procedure of steps F and G applies to units with a preformed nylon dial with no dial screws. (Refer to figure 2.)

F. Sparingly apply a coat of Pliobond 20 or equivalent cement around inside of rear extension of dial (15). Insert synchro assembly (16). Pliobond cement is manufactured by the Goodyear Rubber Products Company, 144 Mulberry Street, Newark, New Jersey.

G. Pass synchro leads back through rear spacer (8); attach and solder leads to terminal pins of connector (6) in conformance with the Wiring Data of Table II. Clean joints to remove flux.

CALIBRATION

A. Attach the mechanism to the precision transmitter 13695-2-A with test cable QB72260-1. Refer to the calibration tables and locate the applicable tabulation. Impose electrical zero. Tap the synchro to overcome the effects of friction so the rotor will assume the true EZ position. Press the pointer on the synchro shaft so that the tip is centered on the electrical zero (EZ) reference mark on the dial.

B. Perform the scale error, friction error, and position error tests outlined in steps D and E of the section - Test Procedures. Minor changes in the calibration of units with a flat dial can be made by slightly shifting the dial. When proper calibration is obtained, back out the dial screws, one at a time, and sparingly apply clear glyptol to the threads, then reinsert the screws. Cure the glyptol by baking at 120°F for two hours or air dry at room temperature for four hours.

FINAL ASSEMBLY

A. When the tests of step B of Calibration have been concluded within tolerance, insert the dial spacer (9) into the case assembly (10). Check the dial and dial screws (if used) to be sure that the paint is not marred. Install the mechanism into the case assembly.

B. Align the polarizing key of the receptacle with the top center line of the dial. Maintain these relative positions and insert the end cover assembly into the case.

C. Apply an axial force of 8 to 12 pounds to end cover to press it into proper position. Maintain the pressure and solder the end cover to the case to effect a hermetic seal.

D. Perform the leak test of step C of Test Procedures to ascertain if proper sealing has been achieved.

E. When proper sealing has been achieved, attach the unit to the vacuum pump Hyper Vac Model 25. Evacuate case to a pressure of 100 microns or less. With vacuum maintained, bake unit at 160°F for two hours. Backfill the case to a pressure of approximately one atmosphere of dry helium. The helium must be at least 98 percent pure, dust free, and it must not contain more than 0.006 milligrams of water vapor per liter (dew point -65 degrees C) at the filling pressure. Solder in the closed end eyelet (4) to seal the case. Touch up unpainted portions of the case with dull black enamel. Air dry only, do not bake the paint.

TABLE II

WIRING DATA

Synchro Lead	Terminal Pin
Rotor	
Black and White	A
Red and White	B
Stator	
Black	A
Yellow	C
Blue	D

TEST PROCEDURE

A. Perform the following tests at atmospheric pressure, approximately 29.92 in.Hg., and at room temperature, approximately 77°F (25°C).

B. Insulation Breakdown Test. Using insulation breakdown test set 13700-1-C, apply a potential of 200 volts rms at a commercial frequency for a minimum period of five seconds across any terminal pin of the electrical receptacle and ground (the indicator case). There shall be no electrical breakdown of insulation. In event of failure of this test, check to make certain that there are no trailing wire ends or deposits of foreign material to cause shorting at the receptacle. Check synchro leads for damaged insulation. Replace a defective synchro if that is cause of failure.

C. Sealing Test. Use helium leak detector, Model 24-120A, to check indicator case for leaks. At a pressure differential of approximately one atmosphere, leak rate must not exceed 1.0 micron-cubic-foot per hour. If leak rate is excessive, correct either by reworking the faulty soldered joint or by replacing the defective component. If a helium leak detector is not available, perform the following immersion test. Treat de-aerated distilled water by adding approximately 0.1 percent by weight of a wetting agent of the alkyl-aryl-sodium-sulfonate type (40 percent active ingredient). Place the treated water within the aquarium of the hermetic sealing stand 13693-1-B or in a similar enclosed chamber. Immerse the indicator in the water and reduce the absolute pressure of the air above the water to approximately 2 1/2 in.Hg. Any bubbles resulting from air entrapped on various exterior portions of the indicator do not constitute evidence of leakage; however, any bubbles emanating from the interior of the indicator case are evidence of leakage. Repair as required.

D. Electrical Zero Tests.

NOTE

Two types of electrical zero (EZ) test apply to the 25122- series indicators. Both are outlined in the following paratraphs. The first described requires a single indicator with the cover glass removed and applies to the following indicators:

25122-A2C-1-A1	25122-A37B-1-A1
25122-A10B-1-A1	25122-A73A-2-A1
25122-A17F-2-A3	25122-B4A-1-A1
25122-A27C-1-A1	25122-B7A-1-A1
25122-A27E-1-A3	25122-B16A-1-A1
25122-A30E-1-A1	25122-B22C-1-A1

Electrical Zero Test - First Type. Obtain a single indicator with the cover glass removed - this unit will be used as the EZ-test-indicator. (The precision transmitter 13695-2-A is not used for this test to prevent possible damage to that instrument.) Connect the indicator under test to the EZ-test-indicator. With power disconnected, displace the pointer of the EZ-test-indicator 180 degrees from the position of the pointer of the indicator under test. Hold the pointer in this position and apply power. Repeat the procedure a minimum of three times; then impose electrical zero on the indicator under test. The tip of the pointer shall be within 0.010 inch of the EZ reference mark on the dial.

Electrical Zero Test - Second Type. Attach the indicator under test to the precision transmitter 13695-2-A with test cable QB72260-1. Impose electrical zero. The tip of the indicator pointer must be within 0.010 inch of the EZ reference mark. The EZ reference mark when coinciding with a calibration mark is specified in the applicable calibration table.

In the event of failure of the electrical zero test, check the position of the pointer on the shaft as outlined in step A of the section - Calibration. Be certain the dial is properly positioned. Replace a defective synchro if that is cause of failure.

E. Scale Error and Friction Error Tests. Connect the indicator to the precision transmitter 13695-2-A. Adjust the controls of the transmitter to bring the transmitter pointer to each of the test points specified in the applicable calibration table. At each test point take two readings: the first before and the second after the indicator is tapped. The difference between the two readings represents friction error which must not exceed the specified friction error tolerance. The second reading must not differ from the specified test point value by an amount greater than the specified scale error tolerance. If any readings are out of tolerance, check the EZ setting as outlined in the previous test, step C. Be certain pointer does not drag on dial or touch glass. Replace a defective synchro if that is cause of failure.

F. Position Error Tests.

NOTE

Two slightly differing position error tests are applicable to the 25122- series indicators. The first test described applies to those units listed in the former part of step C. The second test applies to all other units covered by the manual. Determine the unit under test; perform the proper test.

Position Error Test - First Type. Adjust the controls of the precision transmitter to position the pointer of the indicator at midscale. The indicator reading taken with the indicator in the normal upright operating position must not differ from the reading taken with the indicator in other position by an amount greater than the position error tolerance specified in the applicable calibration table.

Position Error Test - Second Type. Adjust the controls of the precision transmitter 13695-2-A to position the indicator pointer at any value. Observe the exact reading on the indicator dial. Now hold the indicator in any other position. The change in the indicator reading caused by the change in the indicator's position shall not exceed the position error tolerance specified in the applicable calibration table.

If the indicator fails the position error test, check for pointer drag against either the dial or glass. Make certain that the dial is properly positioned. Replace a defective synchro if it has introduced the excessive position error.

SPECIAL TOOLS, FIXTURES AND EQUIPMENT

Part Number	Nomenclature	Application
QB72260-1	Test Cable	Connects indicator to synchro precision transmitter 13695-2-A.
13693-1-B	Hermetic Sealing Stand	Used to hermetically seal the case.
13695-2-A	Synchro Precision Transmitter	Used to calibrate and test indicator.
13700-1-C	Insulation Breakdown Test Set	Used to check insulation for breakdown.
Model 24-120A	Helium Leak Detector Consolidated Engineering Pasadena, Calif.	Used to test sealing of indicator case.
Model 25 Hyper Vac	Vacuum Pump Central Scientific Co. Chicago, Ill.	Used to evacuate case preparatory to backfill with helium.
Model 310A	Pointer Remover Hammel Riglander and Co. New York, N. Y.	Used to withdraw pointer from shaft of synchro.

PARTS BREAKDOWN

NOTE

This parts breakdown lists the components for those indicators incorporating a flat metal dial secured in position with two dial screws. (Refer to figure 1.)

Figure and Index No.	Part Number	Description 1 2 3 4 5 6 7	Units Per Assy.	Usable on Code
1-	25122-A10B-1-A1	INDICATOR, Oil pressure		A
	25122-A15A-1-A2	INDICATOR, Pressure		B
	25122-A17F-2-A3	INDICATOR, Pressure		C
	25122-A23E-2-A2	INDICATOR, Pneumatic pressure		D
	25122-A23F-2-A2	INDICATOR, HIDR pressure		E
	25122-A28C-1-A2	INDICATOR, Clutch pressure		F
	25122-B5D-2-A2	INDICATOR, Fuel flow		G
	25122-B16E-1-A2	INDICATOR, Fuel flow		H
	25122-B22C-1-A1	INDICATOR, Fuel flow		I
	25122-B25B-2-A2	INDICATOR, Fuel flow		J
	25122-B54A-2-A2	INDICATOR, Fuel flow		K
	25122-C72A-17-A3	INDICATOR, Gross weight		L
	25122-C73A-18-A3	INDICATOR, Fuel quantity		M
	25122-C76A-2-A3	INDICATOR, Shaft horse power		N
-1	1489206-10	. CAP, Shipping	1	
-2	1485329-4	. RING, Retaining	1	
-3	1220879	. PLATE, Identification	1	A
	1227587-1	. PLATE, Identification	1	ABCDEFG HIJKLMN
-4	1238723-1	. EYELET, Closed end	1	
-5	1488663-2	. END COVER ASSEMBLY	1	
-6	1489278-5-2	. . RECEPTACLE	1	
-7	1488678-1	. . END COVER	1	
-8	1492495-1	. SPACER, Rear	1	
-9	793444-2	. SPACER, Dial	1	
-10	1492344-1	. CASE ASSEMBLY	1	
-11	1492120-1	. . BEZEL	1	
-12	1492099-1	. . GLASS	1	
-13	1488662-3	. . CASE	1	

Figure and Index No.	Part Number	Description 1 2 3 4 5 6 7	Units Per Assy.	Usable on Code
1-14	1482189-3	. POINTER ASSEMBLY	1	M
	1492119-1	. POINTER ASSEMBLY	1	CDEGJKN
	1492119-2	. POINTER ASSEMBLY	1	ABFHI
	1493547-1	. POINTER ASSEMBLY	1	L
-15	1489266-158	. SCREW, Dial	2	
-16	A251A10B	. DIAL	1	A
	A251A15A	. DIAL	1	B
	C251A17F	. DIAL	1	C
	A251A23E	. DIAL	1	D
	A251A23F	. DIAL	1	E
	A251A28C	. DIAL	1	F
	A251B5D	. DIAL	1	G
	A251B16E	. DIAL	1	H
	A251B22C	. DIAL	1	I
	A251B25B	. DIAL	1	J
	A251B54A	. DIAL	1	K
	A251C72A	. DIAL	1	L
	A251C73A	. DIAL	1	M
	A251C76A	. DIAL	1	N
-17	3016-0406-120	. SCREW	2	
-18	1480981-1	. PLATE, Dial	1	
-19	1497016	. SYNCHRO ASSEMBLY	1	ABCDEF
	1497552	. SYNCHRO ASSEMBLY	1	GHIJKL MN

PARTS BREAKDOWN

NOTE

This parts breakdown lists the components for those indicators incorporating a preformed nylon dial secured in position with locking cement and using no dial screws. (Refer to figure 2.)

Figure and Index No.	Part Number	Description 1 2 3 4 5 6 7	Units Per Assy.	Usable on Code
2-	25122-A1A-1-A2	INDICATOR, Fuel pressure		O
	25122-A2C-1-A1	INDICATOR, Oil pressure		P
	25122-A2J-1-A2	INDICATOR, Torque pressure		Q

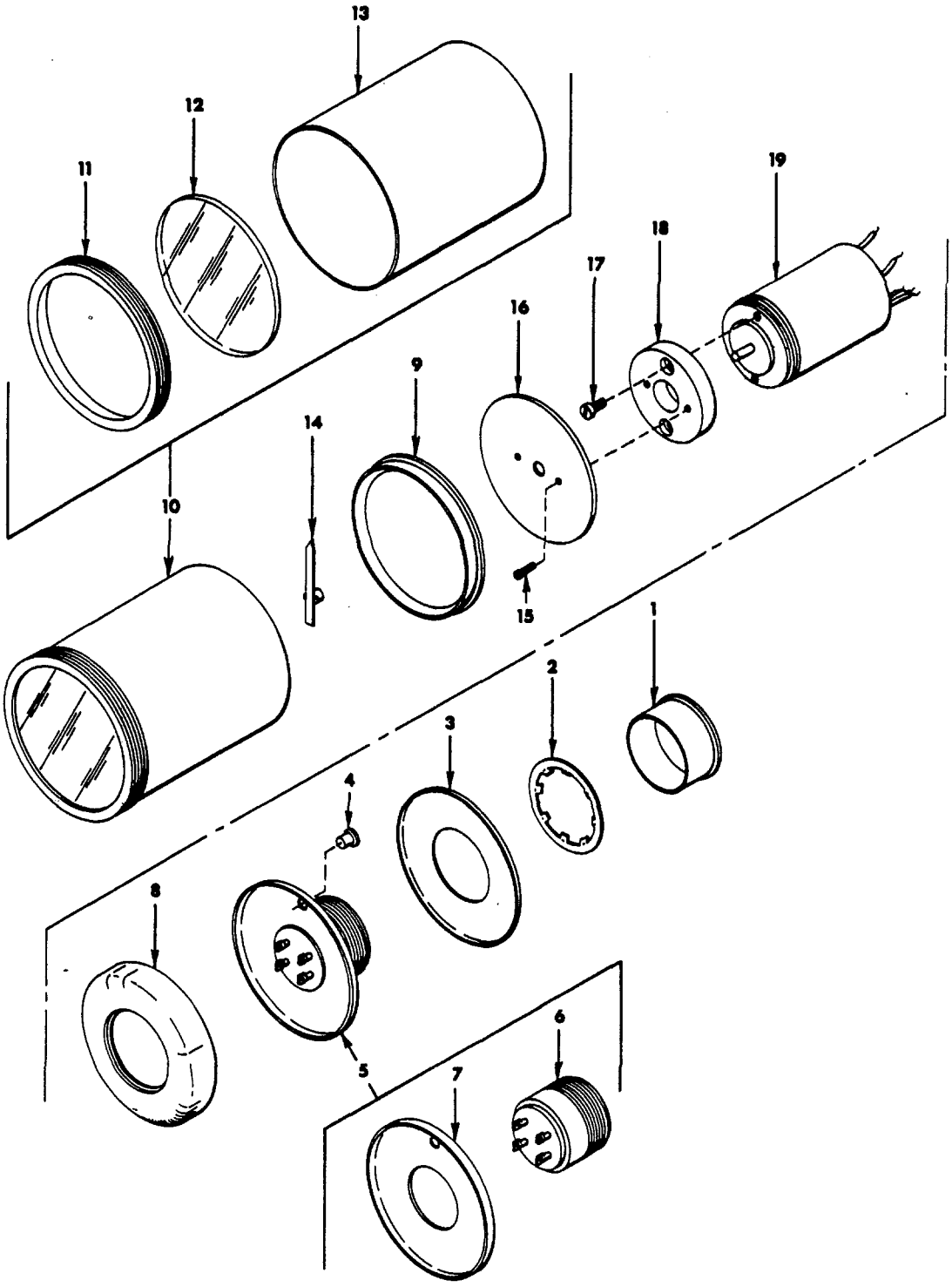


Figure 1. 25122- Series Indicator
With Flat Type of Dial and Dial Screws

Figure and Index No.	Part Number	Description 1 2 3 4 5 6 7	Units Per Assy.	Usable on Code
2-	25122-A15H-2-A2	INDICATOR, Pressure		R
	25122-A27C-1-A1	INDICATOR, Fuel pressure		S
	25122-A37E-2-A3	INDICATOR, Pressure		T
	25122-A29B-2-A2	INDICATOR, Pressure		U
	25122-A30D-1-A2	INDICATOR, Fuel pressure		V
	25122-A30E-1-A1	INDICATOR, Oil pressure		W
	25122-A37A-1-A1	INDICATOR, Hydraulic pressure		X
	25122-A37B-1-A1	INDICATOR, Pressure		Y
	25122-A37M-2-A2	INDICATOR, Hydraulic pressure		Z
	25122-A40A-1-A3	INDICATOR, Oil pressure		AA
	25122-A56A-1-A2	INDICATOR, Pressure		AB
	25122-A73A-2-A1	INDICATOR, Pressure		AC
	25122-B3B-2-A2	INDICATOR, Fuel flow		AD
	25122-B3C-4-A2	INDICATOR, Fuel flow		AE
	25122-B4A-1-A1	INDICATOR, Fuel flow		AF
	25122-B7A-1-A1	INDICATOR, Fuel flow		AG
	25122-B16A-1-A1	INDICATOR, Fuel flow		AH
	25122-B25A-2-A2	INDICATOR, Fuel flow		AI
	25122-B57A-1-A2	INDICATOR, Fuel flow		AJ
	25122-C11A-1-A2	INDICATOR, Rev. per min.		AK
-1	1489206-10	. CAP, Shipping	1	
-2	1485329-4	. RING, Retaining	1	
-3	1212364	. PLATE, Identification	1	AF AH
	1220879	. PLATE, Identification	1	OPQSVWY Z AA AB AC AD AE AG AJ AK
	1227587-1	. PLATE, Identification	1	QRTUWXYZ AA AD AE AG AH AI
	1494150-1	. PLATE, Identification	1	PRTUY AA AB AJ AK
-4	1492991-1	. EYELET, Closed end	1	
-5	1494151	. END COVER ASSEMBLY	1	
-6	1489278-5-2	. . RECEPTACLE	1	
-7	1494146	. . END COVER	1	
-8	1494126	. SPACER, Rear	1	
-9	1494121	. SPACER, Dial	1	
-10	1492344-1	. CASE ASSEMBLY	1	
-11	1492120-1	. . BEZEL	1	
-12	1492099-1	. . GLASS	1	
-13	1488662-3	. . CASE	1	

Figure and Index No.	Part Number	Description 1 2 3 4 5 6 7	Units Per Assy.	Usable on Code
2-14	1484838-2	. POINTER ASSEMBLY	1	AE
	1492119-1	. POINTER ASSEMBLY	1	RTU Z AC AD AI
	1492119-2	. POINTER ASSEMBLY	1	OPQSVWXY AA AB AF AG AH AJ AK
-15	251A1A	. DIAL	1	O
	251A2C	. DIAL	1	P
	251A2J	. DIAL	1	Q
	251A15H	. DIAL	1	R
	251A27C	. DIAL	1	S
	251A27E	. DIAL	1	T
	251A29B	. DIAL	1	U
	251A30D	. DIAL	1	V
	251A30E	. DIAL	1	W
	251A37A	. DIAL	1	X
	251A37B	. DIAL	1	Y
	251A37M	. DIAL	1	Z
	251A40A	. DIAL	1	AA
	251A56A	. DIAL	1	AB
	251A73A	. DIAL	1	AC
	251B3B	. DIAL	1	AD
	251B3C	. DIAL	1	AE
	251B4A	. DIAL	1	AF
	251B7A	. DIAL	1	AG
	251B16A	. DIAL	1	AH
	251B25A	. DIAL	1	AI
	251B57A	. DIAL	1	AJ
	251C11A	. DIAL	1	AK
-16	1497016	. SYNCHRO ASSEMBLY	1	OPQRSTU VWXYZ AA AB AC
	1497552	. SYNCHRO ASSEMBLY		AD AE AF AG AH AI AJ AK

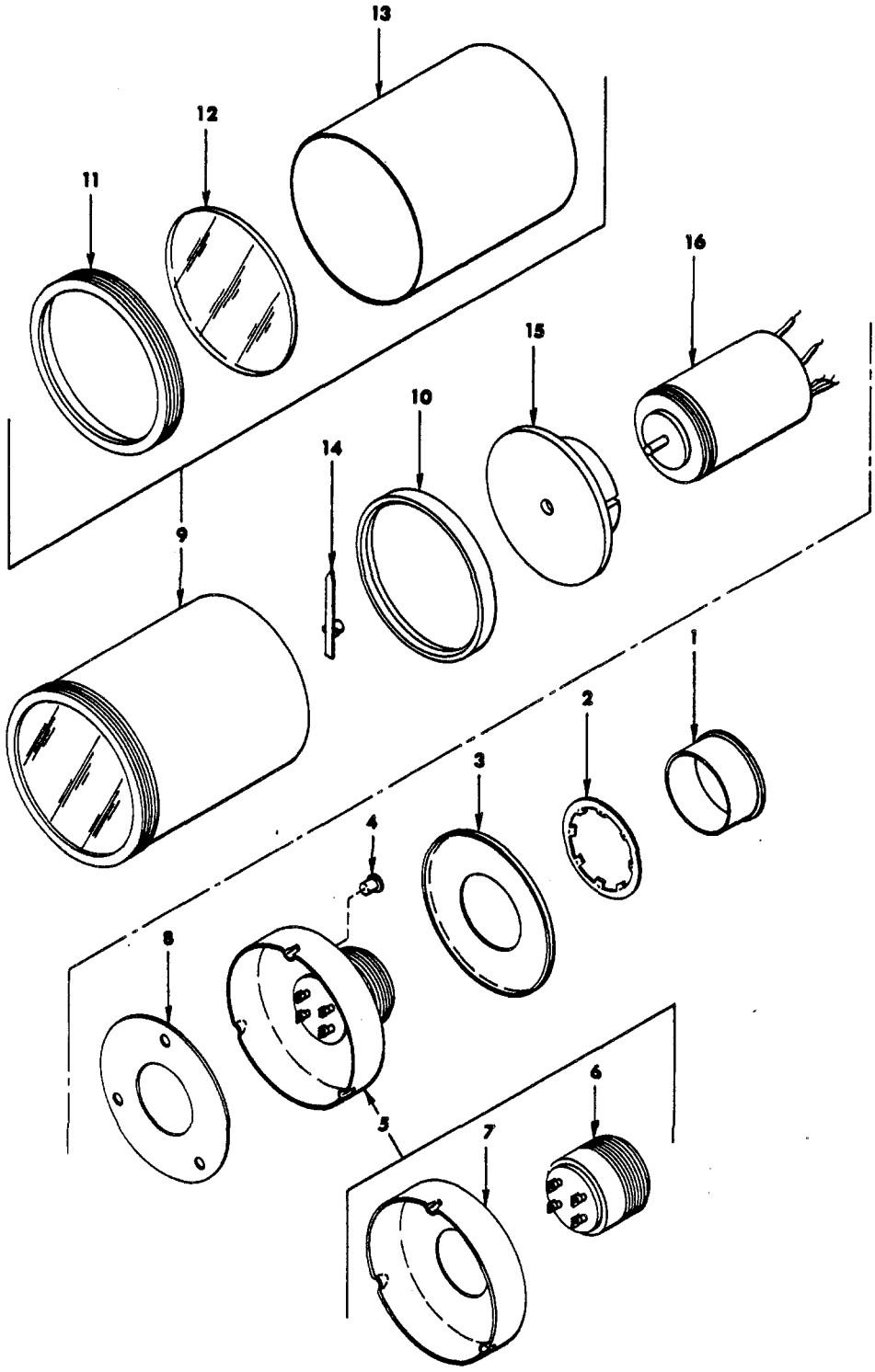


Figure 2. 25122- Series Indicator
With Formed Type of Dial

TROUBLE SHOOTING

Fault	Probable Cause	Remedy
No rotation of pointer.	No power to indicator.	Turn on power. Check for an open in rotor leads.
	Inoperative transmitter.	Remove and replace transmitter.
	Defective indicator.	Remove and replace indicator.
Reversed rotation of pointer of indicator.	Leads reversed.	Reconnect wires.
Erratic movement of pointer.	Pulsating pressure at transmitter.	Install a suitable damping device.
	Open lead.	Repair defect in wiring.
	Loose electrical connector.	Provide proper connection.
	Internal defect of indicator.	Remove and replace the indicator.

MAINTENANCE

Since the 25122- series indicators are hermetically sealed units, no internal inspection is possible; neither is it necessary. Periodic inspection of the system of which the indicator is a component is normally sufficient to insure continued accurate operation of the indicator. Suggested inspection procedures are tabulated in the following chart. Inspection times, as applicable to airframe utilization of the indicator, are indicated.

System Component	Procedure	Time of Inspection
Indicator	Inspect cover glass for loosening, cracks, and discoloration.	Preflight and post flight.
	Turn on power to the indicator. Check for proper normal indicated values before and after activation of the monitored function. Check for apparent lag or sticky operation.	Preflight and post flight.
Indicator and Transmitter	Inspect mountings to be sure instruments are securely fastened in position.	After 300 flying hours.
Pressure Line or other Mechanical Connections to the Transmitter.	Examine to assure that pressure lines and fittings are in good condition; free from leaks and securely attached. Check for proper condition of other mechanical devices.	After 300 flying hours.
Electrical Connectors and Interconnecting Cables	Inspect to be certain connectors are secure and that there is no damage to cables.	After 300 flying hours.

THE BENDIX CORPORATION
FLIGHT AND ENGINE INSTRUMENTS DIVISION
SOUTH MONTROSE, PA. 18843

CALIBRATION CHART

TYPE NUMBER: 25122-A121C-2-B3

TYPE NAME: Indicator

TEST POINTS	DESIRED READINGS (DEGREES)	TOLERANCE (± DEGREES)
0	20.00	4.43
10	69.23	4.43
20	118.46	2.95
30	167.69	2.95
40	216.92	1.47
50	266.15	0.97
60	315.38	1.47
65	340.00	2.95

POSITION ERROR 1.5°

FRICTION ERROR 1.0°

TACHOMETER INDICATOR 34107C1AG13-1A3

NEW PART NO. 3571260-7001

Overhaul with Parts Breakdown

Publication No. 70-6-4

Bendix
Flight & Engine Instruments Division
South Montrose, Pa. 18843

OVERHAUL INSTRUCTIONS WITH PARTS BREAKDOWN

34107C1AG13-1A3

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OVERHAUL INSTRUCTIONS WITH PARTS BREAKDOWN

34107C1AG13-1A3

1. Description and Operation.

The 34107C1AG13-1A3 tachometer indicator is a hermetically sealed, unlighted instrument. It consists of a synchronous motor, a gear train assembly, a drag cup, two pointers and a graduated dial mounted in a 2 inch diameter case.

The indicator is normally connected electrically to a remotely located tachometer generator to form a complete system. Any change in the frequency of the generator (caused by the function being measured) will cause the synchronous motor to change speed. The pointers are mounted on shafts driven by the gear train assembly and the drag cup, which acts as a slipping clutch. In moving over the dial range, the pointers provide a visual indication of the function being measured.

The sub-dial facilitates reading indications between the main dial divisions.

The clamp-on mounting feature used allows the indicator to be rotated in order that all pointers on the instrument panel will be aligned under normal operating conditions with all pointers horizontal to the left. Any deviation from normal (indicated by a pointer dropping out of alignment) will be readily apparent.

The indicator will withstand vibration up to 2 g's.

Table 1. Leading Particulars

Operating Temperature . . .	-54°C to +71°C
Power Requirements	Generator to MIL-G-26611 or MIL-G-9398
Weight	0.9 lbs.
Accuracy	.5%

2. Disassembly.

A. Disassemble the indicator according to the following procedure: (refer to figure 2)

(1) Remove retaining ring (2) using a screwdriver or other suitable instrument to pry off ring.

(2) Lift identification plate (1) over connector (5).

(3) Unsolder eyelet (3) and remove from end cover (4).

(4) Heat edge of case and glass assembly (7) around end cover (4) to melt solder holding end cover in place, and with a wire hook or other suitable tool inserted into eyelet hole, pull cover from case and glass assembly.

NOTE: Do not disassemble connector (5) from end cover unless necessary to replace a damaged part.

(5) Unsolder wires from connector (5).

(6) Remove compression ring (6).

(7) Clean excess solder from inner diameter of case and glass assembly (7) and withdraw indicator mechanism from assembly.

NOTE: Do not disassemble case and glass assembly (7) unless necessary to replace a damaged part.

(8) Remove dial spacer (11) from case and glass assembly (7).

(9) Remove pointer and hub assembly (12) by turning pointer against stop and gently continuing rotation and pulling pointer and hub assembly away from dial (14).

CAUTION: USE CARE TO AVOID BENDING POINTER STOP WHEN REMOVING POINTER AND HUB ASSEMBLY (12).

(10) Remove two dial screws (15).

(11) Insert a strip of thin, flat steel beneath dial (14) directly under pointer assembly (13) and carefully pry pointer assembly loose.

(12) Remove two screws (17) and washers (18) to separate gear train assembly (16) from motor housing (39).

CAUTION: USE CARE IN REMOVING GEAR TRAIN ASSEMBLY (16) TO AVOID DAMAGE TO THE PROTRUDING ENDS OF SHAFTS.

(13) Loosen screw (20) to remove return path assembly (25).

NOTE: Magnet assembly (26) should not be exposed to an open circuit. To avoid such exposure during disassembly, slide the magnet assembly directly from the indicator into magnet keeper 1489036-1. Place magnet and keeper in a non-magnetic container or on a non-magnetic surface.

(14) Remove screw (27) and disc (28) and slide magnet assembly (26) off starter and shaft assembly (34).

NOTE: Do not disassemble magnet assembly (26) unless it is necessary to replace a damaged part.

(15) Slide spacer (35), motor rotor assembly (36), and ball bearings (38) from shaft of starter and shaft assembly (34).

NOTE: Stator assembly (37) is secured in housing by shrink fit. If removal is necessary the housing must be heated.

B. Disassemble the gear train assembly (16) according to the following procedure: (refer to figure 3)

(1) Remove three screws (2) and lockwashers (3) and loosen rear plate assembly (1).

(2) Unsolder outer end of hairspring (10) from hairspring plate (6).

(3) Remove screw (7) and washer (8) to release hairspring plate (6).

NOTE: Do not disassemble jewel (4) from rear plate (5) unless necessary to replace a damaged part.

(4) Slide hub, gear and shaft assembly (9) out of front plate assembly (14).

CAUTION: USE CARE IN DISASSEMBLING GEAR TRAIN ASSEMBLY TO AVOID DAMAGE TO SHAFT PIVOTS, JEWELS, AND TEETH OF GEAR AND PINION.

(5) Remove hairspring (10) from shaft (13).

(6) Balance spring (11) need not be removed.

(7) Remove roll pin (15) and bushing and shaft assembly (17).

NOTE: Do not disassemble jewel (16) from plate assembly (22) unless necessary to replace a damaged part.

Do not disassemble bushing and shaft assembly (17) unless necessary to replace a damaged part.

3. Cleaning.

A. Clean main assembly of indicator according to the following instructions:

WARNING: USE SOLVENT IN A WELL VENTILATED AREA. DO NOT INHALE SOLVENT VAPORS OR ALLOW SOLVENT TO COME IN CONTACT WITH THE SKIN. KEEP SOLVENT AWAY FROM OPEN FLAME.

(1) Clean all metal parts with an approved solvent or use Naptha.

(2) Wash the dial (14) and cover glass (9) with a pure soap and water using care not to damage dial markings. Rinse and dry.

(3) Clean ball bearings (38) with Naptha or an approved solvent. Dry thoroughly. Do not handle ball bearings with bare fingers.

(4) Keep parts clean and free from dust particles.

B. Clean gear train assembly according to the following instructions:

(1) Clean pivots of shafts by inserting them into a piece of pithwood.

(2) Clean jewels (7 and 16) with a piece of soft pegwood freshly tapered for each jewel.

(3) Clean the teeth of pinion (18) and gear and cup assembly (12) with a stiff hair brush or glass fiber brush.

(4) Clean metal parts with Naptha or an approved solvent. Dry in accordance with standard shop practice.

(5) Keep parts clean and free from dust particles until reassembled.

4. Inspection/Check.

A. Inspect main assembly of indicator according to following steps:

(1) Inspect all parts for visible wear, damage, or defects.

(2) Inspect washers for scratches, scoring or damage.

(3) Inspect threads for stripping or burrs.

(4) Inspect lead wires for breaks.

(5) Inspect insulation for damage, breakdown or frayed material.

(6) Inspect pins of connector (5) for bending, breaks or loosening.

(7) Inspect case and glass assembly (7) for leaks, corrosion, dents or damage to case.

(8) Inspect glass (9) for chips or cracks.

(9) Inspect dial (14) and pointers (12 and 13) for chipped paint.

(10) Inspect bearings (38) for damage, wear or foreign material.

B. Inspect gear train assembly according to the following steps:

(1) Inspect jewels (7 and 16) under magnification for cracks or wear.

(2) Inspect teeth of pinion (18) for breaks, stripping, burrs or foreign material.

(3) Inspect teeth of gear and cup assembly (12) for breaks, stripping, burrs or foreign material.

(4) Inspect hairspring (10) for twisting or distortion, or improperly wound convolutions.

5. Repair.

No repair of any parts is recommended. Replace any parts found in inspection to be defective.

6. Assembly.

A. Assemble the gear train assembly according to the following instructions: (refer to figure 3)

CAUTION: USE CARE IN HANDLING AND ASSEMBLING GEAR TRAIN ASSEMBLY. TEETH OF PINION (18), TEETH OF GEAR AND CUP ASSEMBLY (12), PIVOTS OF SHAFTS (13 and 20), AND JEWELS (4 and 16) ARE DELICATE AND CAN BE EASILY DAMAGED.

(1) Assemble jewels (19) with high surface toward bottom jewel housings in bushing (21). Assemble pinion (18) on end of bushing with tapered end. Adjust opposite jewel for end play of shaft of 0.003 to 0.005 inch. Press on pinion (18) to allow clearance of 0.025 inch between inner face of pinion and opposing face of bushing (21). Hand taper ream hub of pinion if necessary.

(2) Press in bushing and shaft assembly (17) flush to 0.002 inch below rear surface of front plate (22).

(3) Press shaft (13) into gear and cup assembly (12) with 0.215 inch length pivot extending from gear on the side on which balance wheel is staked. Press in shaft (13) until shoulder of large diameter of shaft at front extends 0.401 inch beyond front surface of washer on front of hub of gear and cup assembly (12).

(4) Position hairspring (10) into gear and cup assembly (12) with 0.215 inch length pivot extending from gear on side on which balance wheel is staked (toward rear in exploded view illustration). Press in shaft (13) until shoulder of large diameter of shaft at front extends 0.401 inch beyond front surface of washer on front of hub of gear and cup assembly (12).

(5) Position hairspring (10) on shaft (13) as follows:

(a) View cup and gear assembly (12) from rear with the center of hole, which has been pressed into one of three gear spokes in a vertical position. Place hairspring (10) on shaft (13) so that free end of hairspring points clockwise from vertical.

(b) Maintain this position and press hub of hairspring (10) against hub of gear and cup assembly (12). Hairspring must be parallel to main gear; in free condition hairspring must be centered with shaft.

(c) Locate outer end of hairspring so that coils are equally spaced when the spring is wound up approximately 150 degrees. This adjustment is made by bending outer end of spring while free and after soldered to hairspring plate (6).

(6) Press in pin (15) so that they extend 0.130 inch from rear surface of plate assembly (22).

(7) Press in bushing and shaft assembly (17) flush to 0.002 inch below rear surface of front plate assembly (14).

(8) If jewel (16) was removed, press in place with high point of jewel toward rear of front plate assembly (14).

(9) If jewel (4) was removed press in with high point of jewel toward front of rear plate (5).

(10) Assemble front plate assembly (14), hub, gear and shaft assembly (9), and rear plate assembly (1).

(11) Adjust jewel (16) for 0.0013 to 0.0020 inch end play of shaft (13).

(12) Solder end of hairspring (10) to hairspring plate (6). Bend and readjust as necessary to insure that coils are equally spaced when hairspring is wound up approximately 150 degrees.

B. Assemble the main indicator assembly according to the following instructions: (refer to figure 2)

(1) If stator assembly (37) was removed from housing (39), reassemble as follows:

(a) Place housing in oven at 200°F (±20°F) for a period of two hours.

(b) Immerse stator assembly in dry ice for a period of two hours.

(c) Within five minutes after removal of parts from oven and dry ice, insert stator into housing.

(2) Completely demagnetize motor rotor assembly (36) with magnetreater model 990. Using magnet charger 107A with fixture 1489486, fully remagnetize motor rotor assembly. Fixture 1449486 must be used in order to obtain desired magnetic path to assure proper motor starting characteristics. Demagnetize to a field strength of 380 to 420 gauss. Insert motor rotor assembly into magnet keeper 1489071 or install it immediately into motor assembly.

(3) Install spacers (35) and motor rotor assembly (36) on shaft of starter and shaft assembly (34).

(4) Place one bearing (38) on shaft of starter and shaft assembly (34) with flanged edge of bearing against spacer (35).

(5) Insert bearing mounted on shaft into seat at rear of motor housing (39).

(6) Place second bearing (38) on shaft on front side of motor housing (39) with flanged edge of bearing toward front of indicator.

(7) If magnet assembly (26) has been exposed to an open magnet circuit, it must be remagnetized. First demagnetize magnet assembly completely using model 990 magnetreater. Then place magnet assembly in magnet charger model 107A with fixture 1489041-1 and charge to full strength. Discharge maximum dc current through magnet charger winding. Remove magnet assembly from magnet charger directly into magnet keeper 1489036-1. Take care to avoid exposure to an open magnetic circuit. Do not remove magnet assembly from magnet keeper until ready to place in return path (25) in indicator.

NOTE: In order to stabilize magnet assembly (26), immerse magnet assembly (in its keeper) in dry ice for two hours, then immerse in boiling water for ten minutes. Repeat cycle a minimum of four times.

NOTE: If compensating discs (30 and 31) are replaced, they must be replaced with equal diameter discs to those removed.

(8) Assemble magnet assembly (26) on shaft extending through housing (39). To avoid demagnetization, place magnet assembly directly on to shaft from magnet keeper.

(9) Adjust end play of motor 0.0013 to 0.0020 inch with 8 oz. reversing gage load and tighten setscrew (27) against disc (28).

(10) Fit drag cup assembly (19) on shaft of gear train assembly (16). A replacement drag cup assembly may require reaming.

(11) Fasten gear train assembly (16) to motor housing (39) using screws (17) and washers (18).

(12) Install dial (14) on gear train assembly using dial screws (15).

NOTE: Apply purple glyptal lacquer to dial screw holes in gear train assembly by placing a drop of glyptal lacquer to end of a wire and placing it in screw hole. Spread glyptal in hole with wire. Add a second drop of glyptal to hole in same manner.

(13) Press pointers (12 and 13) in place on their respective shafts. If new pointers are used they may require reaming with a 3 degree, 3 flute standard taper reamer to achieve a positive fit on shaft.

(14) Connect leads of stator to connector (5) according to wiring diagram (see figure 1)

NOTE: If drag cup magnet has been remagnetized and thermocycled, before recalibrating, the return path should be positioned forward against the rear plate, connected to a generator and operated at 4200 RPM. In this condition, demagnetize the drag cup magnet until the pointer indicates 92 to 93% RPM. Recalibrate.

(15) Connect indicator to tachometer generator TT3 or equivalent. Adjust smoothness of motor when running at low (75 to 100 rpm) speeds. This is accomplished by adjusting screw (23). Lock screw in place after adjustment with locking nut (24).

(16) Place entire mechanism into case and glass assembly (7). Position rear cover in place and tape securely together.

(17) Conduct tests outlined under section 8, Testing, for room temperature starting, scale error, friction error and position error.

(18) If indicator meets all test requirements, remove tape, clean case and cover of any tape residue. If connector (5) was removed solder in place in end cover (4).

(19) Line up end cover so that polarizing key of connector (5) is within 2 degrees of top centerline of dial (14).

(20) Solder end cover (4) in place in case (10).

(21) Connect indicator to dual valve manifold that is connected to both a vacuum pump and a source of helium. Evacuate indicator to a pressure of 50 microns. With vacuum maintained, bake indicator at 71° to 79°C (160° to 175°F) for twelve hours.

(22) Switch valve to dry helium source, backfill and seal indicator by soldering eyelet (3) in place.

NOTE: Helium used shall be at least 98 percent pure, dust free and shall contain not more than 0.006 milligrams of water vapor per liter (dew point -65°C (-85°F) at filling pressure.

7. Fits and Clearances.

All applicable fits and clearances are called out in assembly procedures.

8. Testing.

A. Unless otherwise specified for an individual test following conditions shall be observed for testing:

(1) All tests shall be conducted at atmospheric pressure (approximately 29.9" Hg.) and at room temperature (approximately +25°C).

(2) Indicator shall be tested in its normal operating position (dial surface shall be held in a vertical plane).

(3) All voltages noted herein are alternating current root-mean-square values. Voltmeter used to measure voltages shall be of a type which is free from frequency error.

(4) Indicator shall be gently tapped or vibrated before a test reading is taken.

B. The indicator shall be subjected to the following tests:

(1) Room temperature starting.

Connect indicator to TT3 generator or an equivalent variable frequency power supply. Supply voltage shall be a maximum of 0.0035 times frequency in cycles per minute. Frequency of supply shall be increased from 0 cycles per minute to a maximum of 150 cycles per minute. Reading shall not be less than 2.5 percent RPM at 150 cycles per minute input.

(2) Scale error.

Connect indicator to TT3 generator and test at points of scale listed in table 2. Test shall be made by setting generator at

speed shown and reading error from indicator, or by setting the indicator at desired reading and reading error in generator speed whichever is more convenient. Errors at test points shall not exceed tolerances specified in table 2. When speed is held constant at any point of scale (above 5.0 percent RPM) pointer shall not oscillate over a range greater than 0.5 percent RPM from 3.5 to 15 percent RPM and 0.3 percent RPM from over 15 to 100 percent RPM as shown on indicator.

(3) Friction error.

Indicator shall be set at 5, 20, 40, 85, and 100 percent RPM graduations. After each setting indicator shall be gently tapped and change in indication noted. Change shall not exceed 1.5 percent RPM at 5 percent RPM graduation, and 0.5 percent RPM at 40, 70, 85 and 100 percent graduations. This test may be combined with scale error test.

(4) Position error.

Indicator shall be operated at 100 percent RPM while indicator is in normal operating position. Indicator reading shall be noted. Maximum deviation from normal position reading, when tested in the following positions, shall not exceed 0.3 percent RPM.

(a) Rotated from normal position through 45 degrees to rear (dial tilted 45° back from vertical position).

(b) Rotated from normal position through 45 degrees to front (dial tilted 45° forward from vertical position).

(c) Rotated from normal position through 45 degrees to right (dial vertical).

(d) Rotated from normal position through 45 degrees to left (dial vertical).

(5) Pointer alignment.

Indicator shall be operated so main pointer will indicate 90 and 96 percent RPM respectively. Sub-dial pointer shall then correspondingly indicate 0 and 6 respectively, within 0.2 percent RPM.

(6) Sealing.

Indicator shall be tested for leaks by means of a mass spectrometer type of helium leak detector. Total leak rate shall not exceed 0.1 micron-cubic foot per hour.

(7) Fogging.

Indicator shall be placed in a controlled ambient temperature of 85°C +5°C for minimum period of two hours. Within ten seconds after removal from oven, immerse indicator to depth of ¾ inch (cover glass down) in ice water bath maintained at 0° to 5°C. After 5 minutes remove indicator and quickly wipe dry. Inspect cover glass and dial immediately for evidence of fog. Evidence of fog is cause for rejection.

As an alternate method, indicator may be placed in a controlled oven with temperature maintained at 71°C ±2°C for a minimum of one hour. Remove indicator and while still at this temperature, rub an ice cube on indicator glass for a period of one to two minutes. Wipe glass dry and inspect indicator for evidence of water or oil fog. Evidence of fog is cause for rejection.

Table 2. Calibration Data

Generator Speed RPM	Current Indication Percent RPM	Scale Error Percent RPM ± Indicated	Tolerance Generator RPM Limits
0	0	0.5	
210	5	0.5	189 - 231
420	10	0.5	339 - 441
630	15	0.5	609 - 651
840	20	0.5	819 - 861
1260	30	0.6	1235 - 1285
1680	40	0.8	1647 - 1713
2100	50	0.8	2067 - 2133
2520	60	0.8	2487 - 2553
2940	70	0.8	2907 - 2973
3150	75	0.5	3129 - 3171
3360	80	0.5	3339 - 3381
3570	85	0.5	3549 - 3591
3780	90	0.5	3759 - 3801
3990	95	0.5	3969 - 4011
4200	100	0.5	4179 - 4221
4263	101.5	0.5	4242 - 4284
4410	105	0.5	4389 - 4431
4620	110	0.5	4599 - 4641

9. Trouble Shooting.

Table 3 contains a list of possible defects that may become evident in the indicator. It lists possible causes and steps to correct them.

Table 3. Trouble Shooting

Trouble	Probable Cause	Remedial Steps
Indicator fails position error test. Right or left.	Hairspring out of position.	Reposition hairspring.
Indicator does not meet minimum starting speed requirement.	Screw (23) out of position in return path (25).	Adjust screw (23) until proper speed is obtained.
	Motor rotor assembly (36) demagnetized.	Remagnetize as called out in paragraph.
Indicator fails scale error test.	Incorrect balance, hairspring out of position.	Reposition hairspring.
Indicator fails friction error test.	Dirt on shaft or pivots.	Clean properly.
Indicator fails fogging test.	Moisture or excessive oil.	Open indicator, bake in oven at 71°C to 79°C (160°F to 175°F) for 12 hours.

DIRECTION OF ROTATION OF MAGNET FOR PHASE SEQUENCE B - A - C WHEN VIEWED FROM REAR END OF MOTOR

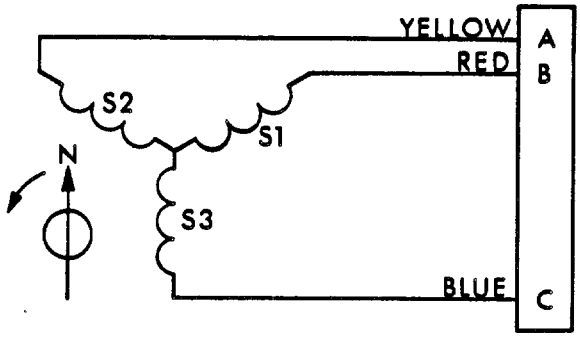


Figure 1. Wiring Diagram

10. Storage Instructions.

Prepare indicator for storage or shipment by placing protective cap, part no. 1489206-12 over connector (5). Using a cardboard box of suitable size, cushion indicator with a sufficient amount of dunnage to prevent any damage during shipment. Make certain that glass (9) is well protected. Seal box with a standard cloth or paper tape.

11. Special Tools, Fixtures and Equipment.

The following listing contains special tools required to overhaul and test indicator. If listed tools are not available, a suitable equivalent may be used. Unless otherwise indicated tools listed are manufactured by The Bendix Corporation.

Table 4. Special Tools and Test Equipment

Part No.	Nomenclature	Application
1489036-1	Magnet Keeper	To hold magnet assembly (26) at disassembly.
1489041-1	Magnetizing Fixture	To hold magnet assembly (26) in magnet charger model 107A.
1489071	Magnet Keeper	To hold motor rotor assembly (36) at disassembly.
1489486	Magnetizing Fixture	To hold motor rotor assembly (36) in magnet charger.
Model 107A	Magnet Charger Radio Frequency Lab. Boonton, N.J.	To remagnetize magnet assembly (26) and motor rotor assembly (36).
Model 990	Magnetreater Radio Frequency Lab. Boonton, N.J.	To demagnetize magnet assembly (26) and motor rotor assembly (36).
MIL-G-26611 MIL-G-9398	Generator	To supply power for indicator tests.

Table 4. Special Tools and Test Equipment (Continued)

Part No.	Nomenclature	Application
Model 24-120A	Helium Leak Detector Consolidated Electro-dynamics Corp. Pasadena, Calif.	To perform helium leak check.

34107C1AG13-1A3

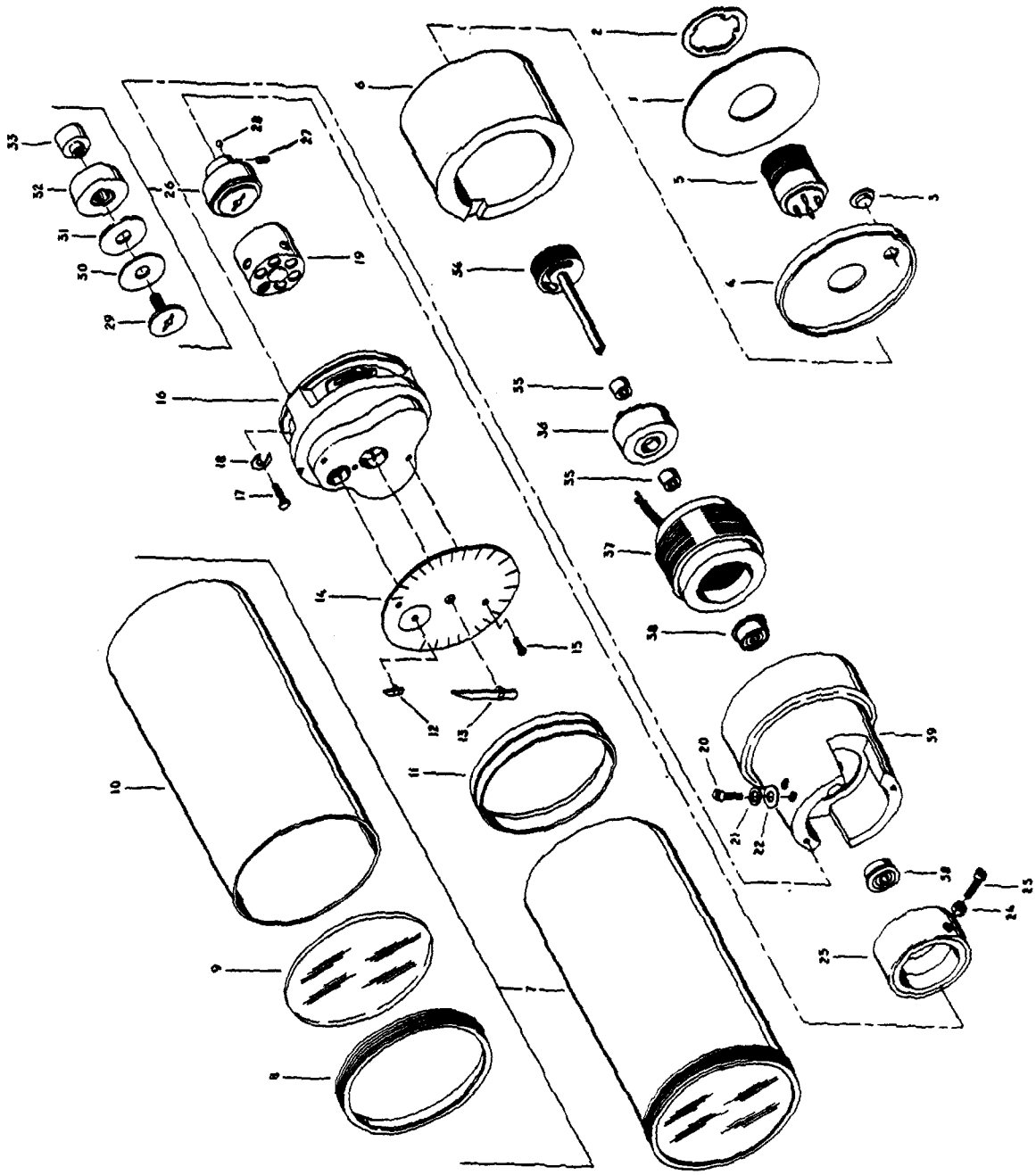


Figure 2. Tachometer Indicator

34107C1AG13-1A3

12. Illustrated Parts List.

FIG. ITEM	PART NUMBER	1234567 NOMENCLATURE	UNITS PER ASSY.
2 -	34107C1AG13-1A3	Tachometer Indicator	
- 1	2272281-0001	.Plate, Identification (Attaching Part)	1
- 2	1485329-2	.Ring, Retaining	1
		---*---	
- 3	1492991-1	.Eyelet	1
- 4	1485804-2	.End Cover	1
- 5	1489278-3-3	.Connector	1
- 6	1490063-2	.Ring, Compression	1
- 7	1485773-1	.Case and Glass Assembly	1
- 8	1492120-1	..Ring, Front	1
- 9	1490785-1	..Glass	1
-10	1485772-1	..Case	1
-11	1485869-1	.Spacer, Dial	1
-12	2270375-001	.Pointer and Hub Assembly	1
-13	1488182-1	.Pointer Assembly	1
-14	H341C1AG	.Dial (Attaching Part)	1
-15	1489266-125	.Screw, Dial	2
		---*---	
-16	1490066-005	.Gear Train Assembly (Attaching Parts)	1
-17	1490637-1	.Screw	2
-18	1490027-1	.Washer	2
		---*---	
-19	1260205-3	.Drag Cup Assembly	1
-20	3003-0412-120	.Screw, Fillister Head	2
-21	3052-04-21	.Washer, Lock	2
-22	3055-125-2-23	.Washer, Flat	2
-23	3003-0412-130	.Screw	1
-24	3060-04-20	.Nut	1
-25	1494934	.Return Path Assembly	1
-26	1490068-3	.Magnet Assembly (Attaching Parts)	1
-27	3017-0404-131	.Screw	1
-28	1488759-1	.Disc	1
		---*---	
-29	1494117-0004	..Screw	1
-30	1492865-0001	..Disc	1
-31	1492866-0001	..Disc	1
-32	1490067-0001	..Magnet	1
-33	1493116-0003	..Hub	1
-34	1494980	.Starter and Shaft Assy.	1

34107C1AG13-1A3

FIG. ITEM	PART NUMBER	1234567 NOMENCLATURE	UNITS PER ASSY.
-35	1485785-3	.Spacer	2
-36	1497000	.Motor Rotor Assembly	1
-37	1497001	.Stator Assembly	1
-38	1494984	.Bearing, Ball	2
-39	1494895	.Housing, Motor	1

3410701AG13-1A3

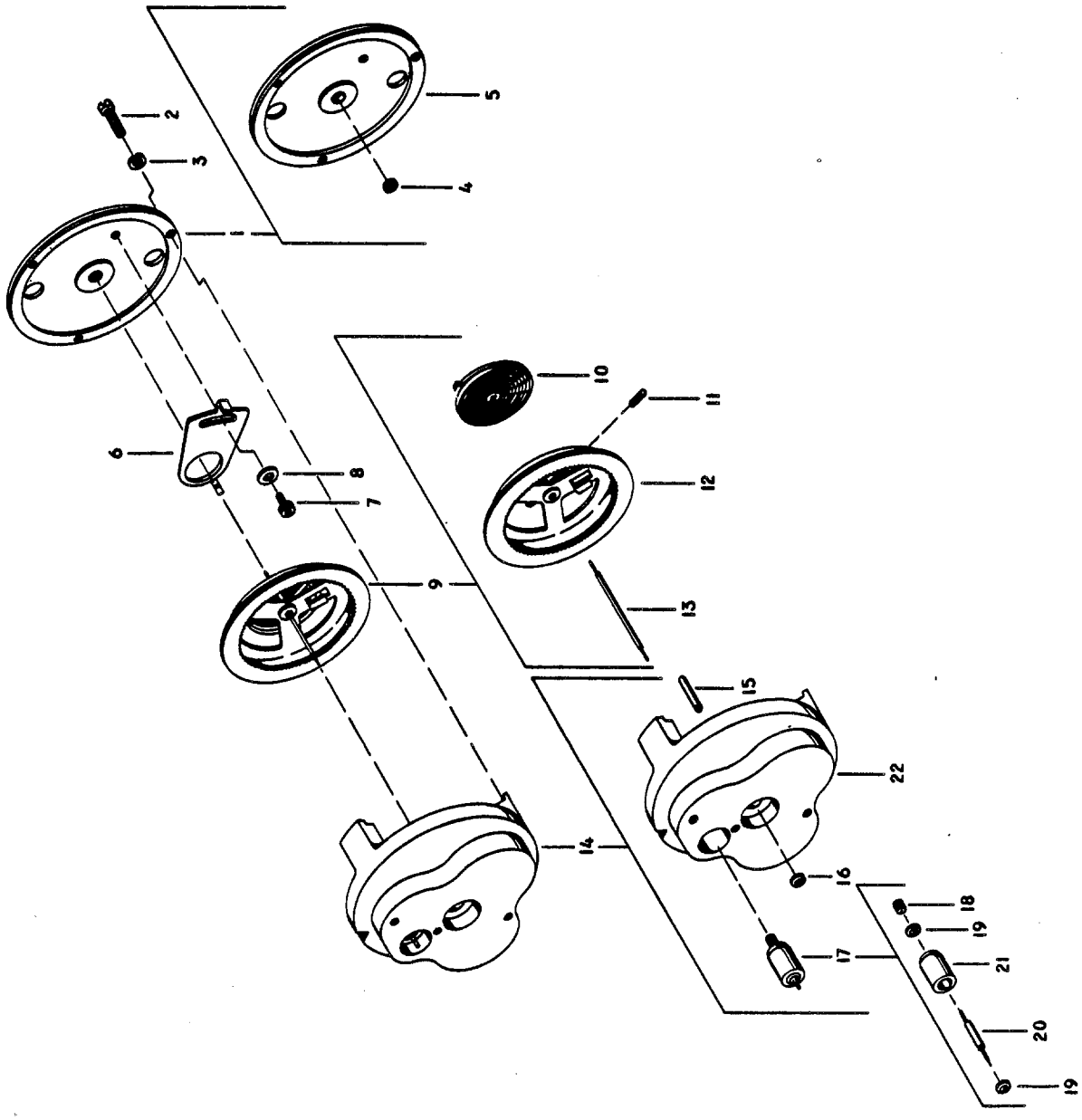


Figure 3. Gear Train Assembly

34107C1AG13-1A3

FIG. ITEM	PART NUMBER	1234567 NOMENCLATURE	UNITS PER ASSY.
3 -	1490066-005	Gear Train Assembly	1
- 1	1490049-1	.Plate, Rear Assembly (Attaching Parts)	1
- 2	3002-0209-120	.Screw	3
- 3	3050-02-21	.Washer	3
		---*---	
- 4	1494116	..Jewel	1
- 5	1490022-1	..Plate, Rear	1
- 6	1485649-1	.Plate, Hairspring (Attaching Parts)	1
- 7	3042-0204-120	.Screw	1
- 8	3055-094-5-23	.Washer, Flat	1
		---*---	
- 9	1490047-005	.Hub, Gear & Shaft Assembly	1
-10	1494983	..Hairspring	1
-11	1488472-2	..Spring, Balance	AR
-12	1490046-0001	..Gear and Cup Assembly	1
-13	1490061-0001	..Shaft	1
-14	1490091-1	.Front Plate Assembly	1
-15	MS171432	..Roll Pin	1
-16	1494116	..Jewel	1
-17	1486711-1	..Bushing and Shaft Assembly	1
-18	1490949-1	...Pinion Assembly	1
-19	1481927-1	...Jewel	2
-20	1490062-1	...Shaft	1
-21	1490035-1	...Bushing	1
-22	1492659-003	...Plate Assembly	1

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INDICATORS

PART NO.
3571810-0003 (25510B25B8A3)
3571810-2001 (25514B25A3A3)
3571810-8001 (25516C96A14A3)

OVERHAUL INSTRUCTIONS

The information disclosed herein is proprietary to the Allied Corporation and is provided exclusively for the maintenance, service, and repair of the equipment referred to herein and is not to be used for any other purpose or reproduced except as specifically authorized in writing by the Allied Corporation, Bendix Aerospace, Bendix Flight Systems Division.

Bendix Flight Systems Division
Teterboro, New Jersey 07608

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Bendix Flight Systems Division
OVERHAUL MANUAL
PART NO. 3571810

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Allied Corporation

Bendix Flight Systems Division

OVERHAUL MANUAL

PART NO. 3571810

RECORD OF REVISIONS

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Fuel Flow Indicators, Part Nos. 3571810-0003 (25510B25B8A3), 3571810-2001 (25514B25A3A3), and Speed Brake Indicator, Part No. 3571810-8001 (25516C96A14A3).

1. Description and Operation

A. General

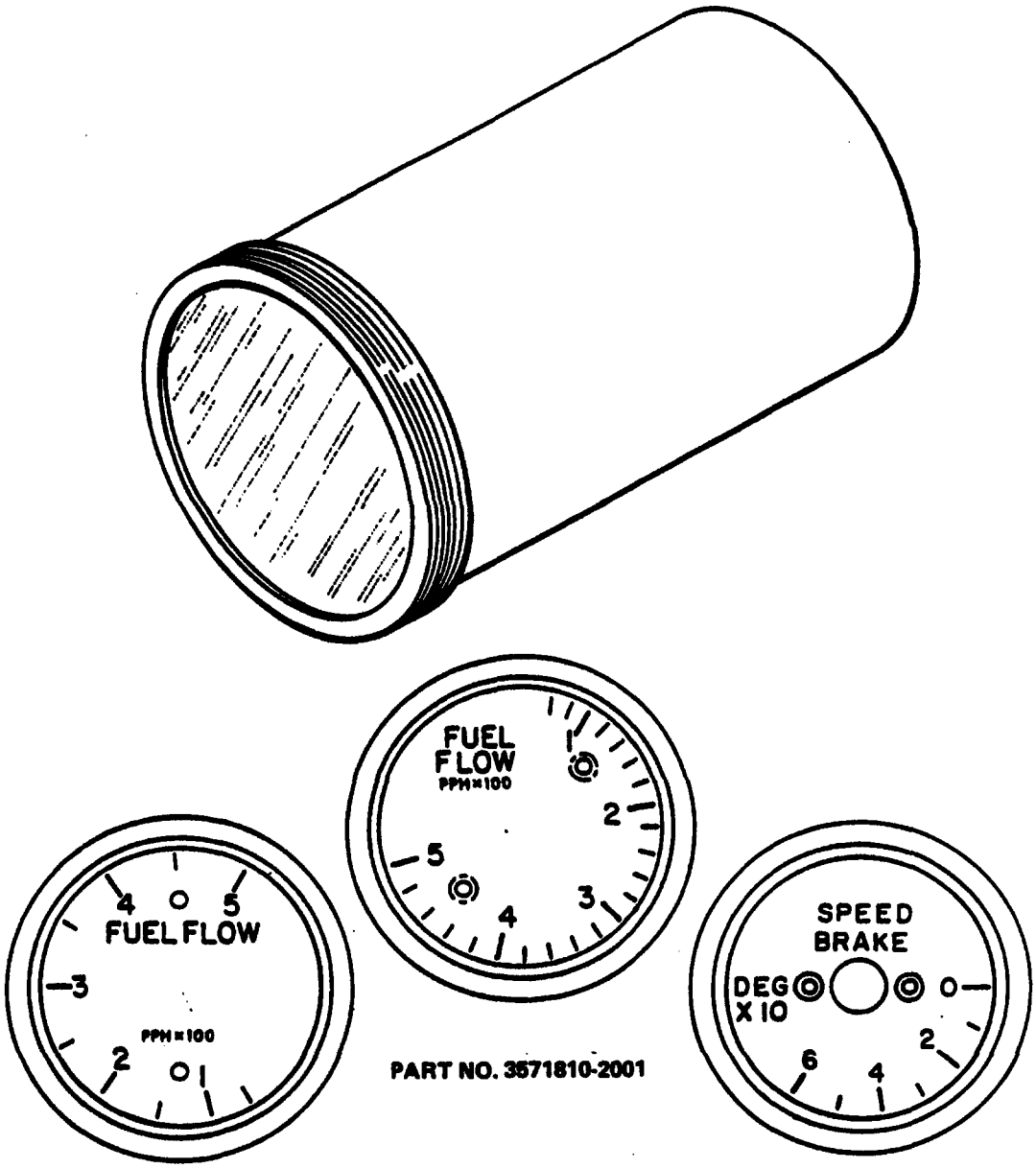
This manual contains descriptive information, maintenance, test instructions, and an illustrated parts list for Fuel Flow Indicators, part Nos. 3571810-0003 (25510B25B8A3), 3571810-2001 (25514B25A3A3), and Speed Brake Indicator, part No. 3571810-8001 (25516C9A14A3), hereinafter referred to as indicator. These indicators are manufactured by the Allied Corporation, Bendix Flight Systems Division, Teterboro, New Jersey 07608. Refer to Figure 1.

B. Description

The indicator is a hermetically sealed unit, with a single synchro. The indicator has a single pointer mounted on the shaft of a receiver synchro that provides visual indication.

C. Operation

In the indicator, the receiver synchro is remotely connected to a mating synchro transmitter. This synchro transmitter produces voltages representative of the angular position of the rotor in relation to the stator. With an ac excitation applied to the rotor, a magnetic field is set up about the rotor, and a voltage is induced in the stator windings. The magnitude and polarity of the output voltage of the stator of the transmitter is dependent at any instant on the angular position of the rotor with respect to the stator. The rotor of the synchro receiver in the indicator is free to turn and assume a position with respect to its stator corresponding to the rotor position of the transmitter synchro to which it is electrically connected. When the rotor of the receiver synchro turns, it moves the pointer connected on its shaft. This pointer moves in front of a dial, thus indicating the required information. The dial of the Speed Break Indicator is translucent permitting filtered light from two lamps to illuminate the dial face.



PART NO. 3571810-2001

PART NO. 3571810-0003

PART NO. 3571810-8001

2853-2-1

Indicator - Three Quarter View
Figure 1

D. Leading Particulars

Leading particulars for the indicator are given in in Table 1.

Table 1. Leading Particulars

	FUEL FLOW INDICATOR 3571810-0003, 3571810-2001	SPEED BRAKE INDICATOR 3571810-8001
Operating Voltage:	26 Volts, 400 Hz	26 Volts, 400 Hz
Lighting Voltage:		5 Volts
Temperature Range:	-54°C to +71°C (-65°F to +159.8°F)	-54°C to +71°C (-65°F to +159.8°F)
Length:	3.25 inches	3.00 inches
Diameter:	2.000 inches	1.563 inches
Dial Spread:	240°	180°
Range:	50 to 500 pph (3571810-0003 only) 60 to 500 pph (3571810-2001 only)	0-60 Degrees
Autosyn* Synchro:		
Primary:	Rotor	Rotor
Voltage & Frequency:	26 Volts, 400 Hz	26 Volts, 400 Hz
Current:	120 milliamps, max.	120 milliamps, max.
Rotor Resistance:	18.0 ohms ± 10%	18.0 ohms ± 10%
Stator Resistance:	10.0 ohms ± 10%	18.0 ohms ± 10%

* Registered in U.S. Patent Office.

2. Disassembly

NOTE: Test the indicator in accordance with paragraph 8 (Testing) to establish the condition of the unit or the most probable cause of malfunction.

A. Disassemble the indicator only to the extent necessary to effect required repairs.

B. Indicator (Ref. IPL Fig. 1)

(1) Remove shipping cap (2).

(2) Remove retaining ring (3).

(3) Remove identification plate (4).

(4) Remove closed-end eyelet (evacuation plug) (5) by heating with a soldering iron and lifting out with needlenose pliers or screwdriver. Remove tubing (6), as necessary.

(5) Apply heat with a soldering iron around edge of end cover assembly (7) where solder holds end cover assembly in place and separate.

(6) Unsolder leads from connector (8); tag wires to facilitate reassembly.

(7) Do not disassemble end cover assembly (7) unless necessary to replace a damaged part. If it is necessary to separate items, use a torch to melt solder in order to separate connector (8) from rear cover (9).

NOTE: Compression ring (10) is used as a spacer, and is position 180° (the two cups facing) in relation to rear cover (9).

(8) Remove compression ring (10).

(9) Carefully withdraw synchro assembly (11) with attached components straight out from case and glass assembly (37).

(10) Remove dial spacer (12).

(11) Using pointer removal tool, remove pointer assembly (13) or (19) by pulling straight away from dial (14) or (22).

(12) Remove dial (14) or (22) by loosening and removing two dial screws (15) or (25).

(13) For Fuel Flow Indicator, Part Nos. 3571810-0003, and 3571810-2001, remove dial plate (16) by removing the two plate screws (17).

(14) For Speed Break Indicator, Part No. 3571810-8001, proceed as follows:

a) Remove filter (26).

b) Remove diffuser assembly (27) by removing two diffuser screws (28) and two washers (29).

c) Remove two screws (31 and 33) and remove terminal lug (30) and wire and contact spring (32).

d) Remove two lamps (34) and two contact rings (35).

NOTE: Do not disassemble case, bezel and glass assembly (37) unless necessary to replace damaged parts. If necessary to disassemble case, bezel and glass assembly (37) for all units, perform the following step.

(15) To disassemble case, bezel and glass assembly (37), place assembly on a hot plate or in an induction coil. Apply heat to bezel indicator (38) until solder melts. Separate into individual parts: bezel indicator (38), glass (39) and case (40).

3. Cleaning

A. Clean all metal parts, except as noted, with solvent, Federal Specification P-S-661. Use a soft brush; dry parts thoroughly. Keep parts clean and free from dust particles until reassembled.

WARNING: USE SOLVENT IN A WELL-VENTILATED AREA. DO NOT INHALE SOLVENT VAPORS OR ALLOW SOLVENT TO COME IN CONTACT WITH THE SKIN. KEEP SOLVENT AWAY FROM OPEN FLAME.

CAUTION: DO NOT IMMERSE AUTOSYN SYNCHRO (11, IPL Fig. 1) IN SOLVENT OR ALLOW SOLVENT TO ENTER INTERIOR OF SYNCHRO SINCE DAMAGE TO COMPONENTS MAY RESULT.

B. Remove residue resin from solder joints with alphatic naphtha, Federal Specification TT-N-95, or equivalent.

C. Clean pointer assembly (13 or 19, IPL Fig. 1) with a soft eraser, such as art gum.

D. Wash glass (39, IPL Fig. 1) with pure soap and water. Rinse, dry and keep glass free from finger marks.

E. Carefully clean dial (14 or 22, IPL Fig. 1) with a lint-free cloth dampened in soap and water, and avoid damage to dial markings. Rinse, dry, and keep dial free from finger marks.

4. Inspection/Check

A. Visually inspect all metallic parts, as applicable, for breaks, cracks, nicks, scratches, scoring, stripped or crossed threads, corrosion, distortion, worn plating, pitting, gouging, or other obvious defects.

B. Perform nondestructive inspection of parts in accordance with Table 301.

Table 301. Nondestructive Inspection Data

Part Name	Type of Inspection	Procedure	Acceptable Defects
Connector (8, IPL Fig. 1)	Visual	Inspect for bent, broken, and loose terminals. Examine insulation for cracks and loosening. Make sure threads are in good condition.	None
Glass (39) (IPL Fig. 1)	Visual	Inspect for chips, cracks, scratches and discoloration. Check that anti-glare coating has not been damaged.	None
Dial (14 or 22, IPL Fig. 1)	Visual	Inspect for damage to dial markings.	None
Pointer Assembly (13 or 19, IPL Fig. 1)	Visual	Inspect for bent or distorted condition and chipped paint.	None
Case, bezel and Glass Assembly (37, IPL Fig. 1)	Visual	Check condition of solder seal between bezel (38, IPL Fig. 1) and case (40, IPL Fig. 1).	None
Case (40, IPL (Fig. 1)	Visual	Inspect condition of paint.	None

5. Repair

A. No repair of parts is recommended.

B. Replace any part disclosed by inspection or testing to be defective.

C. If any component of the matched part assemblies (19,20 21, 22, 23, or 24) needs replacement, all components should be replaced with another matched parts assembly.

6. Assembly

A. Refer to indicator wiring diagram, figure 501, for wiring information.

B. Indicator (Ref. IPL Fig. 1)

(1) If required, reassemble case, bezel and glass assembly (37) with a ring of soft solder, Federal Specification QQ-S-571, Comp. Sn63, Form W, 0.06 inch diameter, placed under glass (39).

CAUTION: AVOID DAMAGE TO ANTI-GLARE COATING ON SURFACE OF GLASS WHEN APPLYING HEAT TO CASE AND GLASS ASSEMBLY.

(2) With bezel indicator (38), glass (39), and case (40) in proper position, place case, bezel and glass assembly (37) in an induction coil or on a hot plate to effect a proper solder bind. Allow parts to cool undisturbed.

(3) Check seal of case, bezel and glass assembly (37) for leaks with a helium leak detector. With interior of case assembly evacuated to approximately 500 microns absolute pressure, any detected leak should not exceed 0.01 micron per cubic foot per hour.

(4) For Fuel Flow Indicator, part numbers 3571810-0003 and 3571810-2001 install dial plate (16) on synchro assembly (11) with two plate screws (17).

(5) For Speed Break Indicator, part number 3571810-8001, proceed as follows:

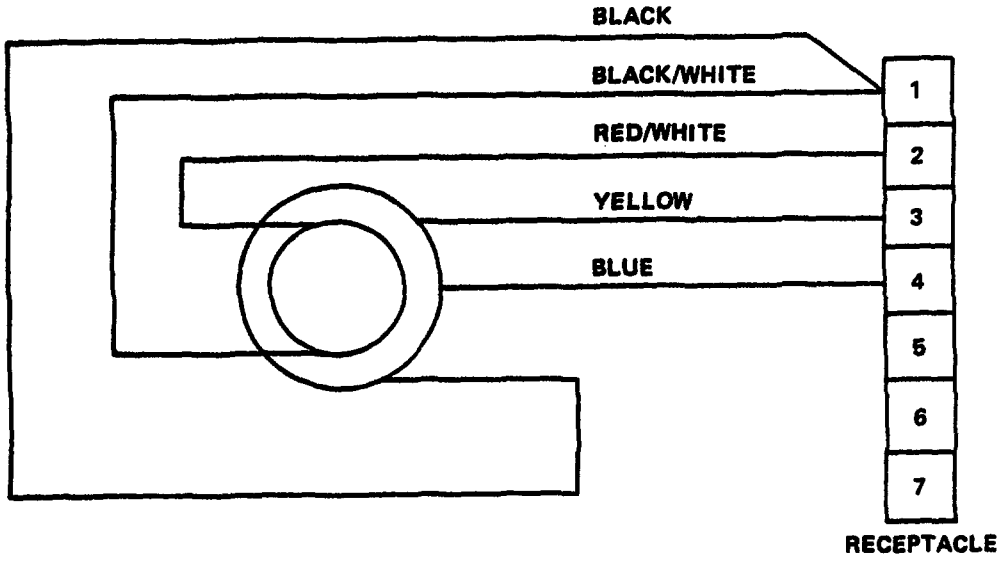
(a) Install two lamps (34) and two contact rings (35) in diffuser block (36).

b) Install contact spring (32) and lug (30) covering lamps (34) and secure with screws (31 and 33).

c) Install diffuser assembly (27) and secure with screws (28) and washers (29).

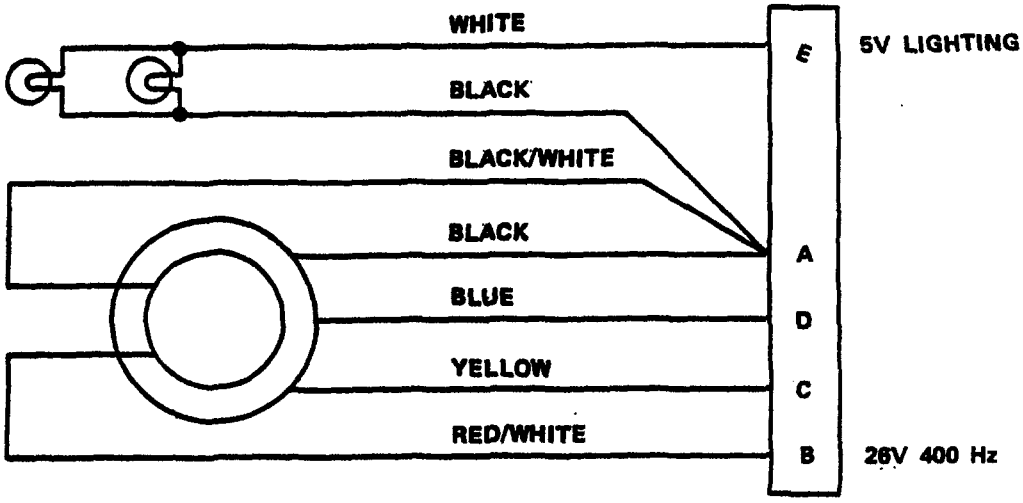
d) Install filter (26).

e) Install retaining ring (21A) on pointer -20.



FUEL FLOW INDICATORS 3571810-0003 AND 3571810-2001

2853-2-2



SPEED BREAK INDICATOR 3571810-8001

Indicator Wiring Diagram
Figure 501

CAUTION: ITEMS 19, -20, -21, 22, -23 AND -24 ARE PARTS OF A MATCHED SET AND MUST NOT BE INTERCHANGED.

(6) Install dial (14) with two dial screws (15). For Fuel Flow Indicators only.

(7) Press pointer assembly (13) or (19) through center of dial (14) or (22) till pointer assembly (13) or (19) clicks into place on shaft of synchro assembly (11).

(8) Pass wires of synchro assembly (11) through compression ring (used as a spacer) (10).

(9) If disassembled, assemble connector (8) and rear cover (9) to make end cover assembly (7).

(10) Connect and solder wires of synchro assembly (11) to connector (8) as tagged during disassembly.

(11) Connect synchro assembly (11) through the connector (8) to precision Autosyn Transmitter Test Set, part No. 13695-2-A. Actuate the electrical zero to position the synchro at its electrical zero prosition.

(12) Readjust pointer assembly (13) or (19) on shaft of synchro assembly (11) so that tip of pointer is at the 300 pounds per hour mark on dial (14) for the indicator, part numbers 3571810-0003 and 3571810-2001, and 0 RPM mark on dial (22), for Speed Break Indicator, part number 3571810-8001. Tip of pointer should be 0.015 inch away from face of dial.

(13) Test uncased indicator in accordance with procedures in Section 8, paragraphs A through H.

(14) Place dial spacer (12) into case, bezel and glass assembly (37).

(15) Insert uncased indicator into case, bezel and glass assembly (37). The key of the connector (8) must line up with the top centerline of the dial (14) or (22).

NOTE: In the procedures to follow, use hermetic sealing stand, part No. 13693-1-B, as necessary.

(16) Assemble identification plate (4) and retaining ring (3) in place, if applicable.

(17) Solder connector (8) to end cover assembly (7).

(18) Solder end cover assembly (7) in place, using solder QQ-S-571, Composition Sn63, Form W, Type S, 0.06-inch diameter and flux part No. 1493835-0000. While soldering, apply an axial force of 8 to 12 pounds to rear cover (9), part of end cover assembly (7), to keep it in its proper position.

(19) Pressurize indicator to 20 p.s.i.g.

WARNING: USE ALCOHOL ONLY IN A WELL-VENTILATED AREA AWAY FROM FIRE, SPARKS, OR OTHER SOURCE THAT MAY CAUSE IGNITION.

(20) Immerse indicator in clean, clear alcohol. Any bubbles coming from within indicate a leak which must be repaired. Mark leaks for repair.

(21) Remove indicator from alcohol container.

(22) Place indicator under bell jar supplied with hermetic sealing stand, part No. 13693-1-B, and connected to vacuum pump, Hyper-Vac Model 25.

(23) Evacuate the bell jar to a pressure of 500 microns or less.

(24) With vacuum maintained, bake indicator in an oven at 71°C (160°F) for 2 hours.

NOTE: Helium-nitrogen mixture should be 88 to 92% nitrogen and the remainder helium. Helium used should be at least 98% pure and dust-free and shall contain not more that 0.006 milligram of water vapor (dew point of 65°C (149°F) at filling pressure.

(25) Backfill indicator with one atmosphere of dry helium-nitrogen mixture and seal.

(26) Replace tubing (6), as necessary. Seal by inserting closed end eyelet (5) into end cover assembly (7) and soldering in place.

(27) Using helium leak detector, model 24-120B, and test port and roughing station, model 24-038 or equivalent, check that maximum allowable total leak rate is 0.01 micron per cubic foot per hour.

(28) If leak rate is over maximum allowable rate, repeat steps (19) through (27) to locate and repair leak.

8. Testing

A. Perform tests at atmospheric pressure of approximately 29.92 inches Hg, at a temperature of approximately 25°C (77°F) and at a relative humidity of 90 percent or less. Unless otherwise specified, test indicator in the normal upright operating position, with the plane of the dial vertical. Prior to taking a test reading, vibrate the indicator lightly by hand.

B. Test Procedures

Connect the indicator to Precision Autosyn Synchro Transmitter Test Set, part No. 13695-2-A, and perform tests listed in paragraphs C, D, E, and J for Fuel Flow indicator and paragraphs F, G, H, I and J for Speed Brake Indicator.

C. Electrical Zero Test

Impose electrical zero (EZ) on indicator. Check that pointer assembly (13), IPL Figure 1 is installed so that the tip of the pointer lies within 0.10 inch of the electrical zero reference mark. This mark is 300 pounds per hour for the Fuel Flow Indicator.

D. Scale Error and Friction Error

Rotate knob of transmitter to bring its pointer to each of the test points indicated in Table 701, Calibration. Two readings shall be taken; the first before the indicator is vibrated and tapped, and the second after the indicator is vibrated and tapped. The difference between the first and second readings shall not exceed 1.4 degrees. The test shall be performed in both up-scale and down-scale directions.

E. Position Error

Set transmitter at any reading and lock. Reading of the Fuel Flow Indicator, while held in any of the following positions, shall not vary by more than 1.4 degrees.

(1) Rotated from normal position through 45 degrees to the rear (dial tilted 45 degrees back from vertical position).

(2) Rotated from normal position through 45 degrees to the front (dial tilted 45 degrees forward from vertical position).

(3) Rotated form normal position through 90 degrees to the right (dial vertical).

(4) Rotated from normal position through 90 degrees to the left (dial vertical).

F. Scale Error and Friction Error

Rotate knob of transmitter to bring pointer of indicator up to but not exceeding the desired test points specified in Table 701. Record reading on transmitter; tap or vibrate indicator and readjust transmitter knob to bring pointer of indicator to initial test point, again record reading on transmitter. The difference between the first and second readings is friction error and shall not exceed the tolerance specified in Table 701. The second reading is scale error and shall be within the "min" and "max" values specified in Table 701. This test shall be accomplished by starting with the lowest test point and progressing to the highest and returning through each test point to the lowest.

G. Position Error

Rotate knob of transmitter to bring pointer of indicator at the 30 graduation mark and record reading on transmitter. Rotate the indicator 90 degrees right, 90 degrees left, face up and face down. At each position if indicator pointer is not at the 30 graduation mark, rotate transmitter knob until 30 graduation mark is obtained and record each transmitter reading. The difference between the two readings at each position shall not exceed ± 1.6 degrees.

H. Lighting

The lighting system shall be excited with 4.5 ± 0.05 volts. Check that all lamps are lit. Perform lighting test using photometric readings per MIL-I-23479.

I. Fogging

The indicator shall be energized and placed in a +71°C ± 2°C controlled ambient temperature for a minimum perid of one (1) hour. After this period and while still at this specified temperature, an ice cube shall be rubbed on the cover glass for a period of 1 to 2 minutes. The glass shall be wiped dry (do not use compressed air) and the indicator inspected for evidence of water or oil fog inside the cover glass. Evidence of fogging shall be cause for rejection.

J. Sealing

A leak rate of 0.01 micron-cubic foot per hour at a pressure differential of approximately one atmosphere must not be exceeded when tested on the helium leak detector.

Table 701. Calibration Data

Test Points (Pounds Per Hour)	Transmitter Reading (Degrees)	Scale Error and Friction Error Tolerance (± Degrees)
50 (3571810-0003 only)	58.5	1.4
60 (3571810-2001 only)	61.2	1.4
100	75.9	1.4
200	125.6	1.4
300 (E-Z REF)	180.0	1.4
400	237.0	1.4
500	299.2	1.4

Indicator Test Points	Transmitter (Degrees)	Transmitter Reading in Degrees		Error Tolerance (± Degrees)
		Min.	Max.	
(3571810-8001 only)				
0(EZ)	180	178.4	181.6	1.6
10	200	198.4	201.6	1.6
20	220	218.4	221.6	1.6
30	240	238.4	241.6	1.6
40	260	258.4	261.6	1.6
50	280	278.4	281.6	1.6
60	300	298.4	301.6	1.6

9. Troubleshooting

Refer to Table 801 for indicator troubleshooting data.

Table 801. Troubleshooting

Trouble	Possible Cause	Remedy
Electrical zero cannot be obtained.	Defective Autosyn synchro (11, IPL Fig. 1)	Replace synchro.
Friction error and/or position error exceeds tolerance.	a. Pointer assembly (13 or 19, IPL Fig. 1) not secure on Autosyn synchro shaft.	a. Check pointer for security. Correct as necessary.
	b. Defective Autosyn synchro (11, IPL Fig. 1)	b. Replace synchro.
Pointer assembly (13 or 19, IPL Fig. 1) not at EZ mark when EZ is applied.	Pointer assembly (13 or 19, IPL Fig. 1) loose on shaft.	Press pointer assembly on shaft securely.
Indicator will not operate.	Improper wiring connection.	Check electrical connections. Check indicator for loose or broken wires.
Indicator fails sealing test	Leaky solder joint on indicator cap, eyelet, or front glass seal.	Locate leak, open indicator, repair leak, and reseal.

10. Storage Instructions

NOTE: Unit in storage (or inoperative in aircraft) beyond specified time limits must be inspected, lubricated, and tested prior to installation or use.

A. The indicator may be stored for 12 months (maximum) provided the following conditions prevail.

CAUTION: IF THESE CONDITIONS ARE NOT OBSERVED, SHELF LIFE WILL BE CONSIDERABLY SHORTENED.

(1) Storage area must be dry.

(2) Unit must not be subjected to extremely high temperatures.

(3) Unit must be effectively protected from dust.

(4) Unit must be handled with care at all times.

(5) Unit should be stored in shipping container.

11. Special Tools, Fixtures and Equipment

Table 1001 lists the special tools and Table 1002 lists the equipment needed to perform the procedures in this manual. If the listed equipment is not available, equivalent substitutes may be used.

Table 1001. Special Tools

PART/MODEL NO.	NOMENCLATURE	APPLICATION
24-038	Test Port and Roughing Station, Consolidated Electro-Dynamics Corp. Rochester, NY 14603	Accessory to leak detector Model 24-120-B
24-120B	Helium Leak Detector Consolidated Electro-Dynamics Corp. Rochester, NY 14603	Helium leak detector
25	Vacuum Pump Central Scientific Co. Central, IL 60690	Evacuate case of indicator
310A	Pointer Remover Hammel Riglander & Co. New York, NY 10014	Remove pointer assembly
13693-1-B	Hermetic Sealing Stand Bendix Flight Systems Div. Teterboro, NJ 07608	Evacuate, fill, leak test, and seal indicator

Table 1002. Test Equipment

PART/MODEL NO.	NOMENCLATURE	APPLICATION
13695-2-A	Precision Autosyn Transmitter Test Set Bendix Flight Systems Div. Teterboro, NJ 07608	Test synchro

12. Illustrated Parts List

A. Introduction

(1) Purpose

This parts list is intended for use in requisitioning, storing, and issuing the replaceable parts of the Fuel Flow Indicator, part number 3571810-0003 (old type No. 25510B25B8A3) Fuel Flow Indicator, part number 3571810-2001 (old type No. 25514B25A3A3), and Speed Break Indicator, part number 3571810-8001 (old type No. 25516C96A14A3).

(2) Effectivity Code Symbols

Since more than one part number is covered in one or more of the parts lists, an effectivity code is included to identify each specific part with its corresponding assembly. If no effectivity code letter is used, the part is common in all units.

(3) How To Use This Parts List

(a) When the part number is not known, locate the part on the illustration and note its item number. Use this item number to locate the part number in the Detailed Parts List, Paragraph 12C.

(b) When the part number is known, but the location on the illustration is not known, find the part number in the Numerical Index, Paragraph 12B, and note the figure and item number. Use this figure and item number to locate the part in the Detailed Parts List, Paragraph 12C. If the Detailed Parts List indicates that the part is illustrated, locate the part on the illustration by its item number.

(4) Bendix Flight Systems Division Part Numbering System

The part number consists of a basic number and a dash number. The dash number indicates variations of the basic part.

(5) Vendor's Code

Parts obtainable from vendors other than the Allied Corporation are listed (by the vendor's part number) in the part number column. The vendor's code number is listed in the nomenclature column, and the Bendix part number is listed for reference purposes following the vendor's code.

NOTE: Inclusion of vendor part numbers and vendor codes in the nomenclature column for Bendix Flight Systems Division controlled parts is for information purposes only and does not authorize direct procurement from those sources.

Code	Name and Address
V55972	Allied Corp. Bendix Flight Systems Division Teterboro, NJ 07608
V57771	Edwin B. Stimpson Co., Inc. 900 Sylvan Ave. Bayport, NY 11705
V79136	Waldes Kohinoor, Inc. 47-16 Austel Place Long Island City, NY 11101
V99017	Protective Closures Co., Inc. Caplugs Div. 2150 Elmwood Ave. Buffalo, NY 14207

B. Numerical Index

	PART NUMBER	AIRLINE PART NO	FIG. ITEM	TTL REQ
	AY110RH113A1		(See 3563110-0021)	
	AY1101-17131		(See 1497552-0001 or 3563110-0002)	
R	AN935-4L		1 29	2
	A1566		1 5	1
	EC10		1 2	1
	EC14		1 2	1
R	1206677-0001		1 39	1
	1206680-0001		1 12	1
R	1480638-0002		1 35	2
R	1480981-0002		1 19	1
R	1482043-0001		1 34	2
R	1483269-0001		1 32	1
R	1484850-0001		1 -20	1
R	1484856		1 37	1
	1485329-0004		1 3	1
R	1485809-0001		1 30	1
R	1486094-0001		1 21A	1
	1486557-0004		(See 3563110-0002)	
	1486557-0011		(See 3563110-0021)	
	1488916-0001		1 -24	R
			1 36	1 R
	1489206-0010		(See EC14)	
	1489206-0012		(See EC10)	
	1489266-0002		1 25	2 R
	1489266-0140		1 15	2
	1489266-0141		1 15	2
	1489278-0502		1 8	1
	1489278-0505		1 8	1
	1490125-0001		1 -23	R
			1 26	1 R
	1490327-0002		1 40	1
	1490327-0003		1 40	1 R
	1490329-0002		1 9	1
	1490329-0005		1 9	1
	1490333-0002		1 10	1

B. Numerical Index

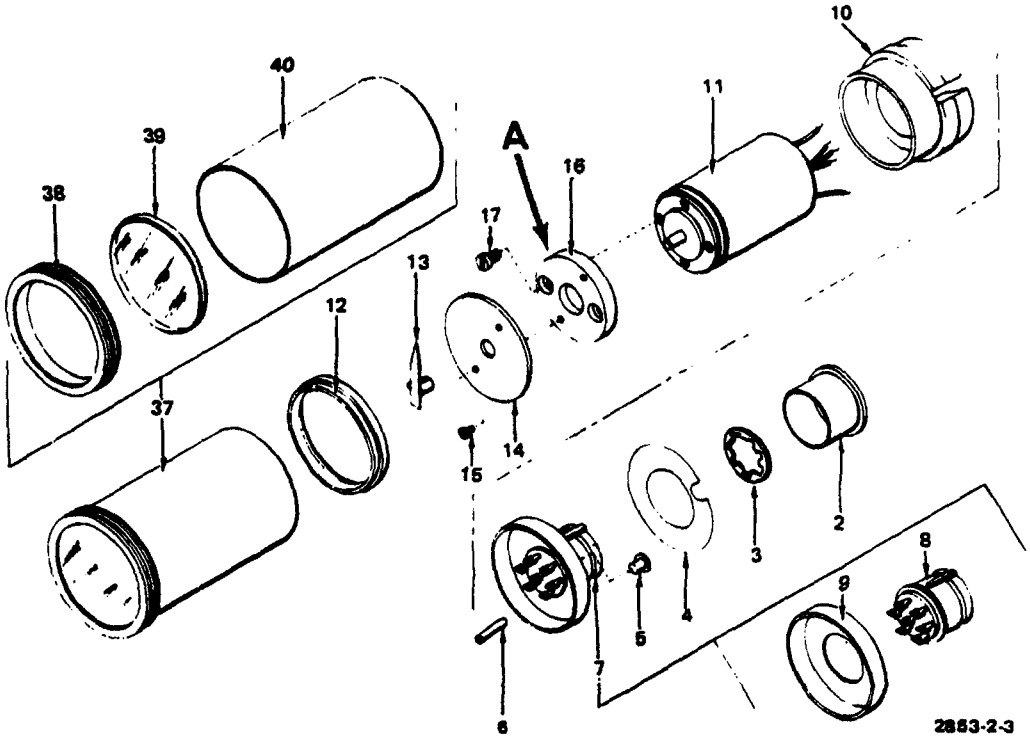
	PART NUMBER	AIRLINE PART NO	FIG. ITEM	TTL REQ
R	1490333-0003		1 10	1
	1490891-0001		1 8	1
	1492016-0001		1 13	1
	1492271-0001		1 7	1
	1492271-0002		1 7	1
	1492272-0040		1 4	1
R	1492374-0006		1 37	1
R	1492724-1		1 27	
	1492991-0001		(See A1566)	
R	1493215-0001		1 38	1
R	1493215-0002		1 38	1
R	1494203-000		1 39	1
	1494307-0007		1 12	1
	1494326-0004		1 4	1
	1494327-0001		1 7	1
	1496929-0001		1 13	1
	1497818-0000		1 11	1
R	2270317-0000		1 4	1
R	2270666-0002		1 -18	1
R	2270735-0001		1 -21	1
R	2270736-0001		1 19	1

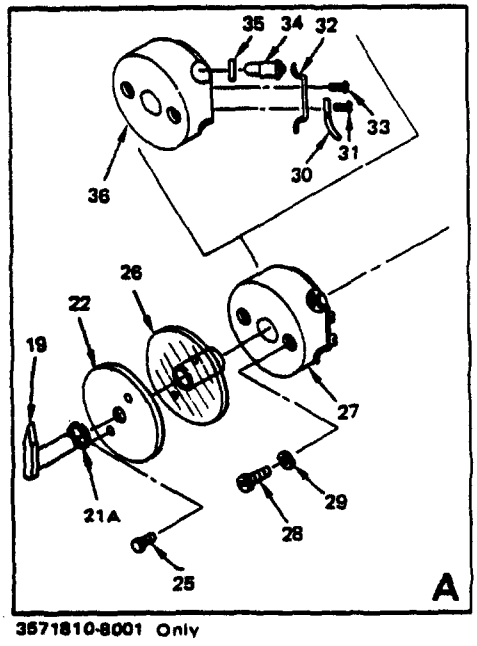
	PART NUMBER	AIRLINE PART NO	FIG. ITEM	TTL REQ	
	2271188-0001		(See 3571810-2001)		
	2271210-0001		(See 3571810-0003)		
	2271210-8001		1 14	1	
	2271210-8002		1 14	1	
	2271243-0001		1 12	1	R
	2271392-0001		(See 3571810-8001)		R
	2271392-8004		1 22	1	R
	2277594-1		1 -20	1	R
	2277595-001		1 19	1	R
	2277596-10		1 -18	1	R
	2277597-1		(See 3571810-8001)		R
	25510B25B8A3		(See 3571810-0003)		
	25514B25BA3A3		(See 3571810-2001)		
	3012041-2120		1 28	2	R
	3016040-6120		1 17	2	

B. Numerical Index

	PART NUMBER	AIRLINE PART NO	FIG. ITEM	TTL REQ
R	3026010-4120		1 31 1 33	1
	3070110-0140		1 6	5
	3070110-1040		1 6	4
	3563110-0002		1 11	1
	3563110-0021		1 11	1
	3563110-2001		1 11	1
	3571810-0003		1 1	1
	3571810-2001		1 1	1
R	3571810-8001		1 1	1
	5105-87H		(See 1485329-0004)	

PART NUMBER	AIRLINE PART NO	FIG. ITEM	TTL REQ





Indicator - Exploded View
IPL Figure 1

C. Detailed Parts List

	FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY
	1 - 1	3571810-0003	INDICATOR ASSY - Fuel flow, dwg No. 2271210-0001 (old type No.25510B25B8A3)		1
	1 - 1	3571810-2001	INDICATOR ASSY - Fuel flow, dwg. No. 2271188-0001 (old type No.25514B25A3A3)	B	1
R	1 - 1	3571810-8001	INDICATOR ASSY - Speed break, dwg. No. 2271392-1, serial Nos. 1 to 8102199 (old type No. 25516C9A14A3)	C	1
R	1 - 1	3571810-8001	INDICATOR ASSY - Speed break, dwg. No. 2277597-1, serial No. 8103101 on up (old type No. 25516C9A14A3)	D	1
R	2	EC14	. CAP - Shipping (V99017) (55972 pn 1489206-0010)	A,C,D	1
	2	EC10	. CAP - Shipping (V99017) (55972 pn 1489206-0012)	B	1
	3	1485329-0004	. RING - Retaining (Source controlled from pn 5105-87H made by V79136)		1
	4	1492272-0040	. PLATE - Identification	A	1
	4	1494326-0004	. PLATE - Identification	B	1
R	4	2270317-0000	. PLATE - Identification	C,D	1
	5	A1566	. EYELET - Closed end (V57771) (55972 pn 1492991-0001)		1
	6	3070110-1040	. TUBING - Electrical insulating	A	4
	6	3070110-0140	. TUBING - Electrical insulating	B	5
	7	1492271-0001	. END COVER ASSY	A	1
	7	1494327-0001	. END COVER ASSY	B	1
R	7	1492271-0002	. END COVER ASSY	C,D	1
	8	1489278-0502	. . CONNECTOR - Receptacle,electrical	A	1
	8	1490891-0001	. . CONNECTOR - Receptacle,electrical	B	1
R	8	1489278-0505	. . CONNECTOR - Receptacle,electrical	C,D	1
R	9	1490329-0002	. . COVER - Rear	A,C,D	1
	9	1490329-0005	. . COVER - Rear	B	1
R	10	1490333-2	. RING - Compression	A,B	1
R	10	1490333-3	. RING - Compression	C,D	1
	11	3563110-0002	. SYNCHRO ASSY - Auto-syn, dwg No. 1486557-0004(old type No. AY1101-17B1)	A,B	1
	11	3563110-0021	. SYNCHRO ASSY - Auto-syn, dwg No. 1486557-0111 (old type No. AY110RH113A1)	A	1
R	11	1497818-0000	. SYNCHRO ASSY - Auto-syn.	C	1
R	11	3563110-2001	. SYNCHRO ASSY - Auto-syn	D	1

- Item not illustrated

	FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY
	12	1494307-0000	. SPACER - Dial	A	1
	12	1206680-0001	. SPACER - Dial	B	1
R	12	2271243-0001	. SPACER - Dial	C,D	1
	13	1496929-0001	. POINTER ASSY	A	1
	13	1492016-0001	. POINTER ASSY	B	1
	14	2271210-8001	. DIAL - Fuel flow	A	1
	14	2271210-8002	. DIAL - Fuel flow	B	1
			ATTACHING PARTS		
	15	1489266-0141	. SCREW - Dial	A	2
	15	1489266-0140	. SCREW - Dial	B	2
			---*---		
R	16	1480981-0002	. PLATE - Dial	A,B	1
			ATTACHING PARTS		
R	17	301604-0-6120	. SCREW - Plate	A,B	2
			---*---		
R	-18	2270666-0002	. MATCHED LIGHTING PARTS	C	1
R	-18	2277596-10	. MATCHED LIGHTING PARTS	D	1
R	19	2270736-0001	. . POINTER AND HUB ASSY *	C	1
R	19	2277595-1	. . POINTER ASSY *	D	1
R	-20	1484850-0001	. . . POINTER *	C	1
R	-20	2277594-1	. . . POINTER *	D	1
R	-21	2270735-0001	. . . HUB *	C	1
R	21A	1486094-0001	. . . RETAINING RING	D	1
R	22	2271392-8004	. . DIAL - Speed break *	C,D	1
R	-23	1490125-0001	. . FILTER - Red *	C	REF
R	-24	1488916-0001	. . BLOCK - Diffuser *	C,D	REF
R	25	1489266-0002	. SCREW - Dial	C,D	2
R	26	1490125-0001	. FILTER - Red	C,D	1
R	27	1492724-1	. DIFFUSER ASSY	C,D	1
			ATTACHING PARTS		
R	28	3012041-2120	. SCREW - Diffuser assy	C,D	2
R	29	AN935-4L	. WASHER, LOCK - Diffuser assy	C,D	2
			---*---		
R	30	1485809-0001	. . LUG - Terminal	C,D	1
			ATTACHING PARTS		
R	31	3026010-4120	. . SCREW	C,D	1
			---*---		
R	32	1483269-0001	. . CONTACT - Spring	C,D	1
			ATTACHING PARTS		
R	33	3026010-4120	. . SCREW	C,D	1
			---*---		
R	34	1482043-0001	. . LAMP - Miniature	C,D	2
R	35	1480638-0002	. . RING - Contact	C,D	2
R	36	1488916-0001	. . BLOCK - Diffuser	C,D	1
R	37	1492374-0006	. CASE, BEZEL, AND GLASS ASSY	A,B	1

- Item not illustrated

*Component of matched assy - for replacement procure nha

	FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	EFFECT CODE	UNITS PER ASSY
R	37	1484856-0002	. CASE, BEZEL, AND GLASS ASSY	C,D	1
R	38	1493215-0001	. . BEZEL - Indicator	A,B	1
R	38	1493215-0002	. . BEZEL - Indicator	C,D	1
R	39	1206677-0001	. . GLASS - Cover	A,B	1
R	39	1494203-000	. . GLASS - Cover	C,D	1
R	40	1490327-0002	. . CASE	A,B	1
R	40	1490327-0003	. . CASE	C,D	1

- Item not illustrated

S.A.V. Ref:- 3328A
Manual Ref:-
77-20-205/5

SMITHS INDUSTRIES LIMITED
AVIATION DIVISION

SERVICE BULLETIN

PRODUCT SUPPORT CENTRE, Northolt Road, Heathrow Airport London, Hounslow, Middlesex
Telephone 01-759 9121, Telex 25662, Telegrams Avtechserv London Telex, Cables Avtechserv London

ENGINE INDICATING - MILLIVOLTMETER TEMPERATURE INDICATORS (GRADED SCALE) TO IMPROVE TEMPERATURE COMPENSATION OF THE MOVING COIL MOD. 02

1. PLANNING INFORMATION

A. Effectivity

Unit affected:- Millivoltmeter Temperature Indicator (Graded Scale).

Code:- */727 MV/BU/* series (except */727 MV/BU/42/690), */762 MV/BU/* series.

B. Reason
The present combination of the thermistor and shunt of the moving coil could cause the unit to indicate maximum specification tolerances over the operating ambient temperatures.

C. Description
The value of the thermistor is changed, which improves temperature compensation of the moving coil and prevents the unit indicating maximum specification tolerances over operating ambient temperatures.

D. Compliance
Optional.

E. Approval
This modification is issued under A.R.B. Authority Reference No. AD/1017/39.

F. Manpower
Not applicable.

G. Material
Not applicable.

H. Tooling
No special tools are required.

I. Weight
Unit weight change ..... None.

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J. References
Overhaul Manual 77-20-205/5.

2. ACCOMPLISHMENT INSTRUCTIONS

The incorporation of this modification will be by the manufacturer, on request.

S.A.V. Ref:- 2974
Manual Ref:-
77-20-205/5

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ENGINE INDICATING - GRADED LONG SCALE MOVING COIL INDICATOR

INTRODUCTION OF COLD JUNCTION WITHIN THE INSTRUMENT CASE

MOD. 01

1. PLANNING INFORMATION

A. Effectivity

Unit affected:- Graded Long Scale Moving Coil Indicator.

Code:- */727 MV/BU/* series, */762 MV/BU/* series.

B. Reason

To reduce time lag between a change in ambient temperature and the correct temperature being indicated.

C. Description

The Cold Junction, which was formally externally fitted, is now incorporated within the case of the instrument.

D. Compliance

Optional.

E. Approval

This modification is issued under A.R.B. Authority Reference No. AD/1017/39.

F. Manpower

This modification will take no extra man hours if undertaken during overhaul.

G. Material

The following parts will be required for this modification and can be supplied as a modification kit:-

727 MV/BU/30 only

Part No.	Description	Qty.
MV 6204	Terminal Block Assy.	1
MV 6209	Case Back Assy. Cpte.	1

All other codes

Part No.	Description	Qty.
MV 6203	Terminal Block Assy.	1
MV 6207	Case Back Assy. Cpte.	1

All codes

Part No.	Description	Qty.
1817-456-07	Symel Silicone Sleeve (Red)	A/R
1817-456-15	Symel Silicone Sleeve (Black)	A/R

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H. Tooling

No special tools are required.

I. Weight

Unit weight change ..... None.

J. References

Overhaul Manual - 77-20-205/5.

K. Availability

Production - September, 1969.
Retrospective - September, 1969.

2. ACCOMPLISHMENT INSTRUCTIONS

A. Embodiment Instructions

(1) Disassemble the unit in accordance with instructions in the Overhaul Manual 77-20-205/5 . Discard the old case back and terminal block assembly.
(2) Proceed with Assembly using the new case back assembly.
(3) Fit the sleeving (supplied in the Mod. Kit) over each of the Chromel and Alumel wires (Red for Chromel and Black for Alumel - see FIG.1).
(4) Using the new terminal block, feed the two sleeved wires through the two 'A' holes in the terminal block and solder to the inserts (see FIG.2). The Chromel wire is connected to the +ve terminal.
NOTE: The length of these wires is important and they must not be shortened.
(5) Complete Assembly and test the unit as instructed in the Overhaul Manual 77-20-205/5.

B. Method of Identification

Mark the modification label to show that Mod. 01 has been incorporated.

S.A.V. Ref:- 2974
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ENGINE INDICATING - GRADED LONG SCALE MOVING COIL INDICATOR

INTRODUCTION OF COLD JUNCTION WITHIN THE INSTRUMENT CASE

MOD. 01

3. MATERIAL INFORMATION

New Part No.	Qty Per Assy.	Key Word	Old Part No.	Instruction-Disposition
A. The modification kit consists of the following parts:-				
727 MV/BU/30 only				
MV 6204	1	.Block Assy. Terminal	MV 5166	Old Parts Redundant
MV 6209	1	.Case Assy., Back	MV 5170	
All other codes				
MV 6203	1	.Block Assy. Terminal	MV 3327	
MV 6207	1	.Case Assy., Back	MV 4371	
All codes				
1817-456-07	A/R	.Sleeving, silicone (Red)	-	New Items
1817-456-15	A/R	.Sleeving, silicone (Black)	-	

B. Parts to be reworked or recoded:-

Nil.

C. The following parts will be made available as future spares:-

Those parts quoted in 'A', above.

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Manual Ref:-
77-20-205/5

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ENGINE INDICATING - GRADED LONG SCALE MOVING COIL INDICATOR

INTRODUCTION OF COLD JUNCTION WITHIN THE INSTRUMENT CASE

MOD. 01

FIG. 1.

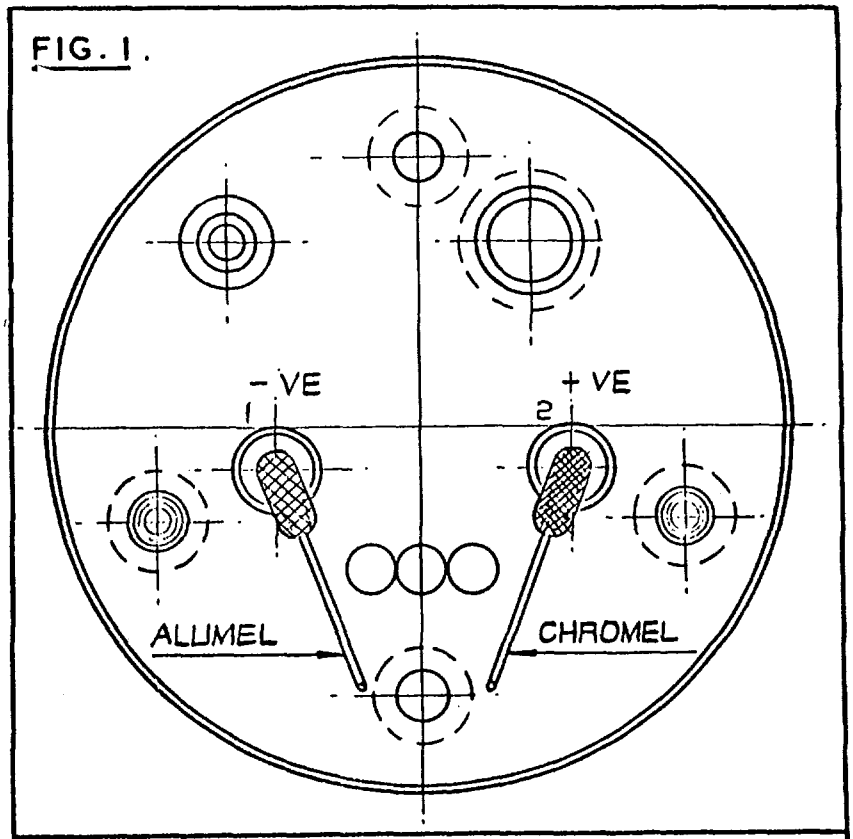
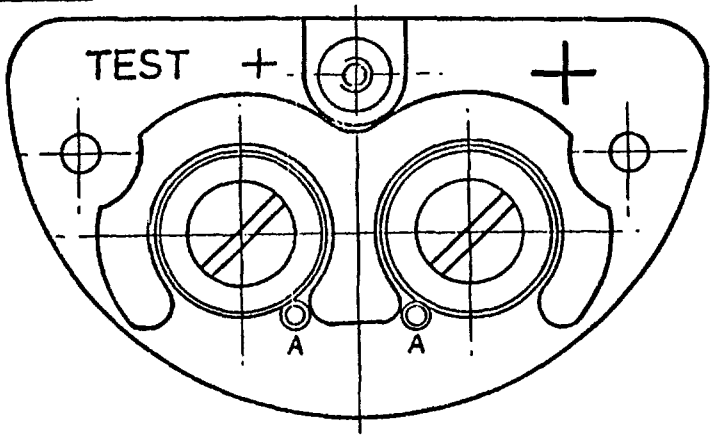


FIG. 2.



POSITION OF CHROMEL AND ALUMEL WIRES ON THE CASE BACK & TERMINAL BLOCK.

EDISON

OVERHAUL MANUAL

No. 1085-5E

TORQUE PRESSURE INDICATOR

Part No. 217-03221

INSTRUMENT DIVISION
THOMAS A. EDISON INDUSTRIES
McGRAW-EDISON COMPANY

WEST ORANGE, NEW JERSEY, U. S. A.

March 1, 1967

Printed in U.S.A.

TORQUE PRESSURE INDICATOR NO. 217-03221

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TORQUE PRESSURE INDICATOR NO. 217-03221

GENERAL INFORMATION

1. Introduction

This manual contains instructions for the overhaul of EDISON Aircraft Torque Pressure Indicator, part No. 217-03221.

It is prepared in accordance with ATA Specification No. 100 including the Uniform Chapterization and Numbering System designated therein so that the pages may be inserted into their proper locations in the basic aircraft overhaul manual if desired.

All of the material in this manual falls within the classification "Engine Indicating - Chapter 77".

2. List of Effective Pages

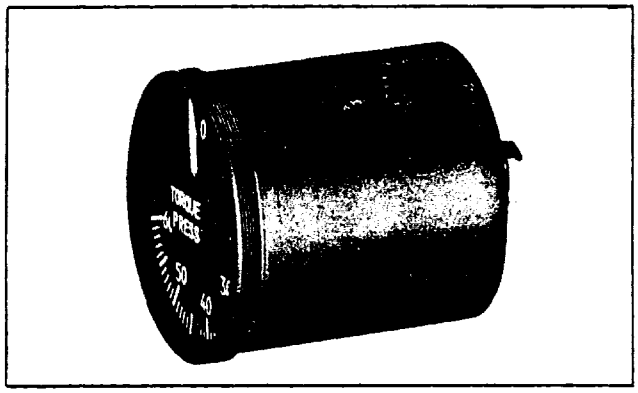
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TORQUE PRESSURE INDICATOR NO. 217-03221

OVERHAUL INSTRUCTIONS

1. Description and Operation

The pressure indicator covered by these overhaul instructions is part of the EDISON variable reluctance type Torque Pressure Indicating System. (Ref. Fig. 1)



The Indicator
Figure 1

Table of Leading Particulars
Power Supply .. 26 V single phase 400 Hz
Pressure Range ..... 0 to 60 psi

It is an hermetically sealed instrument designed to be secured to an instrument panel by means of a standard mounting clamp. An electrical connector on the rear provides for connection to the transmitter and power supply.

The function of the indicator is to translate into torque pressure the voltage applied to its moving coil by the pressure transmitter. This is accomplished through the use of several simple principles as follows:

A. When the current flows in the same direction through two coils, their magnetic flux is in the same direction. Thus their opposite magnetic poles are next to each other, so the coils are attracted to each other. (Ref. Fig. 2A)

B. When alternating current flows through a coil, the resulting flux cutting across a second coil induces a current within it if its circuit is complete. At any given instant the induced current flows in the direction opposite to the applied current. (Ref. Fig. 2B) Thus the induced fluxes are opposed and the coils repel each other.

C. In the indicator a constant 26 volt 400 hertz current flows through the stationary field coil making a flux pattern through the core and across

TORQUE PRESSURE INDICATOR NO. 217-03221

OVERHAUL INSTRUCTIONS

the air gap. (Ref. Fig. 2C) The flux is strongest near the base of the hook-shaped part of the core and decreases uniformly along its length.

D. The moving coil with attached pointer is pivoted to rotate with the core hook at its center. (Ref. Fig. 2D) Two hairsprings transmit applied voltage to coil and furnish torque to swing pointer off low end of scale when no voltage is applied.

E. When the transmitter applies voltage to the moving coil it causes a current at any given instant to be in the same direction as that in the field coil (in phase).

F. At the same time, since the coils are energized with alternating current, the transformer effect is inducing an opposing voltage (180° out of phase) in the moving coil.

G. If the moving coil is at a position where applied voltage is greater than induced voltage, current will flow in the same direction as that of the field coil and the resulting torque will move the coil toward the base of the hook where the field coil flux is greater. (Ref. Fig. 1E) As it moves the induced voltage increases, the current and resulting torque decrease until the coil comes to rest at the point where applied voltage is just enough greater than induced voltage to overcome hairspring torque.

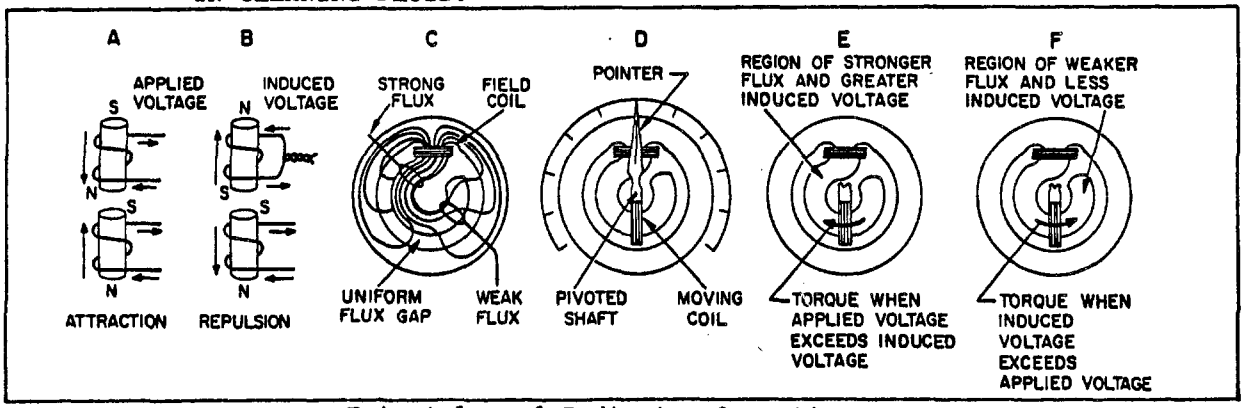
H. If applied voltage decreases below induced voltage, the resulting torque will cause the coil to swing toward the end of the hook until it reaches a point where equilibrium is again achieved. (Ref. Fig. 2F)

I. Because the voltage applied to the moving coil is obtained from two similar inductive, resistive voltage dividers, any variations in power supply voltage cause proportional changes in all voltages involved, hence do not affect the position assumed by the moving coil. (Ref. Fig. 3)

J. In order to compensate for resistance changes in the copper field coils, thermistors are connected in series with them.

2. Disassembly (Ref. Fig. 9)

CAUTION: USE EXTREME CARE TO KEEP DUST, FIBERS AND OTHER FOREIGN MATTER OUT OF SILICONE FLUID IMPREGNATED BEARINGS. DO NOT IMMERSE MECHANISM IN CLEANING FLUID.



Principles of Indicator Operation
Figure 2

TORQUE PRESSURE INDICATOR NO. 217-03221

OVERHAUL INSTRUCTIONS

A. Remove case and mask assembly (6).
   (1) Use induction heater (Ref. Section 11) to unsolder case and mask assembly (6) from base and receptacle assembly (48) of complete movement assembly after stripping paint.

   NOTE: *No further disassembly of case and mask assembly is recommended.*

B. Remove evacuation hole rivet (5).
   (1) Remove the two screws (2) and washers (3, 4) and nameplate (1).
   (2) Unsolder and remove rivet (5) from hole in base and receptacle assembly (48).

   NOTE: No further disassembly of the movement assembly is required to permit cleaning, inspection and check of detail parts. If parts are found to be defective, continue disassembly as required.

C. Remove dial (11)
   (1) Remove dial nut (12), screw (14), washers (13, 15, 16) and bushing (17).
   (2) Tip dial (11) and carefully slide it out from under pointer of rotor and hairspring assembly (24).

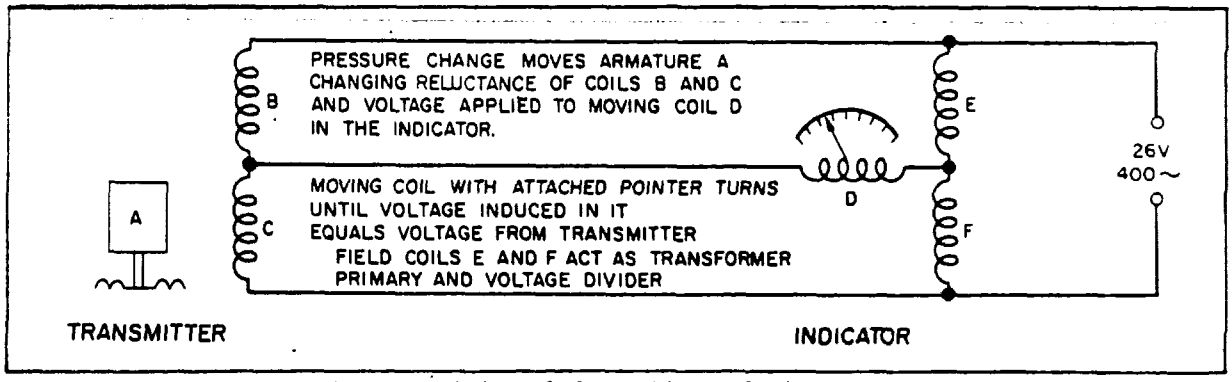
D. Remove rotor balance weights (18, 19).
   (1) Grasp weight (18, 19) with tweezers in manner to straighten the slight bend of the weight so that it may be slipped off of the balance cross of the rotor.

E. Remove front housing and bearing assembly.

   NOTE: If rotor and hairspring assembly (24) is to be removed, delay this step until top plate (22) has been removed.

   (1) Loosen front bearing nut (20).
   (2) Unscrew and remove housing and bearing assembly (21) and nut (20).

F. Remove rotor and hairspring assembly (24).
   (1) Bend cut wire (29), which forms upper snubber, away from rotor shaft to clear outer turn of hairspring (25).
   (2) Unsolder hairsprings (25) from terminal of plate and terminal assembly (28) and board and adjuster assembly (47).



Basic Principle of Operation of the System
Figure 3

TORQUE PRESSURE INDICATOR NO. 217-03221

OVERHAUL INSTRUCTIONS

(3) Remove self-locking nuts (23) and lift off top plate (22) using care not to damage pointer.
(4) Turn and lift out rotor and hairspring assembly (24).

NOTE: Removal of pivots (26) from rotor body assembly (27) is not recommended.

G. Remove hairsprings (25) from rotor and hairspring assembly (24).

H. Remove stator assembly (29-41 assembled) and board and bearing assembly (43-47 assembled).
(1) Lift off top bushings (28).
(2) Unsolder leads from base and receptacle assembly (48).
(3) Lift off stator assembly with board and bearing assembly attached.
(4) Take out bottom bushings (42).
(5) Unsolder fixed coil leads from board and adjuster assembly (44), thus separating stator assembly and board and bearing assembly.

I. Remove fixed coil (40).
(1) Unsolder fixed coil lead from terminal of plate and terminal assy (30).
(2) Unsolder and remove cut wire (29) only if replacement is required.
(3) Remove rivet (32).
(4) Remove plate and terminal assembly (30) and bottom plate (31).
(5) Push out inside core (33).
(6) Remove screws (34, 35), lock washer (36), and shunt nut (37).
(7) Slide shunt (38) and coil bracket (39) from under fixed coil (40).
(8) Slide fixed coil (40) from outside lamination assembly (41).

J. Disassemble board and bearing assembly (43-47 assembled).
(1) Unscrew and remove rear housing and bearing assembly (43).
(2) Unsolder and remove thermistors (45).
(3) Unsolder and remove snubber (46).

3. Cleaning (Ref. Fig. 9)

A. Carefully clean solder from case and mask assembly (6) and base and receptacle assembly (48) so they will be ready for resealing case after assembly.

B. If microscopic inspection of bearings shows hairlike fibers in the bearing cavity, remove with tweezers. Use no other cleaning method on bearings since they are factory impregnated with a special silicone fluid.

C. Vapor degrease all parts made solely of metal, using trichlorethylene.

WARNING: AVOID BREATHING FUMES OR PERMITTING TRICHLORETHYLENE TO CONTACT SKIN.

4. Inspection/Check (Ref. Fig.9)

A. Visual
(1) Check cover glass (9) for cracks or chips.
(2) Check dial (11) for scratches or stains.
(3) Check hairsprings (25) for distortion.
(4) Check pointer of rotor and hairspring assembly (24) for distortion or chipped paint.

TORQUE PRESSURE INDICATOR NO. 217-03221

OVERHAUL INSTRUCTIONS

B. Microscope (30X)
(1) Check pivots (26) for pits, grooves or distortion.
(2) Check housing and bearing assemblies (21, 43) for dents in bearing cap, foreign matter, and loss of clear fluidity of silicone fluid.

C. Ohmmeter
(1) Check moving coil with ohmmeter across adjuster and upper hairspring terminal of assembled indicator, or directly across coil of rotor body assembly (27). Acceptable resistance: 25 ± 8 ohms.
(2) Check fixed coil (40) with ohmmeter across lower terminals. Acceptable resistance: 46 ± 15 ohms.
(3) Check thermistors (45) with ohmmeter across leads. Acceptable resistance at 25°C (77°F): 5.6 ± 0.1 ohm.

5. Repair

Replace all defective or damaged parts.

6. Assembly (Ref. Fig.9)

A. Assemble board and bearing assembly.
(1) Slide snubber (46) to bottom of higher prong of hairspring adjuster of board and adjuster (47). Position the snubber so its projecting wire is over the outer edge of the adjuster, then solder its coil to the adjuster prong.
(2) Place thermistors (45) on lower face of board and adjuster (47) and solder one lead of each together with red or black base connection lead wire (Ref. Fig. 4) in eyelet terminal.
(3) Screw and tighten rear housing and bearing assembly (43) into rear of board and adjuster (47).

B. Assemble stator assembly.
(1) Place fixed coil (40) on hook of outside lamination assembly (41) in position shown. (Ref. Fig. 4)
(2) Slip end of coil bracket (39) between upper face of outside lamination assembly (41) and fixed coil (40).
(3) Slip end of shunt (38) between lower face of outside lamination assembly (41) and fixed coil (40).
(4) Pass screw (35) through lock washer (36), coil bracket (39), outside lamination assembly (41) and shunt (38) and tighten in shunt nut (37).
(5) Pass screw (34) through outer end of shunt and turn it a few turns into shunt nut (37).
(6) Press inside core (33) into outside lamination assembly (41).
(7) Position bottom plate (31) and plate and terminal assembly (30) on previous assembly and secure. Check to be sure holes through plates and inside core are aligned to permit later assembly onto studs of base and receptacle assembly (48).
(8) Make a hook in the end of cut wire (29) as shown and solder it and the center top lead of fixed coil (40) to the neck of the hairspring terminal of plate and terminal assembly (30).

C. Assemble board and bearing assembly and stator assembly on base and receptacle assembly.
(1) Slide board and bearing assembly onto studs.
(2) Slide stator assembly onto studs in position that permits fixed coil leads to run directly down into eyelet terminals with thermistor leads not already soldered in. (Ref. Fig.4)

TORQUE PRESSURE INDICATOR NO. 217-03221

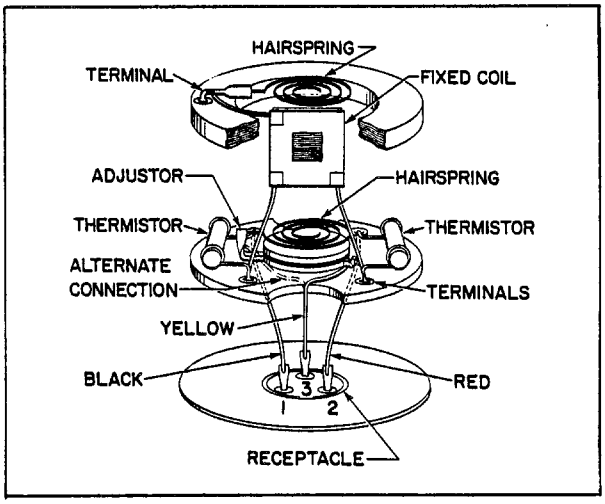
OVERHAUL INSTRUCTIONS

(3) Solder thermistor and fixed coil leads to terminals.
(4) Solder black lead to "1" terminal of receptacle and red lead to "2" terminal.

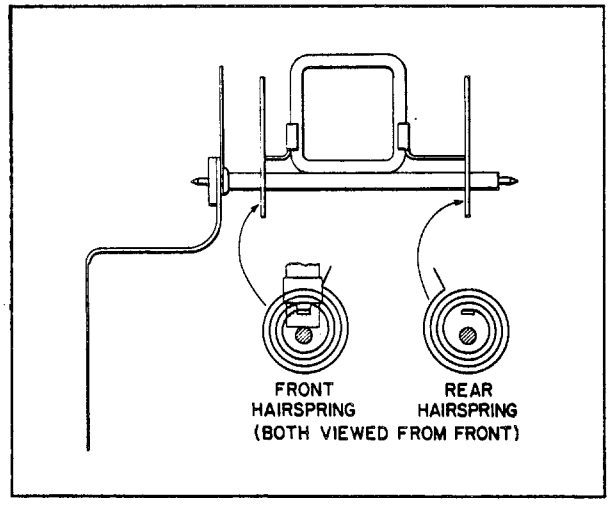
D. Assemble rotor and hairspring assembly.
(1) Solder hairspring (25) to terminals of moving coil on rotor body assembly (27). Ref. Fig. 5)
(2) If necessary, reshape hairspring slightly so that turns are equally spaced and lie in a plane at right angles to rotor shaft.

E. Install rotor and hairspring assembly.
(1) Place rotor and hairspring assembly (24) in stator assembly with hook of outside lamination assembly (41) passing through its moving coil.
(2) Slide top bushing (28) on studs of base and receptacle assembly (48).
(3) Carefully slide tipped top plate (22) over pointer of rotor and hairspring assembly (24) and seat it on studs of base and receptacle assembly (48).
(4) Install and tighten self-locking nuts (23) on studs.
(5) Place front bearing nut (20) on housing and bearing assembly (21).
(6) Screw housing and bearing assembly (21) into top plate (22) and seat pivots (26) of rotor and hairspring assembly (24) in both upper and lower bearings. Be careful pivot is in bearing and not resting against cap of housing.
(7) Adjust housing and bearing assembly (21) to provide 0.001 to 0.002 inch rotor end play, then lock in position by tightening front bearing nut (20). Be careful not to change end play when tightening nut.
(8) Solder hairsprings to their respective terminals. (Ref. Fig. 4)

F. Install dial and adjust movement.
(1) Carefully slide tipped dial (11) over pointer and attach to top plate (22) by means of dial nut (12) and dial screw (14) which passes through dial bushing (17) between dial and top plate. Use washers (13, 15, 16).
(2) Bend upper snubber made from cut wire (29) and lower snubber (46) to position. (Ref. sub-section 7A)



Internal Wiring
Figure 4



Detail of Hairspring Position
Figure 5

TORQUE PRESSURE INDICATOR NO. 217-03221

OVERHAUL INSTRUCTIONS

(3) Bend pointer to position. (Ref. sub-section 7B)
(4) Adjust lower hairspring to proper torque. (Ref. sub-section 7C)
(5) Solder yellow lead to most accessible end of hairspring adjuster.

G. Calibrate the indicator. (Ref. Section 8)

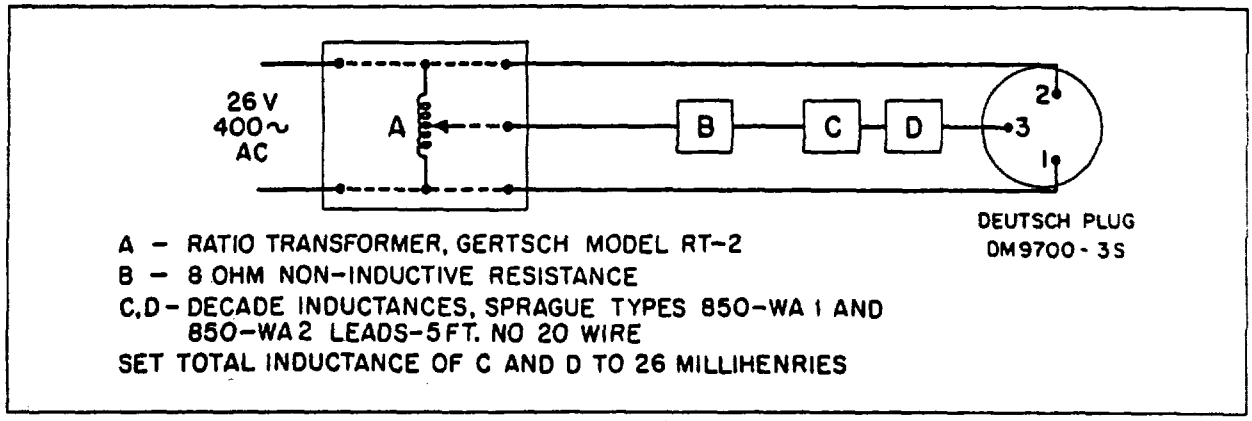
H. Install case and mask assembly and seal indicator.
(1) Install case assembly with mask (7) in proper position over dial (11).
(2) Solder case assembly (8) to base and receptacle assembly (48) with 63-37 resin core solder using induction heater. (Ref. Section 11)
(3) Check to be sure rivet (5) fits hole in base and receptacle assembly (48) but leave out of hole.
(4) Head indicator to 75 ± 5°C (167 ± 9°F) for 30 minutes.
(5) Place indicator in autoclave and evacuate to 200 microns and hold for five minutes.
(6) Admit dry helium, dew point below -55°C (-67°F), to autoclave to pressure of one atmosphere (760 mm mercury).
(7) Re-evacuate to 200 microns then refill with dry helium to one atmosphere of pressure.
(8) Remove indicator from autoclave and immediately place rivet (5) in hole in base and receptacle assembly (48) and seal in place with a minimum of solder.
(9) Touch up case with dull black paint or lacquer.
(10) Using screw (2) and washers (3,4), install nameplate (1).

7. Fits and Clearances

A. Bend snubbers to lie parallel to base, approximately 1/16 inch from hairspring, and approximately 1/32 inch from rotor shaft.

B. Bend pointer so it is parallel with and 0.02 to 0.04 inch from dial, covers half of the length of a minor graduation line and is over offscale reference mark when against low-end stop.

C. With the dial horizontal, rotate the hairspring adjuster to swing the pointer against the low-end stop. Continue turning the adjuster in the down-scale direction an additional 90 to 100 degrees.



Test Circuit
Figure 6

TORQUE PRESSURE INDICATOR NO. 217-03221

OVERHAUL INSTRUCTIONS

8. Testing

A. Calibration Procedures - uncased indicator. (Ref. Fig. 9)

(1) Connect indicator to test circuit. (Ref. Fig.6)
(2) Check to be sure power applied to ratio transformer is 26 ± 0.5 volts, 400 ± 2 hertz.
(3) Set ratio transformer to ".5980".
(4) Holding indicator with dial horizontal, use a screwdriver to avoid moving the housing and bearing assembly (21), loosen dial nut (12).
(5) Loosen dial screw (14).
(6) Rotate dial (11) until pointer indicates 0 psi.
(7) Tighten dial screw (14).
(8) Reduce voltage applied to ratio transformer to 15 volts.
(9) Set ratio transformer to move pointer to exact middle of scale. Since indicator has not yet been calibrated, this will not necessarily be specified mid-scale value.
(10) Install balance weights (18, 19) as required to make pointer position remain unchanged when dial is moved from horizontal to normal vertical operating position, then rotated 90, 180 and 270 degrees.
(11) Increase applied voltage to 26 ± 0.5 volts.
(12) Set ratio transformer to ".5980".
(13) With indicator in normal operating position, if necessary, loosen dial screw (14) and rotate dial until pointer indicates 0 psi, then tighten dial screw (14).
(14) Set ratio transformer to ".4020".
(15) Turn shunt adjusting screw (34) to open or close the shunt (38) until the pointer indicates 60 psi. If necessary, remove and discard screw (34) and bend shunt (38) to obtain correct pointer position.
(16) Set ratio transformer to "5600", then turn power off. If pointer fails to swing off low end of scale without tapping, increase lower hairspring tension as required. Test the indicator in all four dial vertical positions and with dial horizontal.
(17) Check indications at all test values. (Ref. Fig. 7)
(18) Repeat steps 13 and 15 as required to bring all indications within tolerance.
(19) Holding housing and bearing assembly (21) with screwdriver, tighten dial nut (12).
(20) Place a drop of glyptal on shunt screw (34), if used, to seal it in place.

Transformer Setting	Indicated PSI	Tolerance ± PSI	Transformer Setting	Indicated PSI	Tolerance ± PSI
.5980	0	0.9	.4666	40	0.2
.5648	10	0.6	.4344	50	0.3
.5312	20	0.6	.4020	60	0.6
.4989	30	0.3			
Friction Test Tolerance: ± 0.35 psi			Position Error Tolerance: ± 0.30 psi		

Test Values
Figure 7

TORQUE PRESSURE INDICATOR NO. 217-03221

OVERHAUL INSTRUCTIONS

B. Test Procedure - sealed indicator.

(1) Connect the indicator to test circuit. (Ref. Fig. 6)
(2) Check to be sure power supply to ratio transformer is 26 ± 0.5 volts, 400 ± 2 hertz.
(3) With indicator at room temperature and with dial in normal operating position, successively set ratio transformer at each test value shown in Figure 7. Notice indication before and after lightly tapping the indicator. The difference caused by tapping shall not exceed specified Friction Test Tolerance, nor shall the indication after tapping be out of tolerance for the test value involved.
(4) Set ratio transformer to mid-scale value and note pointer position after tapping. Rotate indicator 90, 180 and 270 degrees, then to position with dial horizontal. The difference between the indication in normal position and any other position shall not exceed specified Position Error Tolerance. (Ref. Fig. 7)
(5) Turn off power supply. Pointer shall swing off scale without tapping.

9. Trouble Shooting

The only troubles which occur in an indicator, other than external physical damage, cause failure to pass test specified in sub-section 8B. When it has been determined in which test the trouble occurs, the indicator must be opened (Ref. sub-section 2A) after which possible causes as listed in Figure 8 may readily be checked to isolate the trouble.

TROUBLE	PROBABLE CAUSE	REMEDY
SCALE ERROR TEST		
POINTER OFF SCALE AT ALL VALUES	Open lead or leads	Connect or replace lead
	Open hairspring	Connect or replace hairspring
	Open moving coil	Replace rotor assembly
POINTER SLAMS LOW	Shorted moving coil	Replace rotor assembly
POINTER SLAMS HIGH OR LOW	Open fixed coil	Replace coil
	Open lead	Connect or replace lead
	Open thermistor	Replace thermistor
ERROR AT LOW VALUES	Incorrect zero and span adjustment	Readjust
ERROR AT HIGH VALUES	Incorrect span adjustment	Readjust
ALL READINGS EQUALLY HIGH OR LOW	Incorrect zero adjustment	Readjust
ERROR AT INTERMEDIATE VALUES	Irregular air gap in lamination	Replace inside core, outside lamination assy, or both
POWER FAILS TO RETURN OFF SCALE	Rotor assembly unbalanced	Rebalance rotor assembly
	Incorrect hairspring adjustment	Increase hairspring tension
	Incorrectly shaped pointer	Bend to proper shape
FRICTION TEST EXCESSIVE ERROR	Pivot out of bearing	Adjust position
	No end play	Adjust end play
	Defective pivots	Replace pivots
	Defective or dirty bearings	Replace housing and bearing assembly
	Lint in air gap	Clean
POSITION ERROR TEST EXCESSIVE ERROR	Rotor assembly unbalanced	Rebalance rotor assembly
POINTER FAILS TO RETURN OFF SCALE IN SOME POSITIONS	Rotor assembly unbalanced	Rebalance rotor assembly
	Incorrectly shaped pointer	Bend to proper shape

Trouble Shooting Chart
Figure 8

TORQUE PRESSURE INDICATOR NO. 217-03221

OVERHAUL INSTRUCTIONS

10. Storage Instructions

No special storage requirements apply to this indicator. It is an hermetically sealed unit subject only to damage from rough handling.

11. Special Tools, Fixtures, and Equipment

Autoclave (4 qt. home pressure cooker - modified, add connector and valve) ("Mirro-Matic" or equivalent)

Vacuum Pump (Central Sci. Co., Chicago, Ill. "Cenco-Magnavac" or equivalent)

Induction Heater, 3 KW, RF (McDowell Electronics Inc., Metuchen, N.J., Model 3KW-2 or equivalent)

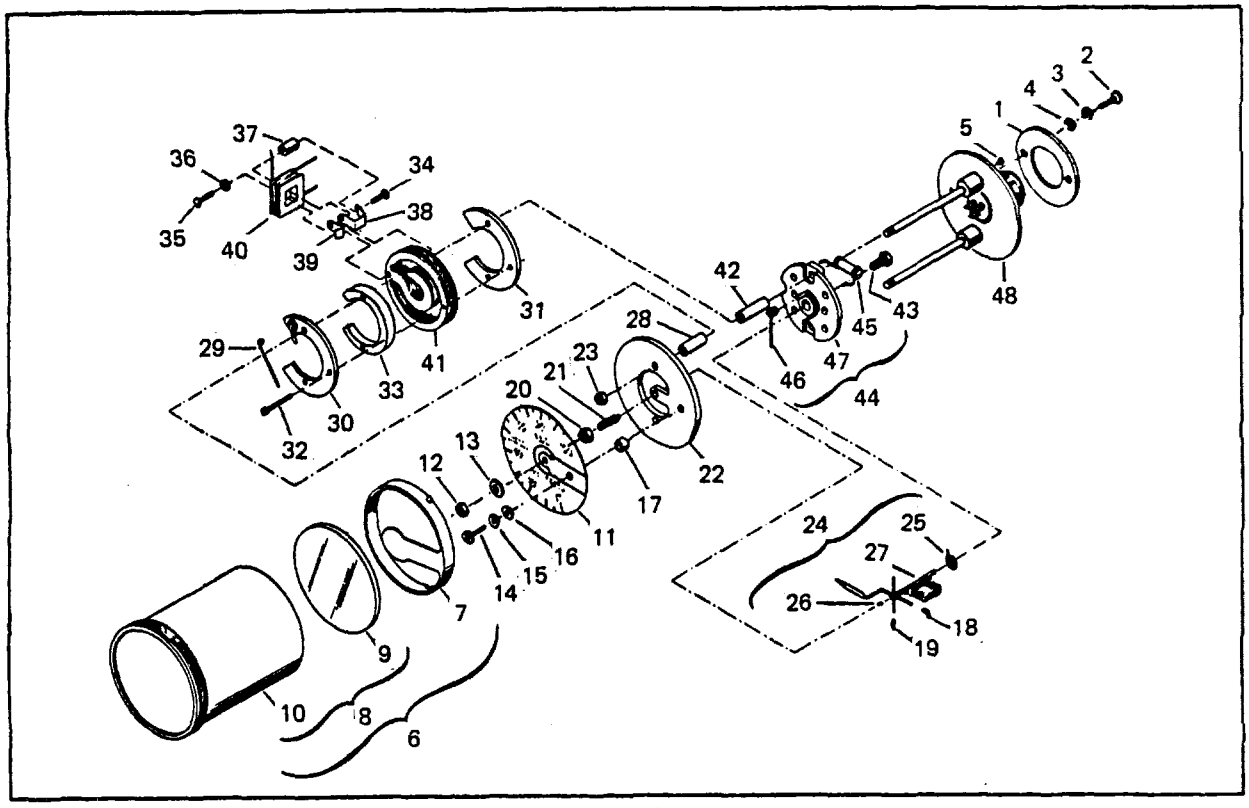
Ratio Transformer (Singer Metrics Inc., Los Angeles, Calif. Gertsch Model RT-2)

Resistor - 8 ohm non-inductive

Decade Inductances (Sprague Elec. Co., North Adams, Mass., Types 850-WA1 and 850-WA2 - one of each required)

TORQUE PRESSURE INDICATOR NO. 217-03221

ILLUSTRATED PARTS LIST



Exploded View
Figure 9

Figure & Index No.	Part Number	1 2 3 4 5 6 7 Nomenclature	Usage Code	Units per Assy
	217-03221	Indicator - Torque pressure		Ref.
9-1	24086-75	. Nameplate - Indicator		1
		ATTACHING PARTS		
-2	10406	. Screw		2
-3	MS35338-77	. Washer - Lock		2
-4	13120-2	. Washer - Flat		2
		***		
-5	14411	. Rivet (Altered from AN427C2-2 by tin plating)		1
-6	No Number	. Case and Mask Assembly		Ref.
-7	60133	. . Mask - Dial		1
-8	41718-3	. . Case Assembly		1
-9	22964	. . . Glass - Cover		1
-10	No Number	. . . Case and Bezel Assembly		Ref.
9-	43185	. Movement Assembly		Ref.
-11	60119	. . Dial		1
		ATTACHING PARTS		
-12	10803	. . Nut - Dial		1
-13	AN935-3L	. . Washer - Lock		1

TORQUE PRESSURE INDICATOR NO. 217-03221

ILLUSTRATED PARTS LIST

Figure & Index No.	Part No.	1 2 3 4 5 6 7 Nomenclature	Usage Code	Units per Assy
9-14	14933	. . Screw - Dial		1
-15	14242	. . Washer - Lock		1
-16	25465	. . Washer - Flat		1
-17	22950	. . Bushing - Dial		1
		***		
-18	10254-1	. . Weight - Rear balance		AR
-18	10254-2	. . Weight - Rear balance		AR
-18	10254-3	. . Weight - Rear balance		AR
-18	10254-4	. . Weight - Rear balance		AR
-18	10254-5	. . Weight - Rear balance		AR
-19	10255-1	. . Weight - Side balance		AR
-19	10255-2	. . Weight - Side balance		AR
-19	10255-3	. . Weight - Side balance		AR
-19	10255-4	. . Weight - Side balance		AR
-20	23517	. . Nut - Front bearing		1
-21	41742	. . Housing and Bearing Assy - Front		1
-22	23953	. . Plate - Top		1
		ATTACHING PARTS		
-23	60FM-264	. . Nut - Self-locking (Standard Pressed Steel Co.) (Edison No. 14254)		2
		***		
-24	41876-2	. . Rotor and Hairspring Assy		1
-25	22944	. . . Hairspring		2
-26	22936	. . . Pivot		2
-27	No Number	. . . Rotor Body Assembly		Ref.
-28	23554	. . Bushing - Top		2
	No Number	. . Stator Assembly		Ref.
-29	23996	. . . Wire - Cut		1
-30	41474	. . . Plate and Terminal Assy		1
-31	23553	. . . Plate - Bottom		1
		ATTACHING PARTS		
-32	15085	. . . Rivet - Oval head tubular ...		1
		***		
-33	42703	. . . Core - Inside		1
	41466	. . . Coil and Lamination Assy		1
-34	AN520UBO-2	. . . . Screw		1
-35	AN520-0-6	. . . . Screw		1
-36	14242	. . . . Washer - Lock		1
-37	22933	. . . . Nut - Shunt		1
-38	22932	. . . . Shunt		1
-39	22942	. . . . Bracket - Coil		1
-40	41461	. . . . Coil - Fixed		1
-41	41473	. . . . Lamination Assy - Outside.		1
-42	23555	. . Bushing - Bottom		2
	No Number	. . Board and Bearing Assy		Ref.
-43	41723	. . . Housing and Bearing Assy-Rear		1
-44	41738	. . . Board and Adjuster Assy		1
-45	LA-4.8-218	. . . . Thermistor (Keystone Carbon Co.) (Edison No. 14241)		2
-46	23994	. . . . Snubber		1
-47	No Number	. . . . Board and Adjuster		Ref.
-48	43162	. . Base and Receptacle Assy		1

EDISON®

OVERHAUL MANUAL

No. 1085-5W

TORQUE PRESSURE INDICATOR

Part No. 217-09261

INSTRUMENT DIVISION
THOMAS A. EDISON INDUSTRIES
McGRAW-EDISON COMPANY

WEST ORANGE, NEW JERSEY, U. S. A.

July 1, 1972

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Instrument Division
WEST ORANGE, NEW JERSEY 07051

Overhaul Manual 1085-5W

TORQUE PRESSURE INDICATOR NO. 217-09261

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Thomas A. Edison
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TORQUE PRESSURE INDICATOR NO. 217-09261

GENERAL INFORMATION

1. Introduction

This Manual contains instructions for the overhaul of EDISON Aircraft Torque Pressure Indicator, part No. 217-09261.

It is prepared in accordance with ATA Specification No. 100 including the Uniform Chapterization and Numbering System designated therein so that the pages may be inserted into their proper locations in the basic aircraft overhaul manual if desired.

All of the material in this manual falls within the classification "Engine Indicating - Chapter 77".

2. List of Effective Pages

Chapter/Section	Page	Date
	Title	July 1/72
General	1	July 1/72
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77-10-81	1	July 1/72
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77-10-81	10	July 1/72
77-10-81	1101	July 1/72
77-10-81	1102	July 1/72
77-10-81	1103	July 1/72

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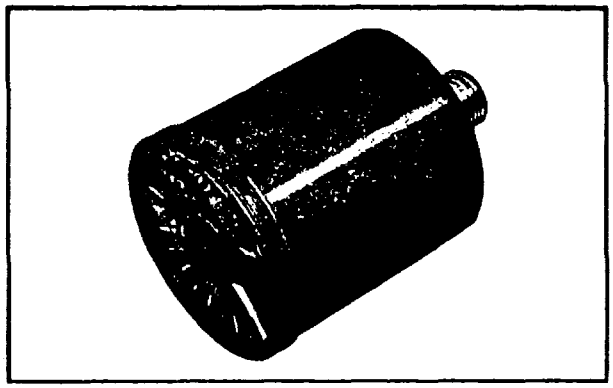
Overhaul Manual 1085-5W

TORQUE PRESSURE INDICATOR NO. 217-09261

OVERHAUL INSTRUCTIONS

1. Description and Operation

The pressure indicator covered by these overhaul instructions is part of the EDISON variable reluctance type Torque Pressure Indicating System. (Ref. Fig. 1)



The Indicator
Figure 1

Table of Leading Particulars
Power Supply .. 26 V single phase 400 Hz
Pressure Range .....0 to 75 psi

It is an hermetically sealed instrument designed to be secured to an instrument panel by means of a standard mounting clamp. An electrical connector on the rear provides for connection to the transmitter and power supply.

The function of the indicator is to translate into pressure units the voltage applied to its moving coil by the pressure transmitter. This is accomplished through the use of several simple principles as follows:

A. When the current flows in the same direction through two coils, their magnetic flux is in the same direction. Thus their opposite magnetic poles are next to each other, so the coils are attracted to each other. (Ref. Fig. 2A)

B. When alternating current flows through a coil, the resulting flux cutting across a second coil induces a current within it if its circuit is complete. At any given instant the induced current flows in the direction opposite to the applied current. (Ref. Fig. 2B) Thus the induced fluxes are opposed and the coils repel each other.

C. In the indicator a constant 26 volt 400 hertz current flows through the stationary field coil making a flux pattern through the core and across

TORQUE PRESSURE INDICATOR NO. 217-09261

OVERHAUL INSTRUCTIONS

the air gap. (Ref. Fig. 2C) The flux is strongest near the base of the hook-shaped part of the core and decreases uniformly along its length.

D. The moving coil with attached pointer is pivoted to rotate with the core hook at its center. (Ref. Fig. 2D) Two hairsprings transmit applied voltage to coil and furnish torque to swing pointer off low end of scale when no voltage is applied.

E. When the transmitter applies voltage to the moving coil it causes a current at any given instant to be in the same direction as that in the field coil (in phase).

F. At the same time, since the coils are energized with alternating current, the transformer effect is inducing an opposing voltage (180° out of phase) in the moving coil.

G. If the moving coil is at a position where applied voltage is greater than induced voltage, current will flow in the same direction as that of the field coil and the resulting torque will move the coil toward the base of the hook where the field coil flux is greater. (Ref. Fig. 1E) As it moves the induced voltage increases, the current and resulting torque decrease until the coil comes to rest at the point where applied voltage is just enough greater than induced voltage to overcome hairspring torque.

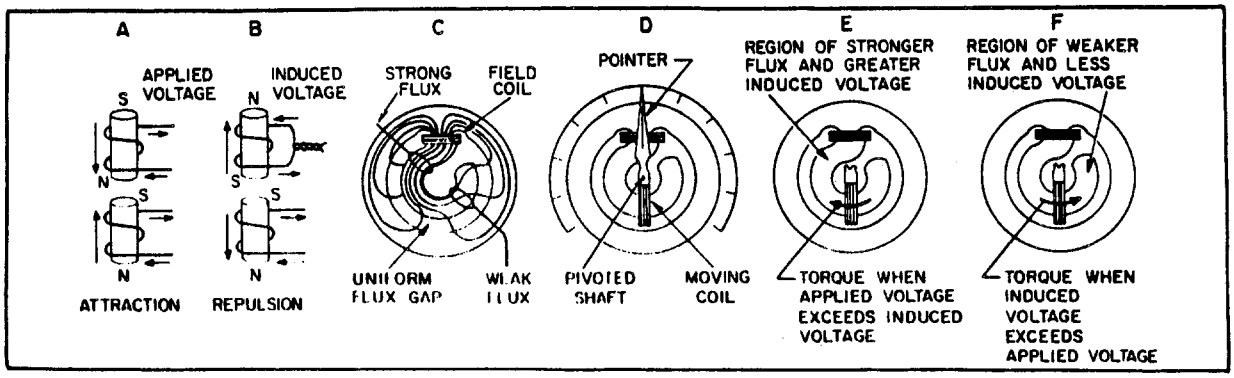
H. If applied voltage decreases below induced voltage, the resulting torque will cause the coil to swing toward the end of the hook until it reaches a point where equilibrium is again achieved. (Ref. Fig. 2F)

I. Because the voltage applied to the moving coil is obtained from two similar inductive, resistive voltage dividers, any variations in power supply voltage cause proportional changes in all voltages involved, hence do not affect the position assumed by the moving coil. (Ref. Fig. 3)

J. In order to compensate for resistance changes in the copper field coils, thermistors are connected in series with them.

2. Disassembly (Ref. Fig. 9)

CAUTION: USE EXTREME CARE TO KEEP DUST, FIBERS AND OTHER FOREIGN MATTER OUT OF SILICONE FLUID IMPREGNATED BEARINGS. DO NOT IMMERSE MECHANISM IN CLEANING FLUID.



Principles of Indicator Operation
Figure 2

TORQUE PRESSURE INDICATOR NO. 217-09261

OVERHAUL INSTRUCTIONS

A. Remove case and mask assembly (6).
   (1) Use induction heater (Ref. Section 11) to unsolder case and mask assembly (6) from base and receptacle assembly (48) of complete movement assembly after stripping paint.

   NOTE: No further disassembly of case and mask assembly is recommended.

B. Remove evacuation hole rivet (5).
   (1) Remove the two screws (2) and washers (3, 4) and nameplate (1).
   (2) Unsolder and remove rivet (5) from hole in base and receptacle assembly (48).

   NOTE: No further disassembly of the movement assembly is required to permit cleaning, inspection and check of detail parts. If parts are found to be defective, continue disassembly as required.

C. Remove dial (11).
   (1) Remove dial nut (12), screw (14), washers (13, 15, 16) and bushing (17).
   (2) Tip dial (11) and carefully slide it out from under pointer of rotor and hairspring assembly (24).

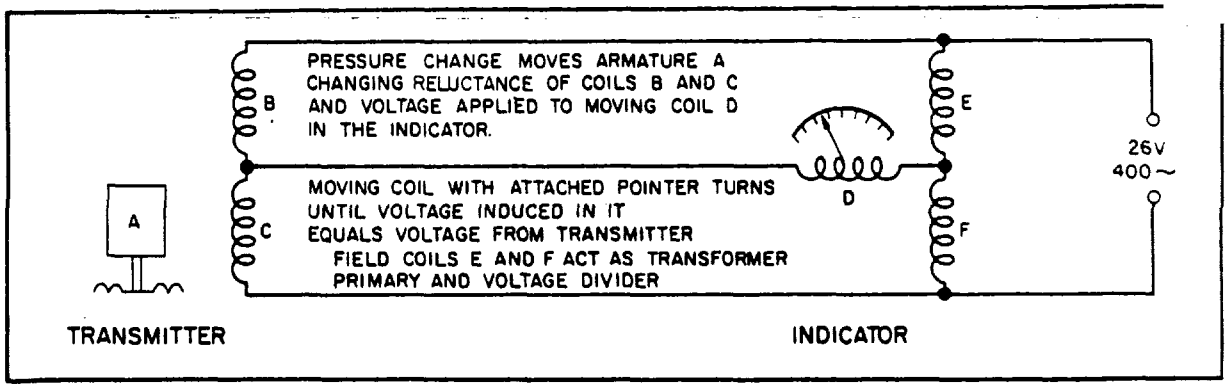
D. Remove rotor balance weights (18, 19).
   (1) Grasp weight (18, 19) with tweezers in manner to straighten the slight bend of the weight so that it may be slipped off of the balance cross of the rotor.

E. Remove front housing and bearing assembly.

   NOTE: If rotor and hairspring assemble (24) is to be removed, delay this step until top plate (22) and snubber (29) have been removed.

   (1) Loosen front bearing nut (20).
   (2) Unscrew and remove housing and bearing assembly (21) and nut (20).

F. Remove rotor and hairspring assembly (24).
   (1) Cut off upper snubber (29).
   (2) Unsolder hairsprings (25) from terminal of plate and terminal assembly (28) and board and adjuster assembly (47).



Basic Principle of Operation of the System
Figure 3

TORQUE PRESSURE INDICATOR NO. 217-09261

OVERHAUL INSTRUCTIONS

(3) Remove self-locking nuts (23) and lift off top plate (22) using care not to damage pointer.
(4) Turn and lift out rotor and hairspring assembly (24).

NOTE: Removal of pivots (26, from rotor body assembly (27) is not recommended.

G. Remove hairsprings (25) from rotor and hairspring assembly (24).

H. Remove stator assembly (29-41 assembled) and board and bearing assembly (43-47 assembled).
(1) Lift off top bushings (28).
(2) Unsolder leads from base and receptacle assembly (48).
(3) Lift off stator assembly with board and bearing assembly attached.
(4) Take out bottom bushings (42).
(5) Unsolder fixed coil leads from board and adjuster assembly (44), thus separating stator assembly and board and bearing assembly.

I. Remove fixed coil (40).
(1) Unsolder fixed coil lead from terminal of plate and terminal assy (30).
(2) Unsolder and remove cut wire (29) only if replacement is required.
(3) Remove rivet (32).
(4) Remove plate and terminal assembly (30) and bottom plate (31).
(5) Push out inside core (33).
(6) Remove screws (34, 35), lock washer (36), and shunt nut (37).
(7) Slide shunt (38) and coil bracket (39) from under fixed coil (40).
(8) Slide fixed coil (40) from outside lamination assembly (41).

J. Disassemble board and bearing assembly (43-47 assembled).
(1) Unscrew and remove rear housing and bearing assembly (43).
(2) Unsolder and remove thermistors (45).
(3) Unsolder and remove snubber (46).

3. Cleaning (Ref. Fig. 9)

A. Carefully clean solder from case and mask assembly (6) and base and receptacle assembly (48) so they will be ready for resealing case after assembly.

B. If microscopic inspection of bearings shows hairlike fibers in the bearing cavity, remove with tweezers. Use no other cleaning method on bearings since they are factory impregnated with a special silicone fluid.

C. Vapor degrease all parts made solely of metal, using trichlorethylene.

WARNING: AVOID BREATHING FUMES OR PERMITTING TRICHLORETHYLENE TO CONTACT SKIN.

4. Inspection/Check (Ref. Fig. 9)

A. Visual
(1) Check cover glass (9) for cracks or chips.
(2) Check dial (11) for scratches or stains.
(3) Check hairsprings (25) for distortion.
(4) Check pointer of rotor and hairspring assembly (24) for distortion or chipped paints.

TORQUE PRESSURE INDICATOR NO. 217-09261

OVERHAUL INSTRUCTIONS

4. B. Microscope (30X)
   (1) Check pivots (26) for pits, grooves or distortion.
   (2) Check housing and bearing assemblies (21, 43) for dents in bearing cap, foreign matter, and loss of clear fluidity of silicone fluid.

   C. Ohmmeter
   (1) Check moving coil with ohmmeter across adjuster and upper hairspring terminal of assembled indicator, or directly across coil of rotor body assembly (27). Acceptable resistance: 25 ± 8 ohms.
   (2) Check fixed coil (40) with ohmmeter across lower terminals. Acceptable resistance: 46 ± 15 ohms.
   (3) Check thermistors (45) with ohmmeter across leads. Acceptable resistance at 25°C (77°F): 5.6 ± 0.1 ohm.

5. Repair

   Replace all defective or damaged parts.

6. Assembly (Ref. Fig. 9)

   A. Assemble board and bearing assembly.
   (1) Slide snubber (46) to bottom of higher prong of hairspring adjuster of board and adjuster (47). Position the snubber so its projecting wire is over the outer edge of the adjuster, then solder its coil to the adjuster prong.
   (2) Place thermistors (45) on lower face of board and adjuster (47) and solder one lead of each together with red or black base connection lead wire (Ref. Fig. 4) in eyelet terminal.
   (3) Screw and tighten rear housing and bearing assembly (43) into rear of board and adjuster (47).

   B. Assemble stator assembly.
   (1) Place fixed coil (40) on hook of outside lamination assembly (41) in position shown. (Ref. Fig. 4).
   (2) Slip end of coil bracket (39) between upper face of outside lamination assembly (41) and fixed coil (40).
   (3) Slip end of shunt (38) between lower face of outside lamination assembly (41) and fixed coil (40).
   (4) Pass screw (35) through lock washer (36), coil bracket (39), outside lamination assembly (41) and shunt (38) and tighten in shunt nut (37).
   (5) Pass screw (34) through outer end of shunt and turn it a few turns into shunt nut (37).
   (6) Press inside core (33) into outside lamination assembly (41).
   (7) Position bottom plate (31) and plate and terminal assembly (30) on previous assembly and secure. Check to be sure holes through plates and inside core are aligned to permit later assembly onto studs of base and receptacle assembly (48).
   (8) Make a hook in the end of cut wire (29) as shown and solder it and the center top lead of fixed coil (40) to the neck of the hairspring terminal of plate and terminal assembly (30).

   C. Assemble board and bearing assembly and stator assembly on base and receptacle assembly.
   (1) Slide board and bearing assembly onto studs.
   (2) Slide stator assembly onto studs in position that permits fixed coil leads to run directly down into eyelet terminals with thermistor leads not already soldered in. (Ref. Fig. 4).

TORQUE PRESSURE INDICATOR NO. 217-09261

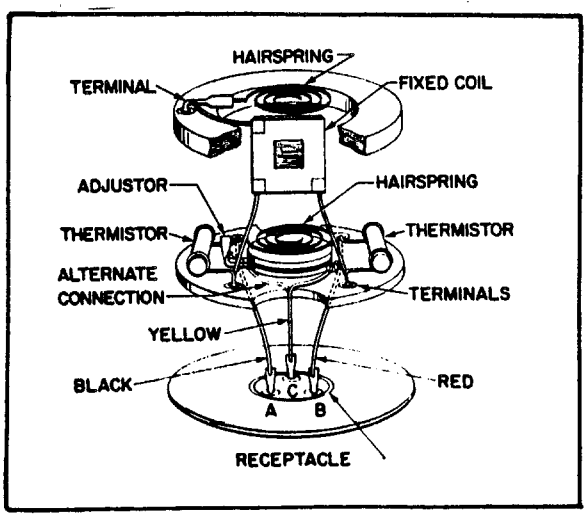
OVERHAUL INSTRUCTIONS

(3) Solder thermistor and fixed coil leads to terminals.
(4) Solder black lead to "A" terminal of receptacle and red lead to "B" terminal.

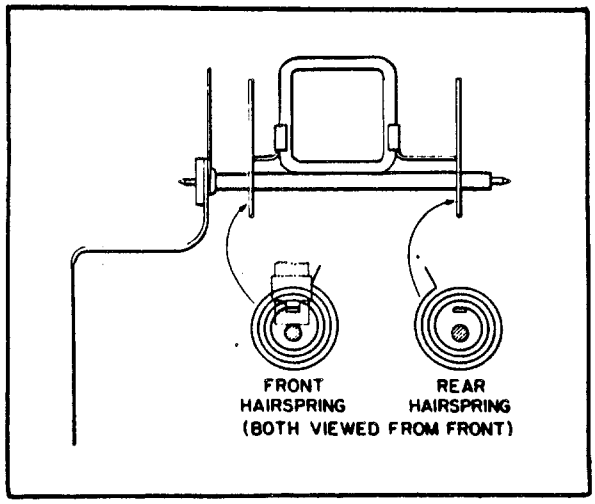
D. Assemble rotor and hairspring assembly.
(1) Solder hairspring (25) to terminals of moving coil on rotor body assembly (27). (Ref. Fig. 5).
(2) If necessary, reshape hairspring slightly so that turns are equally spaced and lie in a plane at right angles to rotor shaft.

E. Install rotor and hairspring assembly.
(1) Place rotor and hairspring assembly (24) in stator assembly with hook of outside lamination assembly (41) passing through its moving coil.
(2) Slide top bushing (28) on studs of base and receptacle assembly (48).
(3) Carefully slide tipped top plate (22) over pointer of rotor and hairspring assembly (24) and seat it on studs of base and receptacle assembly (48).
(4) Install and tighten self-locking nuts (23) on studs.
(5) Place front bearing nut (20) on housing and bearing assembly (21).
(6) Screw housing and bearing assembly (21) into top plate (22) and seat pivots (26) of rotor and hairspring assembly (24) in both upper and lower bearings. Be careful pivot is in bearing and not resting against cap of housing.
(7) Adjust housing and bearing assembly (21) to provide 0.001 to 0.002 inch rotor end play, then lock in position by tightening front bearing nut (20). Be careful not to change end play when tightening nut.
(8) Solder hairsprings to their respective terminals. (Ref. Fig. 4)

F. Install dial and adjust movement.
(1) Carefully slide tipped dial (11) over pointer and attach to top plate (22) by means of dial nut (12) and dial screw (14) which passes through dial bushing (17) between dial and top plate. Use washers (13, 15, 16).
(2) Bend and cement upper snubber (29) using epoxy cement and lower snubber (46) to position. (Ref. sub-section 7A).



Internal Wiring
Figure 4



Detail of Hairspring Position
Figure 5

TORQUE PRESSURE INDICATOR NO. 217-09261

OVERHAUL INSTRUCTIONS

(3) Bend pointer to position. (Ref. sub-section 7B)
(4) Adjust lower hairspring to proper torque. (Ref. sub-section 7C)
(5) Solder yellow lead to most accessible end of hairspring adjuster.

G. Calibrate the indicator. (Ref. Section 8)

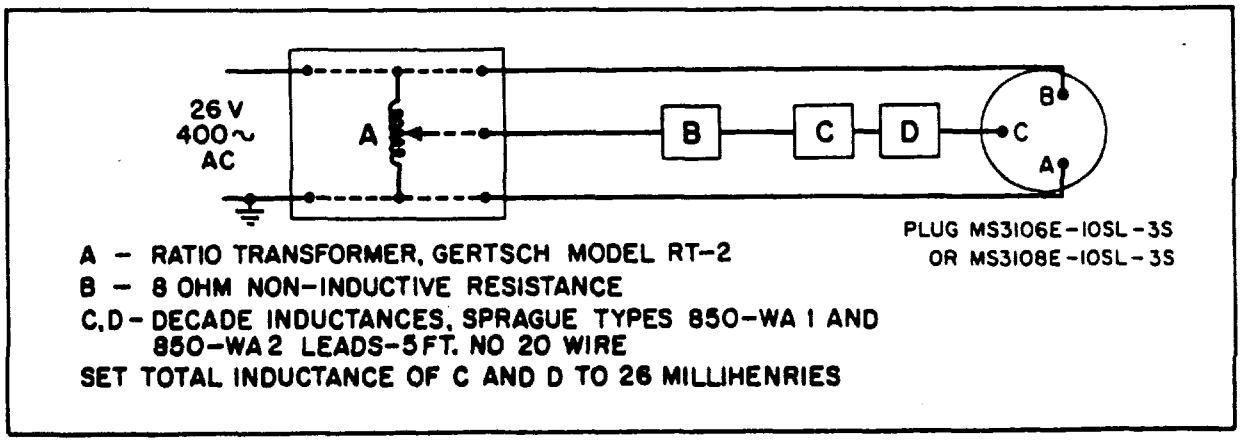
H. Install case and mask assembly and seal indicator.
(1) Install case assembly with mask (7) in proper position over dial (11).
(2) Solder case assembly (8) to base and receptacle assembly (48) with 63-37 resin core solder using induction heater. (Ref. Section 11)
(3) Check to be sure rivet (5) fits hole in base and receptacle assembly (48) but leave out of hole.
(4) Heat indicator to 75 ± 5°C (167 ± 9°F) for 30 minutes.
(5) Place indicator in autoclave and evacuate to 200 microns and hold for five minutes.
(6) Admit a dry mixture of 10% Helium and 90% Nitrogen, dew point below -55°C (-67°F), to autoclave to pressure of one atmosphere (760 mm mercury).
(7) Re-evacuate to 200 microns then refill with a dry mixture of 10% Helium and 90% Nitrogen to one atmosphere of pressure.
(8) Remove indicator from autoclave and immediately place rivet (5) in hole in base and receptacle assembly (48) and seal in place with a minimum of solder.
(9) Touch up case with dull black paint or lacquer.
(10) Using screw (2) and washers (3,4), install nameplate (1).

7. Fits and Clearances

A. Bend snubbers to lie parallel to base, approximately 1/16 inch from hairspring, and approximately 1/32 inch from rotor shaft.

B. Bend pointer so it is parallel with and 0.02 to 0.04 inch from dial, covers half of the length of a minor graduation line and is over offscale reference mark when against low-end stop.

C. With the dial horizontal, rotate the hairspring adjuster to swing the pointer against the low-end stop. Continue turning the adjuster in the down-scale direction an additional 90 to 100 degrees.



Test Circuit
Figure 6

TORQUE PRESSURE INDICATOR NO. 217-09261

OVERHAUL INSTRUCTIONS

8. Testing

A. Calibration Procedures - uncased indicator. (Ref. Fig. 9)

(1) Connect indicator to test circuit. (Ref. Fig. 6)
(2) Check to be sure power applied to ratio transformer is 26 ± 0.5 volts, 400 ± 2 hertz.
(3) Set ratio transformer to ".5980".
(4) Holding indicator with dial horizontal, use a screwdriver to avoid moving the housing and bearing assembly (21), loosen dial nut (12).
(5) Loosen dial screw (14).
(6) Rotate dial (11) until pointer indicates 0 psi.
(7) Tighten dial screw (14).
(8) Reduce voltage applied to ratio transformer to 15 volts.
(9) Set ratio transformer to move pointer to exact middle of scale. Since indicator has not yet been calibrated, this will not necessarily be specified mid-scale value.
(10) Install balance weights (18, 19) as required to make pointer position remain unchanged when dial is moved from horizontal to normal vertical operating position, then rotated 90, 180 and 270 degrees.
(11) Increase applied voltage to 26 ± 0.5 volts.
(12) Set ratio transformer to ".5980"
(13) With indicator in normal operating position, if necessary, loosen dial screw (14) and rotate dial until pointer indicates 0 psi, then tighten dial screw (14).
(14) Set ratio transformer to ".4020".
(15) Turn shunt adjusting screw (34) to open or close the shunt (38) until the pointer indicates 75 psi. If necessary, remove and discard screw (34) and bend shunt (38) to obtain correct pointer position.
(16) Set ratio transformer to "5600", then turn power off. If pointer fails to swing off low end of scale without tapping, increase lower hairspring tension as required, test the indicator in all four dial vertical positions and with dial horizontal.
(17) Check indications at all test values. (Ref. Fig. 7) Vary transformer setting between low and high values to obtain exact reading.
(18) Repeat steps 13 and 15 as required to bring all indications within tolerance. If impossible to obtain acceptable calibration, use alternate dial.
(19) Holding housing and bearing assembly (21) with screwdriver, tighten dial nut (12).
(20) Place a drop of glyptal on shunt screw (34), if used, to seal it in place.

Transformer Setting			Indicated	Tol.	Transformer Setting			Indicated	Tol.
Low	Nominal	High	PSI	± PSI	Low	Nominal	High	PSI	±PSI
.6012	.5980	.5948	0	1.20	.4672	.4664	.4656	50	.30
.5738	.5712	.5686	10	1.00	.4421	.4408	.4395	60	.50
.5469	.5449	.5429	20	.75	.4168	.4149	.4130	70	.75
.5198	.5185	.5172	30	.50	.4046	.4020	.3994	75	1.00
.4926	.4918	.4910	40	.30					
Friction Test Tolerance: ±.75 psi					Position Error Tolerance: ±.75 psi				

Test Values
Figure 7

TORQUE PRESSURE INDICATOR NO. 217-09261

OVERHAUL INSTRUCTIONS

B. Test Procedure - sealed indicator.

(1) Connect the indicator to test circuit. (Ref. Fig. 6).

(2) Check to be sure power supply to ratio transformer is 26 ± 0.5 volts, 400 ± 2 hertz.

(3) With indicator at room temperature and with dial in normal operating position, successively set ratio transformer at each nominal test value shown in Figure 7. Notice indication before and after lightly tapping the indicator. The difference caused by tapping shall not exceed specified Friction Test Tolerance. If indication is not correct, change transformer setting to obtain correct reading, Necessary change shall not be beyond low or high value in figure 7.

(4) Set ratio transformer to mid-scale value and not pointer position after tapping. Rotate indicator 90, 180 and 270 degrees, then to position with dial horizontal. The difference between the indication in normal position and any other position shall not exceed specified Position Error Tolerance. (Ref. Fig. 7).

(5) Turn off power supply. Pointer shall swing off scale without tapping.

9. Trouble Shooting

The only troubles which occur in an indicator, other than external physical damage, cause failure to pass test specified in sub-section 8B. When it has been determined in which test the trouble occurs, the indicator must be opened (Ref. sub-section 2A) after which possible causes as listed in Figure 8 may readily be checked to isolate the trouble.

10. Storage Instructions

No special storage requirements apply to this indicator. It is an hermetically sealed unit subject only to damage from rough handling.

11. Special Tools, Fixture, and Equipment

Autoclave (4 qt. home pressure cooker - modified, add connector and valve) ("Mirror-Matic" or equivalent)
Vacuum Pump (Central Sci. Co., Chicago, Ill. "Cenco-Magnavac" or equivalent)
Induction Heater, 3 KW, RF (McDowell Electronics Inc., Metuchen, N.J., Model 3KW-2 or equivalent)
Ratio Transformer (Singer Metrics Inc., Los Angeles, Calif. Gertsch Model RT-2)
Resistor - 8 ohm non-inductive (General Radio Co., West Concord, Mass., Type 510B)
Decade Inductances (Sprague Elec. Co., North Adams, Mass., Types 850-WA1 and 850-WA2- one of each required.)

TORQUE PRESSURE INDICATOR NO. 217-09261

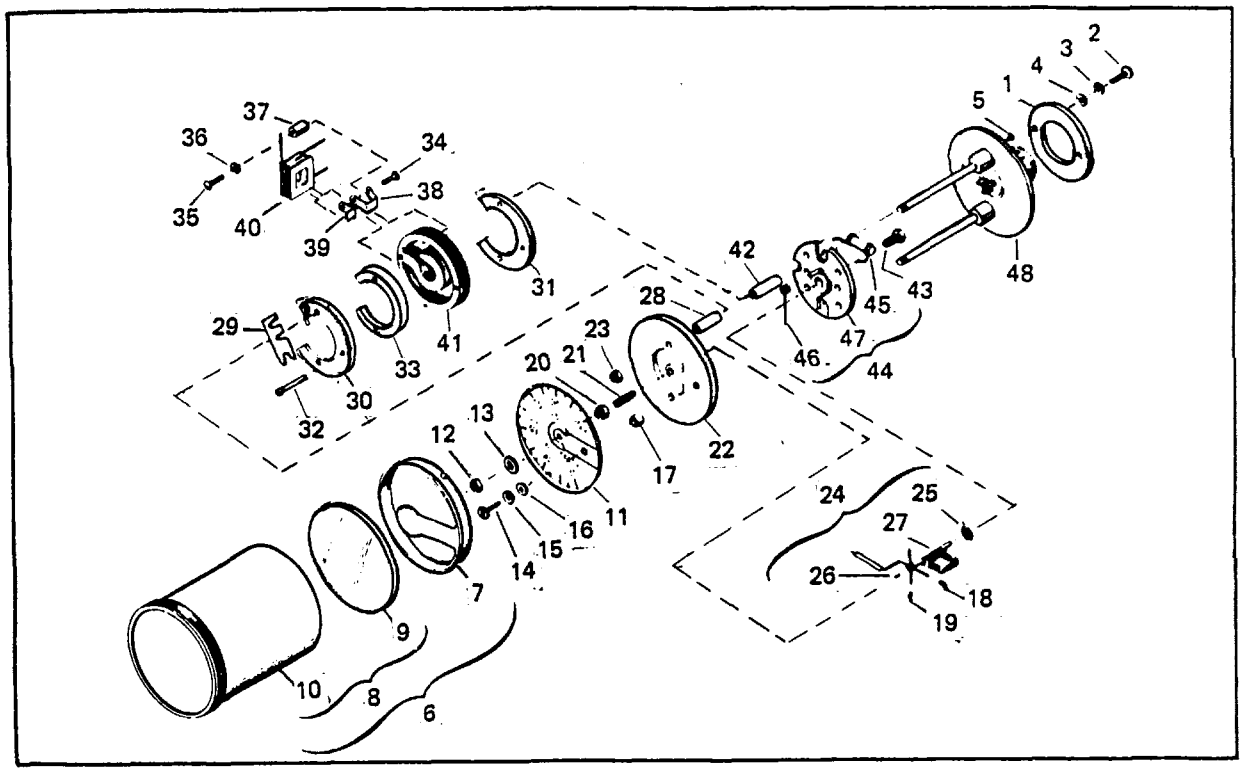
OVERHAUL INSTRUCTIONS

TROUBLE	PROBABLE CAUSE	REMEDY
SCALE ERROR TEST		
POINTER OFF SCALE AT ALL VALUES	Open lead or leads	Connect or replace lead
	Open hairspring	Connect or replace hairspring
	Open moving coil	Replace rotor assembly
POINTER SLAMS LOW	Shorted moving coil	Replace rotor assembly
POINTER SLAMS HIGH OR LOW	Open fixed coil	Replace coil
	Open lead	Connect or replace lead
	Open thermistor	Replace thermistor
ERROR AT LOW VALUES	Incorrect zero and span adjustment	Readjust
ERROR AT HIGH VALUES	Incorrect span adjustment	Readjust
ALL READINGS EQUALLY HIGH OR LOW	Incorrect zero adjustment	Readjust
ERROR AT INTERMEDIATE VALUES	Irregular air gap in lamination	Replace inside core, outside lamination assy, or both
POINTER FAILS TO RETURN OFF SCALE WITH POWER OFF	Rotor assembly unbalanced	Rebalance rotor assembly
	Incorrect hairspring adjustment	Increase hairspring tension
	Incorrectly shaped pointer	Bend to proper shape
FRICTION TEST		
EXCESSIVE ERROR	Pivot out of bearing	Adjust position
	No end play	Adjust end play
	Defective pivots	Replace pivots
	Defective or dirty bearings	Replace housing and bearing assembly
	Lint in air gap	Clean
POSITION ERROR TEST		
EXCESSIVE ERROR	Rotor assembly unbalanced	Rebalance rotor assembly
POINTER FAILS TO RETURN OFF SCALE IN SOME POSITIONS	Rotor assembly unbalanced	Rebalance rotor assembly
	Incorrectly shaped pointer	Bend to proper shape

Trouble Shooting Chart
Figure 8

TORQUE PRESSURE INDICATOR NO. 217-09261

ILLUSTRATED PARTS LIST



Exploded View
Figure 9

Figure & Index No.	Part Number	1 2 3 4 5 6 7 Nomenclature	Usage Code	Units per Assy
	217-00151	Indicator – Oil pressure		Ref
9-1	24086-131	. Nameplate – Indicator		1
		ATTACHING PARTS		
-2	10406	. Screw		2
-3	MS35338-77	. Washer – Lock		2
-4	13120-2	. Washer – Flat		2
		* * *		
-5	14411	. Rivet (altered from AN427C2-2 by tin plating)		1
-6	42003	. Case and Mask Assembly		1
-7	61255	. . Mask – Dial		1
-8	41718-3	. . Case Assembly		1
-9	22964	. . . Glass – Cover		1
-10	No Number	. . . Case & Bezel Assembly		Ref

TORQUE PRESSURE INDICATOR NO. 217-09261

ILLUSTRATED PARTS LIST

Figure & Index No.	Part Number	1 2 3 4 5 6 7 Nomemclature	Usage Code	Units per Assy
9-	43185	. Movement Assembly		1
-11	61236	. . Dial		1
-12		ATTACHING PARTS		
-12	10803	. . Nut - Dial		1
-13	AN935-3L	. . Washer - Lock		1
-14	14933	. . Screw - Dial		1
-15	14242	. . Washer - Lock		1
-16	25465	. . Washer - Flat		1
-17	22950	. . Bushing - Dial		1
		***		
-18	10254-1	. . Weight - Rear balance		AR
-18	10254-2	. . Weight - Rear balance		AR
-18	10254-3	. . Weight - Rear balance		AR
-18	10254-4	. . Weight - Rear balance		AR
-18	10254-5	. . Weight - Rear balance		AR
-19	10255-1	. . Weight - Side balance		AR
-19	10255-2	. . Weight - Side balance		AR
-19	10255-3	. . Weight - Side balance		AR
-19	10255-4	. . Weight - Side balance		AR
-20	23517	. . Nut - Front bearing		1
-21	41742	. . Housing & Bearing Assy - Front.		1
-22	23775	. . Plate - Top		1
		ATTACHING PARTS		
-23	F92-1660-24	. . Nut - Self-locking (Elastic Stop Nut Corp.) (Edison No. 14254).		2
		***		
-24	41876-2	. . Rotor and Hairspring Assembly .		1
-25	22944	. . . Hairpring		2
-26	22936	. . . Pivot		2
-27	No Number	. . . Rotor Body Assembly		Ref.
-28	23554	. . Bushing - Top		2
	No Number	. . Stator Assembly		Ref.
-29	60640	. . . Snubber		1
-30	41474	. . . Plate and Terminal Assembly.		1
-31	23553	. . . Plate - Bottom		1
		ATTACHING PARTS		
-32	15085	. . . Rivet - Oval head tubular ..		1
		***		
-33	42703	. . . Core - Inside		1
	41466	. . . Coil & Lamination Assy		1
-34	AN520UB0-2	. . . . Screw		1
-35	AN520-0-6	. . . . Screw		1
-36	14242	. . . . Washer - Lock		1
-37	22933	. . . . Nut - Shunt		1
-38	22932	. . . . Shunt		1
-39	22942	. . . . Bracket - Coil		1
-40	41461	. . . . Coil - Fixed		1
-41	41473	. . . . Lamination Assy - Outside		1
-42	23555	. . Bushing - Bottom		2
	No Number	. . Board and Bearing Assembly		Ref.

TORQUE PRESSURE INDICATOR NO. 217-09261

ILLUSTRATED PARTS LIST

Figure & Index No.	Part Number	1 2 3 4 5 6 7 Nomenclature	Usage Code	Units per Assy
-43	41723	. . . Housing and Bearing Assy – Rear		1
-44	41738	. . . Board & Adjuster Assy		1
-45	LA-4.8-218	. . . . Thermistor (Keystone Carbon Co.) (Edison No. 1424)		2
-46	23994	. . . . Snubber		1
-47	No Number	. . . . Board and Adjuster		Ref
-48	43162	. . Base and Receptacle Assembly		1
	5950-1 & -2	*Epoxy Cement*		AR

EDISON®

OVERHAUL MANUAL

No. 1084-5D

TORQUE PRESSURE TRANSMITTER

Part No. 318-02020



INSTRUMENT DIVISION
THOMAS A. EDISON INDUSTRIES
McGRAW-EDISON COMPANY

WEST ORANGE, NEW JERSEY, U. S. A.

Revision 1
February 1, 1969

Printed in U.S.A.
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TORQUE PRESSURE TRANSMITTER NO. 318-02020

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TORQUE PRESSURE TRANSMITTER NO. 318-02020

GENERAL INFORMATION

1. Introduction

This Manual contains instructions for the overhaul of EDISON Aircraft Torque Pressure Transmitters, part No. 318-02020.

It is prepared in accordance with ATA Specification No. 100 including the Uniform Chapterization and Numbering System designated therein so that the pages may be inserted into their proper locations in the basic aircraft overhaul manual if desired.

All of the material in this Manual falls within the classification "Engine Indicating - Chapter 77".

2. List of Effective Pages

Chapter/Section	Page	Date
	Title	*Feb. 1/69
General	1	*Feb. 1/69
Contents	1	*Feb. 1/69
77-10-34	1	Oct. 1/67
77-10-34	2	*Feb. 1/69
77-10-34	3	Oct. 1/67
77-10-34	1101	Oct. 1/67

*The asterisk indicates pages revised or added by current revision.

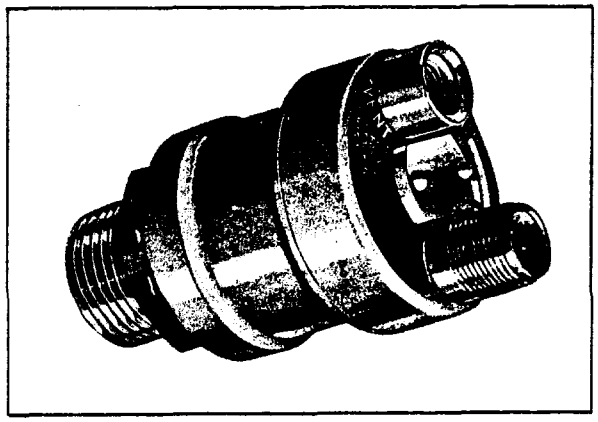
TORQUE PRESSURE TRANSMITTER NO. 318-02020

OVERHAUL INSTRUCTIONS

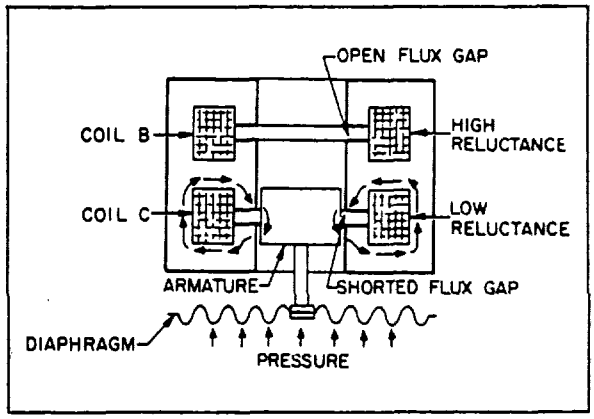
1. Description and Operation

The pressure transmitter covered by these overhaul instructions is the sensing unit of the EDISON variable reluctance type Torque Pressure Indicating System. (Ref. Fig. 1)

It is a factory sealed unit, the lower end of which is provided with both external and internal threads for pressure connection. It can be installed directly on a pressure boss on the engine by means of the external thread. It may also be mounted on a bracket by means of these threads, pressure connection being made to the internal threads by means of fittings and tubing. A pressure boss at the top of the transmitter permits connection of a vent pressure line if differential pressure is to be measured. A removable plug cap at the top of the transmitter gives access for calibration adjustment. An electrical connector receptacle is also on the top of the transmitter.

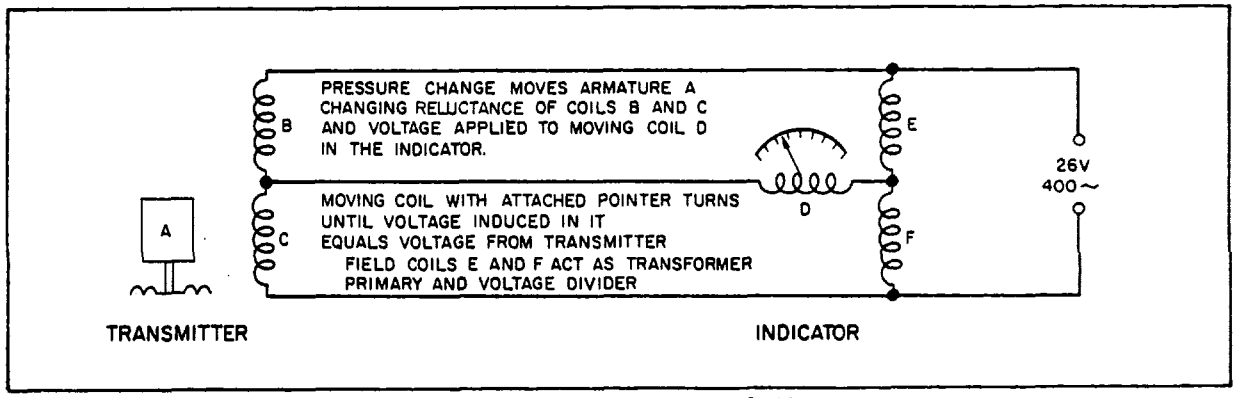


The Transmitter
Figure 1



Principle of Transmitter Operation
Figure 2

Table of Leading Particulars
Power Supply .... 26 V single phase 400 Hz
Pressure Range ..... 0 to 60 psi



Basic Principle of Operation of the System
Figure 3

TORQUE PRESSURE TRANSMITTER NO. 318-02020

OVERHAUL INSTRUCTIONS

The function of the transmitter is to furnish to the indicator an electrical potential which varies according to the applied pressure. In the transmitter a diaphragm moves a magnetic armature inside of two stationary coils whenever there is a change in applied pressure. (Ref. Fig. 2) These coils are connected in series with a 26 volt 400 hertz power source and act as a variable reluctance voltage divider. The armature position determines the effective flux gaps in the magnetic housing of the coils, hence the reluctance of the coils. As connected to the indicator, which contains a similar but fixed voltage divider, a voltage regulated by the transmitter is applied to the moving coil of the indicator. (Ref. Fig. 3)

2. Disassembly (Ref. Fig. 6)

A. Remove plug cap to permit calibration adjustment.
   (1) Remove lockwire.
   (2) Remove screws (2) and lock washers (3).
   (3) Remove plug cap (1) with "O" ring (5) attached.
   (4) Remove nameplate (4).
   (5) Remove "O" ring (5) from plug cap (1).

B. Attempt no other disassembly.

3. Cleaning

A. Wash outside with trichlorethylene and blow dry.

WARNING: AVOID BREATHING FUMES OR PERMITTING TRICHLORETHYLENE TO CONTACT SKIN.

4. Inspection/Check

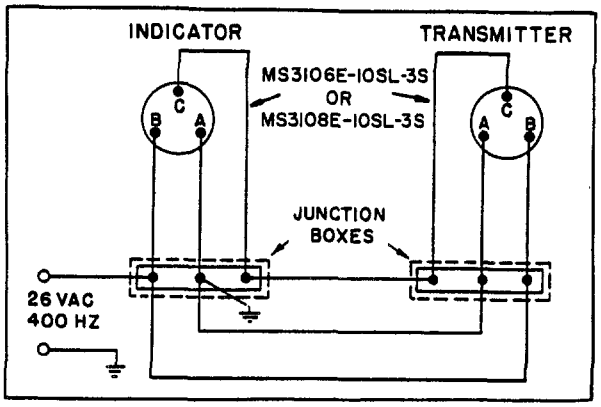
None required.

5. Repair

Non-repairable.

6. Assembly (Ref. Fig. 6)

A. Install plug cap following calibration adjustment.
   (1) Install new "O" ring (5) on plug cap (1).
   (2) Place nameplate (4) on transmitter.
   (3) Install plug cap and "O" ring assembly on transmitter.
   (4) Secure with screws (2) and lock washers (3).
   (5) Install new lockwire.



Test Connections
Figure 4

Test Pressure PSI	Indicated PSI	Tolerance ± PSI
0	0	1.2
10	10	1.0
20	20	1.0
30	30	0.6
40	40	0.3
50	50	0.6
60	60	1.2

Transmitter Test Data
Figure 5

TORQUE PRESSURE TRANSMITTER NO. 318-02020
OVERHAUL INSTRUCTIONS

7. Fits and Clearances

None applicable.

8. Testing

A. For equipment required, refer to sub-heading 11.
B. Test calibration:
(1) Mount the transmitter in vertical position on a dead weight or other type of pressure tester capable of supplying accurate pressure of dry air in the range involved.
(2) Connect the transmitter to EDISON Transmitter Test Indicator, part No. 389-1, or 389-00340, which has been checked for accuracy.(Ref.Fig.4)
(3) Energize the circuit with 26 ± 0.5 volts, 400 ± 5 hertz.
(4) Apply pressure, testing transmitter at each applicable value marked on indicator dial. Before reading indicator, lightly tap both transmitter and indicator. All readings shall be within tolerances as marked on dial.
C. Adjust calibration if necessary.
(1) Leave transmitter connected to indicator and power on.
(2) Set pressure to zero psi value.
(3) Remove plug cap (Ref. sub-heading 2).
(4) Using zero adjusting tool, part No. 41486, turn armature assembly inside transmitter until indicator reads approximately correctly.
(5) Apply maximum pressure for range.
(6) Using both zero adjusting tool, part No. 41486,and scale span adjusting tool, part No. 42015, hold zero adjusting tool stationary while turning scale span adjusting tool to give indicator reading within tolerance after tapping.
(7) Reduce pressure to zero psi value.
(8) Hold span adjusting tool stationary while turning zero adjusting tool to give indicator reading within tolerance after tapping.
(9) Repeat steps (5) through (8) until both readings are within tolerance with tools removed before reading indicator.
(10)Check readings at all test values.
(11)Replace plug cap (Ref. sub-heading 6).
(12)Replace lock wire using No. 20 corrosion resistance steel wire.
D. Test for leakage:
(1) Disconnect wiring and pressure connection.
(2) Connect "VENT" boss to pressure tester by means of flexible tubing.
(3) With transmitter in vertical position, immerse it in alcohol until only the upper half of the electrical connector receptacle projects above the alcohol.
(4) Apply 15 psi air pressure to the "VENT". No evidence of leakage shall be visible.
(5) Remove from alcohol, blow dry, release pressure, and disconnect pressure tube.

9. Trouble Shooting

None required. If transmitter leaks, or can not be calibrated within tolerance, it must be scrapped since no repairs are possible.

10. Storage Instructions

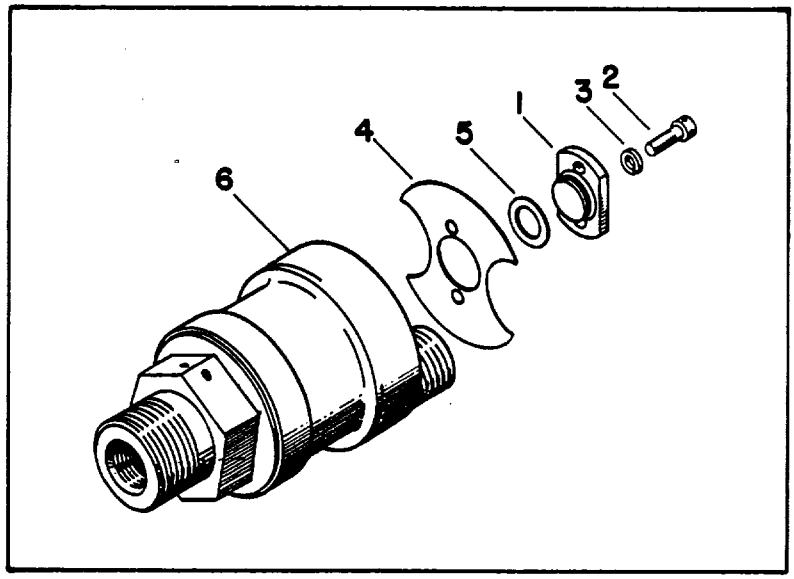
Cover pressure and vent ports and electrical connector to keep out foreign matter during storage. Use shipping caps such as Edison No. 14234, 14235, and 14236, or other suitable means.

11. Special Tools, Fixtures and Equipment

Dead Weight or other Pressure Tester
Transmitter Test Indicator - Edison part No. 389-1 or 389-00340
Zero Adjusting Tool - Edison part No. 41486
Scale Span Adjusting Tool - Edison part No. 42015

TORQUE PRESSURE TRANSMITTER NO. 318-02020

ILLUSTRATED PARTS LIST



Exploded View
Figure 6

Figure & Index No.	Part Number	1 2 3 4 5 6 7 Nomenclature	Usage Code	Units per Assy
	318-02020	Transmitter - Torque pressure		Ref.
6-1	23815	. Cap - Plug		1
-2	AN500D3-4	. Screw		2
-3	AN935C3	. Washer		2
-4	24074-34	. Nameplate		1
-5	14474-1	. "O" Ring		1
-6	No Number	. Body - Assembly of Transmitter		Ref.

EDISON®

OVERHAUL MANUAL

NO. 1084-5M

TORQUE PRESSURE TRANSMITTER

Part No. 418-01064



INSTRUMENT DIVISION
THOMAS A. EDISON INDUSTRIES
McGRAW-EDISON COMPANY

WEST ORANGE, NEW JERSEY, U. S. A.

July 1, 1972

®REGISTERED TRADE MARK
Printed in U.S.A.

TORQUE PRESSURE TRANSMITTER NO. 418-01064

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Thomas A. Edison
Instrument Division
WEST ORANGE, NEW JERSEY 07051

TORQUE PRESSURE TRANSMITTER NO. 418-01064

GENERAL INFORMATION

1. Introduction

This manual contains instructions for the overhaul of EDISON Aircraft Torque Pressure Transmitter, part No. 418-01064.

It is prepared in accordance with ATA Specification No. 100 including the Uniform Chapterization and Numbering System designated therein so that the pages may be inserted into their proper locations in the basic aircraft overhaul manual if desired.

All of the material in this manual falls within the classification "Engine Indicating - Chapter 77".

2. List of Effective Pages

Chapter/Section	Page	Date
	Title	July 1/72
General	1	July 1/72
77	1	July 1/72
77-10-42	1	July 1/72
77-10-42	2	July 1/72
77-10-42	3	July 1/72
77-10-42	4	July 1/72
77-10-42	1101	July 1/72

Thomas A. Edison
Instrument Division
WEST ORANGE, NEW JERSEY 07051

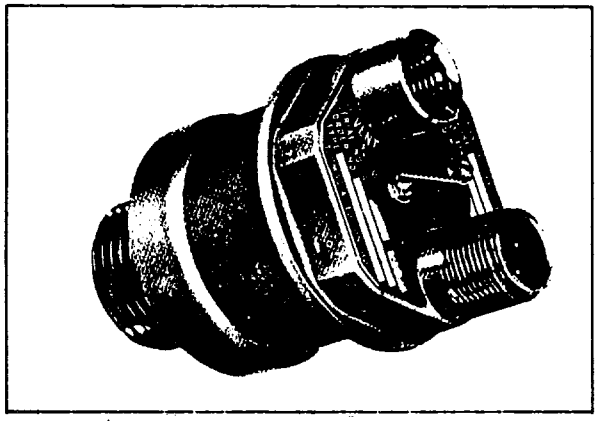
TORQUE PRESSURE TRANSMITTER NO. 418-01064

OVERHAUL INSTRUCTIONS

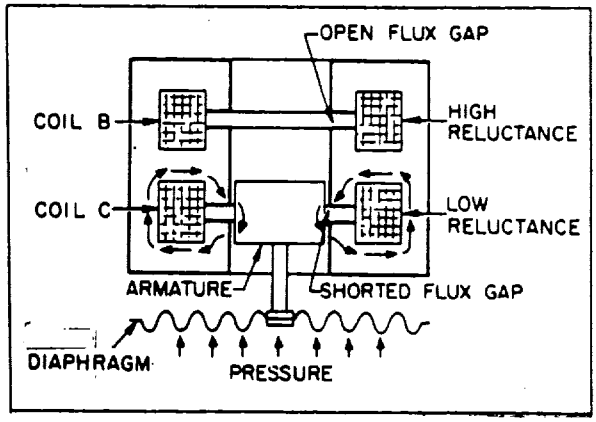
1. Description and Operation

The pressure transmitter covered by these overhaul instructions is the sensing unit of the EDISON variable reluctance type Torque Pressure Indicating System. (Ref. Fig. 1).

It is a factory sealed unit, the lower end of which is provided with both external and internal threads for pressure connection. It can be installed directly on a pressure boss on the engine by means of the external thread. It may also be mounted on a bracket by means of these threads, pressure connection being made to the internal threads by means of fittings and tubing. A pressure boss at the top of the transmitter permits connection of a vent pressure line if differential pressure is to be measured. A removable plug cap at the top of the transmitter gives access for calibration adjustment. An electrical connector receptacle is also on the top of the transmitter.



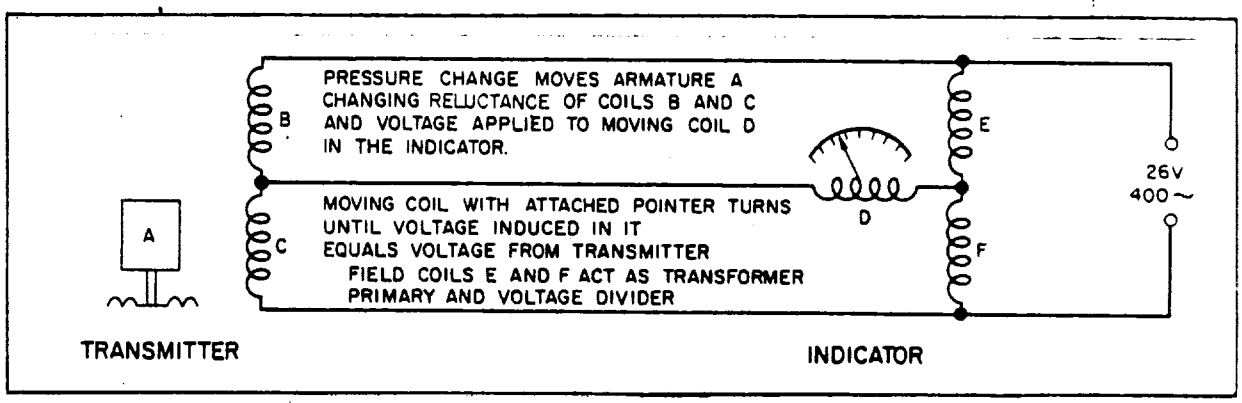
The Transmitter
Figure 1



Principle of Transmitter Operation
Figure 2

Table of Leading Particulars

Power Supply	26 V single phase 400 Hz
Pressure Range	0 to 75 psi



Basic Principle of Operation of the System
Figure 3

TORQUE PRESSURE TRANSMITTER NO. 418-01064

OVERHAUL INSTRUCTIONS

The function of the transmitter is to furnish to the indicator an electrical potential which varies according to the applied pressure. In the transmitter a diaphragm moves a magnetic armature inside of two stationary coils whenever there is a change in applied pressure. (Ref. Fig. 2) These coils are connected in series with a 26 volt 400 hertz power source and act as a variable reluctance voltage divider. The armature position determines the effective flux gaps in the magnetic housing of the coils, hence the reluctance of the coils. As connected to the indicator, which contains a similar but fixed voltage divider, a voltage regulated by the transmitter is applied to the moving coil of the indicator. (Ref. Fig. 3).

2. Disassembly (Ref. Fig. 7)

   A. Remove plug cap to permit calibration adjustment.
      (1) Remove lockwire.
      (2) Remove screws (2) and lock washers (3).
      (3) Remove plug cap (1) with "O" ring (5) attached.
      (4) Remove nameplate (4).
      (5) Remove "O" ring (5) from plug cap (1).
   B. Attempt no other disassembly.

3. Cleaning

   A. Wash outside with trichlorethylene and blow dry.

      WARNING: AVOID BREATHING FUMES OR PERMITTING TRICHLORETHYLENE TO CONTACT SKIN.

4. Inspection/Check

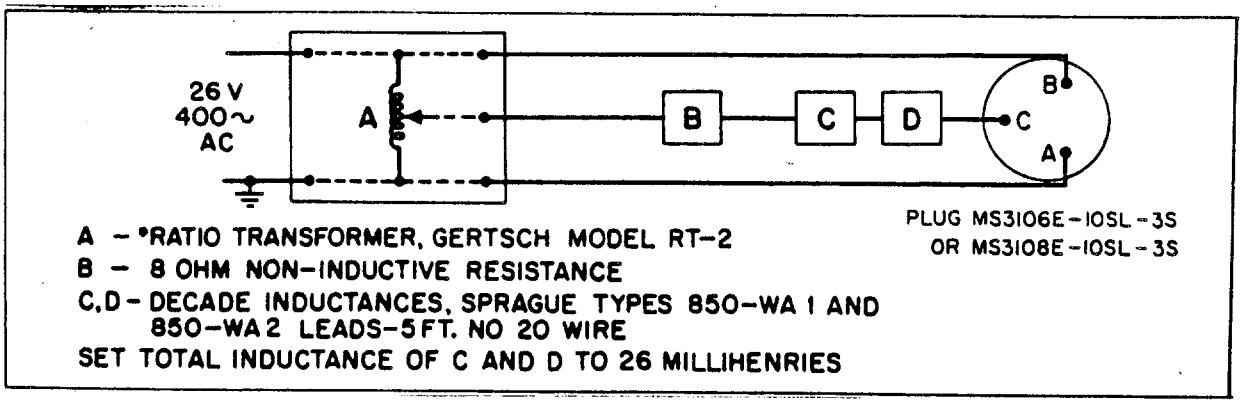
   None required.

5. Repair

   Non-repairable.

6. Assembly (Ref. Fig. 7)

   A. Install plug cap following calibration adjustment.
      (1) Install new "O" ring (5) on plug cap (1).
      (2) Place nameplate (4) on transmitter.
      (3) Install plug cap and "O" ring assembly on transmitter.
      (4) Secure with screws (2) and lock washers (3).
      (5) Install new lockwire.



Indicator Test Circuit

Figure 4

TORQUE PRESSURE TRANSMITTER NO. 418-01064

OVERHAUL INSTRUCTIONS

7. Fits and Clearances

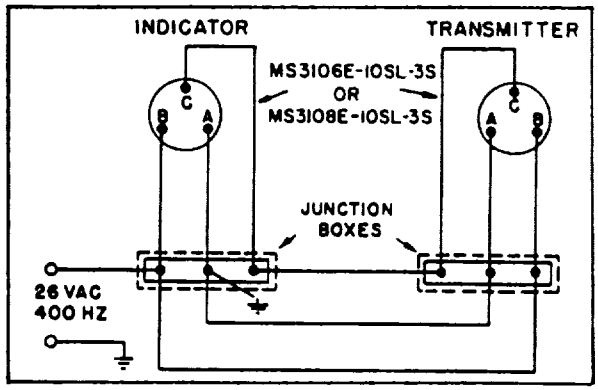
None applicable.

8. Testing

A. For equipment required, refer to sub-heading 11.
B. Test calibration:
(1) Connect test indicator, part No. 289-100A or 289-00341, to test circuit. (Ref. Fig. 4)
(2) Check to be sure power applied to ratio transformer is 26 ± 0.5 volts, 400 ± 10 hertz.
(3) Successively set the ratio transformer to the two values for each test pressure in Fig. 5 and record the readings either as a table or as range marks on a paper pasted on the indicator cover glass. Lightly tap the indicator before each reading.
(4) Mount the transmitter in a vertical position on a dead weight tester or other type of pressure tester capable of supplying accurate pressure of dry air at each test value specified in Fig. 5.
(5) Connect the transmitter to the test indicator. (Ref. Fig. 6)
(6) Energize the circuit with 26 ± 0.5 volts, 400 ± 10 hertz.
(7) Apply exact pressure, testing transmitter at each test value in Fig.5. Before reading, lightly tap both transmitter and indicator. All indicator readings shall be between tolerance values as determined in step (3) for pressure involved.
C. Adjust calibration if necessary.
(1) Leave transmitter connected to indicator and power on.
(2) Set pressure to zero psi value.
(3) Remove plug cap (Ref. sub-heading 2).
(4) Using zero adjusting tool, part No. 41486, turn armature assembly inside transmitter until indicator reads approximately correctly.
(5) Apply 75 psi pressure.
(6) Using both zero adjusting tool, part No.41486, and scale span adjusting tool, part No.42015, hold zero adjusting tool stationary while turning scale span adjusting tool to give indicator reading within tolerance after tapping.
(7) Reduce pressure to zero psi value.
(8) Hold span adjusting tool stationary while turning zero adjusting tool to give indicator reading within tolerance after tapping.
(9) Repeat steps (5) through (8) until both readings are within tolerance with tools removed before reading indicator.

Test Pressure PSI	Indicator Reading To Be Between Readings Caused By Transformer Settings of		Equivalent PSI Tolerance
0	.6015	.5945	± 1.30
10	.5741	.5683	± 1.10
20	.5473	.5425	± 0.90
30	.5203	.5167	± 0.70
40	.4931	.4905	± 0.50
45	.4801	.4781	± 0.40
50	.4671	.4657	± 0.30
60	.4423	.4393	± 0.60
70	.4172	.4126	± 0.90
75	.4048	.3992	± 1.10

Test Values
Figure 5



Transmitter Test Connections
Figure 6

TORQUE PRESSURE TRANSMITTER NO. 418-01064

OVERHAUL INSTRUCTIONS

(10) Check readings at all test values, using method in "B. Test Calibration".
(11) Replace plug cap (Ref. sub-heading 6).
(12) Replace lockwire using No. 20 corrosion resistant steel wire.

D. Test for leakage:
(1) Disconnect wiring and pressure connection.
(2) Connect "VENT" boss to pressure tester by means of flexible tubing.
(3) With transmitter in vertical position, immerse it in alcohol until only the upper half of the electrical connector receptacle projects above the alcohol.
(4) Apply 15 psi air pressure to the "VENT". No evidence of leakage shall be visible.
(5) Remove from alcohol, blow dry, release pressure, and disconnect pressure tube.

9. Trouble Shooting

None required. If transmitter leaks, or can not be calibrated within tolerance, it must be scrapped since no repairs are possible.

10. Storage Instructions

Cover pressure and vent ports and electrical connector to keep out foreign matter during storage. Use shipping caps such as Edison No. 14234, 14235 and 14236, or other suitable means.

11. Special Tools, Fixtures and Equipment

Dead Weight or other Pressure Tester

Transmitter Test Indicator - Edison Part No. 289-100A or 289-00341

Zero Adjusting Tool - Edison Part No. 41486

Scale Span Adjusting Tool - Edison Part No. 42015

Ratio Transformer - Singer Metrics Div., Los Angeles, Calif. (Gertsch Model RT-2)

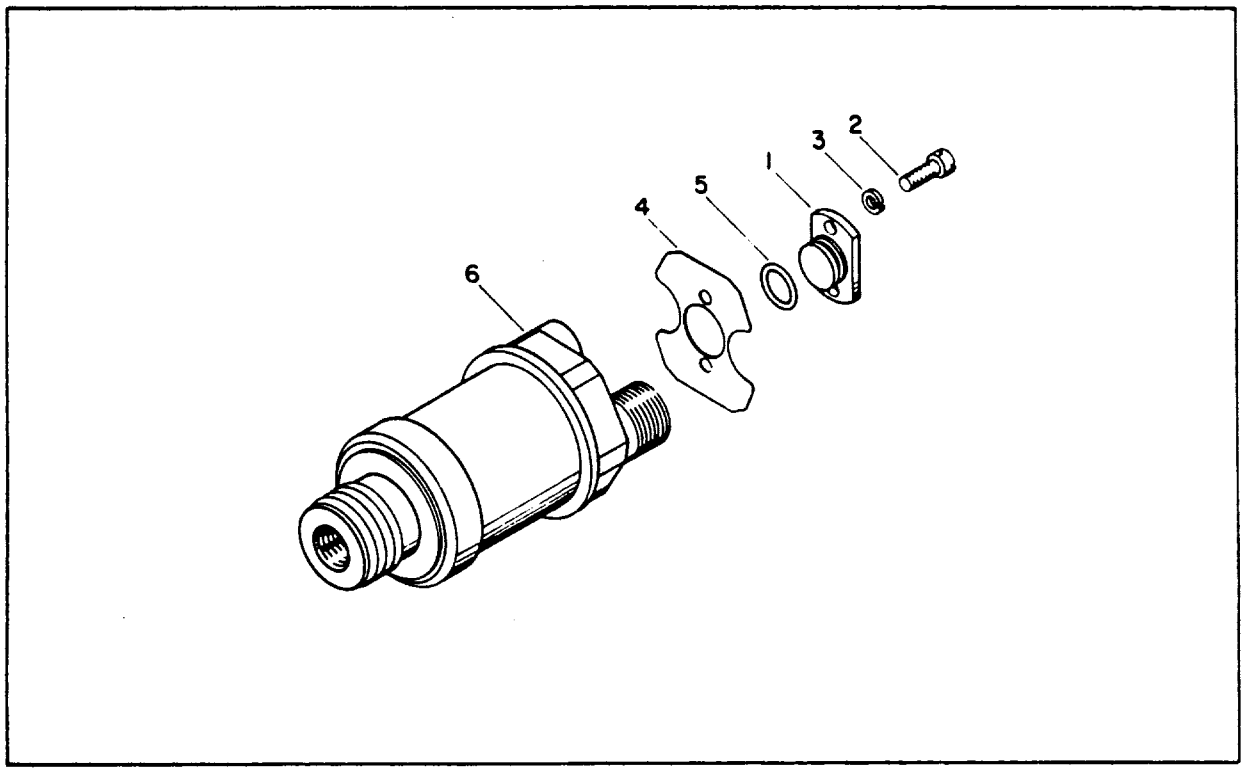
Resistor - 8 ohm non-inductive (General Radio Co., West Concord, Mass., Type 510B Decade Resistor, or equivalent.)

Decade Inductances - Sprague Elec. Co., North Adams, Mass. (Types 850-WA1 and 850-WA2 - one each required)

NOTE: If the last three items are unavailable, the table referred to in paragraph 8.B.3. can be made and supplied by the Edison Instrument Division for any individual test indicator.

TORQUE PRESSURE TRANSMITTER NO. 418-01064

ILLUSTRATED PARTS LIST



Exploded View
Figure 7

Figure & Index No.	Part No.	1 2 3 4 5 6 7 Nomenclature	Usage Code	Units per Assy
	418-01064	Transmitter - Torque pressure		Ref.
7-1	25687	. Cap - Plug		1
-2	AN500D3-4	. Screw		2
-3	AN935C3	. Washer		2
-4	25693-42	. Nameplate		1
-5	14879	. "O" Ring		1
-6	No Number	. Body - Assembly of Transmitter ...		Ref.

198 4563K10-700A
Supersedes 198 4563K10-700

Overhaul Manual

AEROSPACE INSTRUMENTATION

TYPE DJ-81
TACHOMETER INDICATOR

MODELS COVERED

8DJ81AAA1	8DJ81CAM2	8DJ81LAB2	8DJ81LAX2	8DJ81LWC2
AAB1	CAN1	LAC1	LAY2	LWH2
CAA1	CAS2	LAC2	LAZ2	LWM2
CAB2	CAX2	LAD1	LBC2	LWN2
CAC1	CAY2	LAD2	LBD2	LWR2
CAE1	CAZ2	LAE1	LBE2	LWS2
CAE2	CBA2	LAE2	LBF2	LWT2
CAF1	CBB2	LAK1	LBH2	LWV2
CAF2	CBK2	LAK2	LBK2	LWY2
CAH1	CCK2	LAN2	LBL2	LWZ2
CAH2	CCL2	LAT1	LBS2	LXC2
CAK1	CCM2	LAT2	LBT2	LXF2
CAK2	FAA1	LAV2	LBX2	LXG2
CAL1	LAA1	LAW1	LWA1	LXH2
CAM1	LAA2	LAW2	LWB2	LXK2
				LXP2

REVISION NOTICE

THESE ARE SUPERSEDING OR SUPPLEMENTARY PAGES TO SAME PUBLICATION OF PREVIOUS DATE

Insert these pages into basic publication
Destroy superseded pages

GENERAL ELECTRIC

(THIS PUBLICATION FORMERLY IDENTIFIED AS GEI-73341)

Dec. 30/66

77-10-4
(WAS 77-81-1)

LIST OF REVISED PAGES ISSUED

INSERT LATEST REVISED PAGES. DESTROY SUPERSEDED PAGES.

NOTE: The portion of the text affected by the current revision is indicated by the vertical line in the left hand margin.

Page No.	Effective Date		
Title*	Dec. 30/66		
A*	Dec. 30/66		
A-1*	Dec. 30/66		
A-2*	Dec. 30/66		
1-4*	Dec. 30/66	DDS	4563K10-709
1-4*	Dec. 30/66	DDS	4563K10-710
1-4*	Dec. 30/66	DDS	4563K10-713
1-4*	Dec. 30/66	DDS	4563K10-714
93, 94*	Dec. 30/66		

Note: All pages within this Manual have been reidentified as 77-10-4. They were previously incorrectly identified as 77-81-1.

* The asterisk indicates pages revised, added or deleted by the current revision.

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9. Trouble Shooting 26
10. Storage Instructions. 27
11. Special Tools and Test Equipment. 28
12. Parts List. 29

See Page A-1, A-2

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

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Model 8DJ81CAB2	GEI-73341	Pages 53, 54	Nov. 15/61
Model 8DJ81CAC1	GEI-73341	Pages 61, 62	Nov. 15/61
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Model 8DJ81CAE2	GEI-73341	Pages 1 thru 48	Various
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Model 8DJ81LAD1	GEI-73341	Pages 57, 58	Nov. 15/61
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GENERAL ELECTRIC

OVERHAUL MANUAL
TACHOMETER INDICATOR
TYPE DJ-81

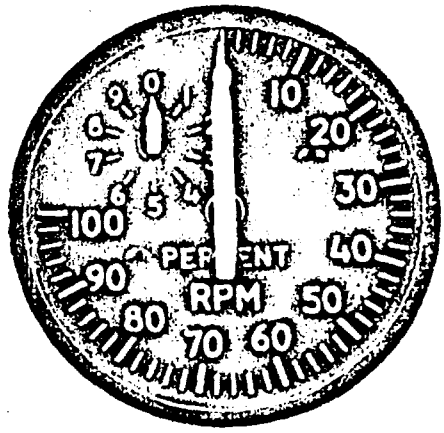
GEI-73341A

1. DESCRIPTION AND OPERATION.

A. GENERAL. This manual provides overhaul instructions and a parts list for Type DJ-81 tachometer indicators, manufactured by the General Electric Company, Instrument Department, West Lynn, Massachusetts. These indicators (see figure 1) are designed for use in aircraft at panel locations to provide visual indication of the speed of rotation of remotely-located shafts. They are provided with and without integral lighting. These overhaul instructions apply to the following models:

MODEL	RANGE
8DJ81CAE1	0-110%
8DJ81CAE2	0-110%
8DJ81LAA1 (Integrally lighted)	0-110%
8DJ81LAA2 (Integrally lighted)	0-110%

Overhaul and Test instructions for additional models are provided in Section 13 by the use of Difference Data Sheets. See Contents page A-1/A-2 for a list of the Difference Data Sheets.



Type DJ-81 Aircraft Panel Instrument
Figure 1

B. DESCRIPTION. The Type DJ-81 tachometer indicator is a hermetically-sealed unit consisting of a synchronous motor, with magnetic coupling to an indicating mechanism. The synchronous motor is driven by the three-phase supply of a tachometer generator whose frequency is a function of the speed at which it is driven. A torque proportional to the motor speed is applied to the indicating mechanism through magnetic coupling. Integral lighting of the indicator scale and pointer is provided in lighted models by three lamps mounted internally and operated on a 5-volt supply (a-c or d-c).

C. PRINCIPLES OF OPERATION. The Type DJ-81 tachometer indicator contains a self-starting, permanent magnet, synchronous motor. The synchronous motor is driven by a tachometer generator coupled to a shaft whose speed

is being measured. Hence, the motor speed is directly proportional to the generator frequency and shaft speed. The indicating mechanism is coupled to the synchronous motor through magnetic coupling, which permits slippage between the drive and the indicating mechanism, but transmits a torque proportional to the motor speed. The indicating mechanism is spring loaded against this torque and deflects through an angle which is proportional to the speed of the shaft being monitored.

D. MODIFICATIONS OF SUB 1 MODELS. In order to improve tachometer indicator performance, a modification to existing design has been initiated to reduce calibration drift noted in some indicators. Hence, all models not converted to the sub 2 configuration should be modified as described below. The modification consists of replacing the existing control spring and method of attachment of the spring to provide a more positive clamping action and more stable calibration.

(1) To perform the modification described herein, proceed as follows:

(a) Disassemble the instrument per instructions in section 2 of this manual. Disassemble only to the point necessary to replace the modified components.

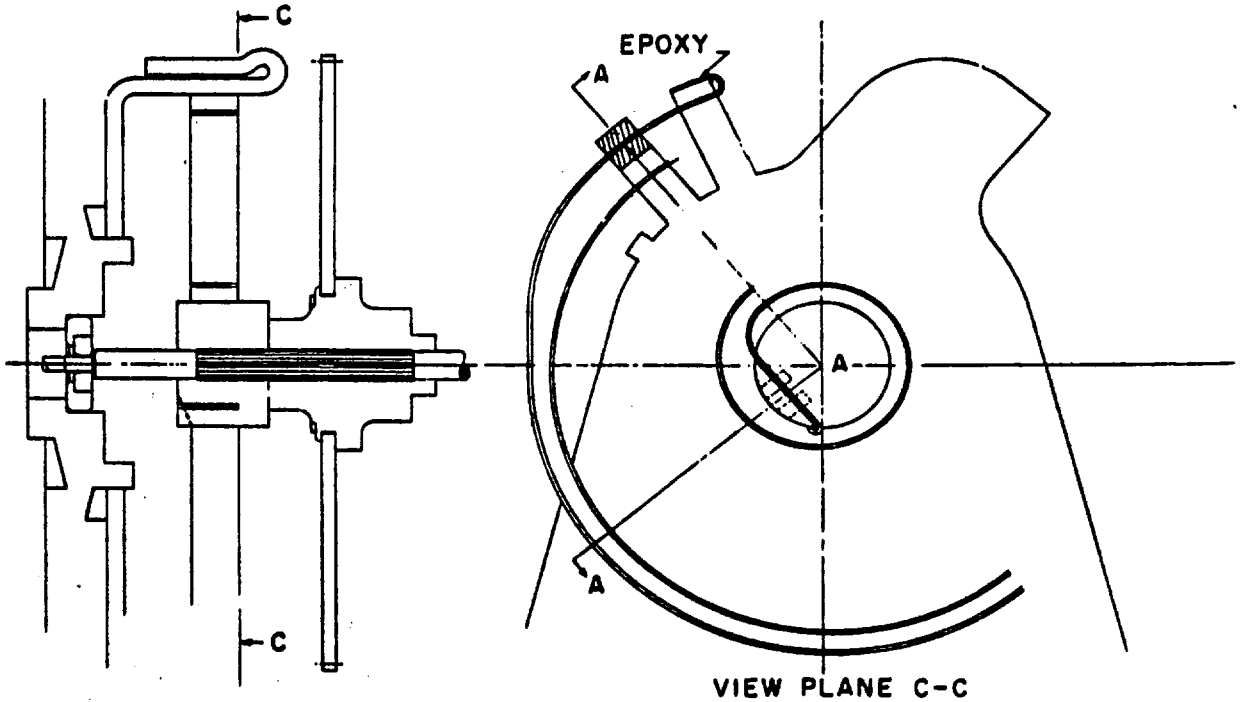
(b) When existing shaft and hub assembly and adjusting arm have been removed, replace as follows:

(1) Slip outer turn of spring into bent-over tab and hook the end of the spring onto the straight tab of the adjusting arm. Pull the hooked portion of the spring tight against the straight tab. (See figure 2.)

(2) Continue assembly per section 2 of this manual. When the instrument is assembled, less the can, level the spring and apply a small amount of epoxy (Armstrong Adhesive A-12) to the straight tab at the point of attachment of the control spring.

NOTE: When properly mixed (i.e. one to one ratio, resin to activator) Armstrong Adhesive A-12 should be quick cured by heating in an 125°C oven for 15 or 20 minutes. Quick curing will eliminate the possibility of movement of the spring under extended cure at room temperature, and guarantees proper flowing of the epoxy. Removal of the epoxy may be facilitated by using a soldering iron to break the bond of the epoxy and allow it to be chipped away. The epoxy stripper should be used for cleaning only and similar to No. 688 Cold Stripper, manufactured by the Fidelity Chemical Products Corp., Newark, New Jersey.

(3) Continue assembly and perform all test of section 8 of this manual.



Layout of Spring Clamping Method
Figure 2

(2) When assembly and test of the instrument is complete, restamp the case nameplate to indicate a sub 2 instead of sub 1. This allows identification that the change has been accomplished.

(3) Modification kits are available to perform the above modification. Table I lists the components of the modification kits.

TABLE I
MODIFICATION KITS

New Part No.	Quantity	Nomenclature	Old Part No.	Disposition
9850494G1	1	Modification Kit*		
5468506G12	1	Shaft and Hub Assembly	5468506G9	Scrap
5468500P6	1	Adjusting Arm	5468500P5	Scrap
9850495G1	1	Modification Kit**		
5468506G13	1	Shaft and Hub Assembly	5468506G2	Scrap
5468500P7	1	Adjusting Arm	5468500P4	Scrap

*For all Type DJ-81 unlighted models.
**For all Type DJ-81 lighted models.

E. LEADING PARTICULARS. Leading particulars of the indicator are listed in Table II.

TABLE II
LEADING PARTICULARS

Stator resistance	Approx. 75 ohms, lead-to-lead
Number of elements	One
Number of poles (motor rotor)	Four
Receptacle	
8DJ81CAE1, CAE2	Hermetically Sealed 10SL-3P
Mating Plug	
8DJ81CAE1, CAE2	MS3106-10SL-3S or MS3108-10SL-3S
Receptacle	
8DJ81LAA1, LAA2	Hermetically Sealed 14S-5P
Mating Plug	
8DJ81LAA1, LAA2	MS3106-14S-5S or MS3108-14S-5S
Scale	
8DJ81CAE1, CAE2	0-110% RPM
8DJ81LAA1, LAA2	0-110% RPM
Weight	
8DJ81CAE1, CAE2	0.7 pounds
8DJ81LAA1, LAA2	0.9 pounds
Length (less receptacle)	
8DJ81CAE1, CAE2	4-1/4 inch (max)
8DJ81LAA1, LAA2	4-1/2 inch (max)
Diameter	2.0 inches
Ambient Temperature Range	-54°C (-67°F) to +70°C (+158°F)

2. DISASSEMBLY.

A. GENERAL. Before disassembly, study the exploded views given in figures 3 and 4 and become familiar with the parts and assemblies, and their relationships. Special overhaul tools available are listed in Table X.

B. REMOVAL OF MOTOR AND HEAD ASSEMBLY.

(1) Disengage retaining ring (2, figure 3) and remove nameplate (1) from motor and head assembly (6).

(2) Unseal the instrument by heating soldered rivet (3) in the sealing hole with the tip of a hot soldering iron for about 15 seconds. The combination of the solder melting and the helium gas expanding will permit the rivet to pop out. Attach a mating plug to the receptacle and fasten the mating plug assembly in a vise. Wrap a damp cloth around the front of the instrument and, with the instrument vertical (dial up), apply a small gas flame to the solder seal on the outer

edge of cup support assembly (16) while pulling and twisting case assembly slightly until it is free. Immediately wipe off any excess solder.

(3) Remove bezel (5) from can assembly (4).

C. DISASSEMBLY OF HEAD ASSEMBLY.

(1) Remove pointers (7 or 7A and 8 or 8A) from their respective shafts.

(2) Remove two screws (11) and remove scale plate (9). On lighted models remove diffuser plate (10).

(3) Separate head assembly (39 or 39A) from motor assembly (13) by removing three screws (14) and lockwashers (15). Remove head assembly (39 or 39A) by sliding it radially outward so that the disk and hub assembly (1 or 1A, figure 4), and the center shaft and hub assembly (7 or 7A) pass through the slot in the shaft and magnet assembly (24, figure 3).

CAUTION: HOLD HEAD ASSEMBLY (39 OR 39A) FIRMLY AGAINST MOTOR ASSEMBLY (13) WHILE REMOVING SCREWS (14) TO PREVENT DAMAGE TO THE DISK AND HUB ASSEMBLY (1 OR 1A, FIGURE 4) AND CENTER SHAFT AND HUB ASSEMBLY (7 OR 7A).

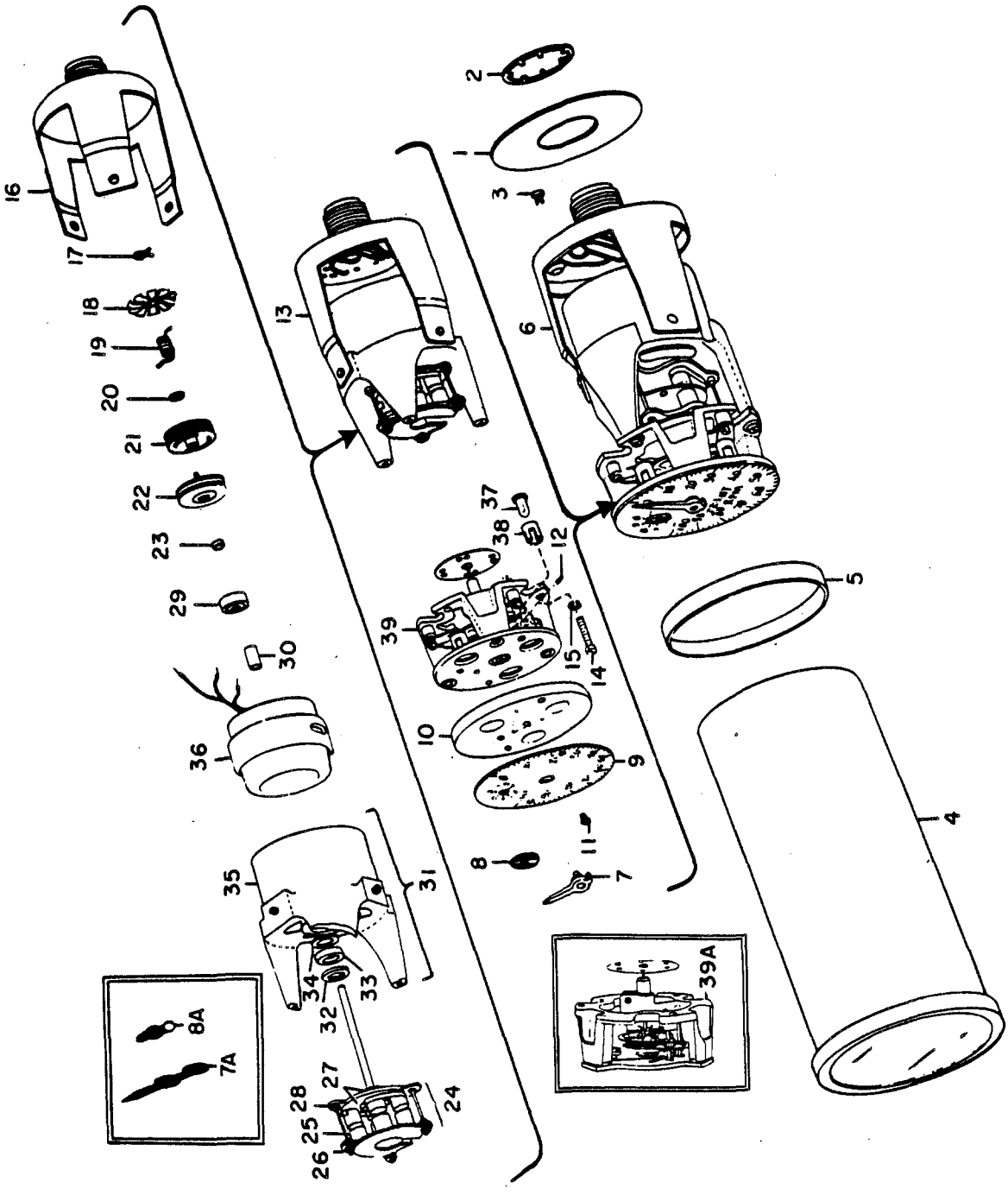
(4) Using a soldering iron, apply heat at the hub of disk and hub assembly (1 or 1A, figure 4) and remove from center shaft and hub assembly (7 or 7A).

NOTE: Clean all solder from the shaft while the solder is still molten, to facilitate reassembly.

(5) To release the outer turn of control spring from the tab on adjusting arm, proceed with the following:

(a) On CAE1 and LAA1 models, unsolder the control spring (8 or 8A) from the adjusting arm (4 or 4A).

NOTE: Bent over tab on spring must be straightened to remove. This whole procedure is not recommended for normal dissembly and repair. Instead, let adjusting arm stay with the spring and center shaft and hub assembly. Center shaft and hub assembly is normally furnished with spring attached. The only time the spring needs to be removed from the adjusting arm is to replace either the arm or center shaft and hub assembly.



Exploded View of Type DJ-81 Tachometer Indicator
Figure 3

Nomenclature for Figure 3

1. Case Nameplate
2. Retaining Ring
3. Rivet
4. Can Assembly
5. Bezel
6. Motor and Head Assembly
7. Pointer Assembly
7A. Pointer Assembly
8. Sub-Dial Pointer Assembly
8A. Sub-Dial Pointer Assembly
9. Scale Plate
10. Diffuser Plate
11. Screw
12. Balance Weight
13. Motor Assembly
14. Screw
15. Lockwasher
16. Cup Support Assembly
17. Pin Spring
18. Balance Wheel
19. Spring
20. Spacer
21. Hysteresis Rotor Assembly
22. Rotor Assembly
23. Spacer
24. Shaft and Magnet Assembly
25. Upper Magnet Assembly
26. Nut
27. Temperature Compensator
28. Lower Magnet and Post Assembly
29. Ball Bearing
30. Spacer
31. Motor Housing Assembly
32. Washer
33. Ball Bearing
34. Washer
35. Motor Housing
36. Stator Frame and Coil Assembly
37. Lamp
38. Lamp Socket
39. Head Assembly
39A. Head Assembly

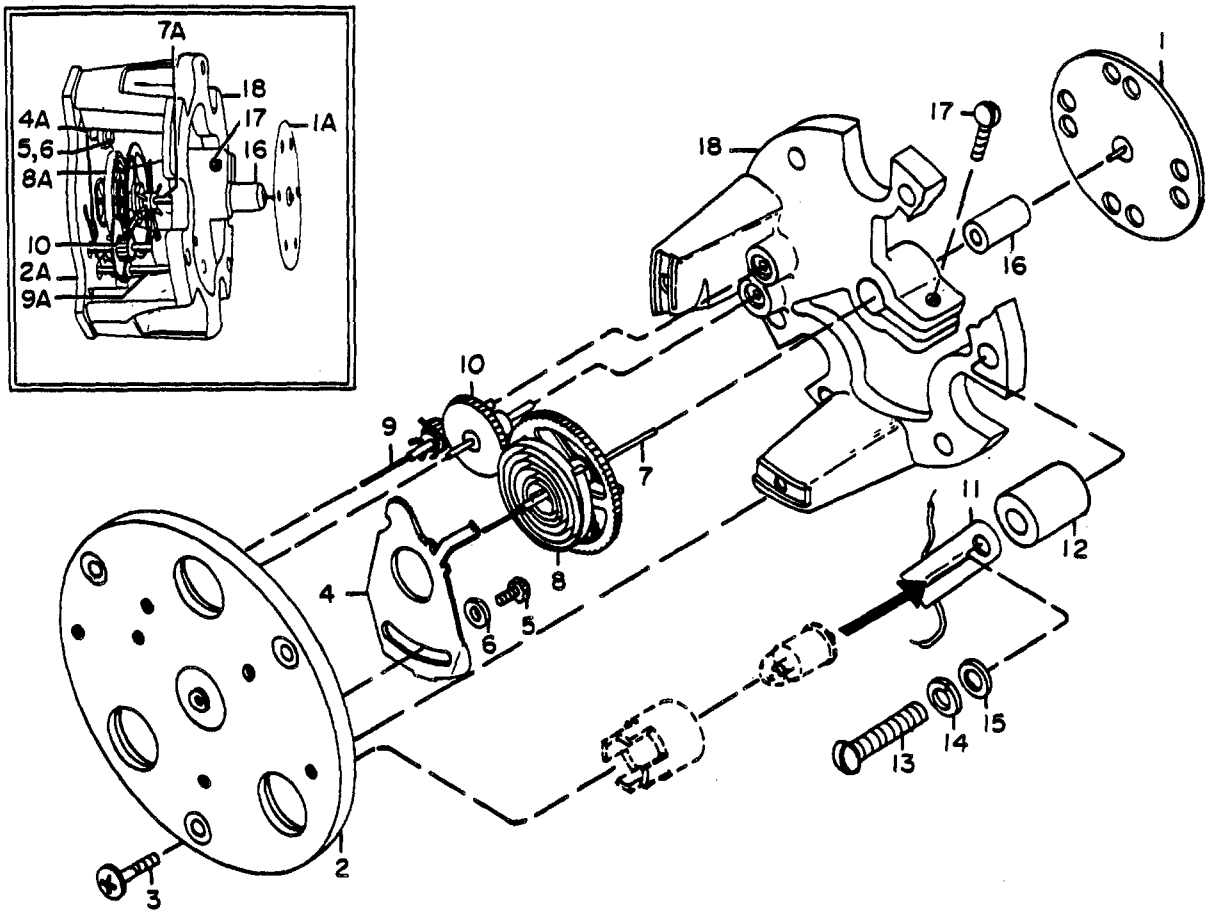
(b) On CAE2 and LAA2 models, apply heat with a soldering iron to break the bond of the epoxy and chip away the rest to release the control spring (8A) from the adjusting arm (4 or 4A). Straighten the bent tab on spring and slip the outer turn of the control spring out of the bent over tab and pull end of spring away from the straight tab on the adjusting arm (4 or 4A).

NOTE: Clean epoxy from adjusting arm (4 or 4A) with cold stripper (Cold Stripper No. 688, see Table III).

(6) Remove plate and jewel assembly (2 or 2A) and adjusting arm (4 or 4A) by removing three screws (3).

(7) Separate plate and jewel assembly and adjusting arm by removing screw (5) and washer (6).

(8) Remove center shaft and hub assembly (7 or 7A) with control spring (8 or 8A), small pointer shaft assembly (9 or 9A), and idler shaft and gear assembly (10) from head and jewel assembly (18), being careful not to damage the gears.



1. Disk and Hub Assembly
1A. Disk and Hub Assembly
2. Plate and Jewel Assembly
2A. Plate and Jewel Assembly
3. Screw
4. Adjusting Arm
4A. Adjusting Arm
5. Screw
6. Washer
7. Center Shaft and Hub Assembly
7A. Center Shaft and Hub Assembly
8. Control Spring
8A. Control Spring
9. Small Pointer Shaft Assembly
9A. Small Pointer Shaft Assembly
10. Idler Shaft and Gear Assembly
11. Spring and Lead Assembly
12. Post
13. Screw
14. Lockwasher
15. Insulating Washer
16. Jewel Holder Assembly
17. Screw
18. Head and Jewel Assembly

Exploded View of Head Assembly
Figure 4

(9) To remove control spring from center shaft and hub assembly, proceed as follows:

(a) On models CAE1 and LAA1, unsolder the control spring (8 or 8A) from the anchor hub of the center shaft and hub assembly (7 or 7A).

NOTE: Bent over tab on spring must be straightened to remove. This whole procedure is not recommended for normal disassembly and repair. Instead, let adjusting arm stay with the spring and center shaft and hub assembly. Center shaft and hub assembly is normally furnished with spring attached. The only time the spring needs to be removed from the adjusting arm is to replace either the arm or center shaft and hub assembly.

(b) On models CAE2 and LAA2 apply heat using a soldering iron to break the bond of epoxy and chip away the rest to release the control spring (8A) from the anchor hub of the center shaft and hub assembly (7 or 7A).

NOTE: Clean anchor hub and control spring (8A) with cold stripper (Cold Stripper No. 688, see Table III).

(10) Loosen screw (17) and slide jewel holder assembly (16) out of head and jewel assembly (18).

D. DISASSEMBLY OF THE MOTOR ASSEMBLY (13, Figure 3).

(1) Remove the cup support assembly (16) from the motor housing (35) by carefully springing the three arms outward so that they are free of the bosses on the casting. Unsolder the leads from the receptacle, taking care not to put a strain on the leads at the soldering points and label the leads.

(2) Remove pin spring (17) and slide balance wheel (18) from the shaft of shaft and magnet assembly (24).

NOTE: Mark top of balance wheel so that it can be replaced in the same position at reassembly. (Same side facing outward.)

(3) Remove spring (19) by grasping the tab and turning it counterclockwise.

(4) Remove spacer (20), hysteresis rotor assembly (21), rotor assembly (22) and spacer (23) from shaft of shaft and magnet assembly (24).

(5) Remove shaft and magnet assembly (24) from motor housing assembly (31) being careful not to damage bearing (33).

(6) Disassemble shaft and magnet assembly (24, figure 3) as follows:

(a) Remove upper magnet assembly (25) attached by three nuts (26).

(b) Remove temperature compensators (27) from upper magnet assembly (25) and lower magnet and post assembly (28).

NOTE: Do not remove or reposition temperature compensators (27) unless components of shaft and magnet assembly (24) are to be replaced. This will likely avoid readjusting of the compensators at reassembly, providing the disk and hub assembly (1 or 1A, figure 4) and/or the control spring (8 or 8A) are not replaced.

(c) Remove three adjusting nuts (26, figure 3) from lower magnet and post assembly (28).

(7) Remove bearing (29) and spacer (30) from motor housing assembly (31).

(8) Unstake and remove stator frame and coil assembly (36).

(9) To disassemble the motor housing assembly (31), unstake washer (32) and remove ball bearing (33) and washer (34) from motor housing (35).

3. CLEANING.

A. Clean metal parts by washing in a suitable solvent. Dry with clean, moisture-free air.

B. Clean bearings (29 and 33, figure 3) and the bearing in rotor assembly (22) and then dry with clean, moisture-free air. Lubricate the bearings immediately after cleaning.

NOTE: Before assembly, lubricate each ball bearing (29 and 33) and the bearing in the rotor assembly (22) with three drops of silicone fluid (D50W97). The fluid must be applied with a No. 25 hypodermic needle (or equivalent), directly into the bearings, avoiding any contact between the needle and the bearings. Spin the bearings so that the fluid will completely cover the balls and races.

C. CLEANING MATERIALS. Table III is a list of approved cleaning materials recommended for use during cleaning and assembly procedures.

The note on page 10A applies only to indicators assembled in accordance with the alternate method (units not sealed).

NOTE: Before assembly, lubricate each bearing in the rotor assembly (22) with two drops of oil, Pioneer P-10 (MIL-L-6085A). The fluid must be applied with a No. 25 hypodermic needle (or equivalent) directly into the bearing avoiding contact between the needle and the bearings. Spin the bearings so that the fluid will completely cover the balls and rails.

This note applied to all indicators sealed and unsealed.

CAUTION: All previous lubrication must be removed in accordance with section 3B.

C. CLEANING MATERIALS. Table III is a list of approved cleaning materials recommended for use during cleaning and assembly procedures.

TABLE III
CLEANING MATERIALS

Materials	Vendor
Petroleum Spirits (G-E Spec D5B8) (for cleaning connectors)	General Electric Company, Instrument Dept., 40 Federal Street West Lynn, Massachusetts
Toluene (G-E Spec D51311) (for cleaning metal parts)	General Electric Company, Instrument Dept., 40 Federal Street West Lynn, Massachusetts
Chlorethane (for removing petroleum base materials)	Dow Chemical Company 200 Main Street Midland, Michigan
Acetone (for rinsing parts cleaned with petroleum spirits or toluene)	Available commercially
Naphtha (for removing anti-rust preservative)	Available commercially
Benzine (for cleaning metal parts)	Available commercially
No. 688 Cold Stripper (epoxy stripper to clean the adjusting arm tab and control spring)	Fidelity Chemical Products Corp. Newark, New Jersey

4. INSPECTION.

A. GENERAL. Tachometer indicator components should be inspected as follows before assembly is undertaken. The components should also be scrutinized carefully during the assembly procedure.

(1) Examine bearings, bearing surfaces, pivots and gears for wear and broken parts. Replace as required.

(2) Measure the resistance of the stator windings. The resistance of the three phases should match within ±1 ohm. Phase resistance is approximately 75 ohms. Replace faulty stators.

(3) Measure the stator winding insulating value by applying 800 volts a-c between the windings and the frame for five seconds. Replace faulty stators.

5. REPAIR.

A. GENERAL. Repair of the indicators is limited to the replacement of worn or broken parts, magnetizing knocked-down or new magnets, and stabilizing the subassemblies.

B. REPLACEMENT OF SHAFTS. When replacing shaft to which disk is attached, tin end of shaft to be soldered using Ruby stainless flux (G-E specification A10B18) and 50-50 solder.

C. MAGNETIZING THE SHAFT AND MAGNET ASSEMBLY (24, Figure 3).

NOTE: Elimination of air gap will facilitate magnetizing.

(1) Magnetizing is accomplished by means of a Magnetizer (R.F.L. Cat. No. 107A) or equivalent and associated fixture (see Table X).

(2) Insert the magnetizing fixture through the long narrow opening formed by the drag magnets and the top and bottom plates of the shaft and magnet assembly. Pass sufficient current through the Magnetizer to produce a minimum magnetizing force of 3000 oersteds in the magnets.

D. TEMPERATURE STABILIZING THE SHAFT AND MAGNET ASSEMBLY.

NOTE: Required only after magnetizing the shaft and magnet assembly.

(1) Temperature stabilization is accomplished by completing four distinct steps as follows:

(a) Soak one hour minimum (in air) at -70°C (-94°F) to -80°C (-112°F).

(b) Soak one hour minimum (in air) at 100°C (212°C) to 125°C (257°F).

(c) Soak one hour minimum (in air) at -70°C (-94°F) to -80°C (-112°F).

(d) Soak one hour minimum (in air) at 100°C (212°F) to 125°C (257°F).

NOTE: The time of one hour for each step may be reduced to 15 minutes if the magnets are submerged alternately in a -70°C (-84°F) alcohol-dry ice bath and a boiling water bath. Transport the magnet assembly rapidly between the low and high temperatures so as to avoid condensation. Care should be taken to avoid having the magnets contact any magnetic material.

E. REFINISH EXTERIOR CAN ASSEMBLY. If the exterior can assembly requires painting, refinish it using Raffi and Swanson (Wilmington, Massachusetts) No. 4851 black paint or equivalent. (See Table IV.) The surface to be painted must be thoroughly clean.

6. ASSEMBLY.

A. GENERAL. During reassembly it is necessary to make certain adjustments and checks. These are described at the appropriate points in the instructions that follow. Table IV lists materials required during assembly.

TABLE IV
BULK MATERIALS

Material	Vendor
Tape (G-E Spec A23C4A2)	General Electric Company, Instrument Dept., 40 Federal Street West Lynn, Massachusetts
Silicone Fluid (G-E Spec D50W97)	General Electric Company, Instrument Dept., 40 Federal Street West Lynn, Massachusetts
Silicone Fluid, G-E Spec SF81 (50)	General Electric Company, Silicone Products Dept., Mechanicville Rd. Waterford, New York
SAF-T-FLUX (number 2213)	Available commercially
Ruby Stainless Flux (G-E Spec A10B18)	Ruby Chemical Company Box 1108 Columbus, Ohio
Epoxy Adhesive A-12 (G-E Spec A50W298-S1)	Armstrong Products Company Argonne Road Warsaw, Indiana
Cold Stripper (No. 688)	Fidelity Chemical Products Corp. Newark, New Jersey
Black Paint (No. 4851)	Raffi and Swanson Wilmington, Massachusetts

B. ASSEMBLY OF MOTOR ASSEMBLY (13, Figure 3).

(1) Assemble Motor Housing Assembly (31) as outlined below:

(a) Install washer (34, Figure 3), ball bearing (33) and washer (32) in motor housing (35). Before staking washer (32), check the thickness of ball bearing (33) and washer (34). Combined thickness must be 0.165 ± 0.002 inch for the disk (1 or 1A, figure 4) to lie in the approximate center of the air gap of the assembled instrument. If the dimension is not within tolerance, replace washer (34, figure 3) with one of the correct thickness. Measure the bearing thickness from one edge of the inner race to the

opposite edge of the outer race and subtract one-half of the total bearing end play, as measured with the bearing under a one-half pound axial load. Table V gives the recommended pairing of bearing and washer.

TABLE V

BEARING THICKNESS (IN.)	WASHER THICKNESS (IN.)
0.158	0.008
0.156	0.008
0.156	0.010
0.154	0.010
0.154	0.012
0.152	0.012
0.152	0.014
0.150	0.014

(2) Assemble shaft and magnet assembly (24, figure 3) as outlined below:

(a) Install three adjusting nuts (26) on lower magnet and post assembly (28).

(b) Install temperature compensator (27) on upper magnet assembly (25) and lower magnet and post assembly (28).

(c) The temperature compensator (27) provides an adjustment for the effect of temperature on the shaft and magnet assembly (24), the disk and hub assembly (1 or 1A, figure 4), and the control spring (8 or 8A). If any of these parts have been replaced, it will be necessary to readjust the position of the temperature compensator. In addition, if the disk and hub assembly (1 or 1A) has been replaced, a different number of compensators may be required. Table VI gives the recommended initial number and location of compensators according to the temperature coefficient of the disk being used. The coefficient number is marked on the disk.

TABLE VI
LOCATION OF TEMPERATURE COMPENSATOR

DISK RES. TEMP. COEFF.	CODE STAMP	NUMBER OF COMPENSATORS		DISTANCE FROM COMPENSATOR TO AIR GAP
		LOWER MAGNET	UPPER MAGNET	
0.00075 0.00076 0.00077	1	2	0	0.070
0.00078 0.00079 0.00080	2	2	1	0.120
0.00081 0.00082 0.00083	3	2	1	0.095
0.00084 0.00085 0.00086	4	2	1	0.070
0.00087 0.00088 0.00089 0.00090	5	2	2	0.120

NOTE: When only one compensator is required, a "dummy" compensator must be added to the diametrically opposite set of magnets for balance purposes. As the dummy compensator will not affect compensation, it can be located at any convenient distance from the air gap.

(d) Assemble upper magnet assembly (25, figure 3) to lower magnet and post assembly (28) and secure with nuts (26), adjusting the air gap between the magnets to 0.045 to 0.050 inch by positioning nuts.

(e) Magnetize the magnets as outlined in Section 5, Paragraph C.

(f) After magnetizing, temperature stabilize the shaft and magnet assembly (24), making sure the compensators are in place, as outlined in Section 5, Paragraph D.

(3) Assemble shaft and magnet assembly to the motor housing assembly (31) as follows:

(a) Insert shaft and magnet assembly carefully through the bearing (33) in the motor housing assembly.

(b) Slide spacer (30), ball bearing (29), and spacer (23) on the shaft of the shaft and magnet assembly.

(c) Slide rotor assembly (22) on the shaft with the arm facing to the rear of the indicator.

(d) Install hysteresis rotor assembly (21) on the shaft, carefully engaging the arm of rotor assembly (22) with the slot in hysteresis rotor assembly (21).

(e) Slide spacer (20) onto the shaft, then install spring (19) with three open turns toward rotor of motor.

(f) Slide balance wheel (18) onto the shaft and lock in place with pin spring (17).

(g) Balancing of the rotors (21 and 22) and shaft and magnet assembly (24) must be performed as follows:

CAUTION: DO NOT PERFORM FOLLOWING BALANCING OPERATION WITH STATOR FRAME AND COIL ASSEMBLY IN PLACE SINCE THE MAGNETIC ATTRACTION BETWEEN THIS ITEM AND THE ROTORS WILL CAUSE ERRONEOUS RESULTS.

(1) Remove sections of the balance wheel (18) as necessary.

(2) When properly balanced, the rotating assembly will not assume a repetitive position when tapped or vibrated.

(h) Install the stator frame and coil assembly (36) as follows:

(1) Insert the stator frame and coil assembly in position in the motor housing assembly (31).

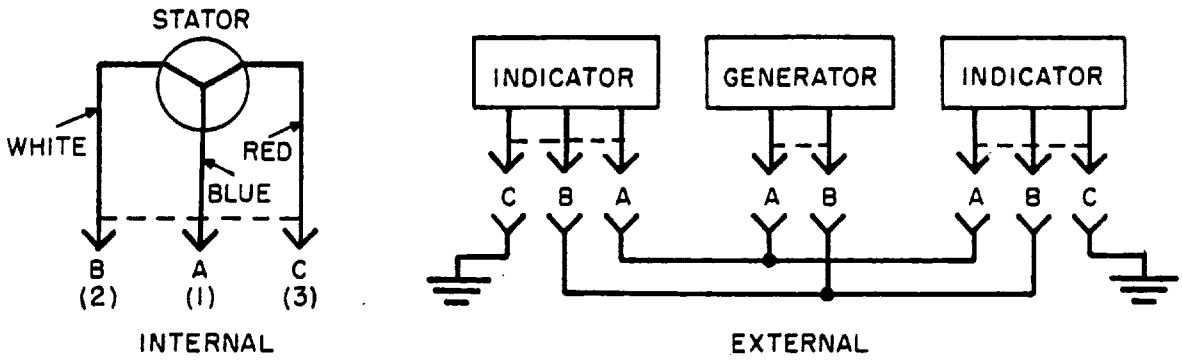
(2) Place the leads midway between two of the posts on cup support assembly (16) and stake the stator frame and coil assembly (36) to the motor housing assembly in three places (120 degrees apart) approximately 3/16 inch wide.

(i) Install the cup support assembly (16) as follows:

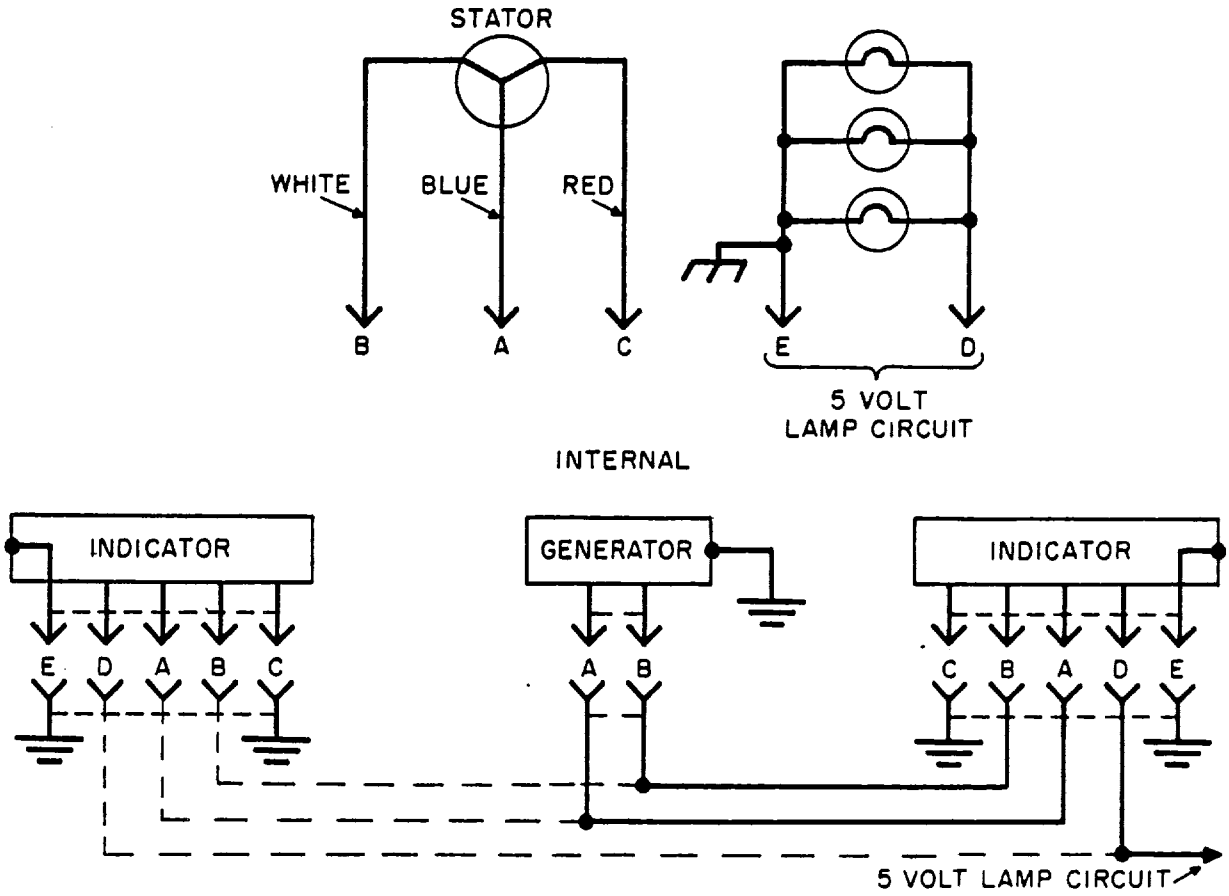
(1) Solder (using 63-37 solder) the stator leads to the connector as shown in figure 5.

NOTE: Position the leads by forming them carefully so that they do not touch the can or interfere with the balance wheel.

(2) Carefully spring the arms on the cup support assembly (16, figure 3) radially outward and set in place over the motor housing assembly (31), engaging the holes in the cup support assembly (16) with bosses on the motor housing assembly.



A. External and Internal Connections for 8DJ81CAE1 and 8DJ81CAE2



COUNTER-CLOCKWISE ROTATION OF GENERATOR AS VIEWED FROM SHAFT END.
FOR CLOCKWISE ROTATION, INTERCHANGE LEADS A AND B.

EXTERNAL

B. External and Internal Connections for 8DJ81LAA1 and 8DJ81LAA2

External and Internal Wiring Connections for Type DJ-81 Tachometer Indicators
Figure 5

C. ASSEMBLY OF HEAD ASSEMBLY.

(1) Slide jewel holder assembly (16, figure 4) into head and jewel assembly (18) and lock in place with screw (17).

(2) To assemble inner turn of control spring (8 or 8A) to spring anchor hub of center shaft and hub assembly (7 or 7A), proceed as follows:

(a) On CAE1 and LAA1 models, tin the ends of the control spring (8 or 8A) to be soldered using three percent zinc chloride (ZnCl) flux and 63-37 solder. If both parts (spring (8 or 8A) and mating part) are pre-tinned, no additional solder is necessary. When only one part is tinned, use a controlled amount of SAF-T-FLUX (number 2213) and 63-37 percent solder.

(b) On CAE2 and LAA2 models, slip inner end of spring (8A) into slot in the spring anchor hub of the center shaft and hub assembly (7 or 7A), and fasten with epoxy (Armstrong Adhesive A-12, G-E Spec A50W298A). Mix epoxy one part resin and one part activator, apply and quick cure by heating in a 125°C (275°F) oven for 15 to 20 minutes.

(c) Thoroughly clean all tinned parts. An acceptable method consists of washing the parts in boiling water, using three successive washes and a separate container for each wash. Then wash in isopropyl alcohol and air dry.

(3) Set center shaft and hub assembly (7 or 7A), subdial pointer shaft assembly (9 or 9A), and idler shaft and gear assembly (10) in place on the head and jewel assembly (18).

(4) Attach adjusting arm (4 or 4A) to place and jewel assembly (2 or 2A) with screws (5) and washer (6), in approximately its center position.

(5) Loosen screw (17), leaving jewel holder assembly (16) free to slide, and set plate and jewel assembly (2 or 2A) in place, carefully setting all shafts in their respective holes in plate and jewel assembly.

(6) Insert three screws (3) to fasten plate and jewel assembly (2 or 2A) to head and jewel assembly (18).

(7) Adjust endshake of center shaft and hub assembly (7 or 7A) to the tolerance given in Table VII by sliding jewel holder assembly carefully against the shaft, and tighten screw (17).

(8) Attach the outer turn of control spring (8 or 8A) to adjusting arm (4 or 4A) so that the turns of the spring lie flat using the following procedure:

(a) On CAE1 and LAA1 models, solder outer turn of control spring (8 or 8A) to the adjusting arm (4 or 4A) so that the turns of the spring lie flat.

(b) On CAE2 and LAA2 models, slip outer turn of spring (8A) into bent-over tab and hook the end of the spring onto the straight tab of the adjusting arm (4 or 4A). Pull the hooked portion of the spring tight against the straight tab. Level the spring and apply a small amount of epoxy (Armstrong Adhesive A-12, G-E Spec A50W298A) to the straight tab at the point of attachment of the control spring (8A).

NOTE: Mix epoxy thoroughly, one part resin to one part activator. Cure by heating in an 125°C (257°F) oven for 15 to 20 minutes.

NOTE: At this point check the action of the spring by adding pointer, temporarily, and turning through the complete range of rotation. The spring turns must remain in a flat plane without adjacent turns touching.

(9) Solder the disk and hub assembly (1 or 1A, figure 4) so that the distance from the disk to the bottom edge of the head and jewel assembly (18) is 0.533 ± 0.002 inch.

(10) Stabilize control spring (4 or 4A) by submitting head assembly to +70°C (+158°F) with the pointer shaft rotated and held at approximately 85% of full scale for 48 hours.

D. ASSEMBLY OF MOTOR AND HEAD ASSEMBLY.

(1) Place balance weight (12, figure 3) in position on counterweight arm of center shaft and hub assembly (7 or 7A, figure 4).

(2) Place the head assembly (39 or 39A, figure 3) and the motor assembly (13) together, carefully placing the shaft of the head assembly through the slot provided in the shaft and magnet assembly (24).

(3) Fasten the motor and head assembly together with three screws (14) and washers (15). In the lighted models apply epoxy cement (Hysol-6020-8328) to the groove in the motor housing assembly (31) and to light wire. Be sure that the wire lies flat in the groove. Solder the lead to pin D on receptacle.

(4) To install scale plate, use the following procedure:

(a) On unlighted models CAE1 and CAE2, install scale plate (9) and attach with two screws (11).

(b) On lighted models LAA1 and LAA2, install scale plate (9A) and plate diffuser (10) with two screws (11). Wrap the edge of the scale plate, plate diffuser, and plate and jewel assembly with tape (No. 805 Metallized Silver Mylar, 1/2 inch wide).

(5) Install pointers (7 or 7A and 8 or 8A) as follows:

(a) Move the adjusting arm (4 or 4A, figure 4) so that the counterweight arm just touches the pointer stop.

(b) Add the pointers, reaming their hubs as necessary with the Point Reamer (G-E Tool No. 404X84) to the shafts at approximately 2.5 percent RPM below the zero setting.

(c) Move the adjusting arm to bring the pointers onto the zero mark.

E. INSTALLATION OF MOTOR AND HEAD ASSEMBLY.

(1) Place the motor and head assembly (6, figure 3) into can assembly (4) along with bezel (5).

(2) Before sealing the indicator, perform successively the tests of Section 8, Testing. Perform the tests of Paragraphs A through L for unlighted models and Paragraphs A through N for integral lighted models.

(3) Seal instrument as follows:

(a) Re-tin the inside edge of the can assembly (4) and the outside edge of the motor and head assembly (6). Do not permit flux to flow into the can, and tin only the surfaces which will be sealed by solder. Use a resin flux (10 percent resin, 90 percent alcohol).

(b) Assemble instrument in case making sure that the receptacle key is located at the top.

(c) Using B20C12A solder and alcohol only, solder outside edge of the motor and head assembly (6) to case being sure that all voids are filled and being careful that there are no cold joints which will later open when subjected to thermal stress. Do not seal hole in cup support assembly (16).

CAUTION: IN NO CASE SHALL SOLDER OR FLUX BE PERMITTED TO RUN INSIDE THE INSTRUMENT.

NOTE: While heating the back end, care must be taken to keep the front end cool by wrapping the front end with a damp cloth.

(d) Place assembled instrument into a vacuum oven at a maximum of 85 microns absolute pressure at a temperature of 75°C (167°F) to 85°C (185°F) for a minimum of 16 hours.

(e) Within 30 seconds of bake, break vacuum by flushing instrument with helium (-65°C dew point).

Alternate instructions of motor and head assembly.

(1) Assemble support cup to motor such that receptacle key is at the top.

(2) Insert bezel (5, figure 3) and motor assembly (6) into can assembly (4).

(3) Perform the tests of Section 8, testing. Perform the tests of paragraphs A through L for unlighted models and paragraphs A through N for integral lighted models.

(4) Fasten instrument into case as follows:

(a) Tack solder outside edge of motor and head assembly (6) to the case at three points, approximately 1/4 inch wide and 120 degrees apart, using 50/50 solder. Use a resin flux (10 percent resin, 90 percent alcohol).

(b) Do not seal hole in cup support assembly.

(5) Stamp letter "A" after serial number on nameplate (1).

(6) Attach nameplate (1) with retaining ring (2).

(f) Immediately (within 30 seconds) after flush, seal cup support hole with rivet (3).

NOTE: Hold instrument with sealing hole down until just before final sealing.

(4) Run a Fog Test in accordance with Section 8, Paragraph O. There shall be no evidence of fog.

(5) Attach nameplate (1) with retaining ring (2).

7. FITS AND CLEARANCES.

A. GENERAL. A listing of fits and clearances for individual part and mating part is given in Table VII.

TABLE VII
TABLE OF FITS AND CLEARANCES

ITEMS INVOLVED	FIT OR CLEARANCE
Temperature Compensators (27, figure 3)	Adjust air gap to 0.045 + 0.005 - 0.000 inch.
Disk and Hub Assembly (1 or 1A, figure 4) and Temperature Compensators (27, figure 3)	Minimum dimension between Disk and Hub Assembly and Temperature Compensators to be 0.005 inch (both sides).
Ball Bearing (33) and Washer (34).	Total combined thickness of bearing and washer to be 0.165 ± 0.002 inch.
Center Shaft and Hub Assembly (7 or 7A, figure 4)	Adjust endshake to 0.0015 to 0.002 inch. (Dimension applies with center shaft against front jewel.)

8. TESTING.

A. GENERAL. Tests should be completed during assembly at specific points noted in the assembly procedures.

B. CONDITIONS OF TESTS.

(1) Make all adjustments in the order given.

(2) All room temperature tests shall be made at approximately 24°C (75.2°F).

(3) Unless otherwise specified, the indicator shall be tested in its normal operating position, with the dial vertical.

(4) Unless otherwise specified, the indicator shall be tapped gently axially before each test reading.

(5) Unless otherwise specified, voltages noted herein are a-c, RMS values. Voltmeters used to measure voltages to the indicator shall be free from wave form and frequency errors over the frequency range used and shall have a minimum resistance of 1000 ohms per volt.

C. INITIAL FULL-SCALE ADJUSTMENT.

(1) There shall be a minimum of 2.0 percent and a maximum of 5.0 percent pointer backtravel beyond the zero graduation.

NOTE: The following steps (2) and (3) apply only when a new or remagnetized magnet assembly is used.

(2) Connect the instrument to the calibrating tester (see Table X) and adjust the frequency to 3000 cycles per minute (CPM). With the synchronous motor running at 3000 CPM, apply a magnetic field of 50 oersteds, minimum perpendicular to the axis of the magnets. If the 50-oersted field produces excessive knockdown, either remagnetization of the drag magnet or a new drag magnet assembly is required.

CAUTION: IN APPLYING THE FIELD TO THE COUPLING MAGNETS, DO NOT APPLY IT TO THE ROTOR OF THE SYNCHRONOUS MOTOR.

(3) Increase the field strength as required to knock down the coupling magnets to such a strength that the indicator will read approximately one percent overscale at this speed.

D. TEMPERATURE COMPENSATION.

(1) Take temperature compensation readings at the input frequencies listed below:

Model	Frequency	Indication	% Change From R.T. Reading at	
			+70°C	-35°C
8DJ81CAE1	4200 CPM	100%	+0.0 -0.3	+1.0 -0.0
8DJ81CAE2	4200 CPM	100%	+0.0 -0.3	+1.0 -0.0
8DJ81LAA1	4200 CPM	100%	+0.0 -0.3	+1.0 -0.0
8DJ81LAA2	4200 CPM	100%	+0.0 -0.3	+1.0 -0.0

(a) Read the instrument after it has been subjected to -35°C for a minimum of two hours.

NOTE: Energize and read the instrument quickly in order to prevent any changes in temperature due to operation of the indicator.

(b) Allow the instrument to return to room temperature and take readings after the instrument has been at room temperature for two hours.

(c) Read the instrument after it has been subjected to +70°C for a minimum of two hours.

(d) All readings should be within the tolerances listed above. Make rough adjustments as outlined in paragraph 2.

(2) Adjust the temperature compensation not to exceed the limits specified in paragraph 1, using compensators (27, figure 3) and dummy compensators. Movement of a single compensator 0.038 inch toward or away from the air gap will change the compensation at -35° about 0.1% at 4200 cpm. At +70°C, the effect at 4200 cpm is approximately 0.07%. The addition of a single compensator 0.135 inch from the air gap or either the upper or lower magnets will increase the compensation 0.4% at -35°C and 0.3% at +70°C.

(3) If the indication is under-compensated at -35°C (indication is high), move the temperature compensator shunt(s) toward the air gap or add compensators. If the indicator is over-compensated at -35°C (indication is low), move the compensator(s) away from the air gap or remove compensators. For tests at +70°C, reverse the adjustments.

(4) Preferred compensation is obtained when the compensators are located a maximum distance from the gap. Thus, when 0.4 percent added compensation is needed, add one compensator and one dummy 0.135 inch from the air gap, in preference to sliding two compensators 0.076 inch toward the gap.

CAUTION: NEVER PLACE THE TEMPERATURE COMPENSATORS CLOSER THAN 0.060 INCH FROM THE AIR GAP.

NOTE: Temperature compensation at +70°C has been added to provide users with a check under more nearly standard operating temperature conditions.

(5) If the readings are not within the limits specified in paragraph 1, repeat the readings for temperature compensation accuracy at +70°C. Continue this adjustment until the readings are within limits.

(6) An alternate method of temperature compensation check follows:

The following simplified methods of temperature compensation are included for use where high accuracy of indication at low temperature extremes is not required or -35°C and/or +70°C temperature boxes are not available.

Indication accuracy at normal operating temperatures will not be adversely affected and may be improved.

(a) Operate the indicator at room temperature and record the reading at 4200 cpm. Then, place the indicator in a 40°C ambient and operate at 4200 cpm and 21 volts for 20 minutes, reading the indicator at the end of the period. The reading at 40°C shall not differ from the room temperature reading by more than 0.2%. Make any necessary compensation adjustments according to paragraphs (2), (3) and (4) of this section.
It is preferable that any change in indication at 40°C be in the negative direction as this will tend to compensate for any slight position change in the zero reading over a period of time.

(b) If a 40°C oven is not available for (a) above, a second alternate method may be used. Wrap the indicator in two layers of aluminum foil to reduce loss of heat. Place the indicator on a surface of low heat conductivity such as a wooden "V" block and proceed as in (a) above, omitting the oven. Self heat of the indicator will raise its internal temperature as required for the 40°C reading.

E. CALIBRATION.

(1) In paragraph C above, an initial full-scale adjustment within one percent was made. Finer adjustments for the purposes of this final calibration are made by varying the magnet gap of the coupling.

(2) Make calibration runs according to Table VIII, noting the error in reading at each point on this curve. Adjust as necessary.

TABLE VIII
CHECK POINTS DURING CALIBRATION RUNS

Type DJ-81 Indicators

GENERATOR FREQUENCY CPM	INDICATOR READING (%)	ERROR TOLERANCE (%)
200	4.8	0.50
400	9.5	0.50
800	19.0	0.50
1600	38.1	0.80
2400	57.1	0.80
3200	76.2	0.50
3400	80.9	0.50
3600	85.7	0.50
3800	90.5	0.50
4000	95.2	0.50
4200	100.0	0.50
4400	104.8	0.50

F. FRICTION CHECK

(1) Test for friction at 200, 800, 1600, 3200, 3600, and 4200 CPM input frequencies according to paragraph F(2) below. The change in indication before and after tapping shall not exceed 1.5% at 200, 0.6% at 800 and 0.5% at the other input frequencies.

(2) In making the tests for friction errors, increase the tachometer generator frequency up to but not exceeding the specified points. Do not read until the pointer comes to rest. When it does, read the indicator, tap it gently on the glass using a rubber tipped hammer (or pencil) to remove any friction error, and read again.

CAUTION: TO OBTAIN ACCURATE READINGS, TAKE PRECAUTIONS TO MINIMIZE EXTERNAL VIBRATIONS FROM HEAVY MACHINERY OPERATING NEARBY, BUILDING VIBRATIONS FROM TRAFFIC, ETC.

G. ATTITUDE ERROR CHECK. At 100 percent RPM, the position error shall not exceed 0.3 percent RPM when the indicator dial is shifted 45 degrees either up or down from the long axis and rotated 45 degrees to the left and to the right on the long axis.

H. POINTER ALIGNMENT CHECK. Check the pointer alignment at 90 and 96 percent RPM. When the large pointer is at the mark, the small pointer must be within 0.2 percent of zero and 6.0 percent respectively.

I. POINTER OSCILLATION CHECK. The pointer oscillation shall not exceed 0.5 percent from zero to 15 percent RPM, and 0.3 percent from 15 percent to 110 percent RPM on the sensitive pointer.

J. STARTING TEST.

(1) The procedures for making the starting test on each of the models of DJ-81 indicators are similar but the tolerances differ.

(2) To make the test, connect the indicator to a tachometer indicator tester having a voltage gradient at 0.0035 volts RMS per cycle per minute (see Table X, Tachometer Indicator Tester (TAKCAL) or equivalent), and increase the frequency from zero up to but not exceeding the value given for the model. After tapping or gently vibrating it, read the indicator. The reading should not be less than value specified for the model.

(3) The instrument shall meet the following requirements:

DJ-81 Model	Frequency (CPM)	Minimum Reading (% RPM)
CAE1	150	2.5
CAE2	150	2.5
LAA1	150	2.5
LAA2	150	2.5

K. FREE RETURN CHECK. With the indicator held at approximately 45 degree downward pitch, increase the frequency slowly up to 4000 CPM. With the indicator then held at 45 degree upward pitch, reduce frequency slowly from 4000 CPM to zero CPM. There shall be no catching or hesitation as caused by mechanical interference above five percent or 200 RPM, whichever is applicable.

L. HIPOT TEST. Wire all pins (except the pins for lighting) together, and apply 400 volts RMS a-c between the pins and the case for five seconds. There shall be no failure of insulation.

M. LAMP OPERATION TEST. For instruments with integral lighting, apply five volts a-c or d-c to the lighting circuit pins (D or 4 and E or 4) and measure the current in the circuit with a one-half ampere ammeter.

Ammeter Reading	Lamp Circuit Condition
Over 0.58	Short Circuit
0.48 to 0.59	Normal
0.31 to 0.39	1 Lamp Open
0.15 to 0.20	2 Lamps Open
0	Open Circuit

N. LAMP BRIGHTNESS CHECK. If it is desired to check the instrument brightness on internally lighted models, this should be done in a dark room before sealing. The following is suggested for this test.

(1) Use A Brightness Spot Meter, Model UB1/2, with external 115-volt, 60-cps power supply unit made by the Photo Research Corporation (or equivalent.- see Table X) calibrated with NBS No. 3215 filter.

(2) Using the brightness meter selected, in accordance with the manufacturer's instructions, take at least three brightness readings on each indicium. Record the average of the three readings on each indicium.

(3) Also record the brightness readings on the tip, midpoint, and the hub of the indicator pointer and average these readings.

(4) The values determined in the steps above should not be less than 0.4 foot lamberts or more than 1.8 foot lamberts. If any of the values found exceed 1.8 foot lamberts, the additional steps outlined below should be followed.

(a) Take readings on all indicia whose brightness readings exceed 1.8 foot lamberts.

(b) None of these readings should exceed 2.3 foot lamberts.

(c) Count all the indicia on the instrument face.

(d) The number of indicia whose brightness reading exceeds 1.8 foot lamberts but does not exceed 2.3 foot lamberts, should not exceed 5 percent of the number of indicia on the instrument face.

O. FOG TEST.

(1) Place sealed instrument in an oven at 80°C ± 5°C (176°F) for a minimum of 2 hours.

(2) Immediately upon removal from oven, connect to test equipment, place in cold box at -35°C (31°F) and operate for 10 minutes at approximately 90 percent of full scale.

(3) There shall be no evidence of fog.

9. TROUBLE SHOOTING.

A. GENERAL. The Trouble-Shooting Chart (Table IX) is provided should trouble be found during calibration and adjustment of the instrument after overhaul. The chart includes the symptoms, type or types of cause the symptom implies, and the remedy or corrective action required for each fault.

TABLE IX
TROUBLE-SHOOTING CHART

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
1. Instrument not within calibration limits.	A. Coupling magnets not at correct strength.	(a) Resaturate, restabilize and knockdown 1 percent overscale.
	B. Coupling magnet gap not correct.	(b) Re-gap to give 1 percent overscale at 4200 CPM.
	C. Wrong spring tension.	(c) Replace spring.
	D. Motor does not come up to speed due to dirt or misalignment.	(d) Check for dirty or worn motor bearings; clean or replace.
2. Instrument out of limits on friction check.	A. Dirty jewel bearings.	(a) Examine; clean with isopropyl alcohol and pith stick.
	B. Dirty pointer shaft.	(b) Clean as above.
	C. Dirty or broken gears.	(c) Clean with petroleum base solvent (no residue) or replace.
3. Attitude error out of limits.	A. Pointer shaft assembly out of balance.	(a) Balance, using balance weight on balance arms.
4. Pointer alignment not within limits.	A. Gear eccentric with shaft.	(a) Check gears for concentricity.
5. Pointer oscillation out of limits.	A. Motor out of balance or rough bearing.	(a) Correct motor balance; or clean or replace rough bearing.
6. Starting test requirements not met.	A. Bearing friction or weak magnet rotor.	(a) Check ball-bearing torque (2 gr. mm max.). If bearings are O.K., replace magnet rotor.
7. Free return check shows mechanical interference.	A. Mechanical interference.	(a) Examine gear train, spring, pointer, bearings, endshake, etc. for interference, and replace parts as necessary.

10. STORAGE INSTRUCTIONS.

A. GENERAL. No special storage procedures are needed for this unit. Pack repaired units as required for storage conditions to be encountered. After removal from storage, and before use, make the following functional tests:

(1) Visual check -- examine the package for any obvious damage during shipment or storage; examine the unit for evidence of water, impact damage, etc.

(2) Make a check of the starting characteristic. See the section on Calibration and Adjustment.

(3) Check the scale error and friction error. See the section on Calibration and Adjustment.

11. SPECIAL TOOLS, FIXTURES, AND TEST EQUIPMENT.

A. GENERAL. Special tools required are given in Table X.

TABLE X
SPECIAL TOOLS, FIXTURES, AND TEST EQUIPMENT

MANUFACTURERS' PART NO.	NOMENCLATURE	SOURCE OF SUPPLY
404X84	Pointer Reamer	General Electric Company Instrument Dept., 40 Federal Street West Lynn, Massachusetts
A-659	Bearing Hand Staking Tool	General Electric Company Instrument Dept., 40 Federal Street West Lynn, Massachusetts
107A	Magnetizer	Radio Frequency Laboratories, Inc. Boonton, New Jersey
F11	Adapter (used with Magnetizer)	Radio Frequency Laboratories, Inc. Boonton, New Jersey
BH150	Tachometer Indicator Tester (TAKCAL)	B&H Instrument Company 3479 Vickery Boulevard Fort Worth, Texas
--	Evacuating Chamber (Capacity: 50 microns of pressure, absolute)	--
UB1/2	Brightness Spot Meter (use with NBS 3215 filter)	Photo Research Corp., 837 No. Cahuenga Boulevard Hollywood 38, California

NOTE: These tools and materials are recommended; however, the sources of supply are for information purposes only, and equivalent equipment from other suppliers may be used.

12. PARTS LIST.

IMPORTANT

DUE TO THE LARGE NUMBER OF MODELS COVERED IN THIS PARTS LIST, FAMILIARIZATION OF THE FOLLOWING PARAGRAPHS IS ABSOLUTELY NECESSARY.

A. INTRODUCTION. This section lists and describes all procurable assemblies and parts for the Type DJ-81 Tachometer Indicator. Models covered in this manual are listed in Table XI and associated Difference Data Sheets where applicable. It is not to be taken as the authority for the procedure of assembly or disassembly, but is intended for use in requisitioning, storing, issuing, identifying parts, and illustrating disassembly relationships.

B. INDEXING. All parts are indexed for cross-reference and easy identification on the exploded views given in figures 6 and 8.

C. DESCRIPTION COLUMN. The description is indented under numbers 1 through 7 to show the relationship of one part or assembly to another part or assembly.

D. ATTACHING PARTS. Those parts used to attach parts or assemblies to the main assembly, or to each other, are designated as "(ATTACHING PARTS)". In general, these attaching parts are listed immediately following the assembly or part they attach. However, in cases where one or more assemblies or parts have the same attaching parts, the attaching parts are listed only after the last assembly or part in that group. The symbol "---*---" denotes the end of the attaching parts and the continuation of the assembly listing.

E. USABLE ON CODE COLUMN.

(1) Assembly coding. When breakdowns of similar assemblies are combined in the same listing, a lower-case letter code appears in the "USABLE ON CODE" column. This code (see Table XIII) applies only to the parts list for figure 8, and shows interchangeability only between the components of that listing. Interchangeability may be determined by locating the code letter that applies to a specific component, and then checking vertically in that column of the table to determine on which assembly or assemblies the part is used. The user should refer to the footnote for the location of the code table.

F. UNITS PER ASSY COLUMN. The number appearing in the "UNITS PER ASSY" column is the total quantity of the listed part required in its immediate assembly. The letters "Ref" indicate that the listing of the part or assembly is repeated and that reference should be made to its previous listing in the Parts List.

G. IDENTIFYING PARTS WITH PART NUMBERS. Locate the part on the illustration and note its index number. Find the index number in the Parts List to determine the part number and description.

H. VENDORS' CODE. When the number listed is not a General Electric Company (Instrument Department) number, a code which denotes the Vendor from whom the part can be procured is shown in parentheses following the description. A Table listing these code numbers is shown below.

VENDORS' CODE DESIGNATION

CODE	VENDOR'S NAME AND ADDRESS
V71500	Carter Carburetor Division of ACF Industries Inc., St. Louis, Mo.

I. ILLUSTRATIONS. The basic model of the equipment and its components are shown in the main portion of each illustration. Visually different parts for similar models are shown on the same illustration in double line boxes.

J. TERMS AND SYMBOLS. The following terms and symbols are used in the Parts List.

Coml - Hardware items procurable from normal commercial sources

AR - As required

NHA - Next higher assembly

K. NUMERICAL PARTS LIST INDEX.

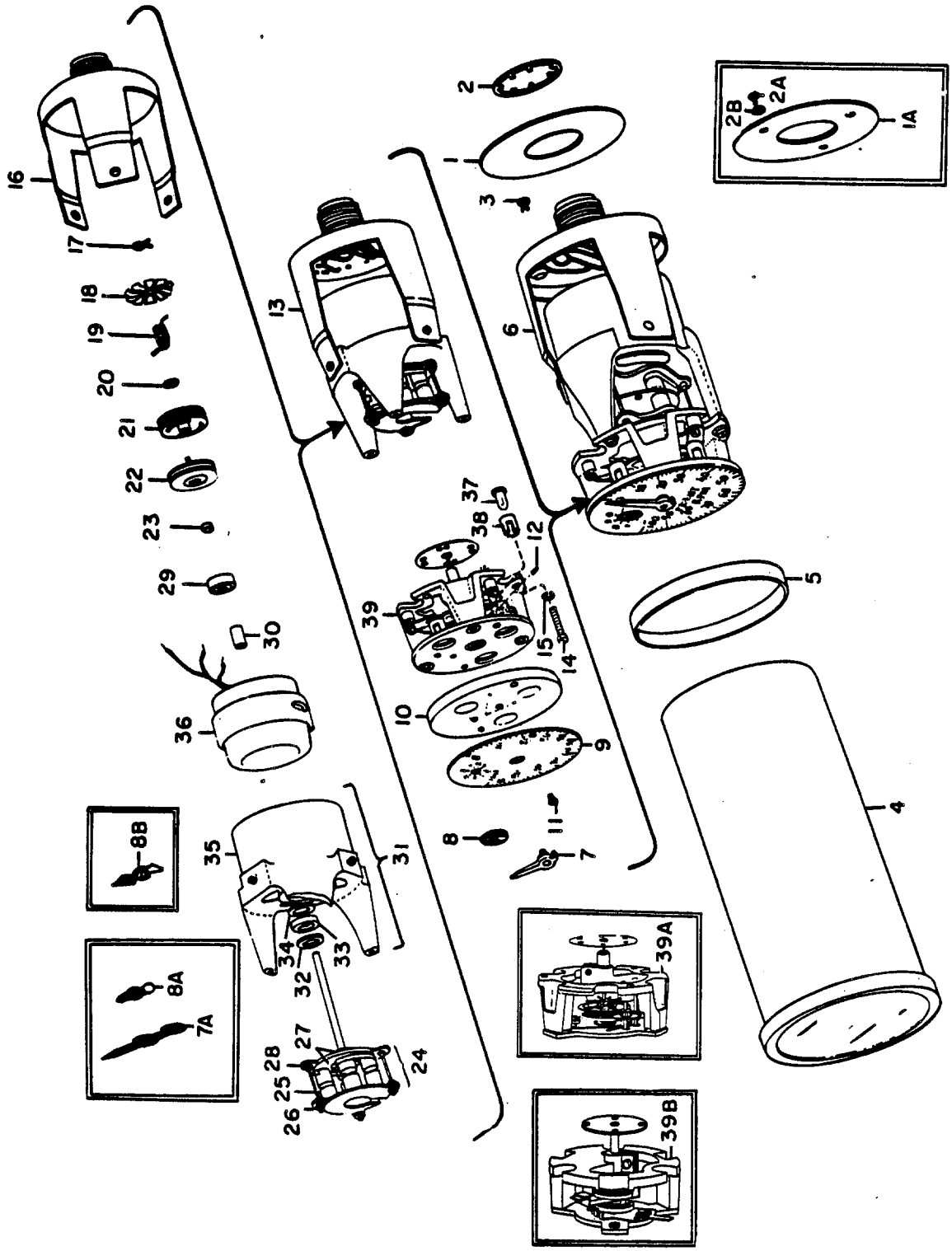
(1) Contents. The Numerical Parts List Index (see Table XIV) is a numerical listing of all part numbers listed in the Parts List, showing their respective figure and index locations, and total quantities.

(2) Numerical Arrangement. Part number numerical arrangement starts in the left-hand column and continues from left to right, one column at a time, until part number numerical arrangement is determined. The order of precedence in determining part number arrangement is as follows:

(1) Space ( )
(2) Diagonal (/)
(3) Point (.)
(4) Dash (-)
(5) Letters A through Z (Alphabetical O's are listed as numerical zeros.)
(6) Numerals 0 through 9.

(3) "Coml" Parts. A part listed as "Coml" in the Parts List is listed alphabetically at the beginning of the Numerical Parts List Index by the principal noun of its description.

(4) Explanation of Quantity. The number shown in the "QTY PER INSTRUMENT" column is the total quantity of that part used in any one instrument.



Exploded View of Type DJ-81 Tachometer Indicator
Figure 6

FIGURE AND INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	USABLE ON CODE	UNITS PER ASSY
		TYPE DJ-81 TACHOMETER INDICATOR		
6-	DJ-81	INDICATOR, Tachometer		1
- 1	No number	. NAMEPLATE (See Table XI for part number and model application)		1
- 1A	No number	. NAMEPLATE (See Table XI for part number and model application) (ATTACHING PARTS)		1
- 2	5796153P1	. RING, Retaining (Used to attach nameplates listed at index No. 1, unlighted models only)		1
	5796153P8	. RING, Retaining (Used to attach nameplates listed at index No. 1, lighted models only)		1
- 2A	Com1	. SCREW, Machine, rd hd, No. 0-80 by 3/16 in. lg, brs, ni pl (Used to attach nameplate listed at index No. 1A)		3
- 2B	Com1	. LOCKWASHER, Spring, 0.071 ID by 0.131 OD by 0.015 in. thick, sst (Used to attach nameplate listed at index No. 1A)		3
		---*---		
- 3	203	. RIVET (Δ9886421P1) (See note)		1
- 4	8905884G34	. CAN ASSY (Used on all unlighted models)		1
	8905884G73	. CAN ASSY (Used on all lighted models except LWA1 and LWB1)		1
	8905884G88	. CAN ASSY (Used on models LWA1 and LWB1)		1
- 5	8948193P38	. BEZEL		1
- 6	5468508	. MOTOR AND HEAD ASSY (See Table XI for complete part No. and model application)		1
- 7	5472342	. . POINTER ASSY, Large (See Table XII for complete part number and model application)		1
- 7A	4145642	. . POINTER ASSY, Large (See Table XII for complete part number and model application)		1
- 8	5462167	. . POINTER ASSY (SUB DIAL) (See Table XI for complete part number and model application)		1
- 8A	4145642	. . POINTER ASSY, Small (See Table XII for complete part number and model application)		1

FIGURE AND INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	USABLE ON CODE	UNITS PER ASSY
		TYPE DJ-81 TACHOMETER INDICATOR (Cont)		
6- 8B	4145642G193	. . POINTER ASSY, Small (Used on model AAA1 only)		1
	4145642G262	. . POINTER ASSY, Small (Used on model AAB1 only)		1
- 9	No number	. . SCALE PLATE (See Table XII for part number and model application)		1
-10	5480290	. . PLATE, DIFFUSER (Used on all lighted models)		1
		(ATTACHING PARTS)		
-11	4149392P11	. . SCREW, Scale Plate (Used on all lighted models)		1
	4149392P6	. . SCREW, Scale Plate (Used on all unlighted models)		1
		---*---		
-12	4155146P4	. . WEIGHT, Balance		AR
	4155146P6	. . WEIGHT, Balance		AR
	4155146P7	. . WEIGHT, Balance		AR
	4155146P8	. . WEIGHT, Balance		AR
-13	5468441	. . MOTOR ASSY (See Table XI for complete part number and model application; see figure 6 for illustration)		1
		(ATTACHING PARTS)		
-14	Com1	. . SCREW, Machine, slotted, fil hd, No. 3-56 by 5/16 in. lg, brs, ni pl		3
-15	Com1	. . LOCKWASHER, Spring, 0.111 ID by 0.188 OD by 0.035 in. thick, sst		3
		---*---		
-16	5468435	. . . CUP AND SUPPORT ASSY (See Table XI for complete part number and model application)		1
-17	5462491	. . . PIN, Spring		1
-18	5468417P1	. . . WHEEL, Balance		1
-19	5468416P1	. . . SPRING		1
-20	4136043P76	. . . SPACER		1
-21	5462078G1	. . . ROTOR ASSY, Hysteresis		1
-22	5468427G1	. . . ROTOR ASSY		1
-23	5468421P2	. . . SPACER		1

FIGURE AND INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	USABLE ON CODE	UNITS PER ASSY
		TYPE DJ-81 TACHOMETER INDICATOR (Cont)		
6-24	5468412G1	. . . SHAFT AND MAGNET ASSY		1
-25	5468411G1	. . . . MAGNET ASSY, Upper		1
-26	1297794P1	. . . . NUT, Hex		6
-27	5468461P1	. . . . COMPENSATOR, Temperature . .		AR
	5468461P2	. . . . COMPENSATOR, Temperature . . (dummy)		AR
-28	5468549G1	. . . . MAGNET AND POST ASSY, Lower .		1
-29	4152116P7	. . . BEARING, Ball		1
-30	5468421P1	. . . SPACER		1
-31	5468410G1	. . . HOUSING ASSY, Motor		1
-32	4136043P277	. . . . WASHER		1
-33	4152116P6	. . . . BEARING, Ball		1
-34	4136043P278	. . . . WASHER (0.008 in. thick) . .		AR
	4136043P279	. . . . WASHER (0.010 in. thick) . .		AR
	4136043P280	. . . . WASHER (0.012 in. thick) . .		AR
	4136043P281	. . . . WASHER (0.014 in. thick) . .		AR
-35	5468399P3	. . . . HOUSING, Motor		1
-36	5468434G4	. . . STATOR FRAME AND COIL ASSY . . .		1
-37	5483215P1	. . LAMP (Used on all lighted models) .		3
-38	5462278P1	. . SOCKET, LAMP (Used on all lighted . models)		3
-39	5468341	. . HEAD ASSY (See Table XI for model . application; see fig. 8 for breakdown)		1
-39A	5468341	. . HEAD ASSY (See Table XI for model . application; see fig. 8 for breakdown)		1
-39B	5468341	. . HEAD ASSY (See Table XI for model . application; see fig. 8 for breakdown)		1

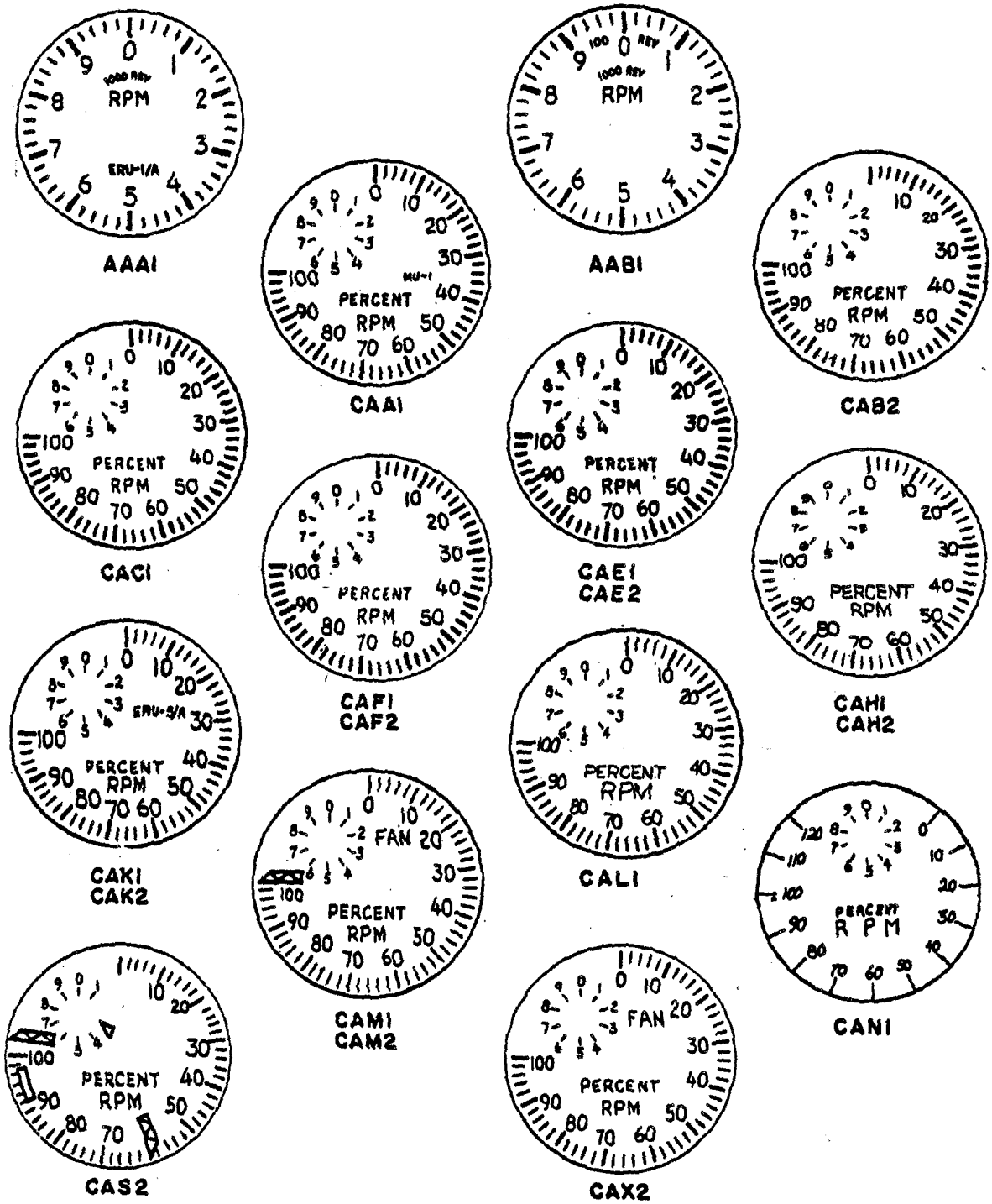
OVERHAUL MANUAL
TACHOMETER INDICATOR
TYPE DJ-81

TABLE XI
NAMEPLATES AND MAJOR ASSEMBLIES

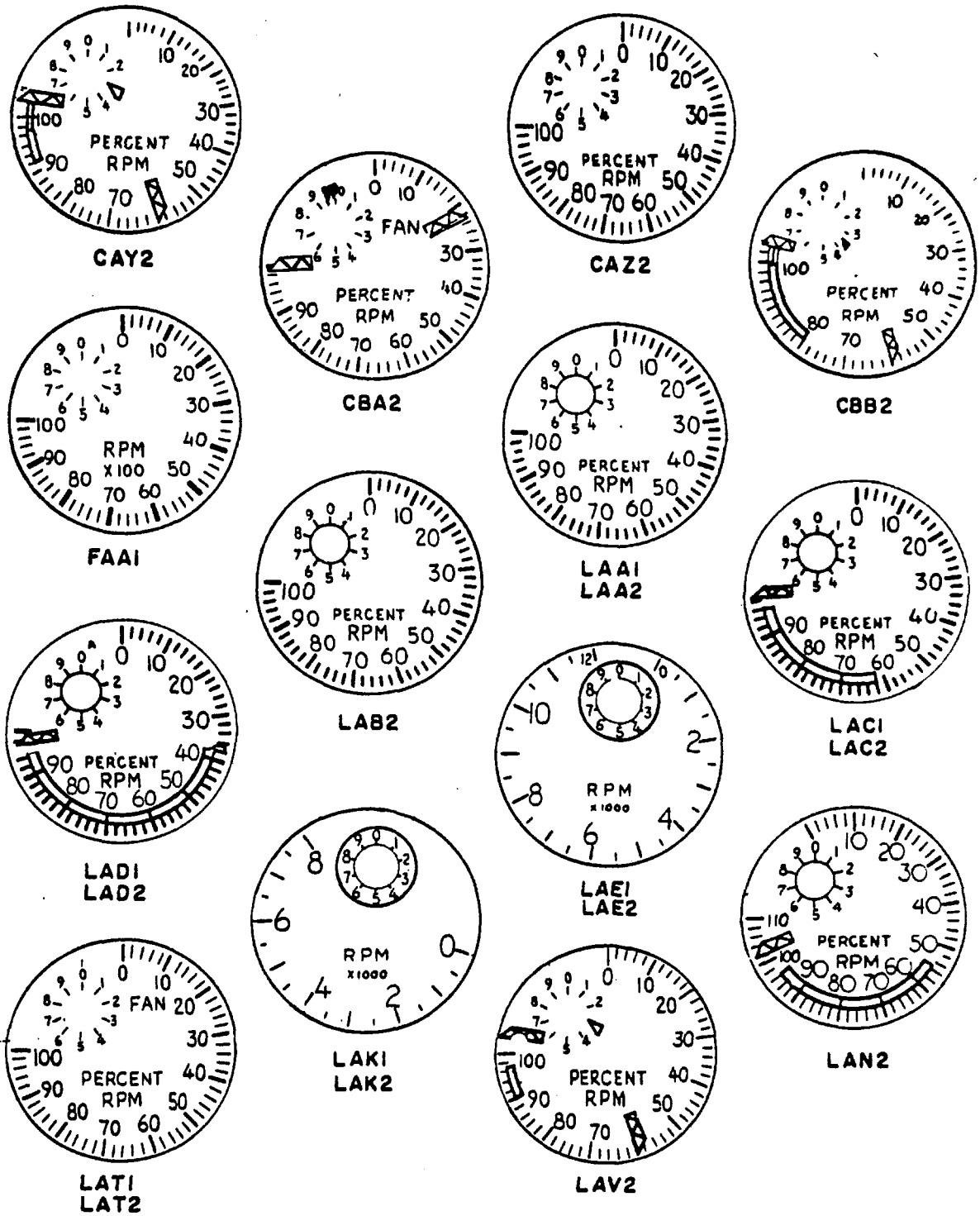
Model No.	Case Nameplate		Motor and Head Assembly	Motor Assembly	Cup and Support Assembly	Head Assembly		
	Fig. 6	Index No.	Fig. 6, Index No. 6	Fig. 6, Index No. 13	Fig. 6, Index No. 16	Fig. 6	G No.	Index No.
AAA1	NP204766	1	5468508G3	5468441G1	5468435G1	5468341	1	39B
AAB1	NP204766	1	5468508G3	5468441G1	5468435G1	5468341	1	39B
CAA1	NP204766	1	5468508G2	5468441G10	5468435G2	5468341	2	39A
CAB2	NP216301	1A	5468508G22	5468441G6	5468435G6	5468341	9	39
CAC1	NP204766	1	5468508G17	5468441G10	5468435G2	5468341	8	39A
CAE1	NP204766	1	5468508G2	5468441G10	5468435G2	5468341	2	39A
CAE2	NP204766	1	5468598G2	5468441G10	5468435G2	5468341	2	39A
CAF1	NP204766	1	5468508G2	5468441G10	5468435G2	5468341	2	39A
CAF2	NP204766	1	5468508G26	5468441G10	5468435G2	5468341	9	39
CAH1	NP204766	1	5468508G2	5468441G10	5468435G2	5468341	2	39A
CAH2	NP204766	1	5468508G26	5468441G10	5468435G2	5468341	9	39
CAK1	NP204766	1	5468508G20	5468441G5	5468435G5	5468341	2	39A
CAK2	NP204766	1	5468508G27	5468441G13	5468435G14	5468341	9	39
CAL1	NP204766	1	5468508G2	5468441G11	5468435G10	5468341	2	39A
CAM1	NP204766	1	5468508G2	5468441G10	5468435G2	5468341	2	39A
CAM2	NP204766	1	5468508G26	5468441G10	5468435G2	5468341	9	39
CAN1	NP204766	1	5468508G31	5468441G16	5468435G15	5468341	12	39A
CAS2	NP216301	1A	5468508G22	5468441G6	5468441G6	5468341	9	39
CAX2	NP216301	1	5468508G30	5468441G15	5468435G6	5468341	9	39
CAY2	NP216301	1A	5468508G22	5468441G6	5468435G6	5468341	9	39
CAZ2	NP204766	1	5468508G27	5468441G13	5468435G14	5468341	9	39
CBA2	NP216301	1	5468508G30	5468441G6	5468435G6	5468341	9	39
CBB2	NP216301	1A	5468508G22	5468441G6	5468435G6	5468341	9	39
FAA1	NP204766	1	5468508G2	5468441G10	5468435G2	5468341	2	39A
LAA1	NP216307	1	5468508G9	5468441G5	5468435G5	5468341	6	39
LAA2	NP216307	1	5468508G9	5468441G5	5468435G5	5468341	6	39
LAB2	NP216301	1A	5468508G23	5468441G7	5468435G7	5468341	10	39
LAC1	NP216307	1	5468508G9	5468441G5	5468435G5	5468341	6	39
LAC2	NP216307	1	5468508G28	5468441G5	5468435G5	5468341	10	39
LAD1	NP216307	1	5468508G9	5468441G5	5468435G5	5468341	6	39
LAD2	NP216307	1	5468508G28	5468441G5	5468435G5	5468341	10	39
LAE1	NP216301	1A	5468508G13	5468441G8	5468435G8	5468341	6	39
LAE2	NP216301	1A	5468508G24	5468441G8	5468435G8	5468341	10	39
LAK1	NP216301	1A	5468508G14	5468441G9	5468435G9	5468341	6	39
LAK2	NP216301	1A	5468508G25	5468441G9	5468435G9	5468341	10	39
LAN2	NP216307	1	5468508G28	5468441G5	5468435G5	5468341	10	39
LAT1	NP204766	1A	5468508G12	5468441G7	5468435G7	5468341	6	39
LAT2	NP216307	1A	5468508G23	5468441G7	5468435G7	5468341	10	39
LAV2	NP216301	1A	5468508G23	5468441G7	5468435G7	5468341	10	39
LAW1	NP216301	1A	5468508G12	5468441G5	5468435G7	5468341	6	39
LAW2	NP216301	1A	5468508G23	5468441G16	5468435G7	5468341	10	39
LAX2	NP229574	1	5468508G28	5468441G5	5468435G5	5468341	10	39
LAY2	NP216307	1	5468508G28	5468441G5	5468435G5	5468341	10	39
LAZ2	NP216307	1	5468508G28	5468441G5	5468435G5	5468341	10	39
LBC2	NP216307	1	5468508G28	5468441G5	5468435G5	5468341	10	39
LBD2	NP216307	1	5468508G28	5468441G5	5468435G5	5468341	10	39
LBE2	NP216307	1	5468508G28	5468441G5	5468435G5	5468341	10	39
LBF2	NP216307	1	5468508G28	5468441G5	5468435G5	5468341	10	39
LBH2	NP216307	1	5468508G28	5468441G5	5468435G5	5468341	10	39
LBK2	NP216301	1A	5468508G23	5468441G7	5468435G7	5468341	10	39
LWA1	NP216307	1	5468508G18	5468441G5	5468435G5	5468341	6	39
LWB2	NP216307	1	5468508G36	5468441G5	5468435G5	5468341	14	39
LWC2	NP216307	1	5468508G28	5468441G5	5468435G5	5468341	10	39
LBL2	NP216301	1A	5468508G23	5468441G7	5468435G7	5468341	10	39

TABLE XII
SCALE PLATES AND POINTERS

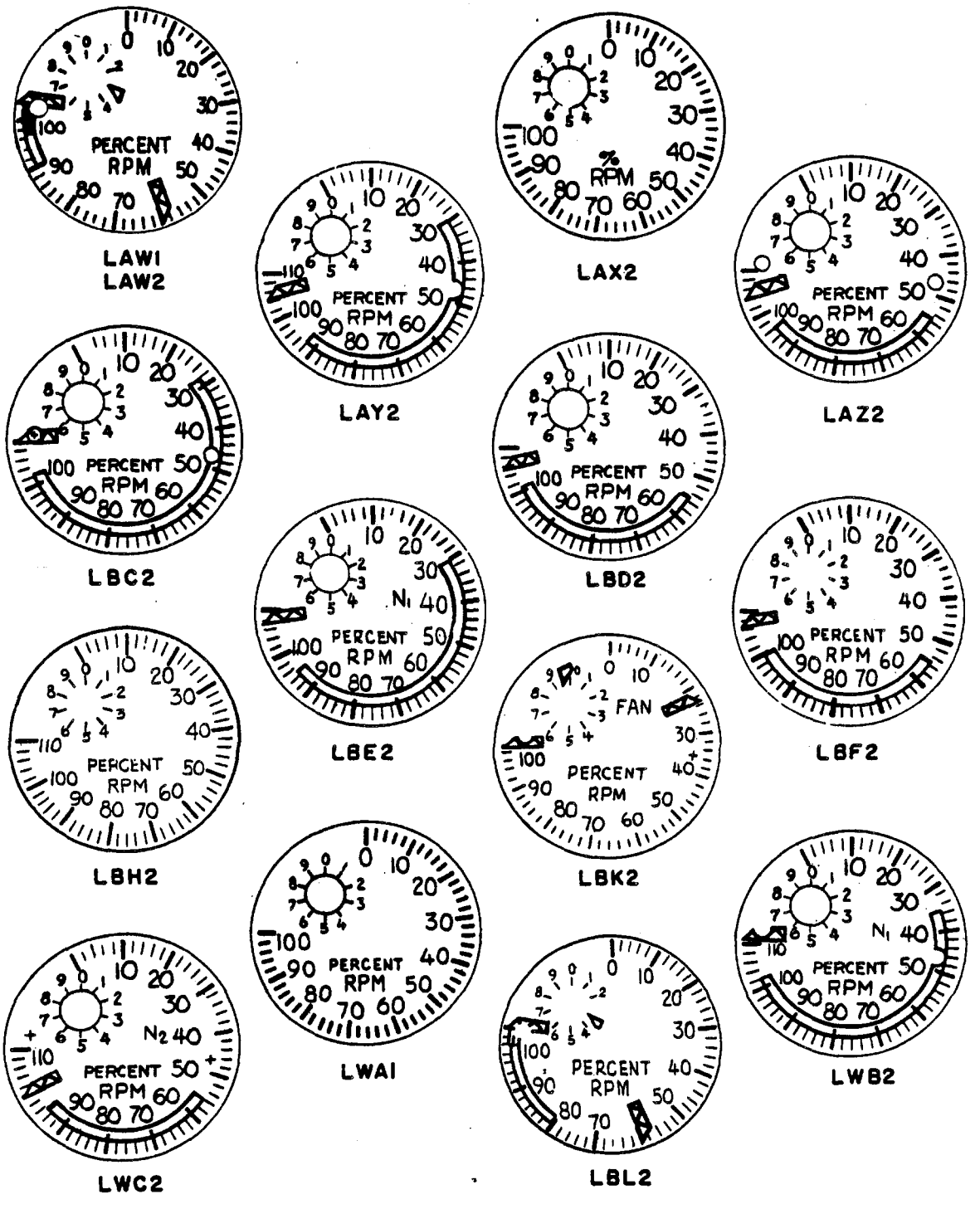
Model No.	Scale Plate (See Fig. 6, Index No. 9)			Pointer (Large)		Pointer (Small)	
	Marking Dwg.	Nameplate No.	Blank Dwg. No.	Fig. 6	Index No.	Fig. 6	Index No.
AAA1	5463163P1	NP192246	5468505P1	4145642G135	7A		
AAB1	5463321P1	NP210018	5468505P1	4145642G261	7A		
CAA1	5463165P1	NP192248	5468505P2	4145642G125	7A	4145642G188	8A
CAB2	5463355P1	NP216287	5468505P2	4145642G253	7A	4145642G254	8A
CAC1	5463310P1	NP209455	5468505P2	4145642G125	7A	4145642G188	8A
CAE1	5463387P1	NP217505	5468505P2	4145642G253	7A	4145642G254	8A
CAE2	5463387P1	NP217505	5468505P2	4145642G253	7A	4145642G254	8A
CAF1	5484105-	NP209455	5468505P2	4145642G274	7A	4145642G275	8A
CAF2	5484105	NP209455	5468505P2	4145642G274	7A	4145642G275	8A
CAH1	5484109-	NP217505	5468505P2	4145642G276	7A	4145642G277	8A
CAH2	5484109	NP217505	5468505P2	4145642G276	7A	4145642G277	8A
CAK1	5484136-	NP227436	5468505P2	4145642G280	7A	4145642G281	8A
CAK2	5484136-	NP227436	5468505P2	4145642G280	7A	4145642G281	8A
CAL1	5484126-	NP217505	5468505P2	4145642G125	7A	4145642G188	8A
CAM1	5484135P1	NP227510	5468505P2	4145642G253	7A	4145642G254	8A
CAM2	5484135P1	NP227510	5468505P2	4145642G253	7A	4145642G254	8A
CAN1	5484182	NP229477	5468505P2	4145642G125	7A	4145642G188	8A
CAS2	5484142	NP227552	5468505P2	4145642G125	7A	4145642G188	8A
CAX2	5484165	NP227863	5468505P2	4145642G253	7A	4145642G254	8A
CAY2	5484187	NP229498	5468505P2	4145642G125	7A	4145642G188	8A
CAZ2	5484214	NP227436	5468505P2	4145642G280	7A	4145642G281	8A
CBA2	6478K32	NP236076	5468505P2	4145642G253	7A	4145642G254	8A
CBB2	6478K29	NP236068	5468505P2	4145642G253	7A	4145642G254	8A
FAA1	5484179	NP229423	5468505P2	4145642G125	7A	4145642G188	8A
LAA1	5463334P2	NP216561	5480291P1	5472342G11	7	5462167G2	8
LAA2	5463334P2	NP216561	5480291P1	5472342G11	7	5462167G2	8
LAB2	5463334P1	NP216204	5480291P1	5472342G11	7	5462167G2	8
LAC1	5463378P1	NP217450	5480291P1	5472342G11	7	5462167G2	8
LAC2	5463378P1	NP217450	5480291P1	5472342G11	7	5462167G2	8
LAD1	5463379	NP217451	5480291P1	5472342G11	7	5462167G2	8
LAD2	5463379	NP217451	5480291P1	5472342G11	7	5462167G2	8
LAE1	5463353P1	NP216285	5480291P1	5472342G11	7	5462167G2	8
LAE2	5463353P1	NP216285	5480291P1	5472342G11	7	5462167G2	8
LAK1	5463352P1	NP216284	5480291P1	5472342G11	7	5462167G2	8
LAK2	5463352P1	NP216284	5480291P1	5472342G11	7	5462167G2	8
LAN2	5484127	NP224223	5480291P1	5472342G11	7	5462167G2	8
LAT1	5484141P1	NP227543	5480291P1	5472342G11	7	5462167G2	8
LAT2	5484141P1	NP227543	5480291P1	5472342G11	7	5462167G2	8
LAV2	5484143P1	NP227553	5480291P1	5472342G11	7	5462167G2	8
LAW1	5484186	NP229497	5480291P1	5472342G11	7	5462167G2	8
LAW2	5484186	NP229497	5480291P1	5472342G11	7	5462167G2	8
LAX2	5484191	NP229543	5480291P1	5472342G11	7	5462167G2	8
LAY2	5484204	NP229666	5480291P3	5472342G11	7	5462167G2	8
LAZ2	5484205	NP229668	5480291P3	5472342G11	7	5462167G2	8
LBC2	5484808	NP229673	5480291P1	5472342G11	7	5462167G2	8
LBD2	5484209	NP229674	5480291P1	5472342G11	7	5462167G2	8
LBE2	5484210	NP224224	5480291P3	5472342G11	7	5462167G2	8
LBF2	5484211	NP224223	5480291P1	5472342G11	7	5462167G2	8
LBH2	6478K19			5472342G11	7	5462167G2	8
LBK2	6478K30	NP236069	5480291P1	5472342G11	7	5462167G2	8
LWA1	5484152P1	NP216204	5480291P2	5472342G17	7	5462167G2	8
LWB2	5484206	NP229670	5480291P4	5472342G17	7	5462167G2	8
LWC2	5484207	NP229672	5480291P4	5472342G11	7	5462167G2	8
LBL2	6478K31	NP236070	5480291P1	5472342G11	7	5462167G2	8



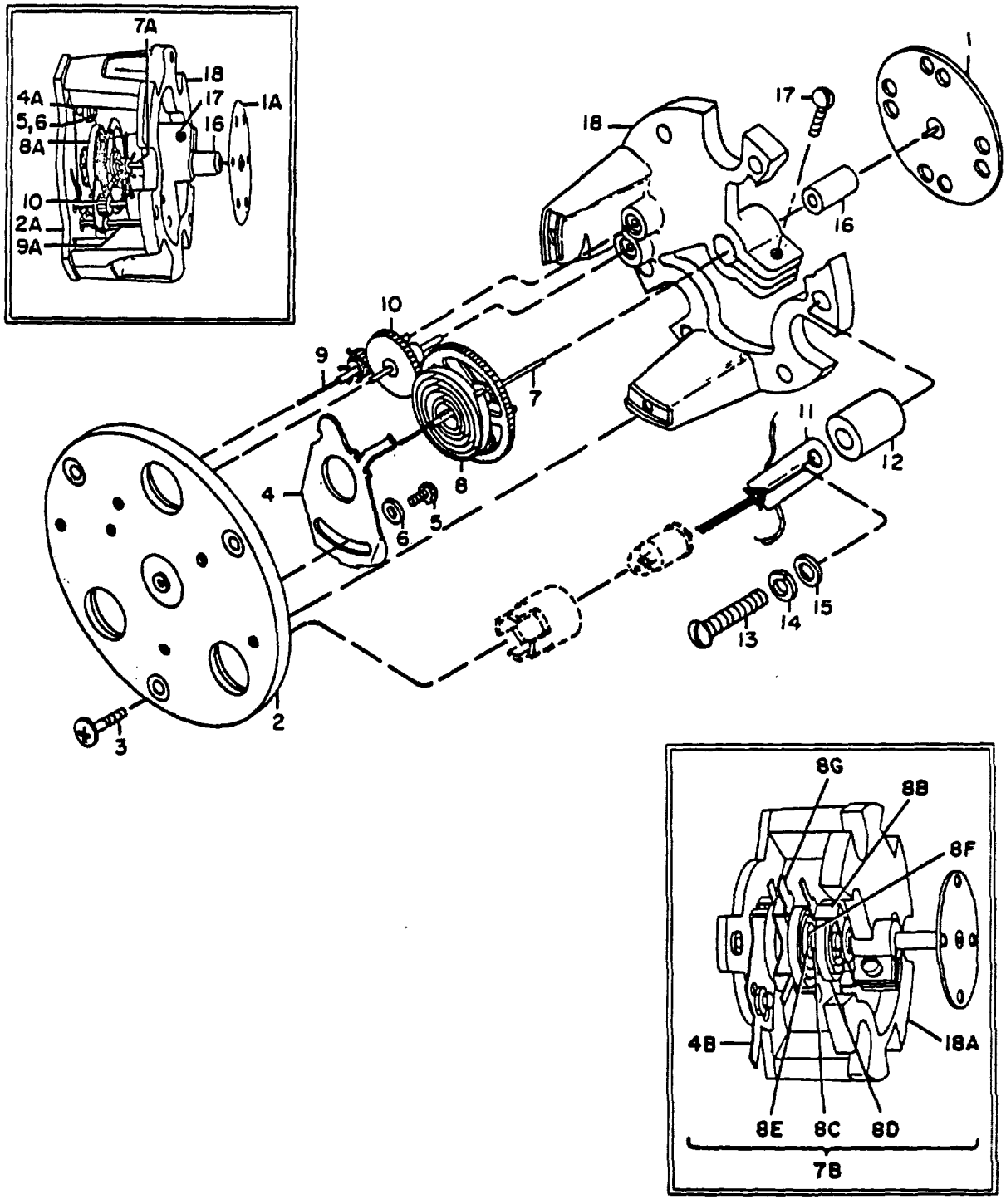
Scale Plates (Sheet 1 of 3)
Figure 7



Scale Plates (Sheet 2 of 3)
Figure 7



Scale Plates (Sheet 3 of 3)
Figure 7



Exploded View of Head Assembly
Figure 8

TABLE XIII
ASSEMBLY CODE

ASSEMBLY PART NO.	CODE DESIGNATION																	
	a	b	c	d	e	f	g	h	j	k	l	m	n	p	q	r	s	t	u
5468341G6	a								j	k	l	m							
5468341G9		b							j	k			n	p	q	r			
5468341G10			c						j	k	l		n				s		
5468341G14				d					j	k	l	m	n				s		
5468341G2					e				j	k				p	q	r		t	u
5468341G8						f			j	k				p	q	r		t	
5468341G12							g		j					p	q			t	u
5468341G1								h	j					p					

FIGURE AND INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	USABLE ON CODE	UNITS PER ASSY
		HEAD ASSEMBLY		
		See Table XIII for explanation of assembly code		
8-	5468341G6	. . HEAD ASSY (See Table XI for model application)	a	Ref
	5468341G9	. . HEAD ASSY (See Table XI for model application)	b	Ref
	5468341G10	. . HEAD ASSY (See Table XI for model application)	c	Ref
	5468341G14	. . HEAD ASSY (See Table XI for model application)	d	Ref
	5468341G2	. . HEAD ASSY (See Table XI for model application)	e	Ref
	5468341G8	. . HEAD ASSY (See Table XI for model application)	f	Ref
	5468341G12	. . HEAD ASSY (See Table XI for model application)	g	Ref
	5468341G1	. . HEAD ASSY (See Table XI for model application)	h	Ref
- 1	4152232G14	. . . DISK AND HUB ASSY	l	1
- 1A	4152232G12	. . . DISK AND HUB ASSY	p	1
- 2	5468507G5	. . . PLATE AND JEWEL ASSY	l	1
- 2A	5468507G2	. . . PLATE AND JEWEL ASSY	q	1
	5468507G3	. . . PLATE AND JEWEL ASSY (ATTACHING PARTS)	h	1
- 3	4149392P7	. . . SCREW	j	3
		---*---		
- 4	5468500P5	. . . ARM, Adjusting	m	1
- 4A	5468500P4	. . . ARM, Adjusting	t	1
	5468500P7	. . . ARM, Adjusting	c	1
	5468500P6	. . . ARM, Adjusting	b	1
- 4B	5468500P2	. . . ARM, Adjusting (ATTACHING PARTS)	h	1
- 5	4149355P2	. . . SCREW	j	1
- 6	4136043P117	. . . WASHER	j	1
		---*---		
- 7	5468506G9	. . . SHAFT AND HUB ASSY, Center . . .	a	1
- 7A	5468506G2	. . . SHAFT AND HUB ASSY, Center . . .	e	1
	5468506G11	. . . SHAFT AND HUB ASSY, Center . . .	f	1
	5468506G12	. . . SHAFT AND HUB ASSY, Center . . .	b	1
	5468506G13	. . . SHAFT AND HUB ASSY, Center . . .	s	1
	5468506G15	. . . SHAFT AND HUB ASSY, Center . . .	g	1
- 7B	5468559G1	. . . SHAFT ASSY, Center	h	1

FIGURE AND INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	USABLE ON CODE	UNITS PER ASSY
		HEAD ASSEMBLY (Cont)		
		See Table XIII for explanation of assembly code		
8 - 8	4145566P50	. . . . SPRING, Control	a	1
- 8A	4145566P43	. . . . SPRING, Control	f	1
	4145566P50	. . . . SPRING, Control	u	1
	4145566P66	. . . . SPRING, Control	n	1
- 8B	5468506G3	. . . . SHAFT AND HUB ASSY, Center .	h	1
- 8C	5468447G1	. . . . HUB AND SPRING ASSY	h	1
- 8D	4145566P46	. . . . . SPRING, Control	h	2
- 8E	8942976P1	. . . . WASHER, Thrust	h	AR
- 8F	9850107P1	. . . . SLEEVE	h	1
- 8G	5468445G1	. . . . SLEEVE AND BEARING ASSY . . .	h	1
- 9	5468510G3	. . . SHAFT ASSY, Small pointer . . .	l	1
- 9A	5468510G1	. . . SHAFT ASSY, Small pointer . . .	r	1
	5468510G4	. . . SHAFT ASSY, Small pointer . . .	g	1
-10	5468512G1	. . . SHAFT AND GEAR ASSY, Idler . . .	k	1
	5468512G2	. . . SHAFT AND GEAR ASSY, Idler . . .	g	1
-11	5480131G1	. . . SPRING AND LEAD ASSY	l	1
-12	5462153P1	. . . POST	l	3
		(ATTACHING PARTS)		
-13	Coml	. . . SCREW, Machine, rd hd, No. 3-56 by 7/16 in. lg, brs, ni pl	l	3
-14	Coml	. . . LOCKWASHER, Spring, 0.111 ID . . by 0.188 OD by 0.035 in. thick, sst	l	3
-15	4136041P493	. . . WASHER, Insulating	l	3
		---*---		
-16	5468436G1	. . . . HOLDER ASSY, Jewel	j	1
		(ATTACHING PARTS)		
-17	Coml	. . . SCREW, Machine, slotted, fil hd, No. 2-64 by 1/4, brs, ni pl	j	1
		---*---		
-18	5468535G1	. . . HEAD AND JEWEL ASSY	q	1
	5468535G3	. . . HEAD AND JEWEL ASSY	l	1
-18A	5468398P4	. . . HEAD	h	1

TABLE XIV
NUMERICAL PARTS LIST INDEX

Part Number	Fig. and Index	Qty Per Instrument
LOCKWASHER		
0.071 by 0.131	6-2B	3
0.111 by 0.188	6-15	6
	8-14	
NAMEPLATE	6-1	1
	6-1A	
SCALE PLATE	6-9	1
SCREW, Machine, rd hd, brs, ni pl		
No. 0-80 by 3/16	6-2A	3
No. 3-56 by 7/16	8-13	3
SCREW, Machine, fil hd, brs, ni pl		
No. 2-64 by 1/4	8-17	1
No. 3-56 by 5/16	6-14	3
DJ-81	6--	1
NP192246	6-9	1
NP192248	6-9	1
NP204766	6-1	1
	6-1A	
NP209455	6-9	1
NP210018	6-9	1
NP216204	6-9	1
NP216284	6-9	1
NP216285	6-9	1
NP216287	6-9	1
NP216301	6-1	1
	6-1A	
NP216307	6-1	1
	6-1A	
NP216561	6-9	1
NP217450	6-9	1
NP217451	6-9	1
NP217505	6-9	1
NP224223	6-9	1
NP224224	6-9	1
NP227436	6-9	1
NP227510	6-9	1
NP227543	6-9	1
NP227552	6-9	1
NP227553	6-9	1
NP227863	6-9	1
NP229423	6-9	1
NP229477	6-9	1
NP229497	6-9	1
NP229498	6-9	1
NP229543	6-9	1
NP229574	6-1	1
NP229666	6-9	1
NP229668	6-9	1
NP229670	6-9	1
NP229672	6-9	1
NP229673	6-9	1
NP229674	6-9	1
NP236068	6-9	1
NP236069	6-9	1
NP236070	6-9	1
NP236076	6-9	1
1297794P1	6-26	6
203	6-3	1
4136041P493	8-15	3
4136043P76	6-20	1
4136043P117	8-6	1
4136043P277	6-32	1
4136043P278	6-34	AR
4136043P279	6-34	AR
4136043P280	6-34	AR
4136043P281	6-34	AR
5642G125	6-7A	1
4145642G135	6-7A	1
4145642G188	6-8A	1
4145642G193	6-8B	1
4145642G253	6-7A	1
4145642G254	6-8A	1
4145642G261	6-7A	1
4145642G262	6-8B	1
4145642G274	6-7A	1
4145642G275	6-8A	1
4145642G276	6-7A	1
4145642G277	6-8A	1
4145642G280	6-7A	1
4145642G281	6-8A	1
4145566P43	8-8A	1
4145566P46	8-8D	2

TABLE XIV (Cont)
NUMERICAL PARTS LIST INDEX

Part Number	Fig. and Index	Qty Per Instrument
4145566P50	8-8,-8A	1
4145566P66	8-8A	1
4149355P2	8-5	1
4149392P11	6-11	1
4149392P6	6-11	1
4149392P7	8-3	3
4152116P6	6-33	1
4152116P7	6-29	1
4152232G12	8-1A	1
4152232G14	8-1	1
4155146P4	6-12	AR
4155146P6	6-12	AR
4155146P7	6-12	AR
4155146P8	6-12	AR
5462078G1	6-21	1
5462153P1	8-12	3
5462167G2	6-8	1
5462278P1	6-38	3
5462491	6-17	1
5463163P1	6-9	1
5463165P1	6-9	1
5463310P1	6-9	1
5463321P1	6-9	1
5463334P1	6-9	1
5463334P2	6-9	1
5463352P1	6-9	1
5463353P1	6-9	1
5463355P1	6-9	1
5463378P1	6-9	1
5463379	6-9	1
5463387P1	6-9	1
5468341G1	6-39B	1
5468341G10	6-39	1
5468341G12	6-39A	1
5468341G14	6-39	1
5468341G2	6-39A	1
5468341G6	6-39	1
5468341G8	6-39A	1
5468341G9	6-39	1
5468398P4	8-18A	1
5468399P3	6-35	1
5468410G1	6-31	1
5468411G1	6-25	1
5468412G1	6-24	1
5468416P1	6-19	1
5468417P1	6-18	1
5468421P1	6-30	1
5468421P2	6-23	1
5468427G1	6-22	1
5468434G4	6-36	1
5468435G1	6-16	1
5468435G10	6-16	1
5468435G14	6-16	1
5468435G15	6-16	1
5468435G2	6-16	1
5468435G5	6-16	1
5468435G6	6-16	1
5468435G7	6-16	1
5468435G8	6-16	1
5468435G9	6-16	1
5468436G1	8-16	1
5468441G1	6-13	1
5468441G10	6-13	1
5468441G11	6-13	1
5468441G13	6-13	1
5468441G15	6-13	1
5468441G16	6-13	1
5468441G5	6-13	1
5468441G6	6-13	1
5468441G7	6-13	1
5468441G8	6-13	1
5468441G9	6-13	1
5468445G1	8-8G	1
5468447G1	8-8C	1
5468461P1	6-27	AR
5468461P2	6-27	AR
5468500P2	8-4B	1
5468500P4	8-4A	1
5468500P5	8-4	1
5468500P6	8-4A	1
5468500P7	8-4A	1
5468505P1	6-9	1

TABLE XIV (Cont)
NUMERICAL PARTS LIST INDEX

Part Number	Fig. and Index	Qty Per Instrument	Part Number	Fig. and Index	Qty Per Instrument
5468505P2	6-9	1	5480291P2	6-9	1
5468506G11	8-7A	1	5480291P3	6-9	1
5468506G12	8-7A	1	5480291P4	6-9	1
5468506G13	8-7A	1	5483215P1	6-37	3
5468506G15	8-7A	1	5484105	6-9	1
5468506G2	8-7A	1	5484109	6-9	1
5468506G3	8-8B	1	5484126	6-9	1
5468506G9	8-7	1	5484127	6-9	1
5468507G2	8-2A	1	5484135P1	6-9	1
5468507G3	8-2A	1	5484136	6-9	1
5468507G5	8-2	1	5484141P1	6-9	1
5468508G12	6-6	1	5484142	6-9	1
5468508G13	6-6	1	5484143P1	6-9	1
5468508G14	6-6	1	5484152P1	6-9	1
5468508G17	6-6	1	5484165	6-9	1
5468508G18	6-6	1	5484179	6-9	1
5468508G2	6-6	1	5484182	6-9	1
5468508G20	6-6	1	5484186	6-9	1
5468508G22	6-6	1	5484187	6-9	1
5468508G23	6-6	1	5484191	6-9	1
5468508G24	6-6	1	5484204	6-9	1
5468508G25	6-6	1	5484205	6-9	1
5468508G26	6-6	1	5484206	6-9	1
5468508G27	6-6	1	5484207	6-9	1
5468508G28	6-6	1	5484209	6-9	1
5468508G3	6-6	1	5484210	6-9	1
5468508G30	6-6	1	5484211	6-9	1
5468508G31	6-6	1	5484214	6-9	1
5468508G36	6-6	1	5484808	6-9	1
5468508G9	6-6	1	5796153P1	6-2	1
5468510G1	8-9A	1	5796153P8	6-2	1
5468510G3	8-9	1	6478K19	6-9	1
5468510G4	6-9A	1	6478K29	6-9	1
5468512G1	8-10	1	6478K30	6-9	1
5468512G2	8-10	1	6478K31	6-9	1
5468535G1	8-18	1	6478K32	6-9	1
5468535G3	8-18	1	8905884G34	6-4	1
5468549G1	6-28	1	8905884G73	6-4	1
5468559G1	8-7B	1	8905884G88	6-4	1
5472342G11	6-7	1	8942976P1	8-8E	AR
5480131G1	8-11	1	8948193P1	6-5	1
5480290	6-10	1	9850107P1	8-8F	1
5480291P1	6-9	1	9886421P1	See 203	1

TACHOMETER INDICATOR — TYPE 100% UNLIGHTED

THE INSTRUCTIONS CONTAINED IN THE PRECEDING SECTIONS OF THIS HANDBOOK APPLY EXCEPT FOR THE DIFFERENCES LISTED IN THIS DATA SHEET.

The models covered by this Difference Data Sheet are as follows:

8DJ81CAK1
8DJ81CAK2
8DJ81CAZ2

1. DESCRIPTION AND OPERATION. Same as for Models 8DJ81CAE1 and CAE2 except as noted below:

A. Replace applicable parts of Table II as follows:

(1) Scale

8DJ81CAK1	0-100%
8DJ81CAK2	0-100%
8DJ81CAZ2	0-100%

(2) Weight

8DJ81CAZ2	0.8 pounds

B. Scale plates

See figure 7 and parts list, Table XII, for scale plate part number and model application.

DISASSEMBLY. Same as for Models 8DJ81CAE1 and CAE2.

3. CLEANING. Same as for Models 8DJ81CAE1 and CAE2.

4. INSPECTION. Same as for Models 8DJ81CAE1 and CAE2.

5. REPAIR. Same as for Models 8DJ81CAE1 and CAE2.

6. ASSEMBLY. Same as for Models 8DJ81CAE1 and CAE2.

7. FITS AND CLEARANCES. Same as for Models 8DJ81CAE1 and CAE2.

8. TESTING. Same as for Models 8DJ81CAE1 and CAE2.

9. TROUBLE SHOOTING. Same as for Models 8DJ81CAE1 and CAE2.

10. STORAGE. Same as for Models 8DJ81CAE1 and CAE2.

11. SPECIAL TOOL AND TEST EQUIPMENT. Same as for Models 8DJ81CAE1 and CAE2.

12. PARTS LIST. See revised parts list dated 15 November 1961.

TACHOMETER INDICATOR — TYPE 103% UNLIGHTED

THE INSTRUCTIONS CONTAINED IN THE PRECEDING SECTIONS OF THIS HANDBOOK APPLY EXCEPT FOR THE DIFFERENCES LISTED IN THIS DATA SHEET.

The model covered by this Difference Data Sheet is as follows:

8DJ81CAY2

1. DESCRIPTION AND OPERATION. Same as for Models 8DJ81CAE1 and CAE2 except as noted below:

   A. Replace applicable parts of Table II as follows:

   (1) Receptacle
   8DJ81CAY2 — Bendix PTIH-10-6P

   (2) Mating Plug
   8DJ81CAY2 — Bendix Scintilla Pygmy PT06E-10-6S

   (3) Scale
   8DJ81CAY2 — 0-103%

   B. Scale plates

   See figure 7 and parts list, Table XII, for scale plate part number and model application.

2. DISASSEMBLY. Same as for Models 8DJ81CAE1 and CAE2, except as noted:

   A. On Model CAY2 the nameplate (1A, figure 3) is attached by screws (2A) and lockwashers (2B).

3. CLEANING. Same as for Models 8DJ81CAE1 and CAE2.

4. INSPECTION. Same as for Models 8DJ81CAE1 and CAE2.

5. REPAIR. Same as for Models 8DJ81CAE1 and CAE2.

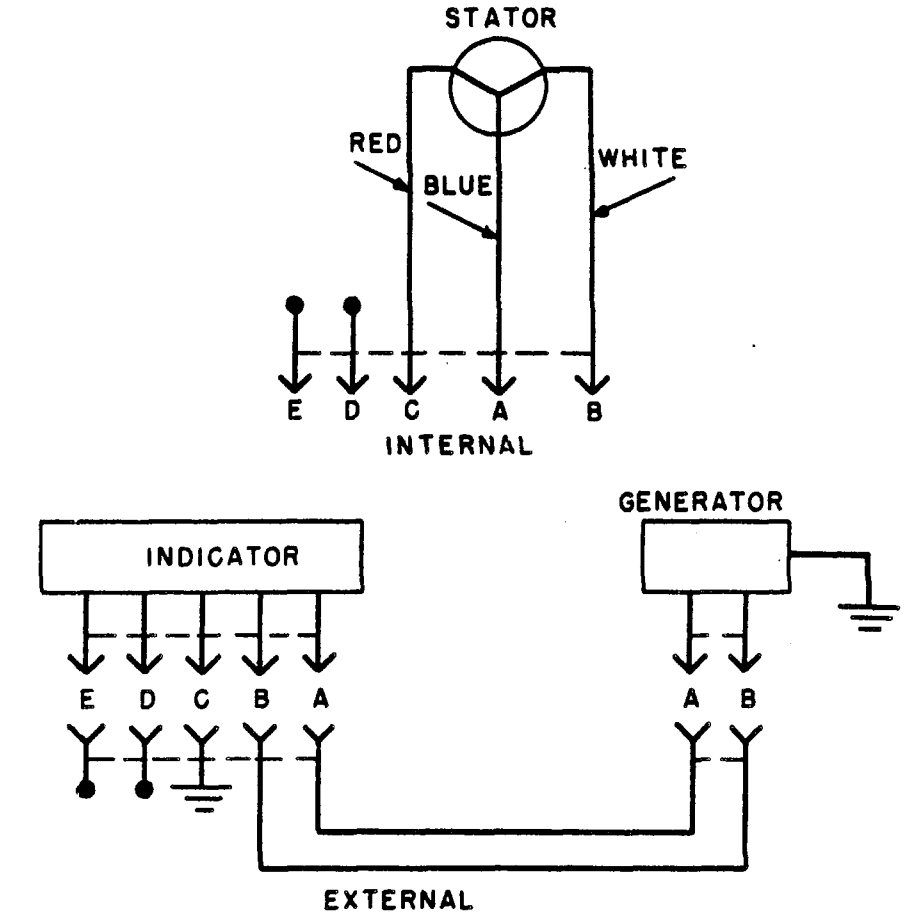
6. ASSEMBLY. Same as for Models 8DJ81CAE1 and CAE2, except as noted:

   A. For external and internal connections see figure 9.

   B. On Model CAY2 the nameplate (1A, figure 3) is attached by screws (2A) and lockwashers (2B).

7. FITS AND CLEARANCES. Same as for Models 8DJ81CAE1, CAE2, LAA1 and LAA2.

8. TESTING. Same as for Models 8DJ81CAE1 and CAE2.



COUNTER-CLOCKWISE ROTATION OF GENERATOR AS VIEWED FROM SHAFT END FOR CLOCKWISE ROTATION, INTERCHANGE LEADS A & B.

External and Internal Connections for 8DJ81CAY2
Figure 9

9. TOUBLE SHOOTING. Same as for Models 8DJ81CAE1 and CAE2.

10. STORAGE. Same as for Models 8DJ81CAE1 and CAE2.

11. SPECIAL TOOL AND TEST EQUIPMENT. Same as for Models 8DJ81CAE1 and CAE2.

12. PARTS LIST. See revised parts list dated 15 November 1961.

TACHOMETER INDICATOR — TYPE 110% UNLIGHTED

THE INSTRUCTIONS CONTAINED IN THE PRECEDING SECTIONS OF THIS HANDBOOK APPLY EXCEPT FOR THE DIFFERENCES LISTED IN THIS DATA SHEET.

The models covered by this Difference Data Sheet are as follows:

8DJ81CAA1	8DJ81CAH1
8DJ81CAB2	8DJ81CAH2
8DJ81CAF1	8DJ81CAS2
8DJ81CAF2	8DJ81CBB2

1. DESCRIPTION AND OPERATION. Same as for Models 8DJ81CAE1 and CAE2 except as noted below:

   A. Replace applicable parts of Table II as follows:

   (1) Receptacle

8DJ81CAB2	Bendix PTIH-10-6P
8DJ81CAS2	Bendix PTIH-10-6P
8DJ81CBB2	Bendix PTIH-10-6P

   (2) Mating Plug

8DJ81CAB2	Bendix Scintilla Pygmy PT06E-10-6S
8DJ81CAS2	Bendix Scintilla Pygmy PT06E-10-6S
8DJ81CBB2	Bendix Scintilla Pygmy PT06E-10-6S

   (3) Weight

8DJ81CAA1	0.8 pounds

   B. Scale plates

   See figure 7 and parts list, Table XII, for scale plate part number and model application.

2. DISASSEMBLY. Same as for Models 8DJ81CAE1 and CAE2, except as noted:

   A. On Models CAB2, CAS2, and CBB2 the nameplate (1A, figure 3) is attached by screws (2A) and lockwashers (2B).

3. CLEANING. Same as for Models 8DJ81CAE1 and CAE2.

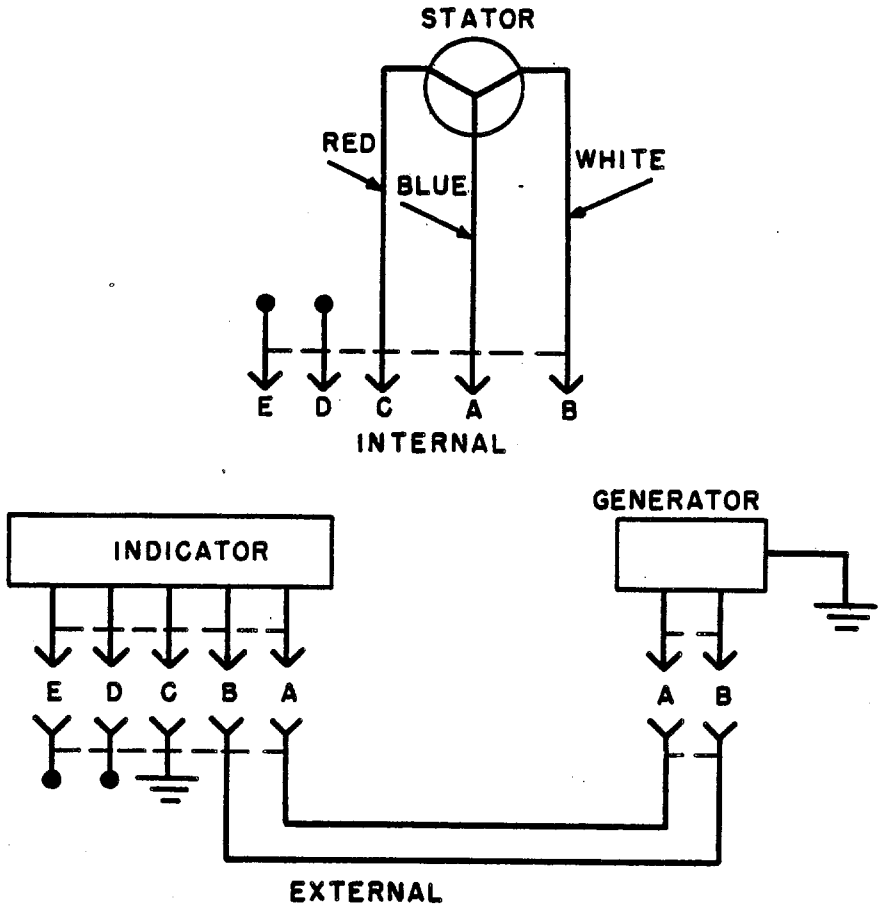
4. INSPECTION. Same as for Models 8DJ81CAE1 and CAE2.

5. REPAIR. Same as for Models 8DJ81CAE1 and CAE2.

6. ASSEMBLY. Same as for Models 8DJ81CAE1 and CAE2, except as noted:

   A. For internal and external connections for Model 8DJ81CAS2 see figure 10.

   B. On Models CAB2, CAS2, and CBB2 the nameplate (1A, figure 3) is attached by screws (2A) and lockwashers (2B).



External and Internal Connections for 8DJ81CAS2
Figure 10

7. FITS AND CLEARANCES. Same as for Models 8DJ81CAE1 and CAE2.

8. TESTING. Same as for Models 8DJ81CAE1 and CAE2.

9. TROUBLE SHOOTING. Same as for Models 8DJ81CAE1 and CAE2.

10. STORAGE. Same as for Models 8DJ81CAE1 and CAE2.

11. SPECIAL TOOL AND TEST EQUIPMENT. Same as for Models 8DJ81CAE1 and CAE2.

12. PARTS LIST. See revised parts list dated 15 November 1961.

DIFFERENCE DATA SHEET MODEL 8DJ81CCL2

THE INSTRUCTIONS CONTAINED IN THE PRECEDING SECTIONS OF THIS MANUAL APPLY EXCEPT FOR THE DIFFERENCES LISTED IN THIS DATA SHEET.

1. DESCRIPTION AND OPERATION. Same as for Model 8DJ81CAA1 except substitute the following:

   A. Replace applicable parts of table II as follows:

Scaleplate Background:	Dull black paint
Markings, other than range marks, white per Fed. Std. 595 No. 37875.	
Green Arc per Fed. Std. 595 No. 34108 from 50 to 101.5%.	
Red Radial per Fed. Std. 595 No. 31168, AT 102.6%.	
Receptacle	10SL-3P
Mating Plug	MS3106-10SL-3S or MS3108-10SL-3S
Range	0-110%

2. DISASSEMBLY. Same as for Model 8DJ81CAA1.

3. CLEANING. Same as for Model 8DJ81CAA1.

4. INSPECTION. Same as for Model 8DJ81CAA1.

5. REPAIR. Same as for Model 8DJ81CAA1.

6. ASSEMBLY. Same as for Model 8DJ81CAA1 except for the following:

   C. Assembly of Head Assembly Same as for Model 8DJ81CAA1.

   (1) Slip the outer turn of the spring through the support eye and bend the spring end up and out, at a right angle to the turn, to form the spring tab. Reposition the spring, with the bent-up portion, against the anchor arm.

   (2) Continue assembly in accordance with the overhaul manual. When the instrument is assembled, less the can, level the spring and apply a small amount of epoxy (Armstrong Adhesive A-12) to the spring tab at the point of attachment.

   NOTE: Armstrong Adhesive A-12 should be quick cured by heating in a 125°C oven for 15 to 20 minutes. Quick curing will eliminate the possibility of movement of the spring under extended cure at room temperature, and guarantee proper flowing of the epoxy. Removal of the epoxy may be facilitated by using a soldering iron to break the bond of the epoxy and allow it to be chipped away. The epoxy stripper should be used for cleaning only. It is similar to Number 688 Cold Stripper, manufactured by Fidelity Chemical Products Corp., Neward, New Jersey.

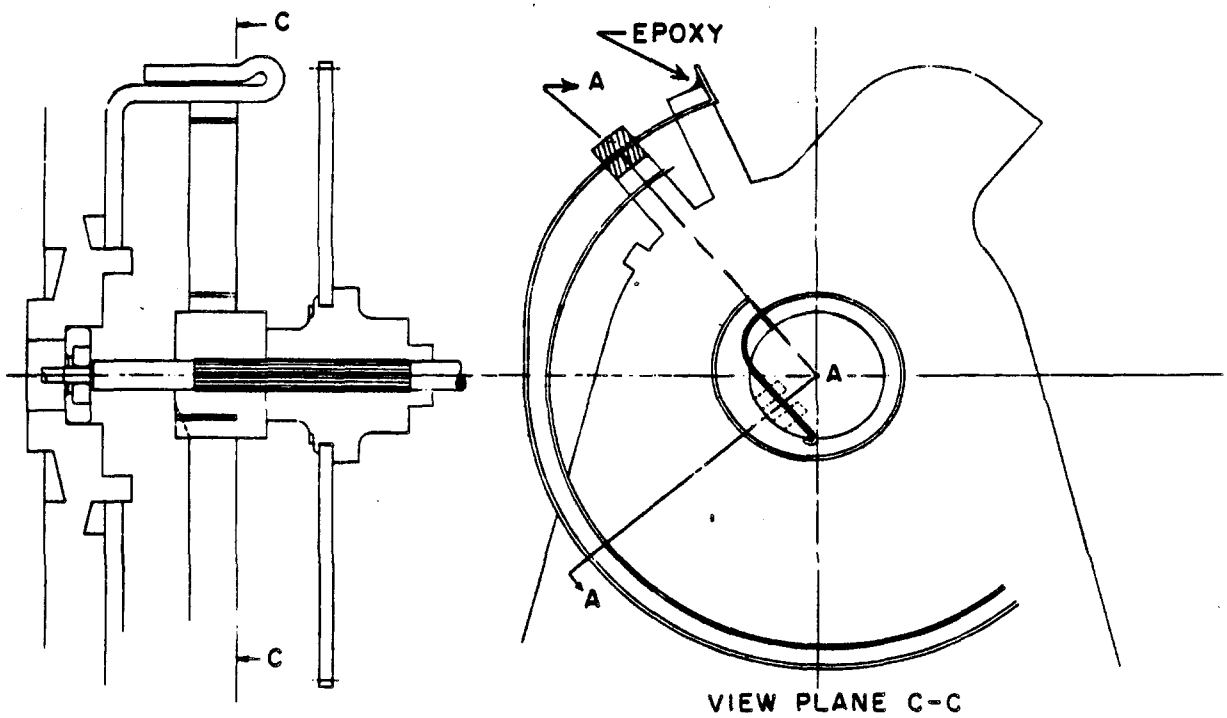


Fig. 1. Layout of spring clamping method

7. FITS AND CLEARANCES. Same as for Model 8DJ81CAA1.

8. TESTING. Same as for Model 8DJ81CAA1 except for the following:

D. Temperature Compensation

(1) Temperature Compensation Check - High and low Temp.

Frequency	Indication	% Change from R.T. Reading AT +70°C	% Change from R.T. Reading AT -35°C
4200 CPM	100%	+0.0 -0.3	+1.0 -0.0

(a) Take temperature compensation readings at -35°C at the input frequency listed above. Read the instrument after it has been subjected to -35°C for a minimum of two hours. Allow the instrument to return to room temperature and take readings after the instrument has been at room temperature for two hours.

9. TROUBLE SHOOTING. Same as for Model 8DJ81CAA1.

DIFFERENCE DATA SHEET MODEL 8DJ81CCL2

10. STORAGE INSTRUCTIONS. Same as for Model 8DJ81CAA1.

11. SPECIAL TOOLS, FIXTURES, AND TEST EQUIPMENT. Same as for Model 8DJ81CAA1.

12. PARTS LIST. Same as for Model 8DJ81CAA1 except for the following:

FIG. & INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	USAGE CODE	UNITS PER ASSY
6-	8DJ81CCL2	Indicator, Tachometer		1
-1	6680K57	. Nameplate		1
--	4141772P059	. . Window		1
-6	5468508G056	. Motor and Head Assy		1
-7	4145642G253	. . Pointer Assy, Large		1
-8	4145642G254	. . Pointer Assy, Small		1
-9	6466K33P001	. . Scaleplate		1
-16	5468435G057	. . . Cup and Support Assy		1
--	9893647P020	. . . . Cup Support		1
-39	5468341G009	. . Head Assembly		1

DIFFERENCE DATA SHEET MODEL 8DJ81CCM2

THE INSTRUCTIONS CONTAINED IN THE PRECEDING SECTIONS OF THIS MANUAL APPLY EXCEPT FOR THE DIFFERENCES LISTED IN THIS DATA SHEET.

1. DESCRIPTION AND OPERATION. Same as for Model 8DJ81CAA1 except for the following:

   Replace applicable parts of table II as follows:
   Scaleplate background: dull black paint.
   Markings, other than range marker, white per Fed. Std. 595 #37875.
   Green arc per Fed. Std. 595 #34108, from 70 to 100%.
   Red radial per Fed. Std. 595 #31168, at 100%.

Receptacle	DM5600-3PY
Mating Plug	DM9700-3SY
Range	0-110%

2. DISASSEMBLY. Same as for Model 8DJ81CAA1.

3. CLEANING. Same as for Model 8DJ81CAA1.

4. INSPECTION. Same as for Model 8DJ81CAA1.

5. REPAIR. Same as for Model 8DJ81CAA1.

6. ASSEMBLY. Same as for Model 8DJ81CAA1 except for the following:

   C. Assembly of Head Assembly, Same as for Model 8DJ81CAA1 except for the following:

      (1) Slip the outer turn of the spring through the support eye and bend the spring end up and out, at a right angle to the turn, to form the spring tab. Reposition the spring, with the bent-up portion, against the anchor arm.

      (2) Continue assembly in accordance with the overhaul manual. When the instrument is assembled, less the can, level the spring and apply a small amount of epoxy (Armstrong Adhesive A-12) to the spring tab at the point of attachment.

         NOTE: Armstrong Adhesive A-12 should be quick cured by heating in a 125°C oven for 15 to 20 minutes. Quick curing will eliminate the possibility of movement of the spring under extended cure at room temperature, and guarantee proper flowing of the epoxy. Removal of the epoxy may be facilitated by using a soldering iron to break the bond of the epoxy and allow it to be chipped away. The epoxy stripper should be used for cleaning only. It is similar to Number 688 Cold Stripper, manufactured by Fidelity Chemical Products Corp., Newark, New Jersey.

MODEL 8DJ81CCM2

DIFFERENCE DATA SHEET

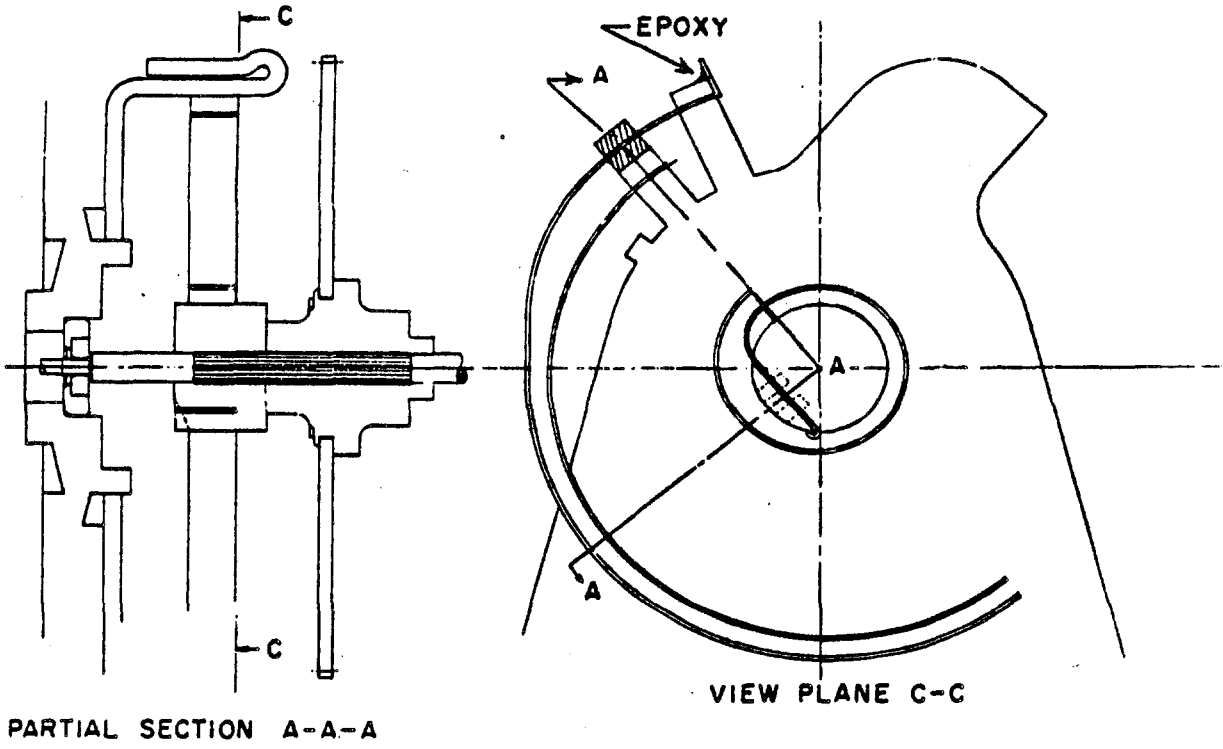
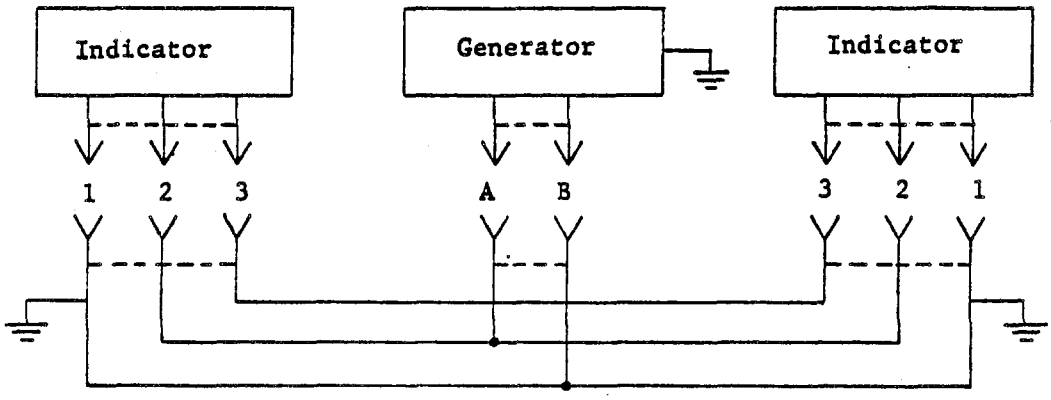


Fig. 1. Layout of spring clamping method



Counter-clockwise Rotation of Generator as Viewed from Shaft End. For Clockwise Rotation, Interchange Leads A & B

Figure 10A External Connection Diagram

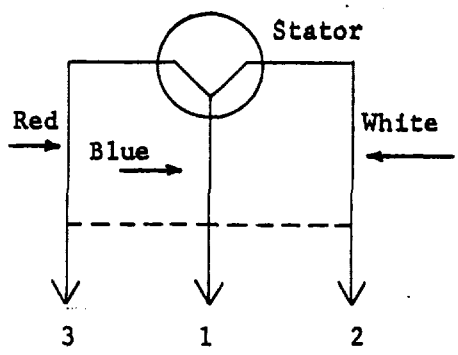


Figure 10B Internal Connection Diagram

7. FITS AND CLEARANCES. Same as for Model 8DJ81CAA1.

8. TESTING. Same as for Model 8DJ81CAA1.

9. TROUBLE SHOOTING. Same as for Model 8DJ81CAA1.

10. STORAGE INSTRUCTIONS. Same as for Model 8DJ81CAA1.

11. SPECIAL TOOLS, FIXTURES, AND TEST EQUIPMENT. Same as for Model 8DJ81CAA1.

12. PARTS LIST. Same as for Model 8DJ81CAA1 except for the following:

FIG. & INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	USAGE CODE	UNITS PER ASSY
6-	8DJ81CCM2	Indicator, Tachometer		1
-1	6680K57	. Nameplate		1
-4	4141772P059	. . Window		1
-6	5468508G057	. Motor & Head Assy		1
-7	4145642G253	. . Pointer Assy, Large		1
-8	4145642G254	. . Pointer Assy, Small		1
-9	6466K34P001	. . Scaleplate		1
-16	5468435G061	. . . Cup and Support Assy		1
--	9893647P103	. . . . Cup Support		1
-39	5468K341G009	. . Head Assy		1

OVERHAUL MANUAL WITH PARTS BREAKDOWN TEMPERATURE INDICATOR LEWIS, TYPE 152B206

OVERHAUL WITH PARTS BREAKDOWN TEMPERATURE INDICATOR, LEWIS 152B206

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OVERHAUL WITH PARTS BREAKDOWN TEMPERATURE INDICATOR, LEWIS 152B206

LIST OF TABLES

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OVERHAUL WITH PARTS BREAKDOWN TEMPERATURE INDICATOR, LEWIS 152B206

DESCRIPTION AND OPERATION

1. Introduction

The Type 152B206 is a thermo-couple temperature indicator, having a temperature range of 0-1200°C. This indicator is manufactured by the Lewis Engineering Company, Naugatuck, Connecticut, U.S.A.

2. Description

A. General: The indicator is housed in a 2" steel case, suitable for clamp mounting, or may be flange mounted by means of a standard bezel. Electrical connections are brought out to terminals at the rear of the case. Refer to Figure 1 for details of dimensions and mounting.

B. Dial Configuration: The dial markings are dull white (FED. STD 595, color 37875) for numerals, lettering and both major and minor graduations. The background is durable dull black (FED. STD 595, color 37038). Other markings are as follows:

(1) Arc from 400°C to 705°C in lusterless green (FED. STD 595, color 24260).

(2) Arc from 705°C to 750°C in lusterless yellow (FED. STD 595, color 33538).

(3) Radial line at 750°C in lusterless red (FED. STD 595, color 31136).

(4) Because of the space occupied by the red radial line at 750°C there are no minor graduations at 760°C and 780°C.

C. Thermo-couple: The 152B206 indicator is calibrated for use with chromel-alumel thermocouples having 8 ohm leads.

D. Circuit Description: Refer to Figure 2, which is a schematic diagram showing the internal wiring of the indicator. The basic indicator is a sensitive moving-coil milli-voltmeter having a copper armature coil which is fed electrically via top and bottom control springs. The armature has a coil of resistance wire, wound on a plastic spool, in series with its negative lead and another resistance with a negative temperature co-efficient in series with its positive lead. The resistance coil provides a means of calibration, since turns of wire can be removed during the test procedure to adjust the meter reading. The negative resistor provides automatic temperature compensation for changes in armature coil resistance due to changes in ambient temperature.

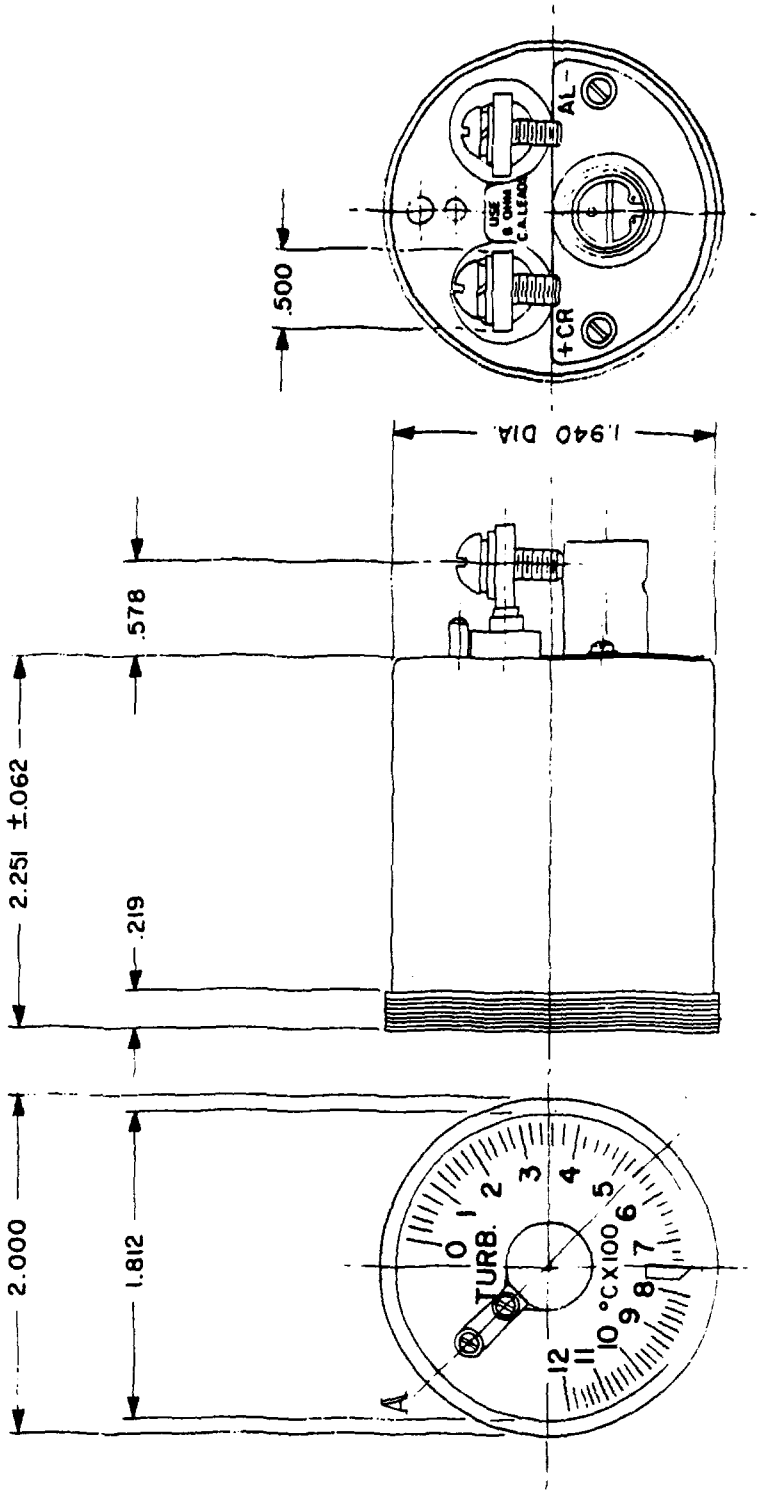
2.(D) - Cont'd.

Since the millivoltage generated in the thermo-couple circuit is dependent on the difference in temperature between the thermo-couple (hot junction) and the cold junction (in the indicator), a bi-metallic spring is connected to the bottom control spring to compensate the indicator for millivolt changes due to variations in ambient temperature. The positive terminal stud of the indicator (10-32 thread) is made of brass and the negative terminal stud (8-32 thread) is of constantan. This preserves the continuity of thermo-couple material into the instrument case where copper and constantan wires are used to the cold junction.

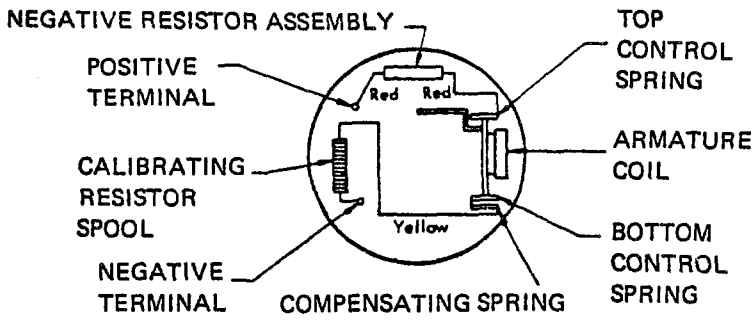
3. Operation:

A. The thermo-couple indicator operates when connected to the external circuit shown in Figure 3. The external wiring consists of the thermo-couples and harness on the engine, extension leads and a balancing resistor AN 5534-2 (Lewis P/N 8T851B3) in series with the negative lead. The indicator is calibrated to operate into an 8 ohm external circuit, therefore since the external circuit resistance will vary according to the length of the leads and the number of thermo-couples in use, the AN 5534-2 balancing resistor contains two spools of constantan resistance wire, one of which is adjusted until the external circuit resistance is 8 ± 0.05 ohms. The other spool is a spare. The external circuit resistance is determined by measuring it with a Wheatstone Bridge. This measurement should be taken twice, with the leads to the bridge reversed the second time. The average of the two readings should then be calculated. This is necessary as slight millivoltages developed due to temperature differential between the ends of the leads and the thermo-couples will deflect the galvanometer of the bridge.

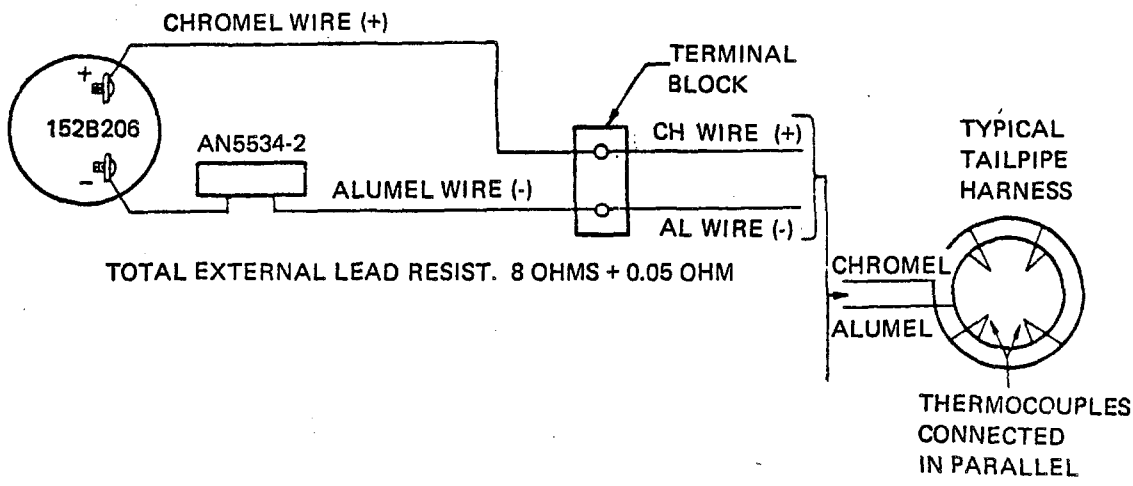
OVERHAUL WITH PARTS BREAKDOWN TEMPERATURE INDICATOR, LEWIS 152B206



Details of Dimensions and Mounting
Figure 1



Internal Wiring Diagram
Figure 2



External Circuit
Figure 3

OVERHAUL WITH PARTS BREAKDOWN TEMPERATURE INDICATOR, LEWIS 152B206

DISASSEMBLY

1. Refer to Figure 1101. Disassemble the indicator in approximately the same order as the index numbers assigned to this figure.

   NOTE: These instruments operate on jewelled bearings. Handle them as you would an expensive watch.

   Disassembly procedure is as follows:

   A. Using an induction heater or large soldering iron, apply it to sealing strap (1) to soften solder bond. Peel off strap and discard.

   B. Remove screws (3) and slide off housing assembly (2). Do not remove lining strip (4) or window (5) from front and body assembly (6) unless they have been damaged.

   C. Remove screws (10) and lockwashers (11). This releases the dial (7), mask (8) and bumper assembly (9). When removing dial (7), take care not to damage pointer of armature assembly (19).

   D. Remove screws (14A) and lift off the dial mounting plate (13). Remove spacers (14).

   E. Carefully unsolder the wires from fixed resistor (43) and thermal resistor (44). The constantan wire (yellow) from the fixed resistor connects to regulator terminal (29) and the red wire from the thermal resistor connects to the terminal on top bridge assembly (16). Remove movement assembly (12) from base assembly (42).

   F. Unsolder outer ends of control springs (20, 24). Remove screws (17) and lockwashers (18), this releases top bridge (16).

   G. Grasp armature assembly (19) by pointer, lift and turn carefully to remove it from pole piece assembly (38). Slide armature coil through slotted core.

   H. Do not disassemble armature assembly (19) further unless control springs (20, 24), pivots (23) or balance weights (21, 22) require replacement. If any other part of the armature assembly is damaged, replace the entire assembly.

CLEANING, INSPECTION AND REPAIR

1. Cleaning and Inspection

Refer to Table 201. Carry out the inspection and cleaning procedures listed therein.

PART	HOW TO CLEAN OR INSPECT
Jewels (26 and 15)	Clean with orangewood stick. Insert fine pointed needle into and over jewel cup to detect fractures.
Pivots (23)	Examine with seven power eye loupe. Clean by rotating pithwood on point.
Dial (7)	Check for chipped or discolored paint. Clean with soft camel-hair brush.
Terminals (52 and 57)	Examine for cracked window insulation and damaged threads.
Zero adjuster (65) and insulator (64)	Operate one full turn to check operation. Check condition of insulator.
Armature (19)	Check for discolored paint on pointer. Check coil with ohmmeter. Resistance should be 22-1/2 ohms ± 2 ohms.
Control springs (20 and 24)	If mis-shapen, re-position by means of fine tweezers. Clean with fine camel-hair brush and trichlorethylene. (Federal Specification No. O-T-634A).
Negative resistor assembly (44)	Test with ohmmeter to terminal wires. Do not disturb constantan shunt winding. Resistance of shunted carbon resistor assembly should be 8.1 ohms ± .4 ohm.
Window (5)	Check for striae or chipped surface. Clean with moist chamois.

Table 201 Cleaning and Inspection Procedures

CLEANING, INSPECTION AND REPAIR (CONT'D)

2. Repair:

When necessary, the following repairs may be made.

A. Replace fractured jewels (26, 15).

B. Replace chipped or flattened pivots (23). Use tool #34 (ref. Table 1001).

C. Replace dial (7) if bent. Refinish if paint chipped or discoloured.

D. To replace damaged terminals (52, 57), place shield (62) on an electric hotplace and use large soldering iron to soften solder. Lift out defective terminals and place new terminal in recess. Flow solder around terminal with soldering iron.

E. Proceed similarly to change defective adjuster (61).

F. To replace defective window (5) place housing (6) on electric hot plate to soften solder bond to window, scrape excess solder from inside housing. Place new window in housing. Cut a piece of 1/32 inch diameter solder to form a ring inside housing in such a position that, when the solder melts, it will flow evenly around edge of window. Add solder if required. Do not overheat. An induction heater may be substituted for the hotplate.

3. Lubrication:

No lubrication is necessary.

ASSEMBLY

1. Preliminary

Assembly is performed in approximately the reverse order of index numbers on Figure 1101.

CAUTION: NEVER TIGHTEN JEWELS SUFFICIENTLY TO CAUSE THEM TO BIND ON PIVOTS AS CRACKED JEWELS OR DAMAGED PIVOTS WILL RESULT.

Proceed as follows:

A. With bottom bridge assembly (32) in place on bottom of pole piece (38), insert armature assembly (19) by carefully sliding through slotted core until bottom pivot rests in cup of bottom jewel (26).

B. Attach top bridge (16) to magnet and gradually lower top jewel (15) until the top pivot is within the cup of the top jewel.

C. Grasp tail arm of quadrant and gently rock armature (19) from side to side to observe side-play of top pivot in top jewel (15). Slowly tighten top jewel (use Tool 36) until side play is approximately 0.004 inch.

D. Re-solder constantan lead to terminal of bottom regulator (29). Attach movement assembly (12) to base assembly (42) and solder lead to top bridge. (See internal wiring diagram, Figure 2). Be sure regulator (30) meshes with zero adjuster (61).

E. Slide movement assembly (12) onto posts of base assembly (42). Install spacers (14) on the threaded ends of the posts.

F. Attach dial mounting plate (13) using screws (14A).

NOTE: When tightening screws (14A) be sure that front bridge (16) is not pressed downward to cause jewels to bind pivots. Re-check side play and re-adjust top jewel (15) if necessary.

G. Attach dial (7), mask (8) and bumper assembly (9) to dial mounting plate (13), using screws (10) and lockwashers (11).

H. Re-solder control springs (20, 24) to terminals on top of front bridge and bottom regulator respectively.

ASSEMBLY (CONT'D)

I. Balance armature with pointer in horizontal and vertical position, moving tail (21) and side (22) weights with wrench 16 or 16B as required (ref. Table 1001).

J. Carry out test procedures detailed in Section 701.

2. Sealing Evacuation and Filling

After successful completion of the test procedures (Section 701), fill and seal the indicator case with a dry gas mixture of 90% nitrogen and 10% helium. Filling and sealing procedure is as follows:

A. Support indicator in LF30 sealing fixture and solder sealing strap (1) in place. Use a 150 watt soldering iron to flow solder from strap to housing. Remove excess solder with coarse file.

B. Test for leaks by immersing indicator in a water jar with filler tube connected to a DRY compressed air supply of 30 psi max. If no leaks are detected remove air hose, hold finger over filler tube and dry indicator by blowing off excess moisture.

C. Place indicator in an air oven heated to about 70°C (158°F) for 30 minutes.

D. Connect filler tube to gas supply and vacuum pump as shown in Figure 501. Evacuate to approximately two mm of mercury as indicated on the vacuum (absolute pressure) gauge. Close valve "B" and slowly open valve "A" to fill indicator with gas.

E. Close valve "A" and open "B" to again evacuate indicator. Close valve "B" and open "A" to again fill with gas.

F. Close valve "A", pinch tube closed with pliers, remove hose and cut off excess length of tube and solder cut end of tube closed.

G. Make final leak test by placing indicator in desiccator jar as shown in Figure 502. Close valve "B" and open "A". Draw a vacuum of about 25 mm of mercury then close valve "A" and slowly open "B" until vacuum falls to about 63 mm of mercury.

H. Check indicator carefully for leaks by watching for a continuous flow of bubbles. If no leak is observed, SLOWLY open valve "B" to equalize pressure within desiccator with atmosphere.

ASSEMBLY (CONT'D)

I. Thoroughly dry indicator and paint with dull black instrument lacquer, Fed. Std. 595 Color 37038.

J. Repeat scale error test described in Section 701 making sure that zero adjuster has been properly operated to bring the pointer on the 90° division while applying the appropriate millivoltage to the indicator terminals for 90°C at room temperature reference through the applicable external resistance. Connect a wire jumper across indicator terminals to dampen pointer swings during handling.

K. Repeat friction and balance tests.

3. Packing for Transportation or Storage

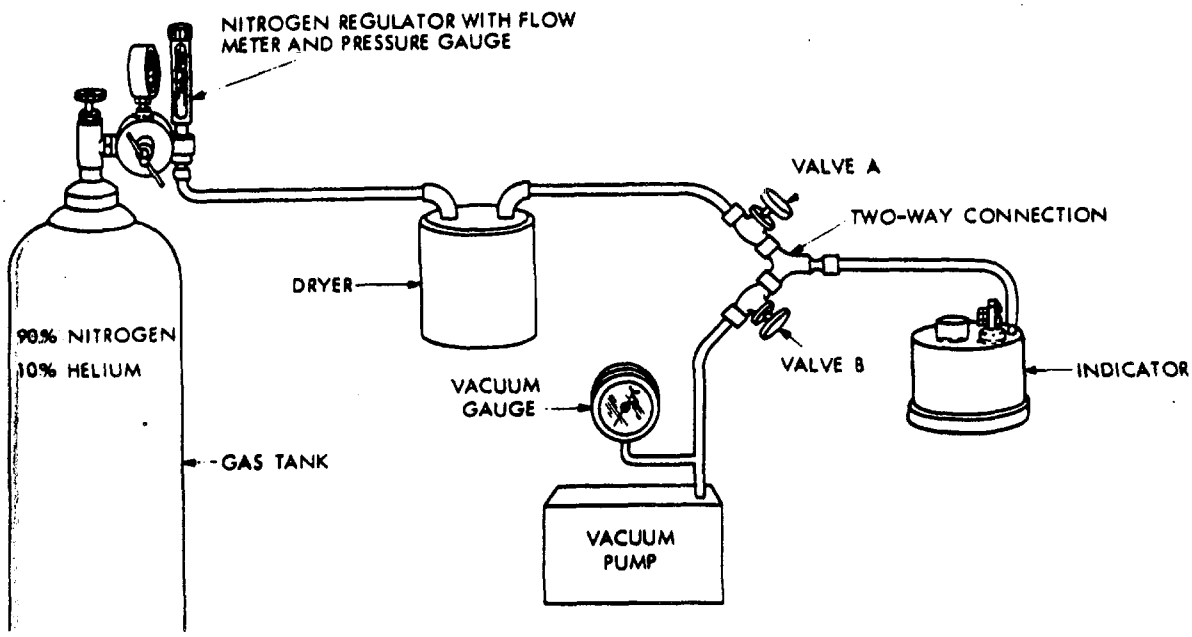
A. Use specification PPB-B-636 Type I, Class II carton 7-1/2 x 7-1/2 x 7-1/2 inches. Insert a pad eight inches wide by five foot long by one-half inch thick, specification PPB-C-843A Type 2, crepe celulose wadding on bottom of carton.

B. Wrap indicator in crepe cellulose wadding three inches wide by ten foot long by one-half inch thick and place in carton.

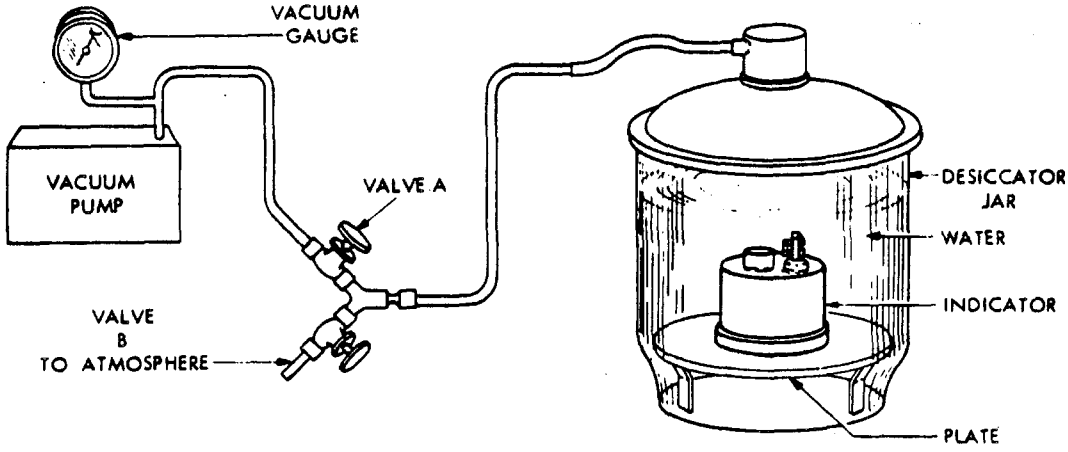
C. Place another pad of eight inch wide by five foot long by one-half inch thick crepe cellulose wadding on top of indicator.

D. Seal carton with specification UU-T-116 tape.

NOTE: To prevent damage to internal components, NEVER ship an indicator unless it has a minimum of three inches of cushioning material on all sides.



Evacuation and Gas Filling Equipment
Figure 501



Final Leak Test Under Vacuum
Figure 502

TESTING

1. Test Procedures. Scale Error Test

The following test procedures are to be carried out after assembly is completed, but before the instrument case is sealed and filled with gas. Before test or adjustment the indicator must remain at a constant temperature for one hour. Removing resistance wire from calibrating resistor (47) will raise pointer indication and vice versa. Tap indicator with fingertip while taking readings. Three methods of scale error testing are given:

A. Using Type N3A Thermometer Tester (Lewis part number 81T27).

B. Using TTU-104/A Thermometer (Lewis part number 81T28).

C. Using Type K2 Potentiometer and ice bath.

2. Type N3A Method

This tester provides chromel alumel calibration millivoltages, through the required eight ohm lead resistance, by turning a master selector switch to the required test temperature.
The test millivoltage output is referenced to zero °C, so there is no ambient (room) temperature compensation in the tester, therefore the ambient temperature, as observed on the liquid-in-glass thermometer supplied with the tester, MUST be physically added to the test temperature, by turning the zero adjuster screw.
First, however, carry out the scale error test as follows:

A. Turn tester selector switch to 900 (this being the value having the smallest tolerance).

B. Turn indicator zero adjuster until pointer reads 900°C.

C. Set the tester selector switch to the scale error test points listed in Table 701. Readings shall be within the °C tolerances given. Adjust calibrating resistor value as described in para 1, if necessary.

To adjust the indicator for ambient temperature, set tester switch to 900. Take reading of liquid thermometer (for example 25°C), then set indicator zero adjuster to make pointer read 925°C.
Full operating instructions are provided with each N3A tester.

TESTING (CONT'D)

3. Type TTU-104/E Method

This tester provides chromel-alumel calibration millivoltages through the required 8-ohm lead resistance, by turning a master selector switch to the required test temperature. The test millivoltage output is automatically referenced to ambient temperature by an internal electrical cold junction compensating circuit in the tester, therefore the reading of the indicator under test should agree with the setting of the selector switch, within allowable tolerances. To run a scale error test on the indicator, set tester selector switch at 900 and set zero adjuster on indicator to bring the pointer to 900. Turn tester selector to each of the test points listed in Table 701. Readings shall be within tolerances given. Adjust calibrating resistor if necessary. Full operating instructions are provided with each TTU-104/E Tester.

4. K-2 Potentiometer and Ice Bath Method

This method electrically removes the cold junction from the indicator and places it at zero °C in the ice bath, thus eliminating any reference to ambient temperature. Connect the equipment together as illustrated in Figure 701.
Apply the millivoltage value for 900°C (37.36 mv) and turn zero adjuster on indicator to bring the pointer to 900 on the scale. Set millivolt supply to the other test values listed in Table 701. The pointer shall indicate the test values within the tolerances given. After completing the scale error test, return to 37.36 mv and the pointer shall again read 900°C within tolerance. Adjust calibrating resistor if necessary.

5. Friction Test

Hold indicator in operating position, and gradually deflect pointer, using any one of the methods described in paras 3, 4 or 5, without tapping, from zero °C to 900°C. Then tap lightly and note change in pointer indication. Change is friction error, which shall not exceed ± 30°C. Clean air gap with needle or replace jewels and pivots if error is greater than the specified value.

6. Balance Test.

Apply 37.36 mv to deflect pointer to 900°C while holding the indicator with the dial in a horizontal plane. Tap indicator while taking readings. Turn indicator so that dial is vertical and pointer horizontal with the 900°C mark on the left. If reading changes, adjust tail balance weight (Figure 1101, -21)

TESTING (CONT'D)

6. Balance Test (Cont'd)

until reading agrees.
Rotate indicator clockwise so that 900°C is at the top. Adjust either or both side balance weights (-22) if necessary to bring pointer to 900°C mark. Hold indicator in normal operating posistion and rotate 90° clockwise and counterclockwise. The maximum change in pointer position shall not exceed ± 25°C.

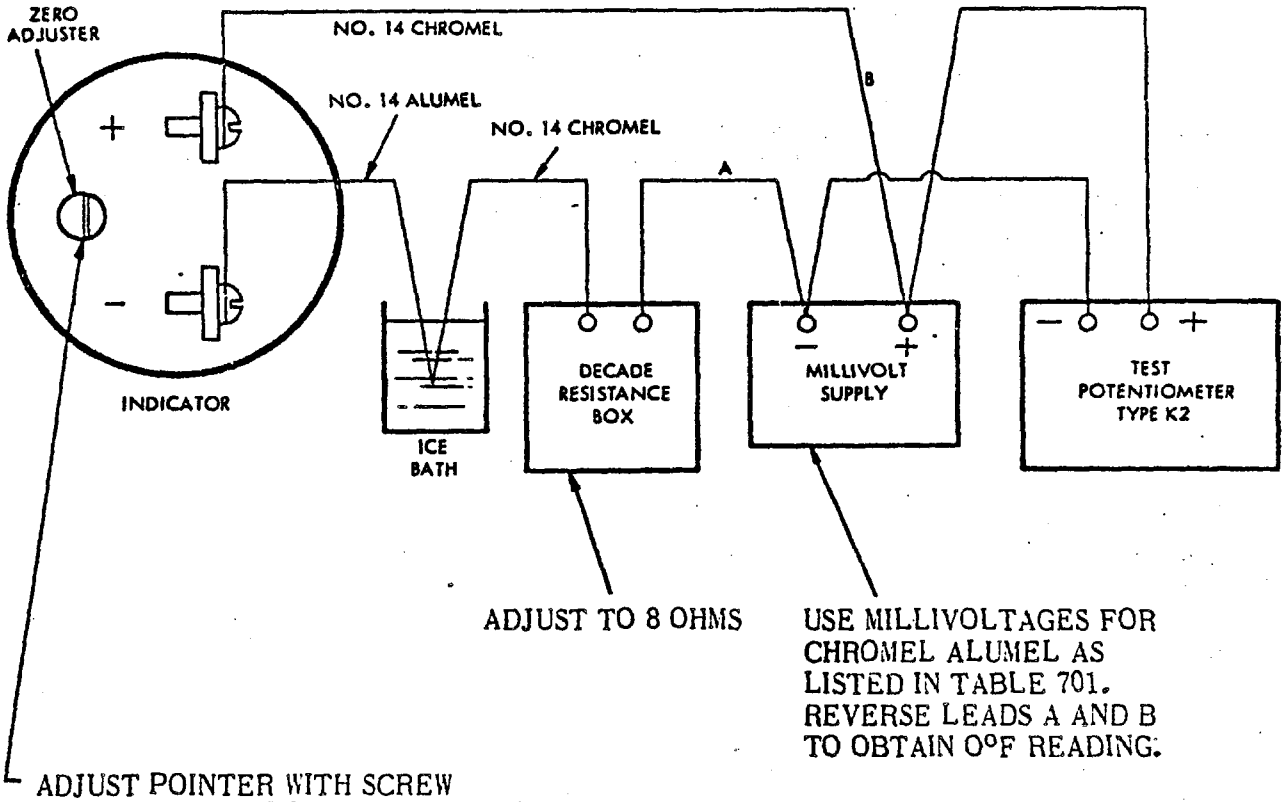
7. Zero Adjuster.

Deflect pointer to 900°C. Turn zero adjuster (65) throughout its range. The resulting pointer motion should be not less than 40°C above and below the setting point. Tap indicator when reading. If necessary to equalize pointer deflection, turn zero adjuster so that regulator (30) is approximately in the center of its travel, then turn terminal (29) to bring pointer to 900°C mark.

8. Final Test

Install housing assembly (2) on indicator and repeat the scale error test using any of the three methods described in paragraphs 2, 3 or 4. If all tolerances are met, carry out the sealing, evacuation and filling procedures described in paragraph 2, Section 501.

OVERHAUL WITH PARTS BREAKDOWN TEMPERATURE INDICATOR, LEWIS 152B206



NOTES:

USE THERMOCOUPLE WIRE WHERE INDICATED. OTHER LEADS ARE NO. 14 COPPER. ICE BATH CONTAINS COLD JUNCTION. HOLD AT ZERO°C.

Calibration Equipment, Potentiometer Method
Figure 701

OVERHAUL WITH PARTS BREAKDOWN TEMPERATURE INDICATOR, LEWIS 152B206

Test Temp. °C	Millivoltage	Tolerance ± °C
0	0	50
200	8.13	30
400	16.40	25
600	24.91	20
800	33.30	10
900	37.36	5
1000	41.31	10
1100	45.66	20
1200	49.82	30

Table 701 Calibration Values

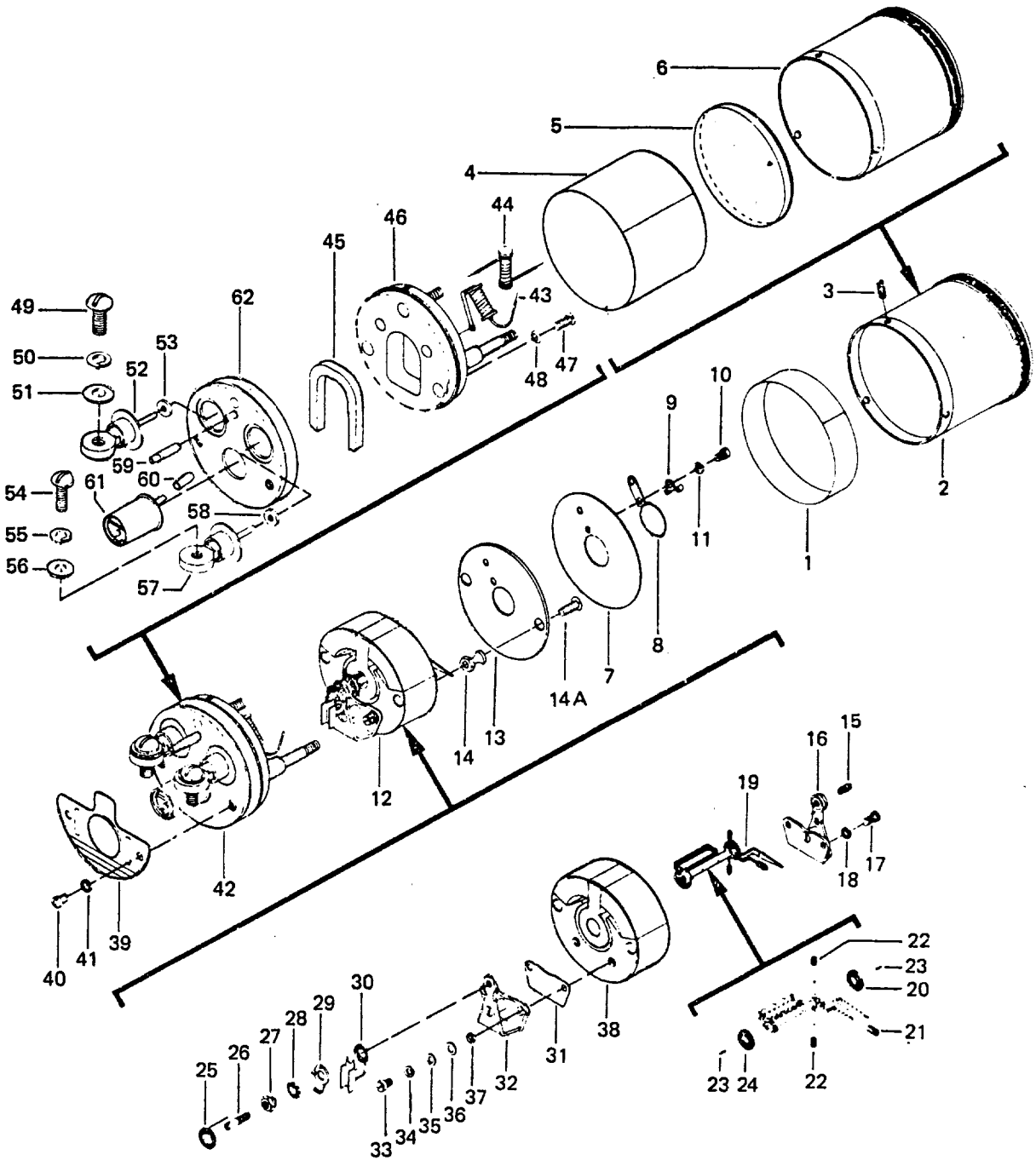
OVERHAUL WITH PARTS BREAKDOWN TEMPERATURE INDICATOR, LEWIS 152B206

SPECIAL TOOLS, FIXTURES AND EQUIPMENT

Tool No.	Nomenclature	Manufacturer's Code
16 & 16B	Balance Wrench	35918
LF 30	Sealing Fixture	35918
34	Pivot Pliers	35918
36	Top-jewel Wrench	35918
FA160102	Absolute Pressure Indicator	79172
600-5	Desiccator Plate	14566
803-0121	Two-way Outlet Connection	80382
806-8124	Gas regulator with flowmeter and pressure gauge	80382
92003-1	Vacuum Pump	11273
3120-250	Desiccator and Cover	14674
81T27	Type N-3A Thermometer Tester	35918
81T28	Type TTU-104/E Thermometer Tester	35918
7552	Type K2 Potentiometer	35529

Table 1001

OVERHAUL WITH PARTS BREAKDOWN TEMPERATURE INDICATOR, LEWIS 152B206



Exploded View Parts Breakdown
Figure 1101

OVERHAUL WITH PARTS BREAKDOWN TEMPERATURE INDICATOR, LEWIS 152B206

FIGURE and INDEX NUMBER	GROUP / MAJOR ASSEMBLY / PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	Units Per Ass'y	Usage on Code
1101-	152B206	Thermocouple Temperature Indicator	1	
- 1	149-140	Strap, Sealing	1	
- 2	162-202	Housing Assembly	1	
	ATTACHING PARTS			
- 3	X24-10	Screw, Machine	3	
		--------*--------		
- 4	162-80B2	Strip, Lining	1	
- 5	149-120	Window	1	
- 6	No number	Front and Body Assembly	1	
- 7	S1347	Dial	1	
- 8	162-84B2	Mask	1	
- 9	162-78	Bumper Assembly	1	
	ATTACHING PARTS			
-10	X24-31	Screw, Machine	2	
-11	X7-44	Washer, Lock	2	
		--------*--------		
-12	345B107	Movement Assembly	1	
-13	162-258	Plate, Dial Mounting	1	
	ATTACHING PARTS			
-14	162-257	Spacer, Dial Mounting Plate	2	
-14A	AN505B2R3	Screw, Machine	2	
		--------*--------		
-15	21-1581F2	Jewel Assembly	1	
-16	21-1503F4	Bridge Assembly, Top	1	
	ATTACHING PARTS			
-17	X24-32	Screw, Machine	2	
-18	AN935B2L	Washer, Lock	2	
		--------*--------		
-19	21-1622F12	Armature Assembly	1	
-20	LS-4	Spring Control	1	
-21	WM21-117F	Balance Weight, Tail	1	
-22	WM21-117B	Balance Weight, Side	2	
-23	WM21-111C	Pivot	2	
-24	WM21-116B31	Spring, Control	1	
-25	17-369B3	Spring, Compensating	1	
-26	21-1132F2	Jewel Assembly, Long	1	
-27	WM21-108C	Nut, Shoulder	1	
-28	21-421	Washer, Spring	1	
-29	21-1131-5	Terminal, Regulator	1	
-30	21-1131C	Regulator, Zero Adjuster	1	
-31	21-1674	Pad, Bridge Insulator	1	

OVERHAUL WITH PARTS BREAKDOWN TEMPERATURE INDICATOR, LEWIS 152B206

FIGURE and INDEX NUMBER	GROUP / MAJOR ASSEMBLY / PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	Units Per Ass'y	Usage on Code
-32	21-1604F4	Bridge Assembly, Bottom	1	
	ATTACHING PARTS			
-33	X24-32	Screw, Machine	2	
-34	AN935B2L	Washer, Lock		
-35	21-1676	Washer, Flat		
-36	21-1675	Washer, Insulating		
-37	21-1672	Bushing, Insulating		
		--------*--------		
-38	21-1601	Pole Piece Assembly		
-39	N553B20	Nameplate	1	
	ATTACHING PARTS			
-40	7F2B2-4C	Screw, Machine	2	
-41	X7-22	Washer, Lock	2	
		--------*--------		
-42	152-40B2	Base Assembly	1	
-43	71A70A10	Resistor, Fixed	1	
-44	X4C5	Resistor, Thermal	1	
-45	149-114	Collar	1	
-46	152-50	Base	1	
	ATTACHING PARTS			
-47	AN510B3-4	Screw, Machine	3	
-48	X7-33	Washer, Lock	3	
		--------*--------		
-49	AN520B10-8	Screw, Machine	1	
-50	AN935B10L	Washer, Lock	1	
-51	AN961-10	Washer, Flat	1	
-52	149-87	Terminal Assembly, Positive	1	
-53	149-113	Washer, Silastic	1	
-54	AN515B8-8	Screw, Machine	1	
-55	AN935B8L	Washer, Lock	1	
-56	AN961-8	Washer, Flat	1	
-57	149-86	Terminal Assembly, Negative	1	
-58	149-113	Washer, Silastic	1	
-59	149-115	Tube, Filler	1	
-60	21-1166	Insulator	1	
-61	X-121L	Adjuster, Zero	1	
-62	152-35B	Shield	1	

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OVERHAUL MANUAL

MILLIVOLTMETER TEMPERATURE INDICATORS

(GRADED SCALE—SINGLE MOVEMENT)

CODE NUMBERS OF UNITS
COVERED BY THIS MANUAL
ARE LISTED ON PAGE 2.

STATEMENT OF INITIAL CERTIFICATION

This manual complies with British Civil Airworthiness Requirements, Section A, Chapter A6-2.

Signed J. L. Hollyer *Date* October 1975

C.A.A. Design Approval No. DAI/1671/41

NOTE: The above certification does not apply to revisions or amendments made after the date of initial certification by other Approved Organisations.
Revisions or amendments made by other Approved Organisations must each be separately certified, and recorded on separate record sheets.

Failure to follow the applicable instructions given in this publication as amended from time to time by SMITHS INDUSTRIES revisions may endanger safety.

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MILLIVOLTMETER TEMPERATURE INDICATORS

LIST OF CODE NUMBERS

*/727MV/BU/1 */727MV/BU/2 */727MV/BU/3 */727MV/BU/4
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762MV-BM-44-791

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LETTER OF TRANSMITTAL

OVERHAUL MANUAL 77-20-205/5
MILLIVOLTMETER TEMPERATURE INDICATORS
REVISION NO.24

Issued January 15/91

	Action	Reason
1.	Ensure that all previous revisions are incorporated. (Revisions are numbered consecutively).	
2.	TITLE PAGE Remove pages 1 and 2 and substitute revised pages.	Additional codes included.
3.	LIST OF EFFECTIVE PAGES Remove page 5 and substitute revised page.	Dates of new and revised pages incorporated.
4.	DESCRIPTION, OPERATION AND DATA Remove page 15 and substitute revised page.	Data for additional codes included.
5.	ASSEMBLY Remove pages 517, 518, 524, 533 and 537. Substitute revised pages and insert new page 538.	Additions and corrections to tables.
6.	TESTING Remove pages 705, 706, 712, 721 and 725. Substitute revised pages and insert new page 726.	Additions and corrections to tables.
7.	SPECIAL TOOLS, FIXTURES AND EQUIPMENT Remove page 1006 and substitute revised page.	Additional drawing numbers included.
8.	ILLUSTRATED PARTS LIST Remove pages 1107 thru 1117 and substitute revised pages.	Spares details for additional units included.

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9. Record the incorporation of this revision in RECORD OF REVISIONS.

10. Retain this letter of transmittal.

This certifies compliance with Section A, Chapter A5-3 of British Civil Airworthiness Requirements.

This revision complies with British Civil Airworthiness Requirements Section A, Chapter A5-3. The technical accuracy of this revision has been checked and is certified as correct.

Signed: J. L. Weston

Date: 8th January 1991

C.A.A. Design Approval No. DAI/1671/41

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ENGINE INDICATING

MILLIVOLTMETER TEMPERATURE INDICATORS

RECORD OF REVISIONS

REV. NO.	INSERTION DATE	BY
1-7	OCT. 66	
8	MAR. 67	
9	AUG. 67	
10	MAR., 68	
11	JAN. 69	
12	JUNE '69	
13	APRIL '70	
14	JULY '71	
15-20	Nov 1981	S.I.
21	June 85	S.I.
22	NOV 85	S.I.
23	SEP 86	S.I.
24	JAN 15/91	S.I.

REV. NO.	INSERTION DATE	BY

TEMPORARY REVISION			CANCELLED BY REV. No.
NO.	DATE	BY	

The introduction of any amendment or revision not certified in accordance with British Civil Airworthiness Requirements Section A, Chapter A6-2, will invalidate the statement of certification. Amendments or revisions embodied in this manual, which have been certified under an approved authorisation other than that applicable to the initial certification must be recorded on separate record sheets.

ENGINE INDICATING

MILLIVOLTMETER TEMPERATURE INDICATORS

LIST OF EFFECTIVE PAGES

With the incorporation of Revision No.24, this subject consists of the following pages:

Page	Date of latest revision	Page	Date of latest revision	Page	Date of latest revision	Page	Date of latest revision
1	Jan. 91	506	July 71	702	July 71	1005	Mar. 80
2	Jan. 91	507	July 71	703	July 71	1006	Jan. 91
3	Oct. 66	508	July 71	704	Feb. 74	1007	Aug. 86
5	Jan. 91	509	July 71	705	Jan. 91	1101	Mar. 80
7	July 71	510	Oct. 75	706	Jan. 91	1102	Mar. 80
8/1	July 71	511	July 71	707	Oct. 75	1103	Feb. 85
9	Apr. 70	512	July 71	708	Oct. 75	1104	Mar. 80
10	Apr. 70	513	July 71	709	Oct. 75	1105	Feb. 85
11	Apr. 70	514	July 71	710	Oct. 75	1106	Feb. 85
12	Apr. 70	515	July 71	711	Oct. 75	1107	Jan. 91
13	Apr. 70	516	Feb. 74	712	Jan. 91	1108	Jan. 91
14	Mar. 80	517	Jan. 91	713	Oct. 75	1109	Jan. 91
15	Jan. 91	518	Jan. 91	714	Oct. 75	1110	Jan. 91
16	Mar. 80	519	Oct. 75	715	Oct. 75	1111	Jan. 91
17	Aug. 86	520	Oct. 75	716	Oct. 75	1112	Jan. 91
101	Apr. 70	521	Oct. 75	716/1	Oct. 75	1113	Jan. 91
102	Apr. 70	522	Oct. 75	717	Oct. 75	1114	Jan. 91
103	Apr. 70	523	Oct. 75	718	Oct. 85	1115	Jan. 91
201	Apr. 70	524	Jan. 91	719	Oct. 75	1116	Jan. 91
301	Oct. 85	525	Oct. 75	720	Oct. 75	1117	Jan. 91
302	Oct. 85	526	Oct. 75	721	Jan. 91	1118	Aug. 86
303	July 71	527	Oct. 75	722	Mar. 80	1119	Aug. 86
401	July 71	528	Oct. 75	723	Oct. 85	1120	Feb. 85
402	Oct. 66	528/1	Oct. 75	724	Oct. 85		
403	Apr. 70	529	Oct. 75	725	Aug. 86	1121	Aug. 86
404	Apr. 70	530	Oct. 85	726	Jan. 91	1122	Feb. 85
405	Apr. 70	531	Oct. 75	801	Oct. 66	1123	Feb. 85
406	Apr. 70	532	Oct. 75	802	Oct. 66	1124	Aug. 86
501	July 71	533	Jan. 91	803	July 71	1125	Aug. 86
502	Apr. 70	534	Mar. 80	901	Mar. 80	1126	Aug. 86
503	June 69	535	Oct. 85	902	Mar. 80		
504	July 71	536	Oct. 85	1001	Aug. 86		
505	Apr. 70	537	Aug. 86	1002	Oct. 85		
		538	Jan. 91	1003	Oct. 85		
		701	Feb. 74	1004	Aug. 86		

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MILLIVOLTMETER TEMPERATURE INDICATORS

MODIFICATIONS

1. GENERAL

When modifications are introduced on units covered by this manual, the text will be revised to cover the latest modification state. The modifications will be listed below together with a statement on whether the overhaul information is affected when any modification is not embodied. When overhaul is affected, the list will cross-refer to details.

2. MODIFICATION DETAILS

Modification No.	Service Bulletin or Modification Sheet No.	Codes Affected	Effect on Overhaul
01	77-102	All	See para. 3. A.
02	77-119	All except *727MV/BU/42/690 *727MV/BU/54/690	See para. 3. B.

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3. EFFECT OF MODIFICATIONS

A. If modification 01 has not been embodied the overhaul instructions are affected as follows :

(1) REPAIR

Ignore the instructions given in para. 2. G. 1.

(2) ASSEMBLY

(a) Para. 3. S. (1) should read :

Referring to fig. 503, solder the case back sealed terminal leads to their appropriate inserts in the terminal block.

(b) Ignore the instructions given in para. 3. R. (2).

B. If modification 02 has not been embodied the overhaul instructions are affected as follows :

(1) INSPECTION

Para. 3. G. (2) should read :

Measure the resistance of the thermistor. The resistance at 20°C should be between :

(a) All codes except */727MV/BU/42/690 and */727MV/BU/54/690

8 and 12Ω.

(b) */727MV/BU/42/690 and */727MV/BU/54/690

18 and 22Ω.

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MILLIVOLTMETER TEMPERATURE INDICATORS

DESCRIPTION, OPERATION AND DATA

1. DESCRIPTION

A. General

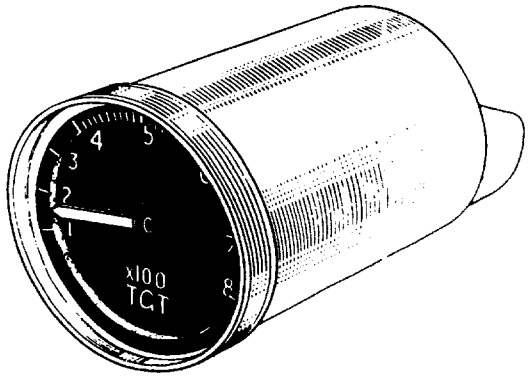


Fig. 1 Typical view

The millivoltmeter temperature indicators covered by this manual operate in conjunction with a thermocouple system, and indicate the temperature of the engine exhaust gases. A general view of a typical indicator is shown in fig. 1. To enable the operating temperature range of a particular engine to be more easily read and to provide an improvement in accuracy, the indicator scale is graded so as to expand the scale over this range, and yet retain the normal full scale range from zero. Within the expanded scale is a band of 100°C (see DATA) which provides a further improvement in accuracy. The indicator codes differ in the temperature range presented, the degree of cold junction temperature compensation provided and the total external resistance required.

The indicator movement is housed in a 2 in nitrogen filled, hermetically sealed case, electrical connections being made to a terminal block at the rear of the indicator.

Some indicators, used in two series connected thermocouple systems, are fitted with a third terminal designated TEST +. This is to enable calibration acceptance tests to be carried out using temperature/e.m.f. constants as for a single thermocouple system.

B. Detail (fig. 501)

The indicator consists of a moving coil movement housed in a main case complete with glass, and a case back, and is hermetically sealed by soldering an iron wire sealing ring in the recess formed between the main case and case back. A capillary tube used for gas filling the indicator is soldered into the case back, and the terminal block is secured to the case back by two screws.

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The indicator zero adjustment mechanism comprises a zeroiser shaft and pinion meshing with a gear wheel in the movement. The rear portion of the zeroiser shaft is housed in a bush fitted on the case back, while the front of the shaft is supported in a hole in the movement mounting plate.

The zeroiser shaft bush is sealed by two sealing rings fitted in grooves in the zeroiser shaft. Rotary movement of the shaft is limited to 180 deg by means of a stop pin.

A back plate, secured to pillars on the case back carries a thermistor and shunt resistor, and on indicators fitted with the TEST + terminal, the test circuit series resistor. This additional resistor is not illustrated. Ceramic inserts in the plate permit connections between the movement and terminal block. The plate is also secured to two pillars extending from the movement mounting plate, and the two pillars are screwed onto two movement fixing studs which project through holes in the movement mounting plate. Two resistors, a padding resistor and the series resistor, are mounted on the movement mounting plate.

The movement consists of a moving coil assembly and a magnet arm assembly. The moving coil assembly consists of a magnet assembly carried in a frame formed by front and rear plates, and a moving element pivoted in jewel bearings fitted in the centre and rear bridge pieces.

The front and rear plates are spigoted into the outer pole piece of the magnet assembly and carry pillars which support the centre and rear bridge pieces. A magnet shield is also supported by the centre bridge piece pillars and an upper support post, and is secured by two front pillars and a hexagonal nut. The shield serves as a screen between the magnet and magnet arm assemblies, and also carries three rubber washers which act as buffer rings.

The moving element (fig. 2) consists of an aluminium spindle to which is secured a pointer spider, a formerless coil, a hairspring and a wire ligament. The coil is bonded to the spindle, and two bent tag connectors are secured on either side of the spindle by two lengths of silicone rubber sleeving, the whole being bonded in position on the spindle with Araldite.

The spindle is hard anodized to insulate the tags. The ends of the moving coil are spot welded to the end of the tags, one end to the end of each tag, and the inner ends of the hairspring and ligament are soldered to the bent portion of the tags, one to each tag. The outer end of the hairspring is soldered to a tag on the rear bridge piece, and the outer end of the ligament is soldered to an anchor tag fitted on a shield post. Electrical connections to the coil are made through the hairspring and ligament. The hairspring

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and ligament are prevented from fouling each other by a shield which fits between them and is secured to a shield post screwed into the rear plate of the magnet assembly. The shield post and anchor tag are shown exploded in fig. 501 for clarity. The front end of the spindle carries a pointer and pointer spider, to which a small double sided stop magnet is fitted, and a pivot which runs in a solid mounted jewel bearing housed in the centre bridge piece.

The rear pivot seats in a jewelled screw bearing in the rear bridge piece which provides adjustment for spindle end shake. The moving element is balanced by the adjustment of counterweights which are carried on the arms of the pointer spider.

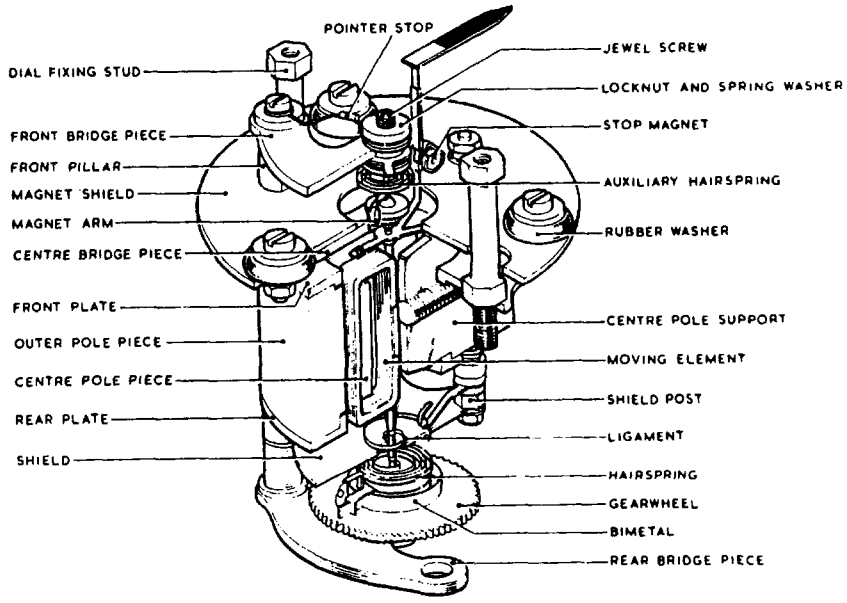


Fig. 2 Part sectioned view of movement

The magnet assembly consists of two magnets, the outer pole piece and a centre pole piece with a centre pole support. The centre pole piece is secured to the centre pole support by a special screw, while the magnets are bonded to the ends of the outer pole piece. The outer pole piece and the centre pole piece are of opposite polarity. An exploded view of the magnet assembly is shown in fig. 401.

The rear bridge piece assembly (fig. 3) carries a central bush which houses the jewelled screw bearing. A gearwheel, compensator arm, rear tag and bimetal are carried on the bush, they are free to rotate but are retained by the end of the bush being spun over. One arm of the rear tag protrudes

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through a slot in the gearwheel and is soldered to the inner end of a bimetal the outer end of which is held in a fork in the compensator arm. The end of the compensator arm is split and the two sections are bent at right angles to each other, the outer end of the moving element hairspring being soldered to one section. The hairspring is thus connected to the rear tag through the compensator arm and bimetal, to ensure a good electrical connections between the compensator arm and bimetal a short length of copper wire is soldered across them. The gear wheel meshes with the pinion of the zero adjuster shaft so that adjustment of the indicator zero mechanism turns the gear wheel and moving element hairspring to alter the position of the pointer. With the gear wheel, and thus the inner end of the bimetal held fixed, the outer end of the bimetal moves with the variations in temperature to adjust the pointer zero and compensate for differences in ambient temperature between the movement and the external thermocouple system. The degree of cold junction compensation depends on the length of the bimetal. The units dealt with in this manual fall into two categories; those that are designed for use in systems incorporating T_1 compensation, and those that are not. The former have a short bimetal and are identified thus in DATA.

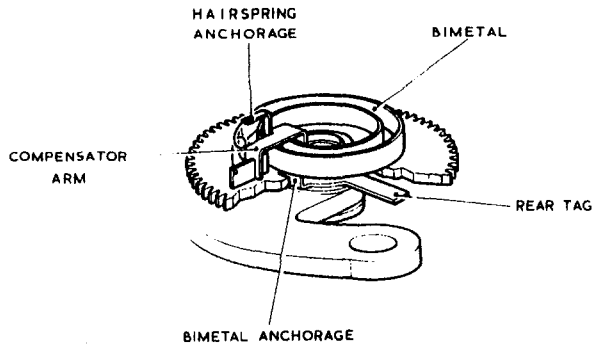


Fig. 3 Rear bridge piece bush assembly

The magnet arm assembly consists of two small stop magnets at either end of a magnet arm which is pivoted at its centre and carries an auxiliary hairspring. The magnet arm rear pivot rotates in a solid mounted jewel bearing housed in the centre bridge piece, the front pivot rotates in a jewel screw bearing housed in the threaded bush of a front bridge piece which is secured to the front pillars of the moving coil assembly. The auxiliary hairspring is anchored to a tag on the front bridge piece, and two pointer stops are secured in position by the two front bridge piece securing screws. The two small stop magnets on the magnet arm are of opposite polarity and are positioned so that they oppose the double sided magnet on the moving element spider.

A front shield, which is made of aluminium is secured on dial fixing studs and to it the instrument dial and dial mask are fitted. The pointer spider of the moving element passes through the annular gap between the dial and dial mask.

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2. OPERATION (fig. 4 or 5)

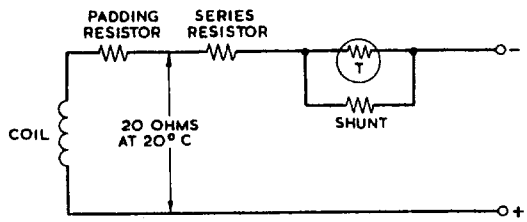


Fig. 4 Circuit diagram

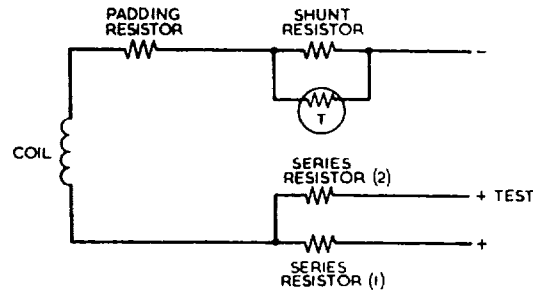


Fig. 5 Circuit diagram (Indicators with TEST + terminal)

The indicator is a moving coil millivoltmeter, and when connected to a thermocouple system, measures the potential difference between the thermocouple hot and cold junctions.

A temperature difference between the thermocouple junctions causes a current to flow in the indicator coil. Since the coil is pivoted in a magnetic field it is deflected an amount proportional to the current in the coil. The pointer then shows the temperature of the hot junction. Over the expanded portion of the scale the moving element of the moving coil assembly is free to act as a normal movement; in the upper and lower ranges of the scale the hairspring on the moving element is opposed by an auxiliary hairspring included in the magnet arm assembly. The movement is therefore suppressed at each end of the scale, the moving element torque and the magnet arm torque being balanced at the indicator zero.

Compensation for change of resistance of the aluminium moving coil due to temperature changes is achieved by means of a thermistor shunted by a wire wound resistor. A copper wound padding resistor is connected in series with the aluminium coil so that the value to be compensated is practically constant.

On indicators fitted with the TEST + terminal, two resistors are connected in series with the moving coil, one being in circuit when the TEST + terminal is connected and the other in circuit when the indicator + terminal is connected (fig. 5). On all other indicators, a single resistor is connected in series with the padding resistor (fig. 4). These series resistors are used where necessary for small adjustments when ranging the instrument.

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3. DATA

Millivoltmeter Temperature Indicator

Code Number	Range °C	Expanded Scale °C	100°C Band	SET Point°C	Ext. Res.Ω	Remarks
*/727MV/BU/1	0-800	400-650	450-550	500	22	
*/727MV/BU/2	0-1000	550-800	600-700	650	22	
*/727MV/BU/3	0-800	400-650	450-550	500	25	
*/727MV/BU/4	0-1000	550-800	600-700	650	25	
*/727MV/BU/5	0-900	500-750	550-650	600	22	
*/727MV/BU/6	0-800	400-650	450-550	500	25	Short bimetal
*/727MV/BU/7	0-900	600-850	650-750	700	8	
*/727MV/BU/8	0-800	450-700	500-600	550	25	
*/727MV/BU/10	0-800	450-700	500-600	550	25	Short bimetal
*/727MV/BU/11	0-1000	550-800	600-700	650	8	
*/727MV/BU/12	0-800	450-700	500-600	550	25	Short bimetal
*/727MV/BU/14	0-800	400-650	450-550	500	18.9	
*/727MV/BU/15	0-1000	550-800	600-700	650	22	
*/727MV/BU/16	0-1000	600-850	750-850	790	25	
*/727MV/BU/17/580	0-800	450-700	550-650	580	25	Short bimetal
*/727MV/BU/17/600	0-800	450-700	550-650	600	25	Short bimetal
*/727MV/BU/17/640	0-800	450-700	600-700	640	25	Short bimetal
*/727MV/BU/18/580	0-800	450-700	550-650	580	25	
*/727MV/BU/18/610	0-800	450-700	550-650	610	25	
*/727MV/BU/18/620	0-800	450-700	550-650	620	25	
*/727MV/BU/18/640	0-800	450-700	600-700	640	25	
*/727MV/BU/19	0-1200	750-1000	850-950	920	8	
*/727MV/BU/20/500	0-800	400-650	450-550	500	25	
*/727MV/BU/20/560	0-800	400-650	500-600	560	25	Short bimetal
*/727MV/BU/21/500	0-800	400-650	450-550	500	8	
*/727MV/BU/22	0-800	400-650	450-550	500	18.9	*
*/727MV/BU/24	0-1200	550-800	650-750	720	8	
*/727MV/BU/25/640	0-900	500-750	600-700	640	8	
*/727MV/BU/26	0-800	450-700	500-600	550	25	
*/727MV/BU/28/580	0-800	400-650	500-600	580	25	
*/727MV/BU/30	0-1200	550-800	650-750	720	8	*With test terminal
*/727MV/BU/32	0-800	400-650	450-550	500	18.9	*
*/727MV/BU/33/580	0-800	450-700	550-650	580	25	
*/727MV/BU/34/700	0-1200	550-800	650-750	700	8	

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Code Number	Range °C	Expanded Scale °C	100°C Band	SET Point°C	Ext. Res.Ω	Remarks
*/727MV/BU/37	0-800	450-700	500-600	550	25	*
*/727MV/BU/38	0-800	400-650	450-550	500	18.9	*
*/727MV/BU/39/700	0-1200	550-800	650-750	700	25	
*/727MV/BU/40/700	0-1200	550-800	650-750	700	8	
*/727MV/BU/42/690	0-1000	550-800	640-740	690	6	
*/727MV/BU/43/550	0-1000	400-650	500-600	550	22	
*/727MV/BU/44/700	0-1200	550-800	650-750	700	25	
*/727MV/BU/46/650	0-1000	550-800	600-700	650	8	
*/727MV/BU/47/580	0-800	450-700	550-650	580	25	
*/727MV/BU/48	0-800	450-700	500-600	550	25	
*/727MV/BU/50	0-800	400-650	450-550	500	22	
*/727MV/BU/51/700	0-1000	550-800	650-750	700	22	
*/727MV/BU/52/640	0-900	550-800	600-700	640	8	
*/727MV/BU/53/650	0-1000	550-800	600-700	650	8	
*/727MV/BU/53/750	0-1000	550-800	700-800	750	8	
*/727MV/BU/54/690	0-1000	550-800	640-740	690	6	
*/727MV/BU/56/730	0-900	550-800	600-700	730	8	
*/727MV/BU/57/740	0-900	550-800	650-750	740	8	
*/727MV/BU/59/720	0-1200	550-800	650-750	720	8	
*/727MV/BU/60/720	0-1200	550-800	650-750	720	8	
*/727MV/BU/61/750	0-1000	550-800	700-800	750	8	
*/727MV/BU/62/700	0-1200	550-800	650-750	700	25	
*/727MV/BU/63	0-800	450-700	500-600	550	25	
*/727MV/BU/64/660	0-800	500-750	610-710	660	25	
*/727MV/BU/65/720	0-1200	550-800	650-750	720	8	
*/727MV/BU/66/660	0-800	500-750	610-710	660	25	
*/727MV/BU/68/640	0-800	450-700	600-700	640	25	
*/727MV/BU/69/750	0-1000	550-800	700-800	750	8	

Code Number	Range °C	Expanded Scale °C	100°C Band	SET Point°C	Ext. Res.Ω	Remarks
*/762MV/BU/1/740	0-800	500-750	650-750	740	25	
*/762MV/BU/2/580	0-800	400-650	500-600	580	25	
*/762MV/BU/3/520	0-800	400-650	500-600	520	25	Short bimetal
*/762MV/BU/3/560	0-800	400-650	500-600	560	25	Short bimetal
*/762MV/BU/5/590	0-800	400-650	500-600	590	25	
*/762MV/BU/5/600	0-800	400-650	500-600	600	25	
*/762MV/BU/6/580	0-800	400-650	500-600	580	25	
*/762MV/BU/7	0-800	500-750	500-600	550	25	
*/762MV/BU/8/550	0-900	450-700	500-600	550	22	
*/762MV/BU/9/550	0-900	450-700	500-600	550	22	
*/762MV/BU/10/700	0-800	500-750	650-750	700	25	
*/762MV/BU/11	0-1000	550-800	600-700	620	25	
*/762MV/BU/12	0-1200	750-1000	800-900	900	25	
*/762MV/BU/15/725	0-900	550-800	650-750	725	25	
*/762MV/BU/16/580	0-800	400-650	500-600	580	25	
*/762MV/BU/18/740	0-1000	600-850	700-800	740	25	
*/762MV/BU/18/750	0-1000	600-850	700-800	750	25	
*/762MV/BU/19/700	0-1000	600-850	650-750	700	8	
*/762MV/BU/20/860	0-1200	700-950	800-900	860	25	
*/762MV/BU/21/860	0-1200	700-950	800-900	860	25	
*/762MV/BU/22/680	0-1200	550-800	650-750	680	8	
*/762MV/BU/23/860	0-1200	700-950	800-900	860	25	
*/762MV/BU/24/790	0-1200	600-850	740-840	790	8	

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Code Number	Range °C	Expanded Scale °C	100°C Band	SET Point°C	Ext. Res.Ω	Remarks
*/762MV/BU/25/720	0-1200	550-800	650-750	720	8	
*/762MV/BU/26/700	0-1000	600-850	650-750	700	8	
*/762MV/BU/27/860	0-1200	700-950	810-910	860	25	
*/762MV/BU/28/800	0-1200	600-850	750-850	800	8	
*/762MV/BU/30/770	0-1000	600-850	720-820	770	25	
*/762MV/BM/31/810	0-1100	600-850	750-850	810	25	
*/762MV/BU/33/700	0-1000	600-850	650-750	700	8	
*/762MV/BU/34/700	0-1000	600-850	650-750	700	8	
*/762MV/BU/36/860	0-1200	700-950	810-910	860	25	
*/762MV/BU/37/800	0-1200	600-850	750-850	800	8	
*/762MV/BU/38/790	0-1200	600-850	740-840	790	8	
*/762MV/BU/40/860	0-1200	700-950	810-910	860	25	
*/762MV/BU/41/805	0-1200	600-850	755-855	805	8	
*762MV-BU42-900	0-1200	700-950	850-950	900	25	
*762MV-BU43-900	0-1200	700-950	850-950	900	25	
*762MV-BM44-791	0-1100	700-950	600-850	791	8	

NOTES:
1. The asterisk prefixing an indicator code number is in place of the dial finish e.g. PW.
2. The three figure suffix included in the code number of some indicators denotes the SET point referred to during overhaul. On indicators without this suffix, the Set point is marked on the dial.
3. Any indicator marked thus * in the Remarks column is used in a two series-connected thermocouple system. All other indicators are used in single thermocouple systems.

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MILLIVOLTMETER TEMPERATURE INDICATORS

DISASSEMBLY

1. PREPARATION AND GENERAL PRECAUTIONS

Observe absolute cleanliness of workbench, tools and parts. Some of the screws, nuts and pillars on the indicator are locked with lockant G. If necessary this may be softened with solvent C. Details of cleansers and materials are given in SPECIAL TOOLS, FIXTURES AND EQUIPMENT.

2. PROCEDURE (refer to fig. 501)

The following procedure applies to all codes except where specified.

A. Case and Case Back

(1) Remove the terminal screws and the two screws and the washers securing the terminal block and withdraw the block to the extent allowed by the leads. Unsolder the leads from the terminal block inserts and withdraw the block.

(2) Remove the tinned iron wire sealing ring from between the main case and the case back by applying heat and pulling on the free end of the wire with a pair of pliers. Clean off any residual solder and withdraw the case.

(3) Remove the stiffnuts and washers securing the case back. Withdraw the case back as far as the leads will allow and disengage the zeroiser shaft from its bush and the pinion from the gearwheel.

(4) Referring to fig. 503, unsolder the case back sealed terminal leads from their distant terminations. Remove the case back and zeroiser shaft.

(5) Unsolder the capillary tube from the case back. Discard the tube.

B. Zeroiser Shaft

Remove the zeroiser shaft from the bush in the case back. Remove and discard the sealing rings and bowed washer.

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C. Back Plate

(1) Indicators fitted with TEST + terminal (fig. 503)

Unsolder the lead connecting the padding resistor to the thermistor and shunt insert terminal, and the lead connecting series resistor (1) to series resistor (2) and the moving coil.

(2) All other codes (fig. 503)

Unsolder the lead connecting the series resistor to the thermistor and shunt insert terminals.

(3) Remove the two stiffnuts and small plain washers securing the back plate to the mounting plate pillars, and remove the back plate.

D. Movement Mounting Plate

Unsolder the lead connecting the padding resistor to the rear tag of the rear bridge piece. Unscrew and remove the two movement mounting plate pillars from the movement fixing studs. Remove the movement mounting plate from the movement fixing studs.

E. Dial and Front Shield

(1) Remove the special screw securing the dial mask, and lift off the mask taking care not to damage the pointer.

(2) Remove the two special screws securing the dial, and lift off the dial taking care not to damage the pointer.

(3) Remove the two screws securing the front shield. Lift off the shield taking care not to damage the pointer.

F. Front Bridge Piece

(1) Unsolder the outer end of the auxiliary hairspring.

(2) Remove the two screws, special washers, pointer stops and small plain washers securing the front bridge piece to the front pillars.

(3) Lift off the front bridge piece and the four insulated bushes. Unscrew and remove the jewel screw and remove the locknut and spring washer. Discard the spring washer.

G. Magnet Arm

Lift the magnet arm assembly from the centre bridge, taking care not to damage the pointer assembly.

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H. Centre Bridge Piece

(1) Unscrew and remove the two front pillars.

(2) Remove the nut, special washer and small plain washer securing the magnet shield to the upper support post. Rotate the moving element until the stop magnet on the spider is aligned with the slot in the shield. Lift off the magnet shield taking care not to damage the pointer. Remove and discard the three rubber washers fitted to the magnet shield.

(3) Carefully lift the centre bridge piece off the front plate pillars, taking care not to damage the moving element pivot.

I. Rear Bridge Piece

(1) Remove the nut and plain washer securing the hairspring shield to the shield post. Withdraw the shield clear taking care not to damage the hairspring.

(2) Unsolder the outer end of the hairspring from the hairspring anchorage on the bimetal assembly.

(3) Remove the two special screws and two special washers securing the rear bridge piece to the rear plate pillars of the magnet assembly.

(4) Lift off the rear bridge piece and four insulated bushes, taking care not to damage the moving element pivot.

(5) Unscrew and remove the jewel screw from the rear bridge piece and remove the locknut and spring washer. Discard the spring washer.

(6) Unsolder and remove the copper wire connected to the rear tag of the rear bridge piece and to the tag fixed by the rear bridge piece securing screw.

MILLIVOLTMETER TEMPERATURE INDICATORS

CLEANING

1. PROCEDURE

A. Movement

(1) Wash out the jewel screws and fixed jewel bearings using a small syringe, camel hair brush and cleanser B. Allow to drain dry.

(2) Wipe the gap faces of the magnet assembly using a small piece of adhesive tape to ensure that all dust and ferrous particles are removed.

(3) Clean the front bridge piece, centre bridge piece and rear bridge piece with a lint free cloth and cleanser B.

(4) Carefully clean the moving element and magnet arm assembly pivots with a camel hair brush and cleanser B.

B. Case and Frame

Remove all dust from the component parts of the case and frame with a lint free cloth.

C. Electrical Connections

Clean, and re-tin if necessary, the tags of the sealed terminals, anchor tags, ceramic inserts, bobbin resistors, and thermistor. Remove surplus flux with cleanser A.

D. Screws and Nuts

Remove all traces of lockant from screws, nuts, tapped holes, and any other areas which have been so treated with solvent C.

2. CLEANING AGENTS

Cleaning agents and materials are listed in *SPECIAL TOOLS, FIXTURES AND EQUIPMENT.*

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MILLIVOLTMETER TEMPERATURE INDICATORS

INSPECTION

1. GENERAL PROCEDURE

Apply the following general procedure to the individual components of the transmitter, including new components to be fitted. Any additional inspection necessary is given in paragraph 2.

A. All Components

Examine as applicable for :

(1) Cleanliness
(2) Distortion
(3) Cracks (visual)
(4) Scores
(5) Dents
(6) Evidence of wear (visual)
(7) Corrosion, including deterioration of protective finish
(8) Serviceability of items not disassembled
(9) Fatigue or deterioration of new sealing rings.

B. Electrical Components

Examine for :

(1) Deterioration if insulation
(2) Security of tags
(3) Evidence of overheating

2. EQUIPMENT REQUIRED

To carry out the inspection of the indicator, items 17 and 26 of the list on page 1002 will be required.

3. DETAILED PROCEDURE

NOTE : Reference is made below to wear of gear teeth. If, when compared with a new gear, it is possible to detect that the teeth curvature has departed from its original involute form, the assembly must be rejected.

A. Moving Element

(1) Ensure that the spindle and pointer spider are not distorted, and that the pivots are undamaged and free from wear. If the spindle, pointer spider, or pivots are damaged, the moving element must

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be renewed; see REPAIR.

(2) Ensure that the hairspring and ligament are undamaged and that they are securely fastened to the spindle. If the hairspring or ligament is damaged it must be renewed, see REPAIR.

B. Magnet Arm Assembly

(1) Ensure that the magnet arm assembly is not distorted, and the pivots are undamaged and free from wear. If the magnet arm or pivots are damaged, the assembly must be renewed.

(2) Ensure that the stop magnets are secure on the magnet arm. If the stop magnets are insecure, renew the assembly.

(3) Ensure that the auxiliary hairspring is undamaged and that the hairspring and collet is securely fastened to the spindle. If the hairspring is damaged it must be renewed, see REPAIR.

C. Jewel Screws

(1) Using a binocular microscope, examine the spring loaded jewel screws for signs of wear or pitting, and the spring for freedom of movement.

D. Jewel Bearings

Using a binocular microscope, examine the solid mounted jewel bearing in the centre bridge piece for signs of wear or pitting. If the jewel is damaged, renew the jewel assembly as described in REPAIR.

E. Rear Bridge Piece

(1) Ensure that the teeth on the gear wheel, as inspected through a binocular microscope, are undamaged and unworn.

(2) Examine the bimetal for security of fixing, and for any signs of distortion or damage. If the bimetal is distorted or damaged it must be renewed as described in REPAIR.

F. Zeroiser Shaft

(1) Ensure that the teeth on the pinion, as inspected through a binocular microscope are undamaged and unworn.

(2) Ensure that the shaft is free from distortion or damage.

(3) Should the zeroiser shaft be damaged, it must be renewed.

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G. Electrical Components

Using a multi-range test meter set to ohms (÷ 100) :

(1) Measure the resistance of the shunt bobbin resistor. The nominal resistance of the shunt resistor is 15 ohms ± 1%.

(2) Measure the resistance of the thermistor. The resistance at 20°C must be between 18 and 22Ω.

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MILLIVOLTMETER TEMPERATURE INDICATORS

REPAIR

1. GENERAL

Faulty parts should be replaced by approved spares only, after inspection for serviceability. To renew a particular component, refer to DISASSEMBLY and disassemble the unit to the extent necessary, fit the replacement component and re-assemble as described in ASSEMBLY. Unless the procedure is obvious, instructions for the renewal of components not covered in the above topics are given below. After any component has been renewed or repaired, carry the full procedure detailed in TESTING. Details of cleaning agents and materials are given in SPECIAL TOOLS, FIXTURES AND EQUIPMENT.

2. PROCEDURE

A. Movement (refer to fig. 401)

If it is required to renew the magnet assembly or moving element, then item 3 of the list of page 1001 will be required. Proceed as follows :

(1) Use the demagnetizer 99 LMT to demagnetize the magnet assembly.

(2) Remove the pointer from the spider by heating the spider with a warm soldering iron, and gently pulling the pointer.

(3) Remove the two dial fixing studs securing the front plate and lift off the front plate.

(4) Unsolder the outer end of the ligament from the shield post anchor tag.

(5) Remove the two movement fixing studs securing the rear plate, and lift off the rear plate.

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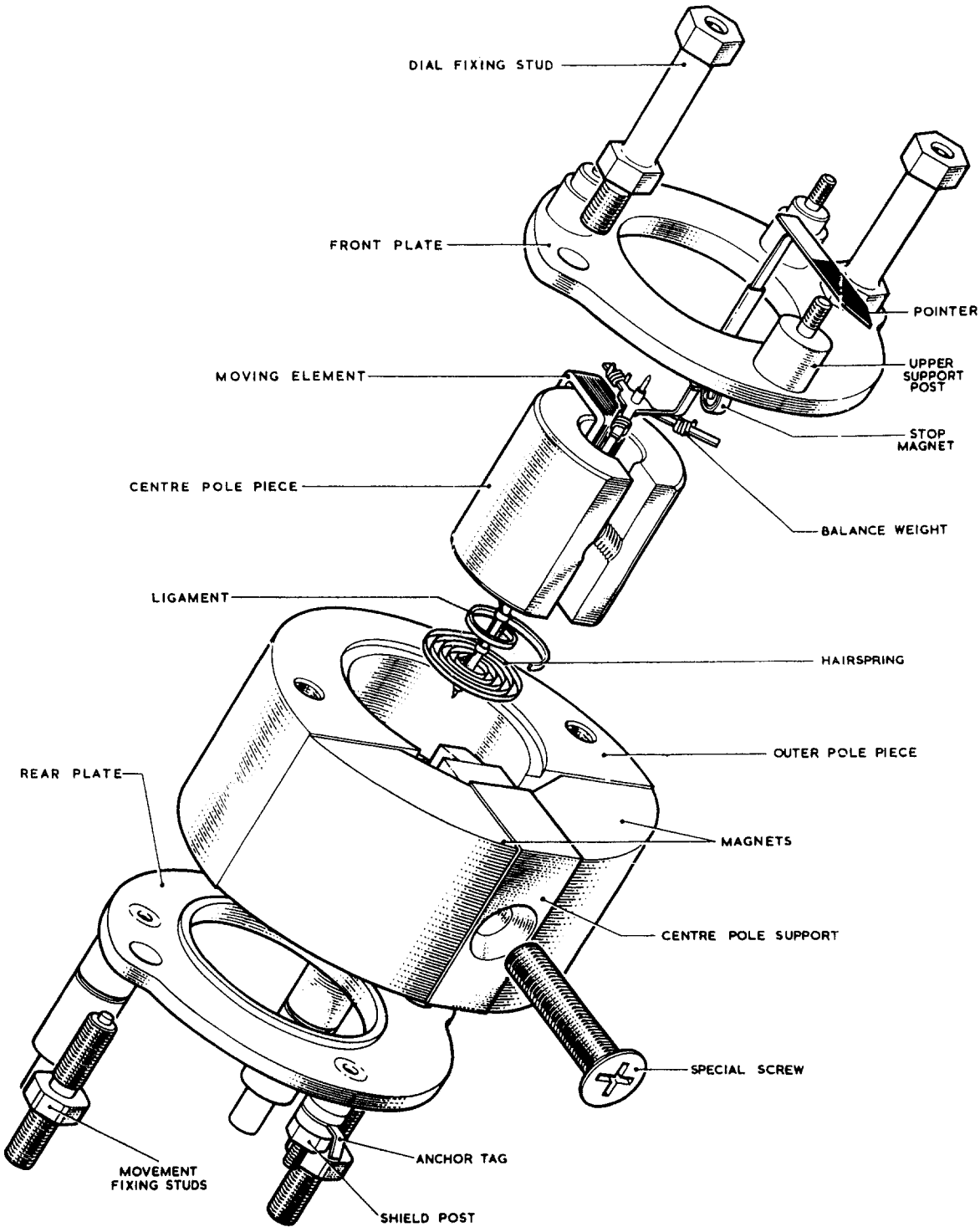


Fig. 401 Exploded view of movement

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(6) Clearly mark the corresponding faces of the component parts of the magnet assembly.

(7) Remove the special screw which passes through the centre pole support and secures the centre pole piece.

(8) Life out the centre pole piece, complete with moving element.

(9) Remove the moving element from the centre pole piece.

(10) Renew the magnet assembly or moving element whichever is defective. If the magnet assembly is renewed, mark the corresponding faces of the component parts before disassembly.

(11) Thread the centre pole piece through the coil of the moving element ensuring that the spindle of the moving element is at the axis of the centre pole piece.

(12) Place the centre pole piece in position on the tongue of the centre pole support, ensuring that the centre pole piece is the correct way up, by observing the marks previously made.

(13) Secure the centre pole piece with the special screw, and lock with lockant G.

NOTE: The magnet assembly will be magnetized and agred during the assembly of the indicator.

(14) Place the rear plate in position on the magnet, and secure it to the magnet with two movement fixing studs, and lock the studs in position with lockant G.

(15) Insert a piece of paper into the movement to hold the moving element in the approximate zero position and pull the outer end of the ligament so that it is as short as possible. Solder the ligament to the shield post anchor tag and remove the paper from the moving element.

(16) Secure the front plate to the magnet with two dial fixing pillars, and lock the pillars in position with lockant G.

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(17) Replace or renew the pointer as applicable. Secure the pointer to the spider with adhesive E in accordance with the maker's instructions.

B. Moving Element Hairspring

To renew the moving element hairspring proceed as follows:

NOTE: Do not apply excessive heat to the tag during soldering, as this will weaken the Araldite joint.

(1) Unsolder the inner end of the hairspring and remove.

(2) Place the new hairspring on the movement spindle so that the hairspring is centralized about the axis of the spindle, and develops anti-clockwise from the centre looking towards the moving coil.

(3) Care is to be taken to ensure that the hairspring is flat and concentric with the spindle. The outer turn of the hairspring must be set if necessary so that the turns are equally spaced when the pointer is approximately at two thirds of full scale deflection.

(4) Solder the inner end of the hairspring to the tag, using solder B.

C. Ligament

To renew the ligament proceed as follows:

NOTE: Do not apply excessive heat to the spindle tag during soldering, as this will weaken the Araldite joint.

(1) Unsolder the outer end of the ligament from the shield post anchor tag; unsolder the inner end from the spindle tag. Remove the defective ligament.

(2) Place the new ligament on the movement spindle so that the ligament develops anti-clockwise from the centre looking towards the moving coil, and is flat and concentric with the spindle.

(3) Solder the inner end of the ligament to the tag using solder B. Insert a piece of paper into the movement to hold the moving element in the approximate zero position and pull the outer end of the ligament so that it is as short as possible. Solder the ligament to the shield post anchor tag and remove the paper from the moving element.

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D. Movement Front Jewel Bearing and Magnet Arm Jewel Bearing

The movement front bearing and magnet arm bearing are both housed in the bush fitted into the centre bridge piece. This bush is a push fit into the bridge piece and is repaired by replacement.

E. Bimetal (Refer to fig.3)

To renew the bimetal proceed as follows :

(1) Unsolder the length of copper wire from the outer end of the bimetal.

(2) Remove the outer end of the bimetal from the slot in the compensator arm by bending up the ends of the arm.

(3) Unsolder the inner end of the bimetal from the rear tag protruding through a slot in the gear wheel.

(4) Place the new bimetal in position.

(5) Using a very hot soldering iron, solder the inner end of the bimetal to the rear tag.

(6) Place the outer end of the bimetal in the slot in the compensator arm and reset the ends ensuring that the bimetal moves freely in the slot with as little side play as possible. Solder the length of copper wire to the outer end of the bimetal using solder B.

F. Auxiliary Hairspring and Collet

To renew the auxiliary hairspring and collet, proceed as follows :

(1) Remove the auxiliary hairspring and collet from the magnet arm assembly spindle.

(2) Press the new hairspring and collet on the magnet arm assembly spindle so that the hairspring develops clockwise from the centre looking towards the movement and, with the spring slot uppermost, so that the outer end of the hairspring coincides approximately with the stop magnet arm, zero side.

G. Wiring

(1) Renewing case back wiring

(a) Unsolder the faulty wire from its sealed terminal and withdraw the wire.

NOTE : In the following para. the distance quoted is not critical but it is essential that the wire length is not altered after the indicator has been ranged.

(b) Thread the silver plated wire (alumel) through sealed terminal 1 and/or the gold plated wire (chromel) through sealed terminal 2 until $1\frac{1}{2}$ in (38.1 mm) protrudes from the terminal on the inner face of the case back. Bend and solder the wire to the sealed terminal tag and sleeve the wires to the colours specified in fig. 503.

(2) Other wiring

Wiring information is given in ASSEMBLY.

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MILLIVOLTMETER TEMPERATURE INDICATORS

ASSEMBLY

1. GENERAL

Faulty parts should be replaced by approved spares only, after inspection for serviceability. Tab and spring washers, rubber washers and sealing rings must be renewed. Electrical connections, except where stated, must be made with solder B using the smallest amount necessary to achieve an efficient joint. All screw threads not otherwise locked are to be locked with lockant G. Details of materials are given in SPECIAL TOOLS, FIXTURES AND EQUIPMENT.

NOTE : The three-figure suffix included in the code number of some units denotes the SET point referred to in the following procedure. On units with code numbers without this suffix, the SET point is engraved on the dial.

2. EQUIPMENT REQUIRED

To carry out the assembly of the indicator, items 1 to 15 inclusive, 17, 22, 23, 24, and 25 of the list on page 1001 will be required for indicators used in single thermocouple systems; item 1 to 9 inclusive, 14, 15 and 17 to 25 inclusive, for indicators used in two series connected thermocouple systems.

3. PROCEDURE (refer to fig. 501)

NOTE : The following procedures apply to all codes unless specified otherwise.

A. Movement and Frame

(1) Rear bridge piece

(a) Using a piece of spade ended 0.002 in diameter wire as an oiler, apply one spot of lubricant A to the rear jewel screw. Avoid applying excess oil.

(b) Position a spring washer and jewel locknut on the rear bridge piece, ensuring that the spigot on the locknut is located in the slot in the bridge piece bush. Press the locknut until the spring washer is fully compressed, and screw the jewel screw a few turns into the locknut and bridge piece. It is essential that the spring washer shall be almost fully compressed, and unless the gap between the locknut and bush is less than 0.012 in (0.3 mm) after assembly, the jewel screw must be unscrewed and re-engaged with the bridge piece bush whilst under increased pressure. Turning the locknut through 180 deg in a clockwise direction brings the but closer to the bush by approximately 0.005 in (0.13 mm). If a piece of wire 0.006 in (0.15 mm) diameter can be inserted between the washer and the bush at the widest gap, then the gap is suspect.

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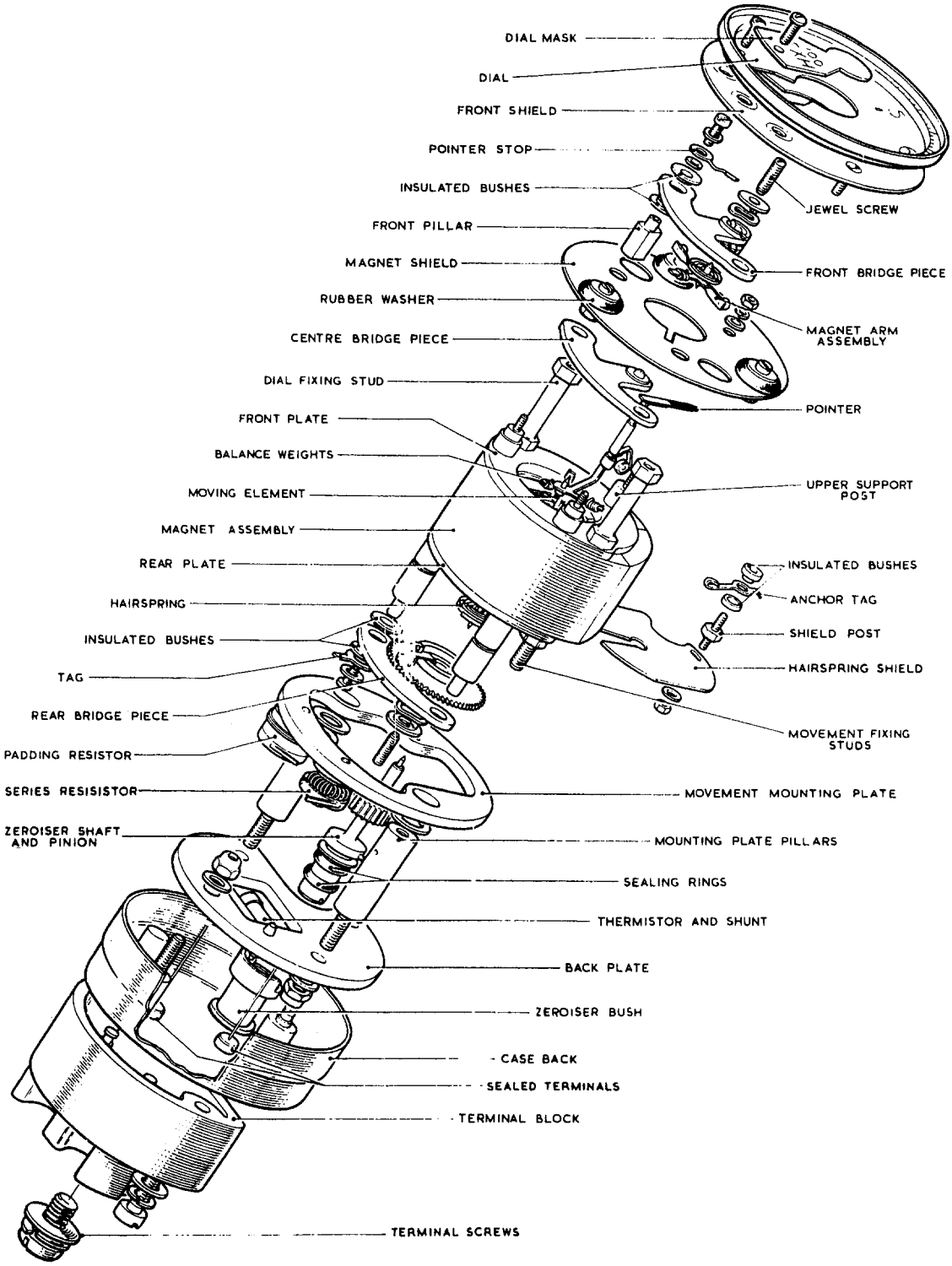


Fig. 501 Exploded view - main case removed

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(c) Taking care not to damage the moving element pivot, secure the rear bridge piece to the rear plate pillars with two special screws, special washers, 12BA small plain washers and four insulated bushes, with the insulated bushes positioned one either side of each screw hole in the rear bridge piece, and the anchor tag located on the shoulder of the rear bush of the left hand pair.

(2) Centre bridge piece

Place the centre bridge piece on the front plate pillars ensuring that the front pivot of the moving element locates in the jewel.

(3) Magnet shield

(a) Fit 3 new rubber washers to the rim of the magnet shield, and secure the washers in position each with a 0-80NF-2A x 1/4 in screw, 0-80NF plain and special washers, and a 0-80NF nut.

(b) Place the magnet shield over the centre bridge piece and upper support post and screw the front pillars on to the threaded portion of the front plate pillars. Secure the magnet shield to the upper support post with a 0-80NF nut, special washers, and a 0-80NF plain washer.

(4) Moving element endshake

Great care must be taken when assembling the rear jewel bearing to ensure that the pivot tip does not come into contact with the insulated bead in the jewel assembly. Adjust the rear bridge piece jewel screw until it engages the moving element rear pivot, and the moving element is supported by the rear jewel screw and the front fixed jewel. Adjust the rear jewel screw until the spindle endshake is reduced to a minimum consistent with minimum friction. Ensure that the clearance between the stop magnet and the magnet shield is at least 0.030 in. (0.76 mm). Insert a piece of paper into the movement to hold the moving element in the approximate zero position.

(5) Hairspring

(a) Rotate the rear bridge piece gearwheel until the hairspring anchorage (fig. 3) is aligned with the outer end of the hairspring. Solder the hairspring to the tag with solder B.

(b) Remove the piece of paper holding the moving coil in the zero position.

(c) If the magnet assembly has been demagnetized during REPAIR, carry out the magnetization procedure described in the following paragraph B. If the magnet assembly has not been demagnetized during REPAIR, proceed to paragraph C.

B. Magnetization

NOTE : The magnet is manufactured from Alcomax III.

(1) Place the movement in the magnetizing blocks, 218 LMT, and position the blocks on the magnetizer so that the centre pole support (see fig. 401) is remote from the North pole of the magnetizer. Operate the equipment to magnetize to saturation point.

(2) Remove the movement and magnetizing blocks from the magnetizer.

C. Hairspring Shield

(1) Place the hairspring shield in position between the movement hairspring and the ligament, ensuring that the shield is securely seated in the slots in the back plate pillars.

(2) Secure the shield to the shield post with a 12BA nut and a 12BA large washer.

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D. Dial

(1) If the existing dial is damaged, mark out a new blank dial in pencil as shown in fig. 502. Taking care not to damage the pointer, secure the front shield to the dial fixing pillars with two 0-80NF x 1/8 in c. sk. screws, and secure the dial to the front shield with two special dial screws.

(2) If the original dial is being refitted, lightly mark in pencil the 0 deg and 250 deg marks as indicated in fig. 502. Taking care not to damage the pointer, secure the front shield to the dial fixing pillars with two 0-80NF x 1/8 in csk. screws, and secure the dial to the front shield with two special dial screws.

(3) Ensure that the pointer is free to travel over the complete range of the indicator and set the pointer to the zero mark by means of the rear bridge piece gear wheel.

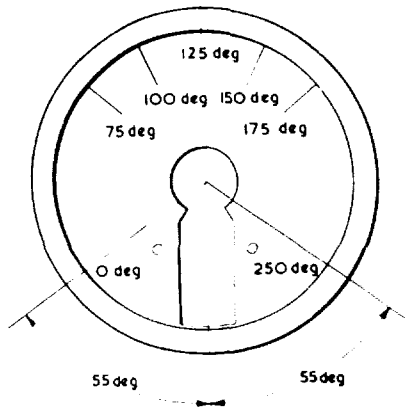


Fig. 502 Blank dial - markings

(4) Solder one end of a 3 in (75 mm) length of 30 SWG tinned copper wire to the tag fixed to the rear bridge piece securing screw. Wind the wire loosely once around the jewel locknut and solder the other end to the tag on the rear bridge piece gear wheel.

E. Movement Mounting Plate and Back Plate

(1) Place the movement mounting plate in position on the movement rear plate so that the movement fixing studs locate in the holes in the mounting plate. Place a plain washer over the movement fixing stud and secure the mounting plate in position by screwing the mounting plate pillars on to the movement fixing studs. Tighten the pillars by using a small tommy bar in the hole provided, and lock the pillars and plate with Akard red lacquer.

(2) Place the back plate in position so that the mounting plate pillars protrude through the holes in the back plate, and secure with two 4-40 UNC stiffnuts and 4-40 UNC plain washers.

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F. Zeroiser Shaft and Case Back

(1) Insert a new capillary tube in the case back and solder in position with solder D.

(2) Place a new spring washer against the shoulder on the slotted head of the zeroiser shaft.

(3) Fit two new sealing rings to the shaft, lubricate the rings with lubricant F and insert the shaft into the case back bush.

(4) Position the case back so that its pillars protrude through the back plate. Do not locate the zeroiser shaft in the movement mounting plate or engage the pinion with the gear wheel.

G. Wiring

(1) Excluding the terminal block connections, wire the indicator in accordance with the appropriate diagram of fig. 503.

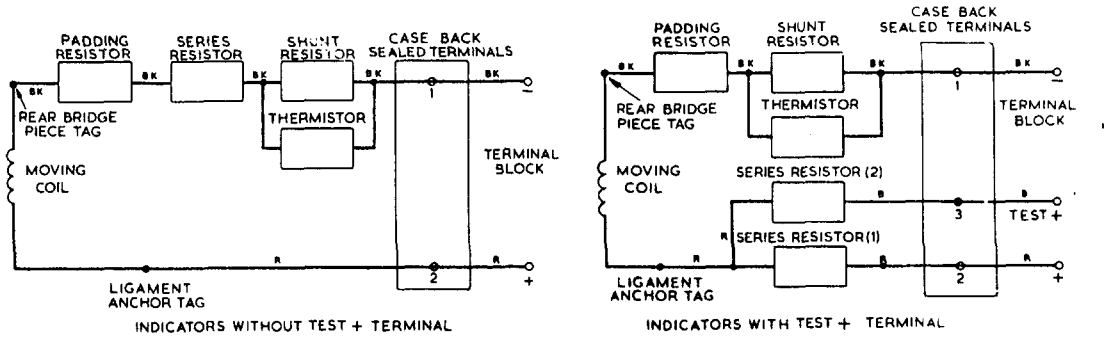


Fig. 503 Wiring diagrams

(2) If the moving coil or the padding resistor have been renewed, check that the resistance of the coil, less the hairspring and ligament, in series with the padding resistor is between 17 and 17.2 ohms at 20°C. If the resistance is high remove wire from the padding resistor. If the resistance is low, renew the padding resistor and adjust as necessary.

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NOTE : To determine the appropriate table for subsequent procedures, refer to table 501. Tables are located at the end of this topic.

H. Movement Balancing

(1) Connect the extreme ends of the indicator leads to the test circuit shown in fig. 504.

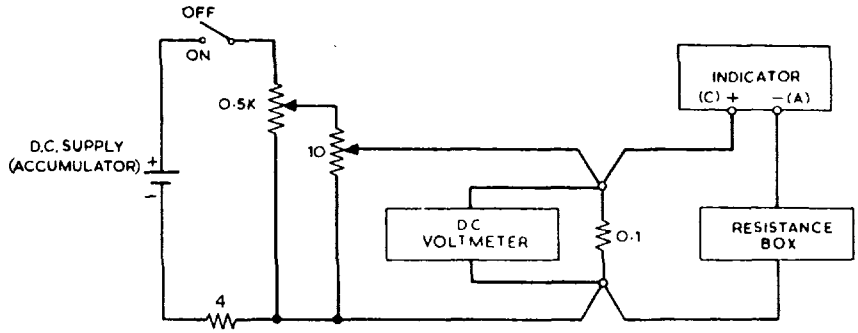


Fig. 504 Test circuit

NOTE PLUG PIN CONNECTIONS ARE SHOWN IN BRACKETS

(2) Referring to DATA, set the decade resistance box to the external resistance of the indicator. Set the controls (variable resistors) to the minimum voltage position and switch on the supply.

(3) Position the indicator so that the dial is in the horizontal plane, and adjust the controls until the pointer is aligned to a mark approximately on the dial vertical centre line.

(4) Position the indicator so that the dial is in the vertical plane.

(5) Turn the indicator so that the pointer successively points horizontally left, vertically upwards, horizontally right and vertically downwards, and at each position check that any deviation of the pointer from the selected scale mark does not exceed ± 8 °C.

(6) If the indications are outside tolerance, adjust the counterweights using the adjusting tools 235 LMT in the manner detailed below and then repeat the procedure in paras. (3), (4) and (5) and if necessary this para. until satisfactory results are obtained.

(a) To move a counterweight inwards, pass the straight slotted end over the counterweight so that the outer tag is engaged by the slot and the inner tag remains free. Turn clockwise.

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(b) To move a counterweight outwards, pass the L slotted end of the tool over the counterweight so that the outer tag is free in the cross slot and the inner tag bears on the side of the long slot. Turn anti-clockwise.

I. Centralising the Zeroiser Shaft

(1) Referring to the dial drawing (listed in SPECIAL TOOLS, FIXTURES AND EQUIPMENT) and to the appropriate table, determine the voltage equivalent to the temperature indicated by the scale vertical centre line.

(2) Adjust the controls to inject this voltage and align the pointer to the centre line by rotating the rear bridge piece gear wheel. Switch off the supply.

(3) Rotate the zeroiser shaft so that it is in the centre of its travel and, ensuring that the shaft engages the movement mounting plate bush, mesh the zero adjusting pinion and gearwheel by closing the case back to the back plate. Secure the case back with two 4-40 UNC stiffnuts and plain washers.

NOTE : If the magnet assembly has not been demagnetised during REPAIR, proceed to Ranging.

J. Magnet Ageing

(1) Rotate the rear bridge piece gearwheel to set the indicator pointer to the left-hand (zero) pencilled mark on the dial.

(2) Switch on the supply and adjust the controls to align the pointer with the dial vertical centre line. Note the voltmeter indication.

(3) Increase the noted voltage by 3%.

(4) Pass the indicator rapidly in and out of the fringe of the field surrounding the coil of the 99 LMT until the pointer has returned to the dial vertical centre line.

K. Ranging

NOTES : 1. Indicators with TEST + terminal

The following procedure must first be carried out with the TEST + terminal connected using voltage equivalents for single systems and then repeated with the + terminal connected using voltage equivalents for double systems (see table).

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2. After ranging it is essential that the length of the wire protruding from the sealed terminals is not altered.

(1) Temporarily fit the indicator into the case. Referring to the table and the dial drawing, adjust the controls to inject the voltage equivalent to the temperature indicated by the dial vertical centre line. Rotate the zero adjuster to align the pointer with this mark.

(2) Adjust the controls to set the pointer, in turn, to the scale mark 100°C less than and 100°C greater than that at the centre line and at each setting check that the voltmeter indication is within the following tolerance of that specified in the table.

(a) Indicators used in double systems ± 0.32mV.

(b) All other indicators ± 0.16mV.

(3) If the indication is excessive, crop the movement hairspring from the outside. It is important that when re-soldering the hairspring, it is aligned as described in REPAIR.

(4) If the indication is less than that required, small adjustments can be made by trimming the series resistor.

(5) Repeat the ranging procedure until satisfactory results are obtained.

(6) Switch off the supply and disconnect the indicator from the test circuit.

L. Temperature Cycling

(1) With the case fitted, place the indicator in a refrigerator and maintain it at a temperature of -65°C for one hour.

(2) Remove the case, place the movement in an oven and maintain it at a temperature of +90°C for one hour.

(3) Allow the mechanism to stabilize at room temperature (20 ± 5°C) before proceeding.

M. Magnet Arm

(1) Remove the two special screws securing the dial and remove the dial.

(2) Remove the two screws securing the front shield to the dial fixing pillars, and remove the shield.

(3) Using a piece of spade-ended 0.002 in diameter wire as an oiler, apply one spot of lubricant A to the front bridge piece jewel screw and centre bridge solid mounted jewel bearing. Avoid applying excess oil.

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(4) Position a spring washer and jewel locknut on the front bridge piece, ensure that the spigot on the locknut is located in the slot in the bridge piece bush. Press the locknut until the spring washer is fully compressed and screw the jewel screw into the locknut and bridge piece. It is essential that the spring washer be almost fully compressed, and unless the gap between the locknut and the bush is less than 0.012in (0.3 mm) after assembly, the jewel screw must be unscrewed and re-engaged with the bridge piece bush whilst under increased pressure. Turning the locknut through 180 deg in a clockwise direction brings the nut closer to the bush by approximately 0.005 in (0.13 mm). If a piece of wire 0.006 in (0.15 mm) dia. can be inserted between washer and bush at the widest gap, the gap is suspect.

(5) Secure the front bridge piece to the front pillars with two 0.80NF-2A x 3/16 in pan hd. screws, two special washers, two plain washers and four insulating bushes, with a pointer stop fitted between the two washers on each screw.

(6) Temporarily place the magnet assembly complete with the auxiliary hairspring, between the centre and front bridge pieces.

(7) Great care must be taken when assembling the jewel bearings to ensure that the pivot tip does not come into contact with the insulating bead in the jewel assembly. Engage the rear pivot in the solid jewel bearing, and adjust the jewel screw until it engages the front pivot.

(8) Check that the stop magnets line up accurately with the stop magnet on the pointer spider. Adjust by bending the magnet arms or the pointer stop magnet assembly.

(9) Unscrew the jewel screw and remove the magnet arm assembly.

(10) Place the magnet arm assembly in the balancing fixture 892 LMT, and adjust the pivot screws to achieve freedom of movement of the magnet arm consistent with minimum friction. Balance the magnet arm by adjusting the balance weight, ensuring the auxiliary hairspring cannot catch on the balance weight tail. Remove the arm from the fixture.

(11) Place the magnet arm assembly complete, between the centre and front bridge pieces.

(12) Engage the rear pivot in the solid jewel bearing and adjust the jewel screw until it engages the front pivot. Adjust the magnet arm endshake by gently oscillating the arm and screwing down the jewel screw until some friction is observed. Undo the jewel screw an amount approximately equal to the width of the slot at the periphery

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of the screw.

(13) Solder the auxiliary hairspring to the extreme end of the anchor tag and ensure that there are no projections which could interfere with the hairspring under vibration conditions.

(14) Check that the hairspring moves concentrically with the spindle, and that it tightens when the arm is moved in an anticlockwise direction.

(15) Secure the front shield to the dial fixing pillars with two 0-80 NF x 1/8 in csk. screws, and secure the dial to the front shield with two special dial screws. Check the position of the pointer stops. The stops must be set so that the pointer can travel 4 deg. beyond both the 0 deg. and 250 deg. marks respectively.

NOTE : Effect the procedure detailed in paras. (16) to (19) only if the original dial is to be used.

(16) Rotate the auxiliary hairspring anchor tag in a clockwise direction until the pointer is aligned to the zero mark on the dial.

(17) Connect the indicator to the test circuit and switch on the supply. Adjust controls to inject an increasing voltage into the indicator. Note the angular deflection at which the magnet arm ceases to have an effect on the pointer.

NOTE : If a new auxiliary hairspring is to be fitted, if necessary, up to two turns can be removed from the outside of the spring. The outer turn must be bent outwards to meet the tag so that the remaining turns are concentric.

(18) Adjust the torque of the auxiliary hairspring by cutting from the outside, until, in addition to arresting the pointer at the zero mark, the magnet arm comes to rest (with no tension in the auxiliary hairspring) as the pointer, with increasing input, reaches the calibrated position of the lowest scale mark on the expanded scale range (see dial drawing) within + 1 deg. - 3 deg. Disconnect the indicator from the test circuit.

(19) If the pointer stop magnet has been adjusted in paragraph (8), carry out the procedure in movement balancing. Adjust the movement balance weights if the pointer stop magnet has been disturbed.

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NOTES : 1. Before commencing the procedure in para. M or N, the indicator must be maintained at a temperature between 15 and 25 °C for one hour. It is important that the temperature remains substantially constant. If the ambient temperature is not 20 °C, correct the voltages given in the tables as follows :

Indicators with short bimetal. Add 0.03mV for each deg C below 20 °C or subtract 0.03mV for each deg C above 20 °C.

All other indicators. Add 0.04mV for each deg C below 20 °C or subtract 0.04mV for each deg C above 20 °C.

2. The indicator must be positioned in the normal viewing attitude. If the original dial is being used, effect the procedure in para. N. To calibrate a new dial, effect the procedure in para. O.

3. The three figure suffix included in the code number of some units denotes the SET point of the indicator. On units with code numbers without this suffix, the SET point is marked on the dial.

4. Indicators fitted with TEST + terminal

The check calibration procedure must first be carried out with the TEST + terminal connected using voltage equivalents for single systems and then repeated with the + terminal connected and using voltage equivalents for double systems (see table).

N. Check Calibration

(1) Temporarily fit the indicator in its case, connect the indicator to the test circuit and switch on the supply.

(2) Adjust the controls to inject the voltage equivalent to the SET point. Adjust the zero adjuster to align the pointer with the SET point.

(3) Adjust the controls to align the pointer, in turn, with each scale mark specified in the table and at each setting check that the voltmeter indication is within the specified tolerance.

(4) If the indications are within tolerance, switch off the supply. Fit the dial mask to the front shield and secure with the special screw. Proceed to Friction Test.

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(5) If the indications are not within tolerance, small adjustments may be made by trimming the series resistor. After any adjustment repeat the Check Calibration and if the indications are still not within tolerance the indicator dial must be removed and discarded. A new dial marked in pencil as shown in fig. 502 must be secured to the front shield and calibrated as detailed in the following procedure.

NOTE : To facilitate the accuracy of subsequent dial location, the dial may be temporarily secured with countersunk screws in the absence of the dial mask.

O. Blank Dial Calibration

(1) Temporarily fit the indicator in the dummy case and with the indicator connected to the test circuit, switch on the supply.

NOTE : Indicator dials differ in their presentation as listed below. Before commencing calibration, refer to the dial drawing to determine the type and effect the procedure in the para. appropriate to that type.

(a) A 100 or 50°C scale mark and the SET point coincident with the dial vertical centre line, refer to para. (2).

(b) A 100 or 50°C scale mark, but not the SET point, coincident with the dial vertical centre line, refer to para. (3).

(c) The indicator turned to bring the SET point on the horizontal or vertical axis, refer to para. (4).

(d) The indicator turned to bring the relevant 100 or 50°C mark on the horizontal or vertical axis, refer to para. (5).

(2) Adjust the controls to inject the voltage equivalent to the SET point of the indicator. Adjust the zero adjuster to align the pointer with the SET point.

(3) Adjust the controls to inject the voltage equivalent to the temperature indicated by the dial vertical centre line. Adjust the zero adjuster to align the pointer with the dial vertical centre line.

(4) Rotate the indicator to the position shown by the dial drawing, then adjust the controls to inject the voltage equivalent to the SET point. Adjust the zero adjuster to align the pointer with the relevant axis.

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(5) Rotate the indicator to the position shown by the dial drawing, then adjust the controls to inject the voltage equivalent to the relevant temperature. Adjust the zero adjuster to align the pointer with the relevant axis.

(6) Inject voltages equivalent to the scale marks shown in the table and at each point mark the dial in pencil.

(7) Effect the procedure detailed in para. M, sub-paras. (16) to (19).

(8) Switch off the supply and disconnect the indicator from the test circuit.

(9) Remove the two screws securing the dial and remove the dial.

(10) Sub-divide and mark the dial in accordance with the dial drawing.

(11) Secure the finished dial and the mask to the front shield with the special screws.

(12) Carry out the Check Calibration procedure.

P. Friction Test

(1) Switch on the supply. With the dial in the vertical plane, adjust the controls to align the pointer with the dial vertical centre line.

(2) Adjust the controls to align the pointer at the minimum end of the scale. Lightly tap the indicator.

NOTE : During the following procedure it is important that :

(a) The pointer does not overshoot the selected scale mark. If pointer overshoot does occur, the procedure must be repeated.

(b) The indicator is not subjected to vibration except where specified.

(3) Gradually adjust the controls until the pointer is aligned to a scale mark on or near the dial vertical centre line. Record the voltmeter indication.

(4) Adjust the controls so that the pointer is at the maximum end of the scale. Lightly tap the indicator.

(5) Adjust the controls until the pointer is aligned with the scale mark selected in para. (3). Record the voltmeter indication.

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(6) Check that the difference in the recorded voltmeter indications does not exceed :

(a) Indicators used in double systems, 0.76mV

(b) All other indicators, 0.48mV.

Switch off the supply.

(7) If the friction error exceeds the specified tolerance, check the endshake of the movement and magnet arm spindles. Adjust the jewel screws if necessary. If the endshake is correct, disassemble the indicator and examine the movement and magnet arm pivots and bearings. Renew if necessary and repeat the assembly procedure.

Q. Moisture Removal

(1) Place the instrument, less case, in an oven at 70°C for 12 hours.

(2) Retain the instrument in a drying cabinet until it is to be sealed in the case.

R. Insulation Resistance Test

Fit the main case to the indicator and using a 500V d.c. insulation tester, measure the insulation resistance between the terminals and the case. The resistance must not be less than 20 megohms.

S. Case Sealing

NOTE : To avoid damaging the instrument by excessive heat during soldering operations, the joint between the case back and the main case may be soldered using high frequency heating equipment, if available. This ensures that there is no heating of the instrument apart from the faces which are to be soldered. If high frequency heating equipment is not available a large soldering iron may be used, but great care must be taken to avoid over-heating of the instrument.

(1) Feed a length of silicone rubber string, sufficient to give two complete turns, into position around the edge of the case back and press well down into the recess formed by the case back and main case. Ensure that the ends are well below the surface.

(2) Place a 19 SWG tinned iron wire sealing ring into the recess, pressing down, but leaving the end free.

(3) Place the instrument, dial end downward, in the high frequency heating equipment, switch on and heat the area to be soldered.

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Make the joint, using solder B, but leave the free end of the wire sealing ring unsoldered to facilitate subsequent unsealing.

(4) Switch off the heating equipment and leave the instrument to cool before carrying out the leak testing procedure.

(5) Mask the sealed terminals and screw threads, and apply a coat of paint H to areas on the case back where the finish has been damaged during overhaul. Allow to dry and remove the masking.

T. Leak Testing and Gas Filling

(1) Using the leak testing, evacuation and gas filling equipment, leak test the indicator. The maximum permissible leak is 10^{-2} lusec.

(2) Flush and finally fill the indicator with gas I at a pressure of 3 lb/in^2 above atmospheric pressure.

(3) Shut off the gas supply and using the special crimping pliers, sever the end of the capillary tube a minimum distance of 9/32 in (7.2 mm) from the case back.

(4) Solder the crimped end of the tube.

U. Terminal Block

(1) Referring to fig. 503, connect the case back sealed terminal leads to the terminal block by passing the leads from sealed terminals 1 and 2 through the appropriate hole in the terminal block and soldering the leads to the flat on the outer face of each terminal block insert.

(2) Indicators with TEST + terminal

Solder the blue lead to the remaining terminal block insert.

(3) Secure the terminal block to the case back with two 4-40 UNC x 5/8 in ch. hd. screws and 6BA plain and spring washers.

(4) Fit the terminal screws to the appropriate terminal block inserts.

V. Testing

Carry out the full procedure on the indicator as detailed in TESTING.

W. Connect the two terminals (fig. 503) together with a suitable shorting strap for movement protection and tighten the terminal.

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Table 501

Indicator	Table
*/727MV/BU/1	502A
*/727MV/BU/2	
*/727MV/BU/3	
*/727MV/BU/4	
*/727MV/BU/5	
*/727MV/BU/7	
*/727MV/BU/8	
*/727MV/BU/11	
*/727MV/BU/14	
*/727MV/BU/15	
*/727MV/BU/20/500	
*/727MV/BU/21/500	
*/727MV/BU/26	
*/727MV/BU/34/700	
*/727MV/BU/39/700	
*/727MV/BU/40/700	
*/727MV/BU/43/550	
*/727MV/BU/44/700	
*/727MV/BU/46/650	
*/727MV/BU/48	
*/727MV/BU/51/700	
*/727MV/BU/53/650	
*/727MV/BU/62/700	
*/727MV/BU/63	
*/727MV/BU/50	502B
*/727MV/BU/6	503
*/727MV/BU/10	
*/727MV/BU/12	
*/727MV/BU/16	504
*/727MV/BU/17/640	505
*/727MV/BU/18/580	506
*/727MV/BU/18/610	
*/727MV/BU/18/620	
*/727MV/BU/33/580	
*/727MV/BU/47/580	

Indicator	Table
*/727MV/BU/18/640	507
*/727MV/BU/68/640	
*/727MV/BU/22	508
*/727MV/BU/32	
*/727MV/BU/37	
*/727MV/BU/38	
*/727MV/BU/24	509
*/727MV/BU/56/730	
*/727MV/BU/57/740	
*/727MV/BU/59/720	
*/727MV/BU/60/720	
*/727MV/BU/65/720	
*/727MV/BU/25/640	510
*/727MV/BU/64/660	
*/727MV/BU/66/660	
*/727MV/BU/30	511
*/727MV/BU/19	512
*/727MV/BU/17/580	513
*/727MV/BU/17/600	514
*/727MV/BU/28/580	515
*/727MV/BU/20/560	516
*/727MV/BU/42/690	517
*/727MV/BU/54/690	
*/727MV/BU/53/750	517A
*/727MV/BU/61/750	
*/727MV/BU/69/750	

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Indicator	Table
*/762MV/BU/1/740	518
*/762MV/BU/3/560	519
*/762MV/BU/3/520	520
*/762MV/BU/20/860	521
*/762MV/BU/2/580	522
*/762MV/BU/5/590	522
*/762MV/BU/6/580	522
*/762MV/BU/16/580	522
*/762MV/BU/5/600	523
*/762MV/BU/7	524
*/762MV/BU/8/550	524
*/762MV/BU/9/550	524
*/762MV/BU/10/700	524
*/762MV/BU/12	524
*/762MV/BU/18/740	524
*/762MV/BU/18/750	524
*/762MV/BU/19/700	524
*/762MV/BU/21/860	524
*/762MV/BU/22/680	524
*/762MV/BU/23/860	524
*/762MV/BU/24/790	524
*/762MV/BU/25/720	524
*/762MV/BU/26/700	524
*/762MV/BU/27/860	524
*/762MV/BU/28/800	524
*/762MV/BU/30/770	524
*/762MV/BU/33/700	524
*/762MV/BU/34/700	524
*/762MV/BU/36/860	524
*/762MV/BU/37/800	524
*/762MV/BU/38/790	524
*/762MV/BU/40/860	524
*/762MV/BU/11	525

Indicator	Table
*/762MV/BU/15/725	526
*/762MV/BU/52/640	527
*/762MV/BU/31/810	528
*/762MV/BU/41/805	529
*762MV-BU43-900	530
*762MV-BU42-900	530
762MV-BM44-791	531
*727MV/BU/52/640	532

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Table 502A and B

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	
	A	B
20	0	0.40
100	3.30	3.70
200	7.33	7.73
300	11.41	11.81
350	13.49	13.89
400	15.59	15.99
450	17.70	18.10
500	19.84	20.24
550	21.97	22.37
600	24.10	24.50
650	26.23	26.63
700	28.34	28.74
750	30.43	30.83
800	32.51	32.91
850	34.55	34.95
900	36.56	36.96
950	38.55	38.95
1000	40.51	40.91
1100	44.34	44.74
1200	48.05	48.45

Tolerances

Dial Reading (°C)	Tolerance(mV)
Set point	±0.04
Up to 50°C either side of set point	±0.16
Upper limit of expanded scale	-0.80+0.32
Lower limit of expanded scale	-0.32+0.80
Remainder of expanded scale	±0.32
Unexpanded scale	±0.80

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Table 503

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C
20	0.22
100	3.52
200	7.55
300	11.63
400	15.81
450	17.93
500	20.06
550	22.19
600	24.32
650	26.44
700	28.56
750	30.64
800	32.73
850	34.77
900	36.78
950	38.77
1000	40.73
1100	44.56
1200	48.27

Tolerances

Dial Reading (°C)	Tolerance (mV)
Set point	±0.04
Up to 50°C either side of set point	±0.16
Upper limit of expanded scale	-0.80+0.32
Lower limit of expanded scale	-0.32+0.80
Remainder of expanded scale	±0.32
Unexpanded scale	±0.80

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Table 504

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.30	±0.80
200	7.33	
300	11.41	
400	15.59	
500	19.84	
600	24.10	-0.32+0.80
650	26.23	±0.32
700	28.34	±0.32
750	30.43	±0.16
790	32.10	±0.04
800	32.51	±0.16
850	34.55	-0.80+0.16
900	36.56	±0.80
1000	40.51	±0.80

Table 505

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.52	±0.80
200	7.55	
300	11.63	
400	15.81	
450	17.93	-0.32+0.80
500	20.06	±0.32
550	22.19	
600	24.32	±0.16
640	26.02	±0.04
650	26.44	±0.16
700	28.56	-0.80+0.16
800	32.73	±0.80

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Table 506

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
580 Set Point	23.25	±0.04
610	24.53	
620	24.95	
100	3.30	±0.80
200	7.33	
300	11.41	
400	15.59	-0.32+0.80
450	17.70	±0.32
500	19.84	±0.16
550	21.97	±0.16
600	24.10	±0.16
650	26.23	-0.80+0.32
700	28.34	±0.80
800	32.51	

Table 507

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.30	±0.80
200	7.33	
300	11.41	
400	15.59	-0.32+0.80
450	17.70	±0.32
500	19.84	
550	21.97	±0.16
600	24.10	±0.04
640	25.81	±0.16
650	26.23	-0.80+0.16
700	28.34	±0.80
800	32.51	

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Table 508

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C
20	0
100	6.60
200	14.66
300	22.82
400	31.18
450	35.40
500	39.68
550	43.94
600	48.20
650	52.46
700	56.68
750	60.86
800	65.02
900	73.12
1000	81.02
1100	88.68
1200	96.10

Tolerances

Dial Reading (°C)	Tolerance (mV)
Set point	±0.08
Up to 50°C either side of set point	±0.32
Upper limit of expanded scale	-1.60+0.64
Lower limit of expanded scale	-0.64+1.60
Remainder of expanded scale	±0.64
Unexpanded scale	±1.60

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Table 509

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
720 (Set Point)	29.18	±0.04
730 (Set Point)	29.60	
740 (Set Point)	30.02	
100	3.30	
200	7.33	±0.80
300	11.41	
400	15.59	
500	19.84	
550	21.97	-0.32+0.80
600	24.10	±0.32
650	26.23	±0.16
700	28.34	
750	30.43	
800	32.51	-0.80+0.32
900	36.56	±0.80
1000	40.51	
1100	44.34	
1200	48.05	

Table 510

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
640 (Set point)	25.81	±0.04
660 (Set point)	26.65	
100	3.30	
200	7.33	±0.80
300	11.41	
400	15.59	
500	19.84	-0.32+0.80
550	21.97	±0.32
600	24.10	
650	26.23	±0.16
700	28.34	
750	30.43	-0.80+0.32
800	32.51	±0.80
900	36.56	

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Table 511

Indicated Temperature (°C)	Single e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)	Double e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.30	±0.80	6.60	±1.60
200	7.33		14.66	
300	11.41		22.82	
400	15.59		31.18	
500	19.84		39.68	
550	21.97	-0.32+0.80	43.94	-0.64+1.60
600	24.10	±0.32	48.20	±0.64
650	26.23	±0.16	52.46	±0.32
700	28.34		56.68	
720	29.18	±0.04	58.36	±0.08
750	30.43	±0.16	60.86	±0.32
800	32.51	-0.80+0.32	65.02	-1.60+0.64
900	36.56	±0.80	73.12	±1.60
1000	40.51		81.02	
1100	44.34		88.68	
1200	48.05		96.10	

Table 512

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.30	±0.80
200	7.33	
300	11.41	
400	15.59	
500	19.84	
600	24.10	
700	28.34	
750	30.43	-0.32+0.80
800	32.51	±0.32
850	34.55	±0.16
900	36.56	
920	37.36	±0.04
950	38.55	±0.16
1000	40.51	-0.80+0.32
1100	44.34	±0.80
1200	48.05	

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Table 513

Indicated Temperature (°C)	e. m. f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.52	±0.80
200	7.55	
300	11.63	
400	15.81	
450	17.93	-0.32+0.80
500	20.06	±0.32
550	22.19	±0.16
580	23.48	±0.04
600	24.32	±0.16
650	26.44	
700	28.56	-0.80+0.32
800	32.73	±0.80

Table 514

Indicated Temperature (°C)	e. m. f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.52	±0.80
200	7.55	
300	11.63	
400	15.81	
450	17.93	-0.32+0.80
500	20.06	±0.32
550	22.19	±0.16
600	24.32	±0.04
650	26.44	±0.16
700	28.56	-0.80+0.32
800	32.73	±0.80

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Table 515

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.30	±0.80
200	7.33	
300	11.41	
400	15.59	-0.32+0.80
450	17.70	±0.32
500	19.84	±0.16
550	21.97	
580	23.25	±0.04
600	24.10	±0.16
650	26.23	-0.80+0.32
700	28.34	±0.80
800	32.51	

Table 516

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.52	±0.80
200	7.55	
300	11.63	
400	15.81	-0.32+0.80
450	17.93	±0.32
500	20.06	±0.16
550	22.19	
560	22.61	±0.04
600	24.32	±0.16
650	26.44	-0.80+0.32
700	28.56	±0.80
800	32.73	

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Table 517

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.30	±0.80
200	7.33	
300	11.41	
400	15.59	
500	19.84	
550	21.97	-0.32+0.80
600	24.10	±0.32
640	25.81	±0.16
650	26.23	
690	27.92	±0.04
700	28.34	±0.16
740	30.01	
750	30.43	±0.32
800	32.51	-0.80+0.32
900	36.56	±0.80
1000	40.51	

Table 517A

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.30	±0.80
200	7.33	
300	11.41	
400	15.59	
500	19.84	
550	21.97	-0.32+0.80
600	24.10	±0.32
650	26.23	
700	28.34	±0.16
750	30.43	±0.04
800	32.51	-0.16+0.80
900	36.56	±0.80
1000	40.51	

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Table 518

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.30	
200	7.33	
250	9.36	±0.72
300	11.41	
400	15.59	
500	19.84	-0.16+0.72
600	24.10	
645	26.02	±0.16
680	27.49	
700	28.34	±0.08
715	28.97	
740	30.01	±0.04
750	30.43	-0.72+0.08
800	32.51	±0.72

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Table 519

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.52	±0.72
200	7.55	
300	11.63	
400	15.81	-0.16+0.72
450	17.93	±0.16
500	20.06	±0.08
550	22.19	
560	22.62	±0.04
600	24.32	±0.08
650	26.44	-0.72+0.16
700	28.56	±0.72
800	32.73	

Table 520

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.52	±0.72
200	7.55	
300	11.63	
400	15.81	-0.16+0.72
450	17.93	±0.16
500	20.06	±0.08
520	20.90	±0.04
550	22.19	±0.08
600	24.32	
650	26.44	-0.72+0.16
700	28.52	±0.72
800	32.73	

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Table 521

Indicated Temperature (^{o}C)	e.m.f. (mV) Reference Junction at 20^{o}C	Tolerance (mV)
100	3·30	±0·72
200	7·33	±0·72
300	11·41	±0·72
400	15·59	±0·72
500	19·84	±0·72
600	24·10	±0·72
700	28·34	-0·16 +0·72
730	29·59	±0·16
750	30·43	±0·16
800	32·51	±0·08
850	34·55	±0·08
860 (Set point)	34·95	±0·04
900	36·56	±0·08
930	37·75	±0·16
950	38·55	-0·72 +0·16
1000	40·51	±0·72
1100	44·34	±0·72
1200	48·05	±0·72

Table 522

Indicated Temperature (^{o}C)	e.m.f. (mV) Reference Junction at 20^{o}C	Tolerance (mV)
580 Set	23·25	
590 Point	23·68	±0·04
100	3·30	
200	7·33	±0·72
300	11·41	
400	15·59	-0·16 +0·72
450	17·70	±0·16
500	19·84	
550	21·97	±0·08
600	24·10	
650	26·23	-0·72 +0·16
700	28·34	
800	32·51	±0·72

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Table 523

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance
100	3.30	±0.72
200	7.33	
300	11.41	
400	15.59	-0.16+0.72
450	17.70	
500	19.84	±0.16
550	21.97	
600	24.10	±0.04
650	26.23	-0.72+0.16
700	28.34	±0.72
800	32.51	

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Table 524

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C
20	0
100	3.30
200	7.33
300	11.41
350	13.49
400	15.59
450	17.70
500	19.84
550	21.97
600	24.10
650	26.23
700	28.34
750	30.43
800	32.51
850	34.55
900	36.56
950	38.55
1000	40.51
1100	44.34
1200	48.05

Tolerances

Dial Reading (°C)	Tolerance (mV)
Set point	±0.04
Up to 50°C either side of set point	±0.08
Upper limit of expanded scale	-0.72+0.16
Lower limit of expanded scale	-0.16+0.72
Remainder of expanded scale	±0.16
Unexpanded scale	±0.72

Table 525

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance
100	3.30	±0.72
200	7.33	
300	11.41	
400	15.59	
500	19.84	
550	21.97	-0.16+0.72
600	24.10	±0.08
620	24.95	±0.04
650	26.23	±0.08
700	28.34	±0.08
750	30.43	±0.16
800	32.51	-0.72+0.16
900	36.56	±0.72
1000	40.51	±0.72

Table 526

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction at +20°C	Tolerance (mV)
100	3.30	±0.8
200	7.33	
250	9.36	
300	11.41	
400	15.59	
500	19.84	
550	21.97	-0.8, +0.2
600	24.10	±0.2
650	26.23	±0.12
700	28.34	
715	28.97	
725	29.39	±0.04
750	30.43	±0.12
800	32.51	-0.8, +0.2
900	36.56	±0.8

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Table 527

Indicated Temperature (^{o}C)	e.m.f. (mV) Reference Junction at 20^{o}C	Tolerance (mV)
100	3.30	
200	7.33	
300	11.41	±0.80
400	15.59	
500	19.84	
550	21.97	-0.32, +0.80
600	24.10	±0.16
640	25.81	±0.04
650	26.23	±0.16
700	28.34	
750	30.43	±0.32
800	32.51	-0.80, +0.32
900	36.56	±0.80

Table 528

Indicated Temperature (^{o}C)	e.m.f. (mV) Reference Junction at 20^{o}C	Tolerance (mV)
100	3.30	
200	7.33	
300	11.41	±0.72
400	15.59	
500	19.84	
600	24.10	-0.16, +0.72
650	26.23	±0.16
700	28.34	
750	30.43	±0.08
800	32.51	
810	32.91	±0.04
850	34.55	+0.16, -0.72
900	36.56	
1000	40.51	±0.72
1100	44.34	

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Table 529

Indicated Temperature (^{o}C)	e.m.f. (mV) Reference Junction at 20^{o}C	Tolerance (mV)
100	3·30	±0·72
200	7.33	
300	11.41	
400	15.59	
500	19.84	
550	21.97	
600	24.10	-0·72 +0·16
650	26.23	±0·16
700	28.34	
750	30.43	±0·08
800	32.51	
805 (Set point)	32.71	±0·04
850	34.55	+0·72 -0·16
900	36.56	±0·72
1000	40.51	
1100	44.34	
1200	48.05	

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Table 530

Indicated Temperature (^{o}C)	e.m.f. (mV) Reference Junction at 20^{o}C	Tolerance (mV)
100	3·30	
200	7·33	
300	11·41	±0·72
400	15·59	
500	19·84	
600	24·10	
700	28·34	-0·72 +0·16
750	30·43	±0·16
800	32·51	
850	34·55	±0·08
900 (Set point)	36·56	±0·04
910	36·96	
930	37·76	±0·08
940	38·16	
950	38·55	+0·72 -0·16
1000	40·51	
1100	44·34	±0·72
1200	48·05	

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Table 531

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction at 20°C	Tolerance (mV)
100	3.30	±0.72
200	7.33	
300	11.41	
400	15.59	
500	19.84	
600	24.10	
650	26.23	
700	28.34	+0.16-0.72
750	30.43	±0.08
791 (Set point)	32.13	±0.04
800	32.51	±0.08
850	34.55	±0.08
900	36.56	±0.12
950	38.53	-0.16+0.72
1000	40.51	±0.72
1100	44.34	

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Table 532

Indicated Temperature (^{o}C)	e.m.f. (mV) Reference Junction at $20^{o}C$	Tolerance (mV)
100	3.30	±0.80
200	7.33	
300	11.41	
400	15.59	
500	19.84	
550	21.97	-0.32 +0.80
600	24.10	±0.16
640	25.81	±0.04
650	26.23	±0.16
700	28.34	
750	30.43	±0.32
800	32.51	-0.80 +0.32
900	36.56	±0.80

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MILLIVOLTMETER TEMPERATURE INDICATORS

TESTING

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1. GENERAL

The following tests are those which are to be carried out after overhaul or whenever any component has been renewed or repaired. They are also the only tests necessary to establish the serviceability of an indicator.

The tests are to be made at an ambient temperature of 15°C to 25°C and, unless otherwise stated, with the instrument in the normal viewing attitude. Light tapping of the indicator is permitted in all tests except the friction test.

NOTE : The three-figure suffix included in the code number of some units denotes the SET point referred to in the following procedure. On units with code numbers without this suffix, the SET point is engraved on the dial.

2. EQUIPMENT REQUIRED

To carry out the testing of the indicator, items 1, 8, 9, 10, 11, 12, 13 and 15 of the list on page 1001 will be required for indicators used in single thermocouple systems; items 1, 8, 9, 15, 18, 19, 20 and 21 for indicators used in two series connected thermocouple systems (see DATA).

3. PROCEDURE

Remove the shorting strap from between the terminal screws.

A. Insulation Resistance

Using a 500V d.c. insulation tester, measure the insulation resistance between the terminals and the case. The resistance must not be less than 20 megohms.

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NOTES : 1. To determine the appropriate table for subsequent procedures, refer to table 701. Tables are located at the end of this topic.

2. Before commencing the following procedures, the indicator must be maintained at a temperature between 15 and 25 °C for one hour. It is important that the temperature remains substantially constant. If the ambient temperature is not 20 °C, correct the voltages given in the tables as follows :

(a) Indicators with short bimetal. Add 0.03mV for each deg C below 20 °C or subtract 0.03mV for each deg C above 20 °C.

(b) All other indicators. Add 0.04mV for each deg C below 20 °C or subtract 0.04mV for each deg C above 20 °C.

3. Indicators with TEST + terminal

The tests must first be carried out with the TEST + terminal connected using voltage equivalents for single systems and then repeated with the + terminal connected and using voltage equivalents for double systems (see table).

B. Accuracy Test

(1) Connect the indicator to the test circuit as shown in fig. 701. Set the decade box to the appropriate external resistance of the indicator under test (see DATA).

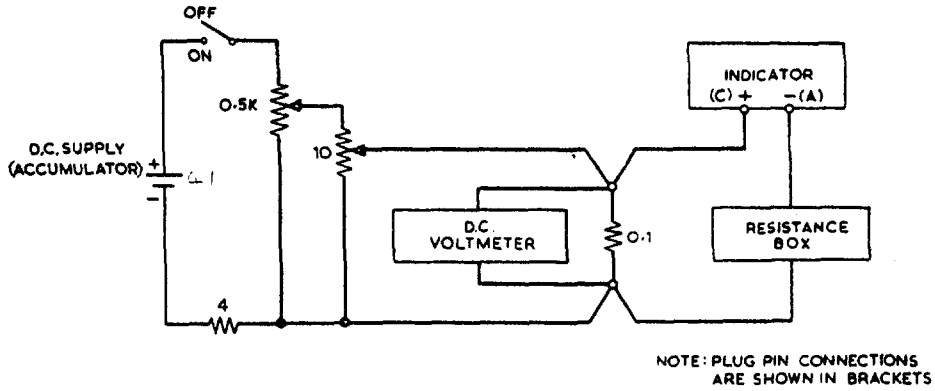


Fig. 701 Test circuit

(2) Switch on the supply and, referring to DATA and the table, adjust the controls to inject the voltage equivalent to the SET point. If necessary, adjust the zero adjuster to align the pointer with the SET point.

(3) Adjust the controls to align the pointer, in turn, with each scale mark specified in the table and at each setting check that the voltmeter indication is within the specified tolerance.

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C. Friction Test

The indicator remains connected as for the previous procedure.

(1) With the dial in the vertical plane, adjust the controls to align the pointer with the dial vertical centre line.

(2) Adjust the controls to align the pointer at the minimum temperature scale mark. Lightly tap the indicator.

NOTE : During the following procedure it is important that :

(a) The pointer does not overshoot the selected scale mark. If pointer overshoot does occur, the procedure must be repeated.

(b) The indicator is not subjected to vibration except where specified.

(3) Gradually adjust the controls until the pointer is aligned to a scale mark on or near the dial vertical centre line. Record the voltmeter indication.

(4) Adjust the controls so that the pointer is at the maximum end of the scale. Lightly tap the indicator.

(5) Adjust the controls until the pointer is aligned with the scale mark selected in para.(3). Record the voltmeter indication.

(6) Check that the difference in the recorded voltmeter indications does not exceed :

(a) Indicators used in double system, 1.60mV.

(b) All other indicators, 0.80mV.

D. Balance Test

The indicator remains connected as shown in fig.701.

(1) Position the indicator so that the dial is in the horizontal plane and adjust the controls until the pointer is aligned to a scale mark on or near the dial vertical centre line.

(2) Position the indicator so that the dial is in the vertical plane.

(3) Turn the indicator so that the pointer successively points horizontally left, vertically upwards, horizontally right and vertically downwards and at each position check that any deviation of the pointer from the selected scale mark does not exceed ±10°C.

E. Damping Test

The indicator remains connected as shown in fig. 701.

(1) Adjust the controls to set the indicator pointer to 80% of full scale deflection. Switch off the supply.

(2) Switch on the supply and check that the pointer, on its first overswing, does not exceed full scale deflection.

(3) Switch off the supply and disconnect the indicator from the test circuit.

F. Final

(1) Connect the terminals together with a suitable shorting strap to protect the movement.

(2) Tighten the terminal screws.

Table 701

Indicator	Table
*/727MV/BU/1	702A
*/727MV/BU/2	
*/727MV/BU/3	
*/727MV/BU/4	
*/727MV/BU/5	
*/727MV/BU/7	
*/727MV/BU/8	
*/727MV/BU/11	
*/727MV/BU/14	
*/727MV/BU/15	
*/727MV/BU/20/500	
*/727MV/BU/21/500	
*/727MV/BU/26	
*/727MV/BU/34/700	
*/727MV/BU/39/700	
*/727MV/BU/40/700	
*/727MV/BU/43/550	
*/727MV/BU/44/700	
*/727MV/BU/46/650	
*/727MV/BU/48	
*/727MV/BU/51/700	
*/727MV/BU/53/650	
*/727MV/BU/62/700	
*/727MV/BU/63	
*/727MV/BU/50	702B
*/727MV/BU/6	703
*/727MV/BU/10	
*/727MV/BU/12	
*/727MV/BU/16	704
*/727MV/BU/17/640	705
*/727MV/BU/18/580	706
*/727MV/BU/18/610	
*/727MV/BU/18/620	
*/727MV/BU/33/580	
*/727MV/BU/47/580	

Indicator	Table
*/727MV/BU/18/640	707
*/727MV/BU/68/640	
*/727MV/BU/22	708
*/727MV/BU/32	
*/727MV/BU/37	
*/727MV/BU/38	
*/727MV/BU/24	709
*/727MV/BU/56/730	
*/727MV/BU/57/740	
*/727MV/BU/59/720	
*/727MV/BU/60/720	
*/727MV/BU/65/720	
*/727MV/BU/25/640	710
*/727MV/BU/64/660	
*/727MV/BU/66/660	
*/727MV/BU/30	711
*/727MV/BU/19	712
*/727MV/BU/17/580	713
*/727MV/BU/17/600	714
*/727MV/BU/28/580	715
*/727MV/BU/20/560	716
*/727MV/BU/42/690	717
*/727MV/BU/54/690	
*/727MV/BU/53/750	717A
*/727MV/BU/61/750	
*/727MV/BU/69/750	

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Indicator	Table
*/762MV/BU/1/740	718
*/762MV/BU/3/560	719
*/762MV/BU/3/520	720
*/762MV/BU/20/860	721
*/762MV/BU/2/580	722
*/762MV/BU/5/590	722
*/762MV/BU/6/580	722
*/762MV/BU/16/580	722
*/762MV/BU/5/600	723
*/762MV/BU/7	724
*/762MV/BU/8/550	724
*/762MV/BU/9/550	724
*/762MV/BU/10/700	724
*/762MV/BU/12	724
*/762MV/BU/18/740	724
*/762MV/BU/18/750	724
*/762MV/BU/19/700	724
*/762MV/BU/21/860	724
*/762MV/BU/22/680	724
*/762MV/BU/23/860	724
*/762MV/BU/24/790	724
*/762MV/BU/25/720	724
*/762MV/BU/26/700	724
*/762MV/BU/27/860	724
*/762MV/BU/28/800	724
*/762MV/BU/30/770	724
*/762MV/BU/33/700	724
*/762MV/BU/34/700	724
*/762MV/BU/36/860	724
*/762MV/BU/37/800	724
*/762MV/BU/38/790	724
*/762MV/BU/40/860	724
*/762MV/BU/11	725

Indicator	Table
*/762MV/BU/15/725	726
*/762MV/BU/52/640	727
*/762MV/BM/31/810	728
*/762MV/BU/41/805	729
*762MV-BU43-900	730
*762MV-BU42-900	730
762MV-BM44-791	731
*/727MV/BU/52/640	732

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Table 702A and B

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	
	A	B
20	0	0.40
100	3.30	3.70
200	7.33	7.73
300	11.41	11.81
350	13.49	13.89
400	15.59	15.99
450	17.70	18.10
500	19.84	20.24
550	21.97	22.37
600	24.10	24.50
650	26.23	26.63
700	28.34	28.74
750	30.43	30.83
800	32.51	32.91
850	34.55	34.95
900	36.56	36.96
950	38.55	38.95
1000	40.51	40.91
1100	44.34	44.74
1200	48.05	48.45

Tolerances

Dial Reading (°C)	Tolerance (mV)
Set point	±0.08
Up to 50°C either side of set point	±0.20
Upper limit of expanded scale	-1.20+0.40
Lower limit of expanded scale	-0.40+1.20
Remainder of expanded scale	±0.40
Unexpanded scale	±1.20

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Table 703

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C
20	0.22
100	3.52
200	7.55
300	11.63
400	15.81
450	17.93
500	20.06
550	22.19
600	24.32
650	26.44
700	28.56
750	30.64
800	32.73
850	34.77
900	36.78
950	38.77
1000	40.73
1100	44.56
1200	48.27

Tolerance

Dial Reading (°C)	Tolerance (mV)
Set point	±0.08
Up to 50°C either side of set point	±0.20
Upper limit of expanded scale	-1.20+0.40
Lower limit of expanded scale	-0.40+1.20
Remainder of expanded scale	±0.40
Unexpanded scale	±1.20

Table 704

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.30	±1.20
200	7.33	
300	11.41	
400	15.59	
500	19.84	
600	24.10	-0.40+1.20
650	26.23	±0.40
700	28.34	
750	30.43	±0.20
790	32.10	±0.08
800	32.51	±0.20
850	34.55	-1.20+0.20
900	36.56	±1.20
1000	40.51	

Table 705

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.52	±1.20
200	7.55	
300	11.63	
400	15.81	
450	17.93	-0.40+1.20
500	20.06	±0.40
550	22.19	
600	24.32	±0.20
640	26.02	±0.08
650	26.44	±0.20
700	28.56	-1.20+0.20
800	32.73	±1.20

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Table 706

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
580 Set Point	23.25	±0.08
610	24.53	
620	24.95	
100	3.30	±1.20
200	7.33	
300	11.41	
400	15.59	
450	17.70	-0.40+1.20
500	19.84	±0.40
550	21.97	±0.20
600	24.10	
650	26.23	
700	28.34	-1.20+0.40
800	32.51	±1.20

Table 707

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.30	±1.20
200	7.33	
300	11.41	
400	15.59	
450	17.70	-0.40+1.20
500	19.84	±0.40
550	21.97	
600	24.10	±0.20
640	25.81	±0.08
650	26.23	±0.20
700	28.34	-1.20+0.20
800	32.51	±1.20

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Table 708

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C
20	0
100	6.60
200	14.66
300	22.82
400	31.18
450	35.40
500	39.68
550	43.94
600	48.20
650	52.46
700	56.68
750	60.86
800	65.02
900	73.12
1000	81.02
1100	88.68
1200	96.10

Tolerances

Dial Reading (°C)	Tolerance (mV)
Set point	±0.16
Up to 50°C either side of set point	±0.40
Upper limit of expanded scale	-2.40+0.80
Lower limit of expanded scale	-0.80+2.40
Remainder of expanded scale	±0.80
Unexpanded scale	±2.40

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Table 709

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
720 Set Point	29.18	±0.08
730 Set Point	29.60	±0.08
740 Set Point	30.02	±0.08
100	3.30	±1.20
200	7.33	±1.20
300	11.41	±1.20
400	15.59	±1.20
500	19.84	±1.20
550	21.97	-0.40+1.20
600	24.10	±0.40
650	26.23	±0.20
700	28.34	±0.20
750	30.43	±0.20
800	32.51	-1.20+0.40
900	36.56	±1.20
1000	40.51	±1.20
1100	44.34	±1.20
1200	48.05	±1.20

Table 710

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
640 Set Point	25.81	±0.08
660 Set Point	26.65	±0.08
100	3.30	
200	7.33	±1.20
300	11.41	
400	15.59	
500	19.84	-0.40+1.20
550	21.97	±0.40
600	24.10	±0.20
650	26.23	±0.20
700	28.34	
750	30.43	-1.20+0.40
800	32.51	±1.20
900	36.56	

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Table 711

Indicated Temperature (°C)	Single e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)	Double e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.30	±1.20	6.60	±2.40
200	7.33		14.66	
300	11.41		22.82	
400	15.59		31.18	
500	19.84		39.68	
550	21.97	-0.40+1.20	43.94	-0.80+2.40
600	24.10	±0.40	48.20	±0.80
650	26.23	±0.20	52.46	±0.40
700	28.34		56.68	
720	29.18	±0.08	58.36	±0.16
750	30.43	±0.20	60.86	±0.40
800	32.51	-1.20+0.40	65.02	-2.40+0.80
900	36.56	±1.20	73.12	±2.40
1000	40.51		81.02	
1100	44.34		88.68	
1200	48.05		96.10	

Table 712

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.30	±1.20
200	7.33	
300	11.41	
400	15.59	
500	19.84	
600	24.10	
700	28.34	
750	30.43	-0.40+1.20
800	32.51	±0.40
850	34.55	±0.20
900	36.56	
920	37.36	±0.08
950	38.55	±0.20
1000	40.51	-1.20+0.40
1100	44.34	±1.20
1200	48.05	

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Table 713

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.52	±1.20
200	7.55	
300	11.63	
400	15.81	
450	17.93	-0.40+1.20
500	20.06	±0.40
550	22.19	±0.20
580	23.48	±0.08
600	24.32	±0.20
650	26.44	
700	28.56	-1.20+0.40
800	32.73	±1.20

Table 714

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.52	±1.20
200	7.55	
300	11.63	
400	15.81	
450	17.93	-0.40+1.20
500	20.06	±0.40
550	22.19	±0.20
600	24.32	±0.08
650	26.44	±0.20
700	28.56	-1.20+0.30
800	32.73	±1.20

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Table 715

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.30	±1.20
200	7.33	
300	11.41	
400	15.59	-0.40+1.20
450	17.70	±0.40
500	19.84	±0.20
550	21.97	
580	23.25	±0.08
600	24.10	±0.20
650	26.23	-1.20+0.40
700	28.34	±1.20
800	32.51	

Table 716

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.52	±1.20
200	7.55	
300	11.63	
400	15.81	-0.40+1.20
450	17.93	±0.40
500	20.06	±0.20
550	22.19	
560	22.61	±0.08
600	24.32	±0.20
650	26.44	-1.20+0.40
700	28.56	±1.20
800	32.73	

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Table 717

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.30	
200	7.33	
300	11.41	±1.20
400	15.59	
500	19.84	
550	21.97	-0.40+1.20
600	24.10	±0.40
640	25.81	±0.20
650	26.23	
690	27.92	±0.08
700	28.34	±0.20
740	30.01	
750	30.43	±0.40
800	32.51	-1.20+0.40
900	36.56	±1.20
1000	40.51	

Table 717A

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.30	
200	7.33	
300	11.41	±1.20
400	15.59	
500	19.84	
550	21.97	-0.40+1.20
600	24.10	±0.40
650	26.23	
700	28.34	±0.20
750	30.43	±0.08
800	32.51	-0.20+1.20
900	36.56	±1.20
1000	40.51	

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Table 718

Indicated Temperature (°C)	e.m.f. (mV) Referemce Junction 20°C	Tolerance (mV)
100	3.30	
200	7.33	
250	9.36	±0.80
300	11.41	
400	15.59	
500	19.84	-0.20+0.80
600	24.10	±0.20
645	26.02	
680	27.49	
700	28.34	±0.12
715	28.97	
740	30.01	±0.08
750	30.43	-0.80+0.12
800	32.51	±0.80

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Table 719

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.52	±0.80
200	7.55	
300	11.63	
400	15.81	-0.20+0.80
450	17.93	±0.20
500	20.06	±0.12
550	22.19	
560	22.62	±0.08
600	24.32	±0.12
650	26.44	-0.80+0.20
700	28.56	±0.80
800	32.73	

Table 720

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.52	±0.80
200	7.55	
300	11.63	
400	15.81	-0.20+0.80
450	17.93	±0.20
500	20.06	±0.12
520	20.90	±0.08
550	22.19	±0.12
600	24.32	
650	26.44	-0.80+0.20
700	28.52	±0.80
800	32.73	

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Table 721

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction at 20°C	Tolerance (mV)
100	3·30	±0·80
200	7·33	±0·80
300	11·41	±0·80
400	15·59	±0·80
500	19·84	±0·80
600	24·10	±0·80
700	28·34	-0·20 +0·80
730	29·59	±0·20
750	30·43	±0·20
800	32·51	±0·12
850	34·55	±0·12
860 (Set point)	34·95	±0·08
900	36·56	±0·12
930	37·75	±0·20
950	38·55	-0·80 +0·20
1000	40·51	±0·80
1100	44·34	±0·80
1200	48·05	±0·80

Table 722

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction at 20°C	Tolerance (mV)
580 Set	23·25	
590 Point	23·68	±0·08
100	3·30	
200	7·33	±0·08
300	11·41	
400	15·59	-0·20 +0·80
450	17·70	±0·20
500	19·84	
550	21·97	±0·12
600	24·10	
650	26·23	-0·80 +0·20
700	28·34	
800	32·51	±0·80

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Table 723

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.30	±0.80
200	7.33	
300	11.41	
400	15.59	-0.20+0.80
450	17.70	±0.20
500	19.84	
550	21.97	
600	24.10	±0.08
650	26.23	-0.80+0.20
700	28.34	±0.80
800	32.51	

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Table 724

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C
20	0
100	3.30
200	7.33
300	11.41
350	13.49
400	15.59
450	17.70
500	19.84
550	21.97
600	24.10
650	26.23
700	28.34
750	30.43
800	32.51
850	34.55
900	36.56
950	38.55
1000	40.51
1100	44.34
1200	48.05

Tolerances

Dial Reading (°C)	Tolerance (mV)
Set point	±0.08
Up to 50°C either side of set point	±0.12
Upper limit of expanded scale	-0.80+0.20
Lower limit of expanded scale	-0.20+0.80
Remainder of expanded scale	±0.20
Unexpanded scale	±0.80

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Table 725

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction 20°C	Tolerance (mV)
100	3.30	±0.72
200	7.33	
300	11.41	
400	15.59	
500	19.84	
550	21.97	-0.16+0.72
600	24.10	±0.08
620	24.95	±0.04
650	26.23	±0.08
700	28.34	±0.08
750	30.43	±0.16
800	32.51	-0.72+0.16
900	36.56	±0.72
1000	40.51	±0.72

Table 726

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction at +20°C	Tolerance (mV)
100	3.30	±0.8
200	7.33	
250	9.36	
300	11.41	
400	15.59	
500	19.84	
550	21.97	-0.2, +0.8
600	24.10	±0.2
650	26.23	
700	28.34	±0.12
715	28.97	±0.08
725	29.39	±0.12
750	30.43	-0.8, +0.2
800	32.51	±0.8
900	36.56	

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Table 727

Indicated Temperature (^{o}C)	e.m.f. (mV) Reference Junction at 20^{o}C	Tolerance (mV)
100	3.30	±1.20
200	7.33	
300	11.41	
400	15.59	
500	19.84	
550	21.97	-0.40, +1.20
600	24.10	±0.20
640	25.81	±0.08
650	26.23	±0.20
700	28.34	
750	30.43	±0.40
800	32.51	-1.20, +0.40
900	36.56	±1.20

Table 728

Indicated Temperature (^{o}C)	e.m.f. (mV) Reference Junction at 20^{o}C	Tolerance (mV)
100	3.30	±0.80
200	7.33	
300	11.41	
400	15.59	
500	19.84	
600	24.10	-0.20, +0.80
650	26.23	±0.20
700	28.34	
750	30.43	±0.12
800	32.51	
810	32.91	±0.08
850	34.55	+0.20, -0.80
900	36.56	±0.80
1000	40.51	
1100	44.34	

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Table 729

Indicated Temperature (^{o}C)	e.m.f. (mV) Reference Junction at 20^{o}C	Tolerance (mV)
100	3·30	
200	7·33	
300	11·41	±0·8
400	15·59	
500	19·84	
550	21·97	
600	24·10	+0·2 -0·8
650	26·23	±0·2
700	28·34	
750	30·43	±0·12
800	32·51	
805 (Set point)	32·71	±0·08
850	34·55	-0·2 +0·8
900	36·56	
1000	40·51	±0·8
1100	44·34	
1200	48·05	

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Table 730

Indicated Temperature (^{o}C)	e.m.f. (mV) Reference Junction at 20^{o}C	Tolerance (mV)
100	3·30	±0·80
200	7·33	
300	11·41	
400	15·59	
500	19·84	
600	24·10	
700	28·34	+0·2 -0·8
750	30·43	±0·2
800	32·51	
850	34·55	±0·12
900 (Set point)	36·56	±0·08
910	36·96	±0·12
930	37·76	
940	38·16	
950	38·55	-0·2 +0·8
1000	40·51	±0·8
1100	44·34	
1200	48·05	

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Table 731

Indicated Temperature (°C)	e.m.f. (mV) Reference Junction at 20°C	Tolerance (mV)
100	3.30	±0.80
200	7.33	
300	11.41	
400	15.59	
500	19.84	
600	24.10	
650	26.23	
700	28.34	+0.2-0.80
750	30.43	±0.12
791 (Set point)	32.13	±0.08
800	32.51	±0.12
850	34.55	±0.12
900	36.56	±0.2
950	38.53	-0.2+0.80
1000	40.51	±0. 80
1100	44.34	

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Table 732

Indicated Temperature (^{o}C)	e.m.f. (mV) Reference Junction at $20^{o}C$	Tolerance (mV)
100	3.30	±1.20
200	7.33	
300	11.41	
400	15.59	
500	19.84	
550	21.97	-0.40 +1.20
600	24.10	±0.20
640	25.81	±0.08
650	26.23	±0.20
700	28.34	
750	30.43	±0.40
800	32.51	-1.20 +0.40
900	36.56	±1.20

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MILLIVOLTMETER TEMPERATURE INDICATORS

TROUBLE SHOOTING

1. GENERAL

It must be noted that whenever any adjustment, repair, or component replacement has been carried out, the unit must be subjected to the complete series of tests described in TESTING.

2. FAULTS LIKELY IN SERVICE

The design of this instrument is such that faults do not fall into the two distinct patterns of those likely in service and those likely after overhaul. Furthermore, investigation of any fault is best carried out at an overhaul base. For these reasons, all procedures are covered as 'Faults Likely After Overhaul'.

3. FAULTS LIKELY AFTER OVERHAUL

A. When the serviceability of an indicator is suspect, it should be subjected to the sequence of tests described in TESTING until it fails to pass a particular test. Reference should then be made to the appropriate paragraph below, and remedial action taken as appropriate. The unit should then again be subjected to the sequence of tests, until either it fails to pass a particular test or, alternatively, passes successfully through the entire sequence. Should another fault be encountered, the tracing, repair and re-testing cycle should be repeated until all test results are satisfactory.

B. Accuracy Test

(1) Failure to pass the accuracy test, described in TESTING 3.B., can be caused by:

(a) Defective series resistor.

(b) Defective hairspring or ligament.

(c) Defective moving element coil and padding resistor.

(d) Moving element end shake incorrect.

(e) Hairs or foreign particles in the magnet gaps.

(f) Defective pivots or jewel bearings.

(g) Movement out of balance.

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(2) If the pointer does not move when a voltage is applied to the indicator, remove the instrument case and check the series resistor for open circuit. A defective series resistor must be renewed and adjusted, see ASSEMBLY.

(3) If the series resistor is not defective, check the ligament and hairspring connections. Resolder if necessary. If the connections are satisfactory, check the moving coil and padding resistor for open circuit. Renew the moving coil or padding resistor as necessary and adjust the padding resistor as described in ASSEMBLY.

(4) If the pointer movement is jerky, or erratic, remove the case, check, and if necessary, adjust the moving element endshake or the magnet arm endshake as described in ASSEMBLY.

(5) If the endshake is correct, remove the dial, dial mask and front shield, and using an eyeglass, examine the magnet gaps for foreign particles.

(6) If the pointer movement is still erractic or jerky, examine the moving element or magnet arm pivots. Renew either the moving element as described in REPAIR, or the magnet arm as necessary. Examine the jewel bearings and renew as necessary.

(7) If the pointer moves smoothly over the dial, but indicates a progressive error, remove the case and examine the hairspring. If necessary renew as described in REPAIR.

(8) If the pointer moves smoothly over the dial, but shows inconsistent errors, check the balance of the instrument, and if necessary, re-balance the movement as described in ASSEMBLY.

(9) If the pointer readings are still out of tolerance, calibrate a new blank dial.

(10) After correction, repeat TESTING.

C. Friction Test

(1) Failure to pass the friction test described in TESTING 3.C can be caused by:

(a) Defective moving element or magnet arm pivots.

(b) Defective moving element or magnet arm jewel bearings.

(c) Insufficient endshake on the moving element or magnet arm spindle.

(2) Disassemble the indicator and examine the moving element or magnet arm pivots and jewel bearings. If the moving element pivots are defective, renew the moving element as described in REPAIR. If the magnet arm pivots are defective, renew the magnet arm. Renew any defective jewel bearings. Adjust the endshake of the moving element pivot and magnet arm pivot as described in ASSEMBLY.

(3) After correction, repeat TESTING.

D. Balance Test

(1) Failure to pass the balance test described in TESTING 3.D is caused by faulty movement balance.

(2) Disassemble the indicator from the case and re-balance the movement as described in ASSEMBLY.

(3) After correction repeat TESTING.

MILLIVOLTMETER TEMPERATURE INDICATORS

STORAGE INSTRUCTIONS

NOTE: *These instructions are applicable to temperate and tropical* climates and the packaging is suitable for storage and transit purposes.

1. PACKAGING PROCEDURE

A. Ensure the shorting strap is fitted between the terminals.

B. Record the details shown on the unit nameplate. Attach warning label (Smiths Code 86-837-384) to the unit.

C. Wrap the unit in waxed paper and secure a protective pad to each end of the unit with adhesive tape.

D. Place the unit in a polythene bag with a label showing the code and serial number of the unit.

E. Partially heat-seal the bag, expel as much air as possible and complete the seal.

F. Place the unit in the container. If necessary wrap the unit so that it fits securely into the shock-resistant material.

G. Close the container lid and secure it with waterproof adhesive tape.

H. Secure to the container a label giving the following information:

(1) Name, code and serial number of the unit.

(2) Modification state.

(3) Date of last overhaul.

(4) Note and date of any component change.

(5) Reason for return, if applicable.

Protect the label with transparent adhesive tape.

2. STORAGE CONDITIONS

For this information refer to publication SAV/OH/SPR.

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3. STORAGE LIMITING PERIOD

For this information reference should be made to publication SAV/OH/SPR. Re-certification and re-storage after this period is dependent upon satisfactory completion of the following procedure:

A. Remove the unit from its packing.

B. Examine the unit visually for signs of corrosion or damage.

C. Carry out the complete procedure described in TESTING.

D. Pack the unit in accordance with 1. above.

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MILLIVOLTMETER TEMPERATURE INDICATORS

SPECIAL TOOLS, FIXTURES AND EQUIPMENT

1. GENERAL

Items with an LMT part number are for local manufacture. Full manufacturing information for these items may be obtained from the vendor. When requesting information please quote the part number.

2. TOOLS, FIXTURES AND EQUIPMENT

Item	Description	Part No. or Ref.	Vendor
1	D.C. Potentiometer and galvanometer or digital valve voltmeter. Accuracy better than 0.1% over the range 0-50mV. (0-100mV for indications in double systems)	As available	
2	Magnetizer	As available Magnetech MC2000J is suitable (see NOTES)	Magnetech
3	Demagnetizer	99 LMT	Smiths Industries
4	Magnetizing blocks	218 LMT	Smiths Industries
5	Leak testing, evacuation, and gas filling equipment	As available M59VBC is suitable	Veeco
6	Counterweight adjusting tools	235 LMT	Smiths Industries
7	Oven (90°C)	As available	
8	Insulation tester (500V d.c. 20 MΩ)	As available	
9	Decade box 0-1000Ω, accuracy better than ±0.1%	As available	
*10	Resistor 4Ω ± 1%, 1W	As available	
*11	Variable resistor 0.5kΩ, 1W	As available	
*12	High resolution variable resistor 10Ω, 1W	As available	
*13	2V accumulator	As available	

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Item	Description	Part No. or Ref.	Vendor
14	Bridge megger	As available	
15	Standard resistance 0.1Ω ± 0.1%	As available	
16	Multi-range testmeter	As available	
17	Crimping tool	A-MP47386/8	A-MP
**18	Resistor 4Ω ± 1%, 4.5 W	As available	
**19	Variable resistor 0.5 K, 4.5 W	As available	
**20	High resolution variable resistor 10Ω, 5 W	As available	
**21	4 V accumulator	As available	
22	Balancing fixture	892 LMT	Smiths Industries
23	Dummy case (see NOTES)	1402/1 TE	Smiths Industries
24	Dial detail drawing	See para. 6.	Smiths Industries
25	Refrigerator	As available	
26	Binocular microscope (magnification x 30)	As available	

NOTES: (1) Items marked thus * are required for indicators used in single thermocouple systems only. Items marked thus ** are required for indicators used in two series connected thermocouple systems only.

(2) A spare indicator case with the glass removed can be used in place of 1402/1 TE.

(3) The magnet is manufactured from Alcomax III.

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3. CLEANING AGENTS

Category		Nomenclature and British Specification or Vendors Trade Name	Alternative Specification	Vendor
Cleanser	A	Iso-propyl alcohol or methylated spirits		Commercially available
Cleanser	B	Trichlorotrifluoroethane 1.1.2		
Solvent	C	Methyl ethyl ketone		

4. MATERIALS

Category		Nomenclature and British Specification or Vendors Trade Name	Alternative Specification	Vendor
Lubricant	A	Oil to DEF STAN 91-49		Commercially available
Solder	B	BS219 Grade K, BS441		Multicore Solders
Solder	C	Comsol		
Solder	D	Pure tin solder		
Adhesive	E	Bostik 1768		Bostik
Lubricant	F	Kalubleum M.O.L.T.		Ragosine
Lockant	G	Akard, CS2465, Type D (18683)		Llewellyn Ryland
Paint	H	Semi-matt black 2SL/5459. Catalyst CSL 6201A. Thinners TSL 5373		International Paints
Gas	I	Oxygen-free nitrogen		As available

5. VENDOR'S ADDRESSES

Vendor	Full Name and Address
Smiths Industries	Smiths Industries, Aerospace and Defence Systems Limited, Product Support, Northolt Road, Heathrow Airport London, Hounslow, Middlesex, TW6 2LW, U.K.
Multicore Solders	Multicore Solders Limited, Multicore Works, Hemel Hempstead, Herts., U.K.
Llewellyn Ryland	Llewellyn Ryland Limited, Balsall Heath Works, Birmingham, 12, U.K.
Bostik	Bostik Ltd., Ulverscroft Road, Leicester.
Veeco	Veeco Instruments Limited, Marshalands Road, Farlington, Portsmouth, Hants., U.K.
International Paints	International Paints, 380 Richmond Road, Kingston-on-Thames, Surrey, KT2 5PS. U.K.
Magnetech	Magnetech Magnatising Techniques Ltd., Flemming Way, Crawley, Sussex RH10 2JY.

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Vendor	Full Name and Address
Ragosine	Ragosine Oil Co. Limited, Alanzol Refinery, Bream, Glos., U.K.
A-MP	Aircraft Marine Products Limited, 60, Kingly Street, Regent Street, London W.1, U.K.

6. DIAL DRAWING NUMBERS

Indicator Code	Dial Drawing Number
*/727MV/BU/1	*/MV4008
*/727MV/BU/2	*/MV4080
*/727MV/BU/3	*/MV4008
*/727MV/BU/4	*/MV4080
*/727MV/BU/5	*/MV4410
*/727MV/BU/6	*/MV4008
*/727MV/BU/7	*/MV4762
*/727MV/BU/8	*/MV4615
*/727MV/BU/10	*/MV4615
*/727MV/BU/11	*/MV4080
*/727MV/BU/12	*/MV4615
*/727MV/BU/14	*/MV4008
*/727MV/BU/15	*/MV4809
*/727MV/BU/16	*/MV4817
*/727MV/BU/17/580	*/MV4839
*/727MV/BU/17/600	*/MV4839
*/727MV/BU/17/640	*/MV4839
*/727MV/BU/18/580	*/MV4839
*/727MV/BU/18/610	*/MV4839
*/727MV/BU/18/620	*/MV4839
*/727MV/BU/18/640	*/MV4839
*/727MV/BU/19	*/MV4972

Indicator Code	Dial Drawing Number
*/727MV/BU/20/500	*/MV4979
*/727MV/BU/20/560	*/MV5349
*/727MV/BU/21/500	*/MV4974
*/727MV/BU/22	*/MV4008
*/727MV/BU/24	*/MV5075
*/727MV/BU/25/640	*/MV5073
*/727MV/BU/26	*/MV5101
*/727MV/BU/28/580	*/MV5115
*/727MV/BU/30	*/MV5075
*/727MV/BU/32	*/MV5280
*/727MV/BU/33/580	*/MV5407
*/727MV/BU/34/700	*/MV5579
*/727MV/BU/37	*/MV4615
*/727MV/BU/38	*/MV5783
*/727MV/BU/39/700	*/MV5900
*/727MV/BU/40/700	*/MV5903
*/727MV/BU/42/690	*/MV5898
*/727MV/BU/43/550	*/MV6108
*/727MV/BU/44/700	*/MV6246
*/727MV/BU/46/650	*/MV6307
*/727MV/BU/47/580	*/MV6285
*/727MV/BU/48	*/MV6320
*/727MV/BU/50	*/MV4008
*/727MV/BU/51/700	*/MV6571
*/727MV/BU/52/640	*/MV6821
*/727MV/BU/53/650	*/MV6660
*/727MV/BU/53/750	*/MV6660
*/727MV/BU/54/690	*/MV6658
*/727MV/BU/56/730	*/MV6666
*/727MV/BU/57/740	*/MV6684
*/727MV/BU/59/720	*/MV6696
*/727MV/BU/60/720	*/MV6768
*/727MV/BU/61/750	*/MV6773
*/727MV/BU/62/700	*/MV5903
*/727MV/BU/63	*/MV6865
*/727MV/BU/64/660	*/MV6882
*/727MV/BU/65/720	*/MV6940
*/727MV/BU/66/660	*/MV7328
*/727MV/BU/68/640	*/MV7375
*/727MV/BU/69/750	*/MV7386

Indicator Code	Dial Drawing Number
*/762MV/BU/1/740	*/MV5453
*/762MV/BU/2/580	*/MV6046
*/762MV/BU/3/520	*/MV5499
*/762MV/BU/3/560	*/MV5499
*/762MV/BU/5/590	*/MV5532
*/762MV/BU/5/600	*/MV6119
*/762MV/BU/6/580	*/MV5611
*/762MV/BU/7	*/MV5823
*/762MV/BU/8/550	*/MV6291
*/762MV/BU/9/550	*/MV6293
*/762MV/BU/10/700	*/MV6338
*/762MV/BU/11	*/MV6416
*/762MV/BU/12	*/MV6418
*/762MV/BU/15/725	*/MV6821
*/762MV/BU/16/580	*/MV6874
*/762MV/BU/18/740	*/MV6979
*/762MV/BU/18/750	*/MV6978
*/762MV/BU/19/700	*/MV6980
*/762MV/BU/20/860	*/MV7132
*/762MV/BU/21/860	*/MV7133
*/762MV/BU/22/680	*/MV7117
*/762MV/BU/23/860	*/MV7134
*/762MV/BU/24/790	*/MV7169
*/762MV/BU/25/720	*/MV7139
*/762MV/BU/26/700	*/MV7167
*/762MV/BU/27/860	*/MV7181
*/762MV/BU/28/800	*/MV7182
*/762MV/BU/30/770	*/MV6979
*/762MV/BM/31/810	LU/MV7295
*/762MV/BU/33/700	*/MV7334
*/762MV/BU/34/700	*/MV7335
*/762MV/BU/36/860	*/MV7350
*/762MV/BU/37/800	*/MV7355
*/762MV/BU/38/790	*/MV7360
*/762MV/BU/40/860	*/MV7365
*/762MV/BU/41/805	*/MV7370
*762MV-BU42-900	*MV7376
*762MV-BU43-900	*MV7378
762MV-BM44-791	MV7380

ILLUSTRATED PARTS LIST

WARNING: ONLY SPARES AND COMPONENTS SPECIFIED BY SMITHS INDUSTRIES SHOULD BE USED.

NOTE:

ORDERING

Certain spare parts listed in the IPL are manufactured by other contractors and have the manufacturer's number or British Standards reference quoted in addition to the part number which Smiths Industries Aerospace & Defence Systems Company supply.

When ordering from SI please quote the SI part number, the other manufacturer's number or British Standards reference and the code number of the LRU on all orders or enquiries.

When ordering from other manufacturers please quote the manufacturer's number and/or British Standards reference only.

NOTES:
1. The asterisk prefixing a part number is in place of the dial finish e.g. PW.

2. ILLUSTRATED PARTS LISTS for codes of Millivoltmeter Temperature Indicators not included in this page block, will be supplied on request.

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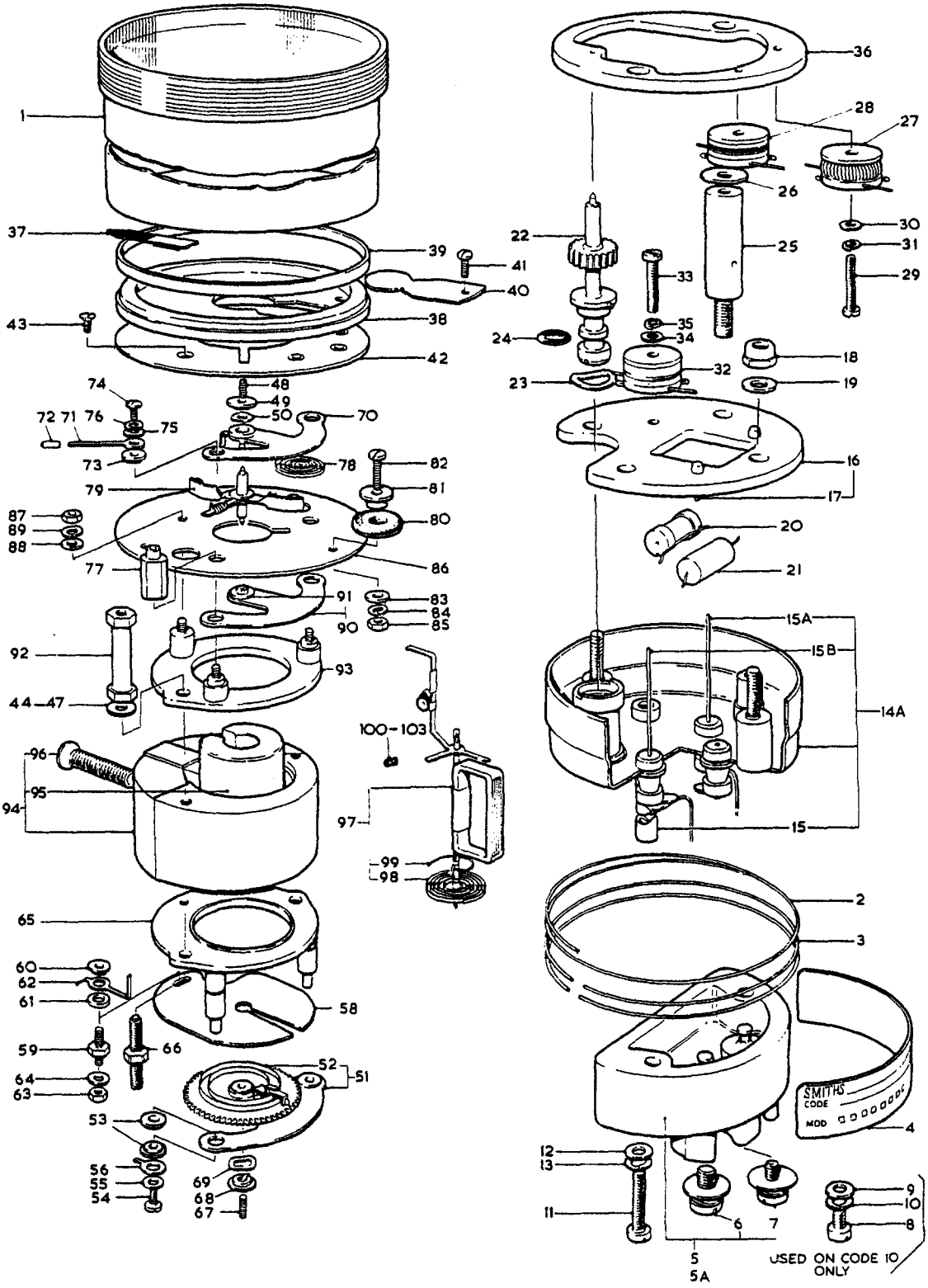


Fig.1101 Spares details

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Fig. & Index No.	Part Number	Nomenclature 1 2 3 4 5 6 7	Usage Code	Units per Assy.
1	2	3	4	5
		PLEASE QUOTE INSTRUMENT CODE FOR REFERENCE WHEN ORDERING SPARE PARTS		
1101				
	*727MVBU1	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU2	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU3	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU4	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU5	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU8	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU14	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU16	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU18-580	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU18-610	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	1	
	*727MVBU18-620	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU18-640	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU26	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU28-580	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU33-580	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU43-550	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU63	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU47-580	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU48	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU51-700	INDICATOR, MOVING COIL GRADED SCALE (MOD.02)		

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Fig. & Index No.	Part Number	Nomenclature 1 2 3 4 5 6 7	Usage Code	Units per Assy.
1	2	3	4	5
1101				
	*727MVBU6	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU10	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU12	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU17-580	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	2	
	*727MVBU17-600	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU17-640	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU60-720	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU65-720	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU11	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	3	
	*727MVBU24	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU34-700	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU15	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU39-700	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	4	
	*727MVBU19	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	5	
	*727MVBU20-500	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU20-560	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	6	
	*727MVBU21-500	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	7	
	*727MVBU22	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU32	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU37	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	8	
	*727MVBU38	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		

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Fig. & Index No.	Part Number	Nomenclature 1 2 3 4 5 6 7	Usage Code	Units per Assy.
1	2	3	4	5
1101				
	*727MVBU25-640	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	9	
	*727MVBU52-640	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU30	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	10	
	*727MVBU40-700	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	11	
	*762MVBU1-740	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	12	
	*762MVBU2-580	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	13	
	*762MVBU5-590	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*762MVBU16-580	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*762MVBU15-725	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*762MVBU6-580	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*762MVBU8-550	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	14	
	*762MVBU9-550	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*762MVBU11	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*762MVBU12	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*762MVBU7	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	15	
	*762MVBU3-520	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	16	
	*762MVBU3-560	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
R				
	*727MVBU42-690	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	17	
	*727MVBU46-650	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	18	
	*727MVBU50	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	19	

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Fig. & Index No.	Part Number	Nomenclature 1 2 3 4 5 6 7	Usage Code	Units per Assy.
1	2	3	4	5
1101	*727MVBU53-650	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU53-750	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	20	
	*727MVBU61-750	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*727MVBU54-690	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	21	
	*727MVBU56-730	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	22	
	*727MVBU57-740	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	23	
	*727MVBU59-720	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	24	
	*727MVBU44-700	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	25	
	*727MVBU62-700	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	26	
	*727MVBU7	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	27	
	*762MVBU18-740	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	28	
	*762MVBU23-860	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	29	
	*762MVBU22-680	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	30	
	*762MVBU25-720	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	31	
	*762MVBU24-790	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	32	
	*762MVBU26-700	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	33	
	*762MVBU27-860	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	34	
	*762MVBU28-800	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	35	
	*762MVBU30-770	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	36	
	LU762MVBU31-810	INDICATOR, TEMPERATURE	37	
	*762MVBU21-860	INDICATOR, TEMPERATURE (MOD.01, 02)	38	
	*727MVBU66-660	INDICATOR, TEMPERATURE (MOD.01, 02)	39	

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Fig. & Index No.	Part Number	Nomenclature 1 2 3 4 5 6 7	Usage Code	Units per Assy.
1	2	3	4	5
1101	*727MVBU64-660	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	40	
	*762MVBU33-700	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	41	
	*762MVBU34-700	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)		
	*762MVBU36-860	INDICATOR, TEMPERATURE (MOD.01, 02)	42	
	*762MVBU37-800	INDICATOR, TEMPERATURE (MOD.01, 02)	43	
	*762MVBU38-790	INDICATOR, TEMPERATURE (MOD.01, 02)	44	
	*762MVBU40-860	INDICATOR, TEMPERATURE (MOD.01, 02)	45	
	*762MVBU41-805	INDICATOR, TEMPERATURE (MOD.01, 02)	46	
	*762MVBU18-750	INDICATOR, TEMPERATURE (MOD.01, 02)	47	
	*762MVBU19-700	INDICATOR, TEMPERATURE (MOD.01, 02)	48	
	*762MVBU5-600	INDICATOR, TEMPERATURE (MOD.01, 02)	49	
	*762MVBU10-700	INDICATOR, TEMPERATURE (MOD.01, 02)	50	
	*762MVBU20-860	INDICATOR, MOVING COIL GRADED SCALE (MOD.01, 02)	51	
	*762MVBU43-900	INDICATOR, TEMPERATURE (MOD.01, 02)	52	
	*762MVBU42-900	INDICATOR, TEMPERATURE (MOD.01, 02)	53	
	762MVBM44-791	INDICATOR, TEMPERATURE (MOD.01, 02)	54	
R	*727MVBU69-750	INDICATOR, TEMPERATURE (MOD.01, 02)	55	
R	*727MVBU68-640	INDICATOR, TEMPERATURE (MOD.01, 02)	56	

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	Fig. & Index No.	Part Number	Nomenclature 1 2 3 4 5 6 7	Usage Code	Units per Assy.
	1	2	3	4	5
	1101				
R	1	STD1531-13	. CASE ASSEMBLY	1 to 15 17 to 25 28,33 36,39 40,41 47 to 50,56 55	1
	1	MV7246	. CASE ASSEMBLY	37,54	1
	1	STD2016-1	. CASE ASSEMBLY	6,16 29,34 38,42 45,51 52,53	1
	1	MV6686-1	. CASE ASSEMBLY	25	1
	1	MV6686-4	. CASE ASSEMBLY	26	1
	1	MV6686-3	. CASE ASSEMBLY	27	1
	1	STD2004-2	. CASE ASSEMBLY	30,31 32,35 43,44 46	1
	2	1814-404	. STRING, SILICONE, SILASTOMER DP2452	ALL	1 ft
	3	STD1809	. WIRE, SEALING	ALL	1
	4	STD2692	. NAMEPLATE, BLANK (ALTERNATIVE)	ALL	1
	4	MV3322	. NAMEPLATE, BLANK (ALTERNATIVE TO STD2692)	1,3 to 15 17,19 21,22 23,25 26,28 29,30	1
	4	MV4484	. NAMEPLATE, BLANK (ALTERNATIVE TO STD2692)	2,16 24	1
R	4	STD2346	. NAMEPLATE, BLANK (ALTERNATIVE TO STD2692)	18,20 55,56	1
R	5B	MV6885	. BLOCK ASSEMBLY, TERMINAL	1 to 9 11 to 36,56 38 to 53,55	
	5	MV7240	. BLOCK ASSEMBLY, TERMINAL	37,54	1
	5A	MV6204	. BLOCK ASSEMBLY, TERMINAL (MOD.01)	10	1
R	6	MV3115	. SCREW ASSEMBLY, TERMINAL	1 to 36,56 38 to 53,55	1

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	Fig. & Index No.	Part Number	Nomenclature 1 2 3 4 5 6 7	Usage Code	Units per Assy.
	1	2	3	4	5
	1101				
	6	MV7239	. SCREW ASSEMBLY, TERMINAL (M4)	37	1
R	7	MV3118	. SCREW ASSEMBLY, TERMINAL	1 to 36,56 38 to 53,55	1
	7	MV7238	. SCREW ASSEMBLY, TERMINAL (M5)	37	1
	8	30-295-401-23	. SCREW, 4-40 UNC X 3/16 IN.LG.	10	1
	9	SP26A	. WASHER, 6BA (SMITHS PT.NO.30-298-145-03)	10	1
	10	30-282-010-11	. WASHER, 6BA SPG.	10	1
	11	30-295-401-30	. SCREW, 4-40 UNC X $\frac{5}{8}$ IN.LG.	ALL	2
	12	SP25A	. WASHER, 6BA (SMITHS PT.NO.30-298-144-03)	ALL	2
	13	SP47A	. WASHER, 6BA SPG. (SMITHS PT.NO.30-298-211-01)	ALL	2
R	14A	MV6208	. CASE ASSEMBLY, BACK (MOD.01)	1 to 9 11 to 56	1
	14	MV4371	. CASE ASSEMBLY, BACK (PRE-MOD.01)	1 to 9 11 to 16 28,29	1
	14A	MV6209	. CASE ASSEMBLY, BACK (MOD.01)	10	1
	14	MV5170	. CASE ASSEMBLY, BACK (PRE-MOD.01)	10	1
	15	MV1728	.. TUBE, CAPILLARY	ALL	1
	15A	MV5109	.. WIRE, (MOD.01) ALTERNATIVES	ALL	1
	15A	MV6889	.. WIRE	ALL	1
	15B	MV5110	.. WIRE, (MOD.01) ALTERNATIVES	ALL	1
	15B	MV6890	.. WIRE	ALL	1
R	16	MV4373	. PLATE ASSEMBLY, BACK	1 to 9 11 to 56	1
	16	MV5168	. PLATE ASSEMBLY, BACK	10	
	17	093S020P	.. TERMINAL, STAND OFF VK0066 (SMITHS PT.NO.40-716-145-01)	ALL	2
	18A	A131A	. STIFFNUT, 4-40 UNC NYLON (SMITHS PT.NO.30-297-679-21) (DESIGN CHANGE)	ALL	4
	18	Y92NM440	. STIFFNUT, 4-40 UNC NYLON (SMITHS PT.NO.30-297-951-21) (PRE-DESIGN CHANGE)	ALL	4

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	Fig. & Index No.	Part Number	Nomenclature 1 2 3 4 5 6 7	Usage Code	Units per Assy.
	1	2	3	4	5
	1101				
	19	SP25A	. WASHER, 6BA (SMITHS PT.NO.30-298-144-03)	ALL	4
	20A	STD2308-7	. THERMISTOR ASSY. (DESIGN CHANGE)	ALL	1
	20	STD2308-6	. THERMISTOR ASSY. (PRE-DESIGN CHANGE)	ALL	1
	21	40-526-430-15	. RESISTOR, 15 OHM WIREWOUND	ALL	1
	22	MV4375	. SHAFT ASSEMBLY, ZEROISER	ALL	1
	23	MV3096	. WASHER, SPRING	ALL	1
	24A	30-781-1008-24	. RING, "O" (DESIGN CHANGE)	ALL	2
	24	30-781-1008-27	. RING, "O" (PRE-DESIGN CHANGE)	ALL	2
	25	MV4377	. PILLAR	ALL	2
	26	SP25B	. WASHER, 4BA (SMITHS PT.NO.30-298-144-04)	ALL	2
	27	MV4012	. BOBBIN ASSEMBLY	ALL	1
R	28	MV3735	. BOBBIN ASSEMBLY	1,2, 4,6, 7,12, 13,14 15,16 19,28 29,34 36,37 38,39 40,42 45,47 49 to 54,56	1
R	28	MV4675	. BOBBIN ASSEMBLY	3,9, 10,20 22,23 24,25 26,27 30,31 32,33 35,41 43,44 46,48 55	1
	28	MV4980	. BOBBIN ASSEMBLY	5,17, 21	1
	28	MV5001	. BOBBIN ASSEMBLY	8	1
	29	30-295-407-90	. SCREW, 0-80 UNF X 7/16 IN.LG.	ALL	2
	30	30-298-141-06	. WASHER, NO.0	ALL	2
	31	30-282-605-01	. WASHER, 0-80 UNF X 7/16 IN.LG. SPG.	ALL	2

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	Fig. & Index No.	Part Number	Nomenclature 1 2 3 4 5 6 7	Usage Code	Units per Assy.
	1	2	3	4	5
	1101				
	32	MV5001	. BOBBIN ASSEMBLY	10	1
	33	30-295-407-90	. SCREW, 0-80 UNF X 7/16 IN.LG.	10	1
	34	30-298-141-06	. WASHER, NO.0	10	1
	35	30-282-605-01	. WASHER, 0-80 UNF X 7/16 IN.LG. SPG.	10	1
	36	MV4376	. PLATE, MOVEMENT MOUNTING	ALL	RF
R	37	*MV4216	. POINTER, FINISHED	1,2, 3,4, 5,6, 7,8, 55	1
			NOTE:- USAGE CODES 4 AND 6 USE THE ABOVE POINTER WITH PW OR OW FINISH ONLY. FOR ALL OTHER FINISHES USE:-	10,11 17,18 19,20 21,22 23,24 27,39 40,56	
	37	*MV4734	. POINTER, FINISHED	4,6	1
	37	*MV5451	. POINTER, FINISHED	12,15	1
	37	*MV5497	. POINTER, FINISHED	14,16 28 to 36,38 41 to 48,50 to 53	1
	37	*MV5112	. POINTER, FINISHED	9	1
	37	*MV5776	. POINTER, FINISHED	13,49	1
	37	*MV6290	. POINTER, FINISHED	25,26	1
	37	MV5497LU	. POINTER, FINISHED	37	1
	37	MV7384	. POINTER, FINISHED	54	1
R	38	MV4415B	. DIAL, BLANK	1 to 11 17 to 27,40 55,56	1
	38	MV5442B	. DIAL, BLANK	12 to 16 28 to 36 38,39 41 to 53	1
	38	MV7295LU	. DIAL, FINISHED	37	1
	38	MV7380	. DIAL, FINISHED	54	1
	39	HSD140	. RING, DIAL	ALL	1
	40		. MASK SEE APPENDIX FOR DETAILS	ALL	1

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	Fig. & Index No.	Part Number	Nomenclature 1 2 3 4 5 6 7	Usage Code	Units per Assy.
	1	2	3	4	5
	1101				
	41	STD1579-1	. SCREW, SPECIAL	ALL	3
	42	MV4004	. SHIELD ASSEMBLY, FRONT	ALL	1
	43	30-295-307-03	. SCREW, 0-80 UNF X $\frac{1}{8}$ IN.LG.	ALL	2
	44	MV4729-1	. SHIM, 18 SWG)	ALL	AR
	45	MV4729-2	. SHIM, 20 SWG)	ALL	AR
	46	MV4729-3	. SHIM, 28 SWG)	ALL	AR
	47	MV4729-4	. SHIM, 40 SWG)	ALL	AR
			. MOVEMENT ASSEMBLY	ALL	RF
	48	STD2027	.. SCREW ASSEMBLY, JEWEL	ALL	1
	49	MV1779	.. LOCKNUT	ALL	1
	50	MV1781	.. WASHER, SPRING	ALL	1
R	51	MV4002	.. BRIDGE PIECE AND BI-METAL ASSEMBLY	1 3 to 15 17,18 20 to 56	1
R	52	MV4003	... BI-METAL	1,3 to 15 17,18 20 to 56	1
	51	MV6346	.. BRIDGE PIECE AND BI-METAL ASSEMBLY	19	1
	52	MV6347	... BI-METAL	19	1
	51	MV4455	.. BRIDGE	2,16	1
	52	MV4454	... BI-METAL	2,16	1
	53	MV1778M	.. BUSH, INSULATING	ALL	4
	54	MV1670-2	.. SCREW, SPECIAL	ALL	2
	55	MV4076	.. WASHER, SPECIAL	ALL	2
	56	MV1797	.. TAG	ALL	1
	-57	1344-1702-15	.. WIRE, 7/0·20 MM P.T.F.E. INSULATING	ALL	1 ft
	58	MV3813	.. SHIELD	ALL	RF
	59	MV3627	.. POST, SHIELD	ALL	1
	60	MV3290M	.. BUSH, INSULATING	ALL	1
	61	MV3291M	.. WASHER, INSULATING	ALL	1
	62	MV3437	.. TAG, ANCHOR	ALL	1
	63	A53X	.. NUT, 12BA PLAIN (SMITHS PT.NO.30-297-114-12)	ALL	1
	64	30-281-075-19	.. WASHER, 12 BA LARGE	ALL	1
	65	MV3288	.. PLATE ASSEMBLY, BACK	ALL	RF
	66	MV4401	.. STUD	ALL	2
	67	STD2027	.. SCREW ASSEMBLY, JEWEL	ALL	1
	68	MV1779	.. NUT, LOCK	ALL	1
	69	MV1781	.. WASHER, SPRING	ALL	1

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Fig. & Index No.	Part Number	Nomenclature 1 2 3 4 5 6 7	Usage Code	Units per Assy.
1	2	3	4	5
1101				
70	MV3998	.. BRIDGE ASSEMBLY, FRONT	ALL	RF
71	MV1691B	.. STOP, POINTER BLANK	ALL	2
72	ACS208-2	.. TUBE, STOP	ALL	2
73	MV1778M	.. BUSH, INSULATING	ALL	4
74	30-295-407-05	.. SCREW, 0-80 NF X 3/16 IN.LG.	ALL	2
75	30-298-141-06	.. WASHER, 0-80 NF	ALL	2
76A	30-282-605-01	.. WASHER, 0-80 NF SPRING PHOS. BRONZE (DESIGN CHANGE)	ALL	2
76	30-282-605-18	.. WASHER, 0-80 NF SPRING (PRE-DESIGN CHANGE)	ALL	2
77	MV3979	.. PILLAR, FRONT	ALL	2
R 78	HSC4231	.. HAIRSPRING AND COLLET ASSEMBLY	1 to 4 6 to 56	1
78	HSC4665	.. HAIRSPRING AND COLLET ASSEMBLY	5	1
79	MV3967	.. ARM ASSEMBLY, MAGNET FINAL	ALL	RF
79A	MV1499	.. WEIGHT, BALANCE	ALL	AR
80	ACR546	.. WASHER, RUBBER	ALL	3
81	MV3980	.. BUSH	ALL	3
82	30-295-407-88	.. SCREW, 0-80 NF X 5/16 IN.LG.	ALL	3
83	30-298-141-06	.. WASHER, 0-80 NF	ALL	3
84A	30-282-605-01	.. WASHER, 0-80 NF SPRING PHOS. BRONZE (DESIGN CHANGE)	ALL	3
84	30-282-605-18	.. WASHER, 0-80 NF SPRING (PRE-DESIGN CHANGE)	ALL	3
85	A224Y	.. NUT, 0-80 NF (SMITHS PT.NO.30-297-614-01)	ALL	3
86	MV3985	.. SHIELD, MAGNET	ALL	RF
87	A224Y	.. NUT, 0-80 NF (SMITHS PT.NO.30-297-614-01)	ALL	1
88	30-298-141-06	.. WASHER, NO.0	ALL	1
89A	30-282-605-01	.. WASHER, 0-80 NF SPRING PHOS. BRONZE (DESIGN CHANGE)	ALL	1
89	30-282-605-18	.. WASHER, 0-80 NF SPRING (PRE-DESIGN CHANGE)	ALL	1
90	MV3997	.. BRIDGE ASSEMBLY	ALL	RF
91	MV3965	... JEWEL ASSEMBLY	ALL	1
92	MV3981	.. STUD, DIAL FIXING	ALL	2
93	MV3962	.. PLATE ASSEMBLY, FRONT	ALL	1
94	MV3261	.. MAGNET ASSEMBLY, COMPLETE	ALL	RF
95	MV3263	... POLE, CENTRE	ALL	1
96	MV2025	... SCREW, SPECIAL	ALL	1

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	Fig. & Index No.	Part Number	Nomenclature 1 2 3 4 5 6 7	Usage Code	Units per Assy.
	1	2	3	4	5
	1101				
R	97	MV3999	.. SPINDLE AND COIL ASSEMBLY	1,2, 4,6, 8,12 to 17 19,21 25,26 28,29 34,36 37,38 42,45 47,49 to 54 56,40	1
R	98	HSC4185	... HAIRSPRING	1,2 4,6, 8,12 to 17 19,21 25,26 28,29 34,36 37,38 42,45 47,49 to 54 56,40	
R	99	1446-201	... STRIP, SILVER GILT	1,2, 4,6, 8,12 to 17 19,21 25,26 28,29 34,36 37,38 42,45 47,49 to 54 56,40	2 ft
R	97	MV4700	.. SPINDLE AND COIL ASSEMBLY	3,7, 9,10 11,18 20,22 23,24 27,30 to 33 35,41 43,55	

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	Fig. & Index No.	Part Number	Nomenclature 1 2 3 4 5 6 7	Usage Code	Units per Assy.
	1	2	3	4	5
	1101				
R	98	HSC4468	... HAIRSPRING	3,7, 9,10 11,18 20,22 23,24 27,30 to 33 35,41 43,44 46,48 55	1
R	99	1446-201	... STRIP, SILVER GILT	3,7, 9,10 11,18 20,22 23,24 27,30 to 33 35,41 43,44 46,48 55	2 ft
	97	MV4978	.. SPINDLE AND COIL ASSEMBLY	5	1
	98	MV4664	.. HAIRSPRING	5	1
	99	1446-201	... STRIP, SILVER GILT	5	2 ft
	100	MV1425	.. WEIGHT, COUNTER)	ALL	AR
	101	MV1582	.. WEIGHT, COUNTER) SELECT AS *REQUIRED*	ALL	AR
	102	MV3028	.. WEIGHT, COUNTER)	ALL	AR
	103	MV3244	.. WEIGHT, COUNTER)	ALL	AR
	-104	1817-454-07	. SLEEVING, RED	ALL	5 ft
	-105	1817-454-12	. SLEEVING, BLUE DELETED BY DESIGN CHANGE	ALL	5 ft
	-106	1817-454-15	. SLEEVING, BLACK	ALL	5 ft
	-108	1665-421	. *TAPE, TERYLENE*	ALL	1 ft
	-109	1817-456-07	. SLEEVING, RED (MOD.01) DELETED BY DESIGN CHANGE	ALL	AR
	-110	1817-456-15	. SLEEVING, BLACK (MOD.01) DELETED BY DESIGN CHANGE	ALL	AR

- Item not illustrated

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Fig. & Index No.	Part Number	Nomenclature 1 2 3 4 5 6 7	Usage Code	Units per Assy.
1	2	3	4	5
		APPENDIX FOR FINISHED MASKS		
	*MV2947	MASK FOR *727MVBU63		
		MASK FOR *727MVBU42-690		
		MASK FOR *727MVBU48		
		MASK FOR *727MVBU50		
		MASK FOR *727MVBU1		
		MASK FOR *727MVBU2		
		MASK FOR *727MVBU3		
		MASK FOR *727MVBU4		
		MASK FOR *727MVBU5		
		MASK FOR *727MVBU8		
		MASK FOR *727MVBU26		
		MASK FOR *727MVBU10		
		MASK FOR *727MVBU15		
		MASK FOR *727MVBU37		
		MASK FOR *727MVBU51-700		
		MASK FOR *727MVBU54-690		
	*MV4458	MASK FOR *727MVBU14		
		MASK FOR *727MVBU6		
		MASK FOR *727MVBU22		
		MASK FOR *727MVBU32		
		MASK FOR *727MVBU38		
		MASK FOR *762MVBU1-740		
		MASK FOR *762MVBU5-600		
		MASK FOR *762MVBU5-590		
		MASK FOR *762MVBU7		
		MASK FOR *762MVBU8-550		
		MASK FOR *762MVBU9-550		
		MASK FOR *762MVBU10-700		
		MASK FOR *762MVBU11		
		MASK FOR *762MVBU12		
	*MV4534	MASK FOR *727MVBU7		
	*MV4771	MASK FOR *727MVBU47-580		
		MASK FOR *727MVBU16		
		MASK FOR *727MVBU18-580		
		MASK FOR *727MVBU18-610		
		MASK FOR *727MVBU18-620		
		MASK FOR *727MVBU18-640		
		MASK FOR *727MVBU28-580		
		MASK FOR *727MVBU12		
		MASK FOR *727MVBU17-580		
		MASK FOR *727MVBU17-600		
		MASK FOR *727MVBU17-640		
		MASK FOR *727MVBU65-720		
R		MASK FOR *727MVBU68-640		

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Fig. & Index No.	Part Number	Nomenclature 1 2 3 4 5 6 7	Usage Code	Units per Assy.
1	2	3	4	5
	*MV4971	MASK FOR *727MVBU60-720		
		MASK FOR *727MVBU24		
		MASK FOR *727MVBU19		
	*MV4977	MASK FOR *727MVBU21-500		
	*MV5016	MASK FOR *727MVBU20-500		
		MASK FOR *727MVBU20-560		
		MASK FOR *727MVBU3-520		
		MASK FOR *727MVBU64-660		
		MASK FOR *727MVBU3-560		
		MASK FOR *727MVBU66-660		
		MASK FOR *762MVBU3-520		
		MASK FOR *762MVBU3-560		
	PWMV5074	MASK FOR *762MVBU30-770		
	*MV5074	MASK FOR *727MVBU25-640		
		MASK FOR *727MVBU52-640		
		MASK FOR *727MVBU56-730		
		MASK FOR *727MVBU57-740		
		MASK FOR *762MVBU6-580		
		MASK FOR *762MVBU18-740		
		MASK FOR *762MVBU18-750		
	*MV5171	MASK FOR *727MVBU34-700		
		MASK FOR *727MVBU30		
	*MV5091	MASK FOR *727MVBU39-700		
		MASK FOR *727MVBU44-700		
		MASK FOR *727MVBU40-700		
		MASK FOR *727MVBU62-700		
	*MV6047	MASK FOR *762MVBU2-580		
		MASK FOR *762MVBU16-580		
R	*MV6661	MASK FOR *727MVBU53-650		
		MASK FOR *727MVBU53-750		
		MASK FOR *727MVBU61-750		
		MASK FOR *727MVBU69-750		
	*MV4758	MASK FOR *727MVBU33-580		
		MASK FOR *727MVBU43-550		
		MASK FOR *727MVBU11		
		MASK FOR *727MVBU46-650		
	*MV6695	MASK FOR *727MVBU59-720		
	*MV6822	MASK FOR *762MVBU15-725		
	*MV6982	MASK FOR *762MVBU19-700		
		MASK FOR *762MVBU26-700		
	*MV7118	MASK FOR *762MVBU22-680		
	*MV7140	MASK FOR *762MVBU25-720		

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Fig. & Index No.	Part Number	Nomenclature 1 2 3 4 5 6 7	Usage Code	Units per Assy.
1	2	3	4	5
	*MV7138	MASK FOR *762MVBU20-860		
		MASK FOR *762MVBU21-860		
		MASK FOR *762MVBU23-860		
		MASK FOR *762MVBU27-860		
		MASK FOR *762MVBU36-860		
		MASK FOR *762MVBU40-860		
		MASK FOR *762MVBU43-900		
		MASK FOR *762MVBU42-900		
	*MV7171	MASK FOR *762MVBU24-790		
		MASK FOR *762MVBU28-800		
		MASK FOR *762MVBU37-800		
		MASK FOR *762MVBU38-790		
		MASK FOR *762MVBU41-805		
	*MV7338	MASK FOR *762MVBU33-700		
		MASK FOR *762MVBU34-700		
	MV7296LU	MASK FOR *762MVBU31-810		
R	MV7383	MASK FOR 762MVBM44-791		
	MV4000-1	MOVEMENT ASSEMBLY		
	MV4000-2	MOVEMENT ASSEMBLY		
	MV4000-3	MOVEMENT ASSEMBLY		

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	Index No.	Part No. (Manufacturer)	Smiths Assigned Part No. (where relevant)
	1-64		30-281-075-19
	1-10		30-282-010-11
	1-76A		30-282-605-01
	1-84A		30-282-605-01
	1-89A		30-282-605-01
R	1-31		30-282-605-01
R	1-35		30-282-605-01
R	1-76		30-282-605-18
R	1-84		30-282-605-18
R	1-89		30-282-605-18
	1-43		30-295-307-03
	1-8		30-295-401-23
	1-11		30-295-401-30
	1-74		30-295-407-05
	1-82		30-295-407-88
	1-29		30-295-407-90
	1-33		30-295-407-90
	1-30		30-298-141-06
	1-34		30-298-141-06
	1-75		30-298-141-06
	1-83		30-298-141-06
	1-88		30-298-141-06
R	1-24A		30-781-1008-24
	1-24		30-781-1008-27
	1-21		40-526-430-15
	1-57		1344-1702-15

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Index No.	Part No. (Manufacturer)	Smiths Assigned Part No. (where relevant)
1-99		1446-201
1-108		1665-421
1-2		1814-404
1-104		1817-454-07
1-105		1817-454-12
1-106		1817-454-15
1-109		1817-456-07
1-110		1817-456-15
1-63	A53X	30-297-114-12
1-18	A131A	30-297-679-21
1-85	A224Y	30-297-614-01
1-87	A224Y	30-297-614-01
1-80	ACR546	
1-72	ACS208-2	
1-98	HSC4185	
1-78	HSC4231	
1-98	HSC4468	
1-78	HSC4665	
1-39	HSD140	
1-100	MV1425	
1-79A	MV1499	
1-101	MV1582	
1-54	MV1670-2	

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Index No.	Part No. (Manufacturer)	Smiths Assigned Part No. (where relevant)
1-71	MV1691B	
1-15	MV1728	
1-53	MV1778M	
1-73	MV1778M	
1-49	MV1779	
1-68	MV1779	
1-50	MV1781	
1-69	MV1781	
1-56	MV1797	
1-96	MV2025	
1-40	*MV2947	
1-102	MV3028	
1-23	MV3096	
1-6	MV3115	
1-7	MV3118	
1-103	MV3244	
1-94	MV3261	
1-95	MV3263	
1-65	MV3288	
1-60	MV3290M	
1-61	MV3291M	
1-4	MV3322	

R

Index No.	Part No. (Manufacturer)	Smiths Assigned Part No. (where relevant)
1-62	MV3437	
1-59	MV3627	
1-28	MV3735	
1-58	MV3813	
1-93	MV3962	
1-91	MV3965	
1-79	MV3967	
1-77	MV3979	
1-81	MV3980	
1-92	MV3981	
1-86	MV3985	
1-90	MV3997	
1-70	MV3998	
1-97	MV3999	
1-51	MV4002	
1-52	MV4003	
1-42	MV4004	
1-27	MV4012	
1-55	MV4076	
1-37	MV4216	
1-14	MV4371	
1-16	MV4373	
1-22	MV4375	

Index No.	Part No. (Manufacturer)	Smiths Assigned Part No. (where relevant)
1-36	MV4376	
1-25	MV4377	
1-66	MV4401	
1-38	MV4415B	
1-52	MV4454	
1-51	MV4455	
1-40	*MV4458	
1-4	MV4484	
1-40	*MV4534	
1-98	MV4664	
1-28	MV4675	
1-97	MV4700	
1-44	MV4729-1	
1-45	MV4729-2	
1-46	MV4729-3	
1-47	MV4729-4	
1-37	*MV4734	
1-40	*MV4758	
1-40	MV4771	
1-40	MV4971	
1-40	MV4977	
1-97	MV4978	
1-28	MV4980	

	Index No.	Part No. (Manufacturer)	Smiths Assigned Part No. (where relevant)
	1-28	MV5001	
	1-32	MV5001	
	1-40	*MV5016	
	1-40	*MV5074	
R	1-40	*MV5091	
	1-15A	MV5109	
	1-15B	MV5110	
	1-37	*MV5112	
	1-5	MV5166	
	1-16	MV5168	
	1-14	MV5170	
R	1-40	* MV5171	
	1-38	MV5442B	
	1-37	*MV5451	
	1-37	MV5497	
	1-37	MV5497LU	
	1-37	MV5776	
	1-40	MV5901	
R	1-40	* MV6047	
	1-5A	MV6203	
	1-5A	MV6204	
	1-14A	MV6207	
	1-14B	MV6208	
	1-14A	MV6209	

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	Index No.	Part No. (Manufacturer)	Smiths Assigned Part No. (where relevant)
	1-37	*MV6290	
	1-51	MV6346	
	1-52	MV6347	
	1-15A	MV6575	
	1-15B	MV6576	
	1-40	*MV6661	
	1-1	MV6686-1	
	1-1	MV6686-3	
	1-1	MV6686-4	
	1-40	*MV6695	
	1-40	*MV6822	
	1-5B	MV6885	
	1-15A	MV6889	
	1-15B	MV6890	
R	1-40	*MV6982	
	1-40	*MV7118	
	1-40	*MV7138	
	1-40	*MV7140	
	1-40	*MV7171	
	1-7	MV7238	
	1-6	MV7239	
	1-5	MV7240	
	1-1	MV7246	

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Index No.	Part No. (Manufacturer)	Smiths Assigned Part No. (where relevant)
1-38	MV7295LU	
1-40	MV7296LU	
1-40	*MV7338	
R 1-38	MV7380	
R 1-40	MV7383	
R 1-37	MV7384	
1-12	SP25A	30-298-144-03
1-19	SP25A	30-298-144-03
1-26	SP25B	30-298-144-04
1-9	SP26A	30-298-145-03
1-13	SP47A	30-298-211-01
1-1	STD1531-13	
1-41	STD1579-1	
1-3	STD1809	
1-1	STD2004-2	
1-1	STD2016-1	
1-48	STD2027	
1-67	STD2027	
1-20	STD2308-6	
1-20A	STD2308-7	
1-4	STD2346	
1-4	STD2692	
1-17	093S020P	40-716-145-01
1-18	792NM440	30-297-951-21

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CHAPTER 79

OIL

BOMBARDIER
AEROSPACE

de Havilland Inc.
DHC–6 TWIN OTTER
COMPONENT MAINTENANCE MANUAL
CHAPTER 79 – OIL
TABLE OF CONTENTS

MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B./T.R.
Bendix	Indicator, Oil Pressure	Old P/N 25510A122A8A2 New P/N 3571810–0007 (C6SC1089)		Mar 15/1970	
Custom Components	Switch	IG177–15 (DHCSC70019–15)	79–30–08	Aug 22/1969	
Edison	Indicator, Oil Pressure	290–02240	79–31–2	Jan 1/1966	
	Transmitter, Torque Pressure	318–100 & 318–00140	77–10–33	Feb 1/1969	
Harrison	Oil Cooler	8535233		Feb 1/1965	
	Oil Cooler	853877 (MOD 6/1438) 8540012 (MOD 6/1481)		Jul 1969	
Lewis	Indicator, Temperature	163B103, 103A & 103B (C6SC1030–9)	31–00–1	Dec 16/1968	
Stewart–Warner	Oil Cooler	15028A	79–20–11	Dec 1/1970	

NOTE: Overhaul data for Transmitter, Oil Pressure Previous Part No. 7749–122A5–1 (New P/N 3567749–9502) (C6SC1084–3) Bendix, is covered in the same manual as the Torque Pressure Transmitter 7749–121A5–1 (3567749–7103). The manual is located in Chapter 77.

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25510A122A8A2
INDICATOR

NEW PART NO. 3571810-0007

Overhaul
with
Parts Breakdown

Bendix
Flight & Engine
Instruments
Division
South Montrose, Pa. 18843

THE BENDIX CORPORATION - FLIGHT & ENGINE INSTRUMENTS DIVISION

OVERHAUL INSTRUCTIONS WITH PARTS BREAKDOWN

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THE BENDIX CORPORATION - FLIGHT & ENGINE INSTRUMENTS DIVISION

OVERHAUL INSTRUCTIONS WITH PARTS BREAKDOWN

25510A122A8A2 - OVERHAUL

1. Description and Operation.

The 25510A122A8A2 indicator is a hermetically sealed single synchro indicator. It consists of a single pointer mounted directly on the shaft of a receiver synchro. The receiver synchro is remotely connected to a synchro transmitter monitoring oil pressure at its source and transmitting an electrical signal to the receiver. The signal is converted to a visual indication of pressure as the receiver synchro rotates the pointer over a graduated dial. The mechanism is mounted in a hermetically sealed case that incorporates a quick disconnect connector.

The indicator is a clamp-on type that allows it to be rotated in order that all pointers on the instrument panel may be aligned under normal operating conditions.

Table 1. Leading Particulars

Operating Voltage	26 volts 400 Hz
Dial spread	320 Degrees
Case diameter	1.500 inches
Range	0 to 125 PSI
Case length	2.56 inches

2. Disassembly.

A. Disassemble the indicator in accordance with the following sequence of instructions: (See figure 2)

(1) Remove locking ring (2) with a screwdriver or other suitable tool.

(2) Remove identification plate (1) by lifting over receptacle (6).

(3) Remove evacuation plug (3) by heating with soldering iron and lifting out with needle nose pliers or screwdriver.

(4) Heat around edge of case and end cover assembly (5) with soldering iron and remove end cover assembly (5) by inserting a wire or hook into the evacuation plug hole and pulling as solder becomes molten.

CAUTION: DO NOT REMOVE END COVER ASSEMBLY (5) BY PULLING ON RECEPTACLE (6). HEAT MAY LOOSEN SOLDER AND RECEPTACLE (6) WILL SEPARATE FROM END COVER (7).

NOTE: Do not remove receptacle (6) from end cover (7) unless necessary to replace a damaged part.

(5) Unsolder wires from end cover assembly (5) and remove tubing (4).

(6) Remove entire mechanism from case and glass assembly (16).

(7) Remove pointer (9) by pulling straight away from dial (10).

(8) Remove dial screws (11) and dial (10).

(9) Remove screws (13) and dial plate (12).

NOTE: Do not disassemble case and glass assembly (16) unless necessary to replace a damaged part.

3. Cleaning.

A. Clean the indicator parts as outlined in the following procedure:

WARNING: NAPTHA IS HIGHLY VOLATILE. USE IN A WELL VENTILATED AREA. DO NOT INHALE OR ALLOW TO COME IN CONTACT WITH SKIN. KEEP NAPTHA AWAY FROM ANY SOURCE OF IGNITION.

(1) Clean metal parts with naptha or an approved solvent. Keep parts clean and free from dust.

CAUTION: DO NOT IMMERSE SYNCHRO RECEIVER (14) IN NAPTHA OR SOLVENT.

(2) Clean glass (18) and dial (10) with a mild soap and water. Rinse and dry thoroughly. Keep parts free from finger marks.

4. Inspection/Check

A. Inspect indicator components as outlined in the following steps:

(1) Visually inspect terminal pins of receptacle (6) for bent, loose or broken pins. Inspect for damaged insulation.

(2) Inspect glass (18) for cracks, chips or discoloring.

(3) Inspect synchro (14) for damaged leads at point where leads enter housing.

(4) Inspect dial (10) and pointer (9) for damaged or chipped paint.

5. Repair.

A. No repair of any parts is recommended. Replace all parts that are not in a like new condition.

6. Assembly.

A. Assemble the indicator in the following steps:

(1) Place dial plate (12) on synchro (14) and secure in place with two flat fillister head screws (13).

(2) Apply a drop of purple glyptal lacquer to a wire 0.010 to 0.015 inch in diameter. Insert glyptal into threaded dial screw hole in dial plate (12). Distribute glyptal in hole evenly. Repeat for second dial screw hole.

(3) Place dial (10) on dial plate (12) and secure with two dial screws (11).

(4) Pass wires of synchro (14) through compression ring (8). Place one piece of tubing (4) over two black wires and one piece over each of the red, yellow and blue wires.

(5) Solder wires to receptacle in end cover assembly (5) as shown in wiring diagram, figure 1 shown under 9. Trouble Shooting.

(6) Connect receptacle (6) to Autosyn precision transmitter 13695-2-A. Actuate the electrical zero to position the synchro at its electrical zero position.

(7) Press pointer assembly (9) on shaft of synchro (14) with the top of the pointer at 62.5 PSI mark of dial (10). Tip of pointer should be 0.040 inch from face of dial.

(8) Place dial spacer (15) in case and glass assembly (16).

(9) Insert assembly mechanism of indicator into case and glass assembly (16). The key of the receptacle (6) must line up with the top center-line of dial (10).

(10) Put a slight pressure on receptacle (6) to keep end cover (7) flush with back edge of case and glass assembly (16) and solder end cover to case.

(11) Pressurize the indicator to 20 psig and immerse it completely in clean, clear alcohol. Any bubbles coming from within indicates a leak which must be repaired. Mark leaks for repair.

(12) Repair any leaks at solder joints.

(13) Place indicator under bell jar supplied with hermetic sealing stand 13693-1-B and connect to vacuum pump.

(14) Evacuate the bell jar to a pressure of 50 microns or less. Switch the dual manifold to draw from a helium-nitrogen mixture and back-fill the indicator with one atmosphere of dry helium nitrogen mixture.

NOTE: The mixture recommended is 88 to 92% nitrogen and the remainder helium.

(15) Place evacuation plug (3) in end cover assembly and solder in place.

(16) Paint any uncovered parts of indicator with dull black enamel.

7. Fits and Clearances.

A. Only clearance involved for entire assembly is called out in paragraph 6, A (7), assembly of pointer assembly (9) to shaft of synchro assembly (14).

8. Testing.

A. Following tests shall be performed at standard atmospheric pressure (approximately 29.92 inches of Hg.) and room temperature (approximately +25°C). Indicator and standard transmitter shall be connected to a 26 volt 400 Hz source and shall be vibrated during all tests unless otherwise specified.

(1) Insulation Breakdown. Apply a voltage of 200 volts at a commercial frequency between any pin of receptacle and ground. There shall be no breakdown of insulation.

(2) Electrical Zero. Electrical zero shall be imposed on indicator. Tip of pointer shall be within 0.010 inch of 62.5 PSI reading.

(3) Scale Error and Friction. Knob of standard transmitter 13695-2-A shall be rotated to each of the readings indicated in Table 2, Calibration. Two readings shall be taken; the first before and the second after the indicator is vibrated or tapped. The difference between the first and second readings shall not exceed 1.5 degrees. The second reading shall not exceed the scale error tolerance specified in Table 2, Calibration.

(4) Position Error. Set standard transmitter and lock at any reading. Reading of transmitter, while held in any position, shall not vary by more than 1.0 degree.

(5) Sealing. A leak rate of one micron-cubic foot at a pressure differential of approximately one atmosphere must not be exceeded when tested on a helium leak detector.

Table 2. Calibration

Test Points (PSI)	Desired Reading (Degrees)	Scale Error Tolerance (± Degrees)
0	20.0	2.0
20	71.2	2.0
40	122.4	2.0
60	173.6	1.0
80	224.8	1.0
100	276.0	1.0
120	372.2	2.0
125	340.0	2.0
EZ-180° at 62.5 PSI Friction Error 1.5° Position Error 1.0°		

9. Trouble Shooting.

A. Table 3 contains a list of causes and remedies for trouble shooting.

Table 3. Trouble Shooting

Trouble	Possible Reason	Remedial Steps
Pointer (9) not at E.Z. mark when E.Z. is applied	Pointer (9) loose on shaft	Press pointer on shaft securely.
Indicator not within test tolerances	Faulty synchro assembly (14)	Replace synchro assembly
Indicator will not operate	Improper wiring connection	Check electrical connection. Check indicator for loose or broken wires

Table 4. Wiring Data

Wire Color		Receptacle Pin
Rotor	Black/White	A
	Red/White	B
Stator	Black	A
	Yellow	C
	Blue	D

10. Storage Instructions.

A. The indicator should be stored in a suitable cardboard box of an appropriate size. Cushion the indicator in the box with a commercial dunnage such as Kimpack. Make certain that glass (17) is well protected and indicator is not loose in sealed box.

11. Special Tools, Fixtures and Equipment.

A. Table 5 contains a list of the special tools required to overhaul and test the indicator. If the listed tools are not available a suitable equivalent may be used. Unless otherwise indicated the tools listed are manufactured by the Bendix Corporation.

Table 5. Special Tools and Equipment

Part No.	Nomenclature	Application
13693-1-B	Hermetic sealing stand	Used in operations required to seal indicator.
13695-2-A	Autosyn Precision Transmitter	Used in calibrating and testing indicator.
13700-1-C	Insulation Breakdown Test Set	Used in insulation breakdown test.
Model 25 Hyper Vac	Vacuum Pump Central Scientific Co. Chicago, Ill.	Used to evacuate indicator housing prior to backfill.
Model 24-120A	Helium Leak Detector Consolidated Engineering Pasadena, Calif.	Used to check indicator for leaks.

25510A122A8A2

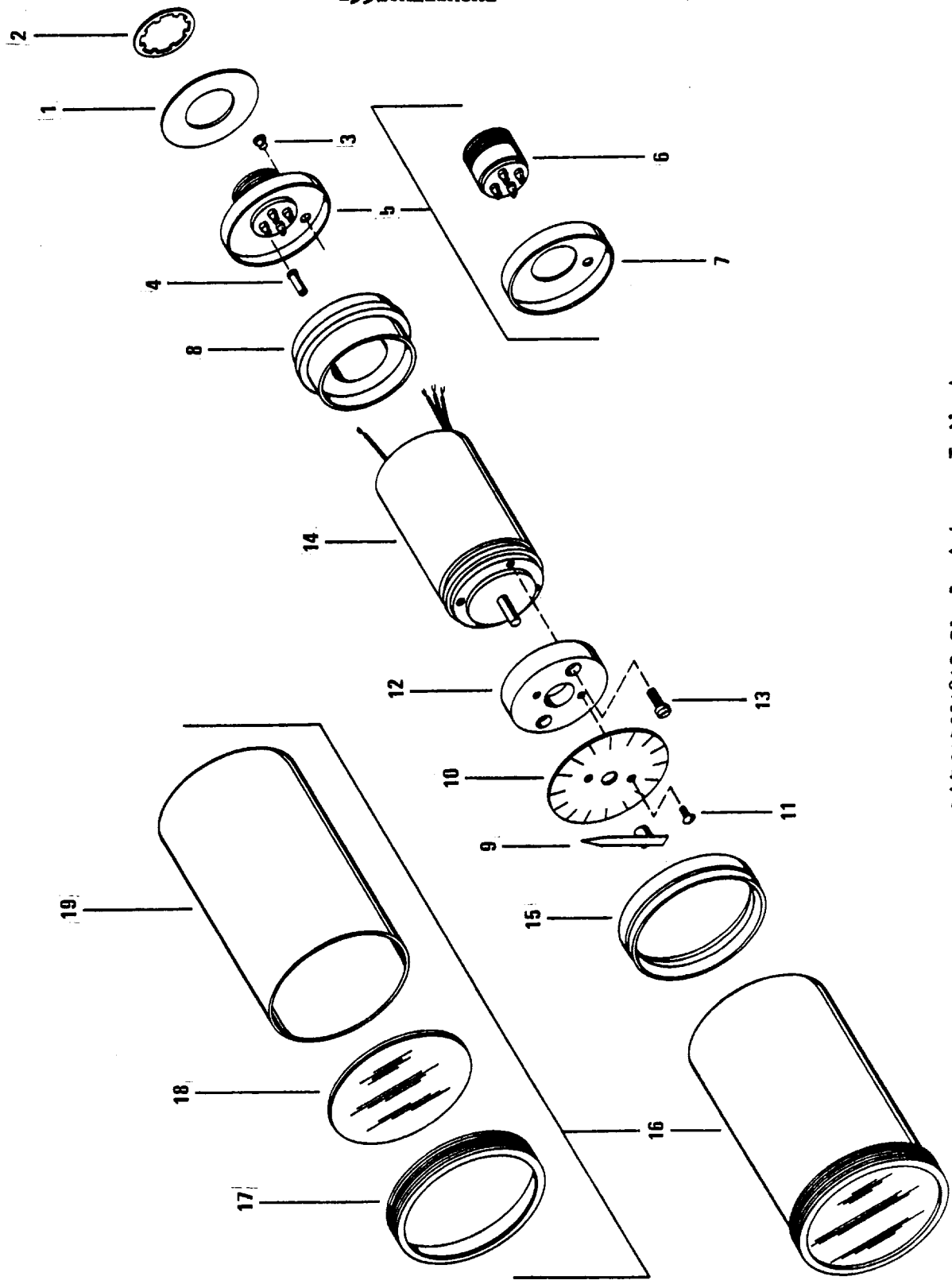


Figure 2. 25510A122A8A2 Single Autosyn Indicator

12. Illustrated Parts List.

FIG. ITEM	PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	UNITS PER ASSY.
2-	25510A122A8A2	Single Autosyn Indicator	
-1	2270317	. Plate, Identification	1
		(ATTACHING PARTS)	
-2	1485329-4	. Ring, Locking	1
		- - - * - - -	
-3	1492991-1	. Plug, Evacuation	1
-4	3070-11-1-040	. Tubing	4
-5	1492271-1	. End Cover Assembly	1
-6	1489278-5-2	. . Receptacle	1
-7	1490329-2	. . Cover, End	1
-8	1490333-2	. Ring, Compression	1
-9	1496929-0001	. Pointer Assembly	1
-10	B255A122A	. Dial	1
		(ATTACHING PARTS)	
-11	1489266-141	. Screw, Dial	2
		- - - * - - -	
-12	1480981-1	. Plate, Dial	1
		(ATTACHING PARTS)	
-13	3016-0406-120	. Screw	2
		- - - * - - -	
-14	1497019	. Synchro Assembly	1
-15	1494307	. Spacer, Dial	1
-16	1492374-6	. Case and Glass Assembly	1
-17	1493215-1	. . Ring	1
-18	1206677-1	. . Glass	1
-19	1493215-1	. . Case	1

CUSTOM COMPONENT SWITCHES, INC.
21111 PLUMMER ST. CHATSWORTH, CALIF.

GAGE PRESSURE SWITCH 1G177-7, -9, -15 OVERHAUL MANUAL

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GAGE PRESSURE SWITCH 1G177-7, -9, -15 OVERHAUL MANUAL

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GAGE PRESSURE SWITCH 1G177-7, -9, -15 OVERHAUL MANUAL

1. DESCRIPTION AND OPERATION

Models 1G177-7, 1G177-9, and 1G177-15 are pressure actuated switches designed to sense gage pressure. Pressure is applied to a diaphragm. The resultant force created by the gage pressure on the diaphragm is conveyed to a negative rate disc spring by the diaphragm. When the increasing gage pressure reaches a preset actuation point, the disc spring snaps over center allowing the pressure plate to actuate the electrical assembly. Upon decreasing gage pressure, at a preset value below the actuation point, the disc spring snaps back to its original position returning the pressure plate and electrical assembly to their original positions.

These models are used on commercial aircraft in the engine oil system for low oil pressure warning.

TABLE I LEADING PARTICULARS

Service Media.....Oil per MIL-L-7808

Actuation Points:

Model	Increasing Pressure	Decreasing Pressure
1G177-7	At 39 ±1 PSIG	At 36 ±1 PSIG
1G177-9	At 50 ±1 PSIG	At 46 ±1 PSIG
1G177-15	At 45 ±1 PSIG	At 41 ±1 PSIG

Proof Pressure:
- 1G177-7.....200 PSIG
- 1G177-9.....250 PSIG
- 1G177-15.....200 PSIG

Ambient Temperature Range.....-54°C to +121°C
-65°F to +250°F

Pressure Port.....Per AND10050-4
7/16-20 UNF-3B

Mounting Provisions.....Two .199 inch dia. holes
on 1.25 inch centers

Electrical Data:
- Switching Element.....SPDT
- Current.....5 amps resistive at 28 VDC
- Receptacle:
  - 1G177-7, -15.....Per MS3102-10SL-3P
    mates with MS3106R10SL-3S
  - 1G177-9.....Per MS33678-12S-3P
    mates with MS3106R12S-3S

Overall Dimensions
- Height.....3.50 inches max
- Width & Depth.....1.87 inches typ
- Weight.....4 ounces est

GAGE PRESSURE SWITCH 1G177-7, -9, -15 OVERHAUL MANUAL

2. DISASSEMBLY (See Figures 3 and 4)

A. Cut and remove lockwire from electrical assembly [13], port cap [2], and body [11].

NOTE: Observe method used to lockwire unit. Use same method to replace lockwire during assembly.

B. Using a 66-4 tool (1G177-7, -15) or a 66-10 tool (1G177-9), remove electrical assembly [13] from body [11]. Remove O-ring [12] from electrical assembly [13].
C. Using a 66-1 tool and a 66-56 tool, remove body [11] from port cap [2].
D. Remove pressure plate [8], disc spring [9], register ring [10], diaphragm [7], O-ring [6], adjustment shoe [5], and helical spring [4] from port cap [2] or body [11].
E. Using a 66-5 tool, remove adjustment screw [3] from port cap [2].

3. CLEANING

A. Clean all metal parts with dry cleaning solvent per Federal Specification P-D-680, Type 1, or equivalent; use a stiff bristle brush and/or a clean, lint-free cloth.

WARNING: AVOID SOLVENT CONTACT WITH SKIN AND AVOID BREATHING SOLVENT VAPORS. OBSERVE FIRE PRECAUTIONS.

B. Dry parts thoroughly with moisture free, compressed air, and/or allow to air dry.

4. INSPECTION/CHECK (See Figures 1, 2, and 4)

A. Inspect all machined surfaces for cracks, burrs, nicks, corrosion, or any other condition which could cause a malfunction in service.
B. Inspect all threaded parts for crossed or stripped threads.
C. Check all plated parts for deterioration.
D. Check helical spring [4] for distortion, length, and rate.
(1) Roll spring on flat surface; there must be no wobble.
(2) Free length should be .360/.390 inch.
(3) With spring deflected to solid height, reaction force should be approximately 4.2 pounds.
E. Using an ohmmeter or other suitable device, check electrical circuitry of electrical assembly [13].
(1) With electrical assembly [13] in the deactuated position there must be:
(a) 1G177-7, -15; closed circuit between receptacle pins A and B; also an open circuit between pins A and C.

(b) 1G177-9; closed circuit between receptacle pins A and B.

(2) Actuate electrical assembly [13] by applying slight pressure to actuating plunger of assembly.

(3) With electrical assembly [13] actuated there must be:

(a) 1G177-7, -15; closed circuit between receptacle pins A and C; also an open circuit between pins A and B.

(b) 1G177-9; open circuit between pins A and B.

F. Test dielectric strength of electrical assembly [13].

(1) With output limited to 18 milliamperes, apply 800 volts RMS 60 cycles between each receptacle pin and the receptacle shell for a period not to exceed one minute.

CAUTION: THE OUTPUT CURRENT MUST BE LIMITED DURING THIS TEST AS A PRECAUTIONARY MEASURE IN ORDER TO PREVENT PERMANENT DAMAGE TO THE ASSEMBLY.

(2) There must be no arcing.

(3) Maximum permissible leakage is 2 milliamperes.

G. Inspect nameplate [14] for legibility and security of attachment to body [11].

5. REPAIR (See Figure 4)

A. Adjustment screw [3] and electrical assembly [13] contain nylon locking inserts. If required, these inserts should be removed and replaced with new nylon pellets of appropriate size.

B. Remove any minor nicks, corrosion, or burrs from aluminum parts with an aluminum oxide abrasive cloth per Federal Specification P-C-451.

C. Remove defects from stainless steel parts using crocus cloth per Federal Specification P-C-458, grade 600 or finer.

D. Repair minor thread damage by carefully chasing threads with an appropriate tap or die.

E. Replace any parts on which the plating has deteriorated.

F. Replace all parts that cannot be made serviceable by steps 5.A. thru 5.D.

6. ASSEMBLY (See Figures 1 thru 4)

A. Apply a thin film of lubricant to O-rings [6 and 12].

NOTE: Recommended lubricant is Insulgrease #G624 manufactured by General Electric Co., Waterford, New York (V01139).

B. Using a 66-5 tool, thread adjustment screw [3] into port cap [2]. Thread as far as possible; then back off 1/4 turn.
C. Install helical spring [4], adjustment shoe [5], O-ring [6], and diaphragm [7] into port cap [2].
D. Install register ring [10], disc spring [9], and pressure plate [8] into body [11].
E. Using 66-1 and 66-56 tools, assemble body [11] to port cap [2]. Tighten to 15 foot pounds torque.

CAUTION: DO NOT EXCEED 15 FOOT POUNDS TORQUE.

F. Install and synchronize electrical assembly [13].
(1) Place O-ring [12] around electrical assembly [13].
(2) Connect the partially assembled unit to a test setup such as shown in Figure 2.
(3) Increase test pressure to actuate disc spring [9] and hold pressure.
(4) Using a 66-4 tool (1G177-7, -15) or a 66-10 tool (1G177-9), thread electrical assembly [13] into body [11] until assembly actuates.

CAUTION: INTERNAL DAMAGE TO ELECTRICAL ASSEMBLY [13] CAN RESULT IF IT IS THREADED TOO FAR.

(5) Reduce test pressure to zero.
(6) Thread electrical assembly [13] an additional 1/6 turn (60°) into body [11].

NOTE: Electrical assembly [13] is now synchronized and should not be rotated again.

G. After unit has been tested and adjusted per paragraph 8, lockwire electrical assembly [13] and port cap [2] to body [11]. Use wire per MS20995C32 or MS20995F32 installed per MS33540.

7. FITS AND CLEARANCES (Not Applicable)

8. TESTING (See Figures 1 thru 4)

A. Connect the completely assembled unit between the valves of a test setup such as shown in Figure 2. The inlet manifold should be connected to a source of clean, dry, compressed air which delivers at least 250 PSIG.
B. Test unit for leakage by slowly applying test pressure (see Table II) to pressure port. Shut off inlet valve and maintain a static pressure head for one minute. If leakage occurs, refer to paragraph 9, TROUBLE SHOOTING.

CAUTION: DO NOT EXCEED MAXIMUM RATED PRESSURE.

C. Test unit operating limits.
(1) With test lamp circuit connected to receptacle, slowly increase test pressure to pressure port until the circuit between receptacle pins A and B opens (A-C closes; 1G177-7, -15 only). Note the exact gage reading the instant this occurs.
(2) Slowly decrease the test pressure until the circuit between receptacle pins A and B closes (A-C opens; 1G177-7, -15 only). Note the exact gage reading the instant this occurs.
(3) If required, adjust unit operation to conform with data given in Table II. Using a 66-5 tool, rotate adjustment screw [3] in small increments and repeat steps 8.C.(1) and 8.C.(2). To increase pressure settings, rotate adjustment screw [3] counterclockwise; to decrease settings, turn clockwise.

D. Test dielectric strength of electrical assembly [13].
(1) With output limited to 18 milliamperes, apply 800 volts RMS 60 cycles between each receptacle pin and the receptacle shell for a period not to exceed one minute.

CAUTION: THE OUTPUT CURRENT MUST BE LIMITED DURING THIS TEST AS A PRECAUTIONARY MEASURE IN ORDER TO PREVENT PERMANENT DAMAGE TO THE ASSEMBLY.

(2) There must be no arcing.
(3) Maximum permissible leakage is 2 milliamperes.

TABLE II UNIT OPERATING CHARACTERISTICS

MODEL	PROOF PSIG	TEST PRESSURE	PRESSURE PSIG	CIRCUIT	
				A-B	A-C
1G177-7	200	Increasing	At 39 ±1	Opens	Closes
		Decreasing	At 36 ±1	Closes	Opens
1G177-9	250	Increasing	At 50 ±1	Opens	none
		Decreasing	At 46 ±1	Closes	none
1G177-15	200	Increasing	At 45 ±1	Opens	Closes
		Decreasing	At 41 ±1	Closes	Opens

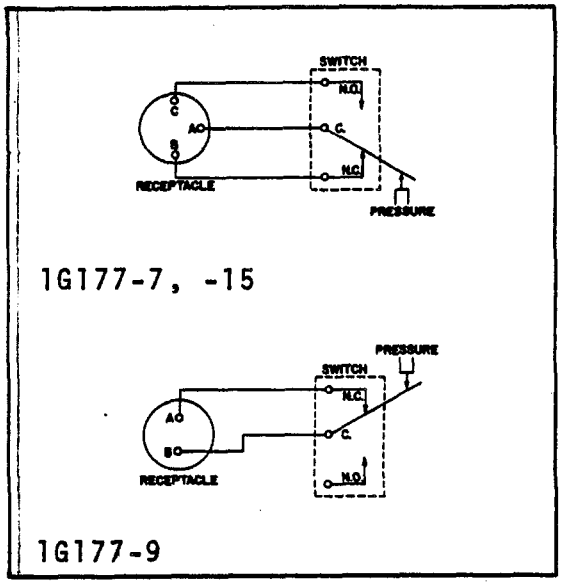


FIGURE 1 ELECTRICAL SCHEMATIC

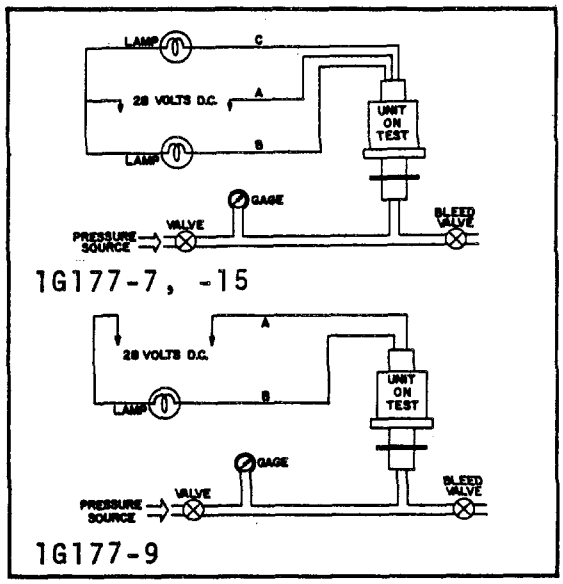


FIGURE 2 SUGGESTED TEST SETUP

9. TROUBLE SHOOTING (See Figure 4)

TABLE III

TROUBLE	PROBABLE CAUSE	REMEDY
Leakage	Defective O-ring [6]	Replace O-ring [6].
	Ruptured diaphragm [7]	Replace diaphragm [7].
Unit fails to operate or operate within pressure limits	Defective electrical assembly [13]	Check per paragraphs 4.E. and 4.F. If defective, replace electrical assembly [13].
	Defective disc spring [9]	Replace disc spring [9].
	Improper adjustment screw [3] setting	Readjust adjustment screw [3] per paragraph 8.C.
	Incorrect synchronization of electrical assembly [13]	Resynchronize electrical assembly [13] per paragraph 6.F.

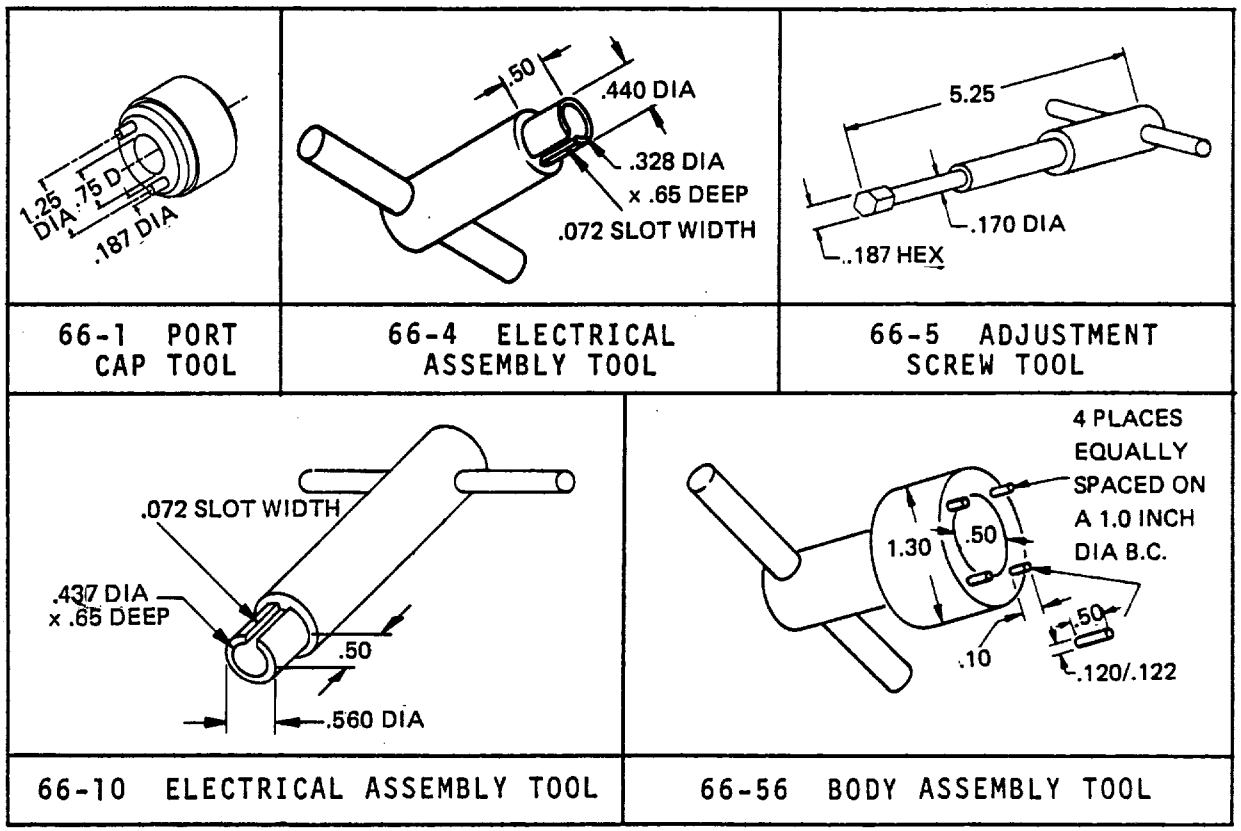
GAGE PRESSURE SWITCH 1G177-7, -9, -15 OVERHAUL MANUAL

10. STORAGE INSTRUCTIONS

Cap pressure port and electrical receptacle with closures per MIL-C-5501. Place unit in a suitable plastic bag and/or corrugated cardboard container.

11. SPECIAL TOOLS (See Figure 3)

Tools similar to those shown in Figure 3 will aid in the assembly, disassembly, and adjustment of the unit. These tools may be made in the average machine shop, or they may be procured from Custom Aviation Supply under part numbers 66-1, 66-4, 66-5, 66-10, and 66-56.



66-1 PORT CAP TOOL | 66-4 ELECTRICAL ASSEMBLY TOOL | 66-5 ADJUSTMENT SCREW TOOL

66-10 ELECTRICAL ASSEMBLY TOOL | 66-56 BODY ASSEMBLY TOOL

FIGURE 3 TOOLS

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12. ILLUSTRATED PARTS LIST

The illustrated parts list provides identification and spare parts ordering information. Order parts by part number and nomenclature.

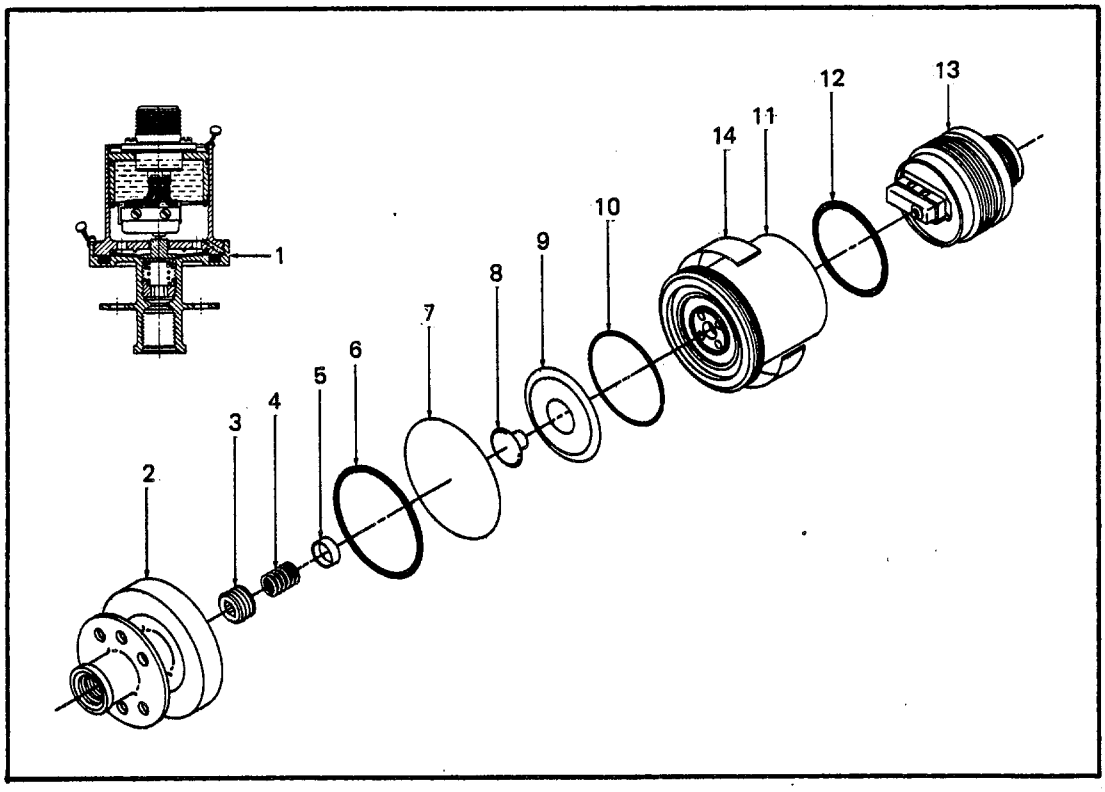


FIGURE 4 EXPLODED VIEW - GAGE PRESSURE SWITCH 1G177-7, -9, -15

GAGE PRESSURE SWITCH 1G177-7, -9, -15 OVERHAUL MANUAL

FIG. ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5 6 7	EFFECT	UNITS PER ASSY	
4 1	1G177-7	SWITCH-GAGE PRESSURE	A	RF	
	1G177-9	SWITCH-GAGE PRESSURE	B	RF	
	1G177-15	SWITCH-GAGE PRESSURE	C	RF	
2	14-289	. Cap-Port		1	
3	29-20	. Screw-Adjustment		1	
4	1-1	. Spring-Helical		1	
5	30-1	. Shoe-Adjustment		1	
6	MS29561-220	. Packing, O-ring CCS P/N 80-220-6		1	
7	31-222	. Diaphragm		1	R
8	32-21	. Plate-Pressure		1	
9	2-116-4-177-7	. Spring-Disc	A	1	
	2-120-4-177-9	. Spring-Disc	B	1	
	2-120-4-177-15	. Spring-Disc	C	1	
10	54-9	. Ring-Register		1	
11	12-166	. Body		1	
12	MS29561-026	. Packing, O-ring CCS P/N 80-026-6		1	
13	46-27-2	. Assembly-Electrical	A, C	1	
	46-317-1	. Assembly-Electrical	B	1	
14	10-1G177-7-264	. Nameplate	A	1	R
	10-1G177-9-264	. Nameplate	B	1	R
	10-1G177-15-264	. Nameplate	C	1	R

EDISON

OVERHAUL MANUAL

No. 1085-2G

OIL PRESSURE INDICATOR

Part No. 290-02240



INSTRUMENT DIVISION

THOMAS A. EDISON INDUSTRIES

McGRAW-EDISON COMPANY

WEST ORANGE, NEW JERSEY, U. S. A.

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OIL PRESSURE INDICATOR NO. 290-02240 GENERAL INFORMATION

1. Introduction

This manual contains instructions for the overhaul of EDISON Aircraft Oil Pressure Indicator, part No. 290-02240.

It is prepared in accordance with ATA Specification No. 100 including the Uniform Chapterization and Numbering System designated therein so that the pages may be inserted into their proper locations in the basic aircraft overhaul manual if desired.

All of the material in this manual falls within the classification "Oil System - Chapter 79".

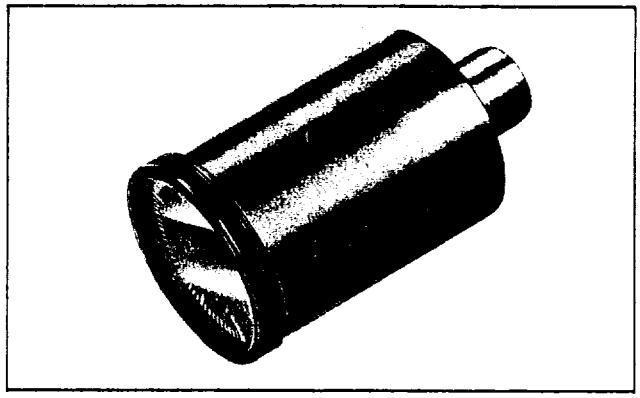
2. List of Effective Pages

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OIL PRESSURE INDICATOR NO. 290-02240 OVERHAUL INSTRUCTIONS

1. Description and Operation

The pressure indicator covered by these overhaul instructions is part of the EDISON variable reluctance type Oil Pressure Indicating System. (Ref. Fig.1)



The Indicator
Figure 1

Table of Leading Particulars
Power Supply .. 26 V single phase 400 cps
Pressure Range .....0 to 100 psi

It is an hermetically sealed instrument designed to be secured to an instrument panel by means of a standard mounting clamp. An electrical connector on the rear provides for connection to the transmitter and power supply.

The function of the indicator is to translate into percent torque the voltage applied to its moving coil by the pressure transmitter. This is accomplished through the use of several simple principles as follows:

A. When the current flows in the same direction through two coils, their magnetic flux is in the same direction. Thus their opposite magnetic poles are next to each other, so the coils are attracted to each other. (Ref. Fig. 2A)

B. When alternating current flows through a coil, the resulting flux cutting across a second coil induces a current within it if its circuit is complete. At any given instant the induced current flows in the direction opposite to the applied current. (Ref. Fig. 2B) Thus the induced fluxes are opposed and the coils repel each other.

C. In the indicator a constant 26 volt 400 cycle current flows through the stationary field coil making a flux pattern through the core and across the air gap. (Ref. Fig. 2C) The flux is strongest near the base of the hook-shaped part of the core and decreases uniformly along its length.

D. The moving coil with attached pointer is pivoted to rotate with the core hook at its center. (Ref. Fig. 2D) Two hairsprings transmit applied voltage to coil and furnish torque to swing pointer off low end of scale when no voltage is applied.

OIL PRESSURE INDICATOR NO. 290-02240 OVERHAUL INSTRUCTIONS

E. When the transmitter applies voltage to the moving coil it causes a current at any given instant to be in the same direction as that in the field coil (in phase).

F. At the same time, since the coils are energized with alternating current, the transformer effect is inducing an opposing voltage (180° out of phase) in the moving coil.

G. If the moving coil is at a position where applied voltage is greater than induced voltage, current will flow in the same direction as that of the field coil and the resulting torque will move the coil toward the base of the hook where the field coil flux is greater. (Ref. Fig. 1E) As it moves the induced voltage increases, the current and resulting torque decrease until the coil comes to rest at the point where applied voltage is just enough greater than induced voltage to overcome hairspring torque.

H. If applied voltage decreases below induced voltage, the resulting torque will cause the coil to swing toward the end of the hook until it reaches a point where equilibrium is again achieved. (Ref. Fig. 2F)

I. Because the voltage applied to the moving coil is obtained from two similar inductive, resistive voltage dividers, any variations in power supply voltage cause proportional changes in all voltages involved, hence do not affect the position assumed by the moving coil. (Ref. Fig. 3)

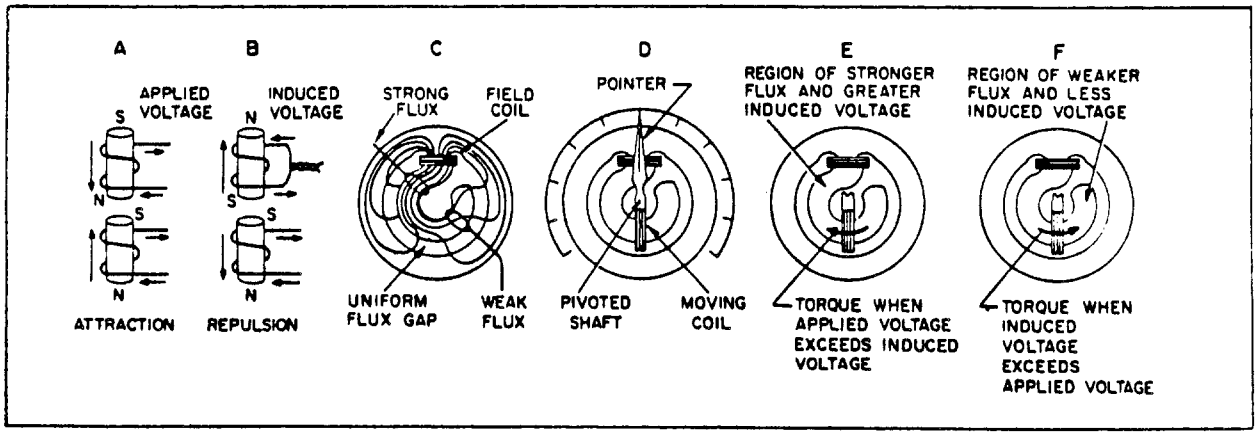
J. In order to compensate for resistance changes in the copper field coils, thermistors are connected in series with them.

2. Disassembly (Ref. Fig. 9)

CAUTION: USE EXTREME CARE TO KEEP DUST, FIBERS AND OTHER FOREIGN MATTER OUT OF SILICONE FLUID IMPREGNATED BEARINGS. DO NOT IMMERSE MECHANISM IN CLEANING SOLVENT.

A. Remove case and mask assembly (6).
(1) Use induction heater (Ref. Section 11) to unsolder case and mask assembly (6) from base and receptacle assembly (46) of complete movement assembly.

NOTE: No further disassembly of case and mask assembly is recommended.



Principles of Indicator Operation
Figure 2

OIL PRESSURE INDICATOR NO. 290-02240 OVERHAUL INSTRUCTIONS

B. Remove evacuation hole rivet (5).
   (1) Remove the two screws (2) and washers (3, 4) and nameplate (1).
   (2) Unsolder and remove rivet (5) from hole in base and receptacle assembly (46).

   NOTE: No further disassembly of the movement assembly is required to permit cleaning, inspection and check of detail parts. If parts are found to be defective, continue disassembly as required.

C. Remove dial (11).
   (1) Remove dial nut (12), screw (13), washers (14, 15), and bushing (16).
   (2) Tip dial (11) and carefully slide it out from under pointer of rotor and hairspring assembly (22).

D. Remove rotor balance weights (17).
   (1) Grasp weight (17) with tweezers in manner to straighten the slight bend in the weight so that it may be slipped off of the balance cross of the rotor.

E. Remove front housing and bearing assembly.

   NOTE: If rotor and hairspring assembly (22) is to be removed, delay this step until top plate (20) has been removed.

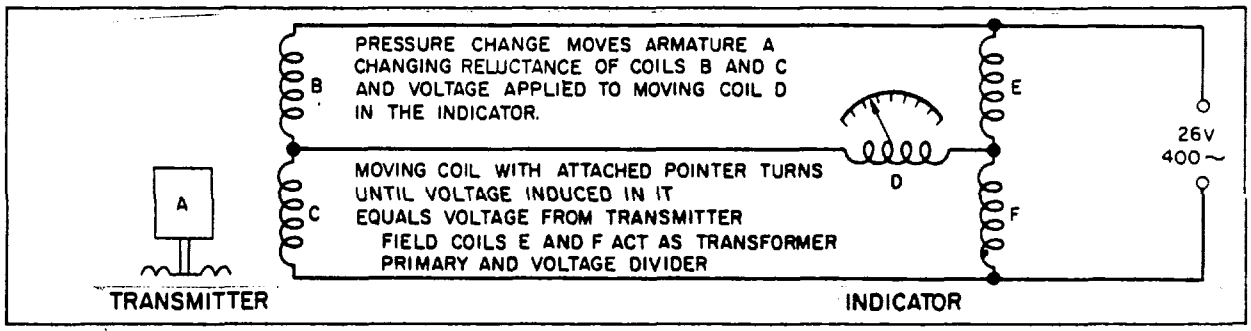
   (1) Loosen front bearing nut (18).
   (2) Unscrew and remove housing and bearing assembly (19) and nut (18).

F. Remove rotor and hairspring assembly (22).
   (1) Bend cut wire (27), which forms upper snubber, away from rotor shaft to clear outer turn of hairspring (23).
   (2) Unsolder hairsprings (23) from terminal of plate and terminal assembly (28) and board and adjuster assembly (45).
   (3) Remove self-locking nuts (21) and lift off top plate (20) using care not to damage pointer.
   (4) Turn and lift out rotor and hairspring assembly (22).

   NOTE: Removal of pivots (24) from rotor body assembly (25) is not recommended.

G. Remove Hairsprings (23) from rotor and hairspring assembly (22).

H. Remove stator assembly (27-39 assembled) and board and bearing assembly (41-45 assembled).



Basic Principle of Operation of the System
Figure 3

OIL PRESSURE INDICATOR NO. 290-02240 OVERHAUL INSTRUCTIONS

(1) Lift off top bushings (26).
(2) Unsolder leads from base and receptacle assembly (46).
(3) Lift off stator assembly with board and bearing assembly attached.
(4) Take out bottom bushings (40).
(5) Unsolder fixed coil leads from board and adjuster assembly (42), thus separating stator assembly and board and bearing assembly.

I. Remove fixed coil (38).
(1) Unsolder fixed coil lead from terminal of plate and terminal assembly (28).
(2) Unsolder and remove cut wire (27) only if replacement is required.
(3) Remove rivet (25).
(4) Remove plate and terminal assembly (28) and bottom plate (29).
(5) Push out inside core (31).
(6) Remove screws (32, 33), lock washer (34), and shunt nut (35).
(7) Slide shunt (38) and coil bracket (37) from under fixed coil (38).
(8) Slide fixed coil (38) from outside lamination assembly (39).

J. Disassemble board and bearing assembly (41-45 assembled).
(1) Unscrew and remove rear housing and bearing assembly (41).
(2) Unsolder and remove thermistors (43).
(3) Unsolder and remove snubber (44).

3. Cleaning (Ref. Fig. 9)

A. Carefully clean solder from case and mask assembly (6) and base and receptacle assembly (46) so they will be ready for resealing case after assembly.

B. If microscopic inspection of bearings shows hairlike fibers in the bearing cavity, remove with tweezers. Use no other cleaning method on bearings since they are factory impregnated with a special silicone fluid.

C. Vapor degrease all parts made solely of metal, using trichlorethylene.

WARNING: AVOID BREATHING FUMES OR PERMITTING TRICHLORETHYLENE TO CONTACT SKIN.

4. Inspection/Check (Ref. Fig.9)

A. Visual
(1) Check cover glass (9) for cracks or chips.
(2) Check dial (11) for scratches or stains.
(3) Check hairsprings (23) for distortion.
(4) Check pointer of rotor and hairspring assembly (22) for distortion or chipped paint.

B. Microscope (30X)
(1) Check pivots (24) for pits, grooves or distortion.
(2) Check housing and bearing assemblies (19, 41) for dents in bearing cap, foreign matter, and loss of clear fluidity of silicone fluid.

C. Ohmmeter
(1) Check moving coil with ohmmeter across terminal "C" and upper hairspring terminal of assembled indicator, or directly across coil of rotor body assembly (25). Acceptable resistance: 25 $\pm$ 8 ohms.
(2) Check fixed coil (38) with ohmmeter across lower terminals. Acceptable resistance: 46 $\pm$ 15 ohms.

OIL PRESSURE INDICATOR NO. 290-02240 OVERHAUL INSTRUCTIONS

(3) Check thermistors (43) with ohmmeter across leads. Acceptable resistance at 25°C (77°F): 5.6 ± 0.1 ohm.

5. Repair

Replace all defective or damaged parts.

6. Assembly (Ref. Fig. 9)

A. Assemble board and bearing assembly.
(1) Slide snubber (44) to bottom of higher prong of hairspring adjuster of board and adjuster (45). Position the snubber so its projecting wire is over the outer edge of the adjuster, then solder its coil to the adjuster prong.
(2) Place thermistors (43) on lower face of board and adjuster (45) and solder one lead of each together with red or black base connection lead wire (Ref. Fig. 4) in eyelet terminal.
(3) Screw and tighten rear housing and bearing assembly (41) into rear of board and adjuster (45).

B. Assemble stator assembly.
(1) Place fixed coil (38) on hook of outside lamination assembly (39) in position shown. (Ref. Fig. 4)
(2) Slip end of coil bracket (37) between upper face of outside lamination assembly (39) and fixed coil (38).
(3) Slip end of shunt (36) between lower face of outside lamination assembly (39) and fixed coil (38).
(4) Pass screw (33) through lock washer (34), coil bracket (37), outside lamination assembly (39) and shunt (36) and tighten in shunt nut (35).
(5) Pass screw (32) through outer end of shunt and turn it a few turns into shunt nut (35).
(6) Press inside core (31) into outside lamination assembly (39).
(7) Position bottom plate (29) and plate and terminal assembly (28) on previous assembly and secure. Check to be sure holes through plates and inside core are aligned to permit later assembly onto studs of base and receptacle assembly (46).
(8) Make a hook in the end of cut wire (27) as shown and solder it and the center top lead of fixed coil (38) to the neck of the hairspring terminal of plate and terminal assembly (28).

C. Assemble board and bearing assembly and stator assembly on base and receptacle assembly.
(1) Slide board and bearing assembly onto studs.
(2) Slide stator assembly onto studs in position that permits fixed coil leads to run directly down into eyelet terminals with thermistor leads not already soldered in. (Ref. Fig. 4)
(3) Solder thermistor and fixed coil leads to terminals.
(4) Solder black lead to "A" terminal of receptacle and red lead to "B" terminal.

D. Assemble rotor and hairspring assembly.
(1) Solder hairspring (23) to terminals of movable coil on rotor body assembly (25). (Ref. Fig. 5)
(2) If necessary, reshape hairspring slightly so that turns are equally spaced and lie in a plane at right angles to rotor shaft.

E. Install rotor and hairspring assembly.
(1) Place rotor and hairspring assembly (22) in stator assembly with hook

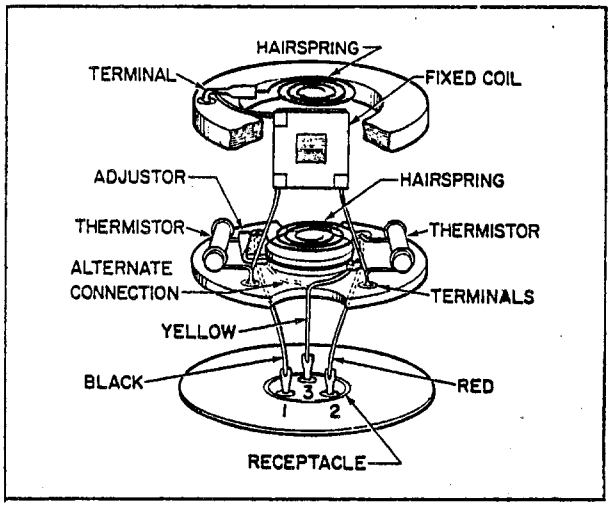
OIL PRESSURE INDICATOR NO. 290-02240 OVERHAUL INSTRUCTIONS

of outside lamination assembly (39) passing through its moving coil.
(2) Slide top bushing (26) on studs of base and receptacle assembly (46).
(3) Carefully slide tipped top plate (20) over pointer of rotor and hairspring assembly (22) and seat it on studs of base and receptacle assembly (46).
(4) Install and tighten self-locking nuts (21) on studs.
(5) Place front bearing nut (18) on housing and bearing assembly (19).
(6) Screw housing and bearing assembly (19) into top plate (20) and seat pivots (24) of rotor and hairspring assembly (22) in both upper and lower bearings. Be careful pivot is in bearing and not resting against cap of housing.
(7) Adjust housing and bearing assembly (19) to provide 0.001 to 0.002 inch rotor end play, then lock in position by tightening front bearing nut (18). Be careful not to change end play when tightening nut.
(8) Solder hairsprings to their respective terminals. (Ref. Fig. 4)

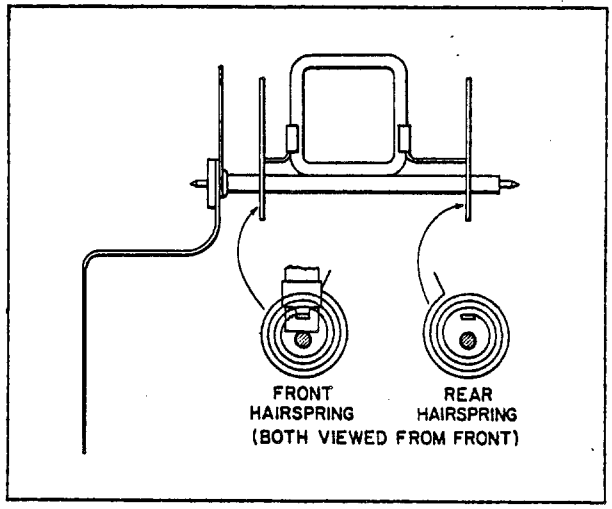
F. Install dial and adjust movement.
(1) Carefully slide tipped dial (11) over pointer and attach to top plate (20) by means of dial nut (12) and dial screw (13) which passes through dial bushing (16) between dial and top plate. Use washers (14, 15).
(2) Bend upper snubber made from cut wire (27) and lower snubber (44) to position. (Ref. sub-section 7A)
(3) Bend pointer to position. (Ref. sub-section 7B)
(4) Adjust lower hairspring to proper torque. (Ref. sub-section 7C)
(5) Solder yellow lead to terminal "C" of receptacle and to most accessible end of hairspring adjuster.

G. Calibrate the indicator. (Ref. Section 8)

H. Install case and ring assembly and seal indicator.
(1) Install case assembly with mask (7) in proper position over dial (11).
(2) Solder case assembly (8) to base and receptacle assembly (46) with 63-37 resin core solder using induction heater. (Ref. Section 11).
(3) Check to be sure rivet (5) fits hole in base and receptacle assembly (46) but leave out of hole.
(4) Heat inductor to 75 ± 5°C (167 ± 9°F) for 30 minutes.
(5) Place indicator in autoclave and evacuate to 200 microns and hold for five minutes.
(6) Admit dry helium, dew point below -55°C (-67°F), to autoclave to



Internal Wiring
Figure 4



Detail of Hairspring Position
Figure 5

OIL PRESSURE INDICATOR NO. 290-02240 OVERHAUL INSTRUCTIONS

pressure of one atmosphere (760 mm mercury).
(7) Re-evacuate to 200 microns then refill with dry helium to one atmosphere of pressure.
(8) Remove indicator from autoclave and immediately place rivet (5) in hole in base and receptacle assembly (46) and seal in place with a minimum of solder.
(9) Using screw (2) and washers (3, 4), install nameplate (1).
(10) Touch up case with dull black paint or lacquer.

7. Fits and Clearances

A. Bend snubbers to lie parallel to base, approximately 1/16 inch from hairspring, and approximately 1/32 inch from rotor shaft.

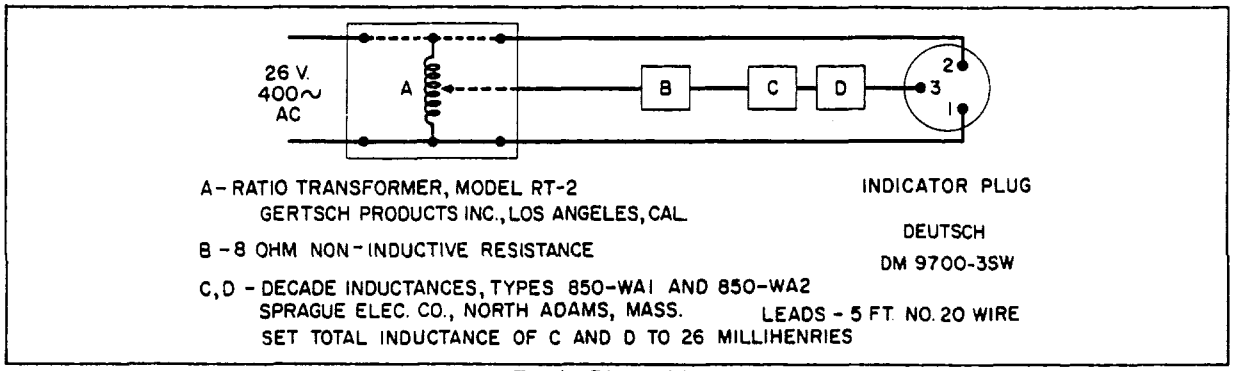
B. Bend pointer so it is parallel with and 0.02 to 0.04 inch from dial, covers half of the length of a minor graduation line and is over offscale reference mark when against low-end stop.

C. With the dial horizontal, rotate the hairspring adjuster to swing the pointer against the low-end stop. Continue turning the adjuster in the down-scale direction an additional 90 to 100 degrees.

8. Testing

A. Calibration Procedures - uncased indicator. (Ref. Fig. 9)

(1) Connect indicator to test circuit. (Ref. Fig. 6)
(2) Check to be sure power applied to ratio transformer is 26 ± 0.5 volts, 400 ± 8 cycles, a.c.
(3) Set ratio transformer to ".5980".
(4) Holding indicator with dial horizontal, use a screwdriver to avoid moving the housing and bearing assembly (19), loosen dial nut (12).
(5) Loosen dial screw (13).
(6) Rotate dial (11) until pointer indicates 0 psi.
(7) Tighten dial screw (13).
(8) Reduce voltage applied to ratio transformer to 15 volts.
(9) Set ratio transformer to move pointer to exact middle of scale. Since indicator has not yet been calibrated, this will not necessarily be specified mid-scale value.
(10) Install balance weights (17) as required to make pointer position remain unchanged when dial is moved from horizontal to normal vertical operating position, then rotated 90, 180 and 270 degrees.



Test Circuit
Figure 6

OIL PRESSURE INDICATOR NO. 290-02240 OVERHAUL INSTRUCTIONS

(11) Increase applied voltage to 26 ± 0.5 volts.
(12) Set ratio transformer to ".5980".
(13) With indicator in normal operating position, if necessary, loosen dial screw (13) and rotate dial until pointer indicates 0 psi, then tighten dial screw (13).
(14) Set ratio transformer to ".4020".
(15) Turn shunt adjusting screw (32) to open or close the shunt (36) until the pointer indicates 100 psi. If necessary, remove and discard screw (32) and bend shunt (36) to obtain correct pointer position.
(16) Set ratio transformer to ".5600", then turn power off. If pointer fails to swing off low end of scale without tapping, increase lower hairspring tension as required. Test the indicator in all four dial vertical positions and with dial horizontal.
(17) Check indications at all test values. (Ref. Fig. 7)
(18) Repeat steps 13 and 15 as required to bring all indications within tolerance.
(19) Holding housing and bearing assembly (19) with screwdriver, tighten dial nut (12).
(20) Place a drop of glyptal on shunt screw (32), if used, to seal it in place.

B. Test Procedure - sealed indicator.

(1) Connect the indicator to test circuit. (Ref. Fig. 6)
(2) Check to be sure power supply to ratio transformer is 26 ± 0.5 volts, 400 ± 8 cycles a.c.
(3) With indicator at room temperature and with dial in normal operating position, successively set ratio transformer at each test value shown in Figure 7. Notice indication before and after lightly tapping the indicator. The difference caused by tapping shall not exceed specified Friction Test Tolerance, nor shall the indication after tapping be out of tolerance for the test value involved.
(4) Set ratio transformer to mid-scale value and note pointer position after tapping. Rotate indicator 90, 180 and 270 degrees, then to position with dial horizontal. The difference between the indication in normal position and any other position shall not exceed specified Position Error Tolerance. (Ref. Fig. 7)
(5) Turn off power supply. Pointer shall swing off scale without tapping.

9. Trouble Shooting

The only troubles which can occur in an indicator, other than external physical damage, cause failure to pass test specified in sub-section 8B. When it has been determined in which test the trouble occurs, the indicator must be opened (Ref. sub-section 2A) after which possible causes as listed in Figure 8 may readily be checked to isolate the trouble.

Transformer Setting	Indicated PSI	Tolerance ± PSI	Transformer Setting	Indicated PSI	Tolerance ± PSI
.5980	0	0.50	.4793	60	0.75
.5777	10	0.50	.4600	70	0.75
.5582	20	0.50	.4408	80	0.75
.5382	30	0.75	.4214	90	0.75
.5185	40	0.75	.4020	100	0.75
.4980	50	0.75			
Friction Test Tolerance: 1 psi			Position Error Tolerance: 1 psi		

Test Values
Figure 7

OIL PRESSURE INDICATOR NO. 290-02240 OVERHAUL INSTRUCTIONS

10. Storage Instructions

No special storage requirements apply to this indicator. It is an hermetically sealed unit subject only to damage from rough handling.

11. Special Tools, Fixtures, and Equipment

Autoclave (4 qt. home pressure cooker - modified, add connector and valve) ("Mirro-Matic" or equivalent)

Vacuum Pump (Central Sci. Co., Chicago, Ill. "Cenco-Magnavac" or equivalent)

Induction Heater, 2 KW, RF (McDowell Electronics Inc., Metuchen, N.J., Model 2KW-2 or equivalent)

Ratio Transformer (Gertsch Products Inc., Los Angeles, Calif. Model RT-2)

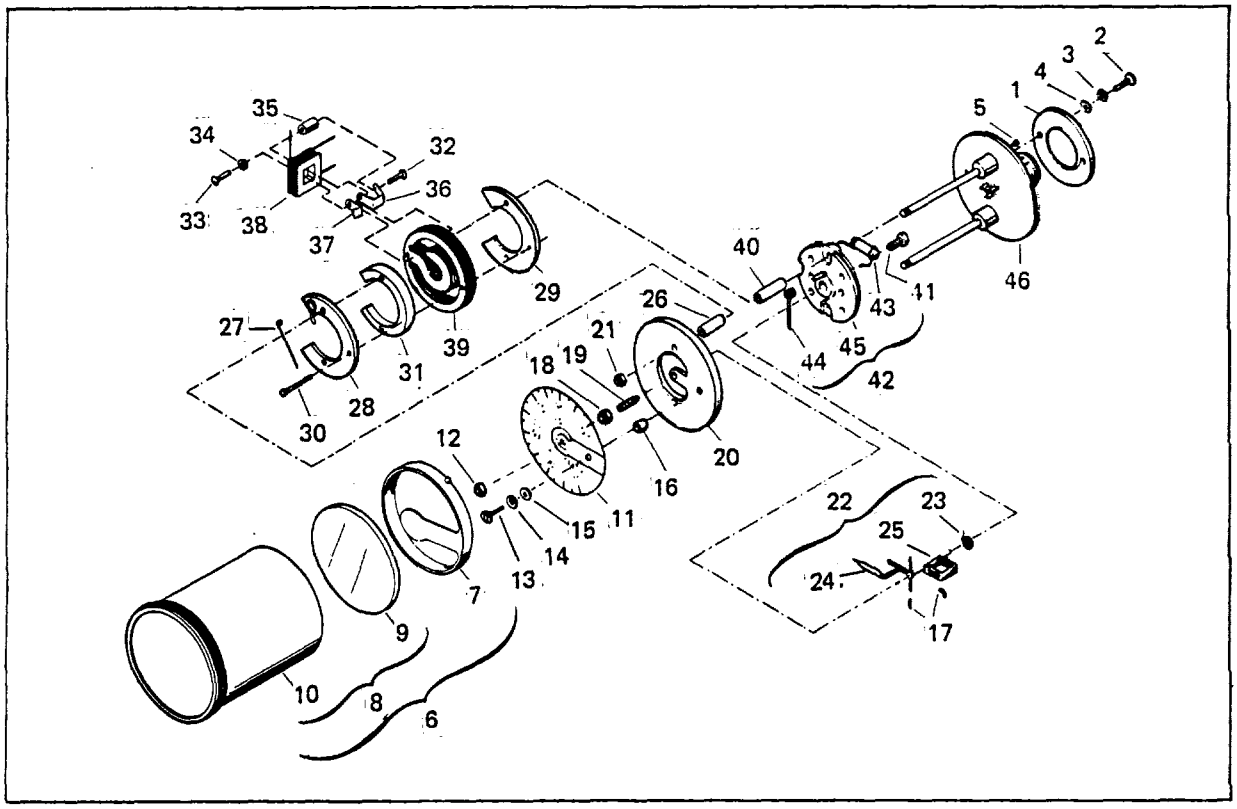
Resistor - 8 ohm non-inductive

Decade Inductances (Sprague Elec. Co., North Adams, Mass., Types 850-WA1 and 850-WA2 - one of each required)

TROUBLE	PROBABLE CAUSE	REMEDY
SCALE ERROR TEST		
POINTER OFF SCALE AT ALL VALUES	Open lead or leads	Connect or replace lead
	Open hairspring	Connect or replace hairspring
	Open moving coil	Replace rotor assembly
POINTER SLAMS LOW	Shorted moving coil	Replace rotor assembly
POINTER SLAMS HIGH OR LOW	Open fixed coil	Replace coil
	Open lead	Connect or replace lead
	Open thermistor	Replace thermistor
ERROR AT LOW VALUES	Incorrect zero and span adjustment	Readjust
ERROR AT HIGH VALUES	Incorrect span adjustment	Readjust
ALL READINGS EQUALLY HIGH OR LOW	Incorrect zero adjustment	Readjust
ERROR AT INTERMEDIATE VALUES	Irregular air gap in laminations	Replace inside laminations, outside laminations assembly, or both
POWER FAILS TO RETURN OFF SCALE	Rotor assembly unbalanced	Rebalance rotor assembly
	Incorrect hairspring adjustment	Increase hairspring tension
	Incorrectly shaped pointer	Bend to proper shape
FRICTION TEST		
EXCESSIVE ERROR	Pivot out of bearing	Adjust position
	No end play	Adjust end play
	Defective pivots	Replace pivots
	Defective or dirty bearings	Replace housing and bearing assembly
	Lint in air gap	Clean
POSITION ERROR TEST		
EXCESSIVE ERROR	Rotor assembly unbalanced	Rebalance rotor assembly
POINTER FAILS TO RETURN OFF SCALE IN SOME POSITIONS	Rotor assembly unbalanced	Rebalance rotor assembly
	Incorrectly shaped pointer	Bend to proper shape

Trouble Shooting Chart
Figure 8

OIL PRESSURE INDICATOR NO. 290-02240 ILLUSTRATED PARTS LIST



Exploded View
Figure 9

Figure & Index No.	Part Number	1 2 3 4 5 6 7 Nomenclature	Usage Code	Units per Assy
	290-02240	Indicator - Oil pressure		Ref
9-1	25852-10	. Nameplate - Indicator		1
		ATTACHING PARTS		
-2	10406	. Screw		2
-3	MS355388-77	. Washer - Lock		2
-4	13120-2	. Washer - Flat		2
-5	14411	. Rivet (Altered from AN427C2-2 by tin plating)..... ***		1
-6	No Number	. Case and Mask Assembly		Ref
-7	60132	. . Mask - Dial		1
-8	41737	. . Case Assembly		1
-9	23547	. . . Glass - Cover		1
-10	No Number	. . . Case and Bezel Assembly		Ref
9-	No Number	. Movement Assembly		Ref
-11	60117	. . Dial		1
		ATTACHING PARTS		
-12	10803	. . Nut - Dial		1
-13	14933	. . Screw - Dial		1

OIL PRESSURE INDICATOR NO. 290-02240 ILLUSTRATED PARTS LIST

Figure & Index No.	Part No.	1 2 3 4 5 6 7 Nomenclature	Usage Code	Units per Assy
9-14	14242	. . Washer - Lock		1
-15	25465	. . Washer - Flat		1
-16	22950	. . Bushing - Dial		1
		***		
-17	10254-1	. . Weight - Balance		AR
-17	10254-2	. . Weight - Balance		AR
-17	10254-3	. . Weight - Balance		AR
-17	10254-4	. . Weight - Balance		AR
-17	10254-5	. . Weight - Balance		AR
-18	23517	. . Nut - Front bearing		1
-19	41742	. . Housing and Bearing Assy		1
-20	23552	. . Plate - Top		1
		ATTACHING PART		
-21	60FM-264	. . Nut - Self-locking (Standard Pressed Steel Co.) (Edison No. 14254)		2
		***		
-22	41739K	. . Rotor and Hairspring Assy		1
-23	22944	. . . Hairspring		2
-24	22936	. . . Pivot		2
-25	No Number	. . . Rotor Body Assy		Ref
-26	23554	. . Bushing - Top		2
	No Number	. . Stator Assembly		Ref
-27	23996	. . . Wire - Cut		1
-28	41474	. . . Plate and Terminal Assy		1
-29	23553	. . . Plate - Bottom		1
		ATTACHING PART		
-30	15085	. . . Rivet - Oval head tubular ..		1
		***		
-31	42703	. . . Core - Inside		AR
	43217	. . . Coil and Lamination Assy ...		1
-32	AN520UBO-2	. . . . Screw		1
-33	AN520-0-6	. . . . Screw		1
-34	14242	. . . . Washer - Lock		1
-35	22933	. . . . Nut - Shunt		1
-36	60149	. . . . Shunt		1
-37	60148	. . . . Bracket - Coil		1
-38	41461	. . . . Coil - Fixed		1
-39	41473	. . . . Lamination Assy - Outside		1
-40	23555	. . Bushing - Bottom		2
	No Number	. . Board and Bearing Assy		Ref
-41	41723	. . . Housing and Bearing Assy - Rear		1
-42	41738	. . . Board and Adjuster Assy		1
-43	LA-4.8-218	. . . . Thermistor (Keystone Carbon Co.) (Edison No.14241) .		2
-44	23994	. . . . Snubber		1
-45	No Number	. . . . Board and Adjuster Assy .		Ref
-46	43161	. . Base and Receptacle Assy		1

EDISON®

OVERHAUL MANUAL

NO. 1084-5C

TORQUE PRESSURE TRANSMITTER

Part No. 318-100, 318-00040,
318-100C and 318-00140

INSTRUMENT DIVISION
THOMAS A. EDISON INDUSTRIES
McGRAW-EDISON COMPANY

WEST ORANGE, NEW JERSEY, U. S. A.

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TORQUE PRESSURE TRANSMITTER NO. 318-100, 318-00040, 318-100C and 318-00140

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TORQUE PRESSURE TRANSMITTER NO. 318-100, 318-00040, 318-100C and 318-00140

GENERAL INFORMATION

1. Introduction

This Manual contains instructions for the overhaul of EDISON Aircraft Torque Pressure Transmitters, part No. 318-100, 318-00040, 318-100C and 318-00140.

It is prepared in accordance with ATA Specification No. 100 including the Uniform Chapterization and Numbering System designated therein so that the pages may be inserted into their proper locations in the basic aircraft overhaul manual if desired.

All of the material in this Manual falls within the classification "Engine Indicating - Chapter 77".

2. List of Effective Pages

Chapter/Section	Page	Date
	Title	*Feb. 1/69
General	1	*Feb. 1/69
Contents	1	*Feb. 1/69
77-10-33	1	June 1/67
77-10-33	2	*Feb. 1/69
77-10-33	3	June 1/67
77-10-33	1101	June 1/67

*The asterisk indicates pages revised or added by current revision.

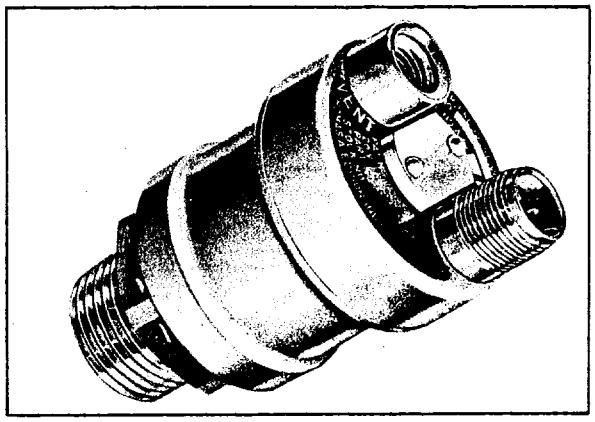
TORQUE PRESSURE TRANSMITTER NO. 318-100, 318-00040, 318-100C and 318-00140

OVERHAUL INSTRUCTIONS

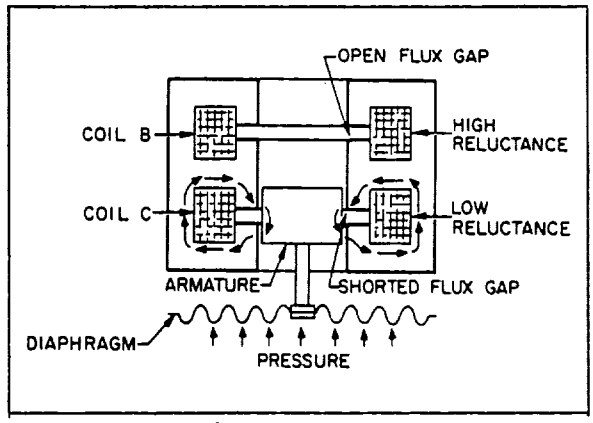
1. Description and Operation

The pressure transmitter covered by these overhaul instructions is the sensing unit of the EDISON variable reluctance type Torque Pressure Indicating System. (Ref. Fig. 1)

It is a factory sealed unit, the lower end of which is provided with both external and internal threads for pressure connection. It can be installed directly on a pressure boss on the engine by means of the external thread. It may also be mounted on a bracket by means of these threads, pressure connection being made to the internal threads by means of fittings and tubing. A pressure boss at the top of the transmitter permits connection of a vent pressure line if differential pressure is to be measured. A removable plug cap at the top of the transmitter gives access for calibration adjustment. An electrical connector receptacle is also on the top of the transmitter.

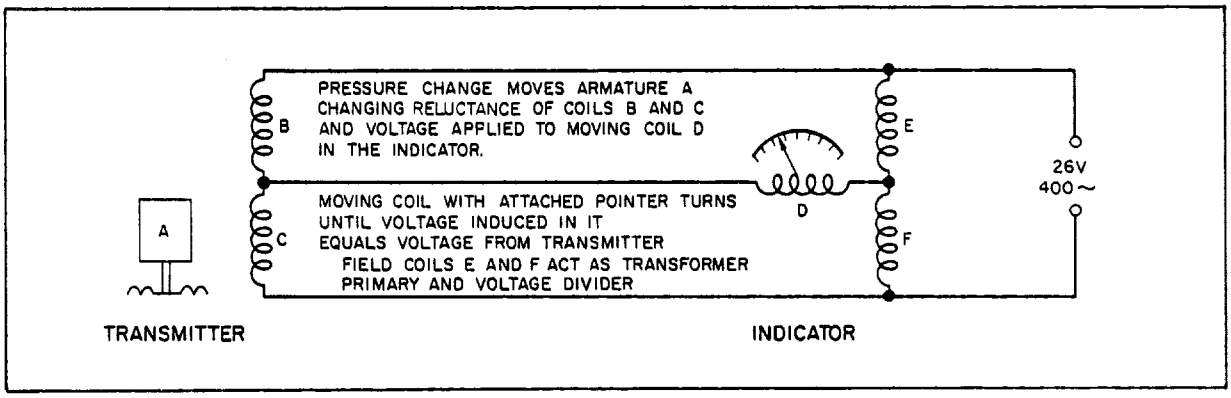


The Transmitter
Figure 1



Principle of Transmitter Operation
Figure 2

Table of Leading Particulars
Power Supply .... 26 V single phase 400 Hz
Pressure Range ..... 0 to 100 psi



Basic Principle of Operation of the System
Figure 3

TORQUE PRESSURE TRANSMITTER NO. 318-100, 318-00040, 318-100C and 318-00140

OVERHAUL INSTRUCTIONS

The function of the transmitter is to furnish to the indicator an electrical potential which varies according to the applied pressure. In the transmitter a diaphragm moves a magnetic armature inside of two stationary coils whenever there is a change in applied pressure. (Ref. Fig. 2) These coils are connected in series with a 26 volt 400 hertz power source and act as a variable reluctance voltage divider. The armature position determines the effective flux gaps in the magnetic housing of the coils, hence the reluctance of the coils. As connected to the indicator, which contains a similar but fixed voltage divider, a voltage regulated by the transmitter is applied to the moving coil of the indicator. (Ref. Fig. 3)

2. Disassembly (Ref. Fig. 6)

A. Remove plug cap to permit calibration adjustment.
   (1) Remove lockwire.
   (2) Remove screws (2) and lock washers (3).
   (3) Remove plug cap (1) with "O" ring (5) attached.
   (4) Remove nameplate (4).
   (5) Remove "O" ring (5) from plug cap (1).

B. Attempt no other disassembly.

3. Cleaning

A. Wash outside with trichlorethylene and blow dry.

WARNING: AVOID BREATHING FUMES OR PERMITTING TRICHLORETHYLENE TO CONTACT SKIN.

4. Inspection/Check

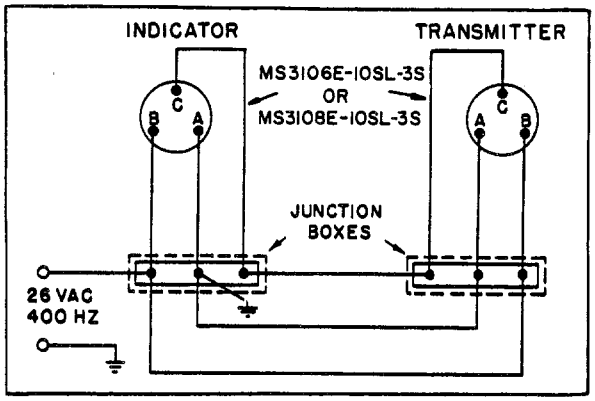
None required.

5. Repair

Non-repairable.

6. Assembly (Ref. Fig. 6)

A. Install plug cap following calibration adjustment.
   (1) Install new "O" ring (5) on plug cap (1).
   (2) Place nameplate (4) on transmitter.
   (3) Install plug cap and "O" ring assembly on transmitter.
   (4) Secure with screws (2) and lock washers (3).
   (5) Install new lockwire.



Test Connections
Figure 4

Test Pressure PSI	Indicated PSI	Tolerance ± PSI
0	0	1.0
10	10	1.0
20	20	1.0
30	30	1.75
40	40	1.75
50	50	1.75
60	60	1.75
70	70	1.75
80	80	2.0
90	90	2.0
100	100	2.0

Transmitter Test Data
Figure 5

TORQUE PRESSURE TRANSMITTER NO. 318-100, 318-00040, 318-100C and 318-00140

OVERHAUL INSTRUCTIONS

7. Fits and Clearances

None applicable.

8. Testing

A. For equipment required, refer to sub-heading 11.
B. Test calibration:
(1) Mount the transmitter in vertical position on a dead weight or other type of pressure tester capable of supplying accurate pressure of dry air in the range involved.
(2) Connect the transmitter to EDISON Transmitter Test Indicator, part No. 389-1, or 389-00340, which has been checked for accuracy.(Ref.Fig.4)
(3) Energize the circuit with 26 ± 0.5 volts, 400 ± 5 hertz.
(4) Apply pressure, testing transmitter at each applicable value marked on indicator dial. Before reading indicator, lightly tap both transmitter and indicator. All readings shall be within tolerances as marked on dial.
C. Adjust calibration if necessary.
(1) Leave transmitter connected to indicator and power on.
(2) Set pressure to zero psi value.
(3) Remove plug cap (Ref. sub-heading 2).
(4) Using zero adjusting tool, part No. 41486, turn armature assembly inside transmitter until indicator reads approximately correctly.
(5) Apply maximum pressure for range.
(6) Using both zero adjusting tool, part No. 41486,and scale span adjusting tool, part No. 42015, hold zero adjusting tool stationary while turning scale span adjusting tool to give indicator reading within tolerance after tapping.
(7) Reduce pressure to zero psi value.
(8) Hold span adjusting tool stationary while turning zero adjusting tool to give indicator reading within tolerance after tapping.
(9) Repeat steps (5) through (8) until both readings are within tolerance with tools removed before reading indicator.
(10)Check readings at all test values.
(11)Replace plug cap (Ref. sub-heading 6).
(12)Replace lock wire using No. 20 corrosion resistance steel wire.
D. Test for leakage:
(1) Disconnect wiring and pressure connection.
(2) Connect "VENT" boss to pressure tester by means of flexible tubing.
(3) With transmitter in vertical position, immerse it in alcohol until only the upper half of the electrical connector receptacle projects above the alcohol.
(4) Apply 15 psi air pressure to the "VENT". No evidence of leakage shall be visible.
(5) Remove from alcohol, blow dry, release pressure, and disconnect pressure tube.

9. Trouble Shooting

None required. If transmitter leaks, or can not be calibrated within tolerance, it must be scrapped since no repairs are possible.

10. Storage Instructions

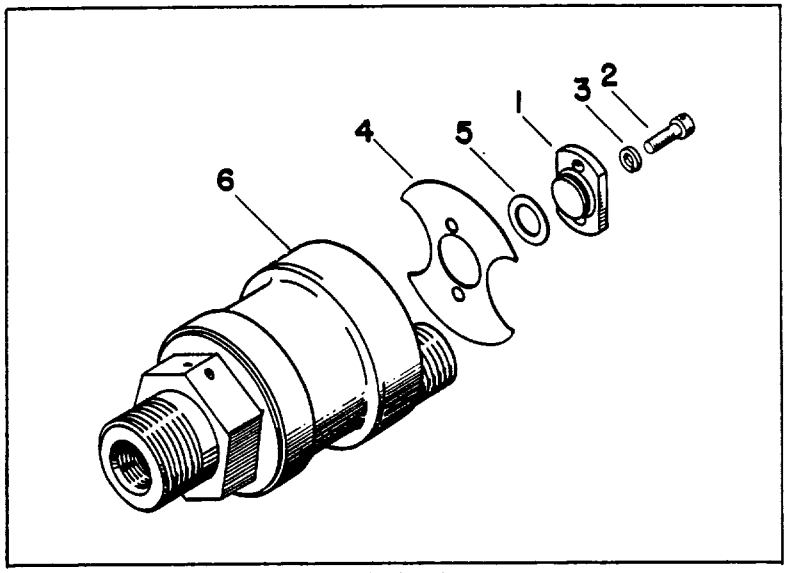
Cover pressure and vent ports and electrical connector to keep out foreign matter during storage. Use shipping caps such as Edison No. 14234, 14235, and 14236, or other suitable means.

11. Special Tools, Fixtures and Equipment

Dead Weight or other Pressure Tester
Transmitter Test Indicator - Edison part No. 389-1 or 389-00340
Zero Adjusting Tool - Edison part No. 41486
Scale Span Adjusting Tool - Edison part No. 42015

TORQUE PRESSURE TRANSMITTER NO. 318-100, 318-00040, 318-100C and 318-00140

ILLUSTRATED PARTS LIST



Exploded View
Figure 6

Part No.	318-100	318-00040	318-100C	318-00140
Usage Code	A	B	C	D

Figure & Index No.	Part No.	1 2 3 4 5 6 7 Nomenclature	Usage Code	Units per Assy
	318-100	Transmitter - Torque pressure	A	Ref
	318-00040	Transmitter - Torque pressure	B	Ref
	318-100C	Transmitter - Torque pressure	C	Ref
	318-00140	Transmitter - Torque pressure	D	Ref
6-1	23815	. Cap - Plug	all	1
-2	AN500D3-4	. Screw	all	2
-3	AN935C3	. Washer	all	2
-4	24074-2	. Nameplate	A	1
	24074-18	. Nameplate	B	1
	24074-10	. Nameplate	C	1
	24074-24	. Nameplate	D	1
-5	14474-1	. "O" Ring	all	1
-6	No Number	. Body - Assembly of Transmitter	A,B	Ref
	No Number	. Body - Assembly of Transmitter	C,D	Ref

OVERHAUL INSTRUCTIONS
FOR
ALUMINUM PLATE TYPE
LIQUID-TO-AIR COOLERS
PART. NO. 8535233

HARRISON
RADIATOR DIVISION
GENERAL MOTORS CORPORATION

SERVICE BULLETIN HES-62-77F
REVISED FEBRUARY 1, 1965

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8535033

REPLACEABLE PARTS LIST

MODEL AP09AN13-05

PART 8535233

OIL COOLER ASSEMBLY

PART NO.	DESCRIPTION	QTY./ASSEMBLY
8530815	VERNATHERM CONTROL VALVE	(1)
8532005	"O" RING, VALVE	(1)
AN814-8CL	PLUG, DRAIN, 3/4-16	(1)
8534162	"O" RING, PLUG, DRAIN, 3/4-16	(1)
8503821-7	WIRE, SCREW LOCKING	(2)

OVERHAUL INSTRUCTIONS
ALUMINUM PLATE TYPE LIQUID-TO-AIR COOLERS

1. GENERAL INFORMATION

A. This service bulletin provides overhaul instructions for commercial aluminum plate-type liquid-to-air coolers. Instructions are included for lightweight and standard thickness plate material. Lightweight material is designated by the letter "N" in the model number; standard weight thickness by the letter "U". For example, AP16AN09-01 indicates lightweight tube material while AP12AU09-01 would indicate standard thickness.

B. All lightweight units prior to Serial Number KK-4334 (and date 1/9/58) and having the letter "N" in the model number have been heat treated. On these units, it is recommended that no repairs be attempted.

C. Records should be kept of the type and extent of repairs performed and the test data prior to re-installation. Over a period of time, this data will provide a standard for repairs and service.

2. BASIC CONSTRUCTION

A. Cooler assemblies fall into several basic classifications, determined by the physical configuration, and design of the units. Examples of characteristics which classify a unit are: Lightweight design; drawn cup design; round, square, crescent (saddle) profile; with or without by-pass tube (s); and with or without thermostatic and pressure relief valves.

B. The basic constructions used for the cooling plate are shown in figure 1 and explained below.

(1) Bar and plate construction consists of two (2) tube plates with bars at the edges.

(2) Drawn cup type construction consists of two equal size plates incorporating end tanks as part of the plate.

(3) Formed plate-fin type construction consists of a male and female stamping.

(4) Prime surface type construction consists of stacked stampings.

(5) All four designs incorporate turbulator features which break up the liquid stream, add to the structural strength, and improve heat transfer.

C. The entire core mass is brazed and welded together. Under no circumstances can it be disassembled.

D. Some units incorporate an oil by-pass passage. The flow through the by-pass is usually controlled by a combination thermostatic and pressure relief valve on the outlet side of the system. With cold oil (or with pressures exceeding the valve setting), the valve is open permitting the oil to flow through the by-pass and back to the system. When fully closed the thermostat plugs the by-pass passage and full cooling action is effected on the oil going through the cooling plates.

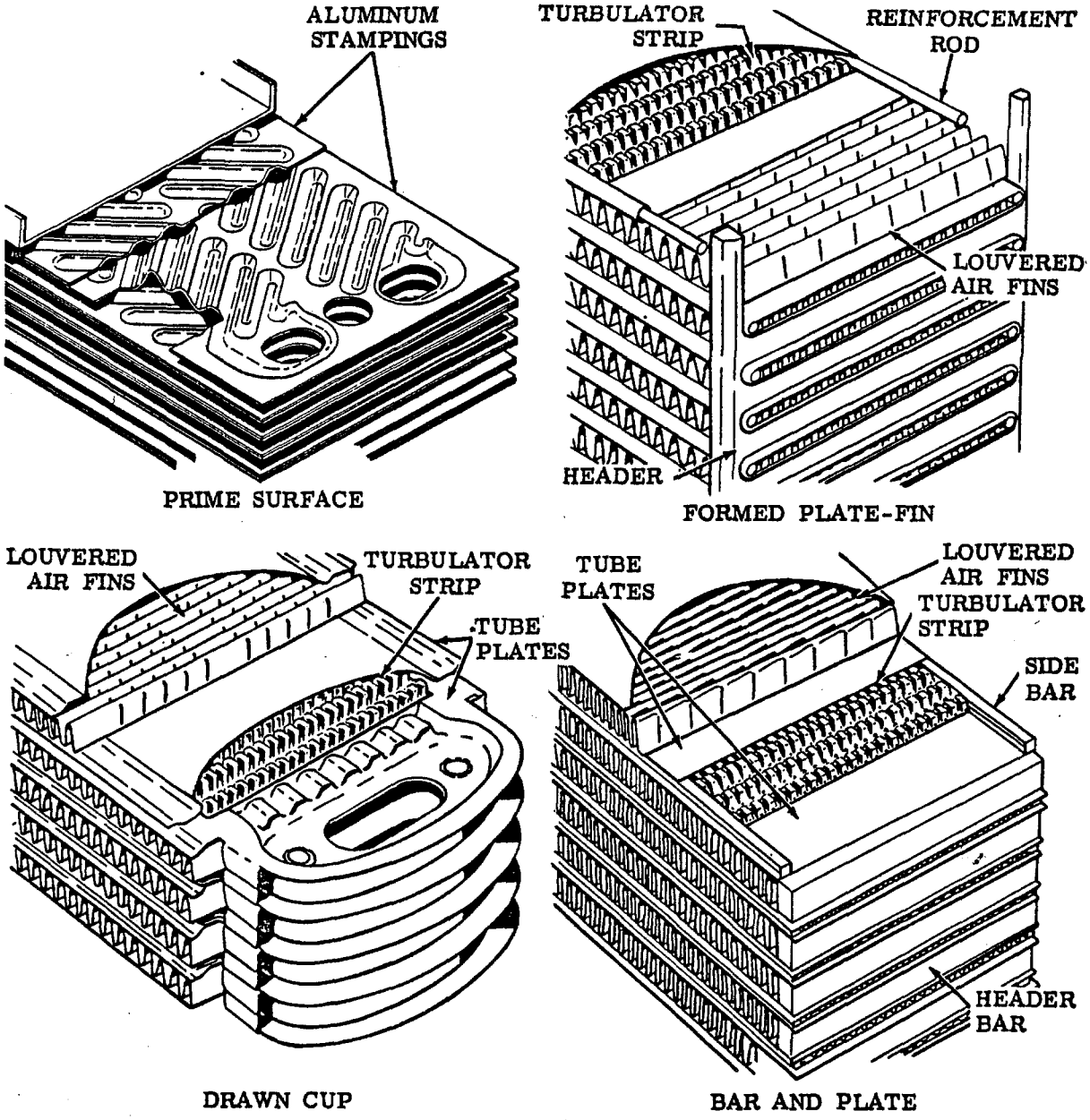


Figure 1. Basic Construtions, Cutaway

3. TOOLS, FIXTURES AND EQUIPMENT

A. Cleaning equipment and supplies required for cleaning operations performed in paragraph 4 follows:

(1) Four (4) storage tanks with inlet at top and outlet at the bottom. These tanks should be large enough to give flows required for the particular unit being overhauled. Flows are determined in step (2) below.

(2) Centrifugal pump with a capacity of 2 to 4 gpm times the number of cooling plates in the unit to be cleaned. The pump must be capable of maintaining 75 psi pressure.

NOTE: Units with 2 or more oil passes will use a flow proportioned to the number of plates in 1 pass.

(3) Hydraulic pressure gauge, 0 to 200 psi (2 required).

(4) Full flow filter.

(5) 100-Mesh screen (2 required).

(6) Pressure relief valve, 75 psi.

(7) Hose (assorted lengths).

(8) Steam cleaning apparatus.

(9) Compressed air supply, 125 psi minimum.

(10) Cleaning solutions (see paragraph 4B).

(11) Corrosion-preventive compound (see paragraph 4B).

B. Test equipment required to perform cooler tests in paragraph 8 is listed below:

(1) Hydrostatic test equipment consisting of: Water reservoir, hydraulic pump, relief valve, control valve, 0 to 500 psig pressure gauge, and hose. The equipment must be capable of supplying 400 psi hydrostatic pressure.

(2) Compressed air source, 200 psi minimum.

(3) Water tank (large enough to submerge core).

C. Repair equipment necessary to perform the repair procedures in paragraph 9 is listed below:

(1) Inert gas shielded tungsten arc welding unit (Heliarc or equivalent) having an output of 3 to 300 amps, at 40 volts.

(2) Two (2) gas torches, each equipped with a Selas PRS-3 tip for use with manufactured gas. For natural gas, use a PR-6 tip.

(3) Acetylene torch with No. 3, 4, 5, and 8 tips, and a preheat adapter.

(4) Temperature stable furnace capable of 950° F. and large enough to accommodate the unit being overhauled.

(5) Alcoa #33 torch brazing flux or equivalent.

(6) Welding rod, 1/8-inch diameter, U.S. Federal Spec. QQ-R-566, Class FS-RA1-43 (Alcoa #43S or equivalent).

(7) Brazing wire, 3/32-inch diameter, U.S. Federal Spec. QQ-R-566, Class FS-RA1-718 (Alcoa #718 or equivalent).

(8) Brazing wire, 1/16-inch diameter, U.S. Federal Spec. QQ-R-566, Class FS-RA1-716 (Alcoa #716 or equivalent).

4. CLEANING

A. Equipment Setup

(1) To clean the interior of an oil cooler assembly core, the pump equipment as specified in paragraph 3A is required. Four solutions are used for the cleaning procedure. There are several possible arrangements of the equipment depending upon equipment availability and versatility. If provision can be made for flushing pump lines, one set of pump equipment can be used with four storage tanks to provide the required four solutions for rinsing, cleaning, and flushing. If such provisions cannot be made conveniently, four sets of pump equipment are required.

(2) Connect the pump equipment as shown in figure 2.

(3) On units incorporating by-pass features, block the by-pass passage prior to cleaning as follows: Remove the thermostatic valve from the valve housing. Press a rubber plug into the by-pass opening in the valve housing. Reinstall valve into the valve housing so that the valve bears up against the rubber plug.

B. Cleaning Operations

CAUTION: USE ONLY CLEANING SOLUTIONS RECOMMENDED IN THESE INSTRUCTIONS OR ONES SATISFACTORY FOR ALUMINUM. MANY SOLUTIONS SATISFACTORY FOR CLEANING COPPER OR COPPER NICKEL COOLERS ARE HIGHLY CORROSIVE TO ALUMINUM AND IF USED WILL RESULT IN THE DESTRUCTION OF THE COOLER. IF EQUIPMENT HAS BEEN PREVIOUSLY USED WITH ANY OTHER CLEANING SOLUTIONS, IT SHOULD BE THOROUGHLY WASHED OUT AND FLUSHED WITH THE RECOMMENDED SOLUTION.

WARNING: CLEANING SOLVENTS AND SOLVENT CLEANING COMPOUNDS ARE TOXIC AND FLAMMABLE, AND MUST BE USED ONLY IN A WELL-VENTILATED ROOM. TAKE ADEQUATE SAFEGUARDS FOR FIRE PREVENTION IN WORK AREA. USE PROTECTIVE CLOTHING AND AVOID CONTACT OF THESE SOLUTIONS WITH THE SKIN.

(1) Steam clean the exterior surfaces and corrugated air fins of each core.

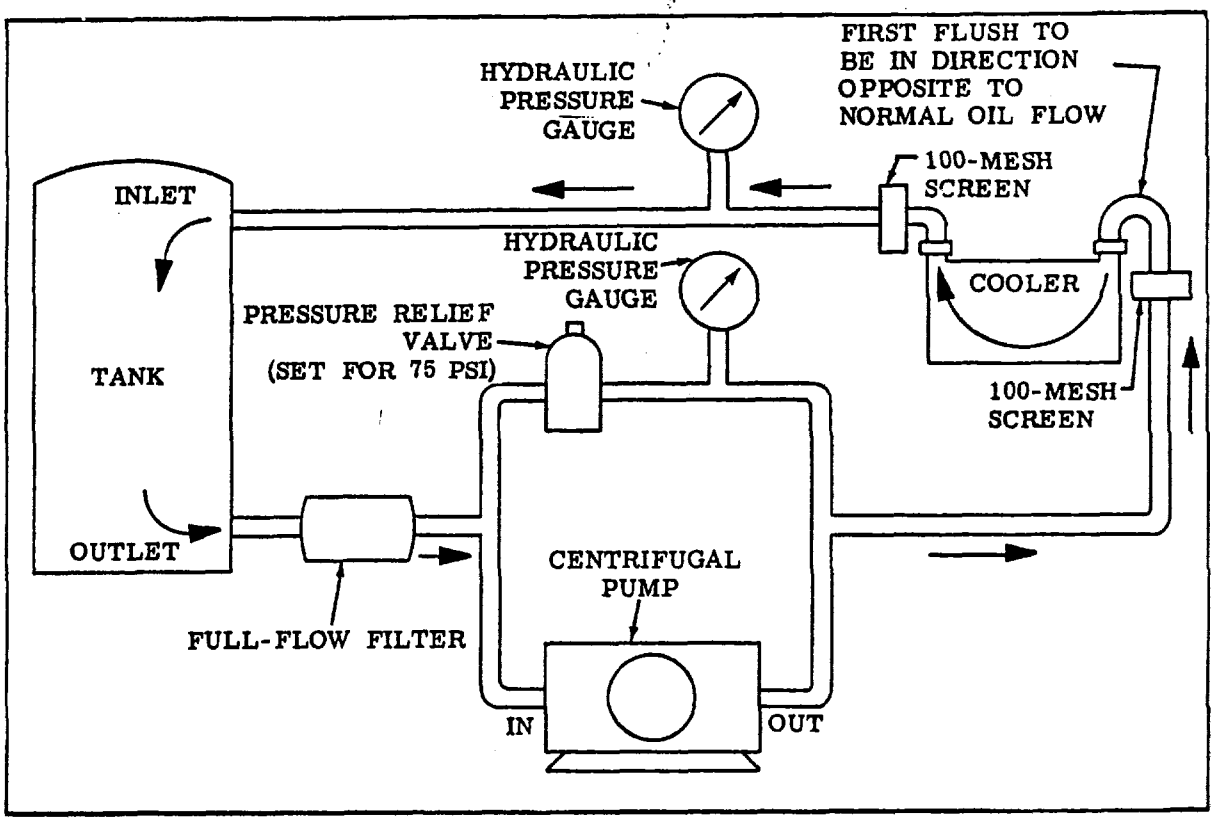


Figure 2. Cleaning Setup

(2) Preclean core interior to remove oil and loose sludge from the core to reduce contamination of cleaning solution in subsequent operations. Connect pump equipment so that fluid flow will be in the reverse direction of normal flow. Use mineral spirits, Federal Spec. TT-T-291, or kerosene, Federal Spec. VV-K-211, or dry cleaning solvent, Federal Spec. P-S-661. Flush core in reverse direction for 30 minutes or until solution appears clean. Reverse lines and flush approximately 15 minutes in the opposite direction. Drain cooler.

(3) Remove carbon deposits, engine oil, gums, lead deposits and foreign contamination by flushing cooler in opposite direction to normal oil flow for 30-60 minutes. Use solvent cleaning compound such as Turco "Surjax" (Turco Products, Los Angeles, California), Beck "OCC-3" (Beck Equipment Company, Cleveland, Ohio), or equivalent compounds conforming to Spec. MIL-C-6864. Reverse lines and flush in opposite direction for 15 minutes.

(4) Remove plug installed in by-pass opening (step 4A (3)) and block cooling section opening. Flush for 15 minutes to clean by-pass passage. Remove plug from cooling section opening and replace in by-pass opening.

(5) Rinse cooler for 10 minutes by circulating clear petroleum solvent such as dry cleaning solvent (Federal Spec. P-S-661), or kerosene (Federal Spec. VV-K-211). System shall be suitably filtered to prevent circulation of foreign matter.

(6) Flush core interior to detect presence of metal particles in the core, and to remove combustible liquids from the core in preparation of repair instructions. Use water at 100^{0} to 160^{0} F. If repairs are not anticipated, cleaning solvent P-S-661 can be used, but if during testing it is found that repairs are required, an additional water flush must be made. Flush ten minutes in each direction with a 100-mesh screen installed at the cooler inlet and outlet. Reflush cooler for 5 minutes in each direction and recheck screens. Remove rubber plug from by-pass opening and replace valve.

CAUTION: IF METAL PARTICLES ARE FOUND AT THE SCREEN DURING THE ABOVE FLUSHING OPERATIONS, IT IS AN INDICATION THAT THE OIL COOLER WAS INSTALLED ON EQUIPMENT THAT FAILED MECHANICALLY. SUCH A COOLER SHOULD BE SCRAPPED UNLESS AN APPROVED METHOD IS KNOWN FOR SALVAGING.

(7) Flush cooler with a preservative oil consisting of three parts MIL-L-6082, Grade 1065, and one part MIL-C-6529, or, for systems employing MIL-L-7808 oil, preservative oil MIL-C-8188B, or equivalent, in preparation for shipment or storage. Connect cooler to pump equipment and flush in each direction for 10 minutes, checking the mesh screen after each flush to ensure that no metal particles have appeared. After flushing operations, install plugs in inlet and outlet ports.

5. DISASSEMBLY

A. Disassemble oil coolers by removing lockwires, bolts, and oil fittings on units having removable fittings.

B. Remove by-pass thermostatic control valves. Do not disassemble valves. If assembly malfunctions or does not pass test, replace valve.

C. Discard any gaskets and "O" rings.

D. Further disassembly of cores is not practical because each core is a brazed and welded unit.

6. INSPECTION

A. Examine the air fins and air passages for distortion or foreign particles that may obstruct the air flow.

B. Inspect the cooler for damaged and bulged plates, cracked castings and flanges, broken welds, and stripped threads. Inspect hardware items for stripped threads, ineffective lock units, and damaged bolt heads.

C. Inspect all openings in core and valve housing assemblies for evidence of foreign matter inside the cooler.

D. Inspect gasket surfaces for scores that may prevent the gaskets from sealing.

E. On units having a thermostatic valve, inspect the valve seat and the control valve housing seat for scoring and wear that would allow excessive leakage when the valve is seated. Inspect the valve for stripped threads and broken spring.

F. Test cores for leaks and test thermostatic valves for proper functioning in accordance with paragraphs 8A and 8B.

7. REASSEMBLY

A. Reassembly of the unit is essentially the reverse of disassembly.

B. Use new gaskets and/or "O" rings.

C. Tighten all bolts and nuts.

D. Install lockwire after final testing.

8. TESTING

A. Cooler Tests

(1) Preliminary cooler test. Conduct an air leak test on the assembled unit as follows: Plug the cooler outlet and attach an air hose to the inlet. Attach the other end of the air hose to an adjustable pressure source. Adjust air pressure to 12 PSIG. Submerge cooler in water at 140^{o} F - 180^{o} F (Heat water to 185^{o} F to expand metal.)

WARNING: INCREASE AIR PRESSURE GRADUALLY TO AVOID BURNS FROM HOT WATER SPLASHING FROM LARGE LEAKS, IF PRESENT.

After five minutes of submersion increase air pressure to 100 PSIG to detect small leaks, if present. Inspect cooler for leaks as evidenced by presence of air bubbles. Mark leaks, remove from water, release air, and blow cooler dry. Repair in accordance with paragraph 9 and retest.

(2) Final cooler test. Conduct a hydrostatic test on the assembled cooler as follows (see figure 3). Plug outlet and apply room temperature water at test pressure to the other port. Lock fluid in cooler for 10 minutes. Examine cooler for blown or bulged plates. Release pressure, drain cooler, and dry with compressed air. Repair and retest.

CAUTION: TEST PRESSURE SHOULD BE IN ACCORDANCE WITH THE ENGINEERING DRAWING SPECIFICATION. IN THE ABSENCE OF THE ENGINEERING DRAWING, DO NOT EXCEED 150 PSIG.

(3) If the unit is found serviceable after completing preliminary to final tests, flush with suitable corrosion preventative compound such as specified in paragraph 4B (7).

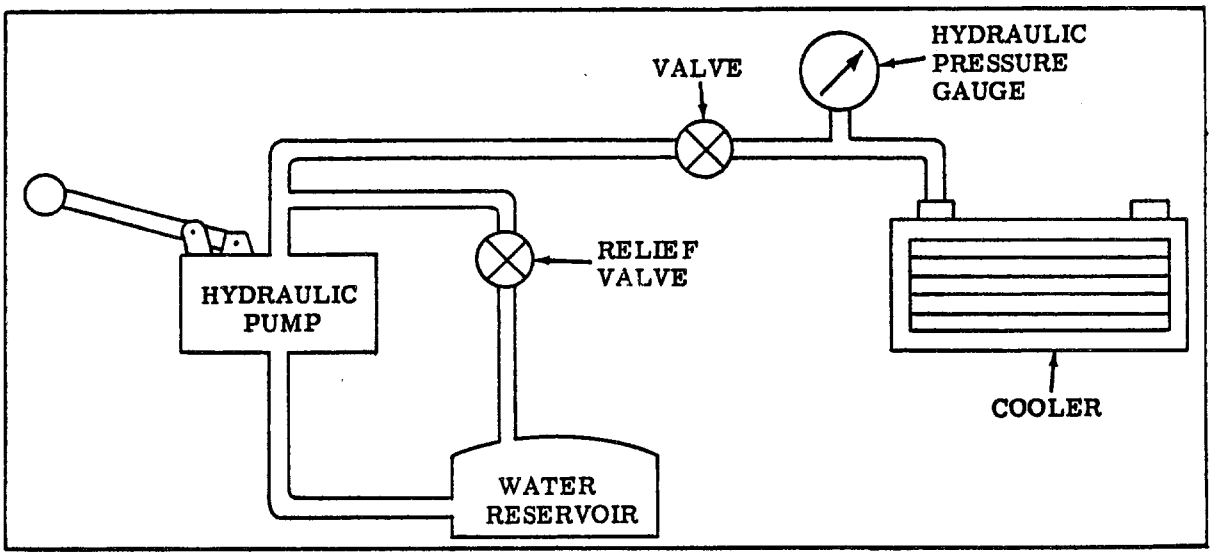


Figure 3. Hydrostatic Test Setup

B. Control Valve Function Test

(1) Check function of control valve by submerging valve in water at Start to Close temperature, indicated in the following table, for five minutes. Remove valve and measure length. Submerge valve in water at Fully Closed temperature, indicated in the table, for five minutes. Remove valve and measure length. Minimum increased length shall be equal to that shown in the table.

(2) Inches of travel should occur between the two temperatures shown.

(3) If valve under test does not function properly, replace with new valve.

NOTE: Start to Close temperatures are approximate.

9. REPAIR

A. Scope

(1) Repair of the cooler assembly is limited to the corrections of accessible leaks by welding and brazing, and should be performed following cleaning (paragraph 4) and testing procedures (paragraph 8).

CAUTION: THE MANUFACTURER DOES NOT RECOMMEND REPAIRING DAMAGED COOLERS. A DAMAGED COOLER SHOULD BE RETURNED TO THE MANUFACTURER FOR REPAIRS. HOWEVER, WHEN MINOR REPAIRS ARE NECESSARY THEY SHALL BE EXECUTED ONLY BY FACTORY TRAINED PERSONNEL. WHEN THE CONDITIONS NOTED IN STEP 9A(2) FOLLOWING ARE PRESENT, THE COOLER MUST BE RETURNED TO THE FACTORY.

(2) Return the cooler to the manufacturer for inspection and repair or replacement if repairs for the following damages are required:

(a) Blown, bulged, or badly dented plates.

Valve Part No.	Temp. Range + - 5° F.		Minimum travel - inches
	Start To Close	Fully Closed	
8509198	150	185	.235
8518329	130	160	.235
8518629	150	185	.160
8518815	50	80	.195
8520496	110	128	.235
8520589	120	150	.235
8520618	110	140	.160
8522532	80	160	.250
8522776	50	80	.195
8522852	80	160	.140
8523427	150	185	.160
8523464	110	128	.235
8524200	125	160	.160
8525961	80	160	.250
8526034	130	160	.235
8526113	120	148	.090
8526613	80	140	.235
8526799	160	183	.090
8527429	80	185	.195
8527855	160	178	.080
8528145	120	150	.090
8528148	120	140	.090
8528613	80	140	.250
8528839	150	165	.160
8528933	130	160	.080
8529080	120	150	.100
8530018	120	150	.125
8530249	150	173	.090
8530269	165	183	.250
8530815	140	160	.090
8532003	158	198	.090

TABLE OF OPERATING TEMPERATURES

(b) Leaks in areas where reinforcement plates, strips, or gussets are joined to the core and usually located on the outside plates.

(c) Non-repairable damage or distortion to the valve seat.

(d) Damaged threads in aluminum fittings, ports, drain bosses, or valve housing.

(e) Major dents and similar damage in tube edges, tanks, or valve bodies, which do not leak but could impair cooler performance and life.

(f) Leaks in difficult locations such as interior plate-to-header leaks, or leaks in the plate away from plate edge.

(3) Replace control valves which do not function properly when tested in accordance with paragraph 8B.

NOTE: Valves should not be replaced until all welding and brazing on the unit has been accomplished.

B. Repair of Leaks

WARNING: PURGE COOLER OF ANY COMBUSTIBLE FLUIDS OR VAPORS BEFORE ATTEMPTING REPAIRS. PURGE WITH WATER, DRAIN, AND DRY COOLER WITH COMPRESSED AIR.

NOTE: Before using any type of torch, apply a light coat of Alcoa #33 flux, or equivalent, which has been mixed with water in accordance with the manufacturer's instructions. Flux and metal changes indicate the reaching of brazing temperature of approximately 1080° F. The flux passes through a color change of green to white. It then melts to a watery appearance and becomes extremely active at brazing temperature. The aluminum will change from a greyish color to a shiny appearance.

(1) Repair accessible leaks or cracks in tanks, casting, Heliarc welds, by-pass tubes, control valve housing pads, inlet or outlet fitting pads, and mounting pads using an inert arc welding process (Heliarc or equivalent) and 1/8-inch diameter welding rod.

If this equipment is not available, or if cracks tend to "creep", or if casting impurities tend to "bubble" using Heliarc, then substitute acetylene torch for repairs. Preheat with a preheating adapter on the torch if the leaking area is adjacent to thin-walled cooler parts. When flux grows shiny, sweat-in 3/32-inch brazing wire, using a #8 tip. Switch to a #3 tip for final braze-in, using 3/32-inch or alternately 1/16-inch brazing wire and #33 flux.

CAUTION: ALL ALUMINUM FLUXES ARE HIGHLY CORROSIVE. USE BOILING WATER TO REMOVE ALL TRACES OF FLUX FROM INTERIOR AND EXTERIOR OF COOLER. KEEP UNITS DRY BETWEEN OPERATIONS INVOLVING FLUX, PARTICULARLY WHEN INTERVALS OF MORE THAN ONE HOUR ARE INVOLVED, AS MOISTURE ACCELERATES CORROSION.

(2) Repair plate seam leak (located at the edge of the plate) using a gas torch and 1/16-inch brazing wire. Use Selas PRS-3 tip (with manufactured gas) or Selas PRS-6 tip (with natural gas). Hold the torch flame about two inches away from the leaking area and rotate in a circular pattern. Air fins may be pushed back or lifted away from the leaking area to gain access. Reposition and tack air fins after the leak has been sealed. If seam leaks are within one inch of the tank header, it may be necessary to direct the flame of a second gas torch on the tank to hold the heat at the leak. If a gas torch is not available, repair with an acetylene torch. First preheat the cooler to 950° F. in an oven. Further preheat the area with a preheating adapter on the acetylene torch. At brazing temperature, use a #3 tip for final braze-in.

(3) Repair leaks or voids along the bottom of the by-pass tube by first heating the unit in a furnace at 900° F. until the unit is up to temperature. Remove to work bench. Apply #33 flux to leaking area and heat with a gas torch until flux grows shiny and 3/32-inch diameter brazing wire is sweated in. Put protective shield made from scrap metal on top of the shroud to prevent burning through.

(4) Repair plate-to-header leaks at outside accessible edges of the unit as in paragraph 9B (2).

C. Remove all traces of flux by scrubbing all accessible areas with a brush dipped in boiling water. Areas not so reached should be thoroughly flushed with boiling water. Complete removal of flux is extremely important to prevent subsequent corrosive destruction of the cooler. Dry with compressed air or in an oven at 250° F.

10. STORAGE

After the cooler has been completely overhauled and flushed with preservative oil, install plugs in the inlet and outlet ports. Package the cooler in a container that will provide suitable protection against damage and deterioration. The container should be so constructed as to permit periodical removal and inspection of the cooler without damage to the container or labels. Labels on the container should contain, in addition to complete identification data, the date of overhaul and an indication of repair performed, parts replaced, and general condition.

OVERHAUL INSTRUCTIONS
FOR
ALUMINUM PLATE TYPE
LIQUID-TO-AIR COOLERS

PART NOS. 8538777 &
8540012.

HARRISON
RADIATOR DIVISION
GENERAL MOTORS CORPORATION

SERVICE BULLETIN HES-62-77F
REVISED JULY 1969

REPLACEMENT PARTS

Replacement Parts List for Harrison Model AP09AN13-08,
Part No. 8540012, Oil Cooler Assembly:

NUMBER/ COOLER	PART NO.	NAME
1	8540011	Thermostatic Control Valve
-	8531588	Gasket, Thermo Valve
1	8534211	Seat, Valve
1	8534212	Spring, Seat Control
1	8534213	Plug, Valve Seat
1	8534163	Gasket "O" Ring
1	8529791	Plug, Drain
1	8534162	Gasket, "O" Ring

REPLACEMENT PARTS

Replacement Parts List for Harrison Model AP09AN13-07, P/N 8538777, Oil Cooler Assembly.

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1	8537927	Thermostatic Control Valve
-	8531588	Gasket, Thermo Valve
1	8534211	Seat, Valve
1	8534212	Spring, Seat Control
1	8534213	Plug, Valve Seat
1	8534163	Gasket "O" Ring
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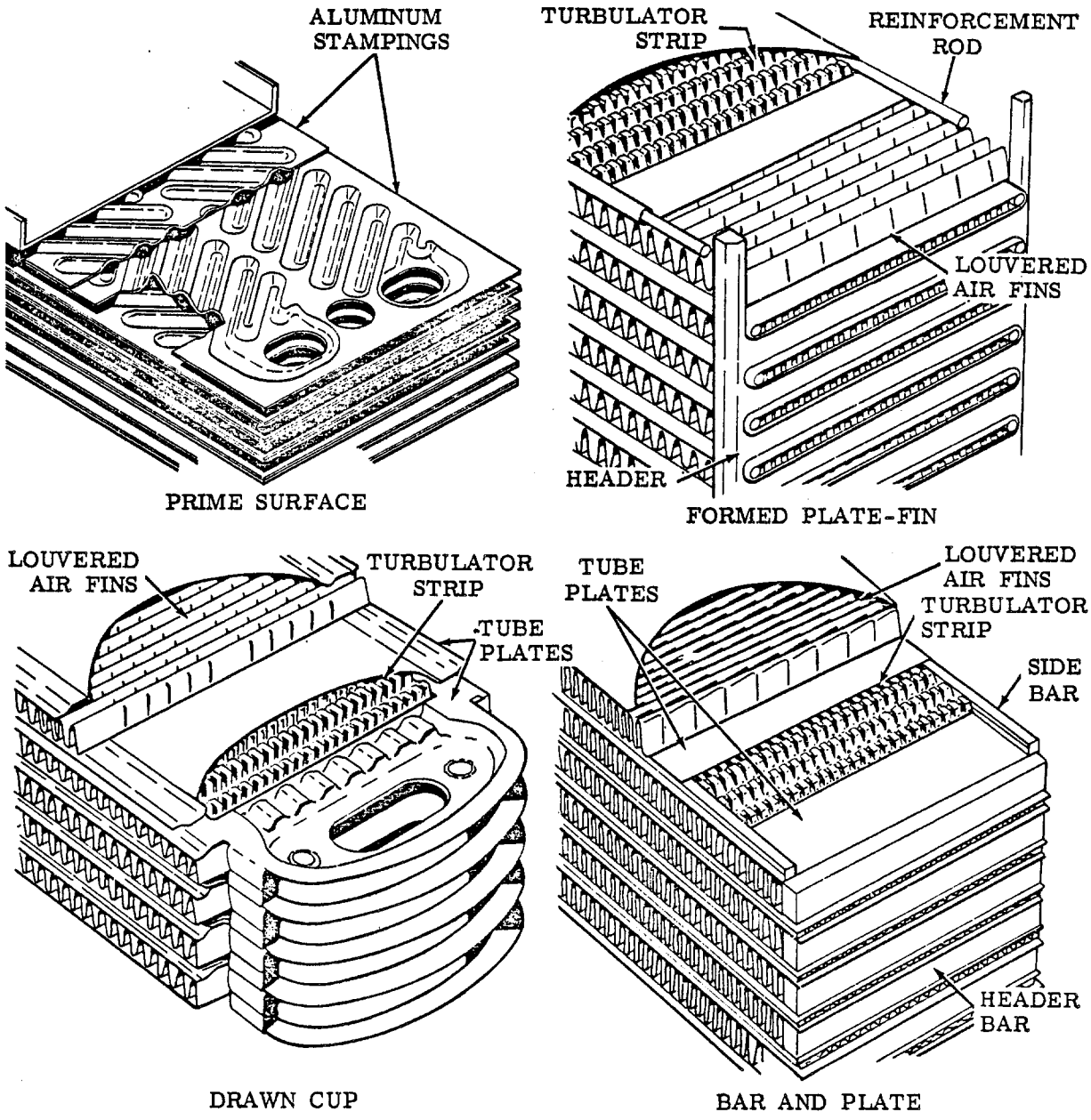


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NOTE: Units with 2 or more oil passes will use a flow proportioned to the number of plates in 1 pass.

(3) Hydraulic pressure gauge, 0 to 200 psi (2 required).

(4) Full flow filter.

(5) 100-Mesh screen (2 required).

(6) Pressure relief valve, 75 psi.

(7) Hose (assorted lengths).

(8) Steam cleaning apparatus.

(9) Compressed air supply, 125 psi minimum.

(10) Cleaning solutions (see paragraph 4B).

(11) Corrosion-preventive compound (see paragraph 4B).

B. Test equipment required to perform cooler tests in paragraph 8 is listed below:

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C. Repair equipment necessary to perform the repair procedures in paragraph 9 is listed below:

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WARNING: CLEANING SOLVENTS AND SOLVENT CLEANING COMPOUNDS ARE TOXIC AND FLAMMABLE, AND MUST BE USED ONLY IN A WELL-VENTILATED ROOM. TAKE ADEQUATE SAFEGUARDS FOR FIRE PREVENTION IN WORK AREA. USE PROTECTIVE CLOTHING AND AVOID CONTACT OF THESE SOLUTIONS WITH THE SKIN.

(1) Steam clean the exterior surfaces and corrugated air fins of each core.

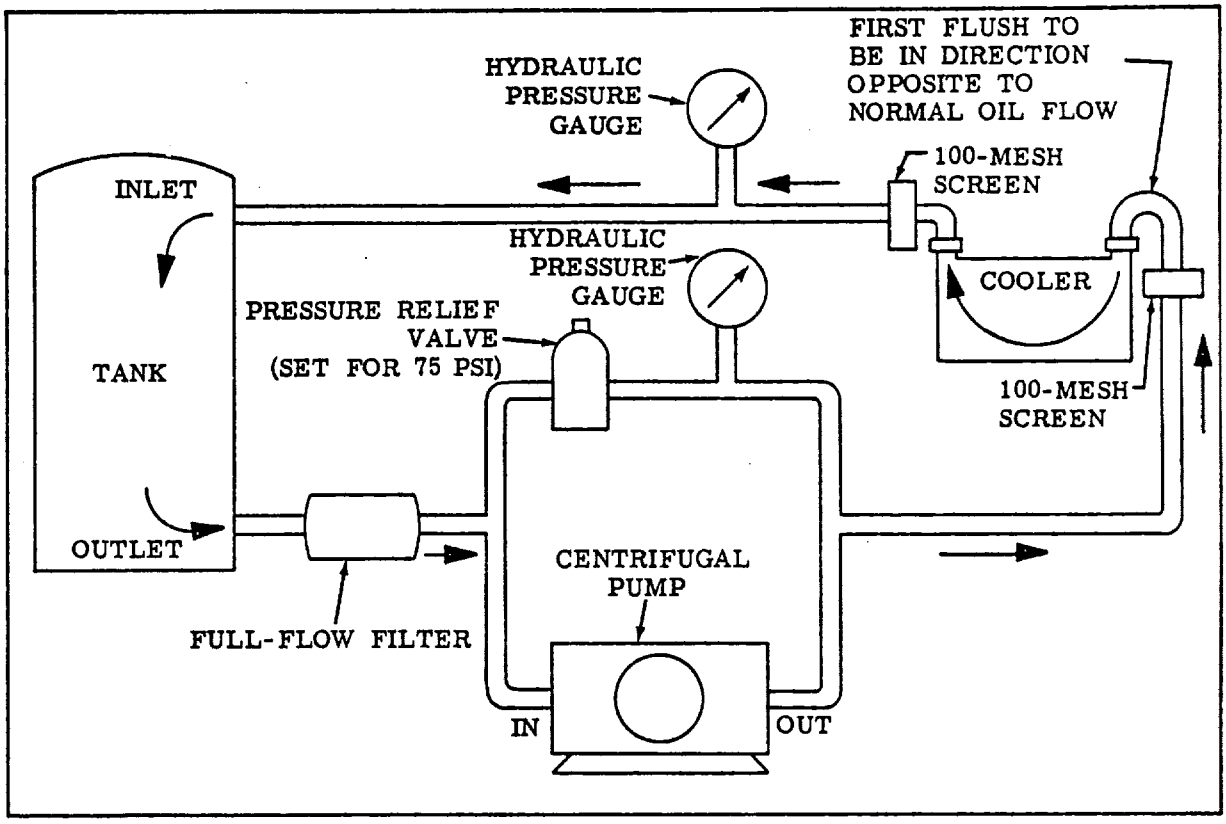


Figure 2. Cleaning Setup

(2) Preclean core interior to remove oil and loose sludge from the core to reduce contamination of cleaning solution in subsequent operations. Connect pump equipment so that fluid flow will be in the reverse direction of normal flow. Use mineral spirits, Federal Spec. TT-T-291, or kerosene, Federal Spec. VV-K-211, or dry cleaning solvent, Federal Spec. P-S-661. Flush core in reverse direction for 30 minutes or until solution appears clean. Reverse lines and flush approximately 15 minutes in the opposite direction. Drain cooler.

(3) Remove carbon deposits, engine oil, gums, lead deposits and foreign contamination by flushing cooler in opposite direction to normal oil flow for 30-60 minutes. Use solvent cleaning compound such as Turco "Surjax" (Turco Products, Los Angeles, California), Beck "OCC-3" (Beck Equipment Company, Cleveland, Ohio), or equivalent compounds conforming to Spec. MIL-C-6864. Reverse lines and flush in opposite direction for 15 minutes.

(4) Remove thermostatic valve and plug installed in by-pass opening (step 4A (3)). Replace valve with fitting which does not block by-pass. Flush for 15 minutes to clean by-pass passage. Remove fitting and reinstall by-pass plug and by-pass valve.

(5) Rinse cooler for 10 minutes by circulating clear petroleum solvent such as dry cleaning solvent (Federal Spec. P-S-661), or kerosene (Federal Spec. VV-K-211). System shall be suitably filtered to prevent circulation of foreign matter.

(6) Flush core interior to detect presence of metal particles in the core, and to remove combustible liquids from the core in preparation of repair instructions. Use water at 100° to 160° F. If repairs are not anticipated, cleaning solvent P-S-661 can be used, but if during testing it is found that repairs are required, an additional water flush must be made. Flush ten minutes in each direction with a 100-mesh screen installed at the cooler inlet and outlet. Reflush cooler for 5 minutes in each direction and recheck screens. Remove rubber plug from by-pass opening and replace valve.

CAUTION: IF METAL PARTICLES ARE FOUND AT THE SCREEN DURING THE ABOVE FLUSHING OPERATIONS, IT IS AN INDICATION THAT THE OIL COOLER WAS INSTALLED ON EQUIPMENT THAT FAILED MECHANICALLY. SUCH A COOLER SHOULD BE SCRAPPED UNLESS AN APPROVED METHOD IS KNOWN FOR SALVAGING.

(7) Flush cooler with a preservative oil consisting of three parts MIL-L-6082, Grade 1065, and one part MIL-C-6529, or, for systems employing MIL-L-7808 oil, preservative oil MIL-C-8188B, or equivalent, in preparation for shipment or storage. Connect cooler to pump equipment and flush in each direction for 10 minutes, checking the mesh screen after each flush to ensure that no metal particles have appeared. After flushing operations, install plugs in inlet and outlet ports.

5. DISASSEMBLY

A. Disassemble oil coolers by removing lockwires, bolts, and oil fittings on units having removable fittings.

B. Remove by-pass thermostatic control valves. Do not disassemble valves. If assembly malfunctions or does not pass test, replace valve.

C. Discard any gaskets and "O" rings.

D. Further disassembly of cores is not practical because each core is a brazed and welded unit.

6. INSPECTION

A. Examine the air fins and air passages for distortion or foreign particles that may obstruct the air flow.

B. Inspect the cooler for damaged and bulged plates, cracked castings and flanges, broken welds, and stripped threads. Inspect hardware items for stripped threads, ineffective lock units, and damaged bolt heads.

C. Inspect all openings in core and valve housing assemblies for evidence of foreign matter inside the cooler.

D. Inspect gasket surfaces for scores that may prevent the gaskets from sealing.

E. On units having a thermostatic valve, inspect the valve seat and the control valve housing seat for scoring and wear that would allow excessive leakage when the valve is seated. Inspect the valve for stripped threads and broken spring.

F. Test cores for leaks and test thermostatic valves for proper functioning in accordance with paragraphs 8A and 8B.

7. REASSEMBLY

A. Reassembly of the unit is essentially the reverse of disassembly.

B. Use new gaskets and/or "O" rings.

C. Tighten all bolts and nuts.

D. Install lockwire after final testing.

8. TESTING

A. Cooler Tests

(1) Preliminary cooler test. Conduct an air leak test on the assembled unit as follows: Plug the cooler outlet and attach an air hose to the inlet. Attach the other end of the air hose to an adjustable pressure source. Adjust air pressure to 12 PSIG. Submerge cooler in water at 140° F - 180° F (Heat water to 185° F to expand metal.)

WARNING: INCREASE AIR PRESSURE GRADUALLY TO AVOID BURNS FROM HOT WATER SPLASHING FROM LARGE LEAKS, IF PRESENT.

After five minutes of submersion increase air pressure to 100 PSIG to detect small leaks, if present. Inspect cooler for leaks as evidenced by presence of air bubbles. Mark leaks, remove from water, release air, and blow cooler dry. Repair in accordance with paragraph 9 and retest.

(2) Final cooler test. Conduct a hydrostatic test on the assembled cooler as follows (see figure 3). Plug outlet and apply room temperature water at test pressure to the other port. Lock fluid in cooler for 10 minutes. Examine cooler for blown or bulged plates. Release pressure, drain cooler, and dry with compressed air. Repair and retest.

CAUTION: TEST PRESSURE SHOULD BE IN ACCORDANCE WITH THE ENGINEERING DRAWING SPECIFICATION. IN THE ABSENCE OF THE ENGINEERING DRAWING, DO NOT EXCEED 150 PSIG.

(3) If the unit is found serviceable after completing preliminary to final tests, flush with suitable corrosion preventative compound such as specified in paragraph 4B (7).

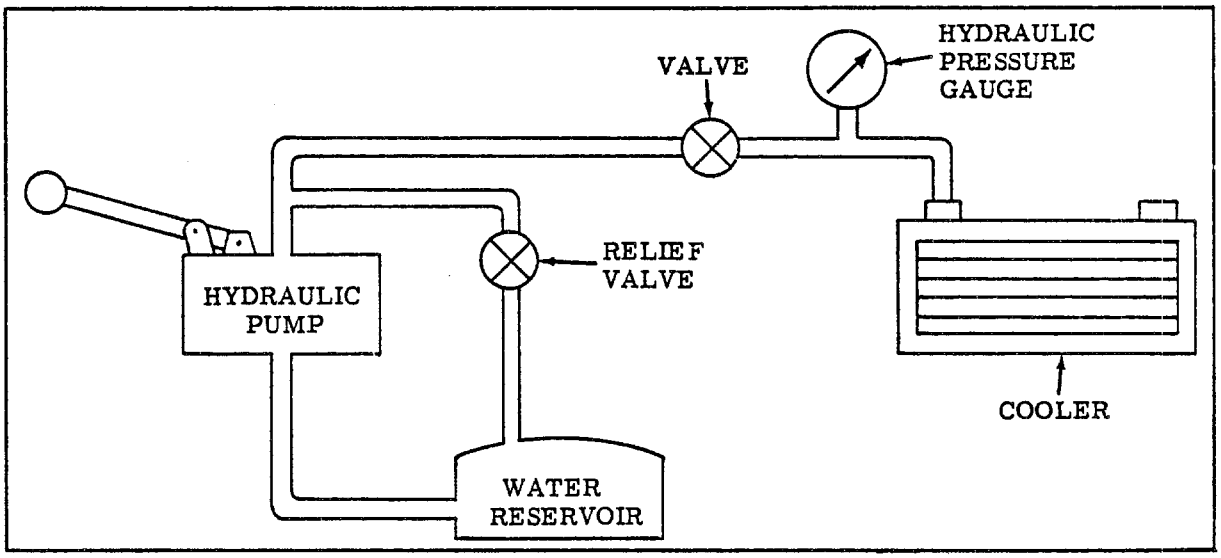


Figure 3. Hydrostatic Test Setup

B. Control Valve Function Test

(1) Check function of control valve by submerging valve in water at Start to Close temperature, indicated in the following table, for five minutes. Remove valve and measure length. Submerge valve in water at Fully Closed temperature, indicated in the table , for five minutes. Remove valve and measure length. Minimum increased length shall be equal to that shown in the table.

(2) Inches of travel should occur between the two temperatures shown.

(3) If valve under test does not function properly, replace with new valve.

NOTE: Start to Close temperatures are approximate.

9. REPAIR

A. Scope

(1) Repair of the cooler assembly is limited to the corrections of accessible leaks by welding and brazing, and should be performed following cleaning (paragraph 4) and testing procedures (paragraph 8).

CAUTION: THE MANUFACTURER DOES NOT RECOMMEND REPAIRING DAMAGED COOLERS. A DAMAGED COOLER SHOULD BE RETURNED TO THE MANUFACTURER FOR REPAIRS. HOWEVER, WHEN MINOR REPAIRS ARE NECESSARY THEY SHALL BE EXECUTED ONLY BY FACTORY TRAINED PERSONNEL. WHEN THE CONDITIONS NOTED IN STEP 9A(2) FOLLOWING ARE PRESENT, THE COOLER MUST BE RETURNED TO THE FACTORY.

(2) Return the cooler to the manufacturer for inspection and repair or replacement if repairs for the following damages are required:

(a) Blown, bulged, or badly dented plates.

TABLE OF OPERATING TEMPERATURES

Valve Part No.	Temp. Range + — 5° F.		Minimum travel — inches
	Start To Close	Fully Closed	
8509198	150	185	.235
8518329	130	160	.235
8518629	150	185	.160
8518815	50	80	.195
8520496	110	128	.235
8520589	120	150	.235
8520618	110	140	.160
8522532	80	160	.250
8522776	50	80	.195
8522852	80	160	.140
8523427	150	185	.160
8523464	110	128	.235
8524200	125	160	.160
8525961	80	160	.250
8526034	130	160	.235
8526113	120	148	.090
8526613	80	140	.235
8526799	160	183	.090
8527429	80	185	.195
8527855	160	178	.080
8528145	120	150	.090
8528148	120	140	.090
8528613	80	140	.250
8528839	150	165	.160
8528933	130	160	.080
8529080	120	150	.100
8530018	120	150	.125
8530249	150	173	.090
8530269	165	183	.250
8530815	140	160	.090
8532003	158	198	.090
8532353	120	140	.090
8532748	60	85	.130
8533227	130	160	.235
8534157	160	178	.080
8534210	140	160	.090
8535061	158	178	.090
8535391	140	165	.200
8535694	100	140	.230
8535767	130	160	.080
8535768	195	221	.080
8535833	140	162	.090
8537927	150	173	.090
8540011	160	185	.170

(b) Leaks in areas where reinforcement plates, strips, or gussets are joined to the core and usually located on the outside plates.

(c) Non-repairable damage or distortion to the valve seat.

(d) Damaged threads in aluminum fittings, ports, drain bosses, or valve housing.

(e) Major dents and similar damage in tube edges, tanks, or valve bodies, which do not leak but could impair cooler performance and life.

(f) Leaks in difficult locations such as interior plate-to-header leaks, or leaks in the plate away from plate edge.

(3) Replace control valves which do not function properly when tested in accordance with paragraph 8B.

NOTE: Valves should not be replaced until all welding and brazing on the unit has been accomplished.

B. Repair of Leaks

WARNING: PURGE COOLER OF ANY COMBUSTIBLE FLUIDS OR VAPORS BEFORE ATTEMPTING REPAIRS. PURGE WITH WATER, DRAIN, AND DRY COOLER WITH COMPRESSED AIR.

NOTE: Before using any type of torch, apply a light coat of Alcoa #33 flux, or equivalent, which has been mixed with water in accordance with the manufacturer's instructions. Flux and metal changes indicate the reaching of brazing temperature of approximately 1080° F. The flux passes through a color change of green to white. It then melts to a watery appearance and becomes extremely active at brazing temperature. The aluminum will change from a greyish color to a shiny appearance.

(1) Repair accessible leaks or cracks in tanks, casting, Heliarc welds, by-pass tubes, control valve housing pads, inlet or outlet fitting pads, and mounting pads using an inert arc welding process (Heliarc or equivalent) and 1/8-inch diameter welding rod.

If this equipment is not available, or if cracks tend to "creep", or if casting impurities tend to "bubble" using Heliarc, then substitute acetylene torch for repairs. Preheat with a preheating adapter on the torch if the leaking area is adjacent to thin-walled cooler parts. When flux grows shiny, sweat-in 3/32-inch brazing wire, using a #8 tip. Switch to a #3 tip for final braze-in, using 3/32-inch or alternately 1/16-inch brazing wire and #33 flux.

CAUTION: ALL ALUMINUM FLUXES ARE HIGHLY CORROSIVE. USE BOILING WATER TO REMOVE ALL TRACES OF FLUX FROM INTERIOR AND EXTERIOR OF COOLER. KEEP UNITS DRY BETWEEN OPERATIONS INVOLVING FLUX, PARTICULARLY WHEN INTERVALS OF MORE THAN ONE HOUR ARE INVOLVED, AS MOISTURE ACCELERATES CORROSION.

(2) Repair plate seam leak (located at the edge of the plate) using a gas torch and 1/16-inch brazing wire. Use Selas PRS-3 tip (with manufactured gas) or Selas PRS-6 tip (with natural gas). Hold the torch flame about two inches away from the leaking area and rotate in a circular pattern. Air fins may be pushed back or lifted away from the leaking area to gain access. Reposition and tack air fins after the leak has been sealed. If seam leaks are within one inch of the tank header, it may be necessary to direct the flame of a second gas torch on the tank to hold the heat at the leak. If a gas torch is not available, repair with an acetylene torch. First preheat the cooler to 950° F. in an oven. Further preheat the area with a preheating adapter on the acetylene torch. At brazing temperature, use a #3 tip for final braze-in.

(3) Repair leaks or voids along the bottom of the by-pass tube by first heating the unit in a furnace at 900° F. until the unit is up to temperature. Remove to work bench. Apply #33 flux to leaking area and heat with a gas torch until flux grows shiny and 3/32-inch diameter brazing wire is sweated in. Put protective shield made from scrap metal on top of the shroud to prevent burning through.

(4) Repair plate-to-header leaks at outside accessible edges of the unit as in paragraph 9B (2).

C. Remove all traces of flux by scrubbing all accessible areas with a brush dipped in boiling water. Areas not so reached should be thoroughly flushed with boiling water. Complete removal of flux is extremely important to prevent subsequent corrosive destruction of the cooler. Dry with compressed air or in an oven at 250° F.

10. STORAGE

After the cooler has been completely overhauled and flushed with preservative oil, install plugs in the inlet and outlet ports. Package the cooler in a container that will provide suitable protection against damage and deterioration. The container should be so constructed as to permit periodical removal and inspection of the cooler without damage to the container or labels. Labels on the container should contain, in addition to complete identification data, the date of overhaul and an indication of repair performed, parts replaced, and general condition.

OVERHAUL MANUAL WITH PARTS BREAKDOWN TEMPERATURE INDICATORS LEWIS, TYPES 163B103, 163B103A and 163B103B

OVERHAUL WITH PARTS BREAKDOWN TEMPERATURE INDICATORS, LEWIS 163B103, 163B103A & 173B103B

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OVERHAUL WITH PARTS BREAKDOWN TEMPERATURE INDICATORS, LEWIS 163B103, 163B103A & 173B103B

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OVERHAUL WITH PARTS BREAKDOWN TEMPERATURE INDICATORS, LEWIS 163B103, 163B103A & 163B103B

DESCRIPTION AND OPERATION

1. Introduction

The types 163B103 and 163B103A are electrical resistance thermometers, both having a temperature range of -70°C to +150°C and using a Standard resistance bulb. The instruments differ slightly in dial configuration but are otherwise identical. The indicators are manufactured by the Lewis Engineering Company, Naugatuck, Connecticut, U.S.A.

2. Description

A. General. The indicator is housed in a 1-1/2" steel case, suitable for clamp mounting. Electrical connections are brought out to a four-pin male receptacle at the rear of the case. Refer to Figure 1 for details of dimensions and mounting.

B. Dial Configurations. The dial markings are generally dull white (FED STD 595, color 37875) for numerals, lettering and both major and minor graduations. The background is durable dull black (FED STD 595, color 37038). Other markings are as follows:

(1) Indicator Type 163B103. (Dial S 1287)

(a) Graduation at 100°C, dull white, color 37875.

(b) Arc from +10°C to +93°C, green, color 34108.

(c) Arc from -40°C to +10°C, yellow, color 33538.

(d) Red radial line at +93°C (6 o'clock position), color 31136.

(2) Indicator, Type 163B103A (Dial S 1287A)

(a) No graduation at 100°C.

(b) Arc from +10°C to +93°C, green, color 34108.

(c) Arc from -40°C to +10°C and arc from +93°C to +99°C, yellow, color 33538.

(d) Red radial line at +99°C. Color 31136.

DESCRIPTION AND OPERATION (CONT'D)

(3) Indicator, Type 163B103B. (Dial S 1287B).

(a) No graduation at 100°C.

(b) Arc from +10°C to +99°C, green, color 34108.

(c) No yellow arcs.

(d) Red radial line at +99°C (6 o'clock position), color 31136.

C. Resistance Bulb. Both instruments are calibrated for use with a resistance bulb, having a resistance of 90.38 ohms at zero °C (32°F).

D. Circuit Description. Refer to Figure 2, which is a schematic diagram, of either indicator. The basic circuit is a Wheatstone bridge arrangement, with the resistance bulb forming the variable arm of the bridge, while resistance spools 71A13-9 and 71A19-2 are the fixed arms. The bridge is energized from the aircraft's 28 vdc supply through resistance spool 71A13-8. The voltage dropped across the resistance spool is regulated by a zener diode in series with it to ground. This regulation of the bridge excitation compensates for any variation of supply voltage. The indicator proper consists of a milliammeter (M) in series with resistance spool 71A18-6 and this circuit is connected across the output of the bridge. Spool 71A19-2 has a slide wire series resistor, which permits adjustment of the milliammeter reading to the exact temperature value when calibrating. Temperature compensation is provided by a thermal resistor (T) connected in parallel with a tap on spool 71A18-6. This adjusts the resistance value of the spool to provide automatic compensation for changes in indicator reading due to changes in ambient temperature.

3. Operation

The electrical resistance thermometer operates using a resistance bulb calbrated to the AN 3-19 curve. The resistance of this bulb varies from 68.27 ohms at -70°C to 151.91 ohms at +150°C. The values of the resistance spools forming the fixed arms of the bridge are chosen so that the variation through 83.64 ohms of the temperature bulb gives full scale deflection of the milliammeter indicator. The slide wire resistor is used to set the dial reading at the calibration point (zero °C = 90.38 ohms). For the calibration adjustment to be fully effective, the resistance of the leads connecting the temperature bulb to the indicator must not exceed 2 ohms per lead and should be the same value for each lead.

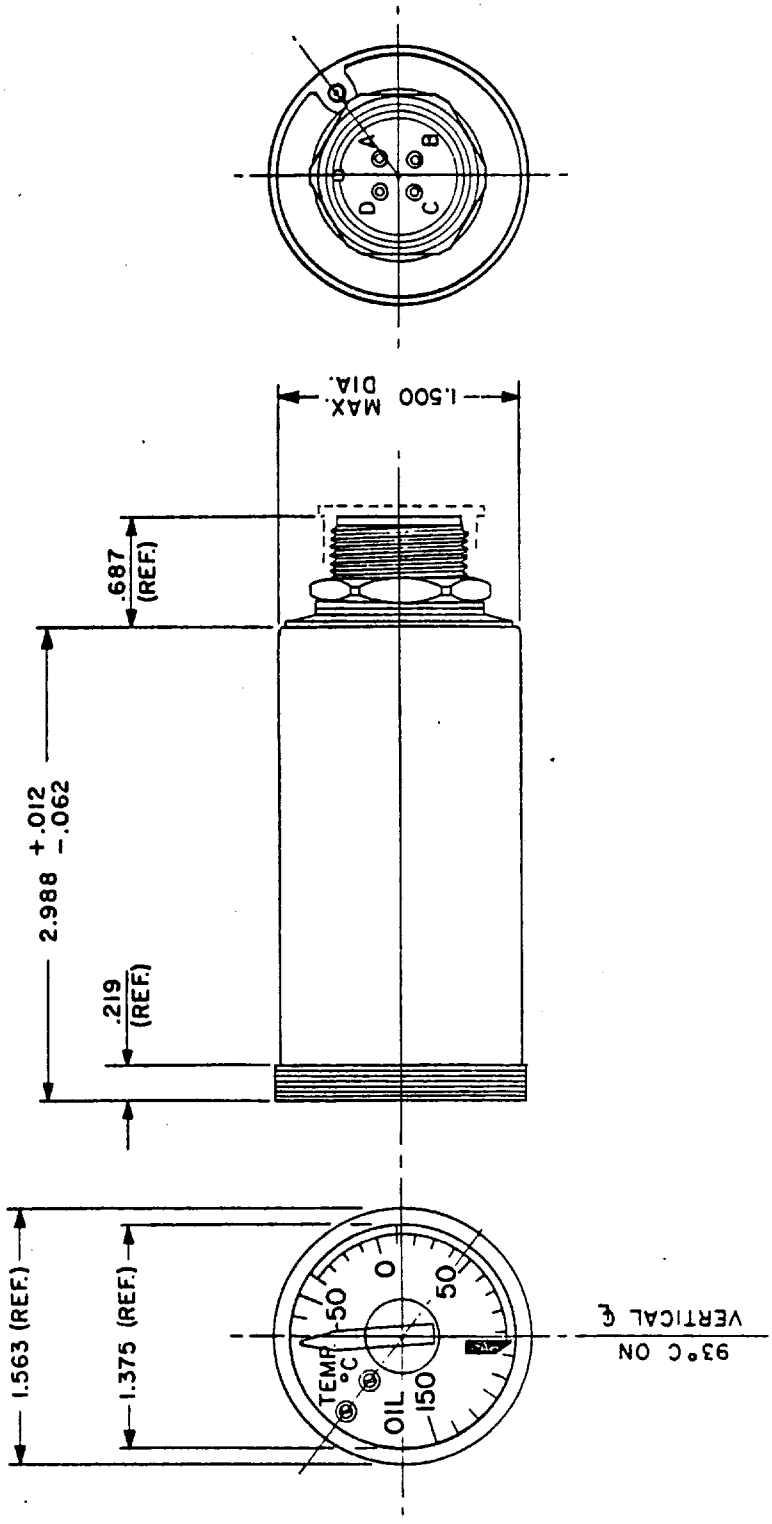


Figure 1 Details of Dimensions and Mounting

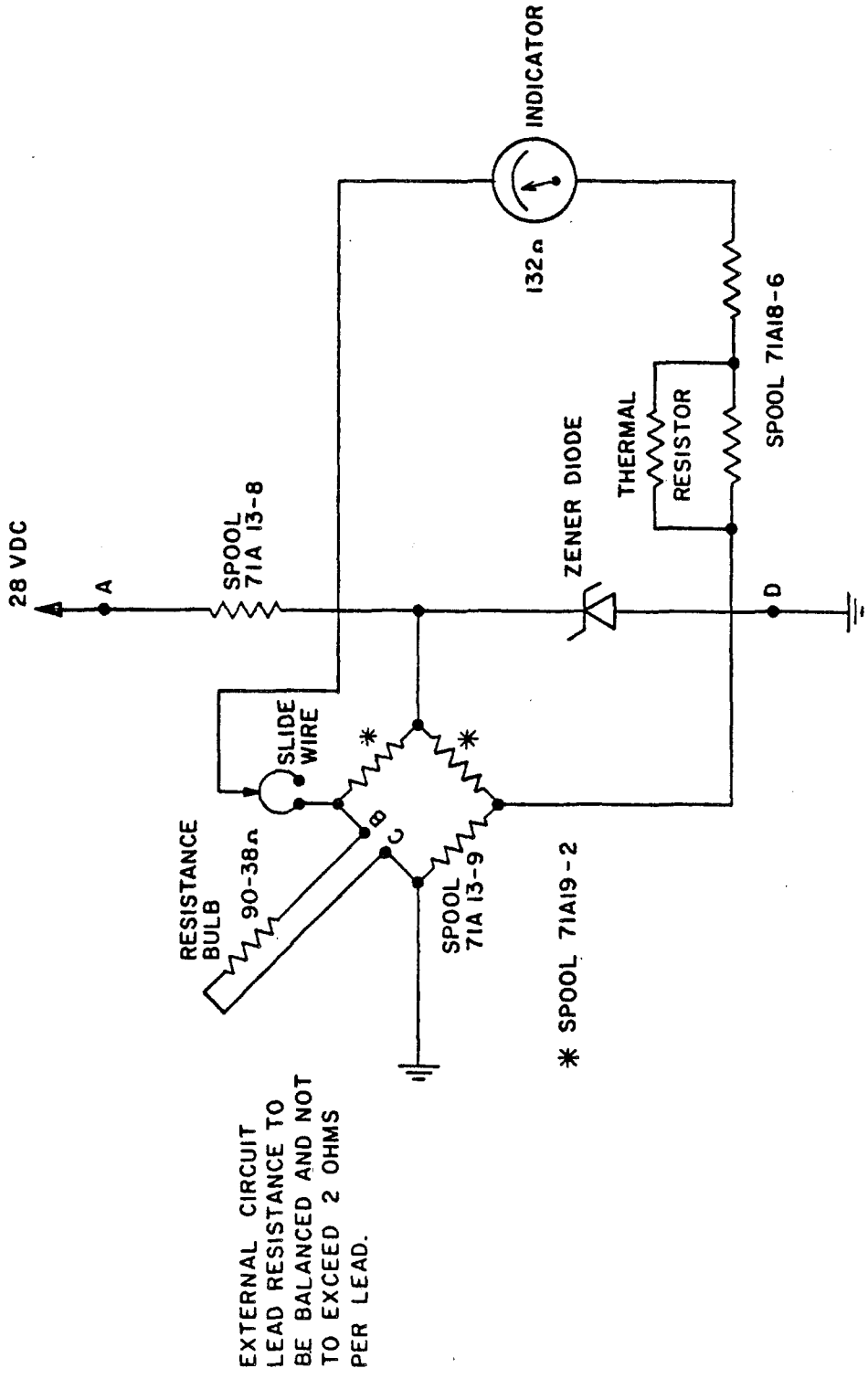


Figure 2 Schematic Diagram. Electrical Resistance Thermometers

OVERHAUL WITH PARTS BREAKDOWN TEMPERATURE INDICATORS, LEWIS 163B103, 163B103A & 163B103B

DISASSEMBLY

1. Refer to Figure 1101. Disassemble the indicator in approximately the same order as the index numbers assigned to this figure.

   NOTE: These instruments operate on jewelled bearings. Handle them as you would an expensive watch.

   Disassembly procedure is as follows:

   A. Using an induction heater or large soldering iron, apply it to sealing strap (1) to soften solder bond. Peel off strap and discard.

   B. Remove screws (8) and slide off housing assembly (2), and shield assembly (7).

   C. Remove nut, hex (11), lockwasher (12) and flat washer (13). This releases connector (9) and identification plate (10). Do not unsolder wires from connector unless defective.

   D. Carefully unsolder the wires from the terminals on the movement assembly (28). The black wire connects to the top bridge and the yellow wire to the bottom bridge.

   E. Remove the parts attaching base assembly (14), hex nut (29) and lockwasher (30). Base (15) and insulator (16) are now released from movement assembly (28). The base assembly (14) need only be disassembled if defective. Proceed as follows:

      (1) Refer to the wiring diagram, Figure 101 before unsoldering any wires from the resistor spools, note color coding and positions of wires.

      (2) Thermal resistor (17) can be replaced by unsoldering it from the terminal posts on base (15). Grip leads on zener diode (33) with pliers to provide heatsink, and unsolder leads from resistor spool No. 1 (18) and pin D on connector (9).

      (3) To remove resistor spools Nos. 1, 2, 3 (18, 19, 20), take out screws (24). To remove resistor spool No. 4, take out screw (25). All spools have a lockwasher (22) and flat washer (23) under the head of their screw. On resistor spool No. 2 (19), removal of screw (24) also releases shouldered washer (26) and slide wire clip (27).

OVERHAUL WITH PARTS BREAKDOWN TEMPERATURE INDICATORS, LEWIS 163B103, 163B103A & 163B103B

DISASSEMBLY (CONT'D)

F. Remove dial screws (58), lockwashers (59). Lift dial (57) carefully over pointer.

G. Remove screws (34) which release diode holder (32) and diode (33).

H. Remove screws (37), and take off dial mounting plate (35). Unsolder outer ends of control springs (42, 56). Unscrew dial mounting plate spacer (38) and remove bumper assembly (36). Remove top bridge assembly (39). Jewel screw (40) should be removed if it requires replacement.

I. Grasp armature assembly (41) with tweezers by the pointer and turn it carefully to remove it from pole piece assembly (31). Slide armature coil through slotted core.

J. Do not disassemble armature assembly (41) further unless control springs (42, 56) or balance weights (43, 44) require replacement. If any other part of the armature assembly is damaged, replace the entire assembly.

K. To remove bottom bridge assembly (45) and bridge insulating pad (46) remove screws (47). This releases lockwasher (49), insulator washer (50) and insulating bushing (51).

L. Bottom bridge assembly (45) can be further dismantled by removing sleeve nut (52) which releases spring washer (53), bottom spring terminal (54) and unlocks jewel screw (55).

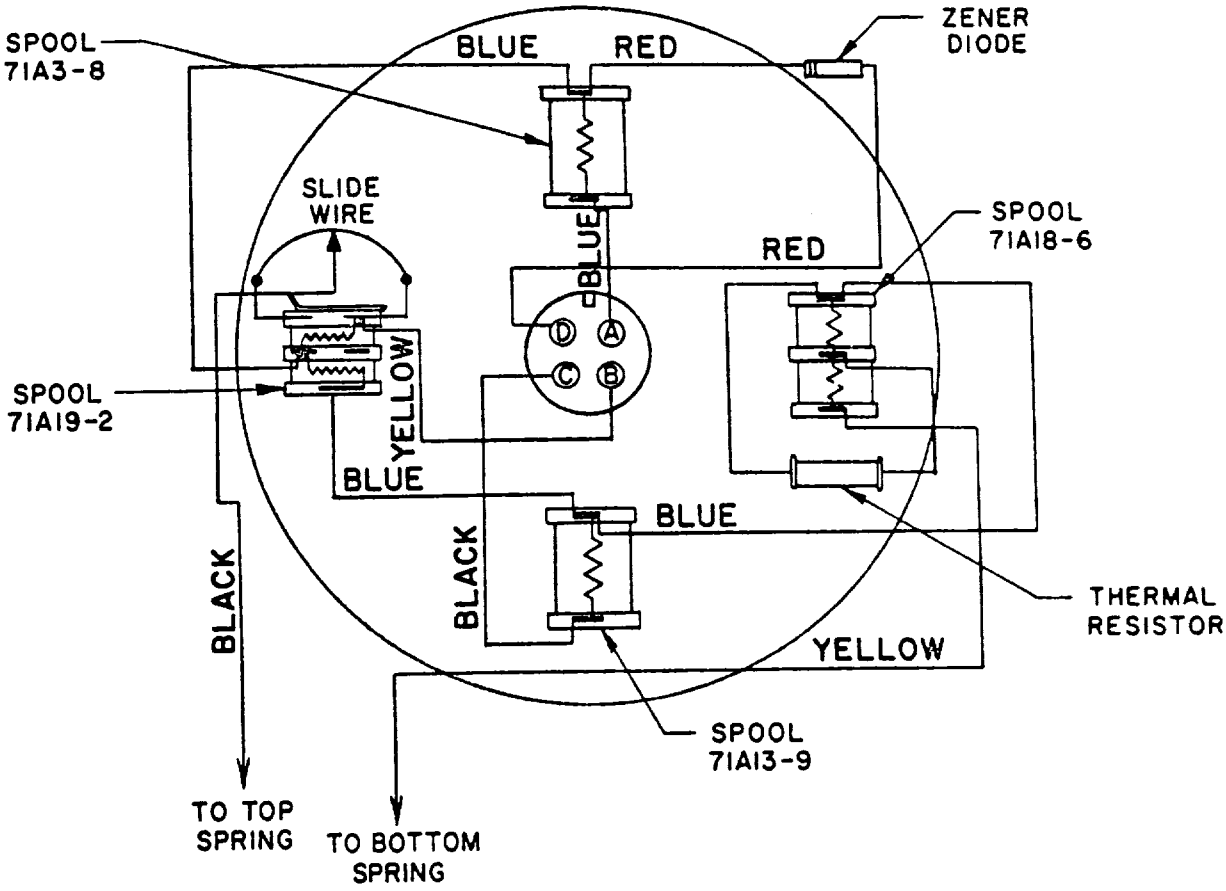


Figure 101 Internal Wiring Diagram

CLEANING, INSPECTION AND REPAIR

1. Cleaning and Inspection

Refer to Table 201. Carry out the inspection and cleaning procedures listed therein.

Part	How to Clean or Inspect
Jewels (40, 55)	Clean with orangewood stick. Insert fine pointed needle into and over jewel cup to detect fractures.
Pivots	Examine pivots on armature assembly (41) using seven power eye loupe. Clean by rotating pithwood on point.
Dial (57)	Check for clipped or discolored paint. Clean with soft camel hair brush.
Armature assy.	Check for discolored paint on pointer.
(41)	Check coil with ohmmeter. Resistance should be 132 ohms ± 10%.
Control Springs (42, 56)	If mis-shapen, reposition by means of fine tweezers. Clean with fine camelhair brush and trichloroethylene, Fed. Spec. O-T-634A.
Thermal resistor (17)	Test with ohmmeter when unsoldered.
Window (4)	Check for striae or chipped surface. Clean with moist chamois

Table 201 Cleaning and Inspection Procedures

2. Repair

When necessary, the following repairs may be made.

A. Replace fractured jewels (40, 55).

B. If pivots are chipped or flattened replace armature assembly (41).

2. Repair (Cont'd)

C. Replace dial (57) if bent. Refinish if paint chipped or discolored.

D. Straighten pointer if bent. Refinish paint on pointer if chipped or discolored. If coil defective, replace armature assembly (41).

E. If control springs (42, 46), cannot be repositioned or are badly damaged, replace springs.

F. Replace thermal resistor (17) if defective.

G. Replace terminal (54) if damaged.

H. To replace a defective window (4), place housing (3) on an electric hot plate, to soften bond to window, scrape excess solder from under housing. Place new window in housing. Cut a piece of 1/32 inch diameter solder to form a ring inside housing in such a position that when the solder melts it will flow evenly around edge of window. Add solder if required. Do not overheat. An induction heater may be substituted for the hotplate.

3. Lubrication

No lubrication is necessary.

ASSEMBLY

1. Preliminary

Assembly is performed in approximately the reverse order of index numbers on Figure 1101.

CAUTION: NEVER TIGHTEN JEWEL SCREWS SUFFICIENTLY TO CAUSE THEM TO BIND ON PIVOTS AS CRACKED JEWELS OR DAMAGED PIVOTS WILL RESULT.

Proceed as follows:

A. Attach bottom bridge assembly (45) to pole piece assembly (31). Ensure that bridge insulating pad (46), insulating bushing (51), insulator washer (50), flat washer (49) and lockwasher (48) are assembled in the proper sequence. Secure with screws (47).

B. Screw jewel (55) into bottom bridge assembly. Install terminal (54), spring washer (53) and sleeve nut (52). Do not tighten nut fully.

C. Insert armature assembly (41) into pole piece assembly (31) by carefully sliding it through the slotted cove until its bottom pivot rests in the cup of bottom jewel (55). Resolder control springs to their terminals.

D. Mount top bridge (39) on the ends of screws (47) which are protruding through pole piece assembly (41). Secure bridge to pole piece with spacers (38). Screw in top jewel until top pivot is within the cup of the top jewel. Do not tighten.

E. Grasp tail of pointer and gently rock armature assembly (41) from side to side to observe side play of pivot in jewel. Slowly tighten top jewel until side play is approximately 0.004 inch. Tighten sleeve nut (52), making sure that bottom pivot (55) does not turn.

F. Install bumper assembly (36) and dial mounting plate (35) on spacers (38), secure with screws (37).

G. Slide movement assembly (28) onto the posts of base assembly (14) and secure them together using lockwashers (30) and nuts (29).

H. Install diode holder (32) and diode (33) on movement assembly using screws (34). Resolder any wires previously removed as per internal wiring diagram Figure 101.

ASSEMBLY (CONT'D)

I. Pass dial (57) carefully over pointer and secure dial to dail mounting plate using screws (58) and lockwashers(59).

J. Balance armature with pointer in horizontal and vertical positions, moving top balance weight (43) and side balance weights (44) as required to obtain balance. Use wrench 16 or 16B, ref. Table 1001.

K. Carry out test procedures detailed in Section 701.

22. Sealing, Evacuation and Filling

After successful completion of the test procedures (Section 701), fill and and seal the indicator case with a dry gas mixture of 90% nitrogen and 10% helium. Filling and sealing procedure is as follows:

A. Support indicator in LF 30 sealing fixture and solder sealing strap (1) in place. Use a 150 watt soldering iron to flow solder from strap to housing. Remove excess solder with coarse file.

B. Test for leaks by immersing indicator in a water jar with filler tube connected to a DRY compressed air supply of 30 psi max. If no leaks are detected remove air hose, hold finger over filler tube and dry indicator by blowing off excess moisture.

C. Place indicator in an air oven heated to about 70°C (158°F) for 30 minutes.

D. Connect filler tube to gas supply and vacuum pump as shown in Figure 501. Evacuate to approximately two mm of mercury as indicated on the vacuum (absolute pressure) gauge. Close valve "B" and slowly open valve "A" to fill indicator with gas.

E. Close valve "A" and open "B" to again evacuate indicator. Close valve "B" and open "A" to again fill with gas.

F. Close valve "A", pinch tube closed with pliers, remove hose and cut off excess length of tube and solder cut end of tube closed.

G. Make final leak test by placing indicator in desiccator jar as shown in Figure 502. Close valve "B" and open "A". Dray a vacuum of about 25 mm of mercury then close valve "A" and slowly open "B" until vacuum falls to about 63 mm of mercury.

ASSEMBLY (CONT'D)

H. Check indicator carefully for leaks by watching for a continuous flow of bubbles. If no leak is observed, SLOWLY open valve "B" to equalize pressure within desiccator with atmosphere.

I. Thoroughly dry indicator and paint with dull black, instrument lacquer, Fed. Std. 595 Color 37038.

J. Repeat test procedure described in Section 701.

3. Packing for Transportation or Storage

A. Use specification PPB-B-636 Type I, Class II carton 7-1/2 x 7-1/2 x 7-1/2 inches. Insert a pad eight inches wide by five foot long by one-half inch thick, specification PPB-C-843A Type 2, crepe cellulose wadding on bottom of carton.

B. Wrap indicator in crepe cellulose wadding three inches wide by ten foot long by one-half inch thick and place in carton.

C. Place another pad of eight inch wide by five foot long by one-half inch thick crepe cellulose wadding on top of indicator.

D. Seal carton with specification UU-T-116 tape.

NOTE: To prevent damage to internal components, NEVER ship an indicator unless it has a minimum of three inches of cushioning material on all sides.

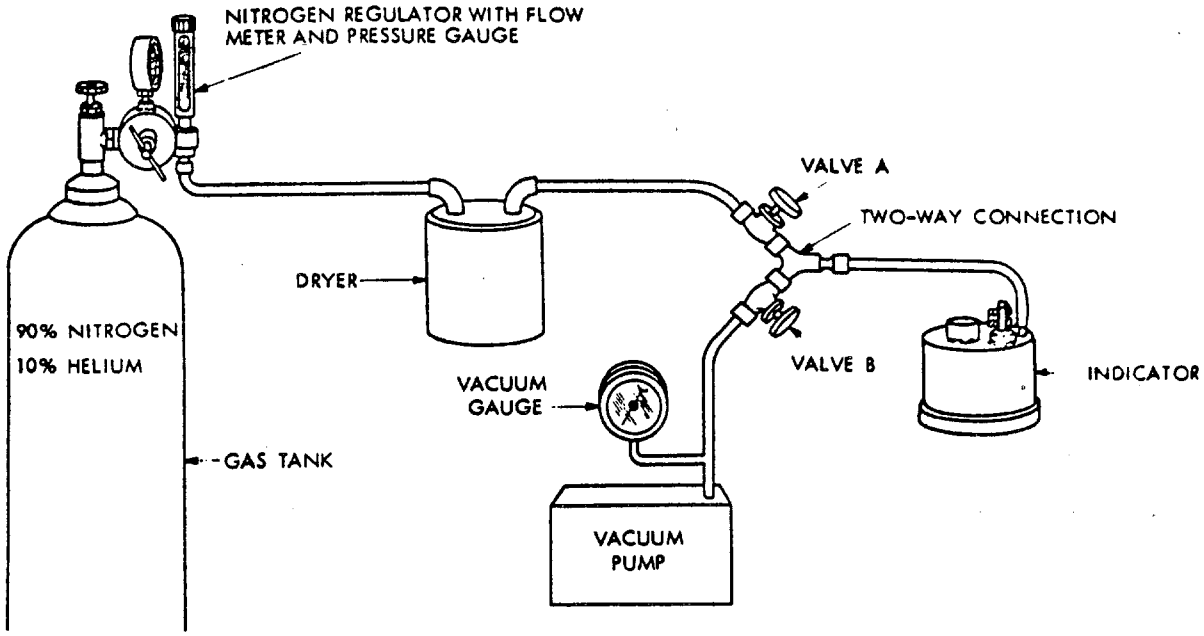


Figure 501 Evacuation and Gas Filling Equipment

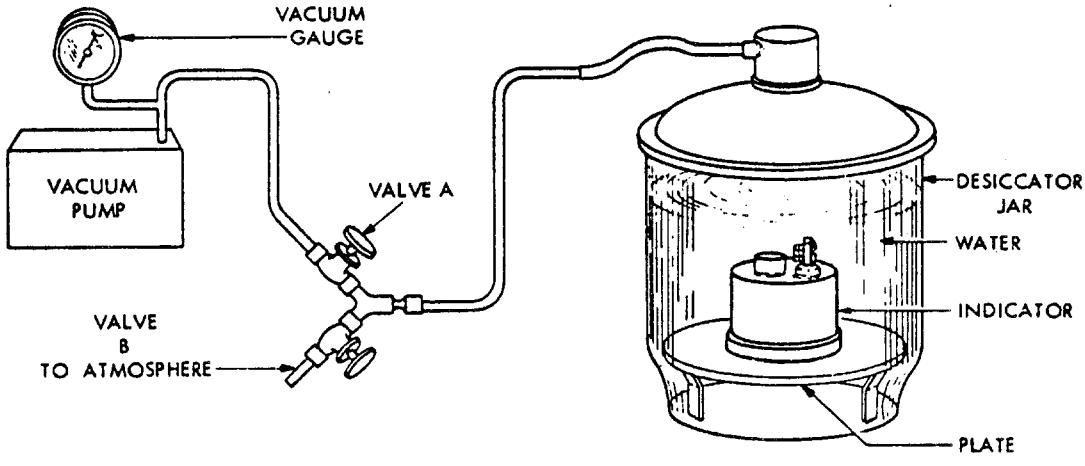


Figure 502 Final Leak Test Under Vacuum

OVERHAUL WITH PARTS BREAKDOWN TEMPERATURE INDICATORS, LEWIS 163B103, 163B103A & 163B103B

TESTING

1. Test Connections

Connect the indicator to a test circuit consisting of a decade box (Ref. Table 701), rheostat and a nominal 28 vdc supply. See Figure 701.

CAUTION: DO NOT APPLY POWER TO THE TEST CIRCUIT WITH THE DECADE BOX DISCONNECTED.

2. Test Procedure

A. Set decade box to the nearest value to 90.38 ohms, simulating 0°C.

Note: The lowest step on the decade box is 0.1 ohm, so adjust it to the nearest 0.1 ohm. For example, 90.38 would be set at 90.4 ohms.

B. Apply power to test circuit and adjust rheostat until voltage measured across pins A and D reads 28 volts ± 0.5 v.

C. Adjust the slide wire clip (27) until the indicator pointer is against the 0°C graduation.

D. Refer to Table 701 and set the decade box to the values listed therein for -70°C to +150°C. The dial indications shall be correct within ± 4.4°C at -70°C, -50°C, 0°C, +50°C +100°C and +150°C.

Note: Tap indicator lightly with fingertip when taking the above readings.

E. Friction Test. Hold indicator in operating position, then, without tapping set the decade box to the resistance values for -70°C, -50°C, 0°C, +50°C, +100°C and +150°C. Tap lightly at each setting and note any change in pointer position. Change is friction error which shall not exceed 4.4°C. Clean air gap with needle or replace pivots and jewels if error is greater than the specified value.

F. Balance Test. Set decade box to give 0°C reading. Hold indicator with pointer in vertical plane and repeat. Hold indicator in normal position and rotate 90° clockwise and counter-clockwise. The reading shall not change more than ± 4.4°C.

G. Reduced Voltage Test. Adjust the rheostat until the test voltage is reduced to 14 volts. Apply the test resistance for 0°C. The pointer reading shall not change more than ± 4.4°C.

TESTING (CONT'D)

3. Final Assembly and Test

A. Pass connector (9) through the rear of shield assembly (7) and install identification plate (10) on the outside. Place flat washer (13) and lockwasher (12) over the connector shell. Secure these parts together with nut (11).

B. Attach shield assembly (7) to base assembly (14) using four screws (8).

C. Install housing assembly (2) on the indicator and secure with four screws (8).

D. Repeat the test procedures given in the previous paragraph. If the tests are satisfactory, carry out the sealing, evacuation and filling procedures described in paragraph 2, Section 501.

Test Temp. °C	Bulb Resistance	Decade Box Setting
-70	68.27	68.3
-60	71.19	71.2
-50	74.24	74.2
-40	77.39	77.4
-30	80.56	80.6
-20	83.77	83.8
0	90.38	90.4
+10	93.80	93.8
20	97.31	97.3
30	100.91	100.9
40	104.60	104.6

Table 701 Calibration Values (Sheet 1 of 2)

TESTING (CONT'D)

Test Temp. °C	Bulb Resistance	Decade Box Setting
50	108.39	108.4
60	112.28	112.3
70	116.27	116.3
80	120.36	120.4
90	124.55	124.5
100	128.85	128.8
110	133.26	133.3
120	137.78	137.8
130	140.08	140.1
140	142.40	142.4
150	151.91	151.9

Table 701 Calibration Values (Sheet 2 of 2)

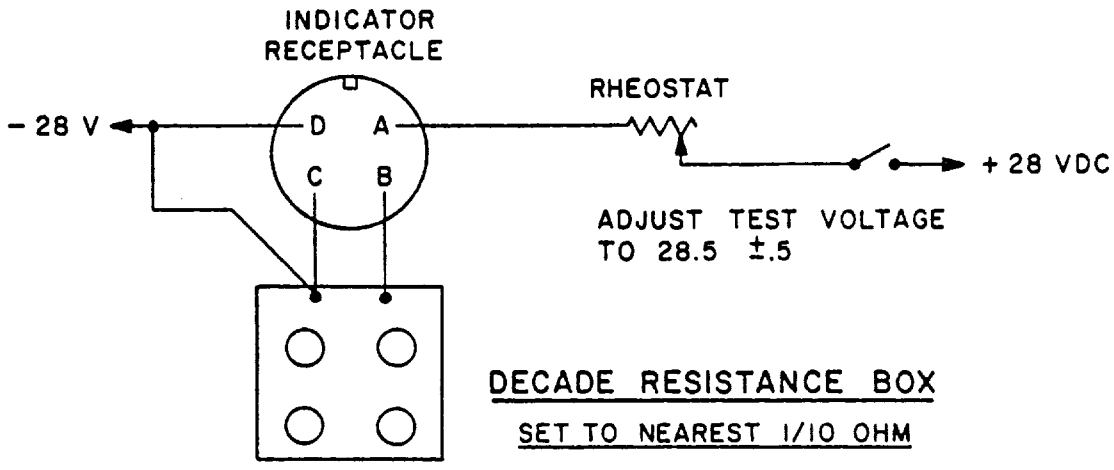


Figure 701 Test Connections

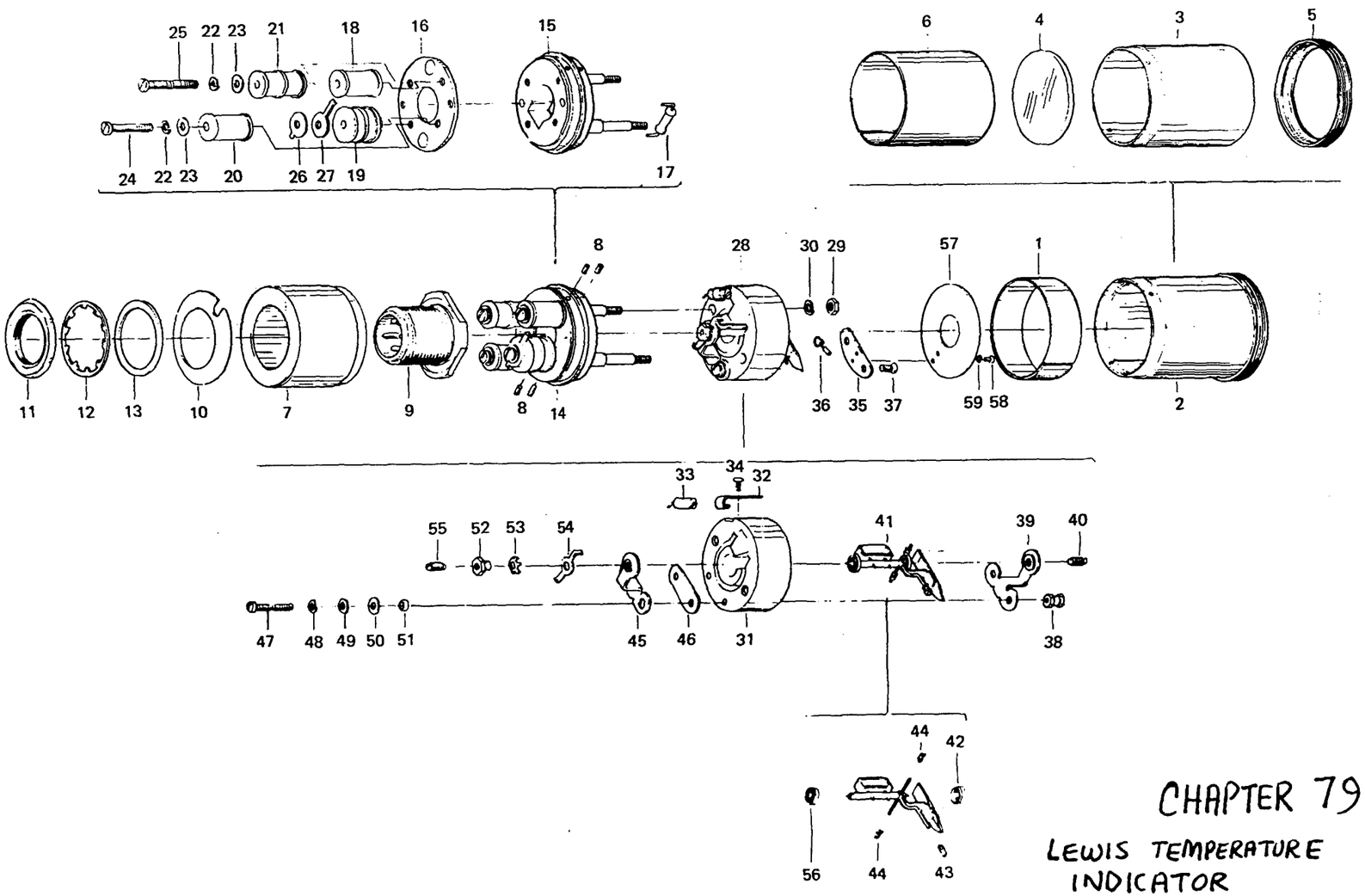
OVERHAUL WITH PARTS BREAKDOWN TEMPERATURE INDICATORS, LEWIS 163B103, 163B103A & 163B103B

SPECIAL TOOLS, FIXTURES AND EQUIPMENT

Tool No.	Nomenclature	Manufacturers Code
16 and 16B	Balance Wrench	35918
Gen. Radio (or equivalent)	Resistance Decade Box	
LF 30	Sealing Fixture	35918
FA 160102	Absolute Pressure Indicator	79172
600-5	Dessicator Plate	14566
803-0121	Two-way outlet connection	80382
806-8124	Gas Regulator with flow-meter and pressure gauge	80382
92003-1	Vacuum Pump	11273
3120-250	Dessicator and Cover	14674

Table 1001

OVERHAUL WITH PARTS BREAKDOWN TEMPERATURE INDICATORS, LEWIS 163B103, 163B103A & 163B103B



CHAPTER 79

LEWIS TEMPERATURE INDICATOR PART NO 163B103

Figure 1101 Exploded View, Parts Breakdown

OVERHAUL WITH PARTS BREAKDOWN, TEMPERATURE INDICATORS, LEWIS 163B103, 163B103A & 163B103B

FIGURE and INDEX NUMBER	GROUP / MAJOR ASSEMBLY / PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	Units Per Ass'y	Usage on Code
1101-	163B103	Temperature Indicator	A	1
	163B103A	Temperature Indicator	B	1
	163B103B	Temperature Indicator	C	1
-1	163-52	Strap, Sealing		1
-2	163-2	Housing Assembly		1
-3	163-10	Body		1
-4	163-20	Glass		1
-5	163-15	Front		
-6	163-80	Strip, Lining		1
-7	163-25C11	Shield Assembly		1
		ATTACHING PARTS		
-8	X24-10	Screw, Machine		4
		--------*--------		
-9	26E4G5A	Connector, Receptacle		1
-10	N485-9	Plate, Identification		1
		ATTACHING PARTS		
-11	X10-43C	Nut, Plain Hex		1
-12	X7-42	Washer, Lock		1
-13	X5-40	Washer, Flat		1
		--------*--------		
-14	163-43B2	Base Assembly		1
-15	163-50B2	Base		1
-16	163-58	Insulator		1
-17	X4-52	Resistor, Thermal		1
-18	71A13-8	Resistor, No. 1 Spool		1
-19	71A19-2	Resistor, No. 2 Spool		1
-20	71A13-9	Resistor, No. 3 Spool		1
-21	71A18-6	Resistor, No. 4 Spool		1
		ATTACHING PARTS		
-22	X7-22	Washer, Lock		4
-23	X5-21	Washer, Flat		4
-24	7F2B2-23B	Screw, Machine		3
-25	7F2B2-26B	Screw, Machine		1
		--------*--------		
-26	163-56	Washer, Shouldered		1
-27	163-57	Clip, Slide wire		1
-28	343B2	Movement Assembly		1
		ATTACHING PARTS		
-29	X10-5	Nut, Plain Hex.		2
-30	AN935B5	Washer, Lock		2

OVERHAUL WITH PARTS BREAKDOWN TEMPERATURE INDICATORS, LEWIS 163B103, 163B103A & 163B103A

FIGURE and INDEX NUMBER	GROUP / MAJOR ASSEMBLY / PART NUMBER	1 2 3 4 5 6 7 NOMENCLATURE	Units Per Ass'y	Usage on Code
1101-		--------*--------		
-31	21-1301	Pole Piece Assembly		1
-32	21-1379	Holder, Diode		1
-33	X204-3	Semiconductor, Diode, Zener		1
	ATTACHING PARTS			
-34	X24-103	Screw, Machine, Truss Hd		2
		--------*--------		
-35	21-1376	Plate, Dial Mounting		1
-36	21-1378	Bumper Assy.		1
	ATTACHING PARTS			
-37	AN510B1-2	Screw, Machine		2
		--------*--------		
-38	21-1375	Spacer, Dial Mounting Plate		2
-39	21-1303F2	Bridge Assembly, Top		
-40	21-1481F2	Screw, Jewel		1
-41	21-1305F3	Armature Assembly		1
-42	LS5	Spring, Control, Top		1
-43	WM21-117F	Balance Weight, Top		1
-44	WM21-117B	Balance Weight, Side		2
-45	21-1304F3	Bridge Assembly, Bottom		1
-46	21-1374	Pad, Bridge Insulating		1
	ATTACHING PARTS			
-47	X24-32	Screw, Machine		2
-48	AN935B2L	Washer, Lock		2
-49	21-1676	Washer, Flat		2
-50	21-1675	Insulator, Washer		2
-51	21-1672	Bushing, Insulating		2
		--------*--------		
-52	WM21-108	Nut, Sleeve		1
-53	21-421	Washer, Spring		1
-54	21-2335	Terminal, Bottom Spring		1
-55	21-90F2	Screw, Jewel		1
-56	WM21-N6B3	Spring, Control, Bottom		1
-57	S1287	Dial	A	1
	S1287A	Dial	B	1
	S1287B	Dial	C	1
	ATTACHING PARTS			
-58	X24-26	Screw, Machine		2
-59	AN935B5	Washer, Lock		2

STEWART-WARNER CORPORATION

(SOUTH WIND DIVISION)

OVERHAUL MANUAL

FOR

OIL COOLER ASSEMBLY

PART NO. 10528A

(PREPARED BY THE DE HAVILLAND AIRCRAFT OF CANADA, LTD.)

Dec 1/70

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STEWART-WARNER
10528A

RECORD OF REVISIONS

Retain this record in the front of the manual. On receipt of revisions, insert revised pages in the manual and enter the revision number, revision date, insertion date, and initials of person incorporating the revision, in the appropriate block on the revision record.

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LIST OF EFFECTIVE PAGES

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STEWART-WARNER
10528A

INTRODUCTION

This manual contains instructions for the overhaul of the Stewart-Warner Corporation (South Wind Division) Oil Cooler Assembly 10528A.

STEWART-WARNER
10528A

OIL COOLER

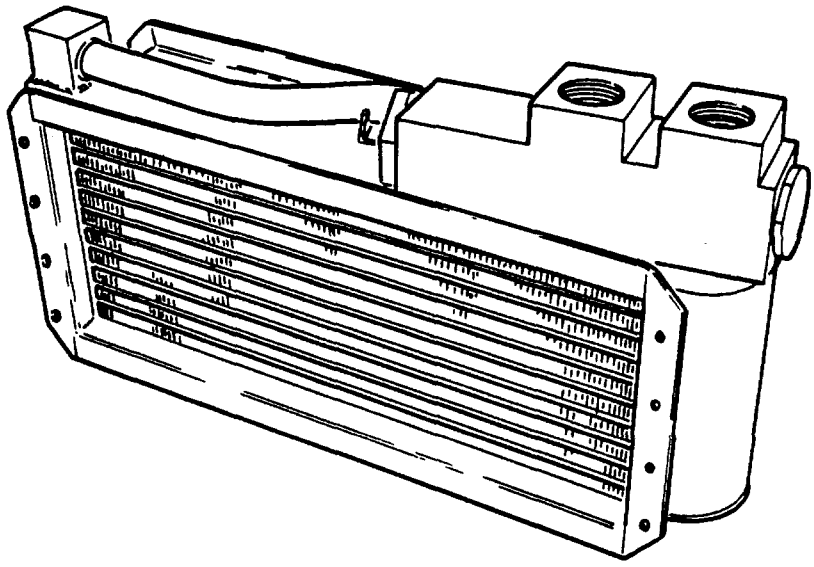
1. Description and Operation

A. Description (Figure 1)

The oil cooler consists of an aluminum body with a plate-fin core construction and a temperature control valve. The core collectors, mounting flanges and control valve body are a single all-brazed assembly.

B. Operation

The cooler is a heat exchanger which reduces the temperature of oil flowing through it by transferring heat to air passing through the cooler core. At an oil inlet temperature below 155° F, the temperature control valve allows all of the oil to by-pass the core and flow directly back to the system. Between an oil temperature of 155° F and 175° F, the thermostatic control of the temperature control valve directs the oil partly through the core and partly through the by-pass. When the oil temperature rises above 175° F, all of the oil will flow through the cooler core.



Oil Cooler Assembly
Figure 1

C. Data

(1) Specifications

Construction:	Plate and Fin with By-Pass Valve
Material:	Aluminum
Weight:	8.60 lb Dry

(2) Performance

	Cold Side	Hot Side
Fluid	Air	Oil
Flow Rate (lbs/min)	160	100
Inlet Temperature	100°F	225°F
Outlet Temperature	136.4°F	197.4°F
Allowable Pressure Differential	10.2 inches of water	18.5 psi
Heat Rejection Rate	1400 BTU/min	

2. Disassembly

A. Disassemble Oil Cooler (Figure 3)

(1) Cut lockwire and unscrew thermostat (1) from end of valve body. Remove gasket (2) from thermostat.

(2) Withdraw spring (3) and poppet valve (4) from inside valve body.

(3) Cut lockwire and unscrew plug (5) from end of valve body and withdraw spring (7) and pushrod (8). Remove O-ring (6) from plug.

(4) Cut lockwire and remove plug (9) from core (11). Remove O-ring (10) from plug.

3. Cleaning

A. Clean Cooler Core

CAUTION: USE ONLY CLEANING SOLUTIONS RECOMMENDED IN THESE INSTRUCTIONS OR ONES SATISFACTORY FOR ALUMINUM. MANY SOLUTIONS SATISFACTORY FOR CLEANING COPPER OR COPPER NICKEL COOLERS ARE HIGHLY

CORROSIVE TO ALUMINUM AND IF USED WILL RESULT IN THE DESTRUCTION OF THE COOLER. IF EQUIPMENT HAS BEEN PREVIOUSLY USED WITH ANY OTHER CLEANING SOLUTIONS, IT SHOULD BE THOROUGHLY WASHED OUT AND FLUSHED WITH THE RECOMMENDED SOLUTION.

WARNING: CLEANING SOLVENTS AND SOLVENT CLEANING COMPOUNDS ARE TOXIC AND FLAMMABLE, AND MUST BE USED ONLY IN A WELL-VENTILATED ROOM. TAKE ADEQUATE SAFEGUARDS FOR FIRE PREVENTION IN WORK AREA. USE PROTECTIVE CLOTHING AND AVOID CONTACT OF THESE SOLUTIONS WITH THE SKIN.

NOTE: Item numbers refer to Figure 3.

(1) Insert suitable plug into internal by-pass port; access is through hole at thermostat position. Insure that after installation of plug, sufficient clearance remains to install thermostat.

(2) Install plug (5) with O-ring (6). Install thermostat (1) with gasket (2). Install plug (9) and O-ring (10).

(3) Steam clean the exterior surfaces and air fins of each core.

(4) Using mineral spirits, kerosene or dry cleaning solvent, remove oil and loose sludge by flushing in reverse direction to normal flow for 30 minutes or until solution appears clean.

NOTE: Carefully examine flushing solution for metal particles.

CAUTION: IF METAL PARTICLES ARE FOUND DURING FLUSHING OPERATIONS, IT IS AN INDICATION THAT THE OIL COOLER WAS INSTALLED ON EQUIPMENT THAT FAILED MECHANICALLY, AND FURTHER INVESTIGATION IS NECESSARY.

(5) Reverse lines and flush approximately 15 minutes in the opposite direction. Drain cooler.

(6) Remove carbon deposits, engine oil, gums, lead deposits and foreign contamination by flushing cooler in opposite direction to normal oil flow for 30 to 60 minutes. Use

solvent cleaning compound such as Turco "Surjax", Beck "OCC-3", or equivalent compounds conforming to Spec MIL-C-6864. Reverse lines and flush in opposite direction for 15 minutes.

(7) Remove plug (5) and thermostat (1).

(8) Remove plug from by-pass port installed in step (1), and hand-flush by-pass port.

(9) Repeat steps (1) and (2).

(10) Rinse cooler for 10 minutes by circulating clear petroleum solvent such as dry cleaning solvent, or kerosene. Install suitable filters, one at cooler inlet and one at cooler outlet, to prevent circulation of foreign matter.

(11) Flush core to remove combustible liquids from the core in preparation for any repairs. Use water at 100° to 160°F. If repairs are not required, dry cleaning solvent can be used. Flush 10 minutes in each direction and check filters for metal particles. Reflush cooler for 5 minutes in each direction and recheck filters.

(12) Remove plug from by-pass port.

B. Clean Temperature Control Valve

(1) Remove deposits by soaking valve components in cleaning compound used in paragraph 3.A., step (6) for 30 minutes. Brush with stiff non-metallic brush.

(2) Rinse components in dry cleaning solvent or kerosene.

Table 1

Cleaning Materials and Compounds

MATERIAL	SPECIFICATION OR MANUFACTURER
Mineral Spirits	TT-T-291
Kerosene	VV-K-211
Dry Cleaning Solvent	P-D-680
Solvent Cleaning Compound	) Surjax (Turco Products, Los Angeles, California)) OCC-3 (Beck Equipment Co., Cleveland, Ohio)) MIL-C-6864

4. Inspection/Check

A. General

(1) Inspect components for defects under a strcng light, using magnification.

(2) Inspect for cracks using the fluorescent penetrant method, or an approved dye penetrant method.

(3) Inspect all parts visually for damage such as galls, scores, scratches, excessive wear and corrosion.

B. Inspect Cooler

(1) Examine the core structure and air passages for distortion or foreign particles that may obstruct the air flow.

(2) Inspect the cooler for damaged and bulged plates, cracked valve body, distorted flanges, broken welds, and stripped threads.

(3) Inspect all openings in core and valve housing assemblies for evidence of foreign matter inside the cooler.

(4) Inspect gasket seats on thermostat and valve body for scores that may prevent the gaskets from sealing.

(5) Inspect inlet pipe for dents, cracks and distortion.

(6) Pressure test and test for leaks as detailed in Testing.

C. Inspect Temperature Control Valve

(1) Check that springs conform to the values given in Table 3.

(2) Examine component parts of valve for wear, cracks and distortion. In particular, check seating surfaces of poppet valve and valve pushrod. See Table 4 for service limits.

5. Repair

A. General

(1) When anodized parts have had protective surface treatment

damaged or removed, apply a protective coating of Alodine solution No. 1200S to affected area or reanodize the part.

(2) Replace gasket (2), O-ring (6) and O-ring (10) at each overhaul. (Refer to Figure 3.)

(3) Replace defective temperature control components.

(4) Replace thermostats which do not meet test requirements. Refer to Testing.

NOTE: Accomplish any welding or brazing repairs before installing temperature control valve components.

(5) Repair of the cooler assembly is limited to the corrections of accessible leaks by welding and brazing, and should be performed following cleaning (paragraph 3) and testing procedures (paragraph 8).

CAUTION: THE MANUFACTURER DOES NOT RECOMMEND REPAIRING DAMAGED COOLERS. A DAMAGED COOLER SHOULD BE RETURNED TO THE MANUFACTURER FOR REPAIRS. HOWEVER, WHEN MINOR REPAIRS ARE NECESSARY THEY SHALL BE EXECUTED ONLY BY APPROVED PERSONNEL. WHEN THE CONDITIONS NOTED IN STEP (6) FOLLOWING ARE PRESENT, THE COOLER MUST BE RETURNED TO THE MANUFACTURER.

(6) Return the cooler to the manufacturer for inspection and repair or replacement if repairs for the following damages are required:

(a) Blown, bulged, or badly dented plates.

(b) Non-repairable damage or distortion to the valve seat.

(c) Damaged threads in aluminum fittings, ports, drain boss, or valve housing.

(d) Major dents and similar damage to core structure, inlet pipe or valve body, which do not leak but could impair cooler performance and life.

(e) Leaks in inaccessible locations such as in the plate away from plate edge.

B. Repair of Leaks

WARNING: PURGE COOLER OF ANY COMBUSTIBLE FLUIDS OR VAPORS BEFORE ATTEMPTING REPAIRS. PURGE WITH WATER, DRAIN, AND DRY COOLER WITH COMPRESSED AIR.

NOTE: Before using any type of torch, apply a light coat of Alcoa No. 33 flux, or equivalent, which has been mixed with water in accordance with the manufacturer's instructions. Flux and metal changes indicate the reaching of brazing temperature of approximately 1080°F. The flux passes through a color change of green to white. It then melts to a watery appearance and becomes extremely active at brazing temperature. The aluminum will change from a greyish color to a shiny appearance.

CAUTION: ALL ALUMINUM FLUXES ARE HIGHLY CORROSIVE. USE BOILING WATER TO REMOVE ALL TRACES OF FLUX FROM INTERIOR AND EXTERIOR OF COOLER. KEEP UNITS DRY BETWEEN OPERATIONS INVOLVING FLUX. PARTICULARLY WHEN INTERVALS OF MORE THAN ONE HOUR ARE INVOLVED, AS MOISTURE ACCELERATES CORROSION.

(1) Repair accessible leaks or cracks in end casing welds, inlet pipe, control valve housing, inlet or outlet fittings, and drain boss using an inert arc welding process (Heliarc or equivalent) and 1/8-inch diameter welding rod.

(2) If inert arc welding equipment is not available, or if cracks tend to "creep", or if casting impurities tend to "bubble" using Heliarc, then substitute acetylene torch for repairs as follows:

(a) Preheat with a preheating adapter on the torch if the leaking area is adjacent to thin-walled cooler parts.

(b) When flux grows shiny, sweat-in 3/32-inch brazing wire, using a No. 8 tip.

(c) Change to a No. 3 tip for final braze-in, using 3/32-inch or alternately 1/16-inch brazing wire and No. 33 flux.

(3) Remove all traces of flux by scrubbing all accessible areas with a brush dipped in boiling water. Areas not so reached should be thoroughly flushed with boiling water. Complete removal of flux is extremely important to prevent subsequent corrosive destruction of the cooler. Dry with compressed air or in an oven at 250°F.

Table 2

Repair Materials and Compounds

MATERIAL	SPECIFICATION OR MANUFACTURER
Alodine Solution 1200S	MIL-C-5541 (Amchem Products)

6. Assembly

A. Assemble Oil Cooler Assembly (Figure 3)

(1) Install O-ring (10) on plug (9) and screw plug into core (11). Lockwire plug with MS20995NC20.

(2) Install O-ring (6) and spring (7) on plug (5). Insert short end of pushrod (8) into plug (5) and screw plug with pushrod and spring into valve body. Lockwire plug with MS20995NC20.

(3) Support cooler with valve body vertical and open end uppermost.

(4) Insert poppet valve (4) into valve body and slide it onto exposed end of pushrod (8).

(5) Install spring (3) on poppet valve (4).

(6) Install gasket (2) on thermostat (1).

NOTE: Insure that thermostat has been tested. Refer to Testing.

(7) Screw thermostat (1) into valve body. Lockwire thermostat with MS20995NC20.

7. Fits and Clearances

(1) Check strength of springs. Refer to Table 3. Reject any spring not within service limits.

Table 3

Spring Values

FIGURE 3 ITEM NO.	CONDITION	LENGTH (INCHES)	LOAD (POUNDS)	SERVICE LIMITS (POUNDS)
3	Free Length	2.93		
	Installed Length	2.015	13.4	12.0
7	Free Length	2.50		
	Installed Length	1.50	39 ± 3	36.0

(2) Refer to Table 4 for original tolerances and service limits. Replace parts worn in excess of service limits.

Table 4

Original Tolerances and Service Limits

FIGURE 3 ITEM NO.	NAME	DISCREPANCY LOCATION	ORIGINAL DIMENSION (INCHES)	SERVICE LIMIT (INCHES)	DISPOSITION
5	Plug	I.D.	$0.250^{+0.004}_{-0.000}$	0.255	Replace
8	Pushrod, Valve	O.D. at plug (5) location	0.247 ± 0.001	0.245	Replace
		O.D. at valve (4) Location	0.247 ± 0.001	0.245	Replace
4	Valve, Poppet	I.D.	$0.250^{+0.004}_{-0.000}$	0.255	Replace

8. Testing

A. Test Equipment

Refer to paragraph 11.

B. Proof Pressure and Leak Test

(1) Seal oil cooler outlet port. Connect pneumatic test rig to oil cooler inlet port.

CAUTION: EXERCISE CARE DURING TESTS TO PRECLUDE ENTRY OF BATH LIQUID INTO THE OIL PASSAGES OF THE OIL COOLER ASSEMBLY.

(2) Submerge oil cooler in liquid bath with the air sides open to atmosphere.

(3) Pressurize the oil circuit to 225 $\pm \frac{5}{0}$ psi air pressure and hold for one minute. There must be no evidence of leakage.

(4) Reduce air pressure to 150 $\pm \frac{5}{0}$ psi and make a close-up inspection for internal and external leakage. There must be no evidence of leakage. Reduce pressure and remove from bath.

(5) Clean and dry oil cooler.

C. Pressure Drop Test

(1) Connect oil ports to recirculating oil supply source.

(2) Adjust and maintain the oil flow rate to 90 $\pm$ 1 pounds/min, oil temperature to 225 $\pm \frac{0}{2}$°F and oil inlet pressure of 27 $\pm$ 5 psi. Check that oil circuit pressure differential is 15 psi maximum.

(3) Remove oil cooler and cap connections.

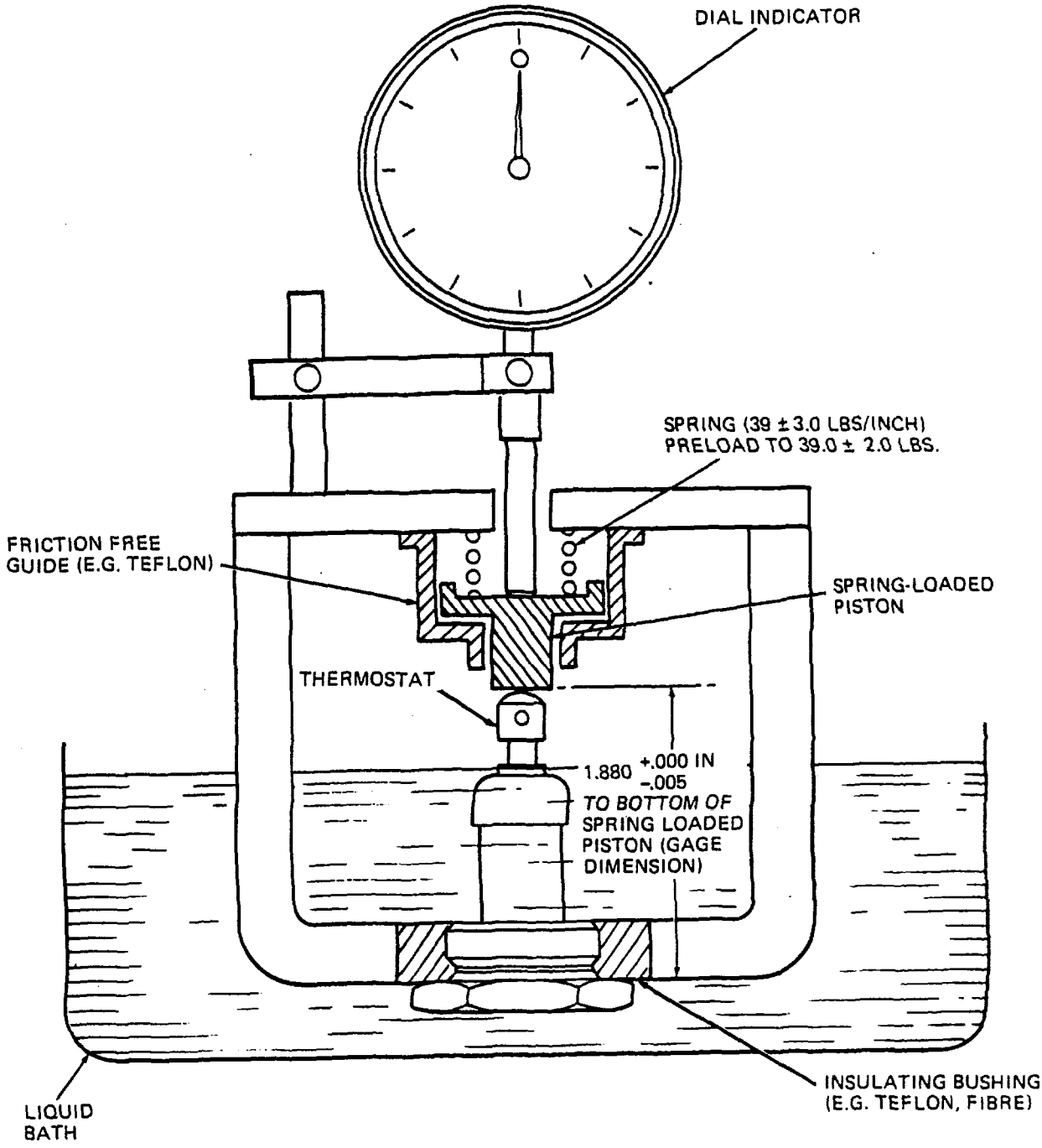
D. Thermostat Test (Figure 2)

(1) Prepare test fixture by setting dial indicator to zero with gage dimension maintained by a suitable gage block installed below spring-loaded piston.

NOTE: Gage dimension of 1.880 $\pm \frac{.000}{.005}$ inch is distance between underside of spring-loaded piston and lower face of test fixture.

(2) Remove gage block and install thermostat (without washer) in test fixture.

(3) Immerse test fixture in controlled temperature bath to a depth that insures complete immersion of the thermostat.



Thermostat Test Fixture

Figure 2

(4) Raise bath temperature slowly to 155 $^{+1}_{-0}$ F. The indicator must now read between -0.024 inch and +0.035 inch.

(5) Raise bath temperature slowly to 175 $^{+1}_{-0}$ F, taking care not to exceed this temperature. Allow thermostat movement to stabilize and check that indicator now reads 0.205 inch to 0.220 inch. Note indicator reading.

(6) Decrease bath temperature slowly to 155 $^{+0}_{-1}$ F, taking care to prevent temperature from falling below this figure. Allow thermostat movement to stabilize and note indicator reading. Compare with reading taken in step (5) and check that thermostat has moved more than 0.100 inch.

(7) Remove test fixture from heated bath and immediately immerse in bath containing fluid at room temperature. Check that thermostat reduces in length and stops at an indicator reading of 0.000 to -0.040 inch.

9. Trouble Shooting

Not applicable.

10. Storage Instructions

A. Preparation

(1) Flush cooler in each direction with preservative oil consisting of three parts MIL-L-6082, Grade 1065 and one part MIL-C-6529 or, for an oil system using oil MIL-L-7808, corrosion-preventive oil MIL-C-8188B, or equivalent. Heat flushing oil to above 175°F to insure full circulation through cooler core.

(2) Install plugs in inlet and outlet ports.

(3) Wrap oil cooler in water vapor resistant barrier material.

(4) Package cooler in a container that will provide suitable protection against damage.

(5) Affix label giving following information:

(a) Identification

(b) Date of overhaul

(c) Inspection

Table 5

Storage Materials and Compounds

MATERIAL	SPECIFICATION OR MANUFACTURER
Barrier Material	MIL-B-121
Lubricating Oil, Grade 1065	MIL-L-6082
Corrosion Preventive	MIL-C-6529
Corrosion - Preventive Oil	MIL-C-8188B

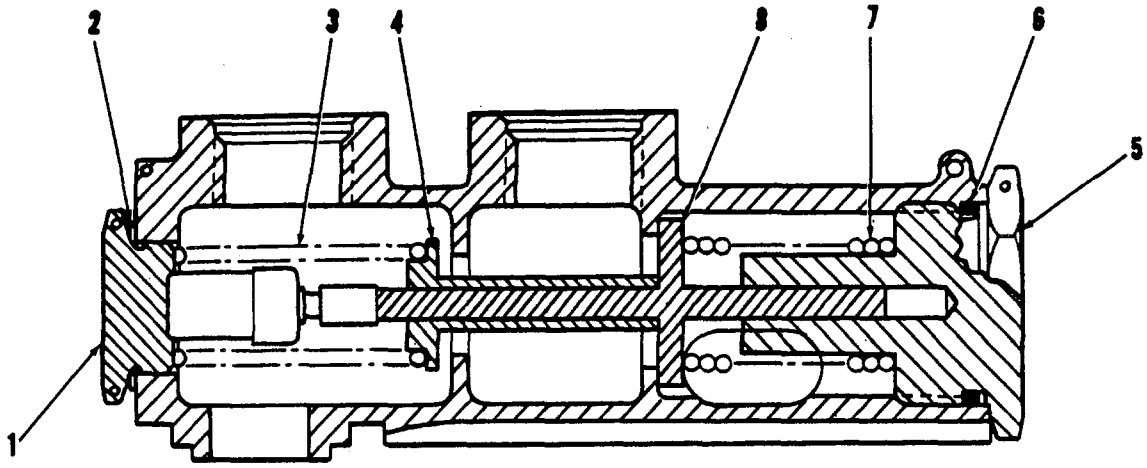
11. Special Tools and Equipment

The tools and equipment required for overhaul are listed in Table 6.

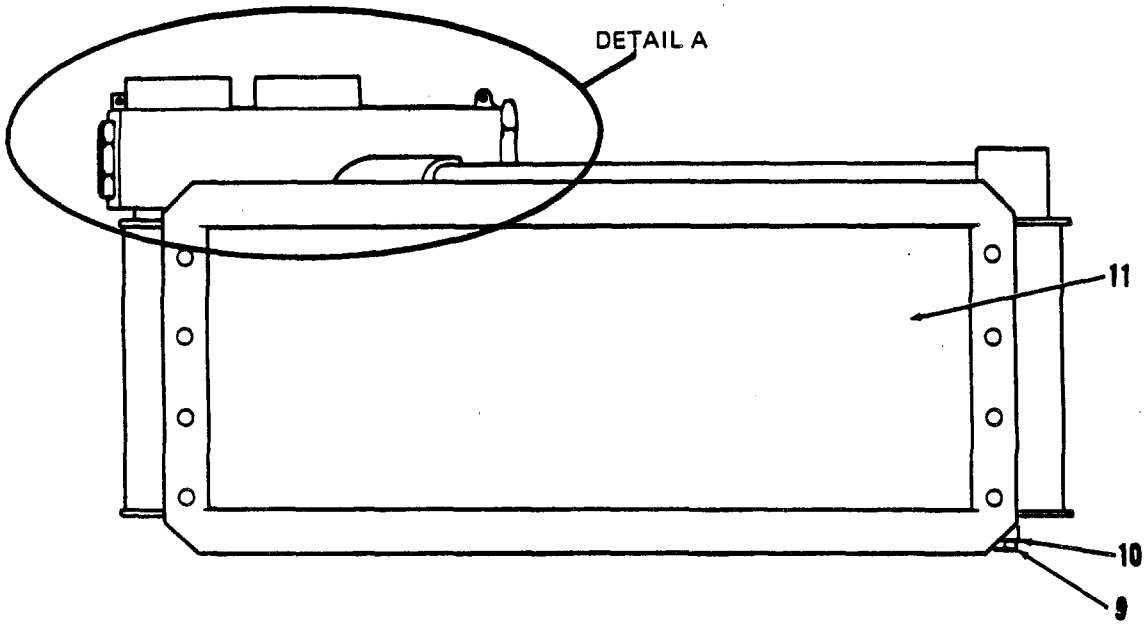
Table 6

Tools and Equipment

EQUIPMENT	MANUFACTURER
Liquid bath (leak test)	Local
Pneumatic test rig capable of supplying and maintaining 225 $\pm \frac{5}{0}$ psi.	-
Recirculating oil supply source capable of supplying 90 pound/min of non-aerated oil (MIL-L-7808) at 35 psi inlet pressure and a temperature of 225°F.	Local
Thermostat test fixture (refer to Figure 2).	Local
Gage block for use with thermostat test fixture.	Local
Liquid bath with agitater and a temperature control of 1°F/min change in the 155 to 175 to 155°F range.	Local
Calibrated thermometer in 1°F increments	-
Dial Indicator	-
Welding equipment (Heliarc or Oxy-Acetylene)	-
Steam cleaning equipment	-
Flushing equipment	-



SECTION THROUGH DETAIL A



Oil Cooler 10528A

Figure 3

12. Illustrated Parts List

A. For explanation of the vendor codes used in the Illustrated Parts List, refer to Table 7.

Table 7

Vendor Codes

CODE	VENDOR NAME AND ADDRESS
78385	Stewart-Warner Corporation, South Wind Division, Indianapolis, Indiana, U.S.A.

B. List of Parts - Oil Cooler 10528A.

FIGURE AND INDEX NO.	NOMENCLATURE PART NUMBER	1234567		USAGE ON CODE	UNITS PER ASSY
3	10528A	Oil Cooler Assembly	(78385)	A	1
1	721648	.Thermostat	(78385)	A	1
2	721090	.Gasket	(78385)	A	1
3	721750	.Spring	(78385)	A	1
4	721670	.Valve, Poppet	(78385)	A	1
5	721270	.Plug	(78385)	A	1
6	721287	.O-ring	(78385)	A	1
7	721275	.Spring	(78385)	A	1
8	721669	.Pushrod, Valve	(78385)	A	1
9	721665	.Plug	(78385)	A	1
10	721700	.O-ring	(78385)	A	1
11	G721656	.Core	(78385)	A	1

CHAPTER 80

STARTING

de Havilland Inc.
DHC-6 TWIN OTTER
COMPONENT MAINTENANCE MANUAL
CHAPTER 80 – STARTING
TABLE OF CONTENTS

MANUFACTURE	COMPONENT	PART NUMBER	ATA NO.	REV. STATUS	S.B./T.R.
United Aircraft	Solenoid Fuel Bleed	U9500		Feb 1/1959	

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9312

1 FEBRUARY 1959

COMPANY CONFIDENTIAL

OVERHAUL INSTRUCTIONS with PARTS BREAKDOWN

FUEL SHUTOFF SOLENOID VALVE ASSEMBLY

PART NO. U-9500

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TABLE OF LEADING PARTICULARS

Operating Voltage	18 to 30 volts
Max. Current	0.9 amp at 30 volts
Port Threads	7/16-20 internal thd for 1/4 in. tube
Spring Length (free)	1 inch
Spring Load	1-7/8 lb at 0.675 in. length
Connector	AN3102A-10SL-4P

1. SPECIAL TOOLS. None.

2. DISASSEMBLY. (See figure 1.)

a. Disassemble in order of index numbers shown on exploded view, noting the following special instructions:

b. It is not practical to drill out pin (1) because of the soft metal surrounding it and because of its small size. If necessary to remove pin, insert fine hack saw blade at opening between body (2) and coil and retainer assembly (6). Remove body and pick out pieces of pin.

c. Avoiding distorting strains, clamp coil and retainer assembly (6) to unscrew body (2) from it. Avoid loss of loose parts (3, 4, 5).

3. CLEANING.

a. Wash in dry cleaning solvent, Federal Specification No. P-S-661, but do not allow plunger assembly or coil and retainer assembly to soak in solvent. Dry thoroughly after cleaning.

4. INSPECTION.

a. Plunger and plunger bore in coil for damage causing sticking of plunger.

b. Valve seat in body and seal on plunger for damage interfering with sealing action.

c. Spring for free length and load at design length.

d. Corrosion at breaks in plated or anodized parts.

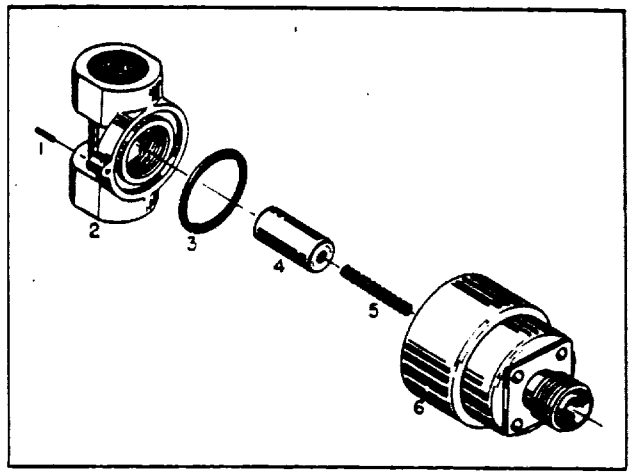


Figure 1. Fuel Shutoff Valve (Exploded)

FIG. & INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY
1-	U-9500	VALVE ASSY, Fuel shutoff	1
-1	U-3116	. PIN	1
-2	U-3101-3	. BODY	1
-3	MS29513-20	. PACKING	1
-4	U-3112	. PLUNGER ASSY	1
-5	U-3102	. SPRING	1
-6	U-9502	. COIL AND RETAINER ASSY	1

e. All threads for condition and cleanliness.

f. Check resistance using potentiometer. Readings should be between 35 and 42 ohms. Or, using a voltmeter and ammeter in circuits, initial amperage at 18 volts should be 0.43 to 0.52; at 24 volts, 0.57 to 0.69.

5. REPAIR AND REPLACEMENT.

a. Do not repair plated or anodized parts if repairs will break protective coating, as corrosion will occur in service.

b. Replace "O" ring packing. Replace plunger assembly if condition is at all doubtful.

6. LUBRICATION. None.

7. REASSEMBLY.

a. Reassembly is the reverse of disassembly. When body is tight on coil and retainer assembly, holes for pin (1) should be in line. If not (because of new body or coil assembly), use No. 56 (0.0465 inch) drill but do not make hole over 1/4 inch deep. Drive new pin home.

8. TEST PROCEDURE.

a. Connect to variable d-c source through switch and apply 50 psi fluid pressure to inlet port. Use standard hydrocarbon test fluid, Specification No. MIL-F-7024. Valve must operate satisfactorily at 18 volts with maximum current of 0.5 ampere. Reduce test pressure to zero.

b. Energize solenoid at 30 volts. Operation must be satisfactory with maximum current not over 0.9 ampere.

c. De-energize solenoid. Apply fluid pressure at inlet from 0 to 75 psi. Check for leakage for 3 minutes.

d. Connect fluid pressure source to outlet port and apply 15 psi against closed valve with inlet port open. Hold for 3 minutes and check for leakage.

e. Any external leakage or internal leakage through closed valve is cause for rejection. Repeated failure of valve to operate smoothly is cause for rejection. Rejected valves must be rebuilt or scrapped.

f. Before attaching tag noting test results, seal both ports against dirt and stamp curing date tag with date of oldest rubber compound used.

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