AZTEC

SERVICE MANUAL

PA-23-235 APACHE

PA-23-250 AZTEC

PA-23-250 (SIX PLACE) AZTEC

PIPER AIRCRAFT CORPORATION

PART NUMBER 753-564 January 1, 2009

Published by
Technical Publications

2926 Piper Drive
Vero Beach, Florida 32960
U.S.A.

Member
General Aviation
Manufacturers Association

REVISION STATUS

Revisions to the Aztec Service Manual (P/N 753-564) originally published April 1, 1960 are as follows:

Revisions	Publication Date	Aerofiche Card Effectivity
CR681001	October 1, 1968	1, 2, 3, 4 and 5
CR720829	August 29, 1972	1, 2, 3, 4 and 5
CR810218	February 18, 1981	1, 2, 3, 4 and 5
PR830426	April 26, 1983	1, 2, 3, 4 and 5
PR860429	April 29, 1986	1
PR860921	September 21, 1986	1
PR040827	August 27, 2004	1 and 3
PR060715	July 15, 2006	1, 2, 3, 4, 5 and 6
PR090101	January 1, 2009	N/A*

*** Piper has ceased production of all Aerofiche (i.e., microfiche) products.**

Service Manual subscriptions are available exclusively from Avantext, Inc. (www.Avantext.com) on CD-Rom or DVD. The CDs/DVDs include applicable Service Bulletins and Service Letters.

Consult the “Customer Service Information File” (available on the Avantext CDs/DVDs above) to verify that you have the latest revision.

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INTRODUCTION

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INTRODUCTION

1. Instructions for Continued Airworthiness

WARNING: INSTRUCTIONS FOR CONTINUED AIRWORTHINESS (ICA) FOR ALL NON-PIPER APPROVED STC INSTALLATIONS ARE NOT INCLUDED IN THIS MANUAL. WHEN A NON-PIPER APPROVED STC INSTALLATION IS INCORPORATED ON THE AIRPLANE, THOSE PORTIONS OF THE AIRPLANE AFFECTED BY THE INSTALLATION MUST BE INSPECTED IN ACCORDANCE WITH THE ICA PUBLISHED BY THE OWNER OF THE STC. SINCE NON-PIPER APPROVED STC INSTALLATIONS MAY CHANGE SYSTEMS INTERFACE, OPERATING CHARACTERISTICS AND COMPONENT LOADS OR STRESSES ON ADJACENT STRUCTURES, THE PIPER PROVIDED ICA MAY NOT BE VALID FOR AIRPLANES SO MODIFIED.

The PIPER PA-23-235/250 Aztec Service Manual constitutes the Instructions for Continued Airworthiness in accordance with Federal Aviation Regulations (FAR) Part 23, Appendix G. Section I contains the Airworthiness Limitations and the Inspection Program is in Section III.

2. General

This publication is prepared in PIPER proprietary format with respect to arrangement and content.

WARNING: USE ONLY GENUINE PIPER PARTS OR PIPER APPROVED PARTS OBTAINED FROM PIPER APPROVED SOURCES, IN CONNECTION WITH THE MAINTENANCE AND REPAIR OF PIPER AIRPLANES.

This manual generally does not contain hardware callouts for installation. Hardware callouts are only indicated where a special application is required. To confirm the correct hardware used, refer to the PA-23-235/250 Aztec Parts Catalog, P/N 753-522, and FAR 43 for proper utilization.

Genuine PIPER parts are produced and inspected under rigorous procedures to insure airworthiness and suitability for use in PIPER airplane applications. Parts purchased from sources other than PIPER, even though identical in appearance, may not have had the required tests and inspections performed, may be different in fabrication techniques and materials, and may be dangerous when installed in an airplane.

Additionally, reworked or salvaged parts or those parts obtained from non-PIPER approved sources, may have service histories which are unknown or cannot be authenticated, may have been subjected to unacceptable stresses or temperatures or may have other hidden damage not discernible through routine visual or nondestructive testing. This may render the part, component or structural assembly, even though originally manufactured by PIPER, unsuitable and unsafe for airplane use.

Piper Aircraft, Inc. expressly disclaims any responsibility for malfunctions, failures, damage or injury caused by use of non-PIPER approved parts.

NOTE: Piper Aircraft, Inc. expressly reserves the right to supersede, cancel and/or declare obsolete any part, part numbers, kits or publication that may be referenced in this manual without prior notice.

In any question concerning the care of your airplane, be sure to include the airplane serial number in any correspondence.

3. Effectivity

This service manual is effective for PA-23-235, PA-23-250, and PA-E23-250 airplane serial numbers 27-1 thru 27-8154030. This encompasses the following model years:

NOTE: The designation PA-23-250 (6) or PA-23-250 (six place) is not used below. Such references should be considered to mean PA-23-250 S/N's 27-2000 and up, unless otherwise indicated.

NOTE: The following is provided as a general reference only.

Model	Sub-Model	Serial Numbers	Model Year
PA-23-250	Aztec	27-1 thru 27-366	1960
		27-367 thru 27-504	1961
PA-23-235	Apache	27-505 thru 27-506	1962
		27-507 thru 27-587	1963
		27-588 thru 27-603	1964
		27-604 thru 27-616	1965
		27-617 thru 27-622	1966
PA-23-250	Aztec "B"	27-2000 (Prototype)	1961
		27-2001 thru 27-2231	1962
		27-2232 thru 27-2436	1963
		27-2437 thru 27-2504	1964
(or PA-E23-250)	Aztec "C"	27-2505 thru 27-2690	1964
		27-2691 thru 27-3070	1965
		27-3071 thru 27-3508	1966
		27-3509 thru 27-3759	1967
		27-3760 thru 27-3943, less 27-3837	1968
	Aztec "D"	27-3944 thru 27-4042, and 27-3837	1968
		27-4043 thru 27-4399	1969
		27-4400 thru 27-4564	1970
		27-4565 thru 27-4573	1971
	Aztec "E"	27-4574 thru 27-4575	1970
		27-4576 thru 27-4755	1971
		27-4756 thru 27-4866	1972
		27-4867 thru 27-4916 (Destroyed 1972 Flood)	
		27-7304917 thru 27-7305234	1973
		27-7405235 thru 27-7405476	1974
		27-7554001 thru 27-7554168	1975
	Aztec "F"	27-7654001 thru 27-7654203	1976
		27-7754001 thru 27-7754163	1977
		27-7854001 thru 27-7854139	1978
		27-7954001 thru 27-7954121	1979
		27-8054001 thru 27-8054059	1980
		27-8154001 thru 27-8154030	1981
PA-E23-250	Reduced gross weight to 4995 lbs for UK market,otherwise same as standard 5200 lbs models.	27-2505 thru 27-8154030	1964-1981

4. Serial Number Explanation

Example - (1960 thru 1972): 27 671

TYPE CERTIFICATE DESIGNATION (No Model Year Designation) — 27

SEQUENCE NUMBER (1 to 4 digits) (No Model Code) — 671

Example - (1973 and 1974): 27 73 00001

TYPE CERTIFICATE DESIGNATION — 27

MODEL YEAR — 73

SEQUENCE NUMBER (5 digits) (No Model Code) — 00001

Example - (1975 thru 1981): 27 77 54 001

TYPE CERTIFICATE DESIGNATION — 27

MODEL YEAR — 77

MODEL CODE 54 = PA-23-250 AZTEC — 54

SEQUENCE NUMBER (3 digits) — 001

5. Assignment of Subject Material

This publication is divided into logical subject groupings based on aircraft system or task function. Refer to paragraph 13, Section Index Guide.

6. Pagination

A modified legacy Aerofiche grid numbering system (explained below) will be used to indicate location within the manual until the next complete revision.

7. Aerofiche Grid Numbering

Piper has ceased production of all Aerofiche (i.e., microfiche) products. The Aerofiche grid numbers will be replaced by Section page numbers (i.e., I-1, II-3, etc.) indicating the Section and the consecutive page number from the beginning of the section in the next complete revision. In the interim, as partial revisions occur, the legacy Aerofiche grid numbering system may be modified, as explained below, to simplify production.

Deviations from the legacy Aerofiche grid numbering system will occur when it becomes necessary to add pages to the manual and will typically take two forms:

A. Inserting pages between two existing grids in the same row.

When inserting two pages between the existing grids 1A8 and 1A9, the two new pages will be numbered 1A8A and 1A8B.

B. Inserting pages at the end of an Aerofiche grid row.

The legacy Aerofiche grid numbering system limited page numbers in a row to a maximum of 24 (i.e., row 1A would be numbered 1A1–1A24). That limit no longer applies. Accordingly, if two pages need to be added between any existing grid row end and grid row start (i.e., 1A24 and 1B1), the new pages will simply be numbered 1A25 and 1A26.

8. Identifying Revised Material

A. 1981 thru April, 1986:

Revised text and illustrations are indicated by a vertical line along the left-hand margin of the frame, opposite revised, added or deleted material. Revision lines indicate only current revisions with changes and additions to or deletions of existing text and illustrations. Changes in capitalization, spelling, punctuation, indexing, the physical location of the material or complete page additions are not identified by revision lines.

B. September, 1986 thru 2004:

Revised text and illustrations are indicated by a vertical line along the left-hand margin of the frame, opposite revised or added material. Revision lines indicate only current revisions with changes and additions to existing text and illustrations. Changes in capitalization, spelling, punctuation, indexing, physical location of material, or complete page additions are not identified by revision lines.

C. 2006:

A revision to a page is defined as any change to the printed matter that existed previously. Revisions, additions and deletions are identified by a vertical line (aka change bar) along the lefthand margin of the page opposite only that portion of the printed matter that was changed. A change bar in the left-hand margin opposite the footer (i.e. - section/subject, grid number and date), indicates that the text was unchanged but the material was relocated to a different page.

NOTE: Change bars are not used in the title pages. Likewise, all change bars are removed when a publication is completely revised (i.e. - reissued).

D. 2009 and later:

A revision to a page is defined as a change to the text or illustrations that existed previously. Revisions, additions and deletions are identified by a vertical line (aka change bar) along the left-hand margin of the page opposite only the text or illustration that was changed. Reformatted, but otherwise unchanged, text is not identified by a change bar.

Change bars in the section Tables of Contents do not indicate a change to that page, but rather that the information in the actual paragraph has changed.

A change bar in the left-hand margin opposite the footer (i.e. - chapter/section/subject, page number and date), indicates that the text was unchanged but the material was relocated to a different page.

Example.

NOTE: Change bars are not used in the title pages. Likewise, when a publication is completely revised (i.e. - reissued), change bars will only appear in the Tables of Contents.

9. Indexing

A Section Index Guide, below, will assist the user in locating desired information. In addition, each Section begins with an individual Table of Contents.

10. Warnings, Cautions and Notes

These adjuncts to the text are used to highlight or emphasize important points when necessary. Warnings call attention to use of materials, processes, methods, procedures or limits which must be followed precisely to avoid injury or death to persons. Cautions call attention to methods and procedures which must be followed to avoid damage to equipment. Notes call attention to methods which make the job easier.

11. Accident/Incident Reporting

To improve our Service and Reliability system and aid in Piper's compliance with FAR 21.3, knowledge of all incidents and/or accidents must be reported to Piper immediately. To expedite and assist in reporting all incidents and accidents, Piper Form 420-01 has been created. See Service Letter 1041 for latest revision. This procedure is to be used by all Dealers, Service Centers and Repair Facilities.

12. Supplementary Publications

The following publications/sources provide servicing, overhaul and parts information for the PA-23-235/250 airplanes and their various components. Use them to supplement this manual.

A. Piper Publications:

	Part Number
(1) Parts Catalog:	753-522
(2) Periodic Inspection Report:	230-205
(3) Progressive Inspection Manual (25 Hour):	761-498
(4) Progressive Inspection Manual (50 Hour):	761-738

NOTE: The four publications listed above are available exclusively from Avantext, Inc. by subscription to the appropriate "Piper Aircraft TechPubs Maintenance Library" on CD-Rom or DVD. See www.avantext.com or PH - (800) 998-8857.

B. Vendor Publications:

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY.

(1) ALTERNATOR:

Vendor Address:
Kelly Aerospace Power Systems — PH: (877) 359-5355
2900 Selma Hwy — FAX: (334) 386-5410
Montgomery, Alabama 36108
http://www.kellyaerospace.com

Overhaul Manual: OE-A2 Overhaul Manual (Starters and Alternators)

(2) BATTERY:

Vendor Address:
GILL Batteries — PH: (800) 456-0070
A Division of Teledyne Continental Motors
http://www.gillbatteries.com

(3) BRAKES AND WHEELS:

Vendor Address:
Parker Hannifin Corp — PH: (800) 272-5464
Aircraft Wheel and Brake Division
1160 Center Road
Avon, Ohio 44011
http://www.parker.com/ag/wbd

(4) COMBUSTION HEATER:

Vendor Address:
Kelly Aerospace Power Systems — PH: (877) 359-5355
2900 Selma Hwy — FAX: (334) 386-5410
Montgomery, Alabama 36108
http://www.kellyaerospace.com/heaters.html

Maintenance and Overhaul Manual: 24E25-1

(5) EMERGENCY LOCATOR TRANSMITTER:

Vendor Address:	Artex Airccraft Supplies 14405 Keil Road NE Aurora, Oregon 97002 http://www.artex.net/	PH:	(800) 547-8901

(6) ENGINE:

Vendor Address:	Lycoming Engines 652 Oliver Street Williamsport, PA 17701 http://www.lycoming.textron.com/index.jsp	PH: FAX:	(717) 323-6181 (717) 327-7101
Overhaul Manual:	Direct Drive Models - P/N 60294-7		
Parts Catalog:	O-540-A Series - PC-115-1 O-540-B, ... Series - PC-115-2 IO-540-A,....., C, , G Series - P/N PC-215-1 IO-540-J, ... Series - P/N PC-215-2 TIO-540 Series - P/N PC-315-6		
Operators Handbook:	O-540, IO-540 Series - P/N 60297-10 TIO-540 Series - P/N 60297-23		

NOTE: The above Lycoming publications can be ordered as a set on CD-ROM from Avantext. See www.avantext.com or PH - (800) 998-8857.

(7) FIRE EXTINGUISHER (PORTABLE):

Vendor Address:	H3R Inc. 483 Magnolia Ave Larkspur, California 94939 http://www.h3raviation.com/	PH:	(800) 249-4289

(8) FUEL CELLS:

Vendor Address:	Engineered Fabrics Corporation 669 Goodyear Street Rockmart, Georgia 30153-0548 http://www.kfefc.com/index.htm	PH: FAX:	(770) 684-7855 (770) 684-7438

(9) FUEL PUMP:

Vendor Address:	Weldon Pumps P.O. Box 46579 640 Golden Oak Parkway Oakwood Village, Ohio 44146 http://www.weldonpumps.com/	PH: FAX:	(440) 232-2282 (440) 232-0606

(10) HI-LOK FASTENERS AND TOOLS:

Vendor Address:	Hi-Shear Corporation 2600 Skypark Drive Torrance, California 90509	PH:	(213) 326-8110

(11) LIGHTS - NAVIGATION, STROBE, AND STANDBY/MAP LIGHTS:

Vendor Address:	Whelen Engineering Co. Inc. Route 145, Winthrop Rd. Chester, Conneticut 06412 http://www.whelen.com/	PH: FAX:	(860) 526-9504 (860) 526-2009

(12) MAGNETOS:

Vendor Address:	Teledyne Continental Motors P.O. Box 90 Mobile, AL 36601 http://www.tcmlink.com	PH: FAX:	(334-438-3411, ext. 8392) (334-433-2325
Service Support Manual:	S-20 & S-200 Series Magnetos, P/N X42002-1 S-1200 Series Magnetos, P/N X42001-1		
or, if installed:			
Vendor Address:	Slick Aircraft Products Unison Industries Attn: Subscription Dept. 7575 Baymeadows Way Jacksonville, FL 32256 http://www.unisonindustries.com/	PH: FAX:	(904) 739-4000 (904) 739-4006
Installation, Operation and Maintenance Instructions:	F1100 MASTER SERVICE MANUAL, 4300/6300 SERIES MAGNETO MAINTENANCE AND OVERHAUL MANUAL - L-1363		

(13) OXYGEN SYSTEM:

Vendor Address:	Avox Systems 225 Erie Street Lancaster, New York 14086 http://www.avoxsys.com/	PH:	(716) 683-5100

(14) PROPELLER:

Vendor Address:	Hartzell Propeller Inc. One Propellor Place Piqua, OH 45356-2634 http://www.hartzellprop.com/index2.htm	PH: FAX:	(937) 778-4379 (937) 778-4321
Overhaul and Maintenance:	Manual No. 109A, 114B, 117D, or 172		
Aluminum Blade Overhaul:	Manual No. 133C		
Propeller Owner's Manual:	Manual No. 115N, 168, or 175		

(15) PROPELLER GOVERNOR:

Vendor Address:	Hartzell Propeller Inc. One Propellor Place Piqua, OH 45356-2634 http://www.hartzellprop.com/index2.htm	PH: FAX:	(937) 778-4379 (937) 778-4321
Governor Maintenance:	Manual No. 130B		

(16) VACUUM PUMPS:

Vendor Address:	Aero Accessories, Inc. 1240 Springwood Avenue Gibsonville, NC 27249 http://www.aeroaccessories.com/index.html	PH:	(800) 822-3200

(17) VACUUM REGULATORS:

Vendor Address:	Parker Hannifin Corp. Airborne Division 711 Taylor Street Elyria, Ohio 44035 http://www.parker.com/portal/site/PARKER/	PH:	(800) 382-8422

(18) VOLTAGE REGULATOR:

Vendor Address:	Lamar Technologies Corp. 14900 - 40th Ave. N.E. Marysville, WA 98271 http://www.lamartech.com/	PH:	(360) 651-6666

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13. Section Index Guide

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NOTE: For Electrical Schematics, Figures 11-68 thru 11-153, see Grid 4C5.

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SECTION

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AIRWORTHINESS LIMITATIONS

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SECTION I - AIRWORTHINESS LIMITATIONS

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AIRWORTHINESS LIMITATIONS

NOTE: The Airworthiness Limitations section is FAA approved and specifies maintenance required under §§ 43.16 and 91. 403 of the Federal Aviation Regulations unless an alternative program has been FAA approved.

1. Limitations

No limitations related to fatigue life of the airplane and its components have been established for the PA-23-235 Apache nor for the PA-23-250 Aztec airplanes.

NOTE: Refer to the LIMITATIONS section in the Airplane Flight Manual for a detailed delineation of the flight limitations of the airplane.

2. Inspections

Refer to Section III for Piper's recommended Inspection Program.

3. Major Repairs to Life Limited Components

Major repairs to areas defined in FAR Part 43, Appendix A, must be shown, using approved data, to not diminish the Life of the Component as stated herein.

4. Life Limited Parts Marking and Disposition

14 CFR Part 43.10, Disposition of Life-Limited Aircraft Parts requires that proper procedures are followed when removing life limited parts with time and/or cycles remaining on them as well as the disposition of life limited parts with no time and/or cycles left. Life limited parts defined by Type Certificate (TC) are listed in paragraph 1, above. Other parts which are replaced or rebuilt at specified intervals are listed in Chapter 5.

a. Parts that are removed prior to accumulating their life limit, are to be marked with indelible ink or marker with the part number, serial number, and accumulated life status as defined in 14 CFR Part 43.10 in a manner that does not affect part structural integrity, i.e. - no surface deformation such as vibration/etching allowed.

b. Parts that have accumulated the life limit shall be disposed of in accordance with the applicable FARs. Piper recommends life limited parts with no time and/or cycles remaining be completely destroyed.

END OF SECTION

SECTION

II

HANDLING AND SERVICING

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SECTION II

HANDLING AND SERVICING

2-1. INTRODUCTION.

This sectioncontains routinehandlingand servicingprocedures that are most frequently encountered . Frequent reference to this section will aid the individual by providing information such as the location of various components, ground handling procedures, routine service procedures and lubrication. When any system or component requires service other than the procedures as outlined in this section, refer to the appropriate section for that component.

2-2. DIMENSIONS.

The principle airplane dimensions are shown in Figures 2-1 thru 2-6, and are listed in Table II-I.

2-3. STATION REFERENCE LINES.

In order to facilitate the location of various components of the airplane which require maintenance and servicing, a method utilizing fuselage station (Sta.), wing station or buttock line (BL), and water line (WL) designations is frequently employed in this manual. (Refer to Figure 2-10,) Fuselage stations, buttock lines, and water lines are reference points measured by inches in the vertical or horizontal direction from a given reference line which indicates station locations of structural members of the airplane, The BL station 0 of the wing and stabiiator is the center line of the airplane; and station 0 (WL) of the vertical stabilizer and rudder is 12 inches below the bottom edge of the forward left side window.

NOTE: For weight andbalance purposes, refer to the airplane Flight Manual. The fuselage station reference lines and the datum lines (arm) are not the same. The reference datum line or arm 0 is 6.25 inches forward of fuselage station 0.

2-4. WEIGHT AND BALANCE DATA.

When figuring various weight and balance computations, the weight and empty weight center of gravity of the airplane may be found in the Weight and Balance Form of the Airplane Flight Manual.

2-5. SERIAL NUMBER PLATE.

The Serial Number Plate for airplanes with Serial Numbers 27-1 to 27-3559 inclusive is located on the top of the tail stringer, underneath the rudder. The Serial Number Plate on airplanes with Serial Numbers 27-3560 and up is located on the bottom of the fuselage just forward of the tail skid. Airplane Serial Numbers will be used in this manual where model differences occur, and should be used when contacting the factory on service or warranty matters. M.A.A. plate is located under the rug in front of the co-pilot's seat.

CAUTION: BEFORE ENTERING THE AFT SECTION OF THE FUSELAGE, BE SURE THE AIRPLANE IS SUPPORTED AT THE TAIL SKID.

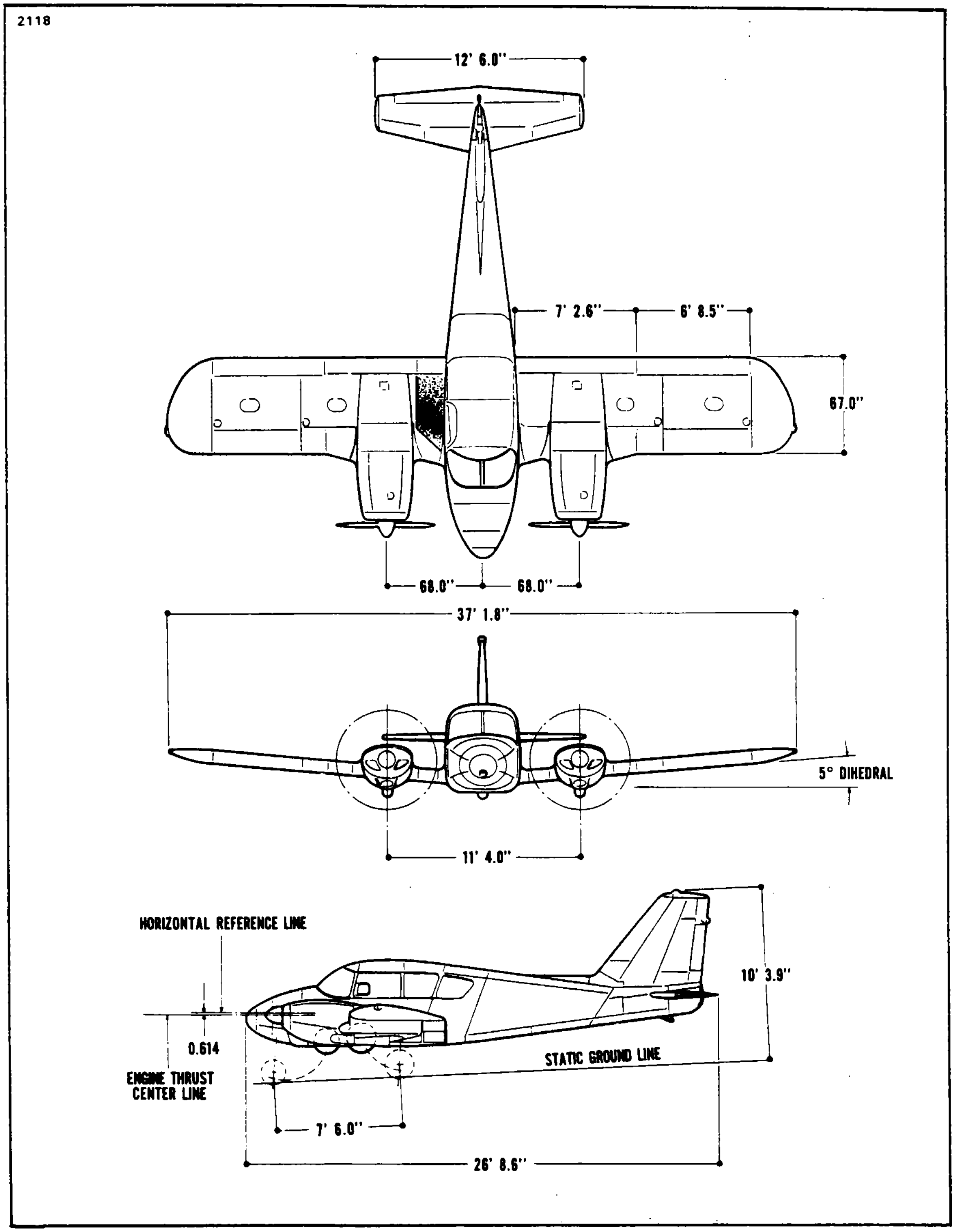

Figure 2-1. Three-View of PA-23-250 and PA-23-235

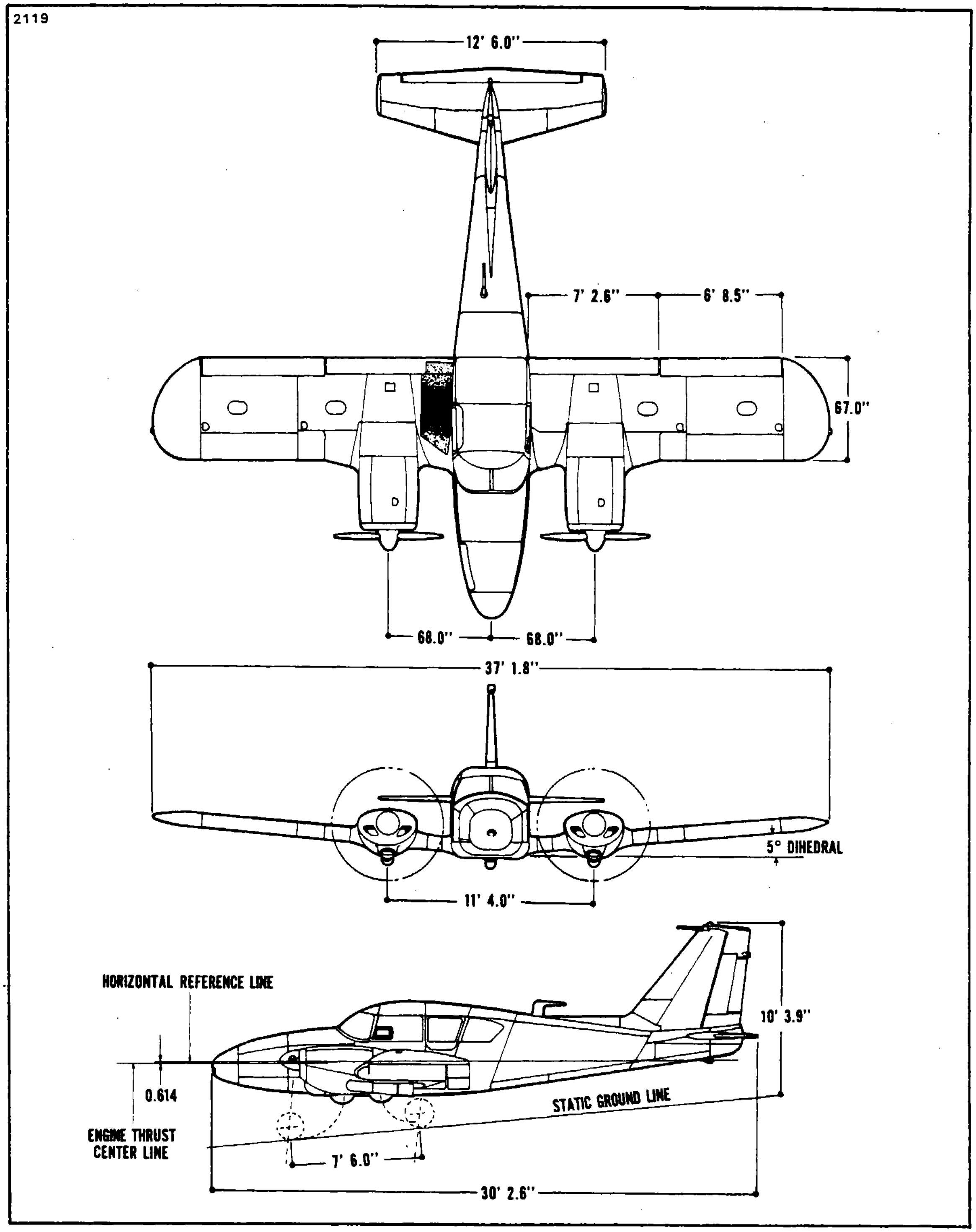

Figure 2-2. Three-View of PA-23-250 (six place)
Serial Nos. 27-2000 to 27-2504 incl.

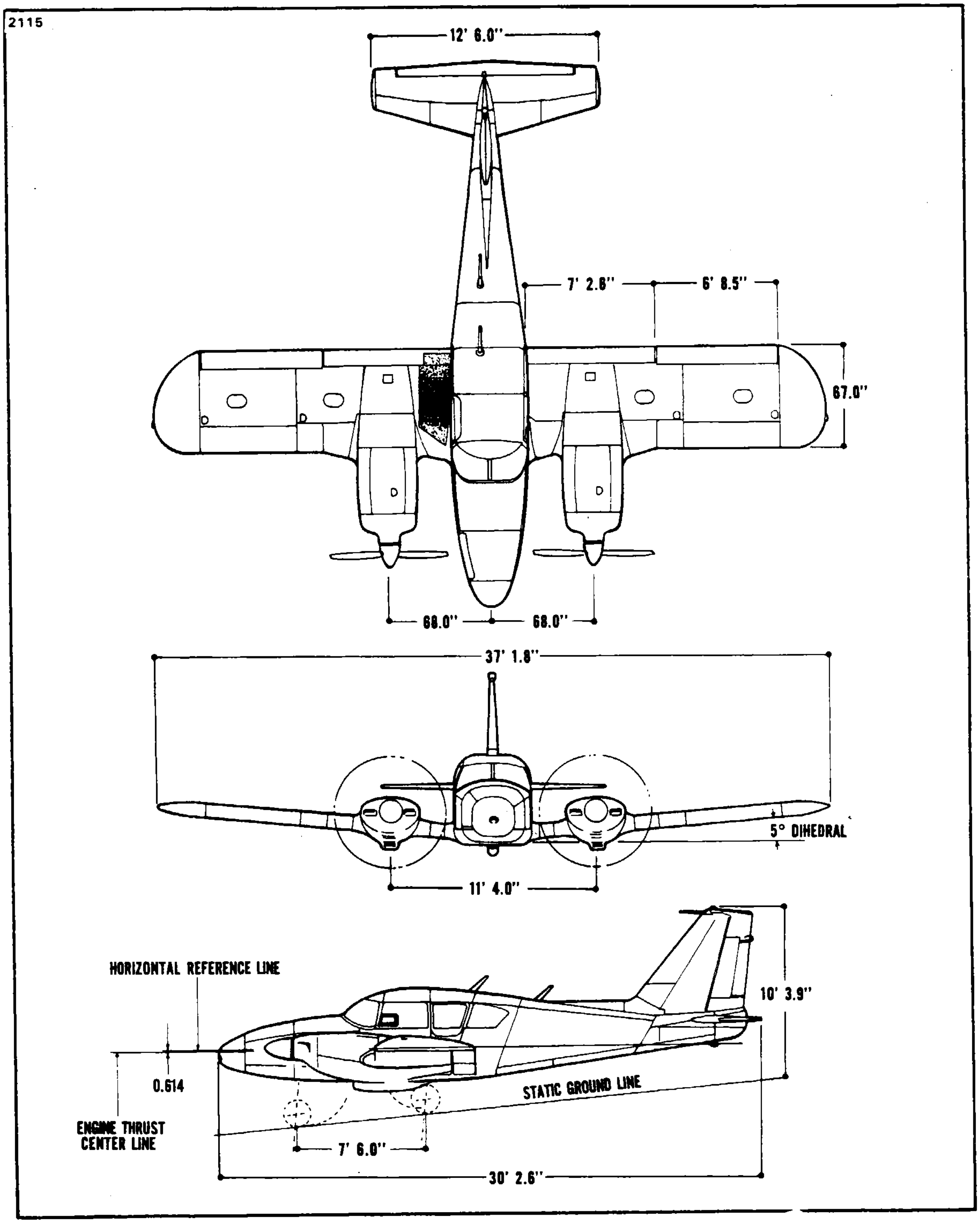

Figure 2-3. Three-View of PA-23-250 (six place)
Serial Nos. 27-2505 to 27-4573 incl.

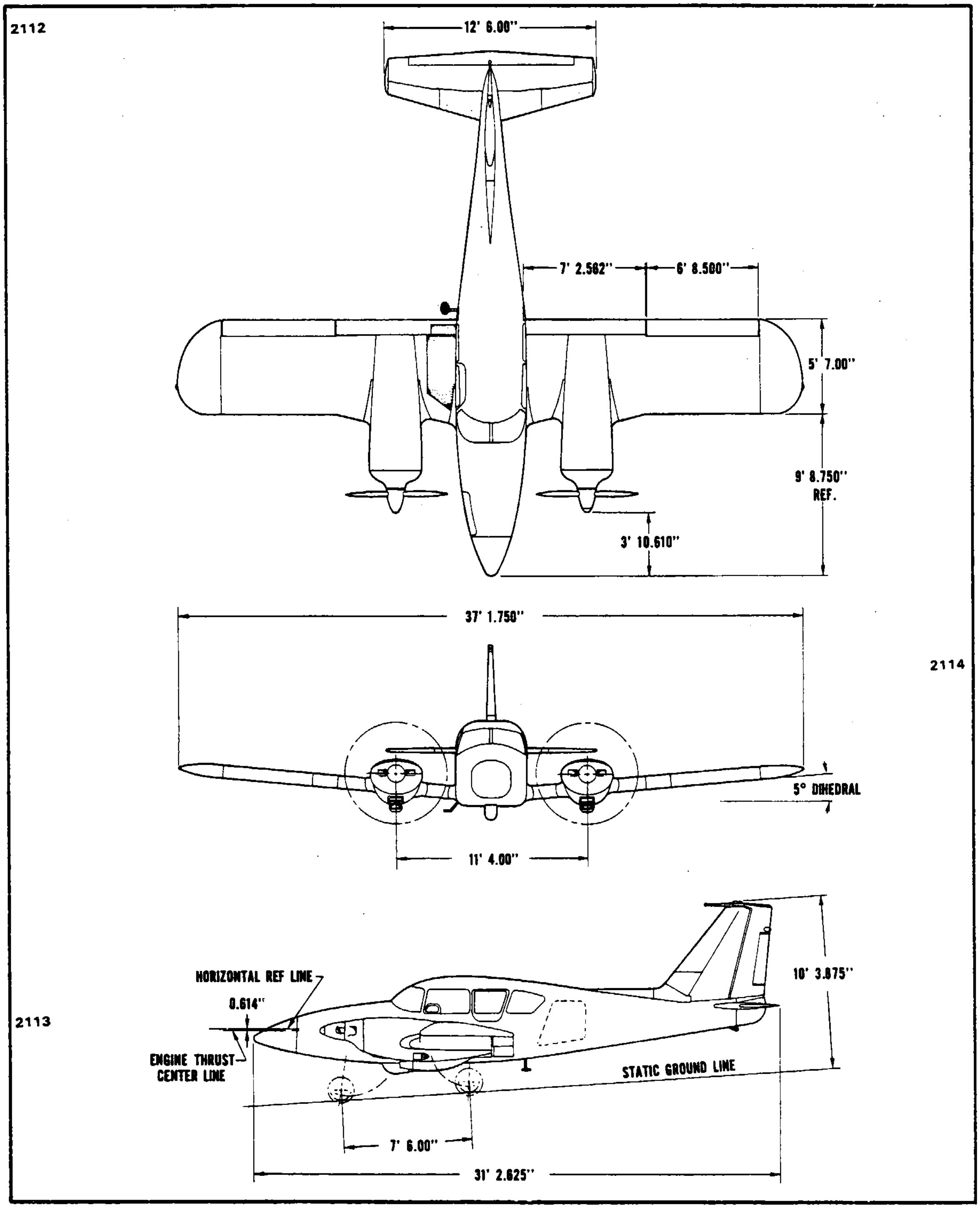

Figure 2-4. Three-View of PA-23-250 (six place)
Serial Nos. 27-4426 and 27-4574 to 27-7554168 incl.

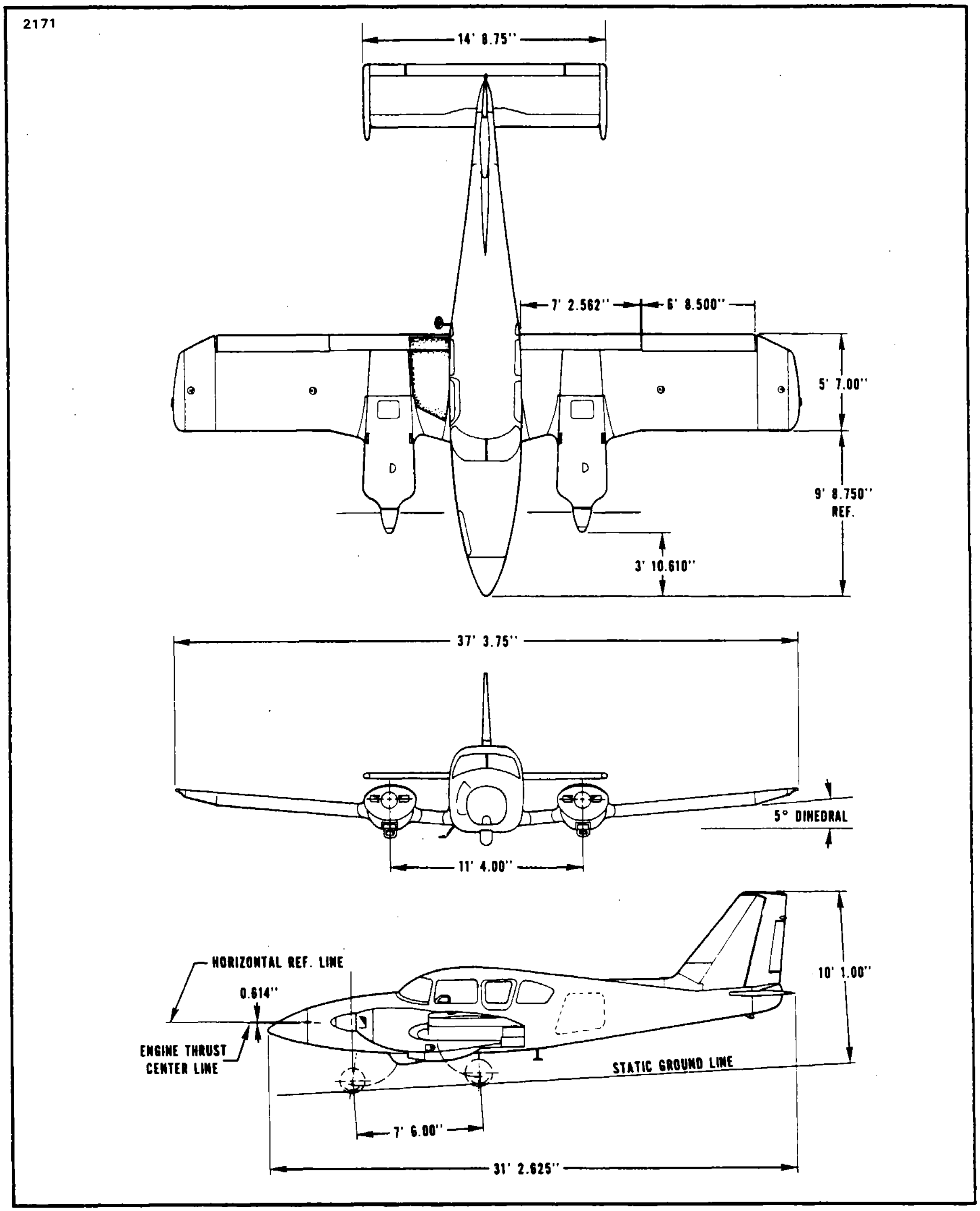

Figure 2-5. Three-View of PA-23-250 (six place)
Serial Nos. 27-7654001 to 27-7954121 incl.

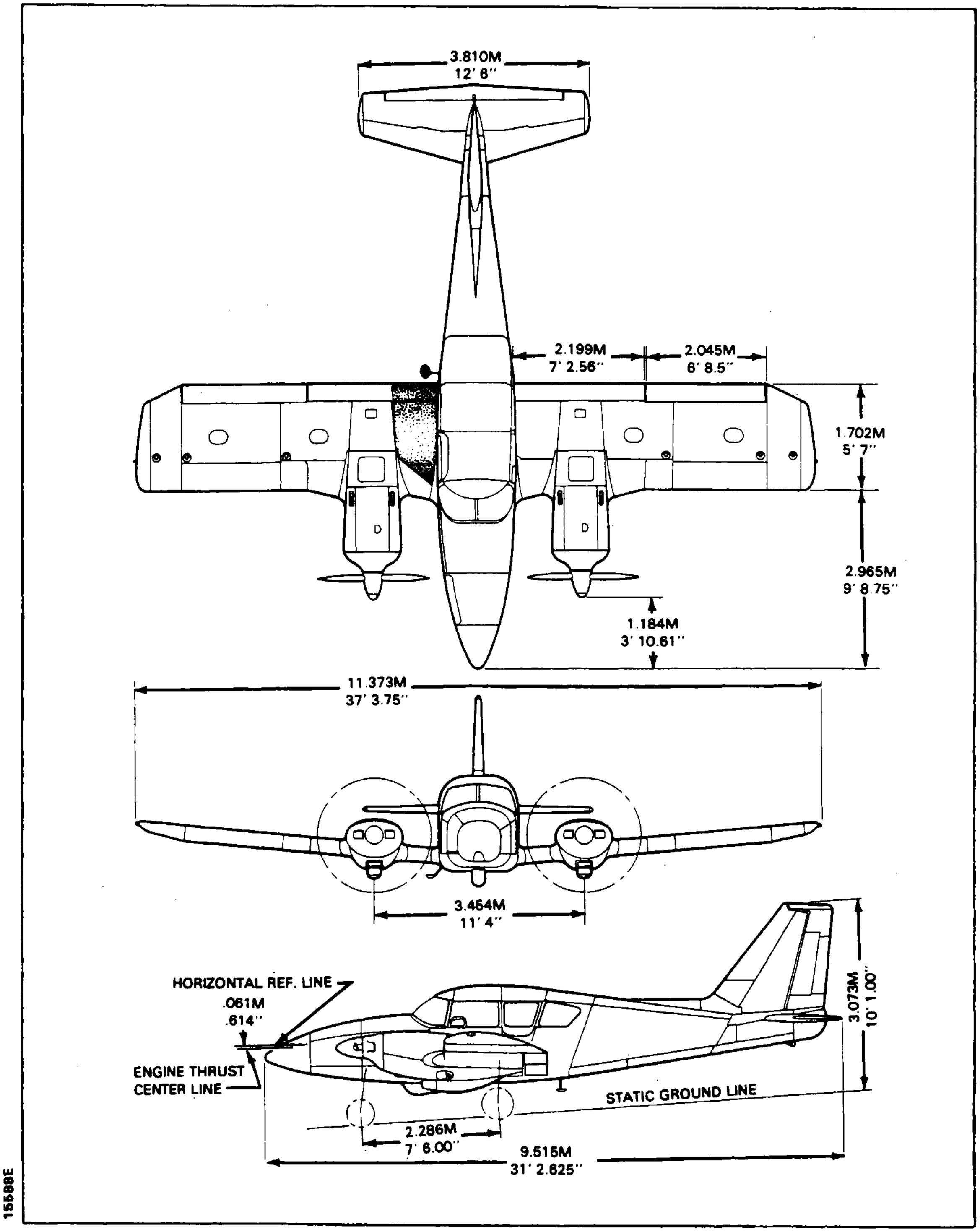

Figure 2-6. Three-View of PA-23-250 (six place)
Serial Nos. 27-8054001 and up

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TABLE II-I. LEADING PARTICULARS AND PRINCIPLE DIMENSIONS

MODEL	PA-23-250	PA-23-235
ENGINE		
Manufacturer	Avco-Lycoming	Avco-Lycoming
Model	O-540-A1B5, O-540-A1D5 or O-540-A3D5	O-540-B1A5
FAA Type Certificate	295	295
Rated Horsepower	250	235
Rated Speed:		
Full Throttle	2575 RPM	2575 RPM
Turbocharger Power Setting:(7)		
Turbo Cruise		
Oil S.A.E. Number	See Table II-V	See Table II-V
Oil Sump Capacity	12 U.S. quarts	12 U.S. quarts
Fuel, Aviation Grade, Minimum		
Octane	91/96	80/87(16)
Carburetor, Marvel-Schebler	MA-4-5	MA-4-5
Fuel Injector Bendix		
Magnetos, Scintilla:		
Right	S6LN-21(1)/S6LN-204(2)(3)	S6LN-204
Left	S6LN-21(1)/S6LN-200(2)(3)	S6LN-200
Magneto Timing	25 degrees BTC	25 degrees BTC
Magneto Point Clearance:		
Main	.018 ± .006	.018 ± .006
Retard	.018 ± .006	.018 ± .006
Retard Angle		
Spark Plugs, Shielded:		
Champion	REM-40E	EM-42E
AC	SR-88	S-88
Spark Plug Gap Setting(8)	.018 to .022	.018 to .022
Firing Order	1-4-5-2-3-6	1-4-5-2-3-6
Starter, Delco-Remy:		
14-Volt	1109688(1)/1109511(2)	1109511
28-Volt	1109696(3)	
Starter, Prestolite:		
14-Volt		
28-Volt		

REFER TO GRID 1B20 FOR FOOTNOTE LEGEND

TABLE II-I. LEADING PARTICULARS AND PRINCIPLE DIMENSIONS (cont)

MODEL	PA-23-250 (six place) Ser. Nos. 27-2000 to 27-2504 incl.	PA-23-250 (six place) Ser. Nos. 27-2505 and up	PA-23-250 (six place) Ser. Nos. 27-3944 and up
ENGINE			
Manufacturer	Avco-Lycoming	Avco-Lycoming	Avco-Lycoming
Model	O-540-A1D5 or IO-540-C1B5	IO-540-C4B5 or IO-540-J4A5	TIO-540-C1A
FAA Type Certificate	295(2)/ 1E4(4)	1E4	E14EA
Rated Horsepower	250	250	250
Rated Speed:			
Full Throttle	2575 RPM	2575 RPM(5)	2575 RPM
Turbocharger Power Setting:(7)			
Turbo Cruise		2400 RPM @ 28.5 in.(6)	2400 RPM @ 34.0 in.
Oil S.A.E. Number	See Table II-V	See Table II-V	See Table II-V
Oil Sump Capacity	12 U.S. quarts	12 U.S. quarts	12 U.S. quarts
Fuel, Aviation Grade, Minimum			
Octane	91/96	91/96(5), 100/130(6)	100/130
Carburetor, Marvel-Schebler	MA-4-5(2)		
Fuel Injector Bendix	RSA-5AD1(4)	RSA-5AD1	RSA-5AD1
Magnetos, Scintilla:			
Right	S6LN-204	S6LN-204(5)/ S6LN-1209(6)	S6LN-1209
Left	S6LN-200	S6LN-200(5)/ S6LN-1208(6)	S6LN-1208
Magneto Timing	25 degrees BTC	25 degrees BTC	25 degrees BTC
Magneto Point Clearance:			
Main	.018 ± .006	.018 ± .006(5)/ .016(6)	0.016
Retard	.018 ± .006	.018 ± .006(5)	
Retard Angle		37° 30'(6)	37° 30'
Spark Plugs, Shielded:			
Champion	REM-40E	REM-40E(5)/ REB-37N(6)	REB 37N
AC	SR-88	SR-88(5)/ AC171(6)	AC171
Spark Plug Gap Setting(8)	.018 to .022	.018 to .022(5), .015 to .021(6)	.015 to .021
Firing Order	1-4-5-2-3-6	1-4-5-2-3-6	1-4-5-2-3-6
Starter, Delco-Remy:			
14-Volt	1109511	1109511	
28-Volt			
Starter, Prestolite:			
14-Volt		MZ-4218	MZ-4218
28-Volt		MHB-4010	MHB-4010

REFER TO GRID 1B20 FOR FOOTNOTE LEGEND

TABLE II-I. LEADING PARTICULARS AND PRINCIPLE DIMENSIONS (cont)

MODEL	PA-23-250	PA-23-235	PA-23-250 (six place) Ser. Nos. 27-2000 to 27-2504 incl.
ENGINE (cont)			
Generator, Delco-Remy:			
14-Volt	1101915 (50 amp)(1)(2)	1101915 (50 amp)	1101915 (50 amp)
28-Volt	1101905 (25 amp)(3)		1105055 (50 amp)
Voltage Regulator, Delco-Remy:			
14-Volt	1119246 (50 amp)(1)(2)	1119246 (50 amp)	1119246
28-Volt	1118976 (25 amp)(3)		1119656
Paralleling Relay, Delco-Remy:			
14-Volt	1116887 (50 amp)(1)(2)	1116887 (50 amp)	1116887
28-Volt	1116902 (25 amp)(3)		1116902
Alternator, Delco-Remy:			
14-Volt			
28-Volt			
Voltage Regulator, Delco-Remy:			
14-Volt			
28-Volt			
Overvoltage Relay, Delco-Remy:			
14-Volt			
28-Volt			
Alternator, Prestolite:			
14-Volt			
28-Volt			
Voltage Regulator, Prestolite:			
14-Volt			
28-Volt			
Voltage Regulator, LAMAR:			
14-Volt			
28-Volt			
OverVoltage Relay, Prestolite:			
14-Volt			
28-Volt			
Fuel Pump Drive	Plunger type	Plunger type	Plunger type

REFER TO GRID 1B20 FOR FOOTNOTE LEGEND

TABLE II-I. LEADING PARTICULARS AND PRINCIPLE DIMENSIONS (cont)

MODEL	PA-23-250 (six place) Ser. Nos. 27-2505 and up	PA-23-250 (six place) Ser. Nos. 27-3944 and up
ENGINE (cont)		
Generator, Delco-Remy:		
14-Volt		
28-Volt		
Voltage Regulator, Delco-Remy:		
14-Volt		
28-Volt		
Paralleling Relay, Delco-Remy:		
14-Volt		
28-Volt		
Alternator, Delco-Remy:		
14-Volt	1100660 or 1100717 (70 amp)	
28-Volt	1100718 (50 amp)	
Voltage Regulator, Delco-Remy:		
14-Volt	9000590	
28-Volt	9000591	
Overvoltage Relay, Delco-Remy:		
14-Volt	1115831	
28-Volt	1115832	
Alternator, Prestolite:		
14-Volt	ALX 8403 (70 amp) 14V	ALX 8403 (70 amp) 14V
28-Volt	ALU 8403 (70 amp) 28V	ALU 8403 (70 amp) 28V
Voltage Regulator, Prestolite:		
14-Volt	VSF 7203-7A	VSF 7203-7A
28-Volt	VSF 7403	VSF 7403
Voltage Regulator, LAMAR:		
14-Volt		B-00286-1 (17)
28-Volt		B-00288-1 (18)
OverVoltage Relay, Prestolite:		
14-Volt	X 17621	X 17621
28-Volt	X 17620	X 17620
Fuel Pump Drive	Plunger type (5) Lear Siegler #RG-17980 (6)	Lear Siegler #RG-17980

REFER TO GRID 1B20 FOR FOOTNOTE LEGEND

TABLE II-I. LEADING PARTICULARS AND PRINCIPLE DIMENSIONS (cont)

MODEL	PA-23-250	PA-23-235	PA-23-250 (six place) Ser. Nos. 27-2000 to 27-2504 incl.
PROPELLER			
Manufacturer	Hartzell	Hartzell	Hartzell
Type (2 blades)	Constant speed, full feathering	Constant speed, full feathering	Constant speed, full feathering
Hub, Model	HC-82XK-2C1 or HC-A2XK-2 or HC-A2VK-2	HC-A2XK-2 or HC-A2VK-2	HC-82XK-2C1 or HC-A2XK-2 or HC-A2VK-2
Blade, Model	8433-10 or 8433B-10	8433-10	8433-10 or 8433B-10
Diameter	74 in.	74 in.	74 in.
Diameter, Minimum	73 in.	73 in.	73 in.
Blade Angle, Low Pitch(9)	15.5 degrees	15.5 degrees	15.5 degrees
Blade Angle, High Pitch(9)	80 degrees (Feathered)	80 degrees (Feathered)	80 degrees (Feathered)
Governor Control	Hartzell	Hartzell	Hartzell
Governor Model	B-4	B-4	B-4

REFER TO GRID 1B20 FOR FOOTNOTE LEGEND

TABLE II-I. LEADING PARTICULARS AND PRINCIPLE DIMENSIONS (cont)

MODEL	PA-23-250 (six place) Ser. Nos. 27-2505 and up	PA-23-250 (six place) Ser. Nos. 27-3944 and up
PROPELLER		
Manufacturer	Hartzell	Hartzell
Type (2 blades)	Constant speed, full feathering	Constant speed, full feathering
Hub, Model	HC-E2YK-2RB or HC-E2YR-2RB(14)	HC-E2YR-2RB or HC-E2YK-2RB(14)
Blade, Model	8465-7R	8465-7R
Diameter	77 in.	77 in.
Diameter, Minimum	76 in.	76 in.
Blade Angle, Low Pitch(9)	14.5 degrees	15.2 degrees
Blade Angle, High Pitch(9)	80 degrees (Feathered)	80 degrees (Feathered)
Governor Control	Hartzell	Hartzell
Governor Model	F-6-5S or F-6-5A	F-6-5S or F-6-5A

REFER TO GRID 1B20 FOR FOOTNOTE LEGEND

TABLE II-I. LEADING PARTICULARS AND PRINCIPAL DIMENSIONS (cont.)

FUEL SYSTEM

Fuel Cells	Four(A)	Four(B)	Four + wing tip cells(C)
Capacity (each)	36 U.S. gals.	35 U.S. gals.	35 U.S. gals.
Wing Tip Cells (each)	—	—	20 U.S. gals.
Combined Cells (total) SEE NOTE	144 U.S. gals.	140 U.S. gals.	180 U.S. gals.

NOTE: Refer to Flight Manuals for unusable fuel per aircraft.
A. All aircraft up to serial nos. 27-7405476.
B. Aircraft with serial nos. 27-7554001 and up.
C. Aircraft with serial nos. 27-7654001 and up with optional wing tip fuel cells.

LANDING GEAR

Type	Hydraulically Retractable
Shock Strut Type	Combination Air-Oil
Fluid Required (Struts, Hydraulic System and Brakes)	MIL-H-5606(19)
Strut Exposure (Static Load)	3 in.
Wheel Tread (from each tire center)	11 ft. 4 in.
Wheel Base	7 ft. 6 in.
Wheel, Nose	Cleveland 38501
Wheel, Main	Cleveland 3080B-1(10), 3080D(11), Cleveland 40-131(15)
Brake Disc	Cleveland 37-200-2 or 37-200A(11), Cleveland 30-96(15)
Tire, Nose	600 x 6 - 4 Ply Rating or 600 x 6 - 6 Ply Rating
Tires, Main	700 x 6 - 8 Ply Rating
Tire Pressure, Nose	27 psi(20), 32 psi(21)
Tire Pressure, Main	42 psi(12), 46 psi(13)

CONTROL SURFACES AND CABLE TENSIONS

Refer to Section V, Table V-I, Grid No. 1H19.

REFER TO GRID 1B20 FOR FOOTNOTE LEGEND

FOOTNOTE LEGEND

(1) O-540-A1B5
(2) O-540-A1D5
(3) O-540-A3D5
(4) IO-540-C1B5
(5) IO-540-C4B5
(6) IO-540-J4A5
(7) TO DETERMINE FUEL CONSUMPTION FOR THESE POWER SETTINGS, REFER TO FUEL CONSUMPTION CHART IN OWNER'S HANDBOOK.
(8) SEE LYCOMING SERVICE INSTRUCTION NO. 1042.
(9) MEASURED AT 30 INCH RADIUS.
(10) SERIAL NOS. 27-1 TO 27-3737 INCL.
(11) SERIAL NOS. 27-3738 AND UP
(12) 4800 LBS. GROSS WT.
(13) 4995 LBS. AND 5200 LBS. GROSS WT.
(14) HC-E2YR-2RBS, HC-E2YK-2RBS, HC-E2YR-2RBF OR HC-E2YR-2RBSF CAN ALSO BE USED WITH THE IO-540-C4B5, TIO-540-C1A OR IO-540-J4A5 ENGINES.
(15) PA-23-250 "F" ONLY
(16) MINIMUM OCTANE: 80/87
SPECIFIED OCTANE: 80/87
ALTERNATE FUELS: REFER TO LYCOMING SERVICE LETTER NO. L185A WHEN USING OTHER THAN SPECIFIED OCTANE FUELS FOR ADDITIONAL INFORMATION AND SERVICE PROCEDURES.
(17) LAMAR 14-VOLT VOLTAGE REGULATOR B-00288-1 APPLIES TO AIRCRAFT WITH SERIAL NOS. 27-4794 TO 27-7405476 INCLUSIVE.
(18) LAMAR 28-VOLT VOLTAGE REGULATOR B-00286-1 APPLIES TO AIRCRAFT WITH SERIAL NOS. 27-4801 AND UP.
(19) SEE CONSUMABLE MATERIALS TABLE.
(20) PRESSURE FOR 600 x 6 - 4 PLY TIRE
(21) PRESSURE FOR 600 x 6 - 6 PLY TIRE

TABLE II-II. CONSUMABLE MATERIALS

Material	Specification	Product	Manufacturer
Alcohol	MC200		* See Note 1
Anti-Seize Compound	TT-A-580 (TT-S-1732)	Armite	Armite Laboratories
Cartridge. Engine Oil Filter		P/N AC6435683	A.C. Spark Plug Division, General Motors Corp. Flint, MI
Cement		EC-678	Minnesota Mining Co. St. Paul, MN
		EC-1300L	Minnesota Mining Co. St. Paul, MN
		3230	Uniroyal Mishawaka, IN 46455
		A-56-B	B.F. Goodrich Co. Akron, OH
Cement, Carbolene Neoprene		F-1	
Cleaner, Air Filter		D-1400	Donaldson Co., Inc. 1400 W. 94th St. Minneapolis, MN 55431
Cleaner, Plastic Window			* See Note 1
Cloth, Crocus	Federal Spec. P-C-458		* See Note 1
Compound, Sealing		EC-801	Minnesota Mining Co. St. Paul. MN
Dry Lubricant		MS-122AD	Miller-Stephenson George Washington Hwy. Danbury, CT 06810 PH: 203-743-4447 www.miller-stephenson.com
Film, Vinyl Chloride Copolymer	48 Gauge, Type B	Saran Wrap	* See Note 1
Fluid, Anti-icing	MIL-F-566		
Fluid, Detector		Type CD-l Solution	
Fluid, Hydraulic	MIL-PRF-5606H	PED3337	Standard Oil, 225 Bush St. San Francisco, CA 94120

* Refer to Grid 1B23 for Notes

TABLE II-II. CONSUMABLE MATERIALS (cont.)

Material	Specification	Product	Manufacturer
Flux, Welding	Type I, Type B No. 16GH	Solar	Solar
Flux, Solder		709	* See Note 1 Kester Solder Co. 4201 Wrightwood Ave. Chicago, IL 60639
Grease, Aircraft	MIL-PRF-23827C MIL-PRF-81322G MIL-G-21164D		*See Note 2 Royal Lubricants Co. Roseland, NJ 07936
Grease, Beacon		325	Exxon Co., Box 2180 Houston, TX 77001
Grease, Lithium Soap Base		# 1925 Molytex "O"	
Grease, Lubricating	SAE-AMS-G-4343	Cosmolube G15	E. F. Houghton and Co. P.O. Box 930 Valley Forge, PA 19482
Grease, Plug Valve, Gasoline, and Oil Resistant	SAE-AMS-G-6032		
Lubricant		Lubriplate 777	Lubriplate Lubricants 129 Lockwood St. Newark, NJ 07105
Lubricant, Bearing		No. 2	Shell Oil Co. One Shell Plaza Houston, TX 77002
Lubricant Krytox		No. 240 AB	
Lubricant, O-rings		Parker O-Lube	Parker Hannifin Corp O-Ring Division 2360 Palumbo Drive Lexington, KY 40509 859-269-2351 www.parker.com
MEK	Federal Spec. TT-M-261	#3339	Uniroyal Mishawaka, IN 46455
Naptha	TT-N-95		* See Note 1

* Refer to Grid 1B23 for Notes

TABLE II-II. CONSUMABLE MATERIALS (cont.)

Material	Specification	Product	Manufacturer
Oil		#10	
Oil, Engine	SAE J 1966		* See Note 1
Oil, Preserving	MIL-0-60XI	1010	* See Note 1
Oil, Turbo	SAE-10W-30	Automotive Multigrade	* See Note 1
Permatex, Aviation			Permatex Co., Inc. Kansas City, Kansas
Rain Repellent	FSCM 50159	REPCON	UNELKO Corporation 14425 N 79th Street Scottsdale, AZ 85260
Rivet	AN426AD3-4 MS20470AD3		* See Note 1
Rod, Stainless Steel Welding	SAE Type 309		* See Note 1
Sealant, Ribbon Dope Thread		Permacel 412	Avery International Corp. Permacel, P.O. Box 671 New Brunswick, NJ 08903-0671
Sealer		#1126	3M Center St. Paul, MN 55101
Sealer, Bead		EC1055	3M Center St. Paul, MN 55101
Solution, Stripper		M-S Stripper	Oakite Products, Inc. 50 Valley Rd. Berkley Heights, NJ 07922
Solvent, Cleaning	Federal Spec. P-S-661 MIL-S-l 8718 R7KC 120 No. 207	 Safety Solvent Lacquer Thinner Thinner	 * See Note 1 Glidden
Solvent, Dry Cleaning	Federal Spec. P-D-680		* See Note 1 Mineral spirits
Tape, Moleskin			* See Note 1

TABLE II-II. CONSUMABLE MATERIALS (cont.)

Material	Specification	Product	Manufacturer
Thread Lubricant, Oleo Stru, Air Valve	MIL-PRF-907E	Kopr-Kote	Jet Lube, Inc. P.O. Box 21258 Houston, TX 77226-1258 1-800-538-5823 www.jetlube.com
Wax, Simonize			* See Note 1
Wire, Safety	MS20995-C32 MS20995-F32 MS20995-F20 MS20995-C20 MS-20995-C41 MS-20995-NC32		* See Note 1

NOTES: 1. Purchase locally.
2. Available in small quantities.

2-6. ACCESS AND INSPECTION PROVISIONS.

The access and inspection provisions for the airplane are shown in Figures 2-6a, 2-7 and 2-8. The component to be serviced or inspected through each opening is assigned an index number to identify it in illustration. All access plates and panels are secured by either metal fasteners or screws. To enter the aft section of the fuselage, remove the rear baggage compartment upholstery panel by removing the attaching screws.

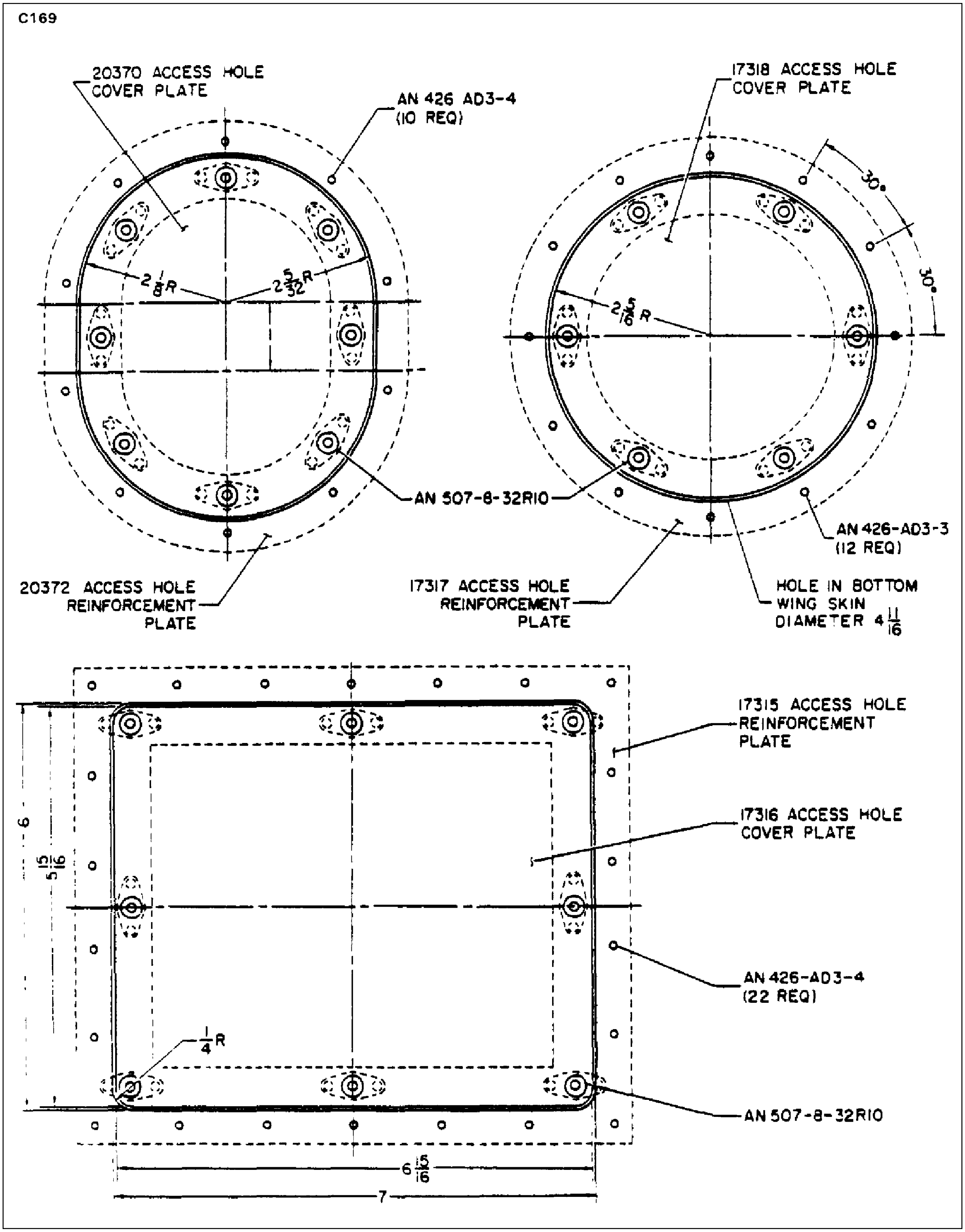
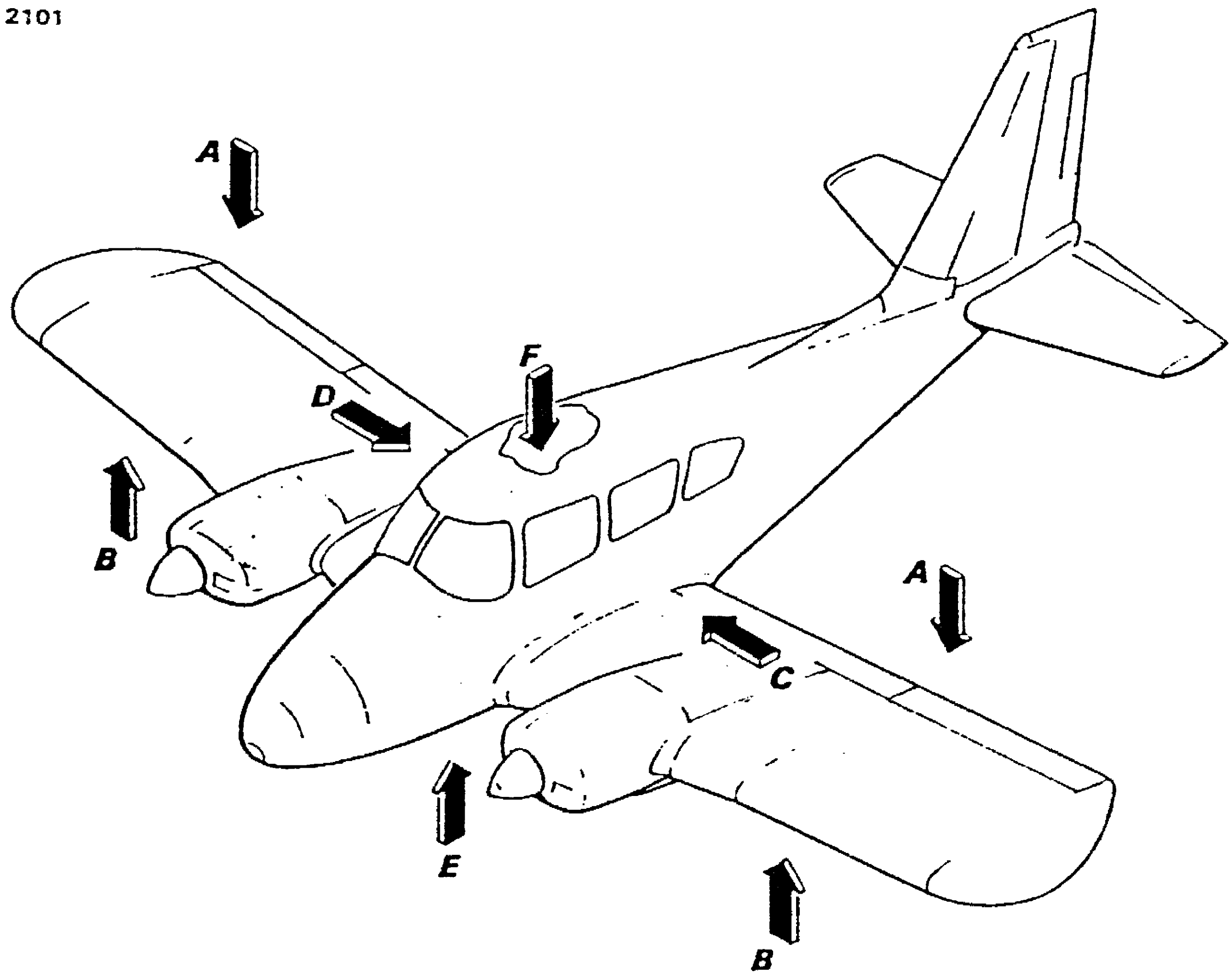


Figure 2-6a. Typical Access Plates and Panels

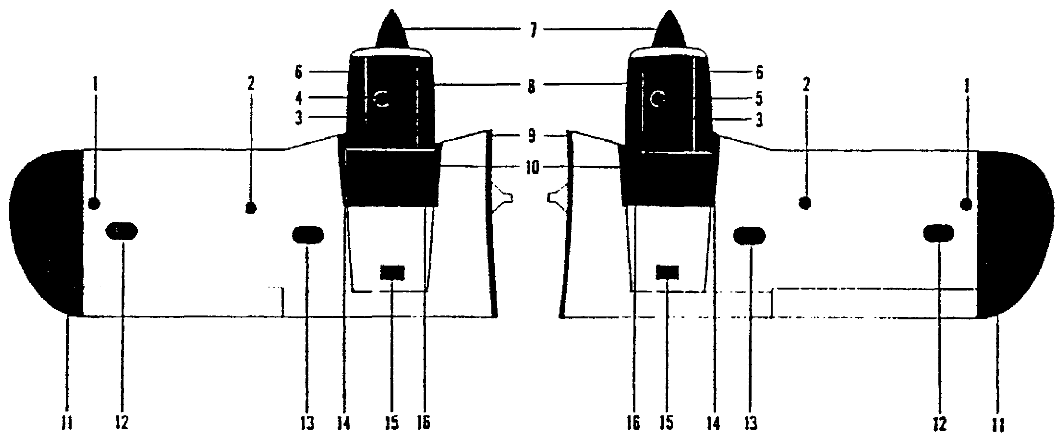


A & B = SHEET 2
C & D = SHEET 3
E & F = SHEET 4

Figure 2-7. Access Plates and Panels PA-23-235 and PA-23-250 (Sheet 1 of 4)

SKETCH A

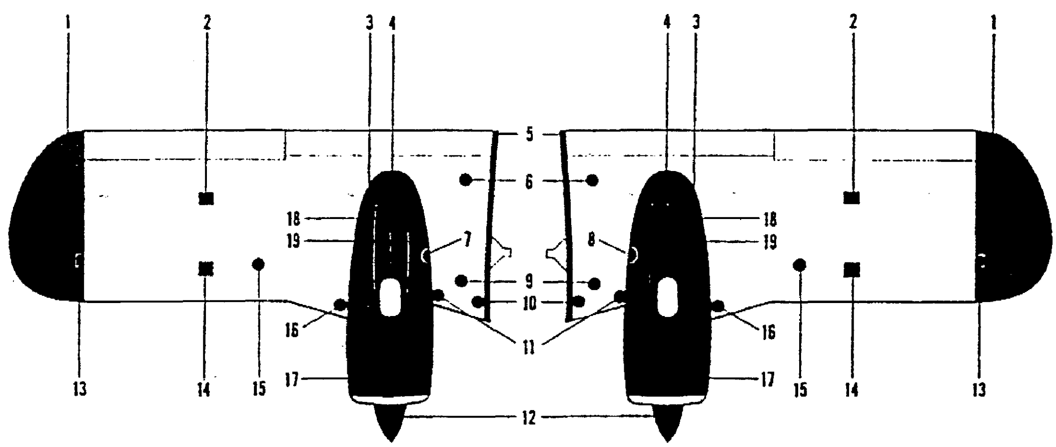
2121



1. FUEL FILLER
2. FUEL FILLER
3. ENGINE ACCESS, TOP
4. OIL FILLER
5. OIL FILLER
6. ENGINE ACCESS, OUTBOARD
7. PROPELLER
8. ENGINE ACCESS, INBOARD
9. WIRING, CONTROL CABLES, LINE FITTINGS, WING ATTACHMENTS
10. NACELLE FAIRING
11. WING TIP
12. FUEL SENDER AND CELL
13. FUEL SENDER AND CELL
14. NACELLE FAIRING
15. ENGINE SUPPORT
16. ELECTRIC FUEL PUMP, VACUUM REGULATOR

SKETCH B

2120

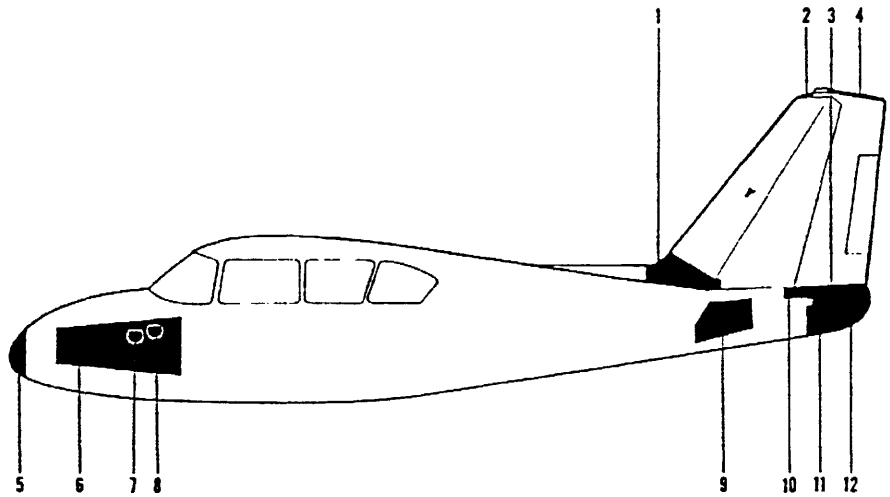


1. WING TIP
2. FUEL VENT LINE
3. FUEL CELL OUTLET LINE
4. FUEL SELECTOR, FUEL STRAINER
5. WIRING, CONTROL CABLES, LINE FITTINGS, WING ATTACHMENTS
6. INSPECTION
7. FUEL STRAINER
8. FUEL STRAINER
9. FUEL LINES, FUEL CONTROL CABLES, AILERON CABLES
10. DEICER LINES
11. FUEL LINES, FUEL CONTROL CABLES
12. PROPELLER
13. FUEL VENT LINE, TIP HINGE
14. AILERON BELLCRANK
15. AILERON CONTROL CABLES
16. PITOT LINE (LEFT WING ONLY), INSPECTION
17. ENGINE ACCESS, BOTTOM
18. LANDING GEAR
19 LANDING GEAR

Figure 2-7. Access Plates and Panels PA-23-235 and PA-23-250 (Sheet 2 of 4)

2123

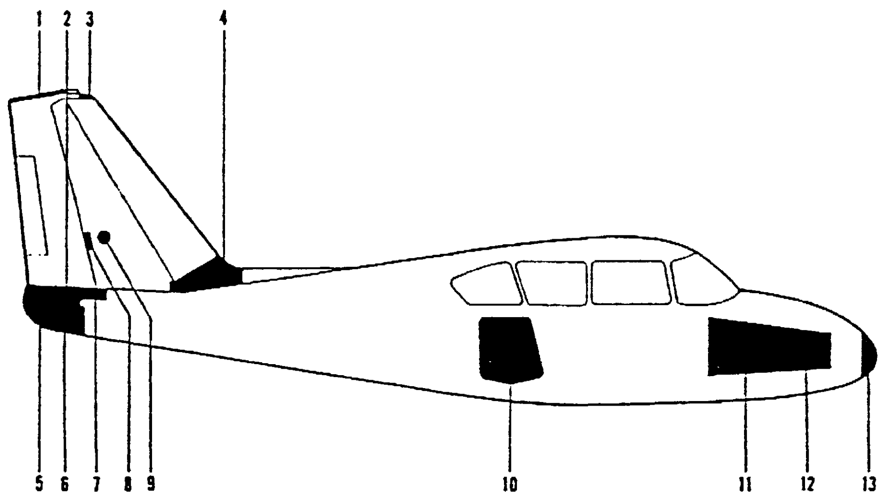
SKETCH C



1. TRIM INDICATOR WIRE, ANTENNA CONNECTOR
2. FIN RIB
3. STABILATOR TORQUE TUBE
4. ROTATING BEACON
5. LANDING LIGHT
6. HEATER, WIRING, MISC. FLUID AND AIR LINES
7. BRAKE RESERVOIR
8. POWERPAK FILLER TUBE
9. CONTROL CABLES AND PULLEYS
10. RUDDER HORN
11. STABILATOR TRIM MECHANISM
12. STABILATOR TRIM ROD

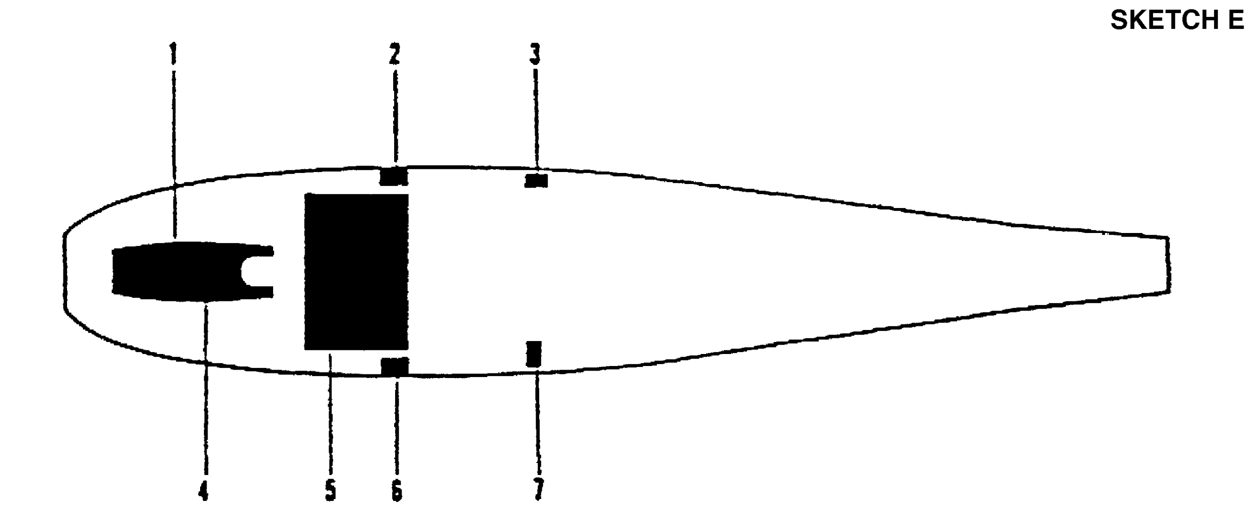
2124

SKETCH D



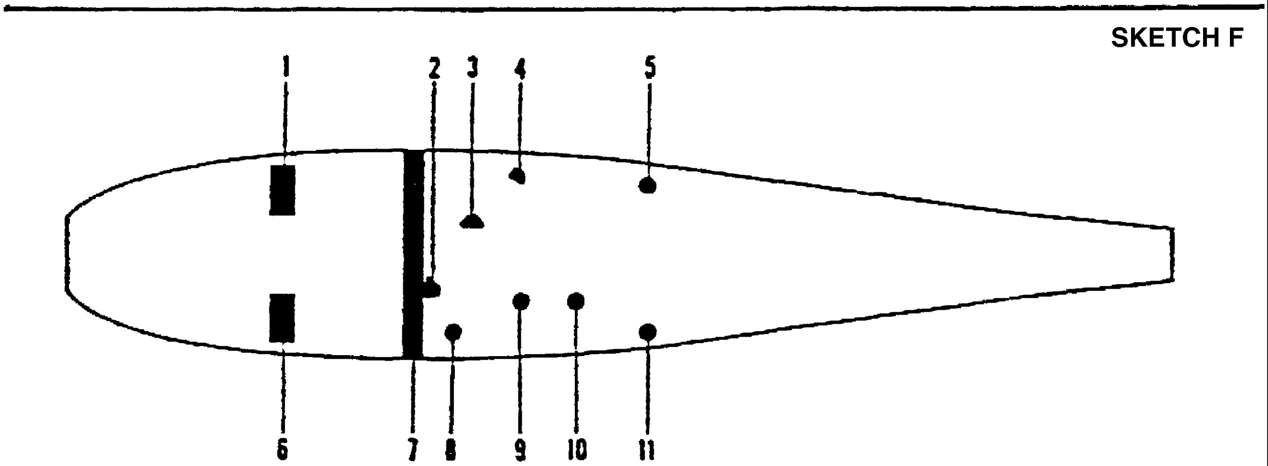
1. ROTATING BEACON
2. STABILATOR TORQUE TUBE
3. FIN RIB
4. TRIM INDICATOR WIRE, ANTENNA CONNECTOR
5. STABILATOR TRIM ROD
6. STABILATOR TRIM MECHANISM
7. RUDDER HORN
8. RUDDER TRIM ROD
9. RUDDER TRIM DRUM
10. BAGGAGE AREA
11. RUDDER PEDALS, CONTROL CABLES, HYDRAULIC LINES, WIRING
12. BATTERY
13. LANDING LIGHT

Figure 2-7. Access Plates and Panels PA-23-235 and PA-23-250 (Sheet 3 of 4)



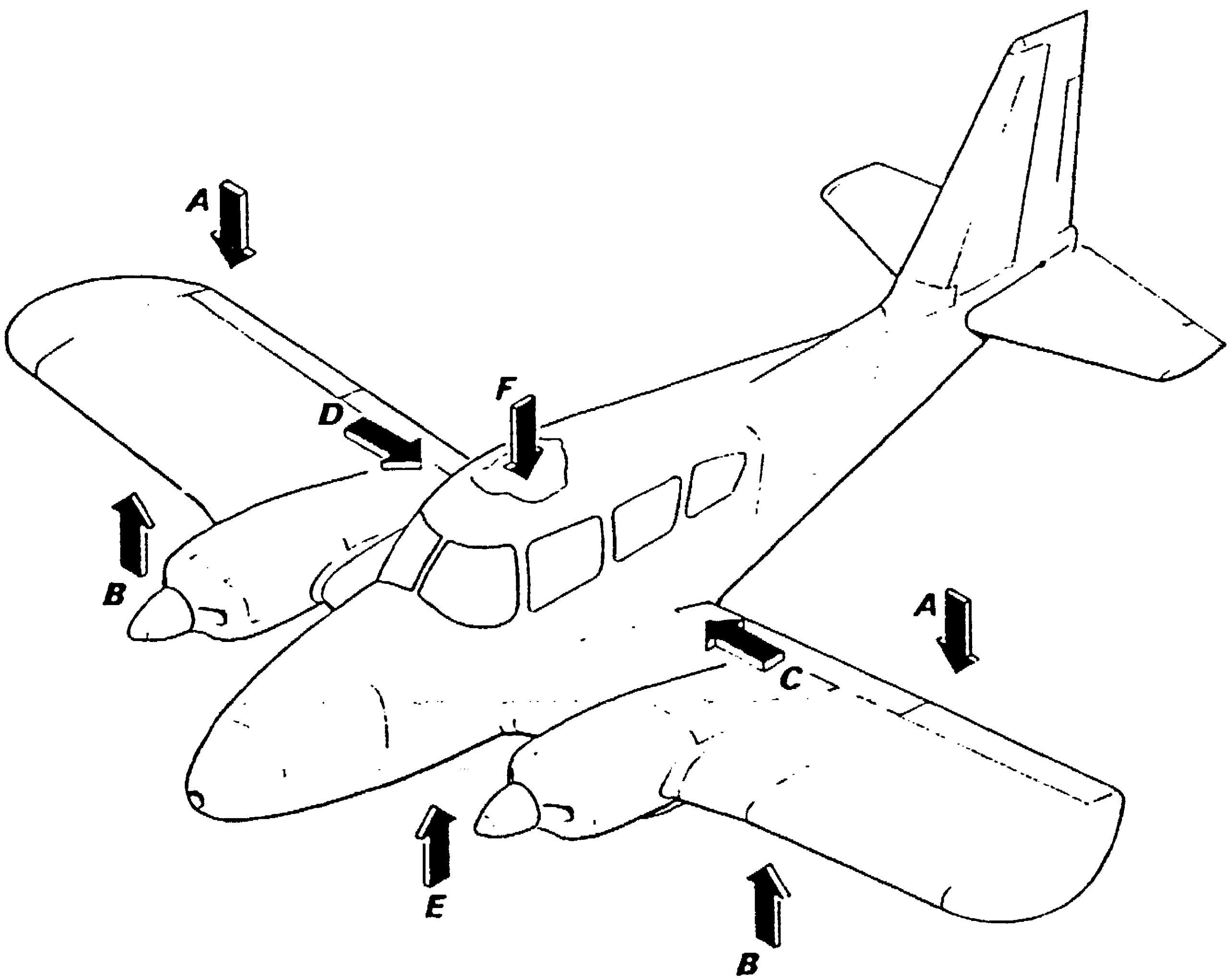
1. LANDING GEAR
2. WING ATTACHMENT
3. FLAP MECHANISM
4. LANDING GEAR
5. CONTROL CABLES, LINE FITTINGS, WIRING, WING ATTACHMENT
6. WING ATTACHMENT
7. FLAP MECHANISM

2122



1. AILERON PULLEY AND CABLE
2. TRIM SENSOR, ALTIMATIC II
3. INSPECTION
4. FLAP SENDER
5. RUDDER CABLES
6. AILERON PULLEY AND CABLE
7. MAIN SPAR
8. RUDDER CABLE AND PULLEY
9. STABILATOR CABLES AND PULLEYS
10. STABILATOR CABLES AND PULLEYS
11. RUDDER CABLE AND PULLEY

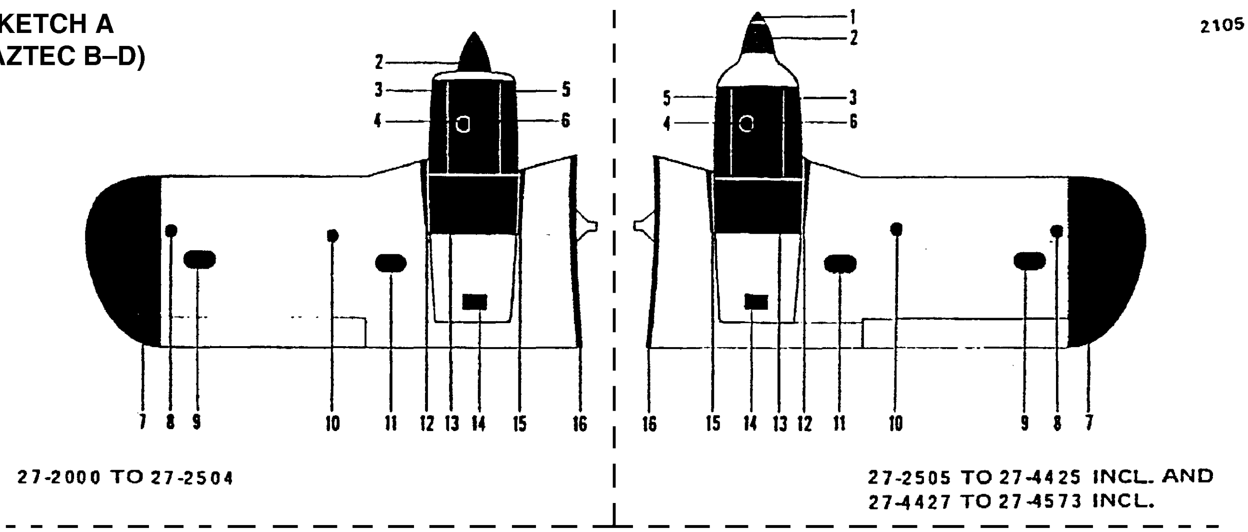
Figure 2-7. Access Plates and Panels PA-23-235 and PA-23-250 (Sheet 4 of 4)



A & B = SHEET 2 (AZTEC B–D)
SHEET 3 (AZTEC E AND LATER)
C & D = SHEET 4
E & F = SHEET 5

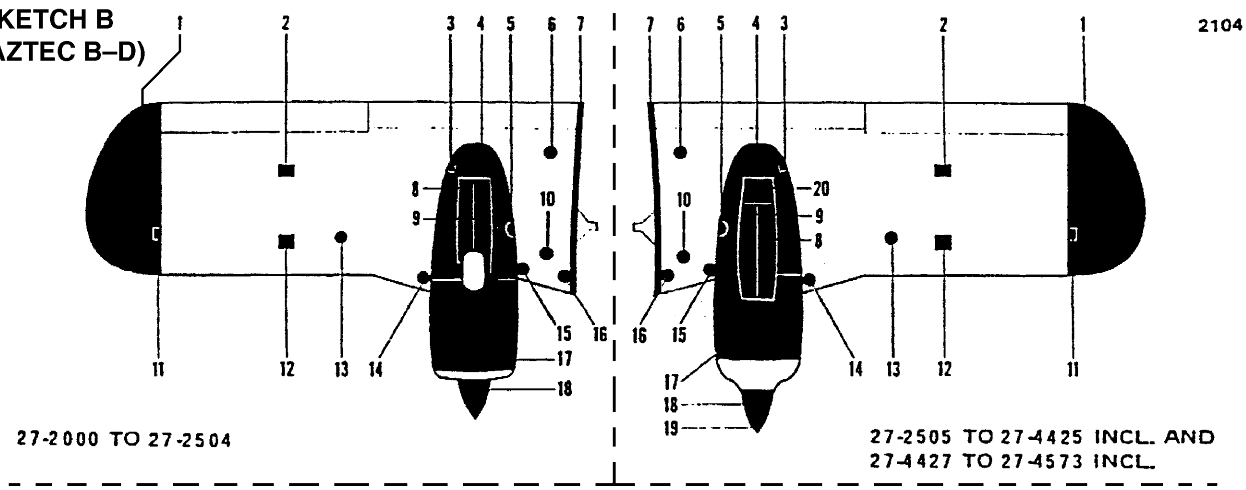
Figure 2-8. Access Plates and Panels PA-23-250 (six place) (Sheet 1 of 5)

SKETCH A
(AZTEC B–D)



1. PROPELLER RECHARGE VALVE
2. PROPELLER
3. ENGINE ACCESS, OUTBOARD
4. OIL FILLER
5. ENGINE ACCESS, INBOARD
6. ENGINE ACCESS, TOP
7. WING TIP
8. FUEL FILLER
9. FUEL SENDER AND CELL
10. FUEL FILLER
11. FUEL SENDER AND CELL
12. NACELLE FAIRING
13. ELECTRIC FUEL PUMP, VACUUM REGULATOR, AILERON CONTROL CABLES, LANDING GEAR ACTUATING CYLINDER AND ROLL SERVO (LEFT NACELLE ONLY)
14. ENGINE SUPPORT
15. NACELLE FAIRING
16. WIRING,CONTROL CABLES, LINE FITTINGS AND WING ATTACHMENTS

SKETCH B
(AZTEC B–D)

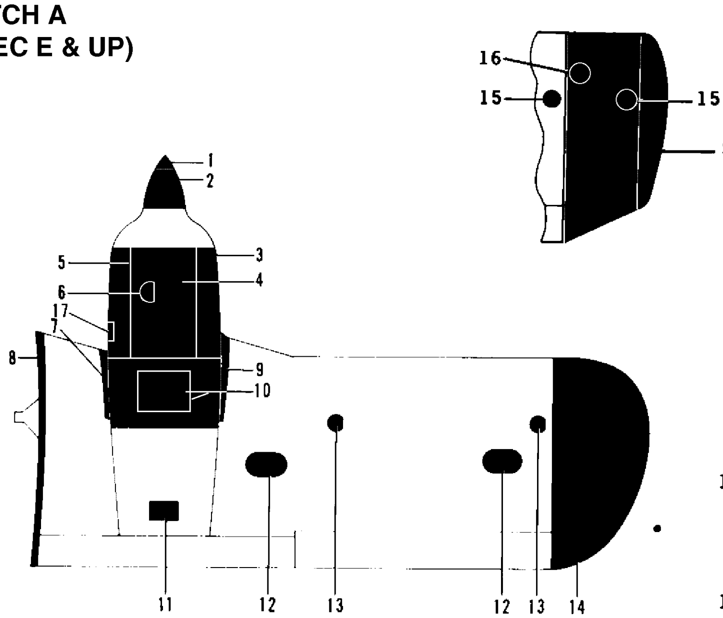


1. WING TIP
2. FUEL VENT
3. FUEL CELL OUTLET LINE
4. FUEL SELECTOR, FUEL STRAINER AND FUEL DRAINS
5. FUEL STRAINER AND FUEL DRAINS
6. INSPECTION
7. WIRING, CONTROL CABLES, LINE FITTINGS AND WING ATTACHMENTS
8. LANDING GEAR
9. LANDING GEAR
10. FUEL LINES, FUEL CONTROL CABLES AND AILERON CABLES
11. WING TIP HINGE
12. AILERON BELLCRANK
13. AILERON CONTROL CABLES
14. PITOT LI NE (LEFT WING ONLY), INSPECTION
15. ENGINE CONTROL CABLES, MISC. LINES
16. DEICER LINES
17. ENGINE ACCESS, BOTTOM
18. PROPELLER
19. PROPELLER RECHARGE VALVE
20. LANDING GEAR

Figure 2-8. Access Plates and Panels PA-23-250 (six place) (Sheet 2 of 5)

SKETCH A
(AZTEC E & UP)

A433



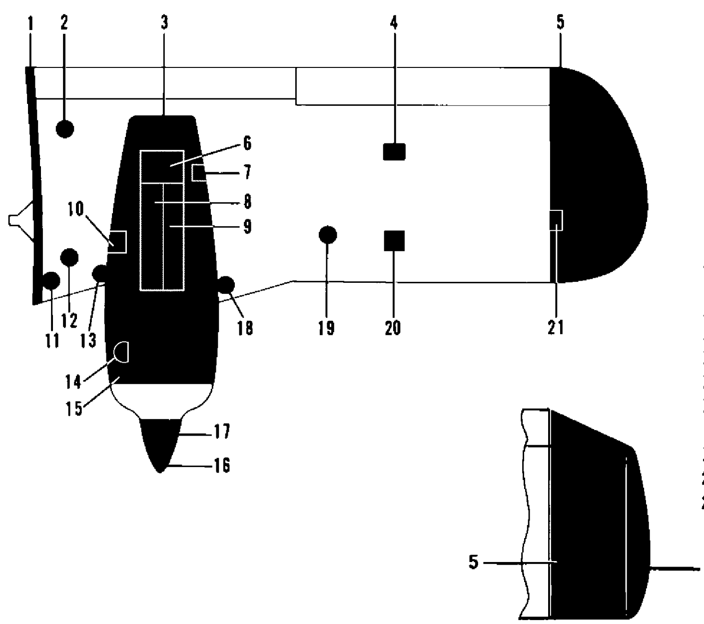
SERIAL NOS. 27-7654001 AND UP

1. PROPELLER RECHARGE VALVE
2. PROPELLER
3. ENGINE ACCESS, OUTBOARD
4. ENGINE ACCESS, TOP
5. ENGINE ACCESS, INBOARD
6. OIL FILTER
7. NACELLE FAIRING
8. WIRING, CONTROL CABLES, LINE FITTINGS, WING ATTACHMENTS
9. NACELLE FAIRING
10. ELECTRIC FUEL PUMP, VACUUM REGULATOR, AILERON CONTROL CABLES, LANDING GEAR ACTUATING CYLINDER, AND ROLL SERVO (LEFT NACELLE ONLY)
11. ENGINE SUPPORT
12. FUEL SENDER AND CELL
13. FUEL FILLER
14. WING TIP
15. FUEL FILLER OR ACCESS COVER
16. FUEL SENDER OR ACCESS COVER
17. OIL COOLER VENT

27–4426 AND 27–4574 AND UP

SKETCH B
(AZTEC E & UP)

1. WIRING, CONTROL CABLES, LINE FITTINGS, WING ATTACHMENTS
2. INSPECTION
3. FUEL SELECTOR, FUEL STRAINER, FUEL DRAINS
4. FUEL VENT
5. WING TIP
6. LANDING GEAR
7. FUEL CELL OUTLET LINE
8. LANDING GEAR
9. LANDING GEAR
10. FUEL STRAINER
11. DEICER LINES
12. FUEL LINES, FUEL CONTROL CABLES, AILERON CABLES
13. ENGINE CONTROL CABLES, MISC. LINES
14. ENGINE
15. ENGINE ACCESS, BOTTOM
16. PROPELLER RECHARGE VALVE
17. PROPELLER
18. PITOT LINE (LEFT WING ONLY), INSPECTION
19. AILERON CONTROL CABLES
20. AILERON BELLCRANK
21. WING TIP HINGE



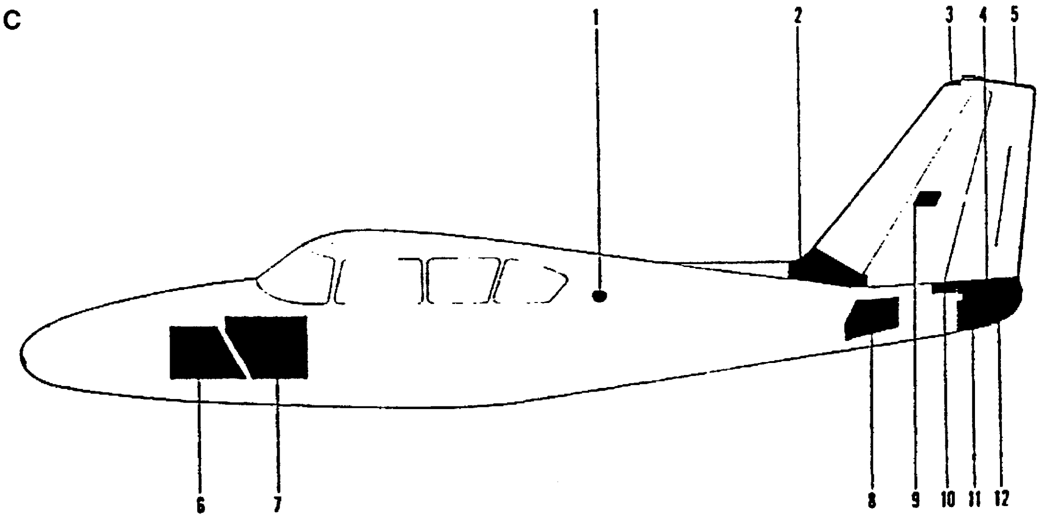
SERIAL NOS. 27-7654001 AND UP

A434

Figure 2-8. Access Plates and Panels PA-23-250 (six place) (Sheet 3 of 5)

2102

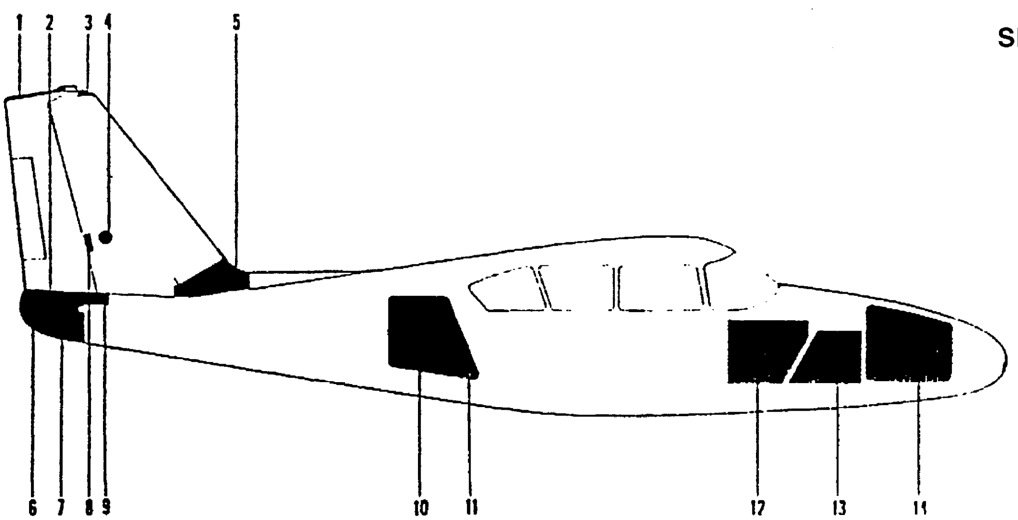
SKETCH C



1. OXYGEN FILLER
2. TRIM INDICATOR WIRE
3. FIN RIB
4. STABILATOR TORQUE TUBE
5. ROTATING BEACON
6. HEATER
7. BRAKE RESERVOIR AND POWER PACK FILLER TUBE
8. CONTROL CABLES AND PULLEYS
9. FLUX SENSOR, SERIAL NOS. 27-7505446, 27-7505456 AND UP
10. RUDDER HORN
11. STABILATOR TRIM MECHANISM
12. STABILATOR TRIM ROD

2103

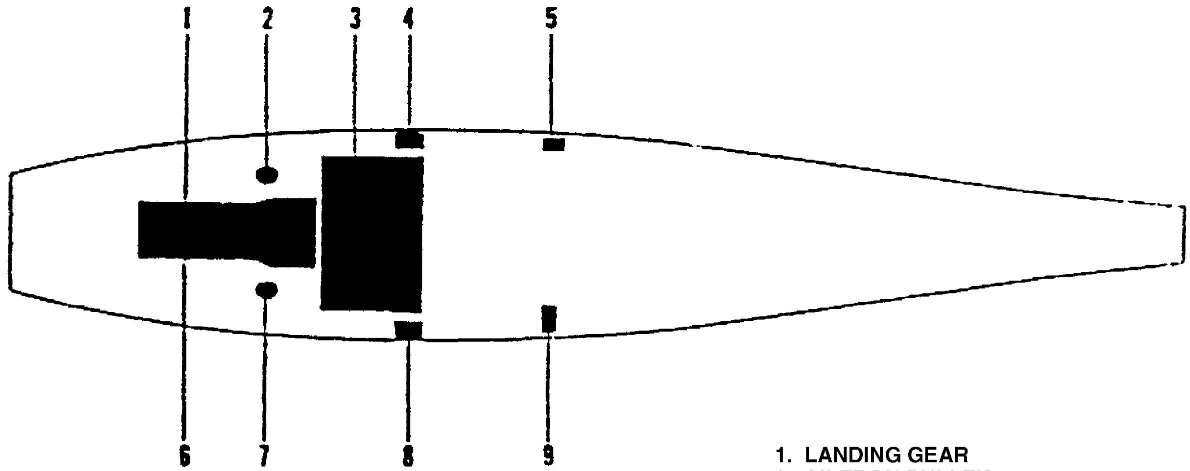
SKETCH D



1. ROTATING BEACON
2. STABILATOR TORQUE TUBE
3. FIN RIB
4. RUDDER TRIM DRUM
5. TRIM INDICATOR WIRE
6. STABILATOR TRIM ROD
7. STABILATOR TRIM MECHANISM
8. RUDDER TRIM ROD
9. RUDDER HORN
10. BAGGAGE DOOR, SERIAL NOS. 27-2000 THRU 27-3050, 27-3052 THRU 27-3153
11. BAGGAGE DOOR, SERIAL NOS. 27-3154 AND UP
12. RUDDER PEDALS, CONTROL CABLES AND HYDRAULIC LINES
13. BATTERY
14. BAGGAGE AREA, ELECTRONICS

Figure 2-8. Access Plates and Panels PA-23-250 (six place) (Sheet 4 of 5)

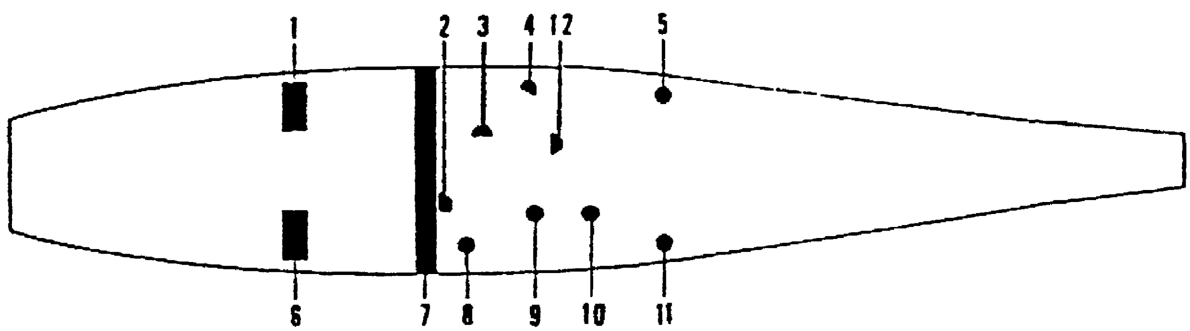
SKETCH E



1. LANDING GEAR
2. AILERON PULLEY
3. CONTROL CABLES, LINE FITTINGS, WIRING AND WING ATTACHMENT
4. WING ATTACHMENT
5. FLAP MECHANISM
6. LANDING GEAR
7. HEATER DUCTS
8. WING ATTACHMENT
9. FLAP MECHANISM

2100

SKETCH F



1. AILERON PULLEY AND CABLE
2. TRIM SENSOR, ALTIMATIC II
3. INSPECTION
4. FLAP SENDER
5. RUDDER CABLES
6. AILERON PULLEY AND CABLE
7. MAIN SPAR
8. RUDDER CABLE AND PULLEY
9. STABILATOR CABLES AND PULLEYS
10. STABILATOR CABLES AND PULLEYS
11. RUDDER CABLE AND PULLEY
12. STABILATOR TRIM & FLAP INTERCONNECT CABLES & PULLEYS, SERIAL NOS. 27-7654001 AND UP

Figure 2-8. Access Plates and Panels PA-23-250 (six place) (Sheet 5 of 5)

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2-7. TOOLS AND TEST EQUIPMENT.

Because of the simplicity and easy accessibility of components, few special tools outside normal shop tools will be required. Tools that are required may be fabricated from dimensions given in the section that pertains to a particular component or are listed in the back of the Aztec Parts Catalog.

2-7A. THREADED FASTENER INSTALLATION (PIR-PPS20015-1, Rev. U.)

a. Fastener Lengths

Fastener lengths must be long enough to prevent bearing loads on threads. The complete chamfer or end radius of the fastener or screw must extend through the nut.

The specified fastener grip length can be varied by one size (longer or shorter) to meet requirements stated above.

b. Washer Usage

Add a maximum of two NAS1149 washers (of the correct diameter, material and finish that matches the fastener being installed) under fastener heads or nuts to correct for variations in material thickness within the tolerances permitted. Where needed, use a maximum of two standard filler washers (spacers) under the nut to adjust for fastener length or alignment of cotter key hole. Where nutplates are used, adjust for protruding head fastener length by using up to a maximum of two standard filler washers under the fastener head.

c. Self-locking Fasteners

The use of self-locking nuts, fasteners and screws, including fasteners with non-metallic inserts is subject to the following limitations:

1. Fasteners incorporating self-locking devices must not be re-used if they can be run up using less than the required minimum torque values specified or as shown in Table II-III. They may be reused, if hand tools are required to run them up, providing there is no obvious damage to the self-locking device prior to installation.
2. Fasteners 5/16 inch diameter and over with cotter pin holes may be used with self-locking nuts. Nuts with non-metallic locking devices may be used in this application only if the fasteners are free from burrs around the cotter pin holes.
3. Self-locking nuts must not be used at joints which subject either the nut or the fastener to rotation.
4. Self-locking fasteners shall never be tapped or rethreaded. Nuts, fasteners and screws with damaged threads or rough ends shall not be used, or rethreaded.

d. Torque

See Torque Wrenches and Torque Requirements, below.

2-8. TORQUE REQUIREMENTS

(PIR-PPS20015-1, Rev. U.)

CAUTION: DO NOT OVERTORQUE FITTINGS.

Table II-III lists the torque values for flared fittings of various sizes and material.

NOTE: When installing flared fittings, verify that male threads are properly lubricated.

The torque values given in Table II-IV are derived from oil-free cadmium-plated threads and are recommended for all airframe installation procedures where torquing is required, unless other values are specified in subject chapter/section. Engine torque values are found in the latest revision of Lycoming Service Table of Limits SSP-1776; and propeller torque values are found in Section VII or VIIA.

NOTE: If normal operation requires movement between any of the components being clamped together, tighten the nut (or bolt) enough to ensure intended operation of the assembly.

a. Calibrate the torque wrench periodically to assure accuracy, and recheck frequently.

b. If the fastener, screw, or nut is listed in Table II-IV, but the mating fastener is not listed, tighten only to the low end of the torque range specified for the listed fastener. In addition, the following limitations shall apply:

1. Fastener and nut threads shall be clean and dry (free of lubricants). If the subject chapter/section requires the fastener and/or nut to be lubricated prior to tightening and does not specify a torque requirement, use the Table II-IV torque range reduced 50 percent.

2. Table II-IV, Sheet 1, shall be used for free running nuts, provided minimal friction drag is determined as specified below.

TABLE II-III. FLARE FITTING TORQUE VALUES

Torque — Inch-Pounds						
Tubing OD Inches	Aluminum - Alloy Tubing Flare - and 10061 or 10078		Steel Tubing Flare and 10061		Hose End Fitting and Hose Assemblies	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
1/8	—	—	—	—	—	—
3/16	—	—	90	100	70	100
1/4	40	65	135	150	70	120
5/16	60	80	180	200	85	180
3/8	75	125	270	300	100	250
1/2	150	250	450	500	210	420
5/8	200	350	650	700	300	480
3/4	300	500	900	1000	500	850
1	500	700	1200	1400	500	1150
1-1/4	600	900	—	—	—	—
1-1/2	600	900	—	—	—	—
1-3/4	—	—	—	—	—	—
2	—	—	—	—	—	—

3. The friction drag torque can be determined as follows: Run the nut down to near contact (but not in contact) with the bearing surface and check the "friction drag torque" required to turn the nut.

   NOTE: Check the friction drag torque by attaching a scale type torque wrench to the nut and determining the torque required to turn the nut on the bolt. (Before the nut makes contact with the bearing surface.)

4. The friction drag torque (if any) shall be added to the desired torque specified in Table II-IV, Sheet 1. This final torque should register on the indicator or be the setting for a snap-over torque limiting device.
5. Torque requirements do not apply to cross recessed or slotted screws or to fasteners installed into rivnuts, pressnuts or other nuts not designed to rotate for wrenching at the fastener unless otherwise specified in the subject chapter/section.
6. Fasteners listed in Table II-IV installed into nutplates, and which are accessible to be torqued at the fastener, must be tightened to the low end of the torque range specified in the appropriate “shear” column. Torque requirements do not apply if the fastener can not be torqued due to torque device accessibility.

   NOTE: When the fastener is stationary and the nut is torqued, use the lower side of the torque range.

   When the nut is stationary and the fastener is torqued, use the higher side of the torque range. In this case, ensure one (1) washer is installed under the head as follows:

   (a) If the subject chapter/section does not specify the use of a washer under the head, install one (1) NAS1149 .032 thick washer under the head. If additional washers are required under nut to adjust for grip length variation as described under Threaded Fastener Installation above: reduce them .032 to allow for the additional .032 washer now installed under head. Check to ensure threads are not bearing loads, due to the added .032 washer thickness.
   (b) All added washers are to be of the correct diameter, material and finish that matches the fastener being installed.

7. Apply a smooth even pull when applying torque pressure. If chattering or a jerking motion occurs during final torque, back off and re-torque.
8. When installing a castellated nut, start alignment with the cotter pin hole at minimum recommended torque, and do not exceed maximum recommended torque. If the hole in the fastener shank and the nut castellation do not align within this range, change washers and try again. Do not exceed the maximum recommended torque. If self-locking castellated nuts are used, include friction drag torque.
9. Unless otherwise specified in the subject chapter/section, when castellated nuts are used with a cotter pin on moving joints, the nut shall not be torqued to Table II-IV values. Nuts shall be tightened to remove looseness in the joint and then the cotter pin installed.

c. Gap Conditions Between Parts Attached with Threaded Fasteners

If a gap condition exists between mating parts where a threaded fastener is to be installed, install fasteners and associated hardware per subject chapter/section or to buildup noted during removal. Then, torque to a value 10% of the final torque required plus the friction drag torque.

For example, if Table II-IV, Sheet 2, torque is 190 in.-lbs. and the friction drag torque of the nut is 80 in.-lbs. (i.e. - Table II-IV, Sheet 2, torque minus Table II-IV, Sheet 1, torque), torque to a value of:

Maximum Permissible
Gap Closing Torque = (Table II-IV, Sheet 1, torque x .10) + (Sheet 2 - Sheet 1) torque

Example: 3/8-24 (190 x .10) + (270-190) = 19 + 80 = 99 in.-lbs.

Accomplish this for all fasteners common to the gapped interface. If no gap exists after accomplishing the above, finish torquing to final torque. If a gap remains consult your Piper Dealer's Service Advisor (DSA) for further assistance.

d. After the final torque, apply a slippage mark to the nut or bolt or screw head as applicable.

NOTE: For more details on torquing, refer to FAA AC 43.13-1, latest revision.

TABLE II-IV. RECOMMENDED NUT TORQUES (SHEET 1 OF 2)

Bolts - Steel		Bolts - Aluminum
AN 3 thru AN 20 AN 42 thru AN 49 AN 525 MS 20033 thru MS 20046 MS 20073 MS 20074 MS 24694 MS 27039	MS 20004 NAS 333 thru NAS 340 NAS 464 NAS 624 thru NAS 644 NAS 1580 NAS 6203 thru NAS 6220 NAS 6603 thru NAS 6620 NAS 6703 thru NAS 6720	AN 3DD Series

Nuts - Steel				Nuts - Aluminum	
Tension	Shear	Tension	Shear	Tension	Shear
AN 310 AN 315 MS 20365 MS 21042 MS 21044 MS 21045 NAS 679	AN 320 MS 20364 MS 21083 MS 21245	AN 310 AN 315 MS 20365 MS 21042 MS 21044 MS 21045 NAS 679	AN 320 MS 20364 MS 21083 MS 21245	AN 310D AN 315D	AN 320D

FINE THREAD SERIES - ADD FRICTION DRAG

Nut-Bolt Size	Torque Limits In.-Lbs.		Torque Limits In.-Lbs.		Torque Limits In.-Lbs.		Torque Limits In.-Lbs.		Torque Limits In.-Lbs.		Torque Limits In.-Lbs.	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
8-36	12	15	7	9					5	10	3	6
10-32	20	25	12	15	25	30	15	20	10	15	5	10
1/4-28	50	70	30	40	80	100	50	60	30	45	15	30
5/16-24	100	140	60	85	120	145	70	90	40	65	25	40
3/8-24	160	190	95	110	200	250	120	150	75	110	45	70
7/16-20	450	500	270	300	520	630	300	400	180	280	110	170
1/2-20	480	690	290	410	770	950	450	550	280	410	160	260
9/16-18	800	1,000	480	600	1,100	1,300	650	800	380	580	230	360
5/8-18	1,100	1,300	660	780	1,250	1,550	750	950	550	670	270	420
3/4-16	2,300	2,500	1,300	1,500	2,650	3,200	1,600	1,900	950	1,250	560	880
7/8-14	2,500	3,000	1,500	1,800	3,550	4,350	2,100	2,690	1,250	1,900	750	1,200
1-14	3,700	4,500	2,200	3,300	4,500	5,500	2,700	3,300	1,600	2,400	950	1,500
1-1/8-12	5,000	7,000	3,000	4,200	6,000	7,300	3,600	4,400	2,100	3,200	1,250	2,000
1-1/4-12	9,000	11,000	5,400	6,600	11,000	13,400	6,600	8,000	3,900	5,600	2,300	3,650

COARSE THREAD SERIES - ADD FRICTION DRAG

Nut-Bolt Size	Torque Limits In.-Lbs.		Torque Limits In.-Lbs.	
	Min.	Max.	Min.	Max.
8-32	12	15	7	9
10-24	20	25	12	15
1/4-20	40	50	25	30
5/16-18	80	90	48	55
3/8-16	160	185	95	110
7/16-14	235	255	140	155
1/2-13	400	480	240	290
9/16-12	500	700	300	420
5/8-11	700	900	420	540
3/4-10	1,150	1,600	700	950
7/8-9	2,200	3,000	1,300	1,800
1-8	3,700	5,000	2,200	3,000
1-1/8-8	5,500	6,500	3,300	4,000
1-1/4-8	6,500	8,000	4,000	5,000

NOTE: Unless otherwise specified, torque size No. 6 screws used with self-locking nutplates to no greater than 4 to 5 in.-lbs.

Use an appropriately calibrated driver.

TABLE II-IV. RECOMMENDED NUT TORQUES (SHEET 2 OF 2)

	Bolts - Steel								**Bolts - Aluminum**			
	AN 3 thru AN 20 AN 42 thru AN 49 AN 525 MS 20033 thru MS 20046 MS 20073 MS 20074 MS 24694 MS 27039				MS 20004 NAS 333 thru NAS 340 NAS 464 NAS 624 thru NAS 644 NAS 1580 NAS 6203 thru NAS 6220 NAS 6603 thru NAS 6620 NAS 6703 thru NAS 6720				AN 3DD Series			
	Nuts - Steel								**Nuts - Aluminum**			
	Tension		**Shear**		**Tension**		**Shear**		**Tension**		**Shear**	
	AN 310 AN 315 MS 20365 MS 21042 MS 21044 MS 21045 NAS 679		AN 320 MS 20364 MS 21083 MS 21245		AN 310 AN 315 MS 20365 MS 21042 MS 21044 MS 21045 NAS 679		AN 320 MS 20364 MS 21083 MS 21245		AN 310D AN 315D		AN 320D	
FINE THREAD SERIES - INCLUDES FRICTION DRAG												
Nut-Bolt Size	**Torque Limits In.-Lbs.**		**Torque Limits In.-Lbs.**		**Torque Limits In.-Lbs.**		**Torque Limits In.-Lbs.**		**Torque Limits In.-Lbs.**		**Torque Limits In.-Lbs.**	
	Min.	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**
10-32	38	43	30	33	43	48	33	38	28	33	23	28
1/4-28	65	100	60	70	110	130	80	90	60	75	45	60
5/16-24	160	200	120	145	180	205	130	150	100	125	85	100
3/8-24	240	270	175	190	280	330	200	230	155	190	125	150
7/16-20	550	600	370	400	620	730	400	500	280	380	210	270

COARSE THREAD SERIES - INCLUDES FRICTION DRAG				
Nut-Bolt Size	**Torque Limits In.-Lbs.**		**Torque Limits In.-Lbs.**	
	Min.	**Max.**	**Min.**	**Max.**
8-32	27	30	22	24
10-24	38	43	30	33
1/4-20	70	80	55	60
5/16-18	140	150	108	115
3/8-16	240	265	175	190
7/16-14	335	355	240	255

NOTE: Unless otherwise specified, torque size No. 6 screws used with self-locking nutplates to no greater than 4 to 5 in.-lbs.

Use an appropriately calibrated driver.

2-9. TORQUE WRENCHES

Torque wrenches should be checked daily and calibrated by means of weights and a measured lever arm to ensure that inaccuracies are not present. Checking one torque wrench against another is not sufficient and is not recommended. Some wrenches are quite sensitive to the way they are supported during a tightening operation. Any instructions furnished by the manufacturer must be followed explicitly.

When it is necessary to use a special extension or adapter wrench together with a torque wrench, a simple mathematical equation must be worked out to arrive at the correct torque reading. Following is the formula to be used: (Refer to Figure 2-9.)

T = Torque desired at the part.

A = Basic lever length from center of wrench shank to center of handle or stamped on wrench or listed for that model wrench.

B = Length of adapter extension, center of bolt to center of shank.

C = Scale reading needed to obtain desired torque (T).

The formula: $$C = \frac{A \times T}{A + B}$$

EXAMPLE: A bolt requires 30 foot pounds and a 3 inch adapter (one-quarter of a foot or 0.25') is needed to get at it. You want to know what scale reading it will take on a one-foot lever arm wrench to obtain the 30 foot pounds at the bolt.

$$C = \frac{1 \times 30}{1 + 0.25} \quad \text{or} \quad C = \frac{30}{1.25}$$

Remember, the 3 inch adapter must be projecting 3 inches straight along the wrench axis. In general, avoid all complex assemblages or adapters and extensions of flex joints.

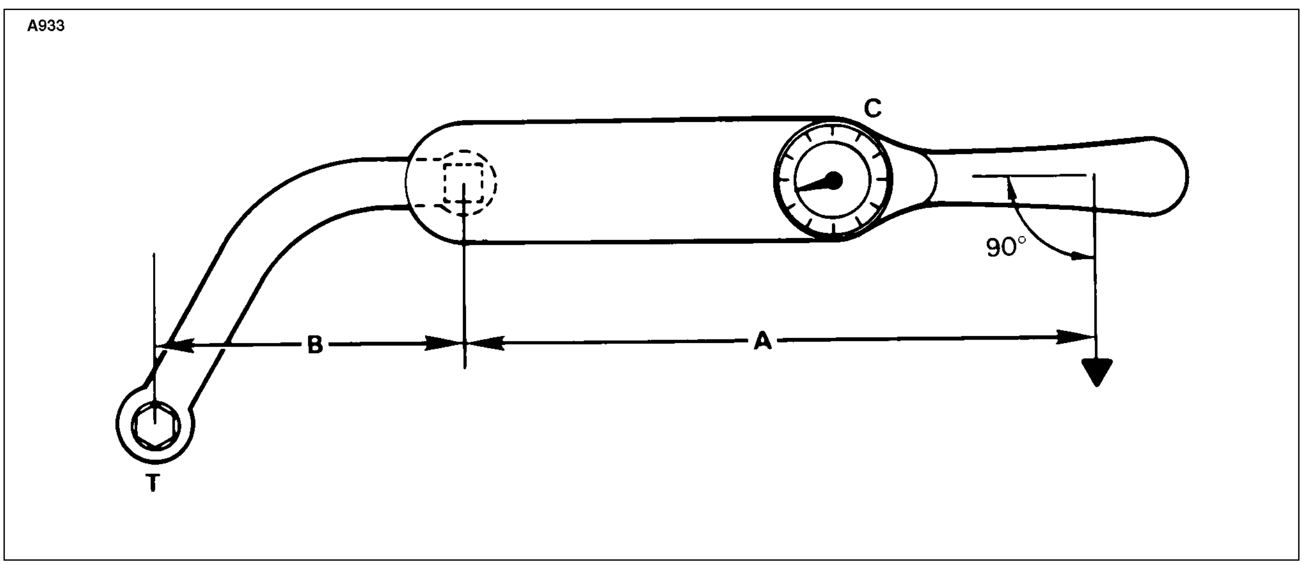

Figure 2-9. Torque Wrench Formula

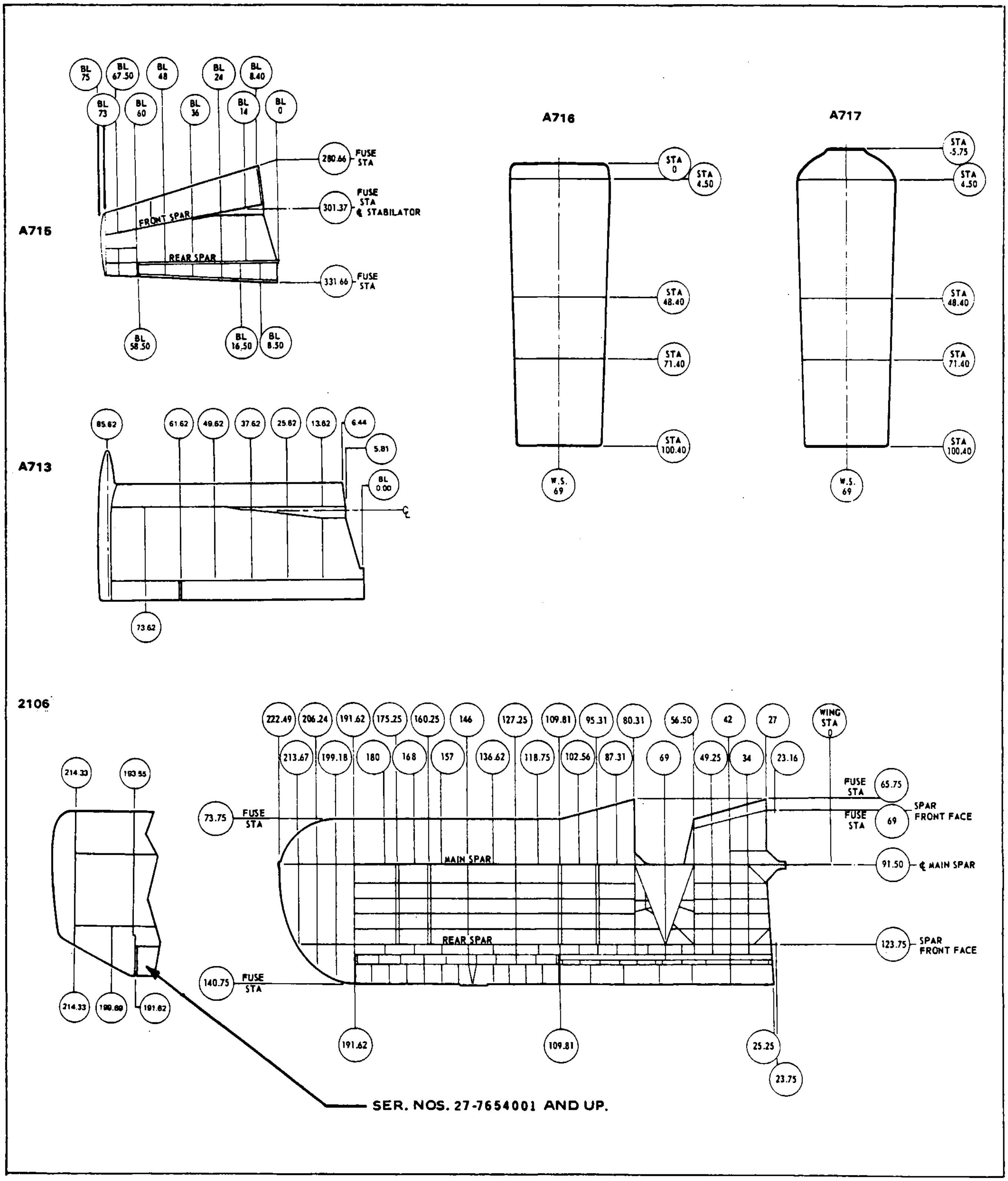

Figure 2-10. Station Reference Lines

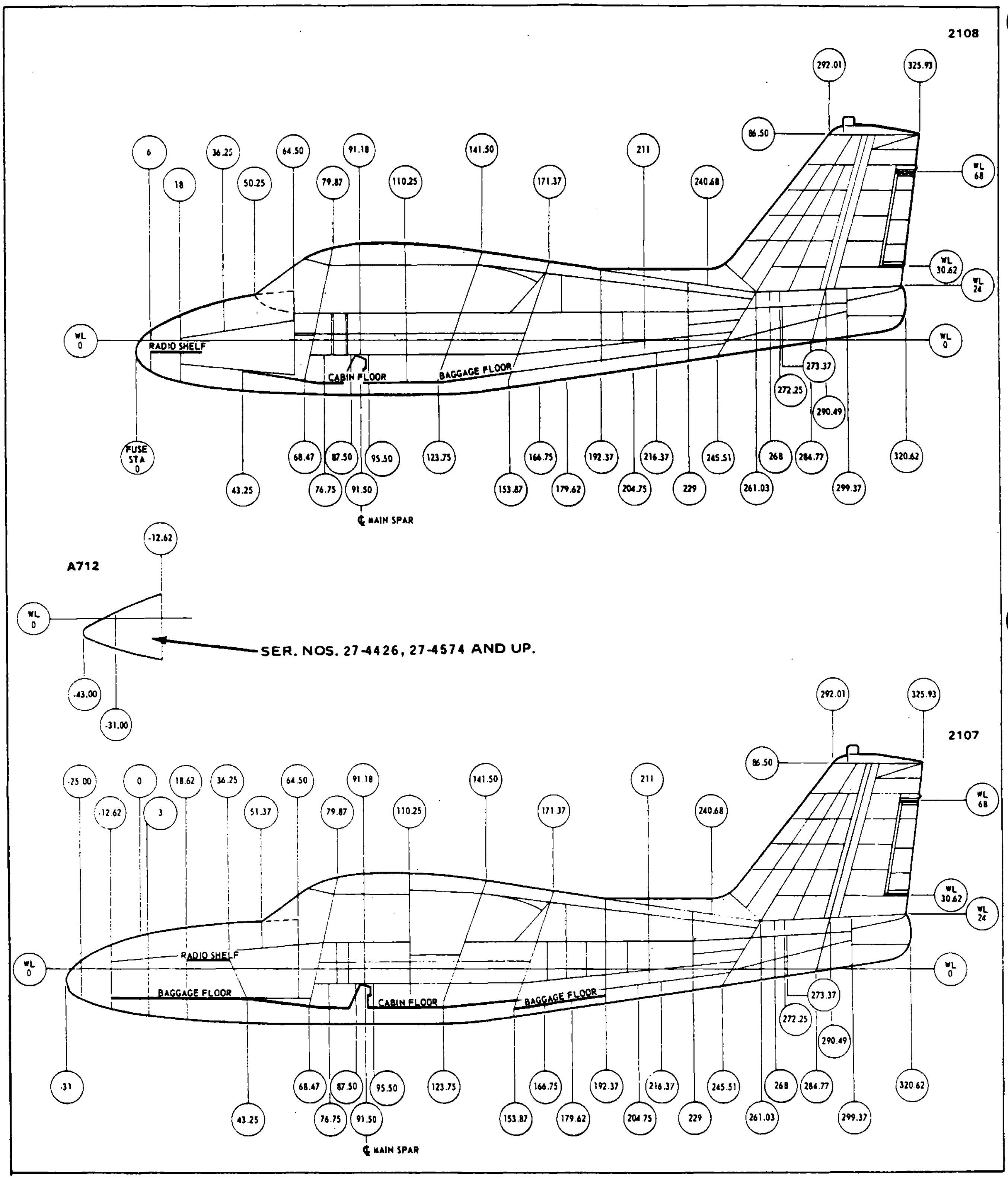

Figure 2-10. Station Reference Lines (cont.)

TABLE II-V. CONVERSION TABLES

1. These tables contain the various conversion data that may be useful when figuring capacities, lengths, temperatures, and various weights and measures from the English system values to the metric system values or back again.

2. The English system is in use by England and the United States. All other countries use the metric system.

3. Procedure for Converting Inches to Millimeters (Refer to Table II-V.)

   A. Example: Convert 1.5 inches to millimeters.

      (1) Read down inches column to 1. inches.
      (2) Read across top inch column to 0.5.
      (3) Read down and across to find millimeters to (1.5 inches is 38.10 millimeters).

4. Procedure for Converting Fahrenheit (°F) and Celsius (°C) (Centigrade) Temperature. (Refer to Table II-V.)

   A. Read number in middle column, if in degrees Celsuis (°C), read Fahrenheit equivalent in right-hand column. If in degrees Fahrenheit (°F), read Celsius equivalent in left-hand column.

      (1) 70°F = 21.1°C.
      (2) 30°C = 86.0°F.

TABLE II-V. CONVERSION TABLES (cont.)

CENTIGRADE—FAHRENHEIT CONVERSION TABLE

Example: To convert 20°C. to Fahrenheit, find 20 in the center column headed (F—C); then read 68.0°F. in the column (F) to the right. To convert 20°F. to Centigrade; find 20 in the center column and read -6.67°C. in the (C) column to the left.

C	F—C	F	C	F—C	F
-56.7	-70	-94.0	104.44	220	428.0
-51.1	-60	-76.0	110.00	230	446.0
-45.6	-50	-58.0	115.56	240	464.0
-40.0	-40	-40.0	121.11	250	482.0
-34.0	-30	-22.0	126.67	260	500.0
-38.9	-20	-4.0	132.22	270	518.0
-23.3	-10	14.0	137.78	280	536.0
-17.8	0	32.0	143.33	290	554.0
-12.22	10	50.0	148.89	300	572.0
-6.67	20	68.0	154.44	310	590.0
-1.11	30	86.0	160.00	320	608.0
4.44	40	104.0	165.56	330	626.0
10.00	50	122.0	171.11	340	644.0
15.56	60	140.0	176.67	350	662.0
21.11	70	158.0	182.22	360	680.0
26.67	80	176.0	187.78	370	698.0
32.22	90	194.0	193.33	380	716.0
27.78	100	212.0	198.89	390	734.0
43.33	110	230.0	204.44	400	752.0
38.89	120	248.0	210.00	410	770.0
54.44	130	266.0	215.56	420	788.0
60.00	140	284.0	221.11	430	806.0
65.56	150	302.0	226.67	440	824.0
71.00	160	320.0	232.22	450	842.0
76.67	170	338.0	257.78	460	860.0
82.22	180	356.0	243.33	470	878.0
87.78	190	374.0	248.89	480	896.0
93.33	200	392.0	254.44	490	914.0
98.89	210	410.0	260.00	500	932.0

TABLE II-V. CONVERSION TABLES (cont.)

INCHES TO MILLIMETER

INCHES ↓ / MILLIMETER	0.0000	0.0001	0.0002	0.0003	0.0004	0.0005	0.0006	0.0007	0.0008	0.0009
0.000		0.0025	0.0050	0.0076	0.0101	0.0127	0.0152	0.0177	0.0203	0.0228
0.001	0.0254	0.0279	0.0304	0.0330	0.0355	0.0381	0.0406	0.0431	0.0457	0.0482
0.002	0.0508	0.0533	0.0558	0.0584	0.0609	0.0635	0.0660	0.0685	0.0711	0.0736
0.003	0.0762	0.0787	0.0812	0.0838	0.0863	0.0889	0.0914	0.0939	0.0965	0.0990
0.004	0.1016	0.1041	0.1066	0.1092	0.1117	0.1143	0.1168	0.1193	0.1219	0.1244
0.005	0.1270	0.1295	0.1320	0.1346	0.1371	0.1397	0.1422	0.1447	0.1473	0.1498
0.006	0.1524	0.1549	0.1574	0.1600	0.1625	0.1651	0.1676	0.1701	0.1727	0.1752
0.007	0.1778	0.1803	0.1828	0.1854	0.1879	0.1905	0.1930	0.1955	0.1981	0.2006
0.008	0.2032	0.2057	0.2082	0.2108	0.2133	0.2159	0.2184	0.2209	0.2235	0.2260
0.009	0.2286	0.2311	0.2336	0.2362	0.2387	0.2413	0.2438	0.2463	0.2489	0.2514

INCHES ↓ / MILLIMETER	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
0.00		0.025	0.050	0.076	0.101	0.127	0.152	0.177	0.203	0.228
0.01	0.254	0.279	0.304	0.330	0.355	0.381	0.406	0.431	0.457	0.482
0.02	0.508	0.533	0.558	0.584	0.609	0.635	0.660	0.685	0.711	0.736
0.03	0.762	0.787	0.812	0.838	0.863	0.889	0.914	0.939	0.965	0.990
0.04	1.016	1.041	1.066	1.092	1.117	1.143	1.168	1.193	1.219	1.244
0.05	1.270	1.295	1.320	1.346	1.371	1.397	1.422	1.447	1.473	1.498
0.06	1.524	1.549	1.574	1.600	1.625	1.651	1.676	1.701	1.727	1.752
0.07	1.778	1.803	1.828	1.854	1.879	1.905	1.930	1.955	1.981	2.006
0.08	2.032	2.057	2.082	2.108	2.133	2.159	2.184	2.209	2.235	2.260
0.09	2.286	2.311	2.336	2.362	2.387	2.413	2.438	2.463	2.489	2.514

INCHES ↓ / MILLIMETER	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0		0.254	0.508	0.762	0.016	1.270	1.524	1.778	2.032	2.286
0.1	2.540	2.794	3.048	3.302	3.556	3.810	4.064	4.318	4.572	4.826
0.2	5.080	5.334	5.588	5.842	6.096	6.350	6.604	6.858	7.112	7.366
0.3	7.620	7.874	8.128	8.382	8.636	8.890	9.144	9.398	9.652	9.906
0.4	10.160	10.414	10.668	10.922	11.176	11.430	11.684	11.938	12.192	12.446
0.5	12.700	12.954	13.208	13.462	13.716	13.970	14.224	14.478	14.732	14.986
0.6	15.240	15.494	15.748	16.002	16.256	16.510	16.764	17.018	17.272	17.526
0.7	17.780	18.034	18.288	18.542	18.796	19.050	19.304	19.558	19.812	20.066
0.8	20.320	20.574	20.828	21.082	21.336	21.590	21.844	22.098	22.352	22.606
0.9	22.860	23.114	23.368	23.622	23.876	24.130	24.384	24.638	24.892	25.146

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TABLE II-V. CONVERSION TABLES (cont.)

MULTIPLY	BY	TO OBTAIN
CENTIMETERS	0.3937 0.03281	IN. FT.
CU. CENTIMETERS	0.001 0.06102 0.0002642	LITERS CU. IN. U.S. GAL.
CU. FT.	28.320 1.728 7.481 28.32	CU. CM. CU. IN. U.S. GAL. LITERS
CU. IN.	16.39 0.01639 0.004329 0.01732	CU. CM. LITERS U.S. GAL. QUARTS
CU. METERS	1000000 35.314 61.023 264.17 999.97	CU. CM. CU. FT. CU. IN. GAL. LITERS
FEET	0.3048 12.000 304.8 0.3333	METERS MILS. MM. YARDS
FT.-LB.	0.1383 0.001285 0.000000376	M-KG BTU KW-HR
FLUID OZ.	8 29.6	DRAM CU. CM.
GAL., IMPERIAL	277.4 1.201 4.546	CU. IN. U.S. GAL. LITERS
GAL., U.S. DRY	268.8 0.1556 1.164 4.405	CU. IN. CU. FT. U.S. GAL., LIQ. LITERS
GAL., U.S. LIQ.	231.0 0.1337 3.785 0.8327 128	CU. IN. CU. FT. LITERS IMPERIAL GAL. FLUID OZ.
IN.	2.540 .08333	CM. FT.
JOULES	0.000948 0.7376	BTU FT.-LB.
KILOGRAMS	2.205 35.27 1000	LB. OZ. GRAMS
LITERS	1000 61.03 0.03532 0.2642 0.22 1.057	CU. CM. CU. IN. CU. FT. U.S. GAL. IMPERIAL GAL. QUARTS
METERS	39.37 3.281 1000	IN. FT. MM.
METER-KILOGRAM	7.233 9.807	FT.-LB. JOULES
OUNCES, AVDP	0.0625 28.35 437.5	LB., AVDP GRAMS GRAINS
OUNCES, FLUID	29.57 1.805	CU. CM. CU. IN.
LB., AVDP	453.6 7000 16.0	GRAMS GRAINS OUNCES
SQUARE INCH	6.4516	SQ. CM.
POUND PER SQUARE INCH (PSI)	0.0703	KG-CM SQUARED
STATUTE MILE	1.609 0.8684	KILOMETER NAUTICAL MILE
NAUTICAL MILE	1.151	STATUTE MILE
QUART	.9463	LITER
MILLIMETER	1000	MICRON
MICRON	0.001 0.000039	MILLIMETER INCH
INCH POUNDS	11.521	METER GRAMS
INCH OUNCES	0.72	METER GRAMS
POUNDS	0.453	KILOGRAMS

TABLE II-VI. DECIMAL/MILLIMETER EQUIVALENTS OF DRILL SIZES

Decimal/Millimeter Equivalents of Drill Sizes From 1/2" to No. 80

Size	Decimal Equiv.	Millimeter Equiv.	Size	Decimal Equiv.	Millimeter Equiv.	Size	Decimal Equiv.	Millimeter Equiv.	Size	Decimal Equiv.	Millimeter Equiv.
1/2	0.500	12.7000	G	0.261	6.6294	5/32	0.1562	3.9687	51	0.067	1.7018
31/64	0.4843	12.3031	F	0.257	6.5278	23	0.154	3.9116	52	0.0635	1.6129
15/32	0.4687	11.9062	E-1/4	0.250	6.3500	24	0.152	3.8608	1/16	0.0625	1.5875
29/64	0.4531	11.5094	D	0.246	6.2484	25	0.1495	3.7973	53	0.0595	1.5113
7/16	0.4375	11.1125	C	0.242	6.1468	26	0.147	3.7338	54	0.055	1.397
27/64	0.4218	10.7156	B	0.238	6.0452	27	0.144	3.6576	55	0.052	1.3208
Z	0.413	10.4902	15/64	0.2343	5.9531	9/64	0.1406	3.5719	3/64	0.0468	1.1906
13/32	0.4062	10.3187	A	0.234	5.9436	28	0.1405	3.5687	56	0.0465	1.1811
Y	0.404	10.2616	1	0.228	5.7912	29	0.136	3.4544	57	0.043	1.0922
X	0.397	10.0838	2	0.221	5.6134	30	0.1285	3.2639	58	0.042	1.0668
25/64	0.3906	9.9212	7/32	0.2187	5.5562	1/8	0.125	3.1750	59	0.041	1.0414
W	0.386	9.8044	3	0.213	5.4102	31	0.120	3.048	60	0.040	1.016
V	0.377	9.5758	4	0.209	5.3086	32	0.116	2.9464	61	0.039	0.9906
3/8	0.375	9.5250	5	0.2055	5.2197	33	0.113	2.8702	62	0.038	0.9652
U	0.368	9.3472	6	0.204	5.1816	34	0.111	2.8194	63	0.037	0.9398
23/64	0.3593	9.1262	13/64	0.2031	5.1594	35	0.110	2.794	64	0.036	0.9144
T	0.358	9.1281	7	0.201	5.1054	7/64	0.1093	2.7781	65	0.035	0.899
S	0.346	8.7884	8	0.199	5.0546	36	0.1065	2.7051	66	0.033	0.8382
11/32	0.3437	8.7300	9	0.196	4.9784	37	0.104	2.6416	1/32	0.0312	0.7937
R	0.339	8.6106	10	0.1935	4.9149	38	0.1015	2.5781	67	0.032	0.8128
Q	0.332	8.4328	11	0.191	4.8514	39	0.0995	2.5273	68	0.031	0.7874
21/64	0.3281	8.3337	12	0.189	4.8006	40	0.098	2.4892	69	0.029	0.7366
P	0.323	8.2042	3/16	0.1875	4.7625	41	0.096	2.4384	70	0.028	0.7112
O	0.316	8.0264	13	0.185	4.699	3/32	0.0937	2.3812	71	0.026	0.6604
5/16	0.3125	7.9375	14	0.182	4.6228	42	0.0935	2.3749	72	0.025	0.635
N	0.302	7.6708	15	0.180	4.572	43	0.089	2.2606	73	0.024	0.6096
19/64	0.2968	7.5387	16	0.177	4.4958	44	0.086	2.1844	74	0.0229	0.58166
M	0.295	7.4930	17	0.173	4.3942	45	0.082	2.0828	75	0.021	0.5334
L	0.290	7.3660	11/64	0.1718	4.3656	46	0.081	2.0574	76	0.020	0.508
9/32	0.2812	7.1425	18	0.1695	4.3053	47	0.0785	1.9939	77	0.018	0.4572
K	0.281	7.1374	19	0.166	4.2164	5/64	0.0781	1.9844	1/64	0.0156	0.3969
J	0.277	7.0358	20	0.161	4.0894	48	0.076	1.9304	78	0.016	0.4064
I	0.272	6.9088	21	0.159	4.0386	49	0.073	1.8542	79	0.0145	0.3683
H	0.266	6.7564	22	0.157	3.9878	50	0.070	1.778	80	0.0135	0.3429
17/64	0.2656	6.7462									

DRILL SIZES AVAILABLE.
Drill may be obtained in regular sizes to a 4 inch diameter, and increase in 64ths of an inch.
The regular metric drills vary from 2 to 76mm. and increase in 0.5mm. variations.

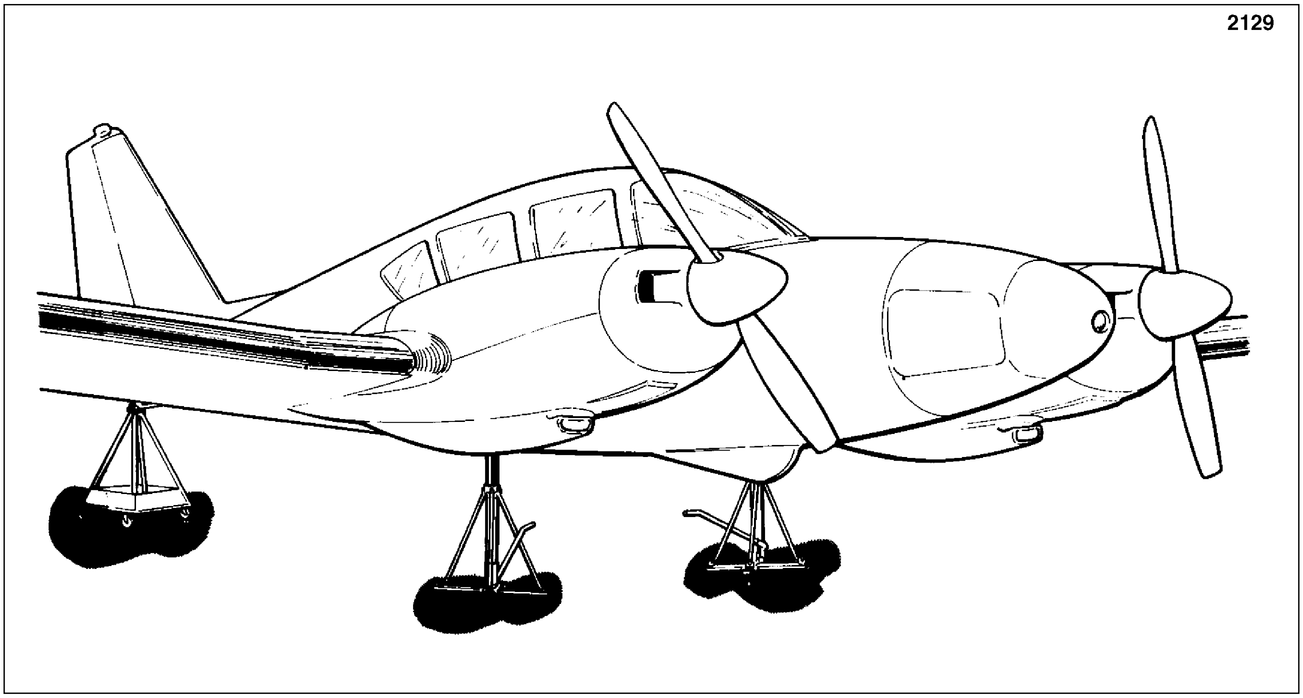


Figure 2-11. Jacking Arrangements

2-10. GROUND HANDLING.

CAUTION: FAILURE TO FOLLOW GROUND HANDLING INSTRUCTIONS MAY RESULT IN SERIOUS DAMAGE TO THE AIRPLANE.

2-11. RESERVED.

2-12. JACKING. The airplane is provided with a jacking pad on each main spar just outboard of the engine nacelle and a support position by making use of the tail skid. (Refer to Figure 2-11.) To jack the airplane, proceed as follows:

a. Place the jacks under the jack pads.

b. Attach the tail support to the tail skid. Place approximately 250 pounds of ballast on the support to hold the tail down.

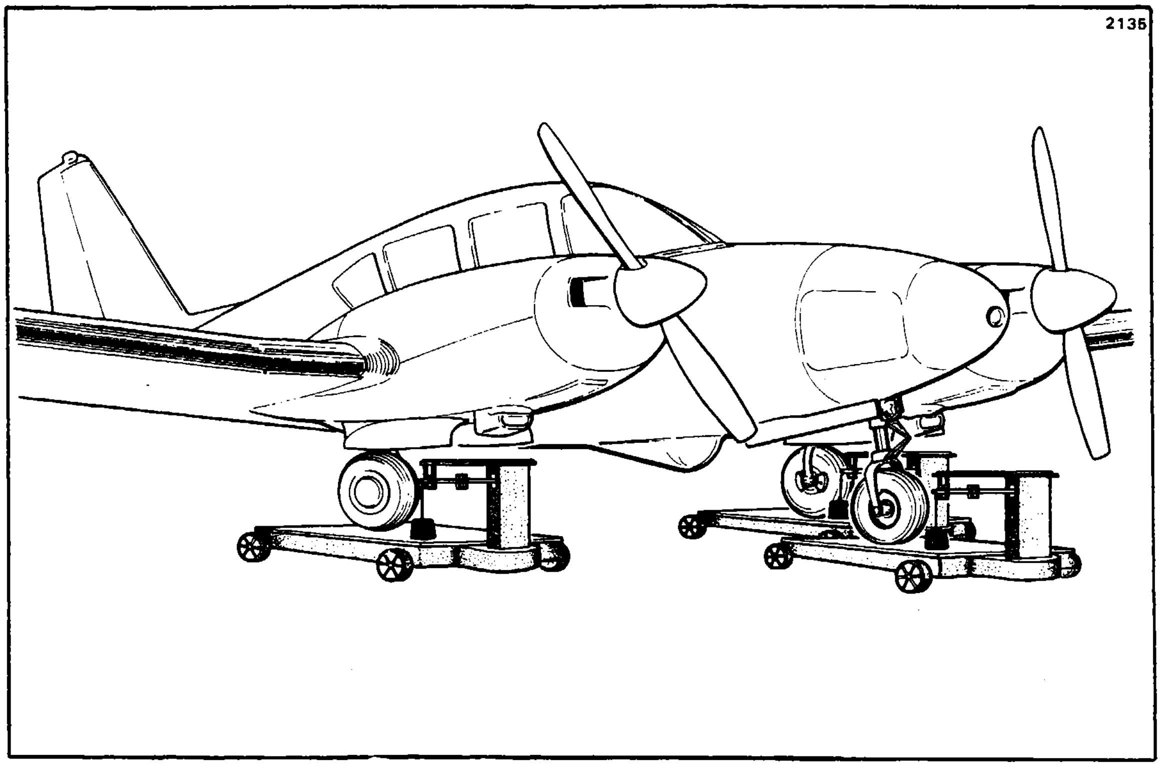


Figure 2-12. Weighing

CAUTION

Be sure to apply sufficient tail support ballast; otherwise the airplane will tip forward and fall on the fuselage nose section.

c. Raise the jacks evenly until all three wheels clear the floor.

2-13. WEIGHING. (Refer to Figure 2-12.)

a. Position a scale and ramp in front of each of the three landing gear wheels.

b. Secure the scales from rolling, and tow the airplane up on to the scales. (Refer to Towing, Paragraph 2.17.)

c. Remove the ramps so as not to interfere with the scales.

d. If the airplane is to be weighed for weight and balance computations, level the airplane per instructions given in paragraph 2-14.

e. The airplanes weight is obtained by adding the reading on each of the three scales.

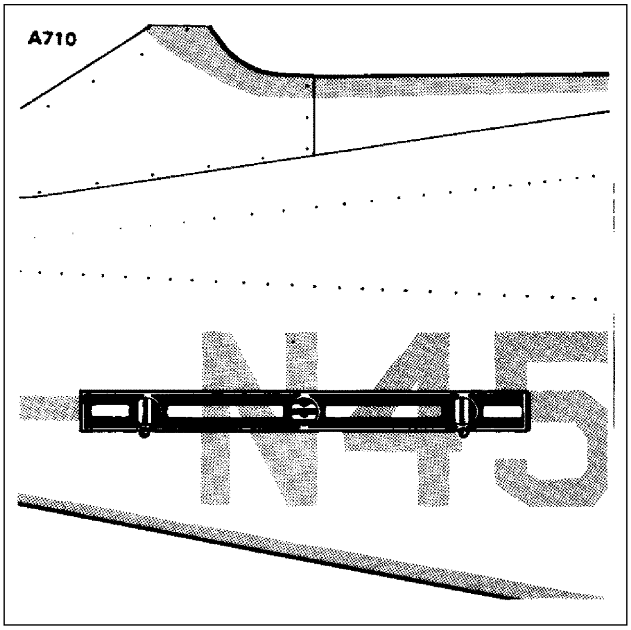


Figure 2-13. Longitudinal Leveling

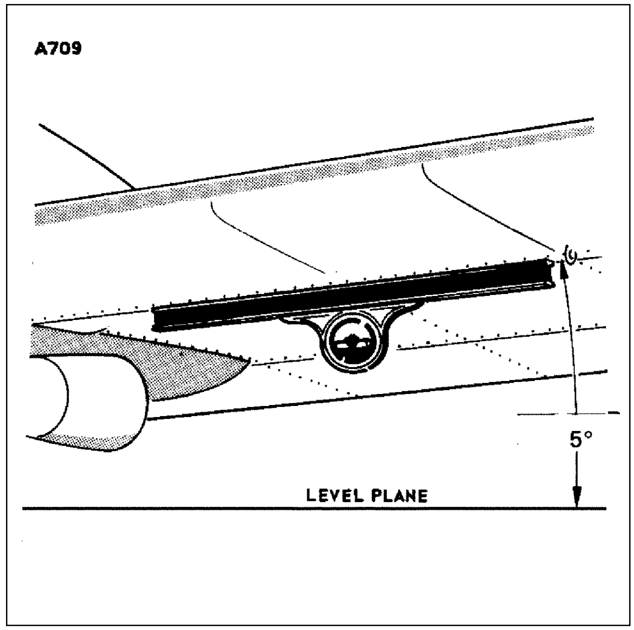


Figure 2-14. Lateral Leveling

2-14. LEVELING. All configurations of the airplane are provided with a means for longitudinal and lateral leveling. The airplane may be leveled while on jacks, during the weighing procedure while the wheels are on scales, or while the wheels are on the ground. To level the airplane for purpose of weighing or rigging, the following procedure should be used:

NOTE: Always level the airplane laterally first, then level the airplane longitudinally.

a. Level the airplane laterally as follows:

1. Ascertain that the landing gear is blocked to the specified strut extensions as stated in step a, 2.
2. Set a bubble protractor at five degrees and place it on a straightedge held along the front spar on the under surface of the wing as shown in Figure 2-14. Do not place the straightedge on any rivet heads.
3. Raise or lower the wing by inflating or deflating the main gear tires or adjusting either jack, until the bubble is centered indicating a five degree dihedral of the wing which will level the fuselage.
4. Check the opposite wing with the protractor to ascertain it also has a five degree dihedral.

b. Level the airplane longitudinally as follows:

1. Ascertain that all tires are inflated to normal pressures.
2. Block the nose gear to obtain 2.50 inches of strut extrusion and the main gear to obtain 6.50 inches of strut extrusion.
3. Partially withdraw the two leveling screws located on the right side of the fuselage forward of the stabilator as shown in Figure 2-13.
4. Place a spirit level on the heads of the screws.
5. Level the airplane by inflating or deflating the nose wheel tire or adjusting the jacks until the bubble on the level is centered.

2-15.. MOORING. The airplane is moored to insure its immovability, protection and security under various weather conditions. The following procedure gives the instructions for proper mooring of the airplane.

a. Head the airplane into the wind, if possible.

b. Block the wheels.

c. Insert control surface locks, if available.

d. Secure tie-down ropes to the wing tie-down rings and the tail skid at approximately 45 degree angles to the ground. When using rope constructed of non-synthetic material, leave sufficient slack to avoid damage to the airplane when the ropes contract due to moisture.

CAUTION

Use square or bowline knots. Do not use slip knots.

NOTE

Additional preparations for high winds include using tie-down ropes from the landing gear forks, and securing the rudder.

e. Install pitot tube cover, if available.

2-16.. PARKING. When parking the airplane, insure that it is sufficiently protected against adverse weather conditions and presents no danger to other aircraft. When parking the airplane for any length of time or overnight, it is recommended that it be moored as in paragraph 2-15.

a. To park the airplane, head it into the wind, if possible.

b. Set the parking brake by applying toe pressure against the top of the rudder pedals and at the same time pull out on the brake handle. To release the parking brake, apply toe pressure on the pedals and push in on the parking brake handle.

NOTE

Care should be taken when setting brakes that are overheated or during cold weather when accumulated moisture may freeze the brakes.

2-17. TOWING. The airplane may be moved by using the nose wheel steering bar that is stowed in the baggage area or power equipment that will not damage or cause excess strain to the nose gear steering assembly. Towing lugs are incorporated as part of the nose gear fork.

CAUTIONS

1. Do not tow airplane with control locks installed.
2. Observe turning limits to prevent strut damage.

CAUTION

When moving the aircraft forward by hand, avoid pushing on the trailing edge of the ailerons as this will cause the aileron contour to change resulting in an out-of-trim condition.

2-18. TAXIING. Before attempting to taxi the airplane, ground personnel should be checked out by a qualified pilot or other responsible person. Engine starting and shut-down procedures should be covered as well. When it is ascertained that the propeller back blast and taxi areas are clear, apply power to start the taxi roll and perform the following checks:

a. Taxi forward a few feet and apply brakes to determine their effectiveness.
b. Taxi with propeller set in low pitch, high RPM setting.
c. While taxiing, make slight turns to ascertain the effectiveness of steering.
d. Observe wing clearances when taxiing near buildings or other stationary objects. If possible, station a guide outside the airplane to observe.
e. When taxiing on uneven ground, look for holes and ruts.
f. Do not operate the engine at high RPM when running up or taxiing over ground containing loose stones, gravel or any loose material that may cause damage to the propeller blades.

2-19. EXTERNAL POWER RECEPTACLE.

2-20. OPERATION OF EXTERNAL POWER RECEPTACLE. The external power receptacle is located on the underside of the nose section forward of the landing gear. When using external power for starting insure that the master switch and all avionics switches are turned OFF. Reduce engines to idle before removing the external power unit. Turn master switch and avionics switches ON only after the external power unit has been disconnected!

2-21. CLEANING.

2-22. CLEANING ENGINE COMPARTMENT.

Before cleaning the engine compartment, place a strip of tape on the magneto vents to prevent any solvent from entering these units.

a. Place a large pan under the engine to catch waste.

CAUTION: DO NOT SPRAY SOLVENT INTO THE GENERATOR OR ALTERNATOR, STARTER AND AIR INTAKES.

b. With the engine cowling removed, spray or brush the engine with solvent or a mixture of solvent and de-greaser, as desired. It may be necessary to brush areas that were sprayed where heavy grease and dirt deposits have collected in order to clean them.

c. Allow the solvent to remain on the engine from 5 to 10 minutes, then rinse the engine clean with additional solvent and allow to dry.

CAUTION: DO NOT OPERATE ENGINE UNTIL EXCESS SOLVENT HAS EVAPORATED OR OTHERWISE BEEN REMOVED.

d. Remove the protective covers from the magnetos.

e. Lubricate controls, bearing surfaces, etc., per Lubrication Chart.

2-23. CLEANING LANDING GEAR.

a. Struts and Torque Links

Before cleaning the landing gear struts and torque links, place a plastic cover or similar material over the wheel and brake assembly.

1. Place a pan under the gear to catch waste.
2. Spray (low pressure only) or brush the gear area with solvent or a mixture of solvent and de-greaser, as desired. It may be necessary to brush areas that were sprayed where heavy grease and dirt deposits have collected in order to clean them.
3. Allow the solvent to remain on the gear from 5 to 10 minutes. Rinse the gear with additional solvent and allow to dry.
4. Remove the cover from the wheel and remove the catch pan.
5. Lubricate the gear per Lubrication Chart.

b. Wheels and Brakes

CAUTION: DO NOT USE HIGH PRESSURE SPRAY WASH EQUIPMENT. ITS USE CAN INJECT SOAP SOLUTION AND WATER INTO THE WHEEL BEARINGS AND OTHER INTERNAL CAVITIES RESULTING IN CORROSION AND REDUCED SERVICE LIFE.

1. Hand wash wheels and brakes with a mild soap and water solution.
2. Rinse with low-pressure spray.
3. Lubricate gear per Lubrication Chart, Section II, if not already done, above.

2-24. CLEANING EXTERIOR SURFACES. The airplane should be washed with a mild soap and water. Harsh abrasive or alkaline soaps or detergents used on painted or plastic surfaces could make scratches or cause corrosion of metal surfaces. Cover areas where cleaning solution could cause damage. To wash the airplane, the following procedure may be used:

a. Flush away loose dirt with water.
b. Apply cleaning solution with a rag, sponge or soft bristle brush.
c. To remove stubborn oil and grease, use a cloth dampened with naptha.
d. Where exhaust stains exist, allow solution to remain on the surface longer.
e. Any good automotive wax may be used to preserve the painted surfaces. Soft cleaning cloths or a chamois should be used to prevent scratches when cleaning or polishing. A heavier coating of wax on the leading surfaces will reduce the abrasion problems in these areas.

2-25. CLEANING WINDSHIELD AND WINDOWS.

a. Remove dirt, mud, etc., from exterior surface with clean water.
b. Wash with mild soap and warm water or an aircraft plastic cleaner. Use a soft cloth or sponge using a straight rubbing motion. Do not harshly rub surfaces.
c. Remove oil and grease with a cloth moistened with kerosene.

NOTE

Do not use gasoline, alcohol, benzene, carbon tetrachloride, thinner, acetone, or window cleaning sprays.

d. After cleaning plastic surfaces, apply a thin coat of hard polishing wax. Rub lightly with a soft cloth. Do not use a circular motion.
e. A severe scratch or mar in plastic can be removed by using jeweler's rouge to rub out the scratch. Smooth both sides and apply wax.
f. To improve visibility through windshield and windows during flights through rain, a rain repellent such as REPCON should be applied to the windshield and windows. The surfaces of the windshield and windows treated becomes so smooth that water beads up and readily flows off the surface. Apply this product in accordance with the manufacturer's instructions. (Refer to Table II-II. Consumable Materials, for Specifications and Manufacturer's address.)

2-26. CLEANING HEADLINER, SIDE PANELS AND SEATS.

a. Clean headliner, side panels and seats with a stiff bristle brush and vacuum where necessary.
b. Soiled upholstery, except leather, may be cleaned by using an approved air type cleaner or foam upholstery cleaner. Carefully follow the manufacturer's instructions. Avoid soaking or harsh rubbing.

WARNING: SOLVENT CLEANERS REQUIRE ADEQUATE VENTILATION.

c. Leather material should be cleaned with saddle soap or a mild soap and water.

2-27. CLEANING CARPETS. Use a small wisk broom or vacuum to remove dirt. For soiled spots, use a non-inflammable dry-cleaning fluid.

2-28. REPAINTING (Polythane Enamel). If it becomes necessary or desirable to repaint the aircraft, the following procedures will apply (PA-23-250 [six place] Aztec).

a. Wash the area to be painted thoroughly. It is not necessary to strip the previous coating, unless it is desired, use an appropriate stripper.

2-29. SCRATCH TOUCH UP ON ALUMINUM SURFACE.

a. "Feather-Edge" the surface with fine wet or dry paper (400-600 grit).

b. If gouges are deep, fill with polyester or epoxy filler. Sand lightly.

c. Apply a coat of Epoxy Primer (8951/8678). Dry overnight and sand lightly. (For Piper Part No. refer to Table II-VII.)

d. Apply a Polythane Enamel.

2-30. COATING PROCEDURE FOR NEW ALUMINUM PANEL-NON ALODIZED.

a. Thoroughly clean all contaminants from surface: solvent wash with industrial grade MEK or Titanine Ti-Two Cleaning Thinner.

NOTE: Deoxidiene 624 or equal is recommended but not required.

b. Apply V-48 Wash Primer.

c. Apply either Epoxy Primer (8951)/Epoxy Converter 8678 or Polythane (6351) Urethane Primer.

d. Topcoat with Polythane Enamel.

2-31. COATING PROCEDURE FOR ALODIZED ALUMINUM.

a. Thoroughly clean all contaminants from surface; solvent wash with industrial grade MEK or Titanine Ti-Two Cleaning Thinner.

b. Apply either Epoxy Primer/Converter, or Polythane Urethane Primer.

c. Topcoat with Polyurethane Enamel.

2-32. MIXING INSTRUCTIONS FOR PRIMERS AND TOPCOATS.

2-33. V-48 WASH PRIMER.

NOTE

Never use Polytane Enamel directly over V-48 without an intermediate primer.

a. Agitate the primer well.
b. While stirring slowly add 1 volume of catalyst to 4 volumes of Primer. DO NOT REVERSE THIS PROCEDURE.
c. Reduce the above mixture with 1/2 (by volume) of LT 327 Thinner.

2-34. EPOXY PRIMER.

a. Mix equal volumes of Epoxy Primer (8951) and Converter (8678). Allow mixture to stand at least 20 minutes before spraying.

NOTE

The pot life of the mixture is 16 hours at 70°-75° F. Approximate spreading rate is 400 Sq. Ft. per gallon of mixture (a).

b. Allow to dry overnight before sanding and recoating with Polytane Enamel.

2-35. POLYTANE 6351 PRIMER.

a. Mix 4 volumes of Primer (6351) with 1 volume of Polytane Catalyst (6352).
b. Reduce this mixture with LT-345 Polytane Reducer, approx. 50%.

NOTE

One gallon of mixed material will cover approximately 300 square feet. Pot life of mixed material is 6-8 hours at 75° F. Allow to dry overnight before light sanding and recoating with Polytane Enamel.

TABLE II-VII. PAINT MATERIALS

Piper Part No.	Titanine No.	Description
*	V-48	Wash Primer Kit
*	LT 327	Wash Primer Reducer
*	3022	Ti-Two Cleaning Solvent
170-139	8905-A	Epoxy Reducer
170-729	8951	Epoxy Primer
170-825	8678	Epoxy Converter
170-735	6351	Polytane Primer
179-141	6350	Polytane Reducer
170-807	6352	Polytane Catalyst
*No Piper number assigned.		

2-36. MIXING INSTRUCTIONS FOR POLYTANE ENAMEL.

2-37. POLYTANE ENAMEL ALL COLORS.

a. Mix 4 volumes of Polytane Enamel with 1 volume of Polytane (6352) Catalyst. Up to 10% of 6350 Polytane Reducer may be added to adjust viscosity for spray.

b. Spray a mist coat, allow 20 minutes setting time, follow with a full wet coat.

NOTE

Pot life of mixed material is 8 hours at 75° F. Allow Polytane Enamel to dry 10 hours minimum before taping. The universal mixing ratio of all colors makes it possible to intermix any combination of POLYTANE colors before catalyzing mixture. This is an aid to those wishing to mix their own special colors. For technical information,phone Titanine (201) 933-1000.

2-38. STANDARD PRACTICES - AIRFRAME. This general information pertains to standard aircraft hardware installation and removal practices. The information included will be very helpful if it is referred to on a regular basis.

For standard repair practices of a minor nature, refer to AC43.13.

If repairs dictate Non-Destructive Testing (N.D.T.) after repair such as welding, magniflux should be used on materials made from 4130 steel such as engine mounts and seat frames.

Testing and inspecting of aluminum castings and machined aluminum parts may be accomplished by the dye penetrant method.

Usually, a good visual inspection with 10X magnifying glass will show any damage or defect in a repair that is of a significant nature.

2-39. CHERRYLOCK RIVETS, REMOVAL. (Refer to Figure 2-15.) Should it be necessary to remove an installed cherrylock rivet, the following procedures are recommended.

a. In thick material remove the lock by driving out the rivet stem, using a tapered steel drift pin. (See View 1.)

NOTE

Do not drill completely through the rivet sleeve to remove a rivet as this will tend to enlarge the hole.

b. If the rivets have been installed in thin sheets, driving out the locked stem may damage the sheets. It is recommended that a small center drill be used to provide a guide for a larger drill on top of the rivet stem, and the tapered portion of the stem be drilled away to destroy the lock. (See Views 2 and 3.)

c. Pry the remainder of the locking collar out of the rivet head with the drift pin. (See View 3.)

d. Drill nearly through the head of the rivet, using a drill the same size as the rivet shank. (See View 4.)

e. Break off rivet head, using a drift pin as a pry. (See View 5.)

f. Drive out the remaining rivet shank with a pin having a diameter equal to the rivet shank. (See View 6.)

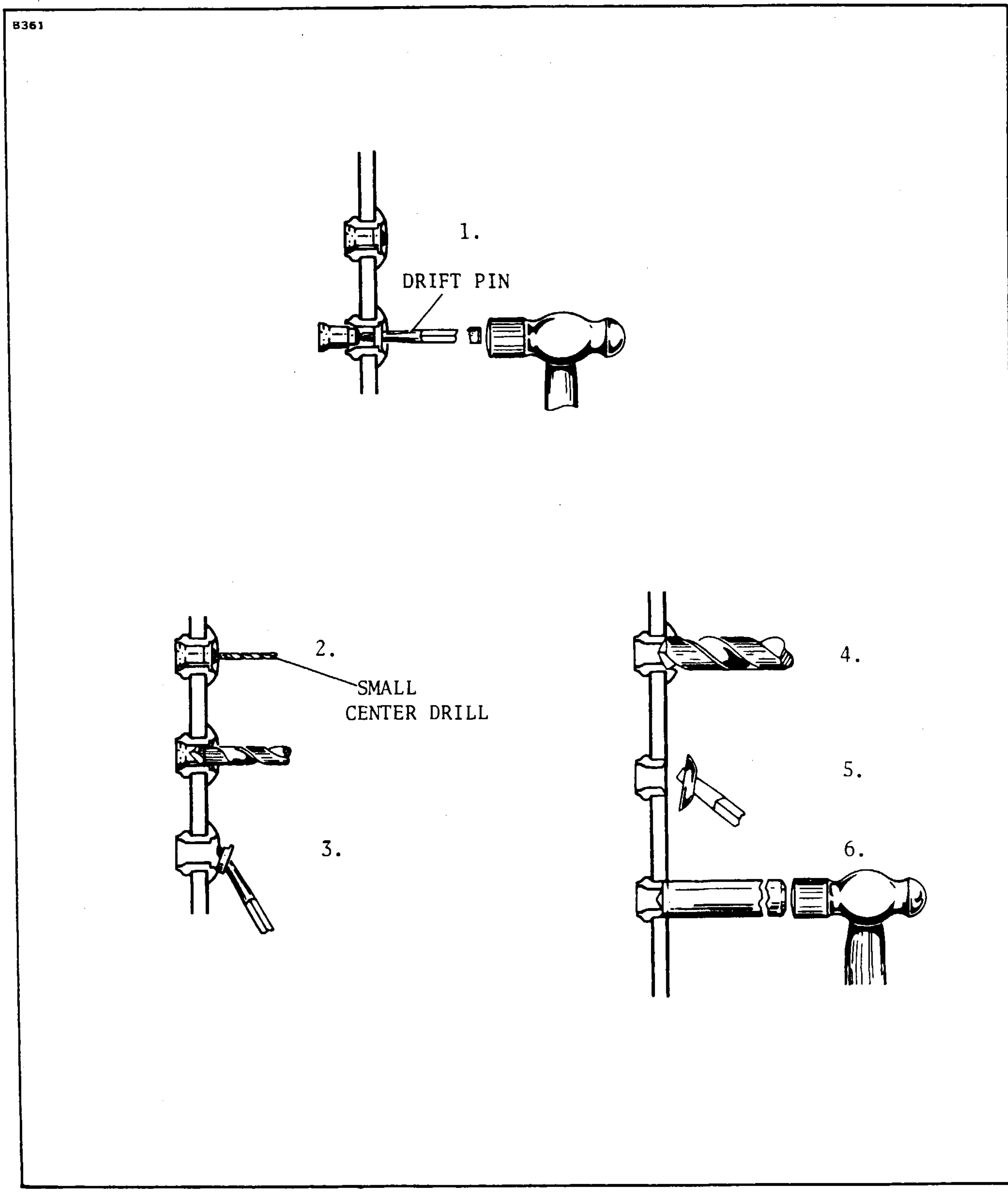


Figure 2-15. Cherrylock Rivet Removal

2-40. IDENTIFICATION OF FLUID LINES. (Refer to Figure 2-16.) Fluid lines in aircraft are often identified by markers made up of color codes, words, and geometric symbols. These markers identify each line's function, content, and primary hazard, as well as the direction of fluid flow.

In most instances, fluid lines are marked with 1-inch tape or decals. Paint is used on lines in engine compartments, where there is the possibility of tapes, decals or tags being drawn into the engine induction system.

In addition to the above-mentioned markings, certain lines may be further identified as to specific function within a system; for example, DRAIN, VENT, PRESSURE, or RETURN.

Lines conveying fuel may be marked FLAM; lines containing toxic materials are marked TOXIC in place of FLAM. Lines containing physically dangerous materials, such as oxygen, nitrogen, or freon, are marked PHDAN.

The aircraft and engine manufacturers are responsible for the original installation of identification markers, but the aviation mechanic is responsible for their replacement when it becomes necessary.

Generally, tapes and decals are placed on both ends of a line and at least once in each compartment through which the line runs. In addition, identification markers are placed immediately adjacent to each valve, regulator, filter or other accessory within a line. Where paint or tags are used, location requirements are the same as for tapes and decals.

2-41. FLARELESS TUBE ASSEMBLIES. (Refer to Figure 2-17.) Although the use of flareless tube fittings eliminates all tube flaring, another operation, referred to as presetting, is necessary prior to installation of a new flareless tube assembly which is performed as follows:

a. Cut the tube to the correct length, with the ends perfectly square. Deburr the inside and outside of the tube. Slip the nut, then the sleeve over the tube (Step a).

b. Lubricate the threads of the fitting and nut. See Figure 20-17 for proper lubricant to use, depending on the type system of the tubing assemblies are to be used on. Place the fitting in the vise (Step 2), and hold the tubing firmly and squarely on the seat in the fitting. (Tube must bottom firmly in the fitting.) Tighten the nut until the cutting edge of the sleeve grips the tube. This point is determined by slowly turning the tube back and forth while tightening the nut. When the tube no longer turns, the nut is ready for final tightening.

c. Final tightening depends upon the tubing. For aluminum allow tubing up to and including 1/2 inch outside diameter, tighten the nut from one to one and one-sixth turns. For steel tubing and aluminum alloy tubing over 1/2 outside diameter tighten from one and one-sixth to one and one-half turns.

After presetting the sleeve, disconnect the tubing from the fitting and check the following points (illustrated in Step c):

a. The tube should extend 3/32 to 1/8 inch beyond the sleeve pilot; otherwise blowoff may occur.

b. The sleeve pilot should contact the tube or have a maximum clearance of 0.005 inch for aluminum alloy tubing or 0.015 inch for steel tubing.

c. A slight collapse of the tube at the sleeve cut is permissable. No movement of the sleeve pilot, except rotation is permissible.

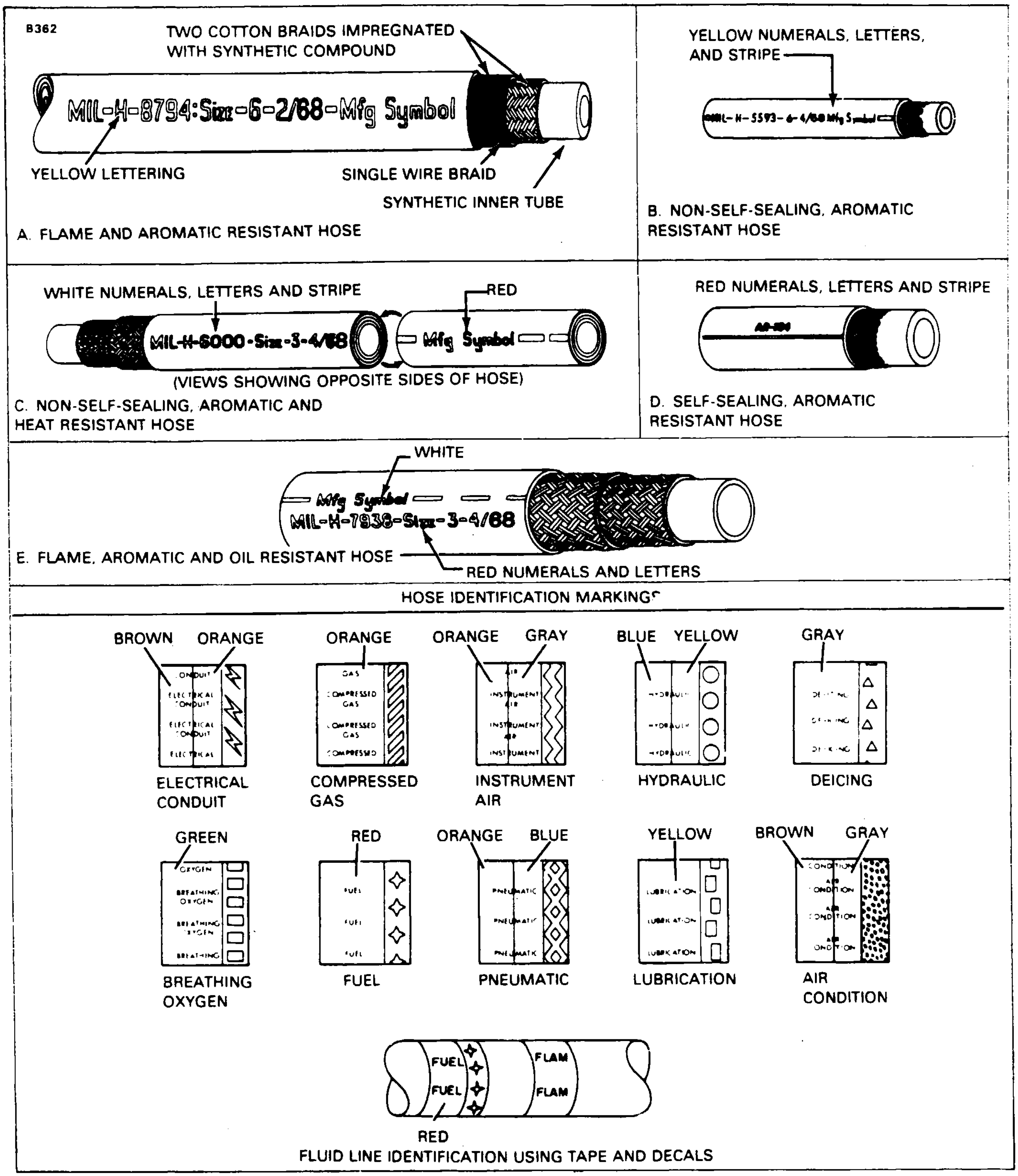


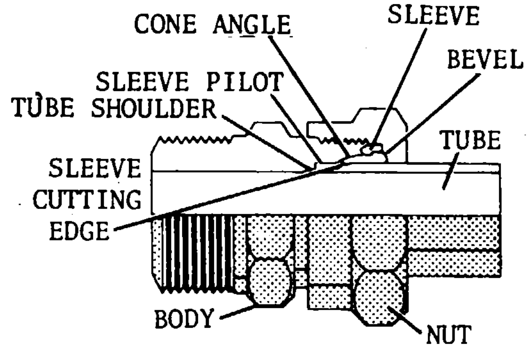
Figure 2-16. Hose/Line Markings

8363

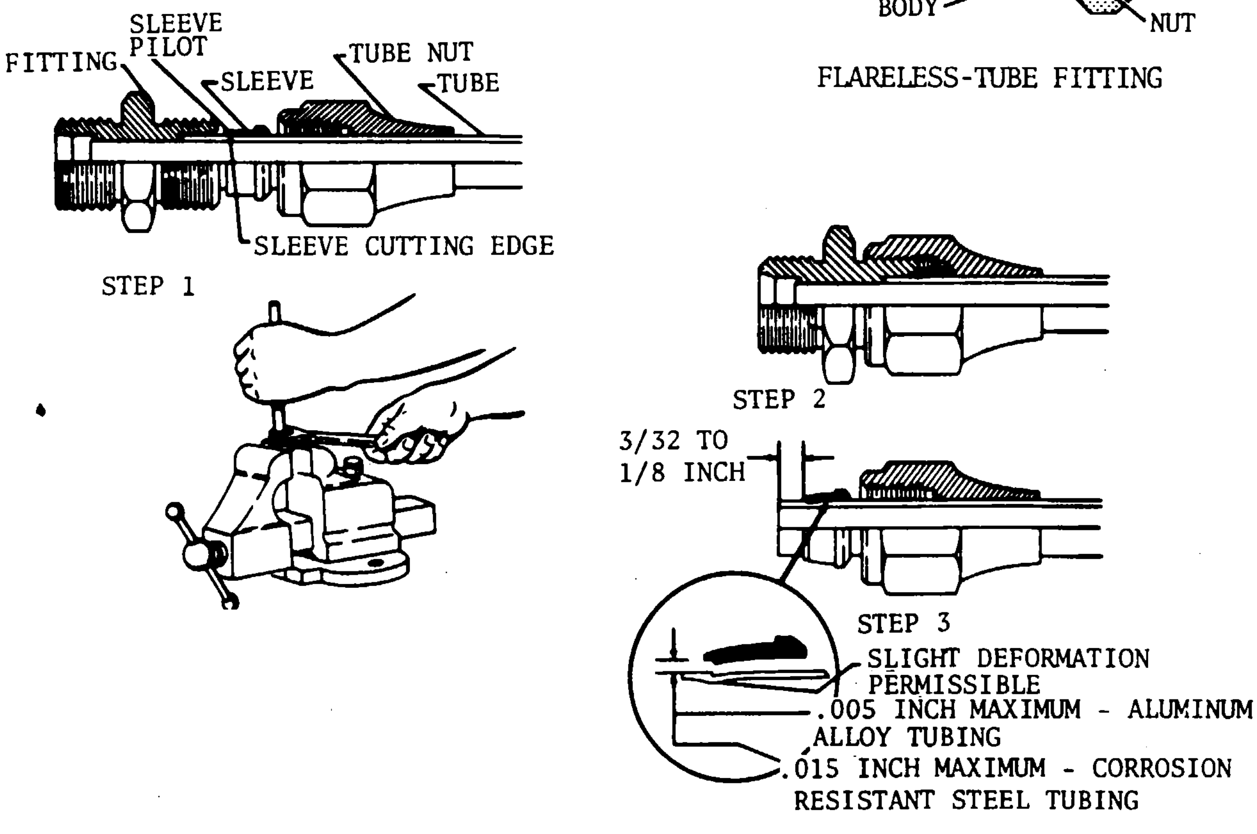
TUBING SYSTEM	LUBRICANT
HYDRAULIC	MIL-H-5606
FUEL	MIL-H-5606
OIL	System Oil
PNEUMATIC	MIL-L-4343
OXYGEN*	MIL-T-5542

*CAUTION-DO NOT USE OIL OR GREASE

TUBING AND HOSE LUBRICANTS



FLARELESS-TUBE FITTING



PRESETTING FLARELESS-TUBE ASSEMBLY

Figure 2-17. Flareless Tube Fittings

2-42. SUPPORT CLAMPS. Support clamps are used to secure the various lines to the airframe or powerplant assemblies. Several types of support clamps are used for this purpose. The rubber cushioned and plain are the most commonly used clamps. The rubber cushioned clamp is used to secure lines subject to vibration; the cushioning prevents chafing of the tubing. The plain clamp is used to secure lines in areas not subject to vibration.

A teflon-cushioned clamp is used in areas where the deteriorating effect of Skydrol 500, hydraulic fluid (MIL-H-5606) or fuel is expected, however, because it is less resilient, it does not provide as good a vibration-damping effect as other cushion materials.

Use bonded clamps to secure metal hydraulic, fuel and oil lines in place. Unbonded clamps should be used only for securing wiring. Remove any paint or anodizing from the portion of the tube at the bonding clamp location. Make certain that clamps are of the correct size. Clamps or supporting clips smaller than the outside diameter of the hose may restrict the flow of the fluid through the hose.

All plumbing lines must be secured at specified intervals. The maximum distance between supports for rigid fluid tubing is shown in Figure 2-18.

TUBE OD (IN.)	DISTANCE BETWEEN SUPPORTS (IN.)	
	ALUMINUM ALLOY	STEEL
1/8	9-1/2	11-1/2
3/16	12	14
1/4	13-1/2	16
5/16	15	18
3/8	16-1/2	20
1/2	19	23
5/8	22	25-1/2
3/4	24	27-1/2
1	26-1/2	30

Figure 2-18. Maximum Distance Between Supports for Fluid Tubing

2-43. SERVICING.

2-44. INTRODUCTION TO SERVICING. Servicing the airplane includes the replenishment of fuel, oil, hydraulic fluid, tire pressures, lubrication requirements and other items required to completely service the airplane.

2-45. HYDRAULIC SYSTEM.

2-46. SERVICING HYDRAULIC SYSTEM. The hydraulic system, which consists of the landing gear and flap actuating system, powerpak, and associated lines, should be checked and serviced every 100 hours. The powerpak should be filled with petroleum base hydraulic fluid, MIL-H-5606 and all hydraulic lines connections, and actuating rods should be kept clean of dirt by wiping with a clean shop rag. Detailed instructions for maintenance of the hydraulic system may be found in Section VI. (See CONSUMABLE MATERIALS CHART for name of fluid vendor.)

CAUTION: DO NOT CONTAMINATE HYDRAULIC FLUID. DIRT OR OTHER FOREIGN MATTER IN THE SYSTEM MAY BECOME LODGED BETWEEN THE VALVES AND SEATS OF THE POWERPAK AND COMPONENT PARTS IN THE VARIOUS ACTUATING CYLINDERS, THUS PREVENTING THE SYSTEM FROM OPERATING PROPERLY. FILTER HYDRAULIC FLUID BEFORE USE, WHETHER IT IS NEW OR USED FLUID. USE A SMALL FUNNEL, A PIECE OF STANDARD COMMERCIAL FILTER PAPER, AND A CONTAINER TO HOLD THE FUNNEL AND FILTERED OIL.

2-47. POWERPAK RESERVOIR.

2-48. FILLING POWERPAK RESERVOIR (GRAVITY).

a. Open the access door or remove the left side panel on the nose to gain access to the hydraulic filler tube. (Refer to Figure 2-8.)

b. Place the airplane on jacks. (Refer to Jacking, Paragraph 2-12.)

c. Remove the cap of filler tube.

d. Place the landing gear selector lever in the UP position.

e. Using the hand pump, raise the landing gear. When the landing gear selector lever returns to neutral, place the wing flaps selector lever in the DOWN position and extend flaps.

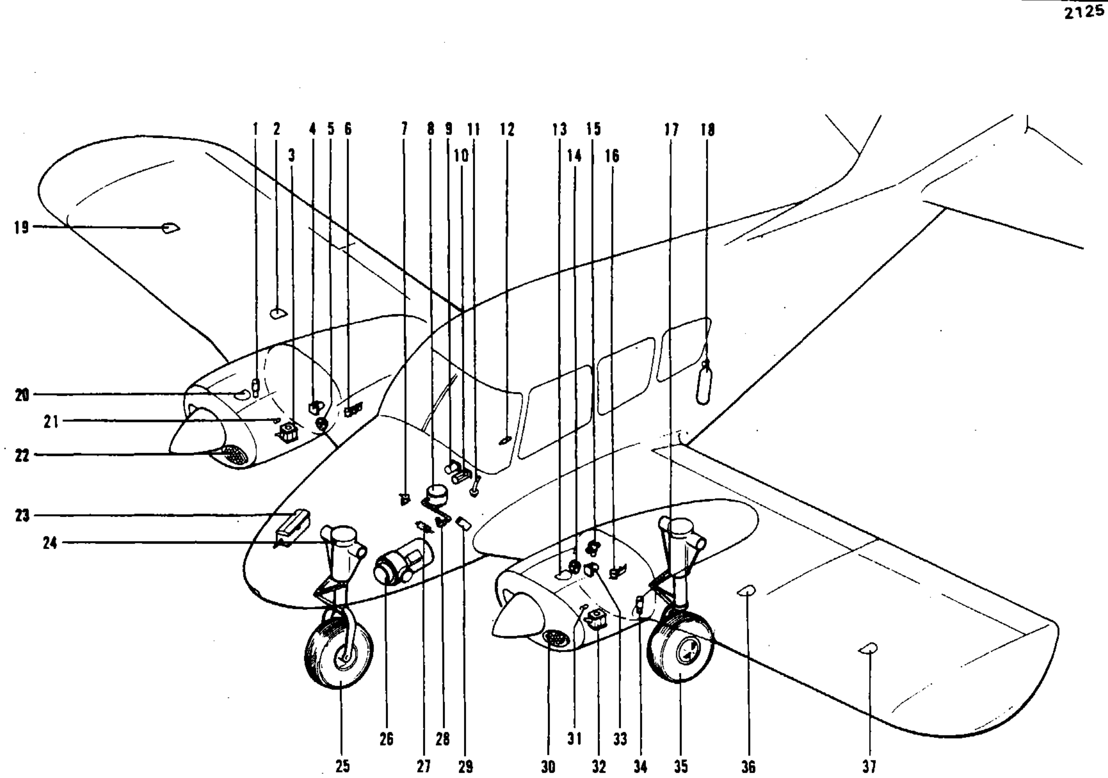
f. Add fluid to the system through the filler tube (refer to Figures 2-19, 2-20 or 2-21) until fluid drips from the overflow located in the nose gear wheel well.

g. Swivel the elbow at the cap end of the filler tube until it points down. Hold the loose end of the filer tube down and let the excess fluid drain off.

h. Recap the filler tube and close the access door or install side panel.

i. Operate the landing gear and flaps through their complete cycle, UP and DOWN at least five times to insure that all air is bled from the system, as indicated by smooth operation of the landing gear and wing flaps.

NOTE: As an added precaution, have a container ready to catch excessive fluid that will be exhausted through the overboard drain in the nose wheel well when recycling landing gear and flaps.



1. COLLECTOR TANK, OIL
2. FILLER, INBOARD FUEL CELL, RIGHT
3. CARBURETOR
4. SCREEN OR FILTER, OIL PRESSURE
5. FILTER, VACUUM REGULATOR
6. STRAINER, FUEL DRAINS
7. STRAINER, HEATER FUEL
8. POWERPAK
9. FILTER, ARTIFICIAL HORIZON (WITHOUT CENTRAL AIR FILTER)
10. FILTER, DIRECTIONAL GYRO (WITHOUT CENTRAL AIR FILTER)
11. DRAIN, CROSSFEED FUEL
12. CYLINDER CO_2
13. OIL FILLER, LEFT ENGINE
14. FILTER, VACUUM REGULATOR
15. FILTER, HYDRAULIC
16. STRAINER, FUEL DRAINS
17. FILLER, OLEO SHOCK STRUT, L AND R
18. CYLINDER OXYGEN
19. FILLER, OUTBOARD FUEL CELL, RIGHT
20. OIL FILLER, RIGHT ENGINE
21. SCREEN, OIL SUCTION
22. FILTER, INDUCTION
23. BATTERY
24. FILLER, OLEO SHOCK STRUT, NOSE
25. TIRE
26. HEATER
27. FILTER, INSTRUMENT AIR
28. FILLER TUBE, POWERPAK
29. RESERVOIR
30. FILTER, INDUCTION
31. SCREEN, OIL SUCTION
32. CARBURETOR
33. SCREEN OR FILTER, OIL PRESSURE
34. COLLECTOR TANK, OIL
35. TIRE
36. FILLER, INBOARD FUEL CELL, LEFT
37. FILLER, OUTBOARD FUEL CELL, LEFT

Figure 2-19. Service Points, PA-23-250 and PA-23-235

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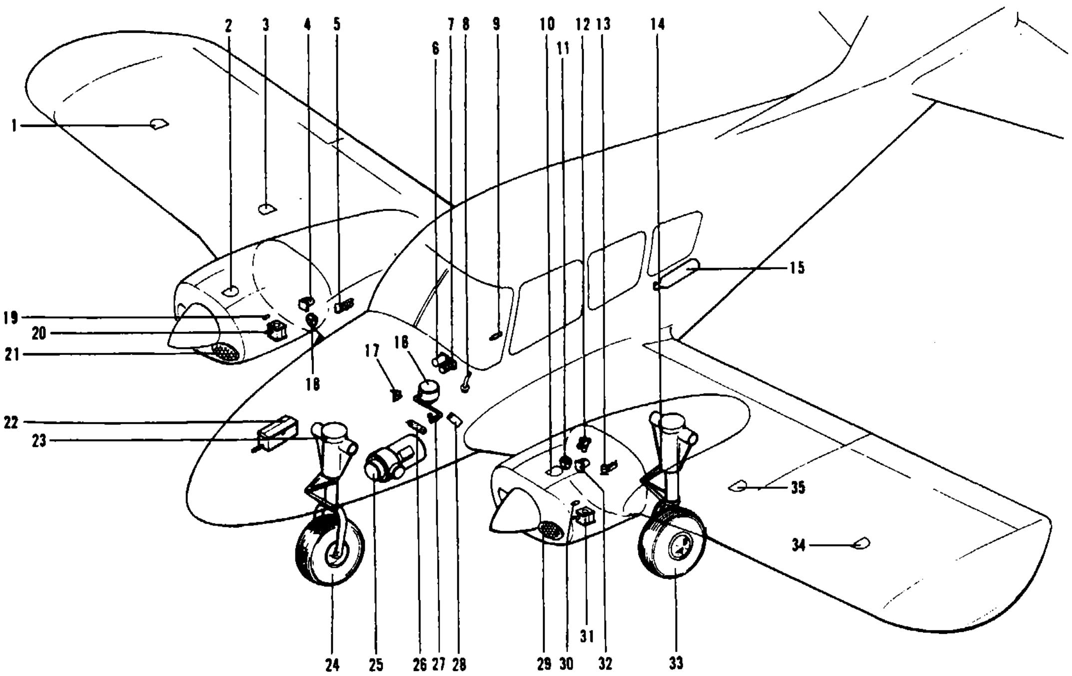
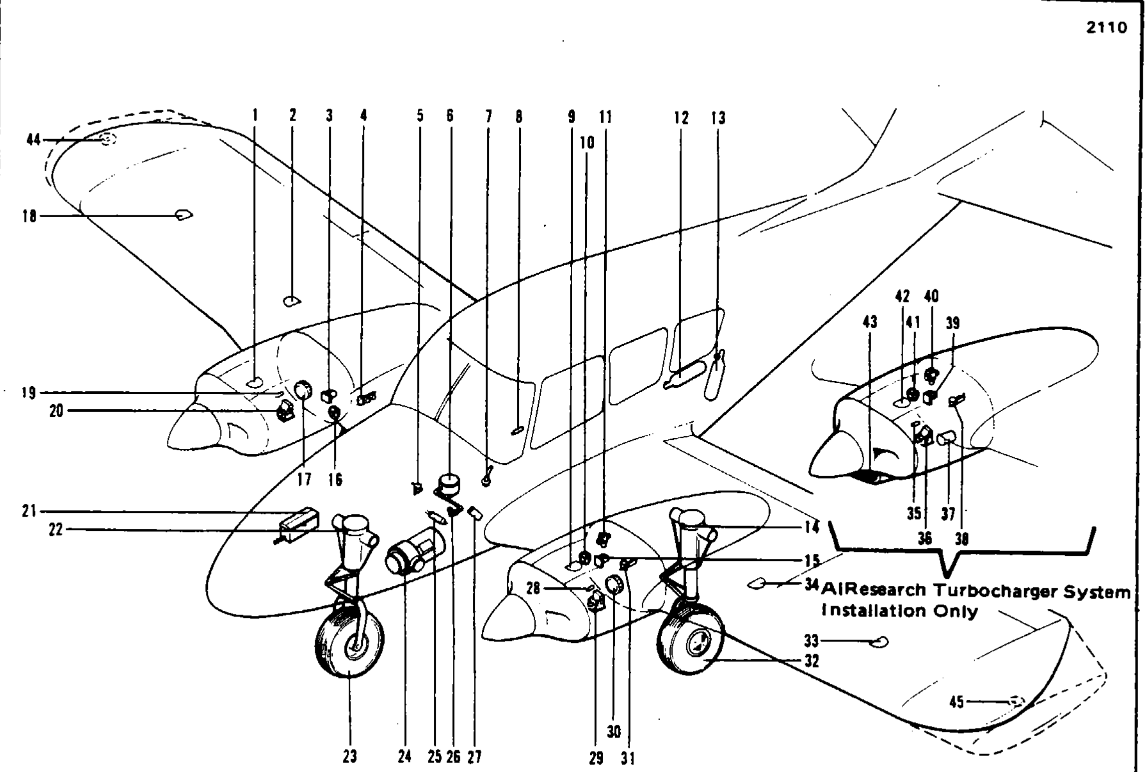


1. FILLER, OUTBOARD FUEL CELL, RIGHT
2. OIL FILLER, RIGHT ENGINE
3. FILLER, INBOARD FUEL CELL, RIGHT
4. SCREEN OR FILTER, OIL PRESSURE
5. STRAINER, FUEL DRAINS
6. FILTER, ARTIFICIAL HORIZON (WITHOUT CENTRAL AIR FILTER)
7. FILTER, DIRECTIONAL GYRO (WITHOUT CENTRAL AIR FILTER)
8. DRAIN, CROSSFEED FUEL
9. CYLINDER CO_2
10. OIL FILLER, LEFT ENGINE
11. FILTER, VACUUM REGULATOR
12. FILTER, HYDRAULIC
13. STRAINER, FUEL DRAINS
14. FILLER, OLEO SHOCK STRUT, L AND R
15. CYLINDER OXYGEN
16. POWERPAK RESERVOIR
17. STRAINER, HEATER FUEL
18. FILTER, VACUUM REGULATOR
19. SCREEN, OIL SUCTION
20. CARBURETOR OR FUEL INJECTOR
21. FILTER, INDUCTION
22. BATTERY
23. FILLER, OLEO SHOCK STRUT, NOSE
24. TIRE
25. HEATER
26. FILTER, INSTRUMENT AIR
27. FILLER TUBE, HYDRAULIC
28. RESERVOIR, BRAKE SYSTEM
29. FILTER, INDUCTION
30. SCREEN, OIL SUCTION
31. CARBURETOR OR FUEL INJECTOR
32. SCREEN OR FILTER, OIL PRESSURE
33. TIRE
34. FILLER, OUTBOARD FUEL CELL, LEFT
35. FILLER, INBOARD FUEL CELL, RIGHT

Figure 2-20. Service Points, PA-23-250 (six place)
Serial Nos. 27-2000 to 27-2504 incl.



1. OIL FILLER, RIGHT ENGINE
2. FILLER, INBOARD FUEL CELL, RIGHT
3. SCREEN OR FILTER, OIL PRESSURE
4. STRAINER, FUEL DRAINS
5. STRAINER, HEATER FUEL (SOUTH WIND HEATER ONLY)
6. POWERPAK RESERVOIR
7. DRAIN, CROSSFEED FUEL
8. CYLINDER CO_2
9. OIL FILLER, LEFT ENGINE
10. FILTER, VACUUM REGULATOR
11. FILTER, HYDRAULIC
12. OXYGEN CYLINDER, SERIAL NOS. 27-2505 TO 27-3049, 27-3051 TO 27-3153
13. OXYGEN CYLINDER, SERIAL NOS. 27-3050, 27-3153 AND UP
14. FILLER, OLEO SHOCK STRUT, L AND R
15. SCREEN OR FILTER, OIL PRESSURE
16. FILTER, VACUUM REGULATOR
17. FILTER, INDUCTION
18. FILLER, OUTBOARD FUEL CELL, RIGHT - WITHOUT TIP FUEL CELL
19. SCREEN, OIL SUCTION, RIGHT ENGINE
20. FUEL INJECTOR, RIGHT ENGINE
21. BATTERY
22. FILLER, OLEO SHOCK STRUT, NOSE
23. TIRE, NOSE
24. HEATER
25. FILTER, INSTRUMENT AIR
26. FILLER TUBE, POWERPAK
27. RESERVOIR, BRAKE SYSTEM
28. SCREEN, OIL SUCTION, LEFT ENGINE
29. FUEL INJECTOR, LEFT ENGINE
30. FILTER, INDUCTION
31. STRAINER, FUEL DRAINS
32. TIRE, L AND R
33. FILLER, OUTBOARD FUEL CELL, LEFT - WITHOUT TIP FUEL CELL
34. FILLER, INBOARD FUEL CELL, LEFT
35. SCREEN, OIL SUCTION
36. FUEL INJECTOR
37. OIL RESERVOIR
38. STRAINER, FUEL DRAINS
39. SCREEN OR FILTER, OIL PRESSURE
40. FILTER, HYDRAULIC
41. FILTER, VACUUM REGULATOR
42. OIL FILLER
43. FILTER, INDUCTION
44. WING TIP FUEL CELL FILLER - RIGHT - SERIAL NOS. 27-7654001 AND UP - OPTIONAL EQUIPMENT
45. WING TIP FUEL CELL FILLER - LEFT - SERIAL NOS. 27-7654001 AND UP - OPTIONAL EQUIPMENT

Figure 2-21. Service Points, PA-23-250 (six place)
Serial Nos. 27-2505 and up

2-49. FILLING POWERPAK RESERVOIR (PRESSURE).

a. Open the access door or remove the left side panel to gain access to the hydraulic filler tube. (Refer to Figure 2-8.)

b. Place the airplane on jacks. (Refer to Jacking, Paragraph 2-12.)

c. Remove the filler tube cap (refer to Figures 2-19, 2-20 or 2-21) and swivel the elbow down.

d. Disconnect the pressure and suction hydraulic lines from the engine driven hydraulic pump and connect these lines to the auxiliary fluid source.

e. Fill the hydraulic system by turning on the motor of the auxiliary fluid source. Fill until fluid overflows the filler tube.

NOTE

Do not cap the filler tube.

f. Turn off the motor of the auxiliary fluid source and operate both the landing gear and flaps at least twice, using the hand pump.

g. With the landing gear retracted and the flaps down start the motor of the auxiliary fluid source and refill the system until the fluid overflows the filler tube.

h. Close the line leading from the reservoir of the auxiliary fluid source to its motor. Start the motor and operate the landing gear and the flap system at least five times.

i. With the landing gear retracted and the flaps down, recheck the fluid level.

j. Extend the landing gear and raise the flaps. Disconnect the auxiliary fluid source and re-attach the lines to the engine driven pump.

k. Recap the filler tube and close the access door or install side panel.

2-50. LANDING GEAR SYSTEM.

2-51. SERVICING LANDING GEAR. The landing gear consisting of tires, brakes, oleo strut assembly, drag links, down locks and gear doors, should be visually inspected to determine proper strut extension, possible hydraulic fluid leakage, security and condition of all related components. Minor service is described in the following paragraphs and detailed service and overhaul instructions are listed in Section VII.

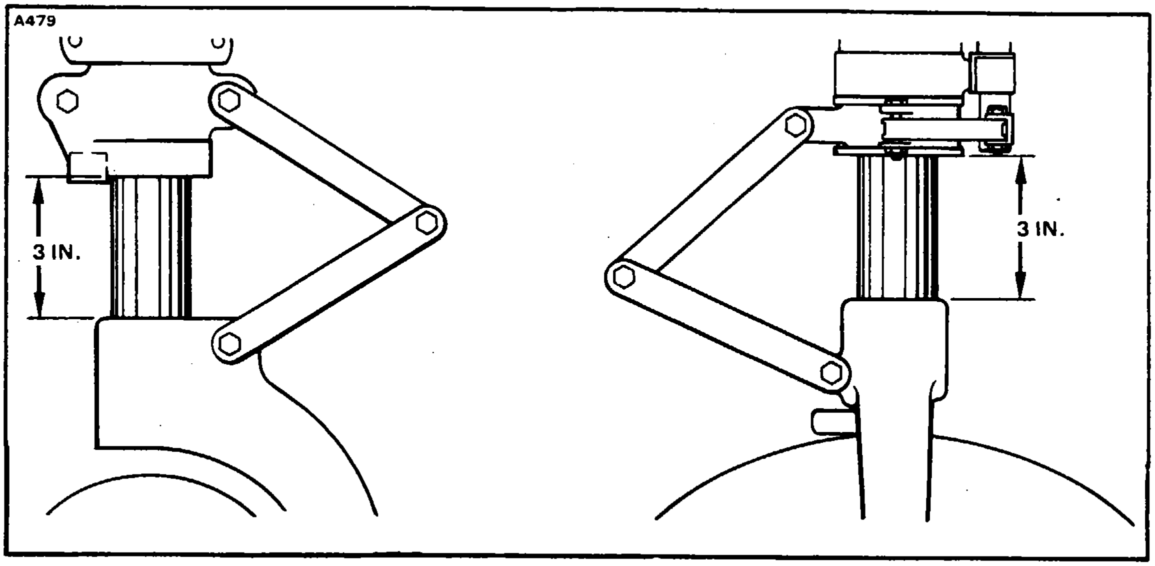


Figure 2-22. Servicing Landing Gear Oleo Struts

2-52. OLEO STRUTS.

2-53. SERVICING OLEO STRUTS. Air-oil shock struts are incorporated in each landing gear oleo assembly to absorb the shock resulting from the impact of the wheels on the runway during landing. To obtain proper oleo action, the nose and main gear oleo struts must have approximately 3.0 inches of piston tube exposed under normal static loads. (Refer to Figure 2-22.) If a strut has less than the required inches exposed, determine whether it needs air or oil by rocking the airplane. If the oleo strut oscillates with short strokes (approximately one inch) and the airplane settles to its normal position within one or two cycles after the rocking force is removed, the oleo strut requires inflating. Check the valve core and filler plug for air leaks, correct if required, and add air as described in paragraph 2-56. If the oleo strut oscillates with long strokes (approximately three inches) and the airplane continues to oscillate after the rocking force is removed, the oleo struts require fluid. Check the oleo for indications of oil leaks, correct if required and add fluid as described in paragraph 2-54. For repair procedures of the landing gear and/or struts, refer to Section VII.

WARNING

Do not release air by removing the strut valve core or filler plug. Depress the valve core pin until strut pressure has diminished.

NOTE

Struts may be serviced per placard on strut.

2-54. ADDING FLUID TO STRUTS. To add fluid to an oleo strut which is partly full, proceed as follows:

a. Place the airplane on jacks. (Refer to Jacking, Paragraph 2-12.)
b. Place a pan under the gear to catch spillage.
c. Release the air in the oleo strut by pressing in on the air valve core pin.
d. Remove the air valve (filler plug). Allow valve core to remain in valve.
e. Extend the strut to two inches from the fully compressed position and fill the strut through the filler opening with fluid as specified.
f. Slowly compress the strut to the fully compressed position allowing fluid to overflow.
g. With oleo strut in the compressed position, reinstall air valve and safety.
h. Inflate the oleo struts with air to the required extension per instructions in paragraph 2-56.

2-55. FILLING OLEO STRUTS. To fill an oleo strut which has been completely emptied because of repair, leakge, etc., proceed as follows:

a. Place the airplane on jacks. (Refer to Jacking, Paragraph 2-12.)
b. Place a pan under the gear to catch spillage.
c. Remove valve core from air valve.
d. Attach a clear plastic tube to the valve stem and place the other end of the tube in a container of hydraulic fluid as specified.

NOTE

An air-tight connection is necessary between the plastic tube and valve stem. Without such a connection, a small amount of air will be sucked into the oleo strut during each sequence, resulting in an inordinate amount of air bubbles and a prolonged filling operation.

e. Extend the oleo strut by pulling down on the wheel. Fluid will be sucked into the oleo strut. Compress and extend the oleo strut until it is full of fluid, and air bubbles cease to appear in the plastic tube.
f. Compress the oleo strut to within 1/4 inch of full compression, allowing the excess fluid to overflow. Reinstall the valve core.
g. Remove the airplane from the jacks.
h. Inflate the oleo struts per instructions given in paragraph 2-56.

2-56. INFLATING OLEO STRUTS. With the proper amount of fluid contained in the strut as described in paragraph 2-53, inflate the strut to the following pressures:

Tire	Tire Pressure (psi)	Strut Pressure (psi)
6.00 x 6 - 4 ply 6.00 x 6 - 6 ply 7.00 x 6 - 8 ply	27 32 46	132 151

NOTE

Strut pressure is with strut fully extended.

2-57. BRAKE SYSTEM.

2-58. SERVICING BRAKE SYSTEM. The brake system incorporates a hydraulic fluid reservoir through which the brake system is periodically serviced. Fluid is drawn from the reservoir by the brake master cylinders to maintain the volume of fluid required for maximum braking efficiency. Spongy brake pedal action is often an indication that the brake fluid reservoir is running low on fluid. Instructions for filling the reservoir are given in paragraph 2-59. When found necessary to accomplish repairs to any of the brake system components, these instructions may be found in Section VII.

2-59. FILLING BRAKE CYLINDER RESERVOIR. The brake cylinder reservoir should be filled to the level marked on reservoir, with the fluid specified in Table II-I. The reservoir, located in the left side of the nose, shown in Figure 2-8 should be checked at every 100 hour inspection and replenished as necessary.

2-60. DRAINING BRAKE SYSTEM. To drain the brake system, connect a hose to the bleeder fitting on the bottom of the cylinder and place the other end of the line in a suitable container. Open the bleeder and slowly pump the desired brake pedal until fluid ceases to flow. To clean the brake system, flush with denatured alcohol.

2-61. TIRES.

2-62. SERVICING TIRES. The tires should be maintained at the pressure specified in Table II-I. When checking tire pressure, examine the tires for wear, cuts, bruises and slippage. (Refer to Card 2I16 Section 7, paragraphs 7-75 and 7-76 for suggestions on tire balancing. See Card 2J3, Figure 7-31 for information concerning construction of a tire balancer.)

2-63. POWER PLANT.

2-64. SERVICING POWER PLANT. The power plants should be visually inspected before each flight to determine possible fuel and oil leakage, and condition and security of all related components. Additional service information may be found in Section VIII or VIIIA.

2-65. INDUCTION AIR FILTER.

2-66. REMOVAL AND INSTALLATION OF AIR FILTER.

a. On PA-23-250, PA-23-235 and PA-23-250 (six place) airplanes with Serial Numbers 27-1 to 27-2504 inclusive, the air filter may be removed and installed by the following procedure:

1. Remove the scoop assembly from the bottom front of the nacelle.
2. Remove the air filter by turning the quick disconnect wing nut fasteners.
3. Install the air filter in reverse order of removal.

b. On PA-23-250 (six place) airplanes with Serial Number 27-2505 and up, that are not equipped with turbocharging units, the air filter may be removed and installed by the following procedure:

1. Remove the cover plate from the air filter box by turning the quick disconnect wing nut fasteners.
2. Remove the filter from the box.
3. Install the air filter.

c. On PA-23-250 (six place) airplanes with Serial Numbers 27-2505 and up, that are equipped with AiResearch turbocharging units, the air filter may be removed by the following procedure:

1. Loosen the quarter turn fasteners.
2. Lower the air scoop and remove the filter.
3. Install a new air filter or cleaned one in reverse order of removal.

d. On PA-23-250 (six place), Serial Nos. 27-3944 and up, that are equipped with Lycoming Turbocharging units, the air filter may be removed by the following procedure:

1. Remove the right and top engine access panels from the engine the filter is to be removed.
2. Remove the two machine screws from the securing brackets on both sides of the filter box and remove the filter.
3. Install a new air filter or a cleaned one in reverse order of removal.

2-67. SERVICE INSTRUCTIONS. The induction air filters should be cleaned every 50 hours or sooner depending upon operating conditions. Filters should be rejected for use if the paper filter material is torn or ruptured, or the housing is damaged. The filter gasket should have no tears and be securely positioned in place.

a. The cartridge type air filters should be cleaned by the following procedure:

1. Remove filter, inspect, and clean by tapping it against a hard surface to remove grit, sand and dirt. (Do not blow out with an air hose, soak in oil, or cleaning fluid.)

2. If the filter is found to be in good condition and is not obstructed after being properly cleaned, reinstall filter.

b. The panel type filter installed only on airplanes equipped with turbocharging units may be cleaned by one of two basic methods, the compressed air method and the washing method. The compressed air method is effective when the major contamination on the panel is dust. The washing method is effective on carbon, soot and oil laden filters. Accumulation of exhaust soot (fine carbon particles) collects on the filter and causes a rapid increase in restriction or short filter life. For best results, visually determine condition of filter and choose either method. This choise will also depend on the availability of the cleaning equipment.

1. The compressed air method of cleaning the filter is as follows:
   (a) With the filter removed, direct a jet of air against the downstream or clean air side of the filter (opposite to normal airflow).
   (b) Move the air jet up and down the pleats, moving air jet over the complete filter.
   (c) Nozzle pressure must not exceed 100 psi and be kept at least one inch away from filter. Take care that the paper is not ruptured by the nozzle or air jet.
2. The washing method of cleaning the filter is as follows:
   (a) If compressed air is available, blow the filter as given in (a).
   (b) The filter can be cleaned by washing in a good non-sudsing detergent or the filter manufacturer's cleaner D-1400. Mix two ounces of D-1400 to one gallon of water.
   (c) Soak filter in solution for 15 minutes, then move filter back and forth about two minutes to free filter of dirt deposits.
   (d) Rinse complete filter in a stream of water until rinse water is clear. (Maximum water pressure 40 psi.) A good thorough rinse is very important.
   (e) Dry filter thoroughly before re-using. Do not use light bulbs or extreme heat for drying.

2-68. PROPELLER.

2-69. SERVICING PROPELLER. The propeller blades, spinner and visible hub parts should be inspected frequently for damage, cracks and oil leakage. Propellers containing an air charge should be checked for proper air pressure as given in Table II-VIII below. The air charge should be free of moisture. Use dry nitrogen gas if available. Nicks should be removed from the leading edge of the blades in accordance with applicable FAA regulations. The blades should be checked that they turn freely on the hub pilot tube, by rocking the blades back and forth through the slight freedom allowed by the pitch change mechanism. Lubricate the propeller at 100 hour intervals according to the Lubrication Charts, Figures 2-25, 2-26 and 2-27. Additional Service Information for the propeller may be found in Section VIII or VIIIA.

A spring backup kit for HC-E2YK-2RB and HC-E2YR-2RB propellers is available to safeguard against an overspeed due to loss of the air charge. This spring produces sufficient force to control propeller rpm, within normal operating range, provided airspeed is reduced and power is applied slowly. Propellers which have this kit installed will have the letter "S" after the hub dash number (HC-E2YK-2RBS or HC-E2YR-2RBS). When servicing propellers make certain that the propellers have the proper air charge, according to the following charts.

TABLE II-VIII. CHAMBER PRESSURE REQUIREMENTS WITH TEMPERATURE

HC-E2YK-2RB or HC-E2YR-2RB			
Temp. °F	Press. (psi)	Temp. °F	Press. (psi)
100	188	30	165
90	185	20	162
80	182	10	159
70	178	0	154
60	175	-10	152
50	172	-30	146

HC-E2YK-2RBS, HC-E2YK-2RBSF or HC-E2YR-2RBS	
Temp. °F	Press. (psi)
100	74
70	70
40	66
10	62
-20	58

NOTE: Do not check pressure or charge with propeller in feather position.

2-70. FUEL SYSTEM.

2-71. SERVICING FUEL SYSTEM. At intervals of 50 hours or 90 days, whichever comes first, clean the screens and bowl in each fuel filter unit located between each bottom wing inboard gear door and fuselage. Remove and clean the filters in accordance with the instructions outlined in Section IX. Additional service information may also be found in Section IX. Inspection intervals of the various fuel system components may be found in Section III.

2-72. FILLING FUEL CELLS. Observe all required precautions for handling gasoline. Fill the fuel cells to the bottom of the filler neck with the fuel specified in Table 11-I. Refer to Figure 2-8 for the location of the access panels for the fuel cells.

WARNING: WHEN REPLACING A FILLER CAP THAT IS WORN, ASCERTAIN THAT THE CAP IS CORRECT FOR THE MODEL IN QUESTION. EARLY MODELS HAVE CAPS WITH VENTS. LATER ONES HAVE CAPS WITHOUT VENTS IN THEM. SEE FIGURES 9-9 AND 9-10 IN SECTION 9.

NOTE: PA-23-235's and PA-23-250 S/N's 27-1 thru 27-7554168 only are equipped with adjustable "Thermos Bottle" type fuel cell caps. Check these caps frequently to ensure that tension is sufficient to prevent looseness of the caps in the fuel cell filler neck. Looseness of these caps in the filler neck may result in loss of fuel, erratic indication of fuel gauges and possible collapse of fuel cells. The tension of these caps is maintained by turning the locking handle of the cap in a clockwise direction to increase tension and anti-clockwise to decrease tension.

2-73. DRAINING MOISTURE FROM FUEL SYSTEM.

a. Drain the crossfeed fuel valve by turning the crossfeed line drain control located on the front of the fuel panel selector control box which is between the two front seats.

b. The strainers and fuel line drains may be reached by opening the access panel located on the inboard sides of the main wheel wells. (Refer to Figure 2-8.) To drain, push up the easy drain valves.

2-74. DRAINING FUEL SYSTEM. Drain the bulk of the fuel from the system by pumping the fuel out of each cell through the filler opening with an electric fuel pump. Complete the draining by opening the crossfeed line drain control. Drain the inboard cells first; then move the fuel selectors to the outboard position, thus allowing the outboard cells to drain through the crossfeed line drain. For an alternate draining procedure, open the fuel line quick drain valves and the fuel strainer bowl drain valve or remove the fuel strainer bowl and allow the fuel to run out by gravity.

2-75. OXYGEN SYSTEM.

2-76. SERVICING OXYGEN SYSTEM. The oxygen for the breathing system is furnished from a stationary cylinder charged to a pressure of 1800 psi with a capacity of 48.3 cubic feet for (DOT 3AA 1800 classification), or 1850 psi with a capacity of 15 cubic feet for (DOT 3HT 1850 classification).

a. On PA-23-250 airplanes the oxygen bottle is installed in the aft cabin area on the left side where the fifth seat is normally installed. These cylinders are serviced at the cylinder regulator by removing the regulator outlet line.

b. On airplanes with Serial Numbers 27-2000 to 27-3049 and 27-3051 to 27-3153 inclusive, the oxygen is installed under the aft baggage compartment floor, on the right side. These airplanes are serviced through a remote charging valve located in the forward right side of the baggage compartment floor.

c. On airplanes with Serial Numbers 27-3050, 27-3154 to 27-3403 inclusive, except those modified by kit Piper No. 757050, the oxygen bottle is installed in a nearly vertical position on the left side of the aft baggage compartment. These airplanes are serviced at the cylinder regulator by removing the pressure gauge line at the cylinder regulator. The gauge line is copper and is the smaller of the two lines coming from the regulator.

NOTE

To refill the oxygen systems, an oxygen filler coupling, Part No. 757 810, is needed.

d. On airplanes with modification kit Piper No. 757050 and Serial Numbers 27-3404 and up, the oxygen bottle is located in a nearly vertical position on the left side of the aft baggage compartment. These airplanes are serviced from outside the airplane on the left side at station 193.38.

e. The plastic disposable mask and its components should be kept in its polifilm envelope, or a suitable container when not in use, so that they will be kept dust free and not distorted by heat or pressure for satisfactory service. Plastic disposable masks may be worn many times by the same person.

2-77. OXYGEN SYSTEM SAFETY PRECAUTIONS. The utmost care must be exercised in servicing, handling and inspection of the oxygen system. Comply with the following precautions:

a. Keep the oxygen regulators, cylinders, gauges, valves, fittings, masks and all other components of the oxygen system free of oil, grease, gasoline and all other readily combustible substances.

b. Do not allow foreign matter to enter the oxygen lines.

WARNING

The presence of foreign matter in the high pressure lines can cause an explosion. When coming in contact with oxygen equipment, keep hands, tools and clothing clean - hospital clean.

c. Never attempt to repair or repaint oxygen equipment.

d. Keep fire and heat away from oxygen equipment. Do not smoke while working with or near oxygen equipment and take care not to generate sparks with carelessly handled tools when working on the oxygen system.

e. Never allow electrical equipment to come in contact with the oxygen cylinder.

f. Use Ribbon Dope Thread Sealant (Permacel 412) on male ends of fittings only. Wrap thread in direction of thread spiral, beginning with the second thread on the fitting. Do not allow sealant to get into the lines. See Consumable Materials Chart.

TABLE II-IX. INDICATED OXYGEN CYLINDER PRESSURES VS. AMBIENT TEMPERATURE

Ambient Temperature - °F	Indicated Cylinder Pressure - Psig
110	1980
100	1935
90	1890
80	1845
70	1800
60	1755
50	1710
40	1665

NOTE

These pressures are not exact, but sufficiently accurate for practical purposes for working pressures between 1800 and 2400 psig cylinders.

2-78. FILLING OXYGEN CYLINDER.

a. To fill the oxygen cylinder, remove the cap from the filler valve and attach the filler hose from the oxygen recharge unit to the filler valve. Ascertain that all fittings are free from oil, grease, dirt, etc. The oxygen cylinder must be removed to refill if there is no filler valve. Otherwise, the procedure is the same.

NOTE

If the airplane's oxygen cylinder pressure is below 50 psi, the system should be purged as described in Section XIV.

b. When using a recharge unit consisting of one supply cylinder, slowly open the valve of the supply unit and allow the oxygen to transfer until the service pressure for the cylinder is reached. Ambient temperature must be considered when filling oxygen cylinders. Refer to Table II-IX for the appropriate filling pressure for the prevailing ambient temperature.

c. When using a recharge unit consisting of two or more supply cylinders (cascade storage system), it is recommended that the following procedure be used:

1. Before opening any valves, check the pressure remaining in the airplane's oxygen cylinder. If it is still partly charged, note the pressure indicated on the cylinder gauge. Then open and close each valve on the cascade storage system and determine which cylinder has the lowest pressure. When found, if this cylinder has a pressure lower than the oxygen cylinder in the airplane, do not attempt using it for filling. Use the storage cylinder that has a pressure higher than the airplane's cylinder but lower than the others.

2. Open the valve on only the one storage cylinder with the lowest pressure. When the pressure indicated on the airplane's oxygen gauge and charging gauge has become equal, close the valve of the storage cylinder; then go to the storage cylinder with the next higher pressure and repeat the procedure.
3. If, after using the last storage cylinder, the airplane's oxygen system is still not fully charged, a full storage cylinder should be put in place of a cylinder with the lowest pressure and used in the same manner.
4. A good deal of oxygen will remain in the large cylinders used in the cascade system after filling only one of the cylinders, but such remaining oxygen will be at a pressure something less than the 1800 pounds, which is not sufficient pressure to completely refill another aircraft cylinder, although it will refill several smaller cylinders.
5. It is not economical, even on a three or four-cylinder cascade system, to begin recharging with oxygen at less thai 300 psi pressure in the 300 cubic foot bank of cylinders. So, use 300 cubic foot cylinders down to approximately 300 psi; then return for refiIling. In two-cylinder systems, use to approximately 600 psi; then return for refilling.

d. When the pressure gauge on the recharge unit or in the airplane reaches the appropriate service pressure, close the pressure regulator valve on the recharge unit. Disconnect the filler hose from the filler valve; replace the protective cap on the filler valve and close the access cover.

NOTE: Refer to Section XIV for detailed service instructions of oxygen system components.

2-79. LUBRICATION.

2-80. OIL SYSTEM (ENGINE).

2-81. SERVICING OIL SYSTEM.

The engine oil level should be checked before each flight and oil and filter (cartridge type) changed after each 50 hours of engine operation or every four months. During oil change, the oil pressure and suction screen should be removed and cleaned. Should fuel other than the specified octane rating for the power plant be used, refer to latest Lycoming Service Letter No. L185 for additional information and recommended service procedures.

2-82. DRAINING OIL SUMP.

To drain oil sump, provide a suitable container with a minimum capacity of 12 quarts. Remove the left side panel from the engine cowl and open the oil drain valve located on the forward left underside of the engine by pushing the arms of the drain up and turning counterclockwise. This will hold the drain in the open position. It is recommended the engine be warmed to operating temperature to insure complete draining of the old oil.

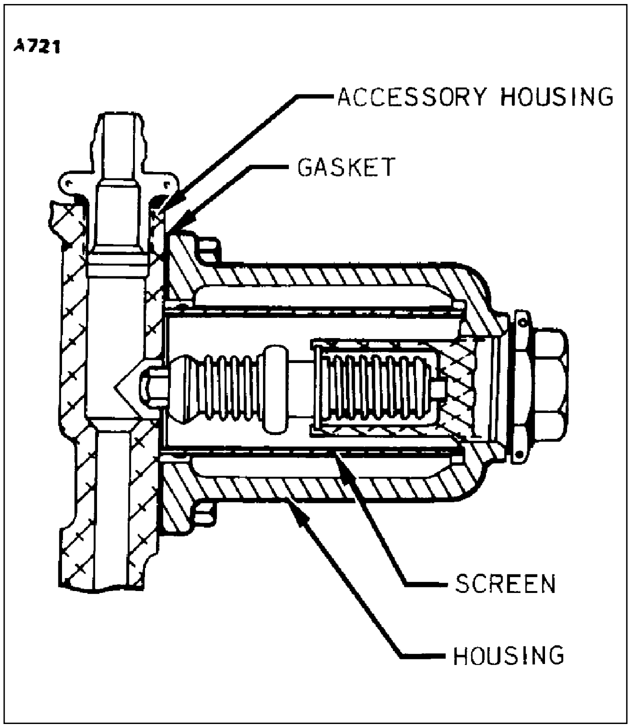


Figure 2-23. Oil Pressure Screen

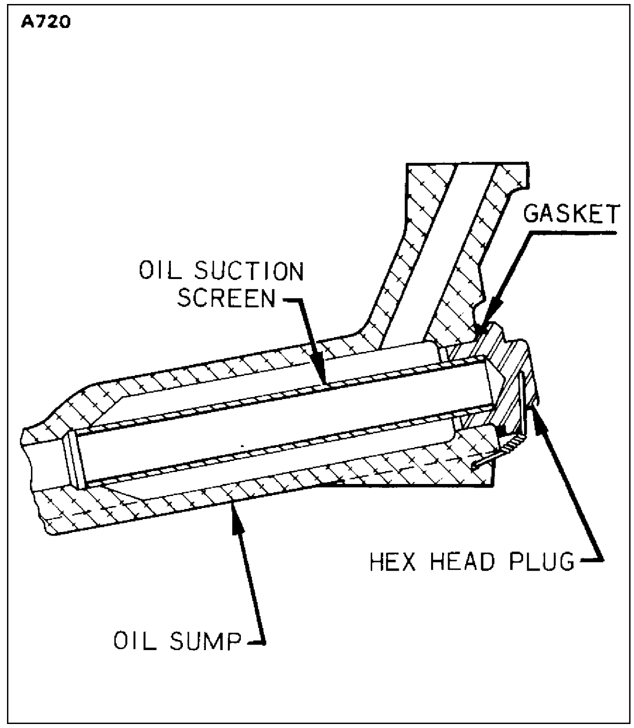


Figure 2-24. Oil Suction Screen

2-83. FILLING OIL SUMP.

The oil sump should normally be filled with oil to the U.S. quart mark on the engine dipstick. The specified grade of oil may be found in Table 11-X, the Lubrication Chart or on each engine oil filler access door. To service the engine with oil, open the quick release access door on top of the nacelle and remove the oil filler cap with dipstick.

2-84. OIL SCREEN (PRESSURE). (Refer to Figure 2-23.)

On airplanes without full flow oil filters, the pressure screen located in a housing on the accessory case of the engine between the magnetos should be cleaned at each oil change to remove any accumulation of sludge and to examine for metal filings or chips. If metal particles are found in the screen, the engine should be examined for internal damage. The pressure screen is removed by disconnecting the temperature indicator wire and removing the four hex head bolts that secure the screen housing to the accessory case. Clean and inspect the screen. Reinstall by first ascertaining that the screen fits flush with the base of the housing. Install the screen and housing to the accessory case using a new gasket; torque the attaching bolts, 50 to 70 inch-pounds.

2-85. OIL FILTER, FULL FLOW.

a. The oil filter cartridge should be replaced after each fifty hours of engine operation or every four months; this is accomplished by removing the lockwire from the bolt-head at the end of the filter housing, loosening the bolt, and removing the filter assembly from the adapter. If the filter is a spin on type, simply turn it counterclockwise to remove.

b. Before discarding the filter cartridge, remove the outer perforated paper cover, and using a sharp knife, cut through the folds of the element at both ends, close to the metal caps. Then, carefully unfold the pleated cartridge and examine the material trapped in the filter for evidence of internal engine damage such as chips or particles from bearings. In new or newly overhauled engines, some small particle of metallic shavings might be found; these are generally of no consequence and should not be confused with particles produced by impacting, abrasion or pressure. Evidence of internal engine damage found in the oil filter justifies further examination to determine the cause. Champion cutter tool CT-470 (available from Champion Spark Plug Co., Toledo, Ohio 43601) may be used to cut open any spin-on type oil filter for inspection.

c. After the cartridge has been replaced, tighten the attaching bolt within 20 to 25 foot-pounds torque. Lockwire (MS-20995C-41) the bolt through the loops on the side of the housing to the drilled head of the thermostatic valve. Be sure the lockwire is replaced at both the attaching bolt head and the thermostatic oil cooler bypass valve. (Replacement filter element assembly, P/N AC6435683.)

d. To install a spin-on filter, lubricate the gasket of the filter with a thin coating of DOW Corning Compound (DC-4) and install on the adapter making sure that gasket is in place. Hand tighten the filter until the gasket just makes contact with the seating surface of the adapter and then turn an additional 3/4 to 7/8 of a turn with torque wrench until a torque of 18-20 foot-pounds is reached.

e. Run engine until warm. SHUT OFF ENGINE FIRST, then check filter for oil leaks.

2-86. OIL SCREEN (SUCTION). The suction screen located in the rear of the sump, should be cleaned at each oil change to remove any accumulation of sludge and to examine for metal filings or chips. If metal particles are found in the screen, the engine should be examined for internal damage. The screen is removed from the sump by cutting the safety wire and removing the hex head plug. Clean and inspect the screen and gasket, and replace the gasket if overcompressed. To eliminate damage to the screen, place it inside the recess in the hex head plug before inserting the assembly in the sump. Exercise care to permit screen to enter recess in sump as shown in Figure 2-24 before tightening plug. As above, any appearance of difficult threading of the plug is indicative of an incorrect installation and the process must be repeated. After installation, safety the hex head plug with MS-20995-C41.

2-87. RECOMMENDATIONS FOR CHANGING OIL. (Refer to latest revision of Lycoming Service Instruction No. 1014.)

a. In engines that have been operating on straight mineral oil for several hundred hours, a change to additive oil should be made with a degree of caution, since the cleaning action of some additive oils will tend to loosen sludge deposits and cause plugged oil passages. When an engine has been operating on straight mineral oil and is known to be in excessively dirty condition, the switch to additive or compounded oil should be deferred until after the engine is overhauled.

b. When changing from straight mineral oil to compounded oil, the following precautionary steps should be taken:

1. Do not add additive oil to straight mineral oil. Drain the straight mineral oil from the engine and fill with additive oil.
2. Do not operate the engine longer than five hours before the first oil change.
3. Check all oil screens for evidence of sludge or plugging. Change oil every 10 hours if sludge conditions are evident. Resume normal oil drain periods after sludge conditions improve.

2-88. LUBRICATION INSTRUCTIONS.

Proper lubrication procedures are of immeasurable value both as a means of prolonging the service life of the airplane and as a means of reducing the frequency of extensive and expensive repairs. The periodic application of recommended lubricants to their relevant bearing surfaces, together with the observance of cleanliness, will ensure the maximum efficiency and utmost serive of all moving parts. Instructions regarding the locations, time intervals, and type of lubricants used may be found in the Lubrication Charts. See also Table II-II, Consumable Materials.

NOTE: If the airplane is inactive for long periods of time, it should be lubricated in accordance with the Lubrication Charts every 90 days.

2-89. PRECAUTIONS

To ensure the best possible results from the application of lubricants, the following precautions should be observed.:

CAUTION: MIL-PRF-23827 AND MIL-PRF-81322, CONTAIN CHEMICALS WHICH MAY BE HARMFUL TO PAINTED SEURFACES.

CAUTION: DRY LUBRICANT (I.E. - PTFE BASED MS-122) WILL ATTACK ANY ACRYLIC BASED PLASTIC (LUCITE), POLYCARBONATES (LEXAN), POLYSTYRENE AND ITS COPOLYMERS (ABS), AND CELLULOSE ACETATE.

CAUTION: AFTER THOROUGHLY WASHING AIRPLANE, ENSURE LANDING GEAR, FLIGHT CONTROLS, FLAP TRACKS, STABILATOR TRIM SCREW, AND ENGINE COMPARTMENT ARE STILL PROPERLY LUBRICATED.

a. Use only recommended lubricants. Where general purpose lubricating oil is specified, but unavailable, clean reciprocating engine oil is a satisfactory substitute.

b. Check components for evidence of excessive wear and replace as necessary.

c. Remove all excess lubricants from components to prevent collecting dirt and sand in abrasive quantities capable of causing excessive wear or damage to bearing surfaces.

2-90. APPLICATION OF GREASE.

When lubricating bearings and bearing surfaces with a grease gun, care must be taken to ensure that gun is filled with new, clean grease of the grade specified for the particular application, before applying lubricant to the grease fittings.

a. If a reservoir is not provided around a bearing, apply lubricant sparingly and wipe off excess.

b. Remove wheel bearings from wheel hub and clean thoroughly with suitable solvent. When repacking with grease, ensure lubricant enters space between rollers in retainer ring. Do not pack grease into wheel hub.

c. Use extra care when greasing constant speed propeller hub to avoid blowing clamp gaskets. Remove one grease fitting while applying grease to other fitting until fresh grease appears at hole of removed fitting. Uneven greasing effects propeller balance.

2-91. APPLICATION OF OIL.

Whenever specific instructions for lubrication of mechanisms requiring lubrication are not available, observe the following precautions:

a. Apply oil sparingly, never apply more than enough to coat bearing surfaces.

b. Do not oil control cables.

c. Squeeze the magneto cam follower felts at regular inspection periods. If oil appears on fingers, do not add oil. If the felt is dry, moisten with light oil.

2-92. LUBRICATION OF THREADS.

Lubricate all fittings on external lines, including attachment points at engine and other components, with proper lubricant (specified in Table II-XI).

When applying thread lubricants, proceed as follows:

a. Thoroughly clean threads before applying lubricant.

b. Use thread lubricant sparingly.

c. Apply thread lubricant to male threads only.

d. Lubricate first three threads only on straight fittings.

e. Do not lubricate first two threads on tapered fittings; apply lubricant to next three threads only.

f. Ensure lubricant does not enter fittings or flared areas.

g. Lubricate any fittings going to engine with same fluid going through lines.

2-93. LUBRICATION CHARTS. (PIR-PPS65103-134, Rev. New.)

The lubrication charts (Figures 2-25 thru 2-27) consist of individual illustrations for the various aircraft systems. Each component to be lubricated is indicated by a number, the type of lubricant, the frequency of application, and special instructions, if any.

NOTE: When the average ambient air temperature is approximately at the dividing line, use the lighter oil.

While the specified lubricant should be used if available, lubricants listed in the Lubrication Charts should all be considered “or equivalent.” Lubricant specifications become problematic over time. Where a specific product is called out, that manufacturer may go out of business, may be sold, or renamed. The named product may subsequently be no longer available, or renamed itself. Many lubricant military specifications have been superceded over the last several years. Accordingly, a cross-reference chart (Table II-XII) is provided for lubricants where specification or product changes have been identified.

TABLE II-XI. THREAD LUBRICANTS

Line	Lubricant
Brakes	MIL-PRF-5606
WARNING: DO NOT PERMIT MIL-T-5544 ANTI-SEIZE COMPOUND TO ENTER SYSTEM. APPLY TO FITTING THREADS ONLY.	
Air Conditioning Refrigerant	MIL -T-5544, Anti-Seize, Compound, Graphite Petrolatum
Fuel	MIL -T-5544, Anti-Seize, Compound, Graphite Petrolatum
Landing Gear Air Valve	MIL-PRF-907E, Anti-Seize, Thread Compound, High Temperature
Oil	SAE-AMS-G-6032, Grease (Gasoline and Oil Resistant)
Pitot and Static	TT-A-580 (TT-S-1732). Anti-Seize Compound
CAUTION: LUBRICATE ENGINE FITTINGS ONLY WITH THE FLUID CONTAINED IN THE PARTICULAR LINE.	

TABLE II-XII. LUBRICANT SPECIFICATION CROSS-REFERENCE

Old Spec / Product	superceded by	New Spec / Product	Product Type
MIL-C-16173		MIL-PRF-16173E	Corrosion Preventative Compound, Solvent Cutback, Cold Application.
MIL-G-3278		MIL-PRF-23827C	Grease, Aircraft & Instrument, Gear and Actuator Screw.
MIL-G-3545		MIL-PRF-81322G	Grease, Aircraft, General Purpose, Wide Temp. (-54 to 177 Degrees C) (-65 to 350 Degrees F).
MIL-G-6032		SAE-AMS-G-6032	Grease, Plug Valve, Gasoline & Oil Resistant.
MIL-G-7711		MIL-PRF-81322G	See MIL-PRF-81322G above.
MIL-G-18709		DOD-G-24508	Grease, High Perfomance, Multipurpose.
MIL-G-23827C		MIL-PRF-23827C	See MIL-PRF-23827C above.
MIL-G-81322		MIL-PRF-81322G	See MIL-PRF-81322G above.
MIL-H-5606		MIL-PRF-5606H	Hydraulic Fluid, Petroleum Base, Aircraft, Missile, and Ordnance.

TABLE II-XII. LUBRICANT SPECIFICATION CROSS-REFERENCE (CONT.)

Old Spec / Product superceded by	**New Spec / Product**	**Product Type**
MIL-L-6082	SAE J 1966	Oil, Lubricating, Aircraft Piston Engine (Non-Dispersant Mineral Oil).
MIL-L-7870	MIL-PRF-7870C	Oil, Lubricating, Low Temp.
MIL-L-22851	SAE J 1899	Oil, Lubricating, Aircraft Piston Engine (Ashless Dispersant).
MIL-L-25567	MIL-PRF-25567	Leak Detection Compound, Oxygen Systems.
MIL-L-60326	MS-122AD *	Dry-Lubricant.
MIL-M-7866	SAE-AMS-M-7866	Molybdenum Disulfide, Technical, Lubrication Grade.
MIL-S-11031B	A-A-59293	Adhesive (Curing), Sealing Compound (Polysulfide Base).
MIL-S-22473	ASTM-D-5363	Adhesive, Anaerobic Single-Component.
MIL-S-8660	SAE-AS-8660	Silicone Compound, Nato S-736, (-54 to 204 Degrees C) (-65 to 400 Degrees F)
MIL-T-5544	SAE-AMS-2518	Thread Compound, Anti-Seize, Graphite-Petrolatum
MIL-T-27730	A-A-58092	Tape, Anti-Seize, Polytetrafluoroethylene
MS-122 *	MS-122AD *	Dry-Lubricant
MS-122-6075 *	MS-122AD *	Dry-Lubricant
Parker O-Ring Lube *	Parker O-LUBE *	O-Ring Lubricant
Parker 6PB * or 6PB Parker *	MIL-PRF-907E (aka Kopr-Kote *)	Anti-Seize Thread Compound, High Temp. (up to 566 Degrees C) (up to 1050 Degrees F)
TT-A-580 (JAN-A-669)	TT-A-580 (TT-S-1732)	Sealing Compound, Pipe Joint and Thread, Lead Free, General Purpose.
* Product Nomenclature		

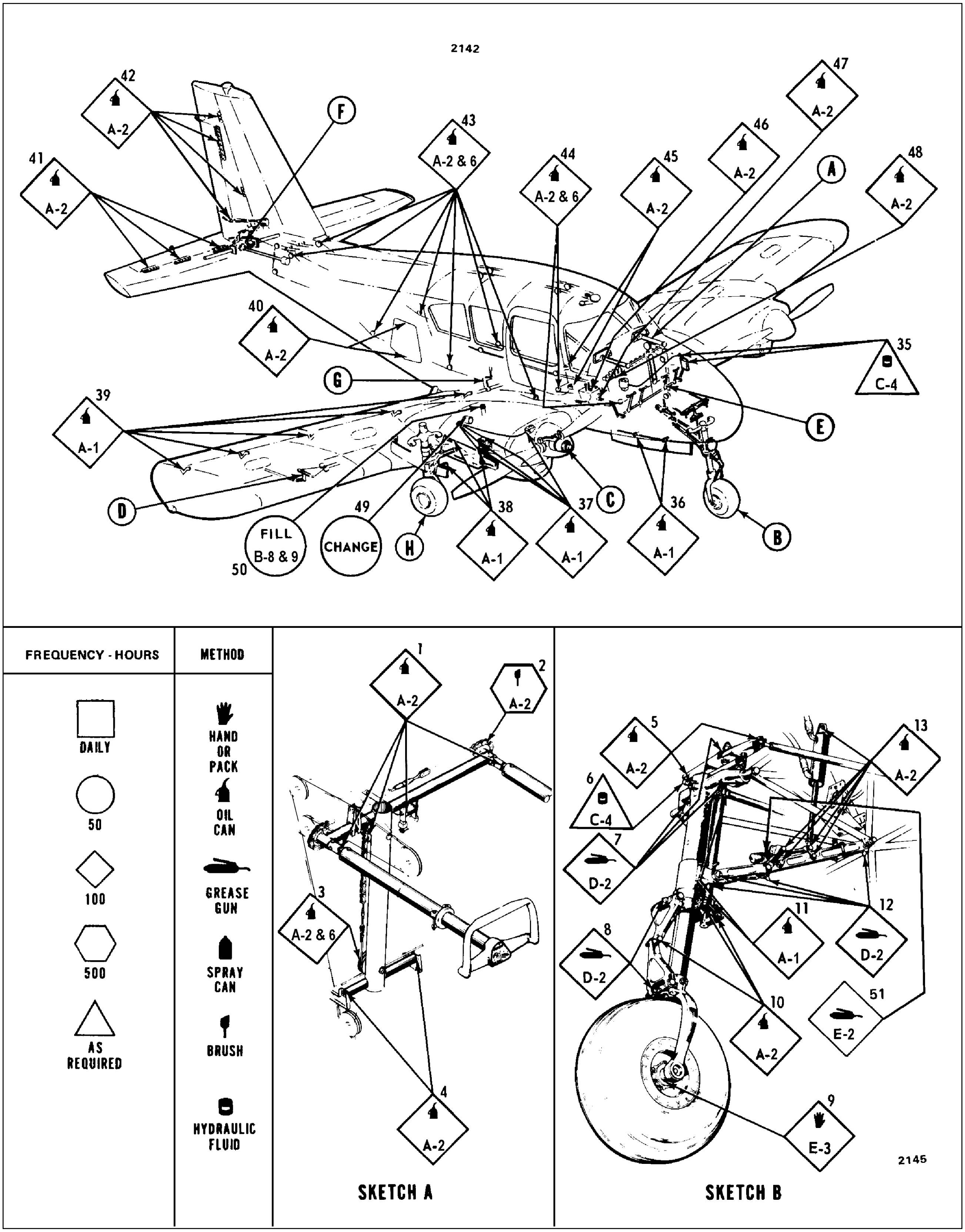


Figure 2-25. Lubrication Chart, PA-23-250 and PA-23-235

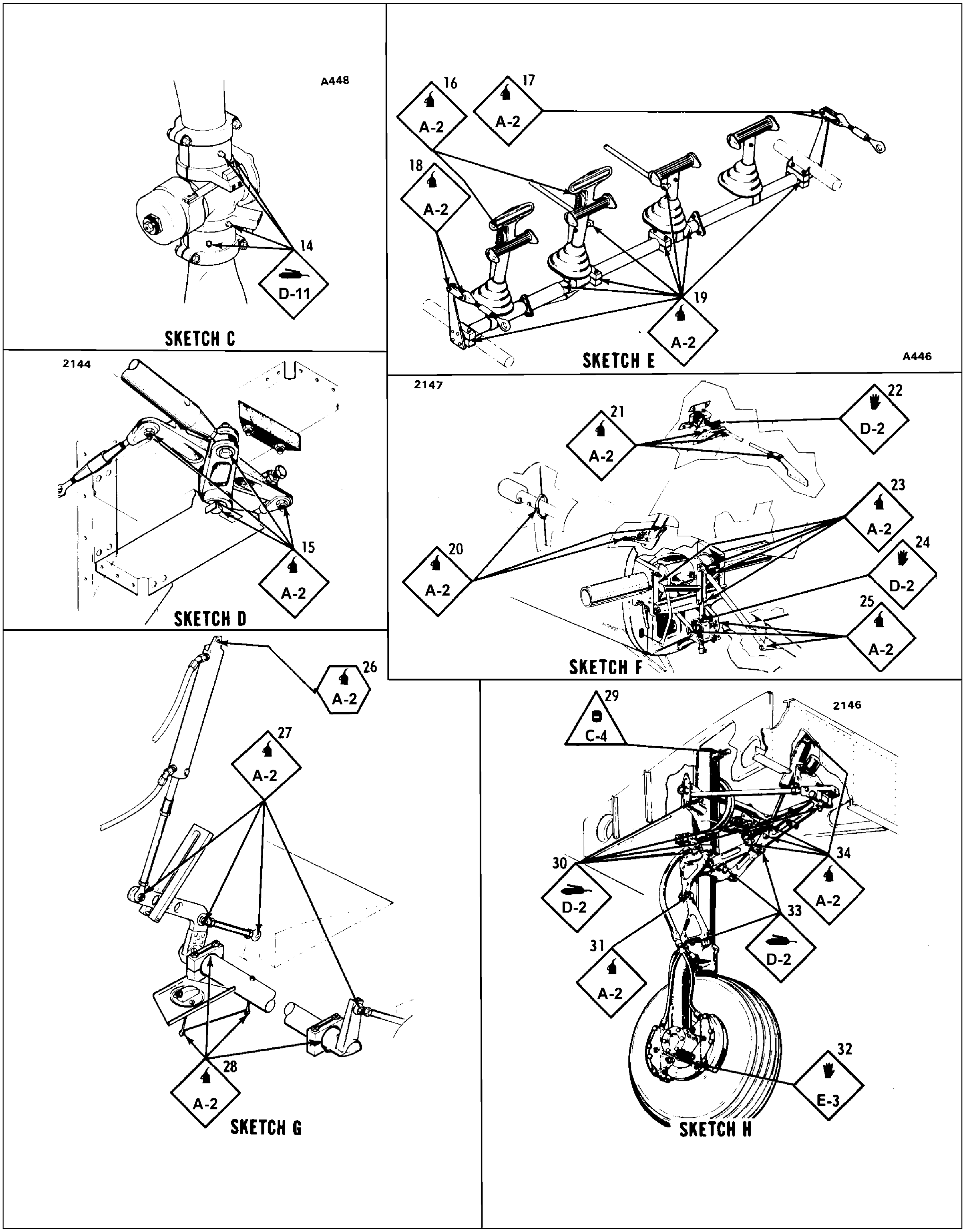
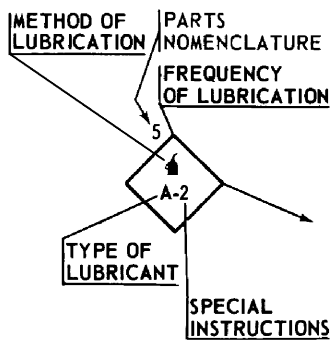


Figure 2-25. Lubrication Chart, PA-23-250 and PA-23-235 (cont.)

EXAMPLE



CAUTIONS

1. DO NOT USE HYDRAULIC FLUID WITH A CASTOR OIL OR ESTER BASE.
2. DO NOT OVER-LUBRICATE COCKPIT CONTROLS.
3. DO NOT APPLY LUBRICANT TO RUBBER PARTS.

NOTES

1. PILOT AND PASSENGER SEATS — LUBRICATE TRACK ROLLERS AND STOP PINS AS REQUIRED. (TYPE OF LUBRICANT: "A")
2. WHEEL BEARINGS REQUIRE CLEANING AND REPACKING AFTER EXPOSURE TO AN ABNORMAL QUANTITY OF WATER.
3. SEE LATEST REVISION OF LYCOMING SERVICE INSTRUCTIONS NO. 1014 FOR USE OF DETERGENT OIL.
4. SEE CONSUMABLE MATERIALS TABLE II-VII FOR LUBRICANT VENDORS.

PARTS NOMENCLATURE

1. UNIVERSAL, DOUBLE SPROCKET, GUIDE ROLLERS
2. AILERON CONTROL CHAIN
3. AILERON CONTROL CABLE PULLEY
4. CONTROL COLUMN BEARINGS
5. STEERING ROD END BEARINGS
6. OLEO AIRCHARGE VALVE
7. NOSE GEAR ATTACHMENT FITTINGS
8. TORQUE LINK ATTACHMENTS
9. WHEEL BEARINGS
10. TORQUE LINKS, STEERING LINK ENDS
11. STEERING TORQUE TUBE BEARING BLOCKS
12. DRAG LINKS
13. LATCH ATTACHMENT, ROD END BEARINGS
14. PROPELLER
15. AILERON BELLCRANK
16. BRAKE CYLINDERS
17. RUDDER CABLE ATTACHMENTS
18. RUDDER CABLE ATTACHMENTS
19. RUDDER TORQUE TUBE, BEARING BLOCKS
20. STABILATOR CABLE ATTACHMENTS, RUDDER BELLCRANK ATTACHMENTS
21. RUDDER TRIM ROD BEARINGS
22. RUDDER TRIM SCREW
23. STABILATOR TORQUE TUBE, TRIM LINKAGE
24. STABILATOR TRIM SCREW
25. TRIM LINKAGE
26. FLAP CYLINDER ATTACHMENT
27. ROD END BEARINGS
28. FLAP BEARING BLOCKS, SENDER LINKAGE
29. OLEO AIRCHARGE VALVE
30. MAIN GEAR ATTACHMENTS, DRAG LINKS, TORQUE LINKS
31. TORQUE LINKS
32. WHEEL BEARINGS
33. DRAG LINKS, TORQUE LINKS
34. CYLINDER ATTACHMENT, LATCH, RETRACTION LINKAGE
35. BRAKE RESERVOIR, POWER PACK FILLER
36. NOSE GEAR DOOR HINGES
37. ENGINE CONTROL CABLE ENDS
38. MAIN GEAR DOOR HINGES
39. AILERON AND FLAP HINGES
40. AFT BAGGAGE DOOR
41. STABILATOR TRIM HINGES
42. RUDDER, RUDDER TRIM HINGES AND TAB BOLTS
43. RUDDER PULLEYS
44. AILERON CONTROL CABLE PULLEYS
45. CABIN DOOR HINGES
46. FUEL CONTROL CABLES AND FUEL VALVES
47. SEAT TRACKS
48. ENGINE CONTROL QUADRANT
49. FULL FLOW OIL FILTER (CARTRIDGE TYPE ELEMENT)
50. ENGINE OIL FILLER TUBE
51. NOSE GEAR DOWNLOCK

Figure 2-25. Lubrication Chart, PA-23-250 and PA-23-235 (cont.)

TYPE OF LUBRICANTS

IDENTIFICATION LETTER	SPECIFICATION	LUBRICANT	
A	MIL-PRF-7870C	LUBRICATING OIL, GENERAL PURPOSE, LOW TEMPERATURE	
B	SAE J 1966	LUBRICATING OIL, AIRCRAFT ENGINE (PISTON) GRADE AS SPECIFIED:	
	SAE 60	Above 80°F (26.67°c)	SAE 60
	SAE 50	Above 60°F (15.55°c)	SAE 40 or SAE 50
	SAE 40	30° TO 90°F (-1.11° to 32.22°c)	SAE 40
	SAE 30	0° TO 70°F (-17.77° to 21.11°c)	SAE 40,30,20W40
	SAE 20	Below 10°F (-12.22°c)	SAE 30,20W30
C	MIL-PRF-5606H	HYDRAULIC FLUID, PETROLEUM BASE	
D	MIL-PRF-23827C	GREASE, AIRCRAFT AND INSTRUMENT, GEAR AND ACTUATOR SCREW	
	AEROSHELL 6	GREASE, PROPELLER. MIL-PRF-23827C CAN ALSO BE USED	
E	MIL-PRF-81322G	GREASE, GENERAL PURPOSE	

SPECIAL INSTRUCTIONS

1. BEARINGS AND BUSHINGS - Clean exterior with a quick-drying solvent before lubricating.
2. LUBRICATION POINTS - Wipe all lubrication points clean of old grease, oil, dirt, etc., before lubricating.
3. WHEEL BEARINGS - Disassemble and clean with a quick-drying solvent. Ascertain that grease is packed between the roller and cone. Do not pack grease in wheel housing. Wheel bearings require cleaning and repacking after exposure to any abnormal quantity of water.
4. OLEO STRUTS, HYDRAULIC PUMP RESERVOIR AND BRAKE RESERVOIR - Fill per instructions on unit or container, or refer to applicable chapter in this manual.
5. NOT USED.
6. CONTROL CABLES - Do not oil control cables. Grease control cables where they pass over a pulley or through a fairlead.
7. AIR FILTER - To clean filter, tap gently to remove dirt particles or wash in warm water and mild detergent and dry. Do not blow out with compressed air. Do not use oil. Replace filter if damaged.
8. OIL AND FILTER - Lycoming recommends changing the oil and filter every 50 hours or four months, whichever comes first.
9. See the latest revision of Lycoming Service Instruction No. 1014 for use of detergent oil.
10. NOT USED.
11. PROPELLER - For each blade: remove a grease fitting; apply grease through the remaining fitting until fresh grease appears at hole of removed fitting. If annual usage is significantly less than 100 hours, increase lubrication frequency to every six months.

Figure 2-25. Lubrication Chart, PA-23-250 and PA-23-235 (cont.)

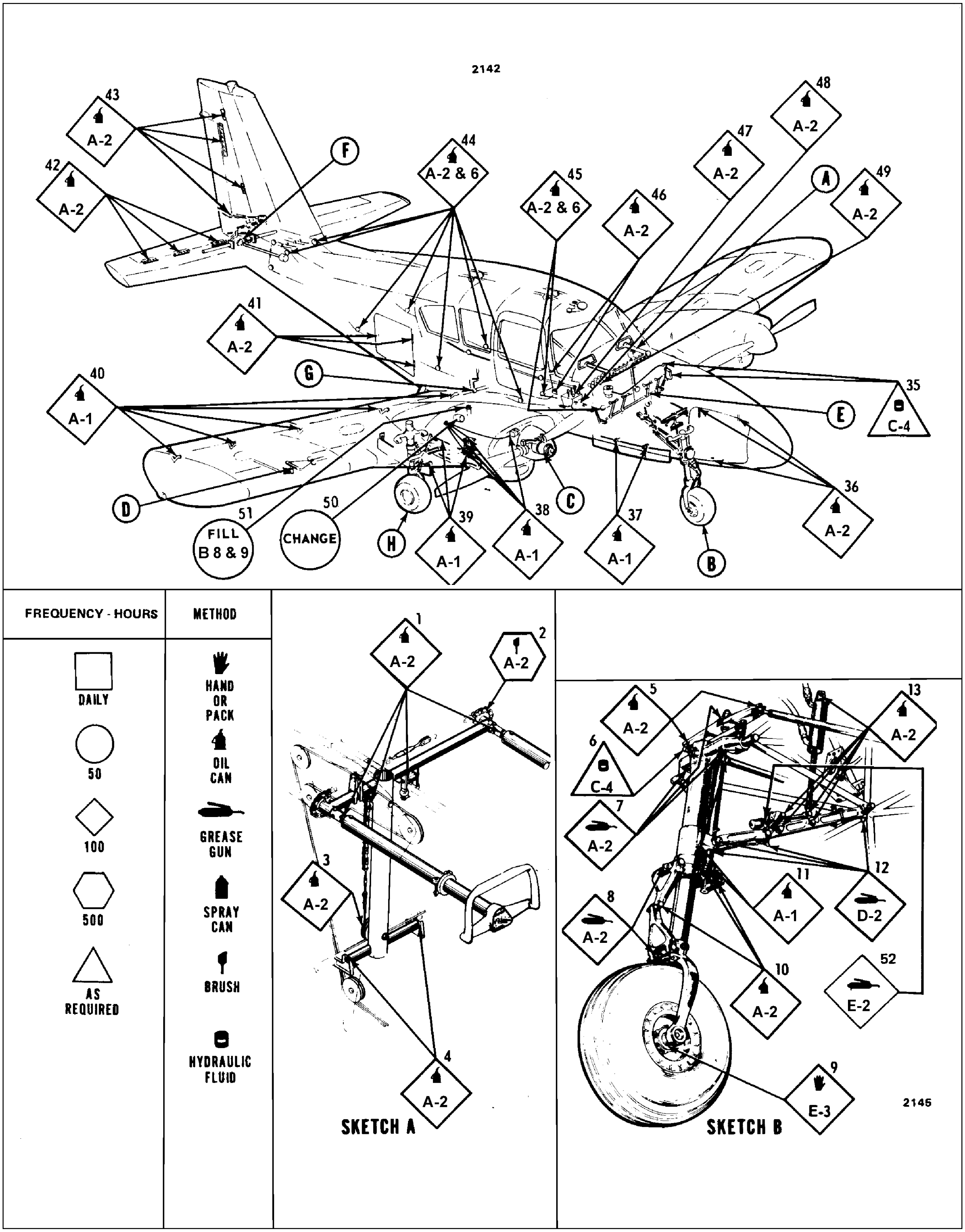


Figure 2-26. Lubrication Chart, PA-23-250 (six place),
Serial Nos. 27-2000 to 27-2504 incl.

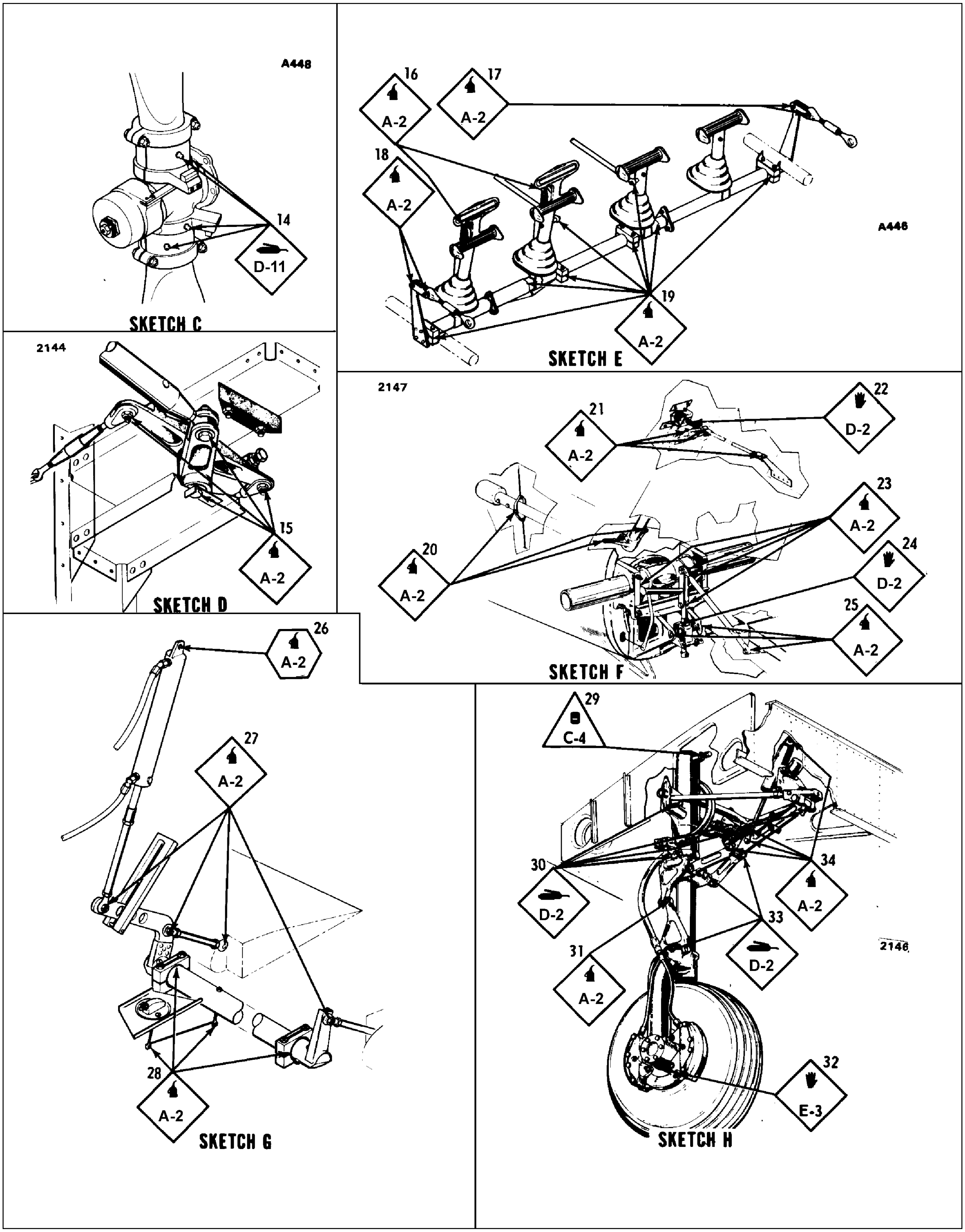
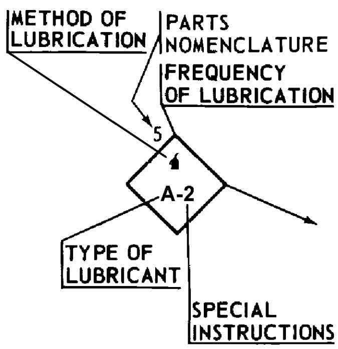


Figure 2-26. Lubrication Chart, PA-23-250 (six place),
Serial Nos. 27-2000 to 27-2504 incl. (cont.)

EXAMPLE



CAUTIONS

1. DO NOT USE HYDRAULIC FLUID WITH A CASTOR OIL OR ESTER BASE.
2. DO NOT OVER-LUBRICATE COCKPIT CONTROLS.
3. DO NOT APPLY LUBRICANT TO RUBBER PARTS.

NOTES

1. PILOT AND PASSENGER SEATS - LUBRICATE TRACK ROLLERS AND STOP PINS AS REQUIRED. (TYPE OF LUBRICANT: "A")
2. WHEEL BEARINGS REQUIRE CLEANING AND REPACKING AFTER EXPOSURE TO AN ABNORMAL QUANTITY OF WATER.
3. SEE LATEST REVISION OF LYCOMING SERVICE INSTRUCTIONS NO. 1014 FOR USE OF DETERGENT OIL.
4. SEE CONSUMABLE MATERIALS TABLE II-VII FOR LUBRICANT VENDORS.

PARTS NOMENCLATURE

1. UNIVERSAL, DOUBLE SPROCKET, GUIDE ROLLERS
2. AILERON CONTROL CHAIN
3. AILERON CONTROL CABLE PULLEY
4. CONTROL COLUMN BEARINGS
5. STEERING ROD END BEARINGS
6. OLEO AIRCHARGE VALVE
7. NOSE GEAR ATTACHMENT FITTINGS
8. TORQUE LINK ATTACHMENTS
9. WHEEL BEARINGS
10. TORQUE LINKS, STEERING LINK ENDS
11. STEERING TORQUE TUBE BEARING BLOCKS
12. DRAG LINKS
13. LATCH ATTACHMENT, ROD END BEARINGS
14. PROPELLER
15. AILERON BELLCRANK
16. BRAKE CYLINDERS
17. RUDDER CABLE ATTACHMENTS
18. RUDDER CABLE ATTACHMENTS
19. RUDDER TORQUE TUBE, BEARING BLOCKS
20. STABILATOR CABLE ATTACHMENTS, RUDDER BELLCRANK ATTACHMENTS
21. RUDDER TRIM ROD BEARINGS
22. RUDDER TRIM SCREW
23. STABILATOR TORQUE TUBE, TRIM LINKAGE
24. STABILATOR TRIM SCREW
25. TRIM LINKAGE
26. FLAP CYLINDER ATTACHMENT
27. ROD END BEARINGS
28. FLAP BEARING BLOCKS, SENDER LINKAGE
29. OLEO AIRCHARGE VALVE
30. MAIN GEAR ATTACHMENTS, DRAG LINKS, TORQUE LINKS
31. TORQUE LINKS
32. WHEEL BEARINGS
33. DRAG LINKS, TORQUE LINKS
34. CYLINDER ATTACHMENT, LATCH, RETRACTION LINKAGE
35. BRAKE RESERVOIR, POWER PACK FILLER
36. NOSE BAGGAGE DOOR
37. NOSE GEAR DOOR HINGES
38. ENGINE CONTROL CABLE ENDS
39. MAIN GEAR DOOR HINGES
40. AILERON AND FLAP HINGES
41. AFT BAGGAGE DOOR
42. STABILATOR TRIM HINGES
43. RUDDER, RUDDER TRIM HINGES AND TAB BOLTS
44. RUDDER PULLEYS
45. AILERON CONTROL CABLE PULLEYS
46. CABIN DOOR HINGES
47. FUEL CONTROL CABLES AND FUEL VALVES
48. SEAT TRACKS
49. ENGINE CONTROL QUADRANT
50. FULL FLOW OIL FILTER (CARTRIDGE TYPE ELEMENT)
51. ENGINE OIL FILLER TUBE
52. NOSE GEAR DOWNLOCK

Figure 2-26. Lubrication Chart, PA-23-250 (six place),
Serial Nos. 27-2000 to 27-2504 incl. (cont.)

TYPE OF LUBRICANTS

IDENTIFICATION LETTER	SPECIFICATION	LUBRICANT	
A	MIL-PRF-7870C	LUBRICATING OIL, GENERAL PURPOSE, LOW TEMPERATURE	
B	SAE J 1966	LUBRICATING OIL, AIRCRAFT ENGINE (PISTON) GRADE AS SPECIFIED:	
	SAE 60	Above 80°F (26.67°c)	SAE 60
	SAE 50	Above 60°F (15.55°c)	SAE 40 or SAE 50
	SAE 40	30° TO 90°F (-1.11° to 32.22°c)	SAE 40
	SAE 30	0° TO 70°F (-17.77° to 21.11°c)	SAE 40,30,20W40
	SAE 20	Below 10°F (-12.22°c)	SAE 30,20W30
C	MIL-PRF-5606H	HYDRAULIC FLUID, PETROLEUM BASE	
D	MIL-PRF-23827C	GREASE, AIRCRAFT AND INSTRUMENT, GEAR AND ACTUATOR SCREW	
	AEROSHELL 6	GREASE, PROPELLER. MIL-PRF-23827C CAN ALSO BE USED	
E	MIL-PRF-81322G	GREASE, GENERAL PURPOSE	

SPECIAL INSTRUCTIONS

1. BEARINGS AND BUSHINGS - Clean exterior with a quick-drying solvent before lubricating.
2. LUBRICATION POINTS - Wipe all lubrication points clean of old grease, oil, dirt, etc., before lubricating.
3. WHEEL BEARINGS - Disassemble and clean with a quick-drying solvent. Ascertain that grease is packed between the roller and cone. Do not pack grease in wheel housing. Wheel bearings require cleaning and repacking after exposure to any abnormal quantity of water.
4. OLEO STRUTS, HYDRAULIC PUMP RESERVOIR AND BRAKE RESERVOIR - Fill per instructions on unit or container, or refer to applicable chapter in this manual.
5. NOT USED.
6. CONTROL CABLES - Do not oil control cables. Grease control cables where they pass over a pulley or through a fairlead.
7. AIR FILTER - To clean filter, tap gently to remove dirt particles or wash in warm water and mild detergent and dry. Do not blow out with compressed air. Do not use oil. Replace filter if damaged.
8. OIL AND FILTER - Lycoming recommends changing the oil and filter every 50 hours or four months, whichever comes first.
9. See the latest revision of Lycoming Service Instruction No. 1014 for use of detergent oil.
10. NOT USED.
11. PROPELLER - For each blade: remove a grease fitting; apply grease through the remaining fitting until fresh grease appears at hole of removed fitting. If annual usage is significantly less than 100 hours, increase lubrication frequency to every six months.

Figure 2-26. Lubrication Chart, PA-23-250 (six place),
Serial Nos. 27-2000 to 27-2504 incl. (cont.)

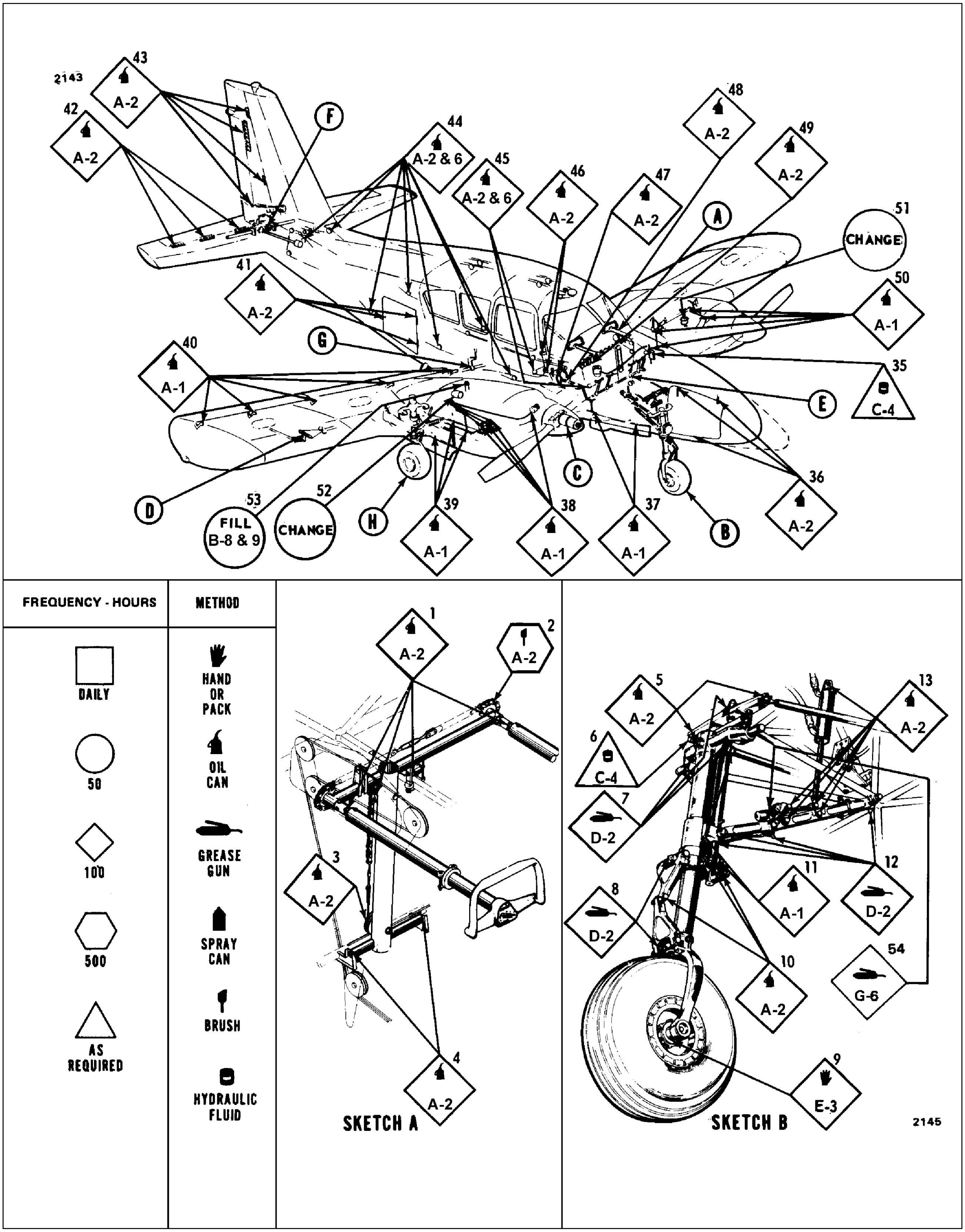


Figure 2-27. Lubrication Chart, PA-23-250 (six place),
Serial Nos. 27-2505 and up.

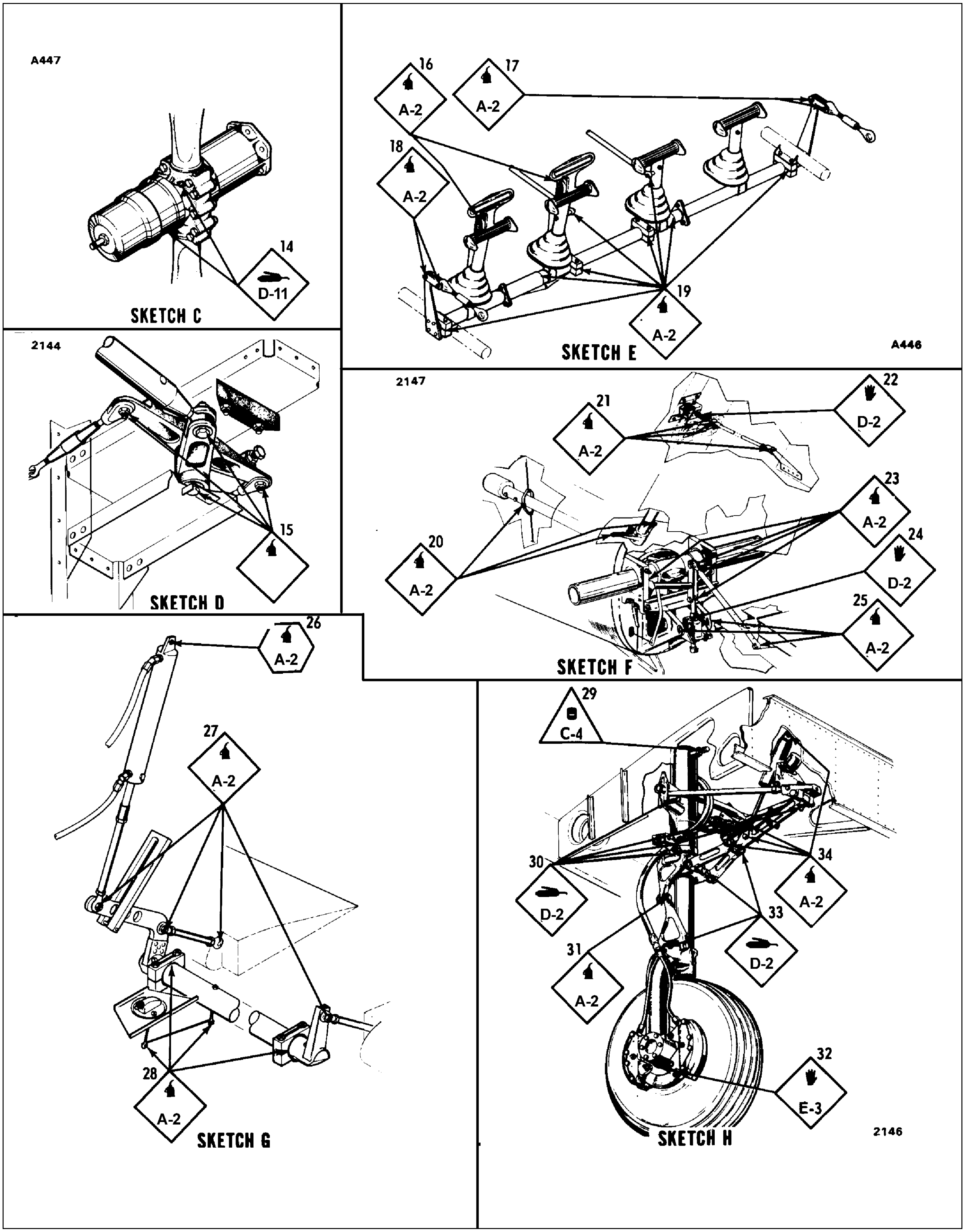
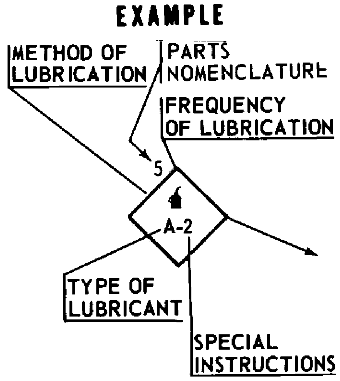


Figure 2-27. Lubrication Chart, PA-23-250 (six place),
Serial Nos. 27-2505 and up. (cont.)



CAUTIONS

1. DO NOT USE HYDRAULIC FLUID WITH A CASTOR OIL OR ESTER BASE.
2. DO NOT OVER-LUBRICATE COCKPIT CONTROLS.
3. DO NOT APPLY LUBRICANT TO RUBBER PARTS.

NOTES

1. PILOT AND PASSENGER SEATS - LUBRICATE TRACK ROLLERS AND STOP PINS AS REQUIRED. (TYPE OF LUBRICANT: "A")
2. WHEEL BEARINGS REQUIRE CLEANING AND REPACKING AFTER EXPOSURE TO AN ABNORMAL QUANTITY OF WATER.
3. FUEL SELECTOR VALVE - LUBRICATE SELECTOR VALVE AS REQUIRED, REFER TO LATEST REVISION OF PIPER SERVICE LETTER NO. 351.
4. SEE LATEST REVISION OF LYCOMING SERVICE INSTRUCTIONS NO. 1014 FOR USE OF DETERGENT OIL.
5. SEE CONSUMABLE MATERIALS TABLE II-VII FOR LUBRICANT VENDORS.

PARTS NOMENCLATURE

1. UNIVERSAL, DOUBLE SPROCKET, GUIDE ROLLERS
2. AILERON CONTROL CHAIN
3. AILERON CONTROL CABLE PULLEY
4. CONTROL COLUMN BEARINGS
5. STEERING ROD END BEARINGS
6. OLEO AIRCHARGE VALVE
7. NOSE GEAR ATTACHMENT FITTINGS
8. TORQUE LINK ATTACHMENTS
9. WHEEL BEARINGS
10. TORQUE LINKS, STEERING LINK ENDS
11. STEERING TORQUE TUBE BEARING BLOCKS
12. DRAG LINKS
13. LATCH ATTACHMENT, ROD END BEARINGS
14. PROPELLER
15. AILERON BELLCRANK
16. BRAKE CYLINDERS
17. RUDDER CABLE ATTACHMENTS
18. RUDDER CABLE ATTACHMENTS
19. RUDDER TORQUE TUBE, BEARING BLOCKS
20. STABILATOR CABLE ATTACHMENTS, RUDDER BELLCRANK ATTACHMENTS
21. RUDDER TRIM ROD BEARINGS
22. RUDDER TRIM SCREW
23. STABILATOR TORQUE TUBE, TRIM LINKAGE
24. STABILATOR TRIM SCREW
25. TRIM LINKAGE
26. FLAP CYLINDER ATTACHMENT
27. ROD END BEARINGS
28. FLAP BEARING BLOCKS, SENDER LINKAGE
29. OLEO AIRCHARGE VALVE
30. MAIN GEAR ATTACHMENTS, DRAG LINKS, TORQUE LINKS
31. TORQUE LINKS
32. WHEEL BEARINGS
33. DRAG LINKS, TORQUE LINKS
34. CYLINDER ATTACHMENT, LATCH, RETRACTION LINKAGE
35. BRAKE RESERVOIR, POWER PACK FILLER
36. NOSE BAGGAGE DOOR
37. NOSE GEAR DOOR HINGES
38. ENGINE CONTROL CABLE ENDS
39. MAIN GEAR DOOR HINGES
40. AILERON AND FLAP HINGES
41. AFT BAGGAGE DOOR
42. STABILATOR TRIM HINGES
43. RUDDER, RUDDER TRIM HINGES AND TAB BOLTS
44. RUDDER PULLEYS
45. AILERON CONTROL CABLE PULLEYS
46. CABIN DOOR HINGES
47. FUEL CONTROL CABLES AND FUEL VALVES
48. SEAT TRACKS
49. ENGINE CONTROL QUADRANT
50. COWL FLAP LINKAGE
51. TURBO OIL SUMP AIRESEARCH TURBOCHARGED ENGINES ONLY
52. FULL FLOW OIL FILTER (CARTRIDGE TYPE ELEMENT)
53. ENGINE OIL FILLER TUBE
54. NOSE GEAR DOWNLOCK

Figure 2-27. Lubrication Chart, PA-23-250 (six place), Serial Nos. 27-2505 and up. (cont.)

TYPE OF LUBRICANTS

IDENTIFICATION LETTER	SPECIFICATION	LUBRICANT	
A	MIL-PRF-7870C	LUBRICATING OIL, GENERAL PURPOSE, LOW TEMPERATURE	
B	SAE J 1966	LUBRICATING OIL, AIRCRAFT ENGINE (PISTON) GRADE AS SPECIFIED:	
	SAE 60	Above 80°F (26.67°c)	SAE 60
	SAE 50	Above 60°F (15.55°c)	SAE 40 or SAE 50
	SAE 40	30° TO 90°F (-1.11° to 32.22°c)	SAE 40
	SAE 30	0° TO 70°F (-17.77° to 21.11°c)	SAE 40,30,20W40
	SAE 20	Below 10°F (-12.22°c)	SAE 30,20W30
C	MIL-PRF-5606H	HYDRAULIC FLUID, PETROLEUM BASE	
D	MIL-PRF-23827C	GREASE, AIRCRAFT AND INSTRUMENT, GEAR AND ACTUATOR SCREW	
	AEROSHELL 6	GREASE, PROPELLER. MIL-PRF-23827C CAN ALSO BE USED	
E	MIL-PRF-81322G	GREASE, GENERAL PURPOSE	
F		LUBRICATING OIL, 10W30	

SPECIAL INSTRUCTIONS

1. BEARINGS AND BUSHINGS - Clean exterior with a quick-drying solvent before lubricating.
2. LUBRICATION POINTS - Wipe all lubrication points clean of old grease, oil, dirt, etc., before lubricating.
3. WHEEL BEARINGS - Disassemble and clean with a quick-drying solvent. Ascertain that grease is packed between the roller and cone. Do not pack grease in wheel housing. Wheel bearings require cleaning and repacking after exposure to any abnormal quantity of water.
4. OLEO STRUTS, HYDRAULIC PUMP RESERVOIR AND BRAKE RESERVOIR - Fill per instructions on unit or container, or refer to applicable chapter in this manual.
5. NOT USED.
6. CONTROL CABLES - Do not oil control cables. Grease control cables where they pass over a pulley or through a fairlead.
7. AIR FILTER - To clean filter, tap gently to remove dirt particles or wash in warm water and mild detergent and dry. Do not blow out with compressed air. Do not use oil. Replace filter if damaged.

7A. AIR FILTER *(Turbocharged Only)* - To clean filter, blow out with compressed air from gasket side or wash in warm water and mild detergent and dry. Do not use oil.

8. OIL AND FILTER - Lycoming recommends changing the oil and filter every 50 hours or four months, whichever comes first.
9. See the latest revision of Lycoming Service Instruction No. 1014 for use of detergent oil.
10. NOT USED.
11. PROPELLER - For each blade: remove a grease fitting; apply grease through the remaining fitting until fresh grease appears at hole of removed fitting. If annual usage is significantly less than 100 hours, increase lubrication frequency to every six months.
12. NOT USED

13, AIR RESEARCH TURBOCHARGED ENGINE ONLY - Drain and refill turbo oil sump (2.6 Quarts) as indicated with automotive multigrade SAE 10W 30 (S/N's 27-2505 thru 27-4221.

Figure 2-27. Lubrication Chart, PA-23-250 (six place), Serial Nos. 27-2505 and up (cont.)

SECTION

III

INSPECTION

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SECTION III - INSPECTION

TABLE OF CONTENTS

SECTION III - INSPECTION

TABLE OF CONTENTS (Continued)

SECTION III

INSPECTION

1. General

Piper Aircraft, Inc. (Piper) takes a continuing interest in having the owner get the most efficient use from his airplane, and keeping the airplane in the best mechanical condition. To that end, Piper publishes a recurring maintenance schedule which is supplemented with Service Bulletins, Service Letters and Service Spares Letters as required.

A. The recurring maintenance schedules for the PA-23-235 Apache and PA-23-250 Aztec are provided in Section III.

B. Piper Service Bulletins are of special importance and Piper considers compliance mandatory.

C. Service Letters deal with product improvements and service hints pertaining to the affected aircraft. Owners should give careful attention to service letter information so they can ensure their airplane is properly serviced and kept up to date with the latest changes.

D. Service Spares Letters offer improved parts, kits and optional equipment which were not originally available. These may be of interest to the owner.

E. Service Bulletins, Service Letters and Service Spares Letters are emailed to Piper Dealers/Service Centers. U.S. registered owners are notified by postcard and encouraged to download these service publications from http://www.piper.com/.

NOTE: Piper mails flight manual (AFM / POH) revisions as well as the postcards cited above to the registered owner's name and address as shown on the Aircraft Registration Certificate. If the aircraft is based and/or operated at a different location (or locations) and/or by a person (or persons) other than those recorded on the aircraft registration, then the registered owner(s) is responsible for forwarding these to the operating location(s) or person(s).

Changes in aircraft registration may take a substantial amount of time to be recorded by the Federal Aviation Administration and received by Piper to change the mailing address. Owners and operators should make arrangements to keep abreast of flight manual revisions and service publications during this interim period through their Piper Dealer/Service Center.

The Federal Aviation Administration (FAA) publishes Airworthiness Directives (AD's) that apply to specific aircraft. They are mandatory changes and are to be complied within a time limit set by the FAA. When an AD is issued, it is sent to the latest registered owner of the affected aircraft and also to subscribers of the service. The owner is solely responsible for being aware of and complying with airworthiness directives.

NOTE: A searchable database of AD's is available on the FAA website. See the "Airworthiness Directives" link at "www1.faa.gov". Additionally, Avantext offers a free email notification service for new AD's as well as the last six weeks worth of AD's at "www.avantext.com".

Owners should periodically check with a Piper Dealer/Service Center to find out the latest information to keep his aircraft up to date.

Service Bulletins, Service Letters, and Service Spares Letters are also available by subscription to the Avantext TechPubs Maintenance Libraries for Piper Aircraft (see www.Avantext.com).

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2. Time Limits

   A. Refer to Section I for the FAA-approved airworthiness limitations section. It sets forth each mandatory replacement time, structural inspection interval, and related structural inspection procedure required for type certification.

   B. Refer to paragraph 6 for Piper's recommended Inspection Programs. They include the frequency and extent of the inspections required for the continued airworthiness of these airplanes.

   C. Inspections required by Flight Hour or Calendar Year, if due, are included as part of the Annual / 100 Hour Inspection and/or the Progressive Inspection Event cycles, and are listed individually in paragraph 8.

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3. Scheduled Maintenance

WARNING: GROUND THE MAGNETO PRIMARY CIRCUIT (P LEAD), BEFORE PERFORMING ANY MAINTENANCE OPERATION ON THE ENGINE.

This section provides instructions for conducting inspections - see Table III-I. Repair or replacement instructions for those components found to be unserviceable during inspections will be found in the applicable airplane system section. (See Section Index Guide, Introduction.)

4. Description

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. (SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.)

The recurring maintenance schedule for the PA-23-235 Apache and PA-23-250 Aztec is provided herein as an Annual / 100 Hour Inspection. Progressive Inspection Programs (25 and 50 Hour) are available exclusively from Avantext, Inc. in a separate manual form. See Piper Publications in the Introduction under Supplementary Publications.

Piper inspection programs comply with the F.A.A. Federal Aviation Regulations Parts 43, 91 and 135. The owner/operator is primarily responsible for maintaining the airplane in an airworthy condition, including compliance with all applicable Airworthiness Directives and conformity with the requirements in FAR 91.409, 91.411 and 91.413.

The first overhaul or replacement of components should be performed at the given periods. The condition of various components can then be used as criteria for determining subsequent periods applicable to the individual airplane, depending on usage, providing the owner/operator has an established Part 91 Progressive Inspection Program (see 91.409(d)) or Part 135 Approved Aircraft Inspection Program (see 135.419).

The time periods given for inspections of various components are based on average usage and environmental conditions.

NOTE: The listed inspection, overhaul and replacement schedules do not guarantee that a particular item or component will reach the listed time without malfunction. Unique operating conditions encountered by individual airplanes cannot be controlled by the manufacturer.

5. Definitions

A. Inspections - Must be performed only by Certified Mechanics who are qualified on these aircraft, using acceptable methods, techniques and practices to determine physical condition and detect defects.

(1) Routine Inspection - Consists of a visual examination or check of the aircraft and its components and systems without disassembly.

(2) Detailed Inspection - Consists of a thorough examination of the aircraft, appliance, component, or system; with disassembly as necessary to determine condition.

(3) Special Inspection - Involves those components, systems or structure which by their application or intended use require an inspection peculiar to, more extensive in scope or at a time period other than that which is normally accomplished during an event or annual inspection.

B. Checks - Can be performed by pilots and/or mechanics who are qualified on this aircraft and consists of examinations in the form of comparisons with stated standards for the purpose of verifying condition, accuracy and tolerances.

C. Approved Inspection - Means a continuing airworthiness inspection of an airplane and its various component and systems at scheduled interval in accordance with procedures approved by the FAA under FAR Part 91.409(d) or Part 135.419.

D. Tests - Operation of aircraft components, appliances or systems to evaluate functional performance.

(1) Operational Test - A task to determine that an item is fulfilling its intended purpose. The task does not require quantitative tolerances. This is a fault finding task.

(2) Functional Test - A quantitative check to determine if one or more functions of an item performs within specified limits. This test may require the use of supplemental bench test equipment.

(3) In addition, each of the above tests must be performed by an FAA Certified Repair Station with appropriate ratings or by a Certified Mechanic who is qualified on this aircraft. The recording of the above function must be made in the permanent aircraft records by the authorized individual performing the test.

E. Bench Test - Means removal of component from the aircraft to inspect for cleanliness, impending failure, need for lubrication, repair or replacement of parts and calibration to at least the manufacturers specifications using the manufacturers recommended test equipment or standards or the equivalent.

Each bench test will be performed by a Piper Service Center, FAA Certified Repair Station with appropriate rating or by a certified mechanic. This test will be performed at the scheduled interval regardless of any bench test performed on a particular component while being repaired/overhauled before scheduled interval bench test. After the component is installed into the aircraft, an operational test of the component and its related system should be performed to ensure proper function. Serviceable parts that were issued to the component will be filed in the aircraft permanent records. The person performing the test must make appropriate entries in the aircraft's permanent maintenance record.

F. Maintenance - The word maintenance as defined by FAR Part 1, means "inspection, overhaul, repair, preservation and the replacement of parts, but excludes preventive maintenance."

G. On Condition Maintenance - A primary maintenance process having repetitive inspections or tests to determine the condition of units, systems, or portions of structure with regard to continued serviceability (corrective action is taken when required by item condition.)

H. Time - as used in this manual.

(1) Time-in-service for aircraft components, unless otherwise specified, is a cumulative total of flight hours or calendar time calculated from the time a new or overhauled component was first installed in any aircraft, and including:

(a) the aircraft time that elapses from the initial installation to the first removal, if any; and,

(b) the aircraft time that elapses from each subsequent installation to each subsequent removal, if any; or,

(c) the calendar time elapsed since the installation.

NOTE: Dates stamped on individual components at the time of manufacture are typically applied to determine shelf life - i.e. the maximum time allowed from manufacture/ assembly/cure until actually installed in an aircraft and are not relevant.

Do not, however; ignore markings applied to life-limited parts when removed with time and/or cycles remaining on them.

(2) Aircraft time, flight hours, or aircraft hours are the “Hobbs Time” shown on, or calculated from, the installed “Hour Meter.”

6. Inspection Requirements

WARNING: INSTRUCTIONS FOR CONTINUED AIRWORTHINESS (ICA) FOR ALL NON-PIPER APPROVED STC INSTALLATIONS ARE NOT INCLUDED IN THIS MANUAL. WHEN A NON-PIPER APPROVED STC INSTALLATION IS INCORPORATED ON THE AIRPLANE, THOSE PORTIONS OF THE AIRPLANE AFFECTED BY THE INSTALLATION MUST BE INSPECTED IN ACCORDANCE WITH THE ICA PUBLISHED BY THE OWNER OF THE STC. SINCE NON-PIPER APPROVED STC INSTALLATIONS MAY CHANGE SYSTEMS INTERFACE, OPERATING CHARACTERISTICS AND COMPONENT LOADS OR STRESSES ON ADJACENT STRUCTURES, THE PIPER PROVIDED ICA MAY NOT BE VALID FOR AIRPLANES SO MODIFIED.

A. Annual / 100 Hour Inspection. (See paragraph 7.)

Owners/operators may maintain the airplane solely under FAR 91.409 (a) and (b) inspection requirements. The 100 hour inspection cycle is a complete inspection of the airplane and is identical in scope to an annual inspection. Inspections must be accomplished by persons authorized by the FAA.

B. Progressive Inspection.

The progressive inspection programs are designed to permit the best utilization of the aircraft through the use of a planned inspection schedule. These schedules are prepared in manual form, available exclusively from Avantext, Inc. on CD-Rom or DVD:

P/N 761-498 for the PA-23-235 / PA-23-250 Aztec (25 Hour);

P/N 761-738 for the PA-23-250 Aztec (50 Hour).

Refer to Piper's Customer Service Information File for a checklist to ensure obtaining latest issue.

NOTE: The Progressive Inspection Manuals (P/N's 761-498 and 761-738) referenced above are not stand-alone documents. They constitute a snapshots of the Airworthiness Limitations and Inspection Sections of the Instructions for Continued Airworthiness (ICA) and are current only at the time of printing. Use them as follows:

(1) Owners/operators desiring to establish a Part 91 Progressive Inspection Program (PIP) (see 91.409(d)) or a Part 135 Approved Aircraft Inspection Program (AAIP) (see 135.419) should use the appropriate Progressive Inspection Manual as a template for submission to their regional FAA office.

(2) Service centers conducting Event Cycle inspections under a FAA-approved PIP or AAIP can use the appropriate Progressive Inspection Manual as a working check-off list/form, provided they verify its currency against the FAA-approved PIP or AAIP.

C. Overlimits Inspection.

If the airplane has been operated so that any of its components have exceeded their maximum operational limits, special inspections may be required by Piper and/or the component manufacturer. See Unscheduled Maintenance Checks, below, and applicable vendor publications.

7. Annual / 100 Hour Inspection Procedure

A. Scheduled Maintenance

(1) The required periodic inspection procedures are listed in Table III-1. These inspection procedures are broken down into major groups which include Propeller, Engine, Turbocharger (where applicable), Cabin and Cockpit, Fuselage and Empennage, Wing, Landing Gear, Special Inspections, Operational Inspection, and General. The first column in each group lists the inspection or procedure to be performed. The second column is divided into two sub-columns indicating the required inspection interval of 50 hours or 100 hours. Each inspection or operation is required at each of the inspection intervals indicated by a circle (O). When a vendor publication specifies a time outside the 50 / 100 hour cycle, it will be listed as a special inspection in paragraph 8.

(2) Refer to the applicable section of this manual for instructions on how to gain access to remove any item that must be removed and is not completely accessible.

(3) Inspection Report Forms.

To help in the performance of periodic inspections, Inspection Report forms are available exclusively from Avantext, Inc. on CD-Rom or DVD:

P/N 230-205 for the PA-23-235 Apache and PA-23-250 Aztec.

NOTE: Service centers conducting Part 91 Annual / 100 Hour Inspections can use the Inspection Report Form (P/N 230-205), as a working check-off list, provided they verify its currency against an up-to-date copy of the ICA (i.e. - this Service Manual, see Section I and Table III-I).

(4) In addition to inspection intervals required in scheduled maintenance (i.e. - Table III-1), preflight inspection must also be performed.

(5) References to service manual applicable areas are per the Piper proprietary system defined by the Section Index Guide.

B. Special Inspections (see paragraph 8.)

C. Unscheduled Maintenance Checks (see paragraph 9.)

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TABLE III-I. INSPECTION REPORT

Refer to Notes 1, 2, 3, and 4 before performing the following inspections.

NATURE OF INSPECTION	L	R	50	100
	Inspection Interval (Hrs)			
A. PROPELLER GROUP				
WARNING: USE EXTREME CAUTION WHEN ROTATING PROPELLER BY HAND; PROPELLER MAY KICK BACK. PRIOR TO ROTATING PROPELLER ENSURE BOTH MAGNETO SWITCH(S) ARE OFF (GROUNDED). IF MAGNETO(S) ARE NOT GROUNDED, TURNING PROPELLER MAY START ENGINE.				
1. Inspect spinner and back plate for cracks, dents, missing screws, and security	O	O	O	O
2. Inspect blades for nicks and cracks	O	O	O	O
3. Inspect for grease and oil leaks	O	O	O	O
4. Lubricate propeller per Lubrication Chart, Section II	O	O		O
5. Inspect spinner mounting brackets for cracks and security	O	O		O
6. Inspect propeller mounting bolts for condition and security. If safety is broken, re-torque and safety	O	O		O
7. Inspect hub parts for cracks and corrosion	O	O		O
8. Inspect pitch actuating arms and bolts	O	O		O
9. Rotate blades and check for tightness in hub pilot tube. (See Note 14.)	O	O		O
10. Inspect complete propeller and spinner assembly for security, chafing, cracks, deterioration, wear, and correct installation	O	O		O
11. Check propeller air pressure	O	O		O
12. If installed, inspect condition of propeller deicer system	O	O		O
B. ENGINE GROUP				
WARNING: IF MAGNETO(S) ARE NOT GROUNDED, TURNING PROPELLER MAY START ENGINE. USE EXTREME CAUTION WHEN ROTATING PROPELLER BY HAND; PROPELLER MAY KICK BACK. PRIOR TO ROTATING PROPELLER ENSURE BOTH MAGNETO SWITCH(S) ARE OFF (GROUNDED).				
NOTE: Read Note 5 prior to completing this group.				
1. Remove engine cowling and inspect for internal and external damage	O	O	O	O
2. Clean and inspect cowling for cracks, distortion, and loose or missing fasteners	O	O		O
3. Drain oil sump. (See Note 8.)	O	O	O	O
4. Clean suction oil strainer at oil change; inspect strainer for foreign particles	O	O	O	O

TABLE III-I. INSPECTION REPORT (cont.)

NATURE OF INSPECTION	Inspection Interval (Hrs) L	R	50	100
B. ENGINE GROUP (CONT.)				
5. Clean pressure oil strainer or change full flow, cartridge type, oil filter element; inspect strainer or element for foreign particles	O	O	O	O
6. Inspect oil temperature sender unit for leaks and security	O	O		O
7. Inspect oil lines and fittings for leaks, security, chafing, dents, and cracks	O	O	O	O
8. Clean and inspect oil radiator cooling fins	O	O		O
9. Fill engine with oil per information on cowling or in Lubrication Chart, Section II	O	O	O	O
CAUTION: USE CAUTION NOT TO CONTAMINATE VACUUM PUMP WITH CLEANING FLUID. (SEE LATEST REVISION OF LYCOMING SERVICE INSTRUCTION NO. 1221.)				
10. Clean engine as required with approved solvents	O	O		O
11. Inspect wiring to engine and accessories. Replace damaged wires and clamps. Inspect terminals for security and cleanliness	O	O		O
12. Inspect condition of spark plugs. Clean and adjust gap as required; adjust per latest revision of Lycoming Service Instruction No. 1042	O	O		O
NOTE: If fouling of spark plugs is apparent, rotate bottom plugs to upper plugs.				
13. Inspect spark plug cable leads and ceramics for corrosion and deposits	O	O	O	O
14. Check cylinder compression. (See latest revision of AC 43.13-1.)	O	O		O
15. Inspect cylinders for cracked or broken fins. (See Note 7.)	O	O		O
16. Inspect rocker box covers for evidence of oil leaks. If found, replace gasket; torque cover screws 50 inch-pounds.	O	O	O	O
17. Inspect ignition harness and insulators for security of mounting, tight connections, high tension leakage and continuity	O	O		O
18. Inspect magnetos and set timing to engine. (See Note 30)	O	O		O
19. Remove air filter and clean per Paragraph 2-67. Replace as required.	O	O	O	O

TABLE III-I. INSPECTION REPORT (cont.)

NATURE OF INSPECTION	Inspection Interval (Hrs) L	R	50	100
B. ENGINE GROUP (CONT.)				
20. Inspect air induction system for leaks, security and damage. Repair or replace as required.	O	O	O	O
21. Inspect condition and operation of carburetor heat or alternate air door and box	O	O	O	O
22. Inspect all induction air and alternate heat ducts for condition and security	O	O		O
23. Drain carburetor, remove and clean inlet line fuel strainer or clean fuel injector inlet line strainer. (Clean injector nozzles as required.) (Clean with acetone only.)	O	O	O	O
24. Inspect intake seals for leaks and clamps for tightness	O	O		O
25. Inspect primer lines for leaks and security of mounting	O	O	O	O
26. Inspect condition of flexible fuel lines	O	O		O
27. Inspect fuel system for leaks (See Note 31.)	O	O		O
28. Inspect engine-driven and electric fuel pumps for condition and operation. Replace as required	O	O	O	O
29. Clean screens in electric fuel pumps (plunger type pump)	O	O	O	O
30. Replace hydraulic filter element. (Inspect filter element for contamination.)	O	O		O
31. Inspect hydraulic pump and gasket for leaks. (See Note 6.)	O	O		O
32. Inspect vacuum pumps, oil separators, and lines for security and condition. (See Note 27 and 28.)	O	O		O
33. Inspect all engine and propeller controls for travel, and operating condition. (See Note 19.)	O	O		O
34. Inspect exhaust system per Exhaust System 100 Hour Inspection. (See Special Inspections, Procedures.)	O	O	O	O
35. Inspect breather tube for obstructions and security	O	O		O
36. Inspect crankcase for cracks, leaks, and security of seam bolts	O	O		O
37. Inspect engine mounts for security and condition	O	O		O
38. Inspect all engine baffles for cracks	O	O		O
39. Inspect rubber engine mounts for deterioration. (Replace as required.) (See Note 16.)	O	O		O
40. Inspect firewall for cracks	O	O		O
41. Inspect condition of firewall seals	O	O		O

TABLE III-I. INSPECTION REPORT (cont.)

NATURE OF INSPECTION	Inspection Interval (Hrs) L	R	50	100
B. ENGINE GROUP (CONT.)				
42. Inspect condition of generator or alternator and starter	O	O		O
43. Inspect security of generator or alternator and starter mounting	O	O		O
44. Inspect condition and tension of generator or alternator drive belt. (See Paragraph 11-102.)	O	O	O	O
45. Replace vacuum regulator filter element	O	O		O
46. Inspect and lubricate all engine controls per Lubrication Chart, Section II. (DO NOT lubricate teflon liners of control cables.)	O	O		O
47. Inspect cowl flap torque tube for axial play (min 0.005 - max 0.012)	O	O		O
48. Inspect cowl flap doors for cracks, loose rivets, defective hinges, missing stop screws, and control rods for loose connections	O	O		O
49. With cowl installed, check cowl flap rigging. (See Paragraph 8-16, 8A-14, or 8B-12, as appropriate.)	O	O		O
50. Install engine cowling	O	O	O	O
C. TURBOCHARGER GROUP				
1. Change turbo oil. (See Note 11.)	O	O	O	O
2. Clean oil filter elements. (See Note 8.)	O	O	O	O
3. Visually inspect system for oil leaks, exhaust system leaks and general condition	O	O	O	O
4. Inspect the compressor wheel for nicks, cracks or broken blades	O	O		O
5. Inspect for excess bearing drag or wheel rubbing against housing	O	O	O	O
6. Inspect turbine wheel for broken blades or signs of rubbing	O	O		O
7. Check rigging of alternate air control	O	O		O
8. Inspect oil inlet and outlet ports in center housing for leaks	O	O		O
9. Inspect turbine heat blanket for condition and security	O`	O		O
10. Inspect linkage between bypass valve and actuator	O	O		O
11. Inspect induction and exhaust components for worn or damaged areas, loose clamps, cracks and leaks. (See Note 15; and V-Band Coupling 100 Hour Inspection in Section VIIIA or VIIIB, as appropriate.)	O	O		O
12. Inspect fuel injection nozzle pressure reference manifold for deteriorated hose, loose connections, leaks or obstructions	O	O		O
13. Inspect fluid power lines leaks and security	O	O		O
14. Inspect for oil leakage from controller	O	O		O
15. Inspect rigging and action of transfer valve	O	O		O
16. Inspect all mounting brackets for tightness, damage or visible cracks	O	O		O
17. Reinstall engine cowling	O	O	O	O

TABLE III-I. INSPECTION REPORT (cont.)

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
D. CABIN AND COCKPIT GROUP		
1. Inspect cabin door, latches, and hinges, and windows, and baggage compartment doors, latches, and hinges for damage, operation, and security		O
2. Inspect windows for scratches, crazing, and condition		O
3. Check operation of emergency exit window		O
4. Check window and door seals for deterioration, cracks, and voids		O
5. Inspect upholstery for tears		O
6. Inspect seats and attaching brackets and hardware for condition, security, and operation		O
7. Inspect seat belts and shoulder harnesses per Restraint System Inspection. (See Special Inspections, Procedures.)		O
8. Inspect trim operation		O
9. Inspect condition and operation of rudder pedals and rudder bar assembly		O
10. Inspect parking brake valve and brake handle for operation and cylinder leaks		O
11. Check operation of parking brake		O
12. Inspect condition and security of control wheels, column, pulleys, cables, turnbuckles, guides, terminals, and fittings, and in S/N's 27-8054001 and up, bobweight installations. (See Note 9.)		O
13. Inspect flap lever to control cable attachment bolt for condition and security. (See Note 9.)		O
14. Check operation of landing, navigation, strobe, cabin, and instrument lights	O	O
15. Inspect condition and security of instruments, avionics, lines, and attachments		O
16. If installed, inspect individual vacuum driven instruments air filter pads.		O
17. Inspect vacuum and gyro operated instruments and electric turn and bank. (Overhaul or replace as required.)		O
18. If installed, replace vacuum regulator filter element		O
19. Inspect static system, altimeter and transponder for installation/certification per latest revision of AC43.13-1 and current test/inspection per FAR's 91.411 and 91.413, respectively		O
20. Inspect and test ELT per FAR 91.207. (See Testing ELT, Paragraph 12-7.)		O
21. Inspect operation of fuel selector valve		O
22. Inspect fuel selector valve control cables for rigging and adjustment, unrestricted motion of cables, cable ends, and valve actuator levers. (See Note 20.)		O
23. Drain crossfeed line	O	O
24. Check operation of crossfeed valve		O
25. Check operation of heater fuel valve		O

TABLE III-I. INSPECTION REPORT (cont.)

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
D. CABIN AND COCKPIT GROUP (CONT.)		
26. Check operation of cowl flaps		O
27. Inspect condition of heater controls and ducts		O
28. Inspect condition and operation of air vents		O
29. Inspect oxygen outlets for defects and corrosion		O
30. Inspect oxygen system operation and components		O
31. If installed, inspect portable fire extinguisher minimum weight as specified on nameplate		O
E. FUSELAGE AND EMPENNAGE GROUP		
1. Remove inspection panels and plates		O
2. Inspect forward baggage door, latch, and hinge for damage, operation and security (See Note 32.)	O	O
3. Check fluid in brake reservoir. (Fill as required.)		O
4. Inspect electronic installations for security and operation		O
5. Inspect fuselage cabin entrance step attachments to fuselage frame for condition, security, etc. (See Note 25.)		O
6. Inspect skins, bulkheads, frames, and stringers for damage, irregularities, or structural defects (i.e. - skin cracks, distortion, dents, corrosion, and loose or missing rivets		O
7. Inspect antenna mounts and electric wiring for damage and security		O
8. If installed, inspect heater for fuel or fume leaks		O
9. If installed, inspect manual heater fuel shutoff valve for fuel leaks and capnut safety		O
10. If installed, inspect heater fuel regulator and shutoff valve for leakage. (See 100 Hour Inspection, Paragraph 13-94A.)		O
11. If installed, drain and clean heater gascolator bowl per Paragraph 13-133		O
12. Inspect fuel lines, valves, and gauges for damage and operation		O
13. Inspect security of all lines		O
14. Inspect hydraulic power pack and lines for damage, leaks and proper fluid level		O
15. Inspect flap torque tube, bearing supports, brackets and hydraulic actuator and bellcrank for security, loose rivets, cracks, and leaks. (See Notes 24 and 26.)		O
16. Inspect CO_2 system for fluid in lines and safeties on CO_2 bottle		O
17. Inspect vertical fin for surface damage or irregularities (i.e. - skin cracks, distortion, dents, corrosion, and excessive paint build up); structural defects (i.e. - loose or missing rivets); misrigging or structural imbalance; and attachment points for missing or worn hardware		O
18. Inspect vertical fin attachments for security		O

TABLE III-I. INSPECTION REPORT (cont.)

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
E. FUSELAGE AND EMPENNAGE GROUP (CONT.)		
19. Inspect rudder and tab for surface damage or irregularities (i.e. - skin cracks, distortion, dents, corrosion, and excessive paint build up); structural defects (i.e. - loose or missing rivets); misrigging or structural imbalance; hinge damage, excessive wear, freedom of movement and proper lubrication; and attachment points for missing or worn hardware		O
20. Inspect rudder and tab horns and attachments for damage, security, and operation		O
21. Inspect rudder control stops to ensure stops have not loosened and locknuts are tight		O
22. Inspect rudder hinge bolts for excess wear. Replace as required.		O
23. Inspect rudder trim mechanism		O
24. Inspect stabilator and tab for surface damage or irregularities (i.e. - skin cracks, distortion, dents, corrosion, and excessive paint build up); structural defects (i.e. - loose or missing rivets); misrigging or structural imbalance; hinge damage, excessive wear, freedom of movement and proper lubrication; and attachment points for missing or worn hardware. (See Note 22.)		O
25. Inspect stabilator bearing and horns for damage and operation		O
26. Inspect stabilator tab horn and attachments for damage, security, and operation		O
27. Inspect stabilator tip balance weight arms for cracks. (See Notes 21.)		O
28. Inspect stabilator control stops to ensure stops are not loose. Ensure bolts and locknuts are tight		O
29. Inspect stabilator trim mechanism and control rod end bearing for safety, damage, and operation		O
30. Inspect aileron, rudder, stabilator, and stabilator trim cables, and cable terminals, turnbuckles, guides, fittings and pulleys for safety, condition, and operation. (See Note 9.)		O
31. Inspect rudder, stabilator, and stabilator trim cable tensions per Table V-I. Use a tensiometer		O
32. Inspect stabilator and rudder control cable attachments per Stabilator and Rudder Control Cable Attachment Inspection. (See Special Inspections, Procedures.)		O
33. Lubricate per Lubrication Chart, Section II	O	O
34. Inspect anti-collision light for security and operation	O	O
35. If installed, inspect condition and security of Autopilot bridle cable clamps. (See Note 17.)		O
36. If installed, inspect condition of pneumatic deicers		O
37. Inspect all controls, air ducts, electrical leads, harnesses, lines, radio antenna leads, and attaching parts for security, routing, chafing deterioration, wear, and correct installation		O

TABLE III-I. INSPECTION REPORT (cont.)

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
E. FUSELAGE AND EMPENNAGE GROUP (CONT.)		
38. Inspect ELT battery for condition/date per FAR 91.207		O
39. Inspect ELT installation and antenna for condition and security. Replace antenna if bent or damaged		O
40. Install inspection plates and panels		O
F. WING GROUP		
1. Remove inspection plates and fairings		O
2. Inspect wing surfaces and tips for damage, loose rivets, and condition of walkway and step		O
3. Inspect ailerons for surface damage or irregularities (i.e. - skin cracks, distortion, dents, corrosion, and excessive paint build up); structural defects (i.e. - loose or missing rivets); misrigging or structural imbalance; hinge damage, excessive wear, freedom of movement and proper lubrication; and attachment points for missing or worn hardware		O
4. Inspect aileron attachments for damage, security, and operation		O
5. Inspect aileron hinge bolts for condition and security. Replace as required.		O
6. Inspect aileron control stops to ensure stops have not loosened and locknuts are tight		O
7. Inspect aileron cables, cable terminals, turnbuckles, fittings, guides, pulleys, and bellcranks for safety, condition, and operation. (See Note 9.)		O
8. Inspect aileron cable tension per Table V-I. Use a tensiometer		O
9. Inspect aileron balance weight and arm for security and operation		O
10. Inspect pitot tube for damage and condition		O
CAUTION: SEVERE BURNS CAN RESULT FROM COMING IN CONTACT WITH A HEATED PITOT TUBE.		
11. Check pitot heat		O
12. Inspect flaps for surface damage or irregularities (i.e. - skin cracks, distortion, dents, corrosion, and excessive paint build up); structural defects (i.e. - loose or missing rivets); misrigging or structural imbalance; hinge damage, excessive wear, freedom of movement and proper lubrication; and attachment points for missing or worn hardware. (See Notes 18 and 29.)		O
13. Inspect flap attachments for damage, security, and operation		O
14. Inspect flap hinge bolts for condition and security. Replace as required.		O

TABLE III-I. INSPECTION REPORT (cont.)

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
F. WING GROUP (CONT.)		
15. Lubricate per Lubrication Chart, Section II	O	O
16. Inspect wing attachment bolts and brackets		O
17. Inspect engine mount attaching structure		O
18. Inspect fuel cells and lines for leaks and water	O	O
19. Remove, drain, and clean fuel strainer bowl and screen		O
20. Inspect fuel fillers for minimum octane markings		O
21. Inspect fuel fillers marked for capacity		O
22. Inspect fuel quantity indicator switches for condition, security, and rigging		O
23. Inspect fuel cell vents and vent lines per Fuel Cell Vent 100 Hour Inspection. (See Special Inspections, Procedures.)		O
24. Inspect all controls, air ducts, electrical leads, lines, and attaching parts for security, routing, chafing, deterioration, wear, and correct installation		O
25. If installed, inspect condition of pneumatic deicers		O
26. If installed, inspect security of Autopilot roll servo bridle cable clamps. (See Note 17.)		O
27. Install inspection plates and fairings		O
G. LANDING GEAR GROUP		
1. Check oleo struts for proper extension and evidence of fluid leakage. (See Paragraph 2-52.)	O	O
2. Inspect nose gear steering control and travel		O
3. Inspect wheel alignment		O
4. Put airplane on jacks. (Refer to Section II.)		O
5. Inspect tires for cuts, uneven or excessive wear, and slippage		O
6. Remove wheels, clean, inspect, and repack bearings		O
7. Inspect wheels for cracks, corrosion, and broken bolts. (Refer to Figure 7-22.)		O
8. Check tire pressure per Table II-I	O	O
9. Inspect brake linings and discs for condition and wear.	O	O
10. Inspect brake backing plates for cracks		O
11. Inspect condition of brake and hydraulic lines		O
12. Inspect shimmy dampener operation		O
13. Inspect gear forks for damage		O
14. Inspect gear struts, attachments, torque links, retraction links, and bolts for condition and security		O
15. Inspect downlocks for operation and adjustment		O
16. Inspect gear doors and attachments		O
17. Check warning horn and light for operation		O
18. Retract gear - Inspect operation. (See Note 23.)		O

TABLE III-I. INSPECTION REPORT (cont.)

NATURE OF INSPECTION	L	R	50	100
G. LANDING GEAR GROUP (CONT)				
19. Retract gear - Inspect doors for clearance and operation				O
20. Inspect anti-retraction system				O
21. In S/N's 27-2505 and up, inspect Emergency Gear Extender Cable for correct rigging per Paragraph 6-129				O
22. Inspect actuating cylinders for leaking and security				O
23. Inspect position indicating switches and electrical leads for security				O
24. Inspect hydraulic lines, electrical leads, and attaching parts for condition and security, (i.e. - routing, chafing, damage, wear, etc.)				O
25. Lubricate per Lubrication Chart, Section II			O	O
26. Remove airplane from jacks				O
H. SPECIAL INSPECTIONS				
See Special Inspections, Requirements, below.				
I. OPERATIONAL INSPECTION				
NOTE: Refer to Note 12 prior to starting engines or taxiing airplane.				
1. Check fuel pump, fuel cell selector and crossfeed operation	O	O	O	O
2. Check fuel quantity, pressure and flow readings	O	O	O	O
3. Check oil pressure and temperatures	O	O	O	O
4. Check generator or alternator output	O	O	O	O
5. Check manifold pressure	O	O	O	O
6. Check operation of carburator heat or alternate air	O	O	O	O
7. Check operation of parking brake			O	O
8. Check vacuum gauge			O	O
9. Check gyros for noise and roughness			O	O
10. Check cabin heater operation			O	O
11. Check magneto switch operation	O	O	O	O
12. Check magneto RPM variation	O	O	O	O
13. Check throttle and mixture operation	O	O	O	O
14. Check propeller smoothness	O	O	O	O
15. Check propeller governor action	O	O	O	O
16. Check engine idle	O	O	O	O
17. Check electronic equipment operation			O	O
18. If installed, check operation of Autopilot, including automatic pitch trim, and manual electric trim. (See Note 13.)			O	O
19. If installed, check operation of pneumatic deicer system			O	O

Inspection Interval (Hrs) applies to columns L, R, 50, 100.

TABLE III-I. INSPECTION REPORT (cont.)

NATURE OF INSPECTION	Inspection Interval (Hrs) 50	100
J. GENERAL		
1. Aircraft conforms to FAA Specifications	O	O
2. Latest revision of applicable FAA Airworthiness Directives complied with	O	O
3. Current and correct Pilot's Operating Handbook or Airplane Flight Manual is in the airplane	O	O
4. Appropriate entries made in the Aircraft and Engine Log books	O	O
5. Registration Certificate is in the aircraft and properly displayed	O	O
6. Aircraft Equipment List, Weight and Balance and FAA Form(s) 337 (if applicable) are in the aircraft and in proper order	O	O
7. Operational inspection and run-up completed	O	O
8. Aircraft cleaned and lubricated after wash (as required)	O	O

K. NOTES

1. Refer to Piper's Customer Service Information File P/N 1753-755 for latest revision dates to Piper Inspection Reports/Manuals and this Service manual. References to Section are to the appropriate Section in this manual.

   WARNING: INSTRUCTIONS FOR CONTINUED AIRWORTHINESS (ICA) FOR ALL NON-PIPER APPROVED STC INSTALLATIONS ARE NOT INCLUDED IN THIS MANUAL. WHEN A NON-PIPER APPROVED STC INSTALLATION IS INCORPORATED ON THE AIRPLANE, THOSE PORTIONS OF THE AIRPLANE AFFECTED BY THE INSTALLATION MUST BE INSPECTED IN ACCORDANCE WITH THE ICA PUBLISHED BY THE OWNER OF THE STC. SINCE NON-PIPER APPROVED STC INSTALLATIONS MAY CHANGE SYSTEMS INTERFACE, OPERATING CHARACTERISTICS AND COMPONENT LOADS OR STRESSES ON ADJACENT STRUCTURES, THE PIPER PROVIDED ICA MAY NOT BE VALID FOR AIRPLANES SO MODIFIED.

2. Inspections or operations are to be performed as indicated by a "O" at the 50 or 100 hour inspection interval. Inspections or operations (i.e. - component overhauls/replacements, etc.) required outside the 100 hour cycle are listed as special inspections in paragraph 8, below. Inspections must be accomplished by persons authorized by the FAA.

   (a) The 50 hour inspection accomplishes preventive maintenance, lubrication and servicing as well as inspecting critical components.

   (b) The 100 hour inspection is a complete inspection of the airplane, identical to an annual inspection.

   NOTE: A log book entry should be made upon completion of any inspections.

TABLE III-I. INSPECTION REPORT (cont.)

K. NOTES (CONT.)

3. Piper Service Bulletins are of special importance and Piper considers compliance mandatory. In all cases, see Service Bulletin/Service Letter Index P/N 762-332 to verify latest revision. See also Table III-II.
4. Piper Service Letters are product improvements and service hints pertaining to servicing the airplane and should be given careful attention.
5. Inspections given for the power plant are based on the engine manufacturer's operator's manual (Lycoming Part No. 60927-10 or 60297-23, as appropriate) for these airplanes. Any changes issued to the engine manufacturer's operator's manual shall supersede or supplement the inspections outlined in this report. Should fuel other than the specified octane rating for the power plant be used, refer to the latest revision of Lycoming Service Letter No. L185 for additional information and recommended service procedures.
6. Overhaul as required and at engine overhaul.
7. Check cylinders for evidence of excessive heat indicated by burned paint on the cylinders. This condition is indicative of internal damage to the cylinder and, if found, its cause must be determined and corrected before the airplane is returned to service. Heavy discoloration and appearance of seepage at the cylinder head and barrel attachment area is usually due to emission of thread lubricant used during assembly of the barrel at the factory, or by slight gas leakage which stops after the cylinder has been in service for a while. This condition is neither harmful nor detrimental to engine performance and operation. If it can be proven that leakage exceeds these conditions, the cylinder must be replaced.
8. Refer to latest revision of Lycoming Service Bulletin No. 480.
9. Examine cables for broken strands by wiping them with a cloth for their entire length. Visually inspect the cable thoroughly for damage not detected by the cloth. Replace any damaged or frayed cables.
   (a) See Control Cable Inspection, in Special Inspections, Procedures, below, or the latest edition of FAA AC 43.13-1.
   (b) At fifteen (15) years time-in-service, begin Cable Fittings 100 Hour Special Inspection (see Special Inspections, Procedures).
10. Not used.
11. Applies only to IO-540-J4A5 engines adapted with AirResearch Turbocharger Unit.
12. Refer to Section 4 of the Pilot's Operating Handbook for preflight and flight check lists.
13. Refer to Airplane Flight Manual or Pilot's Operating Handbook Supplement for preflight and flight check and for intended function in all modes.
14. Does not apply to propellers with spring backup kit installed.
15. For airplanes with turbine housing(s) which have accumulated 700 hours time-in-service or more, see latest revision of Lycoming Service Bulletin No. 347.

TABLE III-I. INSPECTION REPORT (cont.)

K. NOTES (CONT.)

16. Inspect rubber mount for severe cracking, signs of high temperature or burning, separation of rubber from metal surfaces, excessive "sag" or permanent deflection resulting in internal bottoming with spacer, engine and cowl interference, unusual vibration.
17. In PA-23-250 S/N's 27-3457 and up, if installed, inspect Piper AutoControl III, AltiMatic III, AltiMatic IIIB, and AltiMatic IIIB-1 autopilot servo and bridle cable installations per 100 Hour AutoControl III/AltiMatic III Autopilot Inspection (see Special Inspections, Procedures).
18. In PA-23-250 S/N's 27-3154 thru 27-7405330 and 27-3050 only, for those airplanes which have not installed Piper Kits No. 760-861 (right) and 760-817 (left), conduct Outboard Flap Hinge 100 Hour Inspection (see Special Inspections, Procedures).
19. In PA-23-250 S/N's 27-1 thru 27-140 only, for those airplanes which have not installed the improved Engine Controls Support Bracket Assembly, P/N 16975-00, conduct 100 Hour Engine Controls Support Bracket Inspection (see Special Inspections, Procedures).
20. In all PA-23-235's; and PA-23-250 S/N's 27-1 thru 27-7954089 only, inspect fuel selector valve control cable wires per Fuel Selector Control Cable Wire 100 Hour Inspection (see Special Inspections, Procedures,).
21. In PA-23-250 Aztec "F" S/N's 27-7654001 thru 27-7954121 only, inspect stabilator tip tube and weight assemblies per Stabilator Tip Tube and Weight Assembly 100 Hour Inspection (see Special Inspections, Procedures).
22. In PA-23-250 Aztec "F" S/N's 27-7654001 thru 27-7954044 with unmodified stabilator serial numbers 0336-L thru 0340-L and 0401-L thru 0607-L and 0337-R thru 0341-R and 0402-R thru 0609-R only, inspect stabilator lower surface rivets and rib attachment per Stabilator Lower Surface Rivets and Rib Attachment 100 Hour Inspection (see Special Inspections, Procedures).

    NOTE: The stabilator serial number plate is located on the stabilator rear spar.

23. In all PA-23-235's; and PA-23-250 S/N's 27-1 thru 27-7854139 only, for airplanes which have not installed the heavy duty landing gear selector lever P/N 761-213 (i.e. - 28468-002), inspect the landing gear selector lever per Landing Gear Selector Lever 100 Hour Inspection (see Special Inspections, Procedures).
24. In all PA-23-235's; and PA-23-250 S/N's 27-1 thru 27-8054059 only, for airplanes which have accumulated at least 1000 hours total time-in-service, have initially completed Piper Service Bulletin No. 671, and have not installed the improved flap bellcrank P/N 16423-006; inspect the flap bellcrank per Flap Bellcrank 100 Hour Inspection (see Special Inspections, Procedures).
25. In all PA-23-235's; and PA-23-250 S/N's 27-1 thru 27-8054049 only, for airplanes which have accumulated at least 500 hours total time-in-service and have not installed the Footstep Reinforcement Brackets per Piper Service Bulletin No. 672A; inspect the fuselage frame per Fuselage Frame 100 Hour Inspection (see Special Inspections, Procedures).
26. For airplanes which have accumulated at least 2500 hours total time-in-service and have not installed a steel flap torque tube (P/N 17634-002, 104622-002, or 104622-004); inspect the flap torque tube per Flap Torque Tube 100 Hour Inspection (see Special Inspections, Procedures).

TABLE III-I. INSPECTION REPORT (cont.)

K. NOTES (CONT.)

27. For airplanes equipped with Aero Accessories Inc., Tempest Dry Air Pumps only:
    (a) For 215/216 (3215/3216) series pumps which have accumulated 500 hours time-in-service or more, inspect vacuum pump vane wear per Vacuum Pump Vane Wear Inspection (see Special Inspections, Procedures).
    (b) For 400 series pumps:
        (1) for airplanes with frequent de-ice cycles, beginning at 200 hours time-in-service, and each 100 hours thereafter;
        (2) for airplanes with normal de-ice cycles, beginning at 300 hours time-in-service, and each 100 hours thereafter;

    inspect per Vacuum Pump Vane Wear Inspection (see Special Inspections, Procedures).
28. For airplanes equipped with Parker Hannifin / Airborne vacuum pump(s), verify compliance with Parker Hannifin / Airborne Service Letter No. 72.
29. In PA-23-235's; and PA-23-250 S/N's 27-1 thru 27-7405300, for airplanes which have accumulated at least 2000 hours total time-in-service and have not installed improved flap assemblies (P/N's 17104-071 right and 17104-072 left; 17104-073 right and 17104-074 left; or, 17104-069 right and 17104-068 left; as appropriate); inspect the flap spars per Flap Spar 100 Hour Inspection (see Special Inspections, Procedures).
30. For airplanes equipped with TCM/Bendix (Scintilla) Magnetos: inspect magneto(s) per the procedures in the Periodic Maintenance section of the applicable Service Support Manual, available from Teledyne Continental Motors, Inc., PH: (800) 718-3411, or http://www.tcmlink.com/.
31. For All aircraft with RSA-5 or RSA-10 series Fuel Injection Servos which have had a new, rebuilt, overhauled, or repaired engine and/or servo installed since August 22, 2006 inspect to assure that the brass regulator hex plug is not loose.
32. In PA-23-250's 27-2000 thru 27-8154030, and in PA-E23-250 Aztec 27-2505 thru 27-7554168, review maintenance records and verify one of the following:
    (1) initial compliance with Piper Service Bulletin No. 1194; or
    (2) previous accomplishment of the Forward Baggage Door 1000 Hour Inspection in paragraph 4-56A.

    If compliance with either of the above is confirmed, inspect n according to the 100 Hour Inspection in paragraph 4-56A. If neither can be confirmed, perform the Forward Baggage Door 1000 Hour Inspection in paragraph 4-56A, in lieu of the 100 Hour Inspection.

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8. Special Inspections

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. (SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.)

A. Requirements

The following inspections are required in addition to those listed in Table III-I, above. These inspections are required at intervals of:

- Flight hours;
- Calendar Year; or
- the specific operation being conducted or the environment being operated in.

Unless otherwise indicated, these inspections are to be repeated at each occurrence of the specified interval. Note that the items listed herein are guidelines based on past operating experience. Each operator should closely monitor his own unique operating conditions/environment and react accordingly to keep his aircraft airworthy.

NOTE: A log book entry should be made upon completion of any inspections.

(1) Per Flight Hour

(a) **Each 400 Hours**

☐ At every 400 hours of engine operation, remove the rocker box covers and check for freedom of valve rockers when valves are closed. Look for evidence of abnormal wear or broken parts in the area of the valve tips, valve keepers, springs, and spring seats. If any indications are found, the cylinder and all of its components must be removed (including the piston and connecting rod assembly) and inspected for further damage. Replace any parts that do not conform with limits shown in the latest revision for Lycoming Service Table of Limits SSP1776.

(b) **Each 500 Hours**

☐ 1 Remove propeller; remove sludge from crankshaft and clean any residual sludge clinging to the propeller.

☐ 2 Remove and flush oil radiator.

☐ 3 Inspect torque link bolts and bushings. (Rebush if necessary.)

☐ 4 Replace rubber engine shock mounts (lord mounts).

☐ 5 If installed, replace filters in the gyro horizon and directional gyro, and in the manifold pressure line.

☐ 6 If installed, replace the vacuum system inlet air filter (i.e., central air filter, gyro filter, etc.) element each 500 hours time-in-service, annually, and at vacuum pump replacement, whichever comes first.

(b) **Each 500 Hours** (cont.)

- ☐ 7 For airplanes equipped with Southwind Model 940 Combustion Heaters which have previously been overhauled after accumulating their first 1000 hours of operating time, each 500 hours thereafter overhaul the heater per Paragraph 13-49.
- ☐ 8 Inspect condition of stabilator attachment bolts.
- ☐ 9 Replace rudder hinge bolts.
- ☐ 10 Weigh emergency gear extension CO_2 bottle each 500 hours or annually, whichever comes first. Weight should be 132 grams unless otherwise noted on bottle.
- ☐ 11 For airplanes equipped with TCM/Bendix (Scintilla) Magnetos: inspect and clean magneto(s) per the procedures in the Periodic Maintenance section of the applicable Service Support Manual, available from Teledyne Continental Motors, Inc., PH: (800) 718-3411, or http://www.tcmlink.com/.

(c) **Each 1000 Hours**

- ☐ 1 Replace pins and bolts used as flap and aileron hinge.
- ☐ 2 Inspect drag link bolts (Replace as required).
- ☐ 3 Replace engine compartment flexible hoses (fuel, oil, etc.) as required; but not to exceed 1000 hours time-in-service, eight (8) years, or engine overhaul, whichever comes first; except for TSO-C53a - Type D hoses which are replaced on-condition.
- ☐ 4 Overhaul or replace Hartzell steel hub propellers each five (5) years or each 1000 hours. (Refer to latest revision of Hartzell Service Letter No. 61.)
- ☐ 5 Overhaul or replace vacuum pumps.
- ☐ 6 Pressure pumps installed with pneumatic deicer boots should be replaced or overhauled at 1000 hours intervals. All other pressure pumps installed on aircraft with or without pneumatic deicers can be replaced or overhauled at engine TBO or upon condition.
- ☐ 7 Overhaul or replace hydraulic pump.
- ☐ 8 In all PA-23-235's; and PA 23-250's S/N's 27-2223 thru 7305126 only; for those airplanes equipped with Scott fuel selector valves only; see AD 80-18-10.
- ☐ 9 For airplanes equipped with Southwind Model 940 Combustion Heaters conduct the first overhaul, per Paragraph 13-49, when the heater accumulates 1000 hours of operating time.
- ☐ 10 For airplanes equipped with Janitrol Combustion Heaters, overhaul the heater each 1000 hours of heater operating time, when the "Pressure Decay Test" requirements cannot be met, or as specified in the latest revision of Janitrol Maintenance and Overhaul Manual, P/N 24E25-1.

- ☐ 11 In PA-23-250's 27-2000 thru 27-8154030, and in PA-E23-250, Aztec 27-2505 thru 27-7554168 inspect Nose Baggage Door per paragraph 4-56A.

(d) **Each 1200 Hours**

- ☐ For airplanes with engines still equipped with 7/16 inch diameter exhaust valves (original equipment 1965 thru 1966), each 1200 hours, or as specified in the latest revision of Lycoming Service Instruction No. 1009, overhaul or replace engine.

(e) **Each 1500 Hours**

- ☐ For airplanes equipped with TIO-540-C1A engines earlier than S/N L-1754-61, which have not been remanufactured or overhauled by Lycoming after March 1, 1971, and which have not been modified to incorporate large main bearing dowels per Lycoming Service Instruction No. 1225, each 1500 hours, or as specified in the latest revision of Lycoming Service Instruction No. 1009, overhaul or replace engine.

(f) **Each 2000 Hours**

- ☐ 1 Each 2000 hours or seven (7) years, whichever occurs first, remove interior cabinets, panels, and headliner and conduct detailed inspection of aircraft structure (skin, bulkheads, stringers, etc.) for condition and security. Inspection of structure concealed by headliner may be accomplished by alternate means (i.e. - through the use of a borescope) without removing the headliner, providing access is obtained to all concealed areas and borescope provides sufficient detail to adequately accomplish the inspection.
- ☐ 2 Each 2000 hours, or as specified in the latest revision of Lycoming Service Instruction No. 1009, overhaul or replace engine.
- ☐ 3 At engine overhaul or each 2000 hours, whichever comes first, overhaul or replace alternators.
- ☐ 4 Overhaul or replace Hartzell aluminum hub compact series propellers each five (5) or six (6) years or each 2000 or 2400 hours. (Refer to latest revision of Hartzell Service Letter No. 61 to determine specific requirements for individual airplanes.)

(g) **Each 2400 Hours**

- ☐ 1 Overhaul or replace Hartzell aluminum hub compact series propellers each five (5) or six (6) years or each 2000 or 2400 hours. (Refer to latest revision of Hartzell Service Letter No. 61 to determine specific requirements for individual airplanes.)
- ☐ 2 Overhaul or replace Hartzell propeller governors each 2400 hours or at engine overhaul. (Verify TBO in latest revision of Hartzell Service Letter No. 61.)

(2) Per Calendar Year

(a) **Each Seven (7) Days**

☐ If equipped, at least once a week, visually check oxygen cylinder installation for leakage, corrosion, bulges, gouges, distortion, security of mounting, and current hydrostatic test date.

(b) **Each Thirty (30) Days**

☐ 1 Check propeller air pressure.

☐ 2 Inspect battery, box or shelf, and cables. Flush box as required and fill battery per instructions on box or in Section IV.

☐ 3 If installed, inspect portable fire extinguisher for condition and charge. Verify nozzle is unobstructed and safety seal is intact. Determine charge by "hefting" extinguisher.

(c) **Each Ninety (90) Days**

☐ Remove, drain, and clean each fuel strainer bowl and screen.

(d) **Each Four (4) Months**

☐ Change the engine oil and full-flow cartridge oil filter each four (4) months or every 50 hours time-in-service, whichever comes first.

(e) **Each Six (6) Months**

☐ If annual usage is significantly less than 100 Hours, lubricate propeller each six (6) months. See Hartzell Standard Practices Manual No. 202A.

(f) **Each Twelve (12) Months**

☐ 1 Lubricate propeller every 100 Hours or annually, whichever comes first. If annual usage is significantly less than 100 Hours, lubricate propeller each six (6) months. See Hartzell Standard Practices Manual No. 202A.

☐ 2 Weigh emergency gear extension CO_2 bottle each 500 hours or annually, whichever comes first. Weight should be 132 grams unless otherwise noted on bottle.

☐ 3 If installed, replace the vacuum system inlet air filter (i.e., central air filter, gyro filter, etc.) element each 500 hours time-in-service, annually, and at vacuum pump replacement, whichever comes first.

☐ 4 For airplanes equipped with Airborne 1H5 series check valve manifolds and/or 1H37 series check valves, beginning at 5 years from date of check valve/manifold manufacture and each 12 months thereafter, inspect per the latest revision of Airborne SL 39A.

(g) **Each Two (2) Years**

- ☐ 1 Test and inspect the static pressure system and altimeters. Ensure compliance with the requirements of FAR 43, Appendix E. (See FAR 91.411.)
- ☐ 2 Test and inspect the transponder. Ensure compliance with the requirements of FAR 43, Appendix F. (See FAR 91.413.)

(h) **Each Three (3) Years**

- ☐ If installed, hydrostatic test lightweight DOT 3HT 1850 oxygen cylinder every three (3) years. No lightweight composite oxygen cylinder may exceed twentyfour (24) years total time-in-service or 4,380 pressurization cycles, whichever occurs first.

(i) **Each Four (4) Years**

- ☐ For airplanes equipped with TCM/Bendix Magnetos: overhaul or replace TCM/Bendix magnetos at engine overhaul, or each four (4) years time-in-service, whichever comes first.

(j) **Each Five (5) Years**

- ☐ 1 Overhaul or replace Hartzell steel hub propellers each five (5) years or each 1000 hours. (Refer to latest revision of Hartzell Service Letter No. 61.)
- ☐ 2 Overhaul or replace Hartzell aluminum hub compact series propellers each five (5) or six (6) years or each 2000 or 2400 hours. (Refer to latest revision of Hartzell Service Letter No. 61 to determine specific requirements for individual airplanes.)
- ☐ 3 If installed, hydrostatic test standard weight DOT 3AA 1800 oxygen cylinder every five (5) years.
- ☐ 4 If installed, with standard weight DOT 3AA 1800 oxygen cylinder, replace oxygen system regulator each five (5) years time-in-service.
- ☐ 5 If installed, for each oxygen system outlet, inspect outlet and especially rubber components for condition and operation. Replace rubber components or entire outlet on condition.
- ☐ 6 If installed, replace oxygen system external recharge valve each five (5) years time-in-service.
- ☐ 7 If installed, overhaul or replace oxygen masks each five (5) years time-in-service.

(k) **Each Six (6) Years**

- ☐ 1 Overhaul or replace Hartzell aluminum hub compact series propellers each five (5) or six (6) years or each 2000 or 2400 hours. (Refer to latest revision of Hartzell Service Letter No. 61 to determine specific requirements for individual airplanes.)
- ☐ 2 If installed, with lightweight DOT 3HT 1850 oxygen cylinder, replace oxygen system regulator each six (6) years time-in-service.

(l) **Each Seven (7) Years**

- ☐ Each 2000 hours or seven (7) years, whichever occurs first, remove interior cabinets, panels, and headliner and conduct detailed inspection of aircraft structure (skin, bulkheads, stringers, etc.) for condition and security. Inspection of structure concealed by headliner may be accomplished by alternate means (i.e. - through the use of a borescope) without removing the headliner, providing access is obtained to all concealed areas and borescope provides sufficient detail to adequately accomplish the inspection.

(m) **Each Eight (8) Years**

- ☐ Replace engine compartment flexible hoses (fuel, oil, etc.) as required; but not to exceed 1000 hours time-in-service, eight (8) years, or engine overhaul, whichever comes first; except for TSO-C53a type D hoses which are replace on-condition.

(n) **Each Ten (10) Years**

- ☐ 1 Each ten (10) years time-in-service, test fuselage and wing fluid hoses to system pressure. Visually inspect for leaks. Hoses that pass inspection may remain in service, but must be rechecked each five (5) years additional time-in-service. No fluid hose may exceed twenty (20) years total time-in-service.
- ☐ 2 Each ten years time-in-service perform Stabilator Torque Tube Corrosion Inspection (see Special Inspections, Procedures).
- ☐ 3 For airplanes equipped with Airborne 1H5 series check valve manifolds and/or 1H37 series check valves, replace manifold or check valve at 10 years from check valve/manifold date of manufacture. See revision of Airborne SL 39A.

(o) **Each Twelve (12) Years**

- ☐ Hydrostatically test the portable fire extinguisher each twelve (12) years.

(p) **Each Twenty (20) Years**

- ☐ No fluid hose may exceed twenty (20) years total time-in-service.

(3) Per Specific Operation / Operating Environment

(a) **Operation in High Dust or Industrial Pollution Environment**

CAUTION: DISCONNECT LINES FROM PITOT/STATIC SYSTEM BEFORE CONDUCTING THIS INSPECTION.

Item	Inspection	Inspection Interval
☐ Engine Air Filter.	Clean and inspect.	Daily.
☐ Cabin Environmental and Instrument Air Filters.	Inspect and replace if necessary.	100 Hours.
☐ Pitot/Static system.	Check for obstruction. Reverse flow to lines.	100 Hours or as required.
☐ Landing Gear Oleos	Clean.	Before each flight.
	Inspect.	100 Hours.
☐ Landing Gear Wheel Bearings.	Clean, inspect and repack.	50 Hours.
☐ Windows.	Inspect for cracks, erosion, crazing, visibility, and cleanliness.	Daily.
☐ Structure drain holes.	Clean with pipe cleaner.	Before each flight.

(b) **Operation in High Salt or High Humidity Environment**

Item	Inspection	Inspection Interval
☐ Fuselage, Empennage, and Wings.	Remove floor panels and exterior access plates; inspect for corrosion.	200 Hours.
☐ Landing Gear.	Inspect for corrosion and lubrication.	200 Hours.

WARNING: ENSURE BOTH MAGNETO SWITCHES ARE OFF (GROUNDED), BEFORE TURNING PROPELLER. ENGINE MAY START IF BOTH SWITCHES ARE NOT OFF. USE EXTREME CAUTION WHEN ROTATING PROPELLER BY HAND; PROPELLER MAY KICK BACK.

☐ Engines with more than 50 hours total time.	Each five days, pull prop through five complete revolutions. Each 30 days, fly aircraft for 30 minutes or, ground run until oil temperature is in the green arc. Avoid excessive ground run.	Each 5 days and each 30 days.

☐	Engines with less than 50 hours total time.	Each day, pull prop through five complete revolutions. Each 30 days, fly aircraft for 30 minutes or, ground run until oil temperature is in the green arc. Avoid excessive ground run.	Daily and each 30 days.
☐	Instruments and Wiring.	Inspect for proper seal of cases and corrosion.	100 Hours.
☐	Interior.	Inspect upholstery, seat belts, seats and rugs for corrosion and integrity.	100 Hours.

NOTE: Do not use metallic tie downs (i.e. - chains, cables, etc.) in high salt or high humidity environments.

(c) **Operation in Extreme Cold**

	Item	Inspection	Inspection Interval
☐	Hydraulic, Pneumatic and Environmental.	Check all fittings and attachments for security and leaks.	First 100 Hour, then as required.

(d) **Operation from Soft or Unusual Terrain**

	Item	Inspection	Inspection Interval
☐	Landing Gear.	Inspect for cracks, attachment, damage, cleanliness and lubrication.	100 Hours.
☐	Wheels.	Inspect for cracks, damage, chipped rims; bearings for damage, corrosion and lubrication.	100 Hours.
☐	Tires.	Inspect for cuts, wear, inflation and deterioration.	Daily.
☐	Wheel Wells.	Inspect for foreign material, damage and corrosion.	100 Hours.
☐	Brakes.	Inspect for damage, foreign material, cracks and overheating.	Daily.
☐	Flaps, Lower Fuselage and Wing.	Inspect for damage, cracks and corrosion.	100 Hours.

B. Procedures

(1) FUEL CELL VENT 100 HOUR INSPECTION. Water or debris entering the fuel cell vent system through the filler vent/drain hole can block and/or damage the fuel cell vent system. A fuel cell vent system which is blocked can cause the affected fuel cell to collapse as fuel is drawn down. A fuel cell vent line which has split or is otherwise leaking fuel into the interior of the wing structure is a potentially explosive situation. Accordingly, each 100 hours or annually, whichever comes first, inspect the integrity of the fuel cell vent system for each of the four main fuel cells as follows:

(a) Secure a plastic or rubber hose approximately 18 inches long, approximately 0.3125 (5/16) inch I.D., 0.5625 (9/16) inch O.D. or larger, with the end tapered to fit the vent/drain hole inside the fuel filler compartment.

(b) Insert the hose (tapered end) into the fuel filler vent/drain hole and:

1 Apply regulated air pressure (Maximum 5 PSI) or blow through the hose. If the line is blocked, correct the cause before proceeding further.

2 With an assistant under the wing blocking (with the fingers) the vent and drain outlets (0.5625 (9/16) inch and 0.125 (l/8) inch diameter), apply air pressure, as above, and determine that air pressure can be held in the system. If pressure cannot be maintained, locate the leak and correct the cause.

(c) Inspect the thermos-type fuel cell caps for sealing integrity. Caps that have become hardened, dry or cracked should be replaced.

(d) Inspect the fuel filler compartment hinged access cover for sealing integrity. A defective seal may allow rain or wash water to enter the fuel cell filler compartment.

(2) 100 HOUR AUTOCONTROL III / ALTIMATIC III AUTOPILOT INSPECTION. In PA-23-250's S/N's 27-3457 and up, for airplanes equipped with Piper AutoControl III, AltiMatic III, AltiMatic IIIB, or AltiMatic IIIB-1 autopilots, each 100 hours time-in-service or annually, whichever comes first, inspect the servo and bridle cable installations for the following:

NOTE: Refer to a current copy of the appropriate Automated Flight Control System service manual:

Part Number	A.F.C.S. System
753-723	AutoControl III, AltiMatic III and AltiMatic IIIB
761-502	AltiMatic IIIB-1 and AutoControl IIIB

Verify current revision by referring to Piper Customer Service Information Aerofiche (P/N 1753-755).

(a) Loose bridle cables.

(b) Damaged bridle cables or frayed bridle cable strands, particularly at the bridle cable pin where bridle cable attaches to capstan.

(c) Bridle cable clamp screw torque. (See A.F.C.S. Service Manual.)

(d) Safety sleeves replaced (if required). (See A.F.C.S. Service Manual.)

(e) Cable guard positioning and clearance.

(f) Primary control system cables and bridle cable tension settings. (See A.F.C.S. Service Manual.)

(g) Perform clutch override test. (See A.F.C.S. Service Manual.)

(3) OUTBOARD FLAP HINGE 100 HOUR INSPECTION. (See Figure 3-1.) In PA-23-250's S/N's 27-3154 thru 27-7405330, and 27-3050 only, for those airplanes which have not installed Piper Kits No. 760-861 (right) and 760-817 (left), each 100 hours time-in-service or annually, whichever comes first, inspect the outboard flap hinge for cracks as follows:

NOTE: Piper Kits No. 760-861 and 760-817 are no longer available (circa 2006).

(a) Using the hydraulic hand pump, lower the flaps to the full down position.

(b) Clean the flap outboard hinges thoroughly.

(c) Using a 10 power magnifying glass, inspect the hinges thoroughly for evidence of cracks.

1 If cracks are evident, replace with new hinge, P/N 17103-004 (left) and/or 17103-005 (right).

2 If cracks are not apparent, no further action is required until the next required inspection.

(d) Make an appropriate logbook entry documenting completion of this inspection. See also AD 74-10-01.

(4) FUEL SELECTOR CONTROL CABLE WIRE 100 HOUR INSPECTION. (See Figure 3-2.) In all PA-23-235's; and PA-23-250's S/N's 27-1 thru 27-7954089 only, each 100 hours time-in-service or annually, whichever comes first, inspect the fuel selector control cable wires for binding, kinking, or bending, as follows:

(a) Remove the access panel covering the main spar from the bottom section of the nacelle and the access panel covering the main spar from the bottom of the fuselage.

(b) Using 10X magnification, visually inspect the control cable wires at the swivel fittings, switch actuating arms, and actuating lever connections for cracks, sharp radius bends, and kinks. Replace cable wires exhibiting any of the above conditions.

(c) Additionally, inspect all fuel valves and control cables while someone in the cockpit operates the fuel controls through all detent positions while a mechanic observes the fuel valves and control cables for the following:

1 rigging and adjustment,

2 unrestricted motion of cable wires, swivel fittings, and valve actuating levers,

3 proper lubrication of fuel valve attachments and controls.

(d) Correct any deficiencies observed per Section IX.

(e) Reinstall access panels and covers.

(f) Make an appropriate logbook entry documenting completion of this inspection. See also AD 80-18-10

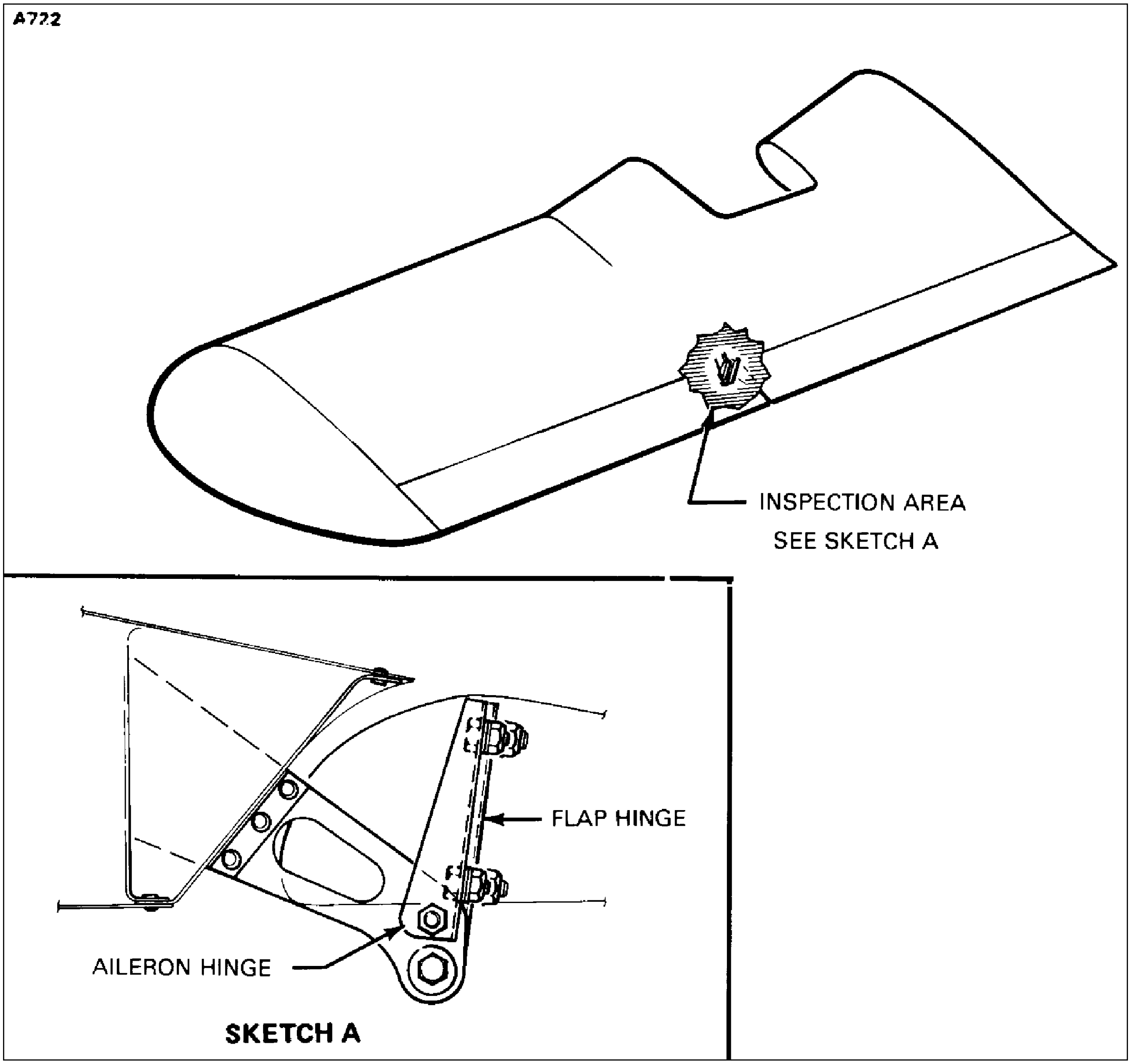

Figure 3-1. Outboard Flap Hinge Inspection
S/N's 27-3050, 27-3154 thru 27-7405330

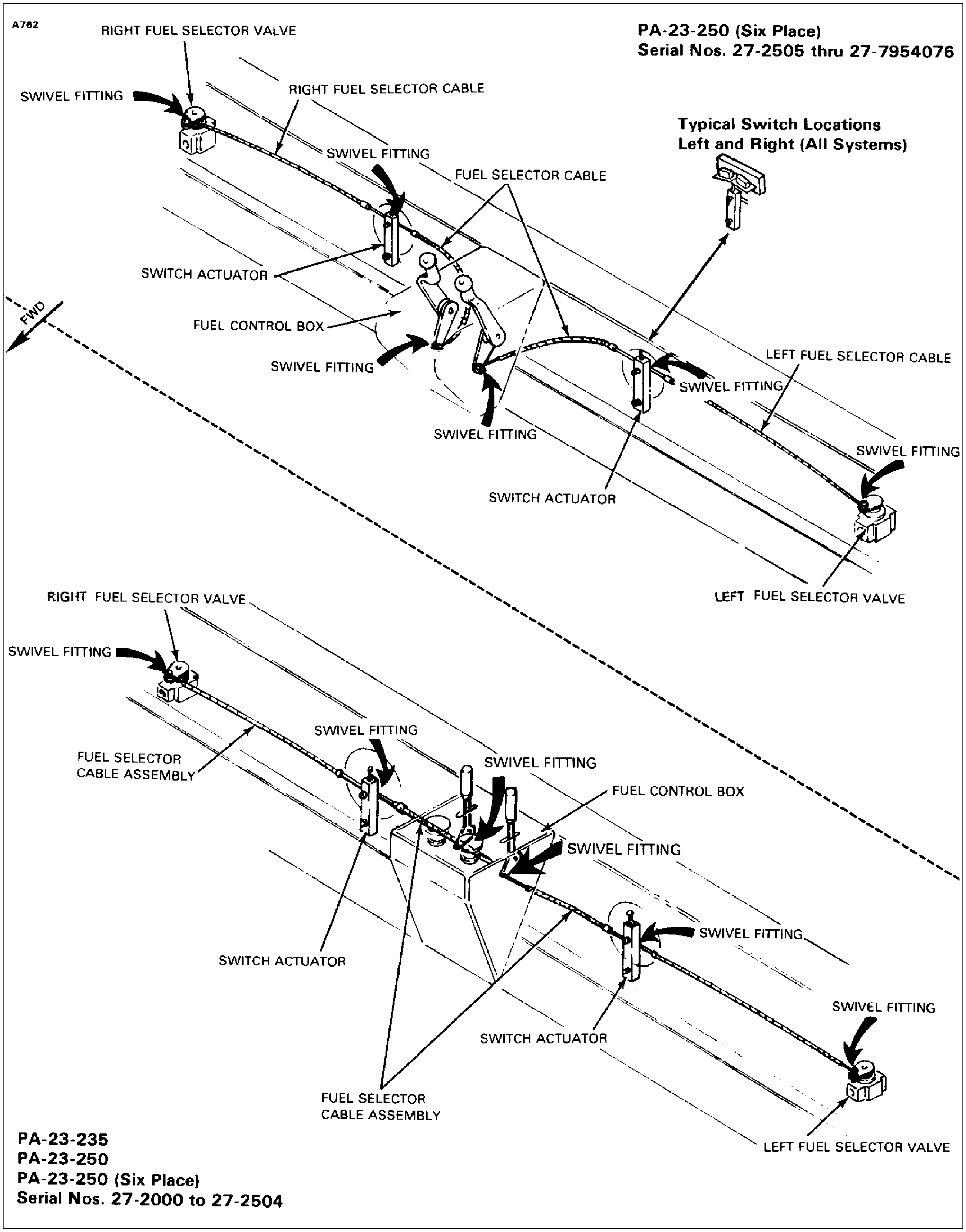

Figure 3-2. Fuel Selector Valve Control Cables

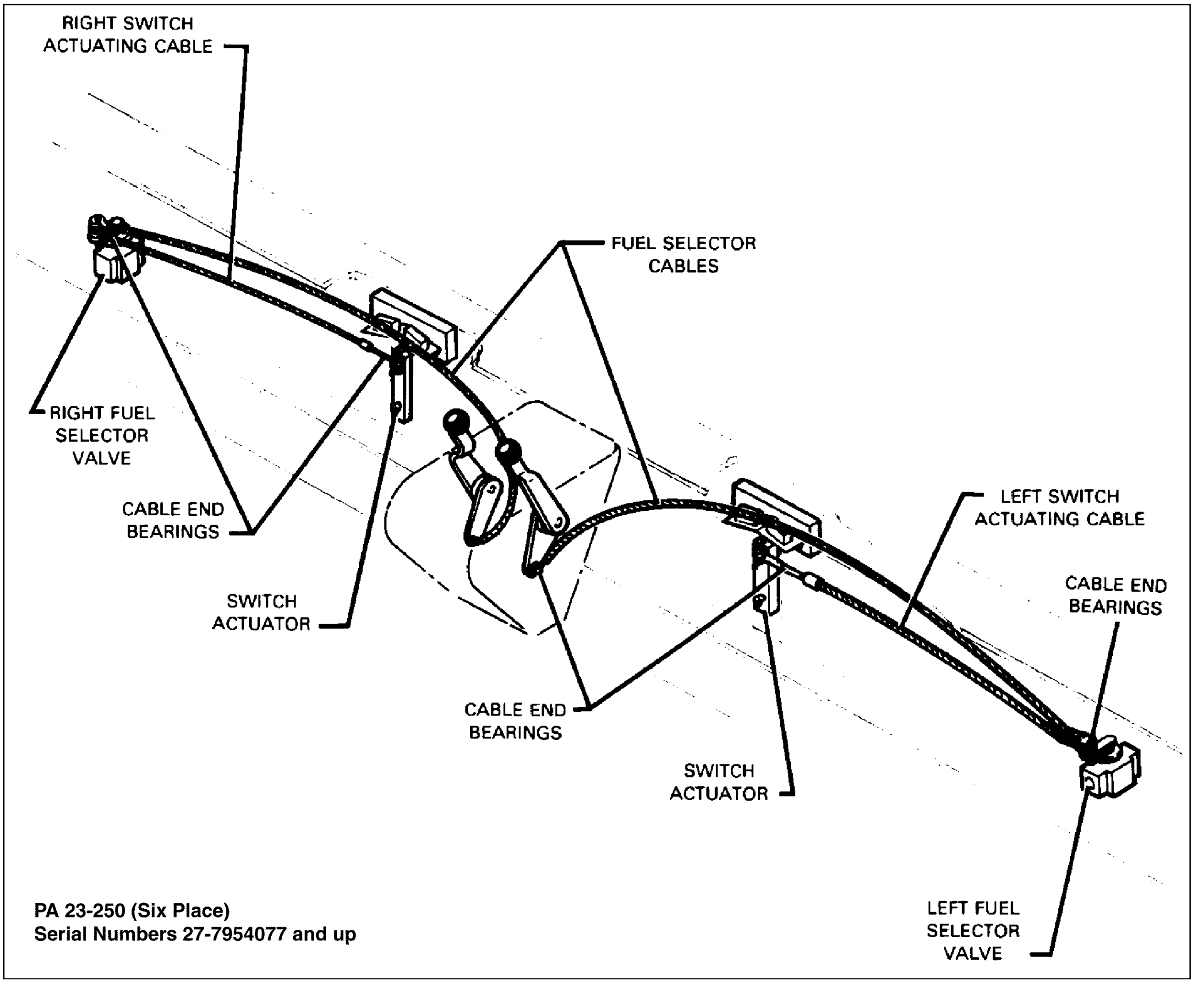

Figure 3-2. Fuel Selector Valve Control Cables (cont.)

(5) STABILATOR TIP TUBE AND WEIGHT ASSEMBLY 100 HOUR INSPECTION. (See Figure 3-3.) In PA-23-250 Aztec "F" S/N's 27-7654001 thru 27-7954121 only, inspect stabilator tip tube and weight assemblies for cracks as follows:

(a) Remove tip assembly from left and right stabilators.

(b) In S/N's 27-7654001 thru 27-7954035 with unmodified P/N 15658-020 tube and weight assemblies:

1 Using a 10X magnifying glass, inspect the square tube on the tube and weight assemblies to determine if any cracks are evident. See "Inspection Area" in Figure 3-x2.

2 If no cracks are detected in either tube:

a The modification below may be accomplished at any time not to exceed the next 100 hours of operation.

b Reinstall the tip assemblies to the stabilators.

c Make an appropriate logbook entry documenting completion of this inspection.

3 If any cracks are detected, modify both tube and weight assemblies as follows:

a Remove tube and weight assembly (P/N 15658-20) from both stabilators. Retain screws, washers and nuts for reinstallation.

b Cut or drill hole in the end of the tube attachment plate to allow a 0.625 (5/8) inch diameter tube to be inserted into the square tube.

c Locate and drill twelve (12) .250 holes in the square tube as shown.

d Insert a 10 inch length of round steel tube (0.625 (5/8) x .058 inch Type 4130 Cond. N) into the square tube and rosette weld the tubes together at the twelve (12) .250 holes.

NOTE: Round steel tube (10 x 0.625 (5/8) x .058 inch Type 4130 Cond. N) should be procured locally, if possible. If necessary, tube may be ordered from Piper as P/N 15589-005.

e Weld shut the area around the hole in the attachment plate and the tubes.

CAUTION: IF WELDING CRACKS NEAR THE LEAD WEIGHT, USE TIG OR MIG WELD INSTEAD OF OXY-ACETYLENE.

f Weld all cracks shut that were discovered when inspecting the square tube.

g Drill a 0.I91 inch hole through the round tube using existing hole in square tube as a guide.

h Clean, prime and paint tube and weight assembly.

i Reinstall the tube and weight assembly to the stabilator using existing attachment hardware.

j Reinstall the tip assembly to the stabilator.

k Refer to paragraph 4-66 and rebalance the stabilator.

NOTE: If stabilator cannot be properly balanced with the trim weights at the stabilator balance arm, it is permissible to remove up to 0.25 (1/4) inch of material from the forward ends of the lead weights on the stabilator tips. (Remove an equal amount from both lead weights).

l Make an appropriate logbook entry documenting completion of this inspection.

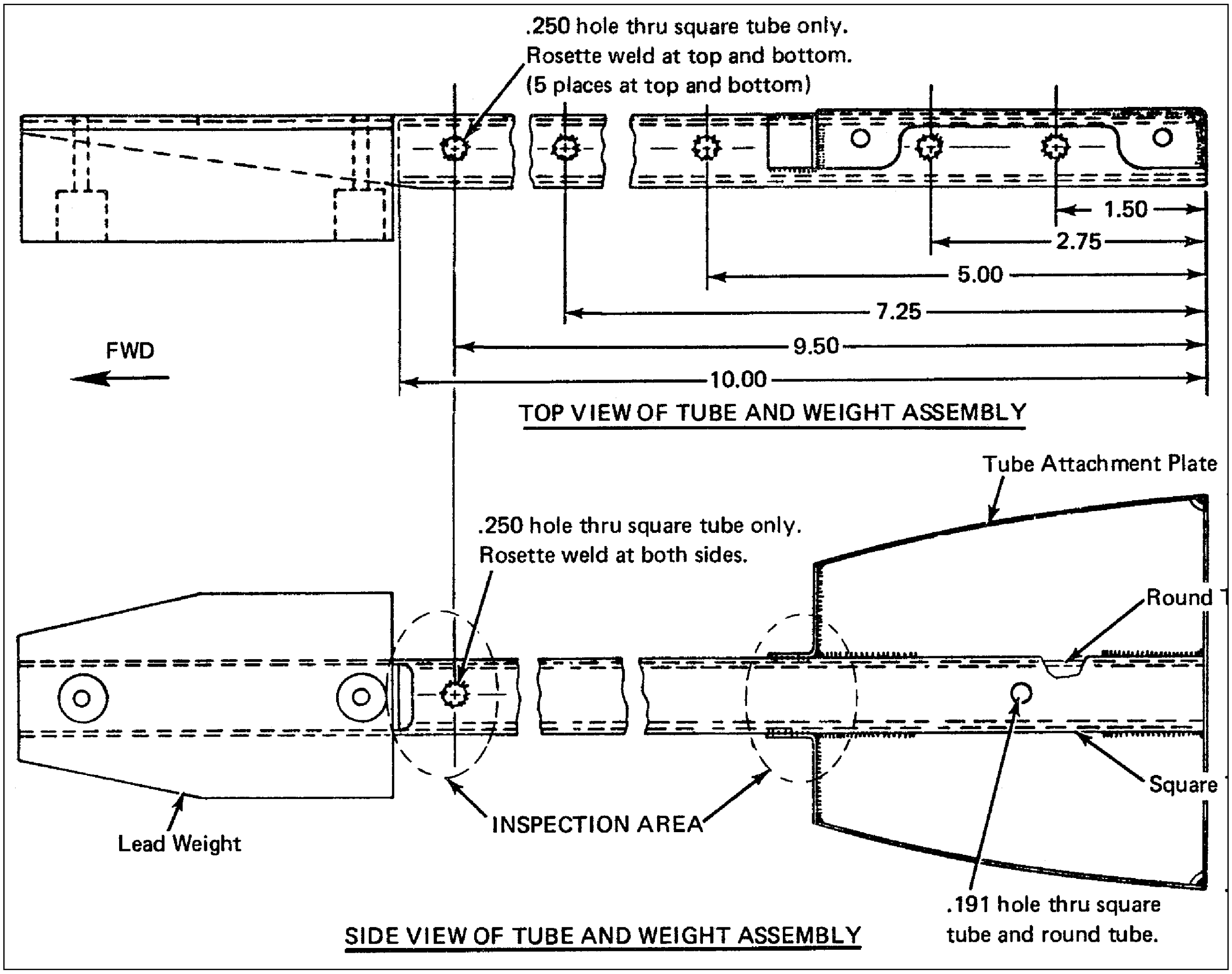

Figure 3-3. Stabilator Tip Tube And Weight Assembly

(c) In S/N's 27-7654001 thru 27-7954035 with modified P/N 15658-020 tube and weight assemblies (see above), or with P/N 15658-029 tube and weight assemblies, or with Piper Kit No. 763-987 installed:

NOTE: Piper Kit No. 763-987 is no longer available (circa 2001).

1 Using a 10X magnifying glass, inspect the square tube on the tube and weight assemblies to determine if any cracks are evident. See "Inspection Area" in Figure 3-x2.

2 If no cracks are detected in either tube:

a Reinstall the tip assemblies to the stabilators.

b Make an appropriate logbook entry documenting completion of this inspection.

3 If any cracks are detected:

a Replace all cracked parts before further flight. See Parts Catalog, P/N 753-522.

b Reinstall the tip assemblies to the stabilators.

c Refer to paragraph 4-66 and rebalance the stabilator.

d Make an appropriate logbook entry documenting completion of this inspection.

(d) In S/N's 27-7954036 thru 27-7954121:

1 Using a 10X magnifying glass, inspect the square tube on the tube and weight assemblies to determine if any cracks are evident. See "Inspection Area" in Figure 3-x2.

2 If no cracks are detected in either tube:

a Reinstall the tip assemblies to the stabilators.

b Make an appropriate logbook entry documenting completion of this inspection.

3 If any cracks are detected:

a Replace all cracked parts before further flight. See Parts Catalog, P/N 753-522.

b Reinstall the tip assemblies to the stabilators.

c Refer to paragraph 4-66 and rebalance the stabilator.

d Make an appropriate logbook entry documenting completion of this inspection.

(6) 100 HOUR ENGINE CONTROLS SUPPORT BRACKET INSPECTION. (See Figure 3-4.) In PA-23-250's S/N's 27-1 thru 27-140 only, for those airplanes which have not installed the improved Engine Controls Support Bracket Assembly, P/N 16975-00, each 100 hours or annually, whichever comes first, inspect the original equipment engine controls support bracket assembly, P/N 17892 -00, as follows:

NOTE: Installation of the improved Engine Controls Support Bracket Assembly, P/N 16975-00, relieves this repetitive inspection requirement.

(a) Inspect the engine controls support bracket assembly, P/N 17892 -00, for any evidence of the tube being cracked, bent, or distorted.

(b) If such evidence is present, remove the existing bracket assembly and install an improved bracket

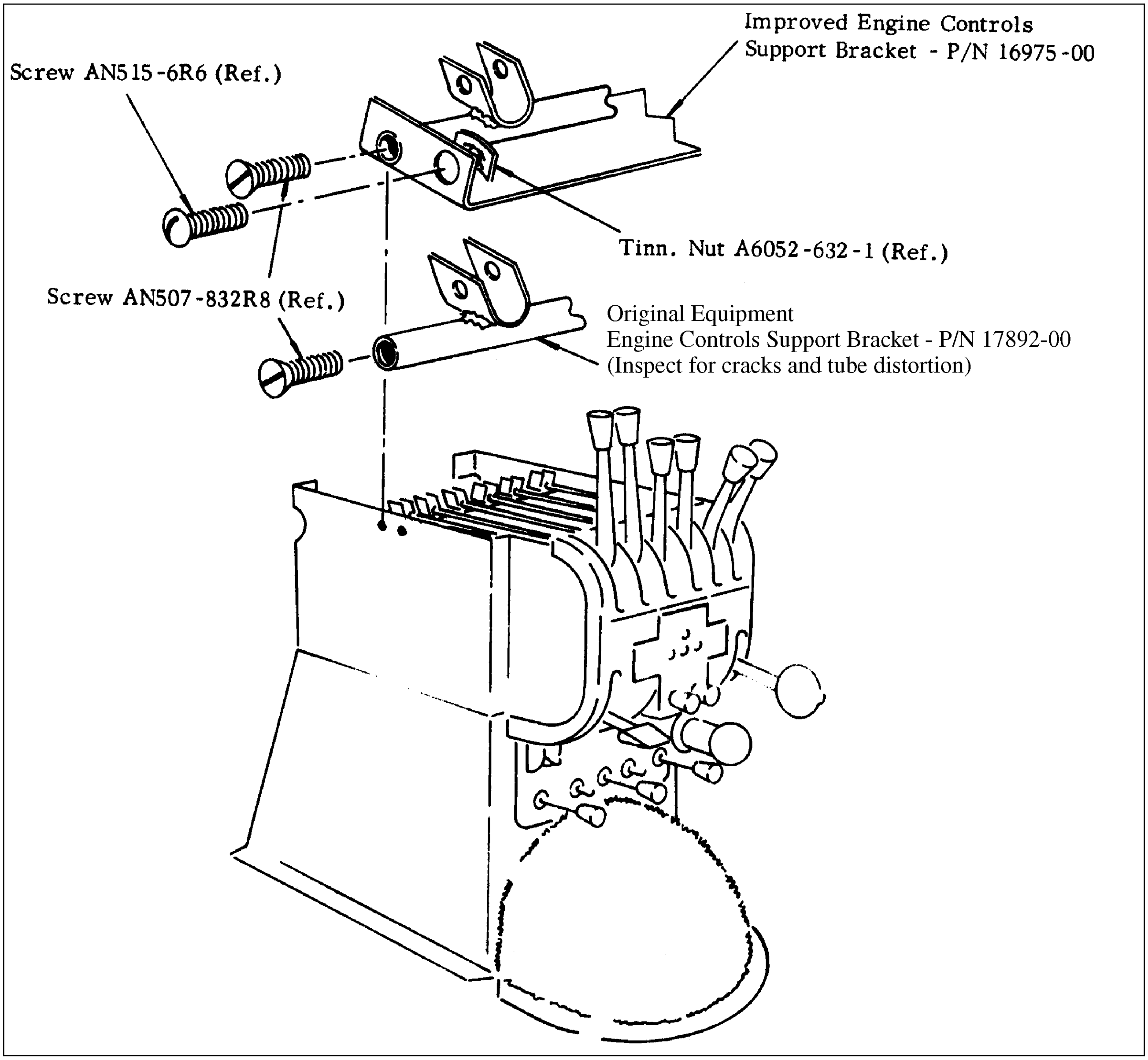

Figure 3-4. Engine Controls Support Bracket Inspection

(7) LANDING GEAR SELECTOR LEVER 100 HOUR INSPECTION. In all PA-23-235's and PA-23-250 S/N's 27-1 thru 27-7854139 only, for airplanes which have not installed the heavy duty landing gear selector lever P/N 761-213 (i.e. - 28468-002), inspect the landing gear selector lever for cracks as follows:

NOTE: Installation of the heavy duty landing gear selector lever P/N 761-213 (i.e. - 28468-002) eliminates this repetitive inspection requirement.

(a) Remove the rectangular access plate from the right side of the control pedestal to gain access to the hydraulic powerpak.

(b) See Sketches A and B in Figure 3-5 to verify which landing gear selector lever is installed in the airplane.

(c) If the heavy duty landing gear selector lever P/N 761-213 (i.e. - 28468-002) is installed, as shown in Sketch B, no further action is required. Proceed to step (e).

(d) If the landing gear selector lever installed is P/N 752-303 (i.e. - 31931-000) as shown in Sketch A, proceed as follows:

1 Inspect the two bend radii shown in Sketch A for evidence of cracks, using a 10X magnifying glass.

2 If no cracks are found, proceed to step (e).

3 If cracks are found, replace existing landing gear selector lever with new heavy duty lever P/N 761-213 (i.e. - 28468-002) as shown in Sketch B before further flight.

(e) Reinstall rectangular access plate on right side of pedestal.

(f) Make an appropriate logbook entry documenting completion of this inspection.

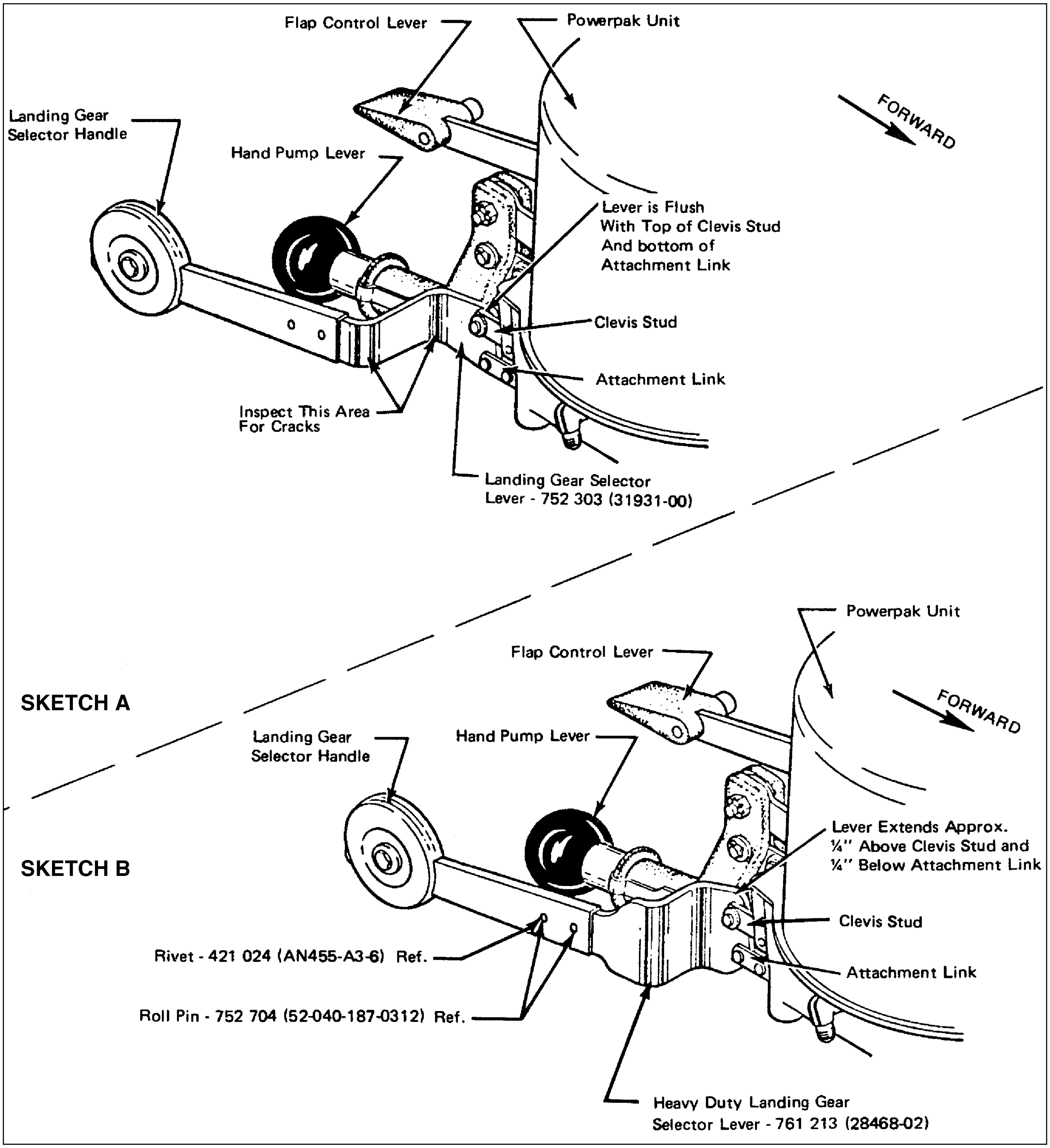

Figure 3-5. Landing Gear Selector Lever

(8) STABILATOR LOWER SURFACE RIVETS AND RIB ATTACHMENT 100 HOUR INSPECTION. In PA-23-250 Aztec "F" S/N's 27-7654001 thru 27-7954044 with unmodified stabilator serial numbers 0336-L thru 0340-L and 0401-L thru 0607-L and 0337-R thru 0341-R and 0402-R thru 0609-R only, inspect stabilator lower surface rivets and rib attachment per Stabilator Lower Surface Rivets and Rib Attachment 100 Hour Inspection (see Special Inspections, Procedures).

NOTE: The stabilator serial number plate is located on the stabilator rear spar.

(a) Inspection.

1 Inspect the lower surface of the left and right stabilator assemblies for evidence of loose blind rivets. See Figure 3-6 for location of existing blind rivets. (Loose rivets may be noted by the presence of dark streaks downstream of the rivet heads.)

2 Remove stabilator tip(s). With a mirror and a light attached to long rods, inspect the bottom flanges of all ribs for evidence of cracks.

a If cracks are found, replace the stabilator assembly with a new assembly:

- S/N's 27-7654001 thru 27-7954035:

  Left Stabilator Assy. (P/N 15658-030)

  Right Stabilator Assy. (P/N 15658-031)

- S/N's 27-7954036 thru 27-7954044:

  Left Stabilator Assy. (P/N 15658-032)

  Right Stabilator Assy. (P/N 15658-033)

b If loose rivets are found, they must be replaced with NAS1738B-4-1, or NAS1738B-4-2, or NAS1738B-4-3 cherry lock rivets.

c If no cracks are found, and loose rivets are replaced, the stabilator tip(s) may be reinstalled and the aircraft returned to service.

d Make an appropriate logbook entry documenting completion of this inspection.

(b) Modification.

Installation of additional cherry lock rivets will eliminate this repetitive inspection requirement. Proceed as follows:

1 Install additional cherry lock rivets (see Figure 3-x3) mid-spaced between the existing blind rivets in the ribs and rear spar on the bottom surface of the stabilator. (The new cherry lock rivets must be installed between all existing blind rivets shown as Rivets "A" & "B" in Figure 3-6.)

2 Reinstall stabilator tip and rebalance stabilator per paragraph 4-66.

3 Make an appropriate logbook entry documenting this modification.

(c) Make an appropriate logbook entry documenting completion of this inspection.

REPLACEMENT RIVETS

RIVET	CHERRY LOCK	PIPER P/N
A	NAS1738B-4-1	522 881
B	NAS1738B-4-2	522 882
C	NAS1738B-4-3	522 883

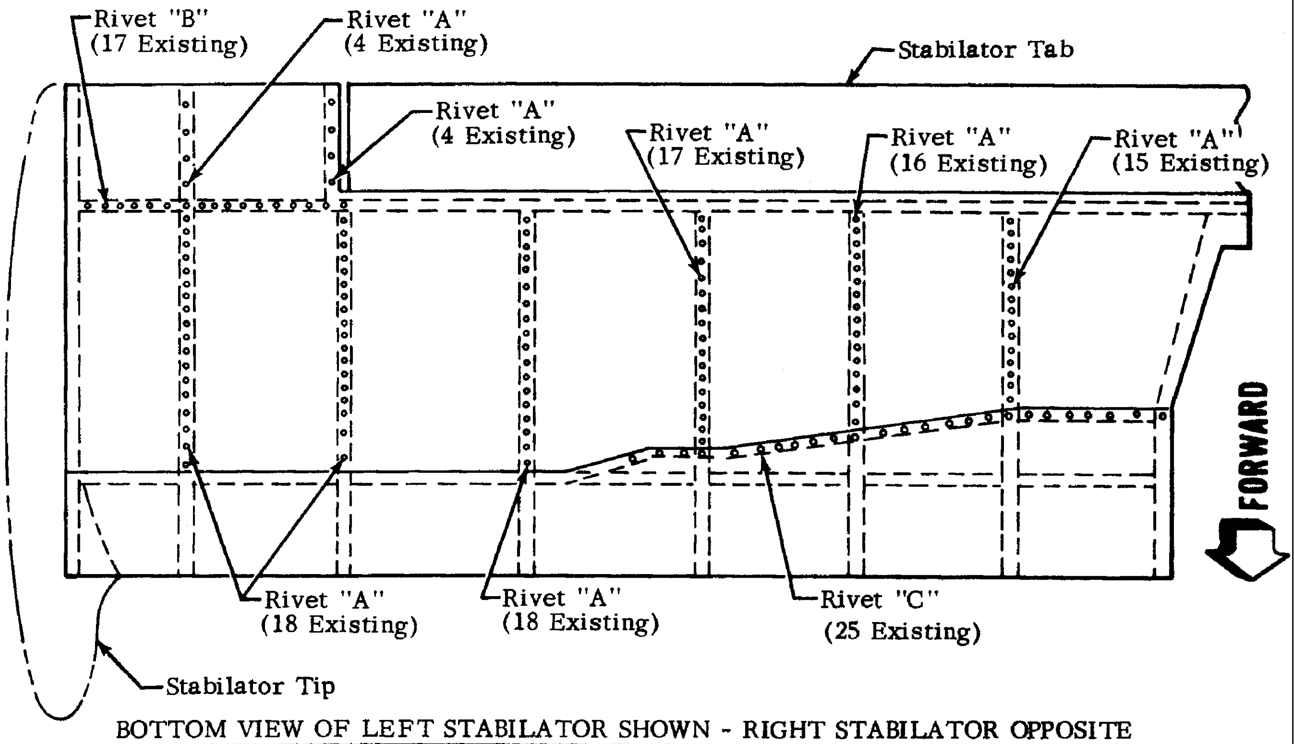

Figure 3-6. Stabilator Lower Surface Rivets And Rib Attachment

(9) FLAP BELLCRANK 100 HOUR INSPECTION. In all PA-23-235's and PA-23-250 S/N's 27-1 thru 27-8054059 only, for airplanes which have accumulated at least 1000 hours total time-in-service, have initially completed Piper Service Bulletin No. 671, and have not installed the improved flap bellcrank P/N 16423-006; each 100 hours or annually, whichever comes first, inspect the flap bellcrank for cracks, corrosion, and condition as follows:

NOTE: Installation of the improved flap bellcrank P/N 16423-006 eliminates this repetitive inspection requirement.

(a) Gain access to the flap torque tube and Flap Control System by removing the aft seats, seat tracks, carpeting, right side fuselage interior trim panel, and the aft cabin floorboard.

(b) Remove the right rear wing root fairings and the right flap torque tube access panels (see Figure 3-7).

(c) Clean the flap bellcrank.

(d) Using suitable tools (mirror, flashlight, magnifier, etc.) visually inspect the flap bellcrank as follows: (see Figure 3-x5)

1 the tube and channel assembly and arm for corrosion and condition;

2 the weld areas for cracks.

(e) If a crack or corrosion is found, replace with new flap bellcrank assembly (P/N 16423-06). See paragraph 4-12A.

(f) If no crack or corrosion is found, lubricate the bushings in the bellcrank assembly with oil as specified in the Lubrication Chart, Section II.

(g) Reinstall the right rear wing root fairings and the right flap torque tube access panels.

(h) Reinstall the aft cabin floorboard, right side fuselage interior trim panel, carpeting, seat tracks, and the aft seats.

(i) Make an appropriate logbook entry documenting completion of this inspection. See also AD 81-04-05 R1.

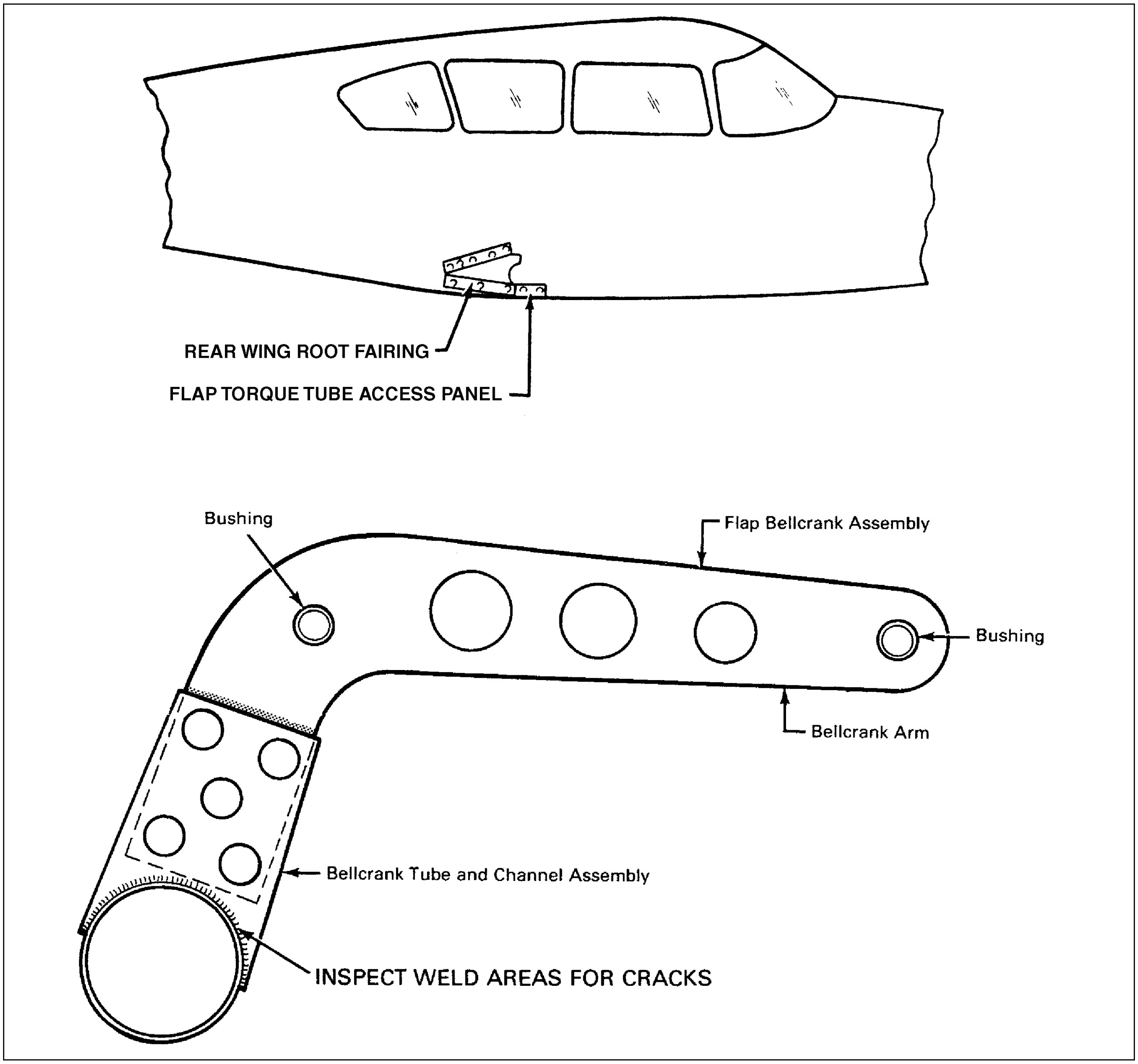

Figure 3-7. Flap Bellcrank Inspection

(10) FUSELAGE FRAME 100 HOUR INSPECTION. (See Figure 3-8.) In all PA-23-235's and PA-23-250 S/N's 27-1 thru 27-8054049 only, for airplanes which have accumulated at least 500 hours total time-in-service and have not installed the Footstep Reinforcement Brackets per Piper Service Bulletin No. 672A; each 100 hours time-in-service or annually, whichever comes first, inspect the fuselage frame, footstep attachment tube, rudder cable pulley brackets, and Sta. 153/171 canted bulkhead for cracks as follows:

NOTE: Installation of Footstep Reinforcement Brackets per Piper Service Bulletin No. 672A relieves this repetitive inspection requirement.

(a) Gain access to the rear baggage compartment thru the rear baggage compartment door.

(b) Remove the oxygen bottle (if installed), rear baggage compartment floorboard and carpeting. Remove middle and aft seats, seat tracks, carpeting, aft cabin floorboard and the right fuselage side panel to gain access to the fuselage tubular frame at the footstep attachment area and to the bottom portion of the Sta. 153/171 canted bulkhead.

(c) Remove the footstep assembly.

(d) Using 10X magnification, inspect the welds on the fuselage frame tube, footstep attachment tube and rudder cable pulley brackets, in the area shown in Sketch A, for cracks. If no cracks are found, proceed to step (e). If cracks are found proceed as follows:

NOTE: All repairs must be done by gas welding.

1 Make a 30 degree scarf cut thru the fuselage frame tube at a point 14.5 inches inboard from the corner of the fuselage frame as shown in Sketch B. Remove excess weld from the inside of the fuselage frame tube, in the area of the pulley brackets, to facilitate installation of a reinforcement tube.

2 Fabricate a 12.5 inch long fuselage frame reinforcement tube from .625 O.D. X .049 wall, round, seamless 4130 steel (MIL-T-6736 type 1, condition N).

NOTE: Reinforcement tube may also be ordered from Piper as P/N 82352-114.

3 Install the reinforcement tube into the fuselage frame tube as shown in Sketch B, using the "inner sleeve method" as described in the latest revision of AC 43.13-l.

4 Weld cracks using acceptable methods listed in the latest revision of AC 43.13-l.

(e) Using 10X magnification, inspect the bottom aft side of Sta. 153/171 canted bulkhead for cracks, in the area where the rudder cable pulley bracket attaches to the bulkhead, as shown in Sketch C.

1 If no cracks are found, proceed to step (f).

2 If cracks are found, repair with acceptable methods listed in the latest revision of AC 43.13-l, or replace with new parts (see Parts Catalog, P/N 753-522).

(f) Reinstall the right fuselage side panel, aft cabin floorboard, carpeting, seat tracks, middle and aft seats, rear baggage compartment floorboard and carpeting, and oxygen bottle (if removed).

(g) Make an appropriate logbook entry documenting completion of this inspection.

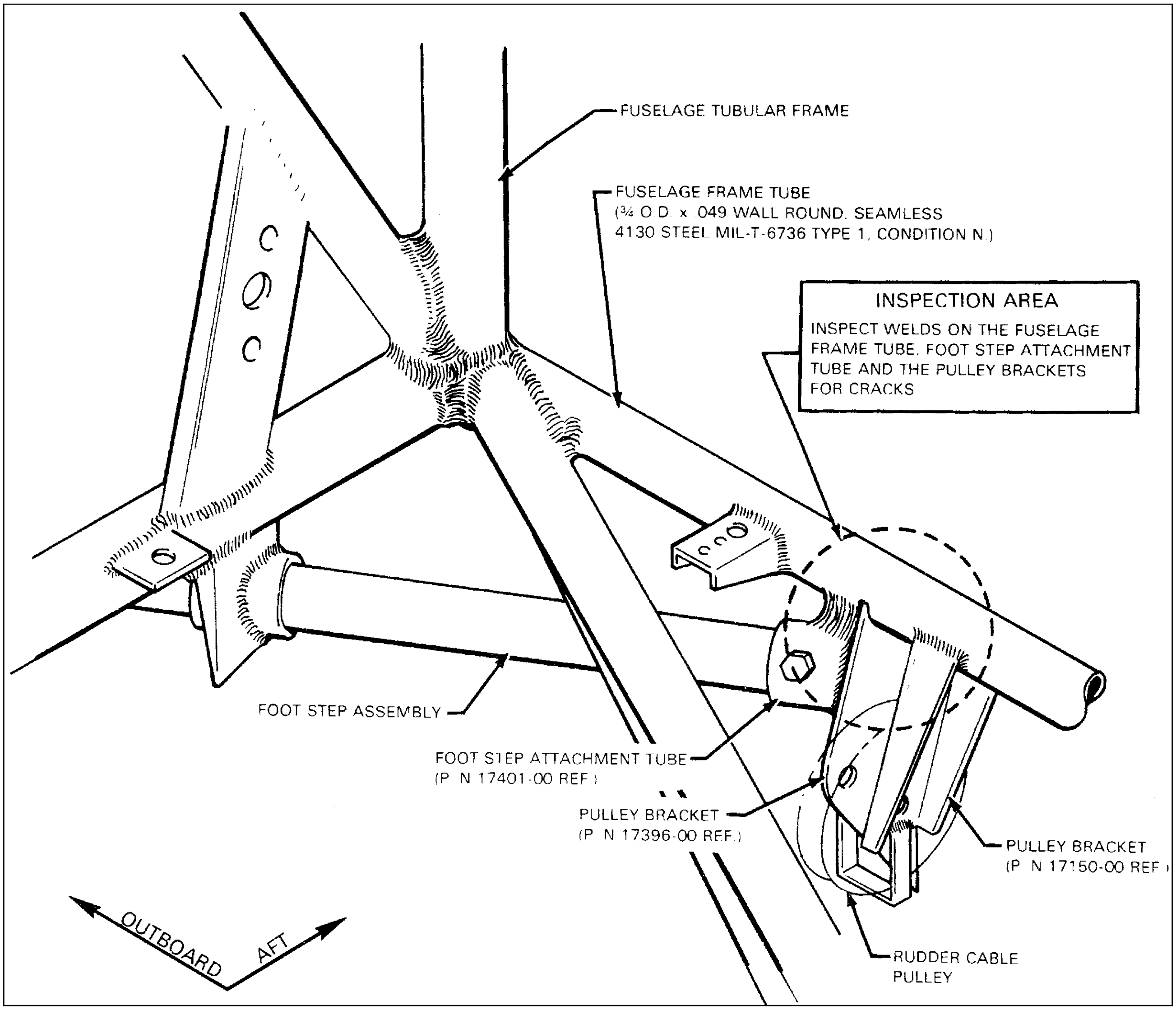

Figure 3-8. Fuselage Frame Inspection

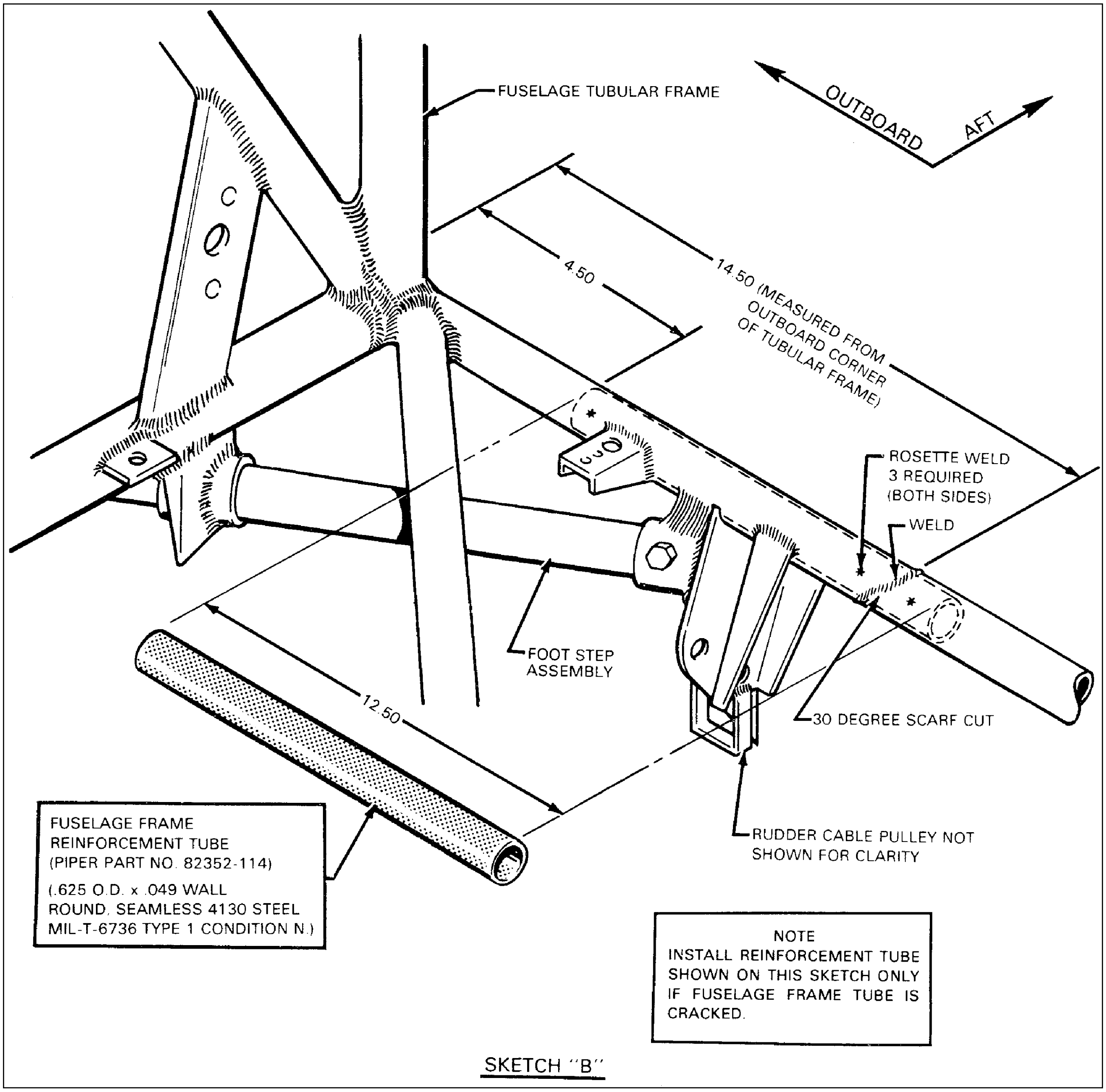

Figure 3-8. Fuselage Frame Inspection (cont.)

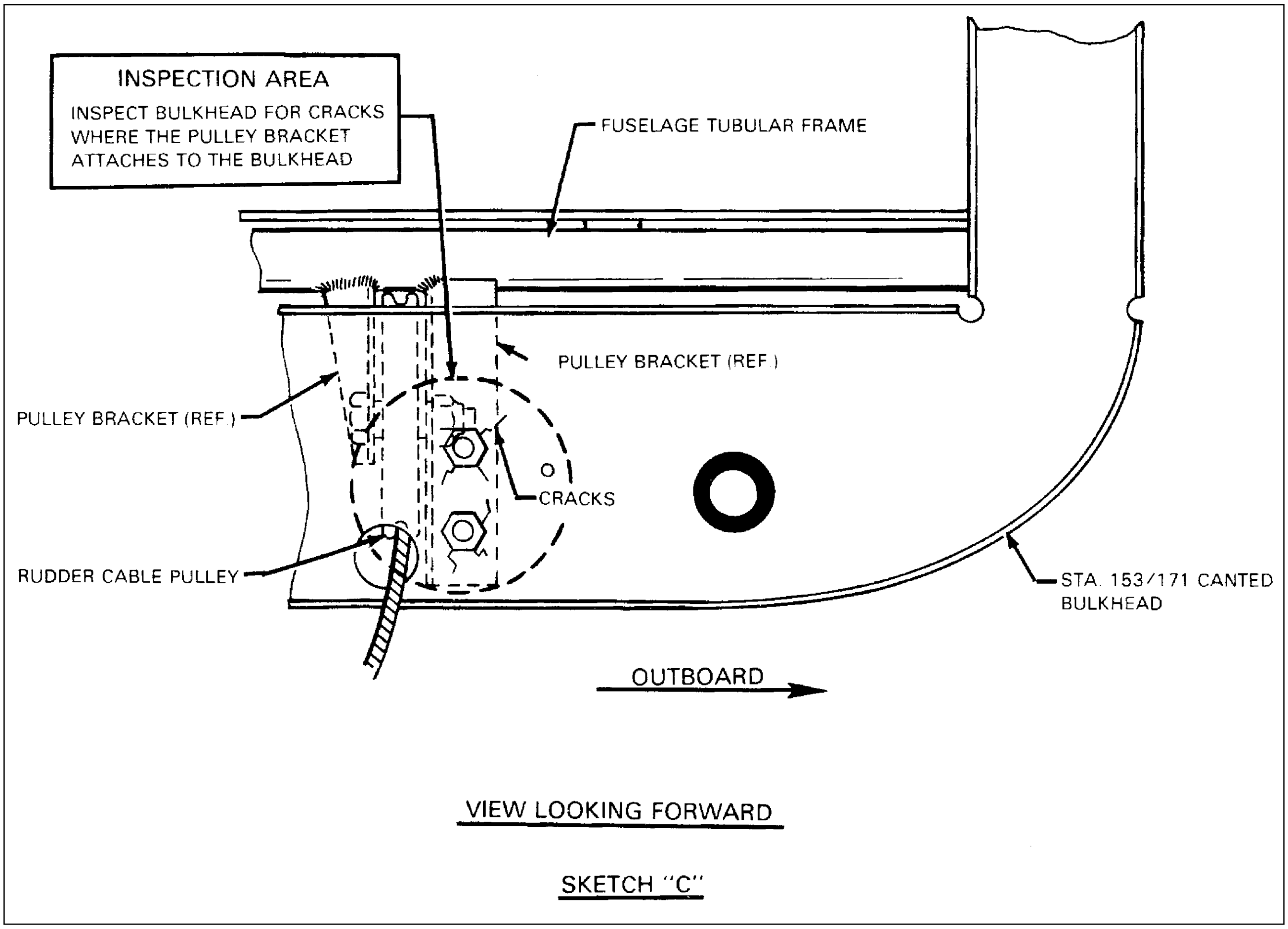

Figure 3-8. Fuselage Frame Inspection (cont.)

(11) FLAP TORQUE TUBE 100 HOUR INSPECTION. For airplanes which have accumulated at least 2500 hours total time-in-service and have not installed a steel flap torque tube (P/N 17634-002, 104622-002, or 104622-004); each 100 hour time-in-service or annually, whichever comes first, inspect the flap torque tube for wear, distortion, and corrosion as follows:

NOTE: Installation of a steel flap torque tube P/N 17634-002, 104622-002, or 104622-004 relieves this repetitive inspection requirement.

(a) Remove the flap torque tube assembly per paragraph 5-50.

(b) After the flap torque tube has been removed from the aircraft and prior to removing the end plugs, examine the area of the torque tube that comes in contact with the torque tube bearing blocks for wear and distortion. If wear or distortion is noted on the tube and the depth exceeds .005 inches, replace the torque tube per paragraph 4-12B.

(c) Inspect the attachment bolt holes (for the flap horn and the flap bellcrank) in the flap torque tube for cracks originating out of each hole using a Fluorescent Penetrant procedure per the latest revision of AC 43.13-1. Also, inspect the subject holes for elongation. Elongation up to .050 inch (see Figure 3-9) is acceptable provided that when the horn or bellcrank is mounted on the tube with the attachment bolts (without nuts) installed, there is no relative motion between the horn or bellcrank and the torque tube with a light load applied in a radial direction simulating a flap air load. Replace the torque tube per paragraph 4-12B, if cracks are noted in the subject holes or elongation exceeds limits.

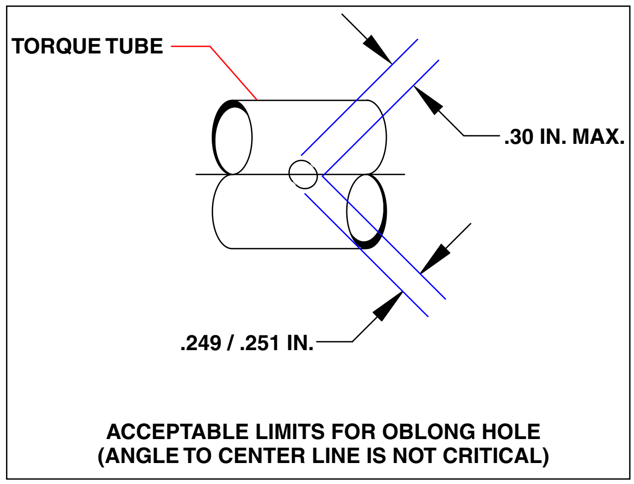

Figure 3-9. Elongation Limits

(d) Remove the end plugs and inspect and remove any corrosion present on the inside diameter of the torque tube, specifically in the area that contacts the wooden end plug (P/N 17631-000). See the latest revision of AC 43.13-1 for corrosion removal and corrosion protection processes. If severe cleaning is required, including the mechanical removal of all the corrosion, the resultant wall thickness must be measured and cannot be less than .063 inches. Replace the torque tube per paragraph 4-12B, if corrosion cannot be repaired, or if remaining wall thickness does not meet minimum requirements.

(e) Inspect the wooden end plugs (P/N 17631-000) for deterioration and close fit with the inside diameter of the torque tube. The maximum acceptable clearance between the inside diameter of the torque tube and the outside diameter of the plug is .015 inches. The plugs should be treated with a wood preservative product such as "tung oil" prior to reinstalling in the torque tube. If replacement of the plugs is required, order new plug P/N 17631-002 which is manufactured from Acetal (Delrin) rod.

(f) If the torque tube meets the inspection requirements, above, it can be reinstalled per paragraph 5-51.

(12) STABILATOR TORQUE TUBE CORROSION INSPECTION. Each ten years time-in-service or whenever both stabilator halves are removed, whichever comes first, inspect the stabilator torque tube assembly for corrosion and condition as follows:

NOTE: The initial ten year inspection interval should date from the logbook entry documenting completion of Piper Service Bulletin No. 1160. If no such logbook entry can be found, perform the initial inspection as part of the next 100 hour or annual inspection.

(a) Remove the aft fairing, aft fuselage access panel, and stabilator halves (see paragraph 4-18).

(b) Inspect the inside and outside surface of the torque tube and the bolts on the inside of the torque tube for corrosion and condition.

(c) Inspect bearings, bearing blocks and attach fittings inside the fuselage for condition.

(d) Inspect balance weight tube attachment fitting and control horn for condition.

(e) If no corrosion is found, proceed to step (j).

(f) If surface corrosion or wear is found other than on the torque tube itself, install replacement parts (see Parts Catalog P/N 753-522), or repair using acceptable methods in accordance with the latest revision of AC 43.13-1.

(g) If surface corrosion is found on the stabilator torque tube, removal of corrosion is permitted only within the following limits:

Minimum Tube O.D. = 2.3113 inches; Minimum Tube Wall Thickness = .161 inch.

(h) Where cadium plating has been removed from the outside of the torque tube, apply a brush coat of cadium plate per MIL-STD-865. Where paint has been removed from the inside of the torque tube, apply 2 swab coats of epoxy primer. Treat all other reworked items with Dinitrol AV8 or CRC Protector 100 Corrosion Inhibitor.

(i) For torque tubes which cannot be cleaned up within the above limits, replace by installing Piper Kit No. 652-579.

NOTE: Destroy the corroded stabilator torque tube to prevent possible inadvertent future installation on an aircraft.

(j) Lubricate the torque tube per the Lubrication Chart, Section II, and reinstall the stabilator halves (see paragraph 4-19), fuselage fairings, and aft fuselage access panel.

(k) Make an appropriate logbook entry documenting completion of this inspection. If repair was accomplished by corrosion removal, annotate the logbook entry accordingly.

(13) CONTROL CABLE INSPECTION. Aircraft control cable systems are subject to a variety of environmental conditions and forms of deterioration that, with time, may be easy to recognize as wire/strand breakage or the not-so-readily visible types of wear, corrosion, and/or distortion. The following data may help in detecting the presence of these conditions:

(a) Cable Damage

Critical areas for wire breakage are sections of the cable which pass through fairleads and around pulleys. To inspect each section which passes over a pulley or through a fairlead, remove cable from aircraft to the extent necessary to expose that particular section. Examine cables for broken wires by passing a cloth along length of cable. This will clean the cable for a visual inspection, and detect broken wires, if the cloth snags on cable. When snags are found, closely examine cable to determine full extent of damage.

The absence of snags is not positive evidence that broken wires do not exist. Figure 3-10, Item A, shows a cable with broken wires that were not detected by wiping, but were found during a visual inspection. The damage became readily apparent (Figure 3-10, Item B) when the cable was removed and bent using the techniques depicted in Figure 3-10, Item C.

(b) External Wear Patterns

Wear will normally extend along cable equal to the distance cable moves at that location. Wear may occur on one side of the cable only or on its entire circumference. Replace flexible and non-flexible cables when individual wires in each strand appear to blend together (outer wires worn 40-50 percent) as depicted in Figure 3-11.

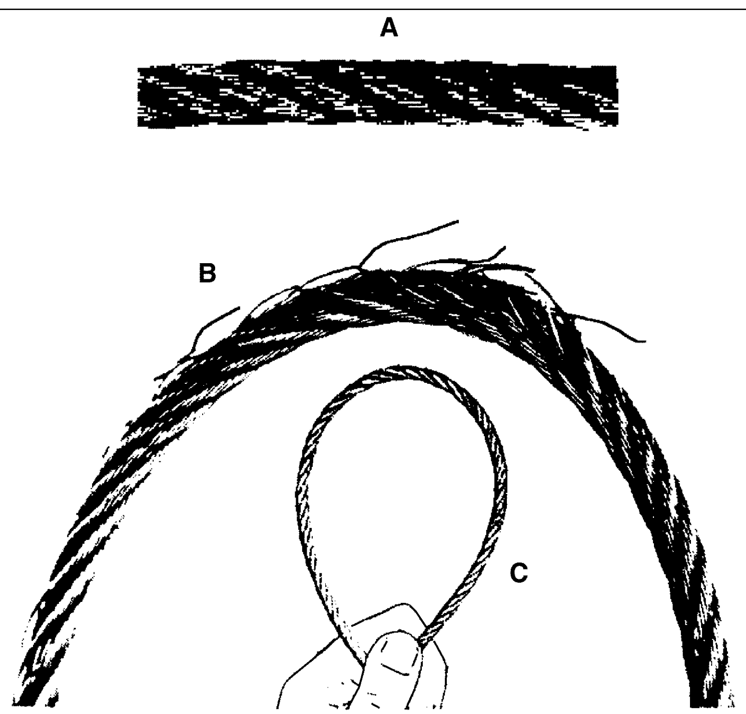

Figure 3-10. Control Cable Inspection

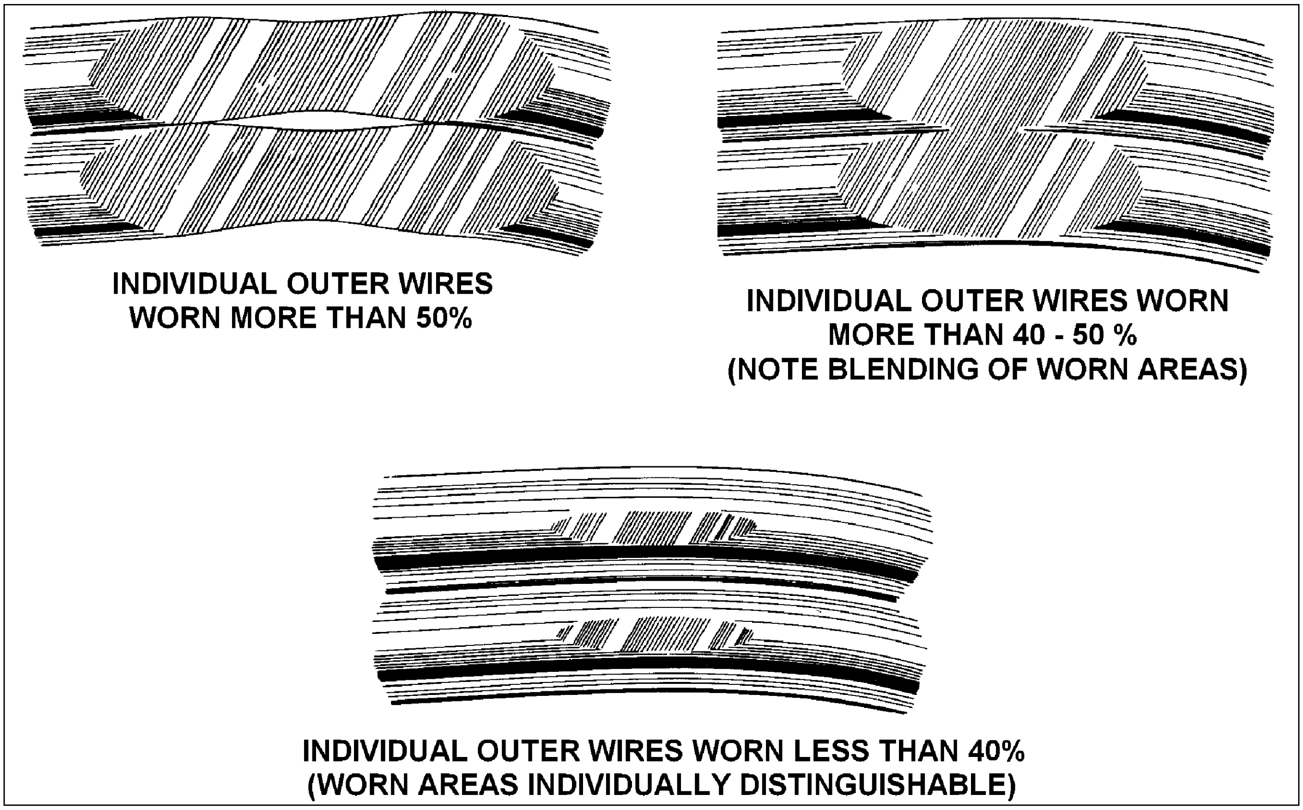

Figure 3-11. External Wear Patterns

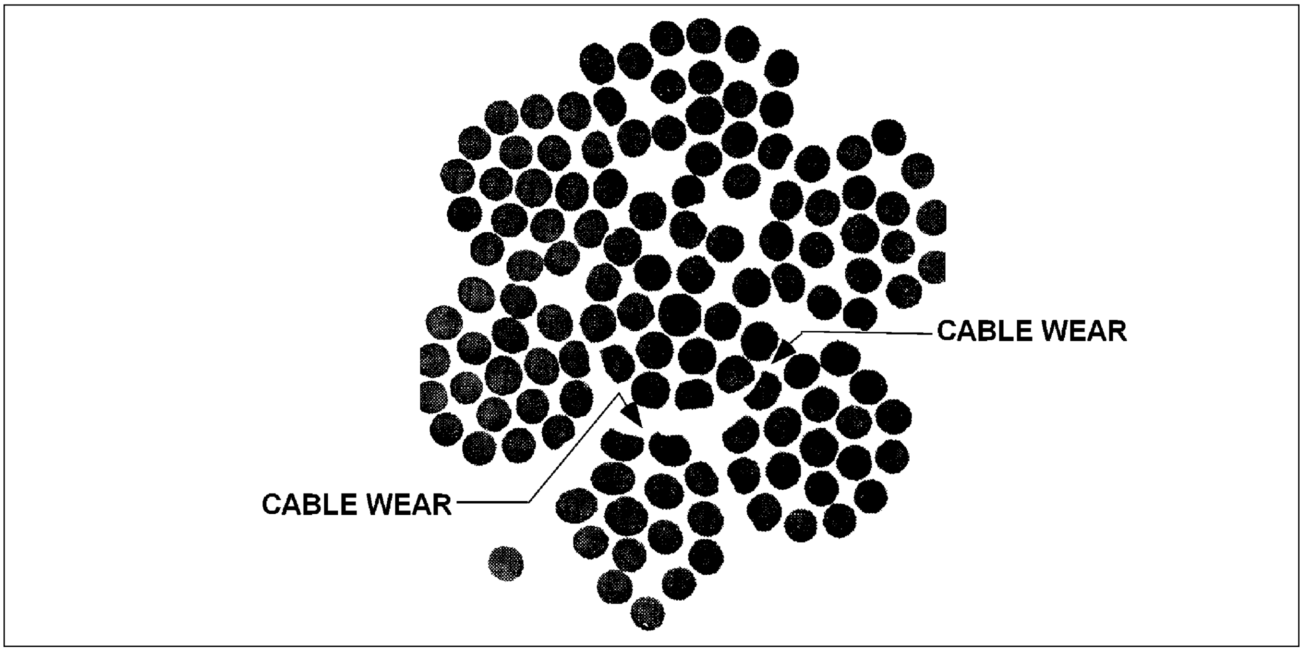

Figure 3-12. Internal Cable Wear

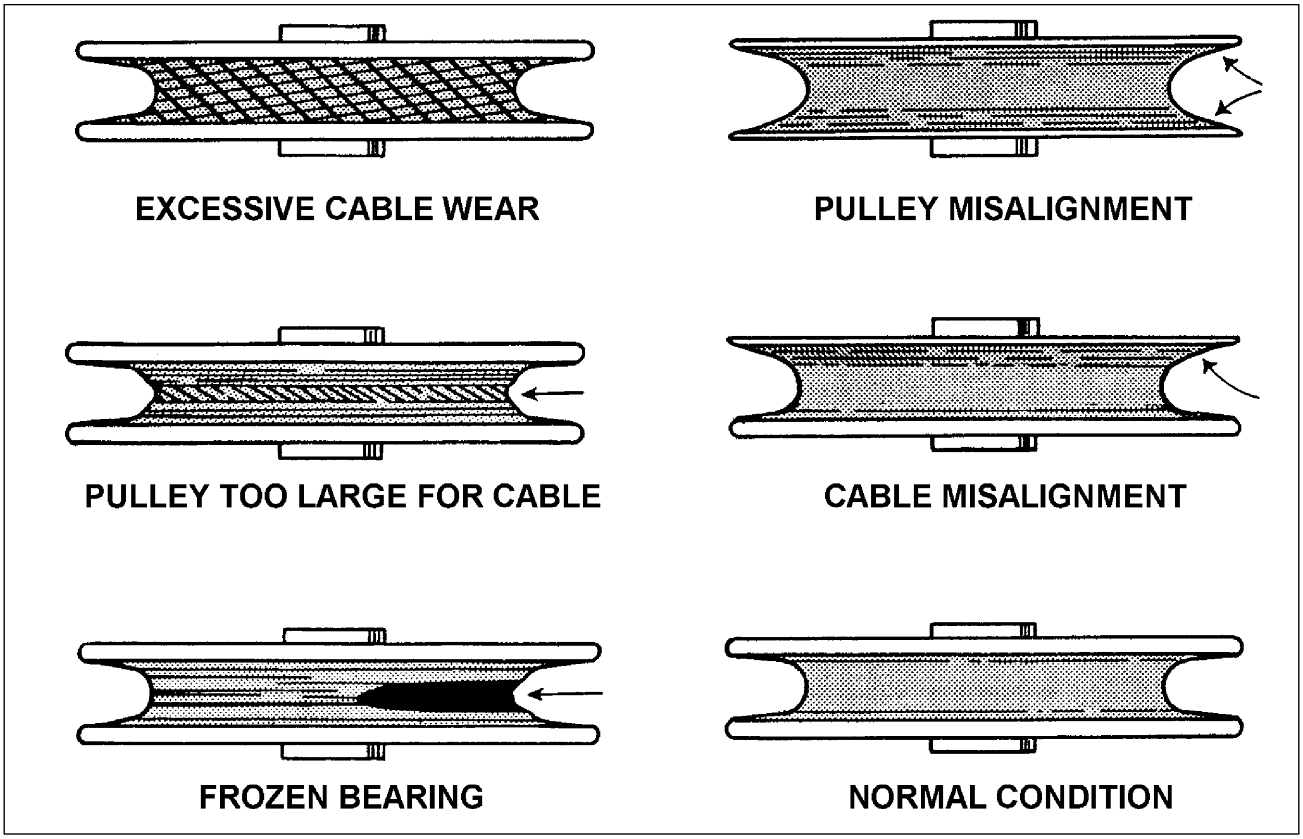

Figure 3-13. Cable Pulley Wear

(c) Internal Cable Wear

As wear is taking place on the exterior surface of a cable, the same condition is taking place internally, particularly in the sections of the cable which pass over pulleys and quadrants. This condition, shown in Figure 3-12, is not easily detected unless the strands of the cable are separated. Wear of this type is a result of the relative motion between inner wire surfaces. Under certain conditions the rate of this type wear can be greater than that occurring on the surface.

(d) Corrosion

Carefully examine any cable for corrosion that has a broken wire in a section not in contact with wear producing airframe components such as pulleys, fairleads, etc. It may be necessary to remove and bend the cable to properly inspect it for internal strand corrosion as this condition is usually not evident on the outer surface of the cable. Replace cable segments if internal strand rust or corrosion is found.

Areas especially conducive to cable corrosion are battery compartments, lavatories, wheel wells, etc., where concentrations of corrosive fumes, vapors, and liquids can accumulate.

NOTE: Check all exposed sections of cable for corrosion after a cleaning and/or metal-brightening operation has been accomplished in that area.

(e) Cable Maintenance

CAUTION: TO AVOID REMOVAL OF CORROSION-PREVENTATIVE COMPOUNDS AND CABLE INTERNAL LUBRICANT, DO NOT USE VAPOR DEGREASING, STEAM CLEANING, METHYLETHYLKETONE (MEK) OR OTHER SOLVENTS.

CAUTION: DO NOT OIL CONTROL CABLES.

Frequent inspections and preservation measures such as rust prevention treatments for bare cable areas will help to extend cable service life. Where cables pass through fairleads, pressure seals, or over pulleys, remove accumulated heavy coatings of corrosion prevention compound. Provide corrosion protection for these cable sections by lubricating as specified in the Lubrication Chart, Section II.

(f) Cable Fittings

1 100 Hour Standard Inspection

Check swaged terminal reference marks for any indication of cable slippage within fitting. Inspect fitting assembly for distortion and/or broken strands at the terminal. Check that all bearings and swivel fittings (bolted or pinned) pivot freely to prevent binding and subsequent failure. Check turnbuckles for proper thread exposure and broken or missing safety wires/clips.

Pay particular attention to corrosion and “pitting” on cable terminals, turnbuckles and cable fittings. Any corrosion or pitting found requires replacement of the corroded fitting and/or cable.

2 100 Hour Special Inspection

For airplanes 15 years old or older, using a 10X magnifier, visually inspect the entire surface of each cable terminal, turnbuckle, or other cable fitting for corrosion or cracking. Inspect under safety wire or clips wrapped around the cable or fitting. Any evidence of corrosion or cracking, however minute, is cause for replacement. A logbook entry documenting the replacement of a cable terminal, turnbuckle, or other cable fitting relieves the inspection requirement for that fitting only, until such time as that fitting has been in service for 15 years.

(g) Pulleys

Inspect pulleys for roughness, sharp edges, and presence of foreign material embedded in the grooves. Examine pulley bearings to assure proper lubrication, smooth rotation, freedom from flat spots, dirt, and paint spray. Periodically rotate pulleys, which turn through a small arc, to provide a new bearing surface for the cable. Maintain pulley alignment to prevent the cable from riding on flanges and chafing against guards, covers, or adjacent structure. Check all pulley brackets and guards for damage, alignment, and security.

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(14) EXHAUST SYSTEM 100 HOUR INSPECTION. Each 100 hours, or annually, whichever comes first, a thorough and detailed inspection of all components of the exhaust system for condition, correct installation, and leakage is critical.

NOTE: In the interest of safety and proper maintenance, a daily visual line inspection of the exhaust stack gaskets, exhaust stack muffler assembly and muffler tail pipe joints should be made to assure tightness; also that all firewall seals are in a satisfactory condition and the engine compartment is free of excessive oil or other combustible materials.

NOTE: For PA-23-235 and early PA-23-250 airplanes, see Figure 3-14 for inspection points. For later PA-23-250 airplanes with ball joint exhaust, see paragraph 8-79.

See also the applicable portions (i.e. - inspection and maintenance of aircraft exhaust systems) of the latest revision of AC 43.13-1

(a) An exhaust and heat exchange system which has been permitted to deteriorate due to age and poor inspection and maintenance can conceivably cause the following difficulties:

1 Carbon monoxide poisoning.

2 Engine compartment originated fires in flight.

3 Engine malfunction or failure in flight.

(b) The entire exhaust system, including heat exchangers, stacks, mufflers, muffler baffles and all exhaust connections must be rigidly inspected at each 100 hour inspection. In addition, the system should be very carefully checked for leaks as the airplane progresses from summer operation (cabin heater not being used) to winter operation (cabin heat on). Removal of the tail pipe will facilitate inspection of the muffler baffle.

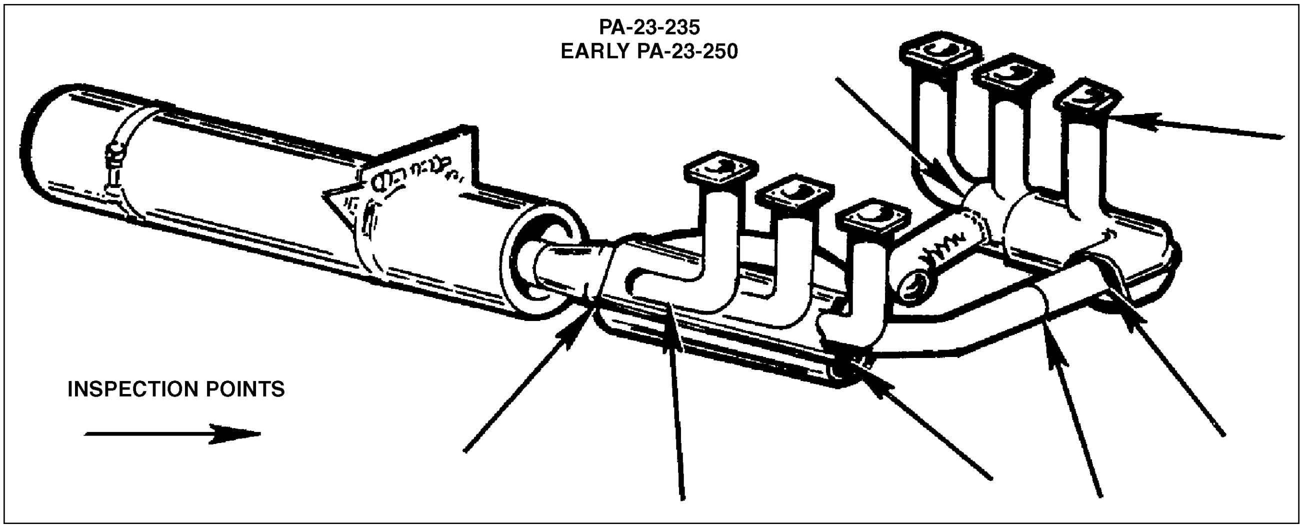

Figure 3-14. Exhaust System Inspection Points, PA-23-235 and early PA-23-250

(c) As with any other system, age (number of hours) must be considered. Even though the best materials and techniques are incorporated in these systems, inspections for instance, at the 700-800 hour period, should be more critical than at the 100 hour mark. Possible replacement of parts should be considered after the 1000 hour mark.

(d) Should you at any time detect the odor of exhaust fumes in the cabin, the pilot must immediately discontinue use of the cabin heater and defroster and open all available cabin ventilators. The pilot should land at the first available airport and determine the source of the leak for immediate correction.

(15) ENGINE MOUNT CORROSION INSPECTION, IMMERSION IN WATER. The following guidance is general in nature and should be applied or varied to fit the individual situation based on water level during immersion, length of time immersed, length of time since exposure, etc. Proceed as follows:

(a) Inspection

1 Level the aircraft in accordance with paragraph 2-14.

2 In two of the larger, lower, engine mount tubes, drill a 3/16 inch hole in the bottom of each tube, at the approximate mid-point.

3 Visually inspect the interior surface of each tube through the 3/16 inch hole for evidence of internal corrosion. Pay particular attention to the lower end of each tube as this is where corrosion is most likely to appear first.

4 Should evidence of corrosion be detected in step (3), above, replace the engine mount. If no corrosion is detected, proceed with Corrosion Prevention, below.

(b) Corrosion Prevention

If no evidence of corrosion is detected in step (3), above, proceed as follows:

1 Place a drip pan below the inspection holes in each engine mount tube.

2 Insert a plastic tube thru each inspection hole and feed it up to the high point of the engine mount tube.

3 Using a syringe inserted into the end of the plastic tube, pump linseed oil into the upper end of the engine mount tube while rotating the syringe / plastic tube assembly to assure maximum coverage. Continue pumping until the lower end of the engine mount tube is filled with linseed oil to the level of the inspection hole.

4 Now, draw the plastic tube out of the upper end of the engine mount tube and reinsert it in the opposite direction, feeding it to the lower end of the engine mount tube.

5 Suck excess linseed oil out of the engine mount tube with the syringe / plastic tube assembly.

6 When linseed oil can no longer be picked up by the syringe / plastic tube assembly, remove it and allow the engine mount tube to drain into drip pans for approximately two hours.

7 Purge excess oil from tubes by applying air pressure to each 3/16 inch inspection hole, one at a time.

8 Insure that roughly the same amount of linseed oil that was pumped in is retrieved in the drip pans.

9 Apply a liberal coating of an approved fuel tank sealant (see Table II-II) to each inspection hole and seal the hole with an appropriate blind rivet. After installing the rivet, apply a liberal coating of the approved fuel tank sealant over the head of the rivet.

(16) VACUUM PUMP VANE WEAR INSPECTION.

For airplanes equipped with service replacement Aero Accessories, Inc., Tempest Dry Air Pumps only. Inspect as follows:

(a) For airplanes equipped with series 215/216 (3215/3216) pumps which have accumulated 500 hours time-in-service; each 100 hours thereafter inspect vacuum pump vane wear as follows:

(1) Remove the inspection port plug and observe vane wear as shown in Figure 3-15.

(2) As vanes wear, they slide outboard in the vane slots in the rotor.

(3) When the portion of the vane that can be observed in the inspection hole covers approximately 1/8 TH of inspection hole, replace the pump.

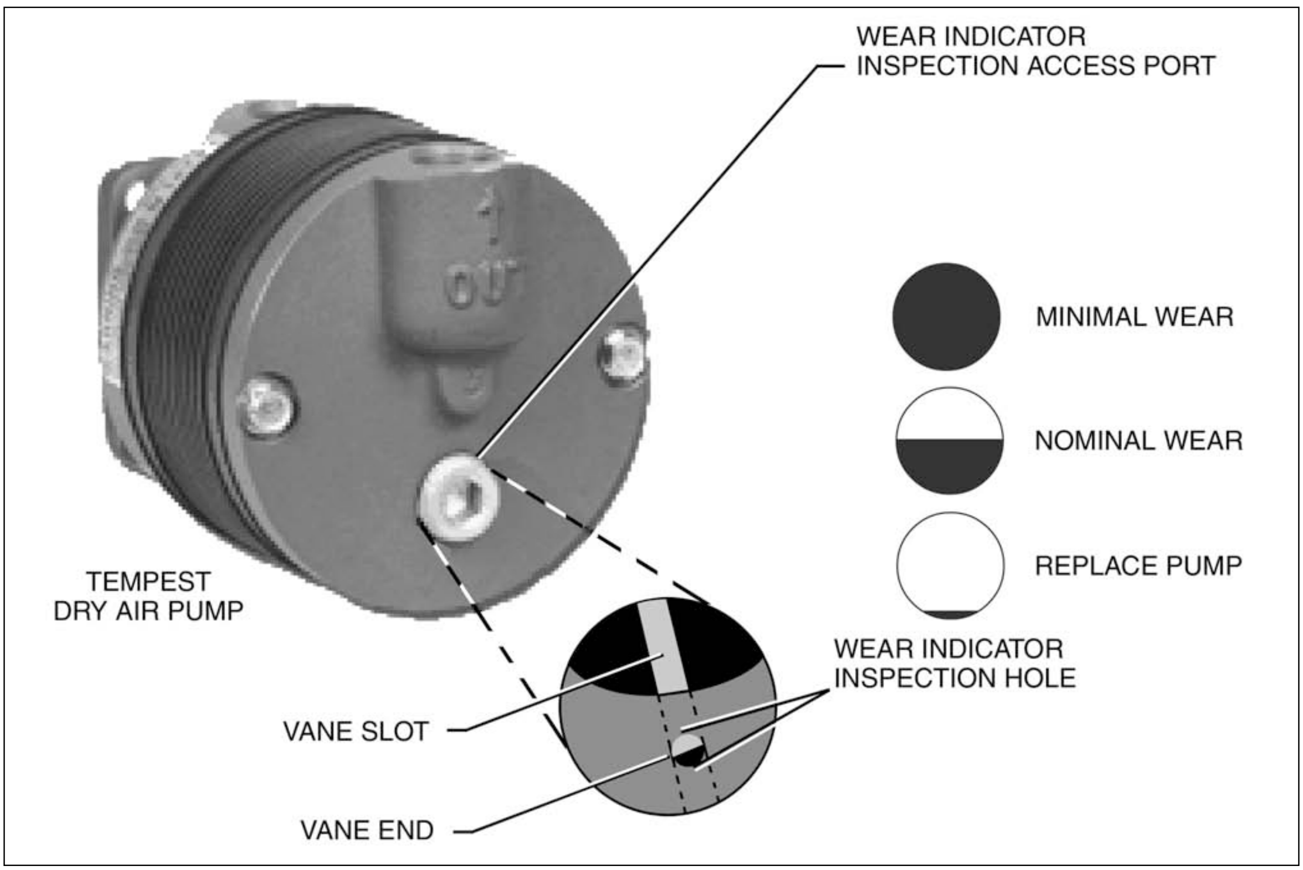

Figure 3-15. 215/216 Series Vacuum Pump Vane Wear Inspection

(b) For airplanes equipped with 400 series pumps;

- ✈ for airplanes with frequent de-ice cycles, beginning at 200 hours time-in-service, and each 100 hours thereafter;
- ✈ for airplanes with normal de-ice cycles, beginning at 300 hours time-in-service, and each 100 hours thereafter;

inspect the vacuum pumps as follows: (See Figure 3-15a.)

(1) Remove engine cowling.

(2) Ground magnetos and turn the fuel selector to OFF.

CAUTION: DIRT, GREASE, OR DEBRIS IN THE AREA OF THE INSPECTION PORT PLUG COULD CONTAMINATE THE PUMP IF THE PLUG IS REMOVED PRIOR TO CLEANING.

(3) Ensure the area around the inspection port plug is clean.

CAUTION: IF THE STAR WASHER IS NOT REMOVED WITH THE PLUG, THE SUBSEQUENT WEAR INDICATION READING WILL BE ERRONEOUS.

(4) Remove the inspection port plug and star washer (View A).

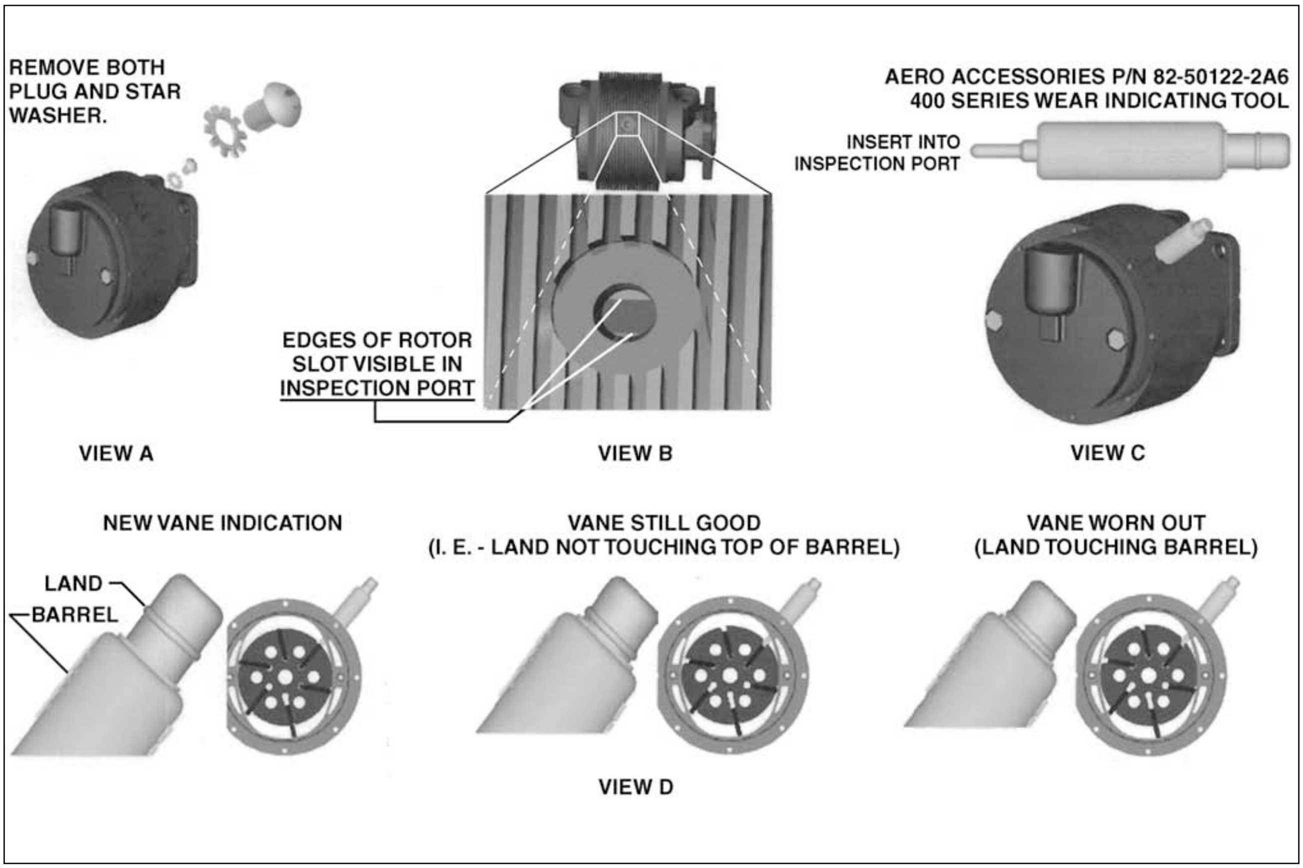

Figure 3-15a. 400 Series Vacuum Pump Vane Wear Inspection

(5) While looking into the inspection port, have an assistant slowly turn the propeller by hand in the normal direction of rotation until a vane slot is centered in the port (View B).

NOTE: If you go too far, just keep turning the propeller until the next vane slot appears. DO NOT turn the propeller backwards.

CAUTION: DO NOT ROTATE PROPELLER OR PUMP SHAFT WITH THE INDICATING TOOL INSERTED INTO THE INSPECTION PORT. IF THE PUMP IS INADVERTENTLY ROTATED WHILE THE INDICATING TOOL IS INSERTED INTO THE INSPECTION PORT, PUMP REPLACEMENT IS REQUIRED - EVEN IF YOU CAN DETECT NO DAMAGE.

(6) Insert the vane wear indicating tool into the inspection port as illustrated in View C.

(a) Hold the barrel securely and squarely against the pump body.

(b) With your finger tip, gently push the plunger into the pump. When the plunger touches the vane you may feel the vane move slightly if it is not at the bottom of its slot.

NOTE: If the plunger does not slip easily into the slot, DO NOT force it. Remove the indicating tool and check the alignment of the vane slot to the inspection port.

(7) Compare the relative positions of the plunger land and barrel top to the illustrations in View D to determine vane wear.

(a) If vane is “worn out,” replace pump.

(b) If vane is “still good” or “new,” proceed to next step.

(8) If vanes are within service limits and pump is otherwise serviceable, clean the threads on the inspection port plug, install a new star washer and torque the port plug to 45 to 50 in.-lbs.

(17) TORQUE TUBE/PUSH ROD DISTORTION INSPECTION. If flaps have been extended at or above V_{FE}, inspect the flap torque tube arm, bellcrank, and pushrods for evidence of distortion.

(a) If the paint is cracked or peeling anywhere along the torque tube arm or pushrod, torsional movement has occurred.

(b) Remove the paint and inspect for cracks:

1 In the welds at the arm on the torque tube end.

2 In the rod ends and pushrod tube.

3 Use a dye penetrant method of inspection.

(c) If cracks are not found, repaint the part(s) and reinstall.

(d) If cracked, replace the affected part(s).

(18) RESTRAINT SYSTEM INSPECTION. Each 100 hours time-in-service or annually, whichever comes first, inspect the restraint system as follows:

(a) Shoulder Harness (If installed.)

1 Inspect ends and attachment points for condition and security.

2 Inspect harness web material for condition and wear over its entire length. Particularly look for wear and fraying where harness web passes in and out of inertial reel. If excessively worn, replace.

3 Check inertia reel mechanism by pulling sharply on strap. Verify reel will lock in place under sudden stress.

(b) Lap Belt

1 Inspect ends and attachment points for condition and security.

2 Inspect harness web material for condition and wear over its entire length. Particularly look for wear and fraying where harness web passes in and out of adjustable buckle end. If excessively worn, replace.

3 If installed, inspect shoulder harness keeper nylon bushing. If excessively worn or missing, replacement of that half of the lap belt is required.

(19) FLAP SPAR 100 HOUR INSPECTION. In PA-23-235's and PA-23-250 S/N's 27-1 thru 27-7405300, for airplanes which have accumulated at least 2000 hours total time-in-service and have not installed improved flap assemblies (P/N's 17104-071 right and 17104-072 left; 17104-073 right and 17104-074 left; or, 17104-069 right and 17104-068 left; as appropriate); each 100 hours time-in-service, inspect the flap spars for cracking in the vicinity of the flap hinge attachments as follows:

NOTE: Installation of improved flap assemblies (P/N's 17104-071 right and 17104-072 left; 17104-073 right and 17104-074 left; or, 17104-069 right and 17104-068 left; as appropriate - see Parts Catalog, P/N 753-522) relieves this repetitive inspection requirement.

(a) Extend the flaps to the full down position.

(b) Thoroughly clean the hinge plates and the accessible spar area around the hinge plates.

(c) Using a light and 5x magnifier, thoroughly inspect the visible spar surface adjacent to the hinge plate for cracks. Examine carefully to distinguish cracked paint from structural cracks.

(d) If structural cracks are found in the spar, repair in accordance with acceptable methods in the latest revision of AC 43.13-1 or replace flap with new flap (preferred).

(e) Make an appropriate logbook entry documenting completion of this inspection.

(20) STABILATOR AND RUDDER CONTROL CABLE ATTACHMENT INSPECTION. Each 100 hours time-in-service or annually, whichever comes first, inspect stabilator and rudder control cable attachments as follows: (see Figure 3-16)

(a) Remove left and right side panels from rear of forward fuselage to gain access to the rudder pedal torque tube arms.

1 Inspect rudder control cable attachment at rudder pedal torque tube arms to ensure that the bolt, washers, nut and cotter pin are properly installed.

2 Make corrections, if required. Check cable fittings for freedom of movement and reinstall side panels.

(b) Remove the aft access cover from top of aft fuselage section to gain access to rudder horn.

1 Inspect rudder control cable attachment at rudder horn (both sides) to ensure that the bolt, washer, nut and cotter pin are properly installed.

2 Make corrections, if required. Check cable fittings for freedom of movement and reinstall access cover.

(c) Remove left side access panel from aft fuselage to gain access to the stabilator balance tube.

1 Inspect stabilator control cable attachment at balance tube to ensure that the bolt, washer, nut and cotter pin are properly installed.

2 Make corrections, if required. Check cable fittings for freedom of movement and reinstall access panel.

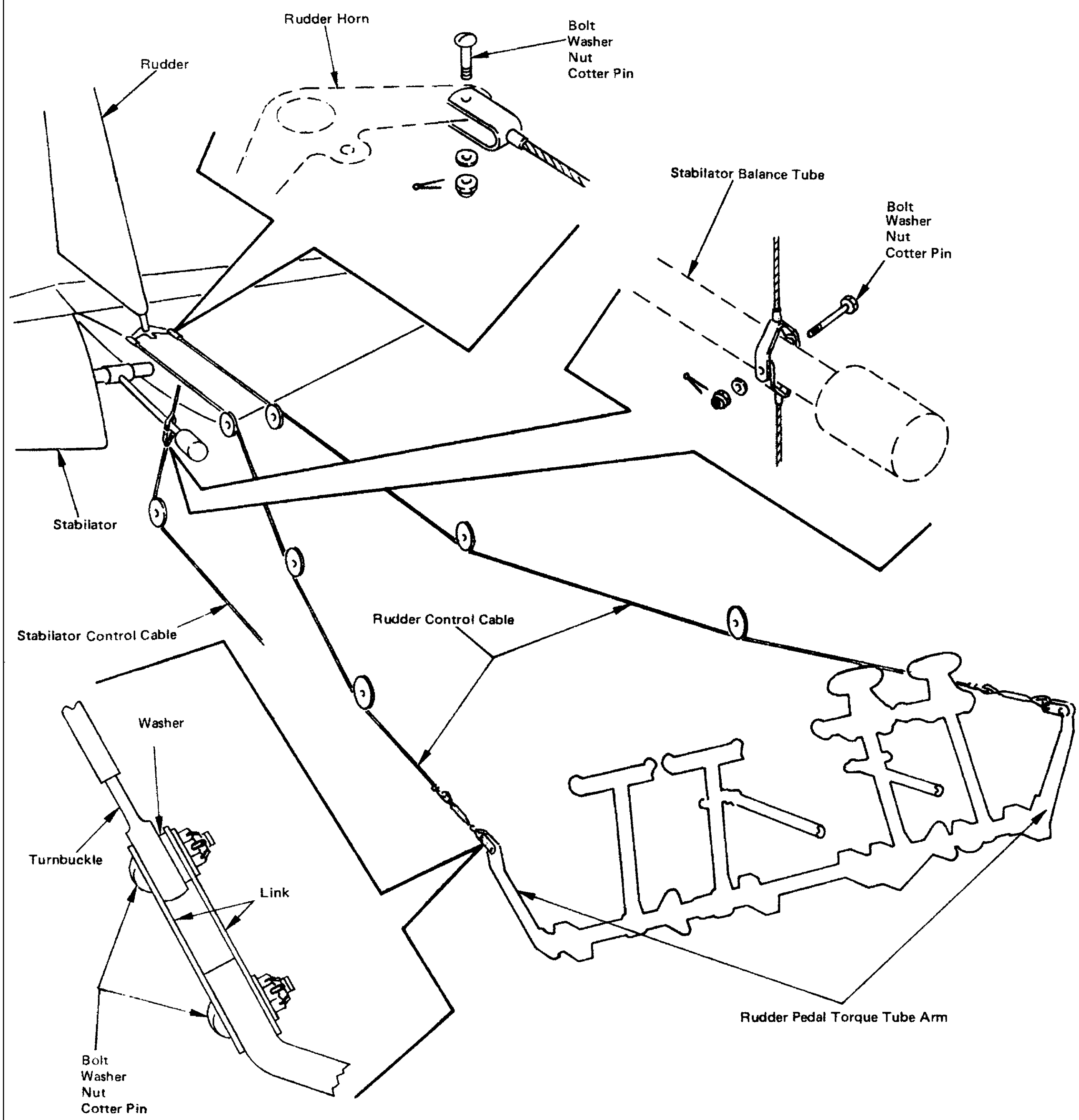

Figure 3-16. Stabilator and Rudder Control Cable Attachment Inspection

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9. Unscheduled Maintenance Checks

WARNING: FAILURE TO CONSULT APPLICABLE VENDOR PUBLICATION(S), WHEN SERVICING OR INSPECTING VENDOR EQUIPMENT INSTALLED IN PIPER AIRCRAFT, MAY RENDER THE AIRCRAFT UNAIRWORTHY. (SEE INTRODUCTION - SUPPLEMENTARY PUBLICATIONS.)

The following inspections are required in response to specific anomalies encountered during aircraft operation. Note that the items listed herein are guidelines based on past operating experience. Each operator should closely monitor his own unique operating conditions/environment and react accordingly to keep his aircraft airworthy.

NOTE: A log book entry should be made upon completion of any inspections.

A. **Lightning Strike**

	Item	Inspection	Inspection Interval
☐	Propeller.	Hartzell Propellers - Refer to the inspection requirements in the latest revision of the Hartzell Owner's Manual No. 115N, 168, or 175.	Each occurrence, before further flight.
☐	Engine.	See latest revisions of appropriate Lycoming Service Bulletins and Overhaul Manual.	Each occurrence, before further flight.
☐	Electrical and Avionics Systems.	Inspect and check harness, connections, and equipment for high voltage damage, burns and insulation degradation. Replace or overhaul as required. Consult with appropriate avionics vendor(s) for inspections and operational checks. Bench check alternator and voltage regulator(s), (see Section XI).	Each occurrence, before further flight.
☐	All exterior surfaces, skins, and structure.	Inspect for burns, evidence of arcing, and damage on surfaces and bearings. Check for correct material properties in the area of the strike path. Degauss engine mount. Replace or repair affected areas/parts.	Each occurrence, before further flight.
☐	System Components.	Inspect instrumentation, vacuum, pitot/static, and fuel systems, for damage and correct operation.	Each occurrence, before further flight.
☐	Static Wicks.	Replace.	Each occurrence, before further flight.
☐	Bearings.	Inspect all control surface hinges and bearings, and landing gear and wheel bearings for pitting and damage. Replace as required.	Each occurrence, before further flight.

B. **Engine Overspeed, Overtemp, Loss of Oil, or Sudden Stoppage**

	Item	Inspection	Inspection Interval
☐	Engine.	See latest revisions of appropriate Lycoming Service Bulletins and Overhaul Manual.	Each occurrence, before further flight.
☐	Propeller.	Hartzell Propellers - Refer to the inspection requirements in the latest revision of the Hartzell Owner's Manual No. 115N, 168, or 175.	Each occurrence, before further flight.
☐	Engine Mount and Attachments.	Inspect for distortion and damage. Replace or repair as required.	Each occurrence, before further flight.

C. **Severe Turbulence, Hard or Overweight Landing**

CAUTION: MINOR OR APPARENTLY SUPERFICIAL DAMAGE MAY INDICATE A MORE SEVERE CONDITION SOMEWHERE ELSE IN THE STRUCTURE.

(1) Place aircraft in a normal level attitude.

(2) Make a preliminary inspection of checking alignment and out-of-track condition of engine, wings, tail, landing gear and doors.

(3) Follow Piper and Lycoming Maintenance Manual procedures. If there are any questions regarding repairs or procedures, contact your Piper Dealer's Service Advisor (DSA).

(4) Inspect the following items closely to determine the extent of damage:

	Item	Inspection	Inspection Interval
☐	Landing Gear Struts. (Not required for severe turbulence.)	Cracks, signs of overstress deformation, loose or damaged strut housings. Axles for cracks, bending or flat spots. Damaged oleos and seals, hydraulic leaks and landing gear alignment.	Each occurrence, before further flight.
☐	Wheels, Tires, Brakes. (Not required for severe turbulence.)	Cracks, chips, loose or cracked mounting bolts, alignment of slippage marks, sidewall distress, hydraulic or air leaks. Inspect the wheels (dye penetrant method) and wheel bolts (magnetic particle method).	Each occurrence, before further flight.
☐	Wheel Wells and Landing Gear attach points. (Not required for severe turbulence.)	Buckling, cracks, overstress, wing skin buckling, and side brace for damage and condition. Inspect landing gear attachment bolts (magnetic particle method).	Each occurrence, before further flight.

C. **Severe Turbulence, Hard or Overweight Landing** (cont.)

	Item	Inspection	Inspection Interval
☐	Wings.	Wing attach bolts for slippage, damage and overstress. Upper and lower wing skins for wrinkles, cracks, popped or loose rivets. Remove access plates and inspect for internal damage to ribs, stringers and sparwebs; and fuel tanks for damage, attachment, and leaks.	Each occurrence, before further flight.
☐	Engine.	Engine mounts for distortion and damage to elastomeric parts. Propeller for evidence of ground strike (i.e. - hard or overweight landing).	Each occurrence, before further flight.
☐	Fuselage.	Loose or missing rivets, door alignment, windows and attachments for overstress, cracks or damage. Wing carry through member for overstress damage. Stringers, bulkheads, keel beams for buckling, cracks, or damage. Avionics, instruments and accessories installation for security and operation.	Each occurrence, before further flight.
☐	Empennage.	Skins for buckling wrinkles, loose or missing rivets. Stabilator, rudder, and vertical fin for security of attachment and overstress of bolts. Ribs, stringers for buckling, cracks and damage.	Each occurrence, before further flight.

D. **Flaps Extended Above Maximum Flap Extension Speed (V_{FE})**

	Item	Inspection	Inspection Interval
☐	Flap torque tube/pushrod.	Inspect for distortion. Replace as required. (See Flap Torque Tube/Pushrod Distortion Inspection, Special Inspections, Procedures)	Each occurrence, before further flight.
☐	Flaps.	Inspect for damage to the skin and attach points. Replace as required.	Each occurrence, before further flight.

E. **Flood Damage, Immersion in Water**

A. These guidelines are general in nature and should be applied or varied to fit the individual aircraft according to water level, length of time of exposure and other variables. Only those areas that might not be obvious to the mechanic are addressed.

CAUTION: MAKE ALL REPAIRS AND/OR ADJUSTMENTS IN ACCORDANCE WITH THE APPROPRIATE PIPER MAINTENANCE MANUAL, THE COMPONENT MANUFACTURER'S MAINTENANCE MANUAL, AND FAR PART 43. PAY PARTICULAR ATTENTION TO SILT, CORROSION AND CONTAMINANTS.

B. Follow Piper and Lycoming Maintenance Manual procedures. If there are any questions regarding repairs or procedures, contact your Piper Dealer's Service Advisor (DSA).

C. Determine the water level on the aircraft. Determine which operating and/or electrical components have been exposed to the water.

D. If the following items were immersed, inspect them closely to determine the extent of damage:

	Item	Inspection	Inspection Interval
☐	Airframe.	Clean silt and contaminants from airframe.	If immersed, each event, before further flight.
☐	Tubular Structures. (i.e. - Engine Mounts, etc.)	Check for internal corrosion. Clean and represerve as required. (See Procedures, Special Inspections, Engine Mount Corrosion Inspection, Immersion in Water.)	If immersed, each event, before further flight.
☐	Wings.	Inspect to ensure that contaminants are cleaned from fuel cell areas.	If immersed, each event, before further flight.
☐	Landing Gear and associated Bearings, Torque Links, Shimmey Dampeners, etc.	Jack airplane and cycle landing gear oleos and torque links to ensure proper operation.	If immersed, each event, before further flight.
☐	Control Surfaces.	Remove surface, clean and check all bearings - relube or replace as necessary. Rebalance before installation.	If immersed, each event, before further flight.
☐	Flight Control System.	Clean and inspect all cables, pulleys, and bearings for evidence of corrosion. Replace corroded cables. Re-preserve galvanized cable with MIL- C-11796 Class 2 (hot).	If immersed, each event, before further flight.
☐	Trim Control System.	Clean and inspect all trim system cables, pulleys, drums, bearings, jack screws, etc. Do not apply preservation to trim cables.	If immersed, each event, before further flight.
☐	Actuating Cables.	Inspect "push-pull" actuating cables for powerplant, heating and ventilating system, fuel system, etc. for proper operation.	If immersed, each event, before further flight.

E. **Flood Damage, Immersion in Water** (cont.)

Item	Inspection	Inspection Interval
☐ Engine.	Remove, disassemble, and inspect. Examine all parts paying particular attention for evidence of corrosion, rust or contaminants imbedded on bearing surfaces, piston, mounting flanges or any aluminum, magnesium or bronze surface that may be porous. Remove evidence of rust, or corrosion. If pitting in stressed areas is found the part should not be reused. Silt imbedded in porous surfaces may be removed. Be certain oil passages, dowel holes and similar hidden openings and recesses are thoroughly free from contaminants. Test electrical components and fuel metering devices in accordance with manufacturer's instructions to determine fitness for future use. Reassemble engine using new seals, gaskets, stressed bolts nuts and crankshaft sludge tubes. All reused parts must conform with Lycoming Table of Limits No. SSP-1776 for fits and clearances. See latest revision of Lycoming Service Bulletin No. 357.	If immersed, each event, before further flight.
☐ Engine Accessories.	Inspect. Aircraft systems that supply either fuel or oil to the engine must be thoroughly cleaned, including oil cooler, lines, valves, etc. to prevent contamination of the engine after reinstallation.	If immersed, each event, before further flight.
☐ Propeller.	Inspect and repair as necessary in an authorized propeller shop.	If immersed, each event, before further flight.

E. **Flood Damage, Immersion in Water** (cont.)

Item	Inspection	Inspection Interval
☐ Electrical Systems.	Replace all circuit breakers and switches.	If immersed, each event, before further flight.
	Replace all solenoids, relays and master contactors.	
	Replace battery.	
	Disassemble all connectors; clean and inspect for corrosion. Replace all corroded or pitted connectors. Inspect for wire corrosion at connector.	
	Check all harness assemblies for entrapped contaminants. Clean and check for short circuits.	
	Remove electric motors and electric pumps.	
	Remove all potted solid state electrical equipment such as alternator inop. switches, low fuel warning switches, etc. Clean, dry and bench check per appropriate maintenance manual.	
	Clean and check voltage regulators and overvoltage relays. Replace as necessary	
	Clean and check aIl strobe light power supplies. Refer to appropriate maintenance manual.	
	Replace all fuel senders, etc.	
	Clean, inspect and check heated pitot systems.	
☐ Autopilot System. (If installed.)	Bench check in accordance with appropriate maintenance manual. Pay particular attention to clutch settings.	If immersed, each event, before further flight.

E. **Flood Damage, Immersion in Water** (cont.)

Item	Inspection	Inspection Interval
☐ Vacuum and Pitot-Static Systems.	Replace gyros. Replace filters. Clean and inspect all lines, and pitot and static vents. Clean and check all regulating valves. Remove and inspect engine driven and auxiliary vacuum pumps.	If immersed, each event, before further flight.
☐ Induction System.	Clean and inspect for silt and corrosion. Check all ducts and gaskets. Replace as necessary. Clean and inspect all heat shrouds and ducting.	If immersed, each event, before further flight.
☐ Fuel System.	Remove and clean fuel cells and fuel cells' wing area. Clean all associated. lines and pumps.	If immersed, each event, before further flight.
☐ Instruments.	Clean and inspect instruments. Bench check per appropriate maintenance manual.	If immersed, each event, before further flight.
☐ Heating and Ventilating Systems.	Replace blower. Clean and inspect all distribution boxes, ducting and valves. Inspect and check system control cables. Replace corroded or binding cables. If installed, clean and inspect air conditioning evaporator, condenser, and compressor.	If immersed, each event, before further flight.

E. **Flood Damage, Immersion in Water** (cont.)

Item	Inspection	Inspection Interval
☐ Avionics Systems.	Replace avionics. Clean and inspect antennas and connectors.	If immersed, each event, before further flight.
☐ Insulation and Upholstery.	Remove all wet insulation and upholstery. Thoroughly clean and dry (or replace) to ensure corrosion is not promoted in adjacent structures.	If immersed, each event, before further flight.

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TABLE III-II. SERVICE PUBLICATIONS LIST

This table is a cumulative list of Piper service publications (i.e. - Service Bulletins, Service Letters, etc.) applicable to the airplane models covered by this manual, with the following exceptions:

A. Service publications which have been fully incorporated into this manual are not listed,

B. Nor are service publications which have become obsolete.

Kits are listed when installation of that single kit indicates compliance with the associated service publication. Kits listed may be no longer available or may have been replaced.

Effectivity is listed by airplane model and year. See the individual service publication for specific serial number applicability.

NOTE: The designation PA-23-250 (6) or PA-23-250 (six place) is not used in this list. Such references elsewhere in this manual, or in individual service publications, should be considered to mean PA-23-250 S/N's 27-2000 and up, unless otherwise indicated.

NOTE: While the PA-E23-250 is separately listed below, owners of PA-E23-250's should generally consider service publications applicable to PA-23-250 airplanes of the same model year and serial number range to be effective for their airplanes.

Model	Year	Pub No.	Kit No.	Subject
Navy UO-1	1960	SB 200	754 387	Oil Radiator Lines, Replacement
		SL 334	754-332	Fuel Cell Filler Neck Reinforcement
	1960-1961	SL 363		Inspection and Modification of Flaps
PA-23-235	1962-1963	SB 214		Carburetor Airbox Throat Vanes
		SL 388		Removal of Carburetor Heat Shroud Screen
		SL 398		Replacement of “”O”” Rings in Fuel Control Valves
		SL 404		Insp. Altimatic Pitch Servo Assy Chain Adj. Screw
	1962-1964	SL 425		Fuel & Oil Vent Rest. AC Diaphragm Fuel Pumps
	1962-1965	SB 225		Vacuum Pump Mounting Gasket, Replacement
	1962-1966	SB 226	756-989	Vacuum Pump Drive Couplings, Replacement
		SB 340		Fuel Cell Vent/Drain Lines Inspection
		SB 401A		Heater Fuel Valve, Inspection
		SB 507		Fuel System Control Cables At Swivel Fittings
		SB 635		Landing Gear Selector Lever Inspect / Replace
		SB 671		Flap Control System Inspection / Reinforcement
		SB 672A		Step Attachment Area Inspection / Reinforcement
		SB 683		Propeller Feathering, Minimum Engine RPM
		SB 771		Parking Brake Application
		SB 822		Special Inspection Of Hydraulic Hose
		SB 836A		Aluminum Wire Inspection / Replacement
	1962-1966	SB 932A		Improved Fuel System Drainage and Inspection
		SB 980		Shoulder Harness Installation

TABLE III-II. SERVICE PUBLICATIONS LIST (cont.)

Model	Year	Pub No.	Kit No.	Subject
PA-23-235	1962-1966	SB 1022		Inspect Induction Air Filter/Purolator SB090298.01
(cont.)	(cont.)	SB 1041		Distribution of Airborne S/L/ No. 56
		SB 1051B		Flap Torque Tube Replacement
		SB 1160		Stabilator Torque Tube Assembly Inspection
		SL 474	757-000	Increase in Flap Extension Speeds
		SL 486A		Cylinder Head Temperature Probe Location
		SL 562		Scott Aviation S/Bulletin No. 35-32
		SL 591		Wing Front Spar Inspection and Reinforcement
		SL 606A		Fuel System Inspection and Modification
		SL 619		Inspection of Piper P/N 83302-13 Retainer Spring
		SL 629		Fuselage Frame Tube Corrosion Inspection
		SL 653		Throttle Lever And Shaft, Serrated
		SL 667A		Stabilator Attachment Bolts
		SL 695		Roll Servo Insp/Maint And Shear Pin Installation
		SL 707		Mod. Flyball Assembly To Improve RPM Control
		SL 726		Cigar Lighter Placard 24 Volt
		VSP 148		Lycoming S / B No. 554 and Supplement No. 1
		VSP 166		Garrett SB 1002143 Oil Turbocharger Oil System
	1963	SB 218		Vacuum Pump Splined Coupling Replacement
	1963-1965	SL 449A		Fuel Cells
PA-23-250	1960	SB 188		Baggage Compartment Doors, Positive Locking
		SB 189	754-329	Stabilator Tab Horn Modification
		SB 195A	754-335	Baffles, Right Engine, Modification
		SB 196	754-344	Rudder Tab Horn Bolt, Installation
		SB 335A		Engine Controls Support Bracket Inspection
		SL 334	754-332	Fuel Cell Filler Neck Reinforcement
		SL 338		Locking of Main Cabin Door
		SL 340		Sealing of Fuel Cell Filler Neck Riveted Seam
		SL 345		Inspect Hartzell Governor (Hartzell SB 75)
	1960-1961	SB 186	754-323	Fuel Lines And Fuel Line Fittings Replacement
		SB 199A	754-393	Stabilator Trim Tab Horn Reinforcement
		SB 200	754 387	Oil Radiator Lines, Replacement
		SL 354		Reinforcement of Aztec Stabilator Leading Edges
		SL 363		Inspection and Modification of Flaps
	1960-1962	SL 560		Scott Fuel Selector Valves
	1960-1963	SB 214		Carburetor Airbox Throat Vanes
		SL 388		Removal of Carburetor Heat Shroud Screen
		SL 404		Insp.Altimatic Pitch Servo Assy Chain Adj. Screw
	1960-1964	SB 1022		Inspect Induction Air Filter/Purolator SB090298.01
		SB 1079		Untested Fuel Pump

TABLE III-II. SERVICE PUBLICATIONS LIST (cont.)

Model	Year	Pub No.	Kit No.	Subject
PA-23-250	1960-1964	SB 683		Propeller Feathering, Minimum Engine RPM
(cont.)	(cont.)	SL 425		Fuel & Oil Vent Rest. AC Diaphragm Fuel Pumps
		SL 653		Throttle Lever And Shaft, Serrated
		SL 705		Turbocharger Oil Tanks, Mod And Related Install
	1960-1965	SB 225		Vacuum Pump Mounting Gasket, Replacement
		SL 464A		Stewart-Warner Heater Modification
	1960-1966	SB 226	756-989	Vacuum Pump Drive Couplings, Replacement
		SB 340		Fuel Cell Vent/Drain Lines Inspection
	1960-1969	SB 300		Hydraulic Pump Hose Assembly Inspection
	1960-1971	SB 324		Vacuum Pump Adapter Drive Assembly
		SL 591		Wing Front Spar Inspection and Reinforcement
		SL 667A		Stabilator Attachment Bolts
	1960-1972	SL 606A		Fuel System Inspection and Modification
		SL 619		Inspection of Piper P/N 83302-13 Retainer Spring
		SL 629		Fuselage Frame Tube Corrosion Inspection
	1960-1973	SL 696		Control Surface Balancing Recommendation
	1960-1974	SB 401A		Heater Fuel Valve, Inspection
		SL 695		Roll Servo Insp/Maint And Shear Pin Installation
		SL 707		Mod. Flyball Assembly To Improve RPM Control
		SL 726		Cigar Lighter Placard 24 Volt
	1960-1976	SB 507		Fuel System Control Cables At Swivel Fittings
	1960-1978	SB 635		Landing Gear Selector Lever Inspect / Replace
	1960-1979	SB 836A		Aluminum Wire Inspection / Replacement
	1960-1980	SB 671		Flap Control System Inspection / Reinforcement
	1960-1981	SB 805A		Hartzell S/B No. 142B (O-ring Deterioration)
		SB 822		Special Inspection Of Hydraulic Hose
		SB 932A		Improved Fuel System Drainage and Inspection
		SB 980		Shoulder Harness Installation
		SB 1041		Distribution of Airborne S/L/ No. 56
		SB 1051B		Flap Torque Tube Replacement
		SL 486A		Cylinder Head Temperature Probe Location
		VSP 148		Lycoming S / B No. 554 and Supplement No. 1
		VSP 166		Garrett SB 1002143 Oil Turbocharger Oil System
	1960-1984	SB 771		Parking Brake Application
		SB 798		“TURBO” Marking Removal
	1961-1964	SB 219A		Heater, 940DB, Modification And Rewinding
	1961-1976	SB 511A	761-032	Oxygen System Outlet Refinement
	1961-1977	SB 530		Fuel Crossfeed Operation
	1961-1979	SB 604A		Forward Baggage Door Locking System Mod
	1961-1980	SB 672A		Step Attachment Area Inspection / Reinforcement

TABLE III-II. SERVICE PUBLICATIONS LIST (cont.)

Model	Year	Pub No.	Kit No.	Subject
PA-23-250	1961-1981	SB 1035		Lycoming S / B 529A
(cont.)	1962-1963	SL 398		Replacement of “”O”” Rings in Fuel Control Valves
	1962-1966	SL 705		Turbocharger Oil Tanks, Mod And Related Install
	1962-1970	SL 562		Scott Aviation S/Bulletin No. 35-32
	1963-1964	SB 218		Vacuum Pump Splined Coupling Replacement
		SL 432		Inspection of Auxiliary Power Plug Solenoid
	1963-1975	SB 456A		Warning Placard Replacement
	1963-1981	SB 1026		Airbourne S/L 48 Inspection/Replacement - dry air
	1964	SL 438	756-878	Clamping Priority Valve Actuating Cable
	1964-1965	SL 441	756-880	Replace Elec Fuel Booster Pumps/Mod Fuel Sys.
		SL 454	756-954	Pitch Breakaway Bail Bracket - AItiMatic II
		SL 462		Inspect Engine Mount Tubes
	1964-1966	SB 230A	757-021	Engine Induction Alternate Air System Modification
	1964-1966	SL 472	757-017	Conduit Installation Modification - B. F. Goodrich
		SL 474	757-000	Increase in Flap Extension Speeds
		SL 482	757-063	Removal of 25,000 ft. Altitude Limitation
	1964-1967	SB 242	757-106	Fuel System, Modification
		SB 243	757-103	Starter Vibrator, Replacement
	1964-1968	SB 269	760-167	Manifold Pressure Gauge Line Filter
		SB 273		Tailpipe, Turbocharger, Clearance To Firewall
		SL 504		Prop De-Icer and Strap Restrainer Installation
	1964-1969	SB 375		Lower Firewall Sealing
		SL 520		Inspection of Turbocharger Plenum Exhaust Welds
	1964-1971	SB 319		Exhaust System Inspection And Modification
		SL 564		Revised Hartzell Propellers
		SL 579	760-538	Heavy Duty Brake Disc Replacement
	1964-1972	SB 353		Fuel Filter Assembly Outlet Port Inspection
		SL 627		Propeller Installation
		SL 636		Prestolite S/B No. ASM-8 Alternator Fan Replace
		SL 786A	760-598	Refined Engine Mount Assembly
	1964-1974	SB 441		Manifold Pressure Hose Clamping
		SL 717		Brake Assembly Cylinder Retract, Improved
	1964-1977	SB 515		Control Cable Ball Joint Retainer Installation
		SB 564		Inspection Of Emergency Gear Extension Control
	1964-1979	SB 663		Fuel Line/Electrical Harness Inspection
	1964-1980	SB 662	763-975	Exhaust System lnspection And Modification
	1964-1981	SB 884		Lock Wiring of V-Band Couplings
		SL 655		Turbocharger Mod - Lycoming SB 361
	1965-1969	SL 522	760-275	Fuel Pump Restrictor Fitting
	1965-1974	SB 408B		Flap Outboard Hinge Replacement

TABLE III-II. SERVICE PUBLICATIONS LIST (cont.)

Model	Year	Pub No.	Kit No.	Subject
PA-23-250	1965-1981	SB 721		Heater Fuel Regulator Valve Shroud / Drain Mod
(cont.)	1966-1968	SL 676		Weight and Balance Equipment List Correction
	1966-1969	SB 303	760-364	Autocontrol III And Altimatic III Series Roll Servo
	1966-1981	SB 320A		Autopilot Servo And Bridle Cable Installations,
	1967-1968	SB 280		Artificial Horizon, R.C. Allen 3”, Case Leakage
	1967-1969	SB 290	760-293	Fuel Flow Gauge Assemblies, Replacement
	1968	SL 511	760-180	Mod. To Auxiliary Power Receptacle Installation
	1968-1969	SB 296	760-324	Fuselage Aft Section Assembly Inspection
		SL 519	760-282	Replace/Relocate Alternator Ground Wire
		SL 525		Add Lock Washers to Elect. Switch Installations
	1968-1969	SL 532	760-331	Voltage Regulation Component Grounding
	(cont.)	SL 533		Exhaust Stack Assembly
	1968-1970	SB 306	760-346	Alternator System Modification
		SL 566	760-472	Spacer Bushing Installation Autopilot Servo
	1968-1971	SB 331	760-505	Electric Trim Switch Inspection and Modification
		SL 584		90 AMP Alternator Circuit Breaker Switch Inspect
	1968-1972	SB 349		Electrical System Master Switch Modification
		SB 527		Electric Trim Switch Modification
	1968-1976	SB 493	761-044	Magnetic Compass Deviation
	1969-1970	SL 545		D Lycoming Turbo Aztec H/book & Pwr Set Chart
		SL 547		Lycoming Turbocharged Aztec Modifications
		SL 559		Inspection of Alternate Air System
	1969-1971	SB 334		Alternate Air Hose Replacement
		SL 582A		Turbocharger Exhaust System Insp/Mod
		SL 593	760-555	Harness Connector Plug Strain Relief Hood Install
		SL 674		Overvoltage Relay Inspection
	1969-1973	SB 389		Bridle Cable and Bridle Cable Clamp Inspection
	1969-1974	SB 404		Flux Sensor Caution Placard Installation
	1969-1981	SB 1147		Turbocharger Clamp, Incorrect Substitution
	1970-1971	SB 345	760-565	Stabilator Bungee Installation
	1970-1973	SB 380		Revised Pitch Servo Bridle Cable Installation
		SL 683		Stabilator Control Cable Attachment Fittings Insp.
	1970-1977	SB 546		Whelen Wing Tip Strobe Lights Reference FAA
	1970-1978	SL 820		Replacement/(LiS02) ELT Batteries/Transmitters
	1971-1973	SL 617B		Piper Automatic Locator Transmitter Replacement
	1971-1977	SB 558		Altimatic V and V F/D Series; M-4D F/D Series
		SB 559		Rudder Tail Light Inspection
	1972	SB 385		Wing Leading Edge Modification
	1972-1973	SL 642		Revised Alternator Inoperative Warning Light
	1972-1981	SB 991A		Replacement/ Mod. of Alternator Out Light Fuse

TABLE III-II. SERVICE PUBLICATIONS LIST (cont.)

Model	Year	Pub No.	Kit No.	Subject
PA-23-250	1973	SL 645		Starter Vibrator Wiring Inspection
(cont.)	1973-1974	SB 451		Throttle Control Shaft, Inspection
		SL 723		Glideslope Indicator Placard
	1973-1975	SB 455		Fuel Selector Valve Inspection
	1974-1975	SB 461	760-971	Encoding Altimeter Harness Rewiring
	1975	SB 452	760-932	Instrument Glare Shield Panel Replacement
	1975-1977	SB 566		Horizontal Situation Indicator, Modification
	1976	SB 486	761-099	Wing Tip Navigation Light Wire Insulation
		SB 498		Inboard Fuel Cell Vent Line Assemblies, Inspection
		SB 514	761-083	Stabilator Tab Modification
		SL 846		Stabilator Assembly Lower Surface Rivet Insp.
	1976-1977	SB 523		Cigar Lighter Element, 24 Volt, Replacement
		SB 547		Stabilator Tip Rib, Inspection
		SB 550		Engine Control Cable Inspection
		SB 569	761-143	Stabilator Tab Horn Replacement
		SL 807A	761-141	Stabilator Outboard Nose Rib Installation
		SL 830		24 Volt Cigar Lighter Element Replacement
	1976-1979	SB 540A	763-987	“Stabilator Tip Tube And Weight Assembly, Insp”
		SB 606		Stabilator Assembly Lower Surface Rivet And Rib
	1976-1984	SB 797B	566-500	Fuel Port Restrictor Installation
	1977	SL 815		Radar Antenna Mounting Plate Inspect/Mod
	1977-1978	SB 590		Inspection Of Stabilator Tab Horn/Stabilator Trim
	1977-1979	SB 630A		Collins VIR-350 and VIR-351 Nav Receiver Mod
	1978-1979	SB 629		Landing Gear Hose Assembly Inspect / Replace
PA-E23-250	1964-1965	SB 225		Vacuum Pump Mounting Gasket, Replacement
	1964-1966	SB 226	756-989	Vacuum Pump Drive Couplings, Replacement
		SB 230A	757-021	Engine Induction Alternate Air System Modification
	1964-1967	SB 242	757-106	Fuel System, Modification
		SB 243	757-103	Starter Vibrator, Replacement
	1964-1968	SB 273		Tailpipe, Turbocharger, Clearance To Firewall
		SL 504		Prop De-Icer and Strap Restrainer Installation
	1964-1969	SB 375		Lower Firewall Sealing
		SL 520		Inspection of Turbocharger Plenum Exhaust Welds
	1964-1970	SL 562		Scott Aviation S/Bulletin No. 35-32
	1964-1971	SB 324		Vacuum Pump Adapter Drive Assembly
		SB 319		Exhaust System Inspection And Modification
		SL 564		Revised Hartzell Propellers
		SL 579	760-538	Heavy Duty Brake Disc Replacement
		SL 591		Wing Front Spar Inspection and Reinforcement
	1964-1972	SB 353		Fuel Filter Assembly Outlet Port Inspection

TABLE III-II. SERVICE PUBLICATIONS LIST (cont.)

Model	Year	Pub No.	Kit No.	Subject
PA-E23-250	1964-1972	SL 606A		Fuel System Inspection and Modification
(cont.)	(cont.)	SL 627		Propeller Installation
	1964-1975	SB 456A		Warning Placard Replacement
	1964-1977	SB 564		Inspection Of Emergency Gear Extension Control
	1964-1981	SB 1035		Lycoming S / B 529A
		SB 1041		Distribution of Airborne S/L No. 56
		VSP 166		Garrett SB 1002143 Oil Turbocharger Oil System
	1966-1968	SL 676		Weight and Balance Equipment List Correction
	1966-1981	SB 320A		Autopilot Servo And Bridle Cable Installations,
	1968-1970	SB 306	760-346	Alternator System Modification
		SL 566	760-472	Spacer Bushing Installation Autopilot Servo
	1968-1971	SB 331	760-505	Electric Trim Switch Inspection and Modification
	1969-1970	SL 547		Lycoming Turbocharged Aztec Modifications
		SL 559		Inspection of Alternate Air System
	1970-1971	SB 345	760-565	Stabilator Bungee Installation

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IV

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SECTION IV

STRUCTURES

4-1. INTRODUCTION.

This section explains procedures for removal and installation of structural components of the airplane, for the check and balance of the stabilator and rudder and for the repair of structural surfaces on all models. Information for the rigging and adjustment of control surfaces, as well as the removal and installation of their controls, may be found in Section V.

4-2. DESCRIPTION.

The fuselage is composed of two basic sections. The forward section which extends from the foremost point on the nose to station 171.1, a point just aft of the rearmost side window, is a tubular structure or truss type construction with bulkheads, channels and stringers. The aft section of the fuselage which extends from station 171.1 to station 299.38 is of semi-monocoque type construction. Windows include a two piece windshield and three windows along each side. A storm window is located on the left side forward window which opens inward when the latch is released. On PA-23-250 (six place) models, the center window on the left side has been designed for use as an emergency exit. On PA-23-250 and PA-23-235 airplanes, there is a baggage door located on the right side of the fuselage at the rear of the cabin area. On PA-23-250 (six place) airplanes there are two baggage doors on the right side, one located just aft of the cabin area, and the other located on the nose section.

Each wing panel is an all metal, full cantilever, multi-spar type construction with metal ribs and stringers covered with stressed skin. Installed in each wing just aft of the center main spar are two bladder type fuel cells. Attached to each wing is the power plant, aileron, flap and main landing gear. The center full length "I" beam type main spar, on each wing, extends into the fuselage where they are joined together with high strength butt fittings, making in effect a continuous center main spar. The main spar is also attached to the side of the fuselage as are the front and rear spars.

The empennage or tail section is an all metal, full cantilever, multi-spar type construction, with ribs, covered with stressed skin. The empennage consists of a vertical stabilizer, rudder, and a two part horizontal stabilator. The vertical stabilizer, rudder and stabilator incorporate two main spars, and attach to the aft bulkhead assembly of the fuselage .

NOTE: When torquing structural assemblies, standard torque values are to be used as found in FAA Advisory Circular 43.13-1 or Torque Tables in Section II of this manual, unless otherwise stated in this section.

4-3. WING GROUP.

4-4. WING TIP.

4-5. REMOVAL OF WING TIP.

NOTE: Airplanes with pneumatic deicers, remove deicers as per instructions in Section XIV.

NOTE: Airplanes with wing tip tanks, disconnect tip cell per instructions in Section IX.

a. Remove the access plate located on the bottom of the front wing spar where the wing skin and tip skin join together. (Refer to Access and Inspection Provisions, Section II.)

b. Remove the hinge pin located inside the access opening on the bottom of the wing tip. Remove the pin through the top of the wing tip by pushing up on the bottom of the pin until the top can be grasped with pliers and pulled out.

NOTE: Some airplanes are equipped with a small plate covering the top of the pin. If the cover plate is installed, loosen the screws on either side and slide the plate into the wing tip.

c. Remove the screws attaching the wing tip to the wing.

d. Pull the wing tip far enough off to disconnect the two fuel cell vent lines and the navigation light wire at the quick disconnect fitting.

NOTE: On airplanes with S/N's 27-1 thru 27-524, and 27-2000 thru 27-2269, there are no fuel cell vent lines installed in the wing tip.

e. Remove the wing tip.

4-6. INSTALLATION OF WING TIP.

NOTE: See Section IX for instructions on installation of wing tip fuel cells if wing tip tanks are installed.

a. Hold the wing tip near the wing and connect the navigation light wire and the two fuel cell vent lines, where applicable.

b. Position the wing tip on the wing.

c. Insert a new hinge pin from the top of the wing tip.

d. Install tip attaching screws and tighten.

e. Install the access cover plate on the bottom of the wing tip.

f. Cover the top of the hinge pin, where applicable, by sliding the cover plate over top of the pin and tightening the screws on either side.

4-6. AILERON

4-8. REMOVAL OF AILERON (Refer to Figure 4-7.)

a. Disconnect the aileron control tube at the center aileron hinge by removing attaching nut and bolt and spacer bushings.

b. Remove the balance weight from the balance weight arm by removing attaching nut and bolt.

c. Disconnect the aileron from its hinge brackets by removing hinge nuts and bolts. Note spacer washers and their locations, if any.

d. Remove the aileron by lowering the inboard end of the aileron and swinging it under the wing so the balance weight arm can be drawn out from the wing tip.

4-9. INSTALLATION OF AILERON (Refer to Figure 4-7.)

CAUTION: CONTROL SURFACE SKINS MUST BE REPLACED IF THEY SUSTAIN DAMAGE OR EXHIBIT CRACKS.

WARNING: AILERONS THAT HAVE BEEN REPLACED OR REPAINTED MUST BE BALANCED BEFORE INSTALLATION. SEE PARAGRAPH 4-68, BALANCING AILERON.

a. Install the aileron by first inserting the balance weight arm into the wing tip.

b. Align the hinges and install the three hinge bolts. Check each hinge attachment for need of spacer washers and secure bolts with nuts.

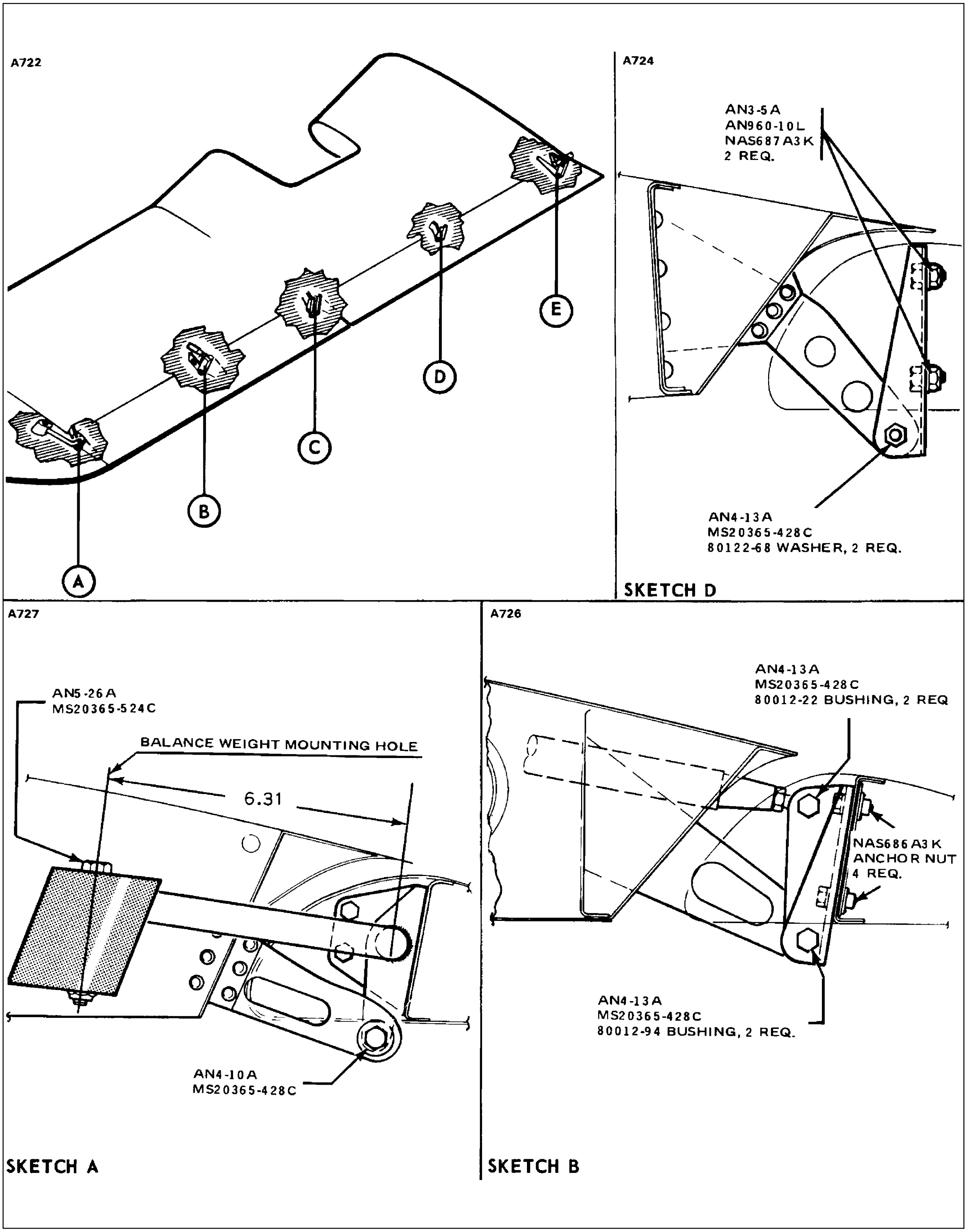


Figure 4-1. Aileron and Flap Installation

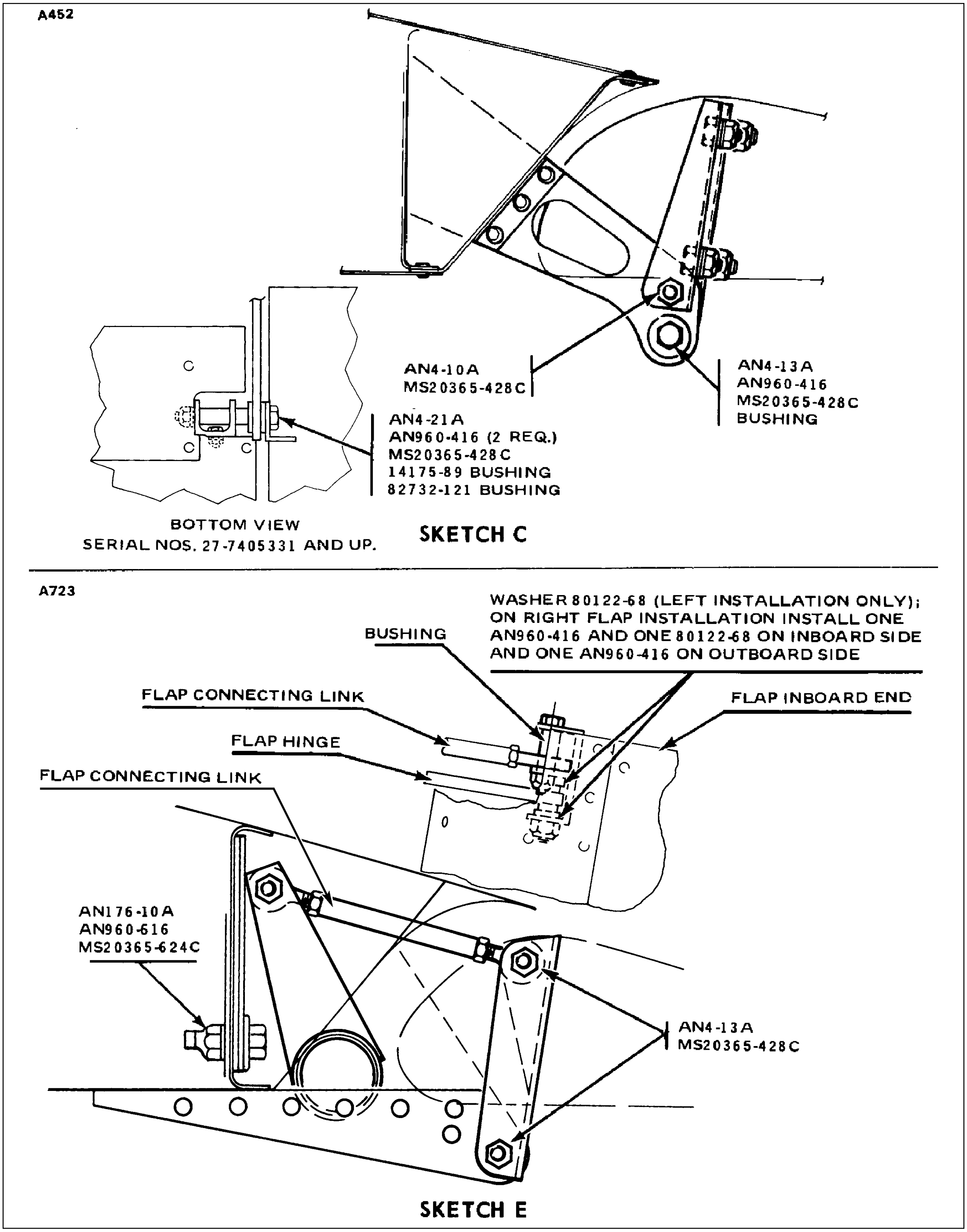


Figure 4-1. Aileron and Flap Installation (cont.)

c. Slide the aileron balance weight on the balance weight arm and secure with bolt and nut.

d. Connect the aileron control tube to the hinge fitting at the center of the aileron with bushings, bolt and nut.

e. Check clearances of control tube, and balance weight and arm.

f. Check rigging and adjustment of aileron as described in Section V.

4-10. FLAP.

4-11. REMOVAL OF FLAP. (Refer to Figure 4-1.)

a. Remove the rear wing root fairing adjacent to flap by removing attaching screws.

b. Using the hydraulic hand pump, lower the flaps to the down position.

c. Disconnect the control tube at the inboard end of the flap by removing attaching bolt and nut.

d. Disconnect the flap from its hinge brackets by removing hinge nuts and bolts. Note spacer bushings and washers, and their locations.

e. Remove the flap from the wing.

4-12. INSTALLATION OF FLAP. (Refer to Figure 4-1.)

CAUTION: CONTROL SURFACE SKINS MUST BE REPLACED IF THEY SUSTAIN DAMAGE OR EXHIBIT CRACKS.

a. Align the hinges and install the three hinge bolts. Check alignment and install washers and nuts.

b. With the flap control rod extended to the down position connect the rod to the flap.

c. Check rigging and adjustment of flaps as described in Section V.

d. Install the rear wing root fairing with attaching screws.

4-12A. FLAP BELLCRANK / FLAP HORN REPLACEMENT. (See Figures 4-1a and 5-14.)

NOTE: See paragraphs 5-50 and 5-51 for removal and installation of the flap actuator assembly.

When replacing a flap bellcrank assembly or flap horn assembly, the service replacement part is delivered without mounting holes. These holes may be drilled as follows:

a. Scribe one straight line on a piece of 1.50 inch O.D. tube (tube should be 10 inches long minimum).

b. Place the existing bellcrank assembly and the new bellcrank assembly (P/N 16423-006) or the existing horn assembly and the new horn assembly (P/N 16424-000) on the 1.50 inch O.D. tube as shown in Figure 4-1a.

c. Insert a 0.25 (1/4) inch rod through the bushings in the bellcrank arms or the horn assemblies to maintain proper alignment.

d. Align the scribed line on the 1.50 inch O.D. tube with the center line of one of the bolt holes in the existing assembly as shown in Figure 4-1a. Lay a straight edge across the new assembly so that the edge of the straight edge aligns with the scribed line on the 1.50 inch O.D. tube. Scribe a center line onto the new assembly. Measure the distance from the end of the existing assembly to the center line of the bolt hole in the existing assembly. Measure this distance on the new assembly and scribe a center line.

e. Rotate the 1.50 inch O.D. tube (approximately 90 degrees) and repeat step D to locate the other bolt hole onto the new assembly.

f. Remove the assemblies from the 1.50 inch O.D. tube.

g. Center punch the two marked center line locations on the new assembly and drill .234 holes in one wall only.

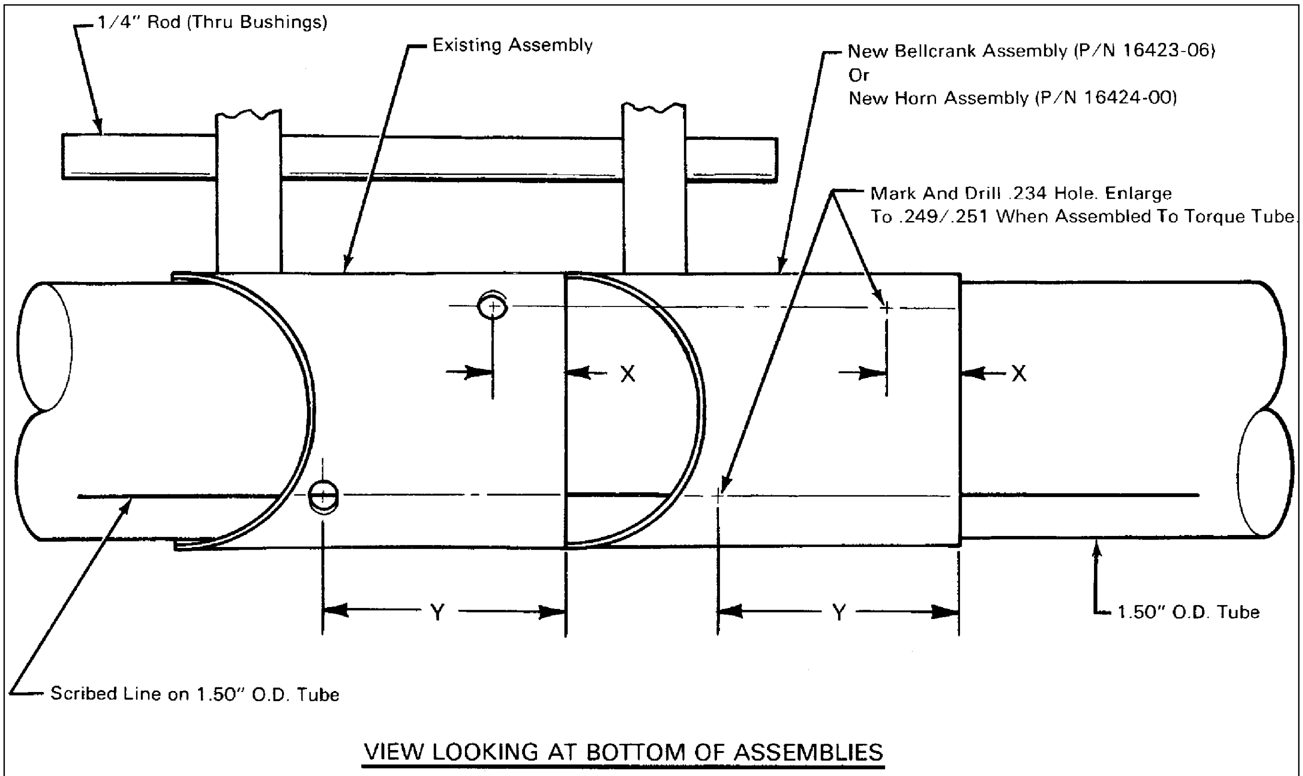
h. Place the new assembly onto the flap torque tube and align the two holes in the new assembly with the existing holes in the flap torque tube.

i. Enlarge one of the holes in the new assembly to .249/.251. Continue drilling .249/.251 through the existing hole in the flap torque tube and through the other wall of the new assembly.

j. Remove all drill burrs from the .249/.251 holes in the new assembly and install existing bolt, washers and nut through the new assembly and the flap torque tube. Safety with new cotter pin (P/N 424-051/MS24665-132).

k. Enlarge the other hole in the new assembly to .249/.251. Continue drilling .249/.251 through the existing hole in the flap torque tube and through the other wall of the new assembly.

l. Repeat step J for this bolt hole.



NOTE: "X" and "Y" represent the distance from the end of the part to the centerline of the hole in the existing assembly.

Figure 4-1a. Flap Bellcrank Replacement

4-12B. FLAP TORQUE TUBE REPLACEMENT. (See Figure 5-14.)

a. In PA-23-250 S/N's 27-7654001 and up (i.e. - with the Stabilator Trim / Flap Interconnect System), remove the forward interconnect cable using the applicable portion of the instructions in paragraph 5-57.

b. Remove the flap torque tube assembly per paragraph 5-50.

c. Pre-installation rework.

Service replacement flap torque tubes (P/N 104622-004) are delivered without holes completely drilled for bellcrank, horn, and if required, stabilator trim/flap interconnect pulley attachment. Accordingly, the following is required before installation: (See Figure 5-14.)

(1) Flap Bellcrank Installation.

(a) Install the flap bellcrank on the right end of the replacement flap torque tube. Rotate the bellcrank until the scarf on the bellcrank matches the scarf on the tube.

(b) Using a transfer punch, mark the centerline of one of the .249/.251 inch holes in the bellcrank on the tube and drill an .189/.191 inch diameter hole thru one side only of the tube. Repeat the same process for the same hole on the opposite side of the bellcrank.

(c) Ream the.189/.191 diameter holes to .249/.251 inch diameter using the bellcrank as a guide. Temporarily install a .250 inch diameter bolt and nut. Repeat the same steps for the other hole in the bellcrank.

(d) After completing the reaming operation, remove the flap bellcrank from the replacement flap torque tube until after the new tube assembly is installed in the aircraft.

(2) Stabilator Trim / Flap Interconnect Pulley Installation. (PA-23-250 S/N's 27-7654001 and up.)

(a) Slide the pulley bracket over the left end of the replacement flap torque tube and toward the right until the .249/.251 inch holes in the pulley bracket align with the .189/.191 inch pilot holes in the replacement flap torque tube (i.e. - approximately 3.75 inches to the right of the tube center).

(b) Using the pulley bracket as a guide, ream the .189/.191 inch holes to .249/.251 inch diameter holes.

(c) Attach the pulley bracket to the replacement flap torque tube using the appropriate hardware.

(3) Flap Horn Installation.

(a) Install the flap horn assembly on the left end of the replacement flap torque tube. Rotate the horn until the scarf on the horn matches the scarf on the tube.

(b) Using a transfer punch, mark the centerline of one of the .249/.251 inch holes in the horn on the tube and drill an .189/.191 inch diameter hole thru one side only of the tube. Repeat the same process for the same hole on the opposite side of the horn.

(c) Ream the.189/.191 inch diameter holes to .249/.251 inch diameter using the horn as a guide. Temporary install a .250 inch diameter bolt and nut. Repeat the same steps for the other hole in the horn.

(d) Attach the flap horn assembly to the left end of the replacement torque tube using the appropriate hardware.

d. Install the flap torque tube assembly per paragraph 5-51.

e. In PA-23-250 S/N's 27-7654001 and up (i.e. - with the Stabilator Trim / Flap Interconnect System), reinstall the forward interconnect cable using the applicable portion of the instructions in paragraph 5-58 and verify adjustment of the system per paragraph 5-59.

f. Lubricate the flap torque tube bearings per the Lubrication Chart, Section II.

g. Make an appropriate logbook entry documenting the installation of P/N 104622-004.

4-13. WING.

4-14. REMOVAL OF WING. (Refer to Figure 4-2.)

a. Remove wing root fairings, all wing inspection plates and panels, front fuselage side access panels and the bottom fuselage access panel. (Refer to Access and Inspection Provisions, Section II.)

b. Close the fuel valve and drain the fuel from the wing to be removed. (Refer to Draining Fuel System, Section II.)

c. Remove the engine from the wing to be removed. (Refer to Engine Removal, Section VIII.)

CAUTION: TO PREVENT DAMAGE OR CONTAMINATION OF FUEL, HYDRAULIC AND MISCELLANEOUS LINES, PLACE A PROTECTIVE COVER OVER THE LINE FITTINGS AND ENDS.

NOTE: To help facilitate reinstallation of control cables and fuel or hydraulic lines, before removing mark cable and line ends in some identifying manner and attach a line where applicable to cables before drawing them through the fuselage or wing.

d. Drain the brake lines and reservoir. (Refer to Draining Brake System, Section II.)

e. Remove the front and center seats.

f. Place the airplane on jacks. (Refer to Jacking, Section II.)

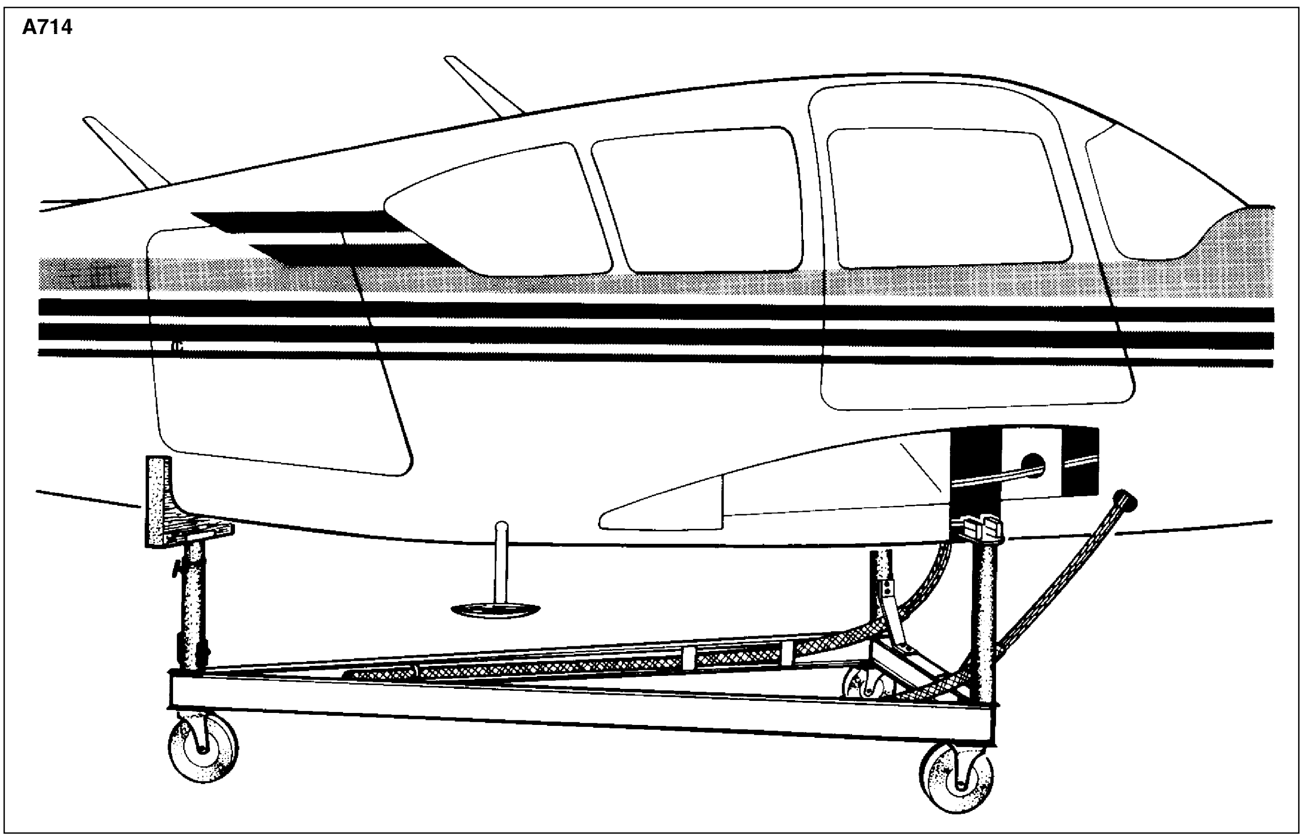


Figure 4-2. Fuselage Cradle

g. Place a cradle under the airplane, lower and remove jacks. If necessary, retract gears slightly.

h. Drain the hydraulic system. (Refer to Draining Hydraulic System, Section II.)

i. Disconnect the fuel shut-off control cable at the fuel shut-off valve. Remove the cable clamp at the rib beside the valve and at the wing butt rib.

j. Disconnect the primer, if installed, and fuel crossfeed lines under the fuel control panel.

k. Remove the interior trim panel just below the door sill on the right side and remove the lower middle section of the panel on the left side.

l. Remove the attaching screws at the floor, at the front and rear of the spar cover. Remove seat brackets from spar and remove cover.

m. Disconnect the aileron control cables at the bellcrank, which are accessible through the inspection opening on the bottom of the wing, about half way out between the engine and the end of the wing. Remove the pulley at the next inboard inspection opening and at the wing butt. Remove the cap on the rub block in the nacelle space and remove the cables from the wing.

n. Disconnect the vacuum and fuel pressure lines.

o. Disconnect the fuel lines at the wing butt, and disconnect the manifold pressure lines.

p. Disconnect the airspeed lines.

q. Disconnect the hydraulic lines and Remove the CO_2 bottle. (Refer to Emergency Gear Extension System, Section VI.)

r. On PA-23-250 and PA-23-235 airplanes, remove the insulating cap from the electric wiring terminal block in the rear section of the fuselage access opening and disconnect the wires. On PA-23-250 (Six place) airplanes, the above wires are connected by a cannon plug located just forward of the main spar.

s. All engine controls (throttle, carburetor heat or alternate air door, propeller governor and mixture) must be removed from the wing. The tachometer shaft is removed last and must be inserted first through the control tube when reassembling, due to the large nut on the shaft.

t. Remove the outside wing bolts and arrange a fuselage support cradle.

u. Place a table or some kind of support under the wing to be removed. Support other wing as necessary.

NOTE: The support for the wing should be covered with felt or similar material to prevent damage to the wing surface .

v. Remove the center bolts and the rear spar bolts. To facilitate reinstallation, note the location and amount of shim or spacer plates and washers.

w. Remove the front spar bolt.

x. Remove the wing.

4-15. INSTALLATION OF WING. (Refer to Figures 4-1 and 4-3.)

a. Ascertain that fuselage is positioned solidly on a support cradle.

b. Place the wing in position for installation, with the spar end a few inches from the side of the fuselage and set on trestles.

c. Prepare the various lines, control cables and wires for inserting into the wing or fuselage when the wing is slid into place.

d. Slide the wing into the fuselage and butt the spar ends. (Maximum distance of .031 of an inch is permissible between spar caps.)

e. Insert the tachometer shaft through the control cable guide tube, followed with the throttle, carburetor heat or alternate air, propeller governor and mixture controls.

f. Attach the main spar to the fuselage frame on the side of the fuselage. Install a bolt down through the spar and fuselage frame on the forward side and secure with washer and self-locking nut. Install a bolt and shim (P/ N 17480-00) down through the spar and fuselage frame, and secure with a washer and self-locking nut.

g. Attach the rear spar to the fuselage frame fitting by inserting the bolt from the aft side. The maximum permissible gap between the rear spar and the frame fitting is . 125 of an inch, before the attaching bolt is tightened. If the gap is .062 of an inch or under, draw up with bolt, washer and self-locking nut. If the gap is .062 to . 125 of an inch, use a shim (P/ N 80122-87) and draw up remaining gap with bolt, washer and self-locking nut.

h. Install the spar straps. Position the straps, one to the top front (a shim P/ N 18283-00 may be used if needed), one to the bottom front, and one to the bottom aft. Keeping in mind the .032 of an inch maximum allowed gap between the spar caps, secure the straps with bolts, installed through the forward side, and self-locking nuts. Torque bolts from 100 to 140 inch-pounds.

i. Connect the top of the main spar at the side of the fuselage. Install the bolt from the front, a spacer block on the front, and a bushing and spacer block on the aft side. Secure with a washer and self-locking nut. Shims (.020, P/N 18380-02; .032, P/N 18380-03; or .064, P/N 18380-04) may be installed between the fuselage frame brackets and the spacer blocks, as required, to obtain a proper fit.

j. Install the plates to the top and bottom of the spar with bolts, washers and self-locking nuts. Washers are required under the heads of the two front center bolts of the upper and lower plates. Torque bolts to 160-190 inch-pounds.

k. Attach the front spar to the fuselage frame bracket with a bolt installed from the front and secured with a self-locking nut. A maximum of two washers (AN960-616) may be installed between spar fitting and frame bracket to provide a proper fit. When installing a new wing, first drill a pilot hole through the forward side of the spar using a fabricated tool, as shown in Figure 4-5, for hole alignment, and a .125 inch drill. (The tool may be fabricated from dimensions given in Figure 4-22.) Then, drill out the spar attachment hole from the aft side using a .375 inch drill.

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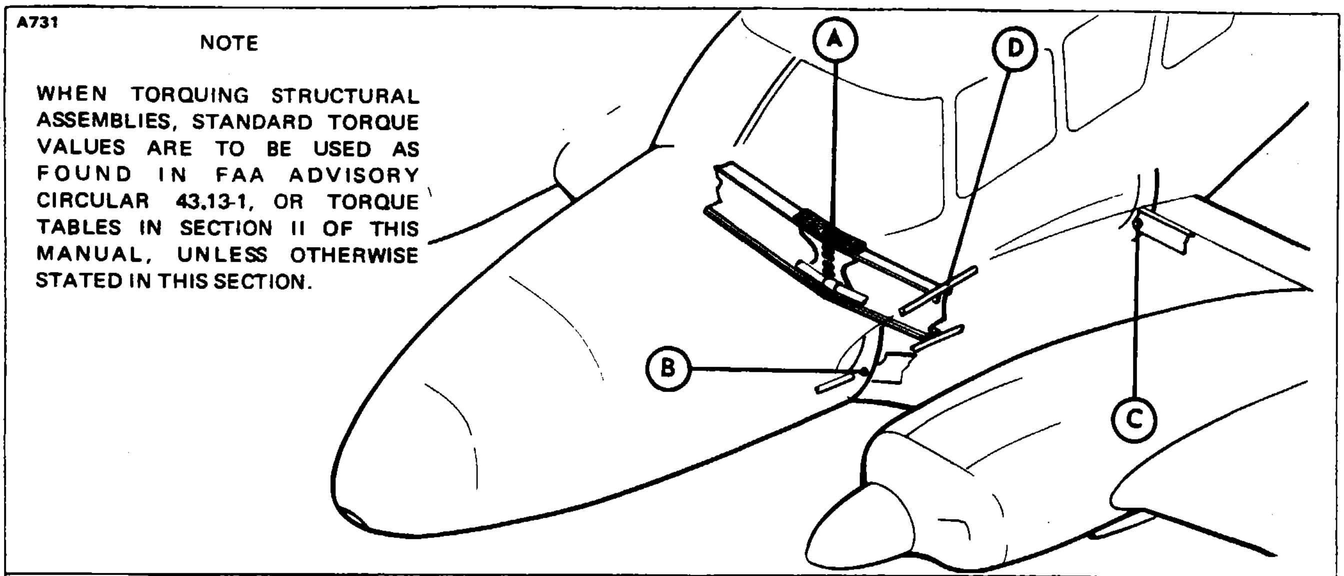

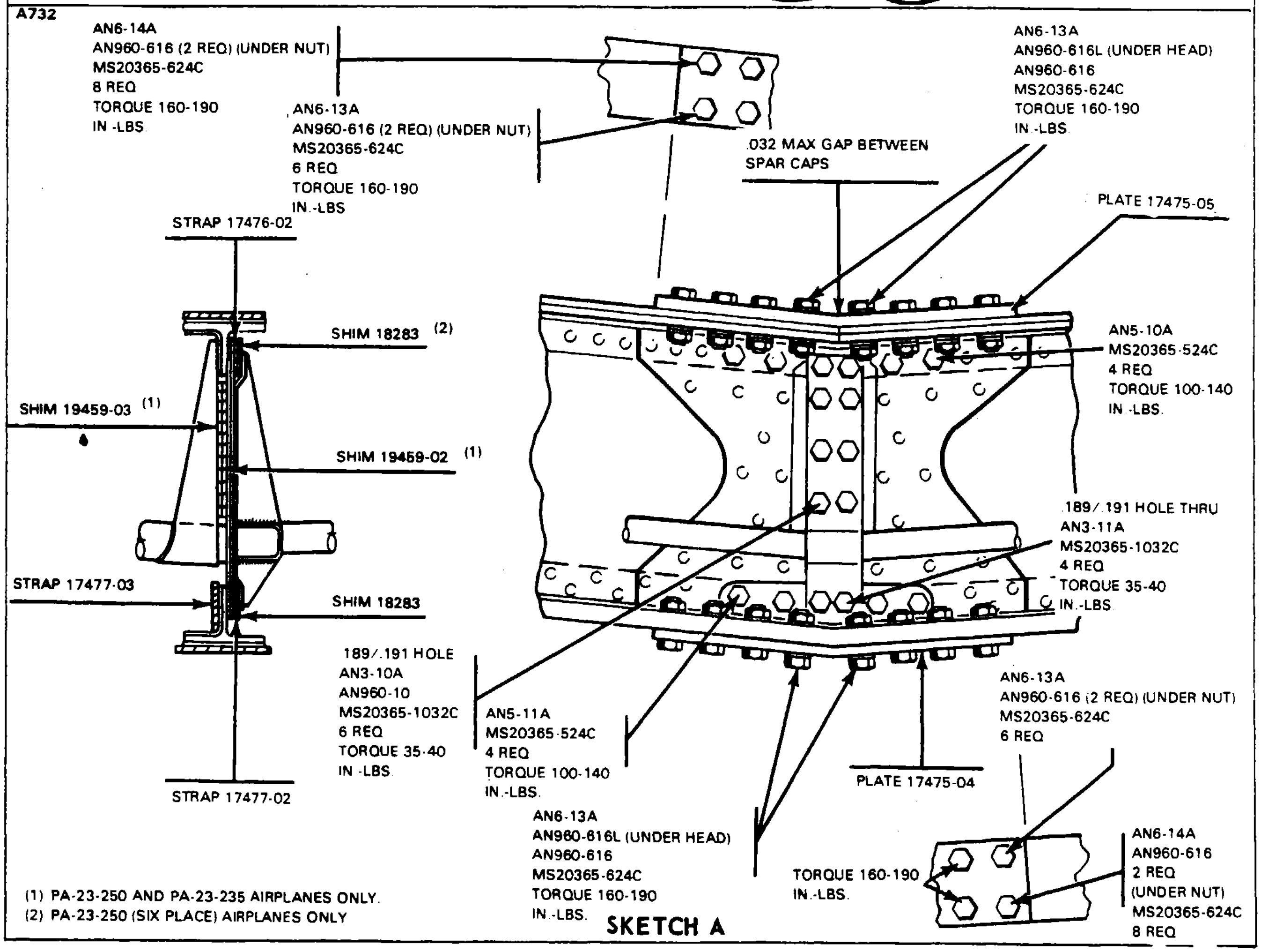

Figure 4-3. Wing Installation

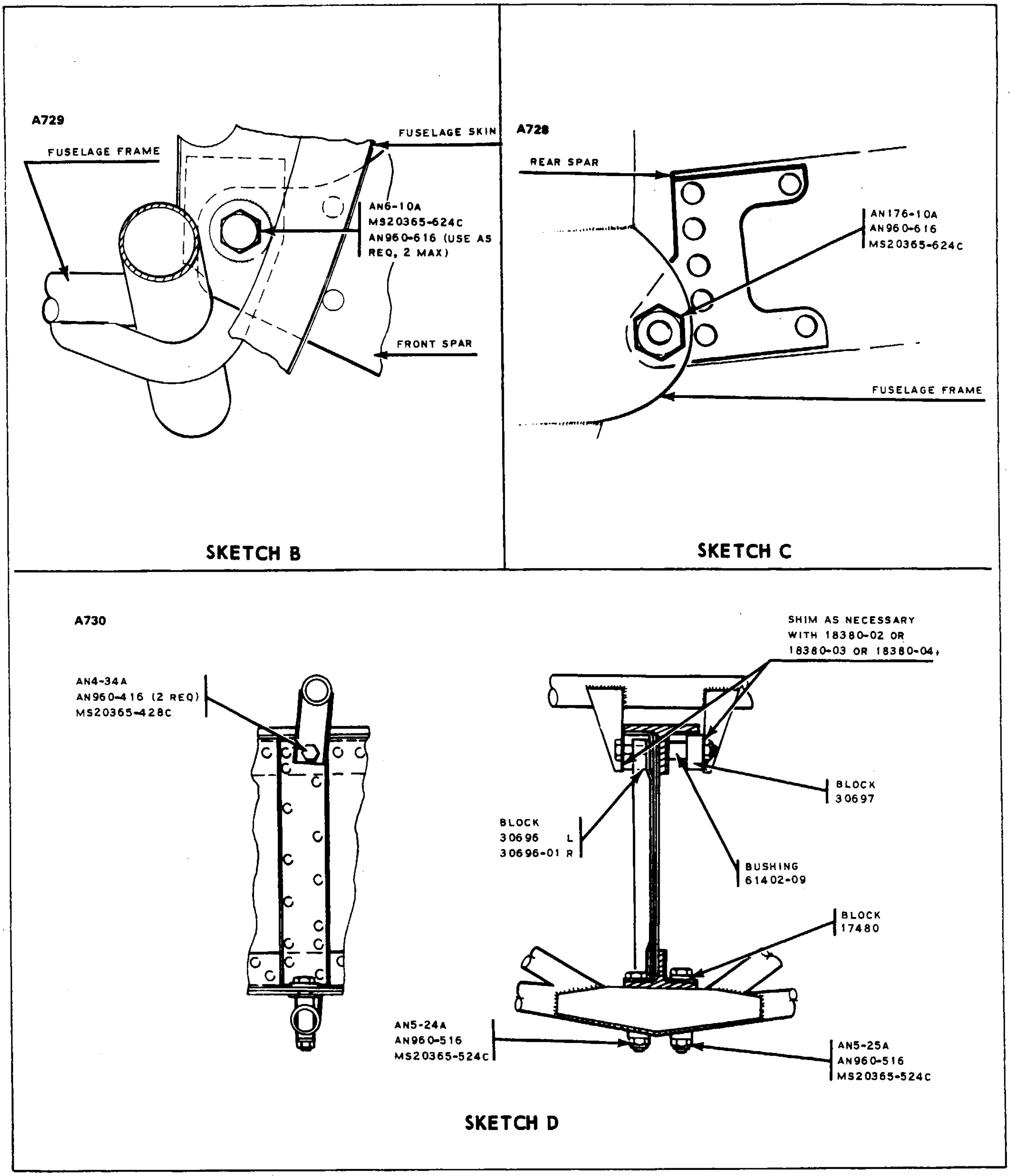

Figure 4-3. Wing Installation (cont.)

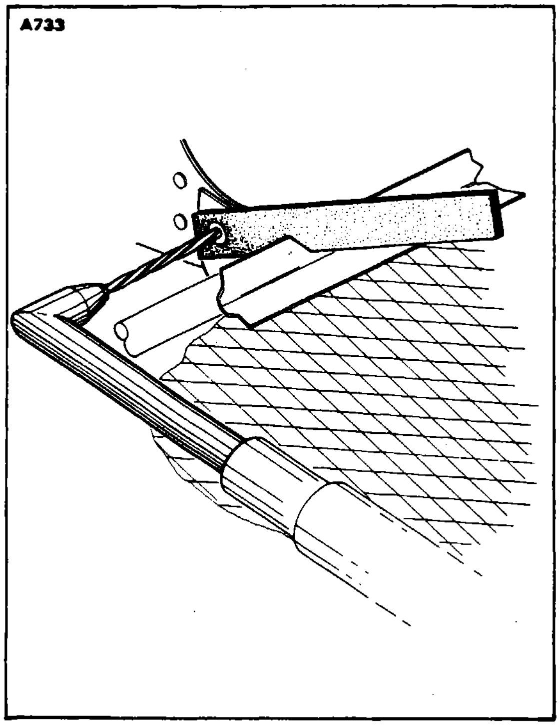

Figure 4-4. Positioning of Front Spar Aligning Tool

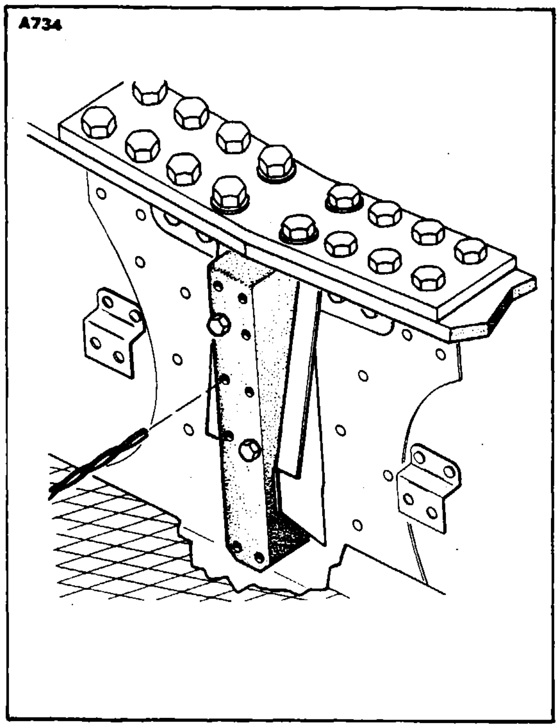

Figure 4-5. Positioning of Main Spar Aligning Tool

1. Bolt the center of butt end of the main spar. If a new wing is being installed, it will be necessary to drill holes in the spar to .189/.191 of an inch to match the fuselage frame fitting. Drill the holes in the spar with the use of a hole jig as shown in Figure 4-5, and a .189 (No. 12) inch drill. (The tool may be fabricated from dimensions given in Figure 4-21.)

NOTE

The holes must be drilled straight for proper alignment and to prevent damaging the aft fuselage frame fitting.

On PA-23-250 and PA-23-235 airplanes, insert a .187 shim plate (P/N 19459-00) against the back of the main spar and a .125 shim plate (P/N 19459-03) between the previous mentioned shim and the aft fuselage frame fitting. On PA-23-250 (six place) airplanes, insert a .313 shim plate (P/N 19303-00) between the main spar and the aft fuselage frame fitting. Install bolts from the front and secure with self-locking nuts. Torque bolts from 35 to 40 inch-pounds. Washers must be used under the nuts of the six center bolt and nut assemblies.

m. Place the wing jacks under the wings and remove the supports.

n. Connect the wires at the electrical wiring terminal block in the rear section of the fuselage access opening.

o. Connect the oil pressure lines.

p. Connect the hydraulic lines.

q. Connect the airspeed lines.

r. Connect the fuel lines at the wing butt and connect the manifold pressure lines.

s. Connect the vacuum and fuel pressure lines.

t. Replace the aileron control cables in the rub block on the wheel well. Replace the pulley at the wing butt and inspection hole, and connect the cables at the bellcrank, which is accessible through the plate on the bottom of the wing midway between the engine and the end of the wing. (Check aileron rigging and adjust-ment per Section V.)

u. Connect the flap control rod to the inboard end of the flap. (Check flap rigging and adjustment per Section V.)

v. Replace the spar cover.

w. Replace the interior trim panel just below the door sill on the right side and replace the lower middle section of the panel on the left side.

x. Connect the primer and fuel crossfeed lines under the fuel control box.

y. Connect the fuel shut-off control cable at the fuel shut-off valve and re-clamp the cable at the rib beside the valve and at the wing butt rib.

z. Fill the hydraulic system. (Refer to Filling Hydraulic System, Section II.)

aa. Replace the front and rear seats.

ab. Fill the brake reservoir and brake system. (Refer to Servicing Brake System, Section II.)

ac. Remove the jacks and fuselage support.

ad. Fill the fuel tank. (Refer to Filling Fuel Cells, Section II.)

ae. Replace engine, engine cowling and top nacelle. (Refer to Installation of Engine, Section VIII or VIIIA.)

af. Replace the bottom fuselage access panel, the front fuselage side access panels, the wing inspection plates and panels, and the wing root fairings.

4-16. EMPENNAGE GROUP.

4-17. STABILATOR.

4-18. REMOVAL OF STABILATOR. (Refer to Figure 4-6.)

NOTE: Perform Stabilator Torque Tube Corrosion Inspection (see Special Inspections, Procedures) whenever both stabilator halves are removed at the same time.

a. Disconnect the stabilator trim control rod at the horn on the center of the tab assembly by removing cotter pin, nut, washer, bushing and bolt.

b. Disconnect the stabilator halves at the attachment fittings on the inboard end of each rear spar by removing nut, washer and bolt.

c. Remove two bolts (close tolerance) with nuts and washers attaching the stabilator half to the torque tube.

d. Slide stabilator from torque tube.

NOTE: Should torque tube bearing block removal become necessary, items secured with Bearing Mount No. 72 may be separated with adequate pressing tools. Installation is accomplished by cleaning parts with Loctite Locquic Primer T and allowing 5 minutes to dry. Apply Loctite Bearing Mount No. 72 to both the inner and outer surfaces of bearing and to the torque tube. Assemble parts and wipe off excess bearing mount sealant. Allow parts to cure 60 minutes at room temperature.

4-19. INSTALLATION OF STABILATOR. (Refer to Figure 4-6.)

CAUTION: CONTROL SURFACE SKINS MUST BE REPLACED IF THEY SUSTAIN DAMAGE OR EXHIBIT CRACKS.

WARNING: IF THE STABILATOR HAS BEEN REPLACED, REPAINTED, OR HAS HAD DEICE BOOTS ADDED OR REMOVED; OR THE TRIM TAB HAS BEEN REPLACED OR REPAINTED; THE STABILATOR MUST BE BALANCED BEFORE INSTALLATION. SEE PARAGRAPH 4-66, BALANCING STABILATORS.

a. Slide the stabilator torque tube and align the two holes in the stabilator with the holes in the torque tube.

b. Secure the stabilator to the torque tube with two close tolerance bolts which have been sprayed with zinc chromite (install when still wet), washers and self-locking nuts. Torque the two bolts between 60-85 inch-pounds.

c. Connect halves of the stabilator assembly at the attachment fittings on the inboard end of each rear spar by installing the bolt, washer and self-locking nut.

d. Temporarily attach the stabilator trim control rod to the stabilator trim tab horn using bushing, washer and bolt. Add washer(s) between each horn to maintain parallel position of horns.

e. Check rigging and adjustment of the trim tab as described in Section V.

f. Secure trim control rod to horn and secure with cotter pin. Torque nut between three (3) to 35 inch-pounds on serial numbers 27-1 to 27-7554168 inclusive. Serial numbers 27-7654001 and up require a torque of 50 to 70 inch-pounds.

4-20. INSTALLATION OF NEW STABILATOR. The two mounting holes in a new stabilator are not drilled to full .312 inch diameter. The reason for this is to assure proper alignment upon installation. To fit a new stabilator to the torque tube, proceed as follows:

a. Slide the stabilator onto the stabilator torque tube.

b. Align the stabilator halves and bolt rear spar attachment fitting together with bolt, washer and nut.

c. Insert a drift pin in one of the stabilator mounting holes to assist in alignment of the stabilator during the reaming operation.

d. Using a .312 reamer, enlarge the mounting holes and install the bolt (close tolerance).

e. Remove the drift pin and repeat the reaming operation on the remaining mounting hole.

f. Install washer and nut with each attaching bolt and torque pounds.

g. Refer to paragraph 4-65 for balancing of the stabilator.

4-21. STABILATOR TRIM TAB. (Refer to Figure 4-6.)

4-22. REMOVAL OF STABILATOR TRIM TAB.

a. Disconnect the stabilator trim control rod at the horn on the center of the tab assembly by removing cotter pin, nut, washer, bushing, and bolt.

b. Remove the stabilator trim hinge pins. Straightening the hinge pin to remove it may enlarge the hinge pin holes. It is recommended that the pins be cut at their bend angle before removal and replaced with new pins upon installation.

4-23. INSTALLATION OF STABILATOR TRIM TAB.

a. Align the hinge pin holes of the trim tab with the stabilator and insert new pins. Refer to Parts Catalog for proper pin size.

b. Secure the pin by bending the end down to 90 degrees.

c. Connect the stabilator trim control rod to the tab horn with attachment hardware. On serial numbers 27-1 to 27-7554168 inclusive, torque the nut finger tight (3 to 35 in. lbs.) then install cotter pin. On serial numbers 27-7654001 and up, the bolt torque is (50 to 70 in. lbs.).

d. Check rigging of stabilator trim as described in Section V.

4-24. STABILATOR TRIM TAB FREE PLAY.

a. Place tab in neutral position (refer to Section V, Table V-I).

b. The total tab free play may not exceed 1/10 inch, measured between the outboard trailing edge of the tab and the trailing edge of the stabilator.

c. Free play in excess of 1/10 inch will require a close inspection of hinge assemblies for source of looseness.

d. Replace hinge pins if evidence of wear is present. Hinge pin diameter should be .093 to .095 of an inch.

NOTE

To withdraw hinge pins, cut pin at bend angle. Do not attempt to straighten.

e. If new hinge pins do not eliminate looseness, replace appropriate stabilator and stabilator tab hinges.

4-25. RUDDER.

4-26. REMOVAL OF RUDDER.

a. Remove the upper section of the tail cone fairing and the rudder horn access panel by removing attaching screws.

b. Remove the left or right access panel, as desired, to the cockpit area below the windshield area.

c. Relieve tension from the rudder cables by loosening one turnbuckle at the rudder pedal torque tube.

d. Disconnect the two control cables from the rudder horn by removing cotter pin, nut, washer and clevis bolt.

e. Disconnect the rudder horn from the lower rudder hinge bracket by removing cotter pin, nut, washer and clevis bolt.

f. Disconnect the rudder trim tab control rod at the tab horn by removing cotter pin, nut, washer and clevis bolt.

g. Disconnect the navigation light and rotating beacon wires at their quick disconnects located between the rudder and fin.

h. Remove the two hinge bolts with cotter pin, washer and nut and remove the rudder.

4-27. INSTALLATION OF RUDDER.

CAUTION: CONTROL SURFACE SKINS MUST BE REPLACED IF THEY SUSTAIN DAMAGE OR EXHIBIT CRACKS.

WARNING: IF THE RUDDER HAS BEEN REPLACED, REPAINTED, OR THE TRIM TAB HAS BEEN REPLACED OR REPAINTED, THE RUDDER MUST BE BALANCED BEFORE INSTALLATION. SEE BALANCING RUDDERS, PARAGRAPH 4-67.

a. Align the two hinge brackets of the rudder with the hinges on the fin and install the two hinge bolts. Install washer and nut on each bolt. Tighten to allow freedom of rotation but with no end float, and safety nut with cotter pin.

b. Connect the rudder horn to the lower hinge bracket of the rudder and install clevis bolt, washer, and nut. Ascertain that the bolt slips freely through each fitting. Should it not, shims (P/N 81262-94) may be used to obtain correct alignment. Tighten nut to allow freedom of rotation and safety nut with cotter pin.

c. Connect the rudder trim tab control rod to the tab horn and secure with clevis bolt, washer, nut and cotter pin.

d. Connect the two control cables to the rudder horn with clevis bolt, washer, nut and cotter pin.

e. Connect the navigation light and rotating beacon wires at their attaching point between the rudder and fin.

f. Set rudder cable tension and alignment as given in Rigging and Adjustment of Rudder, Section VI.

NOTE: The rotating beacon is required for proper rudder mass balance. IT MUST BE INSTALLED.

g. Replace the access fairings and panels and secure.

4-28. RUDDER TRIM TAB.

4-29. REMOVAL OF RUDDER TRIM TAB.

a. Disconnect the trim tab control rod at the tab horn by removing cotter pin, nut, washer and clevis bolt.

b. Remove the rudder trim hinge pins. Straightening the hinge pin to remove it may enlarge the hinge pin holes. It is recommended that the pin be cut at its bend angle before removal and replaced with new pin upon installation.

4-30. INSTALLATION OF RUDDER TRIM TAB.

CAUTION: CONTROL SURFACE SKINS MUST BE REPLACED IF THEY SUSTAIN DAMAGE OR EXHIBIT CRACKS.

a. Align the hinge pin holes of the trim tab with the rudder and insert new pins.

b. Bend the hinge pin ends over to 90 degrees providing a safety for the pin.

c. Connect the rudder trim control rod to the tab horn with clevis bolt, washer, nut and cotter pin. The bolt should be free to rotate by hand when lubricated with general purpose oil.

4-31. VERTICAL STABILIZER (FIN).

4-32. REMOVAL OF VERTICAL STABILIZER (FIN). (Refer to Figure 4-6.)

a. Remove the tail cone fairings and access panel located on the left side of the fuselage below the leading edge of the fin by removing attaching screws.

b. Remove the fin fairing located between the fuselage and leading edge of the fin, and access plates on the right side of the fin by removing attaching screws.

c. Remove the access panel to the aft section of the fuselage located at the aft wall of the baggage compartment.

d. Remove the rudder in accordance with paragraph 4-26.

e. Block the trim cable at the trim drum with wooden blocks, or by tape, to prevent the cable from unwrapping from the drum.

f. Disconnect the trim cable at the turnbuckles within the aft section of the fuselage.

g. Remove the cotter pin cable guards from the cable pulleys within the aft section of the fuselage at station 261.0. Enter through the access opening in the left side of the fuselage.

h. Remove the rudder horn hinge fitting from the fin attachment plate by removing cap bolts; then remove trim pulleys from the fitting by removing attaching bolt, washer and nut. The trim cable is free for removal. Note, if any, the number of shims between the hinge fitting and attachment.

i. Disconnect the trim indicator wire from the forward end of the rudder trim screw.

j. Disconnect electrical wires, antenna wires and cables, and deicer line, as installed.

k. Remove the attaching bolts and screws with nuts and washers at the top of the fin spar rear attachment plate.

l. Remove the attaching bolts and screws with nuts and washers at the top of the fin spar front attachment plate.

m. Pull the fin directly up from the fuselage.

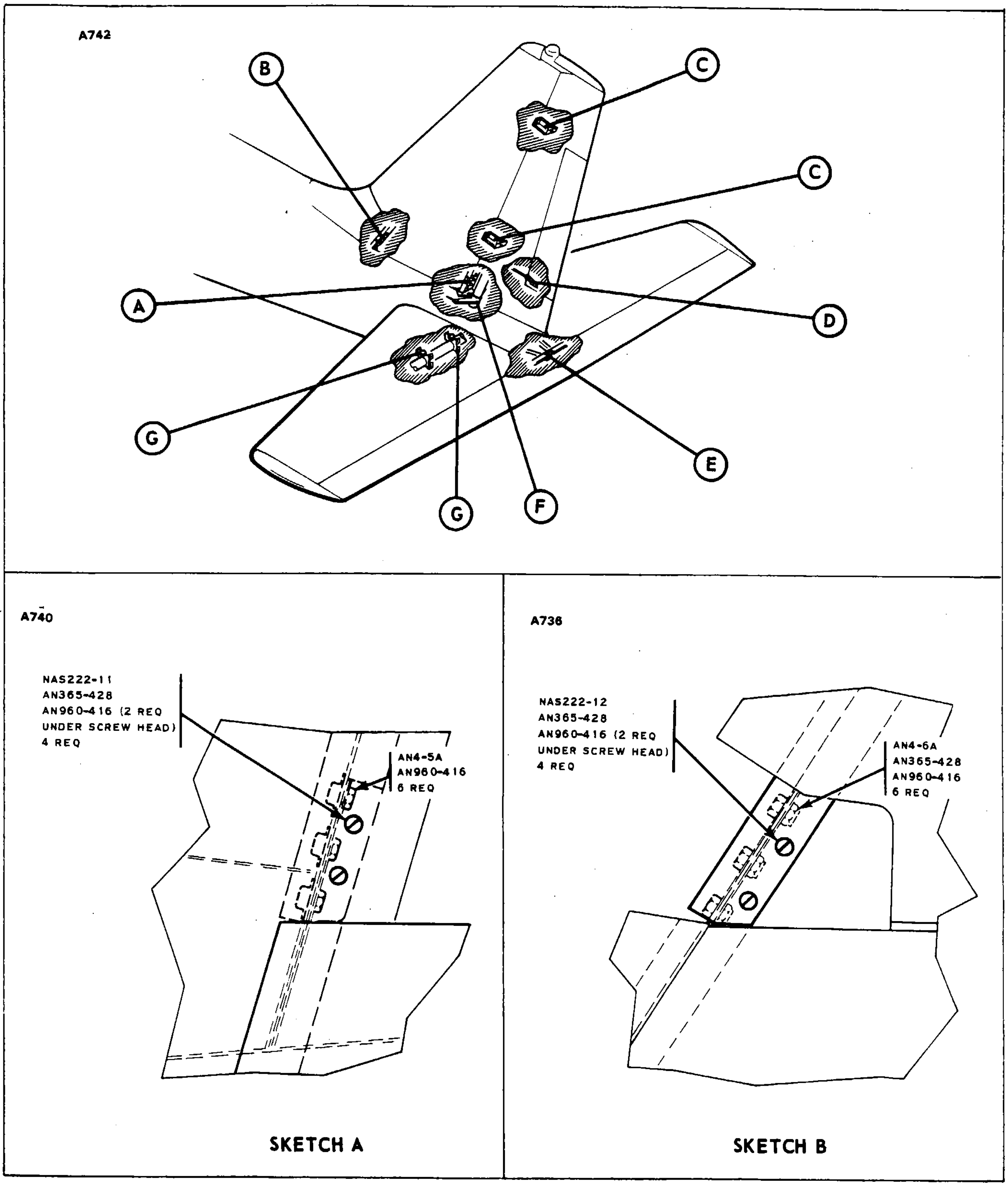

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Figure 4-6. Empennage Installation

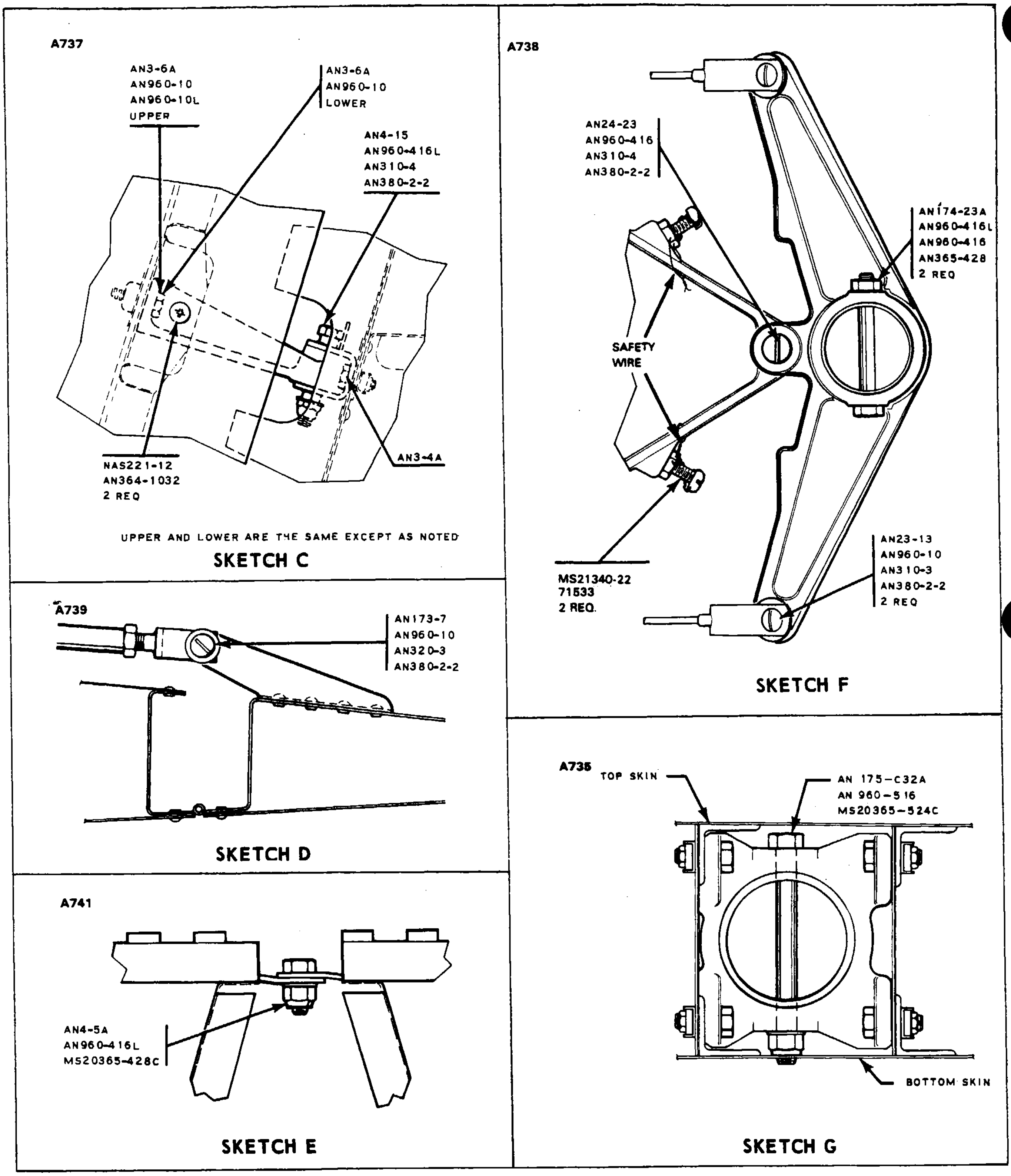


Figure 4-6. Empennage Installation (cont.)

4-33. INSTALLATION OF VERTICAL STABILIZER (FIN). (Refer to Figure 4-4.)

a. Position and align the mounting holes of the front and rear spar of the fin with the matching holes of the attachment plates on the fuselage. Ascertain that the rubber extrusion is attached to the lower skin of the fin.

b. Install and torque attaching bolts and screws with washers and nuts at the front and rear fin attachment locations. A washer is also required under the heads of each attaching screw.

c. Install the rudder trim cable pulleys, with trim cable, on the rudder horn hinge fitting and secure with bolt, washer and nut.

d. Attach the hinge fitting to the attachment plate and secure with washers and cap bolts. If previously installed, install spacer shims between the fitting and plate.

e. Route the trim cable ends forward and connect to the forward control cable.

f. Ascertain that the cable is positioned in the slot of each pulley at fuselage station 261.0, and install cotter pin cable guards.

g. Remove the blocks or tape that secure the cable at the trim mechanism.

h. Draw the trim indicator wire to the trim mechanism in the fin and connect it to the trim screw.

i. Install the rudder in accordance with paragraph 4-30.

j. Connect electrical wires, antenna wires and cables, and de-icer lines, as appropriate.

k. Set cable tensions, and rigging and adjustment of the rudder and rudder trim in accordance with instructions given in Section V. Check rudder and rudder trim operation.

l. Install access panels, plates and fairings and secure with attaching screws or fasteners.

4-34. FUSELAGE ASSEMBLY.

4-35. WINDSHIELD.

4-36. REMOVAL OF WINDSHIELD. (Refer to Figure 4-7 or 4-8.)

a. Remove the trim molding from around the inside of the windshield by removing attaching screws.

b. Remove the machine screws that secure the collar molding around the bottom of the windshield.

c. Remove the outside trim strip from between the windshield halves by holding the round nuts in the inside channel and turning out the machine screws.

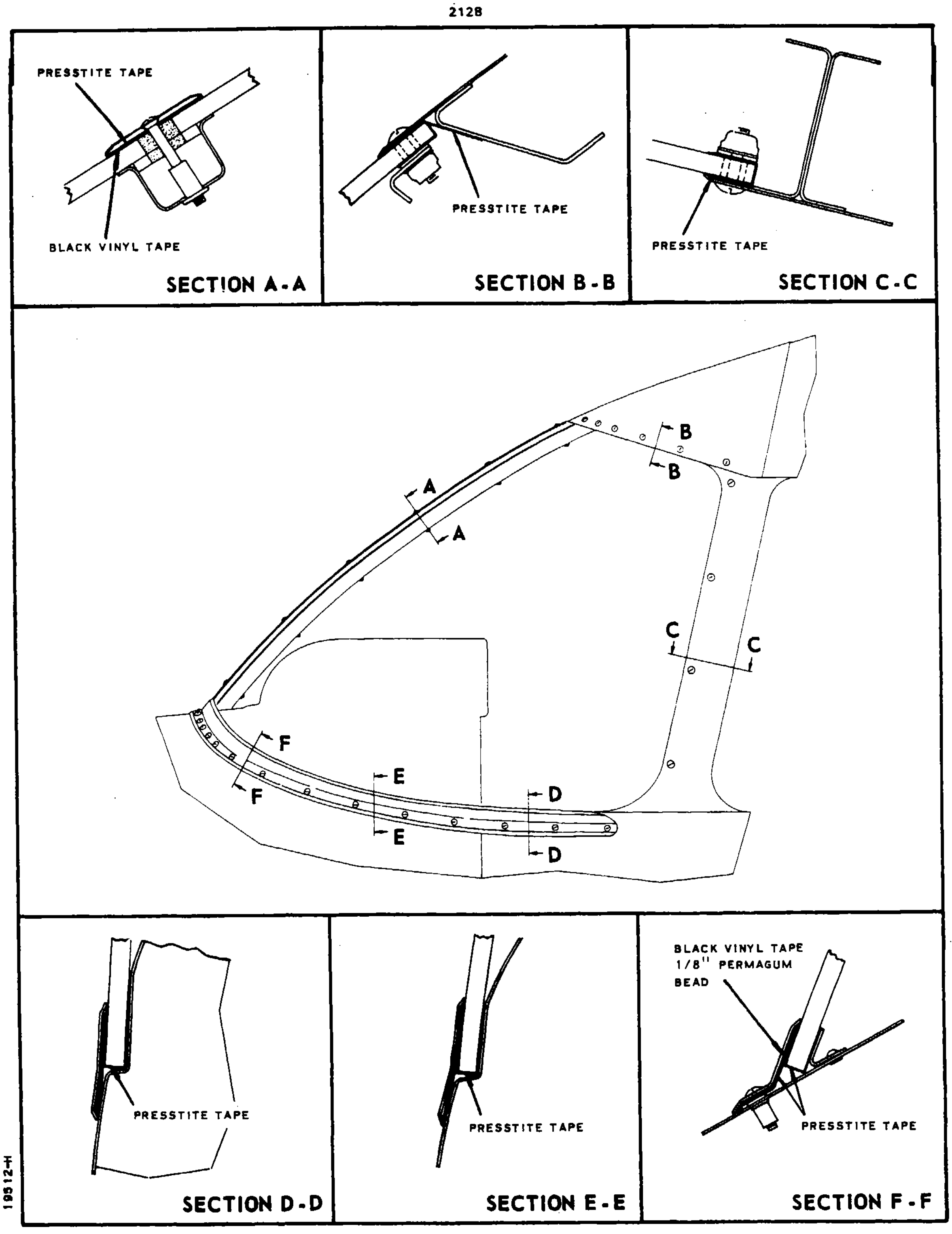


Figure 4-7. Windshield Installation. (PA-23-250 and PA-23-235.)

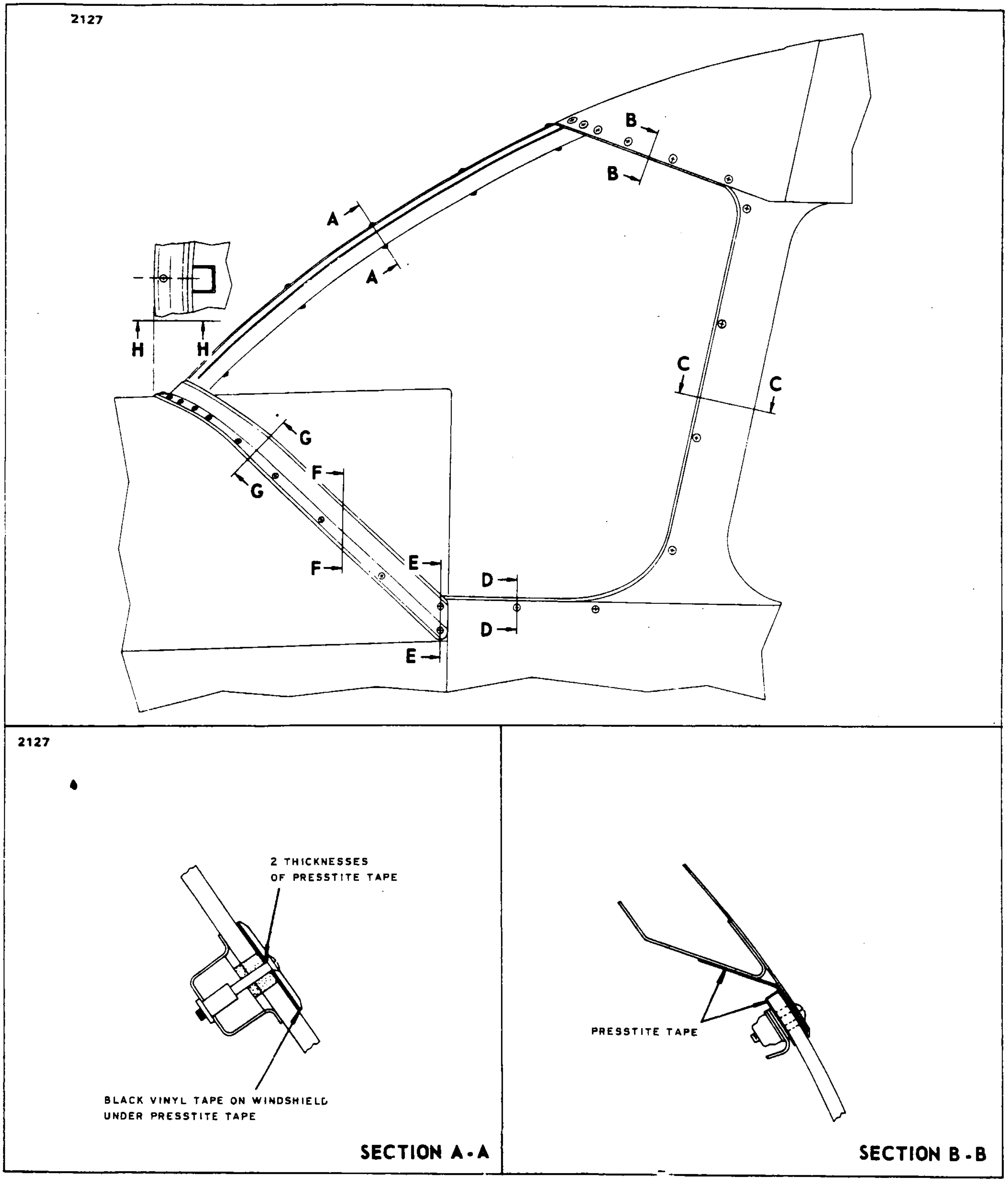


Figure 4-8. Windshield Installation (PA-23-250 - six place)

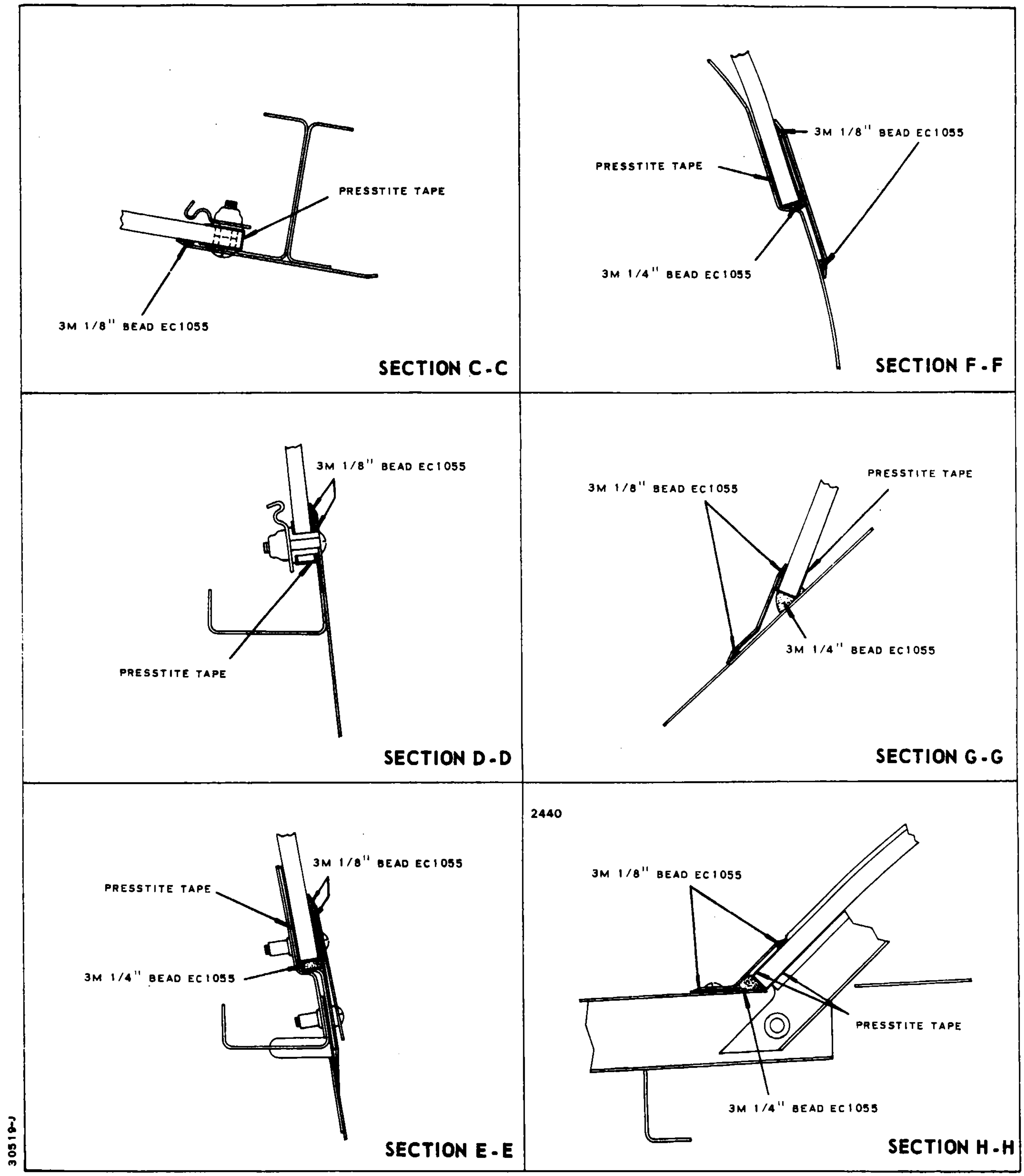


Figure 4-8. Windshield Installation (PA-23-250 - six place) (cont.)

d. Remove the retainer screws from around the top and outboard side of the windshield.

e. Push the windshield out at the bottom and work out of upper and side channels.

f. Clean old window tape from around inside of channel.

4-37. INSTALLATION OF WINDSHIELD. (Refer to Figure 4-7 or 4-8.)

a. Ascertain that new windshield is cut to match windshield removed.

b. Apply one piece of Prestite Tape Number 163 or equivalent over the edge of, and completely around, the windshield; and 3M EC1055 Bead or equivalent under the edge of the fuselage skin at the top and in the recess at the bottom of the windshield opening.

c. Slide the windshield into place being careful not to disturb the placed tape and bead material.

d. Cover the center section of the windshield with a strip of black vinyl tape and two thicknesses of Prestite tape.

e. Install center strip and secure with round nuts and screws.

f. Install inside channel and secure windshield with retainer screws and nuts around the outside of the windshield.

g. Install the collar molding around the bottom of the windshield with screws.

h. Install the trim molding around the inside of the windshield with screws.

i. Seal with sealer any areas around the windshield that may allow water to penetrate past the windshield.

j. Remove excess exposed sealer and tape.

4-38. SIDE WINDOWS.

4-39. REMOVAL OF SIDE WINDOWS. (PA-23-250, PA-23-235 and PA-23-250 (six place) Serial Nos. 27-2000 to 27-2504 incl.)

a. Remove the trim molding from around the window by removing attaching screws.

b. Remove the window retaining strips by removing attaching screws.

c. Remove the window.

d. Clean the old window sealer from the retaining strips and the fuselage skin.

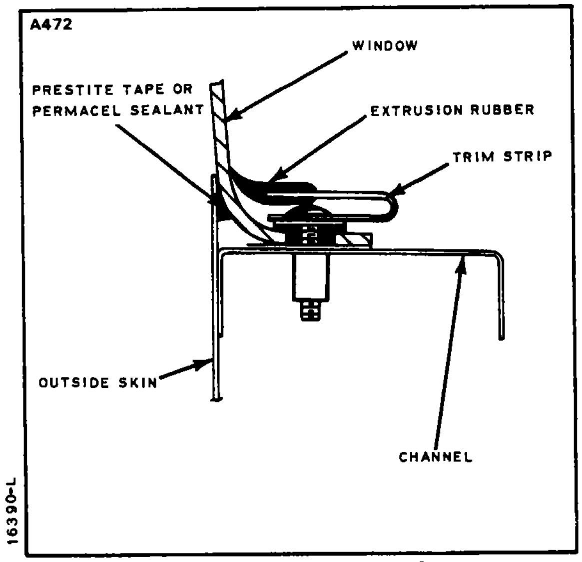


Figure 4-9. Side Window Installation (Typical)
PA-23-250, PA-23-235 and PA-23-250 (six place) Serial Nos. 27-2000 to 27-2504 incl.

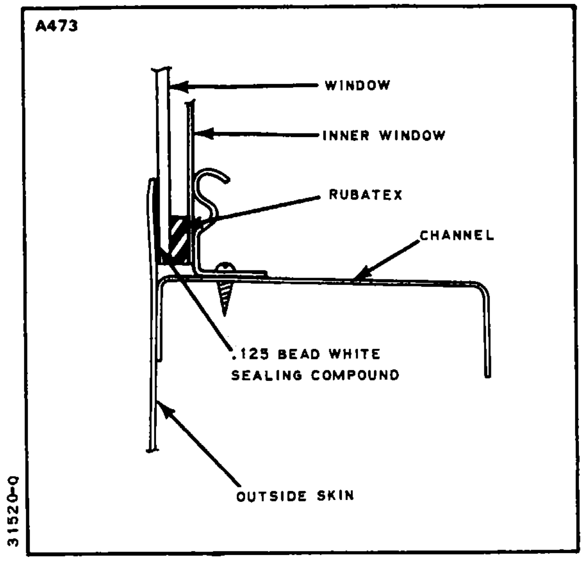


Figure 4-10. Side Window Installation (Typical)
PA-23-250 (six place)
Serial Nos. 27-2505 and up

4-40. INSTALLATION OF SIDE WINDOWS. (PA-23-250, PA-23-235 and PA-23-250 (six place) Serial Nos. 27-2000 to 27-2504 incl.)

a. Ascertain that the new window is cut to the same dimensions as the old window.

b. Apply sealer and tape to the window as follows:

1. On windows with curved edges, apply Prestite Tape No. 163 or equivalent around the window where it contacts the fuselage skin.

2. On windows with straight edges, apply Prestite Tape No. 163 or equivalent around the edge of the window and 3M Sealer No. 1126 or equivalent along the fuselage skin where it contacts the window.

c. Install the window and secure the retaining strips with screws.

d. Install the trim molding around the windows and secure with screws.

4-41. REMOVAL OF SIDE WINDOWS. PA-23-250 (six place) Serial Nos. 27-2505 and up.)

a. Remove the trim molding from around the window by removing attaching screws.

b. Remove the window retaining strips by removing attaching screws.

c. Remove the inner and outer window.
d. Remove the old window sealer from the retaining strips and the fuselage skin.

4-42. INSTALLATION OF SIDE WINDOWS. PA-23-250 (six place) Serial Nos. 27-2505 and up.)

a. Ascertain that the new windows are cut to the same dimension as the old windows.
b. Apply Prestite Tape No. 163 or equivalent over the edge of the outer window.
c. Apply 3M 1126 Sealer or equivalent along the fuselage skin where it contacts the window.
d. Install the outer window.
e. Cement the rub-tex strip around the edge of the outer window using Carbolene Neoprene Cement F-1. Air dry five minutes.
f. Install the inner window against the rub-tex strip and secure the retaining strips.
g. Position and secure retaining strips with screws.
h. Install the trim molding around the window with screws.

4-43. EMERGENCY EXIT. (PA-23-250 (six place) Serial Nos. 27-2000 and up.)

4-44. REMOVAL OF EMERGENCY EXIT ASSEMBLY. The emergency exit, located on the left side of the fuselage is sealed when installed and should only be removed in case of an emergency or for maintenance.
a. Remove the plastic placard.
b. Turn the handle and push out on the bottom of the assembly using a steady pressure. Use caution so as not to drop the assembly.
c. Clean the sealer from around the side of the window and the emergency exit opening in the side of the fuselage.

4-45. INSTALLATION OF EMERGENCY EXIT ASSEMBLY. (Refer to Figure 4-11.)

a. Place sealer, EC1055 bead .250 in. thick, or equivalent, around window assembly.

b. Cover the contacting surfaces of the window assembly with vinyl chloride copolymer film (Saran, 48 gauge, type B MIL-P-6264B.) SEE CONSUMABLE MATERIALS TABLE II-II.

c. Install the exit window by the following procedure:

1. Remove the two access plugs on bottom window panel by prying under plug with a screwdriver blade.

2. Loosen but do not remove screw in access hole.

3. Insert the top of the window assembly under the fuselage skin at the top of the exit opening. Push in on the bottom and sides of the window assembly until it is properly seated.

4. Lock window by turning release handle.

d. Check that the window assembly is flush with the surrounding fuselage skin and install the plastic placard over the release handle.

e. Trim excess polymer film from the inside and outside of the window installation.

f. Fill exterior gap between window assembly and fuselage with Permagum Sealer No. 576.1. (Presstite - Keystone Engineering Co. 3900 Chateau Ave., St. Louis, Missouri.)

4-46. REMOVAL OF EMERGENCY EXIT WINDOW.

a. Remove the trim molding around the inside of the window.

b. Remove the rivets that secure the window retainer molding and remove window.

c. Remove the old window sealer from window retainer molding and fuselage skin.

4-47. INSTALLATION OF EMERGENCY EXIT WINDOW. (Refer to Figure 4-11.)

a. Ascertain that the new window is cut to the same dimensions as the old window.

b. Apply P.R.C. Sealer 1221-B-2 (Product Research Co., Empire Ave., Burbank, Calif. 91504) over the edge of the window.

c. Place the window and retainer molding in position and secure with rivets AN426AD3-4.

d. Install trim molding around inside of window.

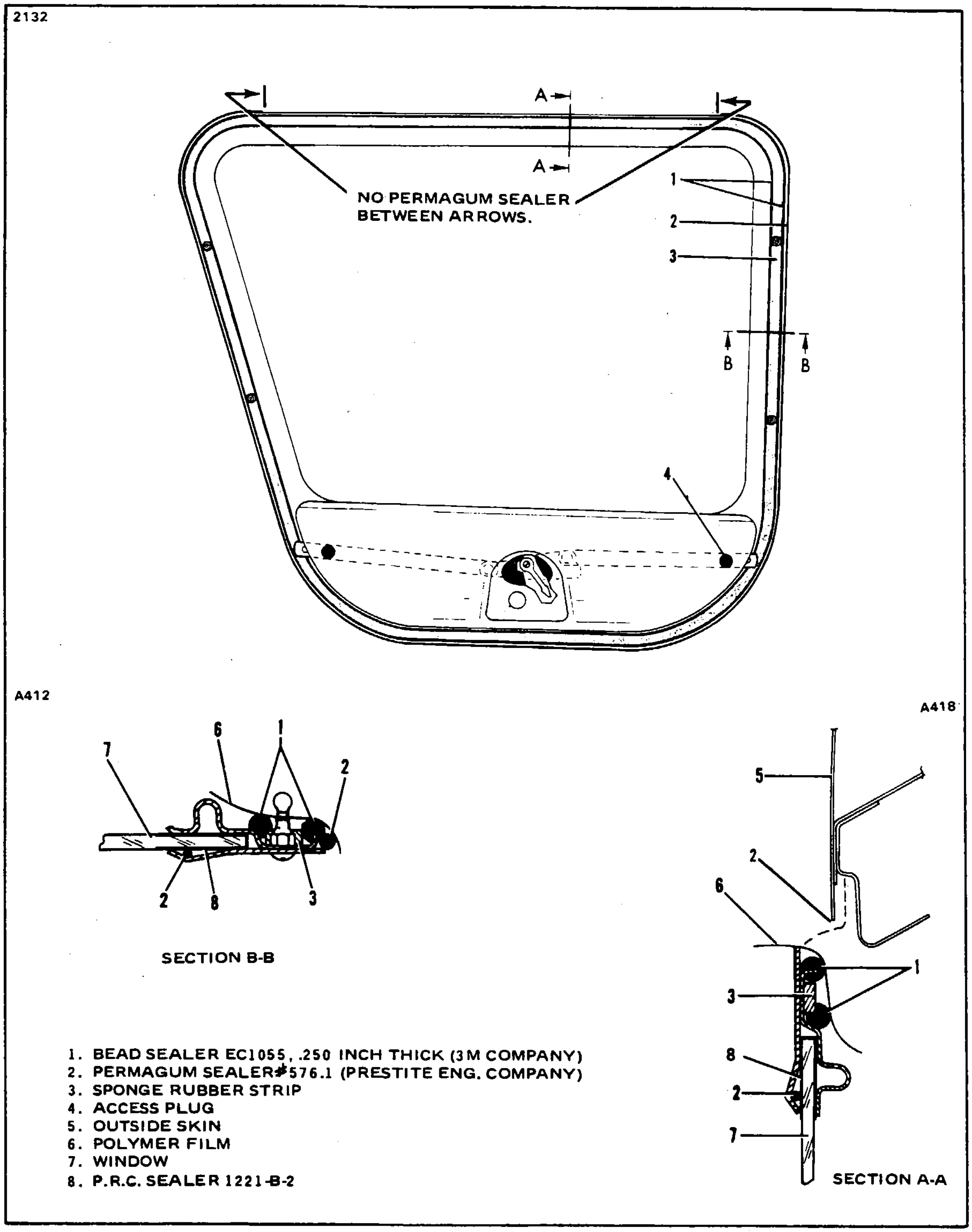


Figure 4-11. Emergency Exit Window Installation
PA-23-250 (six place)

4-48. BAGGAGE DOORS.

4-49. REMOVAL OF AFT BAGGAGE DOOR.

a. On airplanes with Serial Numbers 27-2000 and up, disconnect the baggage door holding rod from the door by removing the cotter pin and washer.

b. Remove the hinge pin that holds the door to the fuselage.

c. Remove the door.

4-50. INSTALLATION OF AFT BAGGAGE DOOR.

a. The installation of an old baggage door may be as follows:

1. Place the door in position and align the hinge halves.

2. Install the hinge pin. It is recommended that a new hinge pin be installed.

3. On airplanes with Serial Numbers 27-2000 and up, connect the baggage door holding rod with a washer and cotter pin.

b. The installation of a new baggage door may be as follows:

1. Remove the hinge half attached to the fuselage by removing the rivets securing it between the outside skin and the door frame.

2. Install a new fuselage hinge half to the baggage door hinge half using a new pin.

3. Place the door in position, inserting the fuselage hinge half between the outside skin and the door frame.

NOTE

The edges of the door may have to be trimmed to allow the door skin to fit flush with the fuselage skin.

4. Using the old rivet holes in the fuselage for a pattern, drill new holes through the top and bottom of the hinge.

5. Temporarily secure the fuselage hinge half in place and check the door for proper fit and operation.

6. Drill the remaining holes in the hinge and secure with rivets.

7. Install the trim panels to the inside of the door and weather molding.

8. Install the latch assembly and cover. (Refer to Paragraph 4-52.)

9. On PA-23-250 (six place) airplanes, install the holding arm and bracket.

4-51. REMOVAL OF AFT BAGGAGE DOOR LATCH ASSEMBLY.

a. On PA-23-250 and PA-23-235 airplanes, the door latch may be removed as follows:

1. Remove the trim panel on the inside of the door by either removing the trim screws or unsnapping it.
2. Remove the two roll pins in the center of the tube assembly.
3. Remove one of the two locking pins located in the end of the tube assembly.
4. Remove the tube assembly by pulling it from the opposite end where the locking pin was removed.
5. Remove the spring and spring retaining pin from the handle assembly.
6. Remove the lock and handle assembly.

b. On PA-23-250 (six place) airplanes, the door latch may be removed as follows:

1. Remove the plastic access cover around the latch assembly.
2. Remove the lock assembly by removing the large nut inside the latch.
3. Remove the latch mechanism by removing the attaching nuts and bolts.

4-52. INSTALLATION OF AFT BAGGAGE DOOR LATCH.

a. On PA-23-250 and PA-23-235 airplanes, the door latch may be installed as follows:

1. Insert the lock and handle assembly into the baggage door.
2. Holding the lock and handle assembly in place, install the spring and spring retaining pin to the door and the lock handle.
3. Install the tube assembly to the handle by sliding it through the bushings on either side of the door.
4. Install the locking pins on either end of the tube assembly.
5. Secure the tube assembly to the handle by means of two roll pins.
6. Install the trim panel to the inside of the baggage door by snapping it in place or using trim screws.

b. PA-23-250 (six place) airplanes, the door latch may be installed as follows:

1. Install the latch mechanism to the door and secure with attaching nuts and bolts.
2. Install the lock assembly and secure with large nut inside the latch.
3. Install the plastic trim cover with attaching screws.

4-52A. FORWARD (i.e., NOSE), BAGGAGE DOOR PRINCIPLE OF OPERATION.
(PA-23-250 S/N's 27-2000 thru 27-81554030 and PA-E23-250 S/N's 27-2505 thru 27-7554168 only.)
(Item and View #'s keyed to Figure 11a.)

As delivered from the factory (and when in compliance with Piper Service Bulletin No. 604A, as applicable), the door latching mechanism and lock assembly provides a safe, reliable means of retaining the nose baggage door closed during flight. The following is intended to provide mechanics and operators a detailed understanding of how the latching and locking components work together to secure the Nose Baggage Door during flight.

Piper Service Bulletin No. 604A states in part:

.... it is possible to close the door and turn the lock to the locked position without the lock tang (also known as locking cam) actually engaging the door handle. As a result, the door would not be properly secured and could possibly come open in flight ....

Prior to implementation of SB604A, the described condition could conceivably occur if the key lock became sufficiently worn so as to allow the locking cam to fit behind the handle in the locked position, with the handle flush to the outer surface of the fuselage. This would appear visually as a locked and secure configuration, when in fact the locking cam is not engaged in the Door Handle slot.

NOTE: The cockpit annunciator light associated with the nose baggage door is controlled by a frame mounted switch that makes contact with the door when the door closes. There is no interaction between the annunciator light circuit and the door mechanisms for latching and locking. Thus, an annunciator light that is turned off confirms only that the door is in the closed position, and does not confirm that the door is latched or locked.

SB604A addressed this concern by installation of the 28467-003 Baggage Door Handle Bracket (hereafter identified as "28467-003 bracket"). Aircraft manufactured after publication of Service Bulletin No. 604A had this bracket (and associated parts) installed at the factory.

The 28467-003 bracket (Item 1) hinges at the forward end on a clevis pin shared with the door handle and door handle bracket P/N 30580-000 (Item 2) and features three right-angle prongs at the aft (key lock) end (Views AA and BB). In the locked position (i.e., prepared for flight), the middle prong exerts contact pressure against the door handle (due to compression force from the coil spring which is mounted on the back of the 28467-003 bracket), holding the adjacent upper and lower prongs inboard, clear from contact with the locking cam.

a. Opening Sequence. (View A).

A key is inserted into the key lock and turned, rotating the locking cam out of the slot in the Door Handle. When the key is rotated beyond approximately 40 degrees from the locked position, the coil spring pushes the aft end of both the 28467-003 bracket and the door handle outboard (open), approximately one quarter (1/4) inch. With the 28467-003 bracket in this outboard position, the upper prong now blocks the return path of the locking cam, preventing the locking cam from rotating back into the locked position unless the handle is pushed back into the fully latched position (i.e., preventing the condition described in the discussion of SB604A, above).

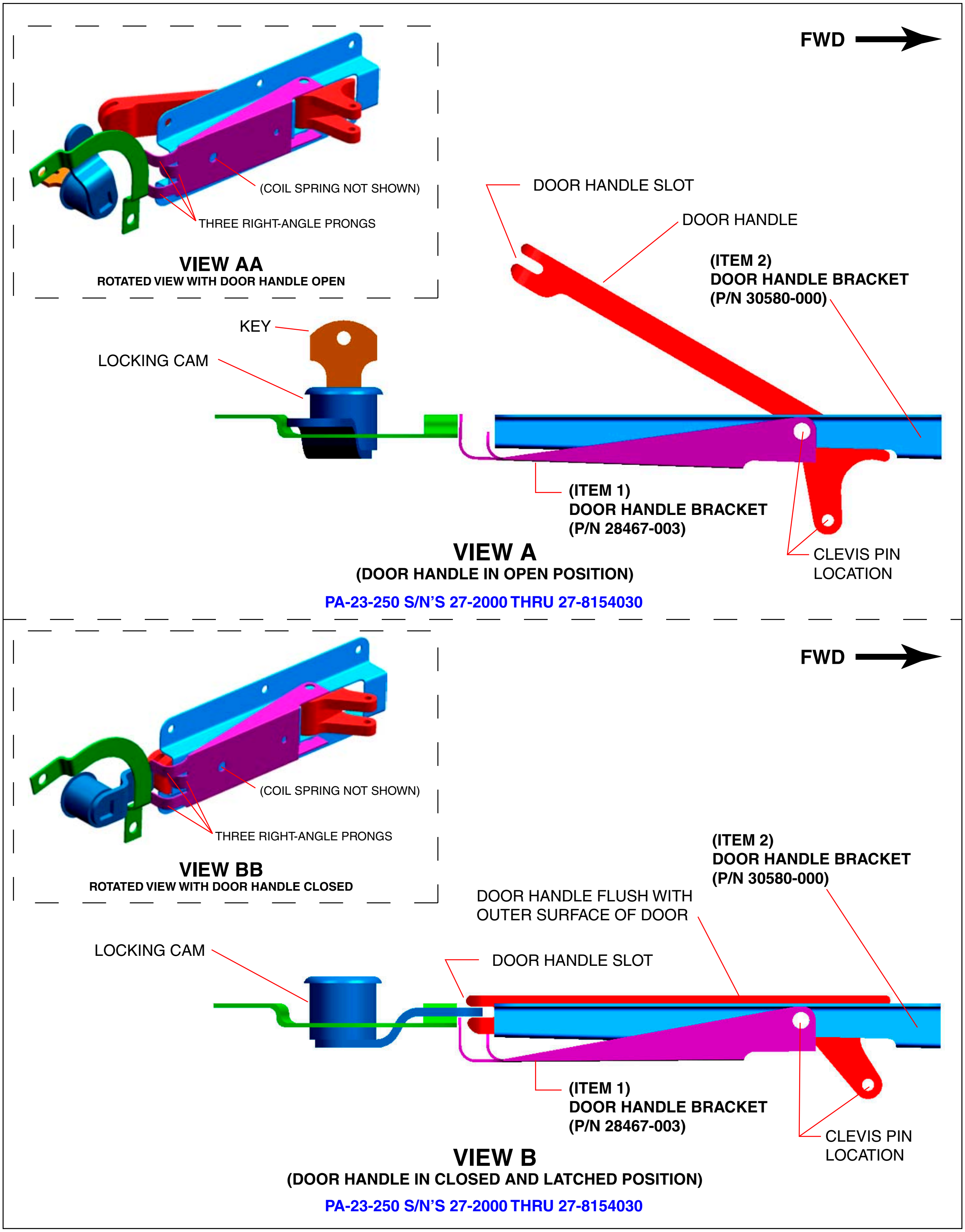


Figure 4-11a. Forward Baggage Door Latch Handle and Bracket Assembly

b. Closing Sequence. (View B).

The aft end (nearest the key lock) of the Door Handle is pressed flush with the outside surface of the baggage door. This action causes contact pressure between the door handle and the middle prong of the 28467-003 bracket. Both parts rotate together on a common hinge line, compressing the spring, and moving the upper prong inboard, out of the path of the locking cam.

With the door handle held flush the key may then be turned to the locked position engaging the locking cam into the slot of the door handle. With the locking cam in the locked position, removal of the key prevents rotation of the locking cam which in turn prevents the door handle from opening.

Several common aging-fleet related conditions exist that can impair the integrity of the door latching mechanism and lock assembly. These are: worn/non-conforming key locks, worn/corroded clevis pins, bent/deformed/non-conforming baggage door brackets, and damaged/corroded door locking springs. The 100 Hour and 1000 Hour Inspections in paragraph 4-56A address these concerns.

4-53. REMOVAL OF FORWARD BAGGAGE DOOR. PA-23-250 (six place).

a. With door open and hinges exposed, remove the cotter pins and washers from the hinge pins.

b. While supporting door, remove the hinge pins and lower the door for removal.

4-54. INSTALLATION OF FORWARD BAGGAGE DOOR. PA-23-250 (six place).

a. While supporting door, align the hinges in the hinge bracket assemblies and insert the hinge pins.

b. Replace the washers and insert the cotter pins into the ends of the hinge pins.

4-55. REMOVAL OF FORWARD BAGGAGE DOOR LATCH. PA-23-250 (six place).

a. Remove the plastic cover on the inside of the door by removing attaching screws.

b. Remove the attaching pin, and spring that attaches the door handle to the tube assembly.

c. Remove the door handle by removing attaching nuts and bolts.

d. Remove the lock assembly by removing the large nut on the inside of the door that holds it in place.

e. Remove the tube assembly by removing the springs and attaching pins on both ends.

f. Remove the arm assemblies from the door by removing attaching screws.

4-56. INSTALLATION OF FORWARD BAGGAGE DOOR LATCH. PA-23-250 (six place).

a. Install the arm assemblies to the door with attaching screws.

b. Install the door handle with attaching bolts and nuts.

c. Holding the tube assembly in place, adjust both ends to obtain a 90 degree angle between the locking arms and the edge of the door.

d. Install the tube assembly to the locking arms with attaching pins.

e. Install the springs between the locking arm and the tube assembly.

f. Install the plastic cover on the inside of the door.

4-56A. FORWARD BAGGAGE DOOR INSPECTIONS.
(PA-23-250 S/N's 27-2000 thru 27-81554030 only.)

a. Forward Baggage Door 100 Hour Inspection

(1) At each 100 hours time in service, remove the inner door cover and inspect door, latch, and lock components for operation and security. Verify that the key can only be removed from the key lock when the key is in the locked position. Lubricate components per Section II, Lubrication Charts, and reinstall cover.

(2) Verify that the aircraft's flight manual (AFM or POH, as appropriate) includes one of the following:

(a) A copy of the Nose Baggage Door Operational Procedure (Figure 4-11e.); or,

(b) A revision has been made to the Flight Manual, which incorporates the content of Figure 4-11e.

(3) Inspect the Baggage Door Handle Placard installed directly above the door handle to verify security and legibility. Replace on condition.

(4) Make a logbook entry indicating compliance with this Forward Baggage Door 100 Hour Inspection.

b. Forward Baggage Door 1000 Hour Inspection.

Each 1000 hours time-in-service replace the parts listed in Table IV-IA and inspect as follows:

(1) Unlock Forward Baggage Door, and lift door to the open position.

(a) Verify condition and function of door electrical switches, as applicable.

(b) With electrical power applied to airplane;

1 verify that the cockpit annunciator light associated with the door position functions properly, as explained in the appropriate flight manual.

2 verify Baggage Compartment Interior Light functions properly.

(2) Remove door from airplane. Remove and discard existing clevis pins from the upper forward and aft door hinges. (See Paragraph 4-53 Removal of Forward Baggage Door).

(3) Remove inner door cover; retain screws and cover for reinstallation. Examine door cover and door mechanical components for any damage, corrosion and wear; repair or replace on condition.

(4) In S/N's 27-2000 thru 27-7954051 only, verify compliance with Piper Service Bulletin No. 604A.

(5) Verify door handle bracket, Figure 4-11a., Item 1, is installed over door handle bracket, Figure 4-11a., Item 2.

(a) The correct bracket is P/N 28467-003, and is made of steel. For confirmation, place a magnet against the 28467 series part that is installed. A magnet will stick to the correct P/N 28467-003, but will not stick to the incorrect P/N 28467-002 which is made of aluminum.

(b) If there is a bracket in place, but the part number is 28467-002, or a magnet will not stick to it, remove and discard the bracket and replace with P/N 28467-003 as listed in Table IV-IA.

CAUTION: A .005 INCH MINIMUM GAP MUST EXIST BETWEEN BRACKET P/N 28467-003 AND THE DOOR LOCK GUIDE, P/N 30852-000, AND THIS GAP MUST BE MAINTAINED DURING THE ENTIRE LATCHING SEQUENCE. SEE FIGURE 4-11B.

(6) Verify that a .005 inch minimum gap exists between the bracket P/N 28467-003 and door lock guide P/N 30852-000 as shown in Figure 4-11b. Verify that this clearance is maintained throughout the entire door latching and locking sequence.

(a) If required clearance is maintained, proceed to step (7).

(b) If these two parts cannot mantain a clearance of .005 inches or more during the entire latching and locking sequence, or if contact between these two parts occurs, relocate the factory installed P/N 30852-000 Plate Assembly - Baggage Door Lock Guide as follows.

(a) Remove upper screw, and loosen lower screw. Rotate the 30852-000 Plate Assembly - Baggage Door Lock Guide as needed to achieve clearance as shown in Figure 4-11b.

(b) With the specified clearance established, verify proper operation of latching and locking mechanism. Mark the door skin with the new location of the upper threaded insert in the door lock guide.

NOTE: Spacing of the new hole from the original must be at least .50 inches.

(c) Drill a .141 to .147 inch diameter hole in the door skin at the location you marked.

(d) Plug the original hole with driven rivet MS20470AD or equivalent with manufactured head placed on the outboard side of the door.

(e) Tighten both screws to secure the guide.

NOTE: If required to achieve the specified operating clearance, up to .05 inches of material may be removed from the P/N 30852-000 Plate Assembly - Baggage Door Lock Guide. The reworked edge must be smooth, free of scratches or burrs, blended into adjacent surfaces, and painted with suitable primer.

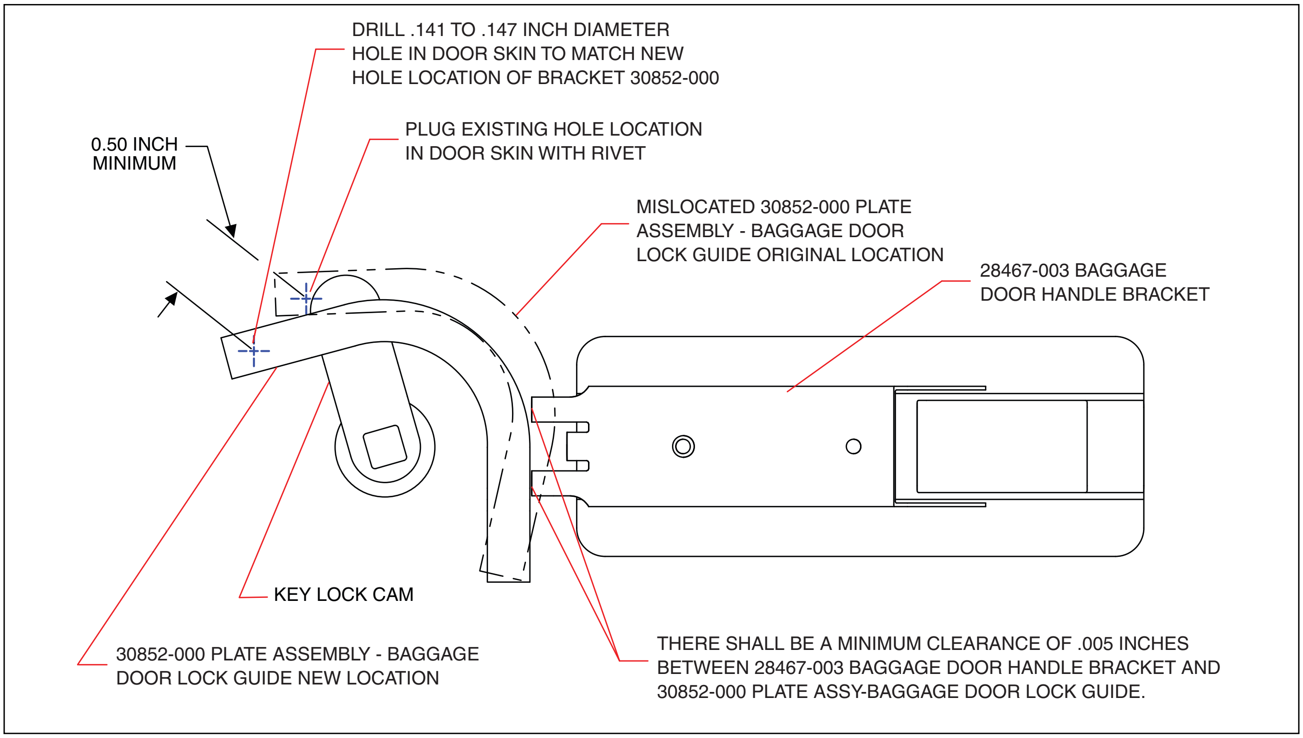


Figure 4-11b. Forward Baggage Door Latch Assembly

(7) Remove and discard springs common to door latch tube assembly, as applicable. Refer to Table IV-IA for applicability and location.

NOTE: The numbers in parentheses in following paragraphs are keyed to Figure 4-11c.

(8) Remove and discard existing clevis pins (1) that join the Baggage Door Latch Tube Assembly to the forward and aft Baggage Door Latch Assembly.

(9) Remove and discard existing clevis pin (2) common to the Door Latch Tube Assembly and Baggagge Door Handle.

NOTE: Some airplanes may have a roll pin installed at this location. If a roll pin is present, carefully drive out roll pin and replace it with hardware specified in Table IV-IA.

(10) Remove and discard the two existing pins (3) common to Door Handle and Door Handle Bracket.

(11) Inspect P/N 28467-003 bracket (4) for damage and condition. Replace as required. Verify the bracket conforms to critical dimensions shown in Figure 4-11d.

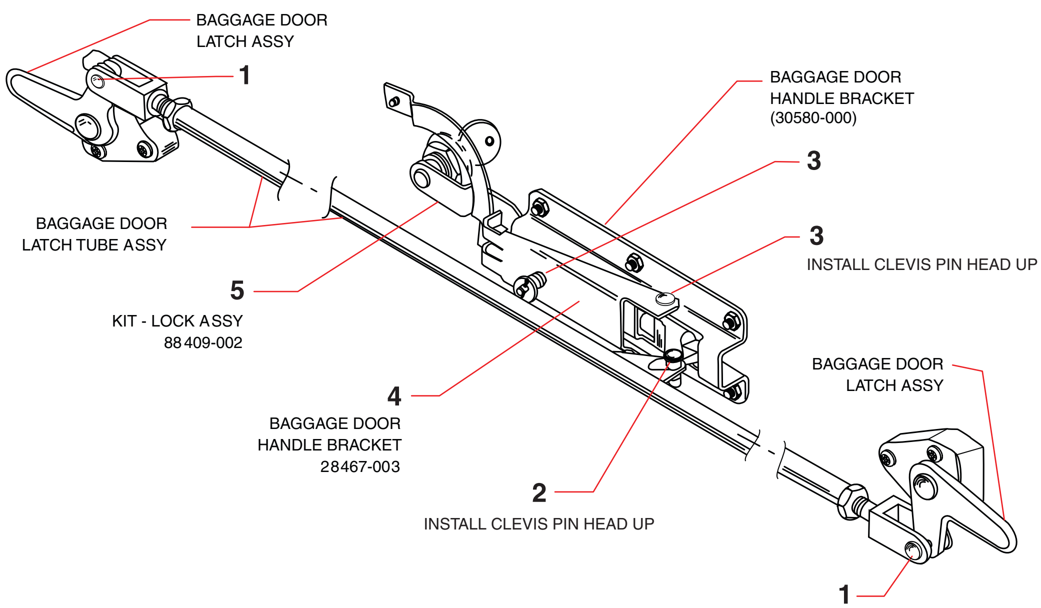
(12) Remove and discard existing door lock (5). Install Kit – Lock Assembly per Table IV-IA.

NOTE: Piper Kit P/N 88409-002 provides complete parts and instructions to assemble a direct replacement key lock for the Forward Baggage Door. Make sure the key is inserted into the lock at all times when the lock is being reworked per the kit instructions, because the existence of the key in the lock captures and retains numerous small internal parts when the outer lock cylinder is removed. Disassembly of the lock without the key inserted would allow these small parts to fall free from the lock and become lost.

(13) Reassemble all components except door cover. Reinstall door on airplane using new components specified in Table IV-IA. Verify proper adjustment of the forward and aft door latch asembly (see paragraph 4-56, Installation of Forward Baggage Door Latch). Lubricate moving parts per Section II, Lubrication Charts.

CAUTION: AVOID CONTACT OF ANY PTFE DRY LUBRICANT WITH PLASTIC PARTS WHILE THE LUBRICANT IS STILL IN ITS LIQUID FORM.

Lubricate key lock with PTFE dry lubricant, such as MS-122AD. (Refer to Table II-II, Consumable Materials).



INSIDE VIEW OF TYPICAL FORWARD BAGGAGE DOOR LATCH

NOTE: For all clevis pins that call out an AN960 washer, place washer under cotter pin.

Figure 4-11c. Forward Baggage Door Latch Assembly

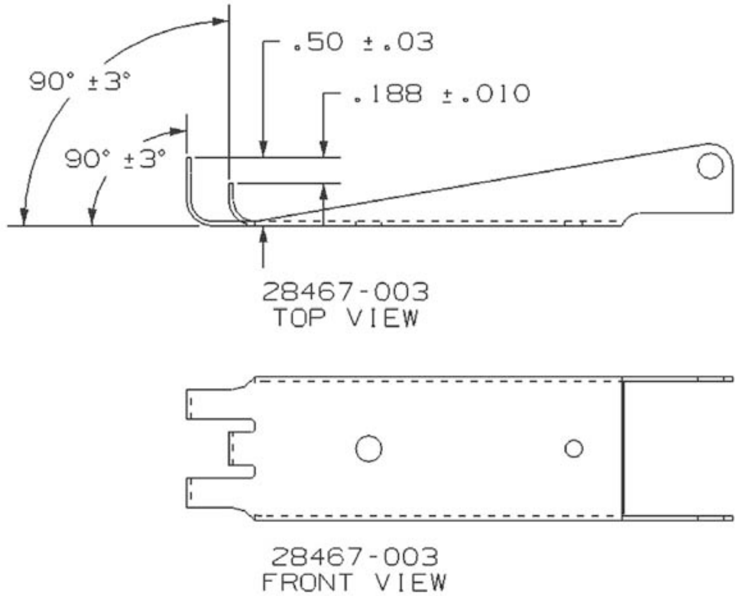


Figure 4-11d. Forward Baggage Door Latch Bracket

(14) Reinstall door cover.

(15) For initial (first-time) compliance with this inspection, follow instruction (a). For subsequent inspections, follow instruction (b).

(a) For initial compliance of this inspection install the Baggage Door Handle Placard Kit on the baggage door. The kit (see Table IV-IA.) includes parts and instructions for installation.

(b) For subsequent compliance of this inspection, inspect door handle placard for security and legibility. Replace on condition.

(16) Place a copy of the Nose Baggage Door Operational Procedure, Figure 4-11e., in the airplane's appropriate flight manual (AFM or POH), where it shall remain until a flight manual revision incorporates it.

(17) Make a logbook entry indicating compliance with this Forward Baggage Door 1000 Hour Inspection.

TABLE IV-I. FORWARD BAGGAGE DOOR REPLACEMENT PARTS

1000 Hr Inspection Step	Qty	P/N	Nomenclature	Installed Location
2	2 (required)	424-182	PIN - (MS20392-2C27)	pins NOSE BAGGAGE DOOR to airframe through the goosneck hinges.
	2 (required)	407-564	WASHER - (AN960-10)	
	2 (required)	424-051	COTTER PIN - (MS24665-132)	
5, 11	1 (on condition)	28467-003	BAGGAGE DOOR HANDLE BRACKET	See Figure 4-11d.
7	2 (required)	487-383	SPRING (83302-047)	attaches to forward & aft ends of BAGGAGE DOOR LATCH TUBE ASSEMBLY
8	2 (required)	424-177	PIN - Clevis, Tube Assembly (MS20392-2C17)	pins the BAGGAGE DOOR LATCH TUBE ASSEMBLY to the forward and aft BAGGAGE DOOR LATCH ASSEMBLY
	2 (required)	407-584	WASHER - (AN960-10L)	
	2 (required)	424-051	COTTER PIN - (MS24665-132)	
9	1 (required)	424-148	PIN - (MS20392-1C23)	pins the FORWARD BAGGAGE DOOR HANDLE to the BAGGAGE DOOR LATCH ASSEMBLY
	1 (required)	407-581	WASHER - (AN960-4L)	
	1 (required)	424-052	COTTER PIN - (MS24665-134)	
10	1 (required)	424-186	PIN - Door handle hinge (MS20392-2C35)	pins the FORWARD BAGGAGE DOOR HANDLE to the BAGGAGE DOOR HANDLE BRACKET
	2 (on condition)	19513-053	WASHER - DOOR HANDLE SPACER	
	1 (required)	407-584	WASHER - (AN960-10L)	
	1 (required)	424-051	COTTER PIN - (MS24665-132)	
	1 (required)	487-458	SPRING (83302-067)	
	1 (required)	424-145	PIN - (MS20392-1C17)	
	1 (required)	407-562	WASHER - (AN960-6)	
	1 (required)	424-051	COTTER PIN - (MS24665-132)	
12	1 (required)	88409-002	KIT – LOCK ASSEMBLY	replaces existing FORWARD BAGGAGE DOOR LOCK
15	1 (required)	88451-002	KIT - PLACARD NOSE BAGGAGE DOOR	required for initial compliance with this Service Bulletin only. For subsequent compliance intervals, inspect and replace on condition.

Nose Baggage Door Operational Procedure

A copy of this page shall remain in the aircraft's appropriate flight manual (AFM or POH), until this content can be included at the next revision to the flight manual.

100700-079 AR

CLOSE AND LOCK NOSE BAGGAGE DOOR BEFORE FLIGHT

1. CLOSE DOOR FULLY AGAINST DOOR FRAME

2. PRESS DOOR HANDLE FLUSH WITH SKIN, AND ROTATE KEY INTO LOCKED POSITION

3. REMOVE KEY

4. PUSH ON FORWARD END OF DOOR HANDLE, TO CONFIRM THAT HANDLE IS LOCKED AND SECURE

Figure 4-11e. Forward Baggage Door Operational Procedure

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4-57. CABIN ENTRANCE DOOR.

4-58. REMOVAL OF CABIN ENTRANCE DOOR.
a. Remove right inside windshield molding by removing attaching screws.
b. Loosen right front interior side panel to gain access to hinge pins.
c. Remove cotter pin from two hinge pins and remove hinge pins.
d. Remove door from fuselage.

4-59. INSTALLATION OF CABIN ENTRANCE.
a. Install the old door as follows:
   1. Position the door to the airplane hinge brackets.
   2. Insert the hinge pins and safety with cotter pins.
b. Install a new door as follows:
   1. Position the door to the airplane aligning the latch, locking pins, and hinges. Shims (.032, P/N 19642-02 and .064, P/N 19642-03) may be added between the door frame and hinge to provide proper alignment of the door to the airplane.
   2. Trim the edges of the door to provide a proper fit to the fuselage.
   3. If the new door being installed is not complete, install the old latch assembly to the new door frame per instructions in paragraph 4-63.
   4. Secure the door skin to the door hinges using four MS20470AD3 rivets.
   5. Position the door to the airplane and install the hinge pins. Recheck the door for proper fit and operation.
c. Install the right front interior side panel with attaching screws.
d. Install the right windshield molding with attaching screws.

4-60. ADJUSTMENT OF CABIN ENTRANCE DOOR. The only adjustment provided for the cabin entrance door is an adjustable latch plate located on the aft side of the door frame. The screws may be loosened and the latch plate moved to provide the desired fit of the door when closed.

NOTE

Improper installation of the cabin door, or use of a damaged door which does not fit properly may cause minor airflow disturbances in the stabilator control system.

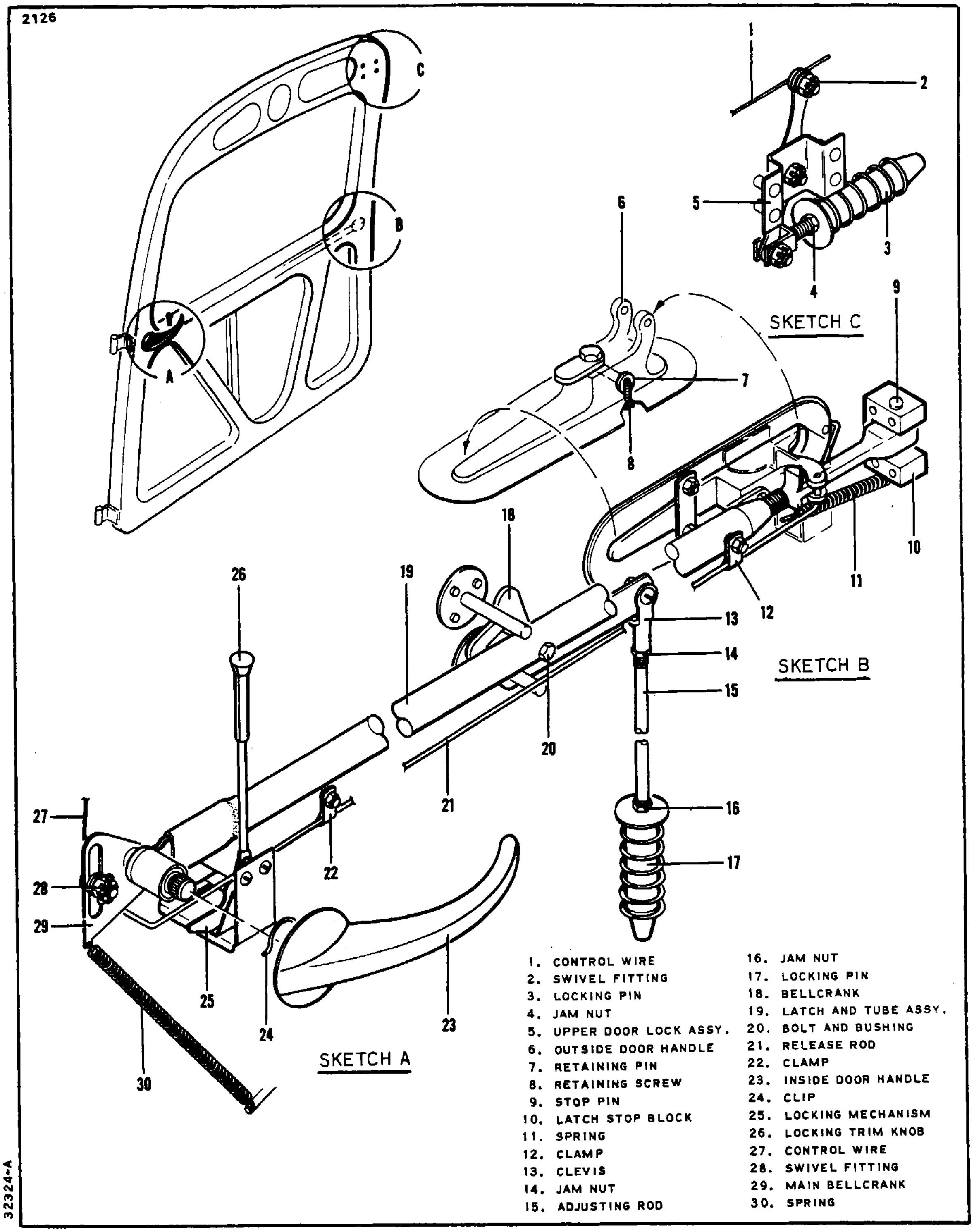


Figure 4-12. Cabin Entrance Door Latch Assembly

4-61. CABIN DOOR LATCH AND LOCK ASSEMBLY.

4-62. REMOVAL OF CABIN DOOR LATCH AND LOCK ASSEMBLY. (Refer to Figure 4-11.)

a. Remove cabin door. (Refer to paragraph 4-58.)

NOTE

It is recommended that the door be placed on a work-table covered with a clean soft material so as not to damage the door or door window.

b. Remove the locking trim knob (26).

c. Remove the window trim molding by removing attaching screws.

d. On airplanes with Serial Numbers 27-2505 and up, remove the armrest by removing attaching screws.

e. Remove the inside door handle (23) by pushing in on the trim panel around the handle and removing the clip (24) that locks the handle to the spline.

f. Remove the trim panels by unsnapping them from the door frame.

g. Remove the upper door lock assembly by the following procedure:

1. Reach up under the door frame along the forward edge and disconnect the control wire (1) from the main bellcrank by loosening the swivel fitting (2) that holds it in place.

2. Remove the attaching bolts from the door frame that secure the flexible control housing inside the door frame.

3. Remove the attaching screws or bolts that hold the upper door lock bell-crank bracket in place.

4. Remove the upper door lock assembly (5) by moving the entire unit forward withdrawing it from the aft opening in the door frame.

h. Remove the lower door lock assembly by removing the bolt from the clevis (13) end of the rod that attaches to the bellcrank (18).

i. Remove the locking mechanism (25) by removing the attaching bolts from the locking mechanism assembly and remove the assembly.

j. Remove the latch assembly as follows:

1. Remove the spring (11) attached to the door lock release rod (21) and the stop pin (9) inserted in the end of the latch.

2. Remove the stop pin (9).

3. Remove the attaching bolts from the clamps (12 and 22) that hold the door lock release rod in place.

4. Remove the door lock release rod by pulling the aft end of the rod down, removing it from the outside door handle, and withdrawing it from the door frame.

NOTE

The door lock release rod will have to be sprung slightly to remove it from the door frame.

5. Remove the aft bottom retaining screw (8) from around the outside door handle.
6. Remove the outside door handle by removing the pin (7) that holds it in place.
7. Disconnect the tube assembly (19) from the main bellcrank (18) by removing nut, washers and bolt.
8. Remove the bolt and bushing (20) from the tube assembly that actuates the bellcrank (16) for the lower lock assembly.
9. Remove the door latch stop block (10) from the door assembly by removing nuts, washers and bolts.
10. Remove the door latch and tube assembly (19).

4-63. INSTALLATION OF CABIN DOOR LATCH AND LOCK ASSEMBLY. (Refer to Figure 4-11.)

NOTE

Any new door to be installed should be compared with the old door for similarity of hole location.

a. Install the latch assembly as follows:
1. Install the tube and latch assembly (19) through the opening in the edge of the door.
2. Install the door latch stop block (10) to the door assembly with attaching bolts, washers and nuts.
3. Install the stop pin (9) through the top of the latch.
4. Temporarily install the bolt that attaches the tube to the main bellcrank.
5. Temporarily install the inside door handle (23) to the spline.
6. If the tube and latch assembly is adjusted properly, a distinct snap through action results when the main bellcrank passes center travel.
(a) If the snap through action is loose, remove the tube assembly from the bellcrank and lengthen the tube and latch assembly by rotating the tube counterclockwise.
(b) If the snap through action is tight, remove the tube assembly from the bellcrank and shorten the tube and latch assembly by rotating the tube clockwise.

NOTE

To check for proper snap through action, five to six pounds tension should be required to unlock the door. Measure the tension with a spring scale 0.5 inch from the end of the inside door handle.

7. Install the bolt, bushing (20), and nut to the tube assembly that actuates the lower lock assembly bellcrank (18).

8. Install the outside door handle (6) to the door and secure in place with a pin (7) inserted up through the door handle bracket.

9. Install a long screw (8) along the bottom of the outside door handle.

10. Insert the door lock release rod (21) inside the door frame by inserting the spring tab end first through the aft end of the door.

NOTE

The door lock release rod will have to be sprung slightly to install it inside the door frame.

11. Insert the aft end of the rod up through the hole in the outside door handle.

12. Install the clamps (12 and 22) around the door lock release rod and secure in place with attaching bolts, washers and nuts.

13. Install the spring (11) that attaches to the door lock release rod and the stop pin in the end of the latch.

b. Install the locking mechanism (25) assembly in place inside the forward end of the door frame and secure with attaching bolts, washers and nuts.

c. Install the lower lock assembly with bolt, washers and nut through the clevis (13) end of the rod attaching it to the bellcrank (18).

d. Install the upper door lock assembly as follows:

1. Install the upper door lock assembly as a complete unit. Insert the flexible control inside the door frame at the top aft opening sliding it around the edge toward the main bellcrank. Insert the rest of the assembly through the opening and move forward into place.

2. Secure the upper door lock assembly with attaching screws, bolts, washers and nuts.

3. Attach the clamps to the flexible control and secure them around the edge of the door frame with bolts, washers and nuts.

4. Connect the control wire (27) to the main bellcrank (29) using a swivel fitting (28).

e. Install the door to the airplane. (Refer to paragraph 4-59.)

f. Adjust the top and bottom locking pins (3 and 17) to allow adequate clearance between the fuselage door frame and the pins using appropriate tools.

g. Operate the door several times to insure proper fit, positive locking and free movement of all parts.

h. Remove the inside door handle and install the trim panels by snapping them in place.

i. Install the inside door handle. Secure the handle by pushing in on the trim panel around it and installing the locking clip (24).

j. On airplanes with Serial Numbers 27-2505 and up, install the armrest with attaching bolts.

k. Install the window trim molding with attaching screws.

l. Install the locking trim knob (26).

4-64. STRUCTURAL REPAIRS.

WARNING: NO ACCESS HOLES ARE PERMITTED IN ANY CONTROL SURFACE.

WARNING: USE OF PATCH PLATES FOR REPAIRS OF ALL MOVABLE TAIL SURFACES IS PROHIBITED. USE OF ANY FILLER MATERIAL NORMALLY USED FOR REPAIR OF MINOR DENTS AND/OR MATERIALS USED FOR FILLING INSIDE OF SURFACES IS ALSO PROHIBITED ON ALL MOVABLE TAIL SURFACES.

CAUTION: CONTROL SURFACE SKINS MUST BE REPLACED IF THEY SUSTAIN DAMAGE OR EXHIBIT CRACKS.

Structural repair methods used must be in accordance with FAA Advisory Circular 43.13-1, latest revision. To assist in making repairs, Figure 4-18, identifies the material and dimensions of the tubing used in the construction of the fuselage frame. Figures 4-19 and 4-20 identify the type and thickness of various skin material used. Never make a skin replacement or patch plate from material other than type of original skin, or of a different thickness than original skin. Repair must be as strong as original skin. However, flexibility must be retained so surrounding areas will not receive extra stress.

Repairs to areas defined in FAR Part 43, Appendix A, must be shown (using approved data) to not diminish the Life of the component, if a life limit is stated herein (see Section I). Temporary repairs, when required, must add Instructions for Continued Airworthiness (ICA) to the maintenance record. Any such ICA must be based on approved data.

Stabilator skins and ribs aft of the main spar are manufactured using a structural adhesive, which prevents skin and rib replacement in these areas. If structural adhesive has been applied between the ribs and skins, contact the manufacturer for recommended alternatives to skin or rib replacement.

4-64A. Metal Wire Stitching Repair. (See Figure 4-12a.) (PIR-PPS20024, Rev. A.)

CAUTION: METAL/WIRE STITCHING (AND THE ALTERNATE METHOD OF JOINING DESCRIBED BELOW) SHALL ONLY BE USED FOR NON-STRUCTURAL, NON-LOAD CARRYING APPLICATIONS.

A metal/wire stitching process is used to staple fabric and rubber seal materials to engine baffles and some composite materials. The following alternate method of joining is approved for field use when replacing these fabric and rubber seal materials.

Alternate (Rivet) Method of Joining.

a. Substitute two rivets in lieu of each staple where stitching was previously used or is specified. Maintain a minimum of .75 inch spacing between rivets.

b. When materials being joined include Stainless Steel, Galvanized Steel or Steel, use:

   1. MS20615M4 Rivet (Monel) and NAS1149CN432R Washer (See Figure 4-12a.)
   2. Install with manufactured (factory) head against hardest material. Install washer against opposite side of joint and upset rivet (bucktail) against washer.

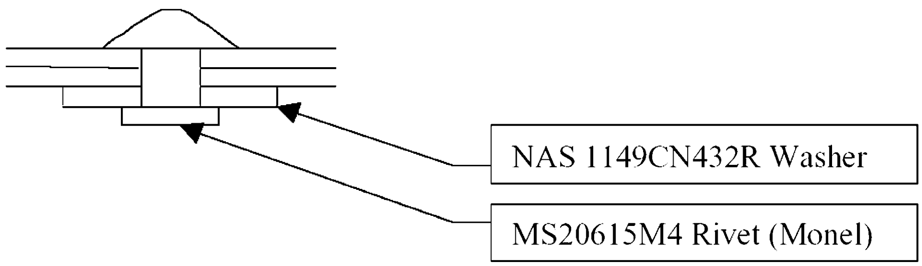
c. When materials being joined include only aluminum and nonmetallic materials use:

   1. MS20470A4 Rivet and NAS1149DN432H Washer (See Figure 4-12a.)
   2. Install with manufactured (factory) head against hardest material. Install washer against opposite side of joint and upset rivet (bucktail) against washer.

When materials being joined include Stainless Steel, Galvanized Steel or Steel, use:

MS20615M4 Rivet (Monel)
NAS1149CN432R Washer

Install with manufactured (factory) head against hardest material. Install washer against opposite side of joint and upset rivet (bucktail) against washer.



When materials being joined include only aluminum and nonmetallic materials use:

MS20470A4 Rivet
NAS1149DN432H Washer

Install with manufactured (factory) head against hardest material. Install washer against opposite side of joint and upset rivet (bucktail) against washer.

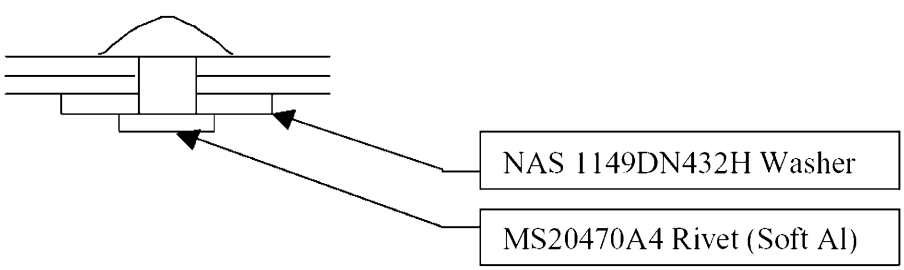


Figure 4-12a. Metal / Wire Stitching Repair

4-64B. ELECTRICAL BONDING

a. General (PIR-PPS55006, Rev. T.)

All electrical and electronic equipment and specified components shall be installed in such a manner as to provide a continuous low resistance path (bonds) from the equipment enclosure/component to the airplane structure. Bonds must be installed to ensure that the structure and equipment are electrically stable and free from the hazards of lightning, static discharge, electrical shock, etc.

1. All parts shall be bonded with as short a lead as possible.
2. All bonding surfaces shall be cleaned prior to the installation of the bonded joint.
3. All nuts used in bonding shall be of the self-locking type. (Do Not use fiber-locking type).
4. All electrical bonding shall be accomplished without affecting the structural integrity of the airframe.

b. 100 Hour Inspection (PIR-AC 43.13-1, Rev. B.)

Each 100 hours, visually inspect shield and shield terminations of each electrical harness for integrity, condition, and security. If electrical arcing is evident, check for intermittant contact between conducting surfaces. Arcing can be prevented by bonding or insulation, as appropriate. Inspect the components listed in Table IV-Ib as follows:

1. Bond connections shall be secure and free from corrosion.
2. Bonding jumpers installed so as not to interfere in any way with the operation of moveable components of the aircraft.
3. No self-tapping screws used for bonding purposes.
4. Exposed conducting frames or parts of electrical or electronic equipment should have a low resistance bond of less than 2.5 millohms to structure. If the equipment design includes a ground terminal or pin, which is internally connected to such exposed parts, a ground wire connection to such terminal will satisfy this requirement.
5. Parts shall be bonded directly to the primary structure rather than to other bonded parts.
6. Where aluminum or copper is bonded to dissimilar metallic structures, ensure installed hardware (typically washers) is as called out in the parts catalog to minimize electrolytic corrosion and ensure the hardware should corrode first.

c. On Condition Inspection

Whenever any electrically bonded component (see Table IV-Ib) is removed and reinstalled, or visual inspection reveals the electrical bonding to be suspect, measure resistance between component and aircraft structure. To ensure proper operation and suppression of radio interference from hazards, electrical bonding of equipment must not exceed the maximum allowable resistance values specified in Table IV-Ib.

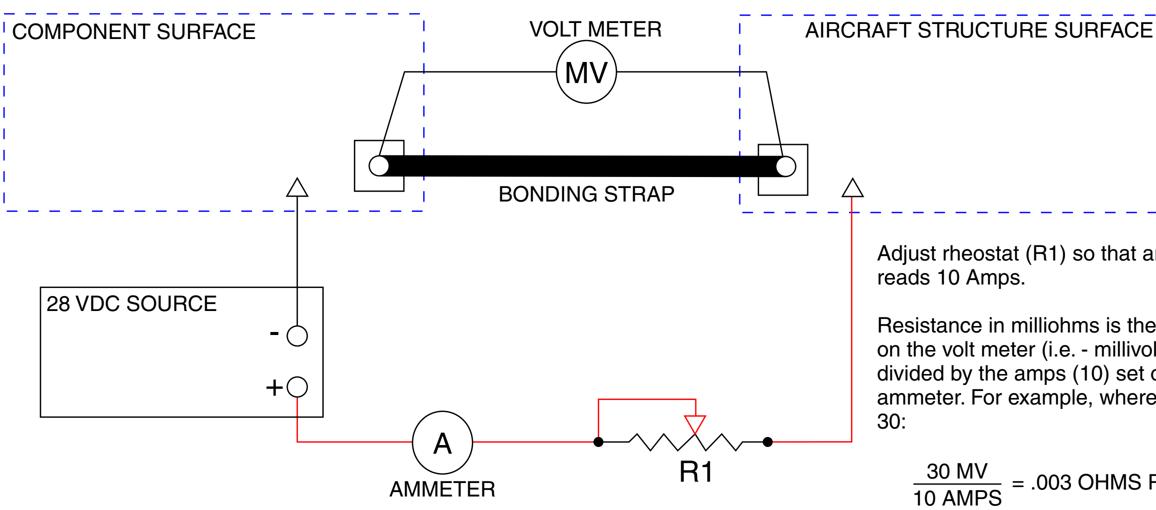
1. Measurements should be performed after the grounding and bonding mechanical connections are complete to determine if the measured resistance values meet the basic requirements.
2. A high quality test instrument (an AN/USM-21A or equivalent) will accurately measure the very low resistance values specified.
3. Another method of measurement is the millivolt drop test as shown in Figure 4-12b.

TABLE IV-IB. ELECTRICAL BONDING RESISTANCE INDEX

Component	Maximum Allowable Resistance Value in Ohms
Engine Mount(s)	.003
Generator(s)	.010
Ailerons	.003
Elevator / Stabilator	.003
Rudder	.003
Alternator(s)	.010
Trim Tab(s)	
Conventional Hinge	.003
Piano Hinge	.010
Instrument Panel Inserts	.010
Exterior Lights Mounted on Non-Conductive Material	.003
Avionics 'Black Boxes'	.003
NOTE: Harnesses should be installed and connected for this check, internal chassis wiring through the connector to ground is permissible for this grounding.	
Battery Ground Point	.010
Static wick mounting plates (TCO Model B-4) P/N 452-094	1.00

NOTE: Where jumper wires or cables are used to accomplish a proper bond, resistance between the jumper terminal and the component or structure shall not exceed .001 ohms. The controlling points for measuring resistance will be within the limits of the cleaned area to be bonded and within 1/4 inch of the exterior limits of the bonding jumper terminal or material called for in the bill of materials of the drawing.

Resistance to ground will be measured from wire terminal to structure for electrical / electronic equipment not internally grounded and from mounting flange to structure for equipment that is internally grounded.



Adjust rheostat (R1) so that ammeter (A) reads 10 Amps.

Resistance in milliohms is then the reading on the volt meter (i.e. - millivolts (MV)) divided by the amps (10) set on the ammeter. For example, where MV equals 30:

$$\frac{30\text{ MV}}{10\text{ AMPS}} = .003\text{ OHMS RESISTANCE}$$

Figure 4-12b. Millivolt Drop Test

4-65. CHECKING CONTROL SURFACE BALANCE. The movable control surfaces of the PA-23-250 have been balanced at time of installation at the factory and normally need not be rebalanced unless the surfaces have been repainted or repaired. Should it become necessary to check the balance of the control surfaces, the procedures given in paragraphs 4-66 and 4-67 may be used.

4-66. BALANCING STABILATORS. (Refer to Figure 4-14.)

Balancing must be done whenever the balance characteristics of the stabilator have for any reason been altered, such as, repairing, repainting or replacing stabilators, installing or removing deicers, or modifying balance weight. The stabilator installation must be complete before balancing, including trim tab and paint. The stabilator control cables and bungee cable must be disconnected from the stabilator balance arm. Hold the tab in its neutral position with a small piece of tape. Due to variations in stabilators used throughout the production life span of this airplane the following instructions have been grouped into Serial Number effectivities. Check the serial number of the airplane being serviced and use the balancing instructions for that airplane.

a. Serial Numbers 27-1 to 27-7305134 inclusive:

1. Disconnect the tab actuator arm from the stabilator tab horn during balancing. The stabilator must be free to rotate.

2. Hook the test weight P/N 16854 on the stabilator rear spar attachment fittings for balancing. (Remove after balancing is completed.)

3. Add trim weight P/N 16780-3 one at a time on the trim weight attachment bolt until the stabilator balances on the neutral position (level). Refer to Paragraph 5-18 for stabilator leveling procedures.

4. If the last weight added for balancing causes overbalance, this complete weight may be used. Secure these weights and recheck the balance. Desired overbalance (leading edge heavy) is 152 inch-pounds.

5. One trim weight P/N 16780 may be used to replace two trim weights P/N 16780-3.

6. When proper balance is obtained, safety the trim weight mounting bolts, connect the control cables and bungee cable to the balance arm and connect the tab actuator arm.

b. Serial Numbers 27-7305135 to 27-7554168 inclusive, and 27-8054001 and up:

1. Disconnect the tab actuator arm at the trim mechanism end during balancing. Cradle the actuator arm just aft of the disconnected end with tape between the left and right stabilator. The stabilator must be free to rotate.

2. Hook the test weight P/N 16854 on the stabilator rear spar attachment fittings for balancing. (Remove after balancing is completed.)

3. Add trim weights P/N 16780-3 one at a time on the trim weight attachment bolt until the stabilator balances in neutral position (level). Refer 8 Paragraph 5-18 for stabilator leveling procedures.

4. If the last weight added for balancing causes overbalance, this complete weight may be used. Secure the weights and recheck the balance. Desired overbalance (leading edge heavy) is 152-158 inch-pounds.

5. One trim weight P/N 16780 may be used to replace two trim weights P/N 16780-3.

6. When proper balance is obtained, safety the trim weight bolts, connect the control and bungee cables and tab actuator arm.

c. Serial Numbers 27-7654001 to 27-7954121 inclusive:

1. Disconnect the trim tab actuator arm at the trim mechanism end during balancing. Cradle the actuator arm just below the installation location between the left and right stabilators with tape. The stabilator must be free to rotate.

2. Add trim weight P/N 49979-17 one at a time on the trim weight attachment bolt as required to balance the stabilator in neutral position (level). Refer to Paragraph 5-18 for stabilator leveling procedures.

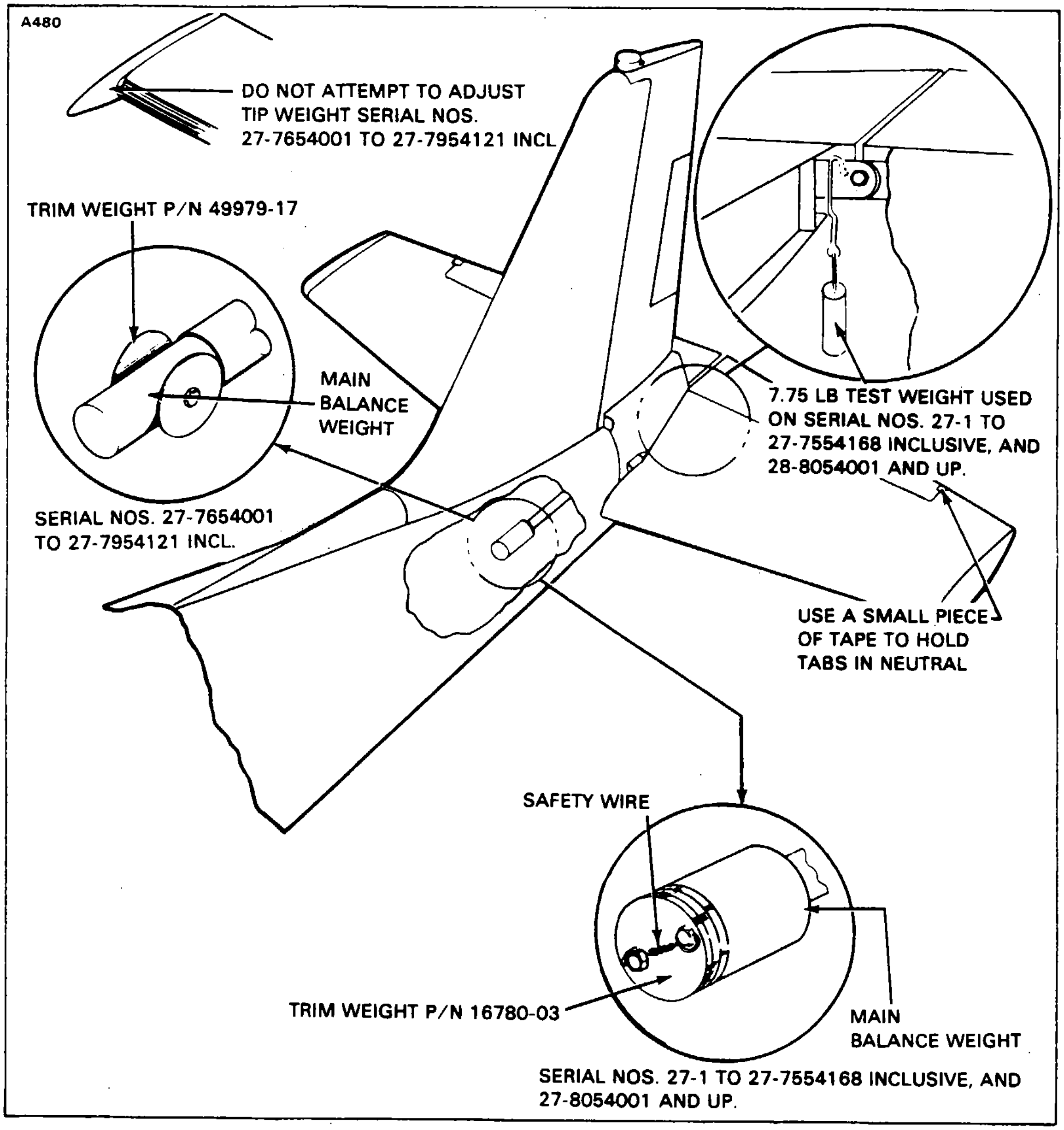


Figure 4-14. Checking Stabilator Balance

3. The maximum number of trim weights allowed is eight for stabilators without de-icer boots or ten for stabilators with de-icer boots. The trim weights must be divided equally on each side of the bolt.
4. The desired overbalance (leading edge heavy) is 2 ± 2 inch-pounds. Secure the weights and recheck balance.
5. Reconnect the control and bungee cables and trim actuator arm.

NOTE

DO NOT ATTEMPT TO ADJUST TIP WEIGHTS.

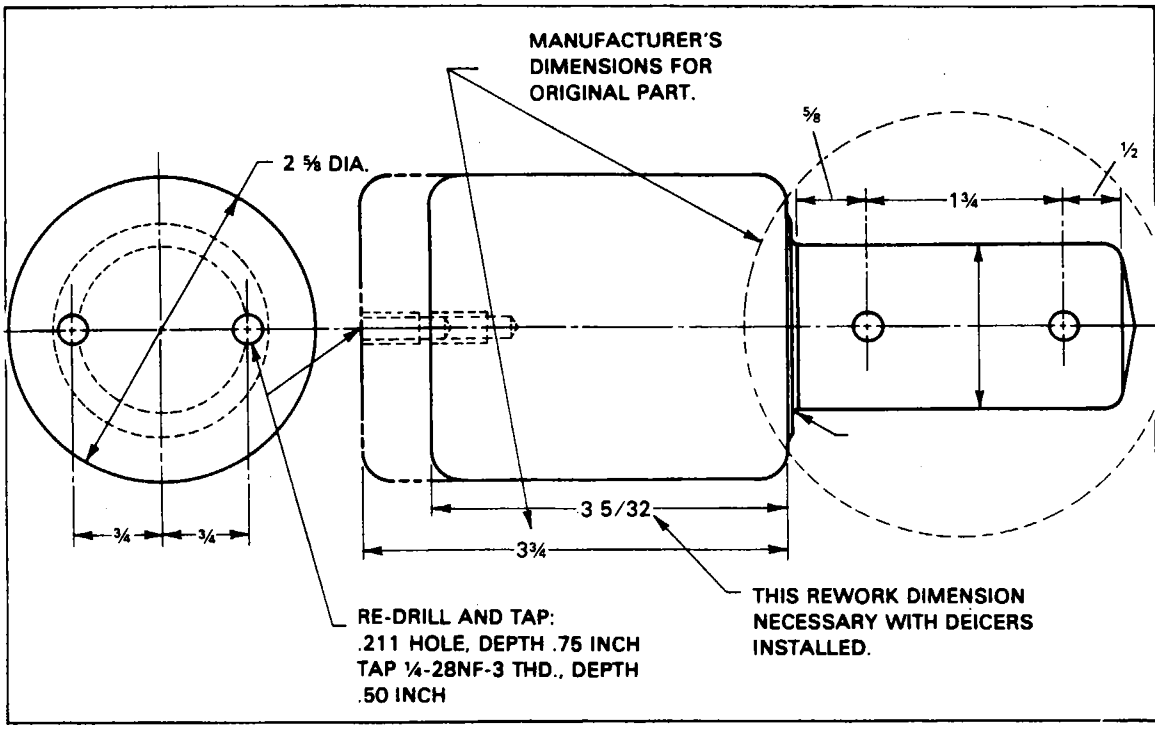


Figure 4-15. Stabilator Balance Weight - Rework

d. BALANCING STABILATORS WITH DEICER BOOTS INSTALLED. (PA-23-250 Serial Nos. 27-1 to 27-7554168 inclusive; 27-8054001 and up.) The following balancing sequence should be followed when installing deicer boots on stabilators of the above listed aircraft. Stabilator installation must be complete before balancing (including tabs and paint).

1. Disconnect stabilator control cables and bungee cable from stabilator balance arm.
2. Disconnect tab actuator arm from stabilator tab horn. Rest actuator arm in a thin wire loop below stabilator tab horn. Stabilator must be free to rotate.
3. Remove all trim weights.
4. Hook 7.75 lb. test weight on stabilator rear spar attachment fittings for balancing (Remove after balancing is completed). If stabilator overbalance with the trim weights removed, rework balance weight per paragraph 4-65 b.
5. Add trim weights one at a time on trim weight attachment bolts until stabilator balances. Refer to Paragraph 5-18 for stabilator leveling procedures.
6. If last weight added causes overbalance, this complete weight may be used. Secure these weights and recheck to assure balance.
7. Desired overbalance (leading edge heavy) is 152 inch-pounds with test weight assembly removed. Safety wire the trim weight attachment bolts and remove the test weight assembly.
8. Reconnect stabilator and tab controls.

e. REWORK - STABILATOR BALANCE WEIGHT

1. Remove balance weight from balance arm.
2. Rework balance weight as per figure 4-15.
3. Replace balance weight in balance arm.

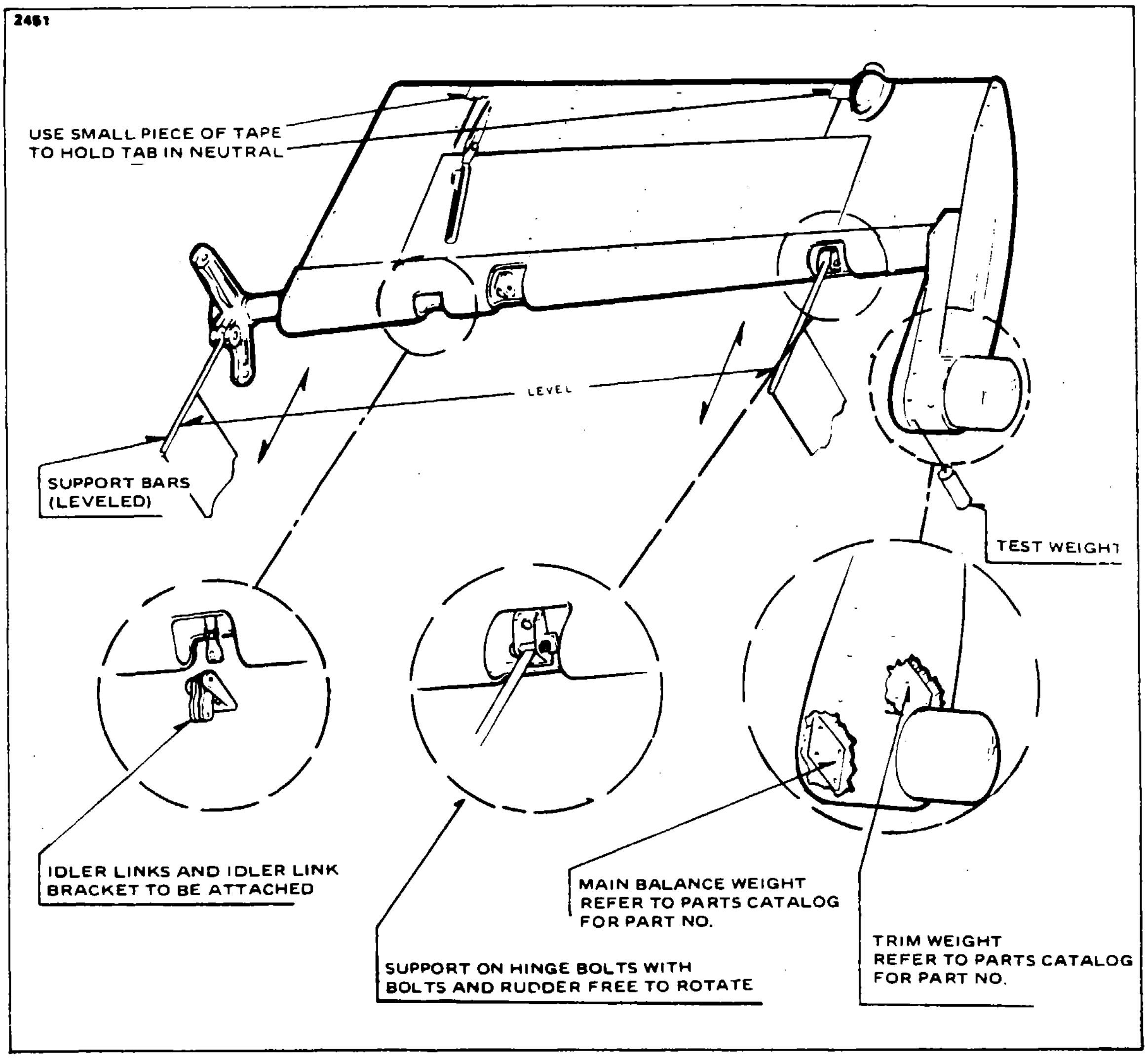


Figure 4-16. Checking Rudder Balance

4-67. BALANCING RUDDERS. (Refer to Figure 4-16.)

Rudder balancing must be accomplished with the assembly removed from the airplane and placed on a fabricated support as shown in figure 4-16, with the rudder hinge bolts in place. The support fixture must be secured to a solid workbench and the rudder allowed to rotate freely on the hinge bolts. Use small pieces of tape to hold the rudder trim tab in its neutral position.

To insure the correct balancing instructions check the data plate on the rudder assembly lower rib for the particular rudder assembly number and using the table supplied below proceed to the given method.

a. Method I.

1. The rudder must be complete before balancing, including rudder control horn, rotating beacon, navigation light, main balance weight, trim tab and tab push rod, idler link bracket and links, and painted. Rudder tip must be in position but need not be secured.

2. Level the rudder and establish a reference mark which aligns with the rudder trailing edge.

3. Loosen the beacon mounting screw and hang the test weight P/N 16857 on this screw, over the leading edge. (Remove the test weight after balancing is completed.)

4. Should the trailing edge of the rudder not align with the level reference line (test weight attached), add trim weights P/N 16845-2 one at a time directly above trim weight attachment anchor nuts until the rudder balances.

5. If the last weight added causes overbalance, this complete weight may be used. Attach these weights under the trim weight attachment screws and recheck balance. Desired underbalance (trailing edge heavy) is 45 ± 5 inch-pounds.

6. One trim weight P/N 16845-3 may be used to replace two P/N 16845-2 trim weights.

b. Method II.

1. The rudder must be complete before balancing, including rudder trim control horn, navigation light, main balance weight, trim tab, trim tab push rod, idler link bracket, idler links and paint. Rudder tip must be in position but need not be secured.

2. Level the rudder and establish a reference mark which aligns with the rudder trailing edge.

3. Loosen the tip attaching screw and hang the test weight P/N 16857 from this screw, over the leading edge. (Remove the test weight after balancing is completed.)

4. Should the trailing edge of the rudder not align with the level reference line (with test weight attached), add trim weights P/N 33451-2 one at a time directly above the trim weight attachment screws until the rudder balances (level with the reference mark).

5. If the last trim weight added for balancing causes an overbalance, the complete weight may be used. However the desired underbalance (trailing edge heavy) is 45 ± 5 inch-pounds.

6. One trim weight P/N 33451-3 may be used to replace two P/N 33451-2 trim weights.

Rudder Assy. No.	Method to Use	Test Weight P/N & WT.
16199-00 16199-14	Method I	16857 3 lbs. - 5 oz.
16199-18 16199-19 16199-20(1)	Method II	16857 3 lbs. - 5 oz.
16199-20(2) with strobe	Method III	16857-9 2 lbs. -10 oz.
16199-21 without strobe	Method IV	16857-9 2 lbs. - 10 oz.

(1) This information to be used when 16844-00 and 16844-02 balance weights are incorporated, affecting aircraft 27-7554001 to 27-7954121.
(2) This information to be used when 28592-02 balance weight is used affecting aircraft 27-8054001 and up.

c. Method III.

1. Rudder must be complete before balancing, including rudder control horn, strobe light, navigation light, main balance weight, trim tab and tab push rod, idler link bracket and links, and paint. Rudder tip must be in position but need not be secured.

2. Level the rudder and establish a reference mark which aligns with the rudder trailing edge.

3. Loosen the strobe light mounting screw and hang the test weight P/N 16857-9 on this screw, over the leading edge. (Remove test weight after balancing is completed.)

4. Should the trailing edge of the rudder not align with the level reference line (with test weight attached), add trim weights P/N 16845-2 one a a time directly above trim weight attachment anchor nuts until the rudder balances.

5. If the last weight added causes overbalance, the complete weight may be used. Attach these weights under the trim weight attachment screws and recheck balance. The desired underbalance (trailing edge heavy) is 35 ± 5 inch-pounds.

6. One trim weight P/N 16845-3 may be used to replace two P/N 16845-2 trim weights.

d. Method IV.

1. The rudder must be complete before balancing, including rudder with control horn, navigation light, main balance weight, trim tab, trim tab push rod, idler link bracket, idler links and paint. Rudder tip must be in position but need not be secured.

2. Level the rudder and establish a reference mark which aligns with the rudder trailing edge.

3. Loosen the tip attachment and screw and hang the test weight P/N 16857-9 from this screw, over the leading edge. (Remove the test weight after balancing is completed.)

4. Should the trailing edge of the rudder not align with the level reference line (with the test weight attached), add trim weights P/N 33451-2 one at a time on the main weight attachment screws until the rudder balances (level with reference mark). Replace main weight attachment nuts and recheck balance.

5. If the last trim weight added causes overbalance the complete weight may be used. However, the desired underbalance (trailing edge heavy) is 35 ± 5 inch-pounds.

6. One trim weight P/N 33451-3 may be used to replace two trim weights P/N 33451-2.

4-68. BALANCING AILERON. (Refer to Figure 4-17.)

The aileron must be complete including paint.

a. Disconnect the aileron from airplane and position on fabricated support stand, similar to stand shown in Figure 4-16 for rudder balancing.

b. Level the aileron and establish a reference mark which aligns with aileron chord line and trailing edge.

c. Place the hook end of a spring scale under the aileron trailing edge. Bring the aileron to a neutral position while pulling up on the spring scale. Note the reading on the spring scale.

d. Using the formula (Ref. figure 4-17) determine the aileron underbalance. Desired underbalance (trailing edge heavy) 4±3 inch-pounds.

e. If the aileron is too trailing edge heavy because of painting over old paint, it is necessary to strip all paint from the aileron and start over. Normally, on the ailerons, the tolerance noted in Step c will be available to permit repainting repairs, addition of static wicks, etc. However, to be certain check the balance.

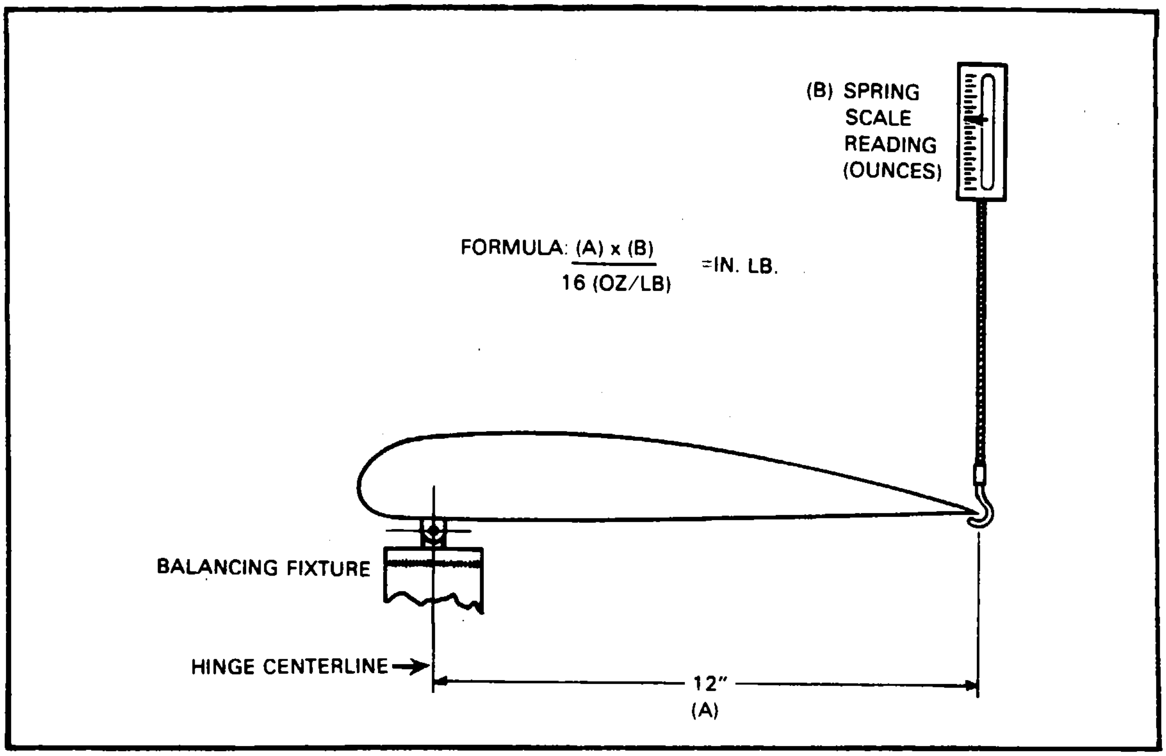


Figure 4-17. Checking Aileron Balance

4-69. FIBERGLASS REPAIRS. The repair procedure in this manual will describe the methods for the repair of fiberglass reinforced structures. Paragraph 4-68 describes Touch-up and Surface Repairs such as blisters, open seams, delaminations, cavities, small holes and minor damages that have not harmed the fiberglass cloth material. Paragraph 4-69 describes Fracture and Patch Repairs such as puncture, breaks and holes that have penetrated through the structure and damaged the fiberglass cloth. A repair kit, part number 756 729, that will furnish the necessary material for such repairs is available through Piper Aircraft dealers or distributors.

NOTE

Very carefully follow resin and catalyst mixing instructions furnished with repair kit.

4-70. FIBERGLASS TOUCH-UP AND SURFACE REPAIRS.

a. Remove wax, oil and dirt from around the damaged area with acetone, Methylethylketone or equivalent and remove paint to gel coat.

b. The damaged area may be scraped with a fine blade knife or a power drill with a burr attachment to roughen the bottom and sides of the damaged area. Feather the edge surrounding the scratch or cavity. Do not undercut the edge. (If the scratch or cavity is shallow and penetrates only the surface coat, continue to Step h.)

c. Pour a small amount of resin into a jar lid or on a piece of cardboard, just enough to fill the area being worked on. Mix an equal amount of milled fiberglass with the resin, using a putty knife or stick. Add catalyst, according to kit instructions, to the resin and mix thoroughly. A hypodermic needle may be used to inject gel into small cavities not requiring fiberglass millings mixed with the gel.

d. Work the mixture of resin, fibers and catalyst into the damaged area, using the sharp point of a putty knife or stick to press it into the bottom of the hole and to puncture any air bubbles which may be present. Fill the scratch or hole above the surrounding undamaged area about 1/16 inch.

e. Lay a piece of cellophane or wax paper over the repair to cut off air and start the cure of gel mixture.

f. Allow the gelt to cure 10 to 15 minutes until it feels rubbery to the touch. Remove the cellophane and trim flush with the surface, using a sharp razor blade or knife. Replace the cellophane and allow to cure completely for 30 minutes to an hour. The patch will shrink slightly below the structure surface as it cures. (If wax paper is used, ascertain wax is removed from surface.)

g. Rough up the bottom and edges of the hole with the electric burr attachment or rough sandpaper. Feather hole into surrounding gel coat, do not undercut.

h. Pour out a small amount of resin, add catalyst and mix thoroughly, using a cutting motion rather than stirring. Use no fibers.

i. Using the tip of a putty knife or fingertips, fill the hole to about 1/16 inch above the surrounding surface with the gel coat mixture.

j. Lay a piece of cellophane over the patch to start the curing process. Repeat Step f, trimming patch when partially cured.

k. After trimming the patch, immediately place another small amount of gel coat on one edge of the patch and cover with cellophane. Then, using a squeegee or the back of a razor blade, squeegee level with area surrounding the patch; leave the cellophane on patch for one to two hours or overnight, for complete cure.

l. After repair has cured for 24 hours, sand patch area using a sanding block with fine wet sandpaper. Finish by priming, again sanding and applying color coat.

4-71. FIBERGLASS FRACTURE AND PATCH REPAIRS.

a. Remove wax, oil and dirt from around the damaged area with acetone, Methylethylketone or equivalent.

b. Using a key hole saw, electric saber saw, or sharp knife cut away ragged edges. Cut back to sound material.

c. Remove paint three inches back from around damaged area.

d. Working inside the structure, bevel the edges to approximately a 30 degree angle and rough-sand the hole and the area around it, using 80 grit dry paper. Feather back for about two inches all around the hole. This roughens the surface for strong bond with patch.

e. Cover a piece of cardboard or metal with cellophane. Tape it to the outside of the structure, covering the hole completely. The cellophane should face toward the inside of the structure. If the repair is on a sharp contour or shaped area, a sheet of aluminum formed to a similar contour may be placed over the area. The aluminum should also be covered with cellophane.

f. Prepare a patch of fiberglass mat and cloth to cover an area two inches larger than the hole.

g. Mix a small amount of resin and catalyst, enough to be used for one step at a time, according to kit instructions.

h. Thoroughly wet mat and cloth with catalyzed resin. Daub resin on mat first, and then on cloth. Mat should be applied against structures surface with cloth on top. Both pieces may be wet out on cellophane and applied as a sandwich. Enough fiberglass cloth and mat reinforcements should be used to at least replace the amount of reinforcements removed in order to maintain the original strength. If damage occurred as a stress crack, an extra layer or two of cloth may be used to strengthen area.

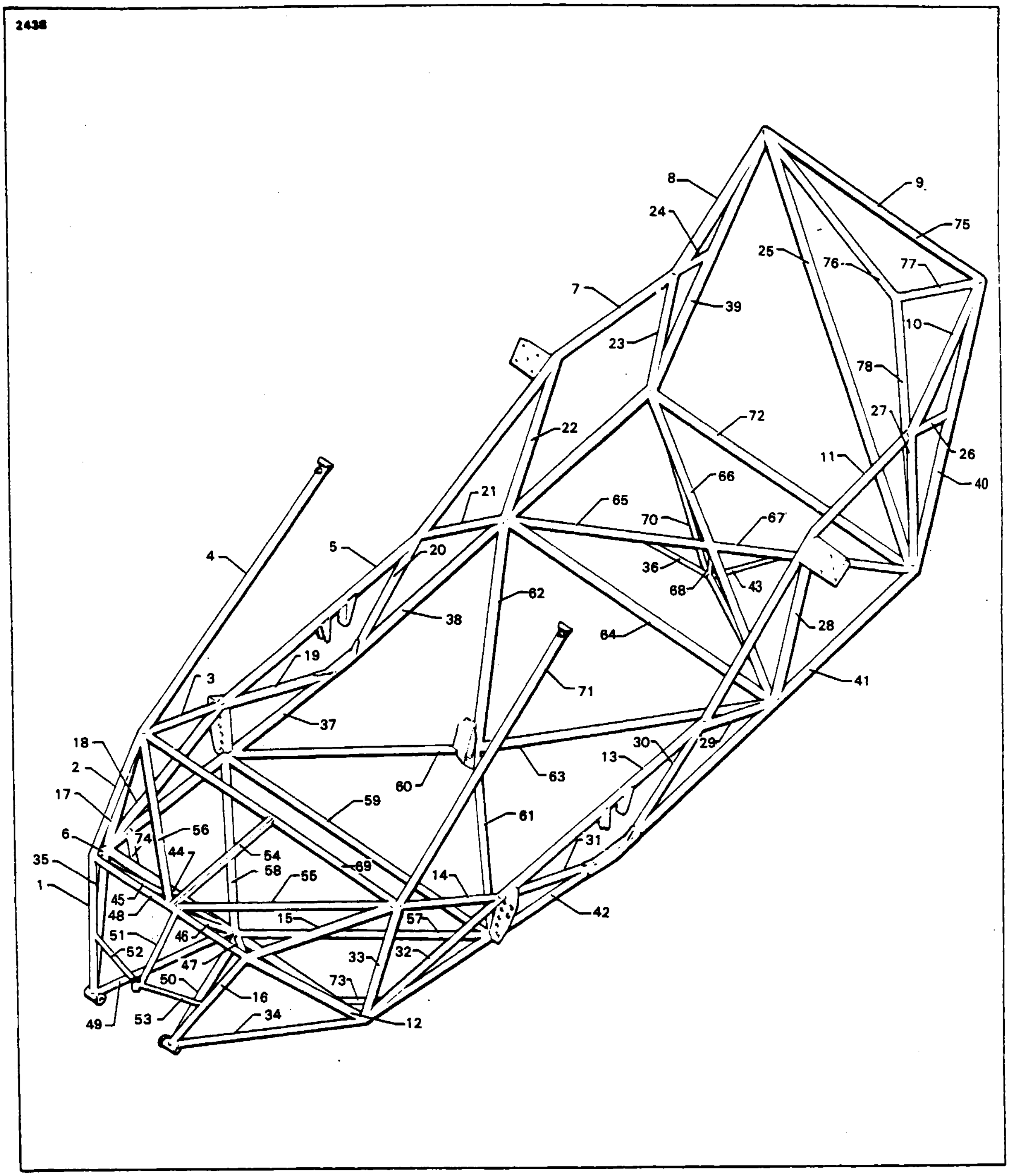
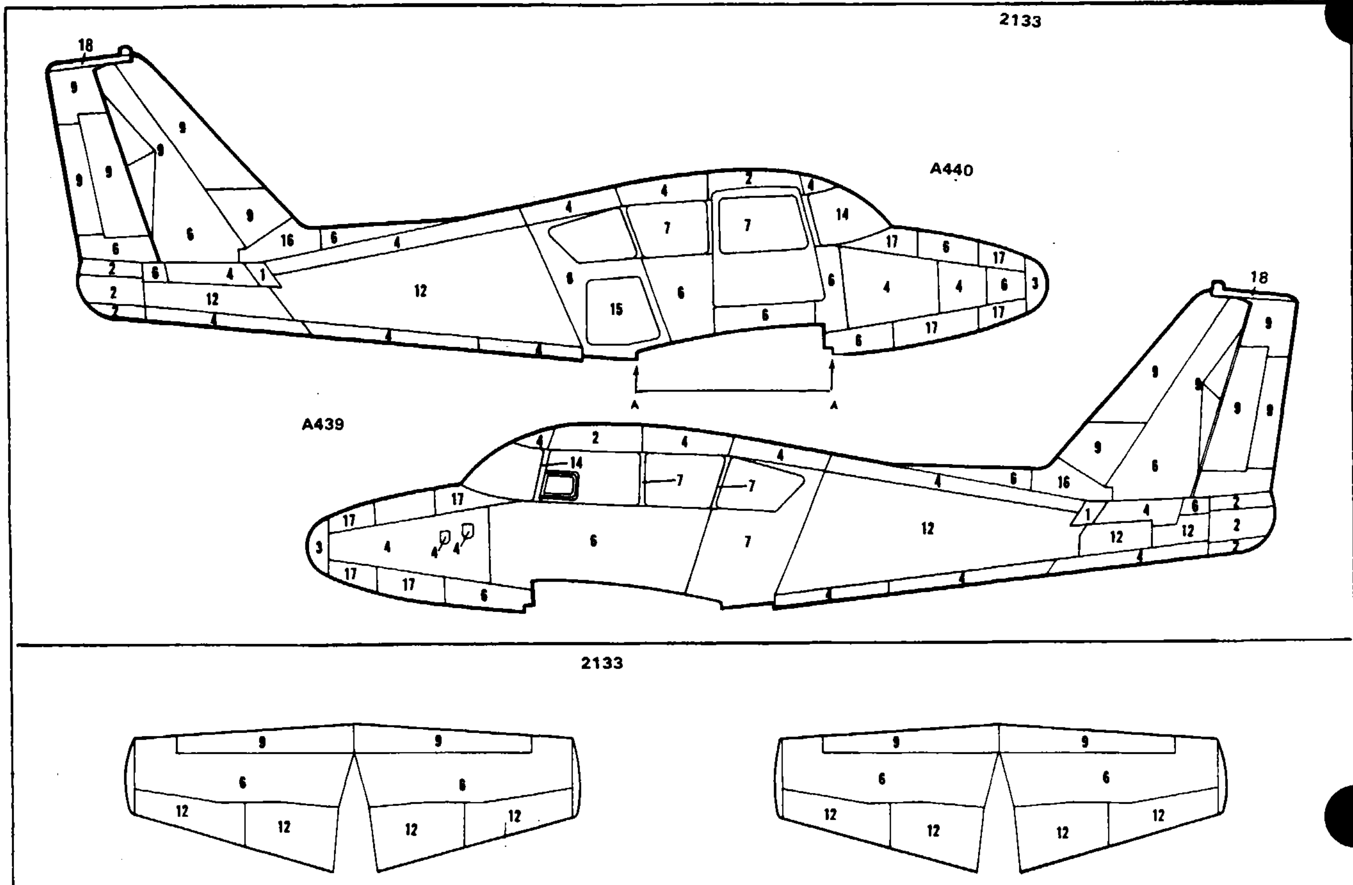


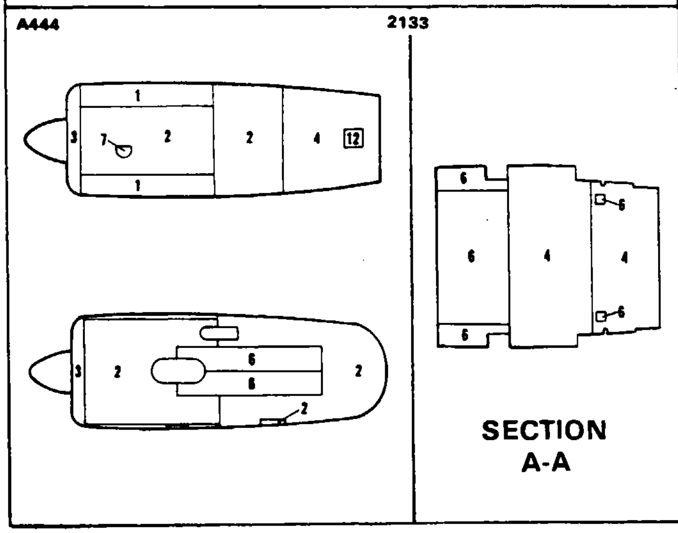
Figure 4-18. Fuselage Frame Tubing

NO.	PART NO.	MATERIAL	DIMENSIONS
1	17134-89	4130 RD STEEL TUBE	1 X .065 X 21.5
2	17134-91	4130 RD STEEL TUBE	1 X .065 X 18
3	17134-31	4130 RD STEEL TUBE	.75 X .035 X 21.25
4	17134-29	4130 RD STEEL TUBE	.875 X .035 X 36.5
5	17134-39	4130 RD STEEL TUBE	1 X .049 X 39.5
6	17134-23	4130 RD STEEL TUBE	.625 X .035 X 20.5
7	22102-19	4130 RD STEEL TUBE	.75 X .058 X 21
8	22102-17	4130 RD STEEL TUBE	1 X .049 X 22.5
9	17134-60	4130 RD STEEL TUBE	.75 X .035 X 37 (1)
10	22102-16	4130 RD STEEL TUBE	1 X .049 X 22.5
11	22102-18	4130 RD STEEL TUBE	.75 X .058 X 21
12	17134-22	4130 RD STEEL TUBE	.625 X .035 X 20.5
13	17134-38	4130 RD STEEL TUBE	1 X .049 X 39.5
14	17134-30	4130 RD STEEL TUBE	.75 X .035 X 21.25
15	17134-92	4130 RD STEEL TUBE	1 X .065 X 18
16	17134-90	4130 RD STEEL TUBE	1 X .065 X 21.5
17	17134-25	4130 RD STEEL TUBE	.625 X .035 X 18.5
18	17134-33	4130 RD STEEL TUBE	.875 X .049 X 26
19	22102-27	4130 RD STEEL TUBE	.875 X .049 X 22
20	22102-40	4130 RD STEEL TUBE	1 X .058 X 48.5
21	22102-43	4130 RD STEEL TUBE	.875 X .065 X 16.5
22	22102-25	4130 RD STEEL TUBE	1 X .058 X 27
23	22102-15	4130 RD STEEL TUBE	.75 X .058 X 24.5
24	22102-21	4130 RD STEEL TUBE	.75 X .035 X 8.5
25	17134-65	4130 RD STEEL TUBE	.75 X .035 X 65
26	22102-20	4130 RD STEEL TUBE	.75 X .035 X 8.5
27	22102-14	4130 RD STEEL TUBE	.75 X .058 X 24.5
28	22102-24	4130 RD STEEL TUBE	1 X .058 X 27
29	22102-42	4130 RD STEEL TUBE	.875 X .065 X 16.5
30	22102-41	4130 RD STEEL TUBE	1 X .058 X 48.5
31	22102-26	4130 RD STEEL TUBE	.875 X .049 X 22
32	17134-32	4130 RD STEEL TUBE	.875 X .049 X 26
33	17134-24	4130 RD STEEL TUBE	.625 X .035 X 8.5
34	17134-97	4130 RD STEEL TUBE	.75 X .049 X 24.75
35	17134-98	4130 RD STEEL TUBE	.75 X .049 X 24.75
36	22102-28	4130 RD STEEL TUBE	.375 X .028 X 8
37	17134-34	4130 RD STEEL TUBE	1 X .035 X 48
38	17134-44	4130 RD STEEL TUBE	1.125 X .049 X 62
39	22102-13	4130 RD STEEL TUBE	1.125 X .058 X 44.5
40	22102-13	4130 RD STEEL TUBE	1.125 X .058 X 44.5
41	17134-44	4130 RD STEEL TUBE	1 X .049 X 62
42	17134-34	4130 RD STEEL TUBE	1 X .035 X 48
43	22102-28	4130 RD STEEL TUBE	.375 X .028 X 8
44	17134-06	4130 RD STEEL TUBE	.75 X .035 X 42
	21121-03 (LINER TUBE)	4130 RD STEEL TUBE	.665 X .035 X 9.5
45	17134-63	4130 RD STEEL TUBE	.75 X .035 X 22.25
46	17134-64	4130 RD STEEL TUBE	.5 X .035 X 18.25
47	17134-62	4130 RD STEEL TUBE	.75 X .035 X 22.25
48	17134-56	4130 RD STEEL TUBE	.625 X .035 X 25
49	17134-04	4130 RD STEEL TUBE	.75 X .035 X 20.5
50	17134-05	4130 RD STEEL TUBE	.75 X .035 X 20.5
51	22102-44	4130 RD STEEL TUBE	.625 X .035 X 16.25
52	17134-71	1025 RD STEEL TUBE	.625 X .035 X 9
53	17134-72	1025 RD STEEL TUBE	.625 X .035 X 9
54	14089-02	1020 SQ STEEL TUBE	.687 X .025 X 14.75
55	17134-58	4130 RD STEEL TUBE	.75 X .035 X 26
56	17134-59	4130 RD STEEL TUBE	.75 X .035 X 26
57	17134-08	4130 RD STEEL TUBE	.75 X .035 X 38
58	17134-09	4130 RD STEEL TUBE	.75 X .035 X 38
59	17134-07	4130 RD STEEL TUBE	.75 X .035 X 43.5
60	17134-10	4130 RD STEEL TUBE	.75 X .035 X 30.5
	17134-82	4130 RD STEEL TUBE	.75 X .035 X 30.5
61	17134-10	4130 RD STEEL TUBE	.75 X .035 X 30.5
	17134-82	4130 RD STEEL TUBE	.75 X .035 X 30.5
62	17134-12	4130 RD STEEL TUBE	1 X .049 X 38.5
63	17134-13	4130 RD STEEL TUBE	1 X .049 X 38.5
64	17134-18	4130 RD STEEL TUBE	1 X .049 X 45
65	17134-15	4130 RD STEEL TUBE	.75 X .035 X 26
66	17134-17	4130 RD STEEL TUBE	.75 X .035 X 51.75
67	17134-16	4130 RD STEEL TUBE	.75 X .035 X 25.75
68	17134-69	4130 RD STEEL TUBE	.375 X .028 X 1.937
69	17134-57	4130 RD STEEL TUBE	.875 X .035 X 42
70	17134-14	4130 RD STEEL TUBE	.375 X .028 X 45.5
71	17134-28	4130 RD STEEL TUBE	.875 X .035 X 36.5
72	17134-99	4130 RD STEEL TUBE	.75 X .049 X 44
73	17134-66	1025 RD STEEL TUBE	.625 X .035 X 6
74	17134-67	1025 RD STEEL TUBE	.625 X .035 X 5.5
75	22102-50	4130 RD STEEL TUBE	.75 X .049 X 37.25 (2)
76	22102-47	4130 RD STEEL TUBE	.75 X .035 X 27.812 (2)
77	22102-48	4130 RD STEEL TUBE	.75 X .035 X 17.5 (2)
78	22102-49	4130 RD STEEL TUBE	.75 X .049 X 38.343 (2)

(1) ON PA-23-250, PA-23-235, PA-E23-250 AND PA-23-250 (SIX PLACE) SERIAL NOS. 27-2000 TO 27-3049 INCL. AND 27-3051 TO 27-3153 INCL.
(2) ON PA-E23-250 AND PA-23-250 (SIX PLACE) SERIAL NOS. 27-3050, 27-3154 AND UP.

Figure 4-18. Fuselage Frame Tubing (cont.)

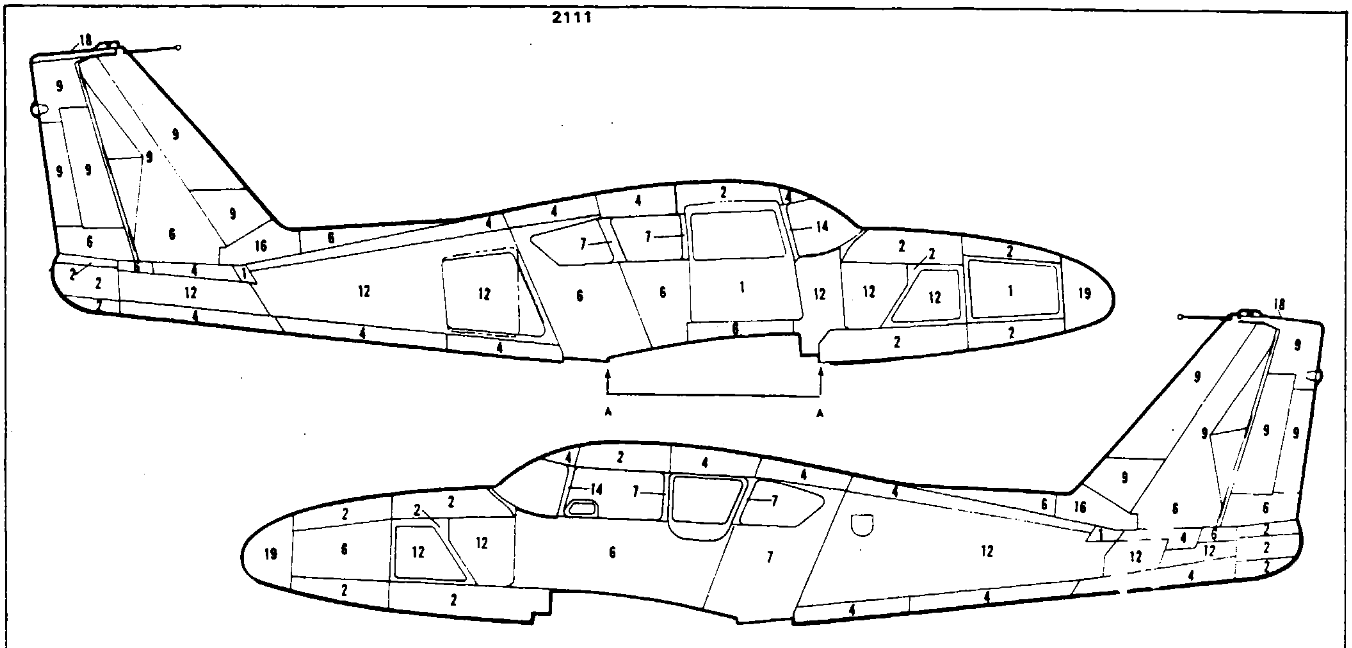


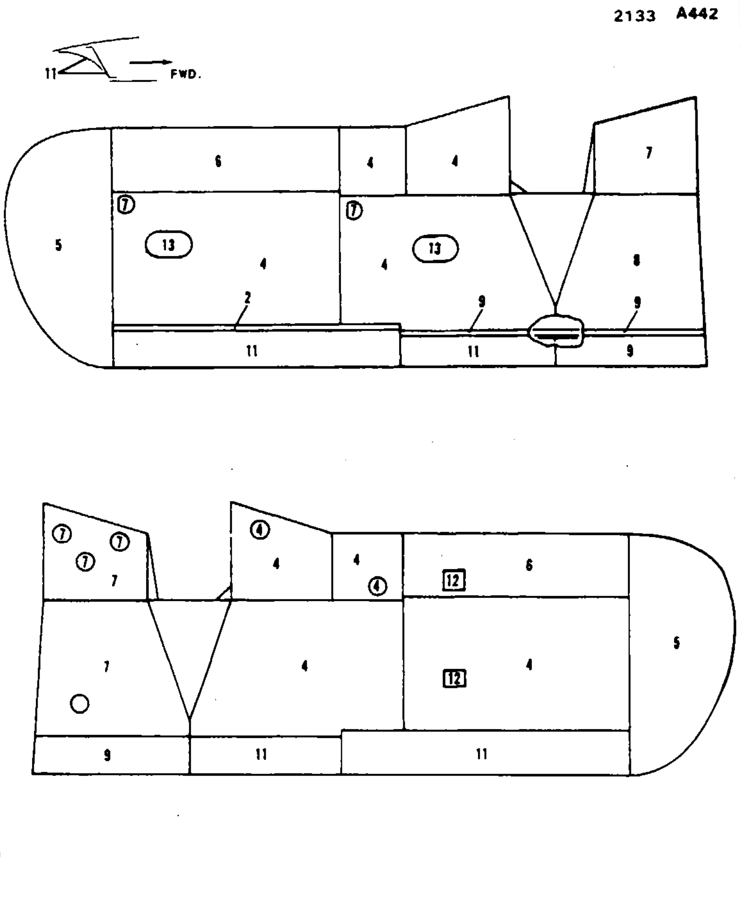


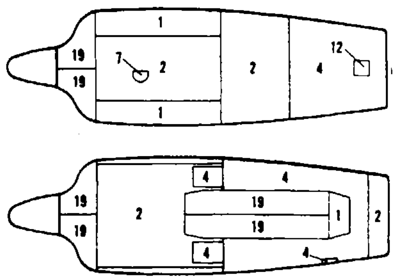
NUMBER	MATERIAL	THICKNESS
1	2024-0	0.032*
2	2024-0	0.025*
3	5052-0	0.040
4	2024-T3	0.025
5	61 SO	0.025**
6	2024-T3	0.020
7	2024-T3	0.040
8	2024-T3	0.051
9	2024-T3	0.016
10	24 ST3	0.016
11	24 ST3	0.025
12	2024-T3	0.032
13	5052-H34	0.025
14	2024-0	0.040*
15	24 ST3	0.020
16	6061-0	0.032
17	2024-0	0.020*
18	THERMOPLASTIC	
19	FIBERGLASS	

*HEAT TREAT TO 2024-T4 AFTER FORMING
**HEAT TREAT TO 61 ST4 AFTER FORMING

Figure 4-19. Skin Materials and Thicknesses







NUMBER	MATERIAL	THICKNESS
1	2024-0	0.032*
2	2024-0	0.025*
3	5052-0	0.040
4	2024-T3	0.025
5	61 SO	0.025**
6	2024-T3	0.020
7	2024-T3	0.040
8	2024-T3	0.051
9	2024-T3	0.016
10	24 ST3	0.016
11	24 ST3	0.025
12	2024-T3	0.032
13	5052-H34	0.025
14	2024-0	0.040*
15	24 ST3	0.020
16	6061-0	0.032
17	2024-0	0.020*
18	THERMOPLASTIC	
19	FIBERGLASS	

*HEAT TREAT TO 2024-T4 AFTER FORMING
**HEAT TREAT TO 61 ST4 AFTER FORMING

Figure 4-19. Skin Materials and Thicknesses (cont.)

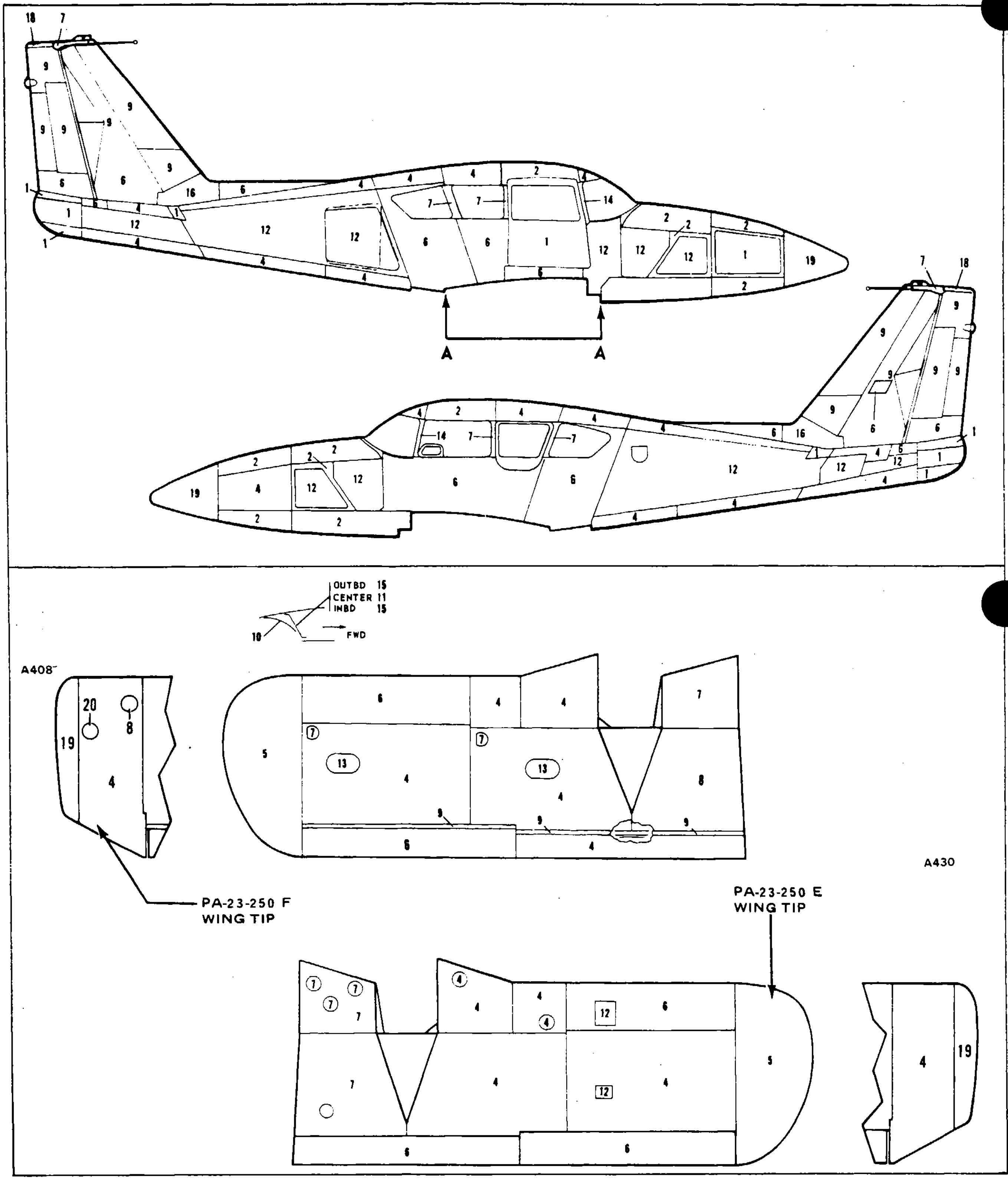
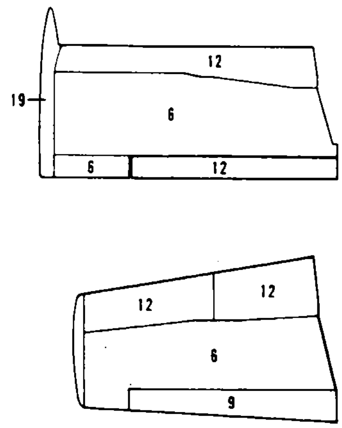


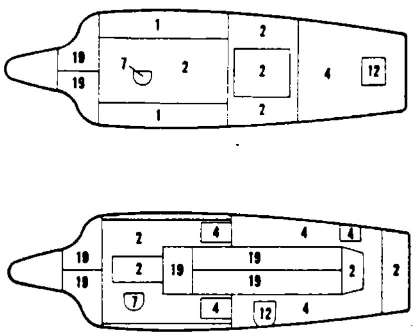
Figure 4-20. Skin Materials and Thicknesses,
PA-23-250 (six place), Serial Nos. 27-4426, 27-4574 and up

A40?



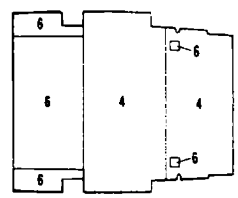
THE LEFT UPPER STABILATOR SURFACE IS SHOWN.
THE LOWER AND OPPOSITE SKINS ARE OF THE SAME MATERIAL AND THICKNESS.

A4:



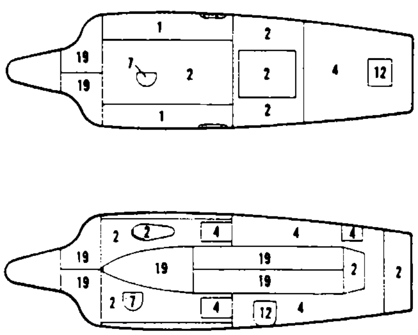
NORMAL

2133



SECTION A–A

A431



LYCOMING TURBO.

NUMBER	MATERIAL	THICKNESS
1	2024-0	0.032*
2	2024-0	0.025*
3	5052-0	0.040
4	2024-T3	0.025
5	6150	0.025**
6	2024-T3	0.020
7	2024-T3	0.040
8	2024-T3	0.051
9	2024-T3	0.016
10	24ST3	0.016
11	24ST3	0.025
12	2024-T3	0.032
13	5052-H34	0.025
14	2024-0	0.040*
15	24ST3	0.020
16	6061-0	0.032
17	2024-0	0.020*
18	THERMOPLASTIC	
19	FIBERGLASS	
20	2024-T3	.064

* HEAT TREAT TO 2024-T4 AFTER FORMING
** HEAT TREAT TO 61ST4 AFTER FORMING

Figure 4-20. Skin Materials and Thicknesses,
PA-23-250 (six place), Serial Nos. 27-4426, 27-4574 and up (cont.)

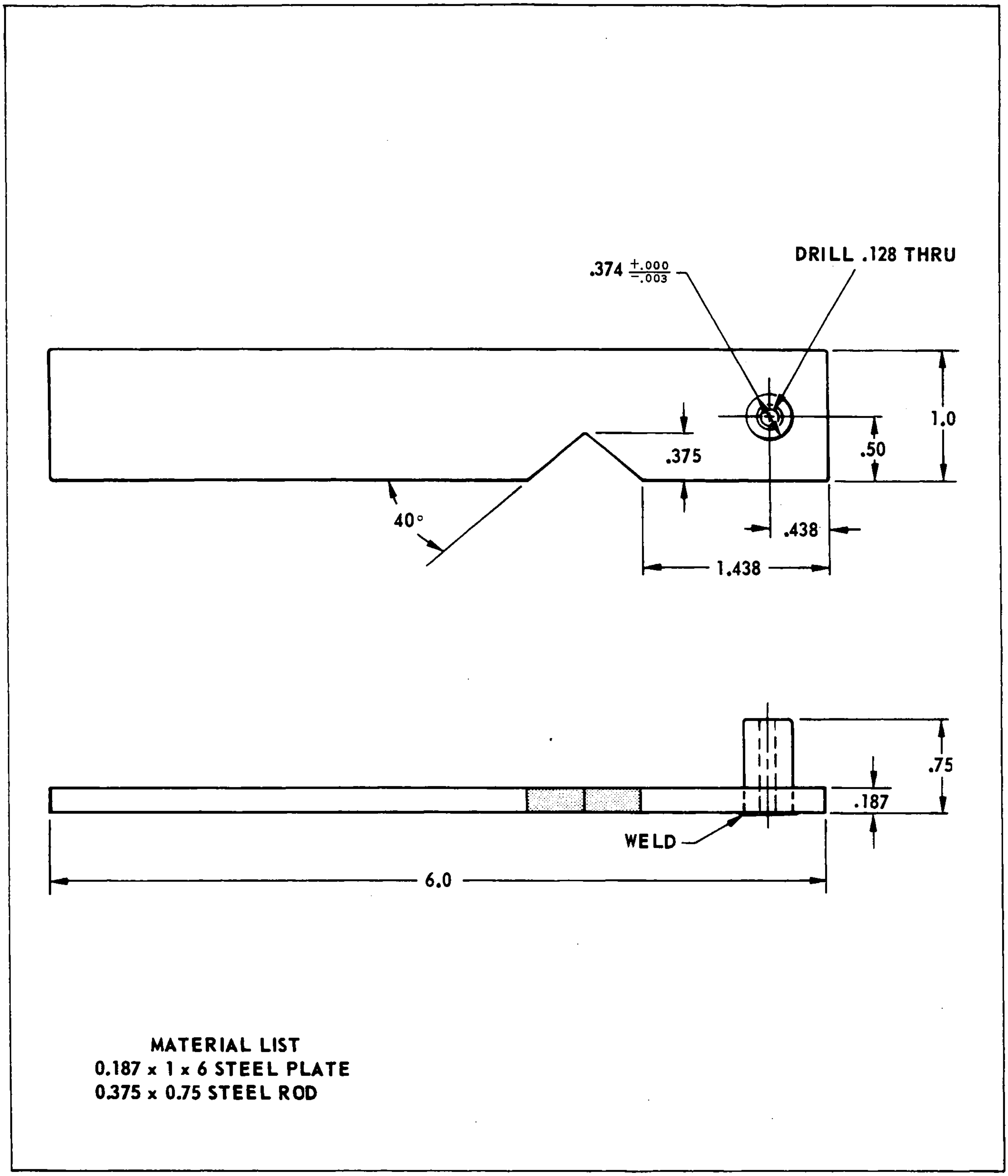


Figure 4-21. Fabricated Tool, Wing Installation

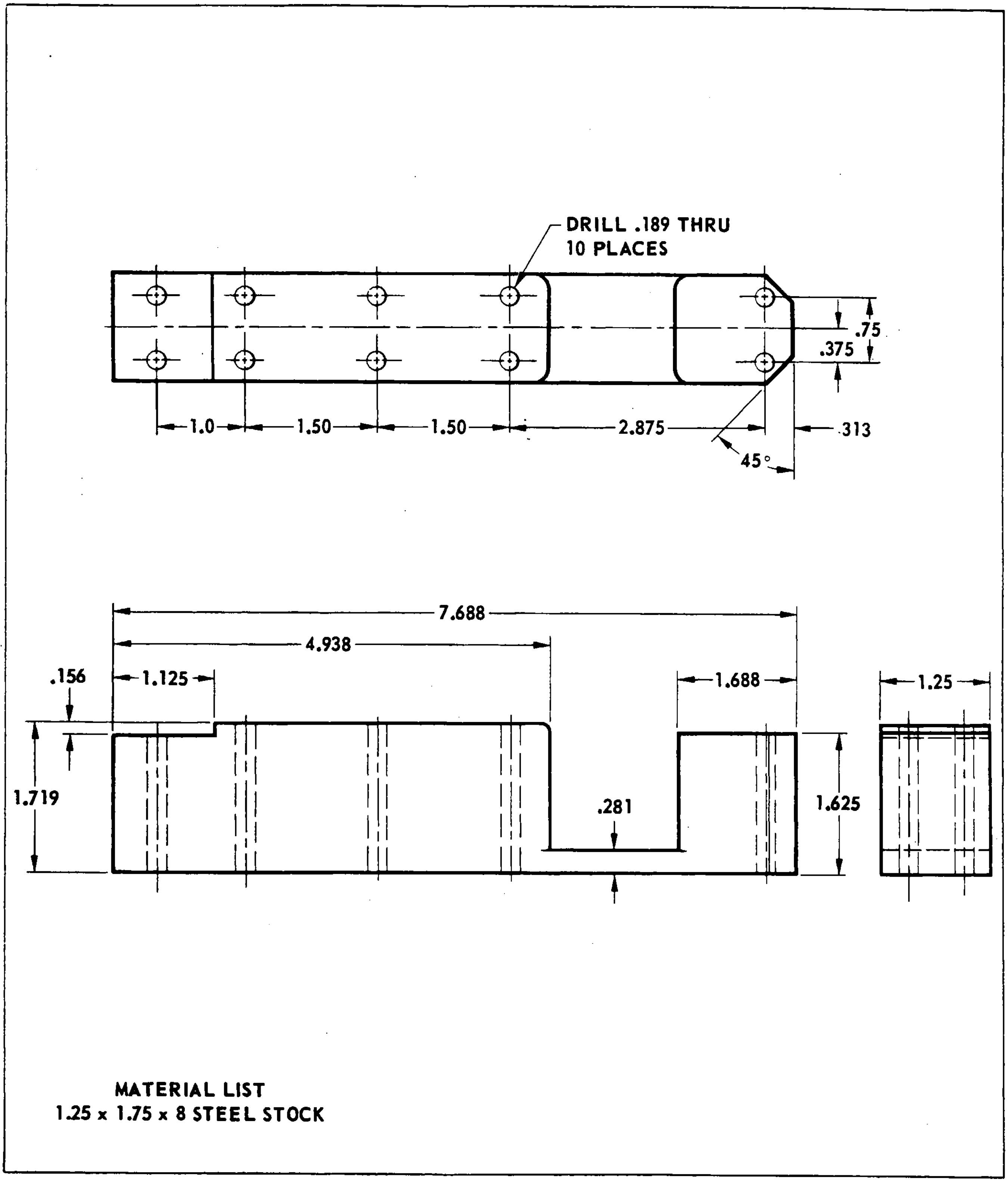


Figure 4-22. Fabricated Tool, Wing Installation

i. Lay patch over hole on inside of structure, cover with cellophane, and squeegee from center to edges to remove all air bubbles and assure adhesion around edge of hole. Air bubbles will show white in the patch and they should all be worked out to the edge. Remove excess resin before it gels on the part. Allow patch to cure completely.

j. Remove cardboard or aluminum sheet from outside of hole and rough-sand the patch and edge of hole. Feather edge of hole about two inches into undamaged area.

k. Mask area around hole with tape and paper to protect surface. Cut a piece of fiberglass mat about one inch larger than the hole and one or more pieces of fiberglass cloth two inches larger than the hole. Brush catalyzed resin over hole, lay mat over hole and wet out with catalyzed resin. Use a daubing action with brush. Then apply additional layer or layers of fiberglass cloth to build up patch to the surface of structure. Wet out each layer thoroughly with resin.

l. With a squeegee or broad knife, work out all air bubbles in the patch. Work from center to edge, pressing patch firmly against the structure. Allow patch to cure for 15 to 20 minutes.

m. As soon as the patch begins to set up, but while still rubbery, take a sharp knife and cut away extra cloth and mat. Cut on outside edge of feathering. Strip cut edges of structure. Do this before cure is complete, to save extra sanding. Allow patch to cure overnight.

n. Using dry 80 grit sandpaper on a power sander or sanding block, smooth patch and blend with surrounding surface. Should air pockets appear while sanding, puncture and fill with catalyzed resin. A hypodermic needle may be used to fill cavities. Let cure and resand.

o. Mix catalyzed resin and work into patch with fingers. Smooth carefully and work into any crevices.

p. Cover with cellophane and squeegee smooth. Allow to cure completely before removing cellophane. Let cure and resand.

q. Brush or spray a coat of catalyzed resin to seal patch. Sand patch, finish by priming, again sanding and applying color coat.

NOTE

Brush and hands may be cleaned in solvents such as acetone or Methylethylketone. If solvents are not available, a strong solution of detergent and water may be used.

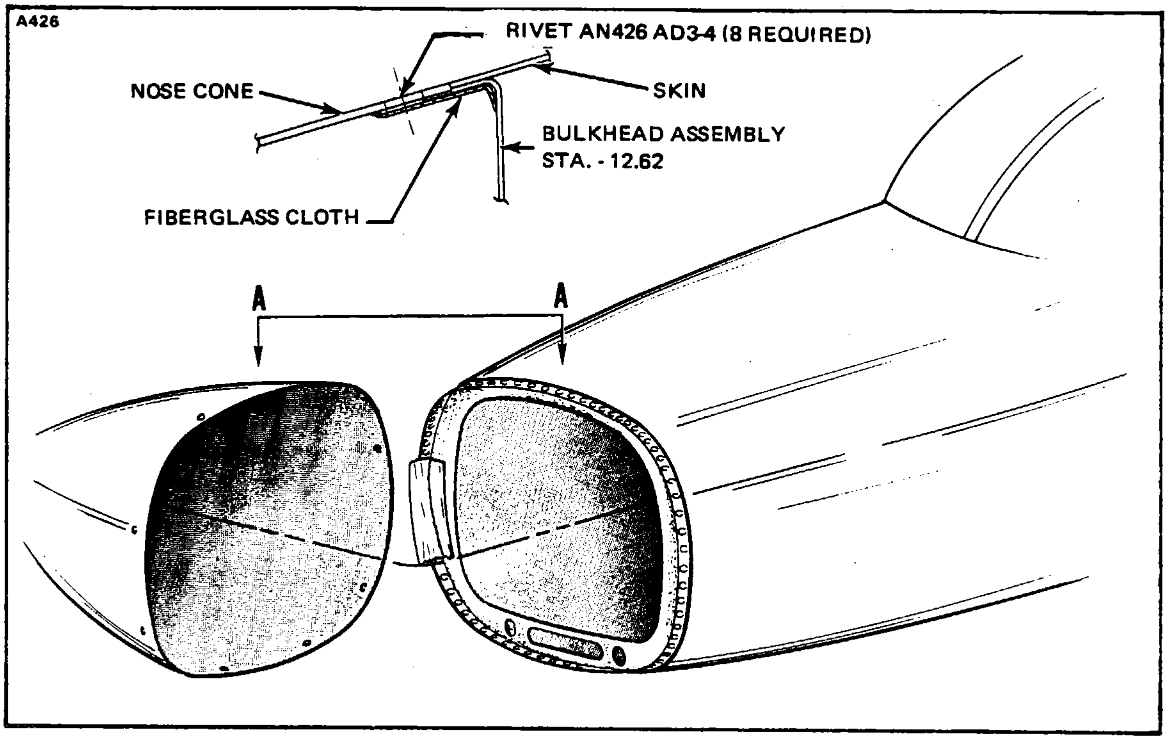


Figure 4-23. Nose Cone Installation, PA-23-250 and PA-23-235

4-72. REPLACEMENT OF DAMAGED NOSE CONE.

a. Disconnect the electrical leads to the landing light and any other equipment located in the nose cone.

b. Remove the damaged nose cone by cutting away the fiberglass attachment cloth between the inner surface of the nose cone and the flange on bulkhead at station -12.62.

c. Drill out the rivets around the mating edge of the nose cone and fuselage skin.

d. Sand off any filler material used on the other mating surfaces between the fuselage skin and nose cone.

CAUTION

Do not sand into the fuselage skin or the bulkhead.

e. Position new nose cone in place over the bulkhead flange.

f. Drill eight .098 holes in new nose cone using existing holes in bulkhead flange as template.

g. Rivet the nose cone to the flange with AN 426 AD3-4 rivets.

h. Fasten the nose cone to the fuselage with the application of fiberglass cloth layed up between the inner surface of the nose cone and flange on the bulkhead. (Refer to Figure 4-23 and instructions given on the use of fiberglass in paragraph 4-69.)

i. The outside seam between the nose cone and fuselage skin is coated with Hysol Epoxy Surface 4343 coat or equivalent and sanded smooth.

j. Finish by priming; again sanding and applying color coat.

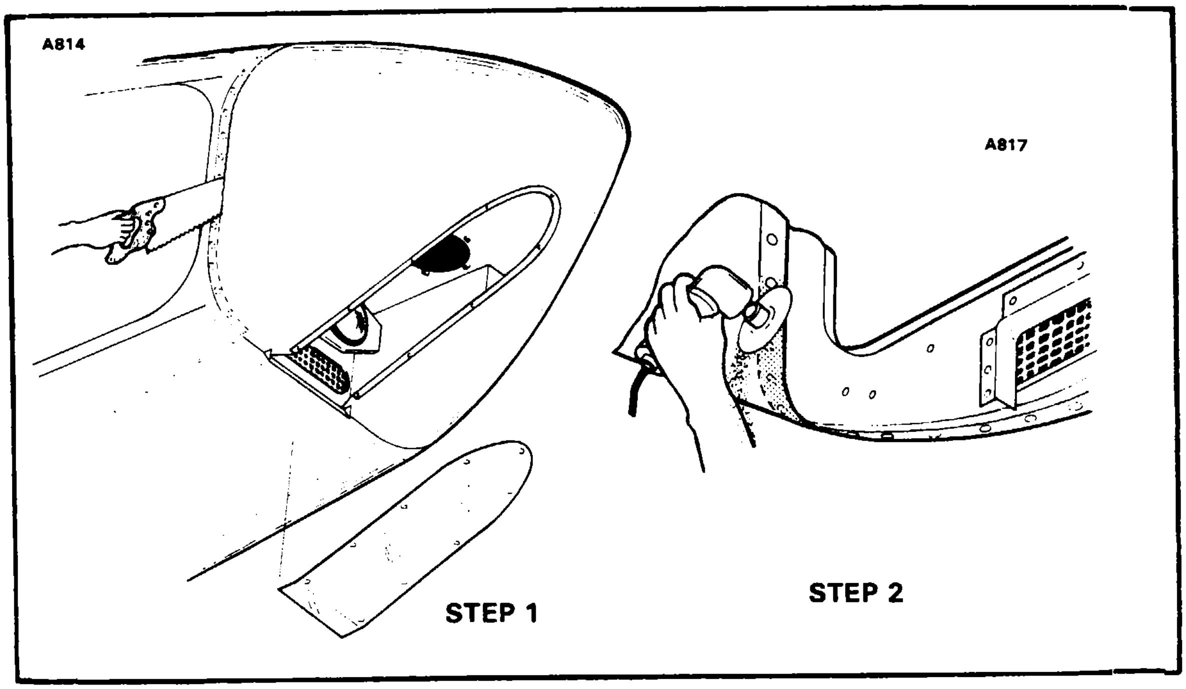


Figure 4-24. Removal of Nose Cone/Radome

4-73. REPLACEMENT/INSTALLATION OF NOSE CONE OR RADOME. PA-23-250 (six place), Serial Nos. 27-4426, 27-4574 and up. (Refer to Figures 4-24, 4-25 and 4-26.)

a. Nose Cones or Radomes damaged beyond repair should be removed as follows:

1. Remove the landing light window, any additional equipment installed in the nose cone or radome, and floorboard access panels in the nose cone.
2. Disconnect any electrical leads to the landing light and remove light assembly.
3. Should the floorboard and light supports in the radome assembly still be serviceable, disconnect them by removing the screws attaching them to the radome bulkhead and dome flanges.
4. If the floorboard and light supports are still serviceable in the standard nose cone, drill out the rivets that attach the floorboard and supports to the bulkhead, station -12.62.
5. To remove the damaged nose cone/radome cut around the dome just forward of the mounting strip(s) (Figure 4-24, Step 1)attached to bulkhead, station -12.62, and remove cone.
6. Remove the floorboard and supports from the nose cone by cutting away the fiberglass attachment cloth at the mounting strips.

b. After removing the nose cone/radome from the aircraft, back drill and remove the rivets on and around the mounting flange at station -12.62 where any fiberglass is still attached.

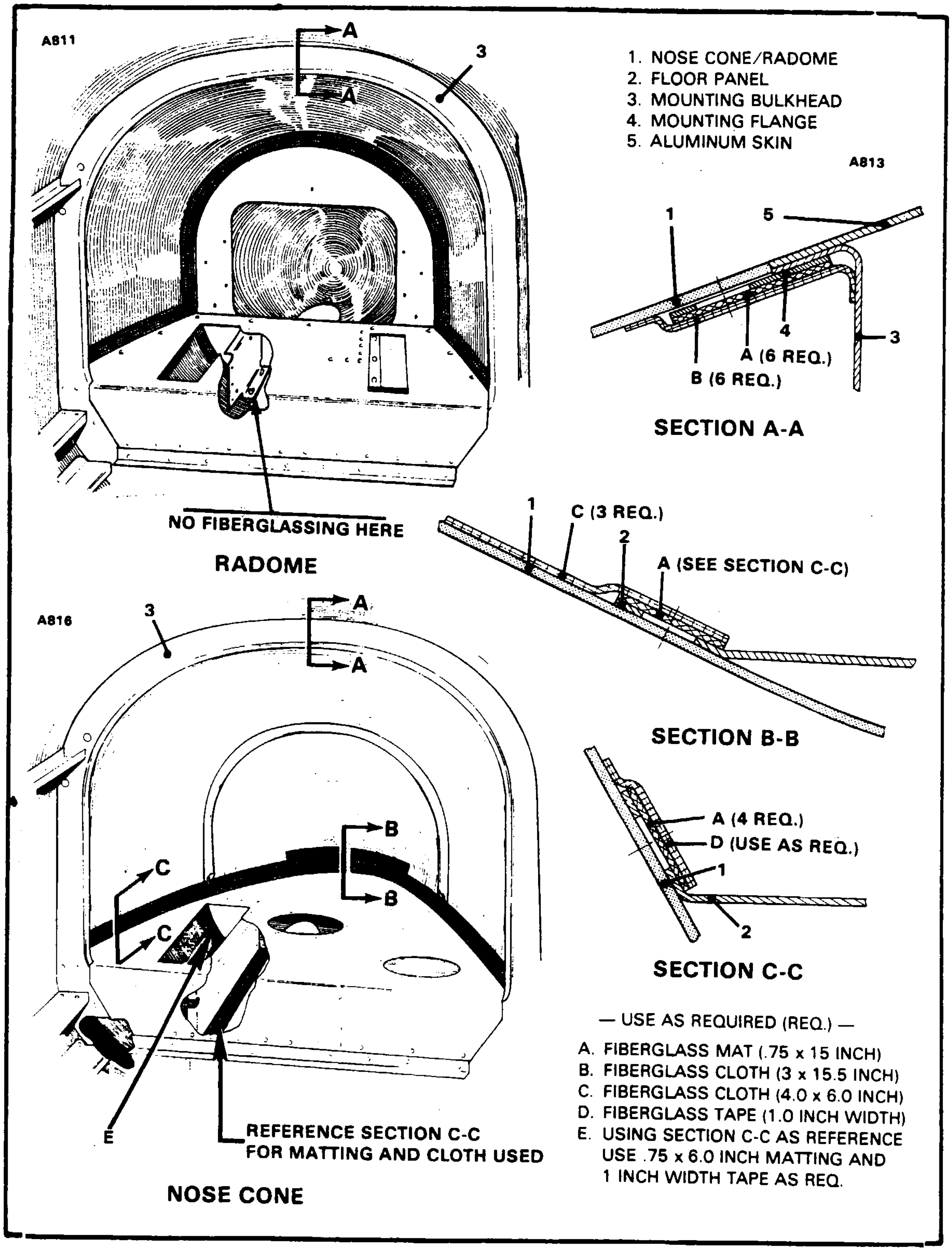


Figure 4-25. Nose Cone/Radome

c. If the bulkhead and mounting flange at station -12.62 are undamaged and not to be replaced, proceed to remove any old fiberglass and filler by grinding or sanding as shown in Step 2 of Figure 4-24. Make sure holes in mounting flange are clear, drill out if necessary.

CAUTION

When grinding off the filler and fiberglass on the mounting flange and skin, be careful not to grind into the aluminum skin of the aircraft. When getting near the skin sand by hand and only ruff up the skin surface such that the filler and body putty will stick.

NOTE

If the floorboard assemblies or bulkheads have been damaged, replacement parts may be ordered using the PA-23-250 Parts Catalog, Part Number 753 522. Piper Kit 761 026 furnishes the radome and hardware for attachment.

d. After removing the old fiberglass, filler, and body putty, position the new nose cone/radome on the mounting flange at bulkhead, station -12.62. Check to make sure the cone covers the holes in the mounting flange.

e. If the nose cone/radome floor panels haven't been removed, ascertain that the floor panels fit properly in the nose cone before proceeding. The floor panel in the nose cone configuration should fit snugly against the nose cone such that it does not deflect up or down. The floor panel in the radome configuration should fit snugly against the bulkhead in the radome in the same manner. If the floor panels on the nose cone/radome have been removed or replaced, check the fit, remove the nose cone, and install the floor panel and supports. Make sure the floor panel and support bonding flanges are clean.

NOTE

Before proceeding with any fiberglassing, wipe down the areas to be bonded with white gas or acetone. AFTER SANDING MAKE SURE DUST IS ALL BLOWN OR CLEANED OFF. When working on exterior of nose cone/radome, make sure to sand prior to applying putty to remove mold wax. (See Paragraph 4-69 for working with fiberglass.)

— WARNING —

Because of the combustibility of the substances used in this procedure, be sure to do the work in a WELL VENTILATED AREA that is FREE FROM sparks and smoking.

f. With floorboards and supports installed, reposition the nose cone/radome over the floorboard and onto the mounting flange at bulkhead, station -12.62. The nose cone/radome should fit far enough on the mounting flange that the edge of the cone completely covers the holes in the mounting flange at bulkhead, station -12.62.

CAUTION

DO NOT physically FORCE the nose cone/radome to fit flush with the aluminum nose section. Maintain at least a 3/8 inch gap and build up the cone with paste (Kit 763 904), and then body putty as shown in Figure 4-26 (of the proper mix) respectively.

g. Drill (as shown in Figure 4-26, Step 1) .098 inch holes in the nose cone to match those in the bulkhead mounting flange, twenty eight of the same for the radome (equally spaced to clear holes in flange), maintaining in the cone at least a 3/8 inch edge distance from the center of the rivet holes to the edge of the fiberglass.

h. Rivet the nose cone or radome to the mounting flange with MS20426AD3 rivets for the nose cone or MS20426AD4 rivets for the radome.

i. With the nose cone/radome riveted in position, prepare four pieces of fiberglass matting (3/4 oz., .75 x 15 inch) by placing the pieces on a piece of carboard, or other, and saturating them with prepared resin by pouring it over them as shown in Figure 4-26, Step 2. Lay and pack the matting around the mounting flange at bulkhead, station -12.62. MAKE SURE the matting is packed such that it contacts the fiberglass cone through the holes in the flange.

j. Prepare the other required matting (see Figure 4-26, Step 2) pieces and install them along their specific mating flanges.

NOTE

Make sure all mating flanges to be bonded are covered and bonded properly.

k. Prepare and apply to the specific areas the proper fiberglass cloth in the same manner as the matting shown in Figures 4-25 and 4-26.

NOTE

If the nose cone/radome does not touch the air scoop on both sides fill in from inside with fiberglass matting and later, outside with body putty as shown in Figure 4-26, Step 5.

l. Using the fiberglass paste kit (763 904) mix up the required amount (working time 15 to 30 min. depending on amount of hardener used) and lay masking tape (as shown in Figure 4-26, Steps 3 and 4) around the seam such that the paste does not spread onto the metal or fiberglass cone. Spread paste into seam with a wood (tongue depressor) or soft plastic spatula.

m. When paste is dry, sand the paste down by hand to a smooth finish.

NOTE

Before applying any body putty to smooth in nose cone/radome to nose section, sand paint off aluminum nose section down to bare metal and entire nose cone/radome.

NOTE

Do not fiberglass the light supports on the bottom of the RADOME. (See Figure 4-25.)

n. Mix some body putty and hardener; then with a wooden or plastic spatula (to keep from scratching the cone or aluminum) apply putty to the seam area, also to the sides of the lower air vent (see Figure 4-26, Step 5) if the cone doesn't contact it, and go over the putty with a wide plastic spreader to even out the putty.

o. Wait for putty to dry and sand down to acquire a smooth finish and pattern from the cone to the nose section.

NOTE

Build up cone to nose section, do not physically force cone to fit.

p. Finish by priming, sanding, and color coating. DO NOT paint over honeycomb section. When finishing radome, tape around the nose cone 18.75 inches back from the tip of the cone and paint that area with a flat black polyurethane paint only. (Refer to Figure 4-26.)

q. Reinstall/install all necessary equipment.

4-74. THERMOPLASTIC REPAIRS. The following procedure will assist in making field repairs to items made of thermoplastic which are used throughout the airplane. A list of material needed to perform these repairs is given along with suggested suppliers of the material. Common safety precautions should be observed when handling some of the materials and tools used while making these repairs.

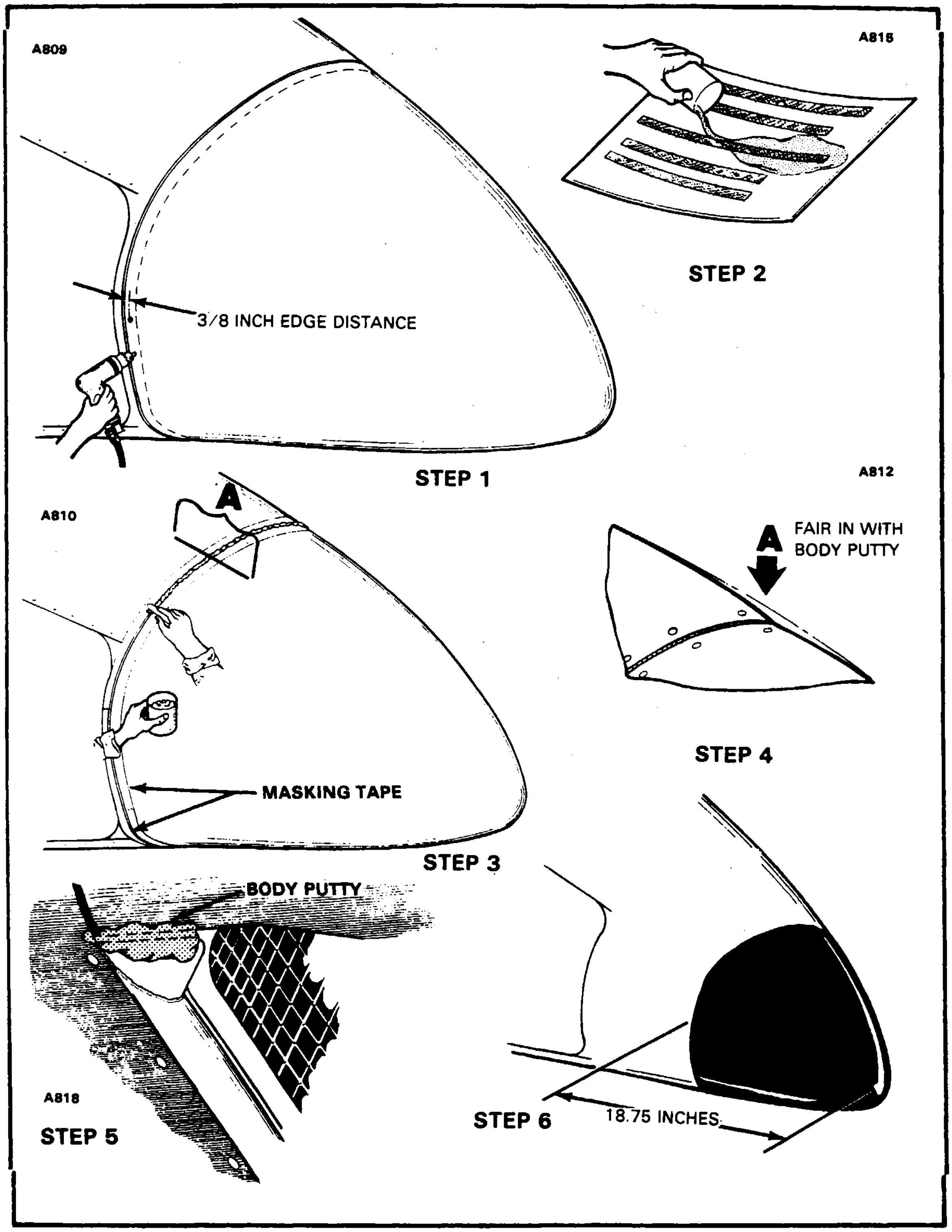


Figure 4-26. Installation of Nose Cone/Radome

TABLE IV-III. LIST OF MATERIALS (THERMOPLASTIC REPAIR)

Items	Descriptions	Suppliers
Buffing and Rubbing Compounds	Automotive Type - DuPont #7	DuPont Company Wilmington, Del. 19898
	Ram Chemical #69 x 1	Ram Chemicals Gardena. Cal. 90248
	Mirror Glaze #1	Mirror Bright Polish Co., Inc. Irvin, Cal. 92713
Cleaners	Fantastic Spray	Obtain From Local Suppliers
	Perchlorethylene	
	VM&P Naphtha (Lighter Fluid)	
ABS-Solvent Cements	Solarite #11 Series	Solar Compounds Corp. Linden, N.J. 07036
Solvents	Methylethylketone	Obtain From Local Suppliers
	Methylene Chloride	
	Acetone	
Epoxy Patching Compound	Solarite #400	Solar Compounds Corp.
Hot Melt Adhesives Polyamids and Hot Melt Gun	Stick Form 1/2 in. dia. 3 in. Iong	Sears Roebuck & Co. or Most Hardware Stores
Hot Air Gun	Temp. Range 300° to 400° F	Local Suppliers

a. Surface Preparation:

1. Surface dirt and paint if applied must be removed from the item being repaired. Household cleaners have proven most effective in removing surface dirt.

2. Preliminary cleaning of the damaged area with perchlorethylene or VM&P Naptha will generally insure a good bond between epoxy compounds with thermoplastic.

b. Surface Scratches, Abrasion or Ground-in-Dirt: (Refer to Figure 4-27.)

1. Shallow scratches and abraded surfaces are usually repaired by following directions on containers of conventional automotive buffing and rubbing compounds.

2. If large dirt particles are embedded in thermoplastic parts, they can be removed with a hot air gun capable of supplying heat in the temperature range of 300° to 400° F. Use care not to overheat the material. Hold the nozzle of the gun about 1/4 of an inch away from the surface and apply heat with a circular motion until the area is sufficiently soft to remove the dirt particles.

3. The thermoplastic will return to its original shape upon cooling.

c. Deep Scratches, Shallow Nicks and Small Holes: (Less than 1 inch in diameter.)(Refer to Figure 4-28.)

1. Solvent cements will fit virtually any of these applications. If the area to be repaired is very small, it may be quicker to make a satisfactory cement by dissolving thermoplastic material of the same type being repaired in solvent until the desired paste-like consistency is achieved.

2. This mixture is then applied to the damaged area. Upon solvent evaporation, the hard durable solids remaining can easily be shaped to the desired contour by filing or sanding.

3. Solvent adhesives are not recommended for highly stressed areas, on thin walled parts or for patching holes greater than 1/4 inch in diameter.

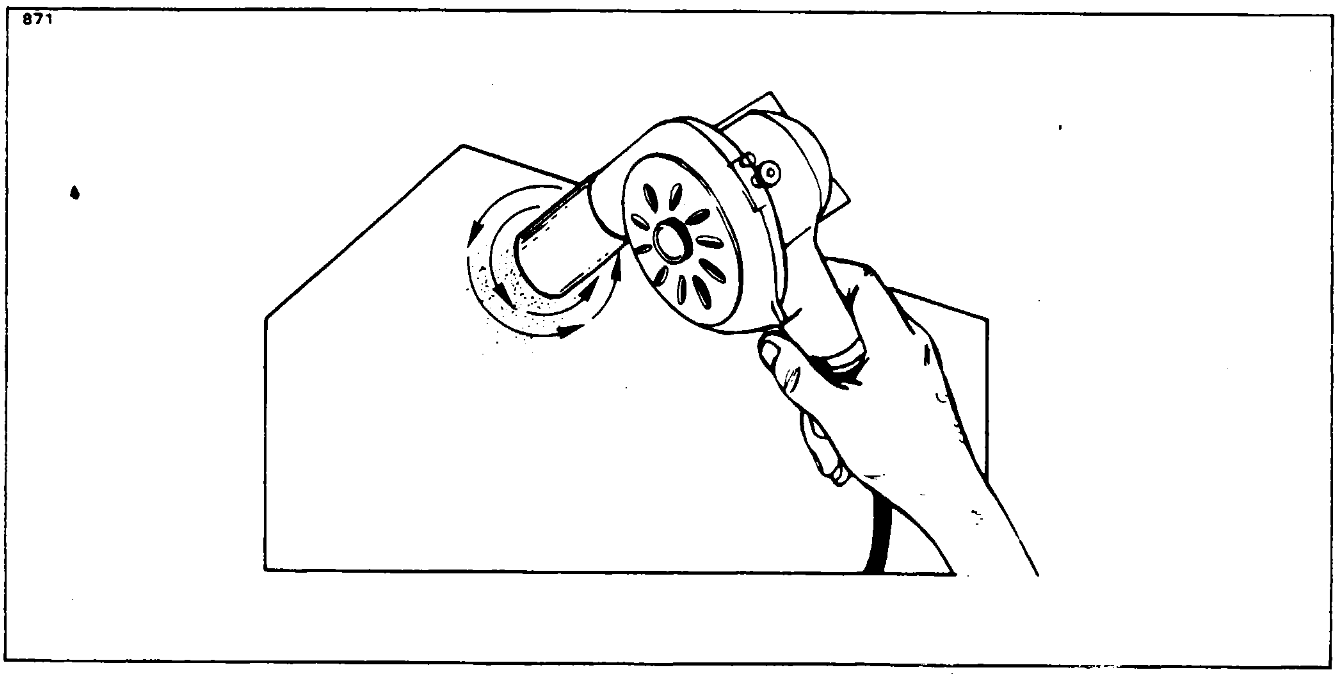


Figure 4-27. Surface Scratches, Abrasions or Ground-in-Dirt

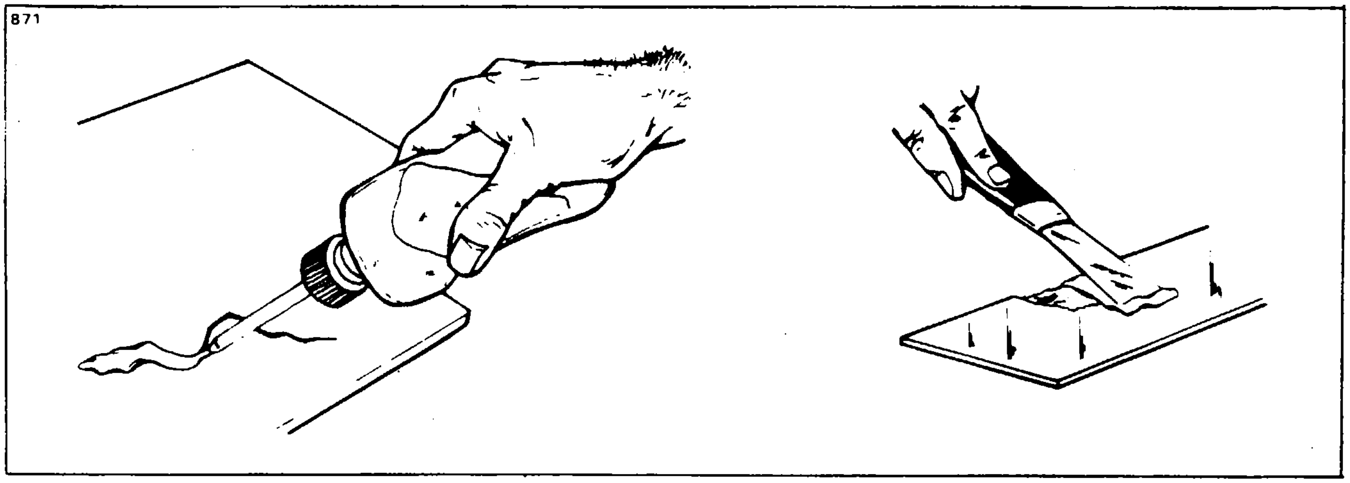


Figure 4-28. Deep Scratches, Shallow Nicks and Small Holes

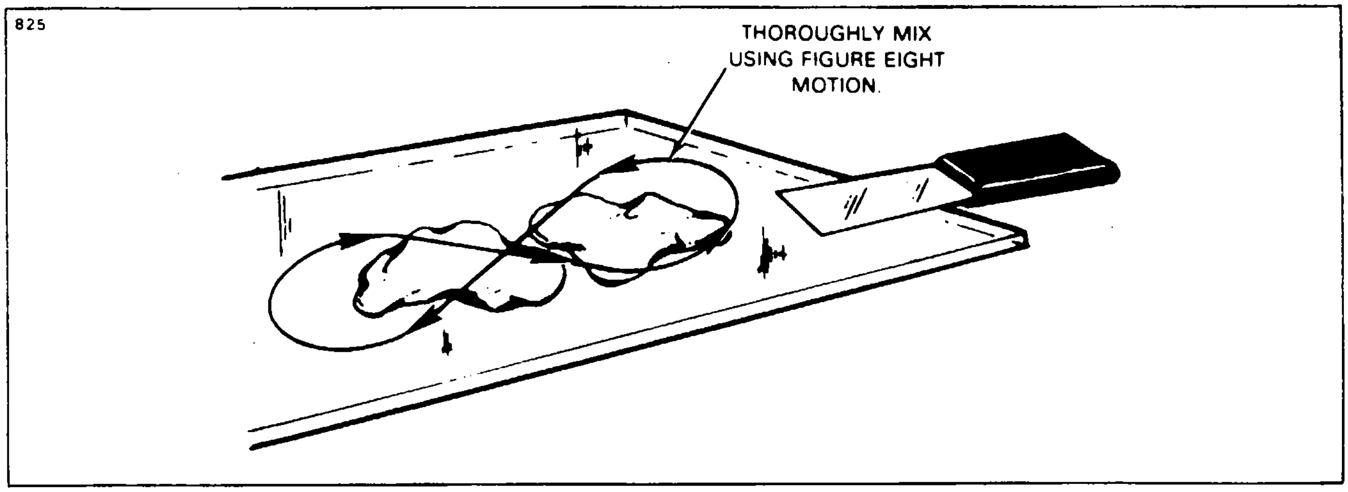


Figure 4-29. Mixing of Epoxy Patching Compound

4. For larger damages an epoxy patching compound is recommended. This type material is a two part, fast curing, easy sanding commercially available compound.

5. Adhesion can be increased by roughing the bonding surface with sandpaper and by utilizing as much surface area for the bond as possible.

6. The patching compound is mixed in equal portions on a hard flat surface using a figure eight motion. The damaged area is cleaned with perchlorethylene or VM&P Naptha prior to applying the compound. (Refer to Figure 4-29.)

7. A mechanical sander can be used after the compound is cured, providing the sander is kept in constant motion to prevent heat buildup.

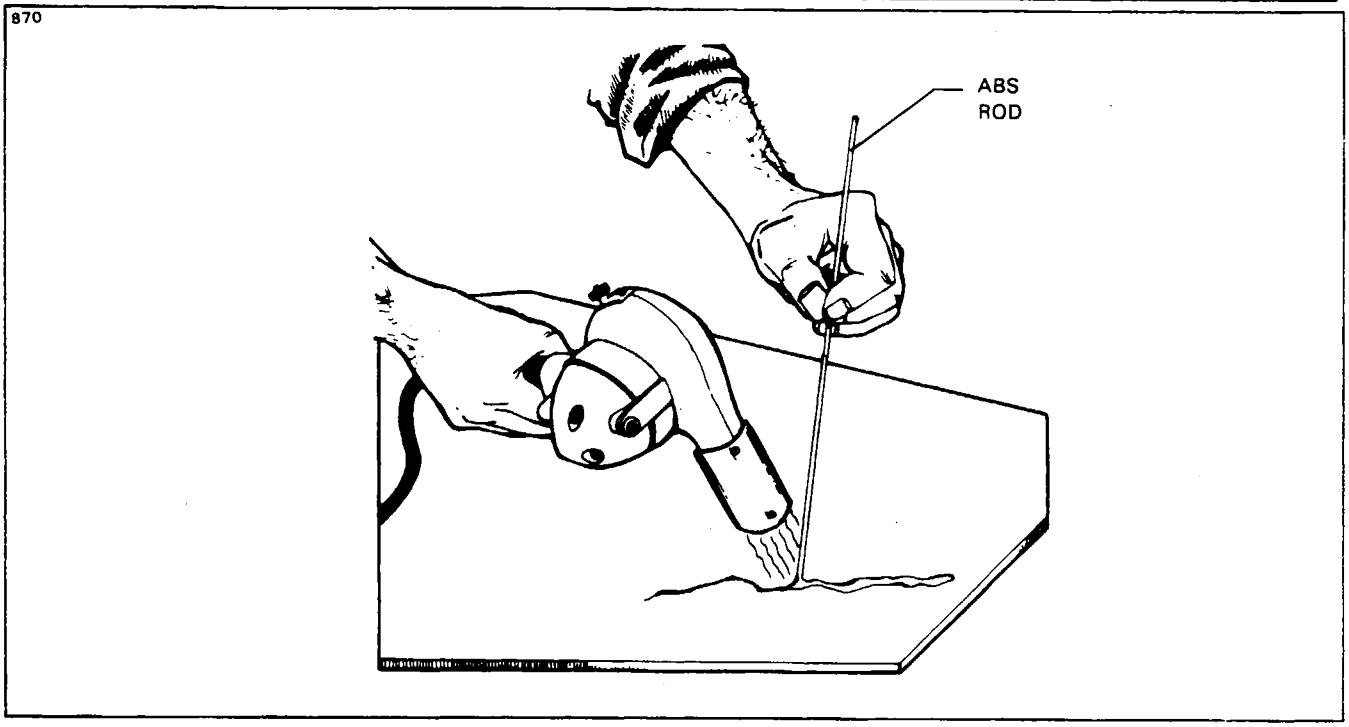


Figure 4-30. Welding Repair Method

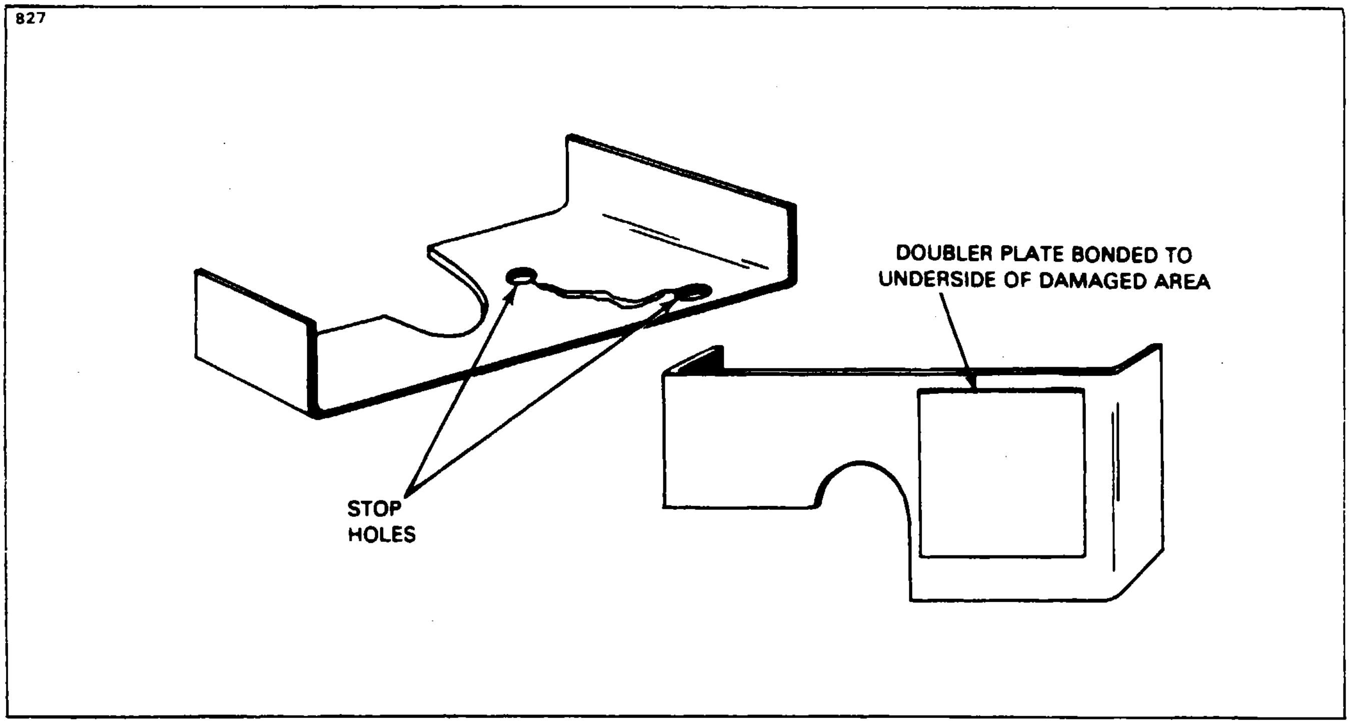


Figure 4-31. Repairing of Cracks

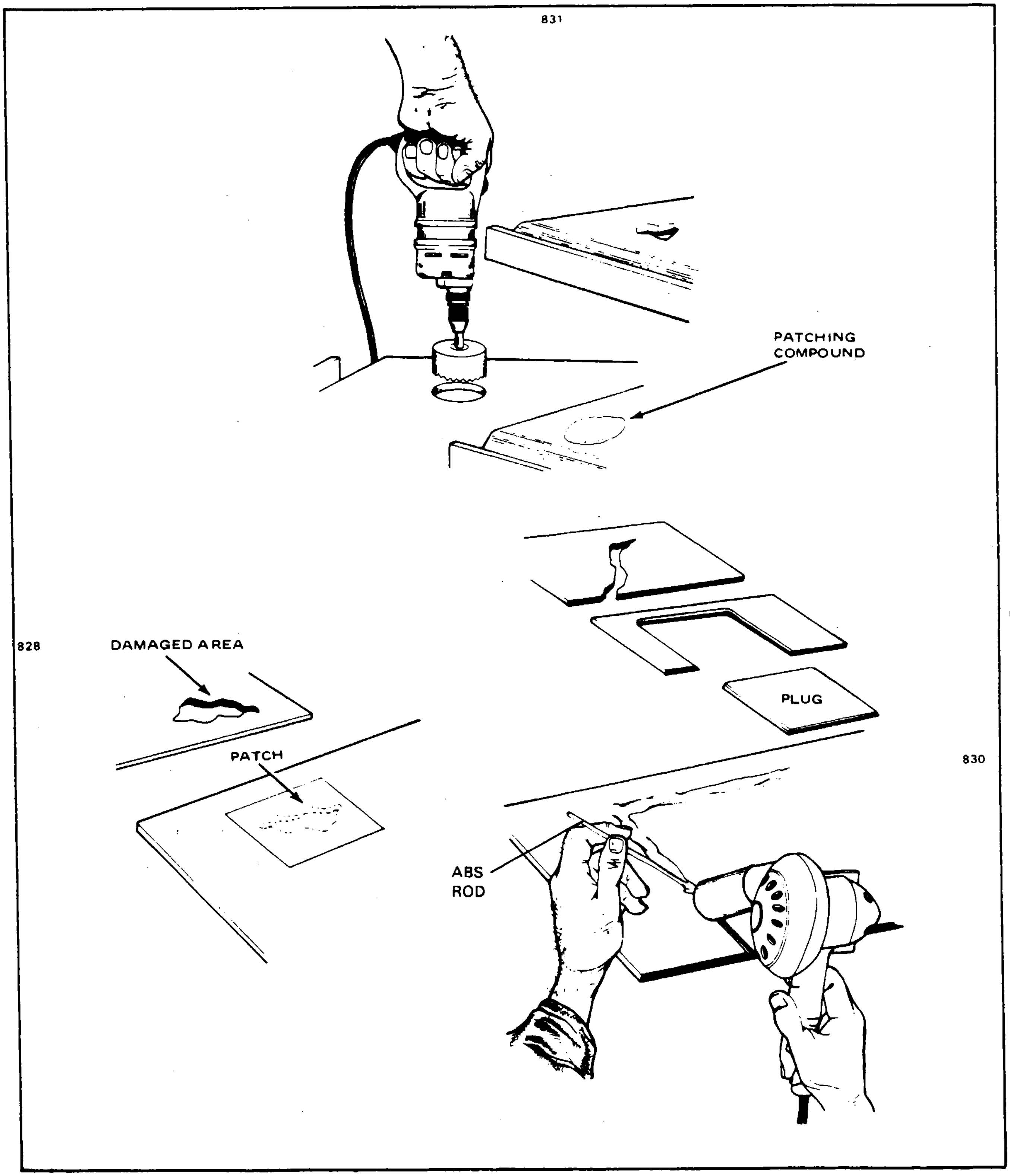


Figure 4-32. Various Repairs

8. For repairs in areas involving little or no shear stress, the hot melt adhesives, polyamids which are supplied in stick form may be used. This type of repair has a low cohesive strength factor.

9. For repairs in areas involving small holes, indentations or cracks in the material where high stress is apparent or thin walled sections are used, the welding method is suggested.

10. This welding method requires a hot air gun and ABS rods. To weld, the gun should be held to direct the flow of hot air into the fusion (repair) zone, heating the damaged area and rod simultaneously. The gun should be moved continuously in a fanning motion to prevent discoloration of the material. Pressure must be maintained on the rod to insure good adhesion. (Refer to Figure 4-30.)

11. After the repair is completed, sanding is allowed to obtain a surface of acceptable appearance.

d. Cracks: (Refer to Figure 4-31.)

1. Before repairing a crack in the thermoplastic part, first determine what caused the crack and alleviate that condition to prevent it recurring after the repair is made.

2. Drill small stop holes at each end of the crack.

3. If possible, a double plate should be bonded to the reverse side of the crack to provide extra strength to the part.

4. The crack should be "V" grooved and filled with repair material, such as solvent cement, hot melt adhesive, epoxy patching compound or hot air welded, whichever is preferred.

5. After the repair has cured, it may be sanded to match the surrounding finish.

e. Repairing Major Damage: (Larger than 1 inch in diameter.) (Refer to Figure 4-32.)

1. If possible a patch should be made of the same material and cut slightly larger than the section being repaired.

2. When appearances are important, large holes, cracks, tears, etc., should be repaired by cutting out the damaged area and replacing it with a piece of similar material.

3. When cutting away the damaged area, under cut the perimeter and maintain a smooth edge. The patch and/or plug should also have a smooth edge to insure a good fit.

4. Coat the patch with solvent adhesive and firmly attach it over the damaged area.

5. Let the patch dry for approximately one hour before any additional work is performed.

6. The hole, etc., is then filled with the repair material. A slight overfilling of the repair material is suggested to allow for sanding and finishing after the repair has cured. If patching compound is used the repair should be made in layers, not exceeding a 1/2 inch in thickness at a time, thus allowing the compound to cure and insuring a good solid buildup of successive layers is required.

f. Stress Lines: (Refer to Figure 4-33.)

1. Stress lines produce a whitened appearance in a localized area and generally emanate from the severe bending or impacting of the material.(Refer to Figure 4-34.)

2. To restore the material to its original condition and color, use a hot air gun or similar heating device and carefully apply heat to the affected area. Do not overheat the material.

g. Painting the Repair:

1. An important factor in obtaining a quality paint finish is the proper preparation of the repair and surrounding area before applying any paint.

2. It is recommended that parts be cleaned prior to painting a commercial cleaner or a solution made from one-fourth cup of detergent mixed with one gallon of water.

3. The paint used for coating thermoplastic can be either lacquers or enamels depending on which is preferred by the repair facility or customer. (SEE NOTE.)

NOTE

It is extremely important that solvent formulations be considered when selecting a paint, because not all lacquers or enamels can be used satisfactorily on thermoplastics. Some solvents used in the paints can significantly affect and degrade the plastic properties.

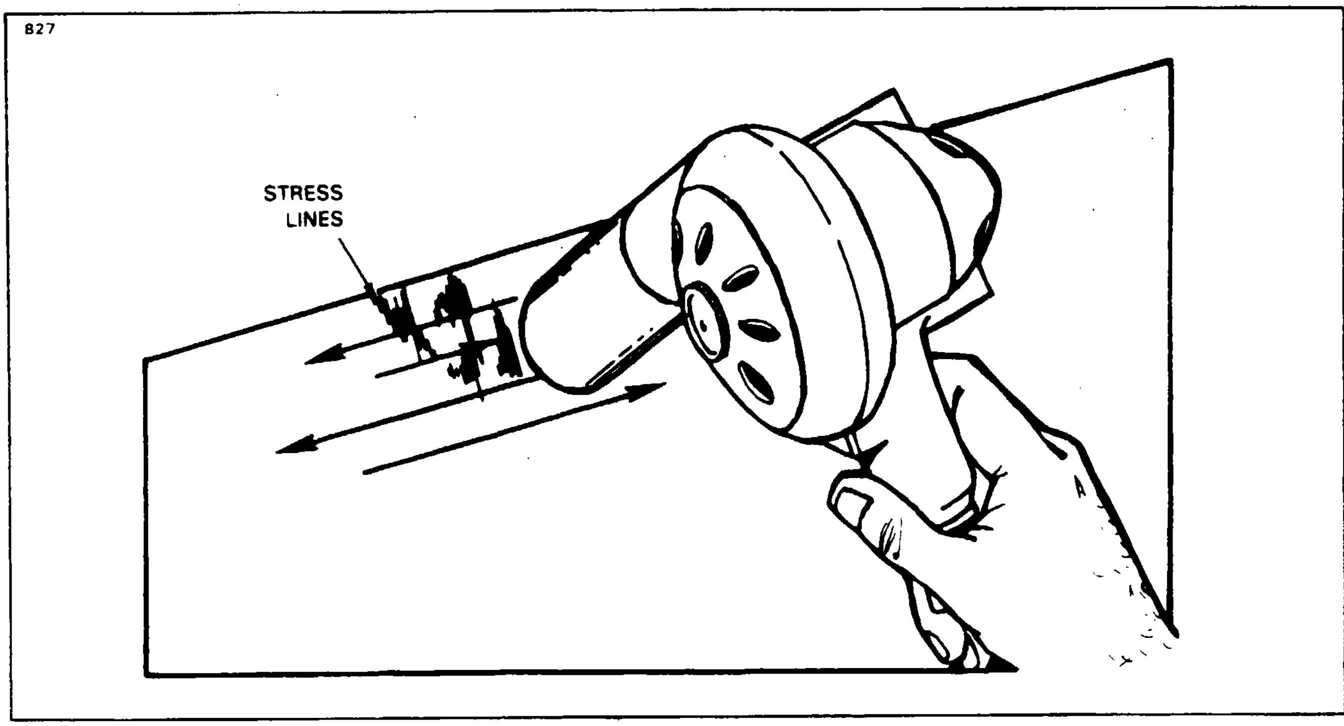


Figure 4-33. Repair of Stress Lines

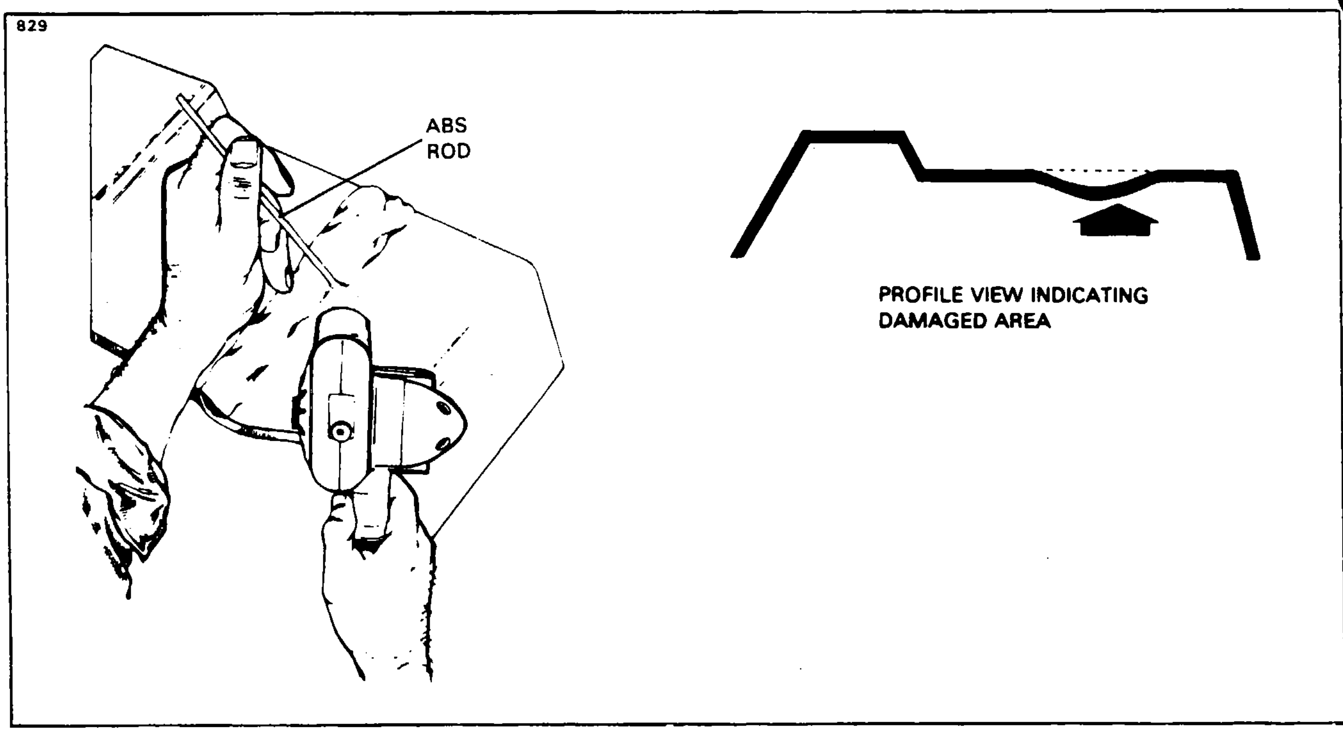


Figure 4-34. Repair of Impacted Damage

4. Another important matter to consider is that hard, brittle coatings that are usually best for abrasion resistance should not be used in areas which incur high stress, flexing or impact. Such coating may crack, thus creating a weak area.

4-75. SAFETY WALK REPAIR.

4-76. SURFACE PREPARATION.

a. Clean all surfaces with a suitable cleaning solvent to remove dirt, grease and oils. Solvents may be applied by dipping, spraying or mopping.

b. Insure that no moisture remains on the surface by wiping with a clean dry cloth.

c. Outline the area to which the liquid safety walk compound is to be applied, and mask adjacent surfaces.

NOTE

Newly painted surfaces shall be allowed to dry for 2.5 hours minimum prior to the application of the safety walk.

4-77. PRODUCT LISTING FOR LIQUID SAFETY WALK COMPOUND. (PPS-45010-1)

a. Suggested Solvents:
   Safety Solvent per MIL-S-18718
   Sherwin Williams Lacquer Thinner R7KC120
   Glidden Thinner No. 207

b. Safety Walk Material:
   Walkway Compound and Matting Nonslip (included in Piper Code No. 179 872)

4-78. APPLICATION OF LIQUID SAFETY WALK COMPOUND. Liquid safety walk compound shall be applied in an area, free of moisture for a period of 24 hours minimum after application. Do not apply when surface to be coated is below 50°F. Apply liquid safety walk compound as follows:

a. Mix and thin the liquid safety walk compound in accordance with the manufacturer's instructions on the container.

b. Coat the specified surfaces with a smooth, unbroken film of the liquid safety walk compound. A nap type roller or a stiff brush is recommended, using fore and aft strokes.

c. Allow the coating to dry for 15 minutes to one hour before recoating or touch-up; if required after application of the initial coating.

d. After recoating or touch-up, if done, allow the coating to dry for 15 minutes to one hour before removing masking.

NOTE

The coated surface shall not be walked on for six hours minimum after application of final coating.

4-79. SURFACE PREPARATION FOR PRESSURE SENSITIVE SAFETY WALK. The areas to which the pressure sensitive safety walk is to be installed must be free from all contaminates and no moisture present. If liquid safety walk is installed the area must be prepared as follows:

a. Area must be masked off to protect painted surfaces.

b. Apply suitable stripper MEK Federal Spec. TT-M-261, U.S. Rubber No. 3339 to wingwalk compound. As compound softens remove by using putty knife or other suitable tool.

c. Area must be clean and dry prior to painting.

d. Prime and paint area.

NOTE

Newly painted surfaces, shall be allowed to dry for 2.5 hours minimum prior to the application of the safety walk.

4-80. APPLICATION OF PRESSURE SENSITIVE SAFETY WALK. Wipe area with a clean dry cloth to insure that no moisture remains on surface. Do not apply when surface temperature is below 50° F. Apply pressure sensitive safety walk as follows:

a. Peel back the full width of the protective liner approximately 2 inches from the leading edge of the safety walk.

b. Apply the safety walk to the wing area, begin at the leading edge, insure proper alignment and position from wing lap.

c. Remove the remaining protective liner as the safety walk is being applied from front to back of wing area.

d. Roll firmly with a long handled cylindrical brush in both lengthwise directions. Make sure all edges adhere to the wing skin.

e. Install and rivet leading edge retainer.

4-81. SHOULDER HARNESS INERTIA REEL ADJUSTMENT.

a. Allow the harness to wind up on the reel as much as possible.

b. On the end of the reel, pry off the plastic cap over the spring, making sure the spring does not come out of the plastic cap, and set cap aside.

c. Unwind the harness completely, then measure and mark the harness 24 inches from the reel center.

d. Wind the harness onto the reel until the 24 inch mark is reached, then hold reel and place cap with spring over the reel shaft end.

e. Aligning slot in shaft with spring tank, wind spring 6 turns ± 1/2 turn and snap in the plastic cover into holes in reel end shaft.

f. Release harness and allowing it to wind up, extend the harness a few times to check reel for smooth operation.

g. With reel fully wound, hold with inertia mechanism end up and pry off plastic cap over mechanism and set reel aside.

h. Install nut in plastic cap so that stud in cap is flush with nut surface, then reposition cap over reel end and orientating properly, snap in place. Extend harness a few times to make sure action is correct.

SECTION

V

SURFACE CONTROLS

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SECTION V

SURFACE CONTROLS

5-1. INTRODUCTION.

This section provides the removal, installation, and rigging and adjustment procedures for the control assemblies of the various structural surfaces. For the removal and installation of the structural surfaces of the airplane, refer to Section IV. The assemblies need not be removed in order of paragraphs since each paragraph describes the individual removal and installation of a component.

5-2. DESCRIPTION.

The primary flight controls of PA-23 series airplanes are of the conventional type, operated by dual control wheels and rudder pedals. A system of cables, pulleys, push-pull rods and bellcranks transfer the movement of the control wheel, control column and rudder pedals to the ailerons, stabilator and rudder.

The aileron controls consist of two-control wheels connected by torque tubes to sprockets on each end of the control column cross member. A chain is wrapped around the sprockets and around a double adjustable sprocket on the vertical post of the control column. The chain is connected to the two piece primary aileron control cable which is routed along the sides of the fuselage to the main spar, where the two pieces are permanently fastened together, and out through the wings to a bellcrank in each wing. A one-piece balance cable is also connected between the bellcranks. As the control wheels are moved, the control cables move the bellcranks and actuate push-pull rods to move the ailerons.

The stabilator controls are also connected to the control column on the top left side. From the connecting point, cables are routed around a series of pulleys down under the floor and aft to the tail section of the airplane. The aft end of each cable connects to the stabilator balance arm which in turn is attached to the stabilator torque tube. As the control wheels are moved forward or aft, the cables movethe balance arm up and down, thus turning the torque tube and stabilator .

The rudder is controlled by the pilot's and copilot's rudder pedals. The rudder pedals also control the nose wheel steering on the ground which is explained in Section VII. Cables are connected to both sides of the rudder pedal assemblyand are routed aft throughthe bottom of thefuselagetothe rudder horn. As rudder pedals are pushed, the cables move in opposite directions turning the rudder horn and rudder.

Stabilator and rudder trim are controlled by hand crank systems located within the cockpit ceiling. As each crank is turned the movement is transferred to the particular trim drum in the tail section. With the rotation of the drums, a screw is moved through the drum, moving a push-pull rod connected to the trim tab. An indicator wire is connected which transmits an indication of trim position to the indicator located in the cockpit ceiling. On PA-23-250 (six place) airplanes with Serial Nos. 27-7654001 and up, a trim tab interconnect system is installed which connects the flap actuation to the stabilator trim tab. On PA-23-250 (six place) airplanes with Serial Nos. 27-8054001 and up a control column bobweight is installed.

The wing flap system is operated by the hydraulic system of the airplane and is described in Section VI. Non-hydraulic components and rigging of the flaps are discussed in this section.

For a visual description of the various control systems, refer to the illustrated figures throughout this section.

5-3. TROUBLESHOOTING.

Troubles peculiar to the control system are listed in Table V-II at the back of this section, along with their probable causes and suggested remedies.

5-4. STANDARD PROCEDURES.

The following tips may be helpful in the removal, installation, and rigging of individual control system assemblies.

a. It is recommended, though not always necessary, to level and place the airplane on jacks during rigging and adjustment of controls.

b. Remove tumbuckle barrels from cable ends before withdrawing cables through structures.

c. Tie a cord to cable end before drawing cable through structures to facilitate reinstallation of cable.

d. Turnbuckle stations are given at neutral position.

e. Mark cable ends, etc., before disconnecting, use a felt tip marking pen.

f. Assemble and adjust the turnbuckles so that each terminal is screwed an approximately equal distance into the barrel. Do not turn the terminals in such a manner that will put a permanent “twist” into the cables.

g. Cable tensions should be taken with the appropriate surface control in its neutral position.

NOTE: Cable rigging tensions specified must be corrected to ambient temperature in the area where the tension is being checked, using Table V-i. When installing new cables, initially tension them 20 to 30 % over nominal tension, then loosen them to the “High Side” of the tolerance. This “pre-stretching” will aid in maintaining specified tension after flight testing.

h. Check all cable ball ends for proper seating in retainers after setting cable tension.

i. After completion of each adjustment, check the turnbuckles to be sure not more than three terminal threads are visible outside the barrel. Install the locking clips, and check for proper installation by trying to remove the clips using fingers only. Both locking clips may be installed in opposite holes. Locking clips which have been installed and removed must be scrapped and not reused. Turnbuckles may be safetied in accordance with Advisory Circular 43.13-1, latest revision.

j. When pushrods or rod ends are provided with an inspection hole, the screw must be screwed in far enough to pass the inspection hole. This can be determined visually or by feel, inserting a piece of wire into the inspection hole. If no hole is provided, there must be a minimum of .375 (3/8) of an inch thread engagement.

k. To remove or install any unit of an AutoPilot, refer to grid 5A9 for the appropraite Piper Service Manual.

l. When installing/adjusting rod end jamnuts, refer to Figure 5-2 for proper method. .

m. After completion of adjustments, each jam nut must be tightened securely.

NOTE: Torque all nuts in the flight control system (including nose wheel steering). Refer to Table II-IV.

n. Ensure all pulley guard pins are properly installed and secured.

5-4a. FLIGHT CONTROL SURFACE TRAVEL.

See Table V-I for specifications, see appropriate paragraph for rigging instructions.

5-4b. FLIGHT CONTROL CABLE TENSION.

CAUTION: CABLE TENSIONS GIVEN IN CHART 2 APPLY ONLY TO AIRPLANES WITHOUT AUTOPILOT BRIDLE CABLE INSTALLATIONS. IF AN AUTOPILOT USING BRIDLE CABLES HAS BEEN INSTALLED, CONSULT THE APPROPRIATE AUTOPILOT VENDOR PUBLICATION FOR CORRECT CABLE TENSIONS WITH AUTOPILOT BRIDLE CABLES ATTACHED.

a. See Table V-I for specifications, see appropriate paragraph for rigging instructions.

b. When a new cable is installed, cable tension must be rechecked after flight test.

TABLE V-i. CABLE TENSION VS. AMBIENT TEMPERATURE

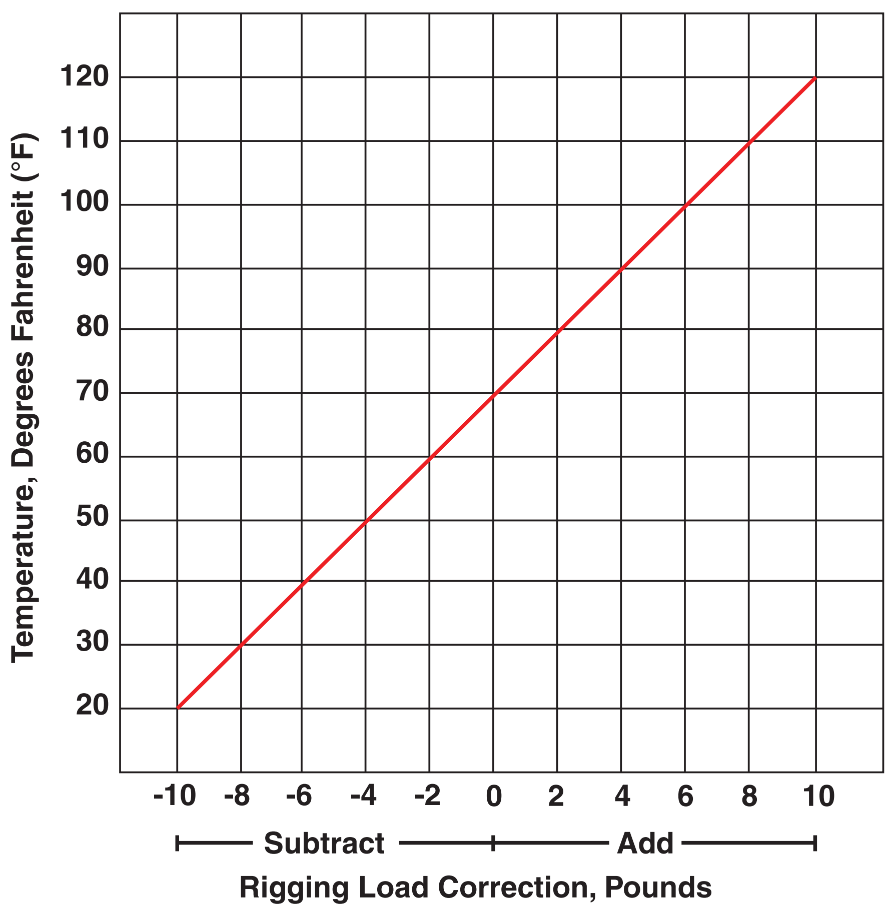

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TABLE V-I. FLIGHT CONTROL SURFACES RIGGING LIMITS

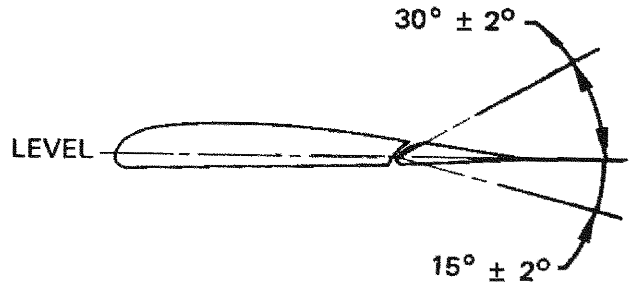
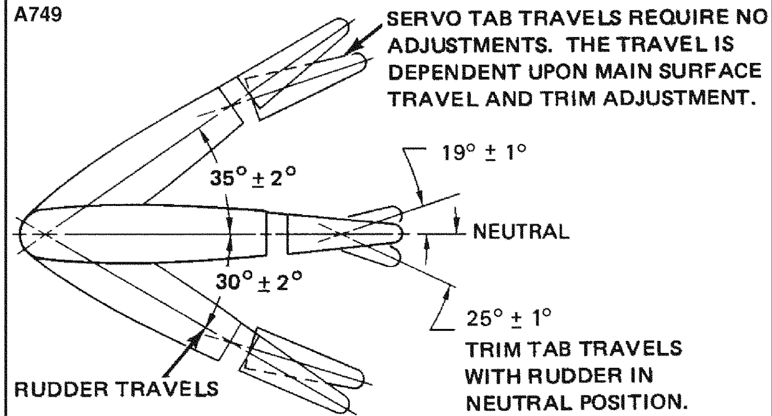
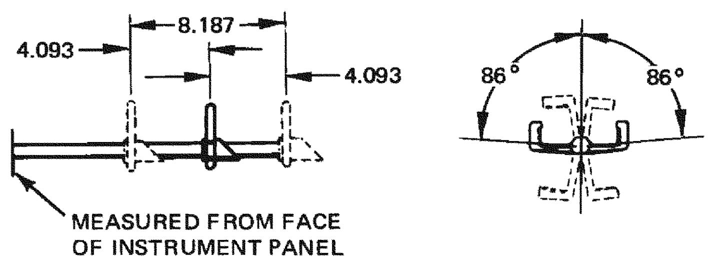
Aileron	A750 
Rudder Rudder Servo Tab Rudder Trim Tab	A749 
Flap	50° ± 2° Down
Control Wheel	A756 
Rudder Pedal	Neutral 12° aft of vertical Neutral to fwd 18.5°, 2.45 in. Neutral to aft 21.5°, 2.843 in. 40°, 5.293 Total

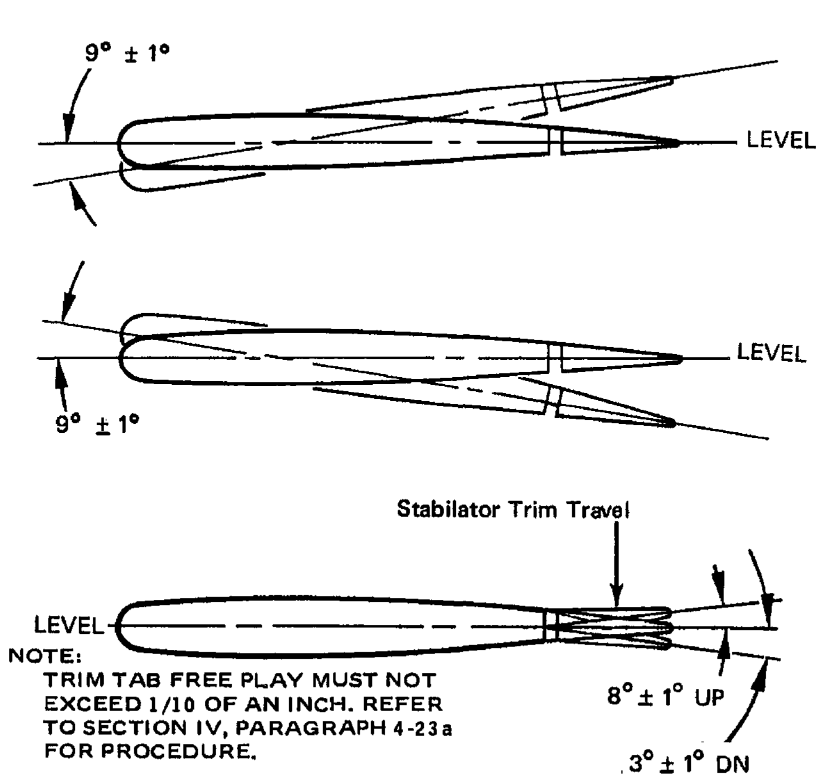
TABLE V-I. FLIGHT CONTROL SURFACES RIGGING LIMITS (cont.)

32635AM

Stabilator
Stabilator Anti-Servo Travel

Serial Nos. 27-1 to 27-4573 inclusive except 27-4426

(PA-23-250)



Stabilator
Stabilator Anti-Servo Travel

Serial Nos. 27-4426, 27-4574 to 27-7554168 incl., and 27-8054001

(PA-23-250)

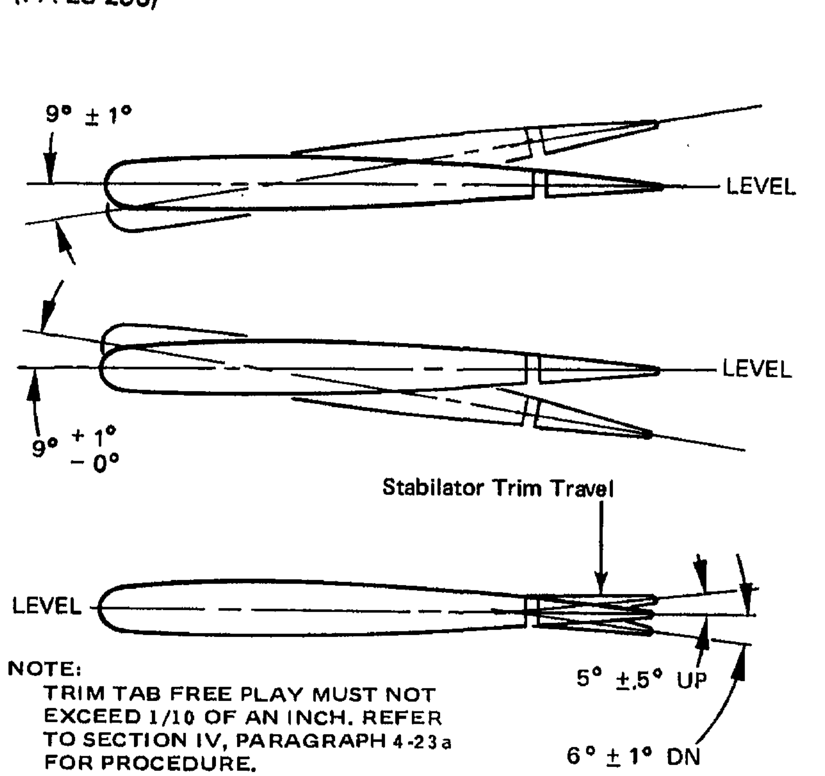
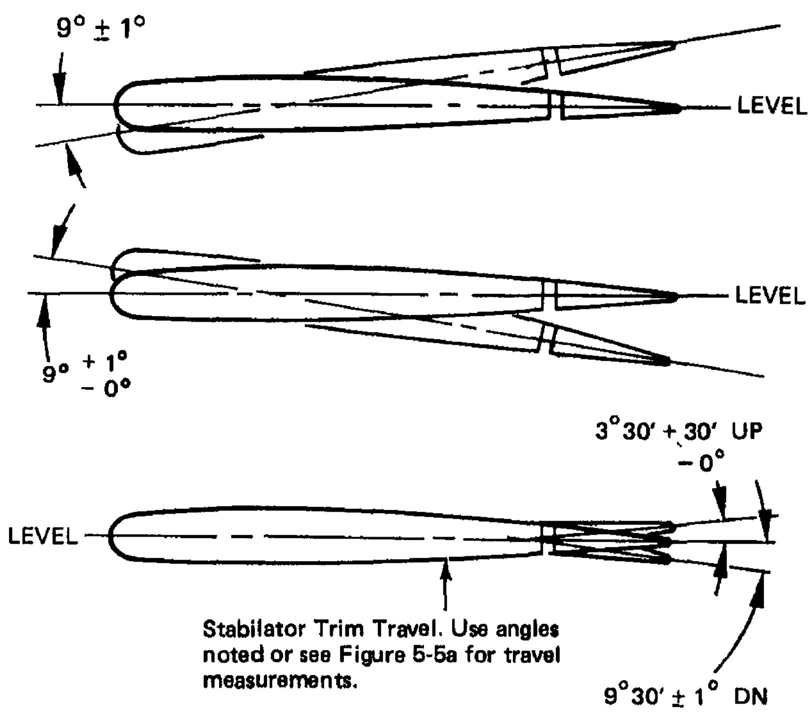


TABLE V-I. FLIGHT CONTROL SURFACES RIGGING LIMITS (cont.)

32635AM

Stabilator
Stabilator Anti-Servo Travel

(PA-23-250)



Serial Nos. 27-76540001 to 27-7954121 incl.

NOTE:
TRIM TAB FREE PLAY MUST NOT EXCEED 1/10 OF AN INCH. REFER TO SECTION IV, PARAGRAPH 4-23a FOR PROCEDURE.

CABLE TENSIONS:

AILERON	40 LBS + 25% -0%
STABILATOR	35 LBS +/- 10%
STABILATOR SERVO TAB*	15 LBS +/- 20%
RUDDER	30 LBS +/- 20%
RUDDER SERVO TAB	10 LBS +/- 20%
TRIM TAB INTERCONNECT**	30-60 LBS.

NOTE

CABLE TENSIONS GIVEN APPLY ONLY TO AIRPLANES WITHOUT AUTOPILOT BRIDLE CABLES ATTACHED. REFER TO APPROPRIATE AUTOPILOT SERVICE MANUAL FOR PROPER CABLE TENSIONS WHEN ATTACHING BRIDLE CABLES.

*WITH BUNGEE DISCONNECTED
**TENSION OF BOTH CABLES ADDED TOGETHER.

5-5. CONTROL COLUMN ASSEMBLY.

5-6. REMOVAL OF CONTROL COLUMN ASSEMBLY COMPONENTS. (Refer to Figure 5-1.)

a. Remove either control tube and wheel by removing the two nuts, washers and bolts from the forward end of the tube. Pull the tube through the instrument panel .

b. The control column roller guide assembly may be removed by the following procedure:

1. Disconnect the recoil strap spring (11) from the fuselage frame guide tube (3) by removing the bolt and self-locking nut holding it in place. (S/N 27-1 to 27-7554168 only.)

2. Cut the safety wire and remove the bolt, spacer (14), bushing (12) and roller (13) from each side of the guide tube.

3. Remove the bushing (12), spring (11), and roller mounting blocks (10) by removing the bolt, bushing, and self-locking nut.

c. The control wheel tube roller assembly (4) may be removed by the following procedure:

1. Remove the instrument trim panel that surrounds the control tube by removing attaching screws and disconnecting instrument lights behind the trim panel, if installed.

2. Remove the four screws from around the control wheel tube that secure the roller assembly.

3. If the control wheel assembly is still installed, remove the rolled assembly by removing the self-locking nut, machine screw, roller, and spring washer from one side and at the bottom of the assembly thus separating the unit. The assembly may be further disassembled as necessary.

d. Either sprocket assembly on the top of the control column may be removed by the following procedure:

1. Remove the chain (9) from the sprocket (15) by disconnecting the turnbuckles on either end of the chain.

2. Remove the bolt and self-locking nut on the forward side of the sprocket to be removed.

3. Remove the bolts installed through the forward end of the control wheel tube, if not previously removed.

4. Remove the sprocket shaft and universal joint (20) from the aft side of the tube.

5. Remove the two bearings (17) and shims (18 and 19), if installed.

e. Remove the center sprocket (2) by removing the attaching bolt and self-locking nut.

f. Remove the bottom center aileron pulley by removing the attaching nut, washer and bolt.

g. Remove the bearings from the bottom of the tube assembly as follows:

1. Remove the nuts from either end of the retaining rod installed through the tube.

2. Remove the retaining rod from the tube.

3. Move the tube away from the mounting brackets.

4. Remove the bearings from both ends of the bottom control tube.

h. On airplane with serial numbers 27-8054001 and up, remove the bobweight assembly as follows:

1. Remove the access panels on the left and right side of the fuselage nose section at station 51.00
2. Disconnect the bobweight control tube from the arm assembly.
3. Remove the lock nuts from the attachment rod extending through the arm assembly piviot and fuselage frame.
4. Remove the attachment rod, bobweight and arm assembly with the inserted bearing on both ends of the piviot tube.
5. The bobweight control tube may be removed from the control column by loosening the clamp from the protective boot inside the cockpit and disconnecting the tube rod end at the control column.

5-7. INSTALLATION OF CONTROL COLUMN ASSEMBLY COMPONENTS. (Refer to Figure 5-1.)

a. Install the bearings to the bottom of the tube assembly as follows:

1. Insert the bearings in both ends of the bottom control tube.
2. Align the tube with the mounting brackets on the floor.
3. Install the retaining rod through the brackets and the bottom control tube.
4. Secure the rod in place with attaching nuts on either end.

b. Install the bottom center aileron pulley with attaching bolt and self-locking nut.

c. Install the center sprocket (2) with attaching bolt and self-locking nut.

d. Install either sprocket assembly to the top of the control column by the following procedure:

1. Install a bearing (17) to each side of the tube for the sprocket to be installed.
2. Install the sprocket shaft and universal (20) through the aft side of the tube.

NOTE

It may be necessary to shim (.012, P/N 85012-58 and .018, P/N 85012-59) the shaft on the aft side to insure a proper fit between the bearings and the end of the universal joint. A .010 maximum clearance is permissible.

3. Install the sprocket (15) on the forward end of the shaft and secure with bolt and self-locking nut.
4. Install the universal (20) to the control wheel tube, if installed.

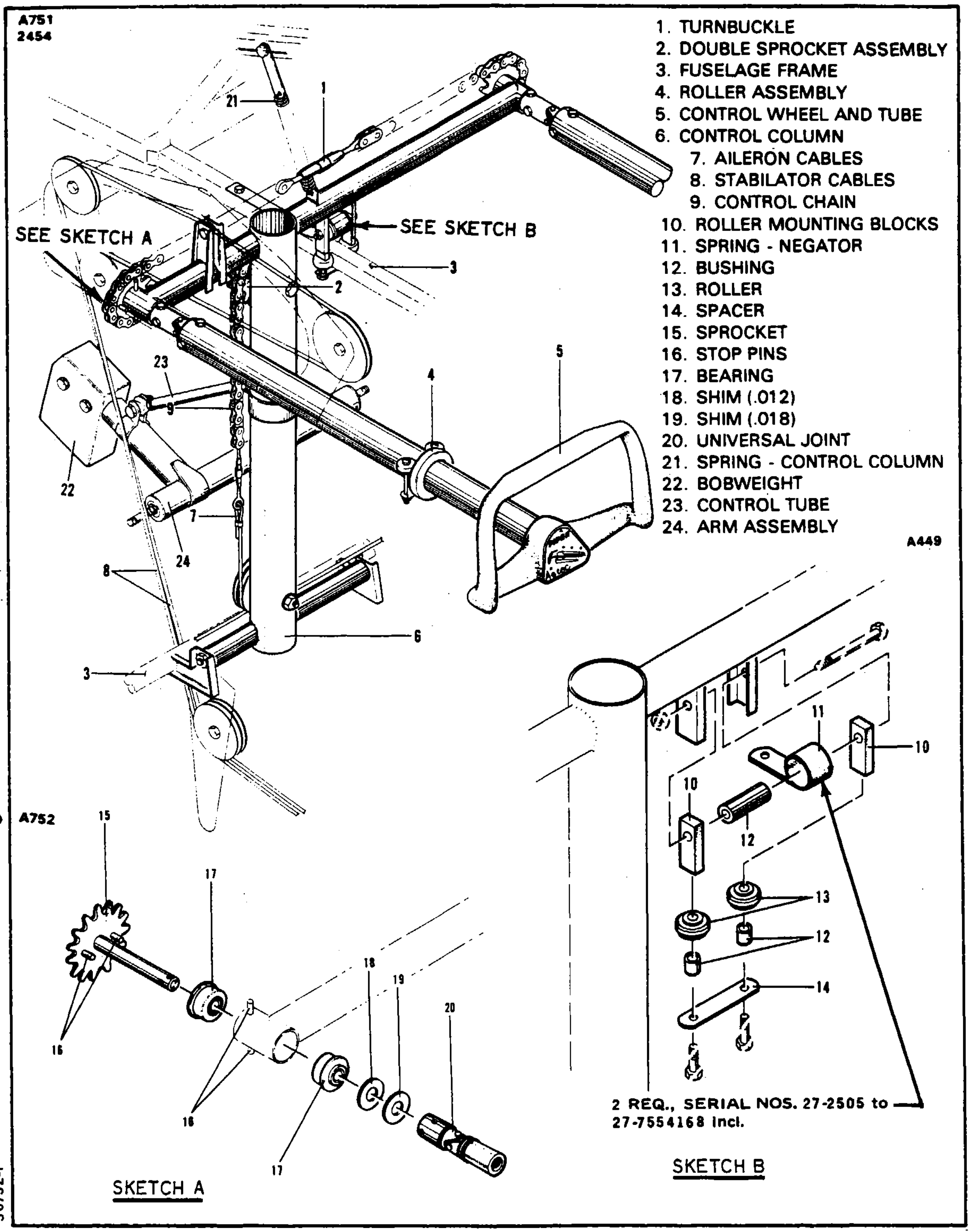


Figure 5-1. Control Column Installation

e. Install the control wheel tube roller assembly (4) by the following procedure:

1. If the control wheel tube is removed, install the assembled unit to the forward side of the instrument panel and secure with attaching screws.

2. If the control wheel tube is installed, assemble the unit around the tube, slide into position and secure to the forward side of the instrument panel with self-locking screws.

3. Position the control wheel in neutral (fore and aft) and adjust the roller attaching bolts until all three rollers contact the tube and the spring washers start to compress.

4. Install the instrument trim panel, if applicable, and connect the instrument lights, if installed.

f. Install the control column roller guide assembly by the following procedure:

1. Assemble the spring (11) to the bushing (12). (On Serial Nos. 27-2505 to 27-7554168, use two springs.)

2. Position the bushing (12), spring(s) (11), and roller mounting blocks (10) to the control column and secure with a bolt and self-locking nut. (No spring for 27-7654001 and up.)

3. Position the spacer (14) below the roller guide tube and install a bolt bushing (12) and roller (13), through the spacer, to each side of the guide tube.

g. Install the control tube and wheel (5) by inserting it through the instrument panel. Slide the tube over the aft end of the sprocket universal (20) and secure with attaching bolts and self-locking nuts.

h. On airplanes with serial numbers 27-8054001 and up install the bobweight assembly as follows:

1. Position the arm assembly with the bearings inserted in the piviot tube ends and the bobweight towards the nose of the airplane, between the fuselage frames at station 42.00.

2. Install the attachment rod through the frame and arm assembly. Secure the rod with locknuts. Ascertain that the arm assembly rotates freely.

3. If removed, install the control tube through the protective boot and connect the rod end to the control column.

4. Connect the control tube to the bobweight arm assembly.

5. Ascertain that there is clearance of 1.20 of an inch between the top surface of the bobweight and the fuselage cross tube at station 36.25 when the control wheel is in its aft most position (stabilator against the up stop).

6. Secure the boot to the control tube inside the cockpit after insuring full travel requirements. Install the access panels to the forward nose section.

5-8. AILERON CONTROLS.

5-9. REMOVAL OF AILERON CONTROL CABLES. (Refer to Figure 5-3.)

a. Remove the access plates located under each wing along the leading edge at stations 121.75 and 141.25.

b. Remove the wing root fairings from each wing by removing attaching screws.

c. Remove the top center section or access panel from each nacelle.

d. Remove the aileron control primary cable (3) by the following procedure:

1. Remove the front seats and tracks.
2. Remove the main spar cover by the following procedure:

(a) Remove the attaching screws around the fuel control pedestal.

(b) Remove the spar cover attaching screws by pulling the floor and side carpet back gaining access to the screws.

(c) Lean the fuel control pedestal forward slightly and remove the spar cover.

3. Remove the scuff plates below the rudder pedals.
4. Pull the carpet back around the rudder pedals and remove the pulley cover in each corner.
5. Disconnect the aileron cables at the control column by separating turnbuckle assemblies (8).
6. Remove the aileron cable pulley (9) on the control column by removing attaching nut, washers and bolt.
7. Remove the side carpet trim panels by removing the trim screws and the molding just under the cabin entrance door.
8. Remove the access panel on the left side of the nose section.
9. Remove the plastic tape from the edge of the left front floor plate around the rudder pedals.
10. Remove the machine screw from the forward outboard side of the floor plate by holding the nut inside the access opening in the nose.
11. Remove the machine screw from the aft outboard side of the floor plate.
12. Remove the left front pulley (7). Lift the left side of floor plate and remove the nut, washers and bolt.
13. Remove the access plate on the bottom right side of the fuselage.
14. Remove the right front pulley (7) by removing the nut, washers and bolt.
15. Remove the aileron rub-blocks (5) that are secured to the fuselage frame on each side of the forward cabin area.
16. Remove the aft aileron pulleys (15) by removing nut, washers, rub-block (12), guard clip (11) and bolt.
17. Draw the forward ends of the control cable back to the main spar.
18. Remove the wiring tube (19) and "U" bolt (18) on each side, located on the inboard wing rib (16).
19. Remove the guide pulleys (17) from the bracket just inside the inboard end of each wing. Move the wiring tube (19) out of the way and remove the nut, washers and bolt.
20. Remove the retaining cap from each rub-block (4) located inside the nacelle.
21. Remove the guard pins from the pulleys (1) at station 121.75 in each wing.

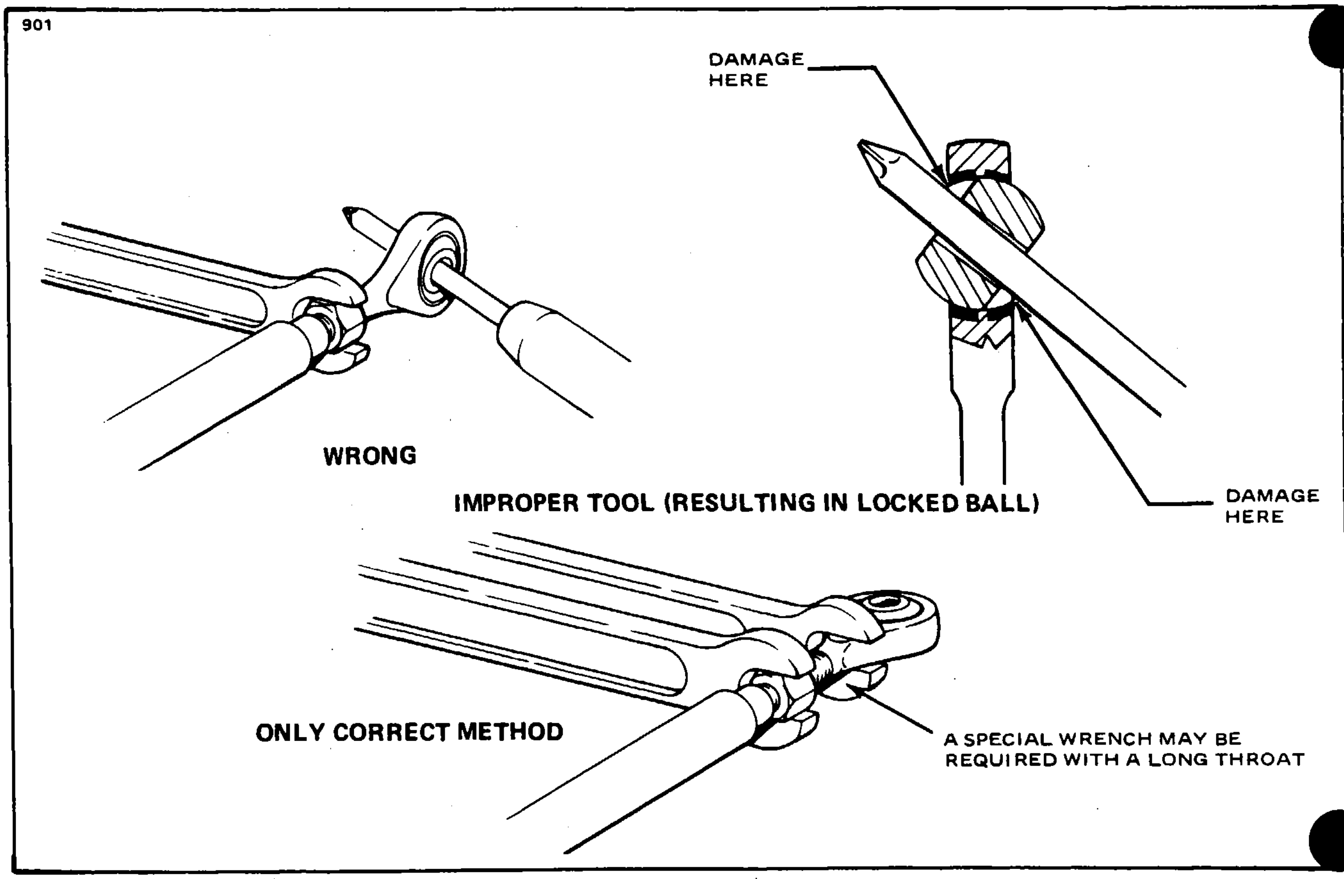
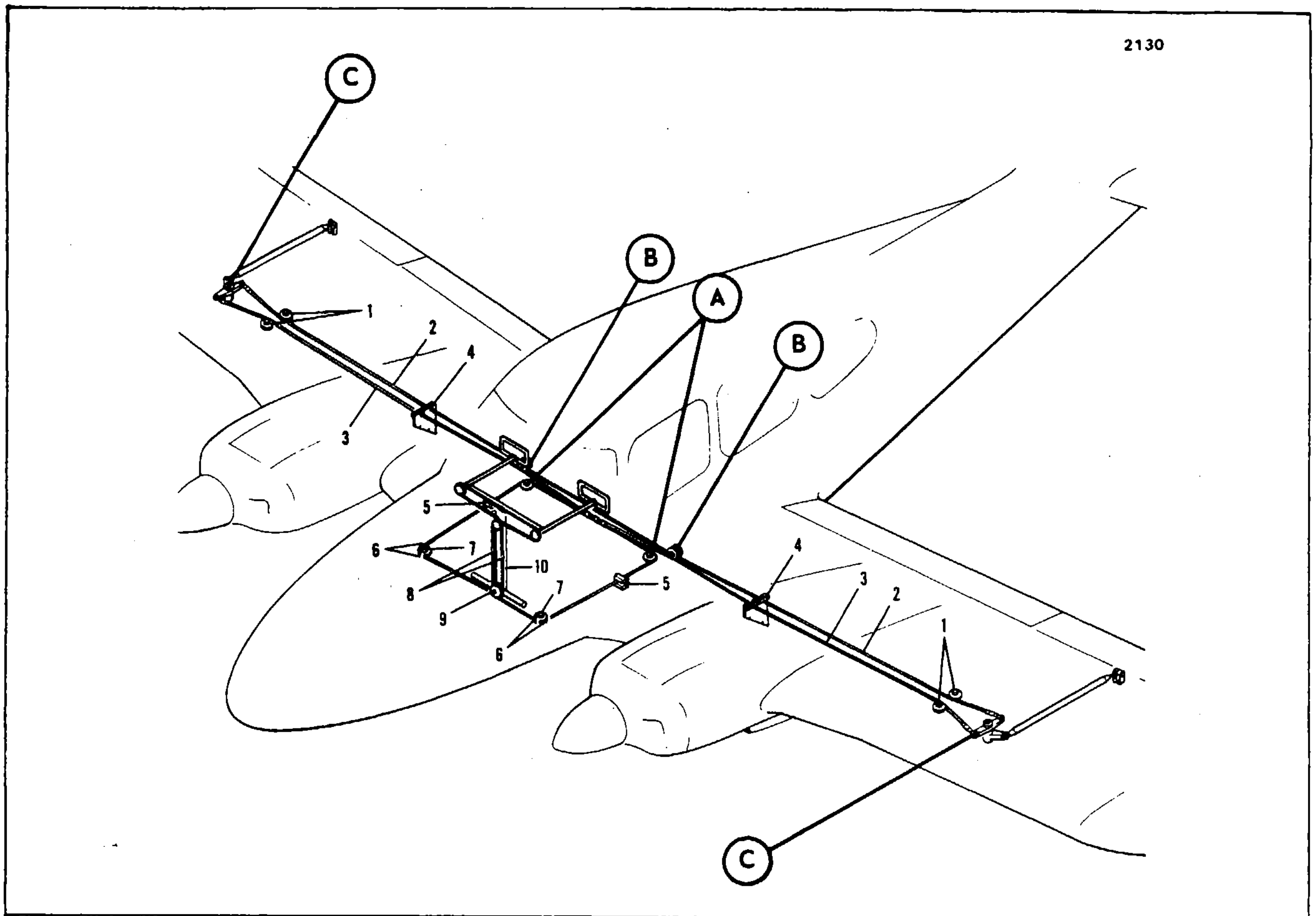


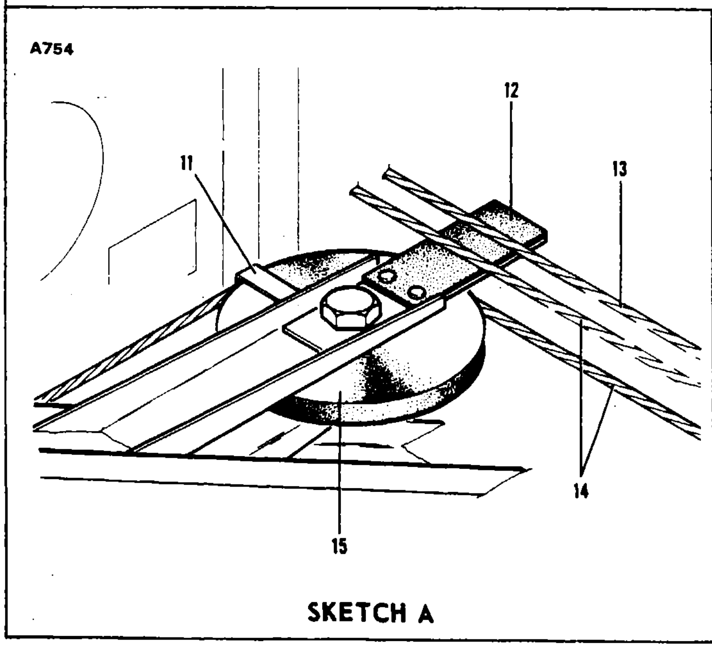
Figure 5-2. Correct Method of Installing Rod End Bearings

22. Separate the forward turnbuckle assembly at the aileron bellcrank (25) and remove the turnbuckle barrel.
23. Draw the cable through the wing into the fuselage.

e. Remove the aileron balance cable (2) by the following procedure:

1. Remove the wiring tube (19), "U" bolt (18) on each side located on the inboard wing rib (16), if not previously removed.
2. Remove the guide pulleys (17) from the bracket just inside the inboard end of each wing. Move the wiring tube out of the way and remove the nut, washers and bolt.
3. Remove the rub-block retaining cap (4) from each rub-block located inside the top center section of the nacelle.





1. PULLEYS
2. BALANCE CABLE
3. CONTROL CABLE
4. RUB BLOCK
5. RUB BLOCK
6. GUARD POSTS
7. PULLEY
8. TURNBUCKLES
9. PULLEY
10. CONTROL COLUMN
11. CABLE GUARD
12. RUB BLOCK
13. BALANCE CABLE
14. CONTROL CABLE
15. PULLEY
16. INBOARD WING RIB
17. PULLEYS
18. "U" BOLT
19. WIRING TUBE
20. GUARD PIN
21. CONTROL CABLE
22. BALANCE CABLE
23. AILERON CONTROL TUBE
24. TURNBUCKLE
25. BELLCRANK
26. BOLT STOP
27. ADJUSTMENT SCREW
28. STOP BLOCK

Figure 5-3. Aileron Controls

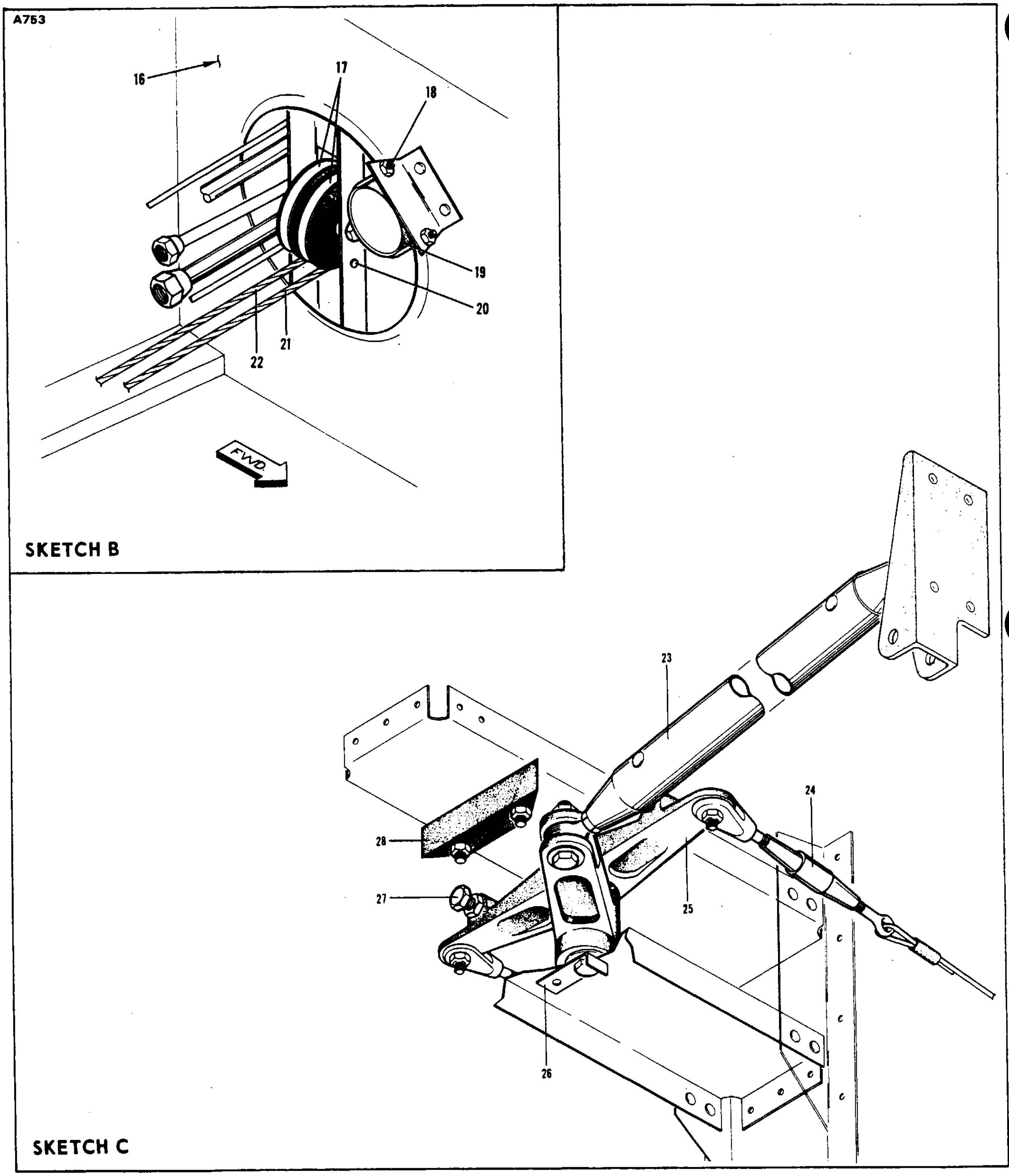


Figure 5-3. Aileron Controls (cont.)

NOTE

If an AltiMatic III or AutoControl III is installed, remove the bridle cable from the aileron balance cable inside the right engine nacelle. Remove the squeeze sleeve and the bridle cable clamp by removing three screws from each clamp.

4. Remove the guard pins from the pulleys (1) at station 121.75 in each wing.
5. Separate the aft turnbuckle assembly (24) at the aileron bellcrank.
6. Draw the cable through the fuselage, the wings, and the access hole at the aileron bellcrank.

5-10. INSTALLATION OF AILERON CONTROL CABLES. (Refer to Figure 5-3.)

a. Install the aileron balance cable (2) by the following procedure:
1. Insert the cable through the access hole at the aileron bellcrank and draw it through the wings and fuselage.
2. Connect the aft turnbuckle assembly (24) to the aileron bellcrank (25) with clevis bolt, washer, nut and cotter pin.
3. Hold the cable in the pulley slot and install a new guard pin through the pulley bracket at station 121.75.
4. Install the cables to the rub-block (4), located inside the top center section of each nacelle, and secure the retaining cap.
5. Install the pulleys (17) to the mounting bracket just inside the inboard end of each wing with bolt, washers and nut.
6. Move the wiring tube (19) on each wing into position and secure with a "U" bolt (18) to the inboard wing rib.

b. Install the aileron control cable (3) by the following procedure:
1. Insert the cable through the side of the fuselage and draw it through the wing.
2. Connect the forward turnbuckle assembly at the aileron bellcrank (25).
3. Hold the cable in the pulley slot and install a new guard pin through the pulley bracket at station 121.75.
4. Install the cables to the rub-block (4), located inside the top center section of each nacelle, and secure the retaining cap.
5. Install the pulleys (17) to the mounting bracket, just inside the inboard end of each wing, with bolt, washers and nuts.
6. Move the wiring tube (19) on each wing into position and secure with a "U" bolt (18) to the inboard wing rib.

7. Install the cable to the aft aileron pulleys (15) and secure in place with bolt, guard clip (11), rub-block (12), washers and nut.

8. Install the aileron rub-blocks (5) to the fuselage frame on each side of the forward cabin area.

9. Install the cable to the forward pulleys (7) and secure them in place with bolt, washers and nut.

10. Secure the left front floor plate using a machine screw in the aft left corner, and a bolt and nut in the forward left corner.

11. Apply plastic tape around the edge of the left front floor plate to cover rough edges and provide a seal between the floorboards and the plate.

12. Wrap the cables around the control column pulley (9) and install the pulley to the lower end of the control column with bolt, washers and nut.

13. Connect the turnbuckle assemblies (8) to the chain on the control column.

14. Install the pulley covers on the front floor plates on each side.

c. Set cable tension per Table V-I and check control cable rigging and adjustment per paragraph 5-13.

NOTE

If an autopilot is installed, consult the bottom of the Section XII (Electronics) Table of Contents page (Aerofiche Grid 5A9) for the part number of the appropriate Service Manual for information on installation of the bridle cable.

d. Install all access plates, panels and trim.

5-11. REMOVAL OF AILERON BELLCRANK ASSEMBLY. (Refer to Figure 5-3.)

a. Remove the access plate to the bellcrank assembly. (Refer to Access and Inspection Providions, Section II.)

b. Relieve cable tension from the control system by rotating one of the turnbuckles attached to the bellcrank.

c. Disconnect the turnbuckle ends from the forward and aft ends of the bellcrank (25) by removing cotter pin, nut, washer and clevis bolt.

d. Disconnect the aileron control tube (23) at the bellcrank.

e. Remove the pivot bolt securing the bellcrank by first bending the corners of the bolt stop (26) away from the nut and removing the nut and bolt.

f. Remove the bellcrank (25) from the wing.

g. The stop block (28) may be removed by unbolting it and removing it from the wing.

5-12. INSTALLATION OF AILERON BELLCRANK ASSEMBLY. (Refer to Figure 5-3.)

a. Install the stop block (28) and torque bolts, if previously removed.

b. Position the bellcrank (2S) with the adjustable stops (27) toward the outboard end of the wing.

c. Install the pivot bolt and nut.

d. Torque the nut, then bend the corners of the bolt stop (26) around the bolt holding it secure.

e. Connect the turnbuckle ends to the bellcrank with clevis bolt, washer and nut. Secure and safety with cotter pins. Do not tighten turnbuckle fork ends on bellcrank so tight that the ends cannot rotate.

f. Connect the aileron control tube (23) to the bellcrank (25) with bolt, nut and cotter pin.

g. Set cable tension and check rigging and adjustment of aileron controls as described in paragraph 5-13 .

h. Install access plate and secure.

5-13. RIGGING AND ADJUSTMENT OF AILERON CONTROLS. (Refer to Figure 5-4.)

NOTE: If an autopilot is installed, consult paragraph 12-13 for the part number of the appropriate Autopilot Service Manual for information on rigging and adjustment.

a. To rig the aileron controls, set the right and left aileron bellcranks m neutral position by attaching a fabricated aligning tool within both wings as shown in Figure 5-4. (This tool may be fabricated from dimensions given in Figure 5-16.) The fabricated tool may be installed by the following procedure:

   1. Remove the access plate to the aileron bellcrank just aft from the leading edge of each wing at station 141.1.
   2. Remove the bellcrank stop block by removing the self-locking nuts and bolts.
   3. Remove the cotter pin and nut from the forward turnbuckle clevis attached to the bellcrank. The bolt should not be removed.
   4. Position the tool to the bellcrank bracket with the tool pins inserted in the stop block attachment holes and the turnbuckle clevis attachment bolt inserted through the thin arm of the tool. Position the holding device in the lightening hole under the tool tightening the machine screw until the bellcrank tool is securely held in place. Do not over tighten the screw.

b. Check and adjust the aileron for neutral position by the following procedure:

   1. Place a straight-edge against the underside of the wing, with the aft end even with the trailing edge of the aileron. Do not place the tool over rivets.
   2. With the bellcrank neutral, the underside of the wing and aileron should fit flush with the straight edge. Apply a slight up pressure against the underside of the aileron at the trailing edge while making this check (or adjustment) to allow for free motion in the controls.

CAUTION: VERIFY FREE AND CORRECT MOVEMENT OF AILERONS. WHILE IT WOULD SEEM SELF-EVIDENT, FIELD EXPERIENCE HAS SHOWN THAT THIS CHECK IS FREQUENTLY MISINTERPRETED OR NOT PERFORMED AT ALL. ACCORDINGLY, UPON COMPLETION OF AILERON RIGGING AND ADJUSTMENT, VERIFY THAT THE RIGHT AILERON MOVES UP AND THE LEFT AILERON MOVES DOWN WHEN THE CONTROL WHEEL IS TURNED RIGHT; AND THAT THE LEFT AILERON MOVES UP AND THE RIGHT AILERON MOVES DOWN WHEN THE CONTROL WHEEL IS TURNED LEFT.

3. If the wing skin and the aileron skin do not contact the straight edge, disconnect the control tube from either the aileron or the bellcrank and rotate the tube and rod-end until the straight edge contacts both skin surfaces.

4. Connect the tube and tighten the rod end jam nuts.

NOTE

Be sure that there are no more than 9 rod end threads exposed on either end after adjustment has been made.

c. With the bellcranks in the neutral position, adjust the cable tension on the balance cable and the control cable between the bellcranks, using tensions given in Table V-I. Alternately adjust the balance and control cable turnbuckles.

d. Ascertain that the control wheels are in a parallel relationship with each other. If the control wheels are not parallel, adjust using the following procedure:

1. Loosen the vertical aileron turnbuckles at the control column.
2. Remove the chain from the center sprocket and one control wheel sprocket.
3. Holding the control wheels in a parallel relationship, reinstall the chain to the sprockets with the chain end turnbuckle hanging even.
4. Tighten the aileron cable turnbuckles.
5. If only a fine adjustment is needed, use the following procedure:
   (a) Loosen the two outside bolts through the center sprocket.
   (b) Adjust the chain turnbuckle to provide a parallel condition in the control wheels.

NOTE

Whenever the chain is moved or the chain turnbuckle adjusted, make sure there is no slack in the chain.

e. With the bellcranks in neutral position, adjust the cable tension on the control cable within the fuselage at the vertical turnbuckles or control column. Adjust to maintain a neutral-center alignment of control wheels.

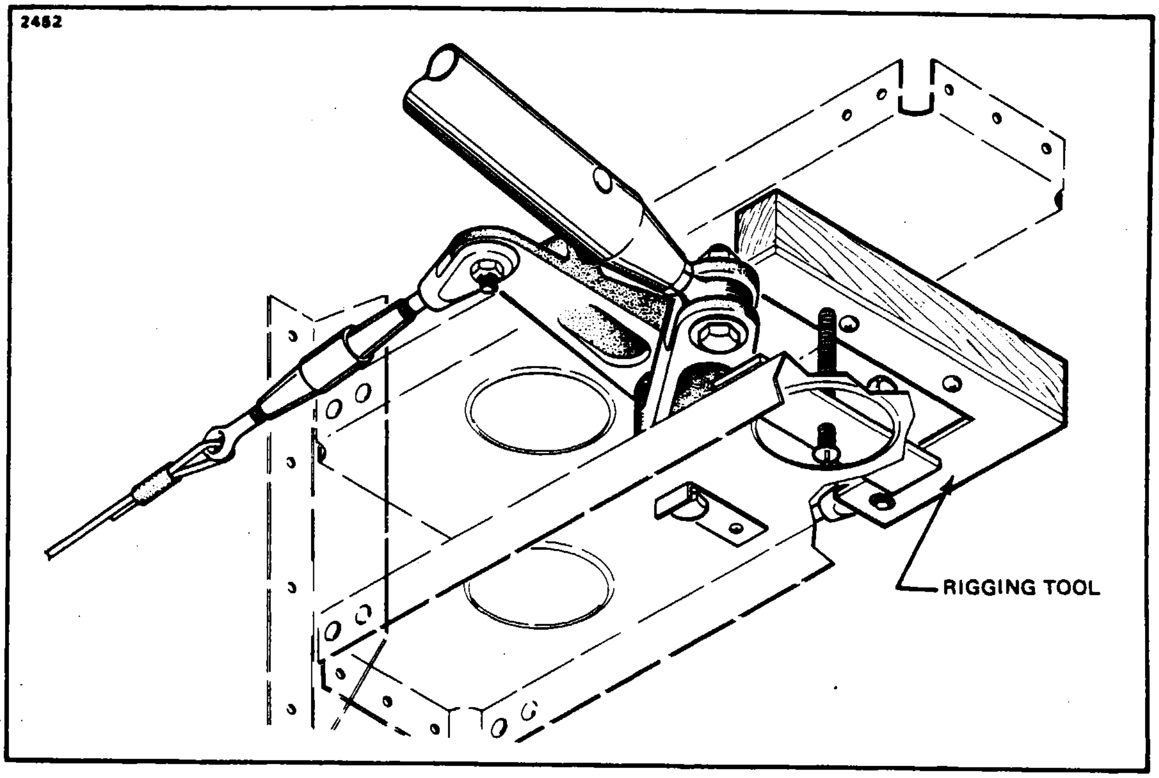


Figure 5-4. Installation of Aileron Bellcrank Rigging Tool

NOTE

It may be necessary to readjust the horizontal turnbuckle on the control column to maintain a parallel relationship between the control wheels. If this turnbuckle is adjusted, the vertical turnbuckles on the control column must be adjusted to maintain proper cable tension.

f. Tighten the nuts of the bolts installed through the center sprocket.

NOTE

When rigging has been completed, tension should be equal all through the system including the control chain.

g. With the aileron neutral, place a bubble protractor on the inboard section of the aileron and establish neutral or zero on the protractor. Remove the tools holding the aileron bellcranks in neutral, replace the aileron stop block and the nut and cotter pin on clevis attaching bolt, and safety. Adjust the bellcrank stop bolts to the specific aileron travel from neutral as given in Table V-I. Stops of both bellcranks should contact their stop blocks at the same time and before the control wheel contacts its stops.

NOTE

Later model PA-23-250(6) Aztecs have provided a means for safetying the aileron bellcrank stop screws. The appropriate parts must be lock-wired in such a manner that the lock-wire is put in tension should the stop screw or lock nut loosen. After starting the lock-wire thru the head of the screw, make one complete wrap around the shank of the screw next to the jam nut. Finish safety wiring thru holes provided in the bellcrank (the lock-wire should be installed and twisted so that the loop around the head stays down and does not tend to come up over the bolt head and leave a slack loop).

h. Check control operation, bolts and turnbuckles for safety and installation of cable guard pins.

i. Install access plates and panels.

5-14. AILERON TRIM. A fixed metal tab, which is adjustable on the ground for lateral trim of the airplane, is incorporated in the trailing edge of each aileron.

5-15. STABILATOR CONTROLS.

5-16. REMOVAL OF STABILATOR CONTROL CABLES. (Refer to Figure 5-5.)

a. Remove the bottom fuselage access panel by removing attaching screws.

b. Remove the access panel located on the left side of the fuselage just forward of the stabilator and the access plate on the underside of the fuselage, located just left of the wheel well.

c. Remove the seats from the airplane.

d. Remove the rear seat tracks.

e. Pull the floor carpet back from the aft cabin wall and remove the access plate from the left corner.

f. Remove the aft cabin trim panel or aft baggage compartment trim panel by removing attaching screws.

g. On PA-23-250 (six place) airplanes, remove the baggage compartment floor panel by removing the attaching screws.

NOTE

If the airplane is equipped with an oxygen system and removal of the oxygen cylinder is necessary, refer to Section XIV.

h. Relieve tension from the stabilator control cables by loosening one of the cable turnbuckles within the aft section of the fuselage.

i. Remove the guard pins (18) from the stabilator control pulley bracket (14) located on the top left side of the control column (16).

j. Remove the cable guard pins (18) from the stabilator pulley bracket (14) beneath the floor panel at station 44.25 by entering through the access opening to the left of the nose gear wheel well.

k. Disconnect the cables at the control column by removing cotter pin, nut, washer and bolt.

l. Draw the cable(s) (2) from the forward part of the fuselage aft to the main spar.

m. Remove the pulleys (1), just aft of the main spar at station 93.5, by removing the self-locking nut, washers and bolt.

n. Remove the cable guard pins from the stabilator pulleys (3) on both sides of the aft cabin area bulkhead at station 153.25.

o. On PA-23-250 and PA-23-250 (six place) airplanes, Serial Nos. 27-3050, 27-3154 and up, if removing the left stabilator cable, remove the cable guard pin from the stabilator pulley bracket just aft of the baggage compartment at station 193.0.

p. If removing the right stabilator cable, remove the fairlead from the fuselage bulkhead at station 192.4.

q. Disconnect the stabilator cable(s) from the aft cable(s) at the turnbuckle(s) in the aft section of the fuselage and draw the cable(s) forward to the main spar.

r. If required, the two aft cables attached to the balance tube may be removed by the following procedure:

1. Disconnect the cables from the balance tube by removing cotter pin, nut, washer and bolt.
2. For the removal of the upper cable, remove the fairlead from the bracket mounted to the bulkhead at station 257.5.
3. Remove the top and/or bottom stabilator pulley, as required, by removing nut, washer and bolt.
4. Remove the cable(s).

5-17. INSTALLATION OF STABILATOR CONTROL CABLES. (Refer to Figure 5-5.)

a. If either of the two cables attached to the balance tube were removed, reinstall by the following procedure:

1. Connect the two cables to the balance arm (40) with bolt, washers, nut and cotter pin.

2. Position the stabilator cables and pulleys (8) above and below the balance tube. Install a bolt, washers and a self-locking nut, securing each pulley in place.

3. For the upper cable, assemble the fairlead (12) to the cable and install it to the bracket mounted to the bulkhead at station 258.0.

b. Install the stabilator cables by drawing them aft from the main spar to the aft section of the fuselage and connect them to turnbuckles of the short cables connected to the balance tube.

c. Assemble the fairlead (11) to the lower cable and install it in the bulkhead at station 192.4.

d. On PA-23-250 (six place) airplanes, Serial Nos. 27-3050, 27-3154 and up, install a new cable guard pin to the bracket of the left cable pulley bracket, just aft of the baggage compartment, at station 193.0.

e. Install new cable guard pin(s) to the pulley bracket at the forward and/or aft side of the bulkhead, located to the lower rear of the tubular structure, at station 153.25.

f. Install the stabilator pulleys (1) just aft of the main spar at station 93.5 using a bolt, washer and self-locking nut.

g. Draw the forward end(s) of the cable(s) forward through the stabilator pulley bracket (14), located through the access opening, to the left of the nose gear wheel well at station 44.25.

h. Position the left cable over the top forward pulley (13) of the stabilator pulley control bracket (14) located at the top left of the control column (16). Temporarily connect the cable end to the control column.

i. Position the right cable over the bottom forward pulley (13) and around the aft pulley (13) of the stabilator pulley control bracket (14). Connect the cable ends to the control column with a bolt, washer, nut and cotter pin. Allow ends freedom to rotate.

CAUTION

Determine that no control cables are crossed, causing opposite control.

j. Install cable guard pins (18) to the control pulley bracket (14) and the bracket directly below at station 44.25.

k. On airplanes equipped with a stabilator bungee spring installation, install bungee spring (47) by attaching it to the adjuster link (50) and to link at station 192.3.

l. Adjust the cable tension and check rigging and adjustment of the stabilator per paragraph 5-18.

m. Safety turnbuckles; install access plates, panels, carpet, trim; and in PA-23-250 (six place) airplanes, the aft baggage compartment floor.

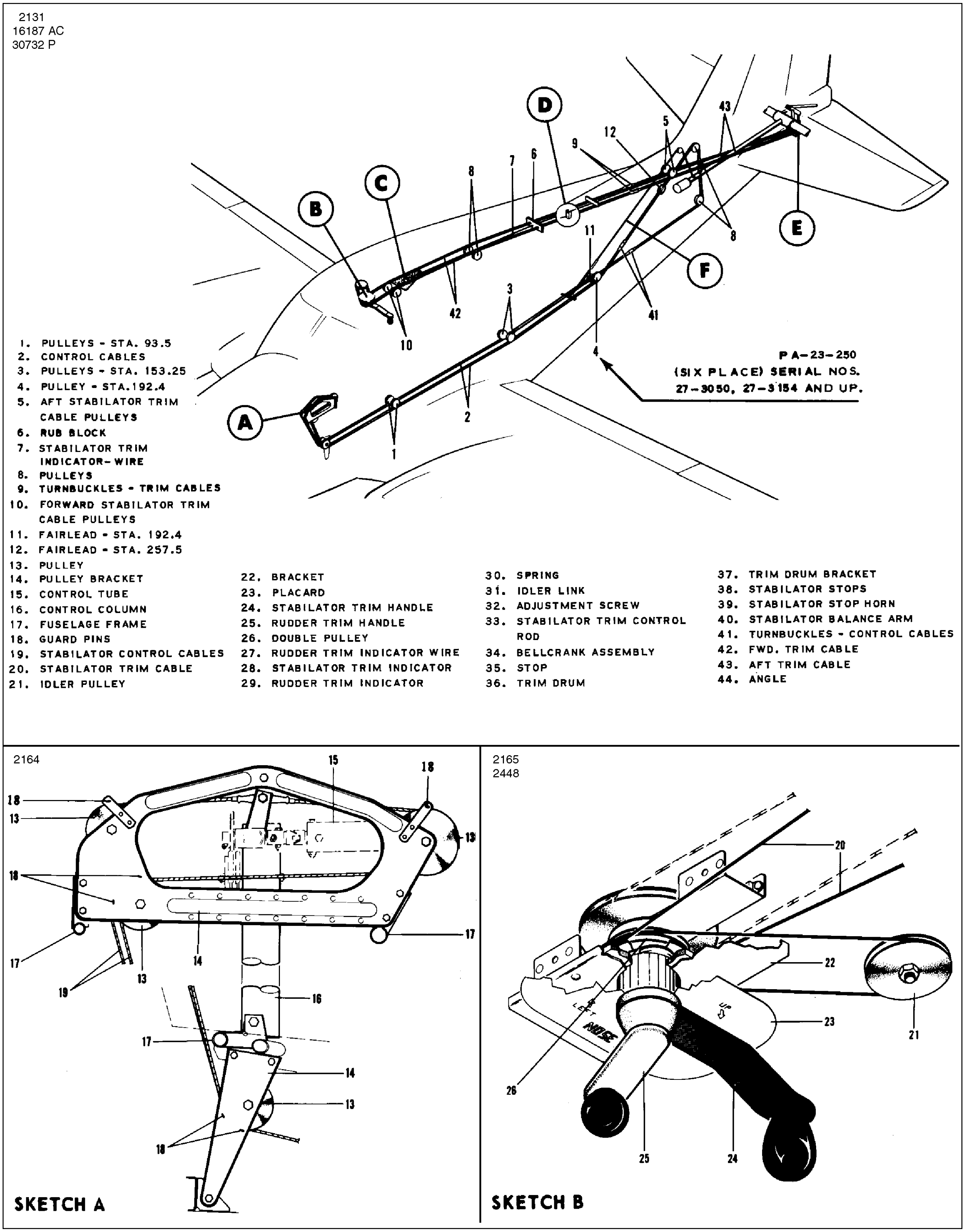


Figure 5-5. Stabilator and Stabilator Trim Controls

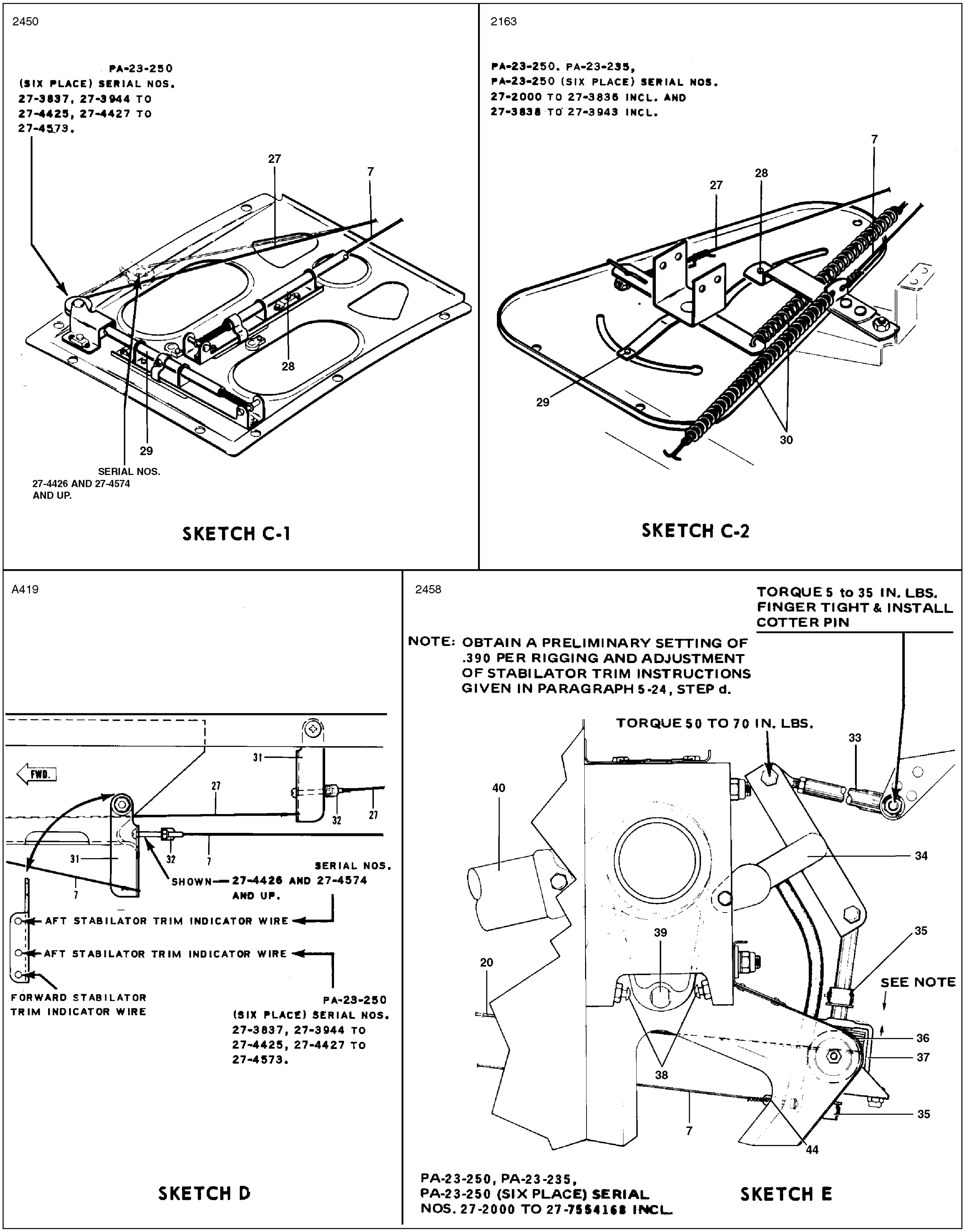
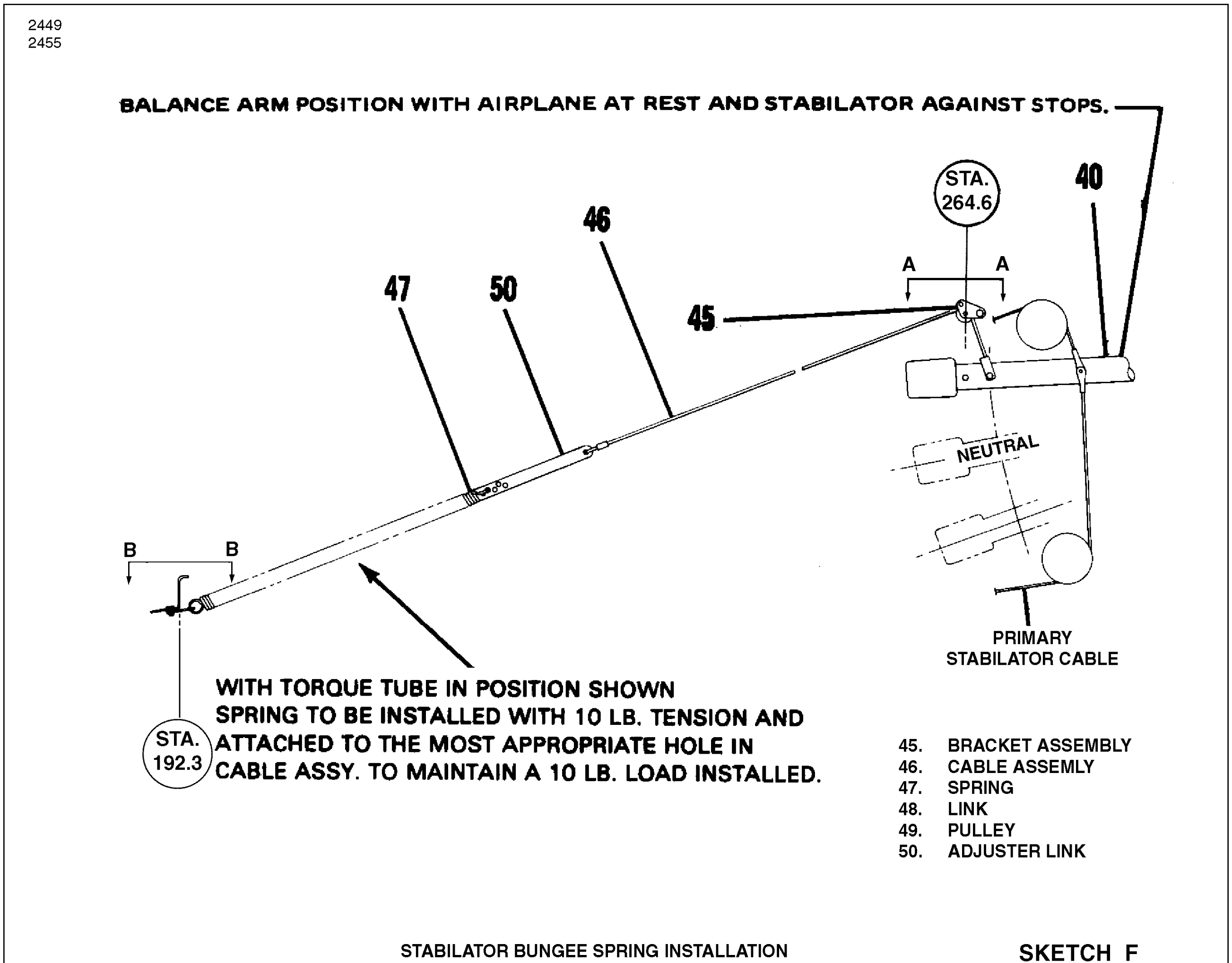
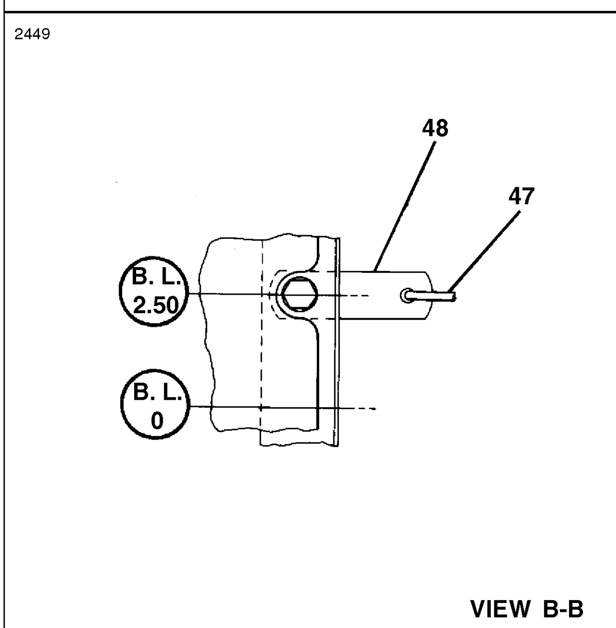


Figure 5-5. Stabilator and Stabilator Trim Controls (cont.)





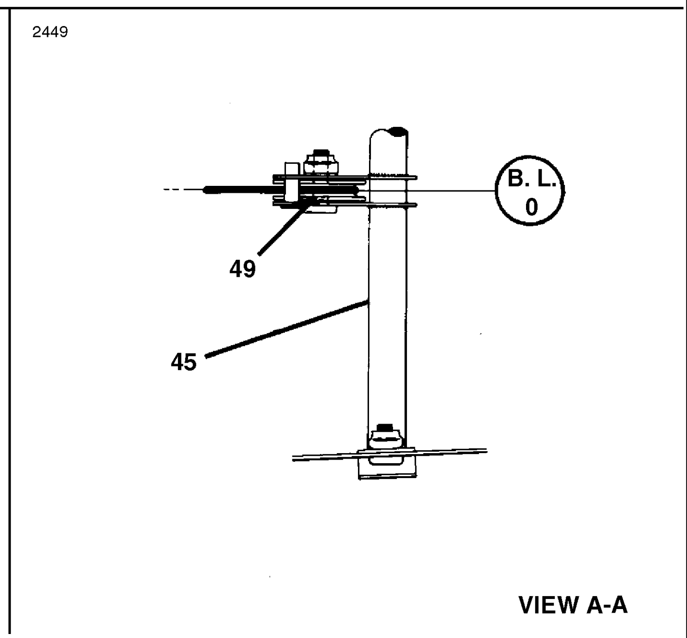


Figure 5-5. Stabilator and Stabilator Trim Controls (cont.)

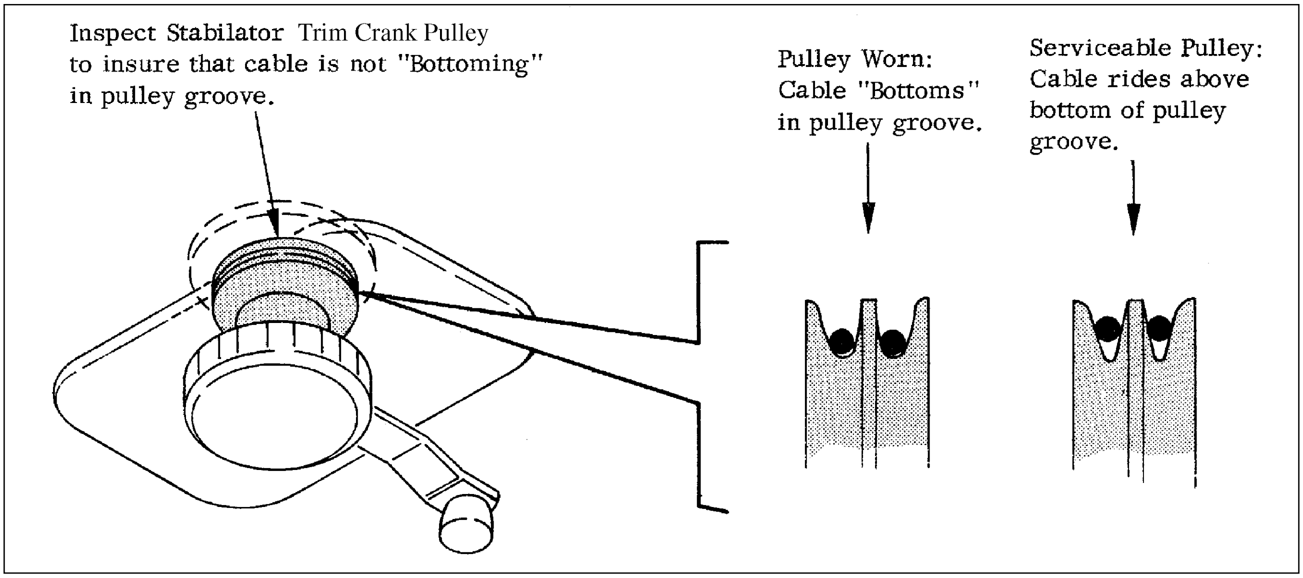


Figure 5-5a. Trim Crank Pulley Inspection

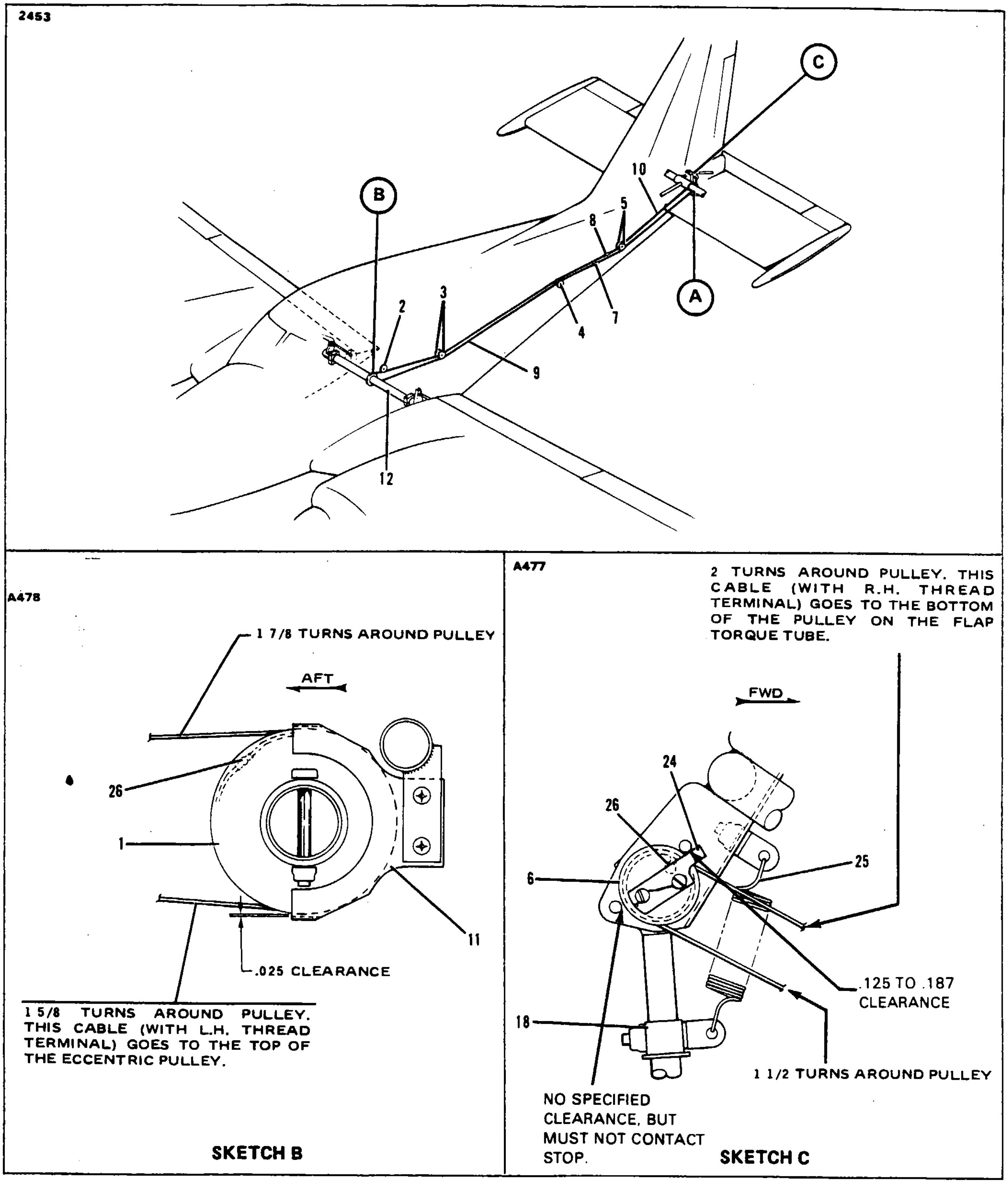
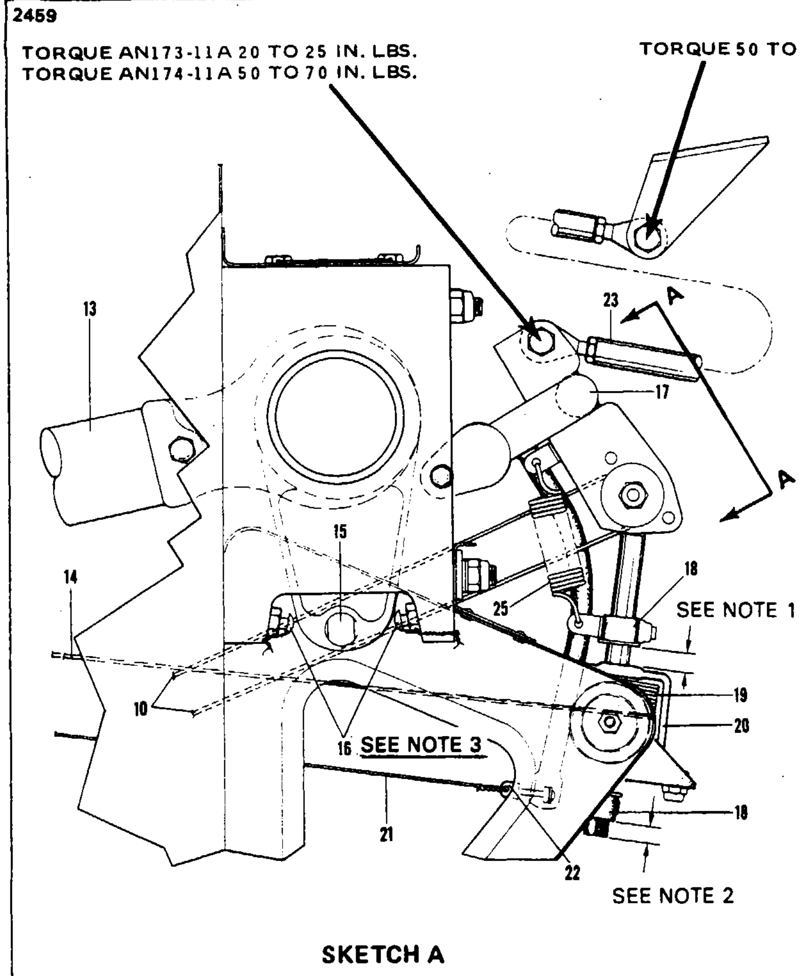
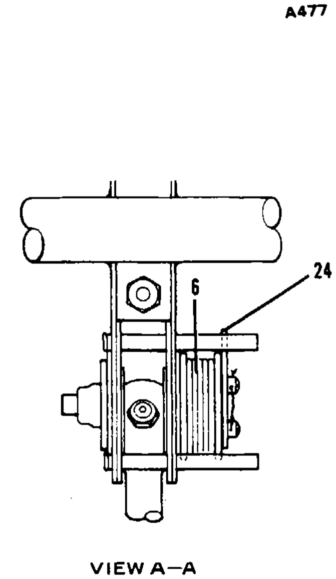


Figure 5-6. Stabilator Trim and Flap Interconnect (Serial Nos. 27-7654001 and up)





NOTE 1. OBTAIN A PRELIMINARY SETTING OF .390 PER RIGGING AND ADJUSTMENT OF STABILATOR TRIM INSTRUCTIONS GIVEN IN PARAGRAPH 5-24, STEP d.

NOTE 2. OBTAIN A PRELIMINARY SETTING OF .3125.

NOTE 3. LATER MODEL PA-23-250(6) AIRCRAFT STABILATOR STOPS REQUIRE SAFETYING. APPLY THE LOCK WIRE IN SUCH A MANNER THAT THE LOCK WIRE SHALL BE PUT IN TENSION SHOULD THE SCREW TEND TO LOOSEN. THE LOCK WIRE SHOULD ALWAYS BE INSTALLED AND TWISTED SO THAT THE LOOP AROUND THE HEAD STAYS DOWN AND DOES NOT TEND TO COME UP OVER THE BOLT HEAD AND LEAVE A SLACK LOOP.

1. PULLEY - FLAP TORQUE TUBE
2. PULLEY - STA. 130.75
3. PULLEYS - STA. 153.88
4. PULLEYS - STA. 229.00
5. PULLEYS - STA. 273.38
6. PULLEY - ECCENTRIC
7. TURNBUCKLE - STA. 258.50
8. TURNBUCKLE - STA. 267.50
9. CABLE - FORWARD INTERCONNECT
10. CABLE - AFT INTERCONNECT
11. GUARD
12. FLAP TORQUE TUBE
13. STABILATOR BALANCE ARM
14. STABILATOR CONTROL CABLES
15. STABILATOR STOP HORN
16. STABILATOR STOPS
17. BELLCRANK ASSEMBLY
18. STOP
19. TRIM DRUM
20. TRIM DRUM BRACKET
21. STABILATOR TRIM INDICATOR WIRE
22. ANGLE
23. STABILATOR TRIM CONTROL ROD
24. STOP - ECCENTRIC PULLEY
25. SPRING
26. BALL - CABLE

Figure 5-6. Stabilator Trim and Flap Interconnect (Serial Nos. 27-7654001 and up) (cont.)

5-18. RIGGING AND ADJUSTMENT OF STABILATOR CONTROLS.

a. Level the airplane. (Refer to Leveling, Section II.)

b. Place the stabilator in a neutral position using a fabricated tool and bubble protractor as shown in Figure 5-7 or Figure 5-8. (The tool may be fabricated from dimensions given in Figure 5-17 or Figure 5-18.)

c. Support the stabilator in neutral position and adjust the control wheel for neutral fore and aft. Refer to Table V-I for neutral position of control wheel.

d. Should adjustment be required, remove the tail cone fairing and the access panel from the left side of the fuselage, just ahead of the stabilator, at station 261.0 by removing attaching screws.

e. To neutralize the control wheel with the stabilator, adjust the stabilator cable turnbuckles within the aft section of the fuselage at stations 249.25 and 296.25 to obtain proper cable tension and to allow the control wheel to neutralize fore and aft. (Refer to Table V-I.)

f. To obtain the proper stabilator travel, as given in Table V-I, adjust the stabilator stop bolts at the torque tube horn. Measure the angle of the stabilator travel up and down with a bubble protractor on the fabricated leveling tool.

NOTE: The stabilator should hit stabilator stop screws before control wheel shaft in cockpit hits stops. Later model PA-23-250(6) Aztecs require that a safety be applied to the stop screws after adjustments are made. Refer to Figure 5-6 for approved installation of safety wire.

g. Check control and direction of travel.

h. To rig airplanes with a stabilator bungee spring installation, position the balance arm (40) so that the stabilator is against its stops, then attach the bungee spring to one of the holes on the adjuster link so that it maintains a 10 lb. load installed.

i. Safety turnbuckles and install the access panel to the side of the fuselage and the tail cone fairing.

CAUTION: VERIFY FREE AND CORRECT MOVEMENT OF STABILATOR. WHILE IT WOULD SEEM SELF-EVIDENT, FIELD EXPERIENCE HAS SHOWN THAT THIS CHECK IS FREQUENTLY MISINTERPRETED OR NOT PERFORMED AT ALL. ACCORDINGLY, UPON COMPLETION OF STABILATOR RIGGING AND ADJUSTMENT, VERIFY THAT THE REAR EDGE OF THE STABILATOR MOVES UP WHEN THE WHEEL IS PULLED BACK; AND, THAT THE REAR EDGE OF THE STABILATOR MOVES DOWN WHEN THE WHEEL IS PUSHED FORWARD.

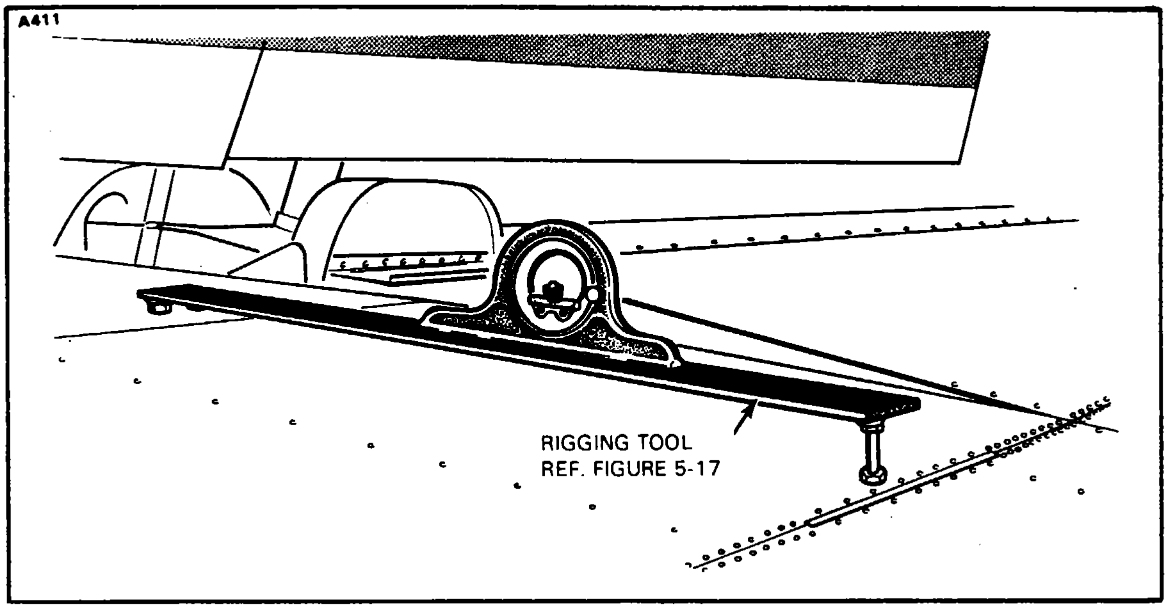


Figure 5-7. Leveling Stabilator
(Serial Nos. 27-1 to 27-7554168 incl. and 27-80540001 and up)

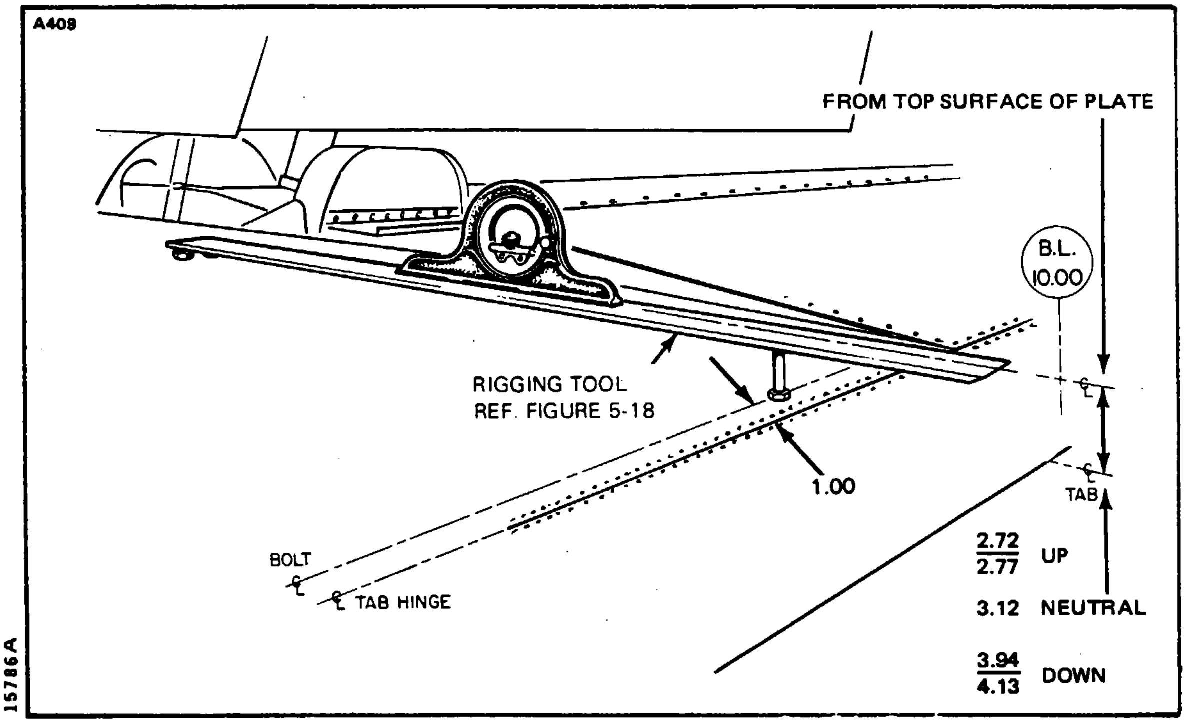


Figure 5-8. Leveling Stabilator
(Serial Nos. 27-7654001 to 27-7954121 incl.)

5-19. STABILATOR TRIM.

— NOTE —

Remove excess lubricant build-up from the stabilator trim cable as follows:

a. Dampen a clean white cloth with Methyl-Ethyl-Ketone solvent.

b. Place the dampened cable in hand and grasp stabilator trim cable near the stabilator trim crank.

c. Crank the cable through it's full travel fore and aft removing any excess buildup of lubricant.

5-20. REMOVAL OF FORWARD STABILATOR TRIM ASSEMBLY. (Refer to Figure 5-5.)

a. Remove the rudder trim control knob or handle (25) by removing the roll pin securing it in place.

b. Remove the stabilator trim control knob and handle (24) by removing the attaching screws from the hub of the handle.

c. Remove the headliner trim plate from around the trim crank assembly by the following procedure:

1. Remove the attaching screws securing the trim plate.
2. Lower the aft side of the trim plate and disconnect the vent lines.
3. Disconnect the wiring from the lights and their switches.

— NOTE —

It is recommended that the wires be marked for identification before removal to facilitate reinstallation.

4. Disconnect the control cable from the air control assembly on each side.
5. Remove the headline trim plate.

d. Remove the trim crank bearing bracket assembly (22) by removing attaching screws.

e. Remove the aft cabin or baggage area trim panel gaining access to the aft section of the fuselage.

f. Disconnect the forward stabilator trim cable (42) at the turnbuckles (9) located in the aft section of the fuselage.

g. On airplanes equipped with an electric pitch trim servo, use the following procedure:

1. On PA-23-250 (six place) airplanes only, remove the baggage compartment ceiling trim panel by removing attaching screws.
2. On all PA-23 airplanes, loosen the two machine screws on the left side of the servo unit in the baggage compartment that hold the cable guard bracket in place.
3. Unwrap the cable from the pulleys on top of the servo unit.

h. If the cable is not to be reused, cut the left end of the forward cable removing the turnbuckle. Solder the blank end of a new cable to the end of the old cable.

NOTE

If the trim cables are to be reused, the headliner insulation, rubblocks and pulleys must be removed from the cabin ceiling. Unless the headliner is to be replaced, it is not recommended that it be removed because of difficulties replacing an old headliner.

5-21. INSTALLATION OF FORWARD STABILATOR TRIM ASSEMBLY. (Refer to Figure 5-5.)

a. Ascertain that the splice where the old and new cables are joined, as described in paragraph 5-20, is smooth and minimum in size.

b. Draw the old stabilator trim cable, that is spliced to the new cable, through the ceiling to the cabin.

NOTE

To prevent breaking the splice, draw the cable in a straight line and do not use force.

c. Wrap the cable (20) around the trim crank and idler pulleys. Starting at the left side, the cable is routed around the top groove on the double pulley (26), then around the idler pulley (21) from right to left and back around the bottom groove on the double pulley (26) from left to right.

d. With the old and new cable ends still soldered together, draw the cable through the ceiling to the aft section of the fuselage.

e. Connect the forward cable end to the corresponding aft cable end by rotating the turnbuckle barrel until three threads on each end are showing.

f. On airplanes equipped with an electric pitch trim servo, use the following procedure:

1. Wrap the cable coming from the forward section of the airplane around top groove on the capstan, around the idler pulley and back around the bottom groove of the capstan to the aft section of the airplane.

2. Position the cable guard to allow a clearance of .031 of an inch between the capstan and the guard. Tighten the two machine screws that secure it in place.

3. On PA-23-250 (six place) airplanes only, install the baggage compartment ceiling trim panel with attaching screws.

g. Assembly the turnbuckle eyes and thimble on the remaining aft cable end (43). Turn the barrel until three threads on each end are showing.

h. Separate the old cable from the new cable where the two were spliced together.

i. Insert the free cable end and a thimble through the turnbuckle eye and draw the cable until it is tight.

j. Temporarily clamp the cable so as not to damage it or allow it to slip.

k. Operate the trim several times to seat the cable to the pulleys and to insure clearance of all moving parts.

l. Remove the temporary clamp and draw the free end of the cable to the approximate required cable tension. (Refer to Table V-I.)

m. Secure the free cable end using a nicopress sleeve.

n. Readjust the cable tension using the turnbuckles.

o. Check rigging and adjustment per paragraph 5-24.

p. Safety all turnbuckles.

q. Install all access plates, panels, and trim.

5-22. REMOVAL OF AFT STABILATOR TRIM ASSEMBLY. (Refer to Figures 5-5 and 5-6.)

a. Remove the tail cone fairing by removing attaching screws.

b. Remove the access panel from the aft left side of the fuselage.

c. On PA-23-250 and PA-23-235 airplanes, remove the rear seat and the aft cabin trim panel by removing attaching screws.

d. On PA-23-250 (six place) airplanes, remove the aft panel from the baggage compartment by removing attaching screws.

e. Block the trim cable at the trim drum to prevent it from unwrapping. (Refer to Figure 5-9.)

f. Disconnect the turnbuckle (item 9, Figure 5-5) at the ends of the aft stabilator trim cables (item 43, Figure 5-5).

g. Remove the guard pins from the stabilator trim pulleys (item 5, Figure 5-5) at station 260.2.

h. Remove the guard pins from the rub blocks at station 272.4.

i. Disconnect the trim screw from the bellcrank per Step 1 or 2 noted below:

1. On airplanes not including the stabilator trim and flap interconnect system, remove cotter pin, nut, washer and bolt connecting trim screw to bellcrank. (Refer to Sketch E, Figure 5-5.)

2. Airplanes including stabilator trim and flap interconnect system require relief of interconnect cable tension. Loosen turnbuckles at stations 258.50 and 267.50. Remove attaching hardware securing trim screw to eccentric pulley on bellcrank and disconnect tension spring. (Refer to Sketch A, Figure 5-6.)

j. Remove the trim drum bracket assembly by removing the four attachment bolts at the bottom of screw assembly.

5-23. INSTALLATION OF AFT STABILATOR TRIM ASSEMBLY. (Refer to Figures 5-5 and 5-6.)

a. Ascertain that the trim cable assembly (item 43, Figure 5-5) is evenly wrapped (centered) on drum (item 36, Figure 5-5 or item 19, Figure 5-6) as given in paragraph 5-48, and the cables are blocked to prevent them from unwrapping. (Refer to Figure 5-9.)

b. Position the trim drum bracket assembly (item 37, Figure 5-5 or item 20 in Figure 5-6) between its support brackets and secure with four bolts, washers and nuts.

c. Draw the cable ends into the fuselage and connect the aft trim cable (item 43, Figure 5-5) to the forward trim cable (item 42, Figure 5-5) at the turnbuckles (item 9, Figure 5-5).

d. Connect trim screw to bellcrank. On airplanes including stabilator trim and flap interconnect system, connect trim screw to eccentric pulley on bellcrank and attach tension spring.

e. Install the guard pins to the rub blocks at station 272.4.

f. Install the guard pins to the stabilator trim pulleys at station 260.2.

g. Set cable tension and check rigging and adjustment of aft stabilator trim assembly per paragraph 5-24. If stabilator trim and flap interconnect system is installed, set cable tension and rigging per paragraph 5-59.

h. Install access plates, panels and trim.

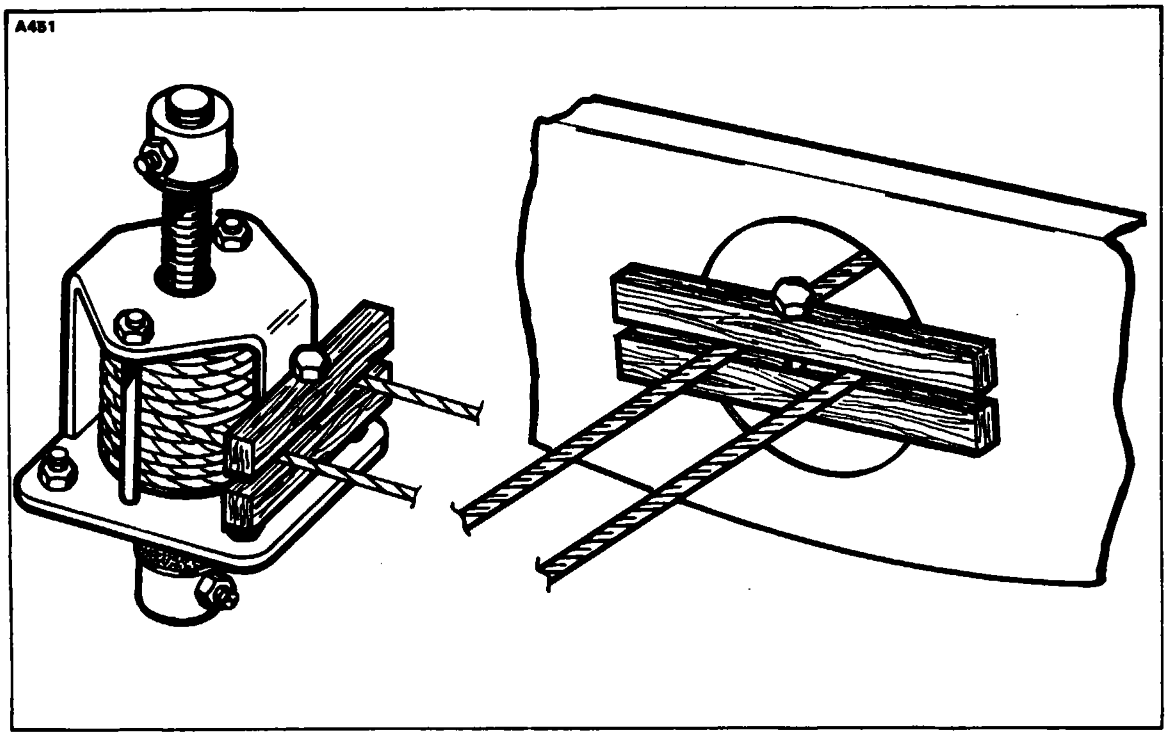


Figure 5-9. Methods of Blocking Trim Cables

5-24. RIGGING AND ADJUSTMENT OF STABILATOR TRIM. (Refer to Figures 5-5 and 5-6.)

a. Remove the tail cone fairing. On airplanes with Serial Nos. 27-4426, 27-4574 and up, remove the access panel on the aft left side of the fuselage.

b. Rotate the trim drum (item 36, Figure 5-5 or item 19, Figure 5-6) until the cable is evenly wrapped and the turnbuckle ends (item 9, Figure 5-5) inside the aft fuselage section are even. (There should be nine and one-quarter wraps on each end of the trim drum.)

c. Ascertain that the cable tension is set as given in Table V-I.

d. A preliminary setting of .390 of an inch between the upper screw stop (item 35, Figure 5-5 or item 18, Figure 5-6) and the drum housing (item 37, Figure 5-5 or item 20, Figure 5-6) as measured along the screw (refer to Sketch E, Figure 5-5 or Sketch A, Figure 5-6) must be confirmed. This measurement is obtained by disconnecting the upper end of the trim screw from the bellcrank (item 34, Figure 5-5) or eccentric pulley connected to the bellcrank (item 17, Figure 5-6) and turning the trim screw until .390 of an inch is obtained. Hold the trim drum stationary while adjusting the screw. If stabilator trim and flap interconnect system is installed, disconnect interconnect cables at turnbuckles before removing eccentric pulley. Reconnect the screw with attachment hardware.

e. Position the stabilator in neutral and proceed to set tab travels. Turn the trim in each direction to screw stops. If tab travels do not agree with angles given in Table V-l, disconnect the control rod (item 33, Figure 5-5 or item 23, Figure 5-6) from the tab, loosen the jam nut on the forward end of the rod and turn the rod until the proper travels are obtained. On aircraft with S/N's 27-7654001 and up the rod end adjustments should be made from both ends of the rod.

NOTE: Upon completion of trim tab rigging of aircraft with S/N's 27-7654001 and up, the tab trailing edge may be .125 to .250 of an inch up from the stabilator neutral position.

f. Check minimum number of wraps left on drum. (Minimum allowable is one and one-quarter wraps.)

g. Check adjustment of trim indicator wire. (Refer to paragraph 5-27 or 5-30.)

h. If stabilator trim and flap interconnect system is installed, reconnect interconnect cables at turnbuckles and adjust per paragraph 5-59.

i. Install the tail cone fairing and if removed, also install the access panel on the aft left side of the fuselage.

NOTE: The stabilator trim control rod end bearing located at the forward end of the control rod (item 33, Figure 5-5 or item 23, Figure 5-6) should be checked for freedom of movement during the regular 100 hour inspection by disconnecting the rod at the trim tab and holding the end between your fingers, try to turn the rod from side to side and rotate up and down. If the rod will not turn or is hard to turn, the bearing should be checked more thoroughly by removing the complete assembly from the airplane.

CAUTION: VERIFY FREE AND CORRECT MOVEMENT OF STABILATOR TAB. WHILE IT WOULD SEEM SELF-EVIDENT, FIELD EXPERIENCE HAS SHOWN THAT THIS CHECK IS FREQUENTLY MISINTERPRETED OR NOT PERFORMED AT ALL. ACCORDINGLY, UPON COMPLETION OF STABILATOR TRIM RIGGING AND ADJUSTMENT, VERIFY THAT THE STABILATOR TAB MOVES UP WHEN THE TRIM WHEEL IS TRIMMED DOWN; AND, THAT THE STABILATOR TAB MOVES DOWN WHEN THE TRIM WHEEL IS TRIMMED UP.

5-25. REMOVAL OF THE STABILATOR TRIM INDICATOR WIRE. (PA-23-250, PA-23-235 and PA-23-250 [six place], SN's 27-2000 thru 27-2504, and PA-23-250 [six place], S/N's 27-2505 thru 27-3836, 27-3838 thru 27-3943) (Refer to Figure 5-5.)

a. Remove the placard plate from the ceiling of the cabin by removing attaching screws.

b. Remove the tail cone fairing by removing attaching screws.

c. Disconnect the indicator wire at the trim control bellcrank.

d. Disconnect the indicator wire at the indicator arm inside the cabin.

e. Solder a piece of .024 steel wire to the old indicator wire.

5-26. INSTALLATION OF STABILATOR TRIM INDICATOR WIRE. (PA-23-250, PA-23-235 and PA-23-250 (six place), Serial Nos. 27-000 to 27-2504 incl. and PA-23-250 (six place), Serial Nos. 27-2505 to 27-3836 incl. and 27-3838 to 27-3943 incl.) (Refer to Figure 5-5.)

a. Draw the old wire from the fuselage installing a new one at the same time.

NOTE

If the indicator wire has broken at a point other than at either end, it may be necessary to remove access and trim panels to the overhead area of the cabin to determine the breaking point and installation procedure.

b. Attach the end of the wire to the aft attachment point and center the nut on the adjustment screw.

c. Ascertain that the stabilator trim tab is rigged properly. (Refer to Paragraph 5-24.)

d. Position the stabilator in a neutral position as described in paragraph 5-18 and turn the trim until the trailing edges of the stabilator and stabilator trim tab align.

e. Insert the end of the wire through the attachment point inside the cabin ceiling. Pull the wire through the hole until the indicator would read approximately neutral. Bend the wire back twisting it around itself a minimum of seven times.

f. Install the placard plate to the ceiling with attaching screws.

g. Adjust the indicator as per paragraph 5-27.

h. Install the tail cone fairing with attaching screws.

5-27. RIGGING AND ADJUSTMENT OF STABILATOR INDICATOR WIRE. (PA-23-250, PA-23-235, and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl. and PA-23-250 (six place), Serial Nos. 27-2505 to 27-3836 incl. and 27-3838 to 27-3943 incl.) (Refer to Figure 5-5.)

a. Ascertain the stabilator is rigged properly as per paragraph 5-18 and position the stabilator in neutral. Turn the trim tab until its trailing edge aligns with that of the stabilator.

b. With the tail cone fairing removed, hold the adjusting screw locknut located at the aft end of the indicator wire and adjust the screw to obtain a neutral indication in the cabin.

c. Install the tail cone fairing with attaching screws.

5-28. REMOVAL OF STABILATOR TRIM INDICATOR WIRES. (PA-23-250 (six place), Serial Nos. 27-3837, 27-3944 and up.)

a. Remove the trim panel from the ceiling of the aft baggage compartment by removing attaching screws.

b. Remove the placard panel from the cabin ceiling by loosening the set screws in the light knobs and removing knobs, and removing panel attaching screws.

c. The forward stabilator indicator wire may be removed by the following procedure:

1. Disconnect the indicator wire from the tab on the indicator in the cabin ceiling.
2. Solder a piece of .024 steel wire to the old indicator wire.

NOTE

If the indicator wire has broken at a point other than at either end, it may be necessary to remove access or trim panels to determine the breaking point and installation procedure.

d. The aft stabilator indicator wire may be removed by the following procedure:

1. Remove the bottom section of the tail cone fairing by removing attaching screws.
2. Disconnect the wire at the arm forward of the trim drum.
3. Solder a piece of .024 steel wire to the old indicator wire.
4. Disconnect the indicator wire or wires at the idler link inside the baggage compartment.

5-29. INSTALLATION OF STABILATOR TRIM INDICATOR WIRE. (PA-23-250 (six place), Serial Nos. 27-3837, 27-3944 and up.)(Refer to Figure 5-5, Sketch D.)

a. Draw the old wire out installing a new wire at the same time.

b. Ascertain that the adjustment nuts, located in the baggage compartment on the idler link and on the stabilator trim control bellcrank, are centered on their screws.

c. Position the stabilator in the neutral position. If stabilator trim and flap interconnect system is installed, also position flaps in full up position. Adjust the trim tab until the trailing edges of each align.

d. Connect the aft wire by the following procedure:

1. Separate the old wire from the new wire.
2. Insert the aft end of the wire through the angle at the attachment point on the trim control bellcrank. Bend the wire forward and wrap it around itself at least seven turns.

3. Hold the idler link perpendicular to its attachment point and attach the forward end of the wire to the angle on the adjustment screw in the same manner as the aft end.

NOTE

The position of the adjustment screw in the idler link is important for proper trim indicator operation. Refer to Figure 5-5, Sketch D for proper location.

e. Connect the forward wire by the following procedure:
1. Separate the old wire from the new wire.
2. Insert the aft end of the wire through the bottom hold in the idler link. Bend the wire forward and wrap it around itself at least seven times.
3. Insert the forward end of the wire through the indicator attachment.

NOTE

Refer to Figure 5-5, Sketch C-1 for the proper routing of the trim indicator wire at the indicator panel for the various installations.

4. Pull the wire through the indicator attachment until the indicator is centered. Bend the wire back and secure it in the same manner as the opposite end.

f. Adjust the wire per instructions in paragraph 5-30.

g. Install the placard plate, light control knobs, baggage compartment trim and the tail cone fairing.

5-30. ADJUSTMENT OF STABILATOR TRIM INDICATOR WIRE. (PA-23-250 (six place), Serial Nos. 27-3837, 27-3944 and up.)

a. Remove the trim panel from the baggage compartment ceiling.

b. Place the stabilator in a neutral position as described in paragraph 5-18. If stabilator trim and flap interconnect system is installed, also position flaps in full up position.

c. Turn the trim tab control until the trailing edge of the tab aligns with the stabilator.

d. Holding the nut, adjust the screw through the idler link in the baggage compartment until the indicator is centered.

e. Reinstall the trim panel to the baggage compartment ceiling.

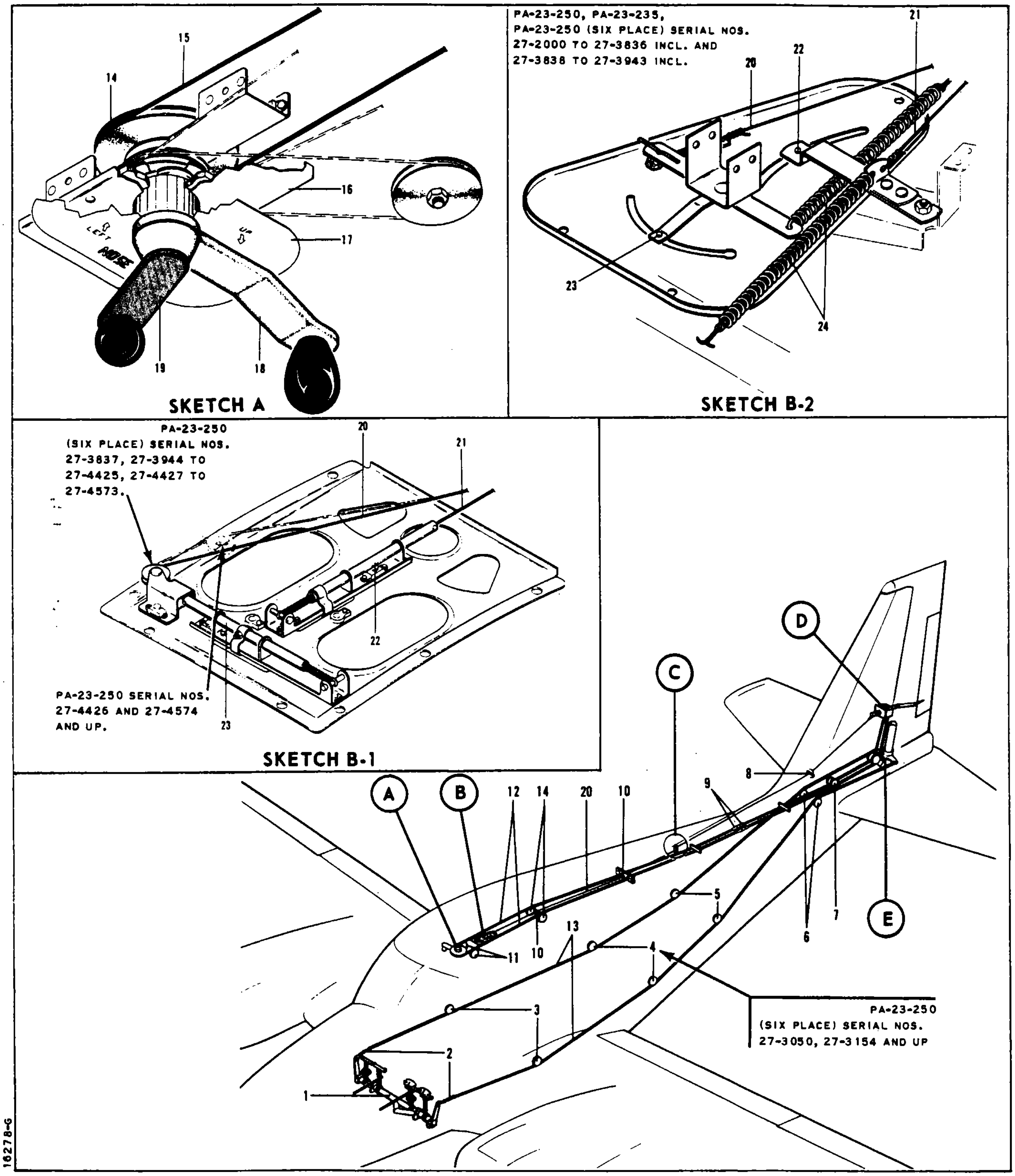
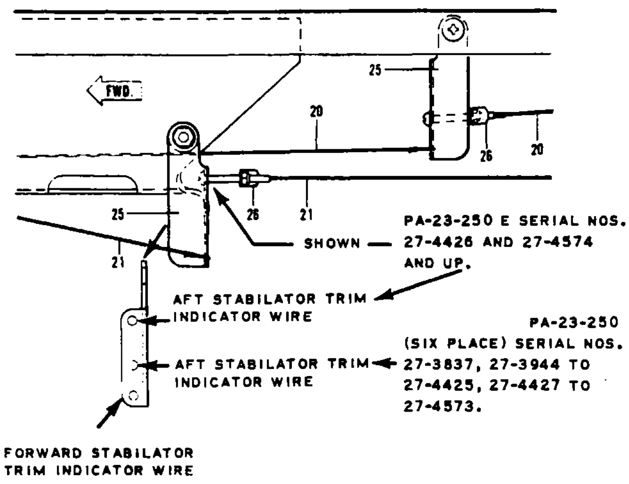
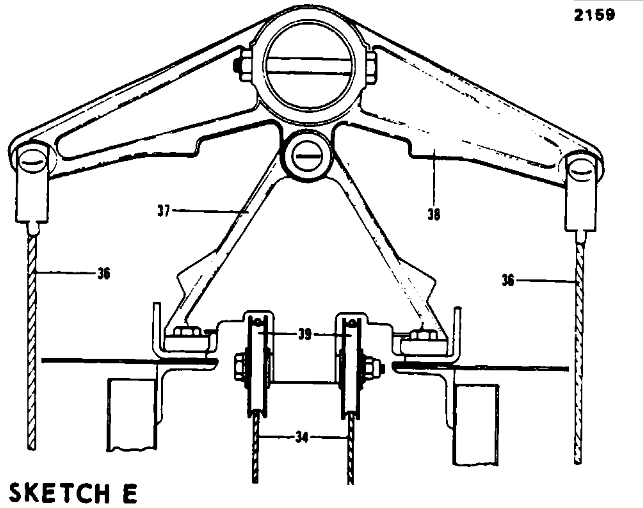


Figure 5-10. Rudder and Rudder Trim Controls



SKETCH C



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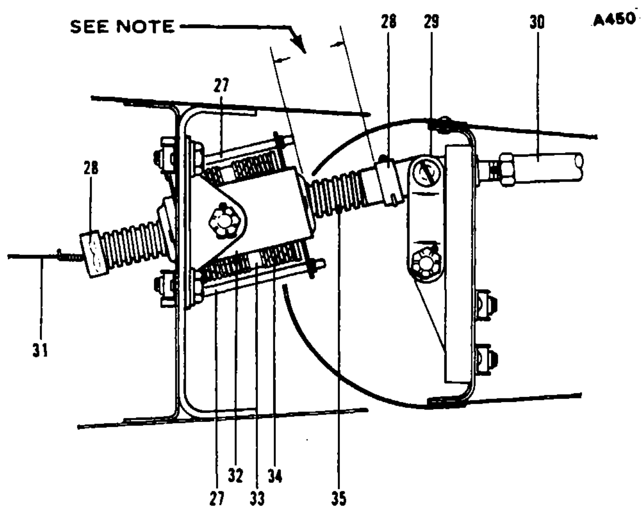

NOTE: OBTAIN A PRELIMINARY SETTING OF .875 PER RIGGING AND ADJUSTMENT OF RUDDER TRIM INSTRUCTIONS GIVEN IN PARAGRAPH 5-40, STEP d.

SKETCH D

1. RUDDER PEDAL ASSEMBLY
2. TURNBUCKLES
3. PULLEYS - STA. 94.0
4. PULLEYS - STA. 152.0
5. PULLEYS - STA. 192.4
6. PULLEYS - STA. 257.5
7. AFT RUDDER TRIM CABLE PULLEYS
8. RUB BLOCK
9. TURNBUCKLES
10. RUB BLOCK
11. FORWARD RUDDER TRIM CABLE PULLEYS
12. TRIM CONTROL CABLES
13. CONTROL CABLES
14. PULLEY
15. RUDDER TRIM CABLES
16. BRACKET
17. PLACARD
18. STABILATOR TRIM HANDLE
19. RUDDER TRIM HANDLE
20. RUDDER TRIM INDICATOR WIRE
21. STABILATOR TRIM INDICATOR WIRE
22. STABILATOR TRIM INDICATOR
23. RUDDER TRIM INDICATOR
24. SPRING
25. IDLER LINK
26. ADJUSTMENT SCREW
27. GUARD PIN
28. STOP
29. LINK
30. RUDDER TRIM CONTROL ROD
31. RUDDER TRIM INDICATOR WIRE
32. TRIM DRUM HOUSING
33. TRIM DRUM
34. TRIM CONTROL CABLES
35. TRIM SCREW
36. RUDDER CONTROL CABLES
37. HINGE BRACKET
38. RUDDER HORN
39. RUDDER TRIM PULLEYS

Figure 5-10. Rudder and Rudder Trim Controls (cont.)

5-31. RUDDER CONTROLS.

5-32. REMOVAL OF RUDDER CONTROL CABLES.

a. Remove the aft access panel from each side of the nose section by releasing the stud type panel fasteners.

b. Remove the access panel from the bottom of the fuselage by removing attaching screws.

c. Remove the access panel from the left side of the fuselage located below the leading edge of the vertical fin.

d. Remove the tail cone fairings by removing attaching screws.

e. Remove the center and rear seats.

f. Remove the rear outboard seat tracks from each side of the cabin floor.

g. Pull the carpet back and remove the access plates from each corner of the aft floor panel of the cabin by removing attaching screws.

h. Remove the trim panel from either the aft cabin or baggage area gaining access to the aft section of the fuselage.

i. Remove the cable guard pins from the rudder cable pulleys just aft of the main spar at station 94.0.

j. Remove the rudder pulleys under the aft cabin floor at station 152.0 by removing nut, washers, and cable guard bracket.

k. On PA-23-250 (six place) airplanes, remove the cable guard pins from the pulleys just forward of the fuselage bulkhead at station 192.4.

l. Remove the guard pins from the rudder cable pulleys at station 257.5.

m. Disconnect the cables from the torque tube arms by removing the turnbuckle barrel.

n. Disconnect the cables from the rudder horn by removing the cotter pin, nut, washers, and bolt from each side.

o. Remove the cables by drawing them aft through the fuselage.

5-33. INSTALLATION OF RUDDER CONTROL CABLES.

a. Connect the cable end straps to each side of the rudder horn with bolt, washers, nut and cotter pin.

b. Draw the cables forward through the fuselage and connect the cable ends to the torque tube arms with the use of turnbuckles.

c. Install new cable guard pins to the pulleys at station 257.5.

d. Within the aft section of the fuselage on PA-23-250 (six place) airplanes, install new cable guard pins to the pulleys just forward of the fuselage bulkhead at station 192.4.

fuselage bulkhead at station 192.4.

e. Install the rudder pulleys, with guard clips, under the aft cabin floor at station 152.0 using bolt, washers and self-locking nut.

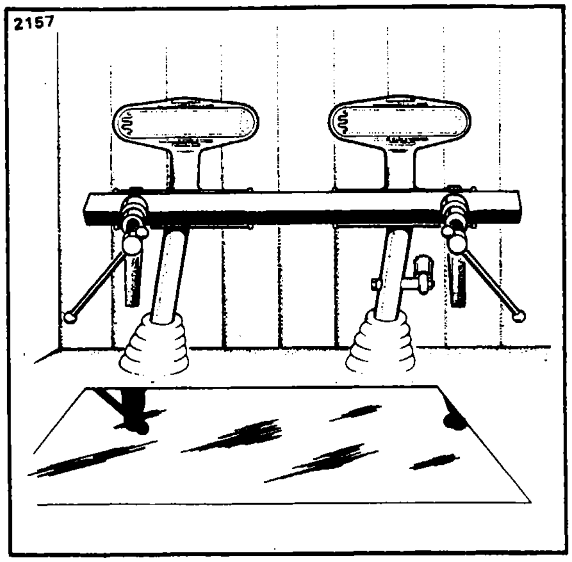

Figure 5-11. Clamping Rudder Pedals in Neutral

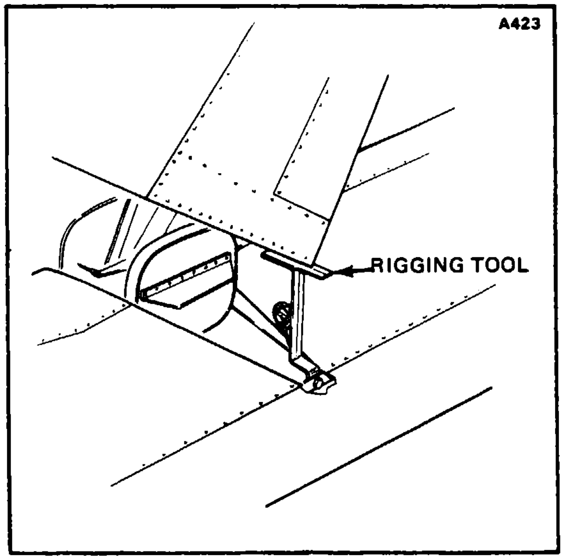

Figure 5-12. Installation of Rudder Aligning Tool (Typical)

f. Install new guard pins to the rudder pulleys just aft of the main spar at station 94.0.

g. Check rigging and adjustment of rudder controls. (Refer to Paragraph 5-34.)

h. Safety turnbuckles and install all access plates, panels, carpets, seat tracks, seats and tail cone fairings.

5-34. RIGGING AND ADJUSTMENT OF RUDDER CONTROLS. To adjust the rudder and rudder pedal for neutral, it first should be ascertained that the nose gear steering has been aligned with the rudder pedals according to Alignment of Nose Landing Gear, Section VII. Adjustment of the rudder and rudder cables may be accomplished as follows:

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Level the airplane laterally. (Refer to Leveling, Section II.)

c. Clamp the rudder pedals to align in a lateral position as shown in Figure 5-11.

d. Remove the aft cabin or baggage area trim panel to gain access to the aft section of the fuselage.

e. Remove the tail cone fairing by removing attaching screws.

f. Remove the nut and washer from the bolt that attaches the left and right stabilator halves together at the rear spar.

g. Attach a fabricated checking tool to the previously mentioned bolt and secure with washer and nut. (Refer to Figure 5-12.) (The tool may be fabricated from dimensions given in Figure 5-19.)

h. Place a level on the edge of the tool, leveling the tool vertically.

i. Position the rudder in neutral by adjusting the rudder cable turnbuckles, at the rudder pedal torque tube arms, until the trailing edge of the rudder is aligned with the scribe line on the fabricated tool. At the same time adjust the cable tension as given in Table V-I.

j. Remove the rudder cable clamps.

k. Move the rudder to the right and left and adjust the stops located at the base of the vertical fin to provide 12.25 + .25 inches left and 14.5 + .25 inches right as measured from a point on the tool where the rudder tip contacts the tool to the center of rudder tip with the rudder against its stop.

l. Check all moving components for freedom of movement.

m. Safety turnbuckles and install the access panel and tail cone fairing.

CAUTION: VERIFY FREE AND CORRECT MOVEMENT OF RUDDER. WHILE IT WOULD SEEM SELF-EVIDENT, FIELD EXPERIENCE HAS SHOWN THAT THIS CHECK IS FREQUENTLY MISINTERPRETED OR NOT PERFORMED AT ALL. ACCORDINGLY, UPON COMPLETION OF RUDDER RIGGING AND ADJUSTMENT, VERIFY THAT THE RUDDER MOVES RIGHT WHEN THE RIGHT PEDAL IS DEPRESSED; AND, THAT THE RUDDER MOVES LEFT WHEN THE LEFT PEDAL IS DEPRESSED.

5-35. RUDDER TRIM CONTROLS.

5-36. REMOVAL OF FORWARD RUDDER TRIM ASSEMBLY.

a. Remove the rudder trim control knob or handle by removing the attaching roll pin.

b. Remove the stabilator trim control knob and handle by removing the attaching screws.

c. Remove the headliner trim plate around the trim crank assembly by the following procedure:

  1. Remove the attaching screws securing the trim plate.
  2. Lower the aft side of the trim plate and disconnect the vent lines.
  3. Disconnect the wiring from the lights and their switches.

  NOTE: It is recommended that the wires be marked for identification before removal.

  4. Disconnect the control cable from the air control assembly on each side of the trim plate.
  5. Remove the headliner trim plate by removing attaching screws.

d. Remove the trim crank bearing bracket assembly by removing attaching screws.

e. Remove the aft cabin or baggage area trim panel gaining access to the aft section of the fuselage.

f. Block the aft cables maintaining their position on the pulleys and the trim drum. (Refer to Figure 5-9.)

g. Disconnect the forward rudder trim cable at the rudder turnbuckle assemblies in the aft fuselage section.

h. If the cable is not to be reused, cut one end of the forward cable removing the turnbuckle thimble. Solder the blank end of a new cable to the end of the old cable.

NOTE

If the trim cables are to be reused, the headliner, insulation, rub blocks and pulleys must be removed from the cabin ceiling. Unless the headliner is to be replaced, it is not recommended that it be removed because of the difficulties replacing an old headliner.

5-37. INSTALLATION OF FORWARD RUDDER TRIM ASSEMBLY.

a. Ascertain that the splice where the two cables are joined together is secure, smooth and minimum in size.

b. Draw the old rudder cable that is spliced to the new cable forward through the ceiling to the cabin area.

NOTE

To prevent breaking the splice, draw the cable in a straight line and do not force.

c. Wrap the cable around the trim crank and draw it aft through the ceiling to the aft section of the fuselage.

d. For cables of undetermined length, connect the forward cable end to the corresponding aft cable and rotate the turnbuckle barrel until three on each end are showing.

e. Separate the old cable from the new cable where the two were spliced together.

f. Assemble the turnbuckle on the remaining aft rudder trim cable. Turn the barrel until three threads on each end are showing.

g. Insert the free cable end and a thimble through the turnbuckle eye and draw it until it is tight. Temporarily clamp the cable so as not to damage it or allow it to slip.

h. Operate the trim several times to seat the cable to the pulleys and to insure clearance of all moving parts.

i. Remove the temporary clamp and draw the free end of the cable to the approximate required tension. (Refer to Table V-I.)

j. Secure the free cable end using a nicopress sleeve.

k. Readjust the cable tension, adjusting the turnbuckles evenly.

l. Check rigging and adjustment of rudder trim. (Refer to Paragraph 5-40.)

m. Safety all turnbuckles.

n. Install all access plates and panels, bearing blocks, and trim cranks.

5-38. REMOVAL OF AFT RUDDER TRIM ASSEMBLY.

a. Remove the tail cone fairing by removing attaching screws.

b. Remove the two access plates from the right side of the vertical fin by removing attaching screws.

c. Remove the aft cabin or baggage area trim panel, gaining access to the aft section of the fuselage.

d. Block the trim cables at the trim drum to prevent them from unwrapping. (Refer to Figure 5-9.)

e. Block the forward rudder trim cables at any bulkhead inside the aft section of the fuselage and disconnect the rudder trim cable turnbuckles in the aft section of the fuselage. (Refer to Figure 5-9.)

f. Disconnect the rudder trim indicator wire from the forward end of the trim screw.

g. Disconnect the rudder trim control rod from the trim screw by removing cotter pin, nut, washer and bolt.

CAUTION

Do not push on the rudder.

h. Turn the nose wheel to the left moving the rudder to the left.

i. Remove the four bolts securing the trim drum and bracket in place. It may be necessary to remove the trim drum from the bracket before removal.

j. If the cable is not to be reused, cut the cable ends removing the turnbuckle eyes. Draw the cable and trim drum aft through the fuselage and vertical fin, removing it from the airplane.

k. If the cable is to be reused, remove the guard pins from the rudder trim cable pulleys at station 160.75 and remove the pulleys at station 290.0. Draw the cable and trim drum aft through the fuselage and vertical fin, removing it from the airplane.

5-39. INSTALLATION OF AFT RUDDER TRIM ASSEMBLY.

a. If a new cable is being installed, use the following procedure:

1. Ascertain that the trim drum is wrapped properly as described in paragraph 5-48.

2. Draw the cables forward through vertical fin and the aft section of the fuselage.

3. Insert the free cable ends and a thimble through the turnbuckle eye and draw them until it is tight. Temporarily clamp the cable so as not to damage it or allow it to slip.

4. Operate the trim several times to seat the cable to the pulleys and to insure clearance of all moving parts.

5. Remove the temporary clamp and draw the free ends of the cable to the approximate required tension (Refer to Table V-I.) and secure with nicopress sleeve.

6. Secure the trim drum and bracket inside the vertical fin with four attaching bolts.

7. Check rigging and adjustment per paragraph 5-40.

b. If the old cable is being installed, use the following procedure:

1. Ascertain that the trim drum is wrapped properly as described in paragraph 5-48.

2. Draw the cables forward through the vertical fin and the aft section of the fuselage.

3. Connect the trim cable turnbuckles.

4. Secure the trim drum and bracket inside the vertical fin with four attaching bolts.

5. Check rigging and adjustment per paragraph 5-40.

5-40. RIGGING AND ADJUSTMENT OF RUDDER TRIM. (Refer to Figure 5-10.)

a. Remove the access plate from the right side of the fin if not previously removed.

b. Rotate the trim drum (33) until the cable is evenly wrapped and the turnbuckle ends (9) inside the aft section fuselage are even. (There should be nine and one-quarter wraps on each end of the trim drum.)

c. Ascertain that the cable tension is set as given in Table V-I.

d. A preliminary setting of .875 of an inch between the aft screw stop (28) and the drum housing (32) as measured along the screw must be confirmed. This measurement is obtained by disconnecting the end of the trim screw from the trim control rod and link (29 & 30), if not previously disconnected, and turn the trim screw until .875 of an inch if obtained. Hold the trim drum stationary while adjusting the screw. Reconnect the screw with bolt, washers, nut and cotter pin.

e. Position the rudder in neutral and proceed to set tab travels. Turn the trim in each direction to screw stops. If tab travels do not agree with angles given in Table V-I, disconnect the control rod (30) from the tab, loosen the jam nut on the forward end of the rod and turn the rod until the proper travels are obtained.

f. Check minimum number of wraps left on drum. (Minimum allowable is one and one-quarter wraps.)

g. Check adjustment of trim indicator wire. (Refer to Paragraphs 5-43 or 5-46.)

h. Install the access plate with attaching screws.

CAUTION: VERIFY FREE AND CORRECT MOVEMENT OF RUDDER TAB. WHILE IT WOULD SEEM SELF-EVIDENT, FIELD EXPERIENCE HAS SHOWN THAT THIS CHECK IS FREQUENTLY MISINTERPRETED OR NOT PERFORMED AT ALL. ACCORDINGLY, UPON COMPLETION OF RUDDER TRIM RIGGING AND ADJUSTMENT, VERIFY THAT THE RUDDER TAB MOVES RIGHT WHEN THE RUDDER TRIM WHEEL IS TRIMMED LEFT; AND, THAT THE RUDDER TAB MOVES LEFT WHEN THE RUDDER TRIM WHEEL IS TRIMMED RIGHT.

5-41. REMOVAL OF RUDDER TRIM INDICATOR WIRE. (PA-23-250; PA-23-235 and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl. and PA-23-250 (six place), Serial Nos. 27-2505 to 27-3836 incl. and 27-3838 to 27-3943 incl.)

a. Remove the placard plate from the ceiling of the cabin by removing attaching screws.

b. Remove the access plate from the right side of the vertical fin.

c. Disconnect the indicator wire at the indicator arm inside the cabin ceiling.

d. Disconnect the indicator wire at the trim screw.

e. Solder a piece of .024 steel wire to one end of the old indicator wire.

NOTE : If the wire has broken at a point other than either end, it may be necessary to remove certain access or trim panels to determine the breaking point and installation procedure.

5-42. INSTALLATION OF RUDDER TRIM INDICATOR WIRE. (PA-23-250; PA-23-235 and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl. and PA-23-250 (six place), Serial Nos. 27-2505 to 27-3836 incl. and 27-3838 to 27-3943 incl.) (Refer to Figure 5-10.)

a. Draw the old wire from the fuselage installing a new one at the same time.

b. Attach the end of the indicator wire to the attachment point on the end of the trim screw.

c. Position the rudder in a neutral position and turn the rudder trim until the trailing edges of the rudder and rudder trim tab align.

d. Insert the remaining end of the wire through the attachment point inside the cabin ceiling. Ascertain the nut on the adjustment screw is centered and pull the wire through the hole until the indicator is centered. Bend the wire back and wrap it around itself at least seven times.

e. Adjust the wire per instructions in paragraph 5-43.

f. Install the placard plate to the ceiling and access plate to the right side of the fin.

5-43. RIGGING AND ADJUSTMENT OF RUDDER TRIM INDICATOR WIRE. (PA-23-250; PA-23-235 and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl. and PA-23-250 (six place), Serial Nos. 27-2505 to 27-3836 incl. and 27-3838 to 27-3943 incl.) (Refer to Figure 5-10.)

a. Remove the placard cover from the cabin ceiling if not previously removed.

b. Position the rudder in a neutral position as described in paragraph 5-34.

c. Turn the rudder trim until the trailing edges of the rudder and rudder trim tab align.

d. Hold the screw where the forward end of the indicator wire is attached and adjust the nut until the indicator is centered.

e. Install the placard cover to the cabin ceiling.

5-44. REMOVAL OF RUDDER TRIM INDICATOR WIRES. (PA-23-250 (six place), Serial Nos. 27-3837, 27-3944 and up.)

a. Remove the trim panel from the ceiling of the aft baggage compartment by removing attaching screws.

b. Remove the placard panel from the cabin ceiling by loosening the set screws in the light knobs, removing the knobs and removing attaching screws.

c. The forward stabilator indicator wire may be removed by the following procedure:

1. Disconnect the indicator wire from the tab in the cabin ceiling.
2. Solder a piece of .024 steel wire to the old indicator wire.

NOTE

If the indicator wire has broken at a point other than either end, it may be necessary to remove certain access or trim panels to determine the breaking point and installation procedure.

d. The aft rudder indicator wire may be removed by the following procedure:

1. Remove the access plate on the right side of the vertical fin.

2. Disconnect the wire at the trim screw inside the vertical fin.
3. Solder a piece of .024 steel wire to the old indicator wire.

5-45. INSTALLATION OF RUDDER TRIM INDICATOR WIRE. (PA-23-250 (six place), Serial Nos. 27-3837, 27-3944 and up.) (Refer to Figure 5-10.)

a. Disconnect the indicator wire or wires at the idler arm inside the baggage compartment.

b. Draw the old wire out installing a new wire at the same time.

c. Ascertain that the adjustment nut located in the baggage compartment is centered on the screw.

d. Position the rudder in a near neutral position and adjust the trim tab until the trailing edges of each align.

e. Connect the aft wire by the following procedure:

1. Separate the old wire from the new wire.
2. Insert the aft end of the wire through attachment point just forward of the trim drum. Bend the wire forward and wrap it around itself at least seven turns.
3. Hold the idler link perpendicular to its attachment point and attach the forward end of the wire to the angle in the same manner as the aft end.

f. Connect the forward wire by the following procedure:

1. Separate the old wire from the new wire.
2. Insert the aft end of the wire through the idler link. Bend the wire forward and wrap it around itself at least seven times.
3. Insert the forward end of wire through the indicator attachment. Pull the wire through until the indicator is centered. Bend the wire back and secure it in the same manner as opposite end.

g. Adjust the wire per instructions in Paragraph 5-46.

h. Install the placard plate, light control knobs, baggage compartment trim and vertical fin access plate.

5-46. ADJUSTMENT OF RUDDER TRIM INDICATOR WIRE. (PA-23-250 (six place), Serial Nos. 27-3837, 27-3944 and up.) (Refer to Figure 5-10.)

a. Remove the trim panel from the baggage compartment ceiling.

b. Place the rudder in a neutral position as described in Paragraph 5-34.

c. Turn the trim tab control until the trailing edge of the tab aligns with the rudder.

d. Holding the nut, adjust the screw through the idler link in the baggage compartment until the indicator is centered.

e. Reinstall the trim panel to the baggage compartment ceiling.

5-47. TRIM DRUM.

5-48. WRAPPING TRIM DRUM. (Refer to Figure 5-13.) All trim drums are wrapped basically by the same procedure and must be removed from the airplane.

a. Mark the end of the drum (2) toward the base of the housing bracket (7) for a reference when later installing and wrapping the cable on the drum.

b. With the drum housing bracket (7) firmly held, remove one of the cable guard bolts (8) from the housing bracket.

c. Remove the drum screw (5) from the trim screw assembly. The screw (5) is removed by removing the stop (4) located on the end of the screw, opposite the base of the housing bracket. Turn the screw from the drum (2).

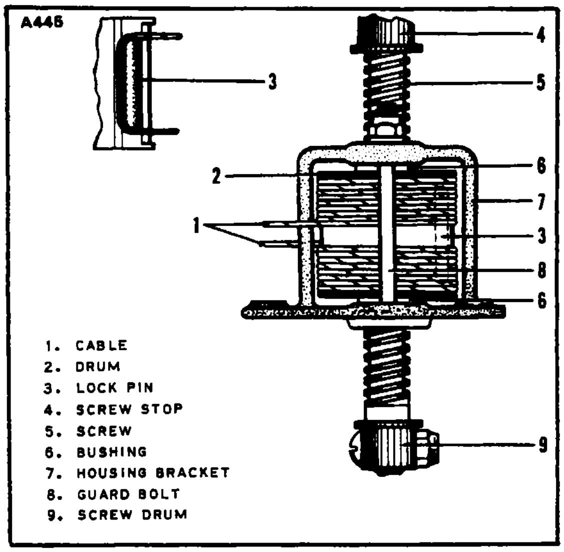

Figure 5-13. Trim Screw Assembly

d. Remove the drum from the housing.

e. Unwrap the trim cable (1) and remove the cable and lock pin (3) from the drum. (If one end of the cable has been marked to facilitate hook-up of the cable ends, note this location in relation to the drum when installing a new cable on the drum.)

f. Check the condition of the bushings (6) in the housing bracket for excess wear.

g. To install and wrap the trim cable, locate the center of the cable, measuring from end to end.

h. Insert the center of the cable into the cable slot in the drum and install the lock pin (3).

i. Hold the drum (2) with the previously marked or base end of the drum down.

j. Looking down on the drum, wrap up the cable that leads from the base end nine and one-quarter turns in a counterclockwise direction. The cable from the upper end, wrap down in a clockwise direction nine and one-quarter turns.

k. Insert the drum in the housing bracket, position the drum and route the cables from the assembly as shown in Figure 5-13.

l. Install the screw (5) and screw stop (4) and secure with the roll pin (3).

m. Block the trim cables in center position to keep them tight and from unwrapping, by the method shown in Figure 5-9.

n. Center the drum between the stops on the screw by rotating the screw.

5-49. WING FLAP CONTROLS.

5-50. REMOVAL OF FLAP ACTUATOR ASSEMBLY. (Refer to Figure 5-14.)

a. Disconnect the flap control rods allowing both flaps to hang free.

b. Remove the two access plates from the outboard undersides of the fuselage at station 128.75.

c. Remove the locknut from the sender unit rod installed through the torque tube and remove the rod.

d. Remove the bellcrank assembly from one end of the torque tube by removing the two bolts, washers, and cotter pins installed through the torque tube.

—NOTE—

If the bellcrank assembly is to be removed from the right side, disconnect the actuating rod from the bellcrank by removing the bolt, washer and self-locking nut.

e. Cut the safety wire from the bearing block bolts and remove the bolts, washers, bearing blocks, bearings and shims if installed from each side.

f. Remove the torque tube, withdrawing it from the aircraft on the opposite side of the airplane that the bellcrank was removed. If stabilator trim and flap interconnect system is installed, slide pulley from torque tube by removing attachment hardware and retaining pulley in fuselage while withdrawing torque tube.

5-51. INSTALLATION OF FLAP ACTUATOR ASSEMBLY. (Refer to Figure 5-14.)

a. Install the torque tube by installing it through the side of the fuselage at station 128.75.

b. Lubricate the torque tube bearings per Lubrication Chart, Section II.

c. Position the torque tube (if stabilator trim and flap interconnect system is installed, slide the pulley on torque tube while positioning tube) and install the bearing blocks with bearings, bolts, washers and shims as required. (Install shims .010 to .014, P/N 41371-002; .015 to .020, P/N 41371-003 or .032, P/N 41371-004 between the bearing blocks to provide a minimum clearance without binding of the torque tube.)

d. Position the bellcrank on the torque tube end and secure by installing two bolts, washers, nuts and cotter pins through the bellcrank and torque tube.

e. Check rigging and adjustment of flaps. (Refer to Paragraph 5-52.)

f. Check adjustment of flap position sender. (Refer to Paragraph 5-55.)

g. Safety the bearing block bolts with MS20995-C32 safety wire and install the access plates.

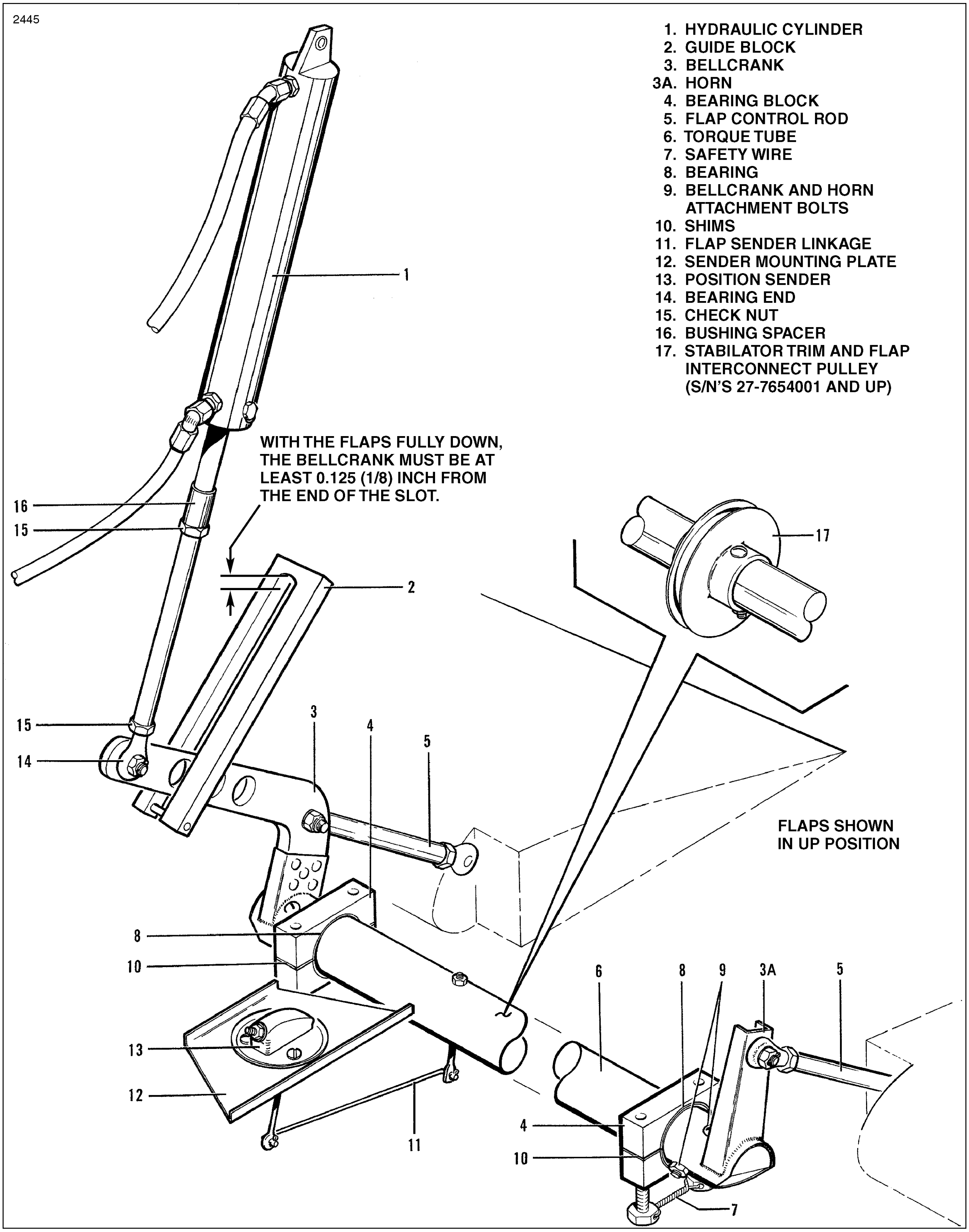

Figure 5-14. Flap Control Installation

5-52. RIGGING AND ADJUSTMENT OF FLAPS.

a. Connect all the flap system linkages together, temporarily.

b. Place the cockpit FLAP control lever in the DOWN position. Using the pedestal hand pump, lower the flaps till there is no movement. At this time the piston will be withdrawn into the flap actuating hydraulic cylinder as far as the bushing, located on it, permits it to go. The locknut for the tube threaded into the piston rod and the bottom of the cylinder are the members between which the bushing is compressed.

c. Observe the position of the flap bellcrank assembly with respect to the slot in the flap actuating arm guide block. The bellcrank must be at least 1/8-inch from the end of the slot. If it strikes the block, remove the bolt, washer, and self-locking nut securing the tube end bearing to the bellcrank and rotate the tube counterclockwise to extend it. Tighten the tube locknut to maintain the new position of the tube relative to the piston rod. Check to see if end bearing locknut is tight.

d. Connect the tube end bearing to the bellcrank with a bolt, plain washer and a self-locking nut.

e. Raise the flaps as far up as they will go.

f. Place a straight edge beneath the wing surface and check if the flap is parallel with the bottom of the wing.

NOTE: On certain airplanes (as listed below), the bottom of the flaps will not be flush with the wing. When the flaps and wings are not flush, set two rubber blocks between a straightedge and the bottom of the wing to check parallelism. (Refer to Figure 5-15.)

Serial Numbers	Size of Rubber Block Between Straightedge and Wing
27-1 thru 27-2504	1/4 inch
27-2505 thru 27-3049 27-3051 thru 27-3153	None (i. e. - Flush)
27-3050, 27-3154 and up	1/8 inch

g. Rectify a non-parallel condition by lowering the flaps completely by the hand pump. Then disconnect the flap control rod assembly from the bolt in the flap bellcrank. Rotate the control rod end bearing to correct the misalignment. Reconnect the control rod to the bellcrank. Raise the flaps until the cockpit control lever returns to neutral and check for parallelism again.

h. If still unsatisfactory, lower the flap and repeat the adjustment. If necessary, also adjust the control rod end bearing at the flap. To do this, do not separate the end bearing from the flap but rotate the flap control rod itself. When satisfactory, install a washer between the end bearing and the bellcrank and secure with a castellated nut and a cotter pin.

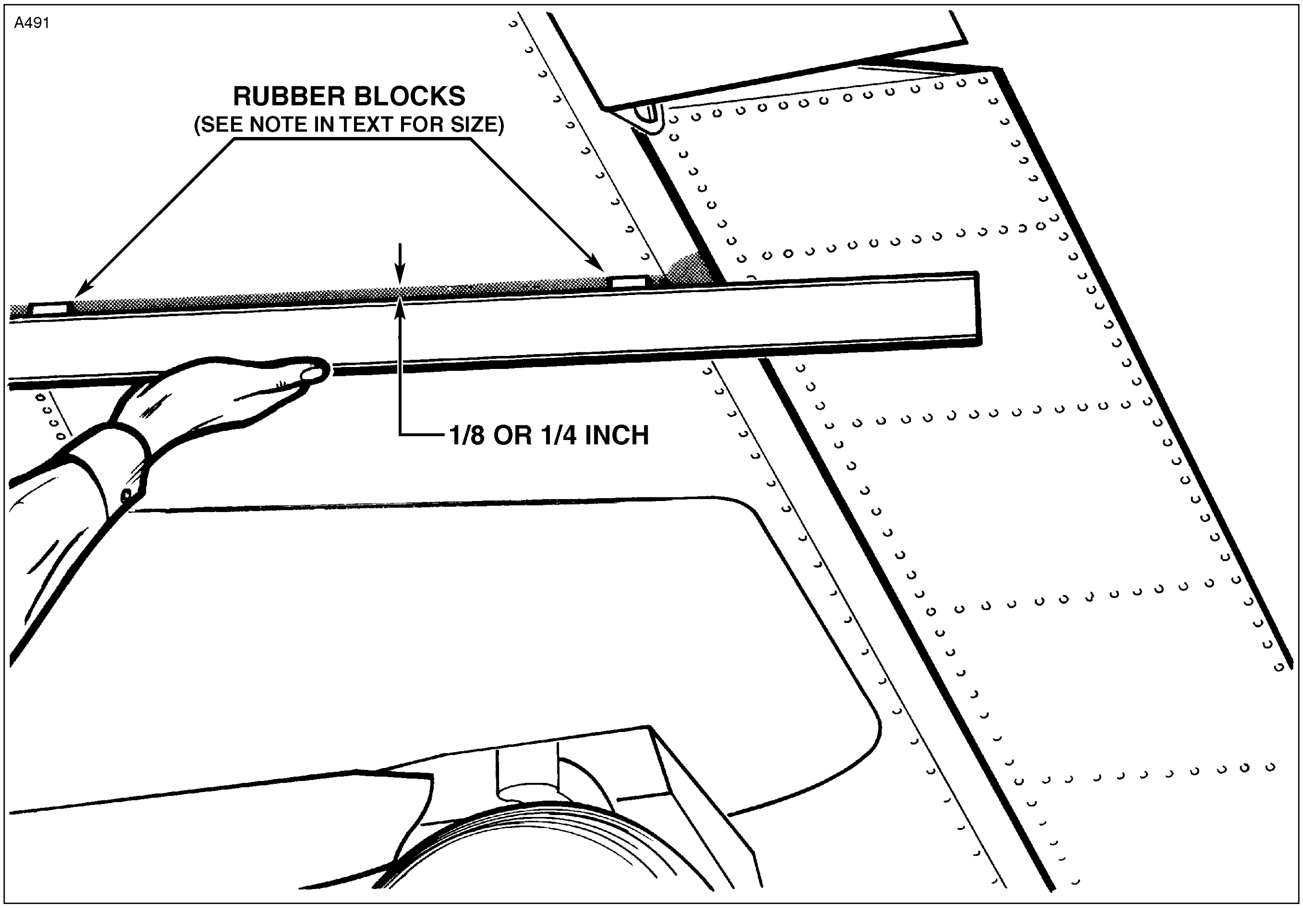

Figure 5-15. Flap Rigging

i. Repeat all of the above procedures on the remaining flap.

NOTE: Place a plain washer under the castellated nut in addition to the washer located between the control rod end bearing and the bellcrank at the left flap.

j. Move the flap within its limits and note if there are 50 degrees of movement, plus or minus two degrees. Check all locknuts for tightness.

CAUTION: VERIFY FREE AND CORRECT MOVEMENT OF FLAPS. WHILE IT WOULD SEEM SELF-EVIDENT, FIELD EXPERIENCE HAS SHOWN THAT THIS CHECK IS FREQUENTLY MISINTERPRETED OR NOT PERFORMED AT ALL. ACCORDINGLY, UPON COMPLETION OF FLAP RIGGING AND ADJUSTMENT, VERIFY THAT THE FLAPS MOVE UP WHEN THE SELECTOR LEVER IS UP; AND, THAT THE FLAPS MOVE DOWN WHEN THE SELECTOR LEVER IS DOWN.

5-53. REMOVAL OF FLAP POSITION SENDER.

a. Remove the access plate from the outboard right underside of the fuselage just inboard of the flap.

b. Disconnect the flap position indicator rod by removing the self-locking adjustment nut and withdraw the rod from the torque tube.

c. Remove the center and rear seats from the right side of the airplane.

d. Remove the outboard seat track from the right side of the airplane by removing attaching screws.

e. Pull the carpet back and remove the access plate located below the center window at station 117.75.

f. Disconnect the electrical leads from the position sender.

g. Remove the position sender by removing the attaching screws.

5-54. INSTALLATION OF FLAP POSITION SENDER.

a. Position the sender and secure with attaching screws.

b. Connect the electrical leads to the sender.

c. Insert the flap position indicator rod through the torque tube and install the self-locking adjustment nut.

d. Adjust the sending unit as described in paragraph 5-55.

e. Install the access plates, carpet, seat track and seats.

5-55. RIGGING AND ADJUSTMENT OF FLAP POSITION SENDER.

a. Remove the access plate from the right underside of the fuselage, just inboard of the flap, if not previously removed.

b. Lower the flaps to an angle of 25 degrees as checked with a bubble protractor.

NOTE: To adjust the flap position sender, the electrical system must supply either 14 or 28 volts to the sender unit, depending on electrical system design for the particular aircraft.

c. Tighten or loosen the adjustment nut until the indicator on the instrument panel points to the half-way mark.

d. Check the three flap positions (retracted, half-way or 25 degrees, and fully extended) with respect to the angular settings and the position indicated on the flap gauge.

e. Install the access plate to the underside of the fuselage with attaching screws.

5-56. STABILATOR TRIM AND FLAP INTERCONNECT SYSTEM. (Serial Nos. 27-7654001 and up.) On PA-23-250 (six place) airplanes with serial nos. noted above, a stabilator trim and flap interconnect system is installed which connects the flap torque tube to the stabilator trim tab. The system includes cables connecting a pulley on the flap torque tube to an eccentric pulley on the stabilator trim bellcrank, so that when the flaps are extended, pressure is exerted against the bellcrank to increase down trim. Thus reducing the pitch change during flap extension. The amount of trim tab displacement is directly proportional to the amount of flap extension.

5-57. REMOVAL OF STABILATOR TRIM AND FLAP INTERCONNECT SYSTEM. (Refer to Figure 5-6.)

a. Remove center seats and rails. Pull the carpet back to gain access to the stabilator trim and flap interconnect access cover at station 126.75. Remove aft baggage compartment trim and floor panels by removing attaching screws. Remove the tail cone fairing.

b. Disconnect the turnbuckles (7 & 8) at stations 258.50 and 267.50.

c. Remove guard pins from pulleys at stations 130.75, 153.88 and 229.00; pull cable (9) forward through fuselage to flap torque tube (12).

d. Remove guard from around flap torque tube pulley; unwind cable from pulley. Remove cotter pins securing cable to torque tube pulley and remove cable from airplane.

e. Remove flap torque tube pulley (1) per paragraph 5-50.

f. Pull guard pin from pulley at station 273.38 and pull remaining cable (10) aft to the stabilator trim bellcrank assembly (17).

g. Disconnect eccentric pulley (6) and remove cable and eccentric pulley from aircraft.

5-58. INSTALLATION OF STABILATOR TRIM AND FLAP INTERCONNECT SYSTEM.

a. Install pulley on torque tube per paragraph 5-51.

b. Hold cable ball in place on flap torque tube pulley with cotter pins.

c. Wrap cable around pulley as shown in Figure 5-6, Sketch B and install pulley guard.

d. Feed cable aft through pulleys at stations 130.75, 153.88 and 229.00 and install guard pins.

e. Slide cable ball on eccentric pulley and wrap cable as shown in Figure 5-6, Sketch C. Install eccentric pulley on bellcrank and screw assembly.

f. Connect tension spring (25) as shown in Figure 5-6.

g. Feed cable forward to the turnbuckles. Install pulley guard pin at station 273.38. Connect the cable end from the bottom of the flap torque tube pulley to the cable from the top of the eccentric pulley. (Refer to Figure 5-6, Sketches B and C.) Connect the other cables and adjust tension per paragraph 5-59.

h. Replace items removed in Step a of paragraph 5-57.

5-59. ADJUSTMENT OF STABILATOR TRIM AND FLAP INTERCONNECT SYSTEM. (Refer to Figure 5-6.)

a. Ascertain that the stabilator trim is rigged and adjusted per paragraph 5-24.

b. Place the flaps in the up position with the stabilator and stabilator trim in neutral then adjust the turnbuckles to obtain the combined cable tension as given in Table V-I.

c. When rigging the interconnect system, the eccentric pulley stop arms should have .125 to .187 of an inch gap between the upper stop pin and the stop arm. Therer is no specified clearance at the lower stop, but the eccentric pulley arm should not conduct the stop pin.

NOTE

With the flaps lowered, one cable will be slack on the eccentric cam, if the lower stop makes contact, tighten up on the slack cable to provide the cushion gap, always maintaining the combined tension as given in Table V-I.

d. With the flaps in the full down position, trim tab deflection should be 3.5° (minimum) up. If deflection of 3.5° is unobtainable recheck the stabilator trim adjustment per paragraph 5-24 and installation of stabilator trim and flap interconnect system per paragraph 5-58.

5-60. CONTROL SYSTEM FRICTION LIMITS.

5-61. FRICTION IN THE STABILATOR CONTROL SYSTEM.

a. Attach a spring scale to the brackets which join the rear spar just forward of the tab.

b. Record the scale reading as the stabilator passes through neutral by raising it from 2.0 inches below neutral to 2.0 inches above neutral.

c. Record the scale reading as the stabilator passes through neutral by lowering it to the original position.

d. Repeat the previous raising and lowering until average readings are obtained, making sure the movement is slow and steady.

e. The total friction is obtained by subtracting the two readings. This shall not exceed 16 lbs. on serial nos. 27-1 to 27-7554172 incl. or 13 lbs. on serial nos. 27-7654001 and up, when stabilator control system is rigged with proper travels and cable tension.

5-62. FRICTION IN THE RUDDER CONTROL SYSTEM.

a. The aircraft shall be on jacks with the nose wheel fully extended and clear of the floor.

b. The rudder shall be pushed to the stop and allowed to slowly return to its stable point.

c. A spring scale is place against the lower rearward corner of the rudder.

d. Move the rudder from the above position through neutral, recording the maximum scale reading.

e. Repeat the procedure for both left and right, gear up and gear down until an average reading is obtained. The movement should be slow and steady with the scale always perpendicular to the chord line of the rudder.

f. The friction is the direct reading obtained in each direction and shall not be in excess of 10 lbs. with the gear down, and 2 lbs. with the gear up, both to the right and left.

5-63. FRICTION IN THE AILERON CONTROL SYSTEM.

a. A spring scale is placed against the trailing edge of either the left or right aileron.

b. Record the scale reading as the aileron passes through neutral by raising it from 1.5 inches below neutral to 1.5 inches above neutral.

c. Record the scale reading as the aileron passes through neutral by lowering it to the original position.

d. Repeat above until average readings are obtained making sure movement is slow and steady with the scale always perpendicular to the chord line of the aileron.

e. The friction is the direct reading obtained in each direction and shall not be in excess of 7 lbs. for each.

5-64. ADJUSTMENT OF STABILATOR TAB POSITION INDICATOR. (Refer to Figure 5-5.)

a. Set tab travels as per Table V-I.

b. Verify that the indicator multiplying link is properly rigged as per Sketch D, Figure 5-5.

c. Crank stabilator trim handle (24) to full nose down position and turn back six (6) full turns.

d. Make adjustment to indicator system placing stabilator trim indicator (28) in center of "TAKE OFF" area.

TABLE V-II. TROUBLESHOOTING - SURFACE CONTROLS

Trouble	Cause	Remedy
	AILERON CONTROL SYSTEM	
Lost motion between control wheel and aileron.	Cable tension too low.	Adjust cable tension, (Refer to Para. 5-13.)
	Linkage loose or worn.	Check linkage and tighten or replace.
	Cables not in place on pulleys.	Install cables correctly. Check cable guards.
	Broken pulley.	Replace pulley.
Resistance to control wheel rotation.	System not lubricated properly.	Lubricate system.
	Cable tension too high.	Adjust cable tension. (Refer to Para. 5-13)
	Control column chain improperly adjusted.	Adjust chain tension, (Refer to Para. 5-13d)
	Pulleys binding or rubbing.	Replace binding pulleys and/or provide clearance between pulleys and brackets.
	Cables crossed or routed incorrectly.	Check routing of control cables.
	Cables not in place on pulleys.	Install cables correctly, Check cable guards.
	Bent aileron and/or hinge.	Repair or replace aileron and/or hinge.
Control wheels not synchronized.	Incorrect control column rigging.	Rig in accordance with Para. 5-13d.
Control wheels not horizontal when ailerons are neutral.	Incorrect rigging of aileron system.	Rig in accordance with Para. 5-13.
Incorrect aileron travel.	Aileron control tubes not adjusted properly.	Adjust in accordance with Para. 5-13b.
	Aileron bellcrank stops not adjusted properly.	Adjust in accordance with Para. 5-13a.

TABLE V-II. TROUBLESHOOTING - SURFACE CONTROLS (cont.)

Trouble	Cause	Remedy
	AILERON CONTROL SYSTEM (cont.)	
Correct aileron travel cannot be obtained by adjusting bellcrank stops.	Incorrect rigging of aileron cables, control wheel and control tube rod ends.	Rig in accordance with Para. 5-13.
Control wheel stops before control surfaces reach full travel.	Incorrect rigging between control wheel and control cables.	Rig in accordance with Para. 5-13.
	STABILATOR CONTROL SYSTEM	
Lost motion between control wheel and stabilator.	Cable tension too low.	Adjust cable tension per Para. 5-18.
	Linkage loose or worn.	Check linkage and tighten or replace.
	Cables not in place on pulleys.	Install cables correctly.
	Broken pulley.	Replace pulley.
Resistance to stabilator control movement.	System not lubricated properly.	Lubricate system.
	Cable tension too high.	Adjust cable tension per Para. 5-18.
	Binding control column.	Adjust and lubricate per Para. 5-7.
	Pulleys binding or rubbing.	Replace binding pulleys and/or provide clearance between pulleys and brackets.
	Cables crossed or routed incorrectly.	Check routing of control cables.
	Cables not in place on pulleys.	Install cables correctly.
	Bent stabilator hinge.	Repair or replace stabilator or hinge.
Incorrect stabilator travel.	Stabilator stops incorrectly adjusted.	Adjust stop screws per Para. 5-18.
	Stabilator control cables incorrectly adjusted.	Adjust control cables per Par. 5-18.

TABLE V-II. TROUBLESHOOTING - SURFACE CONTROLS (cont.)

Trouble	Cause	Remedy
	STABILATOR CONTROL SYSTEM (cont.)	
Correct stabilator travel cannot be obtained by adjusting stabilator stops.	Stabilator cables incorrectly rigged.	Rig cables in accordance with Para. 5-18.
	STABILATOR TRIM CONTROL SYSTEM	
Lost motion between trim control handle and trim tab.	Cable tension too low.	Adjust In accordance with Para. 5-24.
	Cables not in place on pulleys.	Install cables according to Paras. 5-21 and 5-23.
	Broken pulley.	Replace pulley.
	Linkage loose or worn.	Check linkage and tighten or replace.
Trim control handle moves with excessive resistance.	System not lubricated properly.	Lubricate system.
	Cable tension too high.	Adjust in accordance with Para. 5-24.
	Pulleys binding or rubbing.	Replace binding pulleys. Provide clearance between pulleys and brackets.
	Cables crossed or routed incorrectly.	Check routing of control cables.
	Cables not in place on pulleys.	Refer to Paras. 5-21 and 5-23.
	Trim tab hinge binding.	Lubricate hinge. If necessary, replace.
Trim tab fails to reach full travel.	System incorrectly rigged.	Check and/or adjust rigging per Para. 5-24.
	Trim drum incorrectly wrapped.	Check and/or adjust rigging per Para. 5-24.
Trim indicator fails to indicate correct trim position.	Trim indicator unit not adjusted properly.	Adjust in accordance with Paragraph 5-27.
Trim indicator fails to indicate any movement.	Trim indicator defective.	Replace indicator unit.
	Wire broken.	Locate break and splice or replace.

TABLE V-II. TROUBLESHOOTING - SURFACE CONTROLS (cont.)

Trouble	Cause	Remedy
	STABILATOR TRIM CONTROL SYSTEM (cont.)	
Trim control cable slippage.	Worn trim crank pulley causing cable bottoming in pulley groove.	Inspect pulley per Figure 5-5a. Replace pulley as required.
	Incorrect system rigging.	Re-rig per paragraph 5-24.
	Cable mis-routing.	Inspect length of cable to verify proper routing and travel along, over, and around rub blocks, guides, and pulleys. See Figures 5-5 and 5-6.
	Cable tension too low.	Readjust cable tension per Table V-I.
	Cable linkage loose or worn.	Inspect mechanical linkages throughout trim system for condition and security. Verify installation is per paragraphs 5-19 thru 5-30. Replace worn parts. See Figures 5-5 and 5-6.
	Excessive lubricant buildup on cable at trim crank.	Dampen a clean white cloth with a suitable solvent. Holding the cloth over the cable adjacent to the trim crank cycle the trim crank through full fore and aft trim. Note residue on cloth. Repeat until residue on cloth is barely noticeable.
	Improper function (sticking or binding) of trim drum.	Disassemble trim drum. Inspect drum and drum bracket for dirt, grit, burrs, etc. Remove burrs with emery cloth and clean with suitable solvent and brush. Lubricate per lubrication chart, Section II.

TABLE V-II. TROUBLESHOOTING - SURFACE CONTROLS (cont.)

Trouble	Cause	Remedy
RUDDER CONTROL SYSTEM		
Lost motion between rudder pedals and rudder.	Cable tension too low.	Adjust cable tension per Para. 5-34.
	Linkage loose or worn.	Check linkage and tighten or replace.
	Broken pulley.	Replace pulley.
	Bolts attaching rudder to bellcrank are loose.	Tighten bellcrank bolts.
Excessive resistance to rudder pedal movement.	System not lubricated properly.	Lubricate system.
	Rudder pedal torque tube bearing in need of lubrication.	Lubricate torque tube bearings.
	Cable tension too high.	Adjust cable tension per Para. 5-34.
	Cables crossed or routed incorrectly.	Check routing of control cables.
	Cables not in place on pulleys.	Install cables correctly. Check cable guards.
	Pulleys binding or rubbing.	Replace binding pulleys and/or provide clearance between pulleys and brackets.
Rudder pedals not neutral when rudder is streamlined.	Rudder cables incorrectly rigged.	Rig in accordance with Para. 5-34.
Incorrect rudder travel.	Rudder bellcrank stop incorrectly adjusted.	Rig in accordance with Paragraph 5-34.
	Nose wheel contacts stops before rudder.	Rig in accordance with Paragraph 5-34.

TABLE V-II. TROUBLESHOOTING - SURFACE CONTROLS (cont.)

Trouble	Cause	Remedy
	RUDDER TRIM CONTROL SYSTEM	
Lost motion between trim control handle and trim tab.	Cable tension too low.	Adjust in accordance with Para. 5-40.
	Cables not in place on pulleys.	Install cables according to Paras. 5-37 and 5-39.
	Broken pulley.	Replace pulley.
	Linkage loose or worn.	Check linkage and tighten or replace.
Trim control handle moves with excessive resistance.	System not lubricated properly.	Lubricate system.
	Cables crossed or routed incorrectly.	Check routing of control cables.
	Cables not in place on pulleys.	Install cables according to Paras. 5-37 and 5-40.
	Pulleys binding or rubbing.	Replace binding pulleys. Provide clearance between pulleys and brackets.
	Trim tab hinge binding.	Lubricate hinge. Replace if necessary.
Trim tab fails to reach full travel.	System incorrectly rigged.	Check and/or adjust rigging per Para. 5-40.
	Trim drum incorrectly wrapped.	Check and/or adjust rigging per Para. 5-48.
Trim indicator fails to indicate correct trim position.	Trim indicator unit not adjusted properly.	Adjust in accordance with Paragraph 5-43.
Trim indicator fails to indicate any movement.	Trim indicator defective.	Replace indicator unit.
	Wire broken.	Locate break and splice or replace.
	FLAP CONTROL SYSTEM	
	Refer to Hydraulic System Troubleshooting, Table VI-V.	

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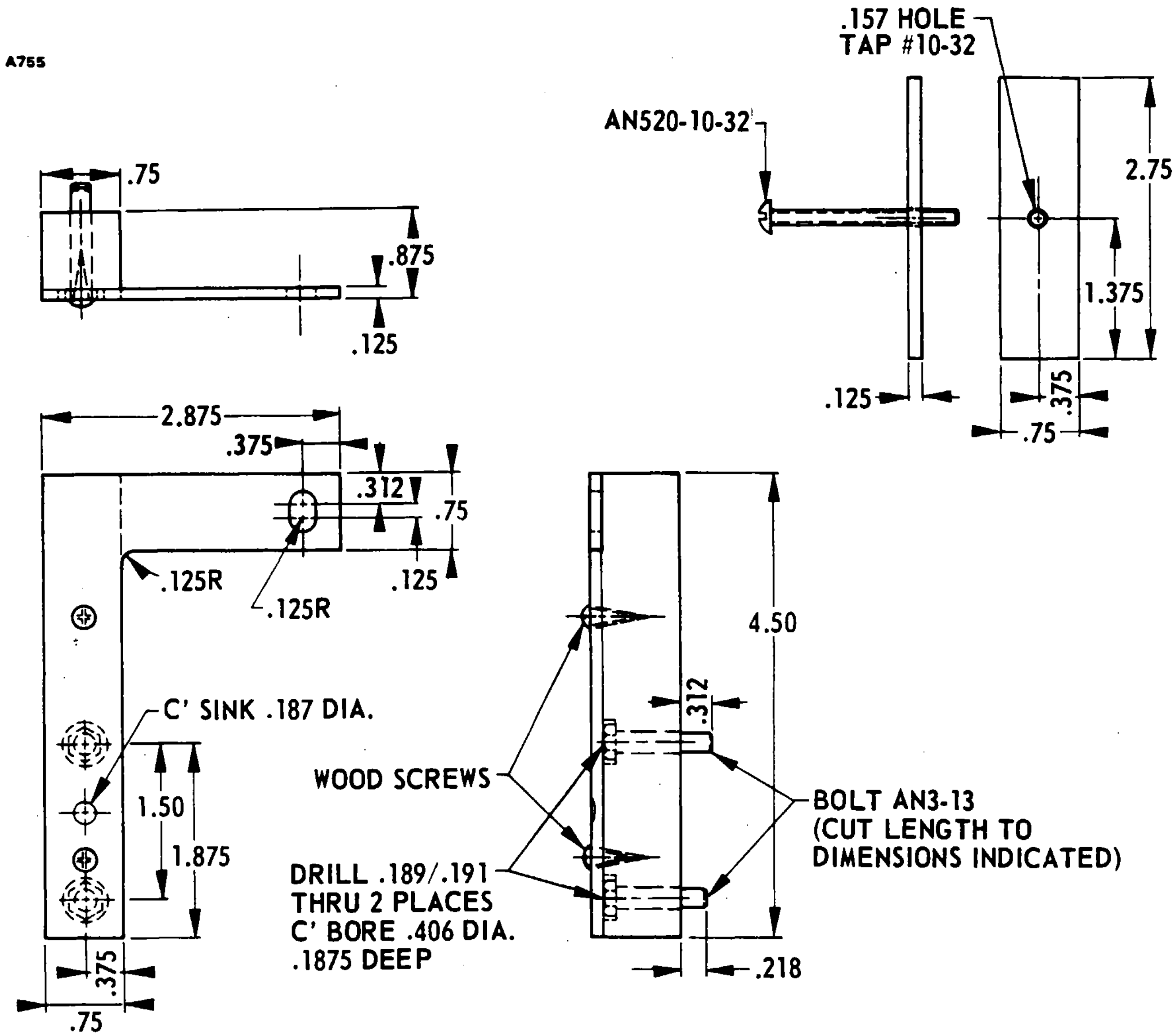

MATERIAL LIST
1-.125 x .75 x 2.75 STEEL PLATE
1-.125 x 2.875 x 4.50 STEEL OR ALUM. PLATE
2-AN3-13 BOLT
1-AN520-10-32 SCREW
2-WOOD SCREWS

Figure 5-16. Fabricated Tool, Aileron Rigging

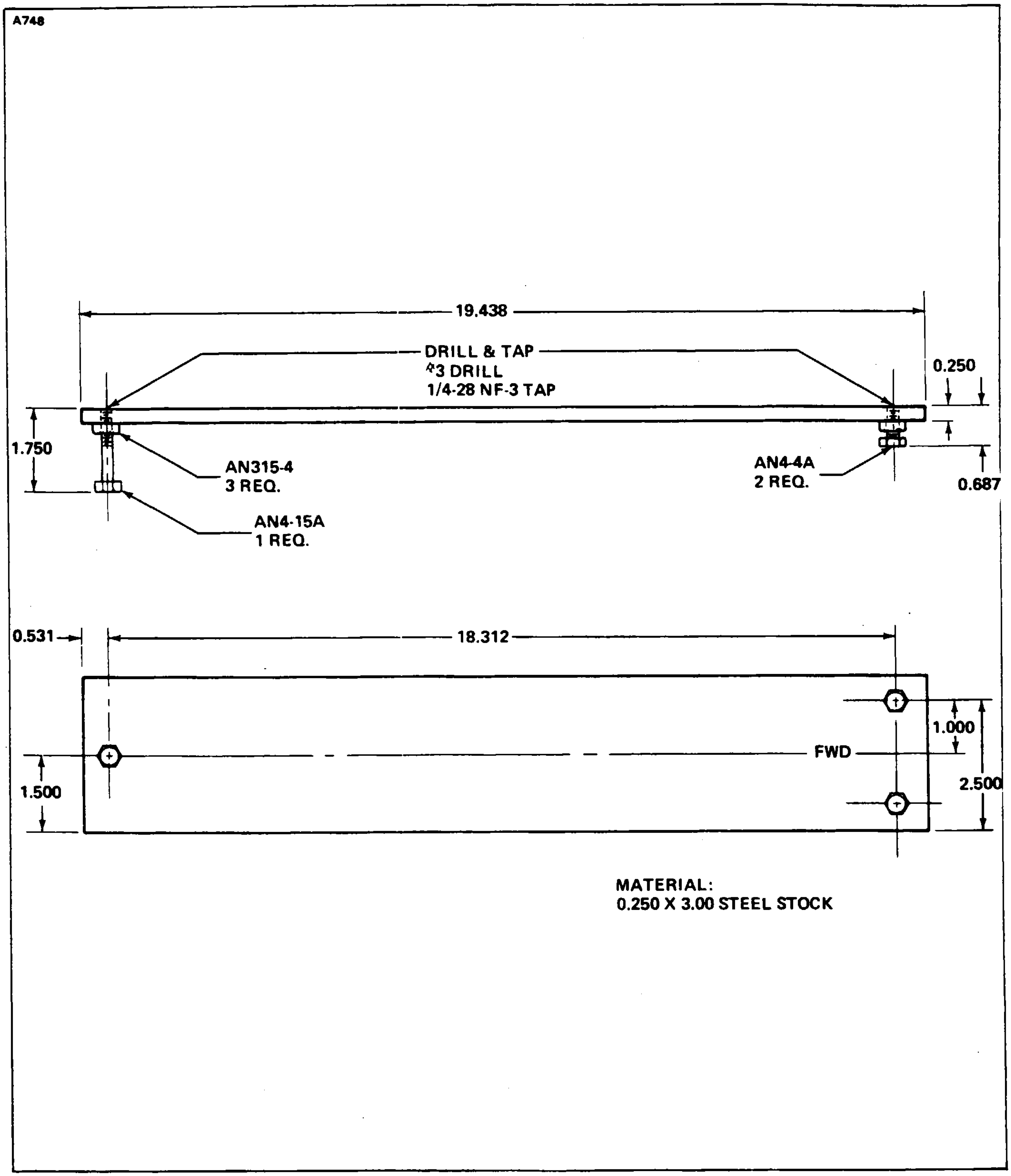

Figure 5-17. Fabricated Tool, Stabilator Leveling
(Serial Nos. 27-1 to 27-7554168 incl. and
27-8054001 and up)

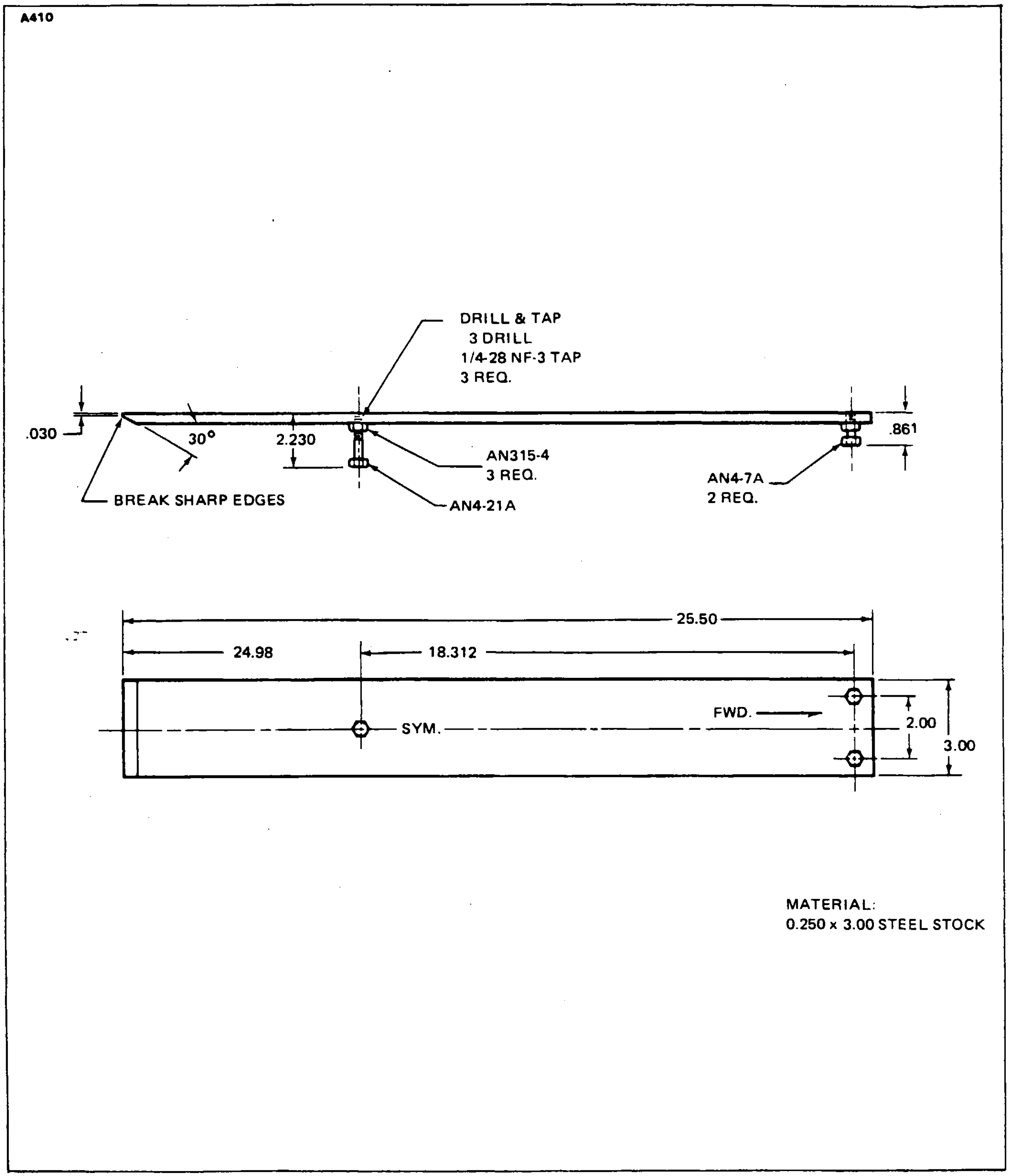

Figure 5-18. Fabricated Tool, Stabilator Leveling
(Serial Nos. 27-7654001 to 27-7954121 incl.)

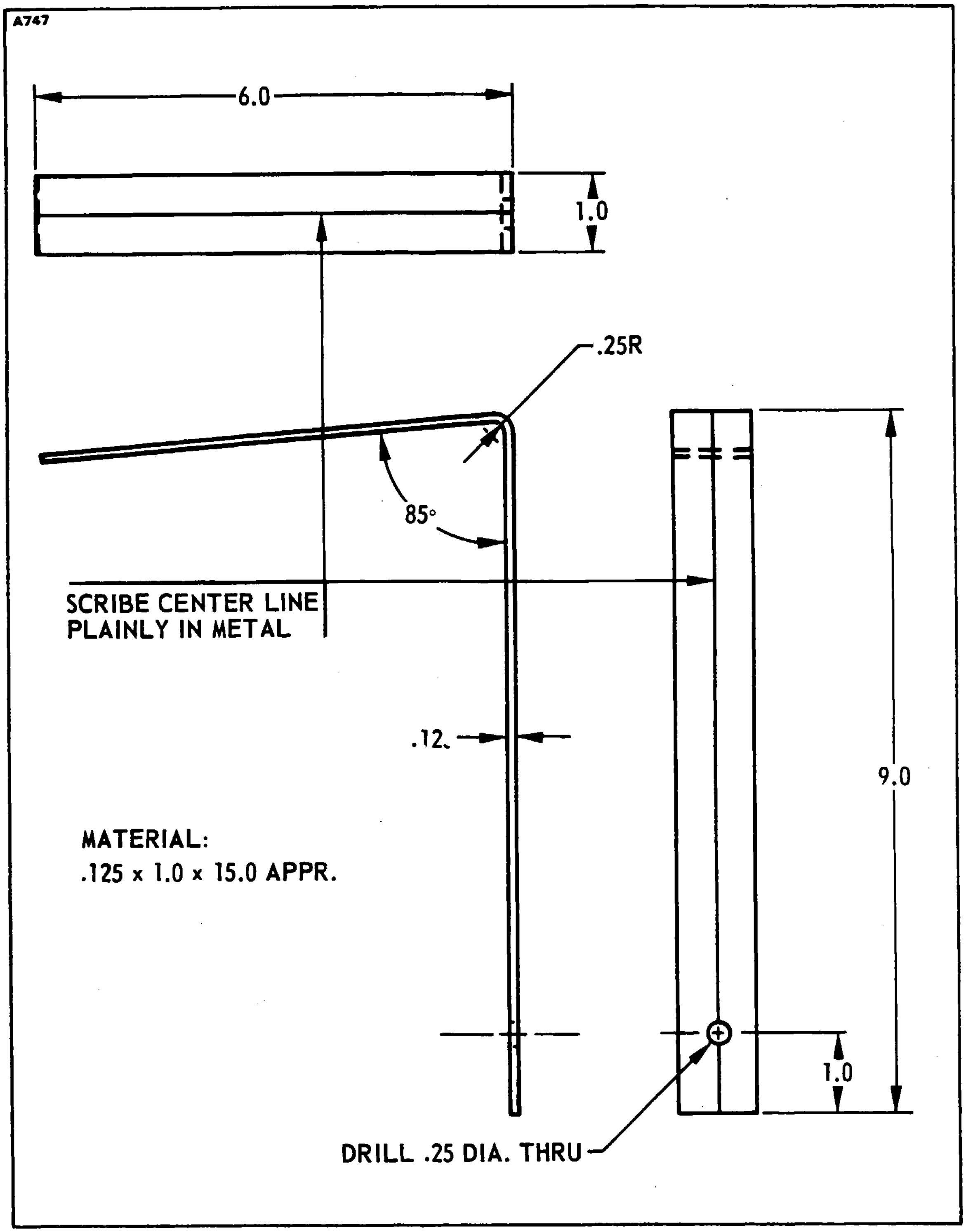

Figure 5-19. Fabricated Tool, Rudder Rigging
(All PA-23 series models except for the PA-23-250 [6] "F")

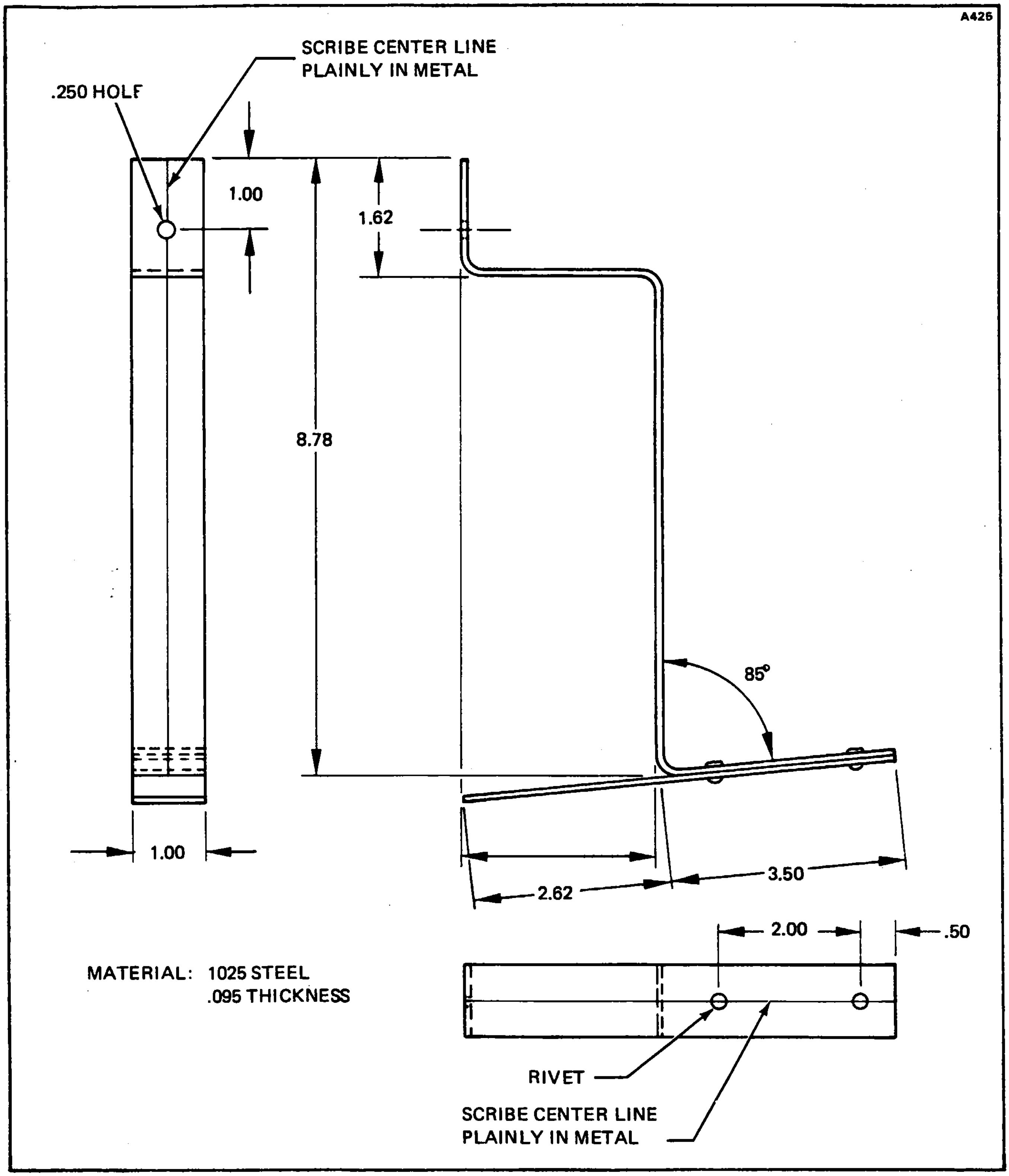

Figure 5-20. Fabricated Tool, Rudder Rigging
(PA-23-250 [six place] "F" Only)

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SECTION

VI

HYDRAULIC SYSTEM

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SECTION VI
HYDRAULIC SYSTEM

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SECTION VI

HYDRAULIC SYSTEM

6-1. INTRODUCTION. The hydraulic system components covered in this section consist of the hydraulic pump(s), the powerpak and its related components, various valves within the system, actuating cylinders, hydraulic lines and filter. The brake system, although hydraulically operated, is not included in this section as it has its own hydraulic system independent of the landing gear and flap system. The brake system along with mechanical aspects of the landing gear is covered in Section VII.

This section provides instructions for remedying difficulties which may arise in the operation of the hydraulic system. The instructions covered are: Description and Principles of Operation, for a basic understanding of the system; Troubleshooting, for a methodical approach in locating the difficulty; Corrective Maintenance, for the removal, repair and installation of components; and Adjustments and Tests, for the operation of the repaired system.

WARNING

Prior to starting any investigation of the hydraulic system, place the airplane on jacks. (Refer to Jacking, Section II.)

6-2. DESCRIPTION AND PRINCIPLES OF OPERATION. The hydraulically operated landing gear and flap system within the PA-23 is supported by a powerpak unit located in the control pedestal below the instrument panel. The operation of the powerpak is controlled by levers protruding through the face of the pedestal; with knobs in the shape of a wheel for the landing gear, and an air foil for the flap. The powerpak also serves as a hydraulic reservoir. Pressure for the hydraulic system is supplied by a pump mounted on the left engine. Hydraulic pumps are installed on both engines on models with Serial Nos. 27-7854051 and up.

The hydraulic pump(s) draws fluid from the reservoir and pumps it through a filter back to the main check valve at the inlet pressure port of the powerpak. From the pressure port, fluid flows into the landing gear selector pressure chamber. When the gear and flap selector levers and poppet valves are in the neutral position, center poppets open, fluid travels through the landing gear selector port, through the wing flap selector port and back to the reservoir.

When either selector lever is moved to the UP or DOWN positions, the fluid then travels through the selected port into the actuating cylinders. An example of this operation, which is the same for both the gear selector lever and the flap selector lever, unless otherwise noted, is as follows. As a selector lever is moved to the UP position, it is locked in place by the action of the detent assembly. The detent snaps into the groove in the camshaft and is held in place by the detent spring. The movement of the camshaft, which is attached to the selector lever, opens and closes poppets within the powerpak to control the flow of fluid to the actuating cylinder(s). As fluid pressure is building up on one side of the piston within the actuating cylinder(s), fluid is forced from the other side of the cylinder through the selector return port and back into the reservoir. When the piston "bottoms" or moves as far as possible, fluid pressure then starts to build up until it reaches a required pressure. At this time, the pressure forces the plunger of the detent assembly up against the spring, relieving the holding pressure from the camshaft. The camshaft return spring then forces the camshaft and selector lever to neutral, thus trapping fluid under pressure in the section of the system actuated. When a selector lever is moved to the DOWN position, operation is identical. The flap may be stopped at any position by moving the selector to neutral. A pictorial description of this operation may be found in Figures 6-10 through 6-14.

NOTE

Either system may be actuated independently of the other. However, although both selector levers may be moved at the same time, the flap system will not operate until the landing gear system completes its operation.

On PA-23-250 (six place) airplanes with Serial Nos. 27-2505 and up, a timer check valve (sequence valve) is provided for each landing gear to prevent the gear doors from closing until each landing gear has fully retracted. When the landing gear is to extend, a priority valve located in the control pedestal, prevents the reverse flow of hydraulic fluid from the gear actuating cylinder to the reservoir until a pressure of 600 psi has build up in the landing gear actuating cylinders. The gear doors, with no pressure restriction, will be allowed to open first.

The hand pump serves as an emergency pump should the engine-driven pump(s) fail. The system check valve prevents the fluid from backing up through the engine-driven pump(s) into the reservoir. In the event of severe leakage of the hydraulic fluid, the standpipe prevents the fluid level from dropping below the emergency quantity required for the operation of the system by means of the hand pump. The engine-driven pump(s) are supplied fluid through the standpipe, so that when the fluid level goes below the top of the standpipe, no fluid will flow. Thus, even though the system may develop a break, and the engine-driven pump continues to operate, devoiding the system of fluid, the standpipe insures enough fluid in the system for hand pump operation. At altitudes above 10,000 feet the hand pump becomes increasingly inefficient.

Also incorporated in the powerpak is the main relief valve and four thermal relief valves. The main relief valve functions as a safety between the engine-driven pump(s) or hand pump and the selector poppets, should an uncontrollable pressure build up in this area of the system. When the main relief valve opens, fluid is directed back to the reservoir. The thermal relief valves provide a means of relieving pressure due to thermal expansion in the hydraulic system.

Included on the left main gear is an oleo actuated bypass valve which makes it impossible to retract the landing gear while the weight of the airplane is on the gear. This valve is open when the oleo strut is compressed and bypasses all hydraulic fluid on the pressure side of the system to the return side, preventing any pressure buildup in the retraction system. When the oleo strut is extended as in flight, or when the aircraft is on jacks, the valve is closed permitting the system to operate in the normal manner.

On airplanes with Serial Nos. 27-1 to 27-7954121 inclusive an independent CO2 emergency landing gear extension system is available to extend the landing gear if failure of the hydraulic system should occur due to line breakage or powerpak malfunction. The control for the system is located beneath a small cover plate under the pilot's seat. When the control is pulled, CO2 flows from a cylinder under the floor panel through separate lines to shuttle valves adjacent to the gear actuating cylinders. The gas pressure opens the shuttle valves allowing CO2 to enter the gear cylinders, extending the gears.

A mechanical latch is incorporated at the landing gear control lever to guard against inadvertent retraction of the landing gear while the aircraft is on the ground. The mechanical latch is located on the control pedestal just above the control lever and must be operated before the control lever can be moved upward. Should the landing gear control lever become movable without using the mechanical latch, the latch and related parts should be checked for wear and possible replacement. (Refer to Parts Catalog.)

Further operating procedures may be found in the Pilot's Operating Manual.

TABLE VI-I. LEADING PARTICULARS, HYDRAULIC SYSTEM

Airplane Model	PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.	PA-23-250 (six place), Serial Nos. 27-2505 and up
System Capacity	0.65 gal. (151 cu. in.)	0.68 gal. (158 cu. in.)
Pump Operating Pressure and Flow Rate	Note identification plate on pump.	Note identification plate on pump.
Hydraulic Fluid Required	MIL-H-5606 [2]	MIL-H-5606 [2]
Powerpak Model	750P-1 [1], 31800-0 [1]	31800-2, 31800-2M and 31800-3.
Priority Valve Cracking Pressure	600 psi to Timer Check Valve and 18 psi to Gear and Door Control and Gear Actuator	

NOTES:
1. ORIGINAL EQUIPMENT
2. PETROLEUM BASE 3126 HYDRAULIC OIL. PURCHASE EXXON CO. BOX 2180 HOUSTON, TEXAS 77001

TABLE VI-II. LEADING PARTICULARS, POWERPAK ASSEMBLY

Powerpak Model	750P-1, 14-volt 31800-0, 14-volt	31800-2, 14-volt 31800-2M, 14-volt 31800-3, 28-volt
Operating Pressure	1000 psi nominal	1000 psi nominal
Main Relief Valve Cracking Pressure	1250 ± 50 psi	1350 + 50-0 psi
Thermal Relief Valve Cracking Pressure	2000 ± 50 psi	2000 ± 50 psi
Selector Lever Detent Release Pressure: Landing Gear Flap	 900 ± 100 psi 900 ± 100 psi	 1250 + 50-0 psi 1000 ± 100 psi
Hand Pump Fluid per Cycle (two strokes)	0.74 cu. in.	0.74 cu. in.
Reservoir Capacity Approx. (full)	4.5 pints (120 cu. in.)	4.5 pints (120 cu. in.)
Reservoir Capacity Approx. (emergency)	0.95 pints (27 cu. in.)	1.0 pint (30 cu. in.)
Weight (dry)	8.25 pounds	8.25 pounds

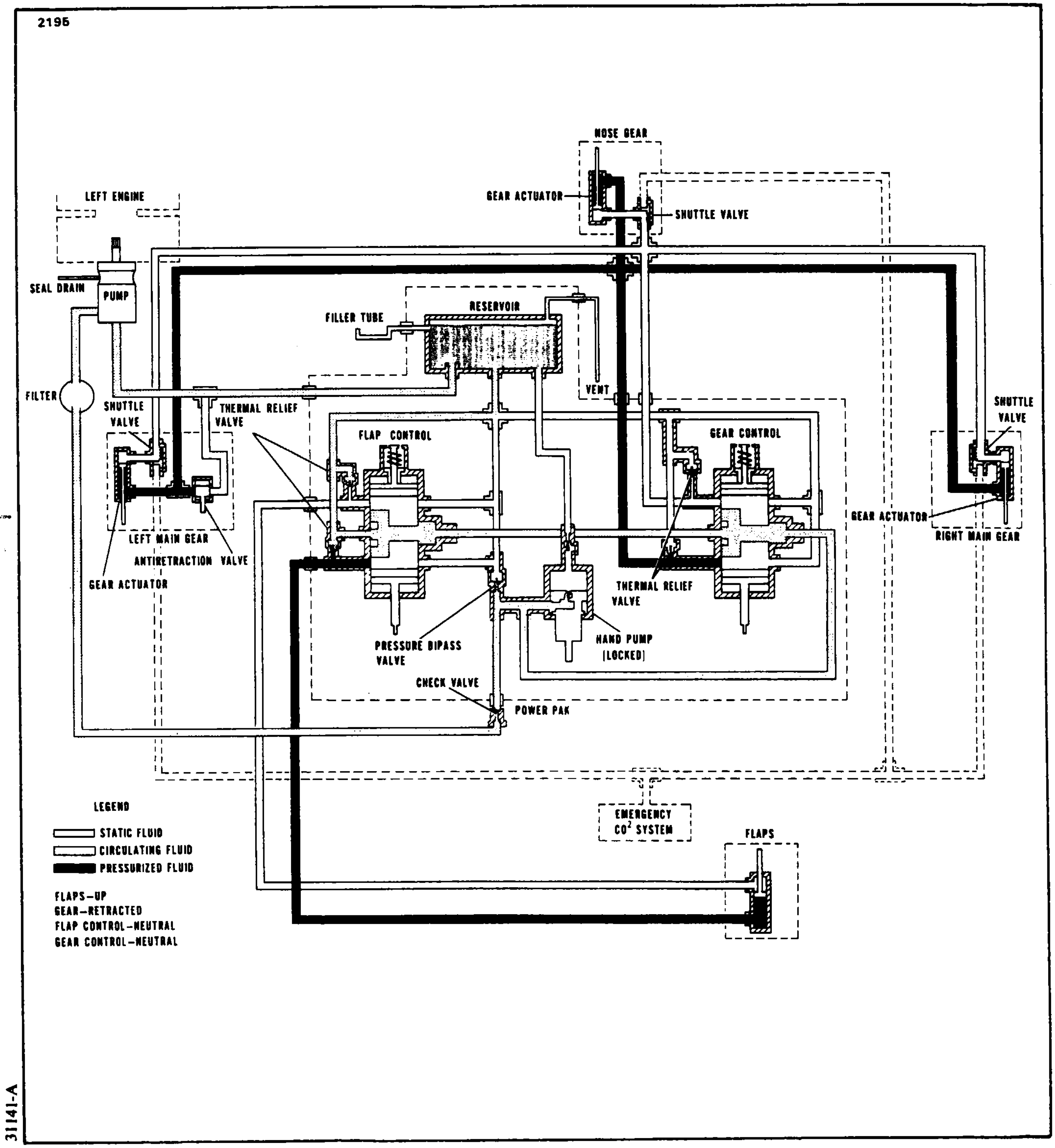

Figure 6-1. Hydraulic System Schematic. PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.

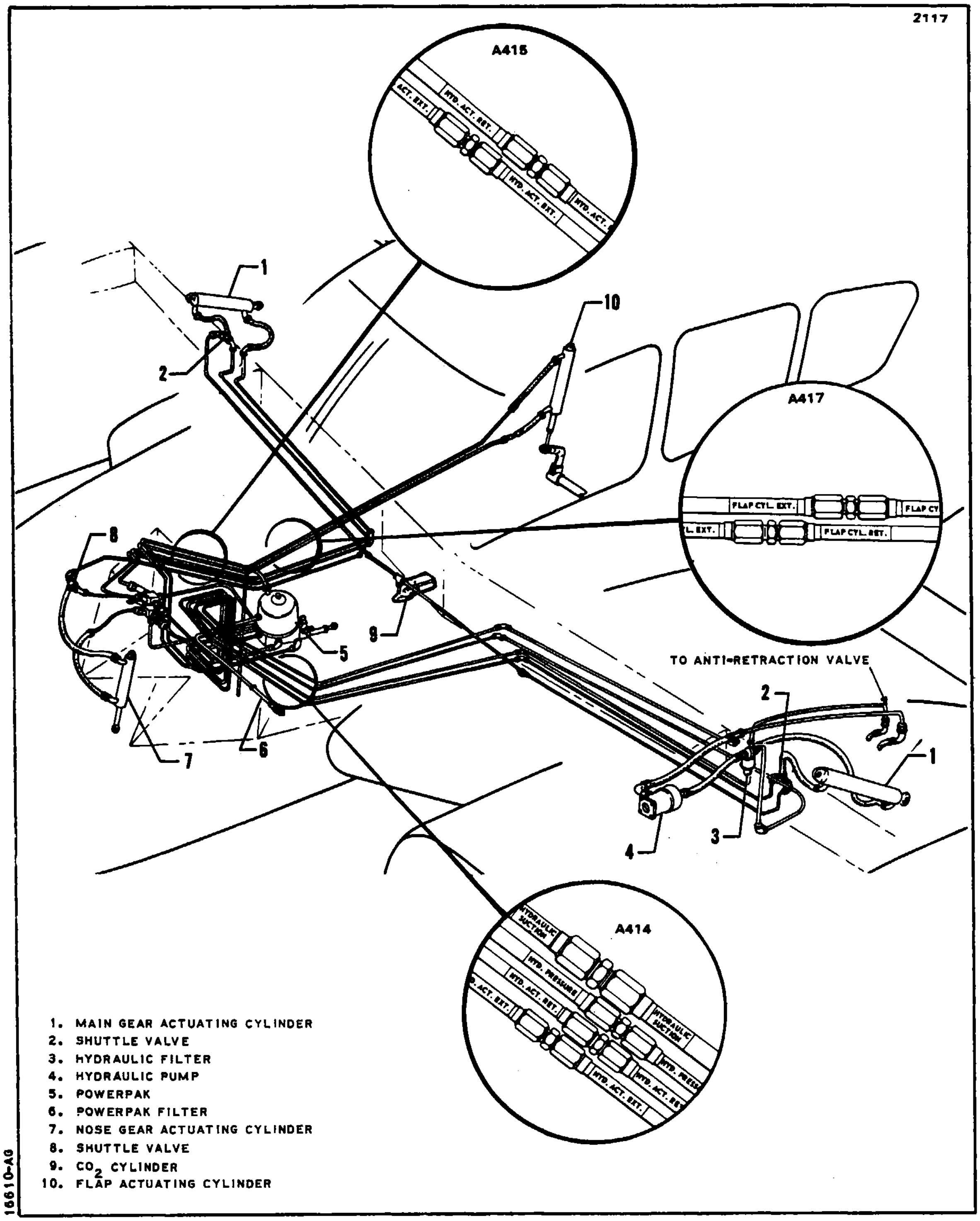

Figure 6-2. Hydraulic System Installation. PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.

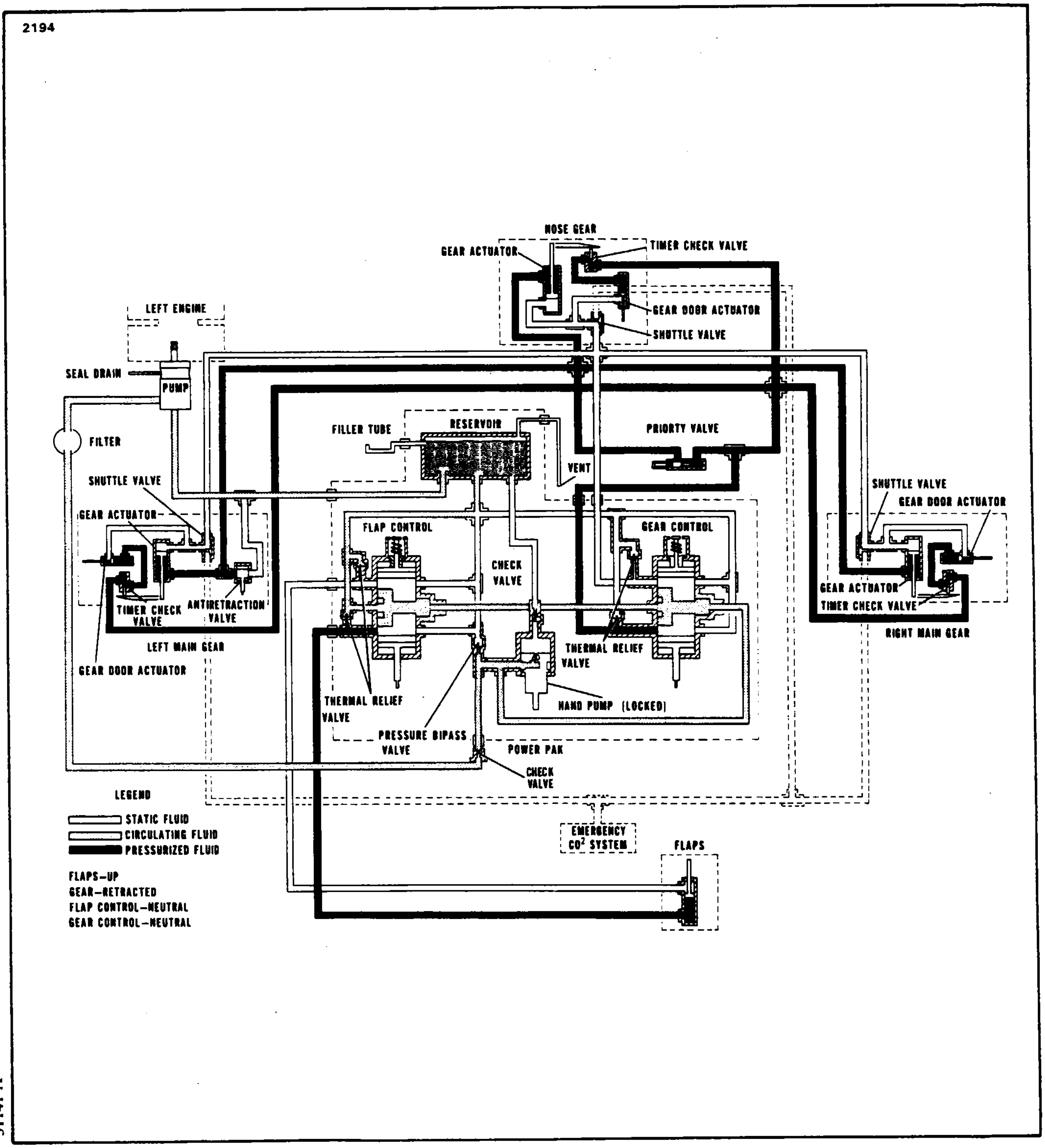

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Figure 6-3. Hydraulic System Schematic
PA-23-250 (six place), Serial Nos. 27-2505 to 27-4425 incl.
and 27-4427 to 27-4573 incl.

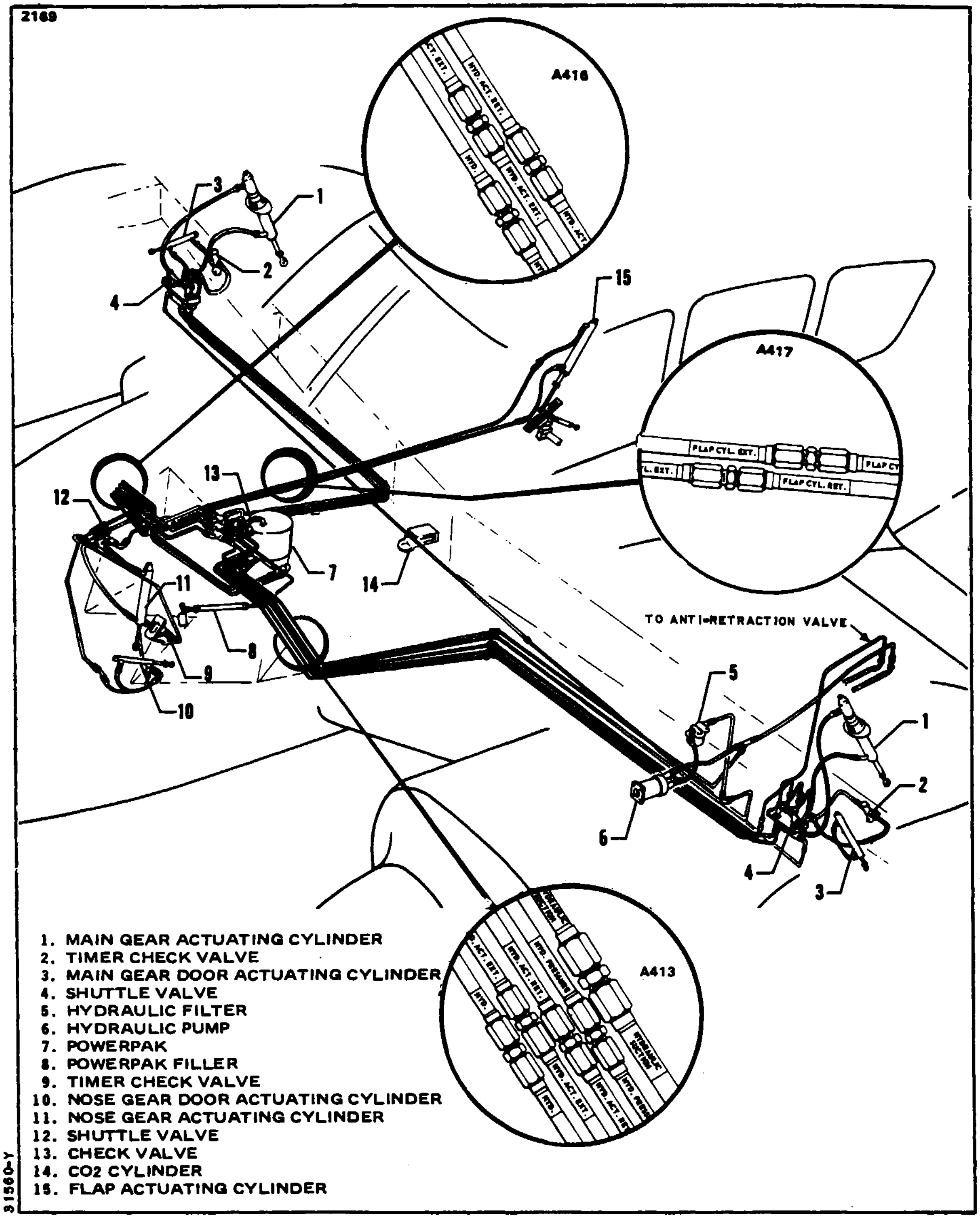
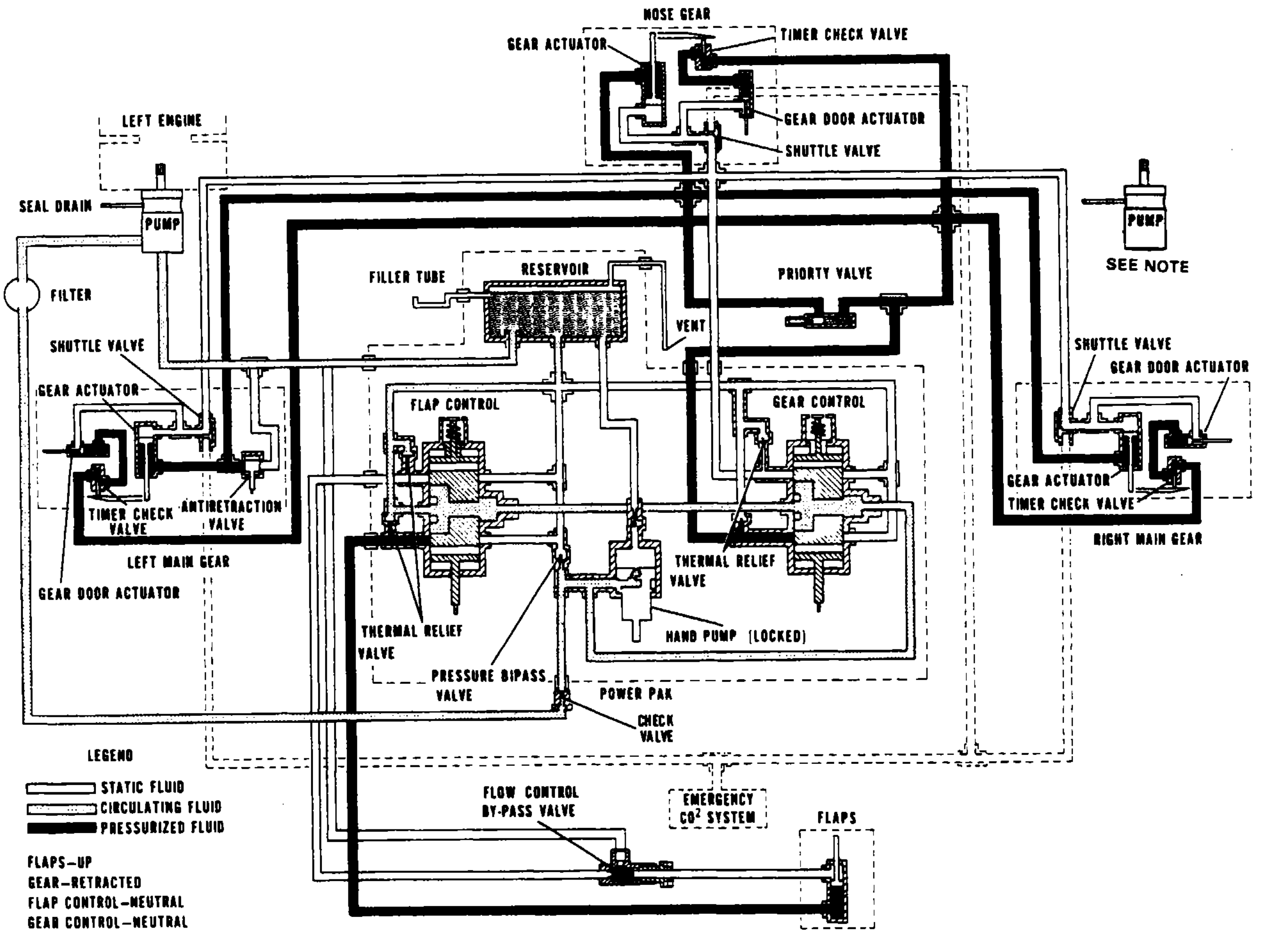


Figure 6-4. Hydraulic System Installation.
PA-23-250 (six place), Serial Nos. 27-2505 to 27-4425 incl. and
27-4427 to 27-4573 incl.



NOTE
DUAL HYDRAULIC PUMP INSTALLATION KIT PIPER P/N 763 836 AVAILABLE FOR AIRCRAFT S/N 27-7654001 THRU 27-7854050.

Figure 6-5. Hydraulic System Schematic
PA-23-250 (six place), Serial Nos. 27-4426 and 27-4574 to 27-7854050 incl.

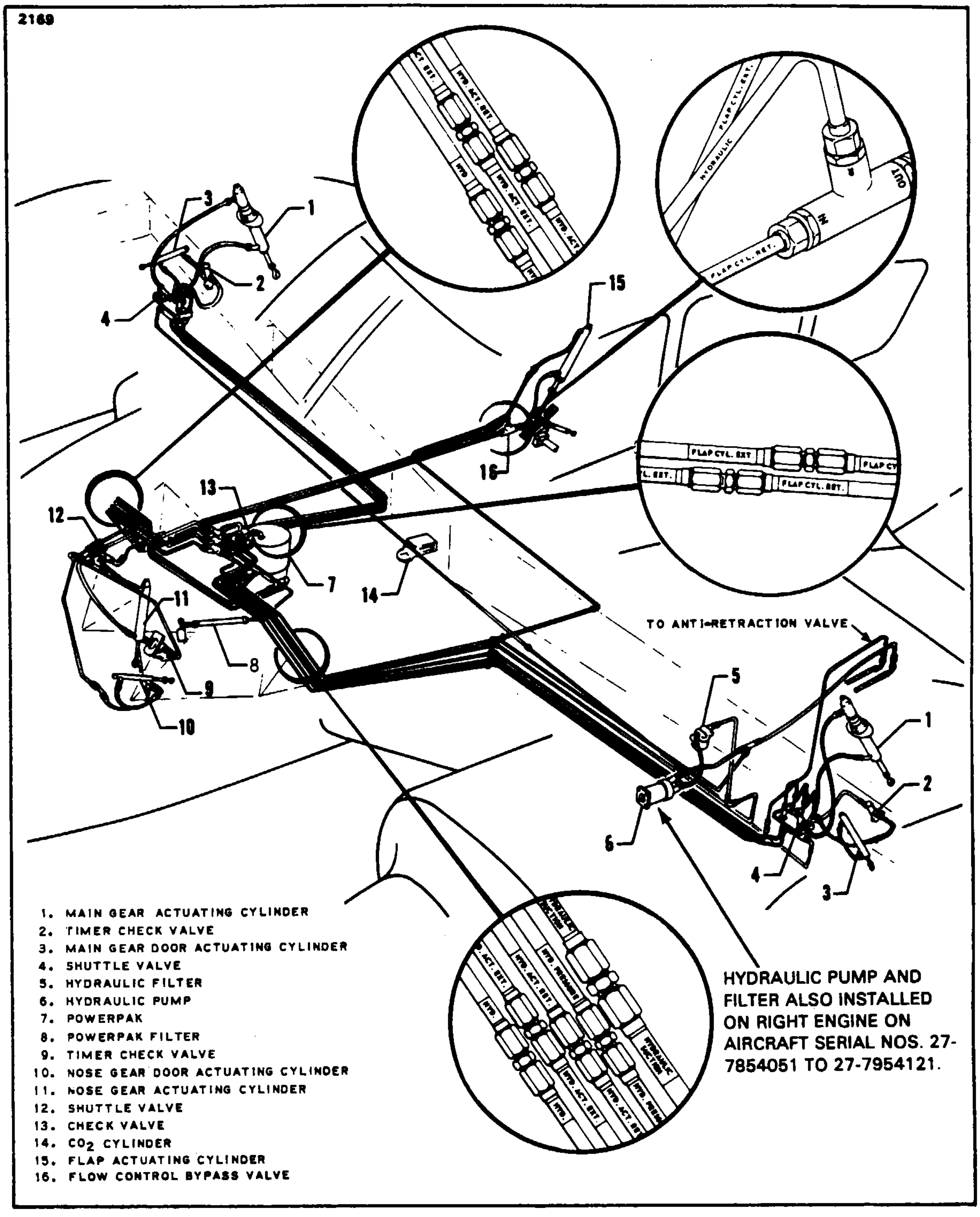


Figure 6-6. Hydraulic System Installation
PA-23-250 (six place), Serial Nos. 27-4426 and 27-4574
to 27-7954121 incl.

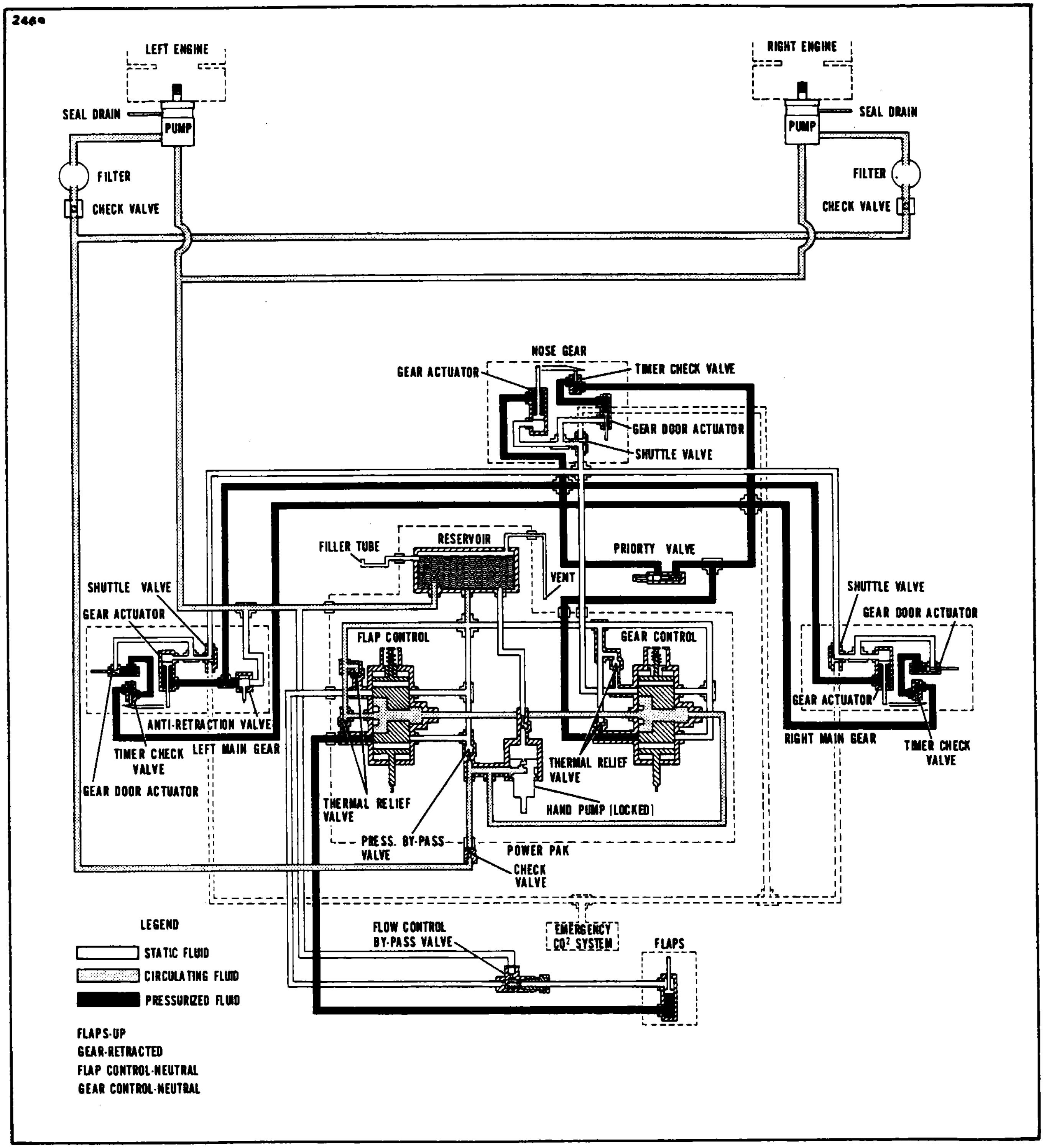
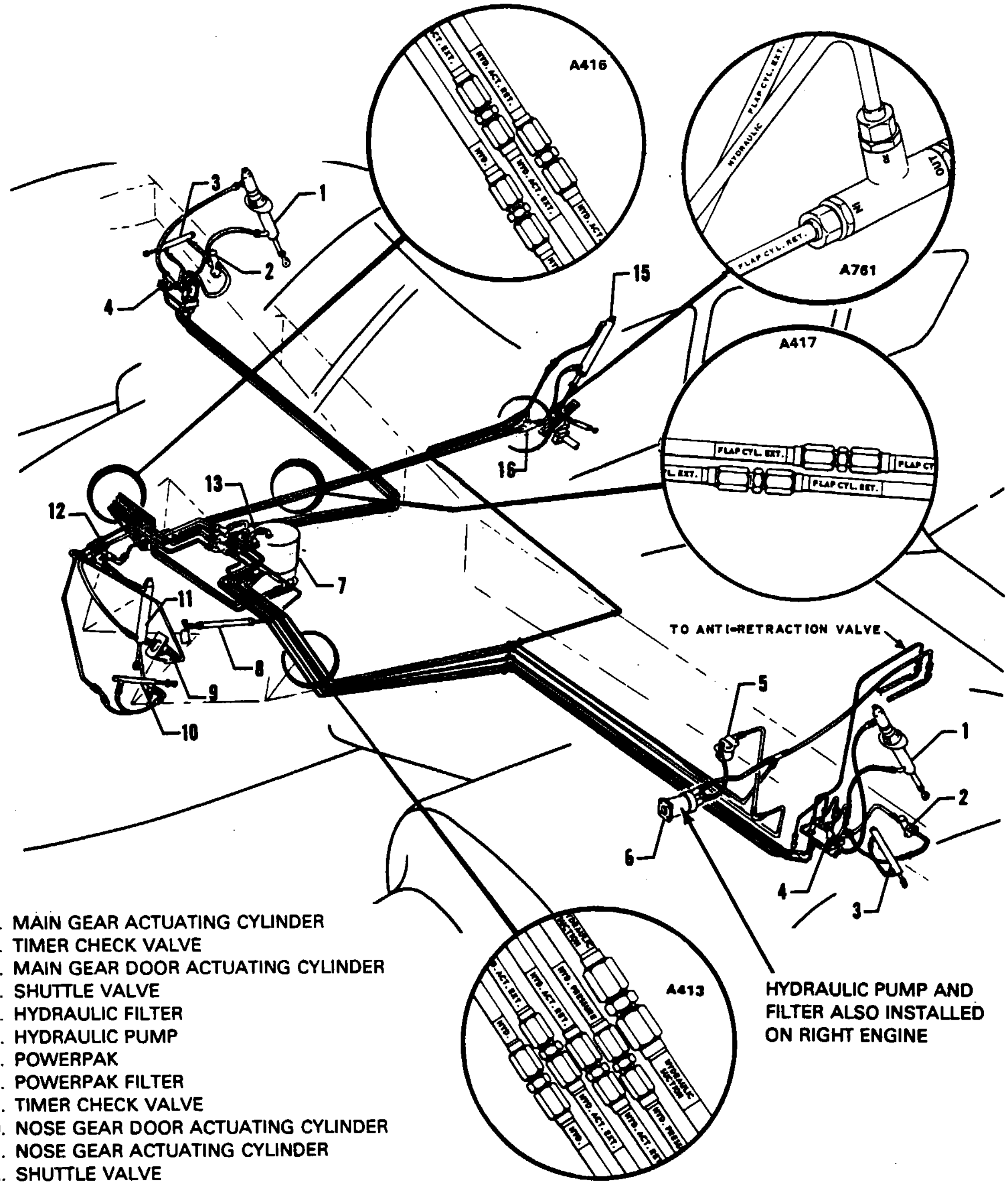


Figure 6-7. Hydraulic System Schematic
PA-23-250 (six place), Serial Nos. 27-7854051 to 27-7954121 incl.



1. MAIN GEAR ACTUATING CYLINDER
2. TIMER CHECK VALVE
3. MAIN GEAR DOOR ACTUATING CYLINDER
4. SHUTTLE VALVE
5. HYDRAULIC FILTER
6. HYDRAULIC PUMP
7. POWERPAK
8. POWERPAK FILTER
9. TIMER CHECK VALVE
10. NOSE GEAR DOOR ACTUATING CYLINDER
11. NOSE GEAR ACTUATING CYLINDER
12. SHUTTLE VALVE
13. CHECK VALVE
14. DELETED
15. FLAP ACTUATING CYLINDER
16. FLOW CONTROL BYPASS VALVE

Figure 6-8. Hydraulic System Installation
PA-23-250 (six place), Serial Nos. 27-8054001 and up

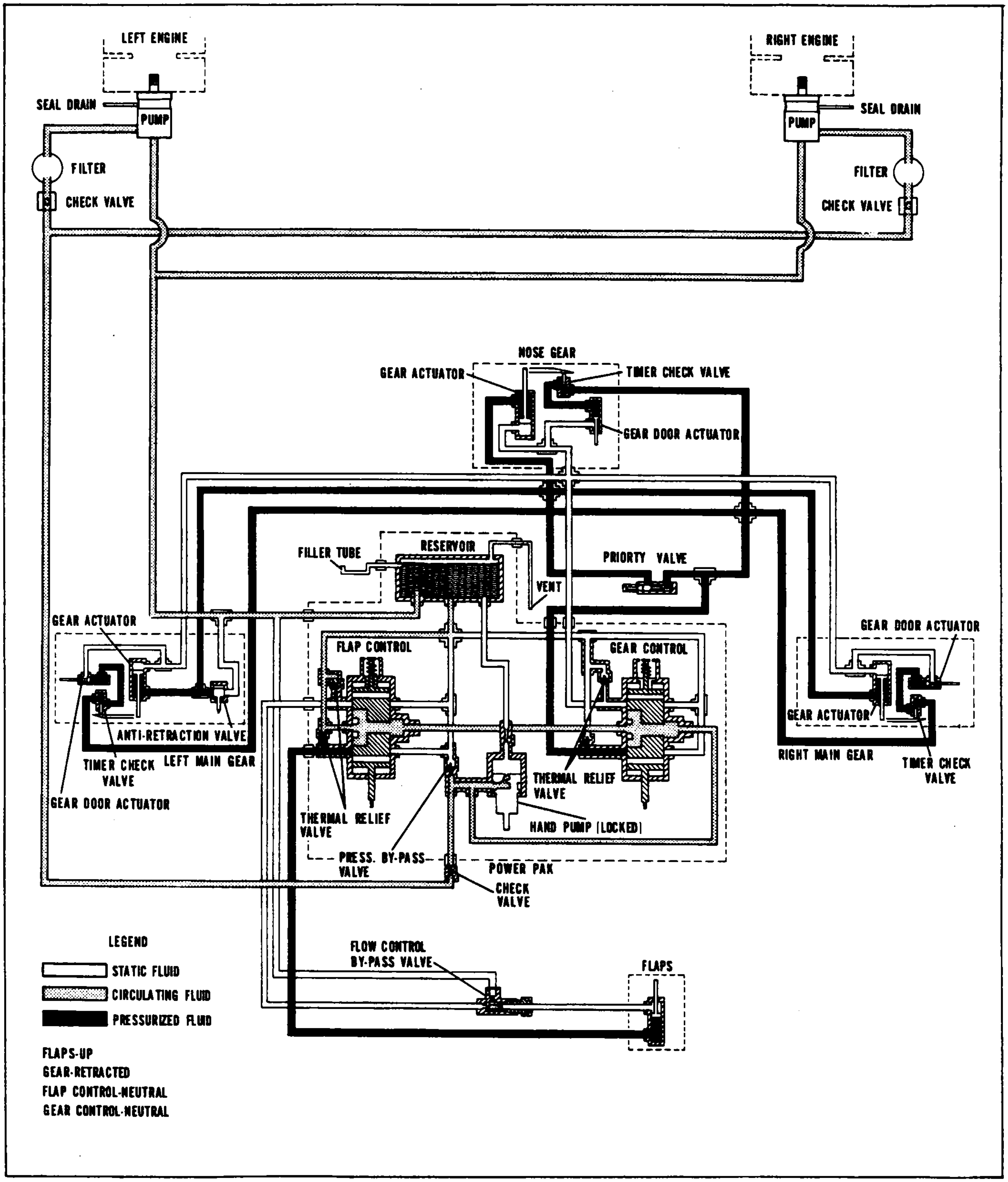


Figure 6-9. Hydraulic System Schematic
PA-23-250 (six place), Serial Nos. 27-8054001 and up

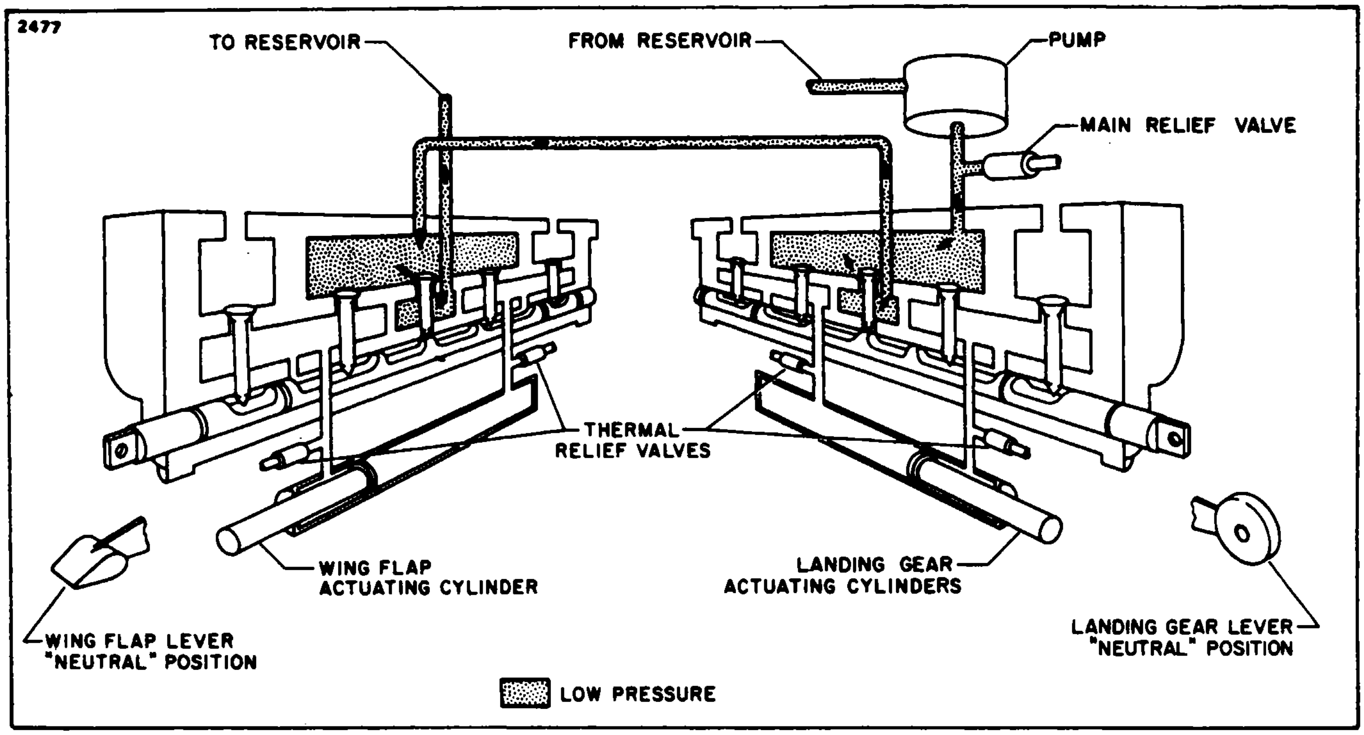


Figure 6-10. Flow Diagram, Both Selector Levers Neutral

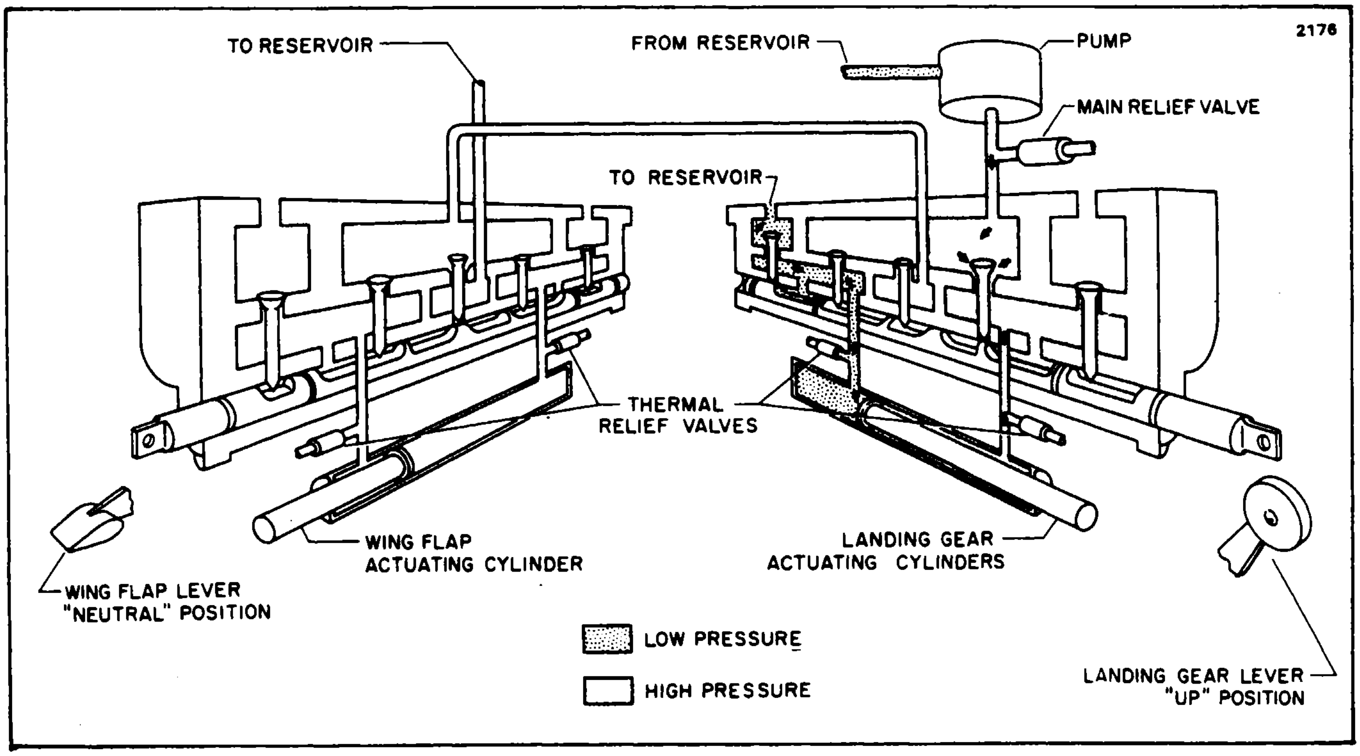


Figure 6-11. Flow Diagram, Landing Gear Selector Lever Up

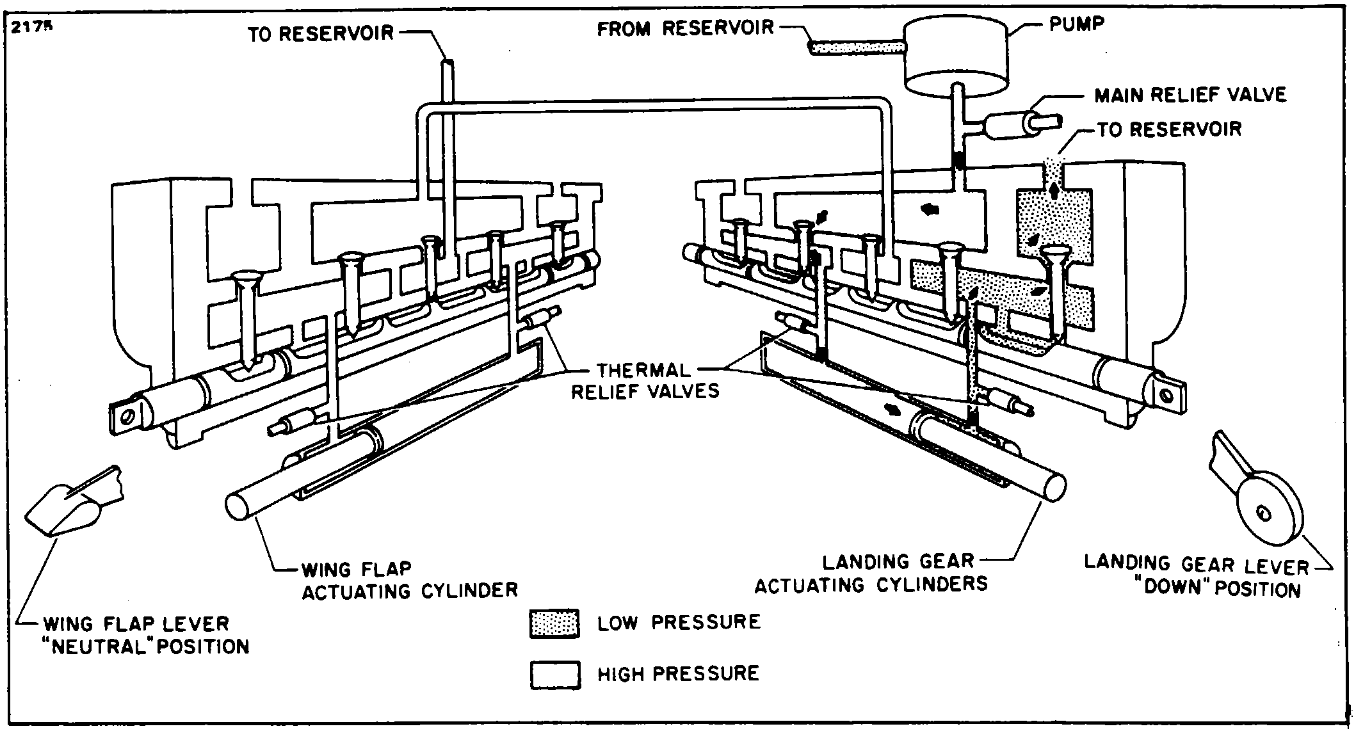


Figure 6-12. Flow Diagram, Landing Gear Selector Lever Down

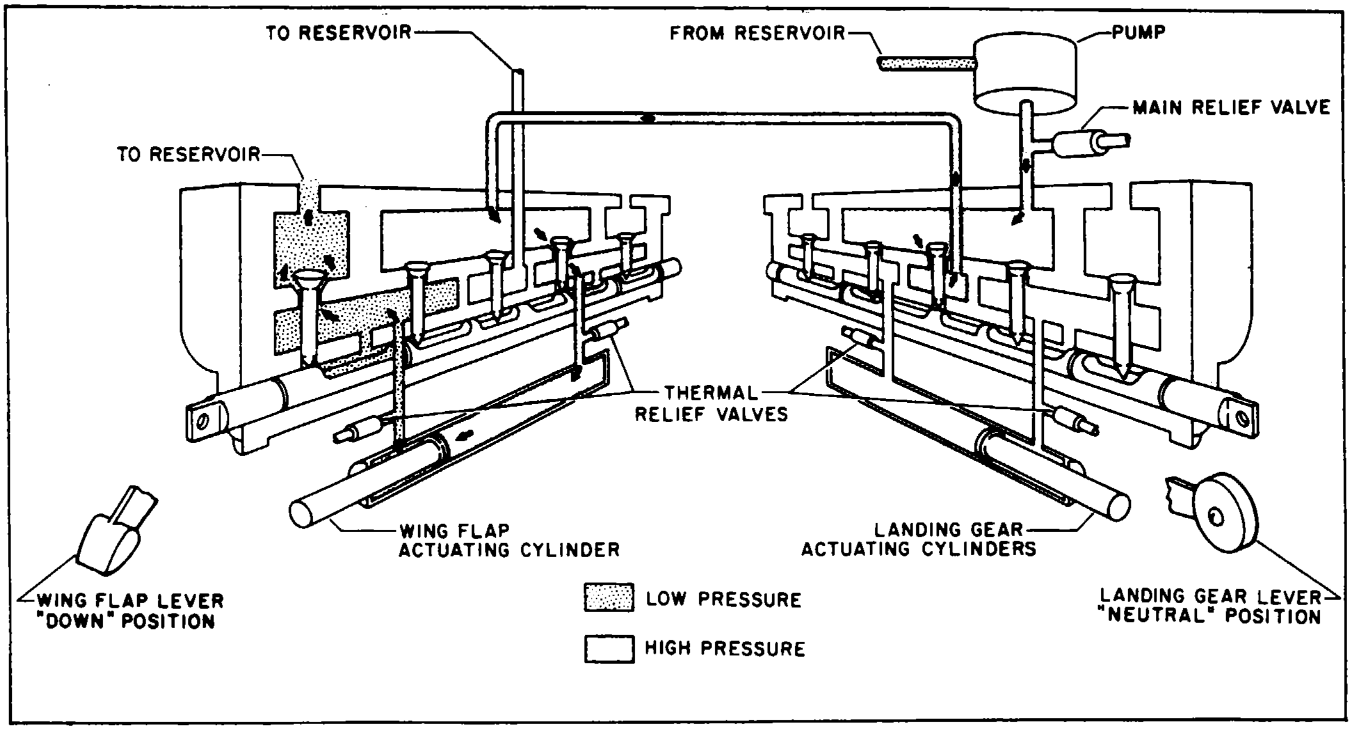


Figure 6-13. Flow Diagram, Flap Selector Lever Down

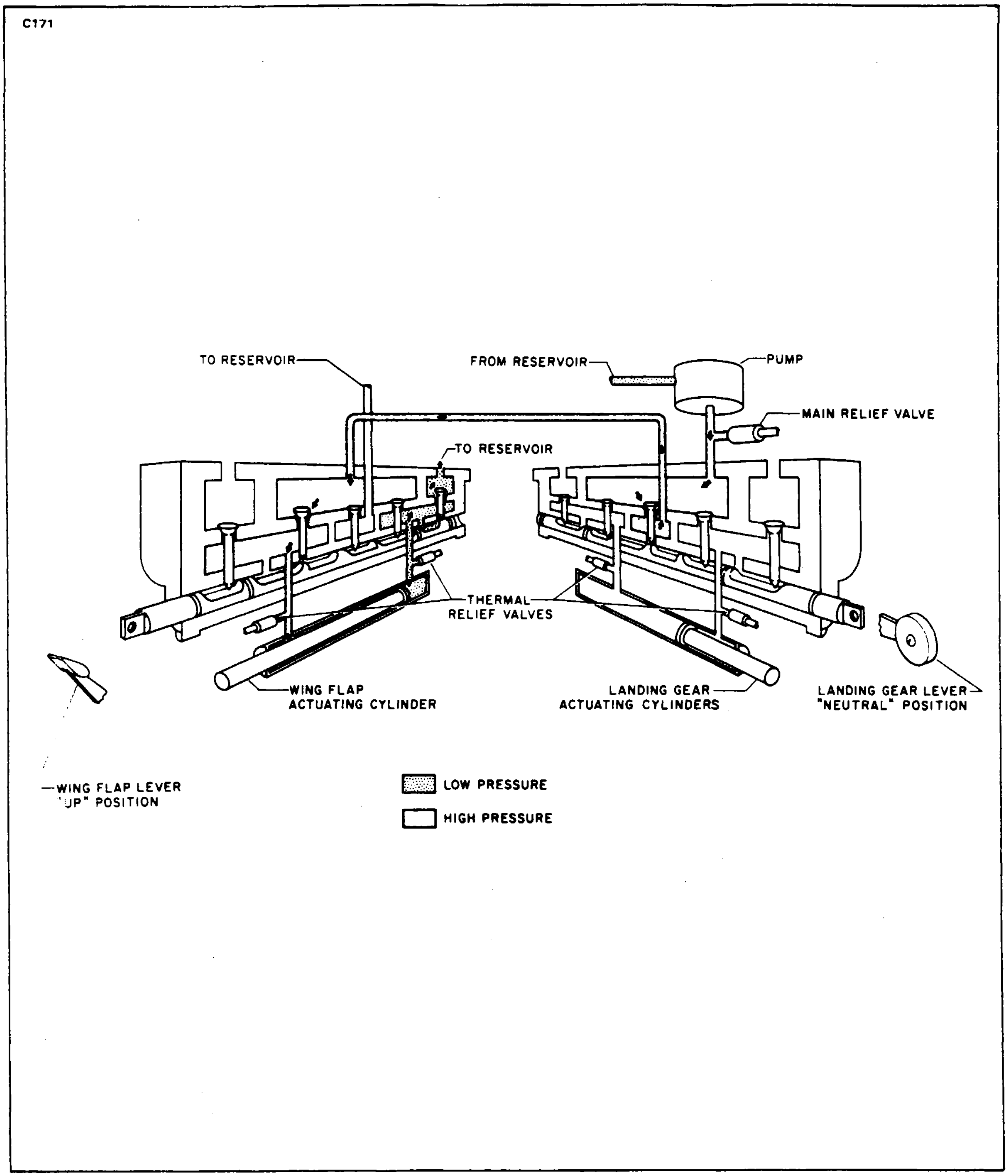


Figure 6-14. Flow Diagram, Flap Selector Lever Up

6-3. TROUBLESHOOTING. Malfunctions of the hydraulic system will result in failure of the landing gear or flaps to operate properly. When trouble arises, jack up the airplane (Refer to Jacking, Section II) and then proceed to determine the extent of the trouble. Table VI-V, at the back of this section, lists the troubles which may be encountered and their probable cause, and suggests a remedy for the trouble involved. A hydraulic system operational check may be conducted beginning with paragraph 6-11. When the trouble has been recognized, the first step in troubleshooting is isolating the cause. Hydraulic system troubles are not always traceable to one cause. It is possible that a malfunction may be the result of more than one difficulty within the system. Starting first with the most obvious and most probable reasons for the trouble, check each possibility in turn and, by process of elimination, isolate the troubles. Table VI-VI lists the possible troubles that may arise with the powerpak.

NOTE

If it is found that the powerpak is at fault and requires disassembly, it is recommended that it be replaced on an exchange basis or overhauled by an overhaul shop recommended by Piper Aircraft Corporation. If, however, this cannot be achieved, the powerpak may be repaired in accordance with the instructions in this section.

6-4. HYDRAULIC TEST UNITS.

6-5. HYDRAULIC TEST UNIT (PIPER NO. 753 080). The Piper unit would offer invaluable assistance in checking hydraulic systems, hydraulic powerpaks and related components in the PA-23. Examples are: Gear and flap cycling, and mechanical operations. Powerpak operating pressure, main relief valve cracking pressure, thermal relief valve cracking pressure, and landing gear detent release pressure.

This unit consists of an electric motor driven hydraulic pump, by-pass valve, fluid reservoir, filter, pressure gauge, hoses and adapter fittings housed in a metal cabinet mounted on casters. This unit is available through Piper Dealers.

6-6. HYDRAULIC TEST UNIT (OPTIONAL). The use of an optional test unit, or one which has many capabilities, must be capable of duplicating the same operating pressures and flow rate as given in Table VI-I for the particular powerpak being tested. Some of its uses are: To flush or fill the airplane's system with micronically filtered hydraulic fluid, to provide hydraulic flow and pressure for testing leakage, and operation of the airplane's hydraulic system without the necessity of operating the airplane's engines. Also, to test and adjust the various components of the airplane's powerpak and hydraulic system. This type of unit should be equipped with a hydraulic hand pump as well as its power driven pump.

6-7. CONNECTING HYDRAULIC TEST UNIT.

a. Remove the inboard engine access panel from the left engine by turning the quarter turn fasteners.

b. Disconnect the hydraulic pump suction hose from the fitting at the engine compartment firewall and connect the suction hose of the test unit to the fitting. Cap the disconnected suction hose.

c. Disconnect the hydraulic pump pressure hose from the inlet side of the hydraulic filter on the engine mount and connect the pressure hose of the test unit to the filter's inlet fitting. Cap the disconnected pressure hose.

d. Connect the vent hose of the test unit, if supplied, to the vent fitting of the powerpak.

e. Operate the test unit per instructions with the unit.

6-8. DISCONNECTING HYDRAULIC TEST UNIT.

a. Ascertain that the landing gear is down and locked, and the selector lever is in the neutral position.

b. Close or open any valves on the test unit per instructions with the unit.

c. Disconnect the test unit suction hose from the firewall fitting. Ascertain that there is fluid in the suction hose from the airplane's pump before connecting it to the firewall fitting.

d. Disconnect the test unit pressure hose from the hydraulic filter. Ascertain that there is fluid in the pressure hose from the airplane's pump before connecting it to the inlet side of the filter.

e. When connected, disconnect the vent hose and check fluid level in the powerpak reservoir.

f. Install the access panel to the inboard side of the left engine.

6-9. CYCLING LANDING GEAR.

a. Jack the airplane as outlined in Section II and connect the hydraulic test unit in accordance with paragraph 6-7.

b. If any reason exists to suspect fluid contamination, take a fluid sample from the hydraulic filter bowl located on the engine mounts.

NOTE

Fluid sampling is necessary only when good reason exists to suspect contamination. If examination of fluid reveals contamination, flush complete hydraulic system with clean hydraulic fluid (MIL-H-5606) and examine several seals and cylinder bores for damage.

c. Operate the hydraulic test unit per instructions furnished with the unit.

d. Set hydraulic test unit by-pass valve open.

e. Start hydraulic test unit pump motor.

f. Slowly close by-pass valve completely.

g. Observe fluid flowing through test unit sight gauge, if test unit is equipped with one. When all air bubbles have dissipated, operations may be continued.

h. Using landing gear selector lever in airplane, operate gear as desired.

NOTE

Gear cycling time can be prolonged by slowly opening the test unit by-pass valve part way. This will bleed off part of the pump flow.

i. After completion of cycling, open test unit by-pass valve and stop pump motor.

j. Disconnect hydraulic test unit in accordance with paragraph 6-8.

k. Ascertain that the landing gear is down and locked and the selector lever is in the neutral position.

l. Remove the airplane from jacks as outlined in Section II.

6-10. FLUSHING HYDRAULIC SYSTEM. When contamination of the hydraulic system is suspected, the complete system should be drained and flushed to remove the contaminated fluid. The cause and type of contamination should be determined and corrected. Use the following steps to perform this operation:

a. Remove the engine cowlings as explained in Section VIII or VIIIA.

b. Using the hand pump, lower the flaps to the full DOWN position.

c. Drain the hydraulic system by disconnecting the hydraulic extension line at the nose gear actuating cylinder, place the end of the line in a suitable container; select lever to the DOWN position and operate the hand pump until the system is empty.

d. Disconnect the hydraulic lines at the actuating cylinders and drain the fluid from the hydraulic lines and cylinders.

e. Disconnect the hydraulic lines from the filter inlet line and the firewall suction line fitting.

f. Remove the hydraulic filter element(s) and flush out the filter bowl(s) and install a new filter element(s).

g. Using a hydraulic test unit, pump clean hydraulic fluid (MIL-H-5606) through the entire system. Examine several seals and cylinder bores for damage.

h. When the hydraulic system is completely flushed and there is no more indication of contamination, reconnect the previously disconnected fittings and replenish the system with clean hydraulic fluid.

i. Bleed the hydraulic system and check for leaks. (Refer to Paragraph 6-9.)

j. Replace the engine cowlings as explained in Section VIII or VIIIA.

k. Recheck filter element(s) after 10 hours of airplane's operation.

6-11. HYDRAULIC SYSTEM OPERATION CHECKS.

6-12. PRE-CHECK AND GENERAL INSTRUCTIONS. Should the hydraulic system malfunction, it may be necessary to perform operational checks to determine the specific cause of the malfunction. The checks in the following paragraphs are intended as a guide for isolating a malfunction to a specific area or component of the system. These checks do not have to be accomplished in order of which they are listed; however, it is recommended that the instructions in paragraphs 6-13 thru 6-26 be read and understood before commencing. In many instances, one check will lead to the next. A review of Description and Principles of Operation, paragraph 6-2, will also help to give a better understanding of the hydraulic system. The following may be helpful in performing operational checks.

WARNING

Before attempting any hydraulic system operational checks, the airplane should be supported on jacks. (Refer to Jacking, Section II.)

a. Before commencing with checks, remove the access panels from both sides of the fuselage nose section. For some of the various checks, remove the panel from the nacelle section aft of the engine firewall.

b. For most checks, a hydraulic test unit of the type described in Paragraph 6-5 or 6-6 may be used. The use of a test unit will require the removal of the inboard access panel at the left engine. The powerpak hand pump may be used to cycle the system should a test unit not be available. The hand pump will not check the pressure and suction lines from the engine driven pumps.

c. Before attempting a check for internal leaks, the entire system should be visually checked for external leaks.

d. Special tools required in addition to a hydraulic test unit are a minimum of two pressure gauges with a range from zero to 2000 psi, and necessary tee fittings and plugs or caps to accomplish the required checks.

e. During checks, ascertain that the powerpak reservoir has sufficient fluid.

f. Before disconnecting any hydraulic lines, place rags or similar material under the connection to absorb any spilled fluid.

g. When disconnecting hydraulic line connection, secure the union fitting while rotating the line coupling.

h. Slowly loosen all line couplings when disconnecting hydraulic lines should any pressure remain present in the system. Moving the selector lever through its full range of travel should remove any high pressure from the system.

6-13. CHECKING ENGINE-DRIVEN HYDRAULIC PUMP(S) OPERATION. To determine the operational condition of the hydraulic system, the following checks may be conducted to determine condition of the engine-driven hydraulic pump(s).

a. Start the left engine and allow it to warm up.

b. With the engine operating at 1200 RPM, move the landing gear selector lever to the DOWN position. The engine-driven hydraulic pump should build up pressure in the system and return the selector lever to the neutral position within a few seconds.

c. Should it be found that the selector lever is abnormally slow during the check, it can be assumed that the hydraulic pump or powerpak is at fault.

d. To determine which of the two units is defective, proceed with the following steps:

1. Shut down the engine and select gear DOWN.

2. Operate the powerpak hand pump until the gear selector lever returns to the neutral position.

3. If the time is shorter than the engine-driven time, it is an indication of a defective engine-driven pump. (Refer to paragraph 6-27.)

4. If the time is approximately the same as the engine-driven time, it is an indication that the powerpak is at fault and requires further checks to isolate the trouble. (Refer to paragraph 6-16.)

e. On airplanes with Serial Nos. 27-7854051 and up, an engine-driven pump has also been installed on the right engine. Check this pump by shutting down the left engine and repeating the preceding steps with the right engine operating. Should it be found that the selector handle is abnormally slow for one pump, but will return normally with the other pump, then it can be assumed that the pump is at fault and it should be removed to determine the cause of the malfunction.

6-14. CHECKING POWERPAK MAIN RELIEF VALVE. The cracking pressure that the main relief valve opens within the powerpak may be determined as follows:

a. Connect a test unit in accordance with instructions given in paragraph 6-7.

b. Open the hydraulic test unit by-pass valve.

c. Hold the landing gear selector lever full DOWN.

d. Operate the test unit, and slowly close the by-pass valve, observing pressure build-up and point at which the pressure stabilizes on test unit gauge. Stabilization indicates relief valve setting. (Refer to Table VI-II for powerpak and its pressure requirement.)

e. The powerpak must be removed (refer to paragraph 6-38) and partially disassembled to adjust the relief valve. (Refer to paragraph 6-61.)

f. If no further checks are desired, remove the hydraulic test unit per instructions in paragraph 6-8.

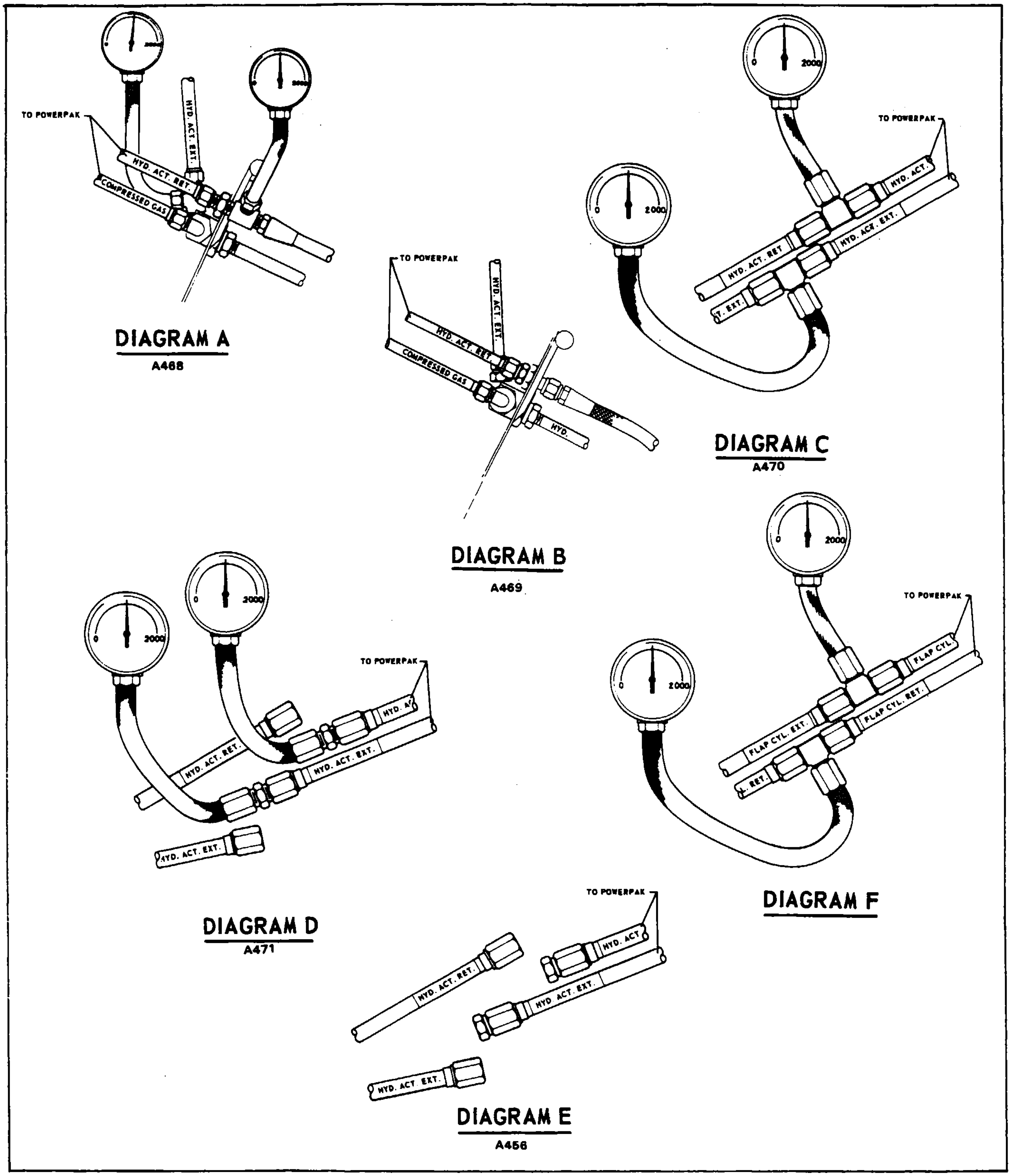


Figure 6-15. Hydraulic System Checking Diagrams, PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.

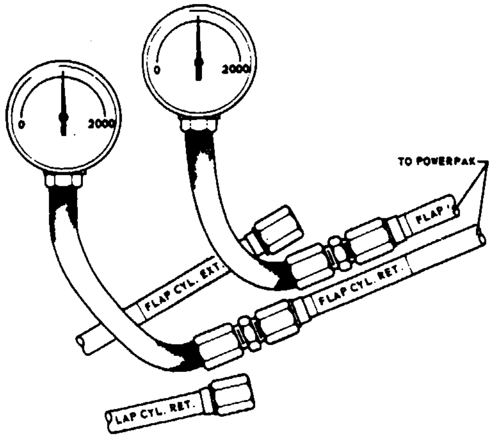


DIAGRAM G

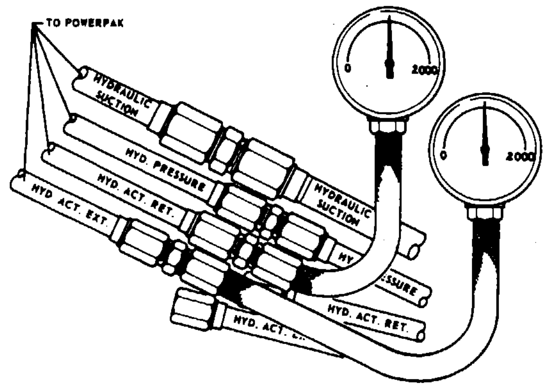


DIAGRAM I

A457

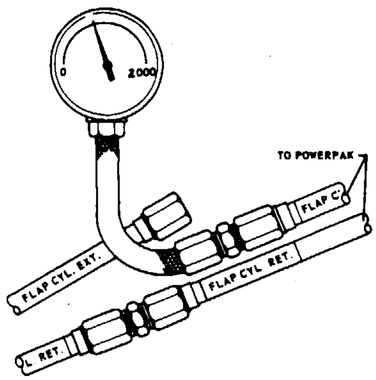


DIAGRAM H

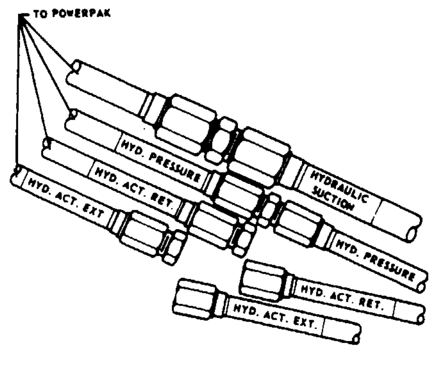


DIAGRAM J

A458

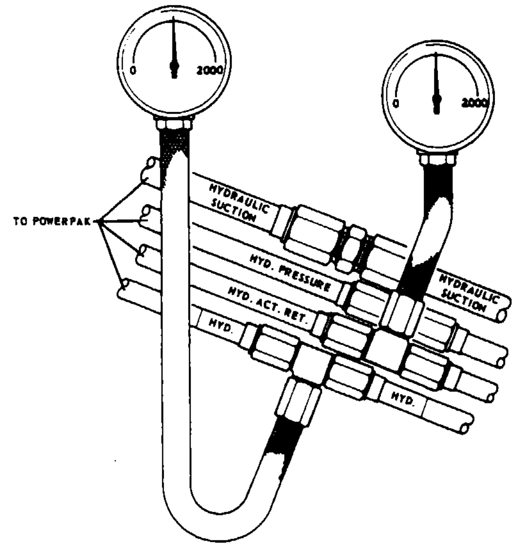


DIAGRAM K

A453

Figure 6-15. Hydraulic System Checking Diagrams, PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl. (cont.)

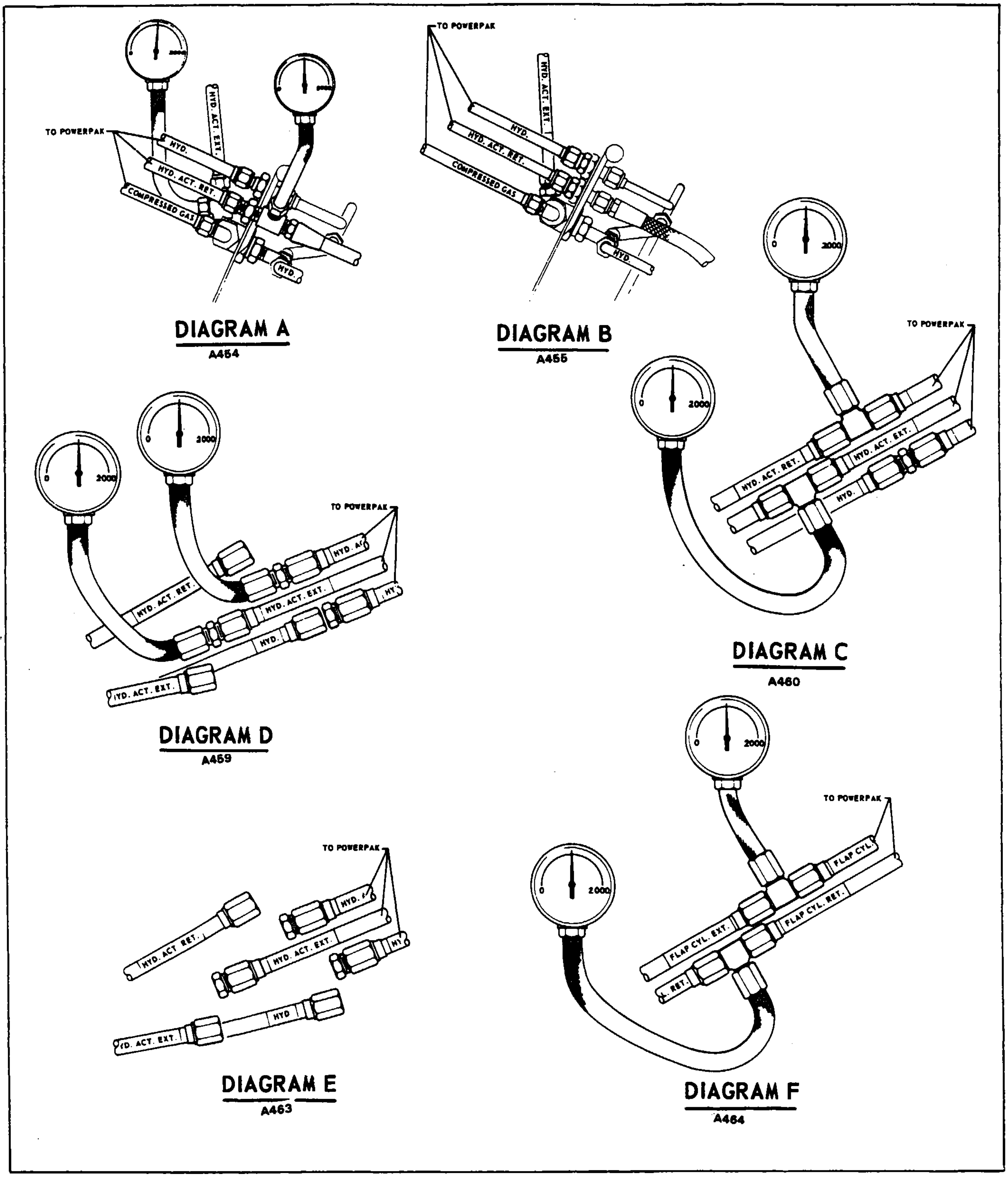


Figure 6-16. Hydraulic System Checking Diagrams, PA-23-250 (six place), Serial Nos. 27-2505 and up

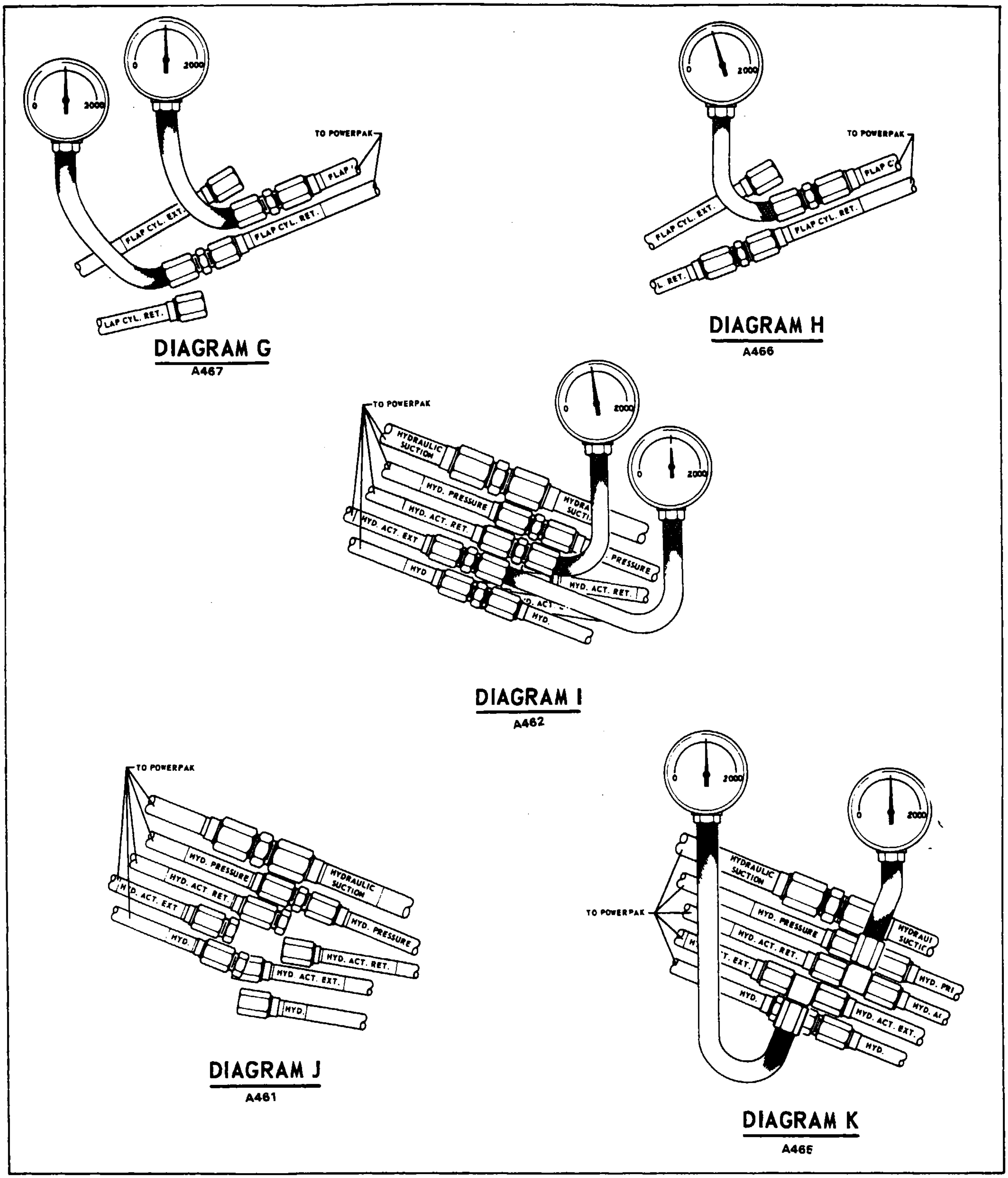


Figure 6-16. Hydraulic System Checking Diagrams, PA-23-250 (six place), Serial Nos. 27-2505 and up (cont.)

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6-15. CHECKING SELECTOR LEVER RELEASE TO NEUTRAL. The following outline may be used to determine the pressure at which the detent assemblies within the powerpak release the gear and flap selector camshafts, thus allowing their respective levers to return to neutral from either the up or down position. This check may be conducted as follows:

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Connect a hydraulic test unit in accordance with instructions given in paragraph 6-7. (The airplane's hand pump may be used for this check should a test unit not be available.)

c. To check operation of the gear selector lever, proceed as follows:

1. Connect pressure gauges to the landing gear extension and retraction lines, at their connections, located in the access opening at the right side of the fuselage just forward of the cabin entrance door. Separate the lines, removing the union fittings, and reconnect using tee fittings with gauges attached. (Refer to Diagram C, Figure 6-15 or 6-16.) To allow separation of the lines, loosen the line support blocks located above the fittings.

NOTE

An alternate and less accurate method for checking release pressures is to use the pressure gauge supplied with the test unit in lieu of connecting gauges into the retraction and extension lines.

2. Turn on the hydraulic test unit (or operate the airplane's hand pump) and operate the landing gear several times through its complete cycle. As the selector lever returns to neutral from both the up and down positions, check the pressure at which the lever trips. The selector lever detent release pressure with powerpak model or part number may be found in Table VI-II.

NOTE

To identify model number of powerpak, refer to paragraph 6-37.

d. To check the operation of the flap selector lever, proceed as follows:

1. Connect pressure gauges to the flap extension and retraction lines, at their connections, located in the access opening at the right side of the fuselage. Separate the lines, removing the union fittings, and reconnect using tee fittings with gauges attached. (Refer to Diagram F, Figure 6-15 or 6-16.) If not previously accomplished, loosen the line support blocks.

2. Operate the flap through several complete cycles and check the pressure at which the lever trips to neutral. The flap lever detent release pressure may also be found in Table VI-II.

e. Should either lever not return to neutral at the required pressure, the external components of the powerpak should be checked for such things as binding of the selector levers and broken or damaged camshaft return springs. The powerpak must be removed (refer to paragraph 6-38) and partly disassembled to adjust the detent assemblies. (Refer to paragraph 6-63.)

f. If no further checks are desired, remove the pressure gauges from the lines, reinstall union fittings and secure support blocks. Also, as desired, disconnect the test unit in accordance with instructions in paragraph 6-8. Check that the landing gear is down and locked and the gear selector lever is at neutral. Remove the airplane from jacks.

6-16. INTERNAL LEAKAGE CHECKS.

6-17. CHECKING HYDRAULIC SYSTEM FOR INTERNAL LEAKS. The outline in this paragraph is given to help determine if an internal leak exists in one of the four areas of operation of the hydraulic system, including the powerpak; these being landing gear retraction, landing gear extension, flap retraction and flap extension. To check each of these areas, proceed as follows:

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Connect a hydraulic test unit in accordance with instructions given in paragraph 6-7. (The airplane's hand pump may be used for this check should a test unit not be available.)

c. To check for internal leaks within the landing gear retraction and extension areas of operation, proceed as follows:

1. Connect pressure gauges to the landing gear extension and retraction lines, at their connections, located in the access opening at the right side of the fuselage just forward of the cabin entrance door. Separate the lines, removing the union fittings, and reconnect using tee fittings with gauges attached. (Refer to Diagram C, Figure 6-15 or 6-16.) To allow separation of the lines, loosen the line support blocks located above the fittings.

2. Operate the hydraulic test unit (or hand pump) and select gear UP. Allow the selector lever to return to neutral and note pressure reading over a 10 minute period.

3. After gear up check, select gear DOWN. Allow the selector handle to return to neutral and note pressure reading over a 10 minute period.

4. As the selector lever returns to neutral, the pressure reading on either gauge will drop slightly and then should stabilize. Once the pressure drop has stabilized, a further drop should not be indicated. Under no circumstances should the initial pressure drop below 700 psi. A slow decrease in pressure or a droppage below 700 psi indicates a possible internal leak in the landing gear section of the powerpak or one of the components in the landing gear portion of the hydraulic system.

d. To check for leaks within the flap areas of operation, continue as follows:

1. Connect pressure gauges to the flap extension and retraction lines also located in the access opening at the right side of the fuselage. Separate the lines, removing the union fitting, and reconnecting using the fittings with gauges attached. (Refer to Diagram F, Figure 6-15 or 6-16.) If not previously accomplished, loosen the line support blocks.

2. Operate the hydraulic test unit (or hand pump) and select flap DOWN. Allow the selector handle to return to neutral and note pressure reading over a 10 minute period.

3. After flap down check, select flap UP. Allow handle to return to neutral and note pressure reading over a 10 minute period.

4. As in the landing gear check, once the pressure drop has stabilized, there should be no further drop indicated on either gauge. Here, too, a slow decrease in pressure or a droppage below 500 psi indicates a possible internal leak in the powerpak or one of the flap components.

e. Should an internal leak be indicated, isolate by using the procedures outlined in the following paragraphs.

f. If no internal leaks are indicated, remove the pressure gauges from the lines, reinstall union fittings and re-secure support blocks. Disconnect the test unit as described in paragraph 6-8. Check that the landing gear is down and locked and the gear selector is at neutral. Remove the airplane from jacks.

6-18. CHECKING POWERPAK FOR INTERNAL LEAKS. The procedure outlined in this paragraph enables a check of the powerpak for internal leaks. The system main check valve, an external component of the powerpak, may also be checked from instructions given in this paragraph. The check may be conducted as follows:

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Connect a hydraulic test unit in accordance with paragraph 6-8. (The airplane's hand pump may be used should a test unit not be available.)

c. To check for internal leaks within landing gear section of the powerpak, proceed as follows:

1. Connect pressure gauges to the landing gear extension and retraction lines that lead from the powerpak, at the line connections, located in the access

opening at the right side of the fuselage. Separate the lines at the union fittings, allowing the fittings to remain attached to the lines from the powerpak. Attach pressure gauges to the union fittings. (Refer to Diagram D, Figure 6-15 or 6-16.) To allow separation of lines, loosen the line support blocks located above the fittings. Lines to the landing gear should be covered to prevent contamination.

NOTE

On airplanes with Serial Nos. 27-2505 and up, two retraction lines are incorporated in the system; these are to the landing gear actuating cylinder and to the door actuating cylinder via the timer check valve. Disconnect the line not fitted with a pressure gauge at the union fitting and cap to prevent leakage.

2. At the access opening in the left side of the fuselage, disconnect the retraction and extension lines at the union fittings and cap off the lines leading from the powerpak. (Refer to Diagram J.)

3. At the shuttle valve located on the aft side of the forward cabin bulkhead, disconnect and cap the retraction and extension lines leading from the powerpak. (Refer to Diagram B.)

4. Operate the hydraulic test unit (or hand pump) and select gear UP. Allow the selector lever to return to neutral and note pressure reading over a 10 minute period.

5. After gear up check, select gear DOWN. Allow the selector lever to return to neutral and note reading over a 10 minute period.

6. As the selector lever returns to neutral, the pressure reading on either gauge will drop slightly and then should stabilize. Once the pressure drop has stabilized, a further drop should not be indicated. A slow decrease in pressure indicates an internal leak in the landing gear section of the powerpak.

d. To check for internal leaks within the flap section of the powerpak, proceed as follows:

1. Connect pressure gauges to the flap extension lines that lead from the powerpak, at the line connections, located in the access opening at the right side of the fuselage. Separate the lines at the union fitting allowing the fittings to remain attached to the lines from the powerpak. Attach pressure gauges to the union fittings. (Refer to Diagram G, Figure 6-15 or 6-16.) Lines to the flap cylinder should be covered.

2. Operate the hydraulic test unit (or hand pump) and select flap DOWN. Allow the selector lever to return to neutral and note pressure reading over a 10 minute period.

3. After flap down check, select flap UP. Allow the selector lever to return to neutral and note reading over a 10 minute period.

4. As in the landing gear check, once the pressure has stabilized there should be no further drop indicated on either gauge. Here, too, a slow decrease in pressure indicates an internal leak in the flap section of the powerpak.

e. Should an internal leak be indicated in either the landing gear or flap section, the powerpak must be removed (Refer to Paragraph 6-36.) and exchanged or overhauled. Uncap and reconnect lines as required. If no internal leaks are indicated in the powerpak, continue with the checks outlined in the following paragraphs.

f. The main check valve may be checked as follows:

1. Disconnect the engine driven pump pressure line at the inlet side of the main check valve, located on the right side of the powerpak.

2. Select flap DOWN, operate the powerpak hand pump and allow the handle to return to neutral.

3. With pressure built up in the system, note if any fluid is seeping from the check valve.

4. If a leak is indicated, remove the valve and replace or overhaul.

g. If no further checks are desired, remove remaining gauges and reconnect lines. Disconnect hydraulic test unit in accordance with instructions in paragraph 6-8. Check that the landing gear is down and locked, and the selector levers are at neutral. Remove the airplane from jacks.

6-19. CHECKING HAND PUMP FOR INTERNAL LEAKS.

a. Connect a gauge to the flap extension line from the powerpak, located in the access opening at the right side of the fuselage, just forward of the cabin entrance door. Separate the line at the union fitting allowing the fitting to remain on the line from the powerpak. Attach the gauge to the fitting. (Refer to Diagram H, Figure 6-15 or 6-16.)

b. Select flap DOWN with the selector lever. Operate the hand pump and observe the pressure reading. The gauge should show a steady increase in pressure during both the up and down stroke.

c. As the gauge reaches approximately 1000 psi, stop the handle operation at mid-stroke; the handle should remain steady. If the handle moves up from the stopped position, the hand pump piston valve is leaking. If the handle moves down, the hand pump suction valve in the powerpak is leaking. A slow build-up of pressure indicates a leaking piston packing.

6-20. CHECKING COMPONENTS FOR INTERNAL LEAKS. This check is given as a method for isolating an internal leak to a specific area of the hydraulic system, such as the nose landing gear, left main landing gear or right main landing gear. Components affected in these areas are the actuating cylinders, the shuttle valves and, for the left gear, the anti-retraction valve. Once the defective area is determined, then each component may be individually checked as found in further paragraphs. The three areas as stated may be checked as follows:

NOTE

Before any of the following checks can accurately be accomplished, it must be determined that the powerpak has been checked and found not defective.

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Connect a hydraulic test unit in accordance with instructions given in paragraph 6-7. (The airplane's hand pump may be used for this check should a test unit not be available.)

c. The check for internal leaks in the hydraulic components located within the area of the nose landing gear may be accomplished as follows:

1. Connect gauges to the nose landing gear extension line at the shuttle valve located at the aft side of the forward cabin bulkhead and the retraction line at the bulkhead fitting forward of the bulkhead. Use tee fitting in the lines to facilitate use of gauges. (Refer to Diagram A, Figure 6-15 or 6-16.)

2. At the access openings in both the left and right sides of the fuselage, disconnect and cap off the retraction and extension lines leading from the powerpak. (Refer to Diagram J for the left side and E for the right side, Figure 6-15 or 6-16.)

3. Operate the hydraulic test unit (or hand pump) and select gear UP (only the nose gear will retract). Allow the selector lever to return to neutral and note pressure reading over a 10 minute period.

4. After gear up check, select gear DOWN. Allow the selector lever to return to neutral and note reading over a 10 minute period.

5. As the selector lever returns to neutral, the pressure reading on either gauge will drop slightly and then should stabilize. Once the pressure drop has stabilized, a further drop should not be indicated. A slow decrease in pressure indicates an internal leak in the actuating cylinder(s) and/or shuttle valve.

d. The check for internal leaks within the left main gear area may be conducted as follows:

1. Connect pressure gauges to the landing gear extension and retraction lines, at their connections, located in the access opening at the left side of the fuselage. Separate the lines, removing the union fittings, and reconnect using

tee fittings with gauges attached. (Refer to Diagram K, Figure 6-15 or 6-16.)

2. At the access opening in the right side of the fuselage, just forward of the cabin entrance door, disconnect the landing gear retraction and extension lines at the union fittings and cap off the lines leading from the powerpak. (Refer to Diagram E.)

3. At the shuttle valve located on the aft side of the forward cabin bulkhead, disconnect and cap the retraction and extension lines leading from the powerpak. (Refer to Diagram B.)

4. Operate the hydraulic test unit (or hand pump) and select gear UP (only the left gear will retract). Allow the selector lever to return to neutral and note pressure reading over a 10 minute period.

5. After gear up check, select gear DOWN. Allow the selector lever to return to neutral and note reading over a 10 minute period.

6. As the selector lever returns to neutral and the pressure drop has stabilized, hereto a further drop should not be indicated. A slow decrease in pressure indicates an internal leak in the actuating cylinder(s), shuttle valve and/or anti-retraction valve.

e. The check for internal leaks within the right main gear area may be conducted as follows:

1. Connect gauges to the landing gear extension and retraction lines, at their connections, located in the access opening at the right side of the fuselage, just forward of the cabin entrance door. Separate the lines, removing the union fittings, and reconnect using tee fittings with gauges attached. (Refer to Diagram C, Figure 6-15 or 6-16.)

2. At the access opening in the left side of the fuselage, disconnect the landing gear extension and retraction lines at the union fittings and cap off lines leading from the powerpak. (Refer to Diagram J.)

3. At the shuttle valve in the nose, disconnect and cap the retraction and extension lines leading from the powerpak. (Refer to Diagram B.)

4. Operate the hydraulic test unit (or hand pump) and select gear UP (only the right gear will retract). Allow the selector lever to return to neutral and note pressure reading over a 10 minute period.

5. After gear up check, select gear DOWN. Allow lever to return to neutral and note reading over a 10 minute period.

6. For either the gear up or down check, once the pressure has stabilized there should be no further drop. A slow decrease in pressure indicates an internal leak in the actuating cylinder(s) and/or shuttle valve.

f. Should a leak be indicated and isolated to one of the three landing gear areas, the components within that area may be individually checked in accordance with instructions given in paragraphs 6-21 thru 6-23.

g. If no further checks are desired, remove the remaining gauges and reconnect hydraulic lines. Disconnect hydraulic test unit in accordance with instructions in paragraph 6-8. Check that the landing gear is down and locked, and the selector levers are at neutral. Remove the airplane from jacks.

6-21. CHECKING ANTI-RETRACTION VALVE FOR INTERNAL LEAKS. The anti-retraction valve, located on the strut housing of the left main landing gear, may be checked as follows:

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Disconnect the left landing gear doors at the control rods, and secure back.

c. Connect a hydraulic test unit in accordance with instructions given in paragraph 6-7. (The airplane's hand pump may be used for this check should a test unit not be available.)

d. Operate the test unit (or hand pump) and retract the landing gear. Allow the selector lever to return to neutral.

e. Disconnect the hydraulic line from the valve at the port stamped "R".

f. Check for evidence of fluid leakage at the open port. An alternate method is to attach a pressure gauge to the fitting at the port stamped "R" and note if a pressure reading on the gauge begins to appear over a few minutes period.

g. Should the valve show indications of leakage, by seepage or by the pressure gauge, the valve should be repaired or replaced. (Refer to paragraph 6-73.)

h. If no further checks are desired, reinstall the hydraulic line and disconnect the hydraulic test unit in accordance with instructions in paragraph 6-8. Check that the landing gear is down and locked, and the selector levers are at neutral.

i. Reconnect gear doors, check adjustment and remove the airplane from jacks.

6-22. CHECKING SHUTTLE VALVE FOR INTERNAL LEAKS. The shuttle valves, one of which is located on the aft side of the forward cabin bulkhead and one located in each engine nacelle aft of the firewall, may be checked by the following procedure:

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Connect a hydraulic test unit in accordance with instructions given in paragraph 6-7. (The airplane's hand pump may be used for this check should a test unit not be available.)

c. Operate the test unit (or hand pump) and extend the landing gear. Allow the selector lever to return to neutral.

d. Disconnect the hydraulic line from the valve at the port stamped "EMG".

e. Check for evidence of fluid leakage at the open port. An alternate method is to attach a pressure gauge to the fitting at the port stamped "EMG" and note if a pressure reading on the gauge begins to appear over a few minutes period.

f. Should a valve show indications of leakage, by seepage or by the pressure gauge, the valve should be repaired or replaced. (Refer to Paragraph 6-80.)

g. If no further checks are desired, reinstall the hydraulic line and disconnect the hydraulic test unit in accordance with instructions in paragraph 6-8. Check that the landing gear is down and locked, and the selector levers are at neutral. Remove the airplane from jacks.

6-23. CHECKING LANDING GEAR ACTUATING CYLINDERS FOR INTERNAL LEAKS. The landing gear actuating cylinders and, if installed, the door actuating cylinders, whether they be installed within the fuselage nose section or wing, may be checked by the following procedure:

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Connect a hydraulic test unit in accordance with instructions given in paragraph 6-7. (The airplane's hand pump may be used for this check should a test unit not be available.)

c. Operate the test unit (or hand pump) and select gear DOWN. Allow the selector lever to return to neutral.

d. To check a landing gear actuating cylinder, disconnect the hydraulic line from the cylinder at its lower end. (The end closest to the exposed actuating rod.)

WARNING

Slowly loosen the line coupling from the cylinder should any pressure remain present in the system.

e. To check a landing gear door actuating cylinder, disconnect the hydraulic line from the forward end of the nose cylinder or inboard end of the left or right main cylinder. (The end closest to the cylinder attachment lug.)

f. Check for evidence of fluid leakage at the open port. An alternate method is to attach a pressure gauge to the fitting from where the line was disconnected and note if a pressure reading on the gauge begins to appear over a few minutes period.

g. Should a cylinder show indications of leakage, by seepage or by the pressure gauge, the cylinder should be replaced or repaired. (Refer to Paragraph 6-85.)

h. If no further checks are desired, reinstall the hydraulic line, and disconnect the hydraulic test unit in accordance with instructions in paragraph 6-8. Check that the landing gear is down and locked, and the selector levers are at neutral. Remove the airplane from jacks.

6-24. CHECKING TIMER CHECK VALVE (SEQUENCE VALVE) FOR INTERNAL LEAKS. (PA-23-250 [six place], Serial Nos. 27-2505 and up.) Three timer check valves are incorporated in the hydraulic system. The valve for the nose gear is located in the lower area of the nose section, just ahead of the forward cabin bulkhead. The valve for each main landing gear is located in the wheel well, above the gear support brace. Any one valve may be checked by the following procedure:

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Disconnect both hydraulic lines from the valve.

c. Connect the pressure line of a hydraulic test unit to the port of the valve furthest from its mounting base.

d. Open the test unit by-pass valve.

e. Operate the test unit and slowly close the by-pass valve.

f. Apply 2000 psi maximum hydraulic pressure to the valve and ascertain that fluid does not appear at the open port.

g. Should the valve show indications of internal leakage, the unit should be replaced or repaired. (Refer to paragraph 6-105.)

h. After completion of check, ascertain that the landing gear is down and locked, and the selector levers are at neutral. Remove the airplane from jacks.

6-25. CHECKING PRIORITY VALVE FOR INTERNAL LEAKS. (PA-23-250 [six place], Serial Nos. 27-2505 and up.) The priority valve, located in the lower right side of the control pedestal, should be removed and checked for internal leaks according to instructions given in paragraph 6-112.

6-26. CHECKING FLAP ACTUATING CYLINDER FOR INTERNAL LEAKS.

NOTE

Before the following checks can accurately be accomplished, it must be determined that the flap section of the powerpak has been checked and found not defective. (Refer to paragraph 6-18.)

a. Connect a hydraulic test unit in accordance with instructions given in paragraph 6-7. (The airplane's hand pump may be used for this check should a test unit not be available.)

b. Connect pressure gauges to the flap extension and retraction lines, at their connection, located in the access opening at the right side of the fuselage just forward of the cabin entrance door. Separate the lines, removing the union fitting and reconnect using tee fittings with gauges attached. (Refer to Diagram F, Figure 6-15 or 6-16.)

c. Operate the hydraulic test unit (or hand pump) and select flap DOWN. Allow the selector lever to return to neutral and note pressure reading over a 10 minute period.

d. After flap down check, select flap UP. Allow lever to return to neutral and note pressure reading over a 10 minute period.

e. As the selector lever returns to neutral, the pressure reading on either gauge will drop slightly and then should stabilize. Once the pressure drop has stabilized, a further drop should not be indicated. A slow decrease in pressure indicates a possible internal leak in the flap actuating cylinder.

f. Should a leak be indicated in the cylinder, the unit should be replaced or repaired.

g. After completion of check, remove the pressure gauges from the lines and reinstall union fitting. Disconnect the hydraulic test unit as described in paragraph 6-8.

6-27. ENGINE-DRIVEN HYDRAULIC PUMP(S).

6-28. PROCEDURE AFTER ENGINE-DRIVEN PUMP FAILURE. Should a pump breakage occur, there may be metal particles in the hydraulic system. To rectify this condition, the hydraulic system should be flushed. Proceed with the following steps:

a. Replace the defective engine-driven hydraulic pump and prime it in accordance with paragraph 6-34. Do not connect the pump to the rest of the hydraulic system until the system has been flushed.

b. Proceed to flush the system in accordance with paragraph 6-10.

c. Remove the filter element and check for metal particles. If metal particles are evident in the filter, clean the filter bowl with dry cleaning solvent and dry with compressed air. Install new filter element in accordance with paragraph 6-123.

6-29. REMOVAL OF ENGINE-DRIVEN PUMP.

a. Remove the engine cowl by releasing skin fasteners and screws from around the cowl, and separate the two halves.

b. Place a drip pan under the engine to catch spillage.

NOTE

If desired, to facilitate easier removal of the pump, the right magneto may be removed.

c. Disconnect the two hydraulic hoses from the pump.
d. Disconnect drain hose from bottom of pump.
e. Remove four nuts, lockwashers, and flat washers from the base of the pump.
f. Remove the pump from engine housing.
g. Upon removal of the pump from its drive pad, remove and discard the gasket from the pump mounting face. The gasket and all seal rings should be replaced with new parts upon reassembly. Never reinstall an old gasket or seal ring.

6-30. DISASSEMBLY OF ENGINE-DRIVEN PUMP. (Refer to Figure 6-17.)

NOTE

The following instructions apply only to Eastern Industries pumps, (Model 1233 HNG, Type 284), (1235 HGG, Type 263) or (1233 HNG, Type 311).

a. Clean outside of pump thoroughly.
b. Mark a line from the rear side, across the centerplate to the drive side with blue Dykem or some equivalent removable substance. This will assure proper reassembly.

CAUTION

During disassembly, do not use a screwdriver or sharp tool to separate the parts.

c. Remove the four socket head cap screws (12) securing the rear side (13), centerplate (10) and drive side (7) together. These screws are threaded into the drive side.
d. Remove the four locknuts (8) from the studs (14) extending out of the drive side flange that mates with the center plate.
e. Remove the rear side by rocking it from side to side and sliding it from the four dowels (11). In case of sticking, tap gently with a plastic or rubber hammer.
f. Remove the four studs (14) from the rear side. Remove and discard the large "O" ring seal (15) from the rear side. Pull the drive (1) and secondary shafts (17) until drive pins (16 and 2) clear gears. Remove drive pins.

g. Remove drive gear (19), secondary gear (18), and secondary shaft (17) by pulling from centerplate (10).

h. Remove drive shaft by pushing out of drive side. Remove centerplate with dowels by rocking it from side to side.

i. Remove large “O” ring seal (9) from drive side and discard.

j. Remove retainer ring (3) securing seal (4 or 5) in drive side seal bore. Note proper position of seal (4 or 5) upon disassembly. Seal must not be reversed at reassembly. Remove and discard the two part seal.

6-31. CLEANING, INSPECTION, REPAIR OF ENGINE DRIVEN PUMP.

WARNING: WEAR GOGGLES, RUBBER GLOVES, AND PROVIDE ADEQUATE VENTILATION WHEN USING TRICHLORETHYLENE OR CLEANING SOLVENTS. REPEATED CONTACT OF SOLVENT WITH SKIN MAY PRODUCE IRRITATION. IF VAPORS ARE INHALED, SERIOUS DAMAGE MAY RESULT.

a. Immerse and wash all metallic parts in trichlorethylene (Military Specification MIL-T-7003) or some equivalent commercial cleaning solvent. Clean all openings and passages with a fine fiber brush, or equivalent, dipped in solvent. Do not scrub any surface with a tool that will scratch surface.

b. Dry all parts thoroughly with a clean, lint-free cloth or with dry, filtered compressed air at 20 psi maximum. Blow out all parts, bores, and passages with compressed air.

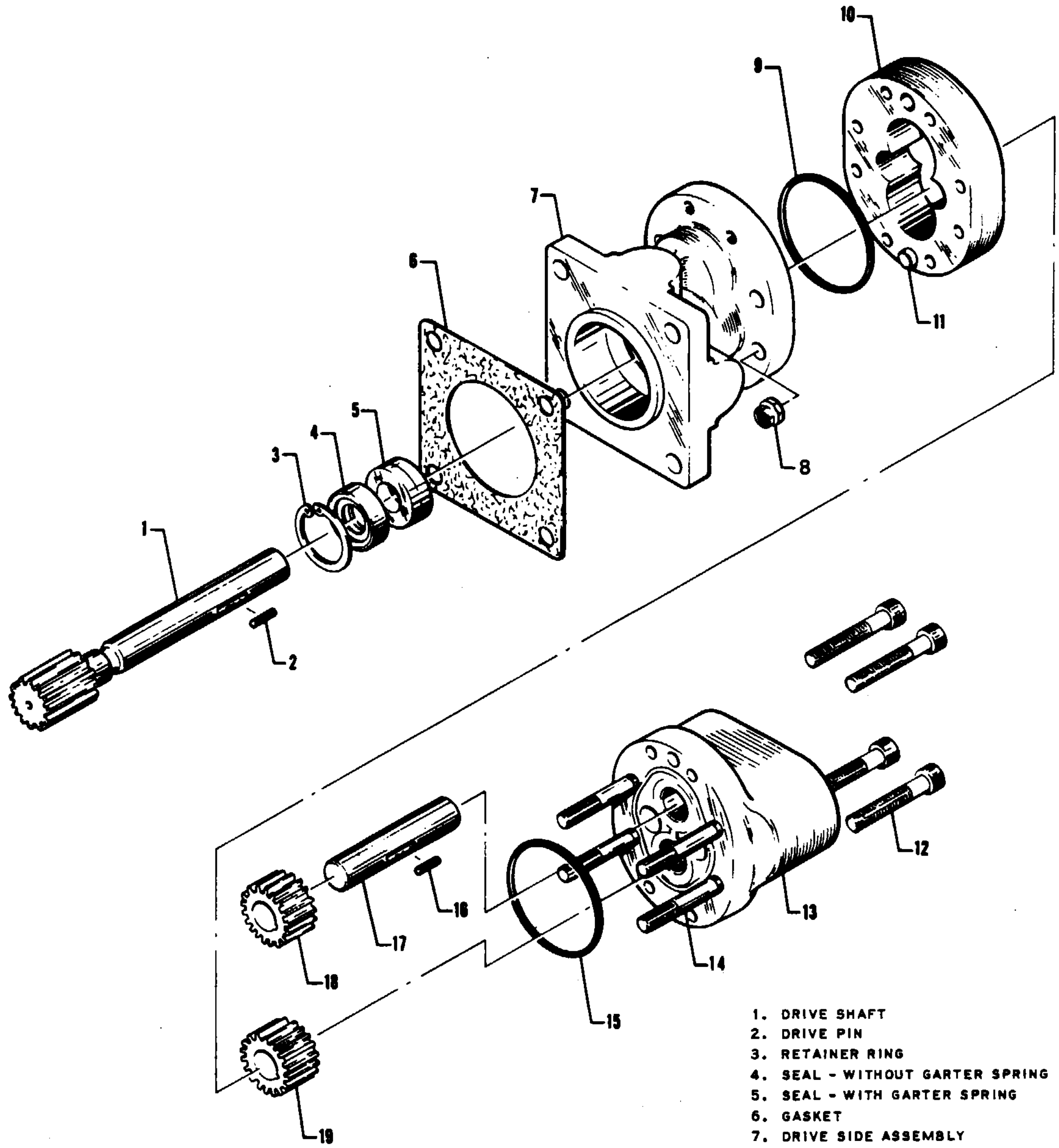
c. Under strong light and preferably under magnification, inspect all parts for scoring, nicks, scratches, pitting, corrosion, cracks, and excessive wear. Inspect all threaded surfaces for chipping and crossed or stripped threads. Inspect parts for conformance to information given in Table VI-III. The table gives the items which should be inspected and the corrective action necessary when the pump parts do not pass this inspection.

TABLE VI-III. INSPECTION AND REPAIR, ENGINE-DRIVEN HYDRAULIC PUMP

ITEM	INSPECTION	REPAIR
Rear Side	Visually inspect the lapped face for scratches or signs of scoring.	Lap the surface to remove any scratches.
Centerplate	Visually inspect the two lapped faces for scratches or scoring. Inspect the gear pockets for deep scratches.	Lightly stone any burrs around the gear pockets. Lap the faces, but do not remove more than 0.0001 in. total of metal from both sides.
Drive Side	Visually inspect the lapped surface for scratches or signs of scoring.	Lap the surface to remove any scratches. If deep scratches are present, replace part.
Secondary Shaft	Inspect the shaft for deep scratches in the bearing area.	If deep scratches are present, replace secondary shaft.
Gears	Visually inspect gears for evidence of chipped teeth or cracks around the bore. Measure the gear O.D., which should be 1.1646/1.1644 in.	If gears are not within tolerance or if there are any cracked teeth, replace the pump.
Bearings	Visually inspect the bearing bores for scratches and/or scoring.	If badly scored, replace pump.

NOTE

The PA-23 Parts Catalog, P/N 753522, should be used to obtain repair kits to service this pump.



1. DRIVE SHAFT
2. DRIVE PIN
3. RETAINER RING
4. SEAL - WITHOUT GARTER SPRING
5. SEAL - WITH GARTER SPRING
6. GASKET
7. DRIVE SIDE ASSEMBLY
8. LOCKNUT
9. "O" RING
10. CENTER PLATE ASSEMBLY
11. DOWELS (4)
12. SCREW, SOC. HD. CAP.
13. REAR SIDE ASSEMBLY
14. STUD
15. "O" RING
16. DRIVE PIN
17. SECONDARY SHAFT
18. SECONDARY GEAR
19. DRIVE GEAR

Figure 6-17. Hydraulic Pump, Exploded View

NOTE

Although the pump may still operate under conditions where some of the parts exceed the wear limits, it will probably be found that the pump is not producing its rated capacity and, therefore, the system may not be doing an adequate job. Therefore, it is necessary to repair or replace any parts that are not within the stated limits.

6-32. ASSEMBLY OF ENGINE-DRIVEN PUMP. (Refer to Figure 6-17.) The seal and seal rings should be soaked in the hydraulic (MIL-H-5606) fluid for two hours minimum time before installation.

a. Replace drive shaft seal (4 or 5) into drive side seal bore. Be sure to install drive shaft seal, "back to back", as noted during disassembly.

b. Replace retainer ring (3) into drive side seal bore.

c. Install new "O" ring seal (9) on drive side.

d. Mate centerplate assembly (10) with drive side assembly (7) and align dowel pins.

e. Install drive shaft (1) from engine side of drive side assembly.

f. Install secondary shaft (17) into centerplate. Install drive and secondary gears (19 and 18) onto drive and secondary shafts (1 and 17). Be sure the drive pin counterbore on the drive gear faces the pump rear side. Install drive pins.

g. Install the four studs (12) and new "O" ring seal (15) on the rear side assembly (13).

h. Lightly oil gear teeth with hydraulic fluid before completing assembly.

i. Mate the rear side assembly (13) with the centerplate (10), using caution to align the drive and secondary shafts with the respective holes in the rear side assembly.

j. Replace the four locknuts (8) on the studs (14) extending out of the drive side flange that mates with the centerplate.

k. Replace the four socket head cap screws (12) that secure the rear side, centerplate and drive side assemblies together. Torque the socket head cap screws and locknut to 60 inch-pounds.

l. When the pump is assembled, turn drive shaft by hand to make sure the pump turns freely. If there is any sticking or binding at all, disassemble pump and determine the trouble. Do not apply power to the pump until it turns freely by hand.

NOTE

If possible, run pump at rated speed while gradually increasing the pressure up to rated pressure by the end of the thirty minute period.

6-33. INSTALLATION OF ENGINE DRIVEN PUMP(S).

a. Place new gasket on the base of housing.
b. Install pump on the housing.

NOTE

When installing pump, keep the drain fitting facing downward.

c. Line shaft up with the gear inside of the housing.
d. Install flat washers, lockwashers and nuts on the base of pump and tighten.
e. Install the two hydraulic hoses and prime the pump before completing the hookup to the firewall fittings in accordance with paragraph 6-34.
f. Install and time magneto.
g. Check to be sure that system reservoir contains the required amount of clean fluid.
h Check all fluid lines for leaks, obstructions or restrictions.
i. Change system fluid filter in accordance with paragraph 6-123.
j. Replace cowling.
k. Run up the engine and check for leaks.

6-34. PRIMING ENGINE DRIVEN PUMP. The following instructions for priming the hydraulic pump assures that the pump will not be operated in a dry condition and shall be followed whenever a pump is serviced or replaced.

a. Remove the hydraulic suction and pressure lines from the firewall fitting and oil filter.
b. Install caps on suction and pressure fitting at the firewall and oil filter to prevent the loss of fluid prior to the hookup of the hydraulic lines.
c. Holding both lines at a level higher than the pump; pour hydraulic fluid, MIL-H-5606, into the lines.
d. Remove one cap at a time from the fittings and connect the appropriate line to the fitting, trying not to spill any of the hydraulic fluid previously put into the lines.
e. After the engine has been operated, check the hookups for leaks.

6-35. HYDRAULIC SYSTEM FAILURE. The emergency use of the hand pump or CO2 system to extend the gears is an indication the engine driven pump(s) were operating without sufficient fluid. This condition causes additional wear on the engine driven pump(s). Therefore, the filter element(s) must be removed and checked even if pump failure is not apparent and/or the primary cause of the problem.

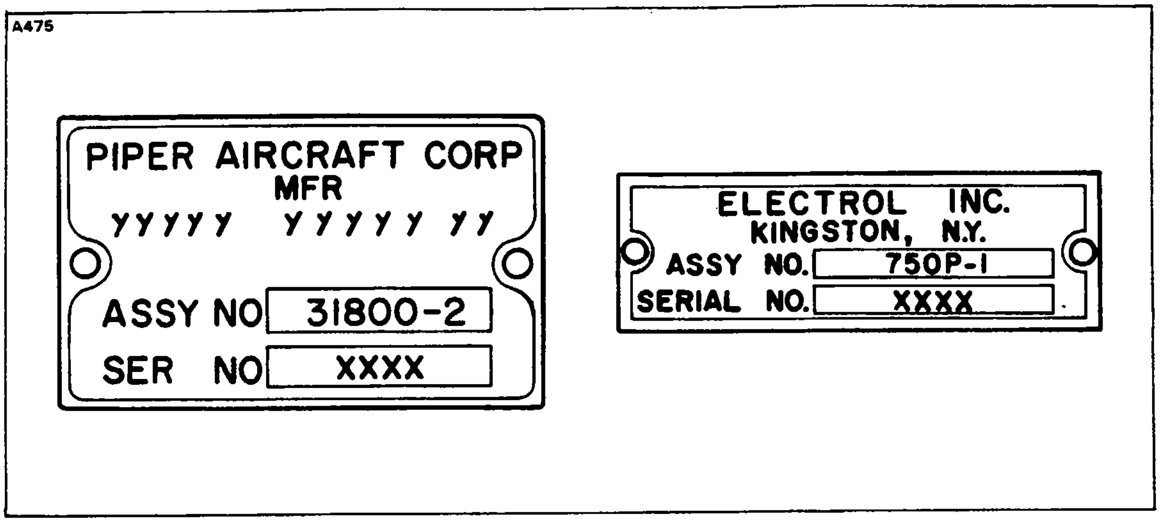


Figure 6-18. Identification of Powerpak

a. Remove the filter element(s) and check for metal particles.
b. If no metal particles are evident, proceed with the following:
   1. Replace filter element(s) per paragraph 6-123.
   2. Replenish fluid as noted in Section II.
c. If metal particles are evident in filter, proceed with the following:
   1. Inspect, replace or repair hydraulic pump. On aircraft with dual pumps both pumps must be inspected if metal particles are found in either filter. (Refer to paragraphs 6-29 to 6-33.)
   2. Prime pump(s) in accordance with paragraph 6-34. Do not connect the pump(s) to the rest of the hydraulic system until the system has been flushed.
   3. Proceed to flush the system in accordance with paragraph 6-10.

6-36. HYDRAULIC POWERPAK.

6-37. IDENTIFICATION OF POWERPAKS. The manufacturer's identification placard located on the powerpak reservoir body, as shown in Figure 6-18, should be used to determine which powerpak is in the airplane being serviced. The placard furnishes the part/model number and serial number of each unit.

6-38. REMOVAL OF POWERPAK.
a. Place the airplane on jacks. (Refer to Jacking, Section II.)
b. Lower the flaps to the full down position, using the hand pump.
c. Drain the hydraulic system by disconnecting the hydraulic extension line at the nose gear actuating cylinder and placing the end of the line in a suitable container. Move the landing gear selector to the DOWN position and operate the hand pump until the system is empty.
d. Remove the two front seats and the carpet from around the base of the control pedestal.

e. Remove the access plate from both sides of the upper section of the pedestal.

f. Disconnect the cannon plug inside the left access opening.

NOTE

On airplanes equipped with turbocharges, disconnect both cannon plugs and mark them for identification.

g. Remove the flap and landing gear selector knobs by removing the Allen screw from the flap knob and the nut and bolt from the landing gear knob.

h. Disconnect the carburetor heat or alternate air knobs on the pedestal control placard. Extend the control knob approximately one inch. Unscrew the outside knob and remove the spring. Unscrew the inside knob and the outside nut that secures the cable to the placard. (The removed cables should be marked for identification.)

i. Remove the attaching screws from around the upper pedestal control cover and remove the cover with placard attached.

j On airplanes with Serial Numbers 27-2505 and up, disconnect the voltage regulator selector switch from the lower placard panel by removing the nut which holds it to the panel.

k. On airplanes with Serial Numbers 27-2505 and up, remove the quick drain from its line coming through the lower placard panel.

l. Disconnect the cabin air controls from the lower placard panel. Extend the control knobs approximately one inch. Unscrew the outside knob and remove the spring. Unscrew the inside knob and the outside nut that connects the cables to the placard panel. (The removed cables should be marked for identification.)

m. Remove the attaching screws from the lower placard panel. On airplanes with Serial Numbers 27-1 to 27-2504 inclusive, swing the panel off to the left. On airplanes with Serial Numbers 27-2505 and up, remove the panel.

n. Disconnect the two wire leads coming through the top left forward section of the upper pedestal plate assembly.

o. On airplanes with Serial Numbers 27-2505 and up, remove the screw from the right side of the lower pedestal plate assembly that secures the priority valve to the plate.

p. Remove the attaching screws from around the outside edge of the lower pedestal plate assembly.

NOTE

It may be necessary to loosen or remove the drip pan and the spacer bar by removing the screws on both sides that hold them in place.

q. Remove the "U" shaped brace from the aft section mounting channel.

r. Remove all hydraulic lines at the powerpak. The lines should be capped or plugged to prevent dirt or dust from entering the system.

s. Remove the vent hose from the grommet at the base of the pedestal assembly.

t. Remove the attaching screws from the two mounting channels that hold the powerpak.

u. Remove the powerpak and place on a rigid base prepared for removal.

6-39. INSTALLATION OF POWERPAK.

a. Insert the powerpak, with mounting channels attached, into the pedestal and attach the channels to the top side panels.

b. Insert the vent hose into the grommet at the base of the pedestal assembly.

c. Connect all hydraulic lines to the powerpak.

d. Connect the "U" shaped brace to the bottom of the aft section mounting channel.

e. Install the lower pedestal plate assembly.

f. On airplanes with Serial Numbers 27-2505 and up, connect the priority valve to the lower pedestal plate assembly on the right side.

g. Insert the two wires from the horn through the grommet on the upper left side of the pedestal plate assembly.

h. Install the lower placard panel.

i. Connect the cabin air controls to the lower placard panel. Screw on the nut that holds the cable to the panel. Screw on the inside knob. Install the spring and screw on the outside knob.

j. On airplanes with Serial Numbers 27-2505 and up, install the quick drain on its line coming through the lower placard panel.

k. On airplanes with Serial Numbers 27-2505 and up, connect the voltage regulator switch to the lower placard panel.

l. Install the upper pedestal cover with placard attached.

m. Connect the carburetor heat or alternate air knobs. Screw on the nut that secures the cable to the placard. Screw on the inside nut. Install the spring and screw on the outside nut.

n. Install the flap and landing gear selector knobs to their respective levers.

o. Connect the cannon plug inside the left access opening.
p. Connect the hydraulic line at the nose gear actuating cylinder.
q. Fill and bleed the hydraulic system (refer to Filling Hydraulic System, Section II) and check for leaks.
r. Install the access plates on both sides of the upper section of the pedestal.
s. Install the two front seats and the carpet around the base of the pedestal.
t. Raise the flaps using the hand pump.

CAUTION

Before removing the airplane from the jacks, ascertain that landing gear is down and locked and selector levers are neutral.

6-40. OVERHAUL OF POWERPAK.

6-41. OVERHAUL INSTRUCTIONS AND PRECAUTIONS. For complete disassembly and assembly of the powerpak, refer to Figure 6-20. The procedure described in the following paragraphs is presented in such a manner that a complete or partial overhaul may be conducted.

NOTE

Before attempting to disassemble the powerpak, be sure the special tools and test equipment specified in paragraph 6-42 are available. The test equipment is necessary for checking adjusting pressures following re-assembly. Refer to paragraph 6-58 for adjustment and check procedures.

Be sure to observe the precautions listed below when overhauling the powerpak. Strict adherence to these precautions ensures a minimum of time and expense for repair of the powerpak and reduces the chance of damage to poppet and valve seats due to careless mishandling of tools. Damage to poppet or valve seats requires return of powerpak to Piper Aircraft Corporation for overhaul or exchanged.
a. Keep the unit free of all foreign matter.
b. For removal and replacement of internal snap rings, use Waldes-Kohinoor, Inc. snap ring pliers No. 1 and 3 (or equivalent).

c. Use long-nose pliers for removal and replacement of all retainer plugs, detent plungers and poppets.

d. Use a hooked tool to remove check valve, relief valve and poppet seats. (These tools may be fabricated from dimensions given in Figures 6-37 and 6-38.)

CAUTION

Use extreme care when handling poppet seats, check valves and seats, relief valve seats and bores. Damage to these parts requires returning the powerpak for overhaul.

NOTE

Poppets and seats are matched parts and must be kept together. Damage to either a poppet or a seat requires replacement of the poppet and seat subassembly.

e. It is recommended that the powerpak be mounted to a combination work and test stand. A stand of this type may be fabricated from dimensions given in Figure 6-36.

f. All threads, either straight or pipe, are right-hand twist unless otherwise noted in instructions.

g. Prior to removal of camshafts, relieve the tension on the appropriate spring loaded detent plungers and poppets.

h. Use care when handling "O" rings. Coat "O" rings and associated parts with grease (MIL-G-4343) or hydraulic fluid before reassembly.

6-42. SPECIAL TOOLS AND TEST EQUIPMENT. Refer to Table VI-IV for special tools and test equipment required for disassembly, reassembly and testing of the powerpak.

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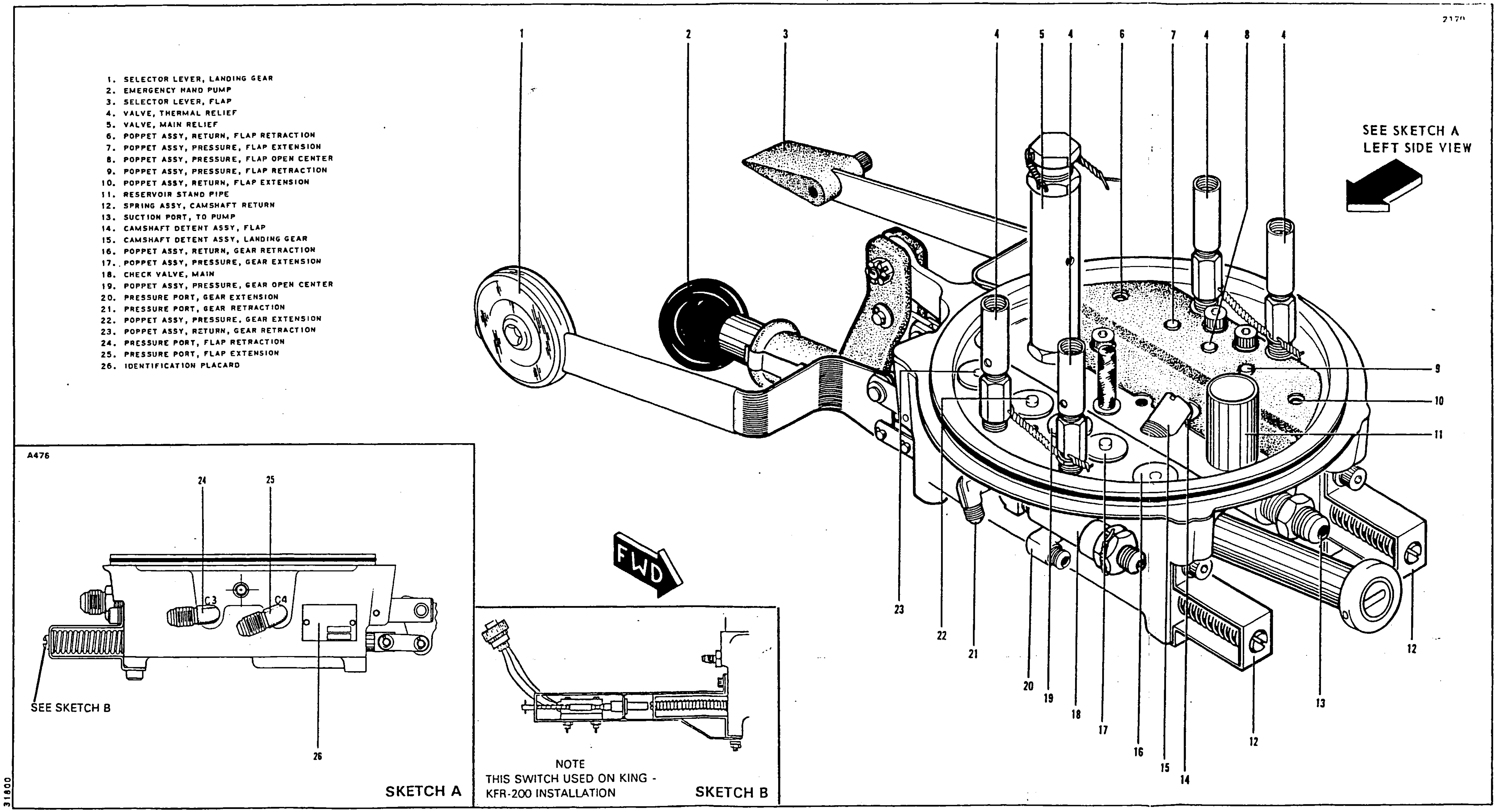
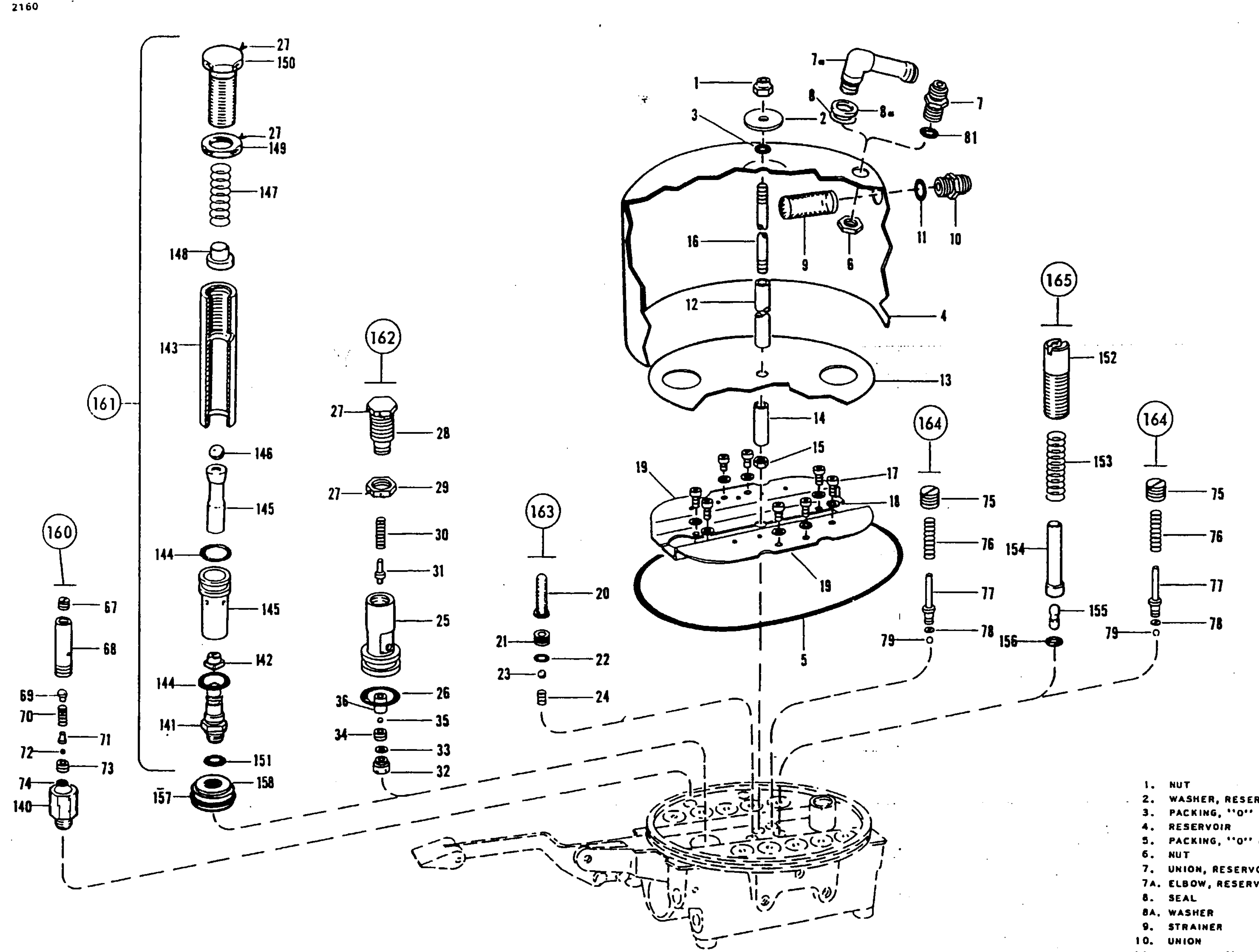
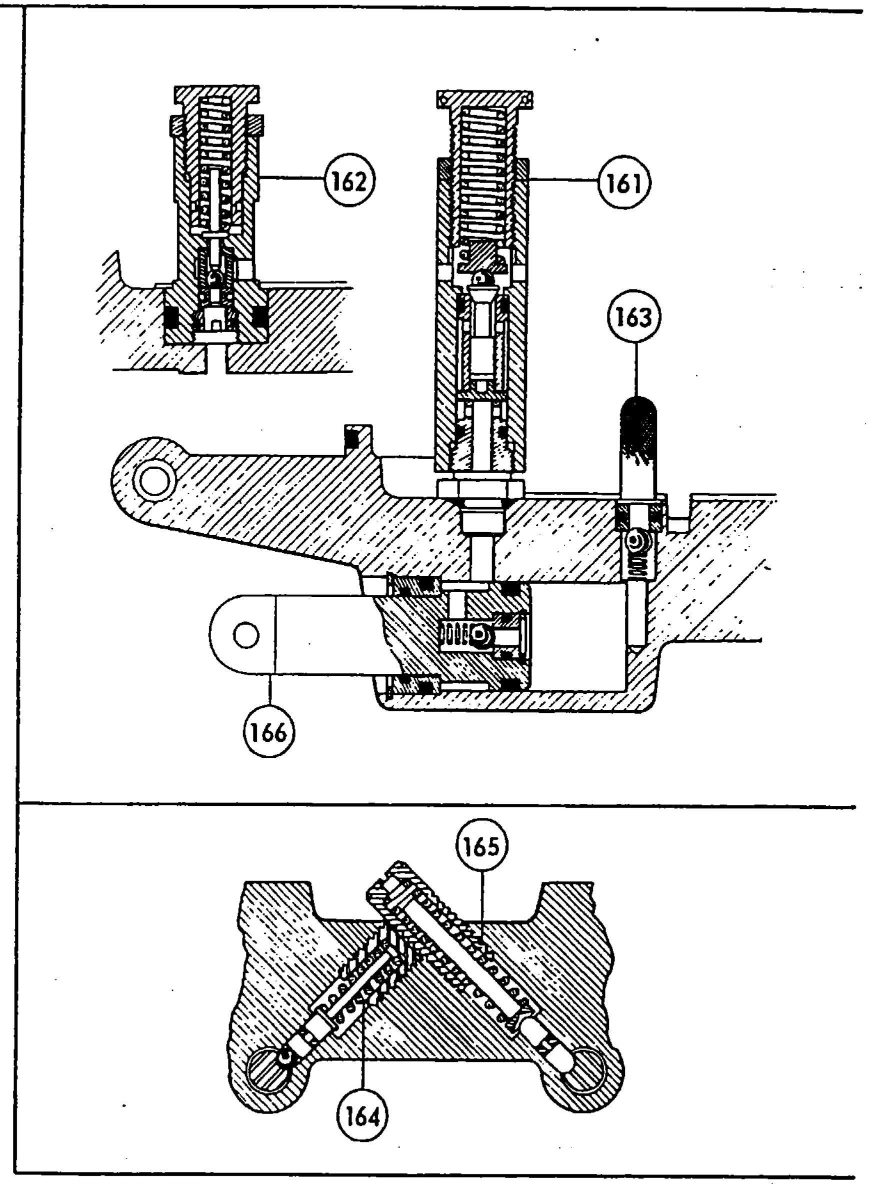


Figure 6-19. Location of Powerpak Components

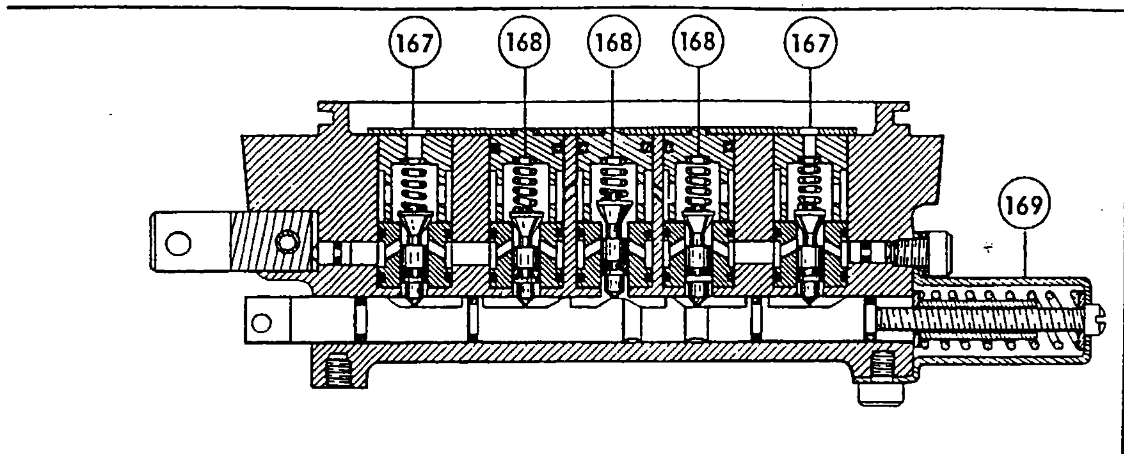


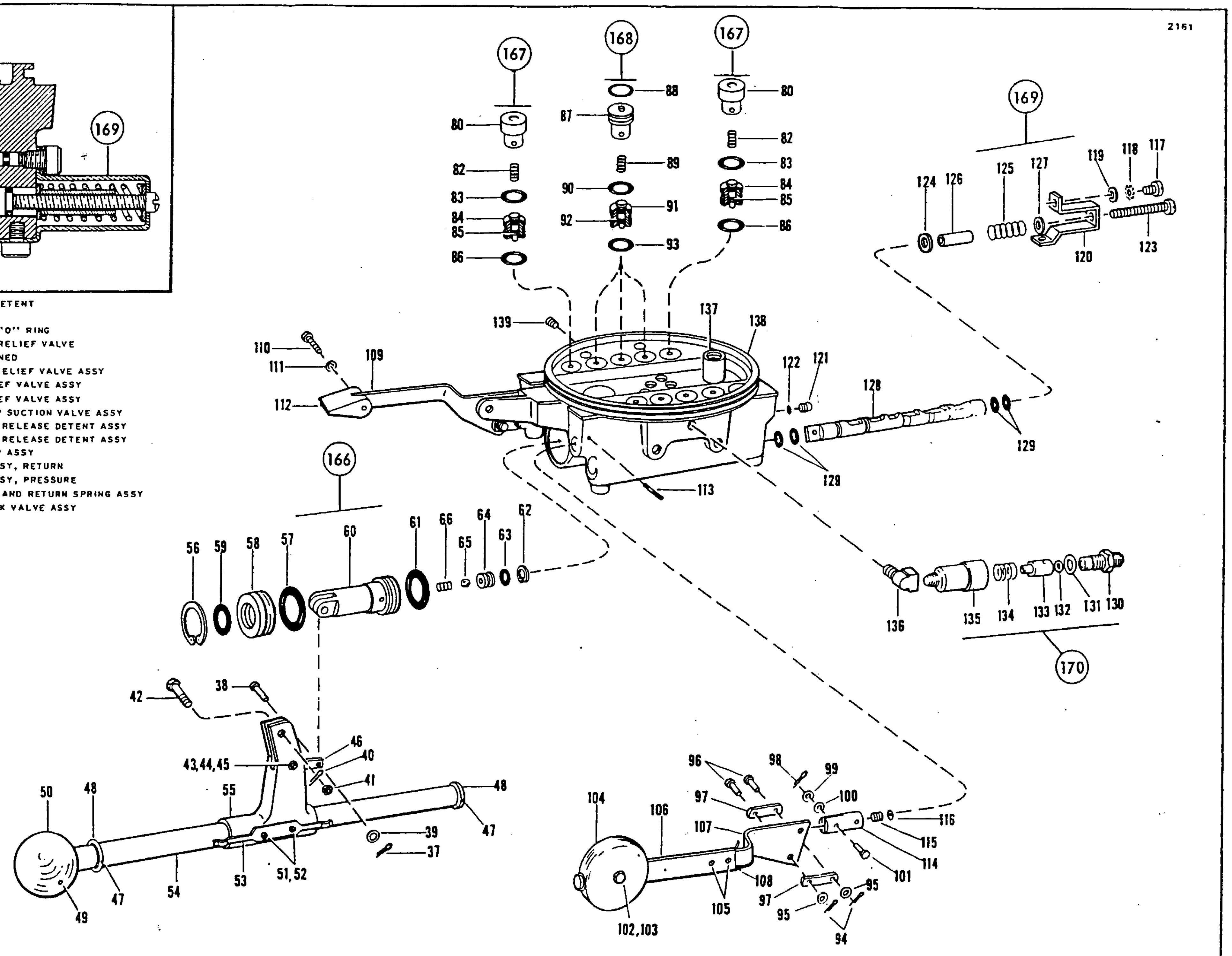


1.	NUT	14.	SPACER, RESERVOIR	29.	NUT	44.	PIN, CLEVIS
2.	WASHER, RESERVOIR	15.	NUT	30.	SPRING	45.	WASHER
3.	PACKING, "O" RING	16.	STUD	31.	PLUNGER	46.	LINK
4.	RESERVOIR	17.	SCREW	32.	PLUG	47.	PIN, ROLL
5.	PACKING, "O" RING	18.	WASHER, LOCK	33.	PACKING, "O" RING	48.	STOP
6.	NUT	19.	PLATE, RETAINER	34.	SEAT	49.	PIN, ROLL
7.	UNION, RESERVOIR	20.	STRAINER	35.	BALL	50.	GRIP
7A.	ELBOW, RESERVOIR	21.	SEAT, CHECK	36.	RETAINER	51.	SCREW
8.	SEAL	22.	PACKING, "O" RING	37.	PIN, COTTER	52.	WASHER, LOCK
8A.	WASHER	23.	BALL	38.	PIN, CLEVIS	53.	SPRING
9.	STRAINER	24.	SPRING, CHECK	39.	WASHER	54.	HANDLE
10.	UNION	25.	BODY, RELIEF VALVE	40.	PIN, COTTER	55.	FORK AND BUSHING ASSY
11.	PACKING, "O" RING	26.	PACKING, "O" RING	41.	NUT	56.	RING, SNAP
12.	SPACER, RESERVOIR	27.	LOCKWIRE	42.	BOLT	57.	PACKING, "O" RING
13.	BAFFLE, RESERVOIR	28.	SCREW	43.	PIN, COTTER	58.	STOP

31800

Figure 6-20. Hydraulic Powerpak, Exploded View





59. PACKING, "O" RING
60. PISTON
61. PACKING, "O" RING
62. RING, SNAP
63. PACKING, "O" RING
64. SEAT, CHECK
65. BALL
66. SPRING, CHECK
67. SCREW ASSY
68. BODY
69. RETAINER, UPPER
70. SPRING
71. RETAINER, LOWER
72. BALL
73. SEAT
74. PACKING, "O" RING
75. PLUG
76. SPRING
77. PLUNGER
78. PACKING, "O" RING
79. BALL
80. RETAINER, RETURN
81. PACKING, "O" RING
82. SPRING
83. PACKING, "O" RING
84. POPPET AND SEAT ASSY
85. PACKING, "O" RING
86. PACKING, "O" RING
87. RETAINER, PRESSURE
88. PACKING, "O" RING
89. SPRING
90. PACKING, "O" RING
91. POPPET AND SEAT ASSY
92. PACKING, "O" RING
93. PACKING, "O" RING
94. PIN, COTTER
95. WASHER
96. PIN, CLEVIS
97. LINK
98. PIN, COTTER
99. WASHER
100. WASHER
101. PIN, CLEVIS
102. NUT, LOCK
103. BOLT
104. KNOB, LANDING GEAR
105. PIN, ROLL
106. TUBE, LEVER
107. LEVER, LANDING GEAR
108. TERMINAL BLOCK AND WIRE ASSY
109. LEVER
110. SCREW
111. WASHER
112. KNOB, WING FLAP
113. PIN, ROLL
114. STUD
115. PLUG
116. PACKING, "O" RING
117. SCREW
118. WASHER, LOCK
119. WASHER
120. RETAINER
121. PLUG
122. PACKING, "O" RING
123. SCREW
124. WASHER
125. SPRING
126. SPACER
127. WASHER
128. CAMSHAFT
129. PACKING, "O" RING
130. END FITTING
131. GASKET
132. PACKING
133. POPPET
134. SPRING
135. BODY
136. ELBOW
137. PIPE, STAND
138. BODY
139. PLUG
140. HEAD, THERMAL RELIEF VALVE
141. END FITTING
142. RETAINER
143. BODY
144. "O" RING
145. POPPET ASSY
146. BALL
147. SPRING
148. GUIDE
149. NUT
150. CAP
151. PACKING, "O" RING
152. GEAR DETENT CAP
153. SPRING
154. DETENT SPRING GUIDE
155. PLUNGER DETENT
156. PACKING
157. PACKING, "O" RING
158. ADAPTER, RELIEF VALVE
159. NOT ASSIGNED
160. THERMAL RELIEF VALVE ASSY
161. MAIN RELIEF VALVE ASSY
162. MAIN RELIEF VALVE ASSY
163. HAND PUMP SUCTION VALVE ASSY
164. CAMSHAFT RELEASE DETENT ASSY
165. CAMSHAFT RELEASE DETENT ASSY
166. HAND PUMP ASSY
167. POPPET ASSY, RETURN
168. POPPET ASSY, PRESSURE
169. CAMSHAFT AND RETURN SPRING ASSY
170. MAIN CHECK VALVE ASSY

Figure 6-20. Hydraulic Powerpak, Exploded View (cont.)

TABLE VI-IV. SPECIAL TOOLS AND TEST EQUIPMENT

Nomenclature	Part No.	Manufacturer
Retaining Ring Pliers or equivalent	Cat. No. 1	Waldes-Kohinoor, Inc. 47-16 Austel Place Long Island City 1, N.Y. 11101
Retaining Ring Pliers or equivalent	Cat. No. 3	Waldes-Kohinoor, Inc. 47-16 Austel Place Long Island City 1, N.Y. 11101
Piper Hydraulic Test Unit or equivalent	753 080	Piper Aircraft Corporation Lock Haven, Pa. 17745
Actuating Cylinder, 2 reqd. (double acting, 1-1/4 in. ID x 8-in. stroke)	31870-02	Piper Aircraft Corporation Lock Haven, Pa. 17745
Speed Control Valve, 4 reqd. (adjusted for 300-400 psi back pressure)	CA111-5	Canfield Supply Comp. 17 Dederick Street Kingston, New York
Pressure Gage, 4 reqd. (2000 psi, 2-in. dial)		Standard
Reservoir, Open Top	31827-00 (Mod.)	Piper Aircraft Corporation Lock Haven, Pa. 17745

6-43. DISASSEMBLY OF POWERPAK.

6-44. REMOVAL OF RESERVOIR, BAFFLE AND PLATES. (Refer to Figure 6-20.)

a. Remove the self-locking nut (1), washer (2) and "O" ring (3) from the top of the powerpak reservoir (4).

b. Remove the powerpak reservoir. The reservoir is held by a snug fit, and can be removed by grasping it firmly on both sides and applying a steady twisting and lifting force.

c. Remove the "O" ring (5) from around the powerpak body (138).

d. Remove the safety wire (27) from around the upper reservoir spacer (12) and main relief valve (161 or 162).

e. Remove the safety wire from between the thermal relief valves (160).

f. Remove the baffle (13) and lower spacer (14).

NOTE

Before disassembling the powerpak further, any checks and/or adjustments should be accomplished at this time. (Refer to paragraph 6-58.)

g. Remove the stud (16) and nut (15). To assist in removal of the stud, install two nuts at the top; lock one against the other and remove with a wrench on the lower of the two nuts.

h. Remove one or both retainer plates by removing screws (17) and washers (18) securing the plate(s) to the powerpak body.

CAUTION

When removing the retainer plates, use caution that the poppet retainers and springs do not "fly" from their ports.

NOTE

On powerpaks with part numbers 31800-2 and 31800-3, it may be necessary to loosen the main relief valve (162) before the retainer plates can be lifted from the powerpak body.

6-45. REMOVAL AND DISASSEMBLY OF MAIN RELIEF VALVE. (Refer to Figure 6-20.) Two style relief valves are used with the various model powerpaks. Powerpaks with part numbers 750P-1 and 31800-0 incorporate the shorter valve (162) of the two shown, while those with part numbers 31800-2, 31800-2M and 31800-3 incorporate the taller valve (161). An adapter (158) is used with the taller valve in powerpak, part number 31800-2M.

a. The main relief valve (162) in powerpaks with part numbers 750P-1 or 31800-0 may be removed and disassembled as follows:

1. Ascertain that the retainer plates (19) have been removed.
2. Lift the valve assembly from the powerpak body.
3. Remove the "O" ring (26) from the valve body (25).
4. Support the valve body in an upside down position and with a 3/16 Allen wrench, remove plug (32) from the bottom of the body.
5. Loosen the jam nut (29) and remove the valve adjusting screw (28).
6. Remove the spring (30) and plunger (31) from the top of the body.
7. With a 0.25 inch aluminum rod inserted into the top of the body, push out the seat (34) with "O" ring (33), check ball (35) and retainer (36).

b. The main relief valve (161) in powerpaks with part numbers 31800-2, 31800-2M and 31800-3 may be removed and disassembled as follows:

1. Ascertain that the retainer plates (19) have been removed.
2. Note if the valve is fitted with an adapter (158) in the powerpak body, and if so, lift the valve assembly from the body. A valve without an adapter installed will require removal by turning a wrench affixed to the hexagon surface of the end fitting (141) at the base of the assembly.
3. If installed, and only if necessary, remove the adatper from the end fitting.
4. If an adapter has been installed, remove the "O" ring (157) from the adapter.
5. Remove the "O" ring (151) from the base of the end fitting.
6. Loosen the jam nut (149) and remove the valve adjusting cap (screw) (150).
7. Remove the spring (147), guide (148), ball (146) and poppet (145) from the top of the valve body (143).
8. Support the end fitting and remove the valve body from the fitting by inserting an aluminum rod, 0.187 of an inch, through the holes in the body and turning it from the fitting.
9. Remove the "O" ring (144) from the fitting.
10. From the inside of the body, remove the retainer (142) and poppet seat (145). An aluminum rod, 0.375 of an inch, may be inserted through the top of the body to push out the seat.
11. Remove the "O" ring from the poppet seat.

NOTE

The poppet and seat assembly (145) is a matched set. If necessary to replace, replace as a set only.

6-46. REMOVAL AND DISASSEMBLY OF THERMAL RELIEF VALVES. (Refer to Figure 6-20.) Four identical valve assemblies (160) are installed in the powerpak; each is removed and disassembled by the following procedure:

a. Cut safety wire attached to the valve.

b. To disassemble the valve assembly, first remove the adjusting screw (67) from the top of the valve body (68).

c. Remove the upper spring retainer (69) and spring (70). The retainer may be lifted from the valve body with a small amount of grease on a small stick or rod.

d. Remove the valve body by inserting a brass rod, 0.156 of an inch, through the holes in the body and turning it from the powerpak body or head (140), whichever applies.

e. Remove the lower spring retainer (71) and ball (72).

f. Remove the valve seat (73) by inserting a fabricated hooked tool into the port hole in the seat and pulling it from the powerpak body or head. (A tool may be fabricated from dimensions given in Figure 6-37.)

g. Remove the "O" ring (74) from the seat.

h. If installed, and only if necessary, the valve head (140) may be removed. Use caution not to damage or crush the head.

6-47. REMOVAL OF CAMSHAFT RELEASE DETENT ASSEMBLIES. (Refer to Figure 6-20.) The two detent assemblies found in the various model powerpaks will be either alike or different in design; this being determined by the model of the powerpak. Powerpaks with part numbers 750P-1 and 31800-0 incorporate the like detent assemblies depicted by call out number 164, while those with part numbers 31800-2, 31800-2M and 31800-3 incorporate one of 164 and one of the later design, used only for the landing gear release, and this is depicted by call out 165. When removing the assemblies, it will be noted that the later assembly (165) must be removed before the earlier or shorter detent assembly (164) can be removed.

a. The later or longer design detent assembly (165) may be removed as follows:

1. Turn the adjusting cap (152) from the powerpak body (138).
2. Remove the spring (153) and spring guide (154) from the port.

3. Remove the plunger detent (155). To facilitate removal of the detent, affix an air hose to the port marked C1 at the right side of the powerpak body and select gear up. Apply air pressure slowly, plug any air leaks and allow the air pressure to push the detent from the port. Place a rag over the port to catch the detent should it leave the port with force. (If the camshaft is removed, apply pressure directly to the port from where the shaft was removed.)

4. Remove the "O" ring (156) from the detent.

b. The earlier or shorter design detent assembly (164) may be removed as follows:

1. Turn the adjusting plug (75) from the powerpak body.
2. Remove the spring (76) and plunger (77) from the port.
3. Remove the "O" ring (78) from the plunger.
4. Remove the ball (79) from the detent. Turn the powerpak upside down to allow the ball to drop out (Use caution that no other parts drop out unintentionally.) or use air pressure applied to port C1 or C4 of the powerpak body and with the selector lever up.

6-48. REMOVAL OF POPPETS AND SELECTOR CAMSHAFTS. (Refer to Figure 6-20.) The arrangement of the poppet assemblies (167 and 168) and selector camshaft assembly (169) is identical for both the landing gear or flap sections of the powerpak. The instructions that follow may be used when working with either section.

CAUTION

Do not mix parts. When removing the various components of the powerpak, keep them in order. The poppet and seat assemblies (84 and 91) are matched sets and should be replaced as a set.

a. Ascertain that the reservoir (4), baffle (13) and plates (19) have been removed in accordance with paragraph 6-44.

b. Ascertain that the camshaft release detent assemblies have been removed in accordance with instructions given in paragraph 6-47.

c. The pressure poppet assemblies (168) that control either the landing gear or flap may be removed as follows:

1. Remove the poppet retainer (87) from the port. Movement of the selector lever through its full travel should move the retainer up from its position in the port.
2. Remove the "O" ring (88) from the retainer.

3. Remove the poppet return spring (89) from the port.

4. Remove the poppet from the poppet seat by lightly gripping the tang on the top of the poppet with a pair of long nose pliers and, while applying a steady pulling force, bring the poppet from the seat.

5. Remove the "O" ring (92) from the poppet.

6. Remove the poppet seat from the port by inserting a tool, fabricated of aluminum, down into the hole in the seat and allowing the hooks of the tool to enter the flow passages. (The tool may be fabricated from dimensions given in Figure 6-38.) Applying a steady pulling force, bring the seat up from the port.

7. Remove the "O" rings (90 and 93) from the seat.

8. Place the poppet back into the seat. Each poppet and seat is a matched set and must be kept together to insure proper operation.

9. The remaining pressure poppet assemblies may be removed, as required, using the same procedure as above.

d. The return poppet assemblies (167) for either the landing gear or flap sections may be removed as follows:

1. Remove the poppet retainer (80) from the port. Movement of the selector through its full travel should move the retainer up from its position in the port.

2. Remove the poppet return spring (82) from the port.

3. Remove the poppet from the poppet seat by lightly gripping the tang on the top of the poppet with a pair of long nose pliers and, while applying a steady pulling force, bring the poppet from the seat.

4. Remove the "O" ring (85) from the poppet.

5. Remove the poppet seat from the port by inserting the tool down into the hole in the seat and allowing the hooks of the tool to enter the flow passages. Applying a steady pulling force, bring the seat from the port.

6. Remove the "O" rings (83 and 86) from the seat.

7. Place the poppet back into the seat.

8. The remaining return poppet assemblies may be removed, as required, using the same procedure as above.

e. The selector levers, either the landing gear or flap, may be removed from the powerpak as follows:

1. Disconnect the selector lever (107 or 109) from the camshaft (128) at the links (97) by removing cotter pin (94), washer (95) and clevis pin (96).

2. Separate the lever from the stud (114) by removing cotter pin (98), washers (99 and 100) and clevis pin (101).

3. The stud may be removed by driving the roll pin (113) from the body and stud with a 3/16 inch punch. (This operation need not be accomplished during cleaning and/or replacement of other components. Normally, only when replacing a damaged stud or an "O" ring (116) on the plug (115).)

4. The forward plug (115) or aft plug (121) may be removed by inserting a soft aluminum wire into either the forward or aft return port and pushing it from the body. To remove the aft plug, it will first require that the spring retainer attaching screw (117) be removed. (It is not recommended either plug be removed unless an external leak around the plug area has been observed.) Remove "O" ring (116 or 122) from plug.

f. The landing gear or flap selector camshaft assembly (128) may be removed as follows:

1. Remove the spring retainer (120) by removing attaching screw (117) and washers (118 and 119). At the lower attachment point, temporarily remove the screw holding the powerpak to the work stand.

2. Remove the return spring (125), spacer (126) and washers (124 and 127) by turning the retaining screw (123) from the camshaft. (Should there be more than two washers (124 and 127) installed on each adjusting screw, note and replace with the same amount.)

3. Remove the camshaft (128) by grasping the selector attachment end with pliers and pulling while rotating it from the body.

4. Remove the "O" ring (129) from the camshaft.

6-49. REMOVAL AND DISASSEMBLY OF HAND PUMP. (Refer to Figure 6-20.)

a. Remove the hand pump handle assembly from the powerpak as follows:

1. Disconnect the link (46) from between the fork (55) and piston (60) by removing cotter pin (37), washer (39) and clevis pin (38).

2. Disconnect the fork from the powerpak housing (138) by removing cotter pin (40), nut (41) and bolt (42).

b. The pump piston assembly may be removed and disassembled as follows:

1. Remove the snap ring (56), that holds the assembly in the powerpak body, from the annular slot in the body.

2. Pull the piston assembly from the body.

3. Withdraw the stop gland (58) with "O" rings (57 and 59) from the piston (60).

4. Remove the piston valve assembly from the piston by removing the snap ring (62), seat (64) with "O" ring (63), check ball (65) and spring (66).

c. The suction valve assembly (163) may be removed as follows:

1. Ascertain that the reservoir (4), baffle (13) and plates (19) have been removed in accordance with paragraph 6-44.

2. Lift the strainer (20) from the housing.

3. Using a small hook fabricated from aluminum rod, pull the seat (21) from the body.

4. Remove "O" ring (22) from the seat.

5. Withdraw the check ball (23) and spring (24) from the body.

6-50. CLEANING, INSPECTION AND REPAIR OF POWERPAK.

a. Discard all old "O" rings and gaskets.

b. Clean all parts with a dry type cleaning solvent (Federal Specification P-S-661 or equivalent) and dry with filtered compressed air.

NOTE

The conditions at repair require cleanliness, carefulness and proper handling of parts to prevent entrance of foreign materials or prevent damage.

c. Inspect all parts for scratches, scores, chips, cracks and indications of excess wear.

d. Service wear limits for components of the powerpak may be found in Table VI-VIII at the back of this section.

e. If the selector lever release detent adjusting plug or cap has been staked to prevent it from rotating, it will be required that the hole be cleaned with a 1/2-20NF-3 tap. Flush body with solvent to remove any metal chips.

f. Repairs are limited to replacement of parts, "O" rings and gaskets.

g. The parts catalog should be used to obtain the proper parts for the powerpak being serviced.

6-51.. ASSEMBLY OF POWERPAK.

6-52. ASSEMBLY AND INSTALLATION OF HAND PUMP. (Refer to Figure 6-20.)

a. The piston assembly may be assembled and installed as follows:

1. Place an "O" ring (63) on the check seat (64).

2. Insert into the piston (60), in order, the check ball spring (66), check ball (65) and seat. Note the two lands on the seat; the thicker land must be inserted into the piston first or next to the ball.

3. Secure the seat with snap ring (62).

4. Place an "O" ring (61) on the piston.

5. Insert the piston into the port provided in the powerpak body.

6. Install "O" rings (57 and 59) on and in the piston stop gland (58).

7. Slide the stop gland over the end of the piston and into the port.

CAUTION

The stop gland must be installed on the piston with the outside "O" ring forward or first.

8. Secure stop gland in position by inserting a snap ring (56) into the annular slot.

b. The hand pump handle may be installed as follows:

1. Position the pump handle fork (55) to the powerpak and secure with bolt (42), nut (41) and cotter pin (40).

2. Attach the fork with the piston using link (46) and secure with clevis pin (38), washer (39) and cotter pin (37).

c. The suction valve assembly (163) may be installed as follows:

1. Place into the suction port in the powerpak body, the spring (24) and check ball (23).

2. Place an "O" ring (22) on the check seat (21).

3. Insert the check seat into the suction port. Note the two lands on the seat, the thicker land must be inserted into the port first or next to the ball.

4. Position the strainer (20) in place on the powerpak body.

5. If no other assembly and/or adjustments are required, install the plates (19), baffle (13) and reservoir (4) in accordance with instructions in paragraph 6-57.

6-53. INSTALLATION OF POPPETS AND SELECTOR CAMSHAFTS. (Refer to Figure 6-20.) The procedure for the installation of the poppet assemblies (167 and 168) and the camshaft assembly (169) for either the landing gear or flap sections of the powerpak is identical, unless otherwise noted in the instructions to follow. It is recommended that before commencing with this assembly, the overhaul precaution in paragraph 6-41 be reviewed.

a. The landing gear or flap selector camshaft assembly (169) may be installed as follows:

NOTE

The landing gear and flap camshafts are not identical. For identification purposes, the landing gear shaft is stamped with the letter "R" on its aft or selector lever attachment end. The flap camshaft is stamped with the letter "L".

1. Place two "O" rings (129) on the aft end of the camshaft (128).
2. Insert the forward end of the camshaft into the aft end of the powerpak body by applying a steady pushing and rotating pressure. Allow the forward end of the shaft to extend through the body far enough to expose the two forward "O" ring grooves in the shaft.
3. Place the two remaining "O" rings (129) on the shaft.
4. Push the camshaft back into the body until the end of the shaft is flush with the surface of the body. Ascertain that the lobes of the shaft are up.
5. Assemble onto the retaining screw (123), in order, a washer (127), spacer (126), spring (125) and remaining washer (124). (If an additional washer was installed, install that washer also.)
6. Turn the screw with attachments into the end of the camshaft.
7. Place the spring retainer (120) over the end of the screw and secure it at the top with flat washer (119), lockwasher (118) and screw (117). Secure the bottom of the retainer with the screw that also attaches the powerpak to the work stand.
8. Adjust the camshaft return spring by first setting the camshaft at neutral. (Neutral position is when the forward end of the camshaft is flush with the powerpak body.) Next, turn the retaining screw in until a gap exists between the aft washer (127) and spring retainer, and then back out until the washer just contacts the retainer.

b. The landing gear or flap selector lever may be installed as follows:

1. If plug (115 or 121) from the flow passage was removed, install an "O" ring (116 or 122) on the plug and insert it into the open port where required. The flat end of the plug is inserted first.

2. Install the selector lever attaching stud (114) by inserting it into the port provided, aligning the holes in the plug and body and securing with roll pin (113).

3. Attach the selector lever (flap to left side and landing gear to right side of powerpak) to the stud and secure with clevis pin (101), washers (99 and 100) and cotter pin (98).

NOTE

Determine that the lobes of the shaft are up before proceeding further.

4. Attach the links (97) with the lever to the camshaft using clevis pin (96), washer (95) and cotter pin (94).

5. Place the selector lever at neutral.

c. The return poppet assemblies (167) for either the landing gear or flap sections of the powerpak may be installed as follows:

1. Place an "O" ring (85) on the poppet of the poppet seat assembly (84).

2. Place "O" rings (83 and 86) on the outside of the poppet seat.

3. Install the poppet into the poppet seat. The poppet must be assembled with the flow passages of the seat pointing toward the head of the poppet as viewed from the outside of the seat.

4. Insert the poppet seat assembly (84) into the port provided in the powerpak until it bottoms.

NOTE

The poppet seat assembly must be installed with the flow passages pointing upward as viewed from the outside of the seat.

5. Position the spring (82) on the head of the poppet. Determine that the spring surrounds the tang on the poppet.

6. Insert the poppet retainer (80) into the port allowing it to align and bottom.

d. The pressure poppet assemblies (168) for either the landing gear or flap sections of the powerpak may be installed as follows:

1. Place an "O" ring (92) on the poppet of the poppet seat assembly (91).
2. Place "O" rings (90 and 93) on the outside of the poppet seat.
3. Install the poppet into the poppet seat. The poppet must be assembled with the flow passages of the seat pointing toward the head of the poppet as viewed from the outside of the seat.
4. Place an "O" ring (88) on the poppet retainer (87).
5. Insert the retainer into the port allowing it to align and bottom.

e. If no other assembly and/or adjustments are required, install the retainer plates (19) in accordance with instructions in paragraph 6-57.

6-54. INSTALLATION OF CAMSHAFT RELEASE DETENT ASSEMBLIES. (Refer to Figure 6-20.) Powerpaks with part numbers 750P-1 and 31800-0 require two like detent assemblies as depicted by callout 164, while those with part numbers 31800-2, 31800-2M and 31800-3 require one each of detent assembly 165 and assembly 164.

a. Ascertain that the threads within the ports that receive the detent cap or plug have been retaped and cleaned. This is required if the cap or plug was staked in place during previous assembly.

b. If the camshaft (128) is not installed, install in accordance with instructions given in paragraph 6-53.

c. The earlier or shorter design detent assembly (164) may be installed into left (flap) port or, if applicable, into the right (gear) port of the powerpak body, as follows:

1. Insert the detent ball (79) into the detent port.
2. Place an "O" ring (8) on the plunger (77).
3. Insert the plunger and spring (76) into the port.
4. Turn the plug (75) into the port until its top is flush with the top of the port.

d. The later or longer design detent assembly (163) may be installed into the right (gear) port as follows:

1. Place an "O" ring (156) on the plunger detent (155).
2. Insert the detent, spring guide (154) and spring (153) into the port.
3. Place the adjusting cap (152) over the spring and turn the cap into the port.

e. Check and adjust either assembly in accordance with instructions given in paragraph 6-63.

f. After completion of adjustment, lightly stake the body next to the cap or plug to prevent it from turning.

6-55. ASSEMBLY AND INSTALLATION OF THERMAL RELIEF VALVES.

a. Place the "O" ring (74) on the valve seat (73).

b. Insert the valve seat into the powerpak body or valve head (140), whichever applies. The end of the seat with the port countersunk or bored larger is inserted first or toward the powerpak body or base of the head.

c. If applicable, secure the head into the powerpak body.

d. Turn the valve body (68) into the powerpak body or until it bottoms against the seat. Turn by inserting a 0.156 rod through the holes in the body.

e. Insert into the top of the body, in order, the ball (72), lower spring retainer (71), spring (70) and upper retainer (69).

f. Turn the adjusting screw (67) into the top of the valve body (68). Pre-set the valve by turning the cap in until its top is approximately 0.156 of an inch below the top of the body.

g. Check and adjust the valve in accordance with instructions in paragraph 6-62.

h. After completion of adjustment, safety as explained in paragraph 6-57.

6-56. ASSEMBLY AND INSTALLATION OF MAIN RELIEF VALVE. (Refer to Figure 6-20.)

a. The main relief valve (162) for powerpaks with part numbers 750P-1 and 31800-0 may be assembled and installed as follows:

1. With the valve body (25) supported in the upside down position, insert the retainer (36) into the base end of the body. The end of the retainer with the small hole is inserted first.

2. Install an "O" ring (33) on the valve seat (34).

3. Insert the check ball (35) and valve seat into the base end of the body. A countersink has been machined into the port at one end of the seat; this end is installed away from the check ball.

4. Install the plug (32) into the base of the valve, small end first, and using 3/16 Allen wrench, torque to 25 inch pounds. If the plug turns into the base and bottoms with no drag, due to worn camlock inserts, a new plug must be installed.

5. Insert the plunger (31), small diameter end first, into the top of the valve body and ascertain that the end of the plunger positions itself into the retainer (36).

6. Insert the valve spring (30) into the body.

7. Twist the jam nut (29) on the valve adjusting screw (28), and install the screw over the exposed end of the spring and into valve body.

8. Place an "O" ring (26) on the base of the valve.

9. Push the base of the valve into the port provided in the powerpak base and allow to bottom.

10. If the retainer plates (19) can be installed at this time, do so as explained in paragraph 6-57.

11. Check and adjust the valve in accordance with instructions given in paragraph 6-61.

12. After completion of adjustment, safety as explained in paragraph 6-57.

b. The main relief valve (161) for powerpaks with part numbers 31800-2, 31800-2M and 31800-3 may be assembled and installed as follows:

1. Place an "O" ring (144) on the poppet and seat assembly (145).

2. Insert the small end of the square based retainer (142) into the end of the poppet seat opposite the "O" ring.

3. With the valve body (143) supported in an upside down position, install the poppet and seat assembly with retainer into the base of the body. The end of the seat with the "O" ring is inserted first.

4. Place an "O" ring (144) on the end fitting (141).

5. Install the end fitting into the valve body and tighten finger tight. Rotate the body end for end, support, and tighten with an aluminum rod (0.187) inserted through the holes in the valve body until the retainer bottoms against the fitting.

6. Install the ball (146) and guide (148) with spring (147) into the body.

7. Twist the jam nut (149) on the valve adjusting cap (screw) (150) and install the cap over the exposed end of the spring and into the valve body. Pre-set the valve by turning the adjusting cap in until a dimension of approximately 4.165 inches overall is obtained.

8. Place an "O" ring (151) on the end fitting.

9. If an adapter (158) is required with the valve, install it on the valve. Place an "O" ring (157) on the adapter.

10. Install the valve. Valves with an adapter, push the assembly into the port provided in the powerpak base and allow it to bottom. Valves without adapters will require twisting into the base. (On powerpaks with part numbers 31800-2 and 31800-3, it may be necessary to install the valve after the retainer plates have been installed.)

11. If the retainer plates (19) can be installed at this time, do so as explained in paragraph 6-57.

12. Check and adjust the valve in accordance with instructions given in paragraph 6-61.

13. After completion of adjustment, safety as explained in paragraph 6-57.

6-57. INSTALLATION OF RESERVOIR, BAFFLE AND PLATES. (Refer to Figure 6-20.) Before installing retainer plates and baffle, check that the main relief valve (161 or 162), poppet assemblies (167 and 168), and hand pump suction screen assembly (162) are all properly installed.

a. Place the retainer plates (19) in position on the powerpak base (138) and secure with washers (18) and screws (17).

b. If the thermal relief valve heads (140) are drilled to allow for safety wire, safety between the left set and then the right set with MS20995-F32 wire.

c. Complete all checks and adjustments as required. (Refer to Paragraph 6-58.)

d. Install reservoir retaining stud (16) and lock with jam nut (15).

e. Place the lower spacer (14) on the stud.

f. Position the baffle and allow it to rest on the lower spacer.

g. Place the upper spacer (12) on the stud.

h. If holes are provided, safety the thermal relief valves by routing MS20995-F32 wire between the holes in the valve bodies of the left set and then the right set.

i. Safety the main relief valve with MS20995-F32 wire. For the short valve in powerpaks with part numbers 750P-1 and 31800-0, the wire is routed through valve hole and the edge of the baffle, through the provided hole in the valve jam nut (29) and to the valve adjusting screw (28). For the taller valve in powerpaks with part numbers 31800-2, 31800-2M and 31800-3, the wire is routed from the upper spacer (12), to the valve jam nut (149) and then to the adjusting cap (150).

j. Install an "O" ring (5) around the powerpak body.

k. Ascertain that the strainer and fittings are installed, and install reservoir, with fittings forward.

l. Secure the reservoir with "O" ring (3), washer (2) and locknut (1).

6-58. POWERPAK BENCH CHECKS AND ADJUSTMENTS.

6-59. CHECK AND ADJUSTMENT INSTRUCTIONS AND PRECAUTIONS. Before overhaul, to determine faults of the powerpak; to adjust components of the unit; or after completion of overhaul, before installation in the airplane, the powerpak may be bench checked using a minimum of test equipment and the instructions given in the paragraphs that follow. Observe the preliminary instructions and precautions that follow:

a. Use only clean hydraulic fluid (MIL-H-5606).

b. Cap all fittings with high pressure caps.

c. Because of using high pressure during check, determine that caps, where

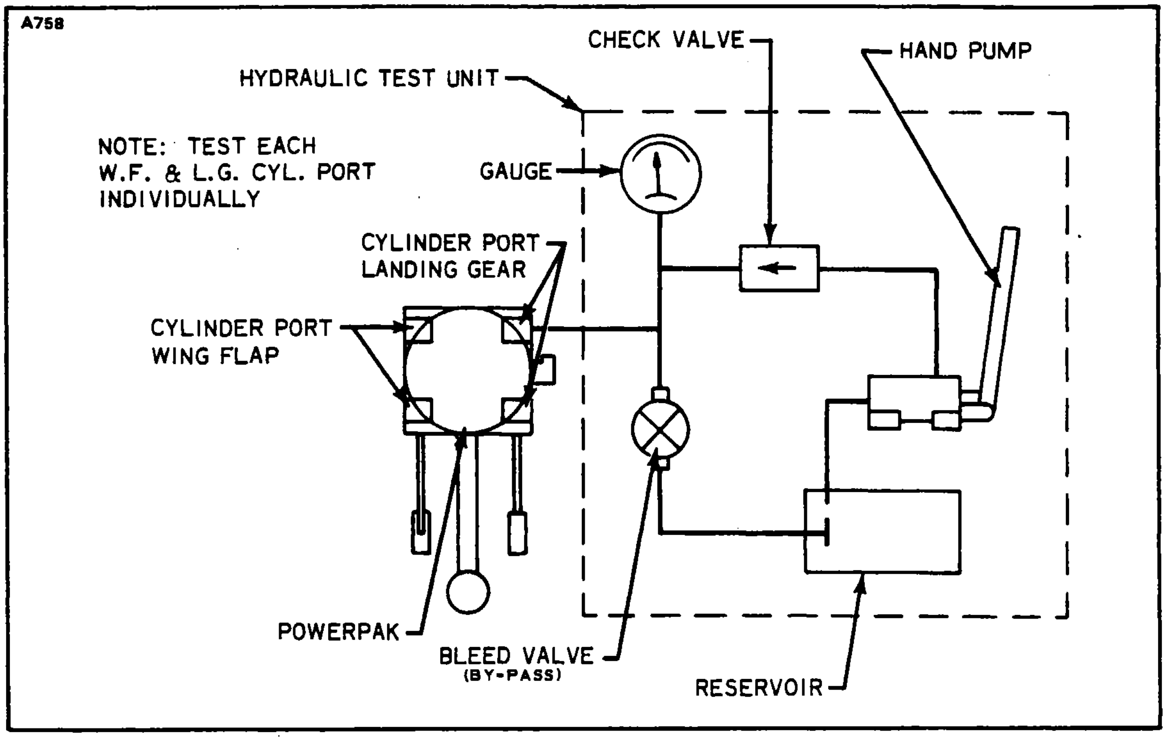


Figure 6-21. Checking and Adjusting Powerpak

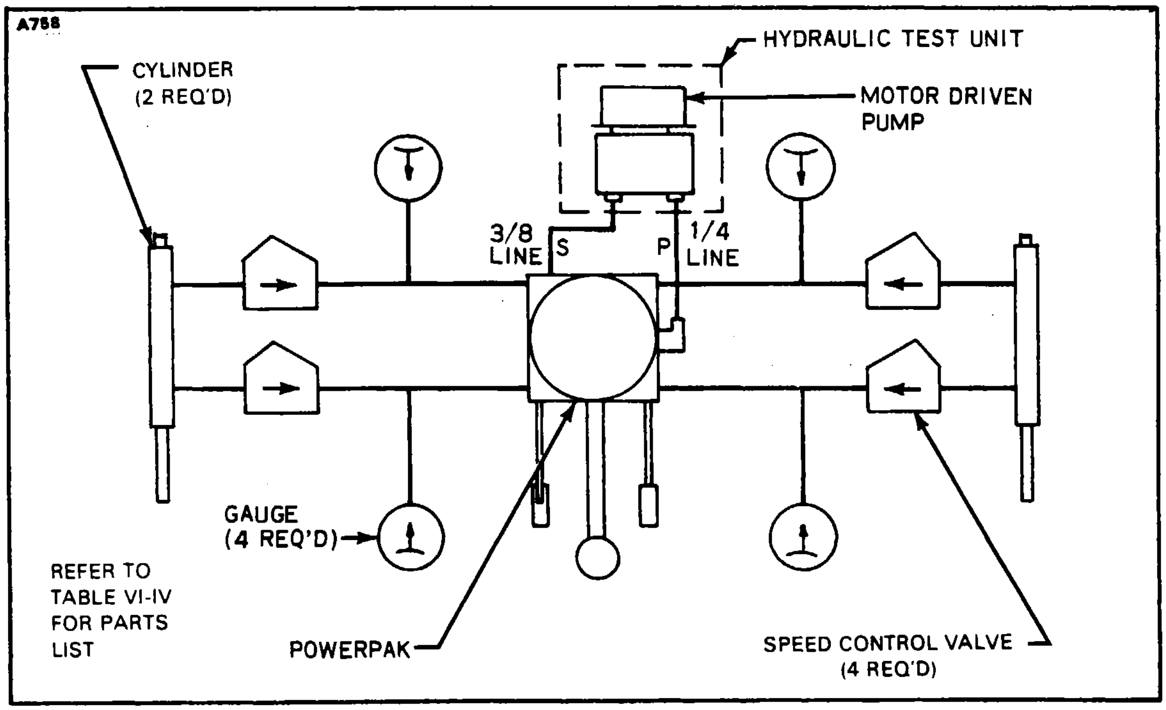


Figure 6-22. Checking Powerpak Operation

required, are secure.

d. Mound the base on a combination work and test stand which may be manufactured from dimensions given in Figure 6-36.

e. Minimum equipment is as follows:

1. Hydraulic test unit as described in paragraphs 6-5 or 6-6 and arranged as shown in Figure 6-21 and 6-22.

2. Tools and test equipment as required in Table VI-IV.

6-60. POWERPAK BLEEDING PROCEDURE. Before conducting any cracking pressure checks and adjustments, the powerpak passages should be free of trapped air and filled with hydraulic fluid. This may be accomplished as follows:

a. Install an open top reservoir.

b. Add hydraulic fluid maintaining level below the top of the powerpak stand pipe.

c. While operating the powerpak hand pump, move the selector levers through each cycle, in sequence, until fluid begins to flow from each pressure port. Provide a container to catch fluid.

d. To check leakage of the poppet assemblies, paragraph 6-64, it will be required to drain the reservoir and wipe the bottom of the reservoir dry.

6-61. CHECK AND ADJUSTMENT OF MAIN RELIEF VALVE. The main relief valve, located in the aft center area of the powerpak, may be pressure checked and adjusted as follows:

a. Connect the pressure line of a hydraulic test unit to the landing gear extension port (C2) fitting at the right forward side of the powerpak. (Refer to Figure 6-21.)

b. Open the hydraulic test unit by-pass valve.

c. Hold the landing gear selector lever full DOWN.

d. Operate the power driven pump or hand pump of the hydraulic test unit and slowly close the by-pass valve.

e. Observe pressure build-up to the point at which the pressure stabilizes on the test unit gauge and fluid begins to ooze from the main relief valve. The required cracking pressure to open the valve for the powerpak being checked will be found in Table VI-II.

f. Should the valve open at a pressure higher or lower than that required, it will be necessary to adjust it by first loosening the jam nut to allow turning of the adjusting plug or cap. To adjust pressure, turn the plug or cap in a clockwise direction to increase pressure or in a counterclockwise direction to decrease pressure.

g. Tighten jam nut and recheck cracking pressure.
h. Again, build up pressure to approximately 100 psi below that required for cracking and note if any fluid seeps from the valve. If so, the valve should be rechecked for a possible leak between the valve and seat or around the seat.

6-62. CHECK AND ADJUSTMENT OF THERMAL RELIEF VALVES. Four thermal relief valves are located in the powerpak, one receiving pressure from each pressure port. Each valve may be checked as follows:
a. Connect the pressure line of a hydraulic test unit to the landing gear extension port (C2) fitting at the right forward side of the powerpak. (Refer to Figure 6-21.)
b. Cap the fittings at the pressure ports not being utilized.
c. Open the hydraulic test unit by-pass valve.
d. Allow the selector levers to remain neutral.
e. Operate the power driven pump or hand pump of the hydraulic test unit and slowly close the by-pass valve.
f. Observe pressure build-up to the point at which the pressure stabilizes on the test unit gauge and fluid begins to ooze from the valve. The cracking pressure required to open the valve will be found in Table VI-II.
g. Should the valve open at a pressure higher or lower than that required, it will be necessary to adjust it by turning adjusting screw in the valve body. To adjust pressure, turn the screw in a clockwise direction to increase pressure or in a counterclockwsie direction to decrease pressure.
h. After adjustment, recheck cracking pressure.
i. Again, build up pressure to approximately 100 psi below that required for cracking and note if any fluid seeps from the valve. If so, the valve should be rechecked for a possible leak between the check ball and seat or around the seat.
j. To check the remaining thermal relief valves, connect the pressure line to the fittings at ports C1, C3 and C4 and check by following steps b thru i for each valve.

6-63. CHECK AND ADJUSTMENT OF CAMSHAFT RELEASE DETENT ASSEMBLIES. The camshaft release detents, installed diagonally into the center of the powerpak body, may be checked and adjusted as follows:
a. The flap detent assembly may be adjusted as follows:
1. Should the landing gear detent assembly be that of the later type, with the adjusting cap extending above the surface of the powerpak body, as depicted by callout 165 in Figure 6-20, it will be required that the cap, spring and spring guide be removed and a plug (75, P/N 31904-00) be installed in the port to prevent loss of pressure. This step is not necessary if the detent assembly is of the

early or short type.

2. Connect the pressure line of a hydraulic test unit to the flap retraction port (C4) fitting at the left rear side of the powerpak.

3. Cap the fittings at the pressure ports not being utilized.

4. Open the test unit by-pass valve.

5. Select flap UP, operate the power driven pump or hand pump of the hydraulic test unit and slowly close the by-pass valve.

6. Observe pressure build-up and note the pressure at which the selector lever returns to neutral. The detent release pressure for the flap with powerpak model may be found in Table VI-II.

7. Should the lever return to neutral at a pressure higher or lower than that required, it will be necessary to adjust by turning the adjusting plug. To adjust release of the detent, turn the plug in a clockwise direction to increase release pressure or counterclockwise to decrease pressure.

8. After adjustment, re-cycle and recheck release pressure.

9. Reconnect the pressure line to the flap extension port (C3) fitting and cap the fitting from where the line was removed.

10. Open the test unit by-pass valve.

11. Select flap DOWN, operate the power driven pump or hand pump and slowly close the by-pass valve.

12. Observe pressure build-up and note the pressure at which the selector lever returns to neutral.

13. Should the lever return to neutral at a pressure higher or lower than that required, it will be necessary to adjust the plug slightly to bring both release pressures within tolerance.

14. Again re-cycle and check release pressure.

15. If a plug was temporarily installed in the landing gear detent port, remove and reinstall the spring guide, spring and cap. (Refer to paragraph 6-54.)

b. The landing gear detent assembly, whether it be the early (short) type or the later (long) type, may be checked and adjusted as follows:

1. Connect the pressure line of the test unit to the landing gear retraction port (C1) fitting at the right rear side of the powerpak.

2. Cap the fittings at the pressure ports not being utilized.

3. Open the test unit by-pass valve.

4. Select landing gear UP, operate the power driven pump or hand pump of the hydraulic test unit and slowly close the by-pass valve.

5. Observe pressure build-up and note the pressure at which the selector lever returns to neutral. The detent release pressure for the landing gear with powerpak model may be found in Table VI-II.

6. Should the lever return to neutral at a pressure higher or lower than that required, it will be necessary to adjust by turning the adjusting plug or cap. To adjust release of the detent, turn the plug or cap in a clockwise direction to increase release pressure or counterclockwise to decrease pressure.

7. After adjustment, re-cycle and recheck release pressure.

8. Reconnect the pressure line to the landing gear extension port (C2) fitting and cap the fitting from where the line was removed.

9. Open the test unit by-pass valve.

10. Select landing gear DOWN, operate the power driven pump or hand pump and slowly close the by-pass valve.

11. Observe pressure build-up and note the pressure at which the selector lever returns to neutral.

12. Should the lever return to neutral at a pressure higher or lower than that required, it will be necessary to adjust the plug or cap slightly to bring both release pressures within tolerance.

13. Again re-cycle and check release pressure.

c. Upon completion of the adjustment of the flap and landing gear detents, lightly stake the body next to the threads of the plug or cap to prevent them from turning out of adjustment.

6-64. CHECK OF POPPETS FOR LEAKAGE. The check procedure for the poppet assemblies to determine if any leakage occurs between a poppet and seat may be conducted by grouping each return and pressure assembly with a port in the powerpak, thus dividing this check into four individual checks. The open center poppet assemblies are checked separately. These checks may be conducted as follows:

a. The cylinder return and pressure poppets may be checked as follows:

1. Connect the pressure line of a hydraulic test unit to the landing gear retraction port (C1) fitting at the right rear side of the powerpak.

2. Cap the fittings at the ports not being utilized.

3. Open the hydraulic test unit by-pass valve.

4. Allow the selector lever to remain neutral.

5. Operate the power driven pump or hand pump of the hydraulic test unit and slowly close the by-pass valve.

6. Increase pressure to approximately 1200 psi for powerpaks with part numbers 750P-1 and 31800-0 or 1300 psi for powerpaks with part numbers 31800-2, 31800-2M and 31800-3. Hold pressure at this requirement.

7. To check a return poppet assembly (that assembly closest to the port being pressurized) for leakage, observe the area around the return hole in the

retainer plate for any evidence of fluid leakage. Should fluid seepage be evident, the return poppet seat sub-assembly should be inspected and replaced as necessary.

8. To check a pressure poppet assembly (that assembly adjacent to the port being pressurized) for leakage, observe the area around the hole in the top of the detent assembly for any evidence of fluid leakage. Due to the area to fill between the poppet and detent, fluid may not appear for a few minutes after pressure has been applied. Should fluid seepage be evident, the pressure poppet-seat sub-assembly should be inspected and replaced as necessary.

9. To check the remaining return and pressure poppet assemblies for leakage, connect the pressure line to the fitting at ports C2, C3 and C4 and check by following steps b thru h for each set.

b. The landing gear and flap center poppet assemblies may be checked as follows:

1. Connect the pressure line of a hydraulic test unit to the engine driven pump pressure port (system check valve) at the right side of the powerpak. (The airplane's hand pump can also be used for this check.)

2. Cap the fitting at all pressure ports, C1 thru C4.

3. Open the hydraulic test unit by-pass valve.

4. Move the landing gear selector lever to the DOWN position. (This will allow the landing gear center poppet assembly to be checked.)

5. Operate the power driven pump or hand pump of the hydraulic test unit (or powerpak hand pump) and slowly close the by-pass valve.

6. Increase pressure to approximately 1200 psi for powerpaks with part numbers 750P-1 and 31800-0 or 1300 psi for powerpaks with part numbers 31800-2, 31800-2M and 31800-3. Hold pressure at this requirement.

7. To check the landing gear center poppet assembly, observe the area around the hole in the top of the detent assembly for any evidence of fluid leakage. Should fluid seepage be evident, the landing gear center poppet-seat sub-assembly should be inspected and replaced as required.

8. Move the landing gear selector lever to neutral and the flap lever to the DOWN position.

9. To check the flap center poppet assembly, again observe the area around the hole in the top of the detent assembly for any evidence of fluid leakage. Should fluid seepage be evident, the flap center poppet-seat sub-assembly should be inspected and replaced as required.

6-65. CHECK OF HAND PUMP.

a. Connect a pressure gauge to the landing gear extension port (C2) fitting at the right forward side of the powerpak.

b. Select landing gear DOWN with the selector lever.

c. Operate the powerpak hand pump and observe the pressure reading. The gauge should show a steady increase in pressure during both the up and down stroke.

d. As the gauge reaches approximately 1000 psi, stop the handle operation at mid-stroke; the handle should remain steady. If the handle moves up from the stopped position, the hand pump piston valve is leaking. If the handle moves down, the hand pump suction valve in the powerpak is leaking.

e. Disconnect the pressure gauge and at the fitting from where the gauge was attached, connect a line to a pint (one U.S. pint) container.

f. With gear selector lever down, operate the hand pump and allow fluid to flow into the container. It should not take more than 40 cycles of the handle, both up and down, to fill the pint container.

6-66. FINAL CHECK OF POWERPAK.

a. Ascertain that the powerpak is completely assembled.

b. Mount the powerpak on the test stand.

c. Using a test unit of the type described in paragraph 6-5 or 6-6, connect the pressure line of the unit to the inlet fitting of the main relief valve and the suction line to the suction port of the powerpak.

d. Connect a hose from the powerpak vent to the vent fitting or reservoir of the test unit.

e. Cap the filler fitting on the forward side of the reservoir.

f. Connect the pressure gauges, speed control valves and actuating cylinders called for in Table VI-IV to the pressure ports of the powerpak as shown in Figure 6-22.

g. Operate the test unit and fill the powerpak reservoir.

h. With the test unit operating, operate the landing gear and flap selector levers UP and DOWN through a minimum of five cycles to remove any air from the circuit.

i. During the operation in step h, adjust all speed control valves to provide 300 to 400 psi back pressure.

j. The main relief valve cracking pressure may be checked as follows:

1. Open the test unit by-pass valve.
2. Hold the landing gear selector lever full DOWN.
3. Operate the power driven pump or hand pump of the hydraulic test unit and slowly close the by-pass valve.

4. Observe pressure build-up to the point at which the pressure stabilizes on the pressure gauge of the test unit. Stabilization indicates the valve has begun to open. The required pressure will be found in Table VI-II.

5. Should the valve not open at the required pressure, check and adjust the valve in accordance with instructions in paragraph 6-61.

k. The pressures at which landing gear and flap selector levers return to neutral may be checked as follows:

1. Open the test unit by-pass valve.
2. Select landing gear DOWN.
3. Operate the power driven pump or hand pump and close the by-pass valve.
4. Observe the pressure at which the lever returns to neutral. The required pressure will be found in Table VI-II.
5. Repeat the above steps for landing gear up, flap down and flap up.
6. Should either lever not return to neutral at their required pressure, check and adjust the camshaft detent release assemblies in accordance with instructions in paragraph 6-63.

l. During the checks in step k, upon return to neutral of the landing gear and flap selector levers, a minimum of 500 psi should be trapped and maintained between the powerpak and actuating cylinders. A loss in pressure indicates a leak in one or more poppet valves. Check poppets in accordance with instructions in paragraph 6-64.

m. Operate the powerpak hand pump and select gear DOWN. When pressure builds up to 1000 psi, stop the handle at mid-stroke; the handle should not creep up or down. Creeping of the handle indicates an internal leak in the pump and should be further checked as found in paragraph 6-65.

n. Disconnect the lines from the pressure ports of the powerpak.

o. The thermal relief valves may be checked as follows:

1. Connect the pressure line of the hydraulic test unit to the landing gear extension port (C2) fitting as shown in Figure 6-22.
2. Cap the fittings at the pressure ports not being utilized.
3. Open the test unit by-pass valve.
4. Allow the selector unit to remain neutral.
5. Operate the test unit and slowly close the by-pass valve.
6. Observe pressure build-up to the point at which the pressure stabilizes on the test unit pressure gauge. Stabilization indicates the valve adjacent to the port has begun to open. The required pressure will be found in Table VI-II.
7. To check the remaining valves, connect the pressure line to the fittings at ports C1, C3 and C4 and repeat steps 2 thru 6 for each valve.
8. Valves not opening at the required pressure should be further checked and adjusted as given in paragraph 6-62.

p. Check the powerpak reservoir for leakage per instructions given in paragraph 6-67.

q. Disconnect lines and remove powerpak from test stand.

6-67. TESTING RESERVOIR FOR LEAKAGE.

a. Cap the powerpak suction port.

b. Fill the powerpak reservoir with hydraulic fluid.

c. Attach an air valve to either the reservoir overflow fitting or filler fitting. Cap the fitting not being utilized.

d. Apply 1 psig of air for 12 hours. At the end of the 12 hour period, check for external leaks.

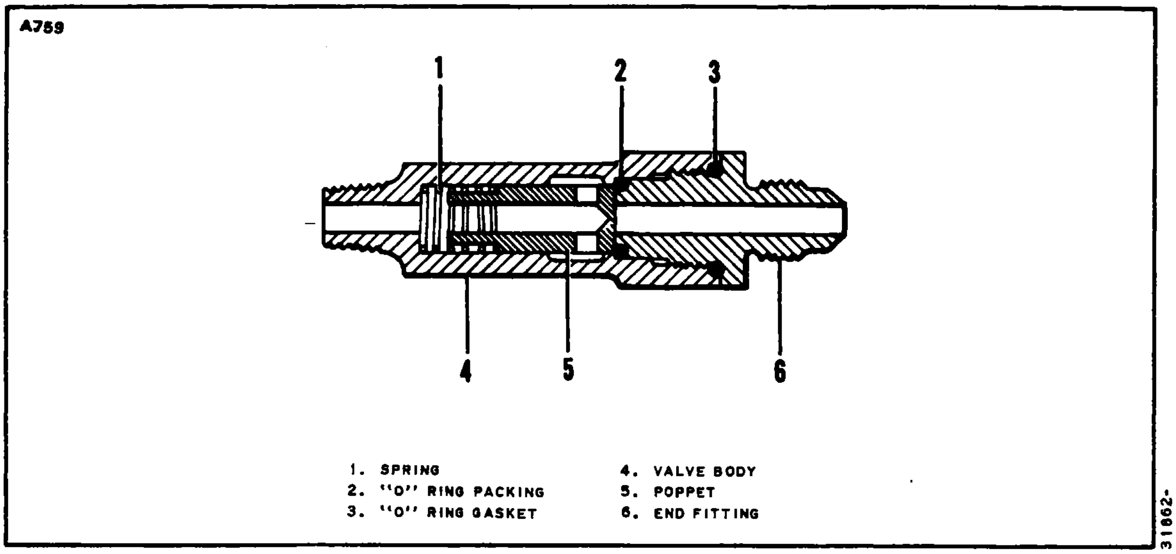


Figure 6-23. Hydraulic System Check Valve

6-68. SYSTEM CHECK VALVE.

6-69. REMOVAL OF CHECK VALVE.

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Drain the hydraulic powerpak by disconnecting the hydraulic extension line at the nose gear actuating cylinder and placing the end of the line in a suitable container. Move the landing gear selector to the DOWN position and operate the hand pump until the system is empty.

c. Remove the access plate from the right side of the pedestal.

d. Disconnect the fitting from the forward end of the valve.

e. Remove the valve from the side of the powerpak.

6-70. CLEANING, INSPECTION AND OVERHAUL OF CHECK VALVE. (Refer to Figure 6-23.)

NOTE

The following procedure covers only valves with part number 31862-00 as shown in Figure 6-23. Valves with no part number on them should be replaced with the new type valve.

a. Cut the safety wire and remove the end fitting (6) from the end of the valve.
b. Remove the poppet (5) and spring (1) from inside the valve body (4).
c. Inspect the valve and valve parts for nicks, scratches and broken or cut "O" rings.
d. Overhaul of the valve is limited to polishing out small nicks or scratches and replacement of "O" rings.
e. Install the spring (1) into the valve body (4).
f. Install the poppet (5) into the valve body by inserting the open end of the poppet first.
g. Install the end fitting (6) with new "O" rings (2 and 3).
h. Safety the end fitting to the valve body with MS20995-NC32 safety wire.

6-71. TESTING CHECK VALVE.

a. Connect the pressure line of a hydraulic test unit to the discharge end of the check valve. (Fittings, AN816 nipple and AN910 coupling may be used to make this connection.)
b. Open the test unit by-pass valve.
c. Operate the test unit and slowly close the by-pass valve.
d. Apply 2000 psi maximum pressure to the valve and ascertain that there is no leakage from the open end.

6-72. INSTALLATION OF CHECK VALVE.

a. Install the check valve to the side of the powerpak.
b. Connect the hydraulic line to the forward end of the valve.
c. Fill the powerpak and cycle the landing gear and flaps several times. (Refer to Filling Powerpak, Section II.)
d. Ascertain that the check valve is not leaking and install the access plate to the right side of the nacelle.
e. Remove the airplane from jacks.

6-73. ANTI-RETRACTION VALVE.

6-74. REMOVAL OF ANTI-RETRACTION VALVE.

a. Place the airplane on jacks. (Refer to Jacking, Section II.)
b. Place a drip pan under the landing gear to catch hydraulic fluid spillage.
c. Move the landing gear selector lever in the cabin to the up position, down position, and to neutral to relieve the pressure in the system.

d. Disconnect the hydraulic lines from the valve. Mark lines to facilitate reinstallation.

e. Remove the barrel nut on the top of the valve arm rod.

f. Disconnect the valve arm return spring from the valve arm.

g. Remove the valve by removing the self-locking nuts, washers and bolts securing it in place.

NOTE

Be careful that the valve arm does not come out of the valve body.

6-75. DISASSEMBLY OF ANTI-RETRACTION VALVE. (Refer to Figure 6-24.)

a. Holding the valve with the end plug (1) up, remove the plug, being careful not to drop the valve spring (2).

b. Remove the valve spring and poppet assembly (3 thru 8) from the valve body (10).

c. Remove the valve arm (13) with the cam (12) attached from the valve body.

d. Remove the line fittings (6 and 9) from the valve body.

6-76. CLEANING, INSPECTION AND REPAIR OF ANTI-RETRACTION VALVE. (Refer to Figure 6-24.)

a. Clean the valve parts with a suitable solvent and dry thoroughly.

b. Inspect the following parts of the valve for defects:

1. Inspect the cam for corrosion, burrs, scratches and excess wear specifically in the areas where the valve rides on the cam, where the attaching bolt extends through the slot in the cam, and the surfaces between the cam and valve body. Check the handle for security of mounting.

2. Inspect the poppet assembly for corrosion, burrs, scratches and excess wear specifically in the areas where the valve contacts the seat and the surfaces between the valve poppet and valve seat.

3. Inspect the line fittings in the threaded area for crossed threads and corrosion.

c. Repairs to the valve are limited to polishing out small scratches and replacing "O" rings.

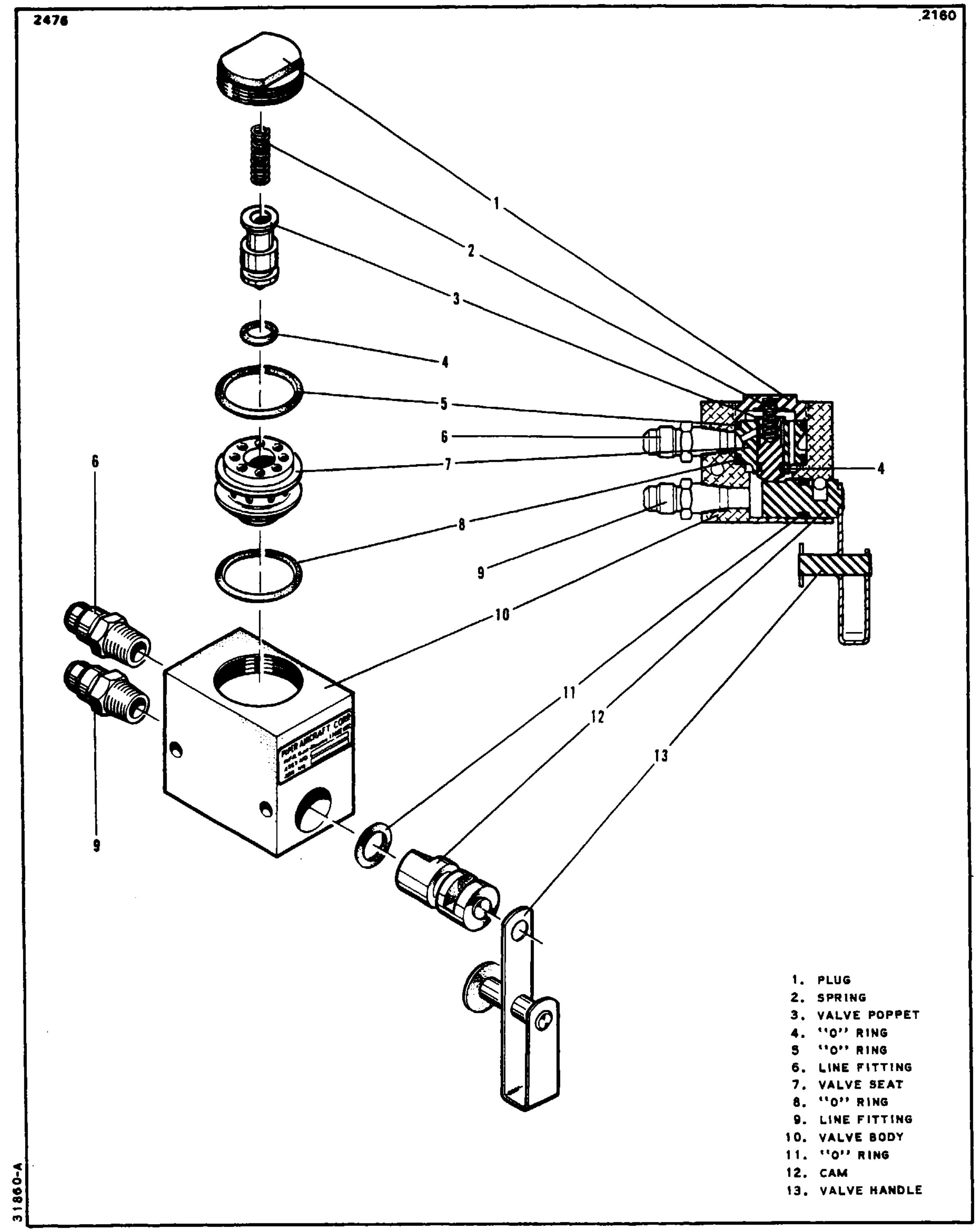


Figure 6-24. Anti-Retraction Valve

6-77. ASSEMBLY OF ANTI-RETRACTION VALVE. (Refer to Figure 6-24.)

a. Install the line fittings (6 and 9) to the valve body (10) being careful not to strip the threads.

b. Lubricate with hydraulic fluid (MIL-H-5606), and install new "O" rings on the cam (12), valve poppet (3) and seat (7).

c. Insert the cam into the valve body.

d. Assemble the valve and seat, and insert the unit into the end of the valve body.

e. Install the valve spring (2) in the hole in the top of the valve.

f. Install the plug into the valve and torque to 20 foot-pounds.

6-78. TESTING ANTI-RETRACTION VALVE.

a. Connect the pressure line of a hydraulic test unit to the port of the valve marked "P".

b. Ascertain that the valve is closed.

c. Open the test unit by-pass valve.

d. Operate the test unit and slowly close the by-pass valve.

e. Apply 1500 psi maximum hydraulic pressure to the valve and ascertain that fluid does not appear at the open end marked "R".

f. Cap the fitting at the port marked "R", open the valve and ascertain that fluid does not appear around the cam or from the attaching hole in the valve body.

6-79. INSTALLATION OF ANTI-RETRACTION VALVE.

a. Position the valve on the landing gear and install two AN3-16A bolts with washers down through the valve and secure with washers and self-locking nuts.

b. Connect the hydraulic lines to the valve, the outboard line is pressure "P" and the inboard line is return "R".

c. Connect the arm return spring to the valve arm.

d. Install the barrel nut to the top of the valve arm rod and adjust per instructions in paragraph 6-80.

e. Fill the powerpak and cycle the landing gear several times to bleed the air out of the system. (Refer to Filling Powerpak, Section II.)

NOTE

When cycling the gear, allow the landing gear selector handle to return to neutral automatically

f. Check the anti-retraction valve to determine that there is no evidence of hydraulic fluid leakage.

g. Remove the airplane from the jacks.

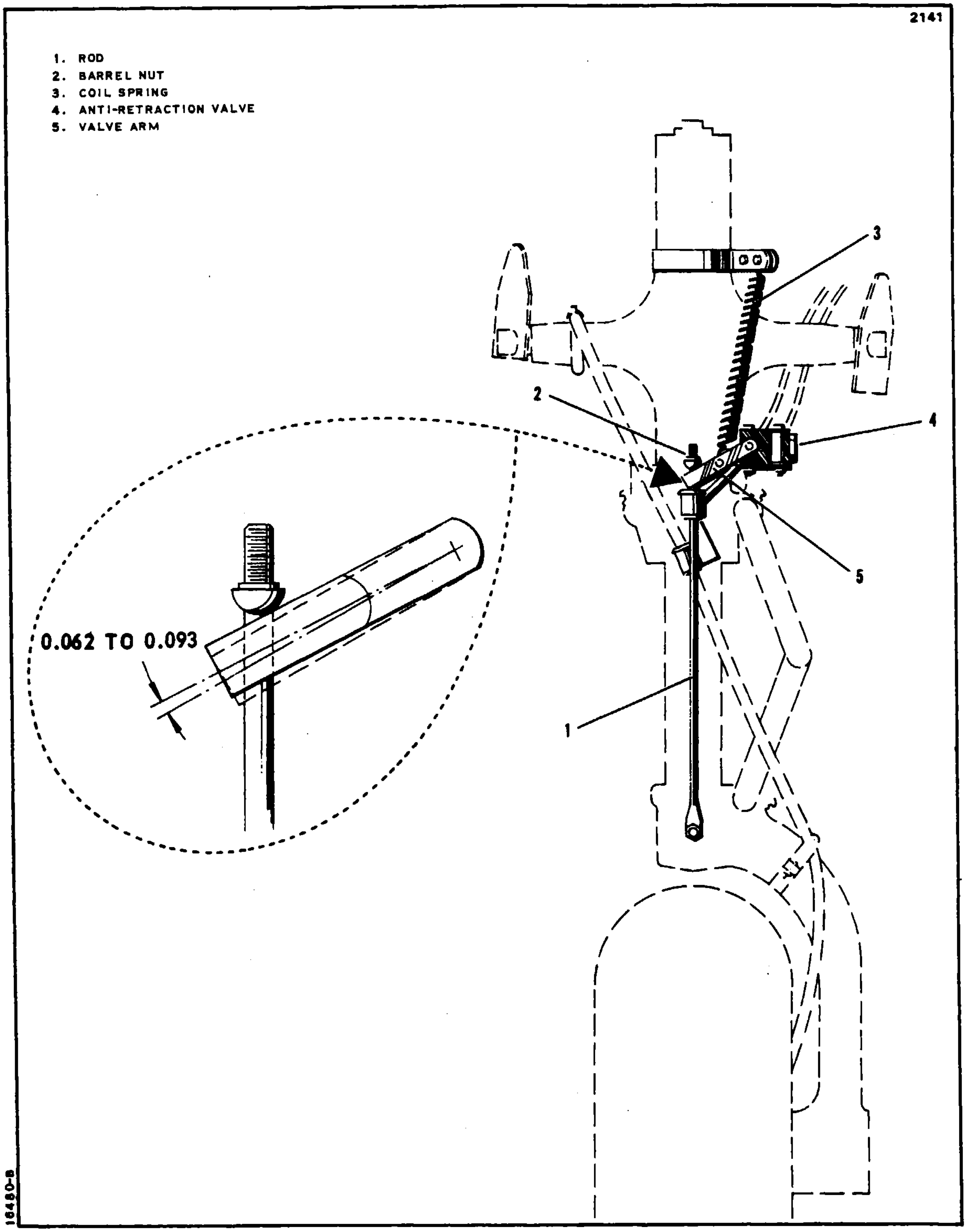


Figure 6-25. Adjustment of Anti-Retraction Valve

6-80. ADJUSTMENT OF LANDING GEAR ANTI-RETRACTION VALVE. (Refer to Figure 6-25.) The landing gear anti-retraction valve, located on the left main gear strut housing, restricts hydraulic fluid pressure from building up in the retraction system until the landing gear strut is fully extended.

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. With the landing gear strut piston in the fully extended position, hold the valve arm in the full down position.

c. Adjust the barrel nut on top of the actuating rod to allow 0.062 to 0.093 of an inch as measured at the end of the valve arm.

6-81. SHUTTLE VALVES.

6-82. REMOVAL OF SHUTTLE VALVES. (Refer to Figure 6-2 or 6-4.)

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Operate the landing gear selector lever to the up position, down position and to neutral to relieve any pressure in the lines.

c. The nose landing gear shuttle valve may be removed by the following procedure:

1. Remove the access panel(s) from the right side of the nose section by turning the quarter turn fasteners and/or attaching screws.
2. Disconnect the hydraulic line and CO2 line from the shuttle valve inside the cabin section, just aft of the forward bulkhead.
3. Disconnect the hydraulic line(s) from the forward side of the shuttle valve inside the nose section just forward of the forward cabin bulkhead.
4. On PA-23-250 (six place) airplanes, Serial Nos. 27-2505 and up, remove the tee fitting installed in the forward end of the valve.
5. Remove the retaining nut securing the valve to the forward cabin bulkhead and remove the valve.

d. The right or left main landing gear shuttle valves may be removed by the following procedure:

1. Remove the top center section of the engine nacelle by removing attaching screws.
2. Disconnect the hydraulic line(s) from the top side of the shuttle valve.
3. Disconnect the hydraulic line and the CO2 line from the valve.
4. Remove the retaining nut securing the valve to the mounting plate inside the nacelle center section and remove the valve.

6-83. CLEANING, INSPECTION AND OVERHAUL OF SHUTTLE VALVE. (Refer to Figure 6-26.)

NOTE

The following procedure covers only valves with part number 32803-00. Valves with part numbers 492 047 and 31424-00 should be replaced if found defective.

a. For I.B.C. Products Inc. shuttle valves refer to the following:

1. Remove the end fitting (4) from the end of the valve marked "MAIN".
2. Remove the piston (6) by pushing from the end of the valve marked "EMG".
3. Inspect the valve and valve parts for nicks, scratches and broken or cut "O" rings.

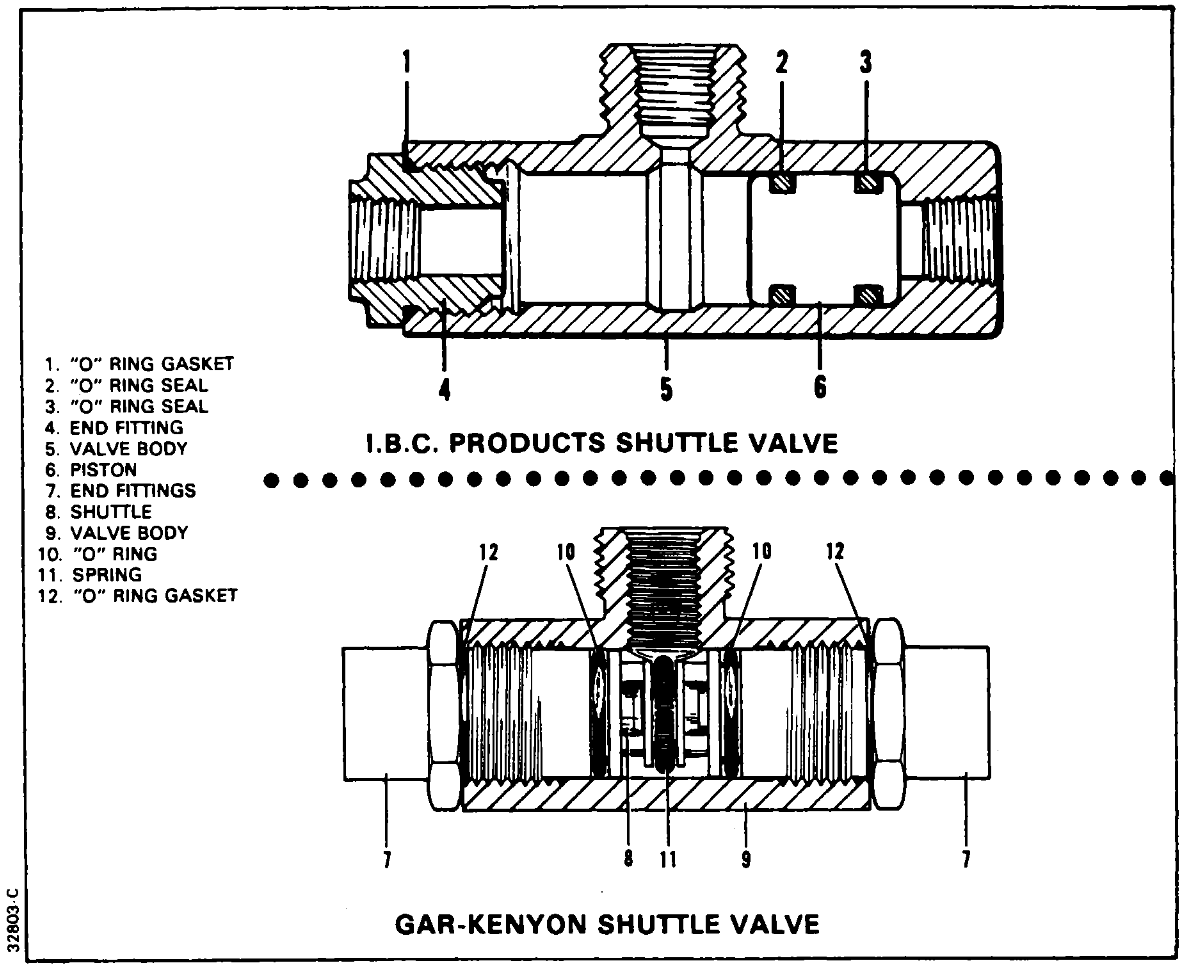


Figure 6-26. Shuttle Valve

4. Overhaul of the valve is limited to replacement of "O" rings and polishing out small nicks and scratches.
5. Lubricate with hydraulic fluid (MIL-H-5606) and install the piston (6) with new "O" rings into the open end of the valve.
6. Install the end fitting (4) with a new "O" ring (1) to the valve.

b. For Gar-Kenyon shuttle valves refer to the following:
1. Remove the end fittings (7).
2. Remove the shuttle (8) from the valve body (9).
3. Inspect the valve and components for nicks, scratches and broken or cut "O" rings.
4. Overhaul of the valve is limited to replacement of "O" rings and polishing out small nicks and scratches.
5. Lubricate end fittings (7) with hydraulic fluid (MIL-H-5606) and install new "O" rings (10 and (12).
6. Position spring (11) on shuttle to close the "EMG" port.
7. Install end fitting (7) and shuttle (8) as noted in Figure 6-26.

6-84. TESTING SHUTTLE VALVE.

a. Connect the pressure line of a hydraulic test unit to the end of the valve marked "MAIN."

b. Plug the outlet port of the valve.

c. Open the test unit by-pass valve.

d. Operate the test unit and slowly close the by-pass valve.

e. Apply 2000 psi maximum hydraulic pressure and ascertain that the valve does not leak fluid from the "EMG" port of the valve.

6-85. INSTALLATION OF SHUTTLE VALVES. (Refer to Figure 6-2 or 6-4.)

a. Install the nose landing gear shuttle valve by the following procedure:

1. Position the valve to the forward cabin bulkhead with the body of the valve on the aft side of the bulkhead and secure the assembly with the retaining unit.

2. On PA-23-250 (six place), Serial Nos. 27-2505 and up, install the tee fitting port of the valve on the forward side of the bulkhead.

3. Connect the hydraulic line(s) to the forward side of valve or the tee fitting.

4. Connect the hydraulic line to the side of the valve stamped "MAIN" and the CO2 line to the side stamped "EMG."

b. Install the right or left main landing gear shuttle valve by the following procedure:

1. Position the valve inside the top center section of the nacelle with the body of the valve below the mounting plate. Secure the valve with the retaining nut.

2. Connect the hydraulic line to the side of the valve stamped "MAIN" and the CO2 line to the side stamped "EMG."

3. On PA-23-250 (six place), Serial Nos. 27-2505 and up, install the tee fitting to the remaining open port of the valve.

4. Connect the hydraulic line(s) to the shuttle valve or the tee fitting.

c. Install the access panels as required.

d. Fill the hydraulic system to replace any hydraulic fluid spillage (refer to Filling Powerpak, Section II), and cycle the landing gear to check for leaks and remove any air trapped in the system.

e. Remove the airplane from jacks.

6-86. ACTUATING CYLINDERS.

6-87. VISUAL CHECKS OF ACTUATING CYLINDERS. Actuating cylinders may leak externally at either elbow or at the seal. A coating of oil between the upper and lower elbows indicates leakage of the top elbow, whereas a coating of oil immediately under the bottom elbow only indicates leakage of the bottom elbow. If the bottom of the cylinder is coated with oil, the seal is leaking.

CAUTION

If one or more of the landing gear actuating cylinders are damaged, be sure the airplane is on jacks before attempting any repairs. This is not necessary if the wing flap cylinder is to be repaired or replaced. Be sure both selector levers are in the neutral position before disconnecting a hydraulic line from a fitting.

a. If either elbow fitting is leaking, do not remove the actuating cylinder from the airplane. Remove the appropriate line and take out the fitting. If the leakage is through the threads, apply a suitable sealing compound to the threads of the fitting and install the fitting. If the fitting is damaged, replace with a new one and reconnect the hydraulic line.

b. If a seal is leaking, remove the actuating cylinder by instructions in the following paragraphs.

6-88. GEAR AND FLAP ACTUATING CYLINDERS.

6-89. REMOVAL OF NOSE GEAR ACTUATING CYLINDER.

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Remove the access panels from both sides of the nose section. (Refer to Access and Inspection Provisions, Section II.)

c. Disconnect the hydraulic lines from the actuating cylinder and cover the open line ends to prevent contamination.

d. Remove the cotter pin, nut, washers and bolt securing the top end of the hydraulic cylinder to the fuselage frame.

e. Remove the cotter pin, nut, washers and bolt securing the actuating rod end bearing to the drag link assembly.

f. Remove the cylinder from the wheel well..

6-90. REMOVAL OF MAIN GEAR ACTUATING CYLINDERS.

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Remove the access panel from the top center section of the nacelle. (Refer to Access and Inspection Provisions, Section II.)

c. Disconnect the hydraulic lines from the actuating cylinder and cover the open line ends to prevent contamination.

d. Remove the cotter pin, nut, washers and bolt securing the actuating rod end bearing to the drag link assembly.

e. Remove the cotter pin, nut, washers and bolt securing the top end of the hydraulic cylinder.

f. Remove the cylinder from the wheel well by removing the black plastic tape around the cylinder and rubber boot and drawing the cylinder through the boot.

6-91. REMOVAL OF FLAP ACTUATING CYLINDER.

a. Remove the center seats from the airplane.

b. Remove the trim panels from right side of the cabin just aft of the cabin entrance door by removing attaching screws.

c. Place the flap selector to the up position, to the down position, and then to neutral to relieve any pressure in the hydraulic lines.

d. Disconnect the hydraulic lines from the flap cylinder. Cap the open line fittings to prevent contamination.

e. Disconnect the cylinder piston rod end bearing from the flap bellcrank by removing the self-locking nut, washer and bolt.

f. Remove the cylinder from airplane by removing the cotter pin, nut, washer and bolt securing the cylinder end fitting to the fuselage frame fitting.

6-92. DISASSEMBLY OF GEAR AND FLAP ACTUATING CYLINDERS. (Refer to Figures 6-27 or 6-28.)

a. With the cylinder removed from the airplane, on early cylinders cut the safety wire (1) and remove the two plugs (2) from the side of the cylinder body (10).

b. On early cylinders draw the piston assembly (8) and cylinder end (6) from the cylinder body (10). On later cylinders, unscrew cylinder end (6) from cylinder body (10).

c. If necessary, the piston assembly (8) may be separated from the cylinder end (6) by loosening the jam nut (4) and unscrewing the rod end (3) from the piston assembly.

d. For the flap actuating cylinder (refer to Figure 6-23), it may be necessary to remove the tube (12), jam nut (13) and bushing (14) from the piston assembly (8).

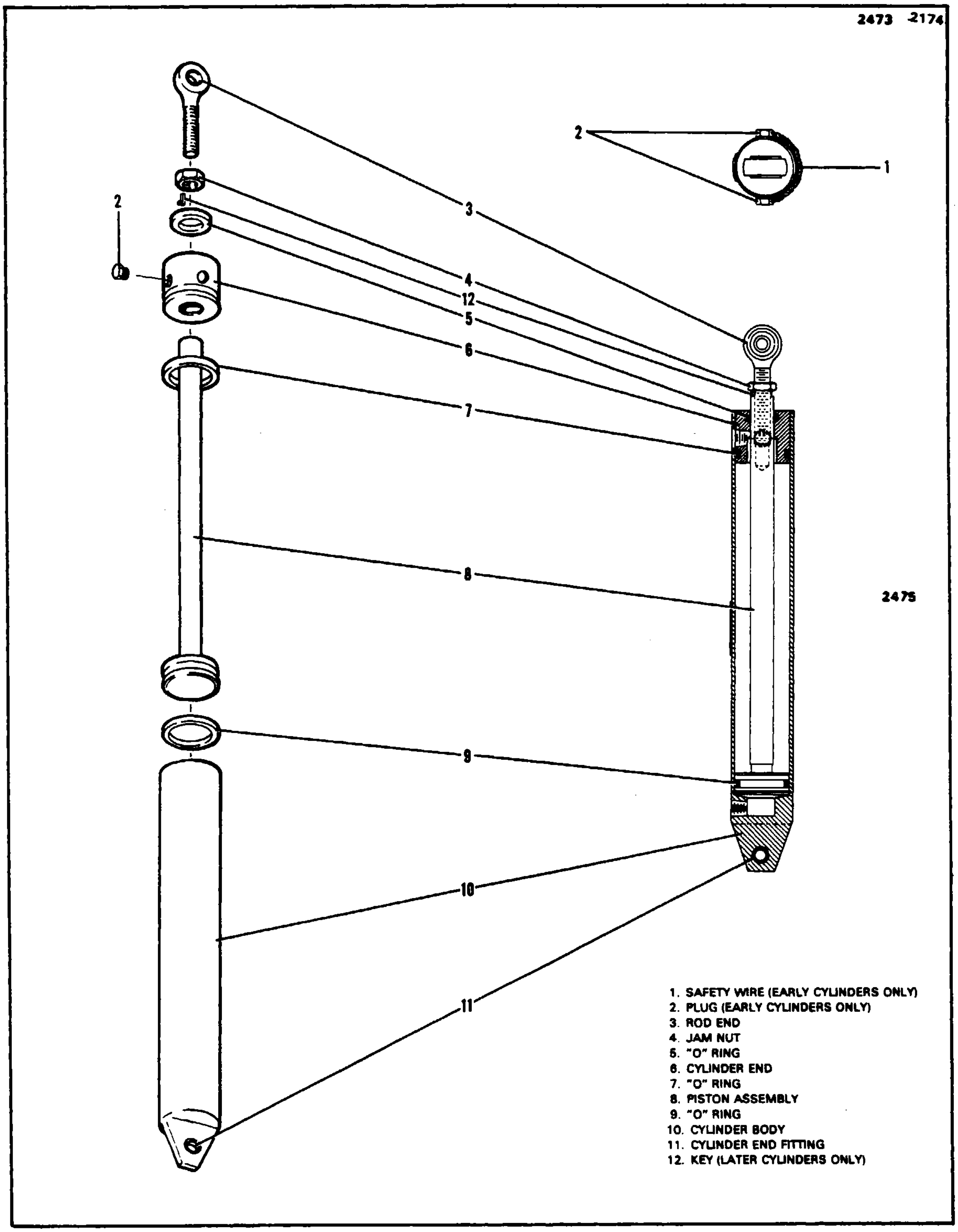


Figure 6-27. Nose and Main Landing Gear Actuating Cylinder

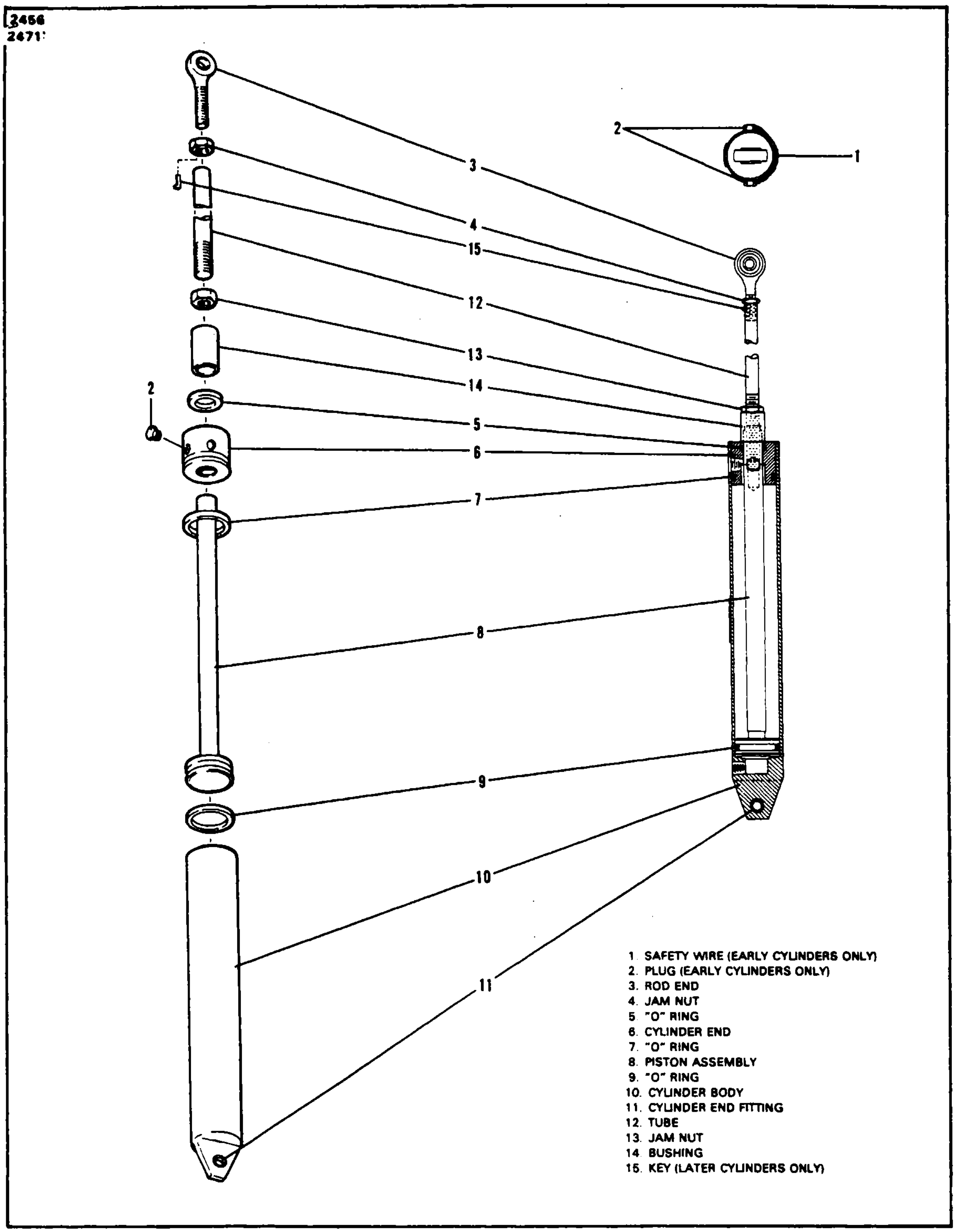


Figure 6-28. Flap Actuating Cylinder

6-93. CLEANING, INSPECTION AND REPAIR OF GEAR AND FLAP ACTUATING CYLINDER.

a. Clean the cylinder parts with a suitable solvent and dry thoroughly.

b. Inspect the cylinder interior walls and piston exterior surfaces for scratches, burrs, corrosion, etc.

c. Inspect threaded areas for damage.

d. Inspect the rod end fitting for wear and corrosion.

e. Repairs to the cylinder are limited to polishing out small scratches, burrs, and replacing parts.

6-94. ASSEMBLY OF GEAR AND FLAP ACTUATING CYLINDERS. (Refer to Figure 6-27 or 6-28.)

a. Install an "O" ring (9) on the piston (8).

b. Install "O" rings (5 and 7) on the interior and exterior of the cylinder end (6). The exterior "O" ring on later cylinders has an "O" ring back up which must be installed along with the "O" ring.

c. Lubricate the piston assembly (8), interior of the cylinder body (10) and the cylinder end (6) with hydraulic fluid (MIL-H-5606).

d. Slide the cylinder end (6) onto the piston assembly (8).

e. Slide the piston assembly (8) and cylinder end (6) into the cylinder body (10). Later cylinders require the cylinder end (6) to be screwed into the cylinder body (10).

f. On early cylinders install the two plugs (2) to the side of the cylinder and safety with MS20995-C41 wire.

g. For the flap actuating cylinder (refer to Figure 6-28), install the tube (12) into the piston assembly (8) and place the bushing (14) over the tube and secure in place with jam nut (13).

h. Install the rod end bearing (3) and jam nut (4) to the piston assembly (8). Later cylinders include the key which must be installed in the reverse order of removal.

6-95. INSTALLATION OF NOSE AND MAIN GEAR ACTUATING CYLINDERS.

CAUTION

Be sure to install each cylinder with its ports pointing down. If installed with the ports pointing up, the cylinder will not clear the tubular structure when the landing gear is retracted.

a. Position the cylinder and attach the cylinder end to the frame with bolt, washers, nut and cotter pin.

b. Connect the hydraulic lines to the cylinder.

c. Cycle the landing gear several times, using the hand pump, to ascertain that all the air is bled from the cylinder being installed.

CAUTION

While cycling the landing gear, make certain the piston rod does not make contact with any items installed in the wheel well.

d. Ascertain that the piston rod of the actuating cylinder being installed is fully extended by operating the landing gear hand pump with the selector in the down position.
e. Connect the piston rod end bearing to the drag links and adjust the landing gear per instructions given in Adjustment of Nose Landing Gear or Adjustment of Main Landing Gear, Section VII.
f. Install any access panels removed for access to the actuating cylinders.
g. Remove the airplane from the jacks.

6-96. INSTALLATION OF FLAP ACTUATING CYLINDER.
a. Position the cylinder to the attachment bracket of the fuselage frame and secure with bolt, washer, nut and cotter pin.

NOTE

Do not tighten attaching bolt completely; allow sufficient clearance to permit approximately 0.25 of an inch side play at the attachment point of where the cylinder rod end bearing attaches to the flap torque tube arm, with the piston rod fully extended.

b. Temporarily connect the piston rod end of the cylinder to the flap bellcrank using a bolt, washer and self-locking nut.
c. Connect the hydraulic lines to the flap cylinder.
d. Check rigging and adjustment of flap as described in Section V.
e. Install the trim panels with attaching screws.

6-97. GEAR DOOR ACTUATING CYLINDERS. (PA-23-250 [six place], Serial Nos. 27-2505 and up.)

6-98. REMOVAL OF NOSE AND MAIN GEAR DOOR ACTUATING CYLINDERS.

a. Disconnect the hydraulic lines from the cylinder and cover the open line ends to prevent contamination.

b. Remove the self-locking nut and machine bolt securing the top end of the cylinder and the self-locking nut, washers and bolt securing the rod end bearings to the door mechanism.

c. Remove the cylinder from the airplane.

6-99. DISASSEMBLY OF NOSE GEAR DOOR ACTUATING CYLINDER. (Refer to Figure 6-29.)

a. Cut the safety wire and drive the roll pins (6) from the cylinder barrel bearing end (5).

b. Remove the bearing end (5) by drawing it from the cylinder barrel (12).

c. The piston assembly (8) may be removed from the bearing end by loosening the jam nut (2) and unscrewing the rod end bearing (1) from the piston.

d. Remove the "O" rings (4, 7 and 10) from the bearing end and piston.

6-100. DISASSEMBLY OF MAIN GEAR DOOR ACTUATING CYLINDERS. (Refer to Figure 6-30.) On main gear door cylinders with Assembly No. 451 844 or 455 934 stamped on the name plate, refer to Disassembly of Nose Gear Door Actuating Cylinder, paragraph 6-99.

a. Cut the safety wire and drive out the roll pins (6 and 12) from both ends of the cylinder.

b. Remove the anchor assembly (14) and the gland fitting (5) by drawing them from the cylinder barrel ends (8).

c. The gland fitting (5) may be removed from the piston assembly (9) by loosening the jam nut (2) and unscrewing the rod end bearing (1) from the piston.

d. Remove the "O" rings (11, 7 and 10) from the anchor assembly, gland fitting and piston.

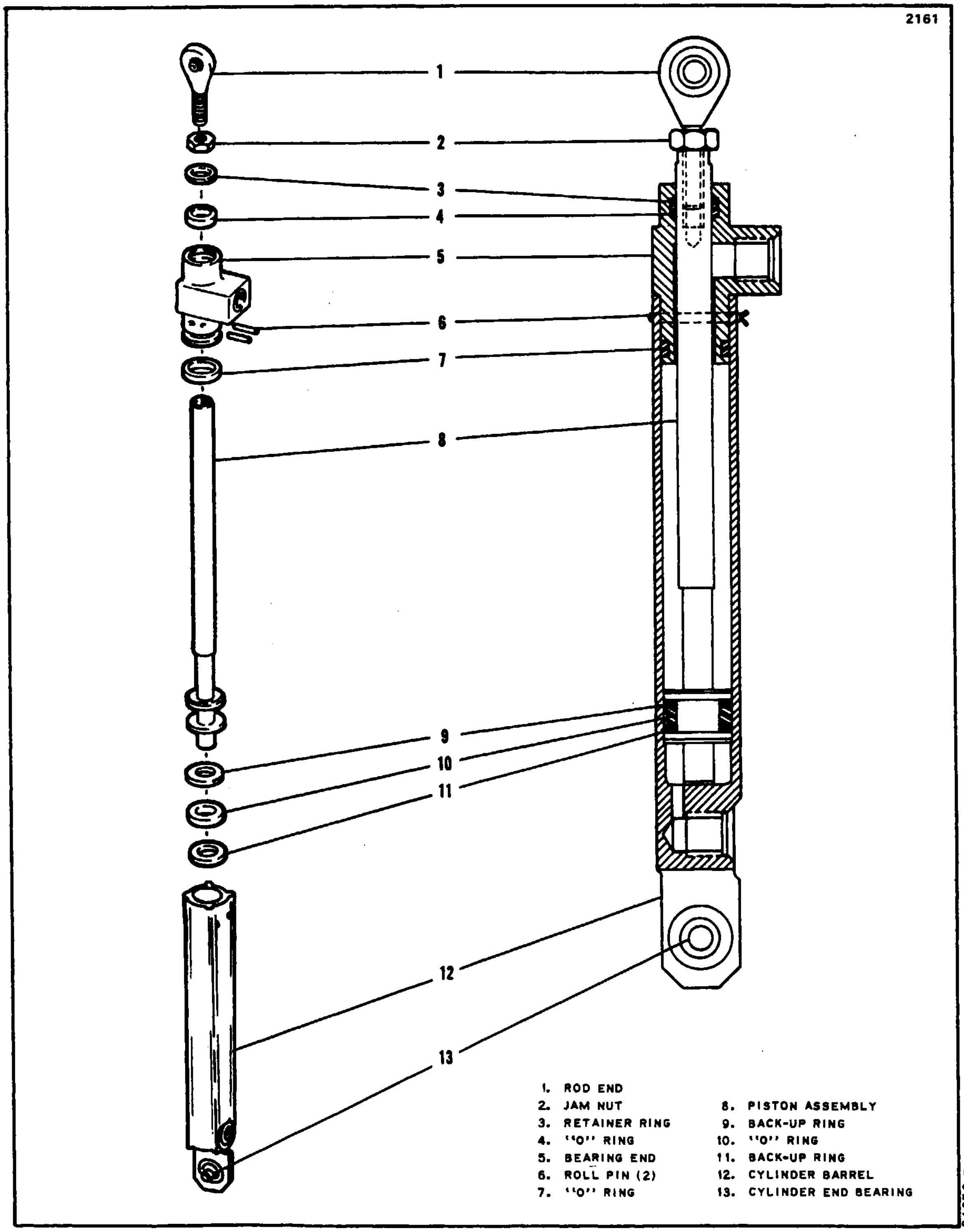


Figure 6-29. Nose Gear Door Actuating Cylinder (451 844 and 451 934)

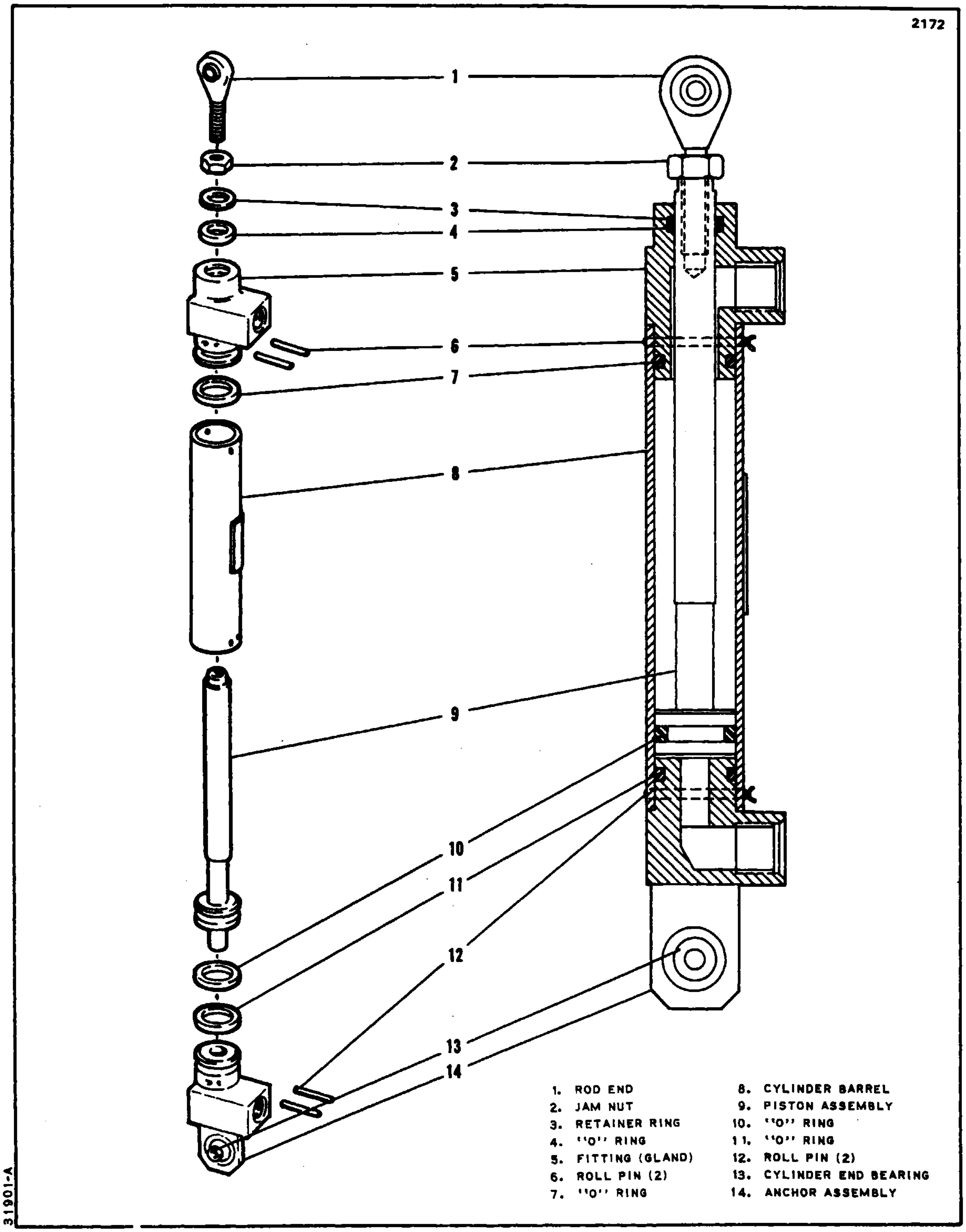


Figure 6-30. Main Gear Door Actuating Cylinder (451 845)

6-101. CLEANING, INSPECTION AND REPAIR OF NOSE AND MAIN GEAR DOOR ACTUATING CYLINDERS.

a. Clean the cylinder parts with a suitable solvent and dry thoroughly.

b. Inspect all surfaces for cleanliness, freedom from cracks and excessive wear.

c. Repair of most parts of the landing gear door actuator assembly is impractical. Replace defective parts with serviceable parts. Minor scratches and scores may be removed by polishing with fine abrasive crocus cloth (Federal Specification P-C-458) providing their removal does not affect the operation of the unit. Install all new "O" rings and back-up rings during reassembly of the actuator.

6-102. ASSEMBLY OF NOSE GEAR DOOR ACTUATING CYLINDER. (Refer to Figure 6-29.)

a. Install new "O" rings to the piston assembly (8) and barrel end (5).

b. Insert the piston assembly into the barrel end and install the jam nut (2) and rod end bearing (1) to the piston end.

c. Insert the piston assembly and barrel end into the open end of the cylinder barrel (12).

d. Align the holes in the cylinder barrel and the barrel end. Install a roll pin (6) to each hole.

NOTE

Install the roll pins with the slots outboard or away from each other.

e. Safety the roll pins with MS20995-C32 wire.

6-103. ASSEMBLY OF MAIN GEAR DOOR ACTUATING CYLINDER. (Refer to Figure 6-30.) On main gear door, cylinders with Assembly No. 451 844 or 455 934 stamped on the name plate, refer to Assembly of Nose Gear Door Actuating Cylinder, paragraph 6-102. The following steps are for Cylinder Assembly No. 451 845 only:

a. Install new "O" rings to the anchor assembly (14), gland fitting (5) and piston (9).

b. Insert the piston into the gland fitting and install the jam nut (2) and rod end bearing (1) to the end of the piston assembly.

c. Insert the piston and gland fitting into one end of the cylinder barrel (8) and the anchor assembly (14) into the other end.

d. Align the holes in the cylinder barrel, gland fitting and the anchor assembly. Install a roll pin (6 and 12) to each hole securing the cylinder ends.

NOTE

Install the roll pins with the slots outboard or away from each other.

e. Safety the roll pins with MS20995-C32 safety wire.

6-104. INSTALLATION OF NOSE AND MAIN GEAR DOOR ACTUATING CYLINDERS.

a. Position the cylinder inside the wheel well.
b. Install the machine bolt securing the cylinder end to the mounting bracket.
c. Connect the hydraulic lines to the cylinder.
d. Connect the rod end bearing to the door mechanism by following the procedure outlined in Adjustment of Main Landing Gear Doors or Adjustment of Nose Landing Gear Doors, Section VII.

6-105. TIMER CHECK VALVE. (SEQUENCE VALVE.) (PA-23-250 [six place], Serial Nos. 27-2505 and up.)

6-106. REMOVAL OF TIMER CHECK VALVE.

a. Place the airplane on jacks. (Refer to Jacking, Section II.)
b. Place a drip pan to catch hydraulic fluid spillage under the landing gear where the valve is to be removed.
c. Disconnect the hydraulic lines from the valve and cover the open line ends to prevent contamination.
d. Remove the valve by removing the self-locking nuts, washers and bolts securing it inside the wheel well.

6-107. DISASSEMBLY OF TIMER CHECK VALVE. (Refer to Figure 6-31.)

a. Holding the valve with the plug end up, remove the plug (14) by unscrewing it from the valve body (1). The plunger (9), washer (10), back-up rings (11 and 13) and the "O" rings (8 and 12) will come out with the plug.
b. Separate the plunger assembly (8 thru 13) from the plug.
c. Remove the back-up seat (6) and its "O" rings (5 and 7).
d. Remove the ball (4), guide (3) and spring (2) from the valve body (1).

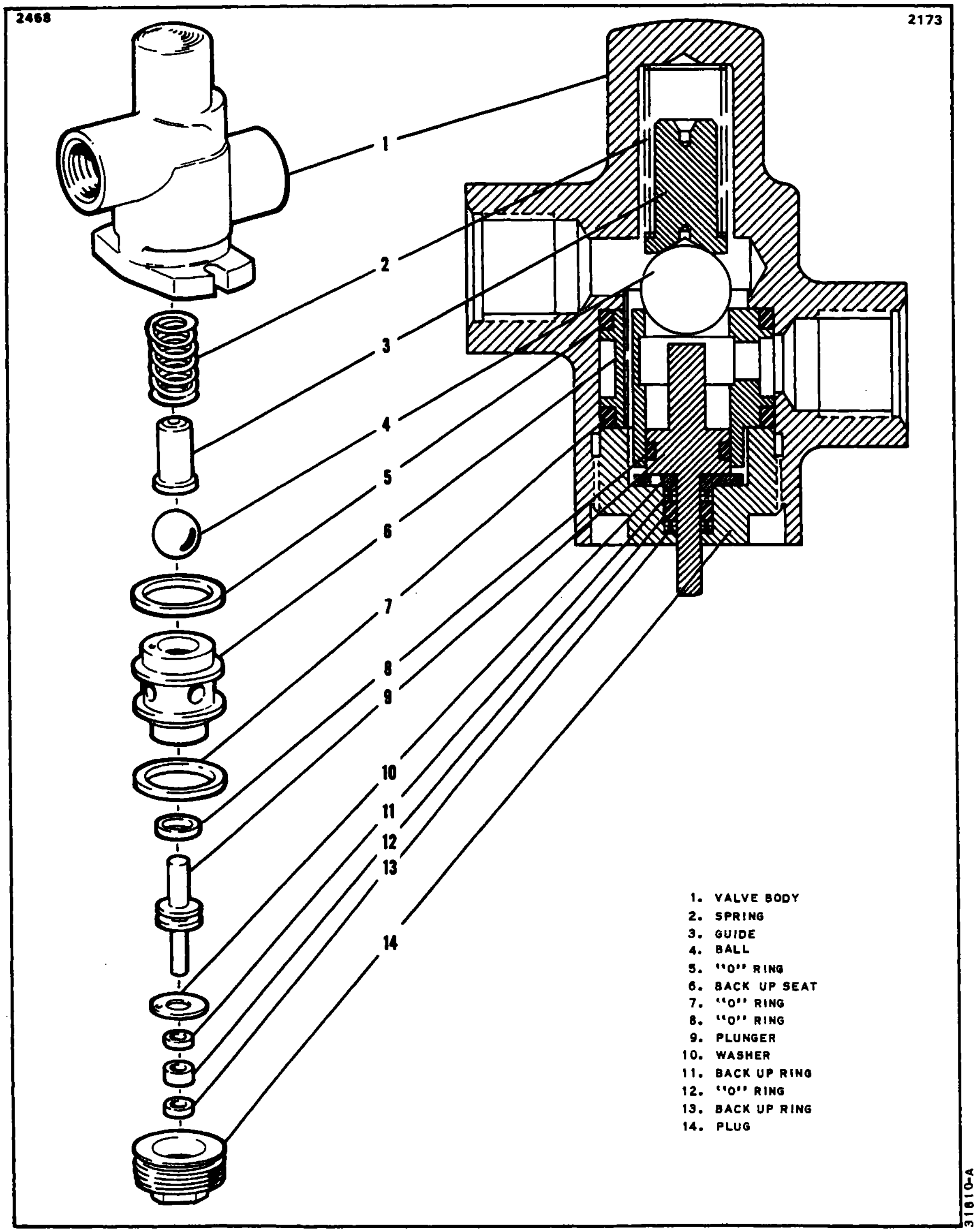


Figure 6-31. Timer Check Valve

6-108. CLEANING, INSPECTION AND REPAIR OF TIMER CHECK VALVE.

a. Clean the valve parts with a suitable solvent and dry thoroughly.

b. Inspect all surfaces for cleanliness and for freedom from cracks and excessive wear.

c. Replace defective parts with serviceable parts. Minor scratches and scores may be removed by polishing with fine abrasive crocus cloth (Federal Specification P-C-458) providing their removal does not affect the operation of the unit. Install all new "O" rings and back-up rings during reassembly of the valve.

6-109. ASSEMBLY OF TIMER CHECK VALVE. (Refer to Figure 6-31.)

a. Install the spring (2), guide (3) and ball (4) to valve body (1).

b. Install new "O" rings (5 and 7) to the back-up seat (6) and install the assembly to the valve body by inserting the large diameter end first.

c. Install an "O" ring (8) to the plunger (9).

d. On the small diameter end of the plunger, install a washer (10), back-up ring (11), "O" ring (12) and back-up ring (13).

e. Insert the small end of the plunger assembly (8 thru 13) into the plug (14).

f. Position the plug and piston assembly to valve body and secure.

6-110. TESTING TIMER CHECK VALVE.

a. Connect the pressure line of a hydraulic test unit to the port of the valve furthest from its mounting base.

b. Open the test unit by-pass valve.

c. Operate the test unit and slowly close the by-pass valve.

d. Apply 2000 psi maximum hydraulic pressure to the valve and ascertain that fluid does not appear at the open end.

6-111. INSTALLATION OF TIMER CHECK VALVE.

a. Position the valve to its bracket inside the wheel well and secure with bolts, washers and self-locking nuts.

b. Uncover and connect the hydraulic lines to the valve. The line coming from the landing gear door cylinder should be connected to the lower of the two valve ports.

c. Fill the powerpak (Refer to Filling Hydraulic System, Section II.) and cycle the landing gear several times using the hand pump. Check the valve for proper operation and leaks.

d. Remove the drip pan and the airplane from jacks.

6-112. PRIORITY VALVE. (PA-23-250 [six place], Serial Nos. 27-2505 and up.)

6-113. REMOVAL OF PRIORITY VALVE.

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Place a container or rag under the priority valve to catch any hydraulic fluid spillage.

c. Disconnect the control wire from lock pin in the end of the priority valve.

d. Disconnect the hydraulic lines from the top of the valve.

e. Remove the valve by removing the self-locking nuts, washers and bolts securing the valve in place.

6-114. DISASSEMBLY OF PRIORITY VALVE. (Refer to Figure 6-32.)

a. Cut the safety wire and loosen the jam nut (5).

b. Remove the lock pin (3).

c. Unscrew the adjusting cap (1) and remove the lock pin bushing (2), spring guide (4), spring (6) and spring guide (7) from the valve body (8).

d. Remove cap (16) and "O" ring (15) from the opposite end of the valve body.

e. Remove the spring (14), check seat (12) with "O" ring (13), and the poppet and pin assembly (11) with back-up ring (10) and "O" ring (9) by pulling on the pin portion of the poppet and pin assembly.

6-115. CLEANING, INSPECTION AND REPAIR OF PRIORITY VALVE.

a. Clean the cylinder parts with a suitable solvent and dry thoroughly.

b. Inspect all surfaces for cleanliness, freedom from cracks and excessive wear.

c. Replace defective parts with serviceable parts. Minor scratches and scores may be removed by polishing with fine abrasive crocus cloth (Federal Specification P-C-458) providing their removal does not affect the operation of the unit. Install all new "O" rings and back-up rings during reassembly.

6-116. ASSEMBLY OF PRIORITY VALVE. (Refer to Figure 6-32.)

a. Install a new "O" ring (9) and back-up ring (10) to the poppet and pin assembly (11) and insert the assembly into the valve body (8) with the round headed poppet end first.

b. Install a new "O" ring (13) to the check seat (12) and install the assembly into the valve body with the slotted end of the seat toward the outside.

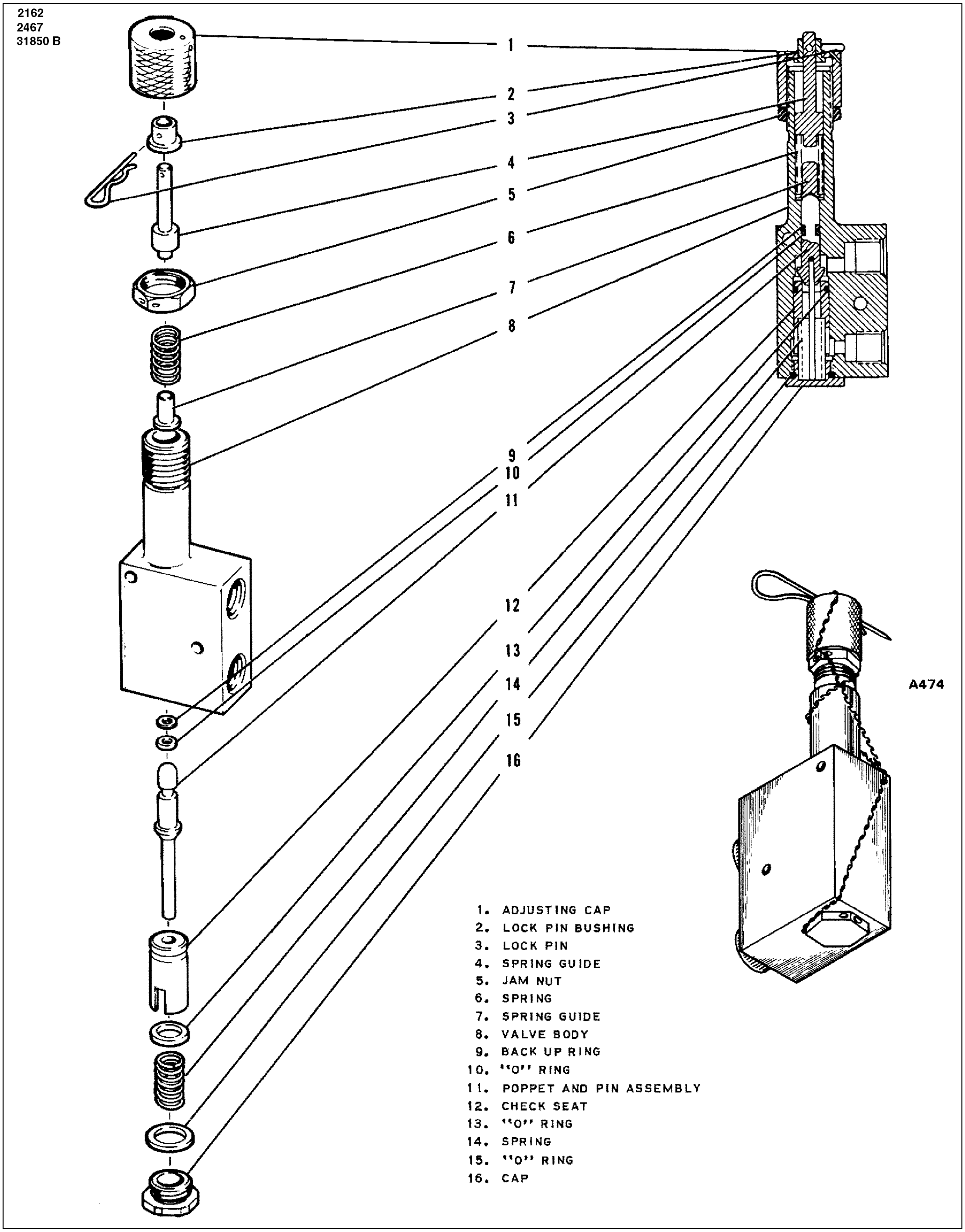


Figure 6-32. Priority Valve

c. Install the spring (14) into the valve body.

d. Install a new "O" ring (15) to the cap (16) and secure the cap to the end of the valve body.

e. In the opposite end of the valve, install the spring guide (7), spring (6), spring guide (4), lock pin bushing (2) and the knurled adjusting cap (1).

f. Tighten the adjusting cap until the lock pin can be freely inserted through the lock pin bushing (2) and the end of the spring guide (4).

g. Test and adjust the valve in accordance with instructions in Paragraph 6-117, and safety valve with MS20995-F20 wire as shown in Figure 6-32.

6-117. TESTING AND ADJUSTMENT OF PRIORITY VALVE.

a. Using a suitable hydraulic test stand, connect a pressure line to the side of the valve marked "GEAR UP."

b. Connect a clear plastic line to the side of the valve marked "DOOR CYL."

c. Apply pressure to the valve slowly to ascertain cracking pressure. The valve should open and hydraulic fluid should appear in the clear plastic tube when 600 ± 25 psi is reached. If the valve does not open or opens below 600 ± 25 psi is obtained, the following procedure may be used to adjust the valve:

1. Loosen the jam nut and tighten the adjusting cap until it stops.
2. Adjust the test unit to maintain 600 psi between the unit and the valve.
3. Slowly unscrew the adjusting cap until fluid starts to flow in the clear plastic tube.
4. Tighten the jam nut against the adjusting cap. Recheck the pressure.

d. If the test stand permits, the valve may be checked for proper flow rate of 1.1 gallons per minute at 700 psi.

e. To check the reverse flow, connect the pressure line to the side of the valve marked "DOOR CYL" and the clear plastic line to the side marked "GEAR UP."

f. Apply pressure to the valve slowly to ascertain cracking pressure. The valve should open and hydraulic fluid should appear in the clear plastic tube when 18 psi is reached.

g. If the test stand permits, the valve may be checked for a proper reverse flow rate of 1.1 gallons per minute at 22 psi.

h. If any of the preceding conditions cannot be obtained, the valve must be overhauled or replaced.

i. Safety the valve in a figure 8 pattern with MS20995-F20. (Refer to Figure 6-32.)

6-118. INSTALLATION OF PRIORITY VALVE.

a. Position the priority valve to its mounting bracket inside the control pedestal and secure with bolts, washers and self-locking nuts.

b. Uncover the hydraulic lines and connect them to the valve.

c. Connect the control wire to the lock pin installed through the end of the valve. Position the pin with the round portion to the left.

d. Remove the airplane from jacks.

6-119. HYDRAULIC LINES.

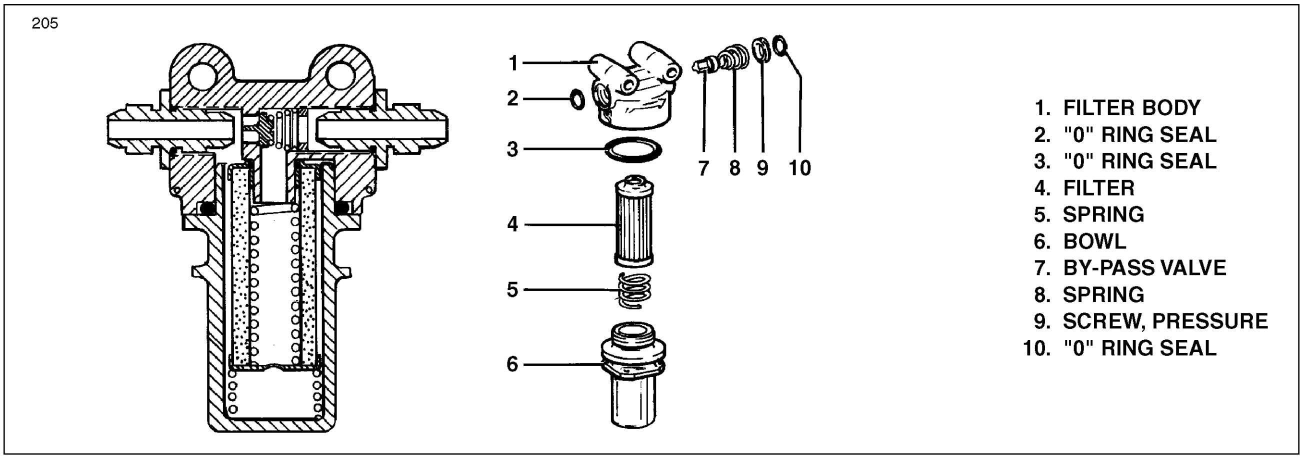


Figure 6-33. Hydraulic Filter

6-120. REMOVAL AND INSTALLATION OF HYDRAULIC LINES. Remove a damaged hydraulic line by disconnecting the fittings at each end and by disconnecting where secured by brackets. Refer to Figure 6-2 or 6-4 as an aid in the location of attaching brackets and bends in the lines. Provide a small container for draining the line. Install a new or repaired line in reverse order.

NOTE: Where straight thread type fittings are used, the locknuts are to be tightened so that the "O" ring seals are on the non-threaded portion of the fitting.

NOTE: In PA-23-235's and PA-23-250 S/N's 27-1 thru 27-4709 only, the landing gear hydraulic lines inside the fuselage and forward of the main spar may be subject to chafing from the aileron cables if not properly installed. Accordingly, during installation or troubleshooting ensure the hydraulic lines are formed and fittings are aligned to maintain at least 0.5 (1/2) inch clearance between the hydraulic lines and aileron cables. Access is via the large fuselage belly panel.

If required, hand-forming the hydraulic lines and rotating fittings as necessary is allowable to obtain the specified clearance.

6-121. HYDRAULIC FILTER(S).

6-122. REMOVAL AND INSTALLATION OF HYDRAULIC FILTER. The hydraulic filter, located on the upper tube of the engine motor mount, is removed by the following procedure:

a. Remove the inboard side panel from the left engine cowl. On airplanes with S/N's. 27-7854051 and up, a filter is also installed on the right engine mount. Access is gained through the outboard side panel of the right engine cowl.

b. Disconnect the filter inlet hose and outlet line from the filter.

c. Remove the filter from the motor mount by holding the bolts at the filter and turning off the nuts at the bracket.

d. The filter may be installed in the reverse procedure.

e. After the engine has been operated, check for leaks.

6-123. REPLACEMENT OF FILTER ELEMENT. (Refer to Figure 6-33.)

a. Remove the side panel from the engine cowl.

b. Cut safety wire, unscrew bowl and remove filter element.

c. Clean filter bowl with a suitable cleaning solvent and dry.

d. Replace filter element and "O" ring on bowl.

e. Half fill filter bowl to minimize trapped air in the hydraulic system and replace bowl.

f. Safety filter bowl with MS20995-C20 safety wire and replace the side panel on the engine cowl.

g. After engine has been operated, check for leaks.

6-124. EMERGENCY GEAR EXTENSION SYSTEM. (S/N's 27-1 thru 27-7954121.)

6-125. DESCRIPTION OF EMERGENCY GEAR EXTENSION SYSTEM. In the event of a hydraulic system failure caused by a line breaking or the powerpak malfunctioning, the landing gear can be lowered by using the emergency gear extender. The control for the extender is located beneath a small cover plate under the pilot's seat. When the control is pulled, $C0_2$ flows from a cylinder under the floorboards through separate lines to the landing gear cylinders and extends the gear.

6-126. SERVICING EMERGENCY GEAR EXTENDER. Replace the $C0_2$ bottle whenever it weighs less than 132 grams or one gram less than the weight marked on the bottle.

6-127. RESETTING EMERGENCY GEAR EXTENDER.

CAUTION: AFTER USING THE EMERGENCY GEAR EXTENDER, DO NOT ACTUATE LANDING GEAR OR FLAP UNTIL THE FOLLOWING PROCEDURES HAVE BEEN PERFORMED.

a. Place the aircraft on jacks. (Refer to Jacking, Section II.)

WARNING: DO NOT REMOVE $C0_2$ BOTTLE UNTIL THE PRESSURE IS RELEASED.

b. Loosen the $C0_2$ lines at the fitting, adjacent to the $C0_2$ bottle, thus allowing release of the pressure in the hydraulic system.

c. In S/N's 27-2505 and up, reset priority valve per instructions given in Paragraph 6-128.

d. On Gar-Kenyon shuttle valves only. (Refer to Figure 6-26.) Remove the elbow fitting from the side of the valve marked "MAIN" and reset the shuttle to the "EMG" side of the valve. Use a wood dowel rod to push on the shuttle. Listen for the click as the shuttle snaps into position.

e. Repair the hydraulic system as required. If necessary for troubleshooting, fill the hydraulic system. (Refer to Hydraulic System, Section II.)

f. After the hydraulic system has been repaired, filled and checked, cycle the landing gear several times, using the hand pump or test unit to ascertain that all the air is bled from the cylinders. Reconnect the $C0_2$ lines and safety the discharge mechanism ring with 0.016 inch soft aluminum safety wire. After arming the cutter head by positioning the cable actuated lever against the cutter head body, install a charged $C0_2$ bottle and anchor with the set screw.

CAUTION: THE BOTTLE ATTACHMENT MUST BE GAS TIGHT.

6-128. RESETTING PRIORITY VALVE. (PA-23-250 [six place], Serial Nos. 27-2505 and up.) When the emergency gear extender is pulled, a locking pin is withdrawn from the hydraulic system priority valve, allowing the valve to open. The priority valve is located approximately six inches up from the floor on the right rear side of the control pedestal.

a. Ascertain that the extender cable is not damaged.

b. Insert lock pin (3, Figure 6-32) into one side of the lock pin bushing (2). This holds the bushing out.

c. Push the guide shaft (4) into the valve, align the holes and finish inserting pin.

d. Ascertain that when the extender ring is pulled, the priority valve will open prior to the CO2 bottle discharging.

6-129. EMERGENCY GEAR EXTENDER CABLE RIGGING. (Refer to Figure 6-34.) It is possible that flexing or slipping of the priority valve actuating cable may retard landing gear extension with the CO2 system. If not previously installed, Kit number 756 878 should be installed in aircraft Serial Nos. 27-2505 to 27-2658 inclusive to prevent further flexing or slipping of this cable. The rigging of the cable follows:

a. Remove the CO2 bottle from the discharge unit.

b. Check the 2.50 inch dimension on the end of the cable housing to the pin in the priority valve as shown in Figure 6-34, Sketch "A" and tighten clamp. If necessary, cut end of flexible housing to obtain the 2.50 inch dimension. This dimension must be maintained.

c. Lift the emergency gear extension cover located under the pilot's seat. Gently pull on the ring until all of the slack is taken up in the cable to the priority valve.

d. Gently take up the slack in the cable to the CO2 discharge unit so that it will slide up the ring as shown in Figure 6-34, Sketch "B." The CO2 cable should be 1 inch longer than the priority valve cable at this point.

e. This will give you the proper rigging of the cables to mechanically open the priority valve before introducing CO2 to the system.

f. Replace the gear extension cover and CO2 bottle in the discharge unit.

6-130. BYPASS FLOW VALVE. (PA-23-250 [six place], Serial Nos. 27-4426, 27-4574 and up.) When the flap system is activated the bypass flow valve allows a set amount of hydraulic fluid to bypass the flap actuating cylinder, thus delaying the time required to extend the flaps.

6-131. BYPASS FLOW VALVE TEST. This test should be performed in flight. Use a power setting of 2400 RPM to obtain an indicated airspeed of 125 MPH. Select flaps down and record the time required for the selector handle to return to neutral; it should be 10 seconds +1 -2 seconds. If the selector handle does not return to neutral it could be due to the bypass valve allowing an excess amount of fluid to flow through the return part of the valve. To check this condition, remove the bypass line from the valve and plug the outlet port and cap the bypass line. Then try the system again, if the handle returns to neutral it means the valve needs readjustment. A slightly less time adjustment may be required to correct this condition.

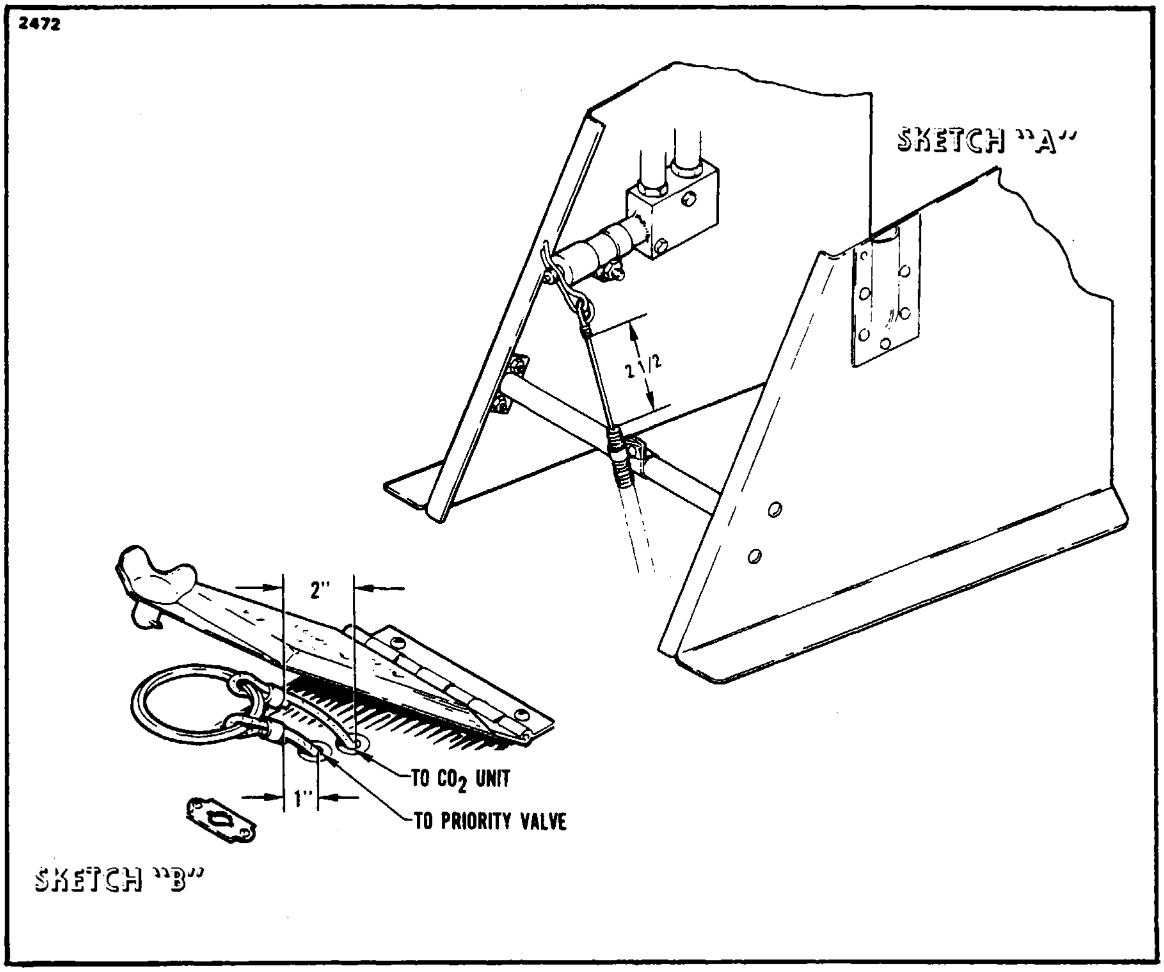


Figure 6-34. Emergency Gear Extender Cable Rigging

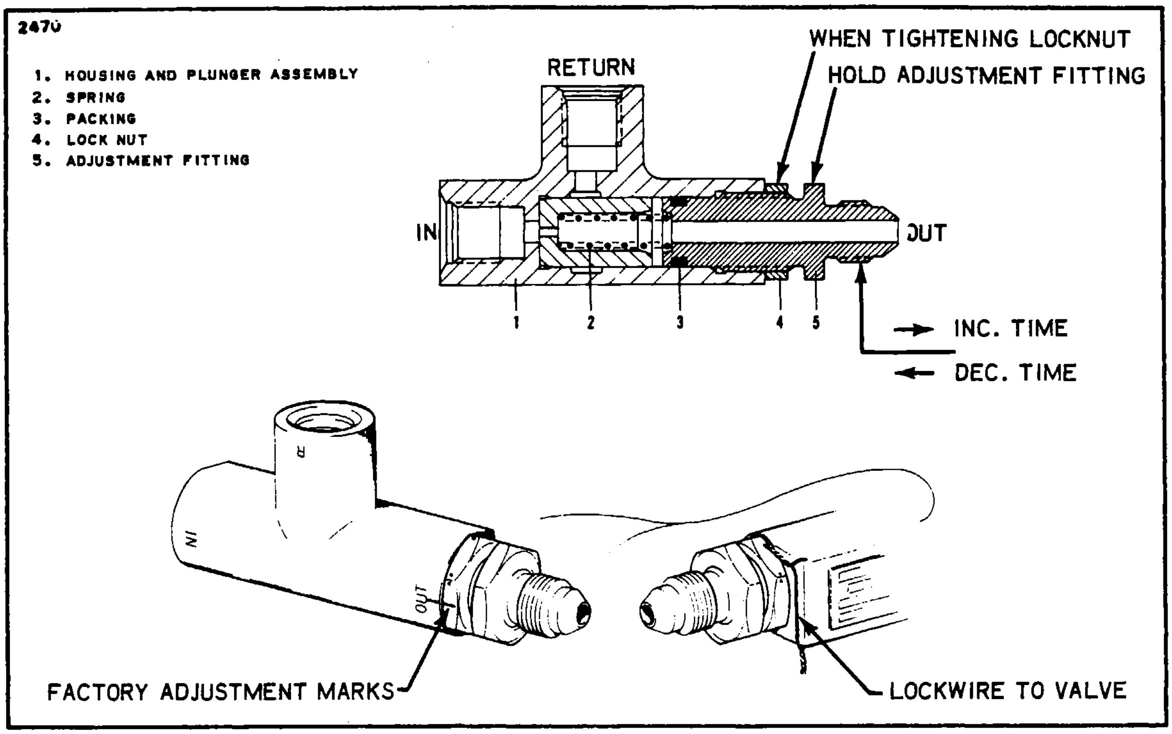


Figure 6-35. Bypass Flow Valve

6-132. BYPASS FLOW VALVE ADJUSTMENT. (Refer to Figure 6-35.)

a. Remove the right center seat from the airplane.

b. Remove the trim panels from the right side of the cabin, just aft of the cabin entrance door.

c. Cut and remove the safety wire from the bypass valve locknut.

d. Adjust the valve by loosening the locknut and turning the fitting IN to decrease or OUT to increase the time.

NOTE

The adjustment fitting should be turned a quarter of a turn between tests as this will give a one or two second change in time.

e. Hold the adjustment fitting securely when tightening the locknut so as not to change the setting.

f. Perform the test given in paragraph 6-131.

g. When the valve is properly adjusted, safety the locknut to the valve body with MS20995C20 safety wire.

h. Install the trim panels and center seats.

TABLE VI-V. HYDRAULIC SYSTEM TROUBLESHOOTING

Trouble	Cause	Remedy
Flap and landing gear systems (both) fail to operate.	Hydraulic fluid reservoir below operating level.	Refer to paragraph 6-35. Then fill powerpak with hydraulic fluid. (Refer to Servicing Hydraulic System, Section II.)
	Hydraulic pump(s) failure.	If both systems function using hand pump and lines are not damaged, check condition of hydraulic pump. (Refer to paragraphs 6-13 and 6-28.)
	Leak or obstruction in hydraulic lines between pump(s) and powerpak.	Check each system with hand pump. If they both work, check lines for damage. Replace damaged line. (Refer to paragraphs 6-35 and 6-120.) If hand pump fails to work refer to "Hydraulic Powerpak failure" under the column heading "Cause."
Landing gear system fails to operate.	Leak or damage in hydraulic lines between the three landing gears actuating cylinders and the powerpak.	Check lines for damage. Replace damaged line. (Refer to paragraphs 6-35 and 6-120.)
	Internal or external leakage in actuating cylinder.	Check all three actuating cylinders for damage. (Refer to paragraph 6-35.)
		Replace defective cylinder. (Refer to paragraph 6-86.)

TABLE VI-V. HYDRAULIC SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Landing gear system fails to operate. (cont.)	Hydraulic Powerpak failure.	Refer to Table VI-VI.
Wing flap system fails to operate.	Leak or damage in hydraulic lines between actuating cylinder and Powerpak.	Check lines for damage. Replace damaged line. (Refer to paragraphs 6-35 and 6-120.)
	Internal or external leakage in actuating cylinder.	Check actuating cylinder for damage. Replace if defective. (Refer to paragraph 6-35.)
	Hydraulic Powerpak failure.	Refer to Table VI-VI.
Landing gear system functions improperly.	Hydraulic Powerpak failure.	Refer to Table VI-VI.
Landing gear operation extremely slow.	Hydraulic fluid reservoir level low.	Refer to paragraph 6-35. Then fill Powerpak with hydraulic fluid. (Refer to Servicing Hydraulic System, Section II.)
	Engine-driven hydraulic pump(s) output low.	Replace or rebuild pump(s). (Refer to paragraph 6-29.)
	Internal leak in Powerpak.	Refer to Table VI-VI.
Landing gear fails to retract fully.	Excessive hydraulic fluid in CO2 system.	Drain CO2 lines.

TABLE VI-V. HYDRAULIC SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Landing gear drops in flight.	Leakage in Anti-Retraction valve. Leakage in Actuating cylinder.	Replace "O" rings in valve or replace valve. Replace "O" rings in actuating cylinder or replace cylinder.
Up light will not stay on in flight.	Hydraulic fluid internal leak in system. Powerpak valve sticking.	Check system for fluid leaks. Refer to Table VI-VI.
(1)Landing gear door(s) closing prior to wheel(s) retracting into well.	Timer check (sequence) valve leaking.	Check condition of valve and replace if necessary.
(1)Landing gear door(s) not opening prior to landing gear(s) starting to extend. 1. PA-23-250 (SIX PLACE), SERIAL NOS. 27-2505 AND UP ONLY.	Priority valve leaking below required pressure on valve side.	Check valve required pressure (Refer to Table VI-I and adjust or replace if necessary.

TABLE VI-VI. POWERPAK TROUBLESHOOTING

Trouble	Cause	Remedy
Flap and landing gear systems both fail to operate.	Broken inner "O" ring seal (129) on landing gear selector spool.	Isolate and replace "O" ring seal.
	External leakage at base of hand pump handle.	Replace "O" rings (57 and 59).
	Internal leakage in main relief valve.	Check for damage or foreign matter lodged between ball (35) and seat (34) of short valve assembly (162), or poppet assembly (145) of tall valve assembly (161). Replace damaged "O" ring (33 or 144).
	Internal leakage in hand pump and filter. (only when using hand pump.)	Check for damage or foreign matter lodged between ball (23) and seat (21). Replace damaged "O" rings (22 and 61).

NOTE

Where duplicate parts are used in the two systems, only one part is illustrated and indexed on the exploded view. Be sure to check the part applicable to the landing gear or flap systems. Also, check the parts which are under pressure first. (Refer to the flow diagrams, Figures 6-10 through 6-14 for illustrations of the parts under pressure for the position of the selector valve when the Powerpak fails.)

NOTE: Reference numbers, refer to Figure 6-20.

TABLE VI-VI. POWERPAK TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Landing gear system fails to operate.	Internal leakage in poppets (84 and 91).	Check for damage or foreign matter lodged between poppets and seats. Replace damaged "O" rings (81, 83, 86, 88, 90 and 93).
	Internal or external leakage at cam spools (128).	Replace damaged "O" rings (129).
	Internal leakage at detent plunger (77).	Replace damaged "O" ring (78).
	Internal leakage in thermal relief valve.	Check for damage or foreign matter lodged between ball (72) and seat (73). Replace damaged "O" ring (74).
	External leakage at at plugs (115 and 121).	Replace damaged "O" rings (116 and 122).
Flap system fails to operate.	Internal leakage in poppets (84 and 91).	Check for damage or foreign matter lodged between poppets and seats. (Replace damaged "O" rings (81, 83, 86, 88, 90 and 93).
	Internal leakage at detent plunger (77).	Replace damaged "O" ring (78).

TABLE VI-VI. POWERPAK TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Flap system fails to operate. (cont.)	Internal leakage in thermal relief valve.	Check for damage or foreign matter lodged between ball (72) and seat (73). Replace damaged "O" ring (74).
	External leakage at plugs (115 and 121).	Replace damaged "O" rings (116 and 122).
Landing gear drops in flight.	Thermal contraction of hydraulic fluid.	"Ground check".
Hydraulic fluid leaks out of vent after filling reservoir.	Excessive fluid in system due to improper filling technique.	Refer to Servicing Hydraulic System, Section II.
Hydraulic fluid continues to leak out of vent after three or more gear cycles.	Engine pump(s) shaft leaking.	Replace pump(s) or seal.
Landing gear drops in flight.	Leak in pressure and/or return poppet (84 and 91).	Replace poppet(s) as required.

TABLE VI-VII. POWERPAK PARTS LIST

Electrol No.		Piper No.
750P-1(1)	. . . .	31800-0(1)
-	. . . .	31800-2
-	. . . .	31800-2M
-	. . . .	31800-3

FIGURE 6-20 INDEX NUMBER	PART NUMBER	DESCRIPTION	UNITS PER ASSY
1	AN365-428	NUT	1
2	31926-00	WASHER, Reservoir	1
3	AN6227-5	PACKING, O-ring	1
4	31827-00	RESERVOIR	1
5	AN6230-36	PACKING, O-Ring	1
6	AN924-6D	NUT	1
7		UNION, Reservoir	1
7a	31927-00	ELBOW, Reservoir	1 (2)
8	Cleveland - 110-9/16	SEAL	1
8a	AN960-916L	WASHER	1
9	31925-00	STRAINER	1
10	AN815-6D	UNION	1
11	AN6290-6	PACKING, O-ring	1
12	31924-00	SPACER, Reservoir	1
13	31944-00	BAFFLE, Reservoir	1
14	31940-00	SPACER, Reservoir	1
15	AN316-4R	NUT	1
16	31939-00	STUD	1
17	1/4-28 NF3	SCREW, Cap socket hd 5/16 in. lg.	8(3) or 10(4)
18	AN936B416	WASHER, Lock	8(3) or 10(4)
19	31886-02 (L)	PLATE, Retainer	1
	31886-03 (R)	PLATE, Retainer	1
20	31912-00	STRAINER	1
21	31937-00	SEAT, Check	1
22	AN6227-6	PACKING, O-ring	1

1. NOT AVAILABLE FOR SERVICE
2. USED ONLY WITH POWERPAK ASSEMBLIES 750P-1 AND 31800-0.
3. USED ONLY WITH POWERPAK ASSEMBLIES 750P-1, 31800-0, 31800-2M AND 31800-3.
4. USED ONLY WITH POWERPAK ASSEMBLY 31800-2M.

DESCRIPTION (cont.)

INDEX NUMBER	PART NUMBER		UNITS PER ASSY
23	31804-05	BALL	1
24	31936-00	SPRING, Check	1
25	31951-00	BODY, Relief Valve	1 (2)
26	AN6227-15	PACKING, O-ring	1 (2)
27	MS20995F32	LOCKWIRE	1 (2)
28	31955-00	SCREW	1 (2)
29	31848-00	NUT	1 (2)
30	31957-00	SPRING	1 (2)
31	31952-00	PLUNGER	1 (2)
32	31953-00	PLUG	1 (2)
33	AN6227-4	PACKING, O-ring	1 (2)
34	31954-00	SEAT	1 (2)
35	31814-07	BALL	1 (2)
36	31956-00	RETAINER	1 (2)
37	AN380-2-2	PIN, Cotter	1
38	AN394-19	PIN, Clevis	1
39	AN960PD416	WASHER	1
40	AN380-2-2	PIN, Cotter	1
41	AN320-3	NUT	1
42	AN3-10	BOLT	1
43	AN380-2-2	PIN, Cotter	1
44	AN393-27	PIN, Clevis	1
45	AN960PD10	WASHER	1
46	31922-00	LINK	1
47	52-028-125-1.187	PIN, Roll (ESNA)	2
48	31934-00	STOP	2
49	52-028-125-1.375	PIN, Roll (ESNA)	1
50	31933-00	GRIP	1
51	AN500-6-3	SCREW	2
52	AN935-6L	WASHER, Lock	2
53	31906-00	SPRING	1
54	31825-00	HANDLE	1

2. USED ONLY WITH POWERPAK ASSEMBLIES 750P-1 AND 31800-0.

DESCRIPTION (cont.)

INDEX NUMBER	PART NUMBER		UNITS PER ASSY
55	31829-00	FORK AND BUSHING ASSY	1
56	5000-106	RING, Snap	1
57	AN6227-16	PACKING, O-ring	1
58	31935-00	STOP.	1
59	AN6227-13	PACKING, O-ring	1
60	31938-00	PISTON	1
61	AN6227-15	PACKING, O-ring	1
62	NAS50-43	RING, Snap	1
63	AN6227-6	PACKING, O-ring	1
64	31937-00	SEAT, Check	1
65	31814-05	BALL	1
66	31936-00	SPRING, Check	1
67	31876-00	SCREW ASSY	4
68	31872-00	BODY	4
69	31875-00	RETAINER, Upper	4
70	31871-00	SPRING.	4
71	31877-00	RETAINER, Lower	4
72	31814-02	BALL	4
73	31874-00	SEAT	4
74	AN6227-4	PACKING, O-ring	4
75	31904-00	PLUG	1 or 2 (5)
76	31947-00	SPRING.	1 or 2 (5)
77	31905-00	PLUNGER	1 or 2 (5)
78	PRP902-3/4	PACKING, O-ring	1 or 2 (5)
79	31814-04	BALL	1 or 2 (5)
80	31923-00	RETAINER, Return	4
81	AN6290-6	PACKING, O-ring	1 (2)
82	31856-00	SPRING.	4
83	2-15PSI-30-5AN	PACKING, O-ring	4
84	31854-00	POPPET AND SEAT ASSY	4
85	AN6227-3	PACKING, O-ring	4

2. USED ONLY WITH POWERPAK ASSEMBLIES 750P-1 AND 31800-0.
5. TWO USED WITH POWERPAK ASSEMBLIES 750P-1 AND 31800-0,
ONE USED WITH POWERPAK ASSEMBLIES 31800-2, 31800-2M AND 31800-3.

INDEX NUMBER	PART NUMBER	DESCRIPTION (cont.)	UNITS PER ASSY
86	2-15PSI-30-5AN	PACKING, O-ring	4
87	31913-00	RETAINER, Pressure	6
88	AN6227-10	PACKING, O-ring	6
89	31856-00	SPRING	6
90	2-15PSI-30-5AN	PACKING, O-ring	6
91	31854-00	POPPET AND SEAT ASSY	6
92	AN6227-3	PACKING, O-ring	6
93	2-15PSI-30-5AN	PACKING, O-ring	6
94	AN380-2-1	PIN, Cotter	4
95	AN960-PD4L	WASHER	4
96	AN392-11	PIN, Clevis	4
97	31930-00	LINK	4
98	AN380-2-2	PIN, Cotter	2
99	AN960PD10L	WASHER	2
100	AN960PD10	WASHER	2
101	AN393-21	PIN, Clevis	2
102	AN364-832	NUT, Lock	1
103	31908-00	BOLT	1
104	31909-02 (24V)	KNOB, Landing gear	1
	31909-00 (12V)	KNOB, Landing gear	1
105	52-040-187-0312	PIN, Roll (ESNA)	2
106	31910-00	TUBE, Lever	1
107	31931-00	LEVER, Landing gear	1
108	31932-00	TERMINAL BLOCK AND WIRE ASSY	2
109	31928-00	LEVER	1
110	10-32NF3	SCREW, Cap 11/16 in. lg	1

DESCRIPTION (cont.)

INDEX NUMBER	PART NUMBER		UNITS PER ASSY
111	AN935-10L	WASHER	1
112	31929-00	KNOB, Wing flap	1
113	52-040-187-0750	PIN, Roll (ESNA)	2
114	31942-00	STUD	2
115	31941-00	PLUG	2
116	PRP902-3/4	PACKING, O-ring	2
117	1/4-28NF3	SCREW, Cap socket hd 5/16 in. lg	2
118	AN936B416	WASHER, Lock	2
119	AN960-PD416	WASHER	2
120	31943-00	RETAINER	2
121	31941-00	PLUG	2
122	PRP902-3/4	PACKING, O-ring	2
123	31907-00	SCREW	2
124	31902-00	WASHER	2
125	31946-00	SPRING	2
126	31888-00	SPACER	2
127	31902-00	WASHER	2
128	31887-00 (L)	CAMSHAFT	1
	31887-01 (R)	CAMSHAFT	1
129	AN6227-6	PACKING, O-ring	8
130	31803-00	END FITTING	1
131	MS28778-6	GASKET	1
132	MS28775-011	PACKING	1
133	31861-00	POPPET	1
134	31799-00	SPRING	1
135	31801-00	BODY	1
136	W/H3400X2	ELBOW	1
137	31911-00	PIPE, Stand	1
138	31840-02	BODY	1
139	AN932-1	PLUG	1
140	31873-00	HEAD, Thermal Relief Valve	4
141	31948-00	END FITTING	1 (6)

6. USED ONLY WITH POWERPAK ASSEMBLIES 31800-2, 31800-2M AND 31800-3.

DESCRIPTION (cont.)

INDEX NUMBER	PART NUMBER		UNITS PER ASSY
142	31885-00	RETAINER	1 (6)
143	31963-00	BODY	1 (6)
144	AN6227-7	O-RING.	2 (6)
145	31899-00	POPPET ASSY	1 (6)
146	31814-03	BALL	1 (6)
147	31949-00	SPRING	1 (6)
148	31900-00	GUIDE	1 (6)
149	31848-00	NUT	1 (6)
150	31962-00	CAP	1 (6)
151	AN6290-4	PACKING, O-ring	1 (6)
152	31917-00	GEAR DETENT CAP	1 (6)
153	31915-00	SPRING	1 (6)
154	31916-00	DETENT SPRING GUIDE	1 (6)
155	31914-00	PLUNGER DETENT	1 (6)
156	PRP902-3/4	PACKING	1 (6)
157	AN6227-15	PACKING, O-ring	1 (7)
158	32278-00	ADAPTER, Relief Valve	1 (7)
159	-	Not assigned	
160	31878-00	THERMAL RELIEF VALVE ASSY . .	4
161	31950-00	MAIN RELIEF VALVE ASSY	1 (6)
162	-	MAIN RELIEF VALVE ASSY	1 (2)
163	-	HAND PUMP SUCTION VALVE ASSY .	1
164	-	CAMSHAFT RELEASE DETENT ASSY .	1 or 2 (5)
165	-	CAMSHAFT RELEASE DETENT ASSY .	1 (6)
166	-	HAND PUMP ASSEMBLY	1
167	-	POPPET ASSEMBLY, Return	2
168	-	POPPET ASSEMBLY, Pressure	6
169	-	CAMSHAFT AND RETURN SPRING ASSY	2
170	31862-00	MAIN CHECK VALVE ASSEMBLY. . .	1

2. USED ONLY WITH POWERPAK ASSEMBLIES 750P-1 AND 31800-0.
5. TWO USED WITH POWERPAK ASSEMBLIES 750-1 AND 31800-0,
ONE USED WITH POWERPAK ASSEMBLIES 31800-2, AND 31800-2M AND 31800-3.
6. USED ONLY WITH POWERPAK ASSEMBLIES 31800-2, 31800-2M AND 31800-3.
7. USED ONLY WITH POWERPAK ASSEMBLY 31800-2M.

TABLE VI-VIII. POWERPAK SERVICE LIMITS						
FIGURE 6-20 INDEX NUMBER	PART NO.	ITEM	MFG. TOL.	NOMINAL	MIN. SERVICE LIMIT	MAX. SERVICE LIMIT
21	31937-00	I.D. Seat - Check	±.005	.171	.1655	.1765
25	31951-00	I.D. Body - Relief Valve	+.002 -.000	.343	.343	.3452
31	31952-00	O.D. Plunger	+.000 -.005	.160	.1545	.160
34	31954-00	I.D. Seat	±.001	.135	.1339	.1361
58	31935-00	I.D. Stop	+.002 -.000	.705	.705	.7072
60	31938-00	O.D. Piston - Shaft	+.000 -.001	.704	.7029	.704
60	31938-00	O.D. Piston - Head	+.000 -.004	.998	.9936	.998
64	31937-00	I.D. Seat - Check	±.005	.171	.1655	.1765
73	31874-00	I.D. Seat	±.001	.100	.0989	.1011
77	31905-00	O.D. Plunger	+.000 -.003	.217	.2137	.217

POWERPAK SERVICE LIMITS (cont.)

INDEX NUMBER	PART NO.	ITEM	MFG. TOL.	NOMINAL	MAX. SERVICE LIMIT	MIN. SERVICE LIMIT
91 & 84	31854-00	Poppet & Seat Ass'y				
	31853-00	I.D. Seat	+.0005 -.0000	.3125	.3125	.31305
	31852-00	O.D. Poppet	+.0000 -.0003	.3122	.31187	.3122
128	31887-00 31887-01	O.D. Spool (Camshaft) (L) (R)	+.0000 -.0005	.4365	.43595	.4365
138	31840-02 31840-03	Body - Bushing Ass'y				
		I.D. Piston Head Bore	+.003 -.000	1.000 1.000	1.000	1.0033
		I.D. Spool Bore	+.002 -.000	.437	.437	.4392
		I.D. Spool Detent Bore	+.003 -.000	.219	.219	.2223

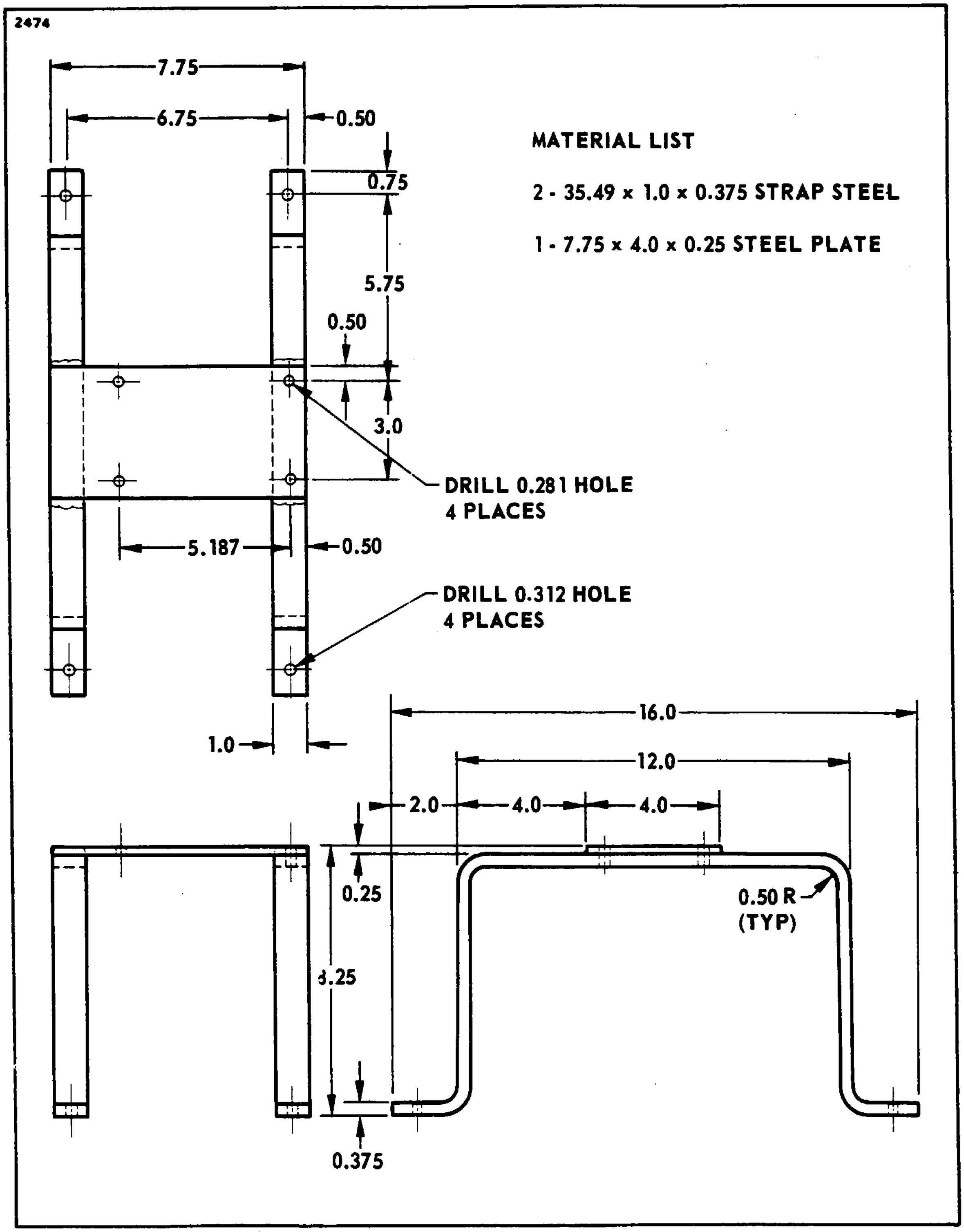


Figure 6-36. Fabricated Work and Test Stand

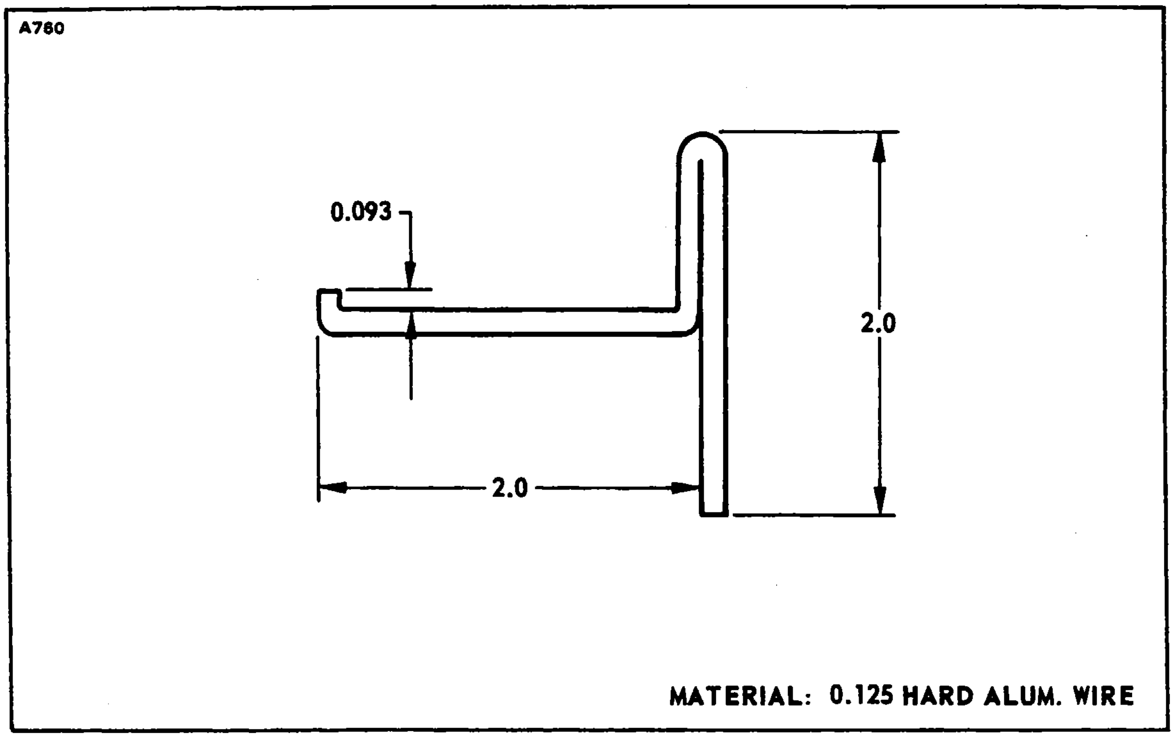


Figure 6-37. Fabricated Hook

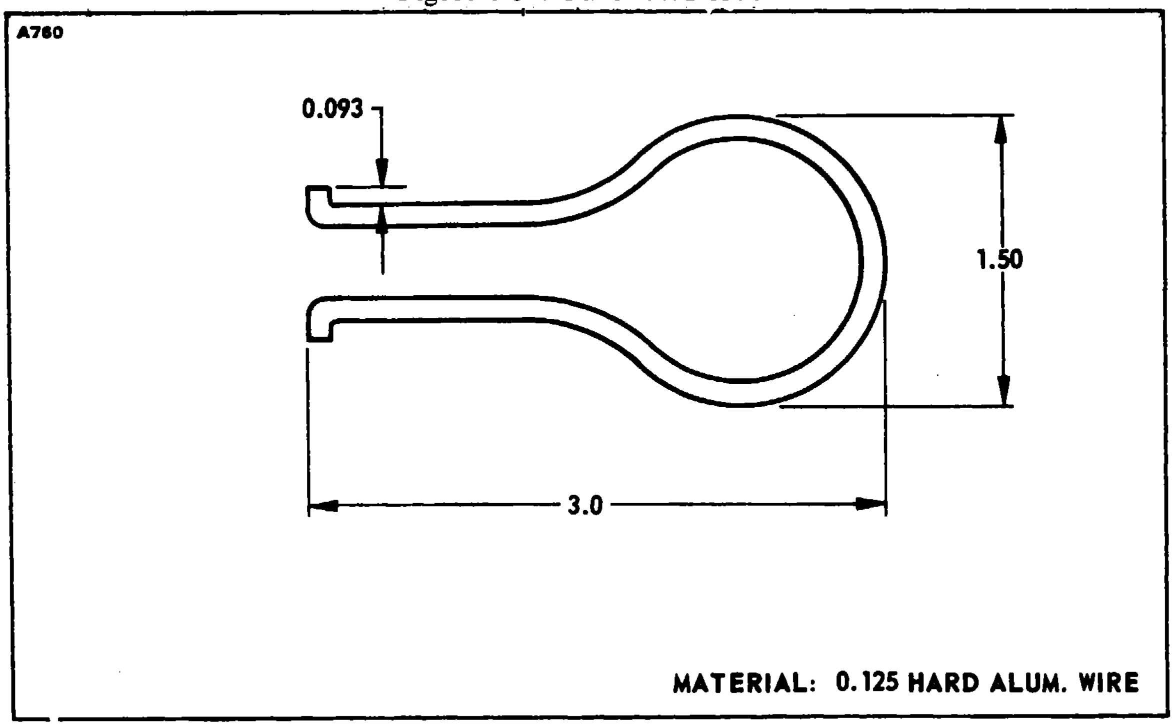


Figure 6-38. Fabricated Hook, Double

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SECTION

VII

LANDING GEAR AND BRAKE SYSTEM

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SECTION VII
LANDING GEAR AND BRAKE SYSTEM

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SECTION VII - LANDING GEAR AND BRAKES

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SECTION VII

LANDING GEAR AND BRAKE SYSTEM

7-1. INTRODUCTION. This section contains instructions for maintenance, overhaul, inspection and adjustment of the various components of the landing gear and brake system. Adjustments are also given for electrical limit and warning switches.

This section does not cover the hydraulic operation of the landing gear. For maintenance of hydraulic system, refer to Section VI.

7-2. DESCRIPTION. The tricycle landing gear system is an air-oil oleo type unit that is hydraulically operated and fully retractable with the nose gear retracting aft into the nose section and the main gear retracting forward into the engine nacelles. On PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl., the doors operate by mechanical linkage, but do not cover the gear completely when retracted. On PA-23-250 (six place), Serial Nos. 27-2505 and up, the doors are hydraulically operated and completely cover the gear when it is retracted.

To prevent the gear from being retracted while the airplane is on the ground, an anti-retraction valve, located on the left main gear, prevents a build up of hydraulic pressure in the retraction system while the weight of the airplane is on its wheels.

The nose gear is steerable through a 30 degree arc by the use of the rudder pedals. As the gear retracts, however, the steering linkage becomes separated from the gear so that rudder pedal action with the gear retracted is not impeded by the nose gear operation.

The position of the landing gear is indicated by four lights located on the pedestal. When the three green lights are on, all three legs of the gear are down and locked; when the amber light is on, the gear is entirely up, gear doors closed and when no light is on, the gear is in an intermediate position. A red light in the landing gear control knob flashes when gear is up and power from one engine is reduced below 14 to 15 inches of manifold pressure. When power from both engines is reduced below 10 to 12 inches of manifold pressure, a warning horn in the cockpit will sound.

The brakes are hydraulically actuated by individual master cylinders mounted on the left (optional on the right) set of rudder pedals. A reservoir, accessible through an access panel located on the left side of nose supplies fluid to each master cylinder. From these cylinders, hydraulic fluid is routed through lines and hoses to a parking brake valve, located on the aft-left side of the nose section, through wings to the brake assemblies on each main landing gear. The brakes are self-adjusting, single-disc, double housing and double piston assemblies. To operate the brakes, apply toe pressure against the top of the rudder pedal. The parking brake may be actuated by applying toe pressure and at the same time pulling out on the brake handle. To relieve parking brake pressure, apply toe pressure on the pedals and at the same time push in on the parking brake handle.

Servicing the hydraulic and brake systems is found in Section II.

7-3. TROUBLESHOOTING. Mechanical and electrical switch troubles peculiar to the landing gear system are listed in Table VII-IV at the back of this section. When troubleshooting, first eliminate hydraulic malfunctions as listed in Section VI. Then proceed to switch malfunctions and last to the mechanical operation of the gear itself, both of which are listed in this section. Always place the airplane on jacks before attempting any troubleshooting of the gear.

7-4. LANDING GEAR SYSTEM.

7-5. NOSE LANDING GEAR SYSTEM.

7-6. DISASSEMBLY OF NOSE GEAR OLEO. (Refer to Figure 7-1.) The nose gear oleo assembly may be removed and disassembled from the gear oleo housing with the gear removed from or installed on the airplane.

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Place a drip pan under the nose gear to catch hydraulic fluid spillage.

c. Remove air and fluid from the oleo strut. Depress the air valve core pin (21) until strut chamber pressure has diminished, remove the air valve (18) and with a small hose siphon as much hydraulic fluid from the strut as possible.

d. Remove the torque link assembly by removing the cotter pin, nut, washer and (close tolerance) bolt from the strut housing and fork assembly.

e. Release and remove the snap ring (12) from the annular slot at the bottom of the strut housing.

f. Pull the piston tube (13), with component parts, from the strut housing.

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1. GREASE FITTINGS
2. AIRCHARGE VALVE
3. SERVICING PLATE
4. BEARING, PISTON
5. RETAINING PIN
6. SPACER
7. "O" RING
8. BEARING
9. "O" RING
10. WIPER STRIP
11. WASHER
12. SNAP RING
13. PISTON TUBE
14. "O" RING
15. PISTON
16. BUSHING
17. GASKET
18. BODY
19. BUSHING
20. CAP
21. CORE
22. STRUT HOUSING
23. SHIMMY DAMPENER
24. "O" RING
25. ORIFICE TUBE
26. ORIFICE PLATE
27. SNAP RING
28. TORQUE LINK, UPPER
29. BUSHING
30. TORQUE LINK, LOWER
31. BOLT
32. WASHER
33. COLLAR
34. FORK ASSEMBLY

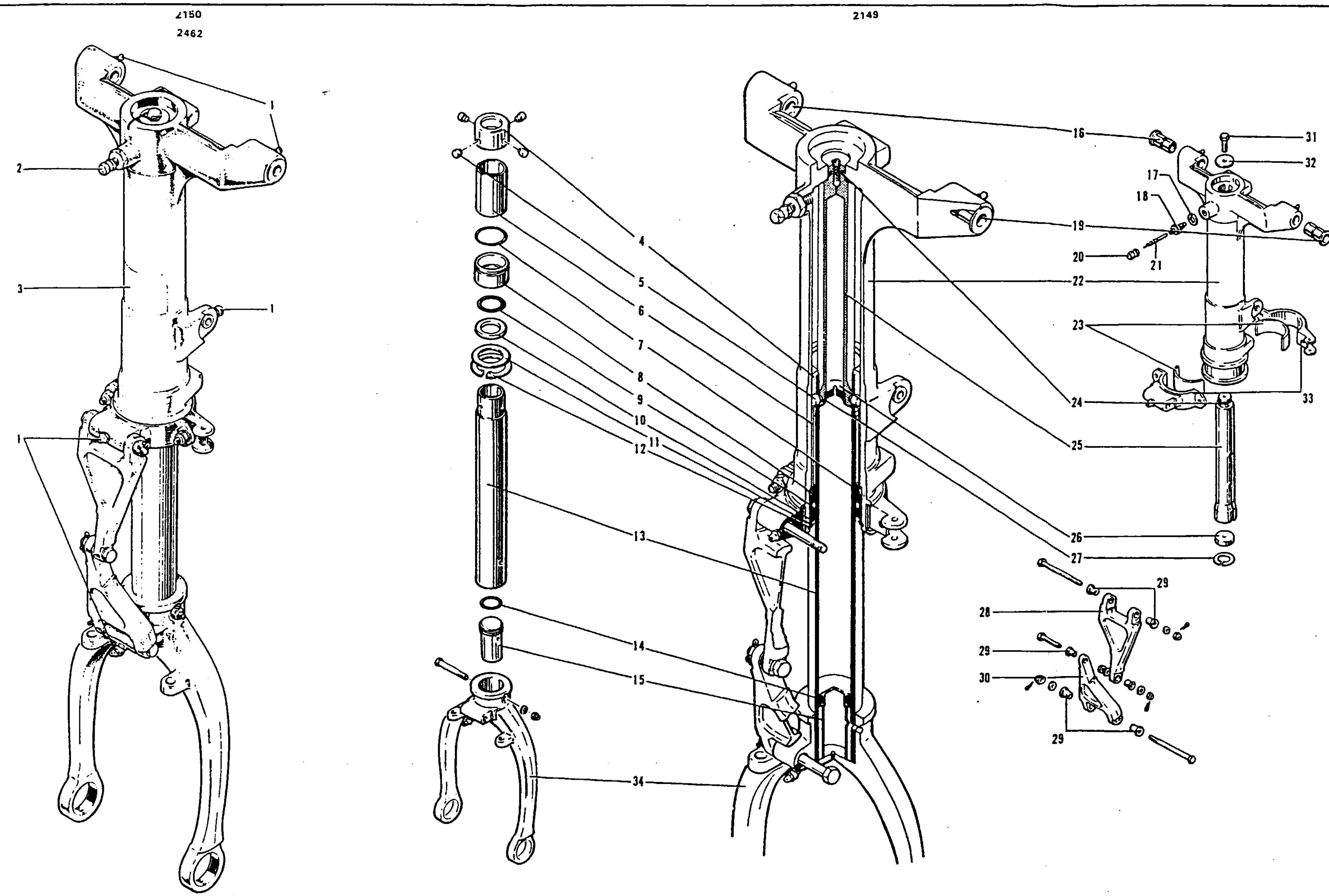


Figure 7-1. Nose Gear Oleo Strut Assembly

g. The piston tube components may be removed by reaching in the tube and pushing out the upper bearing retaining pins (5). Slide the upper bearing (4), spacer (6), lower bearing (8) with outer (7) and inner (9) "O" rings, wiper strip (10), washer (11) and snap ring (12) from the tube.

h. To remove the orifice tube (25), remove the bolt (31) and washer (32) from the top of the strut housing. Pull the tube from the housing (22).

i. The orifice plate (26) is removed from the bottom of the orifice tube by releasing the snap ring (27) that holds the plate in position.

j. To remove the piston tube plug (15) with "O" ring (14) located in the lower end of the tube, remove the bolt assembly at the top of the fork and insert a rod up through the hole in the body of the fork (34), pushing the plug out through the top of the tube.

7-7. CLEANING, INSPECTION AND REPAIR OF NOSE GEAR OLEO.

a. Clean all parts with a suitable dry type cleaning solvent.

b. Inspect the landing gear oleo assembly components for the following:

1. Bearings and bushings for excess wear, corrosion, scratches and overhaul damage.
2. Retaining pins for wear and damage.
3. Snap rings for cracks, burrs, etc.
4. Cylinder and orifice tube for corrosion, scratches, nicks and excess wear.
5. Orifice plate for hole restriction.
6. Fork tube for corrosion, scratches, nicks, dents and misalignment.
7. Air valve for general condition.

c. Repair of the oleo is limited to smoothing out minor scratches, nicks and dents and replacement of parts. Service tolerances for wear of the various components may be found in Table VII-II.

7-8. ASSEMBLY OF NOSE GEAR OLEO. (Refer to Figure 7-1.)

a. Ascertain that parts are clean and inspected.

b. To assemble the fork assembly (34), press the tube end (13) into the fork body, aligning the bolt holes.

c. If a new tube is to be installed that has not been drilled, press the tube into the fork housing until it bottoms. Using the bolt holes in the fork body as a guide, drill a pilot hole and ream to .250 +.002 -.000 through each side of the tube wall. Remove burrs from the inside of the tube and flush the tube with a suitable solvent to remove all metal particles.

d. To install the piston tube plug (15), first lubricate the tube plug and "O" ring (14) with hydraulic fluid (MIL-H-5606) and install the "O" ring on the plug. Lubricate the inside wall of the tube, insert the plug into the top of the tube and push it to the fork end. Align the bolt holes and install bolt assembly.

e. If desired, cement a cork in the hole in the bottom of the fork body to prevent dirt from entering the fork tube.

f. To assemble the orifice tube (25), insert the orifice plate (26) into the bottom of the tube. Secure the plate with the snap ring (27). Lubricate and install and "O" ring (24) on the top end of the tube.

g. Insert the tube up through the bottom of the strut housing (22). With the tube exposed through the top of the housing, install washer (32) and bolt (31). The bolt should only be installed finger tight at this time.

h. The fork tube assembly may be assembled by installing the tube components on the tube. In the following order slide onto the tube, the snap ring (12), washer (11), wiper (10), lower bearing (8) with outer (7) and inner (9) "O" rings, spacer (6) and upper bearing (4). Align lock pin holes of the upper bearing and piston tube and install pins (5).

i. Lubricate the inner wall of the cylinder. Carefully insert the piston tube assembly into the bottom of the housing, allowing the orifice tube to guide itself into the piston tube, until the retainer ring can be installed in the annular slot at the bottom of the cylinder. Slide the washer into position and secure assembly with snap ring.

j. At the top of the housing, tighten the orifice tube retaining bolt and safety.

k. Install the torque link assembly (28 and 30) using bolt (ct), washer, nut, and cotter pin.

NOTE

The bolt should be installed with one of the flat sides of the hex head against the milled stop on the drag links.

m. Lubricate the gear assembly. (Refer to Lubrication Chart, Section II.)

n. Compress and extend the strut several times to ascertain that the strut will operate freely. The weight of the gear wheel and fork should allow the strut to extend.

o. Service the oleo strut with fluid and air. (Refer to Servicing Oleo Struts, Section II.)

p. Check the nose gear for correct adjustment (Refer to Paragraph 7-12.) and for alignment (Refer to Paragraph 7-13.) and gear operation.

q. Lower the airplane and remove jacks.

7-9. REMOVAL OF NOSE LANDING GEAR. (Refer to Figure 7-2.)

a. Remove the left and right access panels from the aft portion of the nose section by releasing fasteners to gain access to the landing gear attachment fittings. (Refer to Access Plates and Panels, Section II.)

b. Place the airplane on jacks. (Refer to Jacking, Section II.)

c. Using the hand pump, retract the gear slightly to relieve the gear from its down and locked position.

d. To remove the drag link assembly, the following procedure may be used:

1. Disconnect the gear retraction rod (19) from the upper drag link (15), by removing cotter pin, nut, washers and bolt.

2. Disconnect the lower drag links (11) from the gear strut housing (4) by removing from each support, the pin, nut, washers, clevis bolt and wire support lug from the left side.

3. Lower the forward end of the drag link assembly and disconnect the down lock indicating switch (22) from its attachment fitting.

4. Remove the drag link assembly by removing the attaching cotter pin, nut, washers and bolt from the aft end of the upper drag link.

e. With the lower drag links disconnected from the gear housing, the gear may be removed by removing the attaching cotter pins, nuts, washers and bolts (close tolerance) at the fuselage frame fitting.

7-10. CLEANING, INSPECTION AND REPAIR OF NOSE LANDING GEAR.

a. Clean all parts with a suitable cleaning solvent.

b. Inspect the landing gear assembly components for the following unfavorable conditions:

1. Bolts, bearings, bushings and ball joints for excessive wear, corrosion and damage.

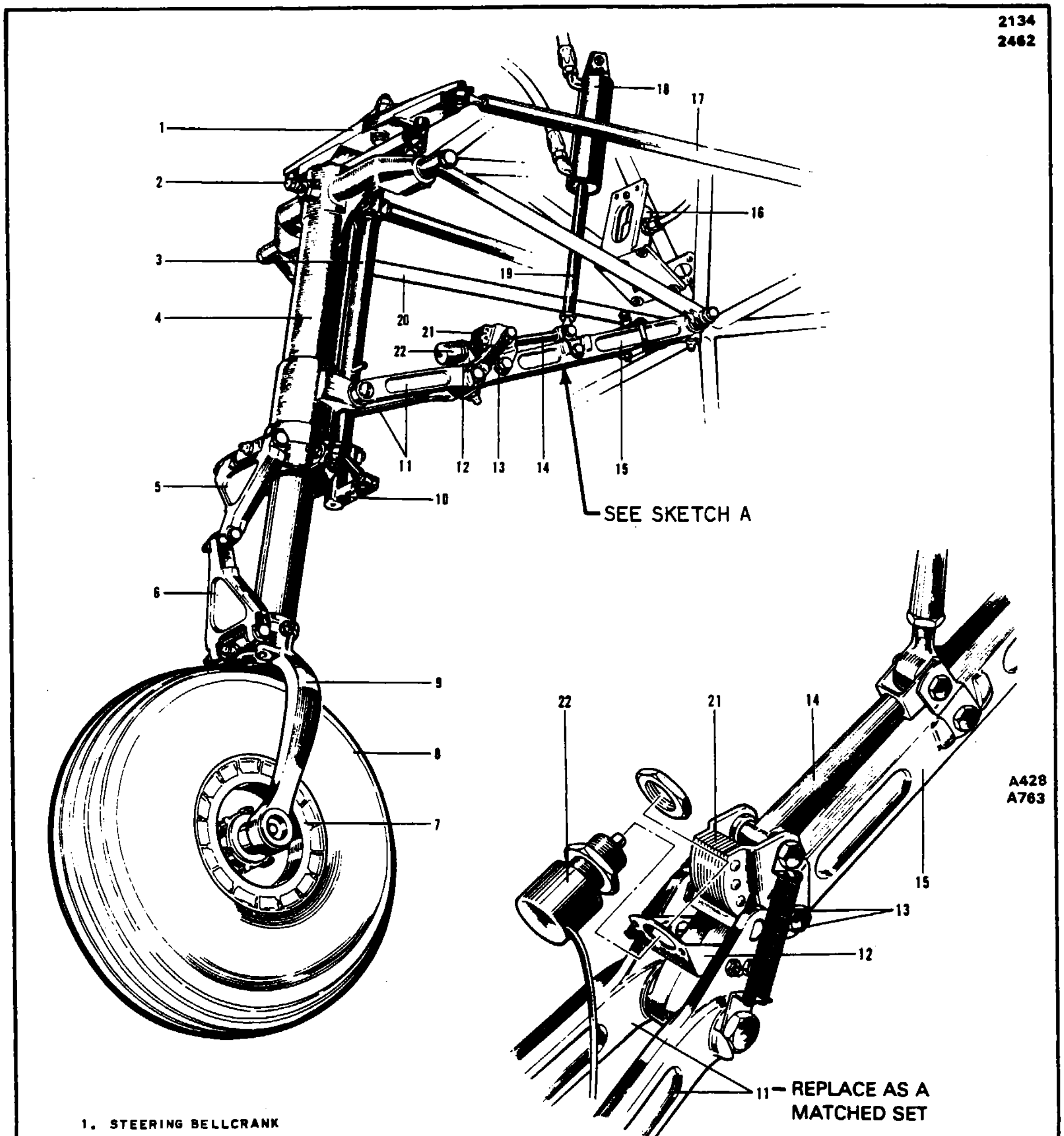
2. Gear housing, drag links, rods and attachments for cracks, bends or misalignment.

3. Downlock springs for wear, corrosion and not returning to complete compression.

4. General condition of limit switches.

5. Wiring for fraying, poor connections or conditions that may lead to failures.

c. Attach the upper and lower drag links and check that there is 0 to .007 of an inch clearance between the latch hook and pin. Dress upper and lower link stop surfaces to obtain minimum clearance. Also check that when the stop surfaces touch, linkage is .250 +.031 -0 inch through center. (Refer to Figure 7-3.) Should this distance exceed the required through center travel, and bolt and bushings are tight, replace one or all drag links.



1. STEERING BELLCRANK
2. AIRCHARGE VALVE
3. STEERING TORQUE TUBE
4. GEAR STRUT HOUSING
5. TORQUE LINK, UPPER
6. TORQUE LINK, LOWER
7. WHEEL
8. TIRE
9. FORK ASSEMBLY
10. STEERING LINK
11. DRAG LINKS, LOWER
12. SWITCH MOUNTING BRACKET
13. SPRINGS
14. DOWN LOCK LINK
15. DRAG LINK, UPPER
16. TIME DELAY VALVE
17. STEERING ARM
18. GEAR ACTUATING CYLINDER
19. GEAR RETRACTION ROD
20. FUSELAGE FRAME
21. LATCH ASSEMBLY
22. GEAR INDICATING SWITCH

Figure 7-2. Nose Landing Gear Installation

d. Repair to the landing gear is limited to reconditioning of parts such as replacing bearings and bushings, smoothing out minor nicks and scratches, repainting of areas where paint has chipped or peeled and replacement of parts. Service tolerances for wear of the various components may be found in Table VII-II.

7-11. INSTALLATION OF NOSE LANDING GEAR. (Refer to Figure 7-2.)

NOTE

When assembling any units of the landing gear, lubricate bearings and friction surfaces with proper lubricant as described in Section II.

a. Position the landing gear portion of the steering mechanism and the gear housing attachment point bushings so they align with the attachment points at the front of the tubular structure. From each outboard side install the stop bolt plate, bolt (ct), washer, nut and cotter pin. Tighten the pivot bolts to a snug fit, allowing the gear to swing free, and safety.

b. If the drag link assembly was removed, reinstall by the following procedure:

1. Ascertain that the linkage through center travel is within tolerance. (Refer to step c, Paragraph 7-10.)

2. Position the aft end of the drag link assembly (15) and install, from left to right, the attaching bolt, washer, nut and cotter pin.

3. Temporarily install the landing gear down limit switch (22) to the attachment bracket (12) on the drag links (11 and 15).

4. Connect the forward end of the drag link assembly (11) to the strut housing. Install, from each outboard side, a clevis bolt, washer, nut and cotter pin.

NOTE

A small right angle wire support lug is installed under the head of the left bolt, with its outstanding leg aft.

5. With the drag link assembly in the down and locked position and the retraction rod (19) fully extended, adjust the rod end until the attachment bolt can be freely inserted.

c. Check adjustment and operation of nose landing gear. (Refer to Paragraph 7-12.)

d. Check adjustment of nose gear down limit switch. (Refer to Paragraph 7-44.)

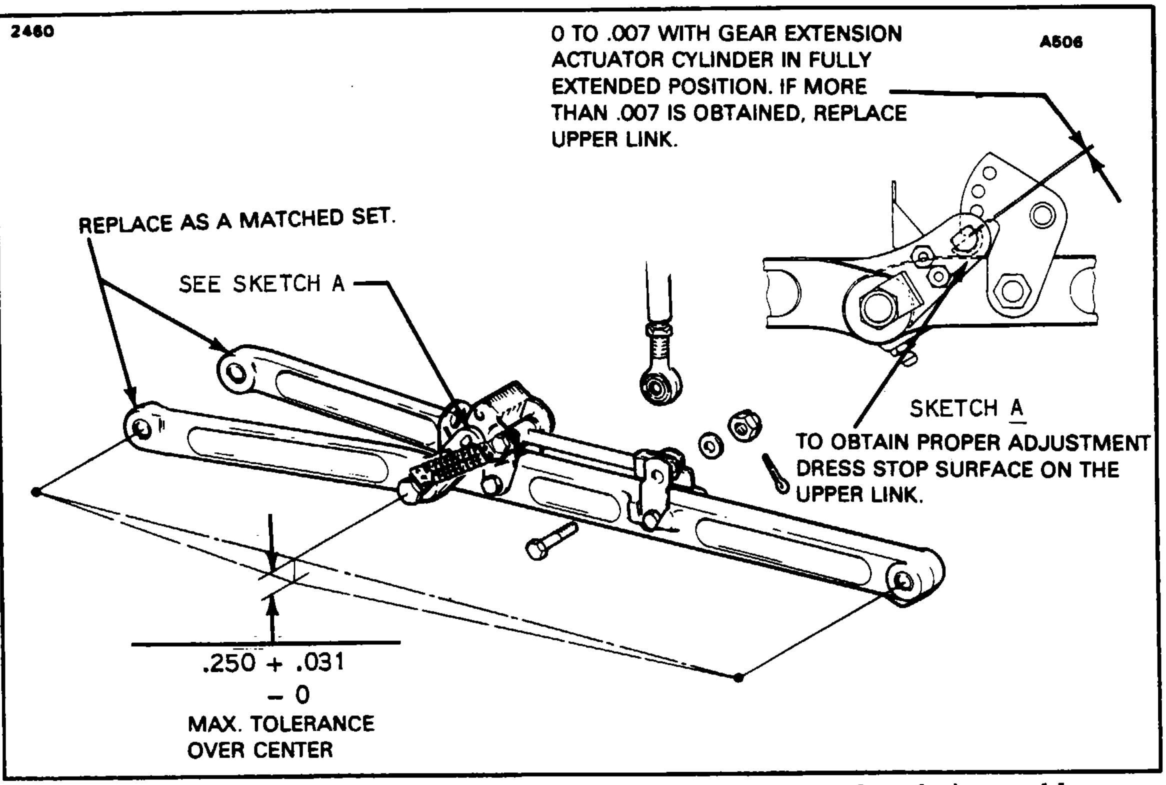


Figure 7-3. Adjustment of Nose Gear Drag Link and Latch Assembly

e. Check alignment of nose gear. (Refer to Paragraph 7-13.)

f. Lubricate the landing gear assembly. (Refer to appropriate Lubrication Chart, Section II.)

g. Lower the airplane and remove jacks.

h. Install canvas cover, if removed, around the upper side of the wheel well with screws and install access panels.

7-12. ADJUSTMENT OF NOSE LANDING GEAR.

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Disconnect the actuator cylinder from the upper drag link assembly, if not previously disconnected.

c. Check to determine that the gear housing is not restricted from swinging far enough forward as a result of the steering arm rollers pressing against the steering bellcrank, thus preventing the drag link assembly from dropping into the locked position. Should there be interference, remove the shims on the steering horn until after drag link adjustments are made. Readjust per Paragraph 7-13.

d. Ascertain that the piston rod of the actuating cylinder is in the fully extended position by operating the hand pump with the landing gear selector in the down position.

e. Disconnect the downlock springs, by removing cotter pin, nut and washer, and the bolt installed through the latch and link assembly. Reinstall the bolt and nut through catch and link.

NOTE

Ascertain that the actuating cylinder has one inch side play, measured at the rod end bearing with the cylinder fully extended. Adjust the actuating cylinder mounting bolt to allow sufficient clearance to permit this side play.

f. Holding the drag links in the down and locked position, adjust the rod end bearing of the actuator until the attaching bolt passes freely through the gear idler link and downlock link assembly. Secure rod end with bolt, washer, nut and cotter pin. Tighten jam nut on rod end against piston rod.

CAUTION

If the actuator is over-extended, the pressure may bend or snap the lock link.

g. Ascertain there is 0 to .007 of an inch clearance between the latch and hook. (Refer to Figure 7-3.)

NOTE

The stop surface on the upper link may be dressed to obtain the 0 to .007 of an inch clearance. If .007 is exceeded replace the upper link. The lower links are matched sets and should be replaced as sets.

h. Reassemble the downlock springs and secure with bolt, washer, nuts and cotter pins.
i. Using the hand pump or a hydraulic test stand, raise and lower the gear several times to determine proper operation of all components.
j. Adjust the gear up bumper block so that the strut housing compresses the rubber pad by approximately .062 of an inch.

NOTE

The strut housing is made to bear against the pad to eliminate up and down bouncing of the strut assembly. The bumper block provides the necessary solid resistance without damaging the gear.

k. Lower the airplane and remove jacks.

7-13. ALIGNMENT OF NOSE LANDING GEAR. Two methods of aligning the nose landing gear are as follows:

I. CHALK METHOD:

a. Remove the access panels from both sides of the nose section and relieve the rudder cable tension by loosening the turnbuckles.

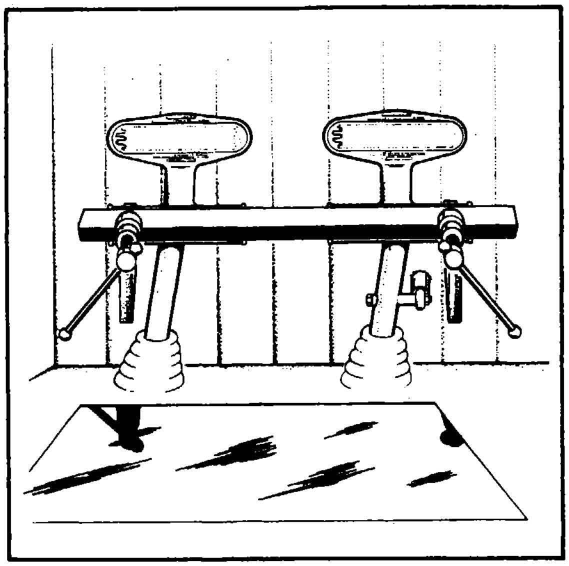


Figure 7-4. Clamping Rudder Pedals in Neutral

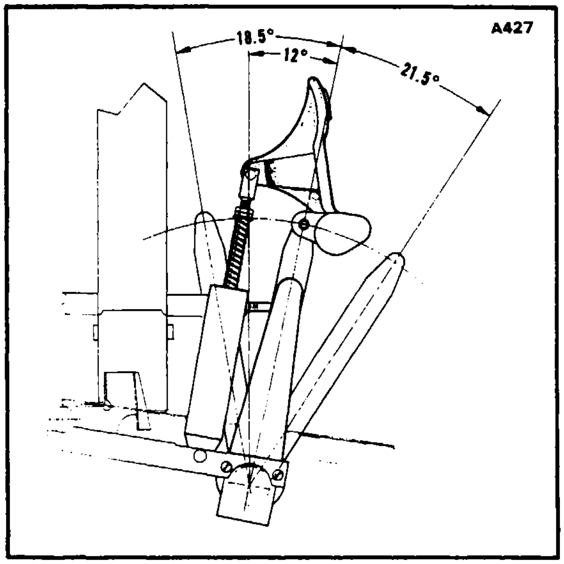


Figure 7-5. Rudder Pedals Neutral Angle

b. Place the airplane on a smooth level floor that will accommodate the striking of a chalk line.

c. Place the airplane on jacks. (Refer to Jacking, Section II.)

d. Level airplane laterally and longitudinally. (Refer to Leveling, Section II.)

e. From the center of the tail skid, extend a plumb bob and mark the contact point on the floor.

f. From the grease fitting, at the upper end of the drag link assembly, extend a plumb bob and mark the contact point on the floor.

g. Using the two plumb bob marks as a guide, snap a chalk line extending several feet beyond each mark.

h. On airplanes with an adjustable nose wheel steering link, check and, if required, adjust the link to maintain a 2.31 inch dimension between the center of the attaching end fittings.

i. Clamp rudder pedals to align in a lateral position. (Refer to Figure 7-4.)

j. To insure full travel of nose wheel, make sure no gaps exist at points where the steering arm travel bushings contact with the steering bellcrank. If gaps exist, install shims (.032, P/N 18874-00; .062, P/N 18874-02 or .125, P/N 18874-03) as required until a maximum gap of .032 of an inch exists between the steering bellcrank rollers and the steering arm.

k. Adjust the rod end bearings of each steering rod to align the nose wheel with the chalk line and to bring the rudder pedals into neutral angle fore and aft. (Refer to Figure 7-5.) The neutral angle of the pedals is 12 degrees aft of the vertical position, with the airplane level. To align the nose wheel straight forward, stand in front of the nose gear and align the center rib of the tire with the chalk line or lay a straightedge along the side of the tire and parallel the straight edge with the chalk line.

l. To check nose gear steering for its 15 degree maximum right and left travel, mark on each side of the nose wheel a 15 degree angle line from centerline and wheel pivot point. Turn wheel to maximum travel in both directions to check for allowable travel. Should travel be exceeded in one direction and not enough in the other direction, check for possible damage to the gear fork or torque links.

m. Adjust the shimmy dampener (refer to Figure 7-1, item 23) by means of its washers to give a good firm fit. If the collar is too tight, the result will be hard steering and, if too loose, nose wheel shimmy will be present. It may be necessary, at times, to try several combinations or thicknesses of washers to get the proper result.

n. Adjust rudder cable tension per Adjustment of Rudder Controls, Section V, and install the access panels.

II. JIG METHOD. (Refer to Figure 7-6.) Fabricate a jig tool conforming to specifications given in Figure 7-32.

a. Remove the access panels from both sides of the nose section and relieve the rudder cable tension by loosening the turnbuckles.

b. Place the airplane on jacks. (Refer to Jacking, Section II.)

c. Level the airplane laterally and longitudinally.

d. Attach the (fabricated) nose wheel jig to the back of the nose wheel at the axle.

e. Extend and attach a plumb bob from the grease fitting at the upper end of the drag link assembly.

f. On airplanes with an adjustable nose wheel steering link, check and if required, adjust the link to maintain a 2.31 inch dimension between the center of the attaching end fittings.

g. Clamp the rudder pedals to align in a lateral position. (Refer to Figure 7-4.)

h. To insure full travel of nose wheel, make sure no gaps exist at points where the steering arm travel bushings contact with the steering bellcrank. If gaps exist, install shims (.032, P/N 18874-00; .062, P/N 18874-02 or .125, P/N 18874-03) as required until a maximum gap of .031 of an inch exists between the steering bellcrank rollers and the steering arm.

i. Adjust the rod end bearings of each steering control rod to align the plumb bob with the centerline marked on the jig and to bring the rudder pedals into neutral angle fore and aft. The neutral angle of the pedals is 12 degrees aft of the vertical position, with the airplane level. (Refer to Figure 7-5.) Do not attempt to make the adjustment by means of one bearing, but divide the adjustment between the bearings at each end of the steering rods. Check that rod ends have sufficient gripping thread by ascertaining that a wire will not go through the check hole in the rod, and then tighten locknut.

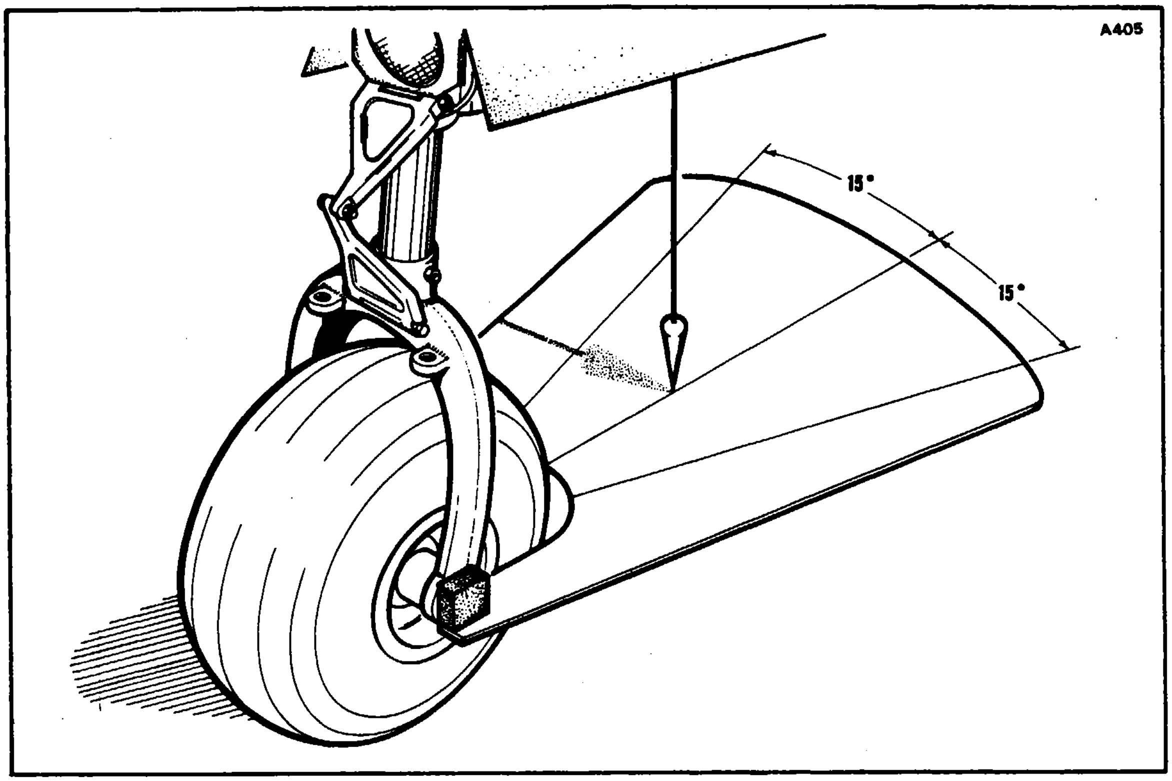


Figure 7-6. Aligning the Nose Gear

j. To check nose gear steering for its 15 degree maximum right and left travel, turn the nose wheel with jig attached in each direction to determine that the plumb bob aligns with the 15 degree marks on the jig. Should travel be exceeded in one direction and not enough in the other direction, check for possible damage to the gear fork or torque links.

k. Adjust the shimmy dampener (refer to Figure 7-1, Item 23) by means of its washers to give a good firm fit. If the collar is too tight, the result will be hard steering and, if too loose, nose wheel shimmy will be present. It may be necessary, at times, to try several combinations or thicknesses of washers to get the proper result.

l. Adjust the rudder cable tension per instructions in Section V and install the access panels.

7-14. NOSE GEAR DOOR ASSEMBLY.

7-15. REMOVAL OF NOSE GEAR DOOR ASSEMBLY. (PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.) (Refer to Figure 7-7.)

a. Disconnect the retraction rod assembly from the door by removing self-locking nut, washers, and bolt from each door half.

b. On PA-23-250 and PA-23-235 airplanes, the doors may be removed by removing the attaching bolt from each hinge. On PA-23-250 (six place) airplanes, the doors may be removed by removing the hinge pins from each door.

c. The operating mechanism may be removed by removing the bolts and washers from the bearing blocks on each side of the wheel well.

NOTE

The operating mechanism may be further disassembled as necessary.

7-16. CLEANING, INSPECTION AND REPAIR OF NOSE GEAR DOOR ASSEMBLY. (PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.)

a. Clean all parts with a suitable cleaning solvent.

b. Inspect the door for cracks or bent skin, loose hinge brackets and worn or corroded bearings.

c. Check the retracting mechanism for worn downlock spring and worn or damaged surfaces.

d. Repair to the door assembly is limited to replacing hinge bearings or rivets and mechanism parts, minor skin repairs and repainting.

7-17. INSTALLATION OF NOSE GEAR DOOR ASSEMBLY. (PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.) (Refer to Figure 7-7.)

a. Position the complete operating mechanism inside the wheel well and secure the bearing blocks with attaching bolts and washers.

b. On PA-23-250 and PA-23-235 airplanes, install the doors by positioning the doors and securing with attaching bolt. On PA-23-250 (six place) airplanes, install the gear doors by positioning the doors and installing a new hinge pin. The hinge pin ends should be bent to provide a safety.

c. Adjust the gear doors. (Refer to Paragraph 7-18.)

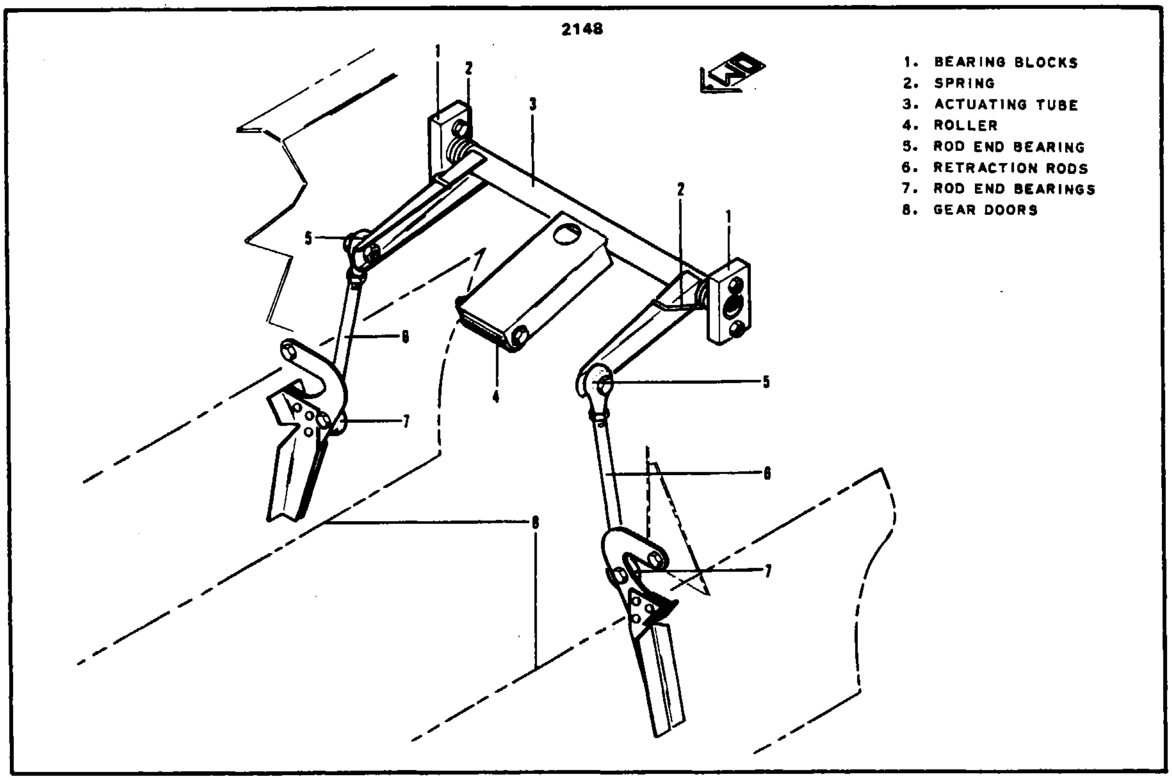


Figure 7-7. Mechanical Nose Gear Door Mechanism
PA-23-250; PA-23-235; and PA-23-250 (six place)
Serial Nos. 27-2000 to 27-2504 incl.

7-18. ADJUSTMENT OF NOSE LANDING GEAR DOORS. (PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.) (Refer to Figure 7-7.)

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Disconnect the nose gear door retraction rods, if not previously disconnected.

c. Using the hydraulic hand pump, raise the landing gear to the full up position.

d. Adjust the doors one at a time. Close the door to the stop and adjust the retraction rod so the connecting bolt passes freely through the hole in the rod and attachment bracket.

e. Disconnect the adjusted door and adjust the other door according to step d.

f. Extend the landing gear and connect both doors.

g. Retract the landing gear fully and ascertain the doors close properly and do not bind.

7-19. REMOVAL OF NOSE GEAR DOOR ASSEMBLY. (PA-23-250 (six place), Serial Nos. 27-2505 and up.) (Refer to Figure 7-8.)

a. Disconnect the rod assembly from the doors by removing the attaching self-locking nut and bolt.

b. The doors may be removed by removing the hinge pins from each door.

c. The operating mechanism may be removed by the following procedure:

1. If a downlock spring is installed, disconnect it from the left side of the wheel well by removing bolt, washer and bushing.
2. Disconnect the hydraulic actuating rod from the front door mechanism.
3. Remove the attaching bolts from the bearing blocks located on each side of the wheel well. Remove the operating mechanism.

NOTE

The operating mechanism may be further disassembled as necessary.

7-20. CLEANING, INSPECTION AND REPAIR OF NOSE GEAR DOOR ASSEMBLY. (PA-23-250 (six place), Serial Nos. 27-2505 and up.)

a. Clean all parts with a suitable cleaning solvent.

b. Inspect the outboard or inboard doors for cracks or bent skin, loose hinge brackets and worn or corroded bearings.

c. Repair to the door assemblies is limited to replacing hinge bearing, brackets or rivets, minor skin repairs and painting.

d. Refer to Section VI for repair of the actuating cylinder.

7-21. INSTALLATION OF NOSE GEAR DOOR ASSEMBLY. (PA-23-250 (six place), Serial Nos. 27-2505 and up.) (Refer to Figure 7-8.)

a. Position the complete operating mechanism inside the wheel well and secure the bearing blocks with attaching bolts.

b. Install the gear doors by positioning the doors and installing a new hinge pin. The hinge pin ends should be bent to provide a safety.

c. If previously installed, attach the downlock spring to the left side of the wheel well with bushing, washer and bolt.

d. Adjust the gear doors. (Refer to Paragraph 7-22.)

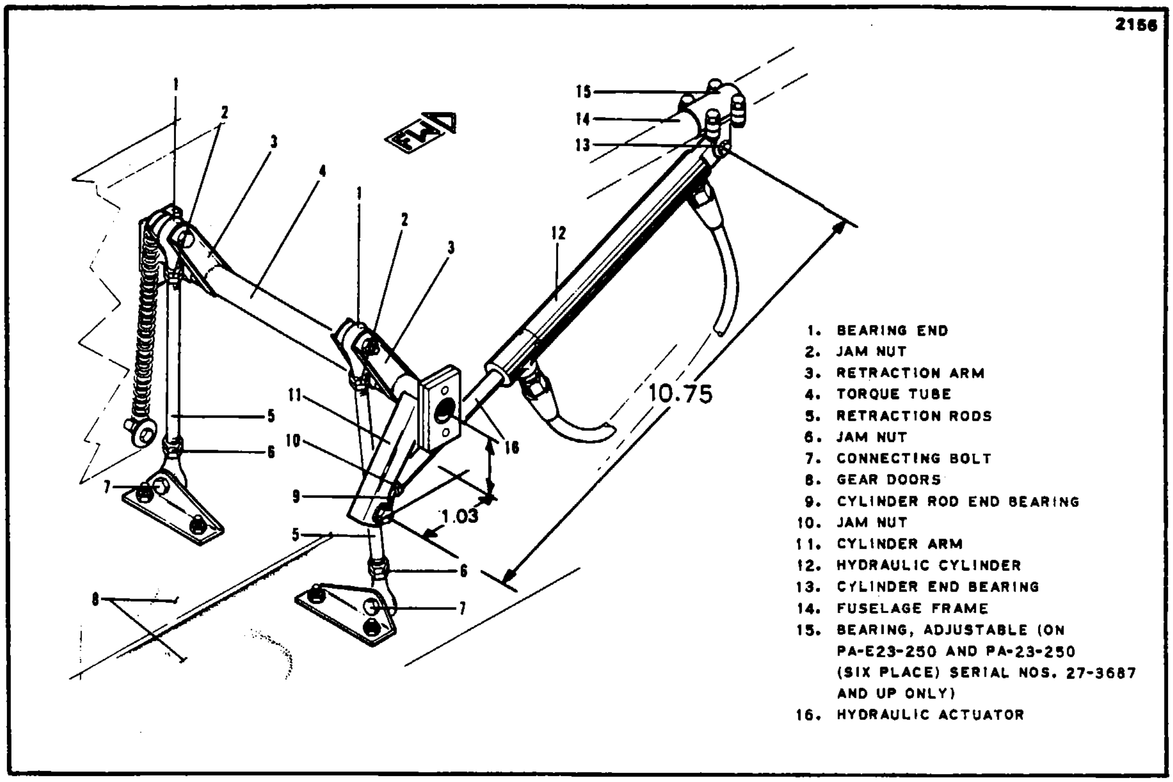


Figure 7-8. Hydraulic Nose Gear Door Mechanism
PA-23-250 (six place), Serial Nos. 27-2505 and up

7-22. ADJUSTMENT OF NOSE LANDING GEAR DOORS. (PA-23-250 (six place), Serial Nos. 27-2505 and up.) (Refer to Figure 7-8.)

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Disconnect the nose gear door retraction rods, if not previously disconnected.

c. Using the hydraulic hand pump, raise the landing gear to the fully retracted position.

d. Ascertain that the door actuator rod is fully extended and adjust the rod end bearing to give 10.75 inches from center of the rod end bearings to center of the cylinder end bearings.

e. Connect the actuating rod to the torque tube arm.

f. On PA-23-250 (six place), airplanes, Serial Nos. 27-3687 and up, with adjustable actuating cylinder attachment bracket, use the following procedure:

1. Loosen the attaching bolts holding the bracket in place on the fuselage frame.

2. With the actuator rod fully extended, move the bracket until a horizontal dimension of 1.03 inches is obtained between the center of the torque tube and the

actuating rod end bearing.

3. Tighten the attaching bolts securing the bracket to the fuselage frame.

g. Adjust doors one at a time. Close door to stop and with no load exerted on the cylinder, adjust retraction rods so the connecting bolts pass freely through their holes.

h. Extend the landing gear, connect both doors.

i. Retract the landing gear fully and ascertain that there is .031 of an inch between doors.

j. Take up each retraction rod two additional turns to pre-load the doors.

7-23. MAIN GEAR ASSEMBLY.

7-24. DISASSEMBLY OF MAIN GEAR OLEO. The main gear oleo assembly may be removed and disassembled from the gear oleo housing with the gear removed from or installed on the airplane. (Refer to Figure 7-9.)

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Place a drip pan under the main gear to catch spillage.

c. Remove air and fluid from the oleo strut. Depress the air valve core pin (27) until strut chamber pressure has diminished, remove the air charge valve (2) and, with a small hose, siphon as much hydraulic fluid from the strut as possible by compressing the strut to the top of the housing.

d. Disconnect the brake hydraulic lines just above the bracket on the main gear fork assembly (18).

e. Remove the torque link assembly (23 and 25) by removing the cotter pin, nut, washer, and bolt (close tolerance) from the strut housing (30) and fork assembly (18).

f. Release and remove the snap ring (14) from the annular slot at the bottom of the strut housing.

g. Pull the piston tube (15), with component parts, from the strut housing.

h. The piston tube components may be removed by reaching in the tube and pushing out the upper bearing retaining pins (7). Slide the upper bearing (6), spacer, lower bearing (10) with outer (9) and inner (11) "O" rings and wiper strip (12), washer (13) and snap ring (14) from the tube (15).

i. To remove the orifice tube (20), remove the bolt (1) and washer (4) from the top of the strut housing. Pull the tube from the housing.

j. The orifice plate (21) is removed from the bottom of the orifice tube by releasing the snap ring (22) that holds the plate in position.

k. To remove the piston tube plug (17) with "O" ring (16) located in the lower end of the tube, remove the bolt assembly at the top of the fork and insert a rod up through the hole in the body of the fork, pushing the plug out through the top of the tube.

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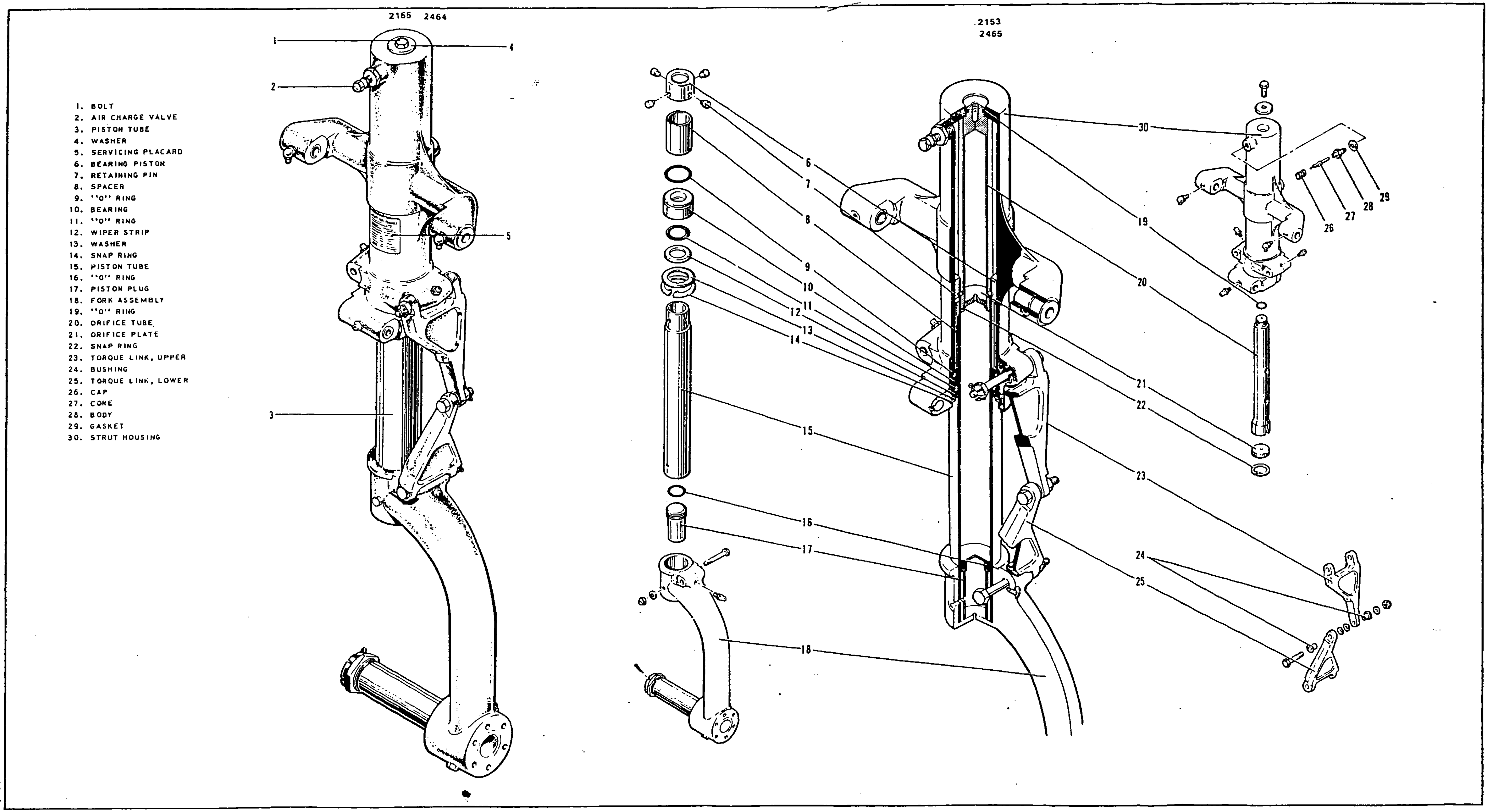


Figure 7-9. Main Gear Oleo Strut Assembly

7-25. CLEANING, INSPECTION AND REPAIR OF MAIN GEAR OLEO.

a. Clean all parts with a suitable dry type cleaning solvent.

b. Inspect the landing gear oleo assembly component for the following:

1. Bearings and bushings for excess wear, corrosion, scratches and overhaul damage.

2. Retaining pins for wear and damage.

3. Snap rings for cracks, burrs, etc.

4. Cylinder and orifice tube for corrosion, scratches, nicks and excess wear.

5. Orifice plate for hole restriction.

6. Fork tube for corrosion, scratches, nicks, dents and misalignment.

7. Air valve general condition.

c. Repair of the oleo is limited to smoothing out minor scratches, nicks and dents and replacement of parts. Service tolerance for wear of the various components may be found in Table VII-III.

7-26. ASSEMBLY OF MAIN GEAR OLEO. (Refer to Figure 7-9.)

a. Ascertain that parts are clean and inspected.

b. To assemble the fork assembly, press the tube end (15) into the fork body (18), aligning the bolt holes.

c. If a new tube is to be installed that has not been drilled, press the tube into the fork housing until it bottoms. Using the bolt holes in the fork body as a guide, drill a pilot hole and ream to .250 + .002 - .000 through each side of the tube wall. Remove burrs from the inside of the tube and flush the tube with a suitable solvent to remove all metal particles.

d. To install the piston tube plug (17), first lubricate the tube plug and "O" ring (16) with hydraulic fluid (MIL-H-5606) and install the "O" ring on the plug. Lubricate the inside wall of the tube, insert the plug into the top of the tube and push it to the fork end. Align the bolt holes and install bolt assembly.

e. If desired, cement a cork in the hole in the bottom of the fork body to prevent dirt from entering the fork tube.

f. To assemble the orifice tube (20), insert the orifice plate (21) into the bottom of the tube. Secure the plate with the snap ring (22). Lubricate and install "O" ring (19) on the upper end of the tube.

g. Insert the tube up through the bottom of the strut housing (30). With the tube exposed through the top of the housing install the packing, washer (4) and bolt (1). The bolt should only be installed finger tight at this time.

h. The fork tube assembly may be assembled by installing the tube components on the tube. In the following order slide onto the tube, the snap ring (14), washer (13), wiper (12), lower bearing (10) with outer and inner "O" rings (9 and 11), spacer (8) and upper bearing (6). Align lock pin holes of the upper bearing and orifice tube and install pins (7).

i. Lubricate the inner wall of the cylinder. Carefully insert the piston tube assembly into the bottom of the housing, allowing the orifice tube to guide itself into the piston tube, until the snap ring can be installed in the annular slot at the end of the cylinder.

j. At the top of the housing, tighten the orifice tube retaining bolt (1) and safety.

k. Install the torque link assembly (23 and 25) using bolt (ct), washer, nut and cotter pin.

NOTE

The bolt should be installed with one of the flat sides of the hex head against the milled stop on the torque links.

l. Connect the brake line.

m. Lubricate the gear assembly. (Refer to Lubrication Chart, Section II.)

n. Compress and extend the strut several times to ascertain that the strut will operate freely. The weight of the gear wheel and fork should allow the strut to extend.

o. Service the oleo strut with fluid and air. (Refer to Servicing Oleo Struts, Section II.)

p. Bleed the brake system. (Refer to Paragraph 7-74.)

q. Align the landing gear. (Refer to Paragraph 7-31.)

r. Lower the airplane and remove jacks.

7-27. REMOVAL OF MAIN LANDING GEAR. (Refer to Figure 7-10.)

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Place a drip pan under the landing gear to be removed to catch spillage.

c. Disconnect the brake line fitting at the main spar.

d. At the left gear only, disconnect the hydraulic line fittings from the anti-retraction valve (3).

e. Remove the clamp around the landing gear strut housing, holding the down lock indicator switch wire.

f. Disconnect the lower drag links (17) from the landing gear strut housing (2) by removing cotter pin, nut, washer and bolt (ct).

g. Remove the cotter pin and nut from the landing gear attaching bolts.

h. Remove the landing gear attaching bolts (ct) (24) with their stop (20), by reaching through an opening in the wing ribs.

NOTE

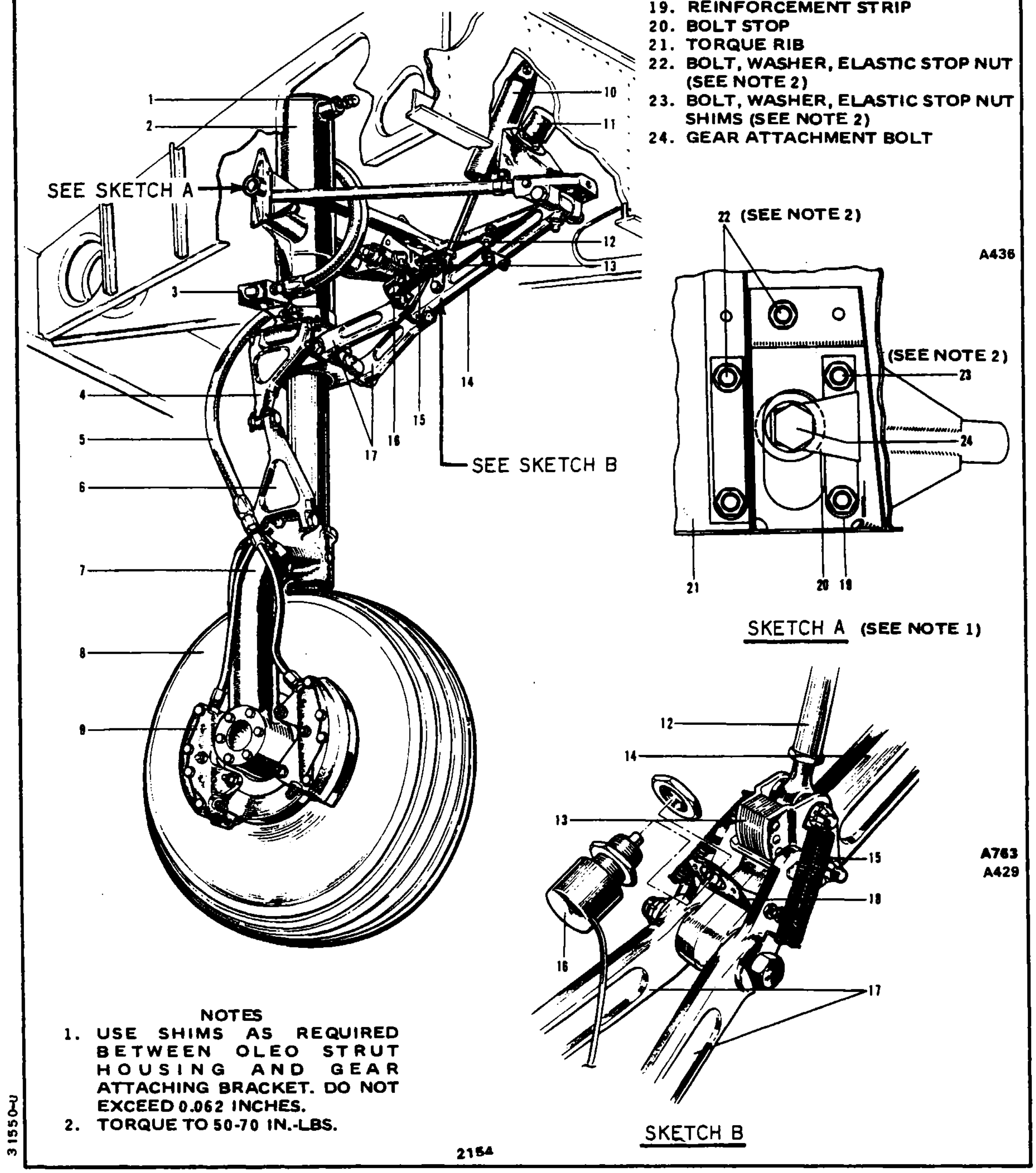
It may be necessary to remove the fabric dust cover from the openings in the wing rib.

i. Remove the landing gear.
j. If the drag link assembly is to be removed, use the following procedure:
1. Disconnect the gear retraction rod (12) from the drag link assembly (14 and 17) by removing cotter pin, nut, washers and bolt.
2. Lower the drag link and remove the downlock indicating switch (16).
3. Remove the attaching cotter pin, nut, washer and bolt from the upper drag link assembly and remove the assembly.

7-28. CLEANING, INSPECTION AND REPAIR OF MAIN LANDING GEAR.

a. Clean all parts with a suitable cleaning solvent.
b. Inspect the landing gear assembly components for the following unfavorable conditions:
1. Bolts, bearings, bushings and ball joints for excessive wear, corrosion and damage.
2. Gear housing, drag links, rods and attachment cracks, bends or misalignment.
3. Downlock springs for wear, corrosion and not returning to complete compression.
4. General condition of limit switches.
5. Wiring for fraying, poor connections or conditions that may lead to failures.
c. Attach the upper and lower drag links and check that there is 0 to .007 of an inch clearance between the latch hook and pin. Dress upper and lower link stop surfaces to obtain minimum clearance. Also check that when the stop surfaces touch, linkage is 0 to .031 inch through center. (Refer to Figure 7-11.) Should this distance exceed the required through center travel and bolt and bushings are tight, replace one or all drag links.
d. Repair to the landing gear is limited to reconditioning of parts such as replacing bearings and bushings, smoothing out minor nicks and scratches, repainting of areas where paint has chipped or peeled and replacement of parts. Service tolerances for wear of the various components may be found in Table VII-III.

1. AIRCHARGE VALVE
2. GEAR STRUT HOUSING
3. ANTI-RETRACTION VALVE
4. TORQUE LINK, UPPER
5. BRAKE LINE
6. TORQUE LINK, LOWER
7. FORK ASSEMBLY
8. TIRE
9. BRAKE HOUSING
10. GEAR ACTUATING CYLINDER
11. TIME DELAY VALVE
12. RETRACTION ROD
13. LATCH ASSEMBLY
14. DRAG LINK, UPPER
15. SPRINGS
16. INDICATING SWITCH
17. DRAG LINK, LOWER
18. SWITCH MOUNTING BRACKET
19. REINFORCEMENT STRIP
20. BOLT STOP
21. TORQUE RIB
22. BOLT, WASHER, ELASTIC STOP NUT (SEE NOTE 2)
23. BOLT, WASHER, ELASTIC STOP NUT SHIMS (SEE NOTE 2)
24. GEAR ATTACHMENT BOLT



NOTES
1. USE SHIMS AS REQUIRED BETWEEN OLEO STRUT HOUSING AND GEAR ATTACHING BRACKET. DO NOT EXCEED 0.062 INCHES.
2. TORQUE TO 50-70 IN.-LBS.

Figure 7-10. Main Landing Gear Installation (Left)

7-29. INSTALLATION OF MAIN LANDING GEAR. (Refer to Figure 7-10.)

NOTE

When assembling any units of the landing gear, lubricate bearings and friction surfaces with proper lubricant as described in Section II.

NOTE

On high time aircraft the main gear attaching brackets may become worn or bolts become loose. Access may be obtained by removing fabric dust covers from the openings in the wing rib to remove the bracket or tighten the bolts. Torque bolts to 50-70 in. lbs.

a. Position the landing gear and install, from each outboard side, the stop plate (20), bolt (ct) (24), nut and cotter pin. Torque the five outer bolts to 50-70 in. lbs.

NOTE

Install shim washers, AN960-816L, as required, between gear strut and gear attaching bracket to prevent side movement of the landing gear. Do not add washers to exceed 0.062 of an inch.

b. If the drag link was removed, reinstall by the following procedure:

1. Ascertain that linkage through center travel is within tolerance as described in paragraph 7-28.
2. Position the aft end of the drag link assembly and install from left to right, bolt (ct), washer, nut and cotter pin.
3. Temporarily install the landing gear down limit switch (16) to the drag link assembly (14 and 17).
4. Connect the forward end of the drag link assembly to the strut housing (2) by installing from right to left, bolt (ct), washer, nut and cotter pin.

NOTE

A small right angle wire support lug is installed under the head of the bolt, with its outstanding leg down.

c. Adjust the main landing gear. (Refer to Paragraph 7-30.)
d. At the left gear only, connect the hydraulic lines to the anti-retraction valve (3) and fill the Powerpak Resevoir. (Refer to Filling Powerpak Reservoir, Section II.)
e. Connect the brake line at the fitting on the main spar and fill the brake cylinder reservoir. (Refer to Filling Brake Cylinder Reservoir, Section II.)
f. Check alignment of main landing gear. (Refer to Paragraph 7-31.)
g. Lubricate the landing gear assembly. (Refer to the Lubrication Chart, Section II.)

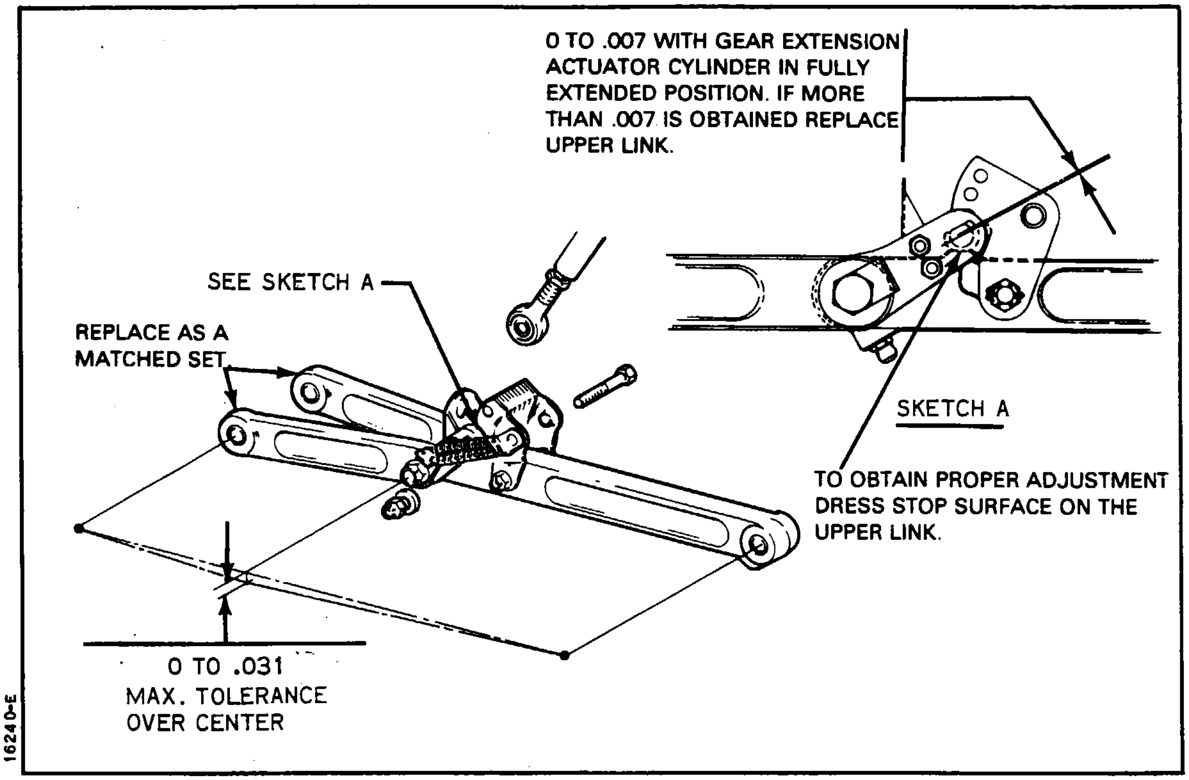


Figure 7-11. Adjustment of Main Gear Drag Link and Latch Assembly

h. Install access covers, lower airplane and remove jacks.

7-30. ADJUSTMENT OF MAIN LANDING GEAR. (Refer to Figure 7-10.)

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Remove the bolt connecting the actuator cylinder retraction rod (12) end bearing to the downlock latch (13).

c. Determine that the piston rod (12) of the actuating cylinder (10) is in the fully extended position by re-cycling the power pack manually.

NOTE

Ascertain that the actuating cylinder has one inch side play, measured at the rod end bearing with the cylinder fully extended. Adjust the actuating cylinder mounting bolt to allow sufficient clearance to permit this side play.

d. Loosen the rod end bearing jam nut at the end of the piston rod. Adjust the end bearing by turning it in the internally threaded end of the piston rod until the attaching bolt passes freely through the gear downlock link assembly and the bearing. This adjustment should be made with the latch springs (15) detached and manually holding the latch (13) in the closed position. When assured that the bolt is not binding, tighten jam nut and reassemble springs.

CAUTION: IF THE ACTUATOR IS OVEREXTENDED, RATHER THAN OBTAINING THE FREE FIT FOR THE BOLT AS DESCRIBED ABOVE, EXCESSIVE PRESSURE MAY BEND OR SNAP THE DRAG LINKS.

e. Ascertain there is a 0 to .007 of an inch clearance between the latch and hook.

NOTE: The stop surface on the upper link may be dressed to obtain the 0 to .007 of an inch clearance. If .007 is exceeded replace the upper link. The lower links are matched sets and should be replaced as sets.

f. Raise and lower the gear by means of the hand pump and check to see if there is any interference encountered by the downlock latch and the stop. If it operates smoothly and the latch completely seats itself, the adjustment is correct.

g. Lower the airplane and remove jacks.

7-31. ALIGNMENT OF MAIN LANDING GEAR WHEEL.

a. Place a straightedge no less than twelve feet long across the front of both main landing gear wheels. Butt the straightedge against the tire at the hub level. Devise a support, or use a box, to hold the straightedge in this position.

b. Set a square against the straightedge and check to see if its outstanding leg bears on the front and rear sides of the tire. (Refer to Figure 7-12.) If it touches both outboard sides of the tire, the landing gear is correctly aligned. The toe-in for these wheels is 0 degrees.

NOTE: A carpenter's square, because of its especially long legs, is recommended for this check.

c. If the square contacts the rear side of the tire, leaving a gap between it and the front side of the tire, the wheel is toed-in. If a gap appears at the rear, the wheel is toed-out.

NOTE: At the point where the upper and lower torque links connect, the upper link is positioned forward of the lower link.

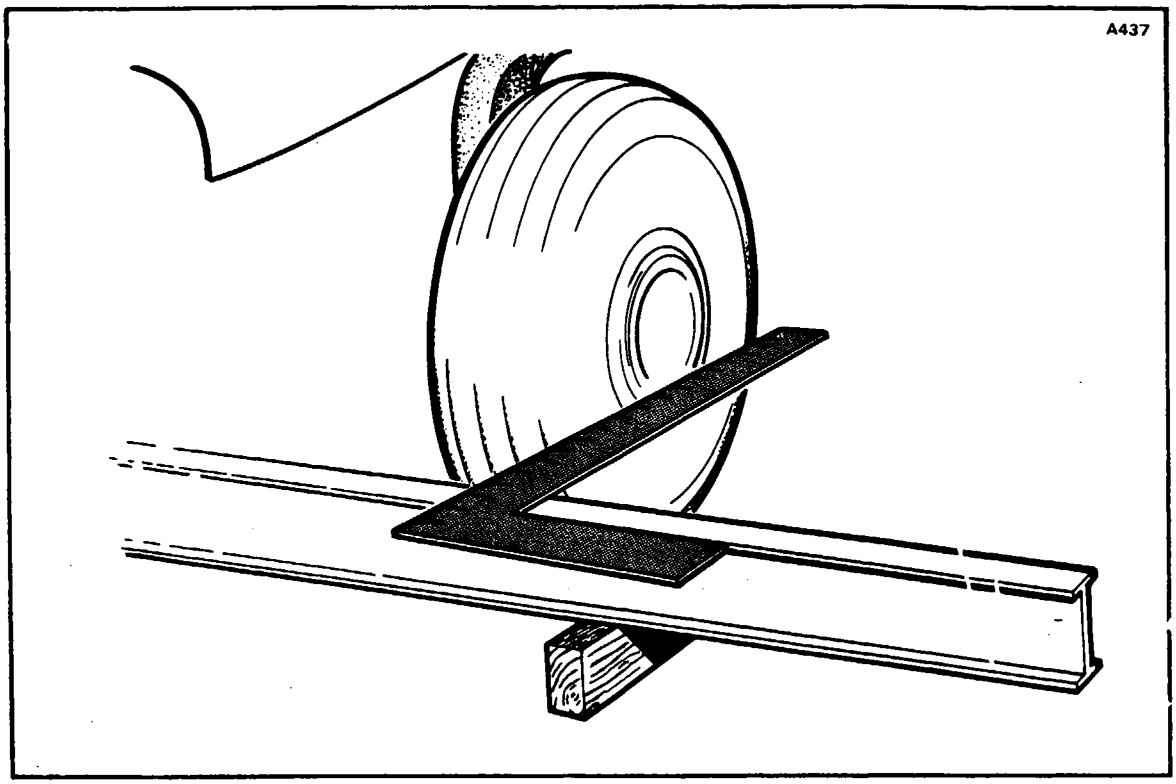


Figure 7-12. Aligning Main Gear

d. Rectify a toed-in condition by removing the cotter pin, castellated nut and bolt at the common pivotal point of the scissor and bushing assembly torque links. On the left landing gear remove a spacer between the two links. If this same condition exists on the right landing gear, it will be necessary to remove a spacer between the two links. Reassemble the torque links.

e. Recheck the wheel alignment. If corrected, safety the castellated nut with a cotter pin. If this condition still exists, add or remove washers in the same manner mentioned in the preceding step.

f. Rectify a toed-out condition on the left landing gear by disconnecting the torque links from each other and add a spacer between the links. It will be necessary to add a spacer between the links on the right landing gear. Reconnect the links and recheck the alignment.

g. If still further adjustment is required, repeat procedure mentioned in preceding step.

NOTE

When adding spacers between the torque links, limit the number installed so that the safety hole is accessible to the cotter pin.

7-32. MAIN GEAR DOOR ASSEMBLY.

7-33. REMOVAL OF MAIN GEAR DOOR AND ACTUATOR ASSEMBLY. (PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 inclusive.)

a. Disconnect the retraction rods from the door hinges by removing the self-locking nut, washer and bolt from each door half.

b. Remove the doors by removing the attaching bolts from the nacelle door hinge brackets.

c. Remove the machine screws securing the bottom of the door springs to the wheel well.

d. Remove the actuating mechanism by removing the bolts, bushings and washers securing the upper end of the link assembly to the wheel well bulkhead.

NOTE

The actuating mechanism may be further disassembled as necessary.

7-34. CLEANING, INSPECTION AND REPAIR OF MAIN GEAR DOOR ASSEMBLY. (PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 inclusive.)

a. Clean all parts with a suitable cleaning solvent.

b. Inspect the outboard or inboard doors for cracks or bent skin, loose hinge brackets and worn or corroded bearings.

c. Repair to the door assemblies is limited to replacing hinge bearing, brackets or rivets, minor skin repairs and painting.

7-35. INSTALLATION OF MAIN GEAR DOOR AND ACTUATOR ASSEMBLY. PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 inclusive.) (Refer to Figure 7-13.)

a. Ascertain that the actuating mechanism is fully assembled.

b. Position the actuating mechanism inside the wheel well and secure with washer, bushing and bolt.

c. Attach the door springs to the sides of the wheel well with machine screws.

d. Position the doors and install the attaching bolts.

e. Adjust the main gear doors for proper operation. (Refer to Paragraph 7-36.)

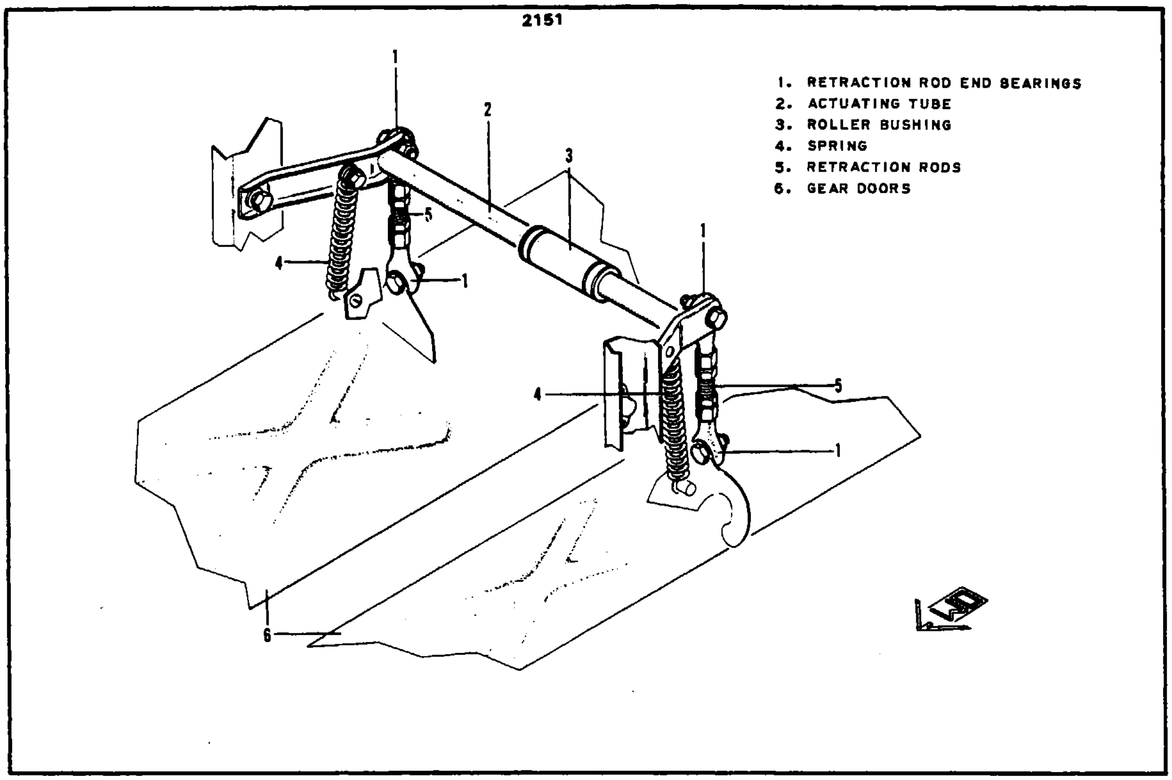


Figure 7-13. Mechanical Main Gear Door Mechanism
PA-23-250; PA-23-235; and PA-23-250 (six place),
Serial Nos. 27-2000 to 27-2504 incl.

7-36. ADJUSTMENT OF MAIN GEAR DOORS. (PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.) (Refer to Figure 7-13.)

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Disconnect the main gear door retraction rods, allowing the doors to hang free.

c. Using the hand pump, retract the landing gear to the fully retracted position.

d. Adjust the doors one at a time. Close the door and adjust the aft retraction rod to allow the aft end of door to fit snug against the nacelle. Adjust the forward retraction rod to allow the attaching bolt to be freely installed.

CAUTION

Over-shorting of the forward retraction rod will draw the door up into the wheel well, warping the door.

e. Disconnect the adjusted door and adjust the other door in a like manner.

f. Using a hand pump, extend the gear and connect all retraction rods.

g. Operate the landing gear and ascertain the doors close evenly, but do not bind. If the doors do not close evenly, readjust the retraction rod of the lower door until they fit evenly.

h. After the doors have been adjusted as previously described, the following checks should be made:

1. Do not permit the hinge edge of either door assembly to strike the nacelle skin when the gear is extended and the doors are open. If they do, adjust the main gear cover actuating tube assembly to provide no less than 0.062 of an inch clearance between the edges of the doors and the skin. On new doors, it may be necessary to trim the hinge edge to provide this clearance.

2. When the landing gear is extended, see if there is a minimum clearance of 6.875 of an inch between the interior surface of the inboard door and the confronting side of the piston portion of the fork and piston assembly.

3. It is necessary to have a minimum of from 0.187 of an inch clearance between the landing gear and the adjacent components.

7-37. REMOVAL OF MAIN GEAR DOOR AND ACTUATOR ASSEMBLY. (PA-23-250 [six place], Serial Nos. 27-2505 and up.) (Refer to Figure 7-14.)

a. The main gear doors may be removed by the following procedure:

1. Disconnect the retraction rods from the doors by removing self-locking nut and bolt from the front doors and the self-locking nut from the aft door.

2. Remove the hinge pins from each door removing each door.

b. The main gear door operating mechanism may be removed by the following procedure:

1. Disconnect the hydraulic actuator rod from the mechanism by removing self-locking nut, washers, and bolt.

2. Remove the connector rod by removing cotter pin, washers, pin, and spring, if installed.

3. Remove the four retraction rods and disconnect the spring where installed by removing self-locking nuts, washers, bolts and the spring bushing.

4. Remove the rivets securing the forward tube assemblies to the aft tube assemblies.

5. Remove the aft tube assemblies by drawing them aft through the main spar.

6. Remove the forward tube assemblies by removing the bearing blocks from the sides of the wheel well.

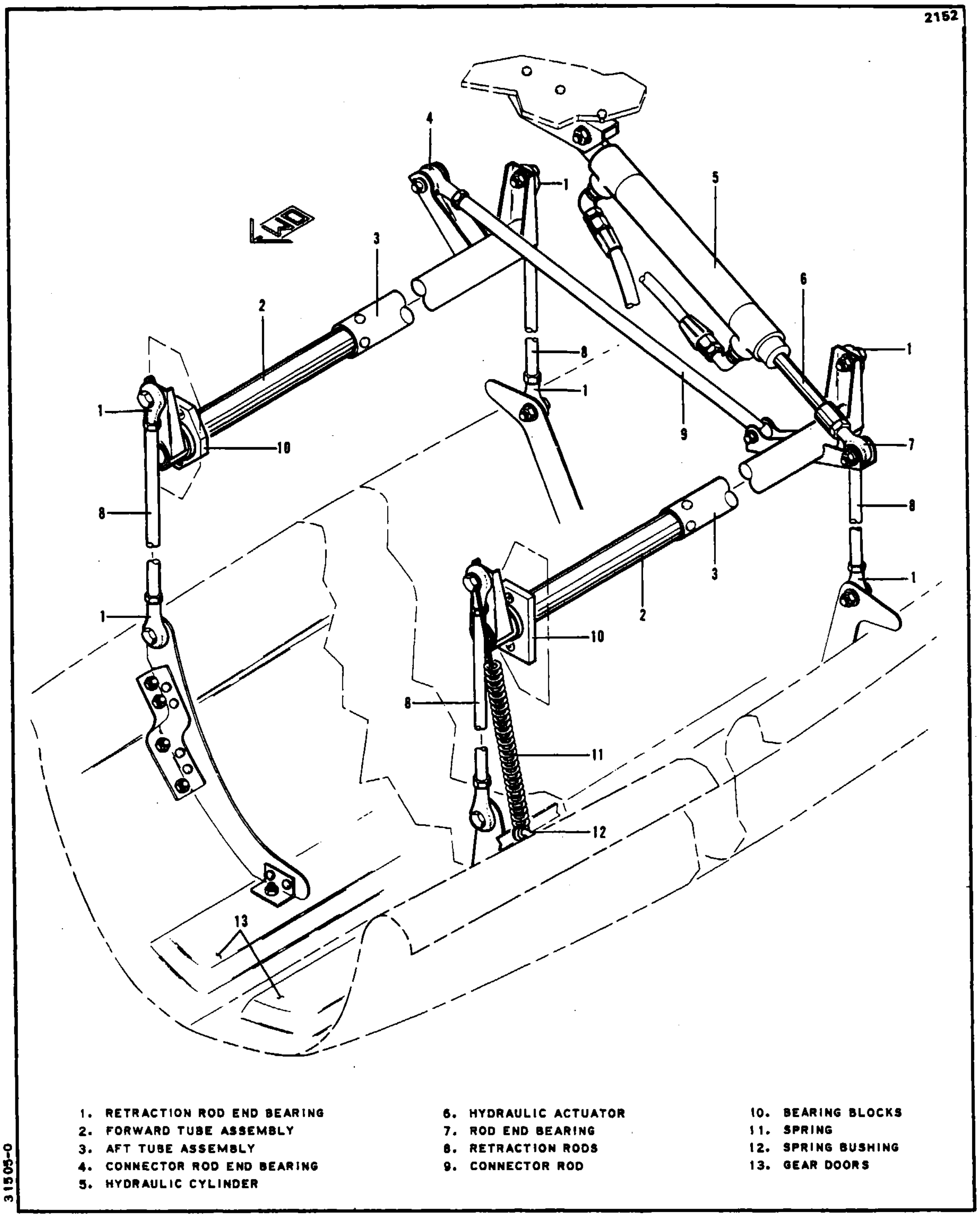


Figure 7-14. Hydraulic Main Gear Door Mechanism
PA-23-250 (six place) Serial Nos. 27-2505 and up

7-38. CLEANING, INSPECTION AND REPAIR OF MAIN GEAR DOOR ASSEMBLY. (PA-23-250 [six place], Serial Nos. 27-2505 and up.)

a. Clean all parts with a suitable cleaning solvent.

b. Inspect the outboard or inboard doors for cracks or bent skin, loose hinge brackets and worn or corroded bearings.

c. Repair to the door assemblies is limited to replacing hinge bearing, brackets or rivets, minor skin repairs and painting.

d. Refer to Section VI for Repair of the Actuating Cylinder.

7-39. INSTALLATION OF MAIN GEAR DOOR AND ACTUATOR ASSEMBLY. (PA-23-250 [six place], Serial Nos. 27-2505 and up.) (Refer to Figure 7-14.)

a. The main gear door operating mechanism may be installed by the following procedure:

1. Install the aft tube assemblies by inserting them forward through the main spar.

2. Install the forward tube assemblies with bearing blocks. Insert the forward tubes into the aft tubes and secure the bearing blocks to the wheel well wall.

3. Align the holes in the tube assemblies and secure together with CR2249-4-2 rivets.

4. Adjust the connector rod to measure 11.312 inches between center line of each attachment hole.

5. Install the adjusted rod to the tube assemblies with pin, washers and cotter pin. Install the spring if previously removed from this position.

6. Install the four retraction rods and spring, where installed, with bolts, washers, self-locking nut and spring bushing.

b. The gear doors may be installed by positioning the doors and installing a new hinge pin. Bend the ends of the hinge pin over to provide a safety.

c. Adjust the main gear doors. (Refer to Paragraph 7-40.)

7-40. ADJUSTMENT OF MAIN LANDING GEAR DOORS. (PA-23-250 [six place], Serial Nos. 27-2505 and up.) (Refer to Figure 7-14.)

a. Disconnect the main gear door retraction rods and static anti-closing spring, allow the doors to hang clear.

b. Place the airplane on jacks. (Refer to Jacking, Section II.)

c. Retract the landing gear fully.

d. Adjust the retraction rod for the rear door so the rod attaches to the door freely with the door tight against its stops.

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e. With the door actuator rod fully extended from the gear door cylinder, adjust the rod end to give 10.88 inches from center of rod end bearing to center of cylinder end bearing. If the door cylinder is removed to obtain this measurement, reinstall at this time.

f. Ascertain that the connector rod is 11.312 inches in length between the center of each attaching point.

g. Adjust doors one at a time. Close door to stop and with load exerted on the cylinder, adjust retraction rods so the connecting bolts pass freely through their holes.

h. Disconnect the adjusted door and adjust the other door in a like manner.

i. Using the hand pump, extend the landing gear, connect both doors.

j. Retract the landing gear fully and ascertain that there is .031 inch between doors.

k. Take up all four retraction rods two turns.

l. Using the hand pump, operate the landing gear and ascertain the doors close tight, but do not bind.

7-41. ADJUSTMENT OF LANDING GEAR LIMIT SWITCHES.

7-42. ADJUSTMENT OF NOSE GEAR UP LIMIT SWITCH. (Refer to Figure 7-17.) The nose gear up limit switch, located just above the upper drag link assembly and aft of the timer check valve on PA-23-250 (six place), Serial Nos. 27-2505 and up, may be adjusted by the following procedure:

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Remove the access panel from the left side of the nose section by releasing fasteners. (Refer to Access Plates and Panels, Section II.)

c. Unsnap the canvas cover over the nose wheel well.

d. Using the hand pump, retract the landing gear to the fully retracted position.

e. On models with the early switches, adjust the switch by loosening the locknut and the switch mounting nut. Then rotate the nuts in whichever direction provides the necessary clearance. The switch actuator should be depressed just far enough to actuate and close the circuit. Tighten the mounting and locknut. On the later switches, rest the spacing tool on switch actuator button between the upper drag link and the switch actuator and adjust by rotating nut so that the tool fits snugly.

f. Extend the landing gear, resnap the canvas cover, connect the gear doors, replace the access panel and remove the jacks.

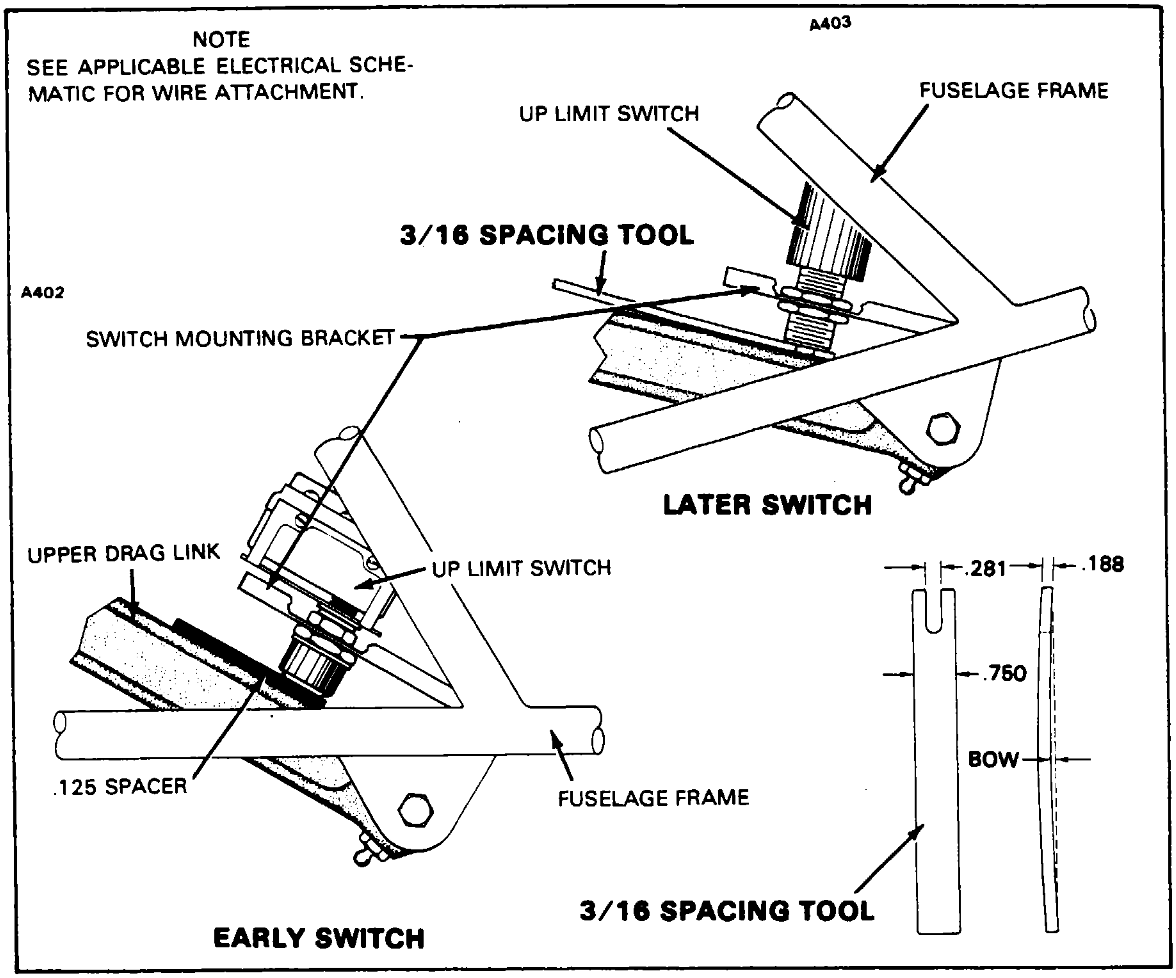


Figure 7-17. Adjustment of Nose Gear Up Limit Switch

7-43. ADJUSTMENT OF MAIN GEAR UP LIMIT SWITCH. (Refer to Figure 7-18.) The main gear up limit switch, located just above the aft drag assembly on PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 inclusive and on the forward side of the main spar adjacent to the gear door mechanism on the PA-23-250 (six place), Serial Nos. 27-2505 and up, may be adjusted by the following procedure:

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. Disconnect the door retraction rods and allow the doors to hang free.

c. Using the hand pump, retract the landing gear to the fully retracted position.

d. On the models with the early switches, adjust the switch by loosening the locknut and the switch mounting nut. Then rotate the nuts in whichever direction provides the necessary clearance when a .125 inch spacer is placed between the upper drag link and the switch actuator. On models with the later switches, rest tool on switch actuator button between the upper drag link and the switch actuator. Adjust in same manner as above. For configuration of tool, refer to Figure 7-17.

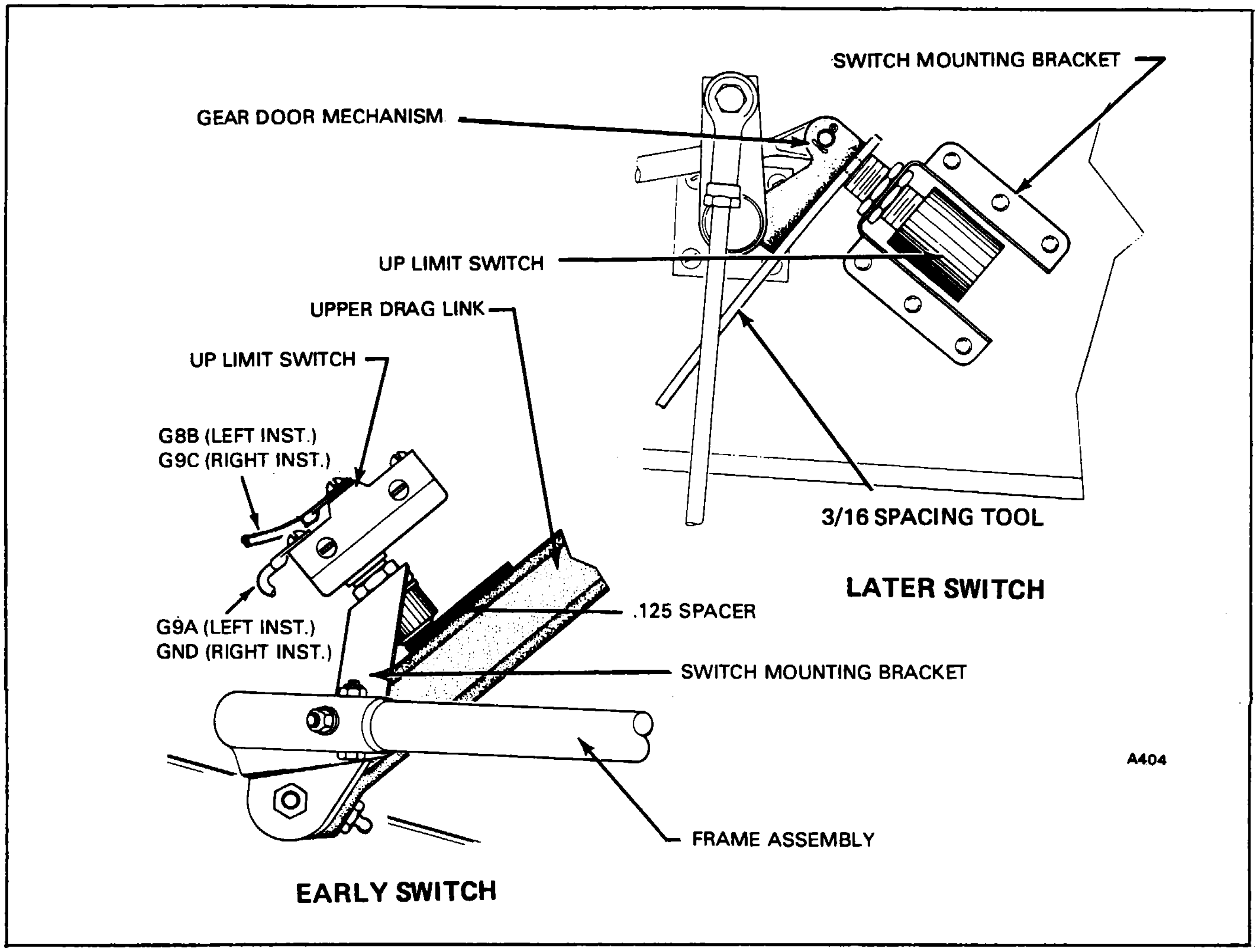


Figure 7-18. Adjustment of Main Gear Up Limit Switch

e. Adjust the switch so that the actuator is completely depressed with the .125 inch spacer or 3/16 inch spacing tool (depending on type of switch) inserted. Tighten the mounting nut until it bears against the bracket and tighten the locknut to secure the switch.

f. Extend the gear, connect the door retraction rods and remove the jacks.

7-44. ADJUSTMENT OF LANDING GEAR DOWN LIMIT SWITCHES. (Refer to Figure 7-19.) The adjustment of the landing gear down limit switches is common to all three landing gears and may be accomplished by the following procedure:

a. Ascertain that the downlocks are properly adjusted. (Refer to Paragraphs 7-12 and 7-30.)

b. Rest tool on switch actuator button between the latch and the switch actuator. Adjust the switch by loosening the locknut and the switch mounting nut. Then rotate the nuts in whichever direction provides the necessary clearance for snug fitting of tool. For configuration of tool, refer to Figure 7-17.

c. Adjust the switch so that the actuator is completely depressed with the 3/16 inch spacing tool inserted. Tighten the mounting nut until it bears against the bracket and tighten the locknut to secure the switch.

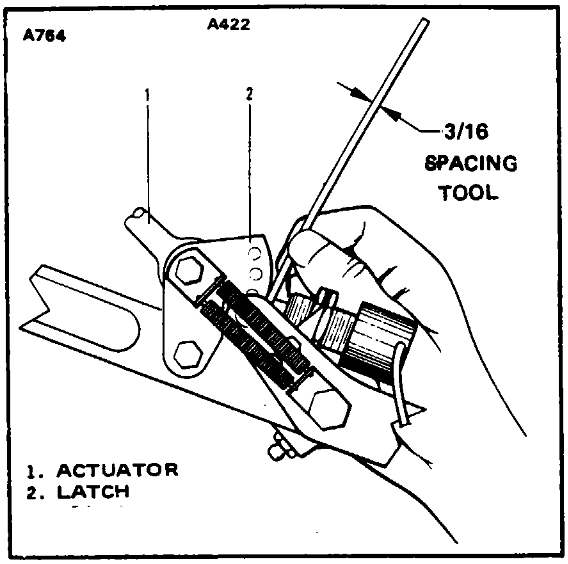


Figure 7-19. Adjustment of Landing Gear Down Limit Switches

7-45. LANDING GEAR WARNING SYSTEM.

7-46. REMOVAL OF GEAR WARNING SWITCHES.

a. Remove the access plate on the left side of the control pedestal.

b. Disconnect the cannon plug inside the access opening.

c. Remove the knobs from the throttle mixture and propeller control levers.

d. Remove the flap and landing gear selector knobs, by removing the Allen screw from the flap knob and the nut and bolt from the landing gear knob.

e. Disconnect the carburetor heat or alternate air knobs on the pedestal control placard. Extend the control knob approximately one inch. Unscrew the outside knob and remove the spring. Unscrew the inside knob and the outside nut that secures the cable to the placard. (The removed cables should be marked for identification.)

f. Remove the attaching screws from around the upper pedestal control cover and remove the cover with placard attached.

g. Disconnect the wiring from the micro switches and mark them for identification.

h. Remove the warning switches and striker plate by removing the two round headed machine screws, nuts and washers securing them in place.

7-47. INSTALLATION OF GEAR WARNING SWITCHES.

a. Position the warning switches and striker plate in the bracket and secure with round headed machine screws, washers and self-locking nuts.

b. Connect the wiring to the warning switches. (Refer to Wiring Schematic, Section XI.)

c. Install the upper pedestal cover with placard attached.

d. Connect the carburetor heat or alternate air knobs. Screw on the nut that secures the cable to the placard. Screw on the inside nut. Install the spring and screw on the outside nut.

e. Install the flap and landing gear selector knobs to their respective handles.

f. Connect the cannon plug inside the left access opening.

g. Install the access plate to the left side of the pedestal.

h. Install the knobs to the control levers.

7-48. ADJUSTING GEAR WARNING SWITCHES. (Refer to Figure 7-20.) The following is a procedure for adjusting the gear up warning light and warning horn micro-switches which are located in the control pedestal at the base of the throttle levers. In S/N's 27-4426, 27-4574 thru 27-7405476, the two outer switches actuate the warning horn and the center switch actuates the warning light. In S/N's 27-7554001 and up, all switches actuate the warning horn and the warning light.

The ground adjustment procedure, as outlined in this paragraph, should allow the landing gear warning light to flash and the warning horn to operate when the power is reduced below approximately 12 inches of manifold pressure with the aircraft in normal descent and the landing gear retracted.

a. Start and run up the engines with propellers set for high RPM.

b. For adjustment of the warning horn and warning light activation, advance the throttles and then retard them until approximately 5 inches of manifold pressure is indicated above the desired in-flight pressure previously stated. Mark the throttles in some manner as a reference for adjusting the gear up warning light and horn switches.

c. Shut the engines down.

d. Retard the throttles to the location, as marked above, which gave the proper manifold pressure indication for the operation of the warning horn and light. Adjust the center switch up or down through the control travel slots until a clicking sound is heard when the switch activates. To check, retard the throttle controls until it is ascertained that the switches actuate at the proper location.

e. Retard the throttles again to the same mark and adjust and check the outer switches in a like manner.

f. To check the horn and light operation, jack the airplane and retract the landing gear. In S/N's 27-4426, 27-4574 thru 27-7405476, with the master switch on, retard one throttle first and then the other until the gear up indicator light comes on. Check the location of the throttle to the adjusting mark. Retard both throttles together and check the warning horn adjustment. The warning horn should not operate when only one throttle is retarded. In S/N's 27-7554001 and up, with the master switch on, retarding either throttle or both to the adjusting mark should actuate both the indicator light and horn.

g. With the warning horn operating, lower the gear to insure that the horn and light cease to operate when the gear is down and locked.

h. Remove the aircraft from the jacks.

i. Flight test the aircraft to insure operation of the warning system when the gear is up and power is reduced to the desired manifold pressure. Also, reduce power on one engine and insure the light operation.

j. If the light and horn fail to operate at the desired settings, mark the throttles at the proper manifold pressure and repeat the preceding adjustment procedure.

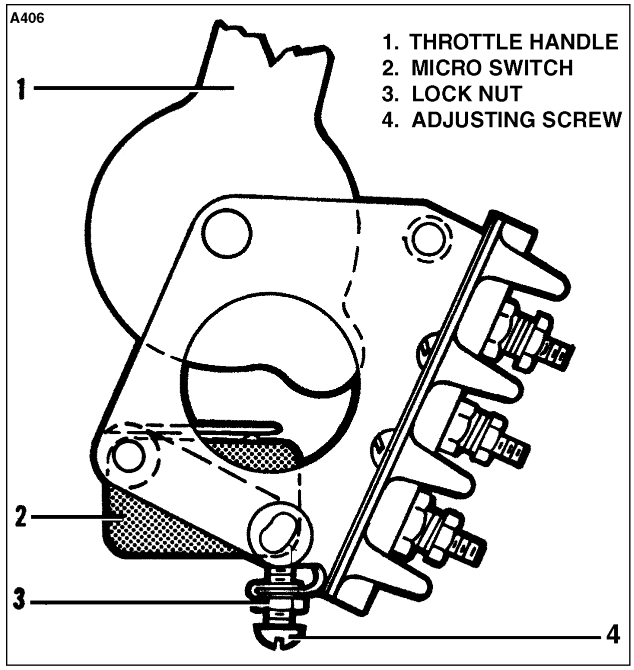


Figure 7-20. Landing Gear Warning Switches

7-49. WHEELS.

7-50. REMOVAL AND DISASSEMBLY OF NOSE WHEEL. (Refer to Figure 7-21.)

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. To remove the nose wheel, remove the axle tie rod nut, tie rod and axle plugs. Insert a 1-7/16 inch diameter tube into the fork and tap out the axle from the wheel assembly.

c. Flex the fork enough to remove the wheel spacers and to allow the wheel to clear the fork assembly.

d. The wheel halves (1 and 2) may be separated by first deflating the tire. With the tire sufficiently deflated, remove the wheel through bolts (3). Pull the wheel halves from the tire by removing the wheel half (2) opposite the valve stem first and then the other half.

e. The wheel bearing assemblies may be removed from each wheel half by first removing the screws that secure the grease seal, and then the retainers (8), grease seals (9) and bearing cones (7). The bearing cups (6) should be removed only for replacement and may be removed by tapping out evenly from the inside.

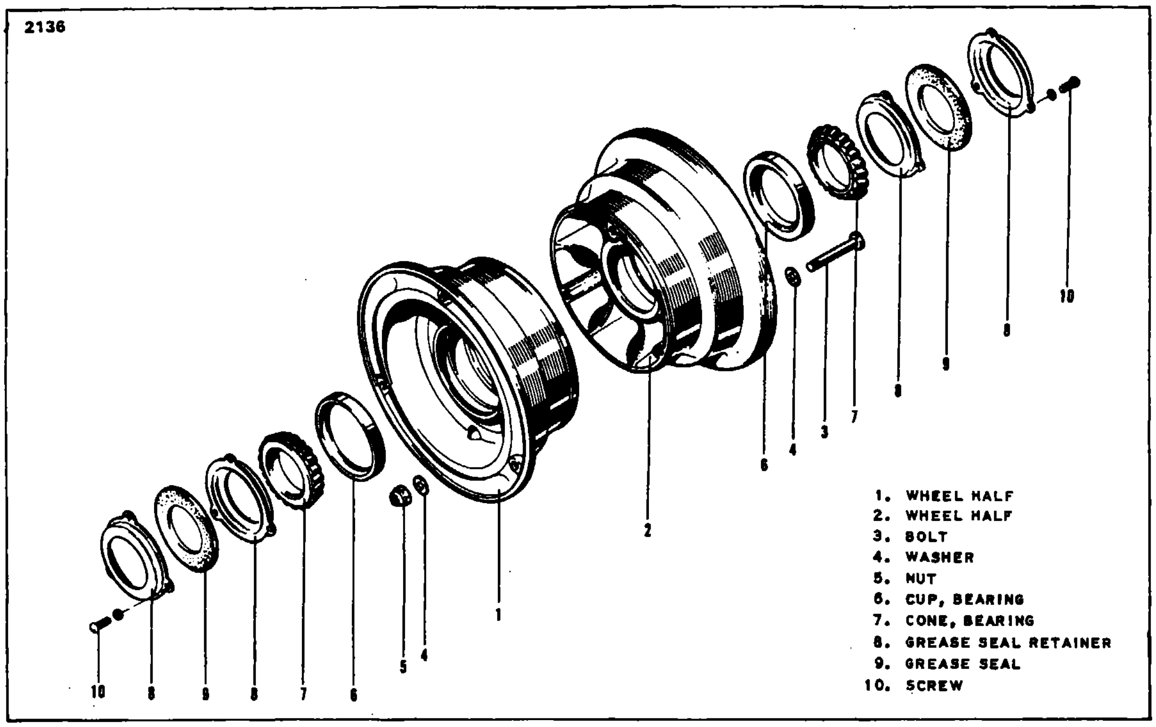


Figure 7-21. Nose Wheel Assembly

7-51. INSPECTION OF NOSE WHEEL ASSEMBLY.

a. Visually check all parts for cracks, distortion, defects and excess wear.

b. Check tie bolts for looseness or failure.

c. Check internal diameter of felt grease seals. Replace the felt grease seal if surface is hard or gritty.

d. Check tire for cuts, internal bruises and deterioration.

e. Check bearing cones and cups for wear and pitting and relubricate.

f. Replace any wheel casting having visible cracks.

7-52. ASSEMBLY AND INSTALLATION OF NOSE WHEEL. (Refer to Figure 7-21.)

a. Ascertain that the bearing cup (6) in each wheel half (1 and 2) is properly installed. Install the tire and join the two wheel halves. Install the through bolts with the nuts to the wheel stem side; torque to the specification given on the wheel and inflate the tire. (Refer to paragraph 7-76 for balancing.) Lubricate the bearing cones (7) and install the cones, grease seals (9) and seal retainer (8). Secure with screws (10).

b. Flex the fork enough to allow for the installation of the wheel and spacer tubes. Insert the axle tube, fork caps and tie bolt. Adjust the tie bolt nut to allow the wheel to turn free, yet not fit loose on the axle.

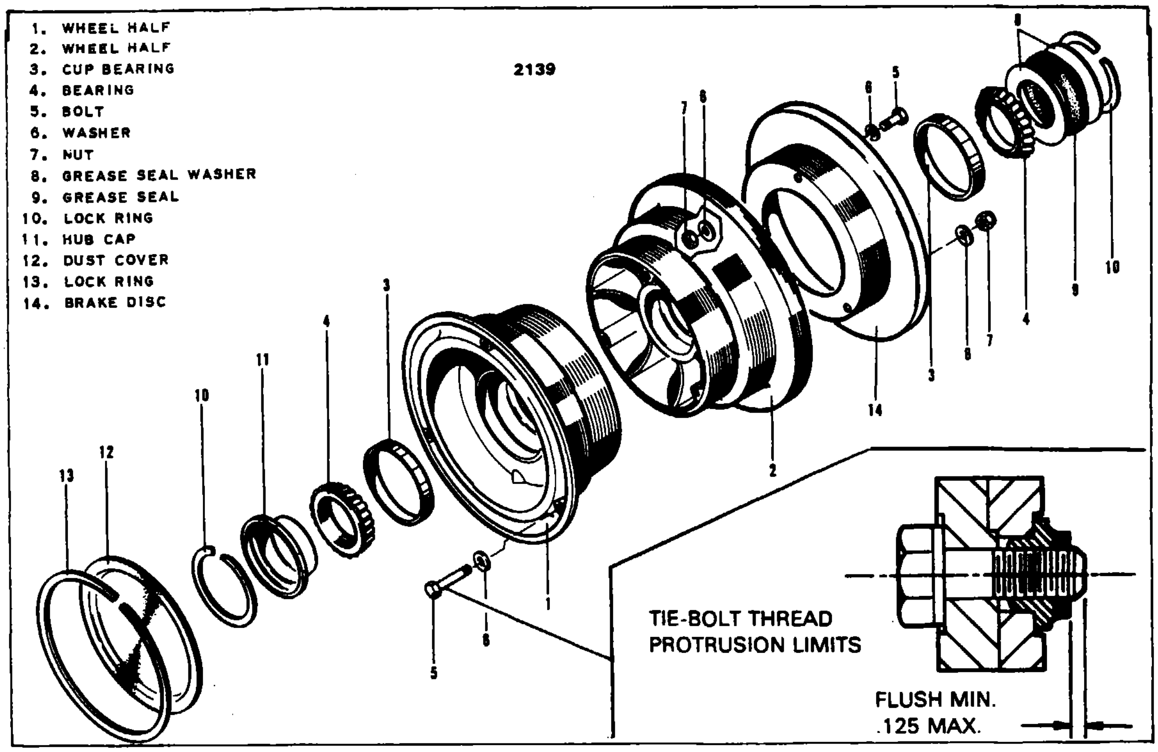


Figure 7-22. Main Wheel Assembly

7-53. REMOVAL AND DISASSEMBLY OF MAIN WHEEL. (Refer to Figure 7-22.)

a. Place the airplane on jacks. (Refer to Jacking, Section II.)

b. To remove the main wheels, remove the four bolts that join brake cylinder and lining back plate assemblies.

c. Remove the brake assembly.

d. Remove the lock ring (13) that secures the dust cover (12) and the lock ring (10) securing the hub cap (11). Remove the cotter pin and axle nut. Slide the wheel off the axle.

e. The wheel may be disassembled by deflating the tire and removing the lock ring (10) securing the grease seal (9) and seal washers (8) from the inner wheel half (2). Remove the bearing cones (4) and loosen and remove the bolts securing the wheel halves. The bearing cups (3) should be removed only for replacement and may be removed by tapping evenly from the inside.

7-54. INSPECTION OF MAIN WHEEL ASSEMBLY. (Refer to Figure 7-22.) It is advisable to clean the assembly thoroughly before inspection. Degrease all parts and dry thoroughly. A soft bristle brush may be used to remove hardened grease, dust or dirt.

WARNING

Quick drying cleaning solvents are toxic and volatile. Use in well ventilated areas only. Avoid contact with skin or clothing and do not inhale vapors.

a. Visually inspect the bearing cones for nicks, scratches, water staining, spalling, heat discoloration, roller wear, cage damage, cracks or distortion. Replace cones if defective or worn.

b. Inspect wheel bearing grease for contamination and solidification at each periodic maintenance inspection. Repack wheel bearings in accordance with lubrication charts in Section II of this manual.

c. Inspect wheel halves for cracks, corrosion, and other damage. Cracked or badly corroded castings should be replaced. Small nicks, scratches, or pits can be blended out using fine (400 grit) sandpaper.

d. Inspect snap rings and grease seals for distortion or wear. Replace any item damaged or deformed. Saturate the grease seal felts with SAE 10 oil (do not soak).

e. Inspect bearing cups for looseness, scratches, pitting, corrosion, or evidence of overheating. If evidence of any defect exists, replace the bearing cup. Refer to paragraph 7-55 for replacement procedures. Coat cups with clean bearing grease.

f. Inspect the brake disc assembly for cracks, excessive wear or scoring, rust and corrosion. Remove rust and blend out small nicks, using fine (400 grit) sandpaper. Refer to Table VII-I for wear limits.

g. Inspect wheel bolts for cracks, corrosion or any other damage. Replace cracked bolts.

h. Inspect self-locking nut for the self-locking feature. Replace any nuts with damaged or destroyed self-locking feature.

TABLE VII-I. WHEEL AND BRAKE WEAR LIMITS

WHEEL ASSY. NO.	BRAKE ASSY. NO.	DISC MIN.	LINING MIN. PRESS. PLATE	LINING MIN. BACK PLATE
3080 B	37-200-2	.657	.097 (1) /.103 (2)	.097 (1) /.103 (2)
3080 D	37-200A	.657	.097 (1) /.103 (2)	.097 (1) /.103 (2)
40-131	30-96	.525	.100	.100

Footnotes: 1. Refers to Riveted Lining only.
2. Refers to Bonded Linings including back plate.

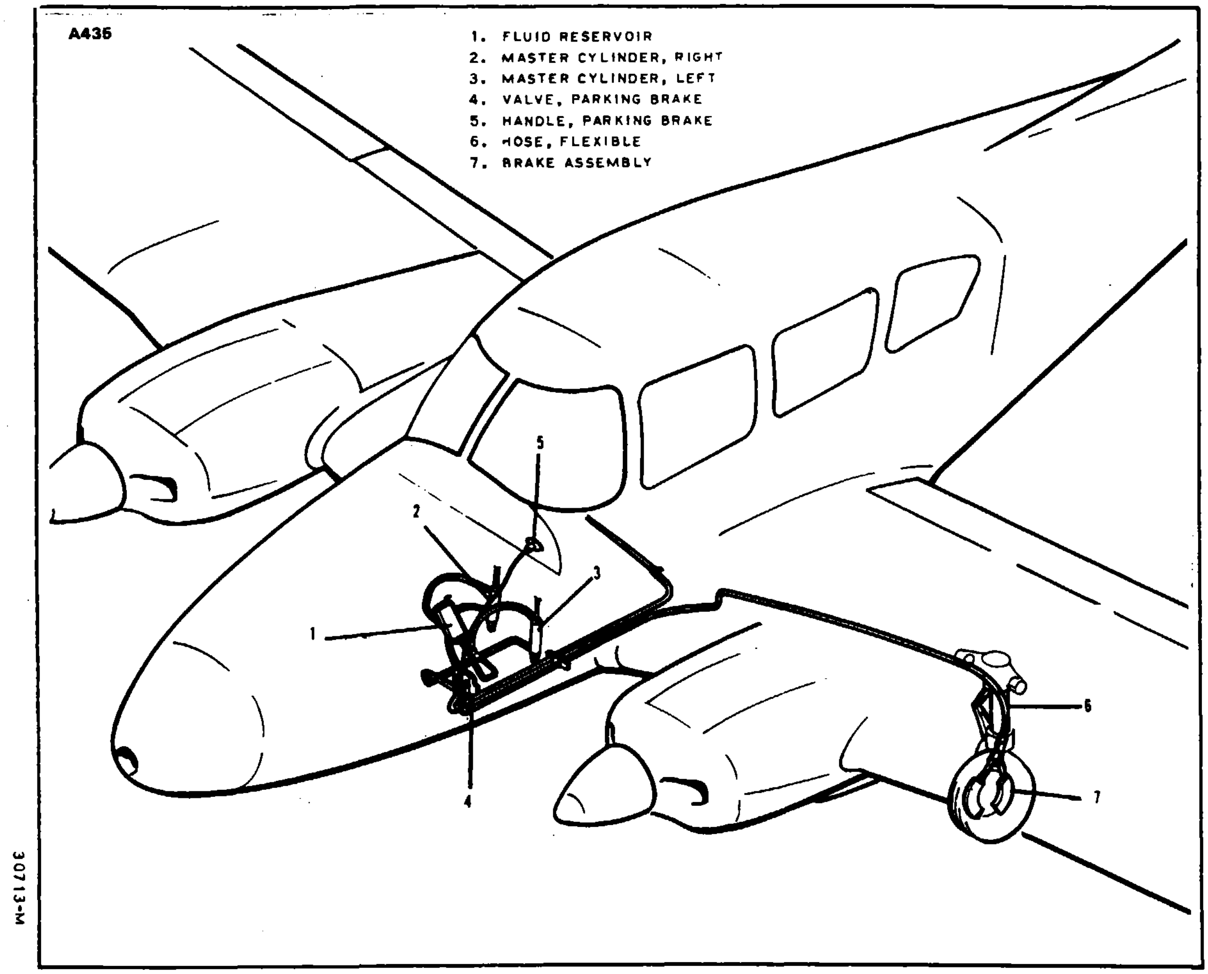


Figure 7-23. Brake Installation

7-55. REPAIR OF MAIN WHEEL ASSEMBLY. (Refer to Figure 7-22.) Repairs to the main wheel assembly are limited to blending out small nicks, scratches, gauges and areas of slight corrosion, plus the replacement of parts which are cracked or badly worn or corroded.

NOTE

Corrosion originates at points where the protective wheel coating is ruptured. All traces of corrosion and residue must be removed before wheel halves are treated and repainted. (Corrosion residue accelerates the corrosion process.)

a. Bearing Cup Replacement:

1. Heat wheel half in boiling water for one hour, or in an oven not exceeding 250°F (121°C) for 30 minutes.

2. Remove wheel half from source of heat. Bearing cup should be loose enough to fall out of the bearing bore when wheel half is inverted. If the cup does not drop out, tap evenly from bore with a fiber drift pin.

3. To install new bearing cup, repeat step 1, and chill the bearing cup in dry ice.

4. Remove wheel half from source of heat and bearing cup from dry ice.

5. Dry chilled bearing cup and coat contacting surface with zinc chromate primer.

6. Install the chilled bearing cup in the heated wheel half. Tap gently and evenly into place, using a fiber drift pin or suitable arbor press.

b. Repainting of of Main Wheel Repaired Surfaces:

1. Thoroughly clean any repaired surfaces and areas of the wheel from which paint has been removed.

2. Paint the exposed areas with one coat of primer and one coat of aluminum lacquer.

CAUTION

Never paint the working surfaces of the bearing cups.

7-56. ASSEMBLY AND INSTALLATION OF MAIN WHEEL. (Refer to Figure 7-22.)

a. Ascertain that the bearing cup (3) in each wheel half (1 and 2) is fully seated in the wheel housing. Install the through bolts with the bolt heads opposite the brake disc side and torque to 90 inch-pounds. Inflate the tire. (Refer to paragraph 7-76 for Tire Balancing.)

NOTE

Visually inspect thread protrusion on assembled and torqued wheel assembly. Thread protrusion should be flush to .125 maximum. Bolts that are below flush or beyond maximum should be replaced with P/N AN4-7A tie bolt (Refer to figure 7-22).

b. Lubricate the bearing cones (4). Install cone, grease seal (9) and seal washers (8) in inner wheel half (2) and secure with lock ring (10).

c. Place the wheel on the axle and install axle nut. Tighten to allow the wheel to run free yet not fit loose on the axle. Safety nut and install the hub cap (11) and dust cover (12) securing with lock rings (10 and 13).

d. Install the brake assembly by installing the brake cylinder on the torque plate, positioning the spacer, lining back plate, and installing the six bolts securing assembly. If the brake line was disconnected, reconnect and bleed brakes.

7-57. BRAKE SYSTEM.

7-58. WHEEL BRAKE ASSEMBLY.

7-59. BRAKE ADJUSTMENT AND LINING TOLERANCES. No adjustment of the brake clearance is necessary as they are self-adjusting. Inspection of the lining is necessary, and it may be inspected visually while installed on the airplane. The linings are of the riveted type and the bonded type. The riveted type need not be replaced until the thickness of any one segment becomes worn to limits given in Table VII-I. The bonded type need not be replaced until the thickness of any one segment, including back plate, becomes worn to limits given in Table VII-I. The linings should be replaced any time they become worn unevenly. Refer to Table VII-I for wear limits for the particular assemblies in question.

7-60. REMOVAL AND DISASSEMBLY OF WHEEL BRAKE ASSEMBLY. (Refer to Figure 7-24.)

a. Place a drip pan around the landing gear and disconnect the brake lines from the cylinder housing.

b. Cut the safety wire and remove the self-locking cap bolts (18) that secure the backing plates (1) to the brake cylinder housing (12). Remove the backing plate, shim spacer block (5). On 37-200A brake assemblies, remove the pressed fiber shim (2) between the backing plate and the shim spacer block.

c. Slide the brake cylinder housing from the torque plate (21) by removing the self-locking nuts (19) and washers (20) from the anchor bolts (13).

d. Remove the pressure plate (7) by removing the nut (17), washer (16), retraction spring (15) and the sleeve (14) from the outside center of the brake cylinder housing (12).

e. The pistons may be removed (9) by injecting low air pressure in the cylinder fluid inlet and forcing the pistons from the housing.

f. Check anchor bolt for wear.

g. Remove anchor bolt by the following procedure:

1. Position cylinder assembly on a holding fixture. (Refer to Figure 7-26.)
2. Use a suitable arbor press to remove the anchor bolt from the cylinder body.

h. Install anchor bolt by the following procedure:

1. Support anchor bolt in a holding fixture. (Refer to Figure 7-26, Step A.)
2. Align cylinder body over anchor bolt. (Refer to Figure 7-26, Step B.)
3. Use a suitable arbor press and apply pressure on the spot face directly over the anchor bolt hole. (Refer to Figure 7-26, Step C.)

7-61. CLEANING, INSPECTION AND REPAIR OF WHEEL BRAKE ASSEMBLY. (Refer to Figures 7-24 and 7-25.)

a. Clean all metal parts, insulators, and O-rings with denatured alcohol, (gasoline and dry cleaning fluids will damage O-rings). If O-rings are damaged or worn excessively, they should be replaced.

b. Inspect the brake cylinder for cracks, nicks, corrosion, damaged threads, etc. Inspect both inlet and outlet hydraulic ports for foreign contaminates. Examine cylinder walls for scoring or excessive wear. Blend and polish light scratches in piston cavities with fine emery cloth (600 grit). Castings that are cracked or have damaged threads should be replaced.

c. Inspect anchor bolts for cracks, corrosion, permanent set, and excessive wear. Replace bolts that are bent, cracked or severly corroded.

d. Inspect pistons for cracks, nicks, burrs or excessive wear. Remove burrs and blend out nicks, using fine emery cloth (600 grit) and clean thoroughly.

e. Inspect pressure plate assembly for cracks, damaged rivets and excessive warpage. Replace if found cracked or severly deformed. Replace cracked or deformed rivets.

f. Inspect brake cylinder bolts for cracks, thread damage, and self-locking feature. Replace bolts that are cracked, bent or have damaged threads.

g. Inspect brake linings for excessive edge chipping and surface deterioration. Refer to Table VII-I for wear limits. Worn lining may be easily removed by prying loose with a screwdriver or a thin, flat wedge. Install new linings in place. Insure that they snap into position.

h. Inspect the torque plate for cracks, nicks, burrs, rust, excessive wear and brinelling in the bolt holes. Replace if cracked or severly deformed.

i. If not previously accomplished inspect the brake disc for grooves, scratches, pits and heat checks. A single groove or isolated grooves up to .031 of an inch deep would not necessitate replacement, but a grooving of the entire surface would reduce lining life and should be replaced. Heat checks are considered to be superficial surface cracks and are not detrimental to the integrity or performance of the breaking system.

j. Replace brake disc if crack length and depth exceeds limits given. Disc P/N 164-32F = length .800, depth .340. Disc P/N 164-57. = length .800, depth .280. If crack depth is not measurable, replace brake disc if crack length exceeds .400 of an inch.

CAUTION

When changing parts or replacing brake lining, use only those specified for that model brake assembly. Refer to Parts Catalog for specific part numbers.

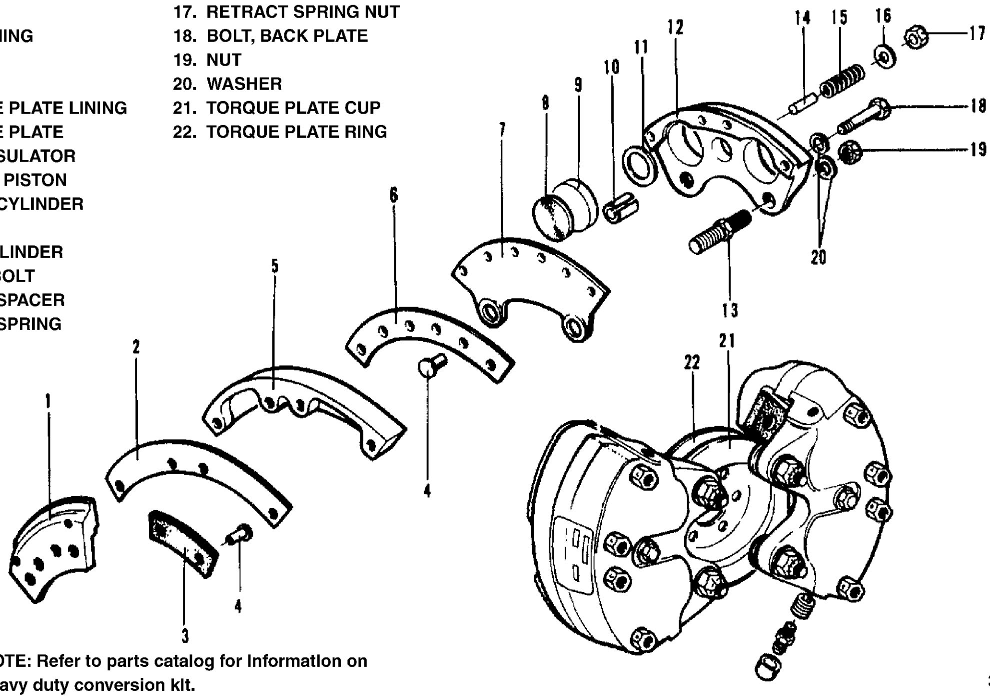
NOTE

If only the brake linings are being replaced, it is not necessary to remove the complete brake assembly.

k. On brake assemblies which have riveted lining, remove worn lining by drilling and punching out the old rivets. Install the new brake linings with rivets and rivet setting Kit (P N 754 165) which is available through your nearest Piper Dealer or Distributor. (Rivet setting tools should be used as rolling of the rivet is very important to get a tight fit between the rivet and rivet hole.) Bonded linings may be removed and replaced as stated in Step g.

2116

1. BACK PLATE
2. SHIM
3. BRAKE LINING
4. RIVET
5. SHIM
6. PRESSURE PLATE LINING
7. PRESSURE PLATE
8. PISTON INSULATOR
9. CYLINDER PISTON
10. RETRACT CYLINDER
11. "O" RING
12. BRAKE CYLINDER
13. ANCHOR BOLT
14. RETRACT SPACER
15. RETRACT SPRING
16. RETRACT WASHER
17. RETRACT SPRING NUT
18. BOLT, BACK PLATE
19. NUT
20. WASHER
21. TORQUE PLATE CUP
22. TORQUE PLATE RING



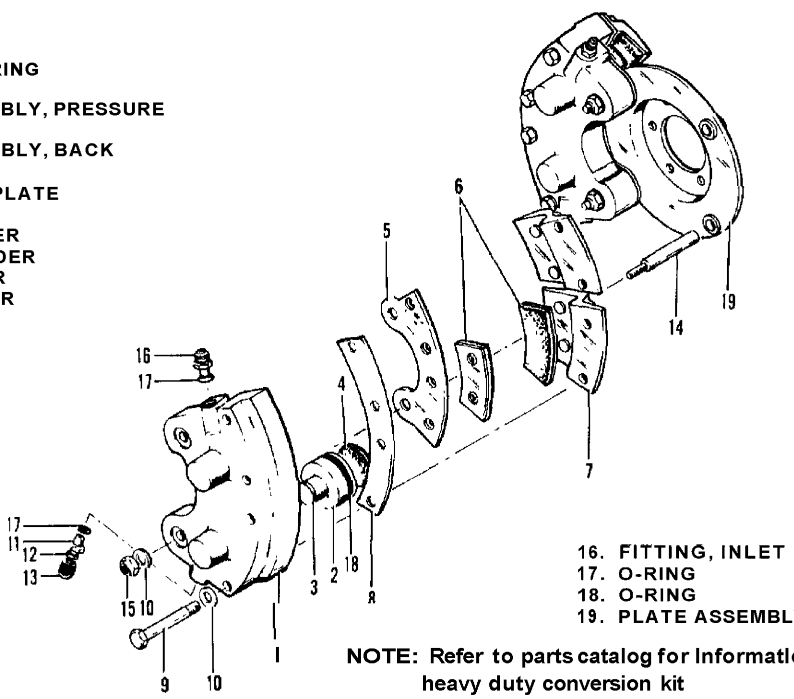
NOTE: Refer to parts catalog for information on heavy duty conversion kit.

37-200a/30-72

Figure 7-24. Wheel Brake Assembly
PA-23-250 (six place) Serial Nos. 27-3738 to 27-7554137 incl., 27-7554139 and 27-7554141 to 27-7554149 incl.

A421

1. CYLINDER
2. PISTON
3. FRICTION SPRING
4. INSULATOR
5. PLATE ASSEMBLY, PRESSURE
6. LINING
7. PLATE ASSEMBLY, BACK
8. SHIM
9. BOLT, BACK PLATE
10. WASHER
11. SEAT, BLEEDER
12. SCREW, BLEEDER
13. CAP, BLEEDER
14. BOLT, ANCHOR
15. NUT



16. FITTING, INLET
17. O-RING
18. O-RING
19. PLATE ASSEMBLY, TORQUE

NOTE: Refer to parts catalog for information on heavy duty conversion kit

30-96

Figure 7-25. Wheel Brake Assembly
PA-23-250 (six place) Serial Nos. 27-7554138, 27-7554140, 27-7554150 and up

l. Thoroughly clean repaired surfaces and areas of the brake assembly from which paint has been removed. Paint exposed areas with one coat of primer and one coat of aluminum lacquer.

CAUTION

Do not paint pistons or the piston bores in the brake cylinder assembly.

NOTE

Replacement linings should be conditioned as follows:

For Cleveland Brake No. 30-8, perform a minimum of six light pedal effort braking applications from 25 to 40 MPH, allowing the brake discs to partially cool between stops.

For Cleveland Brake Nos. 30-72 and 30-96, perform three consecutive hard braking applications from 45 to 50 MPH without allowing the brake discs to cool substantially between stops.

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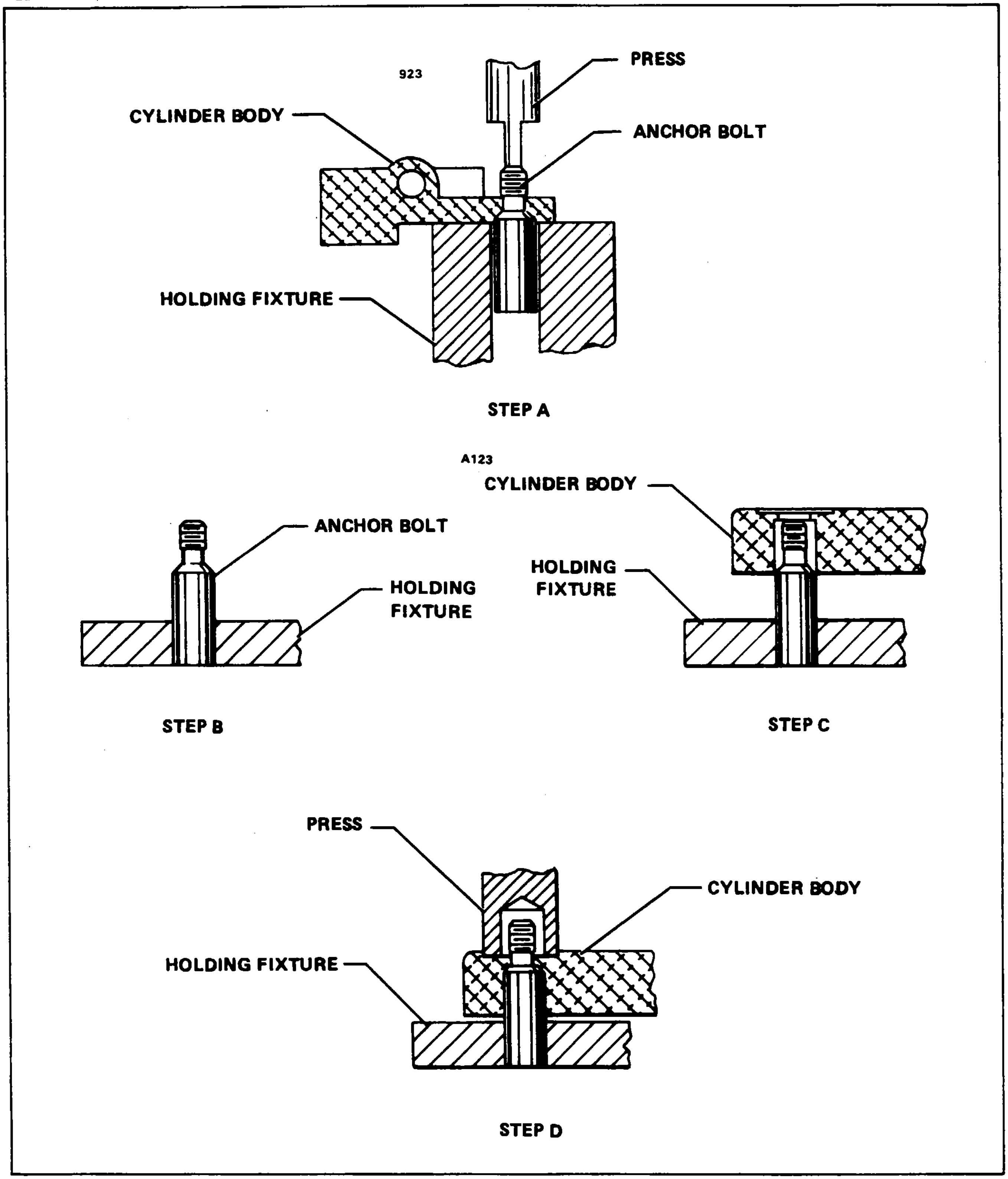


Figure 7-26. Removal and Installation of Anchor Bolts

7-62. ASSEMBLY AND INSTALLATION OF WHEEL BRAKE ASSEMBLY.
(Keyed to Figures 7-24 / 7-25.)

a. Lubricate piston “O” rings (11 / 18) with fluid MIL-PRF-5606 and install on pistons (9 / 2). Slide the pistons in cylinder housing (12 / 1) until flush with surface of the housing. On 37-200A brake assembly, ascertain that the insulators (8) are cemented to the pistons.

b. Position the pressure plate (7 / 5) to the cylinder housing and install the retract cylinder (14), retraction spring (15), washer (16) and self-locking nut (17) securing it in place. Turn the nut only to the point of contact with the sleeve. Do not apply torque in excess of that required to overcome the self-locking friction of the nut.

NOTE: The retract cylinder will move proportional to the pressure plate assembly and should be reset flush to the cylinder face when the lining is replaced.

c. Install the brake cylinder housing to the torque plate (21 / 19).

d. Position the shim spacer block (5) and backing plate (1 / 7) to the brake cylinder. On 37-200A brake assemblies, position a pressed fiber (2) shim between the backing plate and the shim spacer block. Install the self-locking back plate bolts (18 / 9) and torque as shown below. Safety with MS20995-C41 safety wire.

Brake Assembly		Back Plate Bolt Torque (Dry)
37-200-2	=	90 in-lb
37-200-A	=	65 - 70 in-lb
30-96	=	60 in-lb

e. Connect the brake lines to the cylinder housing.

f. Bleed the brakes. (Refer to paragraph 7-74.)

7-63. BRAKE MASTER CYLINDER.

7-64. REMOVAL OF BRAKE MASTER CYLINDER.

The following removal procedure applies to all master brake cylinders, but is only described for removal of one on the left side.

a. Remove the small access plate from the bottom left of the fuselage forward section.

b. Reach up through the access opening and remove the cotter pin, washer and pin securing the bottom of the master cylinder to the fuselage frame.

c. Pull the carpet back from around the rudder pedals.

d. Remove the tape from around the bottom of the brake cylinder boot.

e. Raise the bottom of the boot and disconnect the hydraulic lines from the top and bottom.

NOTE: It is recommended that a lint-free rag be placed around the master cylinder being removed to absorb hydraulic fluid spillage.

f. Place a cap or some similar item over the end of the hydraulic lines removed to prevent dust or dirt from entering the system.

g. Remove the cotter pin, washer and pin attaching the top of the master cylinder to the brake pedal.

h. Remove the master cylinder.

7-65. DISASSEMBLY OF BRAKE MASTER CYLINDER. (Refer to Figure 7-27.)

a. Remove the snap ring (5) from the top of the cylinder (17).

b. Pull the clevis end (1) of the assembly removing all internal parts.

c. The piston and plunger may be further disassembled by unscrewing the clevis from the top of the piston and plunger assembly (10 thru 15).

d. As necessary, the dyna seal (12) located between the piston and plunger may be removed by driving the steel pin (11) from the plunger rod (10).

CAUTION

It is recommended that the plunger and piston assembly be placed on a wooden block to prevent damage to the assembly when removing the pin.

NOTE

If the piston and plunger assembly has an "O" ring between the piston (13) and plunger rod (10), and a roll pin attaching the plunger and piston pin together, it is recommended that the part be replaced with plunger assembly, P/N 31155-02, with dyna seal (12) and solid pin.

7-66. CLEANING, INSPECTION AND REPAIR OF BRAKE MASTER CYLINDER.

a. Clean the cylinder parts with a suitable solvent and dry thoroughly.

b. Inspect the interior walls of the cylinder for scratches, burrs, corrosion, etc.

c. Inspect the general condition of the fitting threads of the cylinder.

d. Check the piston and valve for scratches, burrs, corrosion, etc.

e. Repairs to the cylinder are limited to polishing out small scratches, burrs, etc. and replacing valve, washer, seal and "O" rings.

7-67. ASSEMBLY OF BRAKE MASTER CYLINDER. (Refer to Figure 7-27.)

a. If the piston rod (10) was removed from the plunger and piston assembly (10 thru 15), reassemble by the following procedure:

1. Install new "O" ring (14) to the piston and slide it on to the piston rod.
2. Install a new dyna seal to the piston rod (12).
3. Insert the piston assembly (12 thru 15) into the plunger (10) and secure by installing a solid pin (11), P/N 86092-27. Peen over both ends of the new pin to provide a tight seal between the pin and the plunger.

b. Install the bushing (9) to the plunger with the slots down.

c. Install new "O" rings (6 and 8) to the brake cylinder cap (7) and slide it onto the plunger.

d. Install the spring (16), with its ends closed and ground square, to the piston rod (15).

e. Insert the assembled parts into the cylinder housing (17) and install a snap ring (5) on top of the cylinder cap securing the parts inside the cylinder.

f. Install the spring, with its ends closed (4), to the exposed plunger rod.

g. Install the clevis (1) with jam nuts (2) and washer (3). Adjust the clevis until the extended cylinder length is 8.312 inches $\pm$ .250 as measured from center of a cylinder housing attaching hole to center of clevis attaching hole.

7-68. INSTALLATION OF BRAKE MASTER CYLINDER.

a. Attach the clevis end of the cylinder to the brake pedal using a pin, washer and cotter pin.

b. If the brake cylinder rubber trim boot was removed, reinstall at this time.

c. Connect the hydraulic lines to the top and bottom of the brake cylinder.

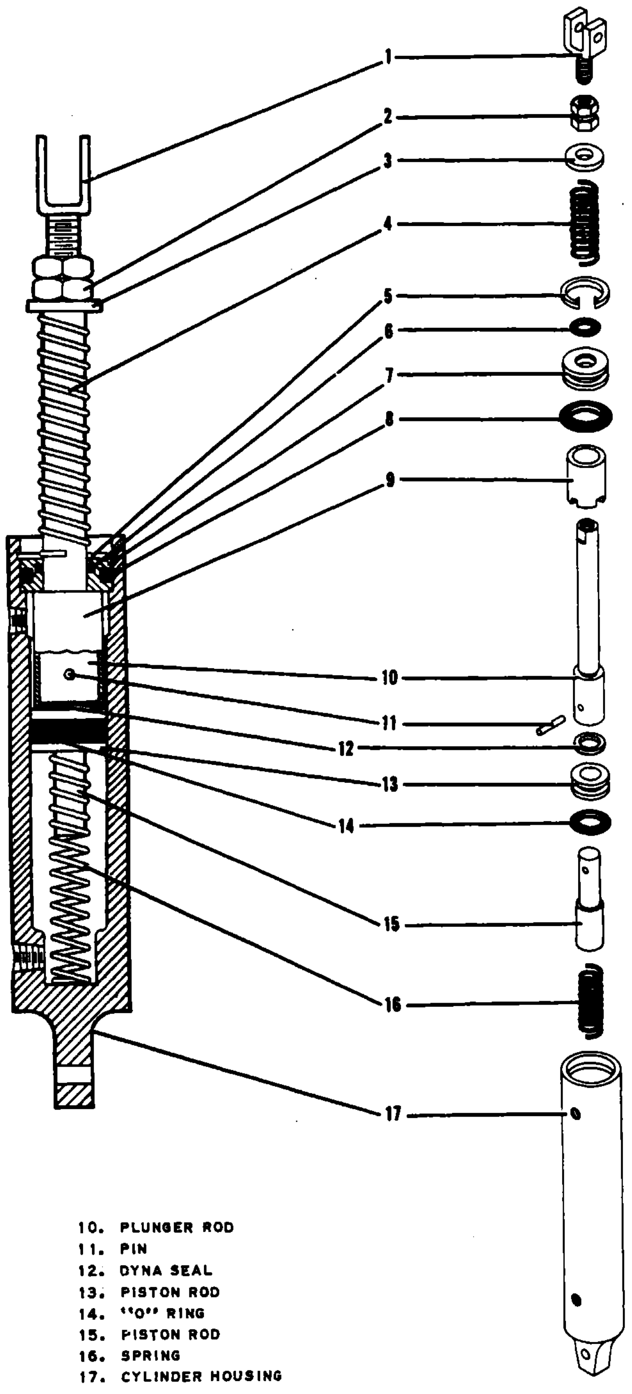
d. Tape the rubber boot to the floor and replace the carpet around the rudder pedals.

e. Through the access plate in the bottom of the fuselage, secure the bottom of the brake cylinder to the fuselage frame with a pin, washer and cotter pin.

f. Install the access plate to the bottom of the fuselage.

g. Bleed the brake system. (Refer to paragraph 7-75.)

2140



1. CLEVIS END
2. JAM NUT
3. WASHER
4. SPRING
5. SNAP RING
6. "O" RING
7. CYLINDER CAP
8. "O" RING
9. BUSHING
10. PLUNGER ROD
11. PIN
12. DYNA SEAL
13. PISTON ROD
14. "O" RING
15. PISTON ROD
16. SPRING
17. CYLINDER HOUSING

16748-A

Figure 7-27. Brake Master Cylinder Assembly

7-69. PARKING BRAKE VALVE.

7-70. REMOVAL OF PARKING BRAKE VALVE. The parking brake valve is located just forward of the cabin area in the lower left side of the nose.

a. Remove the access panel from the left side of the nose by releasing fasteners. (Refer to Access Plates and Panels, Section II.)

b. Disconnect the control wire from the parking brake valve by loosening the set screws.

c. Disconnect all hydraulic lines from the valve and place a protective covering over the line openings to prevent contamination.

NOTE

It is recommended that a lint free rag be placed around the master cylinder being removed to absorb hydraulic fluid spillage.

d. Remove the thru bolts, washers and self-locking nuts securing the valve to the fuselage frame and remove the valve.

7-71. DISASSEMBLY OF PARKING BRAKE VALVE. (Refer to Figure 7-28.)

a. Disconnect the piston assembly (6) from the lever by removing speed nut, washers and pin.

b. Remove the end fitting (1) from the valve body (5).

c. Push the piston (6) out through the body. Ascertain that the end of the piston that connects to the lever is free from damage or burrs that could cause the body piston wall to become scratched or galled as the piston is pushed through.

d. Remove "O" ring packings from the end fitting and piston.

7-72. CLEANING, INSPECTION AND REPAIR OF PARKING BRAKE VALVE.

a. Clean the valve components in a suitable dry type cleaning solvent.

b. Inspect the valve for the following:

1. Check that the friction surfaces of the valve body and stem are free from nicks, dents and burrs.

2. Check that the stop on the piston is secure and undamaged.

3. Check that the threaded surfaces of the body and end fitting are not stripped or cross-threaded.

c. Repair to the valve is limited to reconditioning of parts, such as smoothing out minor nicks and scratches, and the replacement of "O" ring packings.

7-73. ASSEMBLY OF PARKING BRAKE VALVE.

a. Install "O" ring packings (3) on the piston (6) and install piston in the valve body (5). Lubricate "O" rings with hydraulic fluid before installing piston.

b. Install "O" ring packing (2) on end fitting (1) and install end fitting in the valve body.

c. Connect the piston assembly to the lever with rivet pin, washers and speed nut.

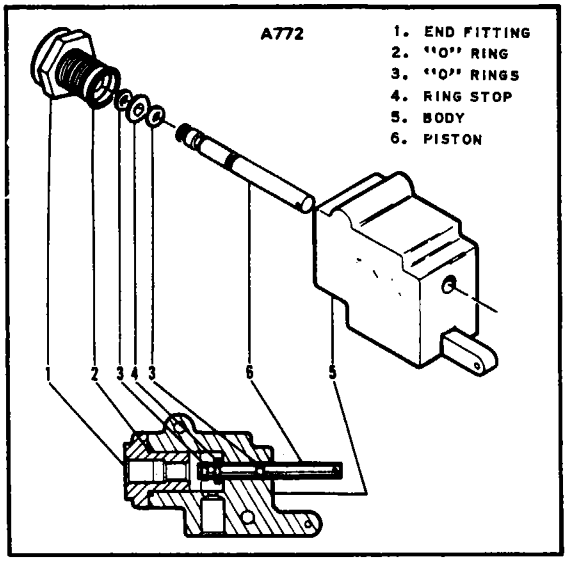


Figure 7-28. Parking Brake Valve Assembly

7-74. INSTALLATION OF PARKING BRAKE VALVE.

a. Position the parking brake valve to the fuselage frame fitting and install the two thru bolts, washers and self-locking nuts.

b. Connect the hydraulic lines to the valve.

c. Connect the control cable to valve lever and determine that when valve lever fits in the closed detent, parking brake handle is .062 to .125 of an inch of being full in against stop.

d. Bleed the brake system. (Refer to paragraph 7-75.)

7-75. BLEEDING PROCEDURE. If the brake line has been disconnected for any reason, it will be necessary to bleed the brake system as described below:

a. Place a suitable container at the brake reservoir to collect fluid overflow.

b. Remove the rubber bleeder fitting cap located on the bottom of the brake unit housing on the landing gear.

c. Slide a hose over the bleeder fitting, loosen the fitting one turn and pressure fill the brake system with MIL-H-5606 fluid. (Refer to Figure 7-29.)

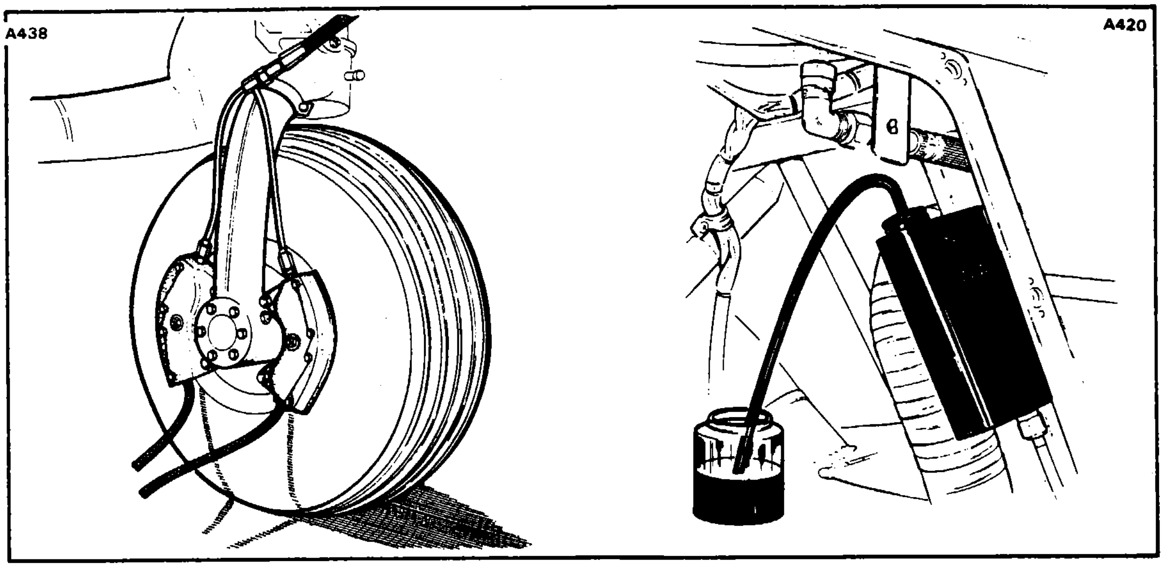


Figure 7-29. Bleeding Brakes

NOTE

By watching the fluid pass through the plastic hose at the top of the brake reservoir, it can be determined whether any air has entered the system. If air bubbles are evident, filling of the system shall be continued until all of the air is out of the system and a steady flow of fluid is obtained.

d. Tighten bleeder fitting, remove hose and check brakes for proper pedal pressure.

e. Repeat this procedure in the other unit.

NOTE

There are two units on each gear and also two bleeder fittings, therefore, it will be necessary to bleed both units to be sure the system is completely free of air.

7-76. TIRE BALANCING. Proper balancing is critical for the life of the aircraft tires. If a new tire is balanced upon installation it will usually remain balanced for the life of the tire without having any shimmy or flat spots, and an inexpensive balancer can be made that will balance almost any tire for light aircraft. (Refer to paragraph 7-77 for fabrication instructions.) Balance the tire as follows:

a. Mount the tire and tube on the wheel, but do not install the securing bolts. Install the wheel bearings in the wheel; then, using the -7 bushings, -6 spacers, and -5 nuts, install the wheel-tire assembly on the -8 pipe. Secure the -5 nuts finger-tight so that the wheel halves touch each other. Be sure the bolt holes are aligned! Insert the -4 axle through the -8 pipe and place the wheel in the center of the balancer. Make sure the axle is only on the chamfered edges of the balancer and that it is at 90° to the sides of the balancer.

b. Release the tire. If it is out of balance it will rotate, coming to rest with the heaviest point on the bottom. Tape a 1/2 ounce patch across top center of the tire. Rotate the tire 45° and release it again. If the tire returns to the same position, add a 1 ounce patch and again rotate the tire and release it. Continue this procedure until the tire is balanced.

c. When balance is attained, put a chalk mark on the sidewall directly below the patch. Use one mark for each half ounce of weight needed. Mark the valve stem location on the tire and the opposite wheel half to assure reassembly in the same position. Remove the wheel from the balance stand, break it down, and clean the tire with toluol. Apply a coat of patch cement to both the patch and the inside center of the tire in line with the chalk marks. When the cement has dried, install the patches making certain they are on the center line of the tire and aligned with the chalk marks on the sidewall. Burnish the patches to remove trapped air, etc.

d. When reassembling the wheel, powder the inside of the tire. Mount the tire on the valve side of the wheel in the same position it was in when it was balanced. Install the other wheel half, aligning the chalk marks. Install the bolts and tighten to required torque, (refer to paragraph 7-56) then air the tire and recheck the balance. The wheel should not be more than 1/2 ounce out of balance.

7-77. CONSTRUCTION OF TIRE BALANCER. (Refer to Figure 7-33.)

a. The following instructions will help in building the balancer: chamfer top edges of -3 sides, leaving 1/16 inch flat on top inboard edge. Rivet -2 tee's to -3 sides using AN 470-AD5 rivets 2" spacing. Use AN 426-AD5 rivets 2" center to center to secure -2 tee's to -1 base. If tee extrusion is unavailable, heavy angle extrusion could be used. -3 sides must be paralleled and vertical.

b. The -4 axle must slide through the -8 pipe. The -5 nuts were made by reaming the existing threads in the AN 365-624 nuts with an R drill, then tapping with a 1/8-27 pipe tap.

c. The -6 spacers were made from ½ inch aluminum tubing. The two lengths of spacers are suitable for balancing most any aircraft wheel.

d. The -7 bushings may be benchmade from one inch phenolic or aluminum using a 1½ inch hole saw to cut out the smaller bushing and a 1¾ hole saw to cut out the larger. By inserting a ¼ inch long threaded bolt through the pilot hole and securing with a washer and nut, a drill press and file may be used to make the off-set on the bushing. The turned-down part should just slide inside the bearing race. Ream the pilot hole to slide over the -8 pipe threads.

e. The -8 pipe was made from a piece of ⅛ inch black ipe and threaded with a 1/8-27 pipe die. Thread 3 inches from each end of the pipe.

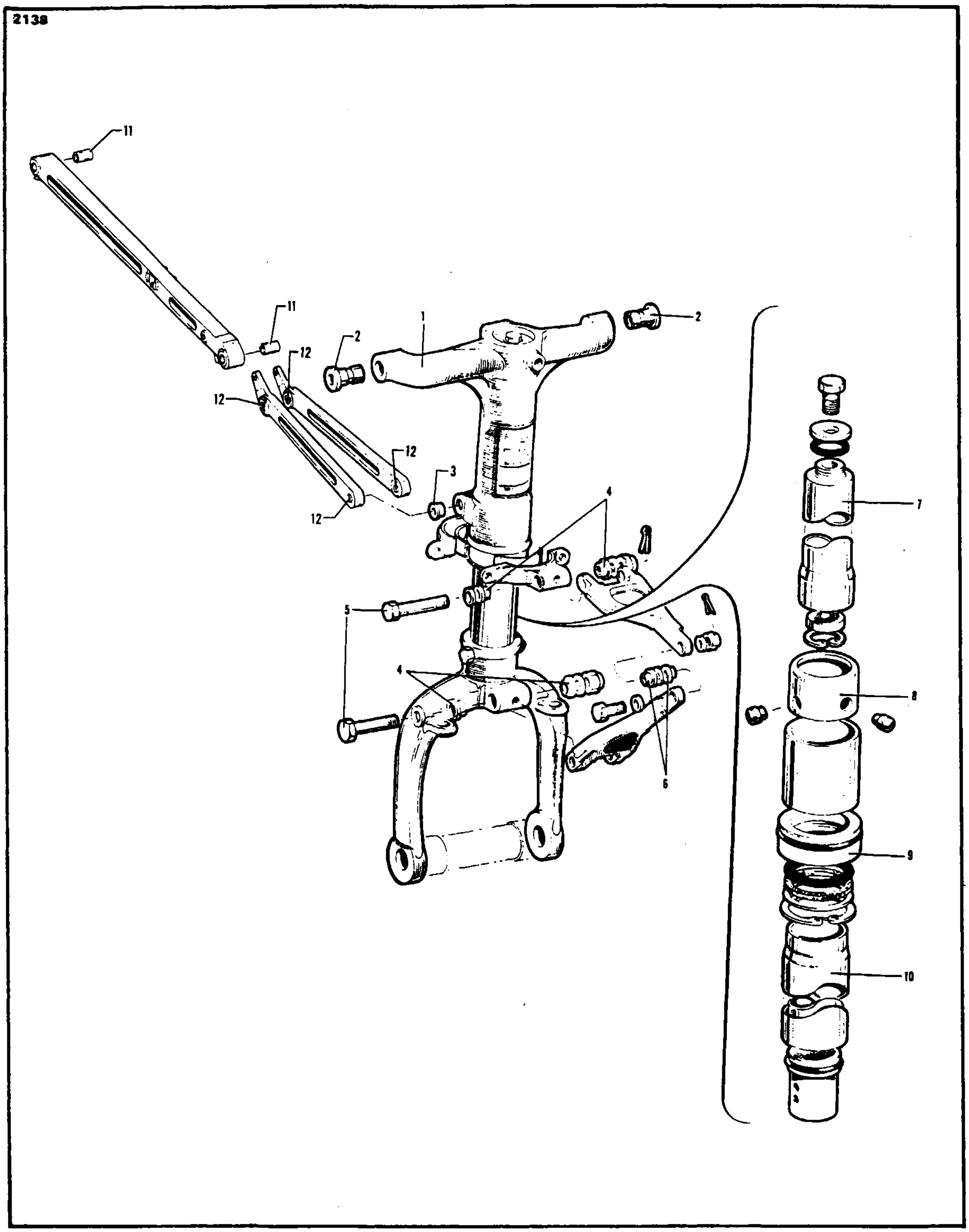


Figure 7-30. Nose Gear Oleo Service Tolerances

TABLE VII-II. LANDING GEAR OLEO SERVICE TOLERANCES
19273-02 NOSE GEAR

Figure 7-29 Index	Part No.	Item	Manufact. Dim.	Manufact. Toler.	Min. Service Limit	Max. Service Limit
8	751 363 (31779-00)	Upper Bearing, Strut Housing	2.373	OD +.000 -.002	2.3708	2.3730
1	751 930 (31768-00)	Body, Strut Housing	2.375	ID +.003 -.000	2.3750	2.3795
9	751 418 (31780-00)	Lower Bearing, Strut Housing	1.9375	ID +.002 -.000	1.9375	1.9405
10	752 770 (31790-00)	Piston Rod, Strut	1.9370	OD +.000 -.001	1.9359	1.9370
7	753 000 (31775-00)	Tube, Orifice	1.623	OD +.000 -.002	1.6208	1.623
10	752 770 (31790-00)	Piston Rod, Strut	1.625	ID +.003 -.000	1.6250	1.6283
3	751 417 (453 722)	Bushing, Drag Link	.375	ID +.0015	.3750	.3773
6	751 369 (31796-00)	Bushing, Torque Link	.251	ID +.001 -.000	.251	.253

TABLE VII-II. LANDING GEAR OLEO SERVICE TOLERANCES
19273-02 NOSE GEAR (cont.)

Figure 7-29 Index	Part No.	Item	Manufact Dim.	Manufact. Toler.	Min. Service Limit	Max. Service Limit
4	751 367 (31785-00)	Bushing, Torque Link	.313	ID +.002 -.000	.3130	.3160
5	402 344 (AN175-32)	Bolt, Torque Link Attachment	.3117	OD +.0000 -.0005	.3112	.3117
2	751 368 (31766-00)	Bushing, Mounting	.5000	ID +.0015 -.0000	.5000	.5023
11	14843-11	Bushing, Upper Drag Link		ID +.3755 -.3745		
12	16198-00 16198-03	Drag Link Assembly (Upper) (No Bushings)		ID +.3755 -.3745		

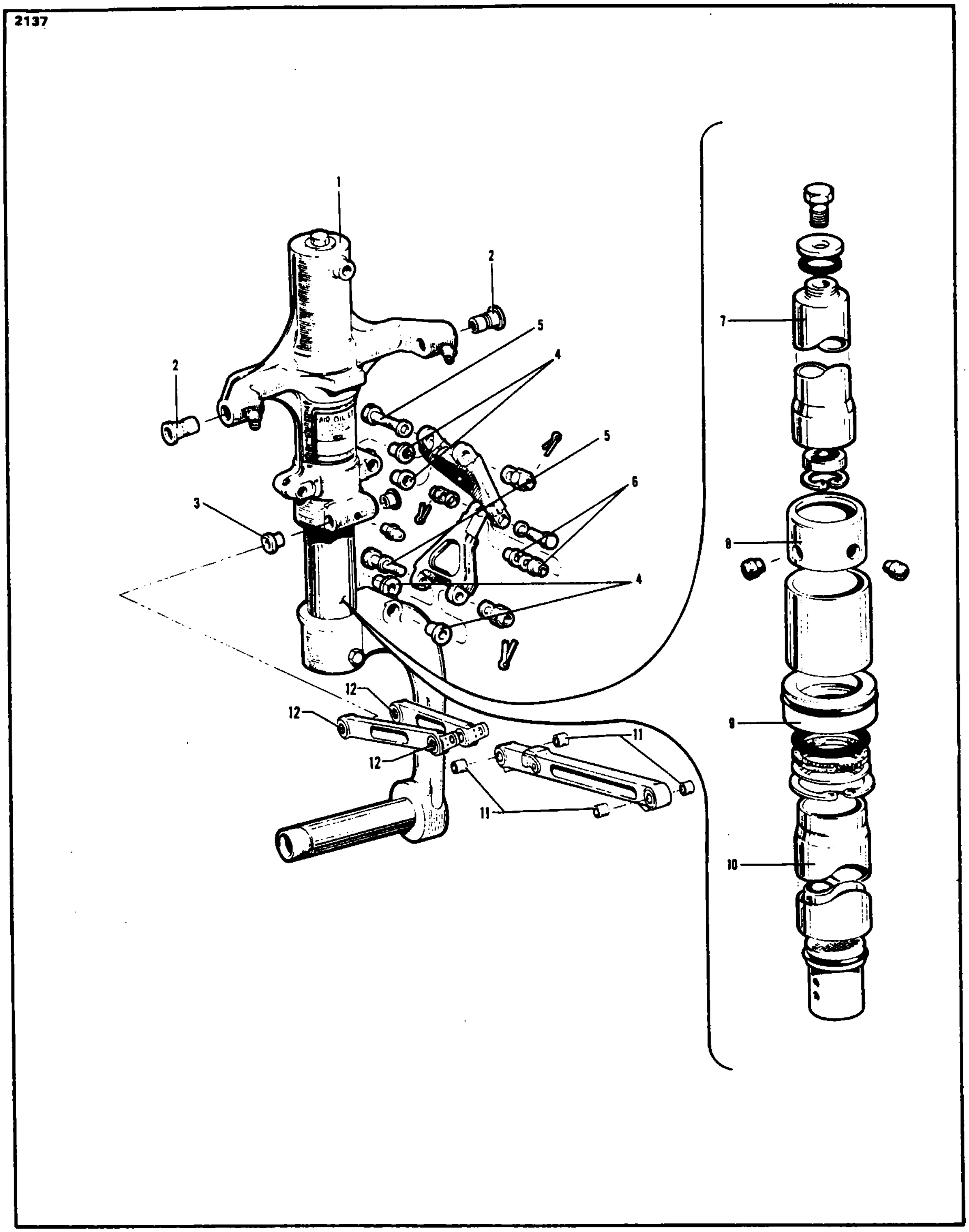


Figure 7-31. Main Gear Oleo Service Tolerances

TABLE VII-III. LANDING GEAR OLEO SERVICE TOLERANCES
19272-02 MAIN GEAR

Figure 7-30 Index	Part No.	Item	Manufact. Dim.	Manufact. Toler.	Min. Service Limit	Max. Service Limit
8	751 363 (31779-00)	Upper Bearing, Strut Housing	2.373	OD +.000 -.002	2.3708	2.3730
1	751 929 (31835-00)	Body, Strut Housing	2.375	ID +.003 -.000	2.3750	2.3795
9	751 418 (31780-00)	Lower Bearing, Strut Housing	1.9375	ID +.002 -.000	1.9375	1.9405
10	752 770 (31790-00)	Piston Rod, Strut	1.9370	OD +.000 -.001	1.9359	1.9370
7	753 000 (31775-00)	Tube, Orifice	1.623	OD +.000 -.002	1.6208	1.6230
10	752 770 (31790-00)	Piston Rod, Strut	1.625	ID +.003 -.000	1.6250	1.6283
3	751 416 (453 723)	Bushing, Drag Link	.4375	ID +.0015 -.0000	.4375	.4398
6	751 369 (31796-00)	Bushing, Torque Link	.251	ID +.001 -.000	.251	.253

TABLE VII-III. LANDING GEAR OLEO SERVICE TOLERANCES
19272-02 MAIN GEAR (cont.)

Figure 7-30 Index	Part No.	Item	Manufact. Dim.	Manufact. Toler.	Min. Service Limit	Max. Service Limit
4	751 367 (31785-00)	Bushing, Torque Link	.313	ID +.002 -.000	.3130	.3160
5	402 344 (AN175-32)	Bolt, Torque Link	.3117	OD +.0000 -.0005	.3112	.3117
2	751 368	Bushing, Mounting	.5000	ID +.0015 -.0000	.5000	.5023
11	14976-33	Bushing, Upper Drag Link		ID +.438 -.436		
12	16191-00 16191-01	Link Assembly - Lower Drag		ID +.438 -.436		

TABLE VII-IV. LANDING GEAR AND BRAKE SYSTEM TROUBLESHOOTING

Trouble	Cause	Remedy
Nose gear shimmies during fast taxi, take-off and landing.	Tire out of balance.	Check balance and replace tire if necessary.
	Worn or loose wheel bearings.	Replace and/or adjust wheel bearings.
	Worn drag link bolts and/or bushings.	Replace bolts and/or bushings.
Main landing gear shimmies during fast taxi, take-off and landing.	Tire out of balance.	Check balance and replace tire if necessary.
	Worn or loose wheel bearings.	Replace and/or adjust wheel bearings.
	Worn drag link bolts and/or bushings	Replace bolts and/or bushings.
Nose gear fails to steer properly	Oleo cylinder binding in strut housing.	Lubricate strut housing.
	One brake dragging.	Determine cause and correct.
	Steering arm roller sheared at top of strut.	Replace defective roller.
Excessive or uneven wear on main tires.	Incorrect operating pressure.	Inflate tire to correct pressure.
	Wheel out of alignment (toe-in or toe-out).	Check wheel alignment.

TABLE VII-IV. LANDING GEAR AND BRAKE SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Strut bottoms on normal landing or when taxiing over rough ground.	Insufficient air and/or fluid in strut.	Service strut with air and/or fluid.
	Defective internal parts in strut.	Replace defective parts.
Green gear down light out.	Lamp burned out.	Replace lamp.
	Gear down limit switch out of adjustment.	Adjust limit switch.
	Landing gear down limit fails to operate.	Replace switch.
	Gear down indicator light circuit breaker open.	Reset circuit breaker.
Flashing red light and warning horn fail to operate when power from both engines is reduced below 14 or 15 inches manifold pressure.	Throttle switches out of adjustment.	Adjust throttle switches.
	Throttle switches are defective.	Replace switch.
	Horn or light defective.	Replace defective part.
	Defective wiring.	Check wiring.

TABLE VII-IV. LANDING GEAR AND BRAKE SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Landing gear and/or doors not fully extended.	Possible jamming from foreign objects.	Inspect for any obstruction.
	Down lock not operating.	Lubricate and check for malfunction.
	Excessive friction in gear and door mechanism.	Lubricate. (Refer to Lubrication Chart.)
Warning horn fails to operate when throttles are closed and landing gear is retracting or fails to stop when throttles are closed and landing gear is extended.	Micro switches on the throttles out of adjustment.	Adjust micro switches.
	Micro switches on the throttles inoperative.	Check wiring, replace switch if necessary.
	Landing gear down limit switch out of adjustment.	Adjust limit switches.
	Landing gear down limit switch inoperative.	Check wiring, replace switch if necessary.
	Warning horn assembly.	Check wires, adjust or replace.

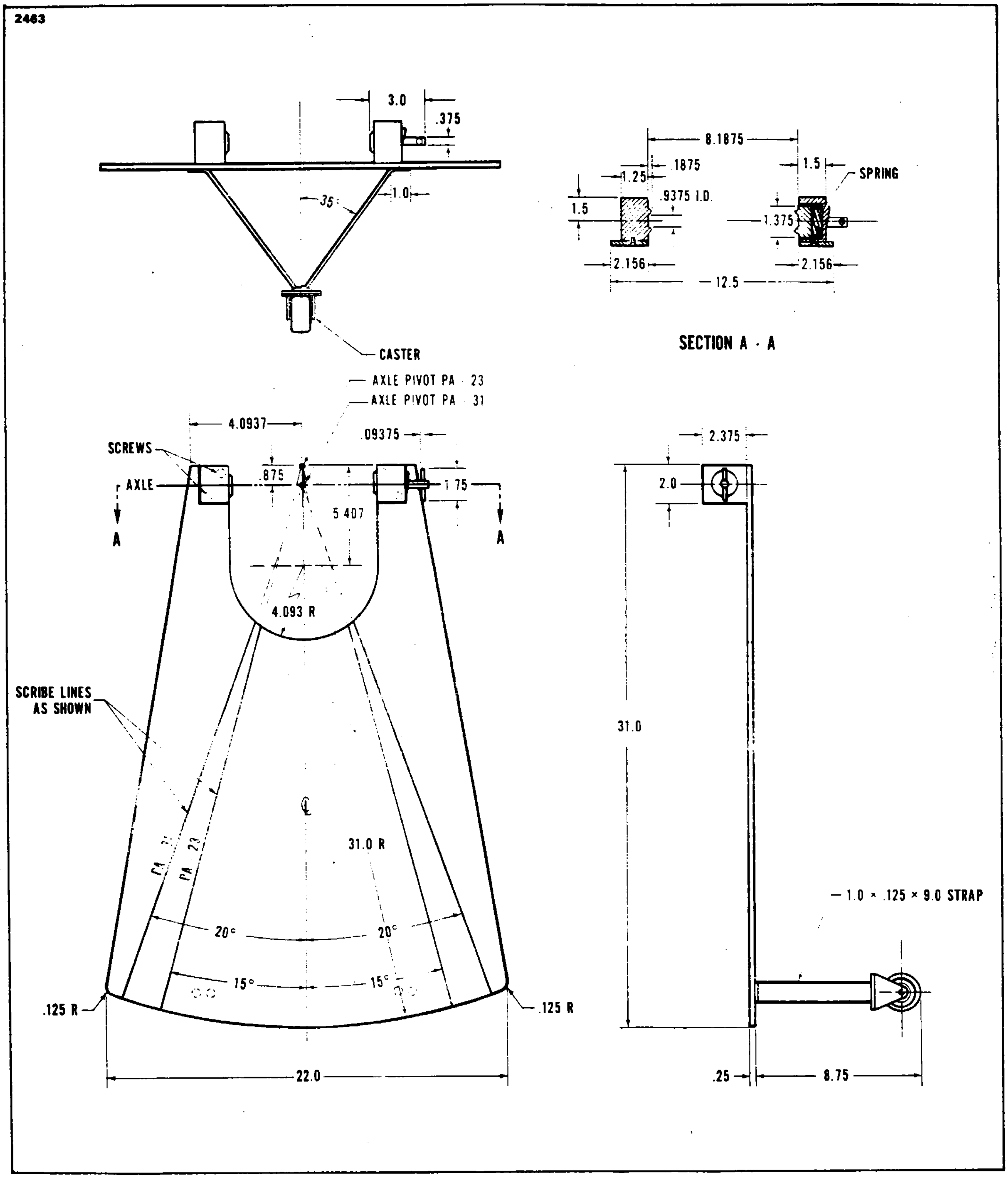
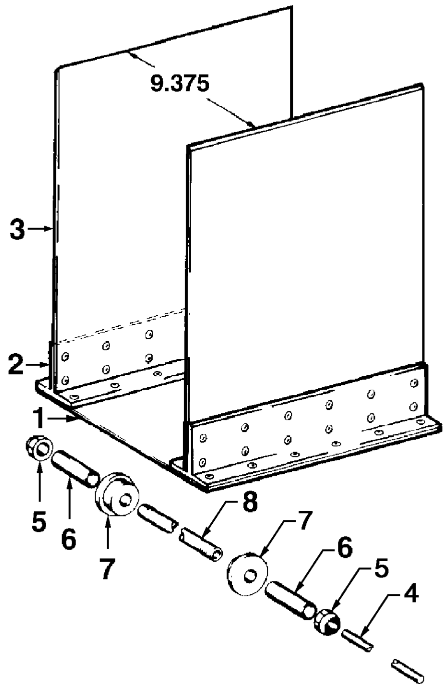


Figure 7-32. Fabricated Tool, Checking Nose Wheel Alignment



USE THE FOLLOWING LIST OF MATERIALS TO MAKE THE BALANCER

- 1. 1 EA BASE	12 X 11	0.190 2024 T3 CLAD ALUMINUM ALLOY
- 2. 2 EA TEE	2.5 X 2 X 11	0.190 2024 T4 EXTRUDED ALUMINUM ALLOY
- 3. 2 EA SIDES	14 X 11	0128 2024 T3 CLAD ALUMINUM ALLOY
- 4. 2 EA AXLE	0.125 X 10.25	4130 STEEL, NOMALIZED
- 5. 2 EA NUTS	AN 365-624	
- 6. 2 EA SPACER	0.50 X 2.25	5052-0 ALUMINUM TUBING
2 EA SPACER	0.50 X 1.25	5052-0 ALUMINUM TUBING
- 7. 2 EA BUSHING	1.480 X 1.625 X 1.00	PHENOLIC OR ALUMINUM
2 EA BUSHING	2.240 X 1.37 X 1.00	PHENOLIC OR ALUMINUM
- 8. 1 EA PIPE	1/8 X 9.3	BLACK STEEL PIPE
* 2 EA BEARINGS	SAVE TWO OF EACH SIZE WORN WHEEL BEARINGS FROM PREVIOUS INSPECTIONS.	

Figure 7-33. Tire Balancer

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SECTION

VIII

POWER PLANT (NORMALLY ASPIRATED)

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SECTION VIII

POWER PLANT
(NORMALLY ASPIRATED)

SECTION VIII

POWER PLANT

(NORMALLY ASPIRATED)

8-1. INTRODUCTION.

This section covers non-turbocharged powerplants used in PA-23 airplanes (as listed below) and is comprised of instructions for the removal, minor repair, service and installation of the engine cowling, propeller, propeller governor, engine, engine shock mounts, induction system, carburetor, fuel injector, fuel air bleed nozzle, ignition system and lubrication system. For more detailed information, refer to the engine or component manufacturer's service manuals.

PA-23-235	**PA-23-250** (14-Volt)	**PA-23-250** (28-Volt)	**PA-23-250 (6)** S/N's 27-2000 thru 27-2504	**PA-23-250 (6)** S/N's 27-2505 and up
O-540-B1A5	O-540-A1B5 or O-540-A1D5	O-540-A3D5	O-540-A1D5 or IO-540-C1B5	IO-540-C4B5

8-2. DESCRIPTION.

The PA-23 is powered by two Avco Lycoming O-540 or IO-540 series six cylinder, direct drive, wet sump, horizontally opposed, air-cooled engines. (Refer to Pilot's Operating Handbook for fuel octane ratings)

Cowlings completely enclose the engines. The cowling is of cantilever construction attached at the firewall. There are access panels on both sides to allow inspection of the accessory section. The cowl flap doors are an integral part of the lower cowl and are operated through mechanical linkage.

Propellers are Hartzell full feathering, constant speed, each controlled by a governor mounted on the engine supplying oil through the propeller shaft at various pressures. Oil pressure from the governor moves the blades into low pitch (high RPM). The centrifugal twisting moment of the blades also tends to move the blades into low pitch. Opposing these two forces are blade counterweights or the force produced by compressed air between the cylinder head and the piston, which tends to move the blades into high pitch in the absence of governor oil pressure. Thus, feathering is accomplished by counterweights or compressed air.

The airframe induction system consists of a dry type air filter and alternate air door. The fuel system of the O-540 series engines consists of a Marvel-Schebler MA-4-5 carburetor and AC diaphragm type fuel pump. The fuel system on the IO-540 series engines consists of a Bendix RSA-5ADl type injector and a Lear-Seigler fuel supply pump. These engines are normally aspirated with no restrictions on maximum power output.

Bendix Scintilla S-20 or S-200 series magnetos are installed with their associated components. The S-20 series system consists of two single contact magnetos. The left magneto incorporates an impulse coupling to aid in starting.

The S-200 series system consists of a single contact magneto, a dual contact magneto to obtain the retard spark necessary for starting, a starter vibrator, magneto switches and starter switch.

In addition to the previously mentioned components, each engine is equipped with a generator or alternator, geared starter, hydraulic pump and pressure pump. Engine mounts are steel tubing construction attached at the firewall and incorporate vibration absorbing mounts. The exhaust stacks and extensions are positioned one for each bank of cylinders. The stack on the right side has a heat muff on it to heat the alternate air plenum. Both stacks merge into one at the lower aft end of the engine nacelle.

The lubrication system is of the full pressure wet sump type. The oil pump, which is located in the accessory housing, draws oil through a drilled passage leading from the oil suction screen located in the sump. The oil from the pump then enters a drilled passage in the accessory housing, which feeds the oil to a threaded connection on the rear face of the accessory housing, where a flexible line leads the oil to the external oil cooler. Pressure oil from the cooler returns to a second threaded connection on the accessory housing from which point a drilled passage conducts oil to the oil pressure filter. In the event that cold oil or an obstruction should restrict the oil flow to the cooler, an oil cooler by-pass valve is provided to pass the oil directly from the oil pump to the oil pressure filter.

The oil pressure filter element, located on the accessory housing, is provided as a means to filter from the oil any solid particles that may have passed through the suction screen in the sump. After being filtered in the pressure filter, the oil is fed through a drilled passage to the oil pressure relief valve, located in the upper right side of the crankcase in front of the accessory housing.

This relief valve regulates the engine oil pressure by allowing excessive oil to return to the sump, while the balance of the pressure oil is fed to the main oil gallery in the right half of the crankcase. Residual oil is returned by gravity to the sump where, after passing through a screen, it is again circulated through the engine.

8-3. TROUBLESHOOTING. Troubles peculiar to the power plant are listed in Table VIII-III in the back of this section, along with their probable causes and suggested remedies. When troubleshooting engines, ground the magneto primary circuit before performing any checks on the ignition system.

8-4. STANDARD PRACTICES - ENGINE. The following suggestions should be applied wherever they are needed when working on the power plant.

a. To insure proper reinstallation and/or assembly, tag and mark all parts, clips, and brackets as to thier location prior to their removal and/or disassembly.

b. During removal of various tubes or engine parts, inspect them for indications of scoring, burning or other undesirable conditions. To facilitate reinstallation, observe the location of each part during removal. Tag any unserviceable part and/or units for investigation and possible repair.

c. Extreme care must be taken to prevent foreign matter from entering the engine, such as lockwire, washers, nuts, dirt, dust, etc. This precaution applies whenever work is done on the engine, either on or off the aircraft. Suitable protective caps, plugs, and covers must be used to protect all openings as they are exposed.

NOTE

Dust caps used to protect open lines must always be installed OVER the tube ends and NOT IN the tube ends. Flow through the lines may be blocked off if lines are inadvertently installed with dust caps in the tube ends.

d. Should any items be dropped into the engine, the assembly process must stop and the item removed, even though this may require considerable time and labor. Insure that all parts are thoroughly clean before assembling.

e. Never reuse any lockwire, lockwashers, tablocks, tabwashers or cotter pins. All lockwire and cotter pins must fit snugly in holes drilled in studs and bolts for locking purposes. Cotter pins should be installed so the head fits into the castellation of the nut, and unless otherwise specified, bend one end of the pin back over the stud or bolt and the other end down flat against the nut. Use only corrosion resistant steel lockwire and/or cotter pins. Bushing plugs shall be lockwired to the assembly base or case. Do not lockwire the plug to the bushing.

f. All gaskets, packings and rubber parts must be replaced with new items of the same type at reassembly. Insure the new nonmetallic parts being installed show no sign of having deteriorated in storage.

g. When installing engine parts which require the use of a hammer to facilitate assembly or installation, use only a plastic or rawhide hammer.

h. Whenever adhesive tape has been applied to any part, the tape and all residue must be removed and thoroughly cleaned with petroleum solvents prior to being subjected to high temperature during engine run. This would also apply to parts that have corrosion preventive compounds applied.

i. Anti-seize lubrication should be applied to all loose-fit spline drives which are external to the engine and have no other means of lubrication. For certain assembly procedures, molybdenum disulfide in either paste or powdered form mixed with engine oil or grease may be used.

CAUTION

Ensure that Anti-seize compounds are applied in thin even coats, and that excess compound is completely removed to avoid contamination of adjacent parts.

j.Temporary marking methods are those markings which will ensure identification during ordinary handling, storage and final assembly of parts.

8-5. ENGINE COWLING.

8-6. REMOVAL OF ENGINE COWLING. (PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.)

a. Ascertain that the master switch and magneto switches are in the off position.

b. Release the quarter turn fasteners and remove the two access panels from both sides of the nacelle.

c. Remove the attaching screws from the front and rear of the top cowling section and lift it off.

d. Remove the fillet fairings from both the inboard and outboard sides of the nacelle by removing attaching screws.

e. Remove the carburetor air scoop by releasing the quarter turn fasteners.

f. Release the four quarter turn fasteners holding the carburetor air bellows to the air filter.

g. Remove the screws at the rear of the bottom cowling assembly and remove by pulling forward and down.

h. The nose cowl may be removed by removing the screws at each side thus separating the upper and lower half.

8-7. REMOVAL OF ENGINE COWLING. (PA-23-250 (six place), Serial Nos. 27-2505 and up.)

a. Ascertain that the master switch and magneto switches are in the off position.

b. Release the quarter turn fasteners and remove the two access panels from both sides of the engine nacelle.

c. Remove the attaching screws from the front and rear of the top cowling section and lift it off.

d. Remove the fillet fairings from both the inboard and outboard sides of the nacelle by removing attaching screws.

e. Disconnect all drain lines attached to the bottom cowl.

f. Remove the attaching bolts and disconnect the cowl flap linkage from the cowl doors.

g. Remove the screws from the front and rear of the bottom cowling assembly and pull it forward and down.

h. Split and remove the nose cowl by pulling out the two (upper and lower) hinge pins.

8-8. CLEANING, INSPECTION AND REPAIR OF ENGINE COWLING.

a. The cowling should be cleaned with a suitable dry type solvent and then wiped with a clean cloth.

b. Inspect the cowling for dents, cracks, loose rivets, damaged or missing fasteners and damaged skin or fiberglas.

c. If repair is necessary, refer to Structural Repairs, Section IV.

8-9. INSTALLATION OF ENGINE COWLING. (PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.)

NOTE

As engine shock mounts age, the engine will tilt forward and down. To ensure clearance underneath the engine, pull down on nose of cowl during installation.

a. Place the bottom cowling assembly in position and fasten to the rear engine nacelle with attaching screws.

b. Attach the carburetor air bellows to the air filter by the four quarter turn fasteners.

c. Place the carburetor air scoop in position and secure with the quarter turn dzus fasteners.

d. Position the fillet fairings in place on both inboard and outboard sides of the engine nacelle and secure with attaching screws.

e. Place the top cowling section in position and secure with attaching screws.

f. Position the two inboard and outboard access panels on the engine nacelle and secure with the quarter turn dzus fasteners.

8-10. INSTALLATION OF ENGINE COWLING. (PA-23-250 (six place), Serial Nos. 27-2505 and up.)

a. Install the nose cowl halves and insert the hinge pins.

b. Position the bottom cowling assembly and secure with the attaching screws.

c. Connect the drain lines to the bottom of the cowling.

d. Position the fillet fairings in place on both inboard and outboard sides of the engine nacelle and secure with attaching screws.

e. Place the top cowling section in position and fasten with attaching screws.

f. Connect the cowl flap linkage to the doors with the attaching bolts and adjust per instructions in paragraph 8-16.

g. Position the two inboard and outboard access panels in place and secure with the quarter turn fasteners.

8-11. ENGINE COWL FLAP. (PA-23-250) (six place), Serial Nos. 27-2505 and up.)

8-12. REMOVAL OF COWL FLAP ASSEMBLY. (Refer to Figure 8-1.)

a. Remove the two side cowl panels from the engine where the cowl flaps are to be removed.

b. Note the position of the rod end (11) to the cowl flap and remove the self-locking nut on the rod end disconnecting it from the cowl flap.

c. Remove the cowl flap by removing the cotter pin, nut, washer and bolt from the hinge bracket on each side.

d. If the operating mechanism is to be removed, the following procedure may be used:

1. Disconnect the control cable clevis end (3) from the torque tube arm by removing cotter pin and clevis pin.

2. Remove the bearing blocks holding each end of the torque tube assembly in place by removing the self-locking nut, washer and bolts.

3. Remove the self-locking nuts, washers and machine screws from the center bearing block. Remove the bearing block.

4. Remove the operating mechanism from the nacelle.

5. The mechanism may be further disassembled as necessary.

e. For removal of the cowl flap control cables, refer to paragraph 8-13.

8-13. REMOVAL OF COWL FLAP CONTROL CABLE.

a. Remove the engine access panels from the sides of the nacelle, if not previously removed.

b. Remove the top center section of the nacelle by removing attaching screws.

c. Remove the access panel from the bottom of the fuselage between the wings by removing attaching screws.

d. Disconnect the clevis end of the control cable by removing the cotter pin and clevis pin.

e. Remove the clevis end from the cable.

f. Remove the clamp securing the cable to the engine mount by removing the self-locking nuts and machine screws.

g. Draw the cable through the fire wall to the center section of the nacelle.

h. Loosen the cable clamps inside the center section of the nacelle.

i. Draw the cable through both clamps.

j. Loosen the clamp securing the cable inside the bottom of the fuselage.

k. Disconnect the cable from the control handle, inside the fuel control box by removing the bolt, washers, and self-locking nut.

l. Remove the cable by drawing it from the nacelle into the bottom of the fuselage and through the clamp.

8-14. INSTALLATION OF COWL FLAP CONTROL CABLE.

a. Draw the cable end through the clamp in the bottom of the fuselage and connect the cable end to the control handle inside the fuel control box.

b. Install the cable through the engine control tube in the wing.

c. Install the cable through the clamps in the center section of the nacelle.

d. Install the cable through the firewall and attach it with a clamp on the engine mount.

e. Install the clevis end and jam nut to the control cable.

f. Check the position of the cable to be certain there are no sharp bends or anything that might hamper proper operation.

g. Tighten all cable clamps.

h. With cowl flaps installed, check rigging and adjustment of cowl flaps as described in paragraph 8-16.

i. Install all access panels.

8-15. INSTALLATION OF COWL FLAP ASSEMBLY. (Refer to Figure 8-1.)

a. If the operation mechanism was removed, reinstall by the following procedure:

1. Position the torque tube and bearing blocks inside the nacelle and secure with bolts, washers and self-locking nuts.

2. Install the bearing block around the center of the torque tube with machine screws, washer and self-locking nuts.

3. Install the rod assembly if removed from the torque tube.

b. Position the cowl flap to the nacelle and secure with bolt, washer, nut and cotter pin.

c. Connect the rod assembly to the cowl flap.

d. Rig and adjust the cowl flaps as described in paragraph 8-16.

e. Install all access panels.

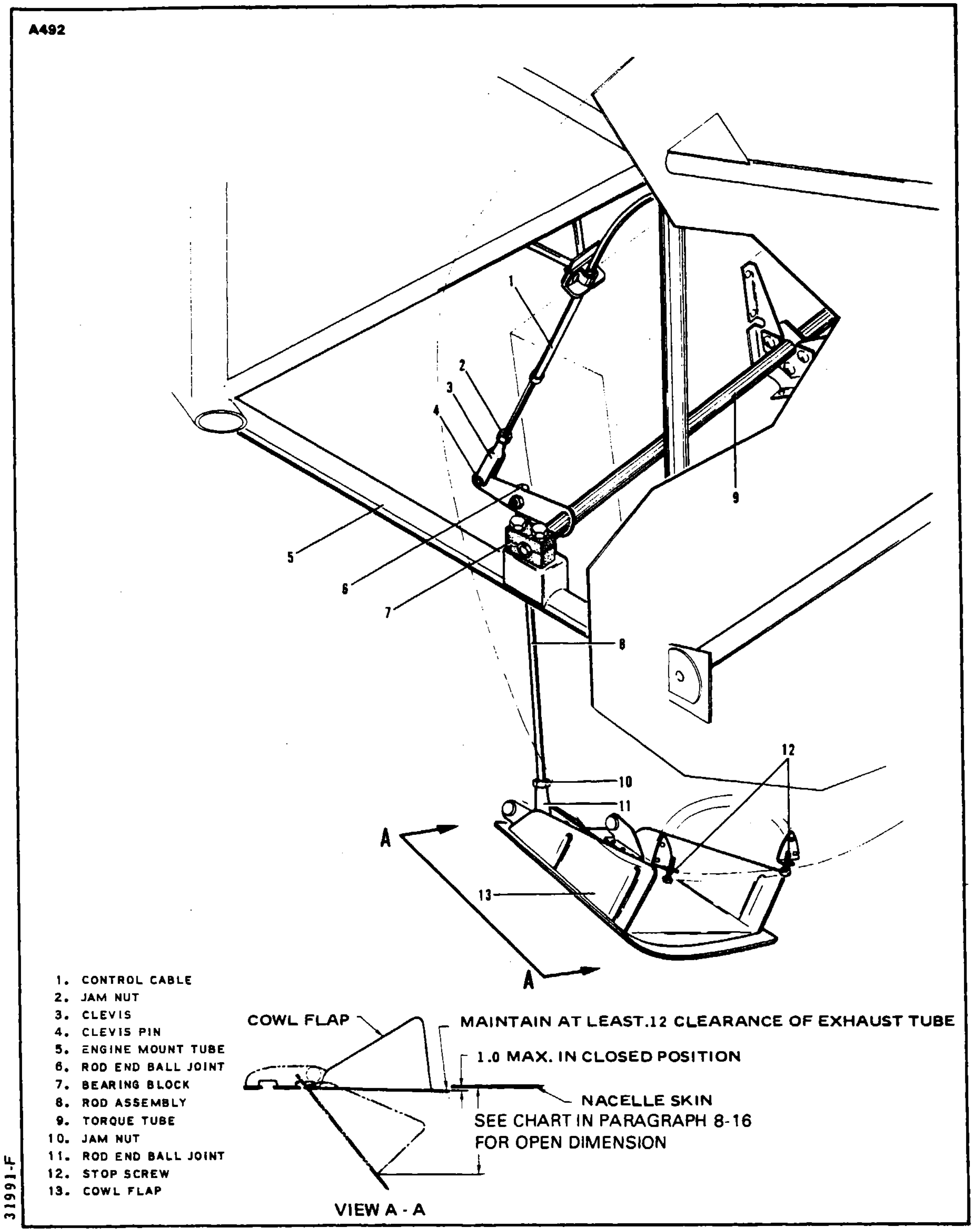

Figure 8-1. Cowl Flap Installation

8-16. RIGGING AND ADJUSTING ENGINE COWL FLAPS. (Refer to Figure 8-1.)

a. Remove the two side cowl panels from each engine.

b. Ascertain that the cowl flap mechanism is properly installed. (Refer to Paragraph 8-15.)

c. With the cowl flap selector in the cabin placed in the OPEN position, adjust the rod ends (6 and 11) of the rod assembly (8) so the cowl flap is open to the dimension shown in Figure 8-1 for the particular serial numbers noted in the following chart.

SERIAL NUMBERS	DISTANCE MINIMUM	DISTANCE MAXIMUM
27-2505 to 27-2868 incl. *	3 inches	
27-2869 and up	3.50 inches	3.75 inches
*Airplanes with Serial Numbers 27-2505 to 27-2868 inclusive which have been modified to a gross weight of 5200 pounds use 3.50 min. to 3.75 max. inches.		

d. This dimension should be measured normal to the nacelle skin. (Refer to Figure 8-1.) Divide the adjustment between both rod ends, and check all rod ends and clevis ends for adequate thread engagement.

e. Move the selector in the cabin to the CLOSED position and check that the trailing edge of the outboard cowl flap clears the exhaust tube by at least .12 of an inch. Do not exceed one inch opening on either the outboard or inboard cowl flap. The dimension is measured normal to the nacelle skin and trailing edge of the cowl flap.

f. It may be necessary to readjust the OPEN position slightly to obtain these measurements.

g. Adjust the two stop screws(12) at the trailing edge of the cowl flaps until they contact the cowl flaps firmly.

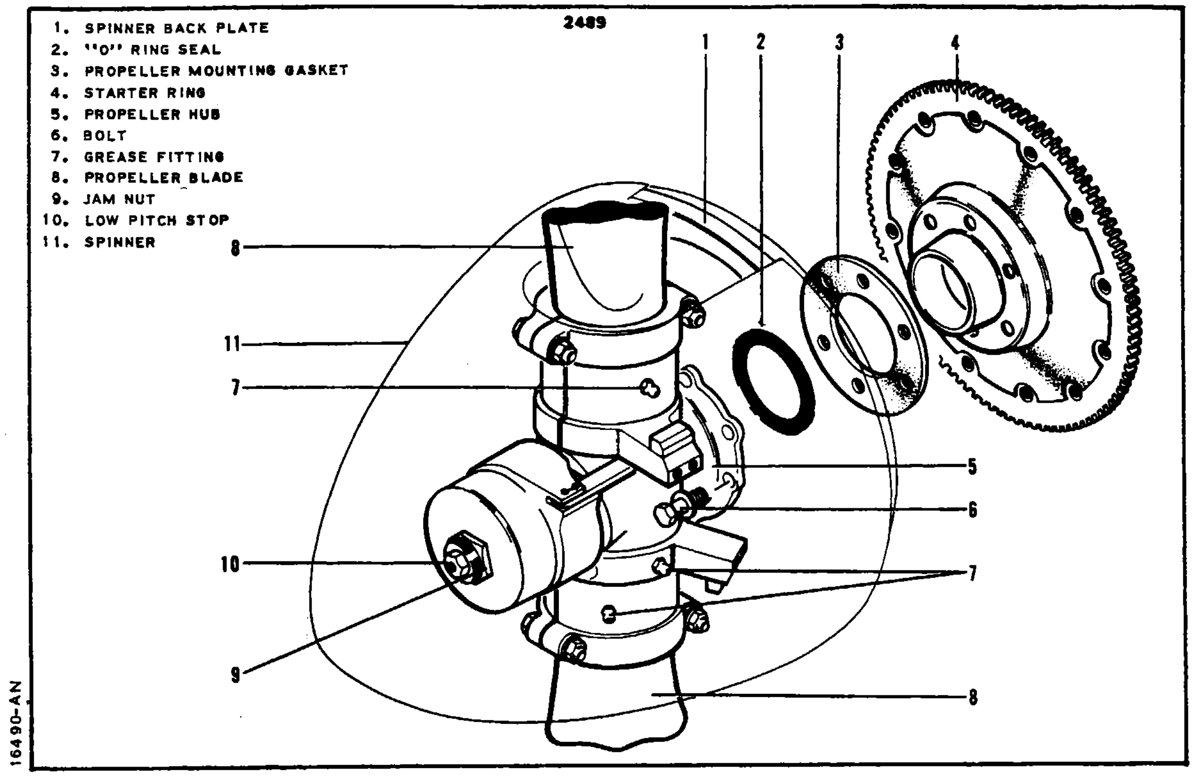

Figure 8-2. Propeller Installation
PA-23-250; PA-23-235; and PA-23-250 (six place),
Serial Nos. 27-2000 to 27-2504 incl.

8-17. PROPELLER.

WARNING

Before performing any service functions on the propeller, ascertain that the master switch is OFF, the magneto switches are OFF (grounded) and the mixture control is in the IDLE CUT-OFF position.

8-18. REMOVAL OF PROPELLER. (PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.) (Refer to Figure 8-2.)

a. Ascertain that the master switch and magneto switches are in the off position and the mixture control lever in the idle cut-off position.

b. Place the propeller control levers in the feather position.

c. Remove the spinner by removing the screws from the outside edge.

d. Place a drip pan under the propeller to catch the oil spillage.

e. Slide a feathering paddle on each propeller blade and turn the blades slightly in the low pitch direction to relieve the high pitch stop pins.

f. Push both pins into their brackets and feather propeller blades completely.

g. Remove the bolts which hold each of the high pitch stop brackets to the propeller hub and remove brackets.

h. Remove the propeller hub mounting bolts holding the propeller hub to the crankshaft flange.

i. Remove the propeller.

8-19. CLEANING, INSPECTION AND REPAIR OF PROPELLER.

a. Check for oil and grease leaks.

b. Clean the spinner, propeller hub interior and exterior, and blades with a non-corrosive solvent.

c. Inspect the hub parts for cracks.

d. Steel hub parts should not be permitted to rust. Use aluminum paint to touch up, if necessary, or replate during overhaul.

e. Check all visible parts for wear and safety.

f. Check blades to determine whether they turn freely on the hub pivot tube. This can be done by rocking the blades back and forth through the slight freedom allowed by the pitch change mechanism. If they appear tight and are properly lubricated, the pitch change mechanism should be removed so that each blade can be checked individually. If blades are tight, the propeller should be disassembled by an authorized service center.

g. Inspect blades for damage or cracks. Nicks in leading edges of blades should be filed out and all edges rounded, as cracks sometimes start from such places. Use fine emery cloth for finishing. Refer to Figure 8-4 for propeller blade care.

h. It is recommended that for severe damage, internal repairs and replacement of parts, the propeller should be referred to the Hartzell Factory or Service Station.

i. Grease blade hub through zerk fittings. Remove one of the two fittings for each propeller blade, alternate the next time. Apply grease through the zerk fitting until fresh grease appears at the fitting hole of the removed fitting. Care should be taken to avoid blowing out hub gaskets.

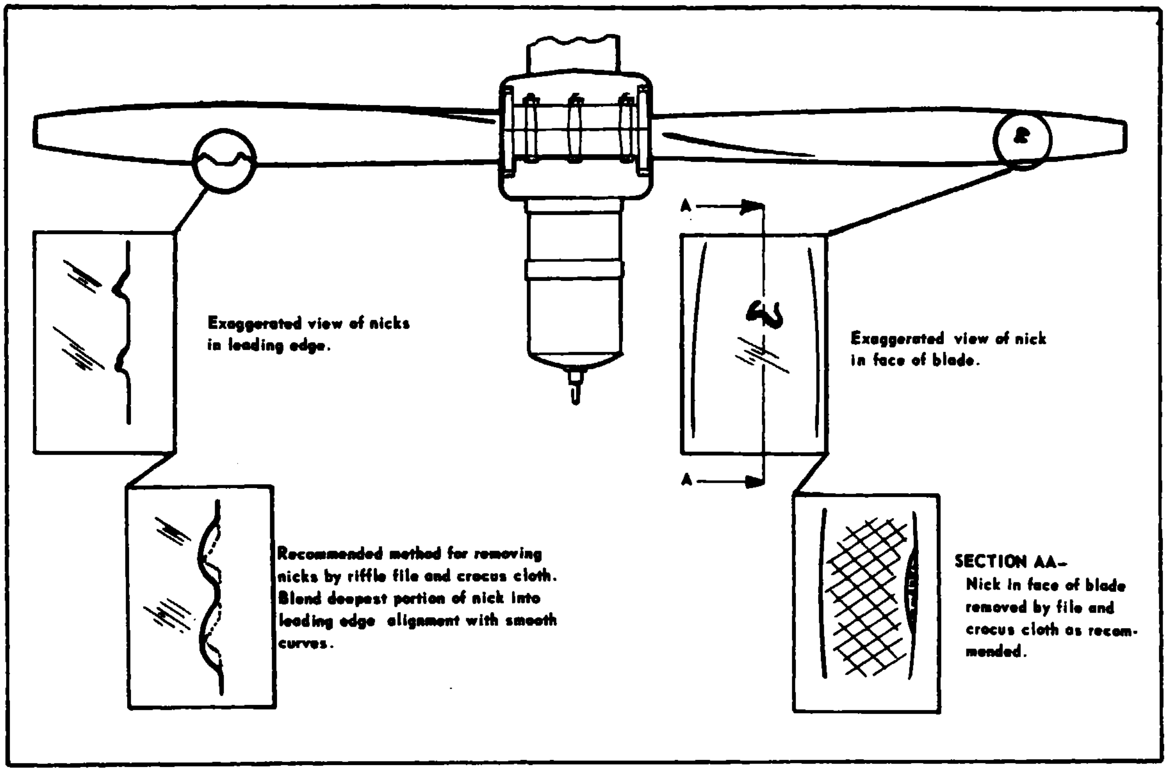

Figure 8-3. Typical Nicks and Removal Method

8-20. INSTALLATION OF PROPELLER. (PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.) (Refer to Figure 8-2.)

a. Ascertain that the master switch and magneto switches are in the off position.

b. Place the propeller control levers in the feather position.

c. Observe the starter ring gear to make sure it is mounted properly on the engine crankshaft flange. One of the bushings on the crankshaft is stamped with an "O" mark and it must be inserted in the starter ring gear hole, likewise identified by an "O" mark.

d. Install a new "O" ring on the crankshaft and the gasket on the propeller mounting bushings.

TABLE VIII-I. PROPELLER SPECIFICATIONS

PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.		
Blade Angle (2 Blades)	Low Pitch (High RPM) High Pitch (Low RPM)	15.5° (1) 80° (1) (Feathered)
(1) MEASUREMENT TAKEN AT 30 INCH RADIUS		
Propeller RPM Setting	Engine Static High RPM Engine Static Low RPM	2575 RPM Max. 1900 RPM Min.
Propeller Torque Limits	Description	Required Torque (Dry)
	Spinner Bulkhead (Aft)	50-70 inch pounds
	Propeller Mounting Bolts	60 foot pounds
	Spinner Attaching Screws	40 inch pounds

NOTE

The reason for this arrangement is that it is necessary to have the timing marks located in the proper position. The timing marks appear on the gear ring in the form of a punch mark which must be lined up with a punch mark or pin on the starter gear drive housing.

e. With the propeller blades feathered completely, raise the propeller into position with the engine and slide the propeller onto the propeller mounting bushings.

f. Install the hexagon head propeller hub mounting bolts and ferry screws and tighten them to 60 foot pounds of torque. Safety with MS20995-C41 wire.

g. Install the high pitch stop brackets making sure there are a sufficient number of shim washers behind the bracket to attain proper alignment of the pin with the pitch stop.

h. Check tightness of all the propeller bolts and safety.

i. Install the spinner and secure with attaching screws.

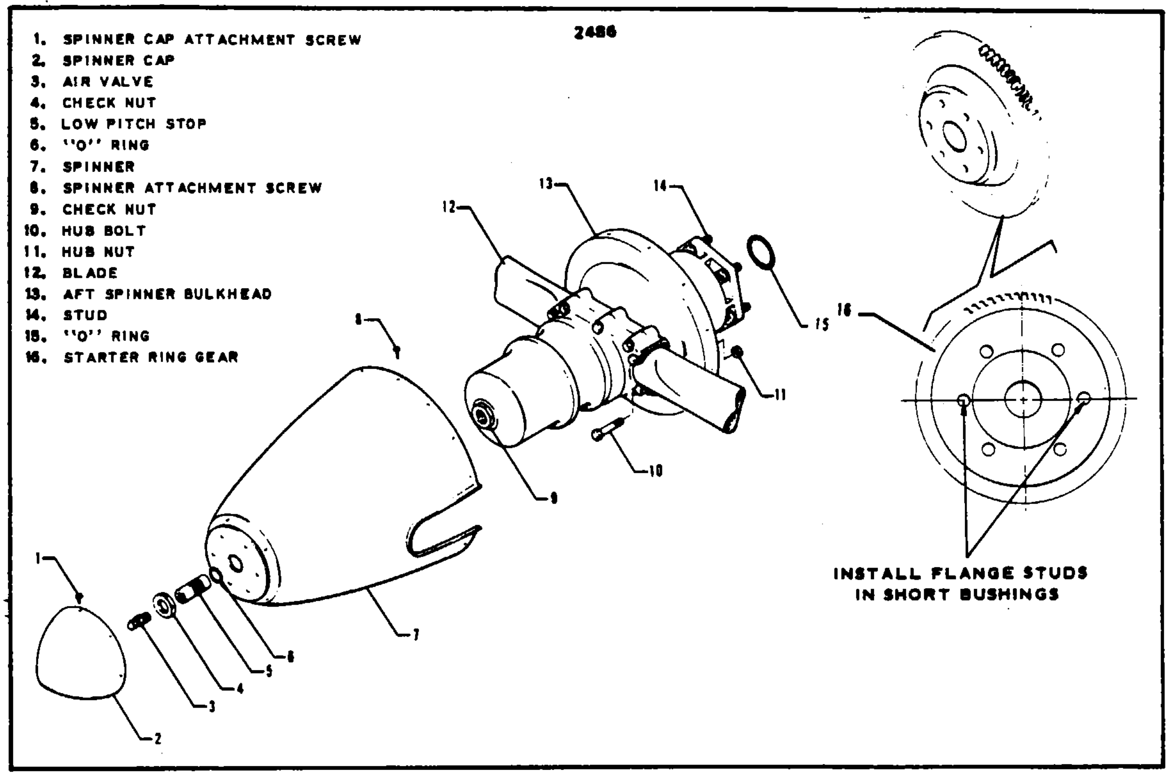

Figure 8-4. Propeller Installation
PA-23-250 (six place), Serial Nos. 27-2505 and up

8-21. REMOVAL OF PROPELLER. (PA-23-250 (six place), Serial Nos. 27-2505 and up.) (Refer to Figure 8-4.) This includes all propellers, standard and with spring backup kit installed, identified by a letter "S" in the dash number.

NOTE

When removing the propeller, it is unnecessary to remove the spinner, feather the blades, or remove the air charge. When the propeller is removed for service or overhaul, the propeller with the spring kit installed should be feathered on the aircraft (see following CAUTION) and the spinner on either prop must be removed according to section d of this paragraph.

TABLE VIII-II. PROPELLER SPECIFICATIONS
PA-23-250 (six place), Serial Nos. 27-2505 and up.

Blade Angle	Low Pitch (High RPM)	14.5° 15.2° (1)
	Feathered	80°

MEASUREMENT TAKEN AT 30 INCH RADIUS
(1) TIO-540-C1A ENGINES ONLY

Propeller RPM Setting	Engine Static High RPM	2575

Propeller Torque Limits	Description	Required Torque (Dry)
	Spinner Bulkhead (Aft)	22 foot-pounds
	Propeller Mounting Bolts	60 foot-pounds
	Spinner Bulkhead Check Nut	35-40 foot-pounds
	Spinner Attachment Screws	40 inch-pounds

CHAMBER PRESSURE REQUIREMENTS WITH TEMPERATURE

HC-E2YR-2RB or HC-E2YR-2RBF or HC-E2YK-2RB or HC-E2YK-2RBF

Temp. °F	Press. (psi)	Temp. °F	Press. (psi)
100	188	30	165
90	185	20	162
80	182	10	159
70	178	0	154
60	175	-10	152
50	172	-20	149
40	168	-30	146

HC-E2YK-2RBS or HC-E2YK-2RBSF or HC-E2YR-2RBS or HC-E2YR-2RBSF

Temp. °F	Press. (psi)
100	74
70	70
40	66
10	62
-20	58

NOTE: Do not check pressure or charge with propeller in feather position.

WARNING

Do not attempt to disassemble the propeller assembly any further than stated in this manual. Only personnel at a certified repair shop are authorized for repair and overhaul of the propeller mechanism.

CAUTION

Under NO condition should blade paddles be used on either propeller, except to unfeather a propeller with the spring kit installed (see paragraph 8-23). If a propeller is to be feathered on the ground, it should be done with the engine operating, by use of the propeller control on the throttle quadrant.

WARNING

Prior to performing any work on the propeller, ascertain that the master switch and magneto switches are OFF (grounded) and the mixture control is in the IDLE CUT-OFF position.

a. Remove all hardware that attaches the nose cowl to the top and bottom engine cowls. The top and side panels of the main cowl assembly may be removed for greater accessibility. Work the nose cowl as far forward as possible, reach through the opening and split the cowl by pulling the upper and lower hinge pins. Pliers may be needed to pull the pins. The two halves of the cowl may be pulled forward and to either side of the propeller, which should be in a vertical position for ease in removing the cowl.

NOTE

In some appropriate manner, index the propeller and starter ring to facilitate installation. (Example - paint stripe.) Do not scratch the surface.

b. Place a drip pan under the propeller to catch oil spillage.

c. Cut safety wire around the propeller mounting studs and remove the studs (14) from the engine flange by wrenching the nuts. These nuts are "frozen" to the studs with loctite and secured with roll pins, so the studs should turn with the nuts. Pull the propeller from the engine shaft.

d. In the event that the spinner and spinner bulkhead are to be removed for cleaning, inspection, adjustment of pitch stop, etc., remove the spinner nose cap attaching screws and cap (1 and 2). Remove the spinner (7) by removing the safety wire and check nut (4) from the propeller at the forward end of the forward spinner bulkhead and the screws (8) that secure the spinner to the aft bulkhead (13). The aft spinner bulkhead may be removed from the hub by removing the locknuts (11).

8-22. CLEANING, INSPECTION AND REPAIR OF PROPELLER.

CAUTION

Prior to performing any work on propeller, release the dome pressure first.

a. Check for oil and grease leaks.
b. Clean the spinner, propeller hub and blades with a non-corrosive solvent.
c. Inspect the hub parts for cracks.
d. Steel hub parts should not be permitted to rust. Use aluminum paint to touch up, if necessary, or replate during overhaul.
e. Check all visible parts for wear and safety.
f. Check the blades of the standard propeller to determine whether they turn freely on the hub pivot tube. This can be done by rocking the blades back and forth through the slight freedom allowed by the pitch change mechanism. Do this by hand being careful not to slam the internal mechanism against the stops. If blades appear tight and are properly lubricated, the propeller may need internal repair. (See WARNING under "Removal of Propeller".) This cannot be done with the spring propeller due to the pressure exerted by the spring even though the dome pressure is discharged.
g. Inspect blades for damage or cracks. Nicks in leading edges of blades should be filed out and all edges rounded , as cracks sometimes start from such places. Use fine emery cloth for finishing. Refer to Figure 8-3 for propeller blade care.
h. Check condition of propeller mounting nuts and studs.

NOTE

It is recommended that for severe damage, internal repairs and replacement of parts, the propeller should be referred to the Hartzell Factory or Certified Repair Station.

i. Each blade face should be sanded lightly with fine sandpaper and painted, when necessary, with a flat black paint to retard glare. A light application of oil or wax may be applied to the surfaces to prevent corrosion.

8-23. INSTALLATION OF PROPELLER. (PA-23-250 (six place), Serial Nos. 27-2505 and up.) (Refer to Table VIII-II and Figure 8-4.)

WARNING

Prior to performing any work around propeller, ascertain that the master switch and magneto switches are OFF (grounded) and the mixture control is in the IDLE CUT-OFF position.

a. Clean the propeller flange, starter ring and crankshaft flange.
b. Install spinner bulkhead (13) on propeller hub and secure with locknuts. Torque bolts to specifications given in Table VIII-II.
c. Ascertain that the starter ring gear is properly on the crankshaft flange. The oversize hole in the starter ring must go over the oversize bushing.
d. Position the prop flange and starter ring gear so the two short bushings are horizontal. (Refer to Figure 8-4.)
e. Lubricate and install O-ring (15) in prop hub.
f. Place the propeller in a horizontal position and mount to the engine crankshaft. Check alignment of paint stripe (refer to NOTE under paragraph 8-21). Screw each stud into its mating engine flange bushing a few threads at a time until all are tight. Torque the studs to the specifications given in Table VIII-II.
g. Safety studs with MS20995-C41 wire. Safety wire is inserted through the roll pins.
h. Install spinner (7). Torque spinner screws (8) and check nut (4) per Table VIII-II. Safety check nut with MS20995-C41 wire.

NOTE

Do not check pressure or charge with **PROPELLER** in feather position.

CAUTION

To obtain an accurate pressure reading when checking propeller dome air pressure or to insure complete release of all air pressure, place the propeller **CONTROL** in the feather detent before measuring or releasing propeller air pressure. This procedure will insure the free flow of all air within the prop dome and prevent possible error in pressure readings or injury to service personnel should the low pitch stop be removed.

NOTE

If the propeller is in feather on the ground, it is undesirable to run it out of feather through engine operation due to roughness which will occur possibly causing severe damage to engine mount and exhaust system. Remove the air charge, unfeather the blades with equal pressure applied by means of blade paddles used on both blades as close to the hub as possible. Listen for the quiet distinctive "clicks" of the high pitch stop pins, then stop and remove the paddles.

i. Charge the cylinder through air valve (3) with dry air or nitrogen gas to the prescribed pressure. Refer to Table VIII-II of this manual for an exact pressure for the existing temperature. It is most important that an accurate charge be maintained.

k. The amount of air pressure per existing temperature, as shown by Table VIII-II, is very important and should always be used. If excessive pressure is used in the propeller, there is a possibility of feathering taking place at idle speed when the engine is warm and the oil viscosity is low. An accurate air pressure gauge should always be used. A pressure gauge and valve kit, part number 756 771, may be purchased through a Piper Dealer or Distributor.

l. When recharging the propeller, dry air or nitrogen gas should be used. It is important not to allow moisture to enter the air chamber as this could cause the piston to freeze during cold weather operation.

m. Test for leakage by using a soap solution or equivalent and applying it around the air valve stem and adjustment stop nut.

n. To reinstall engine cowling, first put the propeller in a vertical position then fit the two halves of the nose cowl together behind the spinner bulkhead and pin them together with the two hinge pins through the top and bottom hinges. Slide the nose cowl back and into proper location with the engine cowls. Locate holes and install all hardware that attaches the cowls together. Install top and side engine cowl panels if removed. Install spinner cap.

8-24. ADJUSTMENT OF LOW PITCH BLADE ANGLE AND STOP. (PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.)

a. The propeller comes from the factory with the low pitch stop adjusted for proper blade angle. If, however, this adjustment has been disturbed, the following procedure is given for obtaining blade angle:

1. The blade angle (refer to Table VIII-II) is determined by placing a propeller protractor on the face side of the propeller at the 30 inch station as measured from the hub centerline. The blade must be horizontal.

2. The low pitch stop is adjusted by rotating the blades in the clamps. This is done by loosening the outer clamp bolts and moving the blades, using a blade bar or plastic mallet. Rotating the blade 0.031 of an inch at the circumference of the blade shank ordinarily will change the static RPM by about 100. Torque the 3/8 bolts to 20 to 22 foot-pounds and the 7/16 bolts to 40 foot-pounds.

b. After the low pitch stop has been adjusted for proper blade angle, the governor should then be adjusted to obtain maximum rated engine RPM during take-off and climb as described in paragraph 8-30.

8-25. ADJUSTMENT OF LOW PITCH BLADE ANGLE AND STOP. (PA-23-250 (six place), Serial Nos. 27-2505 and up.)

NOTE

Both types of propellers referred to, come from the factory with the low pitch stop adjusted for proper blade angle. If, however this adjustment has been disturbed, the procedure given below is used for obtaining blade angle, but applies only to the propeller without the spring kit A-2273 installed. There is no way to check the low pitch blade angle of the propeller, with the spring kit installed, in the field. This is due to the internal spring producing a force near to that of the air charge in the standard propeller which can and has to be released to make this adjustment. The spring supplies constant pressure to the blades making it very difficult to rotate the blades to a point where the low pitch stop is contacted. Therefore, if the blade angle on a spring propeller is suspected to be wrong it should be referred back to the Hartzell factory or Certified repair shop.

a. Procedure for obtaining blade angle and adjusting low pitch stop.

1. The blade angle (Refer to Table VIII-II) is determined by placing a propeller protractor on the face side of the propeller at the 30-inch station as measured from the hub centerline. The blade must be horizontal.

2. The low pitch stop is adjusted by rotating a screw in the nose of the propeller cylinder. Rotating the screw clockwise increases the low pitch angle and reduces the static RPM by about 100 RPM for each half turn, or vice versa.

CAUTION

Before adjusting the low pitch stop screw, the air pressure should be dropped to zero. Unless this is done, it is possible to unscrew the low stop far enough to disengage the threads, allowing the air pressure to blow the stop screw out with great force. To insure the complete discharge of all air pressure within the dome, place the propeller **CONTROL** in the feather detent. There should be at least four threads of the stop screw engaged.

b. After the low pitch stop has been adjusted for proper blade angle, torque the low pitch stop jam nut to 30 foot-pounds. The governor should then be adjusted to obtain maximum rated engine RPM during take-off and climb.

8-26. BLADE TRACK. Blade track is the ability of one blade tip to follow the other, while rotating, in almost exactly the same plane. Excessive difference in blade track - more than 0.062 of an inch, may be an indication of bent blades or improper propeller installation. Check blade track as follows:

a. With the engine shut down and blades vertical, secure to the airplane a smooth board just under the tip of the lower blade. Move the tip fore and aft through its full "blade-shake" travel, making small marks with a pencil at each position. Then center the tip between these marks and scribe a line on the board for the full width of the tip.

b. Carefully rotate propeller by hand to bring the opposite blade down. Center the tip and scribe a pencil line as before and check that lines are not separated more than 1/16 of an inch.

c. Propellers having excessive difference in blade track should be removed and inspected for bent blades, or for parts of sheared "O" ring, or foreign particles, which have lodged between hub and crankshaft mounting faces. Bent blades will require repair and overhaul of assembly.

8-27. PROPELLER GOVERNOR.

8-28. REMOVAL OF PROPELLER GOVERNOR.

a. Remove the upper engine cowl per paragraph 8-6 or 8-7.

b. Disconnect the control cable end from the governor control arm.

c. Remove the governor mounting stud nuts. It will be necessary to move the governor out from the mounting pad as the nuts are being removed before the nuts can be completely removed.

d. Remove the mounting gasket. If the governor is to be removed for a considerable length of time and another unit not substituted, it is advisable to cover the mounting pad to prevent damage caused by foreign matter.

8-29. INSTALLATION OF PROPELLER GOVERNOR.

a. Clean the mounting pad thoroughly, making very certain that there are no foreign particles in the recess around the drive shaft.

b. Place the governor mounting gasket in position with the raised portion of the screen facing away from the engine.

c. Align the splines of the governor shaft with the engine drive and slide the governor into position.

d. With the governor in position, raise the governor enough to install washers and start mounting nuts. Torque nuts even.

e. Connect the control cable end to the governor control arm. The ball stud is installed in the inner hole of the control arm.

f. Adjust governor control per paragraph 8-30.

g. Install engine cowl per paragraph 8-9 or 8-10.

8-30. RIGGING AND ADJUSTMENT OF PROPELLER GOVERNOR. (Refer to Figure 8-5.)

a. Start the engine and warm in the normal manner.

b. To check high RPM, low pitch setting, move the propeller control all the way forward to the INCREASE PROPELLER position. At this position the governor speed control arm (3) should be against the high RPM fine adjusting screw (4). With the throttle full forward, observe engine RPM which should be 2575 RPM with high RPM properly adjusted.

c. Should engine RPM not be as required, the high RPM setting should be adjusted as follows:

1. Shut down the engine and remove the upper engine cowl.
2. Adjust the governor by means of the fine adjustment screw (4) for 2575 RPM. To do this, loosen the high RPM fine adjustment screw locknut and turn the screw in a clockwise direction to decrease engine speed or in a counterclockwise direction to increase engine speed.

NOTE

One revolution of the fine adjustment screw will increase or decrease the engine speed approximately 20 RPM.

3. Reinstall upper engine cowl and repeat step b to ascertain proper RPM setting.
4. After setting the proper high RPM adjustment, run the self-locking nut on the fine adjustment screw against the base projection to lock.
5. Ascertain that the governor control arm (3) is adjusted to the proper angle on the control wheel (2) as shown in Figure 8-5.

d. With the high RPM adjustment complete, the control system should be adjusted so that the governor control arm will contact the high RPM stop when the cockpit lever is 0.062 of an inch from its full forward stop, which is located in the control pedestal. To adjust the control lever travel, disconnect the control cable end from the control arm, loosen the cable end jam nut and rotate the end to obtain the desired lever clearance. Reconnect the cable end and tighten jam nut.

e. It is usually only necessary to adjust the high RPM setting of the governor control system, as the action automatically takes care of the positive high pitch setting.

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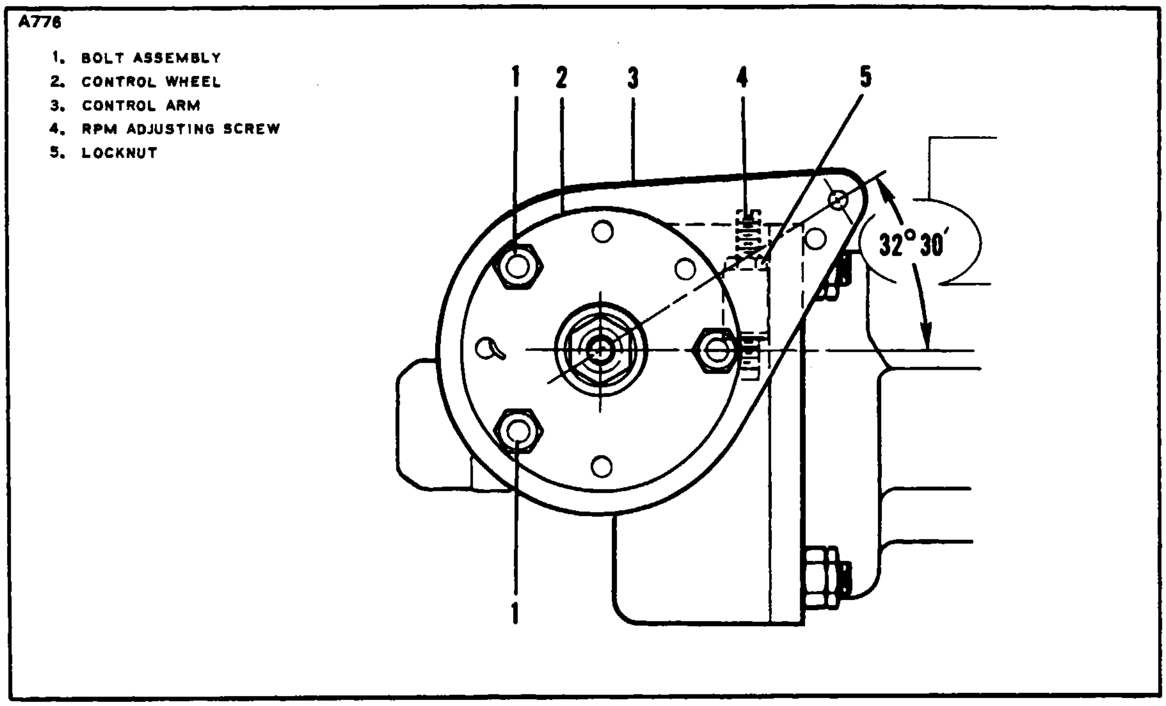


Figure 8-5. Propeller Governor

8-31. ENGINE.

8-32. REMOVAL OF ENGINE. PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.)

NOTE

On airplanes equipped with fuel injection, refer to paragraph 8-34 for Removal of Engine.

The removal of either engine is basically the same procedure, though the routing of some wires, cables, lines, etc. does vary between engines. Each line should be identified to facilitate reinstallation and covered, where disconnected, to prevent contamination.

a. Turn off all cockpit switches and then disconnect the battery ground wire at the battery.

b. Move the fuel valve control lever located on the outboard side of the fuel selector panel to the OFF position.

c. Remove the engine cowling per paragraph 8-6.

d. Drain the engine oil, if desired.

e. Remove the propeller per paragraph 8-18.

f. Disconnect the starter cable at the starter, remove the cable clamps at the left side of the engine and engine mount, and draw the cable aft through the engine baffle to the firewall.

g. Disconnect generator wires and remove the wire clamps, pull the wires aft through the engine baffling to the firewall.

h. Disconnect the governor control cable from the governor.

i. Disconnect the vacuum pump lines from the pump.

j. Disconnect the engine oil cooler air duct bellow by means of the square split type clamp.

k. Disconnect the primer line at the tee connecting fitting.

l. Disconnect the mechanical fuel pump fuel inlet line connected to the right side of the pump and from the connection at the electric fuel pumps.

m. Disconnect the mechanical fuel pump line from the "Y" connection fitting at the left side of the pump.

n. Disconnect the "P" leads from the magnetos and the oil temperature wire at the bulb.

o. Disconnect the tachometer cable, cylinder head temperature thermocouple, oil pressure line and manifold pressure line.

p. Remove the clamp holding manifold pressure line to the rear baffle.

q. Disconnect the engine breather line from the rear of the engine.

r. Disconnect the oil cooler hoses at the rear of the engine.

s. Remove both magneto cooling baffles and rotate magnetos to clear the engine mount.

t. Disconnect the hydraulic lines from the pump on the left engine.

u. Remove the bonding straps from the rear of the engine.

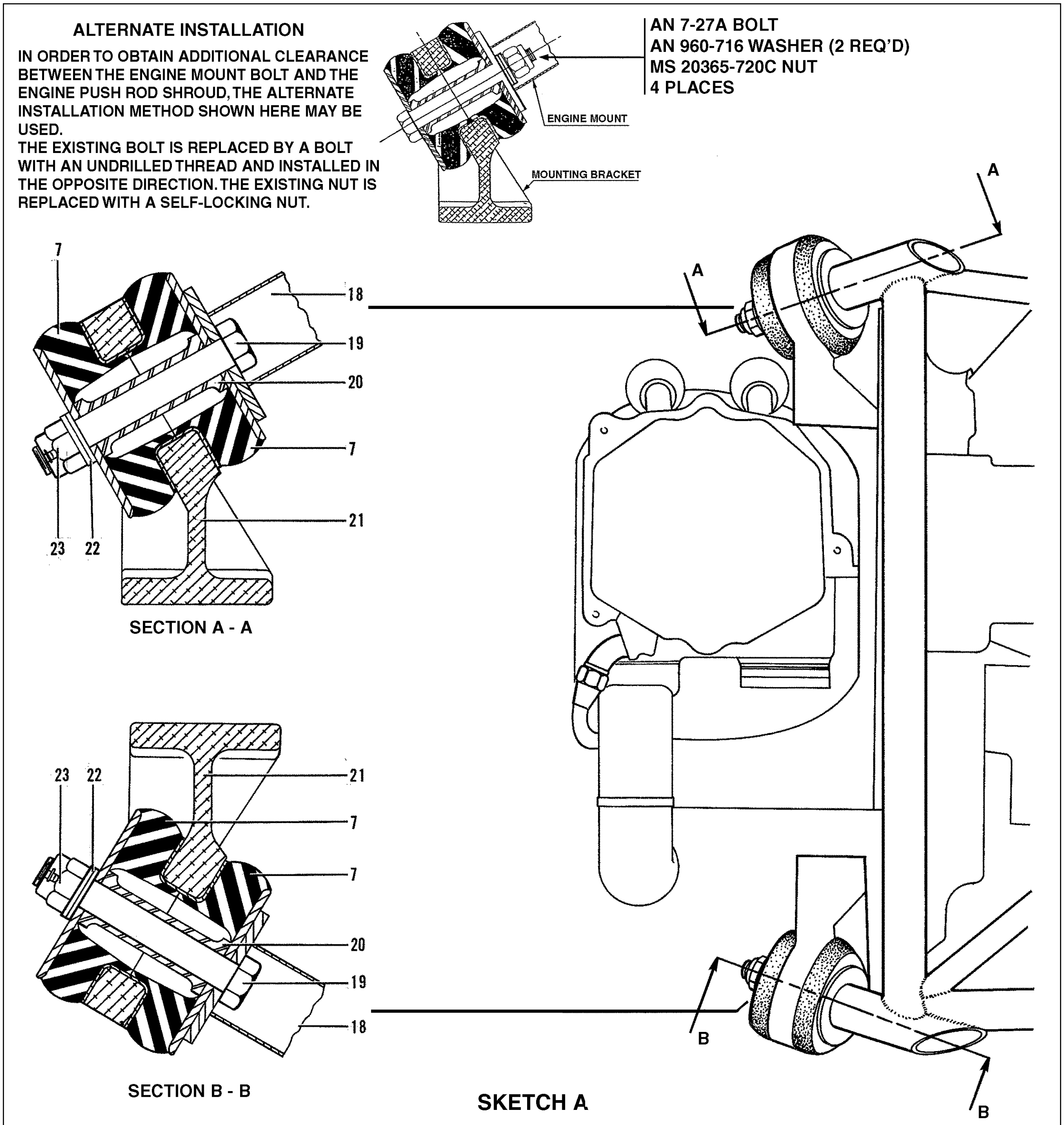
v. Remove engine control support bracket by removing bolts attaching bracket to the engine crankcase.

w. Remove the carburetor mounting nuts and allow the carburetor and carburetor air box to hang by means of the attached engine controls.

x. To prevent damage to the tail when removing the weight of the engine, attach a stand to the tail skid.

y. Attach a one-half ton (minimum) hoist to the hoisting hook and relieve the tension on the mounts.

z. Remove the cotter pin, nuts, washers and front rubber mount from each bolt and remove sleeve. Slide bolts out of attaching points. Swing engine free and place on a suitable support, being careful not to damage any attached parts, and remove rear rubber mounts.



1. OIL COOLER
2. MAGNETO, LEFT
3. OIL PRESSURE SCREEN
4. VACUUM PUMP
5. MAGNETO, RIGHT
6. ENGINE MOUNT ASSEMBLY (SEE SKETCH A)
7. SHOCK MOUNT
8. OIL PRESSURE RELIEF VALVE
9. LIFTING STRAP
10. SPARK PLUG
11. STARTER RING GEAR
12. FUEL PUMP
13. HYDRAULIC PUMP
14. OIL SUCTION SCREEN
15. CARBURETOR
16. INDUCTION INTAKES
17. EXHAUST STACK
18. ENGINE MOUNT FRAME
19. BOLT
20. BUSHING
21. ENGINE MOUNT FITTING
22. WASHER
23. NUT

Figure 8-6. Engine Installation, PA-23-235 and PA-23-250 S/N's 27-1 thru 27-2504

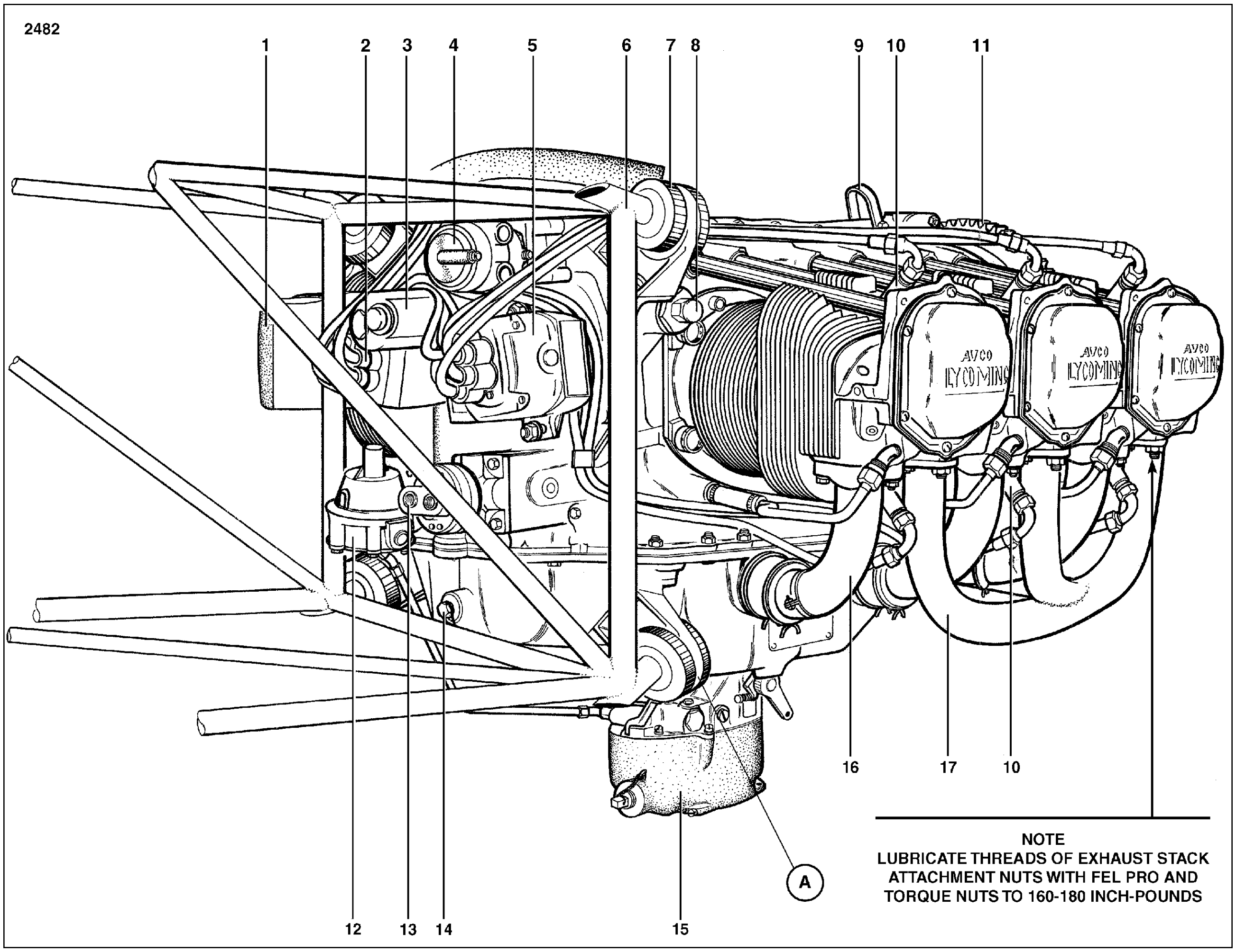


Figure 8-6. Engine Installation, PA-23-235 and PA-23-250 S/N's 27-1 thru 27-2504 (cont.)

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8-33. INSTALLATION OF ENGINE. (PA-23-250; PA-23-235; and PA-23-250 (six place). Serial Nos. 27-2000 to 27-2504 incl.)

NOTE

On airplanes equipped with fuel injection, refer to paragraph 8-35 for Installation of Engine.

a. Attach a one-half ton hoist to the lifting eye and lift the engine. Tilt the rear of the engine downward and out of line until the magnetos clear the ring of the engine mount. Position the mounting lugs of the engine so they align with the engine mount attaching points.

b. Insert a mounting bolt into the engine mount until its threaded end extends one or two threads from the mount itself. Slide a shock mount in between the engine mount and the engine.

c. Repeat the procedures described in step b at the three remaining attachment points.

NOTE

When installing engine, always use new rubber shock mounts.

d. Install the front engine shock mounts on the bolts and over the forward end of the mount spacer; check to see that the shock mounts are not binding. Install a washer and castellated nut on each mounting bolt. Tighten the nuts progressively, following a circular sequence and torque to 40 foot-pounds. Install cotter pins.

e. Place gasket, carburetor, and carburetor air box to bottom of engine and attach with nuts and pal nuts.

f. Attach engine control support bracket with controls attached to the bottom of the engine crankcase with bolts.

g. Install the bonding straps to the rear of the engine.

h. Install both magneto cooling baffles.

i. Connect the oil cooler hoses to rear of engine and hydraulic lines to pump on left engine.

j. Connect the tachometer cable, cylinder head temperature, oil pressure line, oil temperature wire and magneto "P" leads.

k. Connect the fuel lines to the fuel pump.

l. Connect the primer line at tee connection fitting.

m. Connect the vacuum pump hoses.

n. Connect the oil cooler air duct bellows by means of a square split type clamp.

o. Install the governor control cable bracket and the control cable on the governor.

p. Connect the generator wires and clamp them on the rocker arm oil return lines.

q. Connect the starter cable and clamp it to the rocker arm oil return lines and engine mount.
r. Ascertain that the magneto switches are off and install the propeller per paragraph 8-20.
s. Install the proper grade and mount of engine oil. (Refer to the latest revision of Lycoming Service Instruction No. 1241.)
t. Connect the battery ground wire at the battery.
u. Turn on the fuel valve, open the throttle full, open mixture control and turn on the electric fuel pump and check the fuel lines for leaks.
v. Perform an engine operational check.
w. Check for oil leaks.
x. Install the access plate on the engine nacelle and the cowling per paragraph 8-9.

8-34. REMOVAL OF ENGINE. (PA-23-250 (six place), Serial Nos. 27-2372 and up.) The removal of either engine is basically the same procedure, though the routing of some wires, cables, lines, etc. does very between engines. Each line should be identified to facilitate reinstallation and covered, where disconnected, to prevent contamination.

a. Turn off all cockpit switches and then disconnect the battery ground wire at the battery.
b. Move the fuel valve control lever, located on the fuel control box between the two front seats, to the OFF position.
c. Remove the engine cowling per paragraph 8-7.
d. Drain the engine oil, if desired.
e. Remove the propeller per paragraph 8-21.
f. Disconnect the starter cable at the starter, remove the cable clamps and pull it aft to the firewall.
g. Disconnect the alternator wires and wire clamps, pull the wires aft to the firewall.
h. Remove the governor control cable and injector control cables.
i. Disconnect the cylinder head temperature, manifold pressure, oil pressure, fuel pressure and fuel flow gauge vent lines.
j. Disconnect the engine oil breather, magento "P" leads, oil temperature wire and tachometer cable.
k. Disconnect the vacuum hoses, air oil separator line to the engine, oil cooler lines and remove oil cooler.
l. Disconnect fuel lines at the fuel pump, hydraulic pump lines and bonding straps.
m. Loosen the magneto mounting nuts and rotate the magnetos to clear the engine mount.

n. To prevent damage to the tail when removing the weight of the engine, attach a stand to the tail skid.

o. Attach a one-half ton (minimum) capacity hoist to the engine lifting eye and relieve the tension on the mount bolts.

p. Remove the cotter pin, nut, washer, front rubber mount and sleeve from all four mount bolts.

q. Slide mount bolts out of their attaching points and slowly swing engine free. Place on a suitable support being careful not to damage any attached parts.

r. Remove the rear rubber mounts.

8-35. INSTALLATION OF ENGINE. (PA-23-250 (six place), Serial Nos. 27-2505 and up.) Refer to Figure 8-7 for the proper arrangement of the engine mount shock assemblies. The top shocks are assembled so the silver colored shocks are aft and the gold colored shocks are forward. The lower shock mounts are installed opposite of the top shock mounts.

a. Attach a one-half ton hoist to the lifting strap and lift the engine. The exhaust stacks, injector and accessories may be installed.

b. Swing the engine into position with the nose slightly high and inward. Allow the magnetos to clear the ring of the engine mount. Position the mounting lugs of the engine so they align with the engine mount attaching points.

NOTE

When installing engine, always use new rubber shock mounts.

c. Insert a mounting bolt into the engine mount until its threaded and extends one or two threads from the mount itself. Insert a shock mount between the engine mounting bracket and the mount. Slide the mount bolt on through the mount and insert a mount spacer over the bolt and through the engine mounting bracket.

d. Repeat the procedures in step c with the remaining three attaching points.

NOTE

A heat shield is installed with the bottom outboard shock mount. Adjust so as to give maximum protection against exhaust tube heat.

e. Install the front engine shock mounts on the bolts and over the forward end of the mount spacer; check to see that the shock mounts are not binding. Install washers and self-locking nut on each mounting bolt. Tighten the nuts progressively, following a circular sequence and torque to 34 to 42 foot-pounds.

f. Connect the fuel lines to the fuel pump hydraulic pump lines, left engine only, and bonding straps.

g. Connect the vacuum hoses, air oil separator line to the engine.

h. Install the oil cooler and connect oil cooler hoses.

i. Connect engine oil breather, magneto "P" leads, oil temperature wire to bulb and tachometer cable.

j. Connect cylinder head temperature, manifold pressure, oil pressure, fuel pressure and fuel flow gauge vent line.

k. Install governor control cable bracket and cable.

l. Connect injector unit control cables.

m. Connect alternator wires and clamp the wires to rocker arm oil return lines.

n. Connect starter cable and clamp cable to rocker arm oil return lines.

o. Ascertain that the magneto switches are off and install the propeller per paragraph 8-23.

p. Install the proper grade and amount of engine oil. (Refer to latest revision of Lycoming Service Instruction No. 1241.)

q. Connect the battery ground wire at the battery.

r. Turn on the fuel valve, open the throttle full, open mixture control and turn on the electric fuel pump and check the fuel lines for leaks.

s. Perform an engine operational check.

t. Check for oil leaks.

u. Install the access plates on the engine nacelle and the cowling per paragraph 8-10.

8-36. REMOVAL OF ENGINE MOUNT AND SUPPORT ASSEMBLIES. (Refer to Figure 8-7.)

a. Remove the engine per Paragraph 8-34.

b. Disconnect all wires and vent lines that are attached to the firewall.

c. Remove the rivets and screws that secure the firewall assembly and remove the firewall.

d. Remove the bolts that secure the engine mount assembly and remove the mount assembly.

e. Remove the nacelle top center skin assembly and the access plate on the rear section assembly.

f. Disconnect the landing gear actuating cylinder, remove the bolts that secures the engine mount support assembly and remove the support assembly.

8-37. INSTALLATION OF ENGINE MOUNT AND SUPPORT ASSEMBLIES. (Refer to Figure 8-7.)

a. Position the engine mount support assembly, connect landing gear actuating cylinder and secure support assembly with appropriate bolts. Do not torque the bolts at this time.

b. Position the engine mount assembly and secure with appropriate bolts. Do not torque the bolts at this time.

c. Shim the front mounts of the support assembly and lower mounts of the engine mount assembly as required (not to exceed .125). Refer to Parts Catalog for shim part nos.

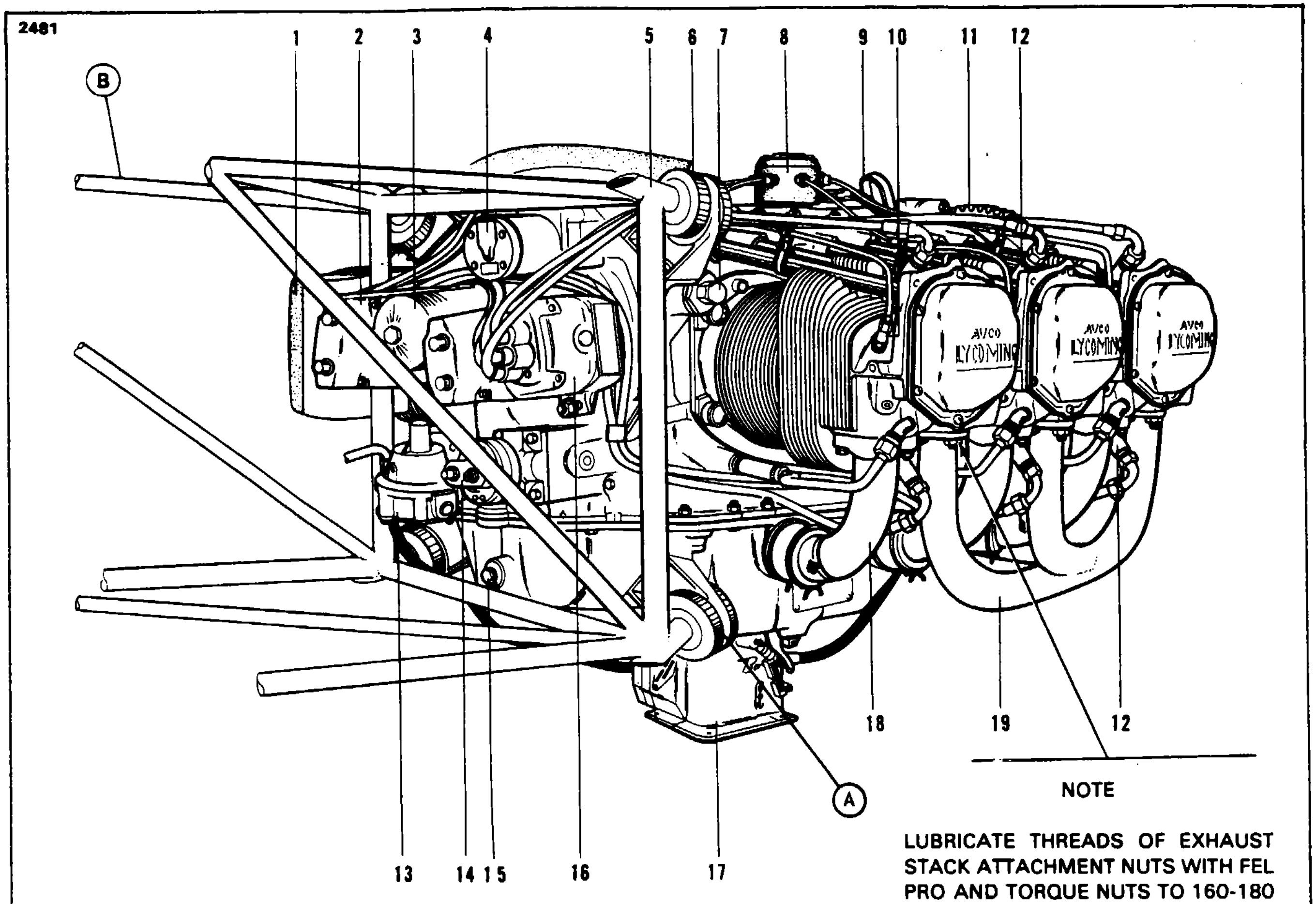
d. Torque support assembly mounting bolts to 50-70 inch-pounds and the lower mounting bolts of the engine mount assembly to 160-190 inch-pounds.

e. Position the firewall, secure it with appropriate rivets (AN441-3-3P and AN426AD3-3) and screws.

f. Connect all wires and vent lines previously disconnected.

g. Install the nacelle to center skin assembly, access plate on the rear section assembly.

h. Install the engine per Paragraph 8-35.



NOTE

LUBRICATE THREADS OF EXHAUST STACK ATTACHMENT NUTS WITH FEL PRO AND TORQUE NUTS TO 160-180 INCH-POUNDS.

1. OIL COOLER
2. MAGNETO, LEFT
3. OIL FILTER
4. VACUUM PUMP
5. ENGINE MOUNT ASSEMBLY (SEE SKETCH A)
6. SHOCK MOUNT
7. OIL PRESSURE RELIEF VALVE
8. FUEL INJECTOR MANIFOLD
9. LIFTING STRAP
10. AIR BLEED NOZZLE
11. STARTER RING GEAR
12. SPARK PLUG
13. FUEL PUMP
14. HYDRAULIC PUMP
15. OIL SUCTION SCREEN
16. MAGNETO, RIGHT
17. FUEL INJECTOR
18. INDUCTION INTAKES
19. EXHAUST STACK
20. NUT
21. ENGINE MOUNT FITTING
22. BUSHING
23. BOLT
24. ENGINE MOUNT FRAME
25. WASHER
26. ENGINE MOUNT SUPPORT ASSEMBLY
27. BOLTS TORQUE 50-70 IN. LBS.
28. SHIMS (NOT TO EXCEED .125)
29. ENGINE MOUNT ASSEMBLY
30. BOLT TORQUE 160-190 IN. LBS.
31. SHIM (NOT TO EXCEED .125)
32. FIREWALL ASSEMBLY
33. RIVETS AN441-3-3P 18 REQ.
34. RIVETS AN426AD3-3 11 REQ.

Figure 8-7. Engine Installation, PA-23-250 (six place) Serial Nos. 27-2505 and up

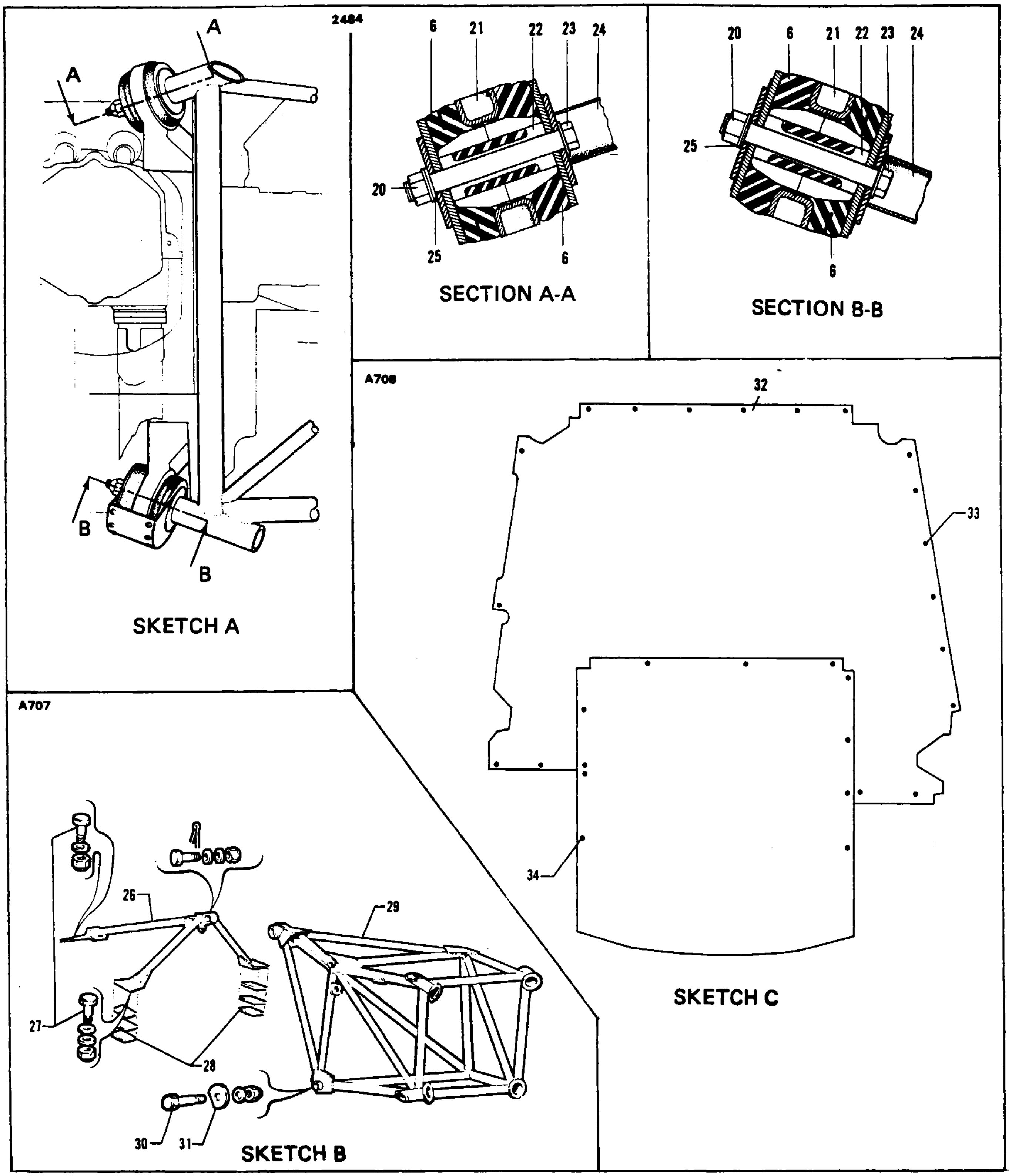


Figure 8-7. Engine Installation, PA-23-250 (six place)
Serial Nos. 27-2505 and up (cont.)

8-38. ENGINE SHOCK MOUNTS. Replace at engine T.B.O. or on condition.

NOTE

Reasons for replacing mounts on condition and prior to engine TBO are:
1. Severe cracking of rubber.
2. Signs of high temperature or burning.
3. Separation of rubber from metal surfaces.
4. Excessive "sag" or permanent deflection resulting in internal bottoming with spacer, engine and cowl interference, unusual vibration.

8-39. REPLACING ENGINE SHOCK MOUNTS. The engine shock mounts may be replaced with the engine installed as well as removed from the airplane. Refer to Figure 8-6 or 8-7 for the arrangement of the shock mount assemblies. On PA-23-250 (six place), Serial Nos. 27-2505 and up, the top mounts are assembled so the silver colored shocks are aft and the gold colored shocks are forward. The lower shock mounts are installed opposite of the top shock mounts. The procedure described in this paragraph is with the engine installed.

a. Remove the engine cowling. (Refer to Paragraph 8-6 or 8-7.)

b. Attach a one-half ton (minimum) hoist to the engine hoisting hooks and relieve tension from the shock mounts.

c. Loosen the upper shock mount attaching nuts.

d. Remove the lower mount attaching nuts, washers, heat shield, forward shock mounts and spacers.

e. Remove the lower attaching bolts just far enough to allow the aft shock mounts to be removed. The bushing in each lower mount must be removed with the bolt.

CAUTION

Care should be taken not to introduce adverse stresses on the control cables, electrical cables, hoses and other items attached to the engine while hoisting the engine.

f. Raise the nose of the engine enough to remove the lower aft shock mounts and replace with new ones.

g. Lower the engine, slide the attaching bolts with bushings into place and install the spacers, forward shock mounts, heat shield, washers and nuts. Start nuts only a few threads. Rotate the shield to provide greatest protection against exhaust heat.

h. Remove the upper mount attaching bolts, nuts, washers, forward shock mounts and spacers.

i. Lower the engine enough to replace the upper aft shock mounts. Raise the engine into position.

j. Install the spacers, forward shock mounts, mounting bolts, washers and nuts.

k. Tighten attaching bolts 34 to 42 foot-pounds.

8-40. CARBURETOR. (PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.)

8-41. CARBURETOR MAINTENANCE. In general, little attention is required between carburetor overhauls. However, it is recommended that the following items be checked during periodic inspection of the engine.

a. Check tightness and lockwire of all nuts and screws which fasten the carburetor to the engine.

b. Check all fuel lines for tightness and evidence of leakage.

c. Check throttle and mixture control rods and levers for travel, tightness and lockwiring.

d. Clean the fuel inlet screen. (Refer to Figure 8-8.)

e. Remove plug at aft position of carburetor and drain any accumulation of foreign matter.

f. Check carburetor air box for wear and full travel of heat door.

g. Check adjustment of idle mixture and idle speed.

8-42. REMOVAL OF CARBURETOR.

a. Ascertain that the fuel selector on the fuel control box inside the cabin is in the off position.

b. Remove the bottom section of the cowling as described in paragraph 8-6 or 8-7.

c. Disconnect the throttle and mixture control cables at the carburetor.

d. Disconnect the fuel lines at the carburetor.

e. Disconnect the air box by removing safety wire and cap bolts. Allow box to swing free of carburetor.

f. Remove the pal locknuts and nuts securing the carburetor to the engine.

g. Remove the carburetor.

8-43. INSTALLATION OF CARBURETOR.

a. Position the carburetor and a new gasket to the engine, and secure with nuts and pal locknuts.

b. Attach the carburetor air box with gasket and secure with cap bolts. Safety bolts with MS20995-C41 wire.

c. Connect the fuel lines to the carburetor.

d. Connect the throttle and mixture cables to the carburetor and adjust as described in paragraph 8-44.

e. Check adjustment of idle mixture as described in paragraph 8-45.

f. Check the adjustment of idling speed as described in paragraph 8-46.

g. Check the area around the carburetor for evidence of fuel leakage.

8-44. ADJUSTMENT OF THROTTLE AND MIXTURE CONTROLS. Throttle and mixture controls are adjusted so that when the throttle arm on the carburetor is rotated forward against its full throttle stop and the mixture control is rotated forward against its full rich stop, the cockpit control knob or lever of the throttle and mixture should have 0.062 of an inch springback when in the forward position.

a. The throttle may be adjusted as follows:

1. At the carburetor, disconnect the clevis end of the throttle control cable from the control arm. Loosen the jam nut that secures the clevis end.

2. Adjust the linkage by rotating the clevis end on the cable to obtain 0.062 of an inch springback when the control is in the forward position.

3. Reconnect the clevis end to the control arm and safety.

b. The mixture may be adjusted as follows:

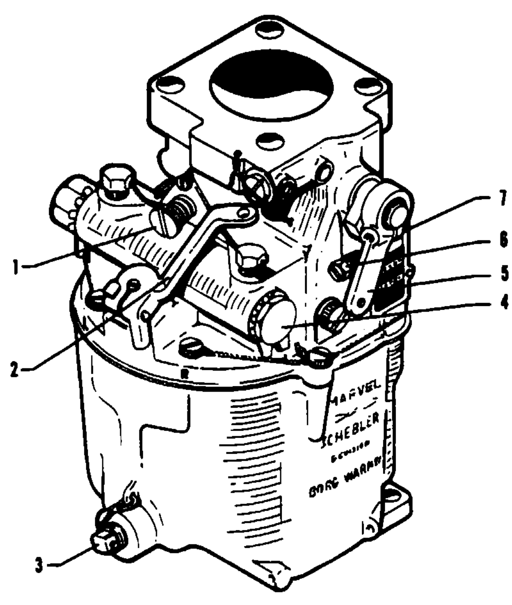
1. At the carburetor, loosen the swivel fitting that connects the wire of the control cable to the mixture arm.

2. Reposition the swivel fitting on the wire to obtain 0.062 of an inch spring back between the knob and plate when the mixture control arm is against its stop.

3. Tighten the swivel fitting and safety. The control wire should be straightened to align with the control cable casing after tightening the swivel fitting.

c. Check security of cable casing attachments.

d. Pull throttle and mixture knob in cockpit full aft to ascertain that the idle screw contacts its stop and the mixture control arm contacts its lean position.



1. IDLE MIXTURE ADJUSTMENT
2. MIXTURE CONTROL ARM
3. BOWL DRAIN
4. FUEL INLET SCREEN
5. THROTTLE ARM
6. IDLE ADJUSTMENT
7. ARM SET SCREW

Figure 8-8. Carburetor

8-45. ADJUSTMENT OF IDLE MIXTURE.

WARNING

When performing engine warm-up indoors, provide a barrier about the engine to prevent serious injury. Also, provide adequate means of ventilating the work area.

a. After performing the standard engine starting procedure, operate the engine for at least two minutes between 800 and 1200 RPM to insure proper engine warm-up.

b. Draw back on the cockpit throttle control lever to obtain a reading of approximately 550 RPM on the tachometer.

c. Turn the idle adjustment screw, located near the rear of the carburetor, clockwise, leaning the fuel mixture. Continue to do this until the engine begins to run roughly, at which time the engine speed will decrease.

d. Turn the screw counterclockwise until the engine runs smoothly again. Continue to turn the screw in the same direction until the engine begins to run roughly once more. At this point, the fuel mixture will be too rich and engine speed will decrease again.

e. Now advance the screw to a midway position between the lean and rich fuel mixture; the RPM of the engine will reach a maximum speed for idle mixture settings.

8-46. ADJUSTMENT OF ENGINE IDLING SPEED.

a. Pull back the cockpit throttle control lever until it is completely aft and in the closed position. Observe the engine speed on the tachometer.

b. Adjust the idle adjustment screw to obtain from 550 to 600 RPM. Rotate screw clockwise to increase the speed of the engine; counterclockwise to decrease engine speed. The screw is located on the throttle arm.

NOTE

One complete revolution of the carburetor idle screw provides a variation of approximately 100 RPM in idling speed.

8-47. FUEL INJECTOR. (Serial Nos. 27-2322 and up.)

CAUTION

Extreme caution should be exercised when handling or working around the injector to prevent oil or fuel from entering the air sections of the injector. As explained previously, damage to the air diaphragm will result. Fluid can easily enter the air section of the injector through the impact tubes or the annular groove around the venturi. For this reason, a protective plate should be installed on the scoop mounting flange when performing routine maintenance on the engine, such as washing down the engine and air scoop, servicing the air filter (surplus oil on the element), or when injecting preservative into the engine prior to storing or shipping.

8-48. FUEL INJECTOR MAINTENANCE.

a. In general, little attention is required between injector overhauls. However, it is recommended that the following items be checked during periodic inspection of the engine.

1. Check tightness and lock of all nuts and screws which fasten the injector to the engine.

2. Check all fuel lines for tightness and evidence of leakage. A slight fuel stain adjacent to the air bleed nozzles is not cause for concern.

3. Check throttle and mixture control rods and levers for tightness and lock.

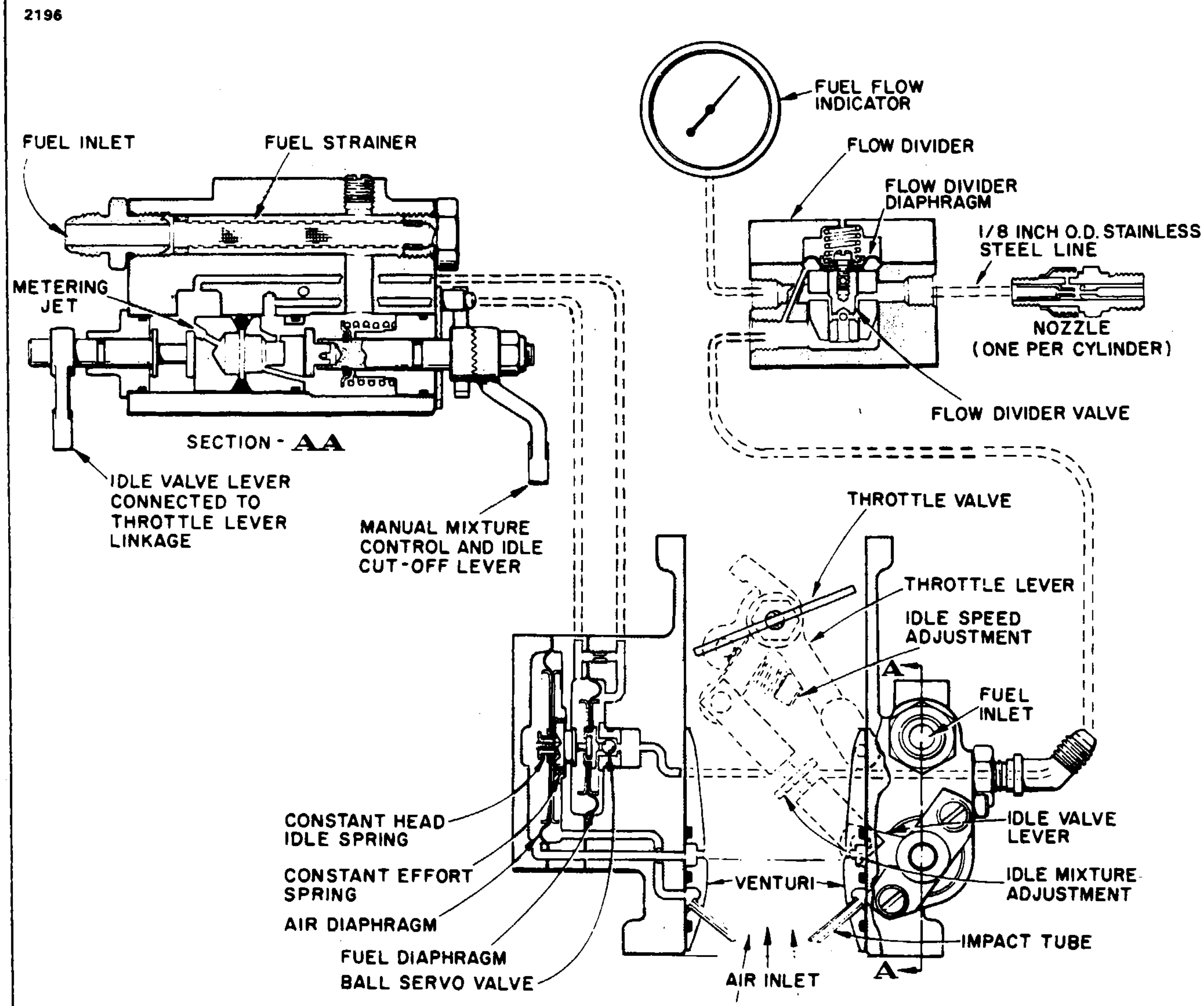


Figure 8-9. Schematic of RSA Fuel Injection System

4. Remove and clean the injector fuel inlet strainer at each 50 hour inspection. Damaged strainer "O" rings should be replaced.

b. Tests prove that gasoline which becomes stale due to prolonged storage absorbs oxygen rapidly. This stale oxidized gasoline acquires a very distinctive odor similar to varnish; causes rapid deterioration of synthetic rubber parts; and also forms a gummy deposit on the internal metal parts. This condition, however, does not occur during normal operation of the injector where fresh fuel is being constantly circulated.

8-49. LUBRICATION OF FUEL INJECTOR.

a. There is very little need for lubrication of the injector in the field between regular overhauls. However, the clevis pins used in connection with the throttle and manual mixture control levers should be checked for freedom of movement and lubricated, if necessary.

b. Place a drop of engine grade oil on the end of the throttle shaft in such a manner that it can work into the throttle shaft bushings.

8-50. REMOVAL OF FUEL INJECTOR, NOZZLE LINES, FUEL LINES AND FUEL FLOW DIVIDER.

a. Remove engine cowling. (Refer to Paragraph 8-6 or 8-7.)

b. Disconnect throttle and mixture control cables at the injector.

c. Remove air box by removing bottom access panel on the air box and remove four attaching screws holding air box to the injector unit.

d. Disconnect fuel inlet line at the injector.

e. Disconnect fuel outlet line to the flow divider at the injector.

f. Remove attaching nuts and remove injector unit.

g. Disconnect the nozzle lines from the air bleed nozzles.

h. Disconnect the fuel flow meter line at the rear baffle.

i. Disconnect the inlet fuel line at the flow divider.

j. Remove the two attaching bolts and remove fuel flow divider and nozzle lines as a unit.

k. Remove air bleed nozzles, (Refer to Paragraph 8-56.)

8-51. PREPARATION FOR STORAGE. Any unit taken out of service, or units being returned for overhaul, must be flushed with preserving oil (Specification MIL-O-6081, Grade 1010), using the following procedure:

—CAUTION—

DO NOT EXCEED AIR PRESSURE GIVEN IN STEP A, BELOW AS INTERNAL DAMAGE TO THE INJECTOR MAY RESULT. SEE ADDITIONAL CAUTION IN PARAGRAPH 8-47.

a. Remove plugs and drain all fuel from the injector. If available, apply 10 to 15 psi air pressure to the fuel inlet until all fuel is discharged from the injector.

b. Replace plugs and apply flushing oil filtered through a 10-micron filter at 13 to 15 psi to the injector inlet until oil is discharged from the outlet.

c. Replace fuel inlet shipping plug.

d. After filling with preservative oil, the injector should be protected from dust and dirt and given such protection against moisture as climatic conditions at the point of storage require. In most cases, storing the unit in a dry area will be sufficient.

e. If the unit is to be stored near or shipped over salt water, the following precautions should be observed:

   1. Spray the exterior of the injector with an approved preservative oil.
   2. Pack in a dustproof container, wrap the container with moisture and vapor-proof material, and seal. Pack the wrapped unit in a suitable shipping case. Pack a one-half pound bag of silica gel crystals in the dustproof container with injector. The bag must not touch the injector.

—CAUTION—

EXTREME CAUTION SHOULD BE EXERCISED WHEN HANDLING OR WORKING AROUND THE INJECTOR TO PREVENT OIL OR FUEL FROM ENTERING THE AIR SECTIONS OF THE INJECTOR.

8-52. INSTALLATION OF FUEL INJECTOR.

a. Install air bleed nozzles. (Refer to Paragraph 8-58.)

b. Install fuel flow divider and nozzle lines, attach divider to the crankcase with attaching bolts and connect lines to nozzles.

c. Connect the inlet fuel line and fuel flow meter line.

d. Install a gasket and attach the injector unit to the engine sump with washers and nuts.

e. Install the airbox with attaching bolts. Safety bolts with MS20995-C41 lockwire. Attach bottom access plate with screws.

f. Connect the throttle and mixture control cables. Check and adjust controls as described in paragraph 8-53.

g. Connect the inlet and outlet fuel lines.

h. Install the cowling as described in paragraph 8-9 or 8-10.

i. Adjust the idle speed and mixture of the injector as described in paragraph 8-54.

8-53. ADJUSTMENT OF THROTTLE AND MIXTURE CONTROLS. The throttle and mixture controls are adjusted so that when the throttle arm on the injector is rotated forward against its full throttle stop and the mixture arm is rotated forward against its full rich stop, their respective cockpit control levers should be 0.062 to 0.125 of an inch in from their full forward stops, which are located in the control pedestal.

a. At the injector, disconnect the throttle and/or mixture control cable end from its control arm.

b. Loosen the jam nut securing the cable end.

c. Adjust the linkage by rotating the cable end to obtain the 0.062 to 0.125 of an inch spring back of the cockpit control lever when the throttle or mixture control arm contacts its stop.

d. Reconnect the cable end to its control arm and secure jam nut.

e. Pull the throttle and mixture control lever in the cockpit full aft to ascertain that the injector idle screw contacts its stop and the mixture control arm contacts its lean position.

8-54. ADJUSTMENT OF IDLE SPEED AND MIXTURE.

a. Start the engine and warm up in the usual manner until oil and cylinder head temperatures are normal.

b. Check magnetos. If the "mag-drop" is normal, proceed with idle adjustment.

c. Close the throttle to idle. If the RPM changes appreciably after making the idle mixture adjustment during the succeeding steps, readjust the idle speed to the desired RPM.

NOTE

The idle mixture must be adjusted with the fuel boost pump ON.

d. When the idling speed has been stabilized, move the cockpit mixture control lever with a smooth, steady pull toward the Idle Cut-Off position and observe the tachometer for any change during the "leaning" process. Caution must be exercised to return the mixture control to the Full Rich position before the RPM can drop to a point where the engine cuts out. An increase of more than 50 RPM

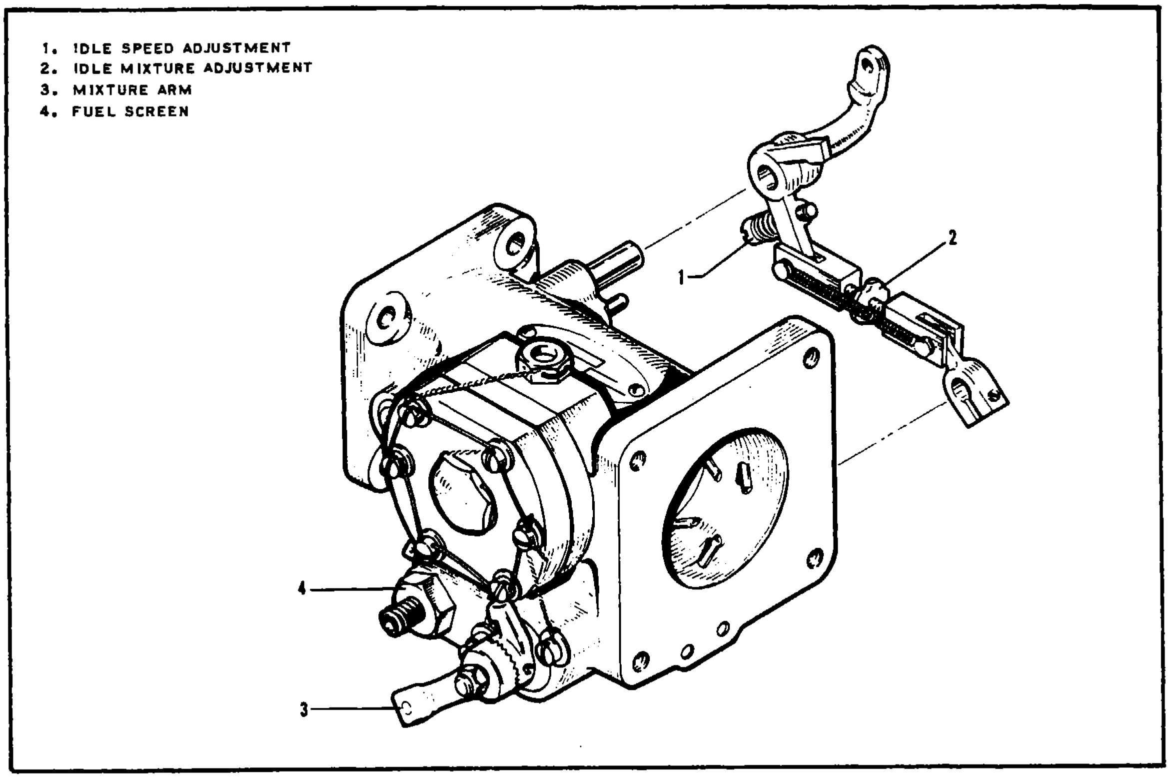


Figure 8-10. Fuel Injector

while "leaning out" indicates an excessively rich idle mixture. An immediate decrease in RPM (if not preceded by a momentary increase) indicates idle mixture is too lean.

e. If the above indicates that the idle adjustment is too rich or too lean, turn the idle mixture adjustment in the direction required for correction, and check this new position by repeating the above procedure. Make additional adjustments as necessary. Each time the adjustment is changed, the engine should be run up to 2000 RPM to clear the engine before proceeding with the RPM check. Make final adjustment of the idle speed adjustment to obtain from 550 to 600 RPM with closed throttle. The above method aims at a setting that will obtain maximum RPM with minimum manifold pressure. In case the setting does not remain stable, check the idle linkage; any looseness in this linkage would cause erratic idling. In all cases, allowance should be made for the effect of weather conditions and field altitude upon idling adjustment.

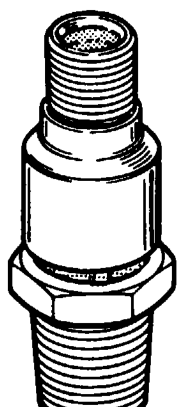


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Figure 8-11. Fuel Air Bleed Nozzle

8-55. FUEL AIR BLEED NOZZLE.

8-56. REMOVAL OF FUEL AIR BLEED NOZZLE. The nozzles must be carefully removed as they or the cylinders may be damaged.

a. Remove the engine cowl. (Refer to paragraph 8-6 or 8-7.)

b. Disconnect the fuel line from the nozzle.

c. Carefully remove the nozzle, using the correct size deep socket.

d. Clean and inspect the nozzle as given in paragraph 8-57.

8-57. CLEANING AND INSPECTION OF FUEL AIR BLEED NOZZLE.

CAUTION

Do not immerse "O" rings in cleaning fluid. The rings may swell.

a. Clean the nozzle with acetone or equivalent and blow out all foreign particles with compressed air in the direction opposite that of the fuel flow. Do not use wire or other hard objects to clean orifices. (Refer to latest revision Lycoming Service Instruction No. 1275.)

b. Inspect the nozzle and cylinder threads for nicks, stripping or cross-threading.

c. Inspect for battered or rounded hexagons.

d. A test procedure for air bleed nozzles is described in latest revision Lycoming Service Instructions No. 1275.

8-58. INSTALLATION OF FUEL AIR BLEED NOZZLES.

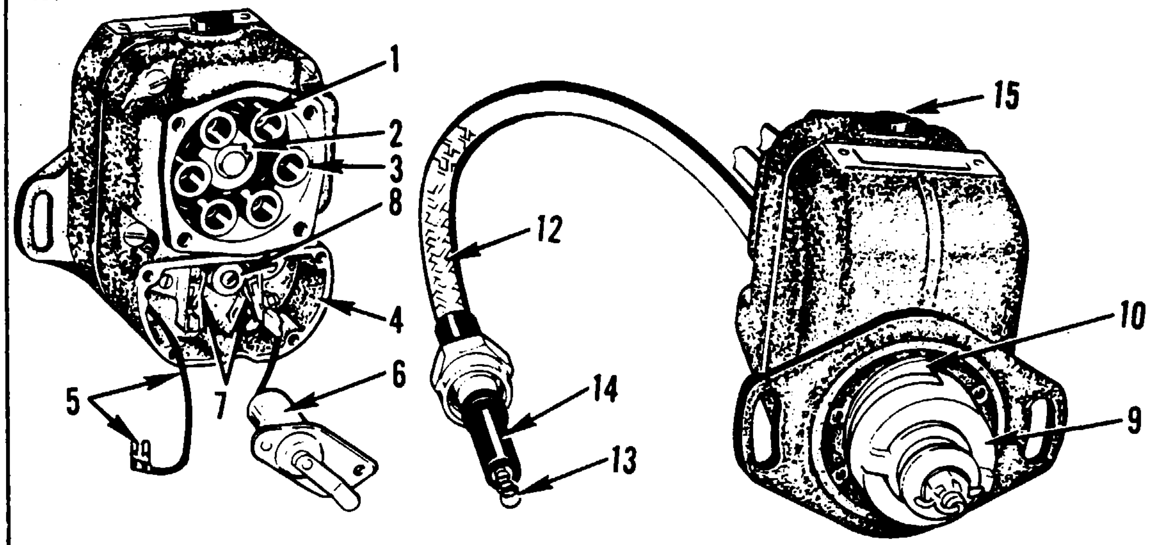
a. It is important for the nozzles to be correctly positioned with the air bleed hole facing up.

b. Install the nozzles and tighten the nozzles to a little less than 60 inch-pounds torque.

c. Continue to tighten the nozzles until the letter or number stamped on the hex of the nozzle is facing down. In this position the air bleed hole will be facing up.

NOTE

Do not exceed 60 inch-pounds torque on nozzles when aligning air bleed hole.



1. CONTACT SPRING
2. RETAINING SPRING
3. DISTRIBUTOR BLOCK
4. BREAKER COMPARTMENT
5. LEAD WIRE
6. CAPACITOR
7. BREAKER ASSEMBLY
8. BREAKER CAM
9. IMPULSE COUPLING
10. FLYWEIGHTS
11. DELETED
12. LEAD CIRCUIT
13. CONTACT SPRING
14. INSULATOR
15. VENT PLUG

Figure 8-12. Magneto Inspection

CAUTION

Start the nozzle and line coupling by hand to prevent the possibility of cross-threading.

d. Connect the fuel line to the nozzle.
e. Install the engine cowl. (Refer to Paragraph 8-9 or 8-10.)

8-59. MAGNETO.

CAUTION

Ascertain that the primary circuits of both magnetos are grounded before working on the engine.

8-60. INSPECTION OF MAGNETOS. At time of engine inspection or when a magneto has been removed from the engine, the following checks may be performed. Each step in the checklist is keyed by number to a part shown in Figure 8-12.

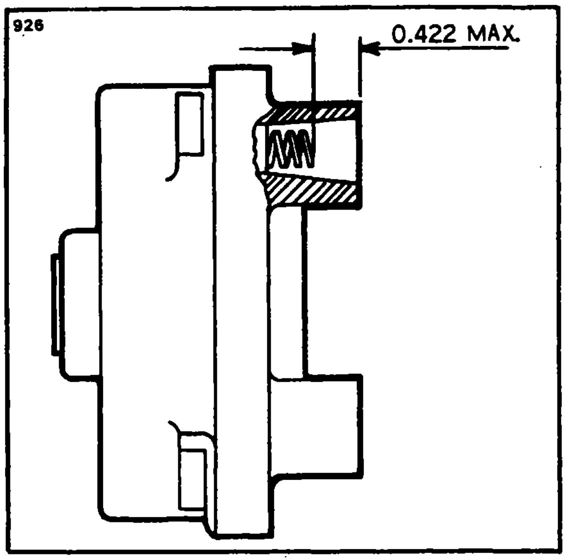


Figure 8-13. Contact Spring Inspection

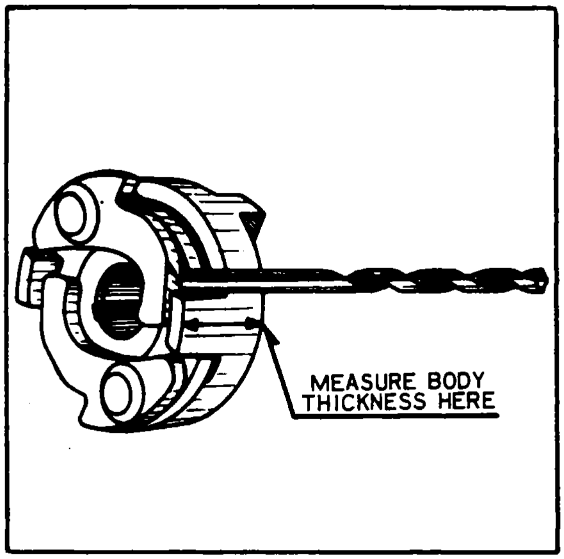


Figure 8-14. Impulse Coupling

a. Inspect distributor block contact springs. Top of spring must not be more than 0.422 inches below top of tower. (Refer to Figure 8-13.) If broken or corroded, they should be replaced.

b. Inspect oil felt washer. It should be saturated with oil. If dry, check for worn bushing. If O.K., add No. 30 oil.

c. Inspect distributor block for cracks or burned areas. The wax coating on the block should not be removed. Do not use solvents.

d. Look for excess oil in breaker compartment. If present, it may mean a bad oil seal or oil seal bushing at drive end. Check manufacturer's overhaul procedure.

e. Look for frayed insulation or broken wire strands in leads in back of magneto. See that terminals are secure. Be sure wires are properly positioned.

f. Inspect capacitor visually. If possible, test for leakage, capacity and series resistance. Remember, an electrical failure of an aircraft capacitor is rare.

g. Adjustment of breakers must be correct for proper internal timing of magneto. (Refer to paragraph 8-62.)

h. Check if breaker cam is clean and smooth, if cam screw is tight (25 inch-pounds). If new points are installed, blot a little oil on cam.

i. Inspect impulse coupling (-21 magneto) flyweights for excessive looseness on the axles. Design couplings having 0.927 inch thick body are checked with a 1/8 drill. Couplings having 0.974 inch thick body are checked with a No. 18 drill. If drill fits between cam and flyweight, the fit is too loose and coupling should be replaced. (Refer to Figure 8-14.)

j. Check impulse coupling for excess wear on the contact edges of body and flyweights.

k. Check that the impulse coupling flyweight axle rivets are tight and there are no cracks in body.

l. Look at the lead conduits. A few broken strands won't hurt, but if the insulation looks tired, you may be in for trouble. The special high temperature coating, used on lightweight harnesses, is provided chiefly for vibration resistance and mechanical protection. The integrity of the harness is not sacrificed if small areas of the braid show peeling or flaking of this coating.

m. Check the springs for breaks, corrosion or deformation. If possible, check continuity from block with tester or light.

n. Check insulators for cracks, breaks, or evidence of "old age." Be sure they are clean.

o. Timing and ventilator plugs. Ventilator has drilled holes and should be in lowest hole in magneto to serve also as drain for excess water or oil. Solid plug is used in other hole or in location exposed to rain or water.

NOTE

The magneto service instructions in this manual are to cover minor repairs and timing. For further repairs and adjustments of the magnetos, it is recommended that the manufacturer's service instructions be followed.

8-61. REMOVAL OF MAGNETO. Before removing the magneto, make sure magneto switches are off.

a. Remove the engine access plates from the side of the engine to be worked on.

b. On PA-23-250; PA-23-235; and PA-23-250 (six place) airplanes, Serial Nos. 27-2000 to 27-2504 inclusive, remove the magneto cooling baffles.

WARNING

The magneto is not internally grounded; when the ground lead is disconnected, the magneto is hot. Removing the harness assembly terminal plate first and installing them last minimizes the danger of starting the engine accidentally when the ground lead is removed from the magneto.

c. Remove the harness assembly terminal plate from the magneto.

d. Disconnect the ground leads from the left and/or right magneto and, where applicable, the retard spark lead on the left magneto, at the magneto.

e. Remove the nuts and washers and draw the magneto from the engine.

8-62. TIMING PROCEDURE. (Internal Timing) (-20 and -200 Series Magnetos). When installing new or adjusting breaker points and before timing the magneto to the engine, it is important that the internal timing of the magneto be correct.

a. Timing procedures for magnetos without timing marks in the breaker compartment.

1. Attach a timing template and pointer as follows:

(a) Using two 8-32 RH screws 1/4 inch long, secure timing template to bottom of breaker housing. (Refer to Figure 8-17.)

(b) Attach a pointer to the magneto cam.

NOTE

A timing kit, including timing plate, etc., may be purchased through the engine or magneto manufacturer.

NOTE

A pointer may be formed as shown in Figure 8-16 using soft wire. Solder formed wire to a flat washer similar to the one used with cam screw. A pointer can also be made by wrapping a piece of soft wire tightly around the head of the cam securing screw and bending it to extend to the timing template. Position pointer at the zero mark when rotor is in its neutral position.

2. Remove the timing inspection plug from the top of the magneto. Turn rotating magnet in its direction of rotation until the painted chamfered tooth on the distributor gear is approximately in center of inspection window. Then turn it back until rotating magnet locates in its neutral position.

3. Remove cam screw and flat washer from cam shaft if pointer was fabricated as in preceding note. Holding magnet in neutral position, install timing pointer on cam shaft so it indexes with the 0 degree mark on the timing plate. Secure pointer in this position with cam screw.

4. Turn rotating magnet in proper rotation until pointer indexes with the respective 10 degree mark ("E" gap). Using the timing light, adjust main breaker contacts to open at this point. Turn rotating magnet until breaker cam follower is on the high point of the cam lobe. Measure contact clearance. It must be 0.018 $\pm$ 0.006 of an inch. If not, readjust breaker and recheck to be sure that contacts will open within "E" gap tolerance of $\pm$ 4 degrees. Replace breaker assembly if "E" gap tolerance and contact clearance cannot be obtained.

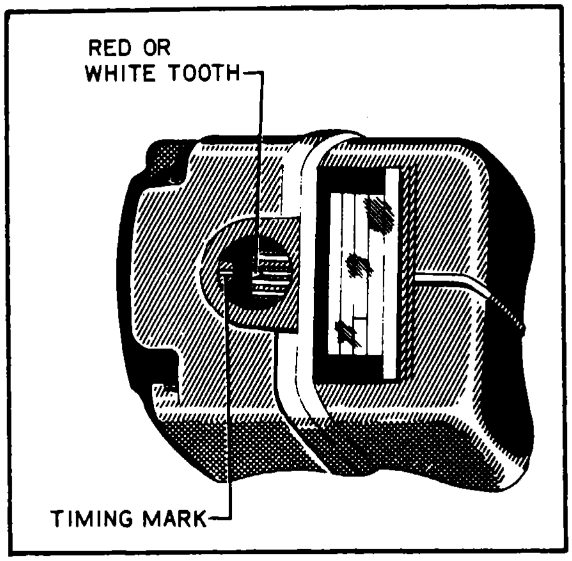


Figure 8-15. Magneto Timing Marks

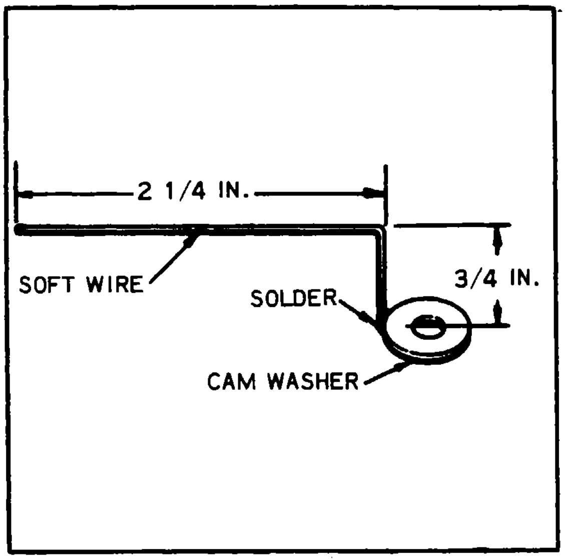


Figure 8-16. Timing Pointer

5. On retard breaker magnetos, the retard breaker is adjusted to open 37.5 degrees after the main breaker opens within +2 -0 degrees. The degree of retard for any particular magneto is stamped in the bottom of the breaker compartment for convenience. At the exact point of main breaker opening, note the degree reading. Add the degrees retard to this noted reading to determine retard breaker opening point. Using the timing light, adjust retard breaker to open at this point +2 -0 degrees. Measure contact clearance. It must be 0.018 ± 0.006 of an inch. If not, readjust breaker and recheck to be sure that contacts will open within retard degree tolerance. Replace breaker assembly if retard degree tolerance and contact clearance cannot be obtained. Remove pointer and replace flat washer, lockwasher and screw. Torque to 16 to 20 inch-pounds.

b. Timing procedure for magnetos incorporating timing marks in the breaker compartment.

1. On each side of the breaker compartment there are timing marks indicating "E" gap and various degrees of retard breaker timing. The marks on the left hand side, viewed from the breaker compartment, are for clockwise rotation. The marks on the right hand side are for counterclockwise rotation. The timing marks indicate "O" position, "E" gap and various degrees of magneto retard. The point in the center of the "E" gap boss indicates the exact "E" gap position. The width of the boss on either side of the point is the allowable tolerance of ± 4 degrees. (Refer to Figure 8-18.) In addition to these marks, some cams have an indented line across their end for locating "E" gap position of the rotating magnet when aligned with the mark at the top of the breaker housing.

2. If the cam does not have an indented line across its end, proceed as follows:

(a) Turn rotating magnet in direction of rotation until painted chamfered tooth on distributor gear is approximately in center of inspection window. Then turn rotating magnet back until it locates in its neutral position.

(b) Attach a pointer. A pointer may be fabricated as shown in Figure 8-16. Remove cam screw and flat washer from cam. Holding magnet in neutral position, install pointer on cam shaft so it indexes with the 0 degree mark. Secure pointer in this position with cam screw.

(c) Turn rotating magnet in proper rotation until pointer indexes with "E" gap mark. At this point, scribe a line on end of cam so it indexes with mark at top of breaker compartment. Remove cam from magnet shaft. Using a three corner file, file an indent on scribe mark at end of cam.

(d) Install cam, pointer and cam screw to magnet shaft and time magneto in accordance with the following paragraphs.

3. Turn rotating magnet in direction of rotation until painted chamfered tooth of distributor gear is just becoming visible in timing window. Continue turning rotating magnet until line on end of cam is aligned with the mark at top of breaker housing.

4. Attach a pointer. A formed pointer is installed by removing cam screw and flat washer from cam shaft of magneto and install pointer.

NOTE

A pointer can be made by wrapping a piece of soft wire tightly around the head of cam securing screw and bending to extend over timing marks in breaker compartment.

5. With indented slot on cam aligned to the mark at top of breaker compartment and with painted chamfered tooth on distributor gear visible in timing window, set pointer on the "E" gap mark on side of breaker compartment. (The magnet is at its exact "E" gap position.) Connect the timing light across main breaker. Adjust main breaker contacts to open at this point. Turn magnet until cam follower is on the high point of the cam lobe. Measure contact clearance. It must be 0.018 ± 0.006 of an inch. If necessary, readjust breaker and recheck to be sure that contacts will open within "E" gap tolerance. Replace breaker assembly if "E" gap tolerance and contact clearance cannot be obtained.

6. On retard breaker magnetos, the retard breaker is set to open a predetermined number of degrees after the main breaker opens within +2 -0 degrees. The degree of retard for any particular magneto is stamped in the lower portion of left hand side of the breaker compartment. (Refer to Figure 8-18.) Move the

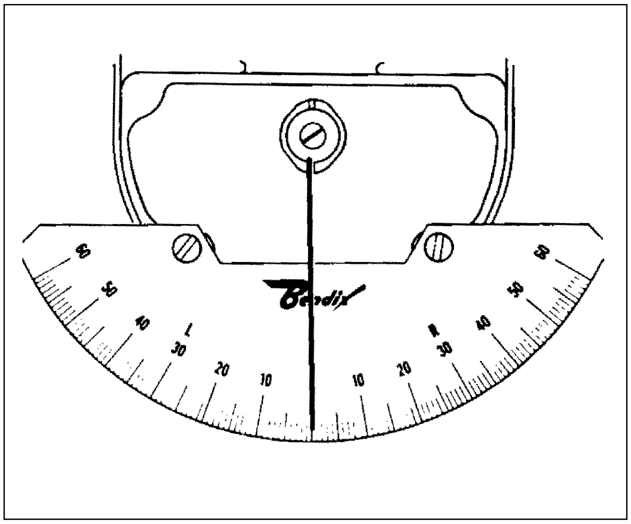


Figure 8-17. Timing Kit Installed

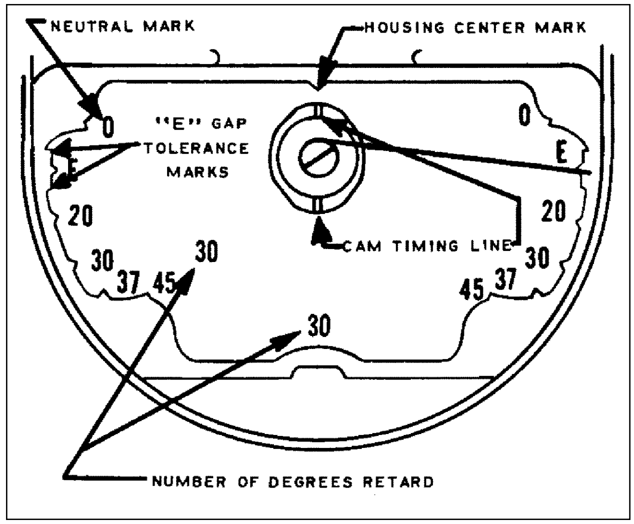


Figure 8-18. Breaker Compartment With Cast Timing Marks

rotating magnet back to the point of main breaker opening. Hold the magnet in this position and move pointer to the "O" mark. Now turn magnet until pointer is over the required retard degree mark. Using the timing light, adjust retard breaker contacts to open at this point. A tolerance of .062 of an inch past the point can be used to get proper contact clearance. Continue turning magnet until cam follower is on the high point of the lobe. Measure contact clearance. It should be 0.018 + 0.006 of an inch. If not, readjust breaker and recheck to be sure that contacts will open within retard degree tolerance. Replace breaker assembly if retard degree tolerance and contact clearance cannot be obtained.

8-63. INSTALLATION AND TIMING PROCEDURE. (Timing Magneto to Engine.)

NOTE: Verify correct engine timing for the airplane being worked on by checking the engine dataplate.

a. Remove a spark plug from No. 1 cylinder and turn crankshaft in direction of normal rotation until the compression stroke is reached.

b. Continue turning the crankshaft until the advance timing mark on the starter ring gear is in alignment with the small hole located on the top face of the starter housing at the two o'clock position. (Refer to Figure 8-19.)

c. Remove the inspection plug on the left magneto and turn the drive coupling in direction of normal rotation until the first painted chamfered tooth is aligned in the center of the inspection hole. (Refer to Figure 8-15.) Without allowing the gear to turn from this position, assemble gasket and magneto to the engine. Secure in place with washers and nuts; tighten only finger tight.

d. Fasten ground wire of electric timing light to any unpainted portion of the engine, and one of the positive wire of the timing light to a suitable terminal connected to the ground terminal of the magneto. Then turn the engine crankshaft several degrees from the advance timing mark in direction opposite to that of normal rotation.

NOTE

Impulse Coupling Magneto - The crankshaft should not be rotated more than 35° in direction opposite normal rotation, as the pawl on the impulse coupling will engage with the stop pin and late timing will be indicated through the impulse coupling mechanism. If this should happen, rotate engine in direction of normal rotation until sharp click is heard, which will indicate that impulse coupling has passed through firing position; then turn crankshaft in direction opposite normal rotation to approximately 35° before top center and proceed with timing check.

e. Turn on the switch of the timing light, which should be lit. Turn the crankshaft slowly in direction of normal rotation until the mark on the starter gear aligns with the hole in the starter housing, at which point the light should go out. If not, turn the magneto in its mounting flange and repeat the procedure until the light goes out. Repeat the same procedures with the right magneto.

NOTE

Battery powered timing lights operate in the reverse manner from that described above; the light goes on when the marks align.

f. After both magnetos have been timed, leave the timing light wires connected and recheck magnetos as previously described to make sure that both magnetos are set to fire together. If timing is correct, both timing lights will go out simultaneously when the timing marks are in alignment. Tighten nuts to specified torque.

g. After magnetos have been properly timed, replace breaker cover and secure.

h. Install the ground lead on both magnetos and the retard spark lead, if required, on the left magneto.

i. Place the harness terminal plate on the magneto and tighten nut around the plate alternately to seat cover squarely on magneto. Torque nuts to 18 to 22 inch-pounds.

8-64. HARNESS ASSEMBLY.

8-65. INSPECTION OF HARNESS.

a. Check lead assemblies for nicks, cuts, mutilated braiding, badly worn section or any other evidence of physical damage. Inspect spark plug sleeves for chafing or tears and damaged or stripped threads on coupling nuts. Check compression spring to see if it is broken or distorted. Inspect grommet for tears. Check all mounting brackets and clamps to see that they are secure and not cracked.

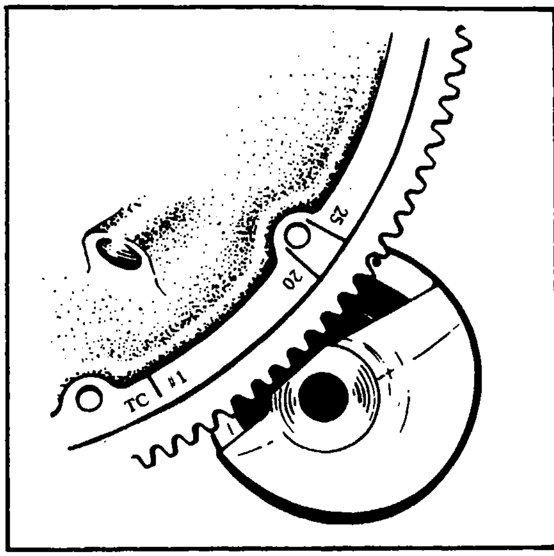


Figure 8-19. Engine Timing Marks

b. Using an ohmmeter, buzzer, or other suitable low voltage device, check each lead for continuity. If continuity does not exist, wire is broken and must be replaced.

c. Minor repair of the harness assembly, such as replacement of contact springs, spring retainer assemblies, insulating sleeves or of one lead assembly, can be accomplished with the harness assembly mounted on the engine. However, should repair require replacement of more than one lead assembly or of a cable outlet plate, the harness should be removed from the engine and sent to an overhaul shop.

8-66. REMOVAL OF HARNESS.

a. Disconnect the clamps that secure the wires to the engine and accessories.

b. Loosen the coupling nuts at the spark plugs and remove the insulators from the spark plug barrel well. Use caution when withdrawing the insulator not to damage the insulator spring.

c. Place a guard over the harness insulators.

d. Remove the harness assembly terminal plate from the magneto.

e. Remove the engine baffle plate that receives the harness assembly.

f. Remove the harness from the airplane.

8-67. INSTALLATION OF HARNESS. Before installing harness on magneto, check mating surfaces for cleanliness. Spray entire face of grommet with a light coat of Plastic Mold Spray, SM-O-O-TH Silicone Spray or equivalent. This will prevent harness grommet from sticking to magneto distributor block.

a. Place the harness terminal plate on the magneto and tighten nuts around the plate alternately to seat cover squarely on magneto. Torque nuts to 18 to 22 inch-pounds.

b. Route ignition wires to their respective cylinders.

c. Clamp the harness assembly in position and replace the engine baffle plate.

d. Connect the leads to the spark plugs.

8-68. SPARK PLUGS.

8-69. REMOVAL OF SPARK PLUGS.

a. Loosen the coupling nut on the harness lead and remove the terminal insulator from the spark plug barrel well.

NOTE

When withdrawing the ignition cable lead connection from the plug, care must be taken to pull the lead straight out and in line with the center line of the plug barrel; otherwise, a side load will be applied which frequently results in damage to the barrel insulator and connector. If the lead cannot be removed easily in this manner, the resisting contact between the neoprene collar and the barrel insulator will be broken by a rotary twisting of the collar. Avoid undue distortion of the collar and possible side loading of the barrel insulator.

b. Remove the spark plug from the engine. In the course of engine operation, carbon and other combustion products will be deposited on the end of the spark plug and will penetrate the lower threads to some degree. As a result, greater torque is frequently required for removing a plug than for its installation. Accordingly, the torque limitations given do not apply to plug removal and sufficient torque must be used to unscrew the plug. The higher torque in removal is not as detrimental as in installation, since it cannot stretch the threaded section. It does, however, impose a shearing load on this section and may, if sufficiently severe, produce a failure in this location.

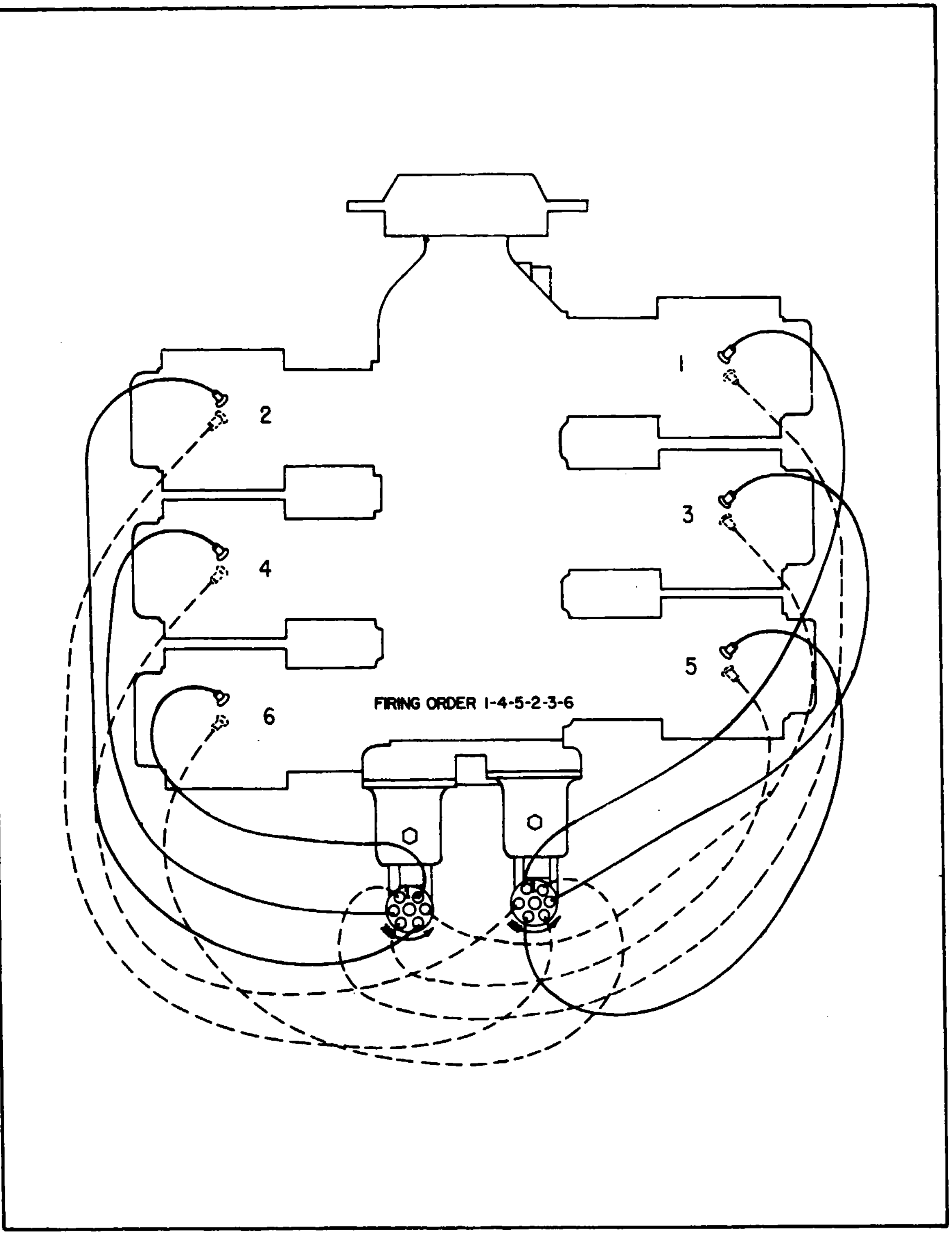


Figure 8-20. Ignition System Schematic

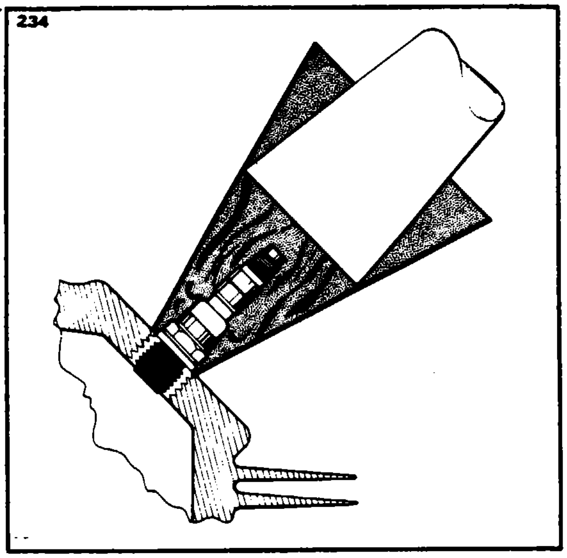


Figure 8-21. Removing Spark Plug Frozen to Bushing

NOTE

Torque indicating handle should not be used for spark plug removal because of the greater torque requirement.

c. Place spark plugs in a tray that will identify their position in the engine as soon as they are removed.

NOTE

Spark plugs should not be installed if they have been dropped.

d. Removal of seized spark plugs in the cylinder may be accomplished by application of liquid carbon dioxide by a Conical metal funnel adapter with a hole at the apex just large enough to accommodate the funnel of a CO_2 bottle. (Refer to Figure 8-20.) When a seized spark plug cannot be removed by normal means, the funnel adapter is placed over and around the spark plug. Place the funnel of the CO_2 bottle inside the funnel adapter and release the carbon dioxide to chill and contract the spark plug. Break the spark plug loose with a wrench. A warm cylinder head at the time the carbon dioxide is applied will aid in the removal of an excessively seized plug.

e. Do not allow foreign objects to enter the spark plug hole.

8-70. INSPECTION AND CLEANING OF SPARK PLUG.

a. Visually inspect each spark plug for the following non-repairable defects:

1. Severely damaged shell or shield threads nicked up, stripped or cross-threaded.
2. Badly battered or rounded shell hexagons.
3. Out-of-round or damaged shielding barrel.
4. Chipped, cracked or broken ceramic insulator portions.
5. Badly eroded electrodes worn to approximately 50% of original size.

b. Clean the spark plug as required, removing carbon and foreign deposits.

c. Test the spark plug both electrically and for resistance.

d. Set the electrode gap. (Refer to latest revision Lycoming Service Instruction 1042.)

8-71. INSTALLATION OF SPARK PLUGS. Before installing spark plugs, ascertain that the threads within the cylinder are clean and not damaged.

a. Apply anti-seize compound sparingly on the upper threads. Do not apply anti-seize compound on bottom two threads to prevent plug failure. Install gasket and spark plugs. Torque 360 to 420 inch-pounds.

CAUTION

Make certain the deep socket is properly seated on the spark plug hexagon as damage to the plug could result if the wrench is cocked to one side when pressure is applied.

b. Insure terminal insulator is free of carbon and dirt and carefully insert in the spark plug and tighten the coupling nut.

8-72. STARTING VIBRATOR. (14 and 28-Volt System)

8-73. STARTING VIBRATOR CHECKING PROCEDURE.

a. Disconnect all spark plug leads from the left magneto at the spark plugs.

WARNING

Be sure all left magneto spark plug leads are removed, thus preventing cross-firing of the magneto and the possibility of hazardous conditions.

b. Rotate engine crankshaft until number one cylinder is in its retard firing position. Using the timing light, check to see that both magneto contact assemblies are open.

c. Disconnect left starter solenoid terminal wire, coded in electrical schematics P20A.

WARNING

It is necessary that the starter be electrically removed from the circuit before the vibrator is put into operation to eliminate possibility of starter being energized during the test.

d. Place left magneto switch in its ON position.
e. Hold left starter switch in the energized position.
f. Holding the number one cylinder spark plug lead approximately 0.187 to 0.250 of an inch away from a good ground, a series of hot sparks should occur.

WARNING

Grasp the spark plug lead far enough away from the connection so as not to produce any dangerous electrical shock.

g. If the spark does not jump the gap, check the applied voltage to the starting vibrator. This voltage should be 14 or 28-volts depending on the electrical system installed in the airplane.
h. If voltage is correct, check the contact points of the magneto. Both sets of contact points shall be opened.
i. Reject all units not complying with the preceding requirements or which show any visual defects.

8-74. REMOVAL OF STARTING VIBRATOR.
a. Remove the left access panel to the nose section interior at station 70.0.
b. The starter vibrator is attached to the extreme left front side of the forward fuselage bulkhead at station 81.0.

NOTE

Make note of positions of the wires before disconnecting electrical leads to facilitate reinstallation.

c. Disconnect the electrical leads from the vibrator.
d. Remove the vibrator from the bulkhead by removing the attachment screws.

8-75. INSTALLATION OF STARTING VIBRATOR.
a. Position the vibrator on the bulkhead and secure with screws.
b. Connect the electrical leads to the vibrator.

NOTE

On 28-volt electrical system only, make sure that the lead with the red marker has been put on the "IN" terminal of the starting vibrator.

c. Check operation per Pargaraph 8-73.
d. Install access panel.

8-76. LUBRICATION SYSTEM.

8-77. ADJUSTMENT OF OIL PRESSURE RELIEF VALVE. The O-540 and IO-540 series engines are equipped with either a non-adjustable or adjustable oil pressure relief valve located above and to the rear of number 5 cylinder. A brief description and setting procedure for both types follows:

a. Oil Relief Valve (Non-Adjustable): The function of the oil pressure relief valve is to maintain engine oil pressure within specified limits (60 psi, min. to 90 psi, max.). This valve is not adjustable; however, the pressure can be controlled by the addition of a maximum of three STD 425 washers under the cap to increase pressure or the use of a spacer (Lyc. P/N 73629 or 73630) under the cap to decrease pressure. Particles of metal or other foreign matter lodged between the ball and seat will result in a drop in oil pressure. It is advisable, therefore, to disassemble, inspect and clean the valve if excessive pressure fluctuations are noted. The oil pressure relief valve is not to be mistaken for the oil cooler by-pass valve, whose function is to permit pressure oil to by-pass the oil cooler in case of an obstruction in the oil cooler.

b. Oil Relief Valve (Adjustable): The adjustable oil relief valve enables the operator to maintain engine oil pressure within the specified limits (60 psi, min. to 90 psi, max.). If the pressure under normal operating conditions should consistently exceed the maximum or minimum specified limits, adjust the valve as follows:

With the engine warmed up and running at approximately 2000 RPM, observe the reading on the oil pressure gauge. If the pressure is above maximum or below minimum specified limits, stop engine and screw the adjusting screw out to decrease pressure and in to increase pressure. Depending on installation, the adjusting screw may have only a screwdriver slot and is turned with a screwdriver; or may have the screwdriver slot plus a pinned 0.375-24 castellated nut and may be turned with either a screwdriver or a box wrench.

8-78. INSTALLATION OF OIL COOLER.

a. When installing fittings in the oil coolers, care should be used to prevent excessive torque being applied to the cooler. When a rectangular fitting boss is provided, backup wrench should be used, employing a scissor motion, so that no load is transmitted to the cooler. When the oil cooler has a round fitting boss, care should be taken not to permit excessive torque on the fitting.

b. If a pipe thread fitting is used, it should be installed only far enough to seal with sealing compound.

c. Apply Lubon No. 404 to all male pipe thread fittings; do not allow sealant to enter the system.

d. If fitting cannot be positioned correctly using a torque of 10 to 15 foot-pounds, another fitting should be used.

e. When attaching lines to the cooler, backup wrench should be used.

f. After installation, inspect the cooler, for distorted end cups.

g. Run-up engine. After run-up, check for oil leaks.

8-79. INSPECTION AND ADJUSTMENT OF BALL JOINT EXHAUST SYSTEM. (See Figure 8-22.)

NOTE: The following incorporates the requirements of Piper Service Bulletin No. 319 as referenced in AD 72-14-05.

The ball joints are not intended to take up any misalignment; that is, they should never be angled in any direction to position the tailpipe in the firewall "chute." Notice that the aft end of the crossover pipe fits into a slip joint at the tailpipe aft of a ball joint. For the crossover pipe forward slip joint to properly align and perform its function, the tailpipe must be held in its proper position. When the tailpipe is in the correct position (tube center line straight thru the ball joint) the crossover tube should align properly and have proper engagement at both the front and rear slip joints. This will prevent loading the front crossover slip joint in a manner which lead to the exhaust system separating at that point.

Perform the following each 100 hours or annually, whichever comes first, and whenever the exhaust system is disassembled.

NOTE: Sketch and View references are to Figure 8-22.

a. Remove both engine cowlings. (See paragraph 8-7.)

b. Visually inspect both outboard exhaust stacks for alignment of ball joint tubes, crossover tubes, and for any cracks which may have developed in the welds as shown in Sketch 3.

c. The centerline of the short slip joint tube on the tail pipe must be parallel with the centerline of the tail pipe tube (see Sketch 3 and View C-C). (If present, remove the figure eight clamp(s) (View D-D).)

NOTE: If the checks described in Step C, above, show any misalignment between the two tubes or cracks at any of the welds, the tail pipe assembly should be replaced.

d. The centerline of the ball joints must match the centerline of the mating tubes as shown in Sketch 3.

e. If the ball joints are not properly aligned, remove the outboard exhaust stacks and crossover tube to properly realign the stacks.

NOTE: To facilitate alignment, the complete exhaust system should be loosened.

CAUTION: USE A STRIP OF MASKING TAPE TO MAKE THE REFERENCE MARK. DO NOT SCRIBE A REFERENCE MARK OR USE A GREASE PENCIL, AS THIS COULD CAUSE A WEAK SPOT OR HOT SPOT ON THE TUBE.

f. Clean and apply Fel-Pro C5A High Temperature Anti-seize Compound to both ends of the crossover tube and its mating slip joint, covering approximately two inches of both pieces. To determine that the slip joints are installed properly, insert the crossover tube into the slip joints as far as it will go, then place a reference mark of masking tape on the tube, in line with the end of the slip joint as shown in Sketch 1. Separate the slip joints, measure and record the engagement dimensions.

g. Align the ball joint centerline with the centerline of the mating tube, forward and aft of the ball joint as shown in Sketch 3. Ascertain that the crossover tube is properly positioned in the slip joints by checking the location of the previously made reference marks. Retighten the exhaust system. Measure the distance between the slip joint end and the taped reference mark. Subtract this dimension from the dimension recorded in Step F. Verify the result is within the min./max. slip joint engagement dimensions shown in Sketch 1.

h. If present, ascertain that the support bracket is shimmed to clear the counterbore on the sump housing with AN960-416 and AN960-416L washers (.062 max.). Adjust the support bracket so there is no preloading on the exhaust system.

i. If present, adjust the clamp at the end of the support bracket (View E-E) to securely hold the tube.

<u>NOTES</u>: 1. The crossover tube must be free to move at both slip joints prior to clamping or attaching isolator.

2. There must be a minimum clearance of 1.25 inches between the tail pipe and the firewall chute, as shown in View F-F. If this dimension is not obtainable, the system is not set properly and should be readjusted.

3. Items H and I, above, are not applicable when P/N 33538-00 Exhaust Stack Support Bracket Assembly is installed (i.e. - in PA-23-250's S/N's 27-7304959 & up, and in PA-23-250's S/N's 27-2505 thru 27-7304958 with Piper Kit No. 760-702 installed). In that case, do not compress or stretch isolators, putting excessive load or severe bending on cables.

j. Verify shroud assembly is the improved P/N 33178-02/-03 or 33178-04/-05, as appropriate (see Parts Catalog, P/N 753-522). Ascertain that .375 inch clearance is maintained between the end of the takeoff assembly and the flange on the shroud (see Sketch 2). The mounting holes in the shroud should match the holes of the clamp assembly. Move the clamp to locate the shroud and maintain the end clearance. Attach cable assembly to shroud half retaining screw and studded clamp assembly.

k. Ascertain that the takeoff assembly is securely fastened to the stack; this may require bending the ears of the takeoff assembly down over the stack before tightening the clamp. (See Sketch 2 and View A-A.)

l. If removed, reattach and secure the alternate air hose to the heat shroud takeoff tube.

m. Recheck all fasteners for tightness and reinstall the engine cowlings.

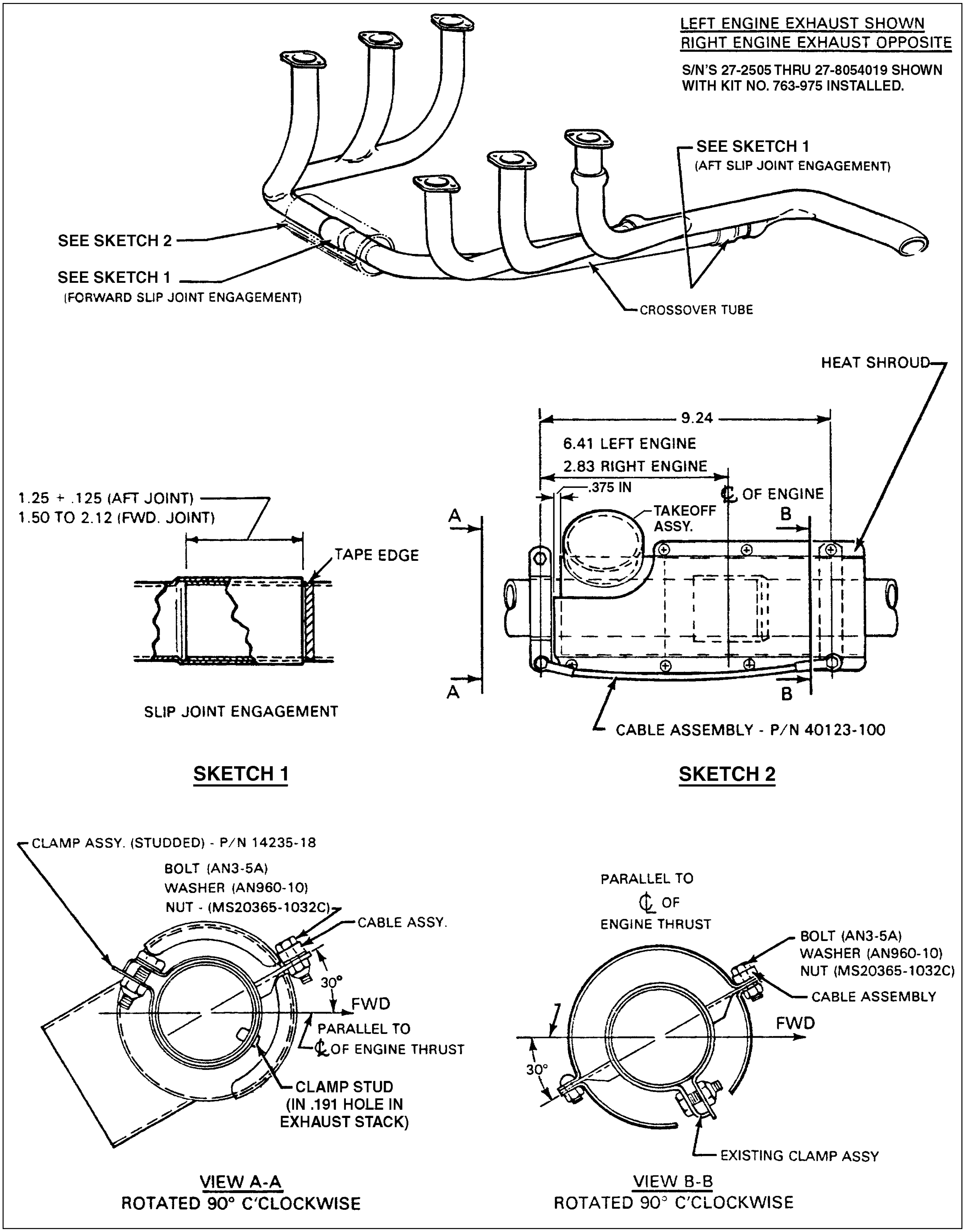


Figure 8-22. Adjustment of Ball Joint Exhaust System

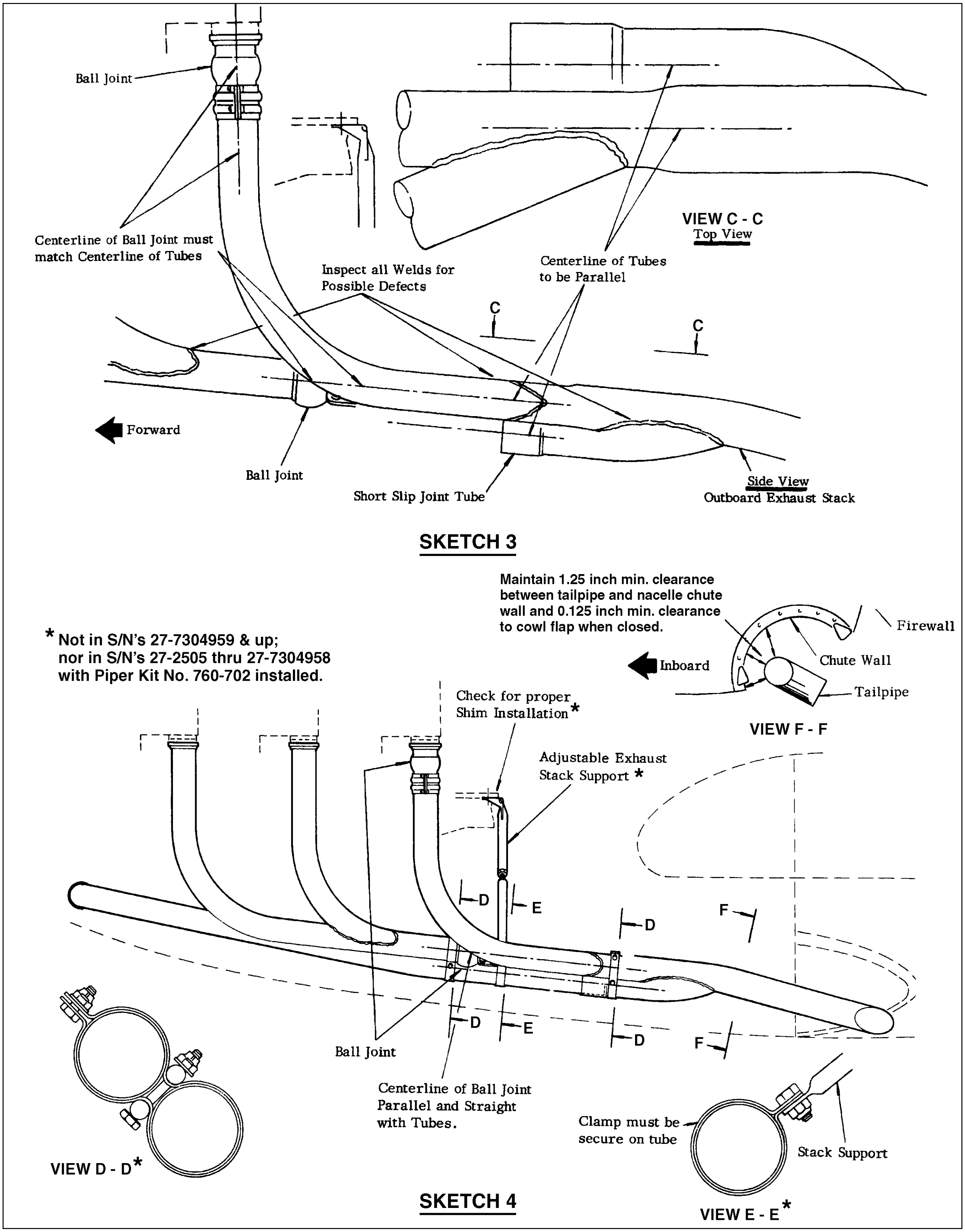


Figure 8-22. Adjustment of Ball Joint Exhaust System (cont.)

TABLE VIII-III. ENGINE TROUBLESHOOTING

Trouble	Cause	Remedy
	CARBURETOR	
Failure of engine to start.	Lack of fuel.	Check fuel system for leaks. Fill fuel cell. Clean dirty lines, strainers, or fuelcocks.
	Underpriming.	Prime with four or five strokes of primer.
	Overpriming.	Place control in "idle cut-off," open throttle and "unload" engine by turning in counter clockwise direction.
	Incorrect throttle setting.	Open throttle to one-tenth of its range.
	Defective spark plugs.	Clean and adjust or replace spark plug or plugs. Refer to Table II-I for spark plug gap adjustments.
	Defective ignition wire.	Check with electric tester and replace any defective wires.
	Defective or weak battery.	Replace with charged battery.
	Improper operation of magneto or breaker points.	Check internal timing of magnetos, Para. 8-62. Clean points.
	Water in carburetor.	Drain carburetor and fuel lines.
	Internal failure.	Check oil sump strainer for metal particles. If found, complete overhaul of the engine may be indicated.
	Improper switch wiring for left magneto starting.	Reverse magneto switch wires.
	Magnetized impulse coupling, if installed.	Demagnetize impulse couplings.
	Frozen spark plug electrodes.	Replace spark plugs or dry out removed plugs.

TABLE VIII-III. ENGINE TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
	CARBURETOR (cont.)	
Failure of engine to start (cont).	Mixture control in idle cut-off.	Open mixture control.
	Shorted ignition switch or loose ground.	Check and replace or repair.
Failure of engine to idle properly.	Incorrect carburetor idle adjustment.	Adjust throttle stop to obtain correct idle.
	Idle mixture.	Adjust mixture, paragraph 8-45 or refer to engine manufacturer's handbook.
	Leak in the induction system.	Tighten all connections in the induction system. Replace any parts that are defective.
	Low cylinder compression.	Check cylinder compression.
	Faulty ignition system.	Check entire ignition system.
	Open primer.	Lock primer.
	Improper spark plug setting.	Check spark plug gap.
	Dirty air filter.	Clean or replace.
Low power and uneven running engine.	Mixture too rich; indicated by sluggish engine operation, red exhaust flame and black smoke.	Check primer. Readjustment of carburetor Para. 8-45.
	Mixture too lean; indicated by overheating or backfiring.	Check fuel lines for dirt or other restrictions. Check fuel supply.
	Leaks in induction system.	Tighten all connections. Replace defective parts.
	Defective spark plugs.	Clean or replace spark plug.
	Improper grade of fuel.	Fill fuel cell with recommended grade.
	Magneto breaker points not working properly.	Clean points. Check internal timing of magneto, Para. 8-62.

TABLE VIII-III. ENGINE TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
	CARBURETOR (cont.)	
Low power and uneven running engine (cont).	Defective ignition wire.	Check wire with electric tester. Replace defective wire.
	Defective spark plug terminal connectors.	Replace connectors on spark plug wire.
	Restriction in exhaust system.	Remove restriction.
	Improper ignition timing.	Check magnetos for timing and synchronization.
Failure of engine to develop full power.	Throttle lever out of adjustment.	Adjust throttle lever, Para. 8-44.
	Leak in induction system.	Tighten all connections and replace defective parts.
	Restriction in carburetor air scoop.	Examine air scoop and remove restriction.
	Improper fuel.	Fill fuel cell with recommended fuel.
	Propeller governor out of adjustment.	Adjust governor, Para. 8-30.
	Faulty ignition.	Tighten all connections. Check system. Check ignition timing, Para. 8-63.
Rough running engine.	Cracked engine mounts.	Repair or replace engine mount.
	Unbalanced propeller.	Remove propeller and have it checked for balance.
	Defective mounting bushings.	Install new mounting bushings.
	Lead deposit on spark plug.	Clean or replace plugs.
	Primer unlocked.	Lock primer.

TABLE VIII-III. ENGINE TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
	CARBURETOR (cont.)	
Low oil pressure.	Insufficient oil.	Check oil supply.
	Dirty oil strainers.	Remove and clean oil strainers.
	Defective pressure gauge.	Replace gauge.
	Air lock or dirt in relief valve.	Remove and clean oil pressure relief valve.
	Leak in suction line or pressure line.	Check gasket between accessory housing crankcase.
	High oil temperature.	See "High Oil Temperature" in trouble column.
	Stoppage in oil pump intake passage.	Check line for obstruction. Clean suction strainer.
	Worn or scored bearings.	Overhaul.
High oil temperature.	Insufficient cylinder cooling.	Check front, rear, and side engine baffles for proper installation and sealing. Make sure rubberized seals at top of baffles do seal well against inside of cowling. Check intercylinder baffles for proper fit up against bottom of cylinders.
	Improperly timed magnetos.	Time magnetos, Para. 8-59.
	Malfunctioning thermostat.	Check vernatherm cooling flow control thermostat for proper operation, or replace.
	Oil coolers plugged inside or outside.	Flush inside of cooler with solvent, until clean. Clean outside of cores with air gun or as necessary.
	Restricted cooling oil flow.	Inspect inside of oil cooler hoses for good condition and fully open. Clean oil strainers.

TABLE VIII-III. ENGINE TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
	CARBURETOR (cont.)	
High oil temperature (cont).	Insufficient cooling air flow.	Adjust cowl flaps, Para. 8-11.
	Loss of cooling air through oil cooler.	Check connection of oil cooler to rear engine baffle, to make sure cooling air can not leak around outside of cooler, instead of through cooler.
	Excessive blow-by.	Perform differential compression check and make indicated corrections.
	Failing or failed bearings.	Examine sump for metal particles and, if found, overhaul engine.
	Improper cam shaft timing.	If engine was recently overhauled, check cam shaft timing.
	Overly lean fuel/air mixture.	Check carburetor float level.
	Excessive external dirt on engine.	Clean engine.
	Oil temperature gauge error.	See TABLE X-III.
Excessive oil consumption.	Failing or failed bearing.	Check sump for metal particles and, if found, overhaul of engine is indicated.
	Worn or broken piston rings.	Install new rings.
	Incorrect installation of piston rings.	Install new rings.
	External oil leakage.	Check engine carefully for leaking gaskets, "O" rings or sand holes.
	Leakage through engine fuel pump vent.	Replace fuel pump seal.
	Engine breather or vacuum pump breather.	Check engine and overhaul or replace pump.

TABLE VIII-III. ENGINE TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
	CARBURETOR (cont.)	
Inaccurate oil pressure readings.	Cold weather.	In extremely cold weather oil pressure readings up to 100 pounds do not necessarily indicate malfunctioning. High or low pressure pressure readings due to extremely cold weather are not necessarily a malfunction. Small and long oil lines will not transfer pressure readings accurately until engine is quite warm.
Overpriming.	Cold weather.	Rotate the crankshaft in the counter-clockwise direction with throttle FULL OPEN and ignition switch OFF.
	FUEL INJECTION	
Failure of engine to start.	Lack of fuel.	Check fuel system for leaks. Fill fuel tank. Clean dirty lines, strainers or fuelcocks.
	Underpriming.	Prime by holding switch 4 to 10 seconds. Check fuel flow indicator.
	Overpriming.	Place control in “idle cutoff.” Open throttle and unload engine by turning over with starter.
	Incorrect throttle.	Open throttle to l/8 of its range.
	Defective spark plugs.	Clean and adjust or replace spark plug or plugs.
	Defective battery.	Replace with charged battery.
	Improper operation of magneto internal breaker points.	Clean points. Check timing of magnetos, Para. 8-62.

TABLE VIII-III. ENGINE TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
	FUEL INJECTION (cont.)	
Failure of engine to start	Air bubbles in fuel system.	Check fuel vent.
(cont.).	Boost or auxiliary fuel pump failure.	Replace pump.
	Fuel line restricted.	Check inlet line.
	Lack of sufficient fuel pressure.	Check fuel strainer and fuel adjustments.
	Internal failure.	Check oil sump strainer for metal particles. If found, complete overhaul of the engine may be required.
Failure of engine to idle-properly.	Incorrect idle adjustment.	Adjust throttle stop to obtain correct idle, Para. 8-53.
	Insufficient fuel pressure.	Check fuel strainer and pump pressure adjustment.
	Clogged injector nozzles.	Remove and clean, Para. 8-55.
	Leak in induction system.	Tighten all connections in the induction system. Replace any defective parts.
	Low cylinder compression.	Check condition of piston rings and valve seats.
	Faulty ignition system.	Check entire ignition system.
Low power and uneven running.	Mixture too rich; indicated by sluggish engine operation, red exhaust flame at night. Extreme cases indicated by black smoke from exhaust.	Injector may need recali-bration by authorized personnel.
	Mixture too lean;- indicated by overheating or back-firing.	Check fuel supply. Check fuel lines for obstructions or restrictions.
	Clogged injector nozzles.	Remove and clean, Para. 8-55.

TABLE VIII-III. ENGINE TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
	FUEL INJECTION (cont.)	
Low power and uneven running (cont).	Dirt in inlet screen.	Remove screen and flush with solvent. Blow with compressed air.
	Dirt in "T" fitting.	Remove "T" fitting at distributor, clean in solvent. Blow through orifice with compressed air-100 psi.
	Fuel supply pressure excessively high.	Readjust fuel pump for lower pressure.
	Leak in manifold line.	Tighten fittings.
	Leak in induction system.	Tighten all connections. Replace defective parts.
	Defective spark plugs.	Clean or replace spark plugs.
	Poor fuel.	Fill fuel cell with fuel of recommended grade.
	Magneto breaker points not working properly. Defective ignition wire.	Clean points. Check internal timing of magnetos. Check wire with electric tester. Replace defective wire.
	Improper ignition timing.	Check magnetos for timing and synchronization.
	Defective spark plug terminal connectors.	Replace connectors on spark plug wire.
Flow meter reads high.	Clogged nozzle.	Remove and clean, Para. 8-55.
Failure of engine to develop full power.	Throttle lever nut out of adjustment.	Adjust throttle lever.
	Leak in induction system.	Tighten intake pipe mounting flange nuts and tighten intake manifold. (Replace defective gasket as req'd.)
	Mixture too lean.	Injector must be recalibrated.

TABLE VIII-III. ENGINE TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
	FUEL INJECTION (cont.)	
Failure of engine to develop full power (cont.).	Throttle linkage limiting travel of throttle valve.	Check throttle linkage and throttle valve opening.
	Restrictions in inlet air scoop.	Examine air scoop and remove restrictions.
	Improper fuel.	Fill fuel cell with recommended aviation fuel.
	Faulty ignition.	Tighten all connections. Check system with tester. Check ignition timing.
Rough engine.	Cracked engine mount.	Replace mount.
	Unbalanced propeller.	Remove propeller and have it checked for balance.
	Defective mounting bushings.	Install new mounting bushings.
Low oil pressure.	Insufficient oil.	Fill oil sump with oil of recommended viscosity.
	Leak in suction line or pressure line.	Check gasket between accessory housing and crankcase.
	Dirty oil strainers.	Remove and clean oil strainers.
	Air lock or dirt in relief valve.	Remove and clean oil pressure relief valve.
	High oil temperature.	See “High Oil Temperature” in “Trouble” column.
	Relief valve out of adjustment.	Adjust valve.
	Defective pressure gauge.	Replace gauge.
	Stoppage in oil pump intake passage.	Check line for obstruction. Clean suction strainer.
	Failing or failed bearings.	Check screens and sump for metal particles.

TABLE VIII-III. ENGINE TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
	FUEL INJECTION (cont.)	
High oil temperature.	Insufficient cylinder cooling.	Check front, rear, and-side engine baffles for proper installation and sealing. Make sure rubberized seals at top of baffles do seal well against inside of cowling. Check intercylinder baffles for proper fit up against bottom of cylinders.
	Improperly timed magnetos.	Time magnetos, Para. 8-59.
	Malfunctioning thermostat.	Check vernatherm cooling flow control thermostat, for proper operation, or replace.
	Oil coolers plugged inside or outside.	Flush inside of cooler with solvent, until clean. Clean outside of cores with air gun or as necessary.
	Restricted cooling oil flow.	Inspect inside of oil cooler hoses for good condition and fully open. Clean oil strainers.
	Insufficient cooling air flow.	Adjust cowl flaps, Para. 8-11.
	Loss of cooling air through oil cooler.	Check connection of oil cooler to rear engine baffle, to make sure cooling air can not leak around outside of cooler, instead of through cooler.
	Excessive blow-by.	Perform differential compression check and make indicated corrections.
	Failing or failed bearings.	Examine sump for metal particles and, if found, overhaul engine.
	Improper cam shaft timing.	If engine was recently overhauled, check cam shaft timing.

TABLE VIII-III. ENGINE TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
	FUEL INJECTION (cont.)	
High oil temperature (cont).	Overly lean fuel/air mixture.	Flow check injector.
	Excessive external dirt on engine.	Clean engine.
	Oil temperature gauge error.	See Table X-III.
Excessive oil consumption.	Low grade of oil.	Fill oil sump with oil conforming to specifications.
	Failing or failed bearings.	Check screens and sump for metal particles. If found, overhaul of engine is indicated.
	Worn piston rings.	Install new rings.
	Incorrect installation of piston rings.	Install new rings.
Cold weather difficulties.	Cold oil.	Move aircraft into a heated hangar. Heat oil.
	Inaccurate pressure readings.	In extremely cold weather oil pressure readings up to 100 pounds do not necessarily indicate malfunctioning. High or low pressure pressure readings due to (cont.)
	Inaccurate pressure readings (cont).	extremely cold weather are not necessarily a malfunction. Small and long oil lines will not transfer pressure readings accurately until engine is quite warm.
	Overpriming.	Rotate crankshaft in direct-tion of normal rotation with throttle “full open,” and mixture in “idle-cut- off” and ignition switch “OFF.”
	Weak battery.	Install fully charged battery.
	Faulty ignition switch.	Check ground wires.

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SECTION

VIIIA

POWER PLANT (TURBOCHARGED)

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SECTION VIIIA

POWER PLANT

(TURBOCHARGED)

8A-l. INTRODUCTION.

This section covers power plants used in the PA-23-250 (six place) turbo powered Aztec (S/N's 27-2505 and up) and is comprised of instructions for the removal, minor repair, service and installation of the engine cowling, propeller, propeller governor, engine, engine shock mounts, induction system, fuel injector, fuel air bleed nozzle, turbocharger, ignition system and lubrication system.

8A-2. DESCRIPTION.

The PA-23-250 (six place) turbo is powered by two Avco Lycoming IO-540-J4A5 series six cylinder, direct drive, wet sump, horizontally opposed, fuel injected, aircooled engines with a compression ratio of 8.5:1, rated at 250 HP at 2575 RPM and designed to operate on 100/130 (minimum) octane aviation grade fuel. The engine contains components which make it adaptable to turbocharging and is equipped with an AiResearch Turbocharger.

Cowlings completely enclose the engines and consist of an upper and lower section. The cowling is of cantilever construction attached at the firewall. Located on both sides of the cowl are access panels that can be removed when their quick fasteners are released, to allow inspection of the accessory section and turbocharger area. Cowl flap doors are an integral part of the lower cowl and are operated through mechanical linkage.

Propellers are Hartzell full feathering, constant speed, each controlled by a governor mounted on the engine supplying oil through the propeller shaft at various pressures. Oil pressure from the governor moves the blades into low pitch (high RPM). The centrifugal twisting moment of the blade also tends to move the blades into low pitch. Opposing these two forces is force produced by compressed air between the cylinder head and the piston, which tends to move the blades into high pitch in the absence of governor oil pressure. Thus, feathering is accomplished by compressed air.

The airframe induction system consists of a dry type air filter and alternate air door. The engine fuel system consists of a Bendix RSA-5ADl type fuel injector and a Lear-Seigler fuel supply pump as an integral part of the fuel injector system.

An AiResearch model P-202 turbocharger is mounted as an integral kit to the engine. The turbocharger is designed to increase the altitude power output and efficiency of an internal combustion engine by supplying compressed air to the engine intake manifold. The power to drive the turbocharger is extracted from the energy of the exhaust gases.

This unit consists of a turbine wheel and an impeller wheel (compressor) mounted on opposite ends of a common shaft, each contained in its own housing with a center housing containing shaft bearings.

Exhaust gas is directed onto the turbine wheel causing it to turn. The compressor wheel is fixed to the opposite end of the shaft and also turns, delivering compressed air to the engine induction system. The speed of the compressor can be varied by dumping or by passing some of the exhaust gas around the turbine and out the exhaust stack. This is done by a device called a wastegate which is employed in the exhaust system. The wastegate is controlled by an absolute controller which is very sensitive to air pressure. If the pressure it senses decreases, a sealed bellows expands, extending a metering pin which reduces the flow of oil through the body of the unit, increasing the pressure across the actuator diaphragm hence forcing the piston down and moving the wastegate towards the closed position. When the air pressure increases, the controller bellows contracts allowing oil to flow through it decreasing the pressure on the piston of the wastegate actuator. Spring tension on the piston forces it up opening the wastegate.

Bendix Scintilla S-1200 series magnetos are installed with their associated components. Each system consists of a single contact magneto, a dual contact magneto to obtain the retard spark necessary for starting, a starter vibrator, magneto switches and starter switch. The magnetos are designed to generate and distribute high tension current through high tension leads to the spark plugs.

In addition to the previously mentioned components, each engine is equipped with an alternator, geared starter, and pressure pump. Some have a hydraulic pump. Engine mounts are steel tubing construction attached at the firewall and incorporate vibration absorbing dynafocal mounts. The two top exhaust stacks and extensions are positioned one for the left and one for the right bank of cylinders. From the exhaust stacks, gases are directed to the turbocharger exhaust plenum, through or around the turbo turbine, as required, and overboard at the bottom of the engine nacelle.

The lubrication system is of the full pressure wet sump type. The oil pump, which is located in the accessory housing, draws oil through a drilled passage leading from the oil suction screen located in the sump. The oil from the pump then enters a drilled passage in the accessory housing, which feeds the oil to a threaded connection on the rear face of the accessory housing where a flexible line leads the oil to the external oil cooler. Pressure oil from the cooler returns to a second threaded connection on the accessory housing from which point a drilled passage conducts the oil to the oil pressure filter. In the event that cold oil or an obstruction should restrict the oil flow to the cooler, an oil cooler by-pass valve is provided to pass the oil directly from the oil pump to the oil pressure filter.

The oil pressure filter element, located on the accessory housing, is provided as a means to filter from the oil any solid particles that may have passed through the suction screen in the sump. After being filtered in the pressure filter, the oil is fed through a drilled passage to the oil pressure relief valve, located in the upper right side of the crankcase in front of the accessory housing.

This relief valve regulates the engine oil pressure by allowing excessive oil to return to the sump, while the balance of the pressure oil is fed to the main oil gallery in the right half of the crankcase. Residual oil is returned by gravity to the sump, where after passing through a screen it is again circulated through the engine.

8A-3. TROUBLESHOOTING. Troubles peculiar to the power plant are listed in Table VIIIA-II in the back of this section, along with their probable causes and suggested remedies. The table is divided into two parts, engine and turbocharger. When troubleshooting engines, ground the magneto primary circuit before performing any checks on the ignition system.

8A-4. STANDARD PRACTICES - ENGINE. (Refer to Section VIII.)

8A-5. ENGINE COWLING.

8A-6. REMOVAL OF ENGINE COWLING.

a. Ascertain that the master switch and magneto switches are in the off position.

b. Release the quarter turn fasteners and remove the two access panels from both sides of the engine nacelle.

c. Remove the attaching screws from the front and rear of the top cowling section and lift it off.

d. Remove the fillet fairings from both the inboard and outboard sides of the nacelle by removing attaching screws.

e. Disconnect all drain lines attached to the bottom cowl.

f. Remove the attaching bolts and disconnect the cowl flap linkage from the cowl doors.

g. Remove the screws from the front and rear of the bottom cowling assembly and pull it forward and down.

h. Split and remove the nose cowl by pulling out the two (upper and lower) hinge pins.

8A-7. CLEANING, INSPECTION AND REPAIR.

a. The cowling should be cleaned with a suitable dry type solvent and then wiped with a clean cloth.

b. Inspect the cowling for dents, cracks, loose rivets, damaged or missing fasteners and damaged skin or fiberglas.

c. If repair is necessary, refer to Structural Repairs, Section IV.

8A-8. INSTALLATION OF ENGINE COWLING.

a. Install the nose cowl halves and insert the hinge pins.

b. Position the bottom cowling assembly and secure with the attaching screws.

c. Connect the drain lines to the bottom of the cowling.

d. Position the fillet fairings in place on both inboard and outboard sides of the engine nacelle and secure with attaching screws.

e. Place the top cowling section in position and fasten with attaching screws.

f. Connect the cowl flap linkage to the doors with the attaching bolts and adjust per instructions in paragraph 8A-14.

g. Position the two inboard and outboard access panels in place and secure with the quarter turn fasteners.

8A-9. ENGINE COWL FLAP.

8A-10. REMOVAL OF COWL FLAP ASSEMBLY. (Refer to Figure 8A-1.)

a. Remove the two side cowl panels from the engine where the cowl flaps are to be removed.

b. Note the position of the rod end (3) to the cowl flap and remove the self-locking nut on the rod end disconnecting it from the cowl flap.

c. Remove the cowl flap by removing the cotter pin, nut, washer and bolt from the hinge bracket on each side.

d. Remove the interconnecting rod between the forward and rear cowl flap. Remove the second cowl flap in the same manner.

e. If the operating mechanism is to be removed, the following procedure may be used:

1. Disconnect the control cable clevis end (7) from the torque tube arm (14) by removing cotter pin and clevis pin.

2. Remove the bearing blocks holding each end of the torque tube assembly in place by removing the self-locking nut, washer and bolts.

3. Remove the self-locking nuts, washers and machine screws from the center bearing block. Remove the bearing block.

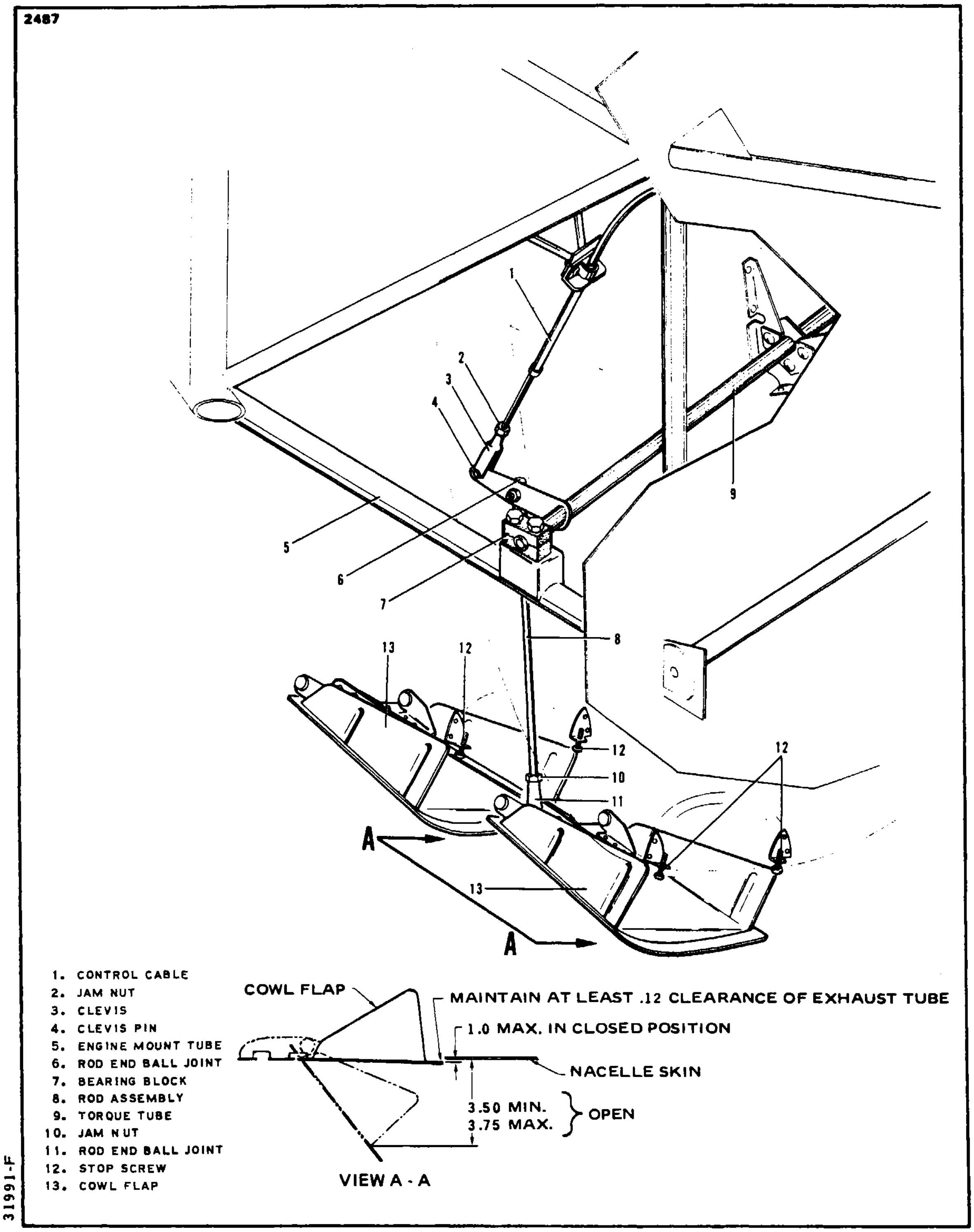

Figure 8A-1. Cowl Flap Installation

4. Remove the operating mechanism from the nacelle.
5. The mechanism may be further disassembled as necessary.

f. For removal of the cowl flap control cables, refer to paragraph 8A-6.

8A-11. REMOVAL OF COWL FLAP CONTROL CABLE.

a. Remove the engine access panels from the sides of the nacelle if not previously removed.

b. Remove the top center section of the nacelle by removing attaching screws.

c. Remove the access panel from the bottom of the fuselage between the wings.

d. Disconnect the clevis end of the control cable by removing the cotter pin and clevis pin.

e. Remove the clevis end from the cable.

f. Remove the clamp securing the cable to the engine mount by removing the self-locking nuts and machine screws.

g. Draw the cable through the firewall to the center section of the nacelle.

h. Loosen the cable clamps inside the center section of the nacelle.

i. Draw the cable through both clamp.

j. Loosen the clamp securing the cable inside the bottom of the fuselage.

k. Disconnect the cable from the control handle, inside the fuel control box, by removing nut, washers and bolt.

l. Remove the cable by drawing it from the nacelle into the bottom of the fuselage and through the clamp.

8A-12. INSTALLATION OF COWL FLAP CONTROL CABLE.

a. Draw the cable end through the clamp in the bottom of the fuselage and connect the cable end to the control handle inside the fuel control box.

b. Install the cable through the engine control tube in the wing.

c. Install the cable through the clamps in the center section of the nacelle.

d. Install the cable through the firewall and attach it with a clamp on the engine mount.

e. Install the clevis end and jam nut to the control cable.

f. Check the position of the cable to be certain there are no sharp bends or anything that might hamper proper operation.

g. Tighten all cable clamps.

h. Check rigging and adjustment of cowl flaps as described in paragraph 8A-14.

i. Install all access panels.

8A-13. INSTALLATION OF COWL FLAP ASSEMBLY. (Refer to Figure 8A-1.)

a. If the operating mechanism was removed, reinstall by the following procedure:

1. Position the torque tube and bearing blocks inside the nacelle and secure with bolts, washers and self-locking nuts.

2. Install the bearing block around the center of the torque tube with machine screws, washers, and self-locking nuts.

3. Install the rod assembly if removed from the torque tube.

b. Position the cowl flaps to the nacelle and secure with bolt, washer, nut and cotter pin.

c. Connect the rod assembly to the aft cowl flap.

d. Install the interconnecting rod to the cowl flaps.

e. Rig and adjust the cowl flaps as described in paragraph 8A-14.

f. Install all access panels.

8A-14. RIGGING AND ADJUSTING ENGINE COWL FLAPS. (Refer to Figure 8A-1.)

a. Remove the two side cowl panels from each engine.

b. Ascertain that the cowl flap mechanism is properly installed. (Refer to Paragraph 8A-13.)

c. With the cowl flap selector in the cabin placed in the OPEN position, adjust the rod ends (6 and 11) of the rod assembly (8) so the cowl flap is open to the dimension shown in Figure 8A-1.

d. This dimension should be measured normal to the nacelle skin. (Refer to Figure 8A-1.) Divide the adjustment between both rod ends, and check all rod ends and clevis ends for adequate thread engagement.

e. Move the selector in the cabin to the CLOSED position and check that the trailing edge of the outboard cowl flap clears the exhaust tube by at least .12 of an inch. Do not exceed one inch opening on either the outboard or inboard cowl flap. This dimension is measured normal to the nacelle skin and trailing edge of the cowl flap.

f. It may be necessary to readjust the OPEN position slightly to obtain these measurements.

g. Adjust the two forward flaps to fit flush when closed by adjusting the rod connecting the front and aft cowl flaps.

h. Adjust the stop screws (12) at the trailing edge of the cowl flaps until they contact the cowl flaps firmly.

8-15. PROPELLER.

8A-16. REMOVAL OF PROPELLER. (Refer to Figure 8A-2.)This includes all propellers, standard and with spring backup kit installed, identified by a letter "S" in the dash number.

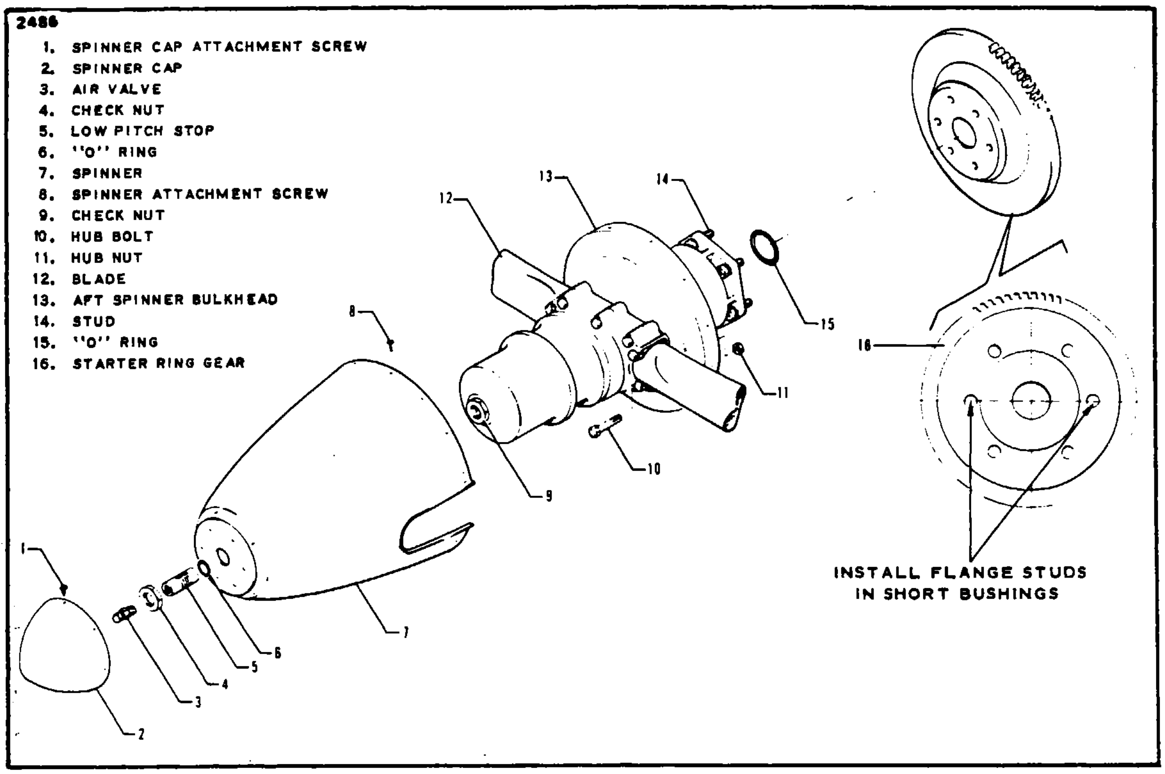

Figure 8A-2. Propeller Installation

NOTE

When removing the propeller, it is unnecessary to remove the spinner, feather the blades, or remove the air charge. When the propeller is removed for service or overhaul, the propeller with the spring kit installed should be feathered on the aircraft (see CAUTION on following page) and the spinner on either prop must be removed according to section d of this paragraph.

WARNING

Do not attempt to disassemble the propeller assembly any further than stated in this manual. Only personnel at a certified repair shop are authorized for repair and overhaul of the propeller mechanism.

CAUTION

Prior to performing any work on the propeller, ascertain that the master switch and magneto switches are OFF (grounded) and the mixture control is in the IDLE CUT-OFF position.

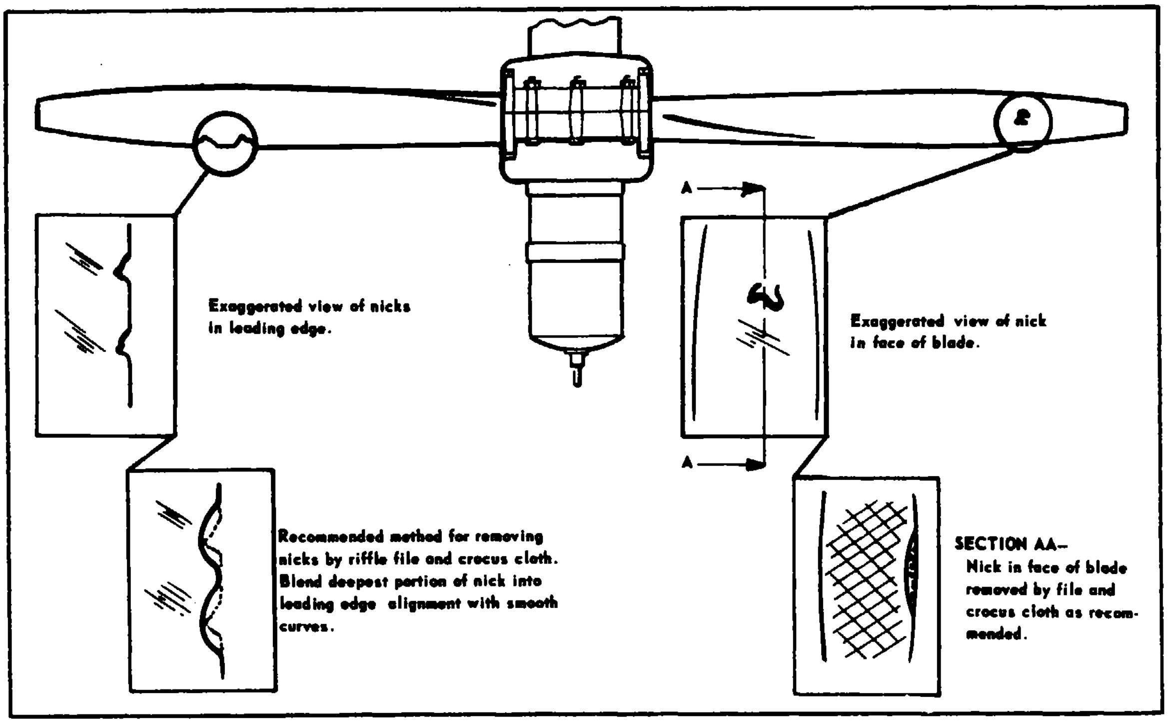

Figure 8A-3. Typical Nicks and Removal Method

CAUTION

Under NO condition should blade paddles be used on either propeller, except to unfeather a propeller with the spring kit installed (see paragraph 8A-18). If a propeller is to be feathered on the ground, it should be done with the engine operating, by use of the propeller control on the throttle quadrant.

a. Remove all hardware that attaches the nose cowl to the top and bottom engine cowls. The top and side panels of the main cowl assembly may be removed for greater accessibility. Work the nose cowl as far forward as possible, reach through the opening and split the cowl by pulling the upper and lower hinge pins. Pliers may be needed to pull the pins. The two halves of the cowl may be pulled forward and to either side of the propeller, which should be in a vertical position for ease in removing the cowl.

NOTE

In some appropriate manner, index the propeller and starter ring to facilitate installation. (Example - paint stripe.) Do not scratch the surface.

b. Place a drip pan under the propeller to catch oil spillage.

c. Cut safety wire around the propeller mounting studs and remove the studs (14) from the engine flange by wrenching the nuts. These nuts are "frozen" to the studs with loctite and secured with roll pins, so the studs should turn with the nuts. Pull the propeller from the engine shaft.

d. In the event that the spinner and spinner bulkhead are to be removed for cleaning, inspection, adjustment of pitch stop, etc., remove the spinner nose cap attaching screws and cap (1 and 2). Remove the spinner (7) by removing the safety wire and check nut (4) from the propeller at the forward end of the forward spinner bulkhead and the screws (8) that secure the spinner to the aft bulkhead (13). The aft spinner bulkhead may be removed from the hub by removing the locknuts (11).

8A-17. CLEANING, INSPECTION AND REPAIR OF PROPELLER.

WARNING

Prior to performing any work on propeller, ensure the dome pressure is discharged.

a. Check for oil and grease leaks.

b. Clean the spinner, propeller hub and blades with a non-corrosive solvent.

c. Inspect the hub parts for cracks.

d. Steel hub parts should not be permitted to rust. Use aluminum paint to touch up, if necessary, or replate during overhaul.

e. Check all visible parts for wear and safety.

f. Check the blades of the standard propeller to determine whether they turn freely on the hub pivot tube. This can be done by rocking the blades back and forth through the slight freedom allowed by the pitch change mechanism. Do this by hand being careful not to slam the internal mechanism against the stops. If blades appear tight and are properly lubricated, the propeller may need internal repair. (See WARNING under "Removal of Propeller".) This cannot be done with the spring propeller due to the pressure exerted by the spring even though the dome pressure is discharged.

g. Inspect blades for damage or cracks. Nicks in leading edges of blades should be filed out and all edges rounded, as cracks sometimes start from such places. Use fine emery cloth for finishing. Refer to Figure 8A-3 for propeller blade care.

h. Check condition of propeller mounting nuts and studs.

NOTE

It is recommended that for severe damage, internal repairs and replacement of parts, the propeller should be referred to the Hartzell Factory or Certified Repair Station.

i. Each blade face should be sanded lightly with fine sandpaper and painted, when

TABLE VIIIA-I. PROPELLER SPECIFICATIONS

Blade Angle	Low Pitch (High RPM)	14.5° 15.2° (1)
	Feathered	80°
MEASUREMENT TAKEN AT 30 INCH RADIUS (1) TIO-540-C1A ENGINES ONLY		
Propeller RPM Setting	Engine Static High RPM	2575
Propeller Torque Limits	Description	Required Torque (Dry)
	Spinner Bulkhead (Aft)	22 foot-pounds
	Propeller Mounting Bolts	60 foot-pounds
	Spinner Bulkhead Check Nut	35-40 foot-pounds
	Spinner Attachment Screws	40 inch-pounds

CHAMBER PRESSURE REQUIREMENTS WITH TEMPERATURE
HC-E2YR-2RB or HC-E2YR-2RBF or HC-E2YK-2RB or HC-E2YK-2RBF

Temp. °F	Press. (psi)	Temp. °F	Press. (psi)
100	188	30	165
90	185	20	162
80	182	10	159
70	178	0	154
60	175	-10	152
50	172	-20	149
40	168	-30	146

HC-E2YK-2RBS or HC-E2YK-2RBSF or HC-E2YR-2RBS or HC-E2YR-2RBSF

Temp. °F	Press. (psi)
100	74
70	70
40	66
10	62
-20	58

NOTE: Do not check pressure or charge with propeller in feather position.

necessary, with a flat black paint to retard glare. A light application of oil or wax may be applied to the surfaces to prevent corrosion.

8A-18. INSTALLATION OF PROPELLER. (Refer to Figure 8A-2.)

WARNING

Prior to performing any work around propeller, ascertain that the master switch and magneto switches are OFF (grounded) and the mixture control is in the IDLE CUT-OFF position.

a. Clean the propeller flange, starter ring and crankshaft flange.
b. Install spinner bulkhead (13) on propeller hub and secure with locknuts. Torque bolts to specifications given in Table VIIIA-I.
c. Ascertain that the starter ring gear is properly on the crankshaft flange. The oversize hole in the starter ring must go over the oversize bushing.
d. Position the prop flange and starter ring gear so the two short bushings are horizontal. (Refer to Figure 8A-2.)
e. Lubricate and install O-ring (15) in prop hub.
f. Place the propeller in a horizontal position and mount to the engine crankshaft. Check alignment of paint stripe (refer to NOTE under paragraph 8A-16). Screw each stud into its mating engine flange bushing a few threads at a time until all are tight. Torque the studs to the specifications given in Table VIIIA-I.
g. Safety studs with MS20995-C41 wire. Safety wire is inserted through the roll pins.
h. Install spinner (7). Torque spinner screws (8) and check nut (4) per Table VIIIA-I. Safety check nut with MS20995-C41 wire.

NOTE

Do not check pressure or charge with **PROPELLER** in feather position.

WARNING

To obtain an accurate pressure reading when checking propeller dome air pressure or to insure complete release of all air pressure, place the propeller **CONTROL** in the feather detent before measuring or releasing propeller air pressure. This procedure will insure the free flow of all air within the prop dome and prevent possible error in pressure readings or injury to service personnel should the low pitch stop be removed.

NOTE

If the propeller is in feather on the ground, it is undesirable to run it out of feather through engine operation due to roughness which will occur possibly causing severe damage to engine mount and exhaust system. Remove the air charge, unfeather the blades with equal pressure applied by means of blade paddles used on both blades as close to the hub as possible. Listen for the quiet distinctive "clicks" of the high pitch stop pins, then stop and remove the paddles.

j. Charge the cylinder through air valve (3) with dry air or nitrogen gas to the prescribed pressure. Refer to Table VIIIA-I of this manual for an exact pressure for the existing temperature. It is most important that an accurate charge be maintained.

k. The amount of air pressure per existing temperature, as shown by Table VIIIA-I, is very important and should always be used. If excessive pressure is used in the propeller, there is a possibility of feathering taking place at idle speed when the engine is warm and the oil viscosity is low. An accurate air pressure gauge should always be used. A pressure gauge and valve kit, part number 756 771, may be purchased through a Piper Dealer or Distributor.

l. When recharging the propeller, dry air or nitrogen gas should be used. It is important not to allow moisture to enter the air chamber as this could cause the piston to freeze during cold weather operation.

m. Test for leakage by using a soap solution or equivalent and applying it around the air valve stem and adjustment stop nut.

n. To reinstall engine cowling, first put the propeller in a vertical position then fit the two halves of the nose cowl together behind the spinner bulkhead and pin them together with the two hinge pins through the top and bottom hinges. Slide the nose cowl back and into proper location with the engine cowls. Locate holes and install all hardware that attaches the cowls together. Install top and side engine cowl panels if removed. Install spinner cap.

8A-19. ADJUSTMENT OF LOW PITCH BLADE ANGLE AND STOP.

NOTE

Both types of propellers referred to, come from the factory with the low pitch stop adjusted for proper blade angle. If, however this adjustment has been disturbed, the procedure given below is used for obtaining blade angle, but applies only to the propeller without the spring kit A-2273 installed. There is no way to check the low pitch blade angle of the propeller, with the spring kit installed, in the field. This is due to the internal spring producing a force near to that of the air charge in the standard propeller which can and has to be released to make this adjustment. The spring supplies constant pressure to the blades making it very difficult to rotate the blades to a point where the low pitch stop is contacted. Therefore, if the blade angle on a spring propeller is suspected to be wrong it should be referred back to the Hartzell Factory or Certified Repair Shop.

a. Procedure for obtaining blade angle and adjusting low pitch stop.

1. The blade angle (refer to Table VIIIA-I) is determined by placing a propeller protractor on the face side of the propeller at the 30 inch station as measured from the hub centerline. The blade must be horizontal.

2. The low pitch stop is adjusted by rotating a screw in the nose of the propeller cylinder. Rotating the screw clockwise increases the low pitch angle and reduces the static RPM by about 100 RPM for each half turn, or vice versa.

CAUTION

Before adjusting the low pitch stop screw, the air pressure should be dropped to zero. Unless this is done, it is possible to unscrew the low stop far enough to disengage the threads, allowing the air pressure to blow the stop screw out with great force. To insure the complete discharge of all air pressure within the dome, place the propeller **CONTROL** in the feather detent. There should be at least four threads of the stop screw engaged.

b. After the low pitch stop has been adjusted for proper blade angle, torque the low pitch stop jam nut to 30 foot-pounds. The governor should then be adjusted to obtain maximum rated engine RPM during take-off and climb.

8A-20. BLADE TRACK. Blade track is the ability of one blade tip to follow the other, while rotating, in almost exactly the same plane. Excessive difference in blade track - more than 0.062 inch - may be an indication of bent blades or improper propeller installation. Check blade track as follows:

a. With the engine shut down and blades vertical, secure to the aircraft a smooth board just under the tip of the lower blade. Move the tip fore and aft through its full "blade-shake" travel making small marks with a pencil at each position. Then center the tip between these marks and scribe a line on the board for the full width of the tip.

b. Carefully rotate propeller by hand to bring the opposite blade down. Center the tip and scribe a pencil line as before and check that lines are not separated more than 0.062 inch.

c. Propellers having excessive difference in blade track should be removed and inspected for bent blades, or for parts of sheared O-ring, or foreign particles which have lodged between hub and crankshaft mounting faces. Bent blades will require repair and overhaul of assembly. Other conditions will require installation in the prescribed manner. (Refer to paragraph 8A-18.)

8A-21. PROPELLER GOVERNOR.

8A-22. REMOVAL OF PROPELLER GOVERNOR.

a. Remove the upper engine cowl per paragraph 8A-6.

b. Disconnect the control cable end from the governor control arm.

c. Remove the governor mounting stud nuts. It will be necessary to move the governor out from the mounting pad as the nuts are being removed before the nuts can be completely removed.

d. Remove the mounting gasket. If the governor is to be removed for a considerable length of time and another unit not substituted, it is advisable to cover the mounting pad to prevent damage caused by foreign matter.

8A-23. INSTALLATION OF PROPELLER GOVERNOR.

a. Clean the mounting pad thoroughly, making very certain that there are no foreign particles in the recess around the drive shaft.

b. Place the governor mounting gasket in position with the raised portion of the screen facing away from the engine.

c. Align the splines on the governor shaft with the engine drive and slide the governor into position.

d. With the governor in position, raise the governor enough to install washers and start mounting nuts. Torque nuts even.

e. Connect the control cable end to the governor control arm. The ball stud is installed in the inner hole of the control arm.

f. Adjust governor control per paragraph 8A-24.

g. Install engine cowl per paragraph 8A-8.

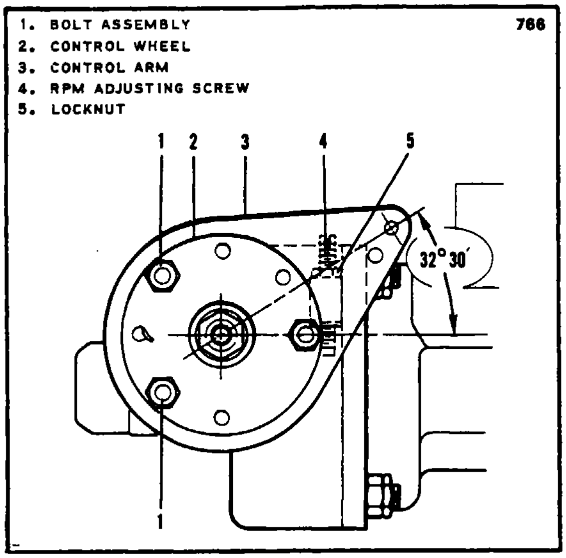

Figure 8A-4. Propeller Governor

8A-24. RIGGING AND ADJUSTMENT OF PROPELLER GOVERNOR. (Refer to Figure 8A-4.)

a. Start engine, park 90 degrees to wind direction and warm in the normal manner.

b. To check high RPM, low pitch setting, move the propeller control all the way forward to the INCREASE PROPELLER position. At this position the governor speed control arm (3) should be against the high RPM fine adjusting screw (4). With the throttle full forward, observe engine RPM which should be 2575 RPM with high RPM properly adjusted.

c. Should engine RPM not be as required, the high RPM setting should be adjusted as follows:

1. Shut down the engine and remove the upper engine cowl.
2. Adjust the governor by means of the fine adjustment screw (4) for 2575 RPM. To do this, loosen the high RPM fine adjustment screw locknut and turn the screw in a clockwise direction to decrease engine speed or in a counterclockwise direction to increase engine speed.

NOTE

One revolution of the fine adjustment screw will increase or decrease the engine speed approximately 20 RPM.

3. Reinstall upper engine cowl and repeat step b to ascertain proper RPM setting.
4. After setting the proper high RPM adjustment, run the self-locking nut on the fine adjustment screw against the base projection to lock.
5. Ascertain that the governor control arm (3) is adjusted to the proper angle on the control wheel (2) as shown in Figure 8A-4.

d. With the high RPM adjustment complete, the control system should be adjusted so that the governor control arm will contact the high RPM stop when the cockpit lever is 0.062 of an inch from its full forward stop which is located in the control pedestal. To adjust the control lever travel, disconnect the control cable end from the control arm, loosen the cable end jam nut and rotate the end to obtain the desired lever clearance. Reconnect the cable end and tighten jam nut.

e. It is usually only necessary to adjust the high RPM setting of the governor control system, as the action automatically takes care of the positive high pitch setting.

8A-25. ENGINE.

8A-26. REMOVAL OF ENGINE. The removal of either engine is basically the same procedure, though the routing of some wires, cables, lines, etc., does vary between engines. Each line should be identified to facilitate reinstallation and covered, where disconnected, to prevent contamination.

a. Turn off all cockpit switches and then disconnect the battery ground wire at the battery.

b. Move the fuel valve control lever, located on the fuel control box between the two front seats, to the off position.

c. Remove the engine cowling per paragraph 8A-6.

d. Drain the engine oil, if desired.

e. Remove the propeller per paragraph 8A-16.

f. Disconnect the starter cable at the starter, remove the cable clamps and pull it aft to the firewall.

g. Disconnect the alternator wires and wire clamps, pull the wires aft to the firewall.

h. Remove the governor control cable and injector control cables.

i. Disconnect the cylinder head temperature, manifold pressure, oil pressure, fuel pressure and fuel flow gauge vent lines.

j. Disconnect the engine oil breather, magneto "P" leads, oil temperature wire and tachometer cable.

k. Disconnect the vacuum hoses, air oil separator line to the engine, oil cooler lines and remove oil cooler.

l. Disconnect the fuel lines at the fuel pump, the hydraulic pump lines and bonding straps.

m. Loosen the magneto mounting nuts and rotate the magnetos to clear the engine mounts.

n. Disconnect the instrument air line at the rear center baffle.

o. Disconnect the turbo oil cooler lines at the cooler located on top of the engine.

p. Disconnect the instrument compressor pressure line located on the turbo air duct leading to the throttle.

q. Disconnect the instrument air line at the fuel pump.

r. Disconnect the oil line leading to the compressor and the return line leading from the compressor to the oil supply tank.

s. Disconnect the oil lines at the wastegate actuator.

t. To prevent damage to the tail when removing the weight of the engine, attach a stand to the tail skid.

u. Attach a one-half ton (minimum) capacity hoist to the engine lifting eye and relieve the tension on the mount bolts.

v. Remove the cotter pin, nut, washer, front rubber mount and sleeve from all four mount bolts.

w. Slide mount bolts out of attaching points and slowly swing engine free and place on a suitable support being careful not to damage any attached parts.

x. Remove the rear rubber mounts.

8A-27. INSTALLATION OF ENGINE. Refer to Figure 8A-5 for proper arrangement of the engine mount shock assemblies. The top shocks are assembled so the silver colored shocks are aft and the gold colored shocks are forward. The lower shock mounts are installed opposite of the top shock mounts.

a. Attach a one-half ton hoist to the lifting strap and lift the engine. The exhaust stacks, injector and accessories may be installed.

b. Swing the engine into position with the nose slightly high and inward. Allow the magnetos to clear the ring of the engine mount. Position the mounting lugs of the engine so they align with the engine mount attaching points.

c. Insert a mounting bolt into the engine mount until its threaded end extends one or two threads from the mount itself. Insert a shock mount between the engine mounting bracket and the mount. Slide the mount bolt on through the mount and insert a mount spacer over the bolt and through the engine mounting bracket.

d. Repeat the procedures in step c with the remaining three attaching points.

NOTE

A heat shield is installed with the bottom outboard shock mount. Adjust so as to give maximum protection against exhaust tube heat.

e. Install the front engine shock mounts on the bolts and over the forward end of the mount spacer; check to see that the shock mounts are not binding. Install washers and a self-locking nut on each mounting bolt. Tighten the nuts progressively, following a circular sequence, and torque to 34 to 42 foot-pounds.

f. Connect the two wastegate actuator oil lines.

g. Connect the compressor oil line and the oil return line from the compressor to the oil supply tank.

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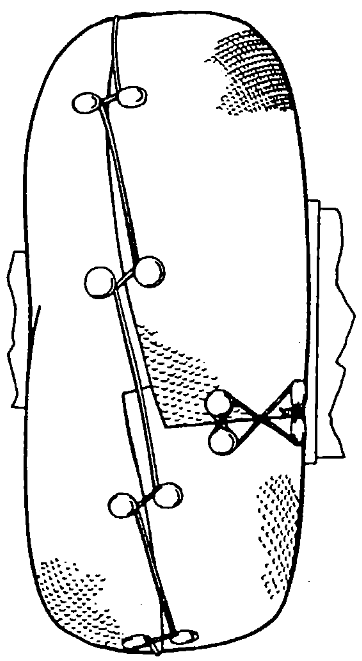

SKETCH A

1. OIL COOLER
2. OIL FILTER
3. PRESSURE CONTROLLER
4. VACUUM PUMP
5. MAGNETO, RIGHT
6. SOLENOID VALVE
7. ENGINE MOUNT ASSEMBLY (SEE SKETCH B)
8. SHOCK MOUNT
9. OIL PRESSURE RELIEF VALVE
10. FUEL INJECTOR MANIFOLD
11. TURBO OIL COOLER TUBES
12. LIFTING STRAP
13. FUEL AIR BLEED NOZZLE
14. STARTER RING GEAR
15. SPARK PLUG
16. PRESSURE WARNING SWITCH
17. OIL FILTER
18. EXHAUST STACK
19. EXHAUST BY-PASS VALVE
20. TURBINE
21. COMPRESSOR
22. AIR BOX
23. INDUCTION INTAKES
24. EXHAUST STACK
25. ENGINE MOUNT FITTING
26. BUSHING
27. BOLT
28. ENGINE MOUNT FRAME
29. WASHER
30. NUT

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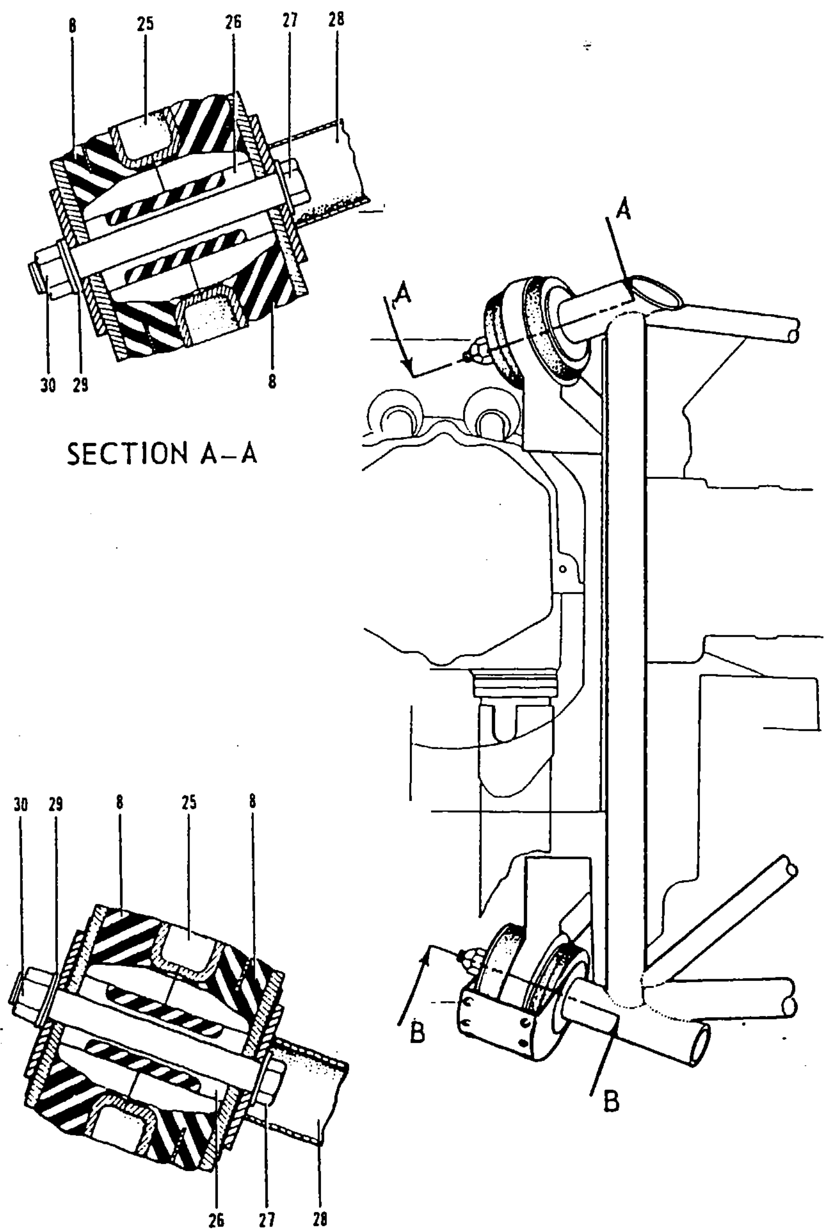

SKETCH B

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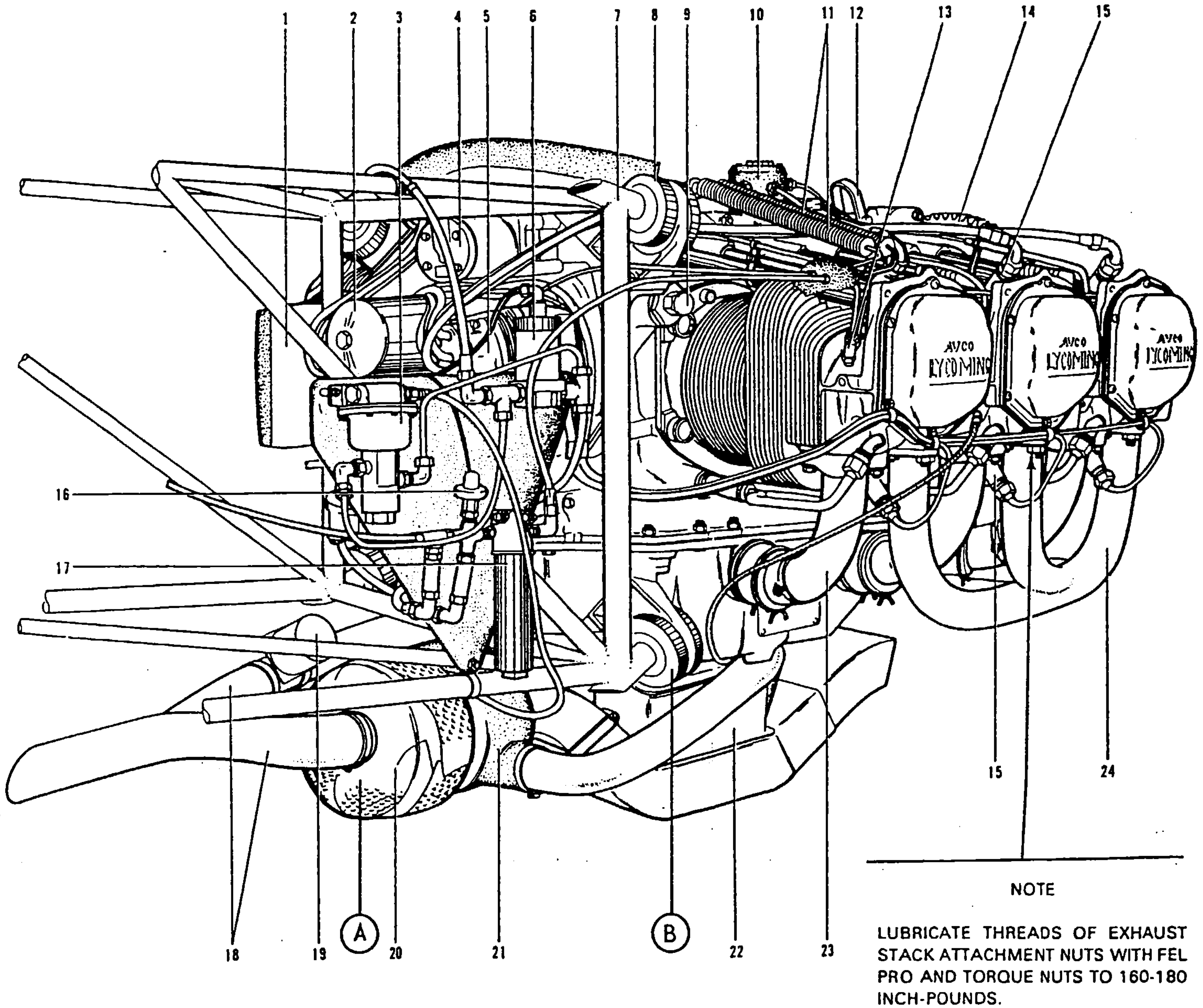

Figure 8A-5. Engine Installation

h. Connect the instrument air line to the fuel pump.

i. Connect the instrument compressor pressure line to the fitting on the tube air duct leading to the throttle.

j. Connect the two oil lines to the turbo oil cooler located on top of the engine.

k. Connect the instrument air line located at the rear center baffle.

l. Connect the fuel lines to the fuel pump hydraulic pump lines, left engine only, bonding straps.

m. Connect the vacuum hoses, air oil separator line to the engine.

n. Install the oil cooler and connect oil cooler hoses.

o. Connect the engine oil breather, magneto "P" leads, oil temperature wire to bulb and tachometer cable.

p. Connect the cylinder head temperature, manifold pressure, fuel pressure and fuel flow gauge vent line.

q. Install the governor control cable bracket cable.

r. Connect the injector unit control cables.

s. Connect the alternator wires and clamp the wires to rocker arm oil return lines.

t. Connect the starter cable and clamp cable to rocker arm oil return lines.

u. Ascertain that the magneto switches are off and install the propeller per paragraph 8A-18.

v. Install the proper grade and amount of engine oil. (Refer to latest revision Lycoming Service Instruction No. 1241 for engine pre-oiling prior to initial start.)

w. Connect the battery ground wire at the battery.

x. Turn on the fuel valve, open the throttle full and turn on the electric fuel pump and check the fuel lines for leaks.

y. Perform an engine operational check.

z. Check for oil leaks.

aa. Install the access plates on the engine nacelle and the cowling per paragraph 8A-8.

8A-28. ENGINE SHOCK MOUNTS. Replace at engine TBO or on condition. (Refer to Section 8, Engine Shock Mounts for conditions.)

8A-29. REPLACING ENGINE SHOCK MOUNTS. The engine shock mounts may be replaced with the engine installed as well as removed from the airplane. Refer to Figure 8A-7 for the arrangement of the shock mount assembly. The top shocks are assembled so the silver colored shocks are aft and the gold colored shocks are forward. The procedure described in this paragraph is with the engine installed.

a. Remove the engine cowling. (Refer to Paragraph 8A-6.)

b. Attach a one-half ton (minimum) hoist to the engine hoisting hooks and relieve tension from the shock mounts.

c. Loosen the upper shock mount attaching nuts.

d. Remove the lower mount attaching nuts, washers, heat shield, forward shock mounts and spacers.

e. Remove the lower attaching bolts just far enough to allow the aft shock mounts to be removed. The bushing in each lower mount must be removed with the bolt.

f. Raise the nose of the engine enough to remove the lower aft shock mounts and replace with new ones.

NOTE

Care should be taken not to introduce adverse stresses on the control cables, electrical cables, hoses and other items attached to the engine while hoisting the engine.

g. Lower the engine, slide the attaching bolts with bushings into place and install the spacers, forward shock mounts, heat shield, washers and nuts. Start nuts only a few threads. Rotate the shield to provide greatest protection against exhaust heat.

h. Remove the upper mount attaching bolts, nuts, washers, forward shock mounts and spacers.

i. Lower the engine enough to replace the upper aft shock mounts. Raise the engine into position.

j. Install the spacers, forward shock mounts, mounting bolts, washers and nuts.

k. Tighten attaching bolts 34 to 42 foot-pounds.

8A-30. FUEL INJECTOR.

CAUTION

Extreme caution should be exercised when handling or working around the injector to prevent oil or fuel from entering the air sections of the injector. As explained previously, damage to the air diaphragm will result. Fluid can easily enter the air section of the injector through the impact tubes or the annular groove around the venturi. For this reason, a protective plate should be installed on the scoop mounting flange when performing routing maintenance on the engine, such as washing down the engine and air scoop, serviceing the air filter (surplus oil on the element), or when injecting preservative into the engine prior to storing or shipping.

8A-31. FUEL INJECTOR MAINTENANCE.

a. In general, little attention is required between injector overhauls. However, it is recommended that the following items be checked during periodic inspection of the engine.

1. Check tightness and lock of all nuts and screws which fasten the injector to the engine.

2. Check all fuel lines for tightness and evidence of leakage. A slight fuel stain adjacent to the air bleed nozzles is not cause for concern.

3. Check throttle and mixture control rods and levers for tightness and lock.

4. Remove and clean the injector fuel inlet strainer at each 50 hour inspection. Damaged strainer "O" rings should be replaced.

b. Tests prove that gasoline which becomes stale due to prolonged storage absorbs oxygen rapidly. This stale oxidized gasoline acquires a very distinctive odor similar to varnish, causes rapid deterioration of synthetic rubber parts, and also forms a gummy deposit on the internal metal parts. This condition, however, does not occur during normal operation of the injector where fresh fuel is being constantly circulated.

8A-32. LUBRICATION.

a. There is very little need for lubrication of the injector in the field between regular overhauls. However, the clevis pins used in connection with the throttle and manual mixture control levers should be checked for freedom of movement and lubricated, if necessary.

b. Place a drop of engine grade oil on the end of the throttle shaft in such a manner that it can work into the throttle shaft bushings.

8A-33. REMOVAL OF FUEL INJECTOR, NOZZLE LINES, FUEL LINES AND FUEL FLOW DIVIDER.

a. Remove the engine cowling. (Refer to Paragraph 8A-6.)

b. Disconnect the throttle and mixture control cables at the injector.

c. Remove the air box by removing bottom access panel on the air box and remove attaching screws holding air box to the injector unit.

d. Disconnect the fuel inlet line at the injector.

e. Disconnect the fuel outlet line to the flow divider at the injector.

f. Remove attaching nuts and remove injector unit.

g. Disconnect the nozzle lines from the air bleed nozzles.

h. Disconnect the fuel flow meter line at the rear baffle.

i. Disconnect the inlet fuel line at the flow divider.

j. Remove the two attaching bolts and remove fuel flow divider and nozzle lines as a unit.

k. Remove air bleed nozzles, (Refer to Paragraph 8A-39.)

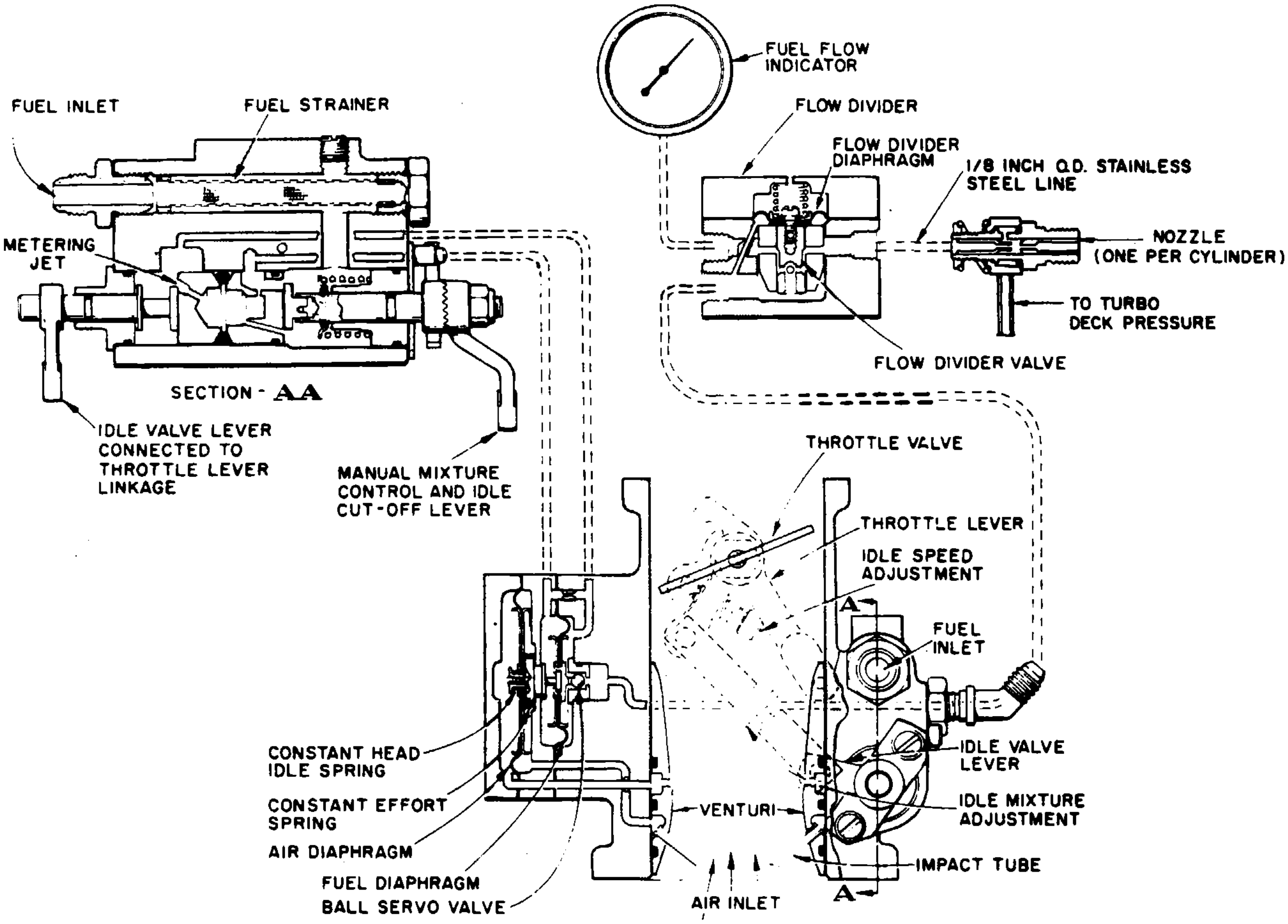

Figure 8A-6. Schematic of RSA Fuel Injection System

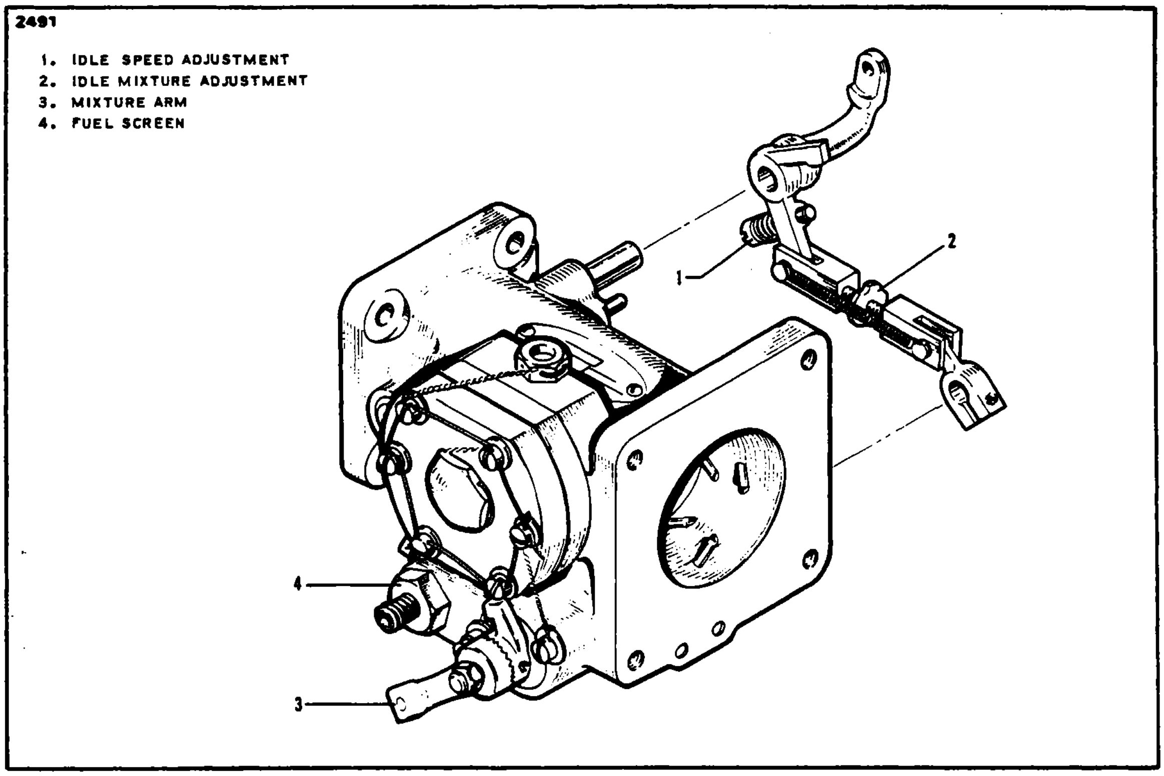

Figure 8A-7. Fuel Injector

8A-34. PREPARATION FOR STORAGE. Any unit taken out of service, or units being returned for overhaul, must be flushed with preserving oil (Specification MIL-O-6081, Grade 1010), using the following procedure:

CAUTION

Do not exceed air pressure below as internal damage to the injector may result. See CAUTION in Paragraph 8A-30.

a. Remove plugs and drain all fuel from the injector. If available, apply 10 to 15 psi air pressure to the fuel inlet until all fuel is discharged from the injector.

b. Replace plugs and apply flushing oil filtered through a 10-microm filter at 13 to 15 psi to the injector fuel inlet until oil is discharged from the outlet.

c. Replace fuel inlet shipping plug.

d. After filling with preservative oil, the injector should be protected from dust and dirt and given such protection against moisture as climatic conditions at the point of storage require. In most cases, storing the unit in a dry area will be sufficient.

e. If the unit is to be stored near or shipped over salt water, the following precautions should be observed:

1. Spray the exterior of the injector with an approved preservative oil.

2. Pack in a dustproof container, wrap the container with moisture and vapor-proof material, and seal. Pack the wrapped unit in a suitable shipping case. Pack a one-half pound bag of silica gel crystals in the dustproof container with injector. The bag must not touch the injector.

CAUTION

Extreme caution should be exercised when handling or working around the injector to prevent oil or fuel from entering the air sections of the injector. As explained previously, damage to the air diaphragm will result. Fluid can easily enter the air section of the injector through the impact tubes or the annular groove around the venturi. For this reason, a protective plate should be installed on the scoop mounting flange when performing routing maintenance on the engine, such as washing down the engine and air scoop, servicing the air filter (surplus oil on the element), or when injecting preservative into the engine prior to storing or shipping.

8A-35. INSTALLATION OF FUEL INJECTOR.

a. Install air bleed nozzles. (Refer to Paragraph 8A-41.)

b. Install fuel flow divider and nozzle lines, attach divider to the crankcase with attaching bolts and connect lines to nozzles.

c. Connect inlet fuel line and fuel flow meter line.

d. Install a gasket and attach the injector unit to the engine sump with washers and nuts.

e. Install air box with attaching bolts; attach bottom access plate with screws.

f. Connect the throttle and mixture control cables.

g. Connect the inlet and outlet fuel lines.

h. Install the cowling as described in paragraph 8A-8.

i. Adjust the idle speed and mixture of the injector.

8A-36. ADJUSTMENT OF THROTTLE AND MIXTURE CONTROLS. The throttle and mixture are adjusted so that when the throttle arm on the injector is rotated forward against its full throttle stop and the mixture arm is rotated forward against its full rich stop, their respective cockpit control levers should be 1/16 to 1/8 of an inch in from their full forward stops which are located in the control pedestal.

a. At the injector, disconnect the throttle and/or mixture control cable end from its control arm.

b. Loosen the jam nut securing the cable end.

c. Adjust the linkage by rotating the cable end to obtain the 0.062 of an inch springback of the cockpit control lever when the throttle or mixture control arm contacts its stop.

d. Reconnect the cable end to its control arm and secure jam nut.

e. Pull the throttle and mixture control lever in the cockpit full aft to ascertain that the injector idle screw contacts its stop and the mixture control arm contacts its lean position.

8A-37. ADJUSTMENT OF IDLE SPEED AND MIXTURE.

a. Start the engine and warm up in the usual manner until oil and cylinder head temperatures are normal.

b. Check magnetos. If the "mag-drop" is normal, proceed with the idle adjustment.

c. Close the throttle to idle. If the RPM changes appreciably after making the idle mixture adjustment during the succeeding steps, readjust the idle speed to obtain from 625 to 675 RPM.

NOTE

The idle mixture must be adjusted with the fuel boost pump ON.

d. When the idling speed has been stabilized, move the cockpit mixture control lever with a smooth, steady pull toward the "Idle Cut-Off" position and observe the tachometer for any change during the "leaning" process. Caution must be exercised to return the mixture control to the "Full Rich" position before the RPM can drop to a point where the engine cuts out. An increase of more than 50 RPM while "leaning out" indicates an excessively rich idle mixture. An immediate decrease in RPM (if not preceded by a momentary increase) indicates the idle mixture is too lean.

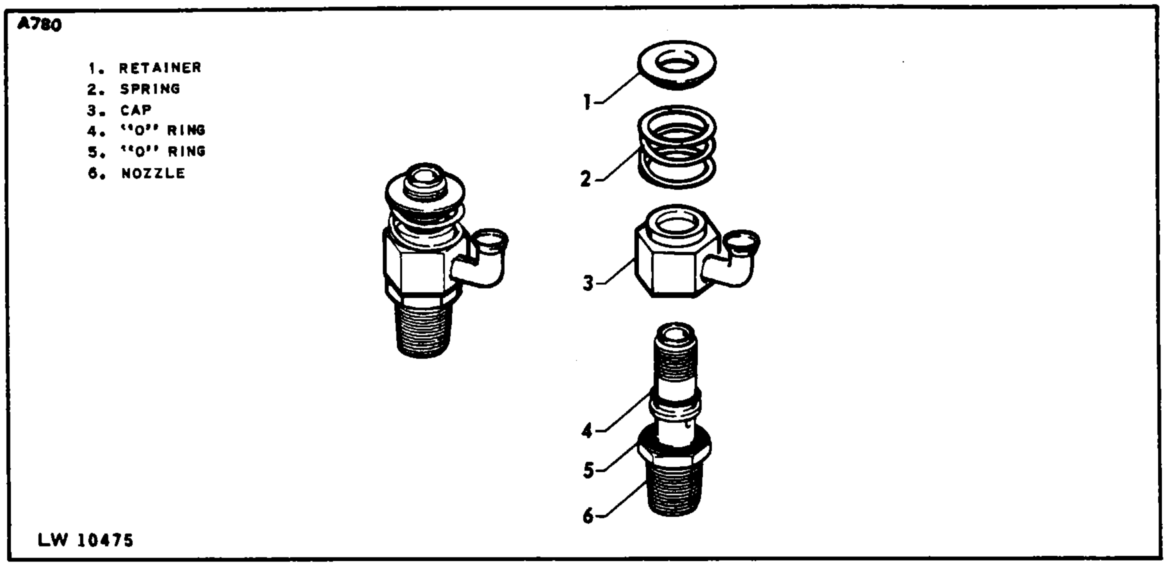

Figure 8A-8. Fuel Air Bleed Nozzle

e. If the above indicates that the idle adjustment is too rich or too lean, turn the idle mixture adjustment in the direction required for correction, and check this new position by repeating the above procedure. Make additional adjustments as necessary. Each time the adjustment is changed, the engine should be run up to 2000 RPM to clear the engine before proceeding with the RPM check. Make final adjustment of the idle speed adjustment to obtain the desired idling RPM with closed throttle. The above method aims at a setting that will obtain maximum RPM with minimum manifold pressure. In case the setting does not remain stable, check the idle linkage; any looseness in this linkage would cause erratic idling. In all cases, allowance should be made for the effect of weather conditions and field altitude upon idling adjustment.

8A-38. FUEL AIR BLEED NOZZLE.

8A-39. REMOVAL OF FUEL AIR BLEED NOZZLE. The nozzles must be carefully removed as they or the cylinders may be damaged.

a. Remove the lower engine cowl. (Refer to paragraph 8A-6.)
b. Disconnect the fuel line from the nozzle.
c. Remove the spring retainer and spring from the nozzle stem.
d. Disconnect the nozzle shroud from the vent hose and remove it from the nozzle.
e. Carefully remove the nozzle using the correct size deep socket.

8A-40. CLEANING AND INSPECTION OF FUEL AIR BLEED NOZZLE.

CAUTION

Do not emerse "O" rings in cleaning fluid; the rings may swell.

a. Clean the nozzle with acetone or equivalent and blow out all foreign particles with compressed air in the direction opposite that of fuel flow. Do not use wire or other hard objects to clean orifices. (Refer to latest revision of Lycoming Service Instruction No. 1275.)
b. Inspect and replace nozzle "O" rings if found to be cracked, brittle or distorted.
c. A test procedure is described in Lycoming Service Instruction No. 1275.

8A-41. INSTALLATION OF FUEL AIR BLEED NOZZLE.
a. It is important for the nozzles to be correctly positioned with the bleed hole facing up.
b. Install the nozzles and torque to 60 inch-pounds.
c. Ascertain that the "O" rings are properly installed on the nozzle stem and install the nozzle shroud. (Refer to Figure 8A-9.)
d. Connect the vent to the nozzle shroud.
e. Install the spring and spring retainer on the nozzle stem.
f. Connect the fuel line to the nozzle and clamp the fuel line as described in latest revision of Lycoming Service Bulletin No. 335.
g. Install the engine cowl. (Refer to paragraph 8A-8.)

8A-42. IGNITION SYSTEM MAINTENANCE.

8A-43. MAGNETO.

WARNING

Ascertain that the primary circuit of both magnetos is grounded before working on the engine.

8A-44. INSPECTION OF MAGNETO.
a. After the first 25 hour and 50 hour periods, and periodically thereafter, the contact assemblies should be checked. Examine the points for excessive wear or burning. Points which have deep pits or excessively burned areas should be discarded. Examine the cam follower felt for proper lubrication. If necessary, points can be cleaned by using any hard finished paper. Clean breaker compartment with dry cloth.
b. If engine operating troubles develop which appear to be caused by the ignition system, it is advisable to check the spark plugs and wiring first before working on the magnetos.
c. Should the trouble appear definitely associated with the magneto, the most effective measure is to install a replacement magneto which is known to be in satisfactory condition and send the suspected unit to the overhaul shop for test and repair.
d. Should this not be possible, a visual inspection may disclose the source of trouble. Remove the harness outlet plate from the magneto. Inspect for the presence of moisture and foreign matter on the rubber grommet and high tension outlet side of the distributor block. Check height of block contact springs. (0.422 maximum from top of block tower to spring.) (Refer to Figure 8A-10.) Also check for broken leads or damaged insulation. If either is present, remove magneto and replace with one known to be in satisfactory condition.

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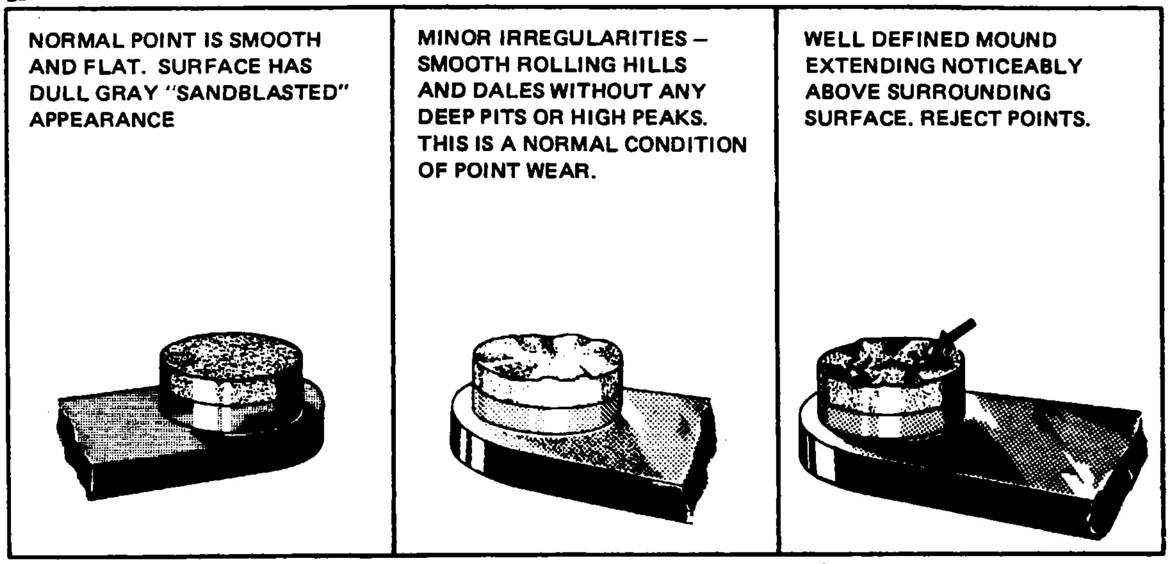

Figure 8A-9. Contact Points

e. Remove the breaker cover and harness securing screws and nuts, and separate cover from magneto housing. Check contact assemblies to see that cam follower is securely riveted to its spring. Examine the contact points for excessive wear or burning. Figure 8A-9 shows how the average contact point will look when surfaces are separated for inspection. Desired contact surfaces have a dull gray, sand-blasted (almost rough) or frosted appearance over the area where electrical contact is made. This means that points are worn in and mated to each other, thereby providing the best possible electrical contact and highest efficiency of performance.

f. Minor irregularities or roughness of point surfaces are not harmful. (Refer to Figure 8A-9 center.) Neither are small pits or mounds, if not too pronounced. If there is a possibility of pit becoming deep enough to penetrate pad, Figure 8A-9 right, reject contact assembly.

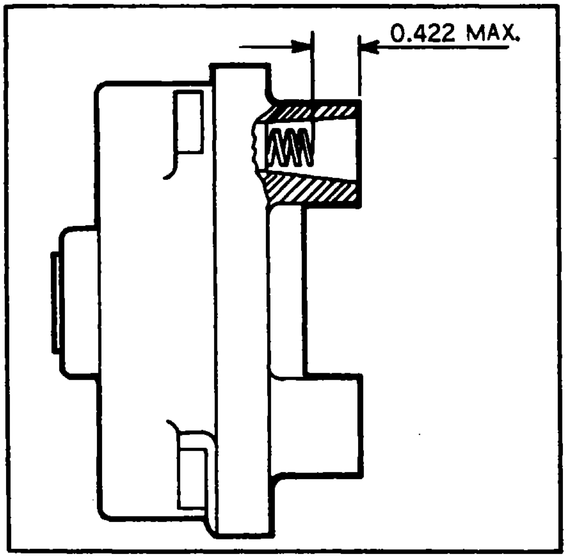

Figure 8A-10. Contact Spring Inspection

NOTE

No attempt should be made to stone or dress contact points. Should contact assembly have bad points or show excessive wear, the complete contact assembly should be replaced.

g. Check the condition of the cam follower felt. Squeeze felt tightly between thumb and forefinger. If fingers are not moistened with oil, re-oil using 2 or 3 drops of Bendix P/N 10-391200 lubricant. Allow approximately 30 minutes for felt to absorb the oil. Blot off the excess with a clean cloth. Too much oil may foul contact points and cause excessive burning.

h. Check the capacitor mounting bracket for cracks or looseness. Using the Scintilla 11-1767-1, -2, or -3 Condenser Tester or equivalent, check capacitor for capacitance, series resistance and leakage. Capacitance shall be at least 0.30 microfarads.

i. Check magneto to engine timing as follows:

1. Connect Scintilla 11-851 Timing Light or equivalent across the main contact assembly.

2. Slowly bring the engine up to number one cylinder advance firing position as instructed in paragraph 8A-57. At this instant the timing light should go out. If it does, the magneto is properly timed to the engine. If the timing light does not go out, removal of the magneto for internal timing check and inspection is recommended.

NOTE

The magneto service instructions in this manual are to cover minor repairs and timing. For further repairs and adjustments of the magneto, it is recommended that the manufacturer's recommended service instructions be followed.

8A-45. REMOVAL OF MAGNETO. Before removing the magneto, make sure magneto switches are off.

a. Remove the engine access plates from the side of the engine to be worked on.

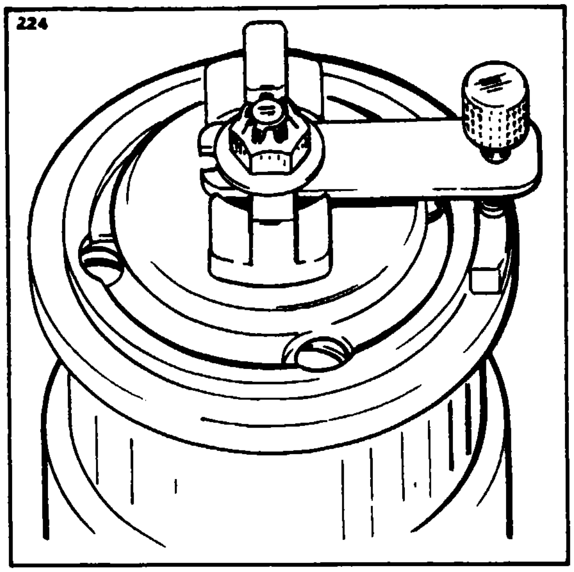

Figure 8A-11. Rotor Holding Tool Installed

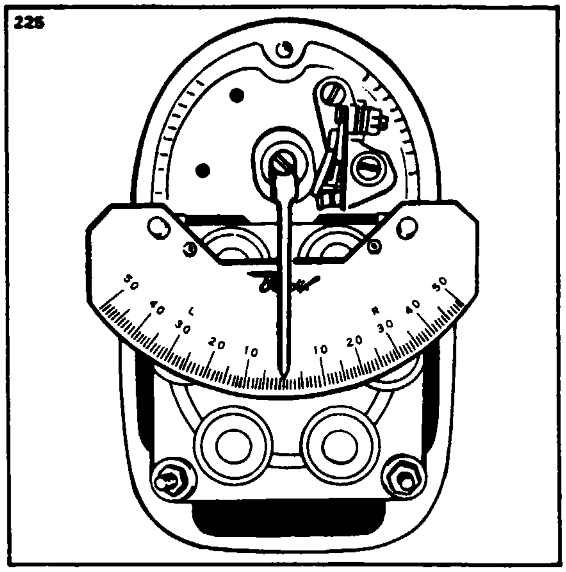

Figure 8A-12. Timing Kit Installed

WARNING

The magneto is not internally grounded; when the ground lead is disconnected, the magneto is hot. Removing the harness assembly terminal plate first and installing them last minimizes the danger of starting the engine accidentally when the ground lead is removed from the magneto.

b. Remove the harness assembly terminal plate from the magneto.

c. Disconnect the ground lead and, where applicable, the retard spark lead on the left magneto, at the magneto.

d. Remove the nuts and washers and draw the magneto from the engine.

8A-46. TIMING PROCEDURE. (Internal Timing.) (-1200 series magnetos.)

a. Remove the cover to the contact(s), distributor block, etc.

b. To internally time the main contact assembly of either the dual-breaker magnetos or the single-breaker magnetos, proceed as follows:

1. Loosen the nut securing the drive plate to the magneto shaft sufficiently in order to install the Scintilla 11-8465 Rotor Holding Tool under the nut and flat washer as shown in Figure 8A-11. Tighten the nut securely.

2. Remove the timing inspection plug from the top of the magneto. Turn rotating magnet to proper neutral position. This position is determined by locating keyways on drive end of magnet shaft at 12 o'clock with respect to name

plate on housing. Tighten adjusting knob of 11-8465 Rotor Holding Tool until pressure is applied on housing flange preventing magnet from turning.

3. Loosen and rotate cam until cam follower of main contact assembly rests on highest point of cam lobe. Adjust main contact assembly securing screws to 20 to 25 inch-pounds.

4. Install the 11-8693 Timing Plate Assembly and the 11-8149 Pointer Assembly of the 11-8150 Scintilla Timing Kit to breaker compartment of magneto. (Refer to Figure 8A-12.) Align pointer assembly with the 0 degree mark on timing plate. Loosen adjusting knob of 11-8465 Rotor Holding Tool and turn rotating magnet in normal direction of rotation until pointer indexes with the respective "E" gap mark ($15^{o} \pm 2^{o}$). Tighten adjusting knob of 11-8465 Tool and remove the 11-8149 Pointer Assembly from magneto. Using a timing light, adjust main contact points to just open. This adjustment shall be made by rotating cam, in opposite direction of rotation, a few degrees beyond point where contacts close. Then rotate cam in normal direction of rotation until contacts just open. While holding cam in this exact position, push cam on magnet shaft as far as possible with the fingers. Extreme care must be exercised in this operation. If cam adjustment is changed in the slightest degree, the timing of the magneto will be thrown off. Do not drive cam on shaft with a mallet or other instrument. Tighten the securing screw thereby drawing the cam down, evenly and tightly. Torque screw to 16-20 inch-pounds. Loosen the 11-8465 Rotor Holding Tool adjusting knob and return rotating magnet to neutral position. Reinstall the 11-8149 Pointer Assembly over 0 degree mark on timing plate. Rotate magnet shaft in normal direction of rotation and check for opening of main contact points at "E" gap setting ($15^{o} \pm 2^{o}$).

c. The retard contact assembly of the dual-breaker magnetos may be timed as follows:

1. The retard contact assembly is adjusted to open a predetermined number of degrees after the main contact assembly opens. The degree of retard for any particular magneto is stamped in the bottom of the breaker compartment.

2. Locate the exact point of main contact assembly opening and set the 11-8149 Pointer Assembly over the 0 degree mark on the 11-8693 Timing Plate Assembly. Turn rotating magnet in the direction of normal rotation until pointer indexes with the degree of retard. Tighten adjusting knob of 11-8465 Holding Tool and set retard contact assembly to just open with +2 or -0 degrees. Tighten securing screws to 20-26 inch-pounds. Loosen adjusting knob of holding tool and turn rotating magnet until cam follower is on high point of cam lobe. Contact clearance shall be 0.016 ± 0.006 inch. If dimension is not within limits, readjust contact assembly and recheck to be sure that points will open within retard degree tolerance. Remove the 11-8150-1 Timing Kit and two studs from the magneto.

d. If the distributor block was not removed from the housing, the internal timing may be checked by turning the magneto in the normal rotation to number one firing position (keyway up and main points just opening). At this position, the reference line on the distributor block should line up between the L and LB marks on the gear. On single contact magnetos the line should favor the L mark and on the fuel contact magnetos the line should favor the LB mark, if possible.

e. If the distributor block was removed from the housing, the distributor gear alignment and internal check may be accomplished as follows:

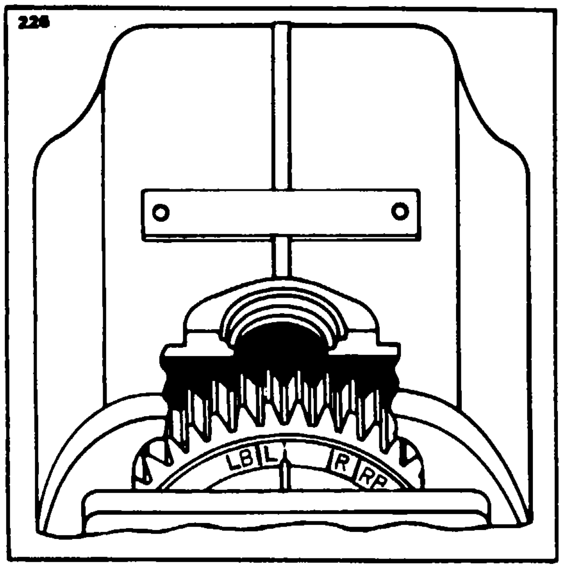

Figure 8A-13. Aligning Timing Marks

1. Turn rotating magnet in direction of rotation until it is located in firing position (keyway up and main points just opening). Tighten adjusting knob of 11-8465 Rotor Holding Tool. Apply a light coating of Bendix Grease P/N 10-27165 to teeth of distributor gear, if needed. The large distributor gear incorporates four timing marks, L and LB for left hand rotation and R and RB for right hand rotation.

2. With distributor gear assembled to block, turn gear until raised rib on block lines up between the L and LB marks. Assemble block and gear into housing, meshing the distributor gears together. For the dual contact assembly magneto, distributor block rib must align between painted marks. However, the rib should favor the LB mark, if possible. (Refer to Figure 8A-13.) On the single contact magneto the rib should favor the L mark.

3. Secure distributor block to housing with studs and washers. Tighten studs finger tight. Loosen the 11-8465 Rotor Holding Tool and turn rotating magnet in reverse direction of rotation until timing light indicates main contact assembly has just opened and check to make certain timing marks align within tolerance indicated above. Tighten block securing studs, first to 4-8 inch-pounds torque and then final torque to 20 inch-pounds.

4. Insert the tip of your small finger through timing hole in housing and against large distributor gear teeth. Rock distributor gear back and forth slightly. There must be perceptible backlash between teeth of large and small gears. This check should be made at three different points, 120 degrees apart on gear. If backlash is not evident, replace large distributor gear.

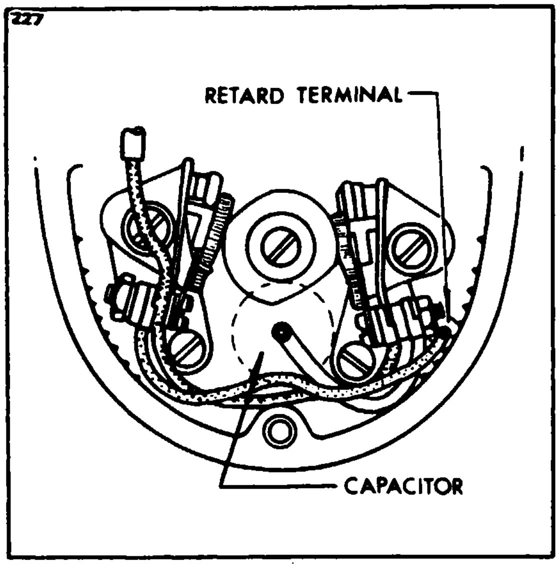

Figure 8A-14. Forming Leads in Breaker Compartment

5. Install the breaker cover and complete reassembly of the magneto. Refer to the manufacturer's publications for complete disassembly and reassembly procedures.

f. Install and time magneto, removed from engine, in accordance with paragraph 8A-47.

g. Secure external switch and retard leads to the breaker cover terminals. Connect harness assembly to the magneto.

8A-47. INSTALLATION AND TIMING PROCEDURE. (Timing Magneto to Engine.)

a. Remove a spark plug from No. 1 cylinder and turn crankshaft in direction of normal rotation until the compression stroke is reached.

b. Continue turning the crankshaft until the advance timing mark is in alignment with the small hole located on the top face of the starter housing at the two o'clock position. (Refer to Figure 8A-15.)

c. Remove the inspection plug on the left magneto and turn the drive coupling in direction of normal rotation until the first painted chamfered tooth is aligned in the center of the inspection hole. (Refer to Figure 8A-16.) Without allowing the gear to turn from this position, assemble gasket and magneto to the engine. Secure in place with washers and nuts; tighten only finger tight.

d. Fasten ground wire of electric timing light to any unpainted portion of the engine, and one of the positive wires of the timing light to a suitable terminal connected to the ground terminal of the magneto. Then turn the engine crankshaft several degrees from the advance timing mark in direction opposite to that of normal rotation.

e. Turn on the switch of the timing light, which should be lit. Turn the crankshaft slowly in direction of normal rotation until the mark on the starter gear aligns with the hole in the starter housing, at which point the light should go out. If not, turn the magneto in its mounting flange and repeat the procedure until the light goes out. Repeat the same procedures with the right magneto.

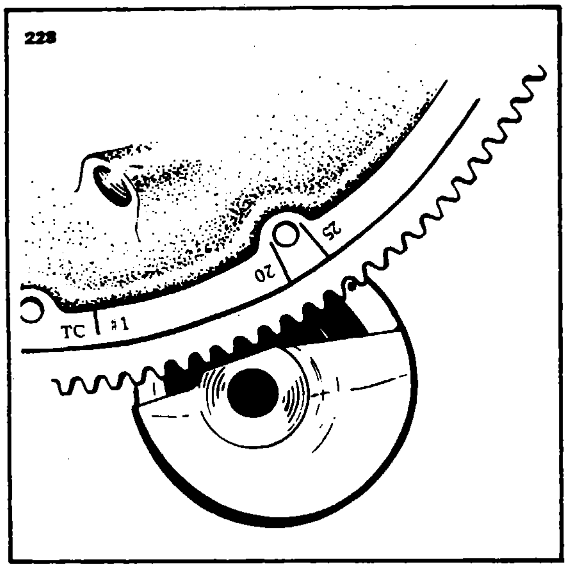

Figure 8A-15. Engine Timing Marks

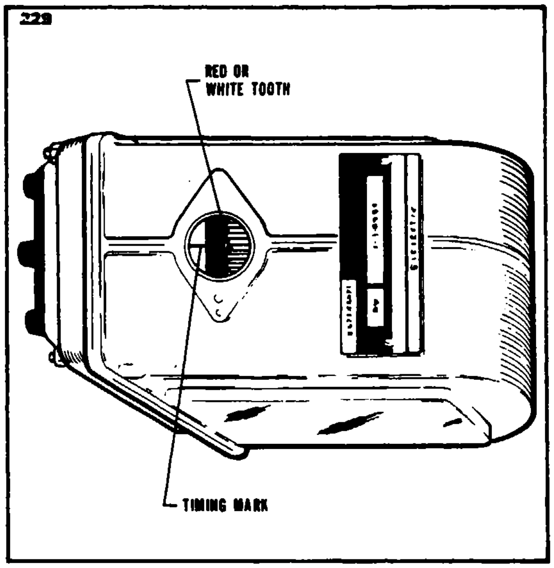

Figure 8A-16. Magneto Timing Marks

NOTE

Battery powered timing lights operate in the reverse manner from that described above; the light goes on when the marks align.

f. After both magnetos have been timed, leave the timing light wires connected and recheck magnetos as previously described to make sure that both magnetos are set to fire together. If timing is correct, both timing lights will go out simultaneously when the timing marks are in alignment. Tighten nuts to specified torque.

g. After magnetos have been properly timed, replace breaker cover and secure.

h. Install the ground lead and the retard spark lead on the left magneto.

i. Place the harness terminal plate on the magneto and tighten nut around the plate alternately to seat cover squarely on magneto. Torque nuts to 18 to 22 inch pounds.

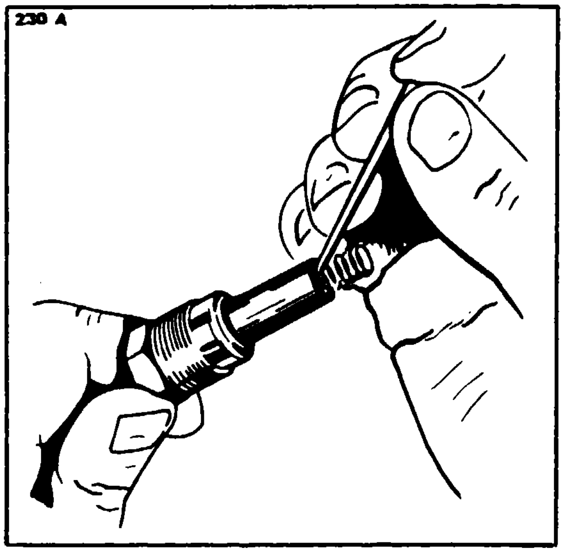

Figure 8A-17. Removal of Spring From Lead Assembly

8A-48. HARNESS ASSEMBLY.

8A-49. INSPECTION OF HARNESS.

a. Check lead assemblies for nicks, cuts, mutilated braiding, badly worn section or any other evidence of physical damage. Inspect spark plug sleeves for chafing or tears and damaged or stripped threads on coupling nuts. Check compression spring to see if it is broken or distorted. Inspect grommet for tears. Check all mounting brackets and clamps to see that they are secure and not cracked.

b. Using an ohmmeter, buzzer, or other suitable low voltage device, check each lead for continuity. If continuity does not exist, wire is broken and must be replaced.

c. For electrical test of harness assembly, use a high voltage, direct current tester such as the TAKK Model 86 or 86A or an equivalent direct current high voltage tester capable of delivering a test potential of 10,000 volts. Connect ground lead of high voltage tester to outer shielding braid of a single lead. Connect plug terminal. Turn tester "ON" and apply 10,000 volts. The insulation resistance should be 100 megohms minimum. Proceed to check other leads of harness in same manner.

d. Minor repair of the harness assembly, such as replacement of contact springs, spring retainer assemblies, insulating sleeves or of one lead assembly, can be accomplished with the harness assembly mounted on the engine. However, should repair require replacement of more than one lead assembly or of a cable outlet plate, the harness should be removed from the engine and sent to an overhaul shop.

8A-50. REMOVAL OF HARNESS.

a. Disconnect the clamps that secure the wires to the engine and accessories.

b. Loosen the coupling nuts at the spark plugs and remove the insulators from the spark plug barrel well. Use caution when withdrawing the insulator not to damage the insulator spring.

c. Place a guard over the harness insulators.

d. Remove the harness assembly terminal plate from the magneto.

e. Remove the harness from the airplane.

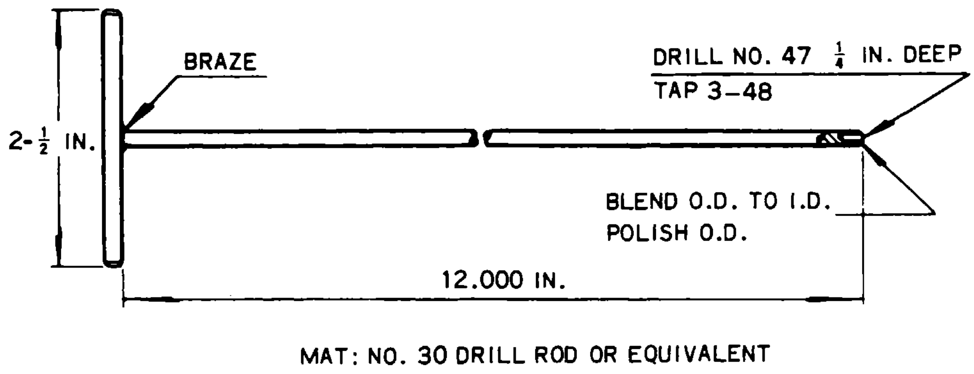

Figure 8A-18. Assembly Tool

8A-51. MAINTENANCE OF HARNESS.

a. To replace contact springs, spring retainer assemblies or insulating sleeves, proceed as follows:

1. Using a Scintilla 11-7073 Needle or a mechanical pencil with the lead retracted, hook the end of the contact spring as shown in Figure 8A-17.
2. Using a needle or pencil, unscrew the spring.
3. Slide insulating sleeve and spring retainer assembly off end of lead assembly.
4. Replace defective component and reassemble as follows:

(a) Fabricate a tool as shown in Figure 8A-18 for installing the insulating sleeves over cable terminals.

(b) Push the tool thru insulating sleeve and spring retainer assembly as shown in Figure 8A-19. Screw the cable terminal into the tool.

(c) Work insulating sleeve and spring retainer assembly into position over the cable and unscrew the tool. Install contact spring on cable terminal.

NOTE

It may be necessary to lubricate the cable and insulating sleeve with a thin film of MC 200 (200,000 centistokes) or commercial grade alcohol to facilitate assembly.

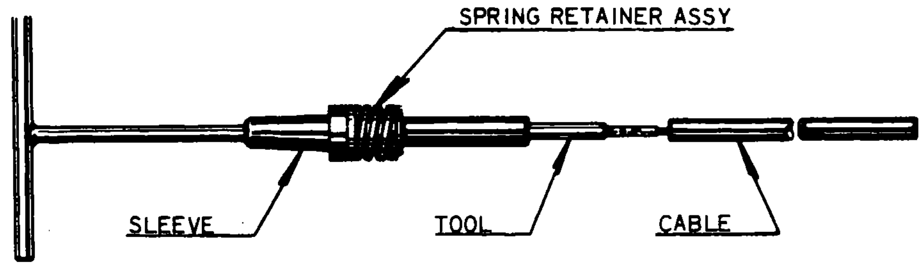

Figure 8A-19. Using Assembling Tool

b. To replace one of the lead assemblies, proceed as follows:

1. Remove clamps and brackets from applicable lead assembly. Cut cable ties from assembly and discard.

2. Cut off condemned lead flush with outer surface of cable outlet plate.

3. Grip eyelet of lead with a pair of pliers and pull short length of conductor out of grommet and cable outlet plate.

4. Using a 3 inch long, 0.270 inch diameter drift, applied at outer surfaces of plate, drive out tapered ferrule and remaining pieces of insulation and shielding.

5. To determine what length the new lead assembly should be cut to, proceed as follows:

(a) Measure the length of the condemned lead assembly. Move coupling nut back on lead assembly and measure from outer end of ferrule at spark plug end. (Refer to Figure 8A-20.)

(b) To the length determined in step a, add 1-3/4 inches.

NOTE

Spare part leads are supplied in various lengths. Use a lead which is longer than, but nearest to the desired length.

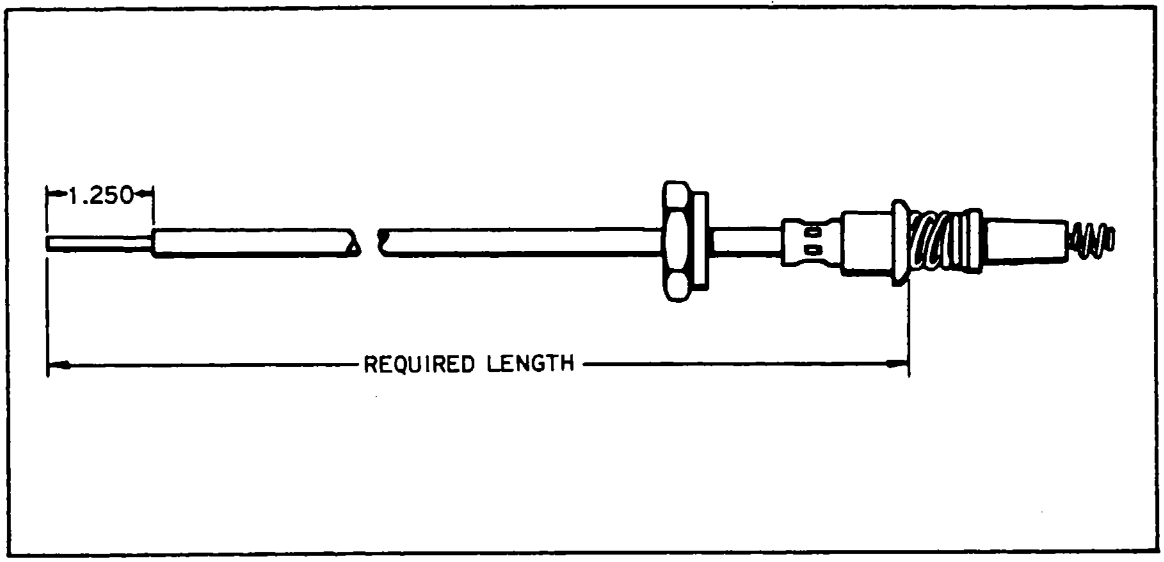

Figure 8A-20. Measuring Lead Assembly Length

6. Cut lead assembly to the length determined in step 5. Mark ferrule on spark plug end of lead with a metal stamp, scribe or rubber stamp to correspond with correct cylinder number.

7. Starting at spark plug location, thread new cable thru grommets and clamps as necessary for correct routing of cut end of cable to magneto location.

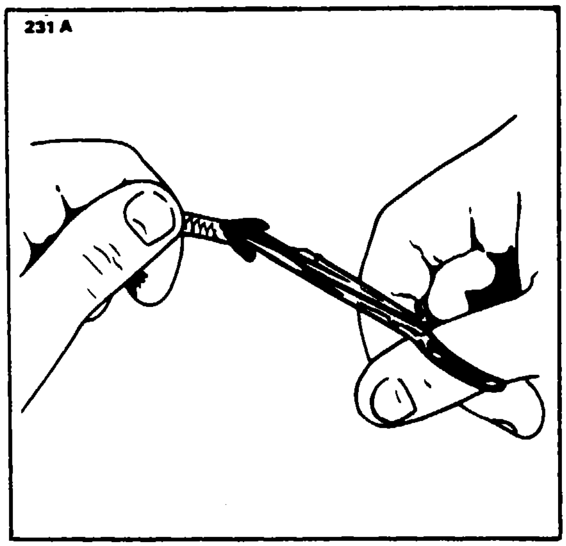

Figure 8A-21. Cutting Metallic Braid From End of Lead

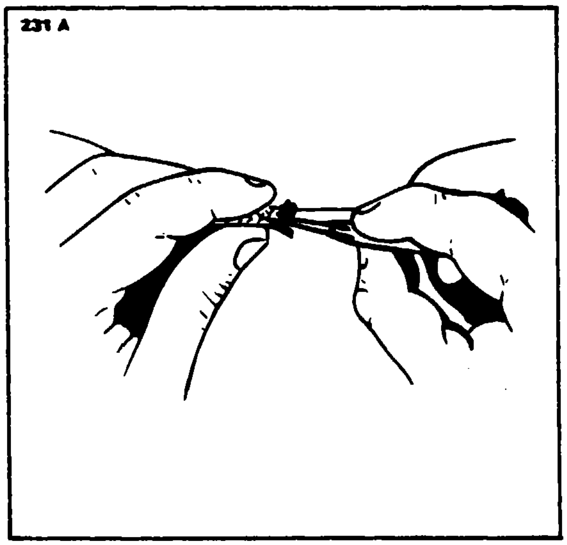

Figure 8A-22. Unbraiding Metallic Shielding

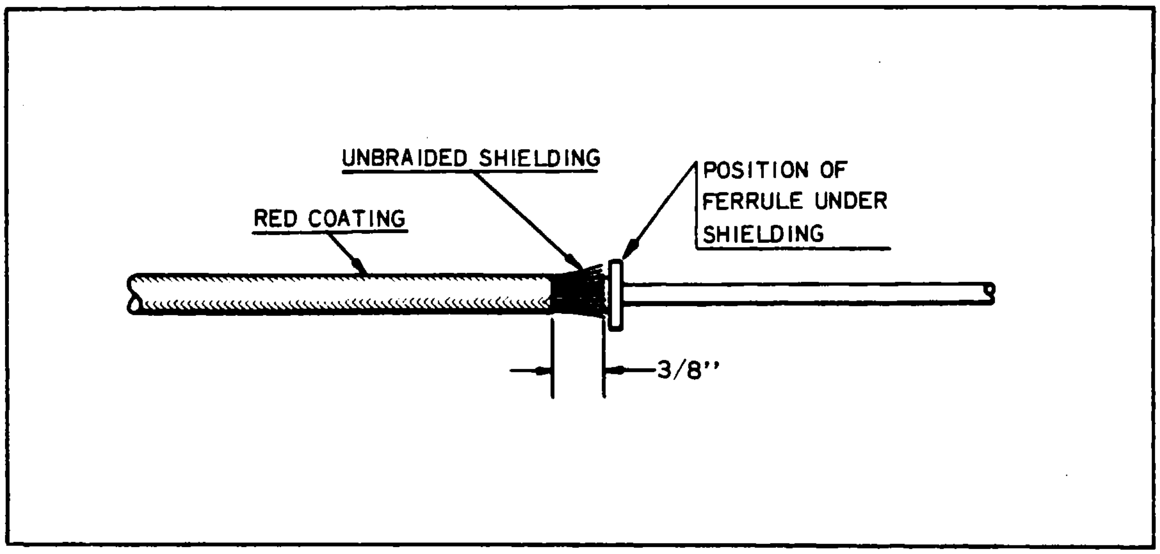

Figure 8A-23. Forming Shielding Around Ferrule

CAUTION

Use care not to nick or cut insulation when removing braid.

8. Using electrician's scissors, carefully remove 1.250 inch of outer braid from end of lead. (Refer to Figure 8A-21.)

9. Using a scribe or similar pointed tool, unbraid 3/8 inch of braided shielding. (Refer to Figure 8A-22.) Wrap a single thickness of electrical tape around unbraided strands to facilitate insertion of lead end thru hole in cable outlet plate.

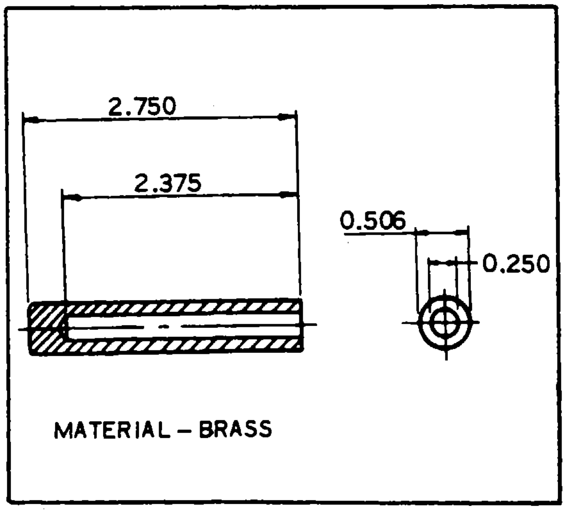

Figure 8A-24. Ferrule Seating Tool

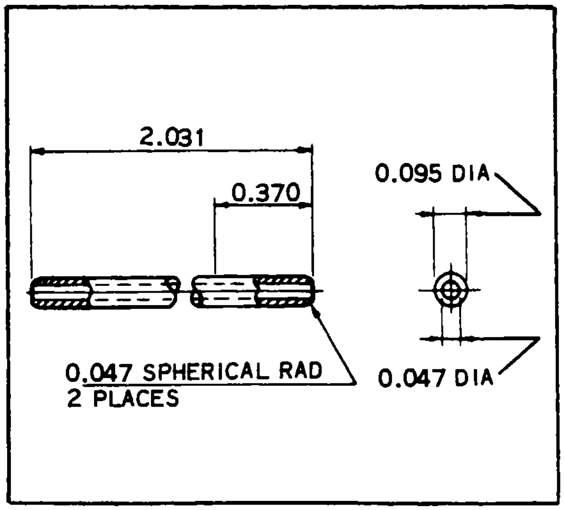

Figure 8A-25. Needle

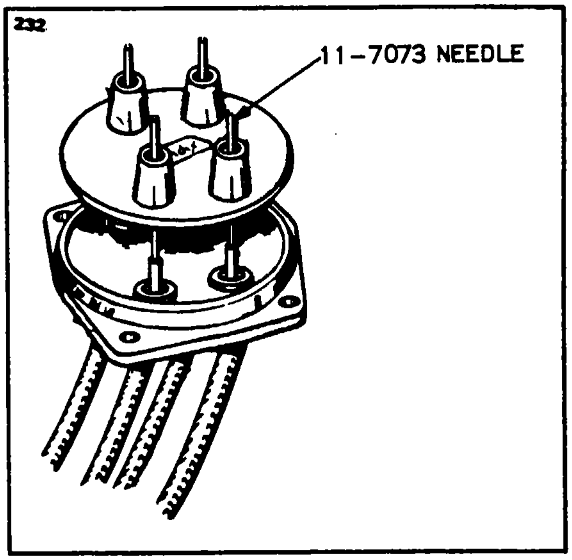

Figure 8A-26. Measuring Wire

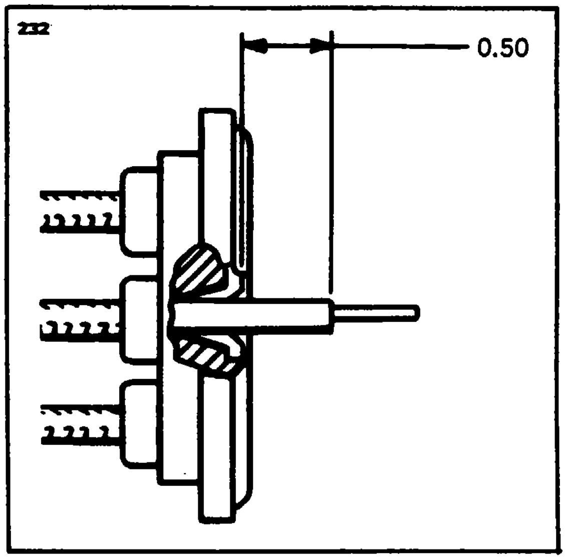

Figure 8A-27. Installing Grommet Over Lead Assemblies

10. Remove cable outlet plate from magneto. Support plate securely and, using suitable cutting pliers, split and remove eyelets from leads adjacent to lead being replaced. When splitting eyelet, make certain that wire strands are not cut. Removal of eyelets on adjacent leads will allow grommet to be pulled away from outlet plate to facilitate insertion of new lead.

11. Pass the taped end of new lead through hole in outlet plate. Remove electrical tape from lead and install tpaered end of ferrule under the unbraided strands of shielding. Form strands of shielding evenly around tapered ferrule as shown in Figure 8A-23 and pull lead assembly back through cable outlet plate until ferrule binds in the outlet well. Position the Scintilla 11-7074 Ferrule Seating Tool (Refer to Figure 8A-24) over the wire and firmly seat the ferrule by tapping the seating tool with a hammer or by using an arbor press.

12. Measure 1/2 inch from tapered ferrule and strip remaining insulation from wire. (Refer to Figure 8A-26.)

13. Insert Scintilla 11-7073 Needle (Figure 8A-25) thru small hole of grommet and over stripped end of wire. (Refer to Figure 8A-27.) Slide grommet down needle until it seats tightly against the tapered ferrule.

14. Cut wire 3/8 inch from top of grommet outlet. (Refer to Figure 8A-27.) Double wire over as shown in A of Figure 8A-29. Slide eyelet over doubled wire until it is firmly seated in recess of grommet outlet.

15. Using the "AB" groove of Scintilla 11-4152 Crimping Tool, or equivalent, crimp eyelet to wire. Approximately 1/32 of an inch of wire should extend from end of eyelet after crimping. (Refer to B of Figure 8A-29.)

NOTE

If the crimping tool is not available, a satisfactory connection can be made by soldering with Kester Flux 709 or equivalent and a non-corrosive solder. After soldering, clean solder joints using denatured alcohol.

16. Install clamps and cable ties as necessary to secure lead to the engine.

8A-52. INSTALLATION OF HARNESS. Before installing harness on magneto, check mating surfaces for cleanliness. Spray entire face of grommet with a light coat of Plastic Mold Spray, SM-O-O-TH Silicone Spray or equivalent. This will prevent harness grommet from sticking to magneto distributor block.

a. Place the harness terminal plate on the magneto and tighten nuts around the plate alternately to seat cover squarely on magneto. Torque nuts to 18 to 22 inch pounds.

b. Route ignition wires to their respective cylinders as shown in Figure 8A-30.

c. Clamp the harness assembly in position.

d. Connect the leads to the spark plugs.

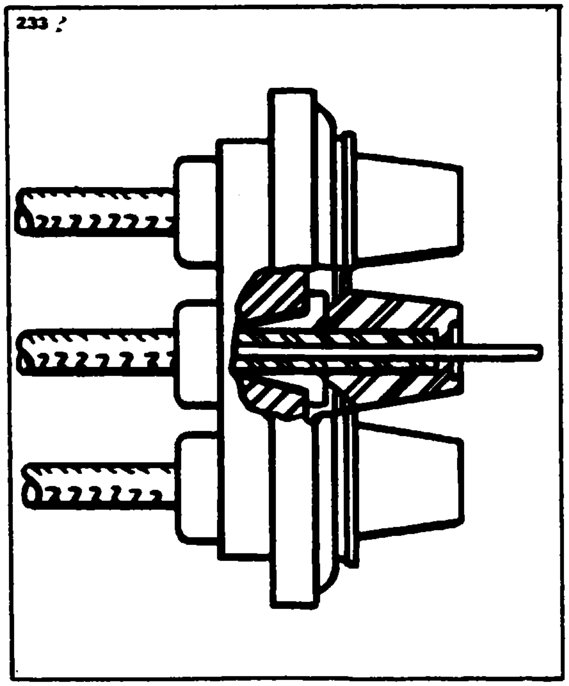

Figure 8A-28. Lead Assembly Installed in Grommet

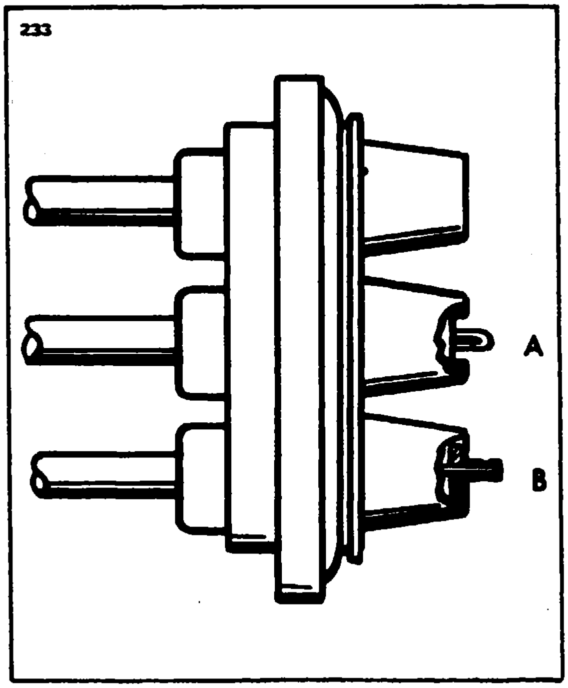

Figure 8A-29. Wire Doubled Over For Installation of Eyelet

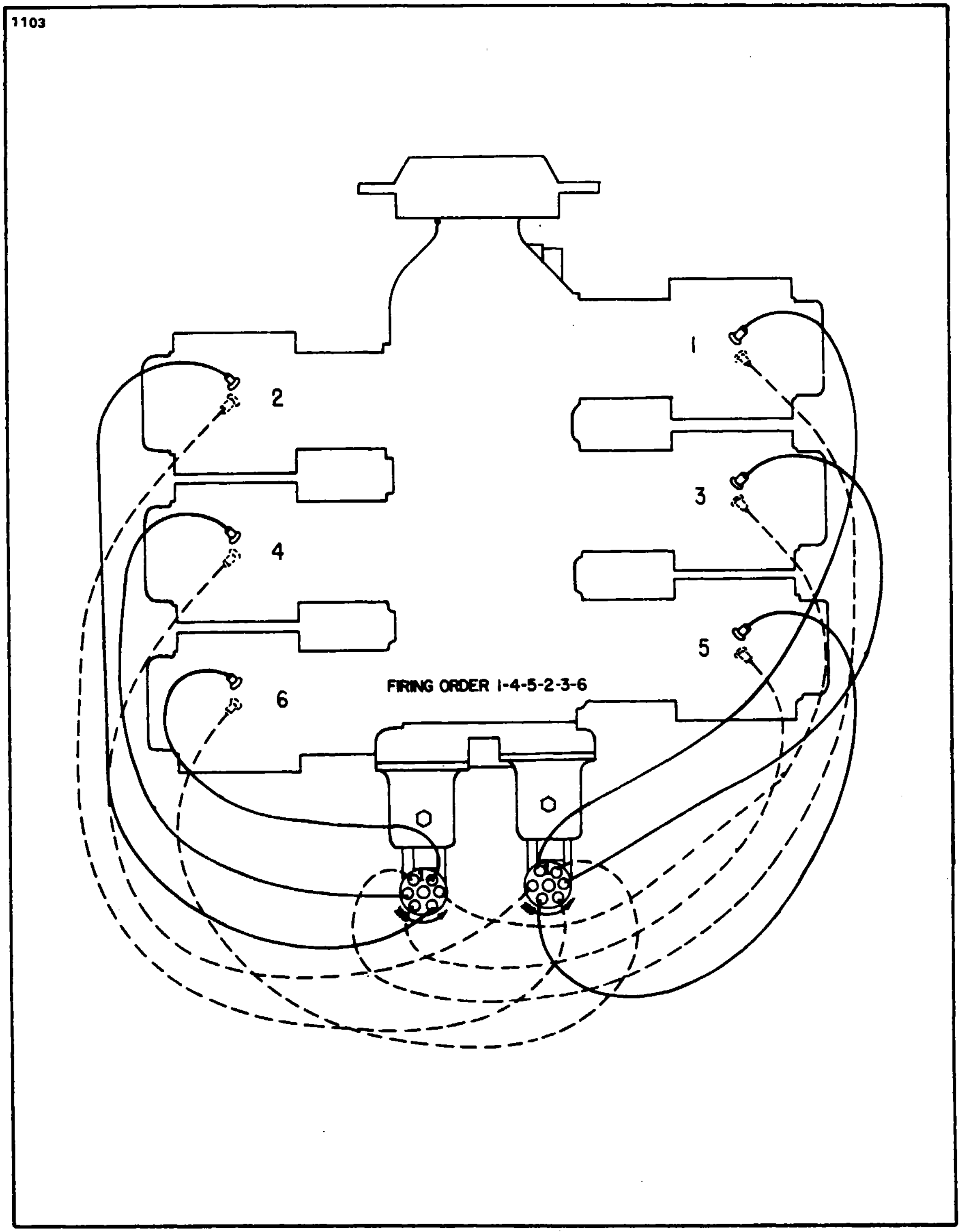

Figure 8A-30. Ignition System Schematic

8A-53. SPARK PLUGS.

8A-54. REMOVAL OF SPARK PLUGS.

a. Loosen the coupling nut on the harness lead and remove the terminal insulator from the spark plug barrel well.

NOTE

When withdrawing the ignition cable lead connection from the plug, care must be taken to pull the lead straight out and in line with the center line of the plug barrel; otherwise, a side load will be applied which frequently results in damage to the barrel insulator and connector. If the lead cannot be removed easily in this manner, the resisting contact between the neoprene collar and the barrel insulator will be broken by a rotary twisting of the collar. Avoid undue distortion of the collar and possible side loading of the barrel insulator.

b. Remove the spark plug from the engine. In the course of engine operation, carbon and other combustion products will be deposited on the end of the spark plug and will penetrate the lower threads to some degree. As a result, greater torque is frequently required for removing a plug than for its installation. Accordingly, the torque limitations given do not apply to plug removal and sufficient torque must be used to unscrew the plug. The higher torque in removal is not as detrimental as in installation since it cannot stretch the threaded section. It does, however, impose a shearing load on this section and may, if sufficiently severe, produce a failure in this location.

NOTE

Torque indicating handle should not be used for spark plug removal because of the greater torque requirement.

c. Place spark plugs in a tray that will identify their position in the engine as soon as they are removed.

NOTE

Spark plugs should not be installed if they have been dropped.

d. Removal of seized spark plugs in the cylinder may be accomplished by application of liquid carbon dioxide by a Conical metal funnel adapter with a hole at the apex just large enough to accommodate the funnel of a CO_2 bottle. (Refer to Figure 8A-31.) When a seized spark plug cannot be removed by normal means, the funnel adapter is placed over and around the spark plug. Place the funnel of the CO_2 bottle inside the funnel adapter and release the carbon dioxide to chill and contract the spark plug. Break the spark plug loose with a wrench. A warm cylinder head at the time the carbon dioxide is applied will aid in removal of an excessively seized plug.

e. Do not allow foreign objects to enter the spark plug hole.

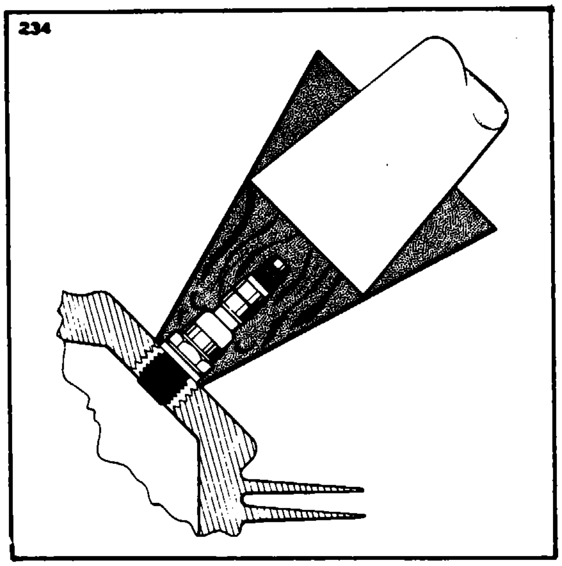

Figure 8A-31. Removing Spark Plug Frozen to Bushing

8A-55. INSPECTION AND CLEANING OF SPARK PLUG.

a. Visually inspect each spark plug for the following non-repairable defects:

1. Severely damaged shell or shield threads nicked up, stripped or cross-threaded.
2. Badly battered or rounded shell hexagons.
3. Out-of-round or damaged shielding barrel.
4. Chipped, cracked or broken ceramic insulator portions.
5. Badly eroded electrodes worn to approximately 50% of original size.

b. Clean the spark plug as required, removing carbon and foreign deposits.

c. Test the spark plug both electrically and for resistance.

d. Set the electrode gap. (Refer to latest revision of Lycoming Service Instructions No. 1042.)

8A-56. INSTALLATION OF SPARK PLUGS. Before installing spark plugs, ascertain that the threads within the cylinder are clean and not damaged.

CAUTION

Make certain the deep socket is properly seated on the spark plug hexagon as damage to the plug could result if the wrench is cocked to one side when pressure is applied.

a. Apply anti-seize compound sparingly on the upper threads. Do not apply anti-seize compound on bottom two threads to prevent plug failure. Install gasket and spark plugs. Torque 360 to 420 inch pounds.

b. Insure terminal insulator is free of carbon and dirt and carefully insert in the spark plug and tighten the coupling nut.

8A-57. STARTING VIBRATOR. (14 and 28-Volt System)

8A-58. STARTING VIBRATOR CHECKING PROCEDURE.

a. Disconnect all spark plug heads from the left magneto at the spark plugs.

WARNING

Be sure all left magneto spark plug leads are removed, thus preventing cross-firing of the magneto and the possibility of hazardous conditions.

b. Rotate engine crankshaft until number one cylinder is in its retard firing position. Using the timing light, check to see that both magneto contact assemblies are open.

c. Disconnect left starter solenoid terminal wire, coded in electrical schematics P20A.

WARNING

It is necessary that the starter be electrically removed from the circuit before the vibrator is put into operation to eliminate possibility of starter being energized during the test.

d. Place left magneto switch in its "ON" position.
e. Hold left starter switch in the energized position.
f. Holding the number one cylinder spark plug lead approximately 3/16 to 1/4 of an inch away from a good ground, a series of hot sparks should occur.

WARNING

Grasp the spark plug lead far enough away from the connection so as not to produce any dangerous electrical shock.

g. If the spark does not jump the gap, check the applied voltage to the starting vibrator. This voltage should be 14 or 28-volts depending on the electrical system installed in the airplane.
h. If voltage is correct, check the contact points of the magneto. Both sets of contact points shall be opened.
i. Reject all units not complying with the preceding requirements or which show any visual defects.

8A-59. REMOVAL OF STARTING VIBRATOR.
a. Remove the left access panel to the nose section interior at station 70.0.
b. The starter vibrator is attached to the extreme left front side of the forward fuselage bulkhead at station 81.0.

NOTE

Make note of positions of the wires before disconnecting electrical leads to facilitate reinstallation.

c. Disconnect the electrical leads from the vibrator.
d. Remove the vibrator from the bulkhead by removing the attachment screws.

8A-60. INSTALLATION OF STARTING VIBRATOR.
a. Position the vibrator on the bulkhead and secure with screws.
b. Connect the electrical leads to the vibrator.

NOTE

On 28-volt electrical system only, make sure that the lead with the red marker has been put on the "IN" terminal of the starting vibrator.

c. Check operation per Paragraph 8A-58.
d. Install access panel.

8A-61. LUBRICATION SYSTEM.

8A-62. ADJUSTMENT OF OIL PRESSURE RELIEF VALVE. The adjustable oil relief valve enables the operator to maintain engine oil pressure within the specified limits (60 psi, min. to 90 psi, max.) If the pressure under normal operating conditions should consistently exceed the maximum or minimum specified limits, adjust the valve as follows:

With the engine warmed up and running approximately 2000 RPM, observe the reading on the oil pressure gauge. If the pressure is above maximum or below minimum specified limits, stop engine and screw the adjusting screw out to decrease pressure and in to increase pressure. Depending on installation, the adjusting screw may have only a screwdriver slot and is turned with a screwdriver, or may have the screwdriver slot plus a pinned 0.375-24 castellated nut and may be turned with either a screwdriver or a box wrench.

8A-63. INSTALLATION OF OIL COOLER.

a. When installing fittings in the oil coolers, care should be used to prevent torque being applied to the cooler. When a rectangular fitting boss is provided, backup wrench should be used, employing a scissor motion, so that no load is transmitted to the cooler. When the oil cooler has a round fitting boss, care should be taken not to permit excessive torque on the fittings.

b. If a pipe thread fitting is used, it should be installed only far enough to seal with sealing compound.

c. Apply Lubon No. 404 to all male pipe thread fittings; do not allow sealant to enter the system.

d. If fitting canot be positioned correctly using a torque of 10 to 15 foot-pounds, another fitting should be used.

e. When attaching lines to the cooler, a backup wrench should be used.

f. After installation, inspect the cooler for distorted end cups.

g. Run-up engine. After run-up, check for oil leaks.

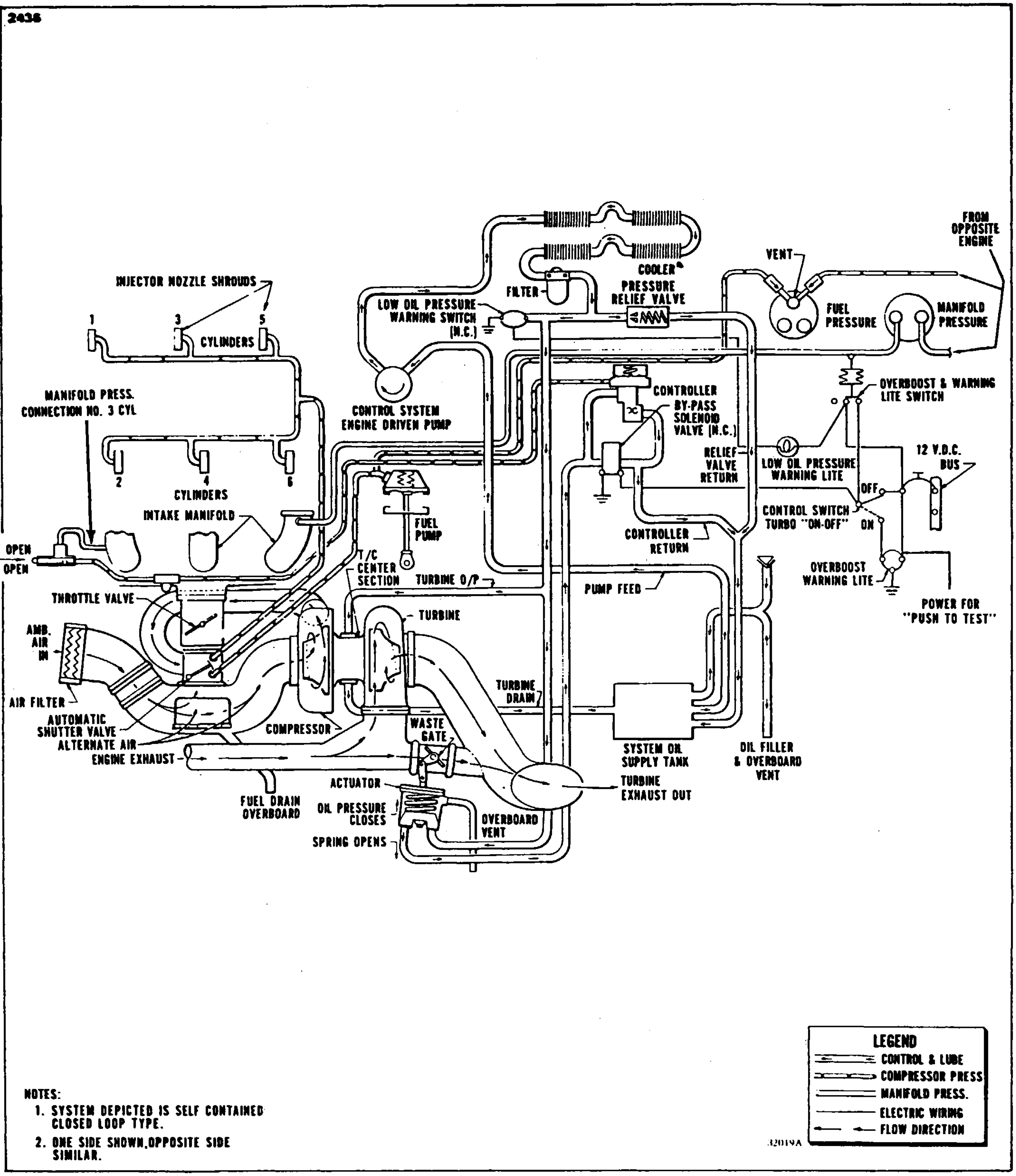

Figure 8A-32. Turbocharger System Diagram

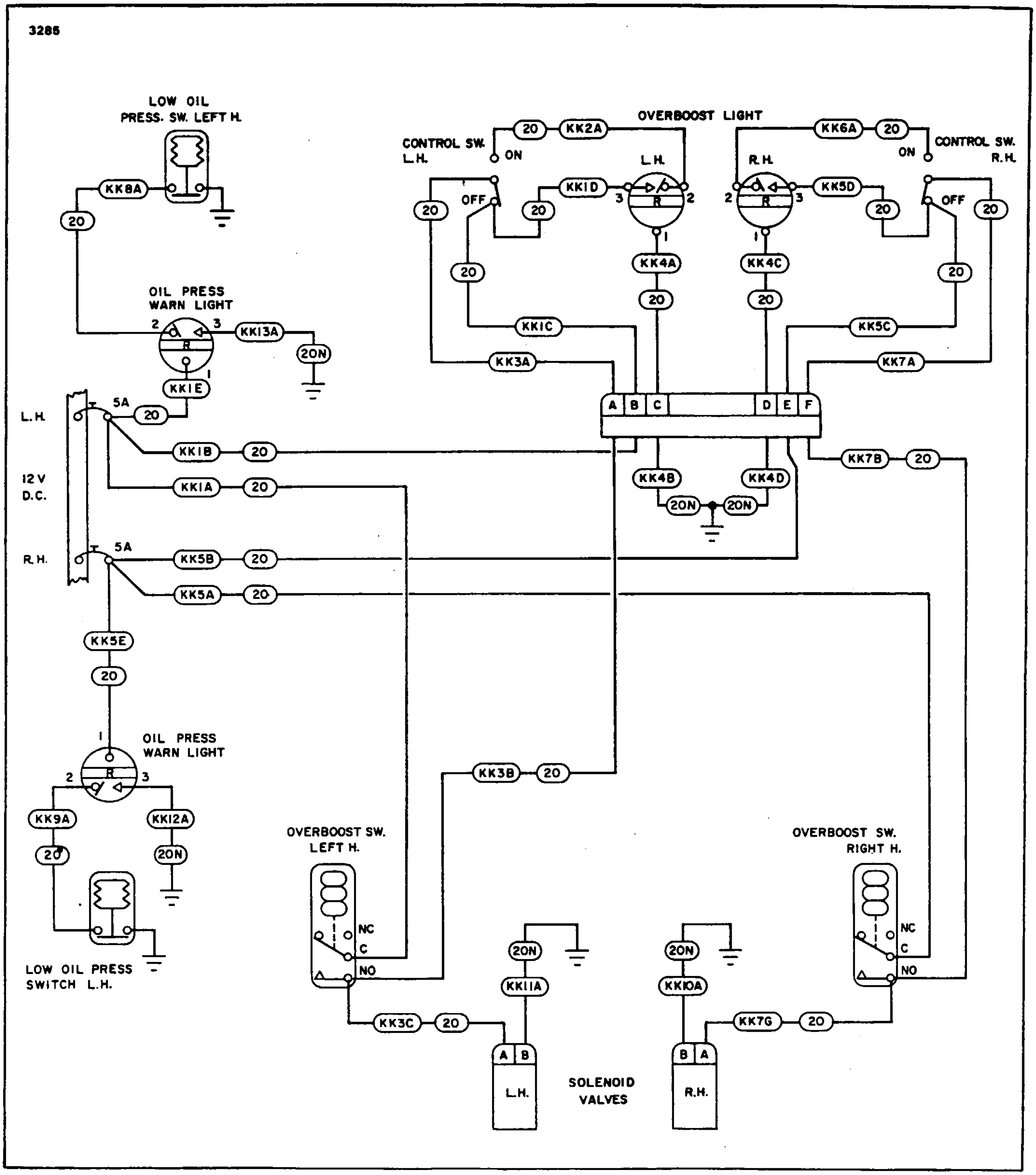

Figure 8A-33. Turbocharger Control Circuit Diagram
S/N 27-2505 to 27-3836 incl., 27-3838 to 27-3943 incl.

8A-64. TURBOCHARGER. (AiResearch). The following paragraphs contain instructions for the removal, installation, service maintenance and adjustment procedures for turbocharger units manufactured by AiResearch Aviation Service Company, 6201 W. Imperial Highway, Los Angeles, California, 90045 and installed in PA-23-250 (six place) airplanes, Serial Numbers 27-2505 to 27-3836 inclusive, and 27-3838 to 27-3943 inclusive.

The turbocharger part number, serial number, model number and other pertinent information appears on the name plate attached to the unit components. Include this information in all correspondence.

Inspection procedures may be found in Section III.

8A-65. SPECIFICATIONS. Listed below are some of the specifications and the location of various turbocharger components.

Type of Control . . . . Naturally aspirated or turbocharged performance available as selected with ON-OFF switch.	Automatic
Control Medium	External Closed Loop Oil System
On-Off Control	Electrical (Solenoid)
Control Oil Pressure Source	External Engine Driven Oil Pump
System Regulated Oil Pressure	60 psi
External Oil System Capacity	2.6 quarts
External Oil Reservoir Sight Gauge. . . On aft side of lower scoop fairing easily viewed from either side of engine.	Located in Wheel Well
External Oil System Filler Tube . . . . Remove combination cover and vent tube to fill.	Standpipe in LH side of each Engine Accessory Compartment
Oil Specifications	Automotive Multigrade SAE 10W 30

8A-66. NOMENCLATURE. Many new and unfamiliar terms may appear on the following pages of this manual. An understanding of them will be helpful, if not necessary, in performing maintenance and troubleshooting. The following is a list of commonly used terms and names as applied to turbocharging.

TERM	MEANING
Turbine	The exhaust driven end of the turbocharger unit.
Turbine Wheel	The bucket wheel in the turbine section.
Turbine Housing	The heaving ductal iron casting housing the turbine wheel.
Turbine Inlet	The opening in the turbine housing where exhaust gases are induced.
Turbine Discharge	The opening in the turbine housing where exhaust gases are discharged and where the turbine wheel is visible.
Compressor	The air delivery end of the turbocharger unit.
Compressor Wheel	The impeller wheel in the compressor section.
Compressor Housing or Compressor Scroll	The aluminum casting housing the compressor wheel.
Compressor Inlet	The large opening in compressor housing where ambient air pressures are supplied.
Compressor Discharge	The smaller opening in compressor housing where compressed air is delivered to engine induction system.
Turbocharger Center Housing	The casting joining the turbine and compressor sections, containing shaft bearings, seals, oil inlet and outlet ports and oil passages.
T/C	Convenient abbreviation for "Turbocharging".

TERM	MEANING
Compressor Discharge Pressure	The pressure at any point in ducting between the compressor discharge and the throttle valve.
Upstream	Ducting carrying ambient air pressures from ram air filter to compressor inlet.
Downstream	Ducting from compressor discharge to throttle valve, subject to compressor discharge pressures.
Inlet Plenum	Formerly the "air box". This is now an airtight, critically designed part of the induction system, containing the by-pass door, pressure reference ports and is subject to compressor discharge pressures.
Exhaust Plenum or Turbine Inlet Plenum	The area in the exhaust system where the total combined exhaust gases enter the turbine housing.
Pressure Reference Line	Tubing or hose to transmit compressor discharge pressure from the plenum to the controller, to the fuel flow gauges, the fuel pump diaphragm and the injector nozzles.
Exhaust By-Pass Valve or Wastegate	The butterfly type valve in the exhaust by-pass which, throughout its travel from open to closed, allows varied amounts of exhaust pressure to by-pass the turbine, controlling its speed hence the output of the compressor.
By-Pass Door	The hinged door in the inlet plenum. It allows induction air to by-pass the compressor whenever discharge pressure is less than ambient pressure, and closes against a seal under discharge pressure when it overcomes ambient pressure.

TERM	MEANING
Transfer Valve	The small plunger valve mounted on the injector and operated by the full open position of the throttle valve arm. Its purpose is to evacuate the controller sensing chamber further than the controller setting at the full throttle position only.
Naturally Aspirated	The turbocharger OFF condition. The wastegate (by-pass) valve is open, the turbocharger is unloaded and the induction system is receiving existing ambient pressures through the by-pass door.
Part Throttle Critical Altitude	The maximum altitude that a given sea level power setting can be maintained without advancing the throttle.

8A-67. REMOVAL AND INSTALLATION OF TURBOCHARGER. Should it be necessary to replace the turbocharger unit, the following procedure has proven to be the fastest and most thorough method. Listed are some do's and don'ts.

a. Do not attempt to remove or install the turbocharger with the turbine inlet plenum attached.

b. Do not separate the lower air inlet plenum from the air box at the by-pass door seal. Always remove this as an assembly at the attach point to the injector. If seal replacement is necessary, do so while the assembly is removed and reassemble prior to installation.

c. Do not overtorque V band clamps on tailpipe or compressor housing. Tailpipe clamp torque is 40 to 50 inch-pounds; compressor clamp torque is 40 inch-pounds (light tapping around the clamps while tightening helps them seat properly).

d. Removing the compressor housing will give better access to the lower mount leg bolts. However, extreme caution must be used to avoid damage to the compressor wheel.

e. Always apply penetrating oil to all mount bolts and turbine plenum bolts prior to removal. Bolts seize due to carbon and rust build-up on threads. Working them back and forth usually avoids shearing them off.

8A-68. REMOVAL OF TURBOCHARGER.

a. Remove all lower engine compartment cowling.

b. Remove clamp attaching turbine discharge duct (tailpipe) to turbine; remove tailpipe.

c. Disconnect oil inlet and outlet lines on wastegate actuator valve (CAP lines).

d. Remove aft clamp on bellows between exhaust header and turbine inlet plenum.

e. Remove four bolts attaching turbine inlet plenum to turbine flange.

f. Disconnect turbocharger oil inlet hose from oil inlet tube assembly.

g. Remove turbocharger oil drain hose between drain assembly and reservoir.

h. Remove ram air filter duct assembly at front of lower inlet plenum.

i. Disconnect alternate air control and all reference lines from air box.

j. Remove four screws attaching air box assembly to bottom of injector.

k. Loosen flex coupling between lower and upper plenum, remove lower plenum and air box as an assembly.

l. Remove upper plenum half and forward turbo mount from compressor inlet and from clip on rear injector mount studs.

m. Remove compressor housing "V" clamp and remove compressor housing.

n. Remove the lower bolt attaching the right mount leg to turbocharger. Loosen the top bolt. (This applies to either the RH or LH Turbocharger.)

o. Using a 9/16 Universal socket remove the four nuts attaching upper mount legs to engine.

p. Lower turbocharger (mounts attached) away from engine.

q. Remove mount legs, heat blanket and oil inlet and outlet tube assemblies.

8A-69. REMOVAL OF COMPRESSOR HOUSING.

a. The compressor scroll (housing) may be removed to provide better access to the bolts attaching main turbine mounts to the turbine center housing. However, extreme caution must be used to avoid damage to the compressor wheel. The shock mounted stabilizing rod must be forced up and high enough to allow the compressor housing to come straight forward until it is clear of the compressor wheel. The same caution is necessary when reinstalling the compressor housing.

CAUTION

Damage of any kind to the compressor blades is cause for rejection of the turbocharger unit.

b. The main turbine mount brackets attach to the turbine center housing with four bolts (two on each leg).

c. With reference to either engine, remove the lower right-hand bolt and loosen the upper right-hand bolt.

d. Using a standard 3/8 inch drive 12 point 9/16 inch universal socket, remove the four nuts holding the upper end of mount legs to the engine. By lowering the right-hand mount bracket from the studs first, the left-hand will slip off easily. (Notice shim washers on studs. They must be there on reinstallation.)

8A-70. INSTALLATION OF TURBOCHARGER.

a. Remove six each bolts and lock tabs holding turbine housing to center housing.

b. Orient center housing to turbine housing per old turbo.

NOTE

The oil inlet and outlet ports should be as near vertical to the center line as possible in the installed position.

c. When properly oriented, install the clamp plates and two bolts (AN76-A-5) that do not pick up the turbomount legs. Tighten to hold center housing in position.

d. Install and lace heat blanket.

e. Install inlet and outlet oil tube assemblies. Tighten and safety. Also safety the two housing bolts that do not pick up the mounts.

NOTE

With reference to either right or left-hand turbo.

f. Install left-hand mount leg with AN76-A-7 bolts. (Do not tighten.)

g. Install right-hand mount leg with top bolt only. (Do not tighten.)

CAUTION

When shimming of upper mount attach points, the casting thickness around the counterbore of the rear engine mount studs (turbo mount attach point) varies. These counterbores must be shimmed using thick and thin washers to insure that the mount bracket is not bottomed on the casting prior to being torqued down. This has been a major cause of brackets cracking in this area and is very critical. Both studs of each mount leg should be shimmed equally.

h. Raise turbocharger into place starting the left mount leg onto studs first while guiding the right mount leg into position.

i. Install four nuts and lockwashers on studs and torque down.

j. Install remaining lower RH bolt. (Do not tighten.)

k. Install compressor housing and orient to approximate position. Snug "V" band clamp (slight final adjustment may be necessary later).

l. Install upper plenum half and forward turbo mount. (Do not tighten large ring bolts or three forward bolts in slotted holes.)

m. Install turbine inlet plenum using new gasket and clamp bellows in position.

n. Install turbine discharge duct (tailpipe) torque clamp 40 to 50 inch-pounds.

o. Adjust turbocharger position.

1. The clearance of the tailpipe to the nacelle determines the final position of the turbocharger.
2. The tailpipe should be generally centered in the nacelle cutout and should clear the structure by three-quarters of an inch at the closest point.
3. Roll adjustment is provided in the lower mount leg bolt holes.
4. Pitch adjustment is provided by the slotted holes at the forward end of the front mount.
5. When determining the pitch adjustment, insure that the ring on the compressor inlet is properly positioned.

p. Tighten and safety the four lower mount leg bolts.

q. Install air box and plenum assembly to injector.

r. Position and tighten compressor housing and install compressor discharge tube.

s. Tighten round forward mount clamp on compressor inlet and connect and tighten flex coupling between lower and upper plenum.

t. Install shims required (maximum, one-eighth inch), and tighten three bolts in slotted holes on forward mount.

u. Connect turbine oil inlet and outlet oil lines, actuator oil lines, all air reference lines to air box and rig alternate air control.

v. Install ram air filter duct and cowl engine.

8A-71. REMOVAL OF TURBOCHARGER OIL PUMP. The instructions to follow apply to both oil pumps, except when removing the right pump eliminate steps f, g and h.

a. Remove inboard and outboard engine compartment access panels.

b. Disconnect pump supply line from fitting on RH side of oil pump.

c. Disconnect pump pressure line from fitting on LH side of oil pump.

d. Disconnect hose from oil pump case drain fitting.

e. Remove four nuts and washers from studs at base of hydraulic pump (cover plate on right engine).

NOTE

Do not disconnect supply or pressure lines from hydraulic pump.

f. Remove hydraulic pump aft and away from mounting studs.
g. Turn fuel tank selector and crossfeed off at fuel management console between pilot and co-pilot seats.
h. Disconnect fuel supply line at engine-driven fuel pump inlet port.
i. Move turbo oil pump aft and off of four long mounting studs.
j. Remove three fittings (inlet, outlet, and case drain) from pump.

8A-72. INSTALLATION OF TURBOCHARGER OIL PUMP.

a. Reverse steps a thru j (eliminate steps f, g and h for right engine), using new gaskets, AiResearch Part No. 8313, on the engine pad and hydraulic pump base.
b. When pump hold-down nuts are installed, tighten evenly until pump is flush and snug on the engine drive pad with no significant torque yet applied to the hold-down nuts.
c. Rotate propeller in direction of engine rotation for at least two revolutions.
d. Torque hold-down nuts evenly by alternating the tightening process of the four nuts.

CAUTION

Tighten nuts diagonally opposite.

e. Ensure there are no loose fittings or hose connections in the pump suction line and the turbo oil reservoir is at least two-thirds full.
f. Disconnect pump pressure line at the bulkhead fitting in the upper engine compartment near baffle (connects with turbo oil cooler).
g. Fill this line with turbo oil and reinstall on bulkhead fitting.
h. Start engine and observe that turbo low oil warning light goes out within 15 seconds of engine start under a maximum of 1500 RPM.
i. If the light does not go out within 15 seconds, stop the engine immediately and investigate the cause.
j. Should it be necessary to further prime the pump, manually induce a small amount of turbo oil into the center housing oil inlet line to lubricate the turbocharger bearings. Failure to do this can result in damage to the turbo bearings and failure of the turbocharger. Repeat steps f, g, h and i.

8A-73. TRANSFER VALVE PURPOSE AND FUNCTION.

a. The purpose of the transfer valve in the turbocharger system is to allow a lower setting of the controller and a lower constant compressor discharge pressure (deck pressure) at climb and cruise power settings (major operating range).

b. It is desirable to keep this pressure low to reduce exhaust back pressures and improve power output and fuel economy. When take-off power is desired, however, the low setting of the controller will not provide the necessary deck pressure to result in take-off manifold pressure at full throttle.

c. When this valve is actuated by the throttle arm at the last bit of travel to the wide open position, the controller reference point is changed from sensing deck pressure to sensing manifold pressure. This utilizes the differential (drop) across the throttle and results in the controller demanding the increase in deck pressure necessary to provide 28.5 inches of manifold pressure.

8A-74. CHECKING TRANSFER VALVE FOR LEAKS.

a. The transfer valve on each engine is part of the control of the turbocharger system. The function of the valve and its integrity influences the overall performance of the turbo system.

b. The lines associated with this valve, copper tubing (superseded by steel braided teflon hose) must be free from leaks or obstructions.

c. The valve itself must not leak by when in the closed position.

d. A quick field check may be made for leakage in the following manner:

1. Place throttle lever in the idle range.
2. Remove the line from the intake port on number 3 cylinder.
3. Substitute a suitable union or fitting in the end of the line and tighten "B" nut.
4. Simulate a suction on the open end of the fitting by mouth and ascertain that a vacuum can be held in the line without bleeding off; if it does not hold, the valve is leaking and should be replaced or new "O" rings should be installed.

e. Rigging can also be checked in this manner by determining the point of full throttle that the valve opens and allows flow.

f. Two orifices exist in the transfer valve system that should be clean and never modified. They appear at these locations:

1. The tee fitting boss on the compressor discharge tube (.059 Dia.).
2. The bottom fitting in the transfer valve (.070 Dia.).

8A-75. ADJUSTMENT OF TRANSFER VALVE.

a. Mount valve and bracket to the forward injector mount studs. Loosen "U" clamp on valve to allow positioning.

b. Place throttle arm against the full open stop.

c. Adjust valve to hold plunger to its full travel. Tighten "U" clamp to secure valve.

d. Remove all friction from the throttle control on pedestal.

e. Advance throttle slowly until contact is felt with the plunger. This should be about three-quarters of an inch from full throttle by the knob.

f. Advance throttle lever to full open on the pedestal and lock with friction lock.

g. The following results must be obtained:

1. The throttle arm on the injector must contact its full open stop and must be able to hold on the stop with normal throttle friction.

2. The plunger must open the valve and allow flow through it.

3. Consideration should be given to synchronizing the plunger action between left and right engines.

NOTE

When new "O" rings are installed, it is normal to observe a "spongy" return action of the plunger.

8A-76. ADJUSTMENT OF AUTOMATIC SYSTEM CONTROLLER. Prior to adjusting the controller it is absolutely necessary to determine that there are no leaks in the transfer valve or associated lines.

The absolute pressure controller in the Aztec system should need adjustment only upon installation or replacement.

Caution should be used in assuming that the controller is at fault when a malfunction of the system is reported and in no case should it be attempted to compensate for a loss of critical altitude by increasing the controller setting.

Should it be determined, through troubleshooting, that the controller is malfunctioning, it should be replaced and the replacement unit adjusted per the following procedure:

a. When field elevation is 1500 feet MSL or above:

1. Start engine and allow the engine temperatures to rise into the normal range.

2. Place turbo control switch in the ON position.

3. Advance throttle slowly to full open position.

4. Allow 12 seconds only for manifold pressure to stabilize. Should manifold pressure go beyond 28.5 inches, the setting is too high. Below 28.2 inches the setting is too low. DO NOT ALLOW MANIFOLD PRESSURE TO EXCEED 30

inches of mercury.

(a) Remove lead seal and safety wire from the one inch hex plug in bottom of controller body and with a stubby screwdriver, feel for slot in adjusting screws.

NOTE

The controller adjustment is extremely sensitive. 20 degrees of turn will produce approximately one-half inch of manifold pressure. The adjusting screw is quite stiff due to a "nylock" friction insert. Turning clockwise will increase manifold pressure; counter-clockwise will decrease manifold pressure.

(b) Adjust accordingly until manifold pressure peaks at 28.5 inches in 12 seconds at full throttle. Turn turbo switch OFF. Manifold pressure should drop to whatever the naturally aspirated engine will produce for the existing barometric conditions.

(c) Install plug in bottom of controller and safety.

b. When field elevation is below 1500 feet MSL, the following procedure is to be followed for proper adjustment of the AiResearch 470688-4 Absolute Pressure Controller at field elevations of 1500 feet MSL or below:

1. Remove the transfer valve sense line from cylinder No. 3 and plug the line.

2. Remove controller sense line from the tee in the compressor discharge tube and connect it to cylinder No. 3 where the transfer valve line was removed in step 1. Cap off the tee.

3. With the turbocharger on-off switch in the OFF position, start the engine(s) and warm up to operating temperature. Advance the throttles to the point at which 26 inches of manifold pressure can be obtained, and lock the throttles. Turn the turbocharger on-off switch to the ON position. The manifold pressure should advance to 29.5 inches of mercury. (There will be a slight oscillation of manifold pressure before it stabilizes.) Should the manifold pressure exceed 29.5 inches of mercury at this point, the controller setting is too high and must be lowered. If the manifold pressure is below 29.5 inches of mercury, the controller setting is too low and must be raised. Under no condition should the manifold pressure be allowed to exceed 30.5 inches of mercury. Care should be taken not to exceed cylinder head temperature limits.

4. After completion of the adjustment, return the system to normal by reversing steps 1 and 2. With the system adjusted in this manner, full throttle application will provide 28.5 inches of mercury manifold pressure up to 20,000 feet density altitude.

NOTE: It is necessary to have equal controller settings on both engines to avoid throttle stagger, errors in fuel flow indication and different part throttle critical altitudes between engines.

8A-77. CLEANING OR REPLACING TURBO OIL FILTER ELEMENT.

a. The turbo oil filter is located on the control cluster panel on the right-hand side of each engine accessory compartment.

b. To remove the filter bowl and element:

1. Remove the safety wire.
2. Place an open end wrench on the square casting at the bottom of the bowl.
3. While holding some pressure on the wrench in a counterclockwise direction, (loosening) tap the head of the filter near the parting surface with a plastic or fiber mallet.
4. Unscrew the bowl from the head and lower slowly.
5. Remove filter element and clean with any approved aircraft solvent or replace with new element.
6. Replace “O” ring seal on bowl.
7. Reinstall element and bowl and safety.

8A-78. V-BAND COUPLING 100 HOUR INSPECTION. (See Figure 8A-34.)

Each 100 hours or annually, whichever comes first, inspect lockwiring on V-band couplings for condition and security. If lockwiring is found broken, inspect T-bolt for stretching, cracking, or any other damage. Replace coupling as required.

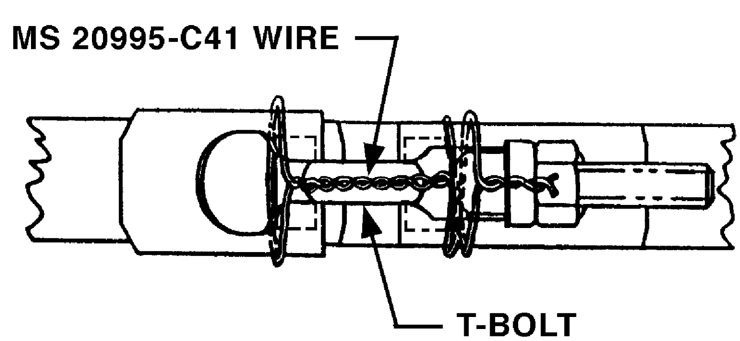

Figure 8A-34. Lockwiring V-Band Coupling

TABLE VIIIA-II. ENGINE TROUBLESHOOTING (FUEL INJECTION)

Trouble	Cause	Remedy
Failure of engine to start.	Lack of fuel.	Check fuel system for leaks. Fill fuel cell. Clean dirty lines, strainers or fuel cocks.
	Underpriming.	Prime by holding switch 4 to 10 seconds. Check fuel flow indicator.
	Overpriming.	Place ontrol in "idle-cut-off". Open throttle and unload engine by turning over with starter.
	Incorrect throttle.	Open throttle to 1/8 of its range.
	Defective spark plugs.	Clean and adjust or replace spark plug(s).
	Defective ignition wire.	Check with electric tester. Replace any defective wires.
	Defective battery.	Replace with charged battery.
	Improper operation of magneto breaker points.	Clean points. Check internal timing of magnetos, paragraph 8A-46.
	Air bubbles in fuel system.	Check fuel vent.
	Fuel pump failure.	Replace pump.
	Fuel line restricted.	Check inlet line.

TABLE VIIIA-II. ENGINE TROUBLESHOOTING (FUEL INJECTION) (cont.)

Trouble	Cause	Remedy
Failure of engine to start (cont.).	Lack of sufficient fuel pressure.	Check fuel strainer and fuel adjustments.
	Internal failure.	Check oil sump strainer for metal particles. If found, complete overhaul of the engine may be required.
Failure of engine to idle properly.	Incorrect idle adjustment.	Adjust throttle stop to obtain correct idle, paragraph 8A-37.
	Insufficient fuel pressure.	Check fuel strainer and pump pressure adjustment.
	Clogged injector nozzle.	Remove and clean, paragraph 8A-38.
	Leak in induction system.	Tighten all connections in the induction system. Replace any defective parts.
	Low cylinder compression.	Check condition of piston rings and valve seats.
	Faulty ignition system.	Check entire ignition system.

TABLE VIIIA-II. ENGINE TROUBLESHOOTING (FUEL INJECTION) (cont.)

Trouble	Cause	Remedy
Low power and uneven running.	Mixture too rich; indicated by sluggish engine operation, red exhaust flame at night. Extreme cases indicated by black smoke from exhaust.	Injector may need recalibration by authorized personnel.
	Mixture too lean; indicated by overheating or back-firing.	Check fuel supply. Check fuel lines for obstructions or restrictions.
	Clogged injector nozzles.	Remove and clean, paragraph 8A-38.
	Dirt in inlet screen.	Remove screen and flush with solvent. Blow with compressed air.
	Dirt in "T" fitting.	Remove "T" fitting at distributor, clean in solvent. Blow through orifice with compressed air - 100 psi.
	Fuel supply pressure excessively high.	Readjust fuel pump for lower pressure.
	Leak in manifold line.	Tighten fittings.
	Leak in induction system.	Tighten all connections. Replace defective parts.
	Defective spark plugs.	Clean or replace spark plugs.
	Poor Fuel.	Fill fuel cell with fuel of recommended grade.

TABLE VIIIA-II. ENGINE TROUBLESHOOTING (FUEL INJECTION) (cont.)

Trouble	Cause	Remedy
Low power and uneven running (cont.).	Magneto breaker points not working properly.	Clean points. Check internal timing of magnetos, paragraph 8A-46.
	Defective ignition wire.	Check wire with electric tester. Replace defective wire.
	Improper ignition timing.	Check magnetos for timing and synchronization.
	Defective spark plug terminal connectors.	Replace connectors on spark plug wire.
Flow meter reads high.	Clogged nozzle.	Remove and clean, paragraph 8A-38.
Failure of engine to develop full power.	Throttle lever nut out of adjustment.	Adjust throttle lever.
	Leak in induction system.	Tighten intake pipe mounting flange nuts and tighten intake manifold. (Replace defective gasket as required.)
	Mixture too lean.	Injector must be recalibrated.
	Throttle linkage limiting travel of throttle valve.	Check throttle linkage and throttle valve opening.

TABLE VIIIA-II. ENGINE TROUBLESHOOTING (FUEL INJECTION) (cont.)

Trouble	Cause	Remedy
Failure of engine to develop full power (cont.).	Restrictions in inlet air scoop.	Examine air scoop and remove restrictions.
	Improper fuel.	Fill fuel cell with recommended aviation fuel.
	Faulty ignition.	Tighten all connections. Check system with tester. Check ignition timing.
Rough engine.	Cracked engine mount.	Replace mount.
	Unbalanced propeller.	Remove propeller and have it checked for balance.
	Defective mounting bushings.	Install new mounting bushings.
Low oil pressure.	Insufficient oil.	Fill oil sump with oil of recommended viscosity.
	Leak in suction line or pressure line.	Check gasket between accessory housing and crankcase.
	Dirty oil strainers.	Remove and clean oil strainers.
	Air lock or dirt in relief valve.	Remove and clean oil pressure relief valve.
	High oil temperature.	See "High Oil Temperature" in "Trouble" column.

TABLE VIIIA-II. ENGINE TROUBLESHOOTING (FUEL INJECTION) (cont.)

Trouble	Cause	Remedy
Low oil pressure (cont.).	Relief valve out of adjustment.	Adjust valve.
	Defective pressure gauge.	Replace gauge.
	Stoppage in oil pump intake passage.	Check line for obstruction. Clean suction strainer.
	Failing or failed bearings.	Check screens and sump for metal particles.
High oil temperature.	Insufficient oil cooling.	Check air inlet and outlet for deformation or obstruction.
	Insufficient oil supply.	Fill engine oil sump to proper level with specified oil.
	Low grade of oil.	Replace with oil conforming to specification.
	Clogged oil lines or strainers.	Remove and clean oil strainers.
	Excessive blow-by.	Usually caused by worn or sticking rings.
	Failing or failed bearings.	Examine sump for metal particles. If found, overhaul of engine is indicated.
	Defective temperature gauge.	Replace gauge.

TABLE VIIIA-II. ENGINE TROUBLESHOOTING (FUEL INJECTION) (cont.)

Trouble	Cause	Remedy
Excessive oil consumption.	Low grade of oil.	Fill oil sump with oil conforming to specification.
	Failing or failed bearings.	Check sump for metal particles. If found, overhaul of engine is indicated.
	Worn piston rings.	Install new rings.
	Incorrect installation of piston rings.	Install new rings.
Cold weather difficulties.	Cold oil.	Move aircraft into a hangar. Heat oil.
	Inaccurate pressure readings.	In extreme cold weather, oil pressure readings up to approximately 100 lbs Do Not necessarily mean malfunctioning.
	Overpriming.	Rotate crankshaft in direction of normal rotation with throttle "full open", and mixture in "idle-cut-off" and ignition switch "OFF".
	Weak battery.	Install fully charged battery.
	Faulty ignition switch.	Check ground wires.

TABLE VIIIA-II. ENGINE TROUBLESHOOTING (TURBOCHARGER)

Trouble	Cause	Remedy
Turbocharger Inoperative - will not come on.	Controller by-pass solenoid stuck open.	Replace controller.
	T/C oil system low or empty.	Check oil level.
	T/C rotor jammed.	Replace rotor.
	T/C oil pump shaft sheared.	Replace pump.
	Controller malfunctioning.	Repair by approved repair station.
	Overboost sensing switch stuck or broken.	Replace switch.
	Wastegate linkage disconnected or broken.	Reconnect or replace linkage.
	Metering jet inlet plugged.	Clean or replace jet.
	Turbocharger inlet duct blocked.	Clean duct.
	Controller pressure sensing line obstructed.	Clean or replace line.
Engine has low critical altitude.	Leak in exhaust system.	Locate and correct leaks.
	T/C system oil needs changing.	Change oil and refer to maintenance recommendations, Section II.

TABLE VIIIA-II. ENGINE TROUBLESHOOTING (TURBOCHARGER) (cont.)

Trouble	Cause	Remedy
Engine has low critical altitude. (cont.)	T/C oil viscosity too high.	Change oil and refer to maintenance recommendations, Section II.
	Controller out of calibration.	Repair by approved repair station.
	Controller malfunctioning.	Repair by approved repair station.
	Metering jet in actuator inlet plugged.	Clean or replace jet.
	Controller pressure sensing line obstructed.	Clean or replace line.
	Compressor discharge duct loose or leaking.	Locate and correct leak.
	Coking in T/C center housing.	Clean, refer to maintenance recommendations.
Manifold pressure surges at altitude.	Controller malfunctioning.	Repair by approved repair station.
	Metering jet in actuator inlet plugged.	Clean or replace jet.
	Controller pressure sen-sensing line obstructed.	Clean or replace line.
	Compressor discharge duct loose or leaking.	Locate and correct leak.

TABLE VIIIA-II. ENGINE TROUBLESHOOTING (TURBOCHARGER) (cont.)

Trouble	Cause	Remedy
Manifold pressure surges at altitude. (cont.)	Ram air filter contaminated.	Clean filter.
	T/C oil system low or empty.	Check oil level.
	Leak in exhaust system.	Locate and correct leak.
	Compressor by-pass door leaking.	Correct leak, refer to maintenance recommendations.
	T/C oil system relief valve stuck open.	Disassemble and clean.
	Tube to transfer valve broken or loose.	Tighten or replace.
Engine smokes at idle.	T/C rotor jammed.	Replace rotor.
	Seal ruptured in controller.	Replace seal.
	T/C bearing seals leaking.	Replace seal.
	T/C oil reservoir vent obstructed.	Clean vent.
	T/C oil system relief valve stuck open.	Disassemble and clean.
Switch will not turn turbo off.	Controller by-pass solenoid stuck closed.	Replace controller.

TABLE VIIIA-II. ENGINE TROUBLESHOOTING (TURBOCHARGER) (cont.)

Trouble	Cause	Remedy
Switch will not turn turbo off. (cont.)	Short in electrical system.	Locate short and repair.
	Controller by-pass solenoid not grounded.	Ground solenoid.
	Wastegate linkage disconnected or broken.	Reconnect or replace linkage.
Oil leaking from actuator drain.	Actuator piston seal ruptured.	Replace seal.
Excessive loss of turbo oil.	T/C oil pump shaft seal leaking.	Replace seal.
	External oil leaks.	Determine cause and correct.
	T/C bearing seals leaking.	Replace seals.
	T/C oil reservoir vent obstructed.	Clean vent.
	T/C oil cooling being impaired.	Determine cause and correct.
	Actuator seal piston ruptured.	Replace seal.
	Seal ruptured in controller.	Replace seal.

TABLE VIIIA-II. ENGINE TROUBLESHOOTING (TURBOCHARGER) (cont.)

Trouble	Cause	Remedy
High manifold pressure at take-off.	Controller out of calibration.	Repair by approved repair station.
	Controller malfunctioning.	Repair by approved repair station.
	Wastegate linkage disconnected or broken.	Reconnect or replace linkage.
	Controller pressure sensing line broken.	Replace line.
	T/C system oil needs changing.	Change oil, refer to maintenance recommendations, Section II.
	T/C oil viscosity too high.	Change oil.
	Tube to transfer valve broken or loose.	Tighten or replace tube.
	Overboost sensing switch stuck or broken.	Replace switch.
	Controller pressure sensing line obstructed.	Clean or replace line.
	T/C oil system relief valve stuck closed.	Disassemble and clean.
Low manifold pressure at take-off.	Controller out of calibration.	Repair by approved repair station.
	Controller malfunctioning.	Repair by approved repair station.

TABLE VIIIA-II. ENGINE TROUBLESHOOTING (TURBOCHARGER) (cont.)

Trouble	Cause	Remedy
Low manifold pressure at take-off. (cont.)	Controller pressure sensing line obstructed.	Clean or replace line.
	Compressor discharge duct loose or leaking.	Locate and correct leak.
	Transfer valve out of rig.	Rerig, refer to maintenance recommendations, paragraph 8A-75.
	Overboost sensing switch stuck or broken.	Replace switch.
	Metering jet in actuator inlet plugged.	Clean or replace jet.
	Leak in exhaust system.	Locate and correct leak.
	Compressor by-pass door leaking.	Repair, refer to maintenance recommendations.
	T/C oil system relief valve stuck open.	Disassemble and clean.
	Ram air filter contaminated.	Clean filter.
High fuel pressure at altitude.	Leak in pressure reference line at fuel pressure gauge.	Repair or replace line.
	Pressure reference line obstructed.	Clean or replace line.

TABLE VIIIA-II. ENGINE TROUBLESHOOTING (TURBOCHARGER) (cont.)

Trouble	Cause	Remedy
Low fuel pressure at altitude.	Leak in pressure referencing line at fuel pump.	Repair or replace line.
	Pressure reference line obstructed.	Clean or replace line.
	Auxiliary fuel pumps not on or inoperative.	Turn on or repair.
	Injector nozzle reference line loose.	Tighten line.
Overboost warning light on - NO overboost.	Overboost sensing switch stuck or broken.	Replace switch.
	Short in electrical system.	Locate short and repair.
Low oil warning light does not come ON.	Oil warning switch not grounded.	Ground switch.
	Oil warning switch malfunctioning.	Replace switch.
Low oil warning light remains ON.	T/C oil system low or empty.	Check oil level.
	T/C oil pump shaft sheared.	Replace pump.
	T/C oil system relief valve stuck open.	Disassemble and clean.

TABLE VIIIA-II. ENGINE TROUBLESHOOTING (TURBOCHARGER) (cont.)

Trouble	Cause	Remedy
Low oil warning light remains ON. (cont.)	Oil warning switch malfunctioning.	Replace switch.
Low manifold pressure on take-off (turbos off).	Ram air filter contaminated.	Clean filter.
Turbo oil darkens prematurely.	Coking in T/C center housing.	Clean, refer to maintenance recommendations.
	T/C oil cooling being impaired.	Determine cause and correct.

SECTION

VIIIB

POWER PLANT

(LYCOMING TURBOCHARGED)

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SECTION VIIIB - POWER PLANT (LYCOMING TURBOCHARGED)

TABLE OF CONTENTS

NOTE: The remaining subject matter for this section duplicates that presented in Section VIIIA. Accordingly, see the following paragraphs in that section.

SECTION VIIIB - POWER PLANT (LYCOMING TURBOCHARGED)

TABLE OF CONTENTS (CONT.)

SECTION VIIIB

POWER PLANT

(LYCOMING-TURBOCHARGED)

8B-l. INTRODUCTION.

This section covers power plants used in the PA-23-250 (six place) Lycoming Turbo-powered Aztec (S/N's 27-3944 and up) and is comprised of instructions for the removal and installation of the engine and turbocharger. For all components not covered in this section, refer to Section VIIIA.

8B-2. DESCRIPTION.

The PA-23-250 (six place) turbo is powered by two Avco Lycoming T10-540-ClA six cylinder, direct drive, wet sump, horizontally opposed, fuel injected, turbocharged, air cooled engines with a compression ratio of 7.2:1, rated at 250 HP at 2575 RPM and designed to operate on 100/130 (Minimum) octane aviation grade fuel.

Cowlings completely enclose the engines and consist of an upper and lower section and a nose section. The cowling is of cantilever construction attached at the firewall. Located on both sides of the cowl are access panels that can be removed when their quick fasteners are released, to allow inspection of the accessory section and turbocharger area. Cowl flap doors are an integral part of the lower cowl and are operated through mechanical linkage.

Propellers are Hartzell full-feathering, compact, constant speed, each controlled by a governor mounted on the engine supplying oil through the propeller shaft at various pressures. Oil pressure from the governor moves the blades into low pitch (high RPM). The centrifugal twisting moment of the blade also tends to move the blades into low pitch. Opposing these two forces is force produced by compressed air between the cylinder head and the piston, which tends to move the blades into high pitch in the absence of governor oil pressures . Thus, feathering is accomplished by compressed air.

The induction system consists of a dry type air filter and alternate air door. The engine fuel system consists of a Bendix RSA-5ADl type fuel injector and a Lear-Seigler fuel supply pump as an integral part of the fuel injector system .

A Lycoming model TE0659 turbocharger is mounted as an integral part of the engine. The turbocharger is designed to increase the altitude power output and efficiency of an internal combustion engine by supplying compressed air to the engine intake manifold. The power to drive the turbocharger is extracted from the energy of the exhaust gas.

This unit consists of a turbine wheel and an impeller wheel (compressor) mounted on opposite ends of a common shaft, each contained in its own housing with a center housing containing shaft bearings.

Exhaust gas is directed onto the turbine wheel causing it to turn. The compressor wheel is fixed to the opposite end of the shaft and also turns, delivering compressed air to the engine induction system. The speed of the compressor can be varied by dumping or by passing some of the exhaust gas around the turbine and out the exhaust stack. This is done by a device called a wastegate which is employed in the exhaust system. The wastegate is controlled by a density controller at full throttle conditions and a differential pressure controller at part throttle. If the pressure differential or density it senses decreases, a sealed bellows expands, extending a metering pin which reduces the flow of oil through the body of the unit, increasing the pressure across the actuator diaphragm hence forcing the piston down and moving the wastegate towards the closed position. When the differential or density it senses increases, the controller bellows contracts allowing oil to flow through it decreasing the pressure on the piston of the wastegate actuator. Spring tension on the piston forces it up, opening the wastegate.

Bendix Scintilla S-1200 series magnetos are installed with their associated components. Each system consists of a single contact magneto, a dual contact magneto to obtain the retard spark necessary for starting, a starter vibrator, magneto switches and starter switch. The magnetos are designed to generate and distribute high tension current through high tension leads to the spark plugs.

In addition to the previously mentioned components, each engine is equipped with an alternator, geared starter, hydraulic pump, and vacuum pump. Engine mounts are steel tubing construction attached at the firewall and incorporate vibration absorbing dynafocal mounts. The two exhaust stacks and extensions are positioned one for the right with a crossover to the manifold for the left bank of cylinders. From the left exhaust manifold, gases are directed to the turbocharger exhaust plenum, through or around the turbo turbine, as required, and overboard at the outboard bottom of the engine nacelle.

The lubrication system is of the full pressure wet sump type. The oil pump, which is located in the accessory housing, draws oil through a drilled passage leading from the oil suction screen located in the sump. The oil from the pump then enters a drilled passage in the accessory housing, which feeds the oil to a threaded connection on the rear face of the accessory housing where a flexible line leads the oil to the external oil cooler. Pressure oil from the cooler returns to a second threaded connection on the accessory housing from which point a drilled passage conducts the oil to the oil pressure filter. In the event that cold oil or an obstruction should restrict the oil flow to the cooler, an oil cooler by-pass valve is provided to pass the oil directly from the oil pump to the oil pressure filter. The oil pressure filter element, located on the accessory housing, is provided as a means to filter from the oil any solid particles that may have passed through the suction screen in the sump. After being filtered in the pressure filter, the oil is fed through a drilled passage to the oil pressure relief valve, located in the upper right side of the crankcase in front of the accessory housing.

This relief valve regulates the engine oil pressure by allowing excessive oil to return to the sump, while the balance of the pressure oil is fed to the main oil gallery in the right half of the crankcase. Residual oil is returned by gravity to the sump where, after passing through a screen, it is again circulated through the engine.

8B-3. TROUBLESHOOTING.

Troubles related to the power plant are listed in Section VIIIA, in the front of Table VIIIA-II, Engine Troubleshooting (Fuel Injection). Trouble related to the turbocharger is listed in Table VIIIB-I in the back of this section along with the probable causes and suggested remedies.

8B-4. STANDARD PRACTICES - ENGINE.

Refer to Section VIII.

8B-5. ENGINE COWLING.

8B-6. REMOVAL OF THE ENGINE COWLING.

Refer to Removal of the Engine Cowling, Section VIIIA.

8B-7. ENGINE COWL FLAP.

8B-8. REMOVAL OF COWL FLAP MECHANISM ASSEMBLY.

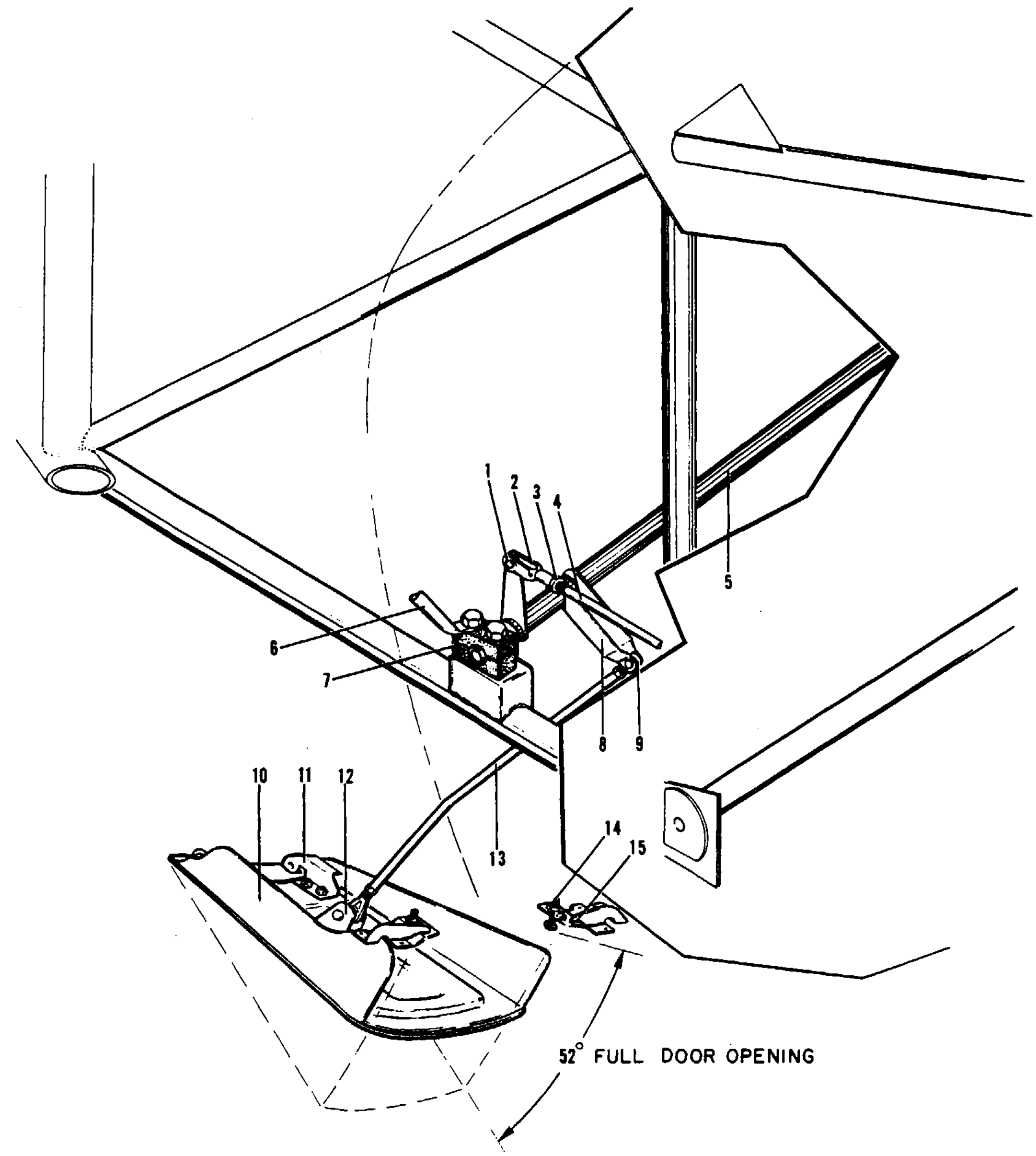
a. Remove the two side cowl panels from the engine where the cowl flaps are to be removed.

b. Remove the nut, washer and bolt attaching the operating rod end to the cowl flap.

c. Remove the cowl flap by removing the self-locking nuts and the machine screws attaching either the flap to the hinge or the hinge to the nacelle. Remove the cowl flap or the cowl flap and hinge assembly.

d. The operating mechanism may be removed by the following procedure:

   1. Disconnect the clevis end of the control cable from the torque tube.
   2. Remove the operating rods by removing the cotter pins, nuts, washers and bolts attaching the rods to the torque tube.



1. CLEVIS PIN
2. CLEVIS
3. JAM NUT
4. CONTROL CABLE
5. TORQUE TUBE
6. OIL COOLER SUPPORT ROD
7. BEARING BLOCK
8. ACTUATING ARM
9. ROD END BEARING
10. COWL, FLAP
11. HINGE
12. ROD SUPPORT
13. ROD ASSEMBLY
14. STOP SCREW
15. STOP ASSEMBLY

Figure 8B-1. Cowl Flap Installation.

3. Remove the self-locking nuts, washers and bolts securing the torque tube to the bearing blocks.

4. Remove the torque tube, bearing blocks and shim washers, if any.

8B-9. REMOVAL OF COWL FLAP CONTROL CABLE. The removal instructions are given for either side of the airplane.

a. Remove the outboard engine access side panel from the nacelle the cable is to be removed.

b. Remove the top section of the nacelle aft of the firewall by removing attaching screws.

c. Disconnect the clevis end of the control cable from the torque tube by removing the cotter pin, washer and pin.

d. Remove the clamp securing the control cable to the engine mount frame inside the nacelle center section.

e. Remove the clamp securing the cable where it enters the wing next to the nacelle.

f. Remove the access plate from the bottom of the wing between the nacelle and the fuselage. (Loosen fairing as required for access.)

g. Remove the clamp securing the cable to the anchor block between the nacelle and the fuselage.

h. Remove the access panel from the bottom of the fuselage by removing attaching screws.

i. Remove the crossfeed drain lever from the fuel control box by removing the Allen head screw.

j. Remove the plate from the front of the fuel control box by removing the attaching screws.

k. Remove the screw from the side of the fuel control box securing the cowl flap control arm assembly to the control lever mechanism.

l. Separate the arm assembly and cowl flap control cable from the control mechanism.

m. Remove the cotter pin, washer and pin separating the cable from the arm assembly.

n. Remove the jam nut that secures the cable to the support bracket below the fuel control box.

o. From the bottom of the fuselage draw the cable from the fuel control box.

p. Remove the second jam nut from the end of the control cable.

q. It is recommended that a string be tied to the end of the control cable below the fuselage and draw the cable through the wing to the center section of the nacelle. Remove the string.

r. Remove the jam nut securing the control cable to the engine firewall and remove the cable.

8B10. INSTALLATION OF COWL FLAP CONTROL CABLE.

a. Position one end of the control cable to the engine firewall with a jam nut and lockwasher on the aft side of the firewall. Install a second jam nut and lockwasher to the control cable on the forward side of the firewall.

b. Draw the remaining end of the cable through the center section of the nacelle and through the wing to the underside of the fuselage.

c. Install a clamp securing the cable to the engine mount frame inside the nacelle center section.

d. Install a clamp securing the cable to the anchor blocks at the inboard side of the nacelle center section where the cable enters the wing.

e. Install a clamp securing the cable to the anchor blocks inside the wing betweeen the nacelle and the fuselage.

f. Install a jam nut and lockwasher to the end of the cable and insert the cable end up through the bracket below the fuel control box. Secure the cable to the bracket with a second lockwasher and jam nut.

g. Connect the arm assembly to the clevis end of the cable at the fuel control box with pin, washer and cotter pin.

h. Secure the arm assembly to the control mechanism inside the fuel control box with screw, washer and nut.

i. Refer to paragraph 8B-12 for connecting the remaining cable end and adjustment of cowl flaps.

j. Install all access plates, panels, and the fuel crossfeed lever to the front of the fuel control box.

8B-11. INSTALLATION OF COWL FLAP MECHANISM ASSEMBLY.

a. Install the hinges and cowl flaps to the bottom of the cowl with machine screws and self-locking nuts.

b. Install the torque tube in the bearing blocks and position on brackets on the engine mount tubes. Secure the assembly with bolt, washer and self-locking nut.

NOTE

As necessary, install shim washers on either or both ends of the torque tube inboard of the bearing blocks (.032, P/N 85012-117 or .062, P/N 85012-118) to provide .032 end play of the torque tube.

c. Position the torque tube with double stem arms of the torque tube pointing aft.

d. Connect the cowl flap operating rods to the double stem arms of the torque tube with bolt, washer, nut and cotter pin.

NOTE

The curved operating rod must be installed on the inboard side of the right engine. The end of the rod painted red must be attached to the torque tube arm.

e. Refer to paragraph 8B-12 for connecting the remaining components and adjustment of cowl flaps.
f. Install all access plates and panels.

8B-12. RIGGING AND ADJUSTMENT OF COWL FLAPS.

a. Remove the side cowl panels, the top center section of the nacelle, and the access panel from the bottom of the fuselage, if not previously removed.
b. Remove the access plate from the front of the fuel control box by first removing the crossfeed drain knob and then the attaching screws.
c. Center the threaded attachment parts of the control cable housing where they are secured to the engine firewall and the bracket below the fuel control box.
d. Position the cowl flap control lever in the half open position.
e. Connect the control cable clevis end to the operating arm assembly, if not previously done, by installing the pin from the inboard side of the clevis and the washer and cotter pin on the outboard side.
f. Position the arm assembly with the cable attached to the operating handle mechanism inside the fuel control box. Secure the items with a screw installed from the outside of the fuel control box and washer and nut.
g. Position the single stem arm of the torque tube vertical and parallel to the engine firewall.
h. Maintaining the position of the torque tube, connect the end of the cable to the single stem arm using a pin, washer and cotter pin.
i. Adjust the operating rods to provide 26 degrees of opening with the previous items remaining constant.
j. Adjust the stops so the cowl flaps fit flush with the nacelles when closed.
k. Ascertain that the cowl flaps open to the full open position of 52 degrees.
l. Tighten all jam nuts, install all access plates and panels and the crossfeed drain knob.

8B-13. ENGINE.

8B-14. REMOVAL OF ENGINE. The removal of either engine is basically the same procedure, though the routing of some wires, cables, lines, etc. does vary between engines. Each line should be identified to facilitate reinstallation and covered, where disconnected, to prevent contamination.

a. Turn off all cockpit switches and then disconnect the battery ground cable at the battery.

b. Move the fuel valve control lever, located on the fuel control box between the two front seats, to the off position.

c. Remove the engine cowling. (Refer to Removal of Engine Cowling, Section VIIIA.)

d. Drain the engine oil, if desired.

e. Remove the propeller. (Refer to Removal of Propeller, Section VIIIA.)

f. Disconnect the starter cable at the starter, remove the cable clamps and pull it aft to the firewall.

g. Remove cylinder head temperature wire from number six cylinder.

h. Disconnect the alternator wires and wire clamps, pull the wires aft to the firewall.

i. Remove the governor control cable and injector control cables.

j. Disconnect the manifold pressure, oil pressure, fuel pressure and fuel flow gauge vent lines.

k. Disconnect the engine oil breather, magneto "P" leads, oil temperature wire and tachometer cable.

l. Disconnect the vacuum hoses, air oil separator line to the engine, oil cooler lines and remove oil cooler.

m. Disconnect the fuel lines at the fuel pump, the hydraulic pump lines and bonding straps.

n. Loosen the magneto mounting nuts and rotate the magnetos to clear the engine mounts.

o. Remove E.G.T. (Exhaust Gas Temperature) probe.

p. Remove exhaust tailpipe and mounting bracket.

q. Remove air filter assembly and inlet duct.

r. To prevent damage to the tail when removing the weight of the engine, attach a stand to the tail skid.

s. Attach a one-half ton (minimum) capacity hoist to the engine lifting eye and relieve the tension on the mount bolts.

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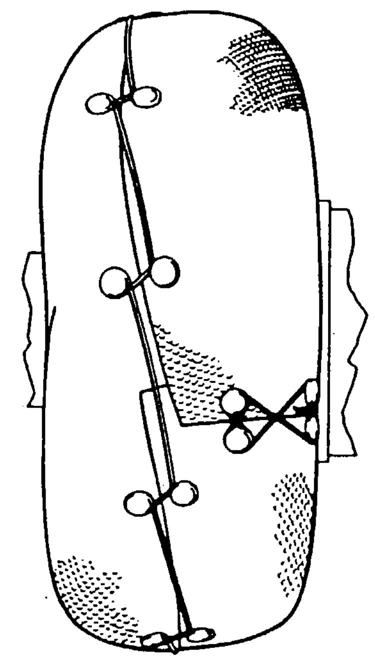

SKETCH A

1. PROPELLER GOVERNOR
2. STARTER RING GEAR
3. LIFTING STRAP
4. FUEL DISTRIBUTION VALVE
5. SPARK PLUG
6. ENGINE MOUNT
7. VACUUM PUMP
8. SHOCK MOUNT (SEE SKETCH B)
9. OIL FILTER
10. MAGNETO, RIGHT
11. AIR BOX
12. COMPRESSOR
13. TURBINE (SEE SKETCH A)
14. EXHAUST PIPE
15. MOUNTING BRACKET, EXHAUST PIPE
16. OIL COOLER
17. EXHAUST BY-PASS VALVE
18. DIFFERENTIAL PRESSURE CONTROLLER
19. CONTROLLER HOUSING
20. INDUCTION PIPE
21. DENSITY CONTROLLER
22. EXHAUST MANIFOLD
23. INDUCTION PIPE HEAT SHIELD
24. FUEL AIR BLEED NOZZLE
25. ENGINE MOUNT FITTING
26. BUSHING
27. BOLT
28. ENGINE MOUNT FRAME
29. WASHER
30. NUT

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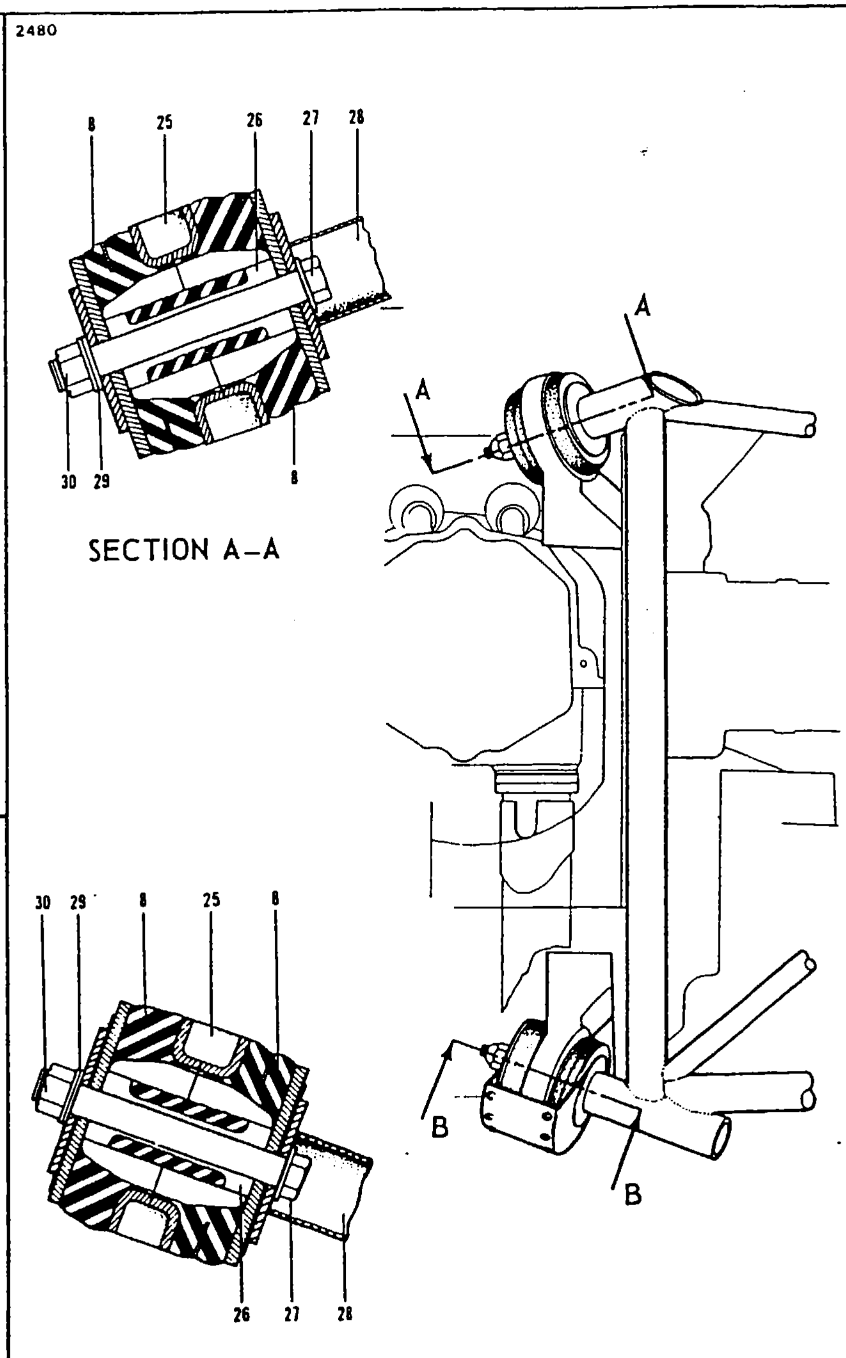
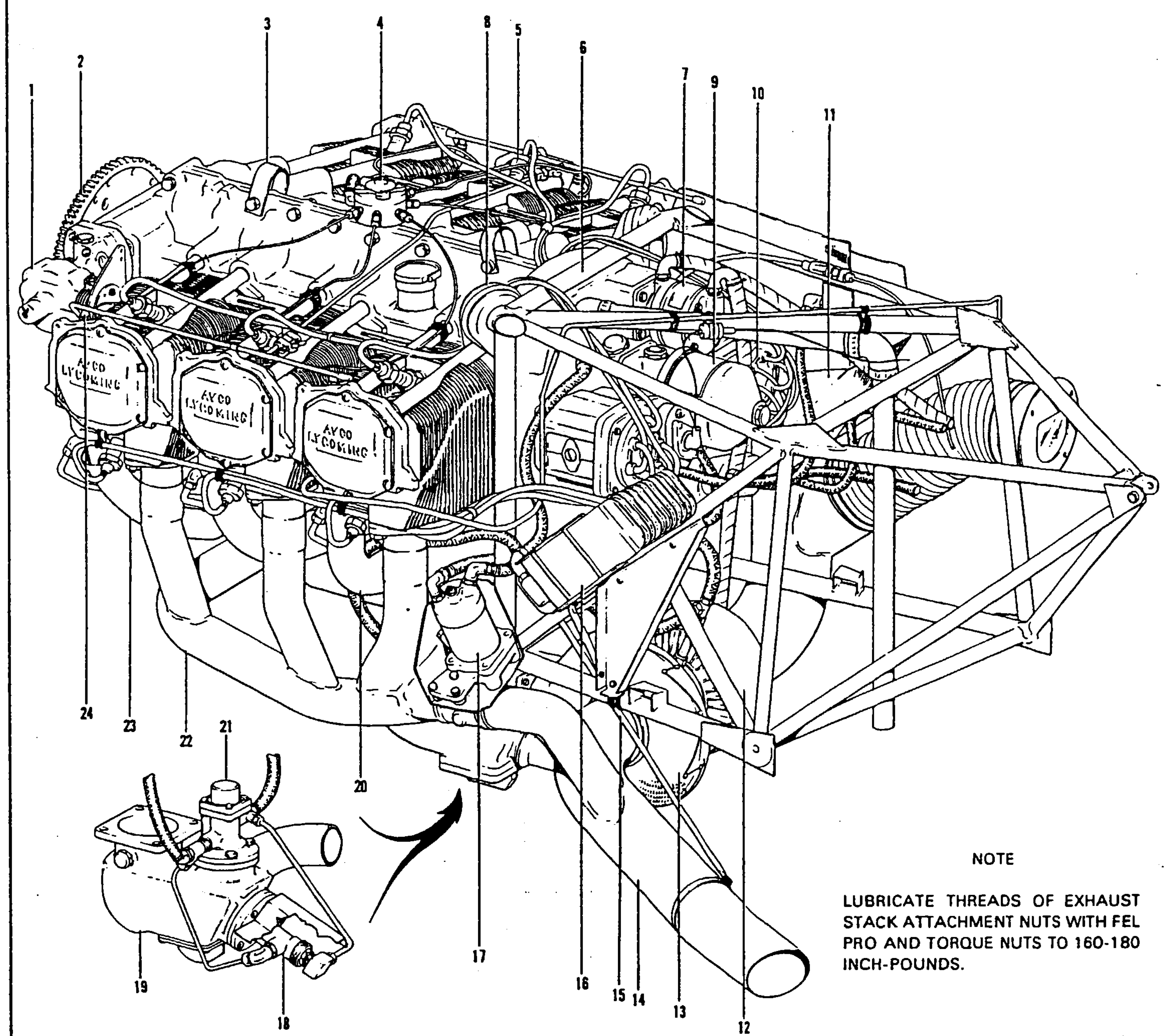


SKETCH B



NOTE

LUBRICATE THREADS OF EXHAUST STACK ATTACHMENT NUTS WITH FEL PRO AND TORQUE NUTS TO 160-180 INCH-POUNDS.

Figure 8B-2. Engine Installation

t. Remove the self-locking nut, washer, front rubber shock mount and sleeve from all four mount bolts.

u. Slide mount bolts out of attaching points and slowly swing engine free and place on a suitable support being careful not to damage any attached parts.

v. Remove the rear rubber shock mounts.

8B-15. INSTALLATION OF ENGINE. Refer to Figure 8B-2 for the proper arrangement of the engine mount shock assemblies. The top shocks are assembled so the silver colored shocks are aft and the gold colored shocks are forward. The lower shock mounts are installed opposite of the top shock mounts.

a. Attach a one-half ton hoist to the lifting strap and lift the engine. Install remaining engine components at this time (exhaust manifolds, accessories, etc.).

b. Swing the engine into position with the nose slightly high and inward. Allow the magnetos to clear the ring of the engine mount. Position the mounting lugs of the engine so they align with the engine mount attaching points.

c. Insert a mounting bolt into the engine mount until its threaded end extends one or two threads from the mount itself. Insert a shock mount between the engine mounting bracket and the mount. Slide the mount bolt on through the mount and insert a mount spacer over the bolt and through the engine mounting bracket.

d. Repeat the procedures in step c with the remaining three attaching points.

NOTE

A heat shield is installed with the bottom left shock mount at exhaust by-pass valve. Adjust so as to give maximum protection against exhaust tube heat.

e. Install the front engine shock mounts on the bolts and over the forward end of the mount spacer; check to see that the shock mounts are not binding. Install washers and a self-locking nut on each mounting bolt. Tighten the nuts progressively, following a circular sequence, and torque to 34 to 42 foot-pounds.

f. Connect the fuel lines to the fuel pump. Connect hydraulic pump lines, left engine only, and bonding straps.

g. Install induction air filter assembly.

h. Connect the vacuum hose, air oil separator line to the engine.

i. Install E.G.T. (Exhaust Gas Temperature) probe.

j. Install the oil cooler and connect oil cooler hoses.

k. Connect the engine oil breather, magneto "P" leads, oil temperature wire to bulb and tachometer cable.

l. Connect the cylinder head temperature, manifold pressure, fuel pressure and fuel flow gauge vent line.

m. Install the governor control cable bracket and cable.

n. Connect the fuel injector unit control cables.

o. Connect the alternator wires and clamp the wires to rocker arm oil return lines.

p. Connect the starter cable and clamp cable to rocker arm oil return lines.

q. Time the magnetos to engine. (Refer to Installation and Timing Procedure, Section VIIIA.)

r. Install the exhaust tailpipe, but do not tighten the securing clamps.

s. Position the tailpipe by the following procedure:

1. Use a bubble protractor on top of one of the rocker box covers to determine a zero reference position.

2. Place the protractor on the top of the tail pipe forward of the brace clamp.

3. Move the tail pipe to provide an angle of 12° from the zeroed position of the protractor. This adjustment provides for clearance between the cowl flap mechanism, nacelle and the tail pipe.

t. Torque the V-clamp at the turbine outlet to 40-50 inch-pounds and safety.

NOTE

Do not over torque V band clamps on tailpipe or compressor housing. (Light tapping around the clamps while tightening helps them seat properly).

u. Torque the clamp at the outlet of by-pass valve to 120-140 inch pounds and safety.

v. Position and tighten the tail pipe brace clamp and torque the tail pipe support assembly cap screw 50 to 70 inch pounds and safety wire the cap screw to the oil sump boss with MS20995-C41 wire.

w. Ascertain that the magneto switches are off and install the propeller per paragraph 8A-18.

x. Install oil drain valve on the inboard side of left engine and the outboard side of the right engine. Torque to 325 +/- 25 inch pounds.

y. Install the proper grade and amount of engine oil. (Refer to latest revision Lycoming Service Instruction No. 1241.)

z. Connect the battery ground wire at the battery.

aa. Turn on the fuel valve, open the throttle full, mixture in idle cut-off, and turn on the electric fuel pump and check the fuel lines for leaks.

ab. Perform an engine operational check.
ac. Check for oil leaks.
ad. Install the access plates on the engine nacelle and the cowling per paragraph 8A-8.

8B-16. TURBOCHARGER. (Lycoming.) The following paragraphs contain instructions for the removal, and installation procedures of turbocharger units supplied by Avco-Lycoming Division, Williamsport, Pennsylvania, 17701, and installed in PA-23-250 (six place) airplanes, Serial Nos. 27-2505 and up.

The turbocharger part number, serial number, model number and other pertinent information appears on the name plate attached to the unit components. Include this information in all correspondence.

Inspection procedures may be found in Section II.

8B-17. REMOVAL OF TURBOCHARGER.

a. Remove the engine cowling. (Refer to Removal of Engine Cowling, Section VIIIA.)
b. Remove the turbocharger assembly from the engine by the following procedure:

1. Remove duct from air filter to compressor housing by removing the clamps.
2. Disconnect the oil scavenge line at the side of the reservoir tank which is mounted on the bottom of the turbocharger.
3. Loosen clamps and slide connecting hose between compressor and controller housing down inlet pipe far enough to clear the compressor.

NOTE

Always apply penetrating oil to all mount bolts and turbine plenum bolts prior to removal. Bolts seize due to carbon and rust build up on threads. Working them back and forth usually avoids shearing them off.

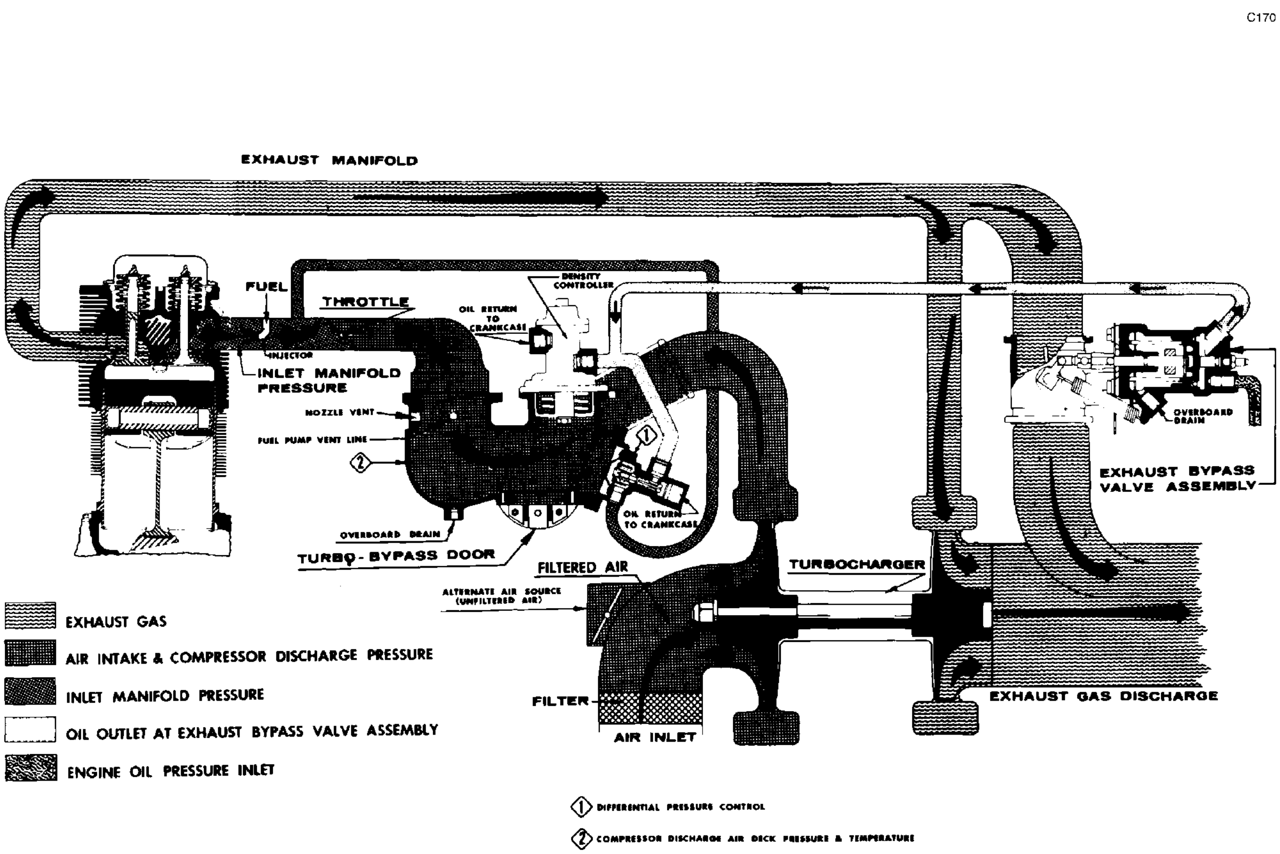


Figure 8B-3. Turbocharger System Diagram

4. Remove tail pipe by the following steps:
   (a) Remove clamps at the exhaust turbine and at the rear of the by-pass valve.
   (b) Remove support bracket from tail pipe.
5. Remove oil lines at the top of the turbocharger unit.
6. Remove turbocharger unit by removing the four attaching bolts, nuts and washers at the turbine housing flange.

8B-18. REMOVAL OF THE CONTROLLER HOUSING.

a. Loosen clamps and slide connecting hose between compressor and controller housing down inlet pipe far enough to clear the compressor.

b. Disconnect all hoses attached to the density controller, differential pressure controller and housing.

c. Remove the controller housing from the injector by removing the attaching bolts.

8B-19. REMOVAL OF EXHAUST BY-PASS VALVE ASSEMBLY.

a. Disconnect two oil lines from on top of valve assembly.

b. Remove tail pipe by the following procedure:
   1. Remove clamps at the exhaust turbine and the by-pass valve.
   2. Remove support bracket from tail pipe.

c. Remove remaining clamp between by-pass valve and exhaust manifold.

8B-20. TURBOCHARGER LUBRICATION SYSTEM PRIMING. Immediately prior to mounting the unit, prime the lubrication system as follows:

a. Invert turbocharger and fill center housing with new clean oil through oil drain.

b. Turn rotating assembly by hand to coat bearings and thrust washer with oil.

c. Coat threads of attaching bolts or studs with high temperature thread lubricant.

d. After installing turbocharger. (Ref. para. 8B-20.) flush oil through oil inlet line and ensure that line is clean and unobstructed.

e. Fill engine and oil inlet line with new, clean lubricating oil, and connect line.

f. Connect oil return line.

NOTE

If the turbocharger is to be installed on a new or newly overhauled engine, operate the engine with a separate oil filter in the oil supply line to the turbocharger during the first hour of operation. This must be done to ensure that no metal particles are carried from the engine into the turbocharger lubrication system.

8B-21. INSTALLATION OF TURBOCHARGER.

a. Slide connecting hose on inlet pipe of the controller housing far enough to allow clearance to mount turbocharger unit.

b. Position turbocharger unit on mounting brackets and attach to exhaust transition section or plenum flange with attaching bolts, nuts and washers. Torque to 225-300 inch pounds.

c. Attach oil lines at the top of turbocharger unit.

d. Install tailpipe by the following steps:

1. Install tailpipe to turbine outlet and secure with clamp. Do not tighten clamp at this time.
2. Install exhaust pipe to by-pass valve making sure to insert metal gasket between matching parts before attaching clamp. Do not tighten clamps at this time.
3. Attach tubular bracket to tail pipe with attaching bolt. Do not tighten.
4. Position tail pipe and torque per paragraph 8B-15.

e. Attach the oil scavenge line at the side of the reservoir tank mounted on the bottom of the turbocharger.

CAUTION: CONNECT TURBOCHARGER DUCTS SO AS TO IMPOSE NO COMPRESSIVE BENDING OR TORSIONAL LOADS ON TURBOCHARGER.

f. Secure duct, from air filter to compressor housing, by attaching clamps.

g. Slide the connecting hose on the controller housing onto the compressor outlet and secure with clamps. Turbo oil scavenge line support is mounted underneath the upper clamp.

8B-22. INSTALLATION OF THE CONTROLLER HOUSING.

a. Slide connecting hose and clamps on inlet pipe of the controller housing far enough to allow clearance between the compressor outlet and controller housing.

b. Install controller housing with gasket to injector and secure with attaching bolt and lockwashers and torque.

c. Connect all hoses to the density controller, differential pressure controller and housing.

d. Slide the inlet pipe connecting hose on compressor outlet and secure with clamps. Turbo oil scavenge line support is mounted underneath the upper clamp.

8B-23. INSTALLATION OF EXHAUST BY-PASS VALVE ASSEMBLY.

a. Mount bypass valve, with gasket, to exhaust manifold by attaching clamp. Torque to 130 inch pounds.

b. Install tailpipe by the following steps:

1. Install tailpipe to turbine outlet and secure with clamp. Do not tighten clamp at this time.
2. Install exhaust pipe to by-pass valve making sure to insert metal gasket between mating parts before attaching clamp. Do not tighten clamps at this time.
3. Attach tubular bracket to tailpipe with attaching bolt but do not tighten.
4. Position and torque tailpipe. (Refer to Paragraph 8B-14.)

c. Connect hoses on top of valve assembly.

8B-23a. V-Band Coupling 100 Hour Inspection (See Figure 8B-4.)

Each 100 hours or annually, whichever comes first, inspect lockwiring on V-band couplings for condition and security. If lockwiring is found broken, inspect T-bolt for stretching, cracking, or any other damage. Replace coupling as required.

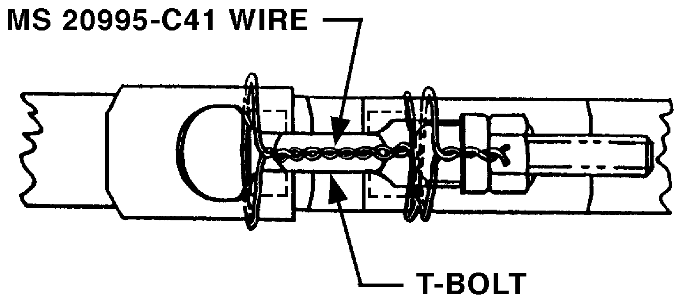


Figure 8B-4. Lockwiring V-Band Coupling

8B-24. ADJUSTMENT OF TURBOCHARGER.

It is recommended that adjustments of the turbocharger be conducted by an authorized overhaul facility, in accordance with the latest revision of Avco Lycoming Service Instruction No. 1187.

8B-25. FUEL INJECTOR.

8B-26. REMOVAL OF FUEL INJECTOR, NOZZLE LINES, FUEL LINES AND FUEL FLOW DIVIDER.

a. Remove the engine cowling. (Refer to Removal of Engine Cowling, Section VIIIA.)
b. Disconnect the throttle and mixture control cables at the injector.
c. Remove controller housing. (Refer to Paragraph 8B-17.)
d. Disconnect the fuel inlet line at the injector.
e. Disconnect the fuel outlet line to the flow divider at the injector.
f. Remove attaching nuts and remove injector unit.
g. Disconnect the nozzle lines from the air bleed nozzles.
h. Disconnect the fuel flow meter line at the rear baffle.
i. Disconnect the inlet fuel line at the flow divider.
j. Remove the two attaching bolts and remove fuel flow divider and nozzle lines as a unit.
k. Remove air bleed nozzles. (Refer to Paragraph 8A-39.)

8B-27. INSTALLATION OF FUEL INJECTOR.

a. Install air bleed nozzles. (Refer to Installation of Fuel Air Bleed Nozzle, Section VIIIA.)
b. Install fuel flow divider and nozzle lines, attach divider to the crankcase with attaching bolts. and connect lines to nozzles.
c. Connect inlet fuel line and fuel flow meter line.
d. Install a gasket and attach the injector unit to the engine sump with washers and nuts.
e. Mount controller housing on bottom of injector. (Refer to Paragraph 8B-21.)
f. Connect the throttle and mixture control cables.
g. Connect the inlet and outlet fuel lines.
h. Install the cowling as described in paragraph 8A-8.
i. Adjust the idle speed and mixture of the injector.

TABLE VIIIB - I. ENGINE TROUBLE SHOOTING

Trouble	Cause	Remedy
Failure of engine to start.	Lack of fuel.	Check fuel system for leaks. Fill fuel tank. Clean dirty lines, strainers or fuel valves.
	Overpriming.	Leave ignition "off" and mixture control in "Idle-Cut-Off", open throttle and "unload" engine by cranking for a few seconds. Turn ignition switch on and proceed to start in a normal manner.
	Defective spark plugs.	Clean and adjust or replace spark plugs.
	Defective ignition wire.	Check with electric tester, and replace any defective wires.
	Defective battery.	Replace with charged battery.
	Improper operation of magneto breaker.	Clean points. Check internal timing of magnetos.
	Lack of sufficient fuel flow.	Disconnect fuel line and check fuel flow.
	Water in fuel injector or carburetor.	Drain fuel injector or carburetor and fuel lines.

TABLE VIIIB-I. ENGINE TROUBLE SHOOTING (cont.)

Trouble	Cause	Remedy
Failure of engine to start. (cont.)	Internal failure.	Check oil screens for metal particles. If found, complete overhaul of the engine may be indicated.
Failure of engine to idle properly.	Incorrect idle mixture.	Adjust mixture.
	Leak in the induction system.	Tighten all connections in the induction system. Replace any parts that are defective.
	Incorrect idle adjustment.	Adjust throttle stop to obtain correct idle.
	Uneven cylinder compression.	Check condition of piston rings and valve seats.
	Faulty ignition system.	Check entire ignition system.
	Insufficient fuel pressure.	Adjust fuel pressure.
Low power and uneven running.	Mixture too rich indicated by sluggish engine operation, red exhaust flame at night. Extreme cases indicated by black smoke from exhaust.	Readjustment of fuel injector or carburetors by authorized personnel is indicated.

TABLE VIIIB-I. ENGINE TROUBLE SHOOTING (cont.)

Trouble	Cause	Remedy
Low power and uneven running. (cont.)	Mixture too lean; indicated by overheating or backfiring.	Check fuel lines for dirt or other restrictions. Readjustment of fuel injector or carburetor by authorized personnel is indicated.
	Leaks in induction system.	Tighten all connections. Replace defective parts.
	Defective spark plugs.	Clean and gap or replace spark plugs.
	Improper fuel.	Fill tank with fuel of recommended grade.
	Magneto breaker points not working properly.	Clean points. Check internal timing of magnetos.
	Defective ignition wire.	Check wire with electric tester. Replace defective wire.
	Defective spark plug terminal connectors.	Replace connectors on spark plug wire.
Failure of engine to develop full power.	Leak in the induction system.	Tighten all connections and replace defective parts.
	Throttle lever out of adjustment.	Adjust throttle lever.

TABLE VIIIB-I. ENGINE TROUBLE SHOOTING (cont.)

Trouble	Cause	Remedy
Failure of engine to develop full power. (cont.)	Improper fuel flow.	Check strainer, gage and flow at the fuel inlet.
	Restriction in air scoop.	Examine air scoop and remove restrictions.
	Improper fuel.	Drain and refill tank with recommended fuel.
	Faulty ignition.	Tighten all connections. Check system with tester. Check ignition timing.
Rough engine.	Cracked engine mount.	Replace or repair mount.
	Defective mounting bushings.	Install new mounting bushings.
	Uneven compression.	Check compression.
Low oil pressure.	Insufficient oil.	Fill sump to proper level with recommended oil.
	Air lock or dirt in relief valve.	Remove and clean oil pressure relief valve.
	Leak in suction line or pressure line.	Check gasket between accessory housing and crankcase.

TABLE VIIIB-I. ENGINE TROUBLE SHOOTING (cont.)

Trouble	Cause	Remedy
Low oil pressure. (cont.)	High oil temperature.	See "High Oil Temperature" in "Trouble" column.
	Defective pressure gage.	Replace.
	Stoppage in oil pump intake passage.	Check line for obstruction. Clean suction strainer.
High oil temperature.	Insufficient air cooling.	Check air inlet and outlet for deformation or obstruction.
	Insufficient oil supply.	Fill oil sump to proper level with specified oil.
	Low grade of oil.	Replace with oil conforming to specifications.
	Clogged oil lines or strainers.	Remove and clean oil strainers.
	Excessive blow-by.	Usually caused by worn or stuck rings.
	Failing or failed bearing.	Examine sump for metal particles. If found, overhaul of engine is indicated.
	Defective temperature gage.	Replace gage.

TABLE VIIIB-I. ENGINE TROUBLE SHOOTING (cont.)

Trouble	Cause	Remedy
Excessive oil consumption.	Low grade of oil.	Fill tank with oil conforming to specification.
	Failing or failed bearings.	Check sump for metal particles.
	Worn piston rings.	Install new rings.
	Incorrect installation of piston rings.	Install new rings.
	Failure of rings to seat (new nitrided cylinders).	Use mineral base oil. Climb to cruise altitude at full power and operate at 75% cruise power setting until oil consumption stabilizes.

TABLE VIIIB-I. ENGINE TROUBLE SHOOTING (TURBOCHARGER)

Excessive noise or vibration.	Improper bearing lubrication.	Supply required oil pressure. Clean or replace oil line; clean oil strainer. If trouble persists, overhaul turbocharger.
	Leak in engine intake or exhaust manifold.	Tighten loose connections or replace manifold gaskets as necessary.
	Dirty impeller blades.	Diassemble and clean.

TABLE VIIIB-I. ENGINE TROUBLE SHOOTING (TURBOCHARGER) (cont.)

Trouble	Cause	Remedy
Engine will not deliver rated power.	Clogged manifold system.	Clear all ducting.
	Foreign material lodged in compressor impeller or turbine.	Disassemble and clean.
	Excessive dirt build-up in compressor.	Thoroughly clean compressor assembly. Service air cleaner and check for leakage.
	Leak in engine intake or exhaust.	Tighten loose connections or replace manifold gaskets as necessary.
	Rotating assembly bearing seizure.	Overhaul turbocharger.
	Restriction in return lines from actuator to waste gate controller.	Remove and clean lines.
	Waste gate controller is in need of adjustment.	Have waste gate controller adjusted.
	Oil pressure too low.	Tighten fittings. Replace lines or hoses. Increase oil pressure to desired pressure.
	Inlet orifice to actuator clogged.	Remove inlet line at actuator and clean orifice.

TABLE VIIIB-I. ENGINE TROUBLE SHOOTING (TURBOCHARGER) (cont.)

Trouble	Cause	Remedy
Engine will not deliver rated power. (cont.)	Waste gate controller malfunction.	Replace unit.
	Waste gate butterfly not closing.	Low pressure. Clogged orifice in inlet to actuator.
	Butterfly shaft binding.	Check bearings.
	Turbocharger impeller binding, frozen or fouling housing.	Check bearings. Replace turbocharger.
	Piston seal in actuator leaking. (Usually accompanied by oil leakage at drain line.)	Remove and replace actuator or disassemble and replace packing.
Critical altitude lower than specified.	Controller not getting enough oil pressure to close the waste gate.	Check pump outlet pressure, oil filters, external lines for leaks or obstructions.
	Chips under metering valve in controller holding it open.	Replace controller.
	Metering jet in actuator plugged.	Remove actuator and clean jet.
	Actuator piston seal failed and leaking excessively.	If there is oil leakage at actuator drain, clean cylinder and replace piston seal.

TABLE VIIIB-I. ENGINE TROUBLE SHOOTING (TURBOCHARGER) (cont.)

Trouble	Cause	Remedy
Critical altitude lower than specified. (cont.)	Waste gate valve sticking.	Clean and free action.
Engine surges or smokes.	Air in oil lines or actuator.	Bleed system.
	Controller metering valve stem seal leaking oil into manifold.	Replace controller.
	Clogged breather.	Check breather for restrictions to air flow.
NOTE Smoke would be normal if engine has idled for a prolonged period.		
High deck pressure (Compressor discharge pressure)	Controller metering valve not opening, aneroid bellows leaking.	Replace controller assembly or replace aneroid bellows.
	Waste gate sticking closed.	Shut off valve in return line not working.
	Butterfly shaft binding.	Check bearings.
		Replace by-pass valve or correct linkage binding.

TABLE VIIIB-I. ENGINE TROUBLE SHOOTING (TURBOCHARGER) (cont.)

Trouble	Cause	Remedy
High deck pressure (Compressor discharge pressure) (cont.)	Controller return line restricted.	Clean or replace line.
	Oil pressure too high.	Check pressure 75 to 85 psi (80 psi desired) at waste gate actuator inlet. If pressure on outlet side of actuator is too high, have waste gate controller adjusted.
	Waste gate actuator piston locked in full closed position. (Usually accompanied by oil leakage at actuator drain line.) NOTE: Waste gate normally closed in idle and low power conditions. Should open when actuator inlet line is disconnected.	Remove and disassemble actuator, check condition of piston and packing or replace actuator assembly.
	Waste gate controller malfunction.	Replace controller.
Manifold pressure drops as altitude increases (below 15,000 feet).	Malfunction of pressure ratio controller.	Replace pressure ratio controller.

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SECTION

IX

FUEL SYSTEM

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SECTION IX

FUEL SYSTEM

9-1. INTRODUCTION. The fuel system components covered in this section consist of the fuel cells, selector valves, control cables, filter screens and electric fuel pumps. Instructions are given for remedying difficulties which may arise in the normal operation of the fuel system. The instructions are organized so the mechanic can refer to: Removal, Repair, Installation and Adjustment of each part of the system.

Maintenance for the carburation and fuel injection system may be found under Power Plant, Sections VIII, VIIIA or VIIIB.

9-2. DESCRIPTION. The fuel system is contained in two independent units that allow each engine to have its own fuel supply. The systems are connected only by a crossfeed valve that will allow fuel to be drawn from one set of fuel cells to the engine on the opposite side, in the event of an emergency.

The fuel cells are of the bladder type and are installed in cavities within the wings, with each inboard cell having a capacity of 35 or 36 U.S. gallons. The outboard cells hold 35 or 36 U.S. gallons each. (Refer to the Pilot's Information Manual for the exact amount of fuel available for the particular airplane being serviced.) Aircraft with serial numbers 27-7654001 and up may have additional optional wing tip fuel cells which are interconnected to the outboard main cells, thus increasing the capacity of each outboard cell to 55 U.S. gallons. On airplanes including wing tip fuel cells an optional sight gauge is installed on the main outboard fuel cell of each wing. A check of the fuel quantity can be performed on the ground during the preflight check of the airplane.

Fuel is taken from each cell through a finger screen located in the cell outlet fitting and then onto the shutoff selector valve. From the selector valve, fuel is drawn in a series configuration through the fuel filter, electric fuel pump and onto the engine driven pump.

Drains are provided for each fuel cell, filter bowl and crossfeed line. The cell drains and filter screen drains are accessible through an access door on the bottom inboard part of each nacelle. The crossfeed drain is located in the fuel control box between the two front seats and is operated by a knob on the front of the box.

The fuel valves are operated by control handles located on the fuel control box between the two front seats. The fuel gauges will indicate the quantity of fuel in each cell that fuel is being drawn from. On aircraft which incorporate wing tip fuel cells, the quantity of fuel is combined with the main outboard fuel cells to give a combined total indication.

Figures 9-1 through 9-7 give a pictorial diagram of the various fuel systems for specific serial numbered aircraft.

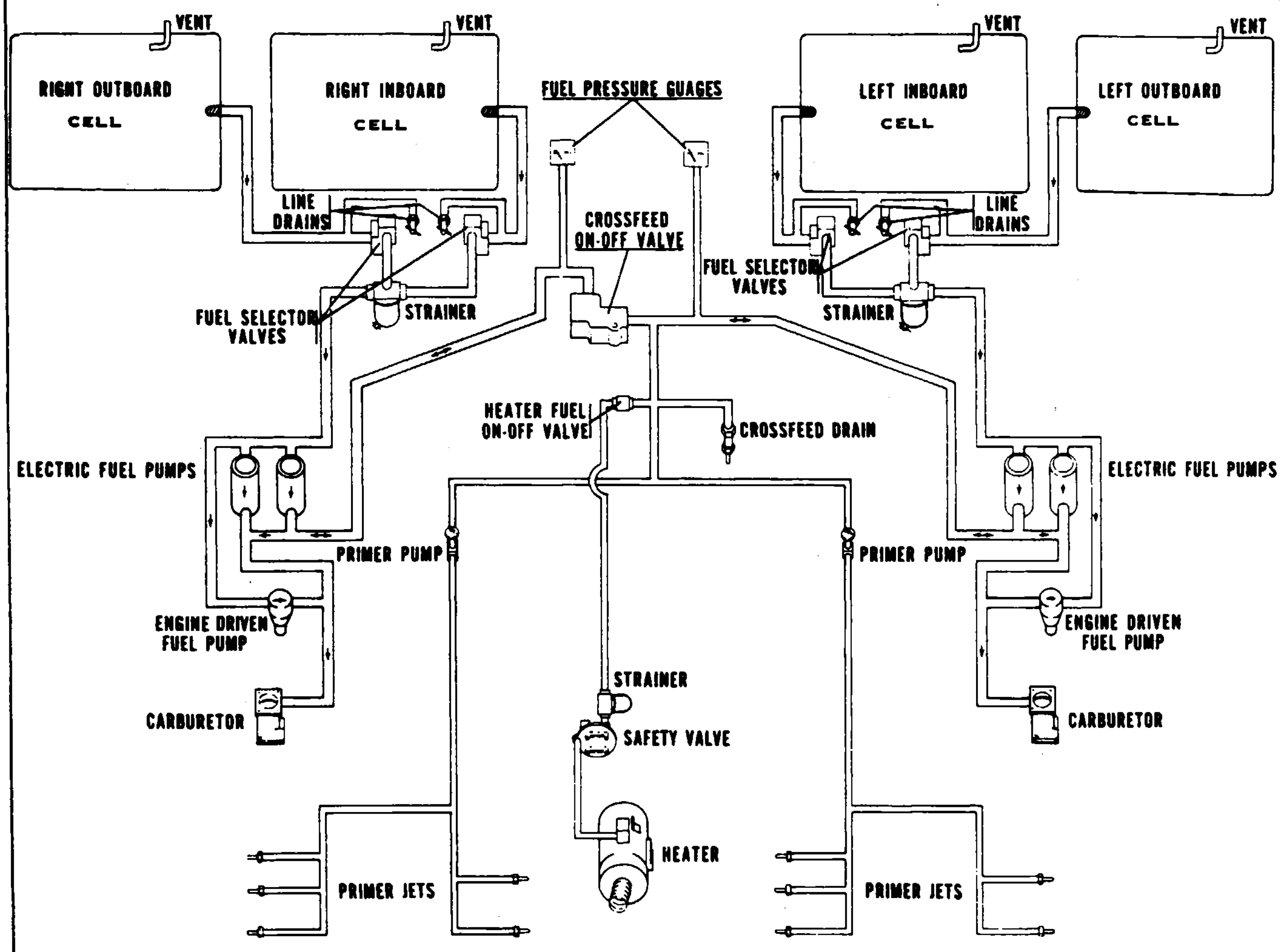


Figure 9-1. Fuel System Diagram (2 valves)
PA-23-250; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2222 incl.

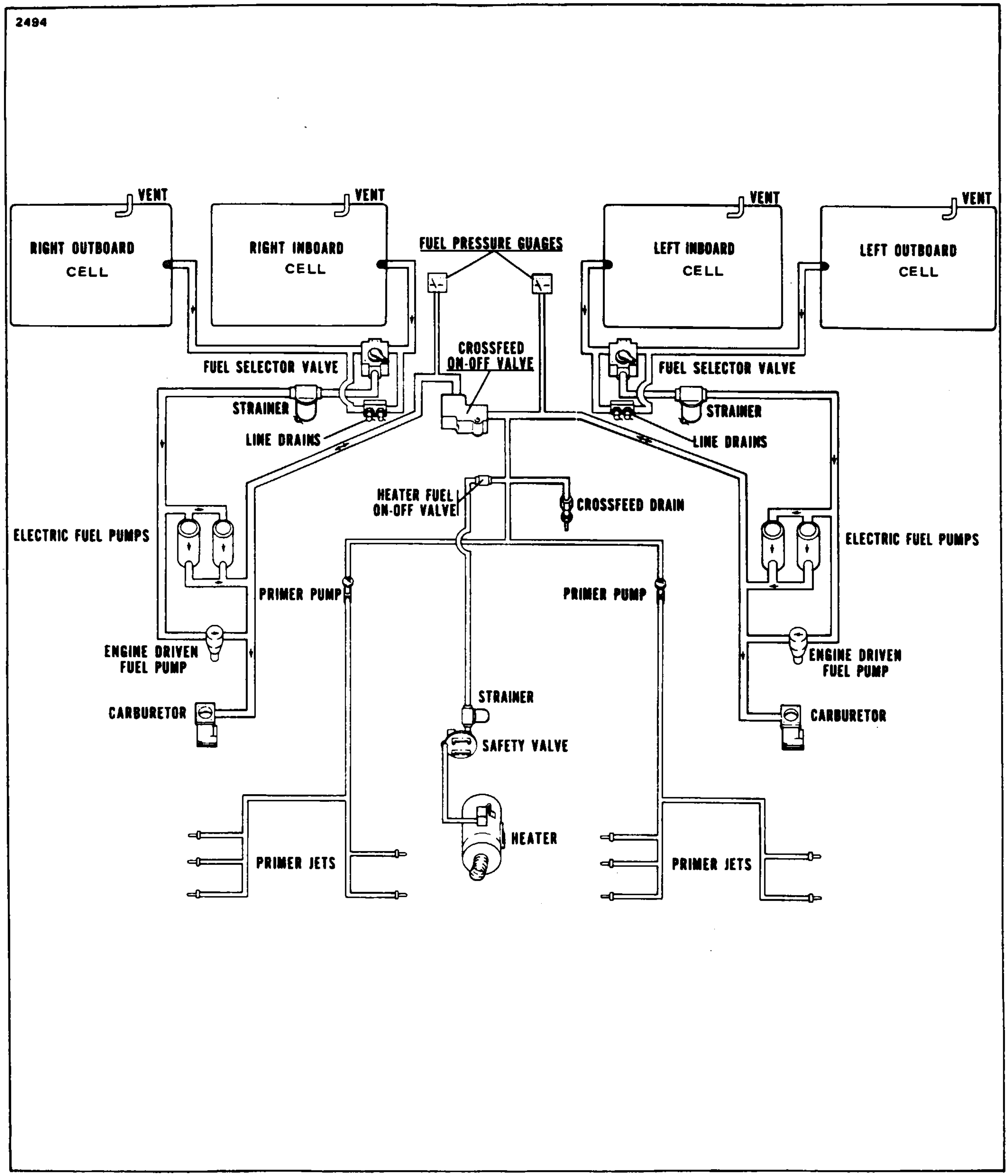


Figure 9-2. Fuel System Diagram
PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2223 to 27-2504 incl.

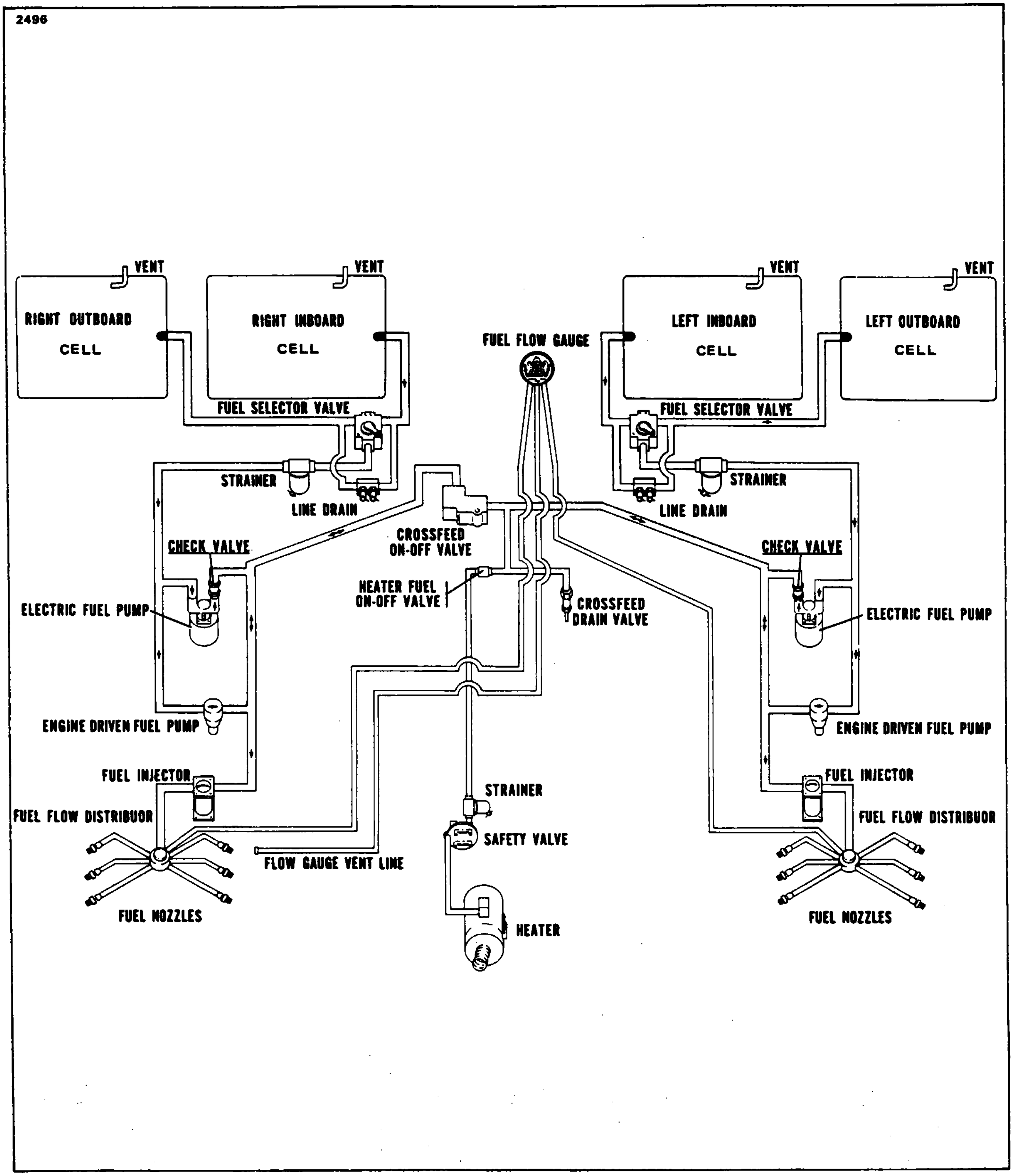


Figure 9-3. Fuel System Diagram
PA-23-250 (six place), Serial Nos. 27-2322 to 27-2504 incl.

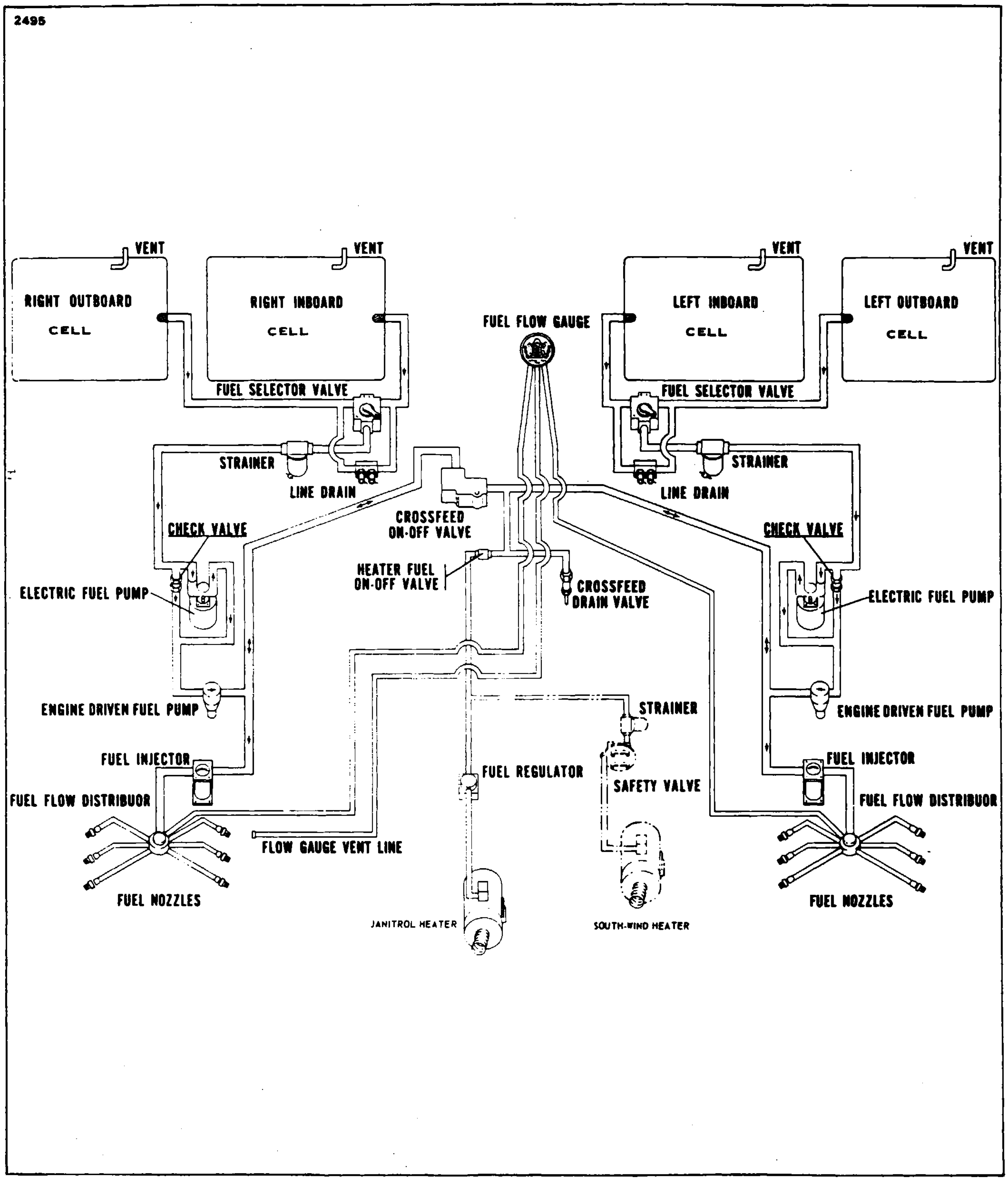


Figure 9-4. Fuel System Diagram, PA-23-250 (six place),
Serial Nos. 27-2505 to 27-3836; 27-3838 to 27-3943 incl.
(Except 27-2582, 27-2686, 27-3135 and 27-3941)

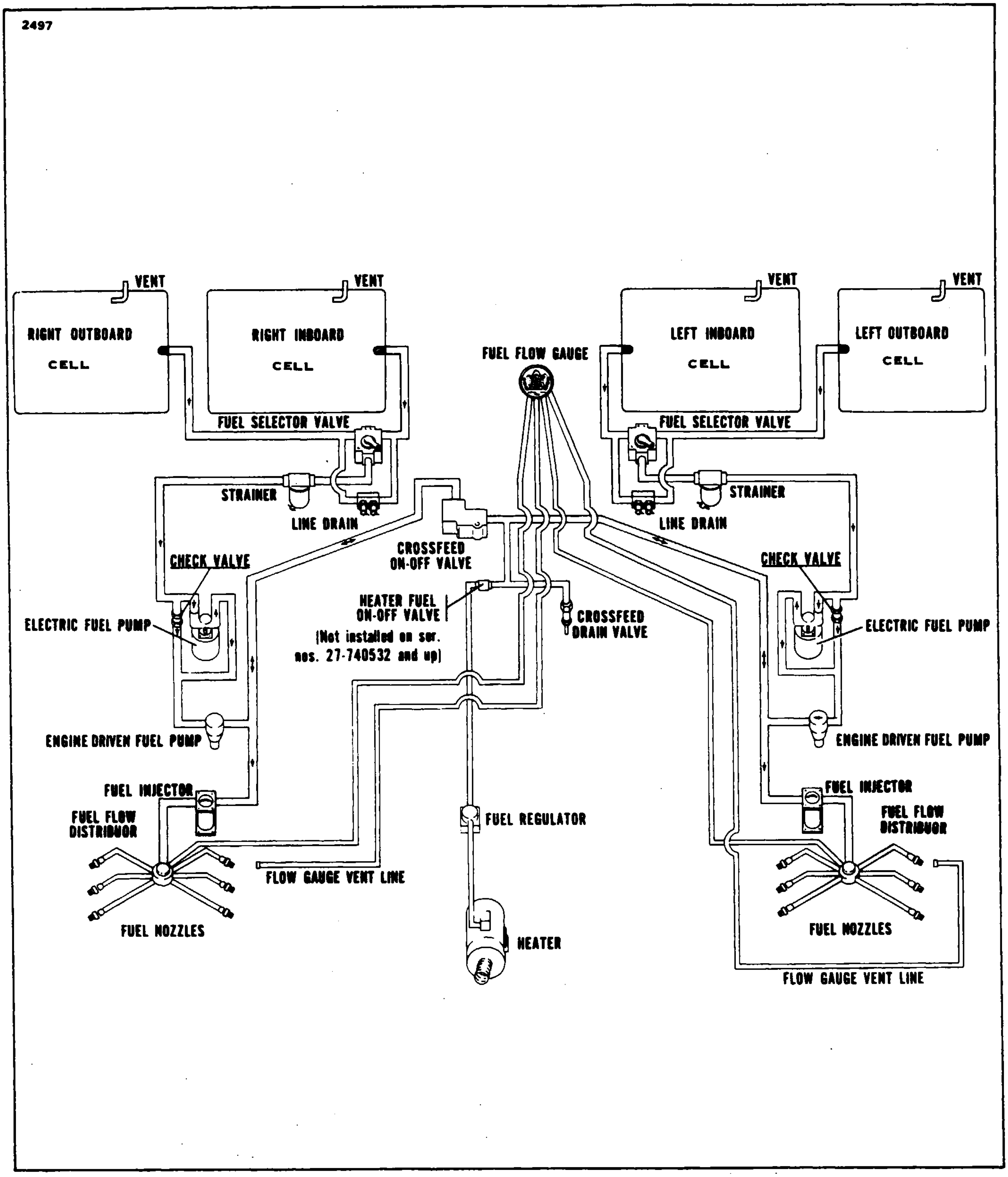


Figure 9-5. Fuel System Diagram, PA-23-250 (six place), Serial Nos. 27-3937 and 27-3944 to 27-7554172 incl. (Except 27-4520)

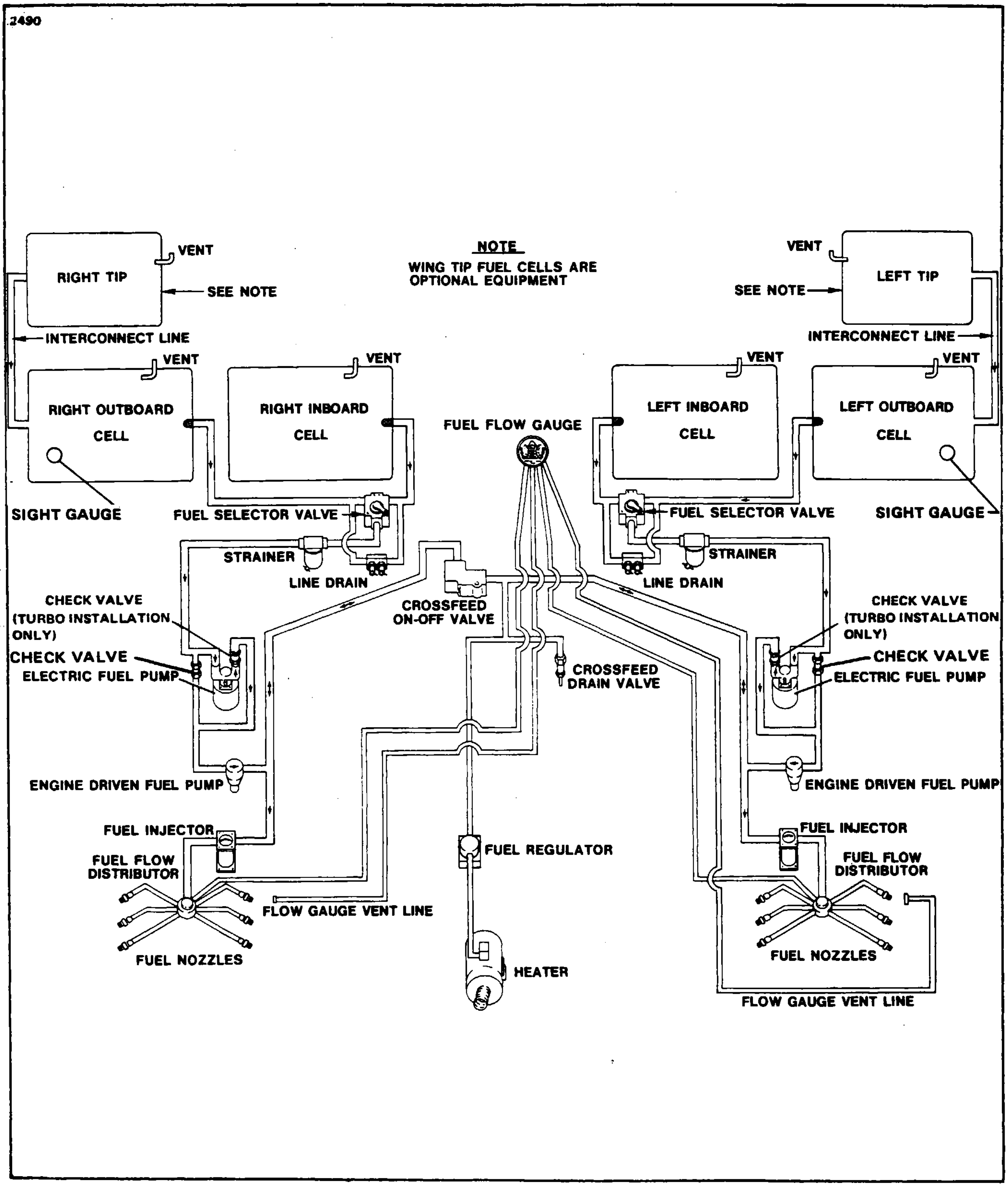


Figure 9-6. Fuel System Diagram, PA-23-250 (six place), Serial Nos. 27-7654001 and up with Optional Wing Tip Fuel Cells

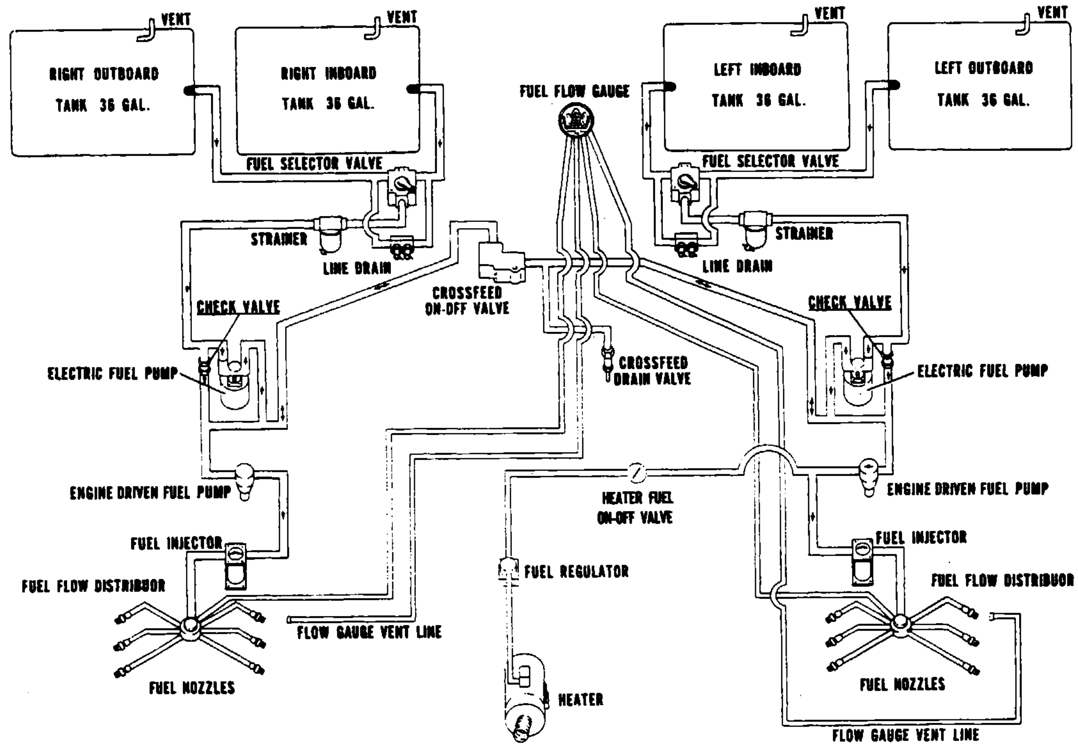


Figure 9-7. Fuel System Diagram, PA-23-250 (six place),
Serial Nos. 27-2582, 27-2686, 27-3135, 27-3941 and 27-4520

9-3. TROUBLESHOOTING. Troubles peculiar to the fuel system are listed in Table IX-I at the back of this section, along with their probable causes and suggested remedies. When troubleshooting, check from the fuel supply to the items affected. If no trouble is found by this method, the trouble probably exists inside individual pieces of equipment; they may then be removed from the airplane and overhauled, or identical units or units tested and known to be good, installed in their place. Troubleshooting the fuel quantity indicator may also be found in Section X, Instruments. The complete electrical system diagram for the system may be found in Section XI, Electrical System.

9-4. FUEL CELLS.

9-5. REMOVAL OF FUEL CELLS. (Refer to Figure 9-9.)

a. Drain the fuel cell to be removed. (Refer to Draining Fuel System, Section II.) Should time permit, and if the cell is to be reused, it is suggested that the cell be flushed, sprayed or rubbed with a light engine oil. Then do not remove the cell until 24 hours have elapsed after the oil has been applied. This will keep the cell pliable until ready to reinstall.

b. Remove the access plate from the underside of the wing at the inboard end of the fuel cell being removed.

NOTE

On aircraft with serial nos. 27-7654001 and up with tip fuel cells, refer to Paragraph 9-6 for removal instructions.

c. Loosen the clamp on the outlet neck.

d. Remove the oval access plate on top of the wing.

e. Disconnect the fuel sender unit wires from the unit inside the access opening.

f. Remove the sender unit plate by removing mounting bolts, lockwashers and gaskets.

g. Remove the filler cap and the mounting bolts around the filler neck plate or optional sight gauge and mounting bolts around plate.

h. Insert an arm between the fuel cell and the top of the wing; work outward from the opening releasing the cell support bayonet clips. The clips fit into brackets in the cell compartment and can be released by exerting pressure downward.

i. Reach under the fuel cell and release the button type fasteners by pushing them in an outward direction toward the corner of the cell unseating them from their mounting brackets.

j. Place tape or equal protective covering around the oval access hole in the top of the wing to prevent damage to the cell when removing it.

k. Fold the cell neatly within the wing and remove it gently through the oval opening.

9-6. REMOVAL OF WING TIP FUEL CELL. (Refer to Figure 9-8.)

NOTE

Airplanes equipped with pneumatic deicers. (Refer to Section XIV for removal instructions.)

a. Place the crossfeed valve in the OFF position and drain the fuel from the outboard and tip fuel cells to be removed. (Refer to Draining Fuel System, Section II.)

b. Remove the wing tip fairing attachment screws; disconnect the navigation light electrical connector, and remove the fairing.

c. Remove the fuel sender access plate on the wing tip; disconnect the sender unit electrical leads; remove the sender unit screws, and carefully withdraw the sender unit with the gaskets from the cell. Note the position of the installed unit to facilitate installation.

d. Disconnect the fuel vent line; remove the oval access plate and the outer and inner rings from the outboard tip rib.

e. Reach into the outboard fuel cell and remove the clamp on the large diameter internal nipple; remove the access plates on the bottom and top skins.

f. Remove the wing tip hinge pin at the centerline of the main spar by removing the screw securing the end of the pin to the bottom of the wing tip, grasping it with pliers, and pulling it out.

g. Remove the wing tip attachment screws and carefully pull the tip away from the wing far enough to gain access to the external nipples of the tip fuel cell, crossover tubes and electrical connector.

h. Loosen the clamps on the three external nipples of the tip fuel cell and the clamp securing the ground lead to the large diameter interconnect tube. Unplug the electrical connector.

i. Remove the tip by separating the tip cell nipples from the crossover tubes and disconnecting the ground leads on the tip rib.

j. Remove the filler cap assembly from the wing tip and the bolts attaching the fuel cell to the filler neck plate assembly.

k. Untie the nylon cords; collapse the fuel cell and neatly fold the cell within the tip. Tape the edges of the oval access opening; tape or tie the cell and remove it through the opening in the tip rib.

9-7. CLEANING, INSPECTION AND REPAIR OF FUEL CELLS.

a. Fuel cells may be cleaned by the following procedure:

1. New Cells: It should not be necessary to clean new cells upon removing them from their containers, if they are installed in the fuel cell cavities promptly. If for any reason the cells are not installed immediately and they become dirty, they should be cleaned with soap and warm water to remove foreign material prior to installation in a clean cavity.

2. Used Cells: Prior to removal, the cells are to be drained of fuel, purged with fresh air and swabbed out to remove all traces of fuel. Following removal, the cells are to be cleaned inside and out with soap and warm water.

WARNING

Use a vapor-proof light for inspection.

b. Fuel cells may be inspected by the following procedure:

1. New Cells: Inspect the cell surface inside and outside for cuts, abraded (scuffed) areas and accessory damage. Also, inspect the fitting seals for nicks, scratches and foreign material.

2. Used Cells: Cells removed from the fuel cell cavity for inspection and repair or cells being returned to service from storage, should be inspected as outlined below:

(a) Remove fuel cells from wing cavity in accordance with Paragraph 9-5.

(b) Check for leakage in accordance with test procedure in Paragraph 9-15.

(1) If leaks appear, repair per Paragraph 9-14, clean per Paragraph 9-7, and reinstall per Paragraph 9-11 or replace with new cells.

(2) If no leakage appears, clean and reinstall cell per Paragraph 9-7 and 9-11.

(c) Check condition of fuel cap assemblies especially the rubber expandable seal portion. Caps showing indications of deterioration or hardening (of seal) should be replaced. On models with Serial Nos. 27-1 to 27-7654000 inclusive, the caps have holes which act as vents for the fuel system. In addition the fuel cells have drain tubes that are attached to the filler neck plate assembly just below the filler cap and gasket. With later models, Serial Nos. 27-7654001 and up, the caps do not have vents. The venting tube is attached lower down in the filler neck assembly, underneath a retainer and gasket. (See Figures 9-9 and 9-10.)

WARNING

Only use the correct type of cap for the airplane in question.

(d) Inspect the fuel cell filler cover plate gasket for evidence of aging, hardening or deterioration; replace gasket if any of these conditions are noted:

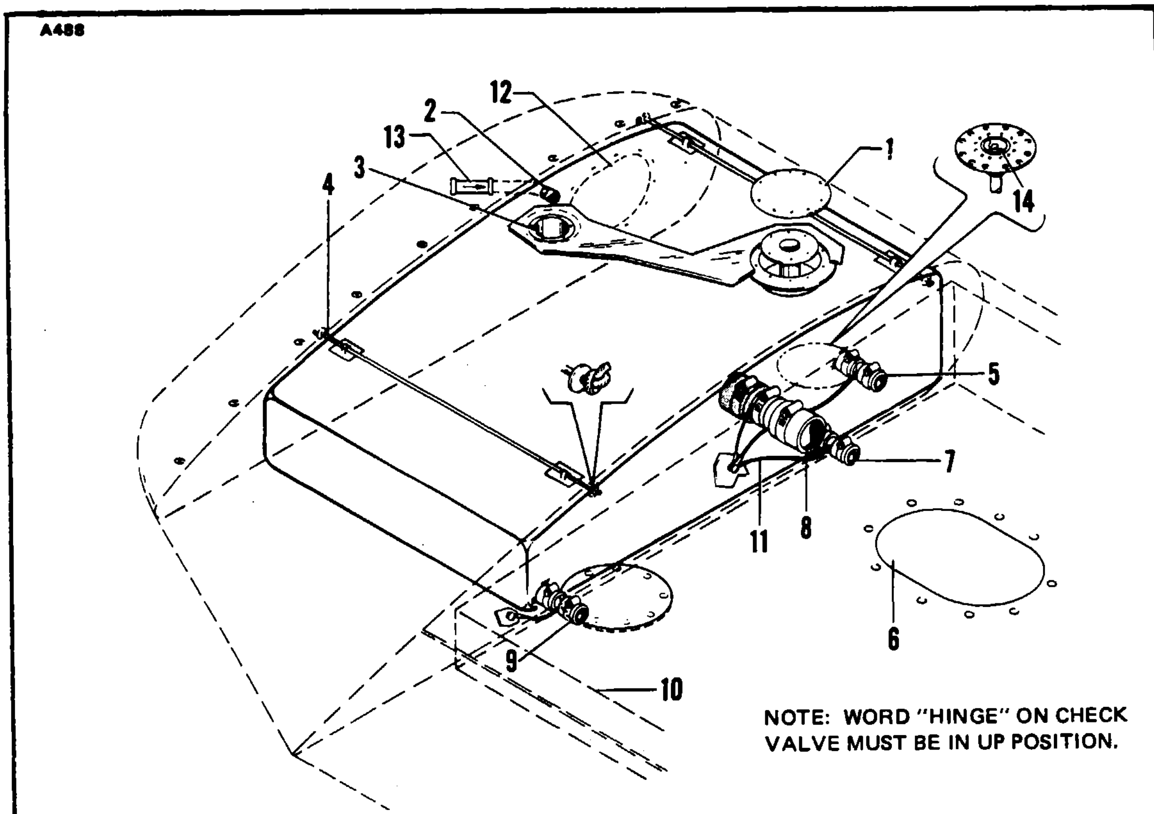
(1) Check fit of cover plate in relation to wing surface when closed; cover plate should fit flush with wing surface.

(e) Check fuel lines and fittings for integrity.

(1) Fuel lines showing evidence of damage or possible splitting and loose or damaged fittings should be replaced.

3. Baffled Fuel Cells: After each 500 hours of operation, conduct the following inspection:
   (a) Defuel the aircraft.
   (b) Remove the inboard and outboard cell access plates on the wings and fuel cells.
   (c) Check the tension and knots of the support cells.
   (d) Inspect the interior of the cells for security of the baffle and free operation of the flapper valve. Inspect both sides of the baffle.
   (e) Inspect the exterior of the cells to insure the Velcro tape has not parted from the cell surface or linear surface.
   (f) Install all access plates on fuel cells and wings; fill cells and check for leaks.

c. Due to the length of the fuel cell repair procedures, this information will be found in paragraph 9-14.



1. ACCESS COVER, WING TIP SENDER UNIT
2. FUEL VENT LINE
3. FUEL FILLER ASSEMBLY
4. NYLON CORD
5. EXTERNAL NIPPLE
6. ACCESS COVER, OUTBOARD FUEL CELL SENDER UNIT
7. EXTERNAL NIPPLE
8. INTERNAL NIPPLE
9. EXTERNAL NIPPLE
10. OUTBOARD FUEL CELL
11. GROUND WIRES
12. OUTBOARD WING TIP RIB ACCESS PANEL
13. CHECK VALVE (SEE NOTE)
14. FUEL SIGHT GAUGE (ON PA-23-250 (SIX PLACE) LATER MODELS)

Figure 9-8. Wing Tip Fuel Cell Installation

9-8. FUEL CELL COMPARTMENT.

a. Thoroughly clear the cell compartment of all fittings, trimmings, loose washers, bolts or nuts.

b. Round off all sharp edges of the fuel cell compartment.

c. Inspect the fuel cell compartment just prior to fuel cell installation.

d. Tape over all sharp edges and all rough rivets with moleskin tape which may be obtained locally.

9-9. RESEALING INBOARD FUEL CELL WING CAVITY AREA.

a. Remove inboard fuel cells from the left and right wings in accordance with Paragraph 9-5.

b. Remove tape from fuel cell liner cutout area where the fuel cell's outlet nipple fits.

c. To facilitate flow-thru of sloshing compound along bottom rib flange at Station 80.31 and bottom skin stringer to rib attachment areas (see detail), proceed as follows:

1. Insert a 1/8 inch welding rod (pointed on end) into fuel cell liner cutout (fuel cell outlet area), routing rod behind inboard fuel cell liner and along bottom rib outside flange using a push-pull motion which will "drill" hole through existing sealant. This procedure shall apply to all four stringer to rib attachment points. Remove rod from wing cavity.

d. Insert two 1/16 inch welding rods into fuel cell liner cutout, one toward front spar and one toward rear spar, routing rods behind inboard fuel cell liner and along bottom inside radius of rib flange. (See detail.) Leave rods in this position. They will be removed later.

e. Cover hole in rib through which the fuel cell's outlet nipple fits, and cover all drain holes in bottom of wing skin between Stations 80.31 and 127.25 with masking tape.

f. Level aircraft longitudinally.

g. Reseal the fuel cell cavity area of one wing at a time, using a sloshing compound that meets MIL-S-4383B specifications. Two sources of this sloshing compound are:

1. Products Research & Chemical Corporation - Gloucester City, New Jersey (Part No. 1005-L)

2. Coast Pro-Seal Company - Compton, California (Part No. 444R)

(a) Pour two quarts of the sloshing compound into the two inboard fuel cell mounting bracket holes in the liner and the liner cutout area of the left wing, so that the compound will flow under the fuel cell liner and be distributed fore and aft along the rib to skin junction.

(b) Place jack under jack pad of right wing and raise until left wing is level on underside. This action will distribute the sloshing compound laterally along the rear and front spar skin junctions. Let the aircraft sit in this position for ten (10) minutes and then remove jack.

(c) Perform Steps (a) and (b) on the right wing.

h. Open drain holes in bottom of wing skins to allow excess sloshing compound to drain out. Return aircraft to normal ground attitude and let drain for one (1) hour.

i. Allow the sloshing compound to dry for twenty-four (24) hours and then remove the two 1/16 inch welding rods from both wings.

j. Retape liner cutout area at inboard end of fuel cell cavities. Also clean out drain holes on bottom wing skins of any buildup of sloshing compound.

k. Reinstall inboard fuel cells in accordance with Paragraph 9-11.

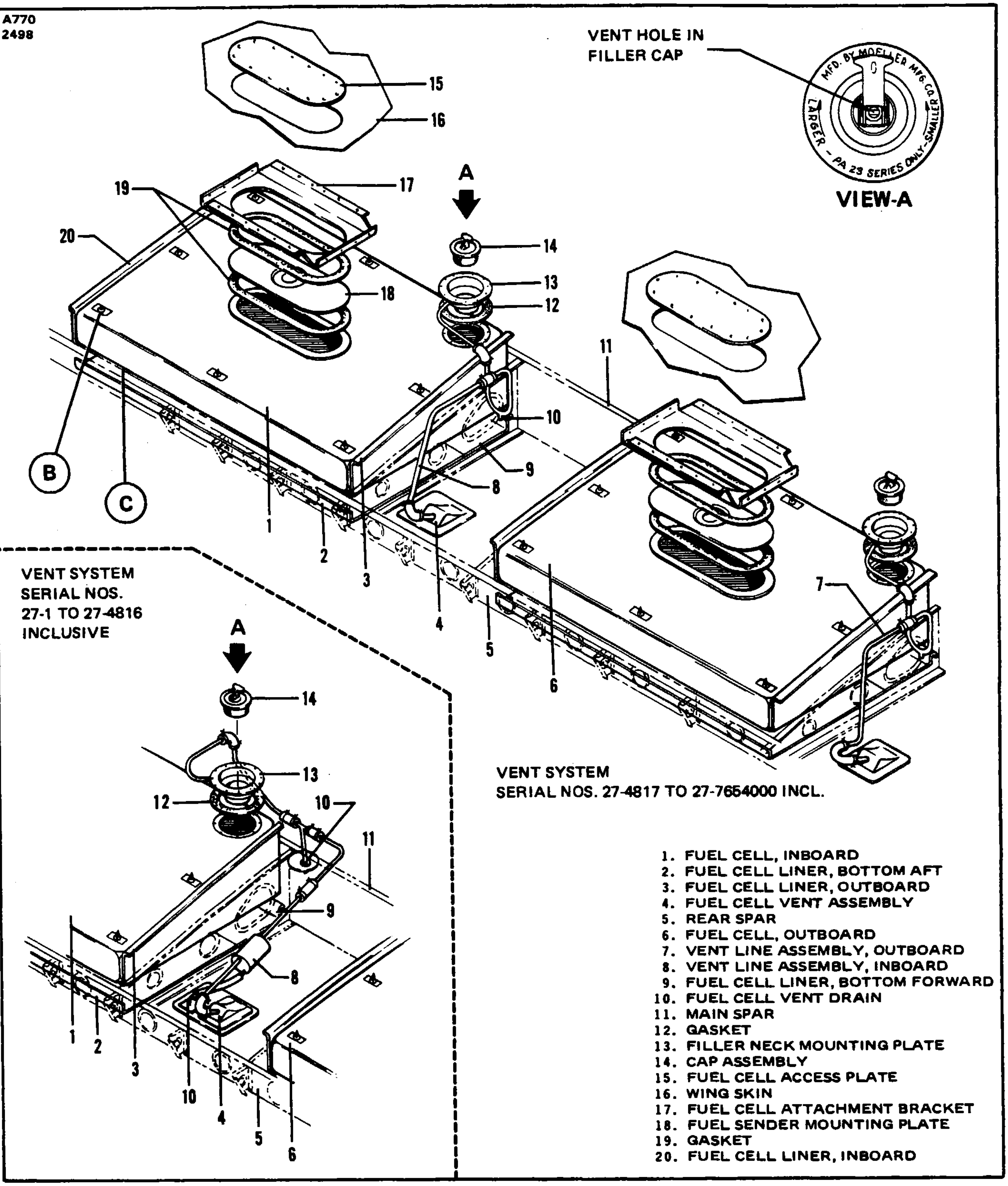
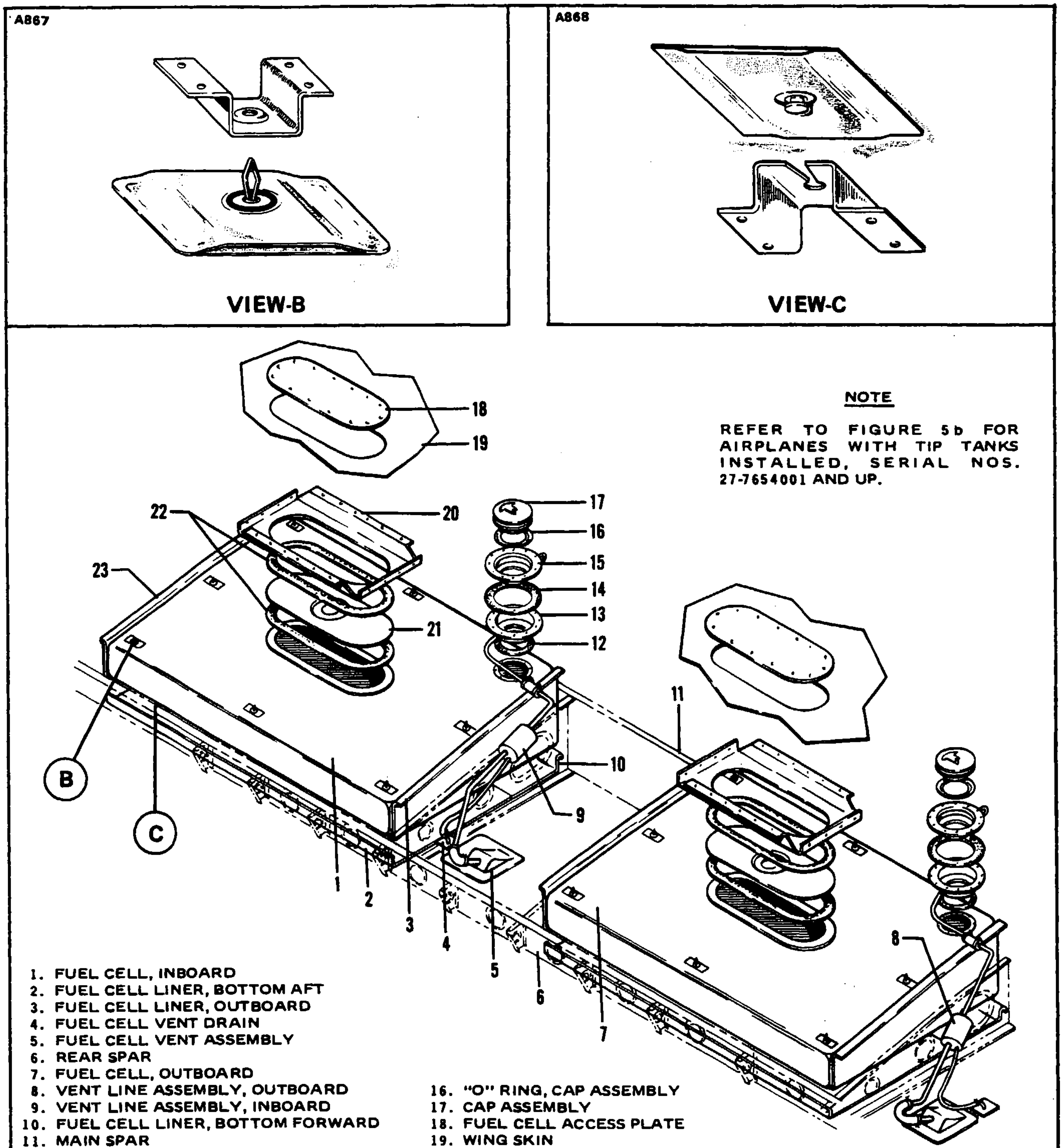


Figure 9-9. Fuel Cell Installation and Vent System
(Serial Nos. 27-1 to 27-7654000 inclusive)



1. FUEL CELL, INBOARD
2. FUEL CELL LINER, BOTTOM AFT
3. FUEL CELL LINER, OUTBOARD
4. FUEL CELL VENT DRAIN
5. FUEL CELL VENT ASSEMBLY
6. REAR SPAR
7. FUEL CELL, OUTBOARD
8. VENT LINE ASSEMBLY, OUTBOARD
9. VENT LINE ASSEMBLY, INBOARD
10. FUEL CELL LINER, BOTTOM FORWARD
11. MAIN SPAR
12. GASKET
13. FILLER NECK MOUNTING PLATE
14. GASKET, FILLER NECK
15. ADAPTER ASSEMBLY
16. "O" RING, CAP ASSEMBLY
17. CAP ASSEMBLY
18. FUEL CELL ACCESS PLATE
19. WING SKIN
20. FUEL CELL ATTACHMENT BRACKET
21. FUEL SENDER MOUNTING PLATE
22. GASKET
23. FUEL CELL LINER, INBOARD

Figure 9-10. Fuel Cell Installation and Vent System
(Serial Nos. 27-7654001 and up)

9-10. MOLDED NIPPLE FITTINGS. The molded nipple fitting is a lightweight fitting developed for ease in installation in certain locations in the airplane. In order to get the best service from this type fitting, it is necessary to exercise certain precautions at the fime of installation. The specific precautions other than the general care in handling are as follows:

a. Insert the flow tube into the fitting until the end is flush with the inside edge of the nipple.

b. The hose clamp must be clear of the end of the fitting by one-quarter inch where possible.

c. Locate the hose clamp on the fabric reinforced area of the nipple.

d. Tighten hose clamp snug. Do this once. Do not re-tighten unless hose clamp is loosened completely and allowed to set for 15 minutes before retightening.

e. Do not use sealing paste or gasket compound.

f. Apply a thin film of Simonize Wax to metal flow tubes to facilitate installation and removal.

9-11. INSTALLATION OF FUEL CELL. (Refer to Figure 9-9.)

a. To allow hook-up of all cell fasteners, note location of each fastener bracket. Do not use sharp tools such as files and screwdrivers for installation purposes.

b. Fold the cell and insert it through the oval opening in the top of the wing.

NOTE

On aircraft with Serial Nos. 27-7654001 and up with tip fuel cells installed, refer to Paragraph 9-12 for installation instructions.

CAUTION

Use care when inserting the fuel cell so as not to cut or damage the cell.

c. Unfold the cell within the wing and position the outlet neck through its hole inside the wing.

d. Fasten the button type fasteners located on the bottom of the cell and then the bayonet type clips on the top, to their respective brackets. Draw each button fastener inward toward the center of the cell cavity to engage it into its bracket. Early cells have locating tabs at each fastener, located inside the cell; later cells do not have these tabs, though installation is similar. Grip the tab or the cell area around the fastener and insert the fastener into its bracket.

e. Reach inside the fuel cell and position the filler opening to the filler neck plate and gaskets. Secure with attaching bolts and washers. If optional sight gauge is installed secure with same procedure.

f. Replace the two oval gaskets and sender unit mounting plate on oval opening to cell. Insert locating pins (P/N 18551-00) to align the gaskets and plate with the twenty four holes in the cell. Pull the pins through the bolt holes in the wing opening and safety temporarily.

Place lock washers under the bolt heads. Turn the 24 bolts in by hand and tighten to 25 inch-pounds with a torque wrench and special torque wrench adapter (P/N 18642-00).

g. Connect the sender unit wires.
h. Tighten the clamp on the cell outlet neck.
i. Check the fuel sender unit as described in Paragraph 9-14.
j. Check for fuel leaks at all fittings.
k. Install access plates.

9-12. INSTALLATION OF WING TIP FUEL CELL. (Refer to Figure 9-8.)

a. Inspect the tip cell cavity for sharp edges.
b. Place tape over the edges of the oval access opening in the tip rib to prevent damage to the fuel cell.

CAUTION

Do not use sharp tools such as files or screwdrivers for installation purposes.

c. Roll the cell into the shape and size that can be inserted through the oval access opening in the tip outboard rib.
d. Insert and unroll the cell establishing the correct relationship of the cell to the tip compartment.
e. Feed the nylon cord through the cell hangers and the tip ribs; draw the cords tight and tie each end as shown in Figure 9-7.)
f. Install the fuel filler neck assembly and secure to fuel cell with screws. The gasket should be positioned between the filler neck plate assembly and the fuel cell outer ring. Torque cap bolts to 25 inch-pounds.
g. Wipe the inside of the cell clean of all dirt and foreign material with a clean, lint free tank cloth, and inspect for cleanliness.
h. Hold the wing tip in position next to the wing and insert the crossover tubes. Install the clamps on the external tip cell nipples. Ascertain that each crossover tube is grounded. Connect electrical wiring.

NOTE

Position clamps on the external nipples with the screw heads positioned so they will be accessible through the access holes in the skins.

i. Secure wing tip to the wing with the attachment screws and insert wing tip hinge pin. Secure the end of the pin.
j. Reach into the outboard fuel cell and install the clamp on the large internal nipple.
k. Install the outboard fuel sender unit; torque cap bolts to 25 inch-pounds. Connect electrical leads and install the oval access plate.
l. Install the tip sender unit; torque cap bolts to 25 inch-pounds. Install access plate.
m. Connect the fuel cell vent line. Ascertain that word "Hinge" on vent check valve is in the up position when installing fuel cell vent line.

n. Install the oval access cover in the tip rib with a gasket on each side of the rib and torque cap bolts to 25 inch-pounds.

o. Place enough fuel in the cells to check for any leakage around the crossover tubes.

p. Install the access plates on the upper and lower skins.

q. Connect the navigation light wires and install the wing tip fairing.

r. Install deicer boots, if equipped, per instructions in Section XIV.

9-13. HANDLING AND STORAGE OF FUEL CELLS. When synthetic rubber fuel cells are placed in service, the gasoline has a tendency to extract the plasticizer from the inner liner of the fuel cell. This extraction of plasticizer is not detrimental as long as gasoline remains in the fuel cell, inasmuch as the gasoline will act as a suitable plasticizer. When the gasoline is drained from the fuel cell, the plasticizing effect of the gasoline is lost and the inner liner of the fuel cell begins to dry out and subsequent cracking will occur. This cracking may penetrate through the walls of the cell after the cell has been refueled. To prevent this failure from affecting serviceable fuel cells which previously contained gasoline and are now to be stored for more than 10 days in the airplane or in storage, a thin coat of engine oil should be applied to the inner liner of the cells. If it becomes necessary to return cells to the contractor, they should be repacked as nearly similar to the original factory pack as possible.

a. Do not drag or handle the fuel cells any more than necessary by their molded nipple fittings, cell openings or attachment fittings.

b. Store cells at room temperature with no more than normal humidity.

c. Do not allow the cells to remain any longer than necessary under strong light.

d. When storing the cells, store in such a manner that their shipping containers are placed level and will not crush the cells. When necessary to stack more than one high, see that the containers are placed squarely on each other so as to preclude any danger of slipping and the sharp edge of one container perforating another.

9-14. REPAIR OF FUEL CELL.

CAUTION

No repairs are to be made on the radius of a cell or in the fitting area of a cell. Cells with such damage are to be returned to the factory for repairs. No damaged areas such as cuts and tears larger than one inch are to be repaired in the field. Return cells to: U.S. Rubber Co.,Fuel Cell Dept., Mishawaka, Indiana.

NOTE

To determine if the fuel cell is repairable, reach through the fuel cell access plate and take a section of cell between thumb and forefinger. Wipe the ridge created by this action with Methylethylketone. If fine cracks are evident, the fuel cell is not repairable.

NOTE

For the following procedure use Piper Fuel Cell Repair Kit, P/N 754 321.

a. Outside of Cell:

1. Use a piece of synthetic rubber coated fabric (U.S. Rubber 5200 outside repair material) large enough to cover damage at least two inches from cut in any direction. Buff this material lightly and thoroughly with garnet paper and wash with Methylethylketone (U.S. Rubber Co. 3339 solution) to remove buffing dust.

2. Cement buffed side to patch with two coats of U.S. Rubber Co. 3230 cement or Minnesota Mining Co. EC-678. Allow each coat to dry 10 to 15 minutes.

3. Buff cell area to be patched lightly and thoroughly with garnet paper and wash with 3339 solution to remove buffing dust.

4. Cement buffed area with two coats of U.S. Rubber 3230 or Minnesota Mining Co. EC-678 cement. Allow each coat to dry 10 to 15 minutes.

5. Freshen cemented area of patch and cemented area of cell with 3339 solution.

6. While still tacky, apply edge of patch to edge of cemented area on the cell. With a roller or blunt instrument, roll or press the patch to the cemented area and roll or press it down a half-inch to an inch across at a time so as not to trap air between patch and cell. Lay 50 pound shot bag over patch which is protected by a piece of Holland Cloth to prevent sticking. Weight should not be removed for six hours.

7. Seal coat edge of patch one-half inch with one coat of U.S. Rubber 3230 or Minnesota Mining Co. EC-678 cement and allow the cement to dry thoroughly.

b. Inside of Cell:

1. After the damaged area has been patched on the outside of the cell and the repair allowed to stand a minimum of six hours, the cell is then ready to have the patch applied on the inside of the cell.

2. Lightly and thoroughly buff a piece of cured U.S. Rubber 5200/5187 nylon sandwich material large enough to cover damage at least two inches from cut in any direction. Wash buffing dust off patch with Methylethylketone solution (U.S. Rubber 3339).

3. Cement buffed side of patch with two coats of black rubber cement, U.S. Rubber 3230 or Minnesota Mining Co. EC-678 and allow each coat to dry 10 to 15 minutes.

4. Buff cell area to be patched lightly and thoroughly with fine sandpaper ("0") and then wash off buffing dust with Methylethylketone solution (U.S. Rubber 3339).

5. Coat buffed area with two coats of black rubber cement, U.S. Rubber 3230 or Minnesota Mining Co. EC-678, and allow each coat to dry 10 to 15 minutes.

6. Freshen cemented area of patch and cemented area of cell with Methylethylketone solution (U.S. Rubber 3339).

7. While still tacky, apply edge of patch to edge of cemented area, centering patch over cut in cell. With a roller or blunt instrument, roll or press the patch to the cemented area on the cell. Hold part of patch off the cemented area and roll or press it down a half-inch to an inch across at a time so as not to trap air between patch and cell. Apply 50 pound shot bag to repaired area and do not disturb for six hours.

8. Seal coat patch and one-half inch from edge of patch with two coats of U.S. Rubber 3230 or Minnesota Mining Co. EC-678 cement. Allow the first coat to dry one hour or more. Wipe patch and cemented area lightly with No. 10 oil, so that when the cell is in its original position, the patch area will not stick to other areas of the cell.

c. Scuffed Fabric:

1. Buff area surrounding scuffed fabric.
2. Wash buffing dust from area with 3339 solution.
3. Apply two coats of U.S. Rubber 3230 or Minnesota Mining Co. EC-678 cement to the buffed area, allowing 10 minutes drying time between coats.

9-15. TESTING FUEL CELLS. When cells are removed from the airplane for suspected leakage, the following method for locating leaks may be used. This method may also be employed after local repairs have been made to check both the efficiency of the repair and presence of other leaks not originally found.

a. Materials Needed:

1. Commercial or household ammonia (28-29% concentration).
2. Indicator solution - contents per gallon as follows:
   (a) 1/2 gallon of distilled water.
   (b) 1/2 gallon of denatured alcohol.
   (c) 15 grams of phenolphthalein crystals or powder.

NOTE

New phenolphthalein-ammonia solution must be prepared each shift and clean or new cloths shall be used each shift.

3. Approximately three yards of balloon cloth or airplane cloth.

b. Procedure:

1. Pour ammonia on an absorbent cloth at the rate of 3cc per cubic foot of cell capacity with a minimum of 10cc. Place saturated cloth inside cell.
2. Close all openings and apply positive test air pressure of 1/4 to 1/2 psi.

CAUTION

Extreme caution must be maintained to prevent cover plates from damaging or cutting the cell during installation, phenol test, deflation and removal.

NOTE

Unsupported tests must be conducted on a level, dirt free surface having no sharp projections or anything which could damage the inflated cell. An unsupported bladder cell can be inflated only to a pressure of 1/4 to 1/2 psi. Any pressure in excess of this will cause damage or rupture of the cell.

3. Soak cloth in phenolphthalein indicator solution.
4. Wring out cloth and spread evenly and smoothly over area of cell being checked.
5. Check all surfaces of cell. Leaks will be indicated by the appearance of pink spots on the cloth.

9-16. FUEL QUANTITY INDICATING SYSTEM.

NOTE: On the latest models of the PA-23-250 (six place), there are fuel gauges installed on the wing tips, left and right. (See Paragraph 9-18 for installation and removal procedures.)

9-17. CHECKING FUEL QUANTITY INDICATING SYSTEM.

NOTE: If you have been asked to check the fuel quantity indicating system, there is probably something wrong with it; write down the answers to the following questions, to speed up troubleshooting. Have the pilot bring the plane in near empty, if it is easier for you to add fuel than to take it out.

1. Is the problem INTERMITTENT? (You have to start out knowing whether the bad part or wire always checks bad.)
2. Is one side OK? (If so, swapping sender wires , at the instrument cluster, is an easy way to check a suspected bad gauge.)
3. Is the problem a fuel quantity needle that sometimes jumps up too high or to the FULL peg? (More sender ohms condition reads more fuel, so a dirty fuel tank switch or worn out sender wiper, that momentarily open the sender circuit, cause the needle to momentarily jump up toward the FULL peg.)

a. General checking of the system.

1. Completely drain the fuel cells that relate to the gauge that is to be checked. (Refer to Draining Fuel Cells, Section II.)
2. Level the airplane longitudinally and laterally. (Refer to Leveling, Section II.)
3. Ascertain that the crossfeed valve is closed.
4. Connect a 1428-volt power supply to the airplane electrical system and observe the fuel quantity gauge. It should read empty with the respective fuel selector lever at both the inboard and outboard ON positions.
5. Add fuel to each cell in the amount of 9.0 U.S. gallons to the outboard cell and 9.0 gallons to the inboard cell, to bring each cell to one-quarter its full capacity.
6. Again move the selector lever to both ON positions and observe the gauge. At either position the quantity pointer should align with any part of the one-quarter index of the gauge.
7. Continue to add fuel in 9.0-gallon increments to the outboard and inboard cells for each quarter capacity of the cells. At each quarter increment, until full, check that the quantity pointer aligns with any part of the index, with the selector lever at either ON position.
8. Should the gauge and the amount of fuel in the cell not correspond, unscrew the belly pan, to disconnect or unplug the sender wires from the FUEL TANK SWITCHES. Drain fuel, in 1/4 tank increments, while watching an ohm meter connected to the appropriate sender wire, and write down the five quarter tank readings from each of the four tanks. EMPTY should read zero to one ohm. Each 1/4 tank of fuel should add about 7 or 8 ohms, so FULL should read about 30 ohms. This will help you decide whether to go on to step b., or c., or d.

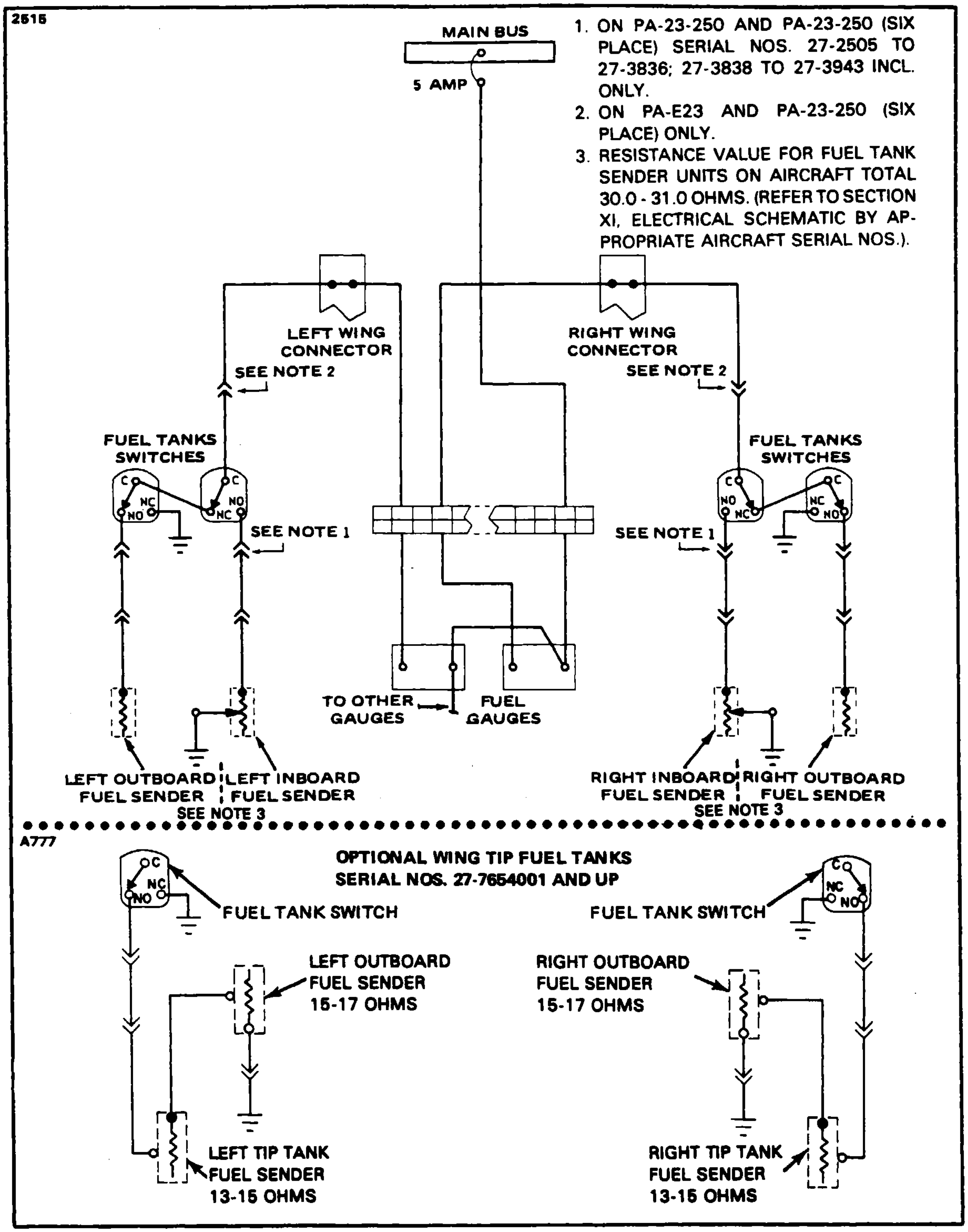


Figure 9-11. Fuel Indicating System Wiring Schematic

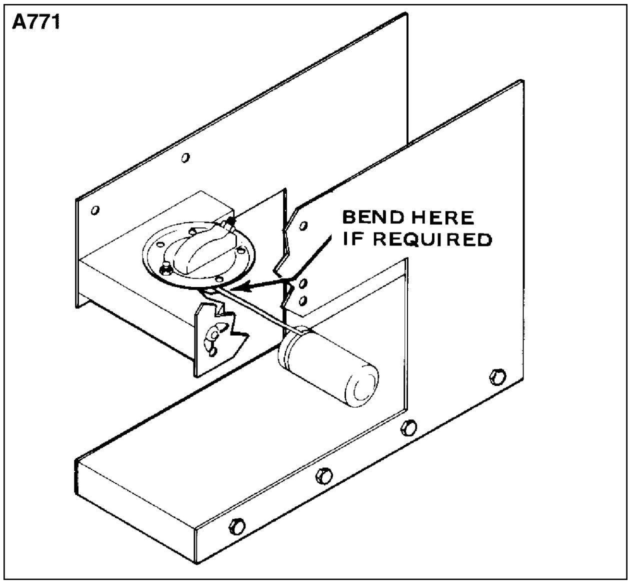


Figure 9-12. Checking Fuel Quantity Sender

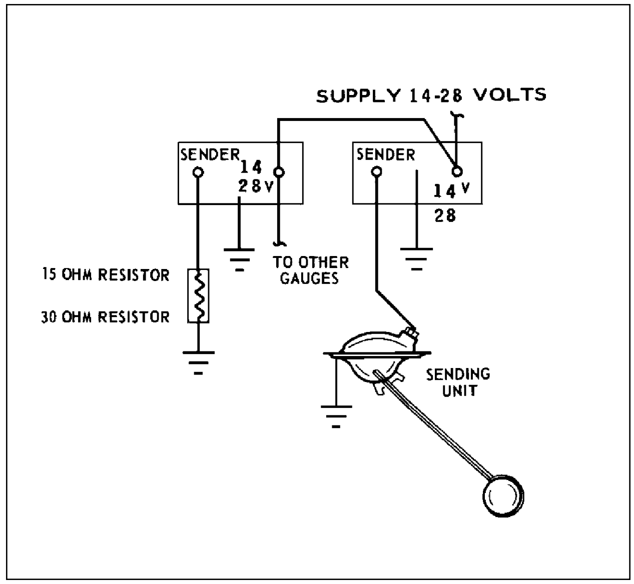


Figure 9-13. Checking FuelGauges Schematic

b. Sender Check:

1. Remove the fuel sender to be checked. (Refer to Paragraph 9-19.)
2. Secure the sender in the appropriate position on the fabricated jig as shown in Figure 9-12. (Fabricate the jig from dimensions given in Figure 9-28.)
3. With the float arm against the bottom stop, the float should be just touching the base of the jig. If the float arm is not touching the base of the jig or the bottom stop, adjust the float by bending the arm at a position shown in Figure 9-12.
4. After the sender has been adjusted, check for the proper amount of resistance by the following procedure:
   (a) Connect an ohmmeter to the sender unit.
   (b) Position the float arm against its bottom stop and ascertain the ohmmeter indicates 0.00 ohms resistance.
   (c) Slowly move the float arm from the bottom stop to the top stop while watching the ohmmeter indicator. The ohmmeter needle should steadily move up, without fluctuation, as the float arm is moved.
   (d) With the float arm against its top stop, the ohmmeter should indicate the following:
      (1) Without tip tank—inboard and outboard 30.0 to 31.0 ohms.
      (2) With tip tank—inboard 30.0 to 31.0 ohms; outboard 15.0 to 17.0 ohms; tip tank 13.0 to 15.0 ohms.

If incorrect resistance or fluctuation is found, the sender should be replaced.

c. Wiring Check: (Refer to Figure 9-13.)

1. Check all ground connections throughout the indicating system for corrosion or loose connections that may cause excessive resistance in the circuit.
2. Check all splices and terminal connections for corrosion and security.
3. Check wiring between connections for excessive resistance due to frayed or broken strands.

d. Gauge check:
  1. Sender Method:
    (a) Position and secure a calibrated sender to the fabricated checking jig.

CAUTION

Make certain the sender restrictor is connected to the proper side of the gauge.

    (b) Connect the sender directly to the gauge being checked using No. 16 or larger wire. (Refer to Figure 9-13.)
    (c) Connect a 14-28 volt power supply to the electrical system of the airplane.
    (d) Operate the power supply and move the sender float arm through its travel. Ascertain that the empty and full positions of the sender and the gauge correspond. If not, the gauge should be replaced.
  2. Resistor Method:
    (a) Connect a 15 ohm resistor to the sender unit of the gauge being checked. (Refer to Figure 9-13.)
    (b) Connect a 14-28 volt power supply to the electrical system of the airplane.
    (c) Operate the power supply and ascertain the gauge indicates one-half full.
    (d) Repeat the procedure using a 30 ohm resistor which should cause the gauge to indicate full.
    (e) If the gauge does not indicate properly, it should be replaced.

9-18. REMOVAL AND INSTALLATION OF WING TIP FUEL SIGHT GAUGE. (On latest models of PA-23-250 (six place) only.)

a. Remove gauge by removing inner circle of screws which fasten gauge to gasket and plate.
b. Withdraw first the gauge, then the arm and float.
c. To install gauge, place the arm and float in wing then secure gauge to gaskets and plates with screws.

9-19. REMOVAL OF FUEL SENDER.

a. Remove the screws attaching the oval access plate to the top of the wing and remove the plate.
b. Disconnect the two electrical leads from the sender.
c. Remove the screws and washers attaching the sender to the mounting plate and remove the sender.
d. On aircraft with tip tanks installed (serial nos. 27-7654001 and up), an additional sender unit is mounted in the tip tank. Remove the tip tank sender unit as follows:
  1. Remove the screws attaching the round sender unit cover to the top of the wing tip.
  2. Disconnect the electrical leads to the sender unit.
  3. Remove the screws attaching the sender unit to the fuel cell mounting plate and carefully withdraw the sender with the gasket from the fuel cell.

9-20. INSTALLATION OF FUEL SENDER.

a. Position the fuel sender to its mounting plate inside the wing. The sender should be installed with the float arm forward.

b. Secure the sender with machine screws and washer.

c. Connect the electrical leads. Connect the lead coming through the wing to the terminal post of the fuel sender. Connect the sender ground strap to one of the mounting plate attaching bolts.

d. Install the oval access plate to the top of the wing.

e. On aircraft with tip tanks installed (serial nos. 27-7654001 and up), install the tip sender unit as follows:

1. Install the gasket on the sender unit and insert the sender unit into the fuel cell with the float arm and float facing outboard.
2. Secure the sender unit with machine screws and washers; connect the ground lead to one of the sender unit mounting screws, and torque all screws evenly to 25 inch-pounds.
3. Connect the positive lead to the sender unit terminal and install access cover.

9-21. FUEL SELECTOR VALVES. (PA-23-250; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2222 incl.)

CAUTION: NO FIELD DISASSEMBLY OR REPAIR OF FUEL SELECTOR VALVES IS AUTHORIZED. MAINTENANCE IS LIMITED TO REMOVAL AND REPLACEMENT OF THE WHOLE UNIT.

9-22. REMOVAL OF FUEL SELECTOR VALVE. (Refer to Figure 9-15.)

a. Remove the aft bottom section of the nacelle by removing attaching screws.

b. Drain the appropriate fuel cell or cells for the selector valve or valves to be removed. (Refer to Draining Fuel System, Section 11.) Close the crossfeed line.

c. Remove the fuel selector for the outboard fuel cell by the following procedure:

1. Disconnect the operating rod and control cable from the valve arm removing the cotter pin and pin.
2. Disconnect the fuel lines from the valve fittings.
3. Remove the valve assembly by removing the two machine screws and self-locking nuts, installed through the valve assembly.

d. Remove the fuel selector for the inboard fuel cell by the following procedure:

1. Disconnect the operating rod from the valve arm if not previously disconnected at the opposite end.
2. Disconnect the fuel lines from the selector valve and fuel strainer fittings.
3. Remove the valve and strainer assembly by removing the two machine screws and self-locking nuts installed through the valve.
4. Separate the selector valve and fuel strainer.

9-23. DELETED.

9-24. DELETED

9-25. DELETED

9-26. LEAK TEST OF FUEL SELECTOR VALVE.

a. Connect the inlet port of the valve to a 50 psi air source.

b. Close valve, apply pressure to 50 psi and submerge in kerosene or a similar petroleum base fluid for two minutes.

c. There should be no evidence of leakage through the valve port around the seat.

d. Disconnect air source and wipe fluid from exterior of valve.

9-27. INSTALLATION OF FUEL SELECTOR VALVE. (Refer to Figure 9-15.)

a. Install the selector valve for the inboard fuel cell by the following procedures:

1. Assemble all fuel line fittings, if previously removed, and fuel strainer to the selector valve,
2. Position the valve and strainer to the mounting bracket inside the aft bottom section of the appropriate nacelle. Install the two machine screws and self -locking nuts securing the units in place.
3. Connect the fuel lines to the valve and strainer fittings.
4. Connect the operating rod to the valve arm, if previously disconnected, and check for proper adjustment. (Refer to Paragraph 9-28.)

b. Install the selector valve for the outboard fuel cell by the following procedure:

1. Assemble all fuel line fittings, if previously removed, to the selector valve.
2. Position the valve to the mounting bracket inside the aft bottom of the appropriate nacelle. Install the two machine screws and self-locking nut, securing the valve in place.
3. Connect the fuel lines to the valve fittings.
4. Connect the operating rod and control cable to the valve arm and check for proper adjustment. (Refer to Para. 9-28)

c. Fill the fuel cell or cells and allow fuel to flow through the valves. Check for leaks.

d. Install the aft bottom section of the nacelle.

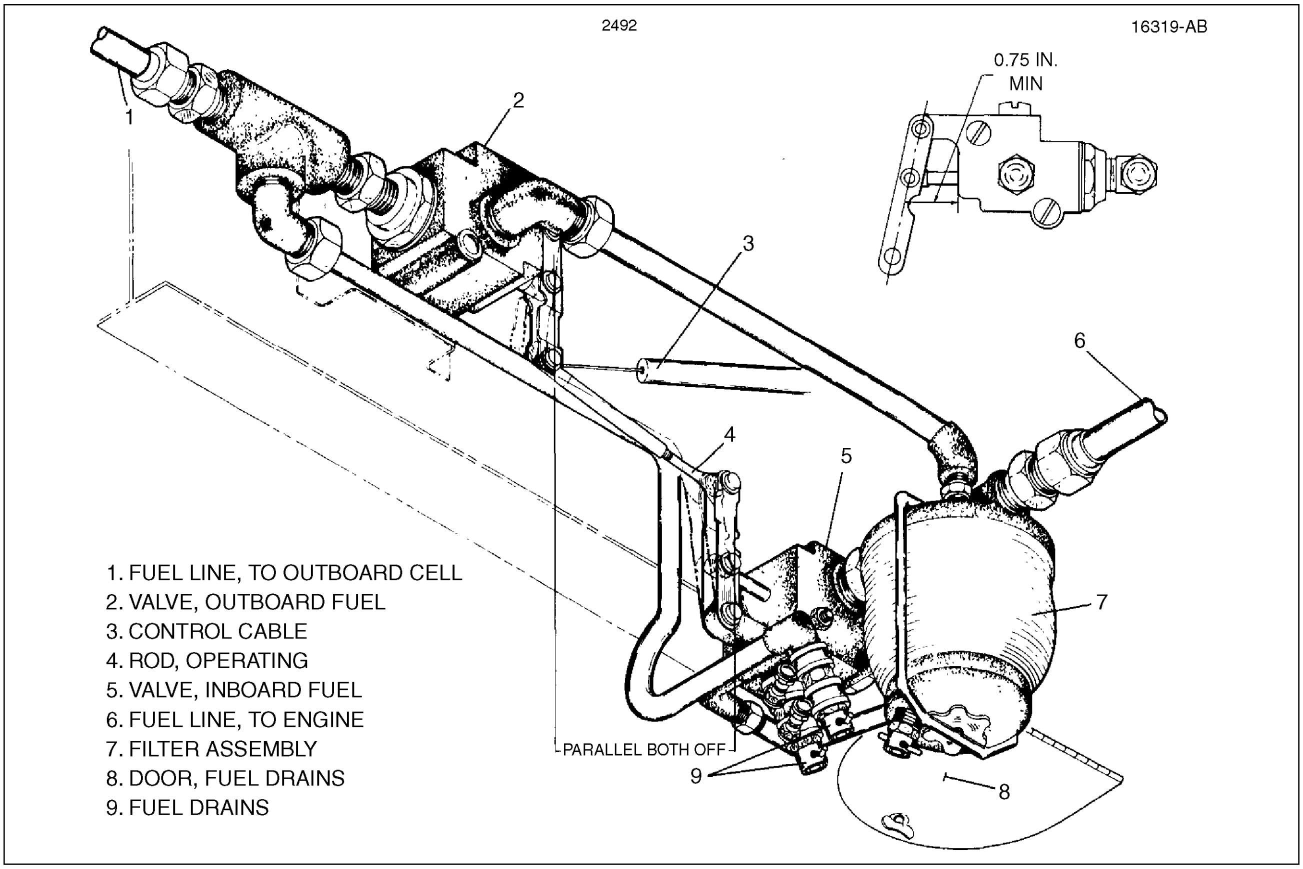


Figure 9-15. Fuel Selector Valve Installation
PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.

9-28. ADJUSTMENTS FOR FUEL SHUT-OFF VALVE CONTROLS. (Refer to Figure 9-15.)

a. With fuel valve controls disconnected at switch actuating arm (under front floorboard) place valve control levers (in cockpit) in “OFF” position.

b. Adjust the position of the valve arms on the inboard tank valve and the outboard tank valve so that they are parallel to each other.

c. Move each valve to the “ON” position and measure distance between valve face and valve arm attachment pin centerline. A 3/4-inch minimum dimension is required here to obtain adequate fuel flow.

NOTE: If this distance is less than 3/4 inch, adjust the connector rod until 3/4 inch is obtained.

d. Reposition valve arms as described in step “B” (both OFF) and secure control cables at switch actuating arm with switch actuating arm in neutral position between switches.

e. Move inboard valve control lever (in cockpit) to “ON” position and check position of valve arm on outboard tank valve. The arm stop bushing must contact the valve face. Move outboard valve control lever to “ON” position and check. The inboard tank valve stop bushing must contact the valve face.

9-29. FUEL SELECTOR VALVE. (Three-way valve) (PA-23-235 and PA-23-250 (six place), S/N's 27-2223 thru 27-7305126.)

CAUTION: NO FIELD DISASSEMBLY OR REPAIR OF FUEL SELECTOR VALVES IS AUTHORIZED BY PIPER. MAINTENANCE IS LIMITED TO REMOVAL AND REPLACEMENT OF THE WHOLE UNIT.

NOTE: In these airplanes, if either fuel selector exhibits binding, sticking, or is otherwise difficult to operate, perform Fuel Selector Control Cable Wire 100 Hour Inspection as a first step. If the condition persists, see AD 80-18-10.

9-30. REMOVAL OF FUEL SELECTOR VALVE. (Refer to Figure 9-17.)

a. Remove the aft bottom section of the nacelle by removing attaching screws.

b. Drain the appropriate fuel cells. (Refer to Draining Fuel System, Section 11.)

c. Disconnect the control cable from the control arm by removing the cotter pin and loosening the nut. Draw the wire from the stud.

d. Disconnect the fuel line from the fuel selector valve and strainer fittings.

e. Remove the selector valve and strainer by removing the four machine screws and self -locking nuts installed through the valve assembly.

f. Separate the valve and strainer.

9-31. DELETED

9-32. DELETED

9-33. DELETED

9-34. LEAK TEST OF SELECTOR VALVE.

a. Connect the inlet port of the valve assembly to a 24 psi source.

b. Plug the right-hand port and close the left-hand port by placing the control lever to the right.

c. Apply pressure to 24 psi, There shall be no evidence of leakage either through the port or around the fitting and lever when submerged in kerosene or a similar petroleum-base fluid for 30 seconds.

d. Depressurize, remove the plug from the right hand port, place on left hand port and close right hand port by placing the lever to left.

e. Repeat step c.

f. Disconnect and wipe fluid from exterior.

9-35. INSTALLATION OF FUEL SELECTOR VALVE.

a. Assemble the line fittings, if previously removed, and the strainers to the selector valve.

b. Position the valve and strainer inside the aft bottom section of the appropriate nacelle. Install the machine screws and self -locking nuts, securing the units in place.

c. Connect the fuel lines to the valve and strainer fittings.

d. Connect the cable wire to the valve arm and check for proper adjustment. (Refer to Paragraph 9-36.)

e. Fill fuel cells allowing fuel to flow through the valve. Check for leaks.

f. Install the aft bottom section of the nacelle.

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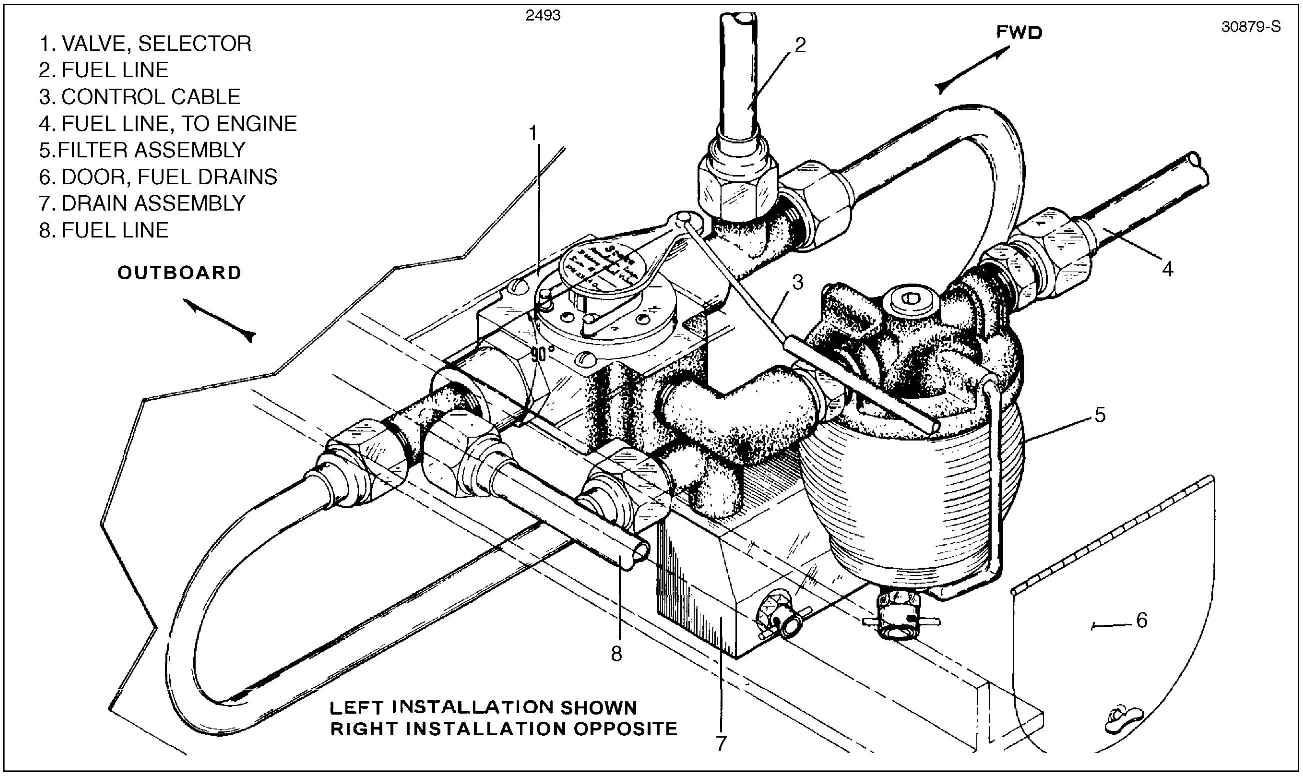


Figure 9-17. Fuel Selector Valve Installation (Scott)
PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2223 to 27-7305126 incl.

9-36. ADJUSTMENT AND LUBRICATION OF FUEL SELECTOR VALVE. (Refer to Figure 9-17.)

a. Lubrication.

Lubricate the fuel selector valve control system with MIL-G-3278 (or equivalent) as follows:

1. Lubricate the detent sprocket on the fuel selector valves.
2. Disconnect the control cables from the fuel selector valves and the cockpit fuel control levers.
   (a) Lubricate the control cable wire the full length it runs through the control cable flexible housing.
   (b) Reconnect the control cables to the cockpit fuel control levers only and operate the control levers through their full range of motion to verify free and correct movement of the control cable system.
3. Reconnect the control cables at the fuel selector valves.
4. Lubricate the control cable swivel fittings attaching the cable to:
   (a) the fuel selector valve.
   (b) the lever in the cockpit.
   (c) the fuel control cable support arm.
5. Lubricate the fuel control cable support arm pivot point.
6. Check system adjustment per Adjustment, below.

b. Adjustment

1. Place the fuel control levers on the fuel control panel box, located between the front seats, in the OFF position. Ascertain that the control cable is connected at the control panel box and clamp at the spar.
2. Place the fuel valve in an OFF position. The fuel valve arm should be at a 90° angle to the spar and can be felt when moved into the OFF position.
3. Clamp the control cable to the spar in the fuselage and at the engine nacelle.
4. Connect and secure the control cable to the shutoff valve.

9-37. FUEL SELECTOR VALVE. (Three Way Valve.) PA-23-235 and PA-23-250 (six place) (Dukes P/N 3564-00-1, -2.)

CAUTION: NO FIELD DISASSEMBLY OR REPAIR OF FUEL SELECTOR VALVES IS AUTHORIZED. MAINTENANCE IS LIMITED TO REMOVAL AND REPLACEMENT OF THE WHOLE UNIT.

9-38. REMOVAL OF FUEL SELECTOR VALVE. (Refer to Figure 9-19.)

a. Remove the aft bottom section of the nacelle by removing attaching screws.

b. Drain the appropriate fuel cells. (Refer to Draining Fuel System, Section II.)

NOTE: In S/N's 27-7954057 and up, remove (noting the order of) two flexible push-pull control cable assemblies (with rod end bearings) from the control arm of the fuel selector valve and proceed with Step d following. Otherwise, (S/N's 27-7954056 and earlier) proceed with Step c following.

c. Disconnect the control cable from the control arm by removing the cotter pin and loosening the nut. Draw the wire from the stud.

d. Disconnect the fuel lines from the fuel selector valve and strainer fittings.

e. Remove the selector valve and strainer by removing the mounting hardware.

f. Separate the valve and strainer.

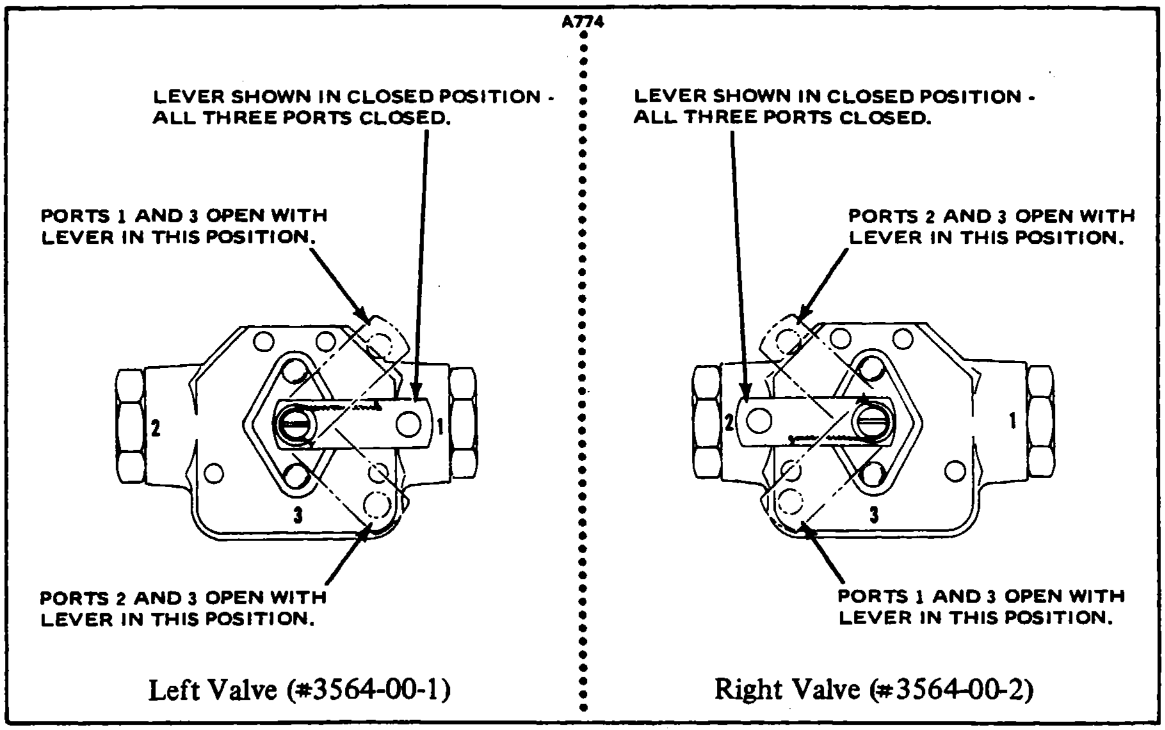


Figure 9-18. Fuel Selector Valve Port Positions

9-39. INSPECTION AND LEAK TEST OF FUEL SELECTOR VALVE. (Refer to Figure 9-18.)

a. Inspect fuel selector valve for proper function. The following function inspection is accomplished with the valve removed from the airplane. (See step b, noted below for function inspection of valve while installed in airplane.)

1. With the selector in the "OFF" position, observe that all three ports are closed.

2. Move the selector lever to either side against the stop. Insert a pipe cleaner or equivalent through the open inlet port. The cleaner should pass through the ball and out port number 3.

3. Move the selector lever to the opposite stop position; use a pipe cleaner to observe that the center and opposite (from step 2) port are open. All lever and port positions must agree with Figure 9-18.

4. If the valve assembly fails any of these steps, remove lever safety wire, screw and washer. Reposition selector lever until all port and lever positions correspond with above inspection as noted in Figure 9-18.

b. Inspect fuel selector valves while installed in the airplane per the following:

1. Ascertain that fuel tanks are full.
2. Turn left and right fuel selector valves and crossfeed valve to off position.
3. At the right and/or left engine compartment(s), gain access to the main fuel feed line at the engine firewall by removing the inboard engine cowl side panels.
4. Disconnect the fuel line from the fitting at the firewall and cap the fuel line to prevent fuel spillage.
5. Place flexible hose over the firewall fitting and place the opposite end of the hose into a five gallon container.

NOTE

Use caution to prevent fuel spillage.

6. Select the "Inboard - Main Tank" position and turn on Emergency Fuel Pump. Observe flow of fuel into container; flow should be full line capacity, indicating proper selector valve function (i.e., no restriction to flow). Allow approximately five gallons to flow into container.
7. Check tank to insure that fuel has been drawn from the selected (inboard) tank.
8. Select "Outboard" tank and repeat step numbers five and six.
9. If no restriction to fuel flow is observed in either tank position, reconnect fuel lines and repeat steps two through seven (above) on opposite engine.
10. Should there be any indication of restricted fuel flow during the above procedure, remove valve from the airplane and conduct function inspection per step a. noted above.

c. Leak test the fuel selector valve using the steps noted below. The valve must first be removed from the airplane. If the following tests indicate a defect, refer to Parts Catalog for replacement valve or components.

NOTE

The leak tests should be conducted with the valve submerged in test fluid of kerosene or similar petroleum-base fluid. The valve should remain submerged when changing lever position.

1. Shaft and cover leak test.
   (a) Plug 1 and 2 ports and position the lever halfway between off position and either stop (neither open or closed). Apply 30 psi air pressure to port 3. There should be no indication of air leakage around the shaft or the cover.
2. Internal leak test.
   (a) Position the lever in the closed position. Apply 13 psi air pressure to port 1.
   (b) Move the lever to the open position for port 2 and back to the closed position.
   (c) There should be no air leakage from port 2 or port 3 during the above open-close cycle.
   (d) Repeat steps (a) through (c) with 2 psi air pressure. This provides a test of valve packing at a lower psi.

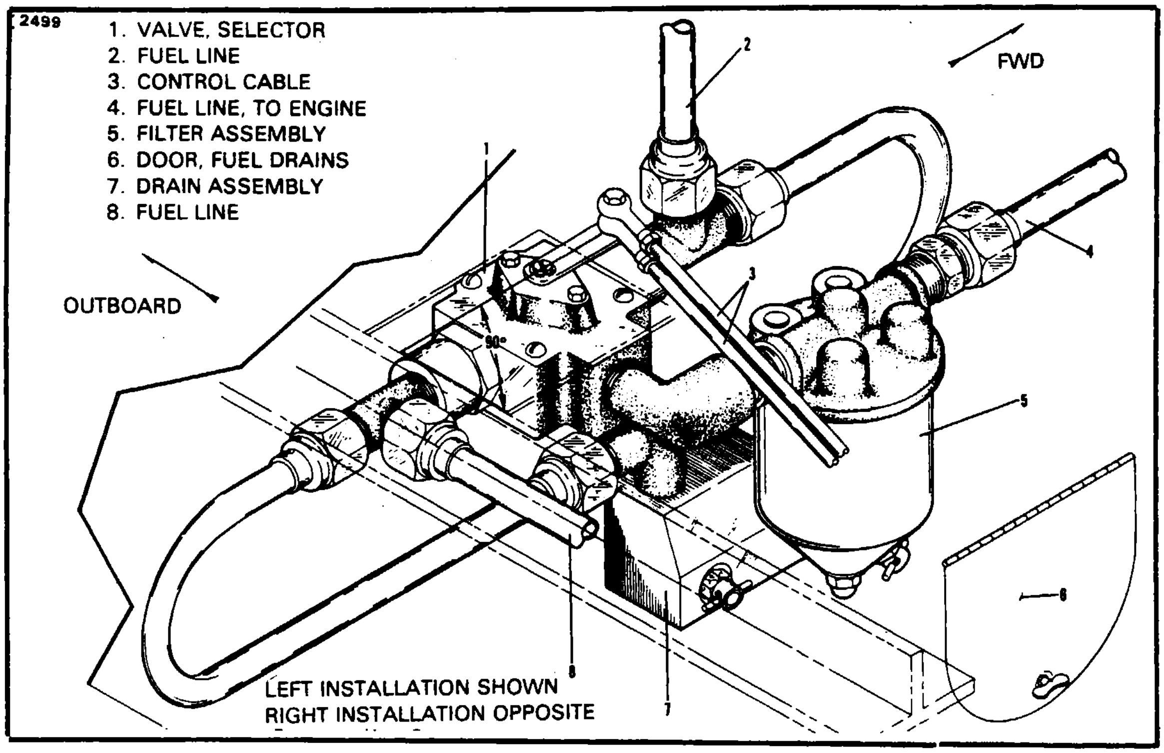


Figure 9-19. Fuel Selector Valve Installation
PA-23-235 and PA-23-250 (six place)
(Dukes P/N 3654-00-1, -2)

(e) Position the lever in the closed position and slowly apply 0 to 15 psi air pressure to port 3. Move the lever 8° clockwise and 8° counterclockwise. There should be no indication of leakage for ports 1 or 2 when the lever is at the closed position or at either 8° position.

d. Check the valve lever for ease of operation from the open position for port 1 to the open position for port 2 (or opposite). Shaft operating torque should not exceed 3 pounds. This includes the breakaway force. The test force must be applied at the lever hole.

9-40. INSTALLATION OF FUEL SELECTOR VALVE. (Refer to Figure 9-19.)

a. Assemble the line fittings, if previously removed, and the strainers to the selector valve. Apply Parker Sealube or equivalent to first thread on elbow.

b. Position the valve and strainer assembly in the mounting bracket and install the machine screws and self-locking nuts securing the unit in place. Do not install mounting screw in the forward inboard hole of the selector valve.

c. Connect the fuel lines to the valve and strainer fittings.

NOTE

On Serial Nos. 27-7954057 and up, reinstall two flexible push-pull control cable assemblies (with rod end bearings) in the reverse order previously removed from the control arm of the fuel selector valve, and adjust lengths per Paragraph 9-42 and the proceed with Step e following. Otherwise, (for Serial Nos. 27-7954056 and earlier) proceed with Step d following.

d. Connect the cable wire to the valve arm and adjust per Paragraph 9-41.
e. Fill the fuel cells and allow fuel to flow through the valve and strainer; check for leaks.
f. Install the aft bottom section of the nacelle.

9-41. ADJUSTMENT AND LUBRICATION OF FUEL SELECTOR VALVE. (PA-23-250 (six place) up to Serial Nos. 27-7954056 incl.)

a. Place the fuel control levers on the fuel control box in the OFF position. Check to be certain the control cable is connected at the control panel box and clamp at the spar.

b. Place the fuel valve in the OFF position. The fuel valve lever should be at a 90 degree angle to the spar. Operate the valve lever and check to be sure the valve detents in the OFF position.

c. Clamp the control cable to the spar in the fuselage and at the engine nacelle.
d. Connect and secure the control cable to the shutoff valve.
e. Lubricate the following points with Exxon Beacon 325 grease:
   1. At the attachment of the control cable to the valve.
   2. Inner member of the control cable.
   3. Attachment of control cable to the lever in the cockpit.

9-42. ADJUSTMENT AND LUBRICATION OF FUEL SELECTOR VALVE. (PA-23-250 (six place), Serial Nos. 27-7954057 and up.)

a. Check to be certain the rod end bearing of the control cable is connected at the control box.

b. With the fuel control lever on the control box held in the off position and the fuel valve in the off position, adjust the effective length of the control cable by proper positioning of the rod end bearing on the cable assembly and mount same to the control arm of the fuel selector valve.

NOTE

OFF position of the control arm is attained with its centerline at 90 degrees with the spar.

c. With the switch actuator (Figure 9-28) centered between the fuel tank switches and the selector valve arm at the OFF position adjust the effective length of the control cable (to the switch actuator) by proper positioning of the rod end bearing on the cable assembly and mount same to the control arm of the fuel selector valve.

d. Secure both rod end bearings to the control arm of the selector valve.

e. Lubricate the inner member of the control cables with Exxon Beacon 325 grease and the rod end bearings with MIL-L-7870.

9-43. FUEL SELECTOR VALVE CONTROL CABLES. (See Figure 9-27.) (PA-23-235, PA-23-250, PA-23-250 (six place), Serial Nos. 27-2000 to 27-7954056 incl.)

9-44. REMOVAL OF FUEL SELECTOR VALVE CONTROL CABLES. (Serial Nos. to 27-7954056 incl.)

a. Remove the outboard control cable by the following procedure:

1. Remove the top aft part of the nacelle by removing attaching screws.
2. Remove the access panel covering the main spar from the bottom section of the nacelle. (Refer to Access and Inspection Provisions, Section II.)
3. Remove the clamps holding the cable next to the selector valve.
4. Disconnect the cable from the selector valve arm.
5. Attach a fish line or similar material to the outboard end of the cable.
6. Remove the clamps holding the cable inside the fuselage on the forward side of the main spar.
7. Disconnect the control cable from the actuator arm on the main spar.
8. Remove the outboard cable drawing it inboard from the wing.

b. Remove the inboard control cable by the following procedure:

1. Remove the access panel covering the main spar from the bottom of the fuselage, if not previously removed. (Refer to Access and Inspection Provisions, Section II.)
2. Remove the clamps holding the cable to the main spar and inside the fuel control box.
3. Disconnect the cable from the actuator arm on the main spar.
4. Disconnect the cable from the control handle assembly inside the fuel control box.
5. Remove the cable.

9-45. INSTALLATION OF FUEL SELECTOR VALVE CONTROL CABLES. (Serial Nos. to 27-7954056 incl.)

a. The outboard cable may be installed by the following procedure:

1. Draw the cable from the fuselage through the wing to the nacelle.
2. Ascertain that the selector valve is in the OFF position and connect the cable end to the valve arm.

NOTE

If the inboard cable is also being installed, perform Steps 3 thru 6 simultaneously with Steps 3 thru 6 of Part b.

3. Position the actuator arm so the screw in the end is centered between the two fuel quantity switches.
4. Insert the cable end to the swivel fitting on the actuator arm.
5. Maintaining an OFF position of the selector valve and the centered position of the actuator arm, tighten the swivel fitting nut and safety with a cotter pin.
6. Install the cable clamps on the main spar and inside the nacelle.

b. The inboard cable may be installed by the following procedure:
1. Position the cable and connect it to the control handle inside the fuel control box.
2. Ascertain that the fuel control handle is in the OFF position.
3. Position the actuator arm so the screw in the end is centered between the two fuel quantity switches.
4. Insert the remaining cable end to the swivel fitting on the actuator arm.
5. Maintaining an OFF position of the control handle and the centered position of the actuator arm tighten the swivel fitting nut and safety with a cotter pin.
6. Install the cable clamps on the main spar and inside the fuel control box.

c. Check the operation of the cable and selector valve. (Refer to Figure 9-27.) Visually check control cable wires at the related swivel fittings for indications of binding, kinking, or bending; have someone in the cockpit operate fuel controls while mechanic inspects the swivel fittings for indications of binding, kinking and/or bending. Replace cables exhibiting any of the above conditions.

d. Check the adjustment of the fuel indicating switches. The actuating screw should be adjusted to actuate the switch and allow free play after actuating, so as not to damage the switch.

e. Install the access panel to the bottom of the fuselage and the top of the nacelle.

9-46. FUEL SELECTOR VALVE CONTROL CABLES. (See Figure 9-28.) (PA-23-250 (six place), Serial Nos. 27-7954057 and up.)

9-47. REMOVAL OF FUEL SELECTOR CONTROL VALVE CABLES. (Serial Nos. 27-7954057 and up.)

a. Gain access to the flexible push-pull fuel control cable assemblies as follows:
1. Release the top aft part of the nacelle by removing the attaching screws.
2. From the bottom section of the nacelle, remove the access panel covering the main spar.
3. From the bottom of the fuselage, remove the access panel covering the main spar and exposing the fuel quantity actuating switch arm.

b. Remove the flexible push-pull fuel control cable assemblies as follows:
1. Disconnect the outboard end of the push-pull cable assembly from the fuel selector control arm by removing the attaching hardware.
2. Disconnect the inboard end of the push-pull assemblies (one from the fuel quantity switch actuator arm and one from the internal arm on the fuel tank control lever) by removing the hardware securing the respective rod-end bearings.
3. Release the outboard ends of both push-pull cable assemblies by removing the cable anchor bracket holding the cable assemblies in place.

4. Release the inboard end of the cable assembly (connected to the fuel quantity switch actuator) by removing the cable retainer holding the cable assembly in place.

5. Attach a fish line or similar material to the outboard end of the cable. Remove the cable by drawing it inboard from the wing.

6. Release the inboard end of the cable assembly (connected to the fuel tank control lever) by removing the cable retainer holding the cable assembly in place.

7. Attach a fish line or similar material to the outboard end of the cable and remove the cable by drawing it inboard from the wing.

9-48. INSTALLATION OF FUEL SELECTOR CONTROL VALVE CABLES. (Serial Nos. 27-7954027 and up.)

a. Draw the cables from the fuselage outboard toward the nacelle.

b. Set the fuel selector valve in the OFF position (with the lever arm at 90 degrees to the wing spar as shown in Figure 9-19.)

c. Assemble and secure the rod-end bearings to the fuel selector valve arm using hardware previously removed. (Be sure the longer of the two control cable assemblies is mounted closest to the selector valve arm.)

CAUTION

Observe standard precautions regarding proper and sufficient thread engagement when assembling and securing rod-end bearings to the selector valve arm.

d. Secure the two cable assemblies in place using the dual cable anchor bracket and hardware previously removed.

e. Secure the sheaths of both cable assemblies within the fuselage, using one cable retainer each and hardware previously removed.

f. With the fuel selector valve arm at 90 degrees with the wing spar (OFF position) and the fuel quantity actuator arm set midway between the fuel quantity switches, set and secure the length of the cable to be connected to the fuel quantity actuator arm.

g. Secure the rod-end bearing to fuel quantity arm. Recheck position of fuel selector valve arm (at 90 degrees with spar) and switch actuator arm (midway between actuating switches). If necessary, readjust length and resecure cable assembly to actuator arm.

h. With the fuel selector lever arm at OFF position (90 degrees with spar) and the fuel tank selector lever in the cabin at "OFF" position, set and secure the length of the cable to be connected to the internal arm of the fuel tank selector lever.

i. Secure rod-end bearing to the internal arm of the fuel tank selector lever.

9-49. FUEL CROSSFEED VALVE.

9-50. REMOVAL OF CROSSFEED VALVE.

a. Remove the two front seats from the airplane.

b. Remove the attaching screws along the sides and bottom of the fuel control box.

c. Remove the crossfeed drain knob from the lower front of the fuel control box by one of the following procedures:

1. On PA-23-235, PA-23-250, and PA-23-250 (six place) airplanes with Serial Nos. 27-2000 to 27-2504, remove the knob by pulling it forward from the stem.

2. On PA-23-250 (six place) airplanes with Serial Nos. 27-2505 and up, remove the knob by removing the socket set screw from the bottom of the knob and pulling it forward from the stem.

d. On PA-23-250 (six place) airplanes with Serial Nos. 27-2505 and up, remove the crossfeed valve knob by unscrewing it from its handle on top of the control box.

e. Lean the box forward away from the main spar cover and remove the machine screws and self-locking nuts from the heater fuel valve handle.

f. Disconnect all quick disconnect fuel lines from the crossfeed valve, crossfeed drain and heater fuel valve.

g. Disconnect the spring from the crossfeed drain valve.

h. Disconnect the crossfeed drain line from the bottom of the crossfeed valve.

i. Remove the two machine screws and self-locking nuts securing the valve to its bracket.

j. Remove the crossfeed valve, crossfeed drain and heater fuel valve from the control box.

k. Separate the fuel valve from the other units.

9-51. DISASSEMBLY OF FUEL CROSSFEED VALVE. (Refer to Figure 9-20.)

a. Remove the end fitting (1) and "O" ring (2) by unscrewing it from the valve body (5).

b. Disconnect the control arm from the valve stem by removing the speed nut, washers and rivet.

c. Examine the exposed portion of the piston (6) for damage before removing it.

d. Remove the piston (6) by pushing it through the end fitting (1) end of the body assembly.

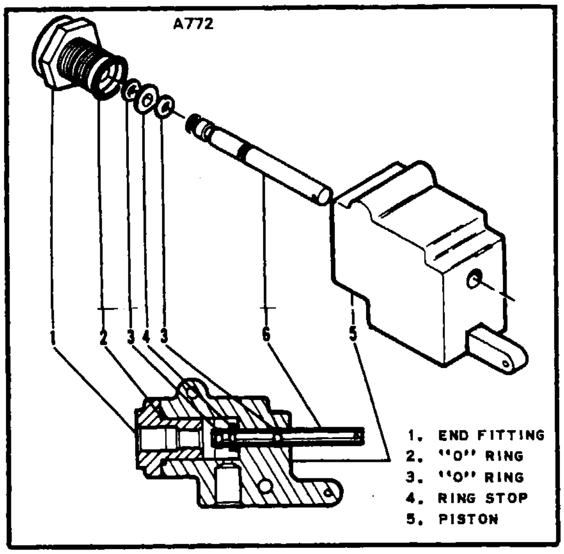


Figure 9-20. Fuel Crossfeed Valve

9-52. CLEANING, INSPECTION AND REPAIR OF FUEL CROSSFEED VALVE.

a. Clean the valve components in a suitable dry type cleaning solvent.

b. Inspect the valve for the following:

1. Check that the friction surfaces of the valve body and stem are free from nicks, dents and burrs.

2. Check that the stop on the piston is secure and undamaged.

3. Check that the threaded surfaces of the body and end fitting are not stripped or cross-threaded.

c. Repair to the valve is limited to reconditioning of parts, such as smoothing out minor nicks and scratches, and the replacement of "O" ring packings.

9-53. ASSEMBLY OF FUEL CROSSFEED VALVE. (Refer to Figure 9-20.)

a. Install new "O" rings (3) to the piston assembly (6).

b. Lubricate "O" rings (3) with lubricating oil (MIL-L-6082) and install the piston (6) to the body assembly (5).

c. Install the end fitting (1) with a new "O" ring (2) to the body assembly (5).

d. Connect the control arm to the piston using washers, rivet and a speed nut.

9-54. LEAK TEST OF CROSSFEED VALVE.

a. Connect the inlet port of the valve to a 50 psi air source.

b. Close valve, apply pressure to 50 psi and submerge in kerosene or a similar petroleum base fluid for two minutes.

c. There should be no evidence of leakage, through the valve port around the seat.

d. Disconnect air source and wipe fluid from exterior of valve.

9-55. INSTALLATION OF FUEL CROSSFEED VALVE.

a. Assemble the crossfeed drain, heater fuel valve and line fittings to the crossfeed valve.

b. Position the assembled unit inside the fuel control box and install the machine screws and self-locking nuts, securing the crossfeed valve to its bracket.

c. Connect the spring to the crossfeed drain valve.

d. Connect the crossfeed drain line to the bottom of the crossfeed valve and safety with MS20995-C32 wire.

e. Connect the fuel lines to the crossfeed valve, crossfeed drain and heater fuel valve.

f. Position the heater fuel knob and stem to the heater fuel valve handle and connect the two with machine screws and self-locking nuts.

g. On PA-23-250 (six place) airplanes with Serial Nos. 27-2505 and up, install the crossfeed knob to the valve handle on top of the control box.

h. Install the crossfeed drain knob to the stem on the lower front side of the control box by one of the following procedures:

1. On PA-23-235, PA-23-250, and PA-23-250 (six place) airplanes with Serial Nos. 27-2000 to 27-2504 incl., align the knob to the stem and press firmly in a parallel direction with the stem.

2. On PA-23-250 (six place) airplanes with Serial Nos. 27-2505 and up, position the knob on the stem with the pointed end to the right. Install the socket set screw in the bottom of the knob.

i. Operate the crossfeed system and check all fittings for evidence of fuel leakage.

j. Position the fuel control box to the main spar cover and install attaching screws.

k. Install the two front seats.

9-56. FUEL FILTER.

9-57. REMOVAL OF FUEL FILTER. The instructions given are for removal of the complete filter assembly from the airplane. For cleaning and servicing purposes only, refer to paragraphs 9-58 or 9-59 thru 9-61.

a. Drain the fuel cells on the side which the filter is to be removed and close the fuel selector valves. (Refer to Draining Fuel System, Section II.)

b. Remove the aft bottom section of the nacelle by removing attaching screws.

c. Disconnect the control cable or control rod from the selector valve by removing the cotter pin and nut or pin.

d. Disconnect the quick-disconnect fuel line fittings from the selector valve and filter.

e. Remove the attaching machine screws and self -1ocking nuts from the selector valve.

f. Remove the filter and selector valve from the airplane.

9-58. DISASSEMBLY, INSPECTION AND ASSEMBLY OF FUEL FILTER. (PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.) (Refer to Figure 9-21.) If the filter assembly has been removed from the airplane, disregard steps a, b and j.

a. Move the fuel selector valve to the OFF position.

b. Open the fuel strainer access door on the bottom inboard side of the nacelle,

c. Cut the safety wire and loosen the round nut on the bottom of the strainer.

d. Swing the bail off to the side and remove the bowl.

e. Remove the bowl gasket and screen.

f. Inspect the screen and bowl quick drain. If the screen wire is broken or frayed, it should be replaced. If the quick drain has been leaking, the "O" ring should be replaced.

g. Install the screen and a new gasket to the strainer housing.

h. Position the bowl and bail, and hand-tighten the nut at the bottom of the bowl. Then tighten one flat with a wrench.

i. Safety the round nut and bail with MS20995 -C32 safety wire.

j. Open the selector valve and check the strainer for leakage,

9-59. DISASSEMBLY OF FUEL FILTER ASSEMBLY. PA-23-250 (six place), Serial Nos. 27-2505 and up.) (Refer to Figure 9-22.)

a. Cut safety wire (16) and remove the cap nut (17) from the bottom of the f i lter bowl (13).

b. Take the bowl from the filter housing (1).

c. The bowl gasket (5) may be removed from the housing,

d. Loosen and remove both the check nut (11) and the nut (10) from the stud (12) that holds the filter cartridge subassembly.

e. Slide the filter cartridge from the stud. The filter discs (7) and washers (8) need not be separated from the element outlet tube (6) for normal cleaning.

f. If it is necessary to disassemble the filter cartridge, remove the retainer cup (9) from the outlet tube (5) and slide the discs (7) and washers (8) from the outlet tube. Do not use a screw driver or sharp tool that may damage the discs.

g. The filter by-pas s assembly may be removed by using the proper size screw driver and turning out the relief valve seat (4). Then remove the check ball (3) and spring (2).

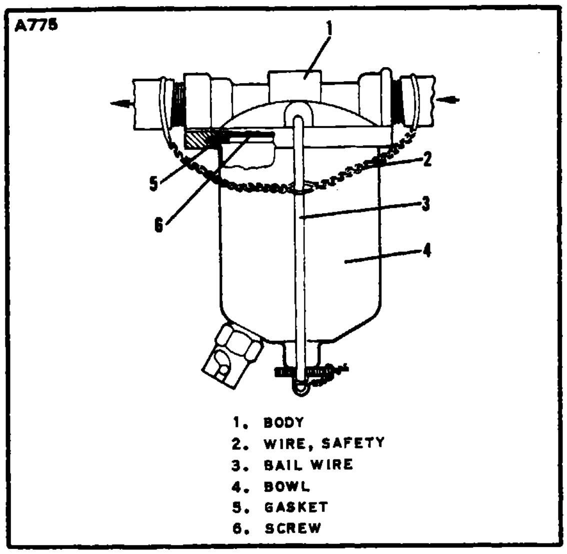


Figure 9-21. Fuel Filter
PA-23-235; PA-23-250; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.

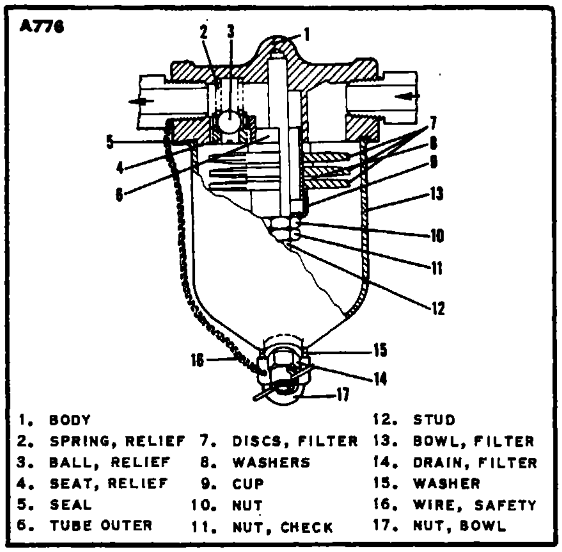


Figure 9-22. Fuel Filter
PA-23-250 (Six place), Serial Nos. 27-2505 and up

9-60. CLEANING, INSPECTION AND REPAIR OF FUEL FILTER. (PA-23-250 (six place), Serial Nos. 27-2505 and up.) (Refer to Figure 9-22.)

a. Wash the element in oil solvent such as mineral spirits. (It is not necessary to remove discs from element outlet tube for normal cleaning.) Plug open ends of element outlet tube while washing to keep out dirt.

b. Inspect filter discs for damage and broken screens.

c. Check condition of bowl gaskets (5 and 15).

d. Check condition of bowl drain and drain "O" ring.

e. Check for corrosion of filter parts.

f. Check movement of by-pass valve.

g. Check condition of filter rubber shock mounts.

h. Normal repairs necessary for the filter are replacement of bowl gaskets and damaged filter discs.

9-61. ASSEMBLY OF FUEL FILTER. (PA-23-250 (six place), Serial Nos. 27-2505 and up.) (Refer to Figure 9-22.)

a. If removed, install by-pass valve spring (2), relief ball (3) and seat (4).

b. Place the filter cartridge (assembled) on the housing stud (12). Ascertain that the end of the outlet tube (6) has positioned itself in the filter body (1).

c. Secure the filter cartridge with nut (10) and check nut.

d. Place bowl gasket (5) on housing and install bowl (13), gasket (15) and cap nut (16). Tighten the cap nut and safety.

e. Install the filter. If the filter was not removed, proceed to step g of paragraph 9-62.

9-62. INSTALLATION OF FUEL FILTER ASSEMBLY.

a. Assemble the fuel selector valve to the strainer, if previously removed.

b. Position the assembled unit inside the lower part of the nacelle.

c. Install machine screws and locking nuts securing the selector valve in place.

d. Connect the fuel lines to the filter and selector valve.

e. Connect the control cable or control rod to the selector valve. Check adjustment of the fuel selector valve cable as described in paragraphs 9-28 and 9-36.

f. Fill the fuel cell or cells.

g. Open the fuel selector valve allowing fuel to flow to the filter.

h. Check the fuel line fittings and filter for evidence of fuel leakage.

NOTE

Ensure fuel filter drain does not open when door is closed.

i. **Install the bottom aft section of the nacelle.**

9-63. ELECTRIC FUEL PUMPS.

9-64. PLUNGER FUEL PUMPS (BENDIX). (PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.)

9-65. REMOVAL OF FUEL PUMP.

a. Remove the inboard access panel on the nacelle that the fuel pump is to be removed from.

b. Determine that the fuel selector valve is in the OFF position.

c. Disconnect the electrical lead.

d. Disconnect the fuel lines from the pump fittings.

e. Remove the pumps by removing the nuts and bolts securing them to the mounting bracket.

9-66. DISASSEMBLY OF FUEL PUMP. (Refer to Figure 9-23.) The following procedure is given for complete disassembly of the fuel pump. For cleaning and servicing purposes only, refer to step 1 of a or b, then proceed to paragraph 9-67 for Cleaning, Inspection and Repair of Component Parts.

a. Early type pump:

1. Cut the safety wire and remove the bottom cover, gasket and filter screen from the pump.

NOTE

If the screen does not come out, use caution removing it from the pump housing so as not to damage it.

2. Remove the three screws securing the plunger spring cup inside the pump. Remove the cup and gasket.

3. Pull the plunger spring and plunger assembly from the pump with fingers.

CAUTION

Do not remove the buffer spring and valve from the plunger assembly.

Do not tamper with seal at center of mounting bracket at side of pump as it retains the dry gas, which surrounds the electric system, in the upper portion of the pump.

b. Late type pump:

1. Cut the safety wire and remove the bottom cover, gasket, magnet and filter screen from the pump.

NOTE

If the screen does not come out use caution removing it from the pump housing so as not to damage it.

2. Remove the retainer spring from the plunger tube using thin nose pliers to spread and remove the ends of the retainer from the tube.

3. Remove the washer, "O" ring seal, cup valve, plunger assembly from the pump.

CAUTION

Do not remove the buffer spring and valve from the plunger assembly.

Do not tamper with seal at center of mounting bracket at side of pump as it retains the dry gas, which surrounds the electric system, in the upper portion of the pump.

9-67. CLEANING, INSPECTION AND REPAIR OF FUEL PUMP.

a. Clean all parts with a suitable dry type solvent. If the plunger assembly does not come clean or there are any rough spots, polish gently with crocus cloth.

b. Inspect the pump for the following:

1. Check the filter screen for damage or distortion.

2. Gently touch the cup valve and check for freedom of movement. Do not disassemble.

3. Shake the plunger assembly and listen for clicks to indicate valve action.

4. On the late model pumps, check the condition of the "O" ring.

5. Check the condition of the cover gasket and plunger spring cup gasket.

c. Repair of the pump is limited to replacement of parts found defective during inspection.

9-68. RESISTANCE CHECK (PLUNGER TYPE PUMP). To check the resistance of the pump, connect an ohmmeter to the lead wire of the pump and the pump body. A reading of 4.87 to 6.4 ohms for a 14-volt pump should be obtained.

9-69. ASSEMBLY OF FUEL PUMP. (Refer to Figure 9-23.)

a. Early type pump:

1. Insert the plunger assembly (10) in the tube with the buffer spring end first. Check fit by slowly raising and lowering the plunger in the tube. It should move fully without any tendency to stick. If a click cannot be heard, the interrupter assembly is not functioning properly in which case the pump should be replaced.

2. Install the component parts in the following order: Cup valve, "O" ring seal, and washer. Install the retainer spring securing the components inside the pump housing.

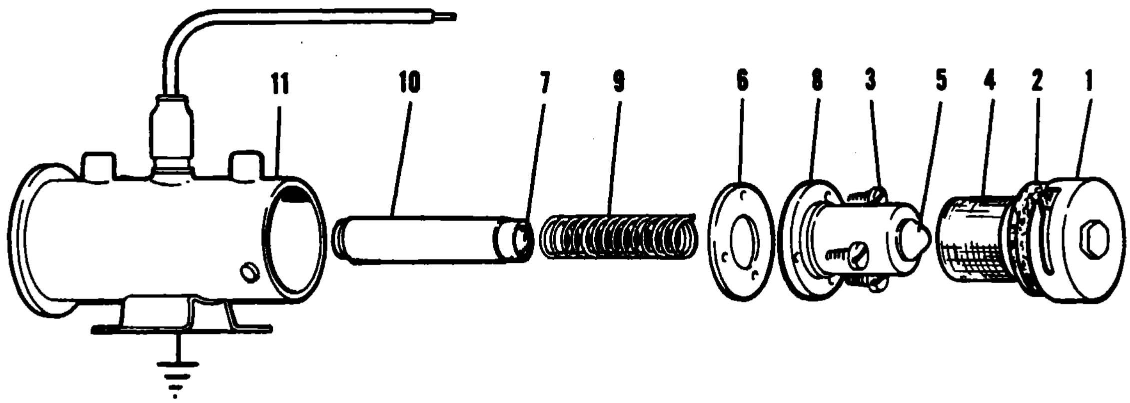
3. Place the cover gasket and magnet in the bottom cover with the filter screw.

4. Carefully guide the screen around the plunger spring cup. The screen must fit snugly at both ends. Do not pinch or distort the screw. Draw the bottom cover tight with a wrench and safety.

b. Late type pump:

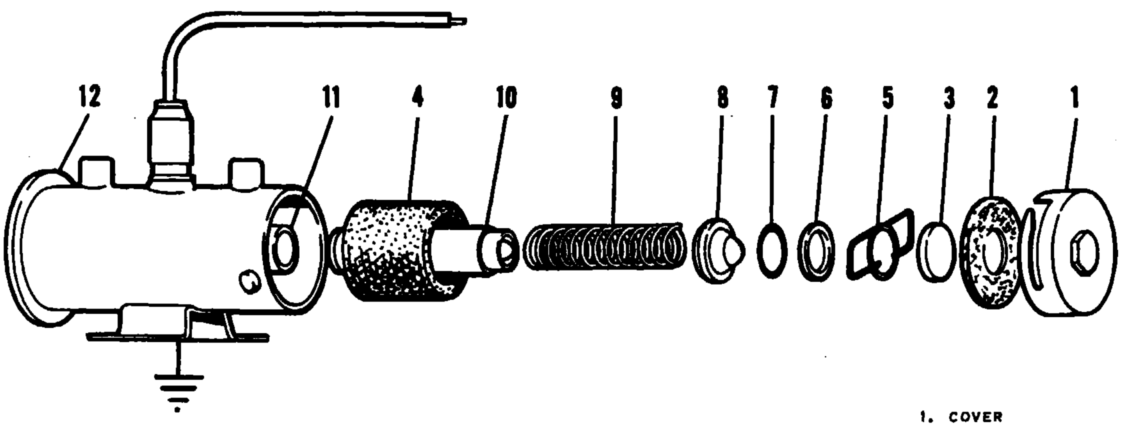
1. Insert the plunger spring assembly (10) in the tube with the buffer spring end first. Check fit by slowly raising and lowering the plunger in the tube. It should move fully without any tendency to stick. If a click cannot be heard, the interrupter assembly is not functioning properly in which case the pump should be replaced.

2. Install the plunger spring cup gasket (use a new one) and the plunger spring cup. Draw the screws reasonably tight, but do not over-tighten them. Be



1. COVER
2. COVER, GASKET
3. SCREW
4. SCREEN
5. CUP VALVE
6. GASKET
7. PLUNGER VALVE
8. PLUNGER CUP
9. PLUNGER, SPRING
10. PLUNGER
11. PUMP, BODY

Early



1. COVER
2. COVER, GASKET
3. MAGNET
4. FILTER
5. RETAINER
6. WASHER
7. 'O' RING
8. CUP VALVE
9. SPRING
10. PLUNGER
11. PLUNGER TUBE
12. PUMP BODY

Late

Figure 9-23. Bendix Electric Fuel Pumps (Early and Late) sure the cup is not cocked to prevent the plunger from binding in the tube.

3. Place the filter screen around the bottom cover magnet.

4. Carefully guide the screen around the plunger spring cup. The screen must fit snugly at both ends. Do not pinch or distort the screen. Draw the bottom cover tight with a wrench and safety with MS20995-C32 wire.

9-70. INSTALLATION OF FUEL PUMP.

a. Position the fuel pumps inside the engine nacelle and secure to its mounting bracket with attaching bolts and nuts.
b. Connect the fuel lines to the pump and tighten.
c. Connect the electrical lead to the fuel pumps.
d. Turn fuel selector valve in the ON position.
e. Operate fuel pump and inspect for leaks.
f. Secure access panel to engine nacelle.

9-71. ADJUSTMENT OF ELECTRIC FUEL PUMP (BENCH TEST).

a. Ascertain that the pump is sufficiently lubricated to prevent damage if run dry for a period greater than five minutes.
b. Connect the electrical lead of one pump to a 14-volt dc power source.
c. Using a suitable container with the proper octane fuel, connect a fuel line from a container to the inlet side of the pump.
d. Connect another line from the outlet side of the pump to a pressure gauge and by-pass valve and back to the container.
e. Run the pump with the by-pass valve open until a steady flow of fuel is obtained. Then close the by-pass valve and check the pressure gauge for the proper reading of 4 to 4.75 psi maximum, no flow.
f. Repeat steps b through e for the second fuel pump.
g. If the proper pressure is not obtained, the plunger spring may be replaced or it may be necessary to replace the complete pump assembly.

9-72. ADJUSTMENT OF ELECTRIC FUEL PUMP (IN AIRPLANE).

a. With the access panel removed and the fuel selector in the OFF position, remove the fuel line from the outlet end of the pump.
b. Connect a test line with a by-pass valve and pressure gauge to the outlet end of the pump to be checked.
c. Place a container below the pump to catch any fuel from the test line during the adjustment of the pump.
d. Disconnect the electrical lead to the pump that is not being checked.
e. Turn the fuel selector on, open the by-pass valve on the test line and start

the pump.

f. When a steady flow of fuel is obtained, close the by-pass valve and check the reading on the pressure gauge. It should read 4 to 4.75 psi maximum, no flow. Do not keep by-pass valve closed for more than one minute during pump operation and adjustment.

g. Repeat steps b through f for the other pump.

h. If the proper pressure is not obtained, the plunger spring may be replaced or it may be necessary to replace the complete pump assembly.

i. Reconnect the orignal fuel line to the pump. Open fuel selector and run the pump to check for any fuel leaks.

j. Shut off the pump, close the fuel selector and replace and secure the access panel.

9-73. ROTARY FUEL PUMPS (WELDON). (PA-23-250 (six place), Serial Nos. 27-2322 and up.

9-74. REMOVAL OF FUEL PUMPS.

a. Remove the top center section or access panel of the nacelle.

b. Determine that the fuel selector valve is in the OFF position.

c. Disconnect the fuel lines from the pump fittings.

d. Disconnect the electrical leads.

e. Remove the pump assembly by cutting the safety wire and removing the four attaching bolts inside the wheel well.

9-75. DISASSEMBLY OF FUEL PUMP. (Refer to Figure 9-24.)

Disassembly and assembly of the Weldon fuel pump should only be attempted when the below listed tools are available to the mechanic. Should these tools not be available, the pump should be returned to:

The Weldon Tool Co.
3000 Woodhill Road
Cleveland, Ohio 44104

Name	P/N or Description	Source
Seal Installation Tool	TP-617	Weldon Tool Co.
Seal Installation Tool	TP-723	Obtain Locally
Steel Rod	3/16" Dia. x 3" length	Obtain Locally
Fixture	15/16" I.D. x 5/8" Deep	Obtain Locally
Tube	13/16" I.D., 1 7/64" O.D. (Max.) x 1" Length (Min.)	Obtain Locally
Alignment Checking Tool	TP-793	Weldon Tool Co.

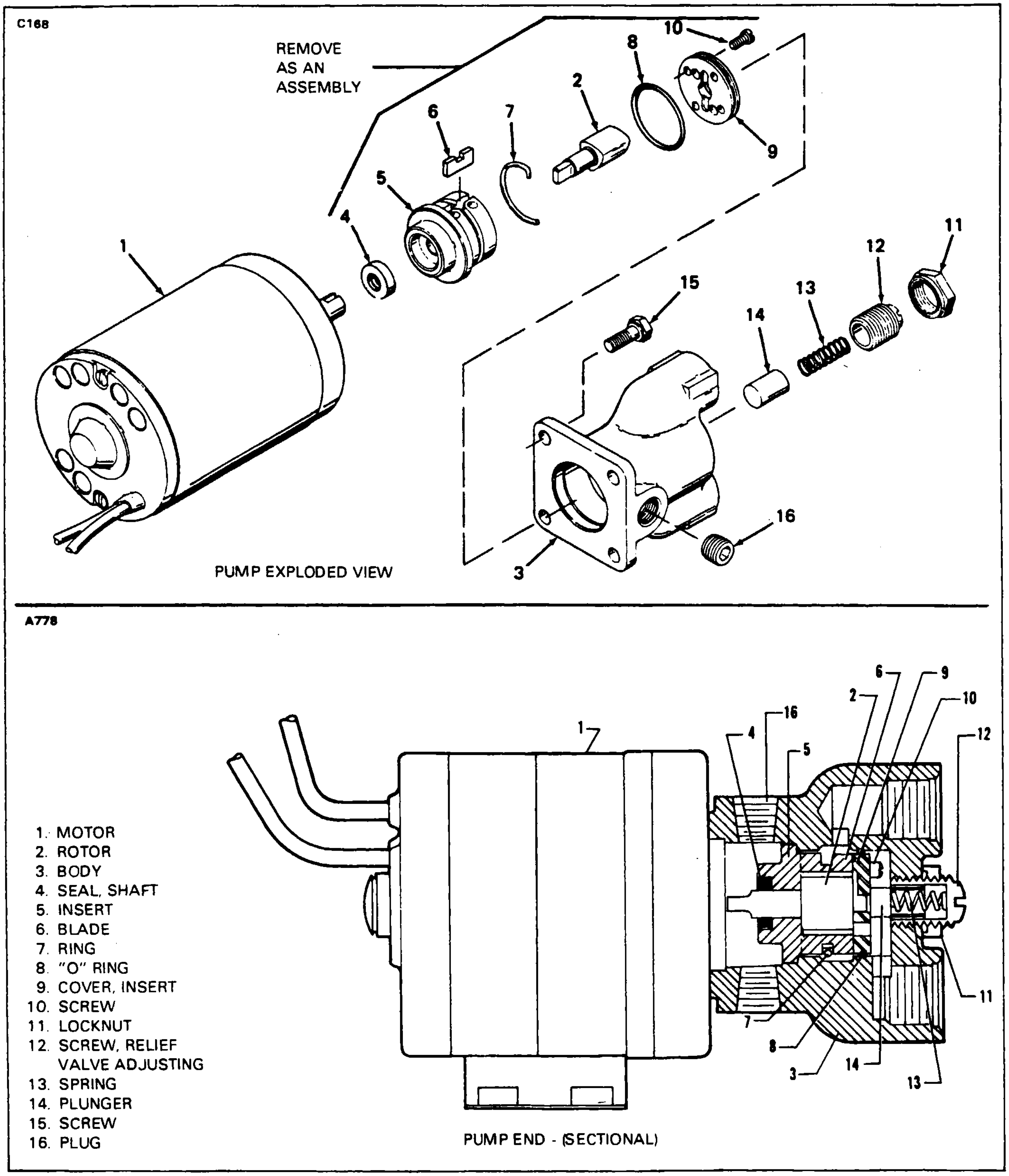


Figure 9-24. Weldon Rotary Fuel Pump

a. Remove the four screws which secure the pump assembly to the motor assembly.
b. Separate the motor assembly from the pump assembly.

NOTE

The drive motor is non-repairable. If defective, replace with new motor. Pump performance may be altered as a result of installing a new motor assembly. Therefore, retest is necessary and pressure relief valve adjustment may be required.

c. Remove locknut, adjusting screw, spring and plunger from end of pump assembly.
d. Insert a 3/16 inch diameter rod through the 1/2 inch tapped hole, from which the relief valve adjusting screw was removed and through the center hole in the insert cover until the rotor is contacted. Apply pressure to the rod with an arbor press to unseat and remove the pumping element from the pump housing. (Refer to Figure 9-24.)

NOTE

To facilitate reassembly, index the relative position of the insert cover to the insert. Also, note proper orientation of the two inlet holes in the insert cover to assist in proper reassembly.

e. Remove the screws which secure the insert cover to the insert and remove the cover.
f. Remove the rotor, blade retaining ring and blades from the insert.
g. To remove the shaft seal from the insert, clamp a simple fixture having a 15/16 inch diameter hole 5/8 inch deep, in a vise (A 15/16 inch socket wrench head may be used as a temporary fixture). Place the insert into the fixture with the shaft seal end up (Refer to Figure 9-24). Using a small screwdriver inserted in the shaft hole of the seal, pry the seal from the seal well. Use extreme caution to avoid damage to the seal well area.
h. Wash pump parts in clean solvent and dry with filtered compressed air.

9-76. INSPECTION AND REPAIR.
a. Inspect those areas from which parts have been removed. Smooth nicks, scratches and burrs in these areas to avoid damage to new seals.
b. Replace "O" rings and seals which have been removed.

NOTE

For detailed inspection procedures and a table of wear limits, refer to the Service Information Manual, Weldon Pump Model No. 33959-3 available from The Weldon Tool Co., 3000 Woodhill Road, Cleveland, Ohio 44104.

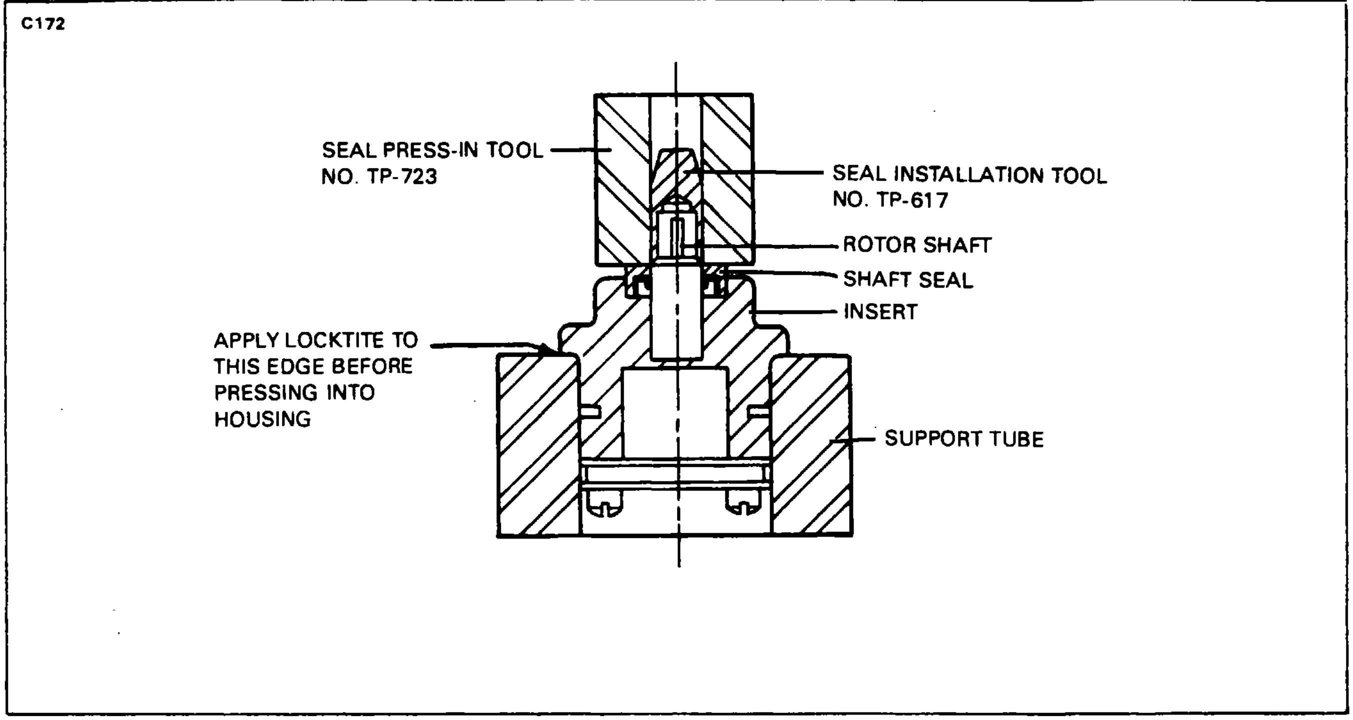


Figure 9-25. Shaft Seal Installation

9-77. ASSEMBLY OF FUEL PUMP (Refer to Figure 9-24.)

a. Install the blade retaining ring on the insert and install the blades.

b. Tilt the blades at an outward angle to allow the rotor to be installed and install the rotor.

c. Place a few drops of light oil on the end of the rotor and in the insert. Position the insert cover and secure with 3/8 inch screws. Torque to 10 inch lbs.

CAUTION

Earlier production fuel pumps usea a 1/4 inch long screw which requires 6 inch pounds of torque. Identify hardware before applying torque.

d. Place the insert in a 15/16 inch I.D. Support Tube (Refer to Figure 9-25).

e. Apply a coating of petroleum jelly to the shaft of the rotor, the shaft seal and Installation Tool No. TP-617.

f. Place Seal Installation Tool TP-617 over the rotor shaft.

g. Slip shaft seal assembly onto Tool TP-617 and bottom seal by hand.

h. With Tool TP-617 still in position, place Seal Installation Tool TP-723 over Tool TP-617.

i. Using an arbor press, push the shaft seal into seal well of insert until it is seated and square.

j. Remove the Seal Installation Tools from the insert. Install a new "O" ring on the insert cover and lubricate the "O" ring with petroleum jelly.

k. Apply Loctite 290 to the 1 1/8 inch "press fit" diameter of the insert assembly.

NOTE

Use a small amount of Loctite exercising care to prevent Loctite from getting into blade slot area of insert.

l. Start the insert assembly into the pump housing by hand to ensure proper alignment.

m. Using an arbor press against a suitable tube (refer to Tool list under "Disassembly" section), press the insert into housing until it is firmly seated.

NOTE

Improper alignment of the insert will cause binding between the rotor tang and motor shaft slot causing excessive motor current and early failure. Use Tool TP-793 (or similar tool) to check alignment. Should the pump shaft bind when the stem of the tool is turned and while the face of the tool is held tight against the pump flange, remove the insert asembly, clean the mating surfaces, re-install and recheck.

Fifteen minutes after installing insert, repress the insert to ensure that it has not moved upward due to the action of the "O" ring.

Allow Loctite to cure for four hours before testing pump.

n. Install locknut on adjusting screw. Place spring and plunger in adjusting screw and install in tapped hole of pump body. Tighten locknut.

CAUTION

The spring loaded poppet contacts the insert cover and provides pressure relief. Over-tightening of adjusting screw will prevent proper pressure relief by restricting return flow or by deforming cover.

o. Align the pump end assembly with the motor assembly. Ensure proper coupling between motor armature slot and pump rotor shaft. Secure pump and motor assemblies together using screws with Loctite 222.

p. Adjust pump pressure as described in "Adjustment of Electric Fuel Pump (Bench Test)."

9-78. INSTALLATION OF FUEL PUMP.

a. Position the fuel pump in the engine nacelle and secure with four attaching bolts up through the bottom of the wheel well. Safety the bolts.

b. Connect the fuel lines to the pump and tighten.

c. Connect the electrical leads.

d. Turn the selector valve to the ON position.

e. Operate the fuel pump and inspect for leaks.

f. Secure the center section or access panel of the engine nacelle.

9-79. ADJUSTMENT OF ELECTRIC FUEL PUMP (BENCH TEST). (Refer to Figure 9-26.)

a. Ascertain that the pump is sufficiently lubricated to prevent damage if run dry for a period greater than five minutes.

b. Connect the electrical leads to a 14-28-volt DC power source, depending on electrical system installation.

c. Using a suitable container with the proper octane fuel, connect a fuel line from a container to the inlet side of the pump.

d. Connect another line from the outlet side of the pump to a pressure gauge and bypass valve and back to the container.

e. Run the pump with the bypass valve open until a steady flow of fuel is obtained. Then close the bypass valve and check the pressure gauge for the proper reading of 26 +3 -0 psi, no flow. Do not keep the bypass valve closed for more than one minute during pump operation and adjustment.

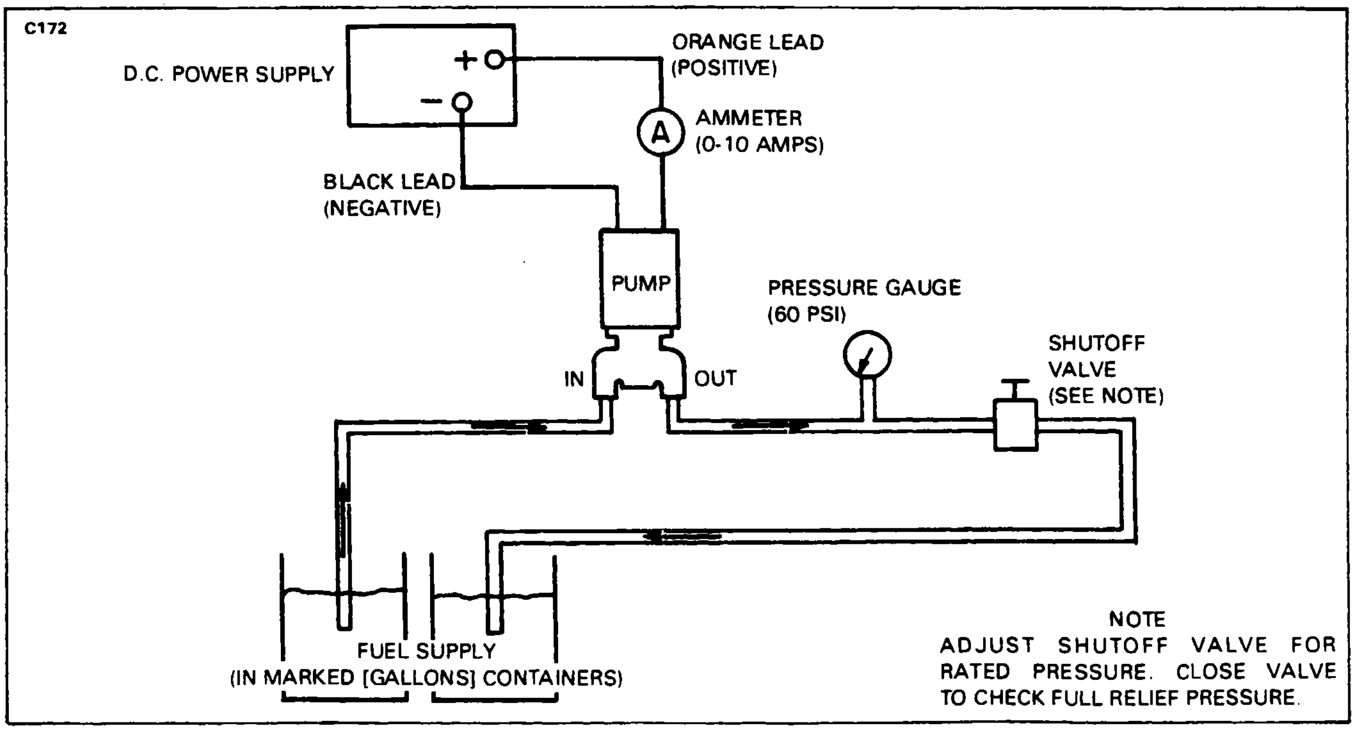


Figure 9-26. Bench Test Set-Up (Typical)

f. Loosen the locknut and turn the adjusting screw until there is a reading of 26 +3 -0 psi, no flow, on the gauge. Repeat steps e and f until the proper pressure is obtained.

g. Disconnect the power source from the pump and lock the adjustment screw with the locknut. Remove the fuel lines from the pump.

9-80. ADJUSTMENT OF ELECTRIC FUEL PUMP (IN AIRPLANE).

a. With the access panel removed and the fuel selector in the OFF position, remove the fuel line from the outlet end of the pump.

b. Connect a test line with a bypass valve and pressure gauge to the outlet end of the pump.

c. Place a container below the pump to catch any fuel from the test line during the adjustment of the pump.

d. Turn the fuel selector on; open the bypass valve on the test line and start the pump.

e. When a steady flow of fuel is obtained, close the bypass valve and check the reading on the pressure gauge. It should read 26 +3 -0 psi, no flow. Do not keep bypass valve closed for more than one minute during pump operation and adjustment.

f. Loosen locknut on adjusting screw and turn screw to obtain the proper pressure of 26 +3 -0 psi, no flow. Repeat steps g and h until adjustment is complete. Lock adjusting screw with locknut.

g. Turn off fuel pump and close fuel selector. Remove the test line from the pump.

h. Reconnect the original fuel line to the pump. Open fuel selector and run the pump to check for any fuel leaks.

i. Shut off the pump; close the fuel selector and replace and secure the access panel.

9-81. ENGINE PRIMER PUMP.

9-82. REMOVAL OF ENGINE PRIMER. (Refer to Figure 9-27.)

a. Disconnect the fuel lines from the primer behind the instrument panel.

b. Loosen the locknut (12) from behind the panel.

c. Unscrew the knurled face nut (10) and withdraw the pump handle (9) and piston (7) from the cylinder (5).

d. Remove the remaining portion of the primer.

9-83. DISASSEMBLY, CLEANING AND ASSEMBLY OF ENGINE PRIMER. (Refer to Figure 9-27.)

a. The primer may be further disassembled after removal by removing the screws (3), springs (2), and check balls (1) from the end of the cylinder housing.

b. Clean the primer parts with acetone or a dry type solvent.

c. Install new "O" rings to the piston (7) and lubricate with light motor oil.

d. Install the balls (1), springs (2) and screws (3) to the cylinder housing.

e. Insert the pump handle (9) and piston (7) into the cylinder (5), and finger tighten the knurled face nut (10).

f. Immerse the pump in gasoline and operate several times to insure proper operation.

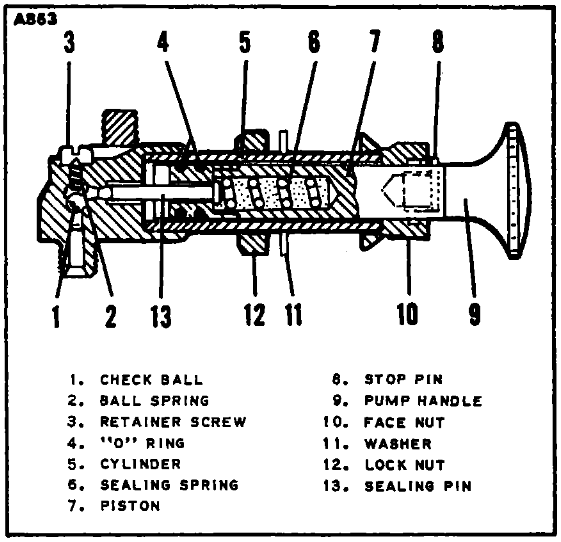


Figure 9-27. Engine Primer

9-84. INSTALLATION OF ENGINE PRIMER PUMP. (Refer to Figure 9-27.)

a. Remove the pump handle (9) and piston (7) by unscrewing the knurled face nut (10), if previously installed.

b. Insert the cylinder assembly through the back side of the panel.

c. Insert the piston into the cylinder (5) and tighten the knurled face nut.

d. Position the primer and tighten the locknut (12) on the cylinder behind the panel.

e. Connect the fuel lines to the primer.

f. Disconnect the primer line inside the engine compartment. Operate the pump to ascertain proper operation.

9-85. PRIME JETS.

a. To remove the prime jets, disconnect the supply line from each jet. With a deep socket and light pressure, remove the jet from the cylinder.

b. To clean the jet, soak in a carbon remover solution long enough to loosen any dirt and blow clean with air pressure in the direction opposite that of fuel flow. Do not use sharp objects or wire brush to clean the jet tube.

c. Install the jet finger tight to assure that the threads are not crossed and then torque 60 inch pounds. Align and install the fuel supply lines, tighten to a snug fit.

NOTE

Should further fuel stoppage of the primer system exist, check the supply lines for stoppage, bent or collapsed walls.

9-86. CLEANING FUEL SYSTEM.

a. To flush the fuel cells and selector valve, disconnect the fuel line at the carburetor or injector.

b. Select a fuel cell, turn on the electric fuel pump and flush fuel through the system until it is determined there is no dirt and foreign matter in the fuel valve or cell. During this operation, agitation of the fuel within the cell will help pick up and remove any dirt.

c. Repeat this procedure for each cell.

d. When all cells are flushed, clean all filters.

TABLE IX-I. FUEL SYSTEM TROUBLESHOOTING

Trouble	Cause	Remedy
Fuel gauge fails to indicate proper tank level.	Sender arm improperly positioned.	Bend sender arm to proper position.
	Incorrect resistance in sender.	Replace sender.
	Gauge inoperative.	Replace gauge.
	Incorrect resistance in gauge.	Replace gauge.
	Incomplete ground.	Check ground connections at fuel senders and security of sender mounting plate attaching bolts.
	Broken wire.	Check and repair.
	Fuel cell selector connections broken.	Repair or replace.
No fuel pressure indication.	No fuel in cells.	Fill fuel cells.
	Broken or disconnected lines.	Check for broken or disconnected lines. Replace or tighten where necessary.
	Fuel selector valve(s) not positioning properly.	Check selector valve(s) for proper travel and positioning.
	Filters dirty.	Clean filters.
	Defective fuel pressure gauge.	Replace gauge.

TABLE IX-I. FUEL SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
No fuel pressure indication (cont.).	Defective fuel pump.	Check pump(s) for fuel flow. Check diaphragm and relief valves in engine pump. Check plunger in "Bendix" electric fuel pumps. Check for obstruction in electric fuel pump(s). Check by-pass valve. Check for air leak in inlet lines.
	Defective gauge.	Replace gauge.
Pressure low or surges.	Blockage in fuel cell vent.	Check and clean fuel cell vent caps.
	Obstruction in inlet side of pump.	Trace lines and locate obstruction.
	Faulty engine driven pump.	Replace pump.
	Fuel selector valve(s) defective or improper positioning.	Check selector valves for proper operation and adjustment.
	Loose fuel line connection.	Check and tighten fuel line fittings where necessary.
Fuel valve leaking.	Defective "O" ring.	Replace "O" rings or valve.

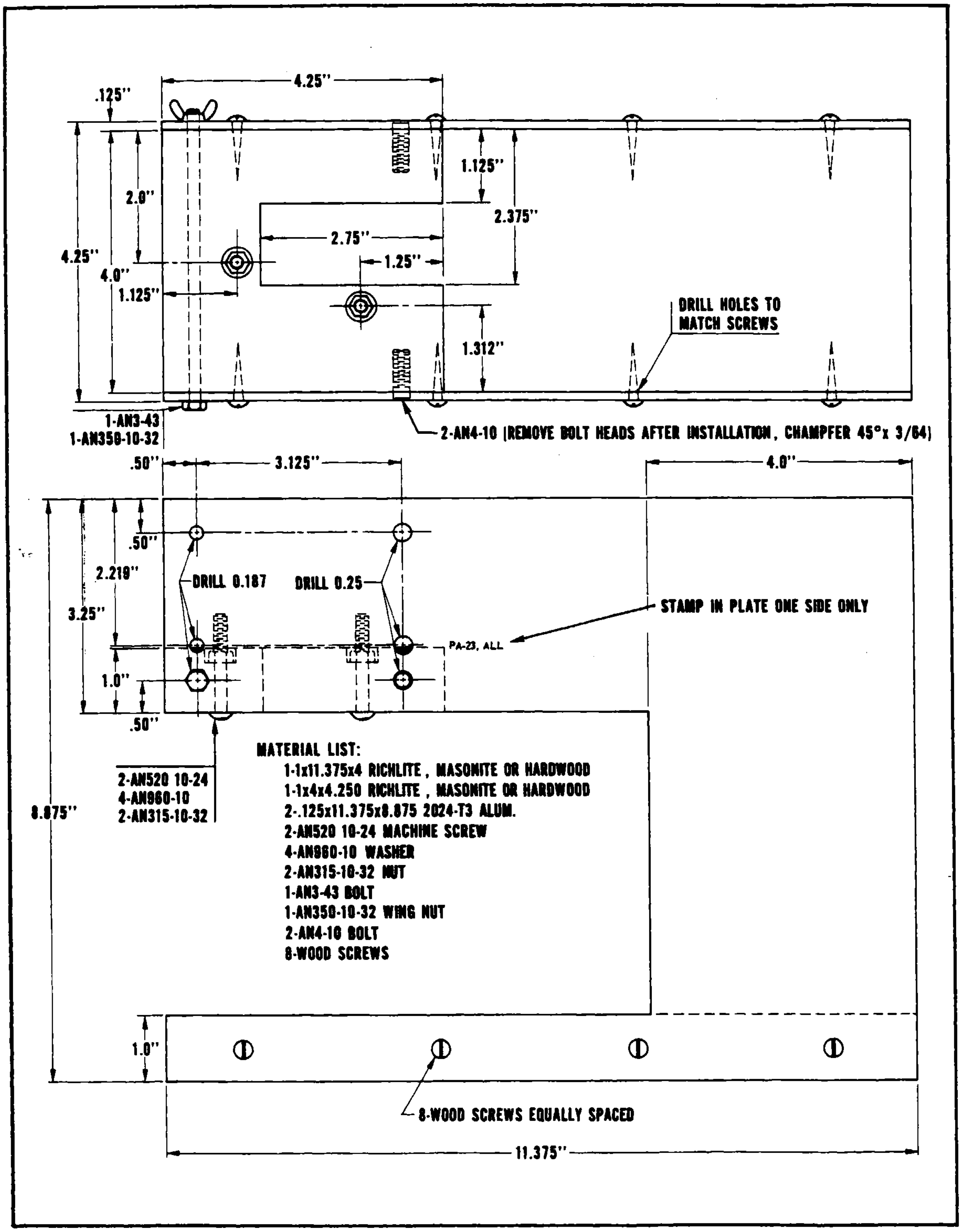


Figure 9-28. Fabricated Fuel Quantity Transmitter Checking Jig

TABLE IX-II. FUEL SYSTEM PRESSURES

ITEM	O-540-A SERIES	O-540-B SERIES	IO-540-C1B5	IO-540-J4A5	TIO-540-C1A
Carburetor Inlet Pressure	Desired 3 psi Maximum 8 psi Minimum .5 psi	Desired 3 psi Maximum 8 psi Minimum .5 psi			
Engine Driven Pump Inlet Pressure			Maximum 30 psi Minimum -2 psi	45 psi to -4 psi	45 psi to -4 psi
Injector Inlet Pressure			14 psi to 45 psi	18 psi to 45 psi	18 psi to 45 psi
Boost Pump Outlet Pressure with zero fuel flow			26^{+3}_{-0} psi	26^{+3}_{-0} psi	26^{+3}_{-0} psi
Maximum Nozzle Pressure with fuel flow gauge red line.			8.0 psi	8.0 psi	11.0 psi

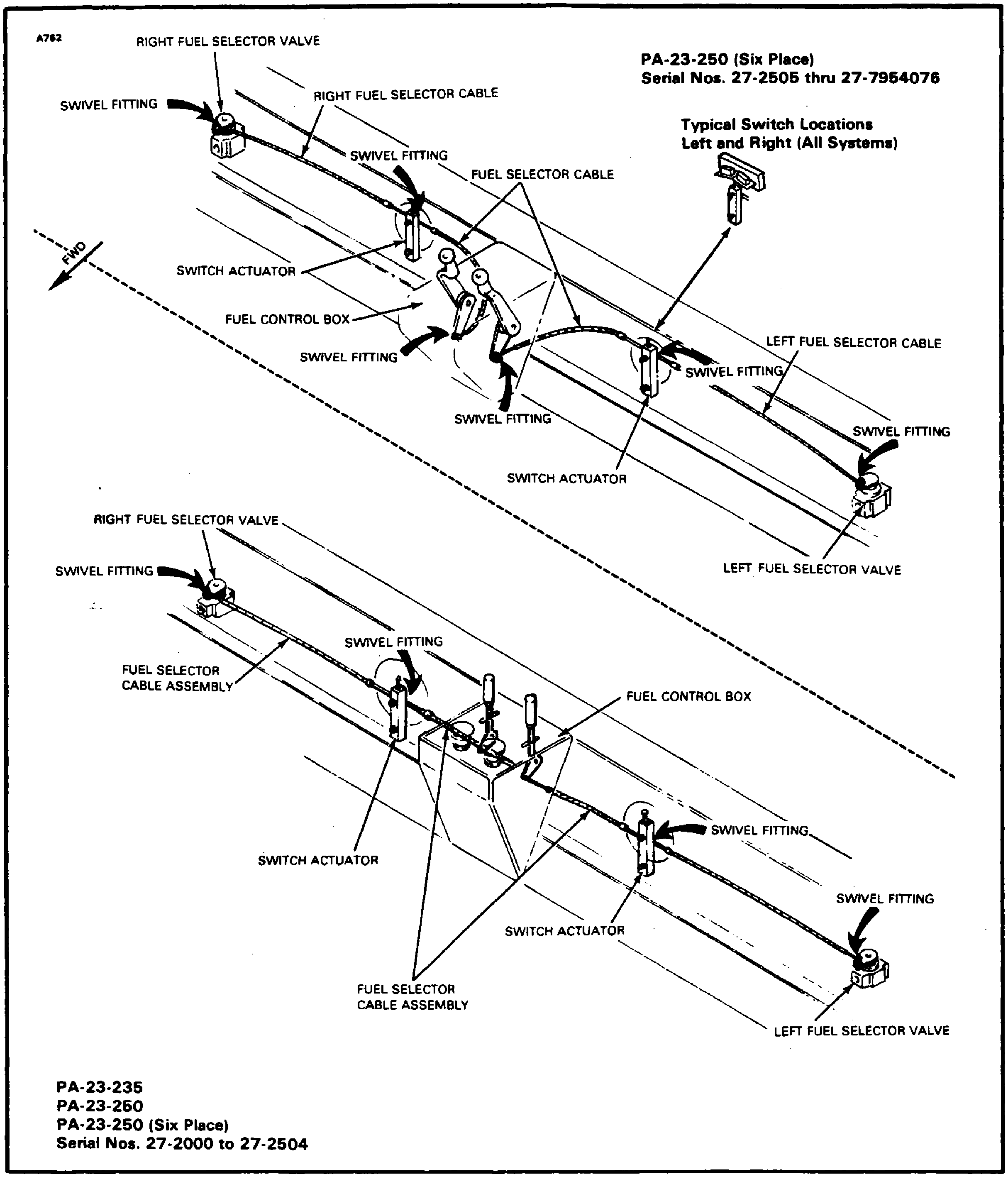


Figure 9-29. Fuel Selector Valve Control Cables, PA-23-235, PA-23-250 and PA-23-250 (six place), Serial Nos. 27-2000 thru 27-7954076

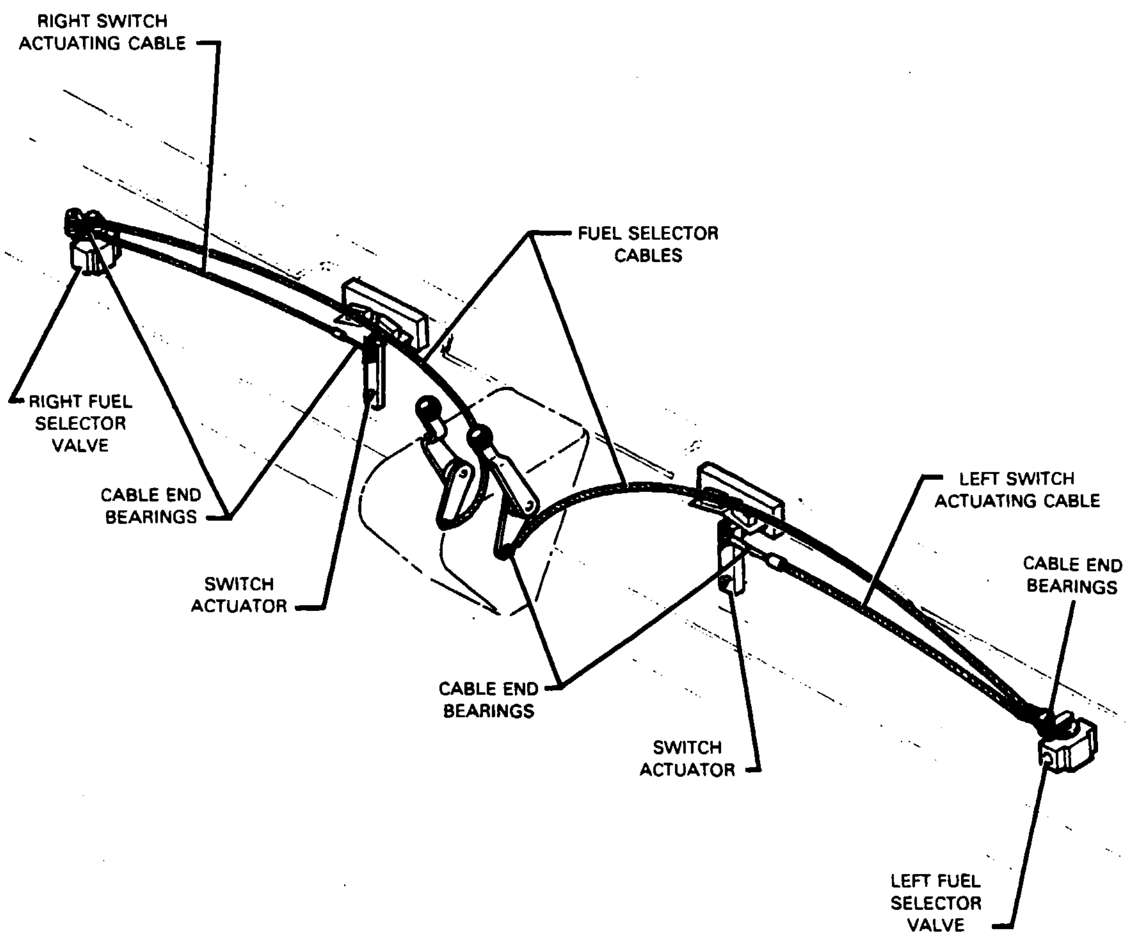


Figure 9-30. Fuel Selector Control Cables,
PA-23-250 (six place), Serial Nos. 27-7954077 and up

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X

INSTRUMENTS

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SECTION X - INSTRUMENTS

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SECTION X - INSTRUMENTS

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SECTION X

INSTRUMENTS

10-1. INTRODUCTION.

This section contains procedures for removal and installation of the various instruments installed in the PA-23 series airplanes. A description of each instrument system along with minor adjustments, tests and maintenance are found in this section. Instrument repairs other than those described in this section should be done. by the manufacturer or an authorized repair station.

10-2. DESCRIPTION.

The instrumentation of the various models provides for all conditions of flight. The instruments are designed to give a quick and actual indication of attitude, performance and condition of the airplane. They are divided into four groups: Vacuum Gyro, Pitot-Static, Electrical and Miscellaneous. Some of the instruments are components of indicating systems that indicate conditions at remote parts of the airplane. A few of the instruments, however, are selfcontained and merely have to be correctly installed to give an indication. Warning lights are installed to indicate unsatisfactory or dangerous conditions in some systems. Instruments requiring power from the electrical system are provided with circuit breakers to isolate the individual systems in the event of trouble. For night operation, each instrument is either individually lighted by overhead spot lights, shielded post lights and/or a light incorporated as part of the instrument.

The panel has been arranged to accommodate flight instruments in the left side, in front of the pilot, electronic equipment in the center, and the engine and miscellaneous instruments to the right.

The flight instruments have been shock mounted to minimize vibration and shock conditions transmitted to the panel.

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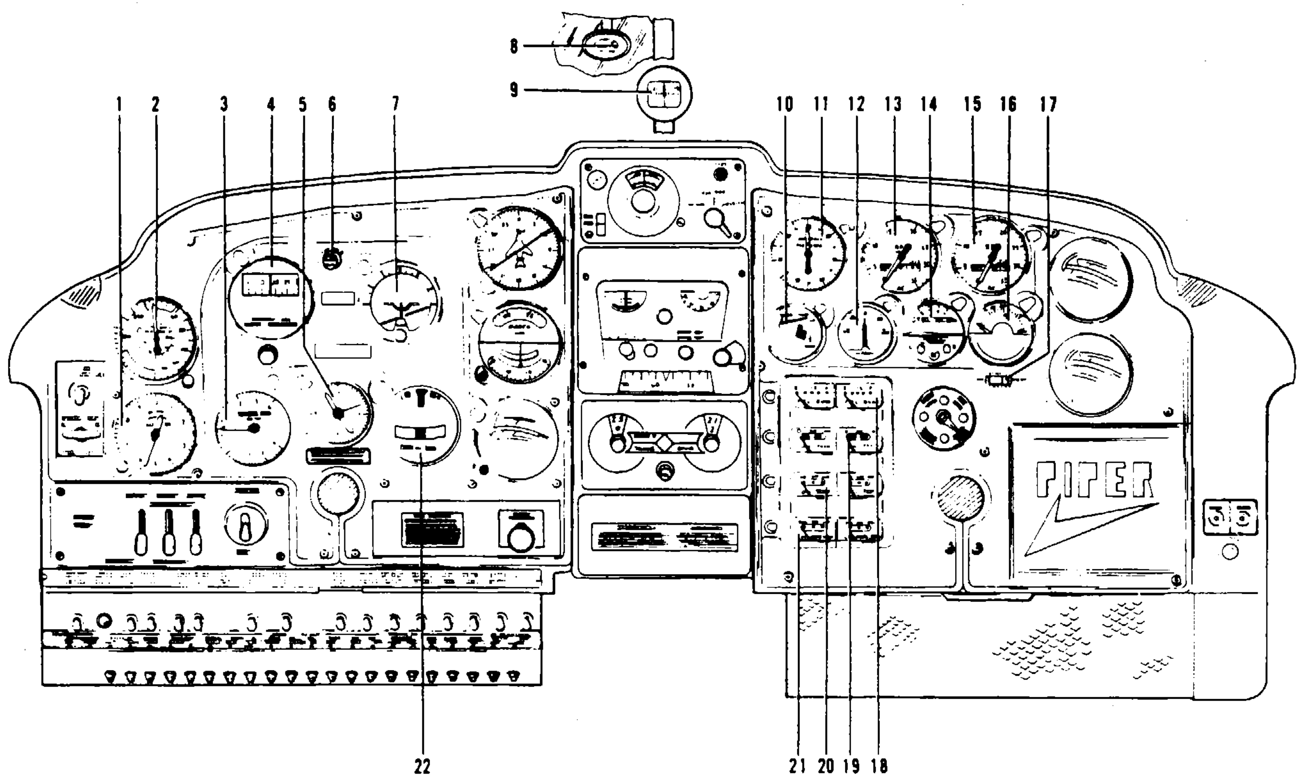
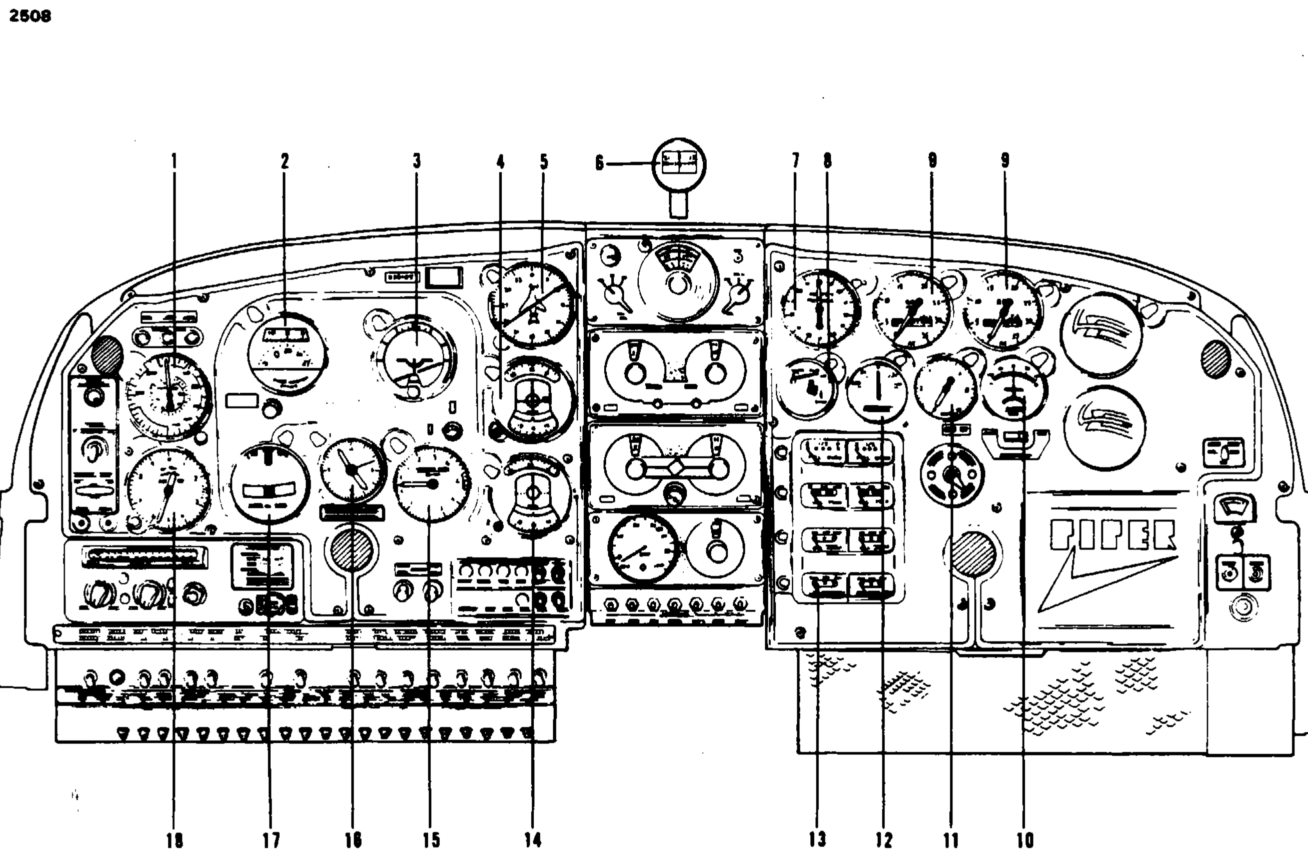


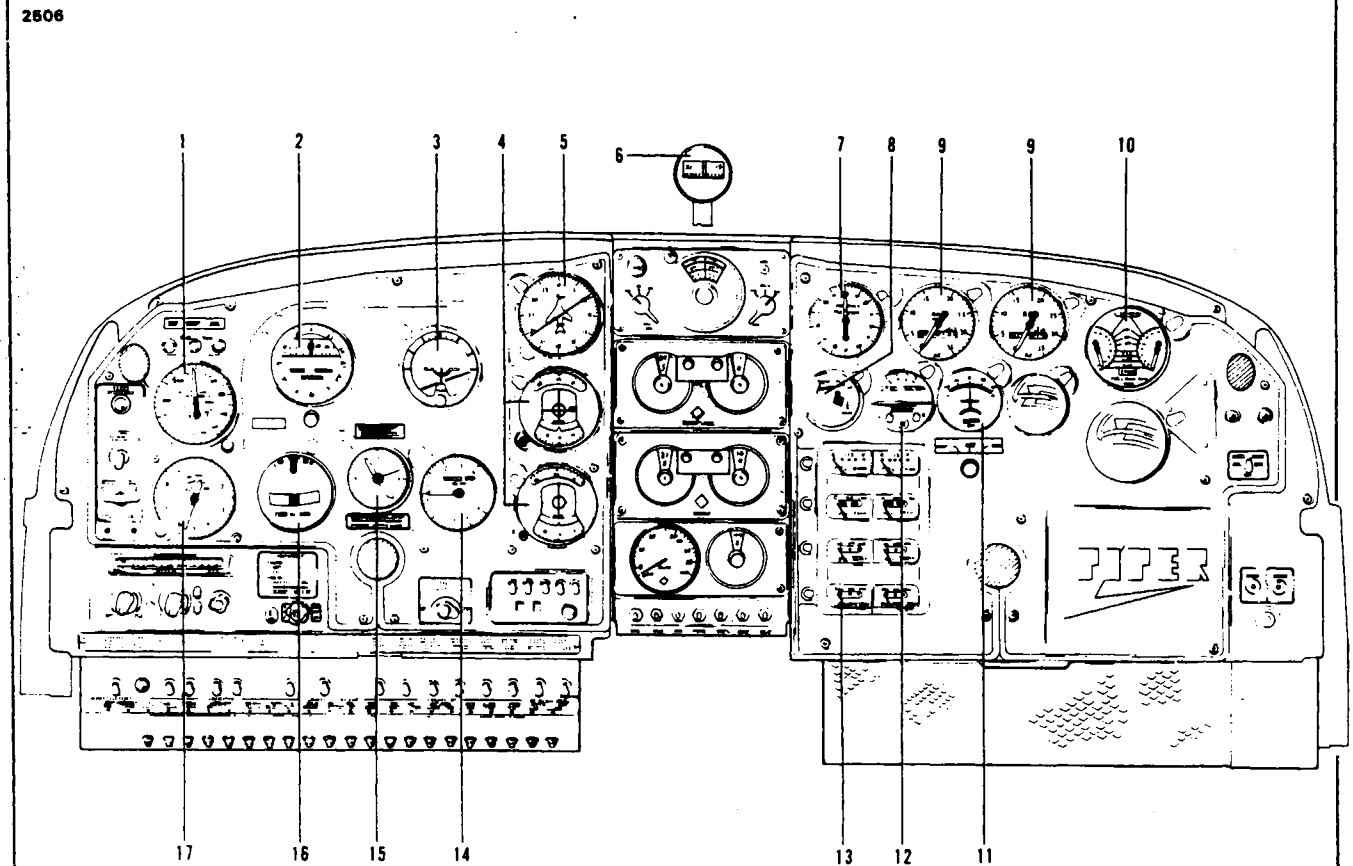
1. ALTIMETER
2. AIRSPEED INDICATOR
3. RATE OF CLIMB INDICATOR
4. DIRECTIONAL GYRO
5. CLOCK
6. AUTOFLIGHT TRIM CONTROL
7. GYRO HORIZON
8. FREE AIR TEMPERATURE
9. MAGNETIC COMPASS
10. FLAP INDICATOR
11. MANIFOLD PRESSURE INDICATOR
12. AMMETER
13. LEFT TACHOMETER
14. VACUUM SUCTION GAUGE
15. RIGHT TACHOMETER
16. CARBURETOR AIR TEMPERATURE INDICATOR
17. CARBURETOR AIR TEMPERATURE SELECTOR SWITCH
18. FUEL QUANTITY INDICATOR
19. FUEL PRESSURE INDICATOR
20. OIL PRESSURE INDICATOR
21. OIL TEMPERATURE INDICATOR
22. TURN AND BANK INDICATOR

Figure 10-1. Instrument Panel, PA-23-250 and PA-23-235



1. AIRSPEED INDICATOR
2. DIRECTIONAL GYRO
3. ARTIFICIAL HORIZON
4. OMNI INDICATOR
5. ADF RADIO COMPASS
6. COMPASS
7. MANIFOLD PRESSURE GAUGE
8. FLAP INDICATOR
9. TACHOMETER
10. MANIFOLD TEMP. GAUGE
11. SUCTION GAUGE
12. AMMETER
13. INSTRUMENT CLUSTER
14. OMNI INDICATOR
15. RATE OF CLIMB INDICATOR
16. EIGHT DAY CLOCK
17. TURN AND BANK INDICATOR
18. ALTIMETER

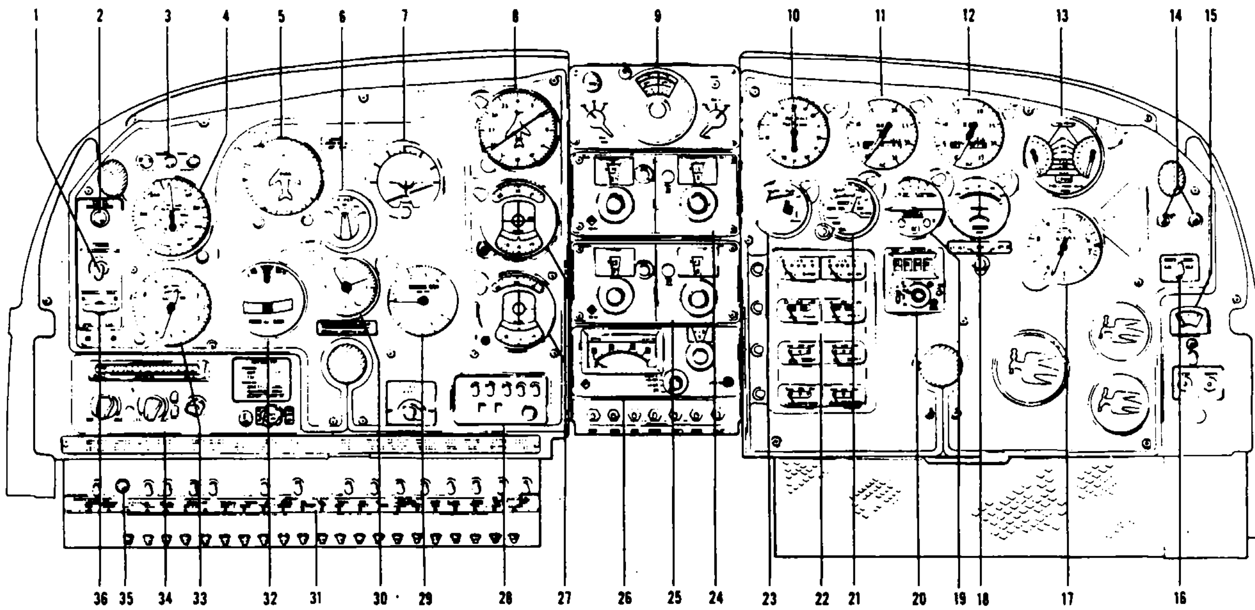
Figure 10-2. Instrument Panel
PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.



1. AIRSPEED INDICATOR
2. DIRECTIONAL GYRO
3. ARTIFICIAL HORIZON
4. OMNI INDICATOR
5. ADF RADIO COMPASS
6. COMPASS
7. MANIFOLD PRESSURE GAUGE
8. FLAP INDICATOR
9. TACHOMETER
10. FUEL FLOW INDICATOR
11. AMMETER
12. SUCTION GAUGE
13. INSTRUMENT CLUSTER
14. VERTICAL SPEED INDICATOR
15. CLOCK
16. TURN AND BANK INDICATOR
17. ALTIMETER

Figure 10-3. Instrument Panel
PA-23-250 (six place), Serial Nos. 27-2505 to 27-3153 incl.

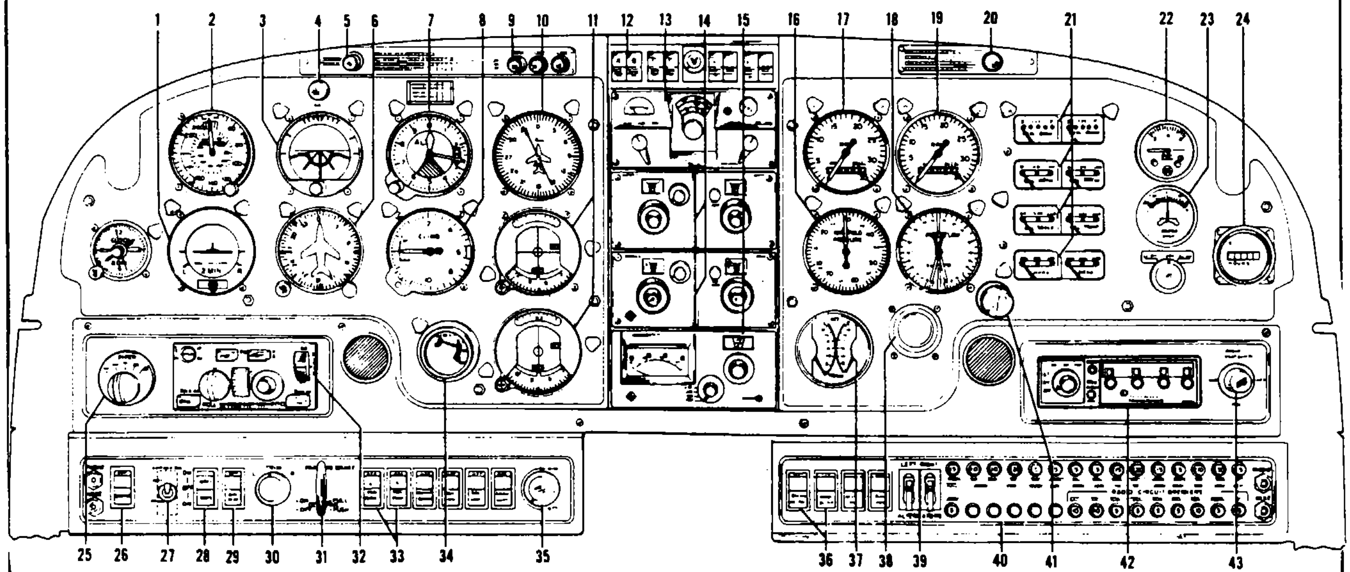
2507



1. STARTER SWITCH
2. STALL WARNING
3. MARKER BEACON INDICATOR
4. AIRSPEED
5. DIRECTIONAL GYRO
6. OMNI COUPLER
7. ARTIFICIAL HORIZON
8. ADF INDICATOR
9. ADF RADIO
10. MANIFOLD PRESSURE
11. TACHOMETER (LEFT ENGINE)
12. TACHOMETER (RIGHT ENGINE)
13. FUEL FLOW GAUGE
14. TURBO OIL PRESSURE
15. DEICER AMMETER
16. METER SWITCH
17. ALTIMETER
18. AMMETER
19. SUCTION GAUGE
20. TRANSPONDER
21. MIXTURE MONITOR
22. INSTRUMENT CLUSTER
23. FLAP POSITION
24. VHF RADIO NAV 1
25. VHF RADIO NAV 2
26. DISTANCE/SPEED INDICATOR
27. OMNI INDICATOR
28. AUDIO SELECTOR
29. VERTICAL SPEED
30. CLOCK
31. SWITCH/BREAKER PANEL
32. TURN AND BANK
33. ALTIMETER
34. ALTIMATIC PILOT
35. DOOR AJAR LIGHT
36. PARKING BRAKE

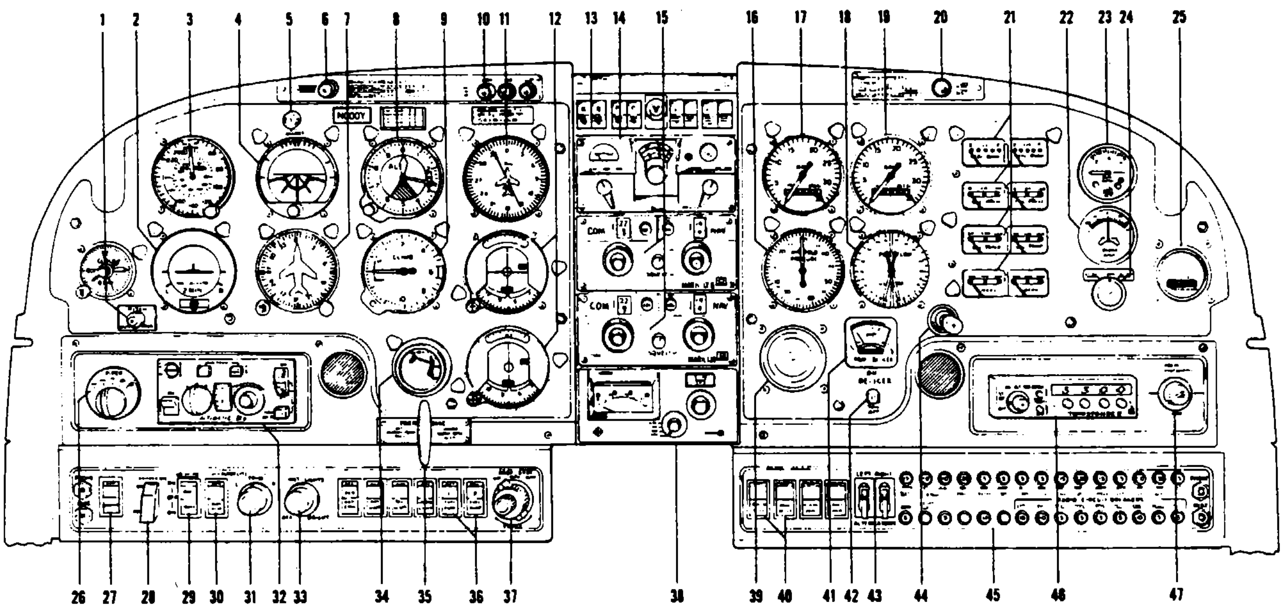
Figure 10-4. Instrument Panel, PA-23-250 (six place), Serial Nos. 27-3154 to 27-3836 and 27-3838 to 27-3943 incl.

2509



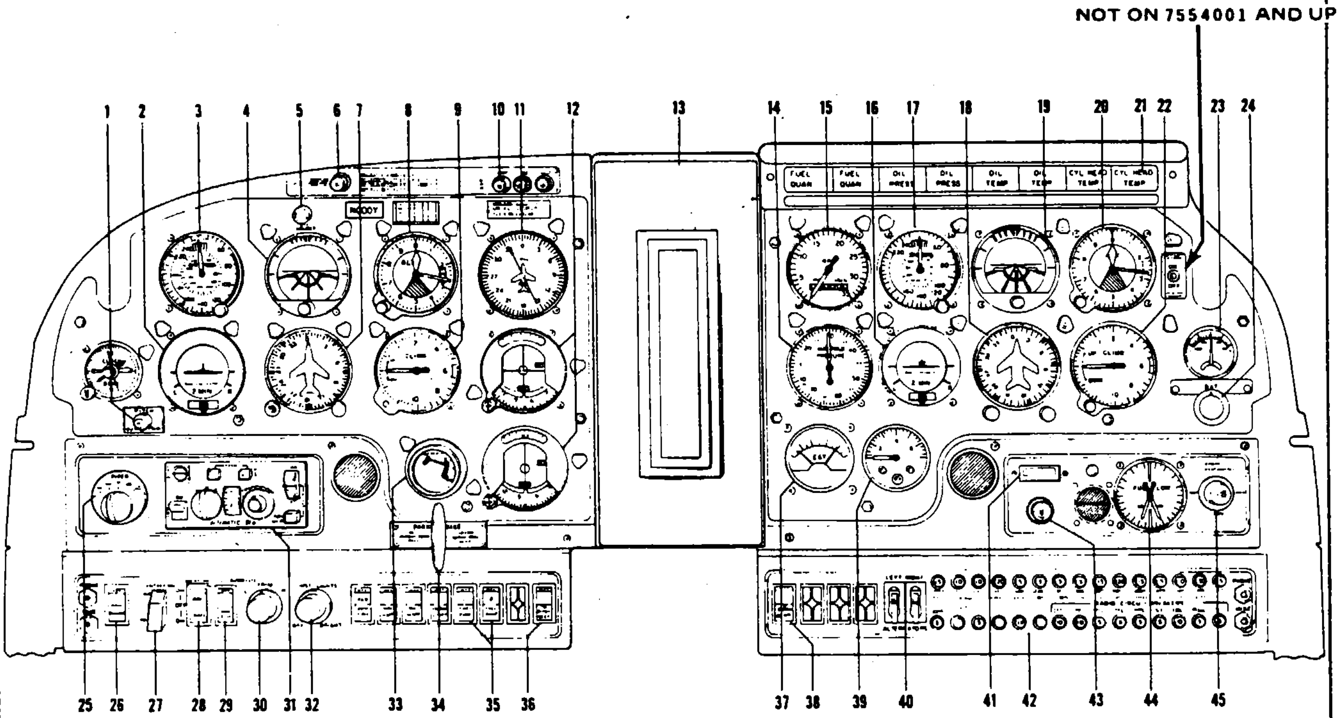
1. TURN COORDINATOR
2. AIRSPEED INDICATOR
3. GYRO HORIZON
4. G/S COUPLER LIGHT
5. STALL WARNING LIGHT
6. DIRECTIONAL GYRO
7. ALTIMETER
8. RATE OF CLIMB
9. MARKER BEACON
10. ADF INDICATOR
11. OMNI BEARING SELECTOR
12. JUNCTION BOX
13. ADF RADIO
14. COMM/NAV TRANSCEIVERS
15. DME CONTROL
16. MANIFOLD PRESSURE GAUGE
17. TACHOMETER, LEFT
18. FUEL FLOW GAUGE
19. TACHOMETER, RIGHT
20. DOOR AJAR LIGHT
21. FUEL/ENGINE GAUGE CLUSTER
22. GYRO SUCTION GAUGE
23. AMMETER
24. HOUR METER (TOTAL)
25. NAV/APPROACH COUPLER
26. MASTER SWITCH
27. VOLTAGE REGULATOR
28. TRANSMITTER SELECTOR
29. AUTOFLITE SWITCH
30. AUTOFLITE TRIM
31. PARKING BRAKE HANDLE
32. ALTIMATIC III
33. FUEL PUMP SWITCHES
34. FLAP POSITION INDICATOR
35. PANEL LIGHTS
36. DEICING SWITCHES
37. EGT GAUGE
38. PANEL
39. ALTERNATOR SWITCHES
40. CIRCUIT BREAKERS
41. LIGHTER
42. TRANSPONDER
43. HEAT CONTROL

Figure 10-5. Instrument Panel
PA-23-250 (six place), Serial Nos. 27-3837, 27-3944 to
27-4425, and 27-4427 to 27-4573 incl.



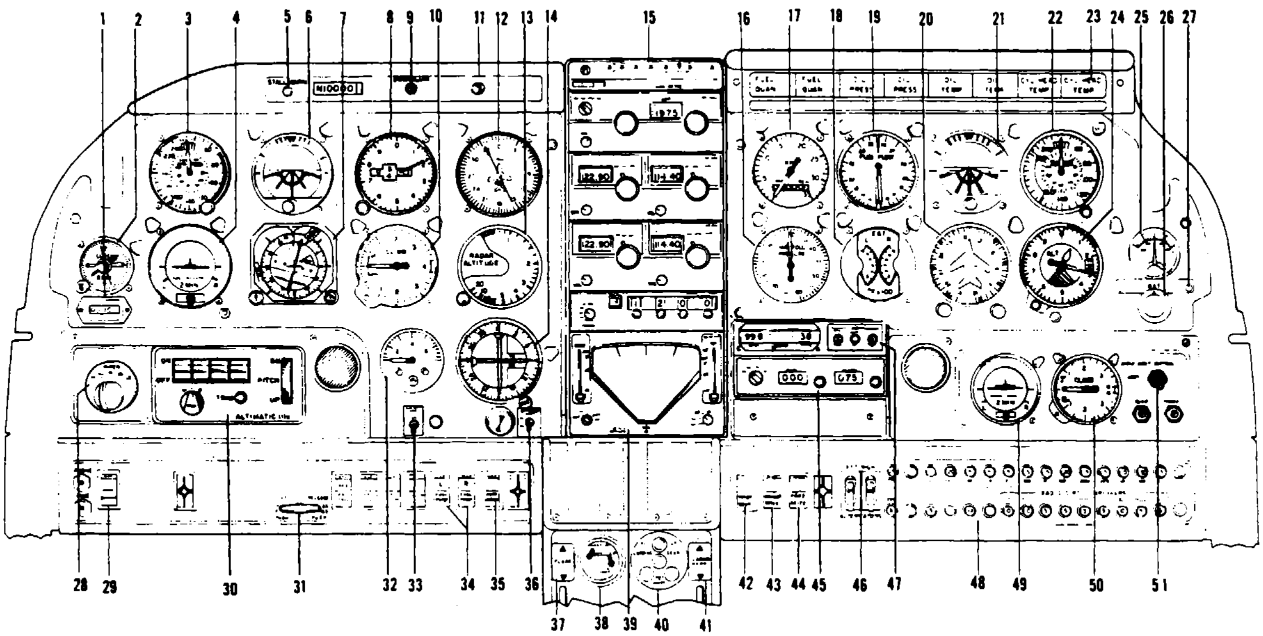
1. TRIM INDICATOR LIGHT
2. TURN COORDINATOR
3. AIRSPEED INDICATOR
4. GYRO HORIZON
5. G/S COUPLER LIGHT
6. STALL WARNING LIGHT
7. DIRECTIONAL GYRO
8. ALTIMETER
9. RATE OF CLIMB
10. MARKER BEACON
11. ADF INDICATOR
12. OMNI BEARING SELECTOR
13. JUNCTION BOX
14. ADF RADIO
15. COMM/NAV TRANSCEIVERS
16. MANIFOLD PRESSURE GAUGE
17. TACHOMETER, LEFT
18. FUEL FLOW GAUGE
19. TACHOMETER, RIGHT
20. DOOR AJAR LIGHT
21. FUEL/ENGINE GAUGE CLUSTER
22. AMMETER
23. GYRO SUCTION GAUGE
24. ALTERNATOR SWITCH
25. HOUR METER (TOTAL)
26. NAV/APPROACH COUPLER
27. MASTER SWITCH
28. VOLTAGE REGULATOR
29. TRANSMITTER SELECTOR
30. AUTOFLITE SWITCH
31. AUTOFLITE TRIM
32. ALTIMATIC IIIB
33. PANEL LIGHTS
34. FLAP POSITION INDICATOR
35. PARKING BRAKE
36. FUEL PUMP SWITCHES
37. PROP SYNCHRONIZER CONTROL
38. DME CONTROL
39. PANEL
40. DEICER SWITCHES
41. AMMETER - PROP DEICER
42. PNEUMATIC DEICER INDICATOR
43. ALTERNATOR SWITCHES
44. LIGHTER
45. CIRCUIT BREAKERS
46. TRANSPONDER
47. HEAT CONTROL

Figure 10-6. Instrument Panel
PA-23-250 (six place), Serial Nos. 27-4426, 27-4574 to 27-7554172 incl.



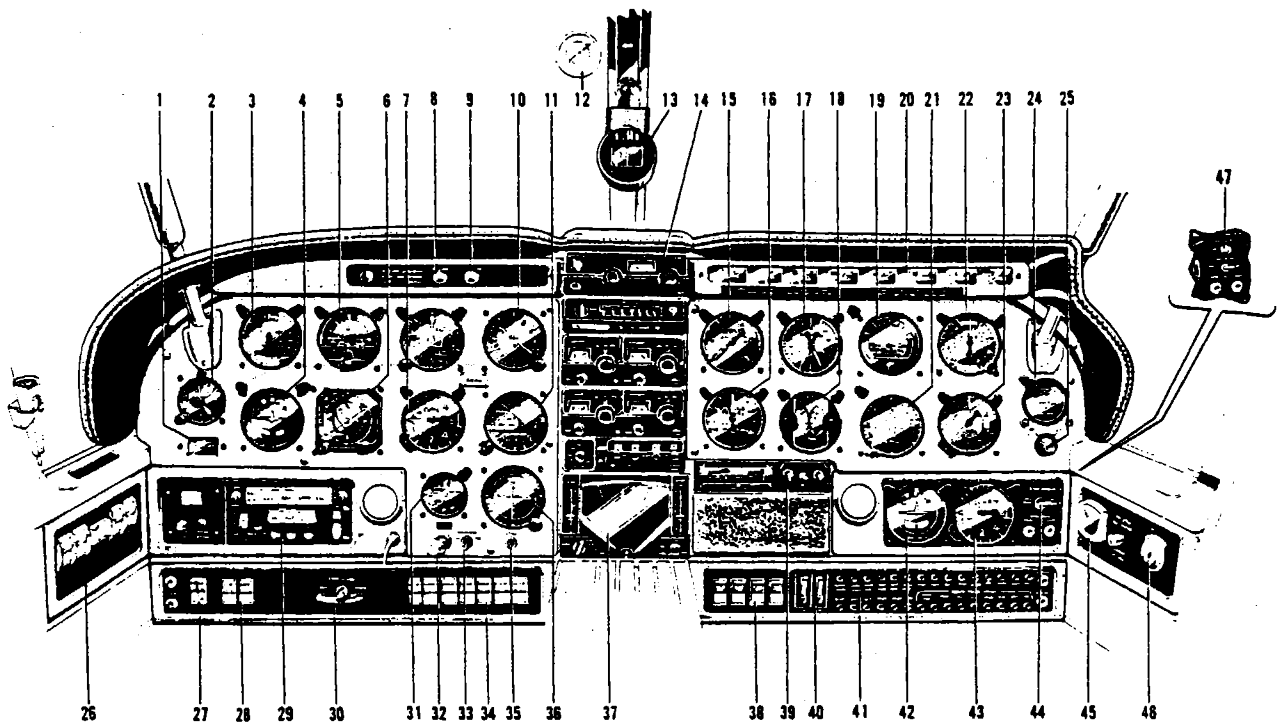
1. TRIM INDICATOR LIGHT
2. TURN COORDINATOR
3. AIRSPEED INDICATOR
4. GYRO HORIZON
5. G/S COUPLER LIGHT
6. STALL WARNING LIGHT
7. DIRECTIONAL GYRO
8. ALTIMETER
9. RATE OF CLIMB
10. MARKER BEACON
11. ADF INDICATOR
12. OMNI BEARING SELECTOR
13. COVER PLATE
14. MANIFOLD PRESSURE GAUGE
15. DUAL TACHOMETER
16. TURN COORDINATOR
17. AIRSPEED INDICATOR
18. DIRECTIONAL GYRO
19. GYRO HORIZON
20. ALTIMETER
21. FUEL/ENGINE INSTRUMENT CLUSTER
22. RATE OF CLIMB
23. AMMETER
24. ALTERNATOR SWITCH
25. NAV/APPROACH COUPLER
26. MASTER SWITCH
27. VOLTAGE REGULATOR
28. TRANSMITTER SELECTOR
29. AUTOFLITE SWITCH
30. AUTOFLITE TRIM
31. ALTIMATIC IIIB
32. PANEL LIGHTS
33. FLAP POSITION INDICATOR
34. PARKING BRAKE
35. FUEL PUMP SWITCHES
36. LEFT PITOT HEAT
37. E.G.T. GAUGE
38. RIGHT PITOT HEAT
39. GYRO SUCTION GAUGE
40. ALTERNATOR SWITCHES
41. HOUR METER (TOTAL)
42. CIRCUIT BREAKERS
43. LIGHTER
44. DUAL FUEL FLOW GAUGE
45. HEAT CONTROL

Figure 10-7. Dual Instrument Panel (Optional Equipment)
PA-23-250 (Six Place), Serial Nos. 27-7305222, 27-7405235 to 27-7554172 incl.



1. HOUR METER
2. CLOCK
3. AIRSPEED INDICATOR
4. TURN COORDINATOR
5. STALL WARNING LIGHT
6. ATTITUDE GYRO
7. HORIZONTAL SITUATION INDICATOR
8. ENCODING ALTIMETER
9. DOOR AJAR LIGHT
10. RATE OF CLIMB INDICATOR
11. GLIDE SLOPE ENGAGED LIGHT
12. ADF INDICATOR
13. RADAR ALTIMETER
14. VOR/GLIDE SLOPE INDICATOR
15. RADIO PANEL
16. MANIFOLD GAUGE
17. TACHOMETER
18. EGT GAUGE
19. FUEL FLOW GAUGE
20. DIRECTIONAL GYRO
21. ATTITUDE GYRO
22. AIRSPEED INDICATOR
23. ENGINE GAUGES
24. ALTIMETER
25. AMMETER
26. ALTERNATOR OUTPUT SELECTOR SWITCH
27. ALTERNATOR INOPERATIVE LIGHTS
28. VOR/LOC COUPLER
29. MASTER SWITCH
30. ALTIMATIC III C
31. PARKING BRAKE
32. GYRO SUCTION GAUGE
33. RADAR ALTIMETER SWITCH
34. FUEL PUMP SWITCHES
35. PROP SYNC
36. AVIONICS MASTER SWITCH
37. FLAP SELECTOR
38. FLAP POSITION INDICATOR
39. RADAR
40. LANDING GEAR INDICATOR LIGHTS
41. LANDING GEAR SELECTOR
42. PITOT HEAT
43. SURFACE DEICE
44. PROP DEICE
45. RNAV
46. ALTERNATOR CIRCUIT BREAKER SWITCH
47. DME
48. CIRCUIT BREAKER PANEL
49. TURN COORDINATOR
50. RATE OF CLIMB
51. HEATER SWITCH

Figure 10-8. Dual Instrument Panel (Optional Equipment)
PA-23-250, Serial Nos. 27-7554001 to 27-7554168 incl.)



1. HOUR METER
2. CLOCK
3. AIRSPEED INDICATOR
4. TURN COORDINATOR
5. ATTITUDE GYRO
6. HORIZONTAL SITUATION INDICATOR
7. RATE OF CLIMB INDICATOR
8. GLIDE SLOPE ENGAGED LIGHT
9. DOOR AJAR LIGHT
10. ADF INDICATOR
11. RADAR ALTIMETER
12. OUTSIDE AIR TEMP. GAUGE
13. COMPASS
14. RADIO PANEL
15. TACHOMETER
16. MANIFOLD PRESS. GAUGE
17. FUEL FLOW GAUGE
18. EGT GAUGE
19. ATTITUDE GYRO
20. ENGINE GAUGES
21. DIRECTIONAL GYRO
22. AIRSPEED INDICATOR
23. ALTIMETER
24. AMMETER
25. ALTERNATOR OUTPUT SELECTOR SWITCH
26. STARTER AND MAGNETO SWITCHES
27. MASTER SWITCH
28. A/P NAV AND ELECTRIC TRIM SWITCHES
29. AUTOPILOT CONTROL PANEL
30. PARKING BRAKE
31. GYRO SUCTION GAUGE
32. CIGAR LIGHTER
33. RADAR ALTIMETER SWITCH
34. LEFT ELECTRICAL SWITCH PANEL
35. AVIONICS MASTER SWITCH
36. VOR/GLIDE SLOPE INDICATOR
37. RADAR
38. RIGHT ELECTRICAL SWITCH PANEL
39. DME
40. ALTERNATOR CIRCUIT BREAKER SWITCHES
41. CIRCUIT BREAKER PANEL
42. TURN COORDINATOR
43. RATE OF CLIMB INDICATOR
44. HEATER SWITCH
45. PROP DEICE AMMETER
46. OXYGEN OUTLET
47. HEATER OVERTEMP RESET SWITCH 27-8154001

Figure 10-9. Instrument Panel (Typical)
PA-23-250 (Six Place) Serial Nos. 27-7654001 and up

10-3. INSTRUMENTS.

10-4. VACUUM-GYRO INSTRUMENTS. The directional gyro is a flight instrument incorporating an air driven gyro stabilized in the vertical plane. The gyro is rotated at high speed by lowering the pressure in the air tight case and simultaneously allowing atmospheric air pressure to enter the instrument against the gyro buckets. Due to gyroscopic inertia, the spin axis continues to point in the same direction even though the aircraft yaws to the right or left. This relative motion between the gyro and the instrument case is shown on the instrument dial which is similar to the compass card. The dial, when set to agree with the airplane magnetic compass, provides a positive indication free from swing and turning error.

The gyro-horizon is essentially an air-driven gyroscope rotating in a horizontal plane and is operated by the same principal as the directional gyro. Due to the gyroscopic inertia, the spin axis continues to point in the vertical direction, providing a constant visual reference to the attitude of the airplane relative to pitch and roll axis. A bar across the face of the indicator represents the horizon. A miniature adjustable airplane is mounted to the case and aligning the miniature airplane to the horizon bar simulates the alignment of the airplane to the actual horizon. Any deviation simulates the deviation of the airplane from the true horizon.

10-5. PITOT-STATIC INSTRUMENTS. The airspeed indicator provides a means of indicating the speed of the airplane passing through the air. The airspeed indication is the differential pressure reading between pitot air pressure and static air pressure. This instrument has the diaphragm vented to the pitot air source and the case is vented to the static air system. As the airplane increases speed, the pitot air pressure increases, causing the diaphragm to expand. A mechanical linkage picks up this motion and moves the instrument pointer to the indicator speed. The instrument dial is calibrated in knots and miles per hour, and also has the necessary operating range markings for safe operation of the airplane.

The altimeter indicates pressure altitude in feet above sea level. The indicator has three pointers and dial scale. The long pointer is read in hundreds of feet. The middle pointer is read in thousands of feet and the short pointer in ten thousand feet. A field pressure window is located on the right side of the indicator dial and set by the knob located on the lower left corner of the instrument. The altimeter consists of a sealed diaphragm that is connected to the pointers through a mechanical linkage. The instrument case is vented to the static air system, and as static air pressure decreases, the diaphragm expands, causing the pointers to move through the mechanical linkage.

The rate of climb indicator measures the rate of change in static pressure when the airplane is climbing or descending. By means of a pointer and dial, this instrument will indicate the rate of ascent or descent of the airplane in feet per minute.

10-6. ELECTRICAL INSTRUMENT. The turn and bank indicator is an electrical instrument used for making correctly controlled turns. The turn portion of the indicator is an electrically driven gyroscope, while the bank portion is a ball sealed in a curved glass tube filled with damping fluid.

The ammeter will indicate the amount of current received or the amount of current drain on the battery. The ammeter is mounted in the right instrument panel.

The two fuel quantity gauges are mounted in a cluster on the right instrument panel. These instruments are calibrated in fractional divisions of one-fourth, one-half, three-fourths and full. A transmitter unit is installed in each fuel cell. This unit contains a resistance strip and a movable control arm. The position of this arm is controlled by a float in the fuel cell and this position is transmitted electrically to the indicator gauge to show the amount of fuel in the cell. The quantity gauges will indicate the amount of fuel in the cell to which the fuel control levers are positioned. When the fuel control levers are moved to the OFF position, the quantity gauges will indicate empty.

The two oil temperature indicators are mounted in the instrument cluster on the right instrument panel. These instruments will provide a temperature indication of the engine oil in degrees Fahrenheit. Each instrument has a separate temperature bulb located in the oil screen assembly, on the engine accessory section.

On PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504, the carburetor air temperature indicator is mounted in the right instrument panel. A selector switch is incorporated in the system to eliminate the use of two instruments. This instrument is calibrated in degrees Fahrenheit and will provide a means of anticipating carburetor icing conditions. A temperature bulb is located in the carburetor air box of each engine and the air temperature indication is transmitted through wires back to the instrument.

On early models the flap position indicator just shows the position of the flaps. On later ones the position of the indicator shows the flap position and also corresponds to the maximum KIAS allowable when the flap is in a certain position. A transmitting unit for this instrument is located under the right rear floor board. The transmitter contains a resistance strip and a moveable contact arm which is connected mechanically to the flap actuating torque tube. As the flaps are actuated, their position is transmitted electrically to the flap position indicator.

10-7. MISCELLANEOUS INSTRUMENTS. The magnetic compass is a self-contained instrument and has an individual light which is connected to the instrument lighting circuit. The compass correction card is located in the card holder mounted near the compass.

The clock is a hand wound, 8-day time piece. It incorporates a stem wind with the knob at the lower left-hand side of the dial. This knob, when pulled and turned, also adjusts the hands.

The tachometer provides an indication of crankshaft speed in revolutions per minute for each engine. The tachometer connects to each engine accessory section by a flexible drive cable. The drive operates a magnetic drag mechanism that gives smooth operation, practically eliminating all pointer oscillation.

The dual manifold pressure gauge is a direct reading pressure instrument that indicates manifold pressure graduated in inches of mercury. As the pressure in the intake manifolds increases or decreases, the evacuated diaphragms contract or expand, moving the respective pointers through a mechanical linkage.

On PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 27-2504 incl., two fuel pressure gauge instruments are mounted in a cluster on the right side of the instrument panel. Each gauge is connected to the fuel system at the wing root section. Pressure is routed through small lines to the individual gauges which are calibrated in pounds per square inch.

On PA-23-250 (six place), Serial Nos. 27-2505 and up, the dual fuel flow instrument is a differential pressure gauge comprised of diaphragm sensing units with sector and pinion movement to amplify diaghragm movement. The gauge indicates fuel flow in gallons per hour by measuring differential pressure between the injector outlet versus deck pressure.

10-8. TROUBLESHOOTING. For troubleshooting of the various instruments, refer to Table X-III in this section.

10-9. REMOVAL OF INSTRUMENTS. (PA-23-250; PA-23-235; PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl; and PA-23-250 (six place), Serial Nos. 27-2505 to 27-3836, 27-3838 to 27-3943 incl.) Seeing that all instruments are mounted in a similar manner, the following description of a typical removal is provided as a guide.

a. Remove the trim panel from the top of the instrument panel by removing the attaching screws.

b. Remove the royalite cover panel from the face of the instrument panel.

c. Disconnect the plumbing and/or electrical connector from the back of the instrument to be removed. Attach a dust cover or plug to each fitting.

NOTE

Each line and/or wire removed should be marked for identification to facilitate reinstallation.

d. Remove the mounting screws from the instrument to be removed and remove the instrument.

NOTE

It may be necessary to remove the screws from the shock mounted panel on the left side of the instrument panel or to remove an upper instrument to gain access to a lower instrument.

10-10. INSTALLATION OF INSTRUMENTS. (PA-23-250; PA-23-235; PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl; and PA-23-250 (six place), Serial Nos. 27-2504 to 27-3836, 27-3838 to 27-3943 incl.) All instruments are mounted in a similar manner, thus the following description of a typical installation is provided as a guide.

a. Position the instrument and secure with attaching screws.
b. Connect the plumbing and/or electrical connector to the back of the instrument.
c. Install the royalite cover panel to the face of the instrument panel.
d. Install the trim panel to the top of the instrument panel and secure with attaching screws.

10-11. REMOVAL OF INSTRUMENTS. (PA-23-250 (six place), Serial Nos. 27-3837, 27-3944 and up.)

a. Pull the control wheel that is at the opposite side of the instrument panel from where the shock-mounted panel is to be removed, to its aftmost position and secure with a cord tied between the wheel and around the seat back.
b. Pad the control wheel tube with foam rubber or similar material.
c. Remove the self-locking nuts that secure the floating panel to its shock mounts. With an open end wrench held next to the back side of the panel, hold the rubber mounts to eliminate twisting as the nuts are being removed.
d. Pull the panel back and allow it to rest on the padded control wheel tube.
e. Unscrew the electrical connector from the post light(s).
f. Disconnect the plumbing and/or electrical connector from the back of the instrument and identify each line to facilitate reinstallation. Attach a dust cap

or plug to each fitting.

g. Remove the post light(s) by turning off nut.

h. Remove the screws that secure the instrument in the panel cutout.

i. Remove the instrument from the panel and secure the panel from rolling off the control tube.

j. Check the general condition of the rubber shock mounts and replace if necessary.

10-12. INSTALLATION OF INSTRUMENTS. (PA-23-250 (six place), Serial Nos. 27-3 83 7, 27-3944 and up.)

a. Place the instrument in its proper panel cutout and secure with screws.

b. Install the post light(s) and secure. Do not overtighten nut.

c. Connect the plumbing and/or electrical connector to back of instrument.

d. Connect the electrical connector of the post light(s). Tighten connector finger tight.

e. Ascertain that one end of the ground straps is placed over the panel side of the shock mount stud.

f. Place the floating panel in position and allow the shock-mount attachment studs to protrude through the panel. Install and tighten attachment nuts.

g. Remove the padding and release the control wheel.

h. Check the instrument and post light operation.

10-13. GYRO SERVICE PROCEDURE.

10-14. GYRO INSTALLATION INSPECTION. The following inspections should be made before removing a suspected gyro instrument from the airplane:

Visual Examination:

a. Has the instrument been modified?

b. Has the instrument been damaged?

c. Does the instrument show any signs of abuse?

Installation Inspection :

a. Are all pressure and static lines free from bends, restrictions or leaks?

b. Has the central air filter been replaced?

c. Is the instrument properly mounted in the panel?

d. Does the instrument physically touch other instruments, tubing or airframe members when the engines are started or stopped?

e. Are unused ports correctly sealed against air leaks?

f. Is the vacuum system correct, and does the vacuum gauge give an accurate reading?

g. Is the vacuum regulator adjusted correctly and functioning properly?

10-14A. HOSES AND CLAMPS.

a. These items should be examined periodically and inspected carefully whenever maintenance activities cause hose disconnections.

b. Ends of hoses should be examined for rubber separation and slivers of rubber on inside diameter of hoses. These slivers can and do become detached. If this happens, the loose particles will migrate throughout the system and may eventually contribute to a failure.

c. Replace old, hard, cracked or brittle hose. Sections of the inner layers may separate.

d. Ensure hoses are clear and clean by blowing them out with shop air. Remove from aircraft as required.

CAUTION: DO NOT WIGGLE HOSE FROM SIDE TO SIDE DURING INSTALLATION. WIGGLING COULD CAUSE PARTICLES TO BE CUT FROM INNER WALL OF HOSE WHICH CAN LEAD TO DAMAGE OF OTHER COMPONENTS.

e. Where hose clearance is tight, making it difficult to reinstall it onto a fitting or barb, spray the fitting or barb with silicone. Let dry, then install hose by pushing it straight on.

CAUTION: WHEN REPLACING ANY THREADED FITTING, DO NOT USE PIPE DOPE, THREADLUBE, OR TAPE. USE ONLY SILICONE SPRAY, LETTING IT DRY BEFORE ASSEMBLY.

f. Hose clamps and fittings should be replaced when broken, damaged or corroded.

10-15. GYRO HANDLING AND SHIPPING. The following information applies to all three inch directional gyros and attitude horizon instruments installed by the factory or a Piper field service facility.

Gyro instruments being returned to the factory are to be placed in approved containers with all ports properly sealed immediately after removal from the aircraft instrument panel. The instrument must also be accompanied by factory copies of the warranty and credit claim forms. These forms and the special containers should be available at any Piper Dealer and/or Distributor. Should any gyro instrument be received by the factory in an unapproved container or if the ports are not sealed, the warranty will be immediately voided and the instrument returned to the sender. The instrument must be returned immediately after removal from the aircraft (not to exceed 15 days following discovery of defect.)

10- 16. GYRO VACUUM SYSTEM (Three Relief Valve System). (PA-23-250, Serial Nos. 27- 1 to 27-443 incl.) (Refer to Figure 10-6.)

10-17. DESCRIPTION OF OPERATION. The three relief valve system employed to operate the gyro instruments is comprised of engine driven wet vacuum pumps, and air-oil separator for each pump, two vacuum relief valves, two check valves, a vacuum gauge, necessary tubing and fittings, and a test selector valve.

The vacuum pumps on the Aztecs are rotary vane, positive displacement units. These units consist of a housing containing a sleeve in which an offset rotor with moving blades is installed. The pumps are gear driven and mounted on the accessory case of the engine. As the pumps operate, they draw engine oil for internal lubrication. Either pump is capable of maintaining a vacuum should one pump fail.

The air-oil separators are mounted on the engine mount tube along the outboard side of each engine. As the air is drawn through the pump it mixes with the lubricating oil and is expe,lled through the exhaust side of the pump. The air-oil mixture is routed through the separator where the oil collects on.baffles and falls to the bottom of the separator to be returned to the engine. The air is vented overboard.

The vacuum relief valves are located in each nacelle. As the vacuum builds up with increasing engine RPM, the relief valves open and allow air to enter the inlet lines to prevent the vacuum in the system from exceeding the operating limits.

A check valve in the line from each pump permits air to move in only one direction; from the instruments toward the pump. If one pump fails, its check valve will close, preventing the operative pump from drawing air through the inoperative side. The check valves are located in the bottom center section of the fuselage.

Two types of vacuum air filter systems are utilized. Some airplanes use individual filtering pads installed in the back of the in.dividual instrument, while others use acentralair filter of the dry cartridge type attached to the air inlet lines forward of the instruments. The system using a central air filter is the newer allowing easy filter replacement when necessary and providing improved filtration.

The vacuum test selector valve, located on the right side of the instrument panel, is a four position, manually operated type valve. This valve, incorporated with the vacuum gauge, provides a means of checking the vacuum at four different locations in the system. This provides a means of localizing trouble in theevent a portion of the system is malfunctioning.

The vacuum gauge is mounted in the right side of the instrument panel, just above the test selector valve. The vacuum gauge iscalibrated in inches of mercury and indicates the amount of vacuum created by the engine driven vacuum pumps.

10-18. ADJUSTMENT OF VACUUM REGULATOR AND RELIEF VALVES.

a. Remove the inboard access panels from each engine nacelle and the access panel from the right side of the nose section.

WARNING: DO NOT ATTEMPT TO ADJUST THE REGULATOR AND RELIEF VALVES WITH THE ENGINE RUNNING. B. WITH A QUALIFIED PILOT OR OTHER RESPONSIBLE PERSON AT THE CONTROLS, START THE ENGINES. ALLOW TIME FOR WARM-UP AND OPERATE AT MEDIUM RPM.

c. With engines running at medium RPM, move the test selector valve to the right source: the vacuum gauge should indicate between 8.00 and 10.00 inches of mercury. When the selector is moved to the left source, the indication should be the same. If the vacuum reading fails to fall within this range, shut down the engines and adjust the relief valves by loosening the locking mechanism from the valve adjusting screw and move the valve adjustment screw clockwise to increase the vacuum. Start the engines and repeat the check. With the right and left source both indicating the recommended vacuum, move the selector to gyro horizon or gyro compass position. The recommended vacuum for these positions is 4.5 to 5.0 inches of mercury. If the vacuum reading fails to fall within this range, shut the engines down and adjust the relief valve located in the nose section as previously described.

d. Restart the engines and repeat the complete system check.

e. Tighten the locking mechanism on the regulator relief valves and replace the engine and nose section access panels.

2504

1. VACUUM REGULATOR
2. FROM ENGINE BREATHER
3. AIR OIL SEPARATOR
4. DRAIN
5. VENT
6. OIL COLLECTOR TANK
7. VACUUM PUMP
8. CHECK VALVE
9. VACUUM REGULATOR
10. CHECK VALVE
11. VACUUM SELECTOR
12. SUCTION GAUGE
13. GYRO HORIZON
14. DIRECTIONAL GYRO

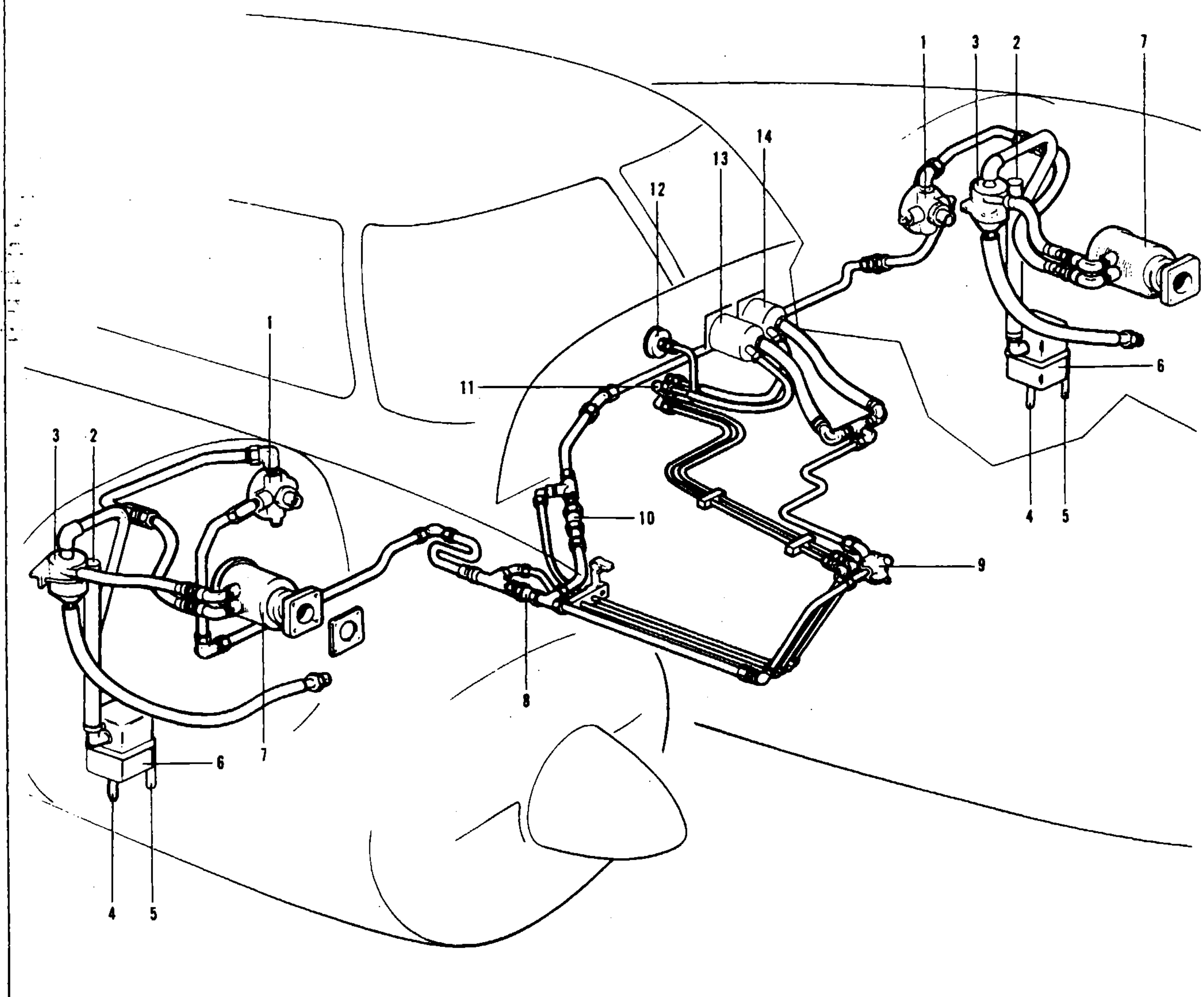


Figure 10-10. Vacuum System, PA-23-250, Serial Nos. 27-1 to 27-443 incl.

10-19. GYRO VACUUM SYSTEM. (Two Relief Valve System). PA-23-250, Serial Nos. 27-444 and up: PA-23-235, PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.: PA-23-250 (Six Place), Serial Nos. 27-2505 and up. (Refer to Figure 10-11 or 10-12.)

10-20. DESCRIPTION OF OPERATION. The two relief valve system employed to operate the gyro instruments is comprised of engine driven wet or dry vacuum pumps, two vacuum relief valves, two check valves, a vacuum gauge, necessary tubing and fittings and on some airplanes, a test selector valve.

The vacuum pumps are rotary four vane, positive displacement units. These units consist of a housing containing a sleeve in which an offset rotor with four moving blades is installed. The pumps are gear driven and mounted on the accessory case of the engine. PA-23-250 and PA-23-235 airplanes, Serial Nos. 27-444 to 27-548 incl. are equipped with wet vacuum pumps which use engine oil for internal lubrication. The PA-23-235, Serial Nos. 27-549 and up, the PA-23-250 (six place) and the PA-E23-250 airplanes, without deicers, are equipped with dry vacuum pumps which are internally lubricated and sealed when manufactured. One wet vacuum pump or one dry vacuum pump is capable of maintaining the vacuum system should the other pump fail.

On airplanes equipped with wet vacuum pumps, an air-oil separator is mounted on the fire wall. As the air is drawn through the pump it mixes with the lubricating oil and is expelled through the exhaust side of the pump. The air-oil mixture is routed through the separator where the oil collects on baffles and falls to the bottom of the separator to be returned to the engine. The air is vented overboard.

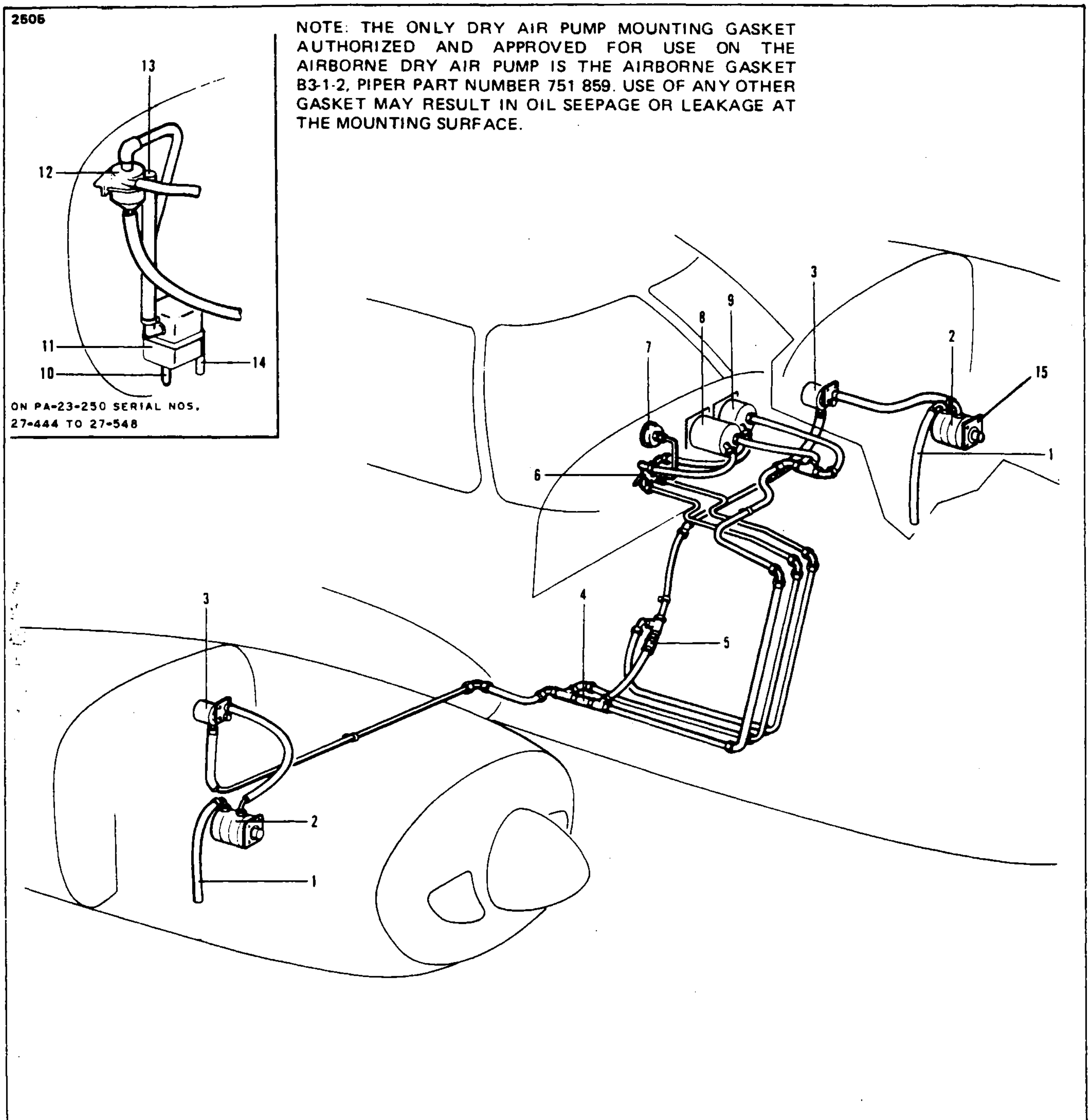
The vacuum relief valves are located in the center section of each nacelle. As the vacuum builds up with increasing engine RPM, the relief valves open and allow air to enter the inlet lines to prevent the vacuum in the system from exceeding the operating limits.

A check valve in the line from each pump permits air to move in only one direction; from the instruments toward the pump. If one pump fails, its check valve will close; preventing the operative pump from drawing air through the inoperative side. The check valves are located in the bottom center section of the fuselage.

Two types of vacuum air filtering systems are utilized. Some airplanes use individual filtering pads installed in the back of the individual instrument, while others use a central air filter of the dry cartridge type attached to the air inlet lines forward of the instruments. The system using a central air filter is the newer, allowing easy filter replacement when necessary and providing improved filtration.

On PA-23-250, PA-23-235 airplanes, Serial Nos. 27-443 and up; and PA-23-250 (six place) airplanes, Serial Nos. 27-2000 to 27-2504 inclusive, a vacuum test selector valve is incorporated. The selector valve, located on the right side of the instrument panel, is a four position, manually operated type valve. This valve, incorporated with the vacuum suction gauge, provides a means of checking vacuum pressure at four different locations of the system. Therefore giving a means of localizing trouble in the event a portion of the system is malfunctioning.

The vacuum gauge is mounted in the right side of the instrument panel, just above the test selector valve. The vacuum gauge is calibrated in inches of mercury and indicates the amount of vacuum created by the engine driven vacuum pumps.



1. VENT
2. VACUUM PUMP
3. VACUUM REGULATOR
4. CHECK VALVE
5. CHECK VALVE
6. VACUUM SELECTOR
7. SUCTION GAUGE
8. GYRO HORIZON
9. DIRECTIONAL GYRO
10. DRAIN
11. OIL COLLECTOR TANK
12. OIL COLLECTOR TANK
13. FROM ENGINE BREATHER
14. VENT
15. GASKET (SEE NOTE)

Figure 10-11. Vacuum System, PA-23-250, PA-23-235 and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.

On PA-23-250 (six place), Serial Nos. 27-2505 and up, a test selector valve is not installed. The vacuum gauge is on the right side of the instrument panel above the control column and operates similar to the one previously described. This gauge will indicate a failure in either side of the system. Should either side of the system fail, a small red button will pop out on the corresponding side of the gauge.

10-21. ADJUSTMENT OF VACUUM REGULATOR AND RELIEF VALVES.

a. Remove the engine access panels from each engine.

WARNING

Do not attempt to adjust the regulator and relief valves with the engine running.

b. On PA-23-250, PA-23-235 airplanes, Serial Nos. 27-443 and up and PA-23-250 (six place) airplanes, Serial Nos. 27-2000 to 27-2504 incl., the regulator relief valves may be adjusted as follows:

1. With a qualified pilot or other responsible person at the controls, start the engines. Allow time for warm-up and operate at medium RPM.

2. With engines running at medium RPM, move the test selector valve to the right source: the vacuum gauge should indicate between 4.5 and 5.0 inches of mercury, or 4.8 to 5.1 inches when a central air filter is installed. When the selector is moved to the left source, the indication should be the same. If the vacuum reading fails to fall within this range, shut down the engine and adjust the relief valves on the fire wall by loosening the locking mechanism from the valve adjusting screw and then turn the valve adjustment screw clockwise to increase or counterclockwise to decrease the vacuum. Start the engines and repeat the check.

c. On PA-23-250 (six place) airplanes, Serial Nos. 27-2505 and up, the regulator relief valves may be adjusted as follows:

1. With a qualified pilot or other responsible person at the controls, start one engine. Allow time for warm-up and operate at medium RPM.

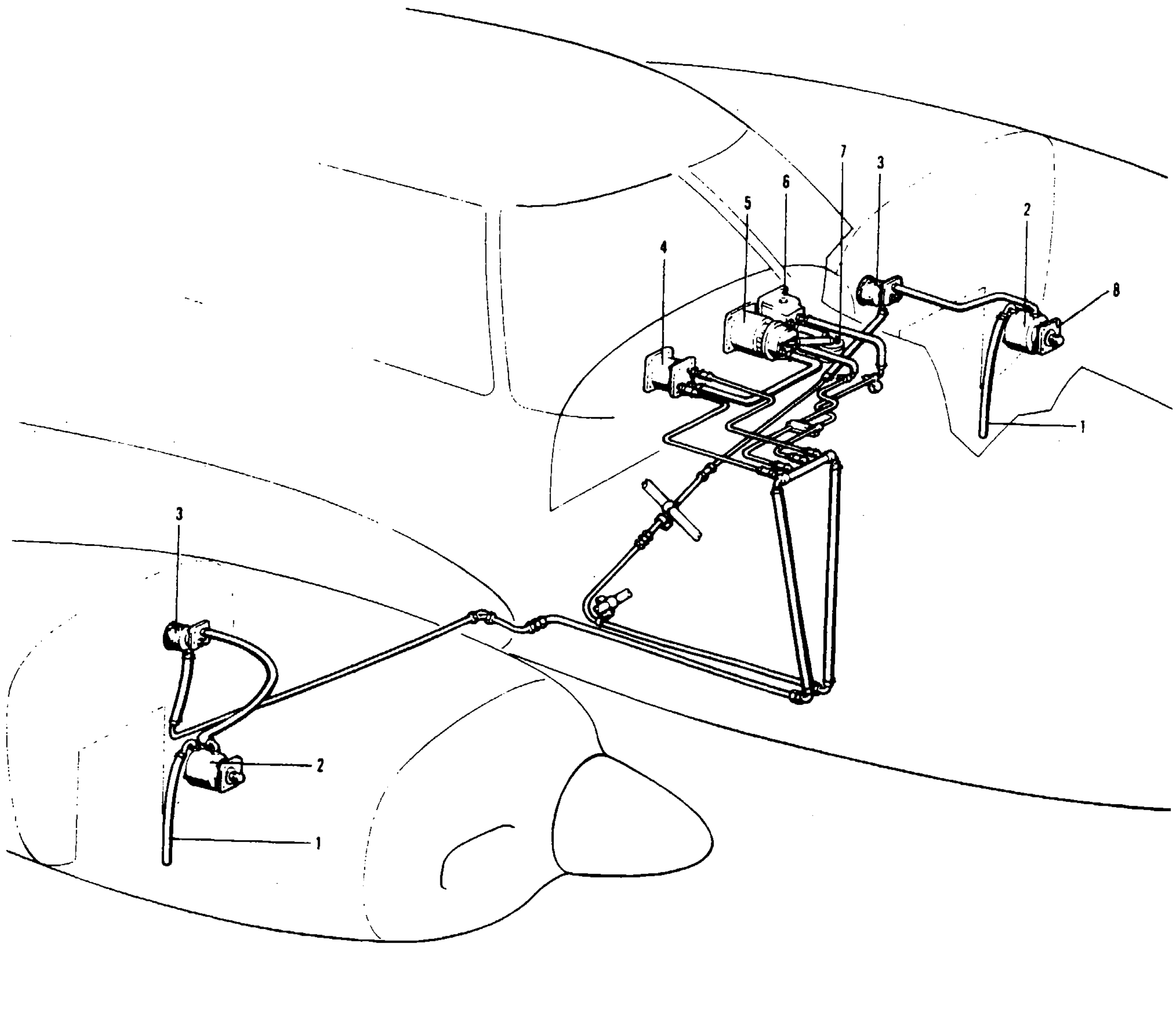
2. With the engine running at medium RPM, the vacuum gauge should indicate between 4.8 and 5.1 inches of mercury. If the vacuum reading fails to fall within range, shut down the engine and adjust the relief valves on the fire wall by loosening the locking mechanism from the valve adjusting screw and then turn the valve adjustment screw clockwise to increase or counterclockwise to decrease the vacuum. Start the engines and repeat the check.

3. Repeat the above procedure for the opposite engine.

d. Install the engine access panels.

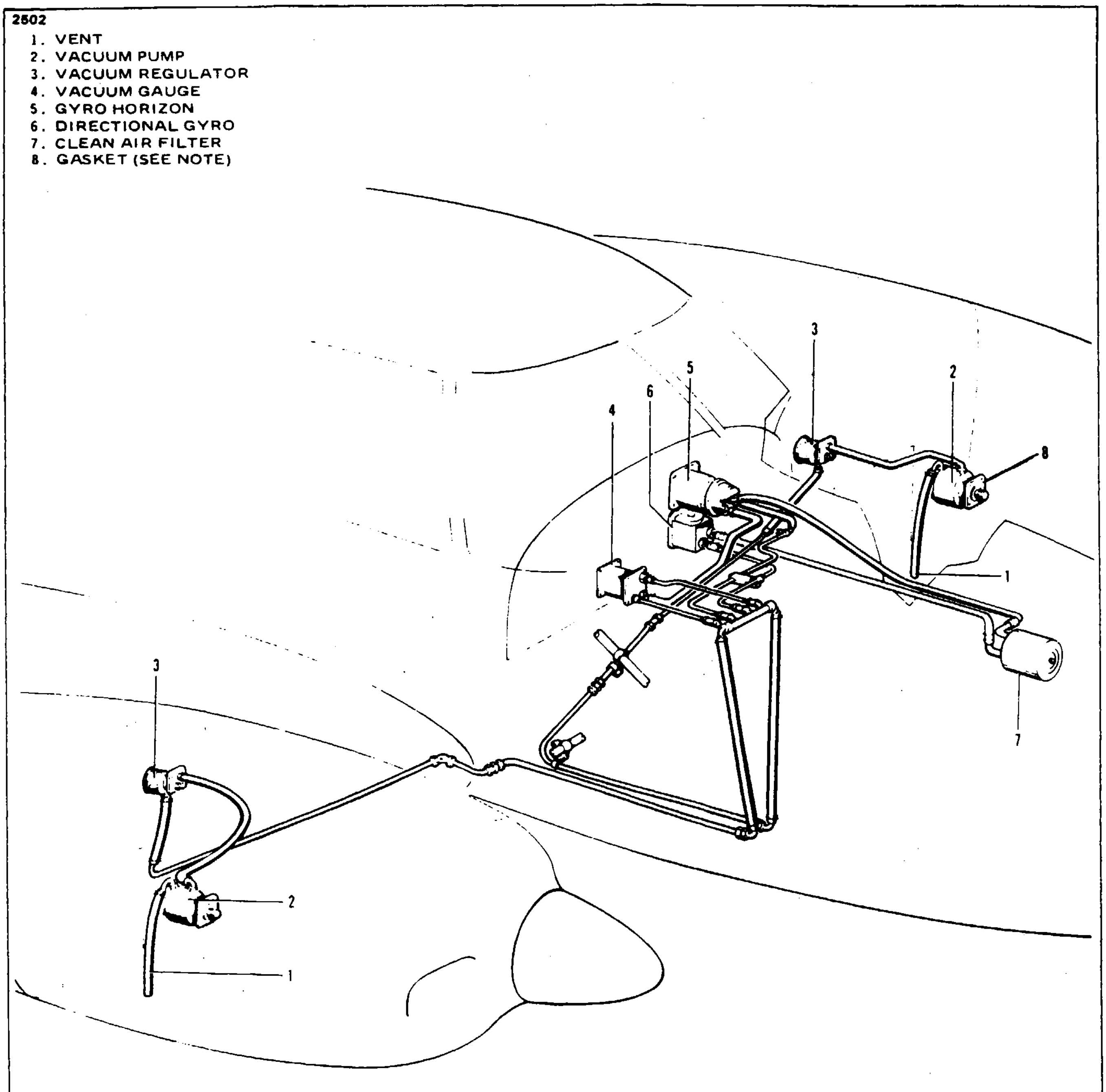
2511

1. VENT
2. VACUUM PUMP
3. VACUUM REGULATOR
4. VACUUM GAUGE
5. GYRO HORIZON
6. DIRECTIONAL GYRO
7. CLEAN AIR FILTER
8. GASKET (SEE NOTE)



NOTE: THE ONLY DRY AIR PUMP MOUNTING GASKET AUTHORIZED AND APPROVED FOR USE ON THE AIRBORNE DRY AIR PUMP IS THE AIRBORNE GASKET B3-1-2 PIPER PART NUMBER 751 859 USE OF ANY OTHER GASKET MAY RESULT IN OIL SEEPAGE OR LEAKAGE AT THE MOUNTING SURFACE.

Figure 10-12. Vacuum System, PA-23-250 (six place), Serial Nos. 27-2505 and up



NOTE: THE ONLY DRY AIR PUMP MOUNTING GASKET AUTHORIZED AND APPROVED FOR USE ON THE AIRBORNE DRY AIR PUMP IS THE AIRBORNE GASKET B3-1-2, PIPER PART NUMBER 751 859. USE OF ANY OTHER GASKET MAY RESULT IN OIL SEEPAGE OR LEAKAGE AT THE MOUNTING SURFACE.

Figure 10-13. Vacuum System, PA-23-250 (six place), Serial Nos. 27-3837, 27-3944 and up

2503

1. VENT
2. VACUUM PUMP
3. VACUUM REGULATOR
4. VACUUM GAUGE
5. GYRO HORIZON
6. DIRECTIONAL GYRO
7. CLEAN AIR FILTER
8. COPILOT GYRO'S SWITCH
9. VALVE
10. GASKET (SEE NOTE)

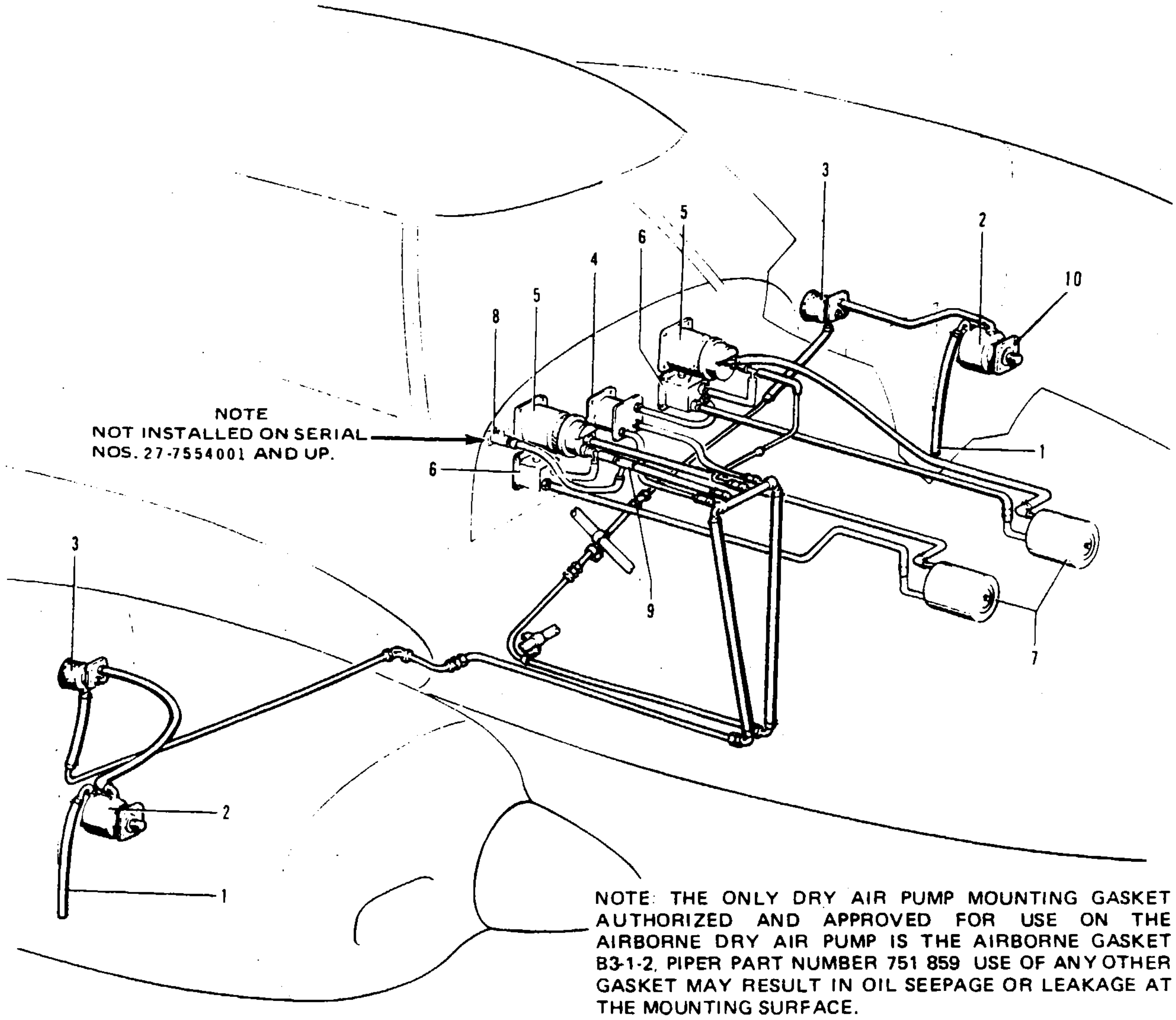


Figure 10-14. Vacuum System, Dual, (Optional Equipment)
PA-23-250 (six place), Serial Nos. 7305222 and 7405235 and up

10-22. VACUUM TEST SELECTOR VALVE. PA-23-250, PA-23-235 and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.

10-23. REMOVAL OF VACUUM TEST SELECTOR VALVE.

a. Remove the royalite trim panel by removing attaching screws. If instrument lighting is installed, disconnect the electrical connector along the bottom of the trim panel.

b. Disconnect and cap the vacuum lines connected to the valve. The lines should be marked for identification and ease of installation.

NOTE

It may be necessary to remove the glove compartment, by removing the attaching machine screws, to gain access to the selector valve.

c. Remove the machine screws and nuts securing the valve to the instrument panel and remove the valve.

NOTE

All open vacuum lines should be covered to prevent dust or other foreign material from entering the system.

10-24. INSTALLATION OF VACUUM TEST SELECTOR VALVE.

a. Position the test selector valve to the instrument panel and secure with machine screws and nuts.

b. Uncap and connect the five vacuum lines to the selector valve.

c. If the glove compartment was removed, reinstall at this time, and secure with machine screws.

d. Install the royalite trim panel and secure with attaching screws. If instrument lighting is installed, connect the electrical connector along the bottom of the trim panel prior to installation.

10-25. MANIFOLD PRESSURE GAUGE FILTERS (Turbocharger Installation Only). The manifold pressure gauge has two filter assemblies secured to the rear of the gauge. The removal of the top instrument access panel is necessary to gain access to the filter assemblies. Remove the two filter assemblies and replace the filter elements during the 500 hour inspection of the airplane.

10-26. EXHAUST GAS TEMPERATURE GAUGE. This instrument, which is commonly referred to as EGT, is used to aid the pilot in selecting the economical fuel-air mixture for cruising flight at a power setting of 75% or less. It is a sensing device to monitor the fuel-air mixture entering the engine cylinders. This gauge is not adjustable. If it is found defective after checking with the troubleshooting chart, it should be replaced.

CAUTION

When replacing leads, it is very important to use the same type and length of thermocouple wire, as the resistance of the leads is critical for the proper operation of this gauge.

10-27. REMOVAL OF EGT PROBE AND GAUGE.

a. Disconnect wires from the EGT gauge at the instrument panel.

b. Remove four bolts which secure the gauge to the instrument panel and remove the gauge.

c. Remove wires from the wire harness going to the engine.

d. Loosen the nut which secures the EGT probe to the exhaust system below the wastegate and remove the probe. (Note location of probe.)

10-28. CLEANING AND INSPECTION. Unless mechanical damage is evident, broken glass, bent or broken pointers, or broken case, the following checks should be performed before removing the instrument.

a. Remove the probe from the exhaust system and check for broken weld (at tip end) or burnt off end.

b. Disconnect the lead wires at the instrument and check for poor electrical connections.

c. With leads connected to the instrument, heat the probe with a propane torch to a dull red. The meter should show a reading. If the pointer does not move, replace the meter.

CAUTION

Do not connect an ohmmeter across the meter. It will burn out the movement of the meter.

10-29. INSTALLATION OF EGT PROBE AND GAUGE.

a. Install the probe into the hole in the exhaust system below the wastegate and secure with locknut.

b. Route the thermocouple wires along with the existing wire harness to the instrument panel.

c. Install the EGT gauge into the instrument panel and secure with four bolts.

d. Connect the thermocouple wires to the rear of the EGT gauge.

TABLE X-I. INSTRUMENT MARKINGS
(PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl. with Carburetor Induction System)

Fuel Pressure	
Green Arc (Normal Operating Range)	.5 to 5 PSI
Radial Red Line:	
Minimum	.5 PSI
Maximum	5 PSI
Tachometer	
Green Arc (Normal Operating Range)	500 to 2575 RPM
Radial Red Line (Maximum continuous)	2575 RPM
Cylinder Head Temperature	
Green Arc (Normal Operating Range)	200° to 500° F
Radial Red Line (Never Exceed)	500° F
Oil Pressure	
Green Arc (Normal Operating Range)	60 to 85 PSI
Yellow Arc (Caution Range)	25 to 60 PSI
Yellow Arc (Caution Range)	85 to 100 PSI
Radial Red Line:	
Minimum	25 PSI
Maximum	100 PSI
Oil Temperature	
Green Arc (Normal Operating Range)	120° to 245° F
Yellow Arc (Caution Range)	60° to 120° F
Radial Red Line (Never Exceed)	245° F
Airspeed Indicator	
Green Arc (Normal Operating Range)	72 to 198 MPH
Yellow Arc (Caution Range)	198 to 249 MPH
White Arc (Flaps Extended Range)	62 to 125 MPH (1)
	63 to 125 MPH (2)
Radial Red Line (Never Exceed - Smooth Air)	249 MPH

(1) PA-23-250 AND PA-23-235 ONLY
(2) PA-23-250 (SIX PLACE), SERIAL NOS. 27-2000 TO 27-2504 INCL. WITH CARBURETOR INDUCTION SYSTEM

TABLE X-II. INSTRUMENT MARKINGS
(PA-23-250 (six place), Serial Nos. 27-2322 and up with Fuel Injection Induction System or AiResearch Turbocharger.)

Fuel Flow	
Green Arc (Normal Operating Range)	0 to 26 GPH
Maximum	26 GPH
Tachometer	
Green Arc (Normal Operating Range)	500 to 2575 RPM
Radial Red Line (Maximum)	2575 RPM
Cylinder Head Temperature	
Green Arc (Normal Operating Range)	200° to 500°F
Radial Red Line (Never Exceed)	500°F
Oil Pressure	
Green Arc (Normal Operating Range)	60 to 90 PSI
Yellow Arc (Caution Range)	25 to 60 PSI
Yellow Arc (Caution Range)	90 to 100 PSI
Radial Red Line:	
Minimum	25 PSI
Maximum	100 PSI
Oil Temperature	
Green Arc (Normal Operating Range)	120° to 245° F
Yellow Arc (Caution Range)	60° to 120° F
Radial Red Line (Never Exceed)	245° F
Airspeed Indicator	
Green Arc (Normal Operating Range)	72 to 198 MPH (1)
	76 to 198 MPH (2), 61 to 175 KIAS (5)
Yellow Arc (Caution Range)	198 to 249 MPH, 175 to 221 KIAS (5)
White Arc (Flaps Extended Range)	68 to 125 MPH (3)
	70 to 125 MPH (4), 55 to 108 KIAS (5)
Radial Red Line (Never Exceed - Smooth Air)	249 MPH, 221 KIAS (5)
Radial Red Line (Minimum Control Speed Single Engine)	64 KIAS (5)
Radial Blue Line (Best Rate of Climb Speed - Single Engine)	88 KIAS (5)

(1) PA-23-250 (SIX PLACE), SERIAL NOS. 27-2505 TO 27-2868 INCL.
(2) PA-23-250 (SIX PLACE), SERIAL NOS. 27-2869 AND UP
(3) 4800 LBS GROSS WT.
(4) 5200 LBS GROSS WT.
(5) PA-23-250 "F" ONLY.

TABLE X-III. TROUBLESHOOTING - INSTRUMENTS

Trouble	Cause	Remedy
DIRECTIONAL GYRO INDICATOR		
Excess drift in either direction.	Excessive vibration with amplitude more than 0.006 inch.	Check shock mounts.
	Insufficient vacuum. If vacuum below that required for model, check for the following: a. Relief valve improperly adjusted b. Incorrect gauge reading. c. Pump failure. d. Vacuum line kinked or leaking.	 a. Adjust. b. Recalibrate. c. Repair or replace. d. Check and repair. Check for collapsed inner wall of hose.
	Defective instrument.	Replace instrument.
Dial spins continuously.	Defective mechanism.	Replace.
GYRO HORIZON INDICATOR		
Bar fails to respond.	Insufficient vacuum.	Check pump and tubing.
Bar does not settle.	Excessive vibration.	Check shock mounts. Replace if necessary.
	Insufficient vacuum.	Check line and pump. Adjust valve.
	Defective instrument.	Replace.
Bar oscillates or shimmies continuously.	Excessive vibration.	Check shock mounts. Replace if necessary.
	Vacuum too high.	Adjust valve.
	Defective mechanism.	Replace instrument.
ALTIMETER		
Excessive scale error.	Improper calibration adjustment.	Replace instrument.
Excessive pointer oscillation.	Defective mechanism,	Replace instrument.
High reading.	Improper venting.	Eliminate leak in static pressure system and check alignment of air-speed tube.

TABLE X-III. TROUBLESHOOTING - INSTRUMENTS (CONT.)

Trouble	Cause	Remedy
	ALTIMETER (CONT.)	
Setting knob is hard to turn.	Wrong lubrication or lack of lubrication.	Replace instrument.
Inner reference marker fails to move when setting knob is rotated.	Out of engagement.	Replace instrument.
Setting knob set screw loose or missing.	Excessive vibration.	Tighten instrument screw if loose. Replace instrument, if screw is missing.
Cracked or loose cover glass.	Excessive vibration.	Replace instrument.
Dull or discolored luminous markings.	Age.	Replace instrument.
Barometric scale and reference markers out of synchronism.	Slippage of mating parts.	Replace instrument.
Barometric scale and reference markers out of synchronism with pointers.	Drift in mechanism.	Refer to the latest revision of AC 43-13-1.
	AIRSPEED TUBES AND INDICATOR	
Tube does not heat or clear itself of ice with switch ON. (Heated pitot tubes only.)	Circuit breaker popped.	Reset.
	Open circuit.	Repair.
	Excessive voltage drop between battery and pitot head.	Check voltage at pitot head.
	Heating element burned out.	Replace pitot head.
Pointers of static instruments do not indicate properly.	Leak in instrument case or in pitot lines.	Check for leak and seal.
Pointer of instrument oscillates.	Leak in instrument case or in pitot lines.	Check for leak and seal.

TABLE X-III. TROUBLESHOOTING - INSTRUMENTS (CONT.)

Trouble	Cause	Remedy
	RATE OF CLIMB INDICATOR	
Pointer does not set on zero.	Aging of diaphragm.	Reset pointer to zero by means of setting screw. Tap instrument while resetting.
Pointer fails to respond.	Obstruction in static line.	Disconnect all instruments connected to the static line. Check individual instruments for obstructions in lines.
Pointer oscillates.	Leaks in static line.	Disconnect all instruments connected to the static line. Check individual instruments for leaks. Reconnect instruments to static line and test installation for leaks.
	Defective mechanism.	Replace instrument.
	TURN AND BANK INDICATOR	
Pointer fails to respond.	Foreign matter lodged in instrument.	Replace instrument.
	No electrical circuit.	Check for voltage at instrument.
Incorrect sensitivity.	Misadjustment of sensitivity spring.	Adjust by means of sensitivity spring screw. If this pulls the pointer from zero, replace instrument.
Pointer does not set on zero.	Gimbal and rotor assembly out of balance.	Replace instrument.
	Pointer incorrectly set on staff.	Replace instrument.
	Sensitivity adjustment pulls pointer off zero.	Replace instrument.
Vibrating pointer.	Gimbal and rotor assembly out of balance.	Replace instrument.
	Pitted or worn pivots or bearings.	Replace instrument.

TABLE X-III. TROUBLESHOOTING - INSTRUMENTS (CONT.)

Trouble	Cause	Remedy
TURN AND BANK INDICATOR (CONT.)		
In low temperature, pointer fails to respond or does so sluggishly and with insufficient deflection.	Oil has become too thick.	Replace instrument.
	Insufficient bearing clearance.	Replace instrument.
Pointer sluggish in returning to zero and does not set on zero when stationary.	Oil or dirt between damping pistons and cylinder.	Replace instrument.
	Excessive clearance between rotor and rotor pivots.	Replace instrument.
Ball in inclinometer does not center.	Instrument out of alignment on panel.	Correct alignment.
OIL TEMPERATURE INDICATORS		
Instrument fails to show any reading.	Wiring open.	Check for battery A+ at "IGN" terminal (stud on pilot's side), on rear of gauge. Check for good ground to tray which supports gauges.
Pointer fails to move upscale, as engine warms up.	Broken sender wire or open temperature probe.	Remove wire from "SEND" terminal (stud on co-pilot's side) on rear of gauge, and measure ohms from wire to airframe ground. See "Resistance Information:" below, for approximate expected resistance. No ohms reading (open circuit) indicates fix broken wire or replace open probe.
Pointer moves up to full hot and stays.	Sender wire or probe shorted to airframe.	Similar to above, but remove sender wire at both ends. Measure ohms to airframe, of wire, and of probe. Fix or replace what measures low ohms, or short.

TABLE X-III. TROUBLESHOOTING - INSTRUMENTS (CONT.)

Trouble	Cause	Remedy
OIL TEMPERATURE INDICATORS (CONT.)		
One gauge OK, one gauge bad.	Don't know.	Trade sender wires only, between left and right gauge, temporarily, to see if malfunction stays with gauge or with sender wire and its probe.
Gauges, wires, and probes appear to be OK, but oil temperature reads too high.	Hot engine.	See "High Oil Temperature" on TABLE VIII-III. ENGINE TROUBLESHOOTING.
Resistance Information:		
60°/654 Ω, 200°/80.7 Ω, 260°/46.3 Ω		14.2v Gauge AC6400636 Piper P/N 752-051 (N.L.A.)
100°/497 Ω, 200°/129 Ω, 260°/73 Ω		28.5v Gauge RPC 6246-00022 Piper P/N 755-454
60°/860 Ω, 200°/130 Ω, 260°/68 Ω		Replacement probe ROC 3080-11 Piper P/N 486-425
NOTE: The Rochester 3080-11 probe is approximately equal to the AC 1514976. Normal oil flow will affect probe resistance, but fixed (power) resistors may often be used to determine that a no longer replaceable gauge is actually still OK.		
MANIFOLD PRESSURE INDICATOR		
Excessive error at existing barometric pressure.	Pointer shifted.	Replace instrument.
Excessive error when engine is running.	Line leaking.	Tighten line connections.
Sluggish or jerky pointer movement.	Improper damping adjustment.	Adjust damping screw.
Broken or loose cover glass.	Vibration or excessive pressure.	Replace glass and reseat case.
Dull or discolored luminous markings.	Age.	Replace instrument.
Incorrect reading.	Moisture or oil in line.	Disconnect lines and blow out.

TABLE X-III. TROUBLESHOOTING - INSTRUMENTS (CONT.)

Trouble	Cause	Remedy
	FUEL PRESSURE GAUGE	
Low or no pressure indication.	Defective fuel pump.	Replace.
	Defective electric fuel pump switch.	Replace.
	Defective wiring.	Repair.
	Defective gauge.	Replace.
	Leak in engine pump diaphragm.	Repair.
	Leak in pressure line.	Repair.
Needle fluctuation.	Surge dome on pump filled with fuel.	Remove and empty.
	FUEL QUANTITY INDICATORS	
Inaccurate or no indication.	Defective gauge.	Replace.
	Defective micro switch.	Replace.
	Defective wiring.	Repair.
	Defective fuel transmitter.	Repair or replace.
Gauge indicates full constantly.	Intermittent or no ground.	Repair.
	CARBURETOR AIR TEMPERATURE INDICATOR	
No temperature indication.	Broken wire or lead.	Repair.
	Defective instrument.	Replace.
	ENGINE OIL PRESSURE GAUGE	
Excessive error at zero.	Pointer loose on shaft. Overpressure or seasoning of bourdon tube.	Replace instrument.
Excessive scale.	Improper calibration adjustment.	Replace instrument.
Excessive pointer oscillation.	Improper damping or rough engine relief valve.	Disconnect line and check for leaks. If trouble persists, clean and adjust relief valve.
Sluggish operation of pointer or pressure fails to build up.	Engine relief valve open.	Check and clean.

TABLE X-III. TROUBLESHOOTING - INSTRUMENTS (CONT.)

Trouble	Cause	Remedy
TACHOMETER		
No reading on indicator, either permanent or intermittent.	Broken shaft.	Replace instrument.
	Springs weak.	Replace instrument.
Pointer oscillates excessively.	Rough spot on, or sharp bend in shaft.	Repair or replace.
	Excess friction in instrument.	Replace instrument.
FLAP POSITION INDICATOR		
Inaccurate or no indication.	Defective indicator.	Replace.
	Defective wiring.	Repair.
	Defective flap transmitter.	Repair or replace.
Indicator indicates up constantly.	Intermittent or no ground.	Repair.
MAGNETIC COMPASS		
Excessive card error.	Compass not properly compensated.	Compensate instrument.
Excessive card error.	External magnetic interference.	Locate magnetic interference and eliminate if possible.
Excessive card oscillation.	Improper mounting on instrument panel.	Align instrument.
	Insufficient liquid.	Replace instrument.
Card sluggish.	Weak card magnet.	Replace instrument.
	Excessive pivot friction or broken jewel.	Replace instrument.
	Instrument too heavily compensated.	Remove excess compensation.
Liquid leakage.	Loose bezel screws.	Replace instrument.
	Broken cover glass.	Replace instrument.
	Defective sealing. gaskets.	Replace instrument.
Discolored luminous markings damping liquid.	Age.	Replace instrument.

TABLE X-III. TROUBLESHOOTING - INSTRUMENTS (CONT.)

Trouble	Cause	Remedy
	MAGNETIC COMPASS (CONT.)	
Defective light.	Burned out lamp or broken circuit.	Check lamp or continuity of wiring.
	EXHAUST GAS TEMPERATURE	
Gauge inoperative.	Defective gauge, probe, or wiring.	Isolate defective circuit, replace defective probe or gauge.
Fluctuating reading.	Loose, frayed, or broken electrical lead.	Tighten connections, and repair or replace defective leads.

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SECTION

XI

ELECTRICAL SYSTEM

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SECTION XI

ELECTRICAL SYSTEM

Paragraph		Aerofiche Grid No.

TABLE XI-I. INDEX - ELECTRICAL SYSTEM SCHEMATICS

System	Figure	Aerofiche Grid No.
Accessory and Autopilot, PA-23-250 (six place), Serial Nos. 27-3457 to 27-7554172 incl.	11-99	4I12
Accessory and Autopilot, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up	11-147	4L11
Alternator System (Delco-Remy), PA-23-250 (six place), Serial Nos. 27-2505 to 27-3836 incl. and 27-3838 to 27-3943 incl.	11-106	4I19
Alternator System (Prestolite), PA-23-250 (six place), Serial Nos. 27-3837, 27-3944 to 27-4793 incl.	11-107	4I21
Alternator Paralleling System (Prestolite), PA-23-250 (six place), Serial Nos. 27-4794 to 27-5005 incl.	11-109	4J1
Alternator Paralleling System (Prestolite), PA-23-250 (six place), Serial Nos. 27-5006 to 27-7554172 incl.	11-108	4I23
Alternator Paralleling System (Prestolite), PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up	11-149	4L13
External Power Supply, PA-23-250 and PA-23-250 (six place)	11-100	4I13
External Power Supply, PA-23-250 and PA-23-235	11-101	4I13
External Power Supply, PA-23-250 (six place), Serial Nos. 27-2505 to 27-3836 incl. and 27-3838 to 27-3943 incl	11-102	4I14
External Power Supply, PA-23-250 (six place), Serial Nos. 27-3837, 37-3944 to 27-7554172 incl.	11-103	4I14
Fuel Pumps (14 & 28-volt), PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.	11-68	4H10
Fuel Pumps, PA-23-250 (six place), Serial Nos. 27-2505 to 27-3836 incl. and 27-3838 to 27-3943 incl.	11-69	4H11
Fuel Pumps, PA-23-250 (six place), Serial Nos. 27-3837, 27-3944 to 27-7554172 incl.	11-70	4H12
Fuel Pumps, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Earlier Models)	11-134	4K23
Fuel Pumps, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Later Models)	11-135	4K24
Generator System (Delco-Remy) (14 & 28-volt), PA-23-250 and PA-23-235	11-104	4I15
Generator System (Delco Remy) (14 & 28-volt), PA-23-250 (six palce), Serial Nos. 27-2000 to 27-2504 incl.	11-105	4I17
Heated Windshield, PA-23-250 (six place), Serial Nos. 27-2505 to 27-7554172 incl.	11-98	4I12
Heated Windshield, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up	11-141	4L5
Heater, Map Lights and Cigar Lighter (14 & 28-volt), PA-23-250 and PA-23-235	11-71	4H13

TABLE XI-I. INDEX - ELECTRICAL SYSTEM SCHEMATICS (cont)

System	Figure	Aerofiche Grid No.
Heater, Map Lights and Cigar Lighter, PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.	11-72	4H14
Heater, Map Lights and Cigar Lighter (28-volt), PA-23-250 (six place), Serial Nos. 27-2298 and 27-2331	11-73	4H15
Heater, Map Lights and Cigar Lighter, PA-23-250 (six place), Serial Nos. 27-2505 to 27-3049 incl. and 27-3151 to 27-3154 incl.	11-74	4H16
Heater, Map Lights and Cigar Lighter, PA-23-250 (six place), Serial Nos. 27-3050, 27-3154 to 27-7554168 incl.	11-75	4H17
Heater and Cigar Lighter, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Earlier Models)	11-136	4L1
Heater and Cigar Lighter, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Later Models)	11-137	4L2
Heater with Reset and Cigar Lighter, PA-23-250 (six place) "F" Model, Serial Nos. 27-8154001 and up	11-138	4L3
Instrument Cluster Wiring (14 & 28-volt Systems), PA-23-250 and PA-23-235	11-121	4K3
Instrument Cluster Wiring (14 & 28-volt Systems), PA-23-250 (six place), Serial Nos. 27-2000 to 27-3837 incl. and 27-3838 to 27-3943 incl.	11-122	4K5
Instrument Cluster Wiring, PA-23-250 (six place), Serial Nos. 27-3837, 27-3944 to 27-7554172 incl.	11-123	4K7
Instrument Cluster Wiring, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Earlier Models)	11-150	4L17
Instrument Cluster Wiring, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Later Models)	11-151	4L19
Interior Lights, PA-23-250 (six place), Serial Nos. 27-2505 to 27-3153 incl.	11-117	4J19
Interior Lights, PA-23-250 (six place), Serial Nos. 27-3154 to 27-3836 incl. and 27-3838 to 27-3943 incl.	11-118	4J21
Interior Lights, PA-23-250 (six place), Serial Nos. 27-3837, 27-3944 to 27-4766 incl.	11-119	4J23
Interior Lights, PA-23-250 (six place), Serial Nos. 27-4767 to 27-7554172 incl.	11-120	4K1
Interior Lights, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 to 27-7954121 incl.	11-145	4L9
Interior Lights, PA-23-250 (six place), Serial Nos. 27-8054001 and up	11-148	4L12
Landing and Taxi Lights (14 & 28-volt), PA-23-250 and PA-23-235	11-76	4H18
Landing and Taxi Lights (14 & 28-volt), PA-23-250 (six place), Serial Nos. 27-2000 to 27-7554172 incl.	11-77	4H19
Landing and Taxi Lights, PA-23-250 "F" Model, Serial Nos. 27-7654001 and up	11-139	4L4
Landing Gear and Flap System, PA-23-250 and PA-23-235	11-124	4K9

TABLE XI-I. INDEX - ELECTRICAL SYSTEM SCHEMATICS (cont)

System	Figure	Aerofiche Grid No.
Landing Gear and Flap System (14 & 28-volt), PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.	11-125	4K11
Landing Gear and Flap System, PA-23-250 (six place), Serial Nos. 27-2505 to 27-3836 incl. and 27-3838 to 27-3943 incl.	11-126	4K13
Landing Gear and Flap System, PA-23-250 (six place), Serial Nos. 27-3837, 27-3944 to 27-7554172 incl.	11-127	4K15
Landing Gear and Flap System, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Earlier Models)	11-152	4L21
Landing Gear and Flap System, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Later Models)	11-153	4L23
Navigation and Instrument Lights, PA-23-250, Serial Nos. 27-1 to 27-258 incl.; 27-365 to 27-401 incl. and 27-403 to 27-504 incl. and PA-23-235	11-80	4H21
Navigation and Instrument Lights (28-volt), PA-23-250, Serial Nos. 27-259 to 27-364 incl.	11-81	4H22
Navigation and Instrument Lights (28-volt), PA-23-250, Serial Nos. 27-402	11-82	4H23
Pitot Heat (14 & 28-volt), PA-23-250 and PA-23-235	11-78	4H20
Pitot Heat (14 & 28-volt), PA-23-250 (six place), Serial Nos. 27-2000 to 27-7554172 incl.	11-79	4H20
Pitot Heat, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up	11-140	4L4
Position Lights (14 & 28-volt), PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.	11-83	4H24
Position Lights, PA-23-250 (six place), Serial Nos. 27-2505 to 27-7554172 incl.	11-84	4I1
Position Lights, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Earlier Models)	11-142	4L6
Position Lights, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Later Models)	11-143	4L7
Post Lights, PA-23-250 (six place), Serial Nos. 27-2505 to 27-2704 incl.	11-85	4I2
Post Lights, PA-23-250 (six place), Serial Nos. 27-2705 to 27-3836 incl. and 27-3838 to 27-3943 incl.	11-86	4I3
Post Lights, PA-23-250 (six place), Serial Nos. 27-4794 to 27-7554172 incl.	11-87	4I4
Post Lights, PA-23-250 (six place), Serial Nos. 27-3837, 27-3944 to 27-4793 incl.	11-88	4I5
Post Lights, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up	11-144	4L8

TABLE XI-I. INDEX - ELECTRICAL SYSTEM SCHEMATICS (cont)

System	Figure	Aerofiche Grid No.
Rotating Beacon (14 & 28-volt), PA-23-250 and PA-23-235	11-89	4I6
Rotating Beacon (14 & 28-volt), PA-23-250 (six place)	11-90	4I6
Stall Warning (14 & 28-volt), PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.	11-93	4I8
Stall Warning, PA-23-250 (six place), Serial Nos. 27-2505 to 27-7554172 incl.	11-94	4I9
Stall Warning, PA-23-250 (six place), Serial Nos. 27-2505 to 27-7554172 incl.	11-95	4I10
Stall Warning, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up	11-146	4L10
Starter System (Delco-Remy, 14 & 28-volt), PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.	11-110	4J3
Starter System (Delco-Remy), PA-23-250 (six place), Serial Nos. 27-2505 to 27-3831 inc.	11-111	4J5
Starter System (Delco-Remy), PA-23-250 (six place), Serial Nos. 27-2505 to 27-3836 incl. and 27-3838 to 27-3943 incl.	11-112	4J7
Starter System (Delco-Remy), PA-23-250 (six place), Serial Nos. 27-2505 to 27-3836 incl. and 27-3838 to 27-3943 incl. with AiResearch Turbocharger Starter System Schematic	11-113	4J9
Starter System (Prestolite), PA-23-250 (six place), Serial Nos. 27-3837, 27-3944 to 27-7554172 incl.	11-114	4J11
Starter System (Prestolite), PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Earlier Models)	11-115	4J13
Starter System (Prestolite), PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Later Models)	11-116	4J15
Strobe Light (Red Anti Collision) (14 & 28-volt), PA-23-250 and PA-23-235	11-91	4I7
Strobe Light (Red Anti-Collision) (14 & 28-volt), PA-23-250 (six place)	11-92	4I7
Strobe Light (Red Anti Collision)	11-128	4K17
Strobe Light (Red Anti Collision)	11-129	4K18
Strobe Light (White Anit Collision)	11-130	4K19
Strobe Light (White Anti Collision)	11-131	4K20
Strobe Light (White Anti Collision) PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Earlier Models)	11-132	4K21
Strobe Light (White Anti Collision) PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Later Models)	11-133	4K22
Turn & Bank (14 & 28-volt), PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.	11-96	4I11
Turn and Bank, PA-23-250 (six place), Serial Nos. 27-2505 and up	11-97	4I11

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SECTION XI

ELECTRICAL SYSTEM

11-1. INTRODUCTION. This section contains instructions for correcting difficulties which may arise in the operation of the electrical system. It includes a general description and function of each part of the system along with test and adjustments of the various components, a circuit load chart and electrical system schematics. For AutoPilot or Radio Service Information, refer to Section XII of this manual.

11-2. DESCRIPTION. Electrical power is supplied by a 14- or 28-volt, direct current, single wire, negative ground electrical system. One or two 12-volt batteries are incorporated in the system to furnish power for starting, and as a reserve power source, in case of generator or alternator failure.

On PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl. airplanes, the system consists of two engine driven, 50-ampere generators when the 14-volt system is installed and two 25-ampere generators when the 28-volt system is utilized; however, a kit is available to convert the 28-volt, 25-ampere system to a 50-ampere system. Two generator regulator assemblies, composed of a voltage regulator, current regulator, and a reverse current cutout, are installed in the generator circuits to protect the system and its components.

On PA-23-250 (six place), Serial Nos. 27-2505 and up airplanes, the electrical system consists of two engine-driven 70-ampere alternators. They are paralleled by the use of one voltage regulator to control field voltage of both units. Also incorporated in the system is an over-voltage relay. Its function is to open and remove field voltage to the unregulated alternators in the event of a failure of the voltage regulator. An auxiliary voltage regulator and over-voltage relay are also furnished.

An external power receptacle can be provided as optional equipment in the nose of the airplane, for the use of external power during cold weather operation. Electrical switches and rheostats are located on the left side of the cockpit under the instrument panel. The circuit breakers are mounted, in a panel, just to the left of the control quadrant. The airplane is equipped with standard navigation lights, one landing light located in the nose, and a taxi light mounted on the nose gear assembly.

11-3. TROUBLESHOOTING. Troubles peculiar to the electrical system are listed in Table XI-I in the back of this section, along with their probable causes and suggested remedies. An electrical schematic index may be found just prior to Section XI.

WARNING

All checks and adjustments of the generator or alternator and/or its components should be made with the engines stopped. Therefore, to complete some checks or adjustments, it will be necessary to remove these units from the airplane and be placed on a test stand.

11-4. GENERATOR SYSTEM (Delco-Remy).

11-5. DESCRIPTION OF GENERATOR SYSTEM. The generator is of the two brush, shunt type and is controlled by a regulator operating on the principal of inserting resistance into the generator field circuit to cause a reduction of generator voltage and current output. With each generator is the regulator assembly, composed of a voltage regulator and current regulator, to prevent overloading of the battery and electrical circuits. Also with the regulator is a reverse current cutout to prevent the generator from being motorized by the battery when the generator output drops below the battery voltage. A paralleling relay is used to connect the two generators. The generator is located on the front lower right side of the engine and utilizes a belt drive from the engine crankshaft. The generator voltage regulator is located on the engine firewall. The best assurance of obtaining maximum service from the generator with minimum trouble is to follow a regular inspection and maintenance procedure.

11-6. DESCRIPTION OF GENERATOR PARALLELING SYSTEM. Dual generators are installed with standard three unit regulators which incorporate a "paralleling winding" on the voltage regulator unit. These paralleling windings function in such a manner that each generator tends to take an equal portion of the electrical load.

The cut-out relay, current regulator and voltage regulator unit of the regulators function in the same manner as standard regulators. The paralleling coil, located on the voltage regulator unit of each regulator, is connected into the cir-

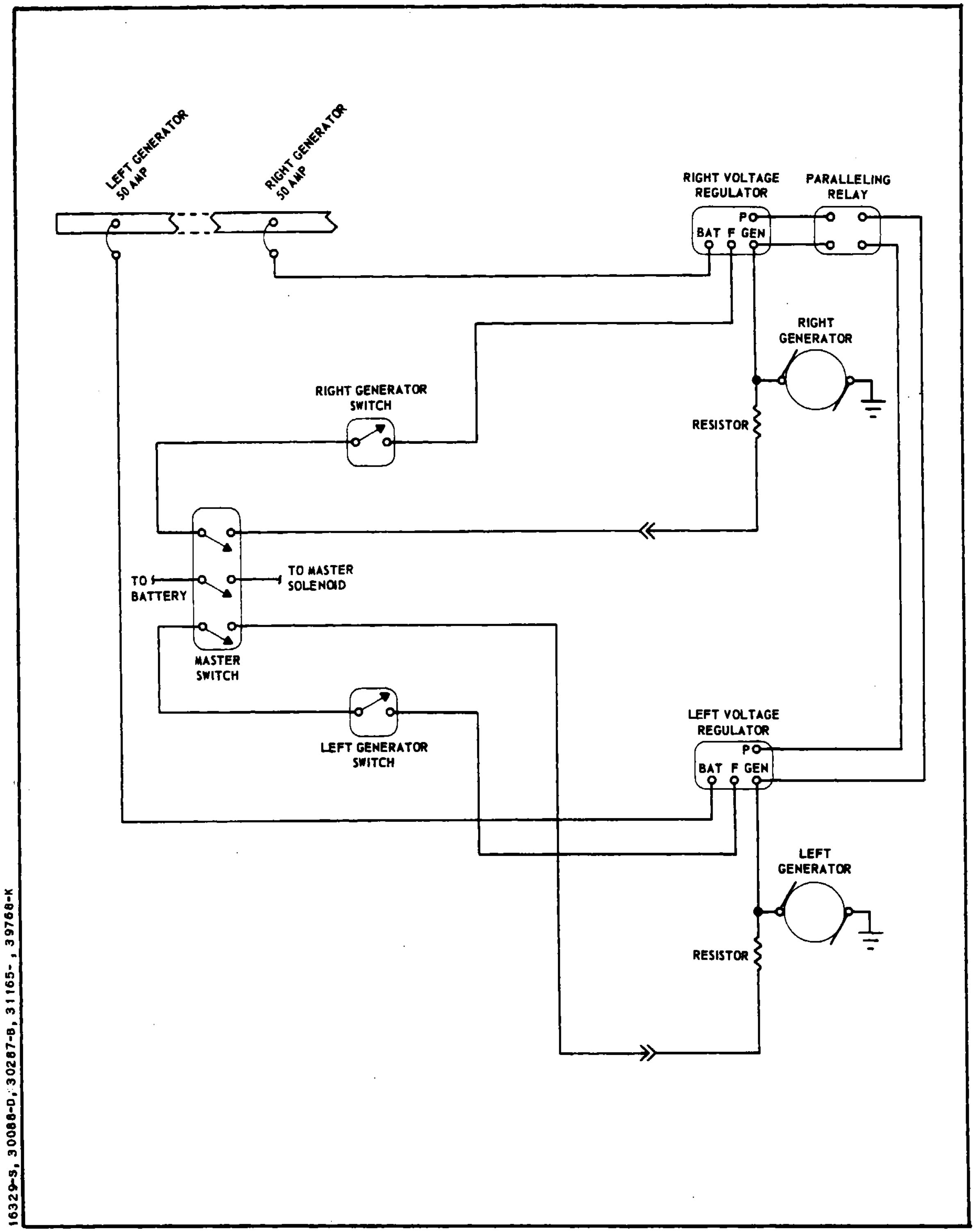

Figure 11-1. Generator Wiring System Schematic

cuit so that it either aids or opposes the voltage regulator shunt winding, depending on the direction of current flow through the coil.

When the operating voltage of one regulator tends to be at a different voltage than that of the other regulator, current will flow through the paralleling coils from the regulator with the higher setting. The paralleling coils are connected so that this current flow lowers the voltage of the regulator with the highest setting. The amount of current which flows through the paralleling coils is the amount required to cause the regulators to operate at the same voltage.

The two-unit paralleling relay acts as a switch to either join or separate the ends of the paralleling coils of the two regulators. Each set of contacts in the external two-unit paralleling relay (Refer to Figure 11-4.) close when the voltage of each respective generator reaches the value for which the relay is adjusted. These contacts close the circuit joining the ends of the paralleling windings on the voltage regulator units. If one generator should fail, the contacts of the paralleling relay unit of that charging system open, breaking the circuit between the paralleling windings. If the other generator and regulator are not defective, they will operate as a normal single generator charging system.

11-7. CHECKING GENERATOR SYSTEM. In analyzing complaints of generator-regulator operation, any of several basic conditions may be found.

a. Fully Charged Battery and Low Charging Rate: This indicates normal generator-regulator operation. Regulator setting may be checked as outlined in paragraph 11-24.

b. Fully Charged Battery and a High Charging Rate: This indicates that the voltage regulator is not reducing the generator output as it should. A high charging rate to a fully charged battery will damage the battery and the accompanying high voltage is very injurious to all electrical units.

This operating condition may result from:

1. Improper voltage regulator setting.
2. Defective voltage regulator unit.
3. Grounded generator field circuit (in either generator, regulator or wiring).
4. Poor ground connection at regulator.
5. High temperature which reduces the resistance of the battery to charge so that it will accept a high charging rate even though the voltage regulator setting is normal.

If the trouble is not due to high temperature, determine the cause of trouble by disconnecting the lead from the regulator "F" terminal with the generator operating at medium speed. If the output remains high, the generator field is grounded either in the generator or in the wiring harness. If the output drops off, the regulator is at fault, and it should be checked for a high voltage setting or grounds.

c. Low Battery and High Charging Rate: This is normal generator-regulator action. Regulator settings may be checked as outlined in paragraph 11-24.

d. Low Battery and Low or No Charging Rate: This condition could be due to:

1. Loose connections, frayed or damaged wires.
2. Defective battery.
3. High circuit resistance.
4. Low regulator setting.
5. Oxidized regulator contact points.
6. Defects within the generator.

If the condition is not caused by loose connections, frayed or damaged wires, proceed as follows to locate cause of trouble.

To determine whether the generator or regulator is at fault, momentarily ground the "F" terminal of the regulator and increase generator speed. If the output does not increase, the generator is probably at fault and it should be checked as outlined in paragraph 11-9. If the generator output increases, the trouble is due to:

1. A low voltage (or current) regulator setting.
2. Oxidized regulator contact points which insert excessive resistance into the generator field circuit so that output remains low.
3. Generator field circuit open within the regulator at the connections or in the regulator wiring.

e. Burned Resistances, Windings or Contacts: These result from open circuit operation or high resistance in the charging circuit. Where burned resistances, windings or contacts are found, always check wiring before installing a new regulator. Otherwise the new regulator may also fail in the same way.

f. Burned Relay Contact Points: This is due to reversed generator polarity. Generator polarity must be corrected as explained in paragraph 11-22 after any checks of the regulator or generator or after disconnecting and reconnecting leads.

11-8. ADJUSTMENTS, TESTS AND MAINTENANCE OF GENERATOR SYSTEM.

The best assurance of obtaining maximum service from generators with minimum trouble is to follow a regular inspection and maintenance procedure. Periodic lubrication where required, inspection of the brushes and commutator and checking of the brush spring tension are essentials in the inspection procedure. In addition, disassembly and thorough overhauling of the generator at periodic intervals are desirable as a safeguard against failures from accummulations of dust and grease and normal wear of parts. This is particularly desirable on installations where maintenance of operating schedules is of special importance. In addition to the generator itself, the external circuits between the generator, regulator and battery must be kept in good condition since defective wiring or loose or corroded connections will prevent normal generator and regulator action. At times it may be found necessary to adjust the voltage regulator or if dual generators are installed, the voltage regulators and paralleling relay. More detailed instructions may be found in the paragraph to follow.

11-9. TEST AND MAINTENANCE OF GENERATOR (Delco-Remy).

11-10. INSPECTION OF GENERATOR.

a. At periodic intervals the generator should be inspected to determine its condition. The frequence with which this should be done will be determined by the type of service in which it is used. High speed operation, excessive dust or dirt, high temperatures and operating the generator at or near full output most of the time are all factors which increase bearing, commutator, and brush wear. Generally speaking, the units should be inspected at approximately 100-hour intervals. The inspection procedure follows:

b. First inspect the terminals, external connections and wiring, mounting, pulley and belt. Then remove the cover band so that the commutator, brushes and internal connections can be inspected. If the commutator is dirty it may be cleaned with a strip of No. 00 sandpaper. Never use emery cloth to clean the commutator.

c. The sandpaper may be used by holding it against the commutator with a wood stick while the generator is rotated, moving it back and forth across the commutator. Gum and dirt will be sanded off in a few seconds. All dust should be blown from the generator after the commutator has been cleaned. A brush seating stone can also be used to clean the commutator.

d. If the commutator is rough, out of round, or has high mica, the generator must be removed and disassembled so that the armature can be turned down in a lathe and the mica undercut.

e. If the brushes are worn down to less than half their original length, they should be replaced. Compare the old brush with a new one to determine how much it is worn. New brushes should be seated to make sure that they are in good contact with the commutator. A convenient tool for seating brushes is a brush seating or bedding stone. This is a soft abrasive material which, when held against a revolving commutator, disintegrates so that particles are carried under the brushes and wear their contacting faces to the contour of the commutator in a few seconds. All dust should be blown from the generator after the brushes are seated.

f. The brush spring tension must be correct since excessive tension will cause rapid brush and commutator wear, while low tension causes arcing and burning of the brushes and commutator. Brush spring tension can be checked with a spring gauge hooked on the brush arm or brush attaching screw. Correction can be made by bending the brush spring as required. If the brush spring shows evidence of

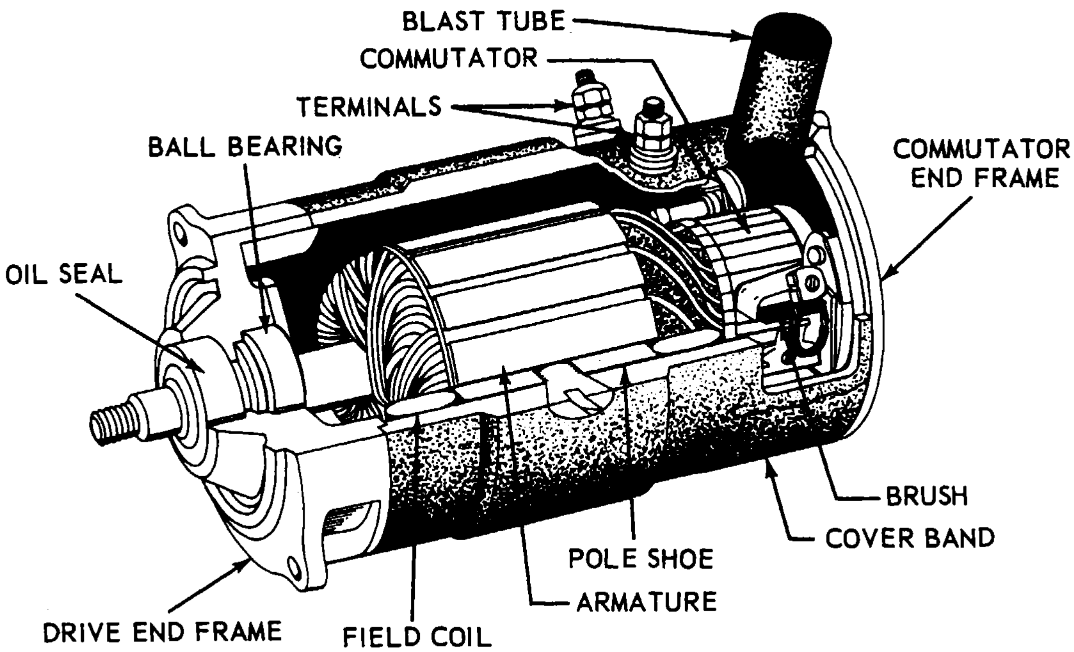

Figure 11-2. Sectional View of Generator

overheating (blued or burned), do not attempt to readjust it, but install a new spring. Overheating will cause a spring to lose its temper.

g. The belt should be checked to make sure that it is in good condition and has correct tension. Low belt tension will permit belt slippage with a resulting rapid belt wear and low or erratic generator output. Excessive belt tension will cause rapid belt and bearing wear. Check the tension of a new belt 25 hours after installation. Proper adjustment is given in paragraph 11-102.

11-11. SHUNT GENERATOR OUTPUT. The maximum output of shunt generators is determined by the current setting of the current regulator with which the shunt generator is used. Checking of this setting is discussed in the applicable regulator bulletin.

11-12. CHECKING DEFECTIVE GENERATORS. If the generator-regulator system does not perform according to specifications (generator does not produce rated output or produces excessive output), and the trouble has been isolated in the generator itself by following the procedure outlined in paragraph 11-6, the generator may be checked further as follows to determine the location of trouble in the generator.

11-13. NO OUTPUT.

a. If the generator will not produce any output, remove the cover band and check the commutator, brushes and internal connections. Sticking brushes, a dirty or gummy commutator (Refer to paragraph 11-21.) or poor connections may prevent the generator from producing any output. Thrown solder on the cover band indicates that the generator has been overloaded (allowed to produce excessive output) so it has overheated and melted the solder at the commutator riser bars. Solder thrown out often leads to an open circuit and burned commutator bars. If the brushes are satisfactorily seated and are making good contact with the commutator, and the cause of trouble is not apparent, use a set of test points and a test lamp as follows to locate the trouble (leads must be disconnected from generator terminals).

b. Raise the grounded brush from the commutator and insulate with a piece of cardboard. Check for grounds with test points from the generator main brush to the generator frame. If the lamp lights, it indicates that the generator is internally grounded. Location of the ground can be found by raising and insulating all brushes from the commutator and checking the brush holders, armature, commutator and field separately. Repair or replace defective parts as required. (Refer to paragraph 11-19.)

NOTE

If a grounded field is found, check the regulator contact points, since a grounded field may have permitted an excessive field current which will have burned the regulator contact points. Burned regulator points should be cleaned or replaced as required.

c. If the generator is not grounded, check the field for an open circuit with a test lamp. The lamp should light when one test point is placed on the field terminal or grounded field lead and the other is placed on the brush holder to which the field is connected. If it does not light, the circuit is open. If the open is due to a broken lead or bad connection, it can be repaired, but if the open is inside one of the field coils, it must be replaced.

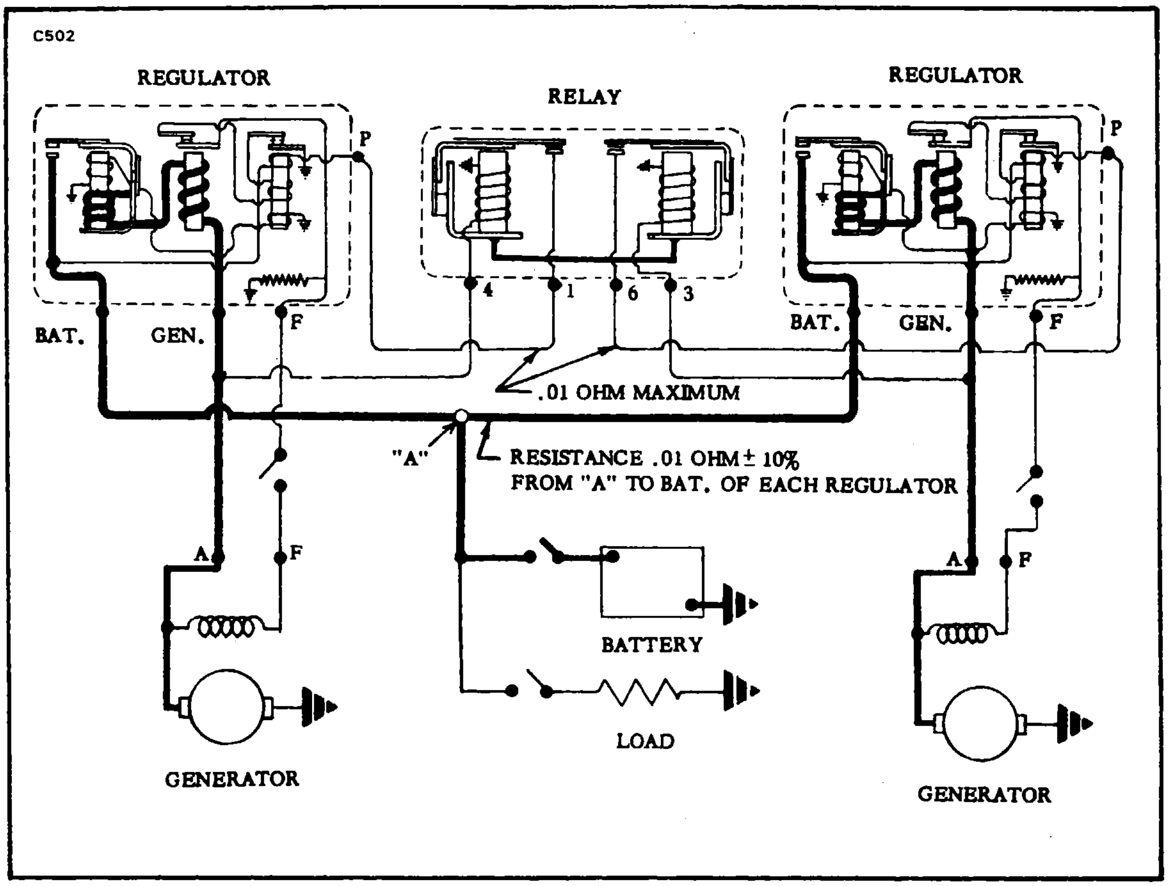

Figure 11-3. Wiring Circuit

d. If the field is not open, check for a short circuit in the field by connecting a battery of the specified voltage and an ammeter in series with the field circuit. Proceed with care, since a shorted field may draw excessive current which might damage the ammeter. If the field is not within specification, new field coils will be required. (Refer to paragraph 11-19.)

NOTE

If a shorted field is found, check the regulator contact points, since a shorted field may have permitted excessive field current which would have caused the regulator contact points to burn. Clean or replace points as required.

e. If the trouble has not yet been located, check the armature for open and short circuits. Open circuits in the armature are usually obvious, since the open circuited commutator bars will arc every time they pass under the generator brushes so that they will soon become burned. If the bars are not too badly burned and the open circuit can be repaired, the armature can usually be saved. In addition to repairing the armature, generator output must be brought down to specifications to prevent overloading by readjustment of the regulator.

f. Short circuits in the armature are located by use of a growler. The armature is placed in the growler and slowly rotated (while a thin strip of steel such as a hacksaw blade is held above the armature core). The steel strip will vibrate above the area of the armature core in which short circuited armature coils are located. If the short circuit is obvious, it can often be repaired so that the armature can be saved.

11-14. UNSTEADY OR LOW OUTPUT. If the generator produces a low or unsteady output, the following factors should be considered:

a. A loose drive belt will slip and cause a low or unsteady output.

b. Brushes which stick in their holders, or low brush spring tension will prevent good contact between the brushes and commutator so that output will be low and unsteady. This will also cause arcing and burning of the brushes and commutator.

c. If the commutator is dirty, out of round, or has high mica, generator output is apt to be low and unsteady. The remedy here is to turn the commutator down in a lathe and undercut the mica. Burned commutator bars may indicate an open circuit condition in the armature as already stated above. (Refer to paragraph 11-13.)

11-15. EXCESSIVE OUTPUT.

a. When a generator produces excessive output on an application, the procedure for determining whether the trouble is in the generator, regulator, or elsewhere is outlined in paragraph 11-7. If the generator output remains high, even with the "F" terminal lead disconnected, then the trouble is in the generator itself, and it must be further analyzed to locate the source of trouble.

b. In the system which has the generator field circuit grounded externally, accidental internal grounding of the field circuit would prevent normal regulation so that excessive output might be produced by the generator. On this type of unit, an internally grounded field which would cause excessive output may be located by use of test points connected between the "F" terminal and the generator frame. Leads should be disconnected from the "F" terminal and the brush to which the field lead is connected inside the generator should be raised from the commutator before this test is made. If the lamp lights, the field is internally grounded. If the field has become grounded because the insulation on a field lead has worn away, repair can be made by reinsulating the lead. It is also possible to make repair where the ground has occurred at the pole shoes by removing the field coils and reinsulating and reinstalling them. A ground at the "F" terminal stud can be repaired by installing new insulating washers or bushings.

NOTE

> If battery temperature is excessive, battery overcharge is apt to occur, even though regulator settings are normal. Under this condition, it is permissible to reduce the voltage regulator setting as explained in the applicable bulletin pertaining to the regulator used on the application.

11-16. NOISY GENERATOR. Noise emanating from a generator may be caused by a loose mounting, drive pulley, or gear; worn or dirty bearings; or improperly seated brushes. Dirty bearings may sometimes be saved by cleaning and relubrication, but worn bearings should be replaced. Brushes can be seated as explained in paragraph 11-10. If the brush holder is bent, it may be difficult to reseat the brush so that it will function properly without excessive noise. Such a brush holder will require replacement.

11-17. DISASSEMBLY, REPAIR AND REASSEMBLY. Normally, disassembly should proceed only so far as is necessary to make repair or replacement of the defective parts. For example, the field coils should be checked for opens, shorts, or grounds before being removed from the field frame. They should be removed only if they require repair or replacement.

11-18. FIELD COIL REMOVAL. Field coils can be removed from the field frame most easily by use of a pole shoe screw driver. It is also advisable to use a pole shoe spreader, since this prevents distortion of the field frame. The pole shoe screw driver permits easy loosening and removal of the pole shoe screws so that the pole shoes and field coils can be taken out of the field frame. The pole shoe screw driver and spreader should be used on reassembly of the field frame. Careful reassembly is necessary to prevent shorting or grounding of the field coils as the pole shoes are tightened into place.

11-19. INSPECTION AND REPAIR OF PARTS. The armature or field should not be cleaned in any degreasing tank or by use of degreasing compounds, since this might damage insulation so that a short or ground would subsequently develop. Sealed ball bearings do not require cleaning or relubrication. Other generator parts should be cleaned and carefully inspected for wear and other damage. Any defective parts should be repaired or replaced. On reassembly all soldered electrical connections should be made with rosin flux. Acid flux must never be used on electrical connections.

11-20. FIELD COIL SERVICE.

a. The field coils should be checked for grounds, opens or shorts as already explained in paragraph 11-13.

b. Grounded field coils may sometimes be repaired by removing them so they can be reinsulated. Care must be used to avoid excessive bulkiness when applying new insulation, since this might cause the pole shoe to cut through and cause another ground when the coils are reinstalled.

c. Usually if a field coil is open or shorted internally it will require replacement, since it is difficult to repair such a defect.

d. To remove or replace field coils in the field frame, the use of a pole shoe spreader and screw driver is recommended.

11-21. ARMATURE SERVICE.

a. The armature should be checked for opens, shorts and grounds as explained in following paragraphs. If the armature commutator is worn, dirty, out of round, or has high mica, the armature should be put in a lathe so the commutator can be turned down and the mica undercut. The mica should be undercut .031 of an inch and the slots cleaned out carefully to remove any trace of dirt or copper dust. As a final step in this procedure, the commutator should be sanded lightly with No. 00 sandpaper to remove any slight burrs that might be left as a result of the undercutting procedure.

b. Open circuited armatures can often be saved when the open is obvious and repairable. The most likely place an open will occur is at the commutator riser bars. This usually results from overloading of the generator which causes overheating and melting of the solder. Repair can be effected by resoldering the leads in the riser bars (using rosin flux) and turning down the commutator in a lathe to remove the burned spot and then undercutting the mica as explained in the previous paragraph. In some heavy-duty armatures, the leads are welded into the riser bars and these cannot be repaired by resoldering.

c. Short circuits in the armature are located by use of a growler. When the armature is revolved in the growler, with a steel strip such as a hacksaw blade held above it, the blade will vibrate above the area of the armature core in which the short is located. Copper or brush dust in the slots between the commutator bars sometimes causes shorts between bars which can be eliminated by cleaning out the slots. Shorts at cross-overs of the coils at the core end can often be eliminated by bending wires slightly and reinsulating the exposed bare wire.

d. Grounds in the armature are detected by use of a test lamp and test points. If the lamp lights when one test point is placed on the commutator with the other point on the core or shaft, the armature is grounded. Grounds occur as a result of insulation failure, which is often brought on by overloading and consequent overheating of the generator. Repairs can sometimes be made if grounds are at core ends (where coils come out of slots) by placing insulating strips between core and coil which has grounded.

11-22. POLARIZING GENERATOR. After a generator has been repaired and reinstalled or at any time after a generator has been tested, it must be repolarized to make sure that it has the correct polarity with respect to the battery it is to charge. Failure to repolarize the generator may result in burned relay contact points, a run-down battery and possibly serious damage to the generator itself. The procedure to follow in correcting generator polarity depends upon the generator-regulator wiring circuits; that is, whether the generator field is internally grounded or is grounded through the regulator.

11-23. GENERATOR SERVICE TEST SPECIFICATIONS. Delco-Remy Specifications for 14- and 28-volt generators installed on PA-23 series airplanes are as follows:

Generator	1101915	1101905	1105055
Delco-Remy, Ref. Service Bulletin	1G-150	1G-150	1G-150
Brush Spring Tension	24 oz.	24 oz.	28 oz.
Field Current (80° F) Amps Volts	 1. 62-1. 72 12	 0. 75-0. 85 24	 1. 45-1. 55 24
Cold Output Amps Volts Approx. R. P. M.	 50 14. 0 3960	 25 26. 0 3550	 50 28. 5 3730

COLD OUTPUT: Cold output data applies to generators at 80 degrees F, and with brushes well seated. Variations in temperature and brush seating as well as the condition of the generator may cause deviations of 100 RPM or more from rated speed.
HOT OUTPUT: Hot output is maximum output as controlled by current regulator.

11-24. REGULATOR (Delco-Remy).

11-25. DESCRIPTION OF REGULATOR. The regulator shown in Figure 11-4 consists of a cutout relay, a voltage regulator and a current regulator unit. The cutout relay closes the generator to battery circuit when the generator voltage is sufficient to charge the battery, and it opens the circuit when the generator slows down or stops. The voltage regulator unit is a voltage-limiting device that prevents the system voltage from exceeding a specified maximum and thus protects the battery and other voltage-sensitive equipment. The current regulator unit is a current-limiting device that limits the generator output so as not to exceed its rated maximum.

11-26. CUTOUT RELAY.

a. The cutout relay (Refer to Figure 11-4.) has two windings, a series winding of a few turns of heavy wire and a shunt winding of many turns of fine wire (shown in dashed lines). The shunt winding is connected across the generator so that generator voltage is impressed upon it at all times. The series winding is connected in series with the charging circuit so that all generator output passes through it. The relay core and windings are assembled into a frame. A flat steel armature is attached to the frame by a flexible hinge so that it is centered just above the stationary contact points. When the generator is not operating, the armature contact points are held away from the stationary points by the tension of a flat spring riveted on the side of the armature.

b. When the generator voltage builds up a value great enough to charge the battery, the magnetism induced by the relay windings is sufficient to pull the armature toward the core so that the contact points close. This completes the circuit between the generator and battery. The current which flows from the generator to the battery passes through the series winding in a direction to add to the magnetism holding the armature down and the contact points closed.

c. When the generator slows down or stops, current begins to flow from the battery to the generator.

d. This reverse flow of current through the series winding causes a reversal of the series winding magnetic field. The magnetic field of the shunt winding does not reverse. Therefore, instead of helping each other, the two windings now oppose so that the resultant magnetic field becomes insufficient to hold the armature down. The flat spring pulls the armature away from the core so that the points separate; this opens the circuit between the generator and battery.

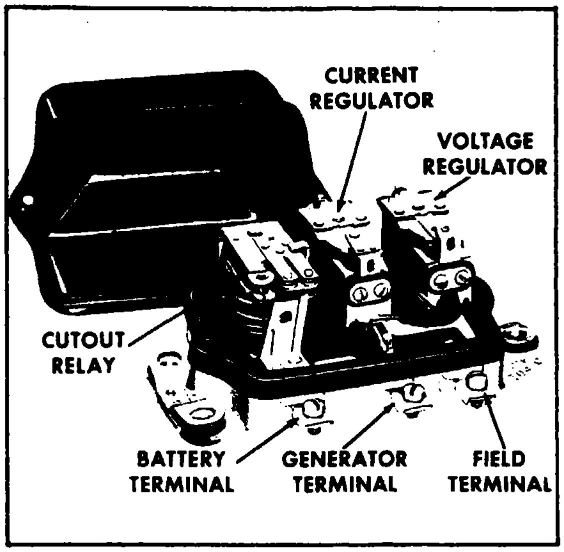

Figure 11-4. Current/Voltage Regulator

11-27. VOLTAGE REGULATOR.

a. The voltage regulator (Refer to Figure 11-4.) has two windings assembled on a single core, a shunt winding consisting of many turns of fine wire (shown in dashed lines) which is shunted across the generator, and a series winding of a few turns of relatively heavy wire which is connected in series with the generator field circuit when the regulator contact points are closed.

b. The windings and core are assembled into a frame. A flat steel armature is attached to the frame by a flexible hinge so that it is just above the end of the core. The armature contains a contact point which is just beneath a stationary contact point. When the voltage regulator is not operating, the tension of a spiral spring holds the armature away from the core so that the points are in contact and the generator field circuit is completed to ground through them.

c. When the generator voltage reaches the value for which the voltage regulator is adjusted, the magnetic field produced by the two windings (shunt and series) overcomes the armature spring tension and pulls the armature down so that the contact points separate. This inserts resistance into the generator field circuit so that the generator field current and voltage are reduced. Reduction of the generator voltage reduces the magnetic field of the regulator shunt winding. Also, opening the regulator points opens the regulator series winding circuit so that its magnetic field collapses completely. The consequence is that the magnetic field is reduced sufficiently to allow the spiral spring to pull the armature away from the core so that the contact points again close. This directly grounds the generator so that generator voltage and output increase. The above cycle of action again takes place and the cycle continues at a rate of 50 to 200 times a second, regulating the voltage to a predetermined value. With the voltage thus limited, the generator supplies varying amounts of current to meet the varying states of battery charge and electrical load.

11-28. CURRENT REGULATOR.

a. The current regulator (Refer to Figure 11-4.) has a series winding of a few turns of heavy wire which carries all generator output. The winding core is assembled into a frame. A flat steel armature is attached to the frame by a flexible hinge so that it is just above the core. The armature has a contact point which is just below a stationary contact point. When the current regulator is not operating, the tension of a spiral spring holds the armature away from the core so that the points are in contact. In this position the generator field circuit is completed to ground through the current regulator contact points in series with the voltage regulator contact points.

b. When the load demands are heavy, as for example, when electrical devices are turned on and the battery is in a discharged condition, the voltage may not increase to a value sufficient to cause the voltage regulator to operate. Consequently, generator output will continue to increase until the generator reaches rated maximum current. This is the current value for which the current regulator is set. Therefore, when the generator reaches rated output, this output, flowing through the current regulator winding, creates sufficient magnetism to pull the current regulator armature down and open the contact points. With the points open, resistance is inserted into the generator field circuit so that the generator output is reduced.

c. As soon as the generator output starts to fall off, the magnetic field of the current regulator winding is reduced, the spiral spring tension pulls the armature up, the contact points close and directly connect the generator field to ground. Output increases and the above cycle is repeated. The cycle continues to take place while the current regulator is in operation 50 to 200 times a second, preventing the generator from exceeding its rated maximum. When the electrical load is reduced (electrical devices turned off or battery comes up to charge), then the voltage increases so that the voltage regulator begins to operate and tapers the generator output down. This prevents the current regulator from operating. Either the voltage regulator or the current regulator operates at any one time - the two do not operate at the same time.

11-29. RESISTANCES. The current and voltage regulator circuits use a common resistor which is inserted in the field circuit when either the current or voltage regulator operates. A second resistor[1] is connected between the regulator field terminal and the cutout relay frame, which places it in parallel with the generator field coils. The sudden reduction in field current occurring when the current or voltage regulator contact points open, is accompanied by a surge of induced voltage in the field coils as the strength of the magnetic field changes. These surges

are partially dissipated by the two resistors, thus preventing excessive arcing at the contact points.
(1)(The second resistor is not present on all regulators. Many aircraft regulators have this resistor omitted.)

11-30. TEMPERATURE COMPENSATION. Voltage regulators are compensated for temperature by means of a bimetal thermostatic hinge on the armature. This causes the regulator to regulate at a higher voltage when cold which partly compensates for the fact that a higher voltage is required to charge a cold battery. Many current regulators also have a bimetal thermostatic hinge on the armature. This permits a somewhat higher generator output when the unit is cold, but causes the output to drop off as temperature increases.

11-31. REGULATOR POLARITY. Some regulators are designed for use with negative grounded systems, while other regulators are designed for use with positive grounded systems. Using the wrong polarity regulator on an installation will cause the regulator contact points to pit badly and give short life. As a safeguard against installation of the wrong polarity regulator, all regulators of this type have the model number and the polarity clearly stamped on the end of the regulator base. (Refer to paragraph 11-33, step f.)

11-32. REGULATOR MAINTENANCE.

NOTE

The regulator maintenance instructions to follow apply to Regulators, P/N 1119246 and 1118976. For maintenance instructions for Regulator, P/N 1119656, refer to Delco-Remy Service Bulletin 1R-119A. Specifications for all regulators are found in paragraph 11-44.

11-33. MAINTENANCE INSTRUCTIONS.

a. Mechanical checks and adjustments (air gaps, point opening) must be made with battery disconnected and regulator preferably off the aircraft.

CAUTION

The cutout relay contact points must never be closed by hand with the battery connected to the regulator. This would cause a high current to flow through the units which would seriously damage them.

b. Electrical checks and adjustments may be made either on or off the airplane. The regulator must always be operated with the type generator for which it is designed.

c. The regulator must be mounted in the operating position when electrical settings are checked and adjusted and it must be at operating temperature.

d. Specified generator speeds for testing and adjusting.

1. Voltage Regulator
   (a) Operating speed
2. Current Regulator
   (a) All generators must be operated at a speed sufficient to produce current in excess of specified setting.
   (b) Voltage of the generator must be kept high enough to insure sufficient current output, but below the operating voltage of the voltage regulator unit.

e. After any tests or adjustments the generator on the airplane must be polarized after leads are connected, but before the engine is started, as follows:

After reconnecting leads, momentarily connect a jumper lead between the GEN and BAT terminals of the regulator. This allows a momentary surge of current to flow through the generator which correctly polarizes it. Failure to do this may result in severe damage to the equipment since reversed polarity causes vibration, arcing and burning of the relay contact points.

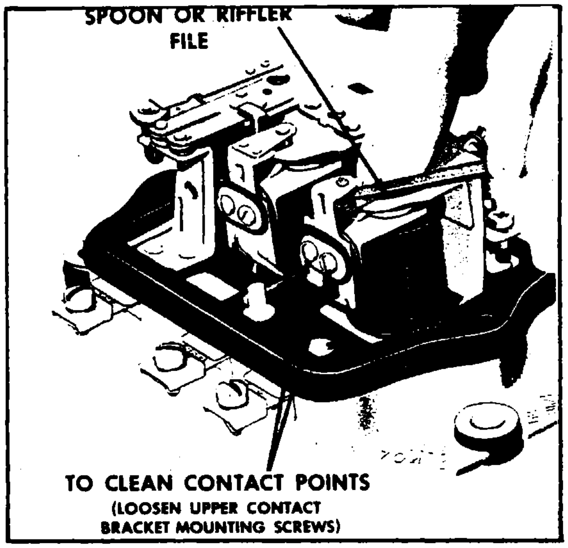

Figure 11-5. Use of Riffler File to Clean Contact Points

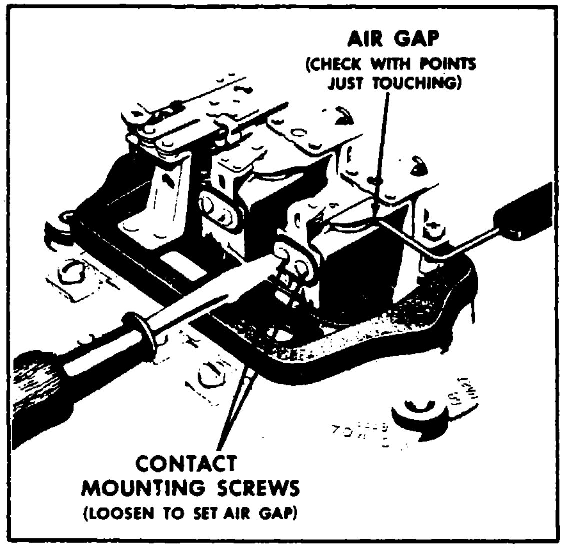

Figure 11-6. Voltage Regulator Air Gap

11-34. CLEANING CONTACT POINTS. The contact points of a regulator will not operate indefinitely without some attention. It has been found that a great majority of all regulator trouble can be eliminated by a simple cleaning of the contact points, plus some possible readjustment. The flat points should be cleaned with a spoon or riffler file. On negative grounded regulators which have the flat contact point on the regulator armatures, loosen the contact bracket mounting screws so that the bracket can be tilted to one side. A flat file cannot be used successfully to clean the flat contact points since it will not touch the center of the flat point where point wear is most apt to occur. Never use emery cloth or sandpaper to clean the contact points. Remove all the oxides from the contact points but note that it is not necessary to remove any cavity that may have developed.

11-35. REGULATOR CHECKS AND ADJUSTMENTS.

11-36. VOLTAGE REGULATOR. Two checks and adjustments are required on the voltage regulator; air gap and voltage setting.

a. Air Gap: To check air gap, push armature down until the contact points are just touching and then measure air gap. (Refer to Figure 11-6.) Adjust by loosening the contact mounting screws and raising or lowering contact bracket as required. Be sure the points are lined up and tighten screws after adjustment.

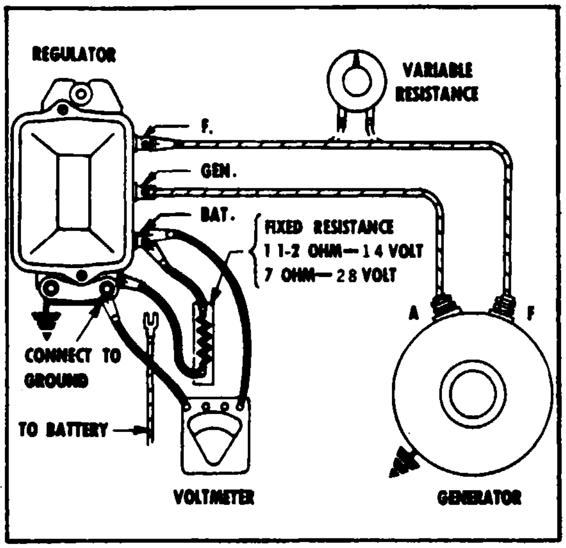

Figure 11-7. Checking Voltage Setting - Fixed Resistance Method

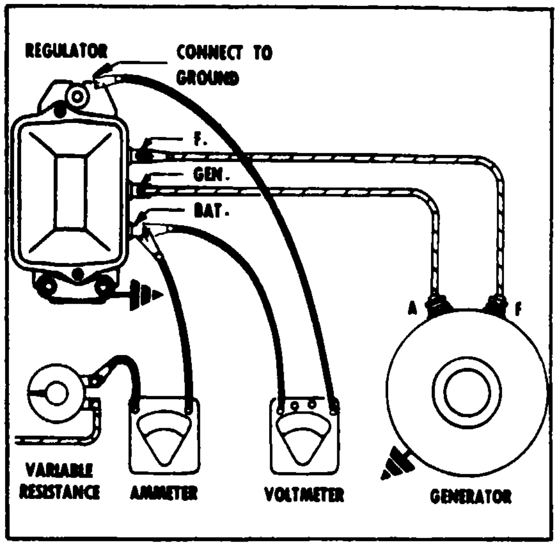

Figure 11-8. Checking Voltage Setting - Variable Resistance Method

b. Voltage Setting: There are two ways to check the voltage setting; the fixed resistance method and the variable resistance method. (Refer to Figures 11-7 and 11-8.)

1. Fixed Resistance Method:

(a) Connect a fixed resistance between the battery terminal and ground as shown in Figure 11-7 after disconnecting the battery lead from the battery terminal of the regulator. The resistance must be one and one-half ohms for 14-volt and seven ohms for 28-volt units. It must be capable of carrying 10 amperes without any change of resistance with temperature changes.

(b) Connect a voltmeter from regulator BAT terminal to ground.

(c) Place the thermometer within 0.25 inch of regulator cover to measure regulator ambient temperature.

(d) Operate generator at specified speed for 15 minutes with regulator cover in place to bring the voltage regulator to operating temperature.

(e) Cycle the generator:

Method 1: Move voltmeter lead from BAT to GEN terminal of the regulator. Retard generator speed until generator voltage is reduced to 4-volts. Move voltmeter lead back to BAT terminal of the regulator. Bring the generator back to specified speed and note voltage setting.

Method 2: Connect a variable resistance into the field circuit as in Figure 11-7. Turn out all resistance. Operate the generator at specified speed. Slowly increase (turn in) resistance until generator voltage is reduced to 4-volts. Turn out all resistance again and note voltage setting (with voltmeter connected as shown in Figure 11-7). Regulator cover must be in place.

(f) Note the thermometer reading and select the Normal Range of Voltage for this temperature as listed in specifications paragraph 11-44.

(g) Note the voltmeter reading with regulator cover in place.

(h) To adjust voltage setting, turn adjusting screw. (Refer to Figure 11-9.) Turn clockwise to increase setting and counterclockwise to decrease setting.

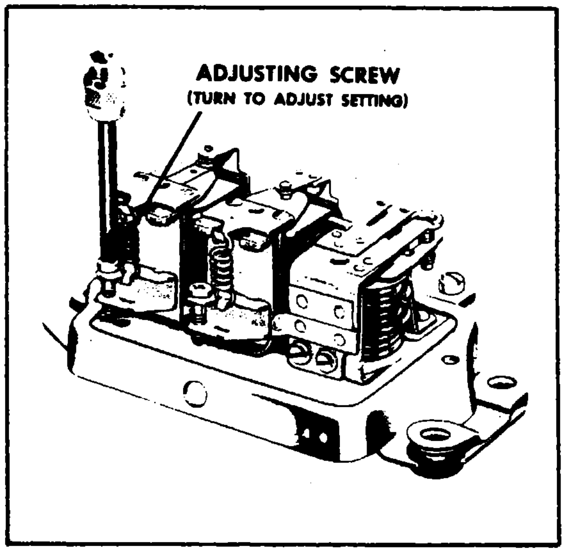

Figure 11-9. Adjusting Voltage Regulator Setting

CAUTION

If adjusting screw is turned down (clockwise) beyond range, spring support may not return when screw is backed off. In such case, turn screw counterclockwise until there is ample clearance between screw head and spring support. Then bend spring support up carefully until it touches the screw head. Final setting of the unit should always be made by increasing spring tension, never by reducing it. If setting is too high, adjust unit below required value and then raise to exact setting by increasing the spring tension. After each adjustment and before taking reading, replace the regulator cover and cycle the generator.

2. Variable Resistance Method:

(a) Connect ammeter and one-quarter ohm variable resistor in series with the battery as shown in Figure 11-7.

NOTE

It is very important that the variable resistance be connected at the BAT terminal as shown in Figure 11-7 rather than at the GEN terminal even though these terminals are in the same circuit. An examination of the wiring diagram, Figure 11-3, will show that regulation begins at the point where the shunt windings are connected to the series circuit. Any small resistance added to the circuit between the generator and this point will simply be offset by a rise in generator voltage without affecting the output shown at the ammeter.

(b) Connect voltmeter between BAT terminal and ground.

(c) Place thermometer within one-quarter inch of regulator cover to measure regulator ambient temperature.

(d) Operate generator at specified speed. Adjust variable resistor until current flow is 8 to 10-amperes. If less current than is required above is flowing, it will be necessary to turn on airplane lights to permit increased generator output. Variable resistance can then be used to decrease current flow to the required amount.

Allow generator to operate at this speed and current flow for 15 minutes with regulator cover in place in order to bring the voltage regulator to operating temperature.

(e) Cycle the generator by either method listed in "Fixed Resistance Method" of "Voltage Setting" procedure.

(f) Note the thermometer reading and select the "Normal Range" of voltage for this temperature as listed in specifications paragraph 11-44.

(g) Note the voltmeter reading with regulator cover in place.

(h) Adjust voltage regulator as required as described in step (h) of "Fixed Resistance Method" of "Voltage Setting Procedure." In using the variable resistance method, it is necessary to readjust the variable resistance after each voltage adjustment to assure that 8 to 10-amperes are flowing. Cycle generator after each adjustment before reading voltage regulator setting with cover in place.

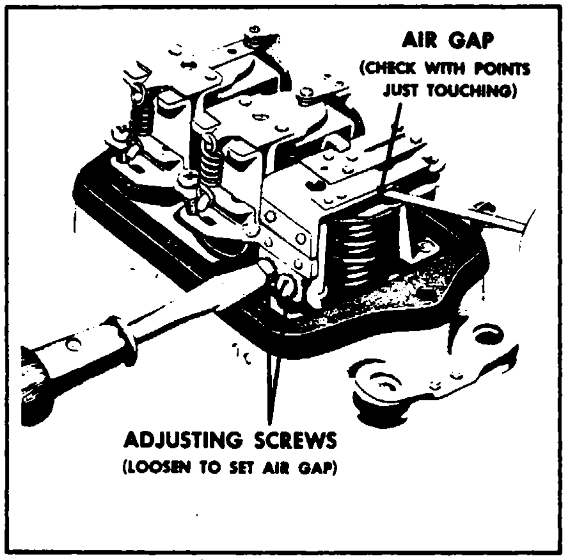

Figure 11-10. Cutout Relay Air Gap Check and Adjustments

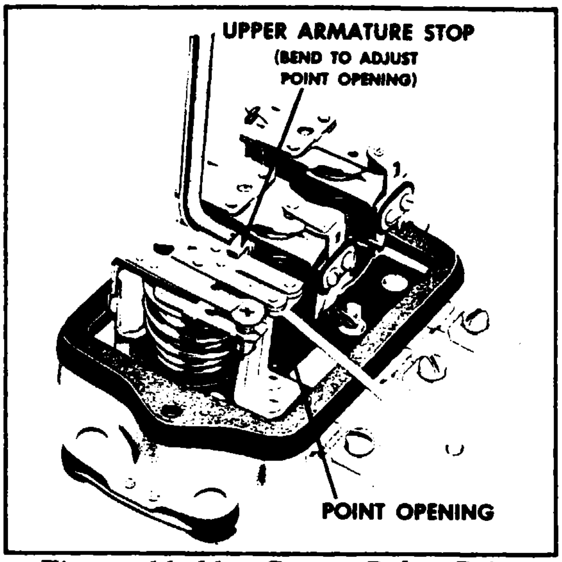

Figure 11-11. Cutout Relay Point Opening Check and Adjustment

11-37. CUTOUT RELAY. The cutout relay requires three checks and adjustments: air gap, point opening and closing voltage. The air gap and point opening adjustments must be made with the battery disconnected.

a. Air Gap: Place fingers on armature directly above core and move armature down until points just close and then measure air gap between armature and center of core. (Refer to Figure 11-10.) On multiple contact point relays, make sure that all points close simultaneously. If they do not, bend spring finger so they do. To adjust air gap, loosen two screws at the back of relay and raise or lower the armature as required. Tighten screws after adjustment.

b. Point Opening: Check point opening and adjust by bending the upper armature stop. (Refer to Figure 11-11.)

c. Closing Voltage: Connect regulator to proper generator and battery. Connect voltmeter between the regulator GEN terminal and ground. (Refer to Figure 11-12.)

Method 1: Slowly increase generator speed and note relay closing voltage. Decrease generator speed and make sure the cutout relay points open.

Method 2: Make connections as in Step c; but, in addition, add a variable resistor connected into the field circuit. (Refer to Figure 11-12.) Use a 25-ohm - 25-watt resistor. Operate generator at medium speed with variable resistance turned all in. Slowly decrease (turn out) the resistance until cutout relay points close. Note closing voltage. With cover in place, slowly increase (turn in) resistance to make sure points open.

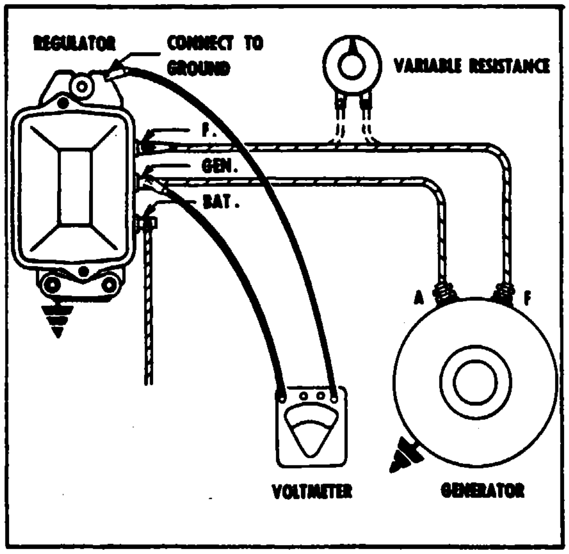

Figure 11-12. Checking Cutout Relay Closing Voltage

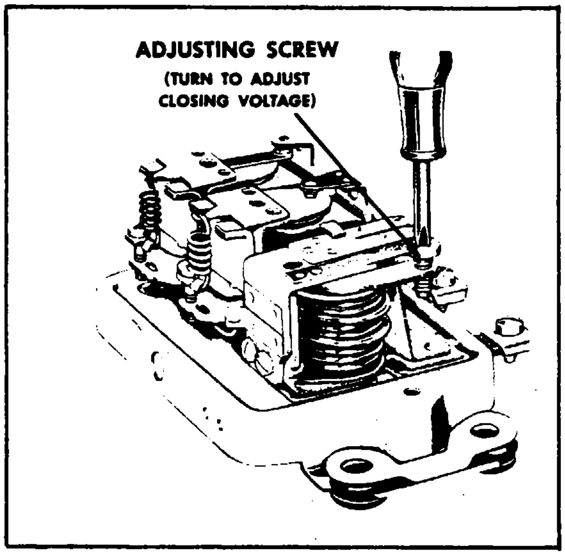

Figure 11-13. Adjustment of Cutout Relay Closing Voltage

d. Adjust closing voltage by turning adjusting screw. (Refer to Figure 11-13.) Turn screw clockwise to increase setting and counterclockwise to decrease setting.

11-38. CURRENT REGULATOR. Two checks and adjustments are required on the current regulator; air gap and current setting.

a. Air Gap: Check and adjust in exactly the same manner as for the voltage regulator.

b. Current Setting: Current regulator setting on current regulators having temperature compensation should be checked by the following method:

1. Load Method:

(a) Connect ammeter into charging circuit as in Figure 11-13.

(b) Turn on all accessory load (lights, radio, etc.) and connect an additional load across the battery (such as a carbon pile or band of lights) so as to drop the system voltage approximately one-volt below the voltage regulator setting.

(c) Operate generator at specified speed for 15 minutes with cover in place. (This establishes operating temperature; see steps (c) and (d) in paragraph 11-33.) If current regulator is not temperature-compensated, disregard 15 minute warm-up period.

(d) Cycle generator and note current setting.

(e) Adjust in same manner as described for voltage regulator. (Refer to Figure 11-9.)

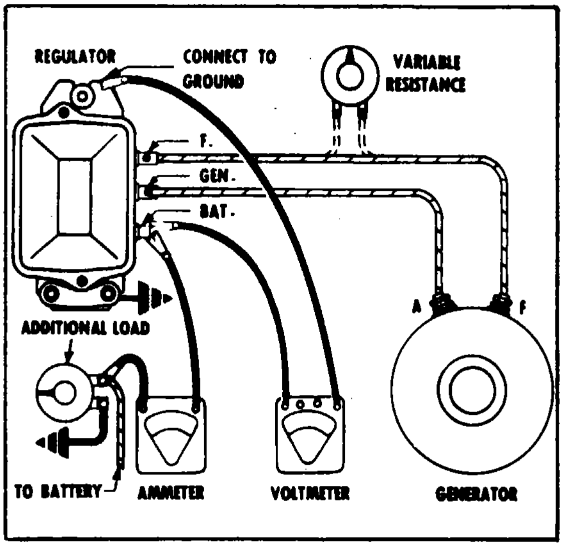

Figure 11-14. Checking Current Regulator, Load Method

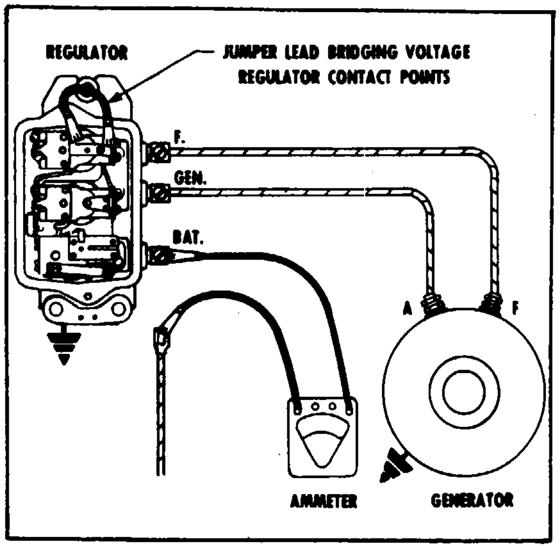

Figure 11-15. Checking Current Regulator, Jumper Lead Method

2. Jumper Lead Method: (Use only for current regulators without temperature compensation.)

(a) Connect ammeter into charging circuit as in Figure 11-15.

(b) Connect jumper lead across voltage regulator points as in Figure 11-14.

(c) Turn on all lights and accessories or load battery as in (b) under Load Method.

(d) Operate generator at specified speed and note current setting.

(e) Adjust in same manner as described for the voltage regulator. (Refer to Figure 11-9.)

11-39. REGULATOR REPAIRS.

11-40. REGULATOR SPRING REPLACEMENT. If it becomes necessary to replace the spiral spring on either the current or voltage regulator unit, the new spring should first be hooked on the lower spring support and then stretched up until it can be hooked at the upper end. Stretch the spring only by means of a screw driver blade inserted between the turns (or in a similar manner). Do not pry the spring into place as this is likely to bend the spring support. After installing a new spring, readjust the unit setting as already described.

11-41. RADIO BY-PASS CONDENSERS. The installation of radio by-pass condensers on the field terminal of the regulator or generator will cause the regulator contact points to burn and oxidize so that generator output will be reduced and a run down battery will result. If a condenser is found connected to either of these terminals, disconnect the condenser and clean the regulator contact points as previously explained.

11-42. REGULATOR ARMATURE REPLACEMENT. The armature may be replaced by drilling out the two rivets attaching the armature to the regulator frame. Support the frame to avoid bending. Center-punch the rivet heads and drill out with a 3/32 inch drill. Attach the new armature with screws, lockwashers and nuts supplied with the service armature. Assemble screws down so that they will not ground against cover.

11-43. HIGH POINTS ON REGULATOR PERFORMANCE AND CHECKS.

a. The voltage regulator unit limits the voltage of the circuit, thus protecting the battery, lights and other accessories from high voltage.

b. The current regulator unit provides protection to the generator, preventing it from exceeding its maximum rated output.

c. Never set the current regulator above the maximum specified output of the generator.

d. Many of the regulators are designed to be used with a positive grounded battery while others are designed to be used with a negative grounded battery only. Never attempt to use the wrong polarity regulator on an application.

e. The majority of reported regulator troubles arise from dirty or oxidized contact points which cause a reduced generator output. Clean the contact points with a spoon or riffler file. Never use emery cloth or sandpaper to clean points.

f. Always make sure that the rubber gasket is in place between the cover and base before replacing the cover. The gasket prevents entrance of moisture, dust and oil vapors which might damage the regulator.

g. The proper testing equipment in the hands of a qualified mechanic is necessary to assure proper and accurate regulator settings. Any attempt on the part of untrained personnel to adjust regulators is apt to lead to serious damage to the electrical equipment and should therefore be discouraged.

h. After any generator or regulator tests or adjustments, the generator must be polarized as explained in paragraph 11-33, step f, in order to avoid damage to the equipment.

i. It is recommended that following replacement or repair of a generator or regulator they be adjusted on a test bench as a matched unit.

11-44. REGULATOR SERVICE TEST SPECIFICATIONS. Delco-Remy specifications for 14 - and 28-volt regulators installed as standard equipment on PA-23 series airplanes are as follows:

Regulator Model	1119246[1]	1118976[1]	1119656[2]
Delco-Remy Ref. Service Bulletin	1R-116A	1R-116	1R-119A
Cutout Relay: Air Gap Point Opening Closing Voltage	 0.020 in. 0.020 in. 11.8-13.5-volts	 0.017 in. 0.032 in. 24 - 27-volts	 0.017 in. 0.032 in. 22.8-25.2 volts
Voltage Regulator: Air Gap Current Setting	 0.075 in. 65°F - 14.2-15.7-volts 85°F - 14.4-15.4-volts 105°F - 14.2-15.0-volts	 0.075 in. 27.9 29.4-volts	 0.067 in. 65°F - 29.4-31.4-volts[3] 85°F - 28.9-30.8-volts[3] 105°F - 28.3-30.1-volts[3]
Current Regulator: Air Gap Current Setting	 0.075 in. 48 - 52-amps	 0.075 in. 23 - 27-amps	 0.075 in. 48 - 52-amps

[1] Paralleling: With no load on battery terminal, add 5-amp load at P-terminal - voltage regulator to operate 2 to 3-volts lower.

[2] Paralleling: With no load on battery terminal, add 2.5-amp load at P-terminal - voltage regulator to operate 2 to 3-volts lower.

[3] Operation on lower contacts must be 0.2 to 0.6-volts lower than on upper contacts.

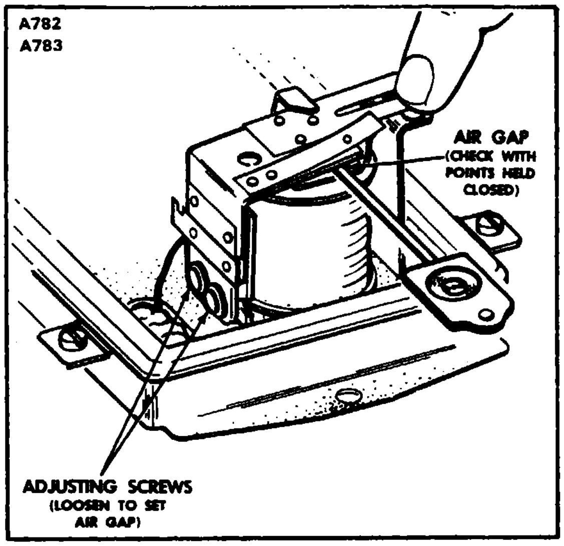

Figure 11-16. Checking and Adjusting Relay Air Gap

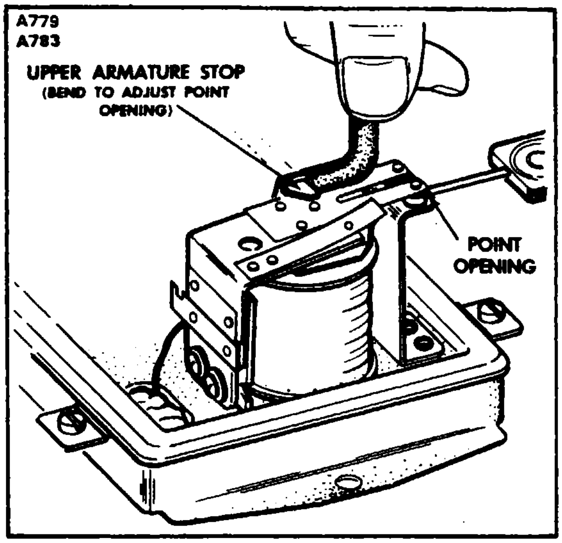

Figure 11-17. Checking and Adjusting Relay Point Opening

11-45. PARALLELING RELAY (Delco-Remy).

11-46. RELAY CHECKS AND ADJUSTMENTS. The cutout relay requires three checks and adjustments: air gap, point opening and closing voltage. The air gap and point opening adjustments must be made with the battery disconnected. (Refer to specifications given in paragraph 11-50.

11-47. AIR GAP. With the armature pushed down so the points are closed, check the air gap between the armature and core. (Refer to Figure 11-16.) To adjust, loosen the two adjusting screws and raise or lower the armature as required. Be sure the points align and tighten the screws after adjustment.

11-48. POINT OPENING. Check point opening and adjust by bending the upper armature stop as illustrated in Figure 11-17.

11-49. CLOSING VOLTAGE. To check the closing voltage of the cutout relay, connect a voltmeter from the GEN terminal of the relay to the relay base or ground as shown in Figure 11-20. Slowly increase the generator speed until the contact points close and read the voltage on the meter. To adjust the closing

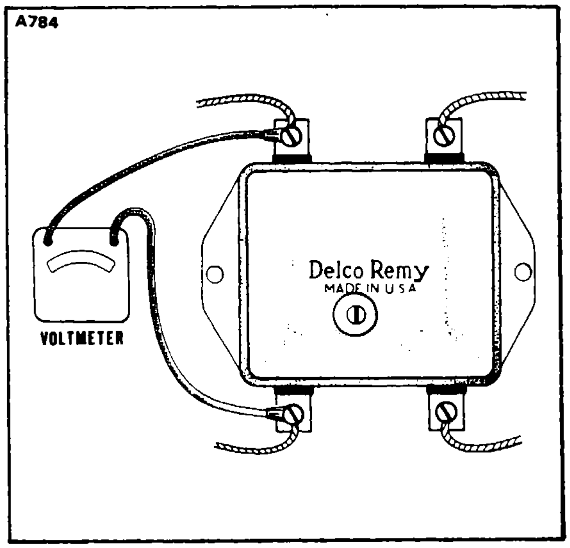

Figure 11-18. Checking Relay Closing Voltage

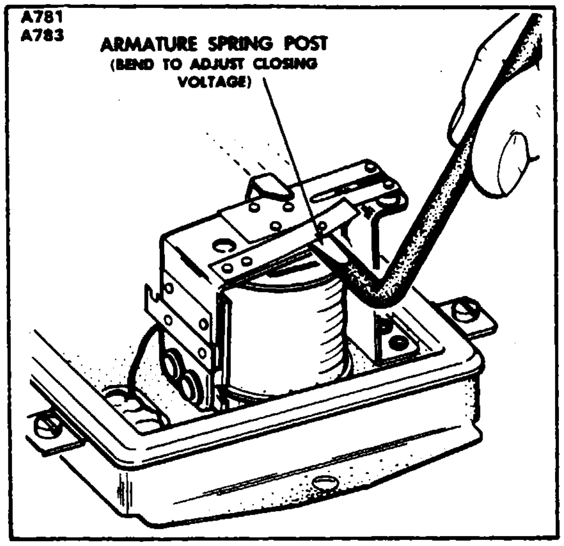

Figure 11-19. Adjusting Relay Closing Voltage

voltage, shut down the engine and bend the armature spring post (Refer to Figure 11-19.) up to increase the closing voltage and bend down to decrease the closing voltage. After each adjustment for both armatures, stop the generator and then slowly increase its speed and check the setting.

11-50. RELAY SERVICE TEST SPECIFICATIONS. Delco-Remy specifications for 14 and 28-volt relays installed as standard equipment on the model PA-23 series airplanes are as follows:

Relay Model	1116887	1116903
Delco-Remy Ref. Service Bulletin	1R100	1R100
Air Gap at Core, Points Closed	0.022 ± 10% in.	0.022 ± 10% in.
Point Opening	0.028 in.	0.028 in.
Closing Voltage (Range)	10.5 to 12.3	21 to 24.6
Opening Voltage (Range)	8 minimum	16 minimum

11-51. ALTERNATOR SYSTEM.

11-52. DESCRIPTION OF ALTERNATOR. For each alternator, the alternator output circuit is connected by means of a 90-ampere circuit breaker, a filter in the line to eliminate radio interference and a shunt to monitor alternator output.

The field circuit consists of a 10-ampere thermal circuit breaker, a volt-regulator, selector switch, over voltage relay, radio noise filter and a special switch ganged to the 90-ampere circuit breaker to remove field voltage from the alternator should the circuit breaker open.

The field and output circuit of both alternators are joined by a bus bar which directs current to the battery. A shunt is installed between the battery and bus to measure current flow to and from the battery. The field circuit is combined with the master switch to turn off the alternator when the master switch is turned off.

A second set of components is installed in the field circuit should a failure of the main regulating system occur.

The 90-ampere alternator circuit breakers should not be switched on and off under load for testing or any other reason.

11-53. CHECKING ALTERNATOR SYSTEM. The ammeter is equipped with a selector switch which enables an independent output check of each alternator, as well as the electrical output-input of the battery. Should either alternator show no output on the ammeter, check the appropriate circuit breakers. If a further check of the ammeter shows no output from both alternators, switch to the auxiliary voltage regulator and over voltage relay. If switching to the auxiliary system indicates no electrical output, further check the alternator system. (Refer to Figure 11-20.)

a. Ascertain that the ammeter is operating properly.

b. Disconnect the battery and field leads at the alternator.

c. Ascertain that all electrical units are off and the battery is fully charged.

d. Turn on the master switch.

e. To check the alternator output circuit, connect a voltmeter or 14 or 28-volt test light to the battery lead and to ground. If a reading of approximately 14 or 28-volts registers on the voltmeter or the test light lights, the battery circuit is operational.

f. Should there be no indication of voltage, trace back through the output circuit until voltage is indicated. (Refer to Figure 11-20.) A component that allows no voltage to pass through it should be replaced.

g. To check the field circuit, connect a voltmeter or 14 or 28-volt test light to the field lead and to ground. Test the field circuit using the same procedure as in steps e and f. Both the main and auxiliary field systems may be checked in a like manner.

h. If voltage is indicated at both the battery lead and field lead, the alternator should be checked for possible malfunction. (Refer to Paragraph 11-55.)

11-54. ADJUSTMENTS. The only adjustments necessary to maintain the alternator system is the adjustment of the voltage control on the voltage regulator. A voltage of 14 or 28-volts is maintained. All other control adjustments are made at time of installation and need not be reset.

IMPORTANT

Since the alternator and regulator are designed for use on only one polarity system, the following precautions must be observed when working on the charging circuit. Failure to observe these precautions will result in serious damage to the electrical equipment.

a. When installing a battery, always check the ground polarity of the alternator to ensure correct battery grounding.

b. When connecting a booster battery, make certain to connect the negative battery terminals together.

c. When connecting a charger to the battery, connect the charger positive lead to the battery positive terminal and the charger negative lead to the battery negative terminal.

d. Never operate the alternator on open circuit. Make absolutely certain all connections in the circuit are secure.

e. Do not short across or ground any of the terminals on the alternator or regulator.

f. Do not attempt to polarize the alternator.

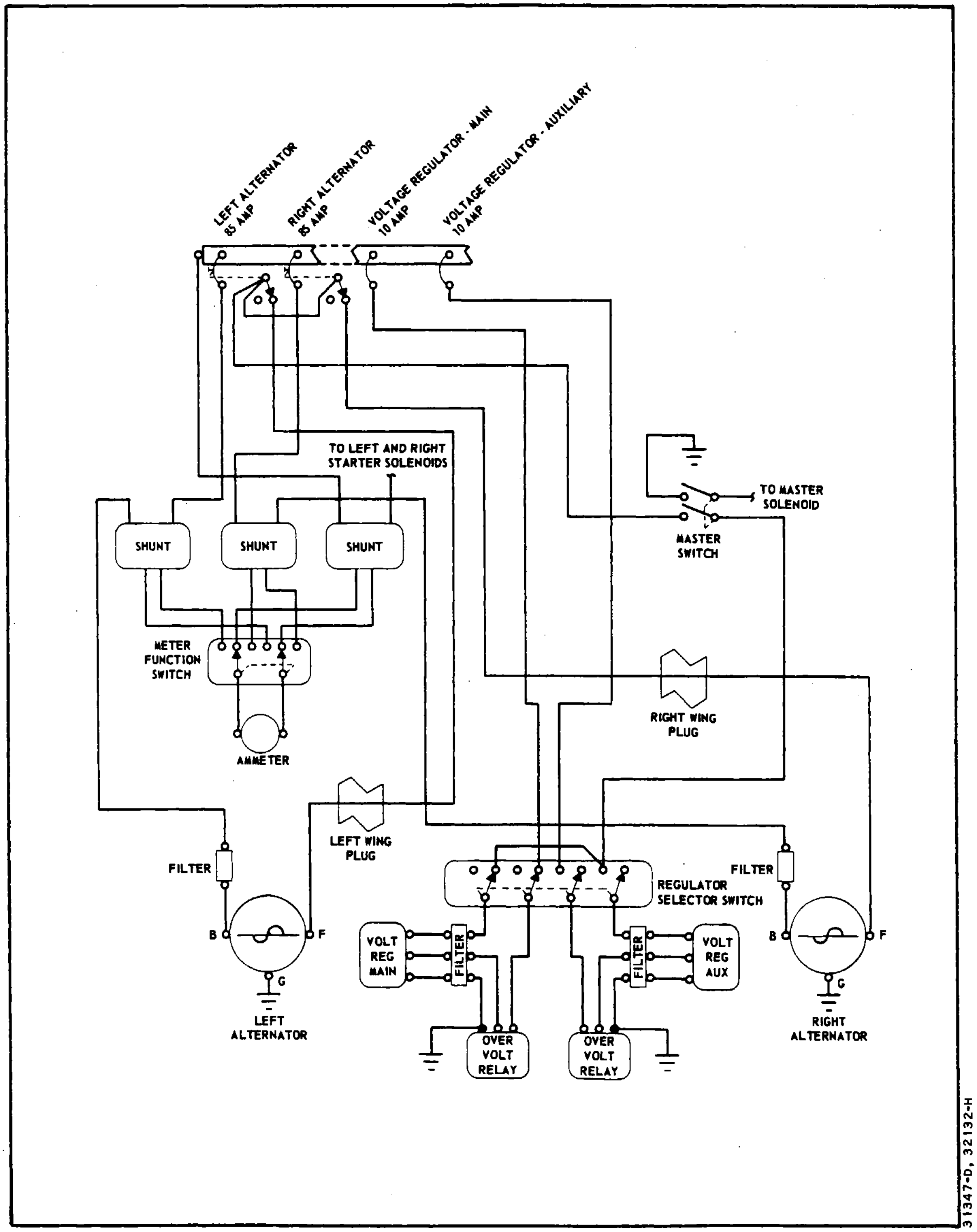

Figure 11-20. Alternator System Wiring Schematic (Delco-Remy)

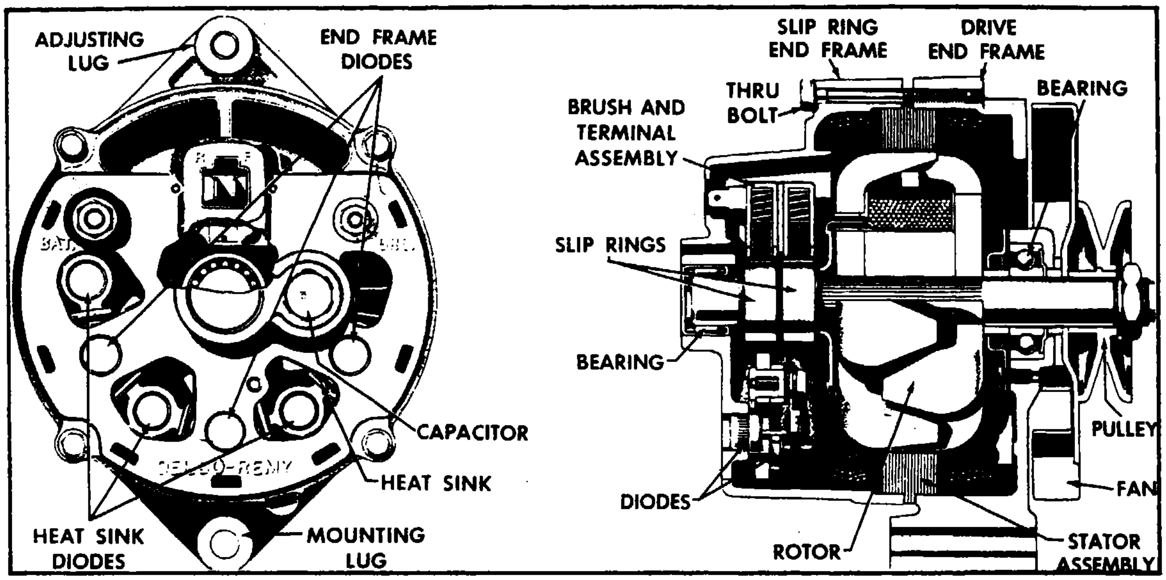

Figure 11-21. Cross-Sectional View of Alternator

11-55. ALTERNATOR AND COMPONENTS (Delco-Remy).

11-56. INSPECTION. At regular intervals, inspect the terminals for corrosion and loose connections, and the wiring for frayed insulation. Check the mounting bolts for tightness, and the belt for alignment, proper tension and wear. Belt tension should be adjusted in accordance with engine manufacturer's recommendations. When tightening belt tension, apply pressure against the stator laminations between the end frames, and not against either end frame.

Noise from an alternator may be caused by worn or dirty bearings, loose mounting bolts, a loose drive pulley, a defective diode, or a defective stator.

11-57. DISASSEMBLY. After extended periods of operation, or at time of engine overhaul, the alternator may be removed for a thorough inspection and cleaning of all parts. The alternator consists of four main components - the two end frames, the stator and the rotor.

To disassemble the alternator, take out the four thru-bolts and separate the drive end frame and rotor assembly from the stator assembly by prying apart with a screwdriver at the stator slot. A mark will help locate the parts in the same position during assembly. The fit between stator and frame is not tight and the two can be separated easily. Note that the separation is to be made between the stator frame and drive end frame. After disassembly, place a piece of tape over the slip ring end frame bearing on both sides to prevent entry of dirt and other

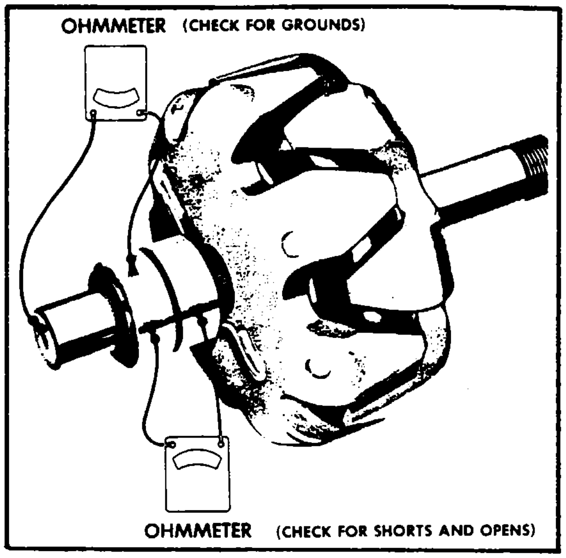

Figure 11-22. Checking Rotor

foreign material, and also place a piece of tape over the shaft on the slip ring end. If brushes are to be re-used, clean with a soft, dry cloth.

CAUTION

Do not use black friction tape. Use only pressure sensitive tape that will not leave any contamination on the shaft surface.

To remove the drive end frame from the rotor, place the rotor in a vise and tighten only enough to permit removal of the shaft nut.

CAUTION

Avoid excessive tightening as this may cause distortion. Remove the shaft nut, washer, pulley, fan and the collar, and then seperate the drive end frame from the rotor shaft.

Additional disassembly procedures are covered in the following sections.

11-58. CHECKS.

a. ROTOR CHECKS: The rotor may be checked electrically for grounded, open, or short circuited field coils. To check for grounds, connect a 110-volt test lamp or an ohmmeter from either slip ring to the rotor shaft or to the rotor poles. If the lamp lights, or if the ohmmeter reading is low, the field winding is grounded. (Refer to Figure 11-21.)

To check for opens, connect the test lamp or ohmmeter to each slip ring. If the lamp fails to light, or if the ohmmeter reading is high (Infinite), the winding is open. (Refer to Figure 11-21.)

The winding is checked for short circuits by connecting a battery and ammeter in series with the two slip rings. Note the ammeter reading and refer to paragraph 11-66 for specifications. An ammeter reading above the specified value indicates shorted windings. An alternate method is to check the resistance of the field by connecting an ohmmeter to the two slip rings. (Refer to Figure 11-21.) If the resistance reading is below the specified value, the winding is shorted. The specified resistance value can be determined by dividing the voltage

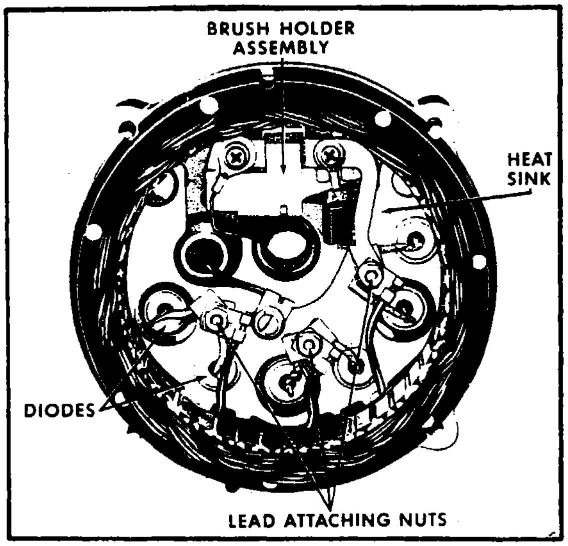

Figure 11-23. Slip Ring End Frame

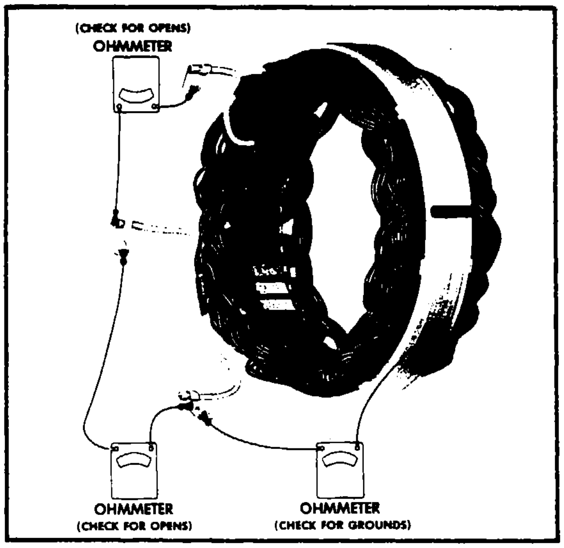

Figure 11-24. Checking Stator

by the current given in paragraph 11-66. If the rotor is not defective, and the alternator fails to supply rated output when checked as covered in the section entitles Output Check, the trouble is in the stator or rectifying diodes.

b. STATOR CHECKS: To check the stator windings, remove all three stator lead attaching nuts (Refer to Figure 11-23), and then separate the stator assembly from the end frame. The fit between stator frame and end frame is not tight, and the two can be separated easily.

The stator windings may be checked with a 110-volt test lamp or an ohmmeter. If the lamp lights, or if the meter reading is low when connected from any stator lead to the frame, the windings are grounded. If the lamp fails to light, or if meter reading is high when successively connected between each pair of stator leads, the windings are open. (Refer to Figure 11-24.)

A short circuit in the stator windings is difficult to locate without laboratory test equipment due to the low resistance of the windings. However, if all other electrical checks are normal and the alternator fails to supply rated output, shorted stator windings are indicated. Also, another possibility is a ground which may have existed between stator windings and either end frame before disassembly. Visually inspect very carefully for this possibility.

c. DIODE CHECKS: Each diode may be checked electrically for a shorted or open condition. Any one of the following methods may be used.

Ohmmeter Method: One method of checking diodes is to use an ordinary ohmmeter. The lowest range scale on the ohmmeter should be used, and the ohmmeter should have a one and one-half volt cell. To determine the cell voltage turn the selector to the lowest scale, and then connect the ohmmeter leads to a voltmeter. The voltmeter will indicate the cell voltage.

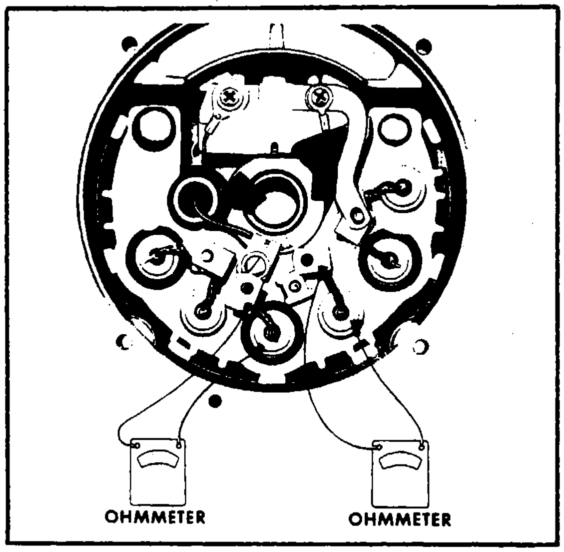

Figure 11-25. Checking Diodes

With the stator disconnected, check a diode in the heat sink by connecting one of the ohmmeter leads to the heat sink, and the other ohmmeter lead to the diode lead, and note the reading. (Refer to Figure 11-25.) Then reverse the ohmmeter lead connections, and note the reading. If both readings are very low, or if both readings are very high, the diode is defective. A good diode will give one low reading and one high reading. Check the other two diodes in the heat sink in the same manner.

To check a diode mounted in the end frame, connect one of the ohmmeter leads to the end frame, and the other ohmmeter lead to the diode lead (Refer to Figure 11-25.), and note the reading. Then reverse the ohmmeter lead connections, and note the reading. If both readings are very low, or if both readings are very high, the diode is defective. A good diode will give one low reading and one high reading. Check the other two diodes in the end frame in the same manner:

Test Lamp Method: An alternate method of checking the diodes is to use a test lamp of not more than 14 or 28-volts (depending on voltage of system) in place of the ohmmeter.

CAUTION

Do not use 110-volt test lamps to check diodes.

With the stator disconnected, connect the test lamp leads across each diode as previously described first in one direction and then in the other. If the lamp lights in both checks, or fails to light in both checks, the diode is defective.

Special Tester Method: Special testers are available which operate without disconnecting the stator. To use these testers, follow the tester manufacturer's recommendations.

11-59. DIODE REPLACEMENT. To replace a diode, use a suitable tool to support the end frame or heat sink, and use an arbor press or vise to push the diode out. Also use a special tool which fits over the outer diode edge to push the diode in, and support the heat sink and end frame with a suitable tool.

NOTE

Diode replacement tools are available from various manufacturers normally supplying tools and test equipment to the aviation industry.

CAUTION

Do not strike the diode, as the shock may damage the other diodes.

11-60. SLIP RING SERVICING. If the slip rings are dirty, they may be cleaned and finished with 400 grain or finer polishing cloth. Spin the rotor in a lathe, or otherwise spin the rotor, and hold the polishing cloth against the slip rings until they are clean.

CAUTION

The rotor must be rotated in order that the slip rings will be cleaned evenly. Cleaning the slip rings by hand without spinning the rotor may result in flat spots on the slip rings, causing brush noise.

Slip rings which are rough or out of round should be trued in a lathe to .002 inch maximum indicator reading. Remove only enough material to make the rings smooth and round. Finish with 400 grain or finer polishing cloth and blow away all dust.

11-61. BEARING REPLACEMENT AND LUBRICATION. The bearing in the drive end frame can be removed by detaching the retainer plate screws, and then pressing the bearing from the end frame. If the bearing is in satisfactory condition, it may be re-used, and it should be filled one-quarter full with Delco-Remy lubricant No. 1960373 before reassembly.

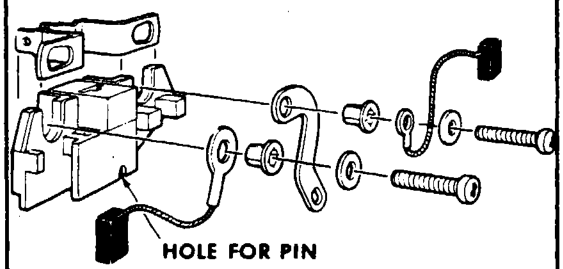

Figure 11-26. Brush Holder Assembly

CAUTION

Do not overfill, as this may cause the bearing to overheat, and use only 1960373 lubricant.

To install a new bearing, press in with a tube or collar that just fits over the outer race. It is recommended that a new retainer plate be installed if the felt seal in the retainer plate is hardened or excessively worn.

The bearing in the slip ring end frame should be replaced if its grease supply is exhausted. No attempt should be made to re-lubricate and re-use the bearing. To remove the bearing from the slip ring end frame, press out with a tube or collar that just fits inside the end frame housing. Press from the outside of the housing towards the inside.

To install a new bearing, place a flat plate over the bearing and press in from the outside towards the inside of the frame until the bearing is flush with the outside of the end frame. Support the inside of the frame with a hollow cylinder to prevent breakage of the end frame. Use extreme care to avoid misalignment or otherwise placing undue stress on the bearing.

Saturate the felt seal with S. A. E. 20 oil, and then reassemble the felt seal and steel retainer.

11-62. BRUSH REPLACEMENT. When the slip ring end frame assembly is separated from the rotor and drive end frame assembly, the brushes will fall down onto the shaft and come in contact with the lubricant. If the brushes are to be re-used, they must be thoroughly cleaned with a soft dry cloth. Also, the shaft must be thoroughly cleaned before reassembly.

The brush springs should be inspected for any evidence of damage or corrosion. If there is any doubt as to the condition of the brush springs, they should be replaced.

To install new brushes, remove the brush holder assembly from the end frame by detaching the two brush holder assembly screws. Install the springs and brushes into the brush holder, and insert a straight wire or pin into the holes at the bottom of the holder to retain the brushes. (Refer to Figure 11-26.) Then attach the brush holder assembly onto the end frame, noting carefully the proper stack-up of parts as shown in Figure 11-26. Allow the straight wire to protrude

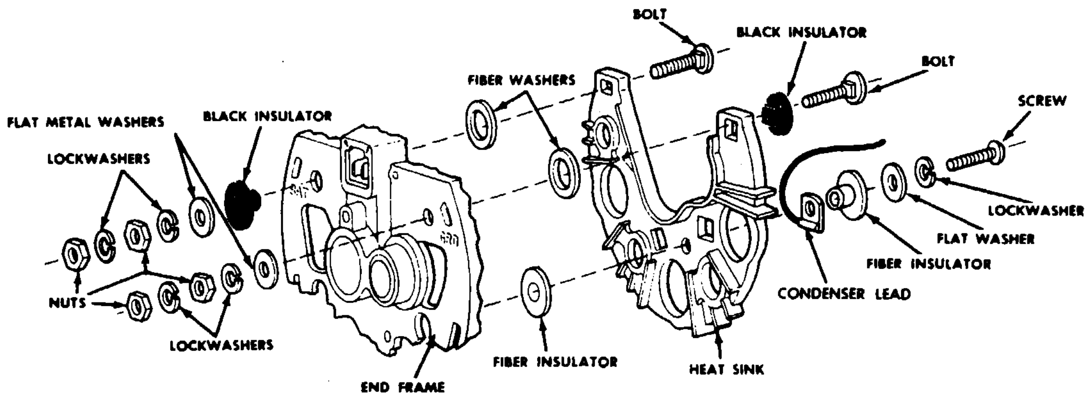

Figure 11-27. Exploded View of Heat Sink Assembly

through the hole in the end frame.

11-63. HEAT SINK REPLACEMENT. The heat sink may be replaced by removing the BAT and GRD terminals from the end frame, and the screw attaching the condenser lead to the heat sink. During reassembly, note the proper stack-up of parts as shown in Figure 11-27.

11-64. REASSEMBLY. Reassembly is the reverse of disassembly. Remember when assembling the pulley to secure the rotor in a vise only tight enough to permit tightening the shaft nut to 50 to 60 foot pounds. If excessive pressure is applied against the rotor, the assembly may become distorted. To install the slip ring end frame assembly to the rotor and drive end frame assembly, remove the tape over the bearing and shaft, and make sure the shaft is perfectly clean after removing the tape.

Insert a straight wire as previously mentioned through the holes in the brush holder and end frame to retain the brushes in the holder. Then withdraw the wire after the alternator has been completely assembled. The brushes will then drop onto the slip rings.

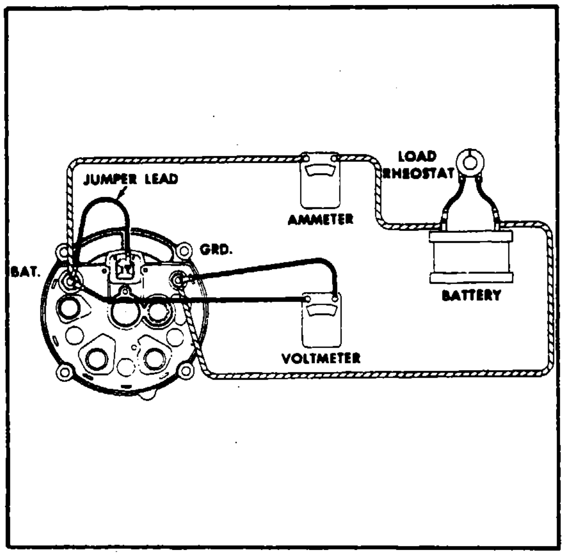

Figure 11-28. Alternator Output Check

11-65. OUTPUT CHECK. To check the alternator on a test bench, make electrical connections as shown in Figure 11-28, operate at specified speed, and check for rated output as given in paragraph 11-66. Adjust the load rheostat, if necessary, to obtain the desired output.

NOTE

A special adapter which can be used for making connections to the alternator is available from tool companies and test equipment manufacturers normally supplying equipment to the aviation trade.

CAUTION

Do not polarize alternator.

11-66. ALTERNATOR SERVICE TEST SPECIFICATIONS. Delco-Remy specifications for 14 or 28-volt alternators installed as standard equipment on the PA-23 series airplanes are as follows:

Alternator	1100660	1100717	1100718
Delco-Remy, Ref. Service Bulletin	1G-186, 1G-262	1G-187, 1G-262	1G-187, 1G-262
Field Current (80° F) Amps Volts	 2.2 - 2.6 12.0	 2.2 - 2.6 12.0	 1.2 - 1.3 24.0
Cold Output: Spec. Volts Amps Approx. R.P.M. Amps Approx. R.P.M.	 14.0 25 2000 65 5000	 14.0 25 2000 65 5000	 24.0 6 2000 46 5000
Hot Output: Amps	 70	 70	 70

TABLE XI-II. SUMMARY OF ALTERNATOR CHECKS

COMPONENT	CONNECTION	READING	RESULTS
Rotor	Ohmmeter from slip ring to shaft	Very low	Grounded
	110 volt test lamp from slip ring to shaft	Lamp lights	Grounded
	Ohmmeter across slip rings	Very high	Open
	110 volt test lamp across slip ring	Lamp fails to light	Open
	Battery and ammeter to slip rings, across slip rings	Observe voltmeter and ammeter readings	Compare with spec- ifieations in IG-186 for shorts
Stator	Ohmmeter from lead to frame	Very low	Grounded
(Disconnected from diodes)	110 volt test lamp from lead to frame	Lamp lights	Grounded
	Ohmmeter across each pair of leads	Any reading very high	Open
	110 volt test light across each pair of leads	Fails to light	Open
Diode	Ohmmeter across diode, then reverse connections	Both readings very low	Shorted
(Disconnected from diodes)		Both readings very high	Open
	14 or 28-volt test lamp across diode, then reverse connections.	Lamp fails to light in both checks	Open
		Lamp lights in both checks	Shorted

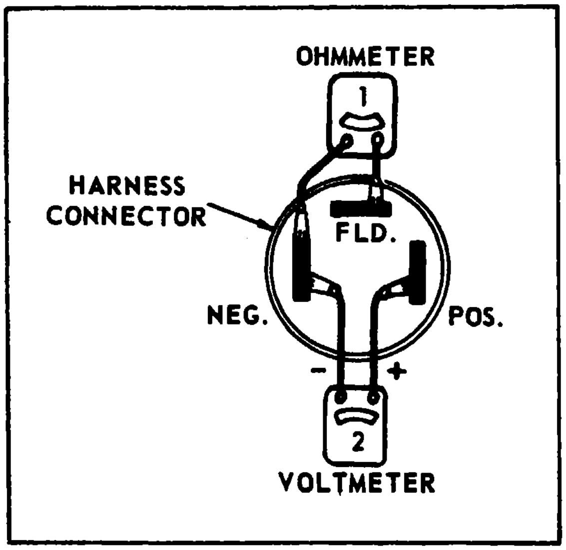

Figure 11-29. Volt - Ohmmeter Test

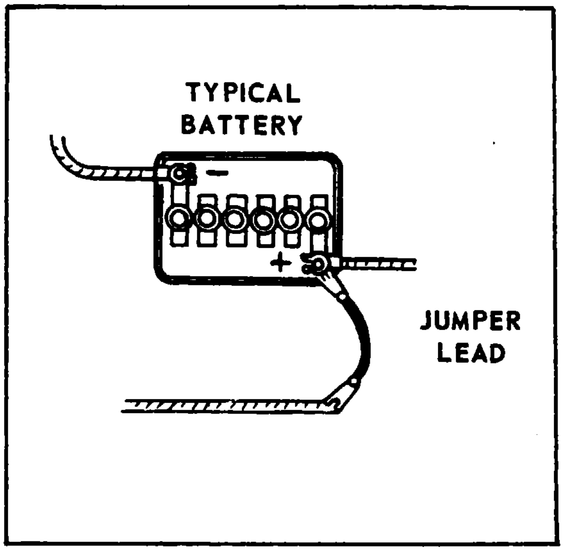

Figure 11-30. Jumper Connection

11-67. REGULATOR (Delco-Remy).

11-68. CHECKING REGULATOR CIRCUIT. Alternator failures may be caused by circuit misconnections, such as reversed leads or shorted or grounding of terminals with a screw driver, etc. The following provides a means of locating circuit misconnections. It also covers the different types of regulator panel board circuit trace defects which indicate a certain type of wiring harness misconnections. A burned circuit trace on the regulator panel board is proof that a circuit misconnection exists, or occurred at some time. However, a misconnection will not always cause a burned circuit trace even though circuit component failures have been caused.

Before installing a new regulator, it is very important to make sure that no wiring circuit defects or wiring harness misconnections exist. If the wiring harness is defective, or if misconnections exist, the new regulator will fail too. Furthermore, repeated replacement of regulators will only result in repeated regulator failures, and this will continue until the circuit defect is corrected.

To check the wiring harness for defects or misconnections before installing the new regulator, observe the following procedure.

NOTE

Meter connections are made to the harness connector that has been unplugged from the regulator.

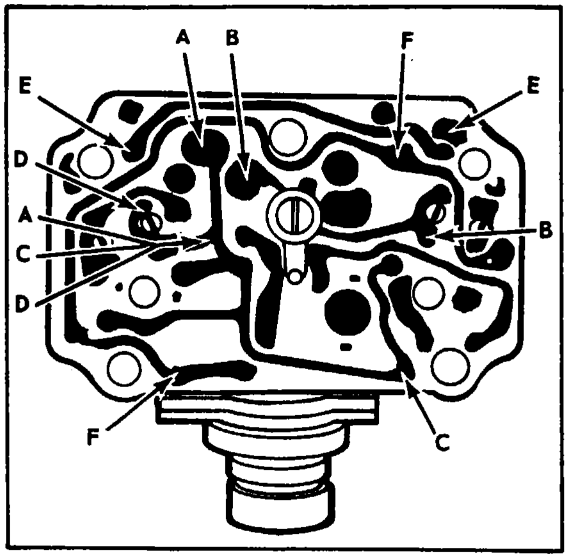

Figure 11-31. Regulator Checks

a. Check the alternator field resistance with an ohmmeter as shown in Step 1, Figure 11-29, and note the reading. Make sure the master switch is OFF. Readings of less than 2-ohms, or more than 8-ohms indicate a defective field winding in the alternator or a defective wiring harness. If the reading is within the 2 to 8-ohm range, check the reading against the allowable resistance in the circuit which can be calculated by dividing the specified voltage for the alternator by the current rating. The specified voltage and the current rating values are found in paragraph 11-66.

1. If the reading is the same as the calculated value, proceed to part b.

2. If reading is much higher (infinite) than the calculated value, proceed to part b.

3. If reading is zero, check for short between NEG and FLD leads, or for a grounded FLD lead. Circuit trace will be burned open between points A-A, B-B or C-C, Figure 11-31.

4. If reading is low, alternator fieldwinding is shorted. Circuit trace may be burned between points A-A, B-B, or C-C, Figure 11-31.

NOTE

To expose the printed circuit for viewing, remove the bottom plate from the regulator, the three panel board attaching screws, the transistor attaching screws, and then separate the heat sink from the panel board.

b. With switch turned ON, connect voltmeter as shown in Step 2, Figure 11-29. Make sure positive (+) and negative (-) voltmeter leads are connected as shown.

c. If meter reads battery voltage, disconnect lead at alternator "Fl" (field) terminal.

1. If reading is still battery voltage, wiring is not defective, and no more wiring tests need be made.

2. If voltage reading is zero, the NEG and FLD leads are reversed. Circuit trace will be burned open between points A-A, B-B or C-C, Figure 11-31.

d. If meter reads zero voltage, disconnect lead at alternator "Fl" (field) terminal, and connect a jumper lead from this lead to battery positive (+) post. (Refer to Figure 11-30.)

1. If meter now reads battery voltage, the POS and FLD leads are reversed. This misconnection alone will not cause the circuit trace to be burned open.

2. If meter now reads backwards, alternator field terminal is connected to regulator negative terminal, the positive line is connected to regulator field terminal, and regulator positive terminal is connected to negative side of circuit. Either the circuit trace will be burned between points C-C, D-D, or E-E, 11-31; or the driver transistor will be open. In either case, the driver bias resistor will have been overheated.

e. If voltmeter reads backwards, disconnect lead at alternator "Fl" (field) terminal.

1. If meter still reads backwards, the POS and NEG leads are reversed. The circuit trace may be burned between points C-C, D-D, E-E or F-F, Figure 11-31. The transient suppression diode always will be open or shorted.

2. If meter now reads zero, the positive line is connected to regulator NEG terminal, the negative line is connected to the regulator FLD terminal, and the alternator "Fl" (field) terminal is connected to the regulator POS terminal. The circuit trace will be burned open between points F-F, Figure 11-31.

IMPORTANT

For further assistance, follow the procedure in Delco-Remy Service Bulletin 1R-273 when troubleshooting circuits containing this regulator.

11-69. RELAY (Delco-Remy).

11-70. CHECKING RELAY. The relay is a protective device against high voltage that may appear in the electrical system. The relay will open the circuit to the alternator field winding if the system voltage should ever reach a predetermined value. When the circuit opens, the alternator voltage will be eliminated. The relay is designed so that the battery will continue to hold the relay contacts open until the engine is stopped or the master switch is opened. The No. 1 terminal on the relay is connected to the master switch, and the No. 2 terminal to the regulator POS terminal. For connections, refer to the aircraft wiring diagram.

With the relay removed from the aircraft, an electrical check can be made on a test bench to determine if the relay is operating properly.

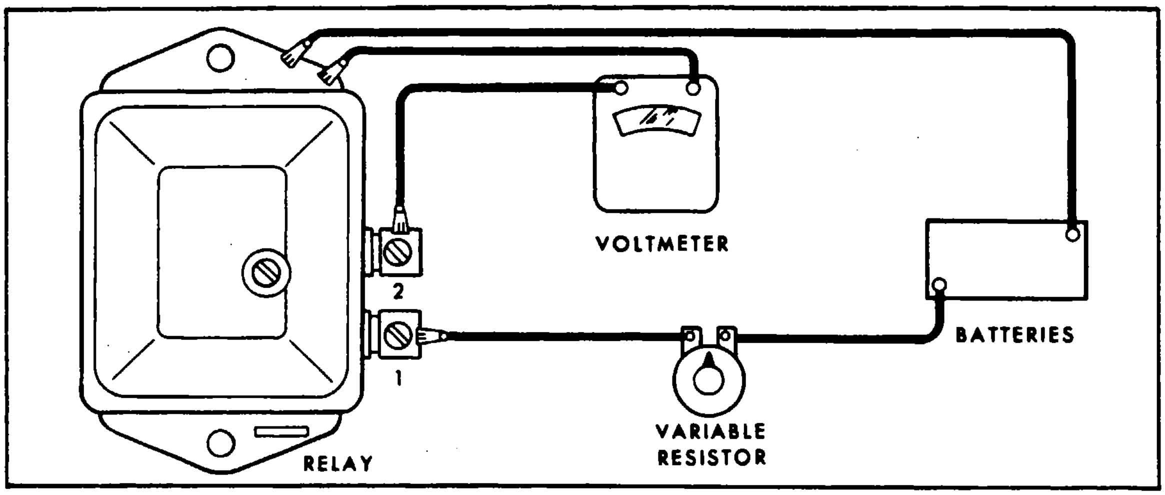

Figure 11-32. Relay Tests

CAUTION

Do not remove the cover and attempt to make adjustments on this relay. If the assembly does not pass the following electrical check, discard the relay. If the relay does pass the following electrical check, it may be re-used.

a. Turn to the "open" or maximum resistance position a 100 ohm variable resistor having a wattage rating of one and one-half watts or above.

b. Connect this resistor with a voltmeter and two 12 volt batteries (for 14 volt systems or three 12 volt batteries for 28 volt systems) in series to the relay as shown in Figure 11-32. Connect the negative battery post to the relay base, and the positive battery post to the variable resistor.

c. Slowly decrease the resistance and observe the maximum voltmeter reading obtained. This reading will be the voltage at which the contacts open.

d. The contacts should open at 16 to 17 volts (14 volt system) or 32 to 36 volts (28 volt system). If they do not, discard the relay.

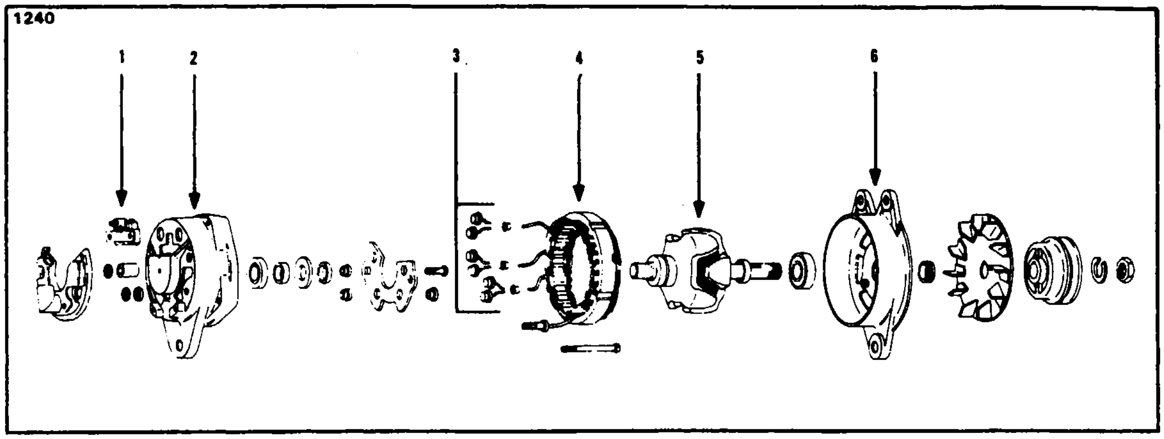

Figure 11-33. Exploded View of Alternator

11-71. ALTERNATOR AND COMPONENTS (Prestolite).

11-72. DESCRIPTION OF ALTERNATOR. (Refer to Figure 11-33.) The principal components of the alternator are the brush holder assembly (1), the slip ring end head (2), the rectifiers (3), the stator (4), the rotor (5) and the drive end head (6).

a. The brush and holder assembly contains two brushes, two brush springs, a brush holder and insulators. Each brush is connected to a separate terminal stud and is insulated from ground. The brush holder assembly can easily be removed for inspection or brush replacement purposes.

b. The slip ring end head provides the mounting for the rectifiers and rectifier mounting plate, output and auxiliary terminal studs, and the brush and holder assembly. The slip ring end head contains a roller bearing and outer race assembly and a grease seal.

c. The rectifiers used in these units are rated at 150 peak inverse voltage (PIV) minimum for transient voltage protection. Three positive rectifiers are mounted in the rectifier mounting plate while the three negative rectifiers are mounted in the slip ring end head. Each pair of rectifiers is connected to a stator lead with high temperature solder. The stator leads are anchored to the rectifier mounting plate with epoxy cement for vibration protection.

d. The stator contains a special lead which is connected to the center of the three phase windings and is used to activate low voltage warning systems or relays. The stator has been treated with a special epoxy varnish for high temperature resistance.

e. The rotor contains the slip ring end bearing inner race and spacer on the slip ring end of the shaft. The rotor winding and winding leads have been specially treated with a high temperature epoxy cement to provide vibration and temperature resistance characteristics. High temperature solder is used to secure the winding leads to the slip rings.

f. The drive end head supports a sealed, prelubricated ball bearing in which the drive end of the rotor shaft rotates.

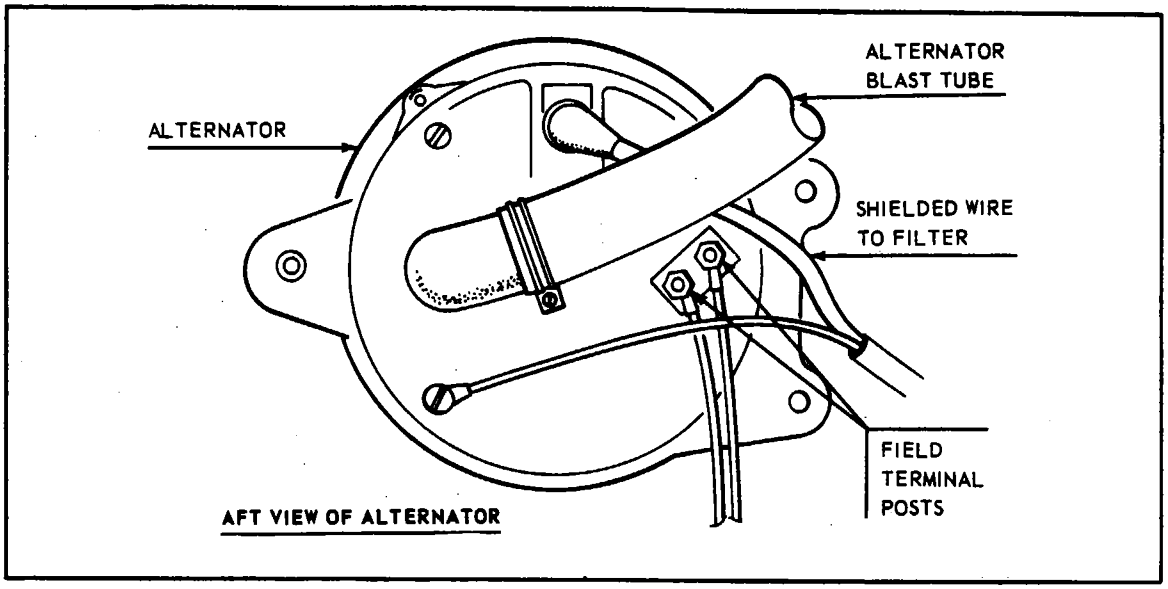

Figure 11-34. Alternator Blast Tube Routing

11-73. OVERHAUL OF ALTERNATOR. When repairing the alternator, complete disassembly may not be required. In some cases it will only be necessary to perform those operations which are required to effect the repair. However, in this section, the complete overhaul is covered step-by-step to provide detailed information on each operation. In actual service practice, these operations may be used as required.

11-74. ALTERNATOR SERVICE INSPECTION. This inspection should be accomplished whenever any service is being done on or around the alternator or during a 100 hour inspection. The inspection consists of visually checking the routing of the alternator blast tube to insure it's not being chafed against the field terminal posts on the alternator. This condition could expose the coiled wire in the blast tube which would then short out the field terminals on the alternator, with subsequent alternator failure. This tube should be routed over the shielded wire to the filter, to clear the field terminal posts. (Refer to Figure 11-34.)

These alternators should also have insulation used to provide protection against bridging the field terminals with a wrench or in the event of a loose connection to keep the field terminal leads from contacting one another. If either of these conditions exist with the master switch on, the regulator will be destroyed. This insulation will deteriorate after a period of time and will no longer provide protection and should be replaced. Refer to latest revision of Lycoming Service Instruction No. 1253 for the proper material.

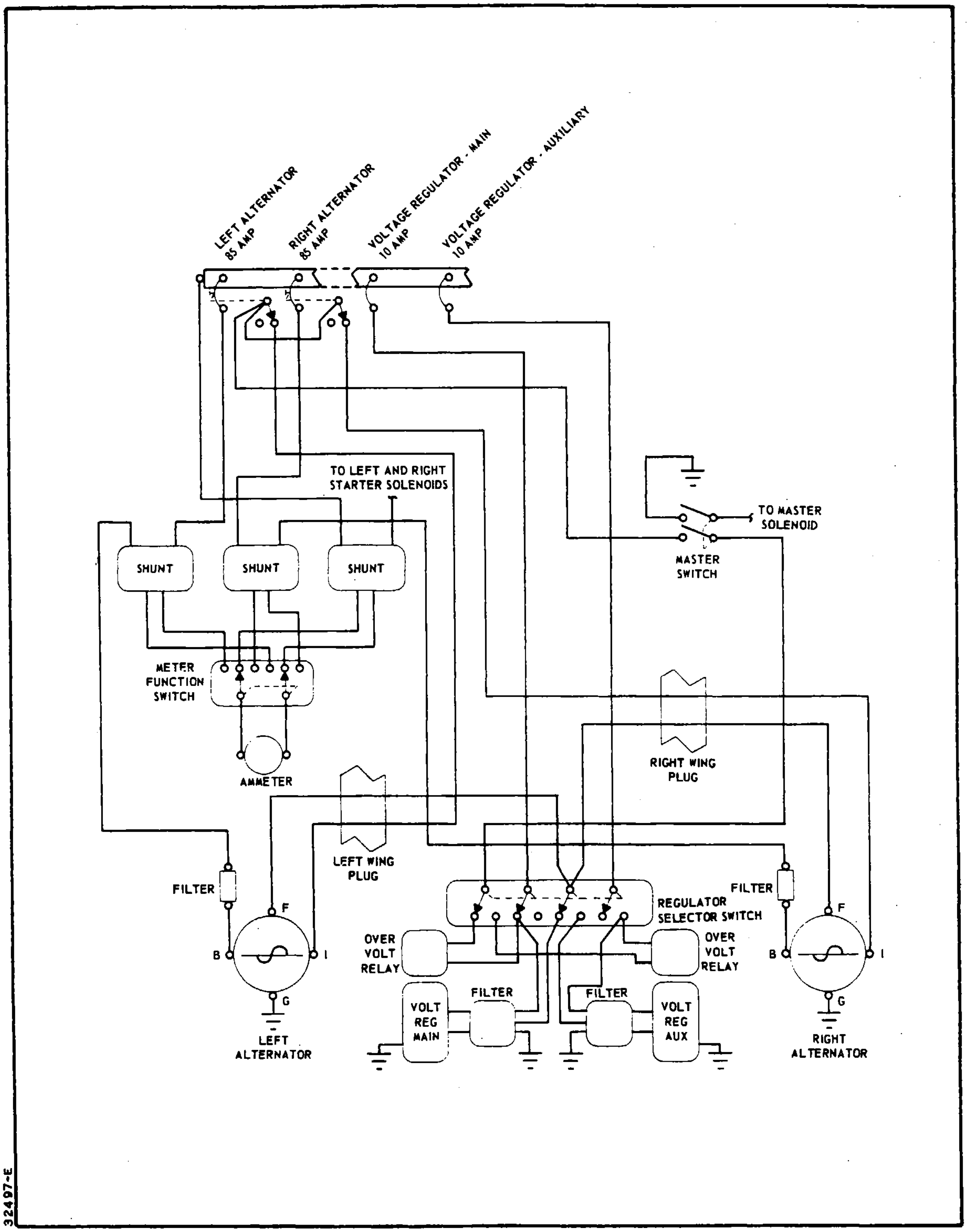

Figure 11-35. Alternator System Wiring Schematic (Prestolite)

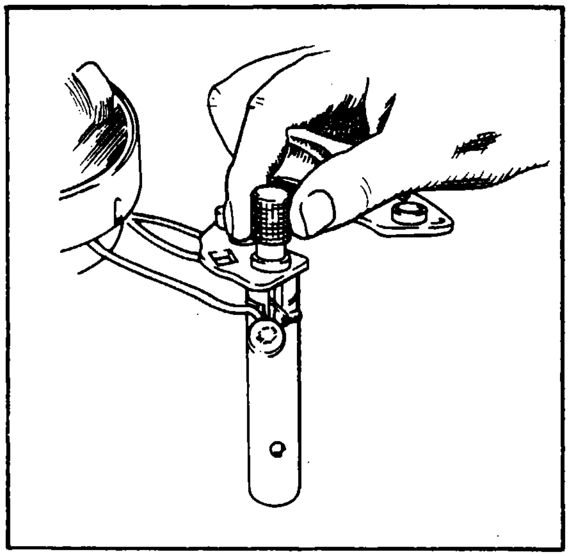

Figure 11-36. Removal of Rectifier

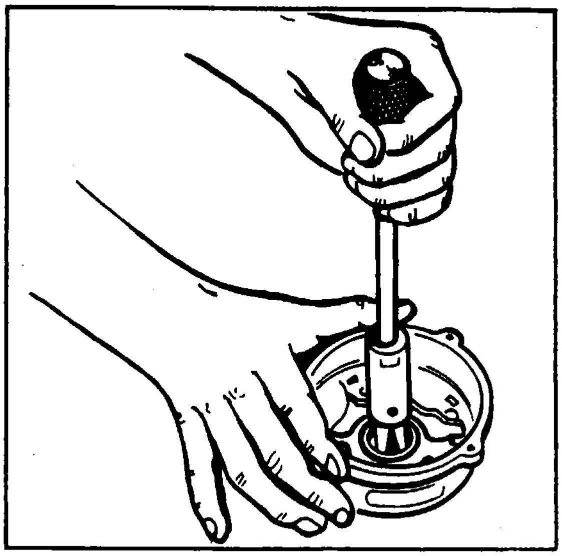

Figure 11-37. Removal of Slip Ring End Bearing

11-75. DISASSEMBLY OF ALTERNATOR.

a. Remove the two Number 10-24 screws holding the brush holder assembly in the slip ring end head. Remove the brush and holder assembly from the end head.

b. Remove the safety wire from the through bolts. Hold the pulley with a strap wrench and remove the pulley nut. The pulley must be removed with a puller. Remove the fan, woodruff key and spacer from the shaft.

c. Remove the four through bolts and tap the drive end head lightly to separate the drive end head and rotor, as a unit, from the stator and slip ring end head.

d. Remove the nuts, lock washers, flat washers and insulators from the output and auxiliary terminal studs. Note carefully the correct assembly of the insulator washers and bushings. Using the special tools shown in Figure 11-36, support the end head and press out the three negative rectifiers. The end head can now be separated from the stator assembly.

e. To remove the slip ring end bearing and grease seal, it will be necessary to have a hook type or impact type bearing puller as shown in Figure 11-37. Do not remove the bearing unless replacement is necessary.

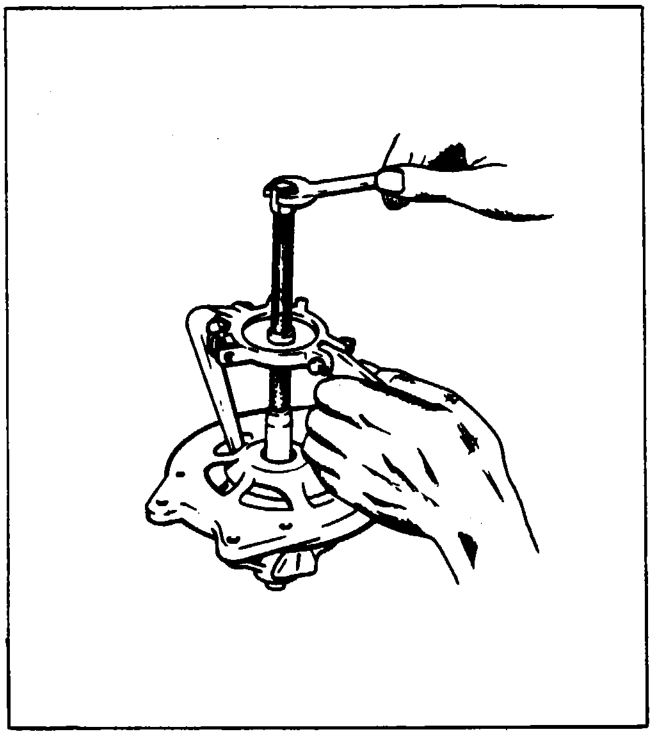

Figure 11-38. Removal of Drive End Head

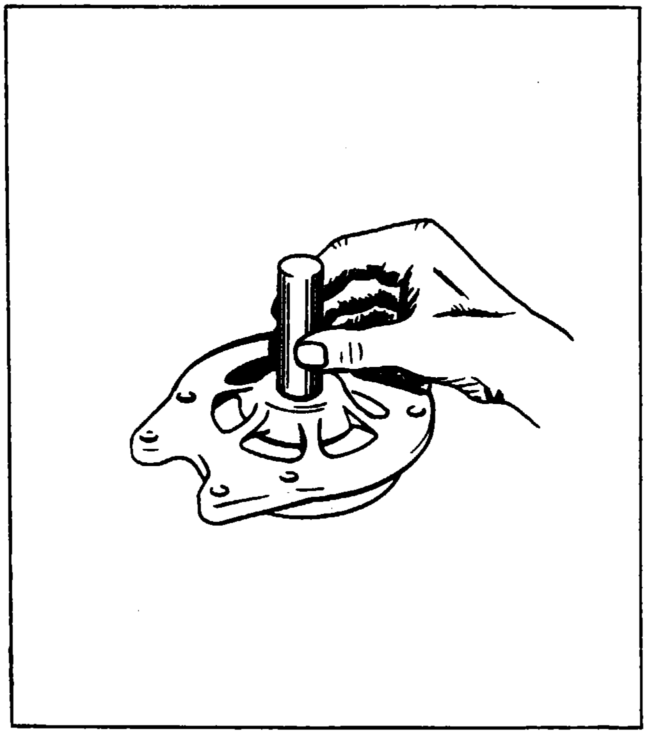

Figure 11-39. Removal of End Head Bearing

NOTE

The inner race of the slip ring end bearing is pressed onto the rotor shaft. When bearing replacement is necessary, always replace the complete bearing assembly, including the inner race.

f. To remove the drive end head from the rotor shaft, use a puller that grips on the bearing retainer plate as shown in Figure 11-38. Do not attempt to remove by supporting the end head and pressing on the shaft, as this may result in distortion of the end head or stripping of the retainer plate screws. Remove the three retainer plate screws and press the bearing out of the end head. (Refer to Figure 11-39.)

11-76. INSPECTION AND TESTING OF COMPNENTS. Upon completion of the disassembly, all parts should be cleaned and visually inspected for cracks, wear or distortion and any signs of overheating or mechanical interference.

a. Rotor: The rotor should be tested for grounded or shorted windings. The ground test can be made with test probes, connected in series with a 110-volt test lamp, an ohmmeter or any type of continuity tester. (Refer to Figure 11-40.) There must not be any continuity between the slip rings and the rotor shaft or poles. To test for shorted turns in the rotor winding, connect a voltmeter, ammeter and rheostat as shown in Figure

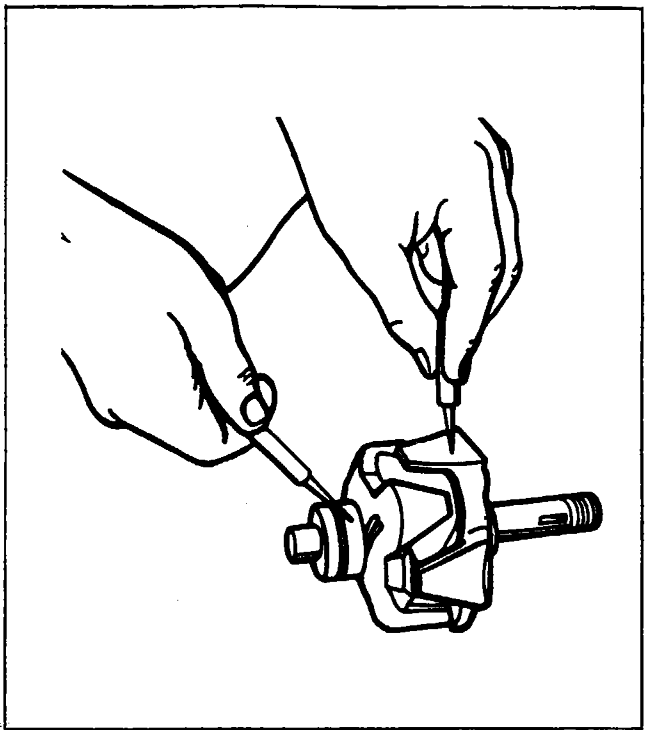

Figure 11-40. Testing Rotor for Grounds

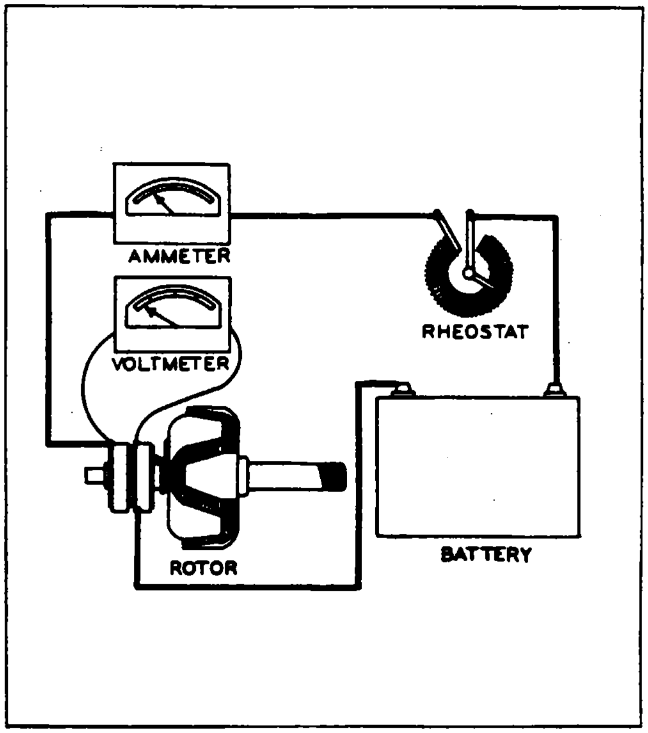

Figure 11-41. Testing Rotor for Shorts

or use an ohmmeter. Rotor current draw and resistance are listed in the individual specification pages. Excessive current draw or a low ohmmeter reading indicates shorted windings. No current draw or an infinite ohmmeter reading would indicate an open winding.

b. Rectifiers: A diode rectifier tester will detect and pinpoint open or shorted rectifiers without going through the operation of disconnecting the stator leads. However, if a tester is not available, test probes and a No. 57 bulb, connected in series with a 12-volt battery, can be used in the following manner. Touch one test probe to a rectifier heat sink and the other test probe to a lead from one of the rectifiers in that heat sink. Then reverse the position of the leads. The test bulb should light in one direction and not light in the other direction. If the test bulb lights in both directions, one or more of the rectifiers in that heat sink is shorted. To pinpoint the defective rectifier, the stator leads must be disconnected and the above test repeated on each rectifier. Open rectifiers can only be detected, when using the test bulb, by disconnecting the stator leads. The test bulb will fail to light in either direction if the rectifier is open.

c. Stator: The stator can be tested for open or grounded windings with a 12-volt test bulb, described in the rectifier section, or an ohmmeter, in the following manner. Separate the stator from the slip ring end head just far enough to insert a fold of rags or blocks of wood. In other words, insulate the stator from the end head. To test for grounded windings, touch one test bulb or ohmmeter probe to the stator frame. If the test bulb lights, or the ohmmeter indicates continiuty, the stator is grounded. To test for open windings, connect one test probe

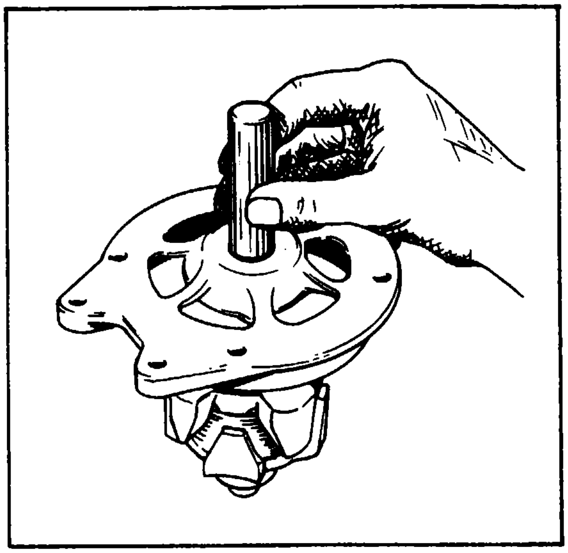

Figure 11-42. Installation of Bearing

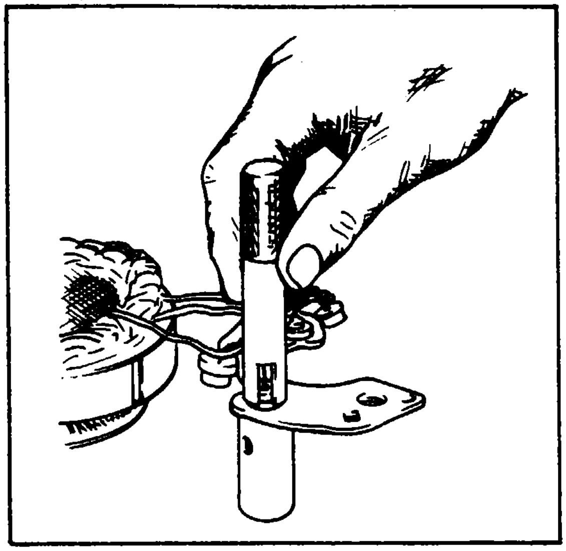

Figure 11-43. Installation of Rectifier

to the auxiliary terminal or the stator winding center connection and touch each of the three stator leads. The test bulb must light, or the ohmmeter must show continuity. Due to the low resistance in the stator windings, shorted windings are almost impossible to locate. However, shorted stator windings will usually cause the alternator to "growl" or be noisy during operation and will usually show some signs of overheating. If all other electrical checks are normal and the alternator fails to supply its rated output, the stator should be replaced to determine whether or not it is the faulty component.

d. Bearings and Seals: Whenever the alternator is overhauled, new bearings and oil or grease seals are recommended, even though the bearings and seals appear to be in good condition. A faulty seal can cause an alternator to fail within a very short period of time.

11-77. ASSEMBLY OF ALTERNATOR.

a. Press the ball bearing into the drive end head using a flat block approximately two inch square so that the pressure is exerted on the outer race of the bearing. Install the retainer plate. With the snap ring and retainer cup in place on the rotor shaft, use a tool that fits over the shaft and against the inner bearing race, and press until the inner bearing race is against the snap ring retainer cup. (Refer to Figure 11-42.)

b. Carefully install the rectifiers in the slip ring end head or rectifier mounting plate by supporting the unit and using the special tools illustrated in Figure 11-43.

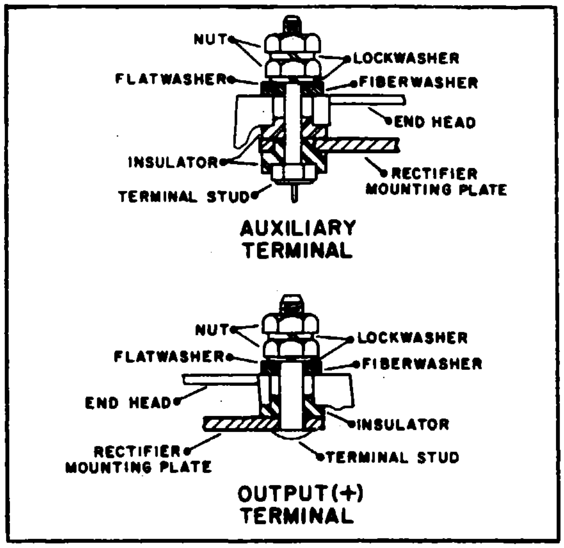

Figure 11-44. Terminal Assembly

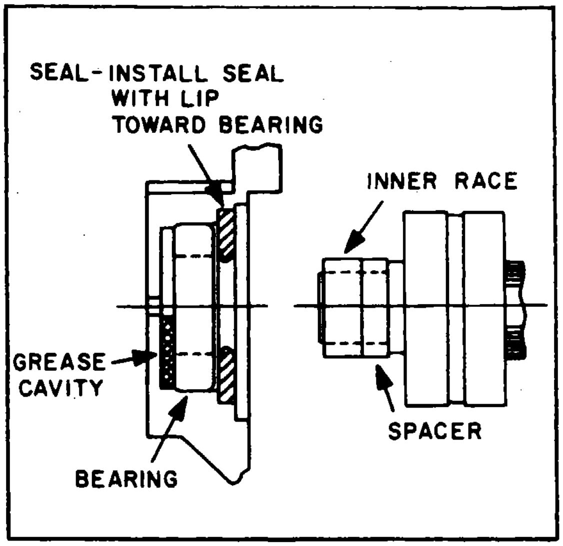

Figure 11-45. Slip Ring End Bearing Assembly

CAUTION

Use an arbor press, do not hammer. Reconnect the stator leads to the rectifiers. When soldering these connections, use pliers as a heat dam on the lead between the solder joint and the rectifier. Too much heat will damage the rectifiers.

c. Reassemble the rectifier mounting plate studs and insulators, making sure they are in the correct order. (Refer to Figure 11-44.)

d. After the slip ring end head is completely assembled, the stator and rectifier leads must be secured to the rectifier mounting plate with epoxy. Make sure the stator leads are positioned so that they do not interfere with the rotor.

e. Install the slip ring end bearing and oil seal. Make sure the lip of the oil seal is toward the bearing and stake the seal in place. Correct assembly of bearing, seal, inner race and spacer is shown in Figure 11-45.

f. Assemble the alternator and install the through bolts. Spin the rotor to make sure there is no mechanical interference. Torque the through bolts to 30 to 35 inch pounds. Safety wire should be installed after the unit has been bench tested for output. Install spacer, woodruff key, fan, pulley, lockwasher and nut. Torque the nut to 35 foot pounds, using a strap wrench to hold the pulley. Do not install the blast tube assembly until after the unit has been bench tested.

g. Install the brush and holder assembly and retaining screws. Spin the rotor and check for interference between the brush holder and rotor. Check across the

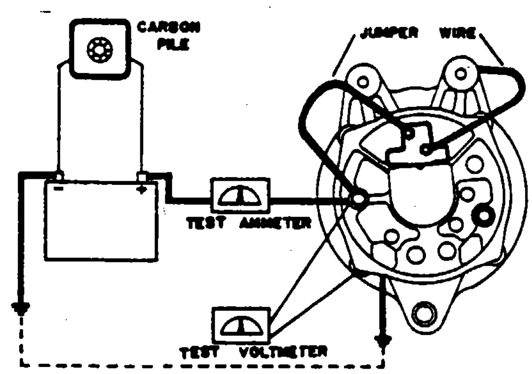

Figure 11-46. Testing Alternator

field terminals with an ohmmeter. The ohmmeter must indicate the amount of rotor resistance listed on the individual specifications page.

11-78. TESTING OF ALTERNATOR.

a. Wiring connections for bench testing the alternator are shown in Figure 11-46. Refer to the individual specification pages for output test figures. Adjust the carbon pile, if necessary, to obtain the specified voltage.

b. After bench testing the alternator, install the safety wire and blast tube and install the alternator on the engine.

NOTE

Always refer to the wiring diagram (Refer to Figure 11-35) when installing the alternator or testing the alternator.

11-79. PRECAUTIONS. The following precautions are to be observed when testing or servicing the electrical system.

a. Disconnect the battery before connecting or disconnecting test instruments (except voltmeter) or before removing or replacing any unit or wiring. Accidental grounding or shorting at the regulator, alternator, ammeter or accessories, will cause severe damage to the units and/or wiring.

b. The alternator must not be operated on open circuit with the rotor winding energized.

c. Do not attempt to polarize the alternator. No polarization is required. Any attempt to do so may result in damage to the alternator, regulator or circuits.

d. Grounding of the alternator output terminal may damage the alternator and/or circuit and components.

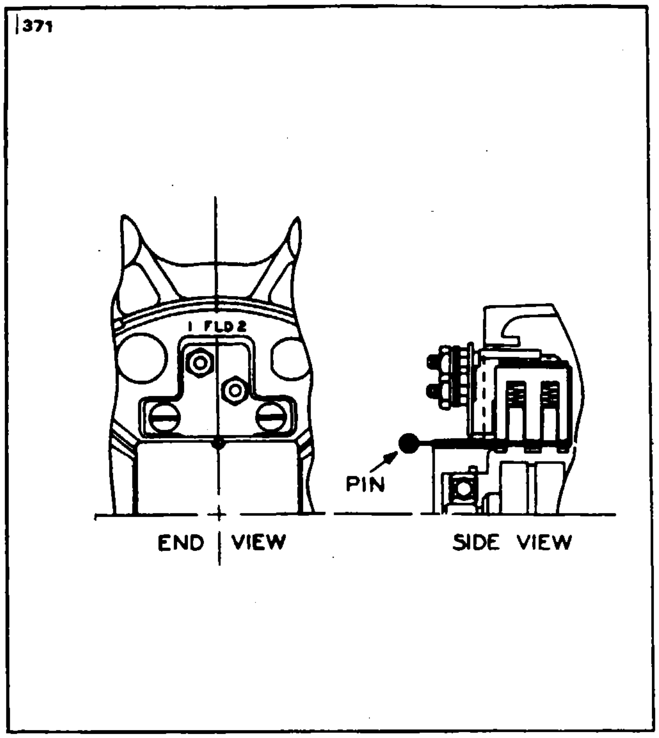

Figure 11-47. Brush Installation

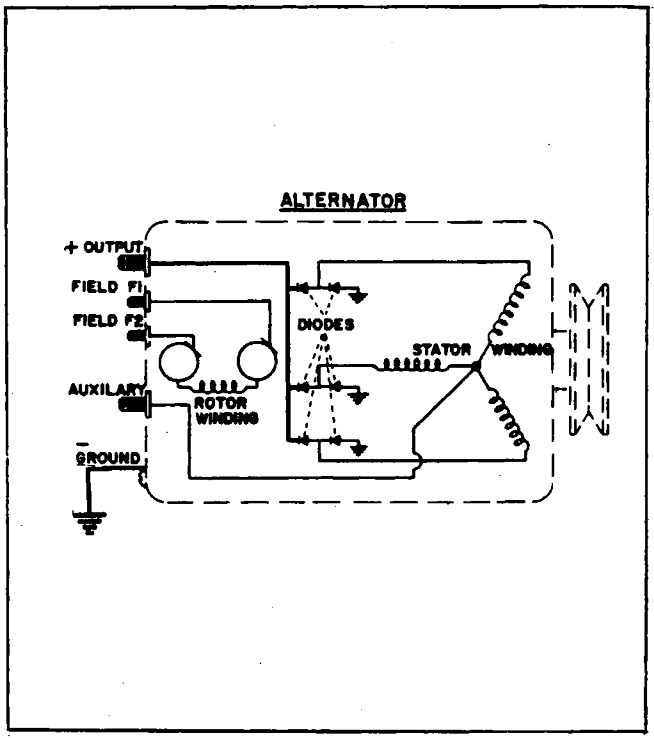

Figure 11-48. Internal Wiring Diagram

e. Reversed battery connections may damage the rectifiers, wiring or other components of the charging system. Battery polarity should be checked with a voltmeter before connecting the battery. Most aircraft are negative ground.

f. If a booster battery or fast charger is used, its polarity must be connected correctly to prevent damage to the electrical system components.

11-80. ALTERNATOR NOMENCLATURE.

a. Bearings: These units have a sealed ball bearing at the drive end and a two-piece roller bearing at the slip ring end. The inner race is presssed onto the rotor shaft and the rest of the bearing is in the slip ring end head. When the unit is assembled, the inner race aligns with the bearing. When the bearing is replaced. the new inner race must be installed on the rotor shaft.

b. Lubrication: The slip ring end bearing should be lubricated whenever the alternator is disassembled. The bearing should be thoroughly cleaned and repacked with Shell Alvania No. 2 or an equivalent bearing lubricant. The cavity behind the bearing should be packed on-third to one-half full with the same lubricant.

c. Brushes: These units have a separate brush holder assembly that is installed after the alternator has been assembled. The brush holder has a small hole that intersects the brush cavities. Use a pin or a piece of wire, as shown in Figure 11-47, to hold the brushes in the holder during assembly. Remove the pin after the brush holder retaining screws have been tightend. Make a continuity check to be sure the brushes are seated against the slip rings.

d. Drive Pulley: Torque the drive pulley retaining nut to 35 foot pounds.

e. Ventilation: The 8400 series units use a slip ring end cover that has a hose type connection for air pressure ventilation. Remove this cover when bench testing the alternator.

11-81. ALTERNATOR SERVICE TEST SPECIFICATIONS. Prestolite specifications for the 14 or 28-volt alternators installed as standard equipment on PA-23 series airplanes are as follows:

Alternator Model	ALX8403		ALU8403	
Voltage	14-volts		28-volts	
Rated Output	70 amperes		70 amperes	
Ground Polarity	Negative		Negative	
Rotation	Bi-Directional		Bi-Directional	
Rotor:				
Current Draw (77° F)	2.9 to 3.3 amps @ 12.0-volts		2.0 to 2.2 amps @ 24.0-volts	
Resistance (77° F)	3.7 to 4.1 ohms		11.3 to 11.9 ohms	
Output Test (77° F):				
Volts	13.0	14.2	26.3	28.4
Amperes Output	10.0	71.5	10.0	51.0
Field Amperes	2.85	3.15	2.05	2.05
Alternator RPM	1780 min.	5000 min.	3220 min.	5000 min.

11-82. ALTERNATOR PARALLELING SYSTEM. (PA-23-250 (six place), Serial Nos. 27-4794 and up.)

11-83. DESCRIPTION OF ALTERNATOR PARALLELING SYSTEM. The positive output terminal of each alternator is connected to the aircraft electrical bus through separate 90 ampere circuit breaker switches. Each alternator has a shunt installed between aircraft electrical bus and its positive output terminal in order to monitor output current on an ammeter.

The field circuit for each alternator is wired through a section of a Dual Master Switch (L or R as appropriate), an auxiliary switch which is ganged to the circuit breaker switch, an overvoltage relay and a voltage regulator. Field voltage can be manually disconnected from either alternator by turning off the appropriate section (L or R) of the Dual Master Switch. Turning both sections of the master switch off completely disconnects all electrical power from the aircraft bus bar. Field voltage will be automatically removed from an alternator whenever its overvoltage relay actuates or its circuit breaker switch trips.

The system has one ammeter installed to measure system currents. The output current of either alternator may be checked by rotating the switch, located below the ammeter to the "Left" or "Right" position. A shunt is installed between aircraft electrical bus and the positive terminal of the battery to allow measuring of the battery charge and discharge current with the ammeter.

An alternator inoperative ("INOP") warning light is provided for each alternator. The appropriate light will illuminate whenever its respective alternator fails to provide output voltage. Whenever the engines are operating at a high differential RPM, the alternator inoperative light for the slower engine may come on.

The 90 ampere circuit breaker switches should not be turned off when their associated alternator is operating normally. Turning "OFF" one of these switches while it is carrying current could cause a high voltage transient to occur on the electrical bus with possible subsequent damage to the semiconductor equipment attached to it.

11-84. DESCRIPTION OF ALTERNATOR. For a complete description of the alternator, refer to Paragraph 11-73.

11-85. CHECKING ALTERNATOR PARALLELING SYSTEM. The alternator paralleling system incorporates an ammeter which provides for an independent check of each alternator, as well as the charge/discharge current of the battery. In the event either ALTERNATOR INOPERATIVE light begins to glow or the ammeter check for either alternator fails to indicate an output, check the appropriate alternator circuit breaker switch, also the voltage regulator circuit breaker. If the circuit breakers are in their normal operating position a further check of the alternator system should be accomplished. (Refer to Figure 11-49.)

a. Verify that the ammeter is operating properly.
b. Disconnect the output (+) lead at the alternator.
c. Disconnect the field F-2 lead at the alternator.

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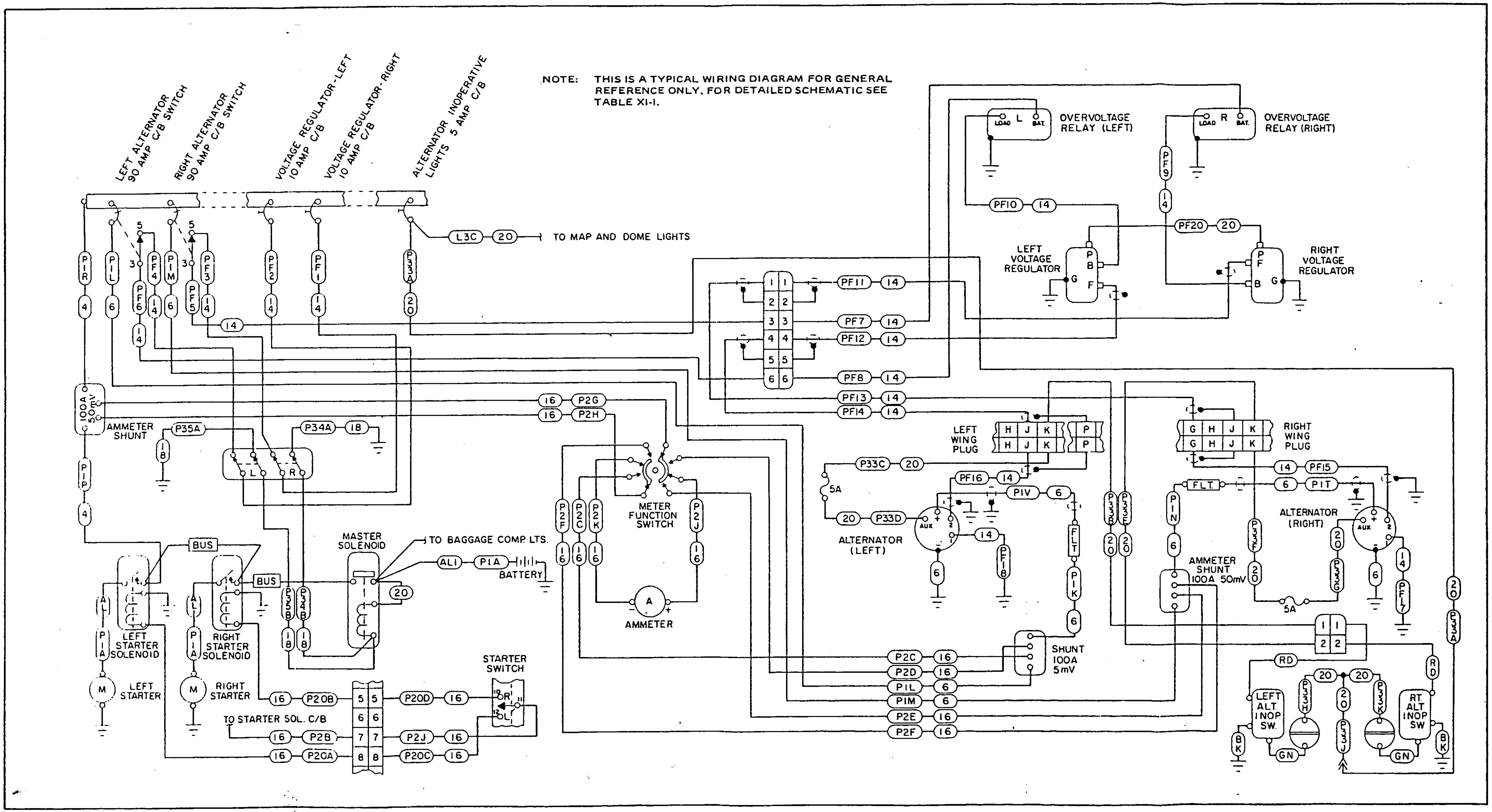

Figure 11-49. Alternator Paralleling System Wiring Diagram (Typical)

CAUTION

DO NOT ALLOW THE FIELD LEAD TO COME IN CONTACT WITH AIRFRAME GROUND WHEN THE MASTER SWITCH IS ON AS THE VOLTAGE REGULATOR WILL BE DAMAGED.

d. Verify that all electrical units are off and the battery is fully charged.

e. Turn ON the section of the master switch for the alternator being tested. (L or R.)

f. To check the alternator output circuit, connect a voltmeter or 14-volt test light to the previously disconnected output (+) lead. Check that the circuit breaker switch for the alternator under test is turned on. If a reading of approximately 14-volts is obtained on the voltmeter, or the test light glows, the output circuit is operational.

g. Should there be no indication of voltage, trace back through the output circuit until voltage is indicated. (Refer to Figure 11-35.) A component that does not indicate voltage at both its input and output terminals should be replaced.

h. Check the field circuit by connecting a voltmeter to previously disconnected field (F-2) lead. If a reading of approximately 14 volts is obtained on the voltmeter, the field circuit is operative.

i. If voltage is present at both the output and field leads, the alternator should be checked for a possible malfunction. (Refer to Paragraph 11-76.)

11-86. REGULATOR.

11-87. REGULATOR COMPONENTS. (Prestolite). Alternator output voltage can, within the limits of the design capability of the alternator, be controlled by properly varying the average level of current flow in the rotor winding of the Prestolite full electronic solid state regulator. The Prestolite alternator has self-limiting current characteristics and needs no current-limiting unit in the regulator.

a. Transistor: The transistor (Symbol "Q") is an electronic device which can control the flow of current in an electric circuit. It has no mechanical or moving parts to wear out.

b. Rectifier Diode: The rectifier diode (Symbol "D") will pass current in only one direction (forward direction); and in this respect it may be compared to a check valve.

c. Zener Diode: The zener diode (Symbol "Z") in addition to passing current in the forward direction, will also pass current in the reverse direction when a particular value of reverse voltage is applied. This property makes it useful as a voltage reference device in the regulator.

d. Capacitor: The capacitor (Symbol "C") is a device which will store electrical energy for short periods of time. This property makes it useful as a filter element to smooth variations of voltage.

e. Resistor: The resistor (Symbol "R") is a device which is used to limit current flow.

11-88. REGULATOR COMPONENTS (Lamar). Alternator output voltage can, within limits of the design capability of the alternator, be controlled by properly varying the average level of current flow in the rotor winding of the Lamar solid state electronic regulator. The Prestolite alternator has self-limiting current characteristics and therefore needs no current-limiting element in the regulator.

a. Transistor: The transistor (Symbol "Q") is an electronic device which can control the flow of current in an electric circuit. It has no mechanical or moving parts to wear out.

b. Rectifier Diode: The rectifier diode (Symbol "D") will pass current in only one direction (forward direction); and in this respect it may be compared to a check valve.

c. Zenor Diode: The zener diode (Symbol "Z") in addition to passing current in the forward direction, will also pass current in the reverse direction when a particular value of reverse voltage is applied. This property makes it useful as a voltage reference device in the regulator.

d. Capacitor: The capacitor (Symbol "C") is a device which will store electrical energy for short periods of time. This property makes it useful as a filter element to smooth variations of voltage.

e. Resistor: The resistor (Symbol "R") is a device which is used to limit current flow.

11-89. OPERATION OF REGULATOR (PRESTOLITE). (Refer to Figure 11-50.)

a. When the alternator switch is turned on, battery voltage is applied to the "I" terminal of the regulator.

b. The npn (negative-positive-negative) power transistor, T3, is turned on by current flow from the ignition terminal through R6 and the collector emitter junction of T2 through D2 through the base emitter junction of T3 to ground.

c. Whenever the power transistor, T3, is on (T2 is also on and T1 is off), current will flow from the ignition terminal through the field winding, through the collector - emitter of T3 to ground.

d. With the master switch on, current will flow from the regulator "I" terminal to ground through a voltage dividing network consisting of R1, R2 and P1. This network determines the system operating voltage relative to the Zenor diode, Z1, reverse conducting voltage.

e. When the system voltage connected to "I" terminal reaches a value at which the Zener diode connected to the divider network conducts, current will flow from the "I" terminal through R1 through Z1 and through the base emitter junction of T1 to ground. This causes the collector emitter junction of T1 to conduct which diverts the base current of T2 flowing from "I" terminal through R4 to ground, turning off T2 which turns off T3, de-energizing the rotor winding; then, when the alternator output voltage falls to a value which permits Z1 to cease conduction, T1 will turn off which turns on T2 and T3, re-energizing the rotor winding.

f. This sequence is performed so rapidly that the rotor current average appears as values usually less that full rotor current depending on rotor RPM and system load connected.

g. Each time the power transistor, T3, is turned off, current flow in the rotor winding is reduced. This causes the rotor magnetic field to collapse which would generate high voltage at the power transistor, T3, if a path were not provided so that the field current can decay at a slower rate. The field suppression diode, D1, provides this path, thus protecting the system and regulator from possible damage.

h. Temperature compensation is flat which means the regulator will hold the alternator output voltage constant with temperature increase or decrease after initial warm-up.

i. The Prestolite solid state regulator uses three npn silicon transistors.

j. Capacitor, C1, is used to filter ripple and alternator diode switching spike when operating without a battery.

k. Neon lamp, L1, provides transient voltage protection acting as a surge suppressor.

l. Control P1 is used to provide a limited range of voltage adjustment.

11-90. OPERATION OF REGULATOR (LAMAR). (Refer to Figure 11-51.)

a. When the alternator is turned on, battery voltage is applied to the "BUS" terminal of the regulator and via Q4 through the "FIELD" terminal of the regulator to the alternator field terminal F2. The amount of voltage applied to the field of the alternator is controlled automatically by action of the regulator in response to alternator output as described below.

b. Current flow through R6 and Z1 establishes a reference voltage across Z1.

c. Resistors R1 and R2+R3 comprise a voltage divider which is adjustable by means of the variable portion R3. Voltage at the junction of R1 and R2 and the reference voltage across Z1 are applied to comparison transistor Q1. R3 is adjusted so that these voltages are balanced with the desired alternator output voltage present on the "BUS" terminal of the regulator.

d. Thereafter, whenever alternator output voltage (as applied to the "BUS" terminal) falls below the desired regulation value, the comparison transistor Q1 will supply increased current to driver transistors Q2/Q3, which in turn will drive power transistor Q4 to a higher value of field current. This will result in alternator output voltage increasing to a value which will restore balance between the two voltages applied to Q1.

e. Conversely, if alternator output voltage (as applied to the "BUS" terminal) increases due to a greater engine speed or reduced loading of the electrical system, the comparison transistor Q1 will act to reduce current flow to the driver transistors Q2/Q3, and thus reduce the drive to power transistor Q4. This will result in a reduction of alternator field current and automatically restore balance between the two voltages applied to comparison transistor Q1.

f. Capacitors C1 and C2 function, together with their related transistors, in a way to smooth alternator output ripple and voltage spikes so that the alternator field current is controlled at a steady value.

g. The LAMAR solid state regulator controls alternator field current to a steady value as required by the electrical load conditions and engine speed. It does not continuously switch field current between high and low values as do mechanical regulators and the switching type of electronic regulators.

h. The design of this unit is such as to provide an alternator output voltage that does not vary with ambient temperature.

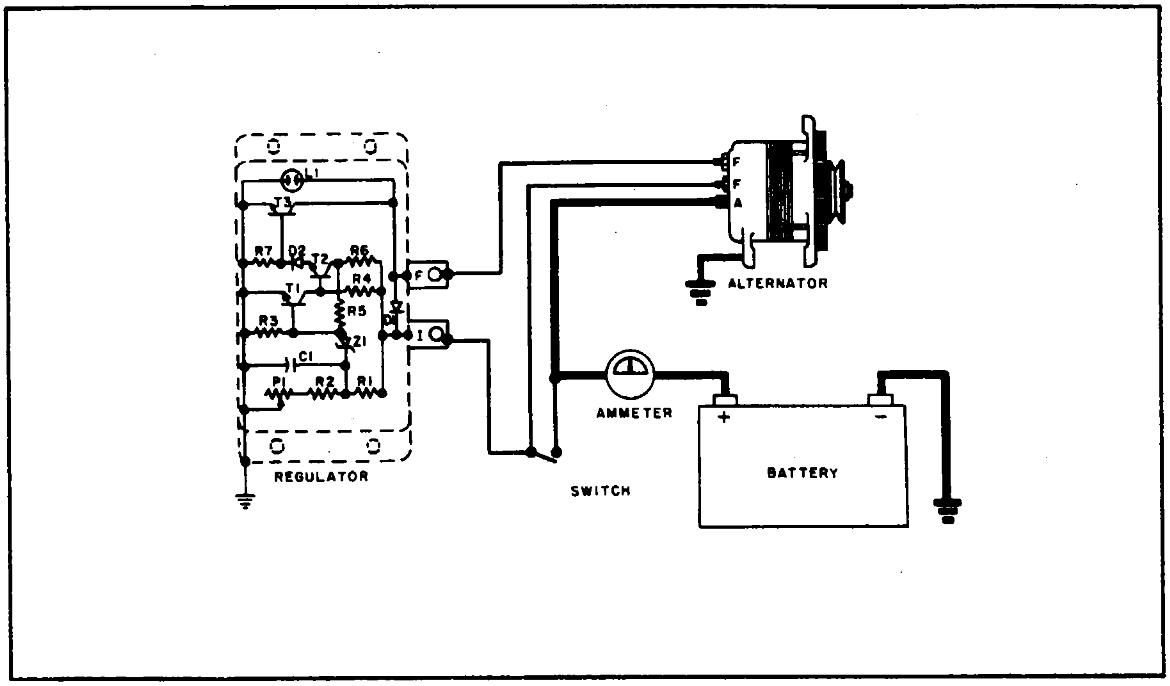

Figure 11-50. Regulator Diagram (Prestolite)

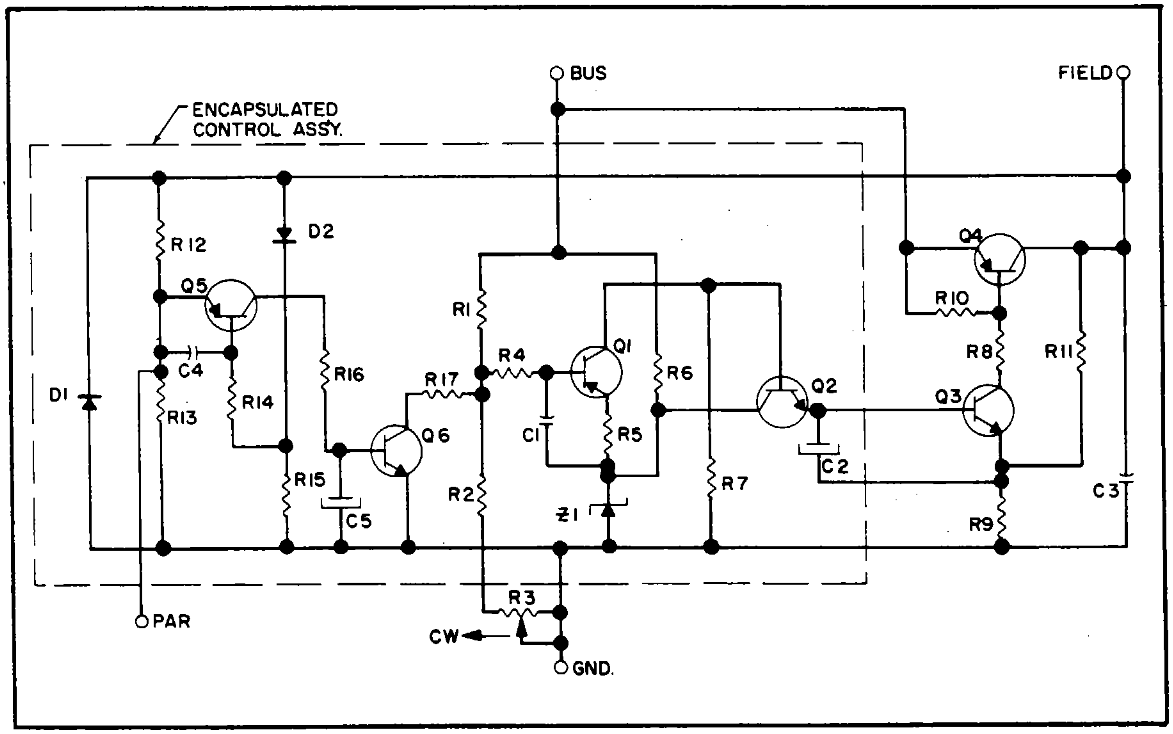

Figure 11-51. Regulator Diagram (Lamar)

11-91. BALANCING CIRCUIT OPERATION. (Considering two identical alternators and regulators having the "PAR" terminals of the regulators connected.)

a. Balancing circuit operation is initiated within one regulator whenever individual field voltages delivered by the regulator units to their related alternators are not equal.

b. When a difference in individual field voltages occurs, one-half the difference is impressed across R12 within each regulator and is thus applied to the input of Q5.

c. In that regulator which is delivering the lower field voltage, the polarity of R12 voltage drop causes Q5 collector current flow.

d. Q5 collector current flow results in conduction occurring in the collector circuit of Q6.

e. Q6 collector current flows from regulator divider R1/R2 + R3 through limiting resistor R17 to ground.

f. Conduction through R17 effectively alters the ratio of the regulator divider R1/R2 + R3 in the direction to increase Q1 collector current flow.

g. As described above under REGULATING CIRCUIT OPERATION, increased Q1 current results in increased output from the regulator to the field of its related alternator.

h. Feedback action results in Q6 collector current stabilizing at a value that results in nearly equal field voltage being delivered by the two regulators to their respective alternator fields.

i. The balancing circuit will thus automatically maintain, at a proper value, the difference voltage applied to the alternator fields. In a parallel system having identical alternators operating at the same RPM, the output currents of the alternators will thus be maintained nearly equal.

j. In whichever regulator of a pair is set to deliver the highest voltage, the balancing circuits are inactive. Thus system voltage is determined by the regulator of a pair which is set to higher voltage. The lower set regulator will adjust itself automatically, as described above, to deliver the same field voltage as the one which is set higher, within the limits of its design capability.

k. The balancing regulator system as described provides for automatic load balancing of parallel operated alternators having independent field excitation circuits. The pilot can, while in flight, remove either alternator system completely from the aircraft system and maintain operation of the other system.

11-92. PREPARATION FOR TESTING. (Regulators may be tested using the aircraft's alternator or an alternator test stand.)

CAUTION

Do not interchange regulator leads. This will destroy regulator and void warranty.

a. The aircraft technician or other electrical systems specialist, must disconnect the battery ground cable at the battery before connecting or disconnecting a test ammeter or other test equipment or before making wiring changes in the electrical system.

b. Voltmeters with test probes or clips are not recommended. Fully insulated bolted terminal connections are best, and these should be attached when all power is removed as described above.

c. When installing a battery in an aircraft, be sure that the battery negative terminal is in a position so that this terminal can be connected to the battery ground cable for negative ground systems.

d. The regulator under test is to be mounted on a grounded metallic surface using three No. 8 screws pulled up tight. For extended test periods the heat transfer from regulator to the mounting surface is significant.

e. A ground wire between the regulator "GND" terminal and the aircraft or test stand structure is essential for proper operation. The alternator frame must also be solidly bonded to the system ground.

f. The alternator does not need to be polarized; therefore, never connect ground, even momentarily, to either the regulator field terminal or to the alternator field terminals. Do not interchange I and F leads to regulator as this will destroy the regulator.

g. The LAMAR regulator is intended for use with alternator systems having one field terminal grounded at the alternator. The other field terminal F2 of the alternator is connected to the "FIELD" terminal of the regulator. NEVER UNDER ANY CIRCUMSTANCE PERMIT A GROUND TO CONTACT THIS CIRCUIT EVEN FOR AN INSTANT WHILE POWER IS APPLIED TO THE SYSTEM. Due to this precaution, the mechanic should not use tools near these circuits while power is applied.

h. The alternator should be in good condition and capable of producing full output, and the alternator drive belt must be adjusted tight enough to prevent slippage. (Refer to Paragraph 11-102.)

i. The battery must be in good condition and should be fully charged.

j. The voltmeter and ammeter should be of the best quality and should be accurate.

k. A carbon-pile connected across the battery may be used to load the charging circuit while testing the regulator.

11-93. TESTING REGULATOR (PRESTOLITE).

a. The procedure for testing the regulator, whether on the airplane or on the test bench, remains the same. Connect test meters as shown in Figure 11-52.

b. All circuit connections should be clean and tight. This includes the test instrument connections which must not come loose or open the charging circuit at any time while the system is operating.

c. The voltmeter will not indicate the true regulator setting until the regulator has been operating in the charging system or on the test bench for at least one minute, at a charge rate of from 10 to 15 amperes.

d. Connect the voltmeter and the ammeter as shown in Figure 11-52. Start the engine and adjust its speed to obtain 900 to 1200 RPM or 3,000 to 4,000 alternator RPM on a test bench setup. Turn on the accessories as needed to establish 10 to 15 amperes electrical load, or use a carbon-pile across the battery to obtain this charge rate.

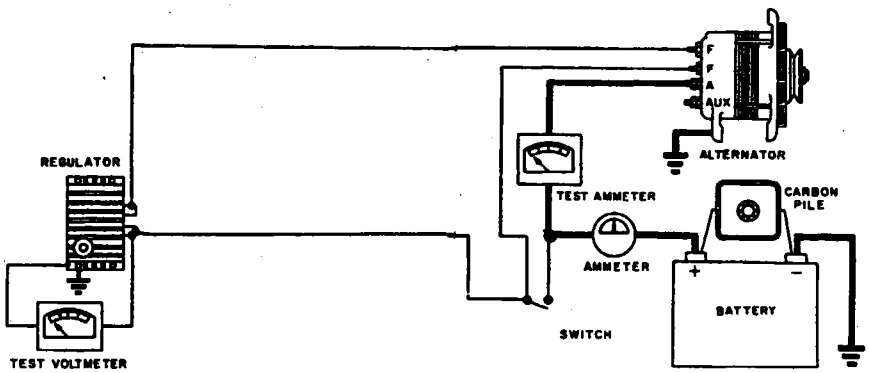

Figure 11-52. Testing Regulator (Prestolite)

e. After one minute operating time, check the regulator operating voltage as indicated by the voltmeter. Refer to Alternator Service Test Specifications, Paragraph 11-81 for the correct operating voltage. The operating voltage is shown for the ambient temperature in which the regulator is operating.

f. If the voltmeter indicates that the operating voltage is not within limits, lift the plastic plug from top of regulator and adjust the voltage to the desired value. Replace the plug after adjustment. Before condemning the regulator, recheck the alternator and the battery; making sure that they are in good condition. Recheck all circuit connections and all wiring for unwanted resistance (voltage drop test). Recheck the voltmeter for accuracy and repeat the entire operating test.

11-94. TESTING REGULATOR (LAMAR).

a. The procedure for testing the regulator, whether on the airplane or on the test bench, remains the same. Connect the test meters and regulator wiring as shown in Figure 11-53.

b. All circuit connections should be clean and tight. This includes the test instrument connections which must not come loose or open the charging circuit at any time while the system is operating.

c. The voltmeter will not indicate the true regulator setting until the regulator has been operating in the charging system or on the test bench for at least five minutes, at a charge rate of from 10 to 15 amperes.

d. With the connections made as shown in Figure 11-53, start the engine and adjust speed to obtain 900 to 1200 RPM or 3,000 to 4,000 alternator RPM on a test bench setup. Adjust the carbon pile or accessory load to establish the 10 to 15 ampere load value. Note that the battery charge current is indicated by the ammeter. Therefore, the current value may change downward at the beginning of a test run. This will be especially true if the battery was used for engine starting.

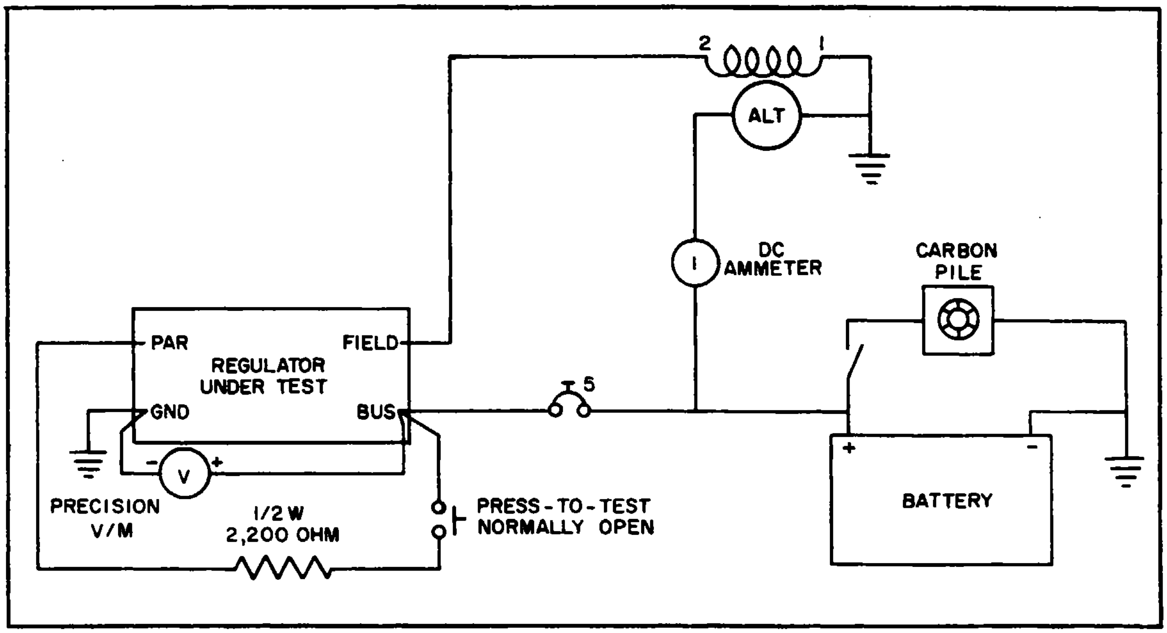

Figure 11-53. Testing Regulator (Lamar)

e. After five minutes operating time, check the regulator operating voltage as indicated by the voltmeter. Refer to Alternator Service Test Specifications as outlined in Paragraph 11-81 for correct operating voltage. The operating voltage is shown for ambient temperature in which the regulator is operating.

f. If the voltmeter reading indicates that the operating voltage is not within limits, carefully insert a small screwdriver (Phillips #O) in the voltage adjustment access hole on top of the regulator and adjust voltage adjustment slowly to obtain desired value. Before condemning the regulator, recheck the alternator and the battery; making sure that they are in good condition. Recheck all circuit connections and all wiring for unwanted resistance (voltage drop test). Recheck the voltmeter for accuracy and repeat the entire operating test.

g. Balance circuit operation is confirmed by closing the press-to-test switch momentarily and observing that the alternator output current increases abruptly to a higher level. Upon release of this switch, the alternator output will be restored to its previous level, except that minor differences may be noted which are due to battery charge conditions.

11-95. ADJUSTING REGULATOR (PRESTOLITE).

a. Adjustment: These units have an external adjustment located under the plastic plug on top of the regulator. The regulator has an adjustment spread ranging from 13.0-volts to 15.0-volts for the 14-volt electrical system or 26.0-volts to 30.0-volts for the 28-volt system. Output is increased by turning the adjustment clockwise.

b. Operating Voltage: The regulator should be adjusted to 14.2-volts (14-volt system) or 28.4-volts (28-volt system) when controlling a load of 10 to 15-amps after one minute operation. These units are not affected by ambient temperatures. The voltmeter must be connected from the "I" or switch terminal to ground.

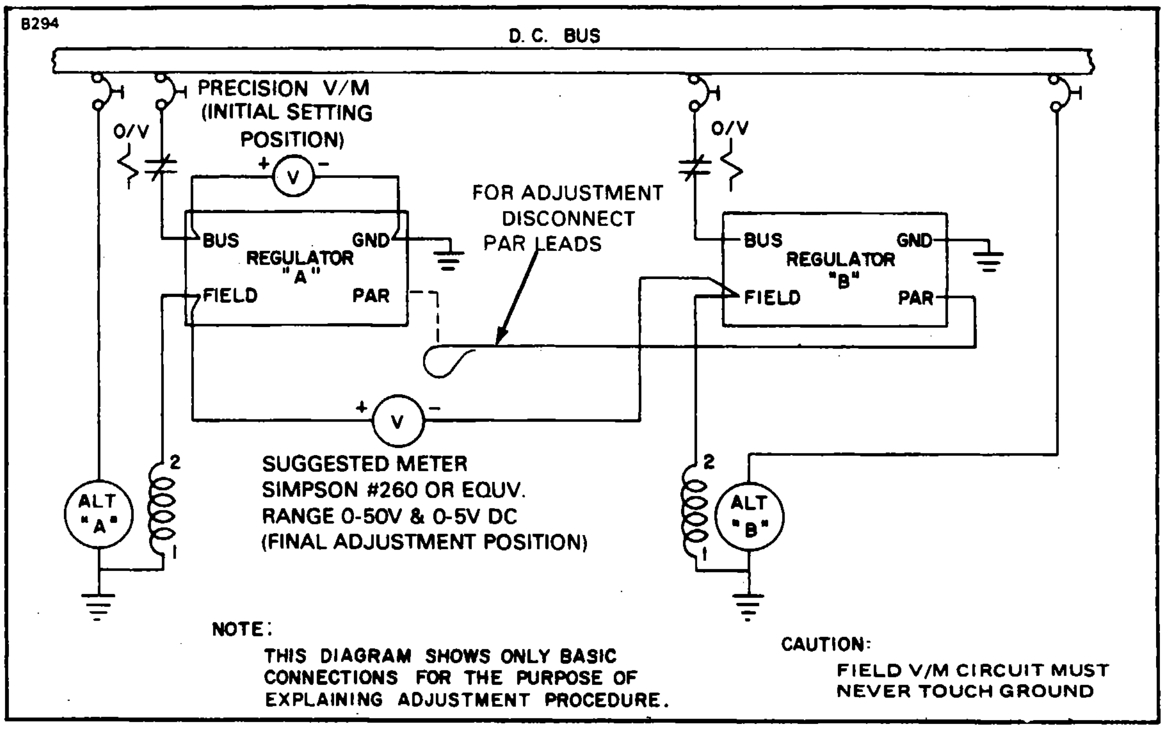

Figure 11-54. Adjusting Regulator (Lamar)

c. Caution Notes:
1. Use only with insulated (ungrounded) field alternators.
2. Regulator base must have a good ground connection.
3. Do not connect ground power to aircraft until voltage regulator "I" terminal has been disconnected from electrical system.
4. Do not (even momentarily) connect the two voltage regulator terminals together.
5. Do not connect battery into system with polarity reversed.
6. Do not force the voltage adjustment screw.
7. This is a sealed unit and not repairable. Replace with a new unit.

11-96. ADJUSTING REGULATOR (LAMAR). (Refer to Figure 11-54.)

a. These regulators are normally used in parallel alternator systems of multi-engine aircraft. Their final adjustment should be made in actual operation in the aircraft system with test equipment connected as shown in Figure 11-54. The balance adjustment is made while operating only one engine, either left or right. The engine to be operated must be selected so as to permit the technician a completely safe access to both of the regulators, so that they may be adjusted while the engine is operating without danger. We shall designate the engine selected to be operated as "LEFT" and the inoperative engine as "RIGHT" for purposes of discussion.

b. Lift the wire from the "PAR" terminal of either regulator and insulate the free end so it will not contact other circuits or ground during the adjustment procedure. Breaking this circuit disables the balancing circuits in both regulators.

c. Turn off the "RIGHT" alternator field switch. All the "LEFT" alternator switches are to be on.

d. Operate the left engine and alternator system with a load of at least 15 amperes and engine speed of 900 to 1500 RPM for at least one minute for warm-up of the system. Place the positive (+) lead of a precision voltmeter on the bus terminal of the left regulator and the negative (-) lead of the voltmeter on the ground terminal of the "LEFT" regulator. If required, carefully set the "LEFT" regulator voltage adjustment to 14.3 or 28.5 volts as per aircraft system. Replace the snap plug in the "LEFT" regulator adjustment access hole.

CAUTION

DO NOT MAKE ANY FURTHER ADJUSTMENT OF THE "LEFT" REGULATOR.

c. While continuing "LEFT" engine operation with electrical load the same as before, turn on the "RIGHT" alternator system switches. (The "RIGHT" engine, however is NOT operating.)

f. Connect a Simpson #260 (or equivalent voltmeter, range 0-50 and 0-5 VDC, as indicated in Figure 11-54. The positive (+) lead of the voltmeter is conneted to the "field" terminal of the "LEFT" regulator and the negative (-) lead of the voltmeter is connected to the "field" terminal of the "RIGHT" regulator. Now very slowly rotate the "RIGHT" regulator voltage adjustment while observing the field circuit voltmeter. (Suggested voltmeter range setting, 0-50V.) If a reverse (downscale) reading is obtained turn the "RIGHT" regulator adjustment counterclockwise to bring the meter up scale. Then, very slowly turn the "RIGHT" regulator adjustment clockwise to make the field voltmeter read near zero. A stable reading should not be expected. A correct adjustment has been achieved when the meter will remain briefly in the vicinity of zero, swinging both upscale and downscale. The use of a low range on the voltmeter is recommended for the final adjustment. (Suggested voltmeter range setting, 0-5V.)

g. Replace the snap plug in the "RIGHT" regulator adjustment hole.

h. Shut down the engine and master switch, then replace the connection to the "PAR" terminal which was removed in step b. Remove all voltmeter leads and test equipment.

11-97. OVERVOLTAGE CONTROL.

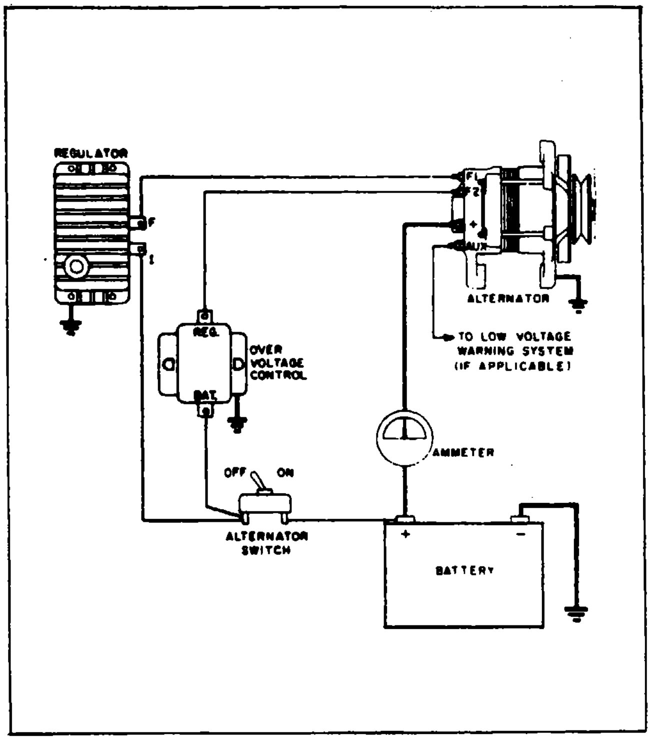

Figure 11-55. Application of Over-Voltage Control

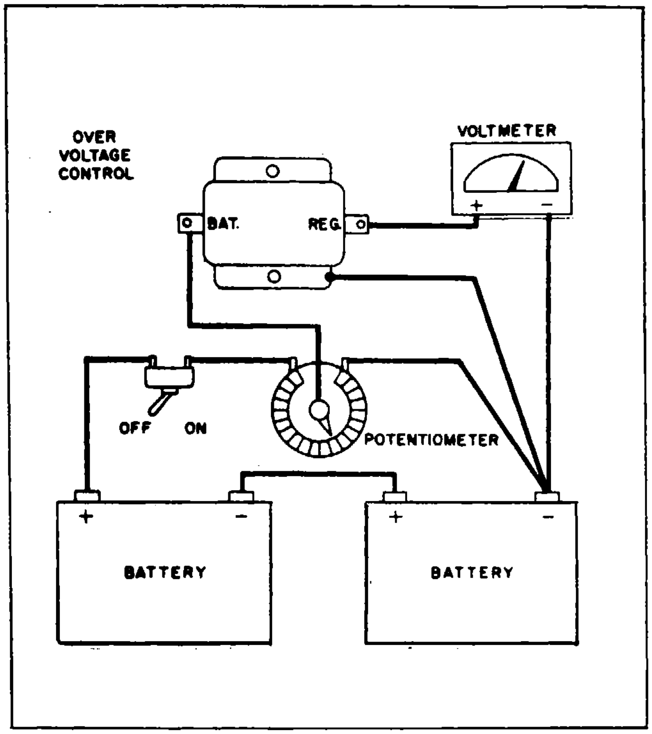

Figure 11-56. Testing Over-Voltage Control

11-98. PURPOSE AND OPERATION.

a. The overvoltage control is used to protect electrical circuits and electronic equipment from excessive voltage in the event of a charging circuit malfunction.

b. The overvoltage control consists of a mechnical relay and a solid state triggering device. The solid state triggering device activates the mechanical relay, when the voltage reaches a present value, thereby opening the relay contacts and disconnecting the field circuit of the alternator.

c. The relay contacts will remain open until the alternator switch is turned off. Figure 11-55 illustrates the overvoltage control connected in a typical Prestolite insulated field alternator.

11-99. TEST PROCEDURE. Connect the relay as shown in Figure 11-56. Use a 100 ohm potentiometer of 15 watt rating, or more, to adjust the voltage. The voltmeter is used to read the voltage until the relays opens, at which time the voltmeter reading will drop to zero. See tabulation for voltage reading. Test figures are at 75 degrees Fahrenheit.

a. 14-volt system: Relay contacts open between 15.5 and 16.5 volts. Use 18 or 24 volts to test.

b. 28 volt system: Relay contacts open between 31.5 and 32.5 volts. Use 36 volts to test.

NOTE

These units are not adjustable. Replace the overvoltage control if it does not test to specifications.

11-100. OVERVOLTAGE RELAY OPERATIONAL CHECK. This check should be made at each 500 hour inspection, per the following instructions:

a. Determine that aircraft master switch is OFF.

b. Pull out (OFF) all circuit breakers except the main and auxiliary voltage regulators (10 amp).

c. Turn off the right and left alternator output circuit breaker switches (90 amp).

d. Set the voltage regulator to MAIN.

e. Obtain a variable D.C. voltage power supply and set it to zero output.

f. Connect the power supply to the aircraft through the external power receptacle.

NOTE

On aircraft without an external power receptacle, disconnect the battery cables and connect the power supply to the cables.

CAUTION

Connections must be positive to positive and negative to negative.

g. Obtain a volt/ohmmeter and set the selector to a D.C. voltage scale of no less than 16.5 volts. Connect the meter VOM lead to the output (REG.) terminal of the MAIN overvoltage relay. Connect the meter COM lead to the airframe ground.

h. Increase the output voltage of the variable D.C. power supply until the MAIN overvoltage relay trips out. When the relay operates, the VOM needle should drop to zero volts. Record the power supply voltmeter reading which was indicated just prior to the overvoltage relay operating. Voltage limits are: Min. 15.5-volts - Max. 16.5-volts for the 14-volt system and Min. 31.5-volts - Max. 32-5-volts for the 28-volt system.

CAUTION

Limit overvoltage operation to two minutes maximum.

i. Reduce the power supply voltage to zero.

j. Set the VOM to resistance scale and determine continuity between battery terminal (BAT) and regulator terminal (REG.) on the overvoltage relay, to insure that the relay is reset.

k. Change the voltage regulator selector switch from MAIN to AUX. Reconnect the volt/ohmmeter to the AUX overvoltage relay and repeat steps i thru l.

l. Reset circuit breakers, turn on alternator output circuit breakers, reset voltage regulator selector to MAIN, disconnect VOM, and reconnect the battery cables if previously removed.

11-101. OVERVOLTAGE RELAY OPERATIONAL CHECK (PARALLELING SYSTEM). This check should be accomplished at each 500 hour inspection, per the following instructions:

a. Pull all circuit breakers to the out (OFF) position except the left and right voltage regulator (10 amp) circuit breakers and the alternator (90 amp) circuit breaker switches.

b. Obtain a variable D.C. voltage power supply and set it to zero output.

c. Connect the power supply to the aircraft through the external power receptacle.

d. Turn ON the left alternator section of the Dual Master Switch.

e. Obtain a volt/ohmmeter and set to 60-volts D.C. Connect the positive lead of the VOM to the output (LOAD) terminal of the LEFT overvoltage relay. Connect the negative lead of the VOM to airframe ground.

f. Increase the output voltage of the variable D.C. power supply until the LEFT overvoltage relay trips out. (An audible click will be heard whenn the relay operates and the VOM needle must drop to zero volts.) Record the power supply voltmeter reading which was indicated just prior to the overvoltage relay operating. Voltage limits are: Min. 15.50-volts-Max. 16.50-volts.

g. Reduce the power supply to zero. Turn OFF the left alternator section of the Dual Master Switch. Another click will be heard when the overvoltage relay resets itself for normal operation.

h. Turn ON the right alternator section of the Dual Master Switch. Reconnect the volt/ohmmeter to the right overvoltage relay and repeat steps f and g.

Width of Belt	Condition	Torque Indicated at Generator or Alternator Pulley
3/8 inch	New	11 to 13 ft. lbs.
3/8 inch	Used	7 to 9 ft. lbs.
1/2 inch	New	13 to 15 ft. lbs.
1/2 inch	Used	9 to 11 ft. lbs.

11-102. CHECKING GENERATOR OR ALTERNATOR BELT TENSION. If properly installed, tensioned and checked periodically, the generator or alternator drive belt will give very satisfactory service. However, an improperly tensioned belt will wear rapidly and may slip and reduce generator or alternator output. Consequently, a belt should be checked for proper tension at the time it is installed, again after 24 hours of operaion and each 100 hours thereafter.

There are two satisfactory methods of checking generator or alternator belt tension; however, the first method described will be found preferable by most maintenance personnel because it is technically simple and requires little time for accomplishment.

a. Torque Method: This method of checking belt tension consists of measuring torque required to slip the belt at the small pulley and is accomplished as follows:

1. Apply a torque indicating wrench to the nut that attaches the pulley to the generator and alternator and turn it in a clockwise direction. Observe the torque shown on the wrench at the instant the pulley slips.

2. Check the torque indicated in step b with torqe specified in the following chart. Adjust belt tension accordingly.

NOTE

The higher tension specified for a new belt is to compensate for the initial stretch that takes place as soon as it is operated. These higher tension values should not be applied to belts which previously have been used.

b. Deflection Method: Belt tension may be checked by measuring the amount of deflection caused by a predetermined amount of tension. This is accomplished in the following manner:

1. Attach the hook of a small spring-scale to the belt at the approximate mid-point between the rear gear support and the generator or alternator.

2. Pull on the scale until a reading of 14 pounds is obtained. (10 pounds for used belts.)

3. Measure the distance the belt has moved with the 10 or 14 pound load applied. The distance (deflection) should be 5/16 inch. If less than 5/16 inch, the belt is too tight.

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11-103. STARTING MOTOR (Delco-Remy).

11-104. OPERATION OF STARTING MOTOR. When the starting motor switch is closed, the armature begins to rotate. The drive pinion, being a loose fit on the drive sleeve located on the armature shaft, does not pick up speed as fast as the armature. Therefore, the drive pinion, having internally matched splines with respect to the splined drive sleeve, moves endwise on the shaft and into mesh with the flywheel. As the pinion hits the pinion stop, it begins to rotate with the armature and cranks the engine.

When the engine starts, the flywheel begins to spin the pinion faster than the armature. Again, because of the splined action of the pinion and drive sleeve assembly, the pinion backs out of mesh with the flywheel ring gear protecting the armature from excessive speeds.

Some Bendix drives incorporate a small anti-drift spring between the drive pinion and the pinion stop which prevents the pinion from drifting into mesh when the engine is running. Others use a small anti-drift pin and spring inside the pinion which provides enough friction to keep the pinion from drifting into mesh.

Never operate the motor for more than 30 seconds without pausing for two minutes to allow it to cool.

11-105. CHECKING STARTING MOTOR. Several checks, both visual and electrical, should be made in a defective starting circuit to isolate trouble before removing any unit. Many times a component is removed from the airplane only to find it is not defective after reliable tests. Therefore, before removing a unit in a defective starting system, the following checks should be made:

a. Determine the condition of the battery.

b. Inspect the wiring for frayed insulation or other damage. Replace any wiring that is damaged. Inspect all connections to the starting motor, solenoid switch, starting switch or any other control switch, and battery, including all ground connections. Clean and tighten all connections and wiring as required. The engine manufacturer specifies allowable voltage drop in the starting circuit. For this information, refer to the manufacturer's shop manual.

c. Inspect starting and solenoid switches to determine their condition. Connect a jumper lead around any switch or solenoid suspected of being defective. If the system functions properly using this method, repair or replace the bypassed unit.

d. If specified battery voltage can be measured at the motor terminal of the starting motor, allowing for some voltage drop in the circuit and the engine is known to be functioning properly, remove the motor and follow the test procedures outlined below.

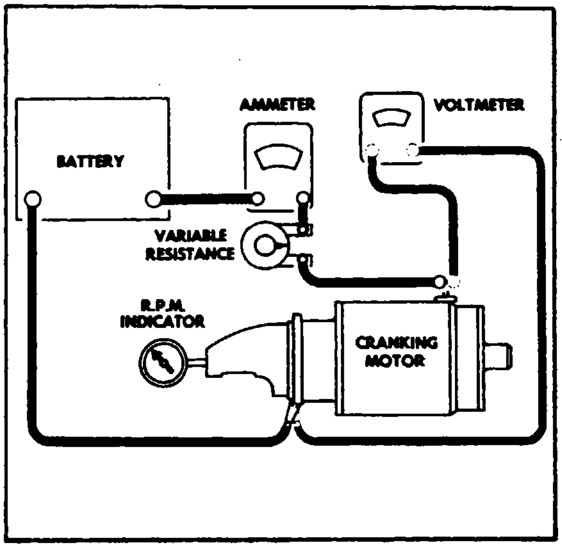

Figure 11-57. No-load Test Hookup

11-106. TEST AND MAINTENANCE OF STARTING MOTORS.

11-107. INSPECTION. With the starting motor removed from the engine, the pinion should be checked for freedom of operation by turning it on the screw shaft. The armature should be checked for freedom of operation by turning the pinion. Tight, dirty, or worn bearings, bent armature shaft, or loose pole shoe screw will cause the armature to drag and it will not turn freely. If the armature does not turn freely, the motor should be disassembled immediately. However, if the armature does operate freely, the motor should be given electrical tests before disassembly.

11-108. NO LOAD TEST. (Refer to Figure 11-57.) Connect the starting motor in series with a fully charged battery of the specified voltage, an ammeter capable of reading several hundred amperes, and a variable resistance. Also connect a voltmeter as illustrated, from the motor terminal to the motor frame. An RPM indicator is necessary to measure armature speed. Obtain the specified voltage by varying the resistance unit. Then read the current draw and the armature speed and compare these readings with the values listed in paragraph 11-114. Interpret the test results as follows:

a. Rated current draw and no load speed indicate normal condition of the starting motor.

b. Low free speed and high current draw indicate:

1. Too much friction - tight, dirty, or worn bearings, bent armature shaft or loose pole shoes allowing armature to drag.

2. Shorted armature. This can be further checked on a growler after disassembly.

c. Failure to operate with high current draw indicates:

1. A direct ground in the terminal or fields.

2. "Frozen" bearings (this should have been determined by turning the armature by hand).

d. Failure to operate with no current draw indicates:

1. Open field circuit. This can be checked after disassembly by inspecting internal connections and tracing circuit with a test lamp.

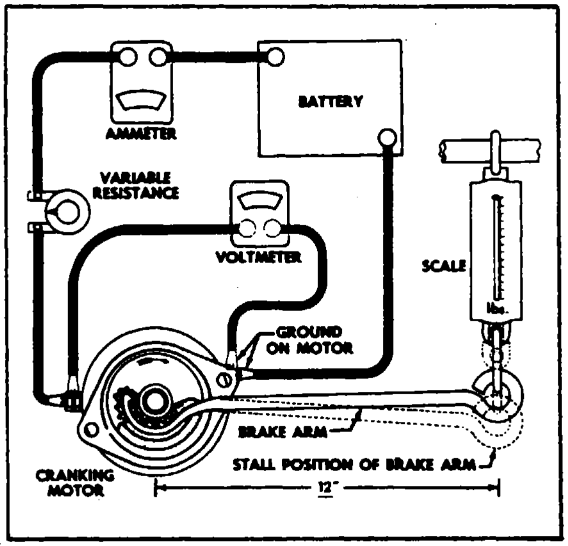

Figure 11-58. Lock-Torque Test Hookup

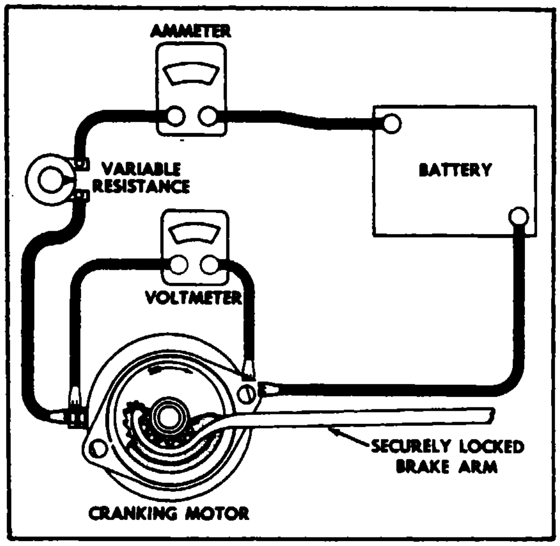

Figure 11-59. Resistance Test Hookup

2. Open armature coils. Inspect the commutator for badly burned bars after disassembly.

3. Broken brush springs, worn brushes, high insulation between the commutator bars or other causes which would prevent good contact between the brushes and commutator.

e. Low no-load speed and low current draw indicate high internal resistance due to poor connections, defective leads, dirty commutator and causes listed under, step d.

f. High free speed and high current draw indicate shorted fields. If shorted fields are suspected, replace the field coil assembly and check for improved performance.

11-109. LOCK-TORQUE TEST. (Refer to Figure 11-58.) The lock-torque test requires the equipment illustrated. A variable resistance with a high current capacity should be used. The starting motor should be securely mounted and a brake arm hooked to the drive pinion. Use extreme caution during this test to make sure the end of the brake arm does not slip off the pinion when current is applied. When specified current is applied, the torque can be computed from the reading on the scale. A one foot brake arm will directly indicate pound-feet. Compare the pound-feet of torque as read on the scale with that listed in paragraph 11-114. If the torque is low, the motor must be disassembled for further tests and repair.

11-110. RESISTANCE TEST. (Refer to Figure 11-59.) This test requires equipment similar to the lock-torque test, with the exception that the pinion is locked secureley so it cannot rotate. When the specified voltage is applied, the current should fall in a range as indicated in paragraph 11-114. A high current indicates grounded or shorted condutors, and a low current indicates excessive resistance.

11-111. DISASSEMBLY. If the motor does not perform in accordance with published specifications, it may need to be disassembled for further testing of the components. Normally the starting motor should be disassembled only so far as is necessary to make repair or replacement of the defective parts. As a precaution, it is suggested that safety glasses be worn when disassembling or assembling the starting motor. Following are general instructions for disassembling a typical Bendix drive starting motor.

a. Remove the cover band, if present, and detach the field coil leads from the brush holders.

b. If gear reduction, remove the drive housing and reduction housing.

c. Remove the bolts attaching the drive housing and commutator end frame to the field frame assembly. Discard the tang lock washers.

d. Separate the commutator end frame, armature assembly, field frame and drive housing.

e. Remove and disassemble the drive from the armature shaft by first identifying the type Bendix drive and then following one of the guides below:

1. Standard Bendix Drive: Remove the head spring screw and slip it off the armature shaft.

2. Folo-Thru-Bendix Drive: Push in the outer anchor plate so the pilot screw or pin can be removed.

NOTE

Some Folo-Thru drives use a rubber cushion in place of a drive spring. To remove from shaft, screw pinion out to drive position, then force pin from shaft through screw sleeve holes.

CAUTION

Do not disassemble this drive, service is by complete replacement.

11-112. COMPONENT INSPECTION AND REPAIR.

a. Brushes and Brush Holders: Inspect the brushes for wear. If they are worn down to one-half their original length, when compared with a new brush, they should be replaced. Make sure the brush holders are clean and the brushes are not binding in the holders. The full brush surface should ride on the commutator with proper spring tension (Refer to Paragraph 11-114.) to give good, firm contact. Brush leads and screws should be tight and clean.

b. Armature: The armature should be checked for short circuits, opens and grounds:

1. Short circuits are located by rotating the armature in a growler with a steel strip such as a hacksaw blade held on the armature. The steel strip will vibrate on the area of the short circuit. Shorts between bars are sometimes produced by brush dust or copper between the bars. Undercutting the insulation will eliminate these shorts.

2. Opens: Inspect the points where the conductors are joined to the commutator for loose connections. Poor connections cause arcing and burning of the commutator. If the bars are not badly burned, resolder the leads in the riser bars and turn the commutator down in a lathe. Then undercut the insulation between the commutator bars .031 of an inch.

3. Grounds in the armature can be detected by the use of a test lamp and prods. If the lamp lights when one test prod is placed on the commutator and the other test prod on the armature core or shaft, the armature is grounded. If the commutator is worn, dirty, out of round, or has high insulation, the commutator should be turned down and undercut as previously described.

c. Field Coils: The field coils should be checked for grounds and opens using a test lamp.

1. Grounds: Disconnect field coil ground connections. Connect one test prod to the field frame and the other to the field connector. If the lamp lights, the field coils are grounded and must be repaired or replaced.

2. Opens: Connect test lamp prods to ends of field coils. If lamp does not light, the field coils are open.

If the field coils need to be removed for repair or replacement, a pole shoe spreader and pole shoe screwdriver should be used. Care should be exercised in replacing the field coils to prevent grounding or shorting them as they are tightened into place. Where the pole shoe has a long lip on one side, it should be assembled in the direction of armature rotation.

11-113. ASSEMBLY. To reassemble the motor, follow the disassembly procedures in reverse. Install new tang lock washers where removed.

CAUTION

If Folo-Thru drive is manually rotated to locked position, do not attempt to force it in a reverse direction. Proceed to install with pinion meshing with flywheel. When engine starts, the drive will return to the demeshed position.

11-114. STARTING MOTOR SERVICE TEST SPECIFICATIONS. Delco-Remy specifications for 14 and 28-volt starting motors installed as standard equipment on PA-23 series airplanes are as follows:

Motor Model	1109688	1109511	1109696
Delco-Remy, Ref, Service Bulletin	1M-110	1M-110	1M-110
Minimum Brush Tension	24 oz.	24 oz.	24 oz.
No-Load Test			
Volts	10.6	10.6	23.5
Min. Amps	----	----	----
Max. Amps	60	60	55
Min. RPM	3000	3000	2800
Max. RPM	----	----	----
Lock Test			
Amps	300	300	150
Torque (ft-lbs)	18	18	14
Approx. Volts	7.3	7.3	21.0

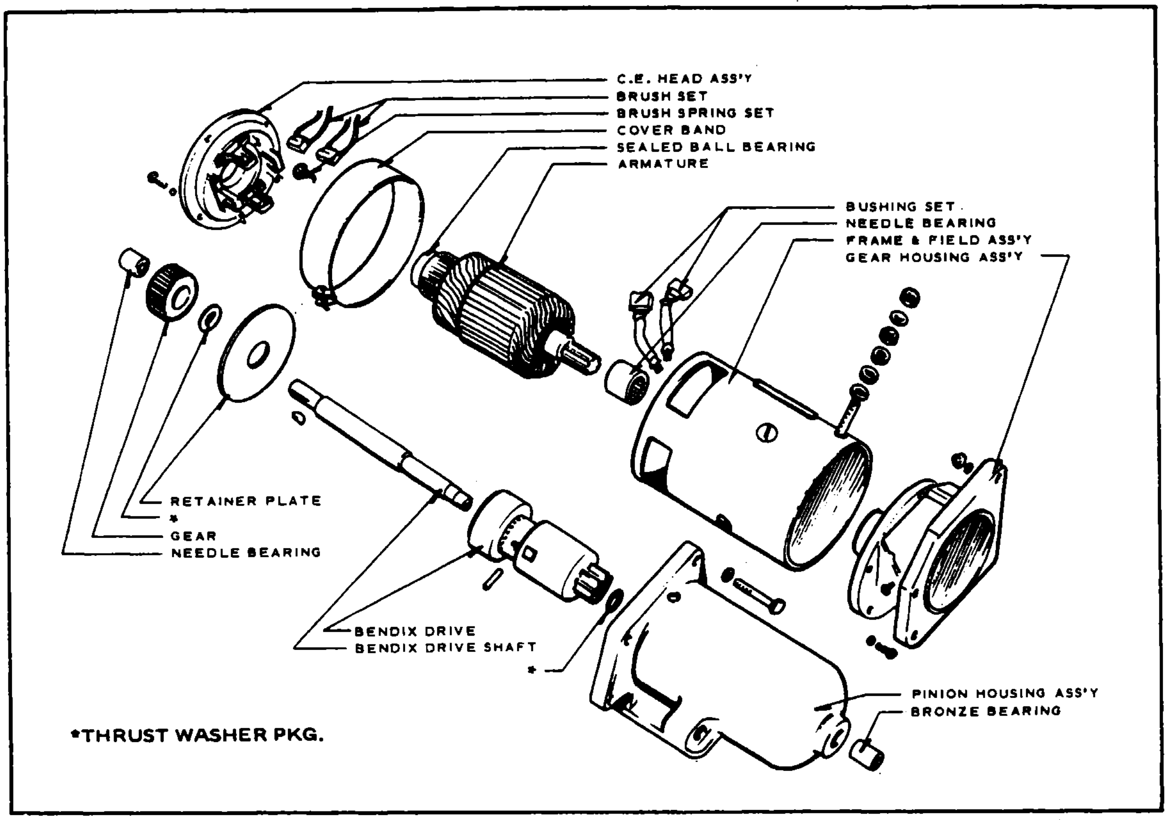

Figure 11-60. Exploded View of Gear Reduction Starting Motor

11-115. STARTING MOTORS (Prestolite).

11-116. DESCRIPTION. The gear reduction starting motor consists of six major components: The Commutator End Head Assembly, The Armature, The Frame and Field Assembly, The Gear Housing, The Pinion Housing, and The Bendix Drive Assembly. (Refer to Figure 11-60.)

11-117. OPERATION. When the starting circuit is energized, battery current is applied to the starting motor terminal. Current flows through the field coils, creating a strong magnetic field. At the same time, current flows through the brushes to the commutator, through the armature windings to ground. The magnetic force created in the armature combined with that created in the field windings begins to turn the armature.

The gear cut on the drive end of the armature shaft extends through the gear housing, where it is supported by a roller bearing. The gear mates with the teeth of the reduction gear that drives the Bendix shaft. The shaft is keyed to the reduction gear. The Bendix drive is held in position on the shaft by a "spirol" pin. The shaft is supported in the gear housing by a closed end roller bearing and in the pinion housing by a graphitized bronze bearing.

When the armature turns the reduction gear, the Bendix drive pinion meshes with the flywheel ring gear by inertia and action of the screw threads within the Bendix sleeve. A detent pin engages in a notch in the screw threads which prevents demeshing if the engine fails to start when the starting circuit is de-energized.

When the engine reaches a predetermined speed, centrifugal action forces the detent pin out of the notch in the screw shaft and allows the pinion to demesh from the flywheel.

11-118. MAINTENANCE. The starting circuit should be inspected at regular intervals, the frequency of which should be determined by the amount of service and the conditions under which the airplane is operated. It is recommended that such inspection be made at least twice a year and include the following:

a. The battery should be checked with a hydrometer to be sure it is fully charged and filled to the proper level with approved water. A load test should be made to determine battery condition. If dirt and corrosion have accumulated on the battery, it should be cleaned with a solution of baking soda and water. Be sure none of the solution enters the battery cells.

b. The starting circuit wiring should be inspected to be sure that all connections are clean and tight and that the insulation is sound. A voltage loss test should be made to locate any high-resistance connections that would affect starting motor efficiency. This test is made with a low-reading voltmeter while cranking the engine or at approximately 100 amperes, and the following limits should be used:

1. Voltage loss from insulated battery post to starting motor terminal - 0.3-volt maximum.

2. Voltage loss from battery ground post to starter frame - 0.1-volt maximum.

NOTE

If voltage loss is greater than the above limits, additional tests should be made over each part of the circuit to locate the high-resistance connections.

c. No lubrication is required on the starting motor except at the time of overhaul. Then lubricate the entire shaft under Bendix Drive, fill grooves in armature shaft at drive end and pack gear box with 1.3 to 2.0 ounces of Lithium Soap Base Grease #1925 Molytex "O" or equivalent.

d. The starting motor should be operated for a few seconds with the ignition switch off to make sure that the pinion engages properly and that it turns freely without binding or excessive noise. Then the engine should be started two or three times to see that the pinion disengages properly when the engine is turned off.

11-119. OVERHAUL. If, during the above inspection, any indication of starting motor difficulty is noted, the starting motor should be removed from the engine for cleaning and repair.

11-120. REMOVAL. To remove the starting motor from the engine, first disconnect the ground cable from the battery post to prevent short circuiting. Disconnect the lead from the starting motor terminal, then take out the mounting bolts. The motor can then be lifted off and taken to the bench for overhaul.

11-121. DISASSEMBLY.

a. Remove the frame screws from the commutator end head and pull end head and armature from frame. Lift the brushes and lock in elevated position with brush springs. Use a puller to remove the end head from the armature. Use a special bearing puller to remove the sealed ball bearing from the armature shaft.

b. Remove the frame screws that secure the gear housing to the frame. Remove bolts and nuts holding the gear housing to the pinion housing and separate the two units. Pull Bendix shaft from pinion housing. Do not lose the steel spacer that is located on the pinion end of the shaft. Remove reduction gear, woodruff key and steel spacer from shaft.

c. Turn the Bendix pinion until it locks in the extended position. Locate "spirol" pin and use a punch to remove. Slide drive assembly off the shaft. Do not attempt to disassemble the drive and do not dip it in cleaning solvent.

d. To remove the roller bearings from the gear housing, use an arbor press and the correct bearing arbor. DO NOT HAMMER OUT. Each part should be cleaned and inspected for excessive wear or damage. Bearings should be checked for proper clearance and evidence of roughness or galling. Oil and dirt should be removed from insulation and the condition of the insulation checked.

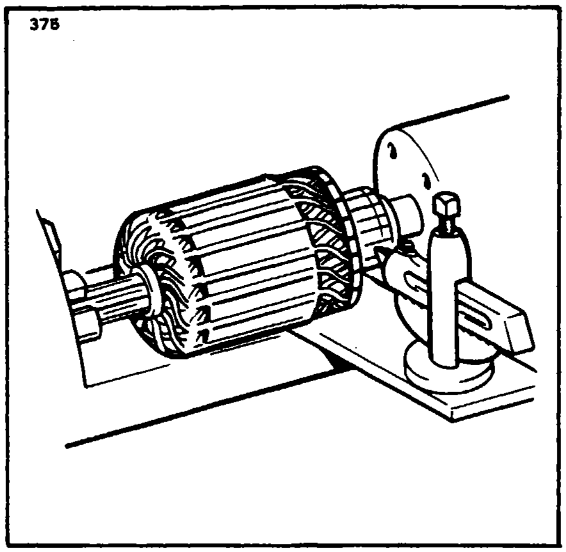

Figure 11-61. Turning Starting Motor Commutator

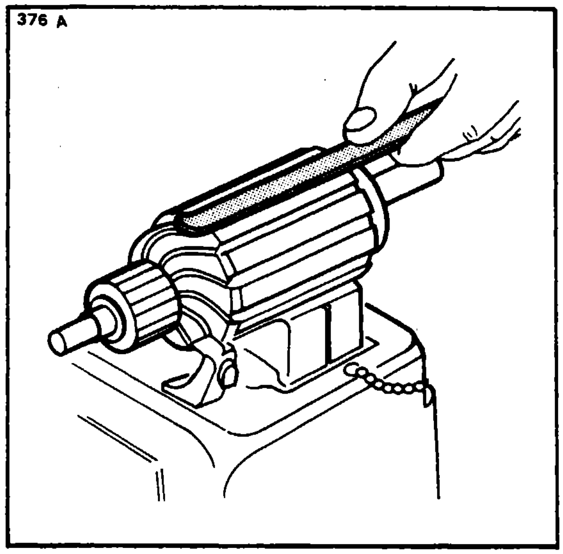

Figure 11-62. Testing Motor Armature for Shorts

11-122. BRUSHES. Check the brushes to see that they slide freely in their holders and make full contact on the commutator. If worn to half their original length or less, they should be replaced.

11-123. ARMATURE.

a. Check the commutator for uneven wear, excessive glazing or evidence of excessive arcing. If only slightly dirty, glazed or discolored, the commutator can be cleaned with 00 or 000 sandpaper. If the commutator is rough or worn, it should be turned in a lathe. (Refer to Figure 11-61.) The armature shaft should be inspected for rough bearing surfaces and rough or damaged splines.

b. To test the armature for grounds, a set of test probes connected in series with a 110-volt light should be used. Touch one probe to a commutator segment and the other to the armature core. If the test lamp lights, the armature is grounded and should be replaced.

c. To test for shorted armature coils, a growler is used. (Refer to Figure 11-62.) The armature is placed on the growler and slowly rotated by hand while a steel strip is held over the core so that it passes over each armature core slot. If a coil is shorted, the steel strip will vibrate.

d. A quick check for opens can be made by inspecting the trailing edge (in direction of rotation) of the commutator segments for excessive discoloration. This condition indicates an open circuit.

11-124. FIELD COILS.

a. Check the field coils for grounds (Refer to Figure 11-63) by placing one test probe on the frame and the other on the starter terminal. Be sure the brushes are not accidentally touching the frame. If the lamp lights, the fields are grounded. Repair or replace.

b. Inspect all connections to make sure they are clean and tight and inspect insulation for deterioration.

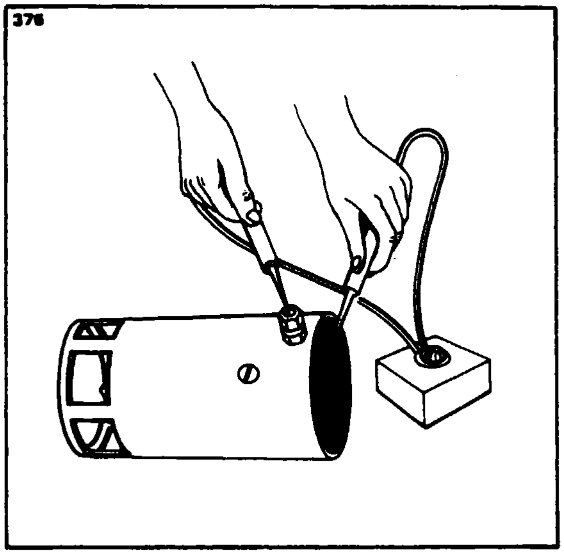

Figure 11-63. Testing Motor Fields for Grounds

11-125. BRUSH HOLDERS.

a. To test brush holders, touch one test probe to the brush plate and the other to each brush holder.

b. The test lamp should light when the grounded brush holders are touched and should not light when the insulated brush holders are touched.

11-126. GEAR AND PINION HOUSING. Inspect housings for cracks and bearings for excessive wear. Remove rust, paint or grease from mounting surfaces.

11-127. BENDIX DRIVE. The Bendix Drive should be wiped clean with a dry cloth. The pinion should turn smoothly in one direction and should lock in the other direction. Replace drive if it fails to check as above or if the pinion teeth are excessively worn or damaged.

11-128. ASSEMBLY.

a. When assembling the starting motor, always use an arbor press and the proper bearing arbor for installing graphitized bronze and roller bearings. The Bendix shaft should have a thin film of Lubriplate #777 or equivalent on the Bendix portion of the shaft. End play should be 0.005 to 0.050 of an inch

b. New brushes should be properly seated when installing by wrapping a strip of 00 sandpaper around the commutator (with the sanding side out) 1-1/4 to 1-1/2 times maximum. Drop brushes on sandpaper covered commutator and turn the armature slowly in the direction of rotation. Dust should be blown out of the motor after sanding.

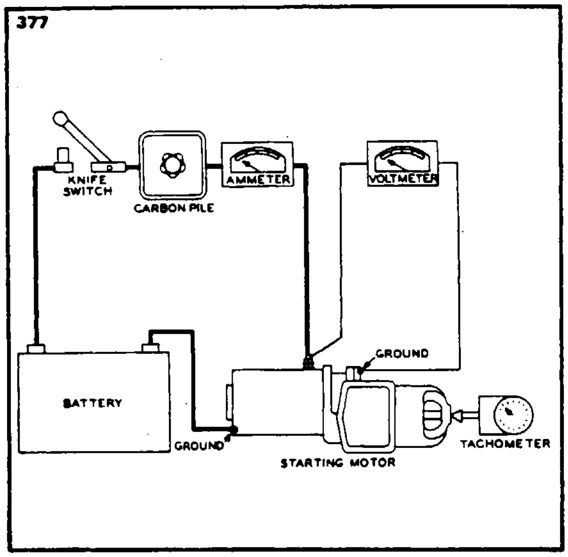

Figure 11-64. No-Load Test Hook-up

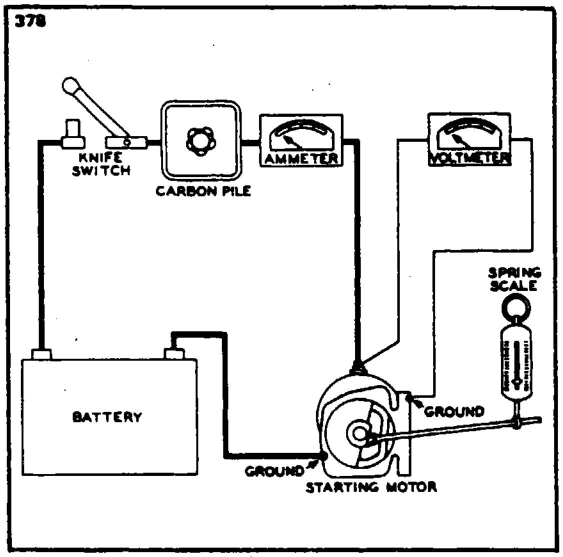

Figure 11-65. Stall-Torque Hook-up

NOTE

The spring tension is 32 to 40 ounces with new brushes. This tension is measured with the scale hooked under the brush spring near the brush and the reading is taken at right angles to the line of force exerted by the brush spring.

c. Check the position of the pinion to be sure the unit will mesh properly with the flywheel ring gear. See specifications for unit for correct dimensions. (Refer to paragraph 11-131.) '.)

11-129. BENCH TESTS.

a. After the starting motor is reassembled, it should be tested to see that the no-load current at a certain voltage is within specifications as given in paragraph 11-131. To make this test, connect as shown in Figure 11-64. If current is too high, check the bearing alignment and end play to make sure there is no binding or interference. Two or three sharp raps on the frame with a rawhide hammer will often help to align the bearings and free the armature.

b. If no difficulty is indicated in the above test, a stall torque test may be made to see if the starting motor is producing its rated cranking power. Make test connections as shown in Figure 11-65.

c. If torque and current are not within specifications, check the seating of the brushes and internal connections for high resistance. If these checks are made and found to be in good order, replace frame and field assembly and retest starter.

11-130. STARTING MOTOR CONTROL CIRCUIT.

a. Inspect the control circuit wiring between the battery, solenoid and manual starting switches for breaks, poor connections and faulty insulation. Tighten all connections and make sure solenoid is firmly mounted and makes a good ground connection.

b. Check the voltage loss across the switch contacts during normal starting. If loss is in excess of 0.2 volts per 100 amperes, the solenoid should be replaced.

c. If solenoid fails to operate when the manual is turned on or if it fails to release when the manual switch is released, it should be removed and tested to specifications. If either opening or closing voltages are not specified, replace the solenoid.

11-131. STARTING MOTOR SERVICE TEST SPECIFICATIONS. Prestolite specifications for 14 and 28-volt starting motors installed as standard equipment on the PA-23 series airplanes are as follows:

Motor Model	MZ-4206	MHB4001
Min. Brush Tension Max. Brush Tension	32 oz. 40 oz.	32 oz. 40 oz.
No-Load Test (77° F) Volt Max. Amps Min. RPM	 10 75 2000	 29 35 1800
Stall-Torque Amps Min. Torque, ft. lbs Approx. Volts	 560 38.0 4.1	 275 42.7 16.0
Pinion Position[1] Drive at rest Drive extended	 1.748 to 1.855 in. 2.388 to 2.495 in.	 1.748 to 1.855 in. 2.388 to 2.495 in.

[1]This dimension is measured from the centerline of the mounting hole nearest the drive end head to the edge of the pinion.

11-132. BATTERY.

11-133. SERVICING THE BATTERY. Access to the battery is through the access panel on the right side of the nose. The stainless steel box has a plastic drain tube located on the bottom side near the right rear corner which is normally closed off with a clamp and should be opened occasionally to drain off any accumulation of liquid. The battery should be checked for fluid level, but must not be filled above the baffle plates. A hydrometer check should be performed to determine the percent of charge present in the battery. All connections must be clean and tight.

11-134. REMOVAL OF BATTERY.

a. Remove the access panel from the right side of the nose section.
b. Remove the wing nuts from either side of the box and remove the lid.
c. Disconnect the battery cables.

NOTE

Always remove the ground cable first and install last to prevent accidental short circuiting or arcing.

d. Remove the battery from the box.

11-135. INSTALLATION OF BATTERY

a. Ascertain that the battery and battery box has been cleaned and is free of acid.
b. Install the battery with the terminals inboard.
c. Connect the battery cables.
d. Install the lid and secure with wing nuts.

11-136. CHARGING BATTERY. If the battery is not up to normal charge, remove the battery and recharge starting with a charging rate of 4 amperes and finishing with 2 amperes.

HYDROMETER READING AND BATTERY CHARGE PERCENT

Hydrometer Readings	Percent of Charge
1280	100
1250	75
1220	50
1190	25
1160	Very little useful capacity
1130 or below	Discharged

11-137. BATTERY BOX CORROSION PREVENTION. The following check against corrosion within the battery box should be performed at least every 30 days.

a. Open the clamp at bottom right rear corner of the battery box and drain off any electrolyte that may have overflowed into the box.

b. Check terminals and connections for corrosion. Corrosion effects may be neutralized by applying a solution of baking soda and water mixed to the consistency of thin cream. Repeat application until all bubbling action has ceased.

CAUTION

Do not allow soda solution to enter battery.

c. Wash battery and box with clean water and dry.

d. Close battery box drain tube clamp.

e. As necessary, paint the battery box with an acid resistant paint.

11-138. CHECKING ELECTRICAL SWITCHES AND CIRCUIT BREAKERS. Electrical switches and circuit breakers, located on the lower left instrument panel, control the navigation and instrument lights, one landing light, one taxi light, the electric turn and bank indicator and other electrical components. The circuit breakers automatically break the electrical circuit if an overload is applied to the system, thus preventing damage to the electrical wiring. To reset the circuit breakers, simply push in the buttons. Allow sufficient time for cooling before resetting circuit breakers. The time for resetting circuit breakers may vary considerably, depending on the nature of the overload and the temperature.

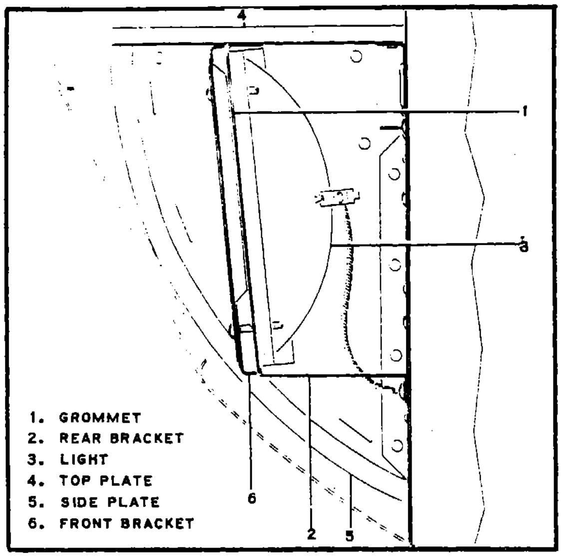

Figure 11-66. Landing Light Inst. PA-23-250 and PA-23-235

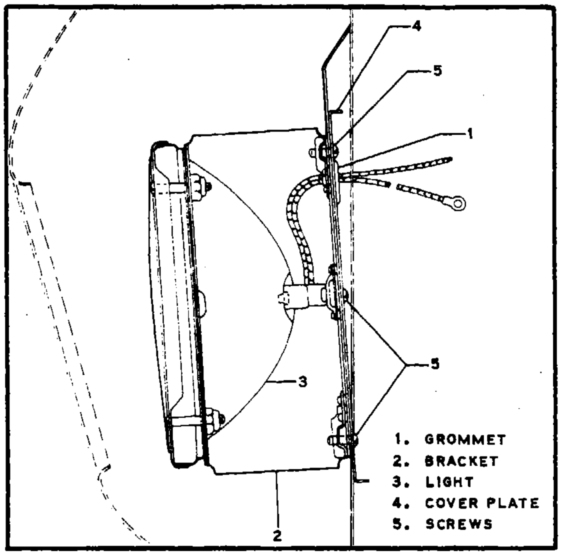

Figure 11-67. Landing Light Inst. PA-23-250 (six place)

11-139. LANDING LIGHT.

11-140. REMOVAL OF LANDING LIGHT. (PA-23-250 and PA-23-235.)

a. Remove fuselage nose cone fairing.

b. Remove the two self-locking nuts from the lower screws passing through both rear and front brackets (2 and 6, Figure 11-66.)

c. Loosen the two self-locking nuts on the upper screws passing through the brackets.

d. Disconnect the electrical leads from the rear of the light (3) and remove the light.

11-141. INSTALLATION OF LANDING LIGHT. (PA-23-250 and PA-23-235.)

a. Install the light between the brackets, making sure the key on the back of the light is in the rear bracket slot at the left of the bracket.

b. Install the two self-locking nuts on the two lower bracket screws, tighten them and the two upper nuts until the edges of both brackets are parallel. Connect the electrical leads to the rear of the light.

c. Prior to removal of the housing, disconnect the electrical leads and use caution not to drop the light when the front and rear brackets are separated.

11-142. REMOVAL OF LANDING LIGHT. (PA-23-250 (six place.) Access for the replacement of the landing light is achieved through the front baggage compartment.

a. Remove the access panel to the nose section.
b. Remove six screws that secure the cover plate and light assembly. (Refer to Figure 11-67.) To prevent the light assembly from dropping, it may be held by reaching through the nose opening.
c. Withdraw the light assembly through the panel opening, disconnect the electrical leads, disassemble and remove light.

11-143. INSTALLATION OF LANDING LIGHT. (PA-23-250 (six place.)

a. Install the light between the brackets, making sure the key on the back of the light is in the rear bracket slot. Connect the electrical leads.
b. Reinstall the light assembly through the panel opening, hold the light in position by reaching through the nose opening, reinstall the panel cover and screws.

11-144. REMOVAL OF LANDING LIGHT. (PA-23-250 Serial Nos. 27-4426 and 27-4574 and up.)
a. Remove the screws securing the plexiglas cover on the bottom of the nose cone.
b. Remove the screws from the front of the lamp attachment plate and remove the plate from the mounting bracket. Do not drop the lamp.
c. Disconnect the electrical leads and remove the light.

11-145. INSTALLATION OF LANDING LIGHT. (PA-23-250 Serial Nos. 27-4426 and 27-4574 and up.)
a. Connect the electrical leads to the lamp and position the lamp on the mounting bracket.
b. Position the front attachment plate over the lamp and secure the plate and lamp to the mounting bracket with four screws.
c. Install the plexiglas cover on the bottom of the nose cone and secure in place with screws.

11-146. REMOVAL OF LAMP IN ANTI-COLLISION WING TIP STROBE LIGHT. The lights are located in both wing tips next to the navigation lights.

a. Remove the screw securing the navigation light cover and remove cover.
b. Remove the three screws securing navigation light bracket assembly and remove light assembly.
c. Remove the strobe lamp by cutting the wires on the lamp beneath the mounting bracket.
d. Remove the defective lamp.
e. Remove and discard the plug with the cut wires from the electrical socket.

11-147. INSTALLATION OF LAMP IN ANTI-COLLISION WING TIP STROBE LIGHT.

a. Route the wires from the new lamp down through the hole in the navigational light bracket.
b. Insert the wire terminals in the plastic plug supplied with the new lamp. Wire according to schematic diagram located in electronics section.
c. Position strobe lamp on navigational light bracket.
d. Secure navigational light assembly and bracket with appropriate screws.
e. Replace navigational light cover and secure with appropriate screws.

11-148. REMOVAL OF LAMP IN ANTI-COLLISION STROBE LIGHT. There is one anti-collision strobe light located on the rudder tip.

a. Loosen the screw in the clamp securing the light cover.
b. Remove the light cover.
c. Remove the defective lamp from the socket.

11-149. TROUBLESHOOTING PROCEDURE FOR ANTI-COLLISION AND WING TIP STROBE LIGHT SYSTEMS. The strobe light assembly functions as a condenser discharge system. A condenser in the power supply is charged to approximately 450 volts D. C., then discharged across the xenon flash tube at intervals approximately 45 flashes per minute. The condenser is parallel across the xenon flash tube which is designed to hold off the 450 volt D. C. applied until the flash tube is triggered by an external pulse. This pulse is generated by a solid state timing circuit in the power supply.

When troubleshooting the strobe light system, it must first be determined if the trouble is in the flash tube or the power supply. Replacement of the flash tube will confirm if the tube is defective. A normal operating power supply will emit an audible tone of 1 to 1.5 KHC. If there is no sound emitted check the system according to the following instructions. When troubleshooting the system utilize the appropriate schematic in this manual.

a. Ascertain the input voltage at the power supply is correct.

CAUTION

When disconnecting and connecting the power supply input connections do not get the connection reversed. Reversed polarity of the input voltage for just an instant will permanently damage the power supply. The reversed polarity destroys a protective diode in the power supply, causing self-destruction from overheating of the power supply. This damage is sometimes not immediately apparent, but will cause failure of the system in time.

b. Check for malfunction in interconnecting cables.

1. Ascertain pins 1 and 3 of interconnecting cable are not reversed.

2. Using an ohmmeter check continuity between pin 1 and 3 of interconnecting cable. If you obtain a reading on the meter the cable is shorted and should be replaced.

NOTE

A short of the type described in steps 1 and 2 will not cause permanent damage to the power supply but the system will be inoperative if such a short exists. Avoid any connection between pin 1 and 3 of interconnecting cable as this will discharge the condenser in the power supply and destroy the trigger circuit.

CAUTION

When disconnecting the power supply allow five minutes of bleed down time before handling the unit.

c. Check interconnecting cables for shorts.

1. Disconnect the output cables from the power supply outlets.

2. The following continuity checks can be made with an ohmmeter.

3. Check for continuity between the connectors of each interconnecting cable by checking from pin 1 to pin 1, pin 2 to pin 2 and pin 3 to pin 3. When making these checks if no continuity exists the cable is shorted and should be replaced.

4. Check continuity between pins 1 and 2, 1 and 3 and 2 and 3 of the interconnecting cable. If continuity exist between any of these connections the cable is shorted and should be replaced.

5. Check for continuity from pins 1, 2 and 3 to airplane ground. If continuity exists the cable is shorted and should be replaced.

d. Check tube socket assembly for shorts.

1. Disconnect the tube socket assembly of the anti-collision light from the interconnecting cables.

2. The following continuity checks can be made with an ohmmeter.

3. Check for continuity between pin 1 of amp connector to pin 1 of tube socket, pin 2 of amp connector to pin 6 and 7 of tube socket and pin 3 of amp connector to pin 4 of tube socket. When making these tests if no continuity exists the tube socket assembly is shorted and should be replaced.

11-150. INSTALLATION OF ANTI-COLLISION LIGHT.

a. Plug in new lamp using correct number.
b. Replace light cover.
c. Tighten screw in clamp to secure light cover.

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TABLE XI-III. ELECTRICAL SYSTEM TROUBLESHOOTING

Trouble	Cause	Remedy
GENERATOR		
Generator operating within rated speed range but voltage output low.	If the voltage is low, the generator is operating on residual magnetism.	Check for loose or high resistance connections; clean and tighten.
	Loose or high-resistance electrical connections.	Clean and tighten all electrical connections.
	Brushes excessively worn.	When brush wears down to 1/2 inch, replace with a new one. The new brush must be seated to at least 75% of the contact surface by running the generator without load (with the line switch open) for at least 15 minutes during the engine warm-up period. CAUTION Do not use abrasives of any description to assist in seating the brushes.

TABLE XI-III. ELECTRICAL SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Generator operating within rated speed range but voltage output low. (cont.)	Brushes binding in the brush boxes.	The brushes should be a free fit without excessive side play in the brush boxes. Binding brushes and the brush boxes should be wiped clean with a cloth moistened in Varsol or undoped gasoline. Replace the brushes as outlined above.
	Brushes not properly seated.	Reseat brushes as outlined above.
	Low brush spring tension.	Brush spring should bear centrally on the top of the brushes, insuring full brush contact with the face of the commutator.
	Dirty commutator.	Clean the commutator with a cloth moistened in Varsol or undoped gasoline.
	Scored or pitted commutator.	Remove and turn commutator down on a lathe.
	Shorted or open armature coils.	Replace armature.
	Improper operations of the voltage regulator.	Adjust regulator.

TABLE XI-III. ELECTRICAL SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Generator operating within rated speed range but voltmeter indicates zero.	Loose or high resistance field coil assembly terminals.	Clean and tighten the terminals.
	Wiring not properly connected.	See airplane wiring diagram.
	Grounded field coil assembly.	Replace entire yoke assembly.
	Open field coil assembly.	Remove the generator and replace with one known to be in good condition.
Generator operating within rated speed range, but voltage output is erratic.	Unstable operation of voltage regulator. Same as "Generator operating within rated speed range but voltage output low," above.	Replace voltage regulator. Use remedy under "Generator operating within rated speed range but voltage output low," above.

TABLE XI-III. ELECTRICAL SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Generator operating within rated speed range, with line switch closed, but system ammeter indicates low or no output.	None.	Since the voltage regulator holds the generated voltage at an almost constant value, the current output depends entirely upon the condition of the battery and the amount of external load. Therefore, when the battery is fully charged and there is no load on the system, the difference in voltage between the generator and the battery is so small that little or no current will flow between them.
	Improper operation of the reverse-current relay.	Readjust the relay.
	Generator field demagnetized.	Flash field.
	Burned-out ammeter.	Replace ammeter.
Generator operating within rated speed range but system ammeter reads off scale in the wrong direction.	Generator field magnetized in the wrong direction.	Flash field as explained above and check to see that reverse-current relay is operating properly.

NOTE

Flash the generator field by turning the generator and battery switch to the "ON" position and momentarily connect the "Bat" and "Gen" terminals of the regulator.

TABLE XI-III. ELECTRICAL SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
System ammeter shows full charge but battery is discharged.	Generator of improper capacity installed in the system.	Install a generator of larger capacity.
	Battery too small for load requirements.	Install a battery of sufficient capacity.
System ammeter fluctuates excessively when indicating full rated load.	Generating system is overloaded.	Check the system for abnormal loads.
	Improper operation of generator reverse-current relay.	Readjust to operate properly.
Burned-out system ammeter or line fuse.	Discharged battery.	Replace with a fully charged battery.
	Defective wiring.	Replace all defective wiring.
ALTERNATOR		
No output from alternatur.	Malfunction of alternator output circuit or field circuit.	Check alternator output and field circuits. (Refer to paragraph 11-58.)
		Check alternator. (Refer to paragraph 11-58.)
Reduced output from alternator.	Open diode.	Check alternator. (Refer to paragraph 11-58.)

TABLE XI-III. ELECTRICAL SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
STARTER		
Starter fails to operate.	Low battery charge.	Check and recharge if necessary.
	Defective or improper wiring or loose connections.	Refer to wiring diagram and check all wiring.
	Defective starter solenoid or control switch.	Replace faulty unit.
	Binding, worn or improperly seated brush, or brushes with excessive play.	Brushes should be a free fit in the brush boxes without excessive side play. Binding brushes and brush boxes should be wiped clean with a gasoline (undoped) moistened cloth. A new brush should be run in until at least 50% seated; however, if facilities are not available for running in brushes, then the brush should be properly seated by inserting a strip of No. 0000 sandpaper between the brush and commutator, with the sanded side side next to the brush. Pull sandpaper in direction of rotation, being careful to keep it in the same contour as the commutator.

TABLE XI-III. ELECTRICAL SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Starter fails to operate. (cont.)	Binding, worn, or improperly seated brush, or brushes with excessive side play. (cont.)	CAUTION Do not use coarse sand paper or emery cloth. After seating, clean thoroughly to remove all sand and metal particles to prevent excessive wear. Keep motor bearing free from sand or metal particles.
	Dirty commutator.	If commutator is rough or dirty, smooth and polish with No. 0000 sandpaper. If too rough and pitted, remove and turn down. Blow out all particles.
	Shorted, grounded, or open armature.	Remove and replace with an armature known to be in good condition.
	Grounded or open field circuit.	Test and then replace new part.
Starter operates at proper speed but fails to crank engine.	Faulty Bendix drive.	Remove Bendix drive assembly. Clean and check, replace.
Low starter and cranking speed.	Worn, rough, or improperly lubricated motor or starter gearing.	Disassemble, clean, inspect and relubricate, replacing ball bearings, if worn.

TABLE XI-III. ELECTRICAL SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Low starter and cranking speed. (cont.)	Same electrical causes as listed under "Starter fails to operate. "	Same remedies listed for these troubles.
Excessive arcing of starter brushes.	Binding, worn or improperly seated brush or brushes, with excessive side play.	See information above dealing with this trouble.
	Dirty commutator, rough, pitted or scored.	Clean as already outlined above.
	Grounded or open field circuit.	Test and replace defective parts.
Excessive wear and arcing of starter brushes.	Rough or scored commutator.	Remove and turn commutator down on a lathe.
	Armature assembly not concentric.	Reface commutator.
BATTERY 12V		
Battery will not hold hold charge.	Battery worn out.	Replace battery.
	Charging rate not set right.	Reset.
	Discharge too great to replace.	Reduce use of starter on the ground; use external power wherever possible.

TABLE XI-III. ELECTRICAL SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Battery will not hold charge. (cont.)	Standing too long.	Remove and recharge battery if left in unused airplane one week or more.
	Equipment left "ON" accidentally.	Remove and recharge. (Refer to paragraph 11-120.)
	Impurities in electrolyte.	Replace.
	Short circuit (ground) in wiring.	Check wiring.
	Broken cell partitions.	Replace.
Battery life is short.	Overcharge due to level of electrolyte being below tops of plates.	Maintain electrolyte level.
	Heavy discharge.	Replace.
	Sulfation due to disuse.	Replace.
	Impurities in electrolyte.	Replace battery.
Cracked cell.	Hold down loose.	Replace battery and tighten.
	Frozen battery.	Replace.
Compound on top of battery melts.	Charging rate too high.	Reduce.

TABLE XI-III. ELECTRICAL SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Electrolyte runs out of vent plugs.	Too much water added to battery.	Drain and keep at proper level.
Excessive corrosion inside container.	Spillage from overfillings.	Use care in adding water.
	Vent lines leaking or clogged.	Repair or clean.
Battery freezes.	Discharged battery.	Replace.
	Water added and battery not charged immediately.	Always recharge battery at least 1/2 hour when adding water in freezing weather.
	Leaking jar.	Replace.
Battery polarity reversed.	Connected backwards on airplane or charger.	Battery should be slowly discharged completely and then charged correctly and tested.
Battery consumes excessive water.	Charging rate too high (if in all cells).	Correct charging rate.
	Cracked jar (one cell only.	Replace battery.

TABLE XI-III. ELECTRICAL SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
BATTERY-DISCONNECT SOLENOID		
Does not operate.	Open circuit.	Replace wiring.
	Dirty contacts on connector plug.	Clean contacts.
	Open circuited solenoid coil.	Replace unit.
	Plunger binding.	Remove and wash plunger and housing thoroughly with carbon tetrachloride. Change spring compression only as a last resort.
Intermittent operation.	Short-circuited coil. Loose electrical connection.	Replace coil. Clean and tighten electrical connections.
	Plunger binding.	See remedy pertaining to "Plunger binding" under "Does not operate".
	Badly burned points.	If points cannot be dressed down, replace the unit.

TABLE XI-IV. LAMP REPLACEMENT GUIDE

Location		Piper Part No.	Bulb No.
AltiMatic Pilot Light (Console)		751 461	65-S28
AltiMatic Pilot Light (Effort)		751 460	65-S19
Baggage Compartment Light	14V	472 753	30-31
Baggage Compartment Light	28V	472 755	30-32
Compass Light	28V	472 028	327
Compass Light	14V	472 037	330
De-Icer Light		752 343	MS25041-3
Dome Light	28V	472 029	303
Dome Light	14V	472 036	89
Door Ajar	28V	472 028	327
Door Ajar	14V	472 037	330
Gear Indicator Light	28V	472 028	327
Gear Indicator Light	14V	472 037	330
Generator Indicator	28V	472 028	327
Instrument Panel Lights	28V	472 028	327
Instrument Panel Lights	14V	472 037	220
Instrument Panel Spot Light	14V	752 322	90
Instrument Panel Spot Light	28V	753 323	304
Landing Light 100 watt	14V	472 661	4509
Landing Light 100 watt	28V	472 708	4591
Landing Light 250 watt	14V	472 654	4522
Landing Light 250 watt	28V	472 706	4553
Map Light	14V	472 026	90
Map Light	14V	472 040	1816
Map Light	28V	472 052	304
Marker Beacon Light		752 318	47
Nav. Lights - Wing Tips	14V	751 381	1512
Nav. Lights - Wing Tips	28V	751 438	1524
Reading Light	28V	472 027	1495
Reading Light	14V	472 040	1816
Receiver Lights		472 028	327
Receiver Lights		752 324	(1401) (262 0464 00)

TABLE XI-IV. LAMP REPLACEMENT GUIDE (cont.)

Location		Piper Part No.	Bulb No.
Rotating Beacon - Grimes	14V	752 307	A7079
Rotating Beacon - Grimes	28V	752 316	7079B
Rotating Beacon - Grimes	28V	753 440	1939
Rotating Beacon - Whelan	14V	751 448	WRM 44
Rotating Beacon - Whelan	28V	751 457	WRM 4S
Strobe Light (Red)	14V	757 635	A406
Strobe Light (White)	14V	761 157	A428
Tail Light	28V	751 437	305
Tail Light	14V	753 431	1073
Transmitter Lamp	28v	752 325	262 0179 00

TABLE XI-V. CIRCUIT LOAD CHART

CIRCUIT	CIRCUIT PROTECTOR RATING IN AMPS.	ITEM	NO. OF UNITS OPERATING SIMULTANEOUSLY	CURRENT DRAIN PER UNIT (MAX.) IN AMPERES AT 12.0V	14.3V
STARTER	15*	STARTER SOLENOID	1	8.40	10.00
		STARTING VIBRATOR	1	4.00	4.77
VOLT REG. MAIN	10*	MAIN VOLT REG. & OVERVOLT RELAY +ALTERNATOR FIELDS L & R	1 SYSTEM	5.88	6.96
VOLT REG. AUX.	10*	AUX. VOLT REG. & OVERVOLT RELAY +ALTERNATOR FIELDS L & R			
FUEL PUMPS	15	LEFT & RIGHT FUEL PUMPS	2	5.04	6.00
STALL WARNING	5	FLASHER UNIT–LIGHT–STALL WARNING	1 SYSTEM	0.18	0.21
FUEL, HORN	5	FLASHER UNIT & HORN–LDG. GEAR WARNING	1 SYSTEM	0.70	0.80
CYL. HD. TEMP.		FUEL GAGES & ENG. INSTRUMENT CLUSTER	1 GROUP	0.51	0.60
TURN & BANK	5	TURN & BANK GYRO	1	0.25	0.30
GEAR & FLAP (INDICATORS)	5	DOOR AJAR LIGHT	1	0.08	0.09
		GEAR UP-GEAR DOWN LIGHTS	3	0.08	0.09
		FLAP INDICATOR	1	0.40	0.48
ELEC. TRIM	5*	PITCH TRIM SERVO	1	0.84	1.00
CABIN HEAT (& LIGHTER)	20*	CIGAR LIGHTER	1	6.64	7.90
		CABIN HEATER SYSTEM (GROUND OPERATION-HEATER IGNITION, VENT BLOWER, AND COMBUSTION BLOWER OPERATING)	MAX.	11.66	13.80
PITOT HEAT	15	PITOT HEATING ELEMENT	1	10.92	13.00
POS. LTS.	5	NAV WING TIP LIGHTS			
		NAV TAIL LIGHT	1 SYSTEM	4.44	4.95
PROP SYNC.	5	ARKORP PROP SYNCHRONIZER	1	1.00	1.19
LAND. LTS.	30	LANDING LIGHT	1	17.65	21.00
		TAXI LIGHT	1	7.13	8.47
INT. LTS. (INTERIOR LIGHTS)	5*	MAP LIGHTS	2	0.30	0.35
		CABIN READING LIGHTS	4	0.86	1.02
		TRIM INDICATOR LIGHTS	2	0.08	0.07
		INSTRUMENT SPOT LIGHTS	2	0.52	0.61
		DOME LIGHT	1	0.96	1.14
		COMPASS LIGHT	1	0.07	0.08
POST LIGHTS	5	AUTOPILOT CONSOLE LIGHT	1	0.08	0.09
		OMNI COUPLER LIGHT	2	0.04	0.05
		POST LIGHTS–GLAR-BAN	AS	0.08	0.09
		LIGHTED SWITCHES (ROCKER)	INSTALLED	0.08	0.09
WINDSHIELD HEAT	15	WINDSHIELD HEATING ELEMENT	1	11.58	13.75
DEICER–WING-TAIL	5*	SURFACE DEICE SYSTEM	1	4.06	4.84
DEICER–PROP	25*	PROPELLER DEICE SYSTEM	1 PR.	17.30	20.60

* CURRENT WILL VARY DUE TO INTERMITTENT LOADS (TYPICAL VALUES SHOWN). CIRCUIT BREAKER CAPACITY IS SUFFICIENT FOR NORMAL OPERATION.

TABLE XI-V. CIRCUIT LOAD CHART (cont.)

CIRCUIT	CIRCUIT PRO-TECTOR RAT-ING IN AMPS.	ITEM		NO. OF UNITS OPERATING SIMULTAN-EOUSLY	CURRENT DRAIN PER UNIT (MAX.) IN AMPERES AT 12.0V.	14.3V.
ANTI-COL. RED	10	ROTATING RED BEACON		AS	4.03	4.80
	5	RED STROBE LIGHT W/POWER SUPPLY		INSTALLED	1.40	2.45
ANTI-COL. WHITE	5	WHITE WING TIP STROBES W/POWER SUPPLY		1 SET	3.80	4.45
COM-NAV 1	10	MK-12A OR MK-12B (NARCO)	(XMIT)	1	6.92	8.25
		TRANSCEIVER	(RCV)		4.03	4.79
		MK-16	(XMIT)	1	4.21	5.02
		TRANSCEIVER	(RCV)		0.63	0.75
		VOA-8 INDICATOR			0.36	0.39
		VOA-9 INDICATOR		AS	0.36	0.39
		VOA-40M		INSTALLED	0.06	0.07
		VOA-50M			0.07	0.07
COM-NAV 2	10	SIMILAR TO COM-NAV 1		AS INSTL.		
ADF	5	BENDIX T12-C ADF RECEIVER		AS INSTL.	0.66	0.78
		KING KR-85 ADF RECEIVER			0.87	1.04
M/B	5	MBT-12 NARCO MARKER BEACON OR PIPER PM-1		AS INSTL.	0.17	0.20
G/S	5	NARCO UGR-2 GLIDE SLOPE RECEIVER		AS INSTL.	0.17	0.23
A/P	5	ALTIMATIC IIIB		AS INSTL.	1.34	1.60
	OR	ALTIMATIC V FD/AP BENDIX			5.75	6.80
	10	AUTOCONTROL III			0.80	0.96
		GLIDE SLOPE COUPLER			0.15	0.18
DME	10	NARCO UDI-4		AS INSTL.	5.69	6.77
XPONDER	5	NARCO AT5-A OR AT6-A		AS INSTL.	1.76	2.09
		NARCO UAT-1			3.05	3.63
ACC. (ACCESSORIES)	5	AUDIO AMP, KING KA-25			0.96	1.14
		RADIO JUNCTION BOX			0.32	0.38
COM-NAV 11, 12, 14		NARCO NAV 11		AS INSTL.	0.60	0.65
		NARCO NAV 12			0.60	0.65
		NARCO NAV 14			0.85	1.00
		NARCO COM 11	(XMIT)	1	1.95	2.50
			(RCV)		0.80	1.00
		NARCO COM 11A	(XMIT)	1	2.40	3.00
			(RCV)		0.80	1.00
		KING KX-175 NAV/COM	(XMIT)	1	4.20	4.80
			(RCV)	AS INSTL.	COM 0.65	0.80
					NAV 0.49	0.65
		KING KX-170A NAV/COM	(XMIT)	1	4.20	4.80
			(RCV)	AS INSTL.	COM 0.65	0.80
					NAV 0.49	0.65
		KMA-20			1.30	1.60
		KT-76			0.95	1.35
		KN-65 DME			2.65	2.95
		KN-60C DME			2.90	3.20

TABLE XI-V . CIRCUIT LOAD CHART (cont.)

CIRCUIT	CIRCUIT PRO-TECTOR RAT-ING IN AMPS.	ITEM	NO. OF UNITS OPERATING SIMULTAN-EOUSLY	CURRENT DRAIN PER UNIT (MAX.) IN AMPERES AT 12.0V	CURRENT DRAIN PER UNIT (MAX.) IN AMPERES AT 14.3V
		KN-73 GLIDE SLOPE RECEIVER		0.20	0.20
		KN-77 VOR/LOC		0.10	0.10
		KNI-520 LOC/GLIDE SLOPE		0.20	0.20
		KNI-211C OMNI		0.30	0.32
		KI-201C OMNI		0.20	0.22
RADAR		AVQ-45/46 RADAR	AS INSTL.	--	--
		RDR-100 RADAR		--	--

TABLE XI-V. CIRCUIT LOAD CHART (cont.)

CIRCUIT	CIRCUIT PRO-TECTOR RAT-ING IN AMPS.	ITEM	NO. OF UNITS OPERATING SIMULTAN-EOUSLY	CURRENT DRAIN PER UNIT (MAX.) IN AMPERES AT	
				24.0 V.	28.5 V.
STARTER	15*	STARTER SOLENOID	1	5.20	--
		STARTING VIBRATOR	1	2.00	--
VOLT REG. MAIN	10*	MAIN VOLT REG. & OVERVOLT RELAY +ALTERNATOR FIELDS L & R	1 SYSTEM	4.00	4.80
VOLT REG. AUX.	10*	AUX. VOLT REG. & OVERVOLT RELAY +ALTERNATOR FIELDS L & R			
FUEL PUMPS	15	LEFT & RIGHT FUEL PUMPS	2	2.50	3.10
STALL WARNING	5	FLASHER UNIT–LIGHT–STALL WARNING	1 SYSTEM	0.10	0.13
FUEL, HORN	5	FLASHER UNIT & HORN–LDG. GEAR WARNING	1 SYSTEM	0.50	0.60
CYL. HD. TEMP.		FUEL GAGES & ENG. INSTRUMENT CLUSTER	1 GROUP	0.25	0.30
TURN & BANK	5	TURN & BANK GYRO	1	0.140	0.155
GEAR & FLAP (INDICATORS)	5	DOOR AJAR LIGHT	1	0.04	0.05
		GEAR UP-GEAR DOWN LIGHTS	3	0.04	0.05
		FLAP INDICATOR	1	0.05	0.06
ELEC. TRIM	5*	PITCH TRIM SERVO	1	0.48	0.55
CABIN HEAT (& LIGHTER)	20*	CIGAR LIGHTER	1	6.60	7.90
		CABIN HEATER SYSTEM (GROUND OPERATION-HEATER IGNITION, VENT BLOWER, AND COMBUSTION BLOWER OPERATING)	MAX.	6.00	7.10
PITOT HEAT	15	PITOT HEATING ELEMENT	1	3.20	3.70
POS. LTS.	5	NAV WING TIP LIGHTS NAV TAIL LIGHT	1 SYSTEM	2.48	2.94
PROP SYNC.	5	ARKORP PROP SYNCHRONIZER	1	1.00	1.19
LAND. LTS.	30	LANDING LIGHT	1	6.00	7.25
		TAXI LIGHT	1	3.06	3.64
INT. LTS. (INTERIOR LIGHTS)	5*	MAP LIGHTS	2	0.24	0.26
		CABIN READING LIGHTS	4	0.44	0.50
		TRIM INDICATOR LIGHTS	2	0.06	0.07
		INSTRUMENT SPOT LIGHTS	2	0.35	0.40
		DOME LIGHT	1	0.25	0.30
		COMPASS LIGHT	1	0.03	0.04
POST LIGHTS	5	AUTOPILOT CONSOLE LIGHT	1	0.05	0.06
		OMNI COUPLER LIGHT	2	0.04	0.05
		POST LIGHTS–GLAR-BAN	AS	0.03	0.04
		LIGHTED SWITCHES (ROCKER)	INSTALLED	0.03	0.04
WINDSHIELD HEAT	15	WINDSHIELD HEATING ELEMENT	1	5.80	6.90
DEICER–WING-TAIL	5*	SURFACE DEICE SYSTEM 6 SEC. OF EACH 3 MIN.	1	4.96	6.30
DEICER–PROP	25*	PROPELLER DEICE SYSTEM	1 PR.	10.15	12.00

* CURRENT WILL VARY DUE TO INTERMITTENT LOADS (TYPICAL VALUES SHOWN). CIRCUIT BREAKER CAPACITY IS SUFFICIENT FOR NORMAL OPERATION.

TABLE XI-V. CIRCUIT LOAD CHART (cont.)

CIRCUIT	CIRCUIT PROTECTOR RATING IN AMPS.	ITEM		NO. OF UNITS OPERATING SIMULTANEOUSLY	CURRENT DRAIN PER UNIT (MAX.) IN AMPERES AT 24.0 V.	28.5 V.
ANTI-COL. RED	10	ROTATING RED BEACON		AS	2.60	3.10
	5	RED STROBE LIGHT W/POWER SUPPLY		INSTALLED	0.90	1.60
ANTI-COL. WHITE	5	WHITE WING TIP STROBES W/POWER SUPPLY		1 SET	2.00	2.30
COM-NAV 1	10	MK-12A OR MK-12B (NARCO)	(XMIT)	1	4.00	4.90
		TRANSCEIVER	(RCV)		1.90	2.35
		MK-16	(XMIT)	1	3.96	4.71
		TRANSCEIVER	(RCV)		0.38	0.45
		VOA-8 INDICATOR			0.31	0.36
		VOA-9 INDICATOR		AS	0.31	0.36
		VOA-40M		INSTALLED	0.06	0.07
		VOA-50M			0.06	0.07
COM-NAV 2	10	SIMILAR TO COM-NAV 1		AS INSTL.		
ADF	5	BENDIX T12-C ADF RECEIVER		AS INSTL.	0.46	0.54
		KING KR-85 ADF RECEIVER			0.87	1.04
M/B	5	MBT-12 NARCO MARKER BEACON OR PIPER PM-1		AS INSTL.	0.19	0.25
G/S	5	NARCO UGR-2 GLIDE SLOPE RECEIVER		AS INSTL.	0.10	0.15
A/P	5	ALTIMATIC IIIB		AS INSTL.	3.50	4.15
	OR	ALTIMATIC V FD/AP BENDIX & -1's			2.90	3.40
	10	AUTOCONTROL III			0.45	0.50
		GLIDE SLOPE COUPLER			0.80	0.95
DME	10	NARCO UDI-4		AS INSTL.	3.06	3.63
XPONDER	5	NARCO AT5-A OR AT6-A		AS INSTL.	1.30	1.55
		NARCO UAT-1			1.55	1.84
ACC. (ACCESSORIES)	5	AUDIO AMP, KING KA-25			1.00	1.15
		RADIO JUNCTION BOX			0.15	0.20
COM-NAV 11, 12, 14		NARCO NAV 11		AS INSTL.	0.60	0.65
		NARCO NAV 12			0.60	0.65
		NARCO NAV 14			1.50	1.95
		NARCO COM 11	(XMIT)	1	4.00	4.80
			(RCV)		1.75	1.90
		NARCO COM 11A	(XMIT)	1	4.75	5.80
			(RCV)		1.75	1.90
		KING KX-175 NAV/COM	(XMIT)	1	4.40	4.95
			(RCV)	AS INSTL.	COM 0.70	0.85
					NAV 0.55	0.70
		KING KX-170A NAV/COM	(XMIT)	1	4.40	4.95
			(RCV)	AS INSTL.	COM 0.70	0.85
					NAV 0.55	0.70
		KMA-20			1.20	1.50
		KT-76			0.95	1.35
		KN-65 DME			0.95	1.55
		KN-60C DME			1.00	1.50
		KN-73 GLIDE SLOPE RECEIVER			0.20	0.20
		KN-77 VOR/LOC			0.10	0.10

TABLE XI-V. CIRCUIT LOAD CHART (cont.)

CIRCUIT	CIRCUIT PRO-TECTOR RAT-ING IN AMPS.	ITEM	NO. OF UNITS OPERATING SIMULTAN-EOUSLY	CURRENT DRAIN PER UNIT (MAX.) IN AMPERES AT 24.0 V.	CURRENT DRAIN PER UNIT (MAX.) IN AMPERES AT 28.5 V.
		KNI-520 LOC/GLIDE SLOPE		0.20	0.20
		KNI-211C OMNI		0.24	0.26
		KI-201C OMNI		0.14	0.16
RADAR		AVQ-45/46 RADAR	AS INSTL.	4.3	5.1
		RDR-100 RADAR		7.22	9.04

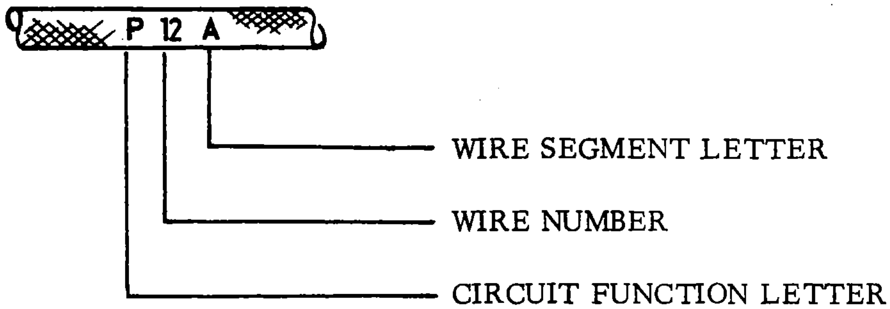
TABLE XI-V. CIRCUIT LOAD CHART (cont.)

CIRCUIT	CIRCUIT PROTECTOR RATING IN AMPS.	ITEM NOTE: 1975 MODELS AND UP.	NO. OF UNITS OPERATING SIMULTANEOUSLY	CURRENT DRAIN PER UNIT (MAX.) IN AMPERES AT 27.5 V.
STARTER	10*	STARTER SOLENOID STARTING VIBRATOR	1 1	
VOLT REG., LEFT	5*	MAIN VOLT REG. & OVERVOLT RELAY +ALTERNATOR FIELDS L & R	1 SYSTEM	2.00 NOM 4.10 F.L.
VOLT REG., RIGHT	5*	AUX. VOLT REG. & OVERVOLT RELAY +ALTERNATOR FIELDS L & R		
FUEL PUMPS	15	LEFT & RIGHT FUEL PUMPS	2	3.10
STALL WARNING	5	FLASHER UNIT - HORN	1 SYSTEM	.20
FUEL, HORN	5	FLASHER UNIT & HORN - LDG. GEAR WARNING	1 SYSTEM	2.30
CYL. HD. TEMP.		FUEL GAUGES & ENG. INSTRUMENT CLUSTER	1 GROUP	2.30
TURN & BANK	5	TURN & BANK GYRO	1	.82
GEAR & FLAP (INDICATORS)	5	DOOR AJAR LIGHT GEAR UP - GEAR DOWN LIGHTS FLAP INDICATOR	1 3 1	.04 .04 .50
ELEC. TRIM	5*	PITCH TRIM SERVO	1	.50
CABIN HEAT (& LIGHTER)	10*	CIGAR LIGHTER CABIN HEATER SYSTEM (GROUND OPERATION - HEATER IGNITION, VENT BLOWER, AND COMBUSTION BLOWER OPERATING)	1 MAX.	7.60 7.10 GND 3.60 FLT
PITOT HEAT	5	PITOT HEATING ELEMENT	1	3.70
POS. LTS.	5	NAV WING TIP LIGHTS NAV TAILLIGHT	1 SYSTEM	2.80
PROP SYNC.	5	ARKORP PROP SYNCHRONIZER	1	1.00
LAND. LTS.	15	LANDING LIGHT TAXI LIGHT	1 1	9.00 3.60
INT. LTS. (INTERIOR LIGHTS)	5*	MAP LIGHTS CABIN READING LIGHTS TRIM INDICATOR LIGHTS INSTRUMENT SPOT LIGHTS DOME LIGHT COMPASS LIGHT	2 4 2 2 1 1	0.26 0.50 0.07 0.40 0.30 0.04
POST LIGHTS	5	AUTOPILOT CONSOLE LIGHT OMNI COUPLER LIGHT POST LIGHTS - GLAR-BAN LIGHTED SWITCHES (ROCKER)	1 2 AS INSTALLED	0.06 0.05 0.04 0.04
WINDSHIELD HEAT	10	WINDSHIELD HEATING ELEMENT	1	7.00
DEICER - WING-TAIL	5*	SURFACE DEICE SYSTEM 6 SEC. OF EACH 3 MIN.	1	3.90
DEICER - PROP	15*	PROPELLER DEICE SYSTEM	1 PR.	12.00

* CURRENT WILL VARY DUE TO INTERMITTENT LOADS (TYPICAL VALUES SHOWN). CIRCUIT BREAKER CAPACITY IS SUFFICIENT FOR NORMAL OPERATION.

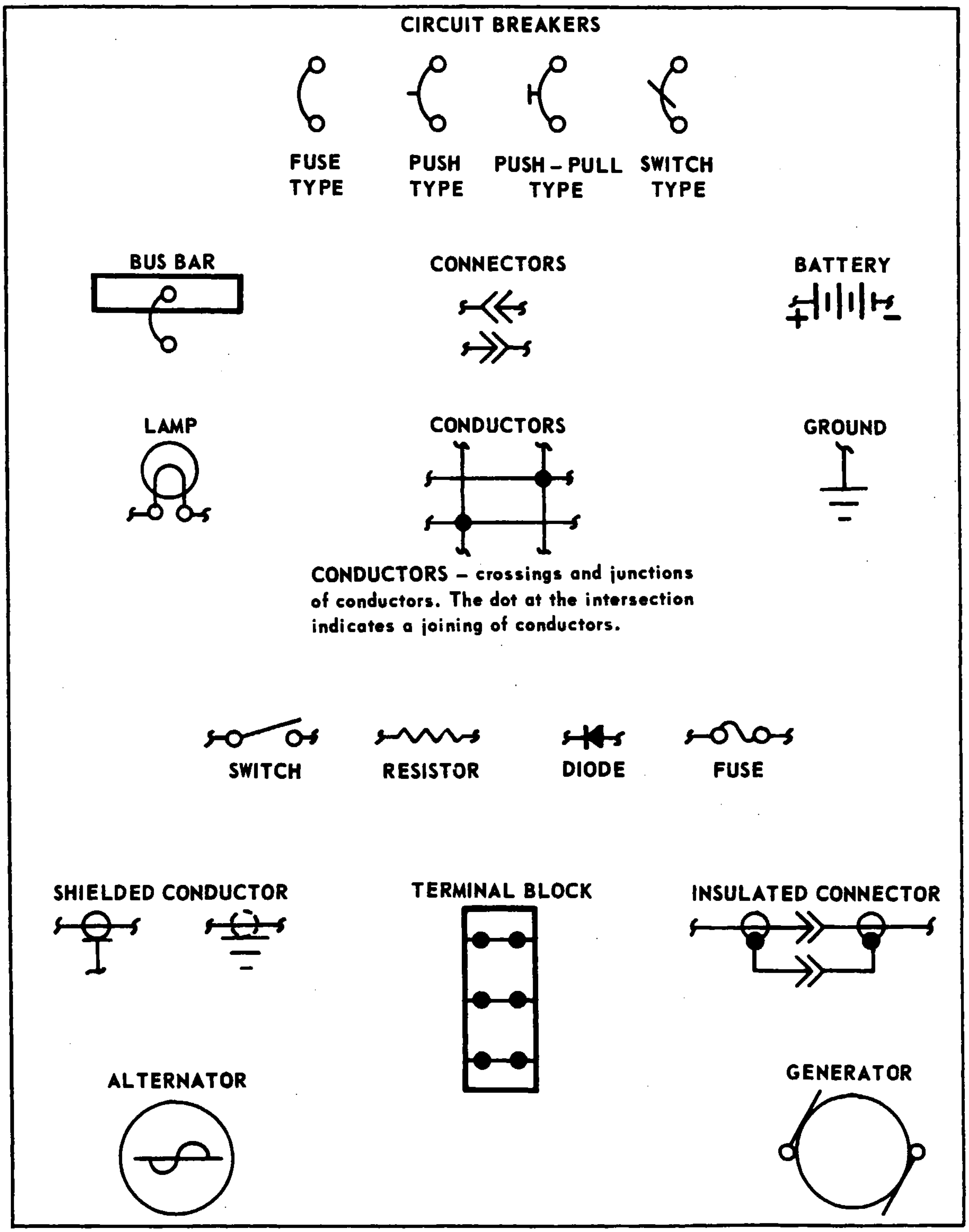
CURRENT AVAILABLE FOR OPTIONAL EQUIPMENT - 100 AMPS.

TABLE XI-VI. ELECTRICAL WIRE CODING



CIRCUIT FUNCTION LETTER	CIRCUITS
A	AUTOPILOT
C	CONTROL SURFACE
E	ENGINE INSTRUMENT
F	FLIGHT INSTRUMENT
G	LANDING GEAR
H	HEATER - VENTILATING & DE-ICING
L	LIGHTING
P	POWER
Q	FUEL & OIL
RP	RADIO POWER
RZ	RADIO AUDIO & INTERPHONE
J	IGNITION
RG	RADIO GROUND

TABLE XI-VII. ELECTRICAL SYMBOLS



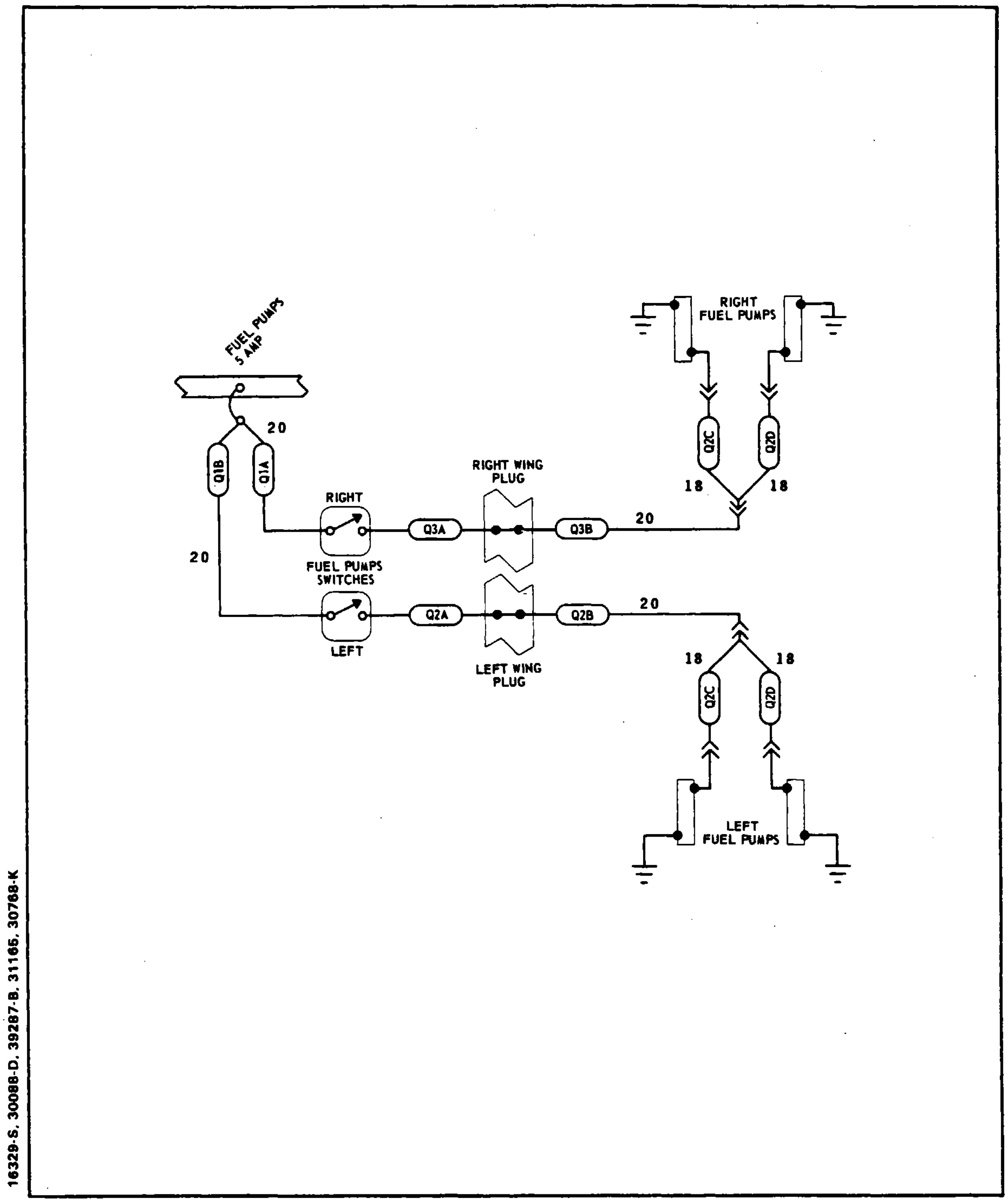


Figure 11-68. Fuel Pumps Schematic (14-volt and 28-volt)
PA-23-250; PA-23-235; and PA-23-250 (six place),
Serial Nos. 27-2000 to 27-2504 incl.

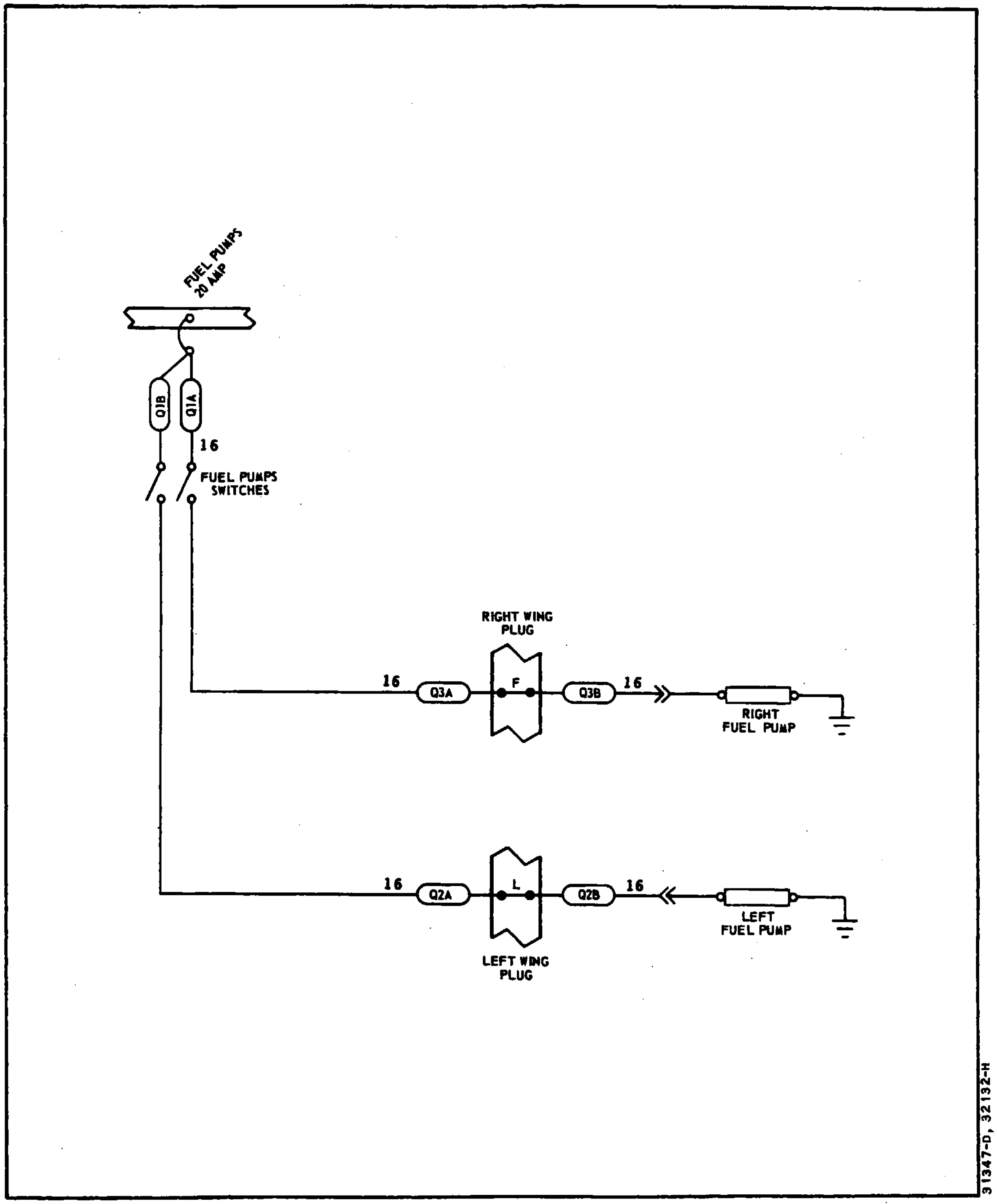


Figure 11-69. Fuel Pumps Schematic
PA-23-250 (six place), Serial Nos. 27-2505 to
27-3836 incl. and 27-3838 to 27-3943 incl.

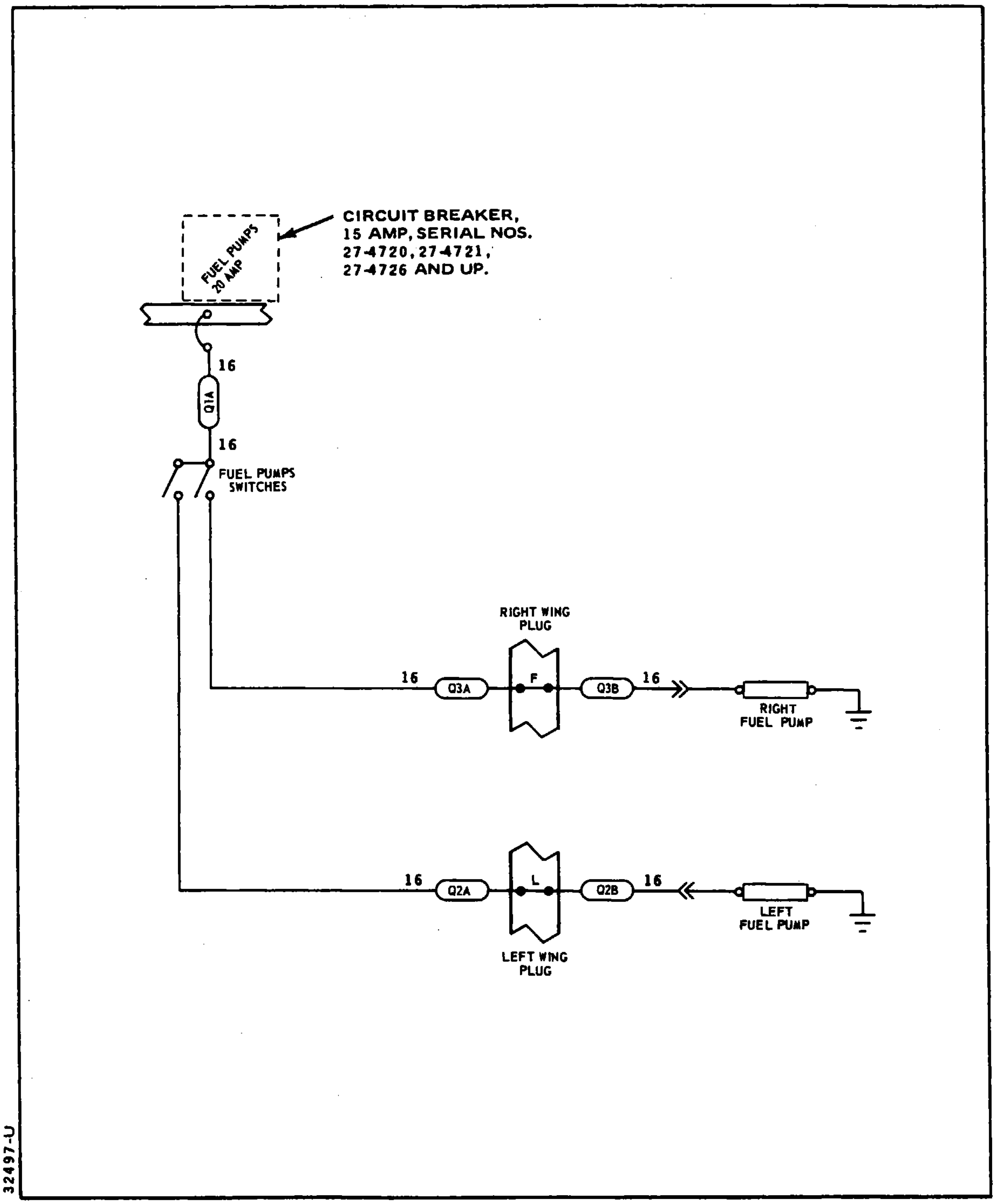


Figure 11-70. Fuel Pumps Schematic
PA-23-250 (six place), Serial Nos. 27-3837,
27-3944 to 27-7554172 incl.

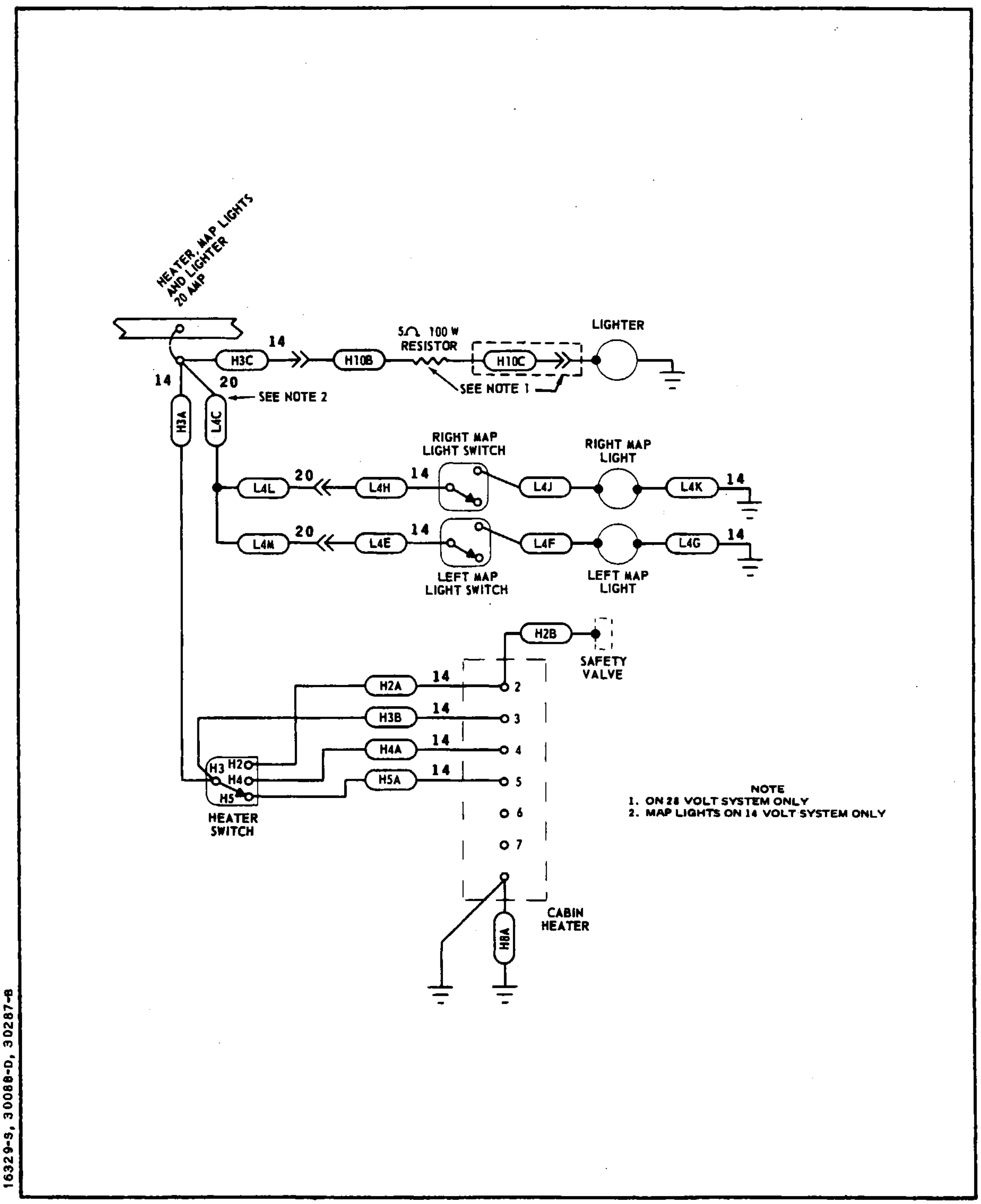


Figure 11-71. Heater, Map Lights and Cigar Lighter Schematic (14-volt and 28-volt), PA-23-250 and PA-23-235

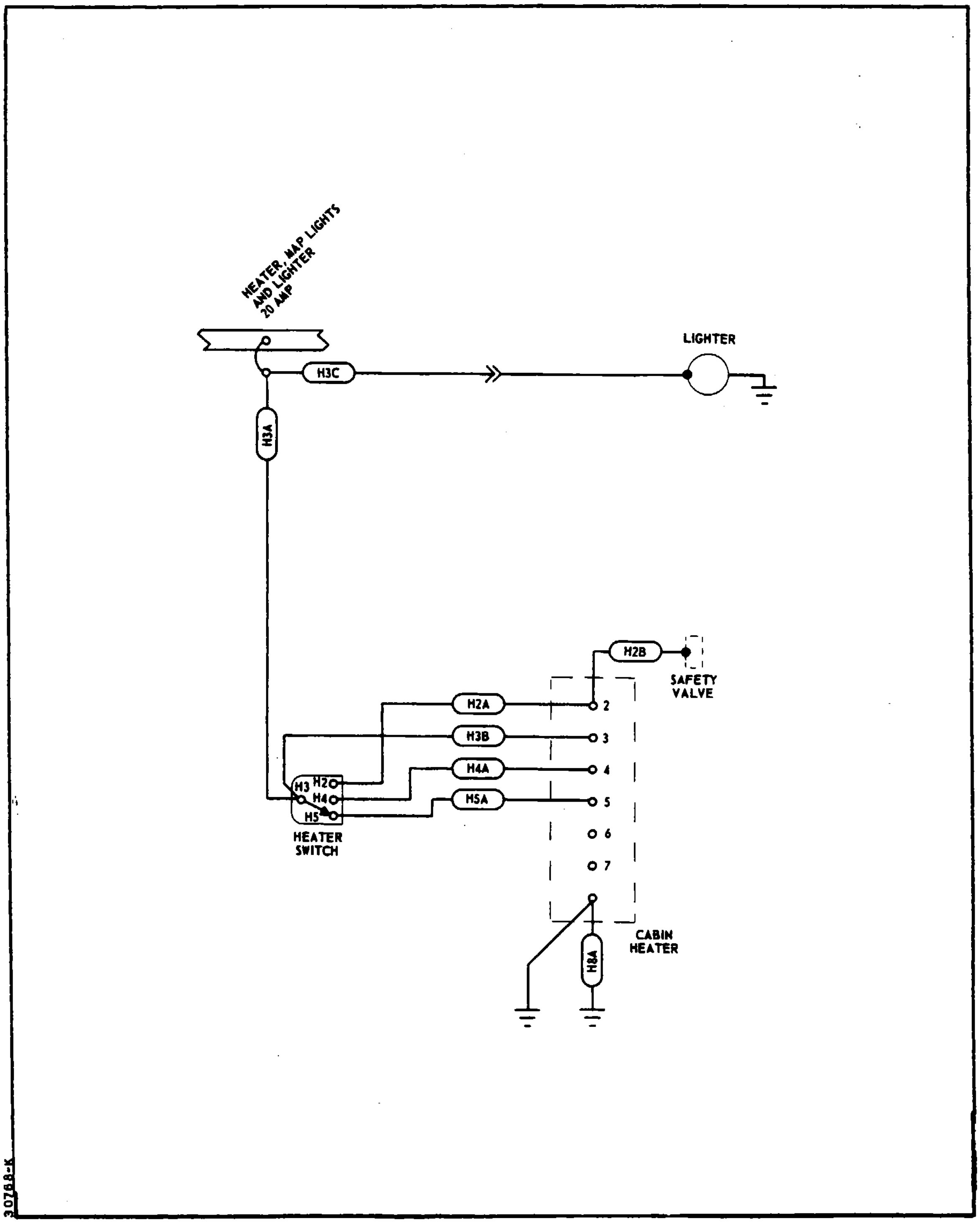


Figure 11-72. Heater, Map Lights and Cigar Lighter Schematic
PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.

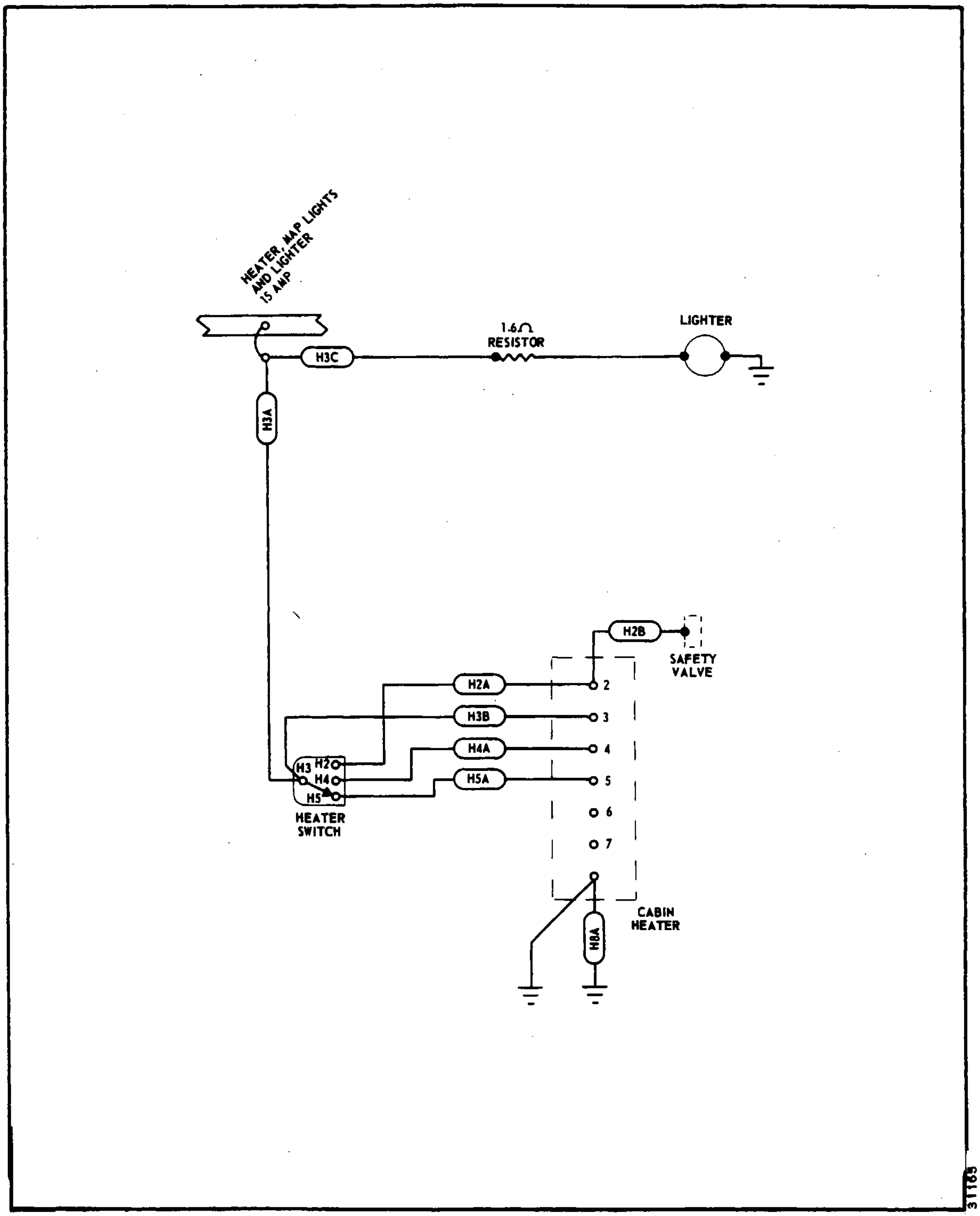


Figure 11-73. Heater, Map Lights and Cigar Lighter Schematic (28-volt) PA-23-250 (six place), Serial Nos. 27-2298 and 27-2331

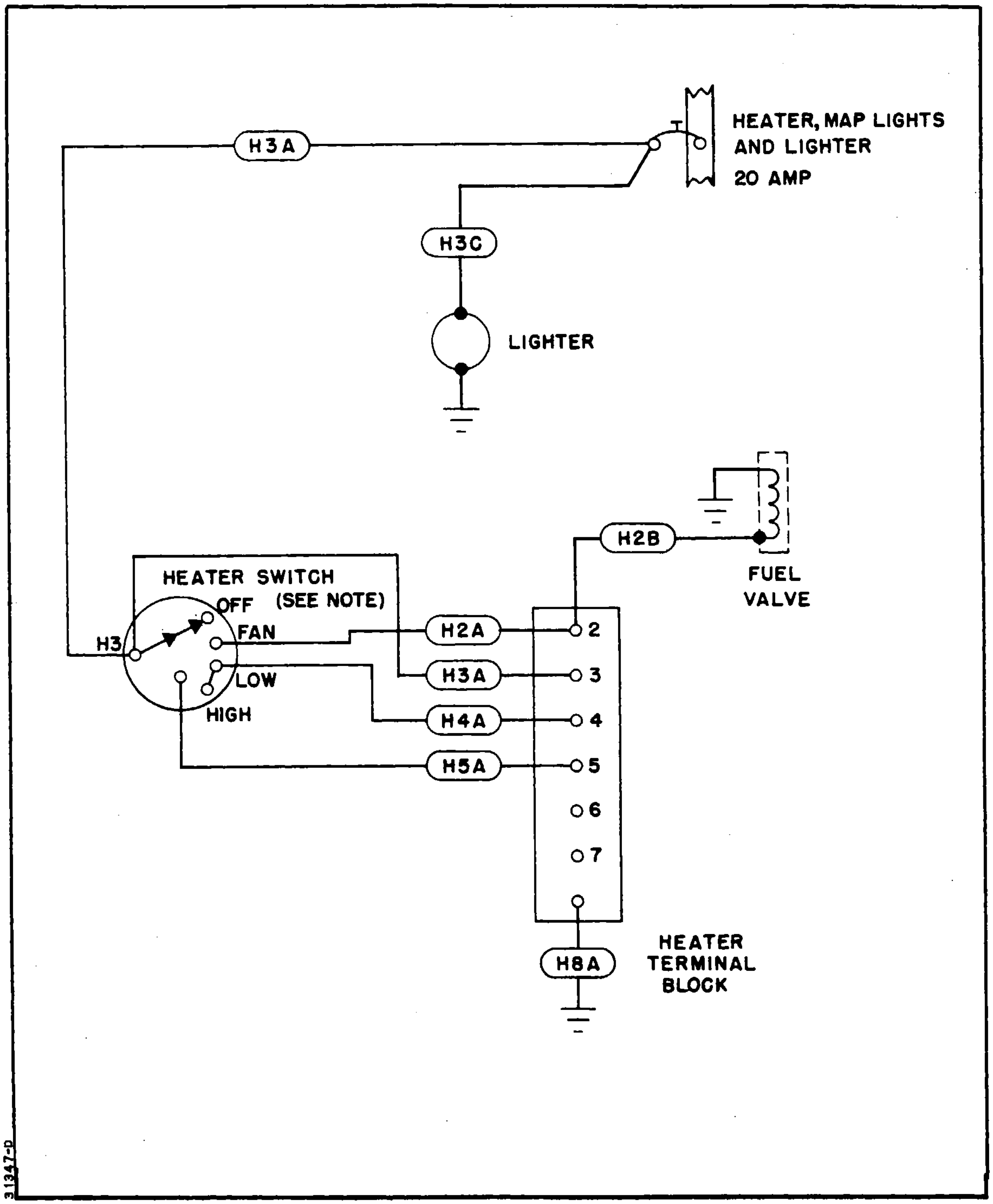


Figure 11-74. Heater, Map Lights and Cigar Lighter Schematic
PA-23-250 (six place) Serial Nos. 27-2505
to 27-3049 incl. and 27-3151 to 27-3154 incl.

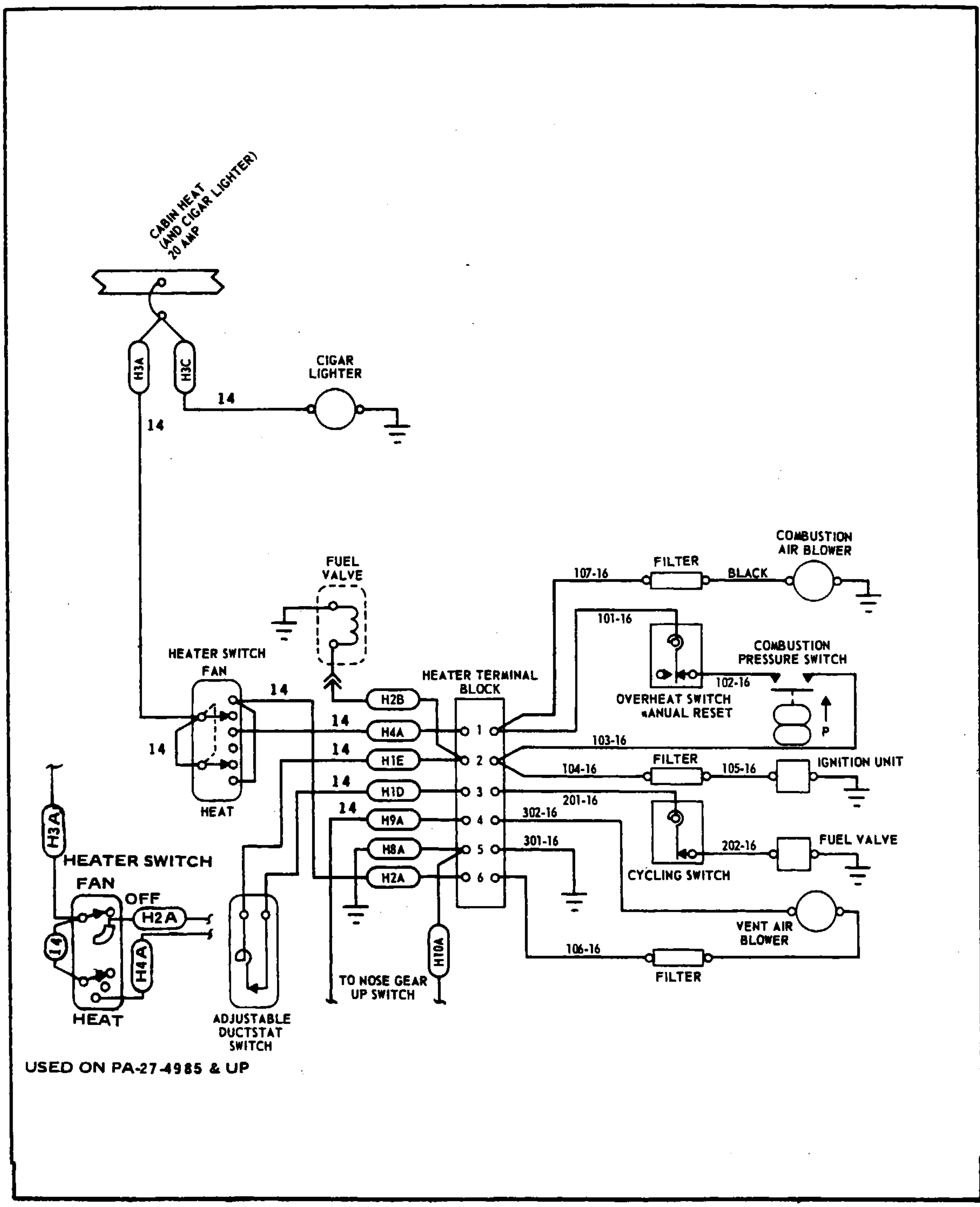


Figure 11-75. Heater, Map Lights and Cigar Lighter Schematic
PA-23-250 (six place), Serial Nos. 27-3050,
27-3154 to 27-7554168 incl.

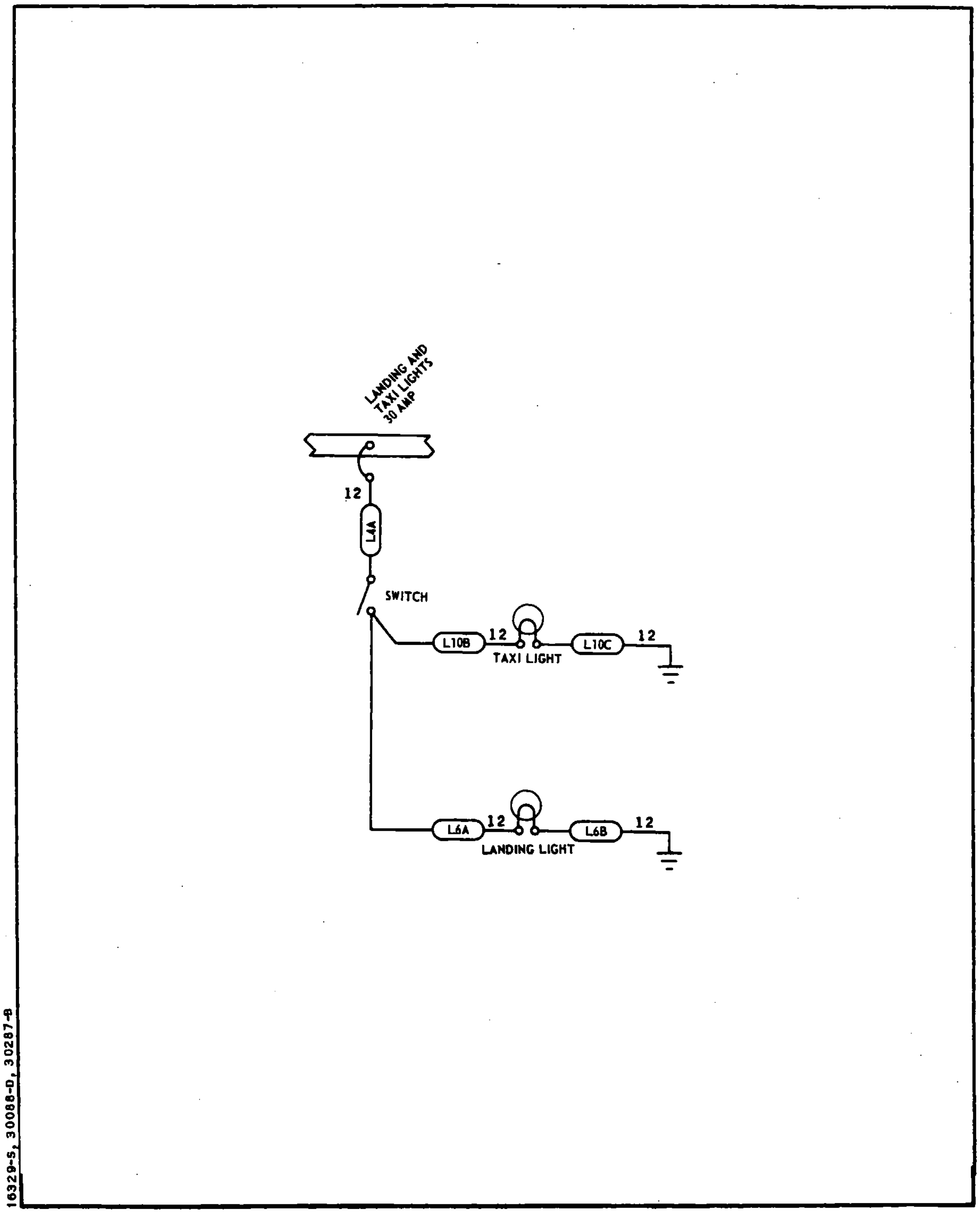


Figure 11-76. Landing and Taxi Lights (14-volt and 28-volt)
PA-23-250 and PA-23-235

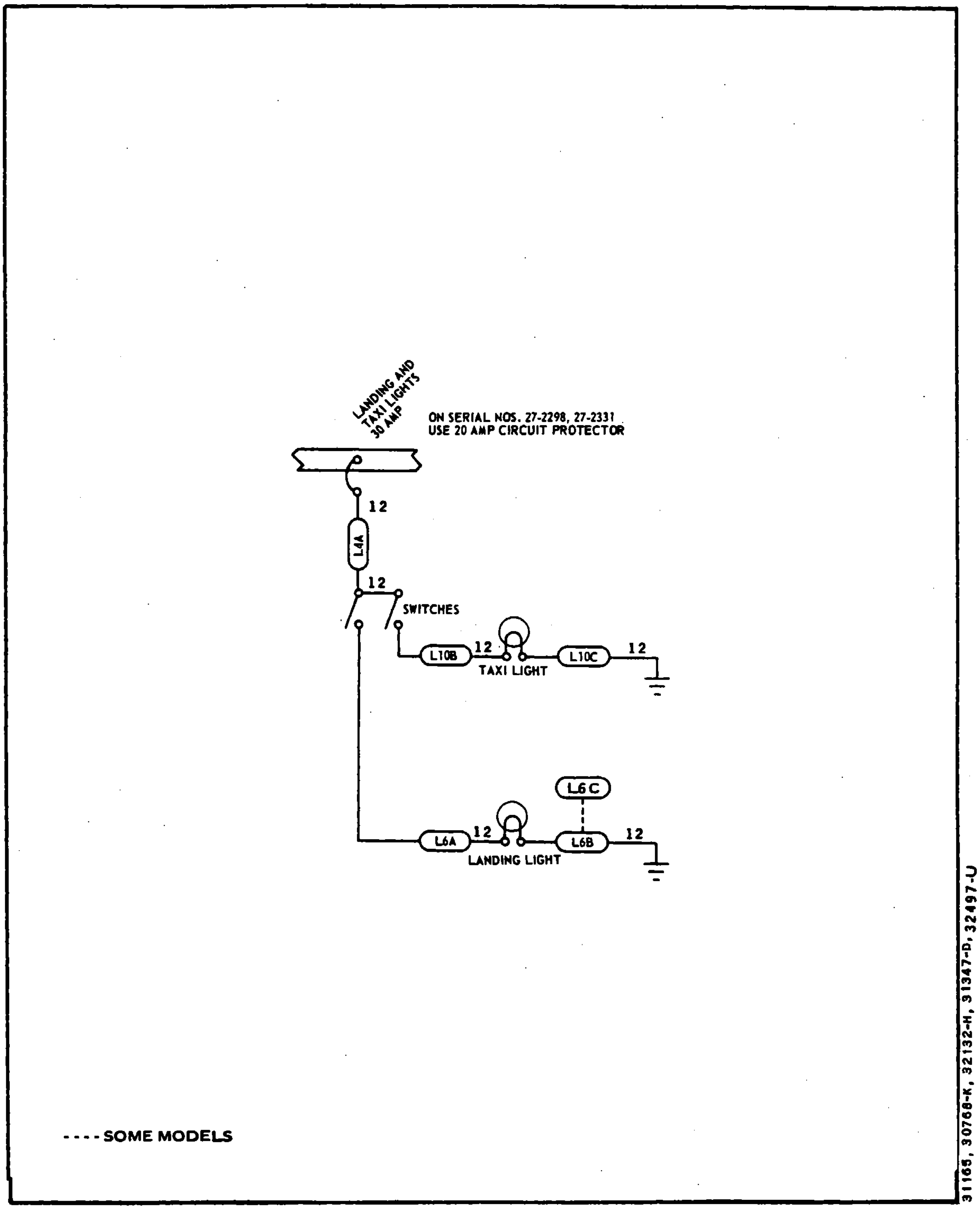


Figure 11-77. Landing and Taxi Lights (14-volt and 28-volt)
PA-23-250 (six place), Serial Nos. 27-2000 to 27-7554172 incl.

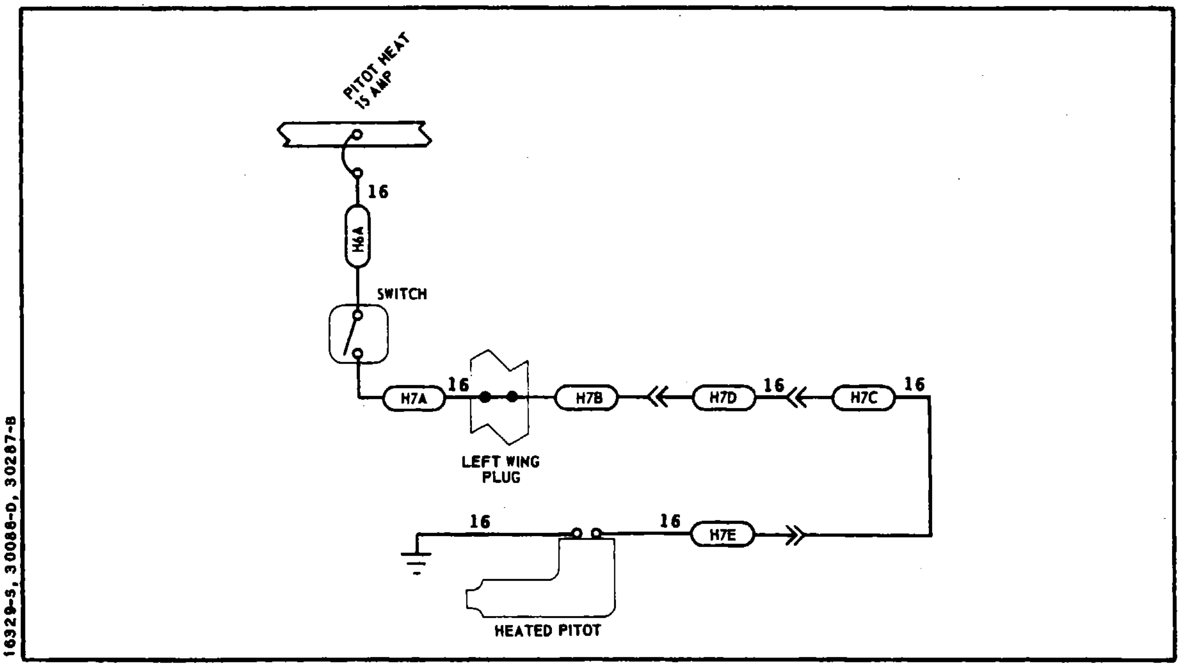


Figure 11-78. Pitot Heat Schematic, (14-volt and 28-volt)
PA-23-250 and PA-23-235

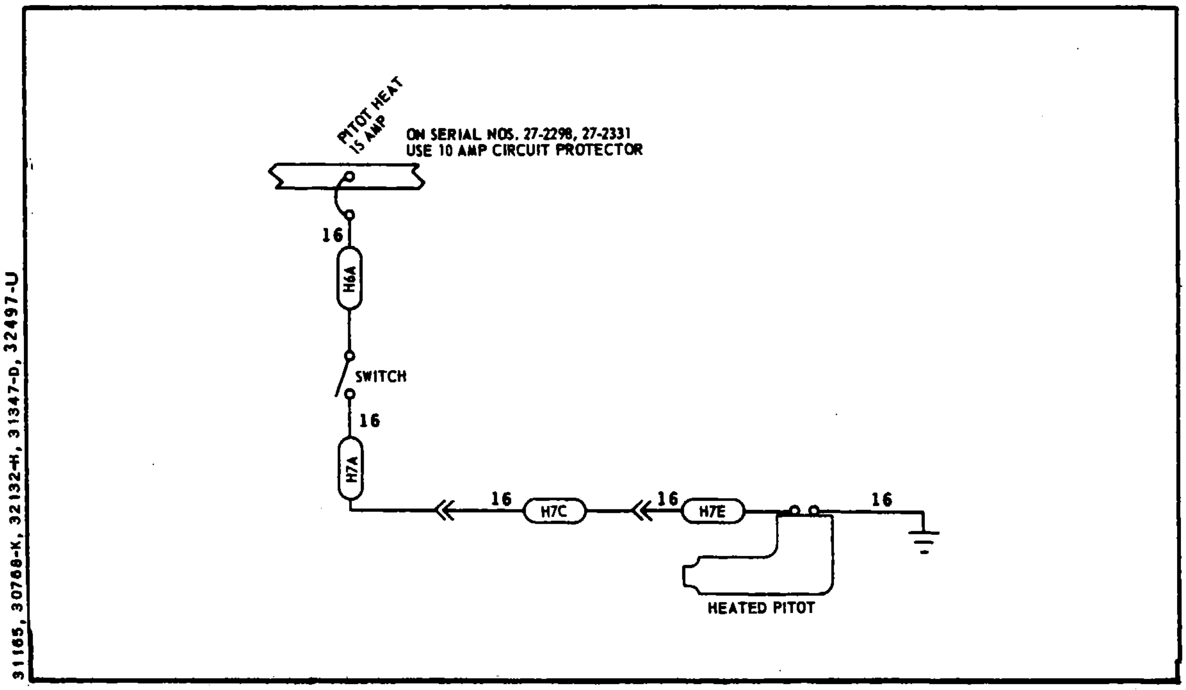


Figure 11-79. Pitot Heat Schematic (14-volt and 28-volt)
PA-23-250 (six place), Serial Nos. 27-2000 to 27-7554172 incl.

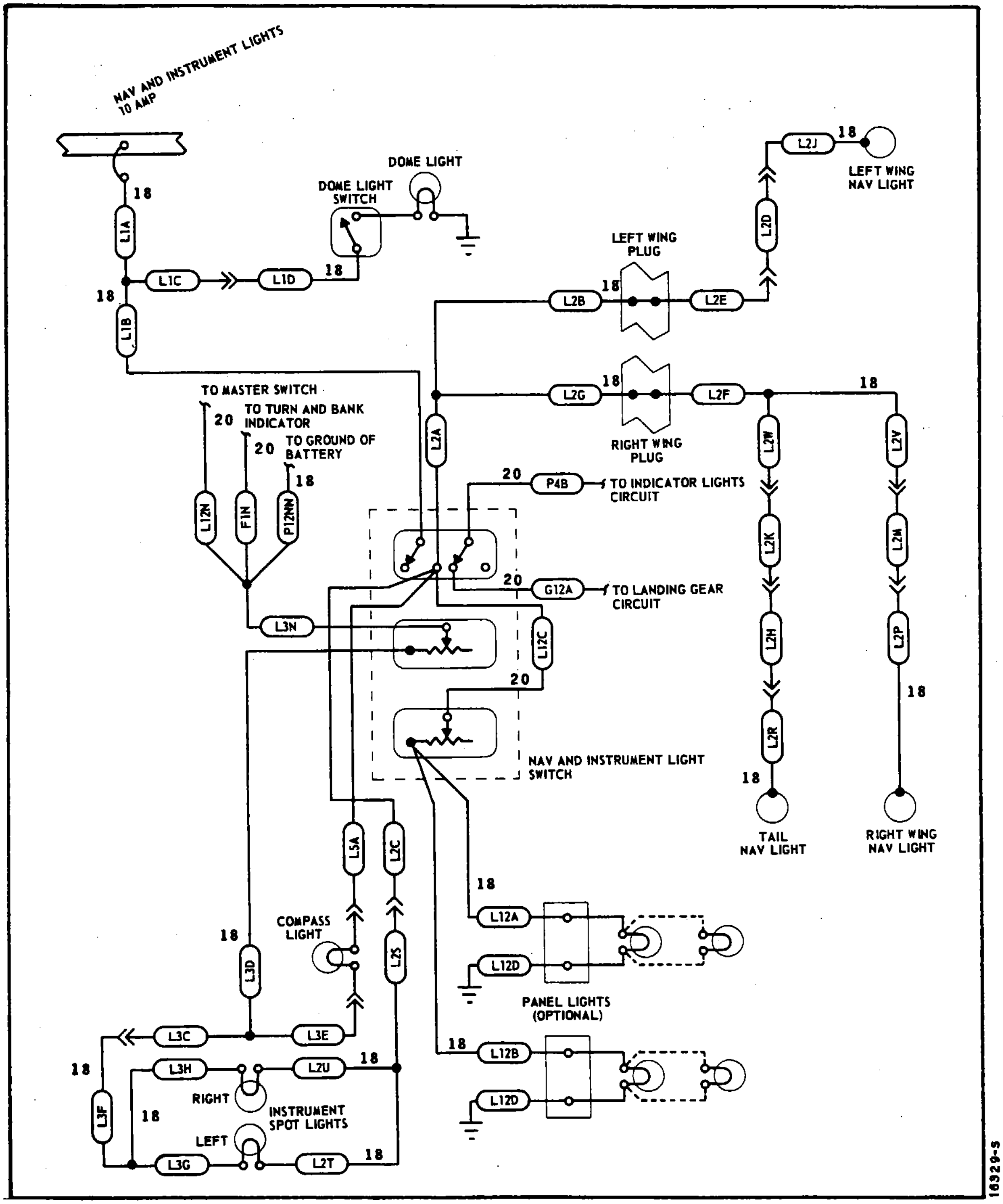


Figure 11-80. Navigation and Instrument Lights Schematic
PA-23-250, Serial Nos. 27-1 to 27-258 incl.; 27-365 to 27-401 incl.
and 27-403 to 27-504 incl. and PA-23-235

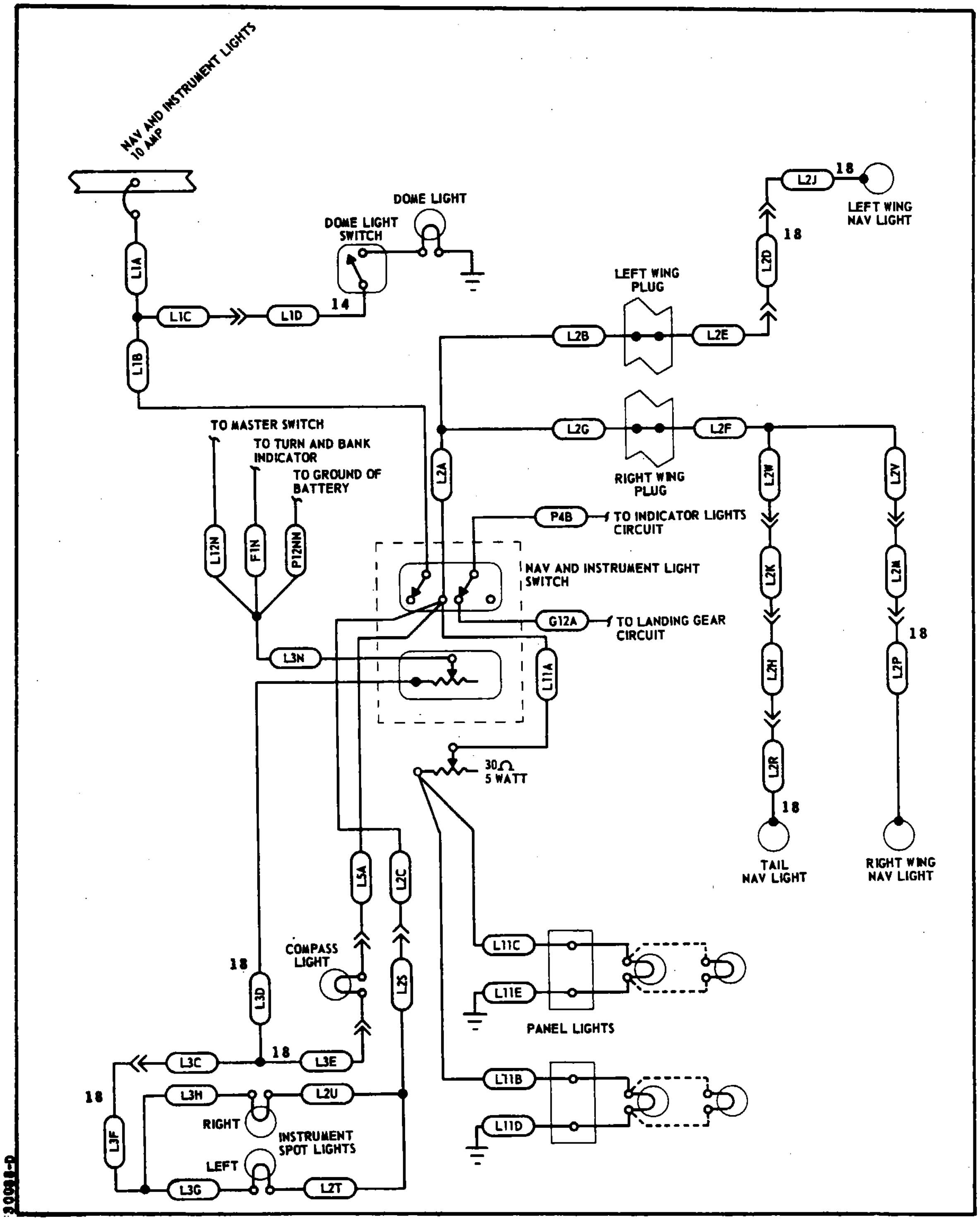


Figure 11-81. Navigation and Instrument Lights Schematic (28-volt)
PA-23-250, Serial Nos. 27-259 to 27-364 incl.

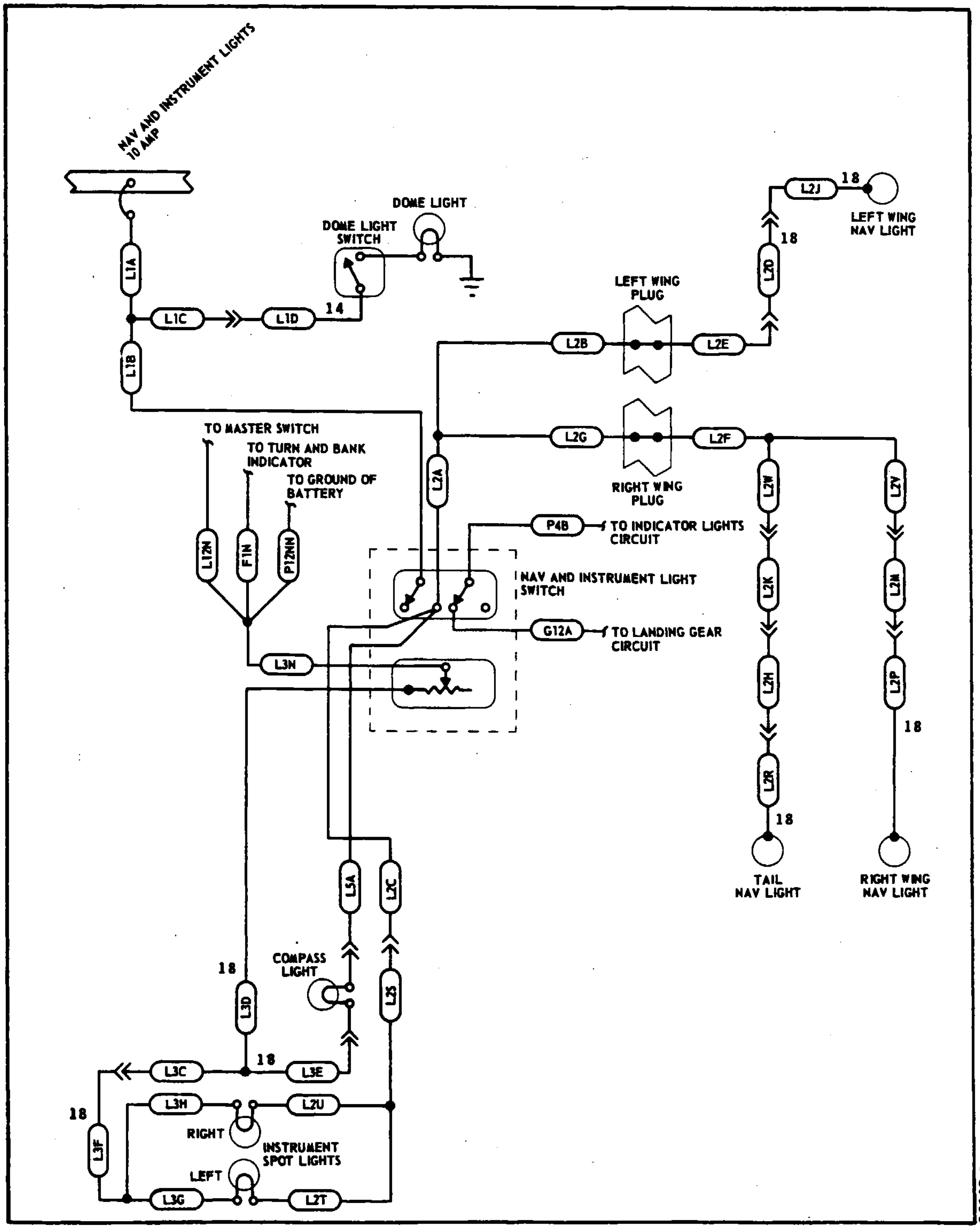


Figure 11-82. Navigation and Instrument Lights Schematic, (28-volt)
PA-23-250, Serial No. 27-402

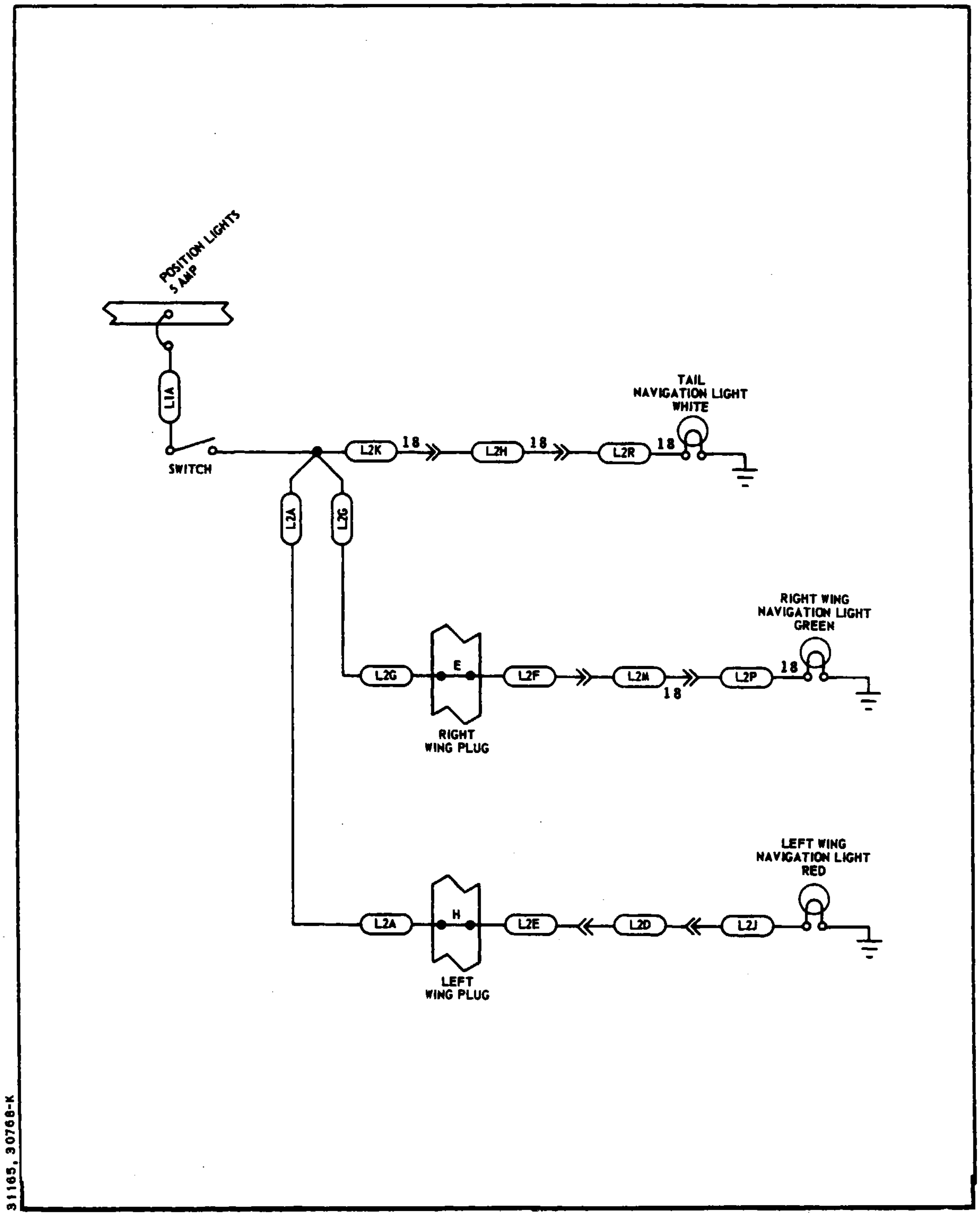


Figure 11-83. Position Lights Schematic (14-volt and 28-volt)
PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.

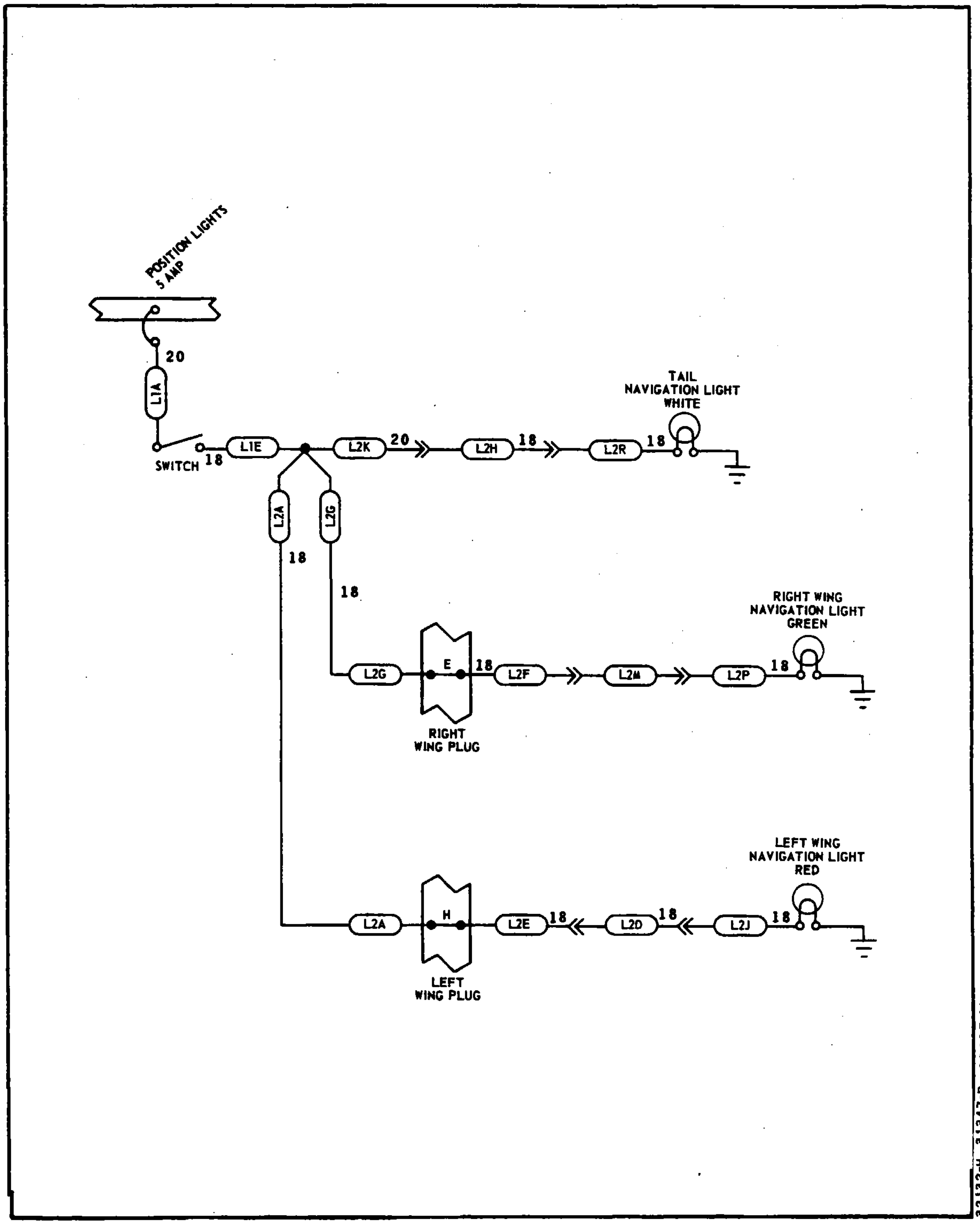


Figure 11-84. Position Lights Schematic
PA-23-250 (six place),
Serial Nos. 27-2505 to 27-7554172 incl.

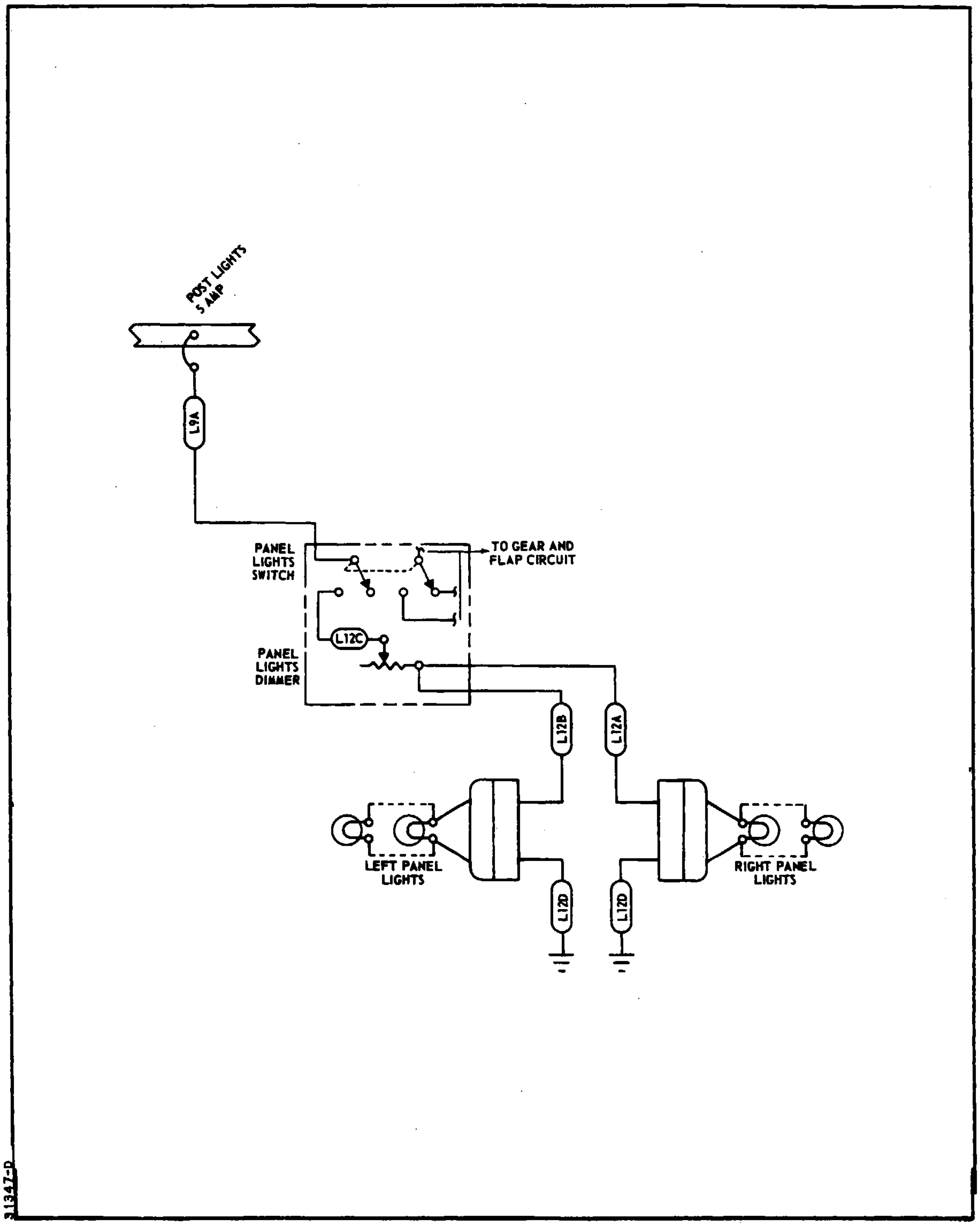


Figure 11-85. Post Lights Schematic
PA-23-250 (six place), Serial Nos. 27-2505 to 27-2704 incl.

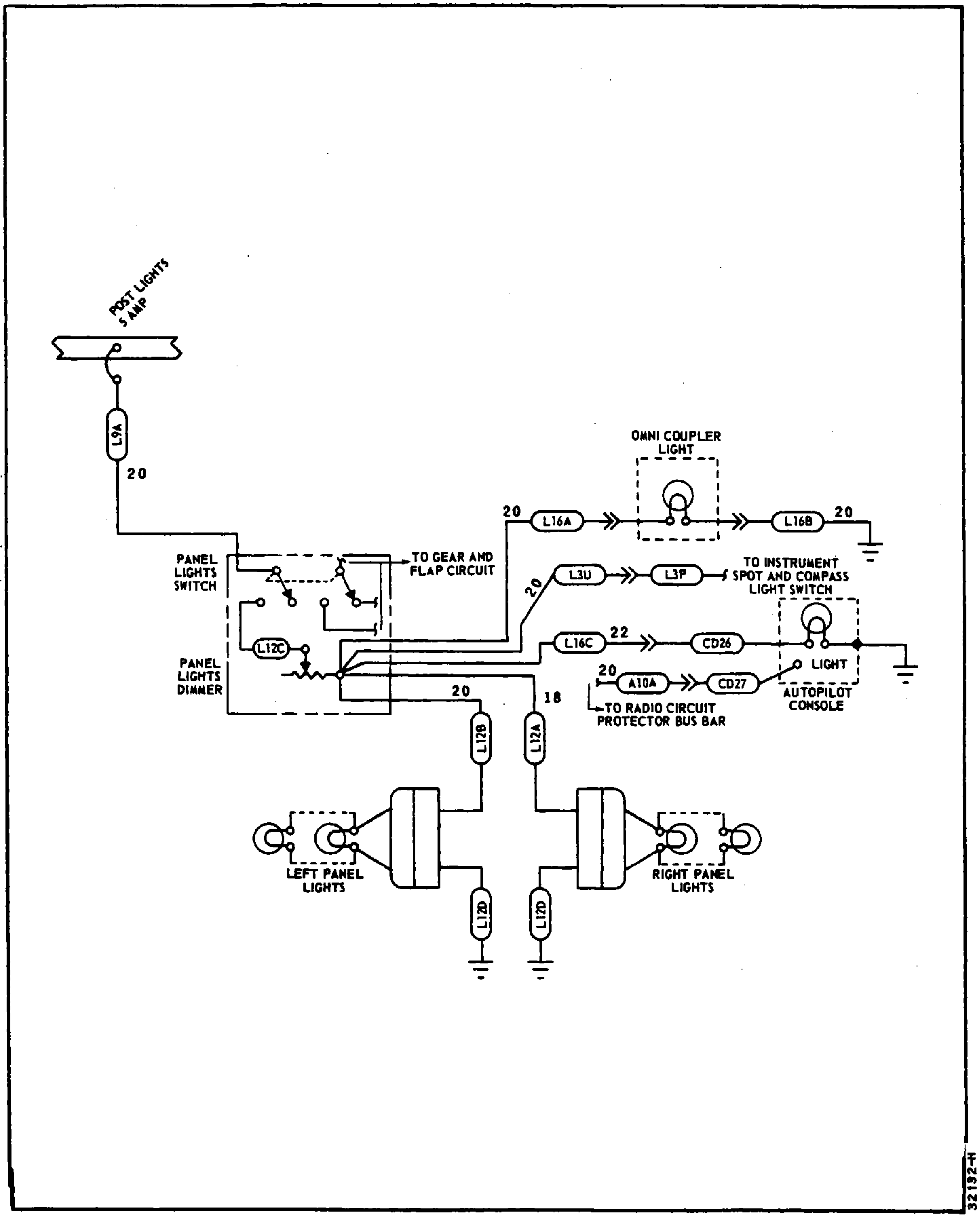


Figure 11-86. Post Lights Schematic. PA-23-250 (six place)
Serial Nos. 27-2705 to 27-3836 incl. and 27-3838 to 27-3943 incl.

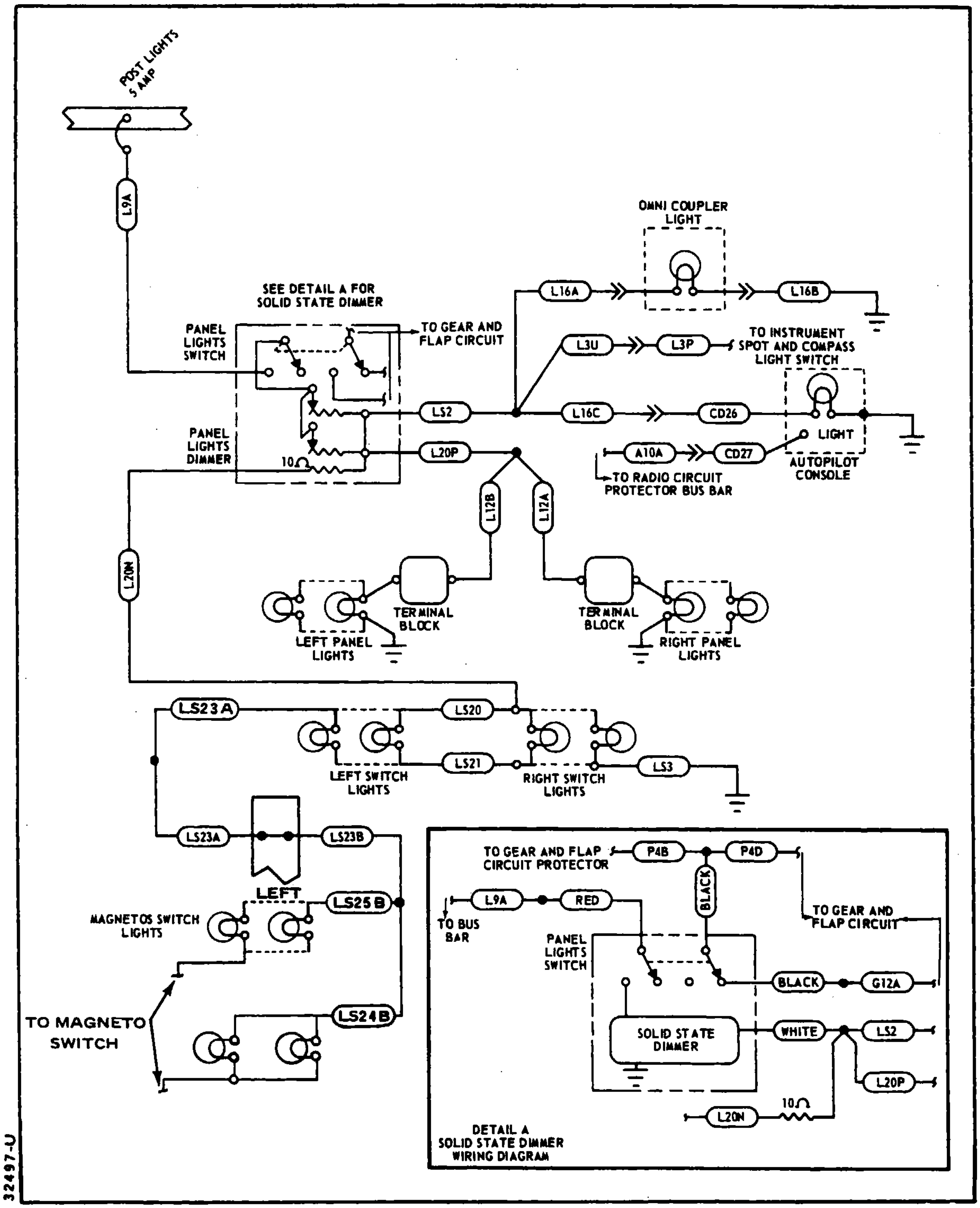


Figure 11-87. Post Lights Schematic
PA-23-250 (six place), Serial Nos. 27-4794 to 27-7554172 incl.

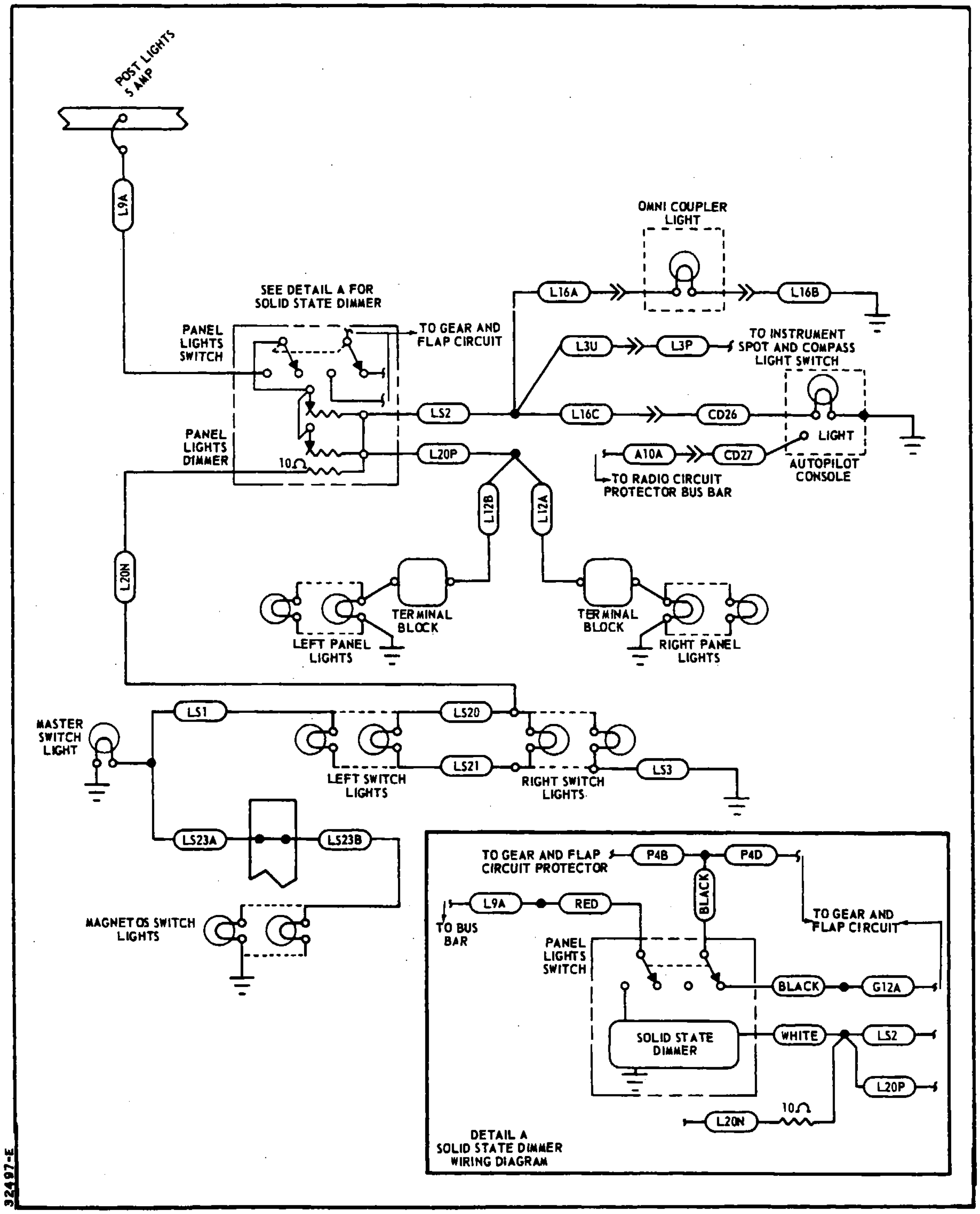


Figure 11-88. Post Lights Schematic
PA-23-250 (six place), Serial Nos. 27-3837, 27-3944 to 27-4793

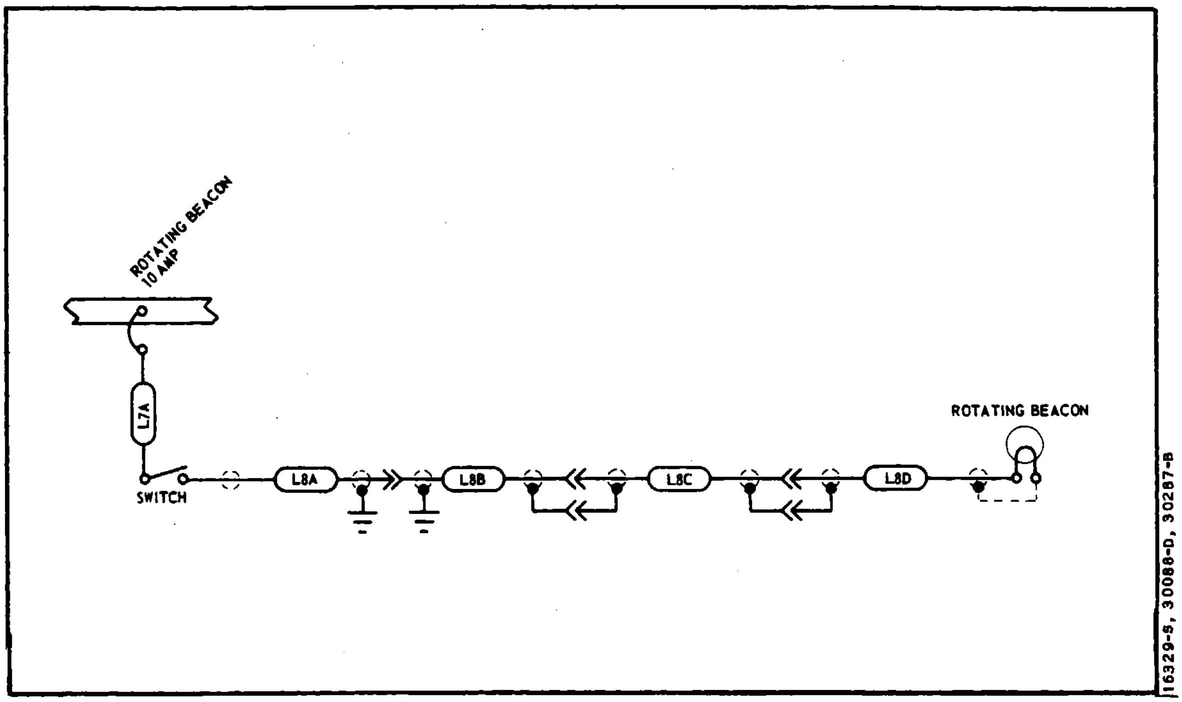


Figure 11-89. Rotating Beacon (14-volt and 28-volt)
PA-23-250 and PA-23-235

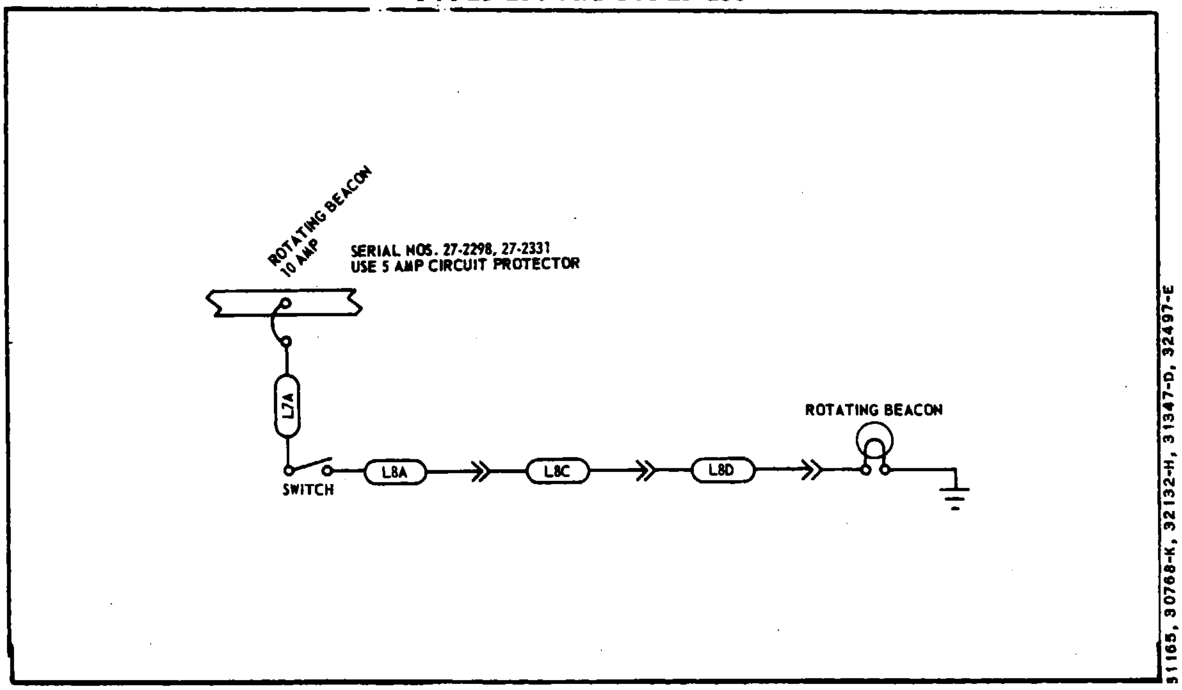


Figure 11-90. Rotating Beacon (14-volt and 28-volt)
PA-23-250 (six place)

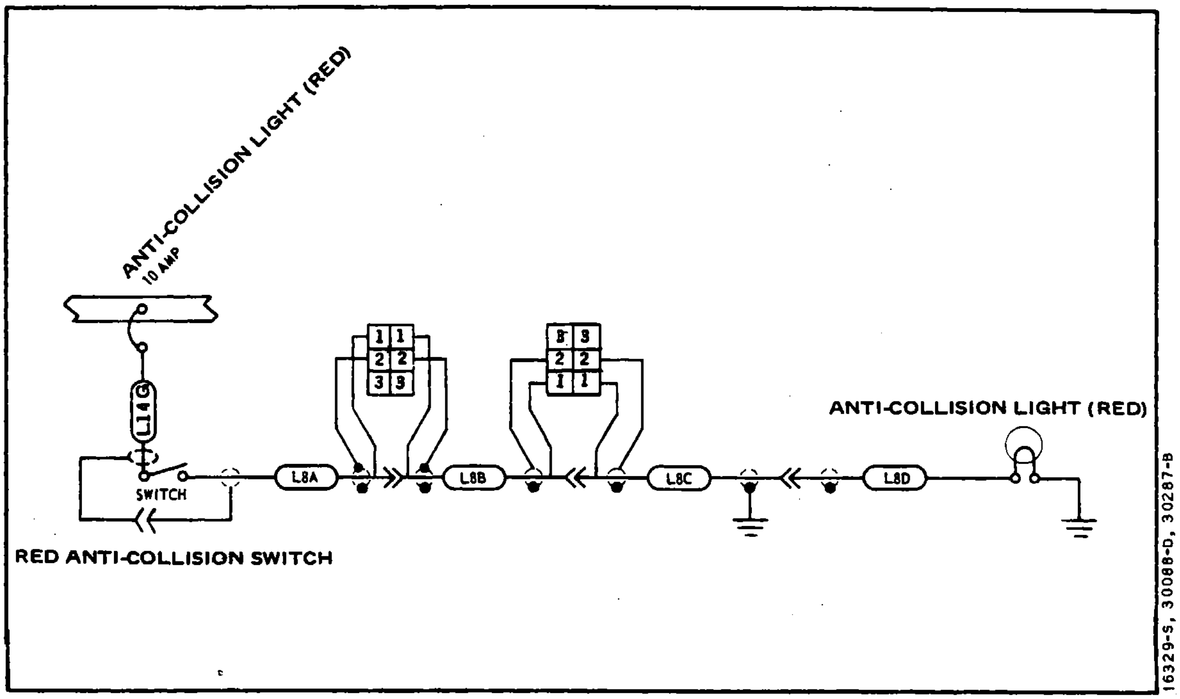


Figure 11-91. Anti-Collision Light (Red)
(14-volt and 28-volt PA-23-250 and PA-23-235

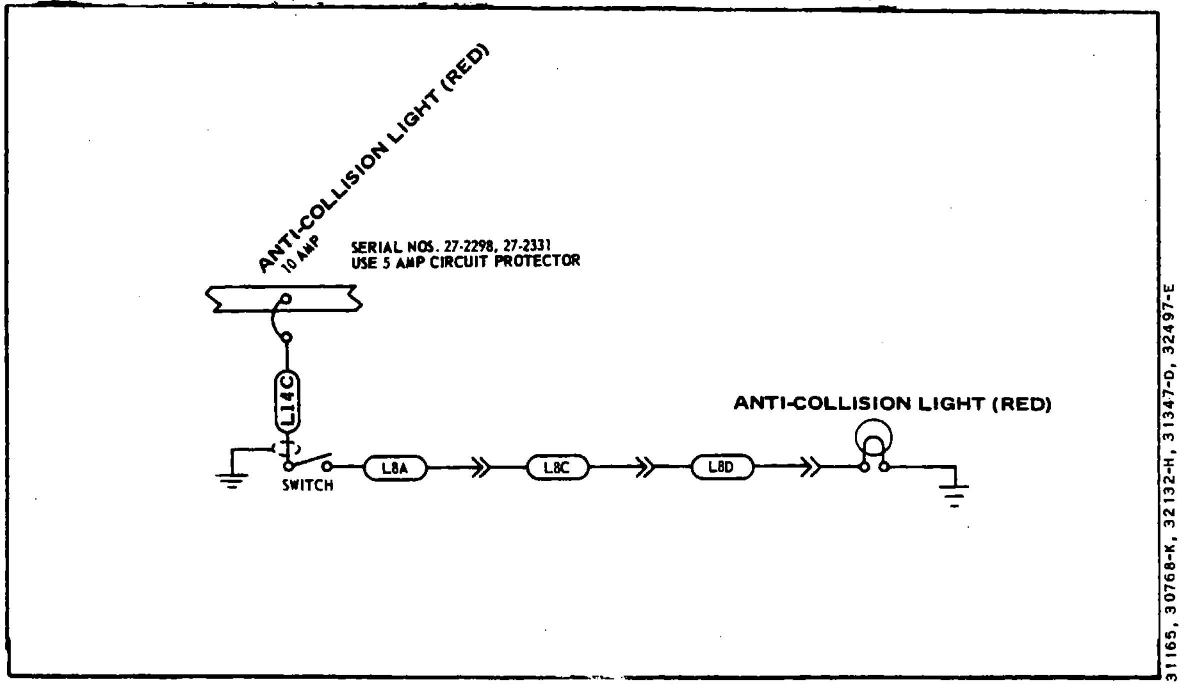
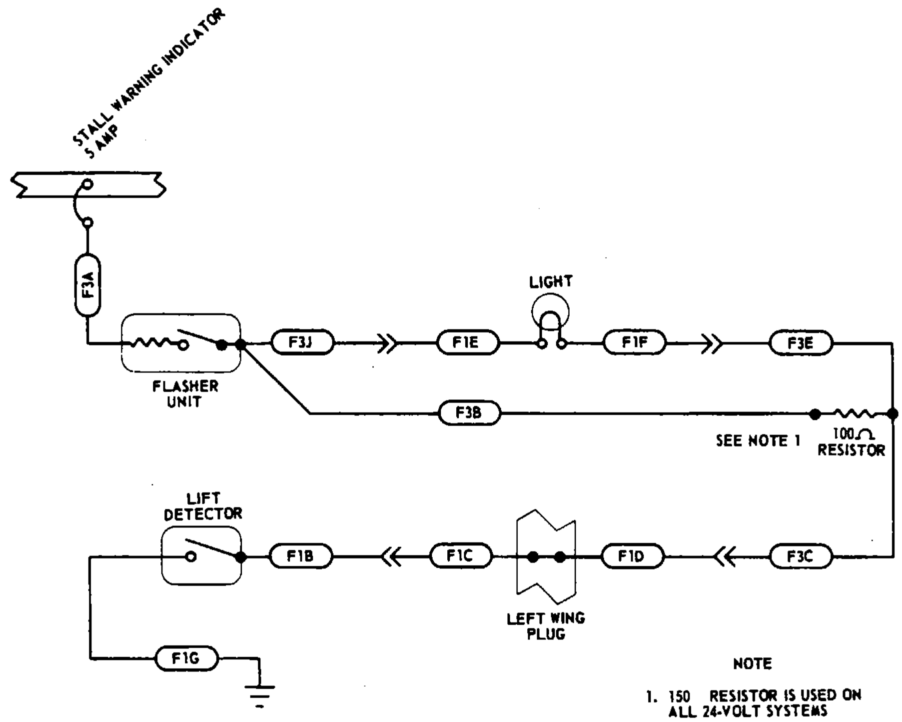


Figure 11-92. Anti-Collision Light (Red)
(14-volt and 28-volt) PA-23-250 (six place)



NOTE

1. 150 RESISTOR IS USED ON ALL 28-VOLT SYSTEMS

16329-5, 30088-D, 30287-8, 31165, 30768-K

Figure 11-93. Stall Warning Schematic (14-volt and 28-volt)
PA-23-250; PA-23-235; and
PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504

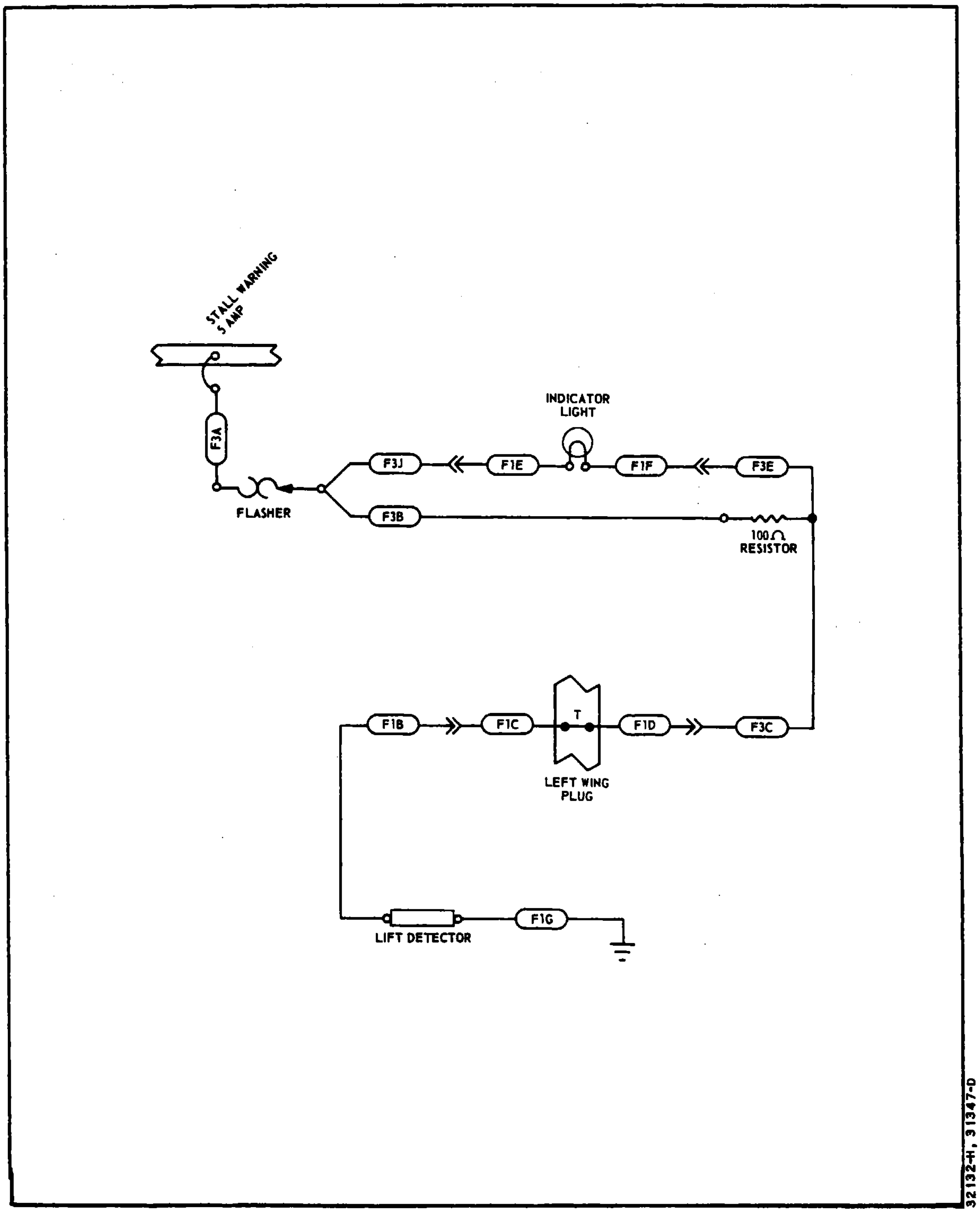


Figure 11-94. Stall Warning Schematic
PA-23-250 (six place), Serial Nos. 27-2505 to 27-7554172 incl.

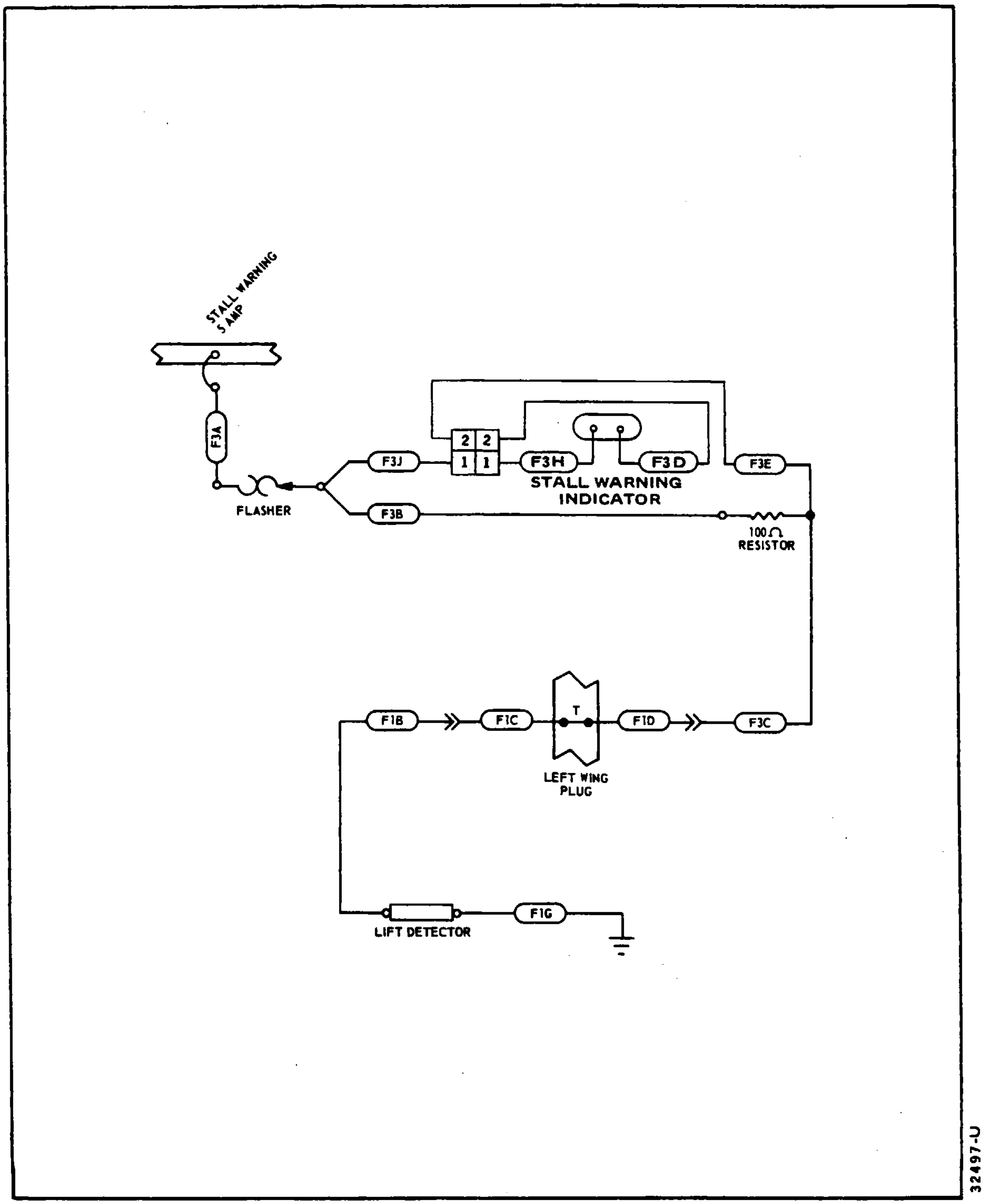


Figure 11-95. Stall Warning Schematic
PA-23-250 (six place), Serial Nos. 27-2505 to 27-7554172 incl.

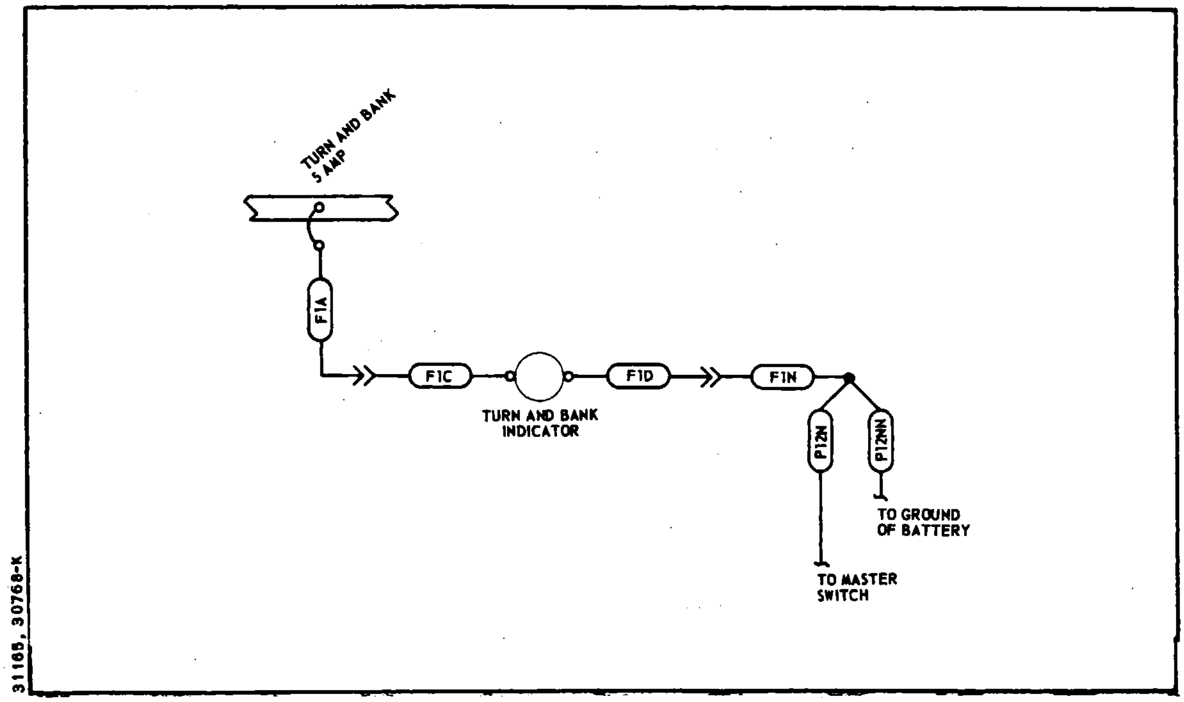


Figure 11-96. Turn and Bank Schematic (14-volt and 28-volt)
PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.

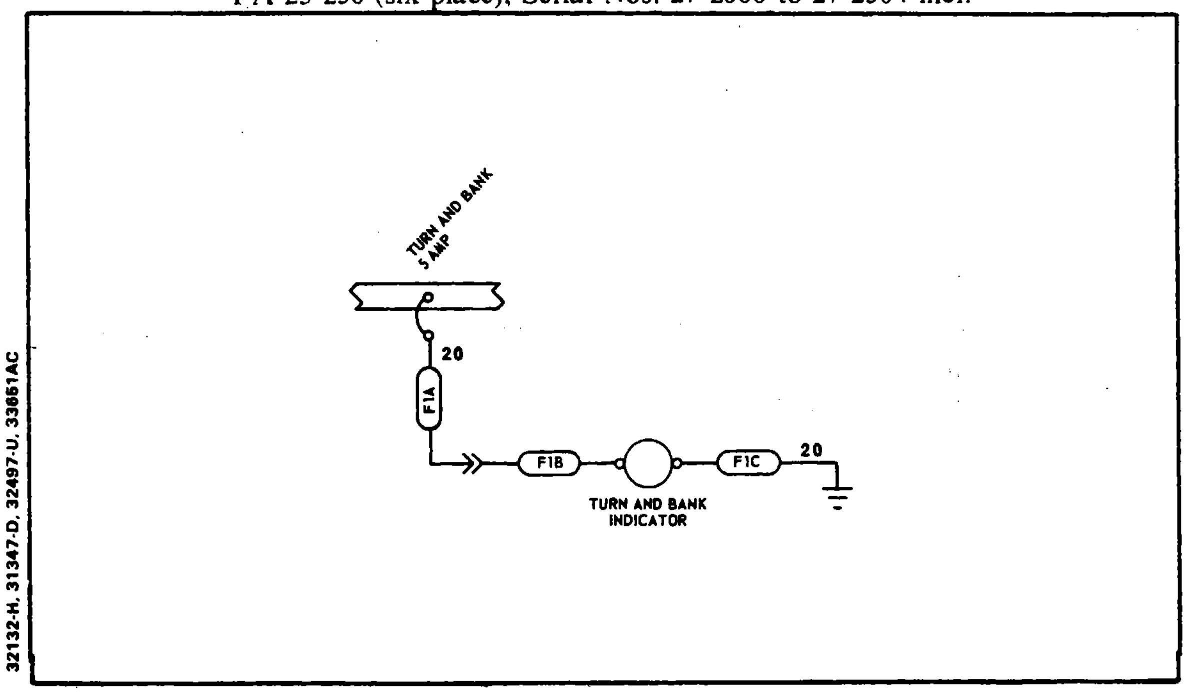


Figure 11-97. Turn and Bank Schematic
PA-23-250 (six place), Serial Nos. 27-2505 and up

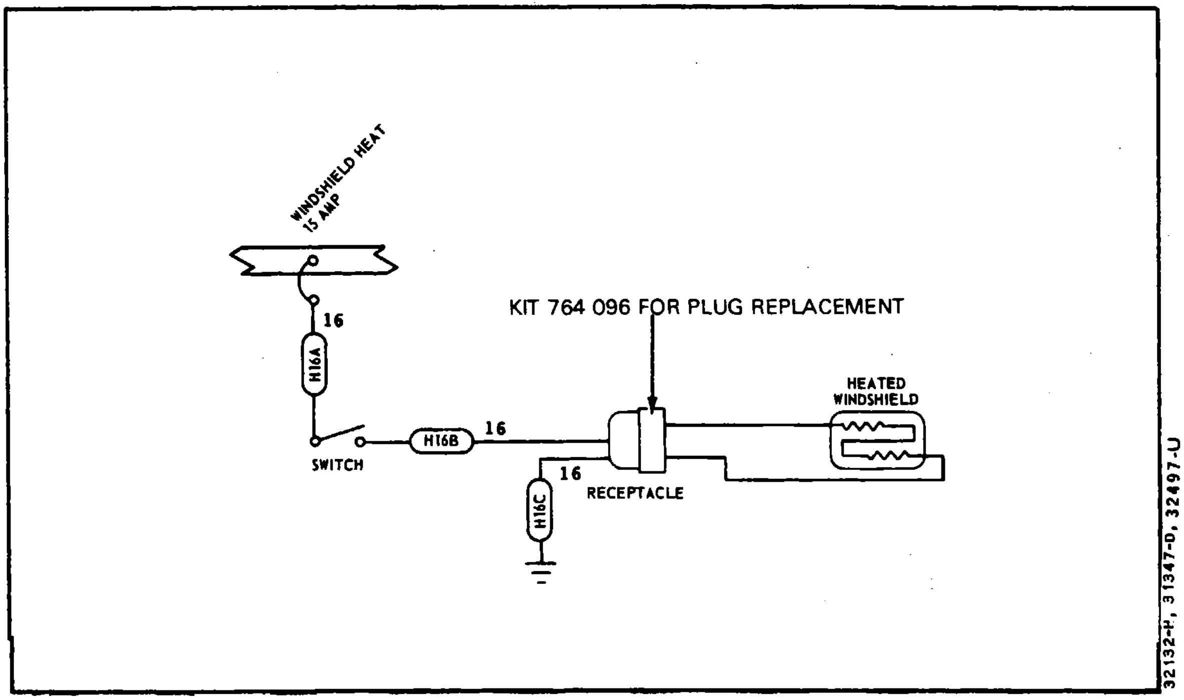


Figure 11-98. Heated Windshield Schematic
PA-23-250 (six place), Serial Nos. 27-2505 to 27-7554172 incl.

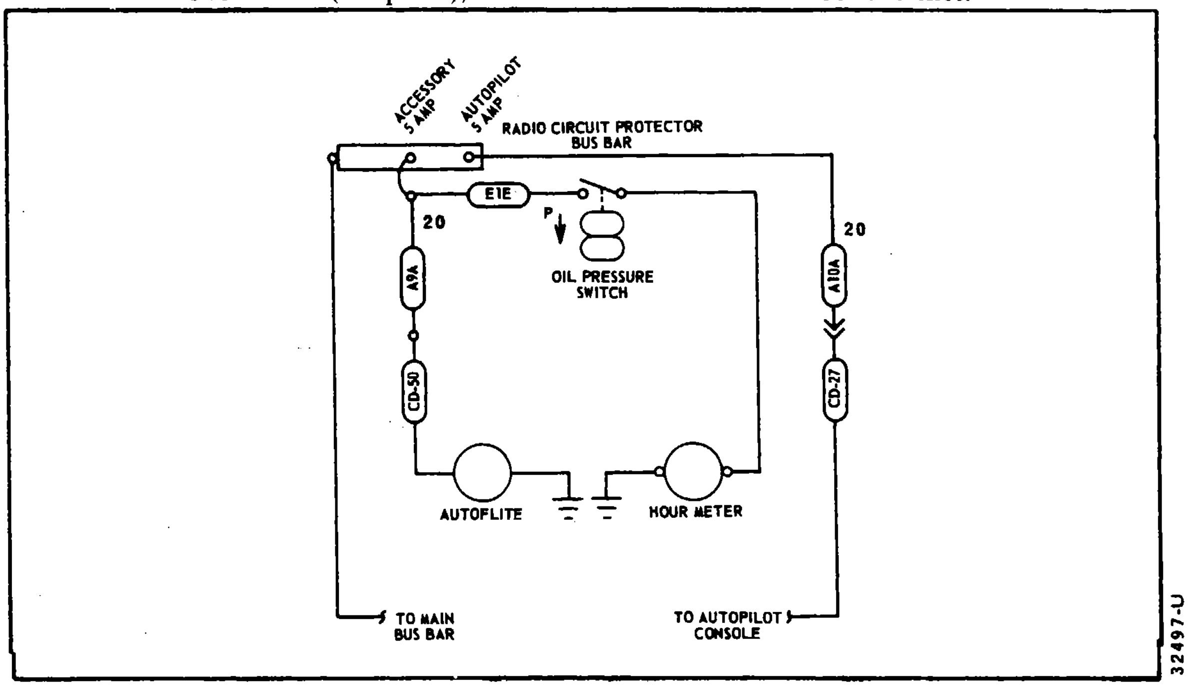


Figure 11-99. Accessory and AutoPilot Schematic
PA-23-250 (six place), Serial Nos. 27-3457 to 27-7554172 incl.

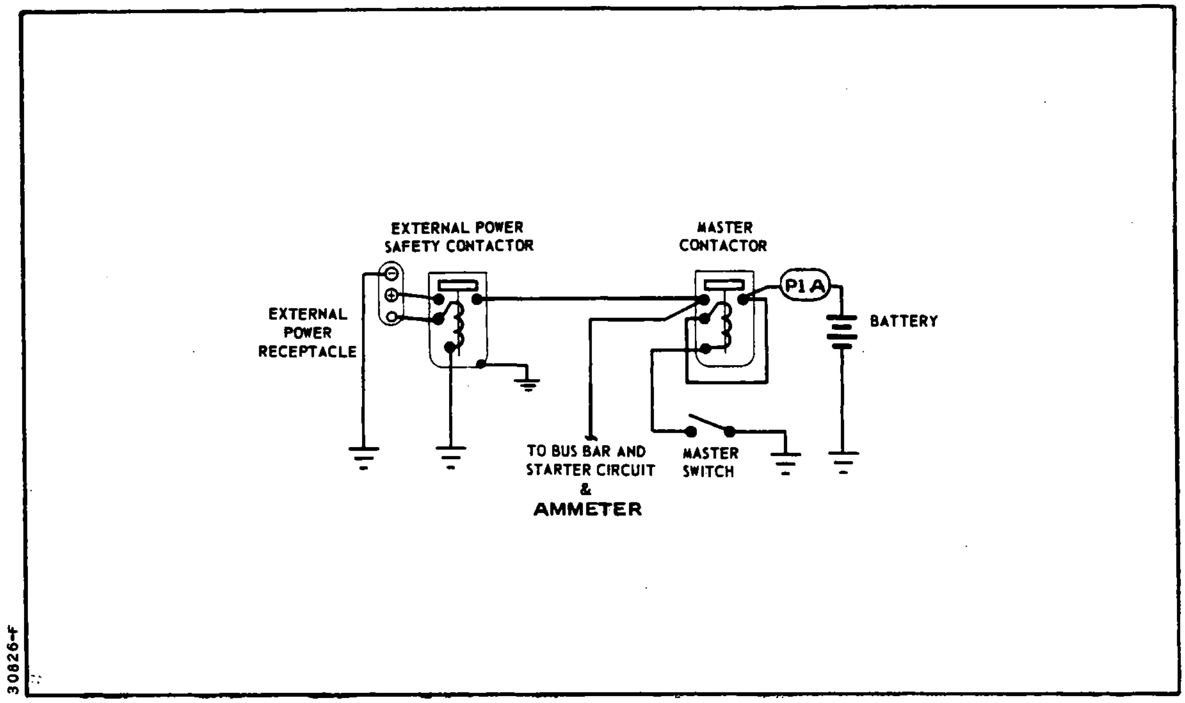


Figure 11-100. External Power Supply
PA-23-250 and PA-23-250 (six place)

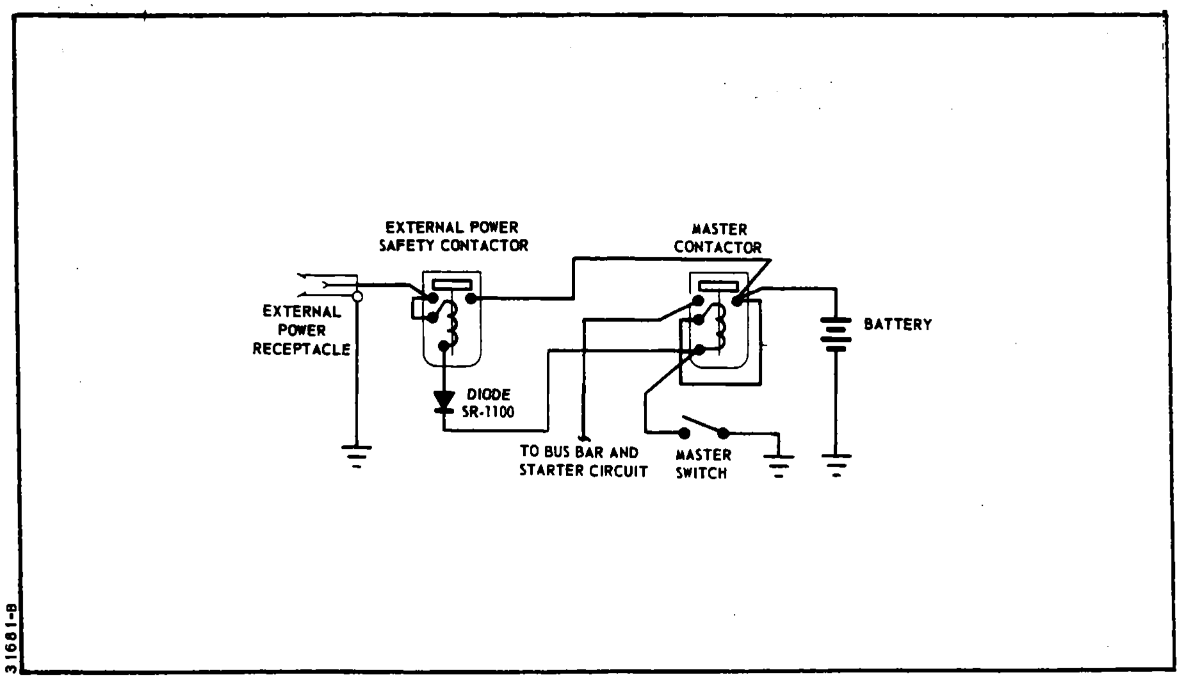


Figure 11-101. External Power Supply
PA-23-250 and PA-23-235

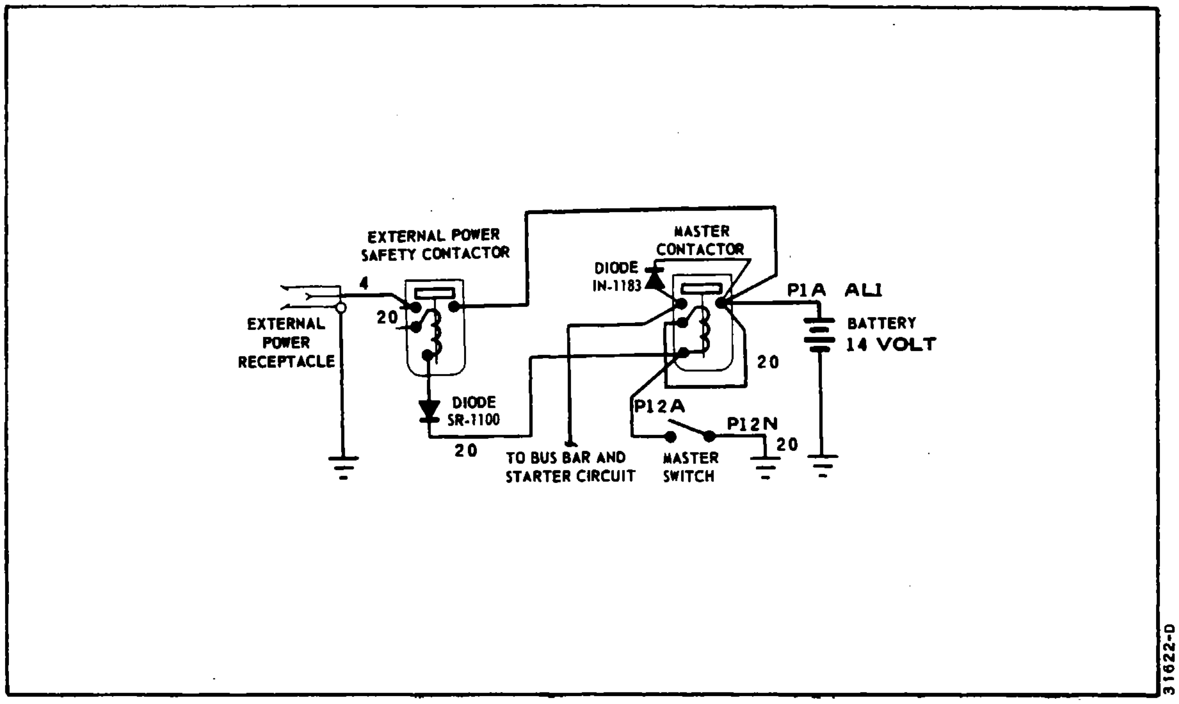


Figure 11-102. External Power Supply. PA-23-250 (six place)
Serial Nos. 27-2505 to 27-3836 incl. and 27-3838 to 27-3943 incl.

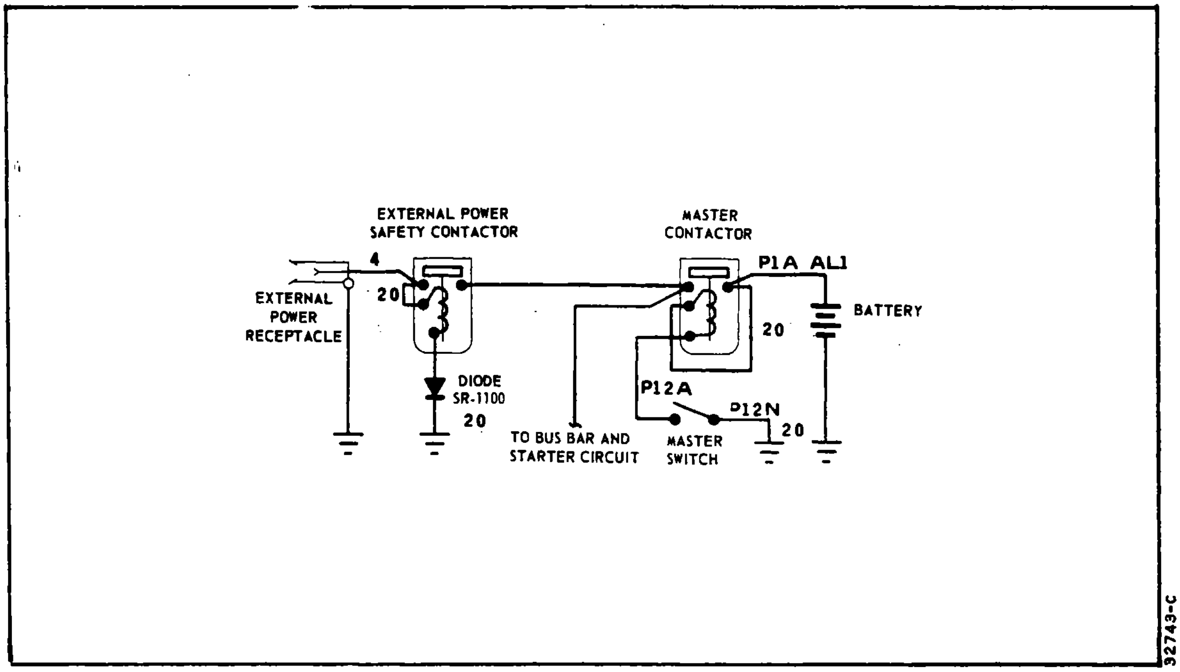


Figure 11-103. External Power Supply
PA-23-250 (six place), Serial Nos. 27-3837, 27-3944 to 27-7554172 incl.

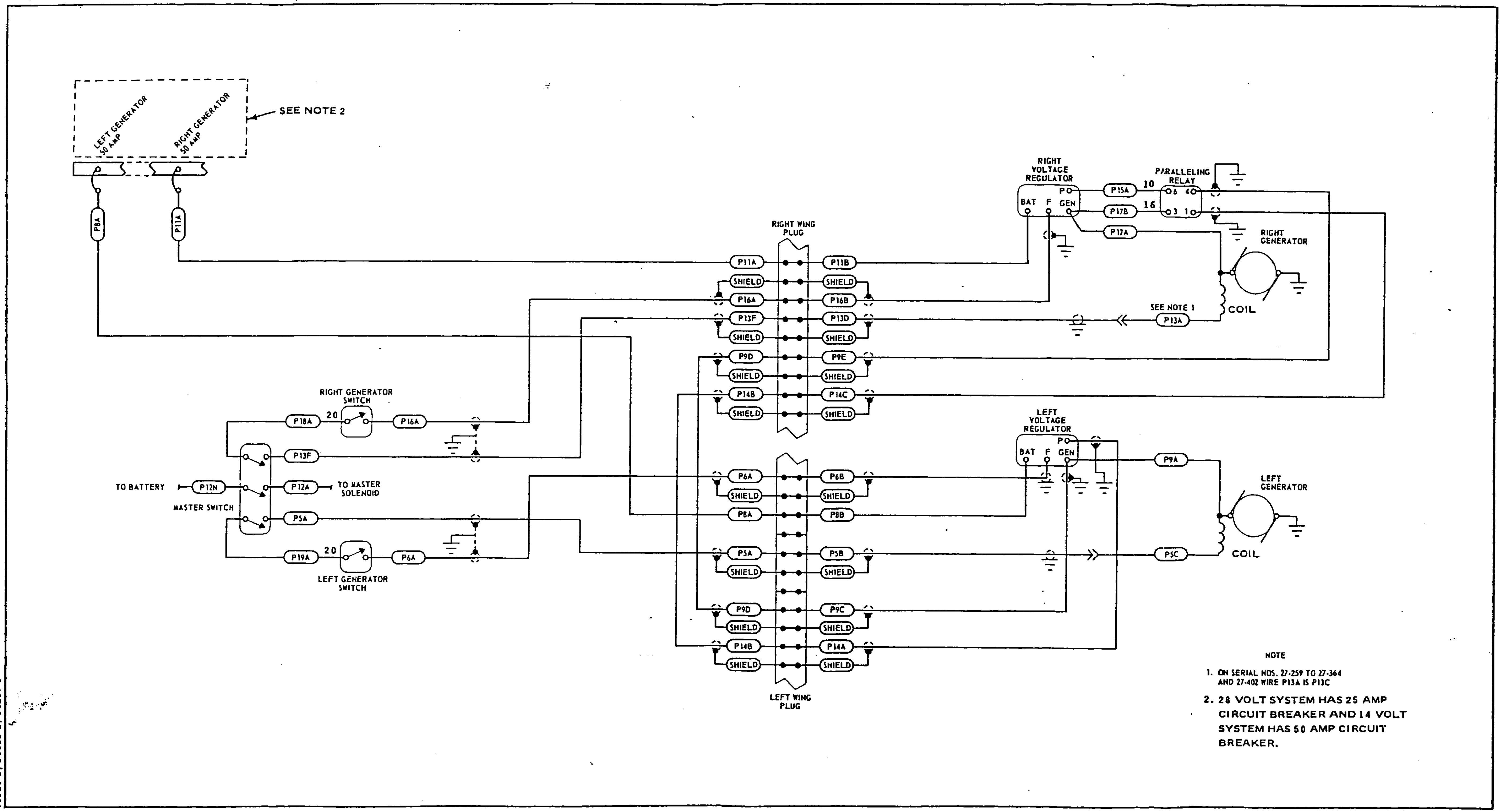


Figure 11-104. Generator System Schematic (Delco-Remy, 14-volt and 28-volt), PA-23-250 and PA-23-235

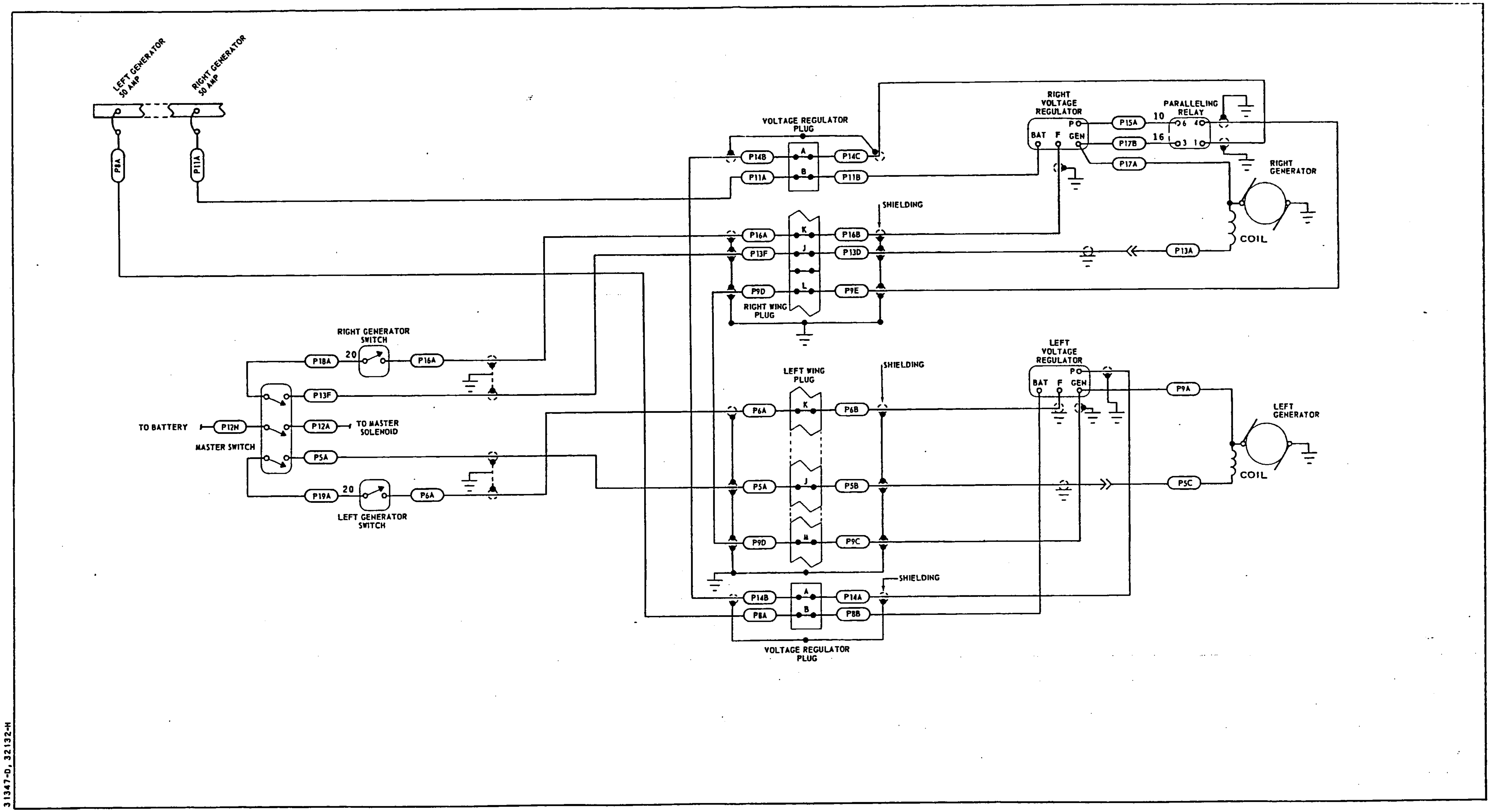


Figure 11-105. Generator System Schematic (Delco-Remy, 14-volt and 28-volt), PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.

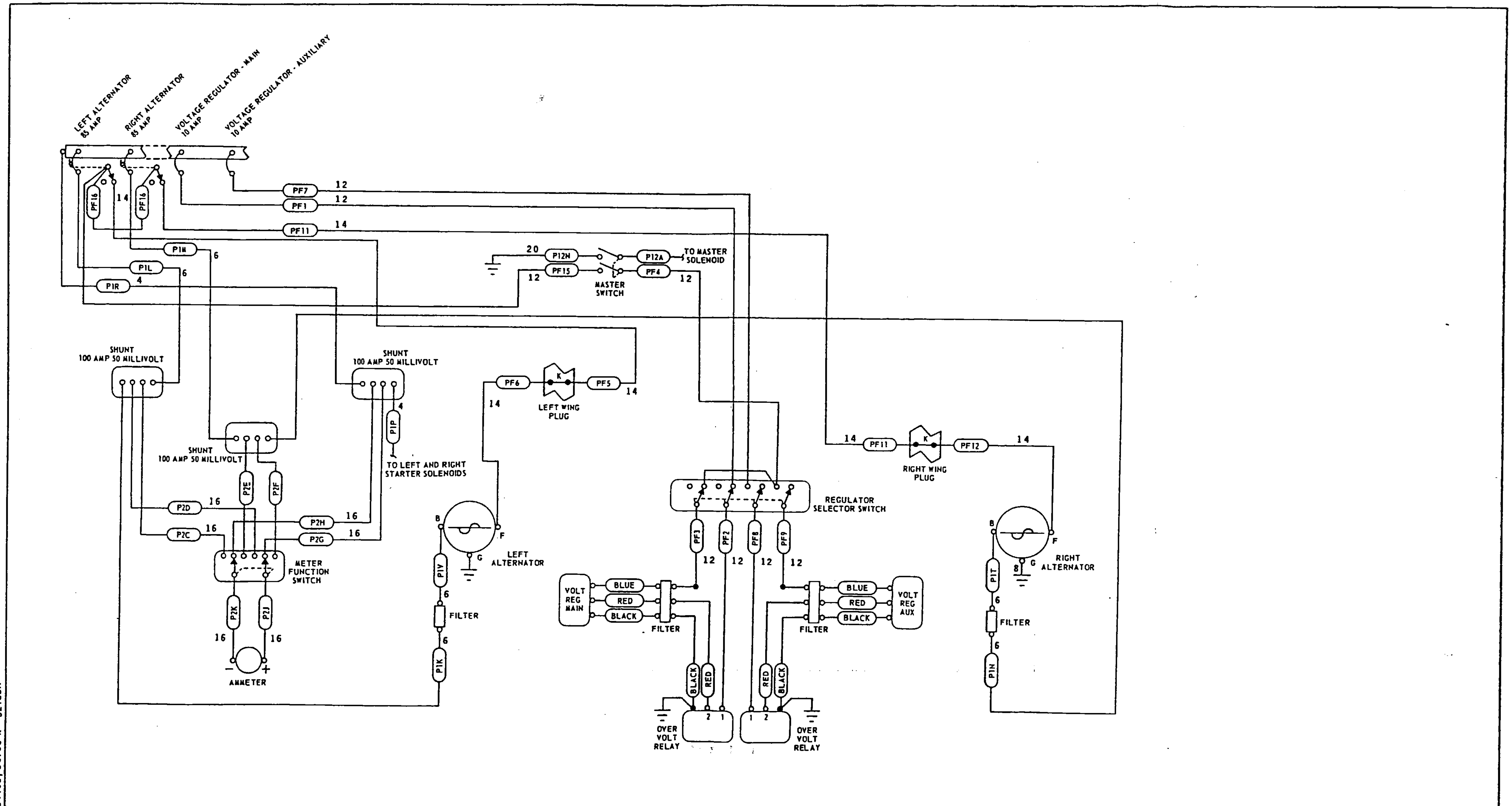
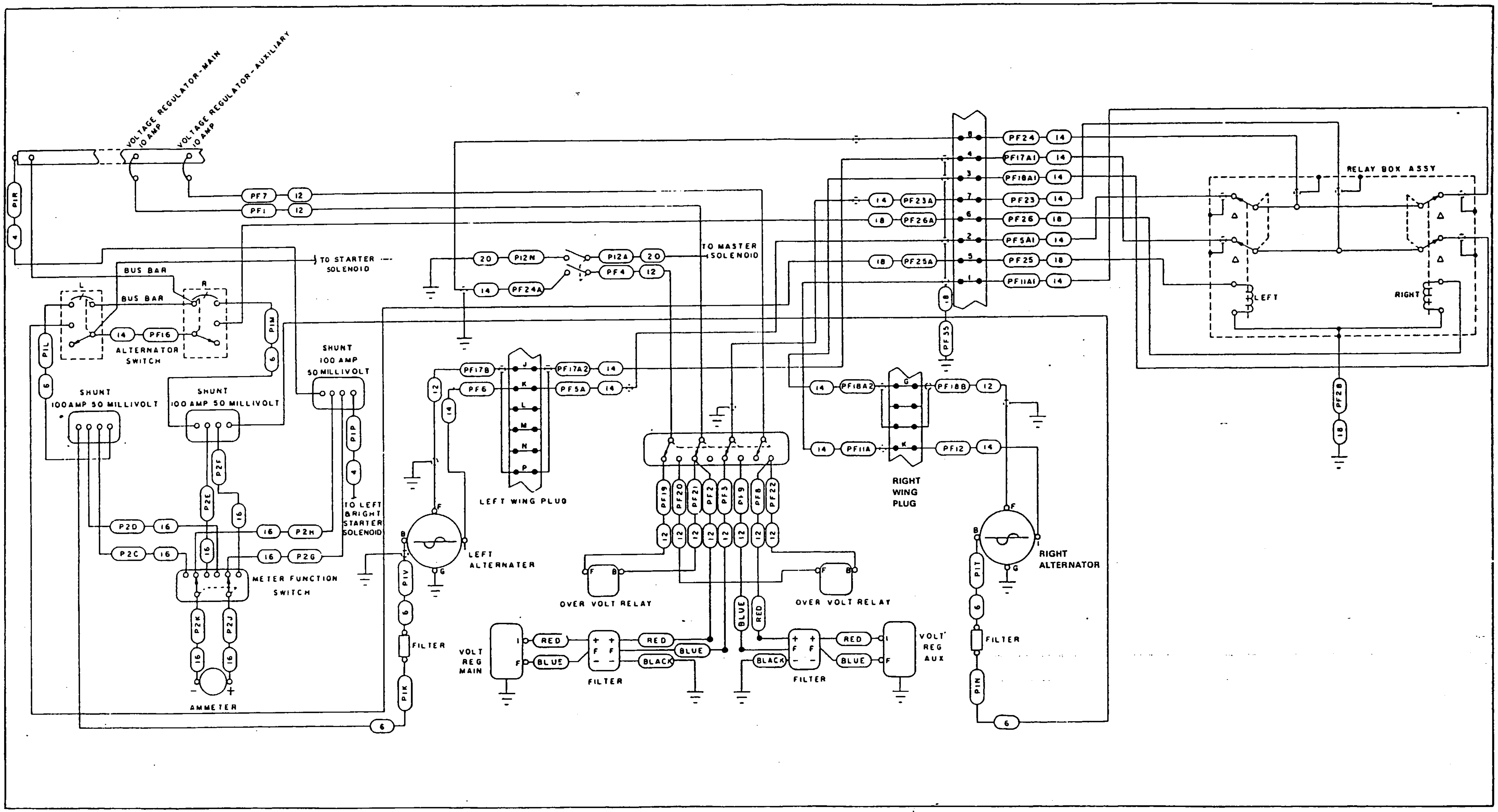
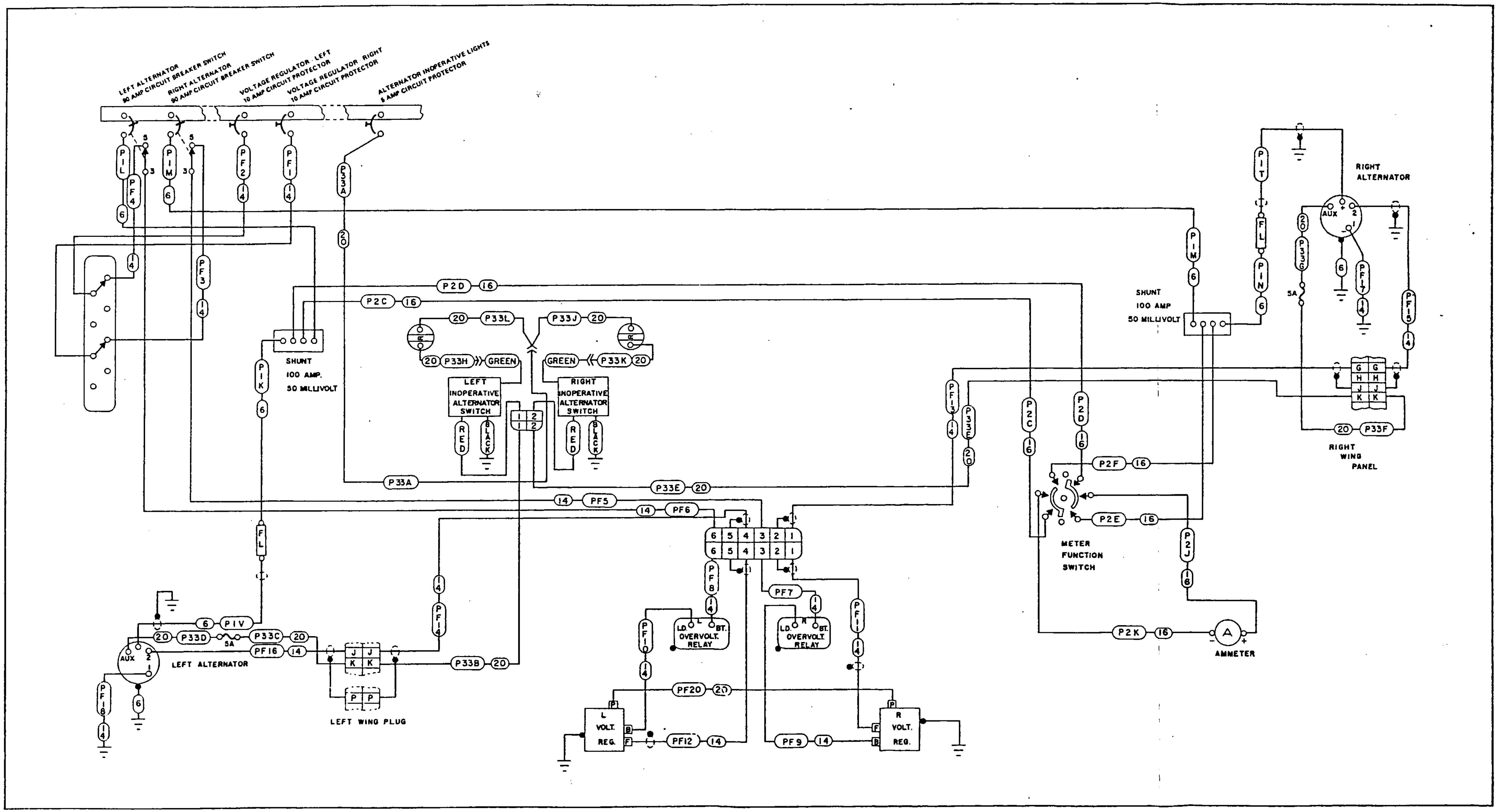


Figure 11-106. Alternator System Schematic (Delco-Remy), PA-23-250 (six place)
Serial Nos. 27-2505 to 27-3836 incl. and 27-3838 to 27-3943 incl.



32497-K

Figure 11-107. Alternator System Schematic (Prestolite), PA-23-250 (six place)
Serial Nos. 27-3837, 27-3944 to 27-4793



32497-U

Figure 11-108. Alternator Paralleling System Schematic (Prestolite), PA-23-250 (six place), Serial Nos. 27-5006 to 27-7554172 incl.

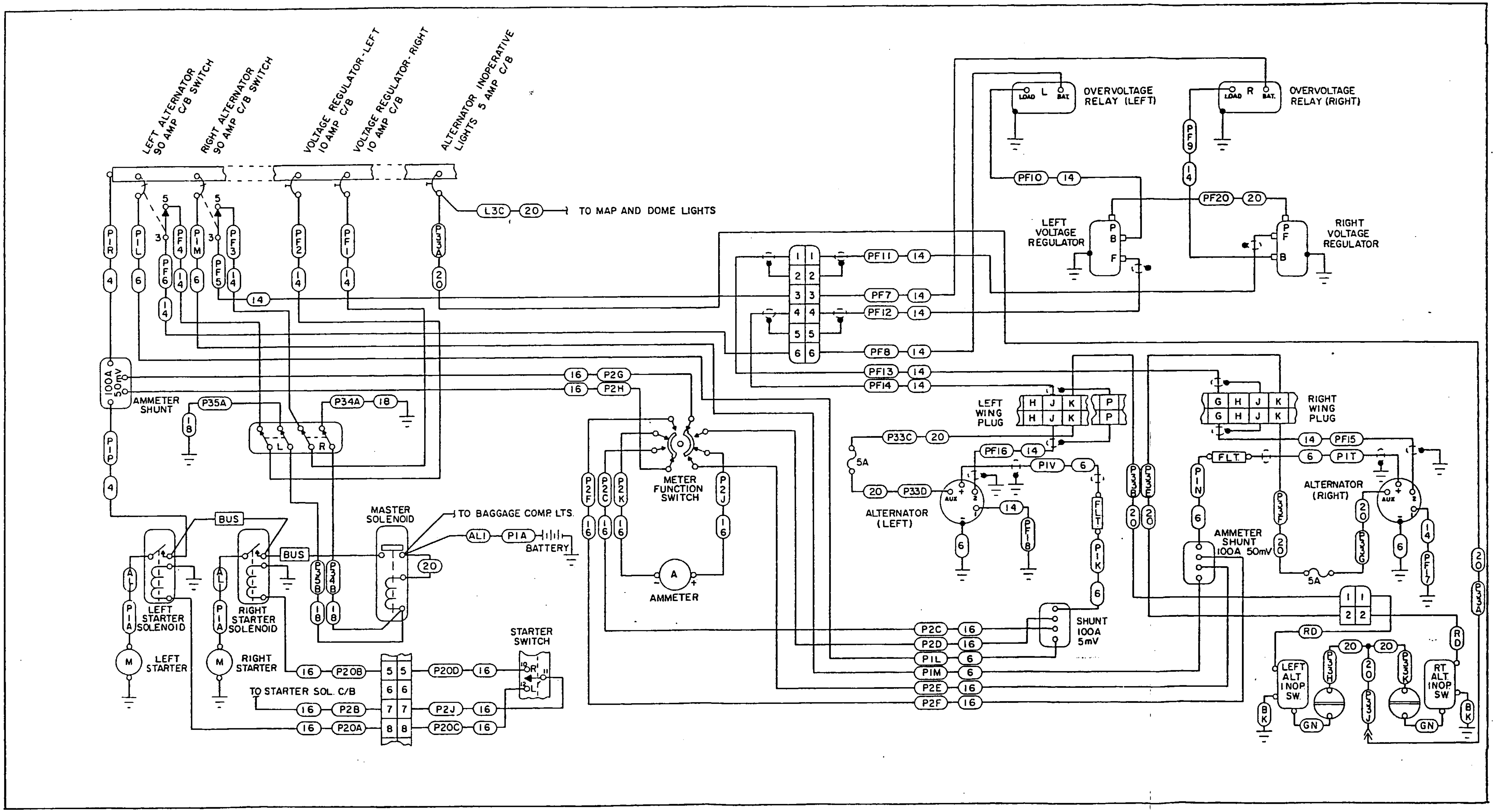
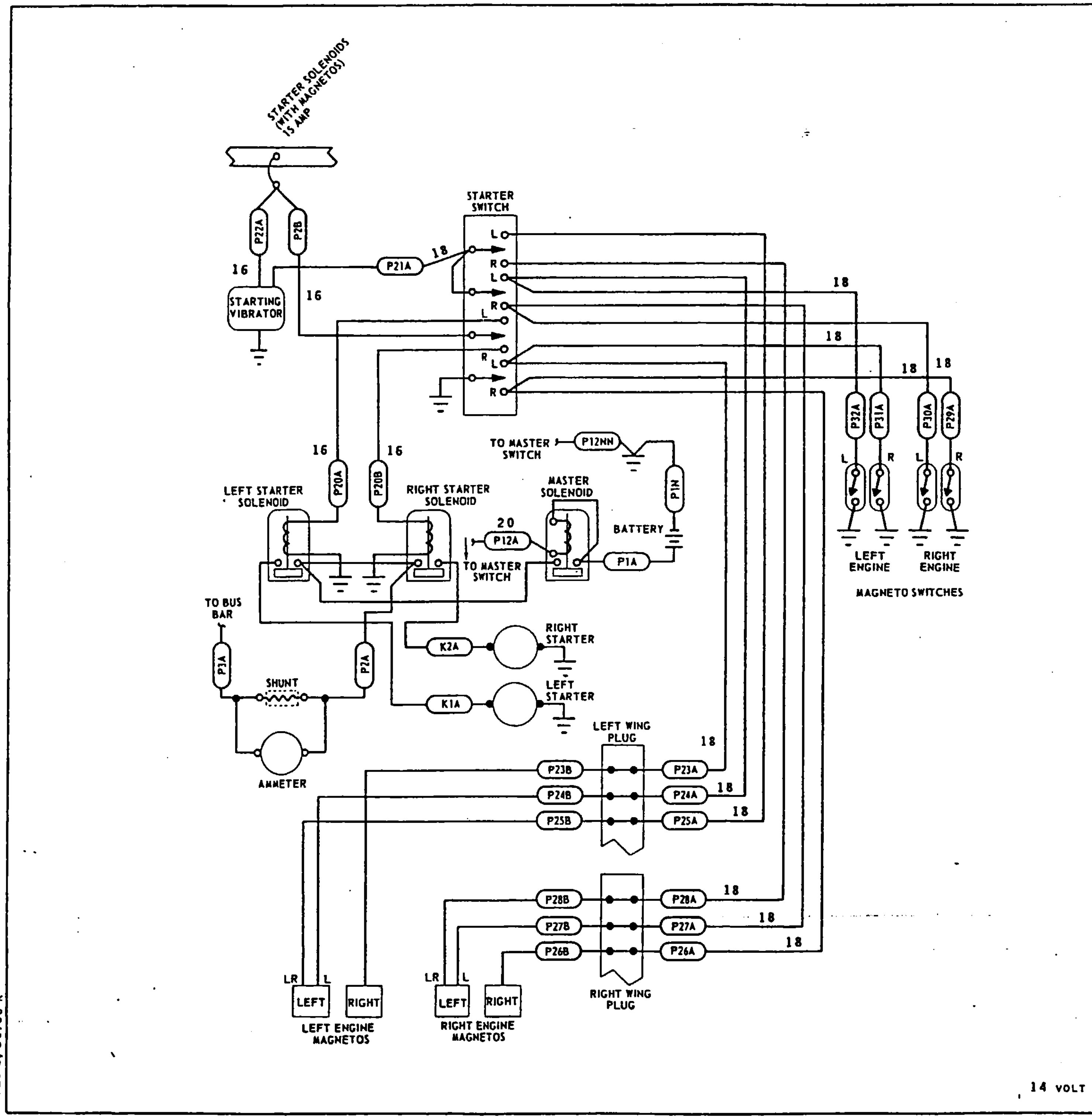


Figure 11-109. Alternator Paralleling System Schematic (Prestolite), PA-23-250 (six place), Serial Nos. 27-4794 to 27-5005



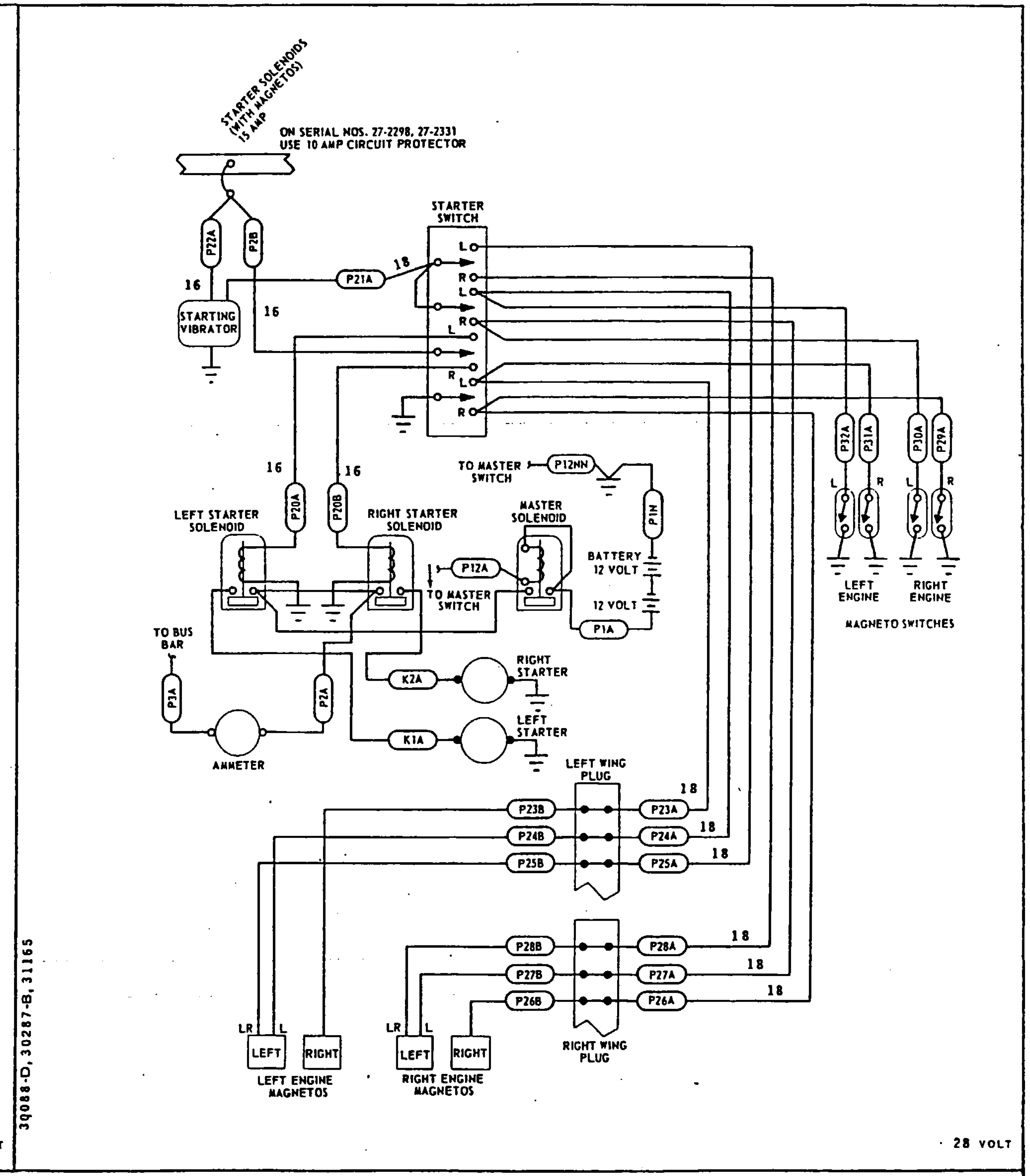


Figure 11-110. Starter System Schematic (Delco-Remy, 14-volt and 28-volt), PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.

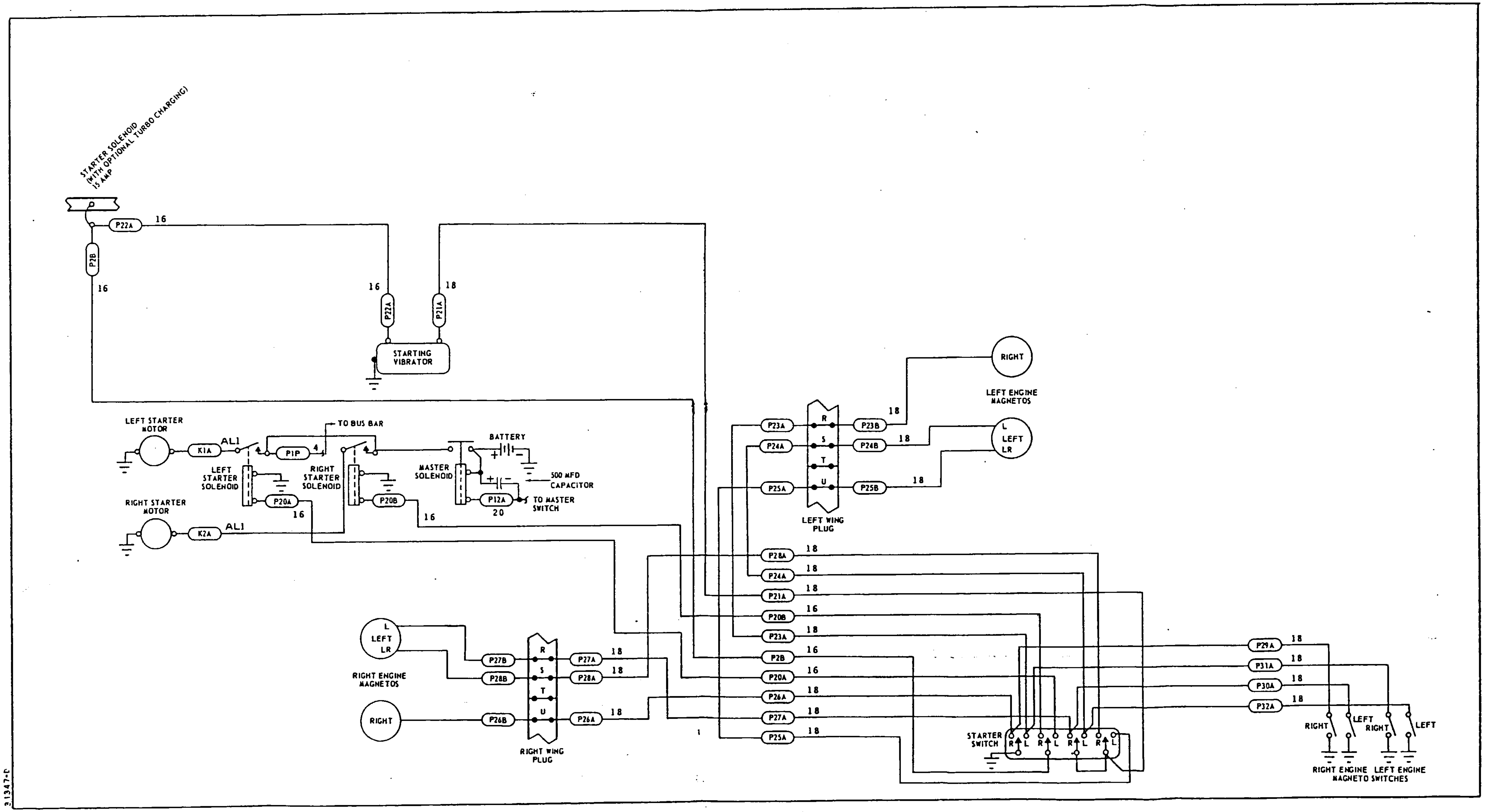


Figure 11-111. Starter System Schematic (Delco-Remy), PA-23-250 (six place), Serial Nos. 27-2505 to 27-3831 incl.

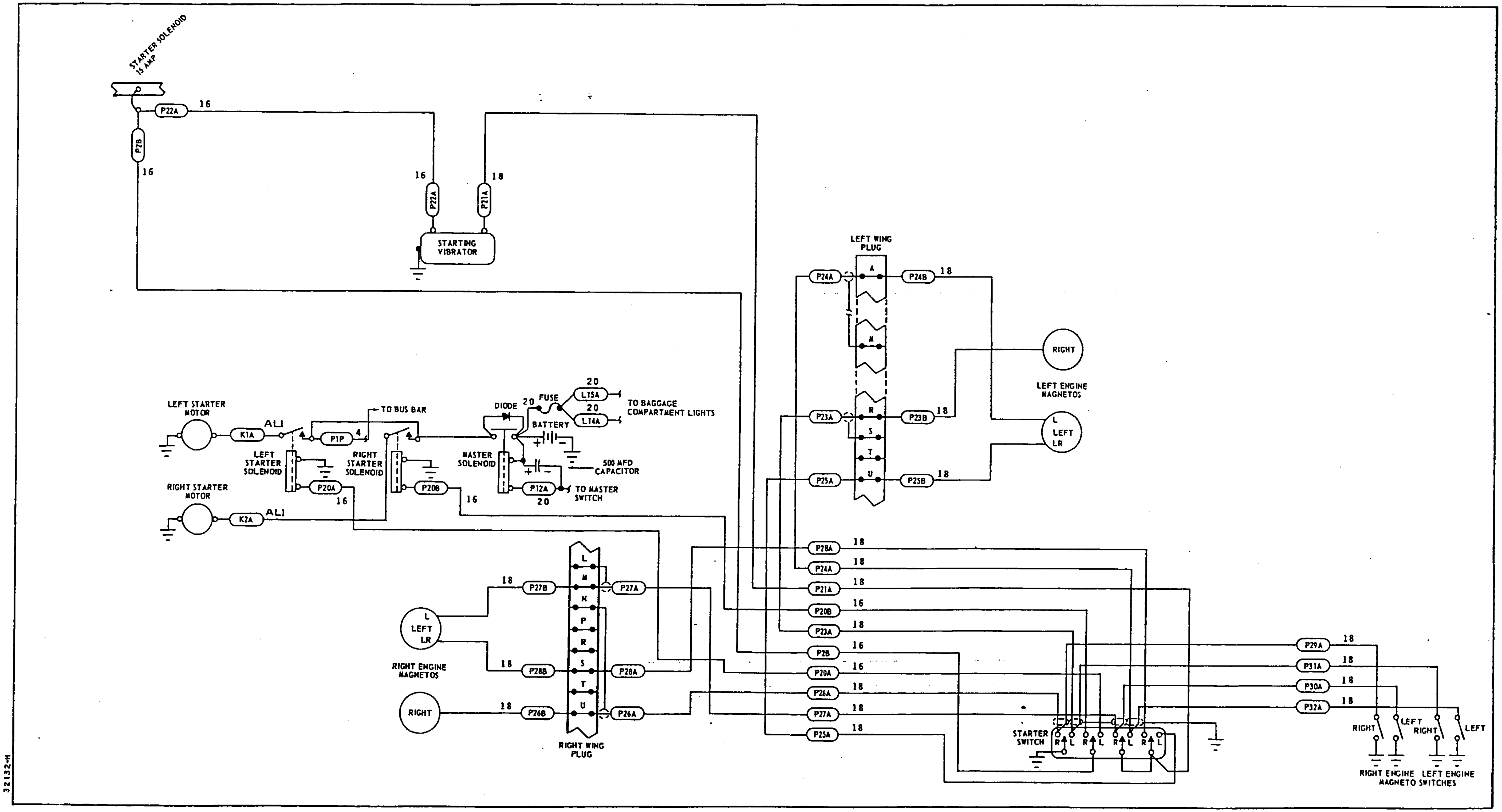


Figure 11-112. Starter System Schematic (Delco-Remy), PA-23-250 (six place), Serial Nos. 27-2505 to 27-3836 incl. and 27-3838 to 27-3943 incl.

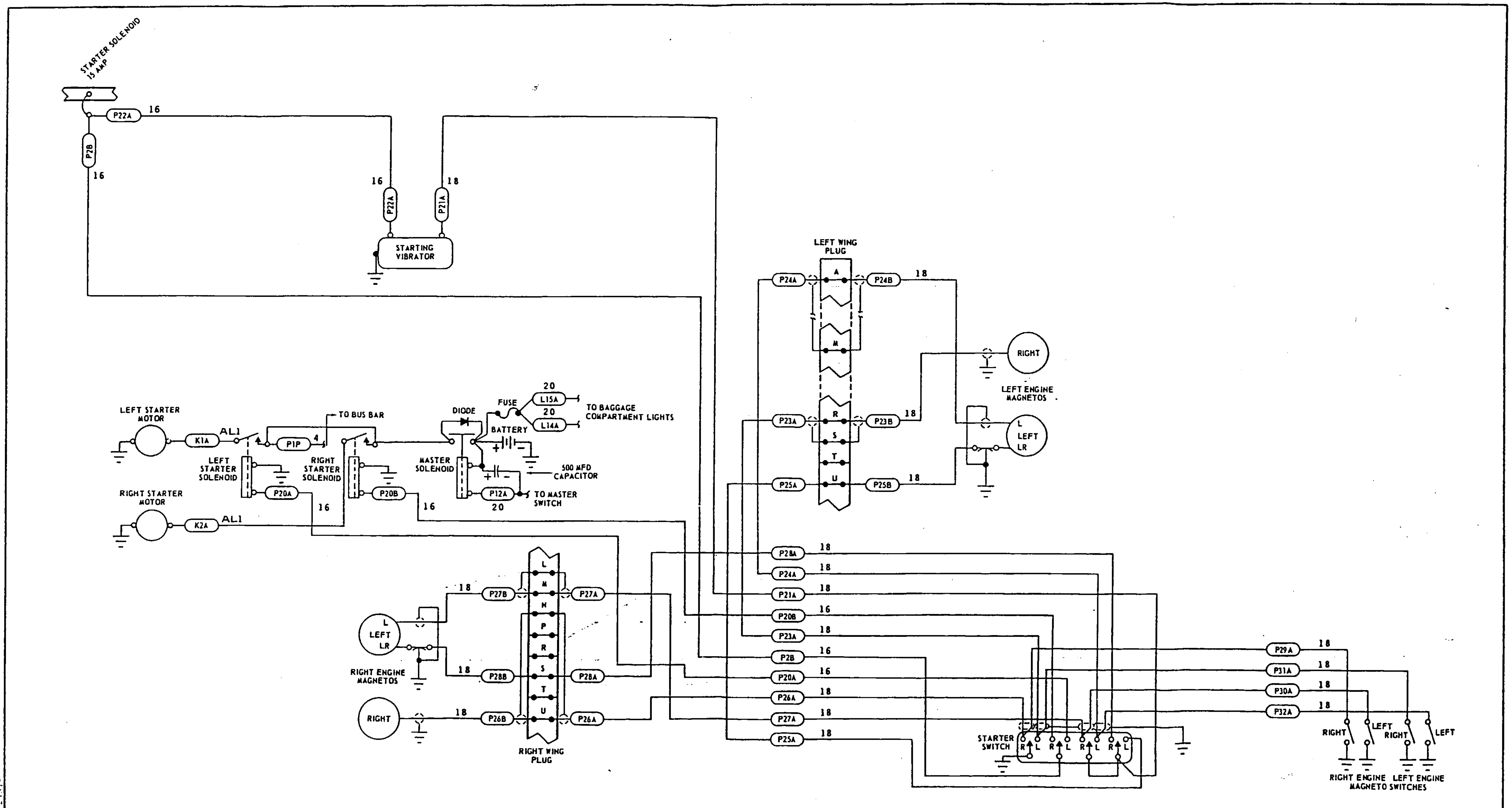


Figure 11-113. Starter System Schematic (Delco-Remy), PA-23-250 (six place), Serial Nos. 27-2505 to 27-3836 incl. and 27-3838 to 27-3943 incl. with AiResearch Turbocharger Starter System Schematic

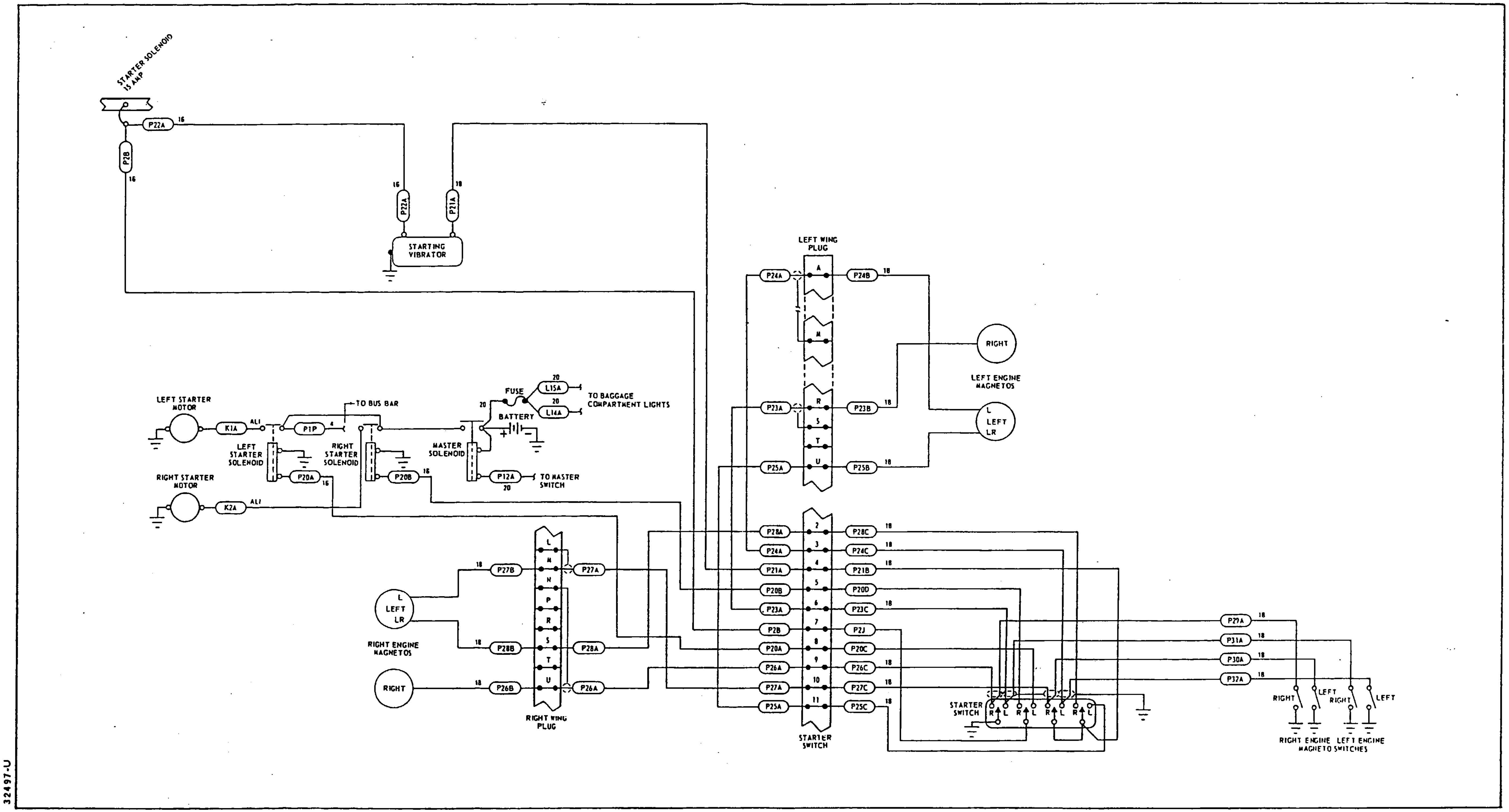


Figure 11-114. Starter System Schematic (Prestolite), PA-23-250 (six place), Serial Nos. 27-3837, 27-3944 to 27-7554172 incl.

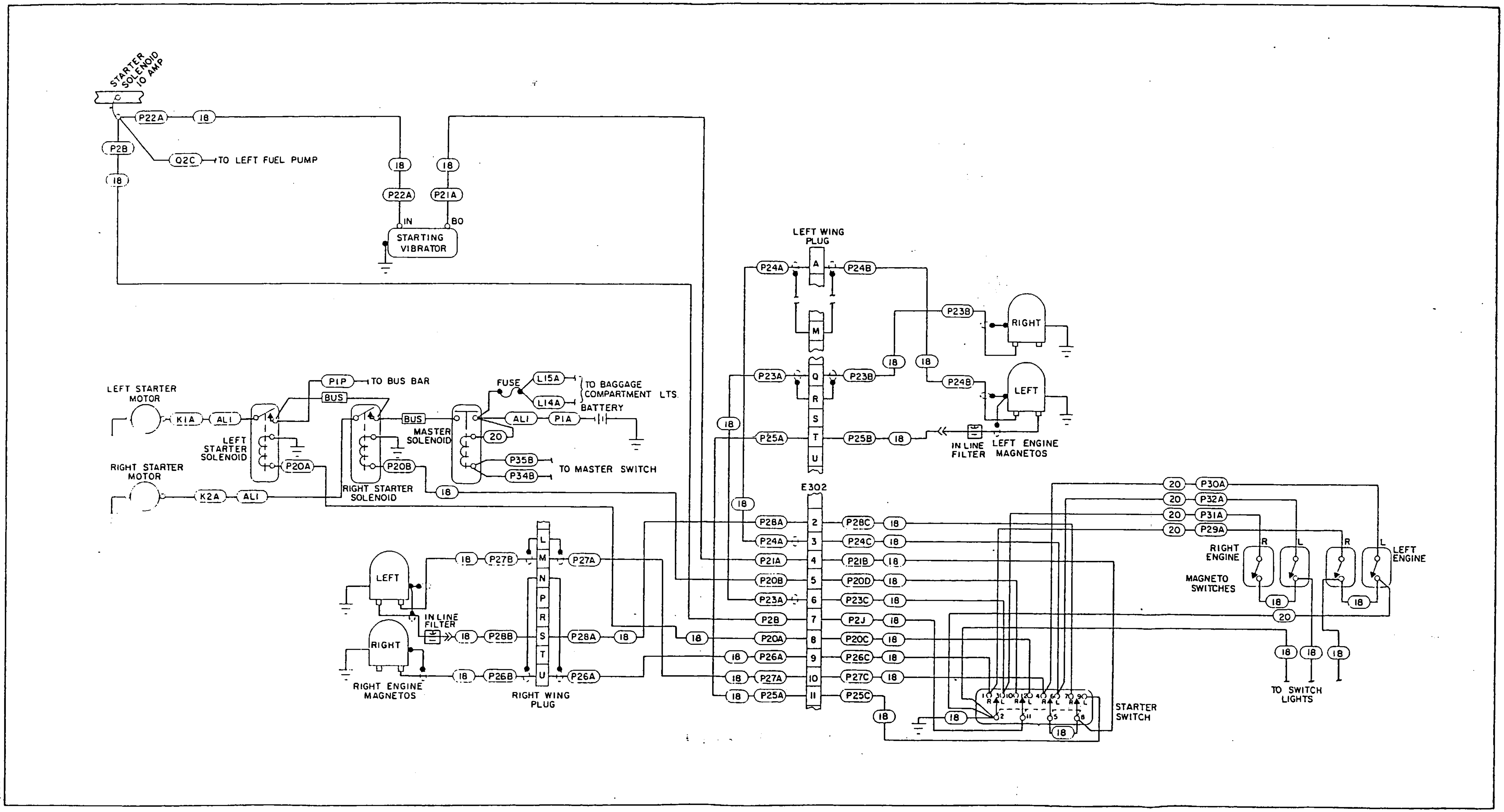


Figure 11-115. Starter System Schematic (Prestolite), PA-23-250 (six place) "F" Model
Serial Nos. 27-7654001 and up (Earlier Models)

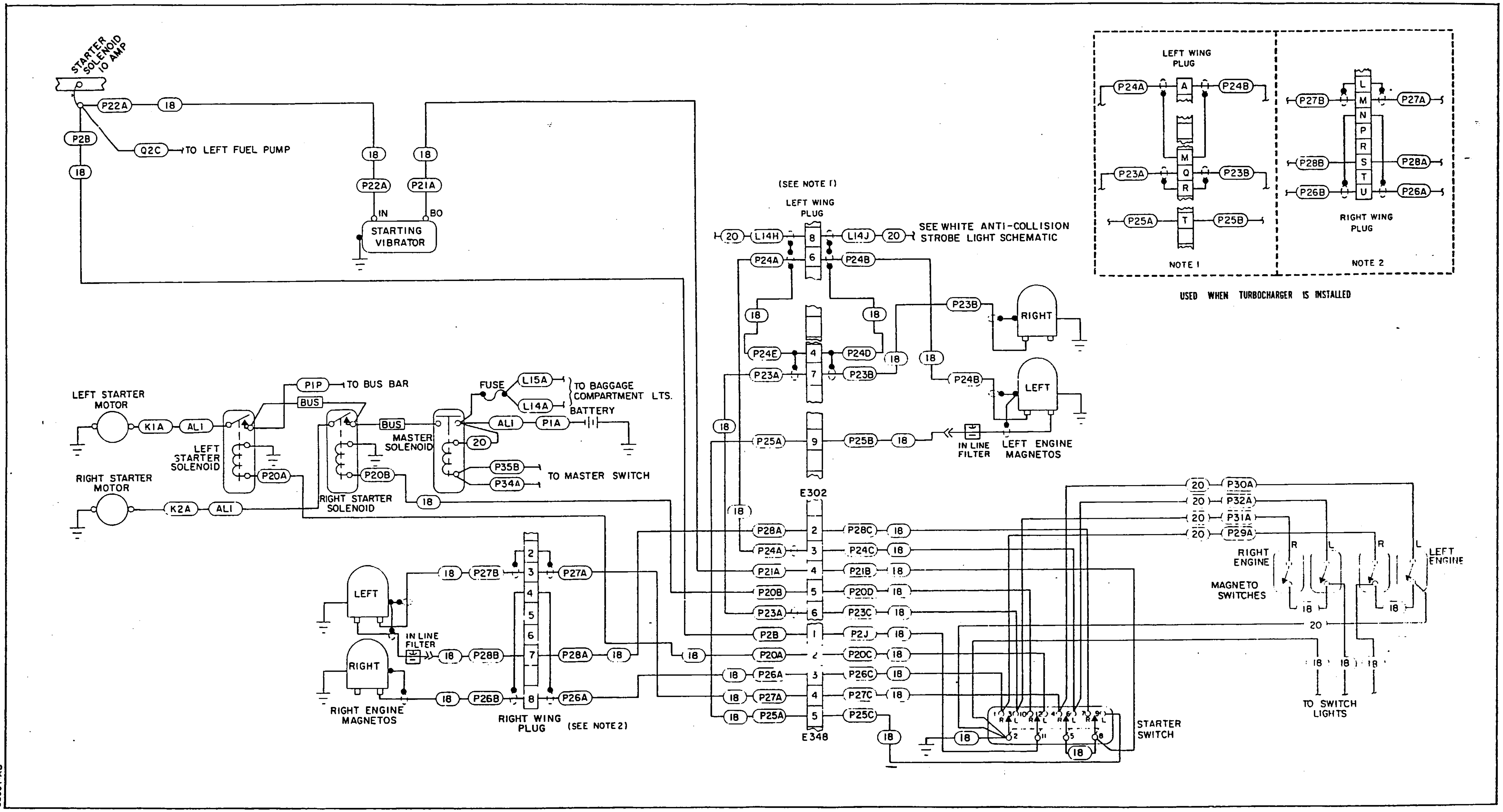


Figure 11-116. Starter System Schematic (Prestolite), PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Later Models)

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INTENTIONALLY
LEFT
BLANK

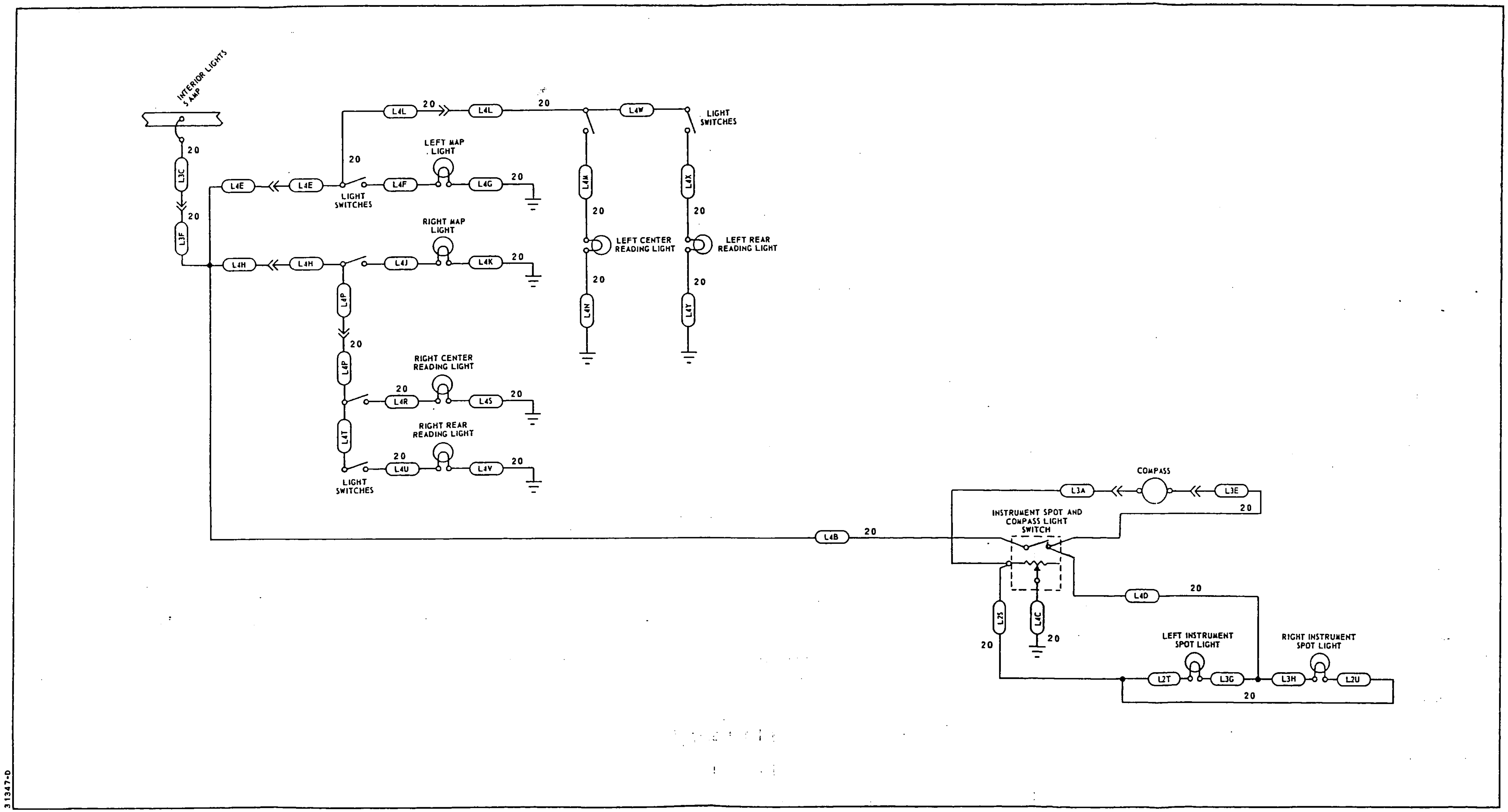


Figure 11-117. Interior Lights Schematic, PA-23-250 (six place), Serial Nos. 27-2505 to 27-3153 incl.

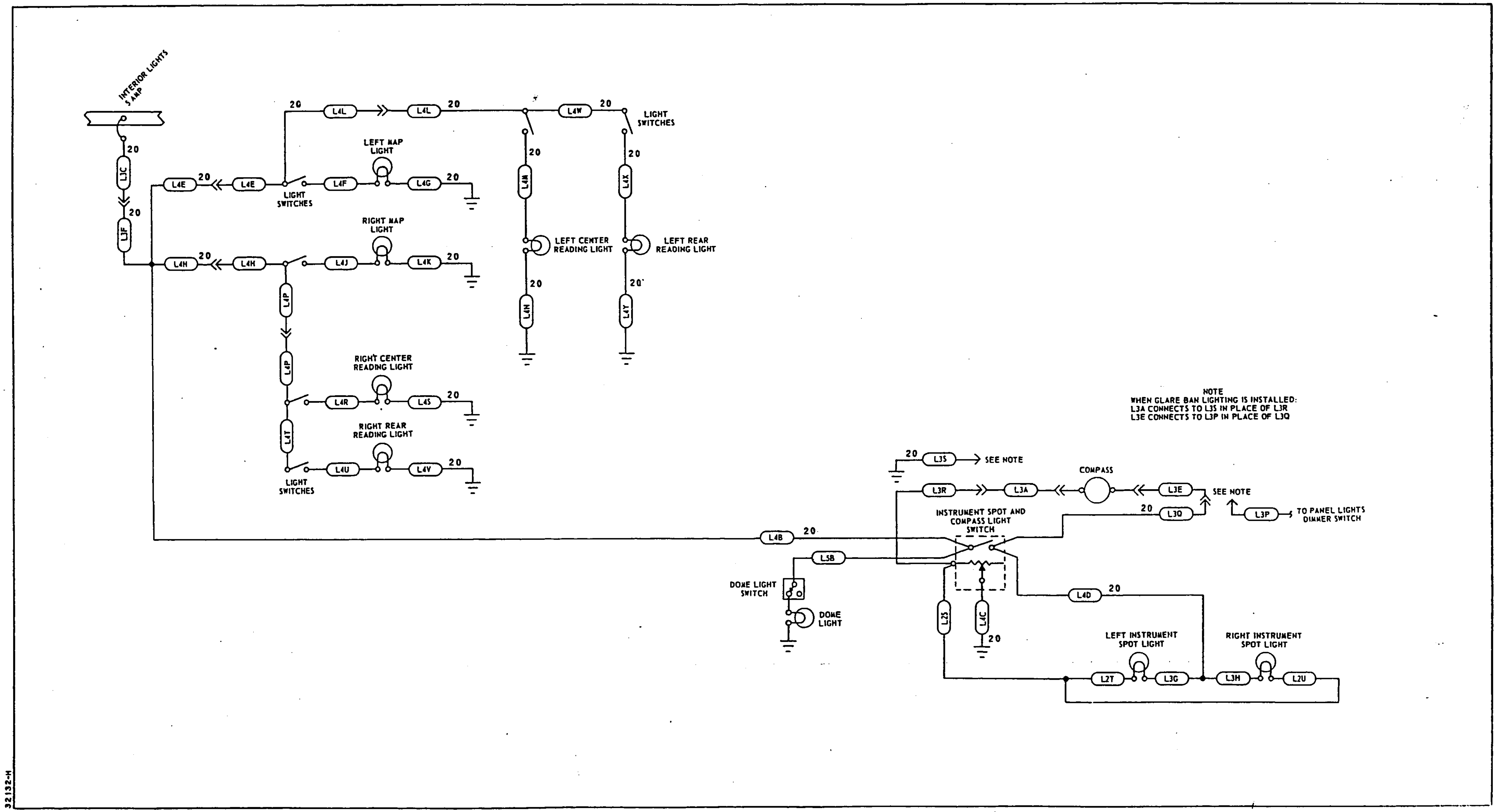


Figure 11-118. Interior Lights Schematic, PA-23-250 (six place), Serial Nos. 27-3154 to 27-3836 incl. and 27-3838 to 27-3943 incl.

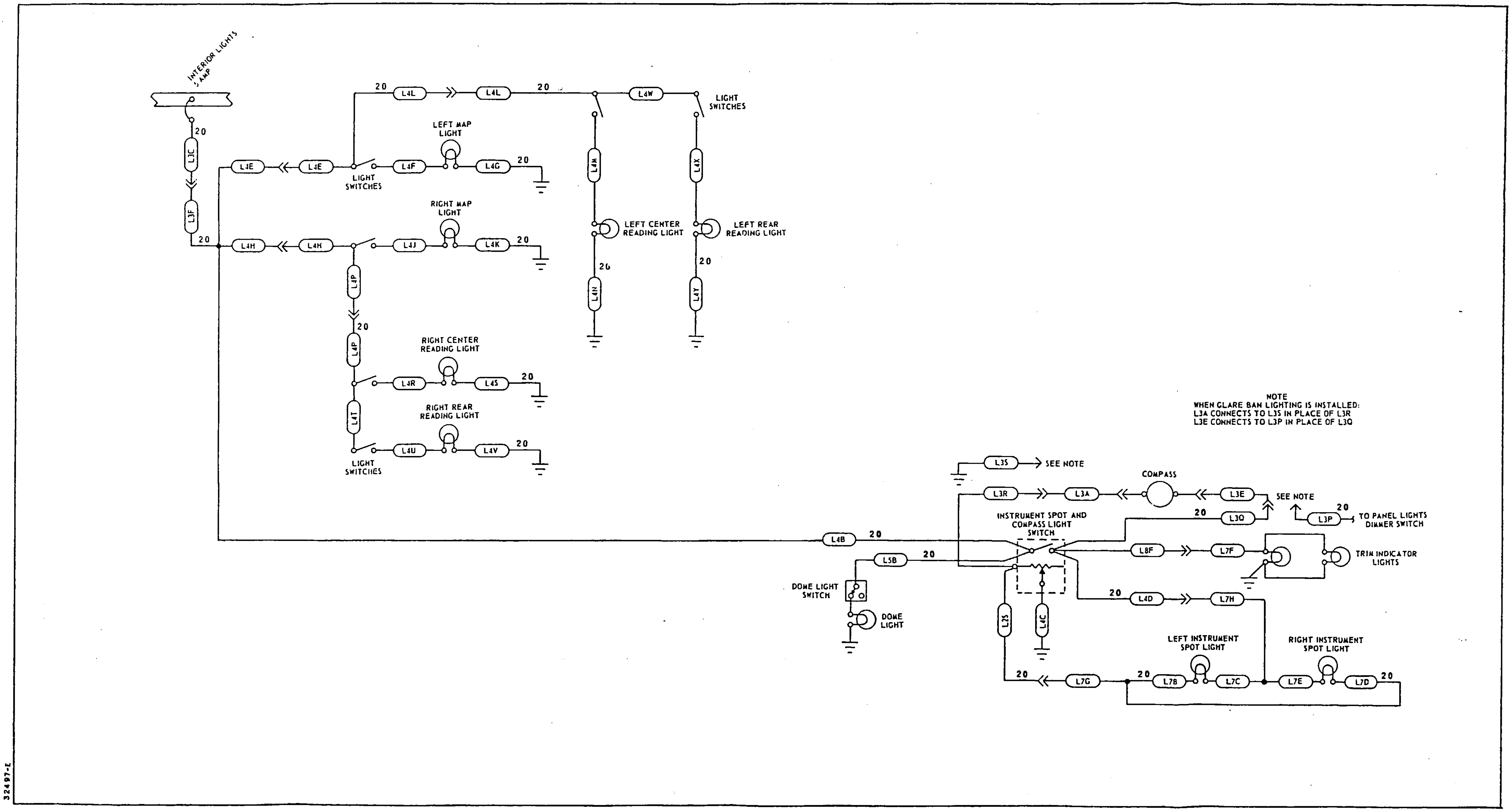


Figure 11-119. Interior Lights Schematic, PA-23-250 (six place),
Serial Nos. 27-3837, 27-3944 to 27-4766 incl.

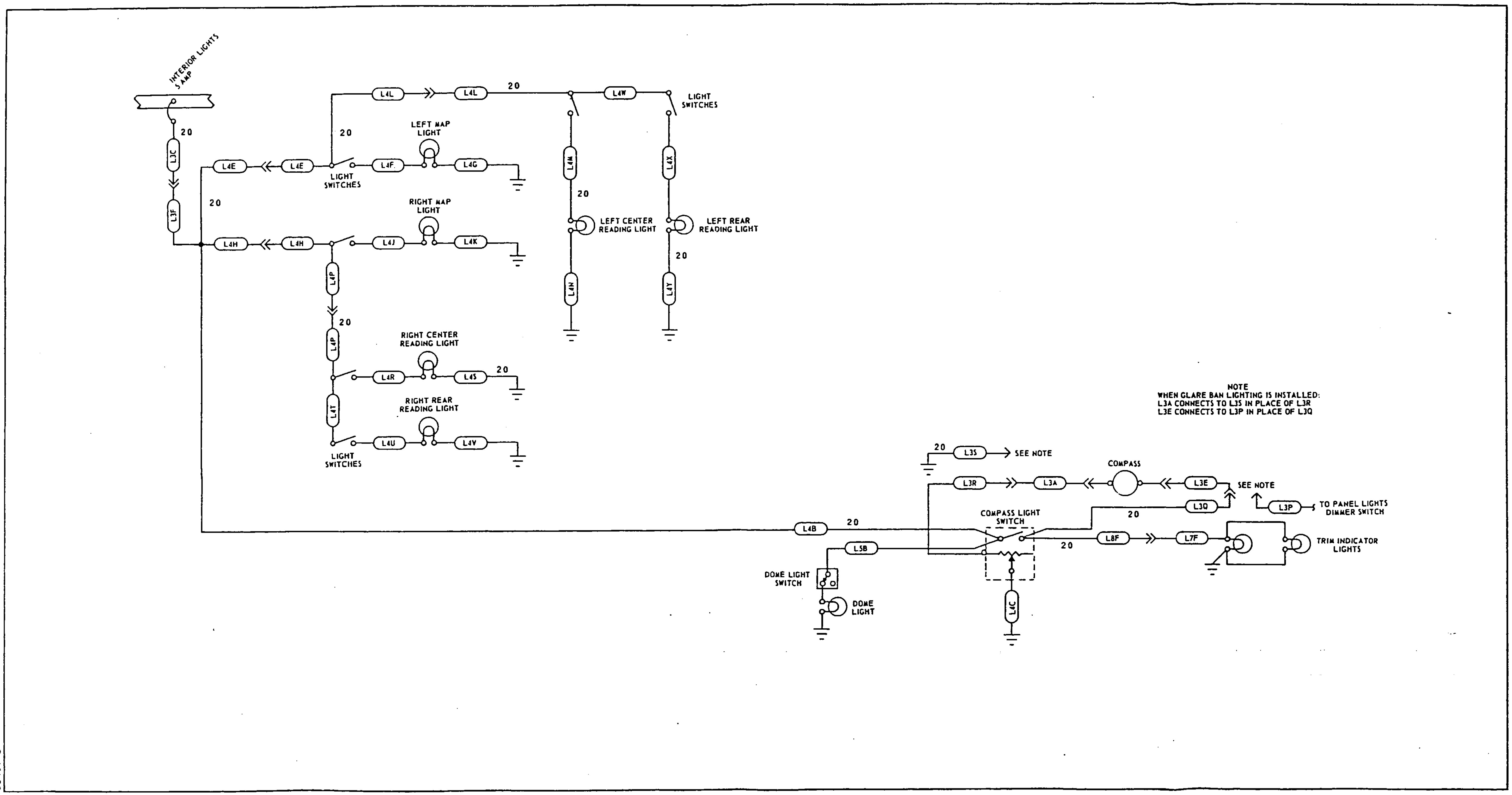


Figure 11-120. Interior Lights Schematic, PA-23-250 (six place), Serial Nos. 27-4767 to 27-7554172 incl.

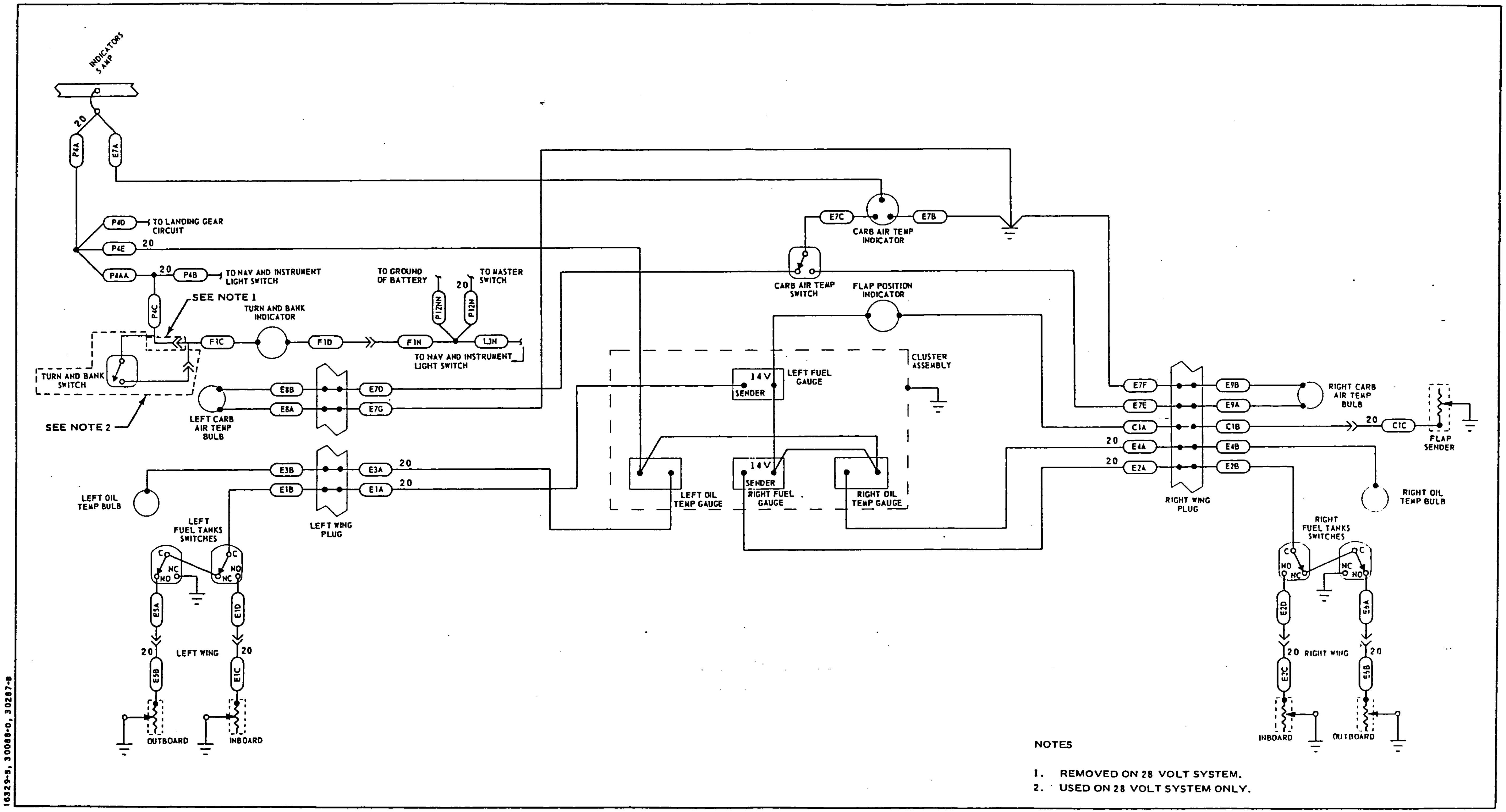


Figure 11-121. Instrument Cluster Wiring Schematic (14-volt and 28-volt systems), PA-23-250 and PA-23-235

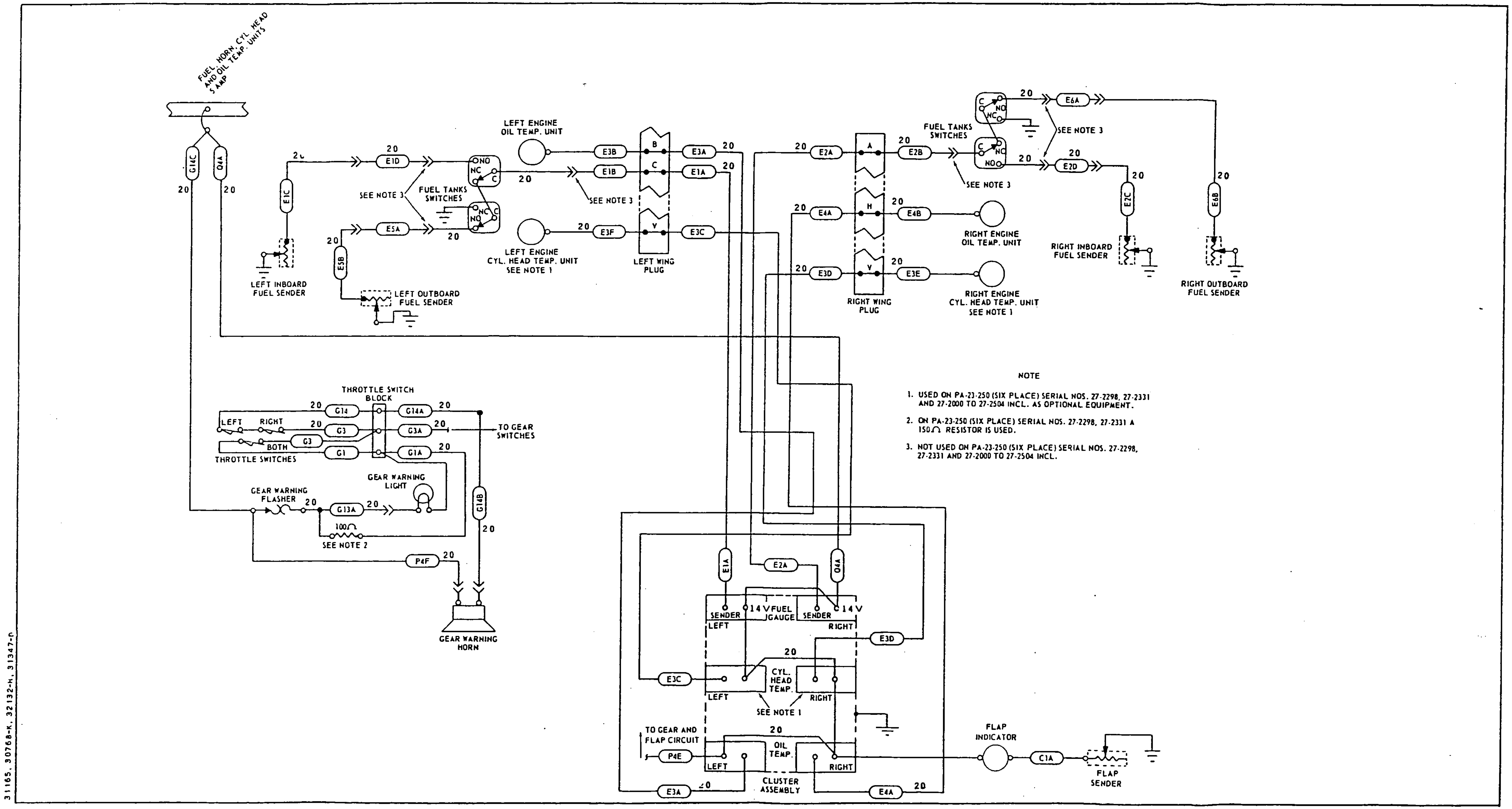


Figure 11-122. Instrument Cluster Wiring Schematic (14-volt and 28-volt systems), PA-23-250 (six place), Serial Nos. 27-2000 to 27-3837 incl. and 27-3838 to 27-3943 incl.

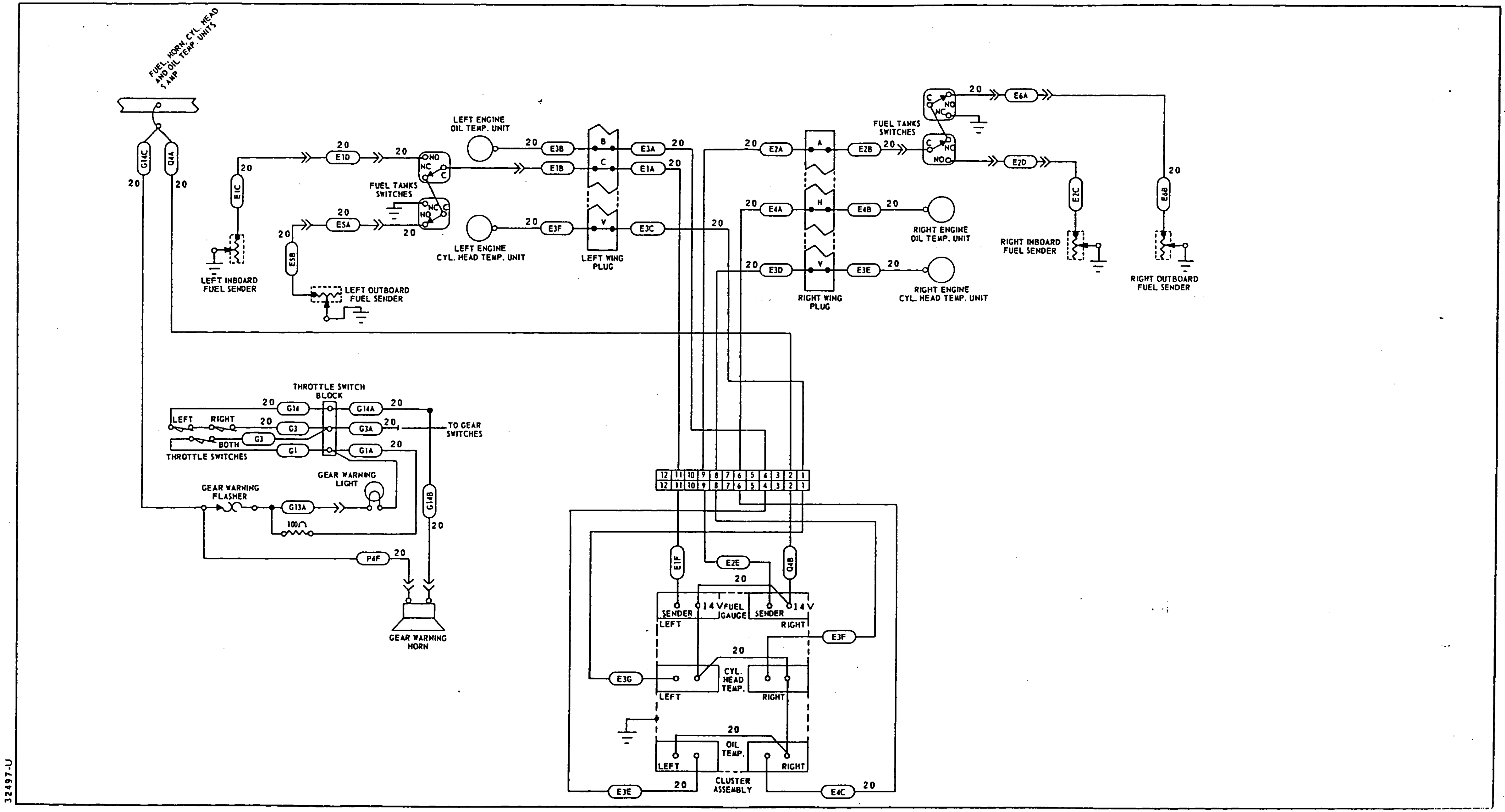
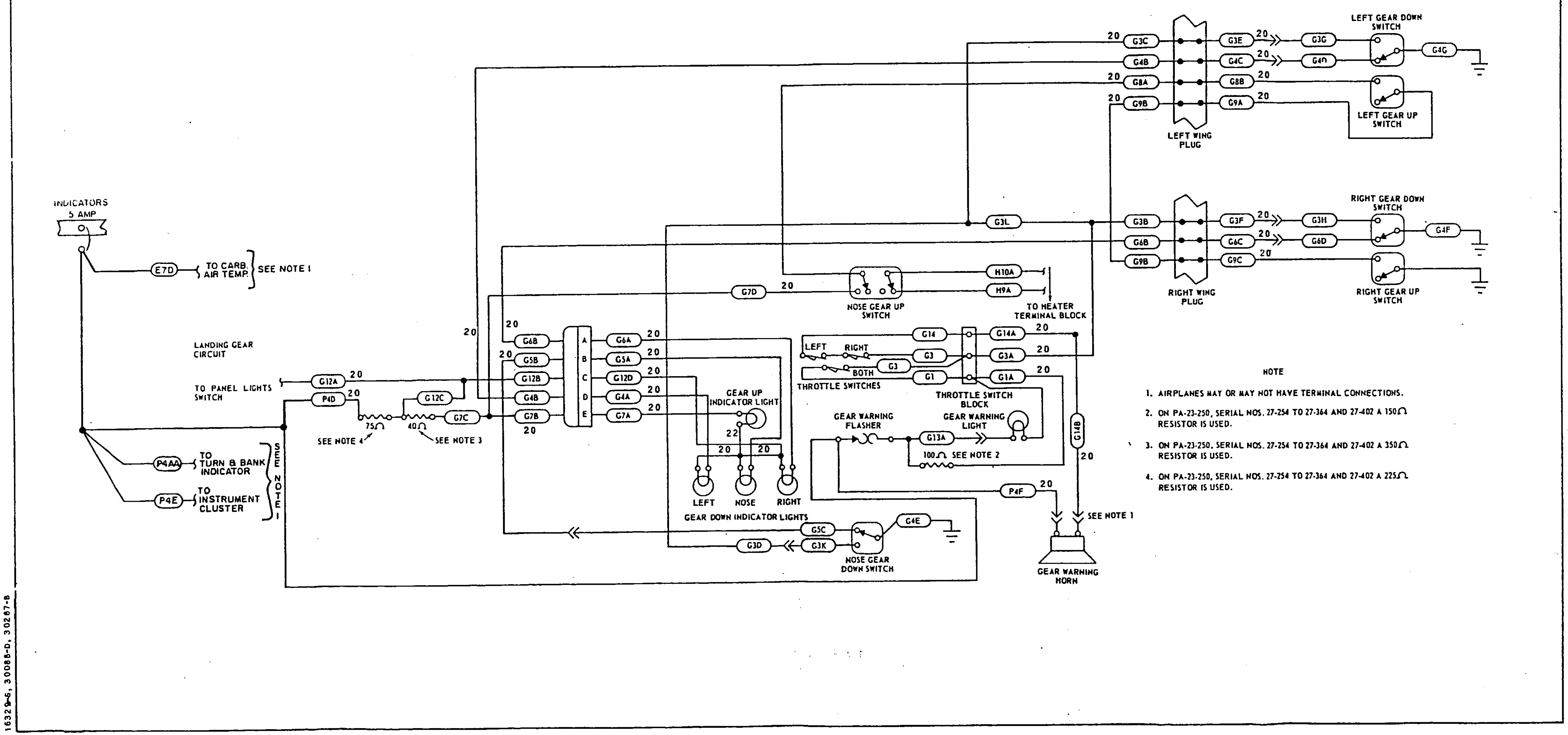


Figure 11-123. Instrument Cluster Wiring Schematic, PA-23-250 (six place), Serial Nos. 27-3837, 27-3944 to 27-7554172 incl.



16329-6, 30088-D, 30287-B

Figure 11-124. Landing Gear and Flap System Schematic, PA-23-250 and PA-23-235

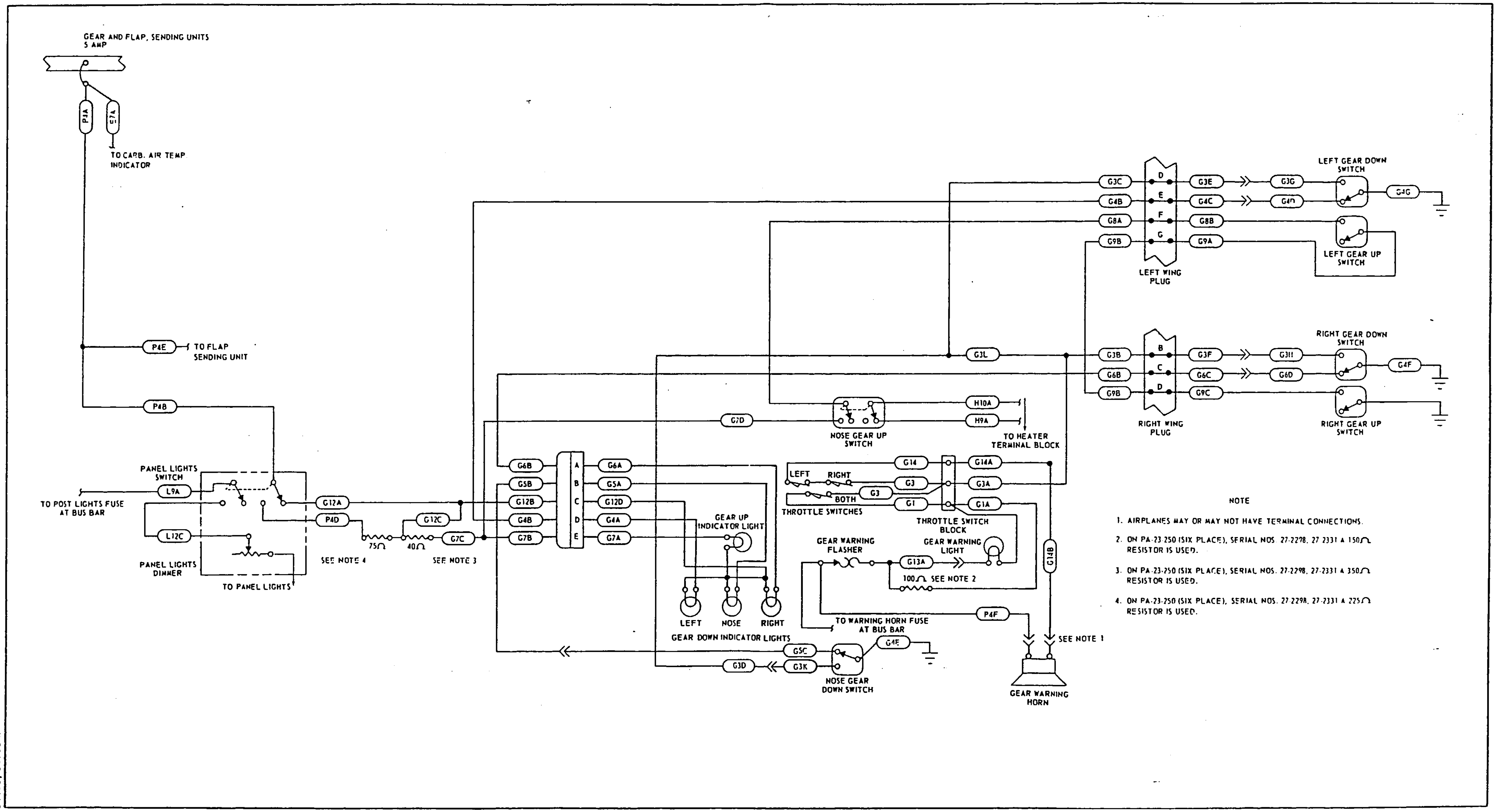


Figure 11-125. Landing Gear and Flap System Schematic (14-volt and 28-volt), PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.

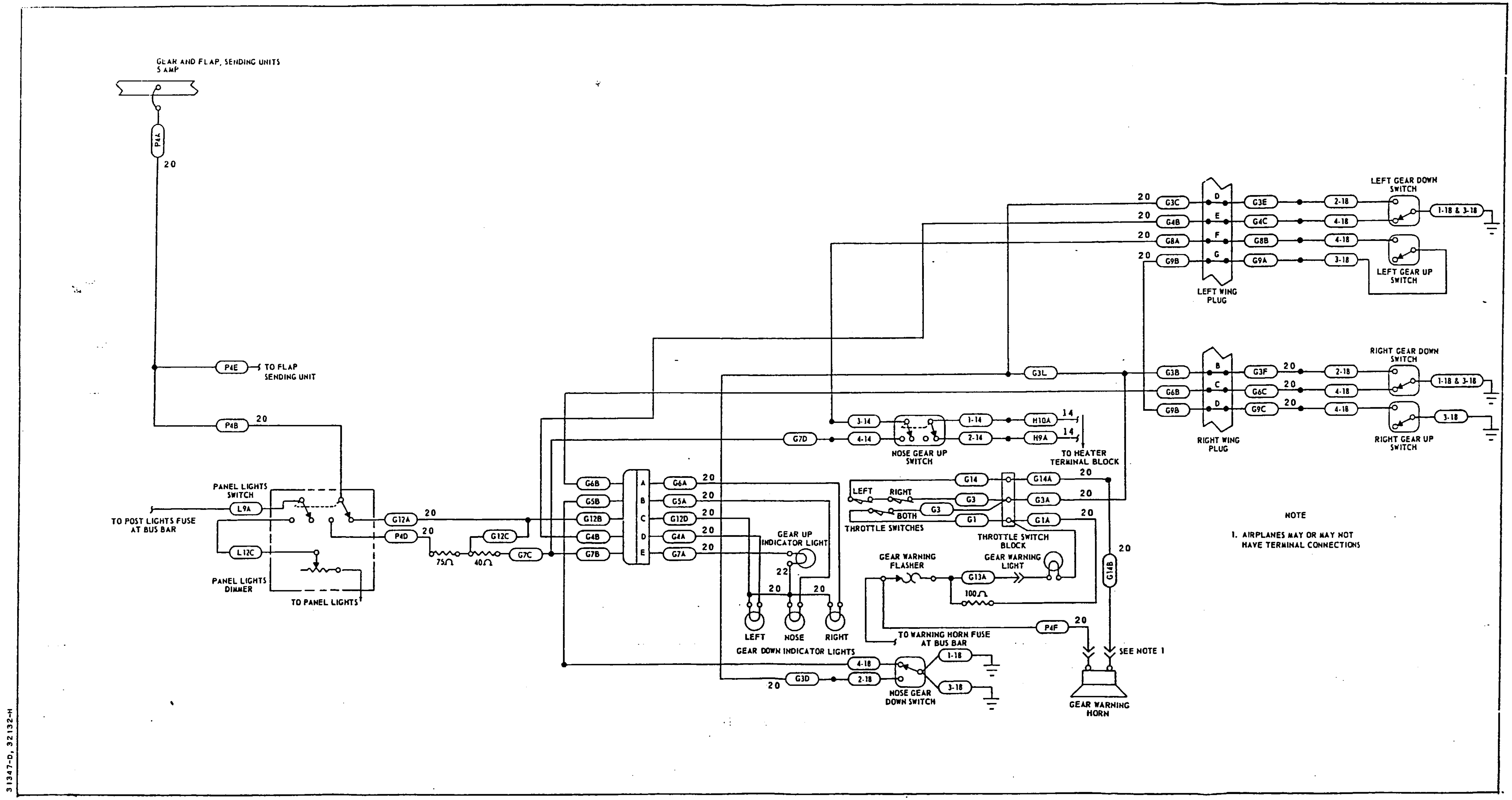


Figure 11-126. Landing Gear and Flap System Schematic, PA-23-250 (six place), Serial Nos. 27-2505 to 27-3836 incl. and 27-2838 to 27-3943 incl.

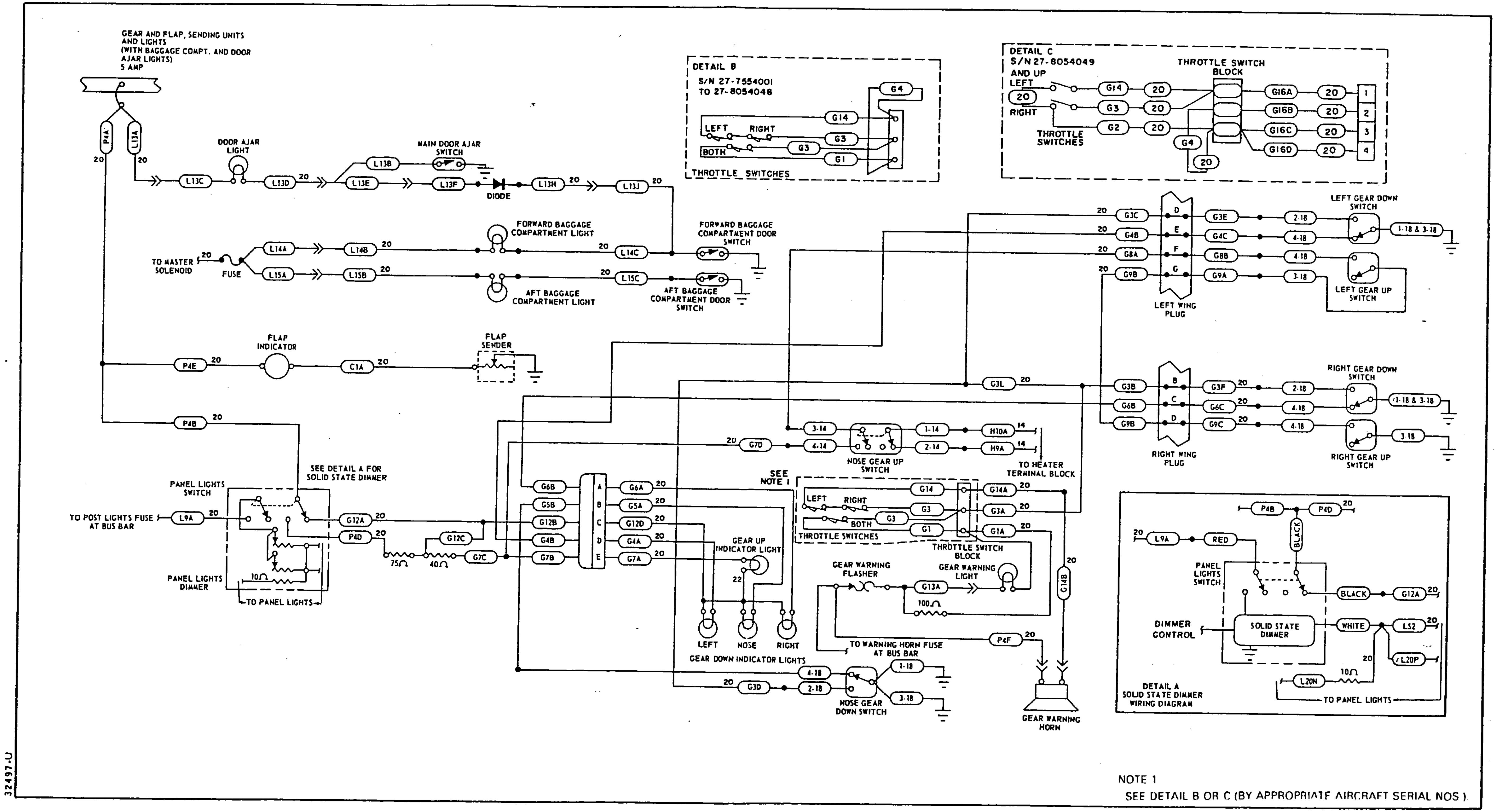


Figure 11-127. Landing Gear and Flap System Schematic, PA-23-250 (six place),
Serial Nos. 27-3837, 27-3944 to 27-7554172 incl.

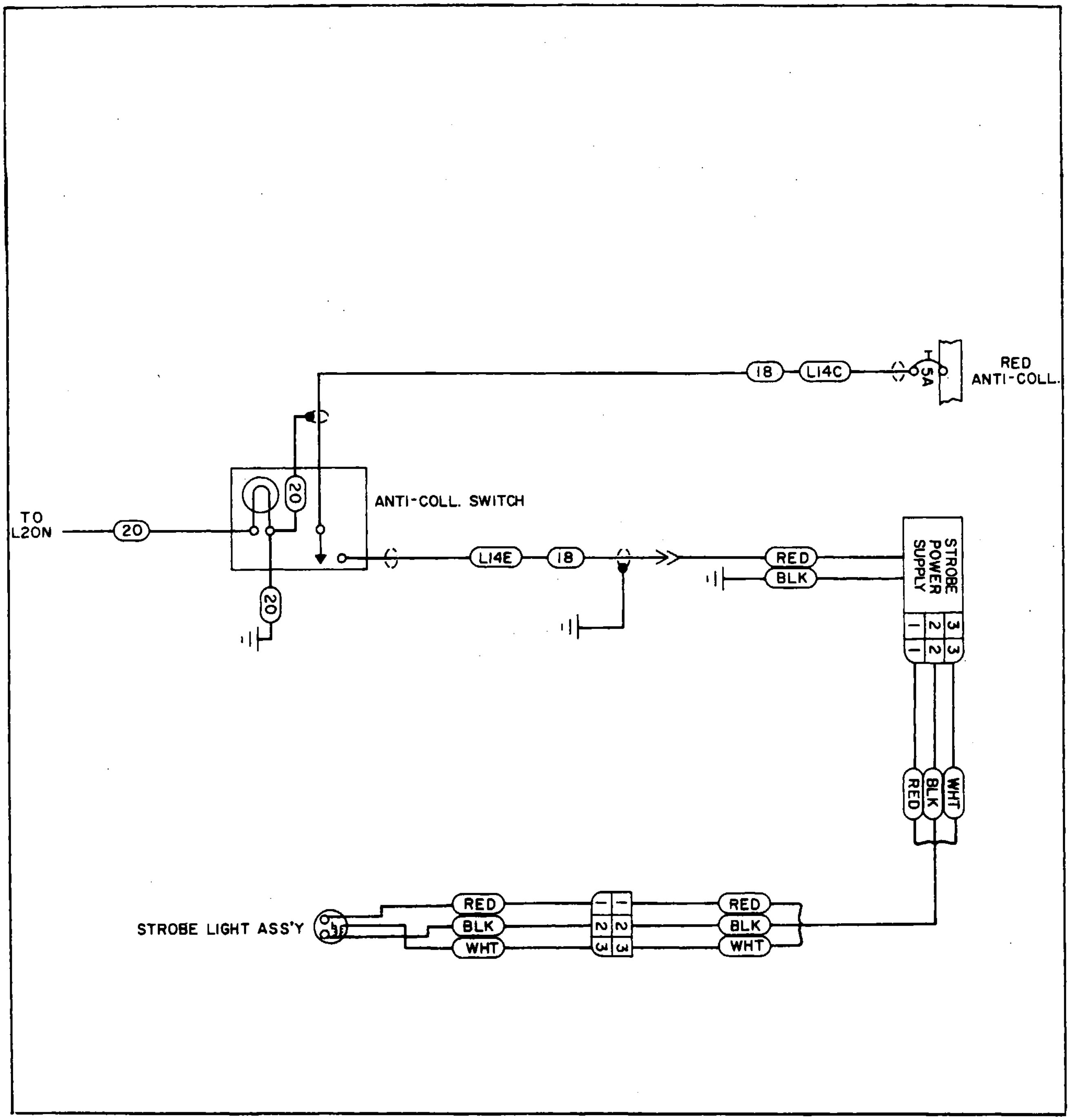


Figure 11-128. Red Anti-Collision Strobe Light (Optional)

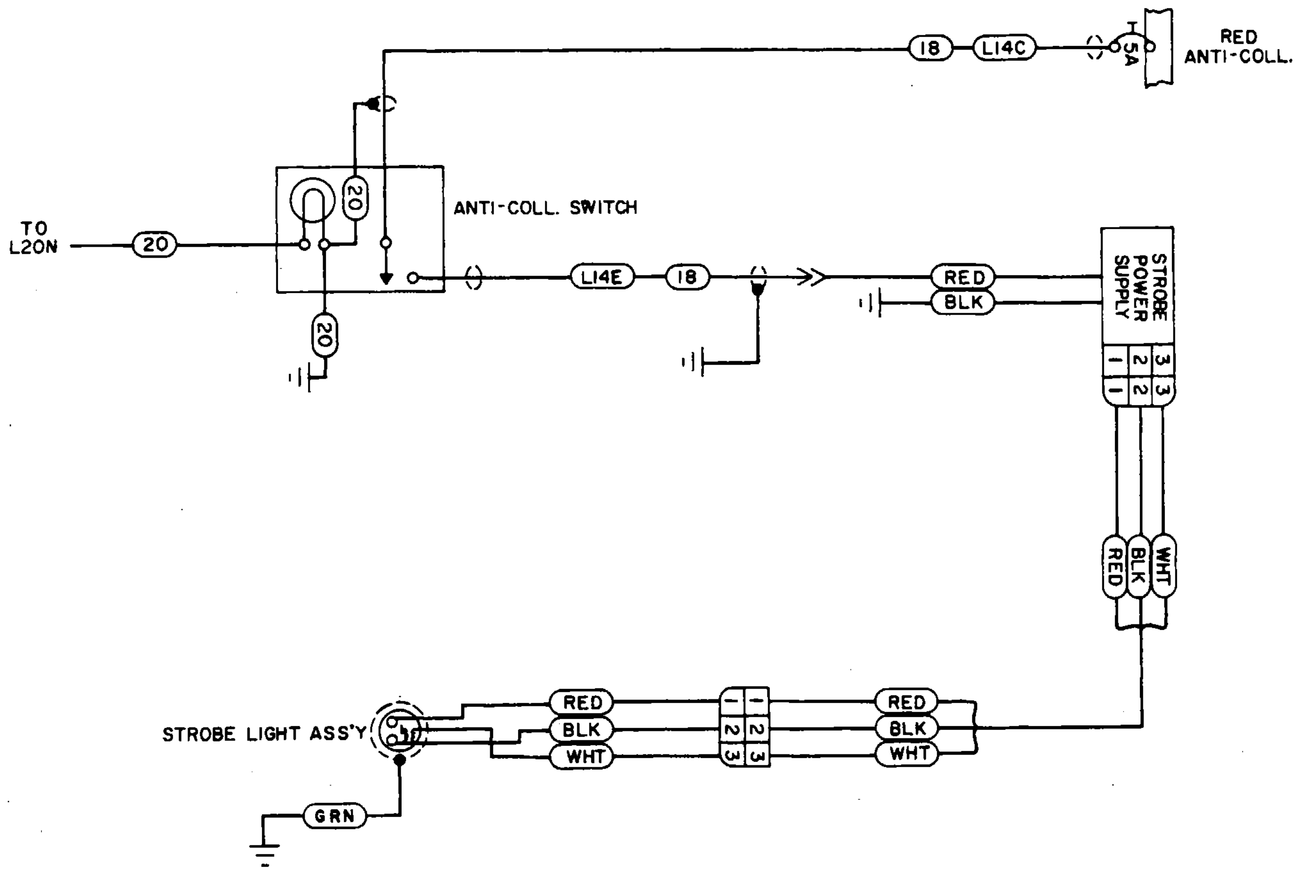


Figure 11-129. Red Anti-Collision Strobe Light (Optional)

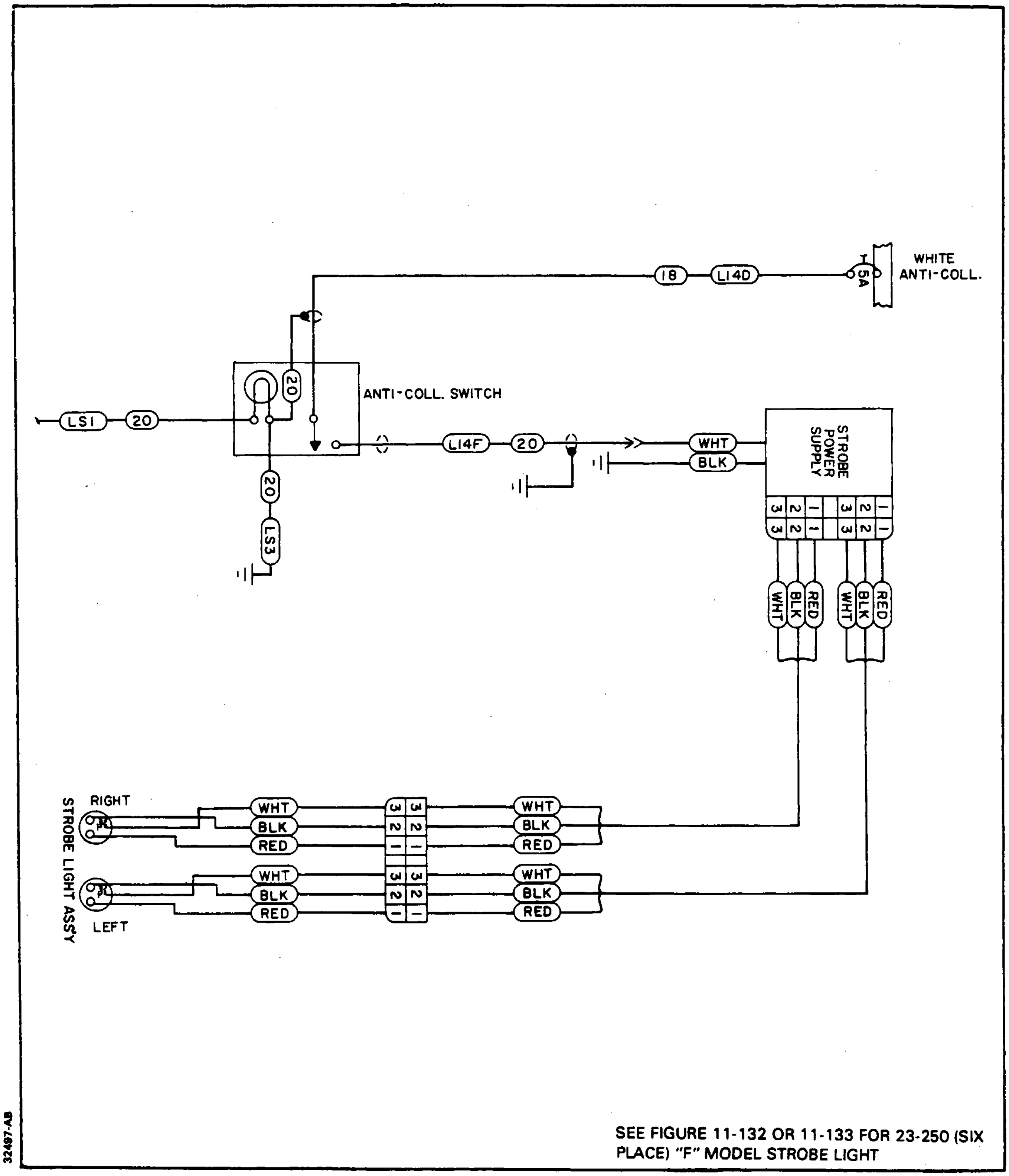
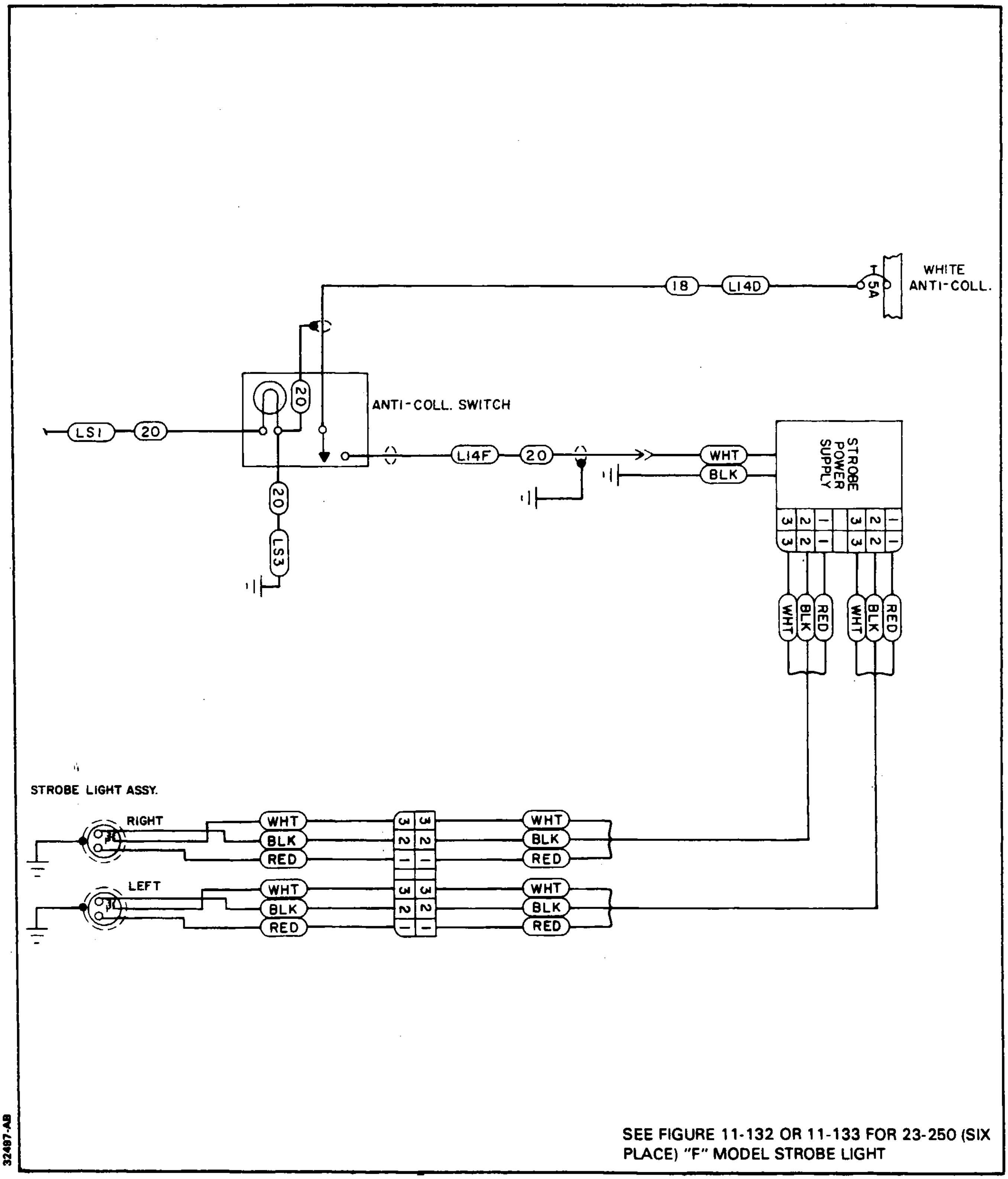


Figure 11-130. White Anti-Collision Strobe Light



SEE FIGURE 11-132 OR 11-133 FOR 23-250 (SIX PLACE) "F" MODEL STROBE LIGHT

Figure 11-131. White Anti-Collision Strobe Light

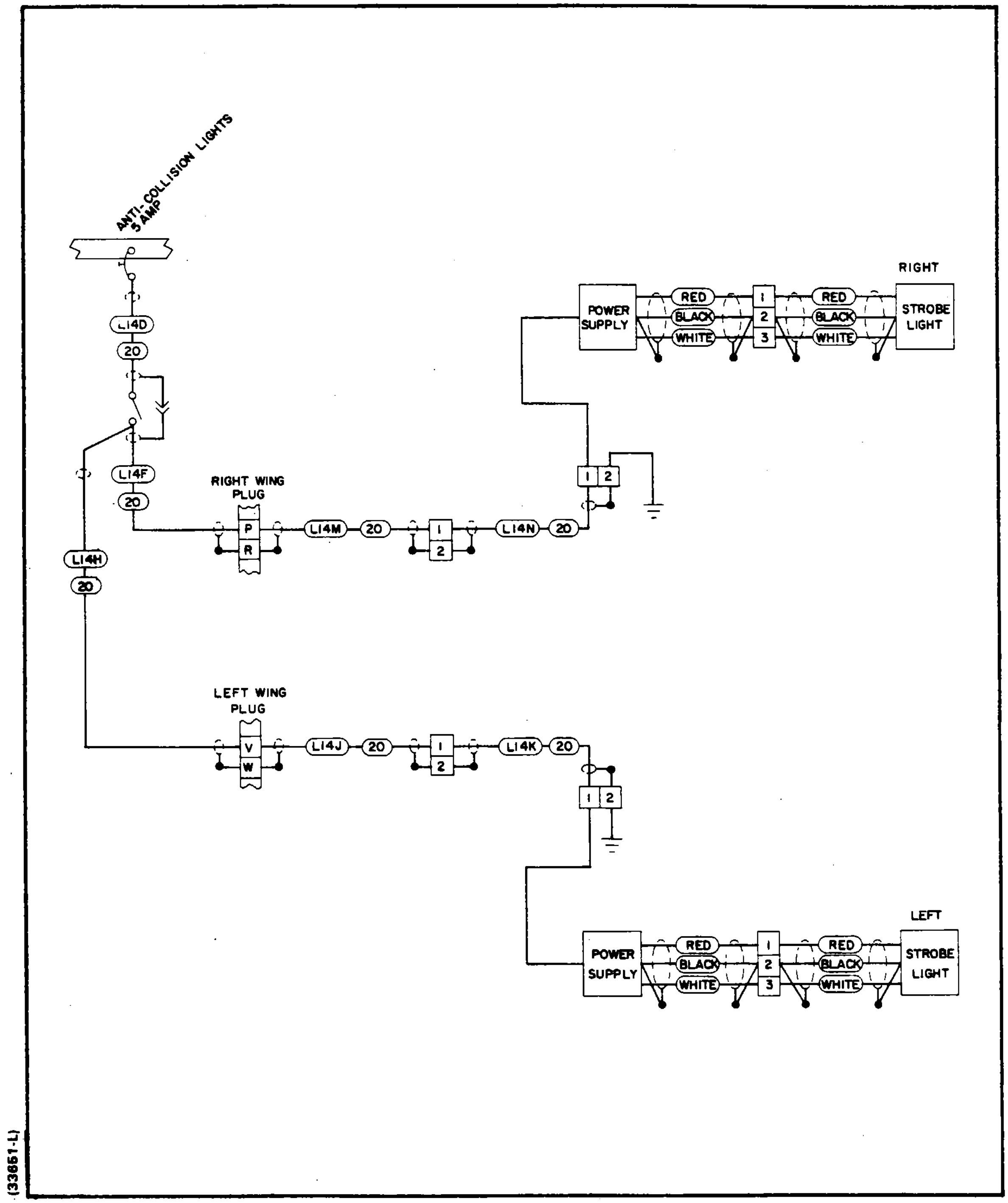


Figure 11-132. White Anti-Collision Strobe Light, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Earlier Models)

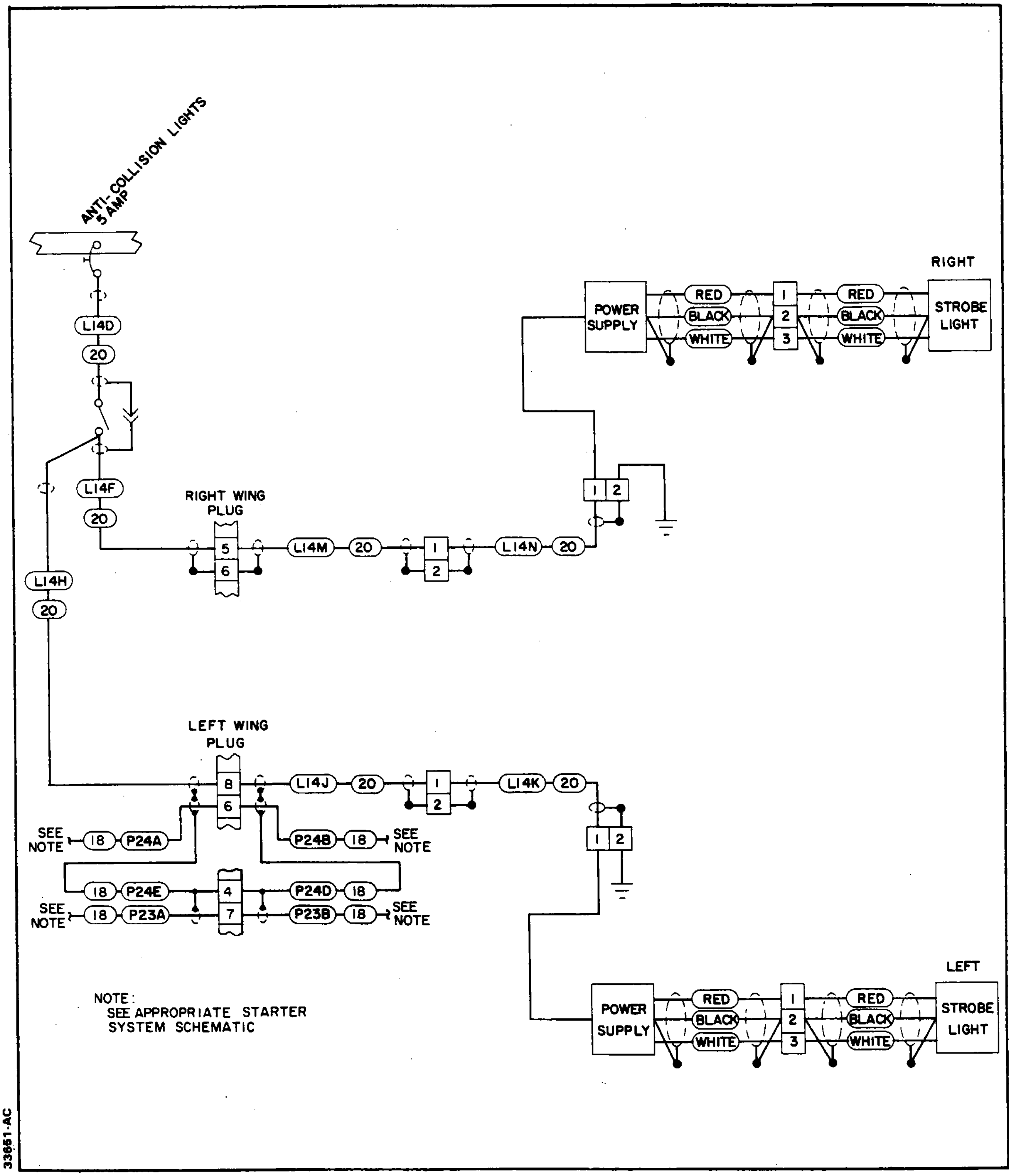


Figure 11-133. White Anti-Collision Strobe Light, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Later Models)

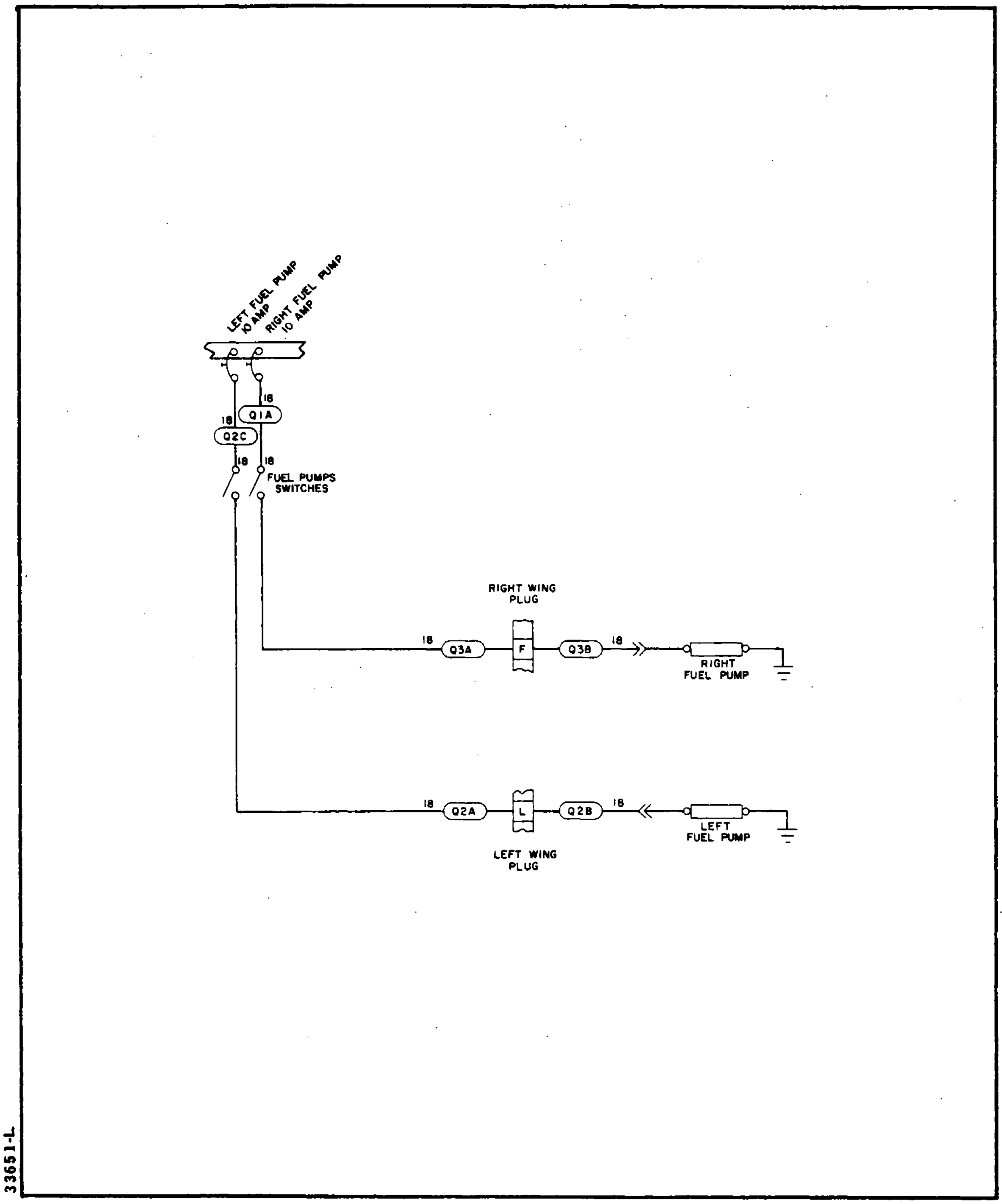


Figure 11-134. Fuel Pumps Schematic, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Earlier Models)

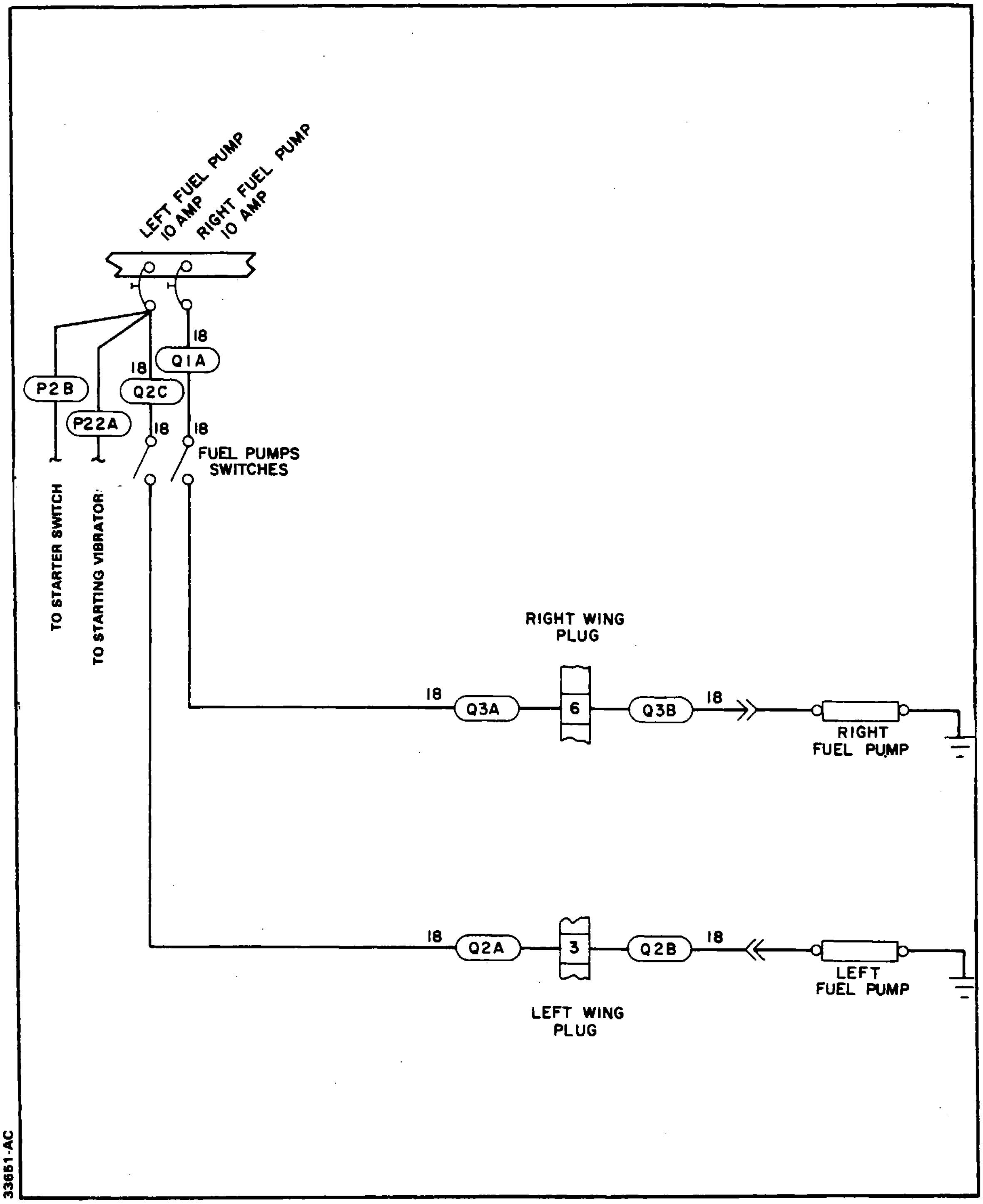


Figure 11-135. Fuel Pumps Schematic, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Later Models)

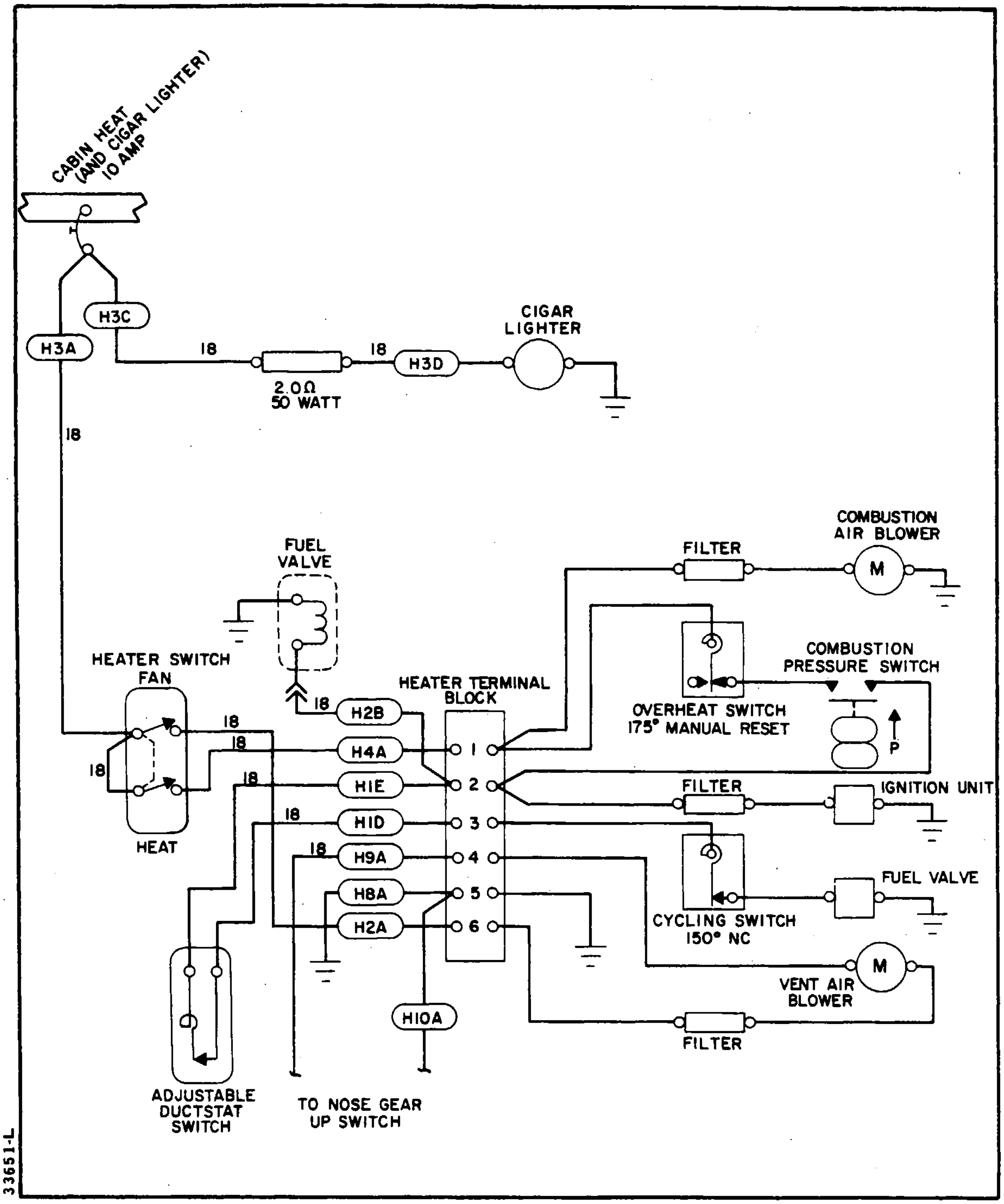


Figure 11-136. Heater and Cigar Lighter Schematic, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Earlier Models)

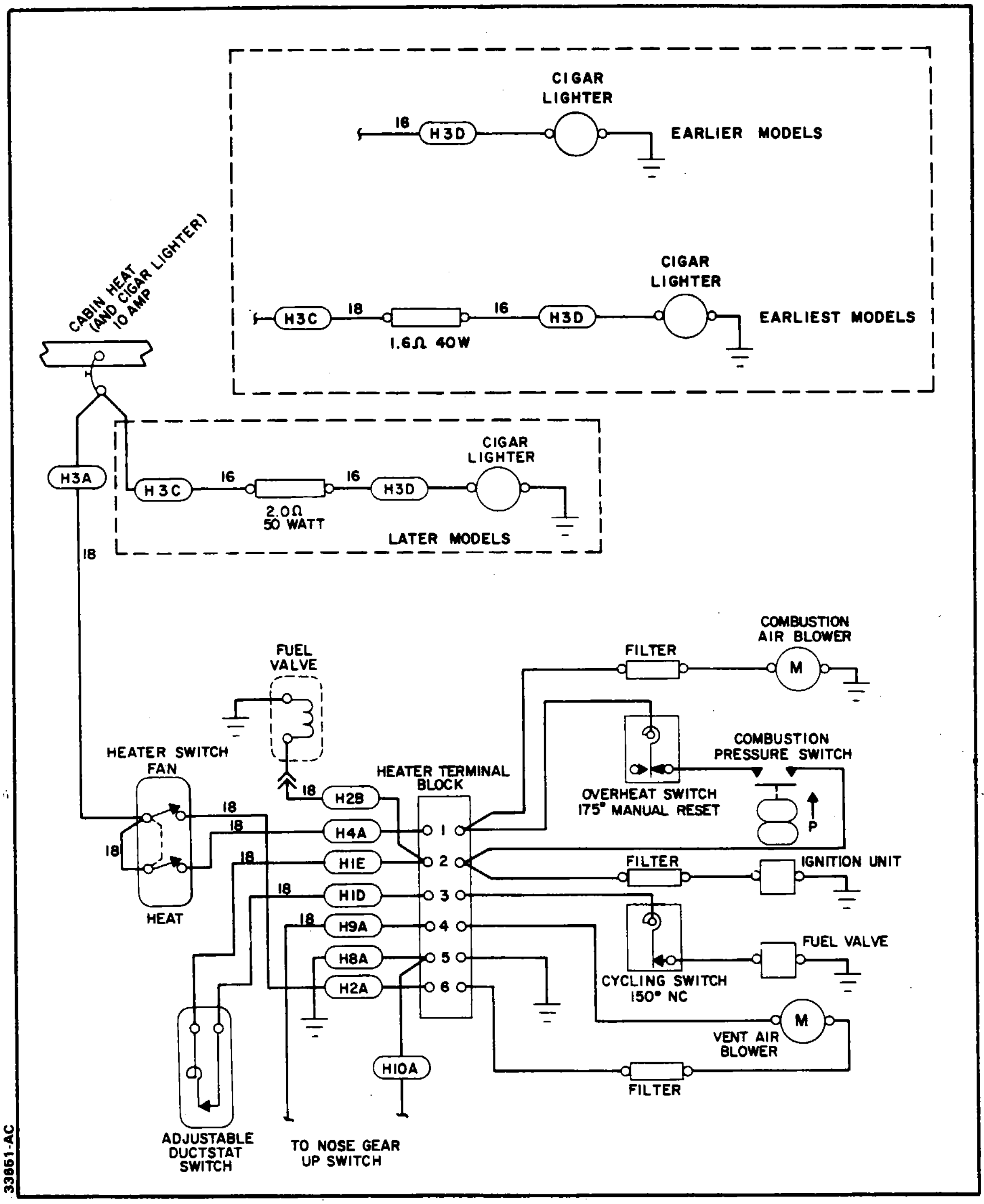


Figure 11-137. Heater and Cigar Lighter Schematic, PA-23-250 (six place)
"F" Model, Serial Nos. 27-7654001 and up

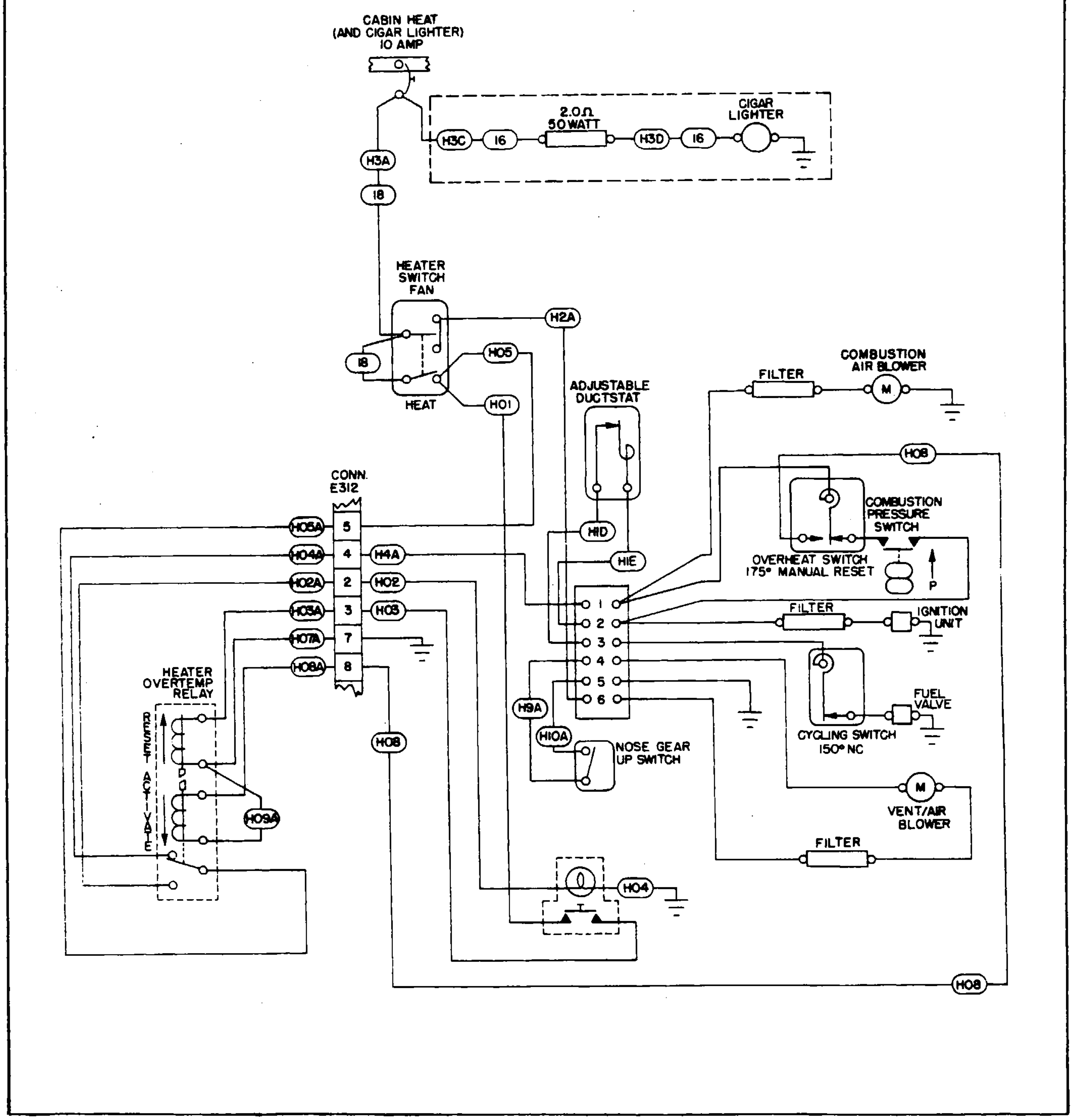


Figure 11-138. Heater with Reset and Cigar Lighter, PA-23-250 (six place) "F" Model, Serial Nos. 27-8154001 and up

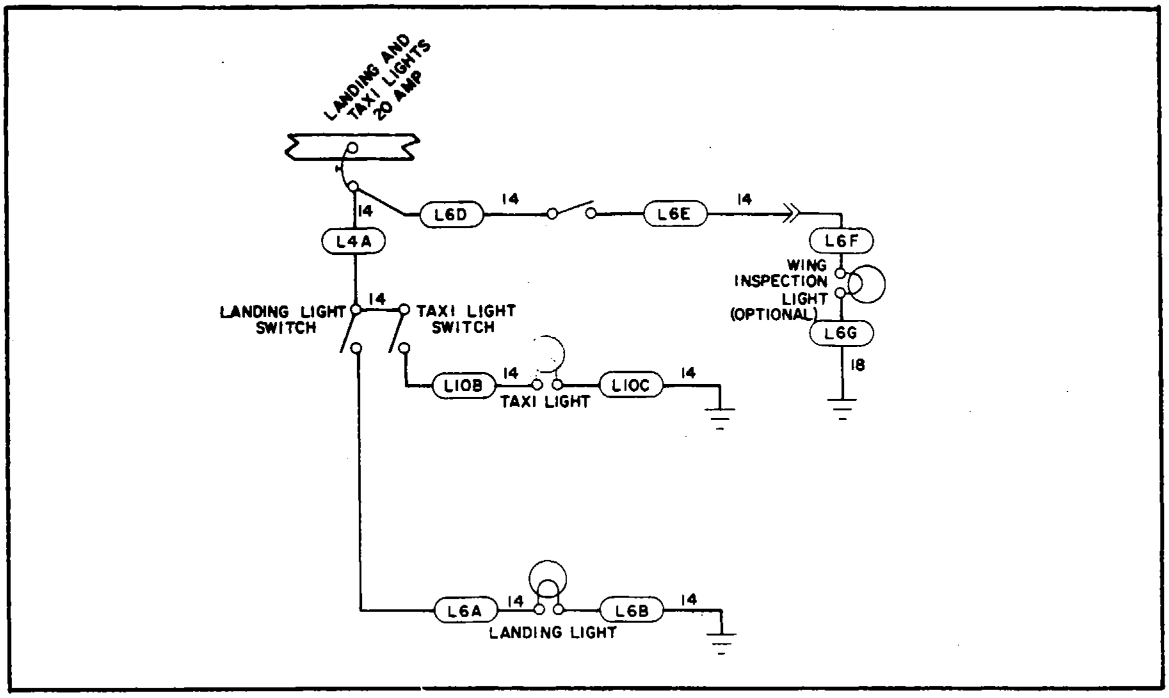


Figure 11-139. Landing and Taxi Lights, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up

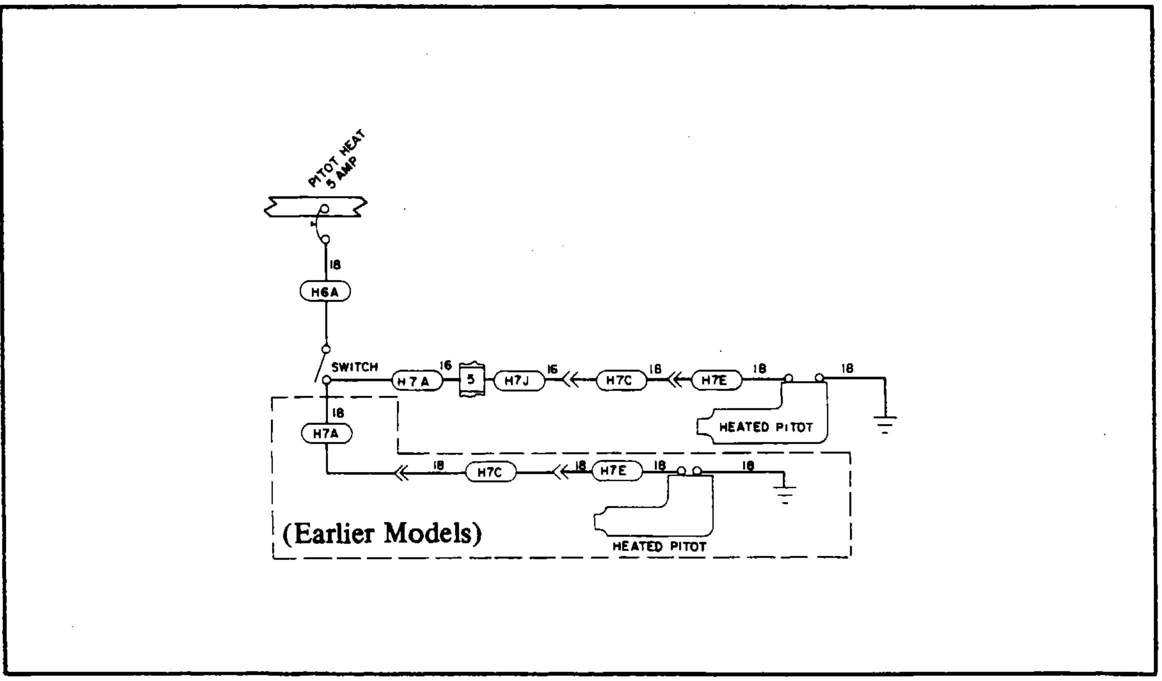


Figure 11-140. Pitot Heat Schematic, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up

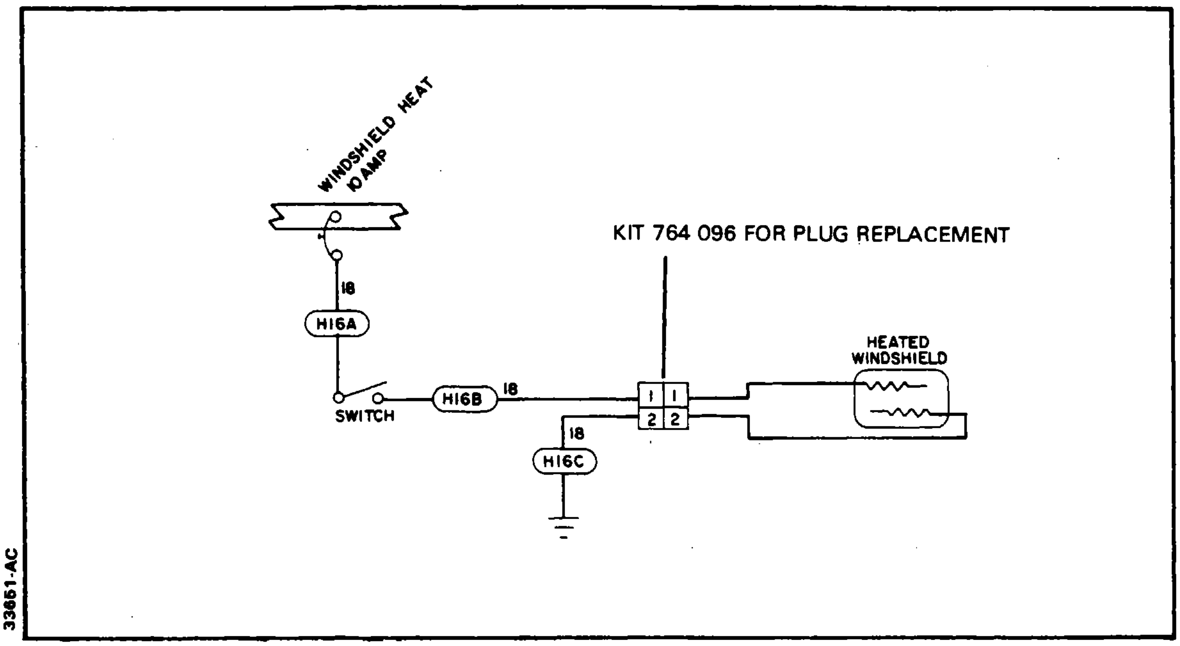


Figure 11-141. Heated Windshield Schematic, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up

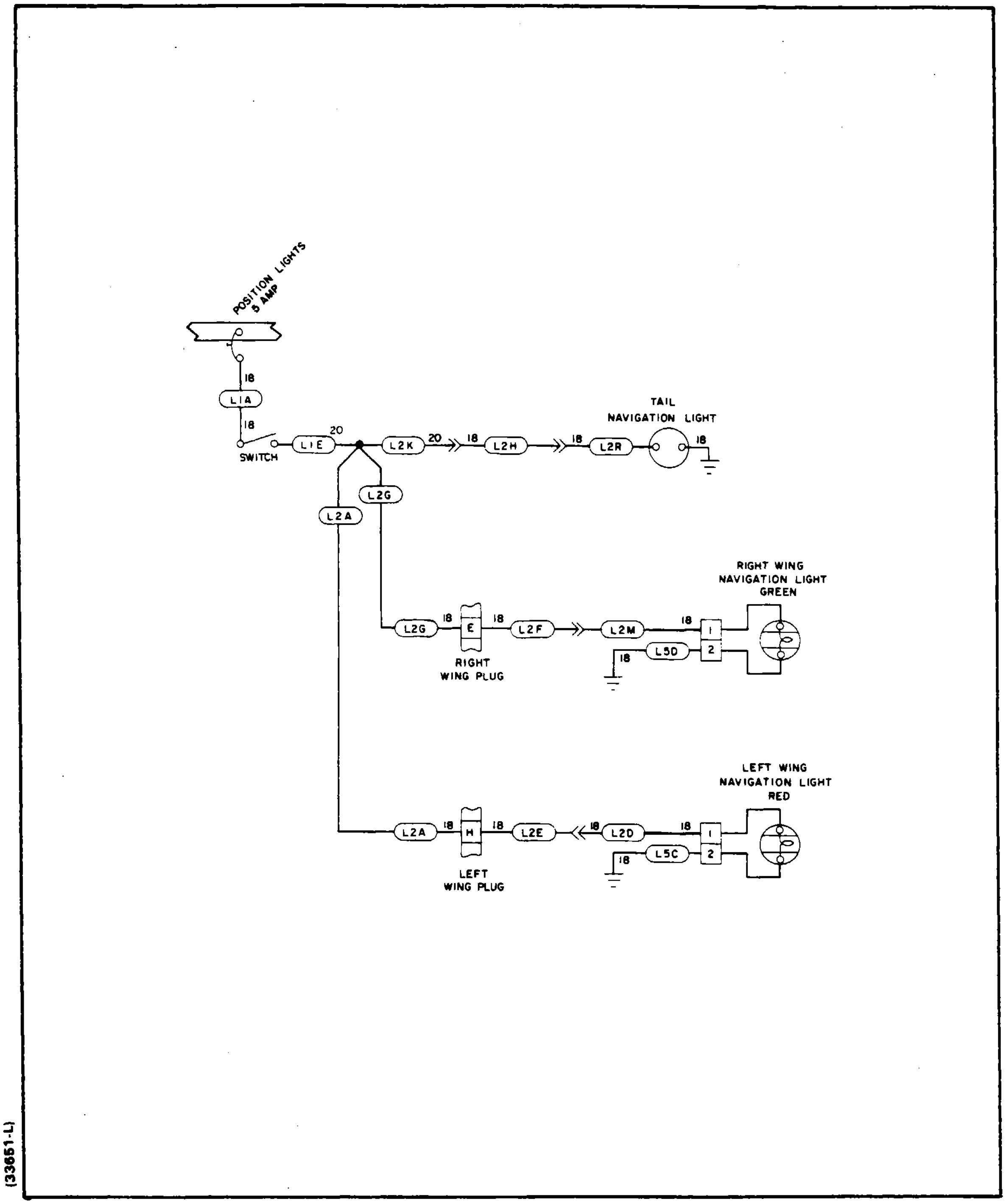


Figure 11-142. Position Lights Schematic, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Earlier Models)

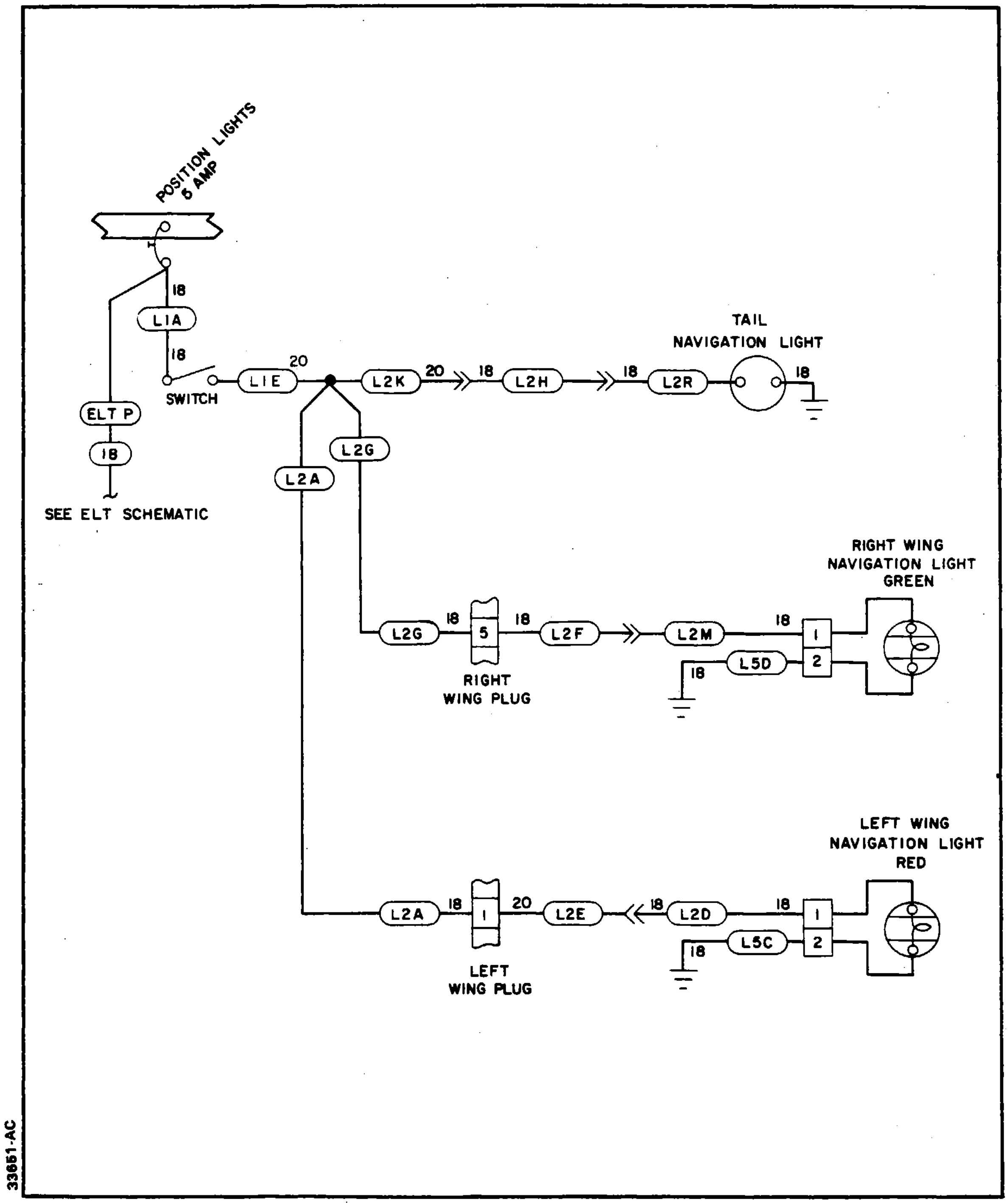


Figure 11-143. Position Lights Schematic, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Later Models)

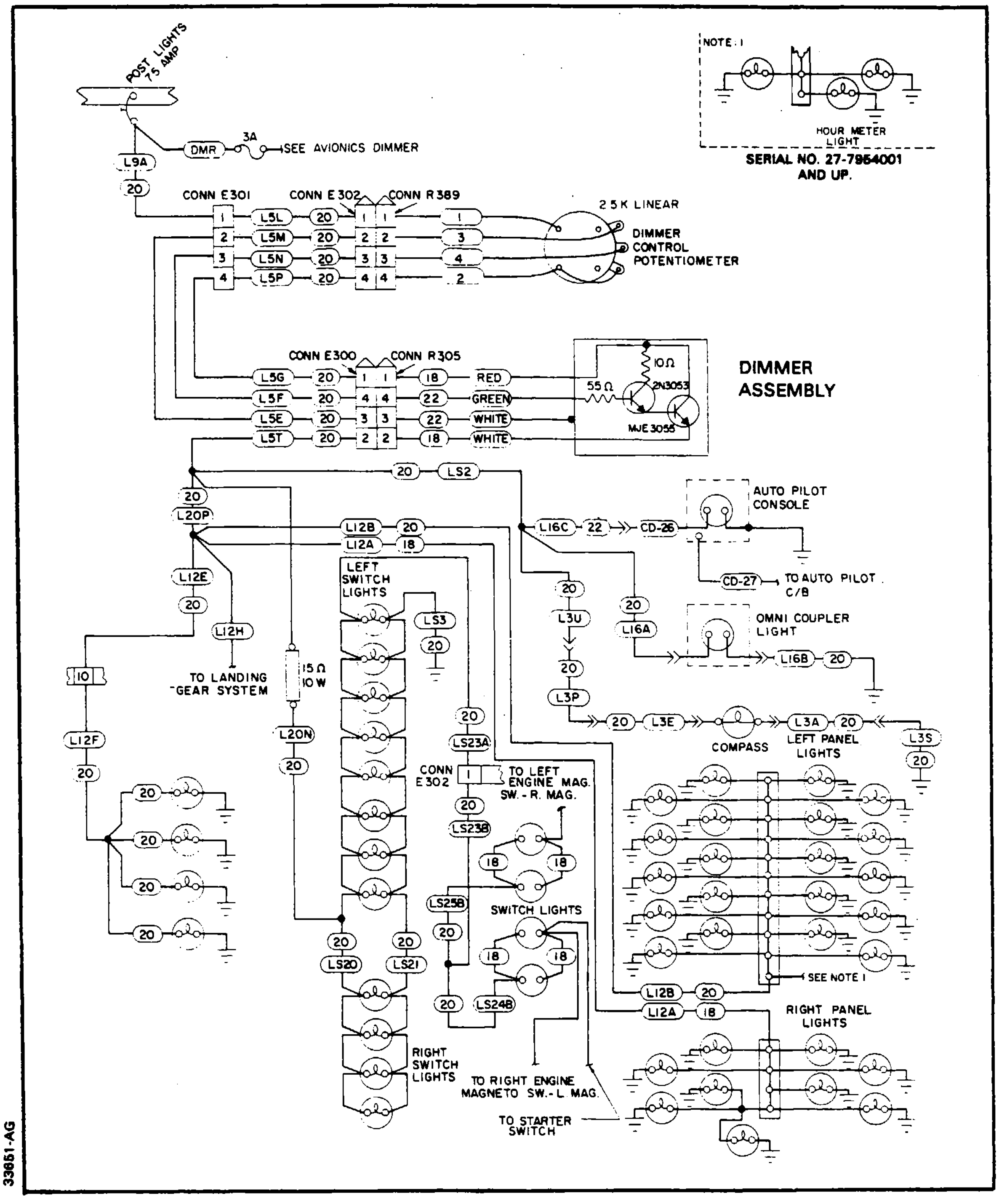


Figure 11-144. Post Lights Schematic, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up

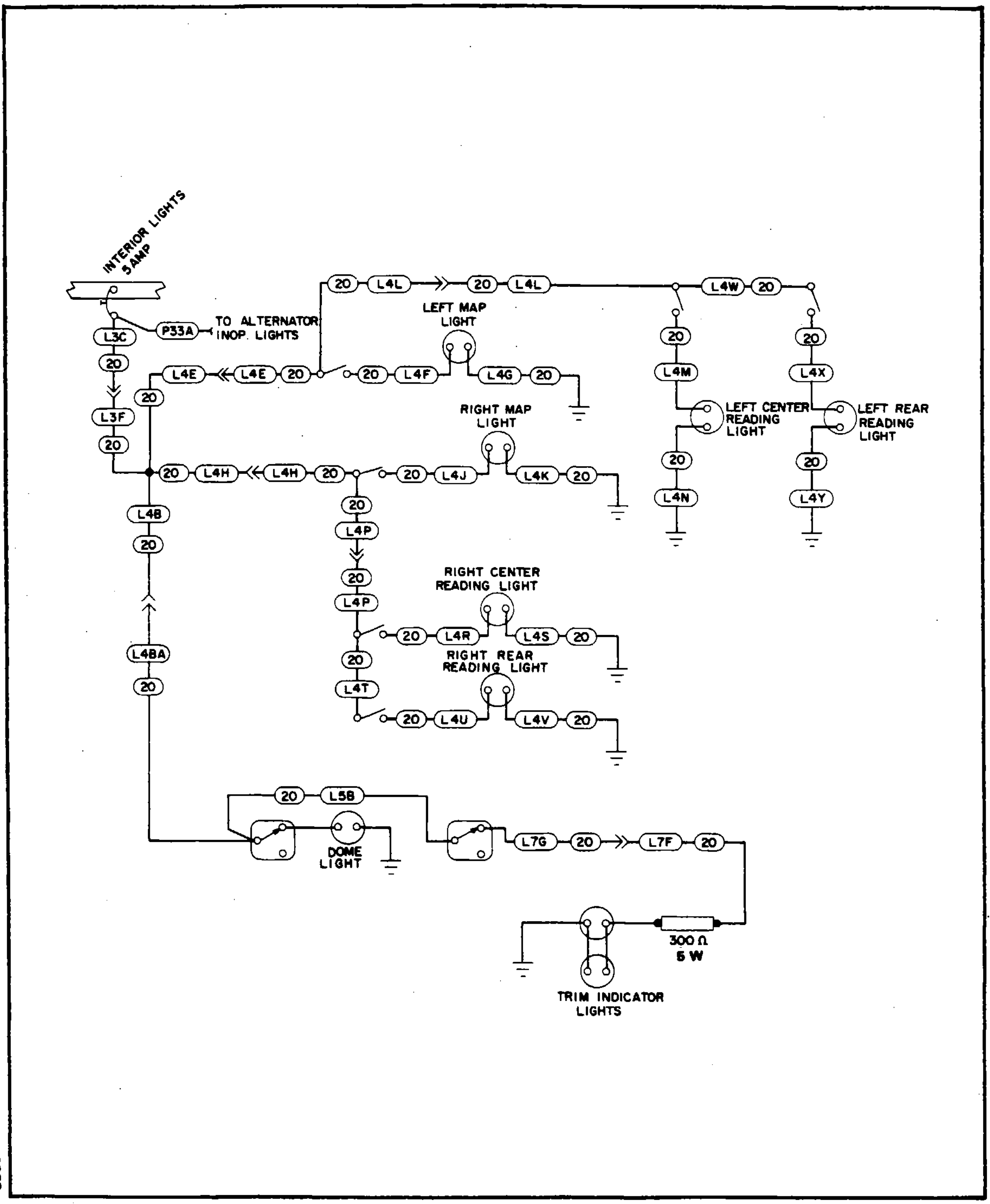


Figure 11-145. Interior Lights Schematic, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 to 27-7954121 incl.

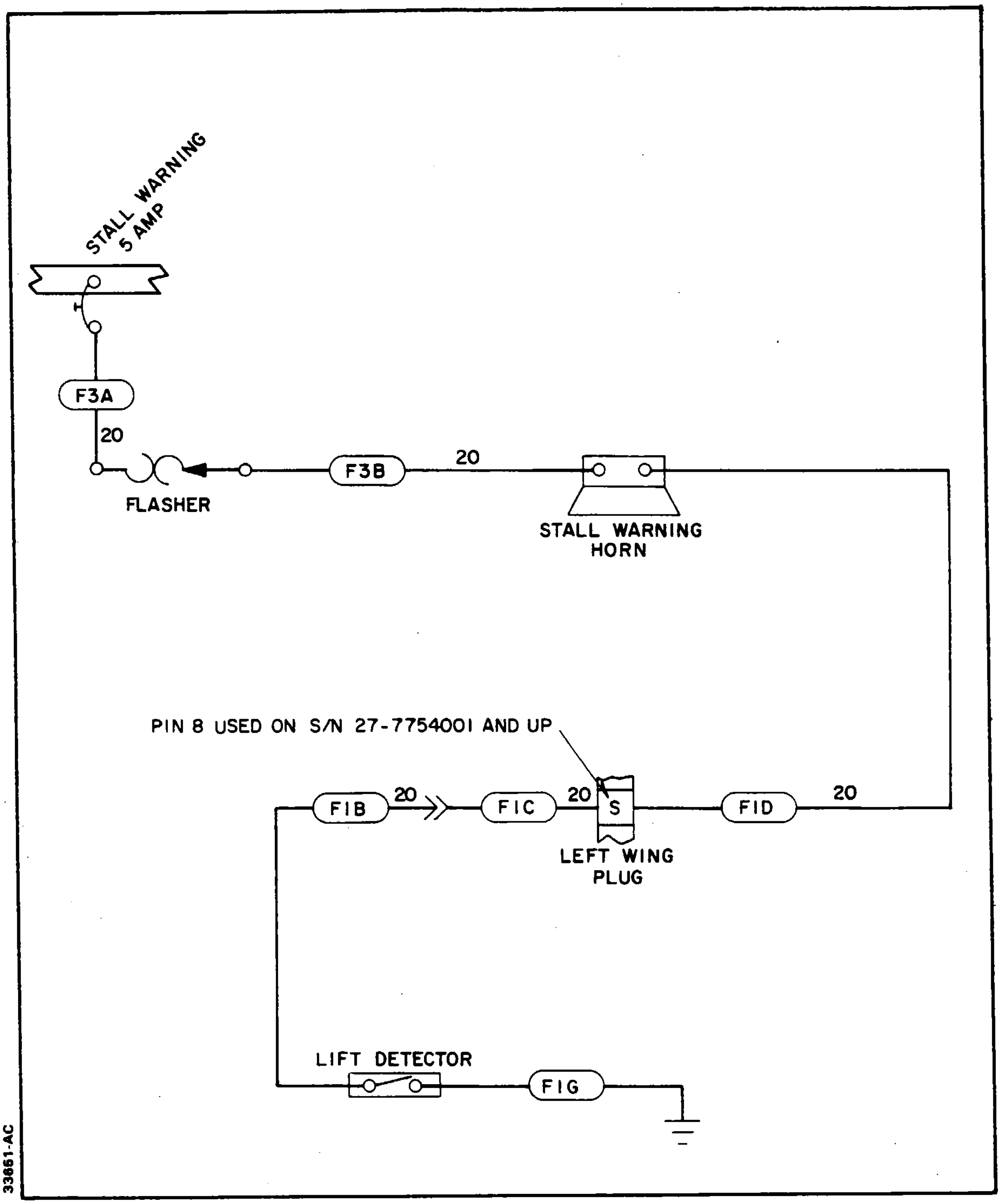


Figure 11-146. Stall Warning Schematic, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up

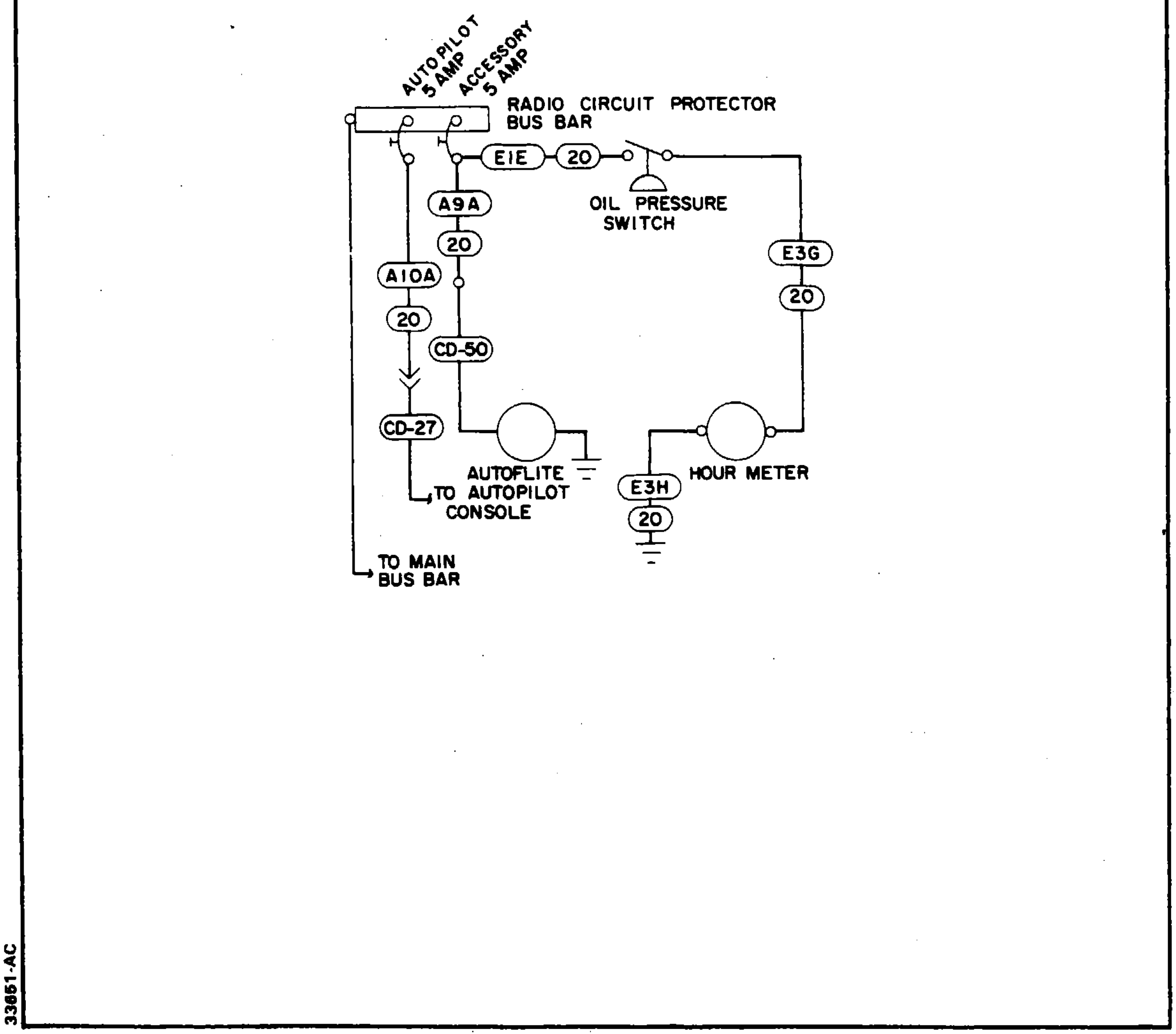


Figure 11-147. Accessory and AutoPilot Schematic, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up

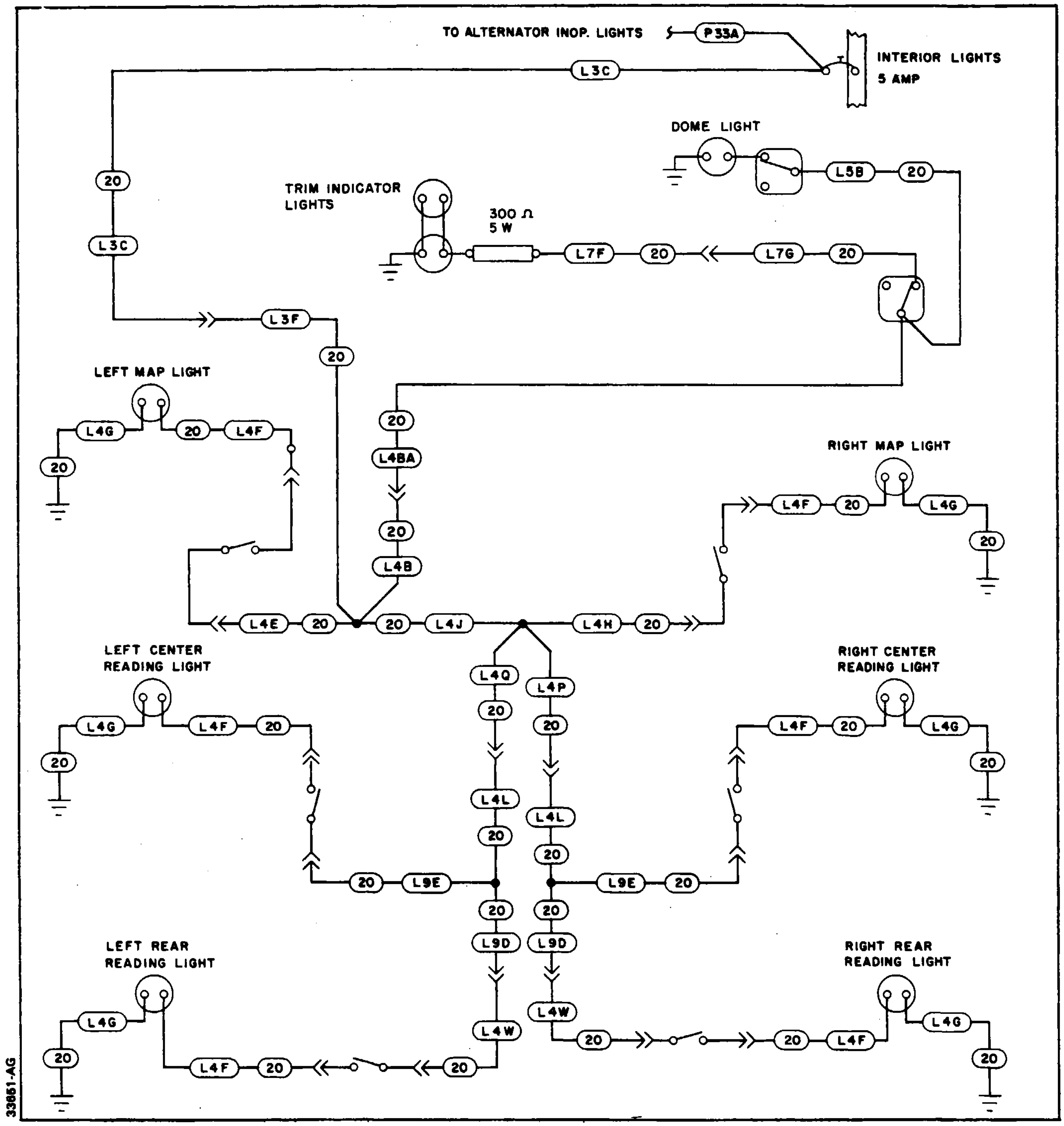


Figure 11-148. Interior Lights Schematic, PA-23-250 (six place)
Serial Nos. 27-8054001 and up

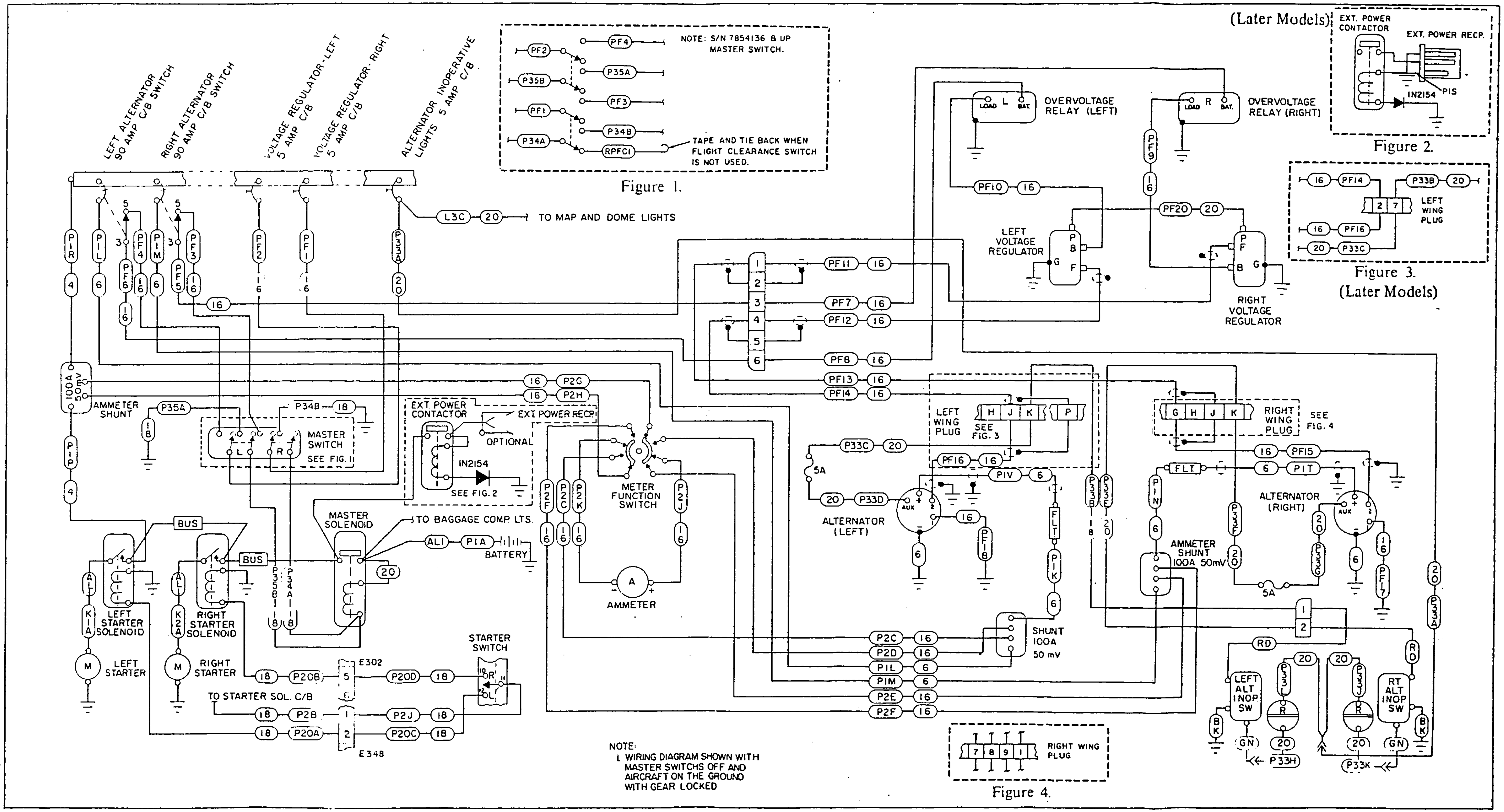


Figure 11-149. Alternator Paralleling System (Prestolite), PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Earlier Models)

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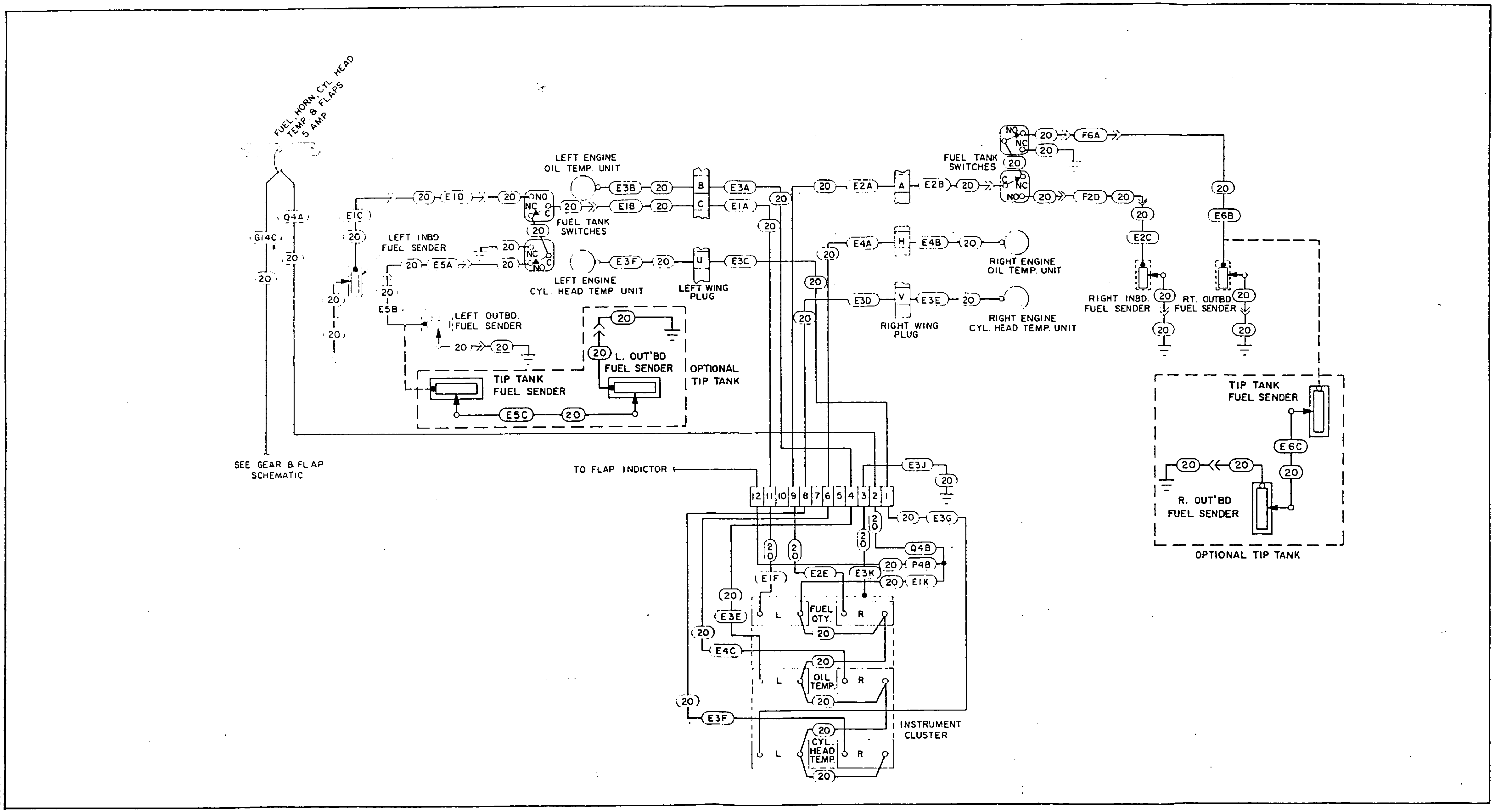

Figure 11-150. Instrument Cluster Wiring Schematic, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Earlier Models)

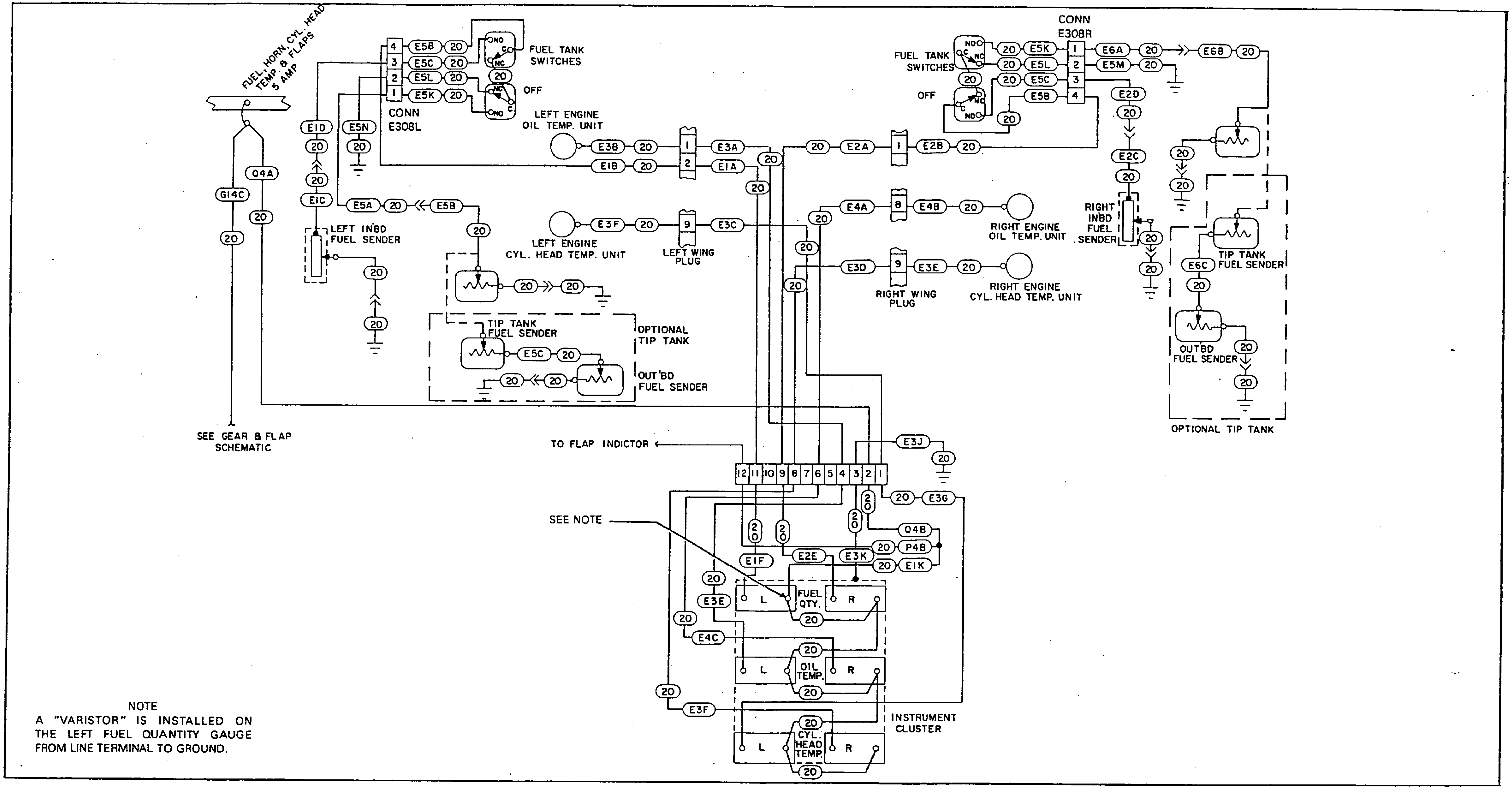

Figure 11-151. Instrument Cluster Wiring Schematic, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Later Models)

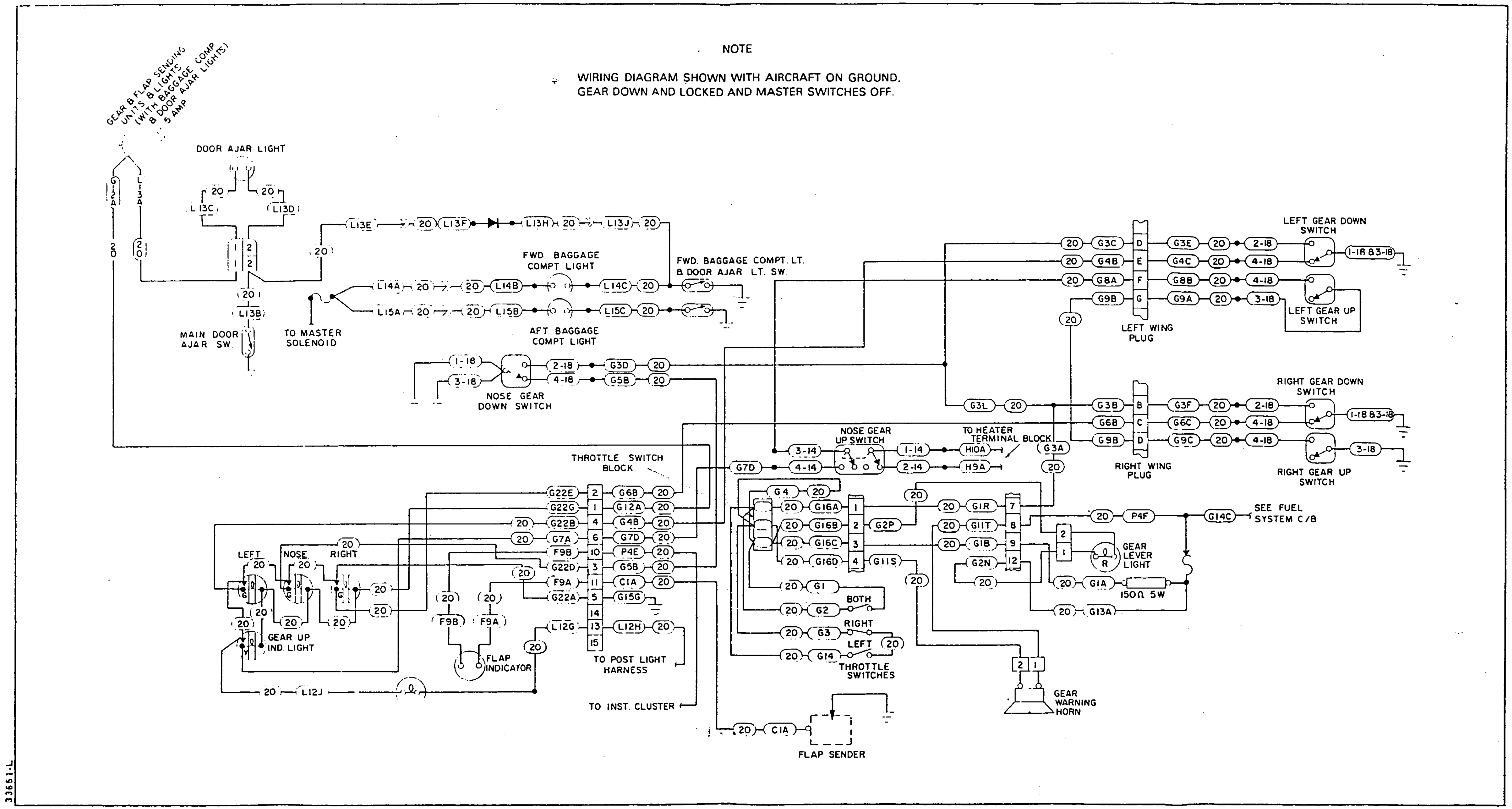

Figure 11-152. Landing Gear and Flap System Schematic, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Earlier Models)

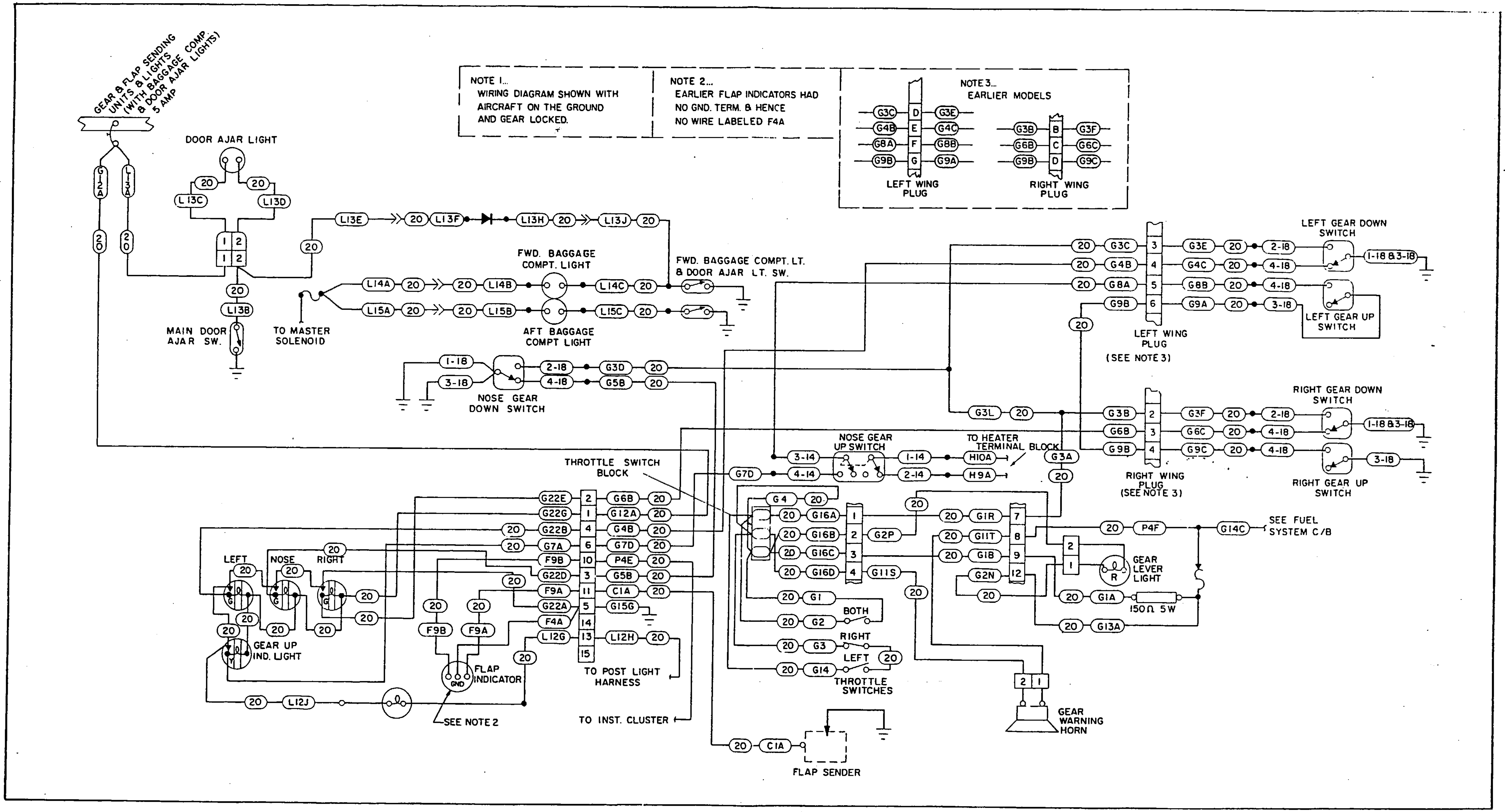

Figure 11-153. Landing Gear and Flap System Schematic, PA-23-250 (six place) "F" Model, Serial Nos. 27-7654001 and up (Later Models)

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SECTION

XII

ELECTRONICS

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SECTION XII - ELECTRONICS

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SECTION XII

ELECTRONICS

12-1. INTRODUCTION.

This section provides the information necessary to perform an operational check of the Emergency Locator Transmitter and/or the Emergency Locator Transmitter with a Pilot's Remote Switch. Included are the appropriate removal and installation instructions to facilitate battery replacement.

12-2. EMERGENCY LOCATOR TRANSMITTER.

12-3. DESCRIPTION.

The ELT is an automatically activated emergency locator transmitter which, when activated, will radiate an omni-directional RF signal on the international distress frequencies. The radiated signal is modulated with a distinctive audio swept tone. Electrical power for the ELT transmitter is supplied by its own self-contained magnesium or alkaline battery. Per FAA regulations, a magnesium battery must be replaced 2 years from the date of manufacture stamped on the battery pack and an alkaline battery must be replaced after five years of shelf life (replacement date is marked on the transmitter label). The battery must also be replaced if the transmitter has been used in an emergency situation or if accumulated test time exceeds one hour. To replace the battery pack in the transmitter, it is necessary to remove the ELT from the airplane.

12-4. REMOVAL AND INSTALLATION.
(GARRETT MFG. LTD. 2 year, magnesium battery, refer to Figure 12-1.)

The ELT is located underneath the dorsal fin.

a. Remove the access panel on the dorsal fin.

b. Set the ON/ARM/OFF switch on the transmitter to the OFF position.

c. Disconnect the antenna coax from the transmitter.

d. Disconnect the harness to the pilot's remote switch from the transmitter.

e. Remove the rear mounting bracket by pulling the plastic knob out. Remove the transmitter from the airplane.

f. Remove the two long or four short screws securing the transmitter plain end cap. Remove the plain end cap.

g. Disconnect the battery connector from the board terminals.

h. Withdraw the battery pack from the transmitter case.

i. Before installing the new battery pack, check the replacement date by adding two years to the date of manufacture on the battery. Transfer this date onto the ELT label.

j. Slide the new battery pack, plain end first, into transmitter. It may be necessary to rotate the battery slightly to get it seated properly in the transmitter case and to achieve correct orientation of the battery connector.

k. Connect the battery connector to board terminals.

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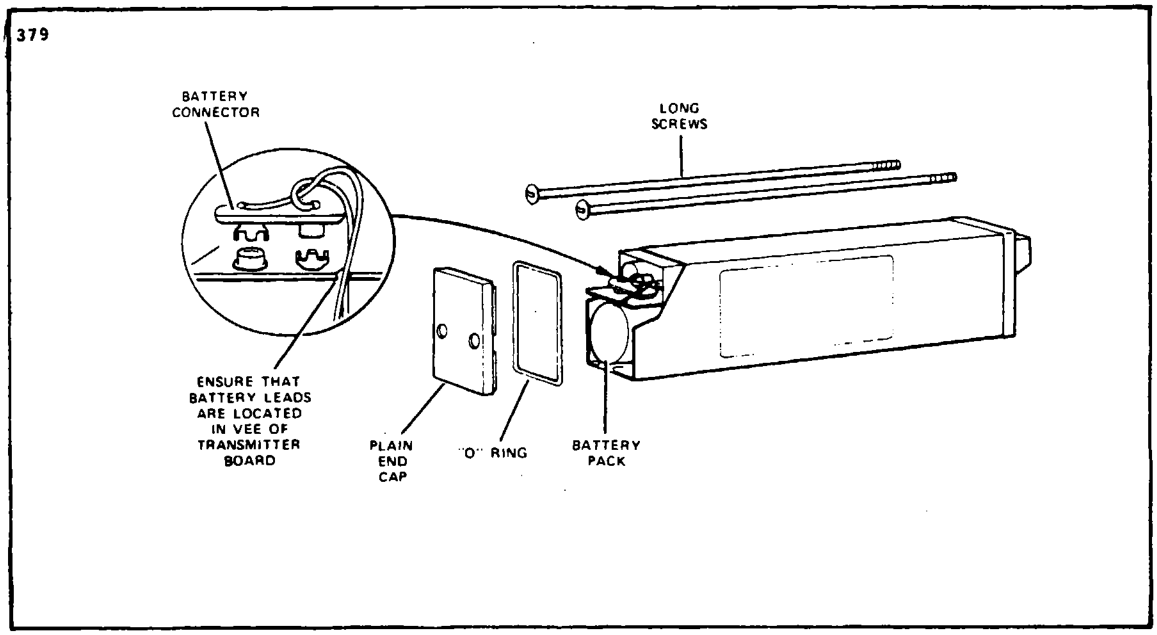

Figure 12-1. Two Year, Magnesium Battery Connection (Garrett)

l. Insure O-ring is fitted in plain end cap and correctly seated.
m. Refit end cap and secure with the screws previously removed.

NOTE

Do not overtighten the two long screws.

n. Place transmitter into its mounting bracket; replace rear mounting bracket by pushing plastic knob into place.
o. Connect the pilot's remote switch harness to the transmitter.
p. Connect the antenna coax to the transmitter.
q. Install the access panel on the dorsal fin and secure with appropriate screws. Make an entry in the aircraft logbook, including the new battery run out date.

NOTE

Before installing access panel ascertain that transmitter switch is in the ARM position. It may also be advisable to test the unit operation before installing the access panel. (Refer to paragraph 12-7.)

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12-5. REMOVAL AND INSTALLATION. (COMMUNICATIONS COMPONENTS CORP., alkaline battery.) The ELT is located under the dorsal fin.

a. Remove the access panel on the dorsal fin.
b. Rotate the ON/ARM/OFF switch to the OFF position.
c. Disconnect the antenna coax cable (twist left, then pull outwards).
d. Disconnect the harness to the pilot's remote switch.
e. Remove the forward mounting bracket by pulling the black plastic knob out. Remove the transmitter from the airplane.
f. Remove the six Phillips-head screws securing the transmitter cover. Remove the cover.
g. Lift out the old battery pack.
h. Copy the expiration date on the battery into the space provided on the external ELT name and date plate.
i. Disconnect and replace with a new battery pack. The nylon battery connector is a friction fit and is easily removed by pulling on the exposed end.
j. Insert transmitter into airplane and fit into place. Reinstall mounting bracket by pushing the black knob into place.
k. Reconnect the pilot's remote switch harness and the antenna coax cable to the transmitter.
l. Set the ON/ARM/OFF switch to the ARM position.

NOTE

It may be advisable to test the unit operation before installing the access panel. (See paragraph 12-7.)

m. Reinstall the access panel previously removed.
n. Make an entry in the aircraft logbook, including the new battery expiration date.

NOTE

Inspect the external whip antenna for any damage. Avoid bending the whip. Any sharply bent or kinked whip should be replaced. Antenna damage may cause structural failure of whip in flight.

12-6. REMOVAL AND INSTALLATION (NARCO). The ELT is located under the dorsal fin. (Refer to Figures 12-6 and 12-7.)

1. Remove the access panel on the dorsal fin.
2. Set the ON/OFF/ARM switch on the transmitter to OFF.
3. Disconnect antenna coaxial cable from ELT.
4. Remove ELT from its mounting bracket by releasing the latch on the strap and sliding the ELT off the bracket.
5. Extend the portable antenna. (See Figure 12-6.)
6. Unscrew the four screws that hold the control head to the battery casing and slide apart.
7. Disconnect the battery terminals from the bottom of the circuit board.
8. Discard old battery pack. (DO NOT EXPOSE TO FLAME.)

CAUTION

The battery pack is shipped with a sealant on the inside lip so that a water tight seal will be retained. DO NOT REMOVE THIS SEALANT.

9. Connect new battery pack terminals to the bottom of the circuit board.
10. Reinsert the control head section into the battery pack being careful not to pinch any wires, and replace the four screws. If the four holes do not line up, rotate the battery pack 180° and reinsert.)
11. Slide the portable antenna back into the stowed position.
12. Place transmitter into its mounting bracket and fasten the strap latch.
13. Connect the antenna coaxial cable to the ELT and ensure that the contact separator is inserted between the antenna contact finger and the portable antenna. (Ref. Fig. 12-7.)
14. Press RESET button and set ON/OFF/ARM switch to ARM.
15. Make an entry in the aircraft logbook, including the new battery expiration date.
16. A unit operational check may now be performed on the ELT. (Refer to Testing Emergency Locator Transmitter, paragraph 12-7.)

NOTE

Inspect the external whip antenna for any damage. Avoid bending the whip. Any sharply bent or kinked whip should be replaced. Antenna damage may cause structural failure of whip in flight.

12-7. TESTING EMERGENCY LOCATOR TRANSMITTER. The transmitter operates on the emergency frequencies of 121.5 and 243 MHz; both of these frequencies are monitored by the various FAA installations. Before performing any operational test of the ELT, the following precautions should be observed:

CAUTION

Testing of an ELT should be conducted in a screen room or metal enclosure to ensure that electromagnetic energy is not radiated during testing. If a shielded enclosure is not available, testing may be performed in accordance with the following procedures:

1. Test should be no longer than three audio sweeps
2. If the antenna is removed, a dummy load should be substituted during the test.
3. Test should be conducted only within the time period made up of the first five minutes after any hour.
4. If the operational tests must be made at a time not including within the first five minutes after the hour, the test should be coordinated with the closest FAA Tower or Flight Service Station.

Consult FAA Advisory Circular AC 20-81 for detailed information concerning the above caution.

a. Remove the access panel or cover to gain access to the transmitter.

b. Turn the aircraft master switch ON.

c. Tune the aircraft communications receiver to 121.5 MHz and switch the receiver ON; deactivate the squelch, and turn the receiver volume up until a slight background noise is heard.

NOTE

If the aircraft is not fitted with a communications receiver, request that the tower listen for your test.

d. On the transmitter, set the ON/ARM/OFF switch to the ON position. Keep the switch in this position for only a few seconds; then set to the OFF position or ARM if there is no OFF. Return to the ARM position.

NOTE

The test transmission should have been picked up by the aircraft communications receiver and/or control tower. During cold weather, there may be a slight delay before transmission occurs.

e. A transmitter which is functioning properly should emit a characteristic downward swept tone.

f. When the test is completed, ascertain the transmitter ON/ARM/OFF switch is in the ARM position.

WARNING

Whenever the unit is checked by moving the transmitter ON/ARM/OFF switch from the ARM to the ON position, it must then be moved to the OFF position, if there is one, before reverting to the ARM position again.

CAUTION

Under normal conditions, the transmitter switch must be set to arm.

g. Place the access panel on the dorsal fin and secure with the appropriate screws.

NOTE

Inspect the external whip antenna for any damage. Avoid bending the whip. Any sharply bent or kinked whip should be replaced. Antenna damage may cause structural failure of whip inflight.

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12-8. PILOT'S REMOTE SWITCH. The Pilot's remote switch is located on the right side of the cabin or on the lower front of the pedestal to provide remote control of the transmitter. On early models, the switch is labeled ON/ARM/OFF RESET. The ON position activates the transmitter in an emergency situation. The ARM position is the normal position for the airplane in flight. The OFF RESET disables the transmitter. On later models, the pilot's remote switch is labeled ON/RESET and ARM (NORMAL POSITION). The switch is normally left in the down or ARM position. To turn the transmitter off move the switch to the ON/RESET position for one second then return it to the ARM position. To actuate the transmitter for test or other reasons, move the switch upward to the ON/RESET position and leave it in that position as long as transmission is desired.

CAUTION

Under normal conditions the switch must be set to ARM.

12-9. TESTING PILOT'S REMOTE SWITCH. Before performing any operational test of the pilot's remote switch, the following precautions should be observed.

CAUTION

The transmitter operates on the emergency frequencies of 121.5 and 243 MHz; both of these frequencies are monitored by the various FAA installations. Permission must be obtained from the FAA/FCC Representative (or other applicable Authority) prior to testing. Keep your test transmission to a minimal duration. See CAUTION in paragraph 12-7.

a. Turn the aircraft master switch ON.

b. Tune the aircraft communications receiver to 121.5 MHz and switch the receiver ON, deactivate the squelch, and turn the receiver volume up until a slight background noise is heard.

NOTE

If the aircraft is not fitted with a communications receiver, request that the tower listen for your test.

c. Put Pilot's Remote Switch to the ON position. Hold in this position for a few seconds only.

NOTE

The test transmission should have been picked up by the aircraft communications receiver and/or control tower. During cold weather there may be a slight delay before transmission occurs.

d. Set the pilot's remote switch to the RESET position for one second; then select the ARM position.

12-10. INADVERTENT ACTIVATION.

a. In the event the ELT is inadvertently activated in aircraft without a pilot's remote switch, the ELT will have to be reset by gaining access to the ELT. (Refer to paragraph 12-4.) Turn ON/ARM/OFF switch to the OFF position. To reset for automatic operation, return switch to the ARM position. (See NOTE.)

b. In aircraft with a pilot's remote switch, if the ELT is inadvertently activated set the pilot's remote switch to the OFF, RESET position for three-position remote switches. If the two-position remote switch is installed turn the switch to the ON, RESET position for one second, then return it to the ARM position. (See Note.)

NOTE

As a routine precaution, it is recommended that the transmitter be replaced at the earliest oppportunity after inadvertent activation. Note, however, that the problem may not be in the transmitter. Check the following:

1. Proper antenna spacing so as to minimize antenna conducted RF.
2. Rigidity of the transmitter installation.

CAUTION

Under normal conditions the Pilot's Remote Switch must be set to ARM.

12-11. GENERAL. Due to the wide varity of A.F.C.S. (Automatic Flight Control System) options, it is mandatory to follow the service literature published by the individual manufacturer of the A.F.C.S. equipment installed in any particular airplane. This includes mechanical service such as; adjusting bridle cable tension, servo removal and installation, servo clutch adjustments, etc.

12-12. NON-PIPER A.F.C.S. EQUIPMENT CONTACTS. Refer to the following list of AutoPilot/Flight Director manufacturers to obtain service direction, parts support, and service literature.

Bendix Avionics Division
2100 N.W., 62nd Street
Fort Lauderdale, Fla. 33310
(305) 776-4100/TWX 5109559884

Collins General Aviation Division
Rockwell International
Cedar Rapids, Iowa, 52406
(319) 395-3625 Telex: 464-421

Edo Corporation - Avionics Division
Box 610
Municipal Airport
Mineral Wells, Texas 76067
(817) 325-2517 Telex: 76067

King Radio Corporation
400 North Rodgers Road
Olathe, Kansas, 66061
(913) 782-0400 Telex: 4-2299-Kingrad

Sperry Flight Systems/Avionics Div.
8500 Balboa Blvd.
P.O. Box 9028
Van Nuys, CA, 91409
(213) 894-8111 Telex: 65-1367

Global Navigation
2144 Michelson Drive
Irvine, CA 92715
(714) 851-0119

12-13. PIPER A.F.C.S. EQUIPMENT. In the case of early models, Piper AutoPilot equipment bears the Piper name, and the appropriate Piper AutoPilot/Flight Director Service Manual shall be used.

NOTE: If a Roll Axis only AutoPilot is installed, or if no AutoPilot is installed, consult the Piper Pitch Trim Service Manual - 753-771 for manual electric pitch trim service information.

The following is a complete listing of Piper A.F.C.S. equipment service literature. It is imperative to correctly identify the AutoPilot system by “faceplate” model name, in order to consult the appropriate service manual. Each manual identifies the revision level and revision status as called out on the Master Parts Price List Aerofiche published monthly by Piper. Consult the aircraft's parts catalog for replacement parts.

NAME	PIPER PART NO.
Autocontrol I/II & AltiMatic I/II	753-798
Autocontrol III & AltiMatic III and IIIB	753-723
Autocontrol IIIB & AltiMatic IIIB-I	761-502
AltiMatic IIIC	761-602
AltiMatic V & V-l	761-525
AltiMatic VF/D & VF/D-1	761-526
AltiMatic X F.D./A.P. & X A.P.	761-668
AutoFlite	763-720
AutoFlite II	761-481
Piper Pitch Trim (Manual-Electric)	757-771

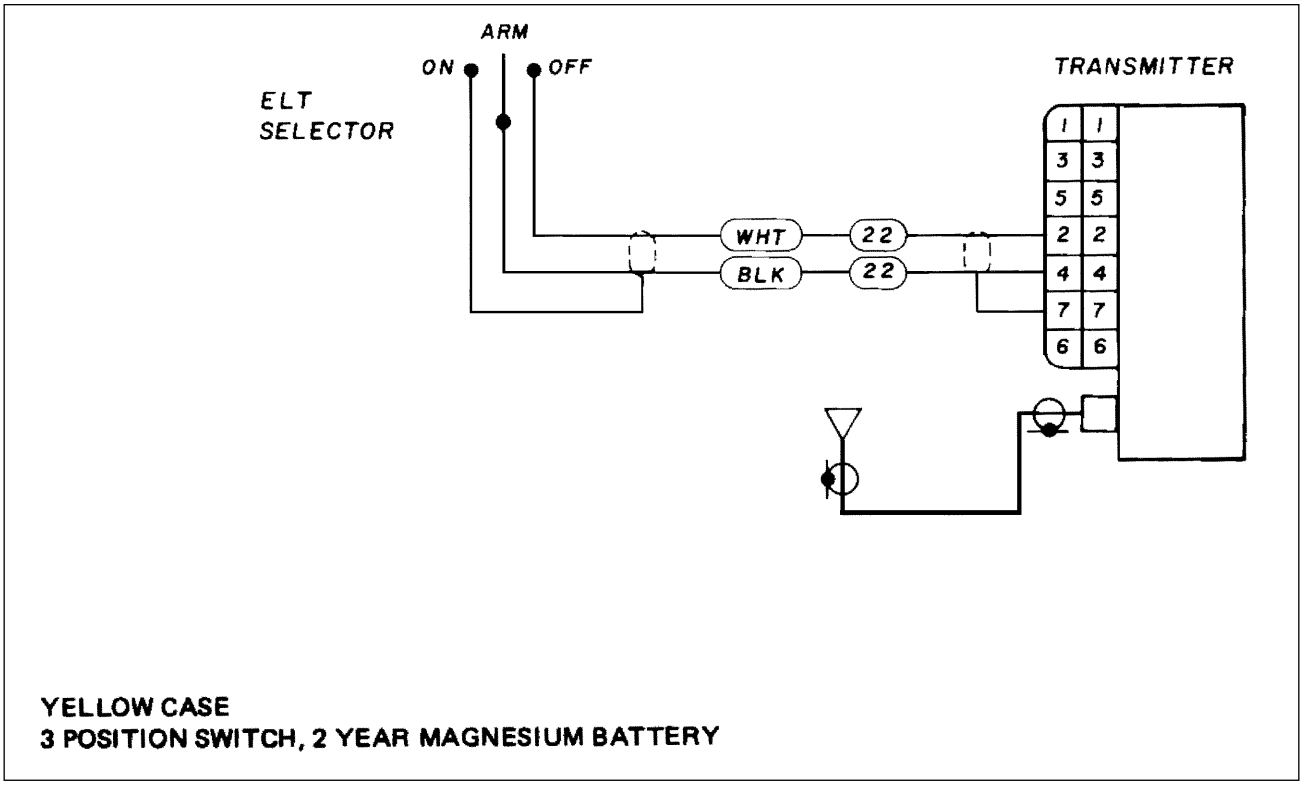

Figure 12-2. Emergency Locater Transmitter Schematic (Garrett)

12-14. RADIO SHELF CAPACITIES. A summary of approved capacities for various shelves in Piper Aircraft listed by models below:

MODEL	SHELF INSTALLATION DRAWING NUMBER	MAXIMUM APPROVED WEIGHT
PA-23-250 and PA-23-235	16300	50 lbs.
	16828	75 lbs.
	16944	15 lbs.
PA-23-250 (six place)	30542	100 lbs.

Shelf Drawing No. 16828, as shown, indicates a maximum approved weight of 75 lbs. which includes the weight of 50 lbs. as approved on Shelf Drawing No. 16300. In no case shall the maximum approved weight on either drawing be used cumulatively.

The maximum approved weight of any of the above radio shelves must not be concentrated, but uniformly distributed on the respective shelf.

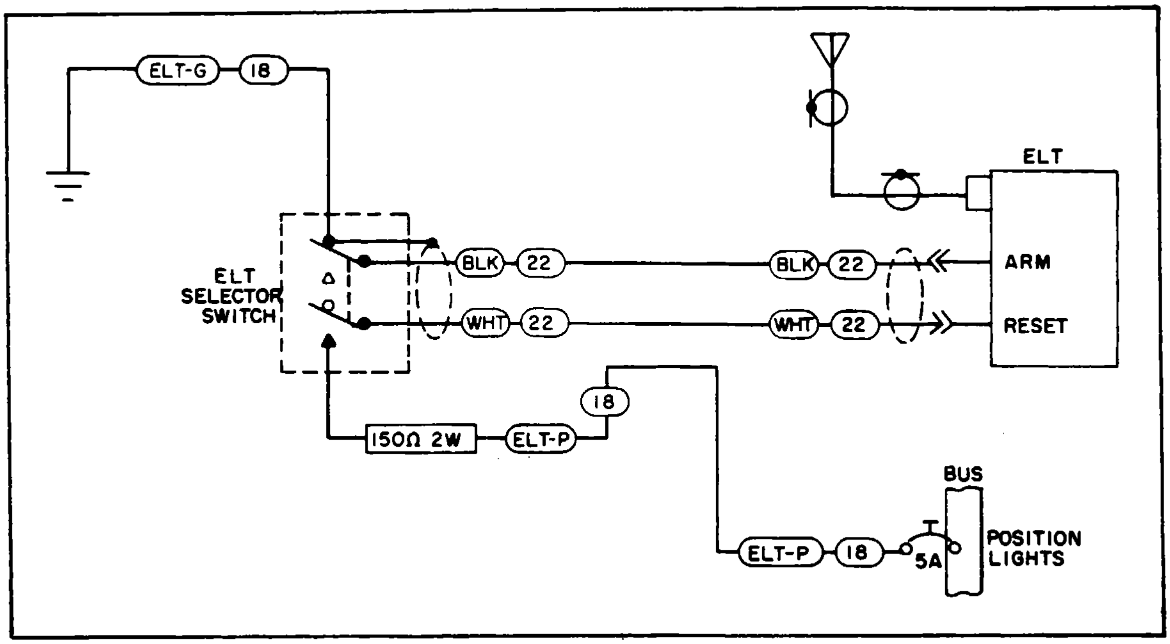

Figure 12-3. Emergency Locator Transmitter Schematic
(Communications Components Corp. Up to Serial Nos. 27-7954006)

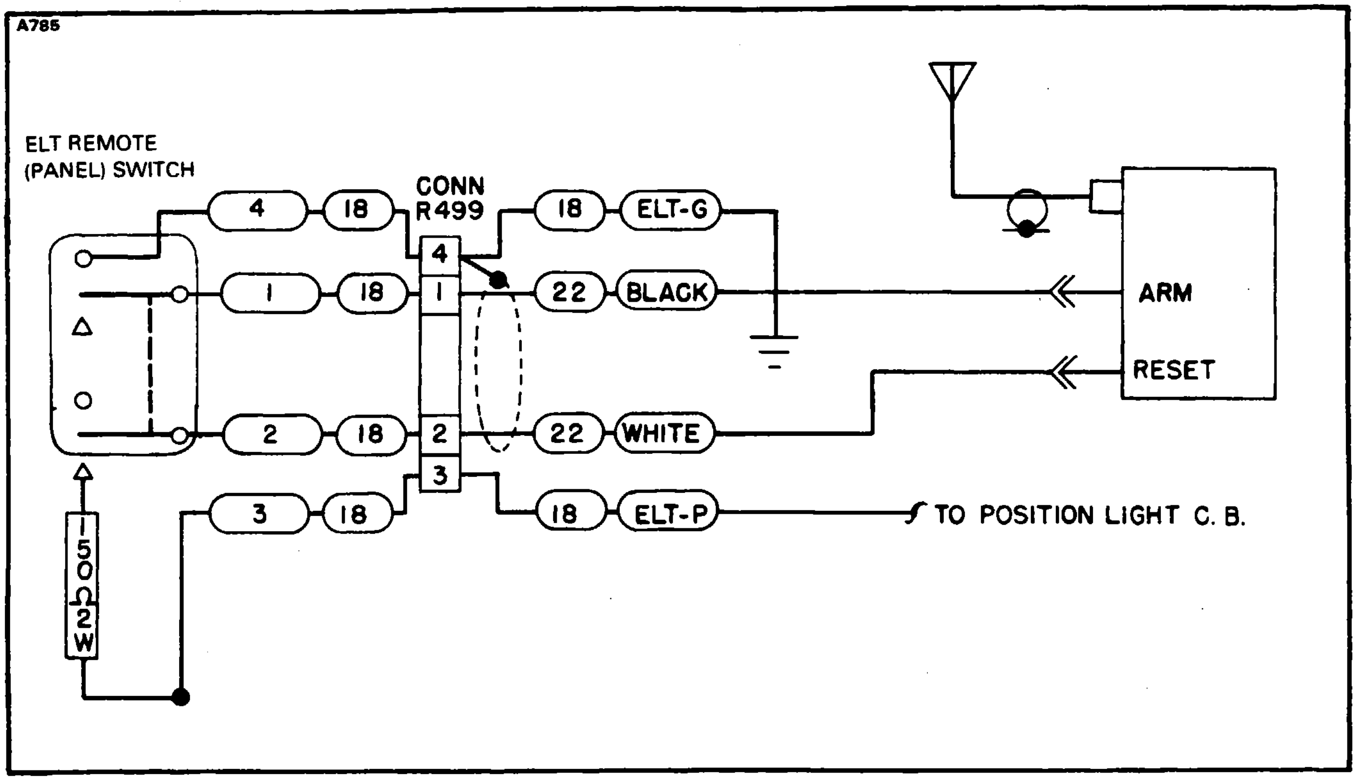

Figure 12-4. Emergency Locator Transmitter Schematic
(Communications Components Corp. Serial Nos. 27-7954007 and up)

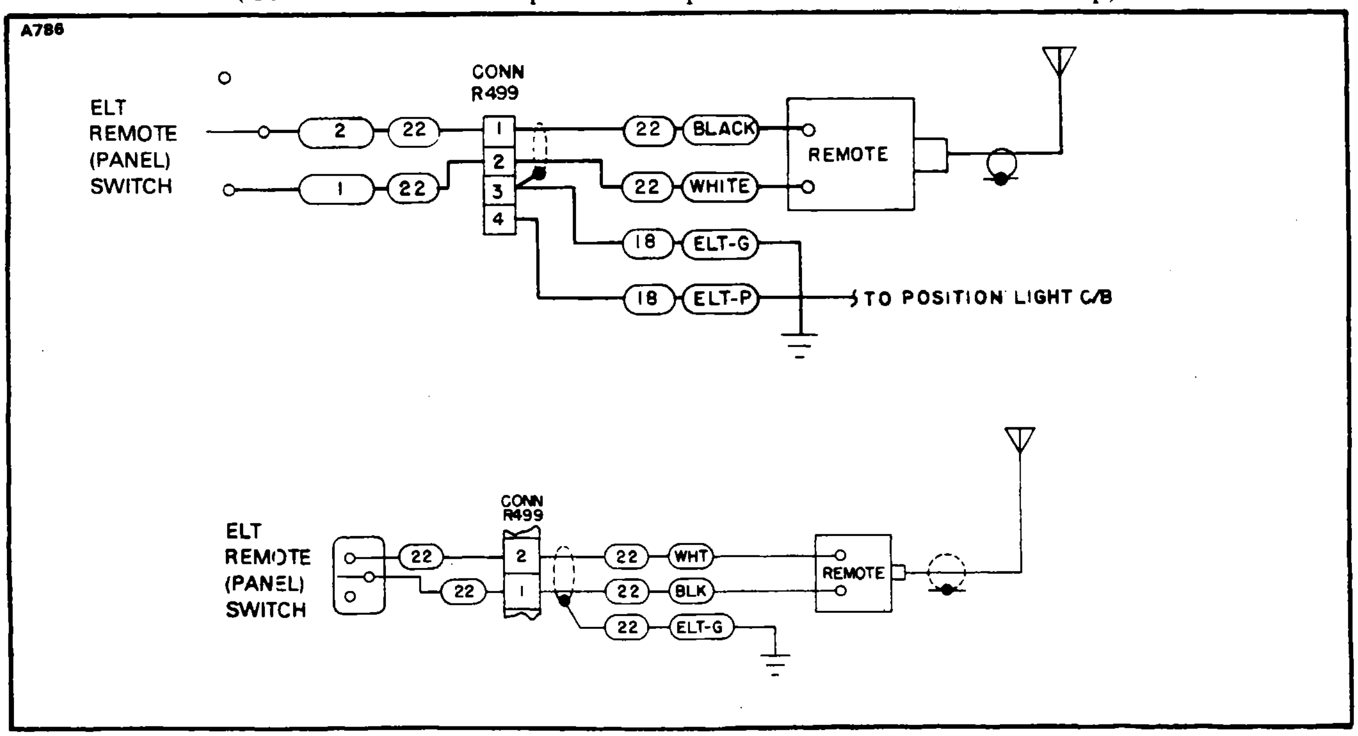

Figure 12-5. Emergency Locator Transmitter Schematic (Narco)
Serial Nos. 27-7954007 and up

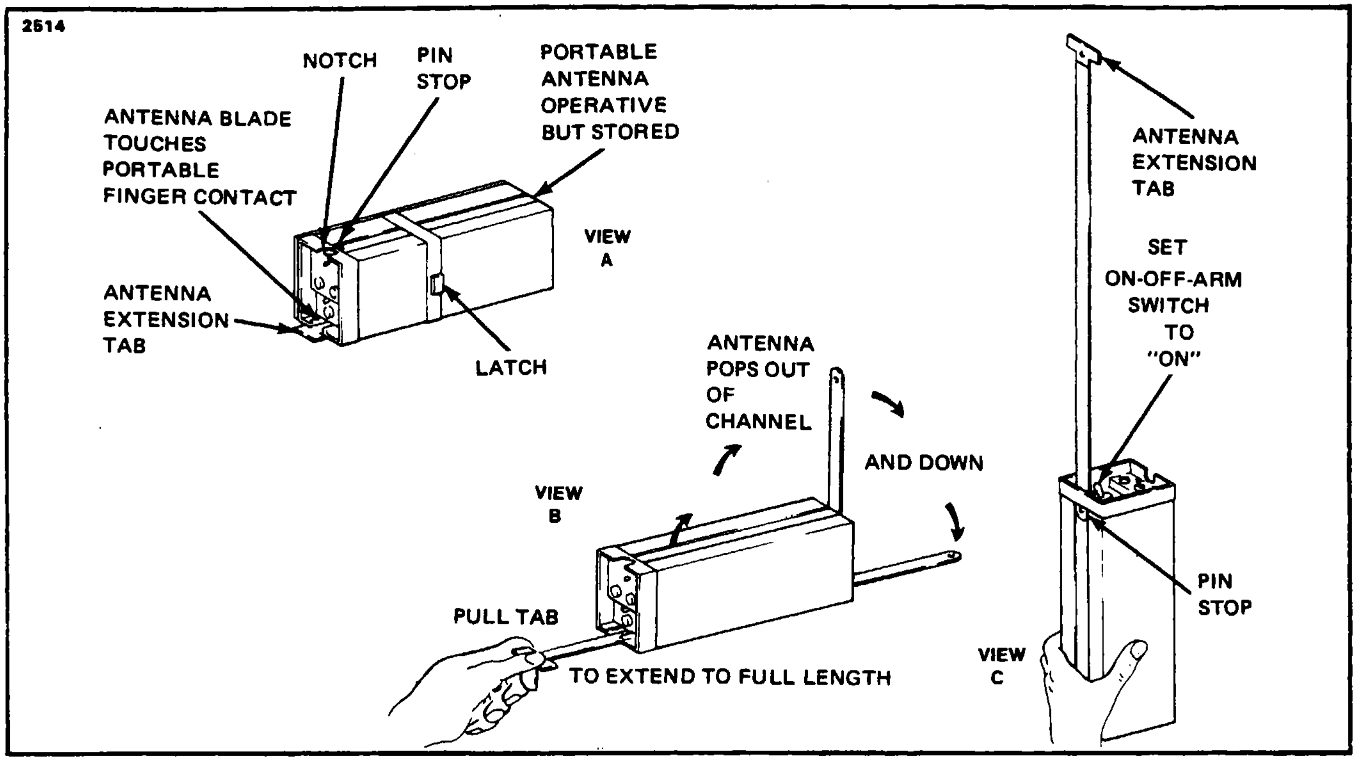

Figure 12-6. ELT Portable Folding Antenna (Narco)

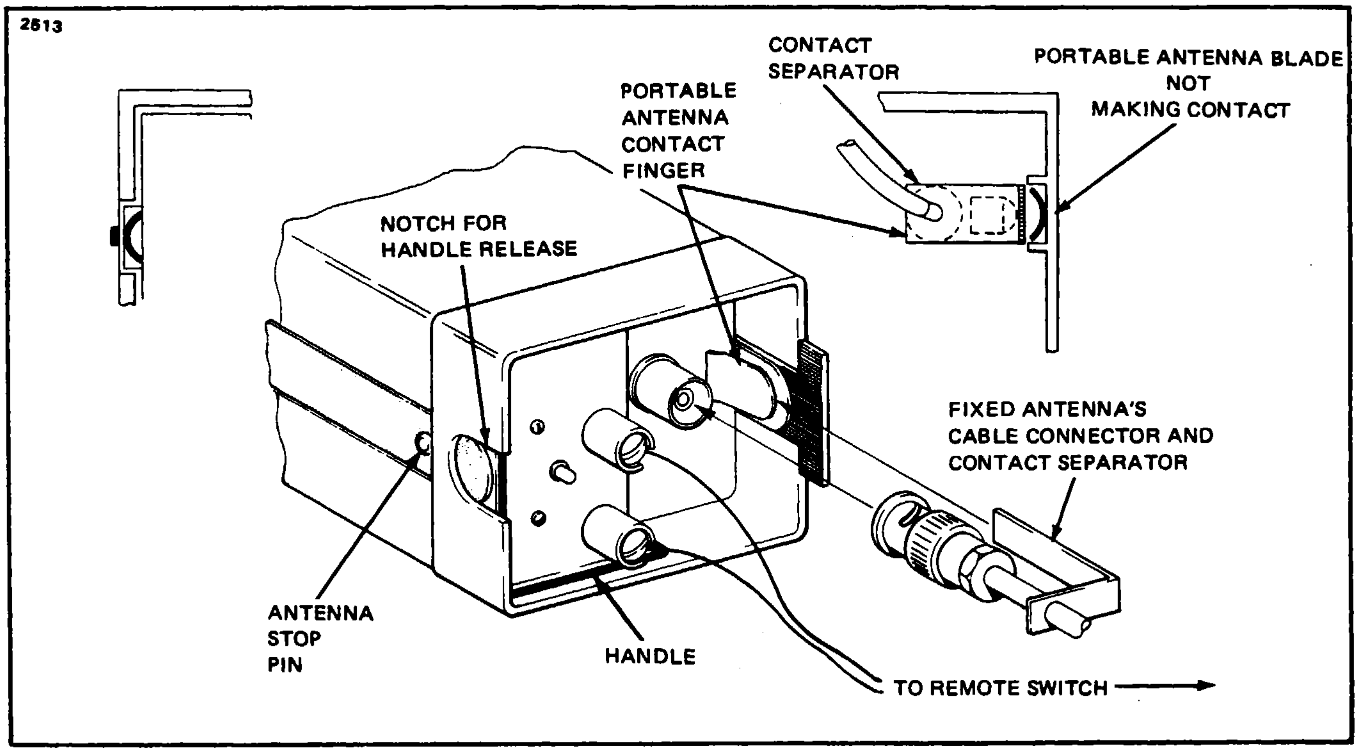

Figure 12-7. ELT Using Fixed Aircraft Antenna (Narco)

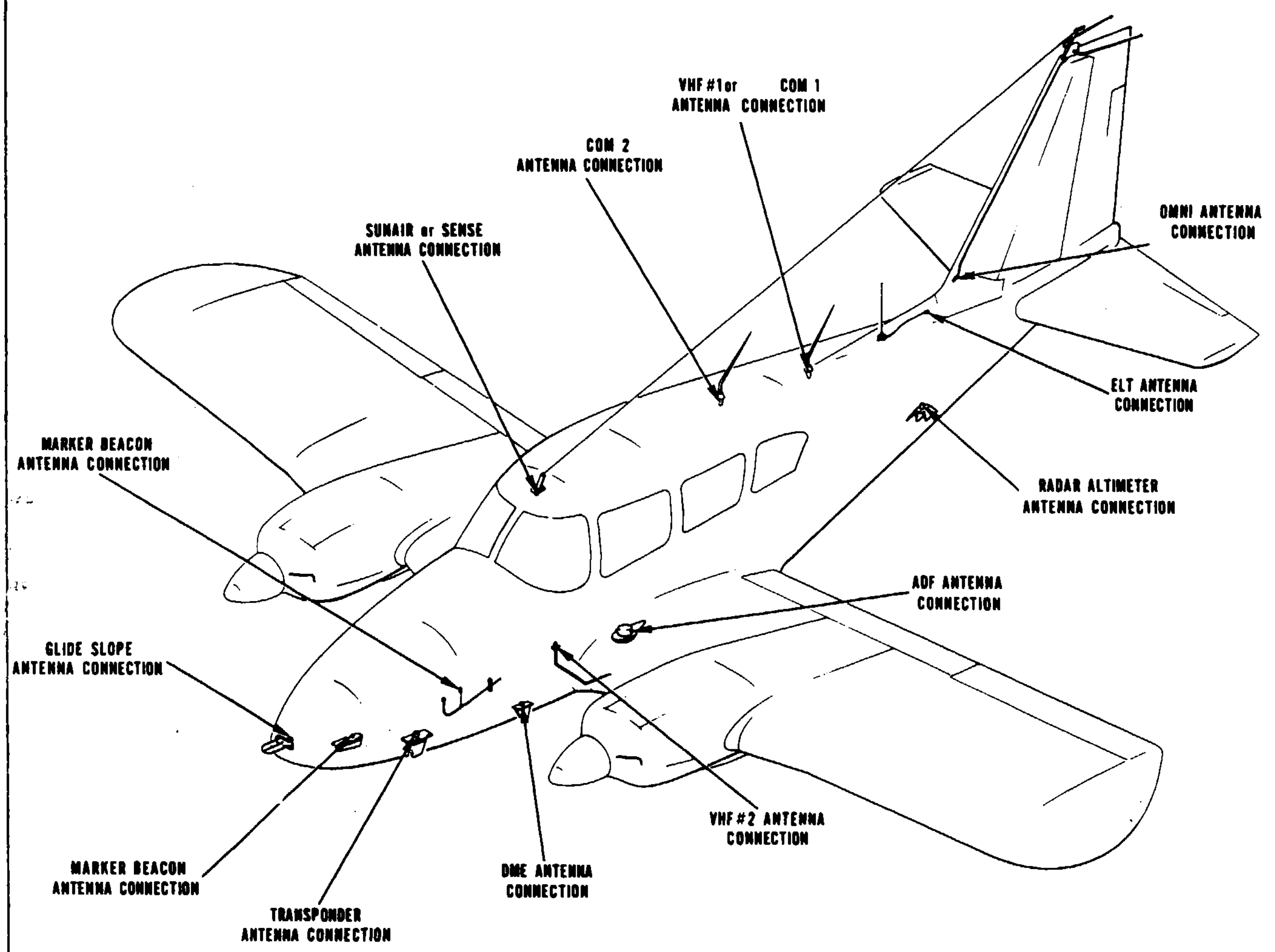

Figure 12-8. Avionic Antenna Locations

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SECTION

XIII

HEATING AND VENTILATING

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SECTION XIII

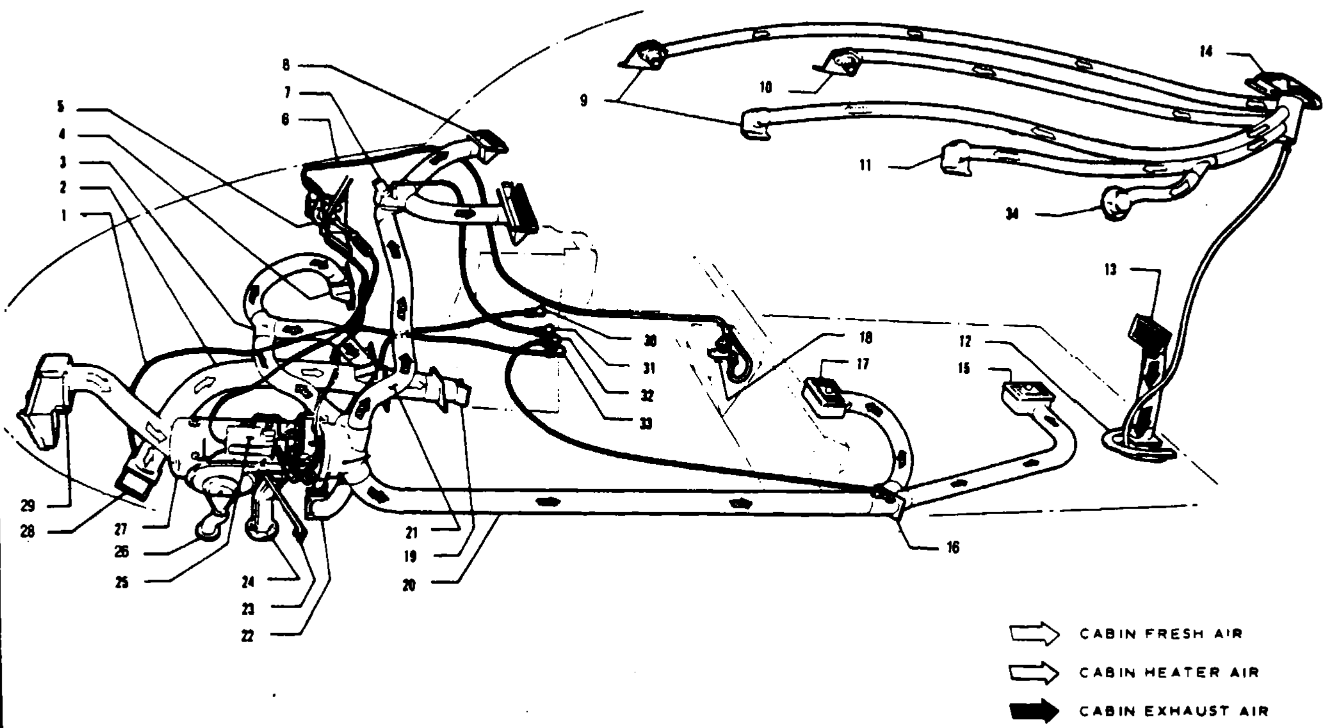
HEATING AND VENTILATING SYSTEM

13-1. INTRODUCTION. This section contains instructions for the operation, maintenance and overhaul of the different heating and ventilating systems found in the PA-23 Series airplanes. In addition, instructions for the inspection and servicing of the components that contribute to the operation of the heating and ventilating system may be found in this section. Inspection time intervals for these systems may be found in Section III of this manual.

13-2. DESCRIPTION. The flow of air for heating and defrosting is taken through an inlet in the airplane nose section and directed to a South Wind or Janitrol heater located in the left side of the nose section. From the heater, air for defrosting is directed through outlets located on the instrument panel cover, while air for cabin heat is delivered through outlets on the forward cabin bulkhead and grills located in the floor. Fresh air is also taken through the same inlet in the nose and delivered to the forward cabin area through an outlet on the forward bulkhead of the cabin. These functions are controlled by a heater switch on the right side of the instrument panel and push-pull knobs, on the cabin air control panel, located at the bottom of the control pedestal.

An additional scoop mounted on top of the airplane or in the dorsal fin draws fresh air into the cabin through individual vents over each seat. Each vent is adjustable for the desired air flow. Located in the aft section of the cabin interior is an exhaust vent to improve the circulation of air in the cabin interior.

A pictorial description of these systems may be found in Figures 13-1 thru 13-5 with a detailed description and operation of the heaters found in paragraphs 13-8 and 13-92.



1. CABLE - COLD AIR INLET CONTROL, FRONT SEAT
2. DUCT - FRESH AIR, FRONT SEAT
3. DUCT - HEATER SYSTEM AIR, FRONT SEAT
4. INLET - HEATER SYSTEM AIR, FRONT SEAT
5. CONTROL VALVE - HEATER FUEL
6. LINE - HEATER FUEL
7. CONTROL VALVE - DEFROSTER
8. INLET - HEATER SYSTEM AIR, DEFROSTER
9. VENTS - FRESH AIR, FRONT SEAT
10. VENT - FRESH AIR, RIGHT REAR
11. VENT- FRESH AIR, LEFT REAR
12. OUTLET - AIR EXHAUST, CABIN
13. BOX - AIR EXHAUST, CABIN
14. SCOOP - FRESH AIR, CABIN
15. INLET - HEATER SYSTEM AIR, REAR CABIN
16. CONTROL VALVE - HEATER SYSTEM, REAR SEATS
17. INLET - HEATER SYSTEM AIR, CENTER CABIN
18. SHUT-OFF VALVE - HEATER FUEL
19. INLET - FRESH AIR, FRONT SEAT
20. DUCT - HEATER SYSTEM AIR, REAR SEATS
21. DUCT - HEATER SYSTEM AIR,
22. DUCT - HEATER SYSTEM AIR, OVERBOARD DUMP
23. VENT LINE - HEATER FUEL
24. TUBE - HEATER EXHAUST
25. CONTROL VALVE - "HI-LO", HEATER FUEL
26. TUBE - COMBUSTION AIR INTAKE
27. HEATER
28. SCOOP, FRESH AIR, FRONT SEAT
29. SCOOP - OUTSIDE AIR TO HEATER SYSTEM
30. CONTROL - FRESH AIR, FRONT SEAT
31. CONTROL - HEATER SYSTEM AIR, DEFROSTER
32. CONTROL - HEATER SYSTEM AIR, REAR SEATS
33. CONTROL - HEATER SYSTEM AIR, FRONT SEATS
34. VENT - FRESH AIR, FIFTH SEAT

Figure 13-1. Heating and Ventilating System
PA-23-235 and PA-23-250 Serial Nos. 27-1 to 27-504 incl.

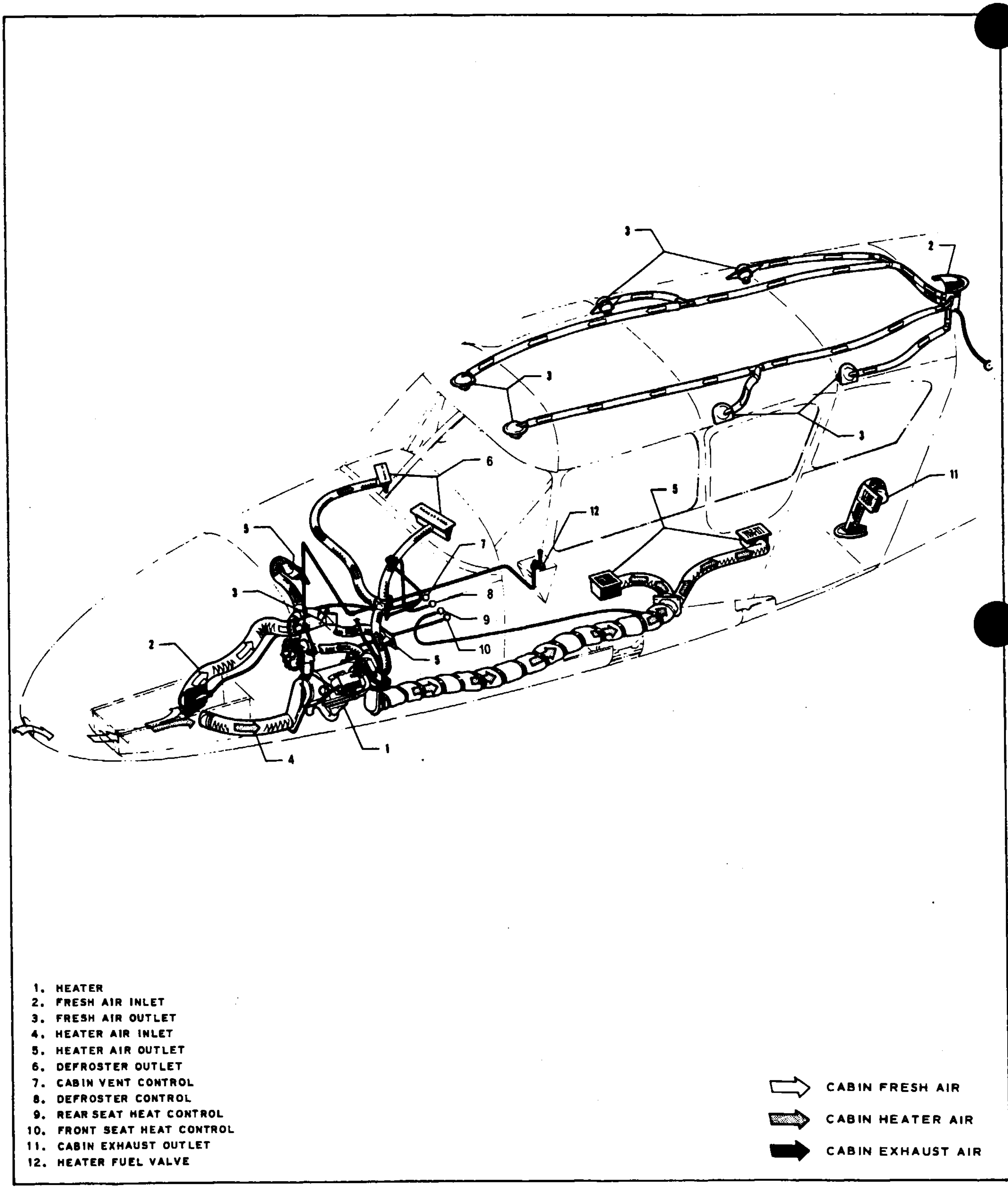


Figure 13-2. Heating and Ventilating System
PA-23-250 (six place) Serial Nos. 27-2000 to 27-2504 incl.

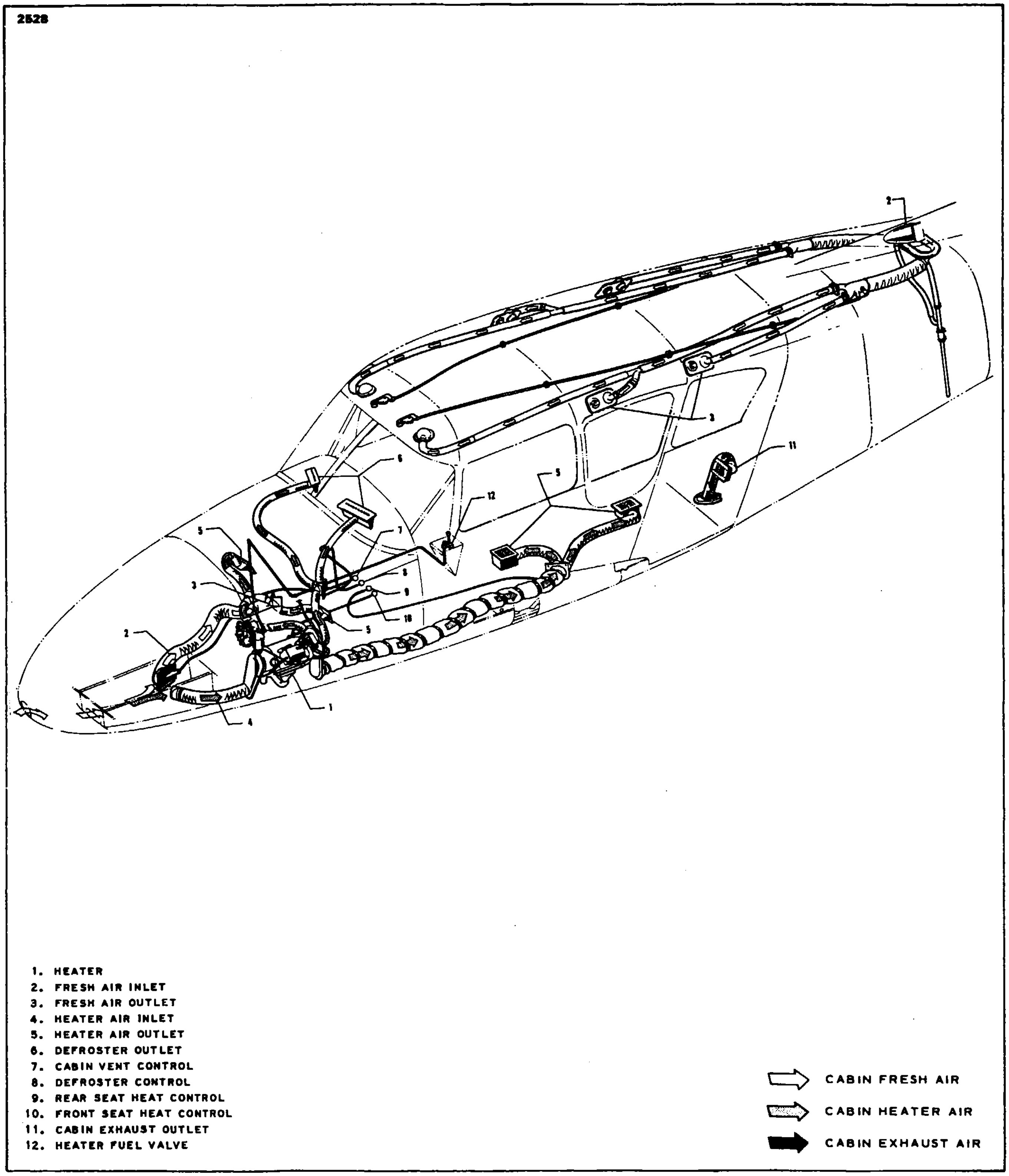
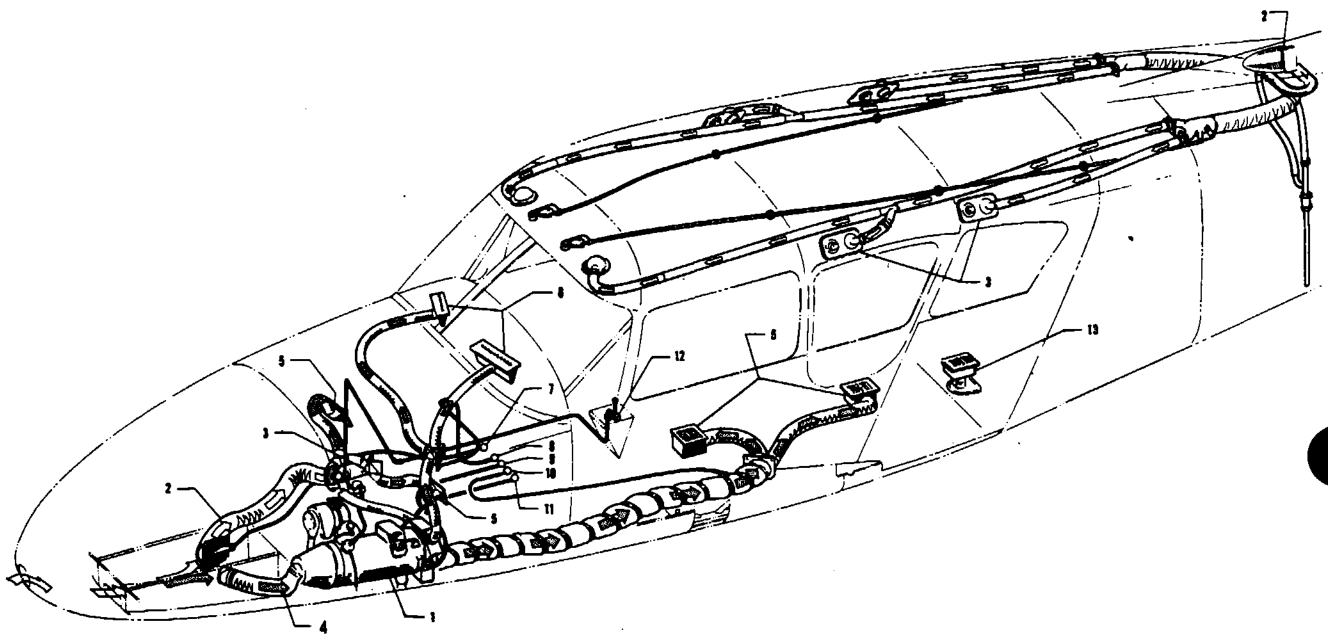


Figure 13-3. Heating and Ventilating System - PA-23-250 (six place)
Serial Nos. 27-2505 to 27-3049, 27-3051 to 27-3153 incl.

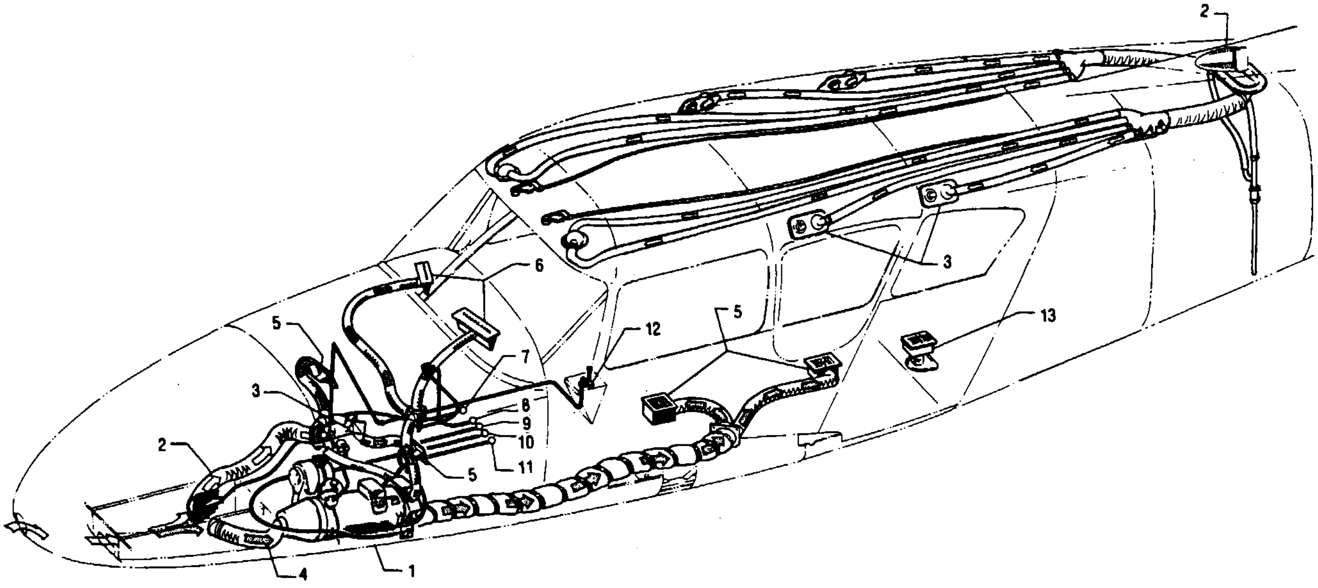
2525



1. HEATER
2. FRESH AIR INLET
3. FRESH AIR OUTLET
4. HEATER AIR INLET
5. HEATER AIR OUTLET
6. DEFROSTER OUTLET
7. CABIN VENT CONTROL
8. DEFROSTER CONTROL
9. THERMOSTAT CONTROL
10. REAR SEAT HEAT CONTROL
11. FRONT SEAT HEAT CONTROL
12. HEATER FUEL VALVE
13. CABIN EXHAUST OUTLET

CABIN FRESH AIR
CABIN HEATER AIR
CABIN EXHAUST AIR

Figure 13-4. Heating and Ventilating system - PA-23-250 (six place)
Serial Nos. 27-3050, 27-3154 to 27-3836, 27-3838 to 27-3943 incl.

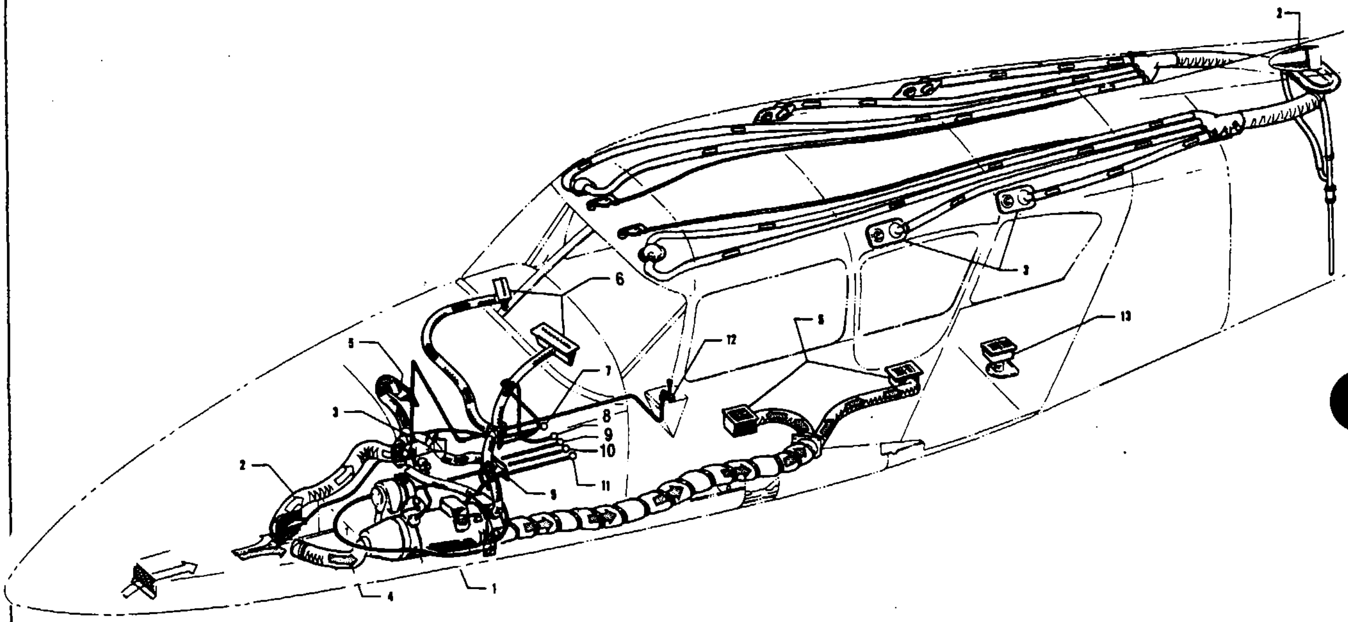


1. HEATER
2. FRESH AIR INLET
3. FRESH AIR OUTLET
4. HEATER AIR INLET
5. HEATER AIR OUTLET
6. DEFROSTER OUTLET
7. CABIN VENT CONTROL
8. DEFROSTER CONTROL
9. CABIN TEMPERATURE CONTROL
10. REAR SEAT HEAT
11. FRONT SEAT HEAT
12. HEATER FUEL VALVE
13. CABIN EXHAUST AIR

CABIN FRESH AIR
CABIN HEATER AIR
CABIN EXHAUST AIR

Figure 13-5. Heating and Ventilating System
PA-23-250 (six place) Serial Nos. 27-3837, 27-3944 to 27-4425 incl. and 27-4427 to 27-4573 incl.

2526



1. HEATER
2. FRESH AIR INLET
3. FRESH AIR OUTLET
4. HEATER AIR INLET
5. HEATER AIR OUTLET
6. DEFROSTER OUTLET
7. CABIN VENT CONTROL
8. DEFROSTER CONTROL
9. CABIN TEMPERATURE CONTROL
10. REAR SEAT HEAT
11. FRONT SEAT HEAT
12. HEATER FUEL VALVE (NOT INSTALLED ON SERIAL NOS. 27-7405432 AND UP)
13. CABIN EXHAUST AIR

CABIN FRESH AIR
CABIN HEATER AIR
CABIN EXHAUST AIR

Figure 13-6. Heating and Ventilating System
PA-23-250 (six place), Serial Nos. 27-4426 and 27-4574 and up

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13-3. HEATER SAFETY LIMIT SWITCH. Located in the South Wind and Janitrol heaters is a heat limit switch, which acts as a safety device to render the heater system inoperative if a malfunction should occur causing excessively high temperatures. This control is located in the downstream end of the vent jacket, with the reset button on the heater shroud. It is reached only through the access panel in the left side of the nose section to insure that the malfunction causing the overheat condition is corrected prior to future heater operation.

13-4. INSPECTION OF HEATER AND HEATER COMPONENTS.

a. Inspect all fuel lines and fittings for fuel stains indicating leakage. Replace lines or tighten fittings as necessary.

b. Check heater for cracks and loose bolts, screws and wiring.

c. Inspect all electrical connections for corrosion; if corrosion is evident, clean affected components and wipe clean with a lightly oiled cloth.

13-5. TROUBLESHOOTING. Troubles peculiar to the heating and ventilating systems are found throughout this section in table form. Heaters are grouped according to heater manufacturer. Further assistance to the electrical function of the heaters may be found in the Electrical System Schematics found in Section XI.

13-6. HEATER (South Wind, Model 940 Series). PA-23-250; PA-23-235; PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.; and PA-23-250 (six place), Serial Nos. 27-2505 to 27-3049, 27-3051 to 27-3153 incl.

13-7. HEATER OPERATIONAL INSTRUCTIONS. The South Wind heater installed in the Aztec is a 27, 500 B. T. U. 12 or 24-volt unit. The 12-volt heaters are Models 940-D12, 940-DA12, 940-DB12 and 940-K12 and the 24-volt units are Models 940-D24, 940-DA24 and 940-DB24. The heater is controlled by a switch located on the right side of the instrument panel labeled OFF, PRIME, LOW and HIGH. To operate the heater, first turn on the fuel control valve located on the fuel selector panel. Move the switch to HIGH or LOW heat. If the heater does not start promptly, return the heater switch to PRIME position for 15 seconds to prime the heater; then upon moving the switch to HIGH heat, the heater should start and continue to operate after one to one and a half minutes of warm-up. When operating the heater for any length of time on the ground, it is recommended to operate the heater in LOW heat position.

The heater uses gasoline from either left fuel cell when the fuel crossfeed is off, and from all cells when the crossfeed is on.

The push-pull knobs at the bottom of the control pedestal control air flow and temperature. The left control regulates air flowing to the front seat through the heater system and the second knob from the left controls air flowing to the rear seat, the second knob from the right is the defroster control and the right knob controls the supply of cool air through the vent on the forward bulkhead.

In airplanes equipped with a Model 940-K12 heater, a fifth knob is installed and this is located in the center of the air control panel between the other knobs. The knob is connected to an adjustable thermostat which makes it possible to select a desired temperature of heated air.

After the heater is turned to the OFF position, combustion in the heater stops, but the combustion fan and the circulating air fan continues to operate for about two minutes, while the heater cools and purges itself of hot air and fumes. To obtain best service life from the heater components, it is recommended that the heater switch be turned off about two minutes before turning off the master switch.

During ground operation or when the landing gear is extended, the ventilating fan motor operates and provides hot air flow through the heater system. In flight, when the gear is retracted, a micro switch on the nose gear cuts off the heater fan, and heater air is supplied by ram pressure through the nose inlet beside the landing light. This arrangement assures an adequate flow of air through the heater at all times. There is a dump valve arrangement in the heater bonnet to exhaust excessive heat thereby making it possible to operate the heater with all controls in the closed position.

For the overhaul and complete disassembly of the South Wind heater and its components, refer to paragraph 13-49 of this manual. A wiring diagram of the heater Electrical System Installation will be found in Section XI of this manual.

13-8. DESCRIPTION AND PRINCIPLES OF OPERATION. Principles of operation are basically the same for all models of the 940 Series heaters since the differences between heaters are confined to safety devices which do not function during normal burning of the heater. Operation of the safety devices follows this description.

The heater produces heat by burning a mixture of gasoline and air in a sealed, all-welded, stainless steel heat exchanger. (Refer to Figure 13-7.) Air for combustion is obtained from a blower on the side of the heater housing and is introduced into the heat exchanger through two metal elbows. Gasoline is obtained from the airplane's fuel system and is supplied to the heater through a safety valve and filter which is mounted in the nose section near the heater.

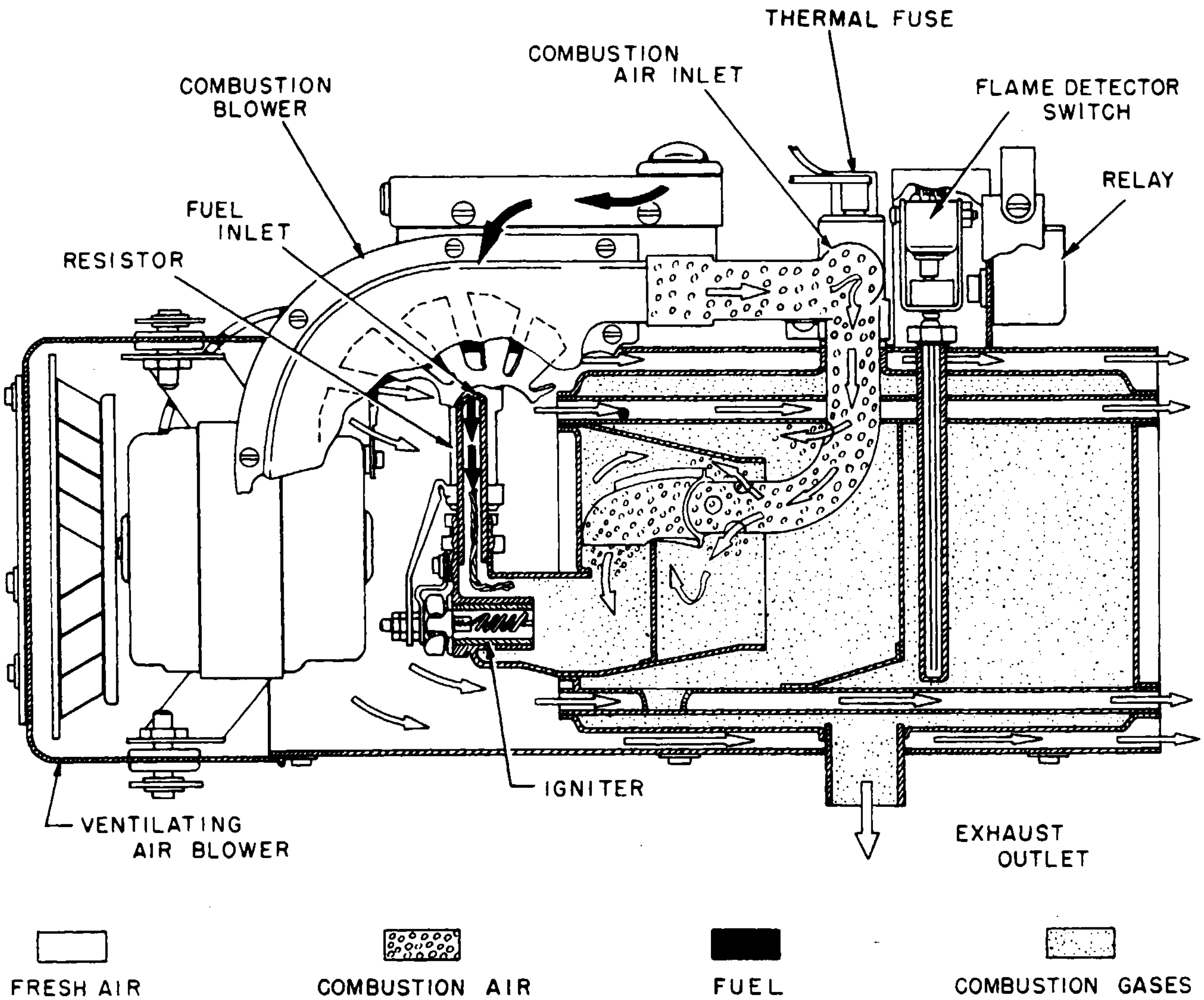

Figure 13-7. Flow System (South Wind Heater)

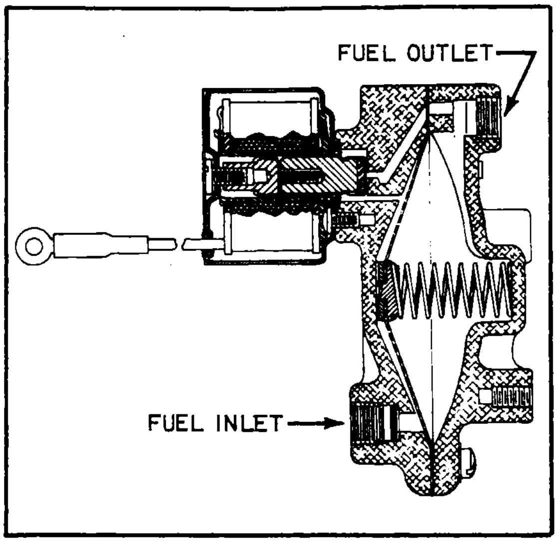

Figure 13-8. Fuel Safety Valve
(Cutaway View)

Fuel is metered at the heater by the fuel control valve, (Refer to Figure 13-9.) which is enclosed in a metal case on top of the heater. The metal case is equipped with fittings for a drain tube at the bottom, and a vent tube at the top. These tubes prevent the possibility of a fire hazard, or release of fumes, in the event that a fuel leak should develop in the valve or fuel line connection.

After being metered by the fuel control valve, the fuel passes through a short steel tube and enters a vertical standpipe. (Refer to Figure 13-7.) The fuel drips down the standpipe and saturates the stainless steel wick in the combustion chamber. The standpipe is surrounded by an electric heating element which is energized during the starting period and serves to preheat the fuel, thus insuring quick starts even at the lowest temperatures.

The fuel is ignited within the heat exchanger by a glow-plug igniter, and the resulting hot gases pass through the wraps of the heat exchanger and out the exhaust tube.

After combustion starts, the igniter and fuel preheater are turned off by the flame detector switch (Refer to Figure 13-10 or 13-11.) which also turns on the ventilating air blower at this time. Since the standpipe is now heated by combustion in the heat exchanger, preheating is no longer required and the preheater is also turned off.

13-9. SAFETY VALVE. (Refer to Figure 13-8.) The safety valve which is supplied with all models of the 940 heater consists of a shutoff solenoid and a casting which houses a large diaphragm and spring. The safety valve provides the initial flow of fuel for ignition. Additional fuel to sustain combustion is permitted to flow only after the shutoff solenoid of the safety valve is energized during a starting cycle. Fuel flows from the fuel source through the filter to the inlet side of the safety diaphragm. Pressure of fuel against the diaphragm forces gasoline, contained in the opposite side of the chamber through the outlet port into the heater.

When the flame detector switch transfers after combustion starts, the shutoff solenoid is energized and opens a by-pass through which fuel then flows to the heater. Gasoline will continue to flow through this system until the heater is turned off. The chamber behind the diaphragm will refill during heater operation as the spring returns the diaphragm to its normal position. This prepares the safety valve for another start. The safety valve may be manually recharged at any time by turning the heater switch to FAN or PRIME position for about 30 seconds.

The safety valve also acts as a second safety fuel shutoff valve, since it is energized through the heater relay. In the event of an overheat condition, which causes the thermal fuse or lockout overheat switch to open, the relay will be de-energized and the safety valve solenoid will close at the same time the heater fuel control valve shutoff solenoid closes. This double shutoff is required by Federal Regulations on airplane heater installations.

13-10. OVERHEAT SWITCH (Models 940-D and 940-DA). Two types of overheat switches are used in the 940 Series heaters. The 940-D Series heaters are equipped with a bimetal blade cycling-type switch which opens at a temperature of 250° F and shuts off fuel flow by de-energizing the fuel control valve shutoff solenoid. This switch is designed to protect the heater and airplane by limiting the heater outlet temperature. The cycling-type switch shuts off fuel only; when the heater cools, the switch will close and permit the heater to restart.

13-11. LOCKOUT OVERHEAT SWITCH (Model 940-K). This model is equipped with a snap-action type overheat switch with a manual reset button. This switch is connected in series with the thermal fuse so that functioning of either device will cause a complete shutdown of the heater. In this event, the fuel control valve solenoid and the safety valve solenoid will both close at the same time. Both of these devices also shut off the igniter.

13-12. THERMAL FUSE (Models 940-D, 940-DA, 940-DB and 940-K). The thermal fuse used on the models listed above consists of a special combustion air inlet elbow which contains a fusible metal link with electric terminals. The fusible link is connected in series with the hot lead from the heater switch.

An additional requirement of Federal Regulations is that airplane heaters be equipped with a device which will prevent operation at any time that combustion air flow is insufficient for safe operation. When applied to the 940 Series heaters, this means that the heater must shut down if combustion air flow is reversed, since the heater will operate safely under any other combustion air flow condition.

The special purposes of the thermal fuse is to shut off the heater if the direction of combustion air flow should be reversed. In such a condition, combustion air would enter through the heater exhaust and flow out through the combustion air inlet. It has been demonstrated that this flow can sustain combustion at a temperature below the overheat switch setting. For this reason, the thermal fuse has been provided at the combustion air inlet. In the event of reverse burning, the hot gases will quickly melt the fusible link and the heater will be completely shut down. The heater cannot be restarted until the fusible link has been replaced after such an occurrence.

NOTE

> The reverse burning described above can only occur under unusual conditions caused by improper installation, or by multiple failure of heater components. The thermal fuse has no effect on the heater during normal operation.

13-13. CYCLING SWITCH (Models 940-DB and 940-K). The cycling temperature limit switch, used on the models listed above, is similar to the cycling overheat switch on the other models but is set at a lower temperature. Its purpose is to prevent unnecessary operation of the lockout overheat switch by limiting heater outlet temperature.

13-14. SYSTEMS. The Model 940 Series heater consists of four systems: The Fuel System, The Combustion Air System, The Ventilating Air System, and The Electrical System. These systems are more fully described below.

13-15. FUEL SYSTEM. The fuel system consists of the safety valve (which was described under Safety Features), the heater fuel control valve and the standpipe. Most heaters are designed to operate with a fuel pressure between 1 and 15 psi. Less than one pound may not be sufficient to operate the safety valve diaphragm, and more than 15 pounds may damage the pressure regulator in the heater fuel control valve. The 940-DB and 940-K heaters are specially designed to operate at a fuel pressure of 20 to 35 psi and must be used only within this pressure range.

13-16. FUEL CONTROL VALVE. (Refer to Figure 13-9.) The fuel control valve provides the proper amount of fuel for high or low heat operation, depending upon position of the thermostat contacts. The complete valve consists of two solenoid valves and a pressure regulator which maintains constant fuel pressure for heater operation, regardless of fluctuations of pressure in the fuel supply. The flow of fuel is regulated by an orifice plate which contains holes of the proper size to meter fuel flow for high and low heat.

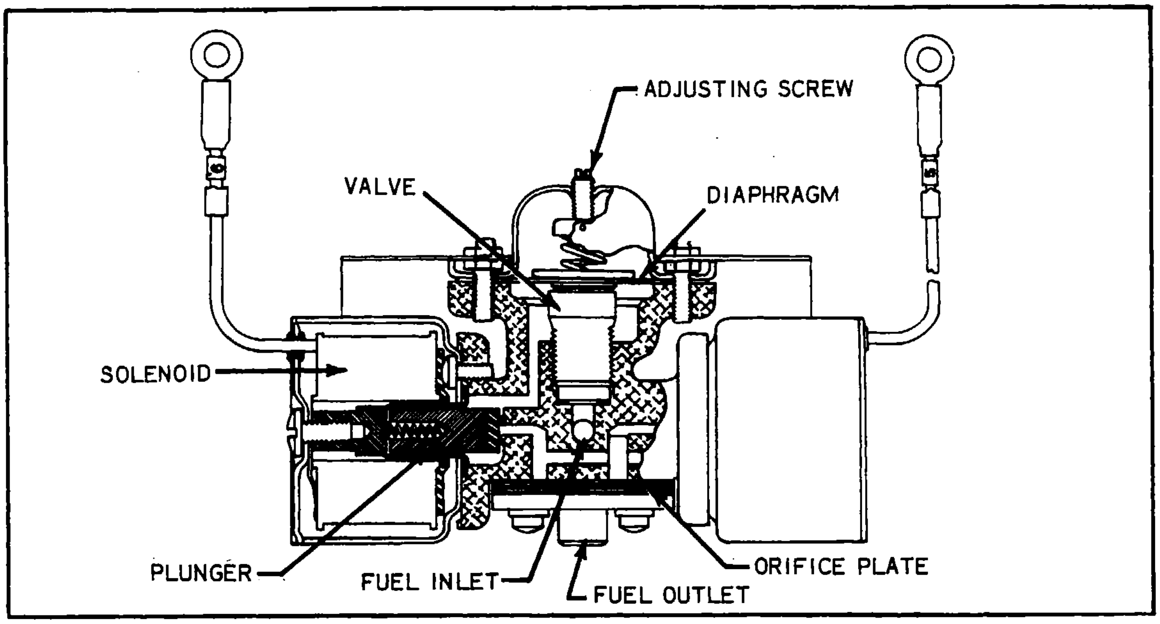

Figure 13-9. Fuel Control Valve (Cutaway View)

When the shutoff solenoid is closed or de-energized, no fuel can enter the standpipe, and the heater is completely shut off. When the shutoff solenoid is energized, fuel flows through the low heat metering orifice and the heater burns on low heat. When both the restriction and shutoff solenoids are energized, fuel flows through both the low heat orifice and the restriction orifice, thereby providing sufficient fuel for high heat operation. After leaving the fuel control valve,, the fuel drips down the standpipe where it saturates the stainless steel wick extending into the combustion chamber. (Refer to Figure 13-7.)

13-17. COMBUSTION AIR SYSTEM. The combustion air blower blows air through the metal elbows into the heat exchanger. Inside the heat exchanger the air passes through another duct (Refer to Figure 13-7.) and is blown into the burner cone, where it mixes with the gasoline vapor and the mixture is ignited by the igniter. The burning gases then swirl around the heat exchanger and exhaust through the outlet tube.

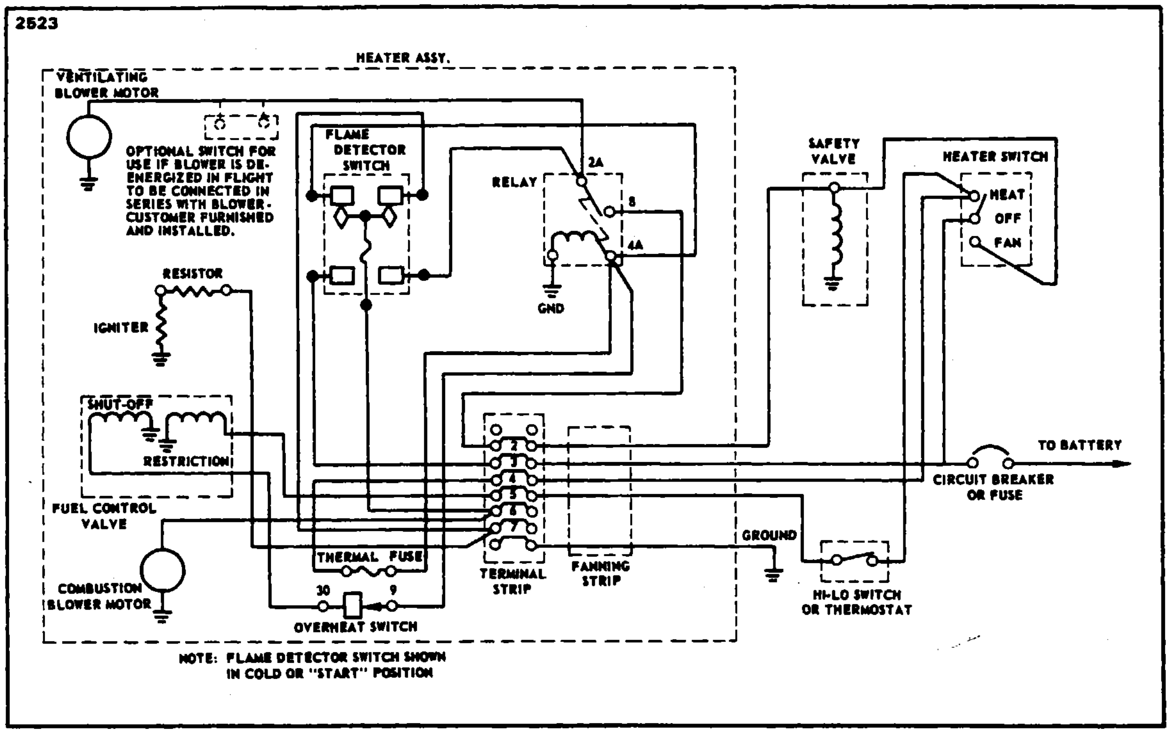

Figure 13-10. Wiring, Models 940-D and 940-DA

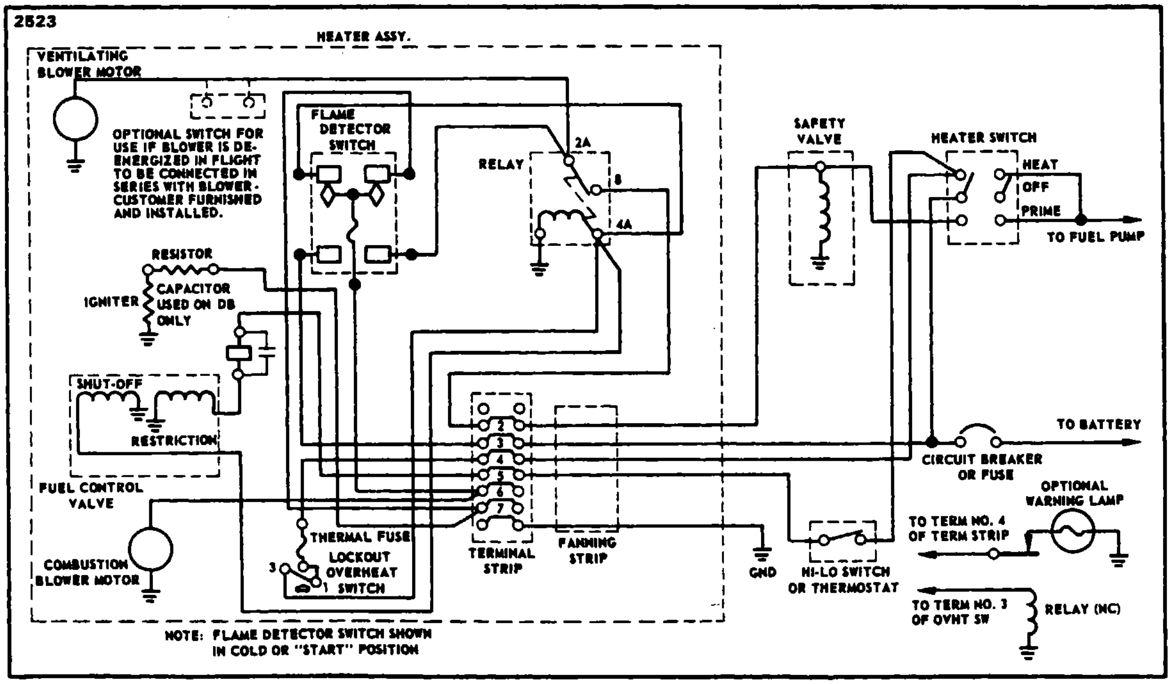

Figure 13-11. Wiring, Models 940-DB and 940-K

13-18. VENTILATING AIR SYSTEM. The ventilating air blower is mounted on the end of the heater by means of bayonet slots. The blower is a mixed-flow type which discharges axially, due to the design of the housing. It picks up clean air from outside the heater housing and blows it through the slots of the heat exchanger and around the sides, where it absorbs heat which is transmitted through the walls of the heat exchanger by the hot products of combustion. The heated air is then conducted to the space which is being heated.

13-19. ELECTRICAL SYSTEM. The heater electrical system consists of the combustion and ventilating air blower motors, the flame detector switch, the fuel valve solenoids, the fuel preheater, and the electric safety devices.

13-20. FLAME DETECTOR SWITCH. The purpose of the flame detector switch is to shut off the igniter and fuel preheater as soon as combustion has been established within the heater, and to provide a "purge" cycle after the heater is shut off. This switch consists of a hollow probe upon which is mounted a bracket and micro switch mechanism. The hollow probe contains a quartz rod which has a low rate of expansion when heated. (Refer to Figure 13-14.) The end of the quartz rod actuates the plunger of the micro switch. A leaf spring between the rod and plunger is provided to maintain a pressure through the rod against the end of the tube.

When installed on the heater, the hollow probe extends into the interior of the heat exchanger where it is subject to the heat of combustion. After combustion starts, the heating effect of the flame causes the metal tube to expand. Since the quartz rod does not expand, the lengthening tube relieves the pressure on the micro switch plunger, and the switch contacts transfer. The switch will then remain in this position as long as the tube remains hot, but will automatically return to the starting position when the heat exchanger cools. This purge cycle, after the heater switch is shut off, holds the blowers on until the residual fuel in the burner has been consumed, and the heater is cooled off.

13-21. IGNITER. The igniter is an electric "glow plug" type of heating element which glows red hot when energized. (Refer to Figure 13-7.) To prolong the life of the igniter, it is shut off by the flame detector switch as soon as combustion starts.

13-22. CYCLE OF OPERATION. When the heater switch is turned on, several things occur simultaneously. (Refer to Figure 13-10 or 13-11 according to heater model.)

a. The shutoff solenoid is energized through terminal No. 4 of the terminal strip, the overheat switch, and through the thermal fuse on models so equipped. This permits fuel to drip into the standpipe and saturate the stainless steel wick.

b. The igniter is energized through the flame detector switch which obtains its energy from terminal No. 4 of the terminal strip (or terminal No. 4A of the relay).

c. The fuel preheater heats up, since it is connected in series in the igniter circuit.

d. The combustion air motor is energized through the center connection of the flame detector switch and the blower starts.

With heated fuel dripping down the standpipe, the igniter glowing red hot, and the combustion air blower in operation, all requirements for combustion are present and burning soon starts in the heater. The heat of combustion causes the tube of the flame detector switch assembly to expand and permits the switch contacts to transfer, as previously described.

13-23. RUNNING CYCLE. When the flame detector switch transfers, the following events take place:

a. The ventilating air blower motor is energized through terminal No. 2 of the terminal strip (or 2A of the relay) and the flame detector switch and the blower start. The combustion air blower continues to run, since it obtains its energy from the center terminal of the flame detector switch. Electric energy for both blowers is now being supplied from the No. 3 terminal which is connected directly to the battery, and the blowers will continue to run until the flame detector switch cools and returns to its starting position.

b. The igniter and fuel preheater are shut off when the flame detector switch transfers. Since combustion is self-sustaining, they are no longer required.

The heater is now in full operation and will continue to burn as long as fuel, air, and electric current are supplied. The temperature of the air may be regulated by opening and closing the restriction solenoid of the fuel control valve by means of a thermostat or HI-LO switch mounted on the right side of the instrument panel.

13-24. PURGING CYCLE. When the heater switch is turned OFF, the following sequence of events takes place:

a. The shutoff solenoid of the fuel control valve is de-energized, and fuel flow stops immediately. Burning soon stops due to lack of fuel.

b. The combustion air and ventilating air blowers continue to run since the flame detector switch is still hot and is in its running position. The flow of ventilating and combustion air cools the heat exchanger and purges it of all unburned gas fumes which might remain after burning stops.

c. When the heat exchanger cools, the tube of the flame detector switch contracts and forces the quartz rod up against the micro switch plunger. The switch then transfers to its cold position and the blowers stop. The fuel safety valve solenoid is also de-energized and will not open again until the flame detector switch becomes heated on another starting cycle.

13-25. OVERHEAT SWITCH. The heater is equipped with a cycling type overheat switch to limit duct temperature to a safe maximum level. This switch is connected in series between terminal No. 4 of the terminal strip and the shutoff solenoid of the fuel control valve. When the ventilating air stream exceeds a temperature of approximately 250° F., the bimetal blade of the overheat switch will open the switch contacts and break the solenoid circuit, shutting off fuel to the heater. Burning then stops, but the blowers continue to run. As soon as the heater cools, the overheat switch contacts will close and energize the fuel shutoff solenoid. At this point, fuel flow is re-established in the heater, but the igniter is off and ignition will not occur until the flame detector switch cools and transfers to its starting position. The igniter is then energized and combustion again starts.

If the heater switch remains on, and the cause of overheating is not corrected, this process which is known as "re-cycling", will continue indefinitely. Air temperature, however, will not exceed the temperature of the overheat switch setting.

13-26. ELECTRICAL SYSTEM (Model 940-D and 940-DA Series). The electrical system of the Model 940-D and 940-DA heaters has all the components provided for in the preceding paragraphs, plus a thermal fuse in the combustion air inlet elbow and the safety valve relay. (Refer to Figure 13-10.)

The starting cycle for these heaters has a safety valve solenoid that is energized through the normally open terminal No. 8 of the relay. The relay is energized through the circuit from the heater switch, terminal No. 4, and the thermal fuse. The relay is energized at the moment the heater switch is turned on and completes the circuit from terminal No. 2A to terminal No. 8, but the safety valve solenoid remains closed because of the flame detector switch, in its cold position, does not energize terminal No. 2A of the relay.

After ignition occurs and the flame detector switch transfers, the safety valve solenoid is energized and burning proceeds. The Model 940-D Series will shut off and re-cycle if an overheat condition, due to restriction of ventilating air, should occur since this condition will not normally affect the thermal fuse.

If an unsafe operating condition should occur, due to a lack of combustion air through the heater while it is burning, the hot gases at the combustion air inlet will quickly melt the fusible link of the thermal fuse assembly. This breaks the circuit from the heater switch through terminal No. 4 of the terminal strip, and is equivalent to turning off the heater switch. The heater will then shut down in the normal manner described in the preceding paragraphs, and cannot be restarted until the thermal fuse has been replaced, since the starting circuit will remain open regardless of heater switch position. In the event of such a shut down, the relay will be de-energized at the moment the overheat condition occurs, and the safety valve and fuel solenoid shutoff valve will both close at the same time without regard to flame detector switch position. The combustion air blower and ventilating air blower will continue to run until the flame detector switch cools and transfers.

13-27. ELECTRICAL SYSTEM (Model 940-DB and 940-K Series). The Models listed above have electrical systems similar to the system of the Model 940-D, except that an additional safety device, the lockout overheat switch, is connected in series with the thermal fuse in the starting circuit, and a cycling temperature limit switch is connected into the restriction solenoid circuit. (Refer to Figure 13-11.) The purpose of the lockout overheat switch is to prevent re-cycling the heater after an overheat condition, and the purpose of the cycling limit switch is to prevent needless operation of the lockout overheat switch.

These heaters start in the same manner described for the 940-D Series heaters. Heater outlet temperature will then be controlled by action of the thermostat which opens and closes the restriction solenoid in the normal manner. If the thermostat should fail in the closed position, or should fail to sense duct temperature for any reason, the cycling switch will automatically limit heat output, since it is connected into the thermostat circuit, and serves the same purpose. This feature prevents heater shut down by the lockout overheat switch and consequent loss of heat, due to a defective thermostat or duct system.

The lockout overheat switch protects the heater and the airplane from an overheat condition caused by excessive fuel flow, or by a combined failure of ventilating air and the cycling limit switch. The lockout overheat switch is set at a higher temperature than the cycling limit switch, and like the thermal fuse, will operate only under extreme conditions. In the event of such an overheat condition, the heater will shut down the same as if the heater switch were turned off and cannot be restarted until the overheat switch plunger has been reset.

TECHNICAL DATA

Electrical Requirements	
940-D12, 940-DA12, 940-DB12, 940-K12	14-volts DC
940-C24, 940-D24	28-volts DC
Current Consumption	
940-D12, 940-DA12, 940-DB12, 940-K12	
Starting	12-amp.
Running	7-amp.
940-D24, 940-DB24	
Starting	11. 5-amp.
Running	3. 5-amp.
Fuel Pressure	
All Models except 940-DB and 940-K	1 to 15 psi
Models 940-DB and 940-K	20 to 35 psi
Fuel Consumption	
940-D	
High Heat	0. 37 gph (0. 037 lb/min)
Low Heat	0. 12 gph (0. 012 lb/min)
940-DA	
High Heat	0. 37 gph (0. 037 lb/min)
Low Heat	0. 18 gph (0. 018 lb/min)
940-K	
High Heat	0. 37 gph (0. 037 lb/min)
Low Heat	0. 08 gph (0. 008 lb/min)
Heat Output	
940-D	
High Heat	27, 500 BTU/HR
Low Heat	10, 000 BTU/HR
940-DA, 940-DB	
High Heat	27, 500 BTU/HR
Low Heat	15, 000 BTU/HR

TECHNICAL DATA (cont.)

Heat Output (cont.)	
940-K	
High Heat	27, 500 BTU/HR
Low Heat	5, 500 BTU/HR
Overheat Switch Operating Temperature	
940-D, 940-DA	250° F
940-K	140° to 160°F
940-DB	205° to 245°F
Cycling Switch Operating Temperature	
940-DB, 940-K	220°F
Dimensions	
All Models	16-7/8 in. long; 7-3/4 in. wide; 9-1/8 in. high Weight: 20 lbs. (Approx.)
Diameter of Housing	6-3/16 in. O.D.
Combustion Air Inlet	1-1/2 in. O.D.
Heater Exhaust	1-1/2 in. O.D.
Exhaust Shroud Flange	2-1/2 in. O.D.

13-28. REMOVAL OF HEATER. (PA-23-250 and PA-23-235.) (Refer to Figure 13-12.)

a. Turn the heater control switches OFF.

b. Remove the access panel from the left side of the nose section.

c. Disconnect the four hoses from the rear of the heater air distributor box. (Refer to Figure 13-1.)

d. Loosen, but do not remove, the four self-locking nuts securing the ventilating air blower assembly to the heater. Twist the blower clockwise and pull it straight off.

e. Disconnect the black blower motor wire from the heater terminal strip. The wire designation is No. 2.

f. Loosen the four screws at the side of the fuel control valve housing and lift off cover.

g. Disconnect electrical leads at rear of the heater terminal strip. Remove harness clamp and starter lead clamp from flame detector switch guard.

h. Disconnect dump valve push-pull control cable.

i. Remove four cap screws located at the bottom left of the fuselage nose and remove the ring from around the exhaust pipe.

j. Pull the heater fuel drain up and out of the grommet in the bottom of fuselage.

k. Remove nut and lockwasher from the heater support bank clamp, releasing clamp tension.

l. Remove cap screws from upper and lower tubular structure brackets which support the heater. Reach into the front of the heater case and remove washer and self-locking nut of each screw as they are freed.

m. With an assistant inside the fuselage, using a screw driver to prevent the screws from turning, remove four self-locking nuts from the left front seat heater system air inlet. Slide the inlet off the screws and push it away from the heater.

NOTE

The inlet is removed to permit heater removal without the heater air box striking nearby components.

n. If only one mechanic is available, an alternate method for step "m", above, is necessary. Remove the five cap screws from the periphery of the heater air distributor box. Slide the box from the rear of the heater case. This procedure eliminates the need to disconnect the hoses and dump box control cable as described in steps "c" and "h".

o. Carefully remove the heater.

13-29. INSTALLATION OF HEATER. (PA-23-250 and PA-23-235.) (Refer to Figure 13-12.) Install the heater in reverse order of the removal instruction of paragraph 13-28, with the qualifications which follow below.

a. Position heater between the two tubular structure brackets and secure it with two cap screws, plain washers and self-locking nuts.

b. Install the ventilating air fan on the front of the heater case with a counter-clockwise twist and secure it with four self-locking nuts.

c. Apply the heater support bank clamp loosely. Adjust the heater position so that the heater distributor air box does not chafe against the tubular structure and the defroster hose does not rub against the left front seat heater system air inlet. Tighten the clamp.

d. Connect the wires to the aft side of the heater terminal strip as indicated.

HEATER TERMINAL BLOCK WIRING	
Terminal No.	Wire Designation
2	H2A
2	H2B
3	H3B
4	H4A
5	H5A
Ground (lowest terminal)	H8A

HEATER TERMINAL BLOCK WIRING TEST	
Terminal No.	Switch Position at Which Lamp Lights
2	PRIME
3	OFF, PRIME, LOW HEAT, HIGH HEAT
4	LOW HEAT, HIGH HEAT
5	HIGH HEAT
6	LOW HEAT, HIGH HEAT
7	LOW HEAT, HIGH HEAT
*With fuel applied and burning, the lamps will light in the PRIME, LOW HEAT, HIGH HEAT positions at Terminal No. 2.	

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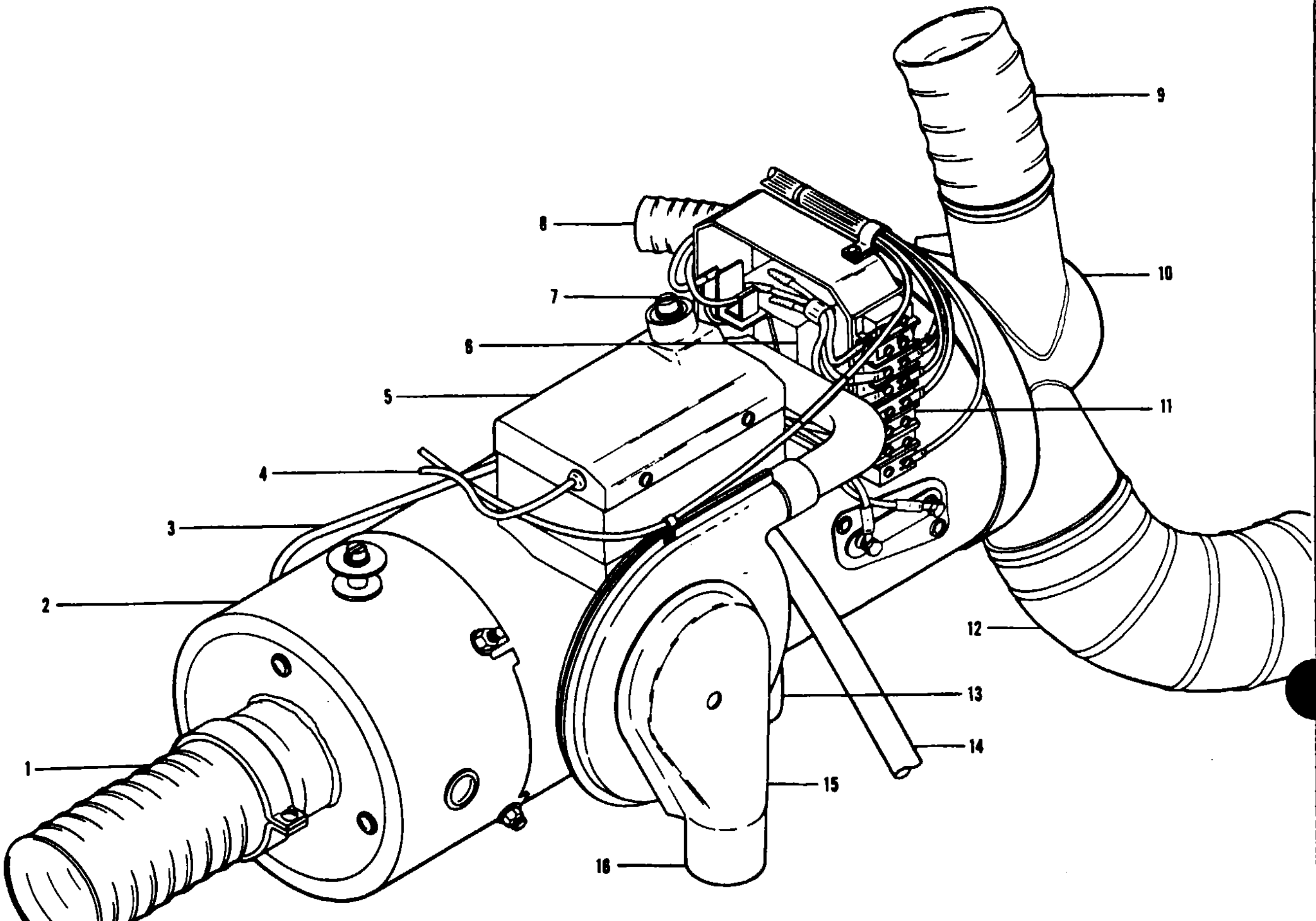

1. HOSE, AIR INLET
2. VENTILATING AIR BLOWER
3. ELECTRICAL LEAD, VENTILATING AIR BLOWER
4. FUEL LINE
5. FUEL CONTROL VALVE
6. FLAME DETECTOR SWITCH
7. FUEL VALVE VENT
8. HOSE, CABIN HEAT
9. HOSE, DEFROSTER
10. AIR DISTRIBUTION BOX
11. TERMINAL STRIP
12. HOSE, CABIN HEAT
13. EXHAUST TUBE
14. FUEL VALVE DRAIN
15. COMBUSTION AIR BLOWER
16. AIR INLET COMBUSTION

Figure 13-12. Heater Installation (PA-23-235 and PA-23-250)

e. Connect the black fan motor wire No. 2 to terminal No. 2 at the leading side of the terminal strip.

f. When a new heater is installed (PA-23-250 only), it will be necessary to remove its name plate. Then move the name plate aft until its two leading attaching holes coincide with the two rear mounting holes in the heater housing. Install two of the original attaching screws in the front of the name plate. Using the two holes in the rear of the name plate as guides, drill two holes into the heater housing and install the two remaining self-tapping attaching screws. It will also be necessary to drill two holes in the heater housing to accommodate the screws from the upper and lower tubular structure brackets.

13-30. REMOVAL OF HEATER. (PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl., and PA-23-250 (six place), Serial Nos. 27-2505 to 27-3049, 27-3051 to 27-3153 incl.) (Refer to Figure 13-13.)

a. Turn the heater control switches OFF.

b. Remove the aft panel in the forward baggage compartment and the heater forward access panel on the left side of the fuselage nose section.

c. From inside the forward baggage compartment remove the fresh air duct from the ventilating fan assembly.

d. Disconnect the black wire to ventilating fan. Loosen, but do not remove, the four self-locking nuts securing the ventilating fan assembly to the heater. Twist the fan clockwise and pull straight off.

e. Loosen the four screws at the side of the fuel control valve housing and lift off the cover. Disconnect the fuel line at the fuel control valve.

f. Disconnect all electrical leads at the rear of the heater terminal strip. Remove the harness clamp and the starter lead clamp from the flame detector switch guard.

g. Remove the four cap screws located at bottom left of fuselage nose and remove ring from around exhaust pipe assembly.

h. Pull the heater fuel drain tube up and out of the grommet in bottom of fuselage.

i. Disconnect the air duct to the heater combustion fan.

j. Remove the nut and lockwasher from heater support band clamp, releasing clamp tension.

k. Remove the cap screw from the lower tubular structure bracket which supports front of heater assembly.

l. Remove the heater distributor assembly located at the aft end of the heater by removing the four securing screws.

m. Carefully remove the heater assembly.

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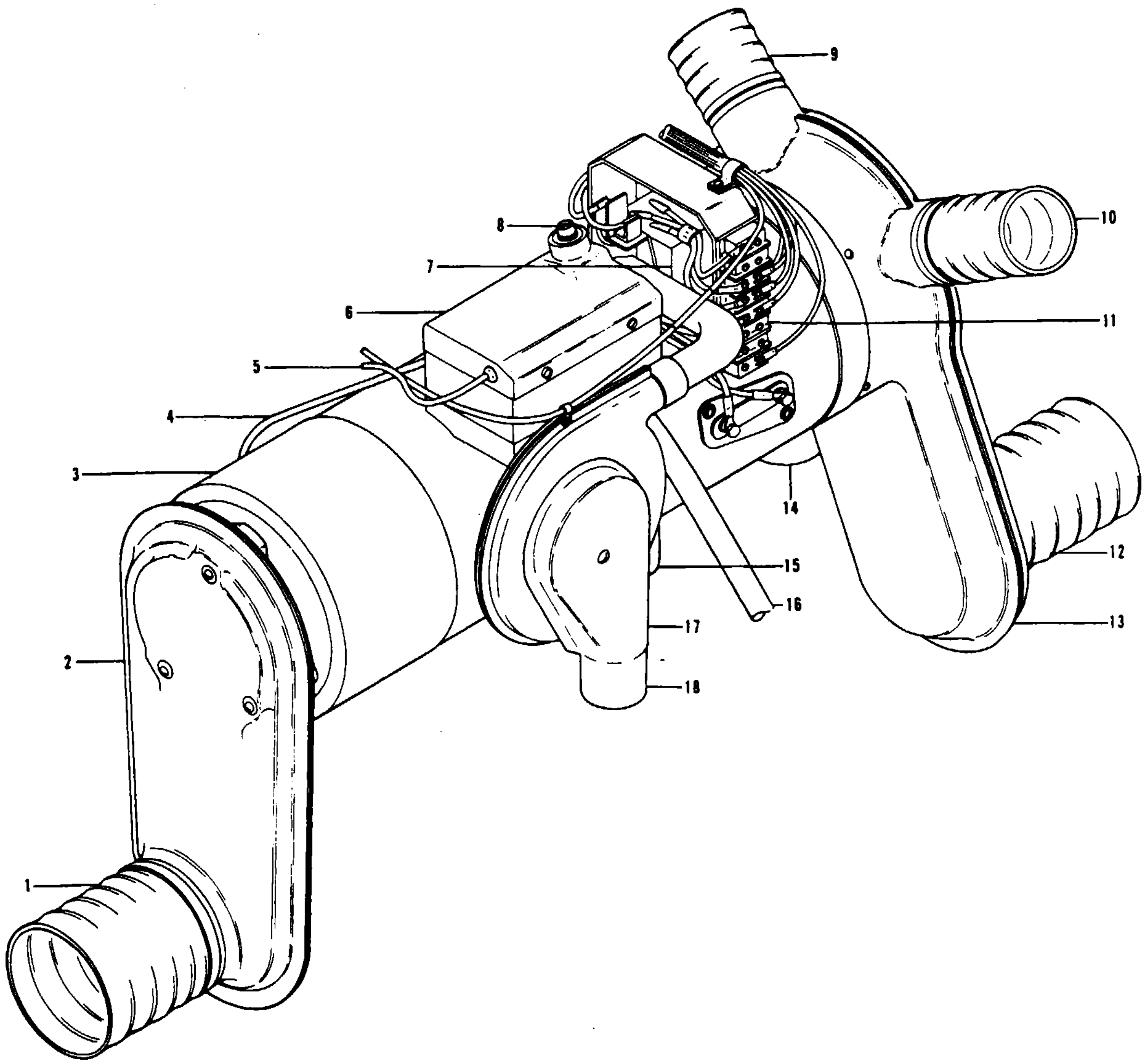


1. HOSE, AIR INLET
2. INTAKE, HEATER AIR
3. VENTILATING AIR BLOWER
4. ELECTRICAL LEAD, VENTILATING AIR BLOWER
5. FUEL LINE
6. FUEL CONTROL VALVE
7. FLAME DETECTOR SWITCH
8. FUEL VALVE VENT
9. HOSE, CABIN HEAT
10. HOSE, DEFROSTER
11. TERMINAL STRIP
12. HOSE, CABIN HEAT
13. AIR DISTRIBUTION BOX
14. HOSE, HOT AIR DUMP
15. EXHAUST TUBE
16. FUEL VALVE DRAIN
17. COMBUSTION AIR BLOWER
18. AIR INLET COMBUSTION

Figure 13-13. Heater Installation
PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.; and PA-23-250 (six place), Serial Nos. 27-2505 to 27-3049, 27-3051 to 27-3153 incl.

13-31. INSTALLATION OF HEATER. (PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl., and PA-23-250 (six place), Serial Nos. 27-2505 to 27-3049, 27-3051 to 27-3153 incl.) (Refer to Figure 13-13.) Install the heater in reverse order of the removal instructions of Paragraph 13-30 with the qualifications which follow below.

a. Position heater between the two tubular structure brackets and secure it with two cap screws, plain washers and self-locking nuts.

b. Install the ventilating air fan on the front of the heater case with a counter-clockwise twist and secure it with four self-locking nuts.

c. Apply the heater support bank clamp loosely. Adjust the heater position so that the heater distributor air box does not chafe against the tubular structure and the defroster hose does not rub against the left front seat heater system air inlet. Tighten the clamp.

d. Connect the wires to the aft side of the heater terminal strip as indicated.

HEATER TERMINAL BLOCK WIRING

Terminal No.	Wire Designation
2	H2A
2	H2B
3	H3B
4	H4A
5	H5A
Ground (lowest terminal)	H8A

HEATER TERMINAL BLOCK WIRING TEST

Terminal No.	Switch Position at Which Lamp Lights
2	PRIME
3	OFF, PRIME, LOW HEAT, HIGH HEAT
4	LOW HEAT, HIGH HEAT
5	HIGH HEAT
6	LOW HEAT, HIGH HEAT
7	LOW HEAT, HIGH HEAT

*With fuel applied and burning, the lamps will light in the PRIME, LOW HEAT, HIGH HEAT positions at Terminal No. 2.

e. Connect the black fan motor wire No. 2 to terminal No. 2 at the leading side of the terminal strip.

f. When a new heater is installed, it will be necessary to remove its name plate. Then move the name plate aft until its two leading attaching holes coincide with the two rear mounting holes in the heater housing. Install two of the original attaching screws in the front of the name plate. Using the two holes in the rear of the name plate as guides, drill two holes into the heater housing and install the two remaining self-tapping attaching screws. It will also be necessary to drill two holes in the heater housing to accommodate the screws from the upper and lower tubular structure brackets.

13-32. SERVICE.

13-33. GENERAL. The Model 940 heater is specifically designed to simplify servicing procedures. All controls are easily accessible and the ventilating air blower is attached by means of bayonet slots to facilitate removal and replacement.

All repairs in the field should be confined to replacement of major subassemblies of the heater. It is not recommended that any attempt be made to repair these assemblies without shop facilities. Attempts to repair the ventilating air blower, fuel control valve, safety valve, or overheat switches, without complete tools and test equipment, are likely to result in equipment failure or inadequate operation. The following major subassemblies are specially designed to permit unit replacement, and this type of maintenance is recommended for field service personnel:

a. Ventilating air blower.
b. Flame detector switch.
c. Fuel control valve.
d. Igniter.
e. Preheater resistor.
f. Overheat switch.
g. Cycling switch.
h. Combustion air blower motor.

Instructions for disassembly, repair and reassembly, appear with paragraph 13-49 of this manual. The assemblies need not be removed in the order shown since each unit is designed for separate replacement.

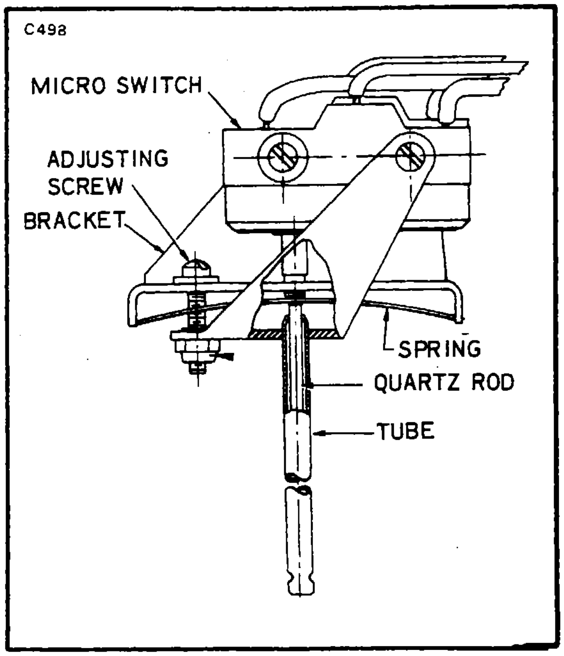


Figure 13-14. Flame Detector Switch (Cutaway View)

13-34. PERIODIC SERVICE.

a. A complete overhaul of the heater is recommended at 1000 hours of heater operating time and thereafter at 500 hour intervals.

b. The fuel filter must be cleaned at regular intervals to prevent the condensation of moisture and formation of ice during cold weather.

c. When the fuel filter is cleaned, all fuel connections should be checked for firmness of connections and condition of insulations.

13-35. ADJUSTING FLAME DETECTOR SWITCH. To adjust the flame detector switch, proceed as follows:

a. Loosen the two locking nuts so that the switch is held firmly but is not locked in position.

b. Back off the adjusting screw until the switch clicks. (Refer to Figure 13-14.)

c. Turn the adjusting screw in slowly until the switch just clicks again.

d. Turn the screw an additional three-quarter turn past the click point.

e. Hold the screws and tighten the switch mounting nuts. Check to make sure the adjusting bracket has not pulled away from the adjusting screw head.

13-36. TROUBLESHOOTING. The Series 940 heaters require a supply of fuel, electric current at the proper voltage, and an unrestricted supply of ventilating and combustion air, for proper operation. External failure of any requirement will cause failure or malfunction, even if the heater itself is in perfect condition. For this reason the external causes should always be checked first and repaired, if necessary, before an inoperative heater is removed from the airplane, or disassembled for repair.

13-37. EXTERNAL CAUSES OF TROUBLE.

13-38. ELECTRIC CHECK.

a. Check voltage at the fuse or circuit breaker, through the heater switch and at terminal No. 3 of the heater terminal strip. Terminal No. 3 should be "hot" at any time the airplane's master switch is on. A minimum of 21-volts at these points is required for proper heater operation. Terminal No. 4 should be "hot" when the heater switch and the master switch are on.

b. Turn the heater switch to FAN or PRIME position and check voltage through the switch to the hot terminal of the heater safety valve. It is possible for the safety valve to lose its charge of gasoline, in which case the heater will not start until the valve is recharged. A defective heater switch or wiring can, therefore, result in failure to start even if the heater and valve are in good condition.

c. Check wiring through the heater thermostat to terminal No. 5 of the heater. This terminal should be hot at any time the heater switch is turned on and the thermostat is calling for heat. A defective thermostat or wiring can cause the heater to burn on low heat continuously and the output will be insufficient for cold weather service.

13-39. FUEL SUPPLY. The Model 940 heaters (except Models 940-DB and 940-K) require a supply of fuel under pressure of at least one pound to operate the safety valve and to properly meter fuel to the heater. Check fuel pressure with a pressure gauge and tee fitting at the inlet to the safety valve while the engine fuel pump, auxiliary fuel pump, or other source of fuel pressure is operating. The heater fuel control valve contains a pressure regulator which will reduce fuel pressure to one psi for proper metering of fuel through the orifice plate. If fuel pressure at the control valve inlet is less than one pound, the pressure regulator ceases to function and the heater will burn at reduced level of heat output, or may fail to ignite. Any pressure between one and fifteen pounds will provide satisfactory operation. The fuel control valve used with the Model 940-DB, 940-K heaters is adjusted for use at a higher pressure and must not be used in a low-pressure system. Conversely, the low-pressure valve must not be used in a high-pressure system.

13-40. COMBUSTION AIR SUPPLY. A reduced or restricted combustion air supply will usually be easy to identify since the heater will produce black smoke at the exhaust outlet and the tube will contain a deposit of soft black carbon. This condition can be caused by an obstruction of any sort in the combustion air inlet, pinching off the combustion air tube, or an installation defect which prevents the combustion air blower from obtaining a sufficient amount of air. Always check these external causes before changing the combustion air motor. (These same symptoms can be caused by a high fuel rate.)

NOTE

The Models 940-D and 940-K heaters require ram air at the combustion air inlet, and the symptoms noted above will always appear if this heater is substituted for one of the other models without making ram air provision. These symptoms will also appear if these heaters, even when properly installed, are operated for any extended period on the ground.

13-41. VENTILATING AIR SUPPLY.

a. The need for ventilating air is apparently less critical than other requirements, since the heater will usually operate at a reduced heat output without any symptoms of malfunctioning when ventilating air flow is impeded. This condition may give the appearance of inadequate heater capacity when the fault is actually an obstruction in the ventilating air stream or a duct system which unduly restricts air flow.

b. Symptoms of inadequate air flow are constant cycling on the cycling switch (or overheat switch) and a relatively high air temperature at the heater outlet. Test for cycling by connecting a test lamp to terminal No. 9 of the overheat switch (or terminal No. 30 of the cycling switch). If the heater cycles constantly, insert a thermometer into the duct about 18 inches from the heater outlet. If the temperature at this point is near 200° F., it can be assumed that ventilating air flow is inadequate and the load on the ventilating air blower must be reduced by removing an obstruction. or reducing the length of the duct system.

c. In extreme cases where air flow is drastically reduced, or completely shut off, the lockout overheat switch on the Models 940-DB or 940-K may operate, shutting the heater completely off. Under the same conditions the Model 940-D will cycle on the overheat switch.

13-42. CHECK-OUT PROCEDURE FOR AN INOPERATIVE HEATER. If a heater fails to ignite, first check external causes previously noted, then proceed as directed in the check-out procedure below. This procedure should be followed through in the order presented, since it is designed to isolate the trouble with a minimum of disassembly.

a. On models so equipped, press the reset button of the lockout overheat switch.

b. Turn the heater control switch to FAN or PRIME position and wait approximately 30 seconds (for the safety valve to charge), then turn heater switch to ON position.

c. The requirements for heater ignition are (1) fuel, (2) a flow of combustion air, and (3) ignition. If the combustion air blower starts when the heater is turned on, the combustion air requirement is satisfied and the thermal fuse and lockout overheat switch are also eliminated as possible sources of trouble, since these components are necessary for blower operation. This leaves only fuel and ignition as causes of failure.

d. If the combustion air blower fails to start, it will be probable that the trouble is in the thermal fuse, lockout overheat switch, flame detector switch, or the combustion air blower itself.

e. Since there is more than one possible cause of either condition described above, the heater starting circuit must be checked out in a methodical way to progressively eliminate the different components. The Starting Circuit Check assumes that the blower is inoperative. If the blower operates, the check-out procedure may be started with paragraph (b) below, since the blower circuit will not be in question.

13-43. STARTING CIRCUIT CHECK.

a. On the 940-D, 940-DB and 940-K heaters, check voltage at terminal No. 4 of the terminal strip, with a test light or voltmeter, then check progressively at both sides of the thermal fuse, at terminal 4A of the relay, and at terminal No. 6 of the terminal strip. Loss of voltage at the thermal fuse indicates a defective fuse; at terminal No. 4A a defective lockout overheat switch (or wiring on 940-D); at terminal No. 6, a defective flame detector switch.

b. If there is voltage at terminal No. 6 and the combustion air blower runs, the trouble is caused by ignition failure or lack of fuel. To differentiate between these possibilities, check voltage at terminal No. 7 of the terminal strip. Loss of voltage at this point will indicate a defective flame detector switch on any model heater.

c. If there is voltage at terminal No. 7, turn off the heater switch and disconnect the igniter wire from terminal No. 7. Connect an ammeter in series between terminal No. 7 and the igniter wire, then turn on the heater switch. The igniter should draw approximately 10 amperes. If there is no current draw, either the igniter or preheat resistor is defective (any model heater). If current draw is normal and there is voltage at terminal 4A of the relay, it can be assumed that the fuel control valve shutoff solenoid is defective (on Models 940-D, 940-DB or 940-K) and the valve must be replaced.

13-44. RUNNING CIRCUIT CHECK. If the heater starts properly, burns for a short time and then goes out, or develops some other type of malfunction, it can be asuumed that the starting circuit is operating properly and the difficulty is in the heater control system. The elements which affect heater operation, after starting, are as follows:

a. Starting safety devices.
b. Fuel control components.
c. The combustion air supply.

13-45. STARTING SAFETY DEVICES. Failure of the flame detector switch to transfer will be indicated by failure of the ventilating air blower to start after the heater has burned for a short time. The fuel safety valve will shut off fuel after about two minutes, but the igniter will continue to be energized and may burn out before the condition is detected, since it is not designed for continuous operation.

In all cases where the heater ignites normally and then goes out, it will be necessary to differentiate between the flame detector switch and the safety valve. First, reset the flame detector switch as directed in this section, prime the safety valve, and make another trial start. If the heater goes out again, check wiring from the heater terminal strip to the safety valve and then replace the flame detector switch if no defect is found in the wire. If the valve primes when the heater switch is in PRIME position but fails to prime automatically when the heater is burning, the defect will be found in the wiring between the safety valve and terminal strip, or between the terminal strip and relay on heaters so equipped. If the heater burns for less than one minute and then goes out, the safety valve is not holding an adequate charge of fuel and must be replaced.

13-46. FUEL CONTROL COMPONENTS. If the heater ignites and the ventilating air blower starts but heat output is unsatisfactory (too low, too high, or constant cycling), the trouble will be found in the thermostat, the cycling switch, or the fuel control valve. Failure of the restriction solenoid to open will cause low heat output and constant burning, regardless of thermostat setting. Failure of the solenoid to close will cause high heat output and constant cycling. Low heat and constant cycling are caused by a cycling switch or a thermostat out of adjustment. Check these causes and replace the defective component, as required.

13-47. COMBUSTION AIR SUPPLY. Since an excess of combustion air (within limitations of the blower design) does not adversely affect heater operation, the only trouble likely to be encountered with combustion air is an inadequate supply. The symptoms of combustion air restriction are easy to recognize, and have been described under External Causes of Failure in this Section. If the air supply is inadequate and the trouble is not caused by restriction, replace the combustion air motor.

NOTE

The combustion air blower must not be subjected to excessive ram air pressures. The blower needs about 1 to 2 inches of water ram air pressure above the pressure in the heater exhaust, especially Models 940-D and 940-K; but ram air pressures above 3 inches of water are quite liable to cause blower wheel failure.

13-48. TROUBLESHOOTING CHART. The Troubleshooting Chart is a brief summary of the defects and remedies discussed in this Section. The chart may be used as a guide when servicing a heater which fails to perform properly when installed.

TABLE XIII-I. TROUBLESHOOTING CHART (SOUTH WIND HEATER)

Trouble	Cause	Remedy
Heater will not start, combustion air blower does not run.	Heater fuel valve not ON.	Check valve position.
	Defective wiring.	Check wiring and connections.
	Defective combustion air blower.	Replace blower.
	Defective thermal fuse.	Replace fuse.
	Defective lockout overheat switch.	Replace switch.
	Defective overheat switch.	Replace switch.
Blower runs when switch is in HEAT position but heater will not ignite.	No fuel pressure.	Check fuel supply.
	Defective igniter.	Replace igniter.
	Defective fuel control valve.	Replace valve.
	Defective cycling overheat switch.	Replace switch.
	Defective preheat resistor.	Replace resistor.
	Broken quartz rod.	Replace quartz rod.
Heater ignites but ventilating air blower will not start.	Defective or improperly adjusted flame detector switch.	Replace or reset switch.

TABLE XIII-I. TROUBLESHOOTING CHART (SOUTH WIND HEATER) (cont.)

Trouble	Cause	Remedy
Heater ignites but ventilating air blower will not start (cont.).	Defective safety valve.	Replace valve.
Heater starts and runs, but goes out later.	Restricted ventilating air flow.	Remove restriction
	Defective cycling overheat switch.	Replace switch.
	Defective safety valve.	Replace valve.
	Defective relay.	Replace relay.
Heater overheats.	Defective fuel control valve.	Replace valve.
	Restricted ventilating air flow.	Remove restriction.
	Defective cycling overheat switch.	Replace switch.
	Defective cycling switch.	Replace switch.
Heat output low.	Defective fuel control valve.	Replace valve.
	HI-LO switch on LO.	Turn to HI.
	Thermostat out of calibration.	Replace thermostat.

TABLE XIII-I. TROUBLESHOOTING CHART (SOUTH WIND HEATER) (cont.)

Trouble	Cause	Remedy
Heat output low (cont.).	Cycling switch out of calibration.	Replace switch.
Heater smokes excessively.	Leaking fuel control valve.	Replace valve.
	Slow combustion air motor.	Replace motor.
	Defective installation.	Correct combustion air supply.
Blower will not stop when heater is turned off.	Defective flame detector switch.	Replace or reset switch.
Heater "pops" or "bangs" when starting.	Leaking fuel control valve.	Replace valve.

13-49. DISASSEMBLY, REPAIR, AND REASSEMBLY. An overhaul of the 940 heater consists of a complete disassembly, cleaning, repair, reassembly and test, as described in the following pages. The information is presented in overhaul sequence, but it should be noted that parts are not necessarily removed in the order shown. When making repair or replacements, it is possible to remove most subassemblies without disturbing other parts.

The instructions in the following paragraphs cover all models of the 940 Series heaters. Figure 13-15 is a composite exploded parts view, showing all parts used on all heaters. Not all of these parts are used on any one heater, but the differences and usage of parts are noted in the text. The procedures outlined below are applicable to all models, unless otherwise noted.

The following special service tools are recommended for service and overhaul of the 940 heater:

a. Fuel valve screen tool.
b. Igniter housing scraper.

13-50. DISASSEMBLY. (Refer to Figure 13-15.)

a. Remove the combustion air inlet adapter (1) by removing the sheet metal screw (2) in its center.

b. Remove the shroud adapter (3) by removing the six screws (4) from the weld nuts in the heater housing.

NOTE

The combustion air inlet adapter and shroud adapter may remain in the airplane when the heater is removed. If attached to the heater they may have other installation parts welded or clamped to them. If such is the case, note positions of such parts before they are removed.

c. Remove the exhaust extension (5), washers (6), "O" ring (7), and gasket (8) from the heater exhaust outlet.

13-51. VENTILATING AIR BLOWER.

a. To remove the ventilating air blower (9), disconnect the blower lead from the heater terminal No. 2, or the relay terminal No. 2A, and free the wire.

b. Loosen, but do not remove the four nuts (10) which secure the blower to the heater housing.

c. Turn the blower counterclockwise and pull it straight off of the heater housing.

d. Remove the air inlet louver (11) from the blower assembly by removing the three screws (12).

13-52. FUEL CONTROL VALVE.

a. Remove the cover (13) from the fuel control valve housing by loosening the four screws (16). Disconnect valve solenoid leads.

b. Disconnect the short fuel line (17) from the standpipe by loosening the compression nut (18). The ferrule (19) will remain on the fuel line.

c. Lift the fuel control valve (20) out of the housing and remove the fuel line (17) from the valve by removing the compression nut. Do not attempt to remove the ferrules from the fuel line.

13-53. FLAME DETECTOR SWITCH.

a. Disconnect leads of the flame detector switch (40) from the terminal strip, or from terminal strip and relay, according to heater model.

b. On Models 940-D and 940-K, disconnect wires from relay (25) by removing terminal screws (28). Reinstall screws in terminals.

c. Remove the four screws (24) which secure the flame detector switch guard (23) to the heater housing. Remove the guard and relay as an assembly, on heaters so equipped.

d. On heaters equipped with the relay (25), remove the nut (26) and lockwasher (27) to free the relay ground wire and relay assembly.

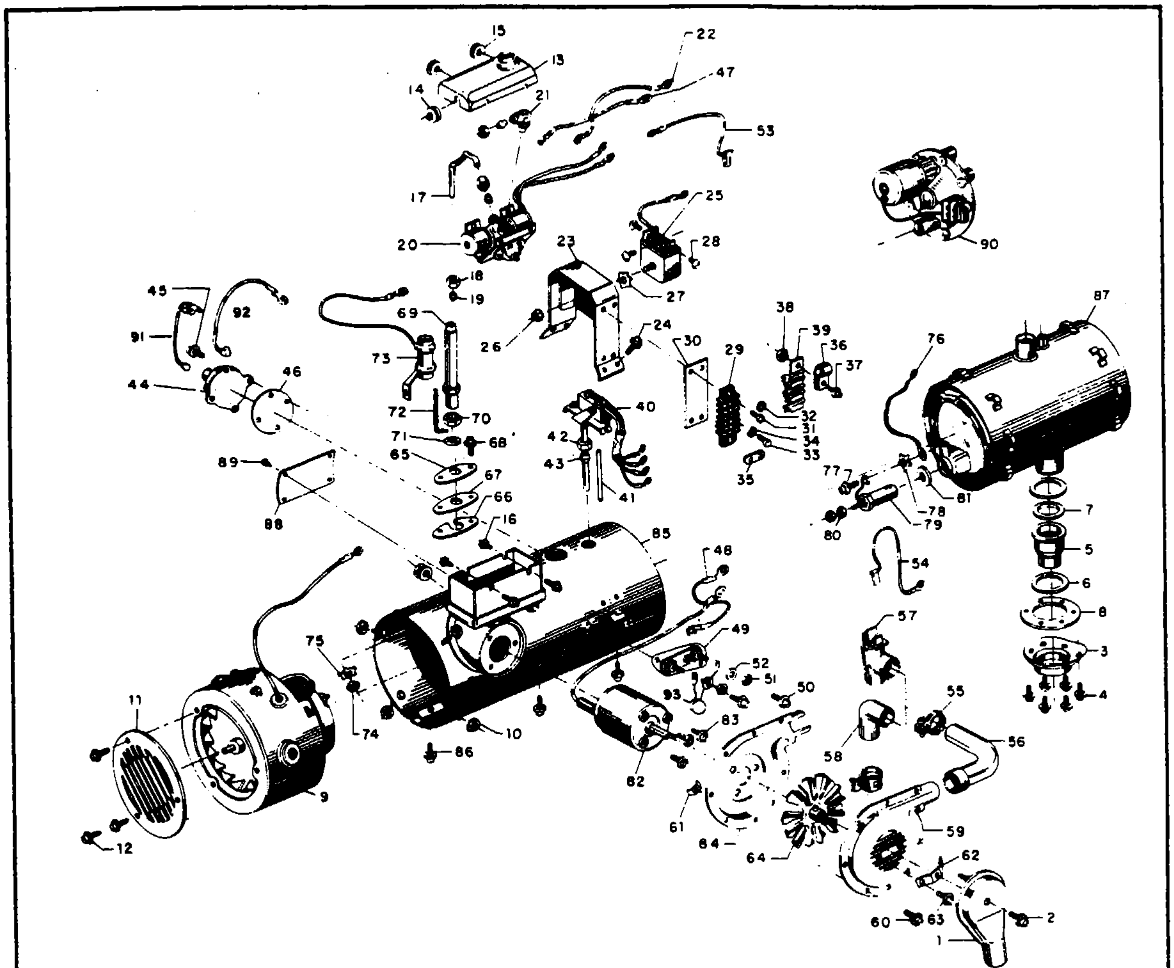
e. Loosen the compression nut (42) underneath the flame detector switch (40) and back it off until it clears the threads of the heat exchanger bushing.

f. Pull the flame detector switch straight out of the heat exchanger, being careful not to bend the tube since it contains a quartz rod (41) which may be broken by rough handling.

13-54. LOCKOUT OVERHEAT SWITCH.

a. On models so equipped, disconnect push-on lead of the lockout overheat switch (44) from the thermal fuse (57). Remove the overheat switch by removing the four screws (45). On older model heaters the leads (91 and 92) are attached to the switch. On current production, leads are separate.

b. On the 940-D heater, the lockout overheat switch is not used, but provision for its installation has been made and the heater housing will have a circular cover plate (46) in its place. This cover need not be removed for overhaul.



1. AIR INLET ADAPTER
2. SCREW
3. SHROUD ADAPTER
4. SCREW (6 REQ)
5. EXHAUST EXTENSION
6. WASHER (2 REQ)
7. "O" RING
8. GASKET
9. VENTILATING AIR BLOWER
10. NUT (4 REQ)
11. AIR INLET LOUVER
12. SCREW (4 REQ)
13. COVER
14. GROMMET (2 REQ)
15. GROMMET
16. SCREW (4 REQ)
17. FUEL LINE
18. NUT (3 REQ)
19. FERRULE (3 REQ)
20. FUEL CONTROL VALVE
21. ELBOW
22. WIRE ASSEMBLY
23. GUARD
24. SCREW (4 REQ)
25. RELAY
26. NUT
27. LOCKWASHER
28. SCREW (3 REQ)
29. TERMINAL STRIP
30. INSULATOR
31. SCREW (4 REQ)
32. WASHER
33. SCREW (10 REQ)
34. WASHER (4 REQ)
35. JUMPER
36. CLAMP
37. SCREW
38. NUT
39. FANNING STRIP
40. FLAME DETECTOR STRIP
41. QUARTZ ROD
42. NUT
43. FERRULE
44. LOCKOUT OVERHEAT SWITCH
45. SCREW (4 REQ)
46. COVER
47. WIRE ASSEMBLY
48. WIRE ASSEMBLY
49. CYCLING OVERHEAT SWITCH OR LIMIT SWITCH
50. SCREW
51. NUT
52. WASHER
53. WIRE ASSEMBLY
54. WIRE ASSEMBLY
55. CLAMP (2 REQ)
56. ELBOW
57. THERMAL FUSE
58. ELBOW
59. BLOWER COVER
60. SCREW (9 REQ)
61. NUT (9 REQ)
62. BRACKET
63. SCREW (2 REQ)
64. BLOWER WHEEL
65. FLANGE
66. TAPPING PLATE
67. GASKET
68. SCREW (2 REQ)
69. STANDPIPE
70. NUT
71. "O" RING
72. KNIFE CABLE
73. PREHEAT RESISTOR
74. NUT
75. LOCKWASHER
76. GROUND STRAP
77. SCREW
78. LOCKWASHER
79. IGNITER
80. NUT
81. GASKET
82. COMBUSTION AIR MOTOR
83. SCREW (3 REQ)
84. BLOWER HOUSING
85. HEATER HOUSING
86. SCREW (3 REQ)
87. HEAT EXCHANGER ASSEMBLY
88. NAMEPLATE
89. SCREW (4 REQ)
90. SAFETY VALVE
91. CABLE ASSEMBLY
92. CABLE ASSEMBLY
93. CAPACITOR ASSEMBLY

Figure 13-15. Exploded Parts View, Heater Assembly

13-55. CYCLING OVERHEAT SWITCH. On all models, remove the cycling overheat switch, or cycling temperature control switch (49) by removing the two attaching screws (50). Also remove the capacitor (93) on the 940-DB models only. These switches appear identical on all heaters, but are set at a lower temperature on models which have the lockout overheat switch and have a different part number.

13-56. COMBUSTION AIR BLOWER.

a. Loosen the two clamps (55) which attach the combustion air elbows (56 and 58), or elbow (56) and thermal fuse (57). Only two of the parts illustrated are used on any one heater. The thermal fuse (57) is used on all models. On all models, disassembly is the same. Disconnect wires from the thermal fuse (if used) and then work the two parts off the blower outlet and heat exchanger inlet. Separate parts after removal.

b. Remove the cover (59) of the combustion air blower, by removing the nine screws (60) and speed nuts (61). It is not necessary to remove the bracket (62), or screws (63) unless replacement is required.

c. Loosen the set screw in the hub of the blower wheel (64) and slide the wheel off the motor shaft.

13-57. STANDPIPE AND PREHEATER RESISTOR.

a. Remove the two screws (68) from the fuel line flange (65) and tapping plate (66). Remove the two plates and the gasket (67).

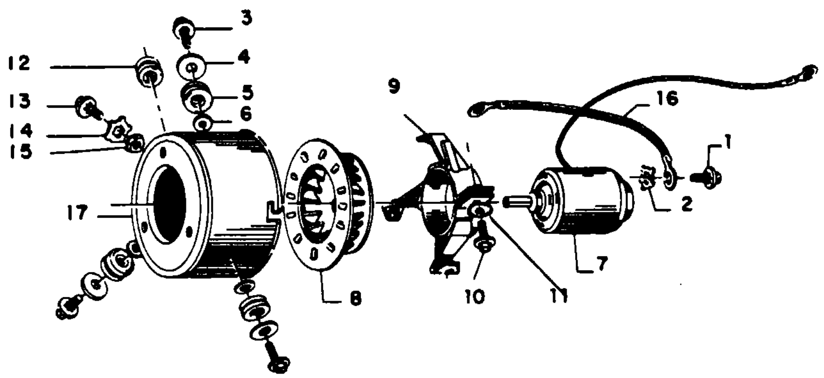
b. Disconnect preheater connector strip from the igniter (69) and loosen the large hex nut (70) on the bottom of the standpipe (69), one or two turns. Remove the standpipe by backing off the smaller hex, which is welded to the pipe. When the threads are clear, the standpipe (69) and preheat resistor (73) can be lifted out through the opening in the heater housing.

c. Remove the preheat resistor (73) from the standpipe and pull out the knit cable (72). Discard the cable and the "O" ring (71). These parts must be replaced at each overhaul.

13-58. IGNITER.

a. Remove the nut (74) and lockwasher (75) from the ground stud inside the heater housing, to free the igniter ground strap (76), then remove the screw (77) and lockwasher (78) to free the igniter ground wire.

b. Remove the igniter (79), using a 13/15 inch deep socket, and remove and discard the igniter gasket (81).



1. SCREW	7. MOTOR	12. GROMMET
2. LOCKWASHER	8. BLOWER WHEEL	13. SCREW
3. SCREW (3 REQ)	9. MOTOR MOUNTING BRACKET	14. LOCKWASHER
4. WASHER (3 REQ)		15. NUT
5. GROMMET (3 REQ)	10. SCREW	16. GROUND STRAP
6. WASHER (3 REQ)	11. LOCKWASHER	17. HOUSING

Figure 13-16. Exploded Parts View, Ventilating Air Blower Assembly

13-59. COMBUSTION AIR MOTOR.

a. To remove the combustion air motor, it is necessary to first remove the combustion air elbows, the blower housing cover, the blower wheel, the stand-pipe and the preheat resistor.

b. After removing the parts noted above, remove the three mounting screws (83) and remove the motor (82) from inside the housing. This will also free the blower housing (84).

13-60. HEAT EXCHANGER. Remove the three screws (86) from the seam of the heat exchanger housing (85) and spread the housing sufficiently to permit the heat exchanger (87) to drop out through the end of the housing.

13-61. VENTILATING AIR BLOWER - ALL MODELS. (Refer to Figure 13-16.)

a. Remove the screw (1) and lockwasher (2) from the end of the motor (7) to free the motor from the ground strap.

b. Remove the three screws (3), washers (4), grommets (5), and small washers (6) to free the motor mounting bracket (9), then withdraw the motor (7), bracket (9), and blower wheel (8) as an assembly.

c. Loosen the set screw in the hub of the blower wheel (8) and remove the wheel from the motor shaft.

d. Mark the position of the mounting bracket (9) on the motor (7) and remove the bracket by loosening the screw (10).

e. Remove the screw, lockwasher, and nut (12, 13 and 14) from the blower housing to free the ground strap (15), then remove the grommet (11) from the housing.

13-62. INSPECTION, CLEANING AND REPAIR.

13-63. HEAT EXCHANGER.

a. Inspect the heat exchanger for possible damage or leaks. Small cracks in the header plate or seams may be repaired by welding, provided the work is done by a welder who is thoroughly experienced in the welding of stainless steel. If the heat exchanger has large cracks, is excessively warped, or has burned through at any point, it must be replaced. When welding cracks, Type 347 weld rod is preferred, although 321 or 310 may be used.

NOTE

Before welding, it is very important to clean all combustion deposits away from the area to be welded, since the lead compounds in the heat exchanger can contaminate the weld to such an extent that a tight weld is almost impossible. Keep all weld beads as small as possible, preferably not over one-eight of an inch.

b. Clean combustion residue from inside walls of igniter housing with igniter housing scraper tool.

c. Remove combustion residue from inside heat exchanger by soaking this assembly in a 20% by weight solution of ammonium acetate at a temperature of 180° F., for a period of 5 to 10 hours. Flush out exchanger with water after cleaning, and dry as well as possible with compressed air. This is the preferred method of cleaning. An alternate is to tap the heat exchanger lightly with a rawhide mallet to loosen carbon from the walls. This will loosen most of the residue, which may then be blown out with compressed air.

d. Pressure test heat exchanger by plugging openings and applying 10 psi air pressure to the flame detector switch or standpipe bushing while the unit is submerged in water. Leakage will be indicated by bubbles. No leakage is permitted.

13-64. FUEL CONTROL VALVE. Replace valve if found defective.

13-65. BLOWER ASSEMBLIES.

a. Clean both blower wheels, housings, and the ventilating air blower motor mounting bracket with dry cleaning solvent, and blow dry. Wipe off outside of motors with a cloth dampened in solvent, but do not immerse motors.

b. Inspect blower wheels for bent blades and cracks. Pay special attention to the combustion air blower wheel. The slightest evidence of small cracks in, or around, the strain relief cutouts near the hub is reason to replace this wheel.

13-66. VENTILATING AIR BLOWER MOTOR OVERHAUL. An overhaul kit, PAC part No. 754 306, is available for all ventilating air blower motors of the 940 Series. This kit contains new bearings, brushes, and other parts required for installation. To overhaul the motor, proceed as follows: (Refer to Figure 13-17.)

a. Remove the two nuts (1) from the end of the motor and pull the end bell (3) off far enough to permit unsoldering of the capacitor lead from the eyelet on the brush holder insulator. Remove the end bell (3).

b. Remove the two nuts (12) from the other end of the motor and pull the two long studs (11) out of the stator (16) without disturbing the two nuts (4) which are threaded part way down to center the studs in the stator.

c. Pull the brush holder (6) out far enough to unsolder stator leads from the eyelets, then remove the brush holder assembly and brushes. If the stator does not have flexible leads to the solder eyelets, cut leads off close to the windings and solder in new leads of flexible stranded wire. This will prevent possible future failure due to vibration.

d. Pull the rotor (13) out of the stator (16). The bearings will remain on the rotor shaft.

e. Remove the load springs (14) from inside the stator (16).

f. Clean the shaft and pull the bearings off the shaft of the rotor (13) with a bearing puller, using anti-seize compound as a lubricant.

g. Clean all parts with a soft bristle brush and blow off with compressed air. Sand commutator of rotor (13) if necessary, or turn down slightly. Do not attempt to repair a badly worn motor. Replace the entire assembly if major repairs are required.

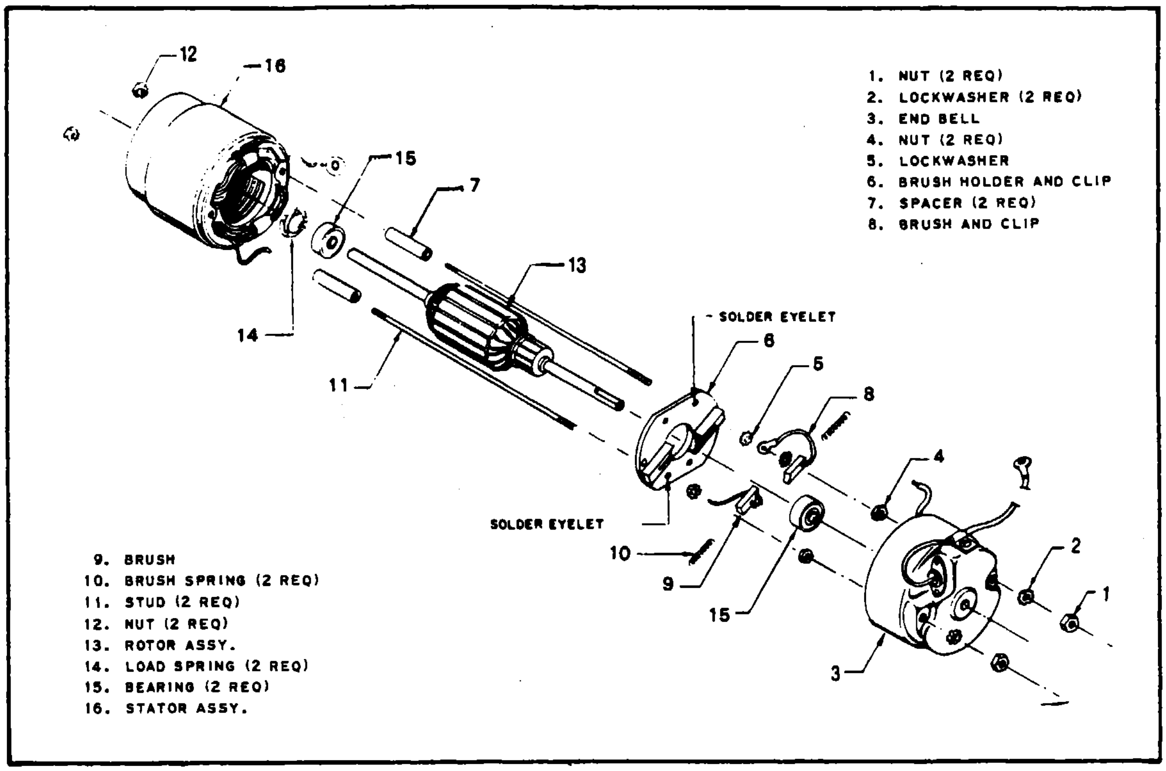


Figure 13-17. Ventilating Air Blower Motor

NOTE

If the commutator is turned, the lathe tool must be ground for copper and must be extremely sharp. Commutator slots must be cleaned after turning to avoid shorts between bars. Sand lightly after turning.

h. Press new bearings on the rotor shaft until they bottom against shoulders on the shaft, using a lubricant.

i. Reassemble the motor parts, using new brushes, brush springs and load springs from the kit. Note that two sets of brushes are provided. Use the new brushes which fit the motor brush holders. The 718855 springs must be used with 1/4 x 3/8 brushes and the 717472 springs with 1/4 x 1/4 brushes. Make sure that stator leads and capacitor lead are securely soldered.

j. No specific test of the motor is required after this repair procedure provided the rotor turns freely and the motor performs satisfactorily after reassembly into the blower assembly. Extensive repairs, that would require performance testing after completion, are not recommended.

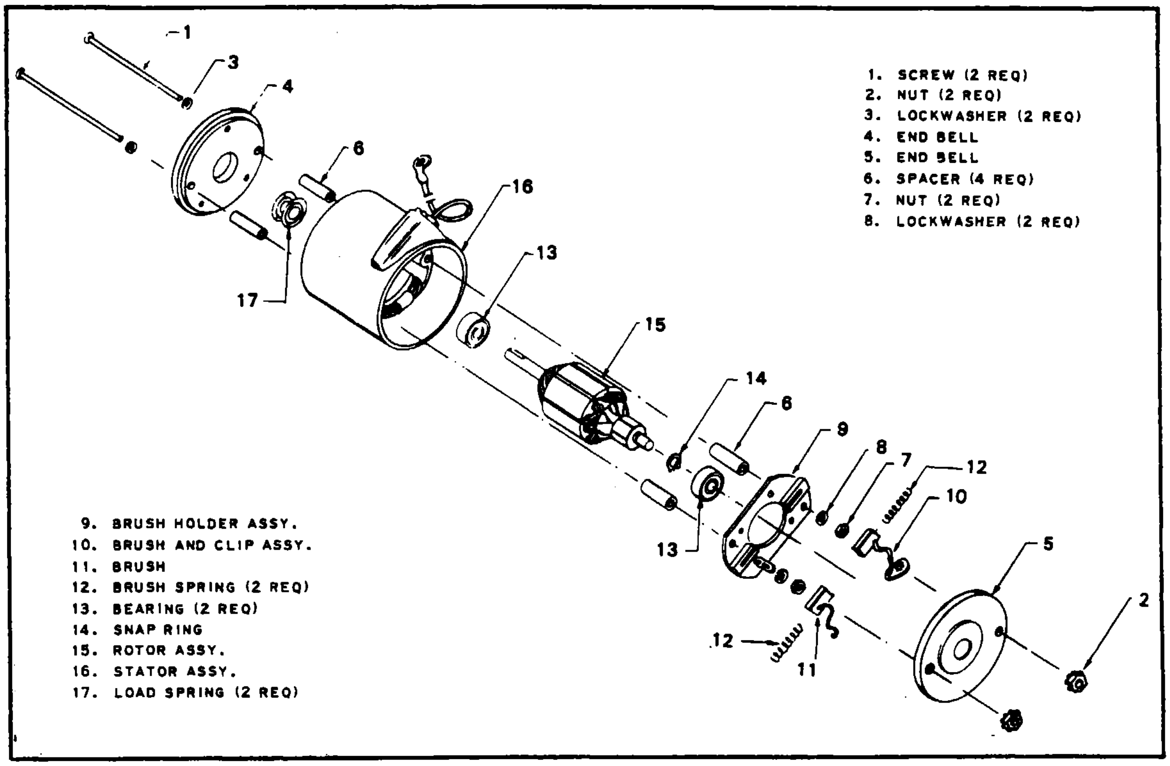


Figure 13-18. Combustion Air Blower Motor

13-67. COMBUSTION AIR BLOWER MOTOR OVERHAUL. An overhaul kit, PAC Part No. 754 307, is available for overhaul of the combustion air blower motor on all models of the 940 Series heaters. To overhaul motor, proceed as follows: (Refer to Figure 13-18.) 7.)

a. Remove the two nuts (2) from the end of the motor and remove the end bell (5).

b. Loosen the two small nuts (7) slightly with a 1/4 inch end wrench (or deep socket), then remove long screws (1) with a screw driver while holding nuts (7). This will free the other end bell (4) and spacers (6).

c. Pull the brush holder assembly (9) out far enough to unsolder the stator lead and remove this entire assembly.

d. Pull the rotor (15) out of the stator (16) with bearings on the shaft. Clean the shaft and remove the bearings with a bearing puller, using a lubricant on the shaft.

e. Clean all parts with a soft bristle brush and blow off with compressed air. Sandpaper commutator of rotor (15) or turn down slightly if required.

NOTE

If the commutator is turned, the lathe tool must be ground for copper and must be extremely sharp. Commutator slots must be cleaned after turning to avoid shorts between bars. Sand lightly after turning.

f. Rebuild motor using new bearings (13), brushes (10 and 11), and brush springs (12). When soldering brush pigtails, use long nosed pliers next to the solder joint to prevent solder from "wicking" into the pigtail.

g. No specific test of the motor is required after the above repair procedure provided the shaft turns freely and the motor performs satisfactorily when reinstalled in the heater. More extensive repairs than those described should not be attempted.

13-68. HEATER HOUSING.

a. Clean inside and out with dry cleaning solvent, and inspect housing for roundness and dents. Straighten, or re-shape, as necessary.

b. Replace all rubber grommets in the housing.

13-69. FLAME DETECTOR SWITCH. Check bow spring to see if pressure of quartz rod is causing it to bow up toward the top of the switch. If the spring is not bowed, but is in a straight position, the quartz rod is broken and must be replaced.

If such is the case, proceed as follows:

a. Loosen the two switch mounting screws.

b. Remove the adjusting screw.

c. Turn micro switch back on the bracket and remove the bow spring. Inspect condition of the quartz rod.

d. If the quartz rod is broken or chipped on either end, it must be replaced. If it is in good condition, replace it in the tube, turn the switch back into position and reinstall the adjusting screw.

e. Back off the adjusting screw until the switch clicks, indicating that the micro switch has transferred.

f. Turn the adjusting screw slowly in, until the switch just clicks again, to determine point of transfer, then turn the screw exactly three-quarter turn past the transfer point.

g. Hold the screws and tighten micro switch mounting nuts to lock switch securely in place.

13-70. OVERHEAT SWITCH AND CYCLING SWITCH. Visually inspect the overheat switch, or cycling switch, for damage and clean contacts by sliding a strip of clean bond paper between the contacts. Do not use a file or sandpaper, and do not attempt to bend the contact arm. These switches are adjusted at the factory and the adjustment cannot be changed in the field. Replace switch if found defective.

13-71. LOCKOUT OVERHEAT SWITCH.

a. Connect wires to the two connector wires of the lockout overheat switch, and suspend this assembly in an oven with an accurate thermometer. Provide a test light, or meter, to indicate opening of the switch contacts. Press the reset button of the switch.

b. Slowly raise the oven temperature until the switch contacts open. Note temperature in the oven at the moment of switch operation. The switch must open at the temperature noted below, according to model. If not within limits, install a new switch. This unit is not adjustable.

Model Used On	Opening Temperature
940-DB 940-K	205 to 245°F. 140 to 160°F.

13-72. THERMAL FUSE AND COMBUSTION AIR ELBOWS.

a. Inspect for dents and fit between parts.

b. Clean elbows with dry cleaning solvent and blow out with compressed air.

c. Inspect fusible link of thermal fuse assembly for tightness of attaching screws and condition of link. The attaching screws may be tightened, if loose, but the entire assembly must be replaced if the link has been damaged or fused. Do not use compressed air to clean the thermal fuse assembly.

13-73. SAFETY VALVE AND FILTER.

a. To clean filter, remove bowl by loosening bail nut and clean inside of bowl. Wash filter element in dry cleaning solvent and blow dry by directing compressed air jet inside the filter. When replacing the bowl, make sure the gasket is in place.

b. Replace the fuel screen in the safety valve and wipe off the outside with a cloth dampened in cleaning solvent. Do not disassemble, or attempt to repair this unit.

c. Replace safety valve if found defective.

13-74. WIRING.

a. Inspect all heater wiring for condition of insulation, and condition of solder connection of the terminals. Repair, or replace, as required.

b. Inspect the terminal strip for damage and the terminal screws for condition of threads.

13-75. RELAY. Apply a variable voltage between terminal 4A of the relay and the ground wire. Increase and decrease the voltage to determine relay pull-in voltage. The 28-volt relay must pull in at not more than 18-volts and the 14-volt relay at not more than 9-volts. Replace relay if not within limits.

13-76. REASSEMBLY.

13-77. VENTILATING AIR BLOWER - ALL MODELS. (Refer to Figure 13-16.)

a. Replace the bracket (9) on the motor (7) in its original position and tighten the screw (10). Slip the wheel (8) on the motor shaft but do not tighten set screw.

b. Install large flat washers (4), new grommets (5), and small washers (6) on each of the three motor mounting bracket screws (3), in order illustrated.

c. Fit the motor and bracket assembly into the housing and start ends of the mounting bracket screws (3) into the weld nuts on the bracket with the washers and grommets on the screws. After screws are started, drop the small washers (6) through the holes in the housing and stuff grommets (5) into the holes. Tighten the screws alternately and evenly to apply a firm pressure to the grommets, and center the motor in the housing. Do not overtighten screws (3), since this will defeat the purpose of the shock-mounting grommets.

d. Reconnect the ground wire (15) to the end of the motor by reinstalling the screw (1) and lockwasher (2).

13-78. HEATER ASSEMBLY. (Refer to Figure 13-15.) Reassembly of the heater is essentially the reverse of disassembly. If the heater is completely disassembled, reassembly will be simplified by following the procedure below, instead of a strict reversal of disassembly.

a. Reinstall the combustion air motor (82) from inside the heater housing (85), place the blower housing (84) on the outside and reinstall the three screws (83). Replace blower wheel (64) on the motor shaft. Adjust wheel for one-sixteenth inch clearance from housing, and tighten set screw.

b. Replace the blower housing (59) by reinstalling nine screws (60) and speed nuts (61).

c. Reinstall the igniter (79) in the heat exchanger (87), using a new gasket (81), and tighten with a 13/16 inch deep socket. Reinstall the screw (77) to connect the igniter ground wire, attaching one end of the bonding strap (76) with the same screw and lockwasher (78).

d. Adjust the vaporizer cable (72) in the standpipe (69), so that it extends about one-half inch from the threaded end. Smooth the end of the cable and twist strands so that loose particles will not break off on threads inside the heat exchanger. Run the nut (70) up on the threads of the standpipe as far as it will go. Place a new "O" ring (71) on the threads at the bottom. Reinstall the standpipe in the heat exchanger by first turning the welded hexagon down tightly into the threads, then turning down the nut (70) against the "O" ring, to obtain a tight seal.

e. Place the preheat resistor (73) around the standpipe, and install the nut (80) to attach the preheat conductor to the igniter terminal.

f. Spread the housing and combustion air blower assembly, and fit it over the heat exchanger, with the end of the standpipe projecting through the opening provided. Reinstall the three screws (86) in the seam of the housing. Attach the free end of the igniter ground wire bonding strap (76) to the stud inside the housing, using the nut (74) and lockwasher (75).

g. Fit the tapping plate (66) around the standpipe inside the housing, and place a new gasket (67) and the old flange (65) on the outside. Reinstall the two screws (68) to secure and seal the standpipe.

h. Fit the large combustion air elbow (56) and small elbow (58), or thermal fuse (57) loosely together, using one of the clamps (55). Fit these parts on the combustion air blower outlet and heat exchanger inlet, using the remaining clamp (55). Adjust parts to fit, then tighten both clamps securely.

i. Reinstall the overheat switch, or cycling switch (49), by reinstalling the two screws (50). Do not overtighten screws, since this may distort the switch and affect its calibration. Also, reinstall the lockout overheat switch (44), on models so equipped, by reinstalling the four screws (45).

j. Reinstall the flame detector switch (40) by tightening the nut (42) on the ferrule (43). Tighten nut firmly, but avoid excessive crushing of the flame detector switch tube. If a new flame detector switch is being installed, use a new ferrule (43) and nut (42). These parts should remain on the tube after the first installation, since the ferrule will be firmly pressed onto the tube. This does not affect operation of the switch which may be removed and replaced, as required, so long as it continues to function properly.

k. Reinstall the terminal strip (9) and insulator (30) on the flame detector switch guard (23) by reinstalling the four screws (31). Also, reinstall the relay (25), on models so equipped, by installing the lockwasher on the relay stud inside the guard, then the relay ground wire and the lockwasher nut (26). Tighten nut securely to obtain good electrical contact, then reinstall guard (23) over flame detector switch, using the four screws (24).

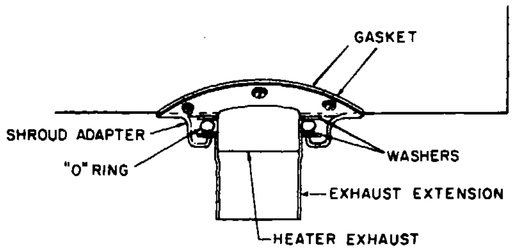


Figure 13-19. Detail of Exhaust Extensions Installation

l. Connect the short fuel line (17) to the outlet of the fuel control valve (20) and tighten compression nut finger tight. Start the screws (16) into the nuts on the fuel control valve mounting bracket. Fit the fuel control valve into the housing and the fuel line into the standpipe, then tighten the two compression nuts (18) very carefully. Fit new grommets (14 and 15) into the slots in the valve housing, then fit the cover (13) on the housing and tighten the four screws (16) into the fuel control valve mounting bracket.

m. Reinstall the air inlet louver plate (11) on the ventilating air blower (9) using screws (12), and reinstall the blower on the heater housing.

n. Install the loose wires (54, 53, 48 and 47), according to the wiring diagram for the heater model, and connect leads of all electric components, using the wiring diagram as a guide. All leads are numbered, with the exception of the two push-on terminals which connect to the thermal fuse. Connect these wires to the nearest terminal. The thermal fuse has no polarity.

o. Place flat washers (6), new "O" ring (7), exhaust extension (5), and flat washer (6) on heater exhaust. Fit new gasket (8) around exhaust and install shroud adapter (3) to hold entire assembly by reinstalling six screws (4).

p. Reinstall the air inlet adapter (1) when the heater is reinstalled in the airplane.

13-79. TESTING.

13-80. GENERAL. Any heater that has been overhauled, or subjected to major repair, should be tested before being returned to service. The test should include a "leak test" and "flow test" of the fuel control valve, a "burn test" of the assembled heater, and a test of the overheat switch.

NOTE

The heat exchanger should have been leak tested as directed in paragraph 13-63 prior to reassembly.

13-81. TEST SET UP. The test set up should include the following components:

a. A suitable cradle or bracket for mounting the heater with provision to dispose of the exhaust gases.

b. A source of 14 or 28-volts dc, depending on the heater model being tested. This should be a variable source from a transformer and rectifier, so that the voltage can be regulated, and must include a voltmeter and ammeter.

c. A source of fuel at a pressure of 1 to 15 psi for all models except 940-DB and 940-K. A filter should be included in the fuel supply line. Fuel pressure may be supplied by a gravity system with a head of at least four feet, or by an electric fuel pump. The 940-DB and 940-K heaters require a source of fuel at 20 to 35 psi from a fuel pump which operates at this pressure.

d. A glass graduate of the type shown in Figure 13-20 is required for testing the fuel control valve, unless a flow meter is available in the fuel supply line.

e. A strobo-type tachometer, although not necessary is desirable to time blower speed.

f. An oven and thermometer, for testing the lockout overheat switch.

13-82. TEST PROCEDURE. The heater test should be conducted in the following order, if possible, since the heater must be cold at the start of the overheat switch test.

13-83. FUEL CONTROL VALVE LEAK TEST. Remove the fuel control valve from the heater, or test the valve separately before reassembly, during the overhaul. Proceed with test as follows:

a. Connect the control valve to the fuel source.

b. Install the short heater fuel line (Refer to Figure 13-15, Ref. 17.) in the fuel control valve outlet, in its normal position. Support the valve in its normal mounting position (Refer to Figure 13-20) so that fuel from the fuel line will drip into a glass graduate.

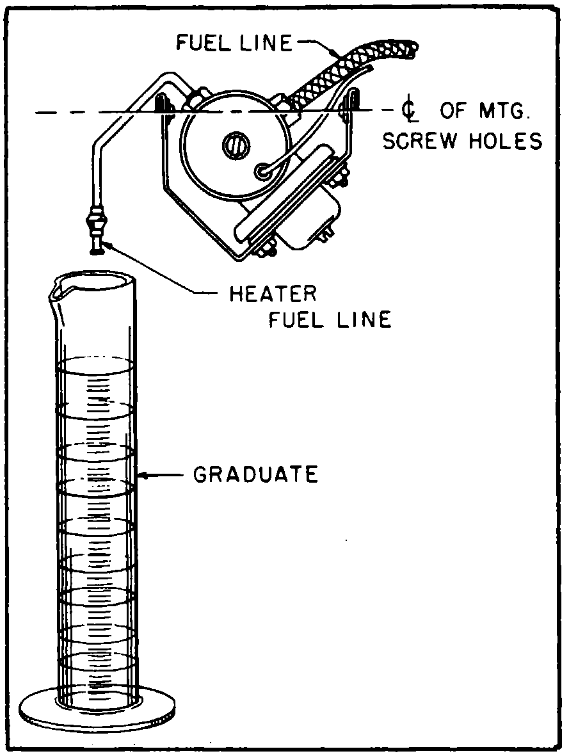


Figure 13-20. Fuel Flow Test Set Up

NOTE

The valve must be supported in a normal position so a line through the mounting screw holes of the bracket will be level. Failure to test the valve in its proper position will affect the fuel rate and may cause rejection of good equipment.

c. Ground the body of the fuel control valve and apply a test voltage to each of the solenoid leads. A distinct click should be heard when the solenoids are energized.

d. Turn on the fuel pressure and energize both solenoids at once. Allow fuel to flow through the valve for a few seconds, then de-energize both solenoids. One or two drops of fuel may fall from the outlet within 15 seconds after the solenoids are closed. After 15 seconds, a drop of fuel may form, but it should not fall. If the valve does not shut off completely, it must be replaced.

13-84. FUEL CONTROL VALVE FLOW TEST. Check fuel flow through the valve, as follows, using the test set up illustrated in Figure 13-20:

a. Energize both solenoids and permit fuel to flow through the valve for a few seconds.

b. Place a glass graduate under the valve outlet and permit fuel to flow for exactly 60 seconds, then shut off both solenoids.

c. Read the graduate at eye level - it should contain the amount of fuel shown in the chart for high heat fuel flow.

d. Repeat the above test with the restriction solenoid de-energized (low heat fuel flow). The graduate should then contain the amount of fuel shown in the table for low heat fuel flow.

e. If fuel flow is not within limits, turn adjusting screw clockwise to increase, or counterclockwise to decrease, fuel flow and retest. Both low and high heat fuel flow must be within limits for proper operation of the heater. Replace or repair the valve if it cannot be brought within limits by adjustment. Reseal the adjusting

FUEL FLOW CHART

Heater Model	Fuel Pressure	High Heat	Low Heat
940-D	1 to 15 psi	22 ± 2 cc (0. 034 to 0. 041 lb/min on flowmeter)	7. 0 to 9. 0 cc (0. 010 to 0. 014 lb/min on flowmeter)
940-DA	1 to 15 psi	22 ± 2 cc (0. 034 to 0. 041 lb/min on flowmeter)	12 ± 2 cc (0. 016 to 0. 020 lb/min on flowmeter)
940-DB	20 to 35 psi	22 ± 2 cc (0. 034 to 0. 041 lb/min on flowmeter)	12 ± 2 cc (0. 016 to 0. 020 lb/min on flowmeter)
940-K	20 to 35 psi	22 ± 2 cc (0. 034 to 0. 041 lb/min on flowmeter)	3. 5 to 6 cc (0. 006 to 0. 014 lb/min on flowmeter)

screw with glyptal cement after test.

13-85. LOCKOUT OVERHEAT SWITCH. The test for the lockout overheat switch is described in paragraph 13-71. This test is normally performed during overhaul, before the switch is installed, but the switch may be removed and tested at any time its operation is in doubt.

13-86. OVERHEAT SWITCH TEST (Models 940-D and 940-DA only). Install the fuel control valve on the heater and install the heater on the test fixture. Make fuel and electrical connections. Proceed with overheat switch test as follows: (Heater should be at room temperature when test is started.)

a. Set the HIGH-LOW switch to HIGH. Preset the voltage control so that voltage, with full starting load, will be 22-volts for the 28-volt heater and 11-volts for the 14-volt heater.

b. Cover the inlet of the ventilating air blower with cardboard or sheet metal, to stop off all flow of ventilating air.

c. Turn on the control switch. Start timing the operation as soon as ignition occurs. When the flame detector switch transfers, reset voltage to 22-volts, or

11-volts, according to heater model.

d. Continue timing until the overheat switch opens and shuts off fuel flow (combustion will stop in the heater). This time must be more than 50 seconds, but less than 80 seconds from the moment of ignition. Replace the overheat switch, if not within limits.

13-87. BURN TEST. Shut the heater off and remove the cover from the ventilating air blower inlet. Allow time for the heater to cool. Proceed with "burn test" as follows:

a. Turn on the heater switch and adjust voltage to 14 or 28-volts, according to heater model. Start timing heater action from the moment the switch is turned on.

b. The current draw should not exceed 13-amperes for either 14 or 28-volt heaters.

c. Ignition should occur within 20 seconds from the moment the switch is turned on.

d. The flame detector switch should close more than 8 seconds, but less than 25 seconds, from the instant the heater ignites.

e. Readjust voltage immediately after the flame detector switch transfers, and allow the heater to run on high heat for at least one minute. If a tachometer is available, the speed of the combustion air motor should be determined with the combustion air adapter removed, and with no restriction on the heater exhaust. The speed should be at least 5000 RPM. In the absence of a suitable light to time the blower, it can be presumed to be operating properly if the heater burns normally and did not have an excessive deposit of carbon in the exhaust tube, or combustion chamber, when cleaned during overhaul. Speed of the ventilating air blower is not critical, since it has no direct effect on combustion.

f. After the heater has burned on high heat for one minute, turn the HIGH-LOW switch to LOW. Burning should decrease in intensity and the heat output should be reduced.

g. Turn off the control switch. Burning must stop within 45 seconds, and both blowers should continue to run for more than one minute but less than two minutes twenty seconds (time from instant the switch is turned off).

13-88. CYCLING SWITCH TEST (Model 940-K).

a. Attach a duct to the heater outlet and insert an accurate thermometer into the airstream, about 18 inches from the heater.

b. Start the heater and permit it to burn until it begins to cycle on the cycling switch.

c. Read the duct temperature, as indicated by the thermometer. It must be within the limits of 200° F to 225° F. If the temperature is not within limits, the cycling switch is defective and must be replaced.

If the heater should fail any test, refer to the Troubleshooting Chart and make repairs or replacements as required.

13-89. JANITROL HEATER. This section contains information for operation, service and overhaul of the combustion heater, Part No. 751 978 and combustion air blower, Part No. 753 443 (14-volt), 758 120 (28-volt) (used with the heater). (Refer to Figure 13-21.)

13-90. TROUBLESHOOTING. The service troubles and suggested remedies listed in Table XIII-II or XIII-III are provided to assist in locating and correcting malfunctions in the heating system. The following procedure is based upon the use of optional components.

13-91. HEATER OPERATION. (PA-23-250 [six place], Serial Nos. 27-3050, 27-3154 to 27-7554040.) The 35,000 B.T.U. Janitrol heater is controlled by a three position switch located on the right side of the instrument panel, labeled FAN, OFF and HEAT. The FAN position will operate the vent blower only and may be used for cabin ventilation on the ground or windshield defogging when heat is not desired. For heat the manual heater fuel valve located on the fuel selector panel must be on and the three position switch turned to HEAT. This will start fuel flow and ignite the burner simultaneously. On Serial Nos. 27-7405432 and up, the manual fuel valve is not installed.

The heater uses gasoline from either left fuel tank when the fuel crossfeed is off and from all tanks when the crossfeed is on.

The push-pull knobs at the bottom of the control pedestal control airflow and temperature. The control regulates air flowing to the front seat through the heater system and the second knob from the left control air flowing to the rear seat. The middle knob is connected to an adjustable thermostat which makes it possible to select a desired temperature of heat air. The second knob from the right is the defroster control and the right knob controls the supply of cold air through the vent on the forward bulkhead. There is also a heater overtemp. reset switch on the lower right hand instrument panel above the heater switch, for inflight reset if and overtemp. of the heater occurs.

For the overhaul and complete disassembly of the janitrol heater and its components, refer to Paragraph 13-103 of this manual. A wiring diagram of the heater Electrical System by appropriate serial number will be found in Section XI of this manual.

TABLE XIII-II. TROUBLESHOOTING CHART (JANITROL HEATER) (14-VOLT)

Trouble	Cause	Remedy
Heater fails to light.	Heater switch or circuit breaker off.	Turn on heater switch or close circuit breaker.
	Low voltage supply.	Apply external power supply. Attempt to start heater. (Refer to paragraph 13-99.)
	Fuel cut off from fuel cell.	Turn on manual shutoff valve or master solenoid.
	Regulator not operating properly	Check for low pressure or replace regulator. (Refer to paragraph 13-117.)
	Restriction in fuel nozzle orifice.	Remove the nozzle and clean or replace it. (Refer to paragraph 13-120, m and n; 13-124, i; and 13-127, k and l.)
	Fuel heater solenoid not operating.	Remove and check solenoid. Replace if faulty. (Refer to paragraph 13-120; 13-124, k and 13-127, a.)
	Fuel lines clogged or broken.	Inspect all lines and connections. It may be necessary to disconnect lines at various points to determine where the restriction is located.

TABLE XIII-II. TROUBLESHOOTING CHART (JANITROL HEATER) (14-VOLT) (cont.)

Trouble	Cause	Remedy
Heater fails to light (cont.).	Ignition vibrator inoperative.	Replace vibrator. Check for defective radio noise filter. (Refer to paragraph 13-113.)
	Manual reset limit (overheat) switch open.	Press reset button firmly and recheck to determine reason for switch opening.
	Combustion air pressure switch open. (Defective switch or low combustion air blower output.)	Check for low blower output due to low voltage and correct it. If switch is defective, replace it. (Refer to paragraph 13-116.)
	Cycling switch open.	Replace if defective. (Refer to paragraph 13-115.)
	Duct switch open.	Operate control to see if switch will come on. Replace switch if defective. (Refer to paragraph 13-118.)
Ventilating air blower fails to run.	HEATER switch OFF. Broken or loose wiring to motor.	Energize the HEATER switch. Check and repair wiring.
	Circuit breaker open.	Close circuit breaker.
	Worn motor brushes.	Replace motor brushes. (Refer to paragraph 13-111.)

TABLE XIII-II. TROUBLESHOOTING CHART (JANITROL HEATER) (14-VOLT) (cont.)

Trouble	Cause	Remedy
Ventilating air blower fails to run (cont.).	Blower wheel jammed.	Remove and check the ventilating air blower wheel and realign if necessary. (Refer to paragraph 13-127, g.)
	Motor burned out.	Remove blower assembly and replace motor. (Refer to paragraph 13-120, l and r thru u; 13-127, b thru g.)
	Defective radio-noise filter.	Replace filter.
Combustion air blower fails to run.	Faulty wiring to motor.	Inspect and replace faulty wiring.
	Poor ground connection.	Tighten ground screw.
	Worn motor brushes.	Replace motor brushes. (Refer to paragraph 13-111, b.)
	Blower wheel jammed. (Usually indicated by hot motor housing.	Overhaul the combustion air blower. (Refer to paragraphs 13-121 and 13-128.)
	Faulty or burned-out motor.	Remove combustion air motor for overhaul or replacement of motor. (Refer to paragraphs 13-110, 13-120 and 13-128.)

TABLE XIII-II. TROUBLESHOOTING CHART (JANITROL HEATER) (14-VOLT) (cont.)

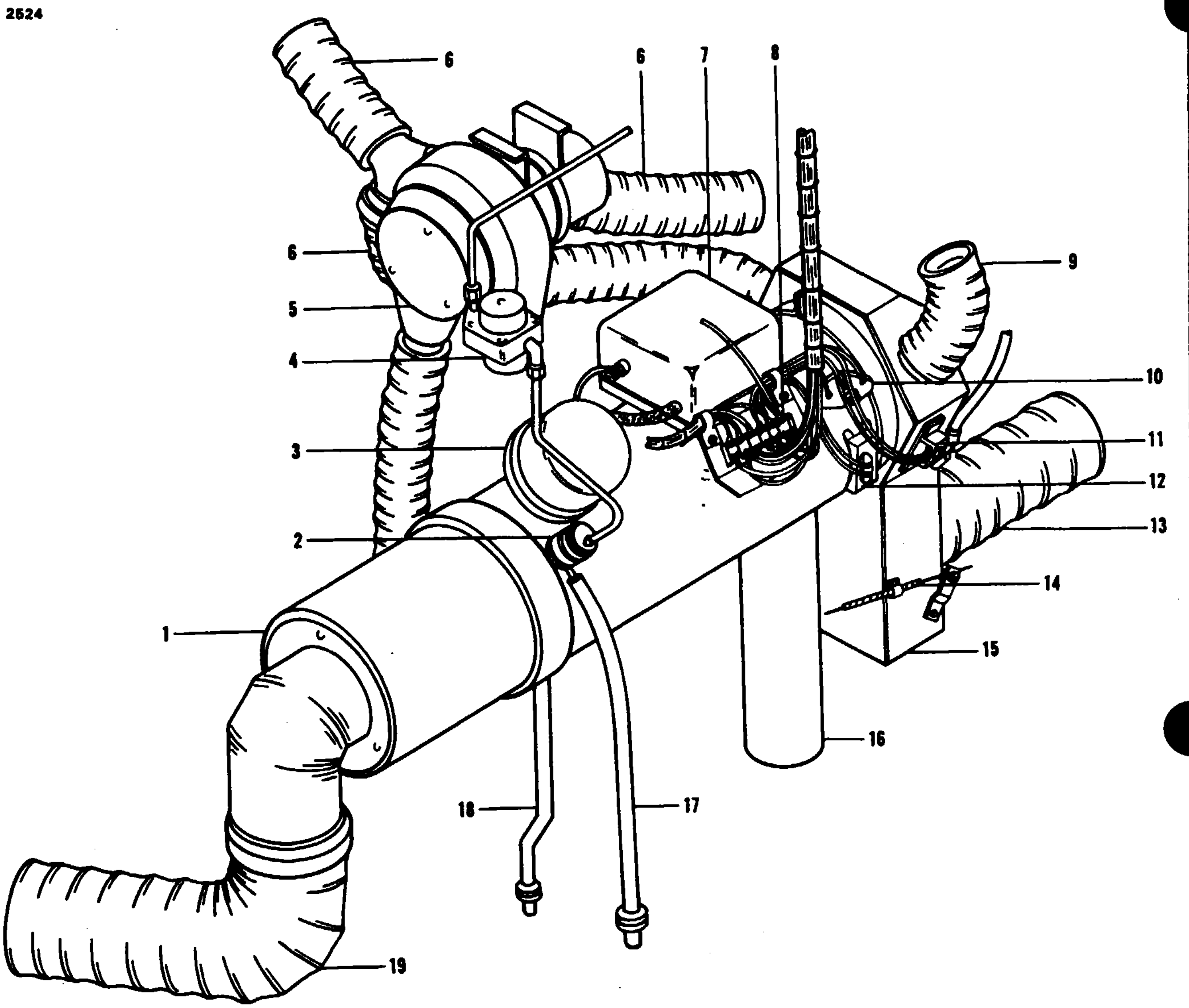
Trouble	Cause	Remedy
Heater fires but burns unsteadily.	Insufficient fuel supply.	Inspect fuel supply to heater including shut-off valve, solenoid valve and fuel lines. Make necessary repairs.
	Spark plug partially fouled.	Replace spark plug. (Refer to paragraph 13-112.)
	Loose primary connection at ignition assembly.	Tighten the connection.
	Faulty vibrator.	Replace the vibrator. (Refer to paragraph 13-113.)
	Combustion air blower speed fluctuates. (Can be caused by low voltage, loose blower wheel, worn brushes or motor.	Remove and overhaul the combustion air blower assembly as required or correct low voltage condition. (Refer to paragraphs 13-111, 13-121, 13-125 and 13-128.)
	High-voltage leak in lead between ignition assembly and spark plug.	Replace ignition assembly. (Refer to paragraph 13-114.)
	Inoperative ignition assembly.	If vibrator is in good condition, replace ignition assembly only. (Refer to paragraph 13-114.)

TABLE XIII-II. TROUBLESHOOTING CHART (JANITROL HEATER) (14-VOLT) (cont.)

Trouble	Cause	Remedy
Heater fires but burns unsteadily (cont.).	Restriction in fuel nozzle orifice.	Remove nozzle for cleaning or replacement. (Refer to paragraphs 13-120, m and n; 13-124, i; and 13-125, k and l.)
	Nozzle loose in retainer or improper spray angle.	Tighten or replace the nozzle as required. (Refer to paragraphs 13-123, e; 13-125, k.)
Heater starts then goes out.	Lack of fuel at heater.	Check fuel supply through all components from the cell to the heater. Make necessary corrections.
	Inoperative or chattering combustion air pressure switch.	Check, adjust, or replace switch. (Refer to paragraph 13-116.)
	Inoperative overheat switch.	Check or replace switch. (Refer to paragraphs 13-115 and 13-132.)
	Inoperative cycling switch.	Adjust or replace the switch. (Refer to paragraphs 13-115 and 13-132.)
	Low voltage.	Attach external power.

TABLE XIII-II. TROUBLESHOOTING CHART (JANITROL HEATER) (14-VOLT) (cont.)

Trouble	Cause	Remedy
Heater fails to shut off.	Fuel solenoid valve in heater stuck open.	Remove and replace solenoid assembly. (Refer to paragraphs 13-120, q; 13-122, k; and 13-125, a.)
	Inoperative duct and cycling switch.	Check and repair. (Refer to paragraphs 13-115 and 13-118.)
	Defective HEATER switch.	Replace the HEATER switch.



1. VENTILATING AIR BLOWER
2. FUEL INLET
3. PRESSURE SWITCH
4. FUEL REGULATOR
5. COMBUSTION AIR BLOWER
6. HOSE, CABIN HEAT
7. IGNITION ASSEMBLY
8. TERMINAL STRIP
9. HOSE, DEFROSTER
10. LIMIT SWITCH
11. HEAT REGULATOR
12. CYCLING SWITCH
13. HOSE, CABIN HEAT, REAR
14. CONTROL CABLE, CABIN HEAT, REAR
15. AIR DISTRIBUTION BOX
16. EXHAUST TUBE
17. DRAIN, FUEL LINE
18. DRAIN, HEATER
19. HOSE, HEATER AIR INTAKE

Figure 13-21. Heater Assembly and Combustion Air Blower

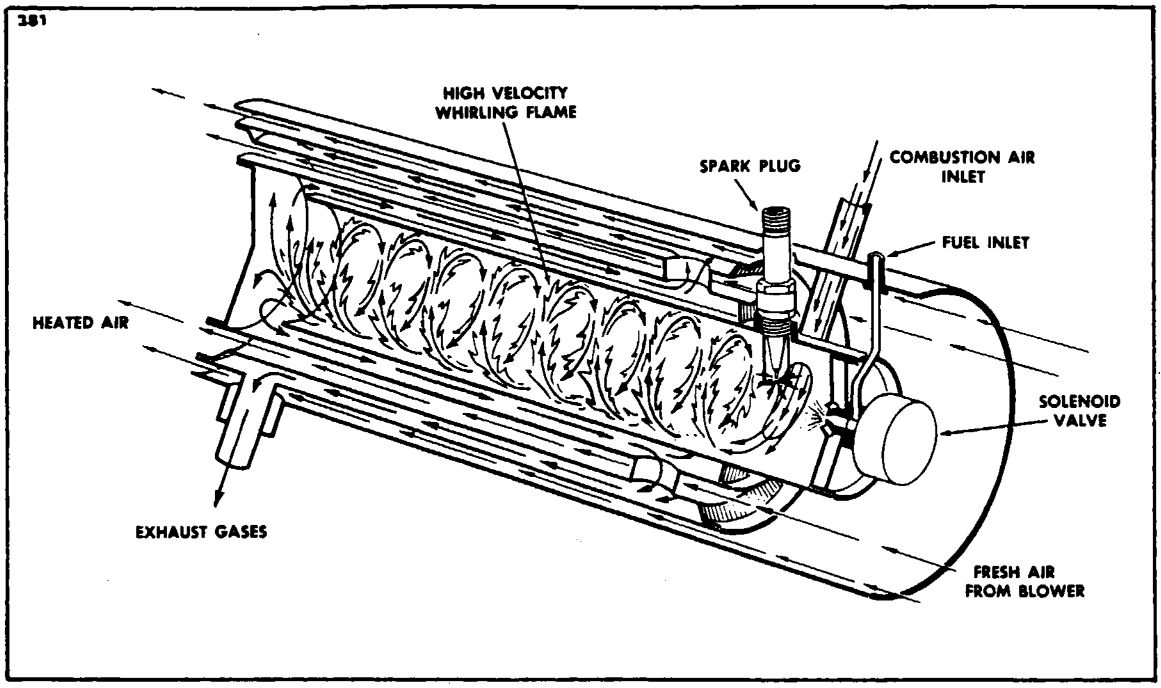


Figure 13-22. Diagramatic Cutaway of Heater to Show Whirling Flame Action

13-92. DESCRIPTION OF HEATER AND BASIC COMPONENTS.

13-93. SPARK-SPRAY IGNITION. (Refer to Figure 13-22.) The controlled atomized spray from a specially designed spray nozzle, coupled with high-voltage spark plug ignition, insures instant firing and continuous burning under all flight conditions.

Heat is produced by burning a fuel-air mixture in the combustion chamber of the heater. Aviation gasoline is injected into the combustion chamber through the spray nozzle. The resulting cone-shaped fuel spray mixes with combustion air and is ignited by a spark from the spark plug. Voltage for ignition is supplied by an ignition unit which steps up the 14 or 28-volts to a high, oscillating voltage to provide a continuous spark across the spark plug gap. A shielded, high voltage lead connects the ignition assembly to the spark plug. Combustion air enters the combustion chamber tangent to its surface and imparts a whirling or spinning action to the air. This produces a whirling flame that is stable and sustains combustion under the most adverse conditions because it is whirled around itself many times. Therefore, ignition is continuous and the combustion process is self-piloting. The burning gases travel the length of the combustion tube, flow around the outside of the inner tube, pass through cross-over passages into an outer radiating area, then travel the length of this surface and out the exhaust.

Ventilating air passes through the heater between the jacket and combustion tube assembly outer surface and through an inner passage in the assembly. Consequently, ventilating air comes into contact with two or more heated, cylindrical surfaces.

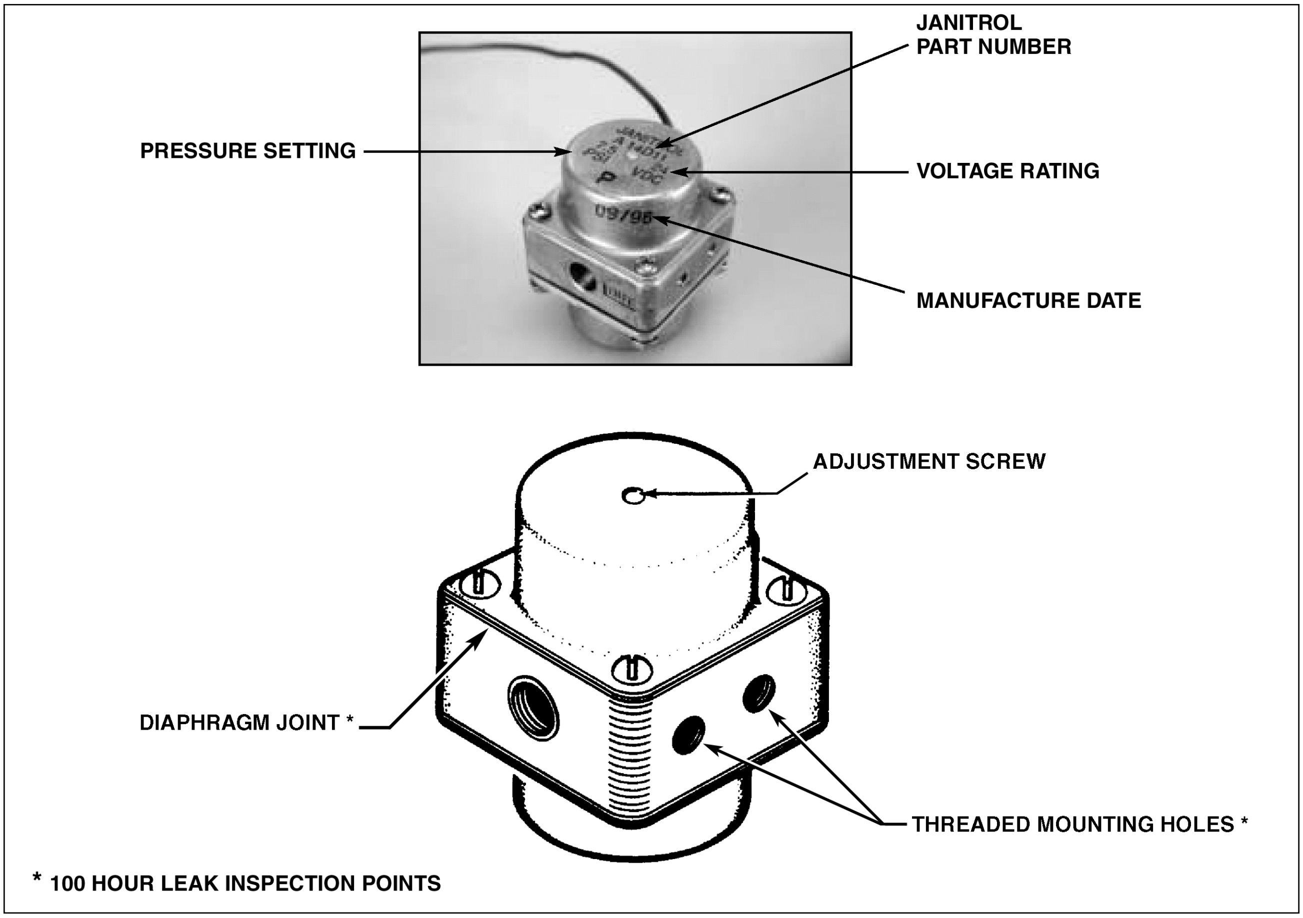


Figure 13-23. Fuel Regulator and Shutoff Valve

13-94. FUEL REGULATOR AND SHUTOFF VALVE. (Refer to Figure 13-23)

This unit provides preset, regulated fuel pressure as well as remote shutoff to the heater, regardless of fuel inlet pressure variations. It is adjustable to 7 psi, with inlet pressures up to 50 psi. The shutoff valve is operated by a solenoid.

13-94A. 100 HOUR INSPECTION.

Visually inspect the valve body for signs of fuel stains, paying careful attention to the diaphragm joint and the threaded mounting holes located in sides of the valve body (see Figure 13-23). Fuel leakage may appear as a greenish blue stain or residue in the area of the diaphragm joint or threaded mount hole. Use supplemental lighting if needed to facilitate visual inspection. Visual inspection must include all four sides of the regulator valve body. If signs of fuel leakage are found replace the valve using a new valve of appropriate part number with a manufacture date code of 02/02 or later. Record valve replacement in the logbook.

13-95. DUCT SWITCH. (Refer to Figure 13-24.)

This switch is installed in the ventilating air duct downstream from the heater to sense the ventilating air outlet temperature. To select the desired cabin temperature, the switch may be adjusted manually from a high of 250° F ± 10° downward through a range of 146° F ± 6°. The switch has a differential of 10° F ± 5° at any given setting.

13-96. COMBUSTION AIR BLOWER. This centrifugal-type blower supplies combustion air to the combustion chamber of the heater. Performance of the combustion air blower is assisted by the use of ram air during flight.

13 -97. VENTILATING AIR BLOWER. This blower is attached to the inlet end of the heater assembly and provides a source of ventilating air through the heater. Ram air from the ventilating air intake scoop is used during flight.

13-98. OPERATING CONTROLS. (Refer to Figure 13-25.)

NOTE: The schematic diagram (Figure 13-25) shows the heater circuit, including the electrical wiring in the airplane.

a. The HEATER SWITCH is connected in the line that supplies electrical power to all heater equipment and controls. When this switch is in the OFF position, the entire heater system is inoperative. This switch has a FAN position which permits use of the ventilating air blower to circulate cool air through the system for summer ground operation. With the switch in FAN position, the heater is inoperative and only the ventilating air blower is energized.

b. The HEATER SWITCH is a normally open switch that supplies power to (lock-in) the safety relay through which power is supplied to the ignition and fuel circuits of the heater.

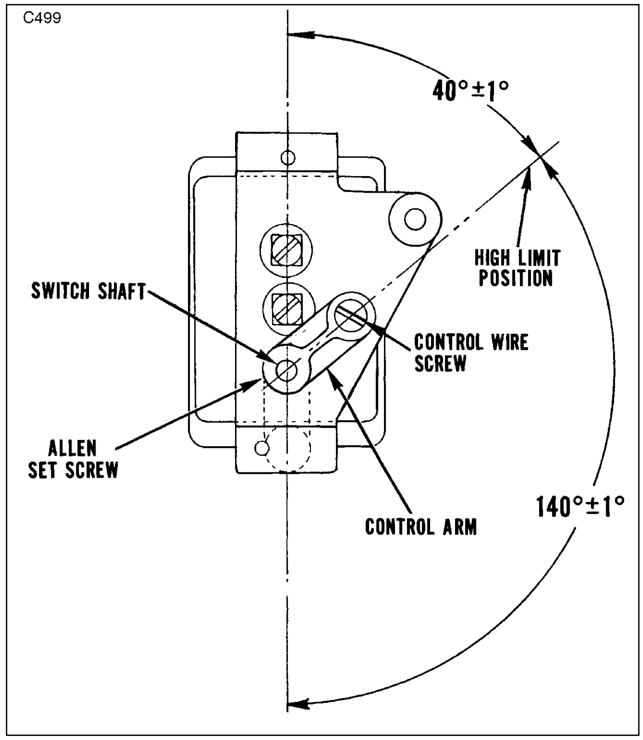


Figure 13-24. Top View - Duct Switch (Typical Control Lever Positions)

13-99. OPERATING PROCEDURE. (Refer to Figure 13-25.)

a. Place the HEATER SWITCH in the ON (or HEAT) position. The ventilating air and combustion air blowers should operate.

b. The heater will ignite and continue to operate.

c. The DUCT SWITCH can be set to regulate the cabin temperature for desired comfort level. If this switch is set for ground operating comfort, it may be necessary to reposition it after being airborne, since ram air will increase the ventilating air flow and the heater output.

d. To stop heater operation, turn off the HEATER SWITCH.

e. It is desirable to operate the fan several minutes to cool the heater after operation. To stop fan operation, turn OFF the HEATER SWITCH.

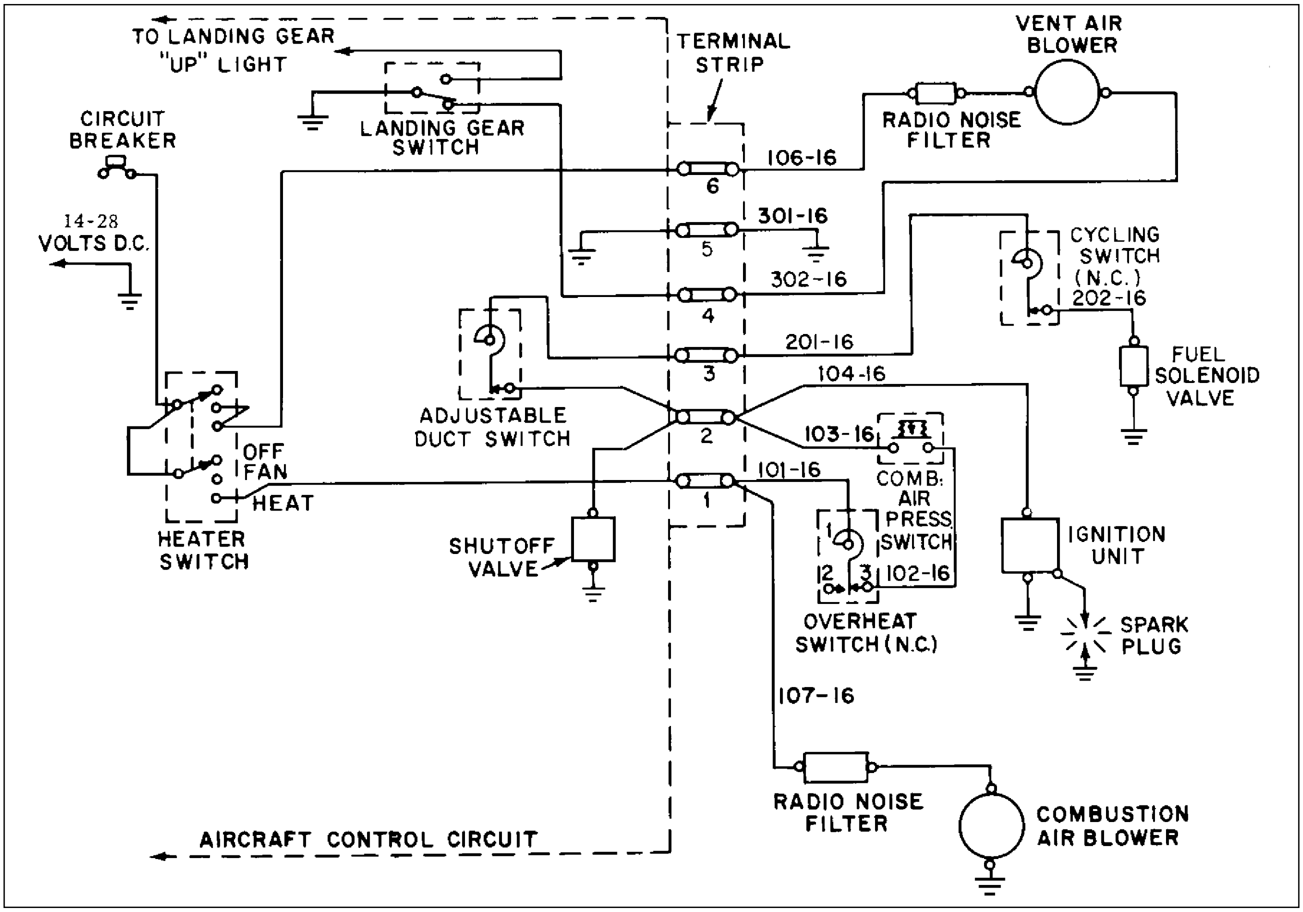


Figure 13-25. Wiring Diagram

13-100. INSPECTION OF HEATER AND HEATER COMPONENTS.

13-101. PREFLIGHT AND OR DAILY INSPECTION.

a. Inspect the ventilating air inlet scoop, combustion air inlet scoop, exhaust outlet and fuel drain for possible obstructions. Make sure that all of these openings are clear of any restrictions and that no damage has occurred to air scoop protrusions.

b. Perform an operational check as follows:

Place the HEATER SWITCH in the ON (or HEAT) position. The ventilating air blower and combustion air blower should operate.

NOTE: To proceed with the operational check, follow Paragraph 13-99, steps a through e. The above procedure should be repeated one or more times.

13-102. 100-HOUR INSPECTION. The mandatory 100-Hour Inspection shall be conducted on new heaters or overhauled heaters with a new combustion tube assembly upon accumulation of 500-heater operating hours or twenty-four months, which-ever occurs first, and thereafter at intervals not to exceed 100-heater operating hours or twenty-four months, whichever occurs first. If an hour-meter is used on the heater assembly, it should be connected across terminals number 2 and 5 on the heater terminal strip. If an hour-meter is not used, count one heater operating hour for each two flight hours for normal aircraft operation. Consideration should be given for any excessive ground operation of the heating system.

NOTE: The 100 Hour Inspection consists of the functional checks and inspection listed below and the Pressure Decay Test.

a. Inspect ventilating air and combustion air inlets and exhaust outlet for restrictions and security at the airplane skin line.

b. Inspect the drain line to make sure it is free of obstructions. Run a wire through it if necessary to clear an obstruction.

c. Check all fuel lines for security at joints and shrouds, making sure that no evidence of leaks exists. Also check for security of attachment of fuel lines at the various attaching points in the airplane. Check fuel pressure to ensure 7 psi.

d. Inspect electrical wiring at the heater terminal block and components for loose connections, possible chafing of insulation~ and security of attachment points.

e. Inspect the high-voltage cable connection at the spark plug to make sure it is tight. Also. examine the cable sheath for any possible indications of arcing, which would be evidenced by burning or discoloration of the sheath.

f. Inspect the combustion air blower assembly for security of mounting and security of connecting tubing and wiring. Tighten any loose electrical terminals and air tube connections.

g. Operate both the combustion and ventilating air blowers and check for unusual noise or vibrations.

h. It is recommended that the condition of the spark plug be checked for operation as described in paragraph titled "Spark Plugs."

i. Evaluate the condition of the combustion chamber by performing a "Pressure Decay Test" as described in Janitrol Maintenance and Overhaul Manual P/N 24E25-1 dated October 1981. See Introduction, Supplementary Publications, Vendor Publications.

j. Following the 100 hour inspection, perform the "Preflight and/or Daily Inspection."

13-103. MAINTENANCE SERVICE. Instructions contained in this section consists of periodic inspection, adjustments, and minor corrections required at normal designated intervals for the purpose of maintaining the heating system in peak operating condition. These inspections assume that a heating system includes accessory components mentioned in preceding paragraphs.

13-104. REMOVAL OF JANITROL HEATER.

a. Turn the heater control switches off.

b. Remove the forward access panel, located on the left side of the fuselage nose section.

c. Open the forward baggage door and remove the heater cover box located on the left rear side of the baggage compartment floor.

d. Remove the screws that attach the air intake elbow to the front of the heater.

e. Note the hook-up of the electrical wires to facilitate reinstallation and disconnect wires from heater.

f. Disconnect the heater exhaust shroud from the heater jacket at the aft bottom side of the heater and slide it down enough to allow the exhaust tube to be disconnected. Remove both the shroud and tube.

g. Disconnect the drain from the forward bottom side of the heater.

h. Loosen the shroud covering the fuel inlet line fitting located at the forward top side of the heater.

i. Disconnect the combustion air blower inlet tube and outlet adapter leading to the heater. Loosen the clamp that secures the air blower motor and roll the unit out of the way or remove it, as desired.

j. Loosen the two clamps that secure the heater to its mounting brackets.

k. Located under the aft clamp are four screws that attach the air distribution box to the heater. Remove these screws.

l. Separate the heater from the air distribution box and remove the heater from the airplane.

m. To remove the air distribution box, disconnect the air hoses located on each upper side of the box.

n. Disconnect the duct switch and cabin heat control cables.

o. Remove the two screws that attach the cabin heat hose to the lower aft end of the distribution box and remove box.

13-105. INSTALLATION OF JANITROL HEATER.

a. Position the air distribution box and attach the cabin heat hose to the lower aft end of the distribution box.

b. Place the heater in position on its mounting brackets and attach the air distribution box to the heater with four screws.

c. Connect and secure the exhaust tube to the exhaust of the heater.

d. Position and secure the exhaust tube shroud to the jacket of the heater.

e. Connect the drain tube to the bottom of the heater.

f. Tighten the two clamps that secure the heater to its mounting brackets.

g. Connect the heat control cable to the control arm located on the right side of the air distribution box. Adjust the cable so that when the door is completely closed, approximately one-sixteenth of an inch exists between the control knob and knob stop.

h. Connect the duct switch control cable to the switch on the left side of the air distribution box. Adjust the cable so that when the control knob is full in against its stop, the control arm aligns with the vertical line of the switch. (Do not loosen the allen set screw that secures the arm to the switch shaft.) Pull the control knob out to ascertain that the control arm will have a 140° ± 1° travel to high heat position. (Refer to Figure 13-24.)

i. Connect the cockpit heat and defroster air hoses to the air distribution box.

j. Place the combustion air blower in position, connect the outlet adapter to the heater and blower inlet tube. Secure blower in position.

k. Connect the fuel inlet line, and secure the fitting shroud in position.

l. Connect the electrical wires to the heater.

HEATER TERMINAL BLOCK WIRING	
Terminal No.	Wire Designation
1	H4A
2	H1E H2B
3	H1D
4	H9A
5	H8A H10A
6	H2A

m. Within the baggage compartment, attach the air intake elbow to the front of the heater.

n. Operate the heater long enough to determine that the unit is operating properly.

o. Install the access box in the baggage compartment and panel at the side of the fuselage.

13-106. HEATER ELECTRICAL SYSTEM CHECKS.

13-107. ELECTRICAL CONTINUITY CHECK. These tests are listed as an aid in isolating open circuited or inoperative components.

NOTE

The schematic wiring diagram (Figures 13-25, 13-26 and 13-27 shows, in addition to the heater circuitry, a suggested aircraft control circuit. For the purposes of this manual, the circuitry shown in these illustrations will be utilized to describe electrical continuity checks.

It must be assumed that power, which is furnished through the heater circuit breaker, is present at the HEATER SWITCH at all times. Always check the

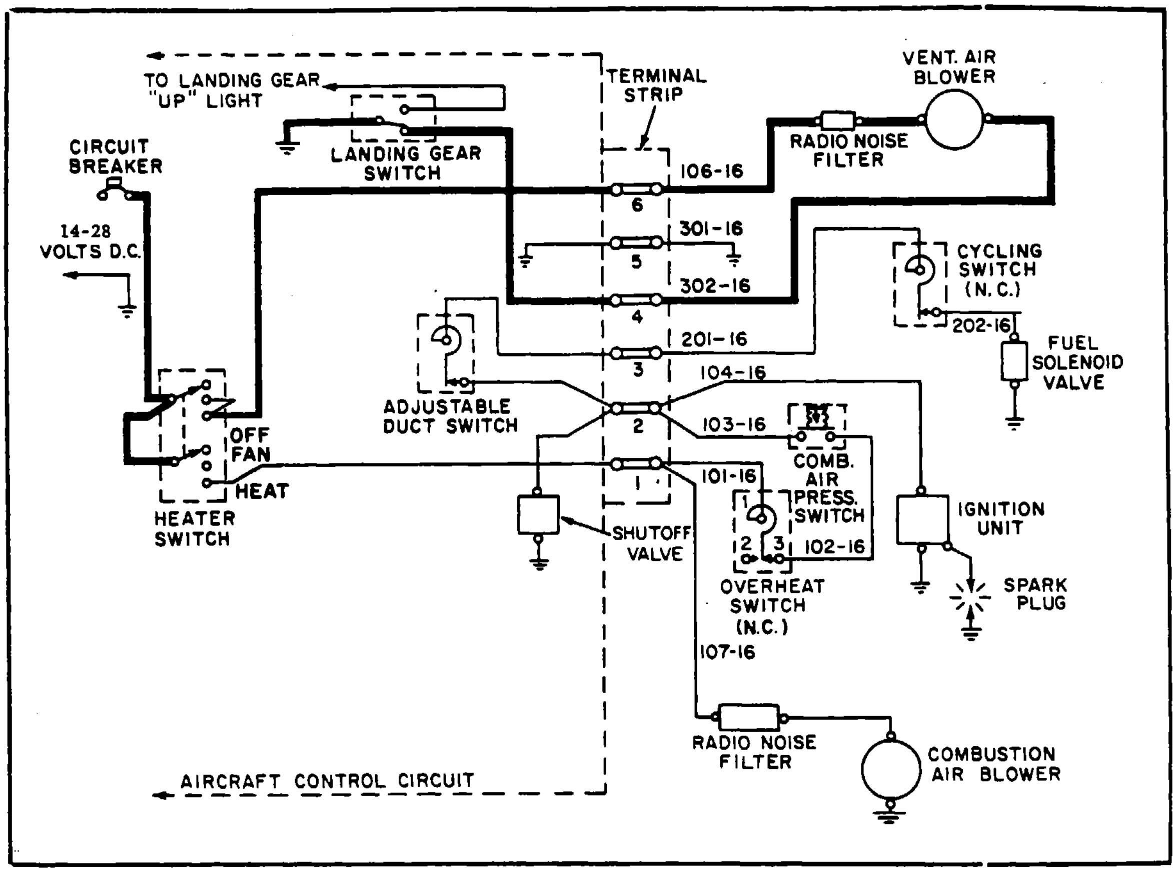


Figure 13-26. Primary Power Circuit

circuit breaker before performing electrical continuity checks.

13-108. VENT BLOWER POWER CIRCUIT CHECK. (Refer to Figure 13-26.) With the HEATER SWITCH in the FAN position, electrical continuity (14-28-volts nominal) should be present at the following locations:

a. Terminal No. 6 on the heater terminal strip.

b. From terminal No. 6 of the heater terminal strip through the radio noise filter to the ventilating air motor.

c. Electrical ground circuit for the ventilating air motor is provided from terminal No. 4 of the heater terminal strip through the LANDING GEAR SWITCH when the landing gear is down. Ventilating air motor is inoperative when the landing gear is up.

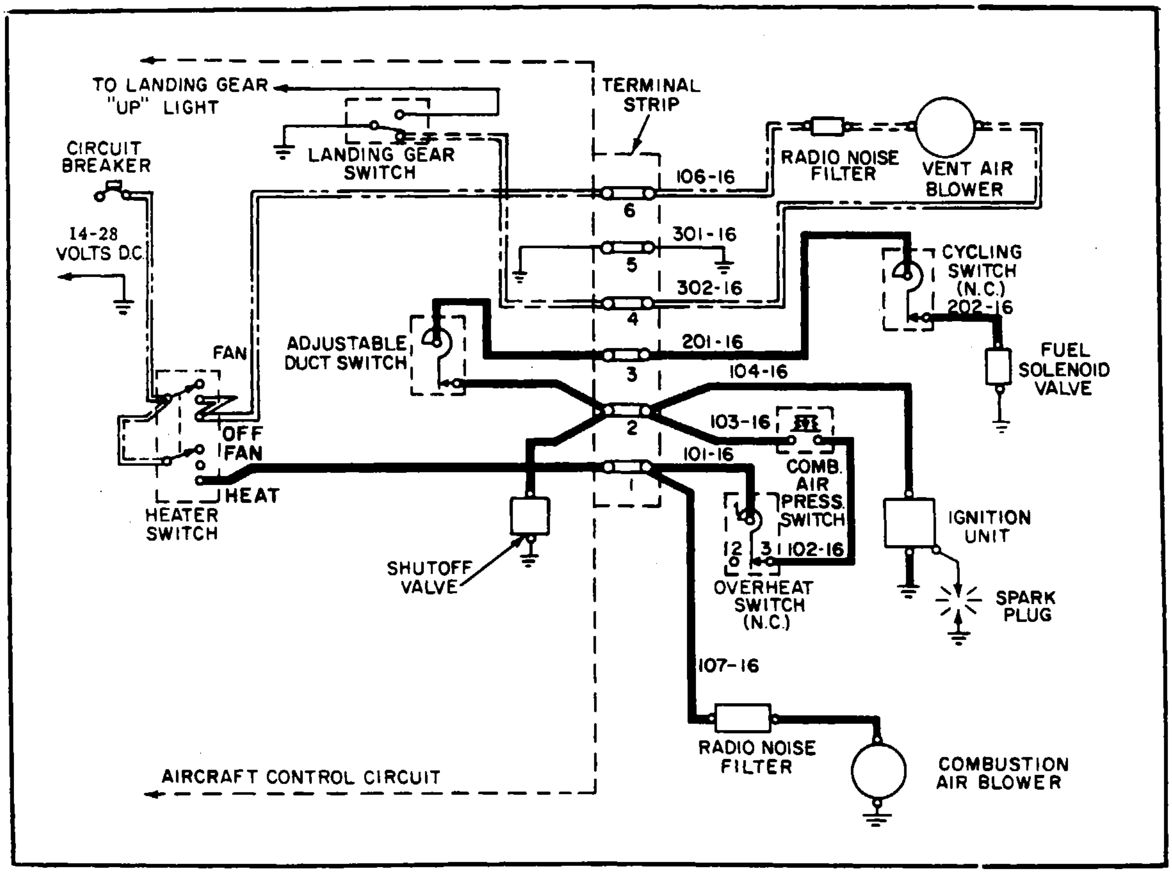


Figure 13-27. Starting Power Circuit

13-109. HEATER POWER CIRCUIT CHECK. (Refer to Figure 13-27.)) With the HEATER SWITCH in the HEAT position, electrical continuity should be present at the following locations:

NOTE

Power for the ventilating air blower is the same as described above except that power is now supplied through the HEAT side of the HEATER SWITCH.

a. Terminal No. 1 of the heater terminal strip.

b. From terminal No. 1 of the heater terminal strip through the radio noise filter, to the combustion air motor and to terminal No. 1 of the overheat switch.

c. From terminal No. 3 of the overheat switch through the combustion air pressure switch to terminal No. 2 of the heater terminal strip.

d. From terminal No. 2 of the heater terminal strip, through the radio noise filter, to the ignition unit; to the shutoff valve; and through the adjustable duct switch to terminal No. 3 of the heater terminal strip.

e. From terminal No. 3 of the heater terminal strip, through the cycling switch to the fuel solenoid valve.

In the event that electrical continuity is not present at one or more of the above listed points, the wiring must be traced back to the power source. If components are still inoperative after the wiring inspection, check the individual inoperative components for continuity and, if necessary, replace them.

13-110. MAINTENANCE AND REPAIRS. Instructions in this paragraph pertain to maintenance of the basic heater and components while the heater is installed in the airplane. Instructions for removal of components are included provided the installation permits accessibility.

NOTE

No special service tools are required for normal periodic maintenance.

13-111. COMBUSTION AIR BLOWER.

a. Removal:

1. Disconnect wire at quick-disconnect terminal.
2. Disconnect the inlet tubing from the inlet air adapter.
3. Loosen the clamps that hold the combustion air blower assembly in the support bracket and slide the motor out of the bracket.

b. Replacing Motor Brushes: (Refer to Figure 13-32.)

1. Remove the brush cap at one of the brush locations. Note position of brush inside the guide and carefully lift the brush and brush spring out of the guide. Be sure to hold the brush so that it can be reinstalled in precisely the same position if no brush replacement is required.
2. Inspect the brush for wear. A new brush is 17/32 inch long. If brushes are worn to a length of 3/16 inch, they must be replaced.
3. Looking through the brush guide, inspect the commutator, which should be smooth and medium brown to dark brown in color. Remove all dust from commutator with compressed air. If the commutator is grooved in the brush track, gouged, scored or shows signs of having burned spots, replace the complete motor assembly. If the commutator is in good condition, install new motor brushes, and tighten brush caps into place. Make sure each brush is oriented so that the curved end fits the curvature of the commutator.

4. After installing new brushes, it is advisable to run-in the brushes as follows: Connect the motor to a controlled voltage supply (rheostat in a 12-volt line). Operate the motor at approximately one-half its normal speed for the first hour, then gradually increase the speed until it is rotating at approximately normal speed. Continue the run-in operation for at least two hours to properly seat the brushes before installing the blower in the airplane.

c. Installation:

1. Prior to installing the combustion air blower, inspect all parts of the assembly for loose screws, loose nuts and poor ground connection on the blower housing. Make sure the blower wheel is tight on the shaft and properly located in the housing. It should have just enough clearance to rotate at full speed without binding against the spill plate. Blower performance is based upon this close-tolerance clearance. It is recommended that correct voltage be applied for this clearance check.

2. Install the blower inlet adapter in the same orientation as before removal.

3. Place the combustion air blower assembly in position in the attaching clamp so the air tubing can be connected, and slide the tubing into position at the point where it was disconnected during removal. Tighten the motor in the attaching strap.

4. Secure the air tubing by tightening the clamp or installing the sheet metal attaching screws.

5. Connect the wire lead to No. 1 terminal on terminal strip.

6. Check motor operation. By disconnecting the wire at the No. 3 terminal on heater terminal strip, blower can be operated without fuel flow to the heater.

13-112. SPARK PLUG. (Refer to Figure 13-31.)

a. Removal:

1. Remove the necessary access panels to expose the spark plug area of the heater assembly.

NOTE

Insure that heater electrical circuits are de-energized.

2. Unscrew and remove the high-voltage lead connector at the spark plug. Exercise care to avoid fouling or damaging the connector.

3. Remove the grommet (23).

4. Using a 7/8 inch deep hex socket, unscrew and remove the spark plug (22). Make sure the spark plug gasket is removed with the spark plug. It will normally stick on the spark plug threads, but if loose, it might drop into the ven-

tilating air passages of the heater. Should this happen, remove the gasket with a wire hook.

b. Inspection and Servicing:

1. If the spark plug appears to be in good condition, except for a mild coating of oxide on the porcelain and electrodes, it may be cleaned and reused. Cleaning is accomplished on a conventional airplane type spark plug cleaner, except that it will be necessary to use two or more adapters in order to raise the long extension of the plug far enough out of the cleaner nozzle opening to provide an effective job. Plug the ceramic insert cavity at the terminal-end of the plug with a piece of paper or cloth to keep out any of the cleaning sand. Wipe this cavity out thoroughly with a cloth, wet with carbon tetrachloride. If, after cleaning, the spark plug porcelain is white, and the electrodes are not eroded, re-gap the spark plug by carefully bending the ground electrode until a 0.055 inch feeler gauge can be inserted between the end of the center electrode and the ground electrode.

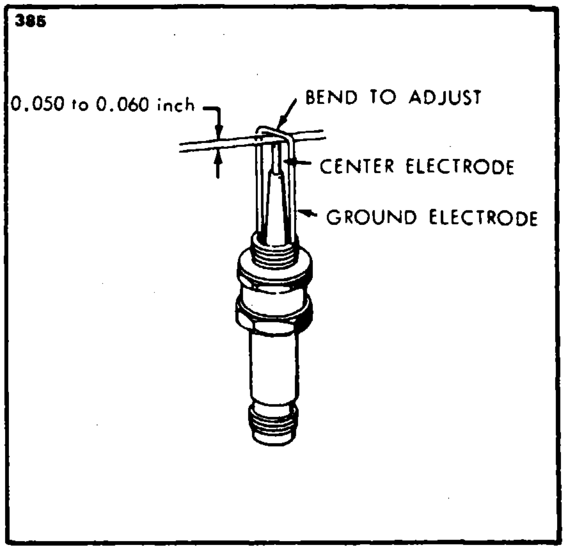


Figure 13-28. Spark Plug Gap Adjustment

NOTE

If the spark plug fails to clean up properly and/or if electrodes are badly eroded, it should be replaced.

c. Installation: (Refer to Figure 13-28.)

1. If a new spark plug is being installed, be sure to measure the gap which should be between 0.051 and 0.060-inches. Do not bend the center electrode.

NOTE

The spark plug can be checked visually for sparking across the gap prior to installing the plug as follows: Disconnect the wire from the No. 3 terminal on the heater wiring side of the terminal strip to de-energize the fuel solenoid valve. Connect the high-voltage lead temporarily and lay the spark plug on the heater jacket.

WARNING

Be sure to plug the spark plug hole in the heater to prevent any possibility of residual fuel blowing out and igniting. Do not touch the spark plug while energized because of dangerously high voltage.

2. Place a new spark plug gasket on the threads. If the gasket does not hold on the threads and would be likely to fall off during installation, place a small drop of Aviation Permatex, or similar material, on the gasket to stick it temporarily to the plug shell.

3. Screw the spark plug into the heater with a deep socket. Tighten to a torque of 28 foot pounds.

4. Install the grommet (Refer to Figure 13-31, 23) in the heater jacket opening.

5. Carefully insert the spring connector on the high-voltage lead into the spark plug shell, press down gently and start the nut on the threads. Tighten the nut to 20 foot pounds.

6. Reconnect the wire to the No. 3 terminal on terminal strip, if disconnected for above tests.

7. Operate the heater to check dependability and close all access openings.

13-113. VIBRATOR ASSEMBLY. (Refer to Figure 13-31.)

a. Measure the distance the vibrator protrudes out of the ignition assembly to determine when the new unit is inserted properly. Grasp the vibrator (19) and with a slight back and forth movement, pull it straight out of the ignition unit. (For a friction grip, it may be necessary to use a piece of masking or friction tape around the exposed portion of vibrator.)

b. Carefully rotate the new vibrator until the index marks are aligned and the connector pins on the vibrator can be felt entering the pin sockets in the vibrator socket, then press the vibrator fully and firmly into position.

c. Check the heater for operation.

13-114. IGNITION ASSEMBLY. (Refer to Figure 13-31.) This unit converts aircraft DC buss voltage to oscillating current capable of producing a continuous spark in the combustion chamber of the heater. This unit remains energized and produces a continuous spark during heater operation. It contains a condenser, resistor, radio noise filter and vibrator socket. It also has an externally mounted vibrator and ignition coil.

a. Removal of ignition assembly:

NOTE

Make sure the heater electrical circuits are de-energized.

1. Disconnect the primary wire (5) from the primary terminal of the ignition assembly (18).
2. Carefully unscrew and disconnect the high voltage ignition cable at the spark plug. Exercise care to avoid fouling or damaging the connector.
3. Remove the four attaching screws (20) and lockwashers (21) and lift the ignition assembly (18) off the mounting brackets on the heater jacket.

b. Installation of ignition assembly:

1. Place the ignition assembly in position on the brackets attached to the heater jacket, with the high voltage cable facing the spark plug end of the heater.
2. Install the four screws (20) and lockwashers (21). Tighten the screws assembly.
3. Carefully connect the high voltage lead to the spark plug. (Refer to paragraph 13-112, c.)
4. Connect the primary lead (5) to the primary terminal on the ignition unit (18) and tighten the nut securely.
5. Check for proper heater operation.

c. Testing ignition unit:

The ignition unit does not require complete overhaul. The following test will indicate whether or not the unit is operational and whether the vibrator should be replace before reinstallation in the aircraft. The following equipment is required to test the components:

1. A battery that will supply power at approximately 14 to 28 volts DC.
2. A voltmeter with a range of 0-30 volts.
3. A lead from the battery to the test fixture in which is included an ammeter with a range of 0-3 amperes and a normally open, momentary-closed switch. The total resistance of the lead including the ammeter and switch must not exceed 0.3 ohms.
4. A spark gap of 0.187 of an inch +/-0. A convenient means of arranging the correct spark gap is to install a spark plug, P/N 39D18, in a test fixture arranged to provide a ground electrode and a .187 of an inch spark gap. (Refer to Figure 13-28a for information on fabricating this fixture.)

NOTE

Any one of the several spark plugs may be used with the new spark plug fixture detailed in Figure 13-28a. However, the "A" dimension in that sketch must be varied with the length of the spark plug electrode to provide a gap of .187 of an inch for all spark plugs.

NOTE

When testing an ignition unit, do not use a screwdriver as a substitute for a spark plug and spark plug fixture.

5. The high tension shielded ignition lead between the ignition unit and the spark plug is a part of the cover assembly.
6. Arrange the test equipment as shown in Figure 13-28b.

d. Operational test of ignition unit:
1. Close the momentary switch and read the voltmeter and ammeter. Release the momentary switch immediately.
2. The amperage reading at 28 volts DC must be 1.25 +/-0.25 amperes.

13-115. CYCLING SWITCH AND LIMIT (OVERHEAT) SWITCH. (Refer to Figure 13-31.)

a. Removal:
1. If the limit switch (27) is damaged or defective, disconnect the two electrical leads from the switch terminals. Be sure to mark the leads for proper reassembly. (The switch terminals are identified by numbers "1", "2" and "3".)
2. Remove the two attaching screws (28), lockwashers (20) and plain washers (30) and lift the limit switch (27) and spacers (gaskets) (31) from the jacket opening.
3. If the cycling switch (32) is damaged or defective, disconnect the electrical leads, being sure to mark them for proper reassembly.
4. Remove the two screws (33), lockwashers (34) and plain washers (35) and lift the cycling switch (32) from the jacket opening.

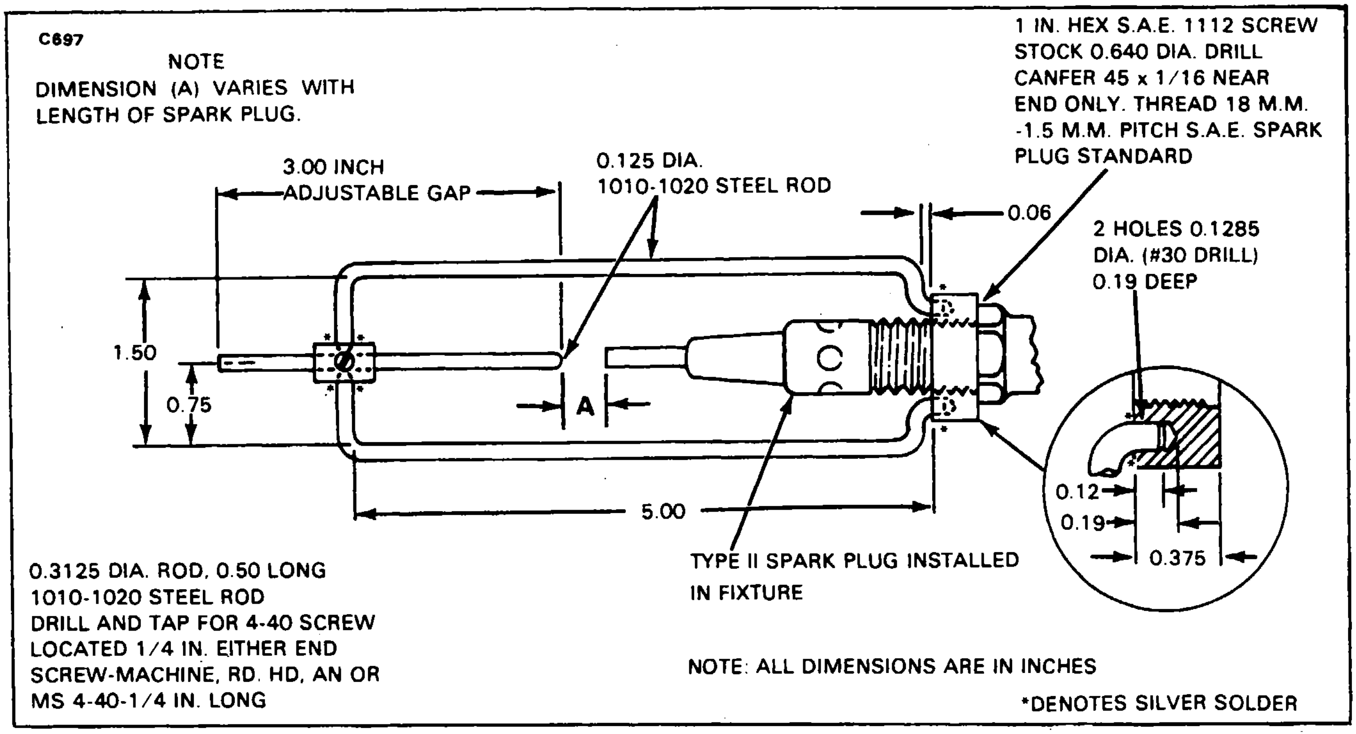


Figure 13-28a. Spark Plug Fixture

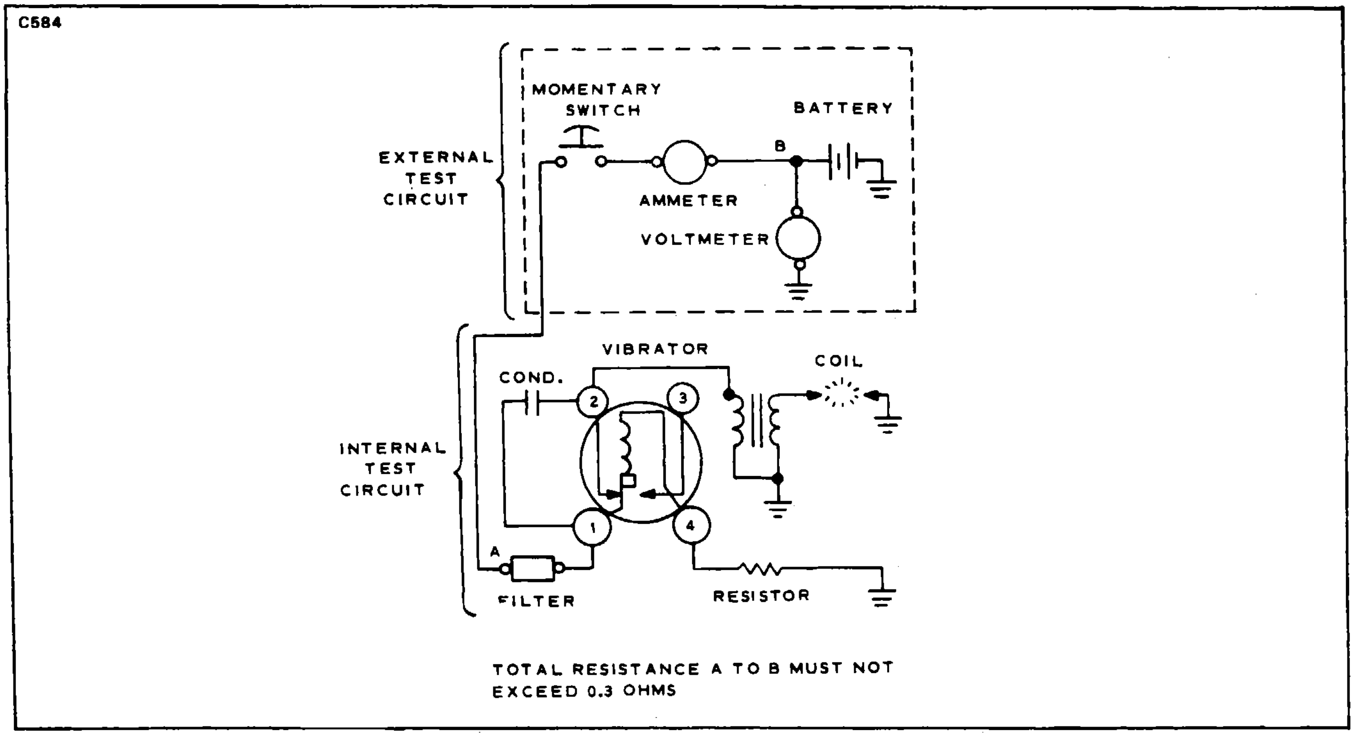


Figure 13-28b. Wiring - Test Setup

NOTE

No attempt should be made to repair either of these switches. If they do not operate properly, they should be replaced. (Refer to paragraph 13-132, m and n for test instructions.)

b. Installation:

1. Install the limit switch (27) and spacer (gasket, 2 required) (31) by placing them in position in the heater jacket opening and installing two screws (28), lockwashers (29) and plain washers (30).

2. Tighten screws securely, then reconnect the electrical leads in accordance with markings made during disassembly. (If electrical connections are uncertain, refer to the wiring diagram, Figure 13-25.)

3. Install the cycling switch (Refer to Figure 13-31, 32) by placing it in position in the heater jacket opening and securing it with the two screws (33), lockwashers (34) and plain washers (35). Tighten screws securely, then reconnect the electrical leads to their respective terminals as marked during disassembly. (If connections are uncertain, refer to wiring diagram, Figure 13-25.)

13-116. COMBUSTION AIR PRESSURE SWITCH. (Refer to Figure 13-31.)

a. Removal:

1. Disconnect electrical leads from the terminals of the combustion air pressure switch (41), being sure to mark them for proper reassembly. Disconnect the tube from the switch cap. Exercise caution not to exert excessive bending of the tube. (It is "tacked" to the combustion chamber inside the jacket.)

2. Unscrew and remove the combustion air pressure switch from the fitting on the combustion air inlet tube.

b. Installation:

1. Install the combustion air pressure switch (41) by rotating it on the threaded fitting of the combustion air inlet tube and tighten it securely. Exercise caution not to over-torque the switch as this could change the setting.

2. Connect electrical leads to their respective terminals in accordance with markings made during removal. If in doubt regarding proper connections, refer to the wiring diagram, Figure 13-25. Connect the tube to the switch cap.

3. Check for proper heater operation.

13-117. FUEL REGULATOR AND SHUTOFF VALVE. (Refer to Figure 13-32.)

a. Removal:

1. Remove the cover from the fuel regulator/shutoff valve shroud assembly.
2. Disconnect the electrical lead to the valve.
3. Disconnect the fuel lines from the valve nipples.
4. Remove the two bolts securing the valve and shroud to the bulkhead, and save the standoff bushings and washers for reinstallation of the valve and shroud assembly.

b. Installation:

1. Place the regulator/shutoff valve into the shroud. Insure the correct positioning of inlet and outlets ports to their respective lines, and secure the valve and shroud to the bulkhead using the two standoff bushings, washers and bolts.
2. Connect the fuel lines to the valve and tighten securely.
3. Connect the electrical lead. Be sure an insulating sleeve or tape is placed over the connection to avoid any possiblity of a short circuit. If a sleeve is used, secure it in place.
4. Perform an operational check of the heater to insure that the unit is functioning properly and no fuel leaks exist.
5. Reinstall the shroud cover on the shroud assembly.

13-118. DUCT SWITCH. (Refer to Figure 13-32.)

a. Removal:

1. Place the control lever arm in high position and loosen the Allen-head set screw that secures the arm to the temperature selector shaft. Slide the lever and arm off the shaft.
2. Disconnect the two electrical leads from the terminals on the exposed face of the switch.
3. Remove the two attaching screws and washers from the duct.
4. Carefully lift out the switch and gasket (if gasket is used).

b. Cleaning and Inspection:

1. Brush off any duster lint from the switch operating mechanism (exposed inside the duct) a wipe external surfaces with a clean cloth.

c. Installation:

1. Insert the switch carefully, with gasket (if used), into the ventilating duct opening and install the two attaching screws and washers.
2. Connect the two electrical leads to their respective terminals, as marked during removal.
3. Set the temperature selector shaft at the high stop. Then carefully place the control lever arm on the shaft at the high position and lock the lever by tightening the Allen-head set screw. (Do not overtighten.) Rotate the lever arm to make sure it clears the electrical terminal screws and support bracket when it is moved to the high position.
4. Operate the heater with the duct switch set above ambient temperature to check operation. (Refer to paragraph 13-132, I for additional tests and setting instructions.)

13-119. OVERHAUL INSTRUCTIONS. The heater assembly shall be overhauled after 1000 hours or whenever the pressure decay test requirement cannot be met. The heater should be removed from the aircraft, disassembled, all parts throughly inspected and necessary repairs and/or replacements made prior to reassembly. Detailed step-by-step instructions are included for a complete heater overhaul. In some instances, however, inspections may reveal that it is unnecessary to remove certain parts. If so, those portions of the overhaul procedures may be eliminated.

NOTE

For disassembly and reassembly operations, refer to the exploded view drawings and the parts list.

13-120. DISASSEMBLY. (Refer to Figure 13-31.)

a. Remove the screw (4) and slide the elbow adapter (3) off the combustion air inlet tube.

b. Disconnect and remove electrical wiring and individual wires from the various components on the heater. If wires appear to be in good condition, it may be desirable to remove wire harness assembly intact. First, disconnect wires at terminal strip and components. The ventilating air blower housing must be removed so that the two motor wires and solenoid valve quick-disconnect connections may be released.

NOTE

It is advisable to label all wires, prior to removal, to insure correct connections during reassembly. Cable straps and clips must be replaced if removed, as they cannot be reused.

c. Carefully disconnect the high-voltage ignition lead at the spark plug. Handle the spring connector on the end of this lead with care to prevent fouling or damage.

d. Remove the four screws (20), lockwashers (21) and cable straps (17) to free the ignition assembly (18) from the heater jacket and remove the ignition assembly. The vibrator may be removed by exerting a firm pull straight away from the ignition assembly case.

e. Remove the two screws (25) and lockwashers (26) to release the radio-noise filter (24) from the jacket (84).

f. Remove the grommet (23) from the jacket (84) and remove the spark plug (22) with a 7/8 inch deep socket. Make sure the spark plug gasket is removed.

g. Remove the two screws (28), lockwashers (29) and plain washers (30) and lift out the overheat (limit) switch (27) and spacer gaskets (31).

h. Remove the two screws (33), lockwashers (34) and plain washers (35) and lift out the cycling switch (32).

i. Remove the four screws (37) and lockwashers (38) to release the terminal strip (36) and insulator (39) from the jacket (84).

j. Disconnect the tube fitting (40) at the cover of the combustion air pressure switch (41). (Refer to paragraph 13-116, a, (1) for precaution on tube bending.) Unscrew and remove the combustion air pressure switch (41) from the combustion air inlet tube.

k. Loosen the four screws (48) and rotate the blower and motor housing (59) to disengage the notched end from the four screws in the end of the heater jacket. Remove the grommet (47) and separate the two electrical quick-disconnects after sliding back the insulator sleeves on the wire ends.

l. Reach inside the inlet end of the jacket assembly (84) with a 3/4 inch open-end wrench and, while holding the fuel-tube fitting at the jacket, remove the reducing bushing adapter (42). Then, with 3/4 inch deep socket, remove the nut (44), fuel fitting shroud (43) and gasket (46).

m. Remove the two screws (72) and lockwashers (73) and carefully withdraw the nozzle holder and valve assembly from the combustion tube assembly (86). Remove the gasket (82).

n. Remove the screws (88 and 69), lockwashers (71) and remaining cable straps (17), if not previously removed, from the seam of the jacket assembly (84). Note positions of cable straps as they are removed. Spread the jacket (84) at the seam and remove it from the combustion tube assembly (86). This will free the rope gasket (85) which can be removed from the particular part on which it remains attached.

o. Carefully unscrew and remove the spray nozzle (83) from the nozzle holder and solenoid valve assembly.

CAUTION

Handle the nozzle with care to avoid damage to the tip. The material around the orifice is very thin and any sharp blow on the face of the nozzle can distort the spray pattern and cause mal-ignition or improper combustion.

p. Remove the screw (76), lockwasher (77), cover (75) and "O" ring (78). Then carefully slide the solenoid coil (79) off the valve assembly. It is not necessary to remove the base plate (80) unless it is warped.

q. Loosen the nut (55) and remove the screw (53), flat washer (45) and rubber grommet (58) from the blower housing.

r. Remove the two screws (54), flat washers (45) and rubber grommets (58) at the other two locations around the blower motor housing (59).

s. Slide the ventilating air blower motor out of the blower housing (50) with the motor bracket assembly (52) and blower wheel (60) attached. Loosen the set screw in the blower wheel (60) and slide it off the end of the motor shaft. The flat washers (58) and rubber washers (57) will fall out when the bracket is removed. Then remove the motor bracket assembly (52). If these parts are in good condition, they need not be disassembled further.

t. Remove the screw (62) and lockwasher (63) to free the capacitor assembly (61) with attached leads.

13-121. DISASSEMBLY OF COMBUSTION AIR BLOWER ASSEMBLY. (Refer to Figure 13-32.)

a. Remove the combustion air blower inlet adapter (2) by removing three screws, lockwashers, cover plate and gasket.

b. Remove the outlet adapter (5) by removing the two screws (6) and lockwashers (7).

c. Remove the inlet flange (8) by removing the three screws (9) and lockwashers (10).

d. Remove screws (12 and 16) and lockwashers (13 and 17), then separate the back plate (20), with motor (25) attached, from the blower housing (15) and free the motor leads and capacitor (11) from the back plate (20).

e. Loosen the set screw in the blower wheel (19) and slide it off the motor shaft.

f. Remove the two hex nuts (21), lockwashers (23) and flat washers (22), and slide the back plate (20) off the motor through bolts. The spacer (24) will drop out.

g. Install new motor brushes as described in paragraph 13-111, b. If the motor commutator is badly worn, or if the motor is defective in any respect, it must be replaced.

13-122. CLEANING. (Refer to Figure 13-31.)

a. Clean individual metal parts (except those parts containing switches and electrical wiring) and the combustion tube assembly, by immersing them in dry-cleaning solvent, such as Stoddard solvent (Federal Specification P-D-680). A bristle brush should be used to assist the cleaning process if foreign accumulations are stubborn to remove.

CAUTION

Do not attempt to buff or scrape off any deposits on face of spray nozzle. The face of the nozzle is very susceptible to damage from mishandling. Carefully repeat cleaning process using only a bristle brush and repeated applications of solvent to loosen any stubborn deposits.

b. Use compressed air or lintless cloth to dry the parts, unless sufficient time is available for them to air dry.

c. Wipe electrical components with a clean, dry cloth. If foreign material is difficult to remove, moisten the cloth in carbon tetrachloride or electrical contact cleaner and clean all exterior surfaces thoroughly.

13-123. CLEANING AND INSPECTING THE COMBUSTION TUBE ASSEMBLY. (Refer to Figure 13-31.)

a. Slight scaling and discoloration of the combustion tube assembly (86) is a normal condition for units that have been in service up to 1000 airplane hours. The slight scaling condition will appear to be mottled and a small accumulation of blue-gray powder may be present on the surface in certain areas. This condition does not require replacement of combustion tube assembly, unless severe overheating has produced soft spots in the metal.

NOTE

This assembly should be inspected prior to cleaning in order to prevent the removal of visible evidences of damage.

b. Look inside the exhaust outlet to determine if the combustion tube appears to be heavily scaled or mottled. Deformation is more difficult to detect visually but can usually be observed by looking straight through the combustion tube assembly and sighting along the outer surface of the inner combustion tube. An assembly that has been obviously deformed should be replaced. Slight deformation will not affect heater operation unless it is extensive and localized enough to reduce the flow of ventilating air through the heater more than 10 percent.

c. The combustion tube assembly may be cleaned by either of two methods:

1. One method is to soak the combustion tube assembly overnight in an Oakite M-S Stripper solution, made by mixing one pound of Oakite salts with each gallon of water used. The solution should be maintained at a temperature of be-

tween 190° F and 210° F. After overnight soaking, rinse the combustion tube assembly thoroughly in water to remove all traces of the Oakite solution. In order to reach all areas of the combustion tube assembly, it is advisable to let it stand in the rinsing water for as long as one-half hour, while occasionally agitating it to circulate the water. All openings should be left open during this operation. Be sure to dry the combustion tube assembly thoroughly after cleaning.

2. A second method of cleaning is what is commonly known as hand "tumbling." Insert shot or other metallic particles through the exhaust outlet opening, then close all openings and shake the combustion tube assembly vigorously, while rotating it and changing from end-to-end frequently. Be sure to pour out all of the particles and loosened material, then with all openings uncovered, direct a stream of compressed air into the combustion tube assembly from first one opening, then the other. Make sure all loose material is removed.

13-124. INSPECTION OF REMAINING COMPONENTS. (Refer to Figure 13-31.)

a. Discard all rubber parts such as grommets, gaskets, etc. These items should always be replaced at overhaul. Also discard the rope gasket (85).

b. Inspect all wires and wiring harnesses for damage to insulation, damaged terminals, chafed or cracked insulation and broken plastic bands. Individual wires can be replaced by making up new wires from No. 16 AWG stock and cut to correct length. It is advisable to use an acceptable crimping tool for installing terminals, rather than solder for all heater wiring connections. If wiring harness damage is visible, the entire harness assembly should be replaced. If only one or more wires are damaged, cut the cable ties, make up new wires, install them in the harnesses, and restore all cable ties and clamps. If heater controls were operating properly at the time of removal, reinstall them.

c. Inspect all hard parts, consisting of bolts, screws, nuts, washers and lockwashers. Replace damaged parts.

d. The combustion air pressure switch (41) must respond to delicate pressure changes and should always be checked and/or replaced at overhaul. (Refer to paragraph 13-125, c, and Figure 13-30.)

e. Replace the vibrator in the ignition unit at each overhaul.

f. Inspect the ignition assembly (Figure 13-31, 18) for dented case, loose or damaged primary terminal insulator and broken or obviously damaged high-voltage lead. Give particular attention to the condition of the spring connector at the end of the lead. If the spring is burned off, visibly eroded, or carbon tracked, the ignition assembly should be replaced.

NOTE

Do not attempt a field repair of the ignition unit, as it is a sealed assembly.

g. Inspect the terminal strip (36) for distortion and cracks and replace it if either condition exists.

h. Inspect radio-noise filters for short circuits by checking from either terminal to ground with an ohmmeter. An open-circuit reading should be obtained.

i. Inspect the spray nozzle (83) with a magnifying glass for any obstructions in the nozzle orifice and any sign of damage to the slight conical protrusion at the nozzle tip. Use compressed air to remove obstructions and re-examine it to make sure the orifice is open. Exercise care when handling the nozzle to avoid pressing or rapping on the tip face. Do not burr or scrape off deposits on the tip face. After cleaning, it is advisable to store the nozzle in a polyethylene bag until ready for reassembly.

j. Replace the nozzle at overhaul.

NOTE

The nozzle (83) can be spray tested by installing it in the holder and connecting the fuel tube to a 7 psi fuel pressure source. Connect the solenoid leads to a 14-28-volt source (battery) to open the solenoid valve. The conical angle spray pattern should be even and dispersed the same in all directions. Exercise caution to keep atomized fuel away from fire.

k. Inspect the nozzle holder and solenoid valve assembly for damaged threads at the fuel-tube fitting, crimped or cracked fuel line or distorted housing. The only part in this assembly that can be replaced is the solenoid winding. Check the solenoid for continuity by connecting across each wire lead with an ohmmeter. A reading of between 18 and 22-ohms should be obtained at room temperature. If not within these limits, or if the solenoid winding shows any form of physical damage or overheating, it should be replaced.

l. Remove the brushes, one at a time, from the ventilating air blower motor (65) by removing the brush cap and carefully withdrawing the brush from its guide. Remove foreign material from the brush guide and commutator with a stream of filtered compressed air. Check for brush wear. (Refer to paragraph 13-111.) Inspect the commutator for grooved brush track, pitting or burning. The commutator surface should be smooth and medium brown in color. Replace the motor if the commutator or other parts show damage.

m. Inspect the combustion air blower motor as described in the preceding step.

n. Inspect the blower wheel for broken or bent vanes and replace it for either condition.

13-125. TESTING. The following tests should be performed as outlined in the succeeding paragraphs.

a. Check ventilating air and combustion air motors for correct RPM and current draw:

1. Connect motor to 14-28-volt DC power supply. Rotation should be counterclockwise when viewed from the shaft end.

2. Both motors should rotate at approximately 7500 RPM at rated voltage. Current draw is approximately five amperes.

3. If current draw is excessive, or if speed is too low, replace the brushes. Recheck both current draw and RPM after brushes are properly run-in. (Refer to paragraph 13-111, b.)

4. If after replacing brushes operation is still unsatisfactory, replace the motor.

NOTE

The motor checks described above should be made without the blower housing attached, for both the ventilating air and combustion air motors.

b. Test the combustion tube assembly (86) for leads as follows:

1. Fashion a sealing plate from approximately .125 inch thick flat stock to seal the nozzle holder opening in the combustion tube assembly. (Refer to Figure 13-29.) Use a rubber gasket under the plate and attach the plate with two screws.

2. Make up seals for all remaining openings, except the one used to connect the air pressure source. (Refer to Figure 13-29.) Use rubber stoppers as shown. The combustion air inlet tube can be sealed best with a drilled stopper and clamp. Other openings should be sealed with expansion plugs. The seal used in the exhaust tube should be formed so that it will not deform the air pressure switch tube which protrudes into the exhaust.

3. Install plugs and caps in all openings except the one to which the combustion air pressure switch is attached. (Any opening can be used to connect the air pressure source, however, the combustion air pressure switch opening is usually the most convenient. The drain opening would normally be considered a second choice.)

4. Connect a regulated air supply to the opening that has not been plugged and apply a pressure of between three and five psi to the combustion tube assembly.

5. Submerge the combustion tube assembly in water for several minutes while watching for bubbles, which would indicate leaks. No air leakage is permitted from the combustion tube assembly. No weld or braze repairs are permitted on a combustion tube assembly.

c. Test the combustion air pressure switch as follows:

1. Connect an adjustable air pressure line that can be controlled in a range of zero to 5.0 (maximum) of water to the switch opening with a water manometer and needle valve in the line ahead of switch. Switch must be tested in 45 degree position as shown in Figure 13-30.

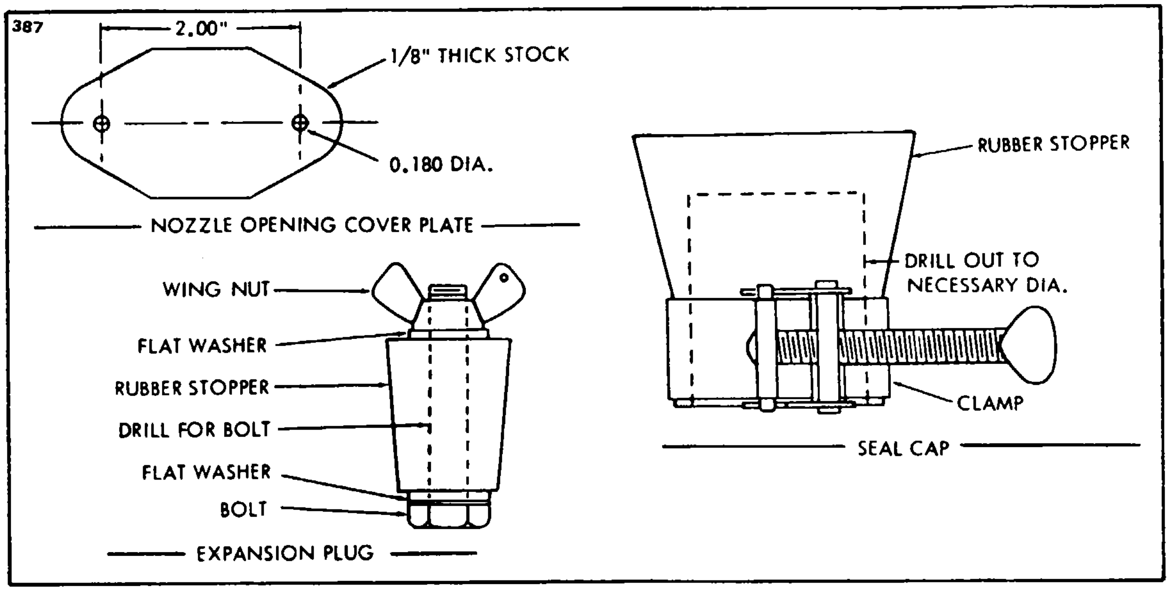


Figure 13-29. Suggested Design for Seal Plate, Plugs and Caps for Combustion Tube Leakage Test

2. Connect an ohmmeter across the switch terminals to determine the exact instant of switch closing.

3. Apply air pressure allowing it to build up very slowly from zero. The switch contacts should close at 0.5 ± 0.1 inches of water which will be indicated on the manometer.

NOTE

The switch cover has a differential pressure tap and this opening must be left open to atmosphere during the test.

4. Make several trials to insure switch reliability. Be sure to increase and decrease the air pressure slowly in order to produce accurate indications.

5. If an adjustment is required, rotate the adjusting screw clockwise to increase settings and counterclockwise to decrease settings.

d. Test the fuel feed and nozzle holder assembly for leaks as follows: This test can be simplified if the following routine is used to test both the fuel line and fuel line shroud tube:

1. Using filtered compressed air, apply 20 psi to the shroud drain port, located on the surface near the threaded nozzle cavity.

2. Immerse the fuel feed and nozzle holder assembly in clean water with the fuel inlet and nozzle cavity left open.

3. Observe for bubbles which would indicate leakage. If bubbles appear at either fuel fitting, there is a leak in the fuel tube. If bubbles appear externally on the shroud tube or at either end of the shroud tube juncture, the shroud tube is leaking.

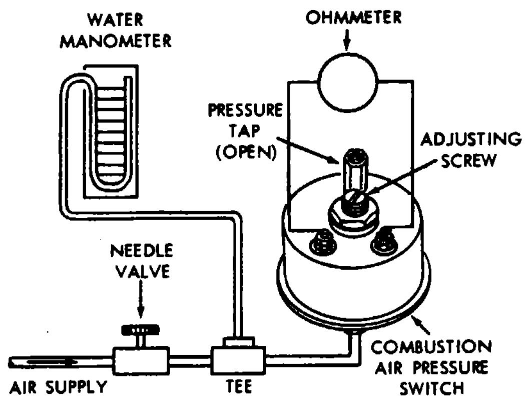


Figure 13-30. Test Setup for Combustion Air Pressure Switch

4. In either of the above cases, the complete fuel feed and nozzle holder assembly must be replaced.

e. Spray test the nozzle (Figure 13-31, 83) as follows:

1. Install the nozzle in the fuel feed and nozzle holder assembly and connect the fuel tube to a 7 psi fuel pressure source.

2. Connect the solenoid leads to a 14-28-volt battery. Connect a switch in the line to open and close the solenoid when desired.

WARNING

Be sure to keep the atomized spray away from fire.

3. With the switch closed (solenoid valve energized) and the fuel line connected, observe the fuel spray pattern. It should be conical in shape with even dispersion in all directions.

4. Energize and de-energize the solenoid several times. The spray should shut off permanently each time the solenoid is de-energized. There should be no sign of dribbling at the nozzle tip in excess of one or two drops.

5. If the spray pattern is distorted, check for an obstruction and clean the nozzle as described in paragraph 13-124, i. If this fails to provide a normal spray pattern, replace the nozzle.

6. If the nozzle continues to dribble, the solenoid valve is not closing properly and the fuel feed and nozzle holder assembly must be replaced.

13-126. REPAIR OF COMBUSTION TUBE ASSEMBLY. No weld or braze repairs of the combustion tube assembly are authorized.

13-127. REASSEMBLY. (Refer to Figure 13-31.)

a. If removed during disassembly, slide the solenoid coil (79) on the stem of the nozzle holder and solenoid valve assembly. Install the "O" ring (78), cover (75), screw (76) and lockwasher (77), then tighten the screw securely. Be careful to avoid pinching the wire leads connected to the solenoid core.

b. Insert the ventilating air motor (65) into the motor bracket assembly (52), slide the blower wheel (60) on the end of the motor shaft and rotate it until the set screw is aligned with the flat side of the motor shaft. Tighten the set screw just tight enough to hold it at this time.

c. Attach the capacitor and leads assembly (61) to the motor bracket (52) with

Legend for Figure 13-31. →

1. HEATER ASSEMBLY
2. PLATE - IDENTIFICATION
3. ADAPTER
4. SCREW - AN530-6R6
5. WIRE ASSEMBLY - IGNITION TO FILTER
6. WIRE ASSEMBLY - BLOWER GROUND
7. WIRE ASSEMBLY - HEATER GROUND
8. WIRE ASSEMBLY - TERMINAL 1 TO OVERHEAT SWITCH
9. WIRE ASSEMBLY - TERMINAL 2 TO IGNITION FILTER
10. WIRE ASSEMBLY - TERMINAL 6 TO BLOWER FILTER
11. WIRE ASSEMBLY - TERMINAL 2 TO PRESSURE SWITCH
12. WIRE ASSEMBLY - TERMINAL 3 TO CYCLE SWITCH
13. WIRE ASSEMBLY - PRESSURE SWITCH TO OVERHEAT SWITCH
14. WIRE ASSEMBLY - CYCLE SWITCH TO FUEL VALVE
15. WIRE ASSEMBLY - TERMINAL 1 TO COMBUSTION AIR BLOWER
16. TIE - CABLE
17. STRAP - CABLE
18. IGNITION ASSEMBLY
19. VIBRATOR - IGNITION
20. SCREW - AN515-8R7
21. WASHER - AN936A8
22. PLUG - SPARK
23. GROMMET - AN931-10-20, MS35489-18
24. FILTER - RADIO NOISE
25. SCREW - AN515-8R5
26. WASHER - AN936A8
27. SWITCH - LIMIT
28. SCREW - AN515-8R8
29. WASHER - AN936A8
30. WASHER - AN960-8
31. GASKET - LIMIT SWITCH
32. SWITCH - CYCLING
33. SCREW - AN515-8R8
34. WASHER - AN936A8
35. WASHER - AN960-8
36. STRIP - TERMINAL
37. SCREW - AN515-8R10
38. WASHER - AN936A8
39. INSULATOR - TERMINAL STRIP
40. ELBOW - PRESSURE SWITCH
41. SWITCH - PRESSURE
42. BUSHING - AN894-4-2
43. SHROUD - FUEL FITTING
44. NUT - AN924-4
45. WASHER - FLAT
46. GASKET - AN900-8
47. GROMMET - MS35489-35
48. SCREW
49. BLOWER ASSEMBLY - VENT AIR
50. SLEEVE - HIGH TEMPERATURE
51. SLEEVE - HIGH TEMPERATURE
52. BRACKET ASSEMBLY - MOTOR
53. SCREW - MACHINE
54. SCREW - MACHINE
55. NUT - AN335-4
56. WASHER - FLAT
57. WASHER - RUBBER
58. GROMMET - MS35489-8
59. HOUSING - BLOWER
60. FAN - VENT AIR BLOWER
61. CAPACITOR ASSEMBLY
62. SCREW - AN515-8R6
63. WASHER . AN936A8
64. WIRE ASSEMBLY - BLOWER GROUND
65. MOTOR ASSEMBLY - VENT AIR BLOWER
66. CAP - BRUSH ASSEMBLY
67. BRUSH ASSEMBLY - MOTOR
68. TERMINAL
69. SCREW - AN515-8R5
70. WASHER - AN960-8
71. WASHER - AN936A8
72. SCREW - AN515-8R8
73. WASHER - AN935-8
74. FUEL FEED, NOZZLE HOLDER AND VALVE ASSEMBLY
75. COVER - SOLENOID
76. SCREW - AN515-8R6
77. WASHER - AN935-8
78. PACKING - "O" RING
79. COIL ASSEMBLY - SOLENOID
80. PLATE - SOLENOID BASE
81. VALVE ASSEMBLY - FUEL
82. GASKET - VALVE ASSEMBLY
83. NOZZLE - FUEL SPRAY
84. JACKET ASSEMBLY
85. GASKET - ASBESTOS
86. TUBE - COMBUSTION
87. TUBE - COMBUSTION AIR SWITCH
88. SCREW - AN515-8R4

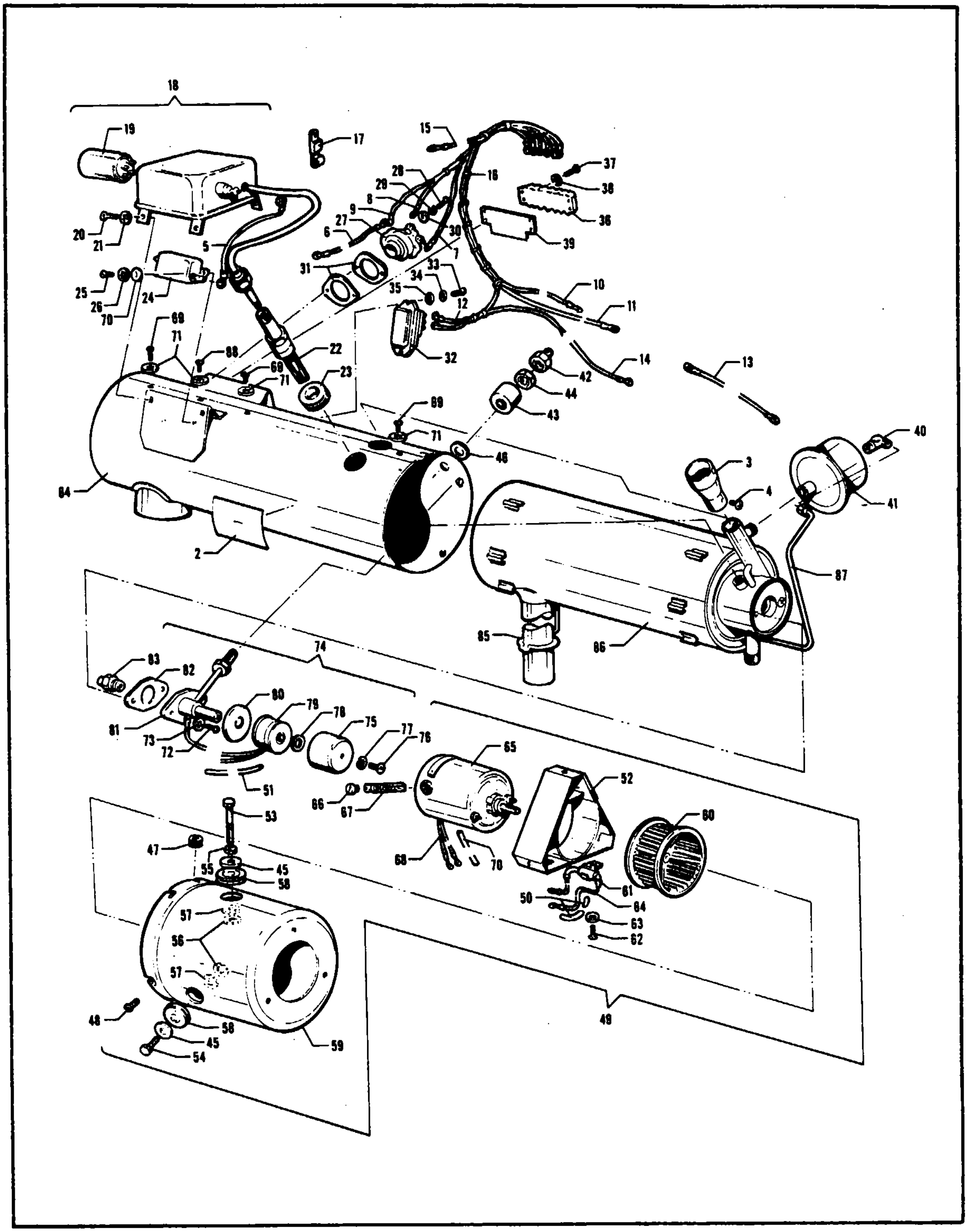


Figure 13-31. Exploded View of Heater Assembly No. 751 978 (14-volt) and 751 999 (28-volt)

the screw (62) and lockwasher (63). Make sure a good electrical ground connection is made at this point.

d. Insert this assembly into the blower housing (59) and position it so the long screw (53) is in alignment with the gap on the inner ring of the motor bracket assembly (52). This is the screw used to secure and align the motor in the bracket.

e. Slide the flat washer (58) and rubber washer (57) into position between the legs of the motor bracket (52) and blower housing (59).

f. Make sure all wires are routed and grommeted as they were prior to disassembly and install the two screws (54), flat washers (45) and new grommets (58) at the two lower edges securing the motor bracket assembly (52). Then install the grommet (58), flat washer (45), nut (55) and screw (53) in the remaining (upper) corner of the motor bracket assembly.

g. Center the motor bracket (52) in the housing and tighten the screw (53) to secure it. The motor (65) should be positioned in the bracket (52) to locate the blower wheel (60) properly in the blower housing (59). The blower wheel should be positioned so it will rotate freely and just clear the contoured spill plate in the blower housing. Tighten the Allen-head set screws and spin the blower wheel by hand for a clearance check. Then apply appropriate voltage to run the motor as a final clearance check.

h. Place a new asbestos gasket (85) in position on the exhaust outlet, spring the jacket assembly (84) open at the seam and insert the combustion tube assembly (86) carefully into the jacket. Exercise care to clear the pressure switch tube in the exhaust outlet and see that the asbestos gasket (85) is properly located. Close the gap on the jacket assembly and install screws (88 and 69) and lockwashers (71) to secure it at the seam. (Two leads ground under these screws. See notations made during disassembly.) Make sure the tongue and channel at the seam are in good condition and a tight fit is effected.

i. Install cable straps at locations noted during disassembly.

j. Remove the spray nozzle (83) from the polyethylene bag. Screw the nozzle into the nozzle holder and tighten to 75-100 inch pounds. It is very important to torque the nozzle to this valve as incorrect tightening could cause improper heater operation and "drool."

CAUTION

The spray nozzle has a slight protrusion on the nozzle face. If this area has been struck by any object which would make a dent or destroy the original contour, the nozzle must be replaced. It cannot be disassembled for cleaning.

k. Insert the fitting on end of nozzle fuel tube through the opening in the jacket (84) and attach the nozzle holder to the combustion tube assembly (86) with the two screws (72) and lockwashers (73). It may be necessary to place a slight bend in the shrouded fuel tube to permit alignment of screw holes. Be sure to use a new gasket (82) and connect the solenoid ground wire under one of these screws. Make sure a good electrical ground connection exists at this point.

l. Using a new spark plug gasket, install the spark plug (22) and tighten to a torque of 28 foot pounds. Install the grommet (23) in the jacket around the spark plug.

m. Install the ignition assembly (18) on the jacket assembly (84) with the four screws (20) and lockwashers (21). Connect the high-voltage lead to the spark plug and tighten it to 20 foot pounds.

n. Attach the radio-noise filter (24) to the jacket assembly (84) with the two screws (25) and lockwashers (26).

o. Attach the overheat limit switch (27) and spacer gaskets (31) to the jacket assembly (84) with two screws (28), lockwashers (29) and flat washers (30). Tighten the screws securely.

p. Attach the cycling switch (32) to the jacket assembly (84) with the two screws (33), lockwashers (34) and flat washers (35).

q. Place the terminal strip insulation (39) in position on the jacket (84), followed by the terminal strip (36). Secure both parts by installing the two screws (37) and lockwashers (38). The two screws are located at two diagonal corners of the terminal strip.

r. Center the fuel fitting in jacket opening. Place the fuel fitting shroud gasket (46) and shroud (43) on the fuel fitting and install the nut (44) finger tight. Insert a 3/4 inch open-end wrench inside the jacket and hold the fuel-tube fitting while tightening the nut (44) with a 3/4 inch deep socket. Install the reducer fitting (42).

s. Rotate the combustion air switch (41) onto the threaded fitting on the combustion air tube and tighten it firmly.

t. Slide the grommet (47) over the combustion air tube and connect the tube to the elbow fitting (40) on the combustion air pressure switch (41).

u. Install the wiring harness and connect all wire leads to their respective terminals. (Refer to the wiring diagram, Figure 13-25.) Place the grommet (47, Figure 13-31) in position in the jacket (84), locate the ventilating air blower (49) at the end of the jacket. Thread the quick-disconnect on the wiring harness through the grommet (47) and connect it to the mating connector on the motor lead.

v. Place the blower housing in position on the jacket assembly (84) and secure it by installing the four screws (48), if removed at disassembly. This operation is easier if the screws (48) are started into their threads and the blower housing rotated into place, allowing the screws to enter the notched openings in edge of blower housing. Tighten all screws securely.

w. Install the elbow adapter (3) with the screw (4).

13-128. REASSEMBLY OF COMBUSTION AIR BLOWER ASSEMBLY. (Refer to Figure 13-32.)

a. Place the spacer (24) over the end of the motor shaft and attach the motor assembly (25) to the back plate (20) with the two self-locking nuts (21), flat washers (22) and lockwashers (23).

b. Slide the blower wheel (19) on the motor shaft and tighten the set screw lightly against the flat portion of the motor shaft.

c. Place the blower housing (15) in position on the back plate (20) and install screws (16) and lockwashers (17).

d. Attach the capacitor (11) at the point shown with the screw (12) and lockwasher (13). The motor ground lead terminal (28) can be grounded to the motor support bracket (3).

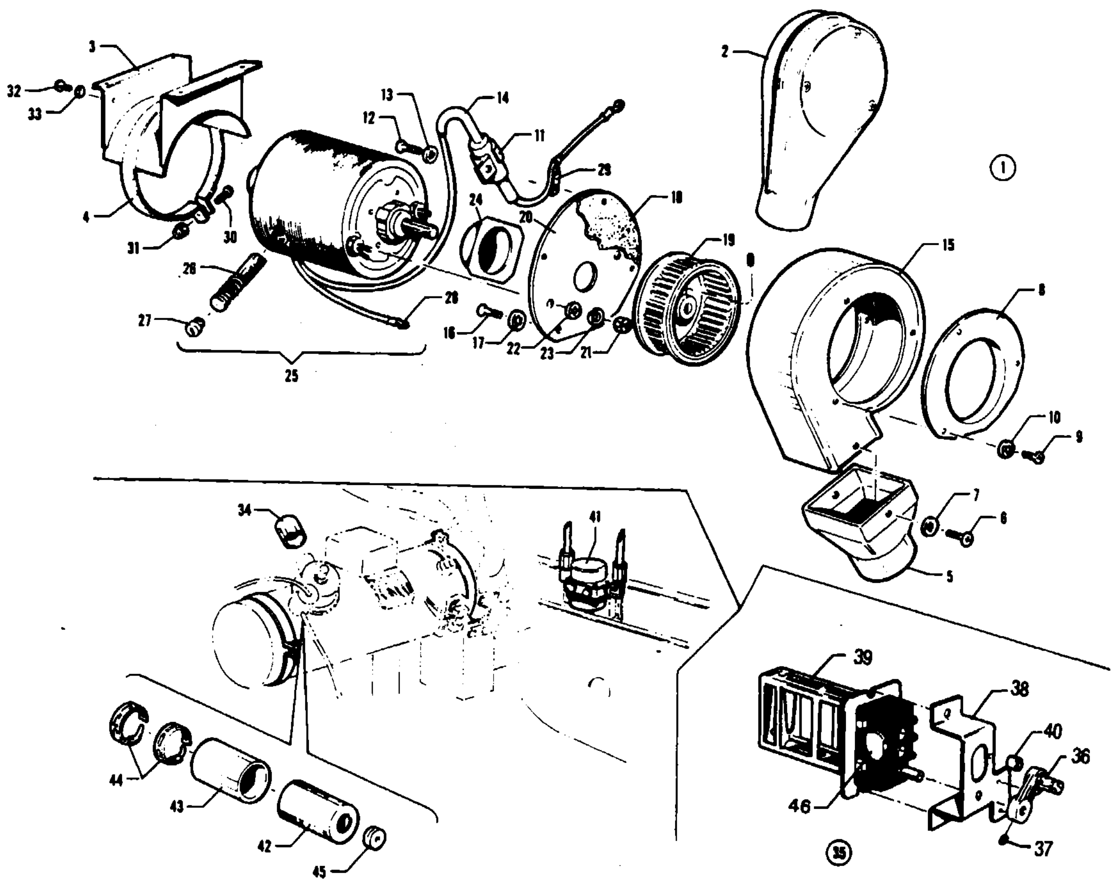
e. Attach the inlet flange (8) and blower inlet adapter (2) to blower housing (15) with three screws (9) and lockwashers (10).

f. Loosen the Allen set screw in the blower fan (19) and shift the fan on the motor shaft until it is near the inlet in the blower housing. Tighten the set screw securely. The blower fan should just clear the inlet flange when rotated at full RPM. Spin the blower fan by hand for clearance check; then apply proper voltage to run motor and recheck for proper clearance.

g. Slide the blower outlet adapter (5) on the blower housing outlet (15) and install the two screws (6) and lockwashers (7).

13-129. TEST PROCEDURE.

13-130. GENERAL INFORMATION. A test of all components should have been made after overhaul to insure proper operation. Some shops may not have complete testing facilities for measuring air flows, pressure drops and other factors which would be accomplished in a laboratory-type test. If such a test cannot be made, install the heater and check operation on the ground and in the air to determine if operation is normal. In shops where complete test equipment is available and a complete functional test can be performed, the test routine described in subsequent paragraphs should be made.



1. COMBUSTION AIR BLOWER AND MOTOR ASSEMBLY
2. ADAPTER ASSEMBLY - BLOWER INLET
3. BRACKET - MOTOR SUPPORT
4. CLAMP - MOTOR MOUNTING
5. ADAPTER - OUTLET
6. SCREW
7. WASHER - AN936A6
8. PLATE - BLOWER HOUSING
9. SCREW
10. WASHER - AN936A6
11. CAPACITOR
12. SCREW
13. WASHER - AN936A6
14. SLEEVE - HIGH TEMPERATURE
15. HOUSING - BLOWER
16. SCREW
17. WASHER - AN936A6
18. GASKET - BACK PLATE
19. FAN - COMBUSTION AIR BLOWER
20. PLATE - BACK
21. NUT - AN345-10
22. WASHER - AN960-10L
23. WASHER - AN936-B10
24. SPACER
25. MOTOR ASSEMBLY - COMBUSTION AIR BLOWER
26. BRUSH ASSEMBLY
27. CAP - BRUSH ASSEMBLY
28. TERMINAL - PREINSULATED
29. STRAP - CABLE
30. SCREW - AN520-10R10
31. NUT - MS20364-1032A
32. SCREW
33. WASHER - AN936-A8
34. TUBE - HOUSING OUTLET
35. SWITCH ASSEMBLY - ADJUSTABLE DUCT
36. LEVER ASSEMBLY - SWITCH
37. SCREW - AN565D8H3
38. COVER - SWITCH
39. SWITCH - ADJUSTABLE DUCT
40. SPACER
41. FUEL REGULATOR AND SHUTOFF VALVE
42. SHROUD - FUEL FITTING
43. HOSE - FUEL FITTING SHROUD
44. CLAMP - HOSE
45. GROMMET - AN931-2-9
46. CAPACITOR - .02M - 1KV

Figure 13-32. Exploded View - Combustion Air Blower
and Motor Assembly No. 753 443 (14-volt), 758 120 (28-volt)

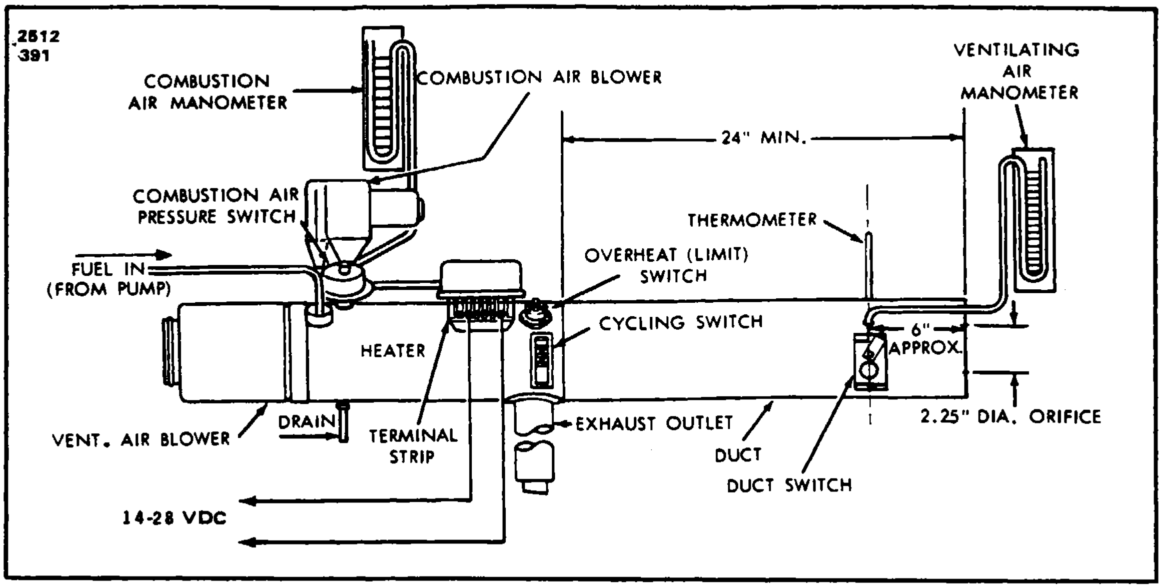


Figure 13-33. Suggested Set-Up for Heater Operation Test

13-131. EQUIPMENT REQUIRED. (Refer to Figure 13-33.)

a. An improvised stand to hold the heater during test. The heater should be located far enough away from any combustible material or atmosphere to avoid hazard. A location should be chosen where exhaust can be dispelled. Do not add an excessive extension to the heater exhaust.

b. A source of fuel capable of being regulated at seven psi.

c. The combustion air blower to be used with the heater should be used for the test.

d. A 14-28-volt DC power supply. A rheostat connected in series with the supply to adjust the voltage and current. An ammeter connected in series with the supply to monitor the current. A voltmeter connected in parallel with the supply to monitor the voltage.

e. Two water manometers (zero to 5.0-inch water column) for measuring the pressure in the ventilating air duct and in the combustion air stream.

f. A piece of duct to be attached to the downstream end of the heater. It should have a minimum length of 24-inches and the same diameter as the heater being tested. A 2.25-inch diameter orifice should be centrally located at the outlet end. An aperature should be provided for the thermometer and duct switch and a static tap should be attached as shown in Figure 13-33.

g. A thermometer with 500° F scale.

h. A fuel-pressure gauge.

i. A controlled source of compressed air for final leakage test.

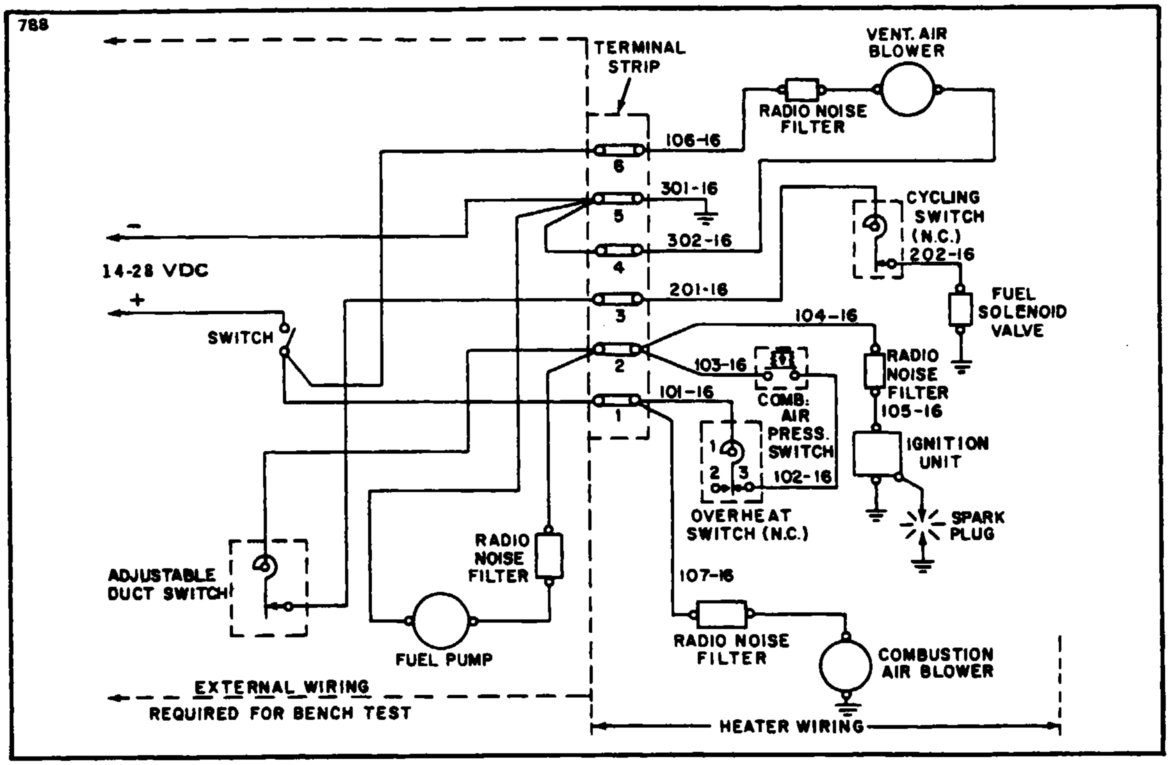


Figure 13-34. Wiring Connections for Heater Operation Test

13-132. OPERATIONAL TEST. (Refer to Figures 13-33 and 13-34.)

a. Connect the heater to the test set-up as shown in Figure 13-33. Make sure the combustion air blower is mounted securely and that the heater is clamped to its supporting stand.

b. Insert the duct switch in the sheet metal extension tube at the location shown in Figure 13-33.

c. Connect components and heater as outlined in the wiring connection diagram, Figure 13-34. The power supply switch should be open.

d. Connect the power source to the heater.

e. Disconnect wire lead from terminal "3" on the heater side of the heater terminal strip to prevent the heater from lighting and close the power source switch to check operation of blowers. The combustion air blower and ventilating air blower should operate at full speed with no blower wheel interference. If either blower fails to run, locate and correct the trouble before proceeding with the test.

f. Connect a voltmeter from open side of combustion air pressure switch terminal to ground to determine if the switch is closed, which would be indicated by a full voltage reading on the meter. If a full voltage reading is not obtained, the combustion air supply is either inadequate or the switch is defective or improperly adjusted. Make necessary corrections.

g. Observe the manometer connected to the ventilating air pressure tap, which should show a reading of 1.1 inches of water (minimum) at rated voltage.

h. Observe the manometer connected to the combustion air tube tap, which should show a reading of 1.5 inches of water (minimum) at rated voltage.

i. Open the power supply switch and reconnect the terminal lead disconnected in preceding step e.

j. Close the power supply switch and turn on the fuel supply. The heater should light within five seconds (may require slightly longer for air to be purged from fuel lines on the first trial).

k. Observe operation of duct switch which should control heater operation according to the switch setting.

l. If the duct switch fails to control the temperature according to the setting, place the control lever in high "H" position and notice the control variation. A high reading of 250° F ± 10° should be obtained (reading will vary in different applications).

m. Connect a jumper across the terminals of the duct switch to make it inoperative and observe action of the cycling switch. The cycling switch should cycle to control the outlet air temperature at approximately 250° F (nominal). This is a function of ambient temperature and air flow conditions. If operation is within a range of 190° F to 290° F, the switch is operating normally. If the switch is out of range it can be reset in the same manner as described for the duct switch, except that no control lever or indicator stop are used. If adjustment fails to restore proper temperature range, replace the switch.

n. With duct switch still jumped, place a jumper across the cycling switch terminals to check operation of the overheat switch. Block the ventilating air outlet and notice if the overheat switch shuts off the heater. It should open at between 300° F and 400° F. (This is also a function of ambient temperature and air flow.) After the switch shuts off, remove ventilating air restriction; remove jumpers from cycling and duct switches and press firmly on the overheat switch reset button until it "clicks." The heater should light and operate.

o. Shut down the heater and check all components visually to make sure no damage has occurred to any of them.

p. Remove heater and other components from the test set-up and install it in the airplane.

13-133. REPLACEMENT OF FUEL FILTER ELEMENT.

The fuel filter element located on the aft bulkhead in the fuselage nose section may be replaced by the following procedures:

a. Remove the access panel from the right side of the nose section.

b. Cut the safety wire on the bottom of the filter.

c. Remove the bowl and filter by unscrewing the round nut at the bottom of the bowl.

d. Clean the bowl and filter with a dry cleaning solvent. Replace the filter element and gasket as necessary.

e. Position the bowl and filter; tighten the round nut and safety with MS20995C32 safety wire.

f. Operate the system and check for fuel leaks.

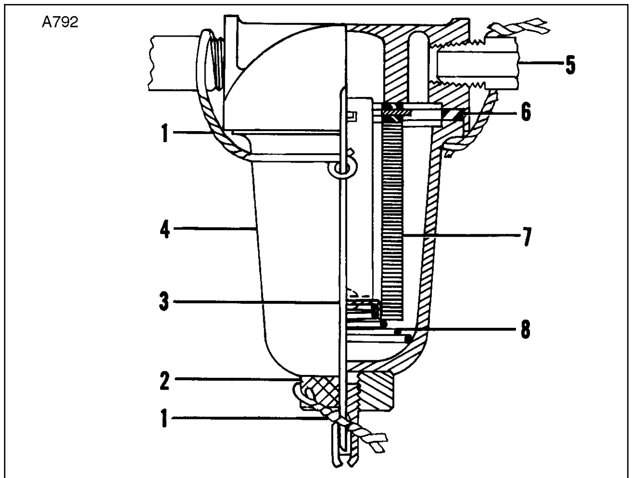


Figure 13-35. Heater Fuel Filter

13-134. REMOVAL OF HEATER FUEL VALVE. (S/N's 27-1 thru 27-7405431.)

The fuel control valve for the heater operation is located in the fuel control box between the two front seats, and may be removed by the following procedure:

a. Remove the two front seats from the airplane.

b. Remove the attaching screws from around the top and sides of the fuel control box.

NOTE: If the valve assembly is being removed due to leakage around the valve stem, refer to paragraph 13-135 for corrective action.

c. Lean the box forward and disconnect the outlet fuel line from the valve in the right side of the box.

d. Disconnect the knob and rod from the top of the valve by removing the self-locking nuts and machine screws.

e. Remove the valve by unscrewing it from the attaching fitting.

13-135. INSPECTION OF HEATER FUEL VALVE. (S/N's 27-1 thru 27-7405431.) (Refer to Figure 13-36.)

a. Remove the elbow fitting from the valve assembly.

b. The stem assembly (2) may be removed by cutting the safety wire (1) and unscrewing the cap nut (6) with stem handle (3).

c. Inspect the stem, seat body and threads for possible damage.

d. If any part of the stem assembly is damaged or if the cap nut (6) is not drilled for safetying purposes, replace the complete valve assembly.

e. Reassemble the unit and tighten the cap nut (6) tight enough to prevent leakage but not to hamper turning the stem handle (3).

f. Safety the cap nut (6) with safety wire (1) MS20995C32. (Refer to Figure 13-36.)

NOTE: If leakage is still evident around the valve stem, replace the complete valve assembly. (Refer to Parts Catalog P/N 753-522.)

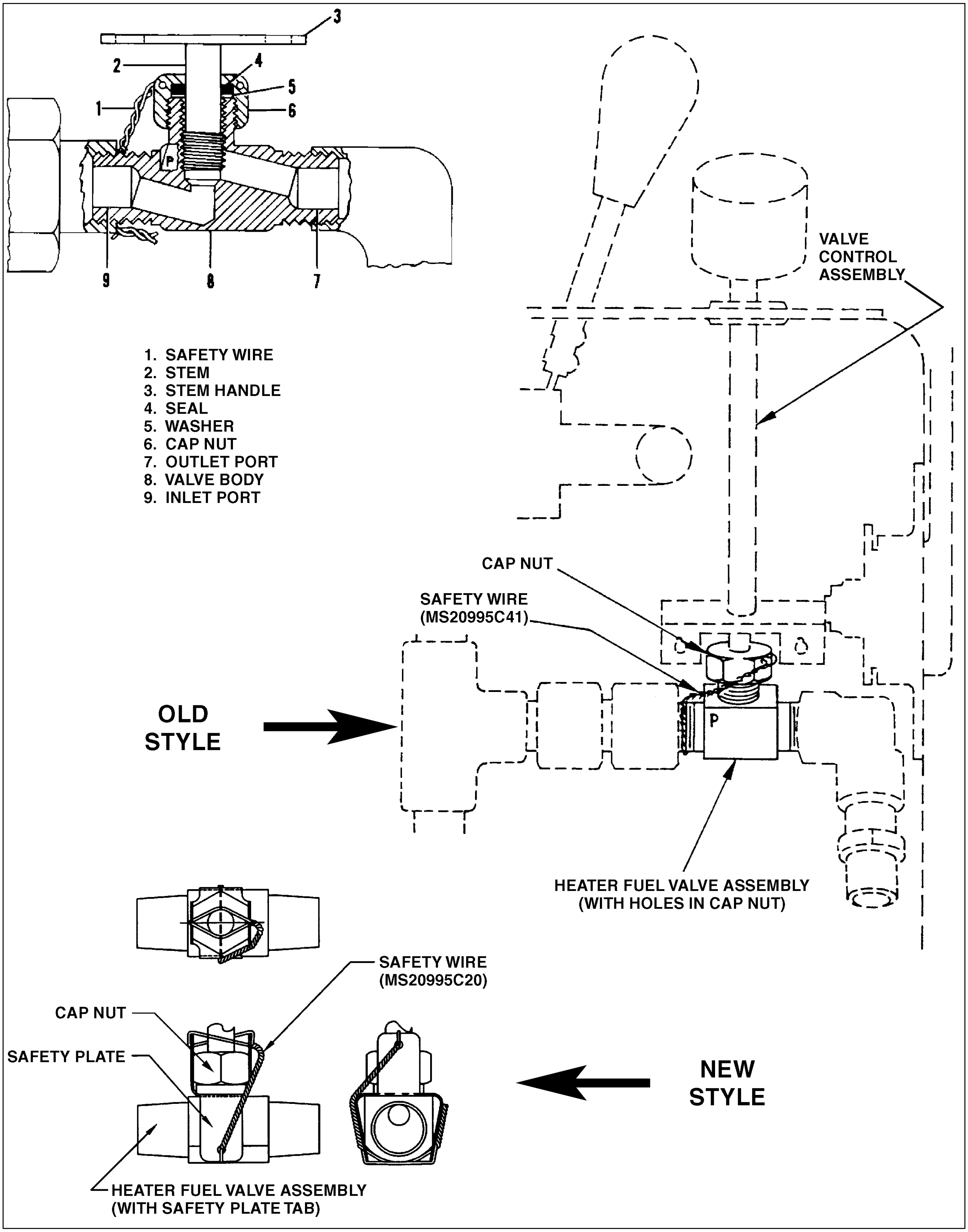


Figure 13-36. Heater Fuel Valve S/N's 27-1 thru 27-7405431

13-136. INSTALLATION OF HEATER FUEL VALVE. (S/N's 27-1 thru 27-7405431.)

a. Install the pressure side of the valve to the crossfeed drain line. The pressure side is marked with a "P" stamped on the valve body. On early valves that are not stamped the pressure side can be determined by looking into the body ends, with the valve closed; the end where no part of the stem or seat is visible is the pressure side.

b. Connect the knob and rod to the stem handle of the valve with machine screws and self-locking nuts.

c. Connect the fuel line fitting on the right side of the box to the valve.

d. Operate the left electric fuel pump and check for leakage around the valve stem and connections of the valve body. To determine that the valve seat does not leak when the valve is closed, remove the fuel filter bowl, turn on the electric fuel pump and note if fuel flows from the filter housing inlet port.

e. Position the fuel control box and secure to the spar covering with attaching screws.

f. Install the front seats.

13-137. JANITROL HEATER. PA-23-250E, (S/N's 27-7554041 and up.)

This section contains information for operation, service and overhaul of the combustion heater, P/N 755-257 and combustion air blower, P/N 758-304 (used with the heater).

13-138. TROUBLESHOOTING.

The service troubles and suggested remedies listed in Table XIII-II are provided to assist in locating and correcting malfunctions in the heating system. The following procedure is based upon the use of optional components.

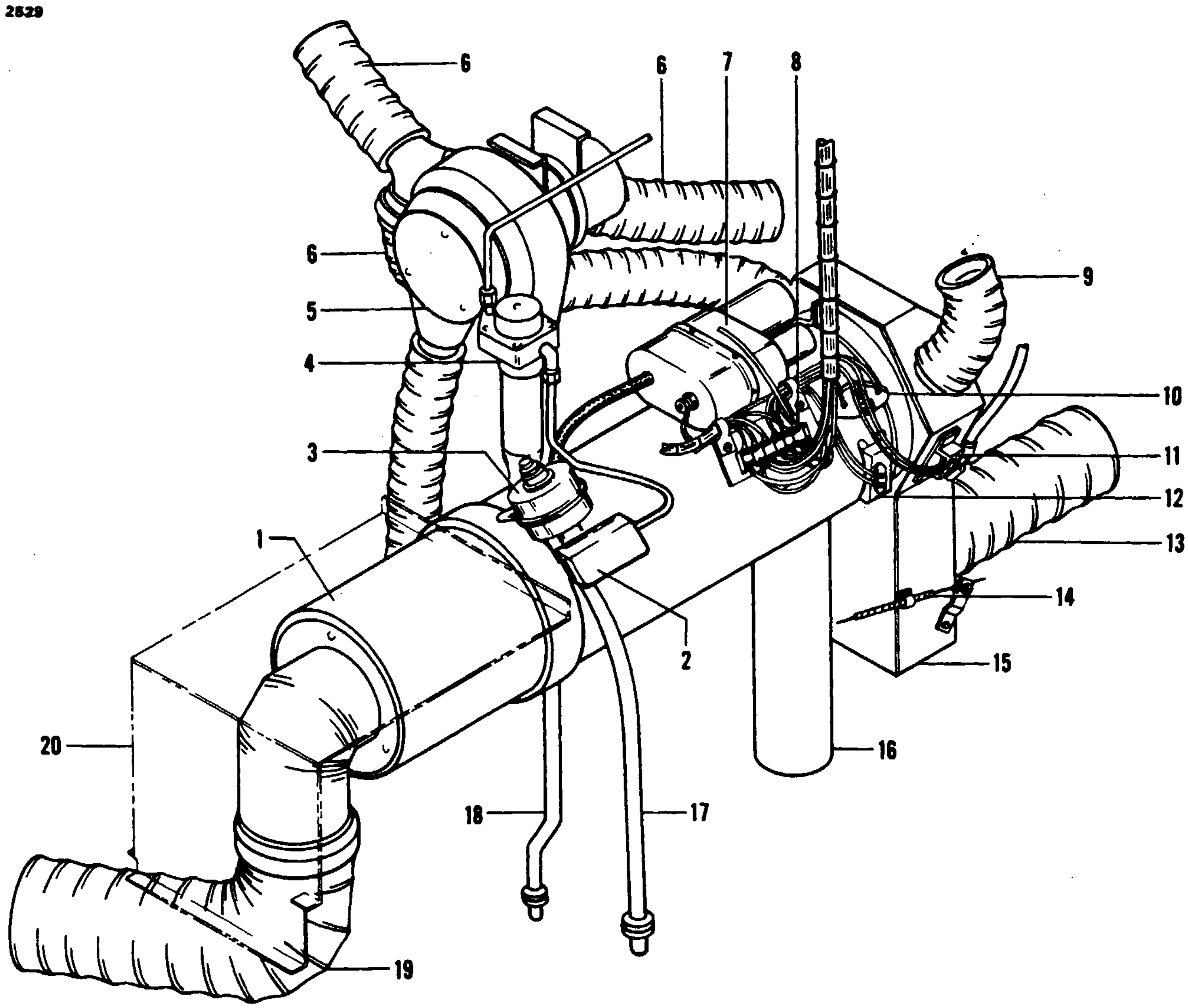
13-139. HEATER OPERATION.

The 35,000 BTU Janitrol heater is controlled by a three position switch located on the right side of the instrument panel, labeled FAN, OFF and HEAT. The FAN position will operate the vent blower only and may be used for cabin ventilation on the ground or windshield defogging when heat is not desired. For heat, the three position switch must be turned to HEAT. This will start fuel flow and ignite the burner simultaneously.

The heater uses gasoline from either left fuel tank when the fuel crossfeed is off and from all tanks when the crossfeed is on.

The push-pull knobs at the bottom of the control pedestal control airflow and temperature. The left control regulates air flowing to the front seat through the heater system and the second knob from the left controls air flowing to the rear seat. The middle knob is connected to an adjustable thermostat which makes it possible to select a desired temperature of heated air. The second knob from the right is the defroster control and the right knob controls the supply of cold air through the vent on the forward bulkhead.

For the overhaul and complete disassembly of the Janitrol heater and its components, refer to paragraph 13-167 of this manual. A wiring diagram of the Heater Electrical System Installation will be found in Section XI of this manual.



1. VENTILATING AIR BLOWER
2. FUEL SHROUD
3. PRESSURE SWITCH
4. FUEL REGULATOR
5. COMBUSTION AIR BLOWER
6. HOSE, CABIN HEAT
7. IGNITION ASSEMBLY
8. TERMINAL STRIP
9. HOSE DEFROSTER
10. LIMIT SWITCH
11. HEAT REGULATOR
12. CYCLING SWITCH
13. HOSE, CABIN HEAT, REAR
14. CONTROL CABLE, CABIN HEAT, REAR
15. AIR DISTRIBUTION BOX
16. EXHAUST TUBE
17. FUEL LINE DRAIN
18. DRAIN HEATER
19. HOSE, HEATER AIR INTAKE
20. HEATER COVER BOX ASSEMBLY

Figure 13-37. Heater Assembly and Combustion Air Blower

TABLE XIII-III. TROUBLESHOOTING CHART (JANITROL HEATER) (28-VOLT)

Trouble	Cause	Remedy
Heater fails to light.	Heater switch or circuit breaker off.	Turn on heater switch or close circuit breaker.
	Low voltage supply.	Apply external power supply. Attempt to start heater. (Refer to paragraph 13-147.)
	Fuel cut off from fuel cell.	Turn on manual shutoff valve or master solenoid.
	Regulator not operating properly.	Check for low pressure or replace regulator. (Refer to paragraph 13-165.)
	Restriction in fuel nozzle orifice.	Remove the nozzle and clean or replace it. (Refer to paragraphs 13-168, 13-172 and 13-175.)
	Fuel heater solenoid not operating.	Remove and check solenoid. Replace if faulty. (Refer to paragraphs 13-168, 13-172, k and 13-175, a.)
	Fuel lines clogged or broken.	Inspect all lines and connections. It may be necessary to disconnect lines at various points to determine where the restriction is located.

TABLE XIII-III. TROUBLESHOOTING CHART (JANITROL HEATER) (28-VOLT) (cont.)

Trouble	Cause	Remedy
Heater fails to light. (cont.)	Ignition vibrator inop- operative.	Replace vibrator. Check for defective radio noise filter. (Refer to paragraph 13-161.)
	Manual reset limit (overheat) switch open.	Press reset button firmly and recheck to determine reason for switch opening.
	Combustion air pressure switch open. (Defective switch or low combustion air blower output.)	Check for low blower output due to low voltage and correct it. If switch is defective, replace it. (Refer to paragraph 13-164.)
	Cycling switch open.	Replace if defective. (Refer to paragraph 13-163.)
	Duct switch open.	Operate control to see if switch will come on. Replace switch if defective. (Refer to paragraph 13-166.)
Ventilating air blower fails to run.	HEATER switch OFF. Broken or loose wiring to motor.	Energize the HEATER switch. Check and repair wiring.
	Circuit breaker open.	Close circuit breaker.
	Worn motor brushes.	Replace motor brushes. (Refer to paragraph 13-159.)

TABLE XIII-III. TROUBLESHOOTING CHART (JANITROL HEATER) (28-VOLT) (cont.)

Trouble	Cause	Remedy
Ventilating air blower fails to run. (cont.)	Blower wheel jammed.	Remove and check the ventilating air blower wheel and realign if necessary. (Refer to paragraph 13-175.)
	Motor burned out.	Remove blower assembly and replace motor. (Refer to paragraphs 13-168 and 175.)
	Defective radio-noise filter.	Replace filter.
Combustion air blower fails to run.	Faulty wiring to motor.	Inspect and replace faulty wiring.
	Poor ground connection.	Tighten ground screw.
	Worn motor brushes.	Replace motor brushes. (Refer to paragraph 13-159.)
	Blower wheel jammed. (Usually indicated by hot motor housing.)	Overhaul the combustion air blower. (Refer to paragraphs 13-169 and 13-176.)
	Faulty or burned-out motor.	Remove combustion air motor for overhaul or replacement of motor. (Refer to paragraphs 13-158, 13-168 and 13-176.)

TABLE XIII-III. TROUBLESHOOTING CHART (JANITROL HEATER) (28-VOLT) (cont.)

Trouble	Cause	Remedy
Heater fires but burns unsteadily.	Insufficient fuel supply.	Inspect fuel supply to heater including shut-off valve, solenoid valve and fuel lines. Make necessary repairs.
	Spark plug partially fouled.	Replace spark plug. (Refer to paragraph 13-160.)
	Loose primary connection at ignition assembly.	Tighten the connection.
	Faulty vibrator.	Replace the vibrator. (Refer to paragraph 13-161.)
	Combustion air blower speed fluctuates. (Can be caused by low voltage, loose blower wheel, worn brushes or motor.	Remove and overhaul the combustion air blower assembly as required or correct low voltage condition. (Refer to paragraphs 13-159, 13-169, 13-173 and 13-176.)
	High voltage leak in lead between ignition assembly and spark plug.	Replace ignition assembly. (Refer to paragraph 13-162.)
	Inoperative ignition assembly.	If vibrator is in good condition, replace ignition assembly only. (Refer to paragraph 13-162.)

TABLE XIII-III. TROUBLESHOOTING CHART (JANITROL HEATER) (28-VOLT) (cont.)

Trouble	Cause	Remedy
Heater fires but burns unsteadily. (cont.)	Restriction in fuel nozzle orifice.	Remove nozzle for cleaning or replacement. (Refer to paragraphs 13-168, 13-172 and 13-173.)
	Nozzle loose in retainer or improper spray angle.	Tighten or replace the nozzle as required. (Refer to paragraphs 13-171 and 13-172, k.)
Heater starts then goes out.	Lack of fuel at heater.	Check fuel supply through all components from the cell to the heater. Make necessary corrections.
	Inoperative or chattering combustion air pressure switch.	Check, adjust, or replace switch. (Refer to paragraph 13-164.)
	Inoperative overheat switch.	Check or replace switch. (Refer to paragraphs 13-163 and 13-180.)
	Inoperative cycling switch.	Adjust or replace the switch. (Refer to paragraphs 13-163 and 13-180.)
	Low voltage.	Attach external power.

TABLE XIII-III. TROUBLESHOOTING CHART (JANITROL HEATER) (28-VOLT) (cont.)

Trouble	Cause	Remedy
Heater fails to shut off.	Fuel solenoid valve in heater stuck open.	Remove and replace solenoid assembly. (Refer to paragraphs 13-168, 13-170 and 13-173.)
	Inoperative duct and cycling switch.	Check and repair. (Refer to paragraphs 13-163 and 13-166.)
	Defective HEATER switch.	Replace the HEATER switch.

13-140. DESCRIPTION OF HEATER AND BASIC COMPONENTS.

13-141. SPARK-SPRAY IGNITION. (Refer to Figure 13-37.) The controlled atomized spray from a specially designed spray nozzle, coupled with high voltage spark plug ignition, insures instant firing and continuous burning under all flight conditions.

Heat is produced by burning a fuel-air mixture in the combustion chamber of the heater. Aviation gasoline is injected into the combustion chamber through the spray nozzle. The resulting cone-shaped fuel spray mixes with combustion air and is ignited by a spark from the spark plug. Voltage for ignition is supplied by an ignition unit which steps up the 28-volts to a high, oscillating voltage to provide a continuous spark across the spark plug gap. A shielded, high voltage lead connects the ignition assembly to the spark plug. Combustion air enters the combustion chamber tangent to its surface and imparts a whirling or spinning action to the air. This produces a whirling flame that is stable and sustains combustion under the most adverse conditions because it is whirled around itself many times. Therefore, ignition is continuous and the combustion process is self-piloting. The burning gases travel the length of the combustion tube, flow around the outside of the inner tube, pass through crossover passages into an outer radiating area, then travel the length of this surface and out the exhaust.

Ventilating air passes through the heater between the jacket and combustion tube assembly outer surface and through an inner passage in the assembly. Consequently, ventilating air comes into contact with two or more heated, cylindrical surfaces.

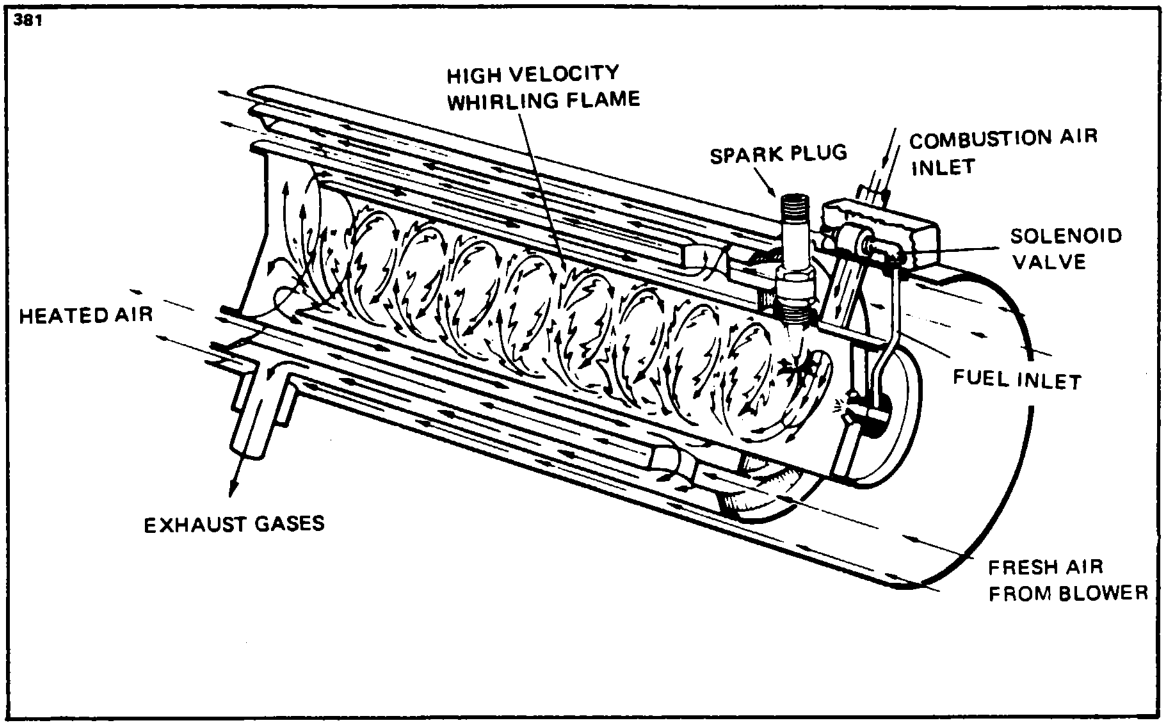


Figure 13-38. Diagramatic Cutaway of Heater to Show Whirling Flame Action

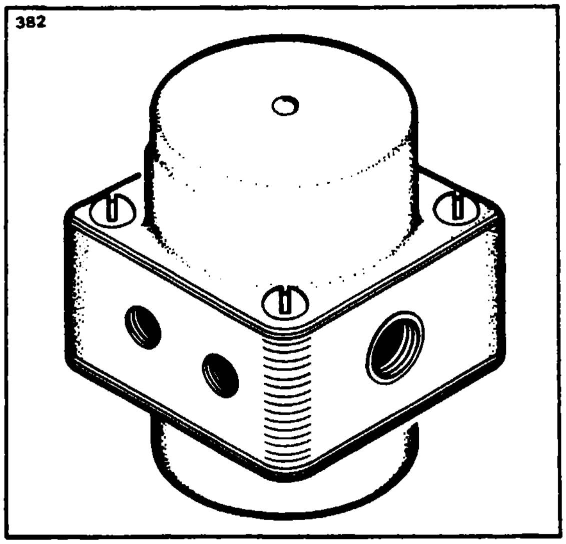


Figure 13-39. Fuel Regulator and Shutoff Valve

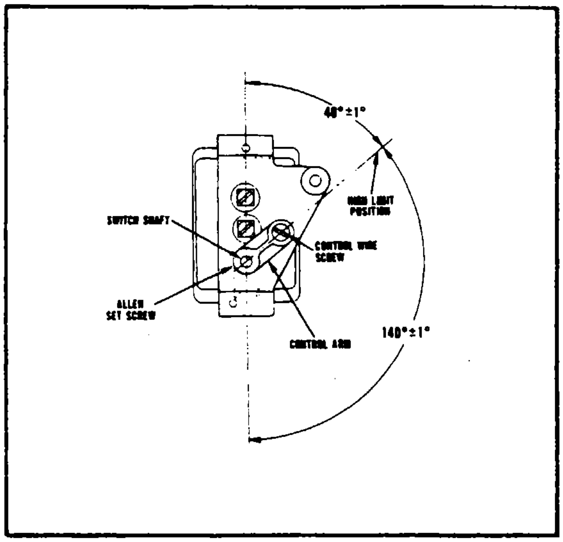


Figure 13-40. Top View - Duct Switch (Typical Control Lever Positions)

13-142. FUEL REGULATOR AND SHUTOFF VALVE. (Refer to Figure 13-39.) This unit provides preset, regulated fuel pressure as well as remote shutoff to the heater, regardless of fuel inlet pressure variations. It is adjustable to 7.5 ± .5 psi with inlet pressures up to 50 psi. The shutoff valve is operated by a solenoid.

13-143. DUCT SWITCH. (Refer to Figure 13-40.) This switch is installed in the ventilating air duct downstream from the heater to sense the ventilating air outlet temperature. To select the desired cabin temperature, the switch may be adjusted manually from a high of 250° F ± 10° downward through a range of 146° F ± 6°. The switch has a differential of 10° F ± 5° at any given setting.

13-144. COMBUSTION AIR BLOWER. This centrifugal-type blower supplies combustion air to the combustion chamber of the heater. Performance of the combustion air blower is assisted by the use of ram air during flight.

13-145. VENTILATING AIR BLOWER. This blower is attached to the inlet end of the heater assembly and provides a source of ventilating air through the heater. Ram air from the ventilating air intake scoop is used during flight.

13-146. OPERATING CONTROLS.

NOTE

The schematic diagram (refer to Figure 13-41) shows the heater circuit, including the electrical wiring in the airplane.

a. The HEATER SWITCH is connected in the line that supplies electrical power to all heater equipment and controls. When this switch is in the OFF position, the entire heater system is inoperative. This switch has a FAN position which permits use of the ventilating air blower to circulate cool air through the system for summer ground operation. With the switch in FAN position, the heater is inoperative and only the ventilating air blower is energized.

b. The HEATER SWITCH is a normally open switch that supplies power to (lock in) the safety relay through which power is supplied to the ignition and fuel circuits of the heater.

13-147. OPERATING PROCEDURE.

a. Place the HEATER SWITCH in the ON (or HEAT) position. The ventilating air and combustion air blowers should operate.

b. The heater will ignite and continue to operate.

c. The DUCT SWITCH can be set to regulate the cabin temperature for desired comfort level. If this switch is set for ground operating comfort, it may be necessary to reposition it after being airborne, since ram air will increase the ventilating airflow and the heater output.

d. To stop heater operation, turn off the HEATER SWITCH.

e. It is desirable to operate the fan several minutes by placing HEATER SWITCH in FAN position to cool the heater after operation. To stop fan operation, turn OFF the HEATER SWITCH.

13-148. INSPECTION OF HEATER AND HEATER COMPONENTS.

13-149. PREFLIGHT AND/OR DAILY INSPECTION.

a. Inspect the ventilating air inlet scoop, combustion air inlet scoop, exhaust outlet and fuel drain for possible obstructions. Make sure that all of these openings are clear of any restrictions and that no damage has occurred to air scoop protrusions.

b. Perform an operational check as follows:

1. Place the HEATER SWITCH in the ON (or HEAT) position. The ventilating air blower and combustion air blower should operate.

NOTE

To proceed with the operational check, follow paragraph 13-147 entitled Operating Procedure, steps a through e. The above procedure should be repeated one or more times.

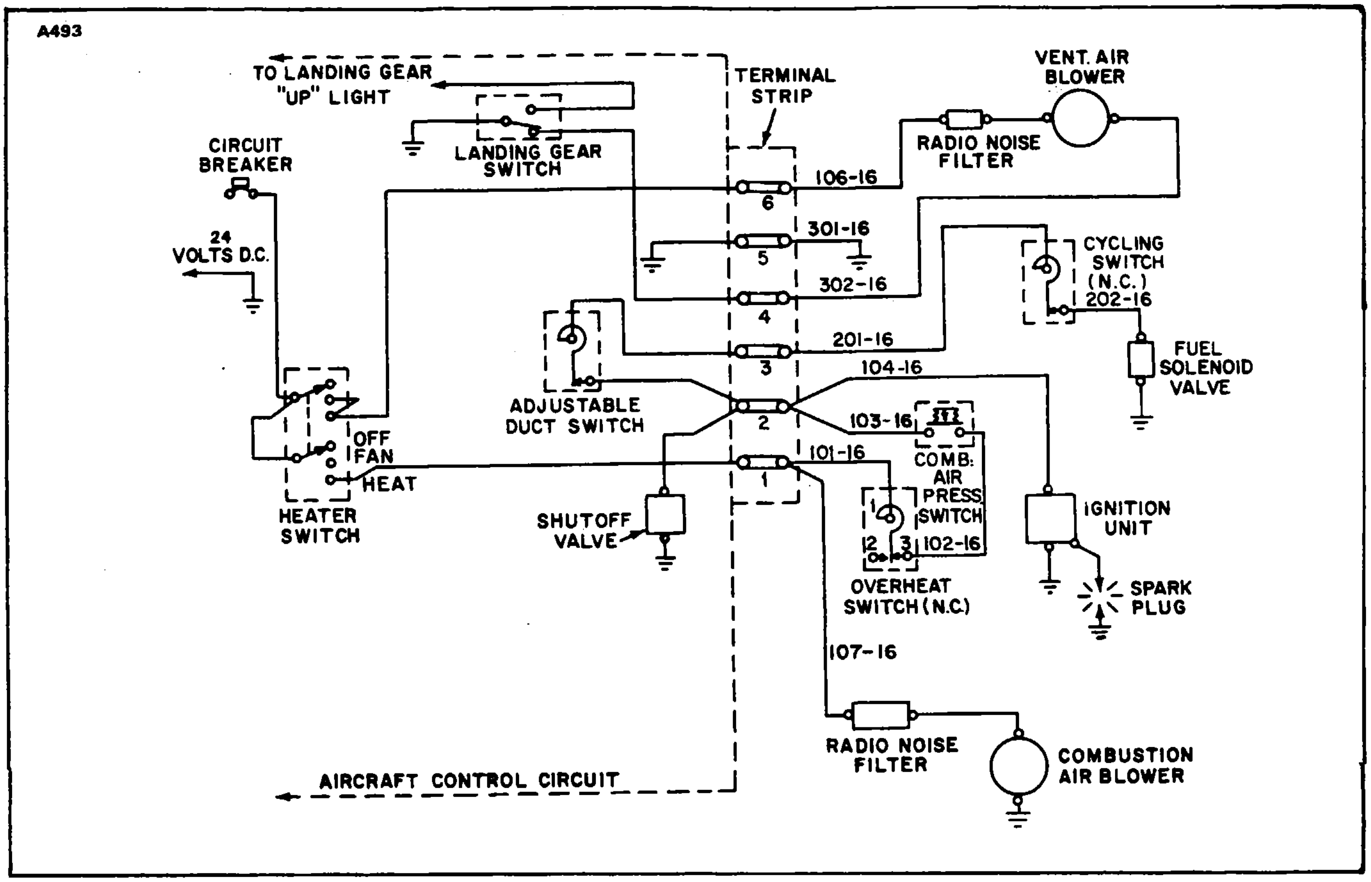


Figure 13-41. Wiring Diagram

13-150. 100-HOUR INSPECTION. The mandatory 100-Hour Inspection shall be conducted on new heaters or overhauled heaters with a new combustion tube assembly upon accumulation of 500-heater operating hours or twenty-four months, which-ever occurs first, and thereafter at intervals not to exceed 100-heater operating hours or twenty-four months, whichever occurs first. If an hour-meter is used on the heater assembly, it should be connected across terminals number 2 and 5 on the heater terminal strip. If an hourmeter is not used, count one heater operating hour for each two flight hours for normal aircraft operation. Consideration should be given for any excessive ground operation of the heating system.

NOTE

The 100 Hour Inspection consists of the functional checks and inspections listed below and the Pressure Decay Test.

a. Inspect ventilating air and combustion air inlets and exhaust outlet for restrictions and security at the airplane skin line.

b. Inspect the drain line to make sure it is free of obstructions. Run a wire through it if necessary to clear an obstruction.

c. Check all fuel lines for security at joints and shrouds, making sure that no evidence of leaks exi[st]. Also check for security of attachment of fuel lines at the various attaching points in the airplane. Check fuel pressure to ensure 7 psi.

d. Inspect electrical wiring at the heater terminal block and components for loose connections, possible chafing of insulation, and security of attachment points.

e. Inspect the high-voltage cable connection at the spark plug to make sure it is tight. Also, examine the cable sheath for any possible indications of arcing, which would be evidenced by burning or discoloration of the sheath.

f. Inspect the combustion air blower assembly for security of mounting and security of connecting tubing and wiring. Tighten any loose electrical terminals and air tube connections.

g. Operate both the combustion and ventilating air blowers and check for unusual noise or vibrations.

h. It is recommended that the condition of the spark plug be checked for operation as described in paragraph titled "Spark Plug".

i. Evaluate the condition of the combustion chamber by performing a "Pressure Decay Test" as described in Janitrol Maintenance and Overhaul Manual P/N 24E25-1 dated October 1981.

j. Following the 100 hour inspection, perform the "Preflight and/or Daily Inspection".

13-151. MAINTENANCE SERVICE. Instructions contained in this section consists of periodic inspection, adjustments, and minor corrections required at normal designated intervals for the purpose of maintaining the heating system in peak operating condition. These inspections assume that a heating system includes accessory components mentioned in preceding paragraphs.

13-152. REMOVAL OF JANITROL HEATER.

a. Turn the heater control switches off.

b. Remove the forward access panel located on the left side of the fuselage nose section.

c. Open the forward baggage door and remove the heater cover box located on the left rear side of [the] baggage compartment floor.

d. Remove the screws that attach the air intake elbow to the front of the heater.

e. Note the hookup of the electrical wires to facilitate reinstallation and disconnect wires from heater.

f. Disconnect the heater exhaust shroud from the heater jacket at the aft bottom side of the heater and slide it down enough to allow the exhaust tube to be disconnected. Remove both the shroud and tube.

g. Disconnect the drain from the forward bottom side of the heater.

h. Remove the shroud covering the fuel inlet line fitting located at the forward top side of the heater.

i. Disconnect the combustion air blower inlet tube and outlet adapter leading to the heater. Loosen the clamp that secures the air blower motor and roll the unit out of the way or remove it, as desired.

j. Loosen the two clamps that secure the heater to its mounting brackets.

k. Located under the aft clamp are four screws that attach the air distribution box to the heater. Remove these screws.

l. Separate the heater from the air distribution box and remove the heater from the airplane.

m. To remove the air distribution box, disconnect the air hoses located on each upper side of the box.

n. Disconnect the duct switch and cabin heat control cables.

o. Remove the two screws that attach the cabin heat hose to the lower aft end of the distribution box and remove box.

13-153. INSTALLATION OF JANITROL HEATER.

a. Position the air distribution box and attach the cabin heat hose to the lower aft end of the distribution box.

b. Place the heater in position on its mounting brackets and attach the air distribution box to the heater with four screws.

c. Connect and secure the exhaust tube to the exhaust of the heater.

d. Position and secure the exhaust tube shroud to the jacket of the heater.

e. Connect the drain tube to the bottom of the heater.

f. Tighten the two clamps that secure the heater to its mounting brackets.

g. Connect the heat control cable to the control arm located on the right side of the air distribution box. Adjust the cable so that when the door is completely closed, approximately one-sixteenth of an inch exists between the control knob and knob stop.

h. Connect the duct switch control cable to the switch on the left side of the air distribution box. Adjust the cable so that when the control knob is full in against its stop, the control arm aligns with the vertical line of the switch. (Do not loosen the Allen set screw that secures the arm to the switch shaft.) Pull the control knob out to ascertain that the control arm will have a $140^{\circ} \pm 1$ travel to high heat position. (Refer to Figure 13-40.)

i. Connect the cockpit heat and defroster air hoses to the air distribution box.

j. Place the combustion air blower in position, connect the outlet adapter to the heater and blower inlet tube. Secure blower in position.

k. Connect the fuel inlet line and secure the fitting shroud in position.

l. Connect the electrical wires to the heater.

m. Within the baggage compartment, attach the air intake elbow to the front of the heater.

n. Operate the heater long enough to determine that the unit is operating properly.

o. Install the access box in the baggage compartment and panel at the side of the fuselage.

HEATER TERMINAL BLOCK WIRING

Terminal No.	Wire Designation
1	H4A
2	H1E H2B
3	H1D
4	H9A
5	H8A H10A
6	H2A

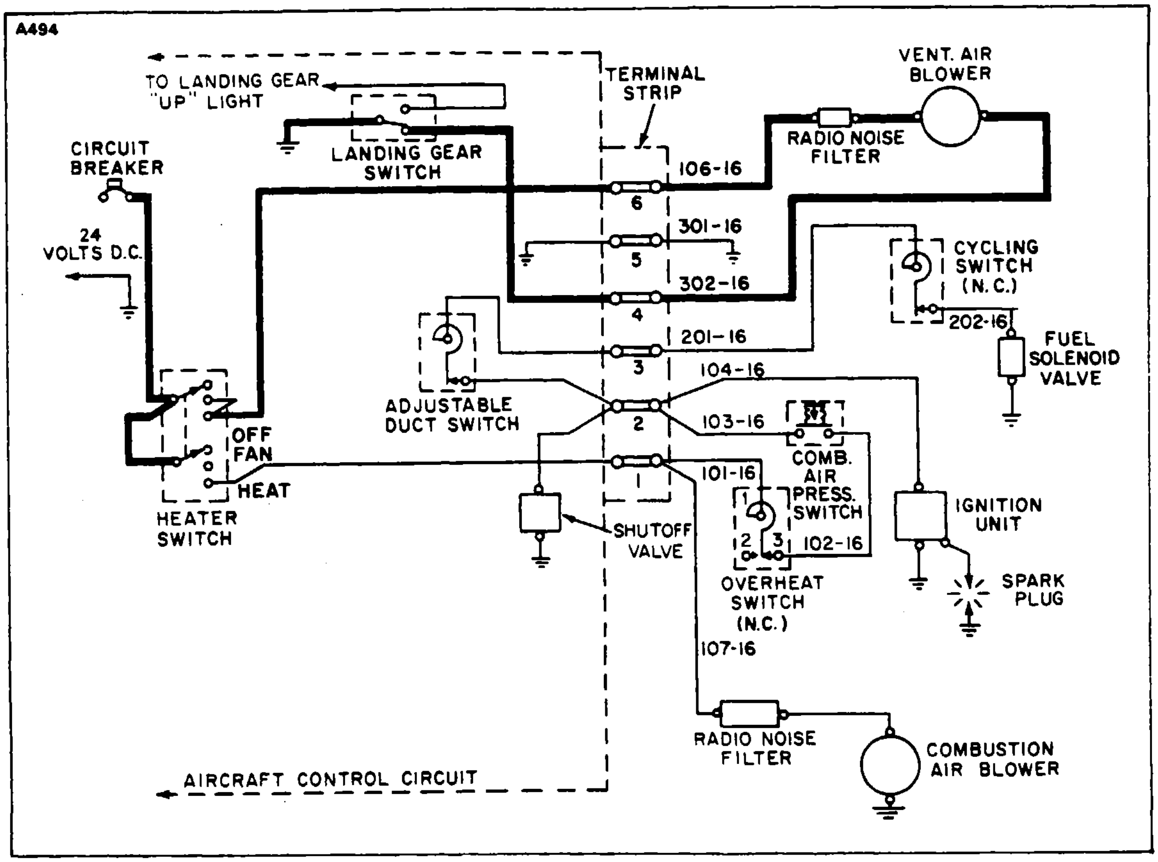


Figure 13-42. Primary Power Circuit

13-154. HEATER ELECTRICAL SYSTEM CHECKS.

13-155. ELECTRICAL CONTINUITY CHECK. These tests are listed as an aid in isolating open circuited or inoperative components.

NOTE

The schematic wiring diagram (Figures 13-41, 13-42 and 13-43 shows, in addition to the heater circuitry, a suggested aircraft control circuit. For the purposes of this manual, the circuitry shown in these illustrations will be utilized to describe electrical continuity checks.

It must be assumed that power, which is furnished through the heater circuit breaker, is present at the HEATER SWITCH at all times. Always check the circuit breaker before performing electrical continuity checks.

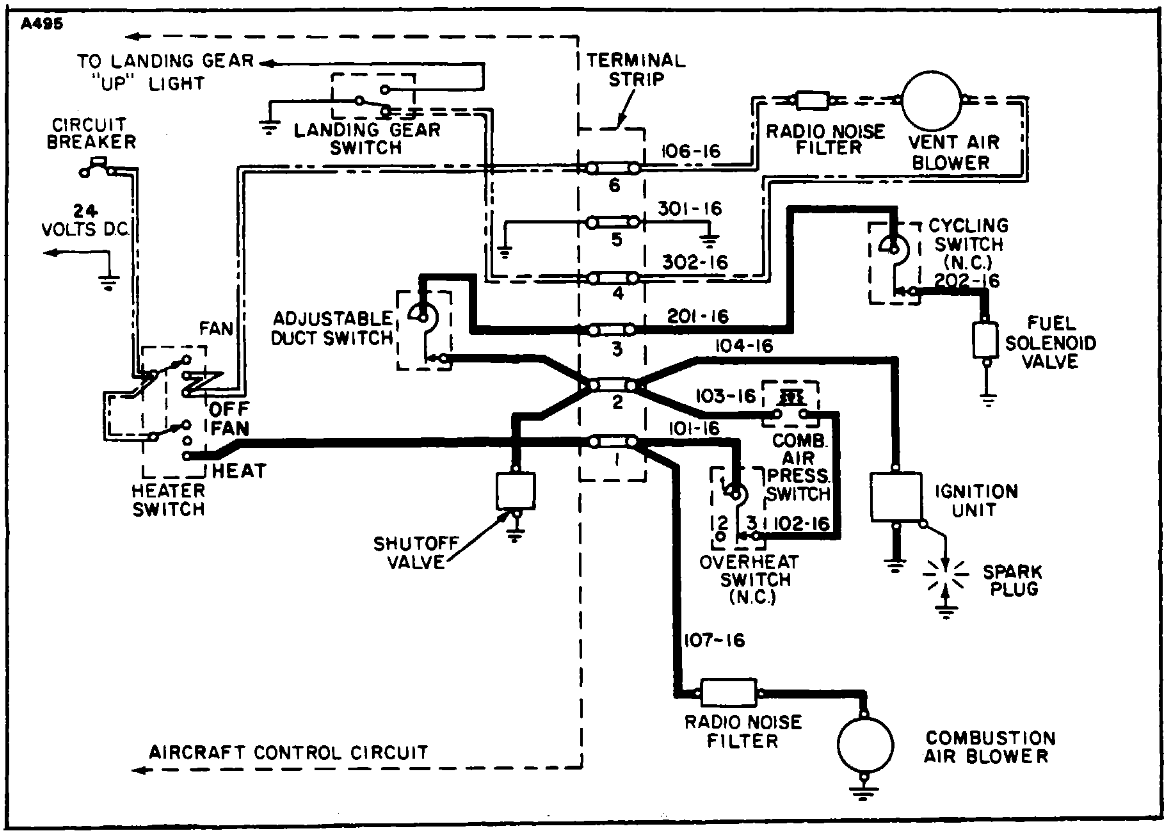


Figure 13-43. Starting Power Circuit

13-156. VENT BLOWER POWER CIRCUIT CHECK. (Refer to Figure 13-41.) With the HEATER SWITCH in the FAN position, electrical continuity (28-volts nominal) should be present at the following locations:

a. Terminal No. 6 on the heater terminal strip.

b. From terminal No. 6 of the heater terminal strip through the radio-noise filter to the ventilating air motor.

c. Electrical ground circuit for the ventilating air motor is provided from terminal No. 4 of the heater terminal strip through the LANDING GEAR SWITCH when the landing gear is down. Ventilating air motor is inoperative when the landing gear is up.

13-157. HEATER POWER CIRCUIT CHECK. (Refer to Figure 13-43.) With the HEATER SWITCH in the HEAT position, electrical continuity should be present at the following locations:

NOTE

Power for the ventilating air blower is the same as described above except that power is now supplied through the HEAT side of the HEATER SWITCH.

a. Terminal No. 1 of the heater terminal strip.

b. From terminal No. 1 of the heater terminal strip through the radio-noise filter to the combustion air motor and to terminal No. 1 of the overheat switch.

c. From terminal No. 3 of the overheat switch through the combustion air pressure switch to terminal No. 2 of the heater terminal strip.

d. From terminal No. 2 of the heater terminal strip to the ignition unit, to the shutoff valve, and through the adjustable duct switch to terminal No. 3 of the heater terminal strip.

e. From terminal No. 3 of the heater terminal strip through the cycling switch to the fuel solenoid valve.

In the event that electrical continuity is not present at one or more of the above listed points, the wiring must be traced back to the power source. If components are still inoperative after the wiring inspection, check the individual inoperative components for continuity and, if necessary, replace them.

13-158. MAINTENANCE AND REPAIRS. Instructions in this paragraph pertain to maintenance of the basic heater and components while the heater is installed in the airplane. Instructions for removal of components are included provided the installation permits accessibility.

NOTE

No special service tools are required for normal periodic maintenance.

13-159. COMBUSTION AIR BLOWER.

a. Removal:

1. Disconnect wire at quick-disconnect terminal.

2. Disconnect the inlet tubing from the inlet air adapter.

3. Loosen the clamps that hold the combustion air blower assembly in the support bracket and slide the motor out of the bracket.

b. Replacing Motor Brushes: (Refer to Figure 13-48.)

1. Remove the brush cap at one of the brush locations. Note position of brush inside the guide and carefully lift the brush and brush spring out of the guide. Be sure to hold the brush so that it can be reinstalled in precisely the same position if no brush replacement is required.

2. Inspect the brush for wear. A new brush is 17/32 inch long. If brushes are worn to a length of 3/16 inch, they must be replaced.

3. Looking through the brush guide, inspect the commutator, which should be smooth and medium brown to dark brown in color. Remove all dust from commutator with compressed air.

NOTE

Installation of new brushes in a motor that has a badly scored or dirty commutator will result in a very short brush life.

If the commutator is grooved in the brush track, gouged, scored or shows signs of having burned spots, replace the complete motor assembly. If the commutator is in good condition, install new motor brushes and tighten brush caps into place. Make sure each brush is oriented so that the curved end fits the curvature of the commutator.

4. After installing new brushes, it is advisable to run in the brushes as follows: Connect the motor to a controlled voltage supply (rheostat in a 28-volt line). Operate the motor at approximately one-half its normal speed for the first hour; then gradually increase the speed until it is rotating at approximately normal speed. Continue the run-in operation for at least two hours to properly seat the brushes before installing the blower in the airplane.

c. Installation:

1. Prior to installing the combustion air blower, inspect all parts of the assembly for loose screws, loose nuts and poor ground connection on the blower housing. Make sure the blower wheel is tight on the shaft and properly located in the housing. It should have just enough clearance to rotate at full speed without binding against the outer housing. Blower performance is based upon this close tolerance clearance. It is recommended that correct voltage be applied for this clearance check.

2. Install the blower inlet adapter in the same orientation as before removal.

3. Place the combustion air blower assembly in position in the attaching clamp so the air tubing can be connected and slide the tubing into position at the point where it was disconnected during removal. Tighten the motor in the attaching strap.

4. Secure the air tubing by tightening the clamp or installing the sheet metal attaching screws.

5. Connect the wire lead to No. 1 terminal on terminal strip.

6. Check motor operation. By disconnecting the wire at the No. 3 terminal on heater terminal strip, blower can be operated without fuel flow to the heater.

13-160. SPARK PLUG. (Refer to Figure 13-47.)

a. Removal:

1. Remove the necessary access panels to expose the spark plug area of the heater assembly.

NOTE

Insure that heater electrical circuits are de-energized.

2. Unscrew and remove the high voltage lead connector at the spark plug. Exercise care to avoid fouling or damaging the connector.

3. Remove the grommet, (39) of Figure 13-47 from the heater jacket opening.

4. Using a 7/8 inch deep hex socket, unscrew and remove the spark plug. Make sure the spark plug gasket is removed with the spark plug. It will normally stick on the spark plug threads, but if loose, it might drop into the ventilating air passages of the heater. Should this happen, remove the gasket with a wire hook.

b. Inspection and Servicing (Spark Plug):

1. If the spark plug appears to be in good condition, except for a mild coating of oxide on the porcelain and electrode, it may be cleaned and reused. Cleaning is accomplished on a conventional airplane type spark plug cleaner, except that it will be necessary to use two or more adapters in order to raise the long extension of the plug far enough out of the cleaner nozzle opening to perform an effective job. Plug the ceramic insert cavity at the terminal end of the plug with a piece of paper or cloth to keep out any of the cleaning sand. Wipe this cavity out thoroughly with a cloth wet with carbon tetrachloride. If after cleaning the spark plug porcelain is white and the electrode is not eroded, proceed to check the ground electrode in the heater and adjust the spark gap in accordance with paragraph 13-160, c and Figure 13-44.

NOTE

If the spark plug fails to clean up properly and/or the electrode is badly eroded, it should be replaced.

c. Spark Gap Check and Adjustment: (See Figure 13-15.)

A spark gap of 0.156 to 0.188 of an inch must be maintained on the P/N 39D18 spark plug. This gap should be checked any time a plug is replaced or at the time of heater overhaul. A spark gap greater than that specified can shorten the life of the ignition assembly. There are several methods in which the spark gap of this heater may be checked. Method I is recommended when the heater is being overhauled and before the installation of the fuel nozzle. Methods II and III are suitable for checking the gap through the spark plug well when the heater is not disassembled.

Method I:

1. Using a 5/32 inch drill (0.156) or a piece of 5/32 rod, reach down through the small opening in the combustion head and find the ground electrode. (It is welded inside the head.)

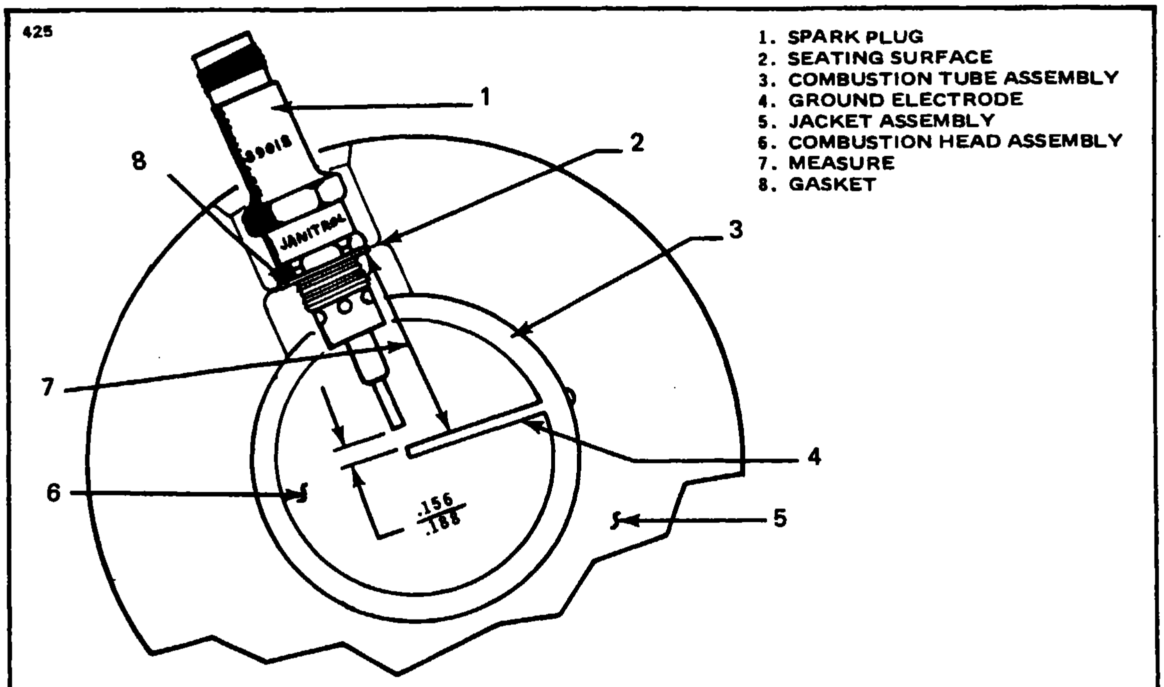
2. Move the drill along the side of the electrode on the spark plug side. (Movement should be from the outer edge towards the center.) The drill should just pass through the spark plug gap opening. Should the drill fail to pass through this opening, the gap is too narrow. If it passes through too freely, the gap is too wide. In either case, it will be necessary to bend the ground electrode in the direction required. This may be done by removing the spark plug and reaching through the opening.

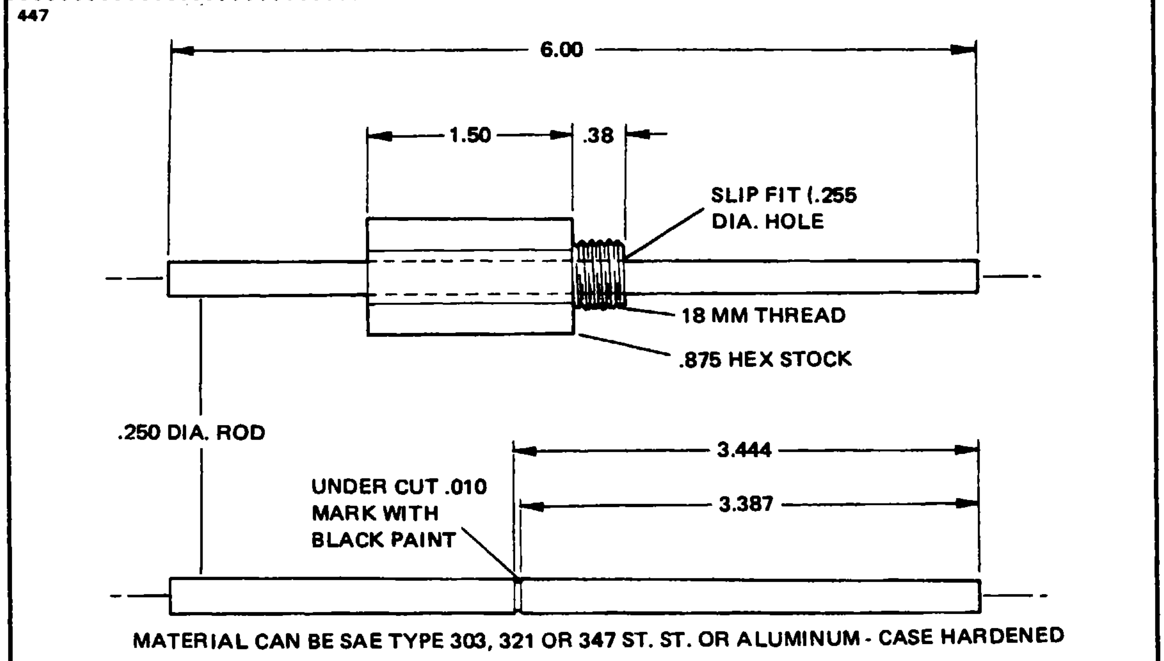
3. Recheck the gap after repositioning of the ground electrode.

Method II:

1. Measure the distance between the seating surface of the spark plug with a new gasket installed to the end of the plug electrode.

2. Using a depth gauge, measure the distance between the ground electrode in the heater to the spark plug seating surface in the heater jacket and check this measurement against the measurement obtained in Step 1. The difference should be between 0.156 to 0.188 of an inch.





GAUGE FOR LOCATING GROUND ELECTRODE IN JANITROL HEATERS.
PIPER TOOL NO. 55988-2.

Figure 13-44. Spark Plug Gap Adjustment and Tool

3. The ground electrode can be bent to obtain the required gap.

Method III:

1. Fabricate or purchase from Piper, the special tool from dimensions given in Figure 13-44.
2. Install the threaded end of the tool into the spark plug hole.
3. Slide the rod of the tool into the combustion head until it contacts the ground electrode.
4. Check that the indicator ring on the rod lines up with the end of the tool. The ground electrode may be bent to obtain the required gap.

NOTE

Inspect the ground electrode for erosion. If it is eroded to approximately half of its original 1/8 inch diameter, it should be replaced. This can be done as follows:

(a) Grind off the head of the rivet where it projects through the combustion head and remove the electrode.
(b) Install a new CRES rivet AN125452 which is 1.500 inches in length.
(c) Heliarc tack weld the rivet head to hold it in place.
(d) Check spark gap as noted in Methods I, II or III.

d. Installation:

1. If a new spark plug is being installed, be sure to adjust the spark gap as outlined in step c. Do not bend the electrode on the spark plug.
2. Place a new spark plug gasket on the threads. A small drop of Aviation Permatex, or similar material may be used on the gasket to help hold it to the spark plug shell during installation.
3. Screw the spark plug into the heater with a deep socket wrench. Tighten to a torque of 28 foot-pounds. Install the grommet in heater jacket opening.
4. Carefully insert the spring connector on the high voltage lead into the spark plug shell; press down gently and start the nut on the threads. Tighten the nut to 20 foot-pounds.
5. Operate the heater to check dependability and replace the access panels.

13-161. VIBRATOR ASSEMBLY. (Refer to Figure 13-47.)

a. Measure the distance the vibrator protrudes out of the ignition assembly to determine when a new unit is inserted properly. Loosen the clamp that holds the vibrator in position and with a slight back and forth movement, pull it straight out of the ignition unit. (For a friction grip, it may be necessary to use a piece of masking or friction tape around the exposed portion of the vibrator.)

b. Carefully rotate the new vibrator until the index marks are aligned and the connector pins on the vibrator can be felt entering the pin sockets in the vibrator socket; then press the vibrator fully and firmly into position.

c. Check the heater for operation.

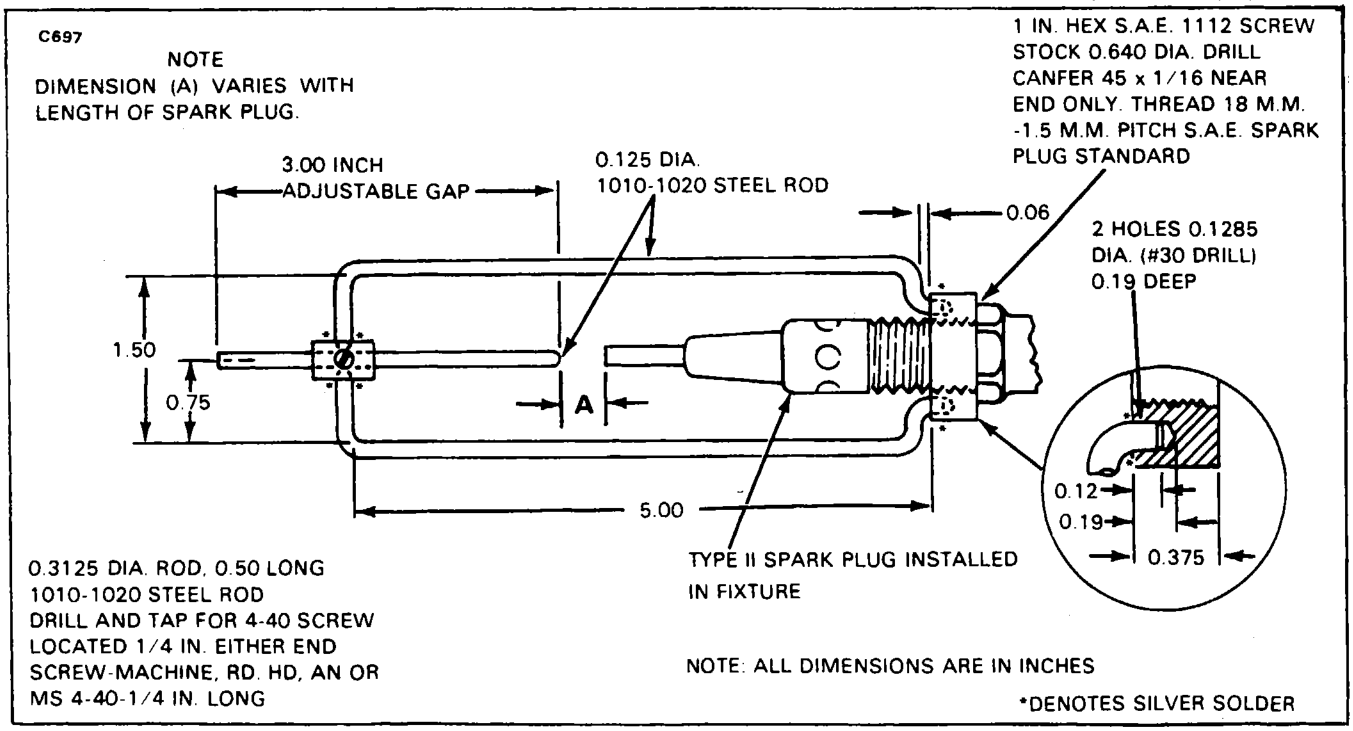


Figure 13-44a. Spark Plug Fixture

13-162. IGNITION ASSEMBLY. (Refer to Figure 13-47.) This unit converts aircraft DC buss voltage oscillating current capable of producing a continuous spark in the combustion chamber of the heater. This unit remains energized and produces a continuous spark during heater operation. It contains a condenser, resistor, radio noise filter and vibrator socket. It also has an externally mounted vibrator and ignition coil.

a. Removal of ignition assembly:

NOTE

Make sure the heater electrical circuits are de-energized.

1. Disconnect the primary wire from the primary terminal of the ignition assembly (2).
2. Carefully unscrew and disconnect the high voltage ignition cable at the spark plug. Exercise care to avoid fouling or damaging the connector.
3. Remove the four attaching screws and lift the ignition assembly (2) off the heater jacket.

b. Installation of ignition assembly:

1. Place the ignition assembly in position on the brackets attached to the heater jacket, with the high voltage cable facing the spark plug end of the heater.
2. Install the four screws. Tighten the screws securely.
3. Carefully connect the high voltage lead to the spark plug. Torque to 20 foot-pounds.
4. Connect the primary lead to the primary terminal on the ignition unit (2) and tighten the nut securely.
5. Check for proper heater operation.

c. Testing ignition unit:

The ignition unit does not require complete overhaul. The following test will indicate whether or not the unit is operational and whether the vibrator should be replaced before reinstallation in the aircraft. The following equipment is required to test the components:

1. A battery that will supply power at approximately 14 to 28-volts DC.
2. A voltmeter with a range of 0-30 volts.
3. A lead from the battery to the test fixture in which is included an ammeter with a range of 0-3 amperes and a normally open, momentary-closed switch. The total resistance of the lead including the ammeter and switch must not exceed 0.3 ohms.
4. A spark gap of 0.187 of an inch +/-0. A convenient means of arranging the correct spark gap is to install a spark plug, P/N 39D18, in a test fixture arranged to provide a ground electrode and a .187 of an inch spark gap. (Refer to Figure 13-44a for information on fabricating this fixture.)

NOTE

Any one of several spark plugs may be used with the spark plug fixture detailed in Figure 13-44a. However, the "A" dimension in that sketch must be varied with the length of the spark plug electrode to provide a gap of .187 of an inch for all spark plugs.

NOTE

When testing an ignition unit, do not use a screwdriver as a substitute for a spark plug and spark plug fixture.

5. The high tension shielded ignition lead between the igntion unit and the spark plug is a part of the cover assembly.

6. Arrange the test equipment as shown in Figure 13-44b.

d. Operational test of ignition unit:

1. Close the momentary switch and read the voltmeter and ammeter. Release the momentary switch immediately.

2. The amperage reading at 28 volts DC must be 1.25 +/-0.25 amperes.

13-163. CYCLING SWITCH AND LIMIT (OVERHEAT) SWITCH. (Refer to Figure 13-47.)

a. Removal:

1. If the limit switch (25) is damaged or defective, disconnect the two electrical leads from the switch terminals. Be sure to mark the leads for proper reasembly. (The switch terminals are identified by numbers "1", "2" and "3".)

2. Remove the two attaching screws and lift switch (25) and spacers (gaskets, 2 required) (27) from the jacket opening.

3. If the cycling switch (24) is damaged or defective, disconnect the electrical leads, being sure to mark them for proper reassembly.

4. Remove the two screws and lift the cycling switch (24) from the jacket opening.

NOTE

No attempt should be made to repair either of these switches. Switches that do not operate properly must be replaced. (Refer to paragraph 13-138, m and n for test instructions.)

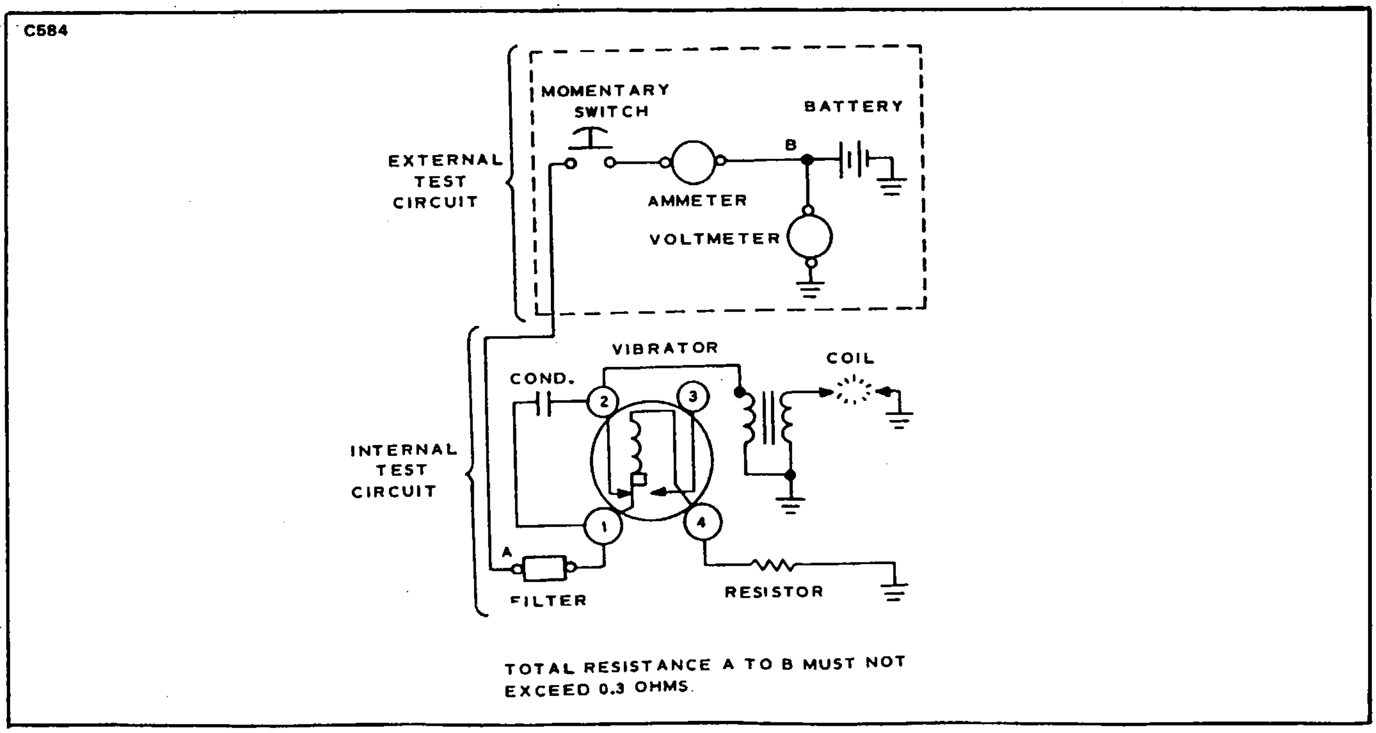


Figure 13-44b. Wiring - Test Setup

b. Installation:

1. Install the limit switch (25) and two spacer gaskets (27) by placing the gaskets in position in the heater jacket opening and installing two screws.

2. Tighten screws securely; then reconnect the electrical leads in accordance with markings made during disassembly. (If electrical connections are uncertain, refer to the wiring diagram, Figure 13-41.)

3. Install the cycling switch by placing it in position in the heater jacket opening and securing it with the two screws. Tighten screws securely; then reconnect the electrical leads to their respective terminals as marked during diasssembly. (If connections are uncertain, refer to wiring diagram, Figure 13-41.)

13-164. COMBUSTION AIR PRESSURE SWITCH. (Refer to Figure 13-47.)

a. Removal:

1. Disconnect electrical leads from the terminals of the combustion air pressure switch (26), being sure to mark them for proper reassembly. Disconnect the tube from the switch. Exercise caution not to exert excessive bending of the tube. (It is "tacked" to the combustion chamber inside the jacket.)

2. Unscrew and remove the combustion air pressure switch from the fitting on the combustion air inlet tube.

b. Installation:

1. Install the combustion air pressure switch (26) by rotating it on the threaded fitting of the combustion air inlet tube and tighten it securely. Exercise caution not to over torque the switch as this could change the setting.

2. Connect electrical leads to their respective terminals in accordance with markings made during removal. If in doubt regarding proper connections, refer to the wiring diagram, Figure 13-41. Connect the tube to the switch.

3. Check for proper heater operation.

13-165. FUEL REGULATOR AND SHUTOFF VALVE. (Refer to Figure 13-48.)

a. Removal:

1. Remove the cover from the fuel regulator/shutoff valve shroud assembly.

2. Disconnect the electrical lead to the valve.

3. Disconnect the fuel lines from the valve nipples.

4. Remove the two bolts securing the valve and shroud to the bulkhead, and save the standoff bushings and washers for reinstallation of the valve and shroud assembly.

b. Installation:

1. Place the regulator/shutoff valve into the shroud. Insure the correct positioning of inlet and outlet ports to their respective lines, and secure the valve and shroud to the bulkhead using the two standoff bushings, washers and bolts.

2. Connect the fuel lines to the valve and tighten securely.

3. Connect the electrical lead. Be sure an insulating sleeve or tape is placed over the connection to avoid any possibility of a short circuit. If a sleeve is used, secure it in place.

4. Perform an operational check of the heater to insure that the unit is functioning properly and no fuel leaks exist.

5. Reinstall the shroud cover on the shroud assembly.

13-166. DUCT SWITCH. (Refer to Figure 13-48.)

a. Removal:

1. Place the control lever arm in high position and loosen the Allen head set screw that secures the arm to the temperature selector shaft. Slide the lever and arm off the shaft.

2. Disconnect the two electrical leads from the terminals on the exposed face of the switch.

3. Remove the two attaching screws and washers from the duct.

4. Carefully lift out the switch and gasket (if gasket is used).

b. Cleaning and Inspection:

1. Brush off any dust or lint from the switch operating mechanism (exposed inside the duct) and wipe external surfaces with a clean cloth.

c. Installation:

1. Insert the switch carefully, with gasket (if used), into the ventilating duct opening and install the two attaching screws and washers.

2. Connect the two electrical leads to their respective terminals, as marked during removal.

3. Set the temperature selector shaft at the high stop. Then carefully place the control lever arm on the shaft at the high position and lock the lever by tightening the Allen head set screw. (Do not over-tighten.) Rotate the lever arm to make sure it clears the electrical terminal screws and support bracket when it is moved to the high position.

4. Operate the heater with the duct switch set above ambient temperature to check operation. (Refer to paragraph 13-180, l for additional switch tests and setting instructions.)

13-167. OVERHAUL INSTRUCTIONS. The heater assembly shall be overhauled after 1000 hours or whenever the pressure decay test requirement cannot be met. The heater should be removed from the aircraft, disassembled, all parts throughly inspected and necessary repairs and/or replacements made prior to reassembly. Detailed step-by-step instructions are included for a complete heater overhaul. In some instances, however, inspection may reveal that it is unnecessary to remove certain parts. If so, those portions of the overhaul procedures may be eliminated.

NOTE

For disassembly and reassembly operations, refer to the exploded view drawings and the parts list.

13-168. DISASSEMBLY. (Refer to Figure 13-47.)

a. Remove the screw and slide the adapter (23) off the combustion air inlet tube.

b. Disconnect and remove electrical wiring and individual wires from the various components on the heater. If wires appear to be in good condition, it may be desirable to remove wire harness assembly intact. First, disconnect wires at terminal strip and components.

NOTE

It is advisable to label all wires, prior to removal, to insure correct connections during reassembly. Cable straps and clips must be replaced if removed, as they cannot be re-used.

c. Carefully disconnect the high voltage ignition lead at the spark plug. Handle the spring connector on the end of this lead with care to prevent fouling or damage.

d. Remove the four screws and cable straps to free the ignition assembly (2) from the heater jacket and remove the ignition assembly. The vibrator may be removed by loosening the clamp and exerting a firm pull straight away from the ignition assembly case.

e. Remove the grommet (39) from the jacket (5) and remove the spark plug (32) with a 7/8 inch deep socket. Make sure the spark plug gasket is removed.

f. Remove the two screws and lift out the overheat (limit) switch (25) and spacer gaskets (27).

g. Remove the two screws and lift out the cycling switch (24).

h. Remove the four screws to release the terminal strip (35) and insulator (36) from the jacket (5).

i. Disconnect the tube fitting (33) at the cover of the combustion air pressure switch (26). (Refer to paragraph 13-164, a, 1 for precaution on tube bending.) Unscrew and remove the combustion air pressure switch (26) from the combustion air inlet tube.

j. Open baggage door on the right side of the fuselage for access to the heater cover box assembly and remove the screws attaching the cover to the baggage compartment bulkhead and floor. Remove the three screws securing the heater air intake tube assembly to the heater and set aside.

k. Loosen the four screws (20) and rotate the blower and motor housing (11) to disengage the notched end from the four screws in the end of the heater jacket. Remove the grommet (45) and separate the electrical quick-disconnects.

l. Remove the upper fuel shroud (10). Remove grommet from fuel shroud (9) and carefully pull fuel solenoid wires through hole in shroud. With open end wrench, remove fuel solenoid assembly. Reach inside the inlet end of the jacket assembly with a 3/4 inch open end wrench and while holding the fuel-tube fitting at the jacket, remove the elbow fitting (34), nut (38), washer (41), gasket (29) and fuel shroud (9).

m. Remove the two screws and carefully withdraw the nozzle holder from the combustion head assembly (6). Remove the gasket (28). Remove the six screws and withdraw the combustion head assembly from the combustion tube assembly (7). Remove the gasket (30).

n. Remove the screws and remaining cable straps, if not previously removed, from the seam of the jacket assembly (5). Note positions of cable straps as they are removed. Spread the jacket at the seam and remove it from the combustion tube assembly (7). This will free the rope gasket (31) which can be removed from the particular part on which it remains attached.

o. Carefully unscrew and remove the spray nozzle (21) from the nozzle holder (8) and remove gasket (28).

CAUTION

Handle the nozzle with care to avoid damage to the tip. The material around the orifice is very thin and any sharp blow on the face of the nozzle can distort the spray pattern and cause malignition or improper combustion.

p. Remove the three screws and rubber grommet from the blower housing (12).

q. Slide the ventilating air blower motor out of the blower housing with the motor bracket assembly (19) and blower wheel (17) attached. Loosen the set screw in the blower wheel and slide it off the end of the motor shaft. Then remove the motor bracket assembly (19) and fasteners (43).

r. Remove the screw and lock washer to free the capacitor assembly (18) with attached leads.

13-169. DISASSEMBLY OF COMBUSTION AIR BLOWER ASSEMBLY. (Refer to Figure 13-48.)

a. Remove the combustion air blower inlet adapter (2) by removing the screw (18).

b. Remove screws (18); then separate the outer housing (3) from the inner blower housing (8) and free the motor leads and capacitor (10) from the inner housing.

c. Loosen the set screw in the blower wheel (7) and slide it off the motor shaft.

d. Remove the two hex nuts (17), lock washers and flat washers (16) and slide the inner housing (8) off the motor through bolts. The spacer (15) will drop out.

e. Install new motor brushes as described in paragraph 13-159, b. If the motor commutator is badly worn, or if the motor is defective in any respect, it must be replaced.

13-170. CLEANING. (Refer to Figure 13-47.)

a. Clean individual metal parts (except those parts containing switches and electrical wiring) and the combustion tube assembly, by immersing them in dry-cleaning solvent, such as Stoddard solvent (Federal Specification P-D-680). A bristle brush should be used to assist the cleaning process if foreign accumulations are stubborn to remove.

CAUTION

Do not attempt to buff or scrape off any deposits on face of spray nozzle. The face of the nozzle is very susceptible to damage from mishandling. Carefully repeat cleaning process using only a bristle brush and repeated applications of solvent to loosen any stubborn deposits.

b. Use compressed air or lintless cloth to dry the parts, unless sufficient time is available for them to air dry.

c. Wipe electrical components with a clean, dry cloth. If foreign material is difficult to remove, moisten the cloth in carbon tetrachloride or electrical contact cleaner and clean all exterior surfaces thoroughly.

13-171. CLEANING AND INSPECTING THE COMBUSTION TUBE ASSEMBLY. (Refer to Figure 13-47.)

a. Slight scaling and discoloration of the combustion tube assembly (7) is a normal condition for units that have been in service up to 1000 airplane hours. The slight scaling condition will appear to be mottled and a small accumulation of blue-gray powder may be present on the surface in certain areas. This condition does not require replacement of combustion tube assembly, unless severe overheating has produced soft spots in the metal.

NOTE

This assembly should be inspected prior to cleaning in order to prevent the removal of visible evidences of damage.

b. Look inside the exhaust outlet to determine if the combustion tube appears to be heavily scaled or mottled. Deformation is more difficult to detect visually but can usually be observed by looking straight through the combustion tube assembly and sighting along the outer surface of the inner combustion tube. An assembly that has been obviously deformed should be replaced. Slight deformation will not affect heater operation unless it is extensive and localized enough to reduce the flow of ventilating air through the heater more than 10 percent.

c. The combustion tube assembly may be cleaned by either of two methods:

1. One method is to soak the combustion tube assembly overnight in an Oakite M-S Stripper solution, made by mixing one pound of Oakite salts with each gallon of water used. The solution should be maintained at a temperature of between 190°F and 210°F. After overnight soaking, rinse the combustion tube assembly thoroughly in water to remove all traces of the Oakite solution. In order to reach all areas of the combustion tube assembly, it is advisable to let it stand in the rinsing water for as long as one-half hour, while occasionally agitating it to circulate the water. All openings should be left open during this operation. Be sure to dry the combustion tube assembly thoroughly after cleaning.

2. A second method of cleaning is what is commonly known as hand "tumbling." Insert shot or other metallic particles through the exhaust outlet opening; then close all openings and shake the combustion tube assembly vigorously, while rotating it and changing from end-to-end frequently. Be sure to pour out all of the particles and loosened material; then with all openings uncovered, direct a stream of compressed air into the combustion tube assembly from first one opening, then the other. Make sure all loose material is removed.

13-172. INSPECTION OF REMAINING COMPONENTS. (Refer to Figure 13-47.)

a. Discard all rubber parts such as grommets, gaskets, etc. These items should always be replaced at overhaul. Also discard the rope gasket (31).

b. Inspect all wires and wiring harnesses for damage to insulation, damaged terminals, chafed or cracked insulation and broken plastic bands. Individual wires can be replaced by making up new wires from No. 16 AWG stock and cut to correct length. It is advisable to use an acceptable crimping tool for installing terminals, rather than solder for all heater wiring connections. If wiring harness damage is visible, the entire harness assembly should be replaced. If only one or more wires are damaged, cut the cable ties, make up new wires, install them in the harnesses, and restore all cable ties and clamps. If heater controls were operating properly at the time of removal, reinstall them.

c. Inspect all hard parts, consisting of bolts, screws, nuts, washers and lock washers. Replace damaged parts.

d. The combustion air pressure switch (26) must respond to delicate pressure changes and should always be checked and/or replaced at overhaul. (Refer to paragraph 13-173, c, and Figure 13-46.)

e. Replace the vibrator in the ignition unit at each overhaul.

f. Inspect the ignition assembly for dented case, loose or damaged primary terminal insulator and broken or obviously damaged high voltage lead. Give particular attention to the condition of the spring connector at the end of the lead. If the spring is burned off, visibly eroded, or carbon tracked, the ignition assembly should be replaced.

NOTE

Do not attempt a field repair of the ignition unit, as it is a sealed assembly.

g. Inspect the terminal strip (35) for distortion and cracks and replace it if either condition exists.

h. Inspect radio-noise filters for short circuits by checking from either terminal to ground with an ohmmeter. An open-circuit reading should be obtained.

i. Inspect the spray nozzle (21) with a magnifying glass for any obstructions in the nozzle orifice and any sign of damage to the slight conical protrusion at the nozzle tip. Use compressed air to remove obstructions and re-examine it to make sure the orifice is open. Exercise care when handling the nozzle to avoid pressing or rapping on the tip face. Do not burr or scrape off deposits on the tip face. After cleaning, it is advisable to store the nozzle in a polyethylene bag until ready for reassembly.

j. Replace the nozzle at overhaul.

NOTE

The nozzle (21) can be spray tested by installing it in the holder and connecting the fuel tube to a 7 psi fuel pressure source. The conical angle spray pattern should be even and dispersed the same in all directions. Exercise caution to keep atomized fuel away from fire.

k. Inspect the nozzle holder for damaged threads at the fuel tube fitting, crimped or cracked fuel line or distorted housing.

l. Check the solenoid for continuity with an ohmmeter. A reading of between 100 and 125 ohms at room temperature should be obtained. If the reading is not within these limits, the solenoid should be replaced.

m. Remove the brushes, one at a time, from the ventilating air blower motor (13) by removing the brush cap and carefully withdrawing the brush from its guide. Remove foreign material from the brush guide and commutator with a stream of filtered compressed air. Check for brush wear. (Refer to paragraph 13-159.) Inspect the commutator for grooved brush track, pitting or burning. The commutator surface should be smooth and medium brown in color. Replace the motor if the commutator or other parts show damage.

n. Inspect the combustion air blower motor as described in the preceding step.

o. Inspect the blower wheel for broken or bent vanes and replace it for either condition.

13-173. TESTING. The following tests should be performed as outlined in the succeeding paragraphs:

a. Check ventilating air and combustion air motors for correct RPM and current draw:

1. Connect motor to 28-volt DC power supply. Rotation should be counterclockwise when viewed from the shaft end.

2. Both motors should rotate at approximately 7500 RPM at rated voltage. Current draw is approximately three amperes.

3. If current draw is excessive, or if speed is too low, replace the brushes. Recheck both current draw and RPM after brushes are properly run in. (Refer to paragraph 13-159, b.)

4. If after replacing brushes, operation is still unsatisfactory, replace the motor.

NOTE

The motor checks described above should be made without the blower housing attached, for both the ventilating air and combustion air motors.

b. Test the combustion tube assembly for leaks as follows:

1. Fashion a sealing plate from approximately .125 inch thick flat stock to seal the combustion head opening in the combustion tube assembly. (Refer to Figure 13-29.) Use a rubber gasket under the plate and attach the plate with six screws.

2. Make up seals for all remaining openings, except the one used to connect the air pressure source. (Refer to Figure 13-45.) Use rubber stoppers as shown. The combustion air inlet tube can be sealed best with a drilled stopper and clamp. Other openings should be sealed with expansion plugs. The seal used in the exhaust tube should be formed so that it will not deform the air pressure switch tube which protrudes into the exhaust.

3. Install plugs and caps in all openings except the one to which the combustion air pressure switch is attached. (Any opening can be used to connect the air pressure source; however, the combustion air pressure switch opening is usually the most convenient. The drain opening would normally be considered a second choice.)

4. Connect a regulated air supply to the opening that has not been plugged and

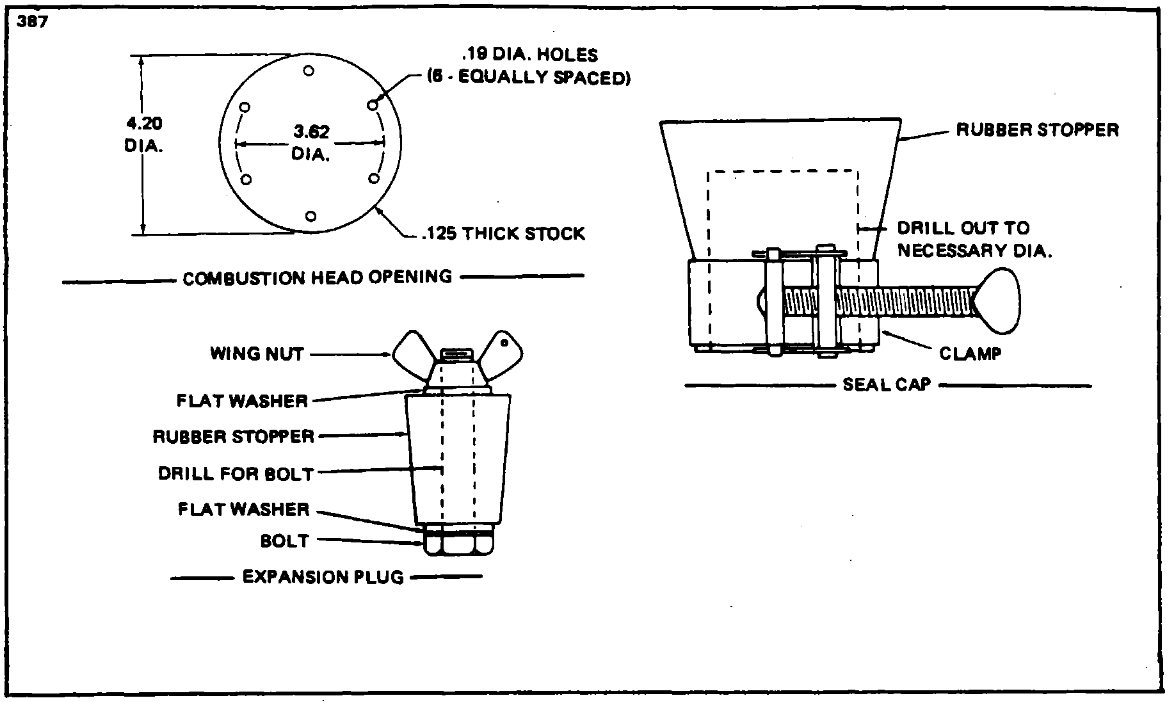


Figure 13-45. Suggested Design for Seal Plate, Plugs and Caps for Combustion Tube Leakage Test

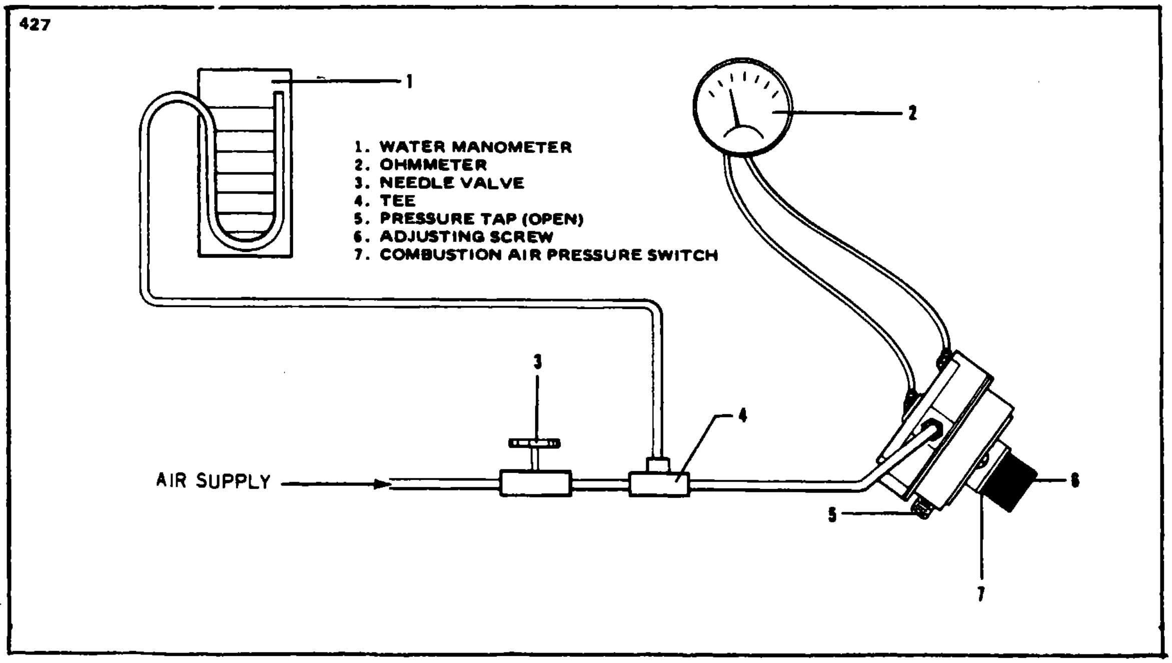


Figure 13-46. Test Setup for Combustion Air Pressure Switch

apply a pressure of between three and five psi to the combustion tube assembly.

5. Submerge the combustion tube assembly in water for several minutes while watching for bubbles, which would indicate leaks. The presence of a small leak, due to a pinhole in the metal or at welded joints, can be repaired successfully, provided it is located in an accessible area and the welder is familiar with stainless steel welds and does not create excessive weld stress concentrations. Be sure to recheck the assembly for leak after welding.

c. Test the combustion air pressure switch as follows:

1. Connect an adjustable air pressure line that can be controlled in a range of zero to 5.0 (maximum) of water to the switch opening with a water manometer and needle valve in the line ahead of switch. Switch must be tested in 45 degree position as shown in Figure 13-46.

2. Connect an ohmmeter across the switch terminals to determine the exact instant of switch closing.

3. Apply air pressure allowing it to build up very slowly from zero. The switch contacts should close at 0.5 ± 0.1 inches of water which will be indicated on the manometer.

NOTE

The switch cover has a differential pressure tap and this opening must be left open to atmosphere during the test.

4. Make several trials to insure switch reliability. Be sure to increase and decrease the air pressure slowly in order to produce accurate indications.

5. If an adjustment is required, rotate the adjusting screw clockwise to increase settings and counterclockwise to decrease settings.

d. Test the fuel feed and nozzle holder assembly for leaks as follows. This test can be simplified if the following routine is used to test both the fuel line and fuel line shroud tube.

1. Using filtered compressed air, apply 20 psi to the shroud drain port, located on the surface near the threaded nozzle cavity.

2. Immerse the fuel feed and nozzle holder assembly in clean water with the fuel inlet and nozzle cavity left open.

3. Observe for bubbles which would indicate leakage. If bubbles appear at either fuel fitting, there is a leak in the fuel tube. If bubbles appear externally on the shroud tube, or at either end of the shroud tube juncture, the shroud tube is leaking.

4. In either of the above cases, the complete fuel feed and nozzle holder assembly must be replaced.

e. Spray test the nozzle as follows:

1. Install the nozzle in the fuel feed and nozzle holder assembly. Connect the fuel tube to the fuel solenoid. Connect solenoid to a 7 psi fuel pressure source.

2. Connect the solenoid leads to a 14/28-volt battery. Connect a switch in the line to open and close the solenoid when desired.

WARNING

Be sure to keep the atomized spray away from fire.

3. With the switch closed (solenoid valve energized) and the fuel line connected, observe the fuel spray pattern. It should be conical in shape with even dispersion in all directions.

4. Energize and de-energize the solenoid several times. The spray should shut off permanently each time the solenoid is de-energized. There should be no sign of dribbling at the nozzle tip in excess of one or two drops.
5. If the spray pattern is distorted, check for an obstruction and clean the nozzle as described in paragraph 13-172. If this fails to provide a normal spray pattern, replace the nozzle.
6. If the nozzle continues to dribble, the solenoid valve is not closing properly and the solenoid must be replaced.

13-174. REPAIR OF COMBUSTION TUBE ASSEMBLY.

No weld or braze repairs of the combustion tube assembly are authorized.

13-175. REASSEMBLY. (Refer to Figure 13-47.)

a. If removed during disassembly, secure the nipple (37) and elbow (34) to the fuel solenoid (22).

b. Insert the ventilating air motor (13) into the motor bracket assembly (19); slide the blower wheel (17) on the end of the motor shaft and rotate it until the set screw is aligned with the flat side of the motor shaft. Tighten the set screw just tight enough to hold it at this time.

c. Attach the capacitor and leads assembly (18) to the motor bracket (19) with the screw and lock washer. Make sure a good electrical ground connection is made at this point. Install ground bracket (44) and three new fasteners.

d. Insert this assembly into the blower housing (12).

e. Make sure all wires are routed and grommeted in the same manner as before disassembly.

f. The motor (13) should be positioned in the bracket (19) to locate the blower wheel

(17) properly in the blower housing (12). The blower wheel should be positioned so it will rotate freely and just clear the contoured spill plate in the blower housing. Tighten the Allen head set screws and spin the blower wheel by hand for a clearance check. Then apply appropriate voltage to run the motor as a final clearance check.

g. Secure the heater air intake tube assembly to the forward section of the heater. Open the baggage door on the forward right side of the fuselage and install the heater cover box assembly.

h. Place a new asbestos gasket (31) in position on the exhaust outlet; spring the jacket assembly (5) open at the seam and insert the combustion tube assembly (7) carefully into the jacket. Exercise care to clear the pressure switch tube in the exhaust outlet and see that the asbestos gasket is properly located. Close the gap on the jacket assembly and install screws (21) to secure it at the seam. Solenoid lead wire is grounded under one of these screws. Make sure the seam is in good condition and a tight fit is effected.

i. Install cable straps at locations noted during disassembly.

j. Remove the spray nozzle from the polyethylene bag. Screw the nozzle into the nozzle holder and tighten to 75-100 inch-pounds. It is very important to torque the nozzle to this valve as incorrect tightening could cause improper heater operation and "drool."

CAUTION

The spray nozzle has a slight protrusion on the nozzle face. If this area has been struck by any object which would make a dent or destroy the original contour, the nozzle must be replaced.

k. Install a new gasket (30) and combustion head (6) in the combustion tube (7) and secure with the six screws.

l. Insert the fitting on end of nozzle fuel tube through the opening in the jacket (5) and attach the nozzle holder to the combustion head assembly (6) with the two screws. It may be necessary to place a slight bend in the shrouded fuel tube to permit alignment of screw holes. Be sure to use a new gasket (28).

m. Using a new spark plug gasket, install the spark plug (32) and tighten to a torque of 28 foot-pounds. Install the grommet (34) in the jacket around the spark plug.

n. Install the ignition assembly (2) on the jacket assembly (5) with the four screws. Connect the high voltage lead to the spark plug and tighten it to 20 foot-pounds.

o. Attach the overheat limit switch (25) and spacer gaskets (27) to the jacket assembly (5) with two screws. Tighten the screws securely.

p. Attach the cycling switch (24) and bracket to the jacket with the six screws.

q. Place the terminal strip insulation (36) in position on the jacket (5), followed by the terminal strip (36). Secure both parts by installing the two screws.

r. Center the fuel fitting in jacket opening. Position the fuel fitting shroud gasket (29), washer (41) and shroud (9); then install the nut (38) finger tight. Insert a 3/4 inch open-end wrench inside the jacket and hold the fuel-tube fitting while tightening the nut (38) with a 3/4 inch deep socket. Install the fuel solenoid elbow (34) and solenoid (22). Avoid twisting or damaging lead. Install wires through grommet in lower shroud (9).

s. Rotate the combustion air switch (26) onto the threaded fitting on the combustion air tube and tighten it firmly.

t. Slide the grommet (16) over the combustion air tube and connect the tube to the elbow fitting (33) on the combustion air pressure switch (26).

u. Install the wiring harness and connect all wire leads to their respective terminals. (Refer to the wiring diagram. Figure 13-41.) Place the grommet (45, Figure 13-47) in position in the jacket (5); locate the ventilating air blower (11) at the end of the jacket. Thread the quick-disconnect on the motor lead through the grommet and connect it to the mating connector on the wiring harness.

v. Place the blower housing in position on the jacket assembly (5) and secure it by installing the four screws (20), if removed at disassembly. This operation is easier if the screws (20) are started into their threads and the blower housing rotated into place, allowing the screws to enter the notched openings in edge of blower housing. Tighten all screws securely.

w. Install the adapter (23) with the screw.

x. After heater is installed in the aircraft and the fuel line is connected, install the upper fuel shroud box (10) with the screws. Ascertain grommet (40) is installed.

13-176. REASSEMBLY OF COMBUSTION AIR BLOWER ASSEMBLY. (Refer to Figure 13-48.)

a. Place the spacer (15) over the end of the motor shaft and attach the motor assembly (5) to the inner housing (8) with the two self-locking nuts (17), flat washers (16) and lock washers.

b. Slide the blower wheel (7) on the motor shaft and tighten the set screw lightly against the flat portion of the motor shaft.

c. Place the outer blower housing (3) in position on the inner housing (8) and install screws (18).

d. Attach the radio noise filter (10) at the point shown with the screw. The motor ground lead terminal can be grounded to the motor support bracket (13).

e. Loosen the Allen head set screw in the blower fan (7) and shift the fan on the motor shaft until it is near the inlet in the blower housing. Tighten the set screw securely. The blower fan should just clear the inlet flange when rotated at full RPM. Spin the blower fan by hand for clearance check; then apply proper voltage to run motor and recheck for proper clearance.

f. Attach the blower inlet adapter (2) to blower housing (3) with screw (18).

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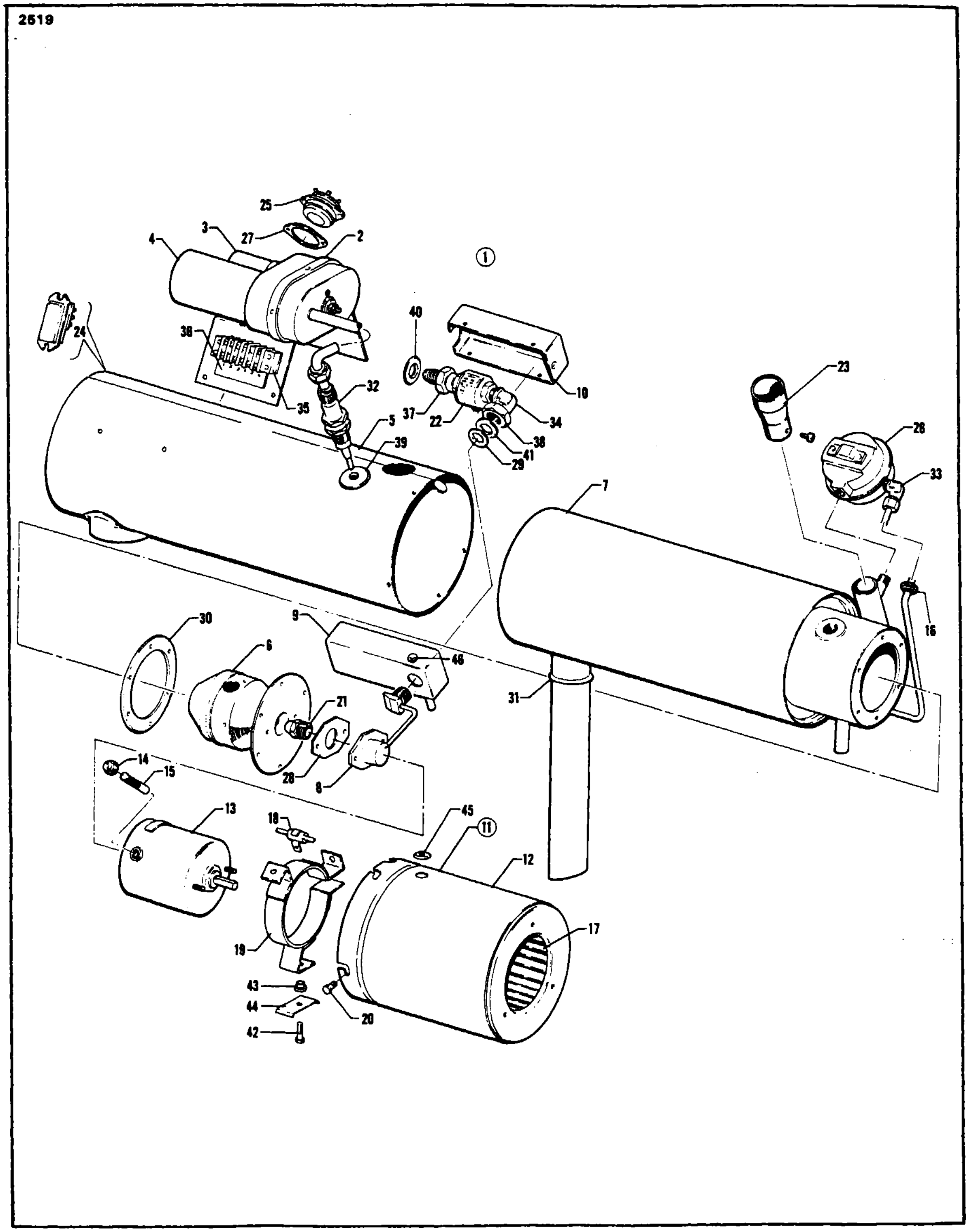
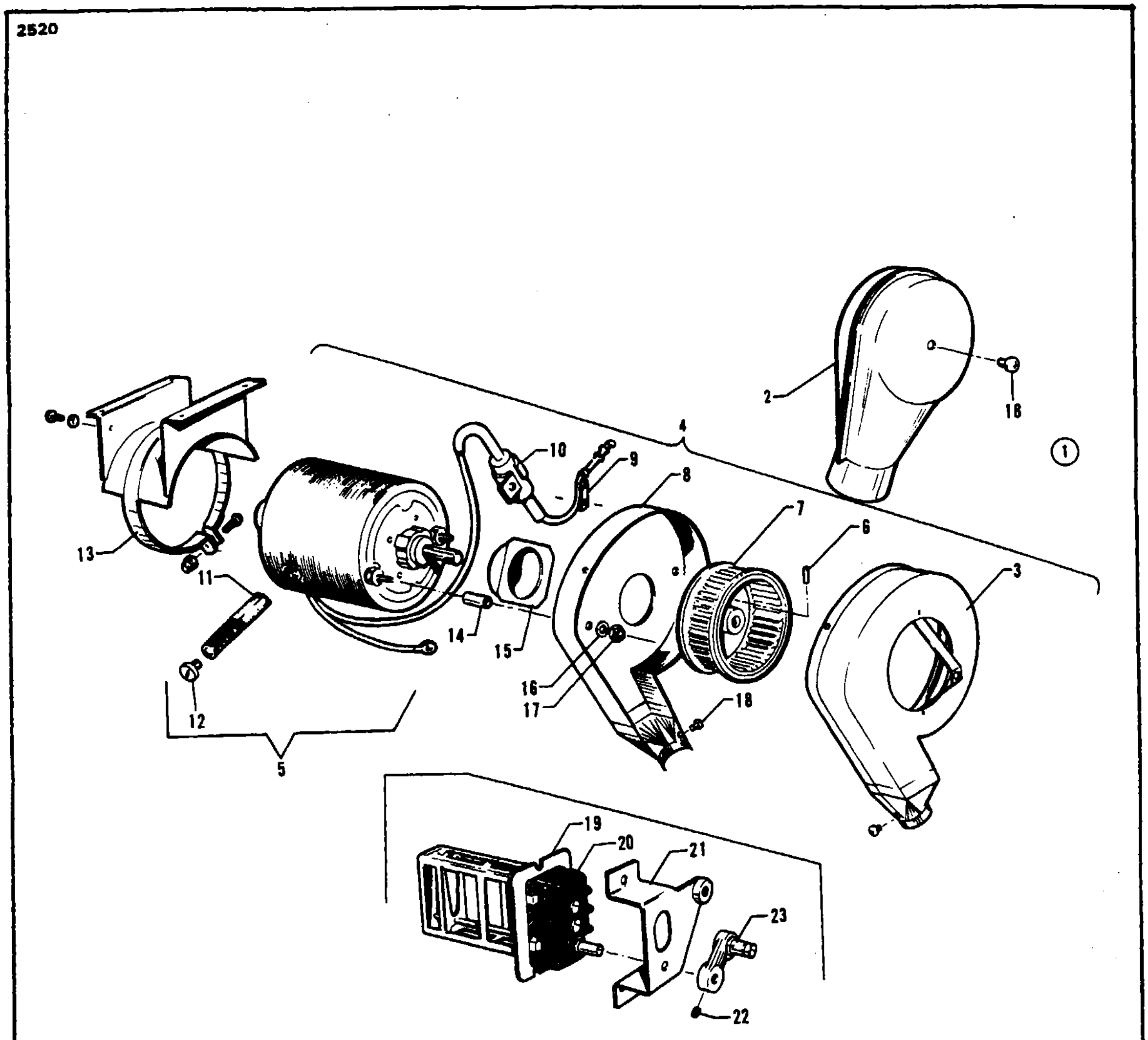


Figure 13-47. Exploded View of Heater Assembly No. 755 257 (28-Volt)

CALLOUTS FOR FIGURE 13-47

1. HEATER ASSEMBLY
2. IGNITION ASSEMBLY
3. VIBRATOR - IGNITION
4. COIL IGNITION
5. JACKET ASSEMBLY
6. HEAD ASSEMBLY - COMBUSTION
7. TUBE ASSEMBLY - COMBUSTION
8. FUEL FEED AND NOZZLE HOLDER ASSEMBLY
9. BOX ASSEMBLY FUEL SHROUD, LOWER
10. BOX ASSEMBLY FUEL SHROUD, UPPER
11. BLOWER ASSEMBLY - VENT AIR
12. HOUSING - BLOWER
13. MOTOR ASSEMBLY - VENT AIR BLOWER
14. CAP BRUSH ASSEMBLY
15. BRUSH ASSEMBLY - MOTOR
16. GROMMET
17. FAN VENT BLOWER
18. CAPACITOR
19. BRACKET ASSEMBLY - MOTOR
20. FASTENER
21. NOZZLE - FUEL
22. SOLENOID ASSEMBLY - FUEL
23. ADAPTER
24. SWITCH - CYCLING
25. SWITCH - LIMIT
26. SWITCH PRESSURE
27. GASKET LIMIT
28. GASKET
29. GASKET
30. GASKET
31. GASKET ASBESTOS
32. SPARK PLUG
33. ELBOW
34. ELBOW
35. STRIP - TERMINAL
36. INSULATOR - TERMINAL STRIP
37. NIPPLE
38. NUT
39. GROMMET
40. GROMMET
41. WASHER
42. SCREWS
43. FASTENERS
44. BRACKET - GROUND
45. GROMMET
46. GROMMET



1. COMBUSTION AIR BLOWER AND MOTOR ASSY.
2. ADAPTER ASSY. - BLOWER INLET
3. HOUSING BLOWER OUTER HALF
4. COMBUSTION AIR BLOWER AND MOTOR
5. MOTOR ASSY. COMBUSTION AIR BLOWER
6. SET SCREW BLOWER FAN
7. FAN COMBUSTION AIR BLOWER
8. HOUSING - BLOWER INNER HALF
9. STRAP - CABLE
10. CAPACITOR
11. BRUSH ASSEMBLY
12. CAP BRUSH ASSEMBLY
13. MOUNT COMBUSTION AIR BLOWER SUPPORT
14. SPACER
15. SPACER
16. WASHER
17. LOCKNUT - AN345-10
18. SCREWS
19. SPACER
20. SWITCH - ADJUSTABLE DUCT
21. COVER - SWITCH
22. SCREW - AN565-D8-H3
23. LEVER ASSEMBLY SWITCH

Figure 13-48. Exploded View of Combustion Air Blower and Motor Assembly No. 758 304

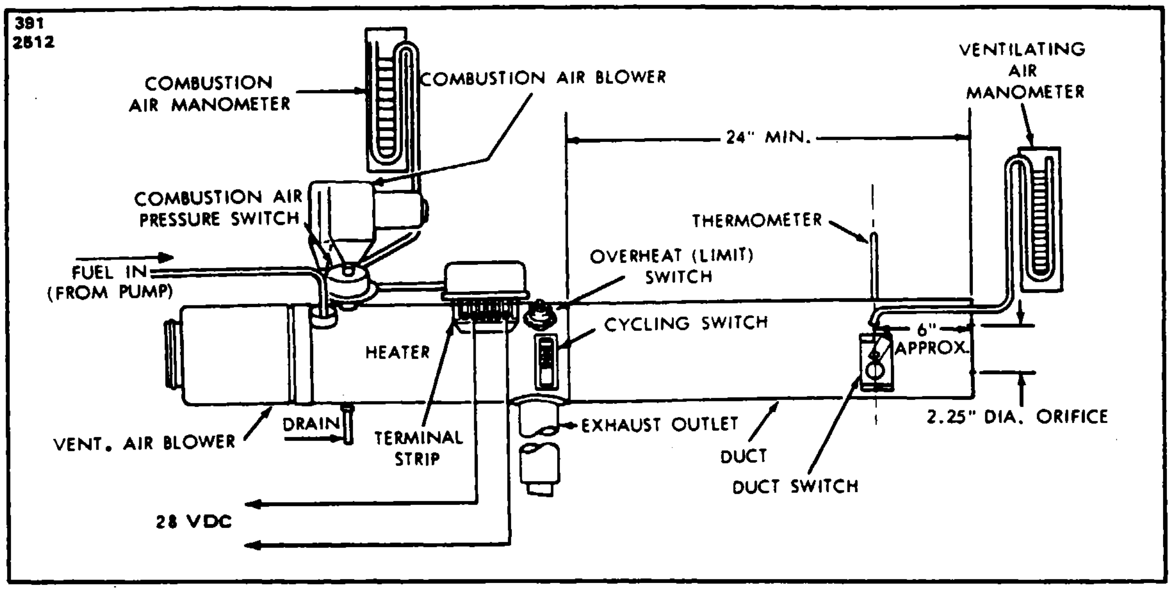


Figure 13-49. Suggested Setup for Heater Operation Test

13-177. TEST PROCEDURE.

13-178. GENERAL INFORMATION. A test of all components should have been made after overhaul to insure proper operation. Some shops may not have complete testing facilities for measuring airflows, pressure drops and other factors which would be accomplished in a laboratory-type test. If such a test cannot be made, install the heater and check operation on the ground and in the air to determine if operation is normal. In shops where complete test equipment is available and a complete functional test can be performed, the test routine described in subsequent paragraphs should be made.

13-179. EQUIPMENT REQUIRED. (Refer to Figure 13-49.)

a. An improvised stand to hold the heater during test. The heater should be located far enough away from any combustible material or atmosphere to avoid hazard. A location should be chosen where exhaust can be dispelled. Do not add an excessive extension to the heater exhaust.

b. A source of fuel capable of being regulated at seven psi.

c. The combustion air blower to be used with the heater should be used for the test.

d. A 28-volt DC power supply. A rheostat connected in series with the supply to adjust the voltage and current. An ammeter connected in series with the supply to monitor the current. A voltmeter connected in parallel with the supply to monitor the voltage.

e. Two water manometers (zero to 5.0 inch water column) for measuring the pressure in the ventilating air duct and in the combustion air stream.

f. A piece of duct to be attached to the downstream end of the heater. It should have a minimum length of 24 inches and the same diameter as the heater being tested. A 2.25 inch diameter orifice should be centrally located at the outlet end. An aperature should be provided for the thermometer and duct switch and a static tap should be attached as shown in Figure 13-49.

g. A thermometer with 500°F scale.

h. A fuel-pressure gauge.

i. A controlled source of compressed air for final leakage test.

13-180. OPERATIONAL TEST. (Refer to Figures 13-49 and 13-50.)

a. Connect the heater to the test setup as shown in Figure 13-49. Make sure the combustion air blower is mounted securely and that the heater is clamped to its supporting stand.

b. Insert the duct switch in the sheet metal extension tube at the location shown in Figure 13-49.

c. Connect components and heater as outlined in the wiring connection diagram, Figure 13-50. The power supply switch should be open.

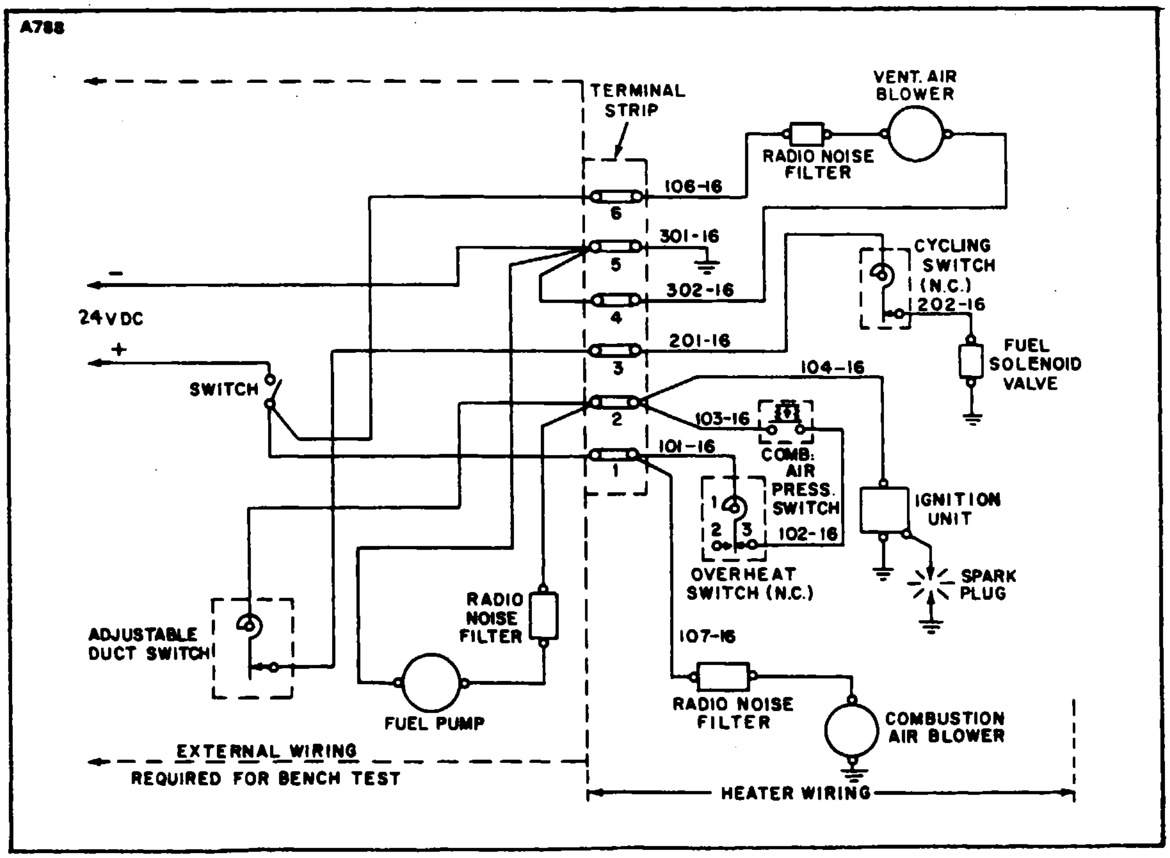


Figure 13-50. Wiring Connections for Heater Operation Test

d. Connect the power source to the heater.

e. Disconnect wire lead from terminal "3" on the heater side of the heater terminal strip to prevent the heater from lighting and close the power source switch to check operation of blowers. The combustion air blower and ventilating air blower should operate at full speed with no blower wheel interference. If either blower fails to run, locate and correct the trouble before proceeding with the test.

f. Connect a voltmeter from open side of combustion air pressure switch terminal to ground to determine if the switch is closed, which would be indicated by a full voltage reading on the meter. If a full voltage reading is not obtained, the combustion air supply is either inadequate or the switch is defective or improperly adjusted. Make necessary corrections.

g. Observe the manometer connected to the ventilating air pressure tap, which should show a reading of 1.1 inches of water (minimum) at rated voltage.

h. Observe the manometer connected to the combustion air tube tap, which should show a reading of 1.5 inches of water (minimum) at rated voltage.

i. Open the power supply switch and reconnect the terminal lead disconnected in preceding step e.

j. Close the power supply switch and turn on the fuel supply. The heater should light within five seconds (may require slightly longer for air to be purged from fuel lines on the first trial).

k. Observe operation of duct switch which should control heater operation according to the switch setting.

l. If the duct switch fails to control the temperature according to the setting, place the control lever in high "H" position and notice the control variation. A high reading of 250°F ± 10°F should be obtained (reading will vary in different applications).

m. Connect a jumper across the terminals of the duct switch to make it inoperative and observe action of the cycling switch. The cycling switch should cycle to control the outlet air temperature at approximately 250°F (nominal). This is a function of ambient temperature and airflow conditions. If operation is within a range of 190°F to 290°F, the switch is operating normally. If the switch is out of range it can be reset in the same manner as described for the duct switch, except that no control lever or indicator stop are used. If adjustment fails to restore proper temperature range, replace the switch.

n. With duct switch still jumped, place a jumper across the cycling switch terminals to check operation of the overheat switch. Block the ventilating air outlet and notice if the overheat switch shuts off the heater. It should open at between 300° F and 400° F. (This is also a function of ambient temperature and airflow). After the switch shuts off, remove ventilating air restriction; remove jumpers from cycling and duct switches and press firmly on the overheat switch reset button until it "clicks." The heater should light and operate.

o. Shut down the heater and check all components visually to make sure no damage has occurred to any of them.

p. Remove heater and other components from the test setup and install it in the airplane.

SECTION

XIV

ACCESSORIES AND UTILITIES

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SECTION XIV

ACCESSORIES AND UTILITIES

14-1. INTRODUCTION.

This section covers accessories which are available in this airplane and are not covered in other sections of this Service Manual. This information provides instructions for remedying difficulties which may arise in any of the accessories and the instructions are organized so the mechanic may refer to whichever component or system he must repair or adjust.

The Oxygen System contains service and maintenance procedures. Reference to this portion will aid the mechanic by providing information, such as the location of the various components, Inspection, Maintenance, Removal and Installation, Safety Precautions and other information of value, for the proper care of the system. A Troubleshooting Table at the end of the instructions will help to locate and remedy any troubles which may arise in the oxygen system.

The B. F. Goodrich Electrical Propeller De-Icing System information provides service and maintenance procedures for the deicers. This information consists of Inspection, Repair, Removal and Installation of all the parts which makeup the system. A Troubleshooting Table is incorporated at the end of these instructions to help in locating any trouble which may arise in this system and its probable cause and recommended remedy for repair. All work done on the De-Icing System must comply with the appropriate Civil Aeronautics Regulations.

The B. F. Goodrich Pneumatic System information provides Service, Maintenance and Repair procedures for the lightweight pneumatic deicers installed on the wing and tail surfaces. For the various components that control the deicers, there are check and adjustment procedures, as well as information for setting-up of the complete system. A Troubleshooting Table is also incorporated as an aid in remedying trouble which may arise.

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14-2. OXYGEN SYSTEM.

14-3. DESCRIPTION AND PRINCIPLE OF OPERATION. The oxygen system for the PA-23-250 series airplanes consists of an oxygen cylinder and regulator, filler valve, pressure gauge, outlets and masks and an ON-OFF control. High pressure is routed from the cylinder and regulator to the pressure gauge. Low pressure oxygen is routed from the cylinder and regulator to the outlets and masks whenever the control knob is pulled to the ON position. Each outlet has a spring-loaded valve which prevents the flow of oxygen until a mask hose is engaged in the outlet.

14-4. TROUBLESHOOTING. A troubleshooting table, Table XIV-I, is located at the back of the oxygen system portion of this section.

14-5. SAFETY PRECAUTIONS. Utmost care must be exercised in servicing, handling and inspection of the oxygen system. A fully charged oxygen cylinder contains enough pressure to cause serious injury to personnel and damage to equipment. Keep hands, tools and working area clean and post NO SMOKING signs. Keep all components of the system free from oil, grease, gasoline and all readily combustible material. Never allow electrical equipment to come in contact with the oxygen cylinder. Keep fire and heat away from oxygen equipment and take care not to generate sparks with carelessly handled tools.

14-6. INSPECTION AND OVERHAUL TIME LIMITS.

Component	Inspection	Overhaul/Test
Cylinder	Weekly [1]	Each 3 Years/5 Years [5]
Regulator	On Condition / Each Use [2]	Each 6 Years/5 Years [6]
Pressure Gauge	On Condition / Each Use [2]	Replace On Condition
High Pressure Lines	On Condition / Each Use [2]	Replace On Condition
Low Pressure Lines	On Condition / Each Use [2]	Replace On Condition
Outlets	On Condition / Each Use [2]	Each 5 Years [3]
External Recharge Valve	On Condition / Each Use [2]	Replace On Condition [4]
Masks	On Condition / Each Use [2]	Each 5 Years

1. Visual inspection for dents, bulges, corrosion, or chafing.
2. Visual inspection in the normal course of use.
3. On condition, replace the rubber components in the assembly or replace assembly.
4. If the screen in front of valve is dirty, replace valve. Valve replacement is recommended every 5 years.
5. Standard weight cyl. DOT 3AA 1800 = 5 years; Lightweight cyl. DOT 3HT 1850 = 3 years
6. Standard weight cyl. DOT 3AA 1800 = 5 years; Lightweight cyl. DOT 3HT 1850 = 6 years

It is recommended that inspection and overhaul be conducted by a DOT Approved Station or the manufacturer, Scott Aviation. The following checks and chart gives recommended inspection and overhaul time for the various parts of the oxygen system:

a. Standard weight cylinders (DOT 3AA 1800 classification) must be hydrostatic tested every 5 years. The lightweight cylinders (DOT 3HT 1850 classification) must be hydrostatic tested every 3 years and must be retired from service after 24 years or 4,380 pressurizations whichever occurs first. The month and year of the last test is stamped on the cylinder beneath the DOT identification.

b. The outlets should be checked for leakage both in the non-use condition and for leakage around an inserted connector.

c. The high pressure gauge may be checked for accuracy by comparing its indicated pressure with that of a gauge of known accuracy.

d. Inspection of the regulator may be effected by introducing into an outlet a mask connector to which is attached a 100 psi gauge. With one other outlet flowing through a plugged in mask, the indicated regulator output pressure shall be not less than 45 psig at sea level with 200 psig supply cylinder pressure. It should be noted that the permissible leakage through the 1/16 diameter vent hole in the side of the upper regulator housing is 10 cc/min. maximum, when the regulator is turned on. There shall be no external leakage anywhere on the regulator when it is turned off. All fittings shall be leak free.

14-7. TESTING FOR LEAKS. Apply detector fluid type CD-I solution or its equivalent. The solution should be shaken to obtain suds or foam. The suds or foam should be applied sparingly to the joints of a closed system. Look for traces of bubbles. No visible leakage should be found. Repair or replace any defective parts and retest system. With the system pressurized to service pressure, further test can be made. The rate of any leak should not exceed one percent of the total supply per 24 hour period. All traces of the detector fluid should be wiped off at the conclusion of the examination.

14-8. MAINTENANCE.

a. Make sure to check the oxygen lines for proper clearance as follows: (Refer to Figure 14-1.)

1. Two inch minimum between oxygen tubes and all flexible moving parts of the aircraft (flexible control cables, etc.). If enough space cannot be attained, protection from abrasion must be provided.
2. At least 1 /2 inch minimum between oxygen tubes and all rigid moving parts of the aircraft such as levers and rigid control rods.
3. Six inch minimum separation between oxygen tubes and hydraulic, fuel, and electrical system lines and components.

   NOTE: When six inch requirement cannot be complied with, one inch is allowed as long as electrical cables and other lines are supported at least every two inches; and, the oxygen tube(s) is protected by rubber neoprene hose fastened in place with cable ties at the location the specific item crosses or is near the oxygen tube(s). If an item is near the oxygen tube for a certain distance the oxygen tube for that distance must be covered.

4. A minimum of 1/8 inch between tubing and structure adjoining the supporting clamp, as shown in Figure 14-1, Sketch A.
5. Where a tube passes through a grommet, the tube must not bear on the grommet in any way that might cause cutting of the grommet in service as shown in Figure 14-1, Sketch D.
6. While in service, items may receive vibrations causing them to come in contact with other parts of the aircraft. With this in mind, low pressure tubing that is supported well enough to prevent relative motion must have at least a minimum clearance of I /8 inch from a projection (bolt, nut, etc.). Low pressure tubing that cannot be supported will enough to prevent motion must have a minimum clearance of 1 /8 inch allowed after the maximum travel of the tube. High pressure lines are affected similarly but require 1/2 inch minimum clearances. Refer to Figure 14-1, Sketch B.

b. Check the cylinder for DOT identification number and for the date of the last FAA inspection and test.

c. If cylinder is completely empty it must be completely disassembled and inspected in an FAA approved facility before recharging.

d. Any lines that are defective should be replaced with factory replacements.

e. Clean all lines and fittings as described in paragraph 14-9.

f. Use Ribbon Dope Thread Sealant (Permacel 412) on male ends of fittings only. Wrap thread in direction of thread spiral, beginning with the second thread on the fitting. Avoid getting any sealant into the lines.

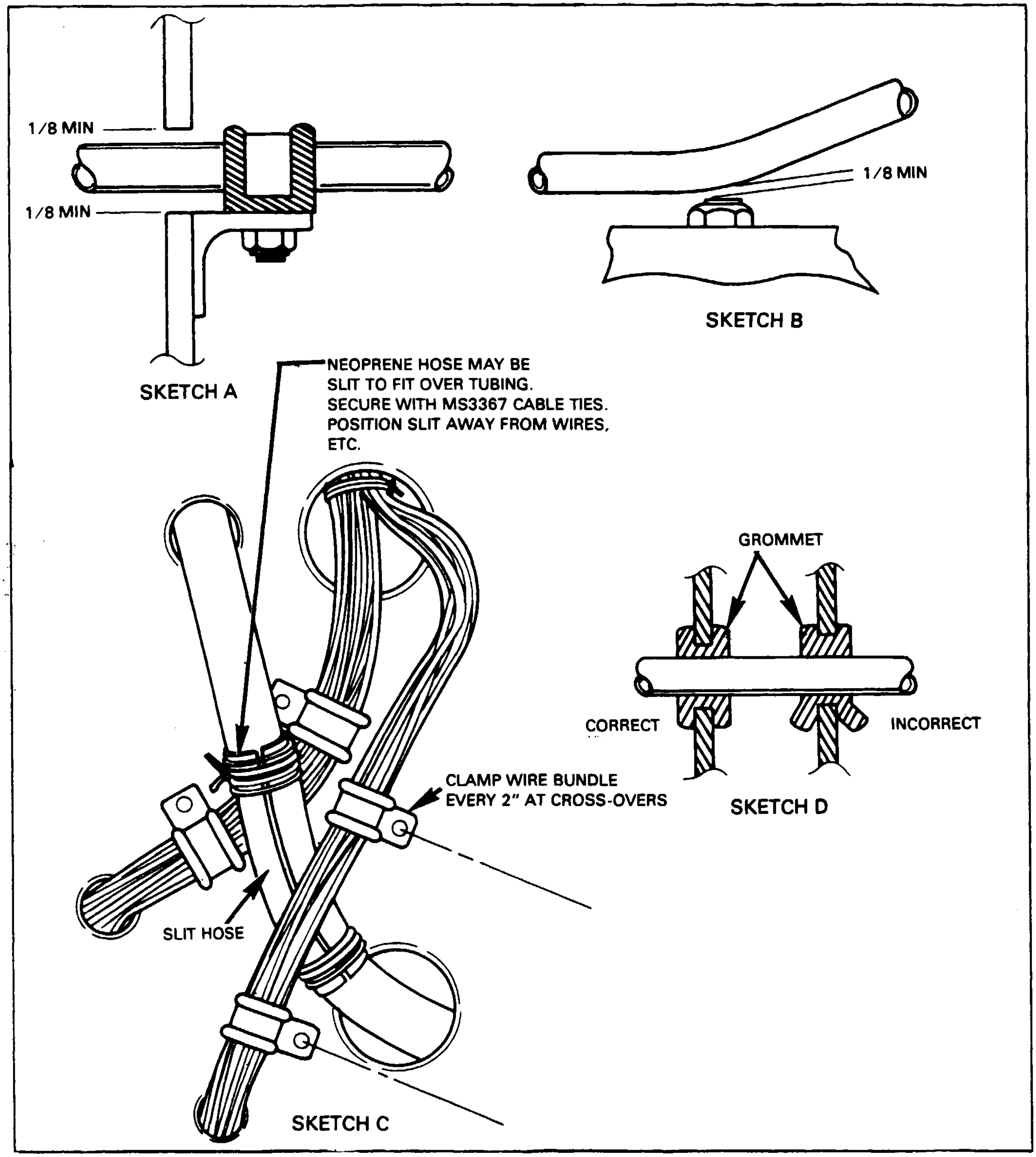
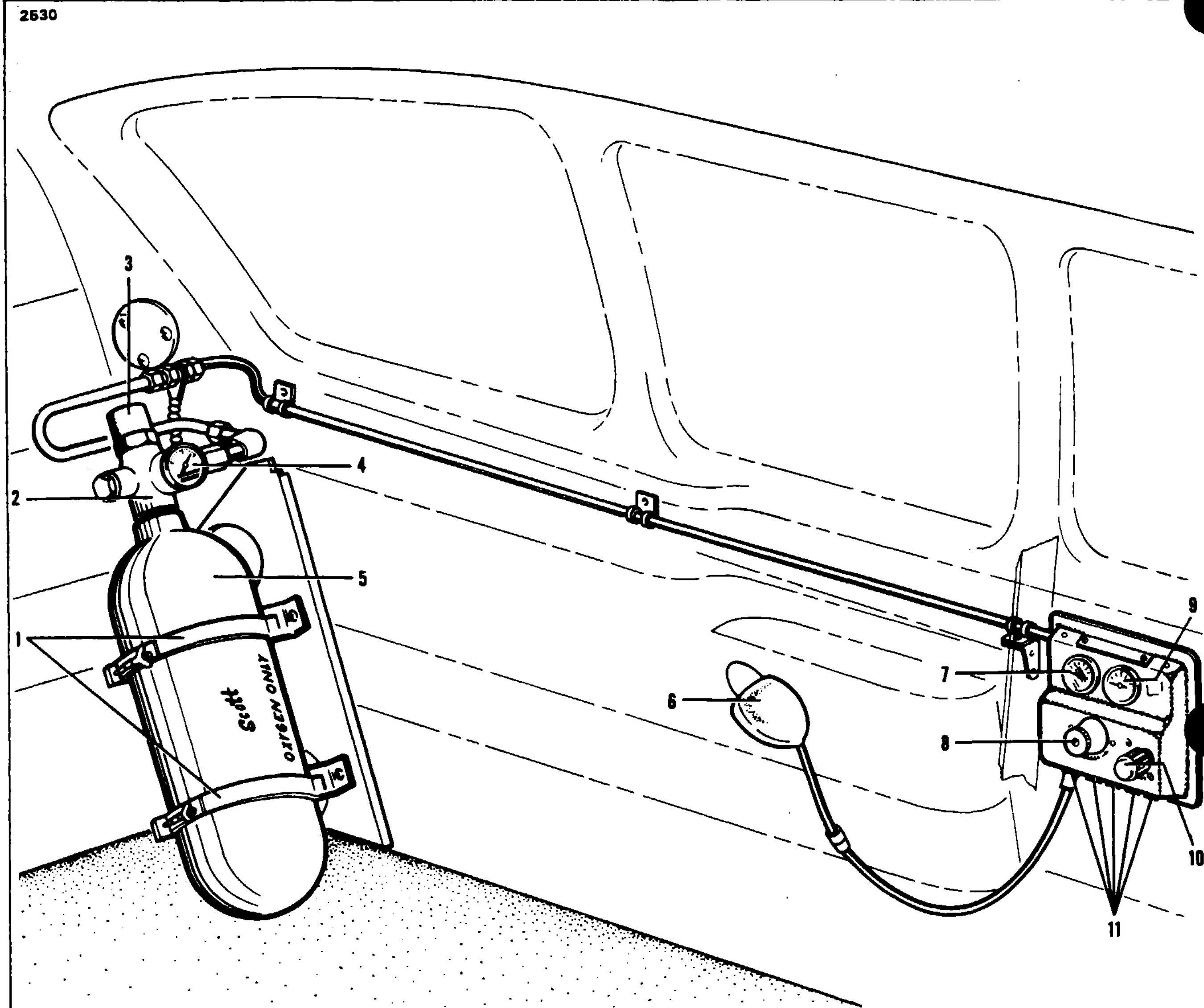


Figure 14-1. Oxygen Tubing Installations



1. MOUNTING STRAPS
2. REGULATOR
3. ON/OFF CONTROL
4. PRESSURE GAUGE
5. CYLINDER
6. MASK AND LINE ASSEMBLY
7. ALTITUDE/FLOW RATE GAUGE
8. FLOW RATE CONTROL
9. PRESSURE GAUGE
10. ON/OFF CONTROL
11. OXYGEN OUTLETS

30050-A

Figure 14-2. Oxygen System Installation, PA-23-250

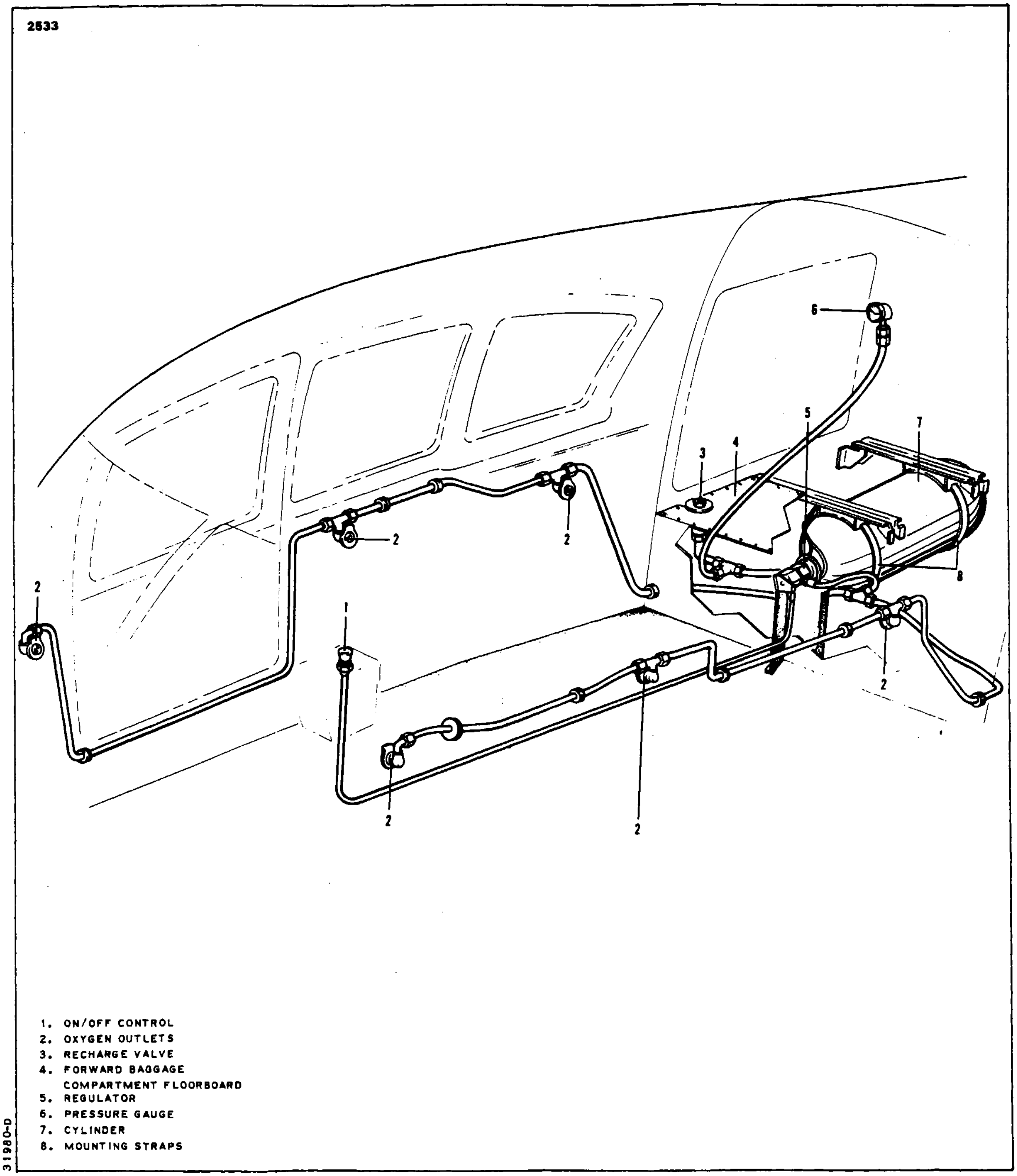


Figure 14-3. Oxygen System Installation, PA-23-250; PA-23-250 (six place), Serial Nos. 27-2000 to 27-3049 incl. and 27-3051 to 27-3153 incl.

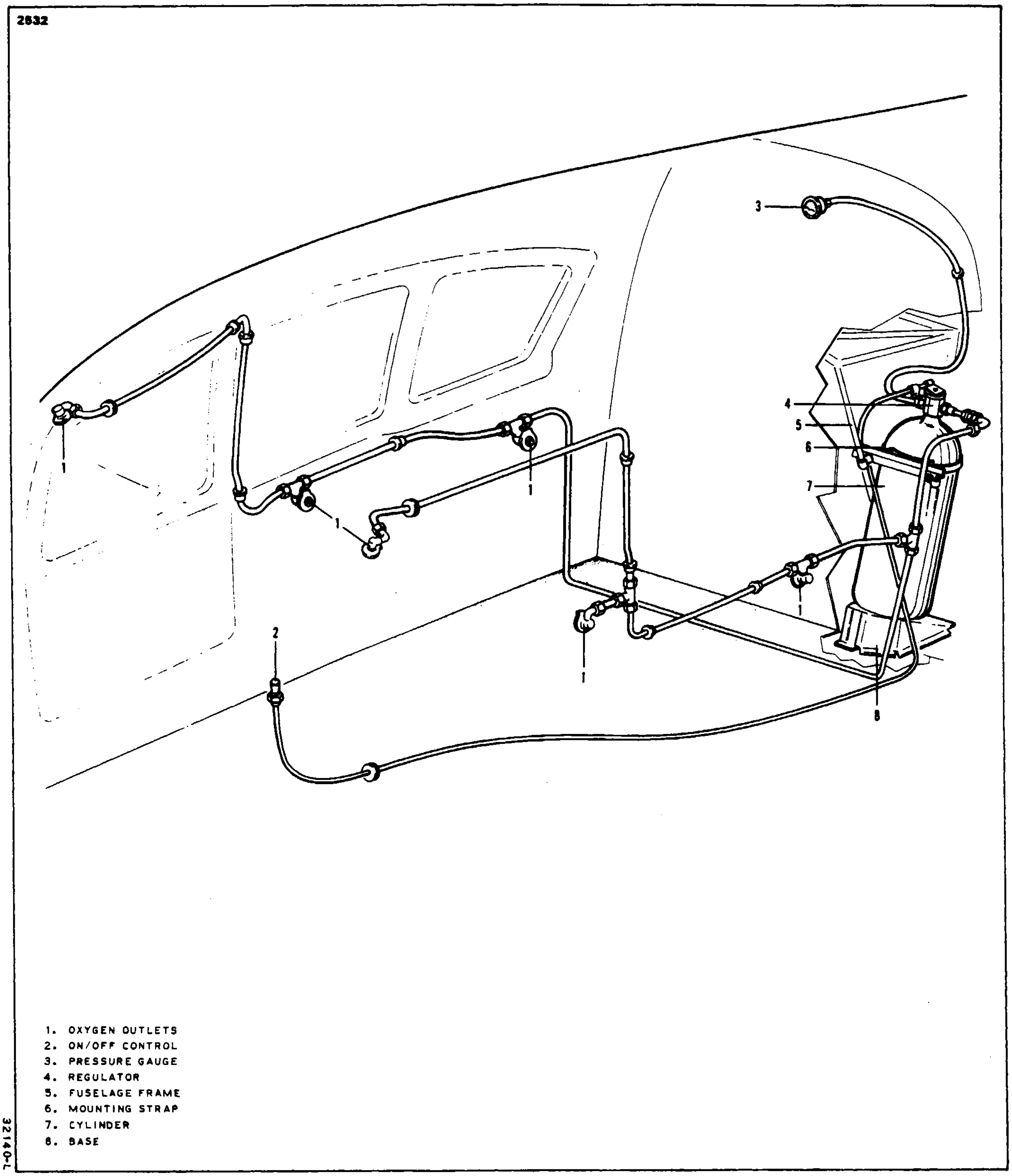


Figure 14-4. Oxygen System Installation. PA-23-250 (six place), Serial Nos. 27-3050, 27-3154 to 27-3836 incl. and 27-3838 to 27-3943 incl.

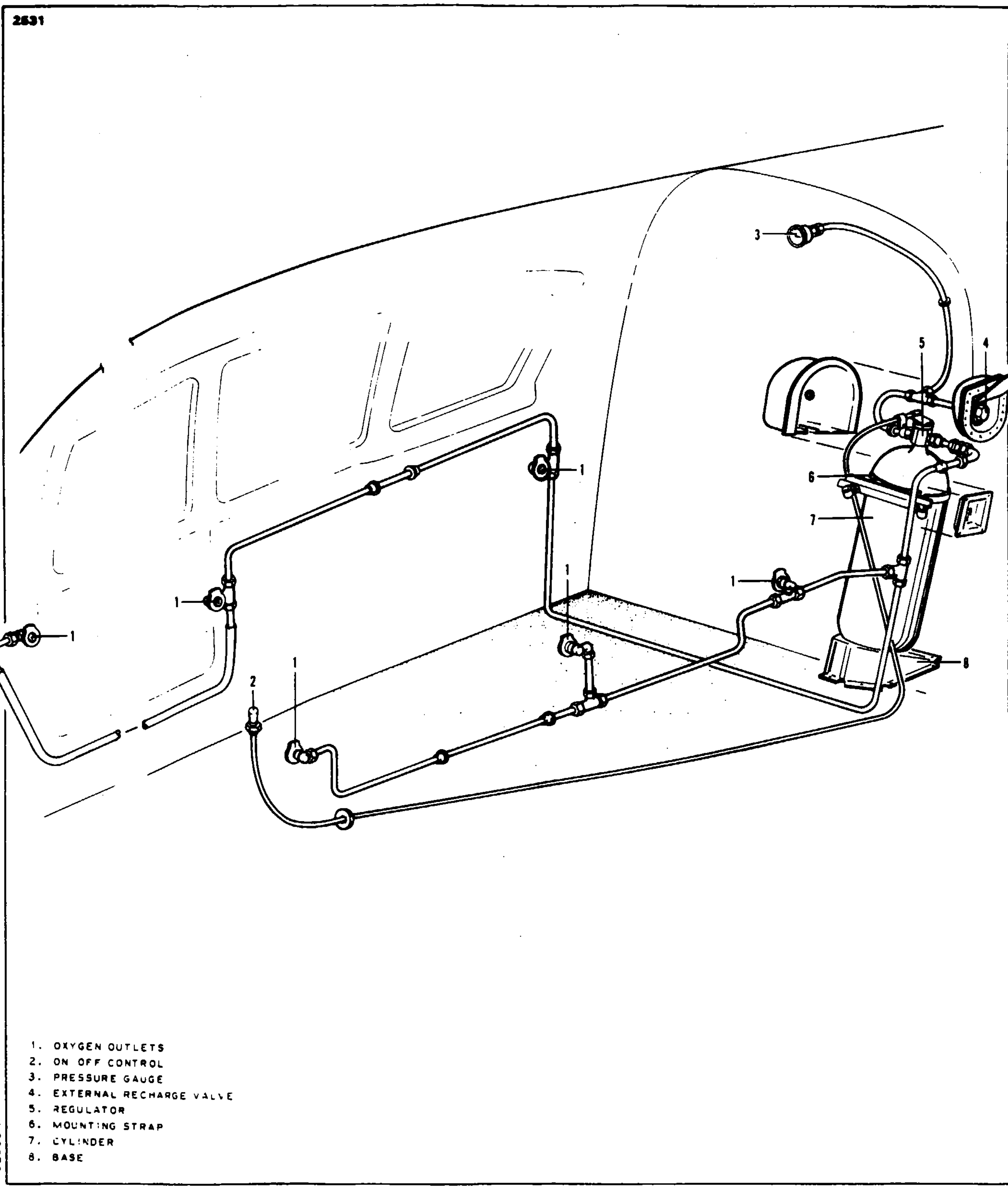


Figure 14-5. Oxygen System Installation, PA-23-250 (six place), Serial Nos. 27-3837, 27-3944 and up

14-9. CLEANING OPERATIONS. To remove oil and grease from tubing and fittings, one of the following cleaning methods may be used:

a. First Method:

1. A vapor degreasing with stabilized trichlorethylene conforming to specification MIL-T-7003 shall be used.

2. Blow tubing clean and dry with a stream of clean, dried, filtered air. Care shall be taken to insure that the interior of the tubing and fittings are thoroughly cleaned.

b. Second Method:

1. Flush with naptha conforming to specifications TT-N-95.

2. Blow clean and dry off all solvent with water pumped air.

3. Flush with anti-icing fluid conforming to specifications MIL-F-566 or anhydrous ethyl alcohol.

4. Rinse thoroughly with fresh water.

5. Dry thoroughly with a stream of clean, dried, water pumped air or by heating at a temperature of 250° to 300° F for a suitable period.

6. The solvents may be reused provided they do not become excessively contaminated with oil. This condition shall be determined as follows:

(a) Evaporate 100 milliliters of the liquid to dryness in a weighed glass dish. Evaporation may be accomplished by heating at 200° F for one-half hour.

(b) After evaporation, cool and weigh the residue. The solvent shall not be used if the residue exceeds 100 milligrams in weight.

c. Third Method:

1. Flush with hot inhibited alkaline cleaner until free from oil and grease.

2. Rinse thoroughly with fresh water.

3. Dry thoroughly with a stream of clean, dried, water pumped air or by heating at a temperature of 250° to 300° F for a suitable period.

14-10. REMOVAL OF OXYGEN CYLINDER AND REGULATOR.

WARNING

Do not attempt to remove the regulator from a charged cylinder.

CAUTION

Be sure the regulator valve is closed before disconnecting any oxygen lines from the cylinder.

a. The oxygen cylinder and regulator, located in the aft cabin section of PA-23-250 airplanes, may be removed as follows:

1. Disconnect the oxygen lines from the regulator.
2. Cut the safety wire loosen and separate the clamps holding the cylinder in place.
3. Remove the cylinder from the airplane. Use caution not to bump the neck of the cylinder and regulator.

b. The oxygen cylinder and regulator, located under the floor of the aft baggage compartment of PA-23-250 (six place) airplanes in Serial Nos. 27-2000 to 27-3049 incl. and 27-3051 to 27-3153 incl., may be removed as follows:

1. Fold the carpet back from the forward part of the aft baggage compartment floor.
2. Remove the forward section of the baggage compartment floorboard by removing attaching screws.
3. Remove the aft baggage compartment trim panel by removing attaching screws.
4. Disconnect the oxygen lines and the ON-OFF control cable from the regulator.
5. Cut the safety wire, loosen and separate the clamps securing the oxygen bottle to the baggage compartment floor channels.
6. Remove the oxygen bottle and regulator through the rear of the aft baggage compartment.

c. The oxygen cylinder and regulator, located in the aft baggage compartment of the PA-23-250 (six place) airplane with Serial Nos. 27-3154 and up, may be removed as follows:

1. Disconnect the oxygen lines and the ON-OFF control cable from the regulator.
2. Cut the safety wire, loosen and separate the clamps holding the cylinder in place.
3. Remove the cylinder from the airplane. Use caution not to bump the neck of the cylinder and regulator.

14-11. INSTALLATION OF OXYGEN CYLINDER AND REGULATOR.

a. On PA-23-250 airplanes, the oxygen cylinder and regulator may be installed in the following manner:

1. Position the cylinder and regulator inside the aft section of the cabin.
2. Connect the clamps securing the bottle in place. Safety the wing nuts.
3. Connect the oxygen lines to the regulator.

b. On PA-23-250 (six place) airplane with Serial Nos. 27-2000 to 27-3049 inclusive and 27-3051 to 27-3153 inclusive, the oxygen cylinder and regulator may be installed in the following procedure:

1. Position the oxygen bottle and regulator under the aft baggage compartment floor.
2. Secure the bottle and safety the clamps.
3. Connect the oxygen lines and ON-OFF control cable to the regulator.
4. Install the forward section of the baggage compartment floor and the aft trim panel with attaching screws.
5. Re-position the baggage compartment floor carpet.

c. On PA-23-250 (six place) airplanes with Serial Nos. 27-3154 and up, the oxygen cylinder and regulator may be installed in the following manner:

1. Position the cylinder and regulator inside the aft baggage compartment.
2. Connect the clamps securing the bottle in place. Safety the wing nuts.
3. Connect the oxygen lines and the control cable to the cylinder.

NOTE

Refer to Section II for filling instructions.

14-12. REMOVAL OF OXYGEN CYLINDER RECHARGE VALVE.

CAUTION

Before attempting to remove the recharge valve, ascertain the oxygen bottle is discharged or the regulator valve is off.

a. The recharge valve on PA-23-250 (six place) airplanes with Serial Nos. 27-2000 to 27-3049 inclusive; 27-3051; 27-3153 and up may be removed by the following procedure:

1. Remove the screws around the base of the recharge valve.
2. Pull the carpet back from around the forward edge of the baggage compartment floor.
3. Remove the screws around the front section of the baggage compartment floor and around the recharge valve. Remove the floor panel.
4. Remove the recharge valve by disconnecting the line fitting just below the valve. Cover the open line to prevent contamination.

b. Remove the recharge valve as follows on PA-23-250 (six place), Serial Nos. 27-3050, 27-3154 and up which incorporate an external valve along the left side of the fuselage.

1. Remove the cover from the top of the oxygen cylinder by removing attaching screws.

2. Disconnect the line fitting to the recharge valve. Cover the open line to prevent contamination.
3. Remove the valve by removing the screws securing it to the side of the fuselage.

14-13. INSTALLATION OF OXYGEN CYLINDER RECHARGE VALVE.

a. The recharge valve on PA-23-250 (six place) airplanes with Serial Nos. 27-2000 to 27-3049 inclusive; 27-3051; 27-3153 and up may be installed by the following procedure:

1. Position the valve and tighten the line fitting.
2. Install the forward section of the baggage compartment floor panel and secure with attaching screws.
3. Re-position the carpet and install the screws around the base of the recharge valve.

b. Install the recharge valve as follows on PA-23-250 (six place) airplanes with Serial Nos. 27-3050, 27-3154 and up which incorporate an external valve along the left side of the fuselage.

1. Position the valve from the outside of the fuselage and secure with attaching screws.
2. Connect the recharge valve to the oxygen cylinder inside of the baggage compartment.
3. Install the cover over the top of the cylinder and secure with attaching screws.

14-14. REMOVAL OF PRESSURE GAUGE. Ascertain that the control valve is closed and there is not pressure in the system.

a. Disconnect the connector from the back of the pressure gauge.
b. Loosen and remove the retainer nut and clamp holding the gauge in place.
c. Pull the gauge out from the front of the panel.

14-15. INSTALLATION OF PRESSURE GAUGE.

a. Place the gauge into the panel from the front and replace the clamp and retainer nut on the back of the gauge. Be sure the gauge is positioned properly before tightening the clamp.
b. Reconnect the connector at the rear of the gauge.

14-16. REMOVAL OF OUTLETS.

a. Using a suitable spanner wrench, remove the outer half of the outlet.

b. Remove the screws holding the trim panel and remove the panel.

c. The outlet can now be removed from the low pressure line.

14-17. INSTALLATION OF OUTLETS.

a. Apply a sealant to the male end of the fitting.

b. Connect the outlet to the low pressure line.

c. Position the trim panel and secure with screws.

d. Position the outer half outlet and secure with a suitable spanner wrench.

e. Torque the fittings into the outlets approximately 30 inch-pounds. Do not over torque as this could damage the outlet.

14-18. PURGING OXYGEN SYSTEM. The system should be purged whenever the cylinder pressure fails below 50 psi or if any lines are left open for any length of time. Also, whenever there are any offensive odors present it will be necessary to purge the system. Use the following procedure:

a. Park the airplane in a NO SMOKING area.

b. Keep all doors and windows open.

c. Be sure all electrical systems are shut off.

d. Connect the oxygen recharging unit to the filler valve.

e. Plug the oxgyen masks into the outlet valves and turn on the system.

f. Set the recharging unit pressure regulator to deliver 50 psi and let the system purge for one hour. If any odor is still present, repeat the procedure for one or more hours. If the odor persists after the second purging, replace the cylinder.

14-19. CLEANING OF FACE MASKS. The disposable masks are designed for one-time use and require [illegible] maintenance. The pilots and co-pilots masks can be cleaned as follows:

a. Remove the microphone from the mask.

b. Remove the sponge rubber discs from the mask turrents. Do not use soap to clean sponge rubber discs, as this would deteriorate the rubber and give off unpleasant odors. Clean in clear water and squeeze dry.

c. Wash the rest of the mask with a very mild solution of soap and water.

d. Rinse the mask thoroughly to remove all traces of soap.

e. Make sure the slides of the breathing bag do not stick together while drying, as this may decrease the life of the rubber in the bag. The mask can be sterilized with a solution of 70 percent ethyl alcohol.

14-20. PROPELLER DE-ICER SYSTEM.

14-21. DESCRIPTION AND PRINCIPLES OF OPERATION. (Refer to Figure 14-6 or 14-7.) This section provides service and maintenance procedures for the B. F. Goodrich Electrical Propeller De-Icing System. Each Propeller De-Icing System consists of an electrically-heated De-Icer (9) bonded to each propeller blade, a slip ring assembly (8) with a brush block assembly (7) to transfer electrical power to the rotating De-Icers, a timer (1), an ammeter (5), and a control switch (3) together with wiring harnesses to complete the circuit.

To conserve electrical power, current is cycled to the De-Icer heaters at timed intervals rather than continuously. Each De-Icer has two separate heaters, one for the outer half and one for the inner half. By heating all outer or inner heaters on only one propeller at a time, rotational balance is held during de-icing. Current is drawn from the airplane electrical system through the switch, ammeter and timer. The timer successively delivers current via the slip ring and brush block arrangement to the outer heaters on the right propeller, the inner heaters on the same propeller, the outer heaters on the left propeller and the inner heaters on the left propeller. The timer energizes each of these four phases in turn for about 30 seconds and then repeats the cycle as long as the control switch is on. The cycling sequence given is vital so that outboard heaters on each propeller operate before the inboard heaters. Refer to Figures 14-8 through 14-11 which represent a typical, not a particular, system. Correct circuit diagrams for each system are shown in Figures 14-18 and 14-19. The use of heat at the ice adhesion surface reduces the grip of the ice which is then removed by the centrifugal effect of rotation and the blast of the airstream. Note that a minimum thickness or weight of ice must build-up before centrifugal force becomes important. The system may be used continuously in flight if needed.

NOTE

Heating may begin at any phase in the cycle depending on the timer position when the switch was turned off from previous use.

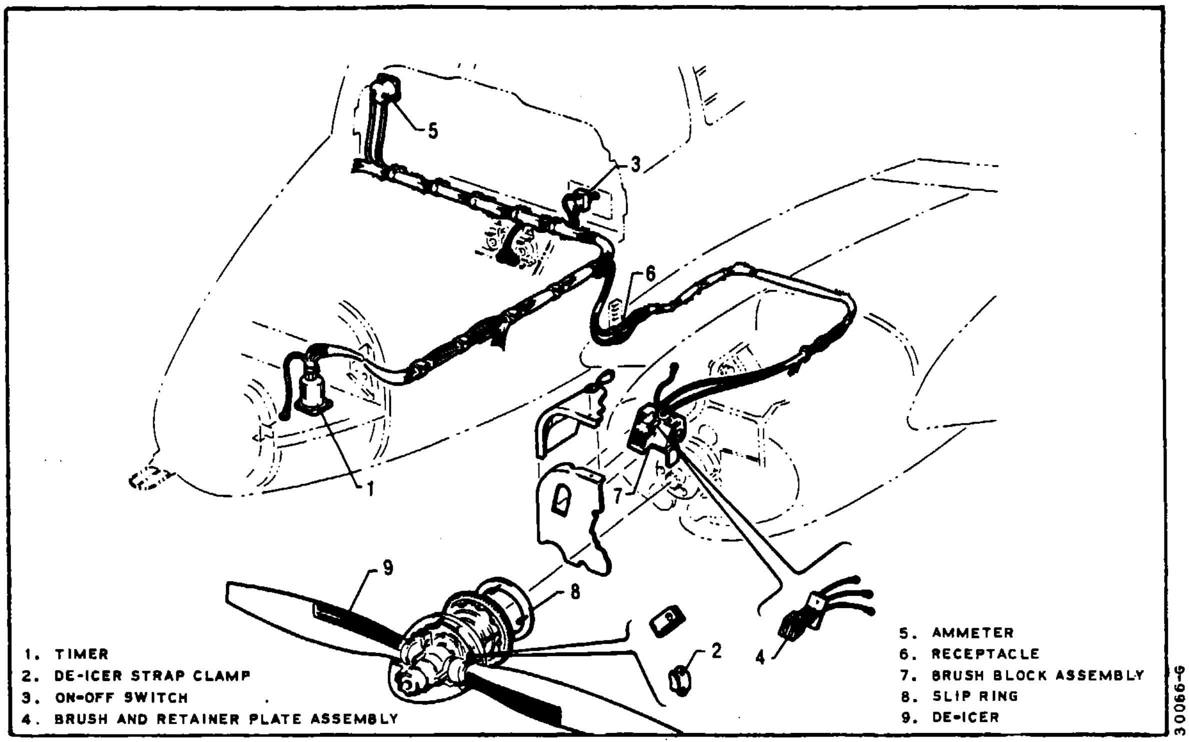


Figure 14-6. Propeller De-Icer Installation, PA-23-250

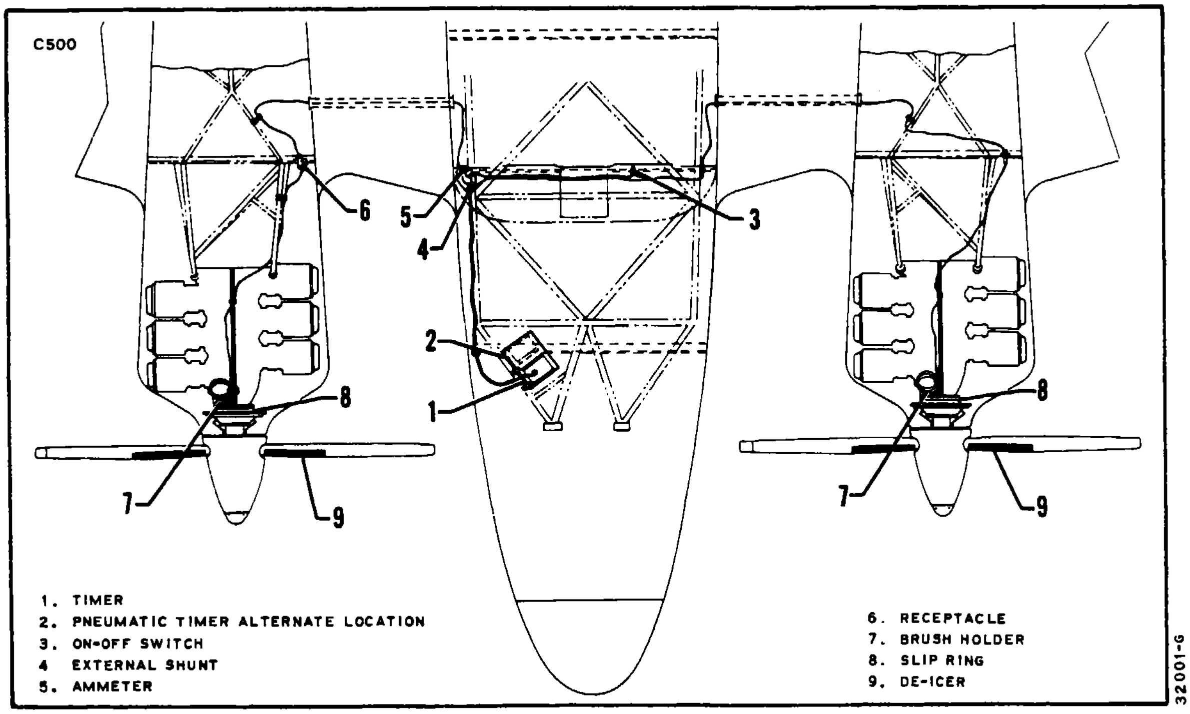


Figure 14-7. Propeller De-Icer Installation, PA-23-250 (six place)

a. De-Icers: The De-Icers contain special heater wires protected by fabric plies and by oil and abrasion-resistant rubber. The side of the De-Icer cemented to the prop has a dull finish whereas the air side finish is "glossy". B. F. Goodrich Report 59-728 covers installation of the De-Icers on the propellers; a copy of such report should be kept with this manual.

NOTE

Each De-Icer has a separate lead for the inboard and outboard heater and a third lead which is a common ground. These leads are so marked on all but a few early de-icers. An unmarked ground can be identified by using an ohmmeter across the three possible pairs of leads. Two pair will show identical resistance; the third pair will show double this resistance. The latter are the "hot" leads and the lead not in this pair is the ground lead.

NOTE

The wiring diagrams in Figures 14-18 and 14-19 show the brush, slip ring and De-Icer connections, which vary according to the system number at hand. Be sure to follow the wiring diagram for the specific system involved.

b. Slip Rings - Brushes and Brush Blocks: To transfer electrical power to the rotating De-Icers, a brush block assembly is mounted to the engine or similar stationary member and has brushes which are spring loaded to press against the revolving slip rings. The slip ring assembly is either mounted on the aft side of the spinner bulkhead or crankshaft flange or, alternately, is provided as a slip ring gear assembly which replaces the original starter ring gear of the engine.

c. Timer: The timer is a sealed unit. If found inoperative, it must be replaced as an assembly - no field repairs are authorized. The two types of timers used are interchangeable electrically. By drilling new mounting holes, timers of either type may be used as replacement for the other.

d. Ammeter: The ammeter is designed for each particular system and it is therefore important that the correct replacement part number be used if replacement should be required. In the event of low airplane battery voltage (very possible in ground checks), the ammeter readings will be lower than at full voltage. Provided the ammeter needle reads in the shaded range on the scale, current flow is to be considered as normal.

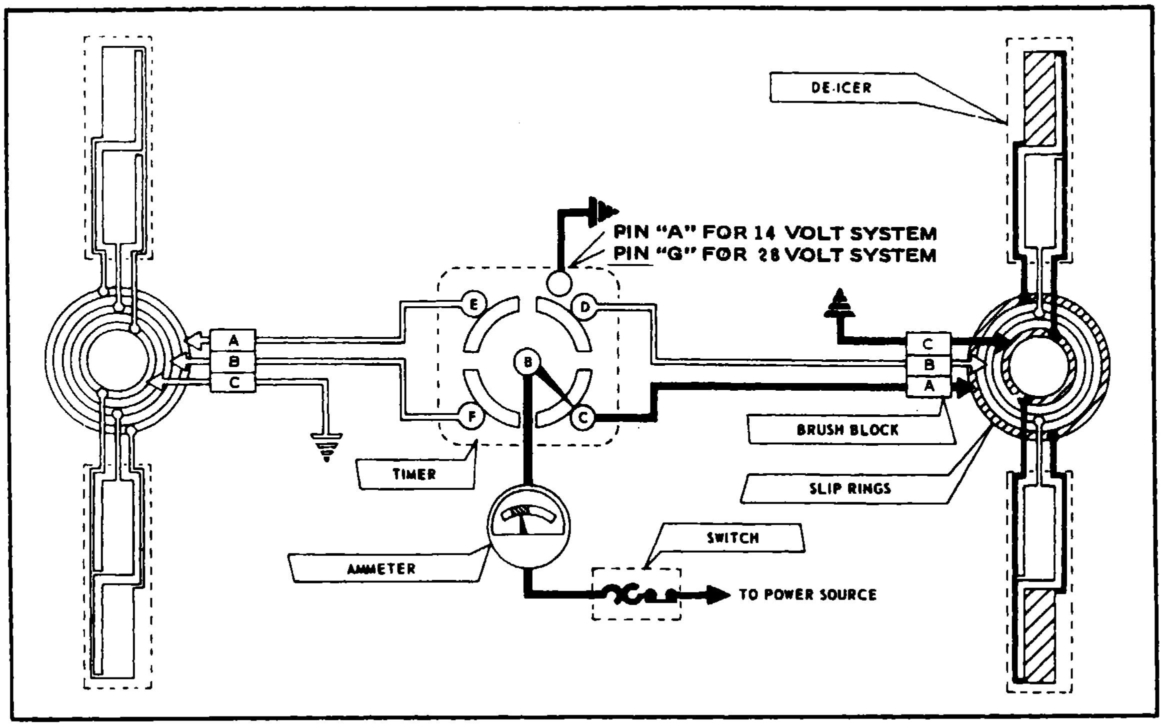


Figure 14-8. Electrical Diagram Showing Cycle Sequence, Phase 1

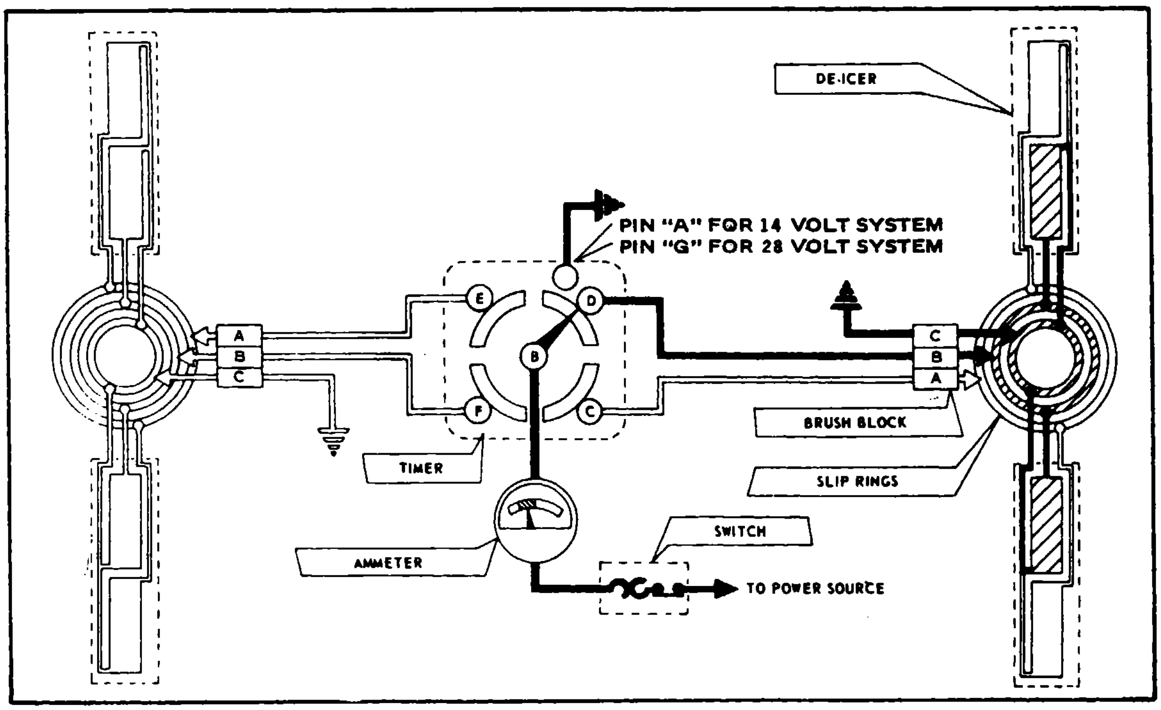


Figure 14-9. Electrical Diagram Showing Cycle Sequence, Phase 2

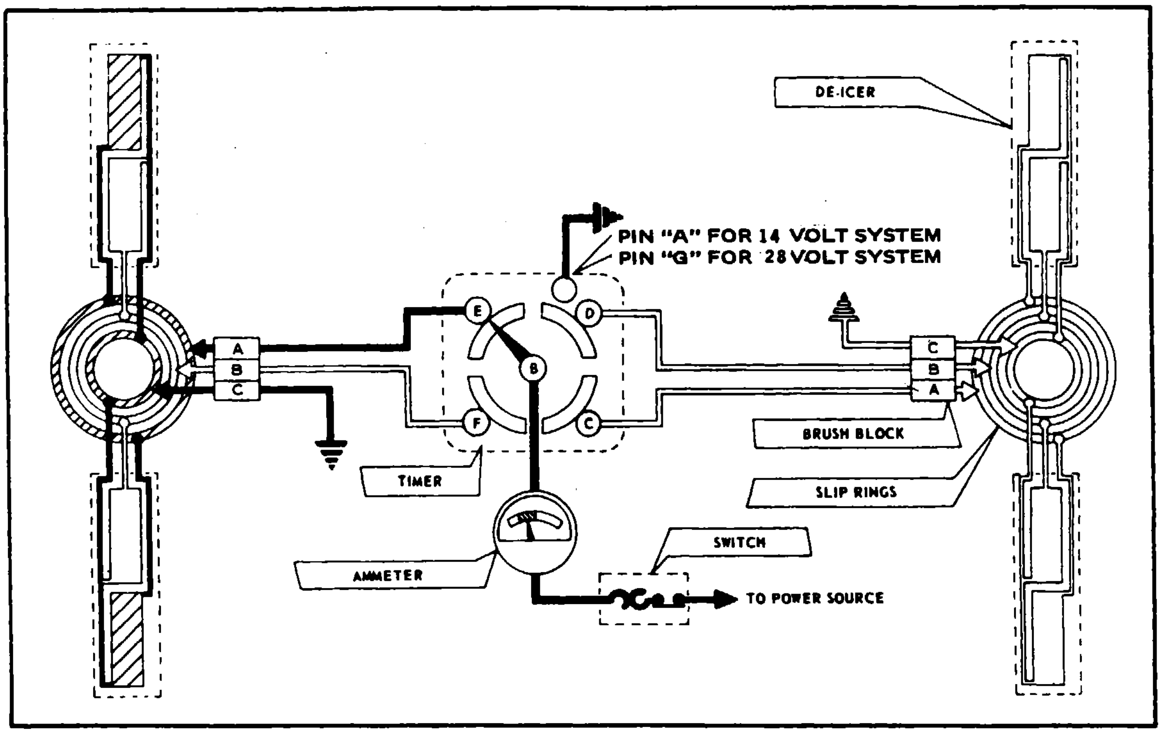


Figure 14-10. Electrical Diagram Showing Cycle Sequence, Phase 3

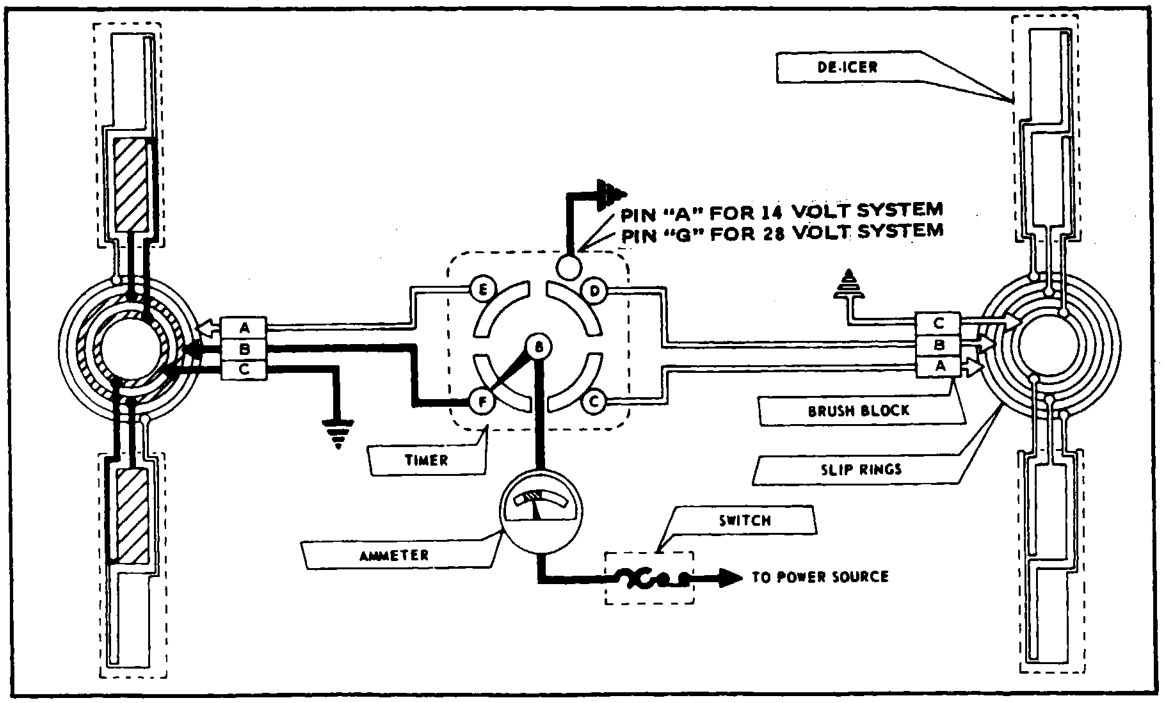


Figure 14-11. Electrical Diagram Showing Cycle Sequence, Phase 4

14-22. DE-ICER SYSTEM OPERATIONAL CHECK.

a. Chock the wheels and operate the engine at near take-off power.

b. Turn De-Icer system switch ON and observe De-Icer ammeter for at least two minutes.

c. The ammeter needle must "flicker" approximately every 30 seconds as the step switch of the timer operates.

d. With engines stopped, turn De-Icer switch ON and feel De-Icers on propellers for proper sequence of heater operation.

e. The starting point is not important but the sequence is vital and must be: Right Outboard, Right Inboard, Left Outboard, Left Inboard heaters, in that order.

f. Temperature rise should be noticeable and each heater should warm for about 30 seconds.

g. Local hot spots indicate surface damage of De-Icer heaters and should be repaired.

14-23. INSPECTION.

14-24. FIFTY-HOUR INSPECTION.

a. Lock brakes and operate engines at near take-off power. Turn De-Icer system switch ON and observe De-Icer ammeter for at least 2 minutes. Ammeter needle must reset within the shaded band except for a "flicker," each approximately 30 seconds, as the step switch of the timer operates. If not, refer to the appropriate entry of the troubleshooting table, Table XIV-III.

WARNING

Stand clear of propellers - be sure ignition switch is OFF.

b. With engines stopped, turn De-Icer switch ON and feel De-Icers on propellers for proper sequence of heater operation. The starting point is not important but sequence is vital and must be: RIGHT OUTBOARD, RIGHT INBOARD, LEFT OUTBOARD AND LEFT INBOARD heaters, in that order. Temperature rise should be noticeable and each heater should warm for about 30 seconds. Local hot spots indicate service damage of De-Icer heaters - inspect and repair as in paragraph 14-32.

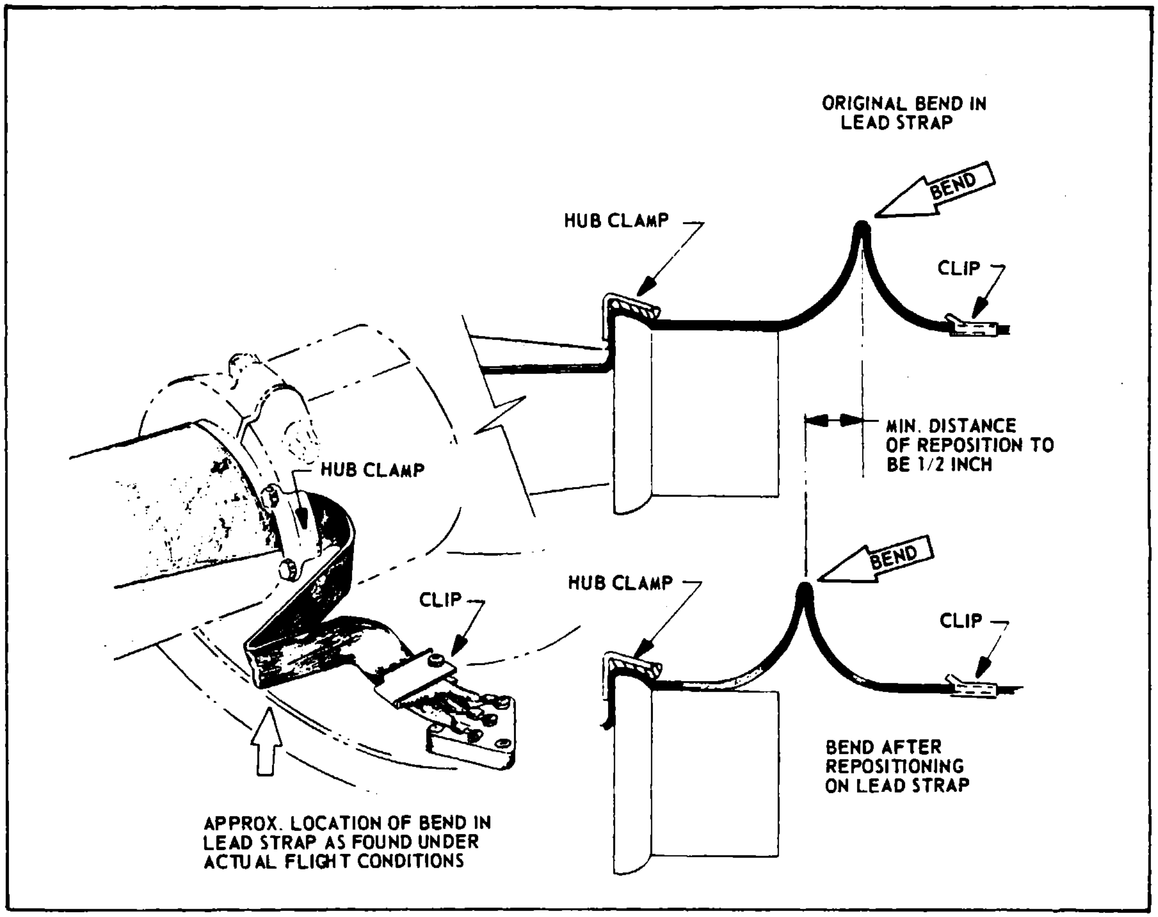


Figure 14-12. Relocating Bend in De-Icer Lead

c. Remove spinner dome and open access doors as required. With assistant observing De-Icer ammeter and with De-Icer switch ON, flex all accessible wiring - particularly the De-Icer lead straps, leads from slip ring assembly and the firewall electrical connectors and their wiring. Any movement of the ammeter needle - other than the "30 second flicker" of cycling - indicates a short or open that must be located and corrected. (Refer to paragraph 14-25, f.)

d. Relocate bend of lead strap between hub clamp and clip as in Figure 14-12. This periodic relocation increases the life of the straps.

e. Check for damaged brush rods, springs or for worn or damaged brushes. Refer to Figure 14-13 or 14-14 as applicable, to determine brush wear.

NOTE

Brush modules should be replaced when 3/8 inch of brush material remains; brush modules MUST be replaced when 1/4 inch remains. Measure as shown in Figure 14-14.

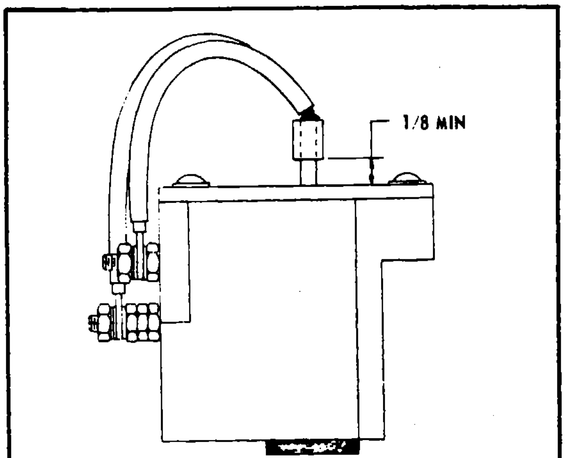


Figure 14-13. Determining Brush Wear

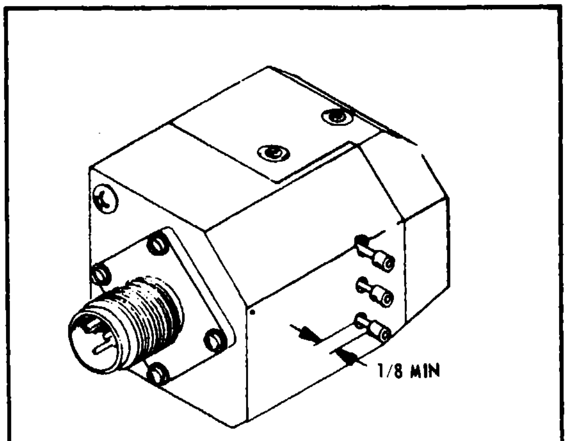


Figure 14-14. Determining Brush Wear

14-25. ONE-HUNDRED HOUR INSPECTION.

a. Conduct 50-hour inspection.

b. Check for radio noise or radio compass interference by operating engine at near take-off power and with radio gear ON while turning De-Icer switch ON and OFF. If noise or interference occurs with De-Icer switch ON and disappears when switch is OFF, see Troubleshooting.

c. Visually and by feel check for clamps, clips, mountings, electrical connections and connectors for tightness and electrical soundness. Look for loose, broken or missing safety wire.

d. De-Icers: Closely check De-Icers for wrinkled, loose or torn areas, particularly around the outboard end and where the strap passes under the hub clamp. Look for abrasion or cuts, especially along the leading edge and the flat or thrust face. If heater wires are exposed in damaged areas or if rubber is found to be tacky, swollen or deteriorated (as from oil or fluids solvent contact), replace the damaged De-Icer.

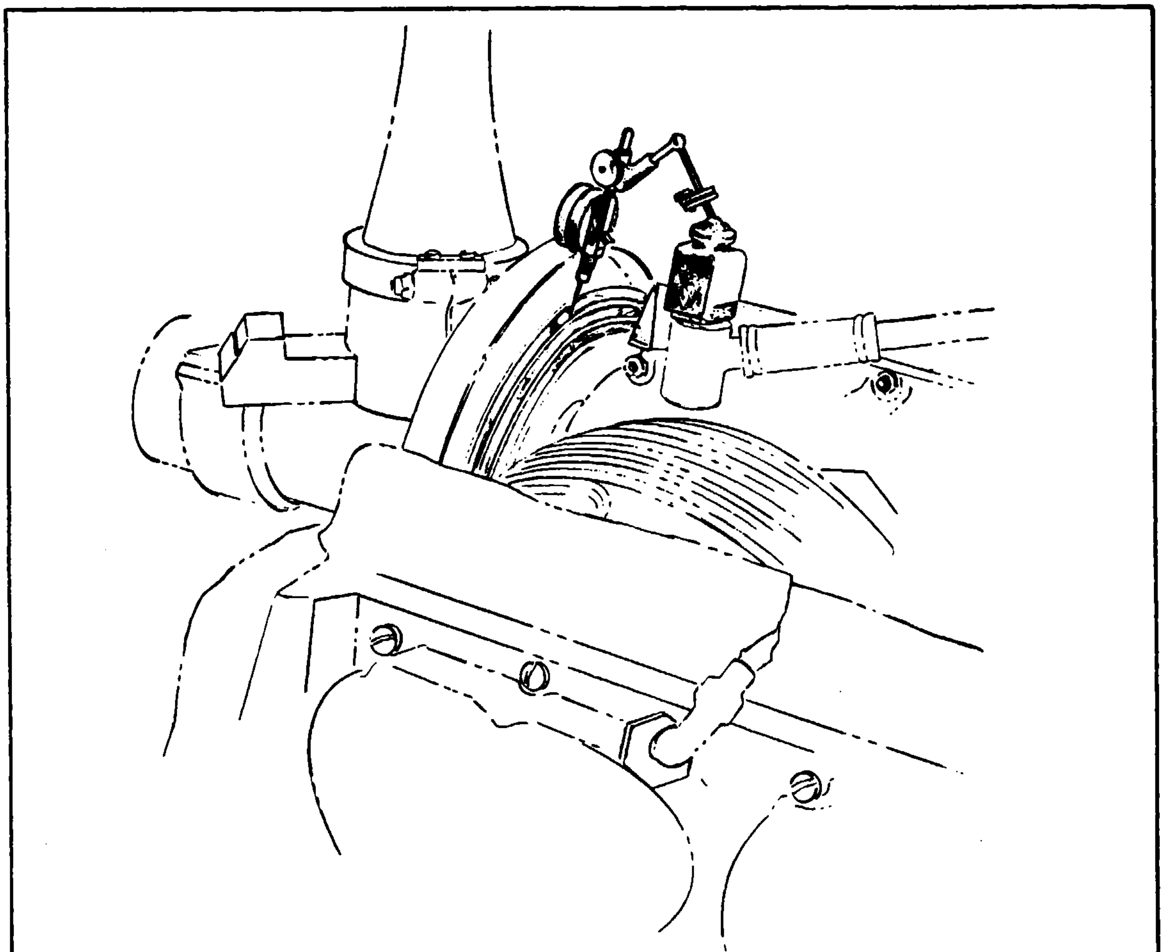


Figure 14-15. Checking Slip Ring Run-Out

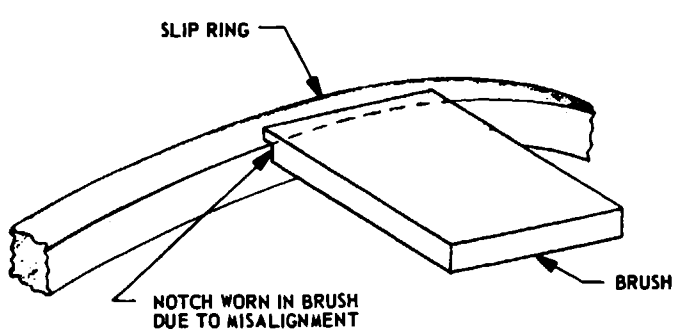


Figure 14-16. Wear Pattern of Misaligned Brush

NOTE

Check that hub clamps are tight. Look for cracks or other damage. See that cushioning material is not missing or damaged, either under hub clamp or on edge of spinner dome. Manually operate propeller from "full pitch" to "feathering" and check that De-Icer lead straps do not come under tension or are pinched by the propeller blade. (Refer to Figures 14-28 and 14-29.)

e. Slip Rings: Visually and by feel check slip rings for gouges, roughened surface, cracks, burned or discolored areas and for deposits of oil, grease or dirt.

1. Clean greasy or contaminated slip rings with CRC 2-26 solvent (from Corrosion Reaction Consultants, Inc. of Philadelphia, Pa.). In such case, a run-in time of 5 hours engine operation must be allowed before De-Icer system is turned on.

2. If uneven wear is found or if wobble is noticed, set up dial indicator as in Figure 14-15 to check alignment of slip rings on prop shaft. (Push in to turn prop to eliminate play in prop thrust bearing.) If runout over 360 degree rotation is over 0.005 inches total or exceeds 0.002 inches in any 4 inch arc, refer to paragraph 14-51.

f. Brush Block - Brushes: Examine mounting brackets and housings for cracks, deformation or other physical damage. See that leads are not chafed or binding. Check for tight connections.

1. Test that each brush rides fully on its slip ring over 360 degrees. Figure 14-16 shows wear pattern if this condition is not correct. If off alignment, shim under brush block or elongate holes at mounting brackets to raise or lower brush block to proper position. (If brushes ride both high and low in relation to slip rings in 360 degree rotation, the slip ring assembly is eccentrically mounted and the spinner bulkhead must be replaced as in paragraph 14-52.

2. Check for proper clearance of brush block to slip rings as in Figure 14-17. If not correct, loosen mounting screws and move in elongated holes to correct block position before tightening securely. (If necessary, shim between thrust bearing plate and mounting plate.)

3. By eye, check brush block to have about 2 degree angle of attack as in Figure 14-17. If not, loosen mounting bolts and twist block but be sure to hold clearance limits shown, when tightening.

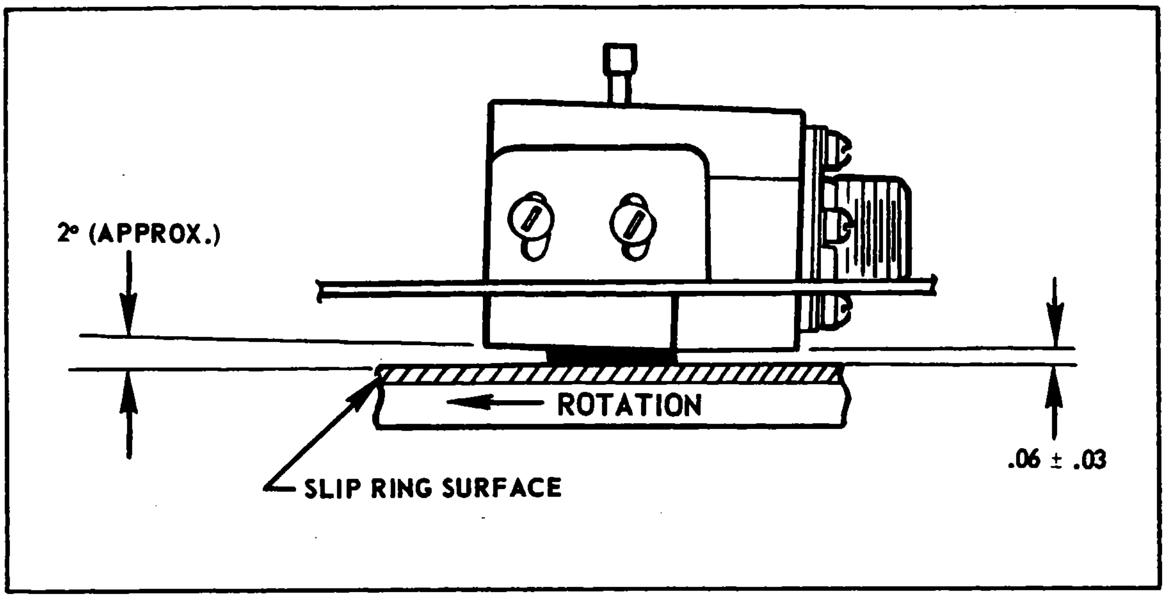


Figure 14-17. Brush Block Positioning

g. System Wiring: With De-Icer system operating, have assistant observe ammeter while visually inspecting and physically flexing wiring from brush blocks thru firewall, to timer, to ammeter, to switch and to airplane power supply. The ammeter will flicker as the timer switches each 30-seconds in the cycle. Jumps or flickers at other times indicate loose or broken wiring in the area under examination at that moment. In such case, check continuity thru affected harness, each wire in turn, while flexing and prodding area that gave initial indication of trouble. Use wiring diagram to trace circuitry.

14-26. TROUBLESHOOTING. (Refer to Table XIV-I.)

14-27. HELPFUL TIPS.

a. If the ammeter reading drops to one-half normal current, this indicates that one heater circuit is open from the slip ring assembly to the De-Icer heater or possibly improper connections allowing both inboard and outboard units to heat at the same time.

b. Excess current reading on the ammeter always indicates a power lead is shorted to ground. In such case, it is possible that the excess current may have welded the time contacts in one phase. The result may be a timer which does not cycle or, possibly, the timer may continue to cycle but also feeds the welded contacts continuously. The latter condition will, in the heat test, show as two phases heating simultaneously, over 3 of the 4 phases. Thus, when trouble of this nature is found it is vital that the grounded power lead be located and corrected. Otherwise, a new timer may suffer the same internal damage during first use of the system.

c. A considerable number of timers have been returned for repair which proved, on test, to be fully workable. Before concluding that the timer is at fault, accomplish the test described in paragraph 14-28.

d. In cases where brush breakage or rapid brush wear is found to be a cause of trouble, be sure to check brush block alignment and adjustment as in paragraph 14-25, f. Also, check slip ring alignment per paragraph 14-51.

14-28. USING AMMETER. Whether in flight or during ground testing, the ammeter can be used to indicate the general nature of most electrical problems. The "Troubleshooting" chart is primarily based on this use of the ammeter and assumes that the user does understand all normal operating modes of the system as given in paragraph 14-21. Read all of the trouble entries to locate that which matches conditions of the particular system being checked. The causes and remedies in the same box then show the recommended sequence of check.

NOTE

When troubleshooting, first use the "ammeter test" and "heat test", paragraph 14-24, a and b, to determine which circuits are involved. Use circuit diagrams to check voltages or continuity.

14-29. TIMER TEST. Field experience indicates that too often the timer is considered at fault when the true trouble lies elsewhere. Before removing a timer as defective, perform this test:

a. Disconnect harness at timer and with De-Icer switch ON, check voltage from pin B of harness plug to ground. If system voltage is not present, the fault is not in the timer. If system voltage is present at pin B, check ground circuit using ohmmeter from either harness plug pin A (if 14-volt system) or pin G (if 28-volt system) to ground. If no circuit is shown, the fault is in ground lead, not in timer. If ground connection is open, the timer step switch will not change position.

b. When power and ground circuits have been checked, connect a jumper wire from pin B of harness to B contact of timer socket to power timer. Connect a jumper wire from either pin A (if 14-volt system) or pin G (if 28-volt system) of harness to A or G contact respectively of timer socket to complete the power circuit. Now use voltmeter from ground to the timer socket and check that timer is cycling to deliver system voltage to C, D, E and F contacts in that order (the starting point is not important but sequence must be as given). Each of these four contacts must deliver voltage for approximately 30-seconds, in turn, and there must be zero voltage on the three contacts not energized.

c. If the timer meets these requirements, it is not the cause of trouble. If it fails to perform as indicated, the trouble does lie in the timer and it should be replaced.

14-30. DE-ICER RESISTANCE CHECK. To determine incorrect resistance, short or open at the brush-to-slip ring contact, disconnect harness at the timer and use low-range ohmmeter to read resistance from each De-Icer circuit lead (pins C, D, E and F of harness plug) to ground. If not in the range shown in the table following, disconnect the De-Icer lead straps to measure heater resistances individually as in the last line of the table. If first check is off limits but second check is OK, the trouble is probably in the brush-to-slip ring area; if the second check is off limits, the De-Icer concerned is damaged and must be replaced.

DE-ICER RESISTANCE CHART (Ohms)		
	No. 4E1188	No. 4E1214
IN PARALLEL (At harness) Two blades	2.30 to 2.65	0.60 to 0.69
INDIVIDUAL HEATER	4.58 to 5.26	1.15 to 1.33

14-31. BRUSH BLOCK RESISTANCE CHECK. To determine when open, short or high resistance is present in brush block, use low range ohmmeter to measure resistance from face of brush to its terminal studs or receptacle pin. If over 0.013 ohms, locate and repair cause of high resistance; if zero, locate and repair open or ground or else replace the brush. Check resistance between the three terminal studs or receptacle pins. This resistance should not be less than 0.5 megohms.

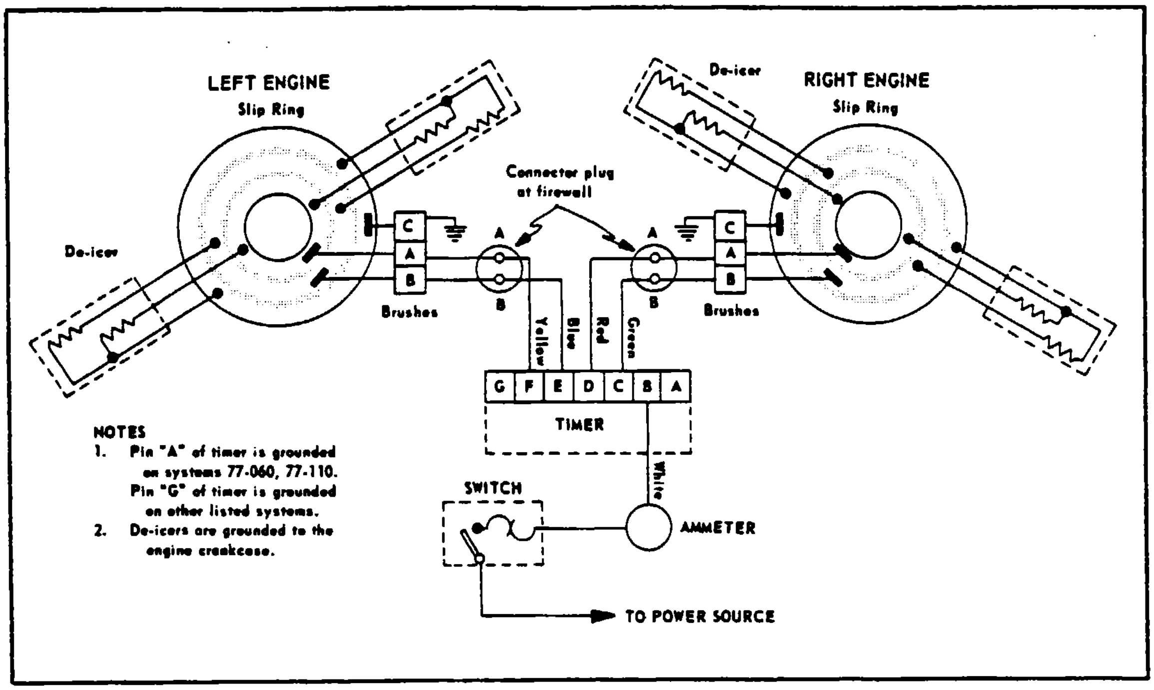


Figure 14-18. Schematic Wiring Diagram, PA-23-250; PA-23-235; and PA-23-250 (six place). Serial Nos. 27-2000 to 27-2504 incl.

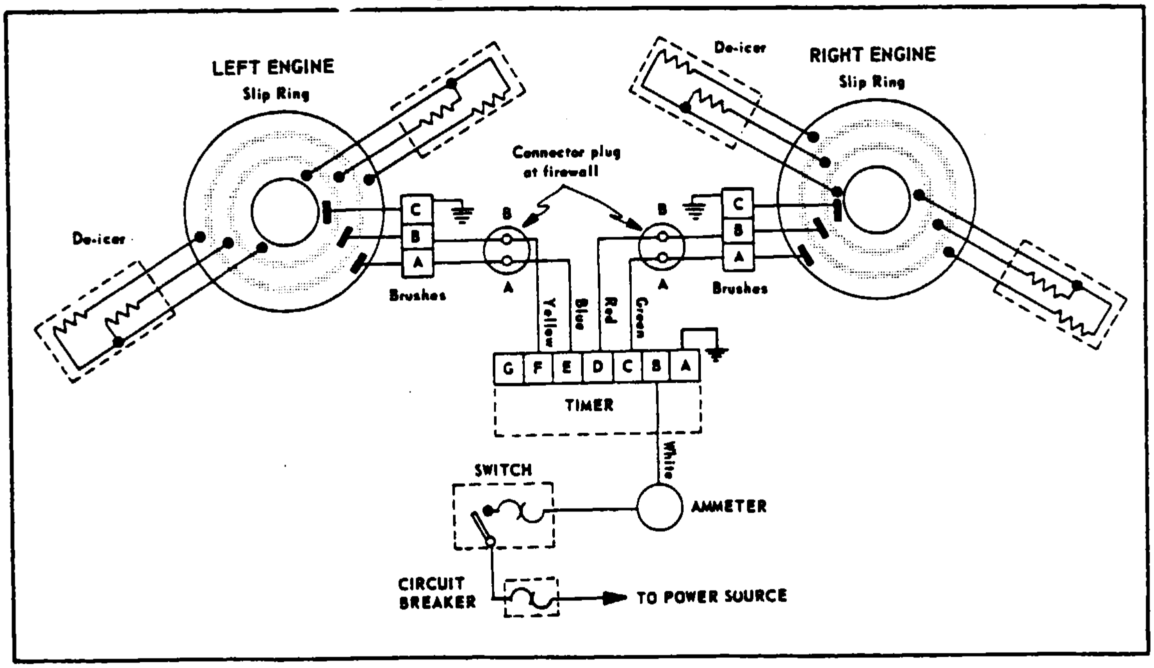


Figure 14-19. Schematic Wiring Diagram, PA-23-250 (six place). Serial Nos. 27-2505 and up

TABLE XIV-I. PROPELLER DE-ICER SYSTEM TROUBLESHOOTING

Trouble	Cause	Remedy
Ammeter shows zero current. (All 4 phases of the 2 minute cycle.)	Blown fuse (if used).	Locate and correct short before replacing the blown fuse.
	Switch faulty.	If no voltage at switch output with voltage at switch input, replace the switch. If voltage is OK at switch output, check ammeter.
	No power from airplane.	If no voltage into switch, locate and correct open.
	Ammeter faulty. (If some or all De-Icers heat with ammeter at zero, replace the ammeter.)	Test for voltage up to and out of ammeter. If low or zero output and input OK, replace ammeter, locate and fix open between switch and ammeter
	Open ammeter to timer.	Disconnect harness at timer and check voltage pin B (of harness) to ground. If none, locate correct open.
Ammeter shows normal current part of cycle, zero current rest of cycle.	Open in wiring between timer and firewall connector.	Use heat test to find De-icers not heating and test for voltage on that pin of firewall connec-

TABLE XIV-I. PROPELLER DE-ICER SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Ammeter shows normal current part of cycle, zero current rest of cycle (cont.)	Open in wiring between timer and firewall connector.	tor. If zero over 2 minutes, locate and fix open in wiring from timer to firewall.
	Open between firewall and De-Icer lead straps.	If voltage OK to firewall plug, try voltage at junction of De-Icer lead and slip ring lead. If no voltage, find and correct open in wiring to brush block, open within brush block or no contact brush to slip ring.
	No ground circuit, one engine.	If voltage at De-Icer leads, locate and fix open from De-Icer to ground.
Ammeter shows normal current part of cycle, low current rest of cycle.	Inner and outer De-Icers heating same phase.	Locate and repair incorrect connections.
	Open in De-Icer or slip ring assembly.	Disconnect De-Icer straps to check heater resistance as in para. 14-30. If OK, locate and fix open in slip ring leads. If not, replace De-Icer with open circuit.
	High resistance in circuit with low current.	If not in contact of brush to slip ring (including ground brush), trace wiring to De-Icer and

TABLE XIV-I. PROPELLER DE-ICER SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Ammeter shows normal current part of cycle, low current rest of cycle. (cont.)	High resistance in circuit with low current. (cont.)	to timer to fix partially broken wire, loose or corroded connection.
Ammeter shows low current over entire cycle.	Airplane voltage low.	Check voltage into switch.
	Ammeter faulty.	Test for voltage up to and out of ammeter. If low or zero output and input OK, replace ammeter. If no voltage to ammeter, locate and fix open between switch and ammeter.
	High resistance up to timer.	Check for partially broken wire, loose or corroded connection in wiring from airplane supply to timer input.
Ammeter shows excess current over entire cycle.	Ammeter faulty.	Test for voltage up to and out of ammeter. If low or zero output and input OK, replace ammeter. If no voltage to ammeter, locate and fix open between switch and ammeter.
	Ground between ammeter and timer.	Disconnect harness at timer and, with ohmmeter, check from pin B (of harness) to ground.

TABLE XIV-I. PROPELLER DE-ICER SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Ammeter shows excess current over entire cycle. (cont.)	Ground between ammeter and timer. (cont.)	If ground is indicated, locate and correct.
Ammeter shows normal current part of cycle, excess current rest of cycle.	Ground between timer and brush block.	Disconnect leads at brush block and, with ohmmeter, check from power leads to ground. If ground is indicated, locate and correct.
	Ground between brush block and De-Icers. (Excluding ground brush circuit.)	If no short exists at brush-slip ring contact, check for ground from slip ring lead to bare prop while flexing slip ring and De-Icer leads. If a ground is indicated, locate and correct.
	Short between two adjacent circuits.	Check for shorts or low resistance between circuits, if any, locate and correct.
	Timer faulty.	Test timer as in para. 14-29.
Ammeter does not "flick" each 30 seconds.	Timer ground open.	Disconnect harness at timer and check with ohmmeter from Pin A or G (of harness) to ground. If no circuit, fix open per appropriate schematic diagram.

TABLE XIV-I. PROPELLER DE-ICER SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Ammeter does not "flick" each 30 seconds.	Timer contacts are welded (caused by short circuit in system).	Test timer as in para. 14-28. If timer does not cycle with voltage at pin B, replace timer but be sure short causing original failure has been located and corrected.
Ammeter flicks between 30 second phase periods (confirm by ground test as in paragraph 14-25, g.)	Loose connection between airplane power supply and timer input.	If trouble occurs over entire cycle, trace wiring from power source to timer input to locate and tighten loose connection.
	Loose or poor connection timer to De-Icers.	If trouble occurs part of cycle, find which De-Icers are affected and check for rough or dirty slip rings causing brush to "skip". If not this, trace circuits to locate and fix loose or poor connection. (If all De-Icers on one prop are affected, check the ground circuit.)
	Timer cycles erratically.	Test timer as in para. 14-28.
Radio noise or interference with De-Icers on.	Brushes "arcing"	Check brush alignment as in para. 14-25, f. Look for rough or dirty slip rings. If this is the

TABLE XIV-I. PROPELLER DE-ICER SYSTEM TROUBLESHOOTING (cont.)

Trouble	Cause	Remedy
Radio noise or interference with De-Icers on. (cont.)	Brushes "arcing". (cont.)	cause, clean, machine or replace slip ring assembly. Check slip ring alignment per paragraph 14-51.
	Loose connection.	Refer to next preceding Trouble.
	Switch faulty.	Try jumper wire across switch - if radio noise disappears, replace the switch.
	Wiring located within 8" of radio equipment wiring.	Relocate at least 8" from input wiring to radio equipment.
Cycling sequence not correct.	Crossed connections.	Check system wiring against circuit diagram for improper connections.
Rapid brush wear or frequent breakage.	Brush block out of alignment	Check brush alignment as in paragraph 14-25, f.
	Slip ring wobbles.	Check slip ring alignment with dial indicator as in paragraph 14-51.

14-32. OVERALL PROCEDURES.

14-33. USE OF CORRECT PARTS. The type and number of De-Icers determine the system current drain. The ammeter and the switch are designed to operate at such specific current. Accordingly, any mixing of De-Icer part numbers on the same airplane or the use of the incorrect ammeter or switch will affect system operation. The parts manual should be followed closely.

CAUTION

Guard against installing two different part number De-Icers on the same propeller or the same airplane. This will throw the De-Icer system out of balance electrically.

14-34. ELECTRICAL.

a. For soldering, use Kester "Resin Five" core solder, 0.062 strand No. 66 or equal. Where flexibility of wire lead is vital, as in brush leads, etc., guard against applying excess solder which would stiffen the wire or joint. This condition is called "wicking" and must be held to 0.125 inch maximum on brush leads. Use care that solder does not deposit on brushrod below barrel when soldering brush leads as this may cause brush to hang up or bind.

b. In crimping terminals to wire, use proper tool and see that terminal is crimped to bare wire, not on insulation. If wires are found too short to repair, replace with same grade and quality, dressed along harness.

c. Bent pins in connectors may be straightened with long nose pliers but check that work hardening does not leave pin brittle and susceptible to breakage. If in doubt, replace the connector. Similarly, minor damage to connector threads may be repaired. Major damage requires replacement.

d. Locate leads and harnesses to be at least eight inches away from radio wiring to avoid radio noise or radio compass interference. Chafed or worn harness areas indicate need to redress the wiring. If not too badly damaged, chafed areas may be wrapped well with insulating tape and covered with vinyl tubing. If in doubt, replace the affected wires or harness.

14-35. MECHANICAL. Use safety wire at timer, wire harnesses, brush block assembly, slip ring, and at hub clamp and clip of blade De-Icers where found at disassembly and wherever provisions are made for its use.

14-36. BALANCING WEIGHTS. For procedure when balancing weights of Hartzell propellers are removed or installed, refer to B. F. Goodrich Service Bulletin E-61-12.

14-37. PROPELLER MARKINGS. For procedure when identification of Hartzell propellers are affected by De-Icer installation, refer to B. F. Goodrich Service Bulletin E-63-20.

14-38. SWITCH, CIRCUIT BREAKER, AMMETER, TIMER, HARNESS.

a. Tighten loose mechanical mounting hardware and/or loose electrical connections but avoid excess force which might strip threads. If replacement is found necessary, replace with the correct part number. Use the same or equivalent hardware to mount and make electrical connections as in the wiring diagrams. Note that airplane power supply lead ties to positive ammeter terminal, negative terminal connects to pin B of connector plug at timer.

14-39. BRUSHES. When replacing brushes or brush retainer assemblies, always install new springs.

14-40. BRUSH REPLACEMENT AS SUB-ASSEMBLY. (PA-23-250; PA-23-235 and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.) (Refer to Figure 14-20.) Dismount the brush insert assembly by taking out the mounting screws and associated hardware at the point labeled (1). Disconnect brush leads at the studs noting the studs to which the leads of the top, middle and bottom brushes are connected. Now take out the screws (2) and associated washers to pull out the brush retainer assembly (3) which includes the brushes, springs and the retainer. Slip the brushes of the new sub-assembly into the slots of the holder and mount the new sub-assembly with screws (2) and associated washers. Connect the brush leads to the studs exactly as noted in removal and check against the wiring diagrams in Figures 14-18 and 14-19 if in any doubt. Mount the brush insert assembly with the screws and associated hardware at (1). (Refer to Paragraph 14-44.)

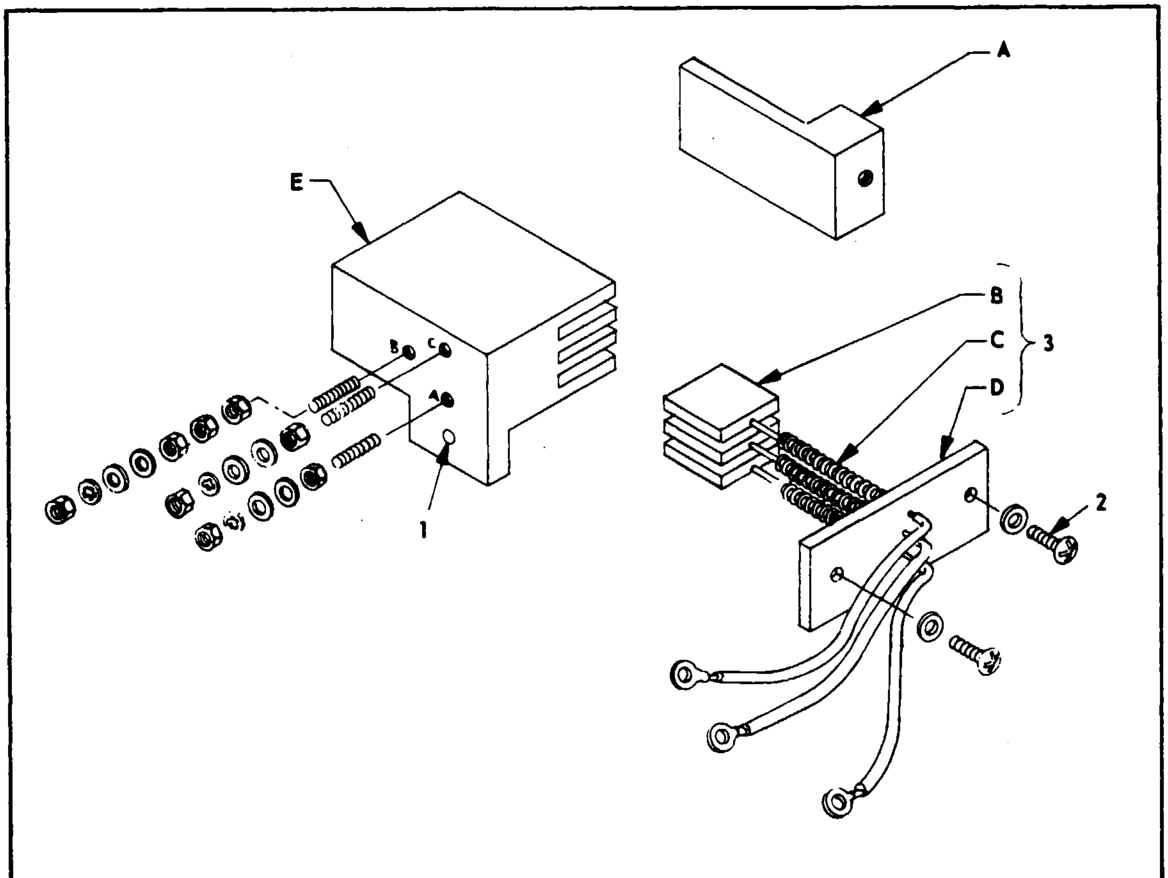


Figure 14-20. Brush Insert Assembly,
PA-23-250; PA-23-235; and PA-23-250 (six place),
Serial Nos. 27-2000 to 27-2504 incl.

14-41. BRUSH REPLACEMENT AS SUB-ASSEMBLY. (PA-23-250 (six place), Serial Nos. 27-2505 and up.) (Refer to Figure 14-21.) Take out screws at point labeled (1) and associated washers to dismount the brush block assembly. Next, remove screws (2) and their washers to slip the smaller block off the brush retainer assembly (3) which includes the brushes, springs, electrical connector and the larger block. Slide the smaller block onto the new brush retainer assembly (3) in the direction of brush travel to pass over the brushes and to then compress the springs. Use care that no side load is applied on brushes and that leads are not pinched or damaged. Install screws (2) with their washers to mount the smaller block to the larger and check for free sliding motion of the brushes. Mount the brush block assembly with the screws at point (1) and associated hardware. (Refer to Paragraph 14-44.)

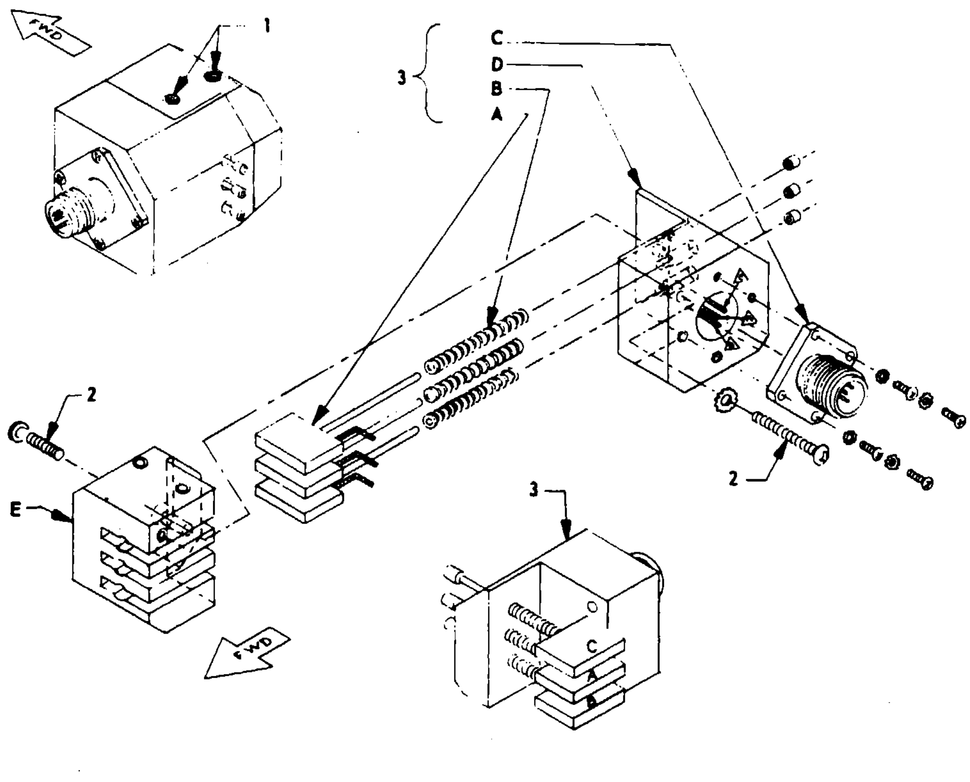


Figure 14-21. Brush Block Assembly,
PA-23-250 (six place), Serial Nos. 27-2505 and up

14-42. REPLACING INDIVIDUAL BRUSHES. (PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.) Remove brush insert assembly by taking out screws at point labeled (1) of Figure 14-20 and associated hardware. Use tape or rubber band to hold brushes in place while the assembly is gently locked in a vise. (Refer to Figure 14-22.) With soldering gun or iron, free soldered lead and barrel from end of brush rod of brush to be replaced. Loosen tape or rubber band to draw out the old brush and its spring. Install new spring and brush, hold with rubber band or tape. Now solder barrel and brush lead to end of brush rod - barrel must be flush with end of brush rod. (Work on one brush at a time and use the undisturbed brush rods adjacent to see how barrel is to be set.) In this step, see that width of braid lead lies parallel to the retainer plate. Avoid excess solder that would stiffen brush lead - 0.125 of an inch "wicking" is maximum allowable. Brush rods must be free of solder between "B" barrel and brush. (Refer to Paragraph 14-44.)

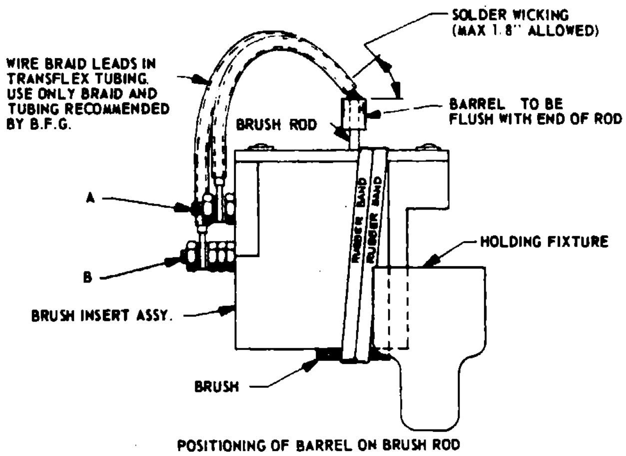


Figure 14-22. Holding Brushes for Soldering, PA-23-250; PA-23-235; and PA-23-250 (six place), Serial Nos. 27-2000 to 27-2504 incl.

14-43. REPLACING INDIVIDUAL BRUSHES. (PA-23-250 (six place), Serial Nos. 27-2505 and up.) Remove brush holder and disassemble brush retainer assembly as in paragraph 14-41, then use rubber band or tape to hold brushes compressed in block as in Figure 14-23. Take out hardware to free the connector and pull it out just so that the leads of the brush to be replaced can be unsoldered. Unsolder the barrel at the end of the brush rod to remove the old brush and its spring. Install a new spring and new brush in the block and hold under rubber band or tape to solder the barrel flush with the end of the brush rod. Barrel must be concentric with brush rod. Brush rod and barrel must be free of solder on its external surface as this may cause brush to hang up. Now solder the brush lead to the connector pin. Remount the connector and reassemble the brush block assembly. Check for free sliding motion of brushes before mounting on the airplane. (Refer to Paragraph 14-44.)

14-44. ALIGNMENT AND RUN-IN OF NEW BRUSHES.

a. At any time that brush block assembly is dismounted, the alignment at re-installation must be checked as described in paragraph 14-25, f.

b. New brushes must be run-in for a minimum of five (5) hours engine operation before the De-Icer system is turned on. This applies whether brushes have been replaced individually or as subassemblies. This requirement does not prevent static operating checkout.

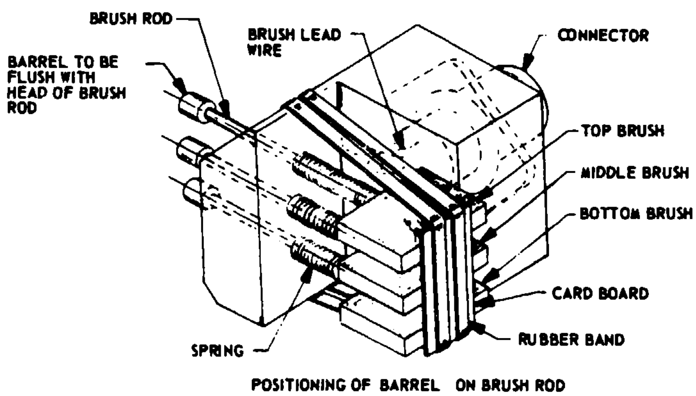
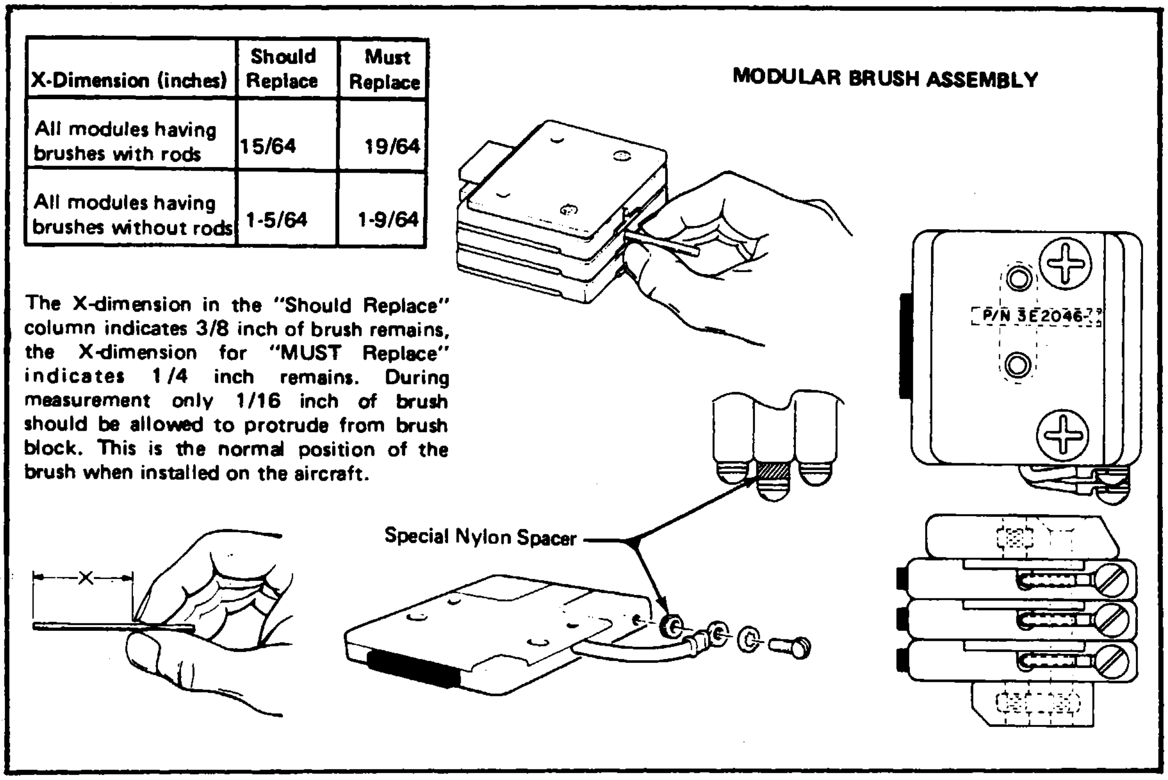


Figure 14-23. Holding Brushes for Soldering, PA-23-250 (six place), Serial Nos. 27-2505 and up



X-Dimension (inches)	Should Replace	Must Replace
All modules having brushes with rods	15/64	19/64
All modules having brushes without rods	1-5/64	1-9/64

Figure 14-24. Modular Brush Assembly

14-45. MODULAR BRUSH ASSEMBLY REPLACEMENT FOR BRUSH BLOCK ASSEMBLY. Modular brush assembly part number 3E2046-1, is a direct replacement for brush block assembly 4E1515-3. Instructions concerning replacement of brush block assemblies with modular brush assemblies are given in B.F. Goodrich Service Bulletin No. E-77-54.

14-46. MODULAR BRUSH ASSEMBLY MAINTENANCE. Brushes are not offered individually as replacements. When a brush wears out, the module containing it should be replaced as follows:

a. Remove the modular brush assembly from the aircraft by removing attaching hardware and disconnect the wire harness.

b. Remove assembly screws and separate module and spacers.

NOTE

The part number of each module is etched into the surface of the plastic housing. Replace with the same part number module.

c. Restack modules and spacers as shown in Figure 14-24. If there is interference between adjacent ring terminals, reorient center module as shown in Figure 14-24.

NOTE

Ascertain flat washer is positioned between star washer and housing.

d. Reconnect aircraft wire harness and insure adjacent ring terminals are not touching.
e. Install assembly on aircraft and check alignment.

14-47. SLIP RINGS.

14-48. MACHINING. If structurally sound, slip rings with roughened or damaged surfaces can be machined to restore to serviceability. Remove the slip ring assembly from the airplane to mount it in a lathe, located concentrically in the lathe and with not over 0.002 wobble or run-out over 360 degree rotation. Take light cut for smooth finish and cut no deeper than required to remove surface damage. Contact surfaces of the three slip rings must be parallel within 0.005 inch and flat within 0.005 inch overall - deviation from flat not to exceed 0.002 inch over a 4 inch arc. If necessary, undercut insulation between slip rings to a depth of 0.020 to 0.030 inches below the contact surface of the slip rings. In this operation, width of slip ring must not be reduced more than 0.005 inch. Contact surface of slip rings must have a finish of 29-35 micro inches. De-burr slip ring edges and re-install in the airplane, and align per paragraph 14-51.

NOTE

If, in machining, the solder or braze connection on the underside of the slip ring is exposed, replacement of the slip ring assembly will be necessary.

14-49. REPLACEMENT. Slip ring assemblies that are open or shorted electrically, cracked or damaged structurally, or which have damaged surfaces beyond the scope of minor repair to clean up, should be replaced with a new slip ring assembly. When replacing, align slip ring assembly per paragraph 14-51 and allow brushes to run-in for a minimum of 5-hours engine operation before turning on De-Icer system, except static operating checkout.

14-50. TORQUE LIMITS. Some systems use a stud brazed to the slip ring for making electrical connection. In any work around these studs, avoid side loads on the studs which may lead to ultimate breaking of the brazed joint and consequent failure of the slip ring.

CAUTION

Excess torque is apt to pull studs from slip rings. In installing or tightening nuts, use torque wrench and tighten to 10 to 12 inch-pounds only.

14-51. ALIGNMENT. (This step not applicable to slip rings on start ring gears .)

Check slip ring run-out with dial indicator set-up as in Figure 14-15. Push in on prop as it is turned to take out play of prop thrust bearing which would affect readings. If the total run-out exceeds 0.005 inch or exceeds 0.002 inch in a 4 inch arc, alignment must be accomplished as follows:

a. Use AN960C416L washers between slip ring and spinner bulkhead to shim for true running. If necessary, fabricate thinner shims to AN960 size.

NOTE: If no toothed washer is used in original mounting, install AN936B416 between two AN960C416L plain washers plus any shims required. The AN936 washers provide an adjustable method of shimming. This change will affect brush block clearance which must be readjusted as in paragraph 14-25, f .

b. In mounting slip ring assembly to spinner bulkhead, snug mounting bolts to approximately 25 inch-pound of torque. Using the dial indicator to follow the points of maximum deviation, adjust slip ring assembly to prescribed run-out by gradual tightening of mounting bolts until all are within 40 to 75 inch-pounds of torque.

14-52. ECCENTRIC RUNNING. If brush block cannot be adjusted sufficiently to prevent brushes from riding partially off the edge of the slip rings at any point through 360 degree rotation, the spinner bulkhead must be replaced to permit proper mounting of the slip ring assembly. There is no adjustment for this condition.

14-53. BLADE DEICERS.

14-54. REPLACEMENT. If tests show the blade Deicer to have an open circuit, to be the wrong resistance or to be visibly damaged beyond repair procedures as outlined in paragraph 14-56, replace the Deicer. Use the correct part as specified, for replacement.

NOTE: See latest revision of Hartzell Aluminum Blade Overhaul Manual, Manual No. 133 (61-13-33).

14-55. CEMENTING PROCEDURE. Use B. F. Goodrich Field Repair Kit No. 77-802 which contains rubber patch material, sponge rubber material, and rubber tubing sufficient for several repair jobs. Cements and solvents specified in these directions are not included in the kit. (The abbreviation "MEK" in further steps stands for Methylethylketone.) The following steps apply wherever "cementing" is specified in the text:

a. Clean the metal or rubber area to be bonded or patched with MEK or acetone to remove all grease and dirt.

NOTE

It is permissible when installing deicer boots on Hartzell Polane coated propeller blades, to rough the surface with fine sandpaper; remove all grit with air; then clean with acetone. MEK is NOT acceptable for cleaning Polane coated propellers. Proceed with standard installation.

It is vital that surface be clean for a good cementing job. After the last wipe with cleaner, quickly wipe surface with a clean, dry lint-free cloth to remove solvent film.

b. Apply one even coat of EC-1300L cement (Minnesota Mining and Mfg. Co.) to area being bonded or patched and allow to dry (approximately 1 hour above 40 degrees F). Apply a second even coat of EC-1300L cement and allow to dry.

c. Cut patching or sponge material as directed in the specific repair step. This material is exposed to airstream, cut clean edges (without fringes) and bevel. On the thicker (0.020 inch) rubber, the protective paper is on the side to be cemented. Apply masking tape on the open side to prevent the patch from curling as cement dries; then strip off protective paper and apply EC-1300L cement in a smooth even coat. Allow to air dry. On the thinner (0.010) rubber, the mylar coating is on the air side and helps to prevent the patch from curling. Wipe the open side with MEK or acetone to clean; follow last wipe immediately with clean, dry lint-free cloth wipe, and apply smooth even coat of EC-1300L cement. Allow to air dry. On sponge material, the rough side is to be cemented. Use MEK or acetone to clean this surface but avoid soaking sponge with the solvent. Apply smooth even coat of EC-1300L cement to rough surface and allow to air dry. After 1 hour, apply second coat and allow to air dry.

d. With cemented surfaces either dry or with just a trace of "tackiness," apply light coat of MEK or Toluol over these surfaces to "re-tackify" and quickly complete the cementing job as directed in the step. Allow one hour to air dry before peeling off the masking tape or mylar coating on the air side. Rub edges and center of patch to see that it is holding before releasing for flight.

NOTE

Do not touch cemented surface with dirty or oily fingers.

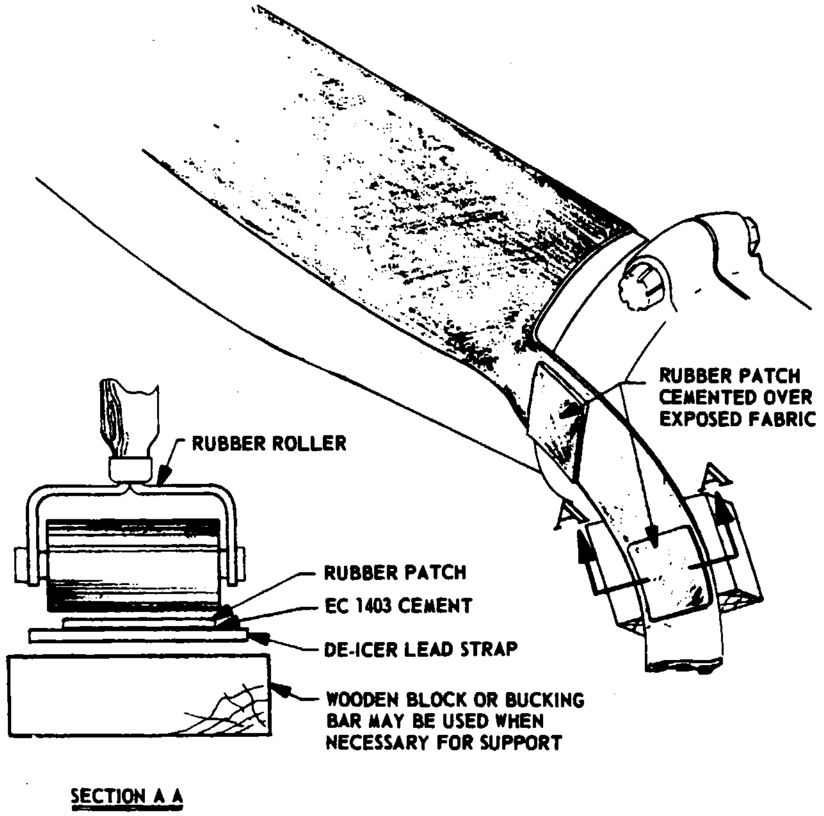


Figure 14-25. Patching De-Icer Lead Strap

14-56. BLADE DE-ICER SURFACE, OUTBOARD OF CLAMP. Cut the patch (0.010 inch rubber) to be about 0.25 of an inch larger on all sides than the damaged area. In setting the re-tackified patch into place, use rubber roller to press patch firmly - a metal roller will damage the wires within the De-Icer. (Refer to Figure 14-25.)

a. If the wires are exposed but not broken (in the De-Icer element), use two plies of 0.010 inch rubber to patch. Place the first patch on as described above and allow to dry one hour. Cut the second patch to be 1/4 inch large on all sides than the first patch. Follow the given procedure to cement the second patch in place and allow one hour to air dry.

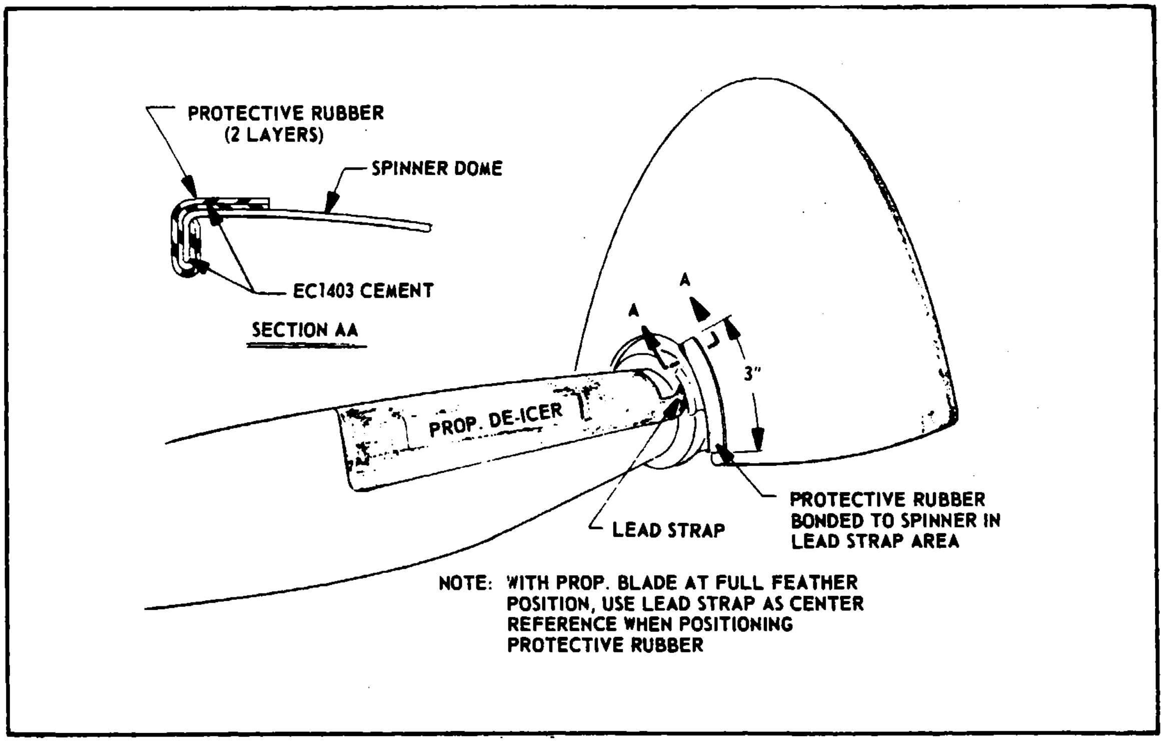


Figure 14-26. Spinner Dome Cushioning

14-57. BLADE DE-ICER LEAD STRAP. Cut the patch (0.020 inch rubber) to be about 1/4 inch larger on all sides than the damaged area. Use rubber roller to press the patch into place - a metal roller will damage the wires in the strap. (Refer to Figure 14-25.)

14-58. SPINNER DOME STRIP. Cut two pieces, each 5/8 by 3 inch of 0.020 inch rubber to fit as shown in Figure 14-26. Lightly sand metal to remove all paint in area to be cemented. Follow the given procedure to cement the first piece in place and allow one hour to air dry. Now cement the second piece over the first and allow one hour to air dry.

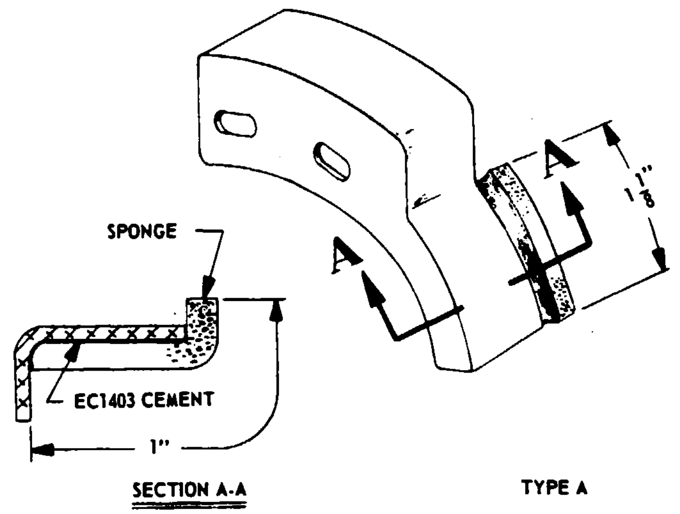


Figure 14-27. Hub Clamp Cushioning

14-59. CLAMP SPONGE CUSHION. (Refer to Figure 14-26.) If cushioning sponge is frayed or damaged, use MEK or toluol liberally to remove old sponge. In such case (or if the sponge cushion is missing), clean metal thoroughly. Cut the sponge 1 by 1-1/8 inches (for type "A" clamp, Figure 14-27) and follow the given procedure to cement sponge into place, pressing firmly with fingers.

14-60. WRINKLED DE-ICERS. If edge of De-Icer is found wrinkled or loose, try recementing. Use MEK or toluol to loosen the bond for an additional 1/4 inch beyond the loose or wrinkled area. Apply one coat of EC-1300L cement to the De-Icer and prop bonding surfaces and allow to air dry for one hour. Then apply a second coat of EC-1300L cement to both the De-Icer and prop bonding surfaces. Re-tackify with MEK or acetone and press with fingers to work out wrinkles or to secure loose edge. If material has stretched and will not cement flat, replace the De-Icer element.

NOTE

Use polyethylene or teflon film between De-Icer element and prop while cement coats are drying so that they do not stick together.

14-61. INSTALLATION OF DE-ICER STRAPS AND WIRE HARNESS.

a. The De-Icer lead strap is fastened to the bulkhead in the same positions from which they were removed.

b. The De-Icer strap is to be attached to the studs on the spinner bulkhead.

CAUTION

Never use Type "B" star washer (teeth on outer diameter) adjacent to tongue of De-Icer terminals.

c. Make certain that there is no slack in the De-Icer lead strap between the terminals and the clip. This is important because it assures enough slack between the clip and the strap restrainer to allow for proper feathering. A test should be conducted on each propeller de-icing system to insure that De-Icer lead straps are installed in such a manner that the propeller can be moved from full low pitch through the feathering position without placing the straps in tension.

NOTE

De-Icers should have a piece of gray plastic bonded to the air side (shiny side) of the De-Icer strap as shown in Figure 14-28. . The strap restrainers should be positioned as shown in Figure 14-29 when the propeller blades are in the full feather position.

d. If damage occurs to slip ring wire harness, rubber spacers or hose clamps, replace damaged parts.

14-62. OTHER COMPONENTS. Do not attempt internal repairs of the timer, ammeter or switch. If inoperative, these components must be replaced with one of the correct part number.

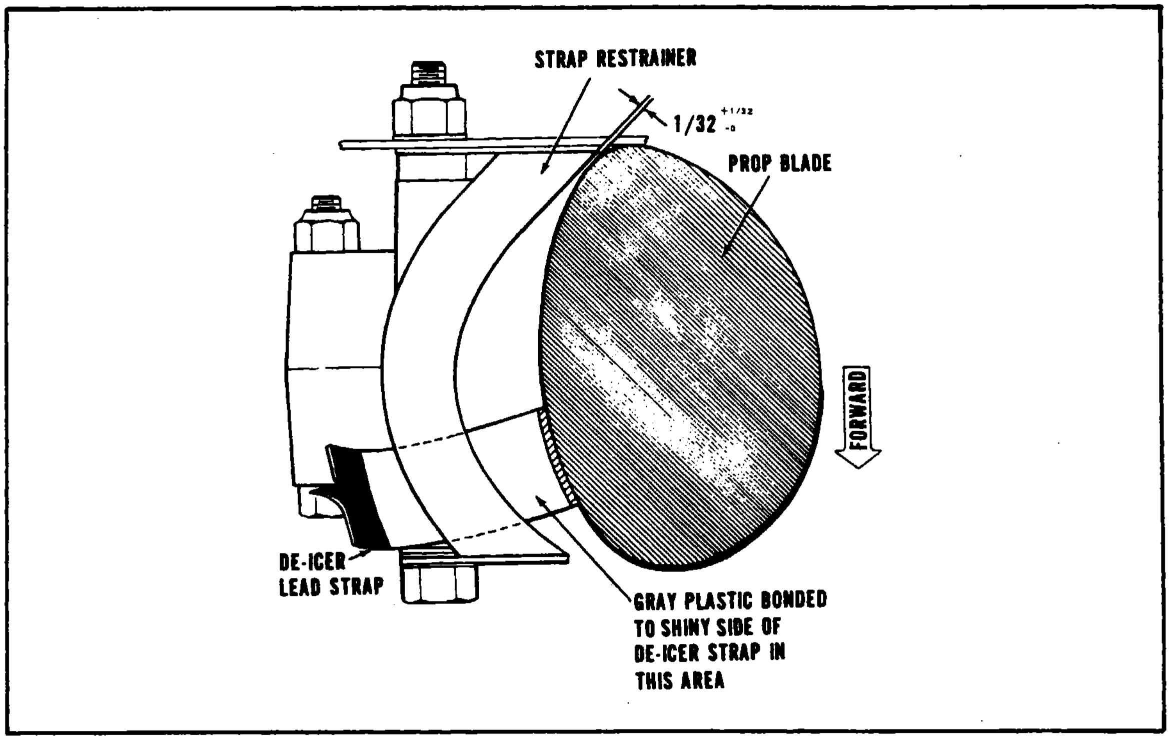


Figure 14-28. Propeller Blade in Low Pitch

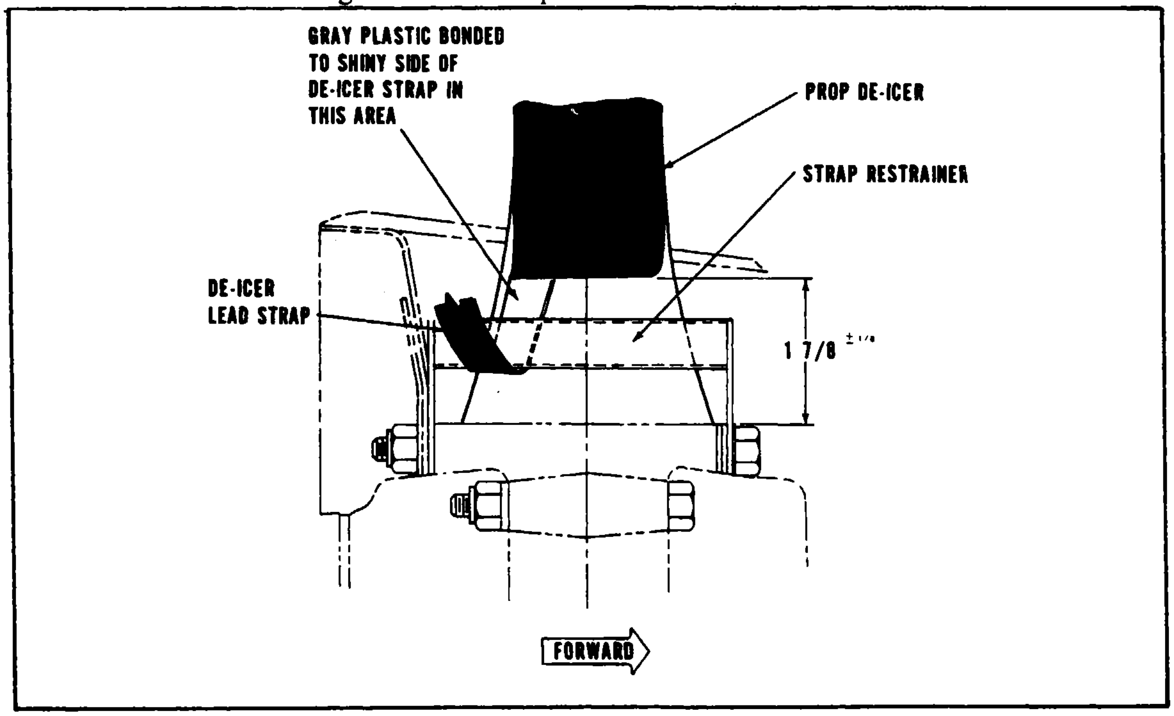


Figure 14-29. Propeller Blade in Feather Position

14-63. PNEUMATIC DEICER SYSTEM.

14-64. INTRODUCTION. This portion of Section XIV provides service and maintenance procedures for the pneumatic deicing systems used in these aircraft.

14-65. DESCRIPTION AND PRINCIPLES OF OPERATION. The deicer boot is essentially a fabric reinforced rubber sheet containing built-in inflation tubes. The type used in this installation have spanwise inflation tubes. Deicers are attached by means of a cement to the leading edges of the surface being protected. There are either aluminum or flexible rubber air connections on the backside of the boots called "air connection stems." Each stem projects from the underside of the boot into the leading edge, through a hole provided in the metal skin. The stems connect to the airplanes pneumatic air supply system.

The pneumatic deicing systems used on these airplanes are lightweight type having single inflation operation and utilize either the 28 volt or 14 volt electrical system. Refer to PA-23-250 Parts Catalog 753 522 for specific part numbers and serial numbers for the particular system and airplane being serviced. On single inflation systems, all the deicers on the wings and tail surfaces are inflated simultaneously in a single sequence.

There are three different systems used on this series of airplane models. The very early system provided automatic cycling operation once every three minutes during timer operation when the deicer system control switch is turned ON. On later installations the timer was replaced with a time module. With this system there is no continuous cycling of the system and it is not necessary to turn the system control switch OFF, as this is done automatically. The time module provides system operation for six seconds. The switch is a momentary ON type which returns to the OFF position when released. Should reactivation of the system be required, the control switch can be moved to the ON position again and released.

On still later installations the system incorporated an additional solenoid exhaust valve and indicator light. This system also uses a momentary ON toggle switch which also has a "MANUAL DEFLATE" position should the system malfunction with the boots inflated. This system does not use a timer or time module to regulate inflation time, instead two pressure switches are used to control system operation. When the system pressure reaches the preset inflation pressure, the pressure switches in conjunction with a relay breaks the circuit, thus de-energizing the solenoid valves and deflating the boots. If the system controlling pressure switch should fail, the second pressure switch acts as a back-up device to break the circuit. In the unlikely event that both of these switches failed, pressure is limited only by the maximum capability of the dry air pumps. This method of operation insures complete inflation of the boots regardless of altitude. There are two indicator lights which monitor system operation, a blue light indicates normal boot inflation and operation, while the red light indicates an over-pressure inflation condition, in which case the toggle switch is placed in the "MANUAL DEFLATE" position which de-energizes the three solenoid valves and returns the boots to the normal hold down position. Should reactivation of the system be required, the toggle switch can be moved to the ON position again and released.

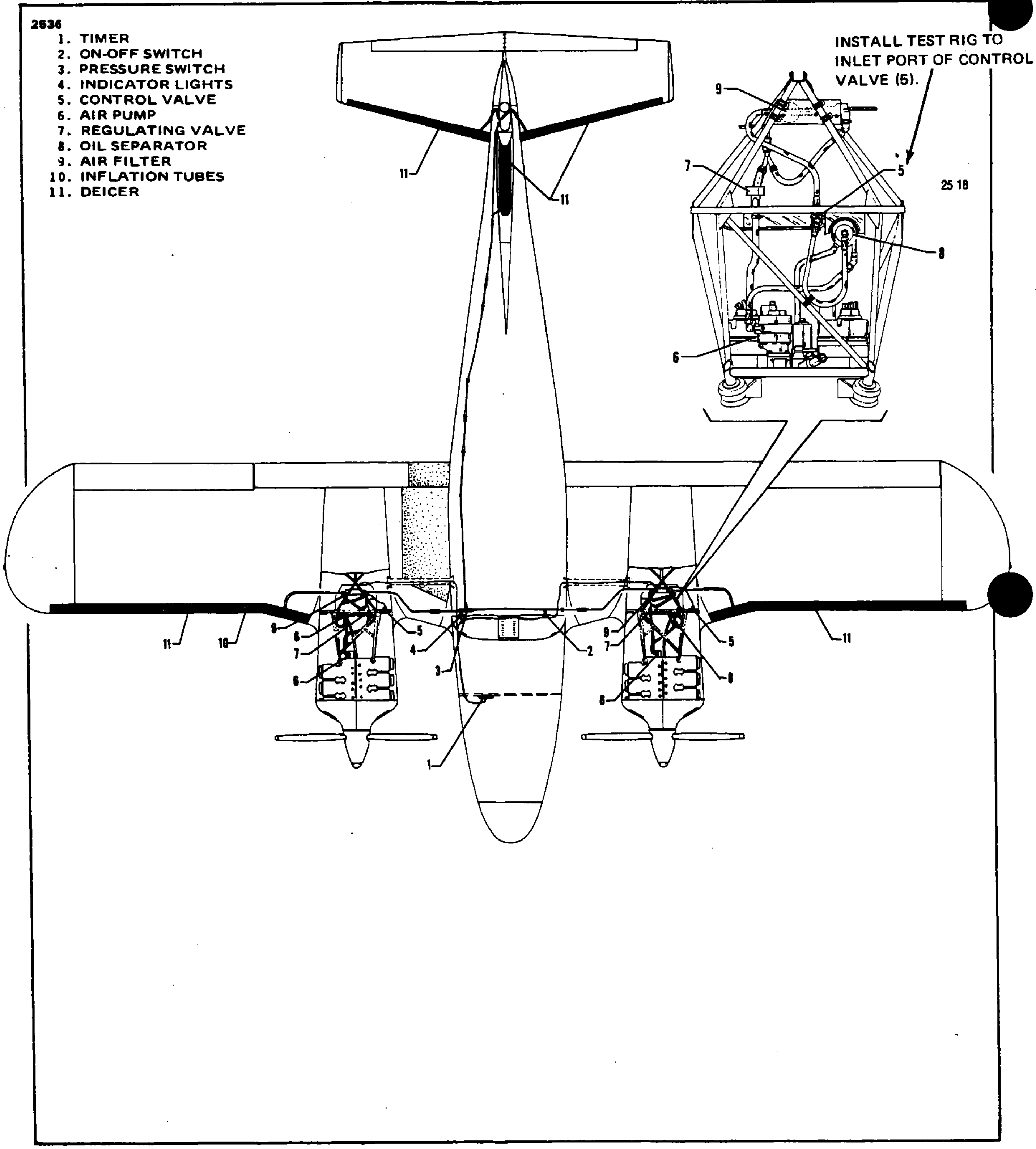


Figure 14-30. Pneumatic Deicing Installation (Wet Vacuum Pump), Serial Nos. 27-2505 to 27-3944 inclusive

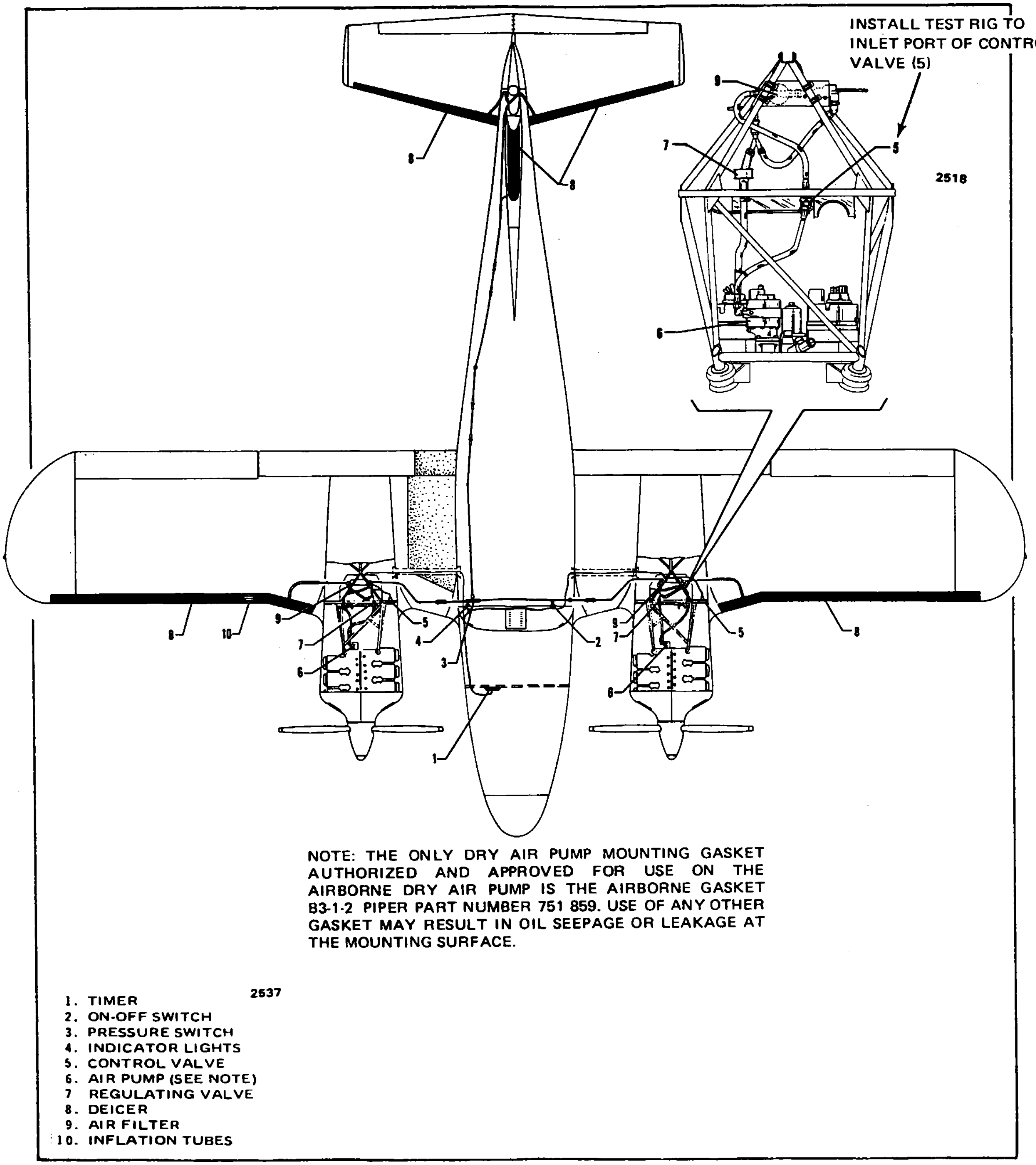
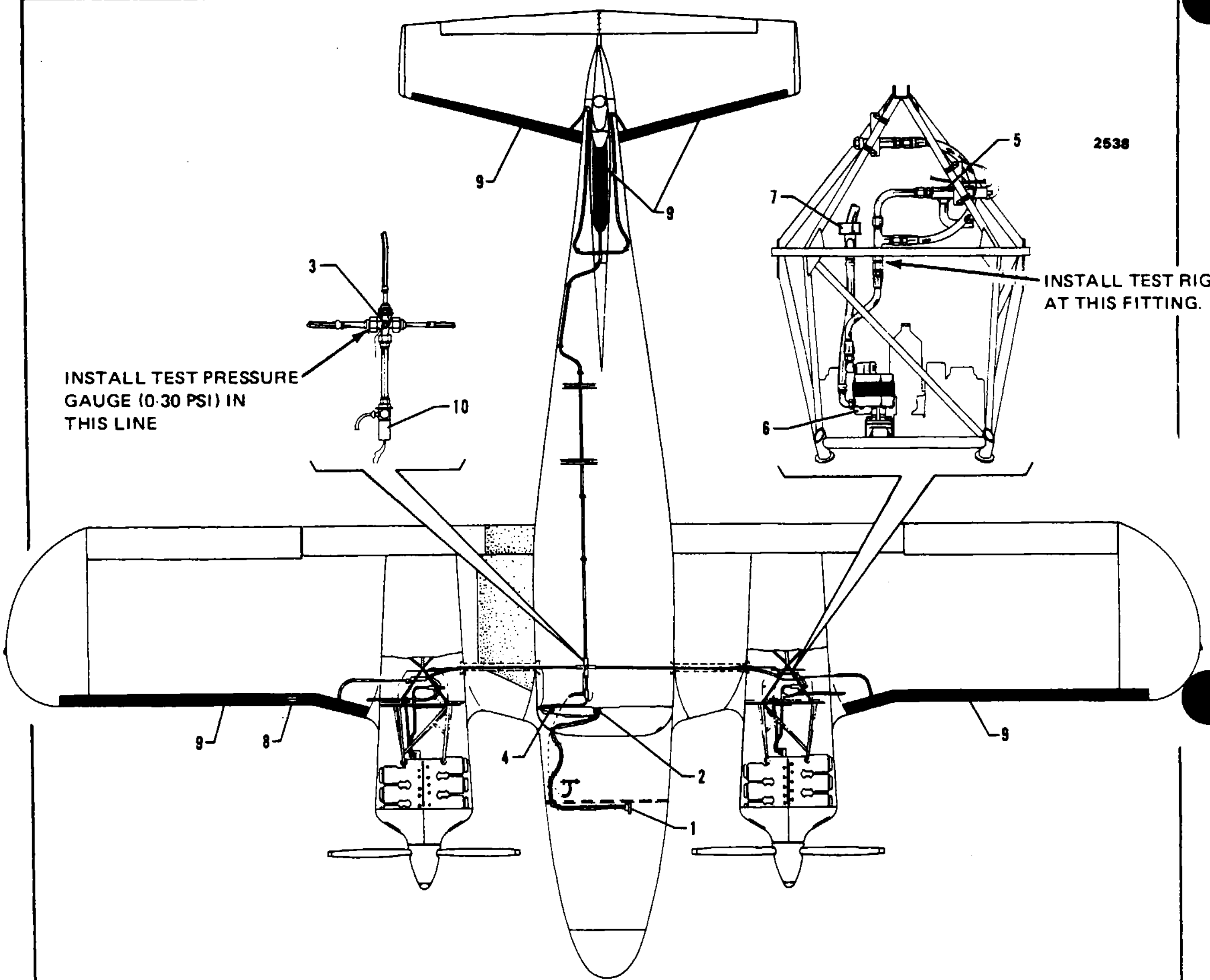


Figure. 14-31. Pneumatic Deicing Installation (Dry Vacuum Pump), Serial Nos. 27-4510 to 27-7304963; 27-7304965 to 27-7304993 inclusive

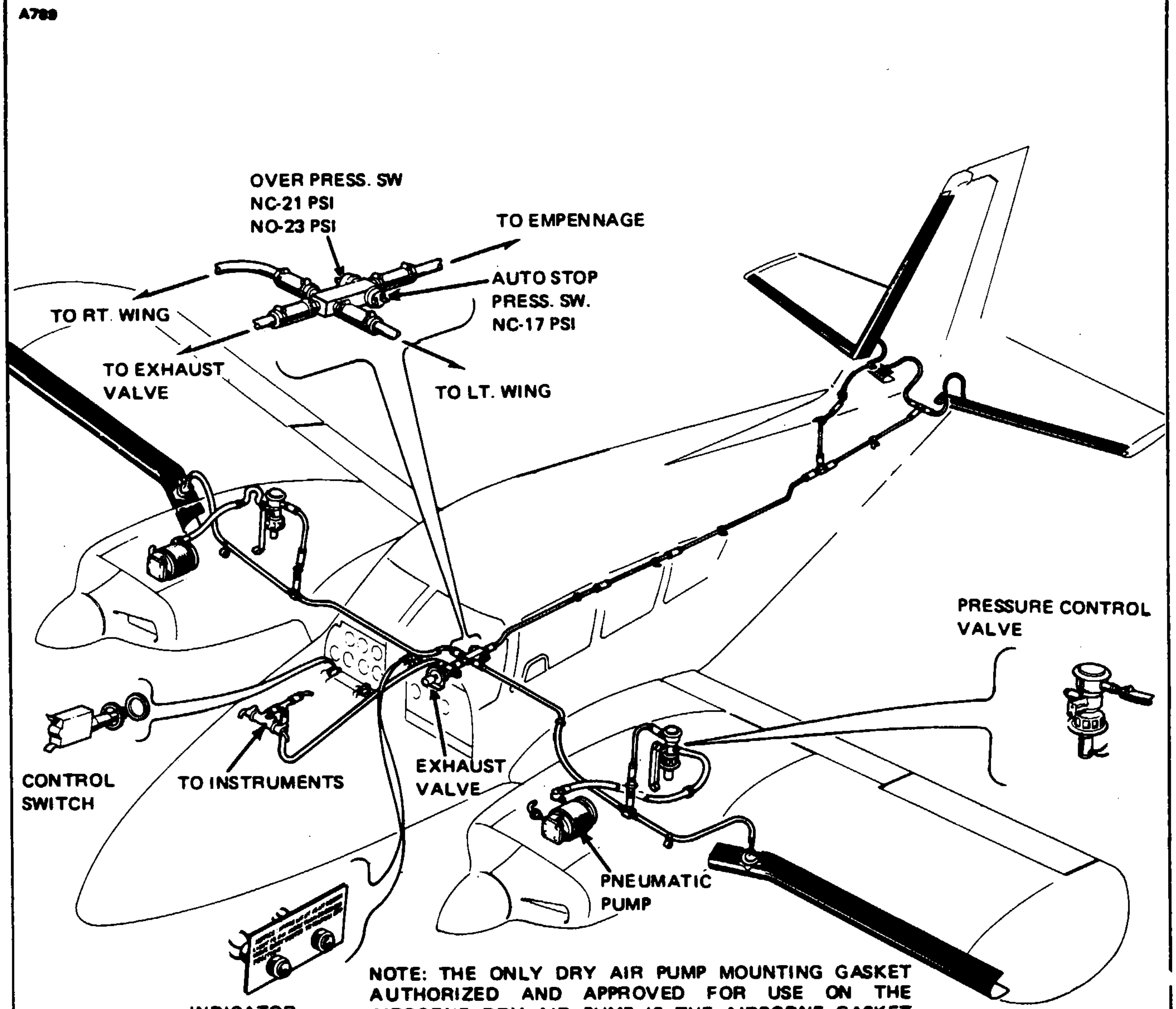


NOTE: THE ONLY DRY AIR PUMP MOUNTING GASKET AUTHORIZED AND APPROVED FOR USE ON THE AIRBORNE DRY AIR PUMP IS THE AIRBORNE GASKET B3-1-2, PIPER PART NUMBER 751 859. USE OF ANY OTHER GASKET MAY RESULT IN OIL SEEPAGE OR LEAKAGE AT THE MOUNTING SURFACE.

2535

1. TIMER
2. SWITCH ASSY. & CIRCUIT BREAKER
3. PRESSURE SWITCH
4. INDICATOR LIGHTS
5. PRESSURE CONTROL VALVE
6. AIR PUMP (SEE NOTE)
7. REGULATING VALVE & FILTER
8. INFLATION TUBES
9. DEICER
10. EXHAUST VALVE ASSEMBLY

Figure 14-32. Pneumatic-Deicing Installation (Dry Vacuum Pump), Serial Nos. 27-7304964 to 27-7554168 inclusive



NOTE: THE ONLY DRY AIR PUMP MOUNTING GASKET AUTHORIZED AND APPROVED FOR USE ON THE AIRBORNE DRY AIR PUMP IS THE AIRBORNE GASKET B3-1-2, PIPER PART NUMBER 751 859 USE OF ANY OTHER GASKET MAY RESULT IN OIL SEEPAGE OR LEAKAGE AT THE MOUNTING SURFACE.

Figure 14-33. Pneumatic Deicer Installation (Dry Vacuum Pump), Serial Nos. 27-7554112 to 27-7554168 inclusive

The engine driven pneumatic pumps normally apply vacuum to the deicer boots and instruments, while the pressure control valves in the engine nacelles relieves all of the pressure produced by the pumps. Through the actuation of the control switch, deicer operation is started. Electrical power is supplied to the solenoids of the control valves. When energized the control valves regulate the pneumatic pump output air pressure to the deicer inflation pressure. After the required time and/or pressure is obtained electrical power is shut-off and pressure within the deicer system is released through an integral pressure relief section of the system and vacuum is reapplied to the deicer boots to hold them down.

14-66. SYSTEM TROUBLESHOOTING. In the utilization of the troubleshooting charts at the end of these instructions, it must be assumed that the engine driven combination pressure-vacuum pumps and the airplane electrical system are operational. It is further assumed that the deicer system installation was made in an approved manner.

14-67. SYSTEM CHECKOUT.

14-68. ELECTRICAL TEST.

a. With engines off, turn airplane battery switch to the ON position.

b. System Indicator Light: Press the indicator light to check light circuit and bulb. If light does not function:

1. Reset circuit breaker and recheck.
2. Test or replace the bulb.
3. Check the circuit from the power source through the circuit breaker to the light to ground.

c. Timer: Turn deicer system switch to the ON position. The timer should begin to operate immediately. Turn the system switch to OFF position. The timer should immediately re-cycle to the start position as evidenced by a brief timer "chatter."

d. Time Modules: Turn system switch ON. The system should begin to operate immediately. System operation should continue for six seconds and then automatically turn off. If timer or timer module do not function:

1. Reset circuit breaker and recheck.
2. Check circuit from power source, through circuit breaker, to system switch, to timer or time module, to ground.
3. Replace timer or time module.

e. Control Valves and Exhaust Valve: Check both control valves; one in each nacelle and the exhaust valve in the fuselage by turning the system switch ON. The solenoids should be actuated immediately for six seconds, as evidenced by an audible "click" that can be felt if a hand is placed on the solenoid. If the valve does not function make the following checks:

1. Unplug the electrical connector at the solenoid. Attach a test light or other suitable test equipment to the connector and re-actuate the system switch. If the test equipment does not indicate a complete circuit:

(a) Check circuit from timer or time module, to the solenoid connector, to ground.

(b) Replace timer or time module.

2. Use an ohmmeter to check the solenoid for an open circuit. If the solenoid circuit is open, replace the control valve.

3. Remove the solenoid safety wire and unscrew the solenoid.

CAUTION

Do not lose steel hex actuator pin or valve poppet.

Re-attach the connector to the solenoid; insert the hex actuator pin into the solenoid and re-actuate the system switch. If the pin is not ejected from the solenoid, replace the control valve.

f. Pressure Switch: With deicers pressurized to 12 psig or above (for procedure, see Air Leakage Test), pressure switch should close circuit to indicator light. If indicator light does not function:

1. Reset circuit breaker and recheck.
2. Check circuit from power source through circuit breaker, to indicator lamp, to pressure switch, to ground.
3. Disconnect and remove pressure switch. Check for plugged line or switch.
4. Replace pressure switch.

14-69. VACUUM REGULATOR ADJUSTMENT. The vacuum regulators must be adjusted to provide adequate vacuum for the airplane instruments. (Refer to Instruments, Section X for the proper procedure.)

14-70. COMPONENT MAINTENANCE AND REPLACEMENT.

14-71. AIR FILTER. Examine filter discs every 100 hours of engine operation and clean if oil has accumulated in housing. As cleaning agent, use a commercial hydrocarbon type solvent such as naphtha, petroleum ether or gasoline. Kerosene type distillates should be avoided. If desirable to replace filter discs, the part numbers are: Air Maze Corporation (Air Maze Division - North American Rockwell Corporation, Cleveland 20, Ohio (H9S888-36 (4 required) and H9S888-26 (5 required).

14-72. CONTROL VALVES. On early Deicing System installations wet vacuum pumps were used and this required periodic inspection of control valves after every 100 hours of engine operation. The valve poppet and internal lining of the control valve can become coated with a film of dried oil causing the valve to stick. To clean, remove the safety wire and unscrew the solenoid. To determine if the valve poppet is sticking, perform the electrical test. If the solenoid checks satisfactorily, remove the valve poppet and clean the control valve bore and poppet. To clean:

a. Remove safety wire and electrical connector. Unscrew solenoid.

CAUTION

Do not lose steel hex actuator pin.

b. Remove valve poppet. It may be necessary to apply slim nose pliers to pin projection to pull poppet from valve.
c. Thoroughly clean valve bore and poppet with commercial hydrocarbon type solvent.
d. Reassemble valve and re-safety wire solenoid.

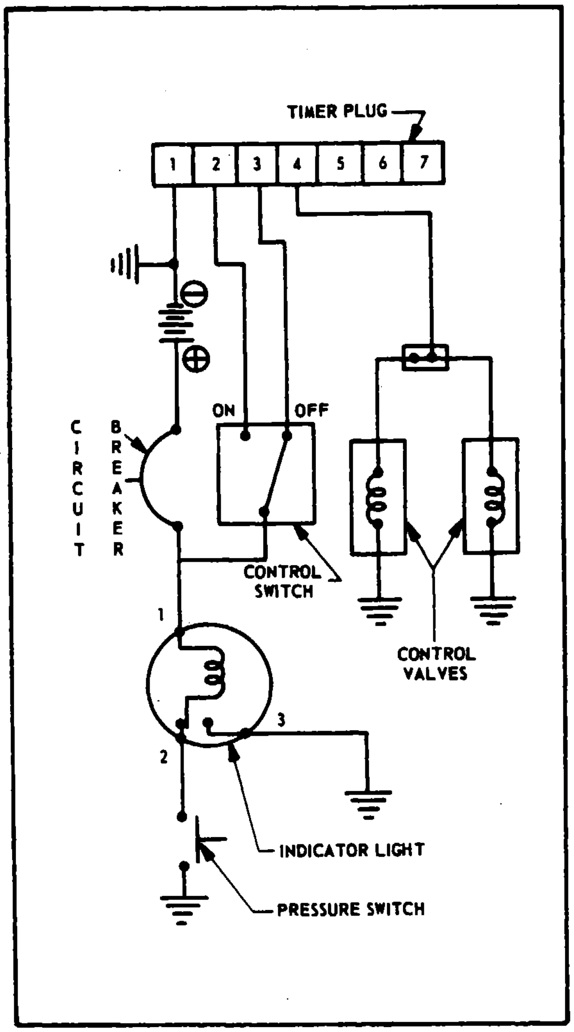


Figure 14-34. 28-Volt DC System
3D1472 Timer

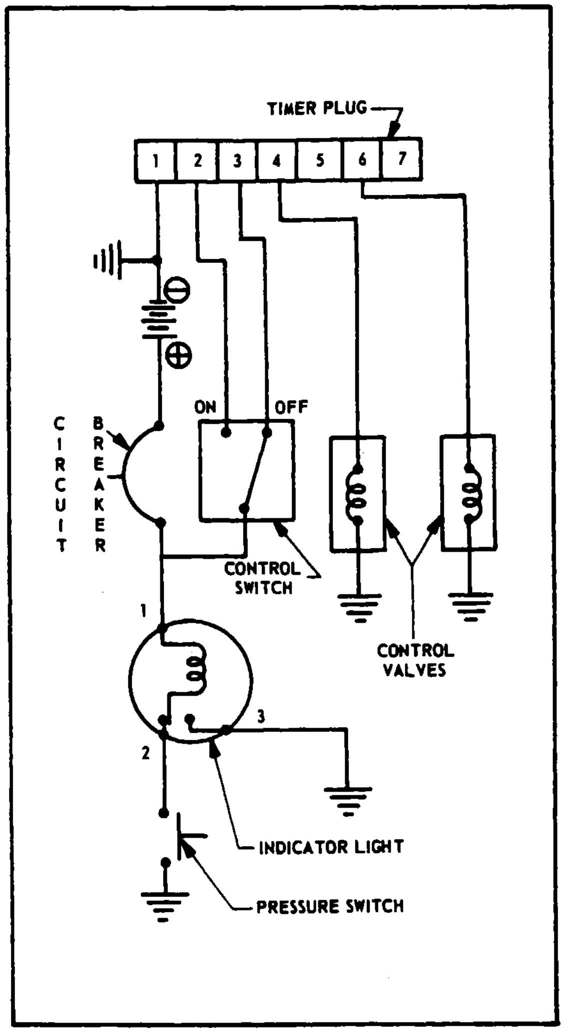


Figure 14-35. 14-Volt DC System
3D1740 Timer

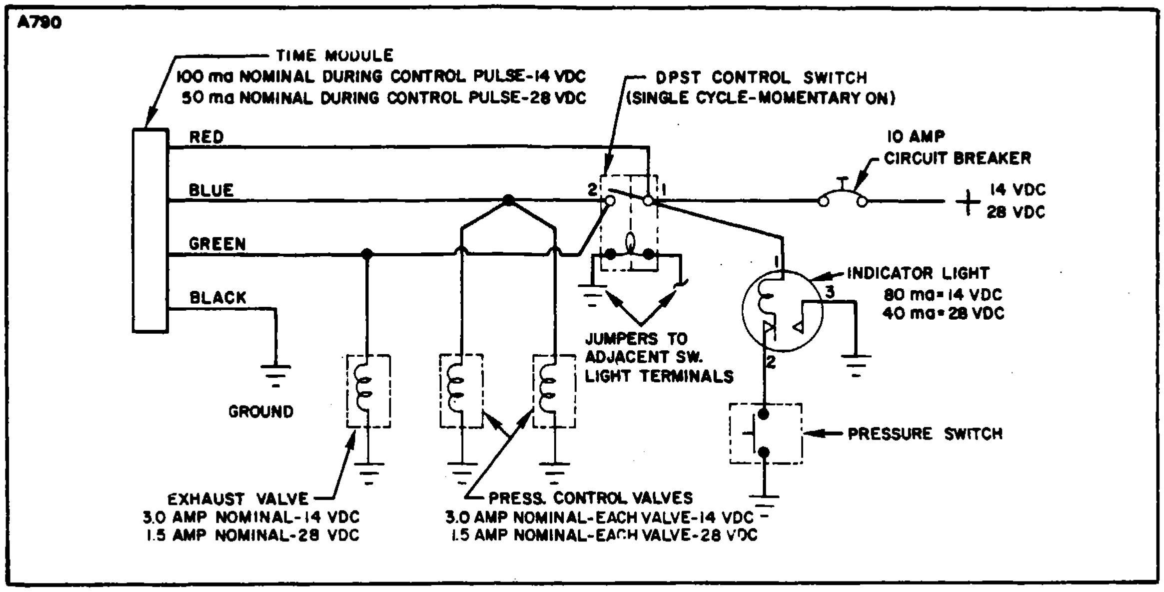


Figure 14-36. Pneumatic Deicer System Schematic (Using Time Module)

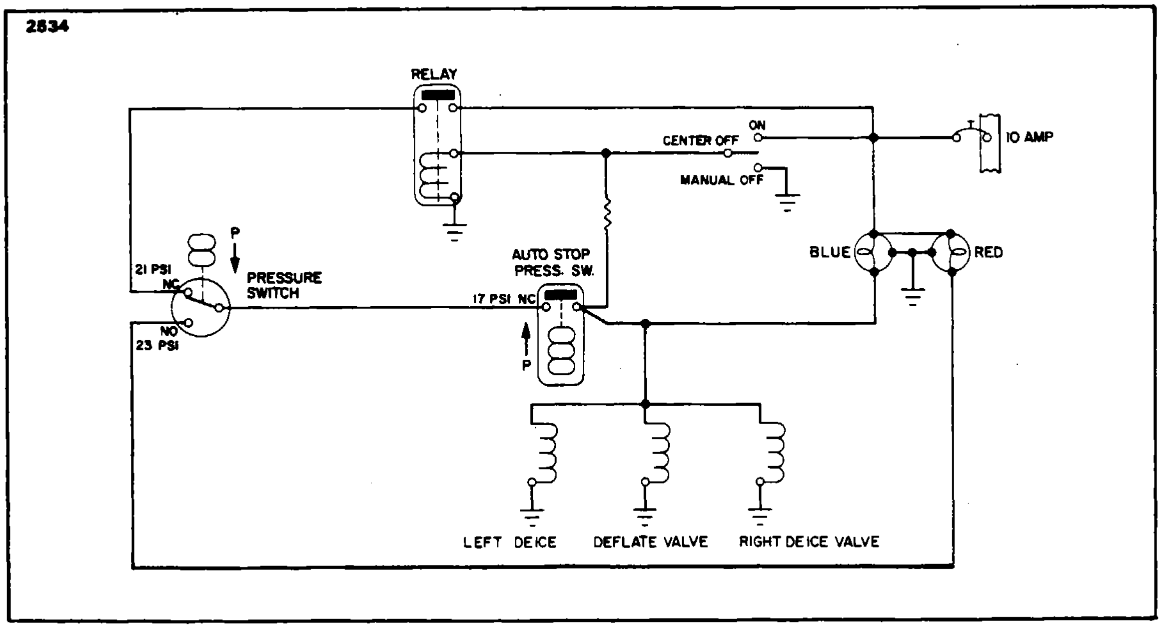


Figure 14-37. Pneumatic Deicer System Schematic (Airborne System)

14-73. TIMER OR TIME MODULE. No field maintenance is recommended. See Parts Catalog for replacement or vendor for repairs.

14-74. SHUTTLE VALVE. No field maintenance is recommended or authorized. For repair or replacement, contact your B.F. Goodrich dealer or distributor.

14-75. REPLACEMENT. No component maintenance other than that described in this manual is recommended.

14-76. INSPECTION (PREFLIGHT). Prior to the first flight each day, the deicer boots and the operating pressure shall be checked as follows:

a. Visually examine the surface of each boot carefully for tears, bruises, holes, loose patches, and clamps, and similar conditions which might result in further damage during flight.

b. Repair any such damage before takeoff is made.

c. Operate the engines at normal cruising RPM. Turn on the deicing system. Check the instrument suction should either side of the system fail, a small red button will appear at the corresponding side of the gauge face.

d. Observe the operation of the deicers carefully for evidence of malfunctioning. Look for tubes which leak or fail to inflate and deflate properly. All defects should be corrected before takeoff is made.

14-77. INSPECTION (POST FLIGHT). After the last flight each day, examine the boots for accumulation of oil, gasoline or other injurious substances. Particular attention should be given to empennage boots and to the inboard wing boots, since these are most likely to catch oil thrown by the engines. Clean off all such accumulations as soon as possible.

14-78. INSPECTION (100 HOURS). At each 100-hour inspection of the airplane, inspect and operate the deicer boots. Make checks as follows:

a. Carefully inspect the deicer for evidence of damage or deterioration and repair or replace damaged boots.

b. Resurface boots which show signs of considerable wear or deterioration.

c. Inspect all hose connections which form a part of the pneumatic deicing system. Replace deteriorated sections on non-kink hose.

d. Check operation of boots. Observe all standard safety precautions while operating the engines and system.

e. If new or replacement boots have been installed, check the tube inflation to make sure that the air connection stems have been properly connected.

f. On early systems using wet pneumatic pumps, disconnect all drain lines in the system and check for proper drainage.

CAUTION

Oil which reaches the deicers will cause rapid deterioration of the rubber. In cold weather, extreme care must be taken to see that engine oil does not collect in critical parts of the system and congeal. Congealed oil will cause sticking of control valves and distributor valve. If sticking of these parts is encountered, remove from the airplane, clean out, and replace.

g. Check the ON-OFF control switch for freedom of action.
h. Clean or replace the air filters.

NOTE

This operation may be omitted if boots were installed on the airplane subsequent to the last previous 100-hour inspection. On the other hand, if operations are being conducted under cold weather conditions below 10°F (-12°C), the filters should be cleaned out at each 100-hour inspection, or more often if difficulties are encountered with valves sticking due to congealed oil.

TABLE XIV-II. OPERATING PRESSURES

Recommended Operating Pressure PSIG	Test Pressure In PSIG	
	MIN.	MAX.
Early B. F. Goodrich 18	16	20
Later B. F. Goodrich 15	13	17
Airborne 17	22	25

14-79. INSPECTION (500 HOURS) AND PRESSURE TEST. A thorough inspection of the complete system including the 100 hour inspection and a functional inspection should be made at every 500 hours of engine operation. The following procedure has been divided into two parts to cover two different system installations. The first part will pertain to B.F. Goodrich systems while the second part pertains to Airborne system.

Part I. Goodrich:

a. To permit ground checking the system without operating the engines, the following procedure should be used in conjuction with recommended operating pressures given in Table XIV-II.

b. Refer to Table XIV-II for operating pressures required for system operation.

c. Using a source of filtered shop air with a testing rig consisting of an adjustable regulator, pressure gauge and shut-off valve connect the shut-off valve so as to trap air in the deicer system.

d. On Goodrich systems per Figure 14-32 disconnect the hose from the firewall bulkhead fitting (pump side) and attach the test rig to this port. Manually depress the solenoid plunger pin in the exhaust valve (if installed) and pressure control valves in the nacelle where the test rig is installed. Apply 15 psig to the system, and using the shut-off valve, trap this pressure in this portion of the system. A soap solution may be used to check for leaks. A pressure drop should not exceed 3 psig per minute. On Goodrich systems per Figures 14-30 and 14-31 cap the overboard port of one of the control valves. Connect a source of clean air to the inlet port of the control valve. Apply 18 psig to the system and by using the shut-off valve, trap the pressure in the deicer system. Observe the system for leakage. The leakage rate should not exceed a pressure drop of 3 psig per minute.

e. With the battery switch in the ON position, check the pressure switch operation with the system under pressure, the indicator light should glow.

f. With the battery switch ON and the deicer control switch OFF, press the indicator light to check the circuit and light bulb. If the indicator light does not function, check and reset the circuit breaker, a short circuit may exist. Refer to wiring schematic.

g. Remove the test rig, lubricate the threads, replace and tighten items dismantled.

h. On Goodrich systems referenced in Figure 14-32 an actual operating pressure test should be performed in the following manner:

1. Move airplane to a clear runup area where prop blast will not disturb anything.
2. Insert a tee connector into one of the lines which extends from the pressure switch fitting to either wing boot. Connect a pressure gauge (0-30 psig range) to the tee to monitor system pressure.
3. Start and permit one engine to reach normal operating temperature. With the engine operating at approximately 2200 RPM, actuate the deicer control switch. Observe the pressure gauge; pressure should reach approximately 17 psig.
4. Repeat step 3 with the opposite engine in operation.

CAUTION

Be sure the aircraft does not move when performing this ground test with both engines operating at high RPM.

5. Repeat step 3 with both engines operating at 2500 RPM.
6. With both engines operating at approximately 2500 RPM, actuate the deicer control switch. Pressure should reach approximately 20 psig.

NOTE

The maximum pressure reading should not be less than 16 psig with a single engine operating at 2200 RPM or greater than 21 psig with both engines operating at 2500 RPM. The pressure control valves can be adjusted to provide operating pressures within these limits. Refer to paragraph 14-80.

i. On Goodrich systems referenced in Figure 14-30 and Figure 14-31 an operating test and time cycle check should be performed in the following manner:

1. System operating test.
   (a) With the engine running at cruise speed, move deicer control switch to ON position and observe deicer operation. System is satisfactory if the indicator light glows within 4.0 seconds after switching.
   (b) Repeat procedure for other engine.
2. Time cycle check.
   (a) With the engines running at minimum cruise speed, move deicer control switch to ON position and note time. With switch ON, reduce engine speed to normal idle and hold for approximately two and one-half minutes. At the end of this interval, increase engine speed to minimum cruise speed and observe deicers for inflation.
   (b) Elapsed time from inflation-to-inflation should be approximately three minutes.

Part II. Airborne:

a. To permit ground checking the system without operating the engines the following procedure should be used.

b. Disconnect the .750 inch hose to the inlet of the deicer control valves and connect a source of filtered shop air which is regulated at 25 psig. This hookup may be done to both valves simultaneously or one side at a time to check each half of the system separately.

CAUTION

Before turning on the air, disconnect and plug the .375 inch vacuum hold down source line where it connects into the suction side of the system to prevent possible air flow backwards through the gyros.

c. Temporarily install a jumper wire on each of the two pressure switches located on the cross fitting within the fuselage. On the pressure switch with the two terminals, place the jumper wire on both terminals. On the pressure switch with three terminals, place the jumper wire on the terminals marked "C" and "NC."

d. Turn on the air supply and energize the solenoid valves. The boots will inflate and the blue and red panel lights will come on and the system can be checked for leaks.

CAUTION

To prevent damage to the solenoid valves, do NOT leave them energized for more than two minutes continuously.

e. Move the toggle switch to the "MANUAL DEFLATE" position and the boots will deflate.

f. Remove the jumper wire shorting out the normally closed and common contacts on the pressure switch containing three terminals.

g. Reactuate the toggle switch to the INFLATE position. The boots will inflate, the blue light will come ON and the boots should deflate automatically.

h. Now remove the jumper wire on the other pressure switch and reinflate the boots, they should automatically deflate as stated in step g.

i. An actual operating pressure test should be performed in the following manner:

1. Move the airplane to a clear runup area where prop blast will not disturb any thing.
2. Check system operation on each engine individually and then with both engines operating.
3. A normal inflation cycle should last three to six seconds with engines operating at minimum cruise RPM before automatic deflation. Any radical departure from this could indicate a system leak. Refer to Table XIV-111 for Troubleshooting Chart.

14-80. PRESSURE CONTROL VALVES ADJUSTMENTS. (Goodrich Systems per Figure 14-32.)

a. To increase the high pressure setting hold the locknut on top of the solenoid push rod with a wrench and with a screwdriver, turn the push rod clockwise until the desired setting is obtained.

NOTE: Directions clockwise and counterclockwise assumes the viewer is looking down on the top of the solenoid.

b. To lower the high pressure setting hold the locknut on top of the, solenoid push rod and turn the push rod counterclockwise until the desired setting is obtained.

14-81. HIGH PRESSURE DEICER BOOTS.

NOTE: Goodrich Black Standard Pneumatic Deicer Installation, Maintenance, and Repair, ATA Report No. 30-10-31, provides approved, alternate procedures for removing and installing de-ice boots. Reference to it is highly recommended. Obtain it online at http://www.goodrich.com/TechPubs.

14-82. DESCRIPTION. A high pressure deicer boot is essentially a fabric reinforced rubber sheet, containing built-in inflation tubes, that is attached to the leading edge of the surface to be protected by means of a cement.

There is an air connection on the backside of the deicer, called an "air connection stem." Each stem projects from the underside of the boot into the leading edge, through a round hole provided in the metal skin for connection to the air supply system.

Air pressure from engine driven pumps is supplied to the inflatable tubes by a suitable pneumatic system.

The deicer outer layer is made of conductive, neoprene to allow static electricity to be dissipated. These charges, if allowed to accumulate, would eventually discharge through the boot to the metal skin beneath, causing static interference with the radio sending and receiving sets and possible punctures in the rubber. Also, such static charges would constitute a temporary fne hazard after each flight.

Deicers have spanwise inflatable tubes, only one inflation port and all tubes are inflated simultaneously. Boots are lightweight construction designed for lightweight airplanes.

14-83. REMOVAL. When necessary to remove the pneumatic deicer, it is recommended that an approved installation station accomplish this operation.

Should it be necessary to remove any portion of the pneumatic deicer, the following steps should be used:

a. Obtain a sharp, pointed non-metallic wedge several inches wide. A hardwood wedge would be suitable. Also, obtain a supply of Methylethylketone (MEK).

b. Start at a deicer corner at an upper edge and with the wedge, work up the deicer, using MEK in combination with the wedge to avoid removing the rubber coating from the back of the deicer. Using a small, oil type squirt can will help direct the flow of MEK and help avoid damaging the paint.

CAUTION

Be extremely careful when removing boot so as not to exert force while pulling or lifting, as this could result in tearing boot.

c. Using the wedge and MEK, continue working up the deicer skin until the deicer has been removed to the desired point.

d. Clean the existing portions of the surface and deicer, thoroughly removing all cement. Use MEK to do this.

14-84. PRE-INSTALLATION REQUIREMENTS

14-85. MATERIALS. The following materials are required:

EC-1300L and/or EC-1403 cement, Minnesota Mining & Manufacturing Co. FSN 8040-628-4199 and/or 8040-514-1880.

Methylethylketone (MEK) Federal Specification TT-M-261, or Acetone, Federal Specification O-A-51.

Tackifying solvent, Toluol or MEK (See note)
Clean, lint-free cleaning cloths
Several empty tin cans
3 inch paint brushes
2 inch rubber hand rollers
1/4 inch metal hand stitcher roller
Carpenter's chalk line
1 inch masking tape
Steel measuring tape
Sharp knives
Fine sharpening stone
Sealing compound EC-801, Minnesota Mining & Manufacturing Co.
Cement A-56-B, B. F. Goodrich Co.

NOTE

MEK may be used instead of Toluol to re-activate cement for installation. However, tests show that MEK causes very rapid drying and provides only 10 seconds working time for deicer application compared with 40 seconds for Toluol.

14-86. PREPARATION OF LEADING EDGES.

a. With 1 inch masking tape, mask off leading edge boot area, allowing 1/2 inch margin. Take care to mask accurately, thus eliminating the need for cleaning off excess cement later.

b. Clean the metal surfaces thoroughly at least twice with MEK or acetone. For final cleaning, wipe the solvent film off quickly with a clean dry cloth before it has time to dry.

c. Fill gaps of skin splices that lead under deicers with sealing compound EC-801.

14-87. PREPARATION OF DEICER. Moisten a clean cloth with MEK or acetone and carefully clean the rough, back surface of the boot at least twice. Change cloths frequently to avoid recontamination of the cleaned areas.

14-88. INSTALLATION OF DEICER.

WARNING

The cements and solvents used for installation are flammable and their fumes slightly toxic. Therefore, all work should be done in a well-ventilated area away from any sparks or flames. (Use a solvent resistant type gloves is recommended.)

NOTE

Do not inflate deicers within 12 hours of installation or until adhesion strength of 10 pounds is obtained.

a. Thoroughly mix EC-1300L cement before using. Apply one even brush coat to the cleaned back surface of the boot and to the cleaned metal surface. Allow the cement to air dry for a minimum of one hour. Apply a second coat to both surfaces and allow to air dry a minimum of one hour. Ambient temperature for installation should be held between 40 and 110 degrees F. However, longer drying time of the cement coats may be required as the humidity approaches 99%. Deicer and leading edge may be cemented for a maximum of 48 hours before actual installation.

b. Using a clean, lint-free cloth moistened with Toluol, re-activate the cement on the leading edge surface and boot in spanwise strips approximately 6 inches wide. Avoid excessive rubbing of the cement which could remove the cement from the surface. Obtain sufficient personnel to hold boot steady during installation. (Limit handling cemented side of boot with fingers.) Roll the deicer firmly against the wing leading edge, being careful not to trap any air under the deicer. Always roll parallel to the inflatable tubes.

c. If the deicer should attach "off course," use MEK to remove and reposition properly. Avoid twisting or sharp bending of the deicer.

d. Rubber roll, applying pressure over entire surface of the deicer. All rolling should be done parallel to the inflatable tubes. Roll trailing edges with a narrow stitcher roller.

e. After the cement has dried, remove all masking tapes and clean surfaces with Toluol being careful not to let Toluol run under edge of cemented down deicer.

f. Apply a brush coat of A-56-B cement to EC-801 seams and along trailing edges of deicer to form a neat straight line being sure that the conductive coating (A-56-B) is continuous from the deicer surface to the wing surface.

14-89. SERVICE LIFE OF DEICERS. An average service life of approximately 30 months can be expected, if the following precautions are observed.

14-90. MAINTENANCE.

1. Keep pneumatic deicers free of oil, gasoline, paint remover, solvents, and other injurious substances.
2. Do not rest ladders or work stands against leading edges having deicers installed. Wrap padding around those portions of work stands which could come in contact with deicers.
3. When refueling or servicing aircraft with oil, do not drag the servicing hose over the deicers. Use suitable padding for protection.
4. Do not walk on the deicer boots. Also, do not lay tools or other objects on them.
5. Exercise care at all times to prevent the boots from being subjected to abuse.
6. Clean deicers when the airplane is washed with a mild soap and water solution. In cold weather, wash the boots with the airplane inside a warm hangar if possible. If the cleaning is to be done outdoors, heat the soap and water solution before taking it out to the airplane. If difficulty is encountered with the water freezing on the boots, direct a blast of warm air along the region being cleaned, using a portable type ground heater.

   As alternates, use benzol or non-leaded gasoline. Moisten the cleaning cloth in the solvent, scrub lightly, and then, with a clean, dry cloth, wipe dry so that the cleaner does not have time to soak into the rubber. Petroleum products such as these are injurious to rubber, and therefore should be used sparingly.
7. Prior to the first flight each day, the deicers should be checked as follows:

   Visually examine the surface of each boot carefully for tears, holes, bruises, loose patches and similar conditions which might result in further damage during flight, and repair any such damage before takeoff per instructions included in Iceguard Repair Kit 700.

   If a replacement is not available, or repair is impossible, remove both the damaged and the corresponding deicer on the opposite side of the airplane before attempting flight. (See paragraph 14-83 for removal instructions.)
8. After the last flight each day, examine the boots for accumulation of oil, gasoline, or other injurious substances, and clean off as soon as possible.

14-91. ICEX APPLICATION. B.F. Goodrich Icex is silicone base material specifically compounded to lower the strength of adhesion between ice and the rubber surfaces of airplane deicers. Icex will not harm rubber, and offers added ozone protection.

Properly applied and renewed at recommended intervals, Icex provides a smooth, polished film that evens out the microscopic irregularities on the surface of rubber parts. Ice formations have less chance to cling. Ice is removed faster and cleaner when deicers are operated.

It should be emphasized that Icex is not a cure-all for icing problems. Icex will not prevent or remove ice formations. Its only function is to keep ice from initially getting a strong foot-hold, thus making removal easier.

One 16 oz. pressurized can of Icex will cover deicer surfaces of the average light twin-engine plane approximately three times. It is also available in quart cans (unpressurized).

Before applying Icex, thoroughly clean deicer or other rubber surfaces with a rag dampened with non-leaded gasoline. Follow by a scrub wash of mild soap and water. Allow time for surfaces to dry.

Shake the Icex can well. Hold the nozzle approximately 12 inches from the surface and spray. Apply sparingly. If the application is too heavy it results in a sticky surface which is very undesirable because it will pick up runway dust and prevent best ice removing efficiency.

Due to the natural abrasive effects on leading edges of deicers, propellers and abrasion boots during flight, reapply Icex every 150 flight hours on wings and empennage deicers.

14-92. REPAIR. Deicer repairs are classified as cold (temporary), made on the boot installed on the airplane, and vulcanized, made on the demounted boot in the shop.

14-93. COLD REPAIR. The materials and supplies for making cold repairs are listed as follows:

Material and Supplies for Cold Repair

Part No.	Quantity	Description
74-451-C (FSN1650-856-7939)	1	Cold Patch Repair Kit (B. F. Goodrich Co.)
74-451-11	1/2 pt. can	A-56-B Conductive cement
74-451-16	30 pcs.	Small oval patch 1-1/4 x 2-1/2 in.
74-451-17	30 pcs.	Medium oval patch 2-1/2 x 5 inch.
74-451-18	10 pcs.	Large oval patch 5 x 10 in.
74-451-19	3 pcs.	Patch 5 x 19 inch.
74-451-20	(2) 1/2 pt.	No. 4 cement[1] (patching only)
74-451-70	2	Cement brush 1/2 in.
74-451-73	1	1/8 in. Steel stitcher
74-451-75	6	Emery buffing sticks
74-451-87	1	Buffing shield

[1] This cement will give best results with the patches in this kit.

Material and Supplies for Cold Repair (cont.)

Part No.	Quantity	Description
The following items may be procured from the B. F. Goodrich Company, Akron, Ohio, or other manufacturer, as required.		
74-451-23	4 ft. long x 8 in. wide	Neoprene surface ply
74-451-24 (FSN8040-628-4199 and/or FSN8040-514-1880)	1 quart	EC-1403 cement and/or EC-1300 L
74-451-74	1	2-1/2 in. sponge rubber roller
Minnesota Mining and Manufacturing Company, Adhesives Division, 411 Piquette Avenue, Detroit, Michigan.		
The following materials may be obtained from local supply:		
		Toluol
	As required	Clean, lint-free cloths (preferably cheese cloth)
	Rolls	1 in. masking tape
	1	Sharp knife
	6 ft. long	Steel measuring tape
	1	Fine sharpening stone
	As required	Steel wood pads
	As required	Hypodermic needles (22 gauge or smaller)
Methylethylketone (MEK) can be used instead of Toluol, however, MEK causes very rapid drying and provides only 10 seconds working time compared with 40 seconds for Toluol.		

14-96. SCUFF DAMAGE. This type of damage will be most commonly encountered, and, fortunately, it is not necessary in most cases to make a repair. On those rare occasions when the scuff is severe and has caused the removal of the entire thickness of surface ply in spots (the brown natural rubber underneath is exposed), repair the damage, using parts No. 74-451-16, 74-451-17, 74-451-18 or 74-451-23, and proceed as follows:

a. Clean the area around the damage with a cloth dampened slightly with solvent.

b. Buff the area around the damage with steel wool so that it is moderately but completely roughened.

c. Wipe the buffed area with a clean cloth slightly dampened with solvent to remove all loose particles.

d. Select a patch of ample size to cover the damaged area.

e. Apply one even thorough coat of cement, Part No. 74-451-20, to the patch and the corresponding damaged area.

f. Allow cement to set a couple of minutes until tacky.

g. Apply the patch to the De-Icer with an edge, or the center, adhering first. Work down the remainder of the patch carefully to avoid trapping air pockets. Thoroughly roll the patch with stitcher-roller, Part No. 74-451-73, and allow to set for ten to fifteen minutes.

h. Wipe the patch and surrounding area from the center outward with a cloth slightly dampened with solvent.

i. Apply one light coat of A-56-B conductive cement, Part No. 74-451-11, to the patched area.

j. Satisfactory adhesion of patch to De-Icer will be reached in four hours. De-Icer may be inflated for checking repair in a minimum of 20 minutes.

14-97. TUBE AREA DAMAGE. Repair cuts, tears or ruptures to the tube area with fabric reinforced patches, Part No. 74-451-16, 74-451-17, 74-451-18 or 74-451-19, depending on size of damage.

a. Select a patch of ample size to cover the damage and to extend to at least 5/8 inch beyond the ends and edges of the cut or tear. If none of the patches is of proper size, cut one to the size desired from one of the larger patches. If this is done, bevel the edges by cutting with the shears at an angle.

NOTE

These patches are manufactured so that they will stretch in one direction only. Be sure to cut and apply the patch selected so that stretch is in the widthwise direction of the inflatable tubes.

b. Proceed with repair in the manner outlined in paragraph 14-96.

c. Buff the area around the damage with buffing stick, Part No. 74-451-75 so that the surface is thoroughly roughened.

d. Apply the patch to the De-Icer with the stretch in the widthwise direction of the inflatable tubes, sticking edge of patch in place, working remainder down with slight pulling action so the injury is closed. Do not trap air between patch and De-Icer surface.

14-98. LOOSE SURFACE PLY IN DEAD AREA (NON-INFLATABLE AREA.) Peel and trim the loose surface ply to the point where the adhesion of surface ply to the De-Icer is good.

a. Scrub (roughen) area in which surface ply is removed with steel wool, scrubbing motion must be parallel to cut edge of surface ply to prevent loosening it.

b. Scrub with steel wool and Toluol directly over all edges, but parallel to edges of surface ply to taper them down to the tan rubber ply.

c. Cut a piece of surface ply material, Part No. 74-451-23, to cover the damaged area and extend at least one inch beyond in all directions.

d. Mask off the damaged boot area 1/2 inch larger in length and width than the size of surface ply.

e. Apply one coat of cement, Part No. 74-451-11, to damaged area and one coat to surface ply. Allow cement to set until tacky.

f. Roll the surface ply to the De-Icer with two inch rubber roller, Part No. 74-451-74. Roll edges with stitcher-roller, Part No. 74-451-73.

g. Apply just enough tension on the surface ply when rolling to prevent wrinkling.

h. Be careful to prevent trapping air. If air blisters appear after surface ply is applied, remove them with a hypodermic needle.

i. Clean excess cement from De-Icer with solvent.

14-99. LOOSE SURFACE PLY IN TUBE AREA. Loose surface ply in tube area is usually an indication of the De-Icer starting to flex fail. This type of failure is more easily detected in the form of a blister under the surface ply when De-Icer is pressurized. If this type of damage (or void) is detected while still a small blister (about 1/4 or 3/8 inch diameter) and patched immediately, the service life of the De-Icer will be appreciably extended.

a. Apply repair patch as outlined in paragraph 14-97.

14-100. DAMAGE TO FABRIC BACK PLY OF HIGH PRESSURE DE-ICER DURING REMOVAL. If cement has pulled loose from the wing skin and adhered to the back surface of the De-Icer, remove it with steel wool and MEK.

a. In those spots where the coating has pulled off the fabric, leaving bare fabric exposed, apply at least two additional coats of cement, Part No. 74-451-24. Allow each coat to dry thoroughly.

14-101. VULCANIZED REPAIR. It is recommended that vulcanized repairs be made by an approved De-Icer Installation Station.

TABLE XIV-III. PNEUMATIC DEICER PUMP SYSTEM TROUBLESHOOTING
(B. F. GOODRICH SYSTEM)

Trouble	Cause	Remedy
De-Icers do not inflate - both engines operating at minimum cruise RPM or either engine at maximum ground RPM. (for 8 seconds.)	Open circuit breaker.	Push circuit breaker to reset.
	System connection loose or wire broken.	Tighten or repair as required.
	Timer not functioning.	See Electrical Test - through Timer.
	Control valves not functioning.	See Electrical Test - through control valve. Valve poppet sticking; see Maintenance - control valve.
	Piping lines blocked or not connected.	See air leakage test. Blow out line and inspect connections.
De-Icers inflate slowly - both engines operating at minimum cruise RPM or either engine at maximum ground RPM (for 8 seconds.)	Piping lines partially blocked or not connected securely.	Inspect and blow out lines. See air leakage test.
	Shuttle valve not functioning.	Check fitting in De-Icer port for proper installation.
	Low air pump capacity.	Check performance to manufacturer's specifications.
	De-Icer puncture.	Repair per specification or replace.

TABLE XIV-III. PNEUMATIC DEICER SYSTEM TROUBLESHOOTING (cont.)
(B. F. GOODRICH SYSTEM)

Trouble	Cause	Remedy
De-Icers inflate - Indicator light does not function.	Indicator lamp burned out.	Replace lamp.
	System pressure not being reached.	Check "De-Icers inflate slowly."
	Pressure switch not functioning.	See Electrical Test - Indicator Light and Pressure Switch.
	Wires loose or broken. Poor grounding of pressure switch.	See Electrical Test - Indicator Light and Pressure Switch.
De-Icers deflate slowly.	Vacuum regulator set too low.	Re-adjust vacuum regulator. See Vacuum Regulator Adjustment.
	Clogged air filters.	Clean or replace filter. See Maintenance - Filter Element.
	Piping, lines partially blocked.	Inspect and blow out lines.
	Overboard line from control valve partially blocked.	Inspect and blow out lines.

TABLE XIV-III. TROUBLESHOOTING - PNEUMATIC DEICER (AIRBORNE SYSTEM)

Trouble	Cause	Remedy
Slow boot inflation.	Air lines blocked or disconnected.	Check lines and repair.
	Low pneumatic pump capacity.	Check performance to manufacturers specifications.
	One or more solenoid valves not functioning properly.	Replace solenoid valve as required.
	Deicer boot punctured.	Repair per specifications or replace.
Boots do not inflate.	Faulty deflate valve.	Replace valve.
	Two faulty deice control valves.	Replace valves.
	Relay not functioning.	Check wiring or replace relay.
	Leak in system.	Repair leak
	Open circuit breaker.	Reset circuit breaker.
Blue indicator light does not light on inflation.	Lamp burned out.	Replace bulb.
	Loose wires.	Repair wires.
	Faulty pressure switch.	Short out N.C. switches separately to find bad one and replace.

TABLE XIV-III. TROUBLESHOOTING - PNEUMATIC DEICER (cont.)
(AIRBORNE SYSTEM)

Trouble	Cause	Remedy
Slow deflation.	Low vacuum.	Readjust regulator.
	Leak in system.	Repair leak.
	Faulty deflate valve.	Replace valve.
Red indicator light does not light with both normally closed switches shorted out during ground testing.	Lamp burned out.	Replace bulb.
	Faulty pressure switch.	Replace switch.
	Loose wires.	Replace wires.
System will not automatically deflate.	Faulty pressure switch.	Check and/or replace.
	Faulty relay.	Check wiring or replace relay.
	Defective switch.	Check and/or replace.

14-102. PROPELLER SYNCHRONIZER. (Hushtrol System)

14-103. DESCRIPTION OF PROPELLER SYNCHRONIZER SYSTEM.

The system consists of two magnetic pickups, an electrical control chassis to monitor the system, a phase servo to regulate the slave propeller governor, and a control head in the cockpit along with the related wire harnesses.

The function of the propeller synchronizer system is to automatically match the propeller RPM of both engines within a preset range of RPM. This is accomplished by using the left engine as the master unit and the right engine as the slave unit. The right hand magnetos of each engine have magnetic pickups which feed electrical pulses into the electronic control chassis located on the right engine mount aft of the firewall. The control chassis detects any difference in the electrical pulses and in turn activates a servo assembly mounted on the right engine mount, which trims the right propeller governor, thus maintaining the same propeller RPM as the master left engine.

NOTE

> The system will only maintain a synchronized condition as long as the RPM setting of the master engine is not changed from the time the system is activated. Should it be necessary to go beyond the limit of the system, the control head switch must be turned to the manual position which will allow the phase servo to center itself and be ready to synchronize the system when reactivated.

Normal governor operations are not changed, but the synchronizer will continuously monitor the propeller RPM and regulate the slave governor as required within the RPM range of the system as long as it is on. The limiting range of operation is built into the system to prevent the slave propeller governor from loosing more than a fixed amount of RPM in case the master engine propeller is feathered with the system in operation.

14-104. TROUBLESHOOTING. Troubles peculiar to this system are listed in Table XIV-IV along with their probable causes and suggested remedies. The following information will help locate system malfunction with the minimum amount of equipment.

14-105. FUNCTIONAL TEST. This test can be done on the ground with no special test equipment required. The following steps should be used:

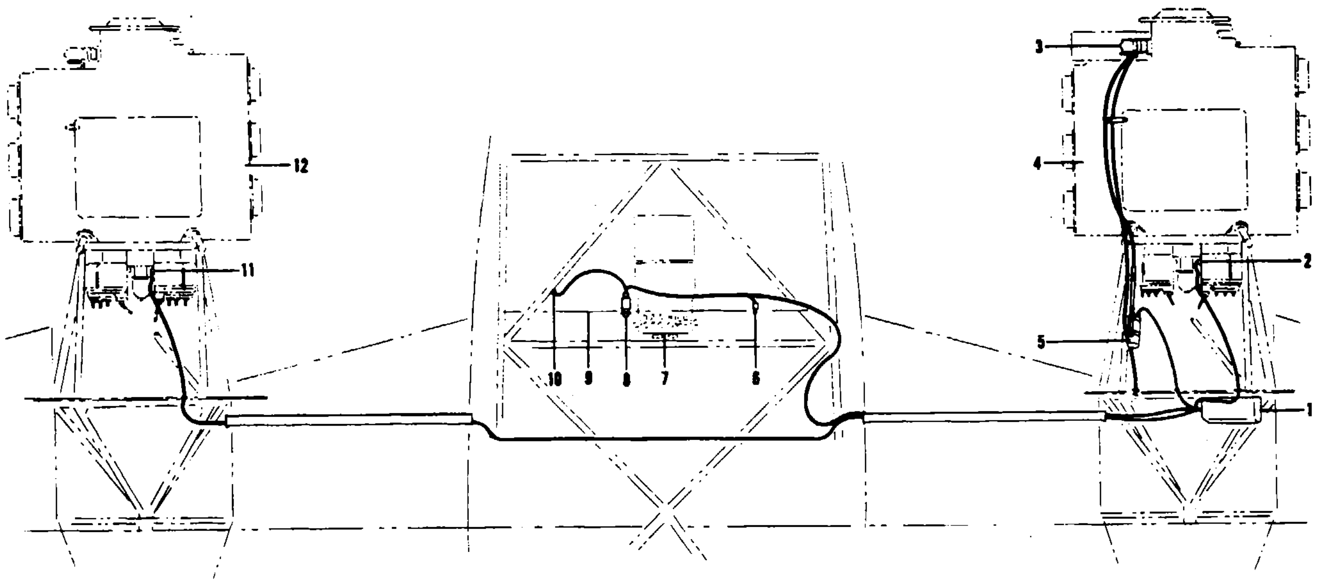
a. Start up both engines and run them at 2100 RPM to get both governors operating.

b. Turn on the synchronizer system and allow the system to stabilize.

c. With the synchronizer still on, shut down the master engine.

d. Pull the synchronizer system circuit breaker off. This will keep the phase servo in whatever position it has moved to.

e. Shut down the other engine and check the phase servo plunger - it should be fully retracted.



1. ELECTRONIC CHASSIS
2. MAGNETIC PICKUP (RT. ENG.)
3. SLAVE GOVERNOR
4. SLAVE ENGINE (RT.)
5. PHASE SERVO
6. CIRCUIT BREAKER
7. CONTROL PEDESTAL
8. CONTROL HEAD
9. INSTRUMENT PANEL
10. GROUND CONNECTION
11. MAGNETIC PICKUP (LT. ENG.)
12. MASTER ENGINE (LT.)

Figure 14-38. Propeller Synchronizer System Installation

f. Repeat steps a. thru b. and now shut down the slave engine. Continue with step d.

g. Shut down the master engine and check the phase servo plunger - it should be fully extended.

h. If the above steps cannot be met the phase servo should be replaced.

14-106. MAINTENANCE. Little maintenance is required on this system apart from visual inspection at the time of regular airplane inspection. Ascertain that the electrical connections and all related components are securely attached.

14-107. REMOVAL OF PHASE SERVO.

a. Remove the right engine cowling.

b. Disconnect the electrical plug from the servo.

c. Loosen the jam nut from the servo cable at the governor end.

d. Loosen jam nut on cable adapter at the servo and disconnect the cable and adapter from the servo.

e. Loosen the four screws which secure the servo in the clamp assembly and slide the servo out.

14-108. INSTALLATION OF PHASE SERVO.

a. Place the servo into the clamp assembly, ascertain that the actuator end is forward the servo cable and adapter.

b. Connect the adapter to the servo, but do not tighten the jam nut at this time.

c. Connect the electrical plug to the servo.

d. Adjust the servo in accordance with paragraph 14-109.

e. Install the right engine cowling.

14-109. ADJUSTMENT OF PHASE SERVO. (Refer to Figure 14-40.)

a. Ascertain that the servo is in its neutral position by momentarily turning the unit on to the manual position.

b. Position the servo cable into the linkassembly and leave approximately .25 to .19 of an inch of threads exposed above the jam nut.

c. Set both propeller pitch control levers to the high position.

d. Hold the governor arm against the high RPM stop and move the servo in its bracket to align the right propeller control lever with the left lever.

NOTE

Increasing the distances between the servo and the control cable housing will move the propeller control lever forward, and decreasing this distance will move the lever aft. This can be accomplished by turning the adapter at the servo or by removing the servo cable from the governor control arm and turning the cable. The servo control cable must be removed at the governor to relieve any twist in the cable assembly.

e. Ascertain that the servo stays within the clamps of the mounting bracket during the adjustment of the propeller control lever. Tighten the clamps to secure the servo in place.

14-110. PROPELLER GOVERNOR ADJUSTMENT. For the synchronizer system to function properly the proper adjustment of the governor is necessary.

With each governor against the high RPM stop, the left hand engine (master) should show 2575 RPM and the right hand engine (slave) should show 2575+ RPM.

NOTE

The slave engine must always be at least 1 RPM more than the master engine for the propeller synchronizer to function properly.

Adjust the governor in accordance with instructions given in Section VIII. Set the slave engine governor approximately 25 RPM higher than the master engine. An incorrect setting of the governor will result in the slave engine searching for an impossible position. If the master engine is set faster than the slave engine when the governors are against the high RPM stops, and the control switch is turned from the manual to the Auto position, the servo will extend attempting to increase the slave engine RPM to match the master engine. But because of the slave engine high RPM stop it will force the propeller pitch control lever aft and will never achieve synchronization.

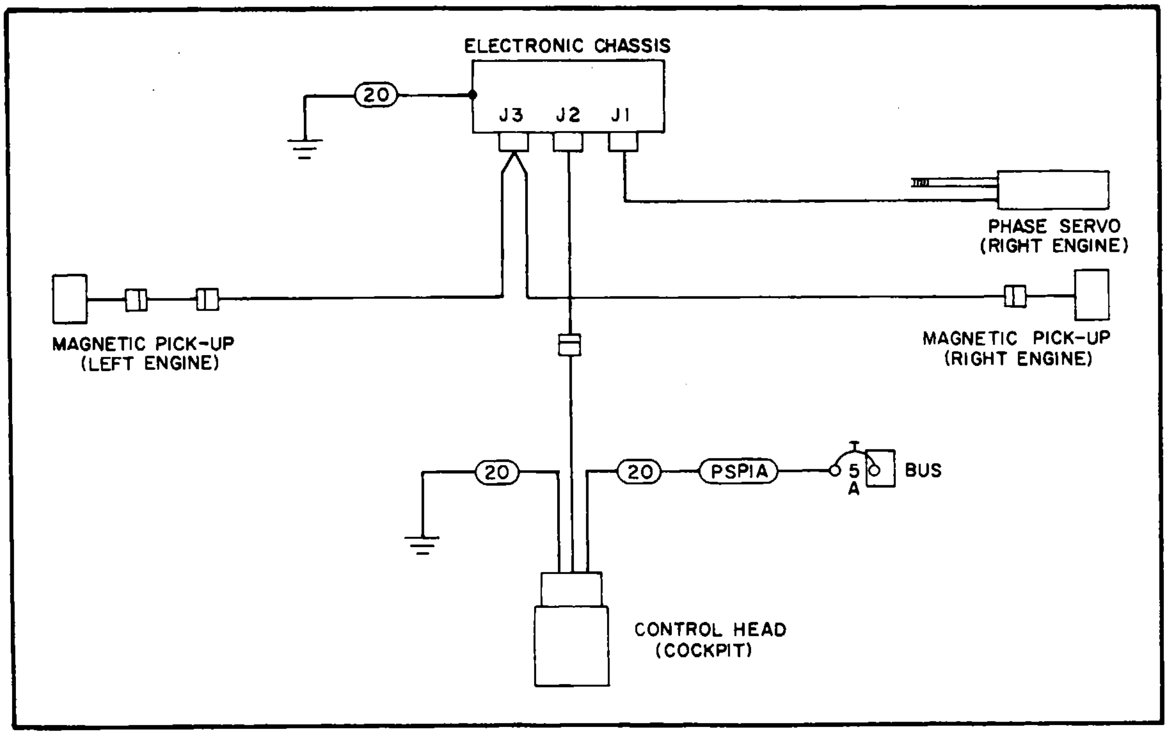


Figure 14-39. Synchronizer Schematic

14-111. REMOVAL OF ELECTRONIC CHASSIS.

a. Remove the access panel on the top of the right engine nacelle.

b. Disconnect the three electrical plugs at the electronic chassis.

c. Loosen and remove the three locknuts and screws which secure the chassis to the engine mount.

d. Remove the chassis from the airplane.

14-112. INSTALLATION OF ELECTRONIC CHASSIS.

a. Position the electronic chassis into the nacelle and secure in place with three screws and locknuts.

b. Connect the three electrical plugs to the chassis.

c. Install the access panel to the top of the nacelle.

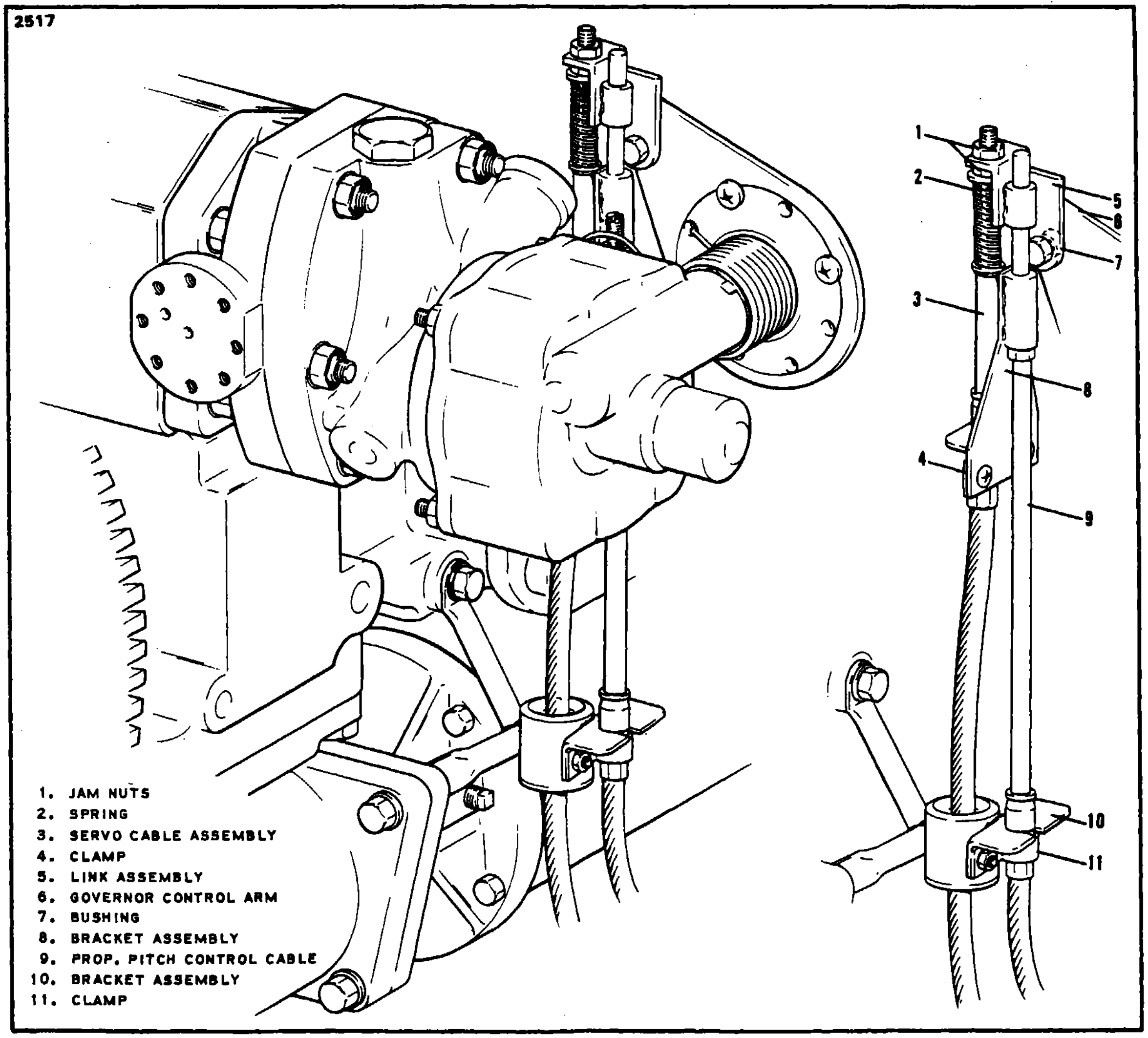


Figure 14-40. Mechanical Connections

14-113. TEST EQUIPMENT. A piece of test equipment can be fabricated to simulate engine running conditions so the system operation can be checked in the hangar without actually running the engines. A list of parts and a schematic are shown in Figure 14-41. The following steps will explain the use of this test box:

a. Disconnect the magnetic pickup plug J-3 from the electronic chassis and connect the matching plug from the test box.

b. Connect the test box AC plug to any available 115-volt AC power supply and set the master switch on the test box ON and both engine switches OFF.

c. Turn the aircraft master switch ON, the synchronizer control to the AUTO position and ascertain that the synchronizer circuit breaker is IN.

d. Set the right engine switch of the test box ON and the left engine switch OFF. The phase servo plunger should be fully retracted.

e. Set the left engine switch of the test box ON and the right engine switch OFF. The phase servo plunger should be fully extended, approximately .50 of an inch.

NOTE

As each engine switch is actuated it will simulate engine running conditions and operate the phase servo accordingly. Operation may be slow, but the plunger should go to the full extreme of its travel.

f. With both engine switches of the test box ON, rotate the phase control slowly and observe the phase servo for a small amount of movement as it tries to change the phase of both engines.

g. If the phase servo does not perform as outlined, the servo, electronic chassis and control head should be returned for further test.

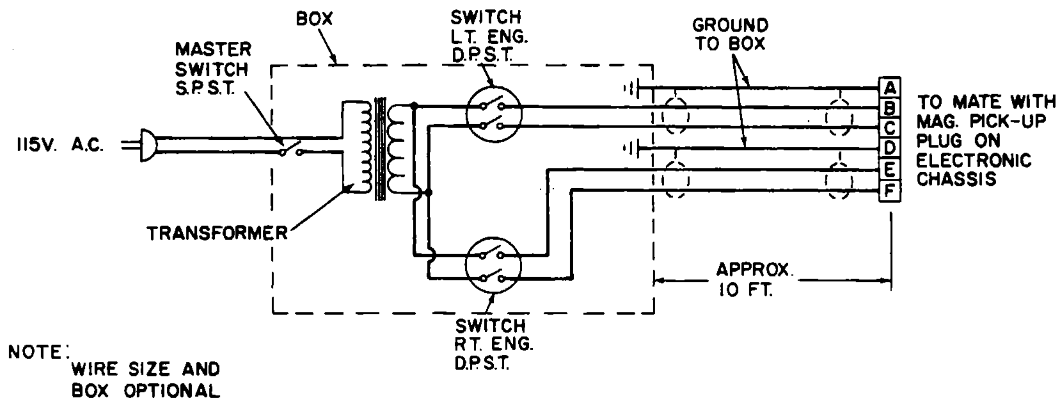
14-114. ELECTRIC WINDSHIELD ANTI-ICE.

14-115. DESCRIPTION. The electric windshield anti-ice consists of an electrically heated anti-ice panel installed in front of the pilot's windshield, a 15 amp circuit protector and a windshield heat on-off switch.

A field repair kit, No. 764-096, is available from Piper dealers for replacement of a defective windshield anti-ice panel connector plug.

PARTS LIST FOR SYNCHRONIZER TEST INSTRUMENT		
Amount	Part	Type
1	10 Volt AC Transformer	any AC
1	Switch	S-P-S-T
2	Switch	D-P-S-T
1	Socket	M53106A-14S-6P
1	Plug	115 Volt AC
Approx. 20 feet.	Cable, two conductor shielded - AN22 or larger.	

A787



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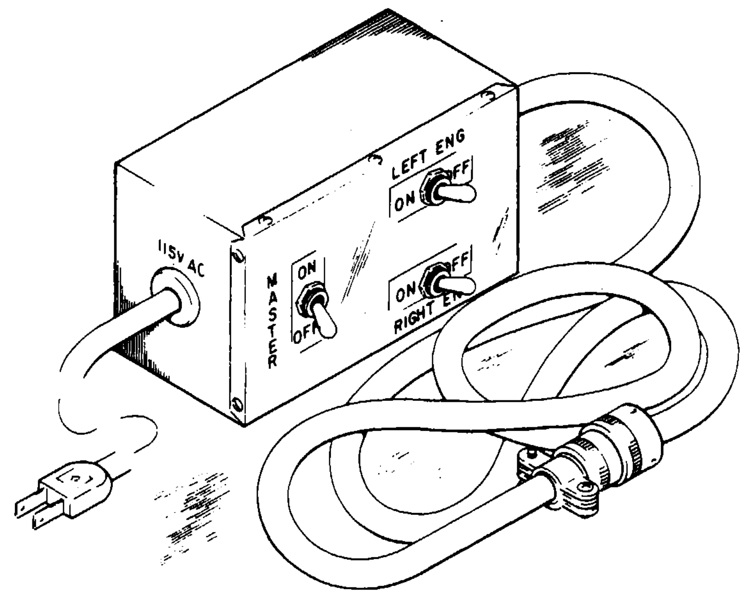


Figure 14-41. Fabricated Test Box

TABLE XIV-IV. TROUBLESHOOTING CHART (PROPELLER SYNCHRONIZER)

Trouble	Cause	Remedy
Synchronizer hunting.	Binding of the governor control arm, and/or cable assembly.	Correct any mechanical binding.
	Master governor speed is varying.	Overhaul governors.
Synchronizer runs out of synchronization when turned on.	Intermittent shorts or opens in the pickup or its wiring.	Replace defective pickup.
Synchronizer will not center.	Defective pickup.	Replace.
	Defective electronic component.	Replace.
	Mechanically misrigged.	Rerig.
Lack of range.	Improper rigging.	Rerig properly.
	Trying to synchronize too close to a mechanical stop.	Adjust prop control in cockpit to move speed control lever further away from stop.
	Defective electronic component.	Replace

TABLE XIV-IV. TROUBLESHOOTING (PROPELLER SYNCHRONIZER) (cont.)

Trouble	Cause	Remedy
Synchronizer corrects in one direction only.	Defective electronic component.	Replace
	Mechanical binding in one direction.	Correct binding.
	Improper rigging.	Rerig.
Slow to synchronize and won't hold synchronization.	Defective electronic component.	Replace
	Excessive mechanical friction.	Current mechanical binding.
	Intermittent short in pickup or wiring.	Repair pickup lead or replace pickup.
	Defective electrical plug connector.	Replace plug connector.

14-116. ENGINE SYNCHROPHASER. (PA-23-250 (six place), Serial Nos. 27-3944 and up.)

14-117. DESCRIPTION OF SYNCHROPHASER SYSTEM. (Refer to Figure 14-42.)

This system consists of a pulse generator, a strobe sensor (replaced by another pulse generator in Serial Nos. 27-7854068 and up), a computer, and an electrical control solenoid.

The pulse generator, located on the master LEFT engine supplies timing information to the strobe sensor on the slave RIGHT engine. The resultant error signal, generated by the strobe sensor is fed to the computer that in turn drives the servo amplifiers. The output of the servo amplifiers controls the electrical solenoid on the slave engine governor. This control action keeps the slave engine in phase with the rotation of the master engine.

NOTE

Serial Nos. 27-7854068 and up have a second generator in lieu of the strobe sensor. The signals from both generators are supplied directly to the computer for comparison. The difference signal is amplified and fed to the governor solenoid to control the slave engine.

The pulse generator is mechanically driven by the camshaft of the master LEFT engine. One rotation of the camshaft constitutes one cycle of engine operation of a four stroke engine. This permits the pulse generator to be timed to any relationship to the firing order of the engine. The strobe sensor (another pulse generator on the later systems) is likewise driven by the camshaft on the slave engine. This gives a latitude of selection, permitting any selection of corresponding operation between master and slave engine.

The selector switch on the panel has two positions, manual or phase. In the manual position, engines and propellers are operated and controlled in the conventional manner. After manually synchronizing engines, the selector switch can be set to the phase position. This permits the synchrophaser to hold engines in RPM agreement and also in the preselected phase relationship.

14-118. SYSTEM OPERATING PROCEDURE. (PA-23-250 (six place), Serial Nos. 27-3944 and up.)

The selector switch should be in the manual position during engine start, taxi and warm-up. The switch may be turned to phase position after the take-off run has started, if desired.

NOTE

With full throttle and full RPM the governors should be set within the synchrophasing range, if not consult Section VIII or VIIIA of this Service Manual for high RPM setting adjustment.

The propeller RPM should be manually adjusted as close to synchronization as possible for cruise, and the quadrant friction control set. Turn the switch to the phase position, if the unit does not synchronize the props, return the selector switch to manual. After 45 seconds adjust engine RPM manually to within 25 to 30 RPM of each other and return the selector switch to the phase position.

Keep the function switch in manual position except when desiring automatic control. The engine synchrophaser will bring into phase, engines with an RPM difference of over 30 RPM. However, the closer the RPM is set manually the sooner automatic phasing will be established.

Note the lack of an audio beat when the propellers are in phase; this should be checked in flight. When an audible beat is heard with the system operating, it is undoubtedly not holding the slave engine in phase with the master engine. Return the selector switch to its manual position for 45 seconds and readjust engine RPM manually to operating RPM. Set selector switch to phase position for automatic operation. If the phasing is not established after the above procedure, it is possible that some unit of the system is not operating properly, and further ground checks should be made.

14-119. OPERATIONAL CHECKS. (PA-23-250 (six place), Serial Nos. 27-3944 thru 27-7854067 only.)

The following checks may be made to evaluate system operating condition. A test unit should be fabricated to perform the required checks. Refer to Figure 14-46 for parts and wiring schematic to fabricate the test unit.

a. Connect an ammeter with a two ampere scale to the meter jack on the front panel of computer amplifier. (Refer to Figure 14-46.) Use a suitable cable and 1/4 inch phone plug to connect to the computer.

NOTE

When fabricating this test box, it is advisable to make the connecting cable long enough to extend from the computer into the cockpit.

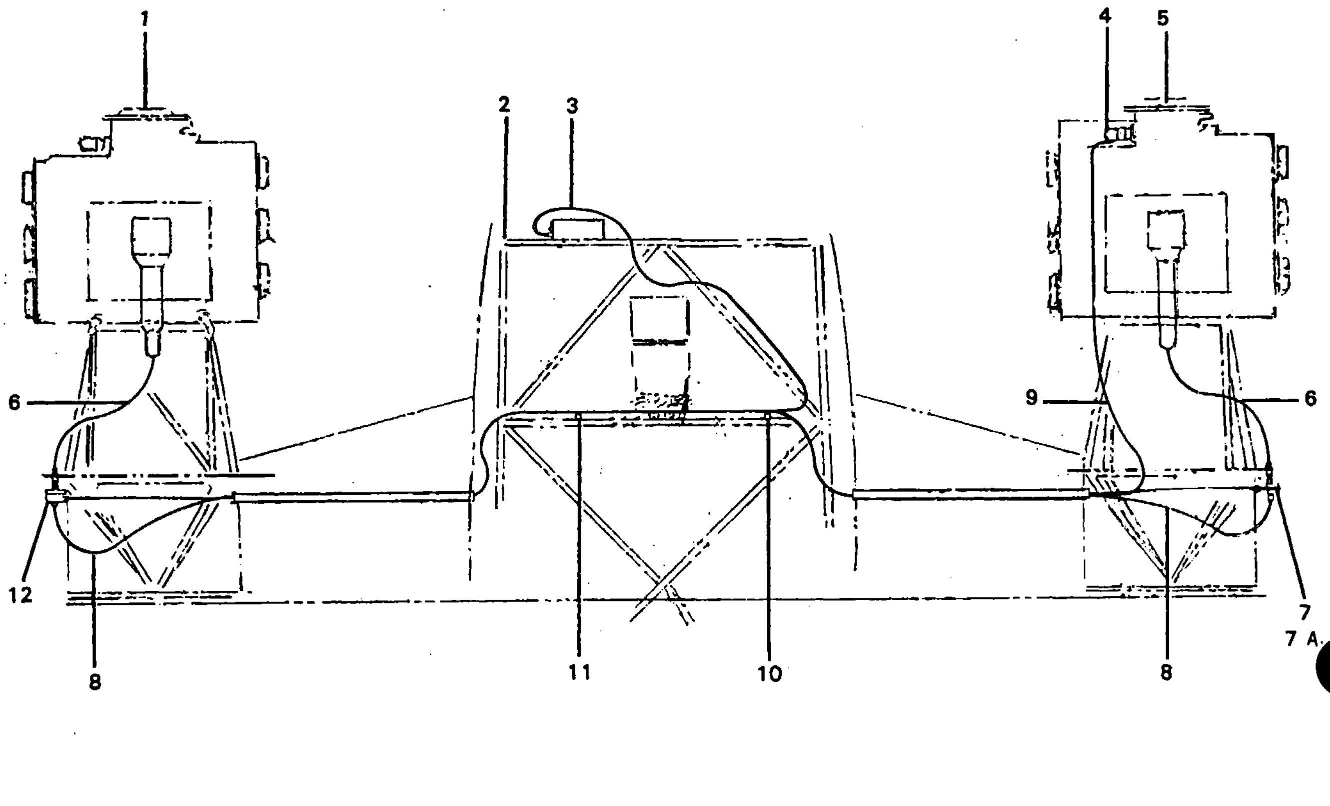
b. Connect a zero center reading 15 volt voltmeter to test wires A and B in the six pin plug which connects to the computer. When the tests are completed the wires can be taped and tied back. (Refer to Figure 14-46.)

c. With meters connected as shown in Figure 14-46, proceed with the ground checks to determine if various units are working properly.

d. Connect the phone plug from the test box to the computer and observe the ammeter, it should show a reading with the master switch ON. This will confirm that there is voltage to the computer.

NOTE

The following steps should be performed from within the cockpit with the use of the aircraft starter switches.



1. MASTER ENGINE (LT.)
2. STATION 36.25
3. COMPUTER ASSY.
4. GOVERNOR ASSY.
5. SLAVE ENGINE (RT.)
6. NEW TACHOMETER SHAFTS
7. STROBE SENSOR (SER. NOS. 27-3944 THRU 27-7854067)
7A. PULSE GENERATOR (SER. NOS. 27-7854068 AND UP)
8. EXISTING TACH SHAFTS
9. ELECTRICAL HARNESS
10. CIRCUIT BREAKER
11. CONTROL SWITCH
12. PULSE GENERATOR

Figure 14-42. Synchrophaser Installation

e. Ascertain that the magneto switches are OFF. Turn the master switch ON, and set the synchrophaser switch on MANUAL. Read the solenoid current on the ammeter. A stabilized reading should be 1 ampere ± .2 ampere.

NOTE

When first selecting the manual operation, the meter current maybe near zero or near maximum of meter scale. The solenoid current is slowly corrected and takes five to thirty-five seconds to stabilize.

NOTE

The above step must always proceed phase operation when flying or making ground checks. Always use manual selection for stand-by service.

f. Start and adjust the master LEFT engine at near cruise RPM (2200 RPM or above). Set the selector switch to propeller sync. Rotate the slave RIGHT engine with the use of the starter (right Magneto switch OFF) until the zero center reading voltmeter deflects to the right or left of center. A full deflection to the right indicates a photo conductor is supplying a signal to the computer amplifier and must cause the ammeter to increase slowly to a maximum of approximately 1.75 amperes.

g. When the above condition is met, rotate the slave RIGHT engine with the use of the starter to a position that will cause the zero center reading voltmeter to deflect to left of center. A full deflection to left must cause a slow amperage decrease to 0 amps. This indicates that the other conductor is supplying a signal to the computer amplifier.

NOTE

A decrease in solenoid current indicates the slave engine is increasing RPM. An increase in solenoid current indicates the slave engine is decreasing RPM.
When conditions of step h and i are met, it will confirm that all components are operating.

h. Return the selector switch to manual and start the slave RIGHT engine. Operate the master LEFT engine at near cruise RPM. Set the selector switch to propeller sync position and advance the slave engine speed slightly over that of the master engine noting the deflection of the voltmeter. If it remains to the right decidely longer than it remains on left, it confirms that the signals from the photo conductors are correct.

i. While still operating the master engine at near cruise RPM, retard revolutions of the slave engine to less than that of master engine. Note the deflection of the voltmeter. If it remains to the left decidedly longer than it remains on the right, it confirms that the signals from the photo conductors are correct.

NOTE

The voltmeter readings will change from side to side with RPM and phase changes, but will show a definite tendency to stay to right or left of zero when engine RPM's are not in phase.

14-120. TROUBLESHOOTING. The following checks should be made when a malfunction of the system is suspected. The checks are divided into two parts, Mechanical and Electrical, and should be performed in that order. A troubleshooting chart is also supplied at the end of these instructions.

CAUTION

Before proceeding any further be certain that the magneto switches are OFF.

a. MECHANICAL CHECKS (PA-23-250 (six place), Serial Nos. 27-3944 and up): Inspect the short tach cables used to drive the pulse generator, strobe sensor (or other pulse generator in later models) and related components for the following conditions:

1. Insufficient lubrication. Lubricate with a suitable High Temperature Grease.
2. The retainer clip on the drive end of the tach cable is not chafing against the bell housing. No signs of chafing should be evident.
3. The square ends of the tach cable is fraying. If so, dip the end in silver solder or braze it. Then file the end square to fit mating unit core.
4. Be certain the core of the pulse generator and strobe sensor (or other pulse generator in later models) rotate when the associated propeller is turned.
5. Check the bulkhead tach drive units for possible broken parts.
6. Check the engine drive pad for possible damage.

b. ELECTRICAL CHECKS (PA-23-250 (six place), Serial Nos. 27-3944 thru 27-7854067 only): Perform the following checks to isolate any trouble in the electrical components of the system.

NOTE

To perform some of the following checks will require a standard multimeter with a 50 volt AC scale and/or other test equipment which can be fabricated from easily obtainable components. It is advisable to make the connecting cables long enough to extend into the cockpit.

1. Pulse generator, glow lamps and wire harness checks:
   (a) Ascertain that all tach shafts are in position and rotate the pulse generator and strobe sensor with rotation of the respective engines.
   (b) Start and run master engine at near cruise RPM. Set selector switch at Prop Sync.
   (c) Disconnect plug PL3 at the strobe sensor and measure AC voltage at pins D to ground coming from the computer.
   (d) Measure AC voltage at pin E to ground coming from the computer.
   (e) These open circuit readings should be from 30 to 40 volts AC.

NOTE

The pulse generator may be removed and checked with the use of an electric drill or air motor regulated to limit the RPM to 1750. Drive the generator from the tang end of the core. A patch cable junction box may be fabricated to simplify the following checks. (Refer to Figure 14-50.)

   (f) Install the fabricated patch cable and check the volt ohmmeter readings at the patch cable junction box with the pulse generator running or the simulator installed.
   (g) If this test is positive, a bad aircraft harness lead may be present. Check the harness with a megger ohmmeter.
   (h) Check the resistance and continuity through the pulse generator harness. Pins D and E of the small plug attached to the computer should be approximately 200 ohms.
   (i) Check the direction of the pulse generator by operating it from both ends and observe if lights in the strobe sensor illuminate. (Use the volt ohmmeter to check light illumination. A decrease in resistance should be read when the lights glow. Connect meter at pins A to C or B to C of the large plug). (The strobe sensor can also be disassembled for a direct visual check).
   (j) To ascertain that the pulse generator is supplying timing information to strobe sensor, disconnect plug PL2 from the computer chassis and measure the AC voltage across contacts E and D while operating the master engine at near cruise RPM. A reading of .2 volts AC ± .1 volts is considered normal. If no voltage is supplied, replace the pulse generator.
2. Computer amplifier:
   (a) If the system operates in the manual mode but not in the phase mode, listen to the computer for an audible relay click when the system is switched from the manual mode to phase mode. The relay is on the bottom deck of the computer assembly. The use of a 2 amp meter and test plug will simplify this check. (Refer to Figure 14-46.)
   (b) If no AC voltage is supplied to the strobe sensor as outlined in step 1d, it is suspected that the lamp amplifier in the computer chassis is defective and the computer should be replaced. (Refer to paragraphs 14-123 and 14-124.)

(c) Inspect the inside of the computer to ascertain that the circuit boards are secure and that the tang plugs are free of corrosion. Also check for any loose wires.

3. Strobe sensor.
   (a) Connect the fabricated strobe sensor tester (refer to Figure 14-48) to the strobe sensor plug in the right nacelle.
   (b) Slowly rotate the strobe sensor core (if the tach shaft is disconnected) or propeller and watch for a drop in the photo conductor resistance. Check both A and B lights. The resistance should be 200,000 ohms with the lights covered and 180 ohms with the lights uncovered.
   (c) If the latter test (Step b) proves negative the sensor unit must be disassembled for a visual check of lamp illumination. If the lamps do work the trouble is in the photo conductors. To be sure, aim the photo conductor cells at a source of light and move a finger or some object back and forth in front of the conductors. If the tester does not indicate a drop in resistance when the conductor cells are exposed to the light, they are inoperative and must be replaced.
   (d) Connect the strobe sensor simulator. (Refer to Figure 14-49.) Move the potentiometer and listen to the computer. The motor should run at approximately 7 volts.
   (e) Adjust the potentiometer just short of motor operation. Move the pressure-drain switch from ON - Pressure to OFF and then ON again; the current on the governor coil should be .05 amps.
   (f) Move the switch from ON - drain to OFF and then ON again, the current on the governor coil should be .05 amps.

CAUTION

The pressure or drain should not be adjusted unless it is absolutely necessary and the system still does not synchronize.

c. WIRING HARNESS CHECK (PA-23-250 (six place), Serial Nos. 27-7854068 and up): This check utilizes a Hartzell Test Box B-4467 to provide assurance that the synchrophaser is properly connected. It also checks the functioning of the governor solenoid coil and the pulse generators.

NOTE

These tests are to be made with all parts installed and connected to the wiring harness except for the computer. Do not plug the computer in until all tests have been satisfactorily completed.

1. Connect the Hartzell Test Box B-4467 to the wiring harness in place of the computer.

2. Turn the master switch ON. The Power light and Coil light should come on. Other lights may also be on but they may be disregarded at this time with the exception of the Coil Short light. If it is on turn the master switch OFF and refer to the following NOTE.

NOTE

If any of the lights on the test box fail to operate correctly, check the wiring harness against the wiring diagram. Check for shorts, open circuit breaker, broken wires and wires connected to the wrong pins.

3. Rotate the right engine by hand and watch the Right Engine light. If the light is off rotate the engine until it comes on or vise versa. The engine may need to be rotated two revolutions to obtain a change. Repeat the procedure for the left engine observing the Left Engine light.

4. Place the phase-manual switch in the MANUAL position. The Manual light should come on and the Phase light should go out. When the switch is placed in the PHASE position the opposite should occur.

5. If the wiring harness checks good but the Right or Left Engine light or the Coil light does not function properly replace the respective pulse generator or the governor.

14-121. REMOVAL OF STROBE SENSOR. (PA-23-250 (six place), Serial Nos. 27-3944 thru 27-7854067 only.) This unit is located in the right engine nacelle aft of the firewall in the upper right hand corner. (Refer to Figure 14-42.)

a. Remove the access panel on top of the nacelle.

b. Loosen the knurled nut on the rear of the strobe sensor and remove the tachometer cable.

c. Disconnect the electrical connector.

d. Loosen the 1 inch hex nut, at the front of the strobe sensor, that connects it to the firewall adapter and remove the sensor.

14-122. INSTALLATION AND ADJUSTMENT OF STROBE SENSOR. (Refer to Figure 14-43.)

a. Attach strobe sensor to firewall adapter by securing loosely with hex nut.

NOTE

The front of the strobe sensor can be defined by the square hole in the center of the unit to accept the square end of a tach shaft.

NOTE

Before proceeding any further be certain the magneto switches are OFF.

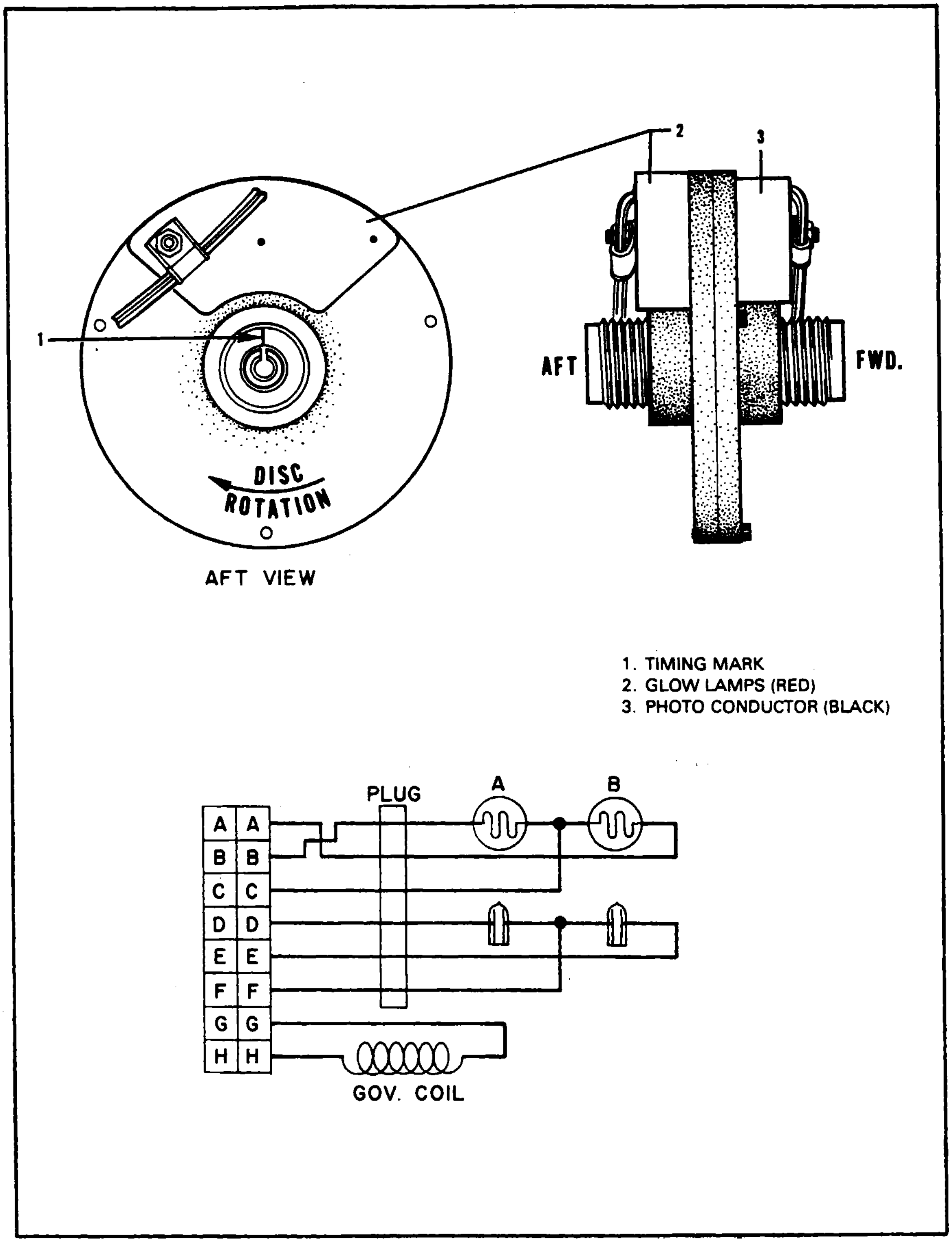


Figure 14-43. Strobe Sensor

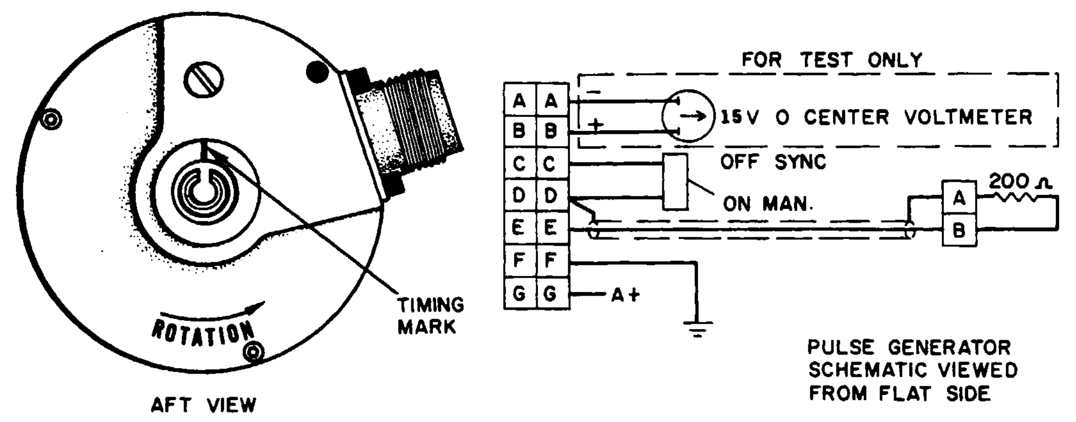


Figure 14-44. Pulse Generator

b. Turn the engine in the direction of rotation to locate No. 2 piston at T.D.C. on the ignition stroke. Use the engine timing mark. Move the propeller blade an additional 30 degrees. This is the timing position.

NOTE

If this point is missed, do not turn the engine backward, start over.

c. Turn the strobe sensor case counterclockwise (viewed from the rear) to align the timing mark with the center of the keyway. This is the phase position. The use of an inspection mirror will be required to view the end of the unit.
d. Tighten the 1 inch hex nut.
e. Pull the prop through (in the direction of rotation) two complete revolutions and stop at the phase position. Check timing mark alignment. Reset if necessary.
f. Connect tachometer shaft to the rear of the strobe sensor and secure with knurled nut.
g. Connect electrical plug connector to the strobe sensor and install the access panel on top of the nacelle.

14-123. REMOVAL OF PULSE GENERATOR. (See following NOTE.) This unit is located in the left engine nacelle aft of the firewall in the upper left hand corner. (Refer to Figure 14-42.)
a. Remove the access panel on top of the nacelle.

b. Loosen the knurled nut on the rear of the pulse generator and remove the tachometer cable.

c. Disconnect the electrical connector.

d. Loosen the 1 inch hex nut, at the front of the pulse generator, that connects it to the firewall adapter and remove the generator.

NOTE

On Serial Nos. 27-7854068 and up, a second pulse generator is used in lieu of a strobe sensor in the right engine nacelle and it is removed as is described for the strobe sensor in Paragraph 14-121.

14-124. INSTALLATION AND ADJUSTMENT OF PULSE GENERATOR. (Refer to Figure 14-44.)

a. Attach the pulse generator to the bulkhead drive unit by securing loosely with hex nut.

NOTE

The front of the pulse generator can be defined by the square hole in the center of the unit to accept the square end of a tach shaft.

CAUTION

Before proceeding further, be certain the magneto switches are OFF.

b. Turn the engine in the direction of rotation to locate No. 1 piston at T.D.C. on the ignition stroke. Use the engine timing mark.

NOTE

If this point is missed, do not turn the engine backward, start over.

c. Turn the pulse generator case counterclockwise (viewed from the rear) to align the timing mark with the center of the keyway. This is the phase position. The use of an inspection mirror will be required to view the end of the unit.

d. Tighten the 1 inch hex nut.

e. Pull the prop through (in the direction of rotation) two complete revolutions and stop at the phase position. Check timing mark alignment. Reset if necessary.

NOTE

The pulse generator timing mark is always set up when the master engine is at T.D.C. of No. 1 cylinder on the ignition stroke. The slave engine is then set at the desired propeller position, cylinder number and ignition stroke. This is predetermined at the factory and is different for each model aircraft.

f. Connect tachometer shaft to rear of pulse generator and secure with knurled nut.
g. Connect the electrical plug connector to the pulse generator and install the access panel on top of the nacelle.

14-125. REMOVAL OF COMPUTER ASSEMBLY. This unit is located in the nose section on the front of bulkhead station 36.25 in the upper center portion. (Refer to Figure 14-42.)
a. The computer unit is accessible through the top rear opening of the nose baggage compartment.
b. Disconnect the two electrical plugs connected to the computer unit.
c. Remove the three machine screws on the top mounting flange and lift the computer unit up and out of the aircraft.

14-126. INSTALLATION OF COMPUTER ASSEMBLY. (Refer to Figure 14-42.)
a. Position the bottom mounting flange of the computer unit into the slot along the bottom of the mounting plate.
b. Secure the unit in place with the three machine screws in the top mounting flange.
c. Connect the two electrical plugs to the computer unit.
d. Check the fuse to ascertain that it is in good condition and of the proper size (3 amp - 250 volts).

14-127. REMOVAL AND INSTALLATION OF GLOW LAMP AND PHOTO CONDUCTOR ASSEMBLIES.
a. Remove the strobe sensor in accordance with paragraph 14-120.

NOTE

A reference mark should be placed along the edge of the sensor unit to facilitate getting the proper alignment of part upon reassembly.

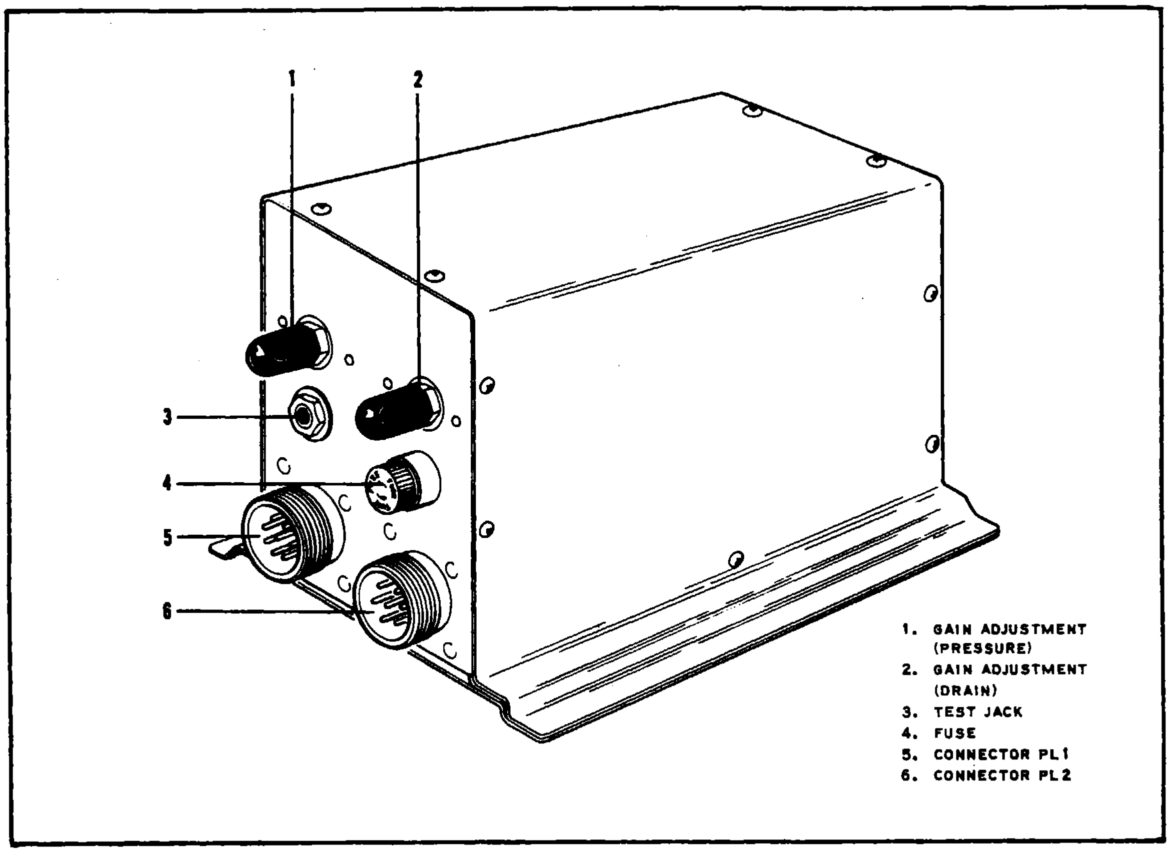


Figure 14-45. Computer Assembly

b. Remove the three allen cap screws holding the two halves of the strobe sensor together. It may be necessary to tap the center shaft to separate the halves.

c. Reconnect plug PL3 and visually observe if both glow lamps light with the master engine turning at near cruising RPM. A pulse generator simulator may be used according to paragraph 14-120 and Figure 14-51.

d. If either of the glow lamps is inoperative, the red colored block that holds the lamps must be replaced. This is done by removing the three countersunk screws, one with an external nut, from inside the strobe sensor case and removing the block assembly. Install the new one by using the removal method in reverse.

e. If the photo conductors are inoperative, the black colored block assembly may be replaced in the same method as the glow lamps, step d, above.

f. Place the two halves of the strobe sensor together and align the previously made reference marks.

g. Secure the two halves of the unit together with the three allen cap screws.

h. Install the strobe sensor in the airplane and adjust it in accordance with paragraph 14-122.

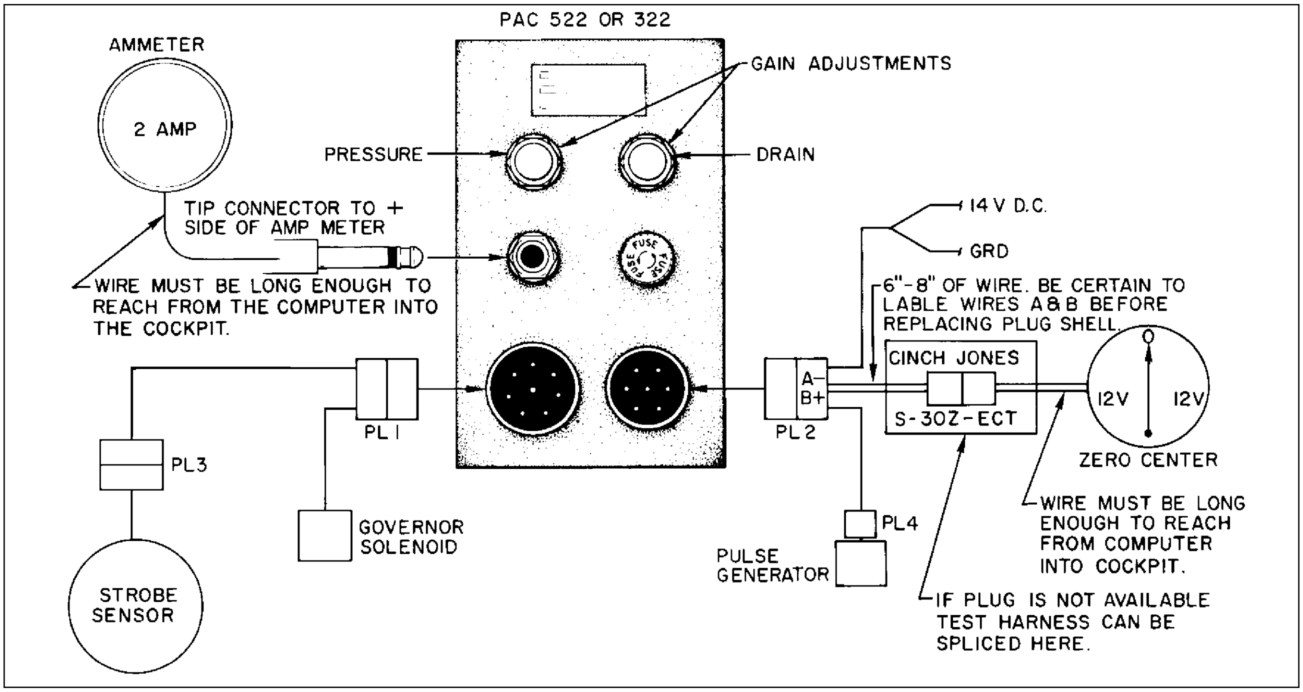


Figure 14-46. Fabricated Test Box

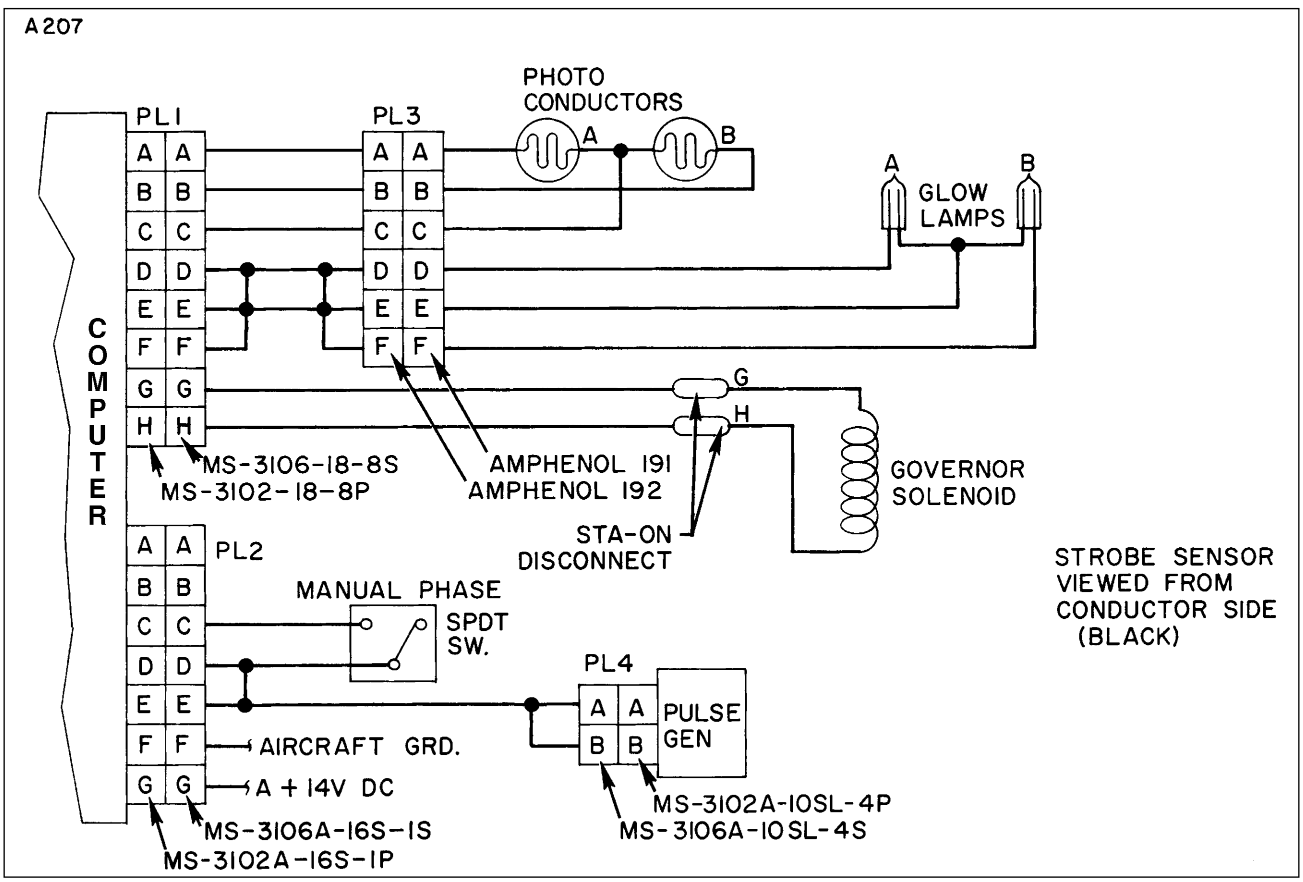


Figure 14-47. Electrical Schematic

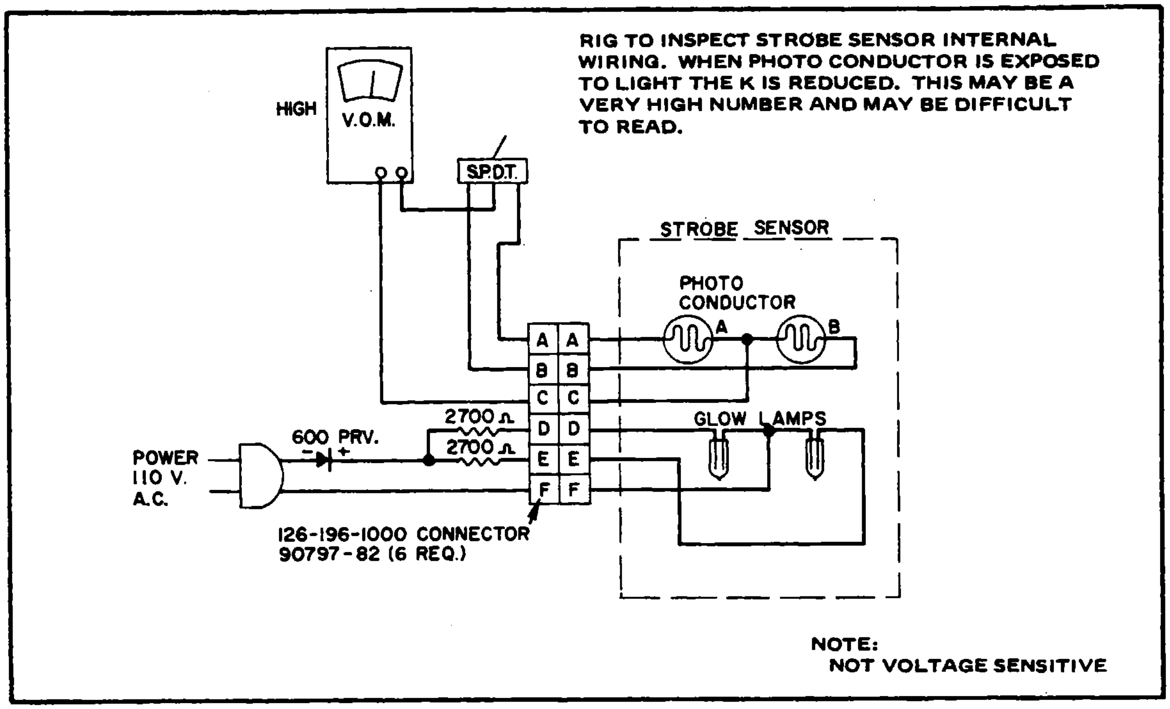


Figure 14-48. Strobe Sensor Internal Wiring Test Unit

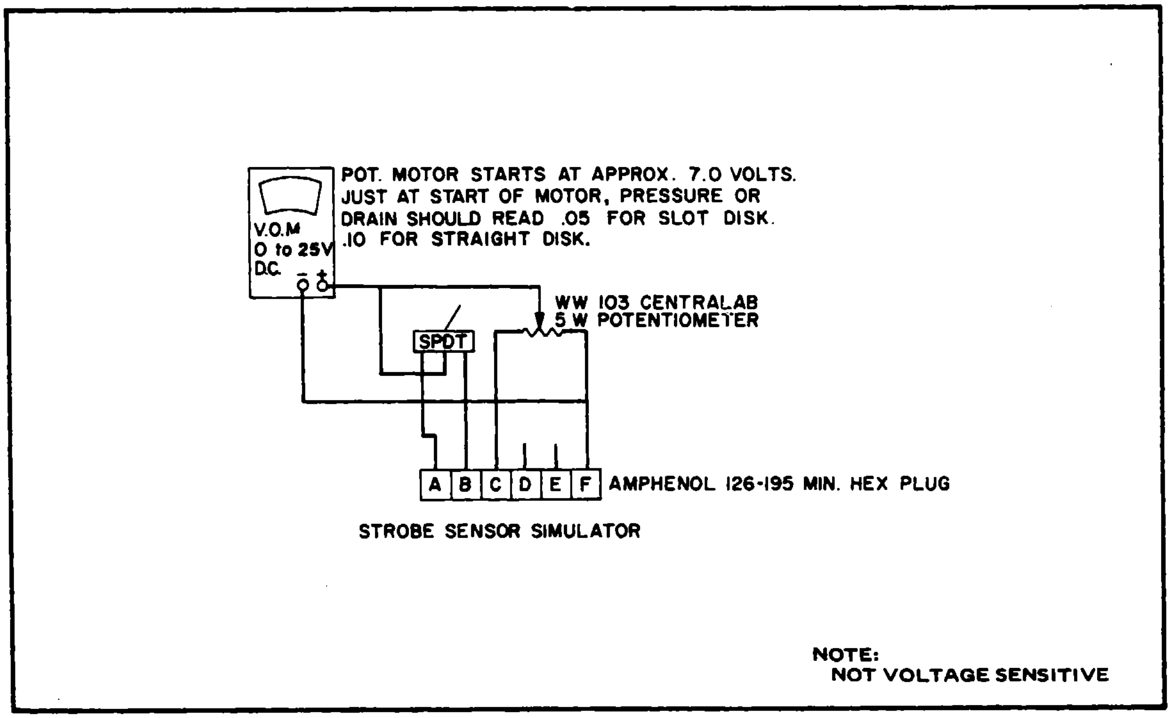
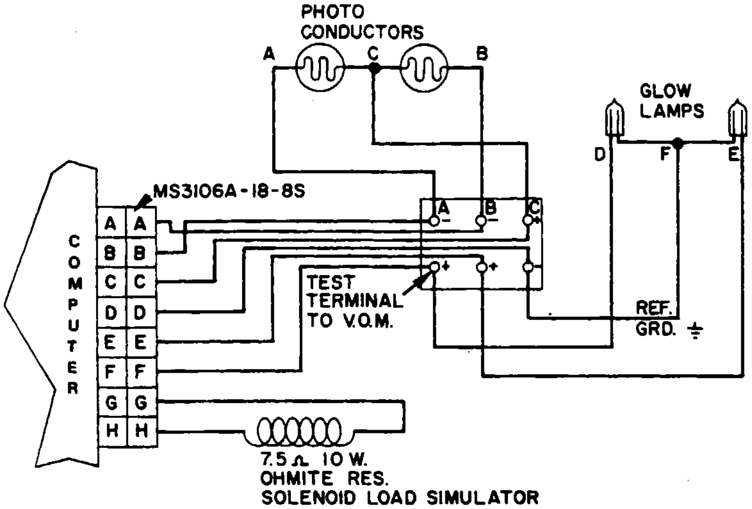


Figure 14-49. Strobe Sensor Simulator



TEST		
A to F	0 to 14 V	D.C.
B to F	0 to 14 V	D.C.
C to F	14 V	D.C.
D to F	6 V	A.C.
E to F	6 V	A.C.

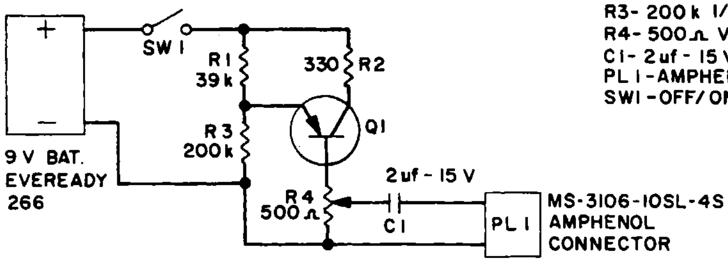
DISCONNECT STROBE SENSOR

TEST		
A to F	0	
B to F	0	
C to F	12 to 14 V	D.C.
D to F	15 V	A.C.
E to F	15 V	A.C.

Figure 14-50. Patch Cable and Test Terminal

PULSE GENERATOR SIMULATOR - APPROX. 1200 R.P.M.

Q1 - UNIJUNCTION TRANSISTOR
MOTOROLA HEP 310
R1 - 39k 1/2 W. 10% RES.
R2 - 330 Ω 1/2 W. 10% RES.
R3 - 200 k 1/2 W 10% RES.
R4 - 500 Ω VAR. V 500 CRL
C1 - 2 uf - 15 V CAP. UNICON
PL 1 - AMPHENOL CONNECTOR
SW1 - OFF/ON SWITCH



ADJUST R4 FOR PULSE AMPLITUDE OF 1.5 VOLTS. USE OSCILLOSCOPE FOR MEASUREMENTS.

Figure 14-51. Pulse Generator Simulator

TABLE XIV-V. TROUBLESHOOTING CHART (ENGINE SYNCHROPHASER)

Trouble	Cause	Remedy
No indication solenoid current.	Master switch OFF.	Turn switch ON.
	Bad fuse in computer.	Replace fuse.
	Faulty wiring.	Check wiring and connections.
	Faulty computer.	Replace computer.
System not operating properly.	Pulse generator and lamp amplifier suspected of faulty operation.	Perform operational check in accordance with paragraph 14-119.
	Tach shafts faulty.	Visually check tach shafts.
	Pulse generator and glow lamp amplifier in computer not operating.	Perform electrical test in accordance with paragraph 14-120.
	Glow lamp or lamps and/or photo conductor or conductors defective.	Replace glow lamp or photo conductor assemblies. Refer to paragraph 14-127.
	Faulty computer.	Perform electrical test in accordance with paragraph 14-120.
System will not sync. (Note) Unit will not sync. on the ground.	Electrical.	Perform electrical test in accordance with paragraph 14-120.
	Mechanical.	Check tach shafts per paragraph 14-120.
	Pilot. Engines not set within range of system.	Refer to paragraph 14-118 for operating procedures.

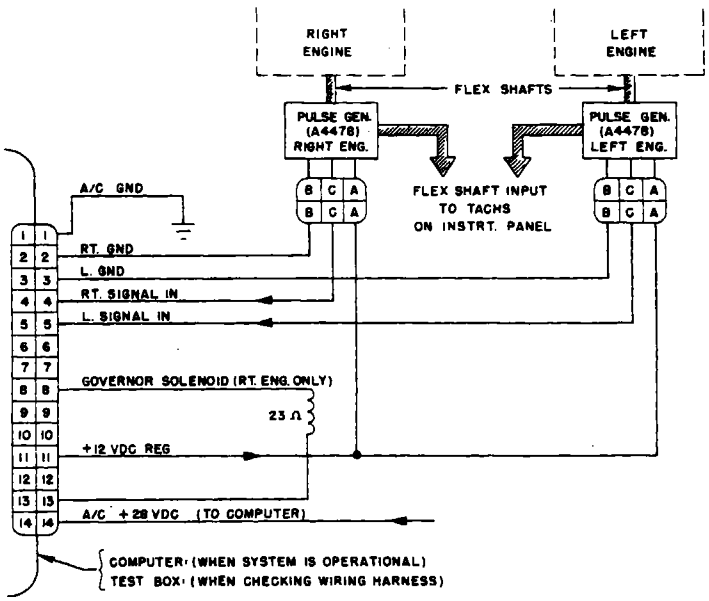


Figure 14-52. Synchrophaser Schematic,
PA-23-250 (six place), Serial Nos. 27-7854068 and up

– END –